



KES Co., Ltd.

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

TEST REPORT

Part 90 & IC RSS-119(Issue 11)

Equipment under test TABLECALL TRANSMITTER

Model name LTK-1600TN

FCC ID QBT LTK-1600TN

IC 5269A- LTK1600TN

Applicant Lee Technology Korea Co., Ltd.

Manufacturer Lee Technology Korea Co., Ltd.

Date of test(s) 2012.07.23 ~ 2012.08.21

Date of issue 2012.08.22

Issued to

Lee Technology Korea Co., Ltd.

3rd FL. Automobile Department Store Bldg, #499-2 Sang-3dong, Wonmi-gu,
Bucheon-city, Kyunggi-do, Korea

Issued by

KES Co., Ltd.

C3701 Dongil Techno Town, 889-1, Gwanyang 2-dong, Dongan-gu, Anyang-si,
Gyeonggi-do, 431-716, Korea

477-6, Hageo-ri, Yeoju-eup, Yeoju-gun, Gyeonggi-do, 469-803, Korea

Tel: +82-31-425-6200 / Fax: +82-31-424-0450

Test and report completed by :	Report approval by :
	
Jeff Do Test engineer	Gyu-cheol Shin Technical manager



KES Co., Ltd.

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

Revision history

Revision	Date of issue	Test report No.	Description
-	2012.08.22	KES-RF-120063	Initial



KES Co., Ltd.

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

TABLE OF CONTENTS

1.0	General product description	4
1.1	Test frequency	4
1.2	Information about variant model	4
1.3	Device modifications	4
1.4	Test facility	5
1.5	Laboratory accreditations and listings	5
2.0	Summary of tests	6
2.1	Test data	7
2.1.1	RF output power	7
2.1.2	20 dB bandwidth & 99 % bandwidth	10
2.1.3	Emission mask	12
2.1.4	Conducted spurious emissions	15
2.1.5	Frequency stability	18
2.1.6	Transient frequency behavior of the transmitter	23
2.1.7	Radiation spurious emissions	27
Appendix A.	Test equipment used for test	32
Appendix B.	Test setup photos	33



KES Co., Ltd.

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

1.0 General product description

Equipment model name : TABLECALL TRANSMITTER
Serial number : N/A
Frequency Range : 450.012 5 MHz ~ 469.975 0 MHz
Type of emission : 10K2F1D
Channel separation : 12.5 kHz
Rated power : 15.85 mW
Power Source : DC 2.4 V
Antenna type : Helical antenna

1.1 Test frequency

	Low channel	Middle channel	High channel
Frequency (MHz)	450.012 5	457.575 0	469.975 0

1.2 Information about variant model

N/A

1.3 Device modifications

N/A



KES Co., Ltd.

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

1.4 Test facility

C3701 Dongil Techno Town, 889-1, Gwanyang 2-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
477-6, Hageo-ri, Yeosu-eup, Yeosu-gun, Gyeonggi-do, 469-803, Korea

The open area test site is constructed in conformance with the requirements ANSI C63.4-2003/2009.

1.5 Laboratory accreditations and listings

Country	Agency	Scope of accreditation	Certificate No.
USA	FCC	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	343818
KOREA	KC	EMI (10 meter Open Area Test Site and two conducted sites) Radio (3 & 10 meter Open Area Test Sites and one conducted site)	KR0100
CANADA	IC	3 & 10 meter Open Area Test Sites and one conducted site	4769B-1

**KES Co., Ltd.**

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

2.0 Summary of tests

Section	Parameter	Status
90.205 RSS-119 5.4	RF output power	C
90.209 RSS-Gen 4.6.1, 4.6.3	20 dB bandwidth limitation and 99 % bandwidth	C
90.210(d) RSS-119 5.8.3	Emission mask	C
90.210(d) RSS-119 5.8.3	Conducted spurious emissions	C
90.213 RSS-119 5.8.3	Frequency stability	C
90.214 RSS-119 5.9	Transient frequency behavior	C
90.210(d) RSS-119 5.8.3	Radiated spurious emissions	C
Note 1: C=Complies NC=Not complies NT=Not tested NA=Not applicable		

2.1 Test data

2.1.1 RF output power

Test setup



Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator
2. Use the following spectrum analyzer setting
 - Span = 2 MHz
 - RBW = 100 kHz
 - VBW = 100 kHz (≥ RBW)
 - Sweep = auto
 - Detector function = peak
 - Trace = max hold

Limit

According to FCC 90.205(h) 450 ~ 470 MHz. (1) The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2. Applicants requesting an ERP in excess of that listed in table 2 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

Table 2. 450 ~ 470 MHz—Maximum ERP/Reference HAAT for a Specific Service Area Radius

	Service area radius (km)									
	3	8	13	16	24	32	40 ⁴	48 ⁴	64 ⁴	80 ⁴
Maximum ERP (W) ¹	2	100	² 500	² 500	² 500	² 500	² 500	² 500	² 500	² 500
Up to reference HAAT (m) ³	15	15	15	27	63	125	250	410	950	2700

¹Maximum ERP indicated provides for a 39 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 29 (See §73.699, Fig. 10 b).

²Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 dBu.

- ³When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: $ERP_{allow} = ERP_{max} \times (HAAT_{ref}/HAAT_{actual})^2$.
- ⁴Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 39 dBu.

RSS-119 5.4

The output power shall be within ±1.0 dB of the manufacturer's rated power.



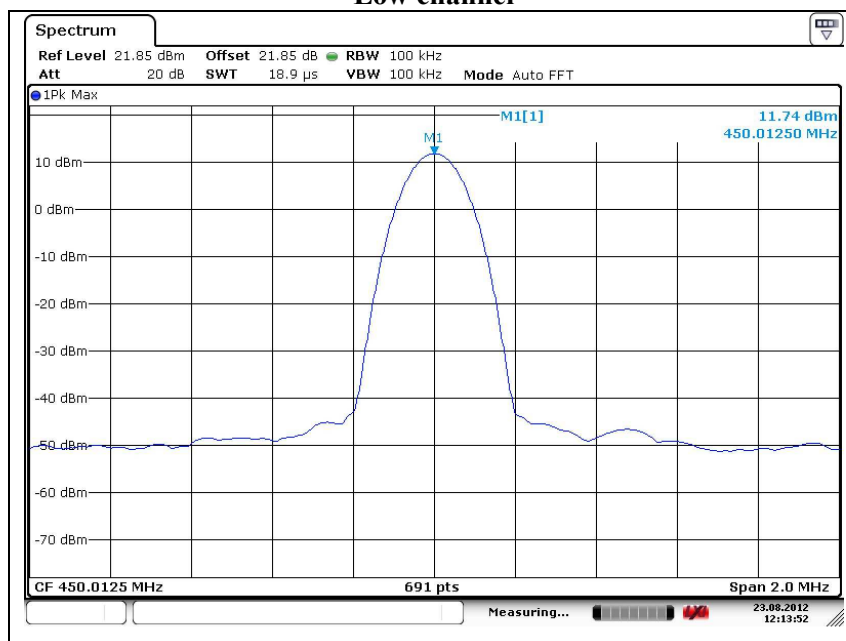
KES Co., Ltd.

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

Test results

Frequency (MHz)	Output power(dBm)	Output power(mW)	Rated power(dBm)
450.012 5	11.74	0.014 9	12
457.575 0	11.62	0.014 5	
469.975 0	11.38	0.013 7	

Low channel

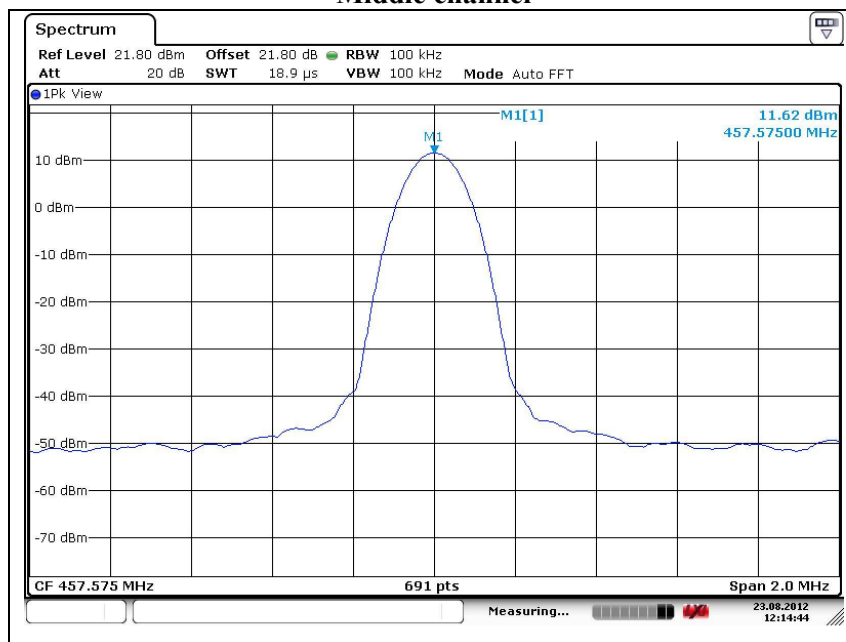




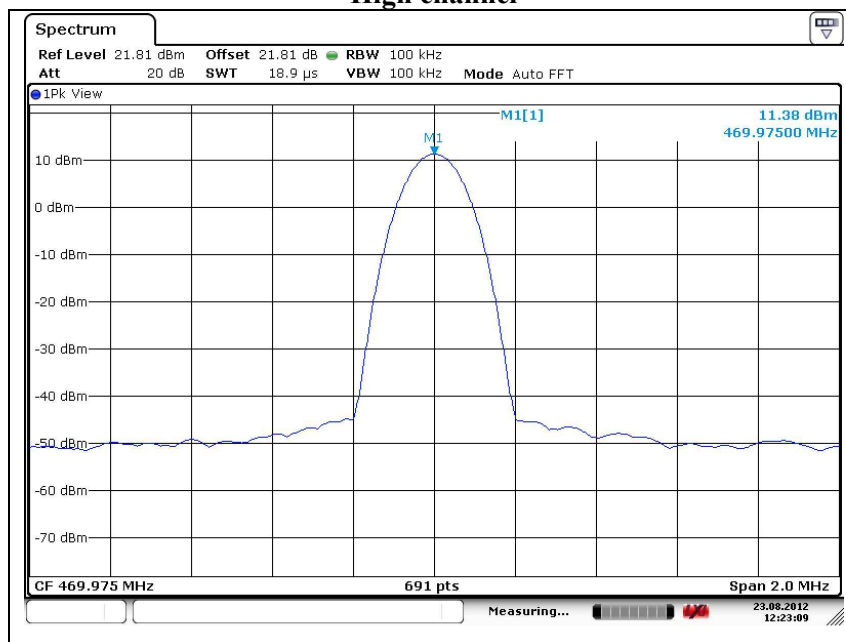
KES Co., Ltd.

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

Middle channel

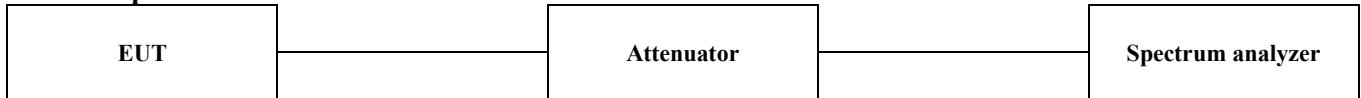


High channel



2.1.2 20 dB bandwidth & 99 % bandwidth

Test setup



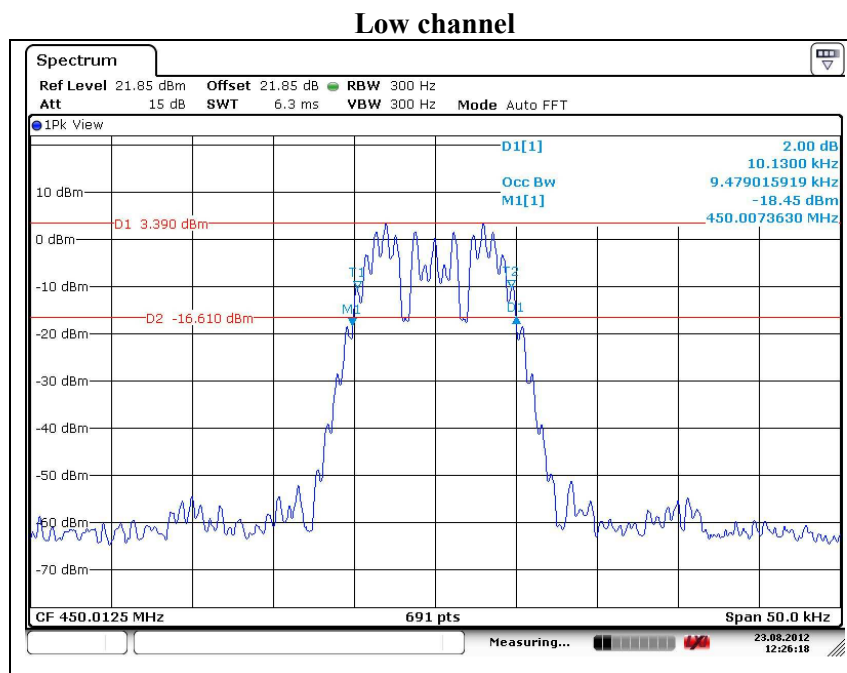
Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator
2. Use the following spectrum analyzer setting
 Span = 50 kHz
 RBW = 300 Hz
 VBW = 300 Hz ($\geq$ RBW)
 Sweep = auto
 Detector function = peak
 Trace = max hold
3. Mark the peak frequency and -20 dB(Upper and lower) frequency.

Limit

N/A

Test results

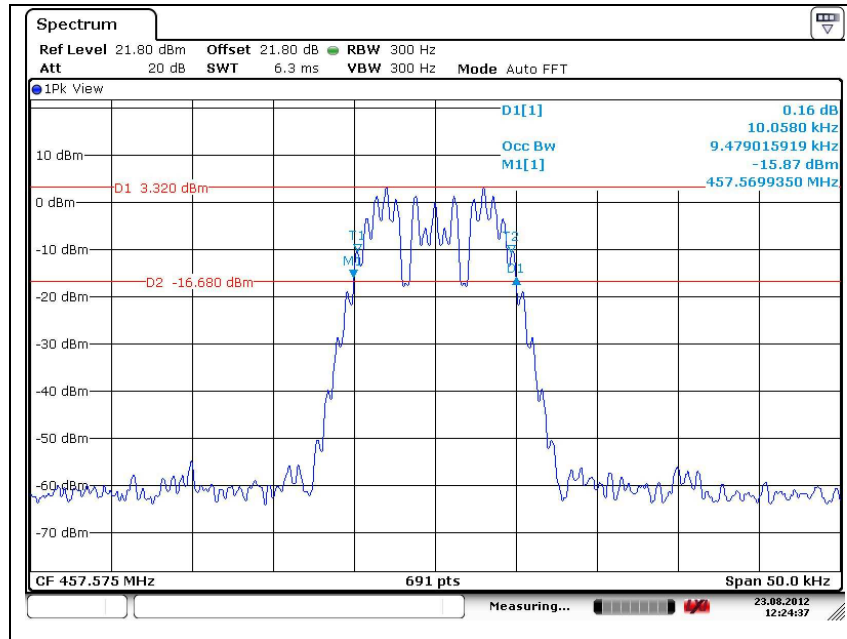




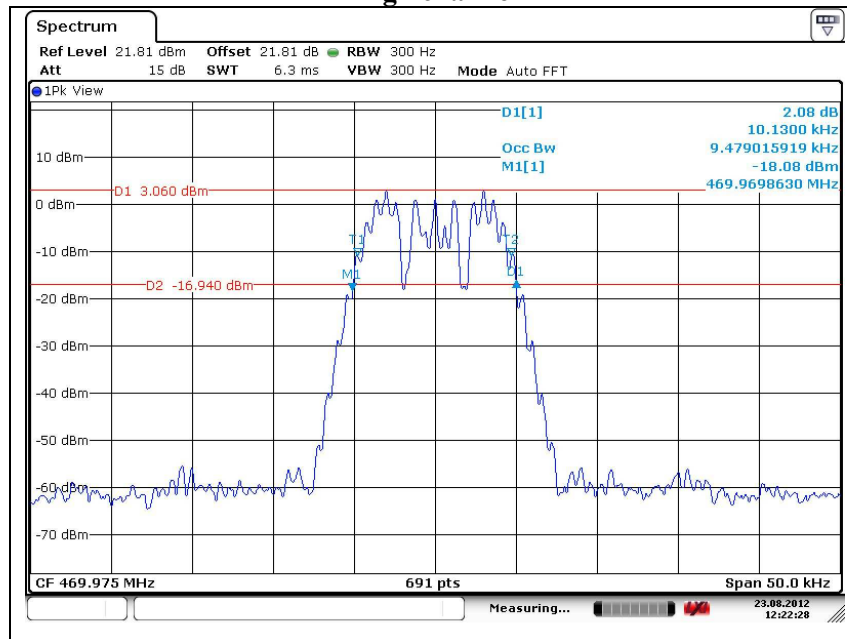
KES Co., Ltd.

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

Middle channel

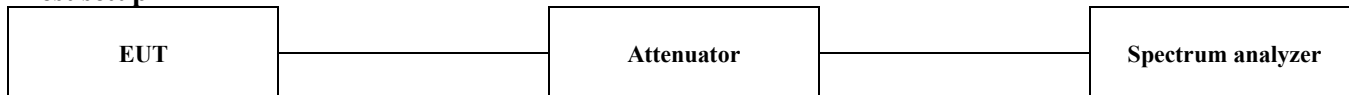


High channel



2.1.3 Emission mask

Test setup



Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator
2. Use the following spectrum analyzer setting
 - Span = 120 kHz
 - RBW = 100 Hz
 - VBW = 100 Hz ($\geq$ RBW)
 - Sweep = auto
 - Detector function = peak
 - Trace = max hold
3. Mark the peak 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.

Limit

According to FCC part 90.210(d) Emission Mask D – 12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power(P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz, but no more than 12.5 kHz: At least 7.27 ($f_d - 2.88$ kHz) dB.
- (3) 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 + 10log(P) dB or 70 dB, whichever is the lesser attenuation.

RSS-119 5.8.3

The power of any emission shall be attenuated below the transmitter output power P(dBW) as specified in Table 6.

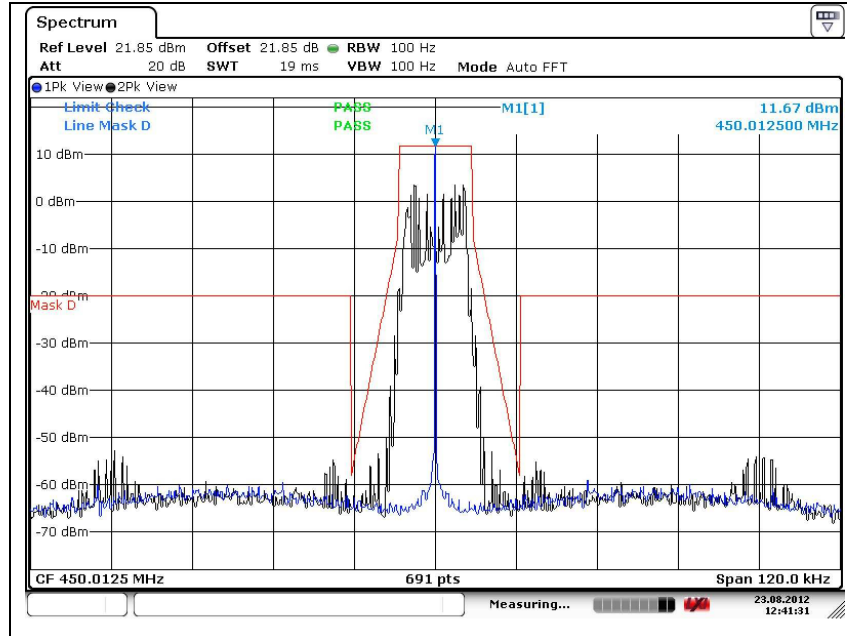
Table 6 – Emission Mask D

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$5.625 < f_d \leq 12.5$	7.27 ($f_d - 2.88$ kHz)	Specified in Section 4.2.2
$f_d > 12.5$	Whichever is the lesser attenuation: 70 or 50 + 10log(P) dB	Specified in Section 4.2.2

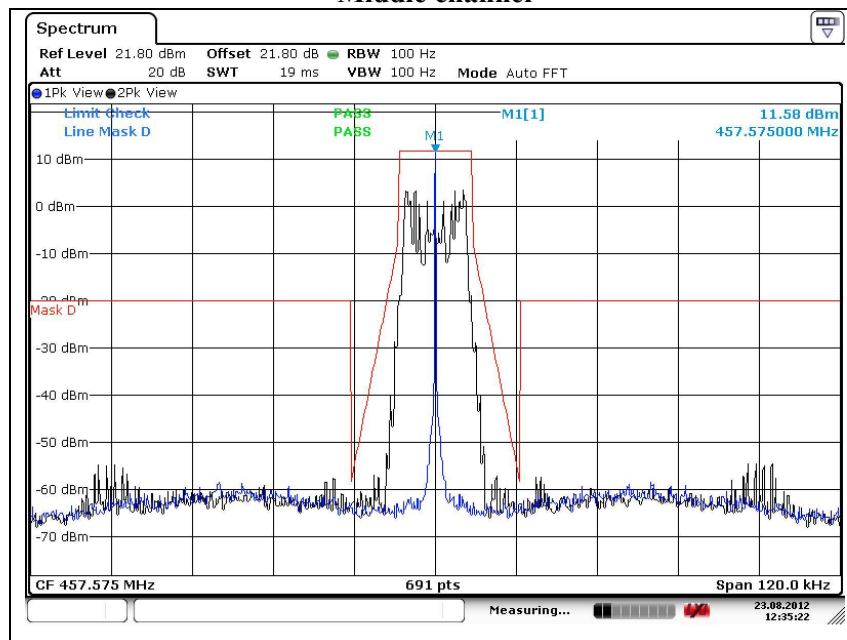


Test results

Low channel



Middle channel

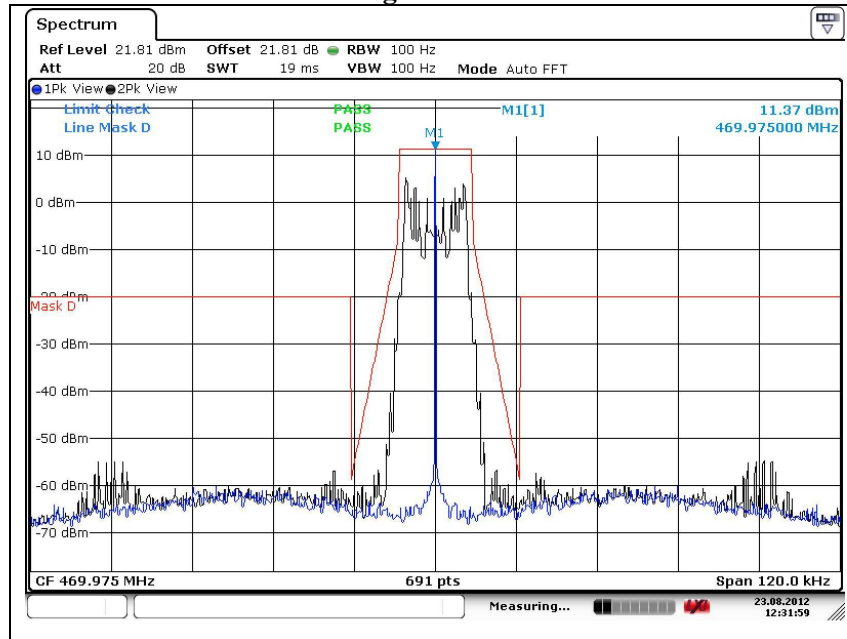




KES Co., Ltd.

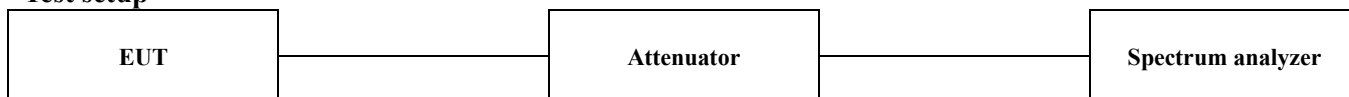
C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

High channel



2.1.4 Conducted spurious emissions

Test setup



Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator
2. Use the following spectrum analyzer setting
 - Span = 30 MHz to 5 GHz
 - RBW = 100 kHz
 - VBW = 100 kHz ($\geq$ RBW)
 - Sweep = auto
 - Detector function = peak
 - Trace = max hold

Limit

According to FCC part 90.210(d) Emission Mask D – 12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power(P) of the highest emission contained within the authorized bandwidth as follows:

- (3) 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 or 70 dB, whichever is the lesser attenuation.

RSS-119 5.8.3

The power of any emission shall be attenuated below the transmitter output power P(dBW) as specified in Table 6.

Table 6 – Emission Mask D

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$5.625 < f_d \leq 12.5$	$7.27 (f_d - 2.88 \text{ kHz})$	Specified in Section 4.2.2
$f_d > 12.5$	Whichever is the lesser attenuation: 70 or $50 + 10\log(P)$ dB	Specified in Section 4.2.2

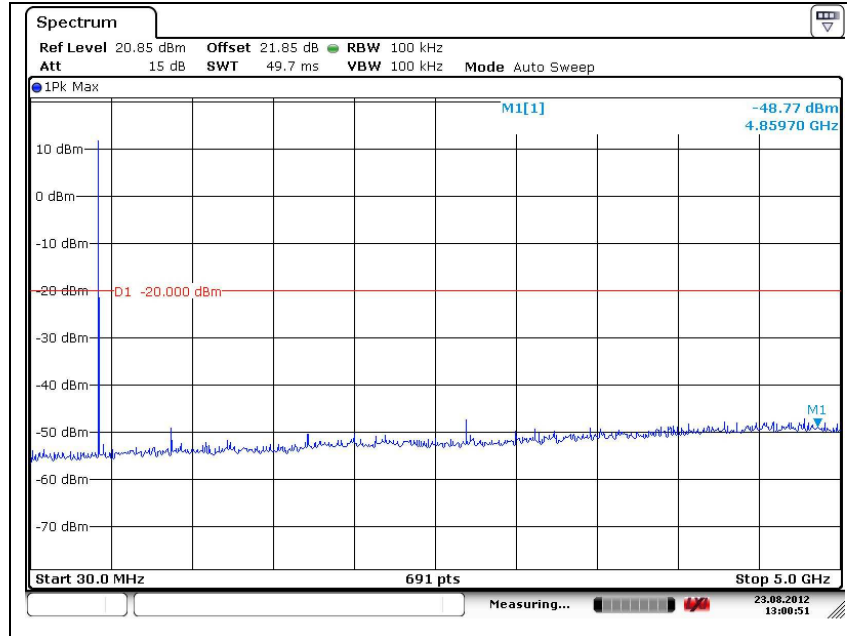


KES Co., Ltd.

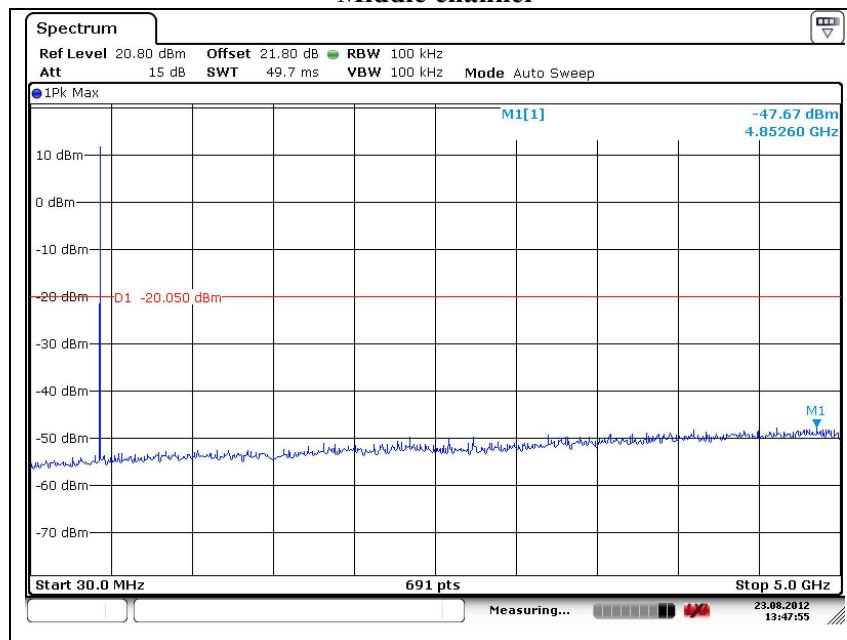
C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

Test results

Low channel



Middle channel

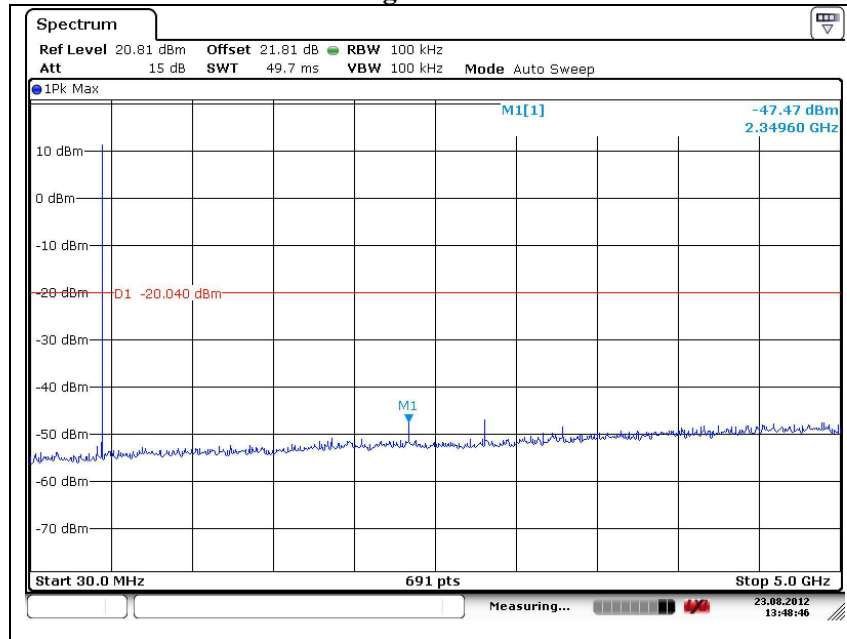




KES Co., Ltd.

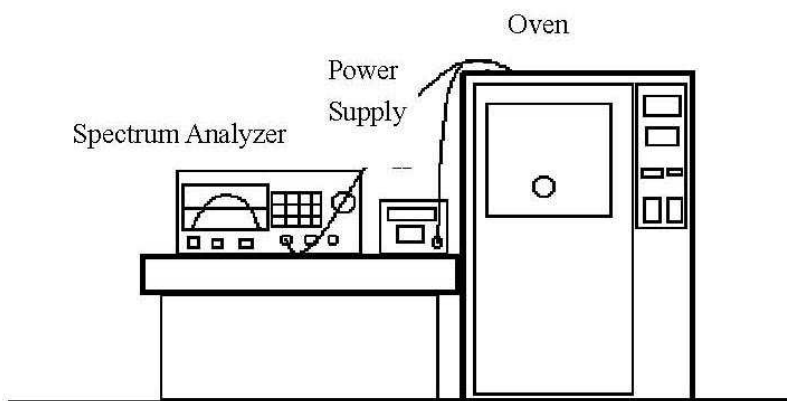
C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

High channel



2.1.5 Frequency stability

Test setup



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 -20°C. 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°C decreased per stage until the highest temperature 50°C is measured, record all measured frequencies on each temperature step.

**KES Co., Ltd.**

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

Limit

1. According to FCC part 2 section 2.1055(a)(1), the frequency stability shall be measured with variation of ambient temperature from -20 °C to +50 °C centigrade.
2. According to FCC part 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, (a) Unless noted elsewhere, transmitters used in the services overned by this part must have a minimum frequency stability as specified in the following table.

Minimum Frequency Stability [Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	^{1,2,3} 100	100	200
25–50	20	20	50
72–76	5		50
150–174	^{5,11} 5	⁶ 5	^{4,6} 50
216–220	1.0		1.0
220–222 ¹²	0.1	1.5	1.5
421–512	^{7,11,14} 2.5	⁸ 5	⁸ 5
806–809	¹⁴ 1.0	1.5	1.5
809–824	¹⁴ 1.5	2.5	2.5
851–854	1.0	1.5	1.5
854–869	1.5	2.5	2.5
896–901	¹⁴ 0.1	1.5	1.5
902–928	2.5	2.5	2.5
902–928 ¹³	2.5	2.5	2.5
929–930	1.5		
935–940	0.1	1.5	1.5
1427–1435	⁹ 300	300	300
Above 2450 ¹⁰			

-
- ¹Fixed and base stations with over 200 watts transmitter power must have a frequency stability of 50 ppm except for equipment used in the Public Safety Pool where the frequency stability is 100 ppm.
- ²For single sideband operations below 25 MHz, the carrier frequency must be maintained within 50 Hz of the authorized carrier frequency.
- ³Travelers information station transmitters operating from 530 ~ 1 700 kHz and transmitters exceeding 200 watts peak envelope power used for disaster communications and long distance circuit operations pursuant to §90.242 and §90.264 must maintain the carrier frequency to within 20 Hz of the authorized frequency.
- ⁴Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
- ⁵In the 150 ~ 174 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
- ⁶In the 150 ~ 174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.
- ⁷In the 421 ~ 512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.
- ⁸In the 421 ~ 512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
- ⁹Fixed stations with output powers above 120 watts and necessary bandwidth less than 3 kHz must operate with a frequency stability of 100 ppm. Fixed stations with output powers less than 120 watts and using time-division multiplex, must operate with a frequency stability of 500 ppm.
- ¹⁰Except for DSRCS equipment in the 5 850 ~ 5 925 MHz band, frequency stability is to be specified in the station authorization. Frequency stability for DSRCS equipment in the 5 850 ~ 5 925 MHz band is specified in subpart M of this part.
- ¹¹Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150 ~ 174 MHz band and 2.5 ppm in the 421 ~ 512 MHz band.
- ¹²Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability.
- ¹³Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.
- ¹⁴Control stations may operate with the frequency tolerance specified for associated mobile frequencies.
- (b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

RSS-119 5.3

The carrier frequency shall not depart from the reference frequency in excess of the values given in Table 1. For transmitters which have an output power of less than 120 mW, the frequency stability may comply with the limits listed in Table 1, of alternatively with the conditions in Section 5.10.

Table 1 – Transmitter Frequency Stability

Frequency range (MHz)	Channel Spacing (kHz)	Frequency Stability (ppm)		
		Base/Fixed	Mobile stations	
			> 2 watts	≤ 2 watts
27.41 ~ 28 and 29.7 ~ 50	20	20	20	50
72 ~ 76	20	5	20	50
138 ~ 174	30	5	5	5
	15	2.5	5	5
	7.5	1	2	5
217 ~ 218 and 219 ~ 220	12.5	1	5	5
220 ~ 222 (Note 1)	5	0.1	1.5	1.5
406.1 ~ 430 and 450 ~ 470 (Note 6)	25 (Note 2)	0.5	1	1
	25	2.5	5	5
	12.5	1.5	2.5	2.5
	6.25	0.5	1	1
764 ~ 776 and 794 ~ 806 (Note 3)	6.25 12.5 25	0.1	0.4 (Note 4)	0.4 (Note 4)
	50	1	1.25 (Note 5)	1.25 (Note 5)
806 ~ 821 / 851 ~ 866 and 821 ~ 824 / 866 ~ 869 (Note 6)	25 (Note 2)	0.1	0.1	0.1
	25	1.5	2.5	2.5
	12.5	1	1.5	1.5
896 ~ 901 / 935 ~ 940 (Note 6)	12.5	0.1	1.5	1.5
929 ~ 930 / 931 ~ 932	25	1.5	N/A	N/A
928 ~ 929 / 952 ~ 953 and 932 ~ 932.5 / 941 ~ 941.5	25	1.5	N/A	N/A
	12.5	1	3 (for remote station)	N/A
932.5 ~ 935 / 941.5 ~ 944	25	2.5	N/A	N/A
	12.5	2.5	N/A	N/A

**KES Co., Ltd.**

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

- Note 1: Mobile units may use synchronizing signals from associated base stations to achieve the specified carrier stability.
- Note 2: This provision is for digital equipment with a channel spacing of 25 kHz and an occupied bandwidth greater than 20 kHz.
- Note 3: Mobile, portable and control transmitters operating in the 764 ~ 776 MHz and 794 ~ 806 MHz must normally use automatic frequency control (AFC) to lock onto the base station signal. The mobile station's frequency stability values given in Table 1 are for mobile stations operating under this condition.
- Note 4: When the mobile, portable and control transmitters are operating in the 764 ~ 776 MHz narrowband segment and the AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2-channel aggregate), and 2.5 ppm for 25 kHz (4-channel aggregate).
- Note 5: When the mobile, portable and control transmitters are operating in the 764 ~ 776 MHz wideband segment and the AFC is not locked to the base station, the frequency stability must be at least 5 ppm or better.
- Note 6: Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

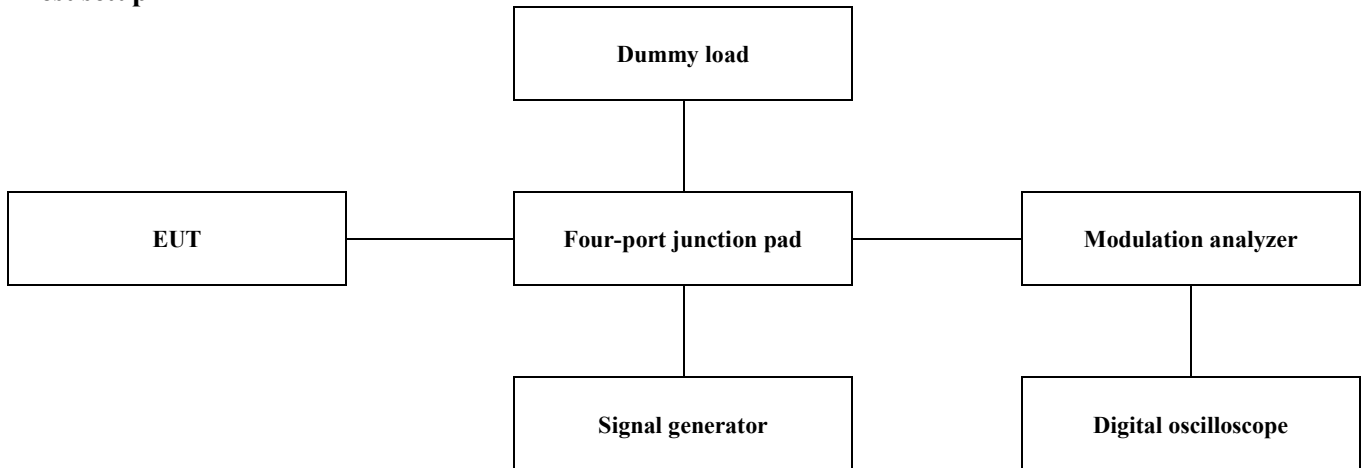
Test results

Assigned frequency (MHz): 469.975

Test voltage (%)	Test voltage (V)	Temperature (°C)	Measure frequency (MHz)	Frequency deviation (Hz)	Frequency deviation (ppm)	Limit (ppm)
100 %	2.40	-20	450.012 501	1	0.00	2.5
100 %		-10	450.012 500	0	0.00	
100 %		0	450.012 561	61	0.14	
100 %		10	450.012 395	-105	-0.23	
100 %		20	450.012 453	-47	-0.10	
100 %		30	450.012 613	113	0.25	
100 %		40	450.012 355	-145	-0.32	
100 %		50	450.012 551	51	0.11	
115%	2.76	20	450.012 453	-47	-0.10	
Battery end point	1.80	20	450.012 453	-47	-0.10	

2.1.6 Transient frequency behavior of the transmitter

Test setup



Test procedure

1. Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ± 12.5 kHz deviation and set its output level to -15 dBm.
2. Key the transmitter.
3. 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.
4. Unkey the transmitter.
5. 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.
6. Connect the output of the RF combiner network to the input of the Modulation analyzer.
7. Set the horizontal sweep rate on the storage oscilloscope to 10 milliseconds per division and adjust the display to continuously view the 1 000 Hz tone. Adjust the vertical amplitude control of the oscilloscope to display the 1 000 Hz at ± 4 divisions vertically centered on the display.
8. 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 t_1 and t_2 . See the figure in the appropriate standards section.
9. During the time from the end of t_2 to the beginning of t_3 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 12.5 kHz.
10. Key the transmitter and observe the stored display. The trace should be maintained within the allowed divisions after the end of t_2 and remain within it until the end of the trace. See the figure in the appropriate standards sections.
11. To test the transient frequency behavior during the period t_3 the transmitter shall be keyed.



KES Co., Ltd.

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

12. 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} .
13. The transmitter shall be unkeyed.
14. Observe the display. The trace should remain within the allowed divisions during period t_3 . See the figures in the appropriate standards section.

Limit

According to FCC 90.214, Transmitters designed to operate in the 150 ~ 174 MHz and 421 ~ 512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

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			
t1 ⁴ -----	±25.0 kHz	5.0 ms	10.0 ms
t2 -----	±12.5 kHz	20.0 ms	25.0 ms
t3 ⁴ -----	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channel			
t1 ⁴ -----	±12.5 kHz	5.0 ms	10.0 ms
t2 -----	±6.25 kHz	20.0 ms	25.0 ms
t3 ⁴ -----	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behaviour for Equipment Designed to Operate on 6.25 kHz Channel			
t1 ⁴ -----	±6.25 kHz	5.0 ms	10.0 ms
t2 -----	±3.125 kHz	20.0 ms	25.0 ms
t3 ⁴ -----	±6.25 kHz	5.0 ms	10.0 ms

¹ t_{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 1 kHz 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 6 watts or less, the frequency difference during this time may exceed the maximum frequency difference for this period.

RSS-119 5.9

When a transmitter is turned on, the radio frequency may take some time to stabilize. During this initial period, the frequency error or frequency difference (i.e. between the instantaneous and the steady state frequencies) shall not exceed the limits specified in Table 17.

Any suitable method of measurement can be used provided that it is fully described in the test report. A suitable and recommended method is given in TIA Standard 603.

Table 17 - Transient Frequency Behaviour

Channel Spacing (kHz)	Time Intervals ^{1,2}	Maximum Frequency difference (kHz)	Transient Duration limit (ms)	
			138 ~ 174 MHz	406.1 ~ 512 MHz
25	t ₁	±25	5	10
	t ₂	±12.5	20	25
	t ₃	±25	5	10
12.5	t ₁	±25	5	10
	t ₂	±12.5	20	25
	t ₃	±25	5	10
6.25	t ₁	±25	5	10
	t ₂	±12.5	20	25
	t ₃	±25	5	10

¹ t_{on}: the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t₁: the time period immediately following t_{on}.

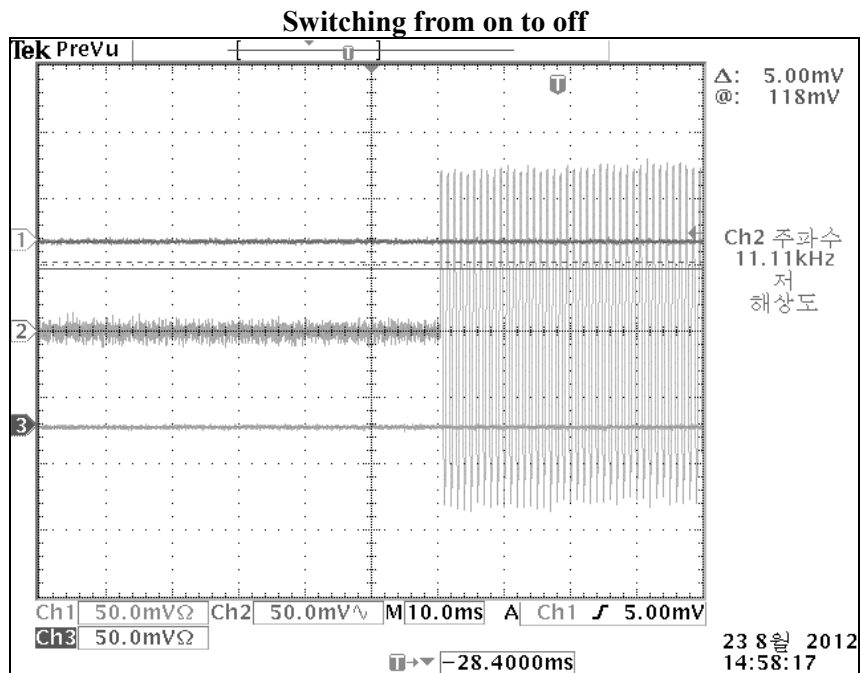
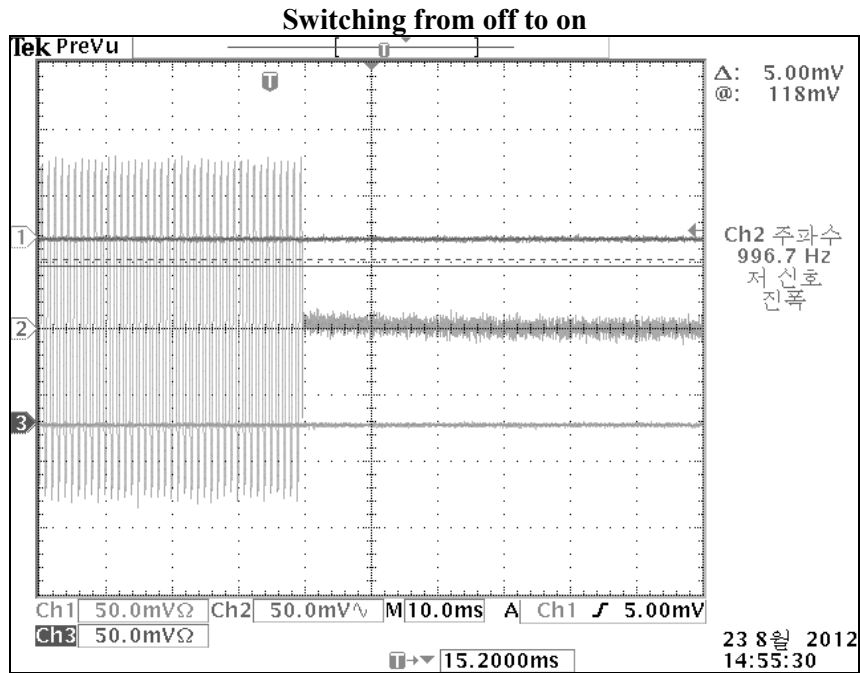
t₂: the time period immediately following t₁.

t₃: the time period from the instant when the transmitter is turned off until t_{off}.

t_{off}: the instant when the 1 kHz test signal starts to rise.

² If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t₁ and t₃ may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t₁ and t₃ shall be recorded in the test report.

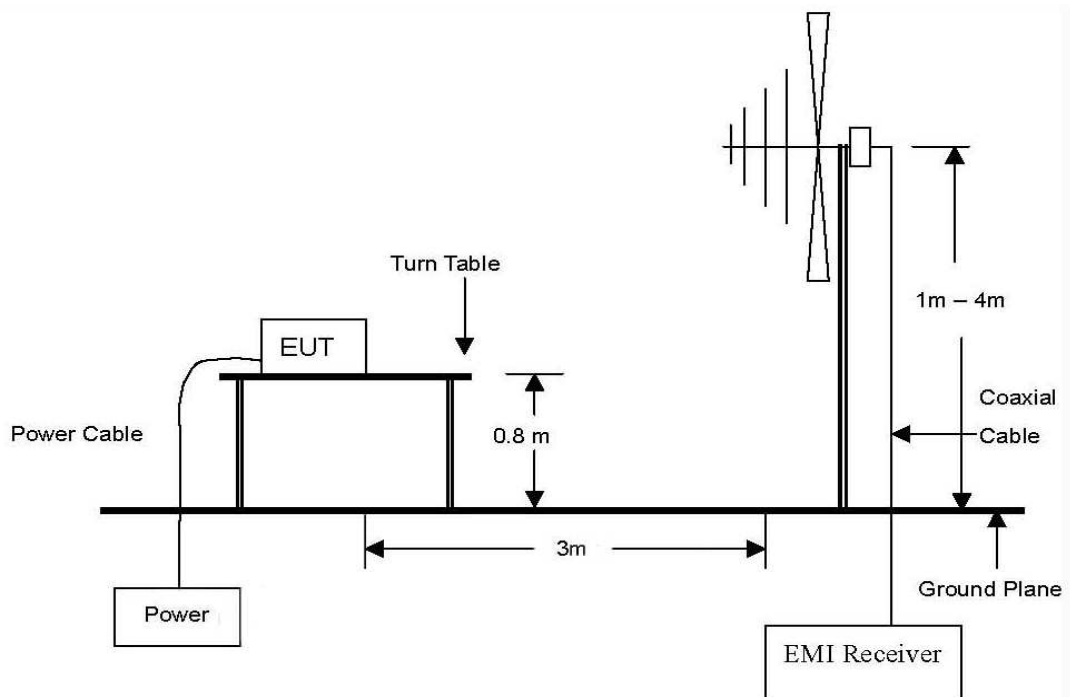
Test results



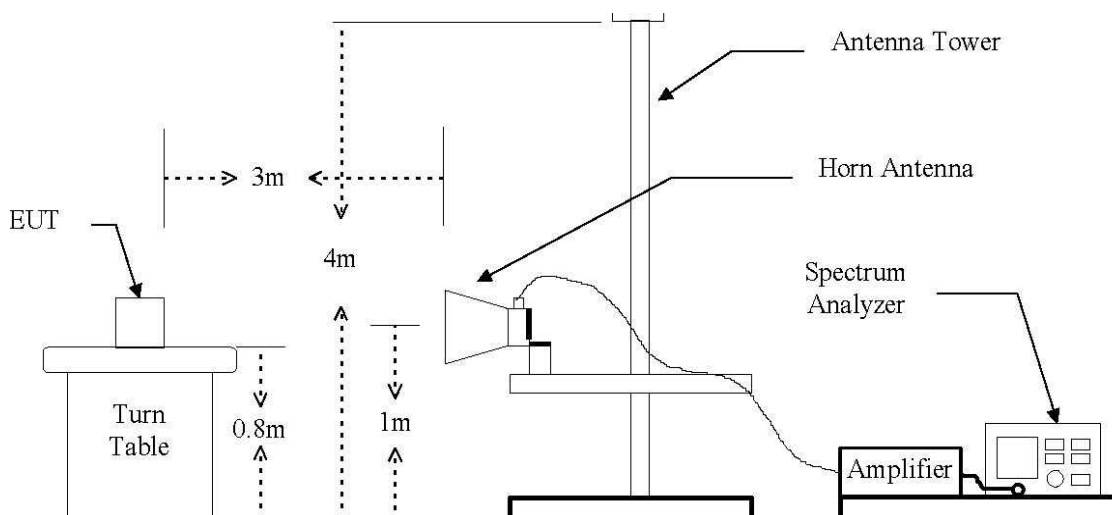
2.1.7 Radiation spurious emissions

Test setup

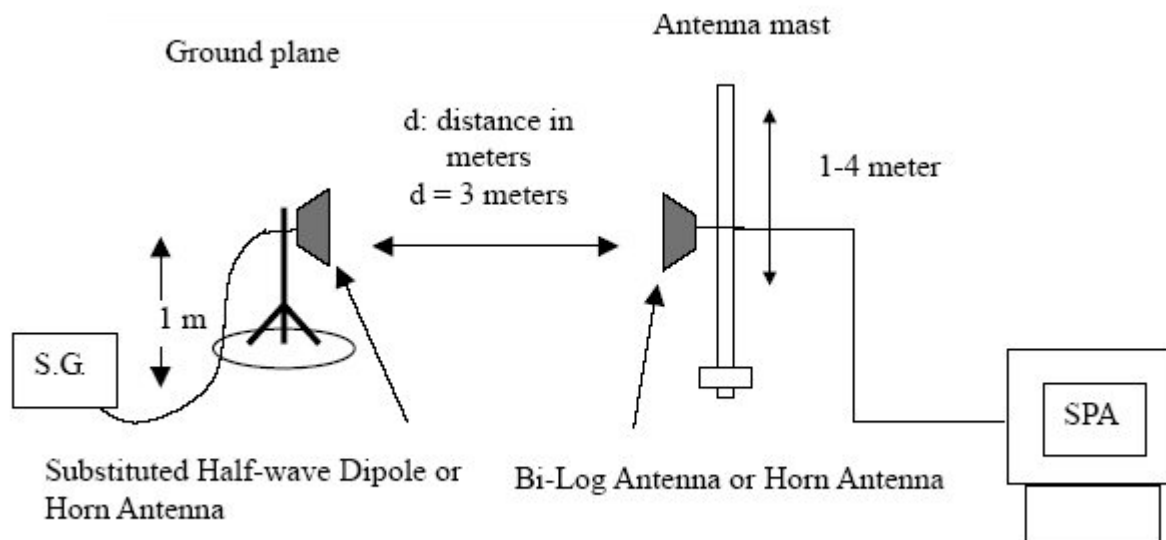
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



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



The diagram below shows the test setup for substituted method



Test procedure: Based on ANSI/TIA 603C: 2004

1. On a test site, the EUT shall be placed at 80 cm 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(< 1 GHz), 1 MHz(> 1 GHz).
 - 2) VBW : 100 kHz(< 1 GHz), 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 be 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 1 000 MHz) or horn antenna(above 1 000 MHz) connected to a signal generator.
11. In necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the 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 receiver, 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.

Limit

According to §90.210(d), Spurious attenuated in dB = 50 + 10log(Power output in watts)

**KES Co., Ltd.**

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

Test results**Low channel**

Frequency (MHz)	Ant. Pol. (H/V)	S.G. Level (dBm)	Correction factor (dB)	Absolute level (dBm)	Spurious attenuation (dBc)	Limit (dBc)	Margin (dB)
900.025 0	H	-30.00	6.32	-23.68	17.12	13.44	3.68
900.025 0	V	-40.00	8.02	-31.98	25.42	13.44	11.98
1 350.037 5	H	-32.00	7.25	-24.75	18.19	13.44	4.75
1 350.037 5	V	-33.00	-2.25	-35.25	28.69	13.44	15.25
1 800.050 0	H	-32.00	-0.67	-32.67	26.11	13.44	12.67
1 800.050 0	V	-36.00	-3.21	-39.21	32.65	13.44	19.21
2 250.062 5	H	-24.00	-2.83	-26.83	20.27	13.44	6.83
2 250.062 5	V	-28.00	-2.18	-30.18	23.62	13.44	10.18
2 700.075 0	H	-34.00	-10.83	-44.83	38.27	13.44	24.83
2 700.075 0	V	-44.00	-12.03	-56.03	49.47	13.44	36.03

**KES Co., Ltd.**

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

Middle channel

Frequency (MHz)	Ant. Pol. (H/V)	S.G. Level (dBm)	Correction factor (dB)	Absolute level (dBm)	Spurious attenuation (dBc)	Limit (dBc)	Margin (dB)
915.150 0	H	-30.00	5.97	-24.03	13.66	9.64	4.02
915.150 0	V	-36.00	3.55	-32.45	22.08	9.64	12.44
1 372.725 0	H	-30.00	3.16	-26.84	16.47	9.64	6.83
1 372.725 0	V	-35.00	-0.51	-35.51	25.14	9.64	15.50
1 830.300 0	H	-30.00	-2.68	-32.68	22.31	9.64	12.67
1 830.300 0	V	-38.00	-1.02	-39.02	28.65	9.64	19.01
2 287.875 0	H	-23.00	-5.07	-28.07	17.70	9.64	8.06
2 287.875 0	V	-25.00	-9.80	-34.80	24.43	9.64	14.79
2 745.450 0	H	-43.00	7.67	-35.33	24.96	9.64	15.32
2 745.450 0	V	-45.00	0.19	-44.81	34.44	9.64	24.80

High channel

Frequency (MHz)	Ant. Pol. (H/V)	S.G. Level (dBm)	Correction factor (dB)	Absolute level (dBm)	Spurious attenuation (dBc)	Limit (dBc)	Margin (dB)
939.950 0	H	-35.00	8.04	-26.96	18.37	11.40	6.97
939.950 0	V	-40.00	3.81	-36.19	27.60	11.40	16.20
1 409.925 0	H	-28.00	-4.82	-32.82	24.23	11.40	12.83
1 409.925 0	V	-36.00	-5.98	-41.98	33.39	11.40	21.99
1 879.900 0	H	-32.00	2.92	-29.08	20.49	11.40	9.09
1 879.900 0	V	-38.00	2.73	-35.27	26.68	11.40	15.28
2 349.875 0	H	-32.00	2.27	-29.73	21.14	11.40	9.74
2 349.875 0	V	-38.00	2.00	-36.00	27.41	11.40	16.01

※Remark;

1. Correction factor: Substitution antenna gain - Tx cable loss
2. E.R.P. or E.I.R.P = S.G. Level + correction factor

**KES Co., Ltd.**

C-3701 Dongil Techno Town, 889-1, Gwanyang 2-dong,
Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450
www.kes.co.kr

Appendix A. Test equipment used for test

Equipment	Manufacturer	Model	Calibration due.
Spectrum Analyzer	R&S	FSV30	2013.01.10
Vector Signal Generator	R&S	SMBV2100A	2013.01.10
Trilog-Broadband Antenna	Schwarzbeck	VULB 9168	2013.04.28
Horn Antenna	A.H.	SAS-571	2013.03.22
Horn Antenna	A.H.	SAS-571	2013.03.22
Dipole Antenna	R&S	VHAP	2013.04.29
Dipole Antenna	R&S	VHAP	2013.04.29
Dipole Antenna	R&S	UHAP	2013.04.29
Dipole Antenna	R&S	UHAP	2013.04.29
High pass filter	Mini-circuits	NHP-800+	2013.08.02
Oscilloscope	Tektronix	TDS3014B	2012.12.20
Four - Port Junction Pad	ANRITSU	6502	2013.03.30

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
N/A			

Appendix B. Test setup photo

Radiated field emissions



N/A