

# 6.9. Conducted Band Edge Measurement

## 6.9.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB 558074 D01 v05r02
Limit:	In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.
Test Setup:	Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol> <li>Set to the maximum power setting and enable the EUT transmit continuously.</li> <li>Set RBW = 100 kHz (≥1% span=10MHz), VBW = 300 kHz (≥RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.</li> <li>Enable hopping function of the EUT and then repeat step 2 and 3.</li> <li>Measure and record the results in the test report.</li> </ol>
Test Result:	PASS

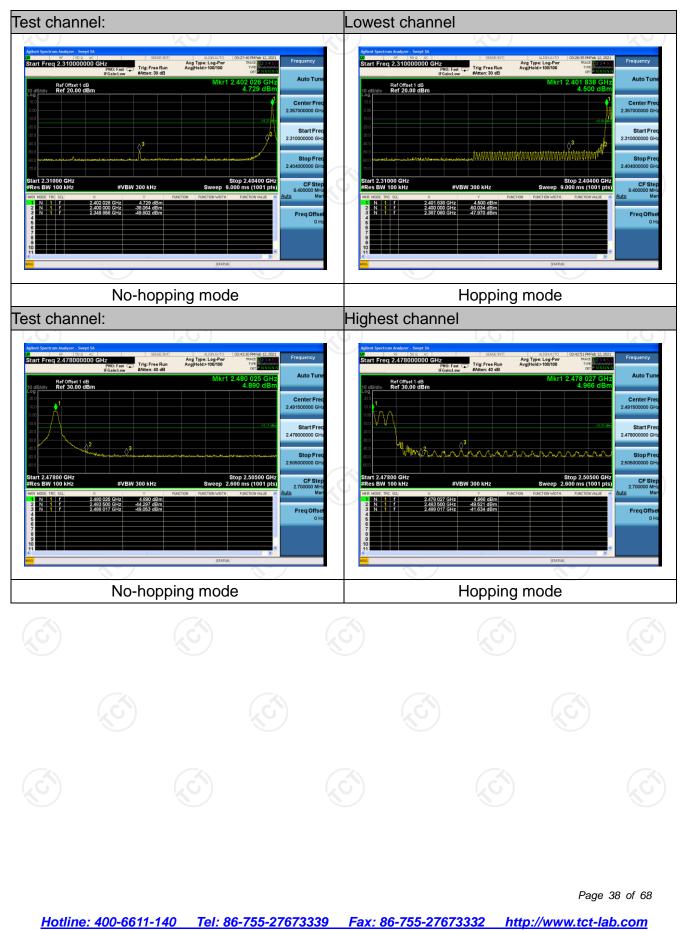
## 6.9.2. Test Instruments

Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Sep. 11, 2021
RF Cable (9KHz-26.5GHz)	тст	RE-06	N/A	Sep. 11, 2021
Antenna Connector	тст	RFC-01	N/A	Sep. 11, 2021

**Note:** The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

## 6.9.3. Test Data

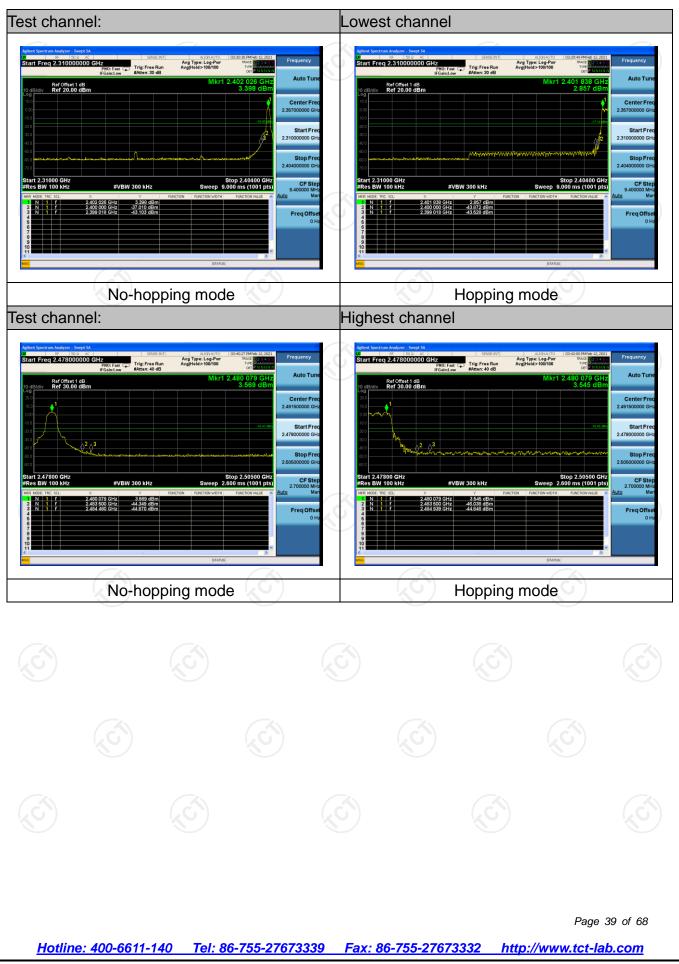
**GFSK Modulation** 



Report No.: TCT210204E015



### **Pi/4DQPSK Modulation**



### TCT通测检测 TESTING CENTRE TECHNOLOGY **8DPSK Modulation** Lowest channel Test channel: Adlent Spectrum Autors 200 Ac Start Freq 2.310000000 GHz Freducting Freduct Aug Type: Log-Pwr Avg Hold>100/100 Avg Type: Log-Pwi Avg[Hold>100/100 Auto Tu Auto Tu Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center Fi Center Start Fr Start Fr Stop F Stop 2.40400 GH Sweep 9.000 ms (1001 pts Start 2.31000 GHz #Res BW 100 kHz Start 2.31000 GHz #Res BW 100 kHz Stop 2.40400 GH2 eep 9.000 ms (1001 pts #VBW 300 kHz CF St CF St #VBW 300 kHz Sw 2.402 120 GHz 3.348 dBm 2.400 000 GHz -36.795 dBm 2.399 018 GHz -43.472 dBm 2.403 154 GHz 3.347 dBm 2.400 000 GHz -37.821 dBm 2.399 018 GHz -43.167 dBm Freq Offs Freq Offs No-hopping mode Hopping mode Highest channel Test channel: RF 50 @ AC tart Freq 2.478000000 GHz RF 50 Q AC Start Freq 2.478000000 GHz Aug Type: Log-Pwr Avg Hold>100/100 : Fast Trig: Free Run #Atten: 30 dB Avg Type: Log-Pwr Avg[Hold>100/100 Fast Trig: Free Run #Atten: 30 dB Auto Tu Ref Offset 1 dB Ref 20.00 dBm Ref Offset 1 dB Ref 20.00 dBm Center F Center F Start Fr Start Fr 2<sup>2</sup> ^3 Stop Fr CF Ste 2.700000 art 2.47800 GHz Stop 2.50500 GH Start 2.47800 GHz Res BW 100 kHz CF St #VBW 300 kHz 2.70 2.479 134 GHz 3.701 dBm 2.483 500 GHz -47,259 dBm 2.497 116 GHz -44,245 dBm 2.480 133 GHz 3.658 dBm 2.483 500 GHz -45.510 dBm 2.484 480 GHz -49.772 dBm N 1 F N 1 F Freq Offs Freq Off Hopping mode No-hopping mode Page 40 of 68

Report No.: TCT210204E015



## 6.10. Conducted Spurious Emission Measurement

## 6.10.1. Test Specification

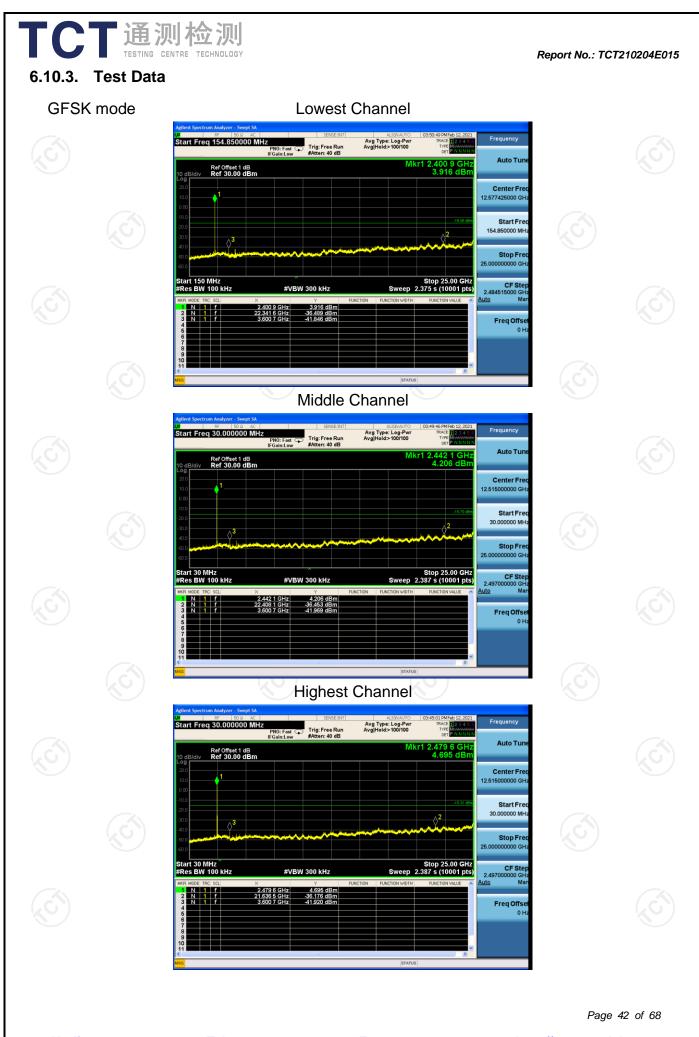
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB 558074 D01 v05r02
Limit:	In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.
Test Setup:	Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol> <li>The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.</li> <li>Set to the maximum power setting and enable the EUT transmit continuously.</li> <li>Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.</li> <li>Measure and record the results in the test report.</li> <li>The RF fundamental frequency should be excluded against the limit line in the operating frequency band.</li> </ol>
Test Result:	PASS

## 6.10.2. Test Instruments

Equipment	Manufacturer	Model	Serial Number	Calibration Due		
Spectrum Analyzer	Agilent	N9020A	MY49100619	Sep. 11, 2021		
Spectrum Analyzer	ROHDE&SCH WARZ	FSQ40	200061	Sep. 11, 2021		
RF Cable (9KHz-26.5GHz)	тст	RE-06	<b>N/A</b>	Sep. 11, 2021		
Antenna Connector	ТСТ	RFC-01	N/A	Sep. 11, 2021		

**Note:** The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

Page 41 of 68



TCT通测检测 TESTING CENTRE TECHNOLOGY	Report No.: TCT210204E015
Pi/4DQPSK mode Lowest Channel	equency   Auto Ture   Start Free   JStop Free   OOD   CF Step   Mart   Freq Offser   OHD   Stop Free   COUDDO GHD   Stop Free   Stop Free   COUDDO GHD   Stop Free   COUDDO GHD   Stop Free   Stop Free   ODDOO GHD   Stop Free   OHD   Stop Free   Stop Free   OHD   Stop Free
Ref Offset 1 dB         Wini 2 2.403 3 GH2           10 gBidity         Ref 30.00 dBm         2.847 dBm           20         2         2         100           100         2         2         100           100         2         100         2         100           100         2         100         100         100         100           100         2         100 <th></th>	
x00         x00 <th></th>	
Middle Channel	
Ref Offset 1 dB         Wirt 1 2:439 8 GHz           100         2.095 dBm           200         1           100         1	
#Res BW 100 kHz     #VBW 300 kHz     Sweep 2.387 \$ (10001 pts)       Men Mode Thrc SqL     X     Y     Function     Function <th></th>	
Examination of the second o	
Image         Image <th< th=""><th></th></th<>	
	Page 43 of 68
<u>Hotline: 400-6611-140 Tel: 86-755-27673339 Fax: 86-755-27673332 htt</u>	p://www.tct-lab.com

	<b>リ检测</b> ENTRE TECHNOLOGY	Report No.: TCT210204E015
8DPSK mode	Lowest Channel	_
	Aglent Spectrum Analyzer - Swept SA           Start Freq 154.850000 MHz         Frequency           Trig: Free Run Brain: 40 dB         Auto Tur Avg Hold>100/100         Trig: Free Run Brain: 40 dB           Ref. Offset 1 dB         MIKIT 2.400 9 GHz	ne
	Ref Offset 1 dB         Wiki 1 2:400 9 GH2           1 o dB/div         Ref 30.00 dBm         2.693 dBm           200         1         1         1           100         1         1         1         1           000         1	
	100 200 300 400 400 400 400 400 400 4	
	600         25.00000000 G           Start 150 MHz         Stop 25.00 GHz           #Res BW 100 kHz         #VBW 300 kHz         Sweep 2.375 s (1001 pts)           MRR MORE TRC ISCI         X         Y         Function         Function worth	⊧p +z
	1         N         1         f         2.400.9 GHz         2.693.dBm           2         N         1         f         21.089.5 GHz         36.292.dBm           3         N         1         f         21.089.5 GHz         36.292.dBm           4         5         5         6         6         01           5         6         6         6         01           7         8         8         9	et
	Middle Channel	
	Aglent Spectrum Analyzer - Swept SA         ENCESNT         ALEXAND 0         0347/19 PMFeb 12, 2021         Frequency           Start Freq 30,00000 MHz         Trig: Free Run IFGaintor 40 dB         Trig: Free Run Avg]Hold>1000000         Trig: Free Run Avg]Hold>1000000         Trig: Free Run Reserved         Trig: Free Run Avg]Hold>1000000         Trig: Free Run Reserved         <	
(C)	Ref Offset 1 dB         Mkr1 2.442 1 GHz         Auto Tur           10 dB/div         Ref 30.00 dBm         3.357 dBm         Center Fr           200         1         12515000000 G         12515000000 G	42
(C)	300         31         32         33         34         35         36         3	
(C)	Start 30 MHz         Stop 25.00 GHz         CF Stop 25.00 GHz           #Res BW 100 kHz         #VBW 300 kHz         Sweep 2.387 s (10001 pts)         2.497000005 MI           MRI MOC TRC SL         X         Y         Function         Function width         Function width         Function width         Function width         Auto         Auto         Mit         Freq Offs         0           1         1         f         2.1097 GHz         -35.70 dBm	e
	Highest Channel	
	Op         SF         SO 0         AC         SEREENT         AUSPLATO         003-06/37 WHR 12 2021           Start Freq 30.000000 MHz         PN0: Fast C         Trig: Free Run #Gaint.low         Avg Hold > 100/100         Trig: Free Run #Atten: 40 dB         Avg Hold > 100/100         Trig: Free Run Kei Data at the series of the s	ne
(C)	10 dB/div Ref 30.00 dBm 2.753 dBm 2.753 dBm 1251500000 G	42
	30         30.000000 M           40         2           50         30.000000 M           50         50	
	WER MOT TO KHZ         WEW JOU KHZ         Sweep         2.38*S (1000 Fpc)         2.49700000 G           MER MOT FICS CL         X         Y         PUNCTON         PUNCTON WIDTH	et
		-
		Page 44 of 68
<u>Hotline: 400-6611-1</u>	140 Tel: 86-755-27673339 Fax: 86-755-27673332 h	<u>ttp://www.tct-lab.com</u>

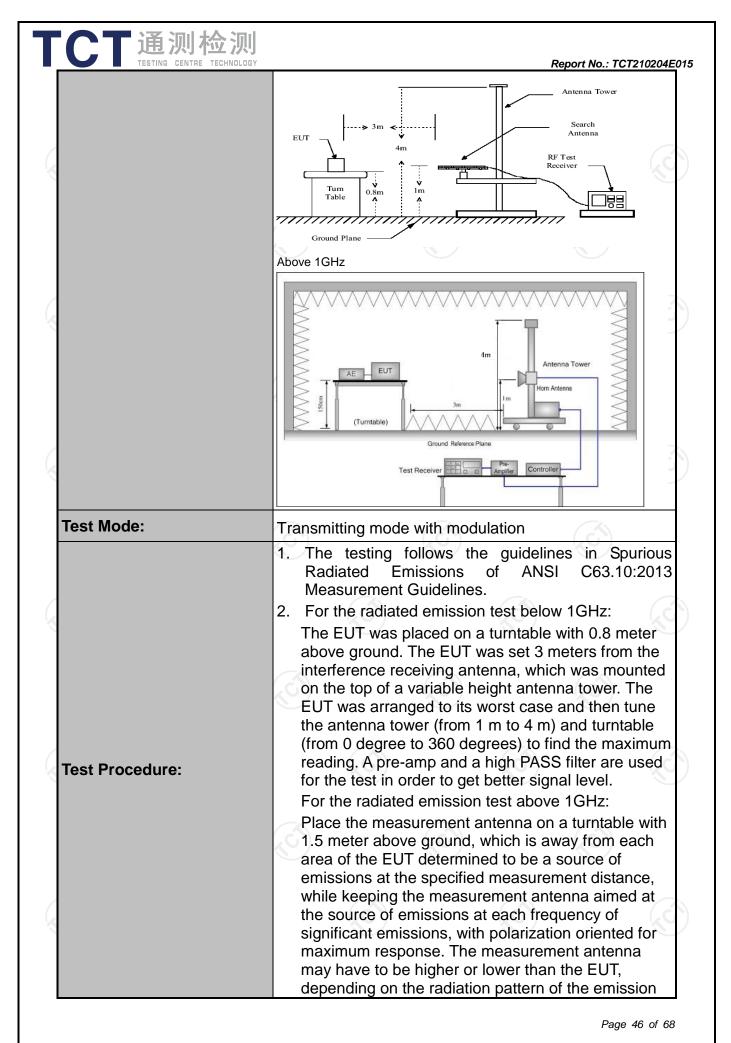


# 6.11. Radiated Spurious Emission Measurement

## 6.11.1. Test Specification

TCT通测检测 TESTING CENTRE TECHNOLOGY

Test Requirement:	FCC Part15 C Section 15.209         ANSI C63.10:2013         9 kHz to 25 GHz										
Test Method:	ANSI C63.10	):2013									
Frequency Range:	9 kHz to 25 (	GHz	3		G	6					
Measurement Distance:	3 m	X	9		K	)					
Antenna Polarization:	Horizontal &	Horizontal & Vertical									
	Frequency	Detector	RBW	VBW	Remark						
	9kHz- 150kHz	Quasi-peal	< 200Hz	1kHz	Quas	si-peak Value					
Receiver Setup:	150kHz- 30MHz	Quasi-peal	k 9kHz	30kHz	Quas	si-peak Value					
-	30MHz-1GHz	Quasi-peal	K 120KHz	300KHz	Quas	si-peak Value					
	Above 1GHz	Peak	1MHz	3MHz	Р	eak Value					
	Above ronz	Peak	1MHz	10Hz	Ave	erage Value					
	Frequer	ю	Field Str (microvolts			asurement nce (meters)					
	0.009-0.4	490	2400/F(			300					
	0.490-1.7	705	24000/F			30					
	1.705-3		30			30					
	30-88	1	100			3					
Limite	88-216		150			3					
Limit:	216-96 Above 9		200 500			3					
	Frequency Above 1GH:	(micro	Field Strength (microvolts/meter) 500 5000		nce Detector rs) Average Peak						
Test setup:	For radiated emis	stance = 3m			Compu Amplifier Receiver						
			(	Ś							
						Page 45 of 0					



	measurement an maximizes the en antenna elevatio restricted to a ran above the ground 3. Set to the maxin EUT transmit co 4. Use the followin (1) Span shall w emission be (2) Set RBW=1 for f>1GHz ; Sweep = an = max hold (3) For average correction f	<ul> <li>and staying aimed at the emission source receiving the maximum signal. The final measurement antenna elevation shall be maximizes the emissions. The measurem antenna elevation for maximum emission restricted to a range of heights of from 1 mabove the ground or reference ground pla</li> <li>3. Set to the maximum power setting and EUT transmit continuously.</li> <li>4. Use the following spectrum analyzer settine (1) Span shall wide enough to fully capter emission being measured;</li> <li>(2) Set RBW=120 kHz for f &lt; 1 GHz, RE for f&gt;1GHz; VBW≥RBW; Sweep = auto; Detector function = p = max hold for peak</li> <li>(3) For average measurement: use dut correction factor method per 15.35(c). Duty cycle = On time/100 m On time =N1*L1+N2*L2++Nn-1*LN Where N1 is number of type 1 pulse length of type 1 pulses, etc. Average Emission Level = Peak Em Level + 20*log(Duty cycle)</li> <li>Corrected Reading: Antenna Factor</li> </ul>					
	On time =N Where N1 length of ty Average En Level + 20 Corrected R	is number of type 1 pulse pe 1 pulses, etc. mission Level = Peak Em 'log(Duty cycle) eading: Antenna Factor	es, L1 is nission + Cable				
Test results:	On time =N Where N1 length of ty Average En Level + 20 Corrected R	is number of type 1 pulse pe 1 pulses, etc. mission Level = Peak Em flog(Duty cycle)	es, L1 is nission + Cable				
Test results:	On time =N Where N1 length of ty Average En Level + 20 <sup>3</sup> Corrected R Loss + Read	is number of type 1 pulse pe 1 pulses, etc. mission Level = Peak Em 'log(Duty cycle) eading: Antenna Factor	es, L1 is nission + Cable				
Test results:	On time =N Where N1 length of ty Average En Level + 20 <sup>3</sup> Corrected R Loss + Read	is number of type 1 pulse pe 1 pulses, etc. mission Level = Peak Em 'log(Duty cycle) eading: Antenna Factor	es, L1 is hission + Cable				
Test results:	On time =N Where N1 length of ty Average En Level + 20 <sup>3</sup> Corrected R Loss + Read	is number of type 1 pulse pe 1 pulses, etc. mission Level = Peak Em 'log(Duty cycle) eading: Antenna Factor	es, L1 is hission + Cable				



## 6.11.2. Test Instruments

	Radiated Em	ission Test Site	e (966)			
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due		
Test Receiver	ROHDE&SCHW ARZ	ESIB7	100197	Jul. 27, 2021		
Spectrum Analyzer	ROHDE&SCHW ARZ	FSQ40	200061	Sep. 11, 2021		
Pre-amplifier	EM Electronics Corporation CO.,LTD	EM30265	07032613	Sep. 02, 2021		
Pre-amplifier	HP	8447D	2727A05017	Sep. 02, 2021		
Loop antenna	ZHINAN	ZN30900A	12024	Sep. 05, 2022		
Broadband Antenna	Schwarzbeck	VULB9163	340	Sep. 04, 2022		
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Sep. 04, 2022		
Horn Antenna	A-INFO	LB-180400-KF	J211020657	Sep. 04, 2022		
Antenna Mast	Keleto	RE-AM	N/A	N/A		
Line-4	RE-high-04	тст	N/A	Sep. 02, 2021		
Line-8	RE-01	тст	N/A	Jul. 27, 2021		
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A		

**Note:** The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

Page 48 of 68

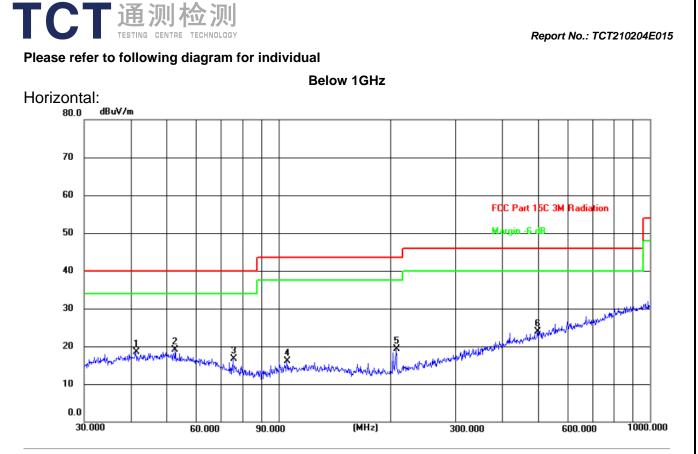
#### 6.11.3. Test Data

#### Duty cycle correction factor for average measurement 3-DH5 on time (One Pulse) Plot on Channel 00 Frequer Center Freq 2.40200 Avg Type: Log-Pwr 000 GH Trig: Free Run 0: Fast Auto Tu Ref Offset 1 dB Ref 20.00 dBm Center Fre 2,40200000 G Start Fre 2.402000000 G Stop Fr X 2.402000000 G er 2.402000000 GHz BW 1.0 MHz Span 0 Hz s (1001 pts) CF Ste #VBW 1.0 MHz Sweep 4.000 m 1.00 2.976 ms (Δ) 532.0 μs 1.65 dB -60.24 dBm Frea Offs 3-DH5 on time (Count Pulses) Plot on Channel 00 Avg Type: Log-Pw Center Freg 2,402000000 GHz Trig: Free Run #Atten: 30 dB Auto Tu Ref Offset 1 dB Ref 20.00 dBn Center Fr 2 40200000 GI Start Fr 2.402000000 G Stop Fre 2.402000000 G CF Ste 1.000000 Center 2.402000 Res BW 1.0 MHz Span 0 Hz Sweep 100.0 ms (1001 pts #VBW 1.0 MHz 2.300 ms 97.70 ms -0.38 df 6.11 dBr Freq Offs

### Note:

- 1. Worst case Duty cycle = on time/100 milliseconds = (2.976\*27+2.300)/100=0.8265
- 2. Worst case Duty cycle correction factor = 20\*log (Duty cycle) = -1.65dB
- 3. 3-DH5 has the highest duty cycle worst case and is reported.
- 4. The average levels were calculated from the peak level corrected with duty cycle correction factor (-1.65dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

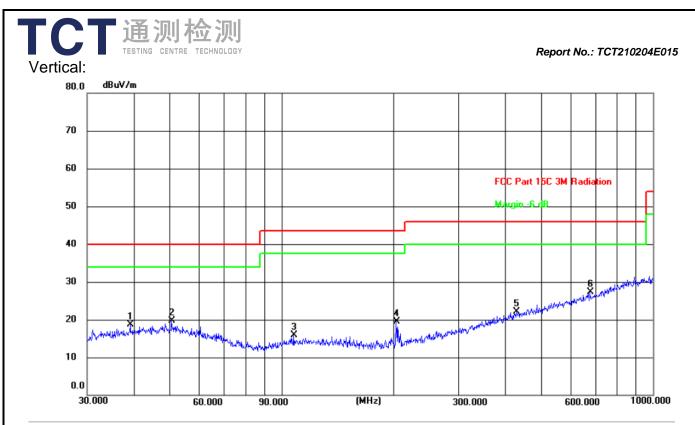
Report No.: TCT210204E015



Site			P	olarization: 🗜	lorizontal	Temp	erature: 2	5(C)
Limit: FC	CC Part 15C 3M Ra	diation	P	ower: AC120	)/60Hz	Humi	dity: 55 %	
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	41.2765	4.80	13.77	18.57	40.00	-21.43	peak	Ρ
2 *	52.7600	5.69	13.35	19.04	40.00	-20.96	peak	Ρ
3	75.4464	6.80	9.84	16.64	40.00	-23.36	peak	P
4	105.2718	5.59	10.43	16.02	43.50	-27.48	peak	Ρ
5	207.1226	9.25	10.13	19.38	43.50	-24.12	peak	Ρ
6	497.6765	5.49	18.43	23.92	46.00	-22.08	peak	Ρ

Page 50 of 68

Hotline: 400-6611-140 Tel: 86-755-27673339 Fax: 86-755-27673332 http://www.tct-lab.com



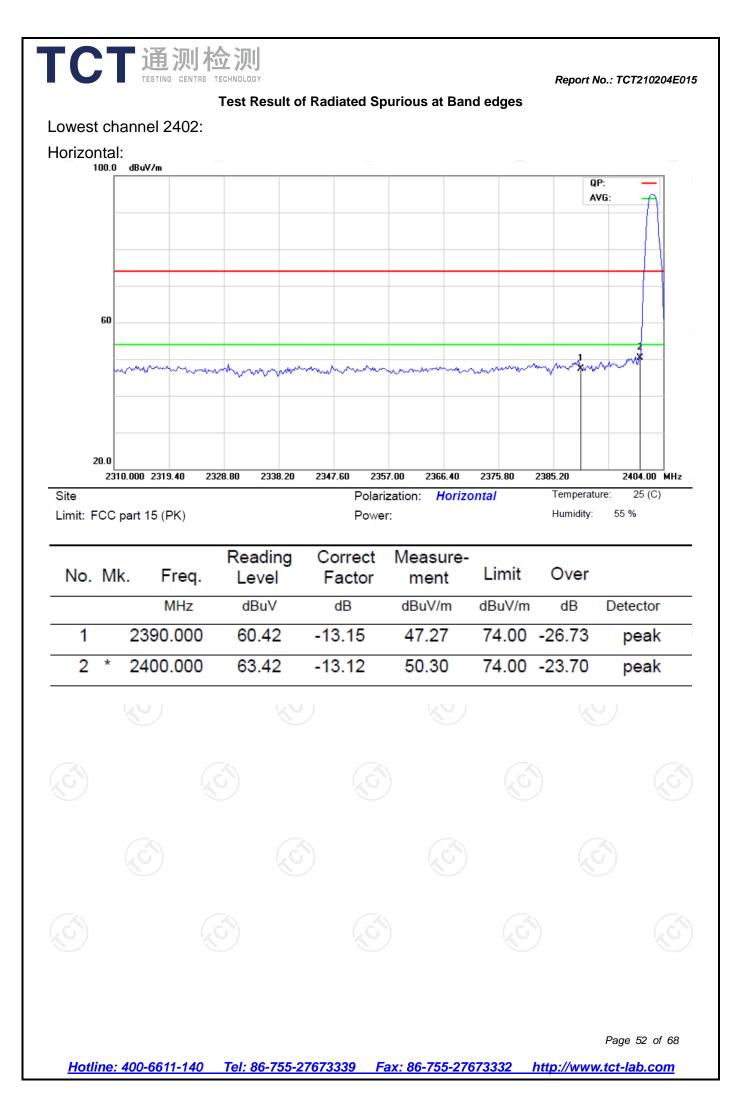
Site			P	olarization: N	/ertical	Temp	erature: 2	25(C)
Limit: FCC Part 15C 3M Radiation			P	ower: AC120	Humidity: 55 %			
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	39.1616	4.95	13.67	18.62	40.00	-21.38	peak	Р
2	50.5860	6.12	13.49	19.61	40.00	-20.39	peak	Р
3	107.8877	5.28	10.63	15.91	43.50	-27.59	peak	Р
4	203.5228	9.60	9.92	19.52	43.50	-23.98	peak	Р
5	429.5228	5.09	17.00	22.09	46.00	-23.91	peak	Р
6 *	677.5798	5.96	21.29	27.25	46.00	-18.75	peak	Р
	· · · · ·		- /		- /		- /	

**Note:** 1. The low frequency, which started from 9KHz~30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported

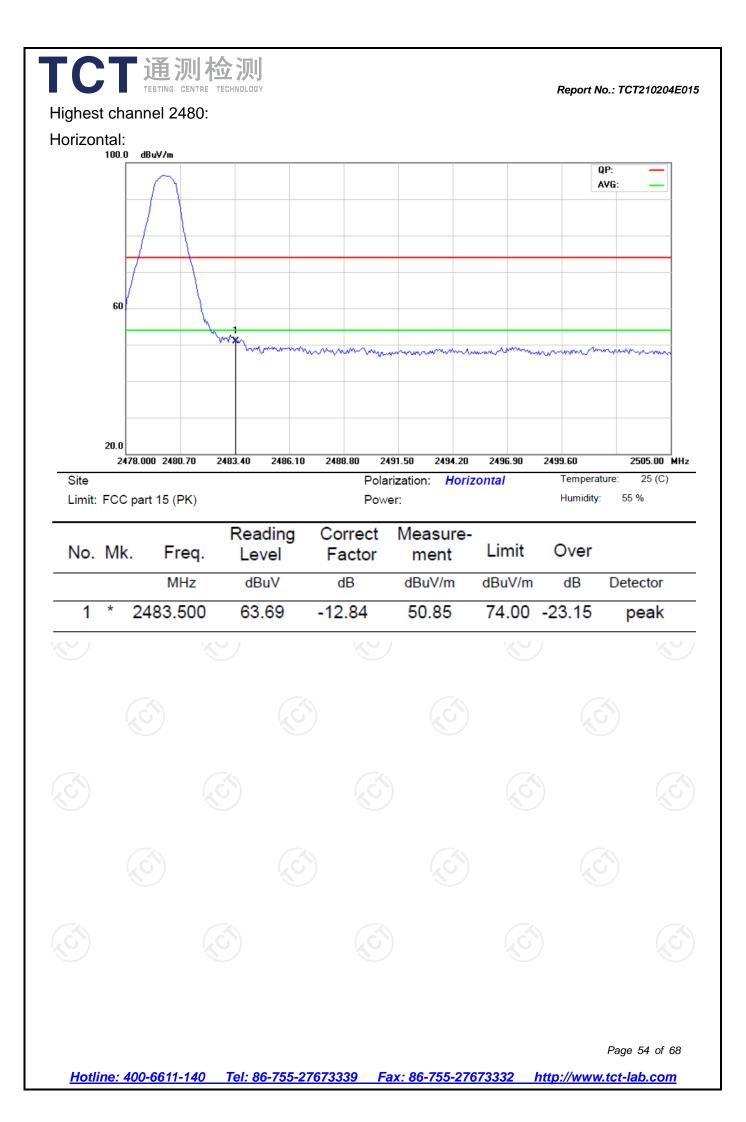
2. Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK, 8DPSK) and the worst case Mode (middle channel and 8DPSK) was submitted only.

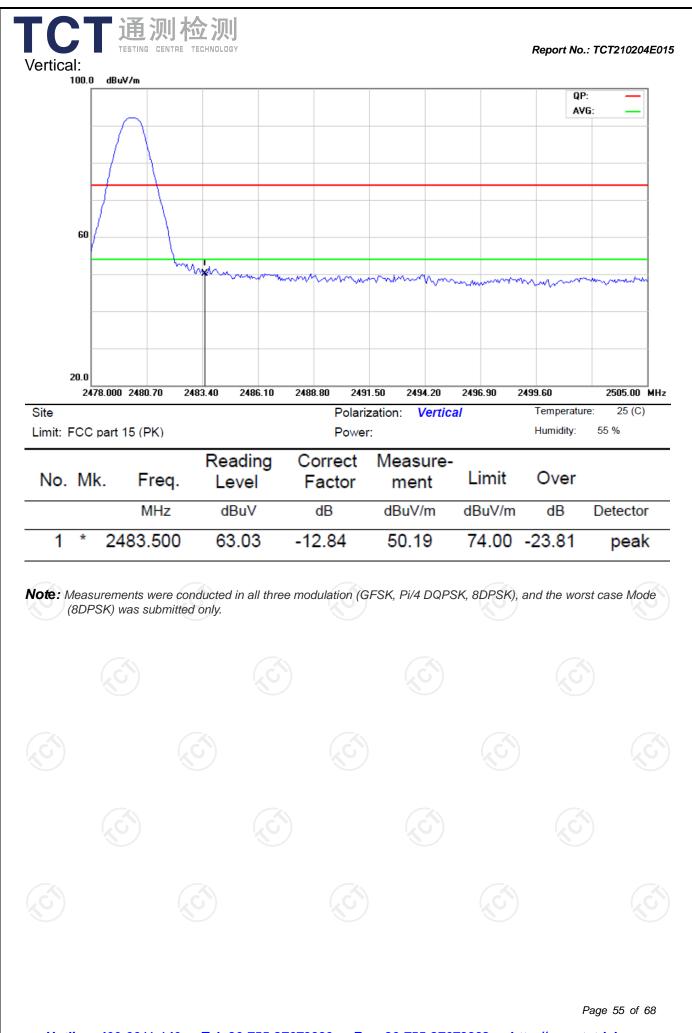
3. Freq. = Emission frequency in MHz Measurement (dBμV/m) = Reading level (dBμV) + Corr. Factor (dB) Correction Factor= Antenna Factor + Cable loss – Pre-amplifier Limit (dBμV/m) = Limit stated in standard Margin (dB) = Measurement (dBμV/m) – Limits (dBμV/m) Any value more than 10dB below limit have not been specifically reported
\* is meaning the worst frequency has been tested in the test frequency range

Page 51 of 68



	100.0	) dBuV/m											QP: AVG	: -	
													ATG		
	60														
													1	3	
		man	when	mmm	series and the second	man	mm	mm	mm	mm	mm	www	njum	n worn	
	20.0 23	10.000 2319	.40	2328.80	2338.20	2347	.60 23	57.00	2366.40	2375	.80	2385.20	)	2404.0	
Site Limit:	FCC	part 15 (P	PK)				Pola Powe	rization: er:	Vert	ical			nperature midity:	:: 25 ( 55 %	C)
			,	Read	ding	Со	rrect		sure	-			-		
No.	M	k. Fr	eq.	Lev			ctor		ent	Lin	nit	0\	/er		
			Hz	dBu			В		V/m		V/m			Detecto	
1		2390.0		62.		-13			.89			-25.		peak	
2	*	2400.0	000	64.	31	-13	.12	51	.19	74	.00	-22.	81	pea	k





### Above 1GHz

Modulation Type: 8DPSK										
Low channel: 2402 MHz										
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBµV)	AV reading (dBuV)	Correction Factor (dB/m)	Peak	n Level AV (dBµV/m)	Peak limit (dBµV/m)	AV limit (dBµV/m)	Margin (dB)	
4804	Н	42.89		0.66	43.55		74	54	-10.45	
7206	Н	34.67		9.5	44.17		74	54	-9.83	
	Н					~~				
	<b>(()</b>		J_			·C`)		$(\mathcal{O})$		
4804	V	41.98		0.66	42.64		74	54	-11.36	
7206	V	34.86		9.5	44.36		74	54	-9.64	
	V									

Middle channel: 2441 MHz							KO)		KC KC
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBµV)	AV reading (dBµV)	Correction Factor (dB/m)	Emissic Peak (dBµV/m)	AV	Peak limit (dBµV/m)		Margin (dB)
4882	Н	45.31		0.99	46.30	·	74	54	-7.70
7323	ζ <sup>O</sup> Ĥ	37.27	1,0	9.87	47.14		74	54	-6.86
	H								
4882	V	45.14		0.99	46.13		74	54	-7.87
7323	V	36.75		9.87	46.62		74	54	-7.38
	V			V	)				

### High channel: 2480 MHz

**CT**通测检测 TESTING CENTRE TECHNOLOGY

Frequency	Ant Pol	Peak	AV	Correction	Emission Level		Peak limit	AV/ limit	Margin
(MHz)	H/V	reading	reading	Factor (dB/m)	Peak	AV	(dBµV/m)	(dBµV/m)	(dB)
		(dBµV)	(dBµV)	(ub/III)	(aph v/m)	(dBµV/m)	,	,	
4960	Н	44.72		1.33	46.05		74	54	-7.95
7440	Н	34.94		10.22	45.16		74	54	-8.84
	Н								
G)		(G)			5		(.G)		(.C
4960	V	46.38		1.33 🔪	47.71		74	54	-6.29
7440	V	34.41		10.22	44.63		74	54	-9.37
	V								

### Note:

1. Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss - Pre-amplifier

2. Margin (dB) = Emission Level (Peak) (dB $\mu$ V/m)-Average limit (dB $\mu$ V/m)

3. The emission levels of other frequencies are very lower than the limit and not show in test report.

4. Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency.

5. Data of measurement shown "----"in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.

6. Measurements were conducted in all three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (8DPSK) was submitted only.

7. All the restriction bands are compliance with the limit of 15.209.

Page 56 of 68



