FCC Test Report

Equipment	:	**POWERFUL WIRELESS BACKHAULING**
Brand Name	:	**Fluidmesh Networks**
Model No.	:	**FM3500, FM4500, FM4500F**
FCC ID	:	**R5S-FMX500**
FCC Standard	:	**47 CFR FCC Part 90(Y)**
Operating Band	:	**4940 MHz – 4990 MHz**
FCC Classification	:	**TNB**
Applicant	:	**Fluidmesh Networks LLC** 81 Prospect St., Brooklyn, New York 11201 United States
Manufacturer	:	**EDIMAX TECHNOLOGY CO., LTD.** No.3, Wu-Chuan 3rd Road, Wu-Ku Industrial Park, New Taipei City, Taiwan

The product sample received on Nov. 04, 2016 and completely tested on Jan. 24, 2017. We, SPORTON, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI/TIA-603-D-2010 shown compliance with the applicable technical standards.

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

Reviewed by:

Phoenix Chen / Assistant Manager

Testing Laboratory 1190

Table of Contents

Summary of Test Result

Conformance Test Specifications				
Report Clause	**FCC. Std. Clause**	**Description**	**Measured**	**Result**
3.1	15.107	AC Power-line Conducted Emissions	[dBuV]: 24.08 MHz 45.69 (Margin 4.31 dB) - AV 46.20 (Margin 13.80 dB) - QP	Complied
1.1.2	2.1047	Emission Types	D1D (OFDM - BPSK,QPSK, 16QAM, 64QAM)	Complied
3.2	2.1049	Emission Bandwidth	Bandwidth [MHz] 20M: 16.93	Complied
3.3	90.1215	Maximum Conducted Output Power	Power [dBm] 4960-4980MHz: 31.55	Complied
3.4	90.1215	Power Spectral Density	PSD [dBm/MHz] 4960-4980MHz: 20.96	Complied
3.5	90.1215	Peak Excursion	8.24 dB	Complied
3.6	90.210	Transmit Spectrum Mask	Device complies with spectral mask – refer to test data	Complied
3.7	2.1051	Transmitter Conducted Unwanted Emissions	9kHz - 40GHz Band [dBm]: 774.70 MHz: -37.77 (Margin -12.77 dB)	Complied
3.8	2.1053	Transmitter Radiated Unwanted Emissions	30MHz - 40GHz Band [dBuV/m at 3m]: 9920.00 MHz: -48.22 (Margin 23.22 dB)	Complied
3.9	2.1055	Frequency Stability	7.36 ppm	Complied

Revision History

Report No.	Version	Description	Issued Date
FL6O2852	Rev. 01	Initial issue of report	Feb. 16, 2017

1 General Description

1.1 Information

1.1.1 Product Details

There are six samples of EUT which model numbers are FM3500, FM4500, FM4500F. Besides, there are two brands of DDR in each model.

The difference part as below:

SKU	Model No.	DDR	DC IN	LAN 1 / PoE Port	LAN 2 Port	Fiber
1	FM3500	Winbond		✔	✔	
2	FM3500	NANYA		✔	✔	
3	FM4500	Winbond	✔	✔	✔	
4	FM4500	NANYA	✔	✔	✔	
5	FM4500F	Winbond	✔	✔		✔
6	FM4500F	NANYA	✔	✔		✔

1.1.2 RF General Information

RF General Information						
Frequency Range (MHz)	**IEEE Std. 802.11**	**Ch. Frequency (MHz)**	**Channel Number**	**Transmit Chains (N_{TX})**	**RF Output Power (dBm)**	**Designation of Emission**
4940-4990	j (20MHz)	4960-4980	192-196 [2]	2	31.55	16M9D1D
Note 1: IEEE Std. 802.11j-2004 modulation consists of BPSK, QPSK, 16QAM and 64QAM and EUT supports 20MHz channel space. Note 2: RF output power specifies that Conducted Output Power.						

1.1.3 Antenna Information

Antenna Category	
☐	Equipment placed on the market without antennas
☐	Integral antenna (antenna permanently attached)
	☐ Temporary RF connector provided
	☐ No temporary RF connector provided Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path.
☒	External antenna (dedicated antennas)
	☒ Single power level with corresponding antenna(s).
	☐ Multiple power level and corresponding antenna(s).

No.	Ant. Cat.	Ant. Type	Model Name	Gain (dBi)
1	External	Sector	JHS-5159-16D90A	9.00

Note: The antenna is not parts and accessories of the product itself when sale in the market.

1.1.4 Type of EUT

Identify EUT	
EUT Serial Number	N/A
Presentation of Equipment	☐ Production ; ☐ Pre-Production ; ☒ Identical Prototype
Type of EUT	
☒	Stand-alone
☐	Combined (EUT where the radio part is fully integrated within another device) Combined Equipment - Brand Name / Model No.: …
☐	Plug-in radio (EUT intended for a variety of host systems) Host System - Brand Name / Model No.: …
☐	Other:

1.1.5 Test Signal Duty Cycle

Operated Mode for Worst Duty Cycle	
☐ Operated normally mode for worst duty cycle	
☒ Operated test mode for worst duty cycle	
Test Signal Duty Cycle (x)	**Power Duty Factor [dB] – (10 log 1/x)**
☒ 100% - IEEE 802.11j (20M)	0

1.1.6 EUT Operational Condition

Supply Voltage	☐ AC mains	☒ DC	
Type of DC Source	☐ External AC Adapter	☒ PoE (48V)	☒ DC Source (48V)
Test Voltage	☒ Vnom (48 V)	☒ Vmax (52.8 V)	☒ Vmin (43.2 V)
Test Climatic	☒ Tnom (20°C)	☒ Tmax (55°C)	☒ Tmin (-40°C)

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 90(Y)
- ANSI/TIA-603-D-2010
- KDB 971168 D01 v02r02
- KDB 971168 D02
- KDB 412172 D01 v01r01
- KDB 662911 D01 v02r01

1.3 Testing Location Information

Testing Location					
☒	HWA YA	ADD :	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.		
		TEL :	886-3-327-3456	FAX :	886-3-327-0973

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
AC Conduction	CO04-HY	Ryan	22°C / 49%	24/Jan/2017
RF Conducted	TH06-HY	Gary	25°C / 56%	20/Jan/2017
Radiated Emission	03CH03-HY	Jeff	22.5°C / 51.8%	20/Jan/2017

Test site registered number [553509] 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)

Measurement Uncertainty		
Test Item		Uncertainty
AC power-line conducted emissions		±2.26 dB
Emission bandwidth		±1.42 %
RF output power, conducted		±0.63 dB
Unwanted emissions, conducted	30 – 1000 MHz	±0.51 dB
	1 – 18 GHz	±0.67 dB
	18 – 40 GHz	±0.83 dB
	40 – 200 GHz	N/A
All emissions, radiated	30 – 1000 MHz	±2.56 dB
	1 – 18 GHz	±3.59 dB
	18 – 40 GHz	±3.82 dB
	40 – 200 GHz	N/A
Temperature		±0.8 °C
Humidity		±3 %
DC and low frequency voltages		±3 %
Time		±1.42 %
Duty Cycle		±1.42 %

2 Test Configuration of EUT

2.1 The Worst Case Modulation Configuration

Worst Modulation Used for Conformance Testing			
Modulation Mode	**Transmit Chains (N_{TX})**	**Data Rate**	**Worst Data Rate**
11j-20M	2	6-54 Mbps	6 Mbps
Note 1: Modulation modes consist of below configuration: 11j-20M: 802.11j 20MHz bandwidth			

2.2 The Worst Case Power Setting Parameter

The Worst Case Power Setting Parameter			
Test Software Version	MT7662 QA V1.0.3.14		
Modulation Mode	**N_{TX}**	**Test Frequency (MHz)**	
		NCB: 20MHz	
		4960	**4980**
11j-20M	2	14, 14	13, 13

2.3 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 Test Voltage: 120Vac / 60Hz
Operating Mode	Operating Mode Description
1	SKU 1 with PoE Mode
2	SKU 2 with PoE Mode
3	SKU 3 with PoE Mode
4	SKU 4 with PoE Mode
5	SKU 5 with PoE Mode
6	SKU 6 with PoE Mode
Mode 2 configuration was pretested and found to be the worst case and measured during the test	

The Worst Case Mode for Following Conformance Tests	
Tests Item	Emission Bandwidth, Maximum Conducted Output Power, Power Spectral Density, Peak Excursion, Transmit Spectrum Mask Transmitter Conducted Unwanted Emissions, Frequency Stability
Test Condition	Conducted measurement at transmit chains
Modulation Mode	11j-20M

The Worst Case Mode for Following Conformance Tests			
Tests Item	Transmitter Radiated Unwanted Emissions, Receiver Spurious Emissions		
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.		
User Position	☐ EUT will be placed in fixed position.		
	☒ EUT will be placed in mobile position and operating multiple positions.		
	☐ EUT will be a hand-held or body-worn battery-powered devices and operating multiple positions.		
Operating Mode < 1GHz	☒ 1. SKU 1 with PoE Mode		
	☒ 2. SKU 2 with PoE Mode		
	☒ 3. SKU 3 with PoE Mode		
	☒ 4. SKU 4 with PoE Mode		
	☒ 5. SKU 5 with PoE Mode		
	☒ 6. SKU 6 with PoE Mode		
	☒ 7. SKU 3 with DC Power Supply Mode		
	☒ 8. SKU 4 with DC Power Supply Mode		
	☒ 9. SKU 5 with DC Power Supply Mode		
	☒ 10. SKU 6 with DC Power Supply Mode		
Mode 5 configuration was pretested and found to be the worst case and measured during the test			
Modulation Mode	11j-20M		
Orthogonal Planes of EUT	**X Plane**	**Y Plane**	**Z Plane**
			
Worst Planes of EUT	V		
Worst Planes of Ant.	V		

2.4 Accessories and Support Equipment

Specification of Accessory				
PoE	Brand Name	I.T.E	Model Name	GM241DA-480050BG
	Power Rating	I/P: 100 – 240 Vac, 50-60Hz, 0.55 A, O/P: 48 Vdc, 0.5 A		

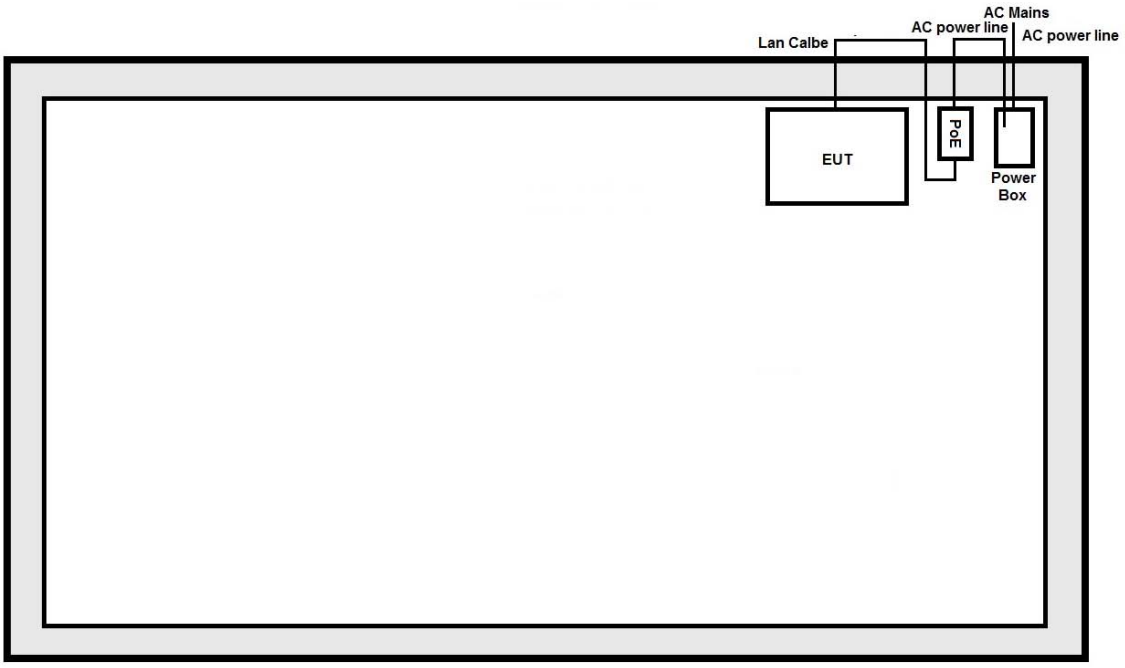
Reminder: Regarding to more detail and other information, please refer to user manual.

Support Equipment - RF Conducted				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	Notebook	DELL	E5410	DoC
2	Adapter for Notebook	DELL	HA65NM130	DoC

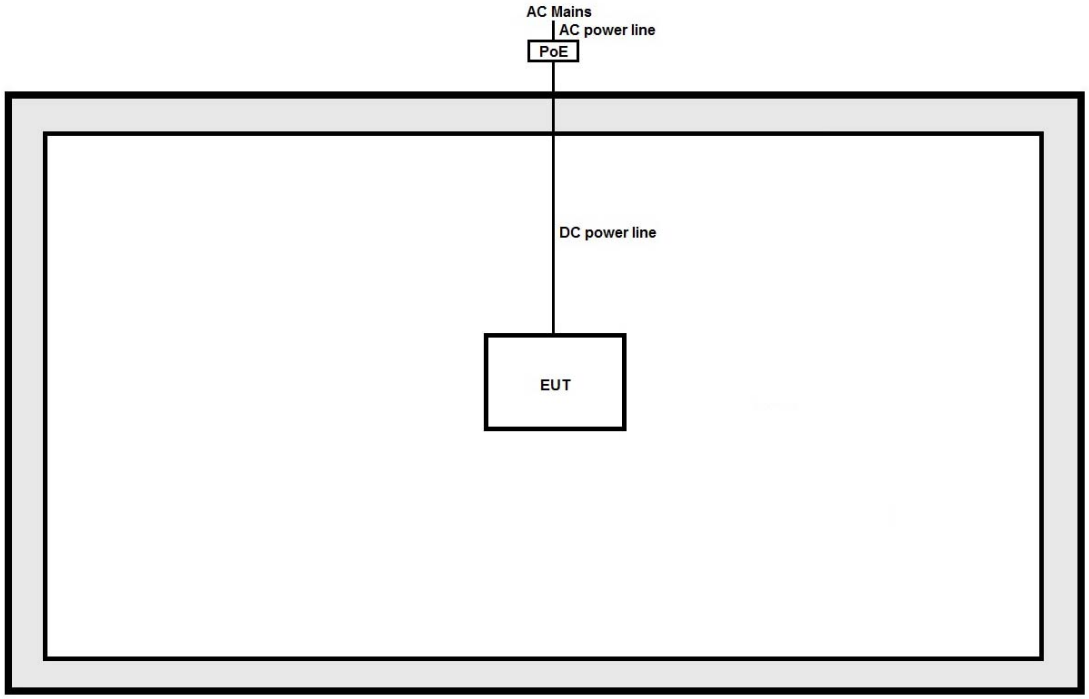
Support Equipment - AC Conduction and Radiated Emission				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	-	-	-	-

2.5 Test Setup Diagram

Test Setup Diagram – AC Line Conducted Emission Test



Test Setup Diagram - Radiated Test



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 [Class A]		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	79	66
0.5-30	73	60
AC Power-line Conducted Emissions Limit [Class B]		
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

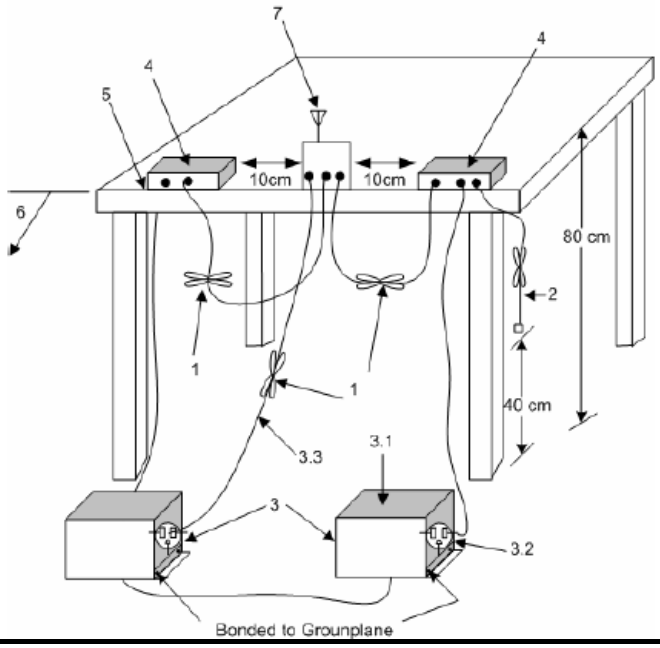
Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method
▪ Refer as ANSI/TIA-603-D-2010, clause 6.2 for AC power-line conducted emissions.

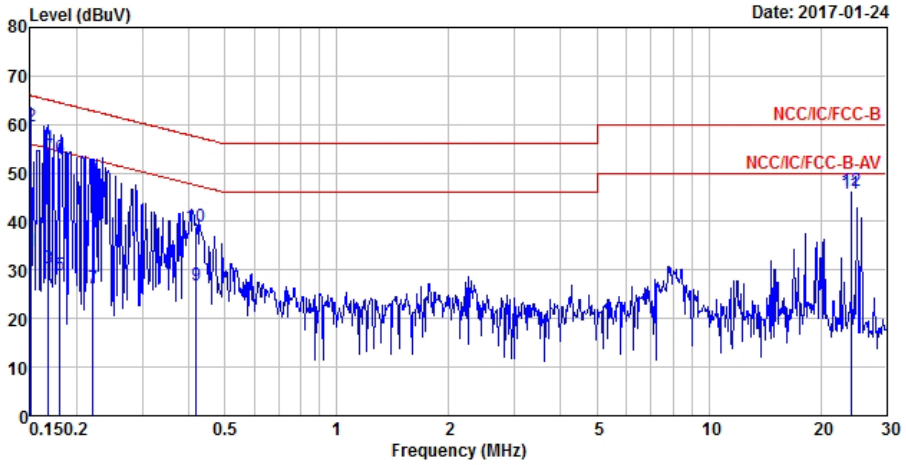
3.1.4 Test Setup

AC Power-line Conducted Emissions



3.1.5 Test Result of AC Power-line Conducted Emissions

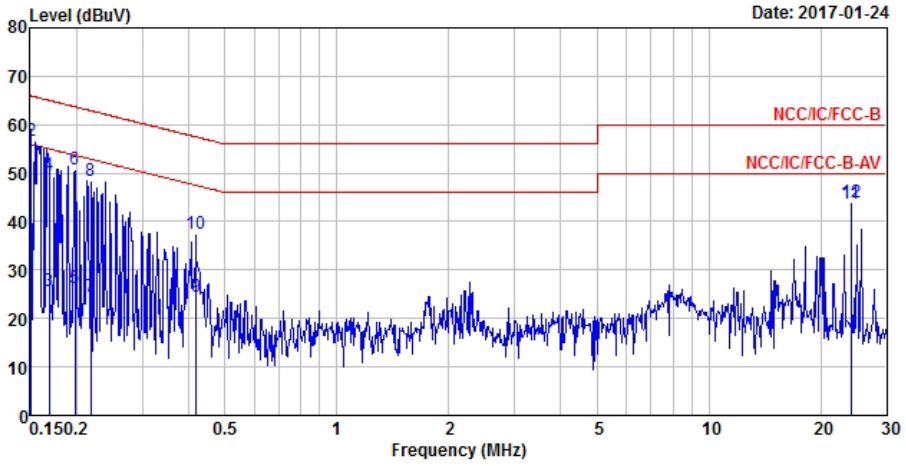
AC Power-line Conducted Emissions Result			
Operating Mode	2	**Power Phase**	Neutral
Operating Function	PoE Mode		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.15	34.04	-21.92	55.96	33.72	0.10	0.22	Average
2	0.15	59.65	-6.31	65.96	59.33	0.10	0.22	QP
3	0.17	30.44	-24.64	55.08	30.09	0.10	0.25	Average
4	0.17	55.22	-9.86	65.08	54.87	0.10	0.25	QP
5	0.18	28.81	-25.65	54.46	28.43	0.11	0.27	Average
6	0.18	53.22	-11.24	64.46	52.84	0.11	0.27	QP
7	0.22	26.32	-26.47	52.79	25.94	0.11	0.27	Average
8	0.22	48.71	-14.08	62.79	48.33	0.11	0.27	QP
9	0.42	26.73	-20.73	47.46	26.51	0.12	0.10	Average
10	0.42	39.03	-18.43	57.46	38.81	0.12	0.10	QP
11 MAX	24.08	45.69	-4.31	50.00	45.08	0.41	0.20	Average
12	24.08	46.20	-13.80	60.00	45.59	0.41	0.20	QP

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			
Operating Mode	2	**Power Phase**	Line
Operating Function	PoE Mode		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.15	29.68	-26.28	55.96	29.35	0.11	0.22	Average
2	0.15	56.79	-9.17	65.96	56.46	0.11	0.22	QP
3	0.17	25.65	-29.40	55.05	25.29	0.11	0.25	Average
4	0.17	49.47	-15.58	65.05	49.11	0.11	0.25	QP
5	0.20	26.24	-27.47	53.71	25.83	0.11	0.30	Average
6	0.20	50.65	-13.06	63.71	50.24	0.11	0.30	QP
7	0.22	24.43	-28.47	52.90	24.05	0.11	0.27	Average
8	0.22	48.36	-14.54	62.90	47.98	0.11	0.27	QP
9	0.42	24.60	-22.86	47.46	24.38	0.12	0.10	Average
10	0.42	37.55	-19.91	57.46	37.33	0.12	0.10	QP
11 MAX	24.09	43.67	-6.33	50.00	43.10	0.37	0.20	Average
12	24.09	44.08	-15.92	60.00	43.51	0.37	0.20	QP

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.)

3.2 Emission Bandwidth

3.2.1 Emission Bandwidth Limit

Emission Bandwidth Limit
N/A. Information only
Note 1: The 99% occupied bandwidth is the frequency bandwidth of the signal power at the 99% channel power of occupied bandwidth when resolution bandwidth should be approximately 1 % to 5 % of the occupied bandwidth (OBW). These measurements shall also be performed at normal test conditions.

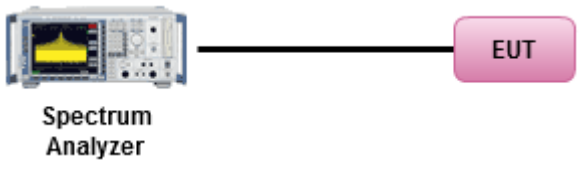
3.2.2 Measuring Instruments

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

3.2.3 Test Procedures

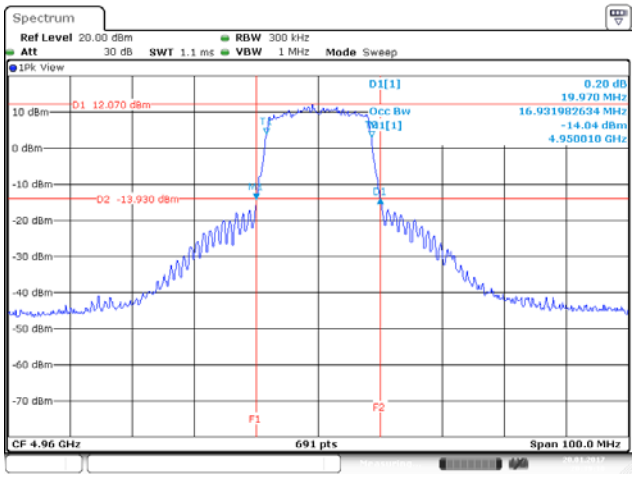
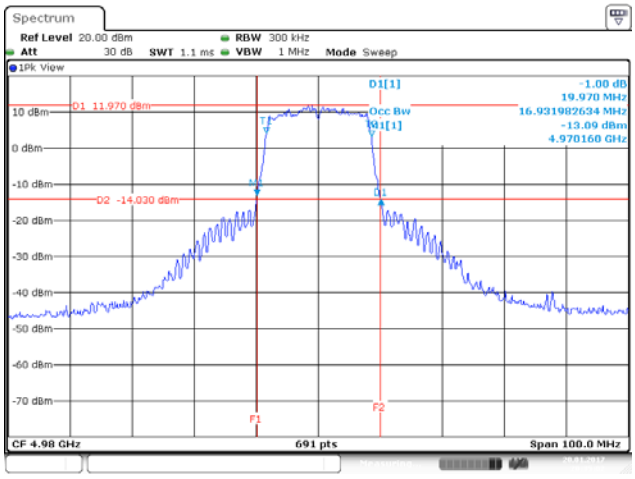
Test Method			
☒	For the emission bandwidth shall be measured using one of the options below:		
	☐	Refer as ANSI/TIA-603-D, clause 1.3.4.4 for test bandwidth.	
	☒	Refer as KDB 971168, clause 4 for signal bandwidth.	
☒	For conducted measurement.		
	☐	The EUT supports single transmit chain and measurements performed on this transmit chain.	
	☐	The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.	
	☒	The EUT supports multiple transmit chains using options given below:	
		☒	Option 1: Multiple transmit chains measurements need to be performed on one of the active transmit chains (antenna outputs). All measurement had be performed on transmit chains 1.
		☐	Option 2: Multiple transmit chains measurements need to be performed on each transmit chains individually (antenna outputs). All measurement had be performed on all transmit chains.
☐	For radiated measurement. The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level.		

3.2.4 Test Setup

Emission Bandwidth


3.2.5 Test Result of Emission Bandwidth

Emission Bandwidth Result			
Condition			Emission Bandwidth (MHz)
Modulation Mode	N_{TX}	Freq. (MHz)	99% Bandwidth
11j-20M	2	4960	16.93
11j-20M	2	4980	16.93
Limit			N/A
Result			Complied
Note 1: N_{TX} = Number of Transmit Chains			

Emission Bandwidth Plots	
11j-20M – 4960 MHz	11j-20M – 4980 MHz
	

3.3 Maximum Conducted Output Power

3.3.1 Maximum Conducted Output Power Limit

Maximum Conducted Output Power		
Channel Bandwidth (MHz)	**Low Power Device (dBm)**	**High Power Device (dBm)**
1	7	20
5	14	27
10	17	30
15	18.8	31.8
20	20	33

Antenna Gain vs Maximum Conducted Output Power	
Low Power Device	
General	If G_{TX} > 9 dBi, then P_{Out} = P – (G_{TX} – 9) dBm
High Power Device	
General	If G_{TX} > 9 dBi, then P_{Out} = P – (G_{TX} – 9) dBm
point-to-point or point-to-multipoint	If G_{TX} > 26 dBi, then P_{Out} = P – (G_{TX} – 26) dBm
P_{Out} = reduction maximum conducted output power limit in dBm, **P** = original w/o reduction maximum conducted output power limit in dBm, **G_{TX}** = the maximum transmitting antenna directional gain in dBi.	

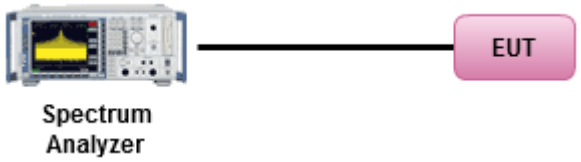
3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

Test Method	
☒	Maximum Transmitter Power
☒	Refer as ANSI/TIA-603-D, clause 3.2.1 for power meter measurement.
☐	Refer as KDB 971168, clause 4 power over the fundamental signal bandwidth.
☒	For conducted measurement.
☐	The EUT supports single transmit chain and measurements performed on this transmit chain.
☐	The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.
☒	The EUT supports multiple transmit chains using options given below: Refer as FCC KDB 662911, In-band power measurements. Using the measure-and-sum approach, measured all transmit ports individually. Sum the power (in linear power units e.g., mW) of all ports for each individual sample and save them.

3.3.4 Test Setup

RF Output Power (Spectrum Analyzer)


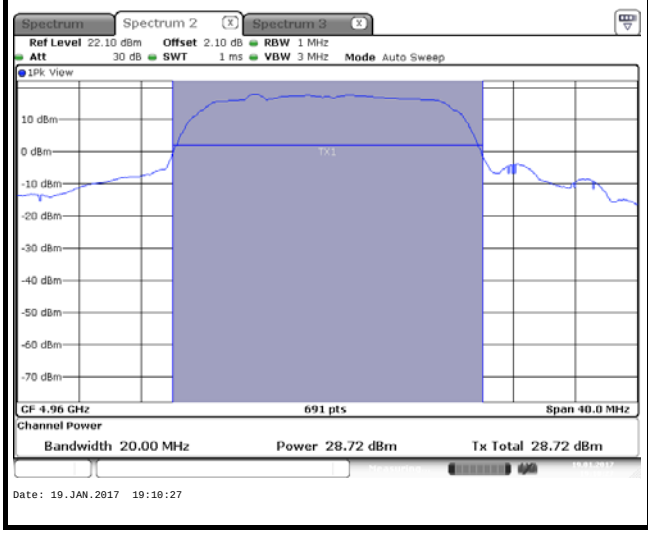
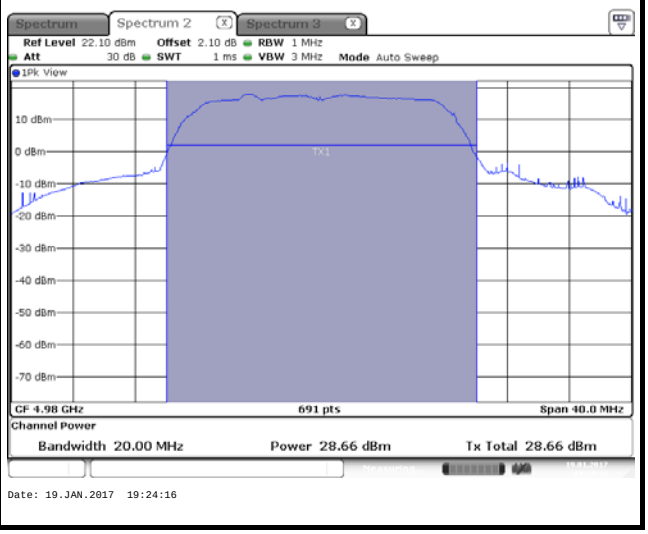
3.3.5 Directional Gain for Power Measurement

Directional Gain (DG) Result					
Transmit Chains No.		1	2	-	-
Maximum G_{ANT} (dBi)		9.00	9.00	-	-
Modulation Mode	**DG (dBi)**	**N_{TX}**	**N_{SS}**	**STBC**	**Array Gain (dB)**
11j-20M	9.00	2	1	-	-

Note 1: For all transmitter outputs with equal antenna gains, directional gain is to be computed as follows:
Any transmit signals are correlated, Directional Gain = $G_{ANT} + 10 \log(N_{TX})$
All transmit signals are completely uncorrelated, Directional Gain = G_{ANT}
Note 2: For all transmitter outputs with unequal antenna gains, directional gain is to be computed as follows:
Any transmit signals are correlated, Directional Gain =$10 \log[(10^{G1/20} + \ldots + 10^{GN/20})^2 / N_{TX}]$
All transmit signals are completely uncorrelated, Directional Gain = $10 \log[(10^{G1/10} + \ldots + 10^{GN/10})/N_{TX}]$
Note 3: For Spatial Multiplexing, Directional Gain (DG) = $G_{ANT} + 10 \log(N_{TX}/N_{SS})$,
where Nss = the number of independent spatial streams data.
Note 4: For CDD transmissions, directional gain is calculated as power measurements:
Directional Gain (DG) = G_{ANT} + Array Gain, where Array Gain is as follows:
Array Gain = 0 dB (i.e., no array gain) for $N_{TX} \leq 4$;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{TX};

3.3.6 Test Result of Maximum Conducted Output Power

Maximum Conducted Output Power							
Condition			RF Output Power (dBm)				
Modulation Mode	N_{TX}	Freq. (MHz)	Chain Port 1	Chain Port 2	Sum Chain	Power Limit	DG (dBi)
11j-20M	2	4960	28.72	28.05	31.41	33	9.00
11j-20M	2	4980	28.66	28.42	31.55	33	9.00
Result			Complied				

Maximum Conducted Output Power Plots	
11j-20M – 4960 MHz	11j-20M – 4980 MHz
	

3.4 Power Spectral Density

3.4.1 Power Spectral Density Limit

Power Spectral Density	
Low Power Device (dBm/MHz)	**High Power Device (dBm/MHz)**
8	21

Antenna Gain vs Power Spectral Density	
Low Power Device	
General	If G_{TX} > 9 dBi, then PSD_{Out} = PSD – (G_{TX} – 9) dBm
High Power Device	
General	If G_{TX} > 9 dBi, then PSD_{Out} = PSD – (G_{TX} – 9) dBm
point-to-point or point-to-multipoint	If G_{TX} > 26 dBi, then PSD_{Out} = PSD – (G_{TX} – 26) dBm
PSD_{Out} = reduction peak power spectral density limit in dBm, **PSD** = original w/o reduction power spectral density limit in dBm, **G_{TX}** = the maximum transmitting antenna directional gain in dBi.	

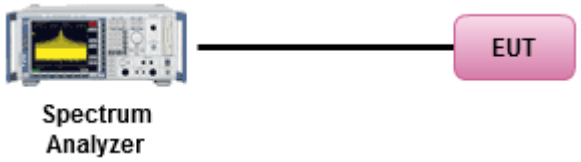
3.4.2 Measuring Instruments

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

3.4.3 Test Procedures

Test Method	
☒	Power Spectral Density
☒	Refer as KDB 971168, clause 5.3 power spectral density over the fundamental signal bandwidth.
☒	For conducted measurement.
☐	The EUT supports single transmit chain and measurements performed on this transmit chain.
☐	The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.
☒	The EUT supports multiple transmit chains using options given below: Refer as FCC KDB 662911, In-band power measurements. Using the measure-and-sum approach, measured all transmit ports individually. Sum the power (in linear power units e.g., mW) of all ports for each individual sample and save them.

3.4.4 Test Setup

Power Spectral Density


3.4.5 Directional Gain for Power Spectral Density Measurement

Directional Gain (DG) Result					
Transmit Chains No.		1	2	-	-
Maximum G_{ANT} (dBi)		9.00	9.00	-	-
Modulation Mode	**DG (dBi)**	**N_{TX}**	**N_{SS}**	**STBC**	**Array Gain (dB)**
11j-20M	12.01	2	1	-	3.01

Note 1: For all transmitter outputs with equal antenna gains, directional gain is to be computed as follows:
Any transmit signals are correlated, Directional Gain = $G_{ANT} + 10 \log(N_{TX})$
All transmit signals are completely uncorrelated, Directional Gain = G_{ANT}

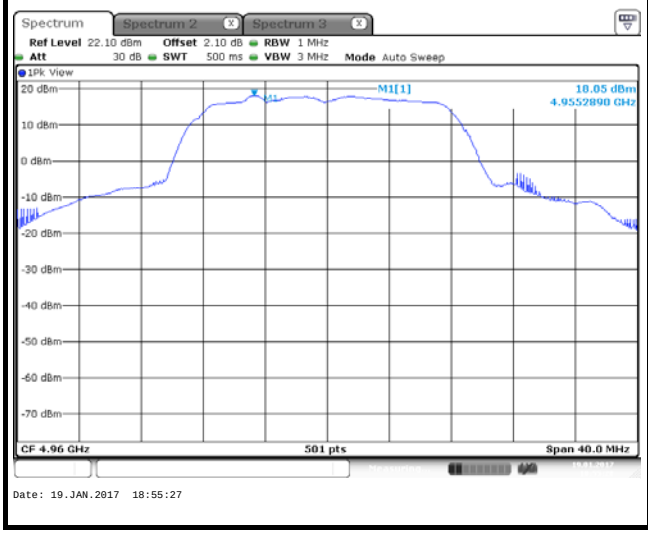
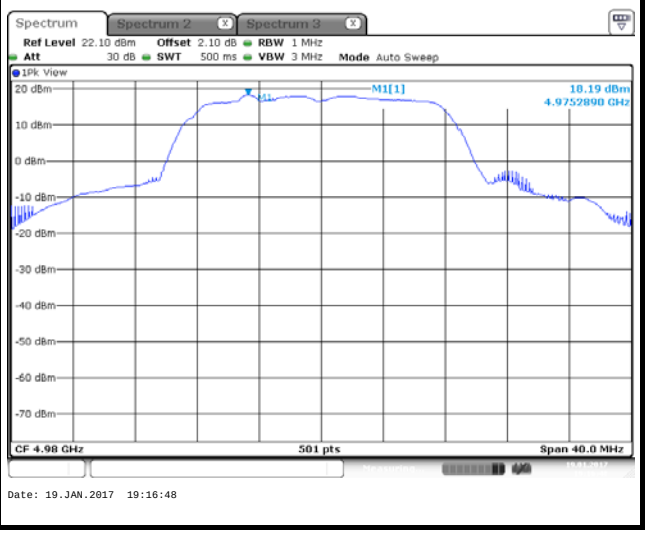
Note 2: For all transmitter outputs with unequal antenna gains, directional gain is to be computed as follows:
Any transmit signals are correlated, Directional Gain =$10 \log[(10^{G1/20} + \ldots + 10^{GN/20})^2 / N_{TX}]$
All transmit signals are completely uncorrelated, Directional Gain = $10 \log[(10^{G1/10} + \ldots + 10^{GN/10})/N_{TX}]$

Note 3: For Spatial Multiplexing, Directional Gain (DG) = $G_{ANT} + 10 \log(N_{TX}/N_{SS})$,
where Nss = the number of independent spatial streams data.

Note 4: For CDD transmissions, directional gain is calculated as power spectral density measurements:
Directional Gain (DG) = G_{ANT} + Array Gain, where Array Gain is as follows:
Array Gain = $10 \log(N_{TX}/N_{SS})$;

3.4.6 Test Result of Power Spectral Density

Power Spectral Density							
Condition			Power Spectral Density (dBm/MHz)				
Modulation Mode	N_{TX}	Freq. (MHz)	Chain Port 1	Chain Port 2	Sum Chain	PSD Limit	DG (dBi)
11j-20M	2	4960	18.05	17.38	20.74	21	12.01
11j-20M	2	4980	18.19	17.69	20.96	21	12.01
Result			Complied				

Power Spectral Density Plots	
11j-20M – 4960 MHz	11j-20M – 4980 MHz
	

3.5 Peak Excursion

3.5.1 Peak Excursion Limit

Peak Excursion (dB)
13

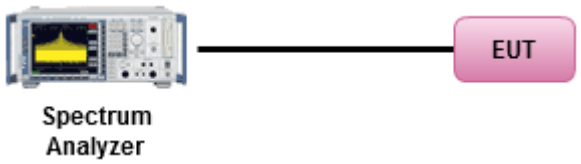
3.5.2 Measuring Instruments

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

3.5.3 Test Procedures

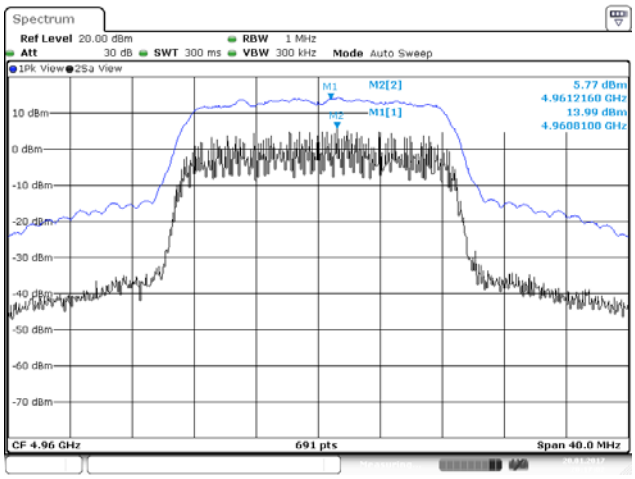
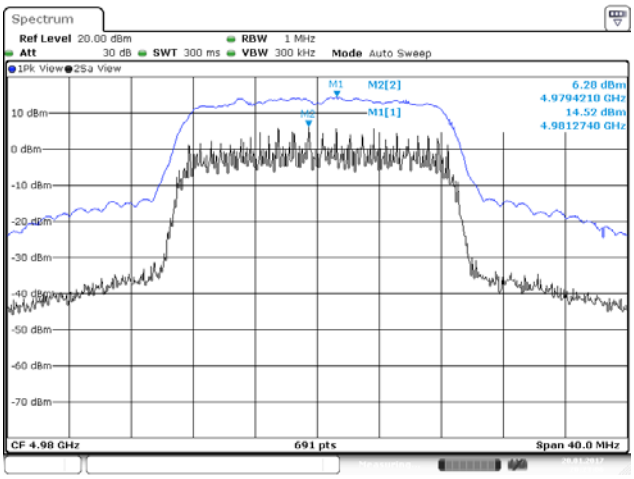
Test Method	
☒	Power Spectral Density
	☒ Refer as KDB 971168, clause 5.7.2 peak-to-average power ratio (PAPR).
☒	For conducted measurement.
	☒ Testing a single output port is sufficient to demonstrate compliance with the peak excursion.

3.5.4 Test Setup

Peak Excursion


3.5.5 Test Result of Peak Excursion

Peak Excursion Result				
Modulation Mode	N_{TX}	Freq. (MHz)	Peak Excursion (dB)	Limit(dB)
11j-20M	2	4960	8.22	13
11j-20M	2	4980	8.24	13
Result			Complied	

Peak Excursion Plots	
11j-20M – 4960 MHz	**11j-20M – 4980 MHz**
	

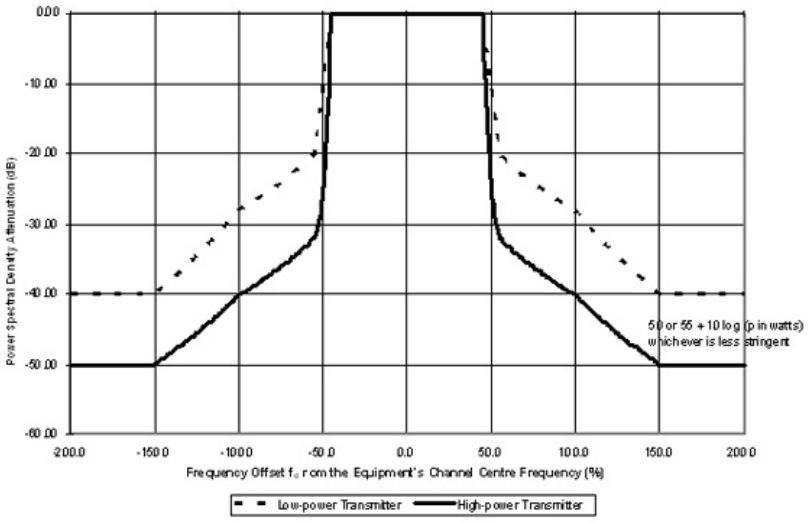
3.6 Transmit Spectrum Mask

3.6.1 Transmit Spectrum Mask Limit

Offset Frequency fd (% of the Equipment's Channel Bandwidth)	Minimum Attenuation (dB)	
	Low Power Transmitter	High Power Transmitter
$0 < f_d \leq 45$	0	0
$45 < f_d \leq 50$	219 log (f_d/45)	568 log (f_d/45)
$50 < f_d \leq 55$	10 + 242 log (f_d/50)	26 + 145 log (f_d/50)
$55 < f_d \leq 100$	20 + 31 log (f_d/55)	32 + 31 log (f_d/55)
$100 < f_d \leq 150$	28 + 68 log (f_d/100)	40 + 57 log (f_d/100)
$f_d > 150$	40	whichever is less stringent 50 or 55 + 10 log P [-25dBm]

Where: f_d (%) = ((f-f_c)/channel bandwidth) x 100;
P: transmitter's output power (in watts)
The 0 dB reference level in the unwanted emission mask is the maximum in-band power spectral density measured in terms of average power in the equipment's channel bandwidth, using a resolution bandwidth of as close as possible to, without being less than 1% of the occupied bandwidth, and a video bandwidth of 30 kHz. The unwanted power spectral density emissions are also measured using the same resolution and video bandwidths used in measuring the reference in-band power spectral density.

Figure 1: Unwanted Emission Mask for Low- and High-power Transmitters



3.6.2 Measuring Instruments

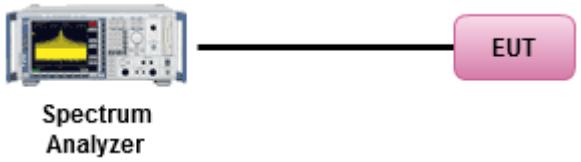
Refer a test equipment and calibration data table in this test report.

3.6.3 Test Procedures

Test Method		
☒	The 0 dB level is measured relative to the highest average power of the fundamental emission. The measurements of transmit spectral density are made using resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and 30 kHz video bandwidth.	
☒	For conducted measurement.	
	☐	The EUT supports single transmit chain and measurements performed on this transmit chain.
	☐	The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.
	☒	The EUT supports multiple transmit chains using options given below: Refer as FCC KDB 662911, when testing emissions against relative emission limits, tests may be performed on each output individually without summing or adding 10 log(N) if the measurements are made relative to the in-band emissions on the individual outputs. All measurements need only to be performed on one of the active transmit chains (antenna outputs). All measurement had be performed on transmit chains 1.
☐	For radiated measurement. The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level.	

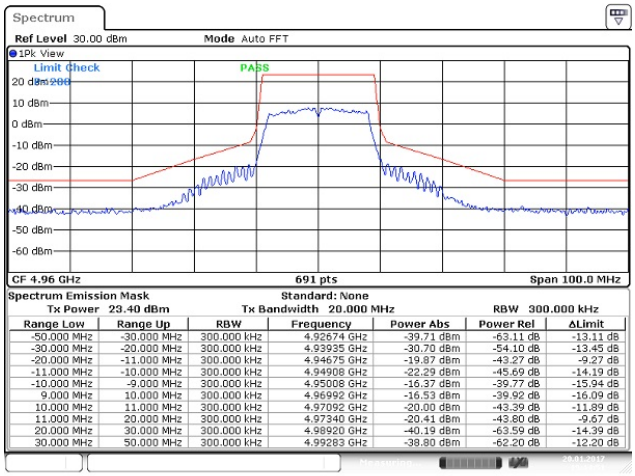
3.6.4 Test Setup

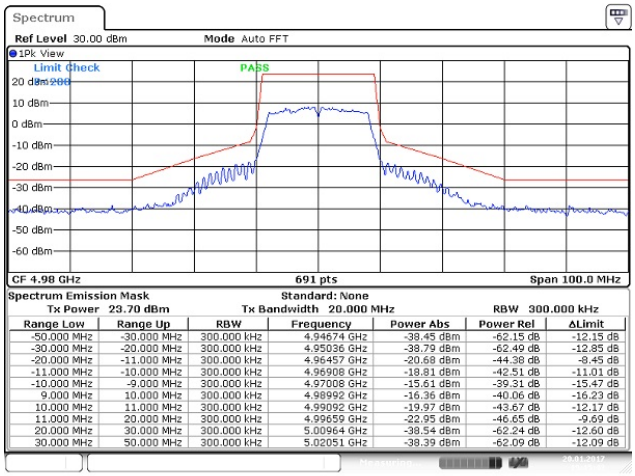
Transmit Spectrum Mask



3.6.5 Test Result of Transmit Spectrum Mask

Transmit Spectrum Mask Result						
Ant. Gain (dBi)			9.00	Transmit Spectrum Mask		
Condition	**Modulation Mode**	**N_{TX}**	**Freq. (MHz)**	**Chain-Port 1**	**Chain-Port 2**	**Result**
TnomVnom	11j-20M	2	4960	Under Spectral Mask	Under Spectral Mask	Complied
TnomVnom	11j-20M	2	4980	Under Spectral Mask	Under Spectral Mask	Complied
11j-20M – 4960 MHz				**11j-20M – 4980 MHz**		





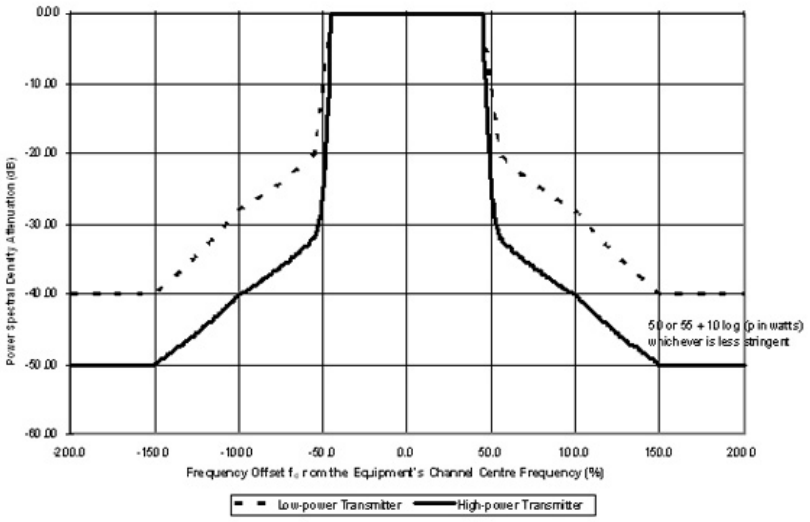
3.7 Transmitter Conducted Unwanted Emissions

3.7.1 Transmitter Conducted Unwanted Emissions Limit

Offset Frequency fd (% of the Equipment's Channel Bandwidth)	Minimum Attenuation (dB)	
	Low Power Transmitter	High Power Transmitter
$0 < f_d \leq 45$	0	0
$45 < f_d \leq 50$	219 log (f_d/45)	568 log (f_d/45)
$50 < f_d \leq 55$	10 + 242 log (f_d/50)	26 + 145 log (f_d/50)
$55 < f_d \leq 100$	20 + 31 log (f_d/55)	32 + 31 log (f_d/55)
$100 < f_d \leq 150$	28 + 68 log (f_d/100)	40 + 57 log (f_d/100)
$f_d > 150$	40	whichever is less stringent 50 or 55 + 10 log P [-25dBm]

Where: f_d (%) = ((f-f_c)/channel bandwidth) x 100;
p: transmitter's output power (in watts)
The 0 dB reference level in the unwanted emission mask is the maximum in-band power spectral density measured in terms of average power in the equipment's channel bandwidth, using a resolution bandwidth of as close as possible to, without being less than 1% of the occupied bandwidth, and a video bandwidth of 30 kHz. The unwanted power spectral density emissions are also measured using the same resolution and video bandwidths used in measuring the reference in-band power spectral density.

Figure 1: Unwanted Emission Mask for Low- and High-power Transmitters



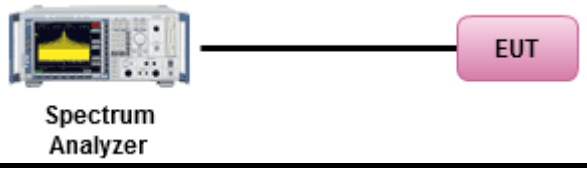
3.7.2 Measuring Instruments

Refer test equipment and calibration data list in test report clause 4.

3.7.3 Test Procedures

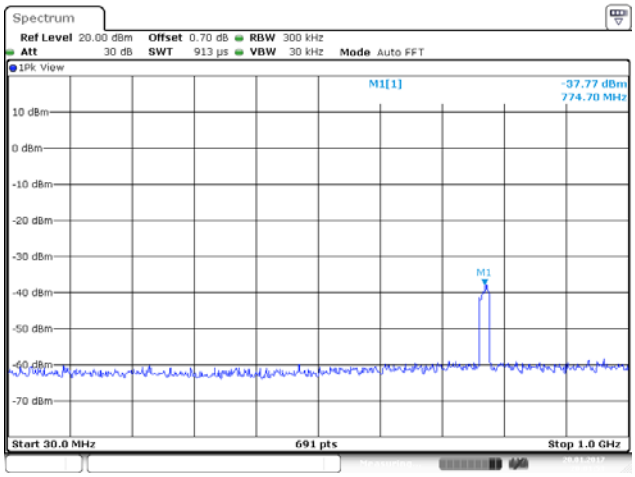
Test Method		
☒	Refer as ANSI/TIA-603-D-2010, clause 3.2.13 for conducted measurement.	
☐	In case a narrower measurement bandwidth was used, the following conversion formula has to be applied: (e.g. if reference bandwidth 1 MHz and measurement bandwidth 100 kHz, then measurement bandwidth conversion factor is 10 dB) $B = A + 10 \log (BW_{ref} / BW_{measured})$ • A is the value at the narrower measurement bandwidth; • B is the value referred to the reference bandwidth;	
☒	For conducted measurement.	
	☒	For conducted measurements on devices with single transmit chain.
	☐	For conducted measurements on devices with multiple transmit chains using options given below:
		☐ Option 1: measure and sum the spectra across the transmitter outputs.
		☐ Option 2: N transmitter outputs, then spurious emissions limits on each individual output. Measure and add 10 log (N) dB.

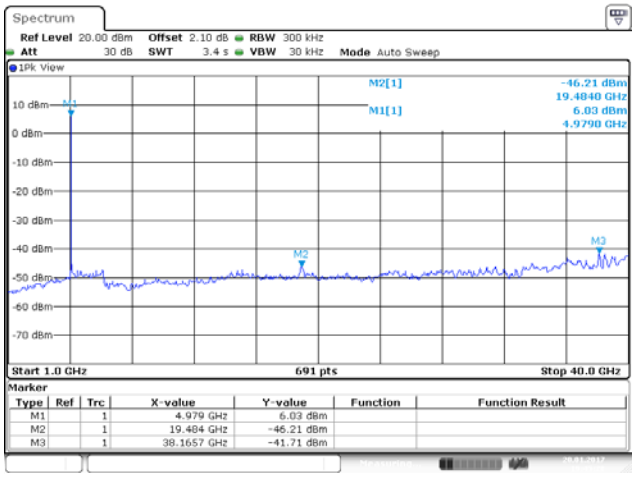
3.7.4 Test Setup

Transmitter Conducted Unwanted Emissions


3.7.5 Test Result of Transmitter Conducted Unwanted Emissions

Transmitter Conducted Unwanted Emissions Result							
Ant. Gain (dBi)			9.00	Transmitter Conducted Unwanted Emissions			
Condition	Modulation Mode	N_{TX}	Freq. (MHz)	Unwanted Freq. (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
TnomVnom	11j-20M	2	4960	753.60	-38.85	-13.85	-25
TnomVnom	11j-20M	2	4980	774.70	-37.77	-12.77	-25
Result				Complied			
11j-20M – 4980 MHz							
30 MHz ~ 1 GHz				1 GHz ~ 40 GHz			





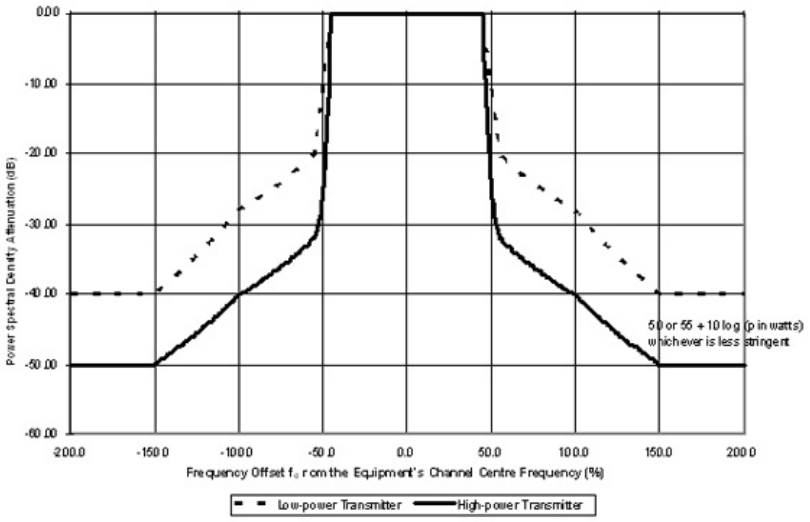
3.8 Transmitter Radiated Unwanted Emissions

3.8.1 Transmitter Radiated Unwanted Emissions Limit

Offset Frequency fd (% of the Equipment's Channel Bandwidth)	Minimum Attenuation (dB)	
	Low Power Transmitter	High Power Transmitter
$0 < f_d \leq 45$	0	0
$45 < f_d \leq 50$	219 log (f_d/45)	568 log (f_d/45)
$50 < f_d \leq 55$	10 + 242 log (f_d/50)	26 + 145 log (f_d/50)
$55 < f_d \leq 100$	20 + 31 log (f_d/55)	32 + 31 log (f_d/55)
$100 < f_d \leq 150$	28 + 68 log (f_d/100)	40 + 57 log (f_d/100)
$f_d > 150$	40	whichever is less stringent 50 or 55 + 10 log P [-25dBm]

Where: f_d (%) = ((f-f_c)/channel bandwidth) x 100;
P: transmitter's output power (in watts)
The 0 dB reference level in the unwanted emission mask is the maximum in-band power spectral density measured in terms of average power in the equipment's channel bandwidth, using a resolution bandwidth of as close as possible to, without being less than 1% of the occupied bandwidth, and a video bandwidth of 30 kHz. The unwanted power spectral density emissions are also measured using the same resolution and video bandwidths used in measuring the reference in-band power spectral density.

Figure 1: Unwanted Emission Mask for Low- and High-power Transmitters



3.8.2 Measuring Instruments

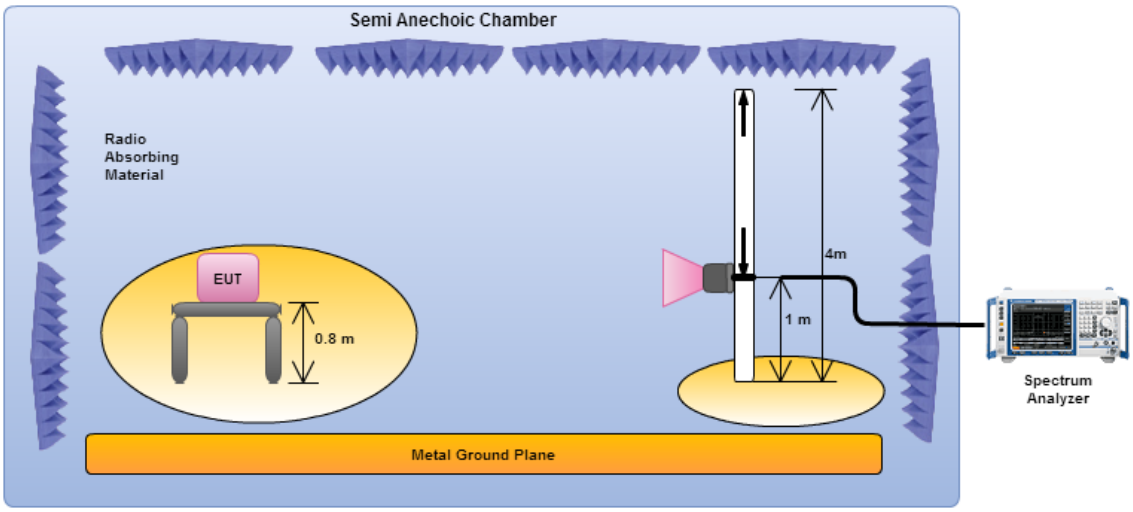
Refer a test equipment and calibration data table in this test report.

3.8.3 Test Procedures

Test Method	
☒	Refer as ANSI/TIA-603-D-2010, clause 3.2.12 for radiated measurement.
☐	In case a narrower measurement bandwidth was used, the following conversion formula has to be applied: (e.g. if reference bandwidth 1 MHz and measurement bandwidth 100 kHz, then measurement bandwidth conversion factor is 10 dB) $B = A + 10 \log (BW_{ref} / BW_{measured})$ • A is the value at the narrower measurement bandwidth; • B is the value referred to the reference bandwidth;
☒	Effective Isotropic Radiated Power (EIRP)
☐	Refer as KDB 412172, clause 1.3.2 following as power approach. e.i.r.p.= P_T+G_T.
☒	Refer as KDB 412172, clause 1.3.1 following as field strength approach. e.i.r.p.= $(E \times d)^2 / 30$.
☐	For radiated measurement.
☐	Refer as KDB 412172, clause 2.2 following eirp can be used radiated test configuration.
☒	Refer as KDB 412172, clause 5 following eirp can be directly determined using the field strength.
☐	Refer as KDB 412172, clause 6 following eirp can be used signal/antenna substitution techniques.

3.8.4 Test Setup

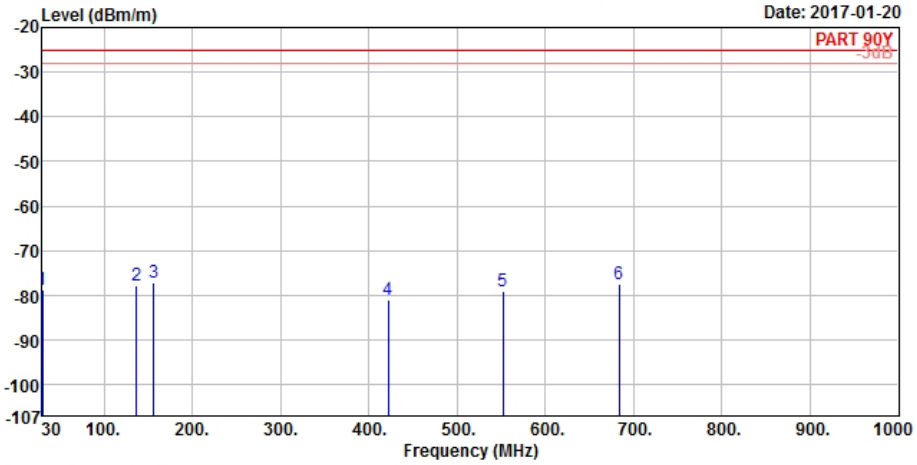
Transmitter Radiated Unwanted Emissions



Magnetic field tests shall be performed in the frequency range of 9 kHz to 30 MHz using a calibrated loop antenna. Electric field tests shall be performed in the frequency range of 30 MHz to 1000 MHz using a calibrated bi-log antenna and the frequency range of 1 GHz to 40 GHz using a calibrated horn antenna.

3.8.5 Test Result of Transmitter Radiated Unwanted Emissions (Below 1GHz)

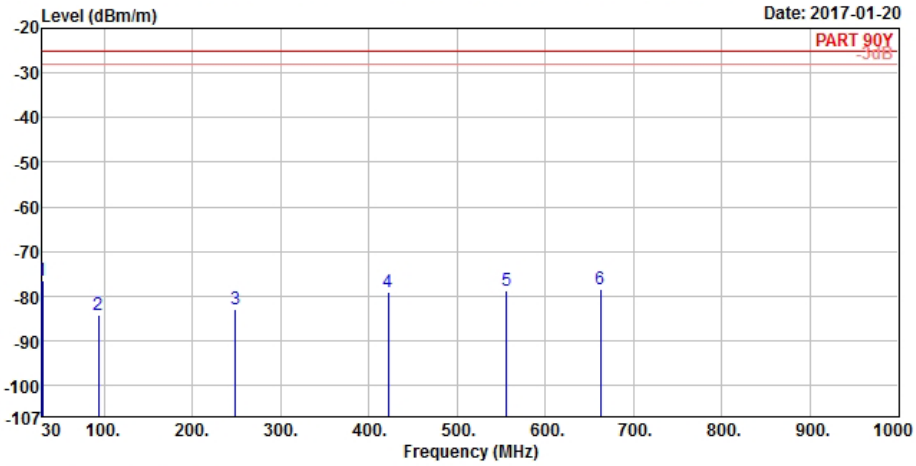
Transmitter Radiated Unwanted Emissions (Below 1GHz)			
Operating Mode	5	**Polarization**	V
Operating Function	PoE Mode		



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	30.000	-78.66	-53.66	-25.00	-74.07	22.02	0.94	27.55	Peak
2	136.700	-77.92	-52.92	-25.00	-69.03	16.40	1.93	27.22	Peak
3	156.100	-77.02	-52.02	-25.00	-67.19	15.23	2.07	27.13	Peak
4	421.880	-80.96	-55.96	-25.00	-78.74	21.31	3.41	26.94	Peak
5	551.860	-79.12	-54.12	-25.00	-79.07	23.81	4.05	27.91	Peak
6	683.780	-77.60	-52.60	-25.00	-78.00	23.97	4.37	27.94	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

Transmitter Radiated Unwanted Emissions (Below 1GHz)			
Operating Mode	5	**Polarization**	H
Operating Function	PoE Mode		

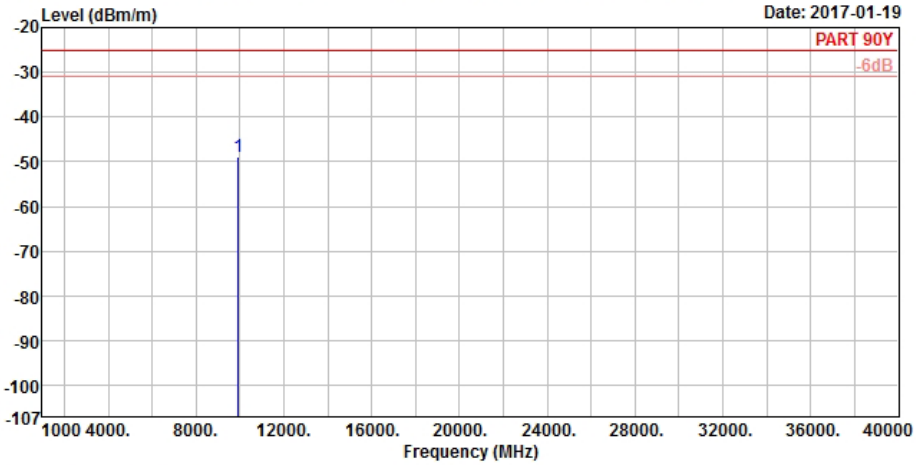


	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	30.000	-76.66	-51.66	-25.00	-72.07	22.02	0.94	27.55	Peak
2	94.020	-84.31	-59.31	-25.00	-73.22	14.75	1.56	27.40	Peak
3	249.220	-83.05	-58.05	-25.00	-76.12	17.32	2.56	26.81	Peak
4	421.880	-78.95	-53.95	-25.00	-76.73	21.31	3.41	26.94	Peak
5	555.740	-78.59	-53.59	-25.00	-78.53	23.80	4.06	27.92	Peak
6	662.440	-78.55	-53.55	-25.00	-78.99	24.00	4.40	27.96	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

3.8.6 Transmitter Radiated Unwanted Emissions (Above 1GHz)

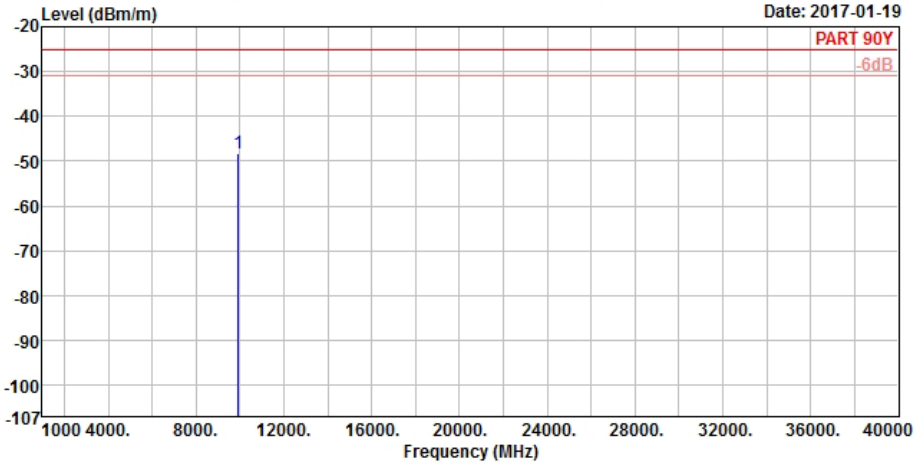
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	11j-20M	**Test Freq. (MHz)**	4960
Operating Function	Transmit	**Polarization**	V



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	9920.000	-49.04	-24.04	-25.00	-65.59	38.78	8.92	31.15	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

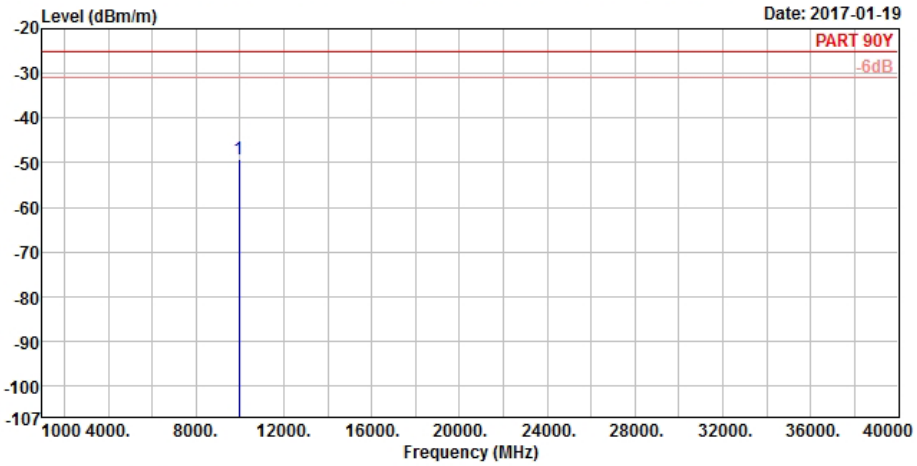
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	11j-20M	**Test Freq. (MHz)**	4960
Operating Function	Transmit	**Polarization**	H



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	9920.000	-48.22	-23.22	-25.00	-64.77	38.78	8.92	31.15	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

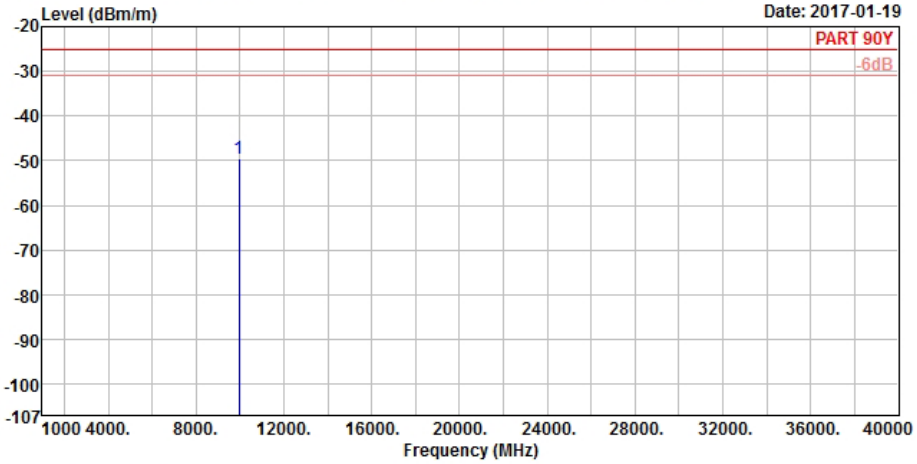
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	11j-20M	**Test Freq. (MHz)**	4980
Operating Function	Transmit	**Polarization**	V



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	9960.000	-49.24	-24.24	-25.00	-65.83	38.79	8.95	31.15	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	11j-20M	**Test Freq. (MHz)**	4980
Operating Function	Transmit	**Polarization**	H



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	9960.000	-49.45	-24.45	-25.00	-66.04	38.79	8.95	31.15	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

3.9 Frequency Stability

3.9.1 Frequency Stability Limit

Frequency Stability Limit
☒ The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized frequency band.
Note 1: These measurements shall also be performed at normal and extreme test conditions. Note 2: Refer as FCC Part 90.213.

3.9.2 Measuring Instruments

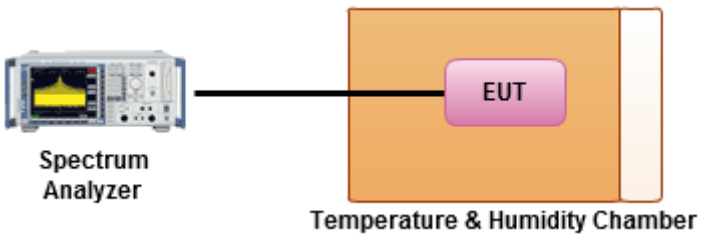
Refer a test equipment and calibration data table in this test report.

3.9.3 Test Procedures

Test Method	
☒	Refer as ANSI/TIA-603-D-2010, clause 3.2.2 for frequency stability tests
	☒ Frequency stability with respect to ambient temperature
	☒ Frequency stability when varying supply voltage
☒	For conducted measurement.
	☒ For conducted measurements on devices with multiple transmit chains: Measurements need only to be performed on one of the active transmit chains (antenna outputs)
☐	For radiated measurement. The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level.

3.9.4 Test Setup

Frequency Stability



3.9.5 Test Result of Frequency Stability

Frequency Stability Result			
Mode		**Frequency Stability (ppm)**	
Condition	**Freq. (MHz)**	**Test Frequency (MHz)**	**Frequency Stability (ppm)**
$T_{20°C}$Vmax	4960	4959.98553	0.15
$T_{20°C}$Vmin	4960	4959.98553	2.92
$T_{20°C}$Vnom	4960	4959.98625	2.77
$T_{-40°C}$Vnom	4960	4960.03653	7.36
$T_{-30°C}$Vnom	4960	4960.03427	6.91
$T_{-20°C}$Vnom	4960	4960.02460	4.96
$T_{-10°C}$Vnom	4960	4960.01881	3.79
$T_{0°C}$Vnom	4960	4960.01158	2.33
$T_{10°C}$Vnom	4960	4959.99783	0.44
$T_{20°C}$Vnom	4960	4959.98625	2.77
$T_{30°C}$Vnom	4960	4959.97612	4.81
$T_{40°C}$Vnom	4960	4959.97395	5.25
$T_{50°C}$Vnom	4960	4959.98698	2.63
$T_{55°C}$Vnom	4960	4959.99132	1.75
Limit (ppm)		10	
Result		**Complied**	
Note 1: Measure at 85 % [Vmin] and 115 % [Vmax] of the nominal voltage [Vnom]. The nominal voltage refer test report clause 1.1.6 for EUT operational condition.			

4 Test Equipment and Calibration Data

< AC Conduction >

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Calibration Due Date
EMC Receiver	R&S	ESR3	102051	9 kHz ~ 3.6 GHz	19/Apr/2016	18/Apr/2017
LISN	SCHWARZBECK MESS-ELEKTRONIK	NSLK 8127	8127-477	9 kHz ~ 30 MHz	26/Jan/2016	25/Jan/2017
LISN (Support Unit)	R&S	ENV216	101295	9 kHz ~ 30 MHz	NCR	NCR
RF Cable-CON	HUBER+SUHNER	RG213/U	07611832020001	9 kHz ~ 30 MHz	24/Oct/2016	23/Oct/2017
EMI Filter	LINDGREN	LRE-2030	2651	< 450 Hz	NCR	NCR

NCR : Non-Calibration Require

< Conducted >

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Calibration Due Date
Spectrum Analyzer	R&S	FSV 40	101013	9 kHz ~ 40 GHz	16/Feb/2016	15/Feb/2017
Signal Generator	R&S	SMR40	100116	10 MHz ~ 40 GHz	21/Jul/2016	20/Jul/2017
RF Cable-0.5m	HUBER+SUHNER	SUCOFLEX_104	MY10713/4	30 MHz ~ 26.5 GHz	02/Oct/2016	01/Oct/2017
RF Cable-0.5m	HUBER+SUHNER	SUCOFLEX_104	MY10714/4	30 MHz ~ 26.5 GHz	02/Oct/2016	01/Oct/2017
RF Cable-0.5m	HUBER+SUHNER	SUCOFLEX_104	MY10715/4	30 MHz ~ 26.5 GHz	02/Oct/2016	01/Oct/2017
Temp. and Humidity Chamber	Giant Force	GTH-225-40-CP-AR	MAA1611-005	-40 ~ 100℃	21/Nov/2016	20/Nov/2018

< Radiated >

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Calibration Due Date
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30 MHz ~ 1 GHz 3m	28/Nov/2016	27/Nov/2017
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	1 GHz ~ 18 GHz 3m	16/Dec/2016	15/Dec/2017
Amplifier	HP	8447D	2944A08033	10 kHz ~ 1.3 GHz	10/May/2016	09/May/2017
Amplifier	Keysight	83017A	MY53270197	1 GHz ~ 26.5 GHz	29/Aug/2016	28/Aug/2017
Amplifier	MITEQ	JS44-18004000-33-8P	1840917	18 GHz ~ 40 GHz	02/Jun/2015	01/Jun/2017
Spectrum	R&S	FSV40	101515	9 kHz ~ 40 GHz	16/Feb/2016	15/Feb/2017
RF Cable-R03m	Jye Bao	RG142	CB021	9 kHz ~ 1 GHz	27/Oct/2016	26/Oct/2017
RF Cable-high	SUHNER	SUCOFLEX106	CB222	1 GHz ~ 40 GHz	28/Oct/2016	27/Oct/2017
Bilog Antenna	SCHAFFNER	CBL 6112B	2723	30 MHz ~ 1 GHz	01/Oct/2016	30/Sep/2017
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170154	18 GHz ~ 40 GHz	29/Jan/2016	28/Jan/2017
Horn Antenna	SCHWARZBECK	BBHA9120D	1531	1 GHz ~ 18 GHz	22/Apr/2016	21/Apr/2017
Loop Antenna	TESEQ	HLA 6120	31244	9 kHz ~ 30 MHz	02/Feb/2015	01/Feb/2017