



FCC Test Report

Equipment : Linksys Tri-Band Wireless-AC Router
Brand Name : Linksys
Model No. : EA8300, EA8250
FCC ID : Q87-EA8300
Standard : 47 CFR FCC Part 15.247
Frequency : 2400 MHz – 2483.5 MHz
Function : Point-to-multipoint; Point-to-point
Applicant : Linksys LLC
121 Theory, Irvine CA 92617, United States

The product sample received on Dec. 07, 2016 and completely tested on Feb. 21, 2017. We, SPORTON, 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 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.


Cliff Chang

SPORTON INTERNATIONAL INC.





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APPENDIX A. TEST RESULTS OF AC POWER-LINE CONDUCTED EMISSIONS**APPENDIX B. TEST RESULTS OF DTS BANDWIDTH****APPENDIX C. TEST RESULTS OF MAXIMUM CONDUCTED OUTPUT POWER****APPENDIX D. TEST RESULTS OF POWER SPECTRAL DENSITY****APPENDIX E. TEST RESULTS OF EMISSIONS IN NON-RESTRICTED FREQUENCY BANDS****APPENDIX F. TEST RESULTS OF EMISSIONS IN RESTRICTED FREQUENCY BANDS****APPENDIX G. TEST PHOTOS****PHOTOGRAPHS OF EUT V01**



Summary of Test Result

Conformance Test Specifications				
Report Clause	Ref. Std. Clause	Description	Limit	Result
1.1.2	15.203	Antenna Requirement	FCC 15.203	Complied
3.1	15.207	AC Power-line Conducted Emissions	FCC 15.207	Complied
3.2	15.247(a)	DTS Bandwidth	$\geq 500\text{kHz}$	Complied
3.3	15.247(b)	Maximum Conducted Output Power	Power [dBm]:30	Complied
3.4	15.247(e)	Power Spectral Density	PSD [dBm/3kHz]:8	Complied
3.5	15.247(d)	Emissions in Non-restricted Frequency Bands	Non-Restricted Bands: $>30\text{ dBc}$	Complied
3.6	15.247(d)	Emissions in Restricted Frequency Bands	Restricted Bands: FCC 15.209	Complied



Revision History



1 General Description

1.1 Information

1.1.1 RF General Information

Frequency Range (MHz)	Bluetooth Mode	Ch. Frequency (MHz)	Channel Number
2400-2483.5	LE	2402-2480	0-39 [40]

Band	Mode	BWch (MHz)	Nant
2.4-2.4835GHz	BT-LE(1Mbps)	1	1TX

Note:

- Bluetooth LE uses a GFSK (1Mbps) modulation for DSSS.
- BWch is the channel separation
- 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 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	
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 4: Ant. 1 (Port 1) and Ant. 2 (Port 2) could transmit/receive simultaneously.

For 5GHz Band 1: 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 Mode Test Duty Cycle

Mode	DC	DCF(dB)	T(s)	VBW(Hz) $\geq 1/T$
BT-LE(1Mbps)	0.62	2.076	404.375u	3k

1.1.4 EUT Operational Condition

EUT Power Type	From power adapter
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1.1.5 Table for Multiple Listing

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

Model No.	Description
EA8300	All models are identical except for the EA8300 supports 256QAM and the EA8250 disable 256QAM.
EA8250	

From the above models, model: EA8300 was selected as representative model for the test and its data was recorded in this report.



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 v03r05

1.3 Testing Location Information

Testing Location				
<input type="checkbox"/>	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		
<input checked="" type="checkbox"/>	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
RF Conducted	TH01-CB	Andy Tsai, Peter Lin	20°C / 58%	Feb. 06, 2017~Feb. 08, 2017
Radiated	03CH01-CB	Jay Luo, Jeff Wu, Steven Liang	25°C / 58%	Dec. 07, 2016~Feb. 21, 2017
AC Conduction	CO01-CB	Da Deng	22°C / 59%	Feb. 20, 2017~Feb. 21, 2017

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%
Radiated Emission (1GHz ~ 18GHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%
Conducted Emission	1.7 dB	Confidence levels of 95%
Output Power Measurement	1.33 dB	Confidence levels of 95%
Power Density Measurement	1.27 dB	Confidence levels of 95%
Bandwidth Measurement	9.74×10^{-8}	Confidence levels of 95%



2 Test Configuration of EUT

2.1 Test Channel Mode

Mode	Power Setting
BT-LE(1Mbps)	-
2402MHz	Default
2440MHz	Default
2480MHz	Default



2.2 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	CTX
1	WLAN 2.4GHz + Adapter 2
2	WLAN 5GHz + Adapter 2
3	Bluetooth + Adapter 2
Mode 2 has been evaluated to be the worst case among Mode 1~3, thus measurement for Mode 4~5 will follow this same test mode.	
4	WLAN 5GHz + Adapter 1
5	WLAN 5GHz + Adapter 3
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	DTS Bandwidth Maximum Conducted Output Power Power Spectral Density
Test Condition	Conducted measurement at transmit chains



The Worst Case Mode for Following Conformance Tests	
Tests Item	Emissions in Non-restricted Frequency Bands 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
1	EUT Z axis + WLAN 2.4GHz + Adapter 1
2	EUT Y axis + WLAN 2.4GHz + Adapter 1
Mode 1 has been evaluated to be the worst case among Mode 1~2, thus measurement for Mode 3~4 will follow this same test mode.	
3	EUT Z axis + WLAN 5GHz + Adapter 1
4	EUT Z axis + Bluetooth + Adapter 1
Mode 1 has been evaluated to be the worst case among Mode 1~4, thus measurement for Mode 5~6 will follow this same test mode.	
5	EUT Z axis + WLAN 2.4GHz + Adapter 2
6	EUT Z axis + WLAN 2.4GHz + Adapter 3
For operating mode 1 is the worst case and it was record in this test report.	
Operating Mode > 1GHz	CTX
1	EUT Z axis
2	EUT Y axis
Mode 2 has been evaluated to be the worst case after evaluating. Consequently, measurement will follow this same test mode.	

The Worst Case Mode for Following Conformance Tests	
Tests Item	Simultaneous Transmission Analysis
Operating Mode	
1	WLAN 2.4GHz + WLAN 5GHz
2	WLAN 5GHz + Bluetooth

Refer to Sporton Test Report No.: FA710901 for Co-location RF Exposure Evaluation

2.3 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.



2.4 Accessories

Accessories			
Power	Brand	Model	Rating
Adapter 1 (Fixed plug)	LEI	MU24-Y120200-A1	Input: 100-240Vac, 50/60Hz, 0.7A Output: 12Vdc, 2.0A
Adapter 2 (Fixed plug)	DVE	DSA-24PFM-12 FUS 120200	Input: 100-240Vac, 50/60Hz, 0.8A Output: 12Vdc, 2A
Adapter 3 (Interchangeable plug)	DVE	DSA-24PFM-12 FCA 120200	Input: 100-240Vac, 50/60Hz, 0.8A Output: 12Vdc, 2A
Others			
Plug*1 (for adapter 3 use only)			
RJ-45 cable: Non-shielded, 0.9m			

Note: Adapter does not affect the radio tests, there is only adapter 1 tested and recorded in this report.

2.5 Support Equipment

For Test Site No: CO01-CB

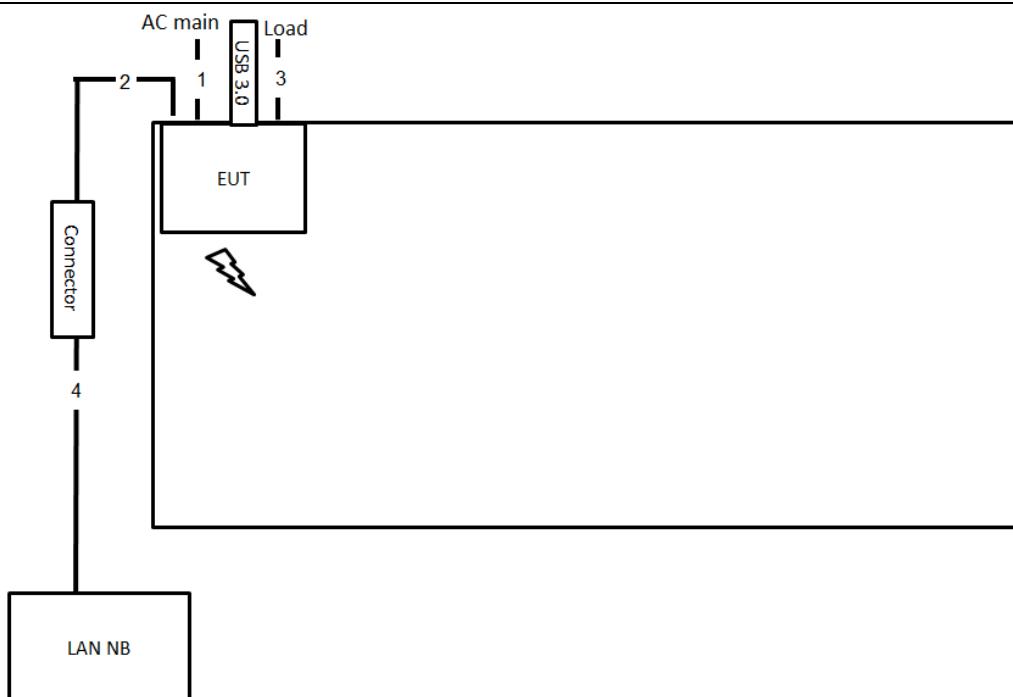
Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID
1	NB	DELL	E6430	DoC
2	Flash disk3.0	Transcend	JetFlash-700	DoC

For Test Site No: 03CH01-CB and TH01-CB

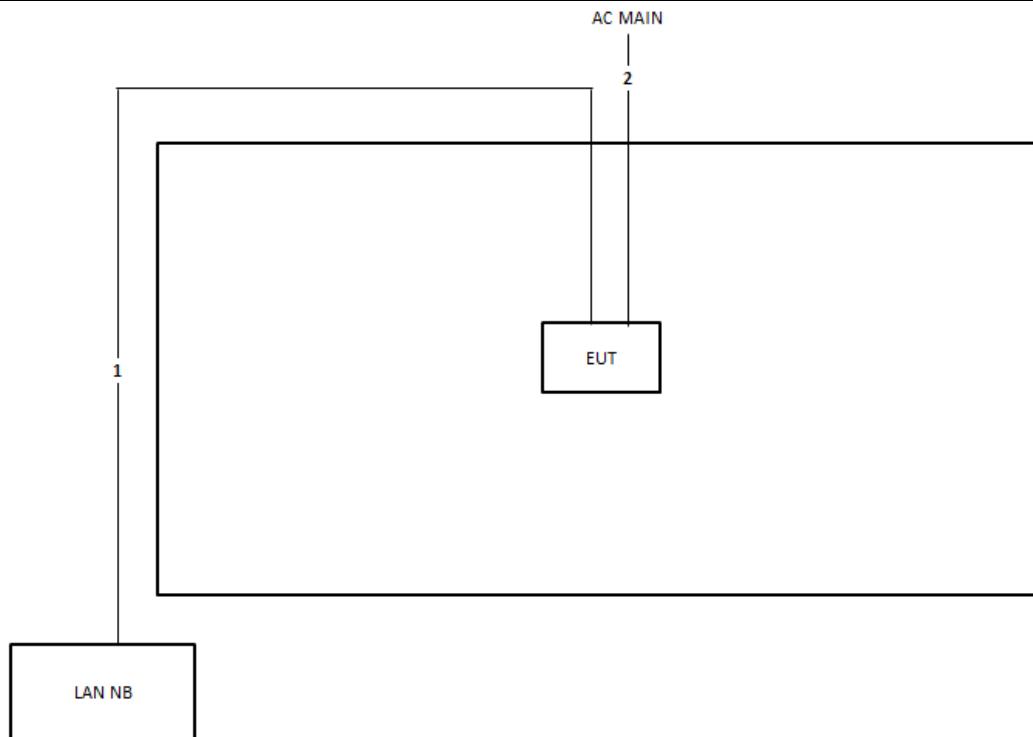
Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID
1	NB	DELL	E4300	DoC

2.6 Test Setup Diagram

Test Setup Diagram – AC Line Conducted Emission Test



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

Test Setup Diagram - Radiated Test

Item	Connection	Shielded	Length
1	RJ-45 cable	No	10m
2	Power cable	No	1.5m

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.

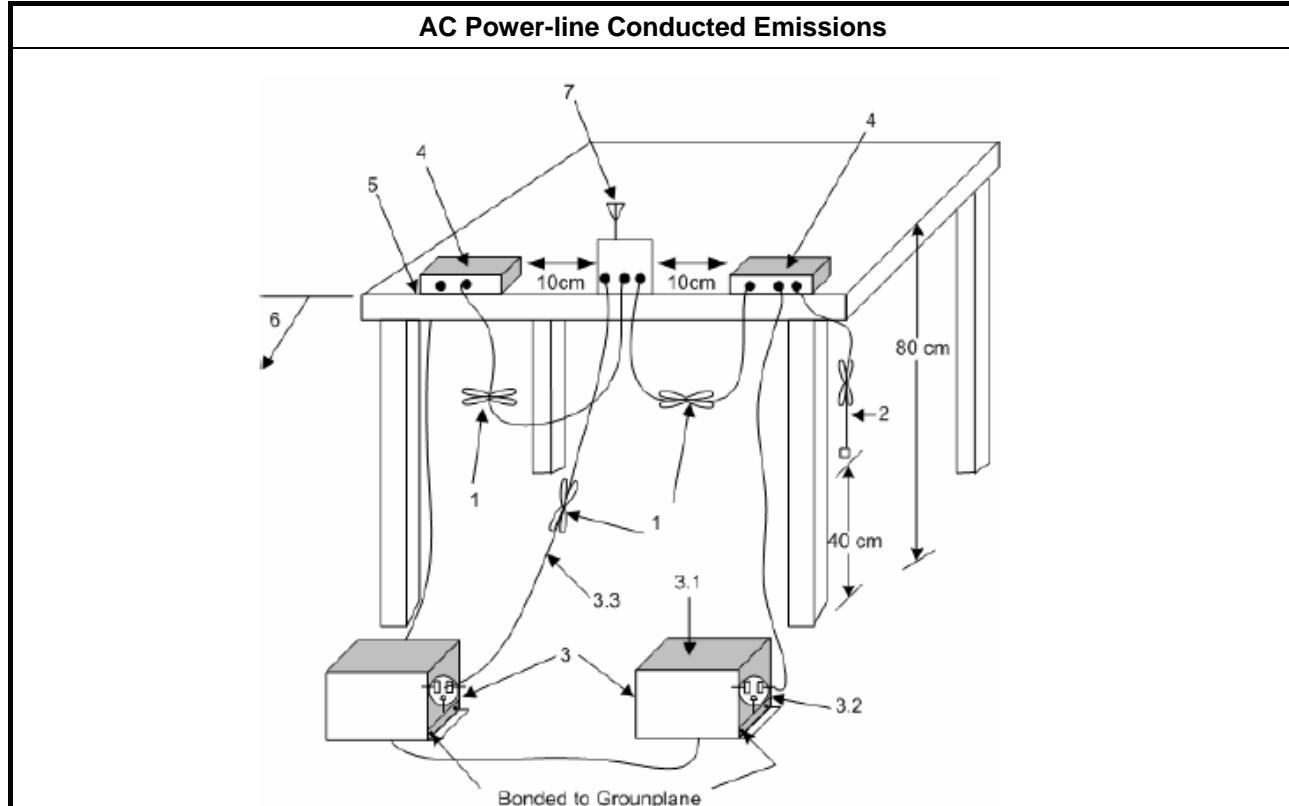
3.1.2 Measuring Instruments

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 foray 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 DTS Bandwidth

3.2.1 6dB Bandwidth Limit

6dB Bandwidth Limit
Systems using digital modulation techniques:
▪ 6 dB bandwidth \geq 500 kHz.

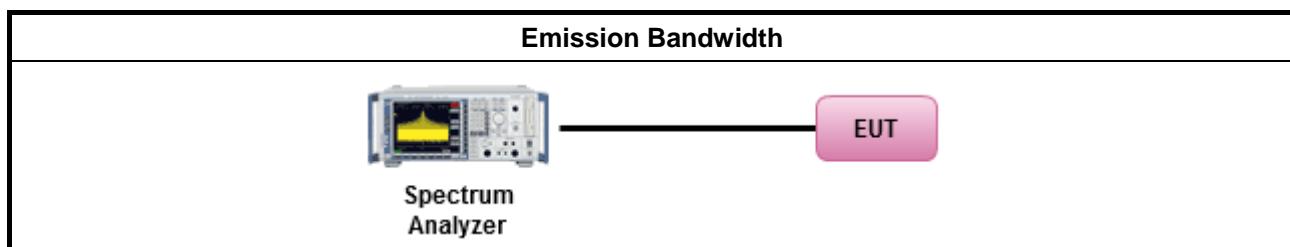
3.2.2 Measuring Instruments

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:
<input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 8.1 Option 1 for 6 dB bandwidth measurement.
<input type="checkbox"/> Refer as FCC KDB 558074, clause 8.2 Option 2 for 6 dB bandwidth measurement.
<input type="checkbox"/> Refer as ANSI C63.10, clause 6.9.1 for occupied bandwidth testing.

3.2.4 Test Setup



3.2.5 Test Result of Emission Bandwidth

Refer as Appendix B



3.3 Maximum Conducted Output Power

3.3.1 Maximum Conducted Output Power Limit

Maximum Conducted Output Power Limit	
	<ul style="list-style-type: none">▪ If $G_{TX} \leq 6 \text{ dBi}$, then $P_{Out} \leq 30 \text{ dBm}$ (1 W)
	<ul style="list-style-type: none">▪ Point-to-multipoint systems (P2M): If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 30 - (G_{TX} - 6) \text{ dBm}$
	<ul style="list-style-type: none">▪ Point-to-point systems (P2P): If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 30 - (G_{TX} - 6)/3 \text{ dBm}$
	<ul style="list-style-type: none">▪ Smart antenna system (SAS):<ul style="list-style-type: none">- Single beam: If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 30 - (G_{TX} - 6)/3 \text{ dBm}$- Overlap beam: If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 30 - (G_{TX} - 6)/3 \text{ dBm}$- Aggregate power on all beams: If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 30 - (G_{TX} - 6)/3 + 8 \text{ dBm}$
P_{Out} = maximum peak conducted output power or maximum conducted output power in dBm, G_{TX} = the maximum transmitting antenna directional gain in dBi.	

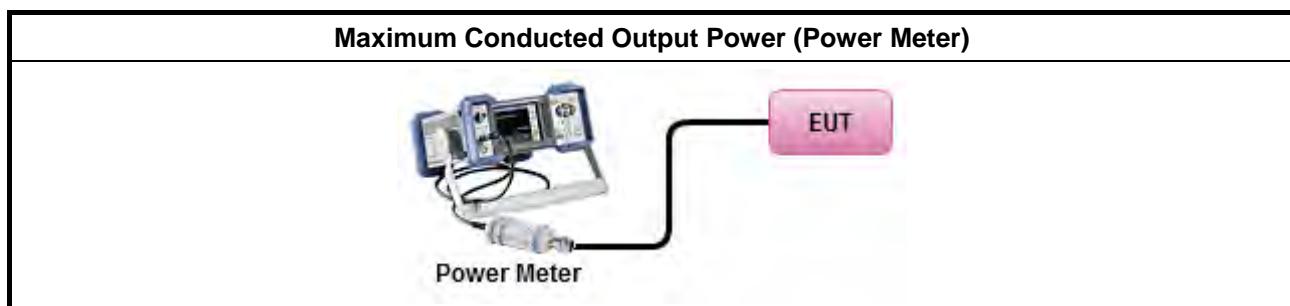
3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

Test Method	
▪ Maximum Peak Conducted Output Power	<input type="checkbox"/> Refer as FCC KDB 558074, clause 9.1.1 Option 1 (RBW \geq EBW method). <input type="checkbox"/> Refer as FCC KDB 558074, clause 9.1.2 Option 2 (peak power meter for VBW \geq DTS BW)
▪ Maximum Conducted Output Power	<p>[duty cycle \geq 98% or external video / power trigger]</p> <input type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.2.2 Method AVGSA-1 (spectral trace averaging). <input type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.2.3 Method AVGSA-1 Alt. (slow sweep speed) duty cycle < 98% and average over on/off periods with duty factor <input type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.2.4 Method AVGSA-2 (spectral trace averaging). <input type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.2.5 Method AVGSA-2 Alt. (slow sweep speed) RF power meter and average over on/off periods with duty factor or gated trigger <input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.3 Method AVGPM-G (using an RF average power meter).
▪ For conducted measurement.	<ul style="list-style-type: none">▪ If 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.▪ If multiple transmit chains, EIRP calculation could be following as methods: $P_{total} = P_1 + P_2 + \dots + P_n$ (calculated in linear unit [mW] and transfer to log unit [dBm]) $EIRP_{total} = P_{total} + DG$

3.3.4 Test Setup



3.3.5 Test Result of Maximum Conducted Output Power

Refer as Appendix C



3.4 Power Spectral Density

3.4.1 Power Spectral Density Limit

Power Spectral Density Limit
▪ Power Spectral Density (PSD)≤8 dBm/3kHz

3.4.2 Measuring Instruments

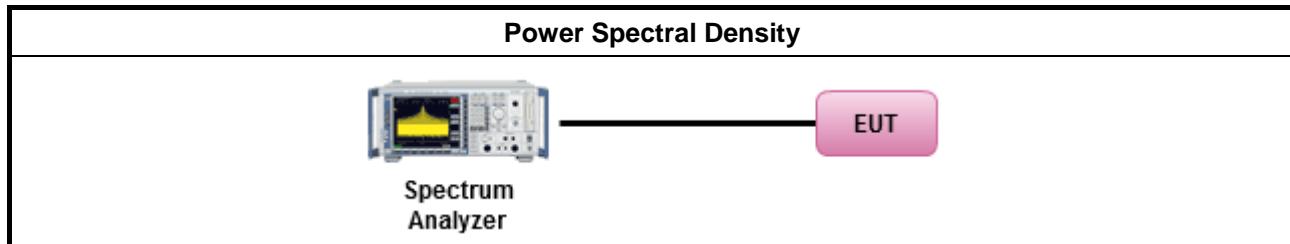
Refer a test equipment and calibration data table in this test report.

3.4.3 Test Procedures

Test Method
▪ Peak power spectral density procedures that the same method as used to determine the conducted output power. If maximum peak conducted output power was measured to demonstrate compliance to the output power limit, then the peak PSD procedure below (Method PKPSD) shall be used. If maximum conducted output power was measured to demonstrate compliance to the output power limit, then one of the average PSD procedures shall be used, as applicable based on the following criteria (the peak PSD procedure is also an acceptable option).
<input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 10.2 Method PKPSD (RBW=3-100kHz; Detector=peak). [duty cycle ≥ 98% or external video / power trigger]
<input type="checkbox"/> Refer as FCC KDB 558074, clause 10.3 Method AVGPSD-1 (spectral trace averaging).
<input type="checkbox"/> Refer as FCC KDB 558074, clause 10.4 Method AVGPSD-2 (slow sweep speed)
duty cycle < 98% and average over on/off periods with duty factor
<input type="checkbox"/> Refer as FCC KDB 558074, clause 10.5 Method AVGPSD-1 Alt (spectral trace averaging).
<input type="checkbox"/> Refer as FCC KDB 558074, clause 10.6 Method AVGPSD-2 Alt. (slow sweep speed)
▪ For conducted measurement.
▪ If The EUT supports multiple transmit chains using options given below:
<input checked="" type="checkbox"/> Option 1: Measure and sum the spectra across the outputs. Refer as FCC KDB 662911, In-band power spectral density (PSD). Sample all transmit ports simultaneously using a spectrum analyzer for each transmit port. Where the trace bin-by-bin of each transmit port summing can be performed. (i.e., in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 and that from the first spectral bin of output 3, and so on up to the NTX output to obtain the value for the first frequency bin of the summed spectrum.). Add up the amplitude (power) values for the different transmit chains and use this as the new data trace.
<input type="checkbox"/> Option 2: Measure and sum spectral maxima across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs. These operations shall be performed separately over frequency spans that have different out-of-band or spurious emission limits,
<input type="checkbox"/> Option 3: Measure and add $10 \log(N)$ dB, where N is the number of transmit chains. Refer as FCC KDB 662911, In-band power spectral density (PSD). Performed at each transmit chains and each transmit chains shall be compared with the limit have been reduced with $10 \log(N)$. Or each transmit chains shall be add $10 \log(N)$ to compared with the limit.



3.4.4 Test Setup



3.4.5 Test Result of Power Spectral Density

Refer as Appendix D

3.5 Emissions in Non-restricted Frequency Bands

3.5.1 Emissions in Non-restricted Frequency Bands Limit

Un-restricted Band Emissions Limit	
RF output power procedure	Limit (dB)
Peak output power procedure	20
Average output power procedure	30

Note 1: If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

Note 2: If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.

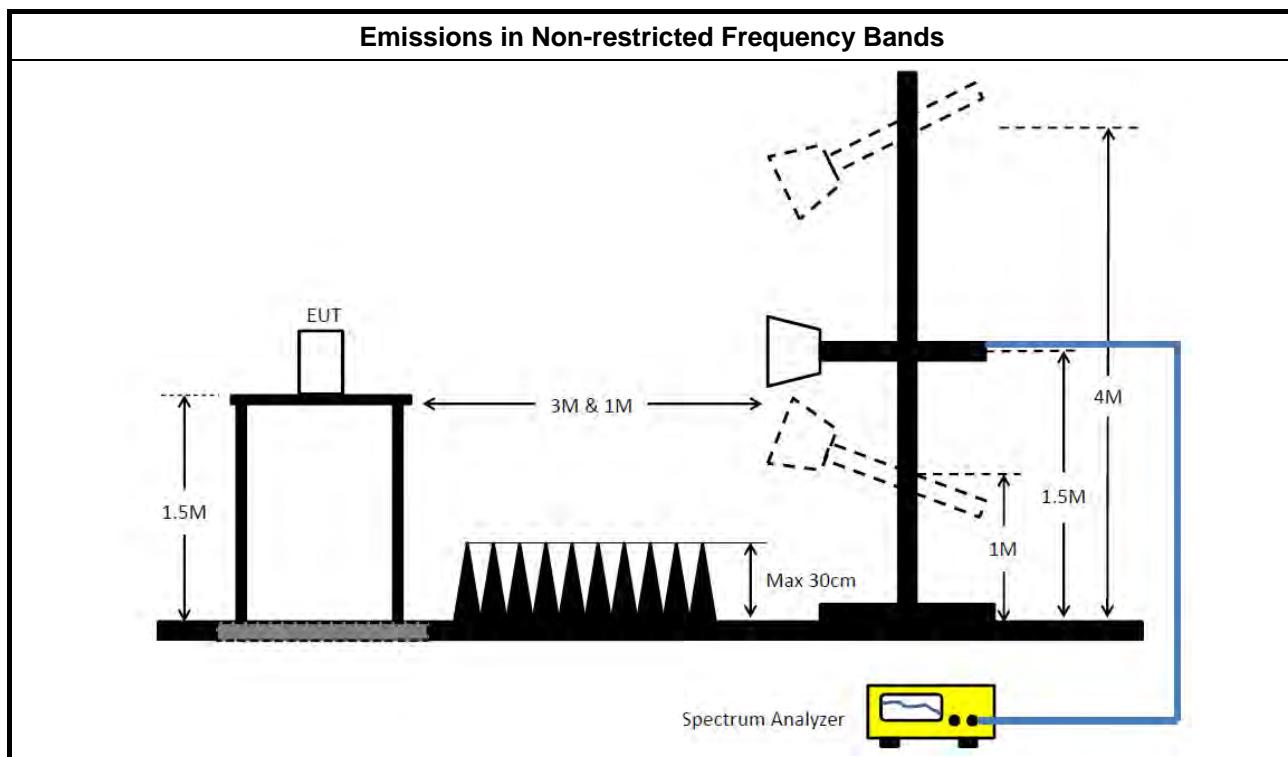
3.5.2 Measuring Instruments

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

3.5.3 Test Procedures

Test Method
▪ Refer as FCC KDB 558074, clause 11 for unwanted emissions into non-restricted bands.

3.5.4 Test Setup





3.5.5 Test Result of Emissions in Non-restricted Frequency Bands

Refer as Appendix E



3.6 Emissions in Restricted Frequency Bands

3.6.1 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.

3.6.2 Measuring Instruments

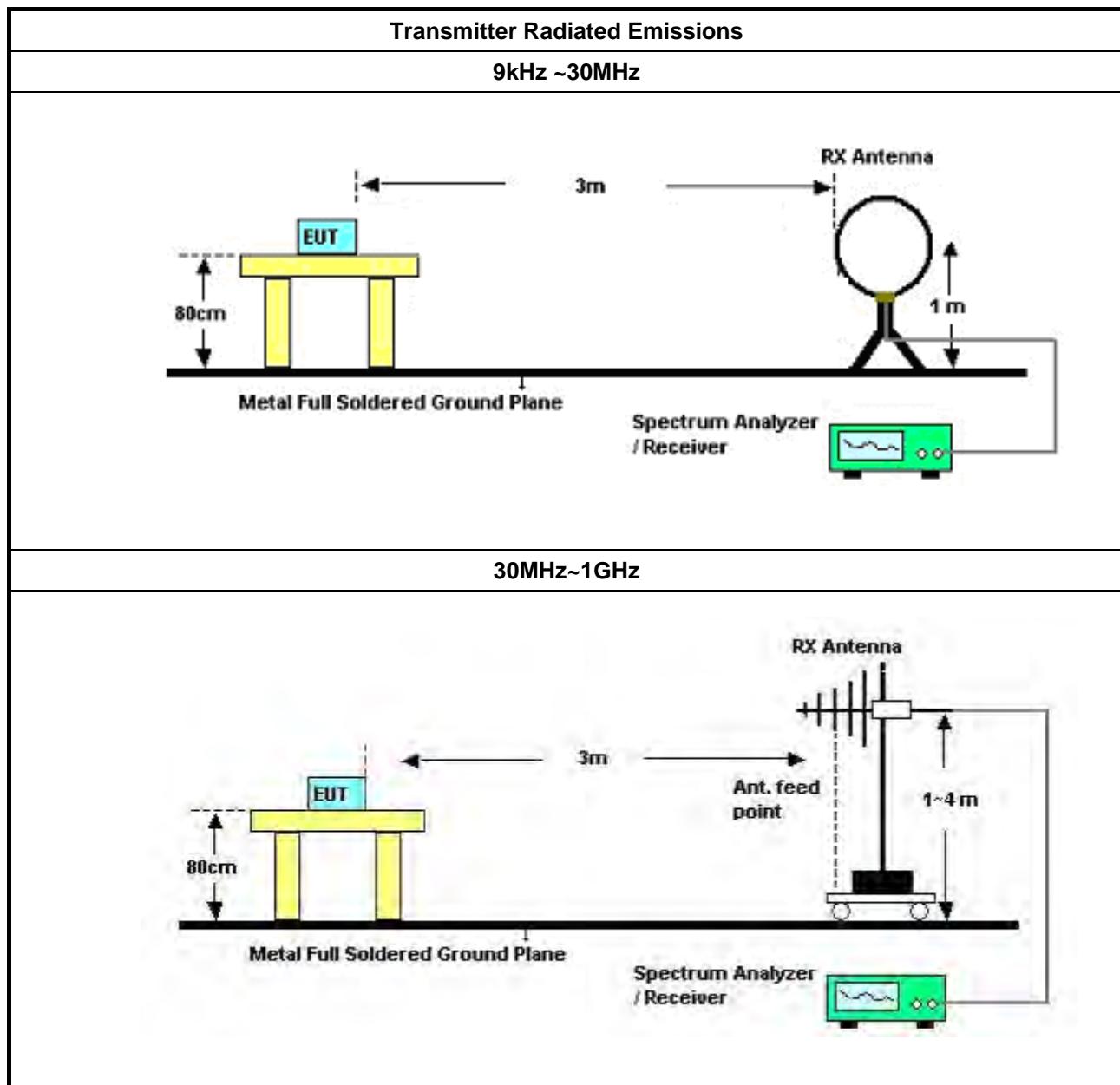
Refer a test equipment and calibration data table in this test report.

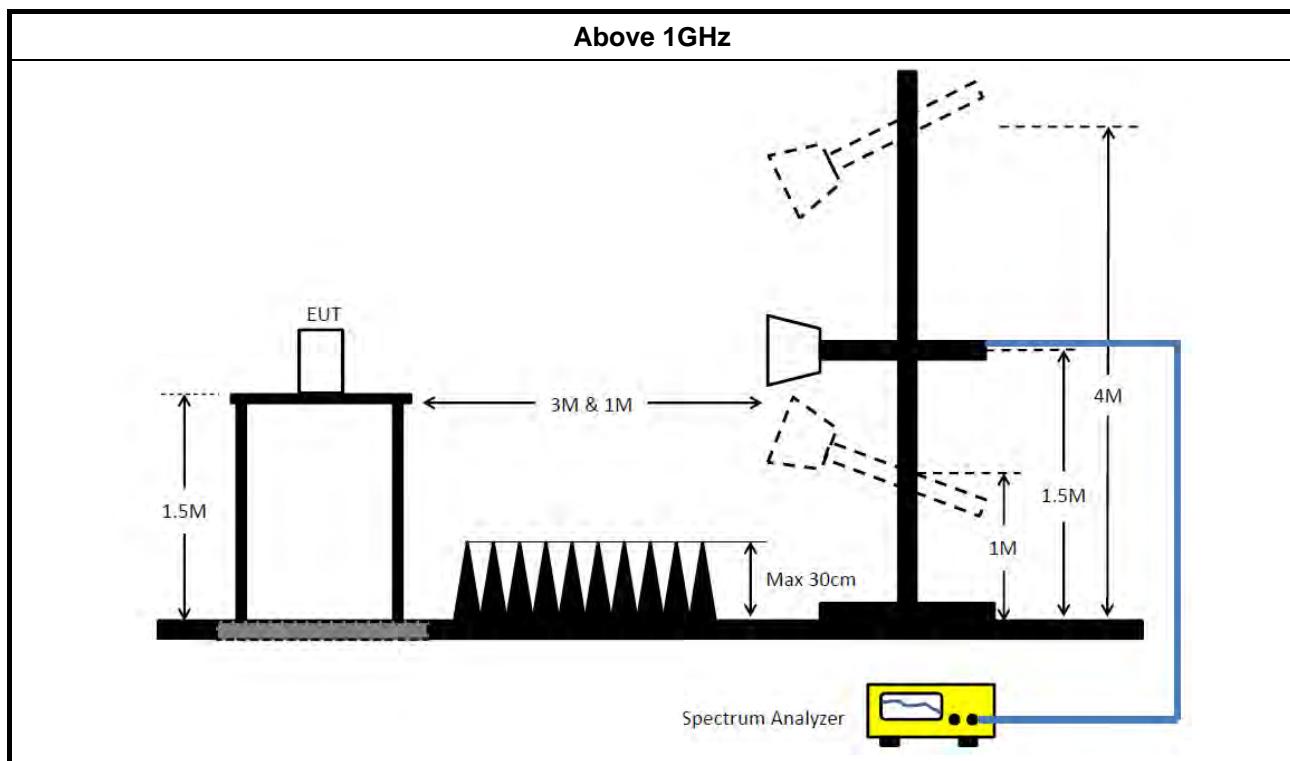


3.6.3 Test Procedures

Test Method	
▪ The average emission levels shall be measured in [duty cycle \geq 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.
	<input type="checkbox"/> Refer as FCC KDB 558074, clause 12.2.5.1 Option 1 (trace averaging for duty cycle \geq 98%)
	<input type="checkbox"/> Refer as FCC KDB 558074, clause 12.2.5.2 Option 2 (trace averaging + duty factor).
	<input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 12.2.5.3 Option 3 (Reduced $VBW \geq 1/T$).
	<input type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.3 (Reduced VBW). $VBW \geq 1/T$, where T is pulse time.
	<input type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.4 average value of pulsed emissions.
	<input checked="" type="checkbox"/> 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.

3.6.4 Test Setup





3.6.5 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.

3.6.6 Transmitter Radiated Unwanted Emissions

Refer as Appendix F



4 Test Equipment and Calibration Data

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.45GHz	Jan. 23, 2017	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 14, 2016	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Dec. 21, 2016	Conduction (CO01-CB)
COND Cable	Woken	Cable	01	150kHz ~ 30MHz	May 24, 2016	Conduction (CO01-CB)
Software	Audix	E3	6.120210n	-	N.C.R.	Conduction (CO01-CB)
BILOG ANTENNA with 6dB Attenuator	TESEQ & EMCI	CBL6112D & N-6-06	37880 & AT-N0609	20MHz ~ 2GHz	Aug. 30, 2016	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Nov. 10, 2016	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 25, 2016	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10991	0.1MHz ~ 1.3GHz	Mar. 15, 2016	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 18, 2016	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 16, 2017	Radiation (03CH01-CB)
Pre-Amplifier	MITEQ	TTA1840-35-HG	1864479	18GHz ~ 40GHz	Jun. 28, 2016	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Nov. 21, 2016	Radiation (03CH01-CB)
EMI Test	R&S	ESCS	100355	9kHz ~ 2.75GHz	May 16, 2016	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-16+17	N/A	30 MHz ~ 1 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16	N/A	1 GHz ~ 18 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16+17	N/A	1 GHz ~ 18 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#1	N/A	18GHz ~ 40 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#2	N/A	18GHz ~ 40 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 16, 2016*	Radiation (03CH01-CB)
Test Software	Audix	E3	6.2009-I0-7	N/A	N/A	Radiation (03CH01-CB)
Spectrum analyzer	R&S	FSV40	100979	9kHz~40GHz	Dec. 26, 2016	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-6	1 GHz – 26.5 GHz	Oct. 24, 2016	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-7	1 GHz –26.5 GHz	Oct. 24, 2016	Conducted (TH01-CB)

**FCC Test Report****Report No. : FR710901AD**

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
RF Cable-high	Woken	RG402	High Cable-8	1 GHz –26.5 GHz	Oct. 24, 2016	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-9	1 GHz –26.5 GHz	Oct. 24, 2016	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-10	1 GHz –26.5 GHz	Oct. 24, 2016	Conducted (TH01-CB)
Power Sensor	Agilent	U2021XA	MY53410001	50MHz~18GHz	Nov. 22, 2016	Conducted (TH01-CB)

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

“*” Calibration Interval of instruments listed above is two years.

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



AC Power-line Conducted Emissions Result

Appendix A

AC Power-line Conducted Emissions Result																																																																																																																																												
Operating Mode		2	Power Phase		Neutral																																																																																																																																							
Operating Function		CTX																																																																																																																																										
<table><thead><tr><th rowspan="2">Freq</th><th rowspan="2">Level</th><th>Over</th><th>Limit</th><th>Read</th><th>LISN</th><th>Cable</th><th rowspan="2">Remark</th><th rowspan="2">Pol/Phase</th></tr><tr><th>Limit</th><th>Line</th><th>Level</th><th>Factor</th><th>Loss</th></tr><tr><th>MHz</th><th>dBuV</th><th>dB</th><th>dBuV</th><th>dBuV</th><th>dB</th><th>dB</th><th></th><th></th></tr></thead><tbody><tr><td>1</td><td>0.1590</td><td>33.36</td><td>-22.16</td><td>55.52</td><td>23.37</td><td>9.95</td><td>0.04 Average</td><td>NEUTRAL</td></tr><tr><td>2</td><td>0.1590</td><td>40.74</td><td>-24.78</td><td>65.52</td><td>30.75</td><td>9.95</td><td>0.04 QP</td><td>NEUTRAL</td></tr><tr><td>3</td><td>0.2863</td><td>38.00</td><td>-12.63</td><td>50.63</td><td>27.98</td><td>9.97</td><td>0.05 Average</td><td>NEUTRAL</td></tr><tr><td>4</td><td>0.2863</td><td>44.97</td><td>-15.66</td><td>60.63</td><td>34.95</td><td>9.97</td><td>0.05 QP</td><td>NEUTRAL</td></tr><tr><td>5</td><td>0.5265</td><td>28.95</td><td>-17.05</td><td>46.00</td><td>18.94</td><td>9.97</td><td>0.04 Average</td><td>NEUTRAL</td></tr><tr><td>6</td><td>0.5265</td><td>36.22</td><td>-19.78</td><td>56.00</td><td>26.21</td><td>9.97</td><td>0.04 QP</td><td>NEUTRAL</td></tr><tr><td>7</td><td>0.8261</td><td>26.67</td><td>-19.33</td><td>46.00</td><td>16.64</td><td>9.98</td><td>0.05 Average</td><td>NEUTRAL</td></tr><tr><td>8</td><td>0.8261</td><td>33.78</td><td>-22.22</td><td>56.00</td><td>23.75</td><td>9.98</td><td>0.05 QP</td><td>NEUTRAL</td></tr><tr><td>9</td><td>2.2367</td><td>24.18</td><td>-21.82</td><td>46.00</td><td>14.11</td><td>9.98</td><td>0.09 Average</td><td>NEUTRAL</td></tr><tr><td>10</td><td>2.2367</td><td>31.38</td><td>-24.62</td><td>56.00</td><td>21.31</td><td>9.98</td><td>0.09 QP</td><td>NEUTRAL</td></tr><tr><td>11</td><td>12.7161</td><td>20.63</td><td>-29.37</td><td>50.00</td><td>10.22</td><td>10.20</td><td>0.21 Average</td><td>NEUTRAL</td></tr><tr><td>12</td><td>12.7161</td><td>27.59</td><td>-32.41</td><td>60.00</td><td>17.18</td><td>10.20</td><td>0.21 QP</td><td>NEUTRAL</td></tr></tbody></table>										Freq	Level	Over	Limit	Read	LISN	Cable	Remark	Pol/Phase	Limit	Line	Level	Factor	Loss	MHz	dBuV	dB	dBuV	dBuV	dB	dB			1	0.1590	33.36	-22.16	55.52	23.37	9.95	0.04 Average	NEUTRAL	2	0.1590	40.74	-24.78	65.52	30.75	9.95	0.04 QP	NEUTRAL	3	0.2863	38.00	-12.63	50.63	27.98	9.97	0.05 Average	NEUTRAL	4	0.2863	44.97	-15.66	60.63	34.95	9.97	0.05 QP	NEUTRAL	5	0.5265	28.95	-17.05	46.00	18.94	9.97	0.04 Average	NEUTRAL	6	0.5265	36.22	-19.78	56.00	26.21	9.97	0.04 QP	NEUTRAL	7	0.8261	26.67	-19.33	46.00	16.64	9.98	0.05 Average	NEUTRAL	8	0.8261	33.78	-22.22	56.00	23.75	9.98	0.05 QP	NEUTRAL	9	2.2367	24.18	-21.82	46.00	14.11	9.98	0.09 Average	NEUTRAL	10	2.2367	31.38	-24.62	56.00	21.31	9.98	0.09 QP	NEUTRAL	11	12.7161	20.63	-29.37	50.00	10.22	10.20	0.21 Average	NEUTRAL	12	12.7161	27.59	-32.41	60.00	17.18	10.20	0.21 QP	NEUTRAL
Freq	Level	Over	Limit	Read	LISN	Cable	Remark	Pol/Phase																																																																																																																																				
		Limit	Line	Level	Factor	Loss																																																																																																																																						
MHz	dBuV	dB	dBuV	dBuV	dB	dB																																																																																																																																						
1	0.1590	33.36	-22.16	55.52	23.37	9.95	0.04 Average	NEUTRAL																																																																																																																																				
2	0.1590	40.74	-24.78	65.52	30.75	9.95	0.04 QP	NEUTRAL																																																																																																																																				
3	0.2863	38.00	-12.63	50.63	27.98	9.97	0.05 Average	NEUTRAL																																																																																																																																				
4	0.2863	44.97	-15.66	60.63	34.95	9.97	0.05 QP	NEUTRAL																																																																																																																																				
5	0.5265	28.95	-17.05	46.00	18.94	9.97	0.04 Average	NEUTRAL																																																																																																																																				
6	0.5265	36.22	-19.78	56.00	26.21	9.97	0.04 QP	NEUTRAL																																																																																																																																				
7	0.8261	26.67	-19.33	46.00	16.64	9.98	0.05 Average	NEUTRAL																																																																																																																																				
8	0.8261	33.78	-22.22	56.00	23.75	9.98	0.05 QP	NEUTRAL																																																																																																																																				
9	2.2367	24.18	-21.82	46.00	14.11	9.98	0.09 Average	NEUTRAL																																																																																																																																				
10	2.2367	31.38	-24.62	56.00	21.31	9.98	0.09 QP	NEUTRAL																																																																																																																																				
11	12.7161	20.63	-29.37	50.00	10.22	10.20	0.21 Average	NEUTRAL																																																																																																																																				
12	12.7161	27.59	-32.41	60.00	17.18	10.20	0.21 QP	NEUTRAL																																																																																																																																				

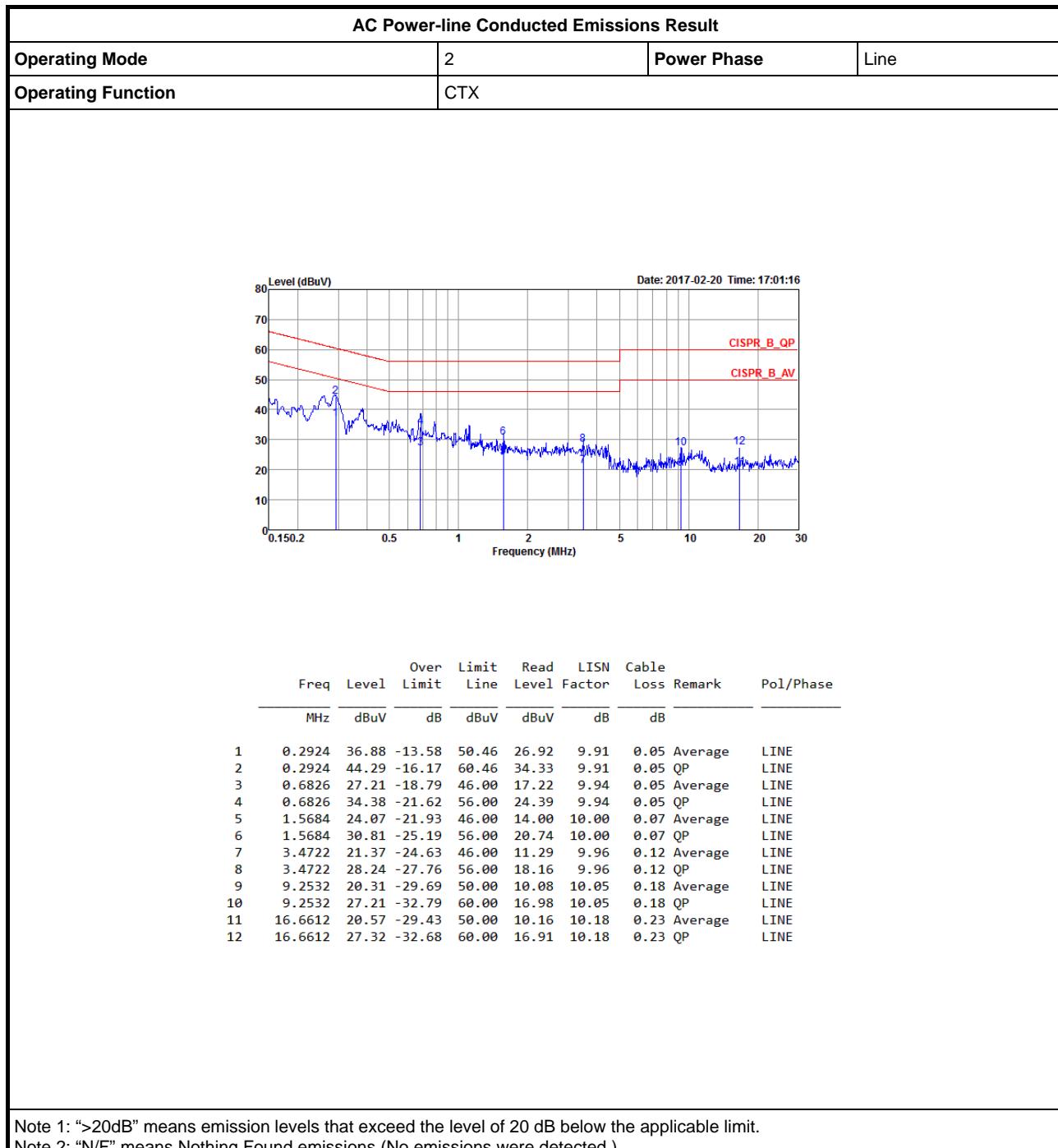
Note 1: ">20dB" means emission levels that exceed the level of 20 dB below the applicable limit.

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



AC Power-line Conducted Emissions Result

Appendix A



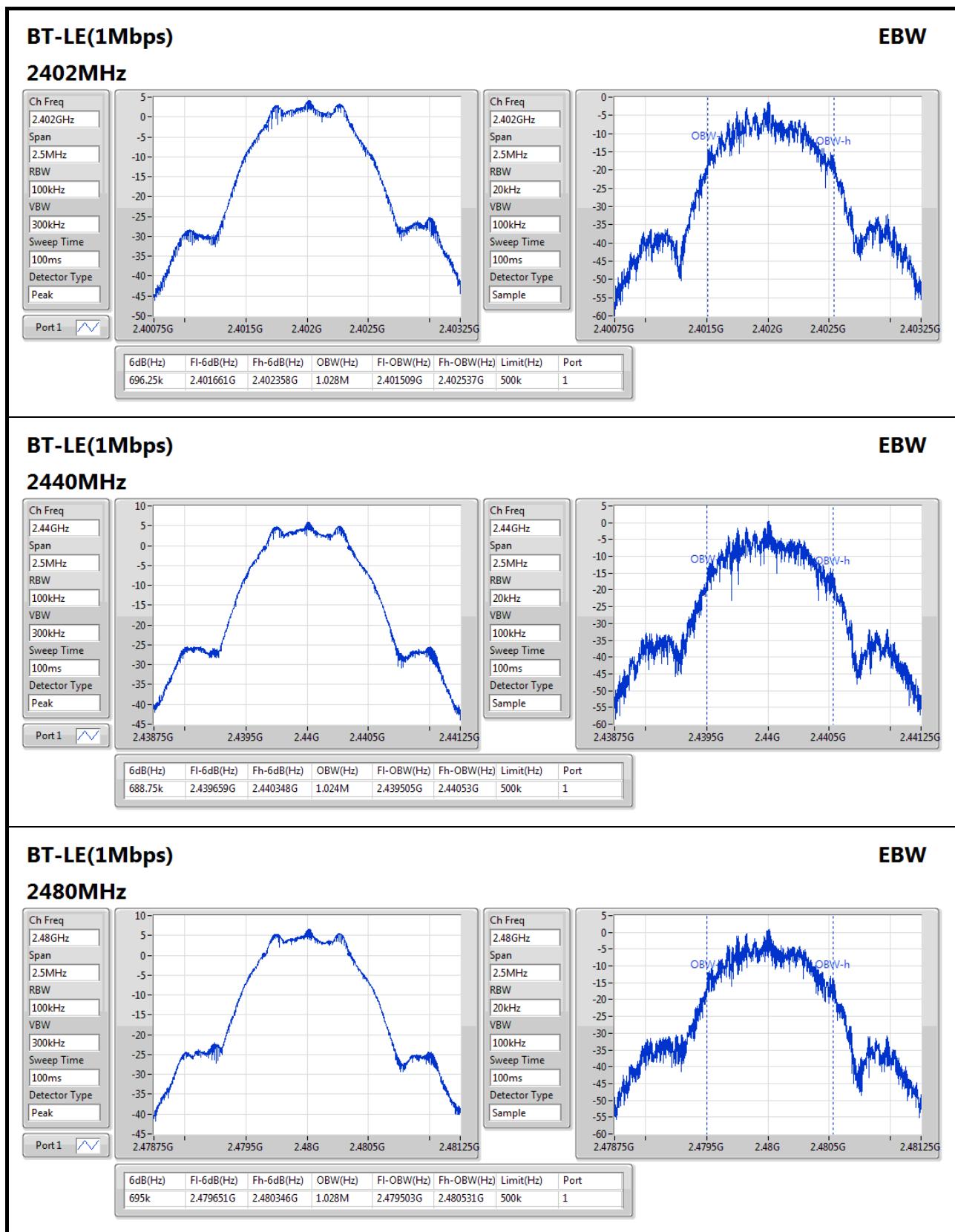
**Summary**

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
BT-LE(1Mbps)	-	-	-	-	-
2.4-2.4835GHz	696.25k	1.028M	1M03F1D	688.75k	1.024M

Max-N dB = Maximum 6dB down bandwidth; **Max-OBW** = Maximum 99% occupied bandwidth;**Min-N dB** = Minimum 6dB down bandwidth; **Min-OBW** = Minimum 99% occupied bandwidth;**Result**

Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	500k	696.25k	1.028M
2440MHz	Pass	500k	688.75k	1.024M
2480MHz	Pass	500k	695k	1.028M

Port X-N dB = Port X 6dB down bandwidth; **Port X-OBW** = Port X 99% occupied bandwidth;



**Summary**

Mode	Power (dBm)	Power (W)
BT-LE(1Mbps)	-	-
2.4-2.4835GHz	7.74	0.00594

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.54	5.60	30.00
2440MHz	Pass	2.54	7.18	30.00
2480MHz	Pass	2.54	7.74	30.00

**Summary**

Mode	PD (dBm/RBW)
BT-LE(1Mbps)	-
2.4-2.4835GHz	-10.45

RBW=3kHz.

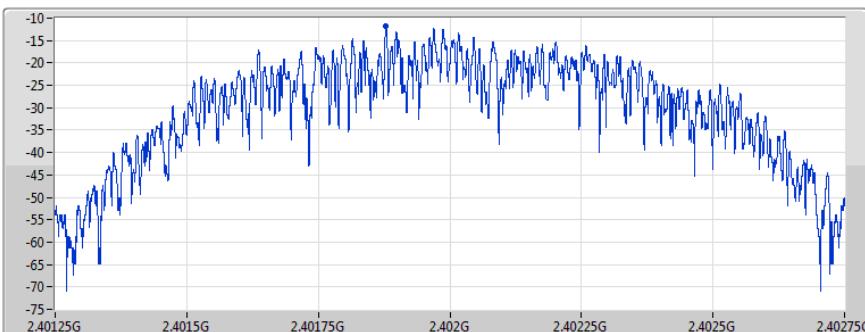
Result

Mode	Result	Gain (dBi)	PD (dBm/RBW)	PD Limit (dBm/RBW)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.54	-11.90	8.00
2440MHz	Pass	2.54	-10.45	8.00
2480MHz	Pass	2.54	-11.68	8.00

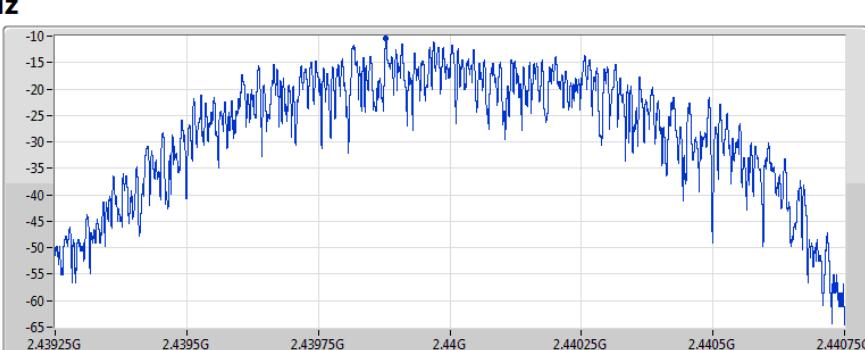
RBW=3kHz.

**BT-LE(1Mbps)****PSD****2402MHz**

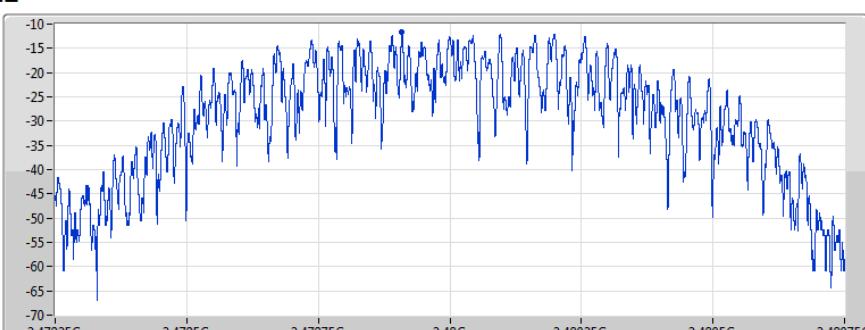
Ch Freq	2.402GHz
Span	1.5MHz
RBW	3kHz
VBW	10kHz
Sweep Time	32.1ms
Detector Type	Peak

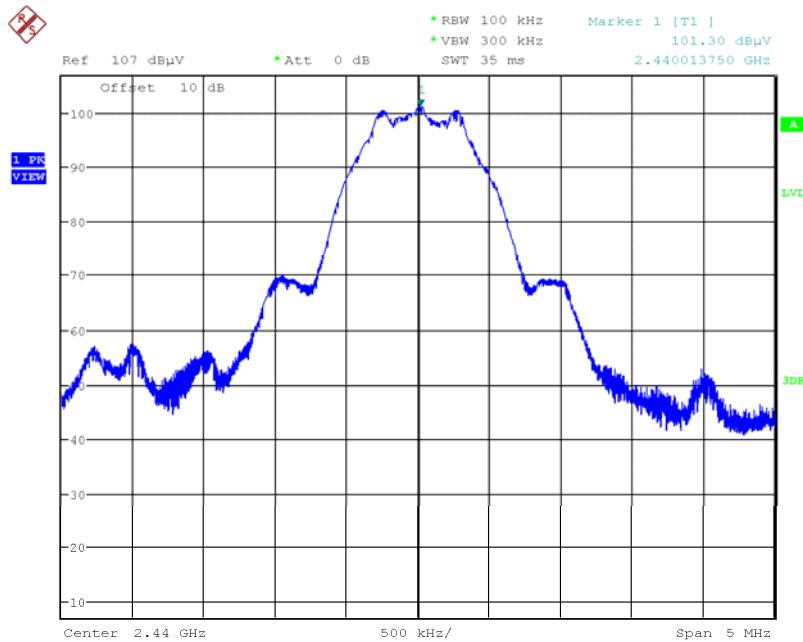
**BT-LE(1Mbps)****PSD****2440MHz**

Ch Freq	2.44GHz
Span	1.5MHz
RBW	3kHz
VBW	10kHz
Sweep Time	32.1ms
Detector Type	Peak

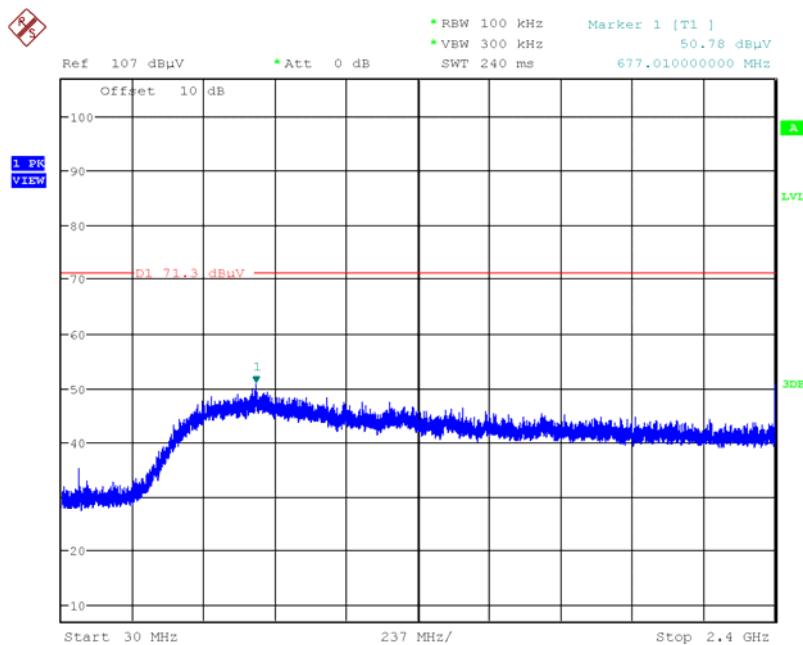
**BT-LE(1Mbps)****PSD****2480MHz**

Ch Freq	2.48GHz
Span	1.5MHz
RBW	3kHz
VBW	10kHz
Sweep Time	32.1ms
Detector Type	Peak

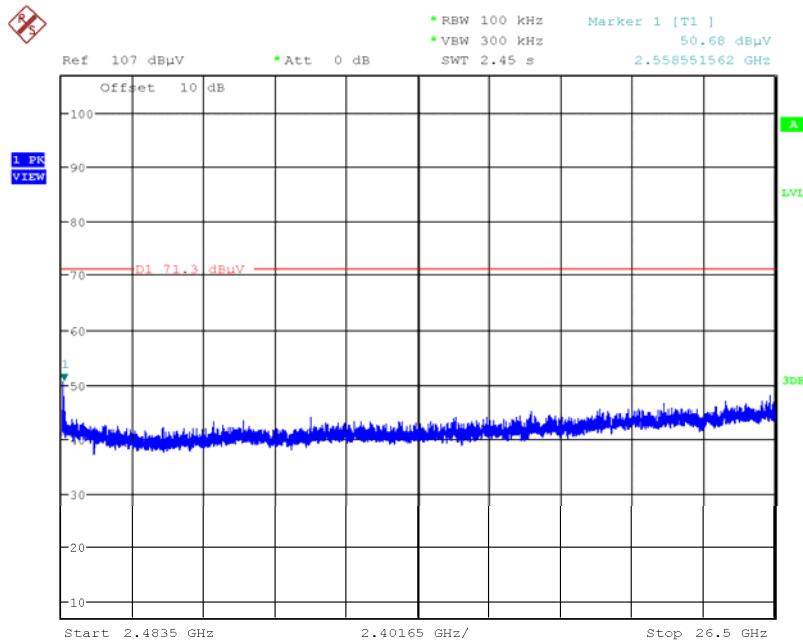
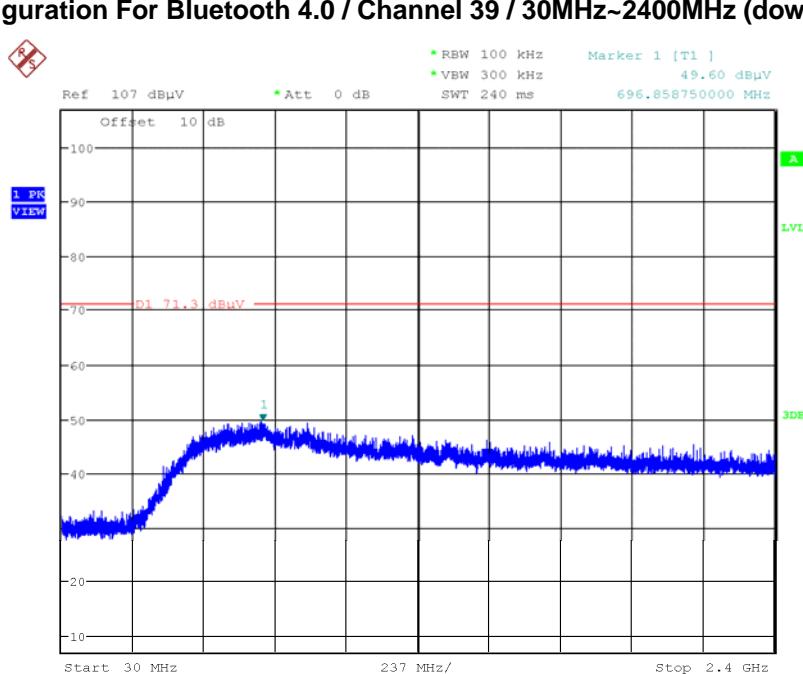


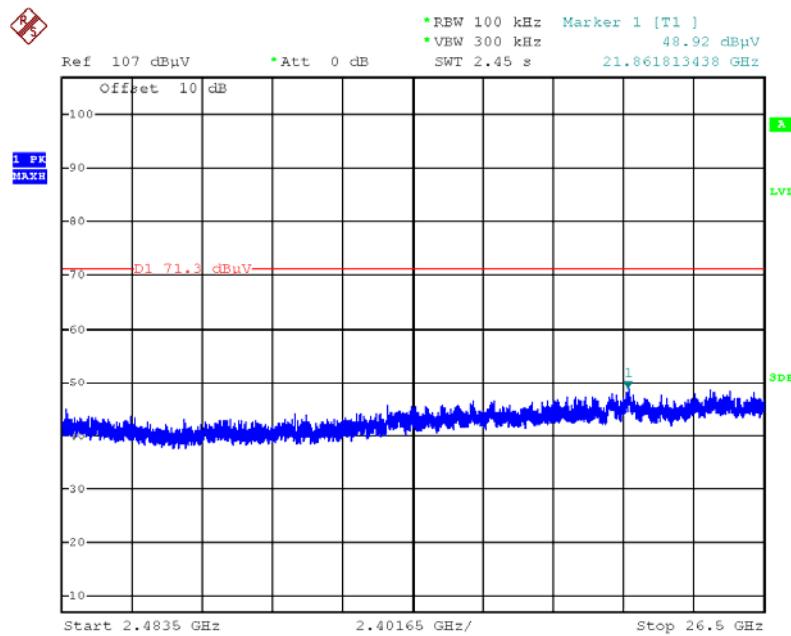
Plot on Configuration / Reference Level


Date: 5.JAN.2017 14:51:42

Plot on Configuration For Bluetooth 4.0 / Channel 0 / 30MHz~2400MHz (down 30dBc)


Date: 5.JAN.2017 14:58:20

Plot on Configuration For Bluetooth 4.0 / Channel 0 / 2483.5MHz~26500MHz (down 30dBc)

Plot on Configuration For Bluetooth 4.0 / Channel 39 / 30MHz~2400MHz (down 30dBc)


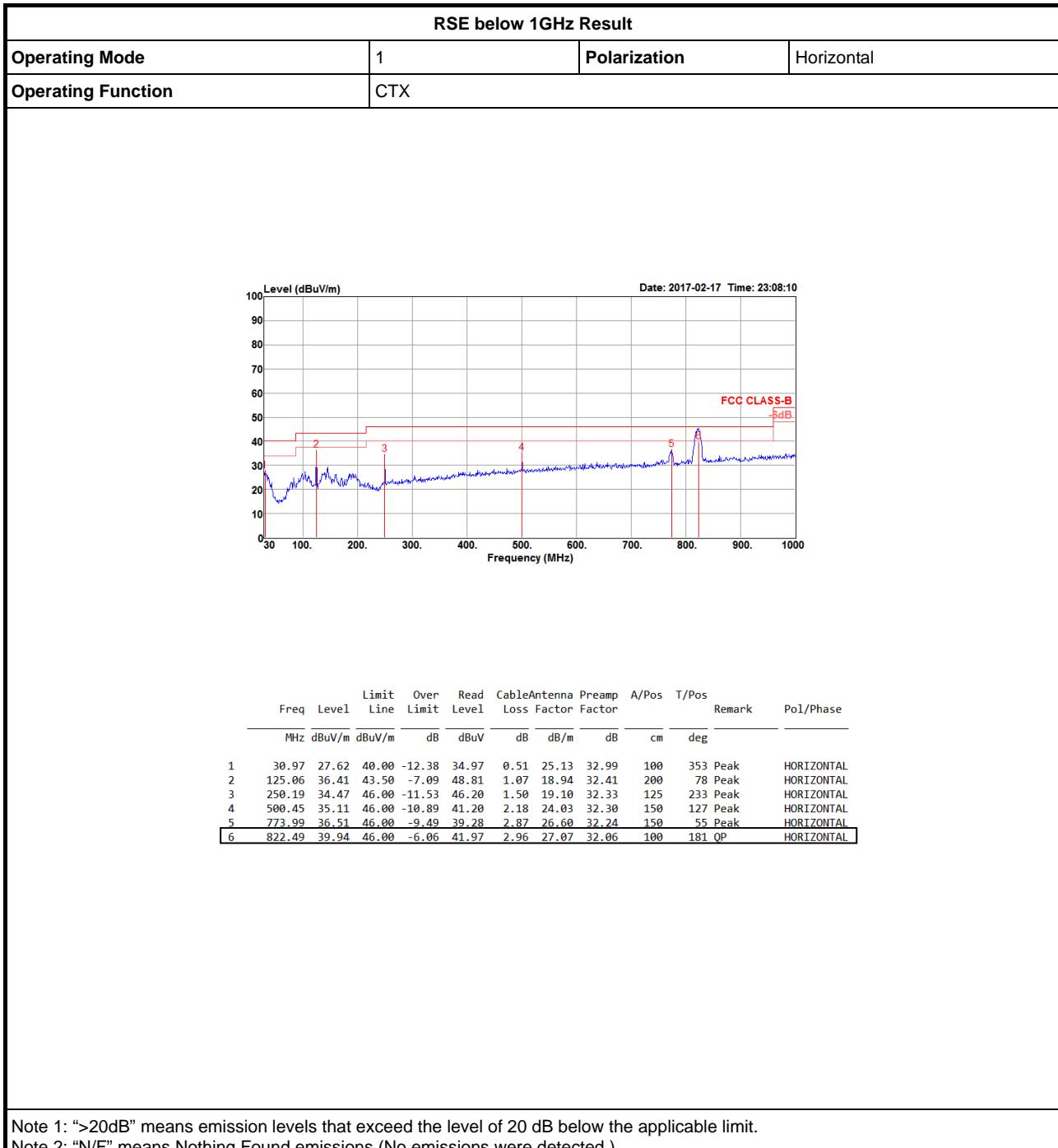
Plot on Configuration For Bluetooth 4.0 / Channel 39 / 2483.5MHz~26500MHz (down 30dBc)


Date: 23.JAN.2017 17:00:38



RSE below 1GHz Result

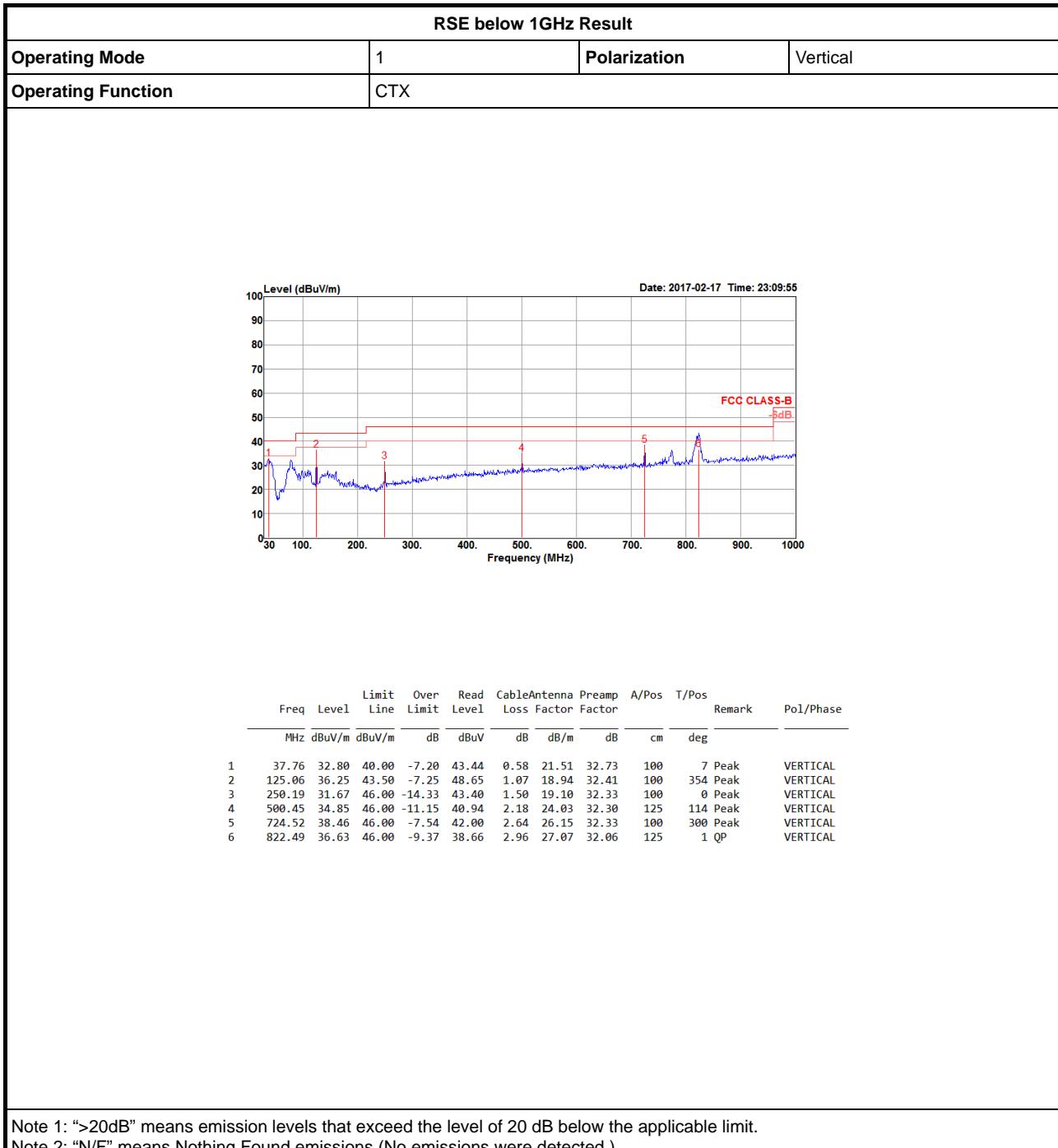
Appendix F.1





RSE below 1GHz Result

Appendix F.1



**Radiated Emissions (1GHz~10th Harmonic)**

Configurations		GFSK CH 0										
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Horizontal

Freq	Level	Limit	Over	Read	Cable	Antenna	Preamp	A/Pos	T/Pos	Remark	Pol/Phase
		Line	Limit	Level	Loss	Factor	Factor				
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4803.76	40.25	54.00	-13.75	34.20	6.18	32.92	33.05	152	196	Average
2	4804.55	50.45	74.00	-23.55	44.40	6.18	32.92	33.05	152	196	Peak

Vertical

Freq	Level	Limit	Over	Read	Cable	Antenna	Preamp	A/Pos	T/Pos	Remark	Pol/Phase
		Line	Limit	Level	Loss	Factor	Factor				
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4803.94	39.60	54.00	-14.40	33.55	6.18	32.92	33.05	134	148	Average
2	4804.52	48.38	74.00	-25.62	42.33	6.18	32.92	33.05	134	148	Peak



Configurations		GFSK CH 19										
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Horizontal

	Freq	Limit Level	Over Line	Read Limit	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg	
1	4879.99	39.70	54.00	-14.30	33.44	6.22	33.06	33.02	264	191	Average
2	4880.61	50.35	74.00	-23.65	44.09	6.22	33.06	33.02	264	191	Peak

Vertical

	Freq	Limit Level	Over Line	Read Limit	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg	
1	4879.43	51.77	74.00	-22.23	45.51	6.22	33.06	33.02	261	105	Peak
2	4879.91	43.12	54.00	-10.88	36.86	6.22	33.06	33.02	261	105	Average



Configurations		GFSK CH 39										
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Horizontal

	Freq	Limit Level	Over Line	Read Limit	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg	
1	4959.87	40.94	54.00	-13.06	34.42	6.27	33.23	32.98	127	293	Average
2	4960.57	50.83	74.00	-23.17	44.31	6.27	33.23	32.98	127	293	Peak

Vertical

	Freq	Limit Level	Over Line	Read Limit	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg	
1	4959.95	51.85	74.00	-22.15	45.33	6.27	33.23	32.98	177	229	Peak
2	4960.05	42.41	54.00	-11.59	35.89	6.27	33.23	32.98	177	229	Average

Note:

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

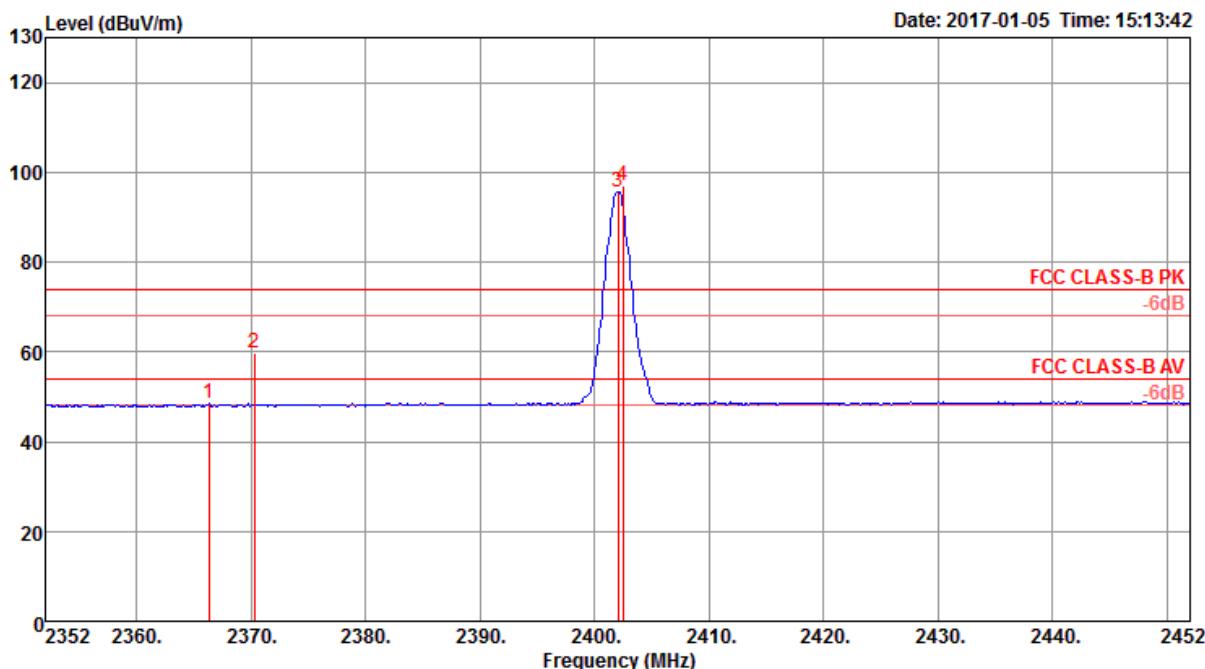
Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

Band Edge Emissions

Configurations	GFSK CH 0, 19, 39
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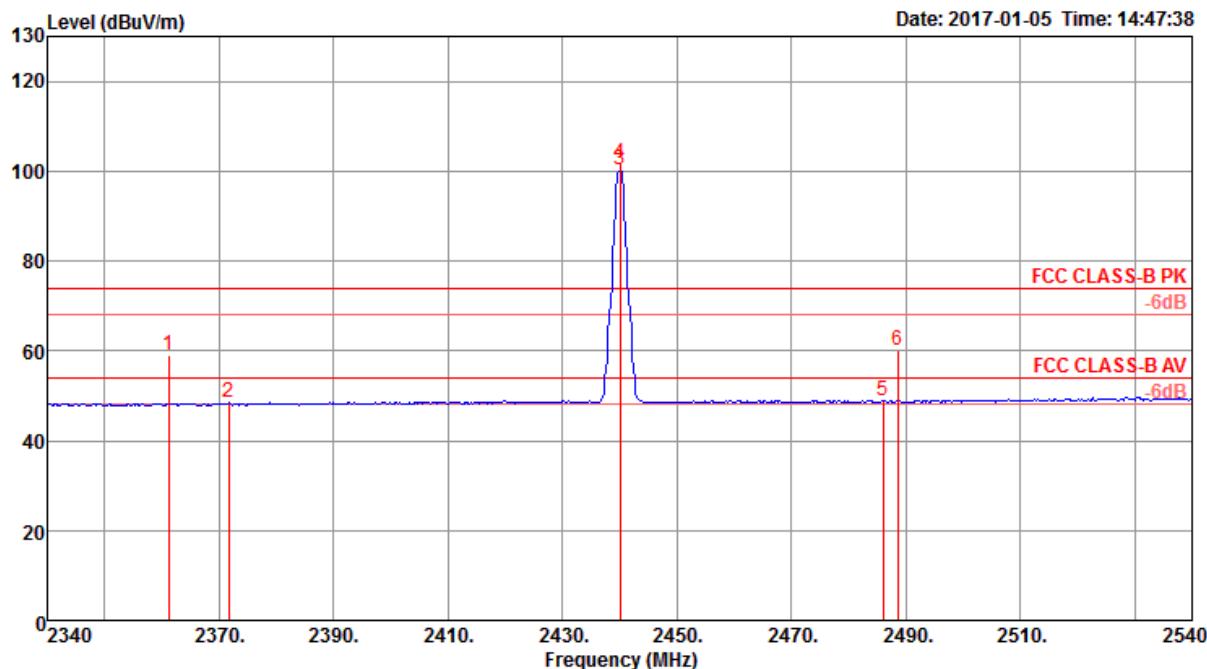
Channel 0



Freq	Level	Limit	Over	Read	Cable	Antenna	Preamp	A/Pos	T/Pos	Remark	Pol/Phase
		Line	Limit	Level	Loss	Factor	Factor	dB	cm		
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB				
1	2366.26	48.41	54.00	-5.59	15.92	4.24	28.25	0.00	191	248 Average	VERTICAL
2	2370.27	59.84	74.00	-14.16	27.31	4.25	28.28	0.00	191	248 Peak	VERTICAL
3 @	2402.00	95.65			63.07	4.27	28.31	0.00	191	248 Average	VERTICAL
4 @	2402.48	97.11			64.53	4.27	28.31	0.00	191	248 Peak	VERTICAL

Item 3, 4 are the fundamental frequency at 2402 MHz.

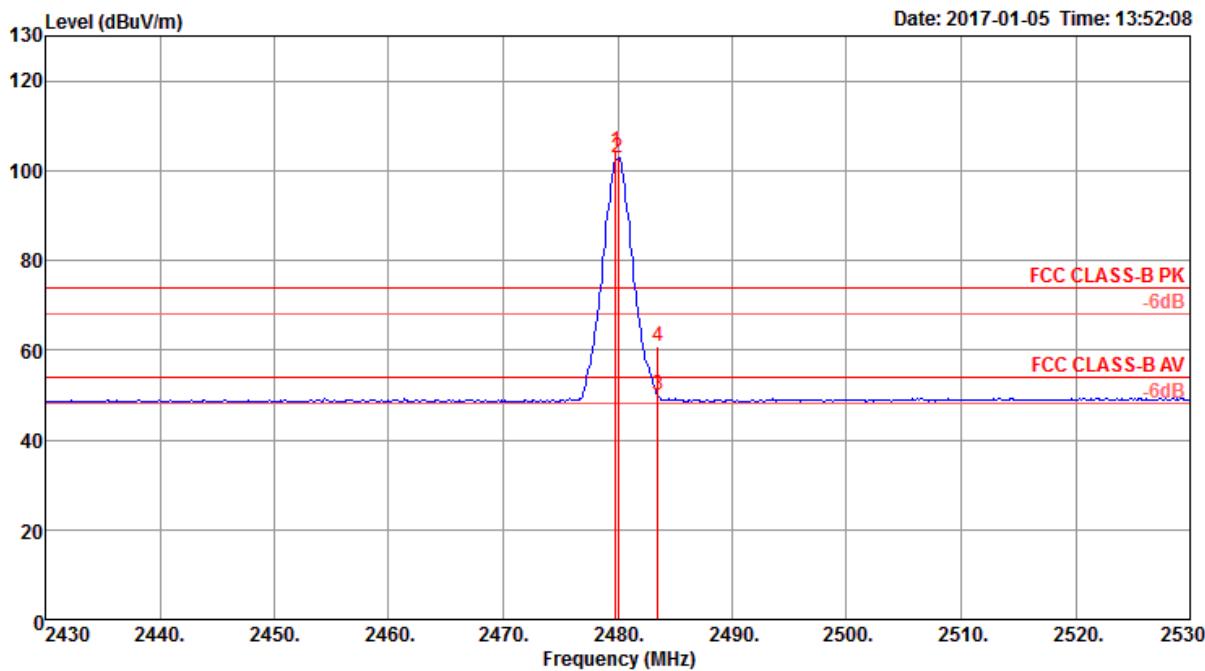
Channel 19



Freq	Limit		Over	Read	Cable		Antenna	Preamp	A/Pos	T/Pos	Remark	Pol/Phase
	Level	Line			Loss	Factor						
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg			
1 2361.15	59.04	74.00	-14.96	26.55	4.24	28.25	0.00	210	297	Peak		HORIZONTAL
2 2371.73	48.41	54.00	-5.59	15.88	4.25	28.28	0.00	210	297	Average		HORIZONTAL
3 @ 2440.00	100.36			67.64	4.31	28.41	0.00	210	297	Average		HORIZONTAL
4 @ 2440.00	101.87			69.15	4.31	28.41	0.00	210	297	Peak		HORIZONTAL
5 2486.06	48.87	54.00	-5.13	16.05	4.35	28.47	0.00	210	297	Average		HORIZONTAL
6 2488.63	60.11	74.00	-13.89	27.26	4.35	28.50	0.00	210	297	Peak		HORIZONTAL

Item 3, 4 are the fundamental frequency at 2440 MHz.

Channel 39



Freq	Level	Limit	Over	Read	Cable			A/Pos	T/Pos	Remark	Pol/Phase
					Line	Limit	Level	Antenna	Preamp		
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	Factor	Factor	cm	deg	
1 @ 2479.84	104.18				71.37	4.34	28.47	0.00	288	297 Peak	HORIZONTAL
2 @ 2480.00	102.77				69.96	4.34	28.47	0.00	288	297 Average	HORIZONTAL
3 2483.50	49.91	54.00	-4.09	17.09	4.35	28.47	0.00	288	297 Average		HORIZONTAL
4 2483.50	60.98	74.00	-13.02	28.16	4.35	28.47	0.00	288	297 Peak		HORIZONTAL

Item 1, 2 are the fundamental frequency at 2480 MHz.

Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.