

Test report No.: KES-RF-17T0002 Page (1) of (36)

TEST REPORT

Part 15 Subpart C 15.247

Equipment under test DUAL-MODE BABY MONITOR

Model name SEM-3057WN

Derivative model SEM-3055WN

FCC ID NLMSEM3057WN

Applicant Hanwha Techwin Co., Ltd.

Manufacturer RDI Technology (Shenzhen) Co., Ltd.

Date of test(s) 2016.12.29 ~ 2017.01.09

Date of issue 2017.01.10

Issued to

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	-
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Revision history

Revision	Date of issue	Test report No.	Description
-	2017.01.10	KES-RF-17T0002	Initial



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1. General inf	ormation
Applicant:	Hanwha Techwin Co., Ltd.
Applicant address:	1204, Changwon-daero, Seongsan-gu, Changwon-si
	Gyeongsangnam-do, South Korea
Test site:	KES Co., Ltd.
Test site address:	C-3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, Korea
	473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
FCC rule part(s):	15.247
FCC ID:	NLMSEM3057WN
Test device serial No.:	Production Pre-production Engineering

1.1. EUT description

Equipment under test	DUAL-MODE BABY MONITOR
Frequency range	FHSS: 2 408 MHz ~ 2 468 MHz
	BT: 2 402 MHz ~ 2 480 MHz
Model:	SEM-3057WN
Derivative model	SEM-3055WN
Modulation technique	FHSS, GFSK
Number of channels	FHSS : 16
	BT : 40
Antenna specification	FHSS Antenna type : Dipole, Peak gain: 2.0 dBi
	BT Antenna type : Patch, Peak gain: 2.14 dBi
Power source	DC 3.7 V (Rechargeable Battery)

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted

15.247(g): The system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): The system does not coordinate it channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

Pseudorandom frequency hopping sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 16 RF channels.

Equal hopping frequency use

All channels are used equally on average.

Example of a 16 hopping sequence in data mode: 12, 14, 03, 16, 02, 05, 10, 06, 09, 01, 13, 07, 11, 08, 15, 04



1.2. Test configuration

The <u>Hanwha Techwin Co., Ltd. DUAL-MODE BABY MONITOR FCC ID: NLMSEM3057WN</u> was tested per the guidance of ANSI C63.10-2013 and DA 00-705. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

1.3. Frequency/channel operations

Frequency (Mz)
2408
-
2440
2468

1.4. Accessory information

Applicant	Equipment	Manufacturer	Model	Power source
-	-	-	-	-

1.5. Device modifications

N/A

1.6. Derivation model information

Software of derivation model is different from the basic model. The circuit diagram and hardware are fundamentally same. It is for model management purpose.



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2. Summary of tes	sts	
Reference	Test description	Test results
15.247(a)(1)(iii)	20 dB bandwidth	Pass
15.247(b)(1)	Output power	Pass
15.247(a)(1)	Channel separation	Pass
15.247(a)(1)(iii)	Number of channels	Pass
15.247(a)(1)(iii)	Time of occupancy	Pass
15.205, 15.209	Radiated restricted band and emission	Pass
15.207(d)	Conducted band edge and out of band emissions	Pass
15.207(a)	AC conducted emissions	Pass



3. Test results

3.1. 20 dB bandwidth

Test procedure

DA 00-705

Test setting

- 1. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
- 2. RBW \geq 1% of the 20 dB bandwidth
- 3. VBW \ge RBW
- 4. Sweep = auto
- 5. Detector function = peak
- 6. Sweep = auto couple
- 7. Trace mode = max hold

Limit

Not applicable

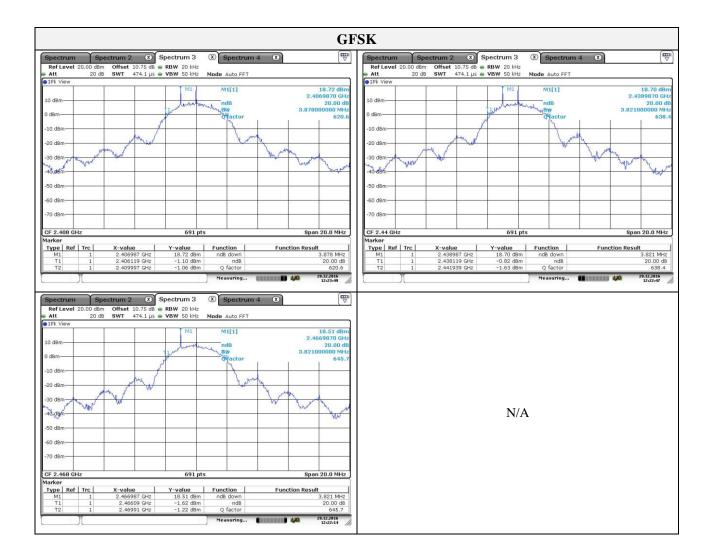
Test results

Frequency(Mz)	20 dB bandwidth(Mz)	Limit(Mb)
2 408	3.878	
2 440	3.821	0.5
2 468	3.821	



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3.2. Peak output power Test procedure DA 00-705

Test setting

- 1. Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- 2. RBW > the 20 dB bandwidth of the emission being measured
- 3. VBW \geq RBW
- 4. Sweep = Auto
- 5. Detector function = Peak
- 6. Trace = Max hold

Limit

According to 15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

According to \$15.247(b)(1), For frequency hopping systems operating in the 2 400 ~ 2 483.5 Mz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 ~ 5 805 Mz band: 1 Watt.

Test results

Frequency(Mz)	Channel no.	Measured power (dBm)	Peak Power Limit (dBm)
2 408	01	18.99	20.97
2 440	09	18.88	20.97
2 468	16	18.64	20.97



Y 2				Spectrum	10	Con Connect		0	14 (8)		9
ectrum Spectrum 2 tef Level 30.00 dBm Offset 10	Spectrum 3	Spectrum 4	× (Ref Level 30.	Spectrum 2	.75 dB • RBW 5		Spectrum	14 (X)		[
Att 30 dB SWT	1 ms . VBW 5 MHz Mod	le Auto Sweep		🖷 Att	30 dB SWT	1 ms e VBW 5		Auto Sweep	٥		
Pk View		M1[1]	18.99 di	1Pk View	1 1	1		M1[1]			18.88 dE
dBm	M1	mili	2.4070160 G	Hz 20 dBm		M1		wrfr1	7	2.4	389290 G
ubiii				1.000				-	-		
dBm				10 dBm			-				-
IBm				0 dBm	_			_	_	-	
dBm-				10 dBm							1
ubin				C UDIN							
dBm				-20 dBm				-	-	-	-
dBm				-30 dBm				-	_		
IBm-				-40 dBm-							
IBm-				-50 dBm				-	-	-	-
IBm				-60 dBm							
200				FOO OBIT							
.408 GHz	691 pts		Span 20.0 MH				591 pts		_	Spa	n 20.0 MI
e Ref Trc X-value M1 1 2.407016	CHz 18.99 dBm	Measuring 🔳	Function Result 29.12.2016 12:20:92	Marker Type Ref T	rc X-value 1 2.43892	Y-valu 9 GHz 18.8	3 dBm	easuring	Fun	nction Resu	29.12.2016
Spectrum	GHz 18.99 dBm Spectrum 3 (₹ 75 dB ● RBW 5 MHz	Measuring Spectrum 4	Function Result 29.12.2016 12:20:92	Marker Type Ref T M1	rc X-value 1 2.43892	Y-val	3 dBm				29.12.2016
Spectrum Spectrum 2 of Level 30.00 dBm Offset 10 t 30 dB SWT	GHz 18.99 dBm Spectrum 3 (X) .75 dB RBW 5 MHz	Measuring Spectrum 4 (Function Result 29,12,2016 12,2062	Marker Type Ref T M1	rc X-value 1 2.43892	9 GHz 18.8	3 dBm				lt 29.12.2016 12:20:38
Spectrum Spectrum 2 off Level 30.00 dBm Offset 10 t 30 dB SWT	GHz 18.99 dBm Spectrum 3 (₹ 75 dB ● RBW 5 MHz	Measuring Spectrum 4	Function Result 29.12.2016 12:20:92	Marker Type Ref T M1	rc X-value 1 2.43892	9 GHz 18.8	3 dBm				29.12.2016
Spectrum Spectrum 2 of Level 30.00 dBm Offset 10 t 30 dB SWT	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	9 GH2 18.8	3 dBm				29.12.2016
Per Ref Trc X-value 41 1 2.407016 5000 dBm Offset 10 1 30 dB SWT View Bm 1	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	Y-vall	3 dBm				29.12.2016
Spectrum Spectrum 2 off.ex 30 dB swr wr k 30 dB swr k k k	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	<u>Y-val</u> 9 GHz 18.8	3 dBm				29.12.2016
e Ref Trc X-value 11 1 2.407016 Ctrum Spectrum 2 FLevel 30.00 dBm Offset 10 30 dB SWT View 3m m	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	<u>Y-val</u> 9 GHz 18.8	3 dBm				29.12.2016
e Ref Trc X-value 41 1 2.407016 Ctrum > Spectrum 2 f Lovel 30.00 dBm Offset 10 30 dB SWT View am	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	<u>Y-val</u> GHz 18.8	3 dBm				29.12.2016
el Ref Trc. X-value 11 2.407016 2.407016 2.407016 Ctrum Spectrum 2 f tovel 30.00 dBm Offset 10 30 dB SWT Sm Sm n Image: Sector Sect	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	GH2 18.8	M				29.12.2016
e Ref Trc X-value 1 2.407016 Ctrum Spectrum 2 (Level 30.00 dBm Offset 10 30 dB SWT View 3m m Bm Bm	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	GH2 18.8	3 dBm				29.12.2016
e Ref Trc X-value 1 2.407016 Ctrum Spectrum 2 Ctruvel 30.00 dem Offset 10 30 dB SWT View 3m m m Bm Bm	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	GH2 18.8	M				29.12.2016
Ber Free X-value M1 1 2:407016 Spectrum Spectrum 2 I favel 30.00 dbm Offset 10 30 db SWT Wew Bm Bm JBm JBm JBm	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	GH2 18.8	M				29.12.2016
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E Ref Trc. X-value 1 2:407016 1 2:407016 Ctrum Spectrum 2 1 2:407016 Itage 30.00 dBm Offset 10 30 dB Sm 30 dB SWT SWT Bm Bm Bm Bm Bm BBm BBm BBm Bm BBm BBm BBm	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	GH2 18.8	M				29.12.2016
Del Ref Trc. X-value M1 1 2.407016 Sctrum Spectrum 2 flevel 30.00 dBm Offset 10 t 30 dB SWT kriew 30 dB SWT Bm Image: Comparison of the set	GHz 18.99 dBm X Spectrum 3 X 75 dB RBW 5 MHz Mod 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Marker Type Ref T M1	rc X-value 1 2.43892	GH2 18.8	M				29.12.2016
Per Ref Trc. X-value M1 1 2.407016 1 Sctrum Spectrum 2 1 1 Flevel 30.00 dBm Offset 10 1 1 Strum 30 dB SWT 1 1 Rm 30 dB SWT 1 1 1 Bm 30 dB SWT 1 </td <td>GHz 18.99 dBm X Spectrum 3 X 7.5 dB RBW 5 MHz 1 ms VBW 5 MHz 1 ms VBW 5 MHz Mod</td> <td>Measuring Spectrum 4 (</td> <td>Function Result 28.12.2015 12:2002</td> <td>Markar Type Ref T M11 Type Ref T M11 M11 M11 M11 M11 M11 M11 M11 M11 M1</td> <td>rc X-value 1 2.43892</td> <td>GH2 18.8</td> <td>M</td> <td></td> <td></td> <td></td> <td>29.12.2016</td>	GHz 18.99 dBm X Spectrum 3 X 7.5 dB RBW 5 MHz 1 ms VBW 5 MHz 1 ms VBW 5 MHz Mod	Measuring Spectrum 4 (Function Result 28.12.2015 12:2002	Markar Type Ref T M11 Type Ref T M11 M11 M11 M11 M11 M11 M11 M11 M11 M1	rc X-value 1 2.43892	GH2 18.8	M				29.12.2016
M1 1 2.407016	GH2 18.09 dBm 75 dB • RBW 5 MH2 1 ms • VBW 5 MH2 1 ms • VBW 5 MH2 1 ms • VBW 5 MH2 691 pts	Measuring	Function Result	Markar Type Ref T M11 Type Ref T M11 M11 M11 M11 M11 M11 M11 M11 M11 M1	rc X-value 1 2.43892	GH2 18.8	M				29.12.2016

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3.3. Carrier frequency separation

Test procedure DA 00-705

Test Setting

- 1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
- 2. Span = wide enough to capture the peaks of two adjacent channels
- 3. Resolution (or IF) Bandwidth (RBW) $\geq 1\%$ of the span
- 4. Video (or Average) Bandwidth (VBW) \geq RBW
- 5. Sweep = auto
- 6. Detector function = peak
- 7. Trace = max hold

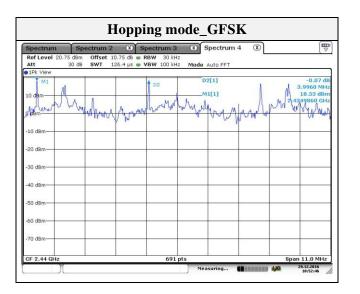
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Limit

According to 15.247(a)(1), frequency hopping system operating in 2 400 ~ 2 483.5 Mz. Band may have hopping channel carrier frequencies that are separated by 25 kHz or two-third of 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test results

Frequency(Mz)	Channel no.	Channel Separation (Mz)
2 440	09	3.996



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3.4. Number of hopping frequency Test procedure DA 00-705

Test setting

- 1. The EUT must have its hopping function enabled.
- 2. Frequency range: 2 400 MHz ~ 2 483.5 MHz
- 3. Span = the frequency band of operation $\frac{1}{2}$
- 4. RBW = 300 kHz (\geq 1% of the span)
- 5. VBW = 1 $M_{\mathbb{Z}} (\geq RBW)$
- 6. Sweep = auto
- 7. Detector function = peak
- 8. Trace = max hold

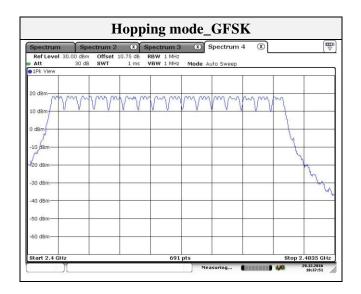
All the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 Mz bands shall use at least 15 hopping frequencies.

Test results

Frequency	Number of hopping frequency	Limit
2 408 ~ 2 468 MHz	16	≥ 15



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3.5. Time of occupancy Test procedure DA 00-705

Test setting

- 1. The EUT must have its hopping function enabled.
- 2. Span = zero span, centered on a hopping channel
- 4. RBW = 1 $M_{\mathbb{Z}}$
- 5. VBW = 1 MHz (\geq RBW)
- 6. Sweep = as necessary to capture the entire dwell time per hopping channel
- 7. Detector function = peak
- 8. Trace = max hold

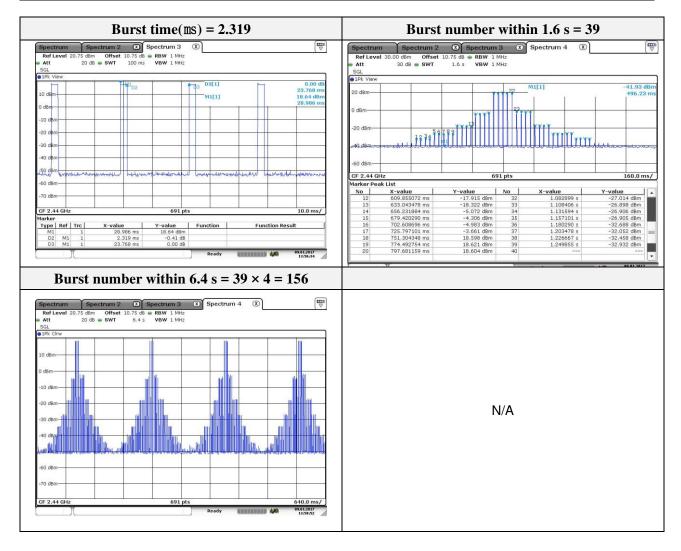
Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 Mz band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 6.4 second period.

A period time = $0.4(s) \times 16 = 6.4(s)$



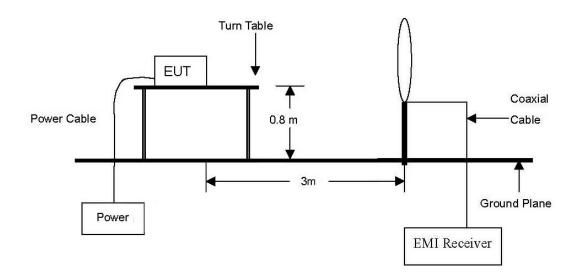
Frequency (MLz)	Burst time (ms)	Burst number	Time of occupancy (ms)	Limit (ms)
2 440	2.319	156	361.764	400



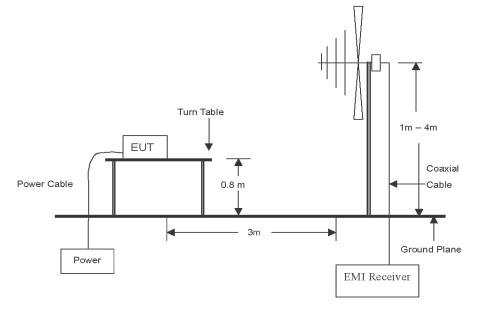


3.6 Radiated restricted band and emissions Test setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 Mz to 1 Gz emissions.

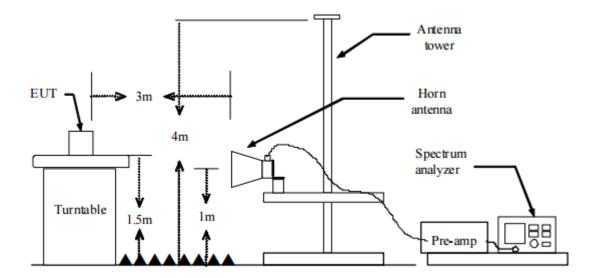


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The diagram below shows the test setup that is utilized to make the measurements for emission from 1 $\mathbb{G}\mathbb{Z}$ to the tenth harmonic of the highest fundamental frequency or to 40 $\mathbb{G}\mathbb{Z}$ emissions, whichever is lower.





Test procedure

- 1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
- 2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- 4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 6. Repeat above procedures until the measurements for all frequencies are complete.
- 7. Spectrum analyzer settings for f < 1 GHz:

 $\begin{array}{l} \mbox{Span} = \mbox{wide enough to fully capture the emission being measured} \\ \mbox{RBW} = 100 \ \mbox{klz} \\ \mbox{VBW} \geq \mbox{RBW} \\ \mbox{Sweep} = \mbox{auto} \\ \mbox{Detector function} = \mbox{quasi peak} \\ \mbox{Trace} = \mbox{max hold} \end{array}$

- 8. Spectrum analyzer settings for $f \ge 1$ GHz: Peak
 - Span = wide enough to fully capture the emission being measured

 $\begin{array}{l} RBW = 1 \hspace{0.1cm} \mbox{Mlz} \\ VBW \geq RBW \\ Sweep = auto \\ Detector \mbox{function} = peak \\ Trace = max \ hold \end{array}$

- 9. Spectrum analyzer settings for $f \ge 1$ (Hz: Average
 - Span = wide enough to fully capture the emission being measured

RBW = 1 MHz

VBW $\geq 1/T$ Hz, where T= pulse width in seconds

- Sweep = auto
- Detector function = average

Trace = max hold

10. Duty Cycle Correction Factor (16 channel hopping)

- a. Time to cycle through all channels = $\Delta t = \tau [ms] \times 16$ channels = 37.104 ms, where $\tau =$ pulse width
- b. 100 ms/ Δt [ms] = H \rightarrow Round up to next highest integer, H '=1
- c. Worst Case Dwell Time = τ [ms] × H' = 2.319 ms
- d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -32.69 dB



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Note:

- 1. The spectrum is measured from 9 kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1 GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20 dB of the respective limits were not reported.
- 2. When Average result is different from peak result over 20 dB (over-averaging), according to 15.35 (c), as a "duty cycle correction factor", pulse averaging with 20 log(duty cycle) has to be used. Duty cycle correction factor = 20log(dwell time/100 ms)
- 3. Emissions below 18 GHz were measured at a 3 meter test distance while emissions above 18 GHz were measured at a 1 meter test distance with the application of a distance correction factor.
- 4. Average test would be performed if the peak result were greater than the average limit.
- 5. Field strength($dB\mu N/m$) = Level($dB\mu N$) + Correction factors(dB/m) + Cable loss(dB) + or F_d(dB)
- 6. Correction factors(dB/m) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB)
- 7. Margin(dB) = Limit(dB μ N/m) Field strength(dB μ N/m)
- 8. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.
- 9. f < 30 Mz, extrapolation factor of 40 dB/decade of distance. $F_d = 40\log(D_m / D_s)$
- $f \ge 30$ MHz, extrapolation factor of 20 dB/decade of distance. F_d = $20\log(D_m / D_s)$

Where:

- F_d = Distance factor in dB
- D_m = Measurement distance in meters
- D_s = Specification distance in meters



Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (Mz)	Distance (Meters)	Radiated (µV/m)
0.009 ~ 0.490	300	2 400 / F(klz)
0.490 ~ 1.705	30	24 000 / F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands $54 \sim 72$ Mb, $76 \sim 88$ Mb, $174 \sim 216$ Mb or $470 \sim 806$ Mb. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.



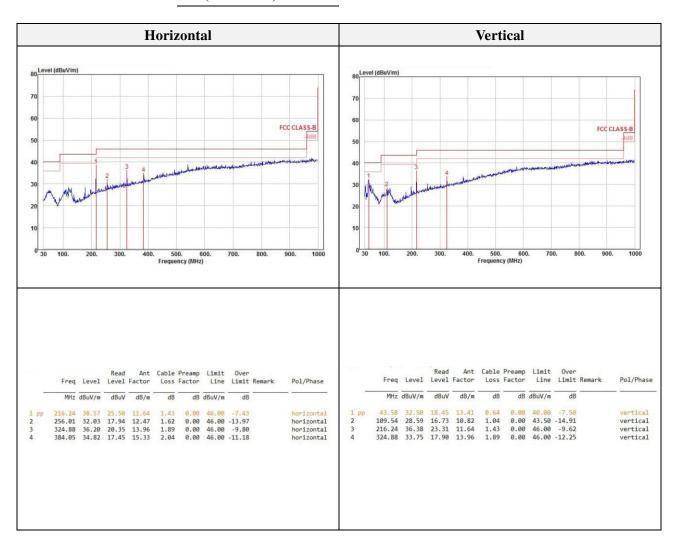
Test results (Below 30 Mz)			
Mode:	GFSK		
Distance of measurement:	3 meter		
Channel:	01 (Worst case)		

Frequency	Level	Ant. Pol.	CF	F _d	Field strength	Limit	Margin
(MHz)	(dBµV)	(H/V)	(dB)	(dB)	(dBµV/m)	(dBµN/m)	(dB)
No spurious emissions were detected within 20 dB of the limit							

	Vertical						
Spectrum 2 🗵			Spectrum Spectrum 2 (8)				
Ref Level 57.00 dBµV	Ref Level 57.00 dBµV	RBW (6dB) 20	0 Hz	,			
Att 0 dB SWT 13.4 ms	VBW 3 kHz Mode Auto FFT		Att D dB St	WT 13.4 ms 🖷 VBW 3	kHz Mode Auto FFT		
IPK VIEW	M1[1]	-1.80 dBµV	The Alem		M1[1]	-1.84 dB	
i0 dBµV		95.620 kHz	50 dBµV			94.400 k	
			0000000				
IO dBµV-			40 dBµV			7	
0 dBµV-			30 dBµV				
Part (Part)			2010/12/07/07				
0 dBµV-			20 dBµV				
.0 dBµV			10 dBµV				
	M3.				N11		
dBµV-	X		0 dBµV		T		
to deput horn we up marched and when	the same		-10 dBUV	Million More and a continue	AN IN		
		multiplenetication			- + A sta a trenda ar our	undertainer the production of the	
20 dBµV-			-20 dBµV				
30 dBµV			-30 dBµV				
abpt -			- SS GDPV				
40 dBµV			-40 dBµV				
tart 9.0 kHz arker	691 pts	Stop 150.0 kHz	Start 9.0 kHz Marker	691 p	its	Stop 150.0 kH	
M1 1 95.62 kHz	Response Function -1.80 dBµV Heasuring.		Type Ref Trc Sti M1 1 1 1 1 Spectrum Spectrum Spectrum Spectrum Spectrum	94.4 kHz -1.84 dBµv	Measuring		
M1 1 95.62 kHz Spectrum Spectrum 2 8 Ref Level 67.00 dbµV 9 8	-1.80 dBµV Measuring.	CANADAR #	M1 1 Spectrum Spectru Ref Level 67.00 dBµV	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring] ()	
M1 1 95.62 kHz Spectrum Spectrum 2 (E) Ref Level 67.00 dBµV Image: Ref Level 67.00 dBµV Image: Ref Level 67.00 dBµV Att 0 dB SWT 2.1 ms = V	-1.80 dBµV Measuring.		M1 1 Spectrum Spectrum Ref Level 67.00 dBµV Att	m 2 (X)	Measuring		
M1 1 95.62 kHz Spectrum Spectrum 2 (E) Ref Level 67.00 dBµV Image: Ref Level 67.00 dBµV Image: Ref Level 67.00 dBµV Nt 0 dB SWT 2.1 ms = V	-1.80 dBµV Measuring.		M1 1 Spectrum Spectru Ref Level 67.00 dBµV	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz spectrum Spectrum 2 (E) Ref Level 67.00 dbµ/ R tt 0 db SWT 2.1 ms V IPk View	-1.80 dBµV Measuring.		M1 1 Spectrum Spectrum Ref Level 67.00 dBµV Att	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz spectrum Spectrum 2 (E) Ref Level 67.00 dbµ/ R tt 0 db SWT 2.1 ms V IPk View	-1.80 dBµV Measuring.		M1 1 Spectrum Spectru Ref Level 67.00 dbµ/ Att D dB SW IPR View Image: Spectrum Spec	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz spectrum Spectrum 2 (E) taf Level 67.00 dBµV R R 0 dB SWT 2.1 ms V 1Pk View 0 0 U	-1.80 dBµV Measuring.		M1 1 Spectrum Spectru Ref Level 67.00 dbµ/ Att D dB SW IPR View Image: Spectrum Spec	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz Spectrum Spectrum 2 Image: Comparison of the system of t	-1.80 dBµV Measuring.		MI I Spectrum Spectru Ref Level 67.00 dbµV 0 dB SW 0 1Pk View 0 dB SW 60 dbµV 50 dbµV	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz Spectrum Spectrum 2 (E) Ref Level 67.00 dBy/V Image: Ref Level 67.00 dBy/V Image: Ref Level 67.00 dBy/V Nation 0 dB swt 2.1 ms V 0 dB swt 2.1 ms V	-1.80 dBµV Measuring.		MI I Spectrum Spectru Ref Level 67.00 dBµV 0 dB SW ● 1Pk View 0 dB 60 dBµV Image: Comparison of the second day of the se	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz spectrum Spectrum 2 Image: Comparison of the system of t	-1.80 dBµV Measuring.		MI I Spectrum Spectru Ref Level 67.00 dbµV 0 dB SW 0 1Pk View 0 dB SW 60 dbµV 50 dbµV	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz spectrum Spectrum 2 Image: Comparison of the system of t	-1.80 dBµV Measuring.		MI I Spectrum Spectru Ref Level 67.00 dbµV dbµV Att 0 db µV 60 dbµV db 50 dbµV 40 dbµV 40 dbµV 30 dbµV	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz pactrum Spectrum 2 Image: Comparison of the particular structure of the particular s	-1.80 dBµV Measuring.		MI I Spectrum Spectru Ref Level 67.00 dbµV db Att 0 db sw © IPk View 60 dbµV db S0 dbµV 40 dbµV 40 dbµV	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz pectrum Spectrum 2 (E) for Level 67.00 dbµV # R 0 db W # R	-1.80 dBµV Measuring.		MI I Spectrum Spectru Ref Level 67.00 dbµV 0 dB SW 0 dbµV 0 dB SW 60 dbµV 0 dB SW 50 dbµV 40 dbµV 30 dbµV 20 dbµV	m 2 🛞 🖷 RBW (6dB) 9 kHz	Measuring		
M1 1 95.62 kHz pectrum Spectrum 2 Image: Comparison of the system of th	-1.80 dBµV H2 BW (6dB) 9 kH2 BW 100 kH2 Mode Auto FFT 		MI I Spectrum Spectru Ref Level 67.00 dBµV 0 dB SW 1Pk View 0 dB SW 60 dBµV 0 dB SW 30 dBµV 0 dBµV 20 dBµV 10 dBµV	m 2 ③	Measuring		
M1 1 95.62 kHz ipectrum Spectrum 2 Image: Comparison of the system of t	-1.80 dBµV H2 BW (6dB) 9 kH2 BW 100 kH2 Mode Auto FFT 		MI I Spectrum Spectru Ref Level 67.00 dbµV 0 dB SW 0 dbµV 0 dB SW 60 dbµV 0 dB SW 50 dbµV 40 dbµV 30 dbµV 20 dbµV	m 2 ③	Measuring		
M1 1 95.62 kHz ipectrum Spectrum 2 Image: Comparison of the system of t	-1.80 dBµV H2 BW (6dB) 9 kH2 BW 100 kH2 Mode Auto FFT 		MI I Spectrum Spectru Ref Level 67.00 dBµV 0 dB SW 1Pk View 0 dB SW 60 dBµV 0 dB SW 30 dBµV 0 dBµV 20 dBµV 10 dBµV	m 2 ③	Measuring Mode Auto FFT		
M1 1 95.62 kHz ipectrum Spectrum 2 (2) kef Level 67.00 dBµV R JPK View 0 dB SWT 2.1 ms • V D dBµV 0	-1.80 dBµV H2 BW (6dB) 9 kH2 BW 100 kH2 Mode Auto FFT 0 0 kH2 Mode Auto FFT		MI I Spectrum Spectru Ref Level 67.00 dBµV 0 dB SW 1Pk View 0 dB SW 60 dBµV 0 dB SW 30 dBµV 0 dBµV 20 dBµV 10 dBµV	m 2 ③	Measuring Mode Auto FFT		
M1 1 95.62 kHz ipectrum Spectrum 2 Image: Comparison of the system of t	-1.80 dBµV H2 BW (6dB) 9 kH2 BW 100 kH2 Mode Auto FFT 0 0 kH2 Mode Auto FFT		MI I Spectrum Spectru Ref Level 67.00 dbµV 0 db SW 1Pk: View 0 dbµV 50 dbµV 40 dbµV 40 dbµV 30 dbµV 20 dbµV 10 dbµV 10 dbµV 10 dbµV 10 dbµV 10 dbµV 10 dbµV 10 dbµV	m 2 ③	Measuring Mode Auto FFT		
M1 1 95.62 kHz ipectrum Spectrum 2 Image: Comparison of the system of t	-1.80 dBµV H2 BW (6dB) 9 kH2 BW 100 kH2 Mode Auto FFT 0 0 kH2 Mode Auto FFT		MI I Spectrum Spectru Ref Level 67.00 dbµV 0 db SW ● IPk View 60 dbµV 50 dbµV 40 dbµV 40 dbµV 9 dbµV 20 dbµV 10 dbµV 10 dbµV 10 dbµV	m 2 ③	Measuring Mode Auto FFT		
M1 1 95.62 kHz pectrum Spectrum 2 Image: Comparison of the second secon	-1.80 dBµV H2 BW (6dB) 9 kH2 BW 100 kH2 Mode Auto FFT 0 0 kH2 Mode Auto FFT		MI I Spectrum Spectru Ref Lavel 67.00 dbµ/ Att 0 db SW 0 19k View 0 db SW 60 dbµ/ 40 dbµ/ 40 dbµ/ 20 dbµ/ 20 dbµ/ 10 dbµ/ -10 dbµ/ -10 dbµ/ -20 dbµ/ -20 dbµ/	m 2 ③	Measuring Mode Auto FFT		
M1 1 95.62 kHz Spectrum Spectrum 2 Image: Comparison of the system of t	-1.80 dBµV H2 BW (6dB) 9 kH2 BW 100 kH2 Mode Auto FFT 0 0 kH2 Mode Auto FFT		MI I Spectrum Spectru Ref Level 67.00 dbµV 0 db SW 1Pk: View 0 dbµV 50 dbµV 40 dbµV 40 dbµV 30 dbµV 20 dbµV 10 dbµV 10 dbµV 10 dbµV 10 dbµV 10 dbµV 10 dbµV 10 dbµV	m 2 ③	Z Mode Auto FFT		
M1 1 95.62 kHz spectrum Spectrum 2 (2) Kef Level 67.00 dBµV R R U 0 dB SWT 2.1 ms • V R JPK View 0 dB JV R 0 dBµV 0 dB JV 0 dB JV 0 dBµV 0 dBµV 0 dBµV 10 dBµV 0 dBµV 0 dBµV 0 dBµV 0 dBµV 0 dBµV	-1.80 dBµV Heasuring.		MI I Spectrum Spectru Ref Level 67.00 dbµV 0 db SW 9 IPk View 60 dbµV 60 dbµV 40 dbµV 30 dbµV 9 40 dbµV 9	m 2 ③	Z Mode Auto FFT		



Test results (Below 1 000 Mz)				
Mode:	GFSK			
Distance of measurement:	3 meter			
Channel:	01 (Worst case)			



Note.

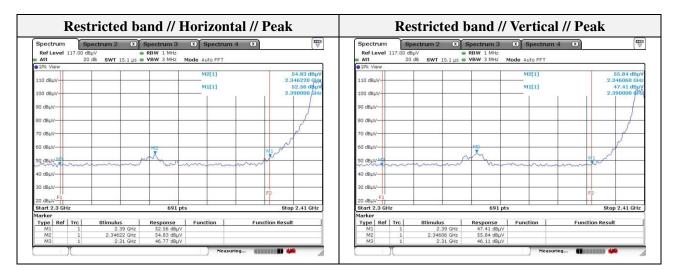
- 1. All spurious emission at channels are almost the same below 1 GHz, so that <u>low channel</u> was chosen at representative in final test.
- 2. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.



Test results (Above 1 000 Mz)

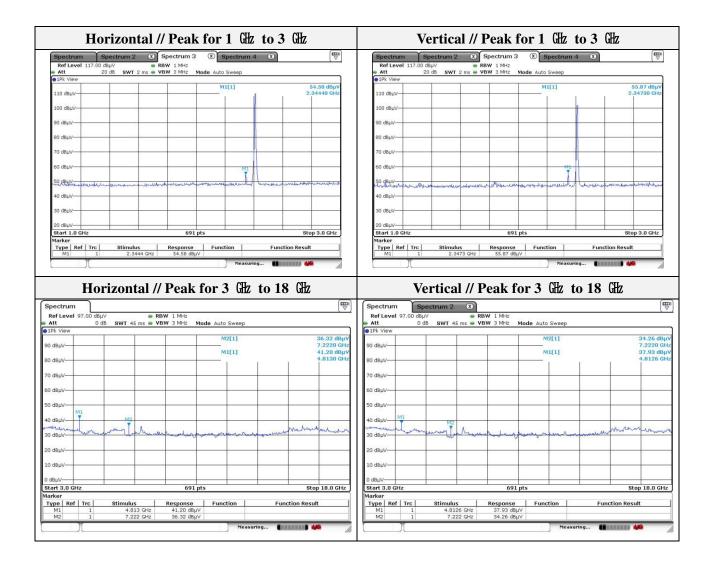
Mode:	GFSK	
Distance of measurement:	3 meter	
Channel:	01	

Frequency DCF Field strength Limit Level Ant. Pol. CF Margin **Detect mode** (M⊞z) $(dB\mu N)$ (H/V) (dB)(dB) $(dB\mu N/m)$ $(dB\mu N/m)$ (dB) 2344.40 54.58 52.63 74.00 21.37 Η -1.95 Peak _ 2346.22 54.83 Peak Η -1.95 -52.88 74.00 21.12 2347.30 55.87 Peak v -1.95 53.92 74.00 20.08 _ 2347.34 55.84 V -1.95 74.00 Peak 53.89 20.11 _ 74.00 23.30 2390.00 52.56 Peak Η -1.86 50.70 -2390.00 47.41 Peak v -1.86 45.55 74.00 28.45 _ 37.93 V 29.52 4812.60 Peak 6.55 44.48 74.00 -4813.00 41.20 47.76 74.00 26.24 Peak Н 6.56 _ 7222.00 36.32 Peak Η 13.80 _ 50.12 74.00 23.88 V 7222.00 34.26 Peak 13.80 48.06 74.00 25.94 _



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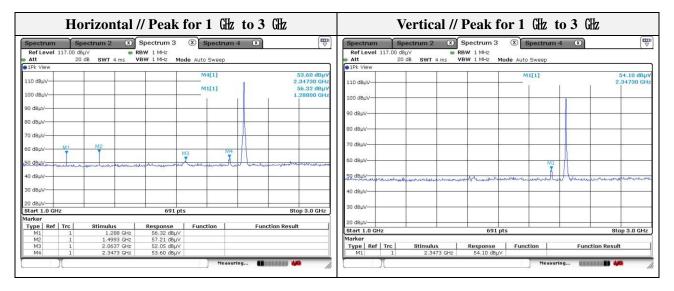




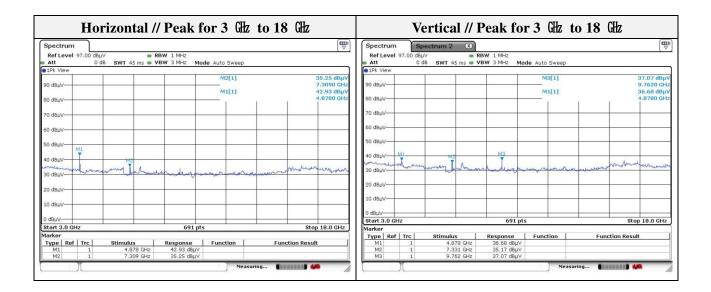


Mode:	GFSK
Distance of measurement:	3 meter
Channel:	09

Frequency (Mz)	Level (dBµN)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµN/m)	Limit (dBµV/m)	Margin (dB)
1288.00	56.32	Peak	Н	-8.56	-	47.76	74.00	26.24
1499.30	57.21	Peak	Н	-7.43	-	49.78	74.00	24.22
2063.70	52.05	Peak	Н	-2.70	-	49.35	74.00	24.65
2347.30	53.60	Peak	Н	-1.95	-	51.65	74.00	22.35
2347.30	54.10	Peak	V	-1.95	-	52.15	74.00	21.85
4878.00	42.93	Peak	Н	7.01	-	49.94	74.00	24.06
4878.00	36.68	Peak	V	7.01	-	43.69	74.00	30.31
7309.00	35.25	Peak	Н	17.22	-	52.47	74.00	21.53
7331.00	35.17	Peak	V	18.08	-	53.25	74.00	20.75
9762.00	37.07	Peak	V	13.41	-	50.48	74.00	23.52









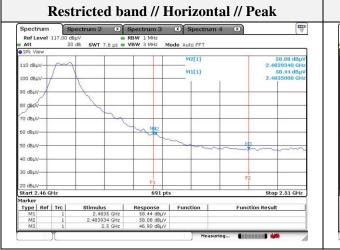
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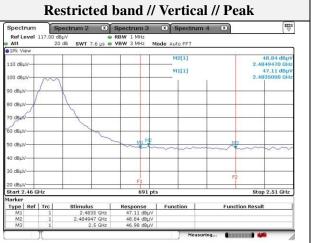
Test report No .: KES-RF-17T0002 Page (26) of (36)

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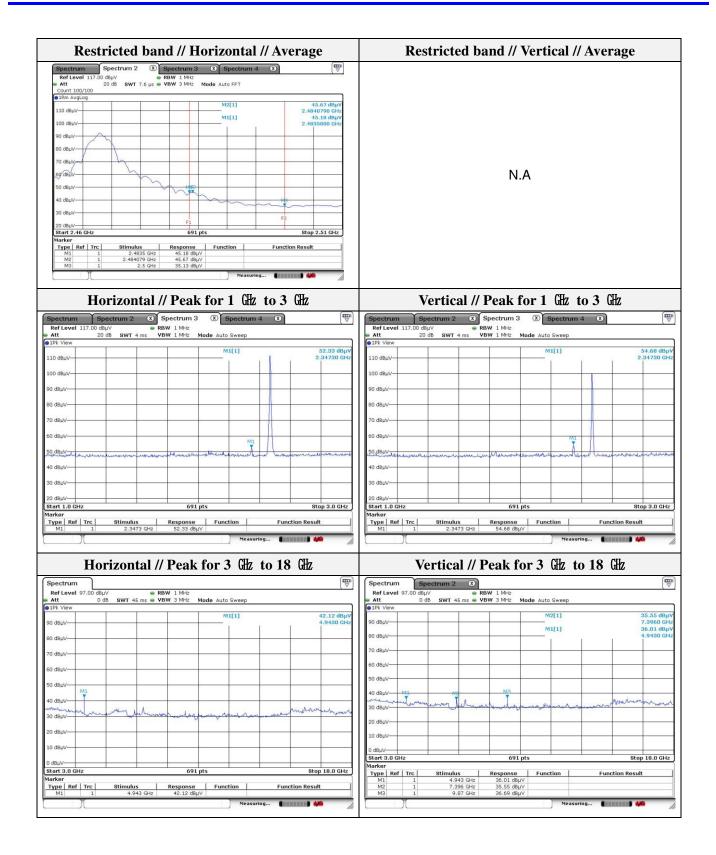
Mode:	GFSK
Distance of measurement:	3 meter
Channel:	16

Frequency (Mbz)	Level (dBµN)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBµN/m)	Limit (dBµV/m)	Margin (dB)
2347.30	52.33	Peak	Н	-1.95	-	50.38	74.00	23.62
2347.30	54.68	Peak	V	-1.95	-	52.73	74.00	21.27
2483.50	58.44	Peak	Н	-1.60	-	56.84	74.00	17.16
2483.50	45.18	Average	Н	-1.60	-32.69	10.89	54.00	43.11
2483.93	58.08	Peak	Н	-1.60	-	56.48	74.00	17.52
2484.08	45.67	Average	Н	-1.60	-32.69	11.38	54.00	42.62
2483.50	47.11	Peak	V	-1.60	-	45.51	74.00	28.49
2484.95	48.84	Peak	V	-1.59	-	47.25	74.00	26.75
4943.00	42.12	Peak	Н	7.46	-	49.58	74.00	24.42
4943.00	36.01	Peak	V	7.46	-	43.47	74.00	30.53
7396.00	35.55	Peak	V	20.63	-	56.18	74.00	17.82
7396.00	20.64	Average	V	20.63	-32.69	8.58	54.00	45.42
9870.00	36.69	Peak	V	13.40	-	50.09	74.00	23.91









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Horizontal // Average for 3 GHz to 18 GHz	Vertical // Average for 3 G	
	Spectrum 2 🛞	Ē
	Ref Level 97.00 dBµV	
	Att 0 dB SWT 45 ms VBW 3 MHz Mode Auto Sweep Count 100/100	
	Rm AvgLog	
	90 dBµV	20.64 dBµV 7.3960 GH2
	80 dBµV	
	70 dBµV	
	60 dBµV	
N/A	50 dBµV	
	40 dBµV	
	30 dBµV	
	20 dByV	mmmm
	10 dBµV	
	0 dBµV	
	Start 3.0 GHz 691 pts	Stop 18.0 GHz
	Marker Trc Stimulus Response Function M1 1 7.396 GHz 20.64 dBµV	Function Result
	Mea	suring 🚺 🗰 🚧



Test results (18 GHz to 30	GHz)
Mode:	GFSK
Distance of measurement:	3 meter
Channel:	01(Worst case)

Frequency	Level	Ant. Pol.	CF	F _d	Field strength	Limit	Margin
(MLz)	(dBµV)	(H/V)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
No spurious emissions were detected within 20 dB of the limit							

Horizontal				Vertical							
Spectrum Ref Level 87. Att		RBW 1 MHz ms VBW 3 MHz	Mode Auto Sweep			Spectrum Ref Level 87.00 Att		BBW 1 MHz BW 3 MHz Mod	e Auto Sweep		
80 dBµV						80 d8µV					
70 dBµV						70 dBµV					
60 dBµV						60 dBµV					
50 dBµV						50 dBµV					_
40 dBµV-	which he was	- Martin Marine	levelen advanta	monument	monartenation	40 dBµV	white management	medination	monument	mothemasul	whenertin
20 dBµV						20 dBµV					
10 dBµV						10 dBµV					
0 dBµV						0 dBµV					_
-10 dBµV			_			-10 dBµV					_
		69	91 pts		Stop 30.0 GHz	Start 18.0 GHz		691 pts			Stop 30.0 GHz
0 dBµV -10 dBµV Start 18.0 GHz Marker		6		asuring	j	-10 dBµV		691 pts	Measur	Ing (1111111	

Note.

- 1. Average test would be performed if the peak result were greater than the average limit.
- 2. Actual = Reading + AFCL(Ant. factor Amp. gain + Cable loss) + DCF(Duty cycle correction factor)
- 3. Duty cycle correction factor = 20log(dwell time/100 ms)



3.7 Conducted spurious emissions & band edge

Test procedure DA 00-705

Test setting

1. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.

- 2. RBW = 100 kHz
- 3. VBW \geq 300 kHz
- 4. Detector = Peak
- 5. Number of sweep points \geq 2 × Span/RBW
- 7. Trace mode = max hold
- 8. Sweep time = auto couple
- 9. The trace was allowed to stabilize

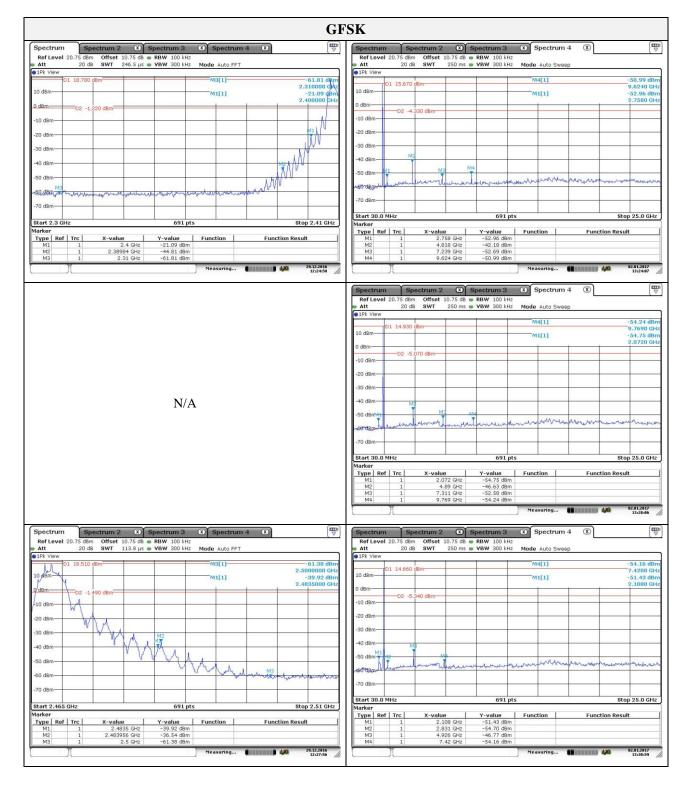
Limit

According to 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section , the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))



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Test results

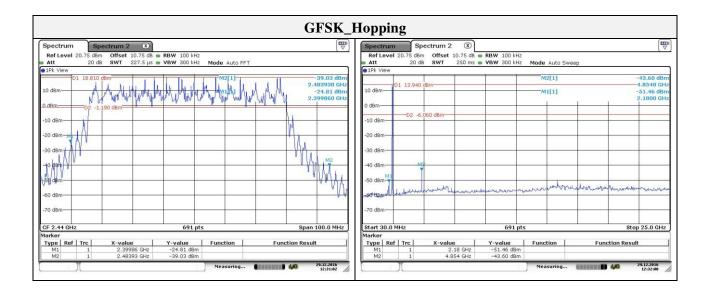


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3.8. AC conducted emissions

Limit

According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Enguara of Emission (Mg)	Conducted limit (dBµN/m)			
Frequency of Emission (Mb)	Quasi-peak	Average		
0.15 - 0.50	66 - 56*	56 - 46*		
0.50 - 5.00	56	46		
5.00 - 30.0	60	50		

Note:

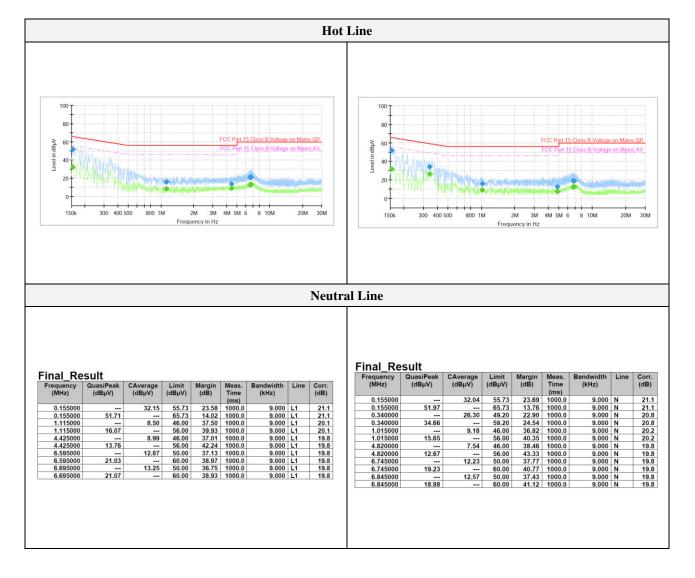
1. All AC line conducted spurious emission are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and the appropriate frequencies. All data rates and modes were investigated for conducted spurious emission. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

2. Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level



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Test results





Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	10076	1 year	2017.07.06
Spectrum Analyzer	R&S	FSV40	101002	1 year	2017.07.06
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2017.01.25
PSG Analog Signal Generator	Agilent	E8257C	US42340237	1 year	2017.07.05
Attenuator	KEYSIGHT	8493C	82509	1 year	2017.01.25
Loop Antenna	R&S	HFH2- Z2.335.4711.52	826532	2 years	2017.03.03
Trilog-broadband antenna	SCHWARZBECK	VULB 9163	9168-713	2 years	2017.05.15
Horn Antenna	A.H.	SAS-571	781	2 years	2017.05.07
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170550	2 years	2017.04.30
High Pass Filter	WAINWRIGHT INSTRUMENT	WHJS3000-10TT	1	1 year	2017.07.04
Low Pass Filter	WEINSCHEL	WLK1.0/18G-10TT	1	1 year	2017.07.04
Preamplifier	HP	8449B	3008A00538	1 year	2017.07.05
Broadband Amplifier	SCHWARZBECK	BBV-9721	PS9721-003	1 year	2017.01.25
EMI Test Receiver	R&S	ESR3	101781	1 year	2017.05.03
EMI Test Receiver	R&S	ESU26	100552	1 year	2017.04.24
EMI Test Receiver	R&S	ESR3	101783	1 year	2017.05.03
LISN	R&S	ENV216	101137	1 year	2017.02.04

Peripheral devices

Device	Manufacturer	Model No.	Serial No.	
-	-	-	-	