TEST REPORT

Part 90 & IC RSS-119(Issue 12)

Equipment under test	IQ TRANSMITTER
Model name	J2002
FCC ID	WDC-J2002
IC	7752A-J2002
Applicant	JTECH an HME Company
Manufacturer	Lee Technology Korea Co., Ltd.
Date of test(s)	2020.01.20 ~ 2020.01.31
Date of issue	2020.02.14

Issued to

JTECH an HME Company
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Suwanee , GA USA 30024

Issued by

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Revision history

Revision	Date of issue	Test report No.	Description
-	2020.02.14	KES-RF-20T0031	Initial

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1. General information

Applicant	JTECH an HME Company
Applicant address	1400 Northbrook Parkway Suite #320 Suwanee , GA USA 30024
Test site	KES Co., Ltd.
Test site address	3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 473-29, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
Rule part(s)	Part 90, IC RSS-119(Issue 12)
Test device serial No.	☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	IQ TRANSMITTER
Frequency range	450.3250 ㎒ ~ 469.9875 ㎒
Model:	J2002
Type of emission	3K5F1D
Channel separation	12.5 ㎑
Rated power	30.00 ㏈m
Antenna specification	BNC type (Helical antenna) // -2.61㏈i
Power source	AC 120V Adapter (Output : DC 12V / 5 A)

1.2. Test frequency

	Low channel	Middle channel	High channel
Frequency (㎒)	450.3250	457.5750	469.9875

1.3. Information about derivative model

N/A

1.4. Device modifications

N/A

1.5. Test configuration

The **JTECH an HME Company ServerCall Transmitter FCC ID : WDC-J2002 IC : 7752A-2002** was tested per the guidance of ANSI C63.4-2014, TIA-603.E-2016, FCC CFR 47 Part 90, RSS-119 Issue 12, RSS-Gen Issue 5 was used to reference the appropriate EUT setup for radiated spurious emissions testing

1.5. Software and Firmware description

The software and firmware installed in the EUT is ver 4.30

1.6. Measurement results explanation example

For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 2.40 + 30.00 = 32.40 (dB)

1.7. Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.62 dB
Uncertainty for Radiation emission test (include Fundamental emission)	9 kHz - 30 MHz	4.54 dB
	30 MHz - 1 GHz	4.36 dB
	Above 1 GHz	5.00 dB
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		

2. Summary of tests

Reference	Parameter	Test results
90.205 RSS-119 5.4	RF output power	Pass
90.209 RSS-Gen 6.7	Bandwidth limitation	Pass
90.210(d) RSS-119 5.8.4	Emission mask	Pass
90.210(d) RSS-119 5.8.3	Conducted spurious emissions	Pass
90.213 RSS-119 5.3	Frequency stability	Pass
90.214 RSS-119 5.9	Transient frequency behavior	Pass
90.210(d) RSS-119 5.8.3	Radiated spurious emissions	Pass

3. Test results

3.1 RF output power

Test setup

EUT — Attenuator — Spectrum analyzer

Test procedure

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

Limit

According to FCC 90.205(h) 450 ~ 470 ㎒. (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 ㎒—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

[1]Maximum ERP indicated provides for a 39 ㏈u signal strength at the edge of the service area per FCC Report R-6602, Fig. 29 (See §73.699, Fig. 10 b).
[2]Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 ㏈u.
[3]When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: $ERP_{allow}=ERP_{max}\times (HAAT_{ref}/HAAT_{actual})^2$.
[4]Applications 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 ㏈u.

RSS-119 5.4
The output power shall be within ±1 dB of the manufacturer's rated power listed in the equipment specifications.
The transmitter output power limits set forth in Table 2 will come into force upon the publication of Issue 12 of this standard and will apply to newly certified equipment.

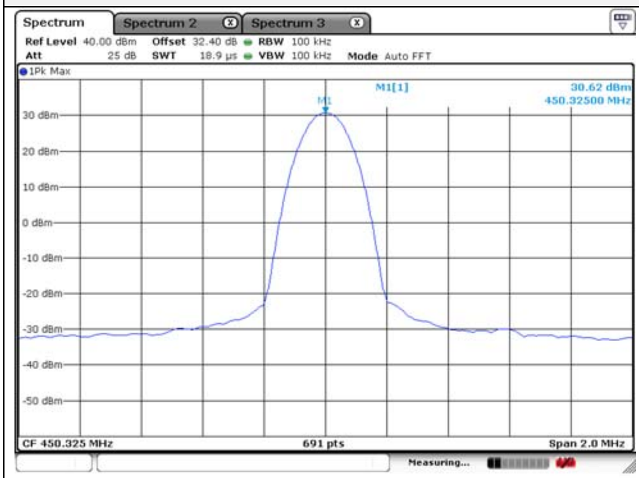
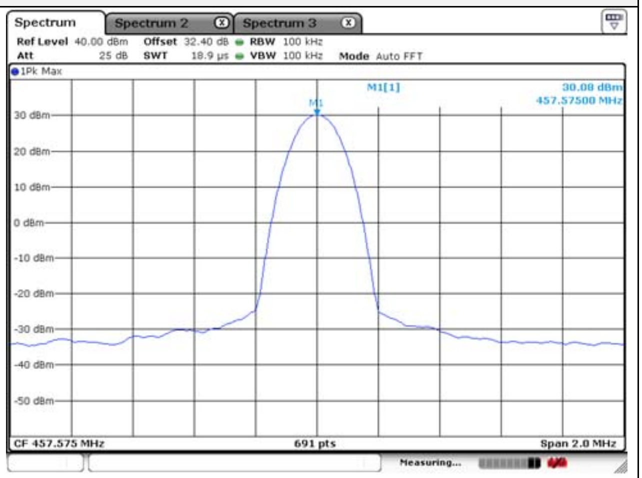
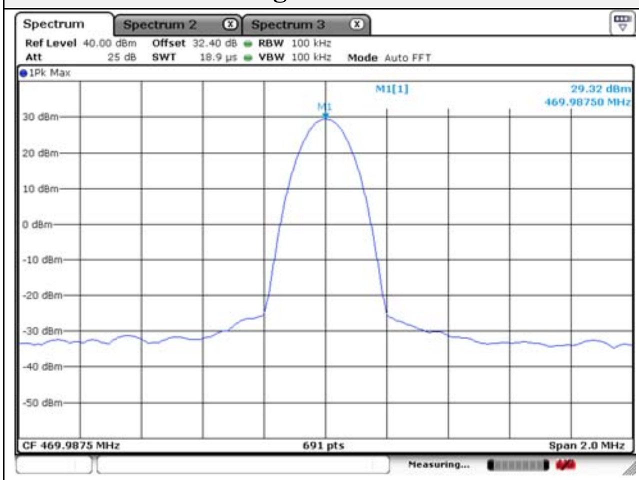
Table 2 – Transmitter Output Power

Frequency Bands (MHz)	**Transmitter Output Power (W)**	
Base/Fixed Equipment	**Mobile Equipment**	
27.41-28 and 29.7-50	300	30
72-76	No limit	1
138-174	110	60
217-218 and 219-220	110	30*
220-222	See SRSP-512 for ERP limit	50
406.1-430 and 450-470	110	60
768-776 and 798-806	See SRSP-511 for ERP limit	30 3 W ERP for portable equipment
806-821/851-866 and 821-824/866-869	110	30
896-901/935-940	110	60
929-930/931-932	110	30
928-929/952-953 and 932-932.5/941-941.5	110	30
932.5-935/941.5-944	110	30

*Equipment is generally authorized for effective radiated power (ERP) of less than 5 W.

Test results

Frequency (㎒)	Output power(dBm)	Output power(W)	Rated power(dBm)
450.3250	30.62	1.15	30.00
457.5750	30.08	1.02	
469.9875	29.32	0.86	

Low channel	Middle channel
	
High channel	**N/A**
	

3.2 Bandwidth limitation

Test setup

EUT	Attenuator	Spectrum analyzer

Test procedure

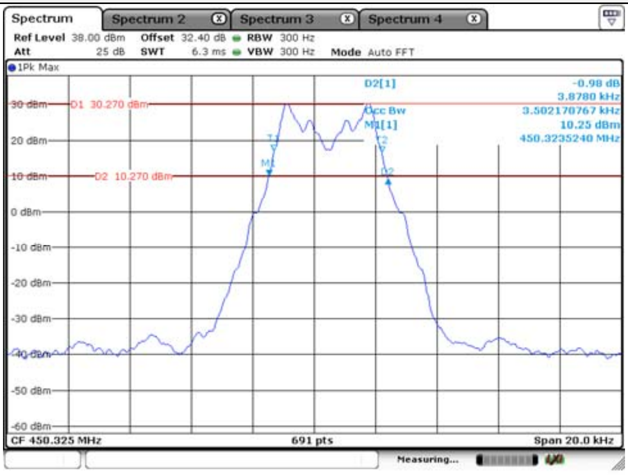
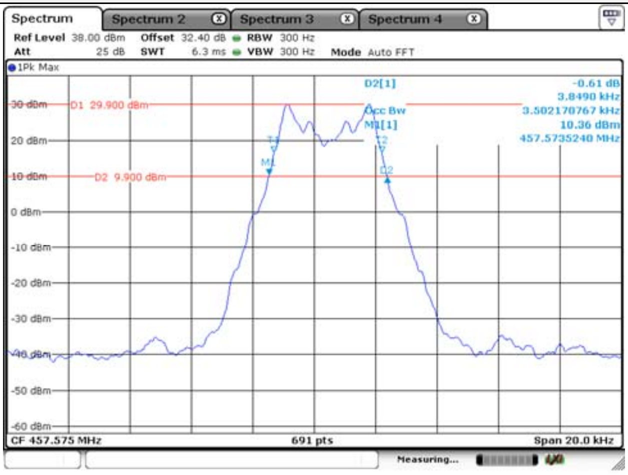
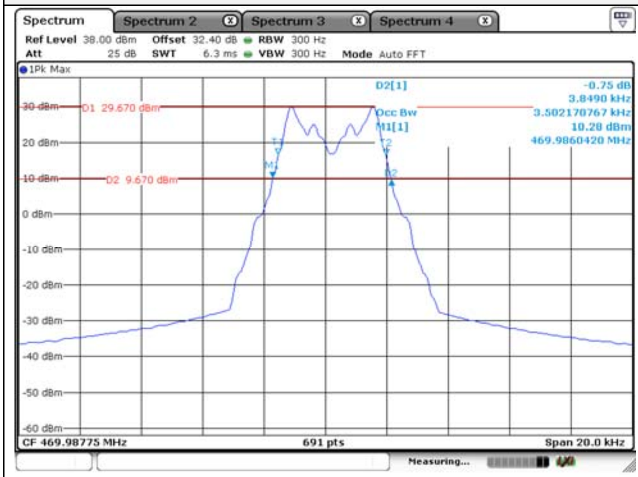
1. The transmitter output was connected to the spectrum analyzer through an attenuator
2. Use the following spectrum analyzer setting
   Span = 50 ㎑
   RBW = 300 ㎐
   VBW = 300 ㎐ (≥ RBW)
   Sweep = auto
   Detector function = peak
   Trace = max hold
3. Mark the peak frequency and -20 ㏈(Upper and lower)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

Limit

N/A

Test results

Frequency(㎒)	20 ㏈ bandwidth (㎑)	OBW (㎑)
450.3250	3.878	3.502
457.5750	3.849	3.502
469.9875	3.849	3.502

Low channel	Middle channel
	
High channel	**N/A**
	

3.3 Emission mask

Test setup

EUT — Attenuator — Spectrum analyzer

Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator
2. Use the following spectrum analyzer setting
   Span = 120 ㎑
   RBW = 100 ㎐
   VBW = 100 ㎐ (≥ 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

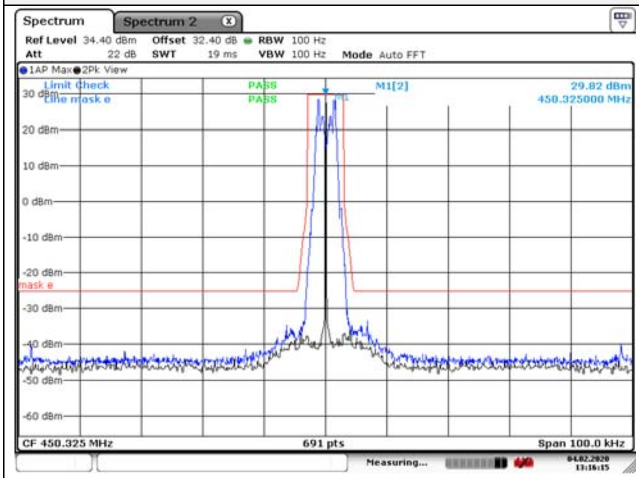
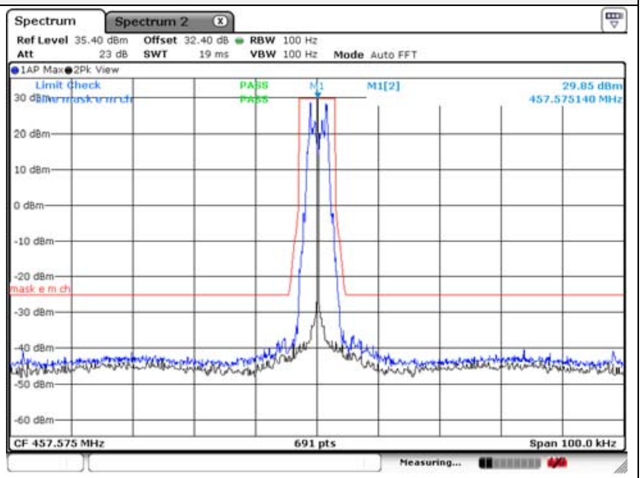
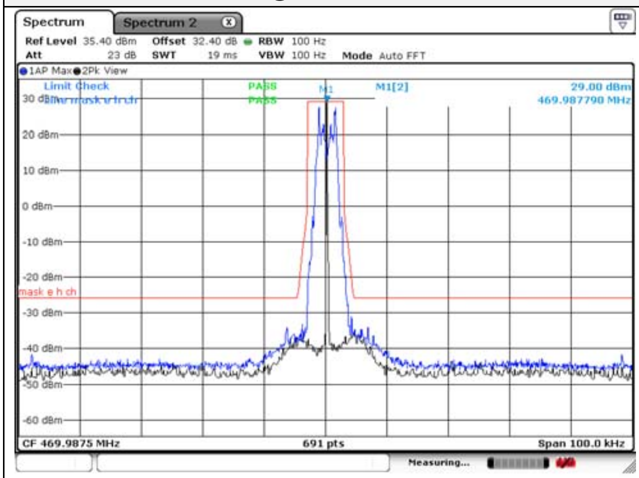
Emission Mask E - 6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 3.0 kHz removed from f0: Zero dB.
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd−3 kHz) or 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.
(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

RSS-119 5.8.4
The power of any emission shall be attenuated below the transmitter output power P(㏈W) as specified in Table 8.
Table 8 – Emission Mask E

Displacement Frequency, f_d(㎑)	Minimum Attenuation (㏈)	Resolution Bandwidth (㎐)
$3 < f_d \leq 4.6$	Whichever is the lesser: 30 + 16.67(fd−3) or 55 + 10 log10(p)	Specified in Section 4.2.2
$f_d > 4.6$	Whichever is the lesser: 57 or 55 + 10 log10(p)	Specified in Section 4.2.2

Test results

Low channel	Middle channel
	
High channel	**N/A**
	

3.4 Conducted spurious emissions

Test setup

EUT	**Attenuator**	**Spectrum analyzer**

Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator
2. Use the following spectrum analyzer setting
   Span = 30 ㎒ to 5 ㎓
   RBW = 100 ㎑(< 1 ㎓), 1 ㎒(> 1 ㎓)
   VBW = 300 ㎑(< 1 ㎓), 3 ㎒(> 1 ㎓)
   Sweep = auto
   Detector function = peak
   Trace = max hold

Limit

Emission Mask E - 6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less 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 more than 4.6 kHz: At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

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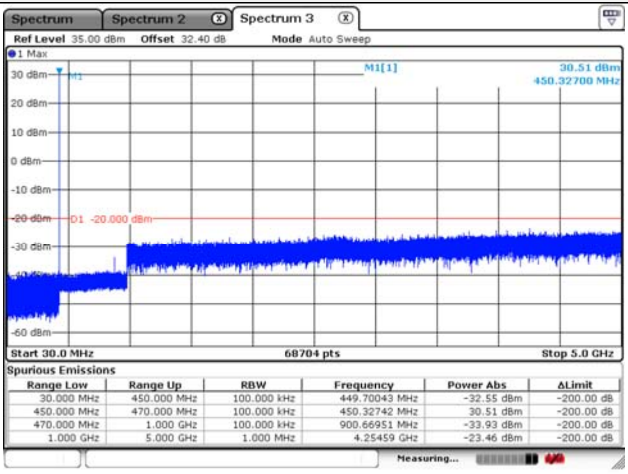
The power of any emission shall be attenuated below the transmitter output power P(dBW) as specified in Table 7.

Table 8 – Emission Mask E

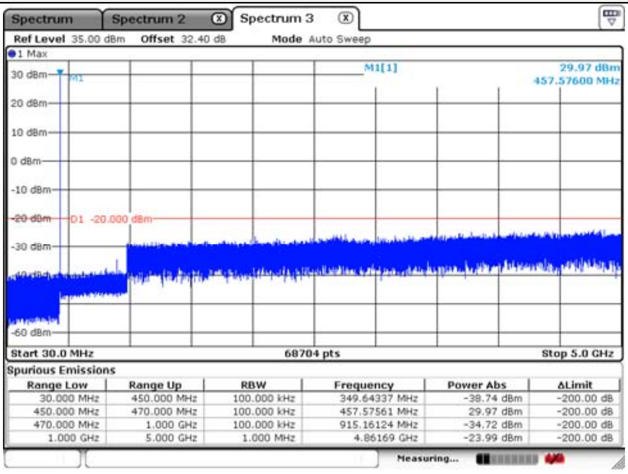
Displacement Frequency, f_d(㎑)	Minimum Attenuation (dB)	Resolution Bandwidth (㎐)
$3 < f_d \leq 4.6$	Whichever is the lesser: 30 + 16.67(fd−3) or 55 + 10 log10(p)	Specified in Section 4.2.2
$f_d > 4.6$	Whichever is the lesser: 57 or 55 + 10 log10(p)	Specified in Section 4.2.2

Test results

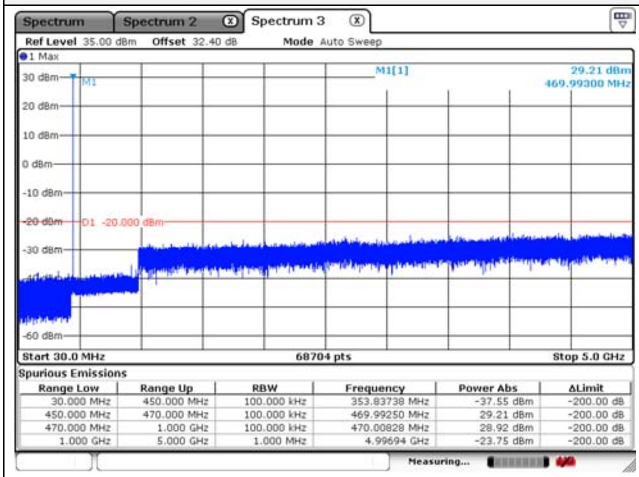
Low channel



Middle channel



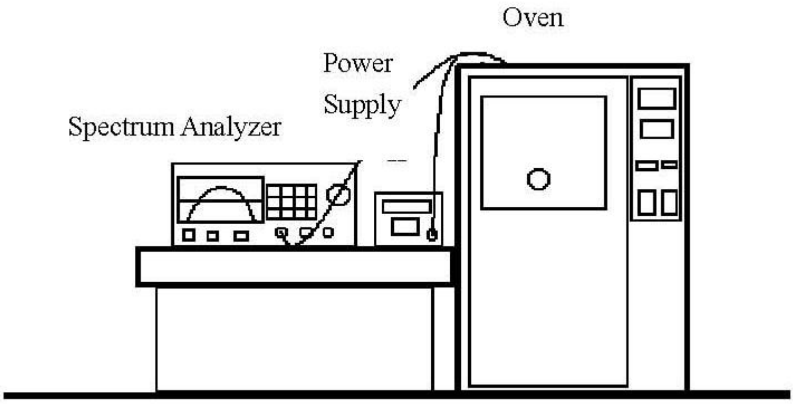
High channel



N/A

3.5 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 ㎑, VBW=1 ㎑.
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.

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 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 (㎒)	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]			

[1]Fixed 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.

[2]For single sideband operations below 25 ㎒, the carrier frequency must be maintained within 50 ㎐ of the authorized carrier frequency.

[3]Travelers information station transmitters operating from 530 ~ 1 700 ㎑ 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 ㎐ of the authorized frequency.

[4]Stations operating in the 154.45 to 154.49 ㎒ or the 173.2 to 173.4 ㎒ bands must have a frequency stability of 5 ppm.

[5]In the 150 ~ 174 ㎒ band, fixed and base stations with a 12.5 ㎑ channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 ㎑ channel bandwidth must have a frequency stability of 1.0 ppm.

[6]In the 150 ~ 174 ㎒ band, mobile stations designed to operate with a 12.5 ㎑ 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 ㎑ channel bandwidth must have a frequency stability of 2.0 ppm.

[7]In the 421 ~ 512 ㎒ band, fixed and base stations with a 12.5 ㎑ channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 ㎑ channel bandwidth must have a frequency stability of 0.5 ppm.

[8]In the 421 ~ 512 ㎒ band, mobile stations designed to operate with a 12.5 ㎑ channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 ㎑ channel bandwidth must have a frequency stability of 1.0 ppm.

[9]Fixed stations with output powers above 120 watts and necessary bandwidth less than 3 ㎑ 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.

[10]Except for DSRCS equipment in the 5 850 ~ 5 925 ㎒ band, frequency stability is to be specified in the station authorization. Frequency stability for DSRCS equipment in the 5 850 ~ 5 925 ㎒ band is specified in subpart M of this part.

[11]Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150 ~ 174 ㎒ band and 2.5 ppm in the 421 ~ 512 ㎒ band.

[12]Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability.

[13]Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 ㎑ from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.

[14]Control 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.

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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 ㎽, the frequency stability may comply with the limits listed in Table 1, of alternatively with the conditions in Section 5.10.

For fixed and base station equipment, in lieu of meeting the frequency stability limit specified in Table 1, the test report can show that the frequency stability is met by demonstrating that the unwanted emission limits, related to the equipment's nominal carrier frequency measured under normal operation, are met when the equipment is tested at the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

Table 1 – Transmitter Frequency Stability

Frequency range (㎒)	Channel Spacing (㎑)	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

Notes:

1. Mobile units may use synchronizing signals from associated base stations to achieve the specified carrier stability.

2. This provision is for digital equipment with a channel bandwidth of 25 ㎑ and an occupied bandwidth greater than 20 ㎑. The mobile station's frequency stability values given in Table 1 are for mobile, portable and control transmitters using automatic frequency control (AFC) to lock onto the base station signal. When the mobile, portable and control transmitters are operating without using AFC to lock onto the base station signal, the frequency stability limit shall be better than 1 ㎑ and the equipment's unwanted emissions measured with maximum frequency shift shall still comply with emission mask Y (Section 5.8.10) at nominal carrier frequency.

3. Mobile, portable and control transmitters operating in the bands 768-776 MHz and 798-806 MHz must normally use 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.

4. When the mobile, portable and control transmitters are operating with channel bandwidths equal to 6.25 ㎑, 12.5 ㎑ or 25 ㎑ in the band 768-776 MHz and the AFC is not locked onto the base station signal, the frequency stability must be equal to or better than 1 ppm for 6.25 ㎑, 1.5 ppm for 12.5 ㎑ (2-channel aggregate), and 2.5 ppm for 25 ㎑ (4-channel aggregate).

5. When the mobile, portable and control transmitters are operating with channel bandwidths equal to 50 ㎑ in the band 768-776 ㎒ and the AFC is not locked onto the base station signal, the frequency stability must be equal to or better than 5 ppm.

6. Control stations may operate with the frequency stability specified for associated mobile frequencies.

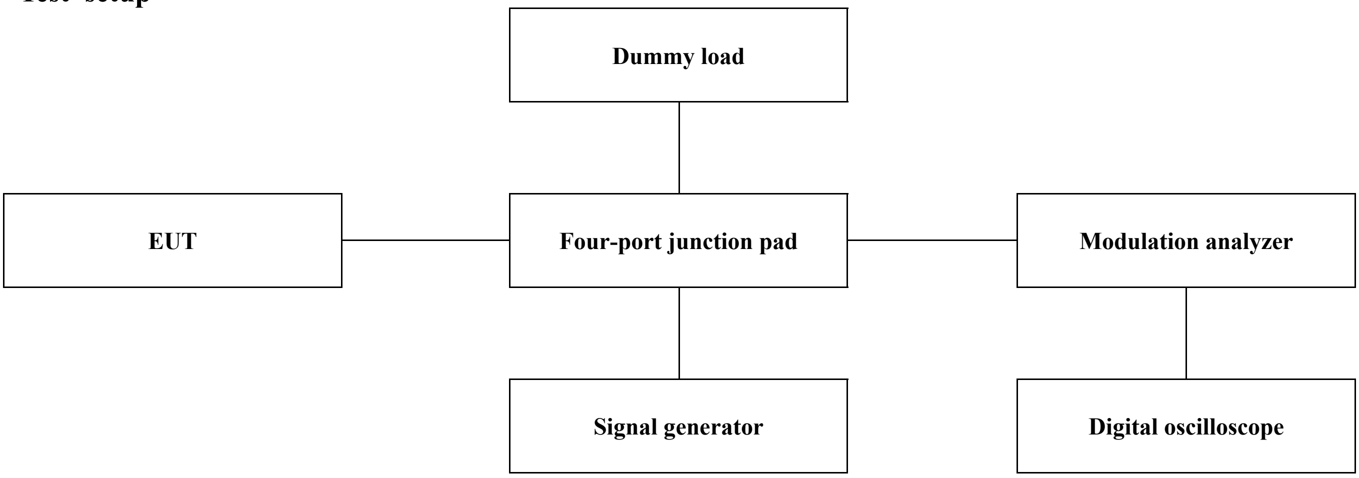
Test results

Assigned frequency (㎒): 450.3250

Test voltage (%)	Test voltage (V)	Temperature (℃)	Measure frequency (㎒)	Frequency deviation (㎐)	Frequency deviation (ppm)	Limit (ppm)	
						FCC	IC
100 %	AC 120	-30	450.325182	182	0.40	2.5	1.5
		-20	450.325102	102	0.23		
		-10	450.325141	141	0.31		
		0	450.325048	48	0.11		
		10	450.325006	6	0.01		
		20	450.325052	52	0.12		
		30	450.325022	22	0.05		
		40	450.324878	-122	-0.27		
		50	450.324831	-169	-0.38		
115 %	AC 102	20	450.325011	11	0.02		
85 %	AC 138	20	450.325006	6	0.01		

3.6 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 ±6.25 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 t1 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.

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 ㎑ 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 t3. See the figures in the appropriate standards section.

Limit

According to FCC 90.214, Transmitters designed to operate in the 150 ~ 174 ㎒ and 421 ~ 512 ㎒ 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 ㎒	421 to 512 ㎒
Transient frequency behaviour for equipment designed to operate on 25 ㎑ channel			
t1[4] ---------------------------	±25.0 ㎑	5.0 ㎳	10.0 ㎳
t2 ---------------------------	±12.5 ㎑	20.0 ㎳	25.0 ㎳
t3[4] ---------------------------	±25.0 ㎑	5.0 ㎳	10.0 ㎳
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 ㎑ Channel			
t1[4] ---------------------------	±12.5 ㎑	5.0 ㎳	10.0 ㎳
t2 ---------------------------	±6.25 ㎑	20.0 ㎳	25.0 ㎳
t3[4] ---------------------------	±12.5 ㎑	5.0 ㎳	10.0 ㎳
Transient Frequency Behaviour for Equipment Designed to Operate on 6.25 ㎑ Channel			
t1[4] ---------------------------	±6.25 ㎑	5.0 ㎳	10.0 ㎳
t2 ---------------------------	±3.125 ㎑	20.0 ㎳	25.0 ㎳
t3[4] ---------------------------	±6.25 ㎑	5.0 ㎳	10.0 ㎳

[1] $_{on}$ is the instant when a 1 ㎑ 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 ㎑ 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.

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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 18.

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 18 - Transient Frequency Behavior

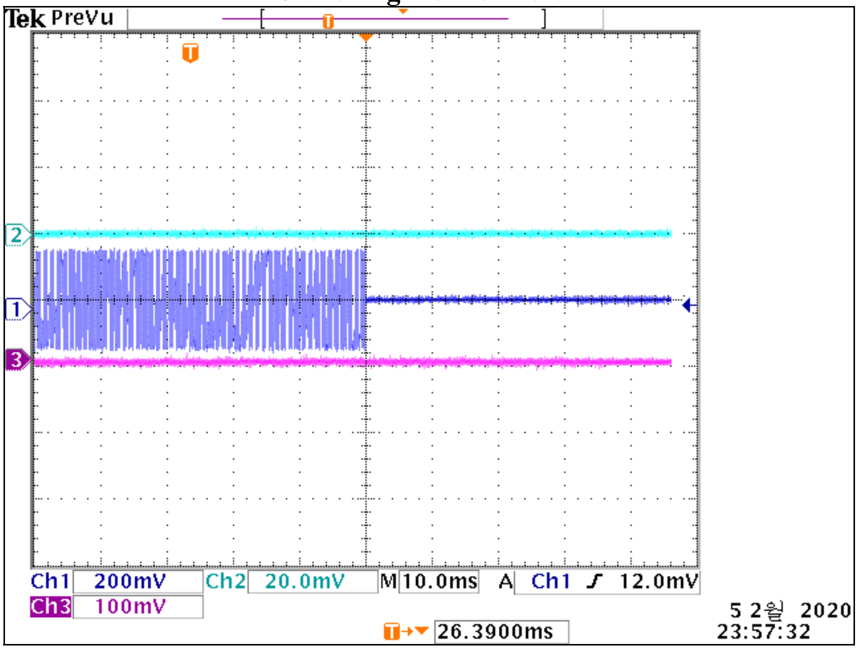
Channel Spacing (㎑)	Time Intervals[1,2]	Maximum Frequency difference (㎑)	Transient Duration limit (㎳)	
			138 ~ 174 ㎒	406.1 ~ 512 ㎒
25	t_1	±25	5	10
	t_2	±12.5	20	25
	t_3	±25	5	10
12.5	t_1	±25	5	10
	t_2	±12.5	20	25
	t_3	±25	5	10
6.25	t_1	±25	5	10
	t_2	±12.5	20	25
	t_3	±25	5	10

[1] t_{on}: the instant when a 1 ㎑ test signal is completely suppressed, including any capture time due to phasing.
t_1: the time period immediately following t_{on}.
t_2: the time period immediately following t_1.
t_3: the time period from the instant when the transmitter is turned off until t_{off}.
t_{off}: the instant when the 1 ㎑ test signal starts to rise.

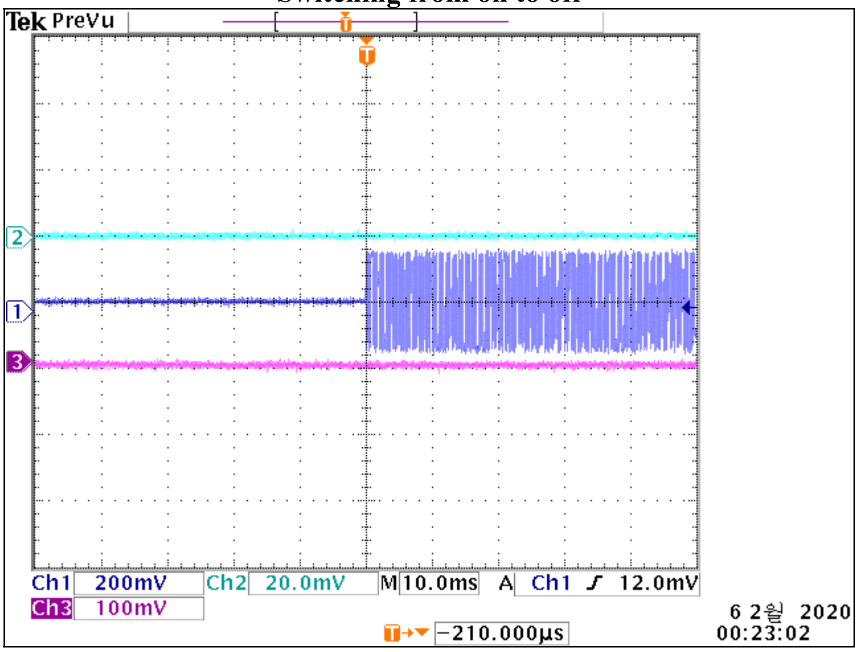
[2] If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t_1 and t_3 may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t_1 and t_3 shall be recorded in the test report.

Test results

Switching from off to on



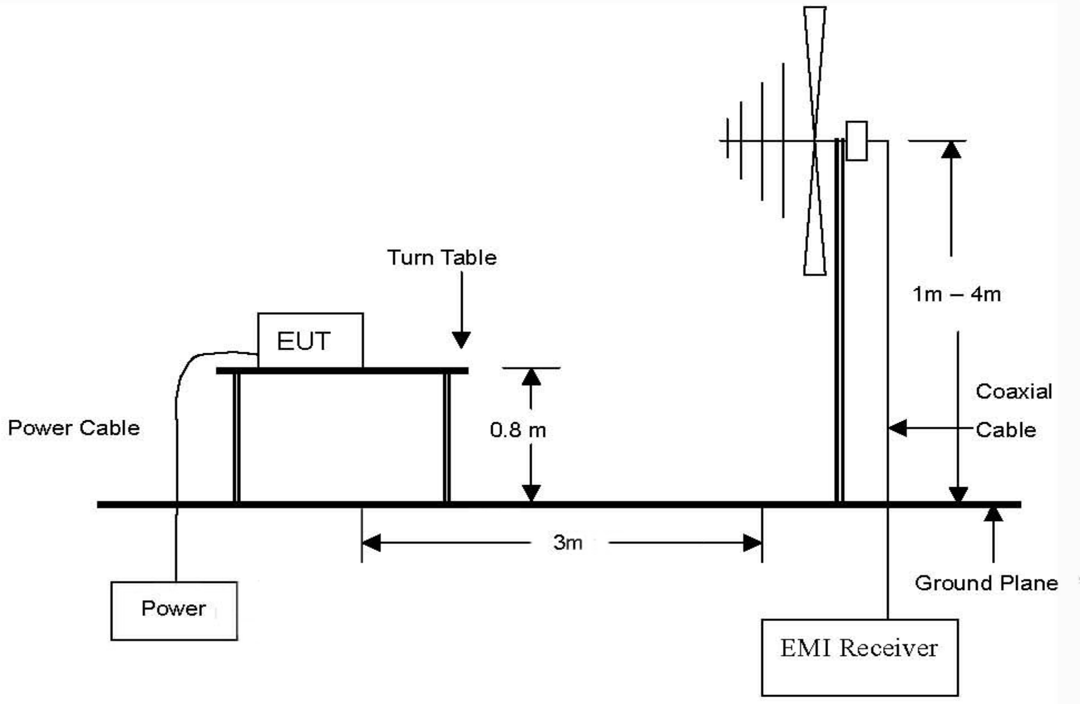
Switching from on to off



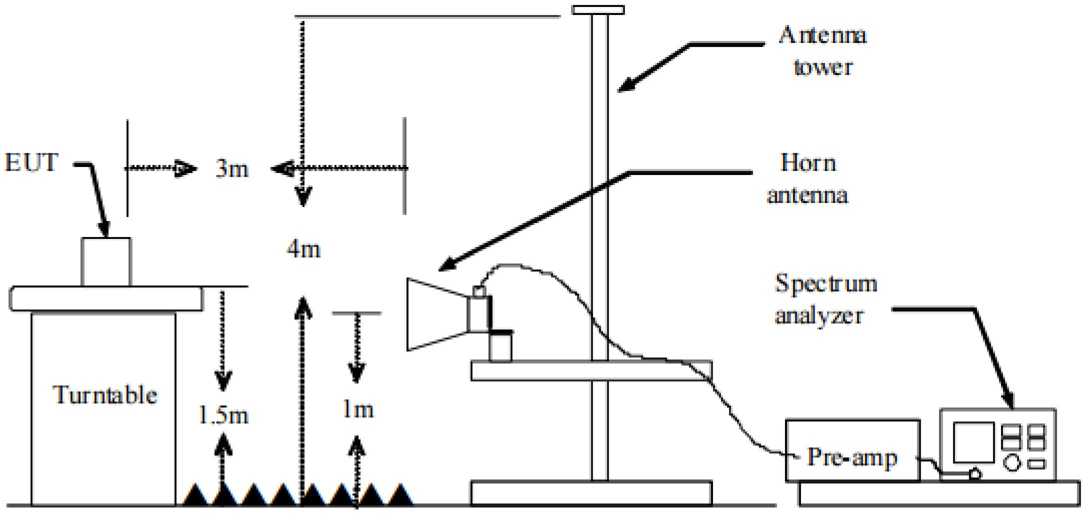
3.7 Radiation spurious emissions

Test setup

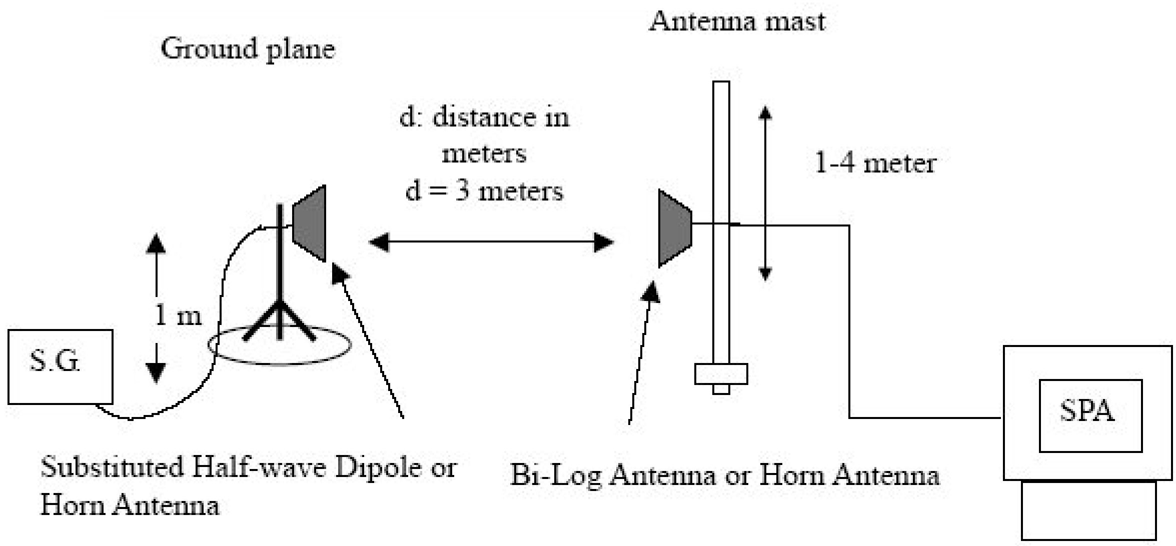
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ Emissions.



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



The diagram below shows the test setup for substituted method



Test procedure: Based on ANSI/TIA 603E: 2016

1. On a test site, the EUT shall be placed at 80 ㎝ height(below 1 000 ㎒) or 1.5 m(above 1 000 ㎒) 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 ㎑(< 1 ㎓), 1 ㎒(> 1 ㎓).
   2) VBW : 100 ㎑(< 1 ㎓), 1 ㎒(> 1 ㎓).
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 1 000 ㎒) or horn antenna(above 1 000 ㎒) 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 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 ㏈m, 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)

Test results

Measurement Condition

Ambient temperature : 20 ℃

Relative humidity : 39 % R.H.

Fundamental output power

Frequency (㎒)	Ant. Pol.(H/V)	Output power(㏈m)	Output power(W)
450.3250	H	20.94	0.124165
	V	19.08	0.080910
457.5750	H	20.78	0.119674
	V	18.95	0.078524
469.9875	H	20.58	0.114288
	V	18.50	0.070795

Low channel

Frequency (㎒)	Ant. Pol. (H/V)	S.G. Level (dBm)	Correction factor (dB)	Absolute level (dBm)	Spurious attenuation (dBc)	Limit (dBc)	Margin (dB)
900.650	H	-38.50	0.55	-37.95	58.89	40.94	17.95
900.650	V	-40.90	0.89	-40.01	60.95	40.94	20.01
1350.975	H	-48.30	4.00	-44.30	65.24	40.94	24.30
1350.975	V	-56.50	4.34	-52.16	73.10	40.94	32.16
1801.300	H	-58.50	4.32	-54.18	75.12	40.94	33.63
1801.300	V	-65.40	4.24	-61.16	82.10	40.94	40.61
2251.625	H	-55.90	4.31	-51.59	72.53	40.94	31.04
2251.625	V	-58.60	3.73	-54.87	75.81	40.94	34.32
2701.950	H	-63.20	4.31	-58.89	79.83	40.94	38.34
2701.950	V	-66.10	4.01	-62.09	83.03	40.94	41.54
3152.275	H	-63.80	4.60	-59.20	80.14	40.94	38.65
3152.275	V	-63.20	4.63	-58.57	79.51	40.94	38.02

Middle channel

Frequency (㎒)	Ant. Pol. (H/V)	S.G. Level (dBm)	Correction factor (dB)	Absolute level (dBm)	Spurious attenuation (dBc)	Limit (dBc)	Margin (dB)
915.150	H	-38.60	0.76	-37.84	58.62	40.78	17.84
915.150	V	-42.90	0.38	-42.52	63.30	40.78	22.52
1372.725	H	-49.50	12.83	-36.67	57.45	40.78	16.67
1372.725	V	-56.20	12.60	-43.60	64.38	40.78	23.60
1830.300	H	-59.40	13.84	-45.56	66.34	40.78	25.56
1830.300	V	-63.30	13.08	-50.22	71.00	40.78	30.22
2287.875	H	-57.40	14.03	-43.37	64.15	40.78	23.37
2287.875	V	-62.60	13.98	-48.62	69.40	40.78	28.62
2745.450	H	-65.80	13.80	-52.00	72.78	40.78	32.00
2745.450	V	-64.90	13.98	-50.92	71.70	40.78	30.92
3203.025	H	-65.20	13.16	-52.04	72.82	40.78	32.04
3203.025	V	-58.90	13.67	-45.23	66.01	40.78	25.23

High channel

Frequency (㎒)	Ant. Pol. (H/V)	S.G. Level (dBm)	Correction factor (dB)	Absolute level (dBm)	Spurious attenuation (dBc)	Limit (dBc)	Margin (dB)
939.975	H	-38.50	0.69	-37.81	58.39	40.58	17.81
939.975	V	-39.00	0.29	-38.71	59.29	40.58	18.71
1409.963	H	-51.20	12.81	-38.39	58.97	40.58	18.39
1409.963	V	-49.00	12.85	-36.15	56.73	40.58	16.15
1879.950	H	-51.50	13.57	-37.93	58.51	40.58	17.93
1879.950	V	-60.00	13.47	-46.53	67.11	40.58	26.53
2349.938	H	-55.00	13.19	-41.81	62.39	40.58	21.81
2349.938	V	-61.00	13.56	-47.44	68.02	40.58	27.44
2819.925	H	-64.00	13.21	-50.79	71.37	40.58	30.79
2819.925	V	-61.00	13.91	-47.09	67.67	40.58	27.09
3289.913	H	-61.00	13.65	-47.35	67.93	40.58	27.35
3289.913	V	-55.00	13.91	-41.09	61.67	40.58	21.09

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

Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	101389	1 year	2021.01.15
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2021.01.15
Vector Signal Generator	R&S	SMBV100A	256397	1 year	2020.06.25
AC POWER SOURCE/ ANALYZER	HP	6813A	3729A00754	1 year	2021.01.15
Attenuator	HP	30dB ATTENUATOR	3318A05137	1 year	2021.01.15
Modulation Analyzer	HP	8901B	3438A05094	1 year	2021.01.15
Audio Analyzer	HP	8903B	3413A14728	1 year	2020.06.25
Trilog-broadband antenna	SCHWARZBECK	VULB 9163	9168-714	2 years	2021.01.14
Dipole antenna	SCHWARZBECK	VHA9103	3093	2 years	2021.06.26
Dipole antenna	SCHWARZBECK	UHA9105	2703	2 years	2021.06.26
Dipole antenna	SCHWARZBECK	VHA9103	3101	2 years	2021.06.26
Dipole antenna	SCHWARZBECK	UHA9105	2702	2 years	2021.06.26
Horn Antenna	A.H.	SAS-571	781	2 years	2021.05.13
Horn Antenna	A.H SYSTEMS	SAS-571	414	2 years	2021.02.11
High Pass Filter	Mini-Circuits	NHP-800+	15542	1 year	2020.06.24
Preamplifier	AGILENT	8449B	3008A01742	1 year	2021.01.08
Preamplifier	HP	8447F	2805A02570	1 year	2021.01.15
Temperature & Humidity Chamber	ESPEC	SH-642	93012670	1 year	2021.01.15
DIGITAL Oscilloscope	Tektronix	TDS3014B	B014295	1 year	2020.09.10
Four-port junction pad	ANRITSU	MA1612A	M14368	1 year	2020.06.24

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook computer	Samsung Electronics Co., Ltd.	NT-R540-PS35S	ZSME93AZ700280W