



#### Antenna4





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Edition: A.5

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No.: BCTC/RF-EMC-007





🊺 Ag	jilent S	Spectri	ım An	alyzer - Sw	ept SA					,		<u> </u>	<u> </u>			
l <b>xi</b> R	L		RF	50	Ω AC			SEN	SE:INT		ALIGN A	UTO	07:44:43	PM Apr 21, 20	23	Peak Search
Mar	ker	19	27.	25000	00000	MIHZ PNO IFGai	:Fast 🖵 in:Low	Trig: Line Atten: 40	dB	#Avg Avg	Hold:>100/1	00	TY D	PE M WAAAA ET P N N N I	6 ₩¥ NN	r cuit coulon
10 d	B/div	v	Ref Ref	Offset 0 30.00	.5 dB dBm							Mkr′	1 927.2 26.3	250 MH 44 dBr	z	NextPeak
Log 20.0 10.0 0.00		1												6.34 ct	377	Next Pk Right
-10.0 -20.0 -30.0																Next Pk Left
-40.0 -50.0 -60.0		Ŵ,	trans <del>ia</del>	daartyg <sup>en</sup> e faarly	mallen.e	hand the second second	Marin Infrancia	N/Mark-f-all/Mathe	ant a baile faith	ild-on <sup>a</sup> llead	herden and the second	arhavalli	n falan mananan	gegenteral person of the		Marker Delta
Star #Re	rt 92 s B	25.0 W 1	O M OO I	Hz kHz	X		#VBW	300 kHz	FUN	ICTION	Swee	р 7.2 иртн	Stop 1.0 200 ms (	0000 GH 1001 pt	z s)	Mkr→CF
1 2 3 4 5 6	N N N	1 1	f f f		9 9 9	27.250   28.000   28.675	MHz MHz MHz	26.344 dE -43.694 dB -42.862 dB	im m m						E	Mkr→RefLvl
7 8 9 10 11														4	•	More 1 of 2
MSG											s	TATUS				

#### ASK Transmitting Band edge-right side

ASK Hopping Band edge-right side







## 10. Occupy Bandwidth

## 10.1 Block Diagram Of Test Setup



## 10.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: The maximum allowed 20 dB bandwidth of the hopping channel is 250 kHz

## 10.3 Test procedure

1. 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.

2. Set to the maximum power setting and enable the EUT transmit continuously.

3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.

Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel; 1%≤RBW≤5% of the 20 dB bandwidth; VBW≥3RBW;

Sweep = auto; Detector function = peak; Trace = max hold.

4. Measure and record the results in the test report.

## 10.4 Test Result

Test chang	a al		ASK	
lest chanr	101	20dB(kHz)	Limit(kHz)	Conclusion
Lowest		72.63	≪250	PASS
Middlest	Antenna1	69.90	≤250	PASS
Highest	1999. 	72.69	≪250	PASS
Lowest		72.68	≤250	PASS
Middlest	Antenna2	69.56	≤250	PASS
Highest	***************************************	72.47	≤250	PASS
Lowest		72.32	≤250	PASS
Middlest	Antenna3	68.65	≤250	PASS
Highest		72.63	≤250	PASS
Lowest		72.73	≪250	PASS
Middlest	Antenna4	67.75	≤250	PASS
Highest	·***	69.55	≦250	PASS



Antenna1

## Report No.: BCTC2304311328E

#### Lowest channel SENSE:INT ALIGN AUTO Center Freq: 902.750000 MHz Trig: Free Run Avg|Hold:>10/10 #Atten: 40 dB 07:00:47 PM Apr 21, 2023 Radio Std: None Trace/Detecto x dB -20.00 dB #IFGain:Low Radio Device: BTS Ref Offset 0.5 dB Ref 30.00 dBm I0 dE **Clear Write** MM 1 loor Average l. ~V~vj Max Hold Min Hold Span 200 kHz Sweep 61.6 ms Center 902.8 MHz #Res BW 2 kHz #VBW 6.2 kHz Detector Average ► Man **Occupied Bandwidth** Auto 71.188 kHz 132 Hz **Transmit Freq Error OBW Power** 99.00 % 72.63 kHz -20.00 dB x dB Bandwidth x dB

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#### Antenna2

#### Lowest channel





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🎉 Agilent Spectru	ım Analyzer - Occupi	ed BW							_	
Center Fre	RF 50 Ω cq 914.7500	AC 00 MHz		SENSE:INT Senter Freq: 914.750	000 MHz	ALIGN AUTO	Radio Std	M Apr 21, 2023 None	Trac	e/Detector
		#IFGair	n:Low 🔭 #	Atten: 40 dB	Argino	u 10/10	Radio Dev	ice: BTS		
10 dB/div	Ref Offset 0. Ref 30.00	5 dB dBm								
20.0 10.0			www.	www.hannym	M					Clear Write
0.00	m Annan	mm				and warded	www.	here a		Average
-30.0 -40.0								- Maril		Max Hold
-50.0										Min Hold
Center 914 #Res BW 2	.8 MHz kHz			#VBW 6.2 kl	lz		Spai Sweep	n 200 kHz 61.6 ms		WIITHOIC
Occupi	ed Bandw	vidth							Auto	Detector Average ▶ Man
		03.42	Э КП2	-						
Transmi	it Freq Erro	r	-71 Hz	Z OBW P	ower	99	.00 %			
x dB Ba	ndwidth	6	9.56 kHz	x dB		-20.	00 dB			
MSG						STATUS				

#### Middlest channel

#### Highest channel





#### Antenna3



#### Middlest channel



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#### Antenna4

#### Lowest channel



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				Middl	est ch	annel				
🎉 Agilent Spectr	um Analyzer - Occu	ipied BW							_	
Center Fro	RF 50 Ω eq 914.750	AC 1000 MHz #IFC	Gain:Low	SENSE:INT Center Freq: 914.7 Trig: Free Run #Atten: 40 dB	50000 MHz Avg Ho	ALIGN AUTO	07:50:50 Radio Std: Radio Dev	M Apr 21, 2023 None	Trac	e/Detector
10 dB/div	Ref Offset Ref 30.00	0.5 dB 0 <b>dBm</b>								
20.0 10.0			ANN AN	mun	WWW					Clear Write
-10.0	MAN	Maria	₩ <sup>7</sup>			har har	why	Mr. Mr.		Average
-30.0 + (1991 *** -40.0								- "Myray		Max Hold
-60.0	4.8 MHz						Spai	1 200 kHz		Min Hold
#Res BW	ied Band	width 68.5	592 kH	#VBW 6.2	KHZ		Sweep	61.6 ms	<u>Auto</u>	Detector Average ► Man
Transm x dB Ba	it Freq Err Indwidth	or	-140 H 67.75 kH	lz OBW lz x dB	Power	99 -20.	0.00 % 00 dB			
MSG						STATUS	5			

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#### Highest channel







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## 11. Conducted Output Power

## 11.1 Block Diagram Of Test Setup



## 11.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

## 11.3 Test procedure

Use the following spectrum analyzer settings: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.

		ASK		
Test cha	innel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest		26.469	30.00	PASS
Middlest	Antenna1	26.439	30.00	PASS
Highest		26.439	30.00	PASS
Lowest		26.654	30.00	PASS
Middlest	Antenna2	26.503	30.00	PASS
Highest		26.482	30.00	PASS
Lowest		26.680	30.00	PASS
Middlest	Antenna3	26.634	30.00	PASS
Highest		26.699	30.00	PASS
Lowest		26.532	30.00	PASS
Middlest	Antenna4	26.446	30.00	PASS
Highest		26.465	30.00	PASS

### 11.4 Test Result

Note : The module does not support the MIMO mode





#### Antenna1

Lowest channel #Avg Type: RMS Avg|Hold:>100/100 Peak Search Marker 1 902.640000000 MHz PNO: Fast IFGain:Low Trig: Free Run Atten: 40 dB Next Peak Mkr1 902.64 MHz 26.469 dBm Ref Offset 0.5 dB Ref 30.00 dBm 0 dB/div Next Pk Right Next Pk Left Marker Delta Mkr→CF Mkr→RefLvl More 1 of 2 Center 902.750 MHz #Res BW 3.0 MHz Span 10.00 MHz Sweep 1.000 ms (1001 pts) #VBW 3.0 MHz

#### Middlest channel





	Highe	est channel	
📁 Agilent Spectrum Analyzer - Swept SA			- 6 -
Marker 1 927.060000000 Μ	IHZ PNO: Fast IFGain:Low Atten: 40 dB	ALIGN AUTO 06:55:20 PM A #Avg Type: RMS TRACE Avg Hold:>100/100 Type Det	pr21, 2023 2 3 4 5 6 WWWWW NNNNN
Ref Offset 0.5 dB 10 dB/div Ref 30.00 dBm		Mkr1 927.00 26.439	MHz NextPeak
20.0			Next Pk Right
0.00			Next Pk Left
-10.0			Marker Delta
-30.0			Mkr→CF
-50.0			Mkr→RefLvl
Center 927.250 MHz	#\/BW/30MH7	Span 10.0	More 00 MHz 1 of 2
MSG	#VBW 5.0 WHZ	status	

#### Antenna2

Lowest channel



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	Middl	est channel	
🎉 Agilent Spectrum Analyzer - Swept SA			- • • <del>•</del>
tx RL RF 50Ω AC Marker 1 914.740000000	MHZ PNO: Fast Trig: Line IFGain:Low Atten: 40 dB	ALIGN AUTO         08:02:01 PM Apr.21,           #Avg Type: RMS         TRACE         123:           Avg Hold:>100/100         TYPE         DET	2023 F5 6 IN N
Ref Offset 0.5 dB 10 dB/div Ref 30.00 dBm		Mkr1 914.74 M 26.503 dE	Hz NextPeak Sm
20.0			Next Pk Right
0.00			Next Pk Left
-10.0			Marker Delta
-30.0			Mkr→CF
-50.0			Mkr→RefLvl
Center 914.750 MHz	#\/P\\// 2.0 M/Hz	Span 10.00 M	More 1 of 2
MSG		SWEEP 1.000 HIS (1001)	

#### Highest channel





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#### Antenna3



Middlest channel





Highest channel m Analyzer - Swent SA Marker 1 927.070000000 MHz PNO: Fast IFGain:Low 08:20:51 PM Apr 21, 202 TRACE 1 2 3 4 5 #Avg Type: RMS Avg|Hold:>100/100 Peak Search Trig: Line Atten: 40 dB Next Peak Mkr1 927.07 MH 26.699 dBn Ref Offset 0.5 dB Ref 30.00 dBm 0 dB/div 771 Next Pk Right Next Pk Left Marker Delta Mkr→CF Mkr→RefLvl More 1 of 2 Center 927.250 MHz #Res BW 3.0 MHz Span 10.00 MHz Sweep 1.000 ms (1001 pts) #VBW 3.0 MHz

#### Antenna4

Lowest channel Marker 1 902,670000000 MHz PNO: Fast ALIGN AUTO #Avg Type: RMS Avg|Hold:>100/100 07:50:00 PN or 21, 2023 Peak Search TYPL DET Trig: Line Atten: 40 dB Next Peak Mkr1 902.67 MHz 26.532 dBm Ref Offset 0.5 dB Ref 30.00 dBm 10 dB/div Next Pk Right Next Pk Left Marker Delta Mkr→CF Mkr→RefLvl More Center 902.750 MHz #Res BW 3.0 MHz 1 of 2 Span 10.00 MHz Sweep 1.000 ms (1001 pts) #VBW 3.0 MHz

JC JC PPR





	M	iddlest channel		
Mailent Spectrum Analyzer - Swept SA				
0// RL RF 50Ω AC Marker 1 914.590000000 Γ	MHz PNO: Fast C Trig: Line	#Avg Type: RMS Avg Hold:>100/100	07:50:27 PM Apr 21, 2023 TRACE 1 2 3 4 5 6 TYPE MWWWWW	Peak Search
Ref Offset 0.5 dB 10 dB/div Ref 30.00 dBm	IFGain:Low Atten: 40 d	В	/kr1 914.59 MHz 26.446 dBm	Next Peak
20.0				Next Pk Right
0.00				Next Pk Left
-10.0				Marker Delta
-30.0				Mkr→CF
-50.0				Mkr→RefLvl
Center 914.750 MHz	#VBW 3.0 MHz	Sween	Span 10.00 MHz	More 1 of 2
MSG		STAT	us	

#### Highest channel



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## 12. Hopping Channel Separation

## 12.1 Block Diagram Of Test Setup



## 12.2 Limit

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.

## 12.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz, Span = 1.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

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

#### 12.4 Test Result

For FHSS:				
		ASK		
Test ch	annel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest		501	72.63	PASS
Middlest	Antenna1	500	69.90	PASS
Highest		499	72.69	PASS
Lowest		499	72.68	PASS
Middlest	Antenna2	501	69.56	PASS
Highest		500	72.47	PASS
Lowest		500	72.32	PASS
Middlest	Antenna3	501	68.65	PASS
Highest		500	72.63	PASS
Lowest		500	72.73	PASS
Middlest	Antenna4	500	67.75	PASS
Highest		500	69.55	PASS



#### Antenna1



#### Middlest channel



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#### Antenna2



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Middlest channel 0:12 PM Apr 21, 2023 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P N N N N #Avg Type: RMS Avg|Hold:>100/100 Peak Search Marker 1 Δ 501.000000 kHz Trig: Line Atten: 40 dB TYPE DET PNO: Wide 🖵 IFGain:Low Next Peak ΔMkr1 501 kHz -0.166 dB Ref Offset 0.5 dB Ref 30.00 dBm 0 dB/div 142 X2 Next Pk Right Next Pk Left Marker Delta Mkr→CF ٨. Mkr→RefLvl More 1 of 2 Center 915.0000 MHz #Res BW 30 kHz Span 1.000 MHz Sweep 1.067 ms (1001 pts) #VBW 100 kHz

Highest channel



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A



#### Antenna3



#### Middlest channel



,TC 3C PPR







#### Antenna4





Middlest channel #Avg Type: RMS Avg|Hold:>100/100 Peak Search Marker 1 Δ 500.000000 kHz Trig: Line Atten: 40 dB DET PNO: Wide 🖵 IFGain:Low Next Peak ΔMkr1 500 kHz 0.007 dB Ref Offset 0.5 dB Ref 30.00 dBm 0 dB/div ₹1∧2 X<sub>2</sub> Next Pk Right Next Pk Left Marker Delta Mkr→CF Mkr→RefLvl More 1 of 2 Center 915.0000 MHz #Res BW 30 kHz Span 1.000 MHz Sweep 1.067 ms (1001 pts) #VBW 100 kHz

#### Highest channel



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## 13. Number Of Hopping Frequency

## 13.1 Block Diagram Of Test Setup



### 13.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

### 13.3 Test procedure

1. 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.

2. Set to the maximum power setting and enable the EUT transmit continuously.

3. Enable the EUT hopping function.

4. Use the following spectrum analyzer settings: Span = the frequency band of operation; set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold

5. The number of hopping frequency used is defined as the number of total channel.

6. Record the measurement data in report.

Antenna	Hopping channel numbers	Result
Antenna1	50 50	PASS
Antenna2	50 50	PASS
Antenna3	50 50	PASS
Antenna4	50 50	PASS

#### 13.4 Test Result

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![](_page_24_Figure_4.jpeg)

![](_page_25_Picture_0.jpeg)

![](_page_25_Figure_2.jpeg)

![](_page_25_Figure_3.jpeg)

![](_page_25_Figure_4.jpeg)

![](_page_26_Picture_0.jpeg)

## 14. Dwell Time

## 14.1 Block Diagram Of Test Setup

![](_page_26_Figure_4.jpeg)

## 14.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

## 14.3 Test procedure

1. 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.

- 2. Set to the maximum power setting and enable the EUT transmit continuously.
- 3. Enable the EUT hopping function.
- 4. The spectrum analyzer is set to:

Center frequency = 914.75MHz, Span = zero

RBW = 100 kHz (RBW shall be  $\leq$  channel spacing and where possible RBW should be set >> 1 / T,

where T is the expected dwell time per channel), VBW  $\geq$  RBW Detector function = peak,

Trace = max hold

I race = max noid

5. Measure and record the results in the test report.

#### 14.4 Test Result

Antenna	Length (ms)	Number	Dwell time (ms)	Limit (ms)	Result
Antenna1	41.04	9	369.36	400	PASS
Antenna2	39.54	9	355.86	400	PASS
Antenna3	40.80	9	367.2	400	PASS
Antenna4	40.26	9	362.34	400	PASS

Note: Dwell time= Length\* Number

ТC

![](_page_27_Picture_0.jpeg)

![](_page_27_Figure_2.jpeg)

Antenna2

![](_page_27_Figure_4.jpeg)

![](_page_27_Figure_5.jpeg)

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![](_page_28_Picture_0.jpeg)

#### Antenna4

![](_page_28_Figure_3.jpeg)

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![](_page_29_Picture_0.jpeg)

## 15. Antenna Requirement

#### 15.1 Limit

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

## 15.2 Test Result

The EUT antenna is External antenna, antenna gain is 0dBi, antenna connector type is RP-SMA, fulfill the requirement of this section.

![](_page_29_Figure_7.jpeg)

![](_page_30_Picture_0.jpeg)

# 16. EUT Photographs

EUT Photo

![](_page_30_Picture_4.jpeg)

Appendix-Photographs Of EUT Constructional Details

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![](_page_31_Picture_0.jpeg)

## 17. EUT Test Setup Photographs

Conducted emissions

![](_page_31_Picture_4.jpeg)

![](_page_31_Picture_5.jpeg)

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![](_page_32_Picture_0.jpeg)

Radiated Measurement Photos

![](_page_32_Figure_3.jpeg)

![](_page_32_Picture_4.jpeg)

![](_page_32_Picture_5.jpeg)

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![](_page_33_Picture_0.jpeg)

## STATEMENT

- 1. The equipment lists are traceable to the national reference standards.
- 2. The test report can not be partially copied unless prior written approval is issued from our lab.
- 3. The test report is invalid without the "special seal for inspection and testing".
- 4. The test report is invalid without the signature of the approver.
- 5. The test process and test result is only related to the Unit Under Test.

6. Sample information is provided by the client and the laboratory is not responsible for its authenticity.

7. The test report without CMA mark is only used for scientific research, teaching, enterprise product development and internal quality control purposes.

8. The quality system of our laboratory is in accordance with ISO/IEC17025.

9. If there is any objection to this test report, the client should inform issuing laboratory within 15 days from the date of receiving test report.

#### Address:

1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China

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## \*\*\*\*\* END \*\*\*\*\*

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