

TEST REPORT

APPLICANT	:	Testo SE & Co. KGaA
PRODUCT NAME	:	WLAN-communication module
MODEL NAME	:	0554 9320
BRAND NAME	:	Testo
FCC ID	:	WAF-05549320
STANDARD(S)	:	47 CFR Part 15 Subpart C
RECEIPT DATE	:	2019-10-25
TEST DATE	:	2019-11-06 to 2019-11-11
ISSUE DATE	:	2019-11-19

Edited by:

Pong Mi Peng Mi (Rapporteur)

Approved by:

Peng Huarui (Supervisor)

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Change History			
Version	Date	Reason for change	
1.0 2019-11-19		First edition	



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1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Testo SE & Co. KGaA	
Applicant Address:	Testo-Strasse 1, Lenzkirch 79853, Germany	
Manufacturer:	Testo Instruments (Shenzhen) Co., Ltd.	
Manufacturer Address:	Block A, B4 Building, China Merchants Guangming Sci&Tech	
	Park, No.3009 Guan Guang Road, Guangming New District,	
	Shenzhen, Guangdong, China	

1.2. Equipment Under Test (EUT) Description

Product Name:	WLAN-communication module				
Serial No:	(N/A, marked #1 t	(N/A, marked #1 by test site)			
Hardware Version:	V2.5				
Software Version:	V3.12.0.1				
Equipment Type:	WLAN2.4G				
Modulation Type:	DSSS, OFDM				
Operating Frequency Range:	802.11b/g/ n(HT20): 2.412GHz - 2.472GHz				
Antenna Type:	Copper Tube Antenna				
Antenna Gain:	0.6dBi				
	Power supply by logger				
Test Fixture:	Input:	4*AA (Dry cell)			
	Output: Typ. 4V/1A				

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) Note1	
	DBPSK	1	
DSSS (802.11b)	DQPSK	2	
	ССК	5.5/ 11	
	BPSK	6 / 9	
OFDM (802.11g)	QPSK	12 / 18	
	16QAM	24 / 36	
	64QAM	48 / 54	
	BPSK	6.5	
OFDM	QPSK	13/19.5	
(802.11n-20MHz)	16QAM	26/39	
	64QAM	52/58.5/65	

Note1: 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
802.11b/g/ n(HT20)	3	2422	10	2457
	4	2427	11	2462
	5	2432	12	2467
	6	2437	13	2472
	7	2442		

Note1: The Lowest Channel (1), Middle Channel (7) and Highest Channel (13) was selected test for 802.11b/g/n(HT20) mode;





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	Result	Method determination /Remark
1	15.203	Antenna Requirement	N/A	N/A	PASS	No deviation
2	N/A	Duty Cycle Of Test Signal	Nov 07, 2019	Wang Meng	PASS	No deviation
3	15.247(b)	Maximum Peak and Average Conducted Output Power	Nov 08, 2019	Wang Meng	PASS	No deviation
4	15.247(a)	Bandwidth	Nov 07, 2019	Wang Meng	PASS	No deviation
5	15.247(d)	Conducted Spurious Emission and Band Edge	Nov 06, 2019	Wang Meng	PASS	No deviation
6	15.247(e)	Power Spectral Density (PSD)	Nov 06, 2019	Wang Meng	PASS	No deviation
7	15.207	Conducted Emission	N/A	N/A	N/A _{Note1}	N/A
8	15.247(d)	Restricted Frequency Bands	Nov 05, 2019	Li Zihao	PASS	No deviation
9	15.209, 15.247(d)	Radiated Emission	Nov 05, 2019	Li Zihao	PASS	No deviation

Note1: Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. This test case does not apply this kind of EUT.

Note2: The tests were performed according to the method of measurements prescribed in







ANSIC63.10-2013, KDB558074 D01 v05r02.

Note3: 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 4: Additions to, deviation, or exclusions from the method should be judged in the "method determination" column of add, deviate or exclude from the specific method should 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







2.147 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	69.47	1.58	
802.11g	30.33	5.18	
802.11n(HT20)	31.28	5.05	

B. Test Plots



(Channel 1, 2412MHz, 802.11b)



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(Channel 1, 2412MHz, 802.11g)



(Channel 1, 2412MHz, 802.11 n (HT20))

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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 exceed1 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

Channal		Measured Output Peak Power		Limit		Vordiot	
		dBm	W	dBm	W	verdict	
1	2412	17.29	0.054			PASS	
7	2442	17.25	0.053	30	1	PASS	
13	2472	16.40	0.044			PASS	

802.11g Test mode

Channel Frequency (MHz)		Measured C	output Peak Power	Limi	Vordict	
		dBm	W	dBm	W	
1	2412	19.69	0.093			PASS
7	2442	20.20	0.105	30	1	PASS
13	2472	19.85	0.097			PASS

802.11n (HT20) Test mode

Channel Fr		Measured C	output Peak Power	Limit		Vordict
		dBm	W	dBm	W	veruici
1	2412	19.44	0.088			PASS
7	2442	19.80	0.095	30	1	PASS
13	2472	19.57	0.091			PASS







Maximum Average Conducted Output Power

802.11b Test Mode

	Fraguanay		Averag	ge Power		Lin		
Channel (MUL=)		Measured	Duty	Duty factor Calculated				Verdict
		dBm	Factor	dBm	W	dBm	W	
1	2412	13.63		15.21	0.033			PASS
7	2442	13.55	1.58	15.13	0.033	30	1	PASS
13	2472	12.84		14.42	0.028			PASS

802.11g Test mode

	Fraguanay		Averag	je Power		Lim	sit		
Channel (Mul-)		Measured	Duty	Duty factor Calculated				Verdict	
	(IVITIZ)	dBm	Factor	dBm	W	dBm	W		
1	2412	5.87		11.05	0.013			PASS	
7	2442	10.46	5.18	15.64	0.037	30	1	PASS	
13	2472	9.29		14.47	0.028			PASS	

802.11n (HT20) Test mode

	Fraguanay		Averag	je Power		Lim	sit		
Channel (MUL=)		Measured	Duty	Duty factor Calculated		Linin		Verdict	
	(INITZ)	dBm	Factor	dBm	W	dBm	W		
1	2412	5.63		10.68	0.012			PASS	
7	2442	9.34	5.05	14.39	0.027	30	1	PASS	
13	2472	8.24		13.29	0.021			PASS	





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	9.11	≥500	PASS
7	2442	9.09	≥500	PASS
13	2472	9.07	≥500	PASS

B. Test Plots



(Channel 1, 802.11b)



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(Channel 7, 802.11b)



(Channel 13, 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	15.08	≥500	PASS
7	2442	15.10	≥500	PASS
13	2472	15.10	≥500	PASS

B. Test Plots:



(Channel 1, 802.11g)



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(Channel 7, 802.11g)



(Channel 13, 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	15.10	≥500	PASS
7	2442	15.09	≥500	PASS
13	2472	15.10	≥500	PASS

B. Test Plots:



(Channel 1, 802.11n(HT20))



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(Channel 7, 802.11n(HT20))



(Channel 13, 802.11n(HT20))

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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	-38.89	5.65	-14.35	PASS
7	2442	-38.76	5.57	-14.43	PASS
13	2472	-38.33	4.39	-15.61	PASS

B. Test Plots:



(Channel = 1, 30MHz to 25GHz)



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(Band Edge, Channel = 1)



(Channel = 7, 30MHz to 25GHz)

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Agilent Spectr	rum Analyzer - Sw	vept SA					
📈 Marker 2	RF 50 G	2 AC	SENSE	E:PULSE SOURCE OFF	ALIGN AUTO Type: Log-Pwr	02:08:28 PM Nov 06, 2019 TRACE 123456	Peak Search
	201101021	PNO: F IEGain:	ast 🕞 Trig: Free nw Atten: 24	eRun Avg∣ dB	Hold:>10/10	DET P N N N N	
					Mkr	2 23.734 0 GHz	Next Peak
10 dB/div	Ref Offset 1: Ref 25.00	dBm				-38.328 dBm	
5.00	_ ≬'						Next Pk Right
-5.00							
-15.0							
-25.0							Next Pk Left
-35.0						<mark>2</mark>	
-45.0					a a a da d	- Antonia Art	
-55.0	a marking the second	and the state of the second	المحيدة والمحاجب المريان	and the second		للمقا عقق	Marker Delta
-65.0							
					,		
Start 30 M #Res BW	VIHZ 100 kHz		#VBW 300 kHz		Sween	Stop 25.00 GHz 387 s (10001 pts)	Mkr.,CE
MKB MODE T		×		FUNCTION			WIKI→CF
1 N 1	f	2.472 1 GH	z 4.391 dE	Bm	Tonenon wibin		
2 N 1 3	f	23.734 0 GF	Iz -38.328 dE	3m			
4 5							wikr→Rer∟vi
6							
8							More
10							1 of 2
11						~	
MSG							

(Channel = 13, 30MHz to 25GHz)



(Band Edge, Channel = 13)

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802.11g 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	-43.39	-0.03	-20.03	PASS
7	2442	-43.77	5.67	-14.33	PASS
13	2472	-43.76	3.48	-16.52	PASS

B. Test Plots:



(Channel = 1, 30MHz to 25GHz)



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(Band Edge, Channel = 1)



(Channel = 7, 30MHz to 25GHz)

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Agilent Spectrum Analyzer - Swept SA				
Marker 2 24.53805500000	0 GHz Trig: Free Bur	AUGNAUTO Avg Type: Log-Pwr Avg1Hold:>10/10	02:12:21 PMNov 06, 2019 TRACE 1 2 3 4 5 6 TYPE MWANNANY	Peak Search
Ref Offset 12 dB 10 dB/div Ref 20.00 dBm	IFGain:Low Atten: 18 dB	Mkr	2 24.538 1 GHz -43.756 dBm	Next Peak
100 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				Next Pk Right
-20.0				Next Pk Left
-50.0 -60.0 -70.0				Marker Delta
Start 30 MHz #Res BW 100 kHz MKR MODE TRC SCL ×	#VBW 300 kHz	Sweep 2	Stop 25.00 GHz 2.387 s (10001 pts) FUNCTION VALUE	Mkr→CF
2 N 1 f 24.5 3 4 5 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	38 1 GHz -43.766 dBm			Mkr→RefLv
7 8 9 10 11			×	More 1 of 2
MSG		I STATUS	3	

(Channel = 13, 30MHz to 25GHz)



(Band Edge, Channel = 13)

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802.11n (HT20) Test mode

A. Test Verdict:

		Measured Max. Out	Limi			
Channel	Frequency (MHz)	of Band Emission	Carrier	Calculated	Verdict	
		(dBm)	Level	-20dBc Limit		
1	2412	-43.66	-43.66 0.55 -19.45		PASS	
7	2442	-44.60	1.98	-18.02	PASS	
13	2472	-43.39	2.21	-17.79	PASS	

B. Test Plots:



(Channel = 1, 30MHz to 25GHz)



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(Band Edge, Channel = 1)



(Channel = 7, 30MHz to 25GHz)

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(Channel = 13, 30MHz to 25GHz)



(Band Edge, Channel = 13)

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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:

	Spect	ral power density (dBm/3kHz)		
Channel	Frequency	Manaurad BSD (dBm/2kHz)	Limit	Vordiot
Channel	(MHz) (MHz) -8 59	Weasured FSD (UBII//SKHZ)	(dBm/3kHz)	veruici
1	2412	-8.59	8	PASS
7	2442	-8.47	8	PASS
13	2472	-9.04	8	PASS

B. Test Plots:



(Channel = 1, 802.11b)



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(Channel = 7, 802.11b)



(Channel = 13, 802.11b)

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802.11g Test mode

A. Test Verd0.90t:

	S	pectral power density (dBm/3kHz)		
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-13.83	8	PASS
7	2442	-10.33	8	PASS
13	2472	-10.67	8	PASS

B. Test Plots:



(Channel = 1, 802.11g)



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(Channel = 7, 802.11g)



(Channel = 13, 802.11g)

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802.11n (HT20) Test mode

A. Test Verdict:

	S	pectral power density (dBm/3kHz)		
Channel	Frequency	Macourod BSD (dBm/2kHz)	Limit	Vordiot
Channel	(MHz)	Measured FSD (UDIII/SKHZ)	(dBm/3kHz)	veruici
1	2412	-12.97	8	PASS
7	2442	-10.61	8	PASS
13	2472	-10.70	8	PASS

B. Test Plots:



(Channel = 1, 802.11n(HT20))



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(Channel = 7, 802.11n(HT20))



(Channel = 13, 802.11n(HT20))

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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 50μ H/50 Ω 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

Note: This test case does not apply this kind of EUT.



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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 [dBµV/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

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:

Channel	Frequency	Detector	Receiver Reading	A _T	A _{Factor}	Max. Emission	Limit	Verdict
	(MHz)	PK/ AV	U _R (dBuV)	(dB)	(dB@3m)	E (dBµV/m)	(dBµV/m)	
1	2386.02	PK	52.75	-29.67	32.56	55.64	74	PASS
1	2386.13	AV	41.37	-29.67	32.56	44.26	54	PASS
13	2486.85	PK	55.31	-29.67	32.56	58.20	74	PASS
13	2486.70	AV	47.45	-29.67	32.56	50.34	54	PASS



B. Test Plots:

📕 Keysight Spectrum Analyzer - Swept SA - | 6° | 💌 ALIGN OFF Avg Type: Voltage Avg|Hold:>100/100 04:43:14 PM Nov 12, 2019 TRACE 123456 TYPE MWWWWW DET PPNNNN Marker Marker 1 2.386016000000 GHz PNO: Fast IFGain:Low Trig: Free Run Atten: 10 dB Select Marker Mkr1 2.386 02 GHz 52.750 dBµV I0 dB/div -og r Ref 106.99 dBµV Normal <mark>♦¹ ♦</mark>2 Delta **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 FUNCTION FUNC N 1 f N 1 f 52.750 dBµV 51.936 dBµV 2.386 02 GHz 2.390 00 GHz **Properties** More 1 of 2





(Channel = 1 AVG, 802.11b)



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(Channel = 13 PEAK, 802.11b)



(Channel = 13 AVG, 802.11b)

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802.11g Test mode

A. Test Verdict:

Channel	Frequency	Detector	Receiver Reading	A _T	A _{Factor}	Max. Emission	Limit	Vordiat
Channel	(MHz)	PK/ AV	U _R (dBuV)	(dB)	(dB@3m)	E (dBµV/m)	(dBµV/m)	verdict
1	2390.00	PK	56.79	-29.67	32.56	59.68	74	PASS
1	2390.00	AV	37.47	-29.67	32.56	40.36	54	PASS
13	2485.94	PK	66.09	-29.67	32.56	68.98	74	PASS
13	2483.50	AV	43.18	-29.67	32.56	46.07	54	PASS

B. Test Plots:



(Channel = 1 PEAK, 802.11g)

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L RPPRESEL 50 Q DC SENSE.INT AALGN OF 07.12.11 PMKvv12, 2019 Marker Kcr 1 2.3389552000000 GHz PN0: Fast Trig: Free Run Atten: 10 dB Avg1yHold:>100/100 Tracc Lip Mikvv12, 2019 Steel tracc Mikvv12, 2019 Normal Stop 2,41200 GHz Stop 2,41200 GHz Stop 2,41200 GHz GHr N 1 f 2.399 55 GHz 37.439 dBNV Stop 2,41200 GHz Off N 1 f 2.399 00 GHz 37.470 dBNV Stop 2,41200 GHz Properties Mikvv12,239 Off N 1 f 2.399 00 GHz 37.470 dBNV S								Swept SA	Analyzer	t Spectrum	Keysight
PNO: Fast Trig: Free Run Avgl/Idd:>100/100 Image: Ref Select Marker Select Mar	07:12:11 PM Nov 12, 2019 TRACE 123456	07:12:11	ALIGN OFF e: Voltage	Avg	SE:INT	SEN	GHz	0Ω DC 20000000	ESEL 5	RF PR	^{RL} arker
Mkr1 2.389 55 GHz 37.439 dBµV Mkr1 2.389 55 GHz 37.439 dBµV B/div Ref 106.99 dBµV Normal Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Tract Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Tract Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Tract Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Tract Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Tract Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Tract Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Tract Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Tract Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Tract Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz			l:>100/100	Avg∣⊦	Run dB	Trig: Free Atten: 10	PNO: Fast G FGain:Low				
Normal Normal Delta	r1 2.389 55 GHz 37.439 dBµV	(r1 2.38 37.4	Mk					99 dBµV	ef 106.	v Re	dB/div
Image: Stop 2.41200 GHz Image: Stop 2.41200 GHz Image: Stop 2.4120 GHz Image: Stop 2.41200 GHz <th></th> <th>7.0</th>											7.0
Image: Delta Image: Delta <td< th=""><th></th><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>7.0</td></td<>											7.0
X Y Function Function Function Function Function Function Punction Punction<											7.0
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More 1 of 2											
1 of 2											7
	•		07.17			11					

(Channel = 1 AVG, 802.11g)



(Channel = 13 PEAK, 802.11g)

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Properties	E	FONCTIO	FONCTION WIDTH			43.179 dBµ 43.071 dBµ	500 GHz 660 GHz	2.483 2.483			N N
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	•	; ;	STATUS			III				_	_

(Channel = 13 AVG, 802.11g)





802.11 n (HT20) Test mode

A. Test Verdict:

Channel	Frequency	Detector	Receiver Reading	A _T	A _{Factor}	Max. Emission	Limit	Verdict
	(1011 12)	PK/ AV	(dBuV)	(UD)	(ub@olli)	∟ (dBµV/m)	(ασμν/π)	
1	2388.48	PK	50.29	-29.67	32.56	53.18	74	PASS
1	2390.00	AV	36.37	-29.67	32.56	39.26	54	PASS
13	2483.81	PK	62.72	-29.67	32.56	65.61	74	PASS
13	2483.50	AV	38.92	-29.67	32.56	41.81	54	PASS

B. Test Plots:



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







🎉 Keysight Spectrum Analyzer - Swept SA				
RL REPRESEL 50 Ω DC Marker 1 2.389376000000	GHz	ALIGN OFF	08:54:10 PM Nov 12, 2019 TRACE 123456	Marker
	PNO: Fast Trig: Free R IFGain:Low Atten: 10 d	un Avg Hold:>100/100 B	DET A P N N N N	Salact Marker
		Mk	1 2.389 38 GHz	
10 dB/div Ref 106.99 dBµV			36.311 dBµV	
97.0				
87.0				Normal
77.0				
67.0				
57.0				Delta
47.0			1	
37.0				
27.0				Fixed⊳
17.0				
Start 2.30000 GHz		_	Stop 2.41200 GHz	
Res BW (CISPR) 1 MHz	#VBW 3.0 MHz	Sweep	12.84 s (1001 pts)	Off
MKR MODE TRC SCL X	Y 9 38 GHz 36.311 dBu	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	
2 N 1 f 2.39	0 00 GHz 36.373 dBµ\			
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(Channel = 1 AVG, 802.11n(HT20))



(Channel = 13 PEAK, 802.11n(HT20))

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Marker	Nov 14, 2019 123456 MWWWWW A P N N N N	01:00:31 AN TRAC TYP DE	ALIGN OFF Type: Voltage Hold:>100/100	Avg Avg	NSE:INT e Run	SE Trig: Fre	Hz PNO: Fast ⊊	ept SA DC 00000 G	nalyzer - Sw SEL 50 Ω 36980	ctrum A RF PRES 2.48	ght Spect R er 2 2	E Keysi RL Iark
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Fixed												37.0 - 27.0 - 17.0 -
Of	000 GHz 001 pts)	Stop 2.50 4.357 s (′	Sweep	,		3.0 MHz	#VBW	łz	GHz R) 1 MH	200 (CISPI	2.462 W (C	Start Res E
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		<u>s</u>	STATUS									SG

(Channel = 13 AVG, 802.11n(HT20))



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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

Note1: 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.

Note2: 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







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.

Note1: 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.

Note2: 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.

Note3: 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 = 7



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plot for Channel = 13



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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802.11g Test mode

Plots for Channel = 1



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plot for Channel = 7



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plot for Channel = 13



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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802.11n (HT20) Test mode





(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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 Tel: 86-755-36698555 Http://www.morlab.cn

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Plot for Channel = 7



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plot for Channel = 13



(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





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.		
	Morlab Laboratory		
	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	Resent	N/A	N/A
EXA Signal Analyzer	MY53470836	N9010A	Agilent	2019.04.09	2020.04.08
USB Wideband Power Sensor	MY54210011	U2021XA	Agilent	2019.04.16	2020.04.15
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 List of Software Used

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





4.4 Radiated Test Equipments

Equipment	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Name		- 76-5			
Receiver	MY54130016	N9038A	Agilent	2019.07.26	2020.07.25
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2019.05.08	2020.05.09
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2019.02.15	2020.02.14
Test Antenna – Horn	01774	BBHA 9120D	Schwarzbeck	2019.07.26	2020.07.25
Test Antenna – Horn	BBHA9170 #774	BBHA9170	Schwarzbeck	2019.07.26	2020.07.25
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	MA02	TS-PR18	Rohde& Schwarz	2019.05.08	2020.05.09
18-26.5GHz pre-Amplifier	MA03	TS-PR18	Rohde& Schwarz	2019.05.08	2020.05.09
Notch Filter	N/A	WRCG-2400- 2483.5-60SS	Wainwright	2018.12.01	2019.11.30
Anechoic Chamber	N/A	9m*6m*6m	CRT	2017.11.19	2020.11.18

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