

Report No.: FR782206-02

FCC RADIO TEST REPORT

FCC ID

: TE7WPA4220V4

Equipment

: 300Mbps Wi-Fi Range Extender, AV600 Powerline

Edition

Brand Name

: tp-link

Model Name

: TL-WPA4220

Applicant

: TP-Link Technologies Co., Ltd.

Building 24 (floors 1,3,4,5) and 28 (floors1-4), Central Science and Technology Park, Nanshan

Shenzhen, 518057 China

Manufacturer : TP-Link Technologies Co., Ltd.

Building 24 (floors 1,3,4,5) and 28 (floors1-4), Central Science and Technology Park, Nanshan

Shenzhen, 518057 China

Standard

: 47 CFR FCC Part 15.247

The product was received on Apr. 11, 2018, and testing was started from May 28, 2018 and completed on Jun. 08, 2018. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

TEL: 886-3-656-9065 FAX: 886-3-656-9085

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History of this test report

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Report No.	Version	Description	Issued Date
FR782206-02	01	Initial issue of report	Jul. 18, 2018

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Summary of Test Result

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Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	-
3.1	15.207	AC Power-line Conducted Emissions	PASS	-
3.2	15.247(d)	Emissions in Restricted Frequency Bands	PASS	-

Reviewed by: Sam Chen Report Producer: Vicky Huang

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1 General Description

1.1 Information

1.1.1 RF General Information

Frequency Range (MHz)	IEEE Std. 802.11	Ch. Frequency (MHz)	Channel Number
2400-2483.5	b, g, n (HT20	2412-2462	1-11 [11]
2400-2483.5	n (HT40)	2422-2452	3-9 [7]

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Band	Mode	BWch (MHz)	Nant
2.4-2.4835GHz	802.11b	20	2TX
2.4-2.4835GHz	802.11g	20	2TX
2.4-2.4835GHz	802.11n HT20	20	2TX
2.4-2.4835GHz	802.11n HT40	40	2TX

Note:

- ◆ 11b mode uses a combination of DSSS-DBPSK, DQPSK, CCK modulation.
- 11g, HT20 and HT40 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation.
- BWch is the nominal channel bandwidth.
- Nss-Min is the minimum number of spatial streams.
- Nant is the number of outputs. e.g., 2(2,3) means have 2 outputs for port 2 and port 3. 2 means have 2 outputs for port 1 and port 2.

1.1.2 Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	-	-	Printed Antenna	N/A	2
2	-	-	Printed Antenna	N/A	2

For IEEE 802.11b/g/n mode (2TX, 2RX):

Ant. 1(Port 1) and Ant. 2(Port 2) can be used as transmitting/receiving antenna.

Ant. 1(Port 1) and Ant. 2(Port 2) could transmit/receive simultaneously.

1.1.3 Mode Test Duty Cycle

Mode	DC	DCF(dB)	T(s)	VBW(Hz) ≥ 1/T
802.11b	0.973	0.119	8.418m	300
802.11g	0.861	0.65	1.397m	1k
802.11n HT20	0.841	0.752	1.309m	1k
802.11n HT40	0.729	1.373	617.5u	3k

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1.1.4 EUT Operational Condition

EUT Power Type	From Internal Power Supply			
Beamforming Function	ion ☐ With beamforming ☐ Without beamforming			Without beamforming
Function	\boxtimes	Point-to-multipoint		Point-to-point

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1.1.5 Table for Class II Change

This product is an extension of original one reported under Sporton project number: FR782206-05 Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
	1. AC Power-line Conducted Emissions
	2. Emissions in Restricted Frequency Bands
	below 1GHz
Undating of EUT version to "Version 04" from "Version 02"	11b 2437 MHz generated the worst case
Updating of EUT version to "Version 04" from "Version 03".	from original, thus only test 11b 2437 MHz
	for below items:
	3. Emissions in Restricted Frequency Bands
	above 1GHz

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1.2 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

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- 47 CFR FCC Part 15
- ANSI C63.10-2013
- FCC KDB 558074 D01 v04
- FCC KDB 662911 D01 v02r01

1.3 Testing Location Information

	Testing Location							
	HWA YA	ADD	:	No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)				
		TEL	:	886-3-327-3456 FAX : 886-3-327-0973				
\boxtimes	JHUBEI	ADD	:	No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C.				
		TEL	:	886-3-656-9065 FAX : 886-3-656-9085				

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
Radiated	03CH01-CB	Joy Tseng	22°C / 54%	May 28, 2018
AC Conduction	CO01-CB	Wei Li	25°C / 61%	Jun. 08, 2018

Test site Designation No. TW0006 with FCC.

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	3.2 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	3.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%

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Test site registered number IC 4086D with Industry Canada.

2 Test Configuration of EUT

2.1 Test Channel Mode

Mode	Power Setting
802.11b_(1Mbps)_2TX	-
2412MHz	22
2437MHz	28
2462MHz	24
802.11g_(6Mbps)_2TX	-
2412MHz	1A
2437MHz	2A
2462MHz	1B
802.11n HT20_Nss1,(MCS0)_2TX	-
2412MHz	1A
2437MHz	2A
2462MHz	1B
802.11n HT40_Nss1,(MCS0)_2TX	-
2422MHz	15
2437MHz	1D
2452MHz	16

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2.2 The Worst Case Measurement Configuration

Ti	The Worst Case Mode for Following Conformance Tests						
Tests Item	AC power-line conducted emissions						
Condition	AC power-line conducted measurement for line and neutral						
Operating Mode	СТХ						

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Th	e Worst Case Mode for Following Conformance Tests					
Tests Item	Emissions in Restricted Frequency Bands					
Test Condition	Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.					
Operating Mode < 1GHz CTX						
	t Y axis and Z axis position for Radiated emission above 1GHz test, and the worst So the measurement will follow this same test configuration.					
1	EUT in Y axis					
Operating Mode > 1GHz	CTX					
The EUT was performed at Y axis and Z axis position, and the worst case was found at Y axis. measurement will follow this same test configuration.						
2	EUT in Y axis					

2.3 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

2.4 Accessories

N/A

2.5 Support Equipment

For Test Site No: CO01-CB

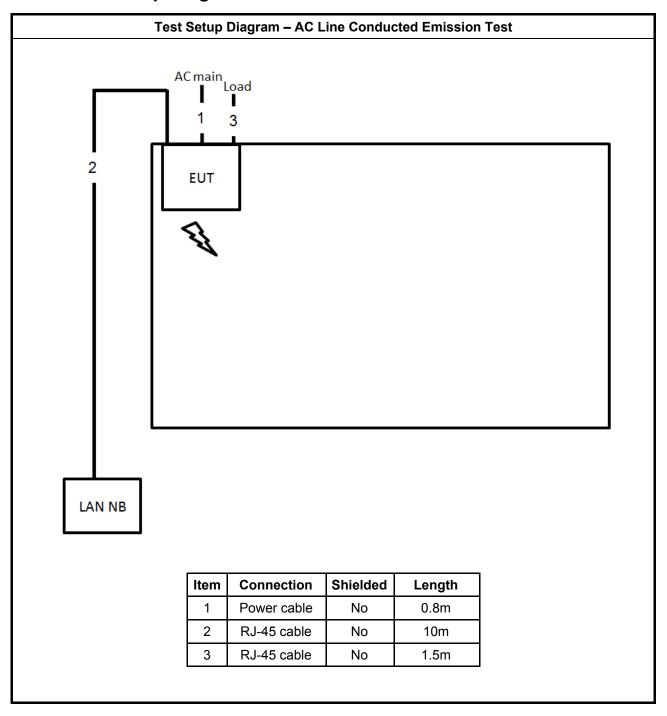
	Support Equipment								
No.	No. Equipment Brand Name Model Name FCC ID								
1	1 NB DELL E6430 N/A								

For Test Site No: 03CH01-CB

Support Equipment									
No.	No. Equipment Brand Name Model Name FCC ID								
1	1 NB DELL E4300 N/A								

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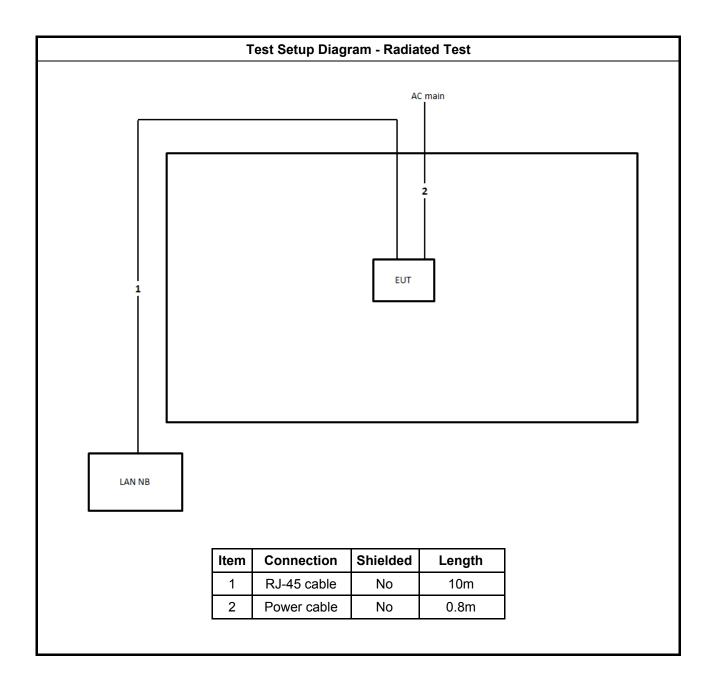
2.6 Test Setup Diagram



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3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line Conducted Emissions Limit Frequency Emission (MHz) Quasi-Peak Average									
0.5-5	56	46							
5-30 60 50									
Note 1: * Decreases with the logarithm of the frequency.									

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3.1.2 Measuring Instruments

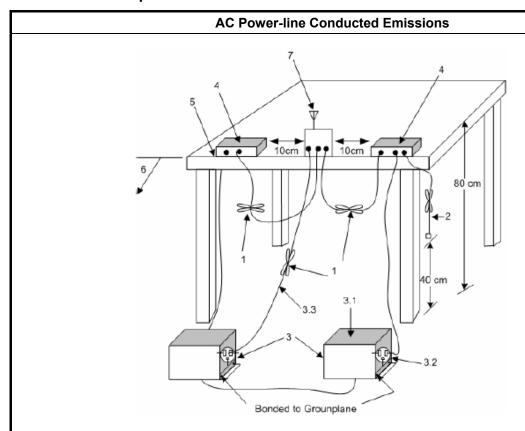
Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method
Refer as ANSI C63.10-2013, clause 6.2 for AC power-line conducted emissions.

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3.1.4 Test Setup



1—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long.

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- 2—The I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- 3—EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN may be placed on top of, or immediately beneath, reference ground plane.
- 3.1—All other equipment powered from additional LISN(s).
- 3.2—A multiple-outlet strip may be used for multiple power cords of non-EUT equipment.
- 3.3—LISN at least 80 cm from nearest part of EUT chassis.
- 4—Non-EUT components of EUT system being tested.
- 5—Rear of EUT, including peripherals, shall all be aligned and flush with edge of tabletop.
- 6—Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.
- 7—Antenna can be integral or detachable. If detachable, then the antenna shall be attached for this test.

3.1.5 Test Result of AC Power-line Conducted Emissions

Refer as Appendix A

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3.2 Emissions in Restricted Frequency Bands

3.2.1 Emissions in Restricted Frequency Bands Limit

Restricted Band Emissions Limit										
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)							
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300							
0.490~1.705	24000/F(kHz)	33.8 - 23	30							
1.705~30.0 30		29	30							
30~88 100		40	3							
88~216 150		43.5	3							
216~960 200		46	3							
Above 960	500	54	3							

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- Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).
- Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.
- Note 3: Using the distance of 1m during the test for above 18 GHz, and the test value to correct for the distance factor at 3m.

3.2.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

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3.2.3 Test Procedures

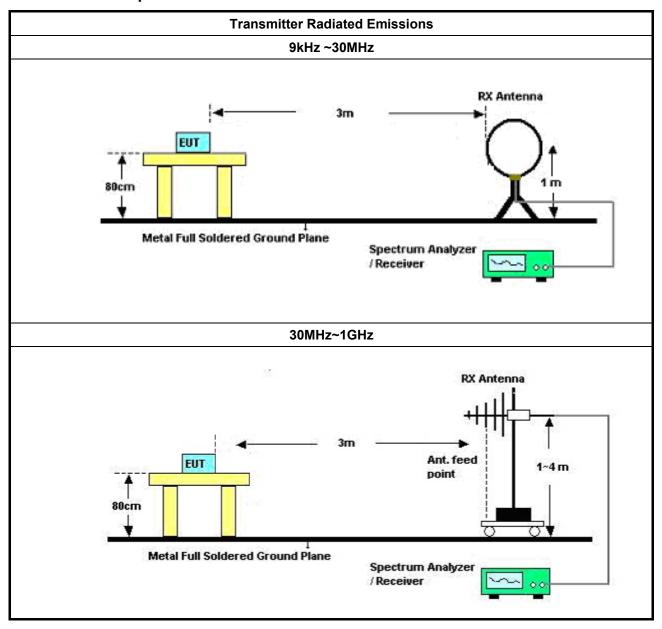
	Test Method
•	The average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].
•	Refer as ANSI C63.10, clause 6.9.2.2 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.
•	For the transmitter unwanted emissions shall be measured using following options below:
	 Refer as FCC KDB 558074, clause 12 for unwanted emissions into restricted bands.
	☐ Refer as FCC KDB 558074, clause 12.2.5.1 Option 1 (trace averaging for duty cycle ≥98%)
	Refer as FCC KDB 558074, clause 12.2.5.2 Option 2 (trace averaging + duty factor).
	Refer as FCC KDB 558074, clause 12.2.5.3 Option 3 (Reduced VBW≥1/T).
	☐ Refer as ANSI C63.10, clause 4.2.3.2.3 (Reduced VBW). VBW ≥ 1/T, where T is pulse time.
	Refer as ANSI C63.10, clause 4.2.3.2.4 average value of pulsed emissions.
	Refer as FCC KDB 558074, clause 12.2.4 measurement procedure peak limit.
•	For the transmitter band-edge emissions shall be measured using following options below:
	 Refer as FCC KDB 558074 clause 13.1, When the performing peak or average radiated measurements, emissions within 2 MHz of the authorized band edge may be measured using the marker-delta method described below.
	 Refer as FCC KDB 558074, clause 13.2 (ANSI C63.10, clause 6.9.3) for marker-delta method for band-edge measurements.
	 Refer as FCC KDB 558074, clause 13.3 for narrower resolution bandwidth (100kHz) using the band power and summing the spectral levels (i.e., 1 MHz).
•	For conducted and cabinet radiation measurement, refer as FCC KDB 558074, clause 12.2.2.
	 For conducted unwanted emissions into restricted bands (absolute emission limits). Devices with multiple transmit chains using options given below: (1) Measure and sum the spectra across the outputs or (2) Measure and add 10 log(N) dB
	For FCC KDB 662911 The methodology described here may overestimate array gain, thereby resulting in apparent failures to satisfy the out-of-band limits even if the device is actually compliant. In such cases, compliance may be demonstrated by performing radiated tests around the frequencies at which the apparent failures occurred.

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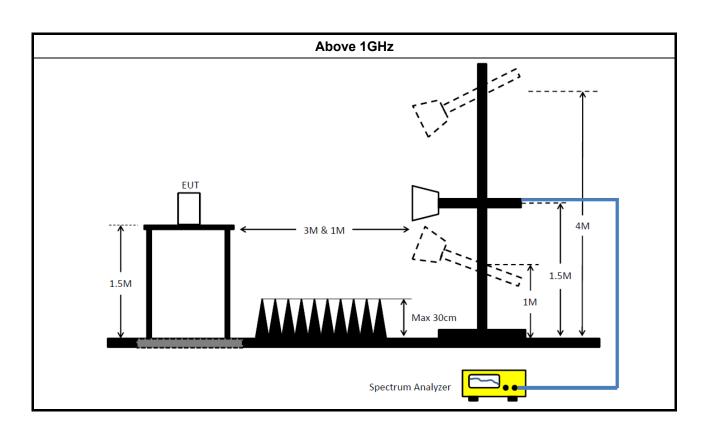
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3.2.4 Test Setup



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3.2.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10 harmonic or 40 GHz, whichever is appropriate.

3.2.6 Test Result of Transmitter Radiated Unwanted Emissions

Refer as Appendix B

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4 Test Equipment and Calibration Data

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.45GHz	Jan. 31, 2018	Jan. 30, 2019	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50- 16-2	04083	150kHz ~ 100MHz	Dec. 20, 2017	Dec. 19, 2018	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	8127647 9kHz ~ 30MHz Dec. 29, 2017 Dec. 28, 2018		Conduction (CO01-CB)	
COND Cable	Woken	Cable	Low cable-CO01	150kHz ~ 30MHz	May 22, 2018	May 21, 2019	Conduction (CO01-CB)
Software	Audix	E3	6.120210n	-	N.C.R.	N.C.R.	Conduction (CO01-CB)
BILOG ANTENNA with 6dB Attenuator	TESEQ & EMCI	CBL6112D & N-6-06	37880 & AT-N0609			Aug. 29, 2018	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 16, 2018	Mar. 15, 2019	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Nov. 20, 2017	Nov. 19, 2018	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 05, 2017	Jul. 04, 2018	Radiation (03CH01-CB)
Pre-Amplifier	EMCI	EMC330N	980332	20MHz ~ 3GHz	May 02, 2018	May 01, 2019	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 09, 2018	Jan. 08, 2019	Radiation (03CH01-CB)
Pre-Amplifier	MITEQ	TTA1840-35-H G	1864479	18GHz ~ 40GHz	Jul. 10, 2017	Jul. 09, 2018	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Nov. 23, 2017	Nov. 22, 2018	Radiation (03CH01-CB)
EMI Test	R&S	ESCS	100354	9kHz ~ 2.75GHz	Dec. 08, 2017	Dec. 07, 2018	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-16+17	N/A	30 MHz ~ 1 GHz	Oct. 11, 2017	Oct. 10, 2018	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16	N/A	1 GHz ~ 18 GHz	Oct. 11, 2017	Oct. 10, 2018	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16+17	N/A	1 GHz ~ 18 GHz	Oct. 11, 2017	Oct. 10, 2018	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#1	N/A	18GHz ~ 40 GHz	Oct. 11, 2017	Oct. 10, 2018	Radiation (03CH01-CB)

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Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
RF Cable-high	Woken	High Cable-40G#2	N/A	18GHz ~ 40 GHz	Oct. 11, 2017	Oct. 10, 2018	Radiation (03CH01-CB)

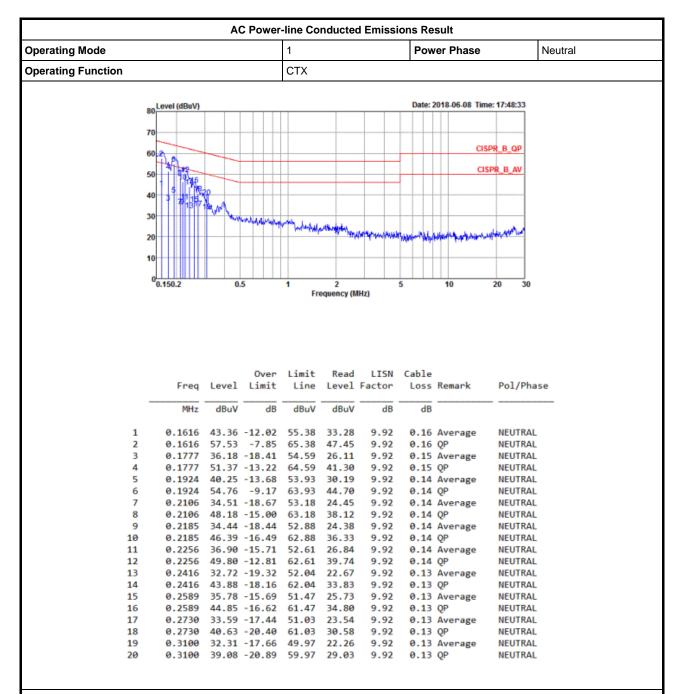
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Note: Calibration Interval of instruments listed above is one year. NCR means Non-Calibration required.

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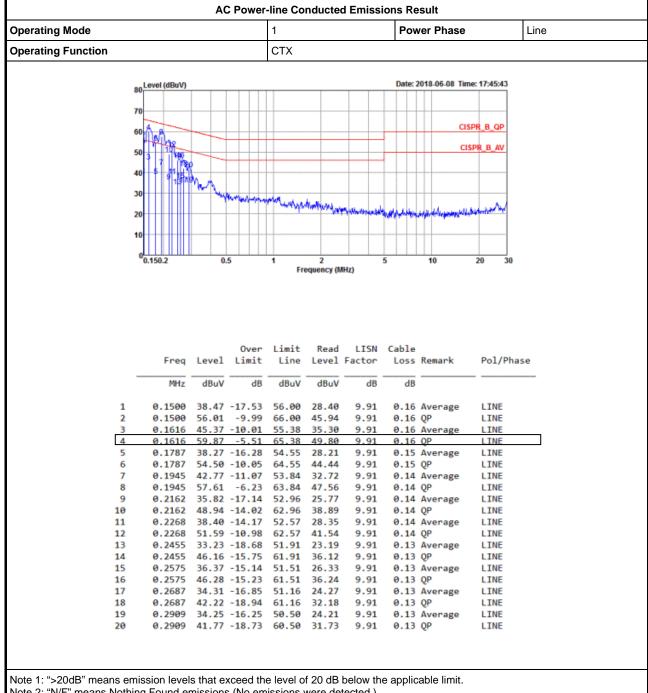
AC Power-line Conducted Emissions Result



Note 1: ">20dB" means emission levels that exceed the level of 20 dB below the applicable limit.

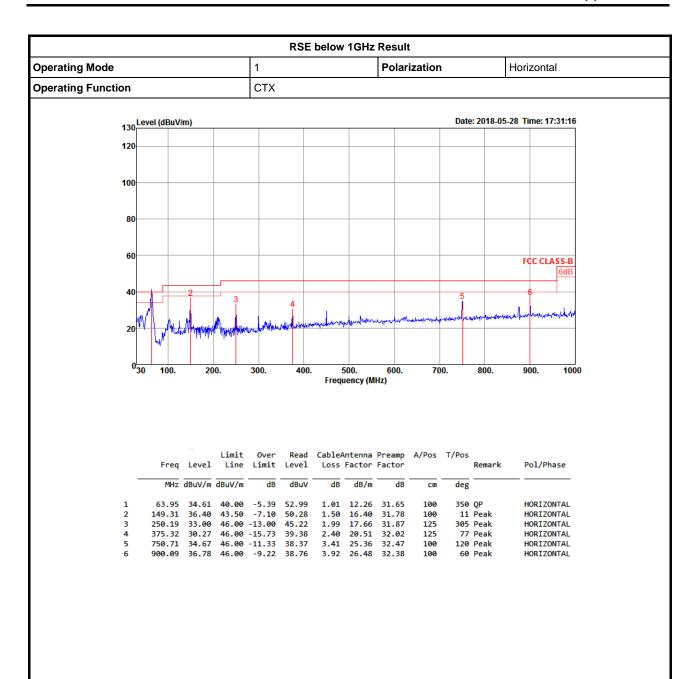
Note 2: "N/F" means Nothing Found emissions (No emissions were detected.)

AC Power-line Conducted Emissions Result



Note 2: "N/F" means Nothing Found emissions (No emissions were detected.)

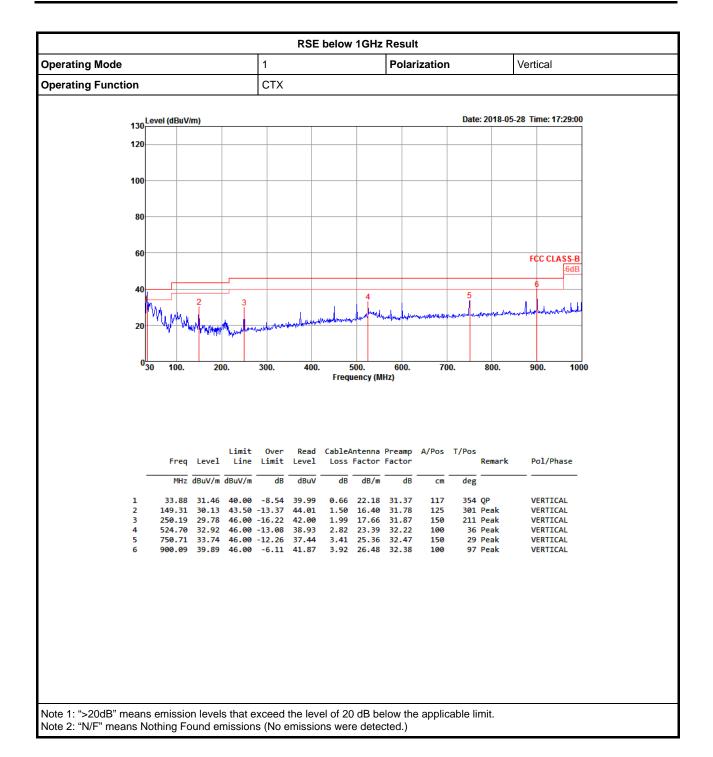




Note 1: ">20dB" means emission levels that exceed the level of 20 dB below the applicable limit.

Note 2: "N/F" means Nothing Found emissions (No emissions were detected.)







RSE TX above 1GHz Result

Appendix B.2

Summary

Mode	Result	Туре	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comments
			(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)	
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-
802.11b_Nss1,(1Mbps)_2TX	Pass	AV	2.367G	53.13	54.00	-0.87	33.15	3	Horizontal	36	2.49	-



