

Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u> Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,</u> <u>HuangJiang Town, Dongguan, China</u> Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com



3.6 Occupied Bandwidth Measurement

3.6.1 Test Setup



Spectrum analyzer test configuration

3.6.2 Test Instruments

Refer to section 5 to get information of above instrument

3.6.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to PEAK. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean power of a given emission.

3.6.4 Deviation from Test Standard

No deviation.

3.6.5 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

Release Ver. 1.4

Page 42 of 63

3.6.6 Test Results

Channel	Frequency	Occupied Bandwidth (MHz)			
Channel	(MHz)	GFSK	8DPSK		
0	2402	0.88081	1.1994		
39	2441	0.87998	1.2083		
78	2480	0.88742	1.2050		

Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u> Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,</u> <u>HuangJiang Town, Dongguan, China</u>

Tel: <u>0769-83078199</u> Web.: <u>www.hwa-hsing.com</u> E-Mail: <u>customerservice.dg@hwa-hsing.com</u>



Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com

Release Ver. 1.4

Page 44 of 63



Hopping Channel Separation 3.7

3.7.1 Limits of Hopping Channel Separation Measurement

At least 25 kHz or two-third of 20 dB hopping channel bandwidth (whichever is greater).

3.7.2 Test Setup



Spectrum analyzer test configuration

3.7.3 Test Instruments

Refer to section 5 to get information of above instrument.

3.7.4 Test Procedure

Measurement Procedure REF

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal a. from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency b. within its operating range.
- By using the MaxHold function record the separation of two adjacent channels. c.
- Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot d. the result on SA screen.
- Repeat above procedures until all frequencies measured were complete. e.

3.7.5 Deviation from Test Standard

No deviation.



3.7.6 Test Results

Channel		Adjacent Channel Separation (MHz)		Minimum Limit (MHz)		Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK	
0	2402	1.000	1.003	0.67	0.67	Pass
39	2441	1.002	1.005	0.67	0.67	Pass
78	2480	1.005	1.004	0.67	0.67	Pass

Note: The minimum limit is two-third 20 dB bandwidth.

Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u> Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,</u> <u>HuangJiang Town, Dongguan, China</u> Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com



Tel: <u>0769-83078199</u> Web.: <u>www.hwa-hsing.com</u> E-Mail: <u>customerservice.dg@hwa-hsing.com</u>

Release Ver. 1.4

Page 47 of 63

3.8 Maximum Output Power

3.8.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125mW.

3.8.2 Test Setup



Spectrum analyzer test configuration

3.8.3 Test Instruments

Refer to section 5 to get information of above instrument.

3.8.4 Test Procedure

Measurement using a spectrum analyzer (SA), Selection of test method:

The proper test method is selected based on the following criteria:

a) **Method AVGSA-1 or method AVGSA-1A (alternative)** shall be applied if either of the following conditions can be satisfied:

1) The EUT transmits continuously (or with a D> 98%).

2) Sweep triggering can be implemented in such a way that the device transmits at the maximum power control level throughout the duration of each of the instrument sweeps to be averaged. This condition can generally be achieved by triggering the instrument's sweep if the duration of the sweep (with the instrument configured as in method AVGSA-1) is equal to or shorter than the duration T of each transmission from the EUT, and if those transmissions exhibit full power throughout their durations.

- b) Method AVGSA-2 or method AVGSA-2A (alternative) shall be applied if the conditions of the preceding item a) cannot be achieved and the transmissions exhibit a constant duty cycle during the measurement duration. Duty cycle will be considered to be constant if variations are less than +2%.
- c) Method AVGSA-3 or method AVGSA-3A (alternative) shall be applied if the conditions of the preceding item a) and item b) cannot be achieved.



Method AVGSA-3 or method AVGSA-3A:

- a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b) Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- c) SA Setting:
 - 1* Set span to at least 1.5 times the OBW
 - 2* Set sweep trigger to "free run."
 - 3^* Set RBW= 1% to 5% of the OBW. not to exceed 1MHz.
 - 4^* Set VBW ≥ 3 x RBW

5* Number of points in sweep \ge 2 x span /RBW.(This gives bin-to-bin spacing \le RBW / 2. so that narrowband signals are not lost between frequency bins).

 6^* Sweep time \leq (number of points in sweep) x T. where T is defined in 11.6. If this gives a sweep time less than the auto sweep time of the instrument. then method AVGSA-3 shall not be used (use AVGSA-3A). The purpose of this step is so that the averaging time in each bin is less than or equal to the minimum time of a transmission.

- 7* Detector =RMS (power averaging).
- 8* Trace mode =max hold.
- 9* Allow max hold to run for at least 60 s or longer as needed to allow the trace to stabilize.

10* Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW

- d. Measure the captured power within the band and recording the plot.
- e. Repeat above procedures until all frequencies required were complete.

3.8.5 Deviation fromTest Standard

No deviation.

3.8.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.



3.8.7 Test Results

PEAK POWER

Channel Freq.		Output Power (mW)		Output Power (dBm)		Power Limit	Pass / Fail
INO.	(IVI⊓Z)	GFSK	8DPSK	GFSK	8DPSK	(11100)	
0	2402	7.95	13.41	9.004	11.275	125	Pass
39	2441	7.51	12.69	8.756	11.036	125	Pass
78	2480	8.26	14.14	9.172	11.506	125	Pass

AVERAGE POWER

Channel Freq.		Output Power (mW)		Output Power (dBm)		Power Limit	Pass / Fail
INO.	(IVI⊟Z)	GFSK	8DPSK	GFSK	8DPSK	(11100)	
0	2402	4.19	4.53	6.217	6.560	125	Pass
39	2441	4.24	3.98	6.275	6.003	125	Pass
78	2480	4.55	3.88	6.577	5.891	125	Pass

Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com





Tel: <u>0769-83078199</u> Web.: <u>www.hwa-hsing.com</u> E-Mail: <u>customerservice.dg@hwa-hsing.com</u>





Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com

Release Ver. 1.4

Page 52 of 63



3.9 Conducted Out of Band Emission Measurement

- 3.9.1 Limits of Conducted Out of Band Emission Measurement
- a. If the maximum peak conducted output power procedure was used to determine compliance as described in 11.9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).
- b. If maximum conducted (average) output power was used to determine compliance as described in 11.9.2. then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc)

3.9.2 Tets Setup

- DTS emissions in non-restricted frequency bands Subclause 11.11 of ANSI C63.10 is applicable.
- DTS emissions in restricted frequency bands Subclause 11.12 of ANSI C63.10 is applicable



Spectrum analyzer test configuration

3.9.3 Test Instruments

Refer to section 5 to get information of above instrument.

3.9.4 Test Procedure

- a. Establish a reference level by using the following procedure:
 - 1) Set instrument center frequency to DTS channel center frequency.
 - 2) Set the span to 21.5 times the DTS bandwidth)
 - 3) Set the RBW= 100 kHz)
 - 4) Set the VBW $\geq 3 \times RBW$
 - 5) Detector = peak
 - 6) Sweep time = auto coupling
 - 7) Trace mode =max hold
 - 8) Allow trace to fully stabilize
 - 9) Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u>				
Address: No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,				
HuangJiang Town, Dongguan, China				

Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com

- b. Establish an emission level by using the following procedure:
 - 1) Set the center frequency and span to encompass frequency range to be measured.
 - 2) Set the RBW = 100 kHz
 - 3) Set the VBW \geq 300 kHz.
 - 4) Detector = peak.
 - 5) Sweep time = auto couple.
 - 6) Trace mode = max hold.
 - 7) Allow trace to fully stabilize.
 - 8) Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

3.9.5 Deviation from Test Standard

No deviation.

3.9.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

3.9.7 Test Results

The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 30dB offset below D1. It shows compliance with the requirement.



Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u> Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,</u> <u>HuangJiang Town, Dongguan, China</u> Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com



Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u> Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,</u> <u>HuangJiang Town, Dongguan, China</u> Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com







Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com



Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u> Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,</u> <u>HuangJiang Town, Dongguan, China</u> Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com

Release Ver. 1.4

Page 58 of 63

Bandedge: GFSK



Bandedge: 8DPSK

Hopping Disabled_Low Channel	Hopping Disabled_High Channel
Aglent Synctrum Analyzer - Single Shi SBRE Shi (SSRE OFF - CLORADIO - OL-655 (SRL 077, 2022) Frequency 2) R.K. R/S SSRE Shi (SSRE OFF - CLORADIO - OL-655 (SRL 077, 2022) Frequency Center Freq 2.352500000 GHz FRO Freq 2.352500000 GHz Frequency Avg Type: RMS - RASA Res 2.55 (SSRL 077, 2022) Ref Offset 376 dB Mkr5 2.399 960 GHz Auto Tu 0.40 491 492 34 800 -40 491 (BB m) Auto Tu	Addred Spectrum Andrew - Swept 54 SPRESP1 (SXARE OFF Addrew - Swept 54 SWEP 54
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	eq 900 1 Center Freq 2.51000000 GHz 2.51000000 GHz
502 502 502 502 502 502 502 502 502 502	eq 0.0
50.2 50.2	eq 50.3 the second seco
Start 2.30000 GHz Stop 2.40500 GHz CF st #Res BW 100 kHz #VBW 300 kHz Sweep 10.07 ms (1001 pts) 10.50000 N MR MORE TRC SCL X Y Punction Punction Mort H Punction Viet H Punction Vi	PD Start 2.47000 GHz Stop 2.55000 GHz Stop 2.550000 GHz Stop 2.550000 GHz Stop 2.550000 GHz Stop 2.55000 GHz
2 N 1 f 2.400 000 GHz -40.491 dBm Freq Off 3 N 1 f 2.900 GHz 46.868 dBm Freq Off 4 N 1 f 2.310 000 GHz 46.868 dBm Freq Off 4 N 1 f 2.399 800 GHz 40.491 dBm G 5 - - - 40.491 dBm G G	et 2 N 1 r 2483 50 GHz 46 881 dBm Freq Offset 48 881 dBm Freq Offset 48 881 dBm OHz 60 Hz
MSG KATUS	MSG Costatus

Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u> Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,</u> <u>HuangJiang Town, Dongguan, China</u> Tel: <u>0769-83078199</u> Web.: <u>www.hwa-hsing.com</u> E-Mail: <u>customerservice.dg@hwa-hsing.com</u>

GFSK

Hopping Enabled_Low Channel	Hopping Enabled_High Channel
Addent Spectrum And/are: Specific Specific Spectrum And/are: Specific Specific Spectrum And/are: Specific	Aglent System Andror - Smyt 51 92962:N1 SXR2 072 4.1014100 005759/M1 M077,2022 V 1 500000000 GHz 92962:N1 SXR2 072 4.1014100 005759/M1 M077,2022 Center Freq 2.5100000000 GHz Frequency Frequency Frequency PD0: Fast -+- Trig: Free Run #Atten: 20 dB Mkrd 2.514 80 GHz Atten: 20 dB Frequency Rto Offset 369 dB 0.472 Att 2.514 80 GHz Atten: 20 dB Auto Tune
0 delivov ref 15.34 dolin 299 234 206 207 2.3525000 4.134	Control <t< td=""></t<>
507	Freq 642 400 A2 A3 44
50.7 50.7 50.7 70.7 70.7	Freq 600 1 1 2 2 55000000 GHz
Start 2.0000 GHz Stop 2.40500 GHz C #Res BW 100 H/z #VBW 300 kHz Sweep 10.07 ms (1001 pts) 105.000 Mark Mode TRE SQL Sweep 10.07 ms (1001 pts) Auto	Step # 25000 GHz #VBW 300 kHz Step 2,5000 GHz B CF Step 30000 GHz B Stop 2,5000 GHz B CF Step 300000 GHz B Step 3000000 GHZ B Step 300000000000 GHZ B Step 3000000000000000000000000000000000000
2 N 1 f 2400 000 GHz 53 850 dBm Freq 3 N 1 f 2300 00 GHz 63 850 dBm Freq Freq Freq N 1 f 2310 000 GHz 63 260 dBm Freq	I I
MSG STATUS	

8DPSK

Hopping Enabled_Low Channel	Hopping Enabled_Low Channel
Algind System Major: Swg 54 Side Alj Sol Swg 671 Algind Swg 671 Algind Swg 671 Algind Swg 671 Algind Swg 771	Alging Systems Audron - Swyl 34 Space 51 <t< td=""></t<>
100 2000 (Conter Freq 100 2000 (Conter Freq 2.325500000 GHz	100 000 0000 0000 0000 0000 0000 0000
300 300 400 44 5 43 42 23000000 GHz	200 Start Freq 2.47000000 GHz 40.0 A2 A3
500 acrosses	50.0 Max - Local - and company and the control of the co
Start 2.30000 GHz Stop 2.40500 GHz CF Step 10.07 ms (1001 pts) #Res BW 100 kHz #VBW 300 kHz Sweep 10.07 ms (1001 pts) MR MODE TRC SCL X Y RN 100 tr 1 2.30595 GHz 8592 rtm	Start 2.47000 GHz Stop 2.55000 GHz CF Step 8 #Res BW 100 kHz #VBW 300 kHz Sweep 7.667 ms (1001 pts) 8.00000 MHz Mrr Mog TRS SL X Y Runctow worth Runctow worth Auto Man
2 N I F 2400 000 GHz 43 280 dBm Freq Offset 3 N 1 f 2300 00 GHz 550 dBm Freq Offset 4 N 1 f 2300 00 GHz 550 dBm 0 Hz 6 N 1 f 230 00 GHz 61 Sto dBm 0 Hz	2 N 1 f 245350 GHz 50 167 68m 3 N 1 f 2500 00 Hz 50 259 48m 7 1 253496 GHz 47 596 48m 0 Hz 60 17 17 17 17 17 17 17 17 17 17 17 17 17
	7 8 9 9 10 11
MSG GETATUS	

Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u> Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,</u> <u>HuangJiang Town, Dongguan, China</u>

Tel: 0769-83078199 Web.: www.hwa-hsing.com E-Mail: customerservice.dg@hwa-hsing.com



4 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo: 210427EL31-3).

Lab: <u>Hwa-Hsing (Dongguan) Testing Co., Ltd.</u> Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park,</u> <u>HuangJiang Town, Dongguan, China</u> Tel: <u>0769-83078199</u> Web.: <u>www.hwa-hsing.com</u> E-Mail: <u>customerservice.dg@hwa-hsing.com</u>



5 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Due Date of Calibration
Spectrum Keysight	N9020A	MY51240612	2022/09/12
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2022/09/12
Power Meter 10Hz~18GHz Tonscend	JS0806-2	188060126	2022/09/12
Signal generator Keysight	E4421B	GB40051020	2022/09/12
Signal generator Keysight	N5182A	MY47420944	2022/09/12
Test Software Tonscend	JS0806-2	NA	NA
Hygrothermograph Yuhuaze	HTC-1	NA	2022/09/12

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.

2. The test was performed in Chamber 1.



Appendix – Information on the Testing Laboratories

We, <u>Hwa-Hsing (Dongguan) Co., Ltd.</u>, A global provider of TESTING and CERTIFICATION services for consumer products, electronic products and wireless information technology products. Adhering to the core values "HONEST and TRUSTWORTHY, OBJECTIVE and IMPARTIALITY, RIGOROUS and AFFICIENT", commitment to provide professional, perfect and efficient comprehensive ONE-STOP solution of TESTING and CERTIFICATION services for Manufacturers, Buyers, Traders, Brands, Retailers. Assist client to better manage risk, protect their brands, reduce costs and cut time to over 150 markets in global. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Lab Address: <u>No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park, HuangJiang Town, Dongguan, China</u> Contact Tel: <u>0769-83078199</u> Email: <u>Customerservice.dg@hwa-hsing.com</u> Web Site: <u>www.hwa-hsing.com</u>

The address and road map of all our labs can be found in our web site also.

--- END ---