TEST REPORT

DT&C Co., Ltd.

	DI&C Co., Ltd.				
Dt&C	42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042 Tel : 031-321-2664, Fax : 031-321-1664				
1. Report No : DRTFCC2007-019	0				
2. Customer					
• Name : Pittasoft Co., Ltd.					
• Address : A 4th floor, ABN Tov South Korea 13488	ver, 331, Pangyo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do,				
3. Use of Report : FCC Original Gra	ant				
4. Product Name / Model Name : C	ar dashcam / DR750X-2CH				
FCC ID : YCK-DR750X-2CH	2				
5. Test Method Used : KDB558074 Test Specification : FCC Part 15.					
6. Date of Test : 2020.04.20 ~ 2020	6. Date of Test : 2020.04.20 ~ 2020.06.21				
7. Location of Test : 🛛 Permanent	Testing Lab On Site Testing				
8. Testing Environment : See apper	nded test report.				
9. Test Result : Refer to the attache	ed test result.				
The results shown in this test report ref	er only to the sample(s) tested unless otherwise stated.				
Tested by	Reviewed by				
Affirmation Name : JungWoo Kim	Studies Name : JaeJin Lee A (Signature)				
L.,					
2020.07.03.					
DT&C Co., Ltd.					
Not abided by KS Q ISO / IEC 17025 and KOLAS accreditation.					

If this report is required to confirmation of authenticity, please contact to report@dtnc.net



Test Report Version

Test Report No.	Date	Description	Revised By	Reviewed by
DRTFCC2007-0190	Jul. 03, 2020	Initial issue	JungWoo Kim	JaeJin Lee



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1. General Information

1.1 Testing Laboratory

DT&C Co., Ltd.

The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014.

- FCC MRA Designation No. : KR0034

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1.2 Testing Environment

Ambient Condition	
 Temperature 	+20 °C ~ +25 °C
Relative Humidity	35 % ~ 45 %

1.3 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

Test items	Measurement uncertainty	
Transmitter Output Power	0.9 dB (The confidence level is about 95 %, k = 2)	
Conducted spurious emission	0.9 dB (The confidence level is about 95 %, k = 2)	
Radiated spurious emission (1 GHz Below)	4.9 dB (The confidence level is about 95 %, k = 2)	
Radiated spurious emission (1 GHz ~ 18 GHz)	5.1 dB (The confidence level is about 95 %, k = 2)	
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, k = 2)	

1.4 Details of Applicant

Applicant	:	Pittasoft Co., Ltd.
Address	:	A 4th floor, ABN Tower, 331, Pangyo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, 13488, South Korea
Contact person	:	Kwangjo Kim

1.5 Description of EUT

EUT	Car dashcam
Model Name	DR750X-2CH
Add Model Name DR750X-1CH, DR750X-1CH Plus, DR750G-1CH Pro, DR750X-2CH IR, DR750X-2CH Plus, DR750X-2CH Tru DR750G-2CH Pro, DR750G-2CH IR Pro, DR750XJ-2CH DR750X-3CH, DR750X-3CH Truck	
Serial Number	Identical prototype
Power Supply	DC 12, 24 V
Frequency Range	2 402 MHz ~ 2 480 MHz
Modulation Technique (Data rate)	GFSK(1Mbps), π/4DQPSK(2Mbps), 8DPSK(3Mbps)
Number of Channels	79
Antenna Type	WIFI Dual Chip Antenna
Antenna Gain	PK : 1.88 dBi

- Auxiliary equipment for testing

Equipment	Model Name	Serial NO.	Manufacturer	Note
Notebook PC	6235ANHMW	JGL491UD801408V	Samsung	FCC ID: A3L6235ANH

1.6 Declaration by the applicant / manufacturer

- NA

1.7 Information about the FHSS characteristics

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following :
 - A) The hopping sequence is pseudorandom
 - Note 1 : Pseudorandom Frequency Hopping Sequence Table as below:
 - Channel: 08, 24, 40, 56, 42, 54, 72, 09, 01, 11, 33, 41, 34, 42, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 41, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 52, 71, 08, 24, 06, 24, 48, 56, 45, 46, 70, 01, 72, 06, 25, 33, 12, 28, 49, 60, 45, 58, 74, 13, 05, 18, 37, 49 etc

The System receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchroniztation with the transmit ted signals.

- B) All channels are used equally on average
- C) The receiver input bandwidth equals the transmit bandwidth
- D) The receiver hops in sequenc e with the transmit signal
- 15.247(g) : In accordance with the Bluetooth Industry Standard, 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) : In accordance with the Bluetooth Industry Standard, the system does not coordinate its 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.
- 15.247(h): The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.

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1.8 Test Equipment List

Туре	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	20/02/26	21/02/26	MY46471251
Spectrum Analyzer	Agilent Technologies	N9020A	19/12/16	20/12/16	MY48011700
Spectrum Analyzer	Agilent Technologies	N9020A	19/06/26	20/06/26	US47360812
DC Power Supply	Agilent Technologies	6654A	19/06/27	20/06/27	MY40002935
DC Power Supply	SM techno	SDP30-5D	19/06/24	20/06/24	305DMG305
Multimeter	FLUKE	17B	19/12/16	20/12/16	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	19/12/16	20/12/16	255571
Signal Generator	ANRITSU	MG3695C	19/12/16	20/12/16	173501
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-1
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-2
Thermohygrometer	BODYCOM	BJ5478	19/06/25	20/06/25	N/A
Loop Antenna	Schwarzbeck	FMZB1513	20/02/19	22/02/19	1513-128
BILOG ANTENNA	Schwarzbeck	VULB 9160	19/04/23	21/04/23	9160-3362
Horn Antenna	ETS-Lindgren	3115	20/01/30	22/01/30	6419
Horn Antenna	A.H.Systems Inc.	SAS-574	19/07/03	21/07/03	155
PreAmplifier	tsj	MLA-0118-B01-40	19/12/16	20/12/16	1852267
PreAmplifier	tsj	MLA-1840-J02-45	19/06/27	20/06/27	16966-10728
PreAmplifier	H.P	8447D	19/12/16	20/12/16	2944A07774
High Pass Filter	Wainwright Instruments	WHKX12-935- 1000-15000-40SS	19/06/26	20/06/26	8
High Pass Filter	Wainwright Instruments	WHKX10-2838- 3300-18000-60SS	19/06/26	20/06/26	1
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5- 6SS	19/06/27	20/06/27	3
Attenuator	Hefei Shunze	SS5T2.92-10-40	19/06/27	20/06/27	16012202
Attenuator	SRTechnology	F01-B0606-01	19/06/27	20/06/27	13092403
Attenuator	Aeroflex/Weinschel	20515	19/06/27	20/06/27	Y2370
Attenuator	SMAJK	SMAJK-2-3	19/06/27	20/06/27	2
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2495A MA2490A	19/06/24	20/06/24	1306007 1249001
EMI Receiver	ROHDE&SCHWARZ	ESW44	19/07/30	20/07/30	101645
Cable	Junkosha	MWX241	20/01/13	21/01/13	G-04
Cable	Junkosha	MWX241	20/01/13	21/01/13	G-07
Cable	DT&C	Cable	20/01/13	21/01/13	G-13
Cable	DT&C	Cable	20/01/13	21/01/13	G-14
Cable	HUBER+SUHNER	SUCOFLEX 104	20/01/13	21/01/13	G-15
Cable	Radiall	TESTPRO3	20/01/16	21/01/16	M-01
Cable	Junkosha	MWX315	20/01/16	21/01/16	M-05
Cable	Junkosha	MWX221	20/01/16	21/01/16	M-06
Cable	Radiall	TESTPRO3	20/01/16	21/01/16	RF-92

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017 Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.



1.9 Summary of Test Results

FCC Part RSS Std.	Parameter	Limit (Using in 2400~ 2483.5 MHz)	Test Condition	Status Note 1
	Carrier Frequency Separation	>= 25 kHz or >= Two thirds of the 20 dB BW, whichever is greater.		с
15.247(a) RSS-247(5.1)	Number of Hopping Frequencies	>= 15 hops		С
1.00 2 11 (0.1)	20 dB Bandwidth	N/A		С
	Dwell Time	=< 0.4 seconds	-	С
15.247(b) RSS-247(5.4)	Transmitter Output Power	For FCC =< 1 Watt , if CHs >= 75 Others =< 0.125 W For IC if CHs >= 75 =< 1 Watt For Conducted Power =< 4 Watt For e.i.r.p, Others =< 0.125 W For Conducted Power. =< 0.5 Watt For e.i.r.p	Conducted	С
15.247(d) RSS-247(5.5)	Conducted Spurious Emissions	The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density.		с
RSS Gen(6.7)	Occupied Bandwidth (99 %)	N/A		NA
15.247(d) 15.205 & 209 RSS-247(5.5) RSS-Gen (8.9 & 8.10)	Radiated Spurious Emissions	FCC 15.209 Limits	Radiated	с
15.207 RSS-Gen(8.8)	AC Conducted Emissions	FCC 15.207 Limits	AC Line Conducted	NA Note3
15.203	Antenna Requirements	FCC 15.203	-	с
Note 1 : C = Comply NC = Not Comply NT = Not Tested NA = Not Applicable Note 2 : For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated With OATS. With OATS. Note 3 : This device is installed in a car. Therefore the power source is only a battery of car.				

1.10 Conclusion of worst-case and operation mode

The EUT has three types of modulation (GFSK, π /4DQPSK and 8DPSK).

Therefore all applicable requirements were tested with all the modulations.

And packet type was tested at the worst case(DH5).

The field strength of spurious emission was measured in two orthogonal EUT positions (X, Y-axis).

Tested frequency information,

- Hopping Function : Enable

	TX Frequency (MHz)	RX Frequency (MHz)
Hopping Band	2 402 ~ 2 480	2 402 ~ 2 480

- Hopping Function : Disable

	TX Frequency (MHz)	RX Frequency (MHz)
Lowest Channel	2 402	2 402
Middle Channel	2 441	2 441
Highest Channel	2 480	2 480



2. Maximum Peak Output Power Measurement

2.1 Test Setup

Refer to the APPENDIX I.

2.2 Limit

FCC Requirements

The maximum peak output power of the intentional radiator shall not exceed the following :

- 1. §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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band 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, provided the systems operate with an output power no greater than 125 mW.
- §15.247(b)(1), For frequency hopping systems operating in the 2400 2483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725 5805 MHz band : 1 Watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

IC Requirements

1. RSS-247(5.4) (b), For FHSS operating in the band 2400 - 2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels, the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p shall not exceed 4 W, except as provided in section 5.4(e)

2.3 Test Procedure

- 1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
- 2. The peak output power of the fundamental frequency was measured with the spectrum analyzer using ;

Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel

 $RBW \ge 20 \text{ dB BW}$ $VBW \ge RBW$ Sweep = auto Detector function = peak Trace = max hold

2.4 Test Results

- 12 V

Modulation	Tested Channel	Frame Average Output Power		Peak Output Power	
wouldton	rested Ghanner	dBm	mW	dBm	mW
	Lowest	3.12	2.05	5.26	3.36
<u>GFSK</u>	Middle	2.69	1.86	5.14	3.27
	Highest	2.48	1.77	5.13	3.26
	Lowest	3.01	2.00	7.29	5.36
<u>π/4DQPSK</u>	Middle	2.56	1.80	7.19	5.24
	Highest	2.37	1.73	7.25	5.31
	Lowest	3.00	2.00	7.75	5.96
<u>8DPSK</u>	Middle	2.50	1.78	7.56	5.70
	Highest	2.35	1.72	7.48	5.60

Note 1: The Frame average output power was tested using an average power meter for reference only. Note 2: See next pages for actual measured spectrum plots.

- 24 V

Modulation	Tested Channel	Frame Average Output Power		Peak Output Power	
	resteu Ghanner	dBm	mW	dBm	mW
	Lowest	2.98	1.99	5.24	3.34
<u>GFSK</u>	Middle	2.54	1.79	5.04	3.19
	Highest	2.44	1.75	5.13	3.26
	Lowest	2.95	1.97	7.30	5.37
<u>π/4DQPSK</u>	Middle	2.55	1.80	7.23	5.28
	Highest	2.34	1.71	7.28	5.35
<u>8DPSK</u>	Lowest	2.91	1.95	7.79	6.01
	Middle	2.52	1.79	7.64	5.81
	Highest	2.33	1.71	7.66	5.83

Note 1: The Frame average output power was tested using an average power meter for reference only. Note 2: See next pages for actual measured spectrum plots.

- Tested Power Supply: 12 V

Peak Output Power



Peak Output Power

Middle Channel & Modulation : GFSK



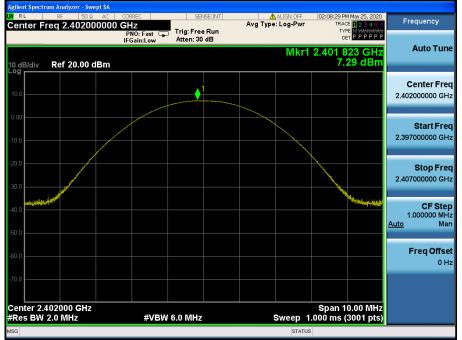


Highest Channel & Modulation : GFSK



Peak Output Power

Lowest Channel & Modulation : π/4DQPSK







Middle Channel & Modulation : π/4DQPSK



Peak Output Power

Highest Channel & Modulation : π/4DQPSK











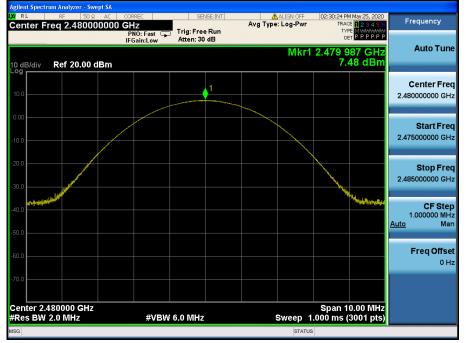
Peak Output Power

<u>Middle Channel & Modulation : 8DPSK</u>





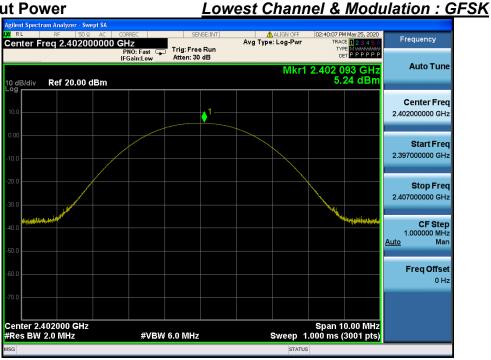
Highest Channel & Modulation : 8DPSK





Dt&C

- Tested Power Supply: 24 V Peak Output Power



Peak Output Power







Highest Channel & Modulation : GFSK



Peak Output Power

Lowest Channel & Modulation : π/4DQPSK







Middle Channel & Modulation : π/4DQPSK



Peak Output Power

Highest Channel & Modulation : π/4DQPSK











Peak Output Power

<u>Middle Channel & Modulation : 8DPSK</u>





Highest Channel & Modulation : 8DPSK



3. 20 dB BW

3.1 Test Setup

Refer to the APPENDIX I.

3.2 Limit

Limit : Not Applicable

3.3 Test Procedure

- 1. The 20 dB bandwidth & Occupied bandwidth were measured with a spectrum analyzer connected to RF antenna Connector(conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
- 2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting:
 - RBW = 1% to 5% of the 20 dB BW & Occupied BW
 - $VBW \ge 3 \times RBW$

Span = between two times and five times the 20 dB bandwidth & Occupied BW

Sweep = auto

Detector function = peak

Trace = max hold

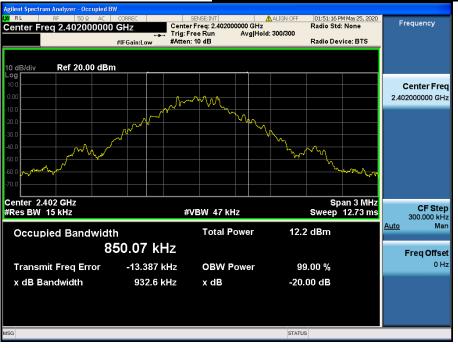
3.4 Test Results

Modulation	Tested Channel	20 dB BW (MHz) (12 V)	20 dB BW (MHz) (24 V)
	Lowest	0.933	0.932
<u>GFSK</u>	Middle	0.931	0.932
	Highest	0.928	0.931
	Lowest	1.314	1.314
<u>π/4DQPSK</u>	Middle	1.313	1.313
	Highest	1.313	1.315
	Lowest	1.266	1.268
<u>8DPSK</u>	Middle	1.266	1.262
	Highest	1.264	1.263



- Tested Power Supply: 12 V 20 dB BW





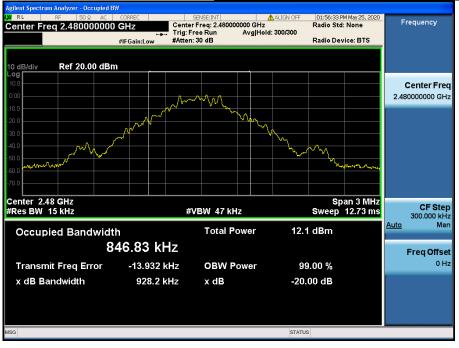
20 dB BW

Middle Channel & Modulation : GFSK





Highest Channel & Modulation : GFSK

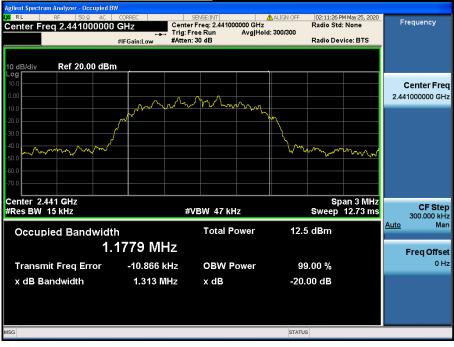


20 dB BW

Lowest Channel & Modulation : π/4DQPSK Occupied BV SENSE:INT ALIGN OFF Center Freq: 2.402000000 GHz Trig: Free Run Avg|Hold: 300/300 #Atten: 30 dB 02:08:08 PM May 25, 2020 Radio Std: None Frequency Center Freq 2.402000000 GHz #IFGain:Low Radio Device: BTS Ref 20.00 dBm **Center Freq** 2.402000000 GHz non Center 2.402 GHz #Res BW 15 kHz Span 3 MHz Sweep 12.73 ms CF Step 300.000 kHz #VBW 47 kHz Auto Man Occupied Bandwidth **Total Power** 12.6 dBm 1.1772 MHz **Freq Offset** 0 Hz Transmit Freq Error -12.023 kHz **OBW Power** 99.00 % -20.00 dB x dB Bandwidth 1.314 MHz x dB STATUS



Middle Channel & Modulation : π/4DQPSK



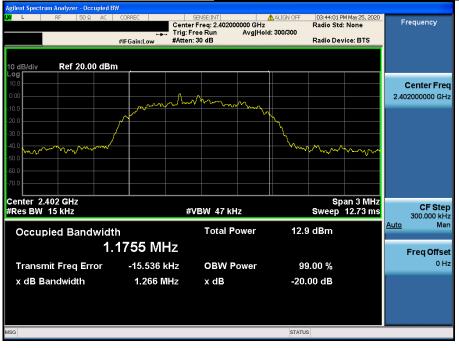
20 dB BW

Highest Channel & Modulation : π/4DQPSK Occupied BV 02:14:02 PM May 25, 2020 Radio Std: None Center Freq: 2.480000000 GHz Trig: Free Run Avg|Hold: 300/300 #Atten: 30 dB Frequency Center Freq 2.480000000 GHz #IFGain:Low Radio Device: BTS Ref 20.00 dBm **Center Freq** 2.480000000 GHz Center 2.48 GHz #Res BW 15 kHz Span 3 MHz Sweep 12.73 ms CF Step 300.000 kHz #VBW 47 kHz Auto Man Occupied Bandwidth **Total Power** 12.5 dBm 1.1818 MHz **Freq Offset** 0 Hz Transmit Freq Error -9.199 kHz **OBW Power** 99.00 % -20.00 dB x dB Bandwidth 1.313 MHz x dB STATUS





Lowest Channel & Modulation : 8DPSK



20 dB BW

Middle Channel & Modulation : 8DPSK Occupied BV SENSE:INT ALIGN OFF Center Freq: 2.441000000 GHz Trig: Free Run Avg|Hold: 300/300 #Atten: 30 dB 02:27:22 PM May 25, 2020 Radio Std: None Frequency Center Freq 2.441000000 GHz #IFGain:Low Radio Device: BTS Ref 20.00 dBm **Center Freq** 2.441000000 GHz Mum Center 2.441 GHz #Res BW 15 kHz Span 3 MHz Sweep 12.73 ms CF Step 300.000 kHz #VBW 47 kHz Auto Man Occupied Bandwidth **Total Power** 12.3 dBm 1.1748 MHz Freq Offset 0 Hz Transmit Freq Error -16.542 kHz **OBW Power** 99.00 % -20.00 dB x dB Bandwidth 1.266 MHz x dB STATUS



Highest Channel & Modulation : 8DPSK

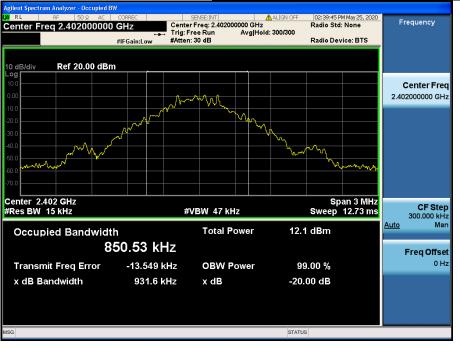




- Tested Power Supply: 24 V



Lowest Channel & Modulation : GFSK



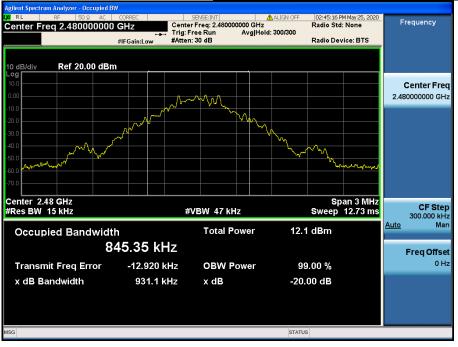
20 dB BW

Middle Channel & Modulation : GFSK





Highest Channel & Modulation : GFSK

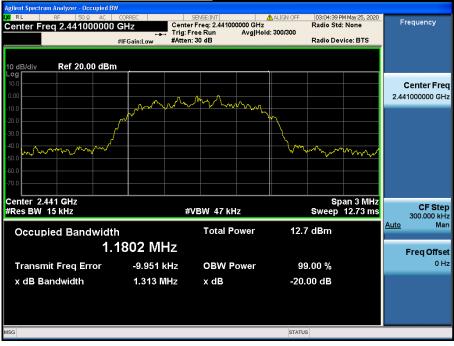


20 dB BW

Lowest Channel & Modulation : π/4DQPSK Occupied BW SENSE:INT ALIGN OFF Center Freq: 2.402000000 GHz Trig: Free Run Avg|Hold: 300/300 #Atten: 30 dB 03:02:02 PM May 25, 2020 Radio Std: None Center Freq 2.402000000 GHz #IFGain:Low Radio Device: BTS Ref 20.00 dBm **Center Freq** 2.40200000 GHz ML/ Span 3 MHz Sweep 12.73 ms Center 2.402 GHz #Res BW 15 kHz CF Step 300.000 kHz #VBW 47 kHz Auto Mar Occupied Bandwidth Total Power 12.6 dBm 1.1840 MHz Freq Offset 0 Hz -8.929 kHz **OBW Power** 99.00 % Transmit Freq Error x dB Bandwidth 1.314 MHz x dB -20.00 dB STATUS



Middle Channel & Modulation : π/4DQPSK

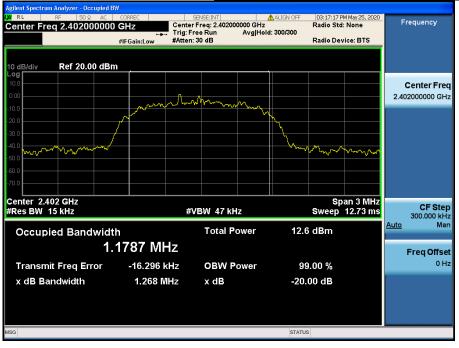


20 dB BW

Highest Channel & Modulation : π/4DQPSK Occupied BV Center Freq: 2.480000000 GHz Trig: Free Run Avg|Hold: 300/300 #Atten: 30 dB 03:08:14 PM May 25, 2020 Radio Std: None Frequency Center Freq 2.480000000 GHz #IFGain:Low Radio Device: BTS Ref 20.00 dBm **Center Freq** 2.480000000 GHz www.w Center 2.48 GHz #Res BW 15 kHz Span 3 MHz Sweep 12.73 ms CF Step 300.000 kHz #VBW 47 kHz Auto Man Occupied Bandwidth **Total Power** 12.7 dBm 1.1736 MHz **Freq Offset** 0 Hz Transmit Freq Error -13.434 kHz **OBW Power** 99.00 % -20.00 dB x dB Bandwidth 1.315 MHz x dB STATUS



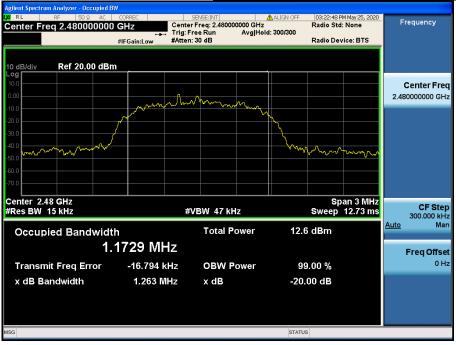
Lowest Channel & Modulation : 8DPSK



20 dB BW

Middle Channel & Modulation : 8DPSK Occupied BV SENSE:INT ALIGN OFF Center Freq: 2.441000000 GHz Trig: Free Run Avg|Hold: 300/300 #Atten: 30 dB 03:20:03 PM May 25, 2020 Radio Std: None Frequency Center Freq 2.441000000 GHz #IFGain:Low Radio Device: BTS Ref 20.00 dBm **Center Freq** 2.441000000 GHz Center 2.441 GHz #Res BW 15 kHz Span 3 MHz Sweep 12.73 ms CF Step 300.000 kHz #VBW 47 kHz Auto Man Occupied Bandwidth **Total Power** 12.6 dBm 1.1735 MHz **Freq Offset** 0 Hz Transmit Freq Error -16.981 kHz **OBW Power** 99.00 % -20.00 dB x dB Bandwidth 1.262 MHz x dB STATUS

Highest Channel & Modulation : 8DPSK





4. Carrier Frequency Separation

4.1 Test Setup

Refer to the APPENDIX I.

4.2 Limit

Limit : ≥ 25 kHz or ≥ Two-Thirds of the 20 dB BW whichever is greater.

4.3 Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the markerdelta function was recorded as the measurement results.

The spectrum analyzer is set to :

Span = wide enough to capture the peaks of two adjacent channels

RBW = Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.

 $VBW \ge RBW$ Sweep = auto Detector function = peak Trace = max hold

4.4 Test Results

- Tested Power Supply: 12 V FH mode

Hopping Mode	Modulation	Peak of reference Channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
	GFSK	2 441.152	2442.156	1.004
Enable	π/4DQPSK	2 441.159	2442.154	0.995
	8DPSK	2440.827	2 441.818	0.991

AFH mode

Hopping Mode	Modulation	Peak of reference Channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
	GFSK	2 441.153	2442.155	1.002
Enable	π/4DQPSK	2 441.159	2442.155	0.996
	8DPSK	2440.825	2 441.829	1.004

Note 1 : See next pages for actual measured spectrum

- Tested Power Supply: 24 V

FH mode

Hopping Mode	Modulation	Peak of reference Channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
	GFSK	2 441.152	2442.153	1.001
Enable	π/4DQPSK	2 441.160	2442.155	0.995
	8DPSK	2439.822	2440.821	0.999

AFH mode

Hopping Mode	Modulation	Peak of reference Channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
	GFSK	2 441.156	2442.150	0.994
Enable	π/4DQPSK	2 441.152	2442.155	1.003
	8DPSK	2440.815	2 441.823	1.008

Note 1 : See next pages for actual measured spectrum

- Minimum Standard :

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. Alternatively, frequency hopping systems operating in the 2400 - 2483.5 MHz band 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, provided the systems operate with an output power no greater than 125 mW

- Tested Power Supply: 12 V Carrier Frequency Separation (FH)

Hopping mode : Enable & GFSK



Carrier Frequency Separation (FH)

<u>Hopping mode : Enable & π/4DQPSK</u>





Carrier Frequency Separation (FH)

Hopping mode : Enable & 8DPSK

Agilent Spectrum Analyzer - Swept SA					
XX RL RF 50Ω AC	CORREC	SENSE:INT	ALIGN OFF	02:38:19 PM May 25, 2020 TRACE 1 2 3 4 5 6	Frequency
Center Freq 2.44100000	PNO: Wide 🕟 Trig: F	ree Run	g Type: Log-Pwr	TYPE MWWWWWWW DET P P P P P P	
	IFGain:Low Atten	: 30 dB		DET PPPPP	
				∆Mkr1 991 kHz	Auto Tune
10 dB/div Ref 20.00 dBm				-0.02 dB	
Log			▲ 1 /	12	
10.0	X2		_ _		Center Freq
0.00	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	2.441000000 GHz
-10.0					
-20.0					
-30.0					Start Freq
					2.439500000 GHz
-40.0					
-50.0					Stop Freq
-60.0					2.442500000 GHz
-70.0					2.442500000 GHZ
Center 2.441000 GHz				Span 3.000 MHz	CF Step
#Res BW 51 kHz	#VBW 150 k	HZ	Sweep 1.	.200 ms (3001 pts)	300.000 kHz
MKR MODE TRC SCL X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	<u>991 kHz (∆)</u> -0. 40 827 GHz 5.10	02 dB dBm			
	+0 627 GHZ 5.10				Freq Offset
4 5					0 Hz
6					
7					
8					
10					
				~	
MSG			STATUS		
100			314103		



Carrier Frequency Separation (AFH) <u>Hopping mode : Enable & GFSK</u>



Carrier Frequency Separation (AFH) <u>Hopping mode : Enable & $\pi/4DQPSK$ </u>





Carrier Frequency Separation (AFH) <u>Hopping mode : Enable & 8DPSK</u>

Aglent Spectrum Analyzer - Swept SA L RF 50 Ω AC	CORREC	SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	04:18:21 PM May 25, 2020 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 20.00 dBm		g: Free Run ten: 30 dB	ΔN	Ikr1 1.004 MHz -0.18 dB	Auto Tune
10.0 0.00 -10.0		2	······································	Δ2	Center Freq 2.441000000 GHz
-20.0					Start Freq 2.439500000 GHz
-50.0 -60.0 -70.0					Stop Freq 2.442500000 GHz
Center 2.441000 GHz #Res BW 51 kHz		Y FUNCT		Span 3.000 MHz .200 ms (3001 pts) FUNCTION VALUE	CF Step 300.000 kHz <u>Auto</u> Man
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1.004 MHz (Δ) 0 825 GHz 5	-0.18 dB 5.32 dBm			Freq Offset 0 Hz
7 8 9 10 11					
MSG			STATUS		

- Tested Power Supply: 24 V Carrier Frequency Separation (FH)

Hopping mode : Enable & GFSK



Carrier Frequency Separation (FH)

<u>Hopping mode : Enable & π/4DQPSK</u>





Carrier Frequency Separation (FH) <u>Hopping mode : Enable & 8DPSK</u>

Agilent Spectrum Analyzer - Swept SA					
RL RF 50 Ω AC Center Freq 2.441000000			ALIGN OFF	03:31:56 PM May 25, 2020 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 20.00 dBm	PNO: Wide	ig: Free Run ten: 30 dB		ΔMkr1 999 kHz -0.02 dB	Auto Tune
10.0 0.00 -10.0		1Δ2	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	·	Center Freq 2.441000000 GHz
-20.0 -30.0 -40.0					Start Freq 2.439500000 GHz
-50.0 -60.0 -70.0					Stop Freq 2.442500000 GHz
Center 2.441000 GHz #Res BW 51 kHz	#VBW 15) KHZ Y FUNCTIO		Span 3.000 MHz .200 ms (3001 pts) FUNCTION VALUE	CF Step 300.000 kHz <u>Auto</u> Man
3 4 5	999 kHz (∆) 39 822 GHz	-0.02 dB 5.31 dBm			Freq Offset 0 Hz
6 7 8 9 10 11					
MSG		III.	STATUS	>	



Carrier Frequency Separation (AFH) <u>Hopping mode : Enable & GFSK</u>



Carrier Frequency Separation (AFH) <u>Hopping mode : Enable & $\pi/4DQPSK$ </u>





Carrier Frequency Separation (AFH) <u>Hopping mode : Enable & 8DPSK</u>

Agilent Spectrum Analyzer - Swept SA			
L RF 50 Ω AC	CORREC SENSE:INT		May 25, 2020 1 2 3 4 5 6 Frequency
	PNO: Wide 🕟 Trig: Free Run	TYP	- [] 2 3 4 5 6 E MWWWWW T P P P P P P
	IFGain:Low Atten: 30 dB	DE	Auto Tune
		ΔMkr1 1.0	
10 dB/div Ref 20.00 dBm).75 dB
Log 10.0		_1∆2	
	Xerro		Center Freq
			2.441000000 GHz
-10.0			
-20.0			Start Freq
-30.0			2.439500000 GHz
-40.0			
-50.0			
-60.0			Stop Freq
-70.0			2.442500000 GHz
Center 2.441000 GHz #Res BW 51 kHz	#VBW 150 kHz	Span 3.	000 MHz CF Step
		Sweep 1.200 ms (:	Auto Man
MKR MODE TRC SCL \times	Y 1.008 MHz (Δ) 0.75 dB	FUNCTION FUNCTION WIDTH FUNCTIO	N VALUE
2 F 1 f 2.440	0.75 GHz 5.01 dBm		
3			Freq Offset
5			0 Hz
6 7			
8			
9			
11			
MSG		STATUS	
mod		514105	



5. Number of Hopping Frequencies

5.1 Test Setup

Refer to the APPENDIX I.

5.2 Limit

Limit : >= 15 hops

5.3 Procedure

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

To get higher resolution, two frequency ranges for FH mode within the 2400 ~ 2483.5 MHz were examined.

The spectrum analyzer is set to :

Span for FH mode = 50 MHz	Start Frequency = 2391.5 MHz, Stop Frequency = 2 441.5 MHz
	Start Frequency = 2 441.5 MHz, Stop Frequency = 2491.5 MHz
Span for AFH mode = 30 MHz	Start Frequency = 2426.0 MHz, Stop Frequency = 2456.0 MHz
RBW = To identify clearly the indi	vidual channels, set the RBW to less than 30% of the channel spacing
or the 20 dB bandwidth, v	vhichever is smaller.
VBW ≥ RBW	Sweep = auto
Detector function = peak	Trace = max hold

5.4 Test Results

- Tested Power Supply: 12 V FH mode

Hopping mode	Modulation	Test Result (Total Hops)			
	GFSK	79			
Enable	π/4DQPSK	79			
	8DPSK	79			

AFH mode

Hopping mode	Modulation	Test Result (Total Hops)			
	GFSK	20			
Enable	π/4DQPSK	20			
	8DPSK	20			

Note 1 : See next pages for actual measured spectrum plots.

- Tested Power Supply: 24 V

FH mode

Hopping mode	Modulation	Test Result (Total Hops)
	GFSK	79
Enable	π/4DQPSK	79
	8DPSK	79

AFH mode

Hopping mode	Modulation	Test Result (Total Hops)			
	GFSK	20			
Enable	π/4DQPSK	20			
	8DPSK	20			

Note 1 : See next pages for actual measured spectrum plots.

- Minimum Standard :

At least 15 hopes



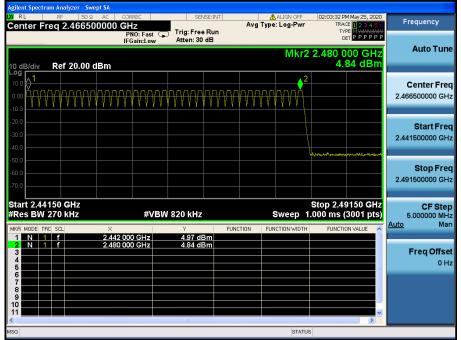
- Tested Power Supply: 12 V Number of <u>Hopping Frequencies 1(FH)</u>

🛈 Dt&C

Но	nnina	mode	•	Enable	8	GFSK
110	pping	moue		LIIANIC	CX.	01 01

Agilent Spec											
	RF		AC COF	REC	SEI	VSE:INT	Ανα Τι	ALIGN OFF		M May 25, 2020	Frequency
Genner	rieq 4	.41050		NO: Fast G	Trig: Fre			,,	TY	PE M IANAHAMAN	
	_		IFC	Gain:Low	Atten: 30	dB			DI	TPPPPP	
								Mkr2	2.441 0	00 GHz	Auto Tune
10 dB/div	Dof	20.00 (1Bm							95 dBm	
Log	Ke	20.00 (1		
10.0			\land								Center Freq
0.00			ňnnnn	החחח		ΠΠΠΠ	MAAA	ากกกกก		ΛΛΛΛΛ	2.416500000 GHz
					¥ ¥ ¥ ¥ ¥ ¥	11111	YYYY	Y Y Y Y Y Y	****	$\{V, V, V, V\}$	2.410300000 0112
-10.0											
-20.0											Start Freq
-30.0											
											2.391500000 GHz
-40.0	www.www.	-									
-50.0											
-60.0											Stop Freq
-70.0											2.441500000 GHz
-70.0											
Start 2.3	39150	GH7							Stop 2.44	150 GHz	CF Step
#Res BV				#VB۱	V 820 kHz			Sweep 1			5.000000 MHz
											Auto Man
MKR MODE	TRC SCL		× 2.402.00		۲ 5.11 dl		CTION	FUNCTION WIDTH	FUNCTIO	IN VALUE	
2 N	1 F		2.441 00		4.95 d						
3					1.00 4.						Freq Offset
4											0 Hz
5										=	
7											
8											
9											
11										~	
<					ш					>	
MSG								STATUS	S		

Number of Hopping Frequencies 2(FH) <u>Hopping mode : Enable & GFSK</u>





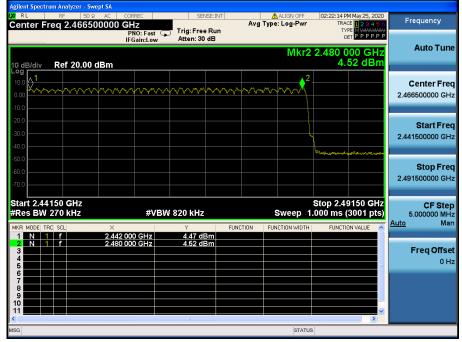
Number of Hopping Frequencies 1(FH)

Hopping mode : Enable & π/4DQPSK

ent Spectrum Analyzer - S RL RF 50	Swept SA	SENSE:INT	ALIGN OFF	02:21:02 PM May 25, 2020	
nter Freq 2.416	500000 GHz		Avg Type: Log-Pwr	TRACE 1 2 3 4 5 6 TYPE M	Frequency
dB/div Ref 20.00	PNO: Fast IFGain:Low	Atten: 30 dB	Mkr2	2.441 000 GHz 5.64 dBm	Auto Tun
	0 ¹		γ	·····	Center Fre 2.416500000 GH
					Start Fre 2.391500000 GH
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0					Stop Fre 2.441500000 GH
art 2.39150 GHz Res BW 270 kHz	×		Sweep 1	Stop 2.44150 GHz .000 ms (3001 pts)	CF Ste 5.000000 MH Auto Ma
1 N 1 f 2 N 1 f 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	2.402 000 GHz 2.441 000 GHz	4.67 dBm 5.64 dBm			Freq Offse 0 H
6 7 8 9 0 1					
G		nu -	STATU	>	

Number of Hopping Frequencies 2(FH)

Hopping mode : Enable & π/4DQPSK





Number of <u>Hopping Frequencies 1(FH)</u>

Hopping mode : Enable & 8DPSK

			alyzer - Sv									
X/ RI Cen		RF req		Ω AC 0					ALIGN OFF e: Log-Pwr	TRA	M May 25, 2020	Frequency
10 d	B/div	Re	f 20.00		PNO: Fast IFGain:Low	Atten: 3			Mkr2	□ 2.441 0	00 GHz 31 dBm	Auto Tune
Log 10.0 0.00 -10.0				2 ¹	v~v~v~v	ᡝ᠕᠕ᠬᢦ᠕᠕ᠰ᠕	᠂ᠬᠯ᠕ᠰ	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~	ᡟᡊ᠇᠅ᠰᠬ	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Center Freq 2.416500000 GHz
-20.0 -30.0 -40.0												Start Freq 2.391500000 GHz
-50.0 -60.0 -70.0												Stop Freq 2.441500000 GHz
#Re	t 2.39 s BW	270	kHz	×	#VE	3W 820 KH: Y 5.26 c	FL	INCTION FL	Sweep 1	.000 ms (4150 GHz (3001 pts) ^{DN VALUE}	CF Step 5.000000 MHz <u>Auto</u> Man
2 3 4 5 6	N 1	f		2.441	000 GHz	4.31 c	IBm				=	Freq Offset 0 Hz
7 8 9 10 11											~	
MSG									STATU	S		

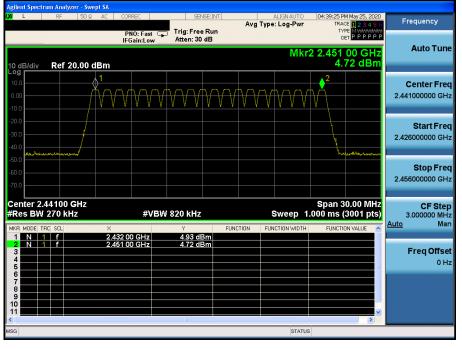
Number of <u>Hopping Frequencies 2(FH)</u>

Hopping mode : Enable & 8DPSK

Agilent Spectrum Analyzer - Swept SA					
X RL RF 50Ω AC Center Freq 2.466500000		BENSE:INT AVG	ALIGN OFF	02:37:04 PM May 25, 2020 TRACE 1 2 3 4 5 6	Frequency
	PNO: Fast FIGain:Low Atten:	ee Run		2.480 000 GHz 5.29 dBm	Auto Tune
10 dB/div Ref 20.00 dBm			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Center Freq 2.466500000 GHz
-20.0					Start Freq 2.441500000 GHz
-50.0 -60.0 -70.0					Stop Freq 2.491500000 GHz
Start 2.44150 GHz #Res BW 270 kHz	#VBW 820 kH	Iz		Stop 2.49150 GHz .000 ms (3001 pts)	CF Step 5.000000 MHz Auto Man
2 N 1 f 2.480 3 - <td></td> <td>FUNCTION dBm dBm</td> <td>FUNCTION WIDTH</td> <td>FUNCTION VALUE</td> <td>Freq Offset 0 Hz</td>		FUNCTION dBm dBm	FUNCTION WIDTH	FUNCTION VALUE	Freq Offset 0 Hz
11 MSG			STATUS		



Number of Hopping Frequencies 1(AFH) Hopping mode : Enable & GFSK



Number of Hopping Frequencies 1(AFH)

Hopping mode : Enable & π/4DQPSK





Number of Hopping Frequencies 1(AFH) Hopping mode : Enable & 8DPSK

gilent Spectrum Analyzer - Swept SA					
<mark>XU</mark> L RF 50Ω AC		SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	04:45:35 PM May 25, 2020 TRACE 123456	Frequency
10 dB/div Ref 20.00 dBm		rig: Free Run Atten: 30 dB	Mkr	2 2.451 00 GHz 5.39 dBm	Auto Tune
10.0 0.00 -10.0				2	Center Fred 2.441000000 GHz
-20.0				- Ang	Start Fred 2.426000000 GH:
-50.0					Stop Free 2.456000000 GH:
Center 2.44100 GHz #Res BW 270 kHz	#VBW 82		Sweep 1	Span 30.00 MHz .000 ms (3001 pts) FUNCTION VALUE	CF Step 3.000000 MH: <u>Auto</u> Mar
1 N 1 f 2.	432 00 GHz 451 00 GHz	5.35 dBm 5.39 dBm			Freq Offset 0 Hz
11 (inclusion of the second sec		Ш	STATUS	×	

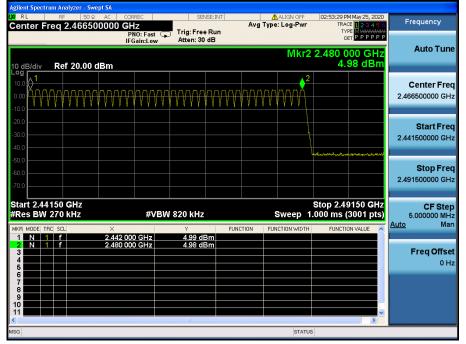
- Tested Power Supply: 24 V Number of <u>Hopping Frequencies 1(FH)</u>

Hopping mode : Enable & GFSK

XI F		pee		RF		er -	0Ω				COR	REC						S	EN9	SE:IN	IT				1	Δ	AL TO	GN (DEE		02	:52:1	17 Pf	M M.	ay 25,	. 202	20							
Ce		er I	re								GH	z				Ι,	ria	Fr						Av	g T	ype							TRAC	CE	23	4 5	6			Fre	qui	enc	У	
10 (IB/o	div	_	Re	ef 2	0.0	0 0	іВ	m				Fas n:Lo	st (w	+)			n: 3					_		_			М	kr?	2 2	2.4		DI	ет Г	PP d	H	P Z				Au	to 1	۲ur	ne
Log 10.1 0.0 -10.1								Ŕ	1 N	Y	Y	Λ	Ŷ	\mathbb{N}	N	N	γ	N	η	γ	Y	N	Y	Ŵ	Y	γ	N	Y	vv	Y	\mathbb{N}	N	\mathcal{V}	N	Ŵ	Ŵ			2.4			ter 0000		· • I
-20.1 -30.1 -40.1	┝		hi ha			- lo																																	2.3			art 0000		
-50.1 -60.1 -70.1	┝																																						2.4	141		op		- 11
Sta #R	es	B۷	V 2	70 SC	kŀ				×					1	w	82	Y	kН				FUN	ICTI	DN		FUN	_	ee		1.0	ito 100	m	s (30	50 (01 ALUE	pts	z 5)	A	uto			CF :		iz
1 2 3 4 5			1	f					2.40	02 11	00) G) G	Hz				<u>5.</u>	24 (05 (m																				F	re	q O	ffs 0⊦	
6 7 8 9 10																																					~							
< MSG		_	_						_					_			11	1		_							_	S	ΤΑΤΙ	JS	_			_		>		L						

Number of Hopping Frequencies 2(FH)

Hopping mode : Enable & GFSK





Number of Hopping Frequencies 1(FH)

Hopping mode : Enable & π/4DQPSK

RL RF 50	wept SA Q AC CORREC	SENSE:INT	ALIGN OFF	03:14:01 PM May 25, 2020	
ter Freq 2.4165	500000 GHz		Avg Type: Log-Pwr	TRACE 1 2 3 4 5 6	Frequency
B/div Ref 20.00	PNO: Fas IFGain:Lo		Mkr2	0er P P P P P P 2.441 000 GHz 5.21 dBm	Auto Tune
	1	v~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Center Free 2.416500000 GH;
	<u>р</u>				Start Freq 2.391500000 GHz
					Stop Freq 2.441500000 GHz
rt 2.39150 GHz s BW 270 kHz	# \	/BW 820 kHz	Sweep '	Stop 2.44150 GHz 1.000 ms (3001 pts)	CF Step 5.000000 MHz Auto Man
N 1 f N 1 f	2.402 000 GHz 2.441 000 GHz	5.95 dBm			Freq Offset 0 Hz
		Ш		>	

Number of Hopping Frequencies 2(FH)

Hopping mode : Enable & π/4DQPSK





Number of <u>Hopping Frequencies 1(FH)</u>

Hopping mode : Enable & 8DPSK

		ctrun		ilyzer - S														
uxu Cer		Fre	RF q 2	50 2.4165		AC 000		z		Trig: F			Av		ALIGN OFF	TRA	PM May 25, 2020	Frequency
10 c	B/div	,	Ref	20.00	dE	3m	IFG	10: Fas iain:Lo	st 🕞	Atten:					Mkr2	2.441	000 GHz	Auto Tune
Log 10.0 0.00					Ş	<mark>)</mark> רייי	~~~	~~~~~	ᡝᠰ᠕	ᢊᡃᡳᡝᠰ	wγ	ᡝᠰ᠋ᢩ᠕ᠰ	m M	ᠰᡎᠰᠶ	a for the second s	ᡝᢦᠬ᠈᠇ᠬ	www	Center Freq 2.416500000 GHz
-10.0 -20.0 -30.0 -40.0				mortan	ſ													Start Freq 2.391500000 GHz
-50.0 -60.0 -70.0																		Stop Freq 2.441500000 GHz
#Re	nt 2.3 es Bi	W 2	70			×		#\) GHz		820 kl			NCTION		Sweep 1	.000 ms	4150 GHz (3001 pts)	CF Step 5.000000 MHz Auto Man
- <mark>2</mark> 3 4 5 6	N		f) GHz		5.31								Freq Offset 0 Hz
7 8 9 10 11																	~	
MSG															STATU	s		

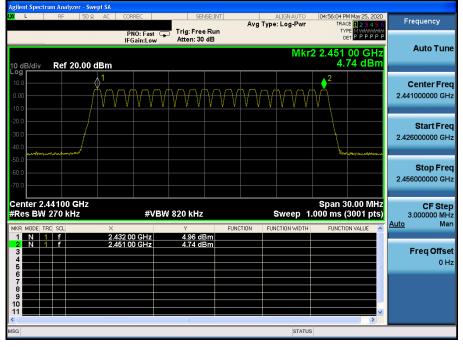
Number of <u>Hopping Frequencies 2(FH)</u>

Hopping mode : Enable & 8DPSK

Agilent Spectrum Analyzer - Swept SA						
RL RF 50Ω AC Center Freq 2.466500000	GHZ	SENSE:IN	Avg	ALIGN OFF Type: Log-Pwr	03:30:01 PM May 25, 2020 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 20.00 dBm	PNO: Fast G	Trig: Free Ru Atten: 30 dB	1	Mkr2	2.480 000 GHz 5.79 dBm	Auto Tune
10.0 1 -10.0		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Center Freq 2.466500000 GHz
-20.0					Manual Concernence of the manual	Start Freq 2.441500000 GHz
-60.0 -60.0 -70.0						Stop Freq 2.491500000 GHz
Start 2.44150 GHz #Res BW 270 kHz	#VBW	820 kHz		Sweep 1	Stop 2.49150 GHz .000 ms (3001 pts)	5.000000 MHz
2 N 1 f 2.480	2 000 GHz 0 000 GHz	Y 5.84 dBm 5.79 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	Auto Man Freq Offset 0 Hz
6 7 8 9 10 11					~	
MSG				STATUS		

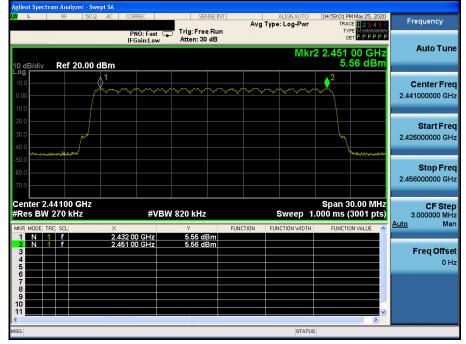


Number of Hopping Frequencies 1(AFH) Hopping mode : Enable & GFSK



Number of Hopping Frequencies 1(AFH)

Hopping mode : Enable & π/4DQPSK





Number of Hopping Frequencies 1(AFH) Hopping mode : Enable & 8DPSK

L R	F 50Ω AC	CORREC	SENS		ALIGNAUTO		M May 25, 2020	Frequency
		PNO: Fast	😱 Trig: Free F	Run	g Type: Log-Pwr	TY	DE <mark>123456</mark> PE M MMMMM ET P P P P P P	rioquonoy
		IFGain:Low	Atten: 30 d	B	D.A.Len			Auto Tun
dB/div R	ef 20.00 dBn	ı			IVINI	2 2.451 5.4	44 dBm	
o.o	1					_ <mark>_</mark> 2		Center Fre
00	^~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim\sim\sim\sim\sim\sim$	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sqrt{\sqrt{2}}$	~~~		2.441000000 GH
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						- h		2.426000000 GH
0.0	- 1000					\	And water and and and and	
).0							. Helonician	Stop Fre
).0								2.456000000 GH
1.0								
enter 2.441						Span 3	0.00 MHz	CF Ste
Res BW 270		#VI	BW 820 kHz		Sweep 1	```		3.000000 MH Auto Ma
R MODE TRC SC		× 2.432 00 GHz	۲ 5.21 dBr	FUNCTION	FUNCTION WIDTH	FUNCTIO	ON VALUE	Addo Mile
2 N 1 f		2.451 00 GHz	5.44 dBr					Freq Offs
								01
7 B								
9								
							~	
1							>	



6. Time of Occupancy (Dwell Time)

6.1 Test Setup

Refer to the APPENDIX I.

6.2 Limit

The maximum permissible time of occupancy is 400 ms within a period of 400 ms multiplied by the number of hopping channels employed.

6.3 Test Procedure

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

The spectrum analyzer is set to :

Center frequency = 2 441 MHz

Span = zero

RBW = 1 MHz (RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel) Detector function = peak

VBW ≥ RBW

Trace = max hold

6.4 Test Results

- Tested Power Supply: 12 V FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
	DH 5	79	2.865	3.780	0.306
Enable	2 DH 5	79	2.865	3.780	0.306
	3 DH 5	79	2.865	3.780	0.306

AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
	DH 5	20	2.865	3.780	0.153
Enable	2 DH 5	20	2.865	3.780	0.153
	3 DH 5	20	2.865	3.780	0.153



- Tested Power Supply: 24 V

FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
	DH 5	79	2.865	3.780	0.306
Enable	2 DH 5	79	2.865	3.780	0.306
	3 DH 5	79	2.865	3.780	0.306

AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
	DH 5	20	2.865	3.780	0.153
Enable	2 DH 5	20	2.865	3.780	0.153
	3 DH 5	20	2.865	3.780	0.153

Note 1 : Dwell Time = 0.4 × Hopping channel × Burst ON time ×

((Hopping rate ÷ Time slots) ÷ Hopping channel)

- Time slots for DH5 = 6 slots (TX = 5 slot / RX = 1 slot)

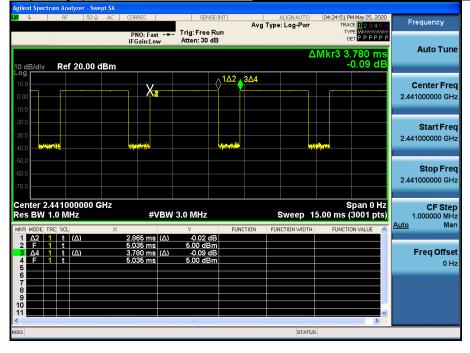
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2 : See next pages for actual measured spectrum plots.



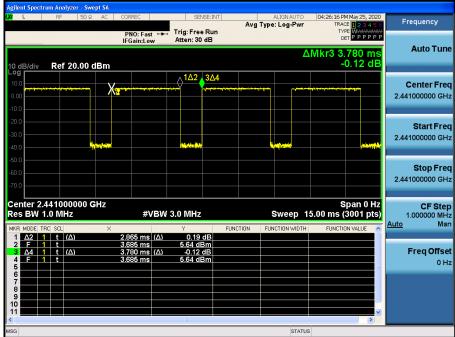
- Tested Power Supply: 12 V Time of Occupancy (FH)

Hopping mode : Enable & DH5



Time of Occupancy (FH)

Hopping mode : Enable & 2-DH5





Hopping mode : Enable & 3-DH5

Time of Occupancy (FH)





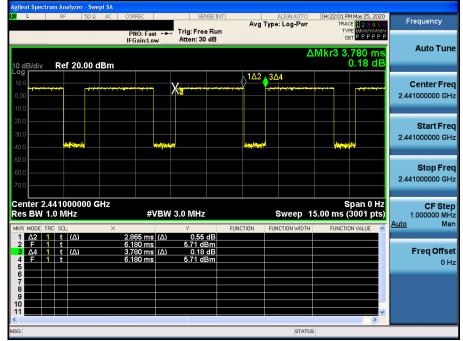
Hopping mode : Enable & DH5

Time of Occupancy (AFH)



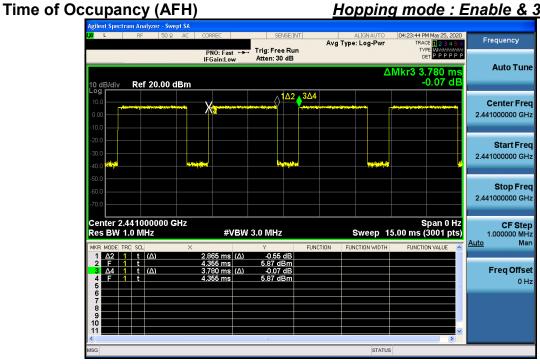
Time of Oc<u>cupancy (AFH)</u>

Hopping mode : Enable & 2-DH5





Hopping mode : Enable & 3-DH5





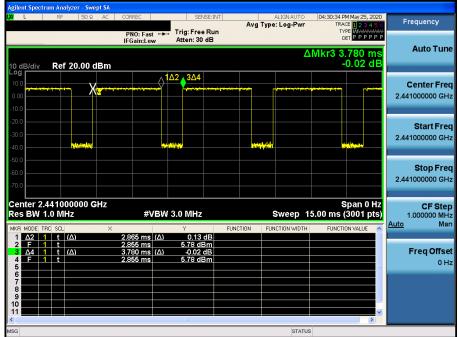
- Tested Power Supply: 24 V Time of Occupancy (FH)

Hopping mode : Enable & DH5



Time of Occupancy (FH)

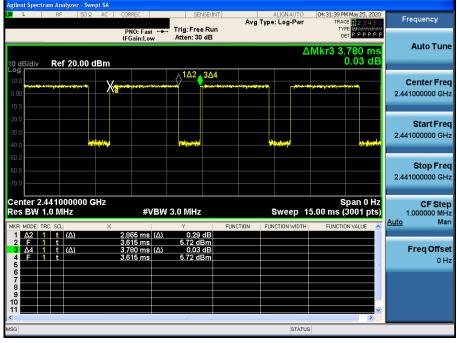
Hopping mode : Enable & 2-DH5





Hopping mode : Enable & 3-DH5

Time of Occupancy (FH)





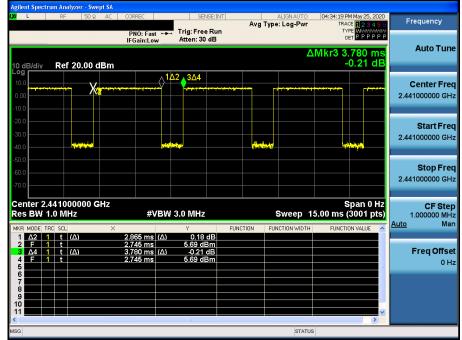
Hopping mode : Enable & DH5

Time of Occupancy (AFH)



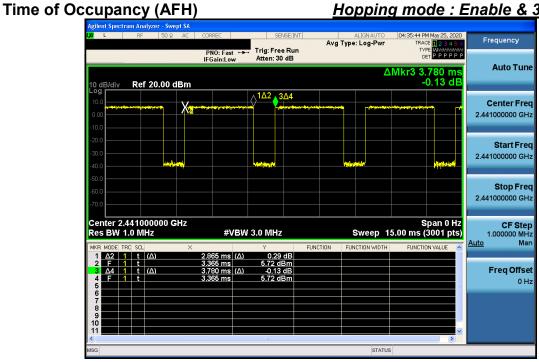
Time of Oc<u>cupancy (AFH)</u>

Hopping mode : Enable & 2-DH5





Hopping mode : Enable & 3-DH5





7. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

7.1 Test Setup

Refer to the APPENDIX I.

7.2 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 §15.205(c))

According to § 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)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1705	24000/F (kHz)	30
1705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	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 - 72 MHz, 76 - 88 MHz, 174 - 216 MHz or 470 - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~ 12.52025	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.57675 ~ 12.57725	156.52475 ~ 156.52525	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	13.36 ~ 13.41	156.7 ~ 156.9	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	16.42 ~ 16.423	162.0125 ~ 167.17	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.69475 ~ 16.69525	167.72 ~ 173.2	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.80425 ~ 16.80475	240 ~ 285	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	25.5 ~ 25.67	322 ~ 335.4	2655 ~ 2900		
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3260 ~ 3267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3332 ~ 3339		
8.37625 ~ 8.38675	74.8 ~ 75.2	960 ~ 1240	3345.8 ~ 3358		
			3600 ~ 4400		

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



7.3. Test Procedures

7.3.1. Test Procedures for Radiated Spurious Emissions

- 1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 or 3 meter away from the interference-receiving antenna.
- 3. For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
- 4. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 5. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.

Measurement Instrument Setting

1. Frequency Range Below 1 GHz

RBW = As specified in table, VBW \ge 3 x RBW, Sweep = Auto, Detector = Peak or Quasi Peak,

Trace mode = Max Hold until the trace stabilize

Frequency	RBW
9 kHz	200 - 300 Hz
0.15 - 30 MHz	9 -10 kHz
30 - 1000 MHz	100 - 120 kHz

2. Frequency Range > 1 GHz

Peak Measurement

RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes Average Measurement

The result of Average measurement is calculated using PK result and duty correction factor.



7.3.2. Test Procedures for Conducted Spurious Emissions

Dt&C

- 1. The transmitter output was connected to the spectrum analyzer.
- 2. The **reference level** of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 300 kHz.
- 3. The conducted spurious emission was tested each ranges were set as below.

Frequency range : 9 kHz ~ 30 MHz RBW = 100 kHz, VBW = 300 kHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

Frequency range : 30 MHz ~ 10 GHz, 10 GHz ~ 25 GHz RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

LIMIT LINE = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 kHz, VBW = 300 kHz)

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 kHz BW.

Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.



7.4. Test Results

7.4.1. Radiated Emissions

- Tested Power Supply: 12 V

9 kHz ~ 1 GHz Data

 GFSK & Lowest Channel 	(Worst Case)
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Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
44.55	V	Х	PK	36.30	-8.30	N/A	N/A	28.00	40.00	12.00
212.04	Н	Х	QP	46.50	-10.00	N/A	N/A	36.50	43.50	7.00
399.57	Н	Х	PK	39.90	-3.30	N/A	N/A	36.60	46.00	9.40
424.79	Н	Х	PK	38.90	-2.60	N/A	N/A	36.30	46.00	9.70
480.08	Н	Х	PK	41.60	-1.80	N/A	N/A	39.80	46.00	6.20
818.60	V	Х	PK	29.00	5.60	N/A	N/A	34.60	46.00	11.40
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

Note.

1. No other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, measurements may be performed at a distance closer than that specified in the regulations. In this case, the distance factor is applied to the result.

- Calculation of distance factor

At frequencies below 30 MHz = 40 log(tested distance / specified distance)

At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)

When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied. 3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.865 ms

- 100 ms / Δ t [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.865 X 20) = 1.75 = 2
- The Worst Case Dwell Time = T [ms] x H' = 2.865 ms X 2 = 5.73 ms
- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.73 / 100) = <u>-24.84 dB</u>

4. Sample Calculation.

Margin = Limit - Result / Result = Reading + T.F + D.C.F + Distance Factor / T.F = AF + CL - AG

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain.

2 402MHz & X axis & Hor

Detector Mode : QP

Input 1 AC 👄 Att	10 dB	Preamp	OFF Step T				
Level	dBµV		Freq	uency	212.	03540	00 MHz
Max Peak Quasipeak	51.73 46.48	- {	52.8 46.5				00 MHz) 00 MHz)
0	20 20		10 10	60 60		80 80	100 100
Scan 😑 1Pk Clrw							
90 dBµV	1 MHz		10 MHz		100 MH	2	
80 dBµV							
70 dBµV							
50 dвµV							
40 dBµV							
30 dBµV							
20 dBµV							
						TE	

Date: 21.JUN.2020 17:44:46



1 GHz ~ 25 GHz Data (Modulation : GFSK)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 388.15	Н	Х	PK	50.82	4.79	N/A	N/A	55.61	74.00	18.39
2 388.15	Н	Х	AV	50.82	4.79	-24.84	N/A	30.77	54.00	23.23
4 803.94	V	Х	PK	49.62	0.78	N/A	N/A	50.40	74.00	23.60
4 803.94	V	Х	AV	49.62	0.78	-24.84	N/A	25.56	54.00	28.44

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 881.72	V	Х	PK	49.98	1.36	N/A	N/A	51.34	74.00	22.66
4 881.72	V	Х	AV	49.98	1.36	-24.84	N/A	26.50	54.00	27.50

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 483.89	Н	Х	PK	49.92	5.26	N/A	N/A	55.18	74.00	18.82
2 483.89	Н	Х	AV	49.92	5.26	-24.84	N/A	30.34	54.00	23.66
4 960.28	V	Х	PK	50.32	1.61	N/A	N/A	51.93	74.00	22.07
4 960.28	V	Х	AV	50.32	1.61	-24.84	N/A	27.09	54.00	26.91

Note.

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.

In this case, the distance factor is applied to the result.

- Calculation of distance factor

At frequencies below 30 MHz = 40 log(tested distance / specified distance)

At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)

When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied. 3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels, where T = pulse width = 2.865 ms

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.865 X 20) = 1.75 = 2

- The Worst Case Dwell Time = T [ms] x H' = 2.865 ms X 2 = 5.73 ms

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.73 / 100) = -24.84 dB

4. Sample Calculation.



1 GHz ~ 25 GHz Data (Modulation : π/4DQPSK)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 386.02	Н	Х	PK	49.87	4.79	N/A	N/A	54.66	74.00	19.34
2 386.02	Н	Х	AV	49.87	4.79	-24.84	N/A	29.82	54.00	24.18
4 803.93	V	Х	PK	49.97	0.78	N/A	N/A	50.75	74.00	23.25
4 803.93	V	Х	AV	49.97	0.78	-24.84	N/A	25.91	54.00	28.09

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 881.62	V	Х	PK	50.46	1.35	N/A	N/A	51.81	74.00	22.19
4 881.62	V	Х	AV	50.46	1.35	-24.84	N/A	26.97	54.00	27.03

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 484.68	Н	Х	PK	49.04	5.27	N/A	N/A	54.31	74.00	19.69
2 484.68	Н	Х	AV	49.04	5.27	-24.84	N/A	29.47	54.00	24.53
4 959.65	V	Х	PK	50.13	1.61	N/A	N/A	51.74	74.00	22.26
4 959.65	V	Х	AV	50.13	1.61	-24.84	N/A	26.90	54.00	27.10

Note.

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.

In this case, the distance factor is applied to the result.

- Calculation of distance factor

At frequencies below 30 MHz = 40 log(tested distance / specified distance)

At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)

When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied. 3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor) - Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = **2.865 ms**

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.865 X 20) = 1.75 = 2

- The Worst Case Dwell Time = T [ms] x H' = 2.865 ms X 2 = 5.73 ms

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.73 / 100) = -24.84 dB

4. Sample Calculation.



1 GHz ~ 25 GHz Data (Modulation : <u>8DPSK</u>)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 388.52	Н	Х	PK	49.52	4.80	N/A	N/A	54.32	74.00	19.68
2 388.52	Н	Х	AV	49.52	4.80	-24.84	N/A	29.48	54.00	24.52
4 804.17	V	Х	PK	50.12	0.78	N/A	N/A	50.90	74.00	23.10
4 804.17	V	Х	AV	50.12	0.78	-24.84	N/A	26.06	54.00	27.94

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 882.22	V	Х	PK	50.15	1.36	N/A	N/A	51.51	74.00	22.49
4 882.22	V	Х	AV	50.15	1.36	-24.84	N/A	26.67	54.00	27.33

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 484.92	Н	Х	PK	50.93	5.27	N/A	N/A	56.20	74.00	17.80
2 484.92	Н	Х	AV	50.93	5.27	-24.84	N/A	31.36	54.00	22.64
4 959.95	V	Х	PK	49.28	1.61	N/A	N/A	50.89	74.00	23.11
4 959.95	V	Х	AV	49.28	1.61	-24.84	N/A	26.05	54.00	27.95

Note.

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.

In this case, the distance factor is applied to the result.

- Calculation of distance factor

At frequencies below 30 MHz = 40 log(tested distance / specified distance)

At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)

When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied. 3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.865 ms

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.865 X 20) = 1.75 = 2

- The Worst Case Dwell Time = T [ms] x H' = 2.865 ms X 2 = 5.73 ms

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.73 / 100) = -24.84 dB

4. Sample Calculation.



Detector Mode : QP

- Tested Power Supply: 24 V

9 kHz ~ 1 GHz Data

ANT	EUT								
Pol	Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Н	Х	QP	46.30	-10.00	N/A	N/A	36.30	43.50	7.20
Н	Х	PK	39.40	-3.30	N/A	N/A	36.10	46.00	9.90
Н	Х	PK	39.50	-2.60	N/A	N/A	36.90	46.00	9.10
V	Х	PK	36.90	-1.80	N/A	N/A	35.10	46.00	10.90
Н	Х	PK	31.50	2.40	N/A	N/A	33.90	46.00	12.10
V	Х	PK	26.80	7.50	N/A	N/A	34.30	54.00	19.70
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
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<u>Note.</u>

1. No other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, measurements may be performed at a distance closer than that specified in the regulations. In this case, the distance factor is applied to the result.

- Calculation of distance factor

At frequencies below 30 MHz = 40 log(tested distance / specified distance)

At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)

When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied. 3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.865 ms

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.865 X 20) = 1.75 = 2

- The Worst Case Dwell Time = T [ms] x H' = 2.865 ms X 2 = 5.73 ms

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = **20 log(5.73 / 100)** = <u>-24.84 dB</u> 4. Sample Calculation.

Margin = Limit – Result / Result = Reading + T.F + D.C.F + Distance Factor / T.F = AF + CL – AG Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain.

2 402MHz & X axis & Hor

₽ Receiver X Spectrum RBW (QPK) 120 kHz MT 100 ms Input 1 AC 👄 Att 0 dB Preamp OFF Step TD Scan Frequency Level dBµV 211.2601000 MHz Max Peak Duasineal 46.03 000 MH₂ 10 Scan ⊖1Pk Clrv 1 MHz 10 MHz 100 MHz . 90 dBL 80 dBuV . 70 dΒµV 60 dBuV 50 dBµV 40 dBu\ 30 dBµV 20 dBµV 10 dBµV Start 150.0 kHz Stop 1.0 GHz 1.06.2020 Measuring...

Date: 21.JUN.2020 17:32:38



1 GHz ~ 25 GHz Data (Modulation : GFSK)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 388.81	Н	Х	PK	50.49	4.80	N/A	N/A	55.29	74.00	18.71
2 388.81	Н	Х	AV	50.49	4.80	-24.84	N/A	30.45	54.00	23.55
4 803.99	V	Х	PK	50.25	0.78	N/A	N/A	51.03	74.00	22.97
4 803.99	V	Х	AV	50.25	0.78	-24.84	N/A	26.19	54.00	27.81

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 882.08	V	Х	PK	49.58	1.36	N/A	N/A	50.94	74.00	23.06
4 882.08	V	Х	AV	49.58	1.36	-24.84	N/A	26.10	54.00	27.90

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 484.06	Н	Х	PK	49.60	5.26	N/A	N/A	54.86	74.00	19.14
2 484.06	Н	Х	AV	49.60	5.26	-24.84	N/A	30.02	54.00	23.98
4 960.44	V	Х	PK	49.24	1.61	N/A	N/A	50.85	74.00	23.15
4 960.44	V	Х	AV	49.24	1.61	-24.84	N/A	26.01	54.00	27.99

Note.

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, measurements may be performed at a distance closer than that specified in the regulations. In this case, the distance factor is applied to the result.

- Calculation of distance factor

At frequencies below 30 MHz = 40 log(tested distance / specified distance)

At frequencies at or above 30 MHz = 20 log(tested distance / specified distance) When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied. 3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.865 ms

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.865 X 20) = 1.75 = 2

- The Worst Case Dwell Time = T [ms] x H' = 2.865 ms X 2 = 5.73 ms

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.73 / 100) = -24.84 dB

4. Sample Calculation.



1 GHz ~ 25 GHz Data (Modulation : π/4DQPSK)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 388.58	Н	Х	PK	50.12	4.80	N/A	N/A	54.92	74.00	19.08
2 388.58	Н	Х	AV	50.12	4.80	-24.84	N/A	30.08	54.00	23.92
4 803.96	V	Х	PK	49.83	0.78	N/A	N/A	50.61	74.00	23.39
4 803.96	V	Х	AV	49.83	0.78	-24.84	N/A	25.77	54.00	28.23

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 881.98	V	Х	PK	50.13	1.36	N/A	N/A	51.49	74.00	22.51
4 881.98	V	Х	AV	50.13	1.36	-24.84	N/A	26.65	54.00	27.35

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 484.56	Н	Х	PK	50.00	5.27	N/A	N/A	55.27	74.00	18.73
2 484.56	Н	Х	AV	50.00	5.27	-24.84	N/A	30.43	54.00	23.57
4 959.60	V	Х	PK	49.25	1.61	N/A	N/A	50.86	74.00	23.14
4 959.60	V	Х	AV	49.25	1.61	-24.84	N/A	26.02	54.00	27.98

Note.

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.

In this case, the distance factor is applied to the result.

- Calculation of distance factor

At frequencies below 30 MHz = 40 log(tested distance / specified distance)

At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)

When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied. 3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor) - Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = **2.865 ms**

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.865 X 20) = 1.75 = 2

- The Worst Case Dwell Time = T [ms] x H' = 2.865 ms X 2 = 5.73 ms

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.73 / 100) = -24.84 dB

4. Sample Calculation.



1 GHz ~ 25 GHz Data (Modulation : <u>8DPSK</u>)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 389.30	Н	Х	PK	49.19	4.80	N/A	N/A	53.99	74.00	20.01
2 389.30	Н	Х	AV	49.19	4.80	-24.84	N/A	29.15	54.00	24.85
4 803.66	V	Х	PK	49.73	0.78	N/A	N/A	50.51	74.00	23.49
4 803.66	V	Х	AV	49.73	0.78	-24.84	N/A	25.67	54.00	28.33

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 881.92	V	Х	PK	50.85	1.36	N/A	N/A	52.21	74.00	21.79
4 881.92	V	Х	AV	50.85	1.36	-24.84	N/A	27.37	54.00	26.63

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 483.79	Н	Х	PK	48.93	5.26	N/A	N/A	54.19	74.00	19.81
2 483.79	Н	Х	AV	48.93	5.26	-24.84	N/A	29.35	54.00	24.65
4 959.97	V	Х	PK	50.43	1.61	N/A	N/A	52.04	74.00	21.96
4 959.97	V	Х	AV	50.43	1.61	-24.84	N/A	27.20	54.00	26.80

Note.

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.

In this case, the distance factor is applied to the result.

- Calculation of distance factor

At frequencies below 30 MHz = 40 log(tested distance / specified distance)

At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)

When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied. 3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.865 ms

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.865 X 20) = 1.75 = 2

- The Worst Case Dwell Time = T [ms] x H' = 2.865 ms X 2 = 5.73 ms

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.73 / 100) = -24.84 dB

4. Sample Calculation.