TEST REPORT



CTK Co., Ltd. (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel: +82-31-339-9970 Fax: +82-31-624-9501

Report No.: CTK-2018-01696 Page (1) / (57) Pages

1. Client

- Name : LifePrint Products, Inc.
- Address : 4667 Golden Foothill Parkway, suite 102 EL Dorado Hills, CA 95762
- Date of Receipt : 2018-05-09

2. Manufacturer

- Name : DSGLOBAL CO., LTD
- Address : 107, Gasan digital 2-ro, Geumcheon-gu, Seoul, KOREA
- 3. Use of Report : For FCC / ISED Certification
- 4. Test Sample / Model: Lifeprint 2x3 Slim Printer / LP007
- 5. Date of Test : 2018-06-07 to 2018-06-08
- 6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247
 - RSS-247 Issue 2 & RSS-Gen Issue 4
- 7. Testing Environment: Temp.: (25 ± 5) °C, Humidity: (47 ± 3) % R.H.
- 8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by Ji-Hye, Kim: Signature	Technical Manager Won-Jae, Hwang: (\$ignature)
		2018-06-11
Republic of KOREA CTK Co., Ltd.		



Report No.: CTK-2018-01696 Page (2) / (57) Pages

REPORT REVISION HISTORY

Date	Revision	Page No
2018-06-11	Issued (CTK-2018-01696)	all

This report shall not be reproduced except in full, without the written approval of CTK Co., Ltd. This document may be altered or revised by CTK Co., Ltd. personnel only, and shall be noted in the revision section of the document. Any alteration of this document not carried out by CTK Co., Ltd. will constitute fraud and shall nullify the document.



Report No.: CTK-2018-01696 Page (3) / (57) Pages

CONTENTS

1. General Product Description
1.1 Client Information
1.2 Product Information
1.3 Peripheral Devices
2. Facility and Accreditations
2.1 Test Facility
2.2 Laboratory Accreditations and Listings
2.3 Calibration Details of Equipment Used for Measurement
3. Test Specifications
3.1 Standards
3.2 Mode of operation during the test
3.3 Maximum Measurement Uncertainty
3.4 Test Software
4. Technical Characteristic Test
4.1 Carrier Frequency Separation
4.1 ourier requerey separation
4.2 Number of Hopping Frequencies
4.2 Number of Hopping Frequencies 10
4.2 Number of Hopping Frequencies
 4.2 Number of Hopping Frequencies
4.2 Number of Hopping Frequencies104.3 20 dB bandwidth & 99% Bandwidth134.4 Time of Occupancy (Dwell Time)144.5 Maximum peak Conducted Output Power25
 4.2 Number of Hopping Frequencies
4.2 Number of Hopping Frequencies104.3 20 dB bandwidth & 99% Bandwidth134.4 Time of Occupancy (Dwell Time)144.5 Maximum peak Conducted Output Power294.6 Unwanted Emissions (Conducted)374.7 Radiated Emission42



1. General Product Description

1.1 Client Information

LifePrint Products, Inc.
4667 Golden Foothill Parkway, suite 102 EL Dorado Hills, CA 95762
Name : Graham Crawford E-mail : graham@lifeprintphotos.com Tel : +916-461-3270

1.2 Product Information

FCC ID	2AJH8LP007
Certification Number ISED	23905-LP007
Product Description	Lifeprint 2x3 Slim Printer
Model name	LP007
Operating Frequency	2 402 MHz – 2 480 MHz
RF Output Power	GFSK : 7.83 dBm (6.07 mW) 8-DPSK : 6.73 dBm (4.71 mW)
Antenna Specification	Antenna type : Chip Antenna Peak Gain : 3.29 dBi
Number of channels	79
Channel Spacing	1 MHz
Type of Modulation	GFSK(1Mbps), π/4 DQPSK(2Mbps), 8-DPSK(3Mbps)
Power Source	DC 7.4 V (Battery)
Hardware Rev	V1.0
Software Rev	V1.0.0

1.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	15-bs563TU	CND7253R6N
AC/DC Adapter	HP	HSTNN-CA40	-
Bluetooth Tester	TESCOM	TC-3000C	3000C000377



2. Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	FC
CANADA	ISED	ISED EMI (3/10m test site)	8737A-2	*
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	V ©I
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	

2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.



3. Test Specifications

3.1 Standards

FCC rule Section(s)	ISED Part Section(s)	Requirement(s)	Status (Note 1)	Test Condition
15.247(a)	RSS-247 Issue 2 5.1 b)	Carrier Frequency Separation	С	
15.247(a)	RSS-247 Issue 2 5.1 d)	Number of Hopping Frequencies	С	
15.247(a)	RSS-247 Issue 2 5.1	20 dB Bandwidth	С	Conducted
15.247(a)	RSS-247 Issue 2 5.1 d)	Time of occupancy (Dwell Time)	С	Conducted
15.247(b)	RSS-247 Issue 2 5.4 b)	Transmitter Output Power	С	
15.247(d)	RSS-247 Issue 2 5.5	Unwanted Emission	С	
15.209	RSS-247 Issue 2 5.5	Radiated Emissions	С	Radiated
15.207	15.207 RSS-GEN Issue 4 8.8 AC Conducted Emission C Line Conducted			
Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
Note 2: The data in this test report are traceable to the national or international standards.				
Note 3: The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-201, ISED RSS-247 Issue 2, RSS-GEN Issue 4				

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments. During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests. The results are only attached worst cases.

Test Frequency

Lowest channel	Middle channel	Highest channel
2 402 MHz	2 441 MHz	2 480 MHz

Test mode

Modulation	Packet type	Data rate	Duty Cycle
GFSK	DH5	1 Mbps	46.8%
8-DPSK	3-DH5	3 Mbps	46.8%



Report No.: CTK-2018-01696 Page (7) / (57) Pages

3.3 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter. Coverage factor k = 2, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	± 1.5 dB
Occupied Bandwidth	± 0.1 MHz
Unwanted Emission(conducted)	± 3.0 dB
Radiated Emissions (f \leq 1 GHz)	± 4.0 dB
Radiated Emissions (f > 1 GHz)	± 5.0 dB

3.4 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	TOYO EMI software EP5RE Ver. 5.1.0
Line Conducted Test	ESCI7, ESCI3 : EMC32 Ver. 8.50.0
	ESR7 : EMC32 Ver. 8.53.0



4. Technical Characteristic Test

4.1 Carrier Frequency Separation

Test Procedures

ANSI C63.10-2013 7.8.2

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function enabled. After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

- a) Span = 5 MHz (wide enough to capture the peaks of two adjacent channels)
- b) RBW = 30 kHz (Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel)
- c) VBW = 30 kHz (\geq RBW) d) Sweep = auto
- e) Detector function = peak
- f) Trace = max hold

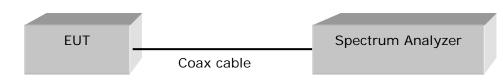


Figure 1 : Measurement setup for the carrier frequency separation

Limit

FHSS operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the -20 dB bandwidth of the hopping channel, whichever is greater.

Test Results

Test mode : GFSK

Channel	Adjacent Hopping Channel Separation [kHz]	Two-third of 20dB bandwidth [kHz]	Minimum Bandwidth [kHz]	Result
Middle	998.6	626.7	25	Complies

Test mode : 8-DPSK

Channel	Adjacent Hopping Channel Separation [kHz]	Two-third of 20dB bandwidth [kHz]	Minimum Bandwidth [kHz]	Result
Middle	1005.8	871.3	25	Complies

See next pages for actual measured spectrum plots.



Report No.: CTK-2018-01696 Page (9) / (57) Pages

... Ref Level 10.00 dBm 😑 RBW 30 kHz SWT 63.2 µs 🗢 VBW 30 kHz Mode Auto FFT 🛢 Att 20 dB 🔾 1Pk Max D1[1] 0.04 dB M D 998/60 kHz 3!29 dBm 0 dBmf M1[1] 2.43997970 GHz ٦. -10 dBm -20 dBm -30 dBm--40 dBm– -50 dBm--60 dBm· -70 dBm· -80 dBm-CF 2.441 GHz 691 pts Span 5.0 MHz 07.06.2018 Measuring...

Test mode : GFSK

Test mode : 8-DPSK





4.2 Number of Hopping Frequencies

Test Procedures

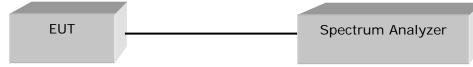
ANSI C63.10-2013 7.8.3

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

a) Frequency range	1: Start = 2 389.5 MHz,	Stop = 2 439.5 MHz
	2: Start = 2 439.5 MHz,	Stop = 2 489.5 MHz

- b) RBW = 300 kHz (To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller)
- c) VBW = 300 kHz (≥ RBW)
 d) Sweep = auto
 f) Trace = max hold



Limit

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

Test Results

Test mode : GFSK

Total number of Hopping Channels	Result		
79	Complies		

Test mode : 8-DPSK

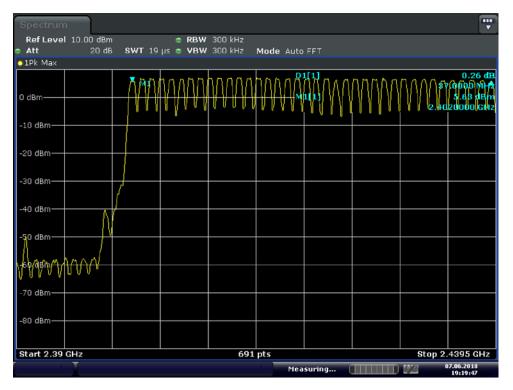
Total number of Hopping Channels	Result		
79	Complies		

See next pages for actual measured spectrum plots.



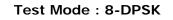
Report No.: CTK-2018-01696 Page (11) / (57) Pages

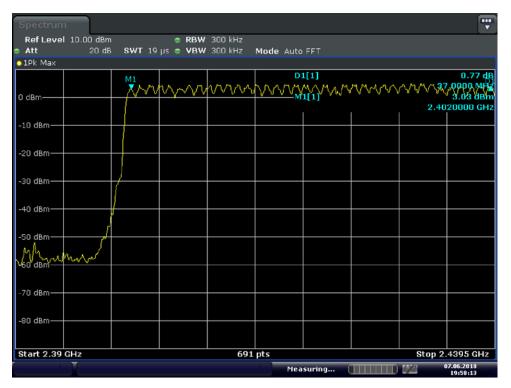




Spectrum					
Ref Level 10. Att		е RBW 300 kHz 18.9 µs е VBW 300 kHz			
1Pk Max					
	ANNAAA	MUUUUUU			0.39 dB 40.0000 MHz 6.03 dBm 1400000 GHz
-20 dBm					
-30 dBm					
-50 dBm					ስለለለስለ
-60 dBm					<u> </u>
-80 dBm					
Start 2.4395 G	Hz	691	Lpts Measuring	Stop	2.4895 GHz 07.06.2018 19:20:05







Spectrun	ı							
Ref Leve Att	l 10.00 dBm 20 dB		е RB 9 µs е VB	W 300 kHz	Mode Au	to FET		
01Pk Max					Hode Ad			
	ᠬᡃᠰᡳᠰ	$\sim \sim $	᠕᠕ᢉᠰ	~~~~~	D: ^^/////M	יניז •••••********************************	2.44	-0.72 dB 0.0000 MHz 3.95 dBm 100000 GHz
-10 dBm								
-20 dBm—								
-30 dBm							L	
-40 dBm								1
-60 dBm							٧٧	When
-70 dBm								
-80 dBm								
Start 2.43	95 GHz			691	nts		Stop 2	.4895 GHz
						suring	<u> </u>	07.06.2018 19:59:35



4.3 20 dB bandwidth & 99% Bandwidth

Test Procedures

ANSI C63.10-2013 6.9.2 RSS-GEN Issue 4 6.6

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Test Procedures

ANSI C63.10-2013 6.9.3 RSS-GEN Issue 4 6.6

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

The spectrum analyzer is set to:

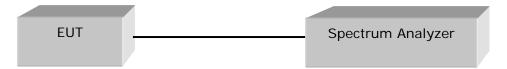
Center frequency = the highest, middle and the lowest channels

a) Span = 3 MHz (between 2 times and 5 times the OBW)

- b) RBW = 30 kHz (1% to 5% of the OBW)
- c) VBW = 100 kHz (approximately 3 times RBW)
- d) Sweep = auto

e) Detector function = peak

f) Trace = max hold



Limit

Limit : N/A



Report No.: CTK-2018-01696 Page (14) / (57) Pages

Test Results

Test mode : GFSK

Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]	Result
Low	2 402	0.840	0.852	Complies
Middle	2 441	0.940	0.862	Complies
High	2 480	1.015	0.868	Complies

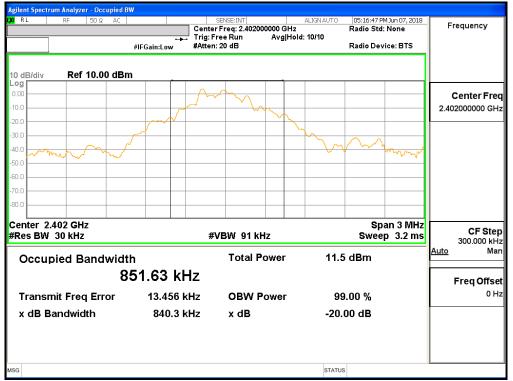
Test mode : 8-DPSK

Channel	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]	Result
Low	2 402	1.317	1.193	Complies
Middle	2 441	1.307	1.192	Complies
High	2 480	1.304	1.194	Complies

See next pages for actual measured spectrum plots.



20 dB bandwidth & 99% Bandwidth - GFSK [Low channel]



[Middle channel]

enter Fre	RF 50Ω AC		SENSE:INT Center Freq: 2.44 Trig: Free Run	1000000 GHz Avg Hold	ALIGNAUTO	05:15:24 PM Jun 07, 2018 Radio Std: None	Frequency
		⊶ #IFGain:Low	#Atten: 20 dB	Avginor	a. 10/10	Radio Device: BTS	
0 dB/div	Ref 10.00 dB	m					
0.0			m	mar and a second			Center Fr 2.441000000 G
0.0 0.0 0.0	www.						
I.O							
).0							
enter 2.4 Res BW (#VBW 91	kHz		Span 3 MHz Sweep 3.2 ms	CF St 300.000
Occup	ied Bandwid {	th 362.25 kl		Power	14.	8 dBm	Auto M Freg Offs
Transm	it Freq Error	-12.205	kHz OBW	Power	9	9.00 %	0
x dB Ba	ndwidth	940.1	KHZ X dB		-20	.00 dB	
3					STATU	IS	Ľ



Report No.: CTK-2018-01696 Page (16) / (57) Pages

[High channel]

	m Analyzer - Occupied E	3W							
Center Fr	RF 50 Ω AC) GHz		ENSE:INT Freq: 2.48000000		ALIGNAUTO	05:15:43 PM Radio Std:	I Jun 07, 2018 None	Frequency
	2.10000000	#IFGain:Low	#Atten: 3		\vg Hold	: 10/10	Radio Devi	ce: BTS	
10 dB/div	Ref 10.00 dBr	n <u>.</u>							
Log 0.00			S	m	_				Center Freq
-10.0			~						2.480000000 GHz
-20.0						<u> </u>			
-30.0	mont						m	0	
-40.0								V WWW	
-50.0									
-70.0									
-80.0									
Center 2.4							Eng	n 3 MHz	
#Res BW			#V	BW 91 kHz				3.2 ms	CF Step 300.000 kHz
Occup	ied Bandwid	th		Total Pow	/er	14.4	l dBm		<u>Auto</u> Man
	8	67.82 k	Hz						Freq Offset
Transm	nit Freq Error	-14.550	kHz	OBW Pov	ver	99	9.00 %		0 Hz
x dB Ba	andwidth	1.015 I	MHz	x dB		-20.	00 dB		
MSG						STATU	S		<u>[]</u>



20 dB bandwidth & 99% Bandwidth - 8-DPSK [Low channel]

XIRL RF 50Ω AC		SENSE:INT nter Freg: 2.402000	ALIGNAUTO	05:17:47 PM Jun 07, 2018 Radio Std: None	Frequency
Center Freq 2.40200000	Tri	g: Free Run tten: 20 dB	Avg Hold: 10/10	Radio Device: BTS	
10 dB/div Ref 10.00 dBr	n				
0.00		mm			Center Free 2.402000000 GH
-20.0					2.40200000 GH
-30.0					
-40.0				and a second and a s	
-60.0					
-70.0					
Center 2.402 GHz				On on 2 Mills	
#Res BW 30 kHz		#VBW 91 kHz	2	Span 3 MHz Sweep 3.2 ms	CF Step 300.000 kH
Occupied Bandwidt	h	Total Po	wer 10.0	6 dBm	<u>Auto</u> Mar
1.	1931 MHz				Freq Offse
Transmit Freq Error	-12.225 kHz	OBW Po	ower 99	9.00 %	он
x dB Bandwidth	1.317 MHz	x dB	-20.	00 dB	
ISG			STATU	s	I Piece

[Middle channel]

agilent Spectrum Analyzer - Occupied α RL RF 50 Ω AC		SENSE:INT	ALIGN AUTO	05:19:25 PM Jun 07, 2018	-
Center Freq 2.44100000	Trig:	er Freq: 2.441000000 GHz Free Run Avg Hol n: 20 dB	d: 10/10	Radio Std: None Radio Device: BTS	Frequency
10 dB/div Ref 10.00 dB	m		•		
0.00	mont	- And			Center Fre 2.441000000 GH
20.0			1		2.441000000 GP
30.0					
40.0			l ~	mm	
50.0					
60.0					
70.0					
30.0					
enter 2.441 GHz Res BW 30 kHz	#	¢VBW 91 kHz		Span 3 MHz Sweep 3.2 ms	CF Step 300.000 kHz
Occupied Bandwid	th	Total Power	12.2	2 dBm	<u>Auto</u> M
-	.1918 MHz				Freq Offs
Transmit Freq Error	-16.708 kHz	OBW Power	99	0.00 %	0
x dB Bandwidth	1.307 MHz	x dB	-20.	00 dB	
G			STATUS		



Report No.: CTK-2018-01696 Page (18) / (57) Pages

[High channel]

	Analyzer - Occupied BW									
	RF 50 Ω AC G	247		NSE:INT req: 2.48000	0000 GHz	ALIGN AUTO	05:19:59 Pf Radio Std:	M Jun 07, 2018 None	Frequency	
	-	IFGain:Low	Trig: Free Run Avg Hold>10/1			l>10/10	Radio Dev	ice: BTS		
10 dB/div	Ref 10.00 dBm									
Log 0.00			Am	m					Center Freq	
-10.0					m				2.480000000 GHz	
-20.0						\mathbf{h}				
-30.0	mont	-								
-40.0						~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Jour word		
-50.0										
-60.0										
-70.0										
-80.0										
Center 2.48 #Res BW 3			#VBW 91 kHz					an 3 MHz p 3.2 ms	CF Step 300.000 kHz	
Occupie	ed Bandwidth			Total Po	ower	11.7 dBm			Auto Man	
	1.1	939 MI	Ηz						Freq Offset	
Transmit	t Freq Error	-19.904 k	κHz	OBW P	ower	99	9.00 %		0 Hz	
x dB Bar	ndwidth	1.304 №	lHz	x dB		-20.	00 dB			
100										
MSG						STATU	5			



4.4 Time of Occupancy (Dwell Time)

Test Procedures

ANSI C63.10-2013 7.8.4

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function enabled.

a) Span: Zero span, centered on a hopping channel.

b) RBW shall be \leq channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.

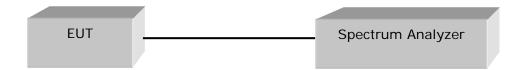
c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel. d) Detector function: Peak.

e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

Number of hops in the period specified in the requirements = (number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)



Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.



Report No.: CTK-2018-01696 Page (20) / (57) Pages

Test Results

Test mode : GFSK

Mode	Number of hops Channels	Transmit time per hop(msec)	Result (msec)	Limit (msec)
DH1	79	0.377	120.6	400
DH3	79	1.630	260.8	400
DH5	79	2.906	310.0	400

Test mode : 8-DPSK

Mode	Number of hops Channels	Transmit time per hop(msec)	Result (msec)	Limit (msec)
3-DH1	79	0.417	133.4	400
3-DH3	79	1.642	262.7	400
3-DH5	79	2.903	309.7	400

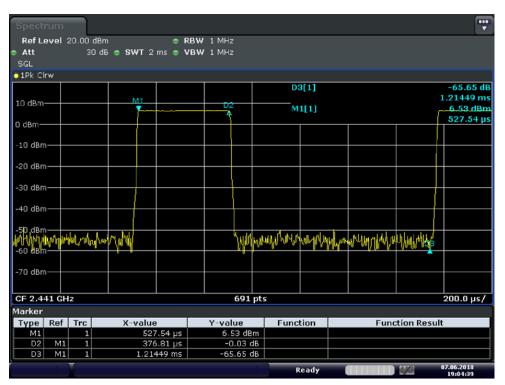
*** Remark:**

dwell time = { (hopping rate / time slots) / hopping channel} x Hopping channel x Burst ON time x 0.4

Time slots for DH1 = 2 slots(TX=1 slot / RX 1slot)
Time slots for DH3 = 4 slots(TX=3 slot / RX 1slot)
Time slots for DH5 = 6 slots(TX=5 slot / RX 1slot)

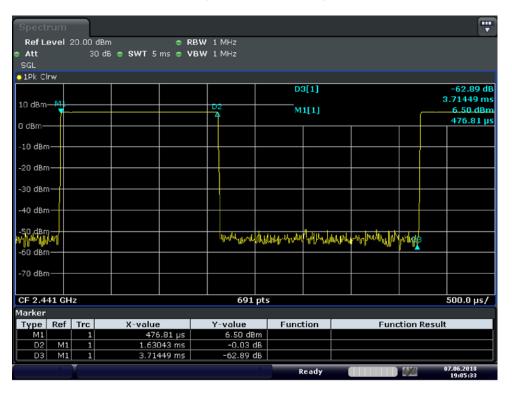
See next pages for actual measured spectrum plots.





Time of Occupancy for PACKET Type DH1(GFSK)

Time of Occupancy for PACKET Type DH3(GFSK)



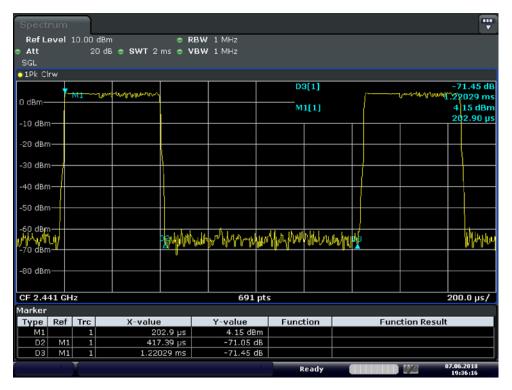


.... Ref Level 20.00 dBm 🗢 RBW 1 MHz 30 dB 😑 SWT 10 ms 😑 VBW 1 MHz att ⊙1Pk Clrw D3[1] -61.09 dB 6.2217 ms 10 dBm-M1[1] 6.50 dBm 1.1870 ms 0 dBm--10 dBm--20 dBm--30 dBm--40 dBm— 59. d800.07 and of the the state of the second of the -60 dBm— -70 dBm-CF 2.441 GHz 691 pts 1.0 ms/ Marker Type Ref Trc M1 1 D2 M1 1 D3 M1 1 Y-value Function ns 6.50 dBm ns -2.42 dB X-value Function Result 1.187 ms 2.9058 ms 6.2217 ms -61.09 dB 07.06.2018 19:06:17 Ready 14.86

Time of Occupancy for PACKET Type DH5(GFSK)



Time of Occupancy for PACKET Type 3-DH1(8-DPSK)



Time of Occupancy for PACKET Type 3-DH3(8-DPSK)

Spectrum					
RefLevel 10.00 dB	Bm 😑 R dB 😑 SWT 5 ms 😑 V	BW 1 MHz			
SGL 20	ub 😅 39991 5 ms 🖶 9				
◯1Pk Clrw					
	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	D3[1]		-70.85 dB 3.70290 ms
			M1[1]		4.11 dBm 391.30 μs
-10 dBm					
-20 dBm					
00.40					
-30 dBm-					
-40 dBm				_	<u> </u>
-50 dBm					
-60 dBm		The last state of the last	hald addressed		
will write h		adiment	and hours of the second	warden of the first	<b>9</b>
-70 dBm					
-80 dBm					
CF 2.441 GHz		691 pt	s		500.0 μs/
Marker					
Type Ref Trc	X-value	Y-value	Function	Funct	ion Result
M1 1 D2 M1 1	391.3 µs 1.64203 ms	4.11 dBm -2.04 dB			
D3 M1 1	3.7029 ms	-70.85 dB			
			Ready		07.06.2018 19:37:09



#### Time of Occupancy for PACKET Type 3-DH5(8-DPSK)

Spectrum					Ţ
Ref Level 10.00 dBr	n 😑	RBW 1 MHz			Ľ
	B 😑 SWT 10 ms 😑				
SGL					
⊙1Pk Clrw					
M1		D2	D3[1]		-67.16 dB 6.1957 ms
0 dBm			M1[1]		4.11 dBm
-10 dBm					884.1 µs
10 0.0					
-20 dBm					
-30 dBm					
-40 dBm					
-+0 0.0111					
-50 dBm		+			
169 dBm		19 martianterio	HIMMANN	hala	
-70 dBm					
-/o ubiii					
-80 dBm					
CF 2.441 GHz			ts		1.0 ms/
Marker					
Type Ref Trc	X-value	Y-value	Function	Fi	unction Result
M1 1	884.1 µs	4.11 dBm			
D2 M1 1	2.9029 ms	-0.81 dB			
D3 M1 1	6.1957 ms	-67.16 dB			ļ
			Ready		07.06.2018 19:37:50



### 4.5 Maximum peak Conducted Output Power

#### **Test Procedures**

ANSI C63.10-2013 7.8.5

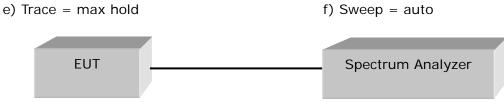
This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

- a) Span = 5 MHz (approximately 5 times of the 20 dB bandwidth)
- b) RBW = 3 MHz (greater than the 20 dB bandwidth of the emission being measured)
- c) VBW = 3 MHz ( $\geq$  RBW)

d) Detector = peak



#### Limit

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels.



Report No.: CTK-2018-01696 Page (26) / (57) Pages

#### **Test Results**

Test mode : GFSK

Frequency [MHz]	Channel No.	Output Power [dBm]	Output power [mW]	Result	
Low	0	7.24	5.30	Complies	
Middle	39	7.50	5.62	Complies	
High	78	7.83	6.07	Complies	

#### Test mode : 8-DPSK

Frequency [MHz]	Channel No.	Output Power [dBm]	Output power [mW]	Result
Low	0	5.81	3.81	Complies
Middle	39	6.52	4.49	Complies
High	78	6.73	4.71	Complies

See next pages for actual measured spectrum plots.



#### Test Mode : GFSK

#### [Low channel]

Spectrun	ı						•••• •
Ref Leve Att	l 20.00 dBm 30 dB	0.90 dB 😑   541.1 ns 😑	RBW 3 MHz VBW 3 MHz		uto FET		
01Pk Max							
					1[1]	2.402	7.24 dBm 18810 GHz
10 dBm				M1			
- <del>0-dB</del> m							
-10 dBm—							
-20 dBm—							
-30 dBm—							
-40 dBm							
-50 dBm—							
-60 dBm—							
-70 dBm							
CF 2.402 0	GHz		691	pts		Spa	n 5.0 MHz
				Mea	suring (	1000	7.05.2018 18:59:21

#### [Middle channel]

Spectrum					
RefLevel 20.00 dBm Att 30 dB		RBW 3 MHz			
● Att 30 dB	5WI 041.1 NS 🚍	VBW 3 MHz	Mode Auto FFT		
			M1[1]		7.50 dBm
			ning til	2	.44083360 GHz
10 dBm		M1			
U dBm		+			
-10 dBm		$\vdash$			
-20 dBm		+			
-30 dBm					
-40 dBm					
-50 dBm					
-60 dBm					
-70 dBm					
CF 2.441 GHz		691 pt:			Span 5.0 MHz
			Measuring		07.06.2018 19:01:52



Report No.: CTK-2018-01696 Page (28) / (57) Pages

[High channel]

Spectrum									
Ref Level Att	20.00 dBm 30 dB	Offset SWT	0.90 dB 😑	RBW 3 MHz VBW 3 MHz		uto EET			
0 1Pk Max	00 40	0111	0111110		MOUL A				
				M1	M	1[1]	1	2.479	7.83 dBm 81910 GHz
10 dBm				<b>Y</b>					
U dBm									
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
-50 dBm									
-60 dBm									
-70 dBm									
CF 2.48 GH	z			691	pts			Spa	n 5.0 MHz
					Mea	suring		1220	7.06.2018 19:07:11



#### Test Mode : 8-DPSK

#### [Low channel]

Spectrun	n						
Ref Leve Att	l 20.00 dBm 30 dB	0.90 dB 😑					
0 1Pk Max	50 GD	 )+1.1 IIS 😈	TON OTHER	Moue A			
				М	1[1]	2.401	5.81 dBm 98550 GHz
10 dBm		 	M	i 7			
0_dBm							
-10 dBm—							
-20 dBm—							
-30 dBm							
-40 dBm—							
-50 dBm							
-60 dBm							
-70 dBm							
05.0.400.0							
CF 2.402 0	iHz		691			 	n 5.0 MHz
				Mea	suring	1970	19:31:24

#### [Middle channel]

Spectrum					
RefLevel 20.00 dBm Att 30 dB		RBW 3 MHz			
■ Att 30 0B	5WI 041.1 ns =	VBW 3 MHz	Mode Auto FFT		
TEK Man			M1[1]		6.52 dBm
				2	.44095660 GHz
10 dBm		M1			
.0.dBm					
-10 dBm					
-20 dBm					
-30 dBm		+			
-40 dBm		+			
-50 dBm		+			
-60 dBm					
-70 dBm					
-yo abin					
CF 2.441 GHz		691 pts			8pan 5.0 MHz
			Measuring		07.06.2018 19:34:33



Report No.: CTK-2018-01696 Page (30) / (57) Pages

[High channel]

Spectrum									
	20.00 dBm 30 dB	Offset SWT							
Att 1Pk Max	30 QB	511	641.1 ns 😑	VBW 3 MHz	Mode A				
					M1[1]		6.73 dBm 2.47995660 GHz		
10 dBm			<b> </b>				 		
-0-dBm									
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
-50 dBm									
-60 dBm									
-70 dBm									
CF 2.48 GH	z			691	pts		Spa	n 5.0 MHz	
					Mea	suring		7.06.2018 19:38:38	



Report No.: CTK-2018-01696 Page (31) / (57) Pages

### 4.6 Unwanted Emissions (Conducted)

#### **Test Procedures**

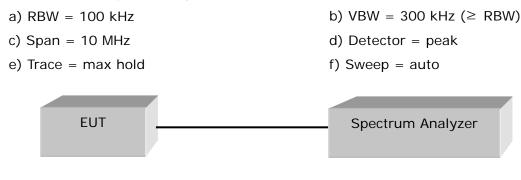
ANSI C63.10-2013 7.8.6 / ANSI C63.10-2013 7.8.8

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB.

The bandwidth at 20 dB down from the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function disabled at the highest, middle and the lowest available channels.

#### The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels



#### Limit

> 20 dBc

#### **Test Results**

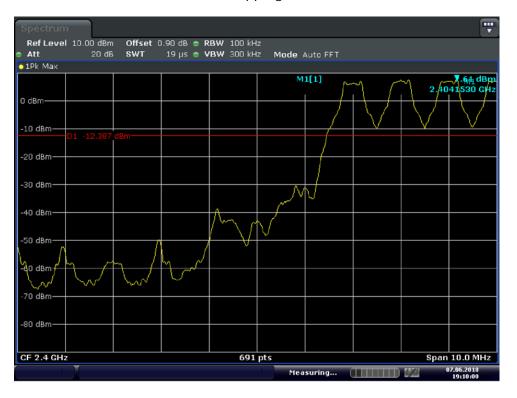
All conducted emission in any 100 kHz bandwidth outside of the spectrum band was at least 20 dB lower than the highest level of the in-band spectral density. Therefore the applying equipment meets the requirement.

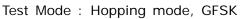
See next pages for actual measured spectrum plots.

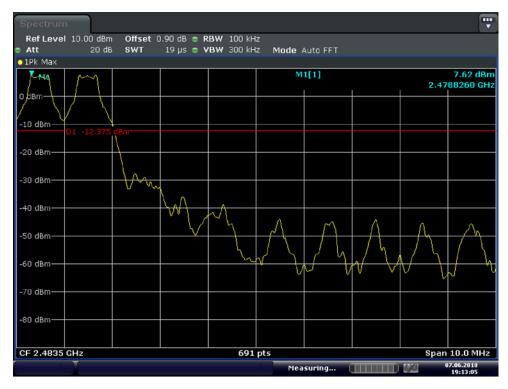


Report No.: CTK-2018-01696 Page (32) / (57) Pages

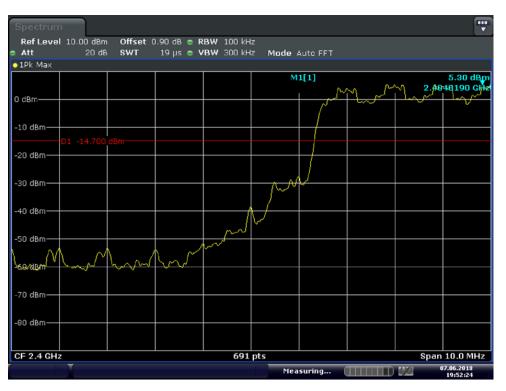
### Band Edge



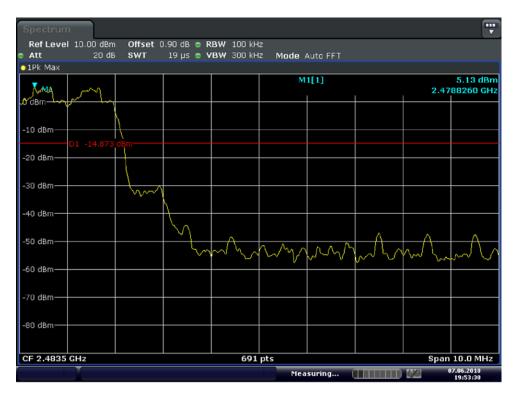




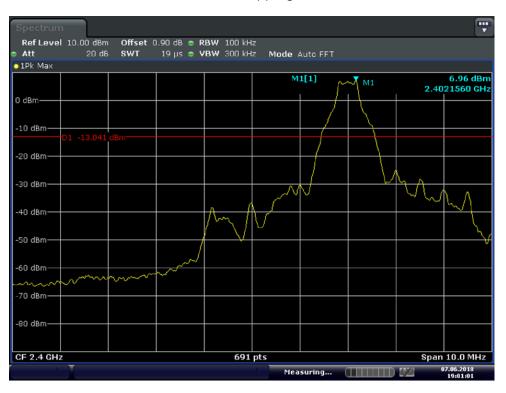




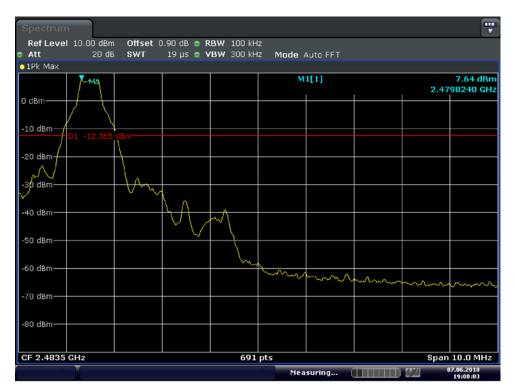








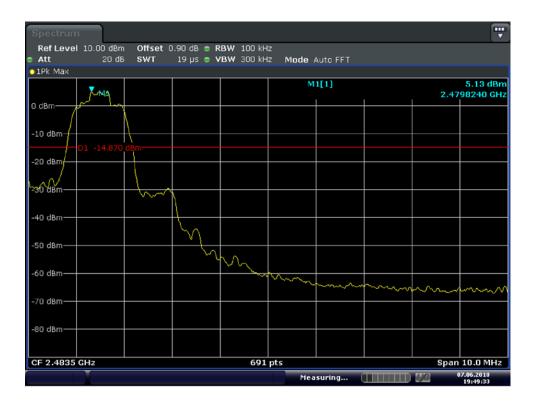
Test Mode : Non-Hopping mode, GFSK





Spectrum									
	10.00 dBm	Offset	0.90 dB 😑 R	<b>BW</b> 100 kH	7				لينت
<ul> <li>Att</li> </ul>	20 dB			'BW 300 kH		Auto FFT			
💿 1Pk Max									
					M	1[1] M1	~	2.40	4.04 dBm 18230 GHz
0 dBm						کسم	ty-		
-10 dBm	01 15 060	dDes							
-20 dBm	D1 -15.960	Uolli							
-30 dBm					$- n^{N}$	V	$\vdash$		
-40 dBm				(	$\bigvee$		`	m	
-50 dBm				mm ~	~			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
-60 dBm			كسمهمهم						www
-70 dBm		~~~~	Ť						
-80 dBm									
CF 2.4 GHz				691	pts			Span	10.0 MHz
	I					suring (			07.06.2018 19:32:16

Test Mode : Non-Hopping mode, 8-DPSK



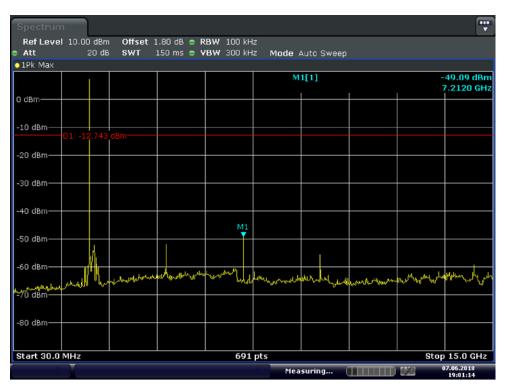


Report No.: CTK-2018-01696 Page (36) / (57) Pages

### **Spurious Emission**

Test Mode : GFSK

[Low Channel]

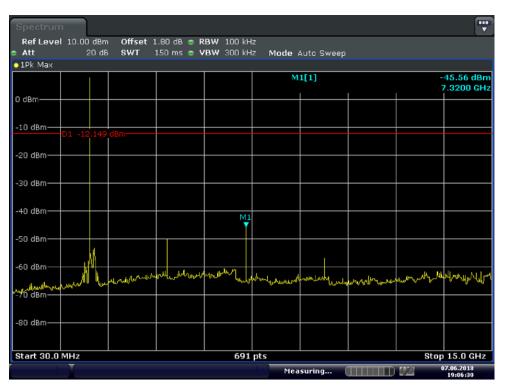


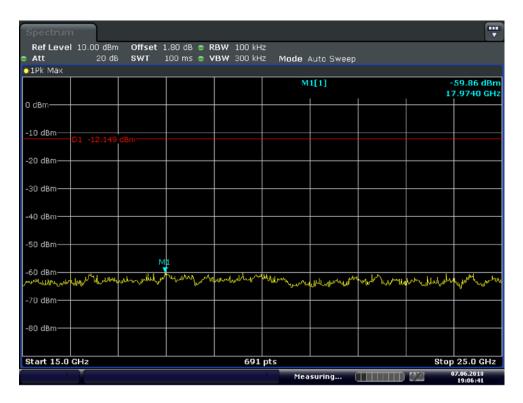
Spectrum									••••	
Ref Level Att	10.00 dBm 20 dB		1.80 dB 😑 R 100 ms 😑 V			Auto Sweep				
01Pk Max					- Mode /	Kuto Sweep				
					M1[1]			-59.39 dBm 18.8420 GHz		
0 dBm										
-10 dBm	01 -12.743	dBm								
-20 dBm										
-30 dBm										
-40 dBm										
-50 dBm										
-60 dBm	when	Manangarang	M1 Wyther M	millhoutharde	where have	where where and	مهريها لعمر روالمهمد	والمالي مراجع والمسالي	4 work	
-70 dBm										
-80 dBm										
Start 15.0 (	GHz			691	pts			Stop	25.0 GHz	
	I				Mea	suring (		1,70	07.06.2018 19:01:26	



Report No.: CTK-2018-01696 Page (37) / (57) Pages

[Middle Channel]

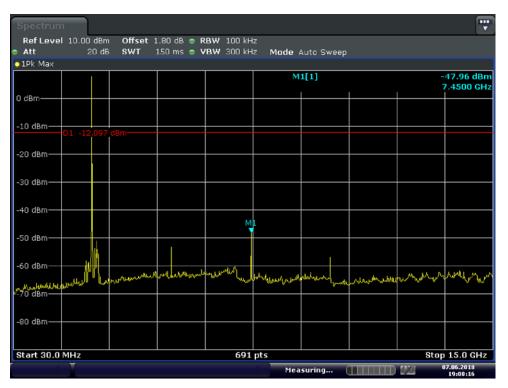


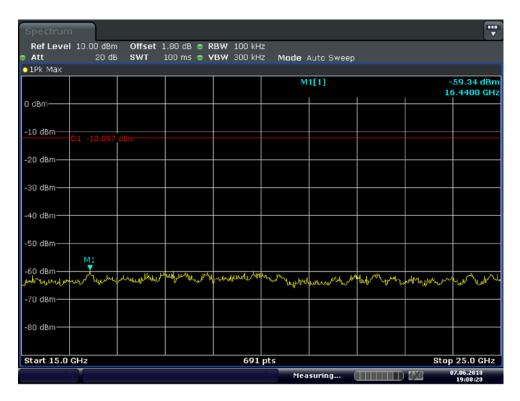




Report No.: CTK-2018-01696 Page (38) / (57) Pages

[High Channel]

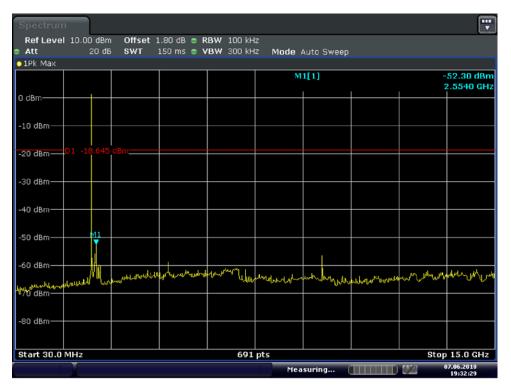






## Test Mode : 8-DPSK

## [Low Channel]

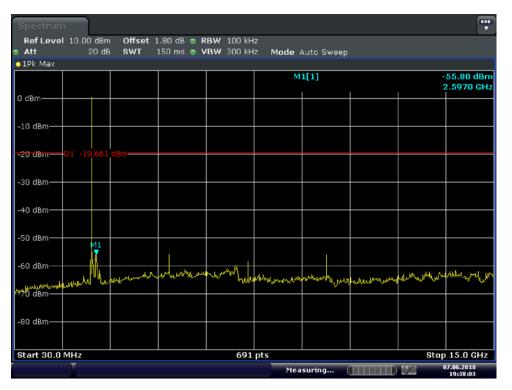


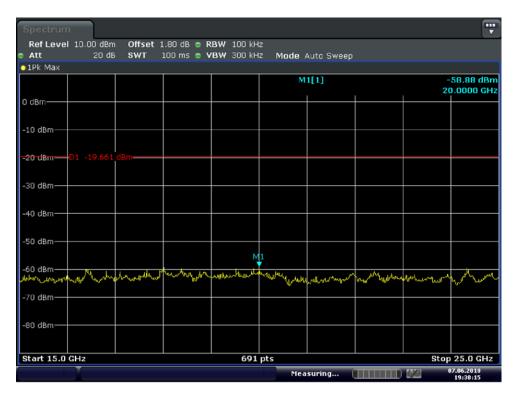
RefLevel 10.0 Att				BW 100 kH BW 300 kH		Auto Sweep			
⊃1Pk Max									
					M	1[1]			59.74 dBi 9.2190 GH
0 dBm									
-10 dBm									
-20 dBm 01 -	18.645 dBr	n							
-30 dBm									
-40 dBm									
-50 dBm									
				M1					
	Wellow	when ?	when the work	where the state of	when the year has	والعور ومنظر ومنطق	Mar Martine	home hold of the	hand the form
-70 dBm									
-80 dBm									
Start 15.0 GHz				691	pts			Stop	25.0 GH
						suring			7.06.2018



Report No.: CTK-2018-01696 Page (40) / (57) Pages

[Middle Channel]

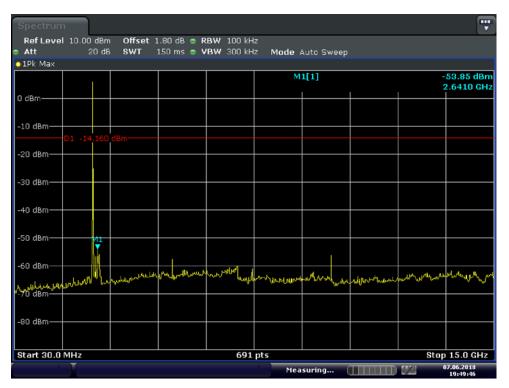


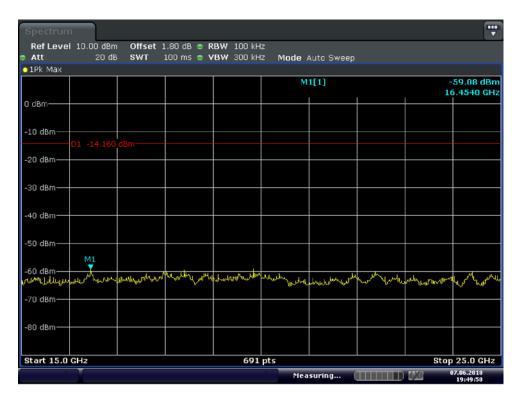




Report No.: CTK-2018-01696 Page (41) / (57) Pages

[High Channel]







Report No.: CTK-2018-01696 Page (42) / (57) Pages

# 4.7 Radiated Emission

#### **Test Location**

 $\boxtimes$  10 m SAC (test distance :  $\square$  10 m,  $\boxtimes$  3 m)  $\boxtimes$  3 m SAC (test distance : 3 m)

## **Test Procedures**

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency rage above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

#### Test Settings:

Frequency Range =  $9 \text{ kHz} \sim 25 \text{ GHz} (2.4 \text{ GHz} 10^{\text{th}} \text{ harmonic})$ 

- a) RBW = 1 MHz for f  $\geq$  1 GHz, 100 kHz for f < 1 GHz, 9 kHz for f < 30 MHz
- b) VBW  $\geq$  RBW
- c) Sweep time = auto couple



## Limit :

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	MHz	GHz
0.09-0.11	8.37626-8.38675	73-74.6	399.9-410	2690-2900	10.6-12.7
¹ 0.495-0.505	8.41425-8.41475	74.8-75.2	608-614	3260-3267	13.25-13.4
2.1735-2.1905	12.29-12.293	108-121.94	960-1240	3332-3339	14.47-14.5
4.125-4.128	12.51975-12.52025	123-138	1300-1427	3345.8-3358	15.35-16.2
4.17725-4.17775	12.57675-12.57725	149.9-150.05	1435-1626.5	3600-4400	17.7-21.4
4.20725-4.20775	13.36-13.41	156.52475- 156.52525	1645.5-1646.5	4500-5150	22.01-23.12
6.215-6.218	16.42-16.423	156.7-156.9	1660-1710	5350-5460	23.6-24
6.26775-6.26825	16.69475-16.69525	162.0125-167.17	1718.8-1722.2	7250-7750	31.2-31.8
6.31175-6.31225	16.80425-16.80475	167.72-173.2	2200-2300	8025-8500	36.43-36.5
8.291-8.294	25.5-25.67	240-285	2310-2390	9000-9200	² Above 38.6
8.362-8.366	37.5-38.25	322-335.4	2483.5-2500	9300-9500	

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown is Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.



FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Deasurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

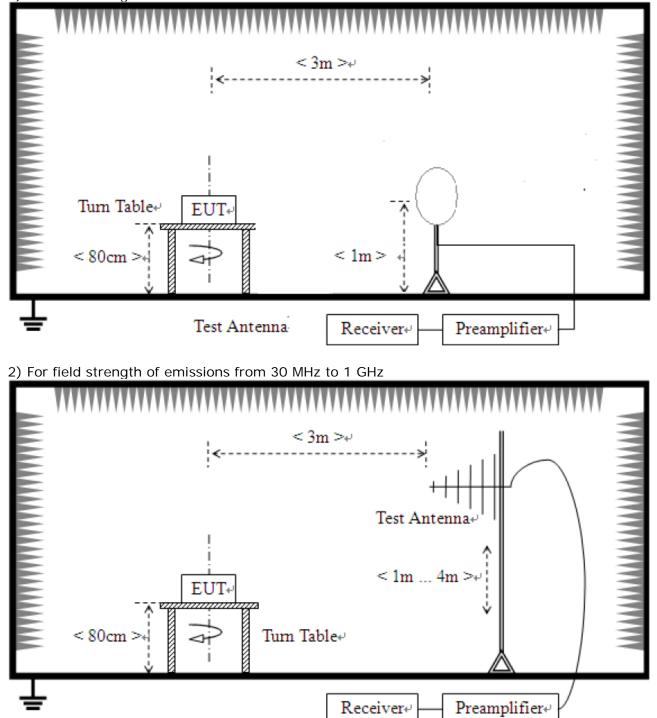
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)
- For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 1 MHz for peak measurement and 10 Hz for average measurement. (Duty Cycle is > 98%,)
- 4) Duty Cycle is < 98%, VBW setting will need to > 1/T.
- 5) DCCF = Duty Cycle Correction Factor DCCF =  $20*Log(T_{on}/100 \text{ ms})$   $T_{on} = 2.906 \text{ ms}(\text{GFSK}) / 2.903 \text{ ms}(8-\text{DPSK})$ DCCF = -30.73 dB(GFSK) / -30.79 dB(8-DPSK)Result Average = Result Peak + DCCF



Report No.: CTK-2018-01696 Page (45) / (57) Pages

# Test Setup:

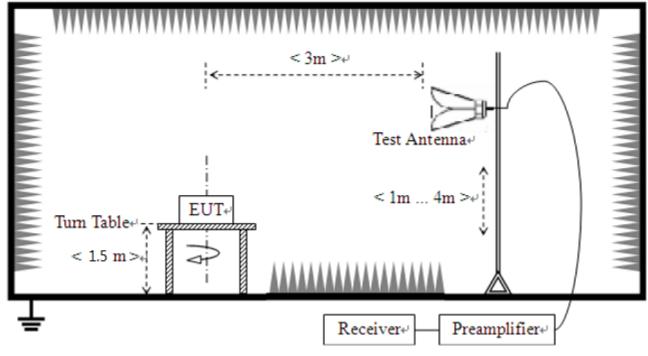
1) For field strength of emissions from 9 kHz to 30 MHz





Report No.: CTK-2018-01696 Page (46) / (57) Pages

## 3) For field strength of emissions above 1 GHz



## **Test results**

## 1) 9 kHz to 30 MHz

The requirements are:

 $\boxtimes$  Complies

			1
Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
-	-	-	See note

#### Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = 40 log (specific distance / test distance) (dB)



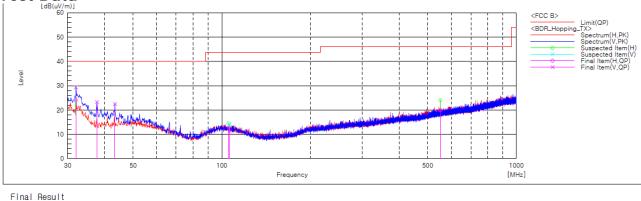
Remark

# 2) 30 MHz to 1 GHz

Test mode : GFSK, Hopping mode

The requirements are:  $\square$  Complies

# Test Data



No.	Frequency	(P)	Reading QP	c.f	Result QP	Limit QP	Margin QP	Height	Angle
	[MHz]		[dB(uV)]	[dB(1/m)]	[dB(uV/m)]	[dB(uV/m)]	[dB]	[cm]	[deg]
1	31.960	V	44.4	-15.1	29.3	40.0	10.7	99.8	326.6
2	31.960	Н	39.1	-15.1	24.0	40.0	16.0	99.8	358.3
3	37.730	V	37.6	-14.3	23.3	40.0	16.7	99.8	359.6
4	43.391	V	34.9	-12.5	22.4	40.0	17.6	99.8	206.4
5	552.020	Н	28.6	-8.6	20.0	46.0	26.0	99.8	84.3
6	105.445	Н	27.0	-14.3	12.7	43.5	30.8	99.8	48.4
7	106.425	V	25.5	-14.3	11.2	43.5	32.3	99.8	206.4

## Remark :

- 1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.
- 2. Result = Reading + c.f(Correction factor)
- 3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator Amp Gain

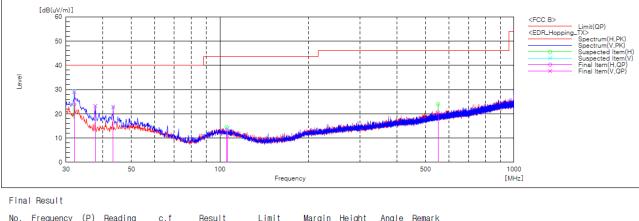


Report No.: CTK-2018-01696 Page (48) / (57) Pages

#### Test mode : 8-DPSK, Hopping mode

The requirements are:  $\square$  Complies

# Test Data



No.	Frequency	(P)	Reading QP	c.f	Result QP	Limit QP	Margin QP	Height	Angle	Remark
	[MHz]		[dB(uV)]	[dB(1/m)]		[dB(uV/m)]	[dB]	[cm]	[deg]	
1	31.960	V	44.0	-15.1	28.9	40.0	11.1	99.8	320.6	
2	31.960	Н	39.0	-15.1	23.9	40.0	16.1	99.8	355.1	
3	37.730	V	37.6	-14.3	23.3	40.0	16.7	99.8	359.7	
4	43.391	V	35.4	-12.5	22.9	40.0	17.1	99.8	211.2	
5	552.020	Н	29.2	-8.6	20.6	46.0	25.4	99.8	85.7	
6	105.445	Н	27.6	-14.3	13.3	43.5	30.2	99.8	50.3	
7	106.425	V	24.8	-14.3	10.5	43.5	33.0	99.8	201.4	

## Remark :

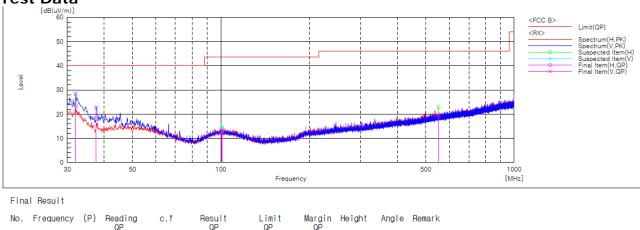
- 1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.
- 2. Result = Reading + c.f(Correction factor)
- 3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator Amp Gain



#### Test mode : Receiver mode

The requirements are:  $\square$  Complies

# Test Data



No.	Frequency	(P)	Reading QP	c.f	Result 0P	Limit	Margin QP	Height	Angle	Ren
	[MHz]		[dB(uV)]	[dB(1/m)]	[dB(uV/m)]	[dB(uV/m)]	[dB]	[cm]	[deg]	
1	31.960	V	43.6	-15.1	28.5	40.0	11.5	99.8	359.7	
2	32.068	Н	38.6	-15.1	23.5	40.0	16.5	99.8	156.4	
3	37.621	V	37.3	-14.4	22.9	40.0	17.1	99.8	101.9	
4	100.873	Н	27.4	-14.1	13.3	43.5	30.2	99.8	278.0	
5	101.199	V	26.9	-14.1	12.8	43.5	30.7	99.8	238.0	
6	552.020	Н	27.9	-8.6	19.3	46.0	26.7	99.8	278.0	

#### Remark :

- 1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.
- 2. Result = Reading + c.f(Correction factor)
- 3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator Amp Gain



# 3) above 1 GHz

Test mode : GFSK

The requirements are:  $\square$  Complies

## Test Data

Low(2 402 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]
4 804.00	Н	54.00	74.00	17.89	48.62	36.11	25.38
4 804.00	V	54.00	74.00	16.69	47.42	37.32	26.59
7 206.00	Н	54.00	74.00	21.68	52.41	32.32	21.59
7 206.00	V	54.00	74.00	22.74	53.47	31.26	20.53

## Mid(2 441 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]
4 882.00	Н	54.00	74.00	11.38	42.11	42.62	31.89
4 882.00	V	54.00	74.00	11.57	42.30	42.43	31.70
7 323.00	Н	54.00	74.00	24.03	54.76	29.97	19.24
7 323.00	V	54.00	74.00	26.26	56.99	27.74	17.01

## High(2 480 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]
4 960.00	Н	54.00	74.00	15.09	45.82	38.91	28.18
4 960.00	V	54.00	74.00	17.07	47.80	36.93	26.20
7 440.00	Н	54.00	74.00	24.31	55.04	29.69	18.96
7 440.00	V	54.00	74.00	24.40	55.13	29.60	18.87
2 483.50	Н	54.00	74.00	21.15	51.88	32.85	22.12

Receiver mode

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]			
The emissions above 1 GHz were 20 dB lower than the limit.										

## Remarks

1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.



#### Test mode : 8-DPSK

The requirements are:  $\square$  Complies

#### Test Data

Low(2 402 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]
4 804.00	Н	54.00	74.00	14.03	44.82	39.97	29.18
4 804.00	V	54.00	74.00	12.84	43.63	41.16	30.37
7 206.00	Н	54.00	74.00	15.49	46.28	38.51	27.72
7 206.00	V	54.00	74.00	16.00	46.79	38.01	27.22

#### Mid(2 441 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]
4 882.00	Н	54.00	74.00	11.46	42.25	42.54	31.75
4 882.00	V	54.00	74.00	11.02	41.81	42.98	32.19
7 323.00	Н	54.00	74.00	17.87	48.66	36.13	25.34
7 323.00	V	54.00	74.00	19.53	50.32	34.47	23.68

#### High(2 480 MHz)

Frequency	(P)	Limit AV	Limit PK	Result AV	Result PK	Margin AV	Margin PK
[MHz]		[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]
4 960.00	Н	54.00	74.00	13.06	43.85	40.94	30.15
4 960.00	V	54.00	74.00	14.21	45.00	39.79	29.00
7 440.00	Н	54.00	74.00	18.11	48.90	35.89	25.10
7 440.00	V	54.00	74.00	18.68	49.47	35.32	24.53
2 483.50	Н	54.00	74.00	21.72	52.51	32.28	21.49

Receiver mode

Frequency	(P)	Limit AV	Limit PK	Result AV	Result PK	Margin AV	Margin PK		
[MHz]		[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]		
The emissions above 1 GHz were 20 dB lower than the limit.									

#### Remarks

1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.



Report No.: CTK-2018-01696 Page (52) / (57) Pages

# 4.8 AC Power Line Conducted Emissions

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits.

## Instrument Settings

IF Band Width: 9 kHz

#### **Test Procedures**

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

#### Limit

Frequency	Conducted	l Limit (dBuV)
(MHz)	Quasi-peak	Average**
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* The level decreases linearly with the logarithm of the frequency.

** A linear average detector is required.

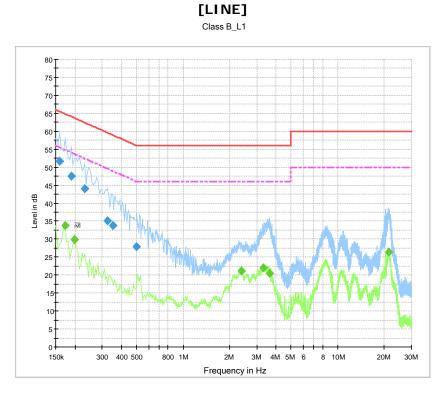
# **Test Results**

The requirements are:  $\square$  Complies



Report No.: CTK-2018-01696 Page (53) / (57) Pages

# Test Data



# **Final Result 1**

Frequency	QuasiPeak	Meas.	Bandwidth	Filter	Line	Corr.	Margin	Limit
(MHz)	(dBµV)	Time (ms)	(kHz)			(dB)	(dB)	(dBµV)
0.159000	51.7	1000.0	9.000	On	L1	9.8	13.8	65.5
0.190500	47.5	1000.0	9.000	On	L1	9.9	16.5	64.0
0.231000	44.0	1000.0	9.000	On	L1	9.8	18.4	62.4
0.325500	35.2	1000.0	9.000	On	L1	9.9	24.4	59.6
0.352500	33.7	1000.0	9.000	On	L1	9.9	25.2	58.9
0.501000	27.8	1000.0	9.000	On	L1	9.9	28.2	56.0

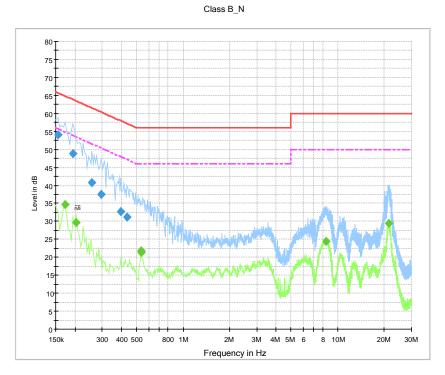
# **Final Result 2**

Frequency (MHz)	CAverage (dBµV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
		(ms)						
0.172500	33.7	1000.0	9.000	On	L1	9.8	21.1	54.8
0.199500	29.9	1000.0	9.000	On	L1	9.9	23.8	53.6
2.373000	21.1	1000.0	9.000	On	L1	9.8	24.9	46.0
3.286500	22.1	1000.0	9.000	On	L1	9.8	23.9	46.0
3.642000	20.6	1000.0	9.000	On	L1	9.8	25.4	46.0
21.444000	26.3	1000.0	9.000	On	L1	10.0	23.7	50.0



Report No.: CTK-2018-01696 Page (54) / (57) Pages

[NEUTRAL]



# **Final Result 1**

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
		(ms)						•••
0.154500	54.0	1000.0	9.000	On	N	9.8	11.7	65.8
0.195000	48.9	1000.0	9.000	On	N	9.9	14.9	63.8
0.258000	40.8	1000.0	9.000	On	N	9.6	20.7	61.5
0.294000	37.5	1000.0	9.000	On	N	9.7	22.9	60.4
0.393000	32.7	1000.0	9.000	On	N	9.9	25.3	58.0
0.433500	31.2	1000.0	9.000	On	N	9.9	25.9	57.2

# **Final Result 2**

Frequency (MHz)	CAverage (dBµV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
		(ms)						
0.172500	34.6	1000.0	9.000	On	Ν	9.8	20.2	54.8
0.204000	29.7	1000.0	9.000	On	N	9.9	23.7	53.4
0.532500	21.3	1000.0	9.000	On	N	9.9	24.7	46.0
0.537000	21.9	1000.0	9.000	On	N	9.9	24.1	46.0
8.448000	24.5	1000.0	9.000	On	N	9.9	25.5	50.0
21.430500	29.4	1000.0	9.000	On	N	10.1	20.6	50.0



Report No.: CTK-2018-01696 Page (55) / (57) Pages

# 4.9 Frequency Hopping System Requirements

## Standard Applicable

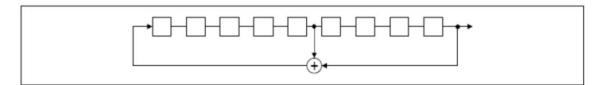
According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

#### EUT Pseudorandom Frequency Hopping Sequence

The pseudo random sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage, and the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones. Number of shift register stages: 9 Length of pseudo-random sequence:  $2^9-1 = 511$  bits Longest sequence of zeros: 8 (non-inverted signal)



## Linear Feedback Shift Register for Generation of the PRBS sequence

0246	62 64	78 1	73 75 77
	<u>{</u>	<u>_                                    </u>	<u>                                  </u>

Each frequency used equally on the average by each transmitter. The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.



Report No.: CTK-2018-01696 Page (56) / (57) Pages

#### **Frequency Hopping System**

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule. This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

*Example for a Bluetooth device using channel numbers would be : Ch 44, 35, 78, 03, 15, 21, 76, 40, 56, 13, 02, 19, 67, 39, 78, 20, 21, 64, 75 etc.



Report No.: CTK-2018-01696 Page (57) / (57) Pages

# **APPENDIX A – Test Equipment Used For Tests**

	Name of Equipment	Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date
1	Signal Analyzer	Agilent	N9020A	MY48011598	2017-11-01	2018-11-01
2	Signal Analyzer	R&S	FSV30	100925	2018-01-26	2019-01-26
3	Signal Generator	Rohde & Schwarz	SMB100A	175528	2017-11-01	2018-11-01
4	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2017-11-01	2018-11-01
5	Bilog Antenna	Schaffner	CBL6111C	2551	2018-05-10	2020-05-10
6	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2018-05-27	2020-05-27
7	6dB Attenuator	R&S	DNF	272.4110.50-2	2017-10-25	2018-10-25
8	AMPLIFIER	SONOMA	310	291721	2018-02-02	2019-02-02
9	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2018-02-01	2019-02-01
10	Preamplifier	Agilent	8449B	3008A02011	2017-11-30	2018-11-30
11	Horn Antenna	ETS-Lindgren	3116	00062916	2017-04-25	2019-04-25
12	Horn Antenna	ETS-Lindgren	3117	00154525	2017-09-14	2019-09-14
13	Band Reject Filter	Micro Tronics	BRM50702	G233	2018-01-26	2019-01-26
14	LISN	Rohde & Schwarz	ENV216	101760	2018-01-31	2019-01-31
15	BLUETOOTH TESTER	TESCOM	TC-3000C	3000C000377	2017-11-01	2018-11-01
16	RF Cable	Canare Corporation	L-5D2W	N/A	-	-
17	RF Cable	Junkosha Inc.	MWX221	1510S085	-	-
18	RF Cable	HUBER+SUHNER	SUCOFLEX 102	MY073/2	-	-
19	RF Cable	HUBER+SUHNER	SUCOFLEX 102	MY4728/2	-	-
20	RF Cable	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	-	-
21	RF Cable	HUBER+SUHNER	SUCOFLEX 104	N/A	-	-
22	RF Cable	HUBER+SUHNER	SUCOFLEX 104	MY27573/4	-	-
23	RF Cable	HUBER+SUHNER	SUCOFLEX 106	N/A	-	-