

# **TEST REPORT**

APPLICANT : S	Shenzhen Xhorse	Electronics Co.,Ltd	
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- PRODUCT NAME : KEY TOOL MAX
- MODEL NAME : XDKM
- BRAND NAME : Xhorse
- FCC ID : 2AI4T-XDKM00
- STANDARD(S) : 47 CFR Part 15 Subpart C
- RECEIPT DATE : 2020-01-13
- TEST DATE : 2020-03-09 to 2020-05-15
- **ISSUE DATE** : 2020-06-24

Edited by:

Chen Bilian Chen Bilian (Rapporteur)

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	Change History	
Version	Date	Reason for Change
1.0	2020-06-24	First edition





# **1. Technical Information**

Note: Provide by applicant.

# **1.1. Applicant and Manufacturer Information**

Applicant:	Shenzhen Xhorse Electronics Co.,Ltd.
Applicant Address:	2009-2011, Changhong Science and Technology Building, Science Park South Twelfth Road, Nanshan District, Shenzhen,
	Guangdong, China
Manufacturer:	Shenzhen Xhorse Electronics Co.,Ltd.
Manufacturer Address:	2009-2011, Changhong Science and Technology Building,
	Science Park South Twelfth Road, Nanshan District, Shenzhen,
	Guangdong, China

# **1.2. Equipment Under Test (EUT) Description**

Product Name:	KEY TOOL MAX	
Serial No.:	(N/A, marked #1 by te	est site)
Hardware Version:	V1.2	
Software Version:	V1.1.3	
Equipment Type:	WLAN2.4G	
Modulation Technology:	DSSS, OFDM	
Modulation Type:	Refer to section1.3	
Operating Frequency Pange	802.11b/g/ n(HT20): 2	2.412GHz - 2.467GHz
Operating Frequency Kange.	802.11 n(HT40): 2.422	2GHz - 2.457GHz
Antenna Type:	PCB Antenna	
Antenna Gain:	1dBi	
Accessory Information:	Battery	
	Brand Name:	ВАК
	Model No.:	G795260P
	Serial No.: (N/A, marked #1 by test site)	
	Capacity: 3375mAh	
	Rated Voltage: 3.7V	
	Charge Limit:	4.2V

Note 1: We use the dedicated software to control the EUT continuous transmission.





**Note 2:** For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

# **1.3. Modulation Type and Data Rate of EUT**

Modulation Technology	Modulation Type	Data Rate (Mbps) Note 1
	DBPSK	1
DSSS (802.11b)	DQPSK	2
	ССК	5.5/ 11
	BPSK	<b>6</b> / 9
	QPSK	12 / 18
0FDIVI (802.119)	16QAM	24 / 36
	64QAM	48 / 54
	BPSK	6.5
OFDM	QPSK	13/19.5
(802.11n (HT20)	16QAM	26/39
	64QAM	52/58.5/65
	BPSK	13.5
OFDM	QPSK	27/40.5
(802.11 n (HT40))	16QAM	54/81/108
	64QAM	121.5/135

**Note 1:** The worst-case mode (bold face) in all data rates has been determined during the pre-scan, only the test data of the worst-case were recorded in this report.





# **1.4. The Channel Number and Frequency**

Test Mode	Channel	Frequency (MHz)	Channel	Frequency (MHz)
	1	2412	8	2447
	2	2417	9	2452
902 11b/a/	3	2422	10	2457
002.11D/g/	4	2427	11	2462
1(1120)	5	2432	12	2467
	6	2437		
	7	2442		
Test Mode	Channel	Frequency (MHz)	Channel	Frequency (MHz)
	3	2422	8	2447
	4	2427	9	2452
n(HT40)	5	2432	10	2457
	6	2437		
	7	2442		

Note 1: The black bold channels were selected for test.





# 1.5. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 15	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Test Date	Test Engineer		Method Determination /Remark
1	15.203	Antenna Requirement	N/A	N/A	PASS	No deviation
2	N/A	Duty Cycle Of Test Signal	Mar 9, 2020	Ouyang Feng	PASS	No deviation
3	15.247(b)	Maximum Peak and Average Conducted Output Power	Mar 9, 2020	Ouyang Feng	PASS	No deviation
4	15.247(a)	Bandwidth	Mar 9, 2020	Ouyang Feng	PASS	No deviation
5	15.247(d)	Conducted Spurious Emission and Band Edge	Mar 9, 2020	Ouyang Feng	PASS	No deviation
6	15.247(e)	Power Spectral Density (PSD)	Mar 9, 2020	Ouyang Feng	PASS	No deviation
7	15.207	Conducted Emission	May 15, 2020	Huang Zhiye	PASS	No deviation
8	15.247(d)	Restricted Frequency Bands	Apr 17, 2020	Peng XueWei	PASS	No deviation
9	15.209, 15.247(d)	Radiated Emission	Apr 16, 2020	Peng XueWei	PASS	No deviation

**Note 1:** The tests were performed according to the method of measurements prescribed in ANSIC63.10-2013, KDB558074 D01 v05r02.

**Note 2:** The path loss during the RF test is calibrated to correct the results by the offset setting in the test equipments. The ref offset 12dB contains two parts that cable loss 2dB and Attenuator 10dB.





**Note 3:** Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

# **1.6. Environmental Conditions**

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15-35
Relative Humidity (%):	30-60
Atmospheric Pressure (kPa):	86-106



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# 2. 47 CFR Part 15C Requirements

# 2.1. Antenna Requirement

## 2.1.1. Applicable Standard

According to FCC 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

#### 2.1.2. Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.





# 2.2. Duty Cycle of Test Signal

# 2.2.1. Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).

When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this subclause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than  $\pm 2\%$ ; otherwise, the duty cycle is considered to be nonconstant.

## 2.2.2. Test Description

## **Test Setup:**



ANSI C63.10 2013 Clause 11.6 was used in order to prove compliance.





# 2.2.3. Test Result

# A. Test Verdict:

Test Mode	Duty Cycle (%) (D)	Duty Factor (10*lg[1/D])
802.11b	97.51	0.11
802.11g	81.93	0.87
802.11n(HT20)	86.44	0.63
802.11n(HT40)	76.26	1.18

# B. Test Plots



(Channel 1, 802.11b)



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						- Swept SA	ım Analvzer ·	Spectru	ailent
Marker	04:56:03 PM Mar 09, 2020	ALIGN AUTO	IT Au	SENSE:I		50 Ω DC	RF		
Select Marker		Type: Log-Pwr	n Av	Trig: Free Ru Atten: 40 dB	PNO: Fast ↔ IFGain:Low	00 ms	1.425	3 <u>/</u>	rker
3	Mkr3 1.425 ms -0.42 dB	Δ				et 12.5 dB 50 dBm	Ref Offse Ref 35.	v	IB/di
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Fixed									
c	Span 0 Hz 000 ms (1001 pts)	Sweep 5.		8.0 MHz	#VBW	00 GHz	1200000 VIHz	2.41 V 8 M	nter s BV
	FUNCTION VALUE	FUNCTION WIDTH	FUNCTION	Y	205.0	Х	SCL	TRC	MOD
Properties	н			15.96 dBm 1.74 dB -0.42 dB	395.0 μs .390 ms (Δ) .425 ms (Δ)		t (Δ) t (Δ)	1	Ν Δ1 Δ1
Mo 1 of									
		STATUS							_

# (Channel 1, 802.11g)



## (Channel 1, 802.11 n (HT20))

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	- # <b>X</b>
50 Ω         C         SENSE:INT         ALIGN AUTO         04:57:30 PMMar 09, 2020         Mar           .000 μs         Avg Type: Log-Pwr         TRACE         2:3:4:5:6         Mar	rker
PNO: Fast + Trig: Free Run DFF PINNNN IFGain:Low Atten: 40 dB DET PINNNN	Marker
ffset 12.5 dB ΔMkr3 681.0 μs 35.50 dBm 0.38 dB	3
antificition and a second s	Norma
	Delta
	Fixed
0000 GHz Span 0 Hz #VBW 8.0 MHz Sweep 3.000 ms (1001 pts)	Of
786.0 μs         12.33 dBm         Forction         Forction value         Process           Δ)         645.0 μs         (Δ)         1.72 dB         Δ)         681.0 μs         (Δ)         0.38 dB         Ε         Ε         Process         Ε	perties
	Mor 1 of:

(Channel 3, 802.11 n (HT40))





# 2.3. Maximum Peak and Average Conducted Output Power

# 2.3.1. Requirement

According to FCC section 15.247(b)(3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: The maximum peak conducted output power of the intentional radiator shall not exceed 1 Watt.

## 2.3.2. Test Description

The measured output power was calculated by the reading of the USB Wideband Power Sensor and calibration.

# Test Setup:



The EUT (Equipment under the test) which is coupled to the USB Wideband Power Sensor; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading.





# 2.3.3. Test Result

# Maximum Peak Conducted Output Power

#### 802.11b Test mode

Channel			output Peak Power	Limi	Vardiat	
Channel Frequency (MHZ)		dBm	W	dBm	W	verdict
1	2412	18.51	0.071			PASS
6	2437	18.92	0.078	30	1	PASS
12	2467	18.87	0.077			PASS

# 802.11g Test mode

Channel	Erequency (MHz) Measured Output Peak Power		Limi	Vordict		
Channel	Frequency (MHZ)	dBm	W	dBm	W	veruici
1	2412	22.26	0.168			PASS
6	2437	22.82	0.191	30	1	PASS
12	2467	23.09	0.204			PASS

#### 802.11n (HT20) Test mode

Channel	Fraguanay (MHz)	Measured C	utput Peak Power	Limi	t	Vordiot
Channel	Frequency (IVIEZ)	dBm	W	dBm	W	verdict
1	2412	22.56	0.180			PASS
6	2437	23.16	0.207	30	1	PASS
12	2467	22.97	0.198			PASS

#### 802.11n (HT40) Test mode

Channel	Channel Frequency (MHz)		utput Peak Power	Limi	Vordict	
Channel Frequency (MHZ)		dBm	W	dBm	W	veruici
3	2422	22.48	0.177			PASS
6	2437	22.77	0.189	30	1	PASS
9	2452	22.23	0.167			PASS







# Maximum Average Conducted Output Power

### 802.11b Test mode

			Average Power					
Channel	Frequency	Maggurad		Duty F	actor	Lin	nit	Vardiat
Channel (MHz)		Measured	Duty	Calcu	lated			verdict
		dBm	гастог	dBm	W	dBm	W	
1	2412	15.75		15.86	0.039			PASS
6	2437	16.05	0.11	16.16	0.041	30	1	PASS
12	2467	16.10		16.21	0.042			PASS

# 802.11g Test mode

		Average Power						
Channel	Frequency	Moogurad	Dut	Duty F	actor	Lin	nit	Vardiat
Channel	(MHz)	Measureu	Calculated		lated			verdict
		dBm	гастог	dBm	W	dBm	W	
1	2412	13.16		14.03	0.025			PASS
6	2437	15.17	0.87	16.04	0.040	30	1	PASS
12	2467	15.68		16.55	0.045			PASS

# 802.11n (HT20) Test mode

			Averag	Average Power					
Channel	Frequency		Duty	Duty F	actor	Lin	nit	Vardiat	
Channel	(MHz)	Measured		Calcu	Calculated			verdict	
		dBm	dBm	Factor	dBm	W	dBm	W	
1	2412	13.71		14.34	0.027			PASS	
6	2437	15.81	0.63	16.44	0.044	30	1	PASS	
12	2467	15.73		16.36	0.043			PASS	

# 802.11n (HT40) Test mode

		Average Power						
Channel	Frequency	Maggurad		Duty F	actor	Lin	nit	Vardiat
(MHz)		Measured	Duty	Calcu	lated			verdict
		dBm	гастог	dBm	W	dBm	W	
3	2422	14.57		15.75	0.038			PASS
6	2437	15.11	1.18	16.29	0.043	30	1	PASS
9	2452	14.55		15.73	0.037			PASS



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# 2.4.1. Requirement

According to FCC section 15.247(a) (2), Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

#### 2.4.2. Test Description

#### Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

#### 2.4.3. Test Procedure

KDB 558074 Section 8.2 was used in order to prove compliance.





### 2.4.4. Test Result

#### 802.11b Test mode

#### A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	10.03	≥500	PASS
6	2437	9.09	≥500	PASS
12	2467	9.57	≥500	PASS

#### **B.** Test Plots



(Channel 1, 802.11b)



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#### (Channel 6, 802.11b)



#### (Channel 12, 802.11b)

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#### 802.11g Test mode

#### A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	15.14	≥500	PASS
6	2437	15.13	≥500	PASS
12	2467	15.13	≥500	PASS

#### B. Test Plots:



(Channel 1, 802.11g)



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Agilent Spectrum Analyzer - Occupied BW					
RF 50 Ω DC		SENSE:INT	ALIGN AUTO	05:01:17 PM Mar 09, 2020	Maga Satur
Center Freq 2.437000000	GHz Center Tria: I	r Freq: 2.437000000 GHz	R	adio Std: None	Meas Setup
	#IFGain:Low #Atter	n: 40 dB	R	adio Device: BTS	Avg/Hold Nun
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Center 2.437 GHz				Span 30 MHz	
#Res BW 100 kHz	#	VBW 300 kHz	s	weep 3.733 ms	
Occupied Bandwidt	h	Total Power	21.1 d	IBm	
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x dB Bandwidth	15.13 MHz	x dB	-6.00	) dB	
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					1 of :
			OTATIO		
Mou			STATUS		

#### (Channel 6, 802.11g)



#### (Channel 12, 802.11g)

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#### 802.11n (HT20) Test mode

#### A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	15.14	≥500	PASS
6	2437	15.12	≥500	PASS
12	2467	15.13	≥500	PASS

#### B. Test Plots:



(Channel 1, 802.11n (HT20))



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Acilent Spectrum Analyzer - Occupied BW							
RF 50 Ω DC		SENSE:INT	ALIGN AUTO	05:04:00 P	M Mar 09, 2020		
Center Freq 2.437000000	GHz Cente	r Freq: 2.437000000 GHz	: 	Radio Std	None	ivie	as Setup
	#IFGain:Low #Atter	n: 40 dB	Ju.~10/10	Radio Dev	ice: BTS	Avg	/Hold Num
							10
10 dB/dia Bef 20.00 dBm						<u>On</u>	Off
Log							
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-30.0 Jacof Will Wardshire					www.www.		
-40.0							
-50.0							
-60.0						C	BWPower
-70.0							99.00 %
Center 2.437 GHz				Spa	n 30 MHz		
#Res BW 100 kHz	#	VBW 300 kHz		Sweep	3.733 ms		
Occupied Bandwidth	n	Total Power	20.8	dBm			
47	500 MU-						
1/	.562 MHZ						x dB
Transmit Fred Error	4 903 kHz	OBW Power	QQ	00 %			-6.00 dB
	4.505-KHZ						
x dB Bandwidth	15.12 MHz	x dB	-6.	00 dB			
							More
							1 of 2
MSG			STATUS				
			01/100				

# (Channel 6, 802.11n (HT20))



#### (Channel 12, 802.11n (HT20))

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#### 802.11n (HT40) Test mode

#### A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
3	2422	35.16	≥500	PASS
6	2437	35.35	≥500	PASS
9	2452	35.14	≥500	PASS

#### B. Test Plots:



(Channel 3, 802.11n (HT40))



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Agilent Spectrum Analyzer - Occupied BW     RF   50 Ω DC       Center Freq 2.437000000	GHZ Center #FGain:Low #Atten	SENSE:INT Freq: 2.437000000 GHz ree Run Avg Hol : 40 dB	ALIGN AUTO 05:06: Radio d:>10/10 Radio	29 PM Mar 09, 2020 Std: None Device: BTS	Meas Setup Avg/Hold Nu	m 10
10 dB/div Ref 20.00 dBn	1					-
10.0					AvaMoo	de
0.00	A A A I disk distribution	un un hand all all all and and a she at a se	6 h à d a n		Exp Repe	eat
-10.0	M (MA) - MAIN AND AND AND AND AND AND AND AND AND AN		a rand nand loand from Ja			
-20.0 -30.0 -40.0				und war when a		
-50.0						
-60.0					OBWPow	er
-70.0					99.00	%
Center 2.437 GHz #Res BW 100 kHz	#	VBW 300 kHz	Swee	pan 60 MHz p 7.467 ms		
Occupied Bandwidt	h	Total Power	20.0 dBm			
35	5 834 MHz					
Transmit Freq Error	37.199 kHz	OBW Power	99.00 %		-6.00 c	зB
x dB Bandwidth	35.35 MHz	x dB	-6.00 dB		<b>Mo</b> 1 of	re f 2
MSG			STATUS			

# (Channel 6, 802.11n (HT40))



## (Channel 9, 802.11n (HT40))

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# 2.5. Conducted Spurious Emissions and Band Edge

## 2.5.1. Requirement

According to FCC section 15.247(c), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

## 2.5.2. Test Description

#### Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

#### 2.5.3. Test Procedure

KDB 558074 Section 8.5 and 8.7 was used in order to prove compliance.





## 2.5.4. Test Result

# 802.11b Test mode

#### A. Test Verdict:

		Measured Max. Out	Limi	t (dBm)	
Channel	Frequency (MHz)	of Band Emission	Carrier	Calculated	Verdict
		(dBm)	Level	-20dBc Limit	
1	2412	-50.36	7.40	-12.60	PASS
6	2437	-51.80	7.85	-12.15	PASS
12	2467	-51.28	7.44	-12.56	PASS

## B. Test Plots:

- ē 💌								pt SA	Analyzer - Swej	t Spectrum	🕻 Agilen
Peak Search	4 Mar 09, 2020 E 1 2 3 4 5 6 E M	04:17:10 PM TRAC TYF	ALIGN AUTO pe: Log-Pwr d:>10/10	Avg T Avg H	Run	SEN	GHz PNO: Fast	DC 00000 (	F 50 Ω 705060	r 2 3.7	larke
Next Peal	) 5 GHz 63 dBm	r2 3.770 -50.30	Mk		) dB	Atten: 20	IFGain:Low	2.5 dB dBm	of Offset 12 of 20.00 (	R liv R	10 dB/c
Next Pk Righ									) <sup>1</sup>	(	-og - 10.0 - 0.00 -
Next Pk Le									.2-		20.0
Marker Delt			al second providence of		alay And Barris			h			50.0
Mkr→C	5.00 GHz 0001 pts)	Stop 2: 2.387 s (1) EUNCTIO	Sweep 2		EI EI	/ 300 kHz	#VB	X	) kHz	BO MHZ BW 10	Start 3
Mkr→RefL	ш				3m 3m	7.399 dE -50.363 dE	09 6 GHz 70 5 GHz	<u>2.40</u> 3.77			1 N 2 N 3 4 5 6
Mor 1 of	-										7 8 9 10 11
	•		STATUS								sg

(Channel 1, 30MHz to 25GHz)



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				Surger CA	terre Archaer Cu	M Anilant Car
Mar 09, 2020 1 2 3 4 5 6 M WWWWWWW	04:12:04 PM Mar 09, 2020 TRACE 1 2 3 4 5 TYPE M WWWW	ALIGN AUTO Avg Type: Log-Pwr Avg Hold:>100/100	SENSE:INT	Swept SA 0 Ω DC 0000000 GHz PNO: Fast	RF 50 9	Marker 2
OGHZ 1 5 dBm	cr2 2.398 0 GHz -32.485 dBm	Mk	Atten: 20 dB	IFGain:Low 12.5 dB 10 dBm	Ref Offset 1 Ref 20.00	10 dB/div
Clear Write						10.0
Trace Average		· · · · · · · · · · · · · · · · · · ·				-10.0
Max Hold	hand and a for the second s	γ <sup>·</sup>	noral former &	almonder which when	inality and the second s	-50.0 -60.0
0.0 MHz 001 pts) Min Hold	Span 100.0 MH: .600 ms (1001 pts	Sweep 9	BW 300 kHz Y	z #V	40000 GHz 100 kHz	Center 2 #Res BW
View Blank Trace On			8.116 dBm -32.485 dBm	2.411 5 GHz 2.398 0 GHz		1 N 2 N 3 4 5 6
More 1 of 3						7 8 9 10 11
	5	STATUS				MSG

### (Band Edge, Channel 1)



(Channel 6, 30MHz to 25GHz)

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Agilent Spect	trum Analvzer - Swept	SA					
arker 2	RF 50 Ω 3.76301500	DC 0000 GHz PNO: Fast	SENSE	INT Avç un Avg	ALIGN AUTO Type: Log-Pwr  Hold:>10/10	04:29:46 PM Mar 09, 2020 TRACE 1 2 3 4 5 TYPE M	Peak Search
dD (aliu	Ref Offset 12.5	IFGain:Low	Atten: 20 dl	8	Mk	r2 3.763 0 GHz -51 279 dBm	NextPeal
	↓ ↓						Next Pk Righ
).0 ).0 ).0	2						Next Pk Lei
).0 ).0 ).0	New York Contraction	hand the second descent of the second descent descent descent descent descent descent descent descent descent d					Marker Delt
art 30 M Res BW	IHz 100 kHz	#VI	300 kHz	FUNCTION	Sweep 2	Stop 25.00 GHz 2.387 s (10001 pts FUNCTION VALUE	Mkr→C
1 N 1 2 N 1 3 4 5	f	2.46/ 1 GHZ 3.763 0 GHZ	-51.279 dBm				Mkr→RefLv
7 B B B 9 D 1 D							Mon 1 of:
à			m		STATUS	5	

# (Channel 12, 30MHz to 25GHz)



#### (Band Edge, Channel 12)

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# 802.11g Test mode

### A. Test Verdict:

		Measured Max. Out	Limit	t (dBm)	
Channel	Frequency (MHz)	of Band Emission	Carrier	Calculated	Verdict
		(dBm)	Level	-20dBc Limit	
1	2412	-52.38	-0.44	-20.44	PASS
6	2437	-51.39	1.88	-18.12	PASS
12	2467	-50.49	1.81	-18.19	PASS

#### B. Test Plots:



(Channel = 1, 30MHz to 25GHz)



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	04:40:01 PM Mar 09, 2020	ALIGN AUTO	NT	SENSE:I		ept SA 2 DC	trum Analyzer - Sw RF 50 !	Agilent Spec
Select Marker	TRACE <b>1 2 3 4 5 6</b> TYPE <b>M</b> DET <b>P</b> N N N N N	Type: Log-Pwr Hold:>10/10	Avg n Avg	Trig: Free Ru Atten: 20 dB	IZ NO:Fast ♀ Gain:Low	00000 GH PN IFC	2.4000000	larker 2
2	r2 2.400 0 GHz -35.671 dBm	Mk				2.5 dB dBm	Ref Offset 1 Ref 20.00	0 dB/div
Norma		1	MARANA A					10.0
Delt		Lange Arring Inc.	<u> </u>	and the second s				10.0 20.0 30.0
Fixed	the and the second s				have a set the set	a Verebildelagud	ارمین اور اور می مورد م	50.0 50.0 50.0 70.0
o	Span 100.0 MHz 600 ms (1001 pts)	Sweep 9.		00 kHz	#VBW 3		10000 GHz 100 kHz	enter 2. Res BW
Properties	FUNCTION VALUE	FUNCTION WIDTH	FUNCTION	Y 3.256 dBm 35.671 dBm	3 GHz 0 GHz -3	× 2.413 2.400	C SCL f f	IKR MODE TF 1 N 1 2 N 1 3 4 5 6
Moi 1 of								7 8 9 9 1 1
	4	STATUS		m				G

(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)

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Ref 2 20.6	= 50 Ω 6527230 f Offset 12. f 20.00 d	D000000 P IF 5 dB IBm	GHZ PNO: Fast Gain:Low	Trig: Free Atten: 20	e Run dB	Avg T Avg H	ALIGN AUTO Ype: Log-Pwr old:>10/10	04:38:57 PI TRAC TY 2 20.652 -50.4	MMar 09, 2020 El 2 3 4 5 6 MWWWWW PNNNNN 2 7 GHz 92 dBm	Peak Search Next Peal
Ref div Ref	f Offset 12. f 20.00 d	.5 dB IBM					Mkr	2 20.652 -50.4	2 7 GHz 92 dBm	Next Peal
30 MHz	,1									Next Pk Righ
30 MHz										
0 MHz										
0 MHz								2		Next Pk Left
0 MHz 3W 100	يالنانيا <sup>ير</sup> اينامي	h <sub>a</sub> ringh <sub>an</sub> ri	te a desta fil a thair de	dia dia mandri kana dia kana ya sa	and a state of the state of the	an di mi pitan	and the second strends			Marker Delta
	kHz		#VB\	W 300 kHz			Sweep 2	Stop 2 2.387 s (1	5.00 GHz 0001 pts)	Mkr→CF
DE TRC SCL		× 2.467	1 GHz	۲ 1.809 di	FUN		FUNCTION WIDTH	FUNCTIO	DN VALUE	
		20.652	2 7 GHz	-50.492 di	3m				E	Mkr→RefLvl
										More
				III						1 012

(Channel = 12, 30MHz to 25GHz)



(Band Edge, Channel = 12)

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#### 802.11n (HT20) Test mode

#### A. Test Verdict:

		Measured Max. Out	Limit	t (dBm)		
Channel	Frequency (MHz)	of Band Emission	Carrier	Calculated	Verdict	
		(dBm) Level		-20dBc Limit		
1	2412	-51.88	2.44	-17.56	PASS	
6	2437	-51.14	2.17	-17.83	PASS	
12	2467	-51.85	2.32	-17.68	PASS	

#### B. Test Plots:



(Channel = 1, 30MHz to 25GHz)



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(Band Edge, Channel = 1)



(Channel = 6, 30MHz to 25GHz)



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- 6									t SA	alyzer - Swep	trum An	lent Spect
Peak Search	Mar 09, 2020 E 1 2 3 4 5 6 E M WWWWW FT P N N N N N	04:43:35 PM TRAC TYP DE	ALIGN AUTO :: Log-Pwr :>10/10	Avg Typ Avg Hol	INT In	g: Free Riter: 20 dB		GHZ PNO: Fast IFGain:Low	DC 00000	548800	RF 3.78	ker 2
Next Pea	5 GHz 53 dBm	r2 3.785 -51.85	Mk						5 dB I <b>B</b> m	Offset 12. 20.00 d	Ref Ref	3/div
Next Pk Rigi												
Next Pk Le										2		
Marker Del				instructure de			141.49 	produkti kangai k	li den grika			فتبلغتهم
Mkr→C	5.00 GHz 0001 pts)	Stop 2: 2.387 s (10 FUNCTIO	Sweep 2	ON FU	FUNC	kHz	'BW 31	#V	X	kHz	/IHz 100	t 30 IV 5 BW 100e TR
Mkr→RefL						<u>318 dBm</u> 853 dBm	-5	7 <u>2 1 GHz</u> 35 5 GHz	<u>2.47</u> 3.78		f	N 1 N 1
<b>Mo</b> r 1 of	_											
	•		STATUS								_	

(Channel = 12, 30MHz to 25GHz)



(Band Edge, Channel = 12)

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### 802.11n (HT40) Test mode

#### A. Test Verdict:

		Measured Max. Out	Limi		
Channel	Frequency (MHz)	of Band Emission	Carrier	Calculated	Verdict
		(dBm)	Level	-20dBc Limit	
3	2422	-51.33	1.17	-18.83	PASS
6	2437	-51.27	1.72	-18.28	PASS
9	2452	-51.71	0.23	-19.77	PASS

#### B. Test Plots:



(Channel = 3, 30MHz to 25GHz)



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📁 Agilent Spectrum Analyzer - Swept SA							
RF         50 Ω         DC           Marker 2 2.400000000000         G	iHz	SENSE:INT	Avg	ALIGN AUTO Type: Log-Pwr	04:52:34 PM TRACE	Mar 09, 2020	Marker
	NO: Fast 😱 Gain:Low	Trig: Free Run Atten: 20 dB	Avg	Hold:>10/10	TYP		Select Marker
Ref Offset 12.5 dB 10 dB/div Ref 20.00 dBm				Mk	r2 2.400 -31.09	0 GHz 0 dBm	2
		I	J.J.J.J.J.J.	المعلم م	rhank belach		Norma
-100 -200 -300 -400	Annanghad			V		Liphoneliamen	Delta
-50.0 -70.0							Fixed▷
Center 2.40000 GHz #Res BW 100 kHz	#VBW 3	00 kHz		Sweep 9	Span 10 .600 ms (1	00.0 MHz 1001 pts)	Of
MKR         MODE         TRC         SCL         X           1         N         1         f         2.424	5 GHz	Y 1.419 dBm	FUNCTION	FUNCTION WIDTH	FUNCTIO	N VALUE	
2 N 1 f 2.400 3 5 6 6	) 0 GHz -3	1.090 dBm				=	Properties •
7 8 9 9 9 9 9 9 9 10 10 10 10 10 10 10 10 10 10 10 10 10							<b>More</b> 1 of 2
						•	
MSG				STATUS	5		

(Band Edge, Channel = 3)



(Channel = 6, 30MHz to 25GHz)



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Agilent Spect	trum Analyzer - Swep	ot SA			1		_ 6
irker 2	RF 50 Ω 3.83043400	DC DOOOO GHZ PNO: Fast IFGain:Lov	Trig: Free Atten: 20	E:INT Av Run Avç JB	g Type: Log-Pwr   Hold:>10/10	04:51:52 PM Mar 09, 202 TRACE 1 2 3 4 5 TYPE MWWWM DET P NNN	0 6 Peak Search ₩ N
dB/div	Ref Offset 12. Ref 20.00 c	.5 dB IBm			Mk	r2 3.830 4 GH -51.714 dBn	NextPea
9 .0 .0 .0	1						Next Pk Rigi
							Next Pk Le
	Janna	Angelan in a star proposition is			hter of the strength of the st		Marker Del
art 30 M es BW	1Hz 100 kHz	#V	BW 300 kHz		Sweep 2	Stop 25.00 GH 2.387 s (10001 pts	2 )) Mkr→C
N 1 N 1	f f	2.444 6 GHz 3.830 4 GHz	0.231 dB -51.714 dB	m m			Mkr→RefL
							Mo 1 of
			m			•	

(Channel = 9, 30MHz to 25GHz)



(Band Edge, Channel = 9)

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# 2.6. Power Spectral Density (PSD)

## 2.6.1. Requirement

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

## 2.6.2. Test Description

### Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading.

## 2.6.3. Test Procedure

KDB 558074 Section 8.4 was used in order to prove compliance.





## 2.6.4. Test Result

## 802.11b Test mode

### A. Test Verdict:

	Spectral Power Density (dBm/3kHz)							
Channol	Frequency	Massurad PSD (dBm/3kHz)	Limit	Verdict				
Channel	(MHz)	Weasured FSD (ubin/skiiz)	(dBm/3kHz)					
1	2412	1.44	8	PASS				
6	2437	-6.01	8	PASS				
12	2467	6.61	8	PASS				

### B. Test Plots:



(Channel = 1, 802.11b)



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#### (Channel = 6, 802.11b)



# (Channel = 12, 802.11b)

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### 802.11g Test mode

#### A. Test Verdict:

	S	pectral Power Density (dBm/3kHz)		
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-9.86	8	PASS
6	2437	-8.10	8	PASS
12	2467	-8.61	8	PASS

### B. Test Plots:



(Channel = 1, 802.11g)









#### (Channel = 6, 802.11g)



### (Channel = 12, 802.11g)

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## 802.11n (HT20) Test mode

#### A. Test Verdict:

	SI	pectral Power Density (dBm/3kHz)			
Channel	Frequency	Macourod BSD (dBm/2kHz)	Limit	Verdict	
Channel	(MHz)	Measured FSD (UBIII/SKHZ)	(dBm/3kHz)		
1	2412	-10.23	8	PASS	
6	2437	-8.80	8	PASS	
12	2467	-9.01	8	PASS	

#### B. Test Plots:



(Channel = 1, 802.11n(HT20))



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(Channel = 6, 802.11n(HT20))



(Channel = 12, 802.11n(HT20))



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## 802.11n (HT40) Test mode

#### A. Test Verdict:

	Spectral Power Density (dBm/3kHz)							
Channel	Frequency	Macourod DSD (dBm/2kHz)	Limit	Vardiat				
Channel	(MHz)	Measured FSD (dBIII/SKHZ)	(dBm/3kHz)	verdict				
3	2422	-12.53	8	PASS				
6	2437	-13.78	8	PASS				
9	2452	-10.60	8	PASS				

#### B. Test Plots:



(Channel = 3, 802.11n(HT40))



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(Channel = 6, 802.11n(HT40))



(Channel = 9, 802.11n(HT40))



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# 2.7. Conducted Emission

## 2.7.1. Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a  $50\mu$ H/ $50\Omega$  line impedance stabilization network (LISN).

Frequency range	Conducted	Limit (dBµV)
(MHz)	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

Note:

(a) The lower limit shall apply at the band edges.

(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

## 2.7.2. Test Description

#### Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10 2013.

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# 2.7.3. Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below. **Note:** Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

## A. Test Setup:

Test Mode: <u>EUT + ADAPTER + wifi TX</u> Test Voltage: <u>AC 120V/60Hz</u> The measurement results are obtained as below: E [dB $\mu$ V] =U<sub>R</sub> + L<sub>Cable loss</sub> [dB] + A<sub>Factor</sub> U<sub>R</sub>: Receiver Reading A<sub>Factor</sub>: Voltage division factor of LISN







### B. Test Plots:



# (L Phase)

NO.	Fre.	Emission L	.evel (dBµV)	Limit (	dBµV)	Power-line	Verdict
	(MHz)	Quai-peak	Average	Quai-peak	Average		
1	0.1503	35.84	25.12	65.98	55.98		PASS
2	0.2129	33.57	24.14	63.09	53.09		PASS
3	0.2713	33.18	23.25	61.08	51.08	Lino	PASS
4	0.3572	32.09	22.21	58.79	48.79	LITE	PASS
5	0.7343	30.84	21.07	56.00	46.00		PASS
6	14.6435	29.17	14.32	60.00	50.00		PASS





(N Phase)

NO.	Fre.	Emission L	.evel (dBµV)	Limit (	dBµV)	Power-line	Verdict	
	(MHz)	Quai-peak	Average	Quai-peak	Average		Verdiet	
1	0.1501	47.95	28.47	66.00	56.00		PASS	
2	0.1590	43.65	26.98	65.52	55.52		PASS	
3	0.1906	33.49	25.28	64.01	54.01	Noutral	PASS	
4	0.3119	31.18	24.07	59.92	49.92	Neuliai	PASS	
5	0.6671	31.40	26.53	56.00	46.00		PASS	
6	1.3701	28.05	21.38	56.00	46.00		PASS	



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# 2.8. Restricted Frequency Bands

## 2.8.1. Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

## 2.8.2. Test Description

## Test Setup



The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.





## 2.8.3. Test Procedure

KDB 558074 Section 8.6 and 8.7 was used in order to prove compliance.

# 2.8.4. Test Result

The lowest and highest channels are tested to verify Restricted Frequency Bands.

The measurement results are obtained as below:

 $E [dB\mu V/m] = U_R + A_T + A_{Factor} [dB]; A_T = L_{Cable loss} [dB] - G_{preamp} [dB]$ 

A<sub>T</sub>: Total correction Factor except Antenna

U<sub>R</sub>: Receiver Reading

G<sub>preamp</sub>: Preamplifier Gain

A<sub>Factor</sub>: Antenna Factor at 3m

**Note:** Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

# 802.11b Test mode

# A. Test Verdict:

	Frequency	Detector	Receiver Reading	A <sub>T</sub>	A <sub>Factor</sub>	Max. Emission	Limit	Verdict
Channel	(MHz)	PK/ AV	U <sub>R</sub> (dBuV)	(dB)	(dB@3m)	E (dBµV/m)	(dBµV/m)	veraiet
1	2386.35	PK	45.90	-29.67	32.56	48.79	74	PASS
1	2382.99	AV	44.51	-29.67	32.56	47.40	54	PASS
12	2483.79	PK	52.72	-29.67	32.56	55.61	74	PASS
12	2484.17	AV	44.65	-29.67	32.56	47.54	54	PASS



## B. Test Plots:

Keysight Spectrum Analyzer - Swept SA ALIGN OFF #Avg Type: Voltage Avg|Hold:>100/100 05:59:40 AM Apr 17, 2020 SENSE:INT Marker 1 2.386352000000 GHz RACE 1 2 3 4 5 TYPE MWWWW DET P P N N N Marker PNO: Fast IFGain:Low Trig: Free Run Atten: 10 dB Select Marker 2.386 35 GHz 45.896 dBµV Mkr1 Ref 106.99 dBµV 0 99 di۱ Normal Delta <sup>1</sup> 0<sup>2</sup> **Fixed** Start 2.30000 GHz #Res BW (CISPR) 1 MHz Stop 2.41200 GHz Sweep 1.000 ms (1001 pts) #VBW 3.0 MHz Off 2.386 35 GHz 2.390 00 GHz 45.896 dBµV 45.554 dBµV N 1 f N 1 f **Properties** More 1 of 2 STATUS

(Channel = 1 PEAK, 802.11b)



(Channel = 1 AVG, 802.11b)



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Keysight Spectrum Analyzer - Swe	ot SA						
RL RF PRESEL 50 Ω larker 2 2.48379000	0000 GHz	SEN Trig: Free	NSE:INT ## eRun An	Avg Type: Voltage	06:04:20 AM Apr 17, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWWW	Marker	
	IFGain:L	ow Atten: 10	) dB	Mkr2	2 483 790 GHz	Select Marker	
0 dB/div Ref 106.99	dBµV				52.719 dBµV	_	
97.0	~~~~					Norma	
87.0						Horme	
67.0							
57.0			~ () <sup>2</sup>			Delt	
47.0				nalaninan yang mengenang seria dan seria Seria dan seria dan se	and the and the first sector and the sector and		
27.0						Fixed	
17.0							
itart 2.46200 GHz				Sween 1	Stop 2.50000 GHz	01	
	× "	Y	FUNCTION		FUNCTION VALUE		
1 N 1 f 2 N 1 f	2.483 500 GH 2.483 790 GH	z 53.611 dB z 52.719 dB	μV μV				
3						Properties	
6							
8						Mor	
						1 of	
s <mark>G</mark> ↓File <b-12 av.png=""> s</b-12>	aved			STATUS	3		

(Channel = 12 PEAK, 802.11b)



(Channel = 12 AVG, 802.11b)

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## 802.11g Test mode

#### A. Test Verdict:

Channel	Frequency	Detector	Receiver Reading	A <sub>T</sub>	A <sub>Factor</sub>	Max. Emission	Limit	Vordiot
Channel	(MHz)	PK/ AV	U <sub>R</sub> (dBuV)	(dB)	(dB@3m)	E (dBµV/m)	(dBµV/m)	verdici
1	2386.91	PK	48.35	-29.67	32.56	51.24	74	PASS
1	2383.66	AV	45.50	-29.67	32.56	48.39	54	PASS
12	2484.09	PK	66.10	-29.67	32.56	68.99	74	PASS
12	2483.90	AV	46.90	-29.67	32.56	49.79	54	PASS

#### B. Test Plots:



(Channel = 1 PEAK, 802.11g)



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						went SA	ım Analyzer - S	evsight Spectr
Marker	05:57:27 AM Apr 17, 2020 TRACE 1 2 3 4 5 6 TYPE M WWWWWW	ALIGN OFF g Type: Voltage  Hold:>100/100	n Av	SENSE:I	Hz PNO: Fast	Ω DC 000000 (	PRESEL 50	rker 1 2
Select Marker	1 2.383 66 GHz 45.496 dBµV	Mkr		Atten: 10 dB	FGain:Low	9 dBµV	Ref 106.9	B/div
Normal								
Delta	2 hurenner	1						
Fixed⊳								
Off	Stop 2.41200 GHz 000 ms (1001 pts) FUNCTION VALUE	Sweep 1	FUNCTION	.0 MHz*	#VBW	VIHz ×	00 GHz ISPR) 1	es BW (C
Properties►	E			5.496 dBµV 5.909 dBµV	66 GHz 00 GHz	2.383 2.390	f	N 1 N 1
More 1 of 2								
		STATUS						

(Channel = 1 AVG, 802.11g)



(Channel = 12 PEAK, 802.11g)



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								vept SA	Analyzer - Sv	: Spectrum	Keysight
Marker	AM Apr 17, 2020 RACE 1 2 3 4 5 6 TYPE MWWWW	06:07:00 A TRAC TY	ALIGN OFF pe: Voltage d:>100/100	#Avg Avg H	se:INT	SEN	Hz PNO: Fast	2 DC	SEL 50 9 339040	RF PR 2 2.4	<sub>RL</sub> arker
Select Marker 2	904 GHz 99 dBµV	2.483 9 46.89	Mkr2		dB	Atten: 10	Gain:Low	9 dBµV	f 106.9	v Re	) dB/div
Norma											7.0
Delta					<u>()</u> 2						7.0 i7.0 i7.0
Fixed											7.0 7.0 7.0
Of	50000 GHz (1001 pts)	Stop 2.5 5.625 s (	Sweep	TION	FUN	3.0 MHz	#VBW	/IHz ×	GHz PR)1N	46200 W (CIS	tart 2. Res B
Properties						47.243 dB 46.899 dB	00 GHz 04 GHz	2.483 5 2.483 9		1 f 1 f	1 N 2 N 3 4 5 6
More 1 of 2	-										7 8 9 0 1
		6	STATUS								G

(Channel = 12 AVG, 802.11g)



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## 802.11 n (HT20) Test mode

#### A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading U <sub>R</sub>	A <sub>T</sub> (dB)	A <sub>Factor</sub> (dB@3m)	Max. Emission E	Limit (dBuV/m)	Verdict
		PK/ AV	(dBuV)	(- )	(	(dBµV/m)	(* F * )	
1	2389.04	PK	50.13	-29.67	32.56	53.02	74	PASS
1	2388.26	AV	46.94	-29.67	32.56	49.83	54	PASS
12	2484.09	PK	67.34	-29.67	32.56	70.23	74	PASS
12	2483.87	AV	47.55	-29.67	32.56	50.44	54	PASS

### B. Test Plots:



## (Channel = 1 PEAK, 802.11n(HT20))

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🎉 Keysight Spectrum Analyzer -	Swept SA					_ # <b>*</b>
K RL RF PRESEL 5		SENSE:IN	π #Δva	ALIGN OFF	05:55:01 AM Apr 17, 2020	Trace/Detector
Marker 1 2.300250	PNO: Fast	Trig: Free Rur	n Avg∥⊦	lold:>100/100	TYPE MWWWWW	
	IFGain:Lov	Atten: 10 dB			DETAPNNNN	Select Trace
				Mkr	1 2.388 26 GHz	1
10 dB/div Ref 106.	99 dBµV				46.942 dBµV	
Log						
97.0						Clear Write
87.0					- Alexandream	
77.0						
67.0					/	
57.0					12	Trace Average
47 በ					Mart - Aller	
37.0	the and the second second second	alighted and the second	protection of the board of	and a free state of the state of the state of the		
57.0						May Hold
27.0						Max Hold
17.0						
Start 2 30000 GHz					Ston 2 41200 GHz	
#Res BW (CISPR) 1	MHz #V	/BW 3.0 MHz*		Sweep 1	.000 ms (1001 pts)	Min Hold
MKR MODELTROUSOL	X	Y	FUNCTION		EUNCTION VALUE	
	2.388 26 GHz	46.942 dBµV	TONCHON	T ONCE TO A VIDE TH	TONCHON VALUE	
2 N 1 f	2.390 00 GHz	47.787 dBµV				View Blank
4						Trace On
5					E	
7						
8						More
10						1 of 3
11					-	
				07.1715	•	
MSG				STATUS		

(Channel = 1 AVG, 802.11n(HT20))



(Channel = 12 PEAK, 802.11n(HT20))



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								Swept SA	Analyzer - S	Spectrum	Keysight
Marker	M Apr 17, 2020 E <b>1 2 3 4 5 6</b> PE <b>M WWWWW</b> A P N N N N	06:15:00 A TRAC TYF DE	ALIGN OFF Type: Voltage old:>100/100	#Avg Avg	Run dB	Trig: Free Atten: 10	GHz PNO: Fast ⊊ IFGain:Low	Ω DC 0000000	ESEL 50 83866	RF PR 2 2.4	arker
2	66 GHz 3 dBµV	2.483 8 47.55	Mkr2					9 dBµV	ef 106.9	Re	0 dB/di
Norma											97.0 87.0
D-#							$\rightarrow$				77.0 67.0
Deit				2	()						\$7.0
Fixed											27.0
0	0000 GHz 1001 pts)	Stop 2.50 5.625 s (	Sweep			3.0 MHz	#VBW	MHz	GHz SPR) 1	16200 N (CIS	tart 2. Res B
	ON VALUE	FUNCTION	FUNCTION WIDTH	ICTION	FUN	Y 47.842 dB	500 GHz	× 2 483	L	TRC SC	KR MODE
Properties	E				μV	47.553 dB	B66 GHz	2.483		i f	2 N 3 4 5 6
Mor 1 of											7 8 9
											ĭ
		6	STATUS								G

(Channel = 12 AVG, 802.11n(HT20))



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## 802.11n (HT40) Test mode

#### A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading U <sub>R</sub>	A <sub>T</sub> (dB)	A <sub>Factor</sub> (dB@3m)	Max. Emission E	Limit (dBµV/m)	Verdict
	· · ·	PK/ AV	(dBuV)		· · · ·	(dBµV/m)	、 I	
3	2388.26	PK	58.45	-29.67	32.56	61.34	74	PASS
3	2388.48	AV	40.56	-29.67	32.56	43.45	54	PASS
9	2484.66	PK	66.79	-29.67	32.56	69.68	74	PASS
9	2484.25	AV	47.08	-29.67	32.56	49.97	54	PASS

### B. Test Plots:



(Channel = 3 PEAK, 802.11n (HT40))



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1:22 AM Apr 17, 2020	05:51:22 AM Apr 17,	🛕 ALIGN OFF	NT	SENSE		r - Swept SA 50 Ω DC	ctrum Analyze RF PRESEL	Keysight Spe RL
TRACE 1 2 3 4 5 6 TYPE MWWWWW DET A P N N N N	TRACE 1 2 3 TYPE MWW DET A P N	g Type: Voltage  Hold:>100/100	n	Trig: Free R	PNO: Fast	0000000	2.38848	larker 1
Select Marker 88 48 GHz .558 dBµV	1 2.388 48 G 40.558 dB	Mkr		Anten I o de	IFGall.LOW	6.99 dBµV	Ref 10	0 dB/div
Normal								- <b>og</b> 97.0 87.0
Delta	12							77.0 67.0 57.0
Fixed⊳	ý – – – – – – – – – – – – – – – – – – –							47.0 37.0 27.0
2.41200 GHz 3 s (1001 pts) Off	Stop 2.41200 0 16.58 s (1001	Sweep	ELINCTI	3.0 MHz	#VBV	1 MHz	000 GHz (CISPR)	Start 2.30 Res BW
Properties►		TONCTON WIDTH	TONCTIN	40.558 dBµV 41.076 dBµV	8 48 GHz 0 00 GHz	2.388 2.390	f	1 N 1 2 N 1 3 4 5
More 1 of 2								6 7 8 9 10
		STATUS		m				sg

(Channel = 3 AVG, 802.11n (HT40))



(Channel = 9 PEAK, 802.11n (HT40))

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				_	_				ept SA	nalyzer - Swe	Spectrum A	Keysight !
Marker	Apr 17, 2020	06:18:34 A	ALIGN OFF pe: Voltage d:>100/100	#Avg T Avg He	INT INT	ee Ru	S Trig: Fr	Hz PNO: Fast C	DC 00000 G	EL 50 Ω 424600	RF PRES 2 2.48	<sup>RL</sup> arker
Select Marker 2	46 GHz 4 dBµV	2.484 2 47.08	Mkr2			10 dB	Atten: 1	FGain:Low	dBµV	106.99	Ref	dB/div
Norma												9 7.0 7.0
Delt				2								7.0
Fixed												7.0 7.0 7.0
o	0000 GHz 1001 pts)	Stop 2.50 5.625 s (	Sweep	EION .	ELINC	z	V 3.0 MH	#VB	Hz	GHz PR) 1 M	16200 ( V (CISI	art 2.4 tes Bl
Properties		Toneth				IBμV IBμV	47.412 d 47.084 d	00 GHz 46 GHz	<u>2.483 5</u> 2.484 2		1 f 1 f	N N N N N
Moi 1 of												
	•	;	STATUS				m					

(Channel = 9 AVG, 802.11n(HT40))



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# 2.9. Radiated Emission

## 2.9.1. Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

**Note 1:** For above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

**Note 2:** For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK). In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table).





# 2.9.2. Test Description

#### **Test Setup:**

1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz





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3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz. Test site have a minimum area of the ground plane covered with RF absorbing material as specified in Figure 6 of ANSI C63.4: 2014.

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10 (2013). For radiated emissions below or equal to 1GHz, The EUT was set-up on insulator 80cm above the Ground Plane, for radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10.

For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of

the site as factors are calculated to correct the reading.



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For the Test Antenna:

(a) In the frequency range of 9kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.

(b) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The test antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final test antenna elevation shall be that which maximizes the emissions. The test antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. The emission levels at both horizontal and vertical polarizations should be tested.

# 2.9.3. Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:  $E [dB\mu V/m] = U_R + A_T + A_{Factor} [dB]; A_T = L_{Cable loss} [dB] - G_{preamp} [dB]$   $A_T$ : Total correction Factor except Antenna  $U_R$ : Receiver Reading  $G_{preamp}$ : Preamplifier Gain  $A_{Factor}$ : Antenna Factor at 3m During the test, the total correction Factor  $A_T$  and  $A_{Factor}$  were built in test software.

**Note 1:** All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

**Note 2:** For the frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

**Note 3:** For the frequency, which started from 18GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.





## 802.11b Test mode

Plots for Channel = 1



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plot for Channel = 6



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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#### Plots for Channel = 12



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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# 802.11g Test mode

Plot for Channel = 1



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plot for Channel = 6



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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### 802.11n (HT20) Test mode

#### Plots for Channel = 1



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plots for Channel = 12



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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### 802.11n(HT40) Test mode

#### Plots for Channel = 3



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plots for Channel = 6



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plots for Channel = 9



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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# **Annex A Test Uncertainty**

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

Test Items	Uncertainty
Peak Output Power	±2.22dB
Power Spectral Density (PSD)	±2.22dB
Bandwidth	±5%
Conducted Spurious Emission	±2.77dB
Restricted Frequency Bands	±5%
Radiated Emission	±2.95dB
Conducted Emission	±2.44dB

This uncertainty represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



# **Annex B Testing Laboratory Information**

### 1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd.				
	Morlab Laboratory				
Laboratory Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang				
	Road, Block 67, BaoAn District, ShenZhen, GuangDong				
	Province, P. R. China				
Telephone:	+86 755 36698555				
Facsimile:	+86 755 36698525				

### 2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd.		
	FL.3, Building A, FeiYang Science Park, No.8 LongChang		
Address:	Road, Block 67, BaoAn District, ShenZhen, GuangDong		
	Province, P. R. China		

### 3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.





## 4. Test Equipments Utilized

### 4.1 Conducted Test Equipments

Equipment Name	Serial No.	Туре	Manufacturer	Cal. Date	Cal. Due
Attenuator 1	N/A	10dB	Resnet	N/A	N/A
EXA Signal Analzyer	MY53470836	N9010A	Agilent	2020.04.01	2021.03.31
USB Wideband Power Sensor	MY54210011	U2021XA	Agilent	2020.04.01	2021.03.31
RF cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
Coaxial cable	CB02	RF02	Morlab	N/A	N/A
SMA connector	CN01	RF03	HUBER-SUHNER	N/A	N/A
Computer	T430i	Think Pad	Lenovo	N/A	N/A

## 4.2 Conducted Emission Test Equipments

Equipment Name	Serial No.	Туре	Manufacturer	Cal. Date	Cal. Due
Receiver	MY56400093	N9038A	KEYSIGHT	2020.03.26	2021.03.25
LISN	812744	NSLK 8127	Schwarzbeck	2020.03.26	2021.03.25
Pulse Limiter (10dB)	VTSD 9561	VTSD	Sobworzhook	2019.08.13	2020.08.12
	F-B #206	9561-F	Schwarzbeck		
Coaxial cable(BNC)	CR01		Marlah	NI/A	N1/A
(30MHz-26GHz)	CBUT		INIONAD	IN/A	IN/A

### 4.3 List of Software Used

Description	Manufacturer	Software Version
Test system	Tonscend	V2.6
Power Panel	Agilent	V3.8
Morlab EMCR V1.2	Morlab	V1.0





### 4.4 Radiated Test Equipments

Equipment Name	Serial No.	Туре	Manufacturer	Cal. Date	Cal. Due
Receiver	MY54130016	N9038A	Agilent	2019.07.29	2020.07.28
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2019.05.24	2022.05.23
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2019.02.14	2022.02.13
Test Antenna – Horn	01774	BBHA 9120D	Schwarzbeck	2019.07.26	2022.07.25
Test Antenna – Horn	BBHA9170 #774	BBHA9170	Schwarzbeck	2019.07.26	2022.07.25
Coaxial cable (N male) (9KHz-30MHz)	CB04	EMC04	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-26GHz)	CB02	EMC02	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-26GHz)	CB03	EMC03	Morlab	N/A	N/A
1-18GHz pre-Amplifier	61171/61172	S020180L32 03	Tonscend	2019.07.29	2020.07.28
18-26.5GHz pre-Amplifier	46732	S10M100L38 02	Tonscend	2019.07.29	2020.07.28
Notch Filter	N/A	WRCG-2400- 2483.5-60SS	Wainwright	2019.12.01	2020.12.01
Anechoic Chamber	N/A	9m*6m*6m	CRT	2020.01.06	2023.01.05

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