



FCC RADIO TEST REPORT

FCC ID : Q87-EA8300
Equipment : Linksys Tri-Band Wireless-AC Router
Brand Name : Linksys
Model Name : EA8300, EA8250, MR8300, MR8250
Applicant : Linksys LLC
121 Theory, Irvine CA 92617, United States
Standard : 47 CFR FCC Part 15.247

The product was received on Jul. 27, 2018, and testing was started from Jul. 31, 2018 and completed on Aug. 28, 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 standards.

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.



Approved by: Sam Chen

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



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History of this test report

[illegible]



Summary of Test Result

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 Non-restricted Frequency Bands	PASS	-

Reviewed by: Sam Chen**Report Producer: Sandy Chuang**

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), ac (VHT20)	2412-2462	1-11 [11]
2400-2483.5	n (HT40), ac (VHT40)	2422-2452	3-9 [7]

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	802.11g-BF	20	2TX
2.4-2.4835GHz	802.11n HT20	20	2TX
2.4-2.4835GHz	802.11n HT20-BF	20	2TX
2.4-2.4835GHz	802.11ac VHT20	20	2TX
2.4-2.4835GHz	802.11ac VHT20-BF	20	2TX
2.4-2.4835GHz	802.11n HT40	40	2TX
2.4-2.4835GHz	802.11n HT40-BF	40	2TX
2.4-2.4835GHz	802.11ac VHT40	40	2TX
2.4-2.4835GHz	802.11ac VHT40-BF	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.
- ♦ VHT20, VHT40 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM, 256QAM 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	P/N	Type	Connector	Gain (dBi)	
					2.4GHz	5GHz Band 3, 4
1	ARISTOTLE	RFA-52-F90S-240-165	Dipole	I-PEX	2.70	3.14
2	ARISTOTLE	RFA-52-F90-195-105	Dipole	I-PEX	2.06	3.47
Ant.	Brand	P/N	Type	Connector	5GHz Band 1, 2	
3	ARISTOTLE	RFA-05-F90-120	Dipole	I-PEX	3.59	
4	ARISTOTLE	RFA-05-F90S-165	Dipole	I-PEX	3.49	
Ant.	Brand	P/N	Type	Connector	Bluetooth	
5	PSA	RFMTA271200NNAB003	PIFA	N/A	2.54	

Note: The EUT has five antennas.

For WLAN 2.4GHz (2TX/2RX):

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

For WLAN 5GHz (2TX/2RX):

For 5GHz Band 3, 4: Ant. 1 (Port 1) and Ant. 2 (Port 2) could transmit/receive simultaneously.

For 5GHz Band 1, 2: Ant. 3 (Port 1) and Ant. 4 (Port 2) could transmit/receive simultaneously.

For Bluetooth (1TX/1RX):

Only Ant. 5 (Port 1) can be used as transmitting/receiving antenna.

1.1.3 EUT Operational Condition

EUT Power Type	From power adapter			
Beamforming Function	☒	With beamforming	☐	Without beamforming
	The product has beamforming function for 802.11a/g/n/ac.			

1.1.4 Table for Multiple Listing

The EUT has four model names which are identical to each other in all aspects except for the following table:

EUT	Model name	Support 256QAM	Software Versions	Equip Adapter	LED design	Support Function	Description
1	EA8300	Yes	1.1.1.179884	Adapter 1~4	Please refer to the Photographs of EUT	AP, Bridge	All models are identical except for the EA8300 supports 256QAM and the EA8250 disable 256QAM.
2	EA8250	No			Same as EUT 1	AP, Bridge	
3	MR8300	Yes	1.1.1.189701	Adapter 1~4	Please refer to the Photographs of EUT	AP	All models are identical; different models serve as marketing strategy.
4	MR8250				Same as EUT 3	AP	

From the above models, model: EA8300 (EUT 1) and MR8300 (EUT 3) were selected as representative model for the test and its data was recorded in this report.

1.1.5 Table for Class II Change

This product is an extension of original one reported under Sporton project number: FR710901AA

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
1. Change the software version to "1.1.1.189701" for the two new model names: MR8300 and MR8250. 2. Removing the bridge Mode for the two new model names: MR8300 and MR8250.	Do not effect the test results.
3. Adding a new adapter 4 (Model: KSA-24W-120200HU). 4. Change the LED design for the two new model names: MR8300 and MR8250. 5. Adding two model names: MR8300 and MR8250. The difference between old and new model names, please refer to section 1.1.4Table for Multiple Listing.	1. Conducted Emissions 2. Emissions in Restricted Frequency Bands (Below 1GHz)

1.2 Testing Applied Standards

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

- ◆ 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, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.	TEL : 886-3-327-3456	FAX : 886-3-318-0055
☒	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	Lance Wu / KJ Huang	22°C / 54%	Jul. 31, 2018~Aug. 28, 2018
AC Conduction	CO01-CB	Deven Huang / Max Lin	23°C / 60%	Aug. 03, 2018~Aug. 28, 2018

Test site Designation No. TW0006 with FCC.

Test site registered number IC 4086D with Industry Canada.

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%

2 Test Configuration of EUT

2.1 The Worst Case Measurement Configuration

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	Normal Link
1	EUT 1 with Adapter 4
2	EUT 3 with Adapter 1
3	EUT 3 with Adapter 2
4	EUT 3 with Adapter 3
5	EUT 3 with Adapter 4
For operating mode 2 is the worst case and it was record in this test report.	

The 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	Normal Link
1	Place EUT 1 in Z axis with Adapter 4
2	Place EUT 1 in Y axis with Adapter 4
Mode 1 has been evaluated to be the worst case among Mode 1~2, thus measurement for Mode 3~6 will follow this same test mode.	
3	Place EUT 3 in Z axis with Adapter 1
4	Place EUT 3 in Z axis with Adapter 2
5	Place EUT 3 in Z axis with Adapter 3
6	Place EUT 3 in Z axis with Adapter 4
Mode 1 generated the worst test result, so it was recorded in this report.	

Note: The customer designated the AP mode to perform all test and its test result was written in the report.

2.2 EUT Operation during Test

During the test, the EUT operation to normal function.

2.3 Accessories

Power	Brand	Model	Rating
Adapter 1	LEI	MU24-Y120200-A1	Input: 100-240V~50/60Hz, 0.7A Output: 12V, 2.0A
Adapter 2	DVE	DSA-24PFM-12 FUS 120200	Input: 100-240V~50/60Hz, 0.8A Output: +12V, 2A
Adapter 3	DVE	DSA-24PFM-12 FCA 120200	Input: 100-240V, 50/60Hz, 0.8A Output: 12V, 2A
Adapter 4	Ktec	KSA-24W-120200HU	Input: 100-240V~50/60Hz, 0.6A Output: 12V, 2.0A
Others			
Plug*1 (for adapter 3 use only)			
RJ-45 Cable*1: Non-Shielded, 0.9m			

2.4 Support Equipment

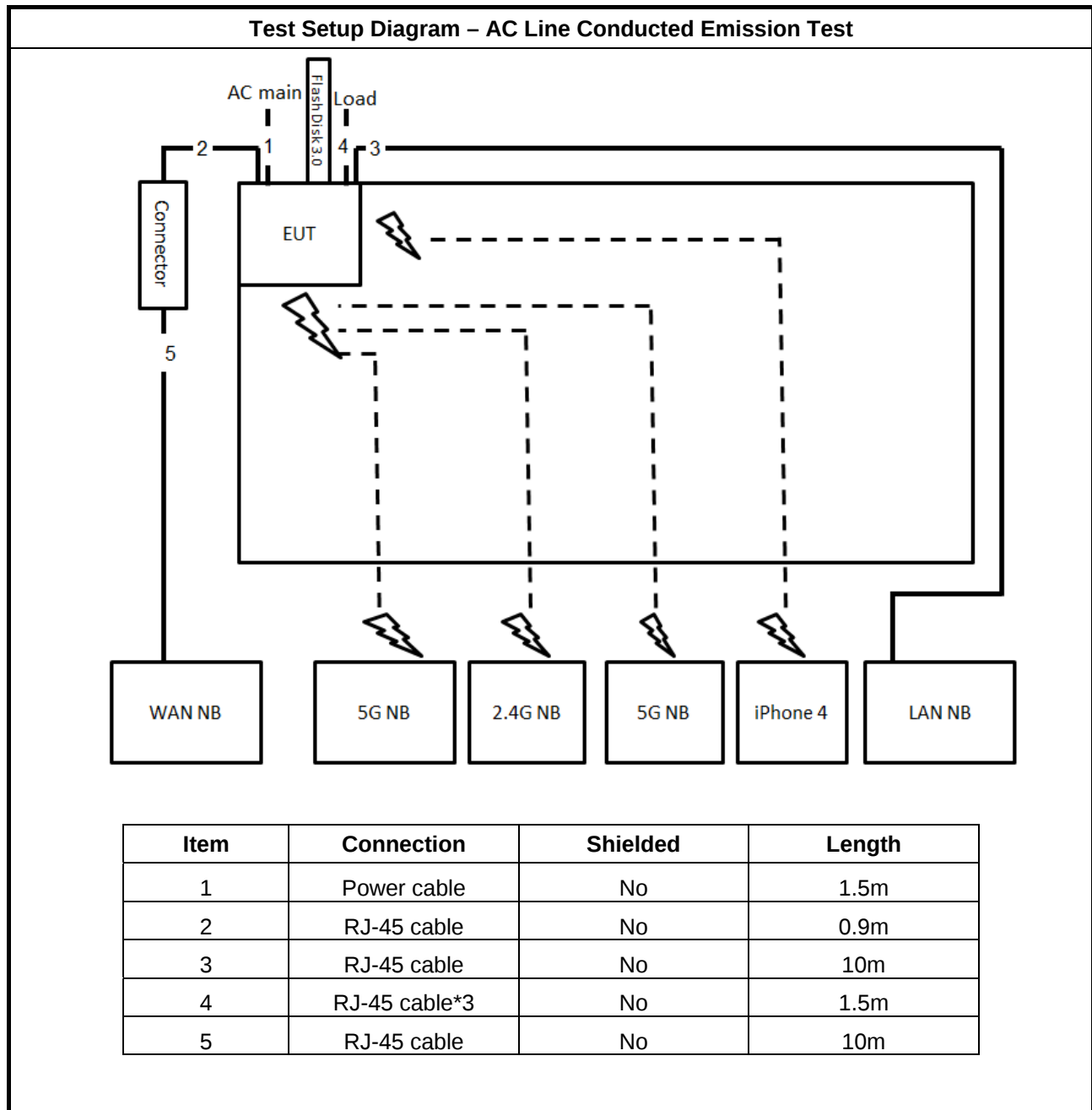
For Test Site No: CO01-CB

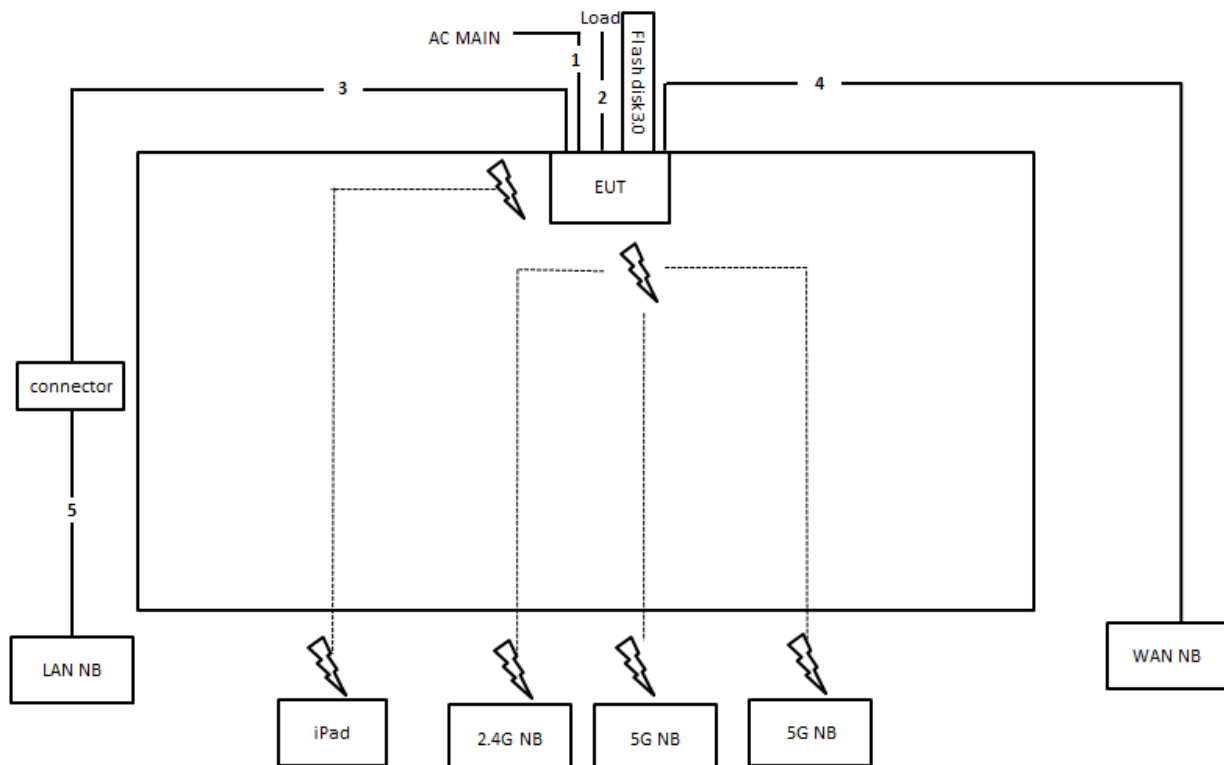
Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID
1	NB*5	DELL	E6430	N/A
2	iPhone 4	Apple	A1332	N/A
3	Flash disk3.0	Transcend	JetFlash-700	N/A

For Test Site No: 03CH01-CB

Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID
1	NB*2	DELL	E4300	N/A
2	NB*3	Apple	Mac Book	N/A
3	iPad	Apple	A1430	N/A
4	Flash disk3.0	Transcend	JetFlash-700	N/A

2.5 Test Setup Diagram



Test Setup Diagram - Radiated Test


Item	Connection	Shielded	Length
1	Power cable	No	1.5m
2	RJ-45 cable*3	No	1.5m
3	RJ-45 cable	No	0.9m
4	RJ-45 cable	No	10m
5	RJ-45 cable	No	10m

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
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: * Decreases with the logarithm of the frequency.

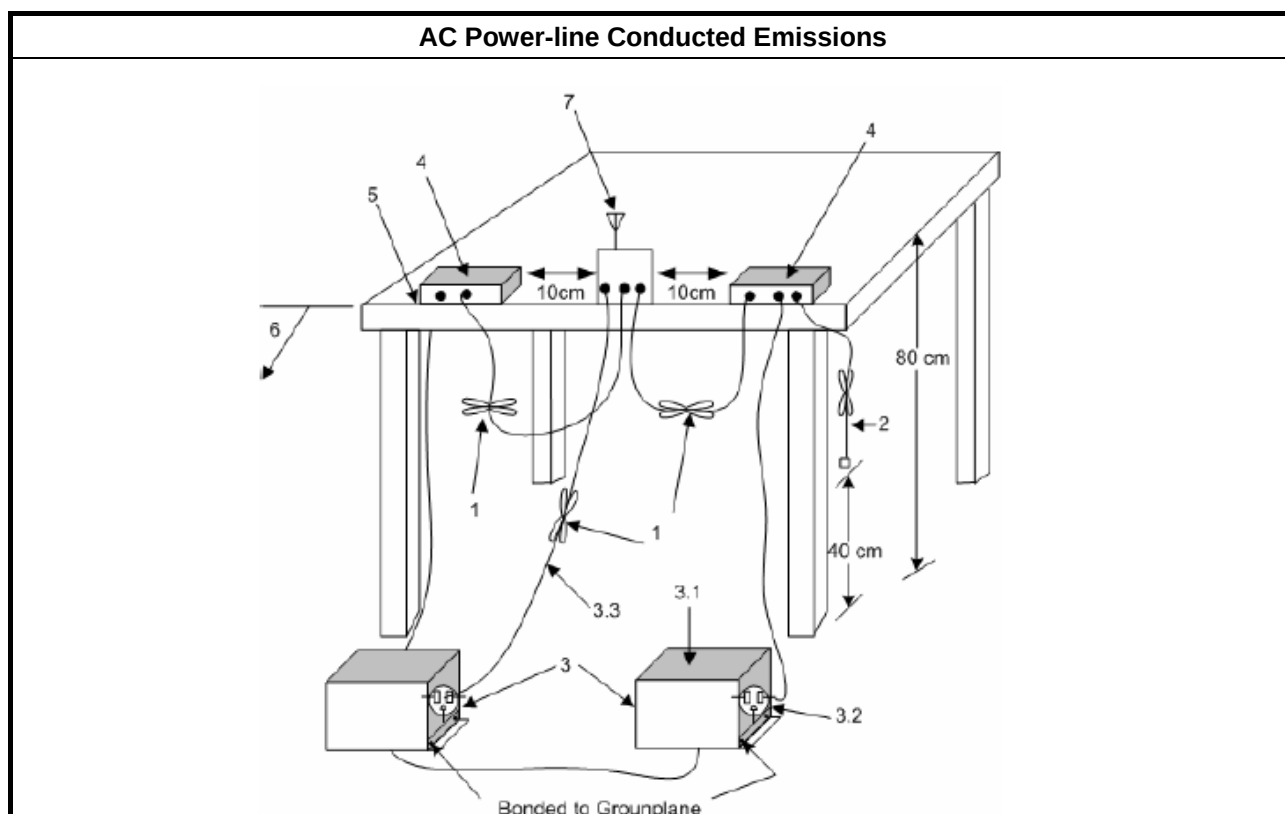
3.1.2 Measuring Instruments

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.

3.1.4 Test Setup



3.1.5 Test Result of AC Power-line Conducted Emissions

Refer as Appendix A

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

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.

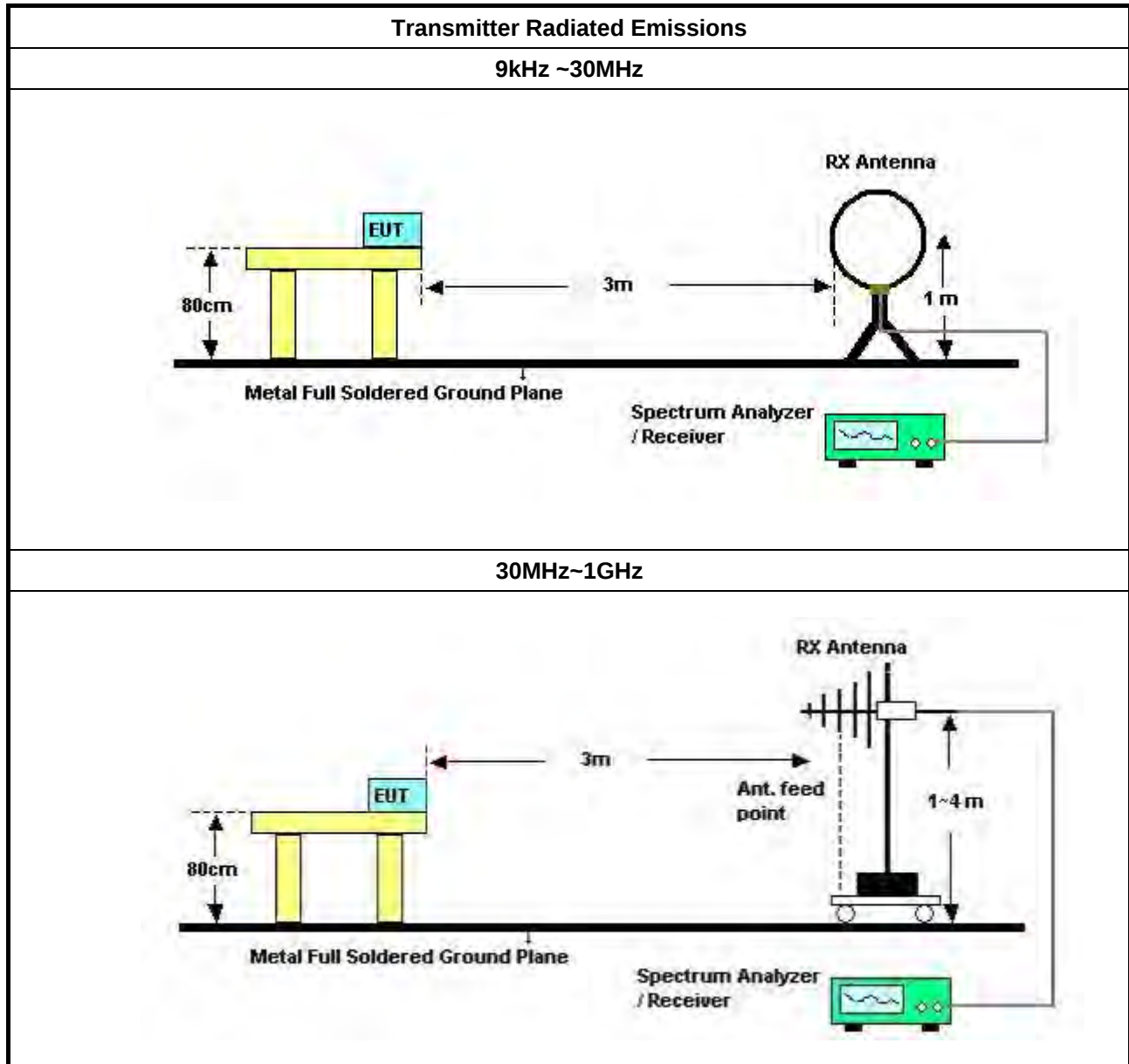
3.2.2 Measuring Instruments

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

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 $\geq 98\%$)
	☐ 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 $\geq 1/T$).
	☐ Refer as ANSI C63.10, clause 4.2.3.2.3 (Reduced VBW). VBW $\geq 1/T$, 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.

3.2.4 Test Setup



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



4 Test Equipment and Calibration Data

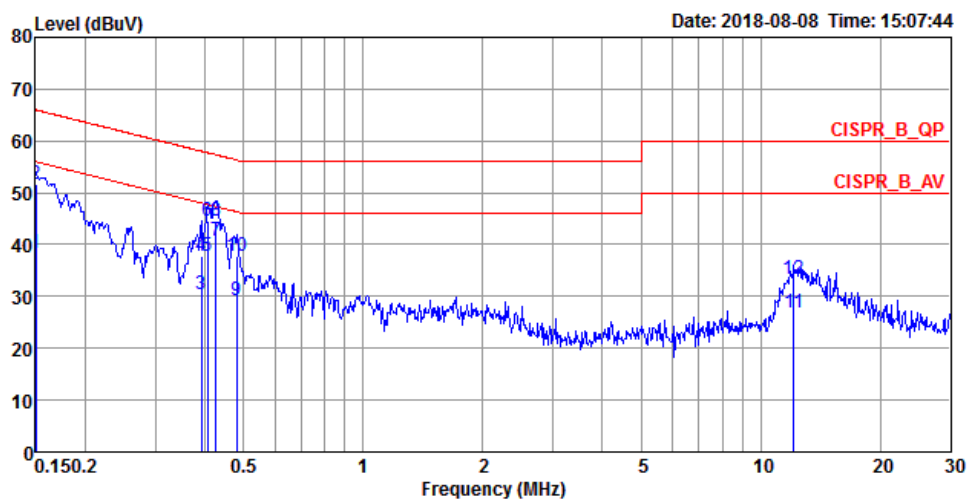
Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.45GHz	Jan. 31, 2018	Jan. 30, 2019	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 20, 2017	Dec. 19, 2018	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	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	20MHz ~ 2GHz	Aug. 30, 2017	Aug. 29, 2018	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 16, 2018	Mar. 15, 2019	Radiation (03CH01-CB)
Pre-Amplifier	EMCI	EMC330N	980332	20MHz ~ 3GHz	May 02, 2018	May 01, 2019	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)

Note: Calibration Interval of instruments listed above is one year.

N.C.R. means Non-Calibration required.

AC Power-line Conducted Emissions Result

Operating Mode	2	Power Phase	Neutral
Operating Function	Normal Link		



	Freq	Level	Over	Limit	Read	LISN	Cable	Remark	Pol/Phase
	MHz	dBuV	Limit	Line	Level	Factor	Loss		
			dB	dBuV	dBuV	dB	dB		
1	0.1500	38.26	-17.74	56.00	28.18	9.92	0.16	Average	NEUTRAL
2	0.1500	51.51	-14.49	66.00	41.43	9.92	0.16	QP	NEUTRAL
3	0.3914	30.52	-17.51	48.03	20.48	9.92	0.12	Average	NEUTRAL
4	0.3914	37.66	-20.37	58.03	27.62	9.92	0.12	QP	NEUTRAL
5	0.4061	37.90	-9.83	47.73	27.86	9.92	0.12	Average	NEUTRAL
6	0.4061	44.58	-13.15	57.73	34.54	9.92	0.12	QP	NEUTRAL
7	0.4260	40.70	-6.63	47.33	30.65	9.92	0.13	Average	NEUTRAL
8	0.4260	44.60	-12.73	57.33	34.55	9.92	0.13	QP	NEUTRAL
9	0.4812	29.33	-16.99	46.32	19.27	9.92	0.14	Average	NEUTRAL
10	0.4812	37.65	-18.67	56.32	27.59	9.92	0.14	QP	NEUTRAL
11	12.1240	26.93	-23.07	50.00	16.61	10.14	0.18	Average	NEUTRAL
12	12.1240	33.45	-26.55	60.00	23.13	10.14	0.18	QP	NEUTRAL

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.)

