FCC Test Report

Equipment	:	**802.11a/b/g/n/ac RTL8821CE Combo module**
Brand Name	:	**REALTEK**
Model No.	:	**RTL8821CE**
FCC ID	:	**TX2-RTL8821CE**
Standard	:	**47 CFR FCC Part 15.247**
Frequency	:	**2400 MHz – 2483.5 MHz**
Function	:	**☒Point-to-multipoint; ☐Point-to-point**
Applicant	:	**Realtek Semiconductor Corp. No. 2,Innovation Road II, Hsinchu Science Park, Hsinchu 300,Taiwan**
Manufacturer	:	**Realtek Semiconductor Corp. No. 2,Innovation Road II, Hsinchu Science Park, Hsinchu 300,Taiwan**

The product sample received on Sep. 30, 2016 and completely tested on Nov. 29, 2016. 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 INTERNATIONALINC., the test report shall not be reproduced except in full.

Sam Chen
SPORTON INTERNATIONAL INC.

Testing Laboratory
1190

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APPENDIX I. ANTENNA LIST

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	≥500kHz	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 dBc	Complied
3.6	15.247(d)	Emissions in Restricted Frequency Bands	Restricted Bands: FCC 15.209	Complied

Revision History

Report No.	Version	Description	Issued Date
FR692918AD	Rev. 01	Initial issue of report	Dec. 08, 2016

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
2.4G	BT-LE	1	1

Note:
- 2.4G is the 2.4GHz Band (2.4-2.4835GHz).
- 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	Model Name	Antenna Type	Connector	Gain (dBi)	
					2.4GHz	5GHz
1	LYNwave	ALA110-222050-300011	PIFA Antenna	IPEX MHF4	3.5	5
2	PSA	RFDPA171320EMLB301	Dipole Antenna	IPEX MHF4	3.14	5

Note: 1. The EUT has two types of antenna and there are above only records higher gain of same type antenna.

2. For more information, refer to Appendix I. Antenna List.

3. There are four configurations for EUT.

4. Chain 1: Connect to Ant. 1 or Ant. 2, Chain 2: Connect to Ant. 1 or Ant. 2

EUT	Configuration	Antenna Chain	Description
EUT 1	Config.1 Diversity	2 chains	The EUT supports the antenna with TX/RX diversity function for WLAN and Bluetooth. (Ex. Assume chain 1 was selected to conduct transmitting function in WLAN, so chain 2 was selected in Bluetooth Mode. Vice versa.) WLAN 2.4GHz and Bluetooth will be transmitting from the different chains; WLAN 5GHz and Bluetooth will be transmitting from the same chain. **WLAN function (1TX, 1RX) / Bluetooth function (1TX, 1RX)** The EUT supports 1TX/1RX function, and it supports TX/RX diversity function. Both chain 1 and chain 2 could be used as transmitting/receiving antenna, but only one of them could transmit/receive at the same time.
EUT 2	Config.2 Fixed	2 chains	**WLAN function (1TX, 1RX) / Bluetooth function (1TX, 1RX)** Chain 2 is designated for WLAN (2.4GHz), Chain 1 is designated for WLAN (5GHz) and Bluetooth.
EUT 3	Config.3 Single	1 chain	**WLAN function (1TX, 1RX) / Bluetooth function (1TX, 1RX)** WLAN and BT share a common chain, where WLAN (2.4GHz) and BT couldn't transmit/receive at the same time, but WLAN (5GHz) and BT could transmit/receive at the same time.
EUT 4	Config.4 Single	1 chain	**WLAN function (1TX, 1RX) / Bluetooth function (1TX, 1RX)** WLAN and BT share a common chain, where WLAN (2.4GHz) and BT couldn't transmit/receive at the same time, but WLAN (5GHz) and BT could transmit/receive at the same time.

Note 1: After evaluating, EUT 1 has been evaluated to be the worst case, so it was performed for all tests.

For WLAN 2.4GHz function:

Chain 2 generated the worst case in configuration 1, so it was selected to test and record in the report.

For WLAN 5GHz and Bluetooth function:

Chain 1 generated the worst case in configuration 1, so it was selected to test and record in the report.

1.1.3 Mode Test Duty Cycle

Mode	DC	T(s)
BT-LE	1	n/a (DC>=0.98)

1.1.4 EUT Operational Condition

EUT Power Type	From host system

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							
☐	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
RF Conducted	TH01-CB	Eddie Weng	24°C / 58%	Nov. 15, 2016 | Nov. 23 2016
Radiated	03CH01-CB	Lucke Hsieh, Paul Chen	22°C / 54%	Oct. 20, 2016 | Nov. 29, 2016
AC Conduction	CO01-CB	Kane Liu	23°C / 60%	Oct. 15, 2016

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%

2 Test Configuration of EUT

2.1 Test Channel Mode

Band	Mode	BWch (MHz)	Nss-Min	Nant	Ch. (MHz)	Range	Power Setting
2.4G	BT-LE	1	1	1	2402	L	Default
2.4G	BT-LE	1	1	1	2442	S	Default
2.4G	BT-LE	1	1	1	2480	H	Default

Note:
- Test range channel consist of L (Low Ch.), M (Middle Ch.), H (High Ch.), S (Single Ch.) and C (Straddle Band Ch.).

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	Normal Link
1	EUT 1 with Ant. 1 (wireless 2.4GHz + Bluetooth 4.2)
2	EUT 1 with Ant. 1 (wireless 5GHz + Bluetooth 4.2)
Mode 1 has been evaluated to be the worst case between Mode 1~2, thus measurement for Mode 3 will follow this same test mode.	
3	EUT 1 with Ant. 2 (wireless 2.4GHz + Bluetooth 4.2)
For operating mode 1 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 Emissions in Non-restricted Frequency Bands	
Test Condition	Conducted measurement at transmit chains	
Test Mode	1	EUT 1 with Ant. 1

Note: For Conducted measurement Test: only the higher gain antenna “Ant. 1” was selected to perform the test and recorded in this 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 < 1GHz	Normal Link
1	EUT 1 Y axis with Ant. 1 (wireless 2.4GHz + Bluetooth 4.2)
2	EUT 1 Y axis with Ant. 1 (wireless 5GHz + Bluetooth 4.2)
Mode 1 has been evaluated to be the worst case between Mode 1~2, thus measurement for Mode 3 will follow this same test mode.	
3	EUT 1 Z axis with Ant. 1 (wireless 2.4GHz + Bluetooth 4.2)
Mode 3 has been evaluated to be the worst case between Mode 1~3, thus measurement for Mode 4 will follow this same test mode.	
4	EUT 1 Z axis with Ant. 2 (wireless 2.4GHz + Bluetooth 4.2)
For operating mode 3 is the worst case and it was record in this test report.	
Operating Mode > 1GHz	CTX
The EUT was performed at X axis, Y axis and Z axis position for Radiated emission test, and the worst case was found at X axis. So the measurement will follow this same test configuration.	
1	EUT 1 X axis with Ant. 1
2	EUT 1 X axis with Ant. 2

The Worst Case Mode for Following Conformance Tests	
Tests Item	Simultaneous Transmission Analysis
Test Condition	Radiated measurement
Operating Mode	Normal Link
1	EUT 1 X axis with Ant. 1 (wireless 2.4GHz + Bluetooth 4.2)
2	EUT 1 Y axis with Ant. 1 (wireless 2.4GHz + Bluetooth 4.2)
3	EUT 1 Z axis with Ant. 1 (wireless 2.4GHz + Bluetooth 4.2)
4	EUT 1 X axis with Ant. 1 (wireless 5GHz + Bluetooth 4.2)
5	EUT 1 Y axis with Ant. 1 (wireless 5GHz + Bluetooth 4.2)
6	EUT 1 Z axis with Ant. 1 (wireless 5GHz + Bluetooth 4.2)
7	EUT 1 X axis with Ant. 2 (wireless 2.4GHz + Bluetooth 4.2)
8	EUT 1 Y axis with Ant. 2 (wireless 2.4GHz + Bluetooth 4.2)
9	EUT 1 Z axis with Ant. 2 (wireless 2.4GHz + Bluetooth 4.2)
10	EUT 1 X axis with Ant. 2 (wireless 5GHz + Bluetooth 4.2)
11	EUT 1 Y axis with Ant. 2 (wireless 5GHz + Bluetooth 4.2)
12	EUT 1 Z axis with Ant. 2 (wireless 5GHz + Bluetooth 4.2)
Mode 3 has been evaluated to be the worst case between Mode 1~3, thus measurement for Mode 13 will follow this same test mode.	
13	EUT 4 Z axis with Ant. 1 (wireless 2.4GHz + Bluetooth 4.2)
Mode 6 has been evaluated to be the worst case between Mode 4~6, thus measurement for Mode 14 will follow this same test mode.	
14	EUT 4 Z axis with Ant. 1 (wireless 5GHz + Bluetooth 4.2)
Mode 9 has been evaluated to be the worst case between Mode 7~9, thus measurement for Mode 15 will follow this same test mode.	
15	EUT 4 Z axis with Ant. 2 (wireless 2.4GHz + Bluetooth 4.2)
Mode 12 has been evaluated to be the worst case between Mode 10~12, thus measurement for Mode 16 will follow this same test mode.	
16	EUT 4 Z axis with Ant. 2 (wireless 5GHz + Bluetooth 4.2)
Mode 3 has been evaluated to be the worst case between Mode 1~3, thus measurement for Mode 17 will follow this same test mode.	
17	EUT 3 Z axis with Ant. 1 (wireless 2.4GHz + Bluetooth 4.2)
Mode 6 has been evaluated to be the worst case between Mode 4~6, thus measurement for Mode 18 will follow this same test mode.	
18	EUT 3 Z axis with Ant. 1 (wireless 5GHz + Bluetooth 4.2)
Mode 9 has been evaluated to be the worst case between Mode 7~9, thus measurement for Mode 19 will follow this same test mode.	
19	EUT 3 Z axis with Ant. 2 (wireless 2.4GHz + Bluetooth 4.2)
Mode 12 has been evaluated to be the worst case between Mode 10~12, thus measurement for Mode 20 will follow this same test mode.	

20	EUT 3 Z axis with Ant. 2 (wireless 5GHz + Bluetooth 4.2)
Mode 18 and Mode 19 are worst test result among Mode 1 ~ Mode 20, and the test result of those two modes are selected to record in the test report. Refer to Sporton Test Report No.: FA692918 for Co-location RF Exposure Evaluation and Appendix G for Radiated Emission Co-location.	

2.3 EUT Operation during Test

For CTX Mode:

The EUT was programmed to be in continuously transmitting mode.

For Normal Link:

During the test, the EUT operation to normal function.

2.4 Accessories

N/A

2.5 Support Equipment

For Test Site No: CO01-CB

Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	NB*2	DELL	E6430	DoC
2	Earphone	SHYARO CHI	MIC-04	DoC
3	Mouse	HP	FM100	DoC
4	Test fixture*2	REALTEK	N/A	N/A
5	AP Router	Planex	GW-AP54SGX	KA220030603014-1
6	Device	REALTEK	RTL8821CE	TX2-RTL8821CE

For Test Site No: 03CH01-CB (below 1GHz)

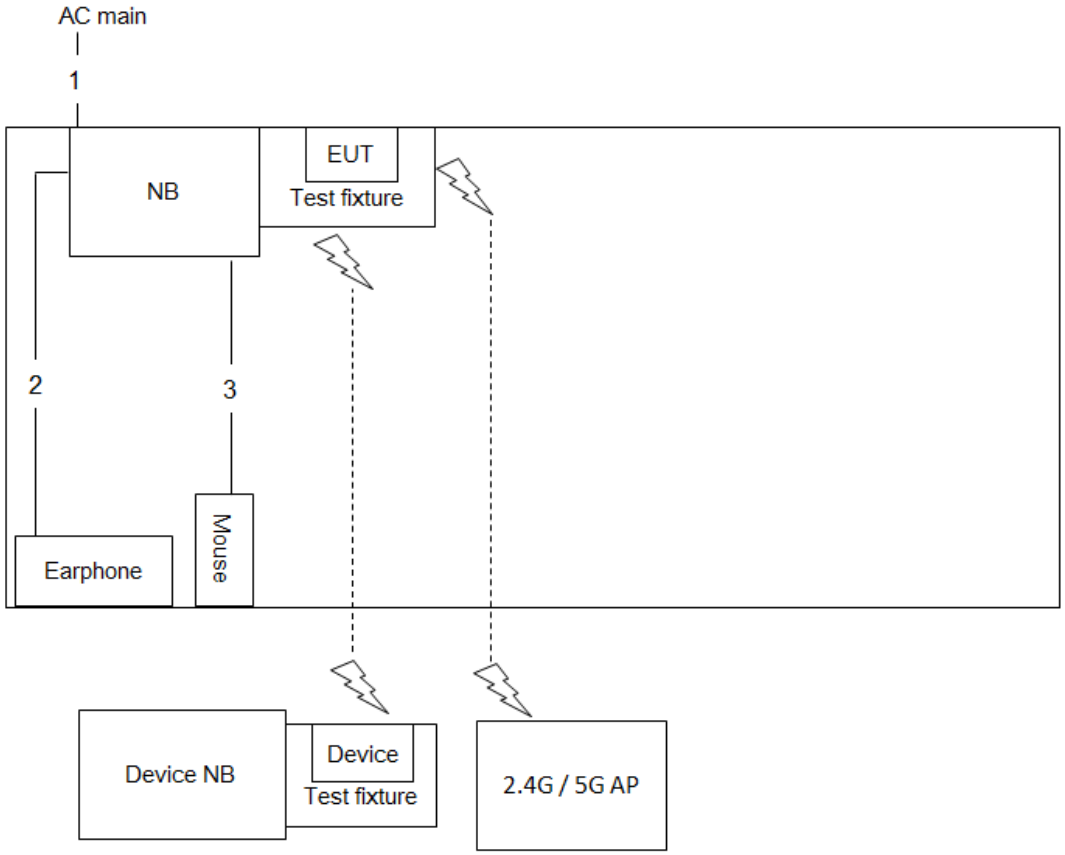
Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	NB*2	DELL	E4300	DoC
2	Mouse	Logitech	M-U0026	DoC
3	Earphone	SHYARO CHI	MIC-04	N/A
4	Test fixture*2	REALTEK	N/A	N/A
5	WLAN AP	D-LINK	DIR860L	KA2IR860LA1
6	Device	REALTEK	RTL8821CE	TX2-RTL8821CE

For Test Site No: 03CH01-CB (above 1GHz) and TH01-CB

Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	NB	DELL	E4300	DoC
2	Test fixture*2	REALTEK	N/A	N/A

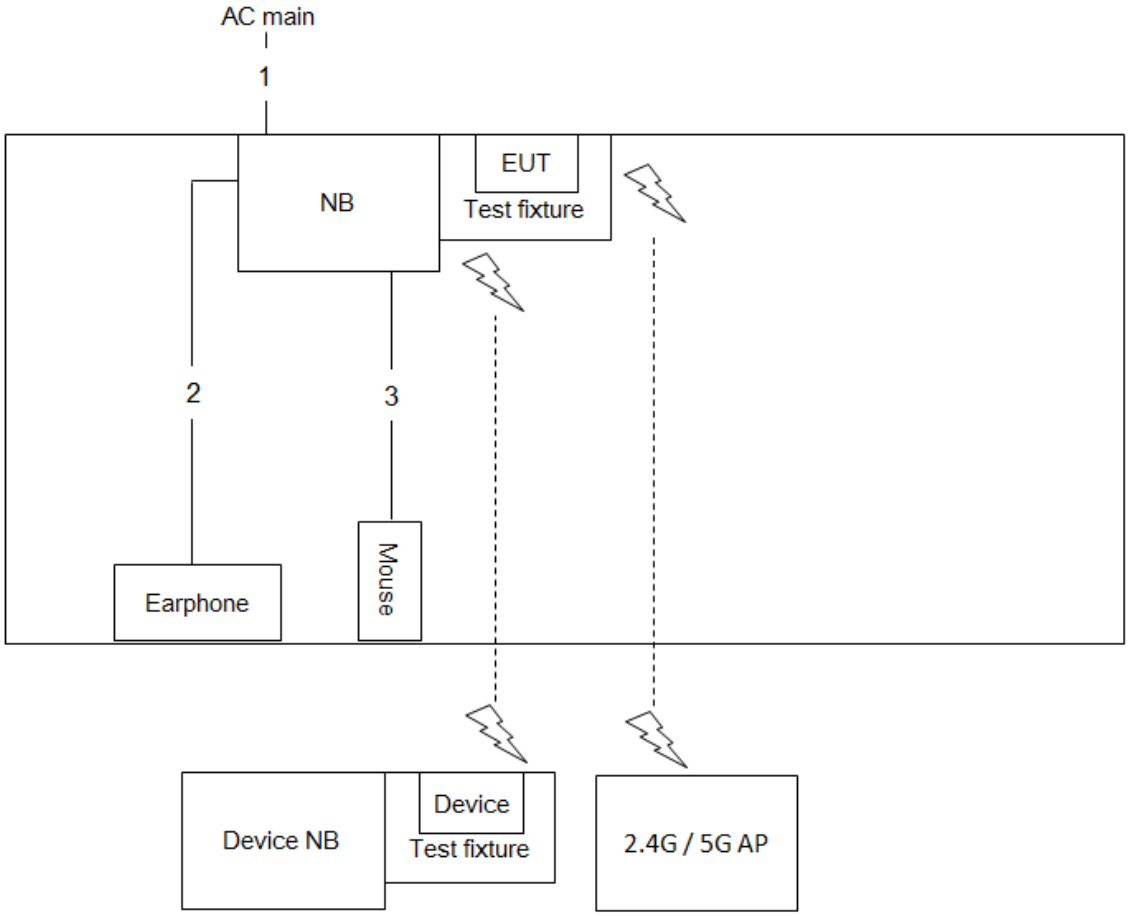
2.6 Test Setup Diagram

Test Setup Diagram – AC Line Conducted Emission Test



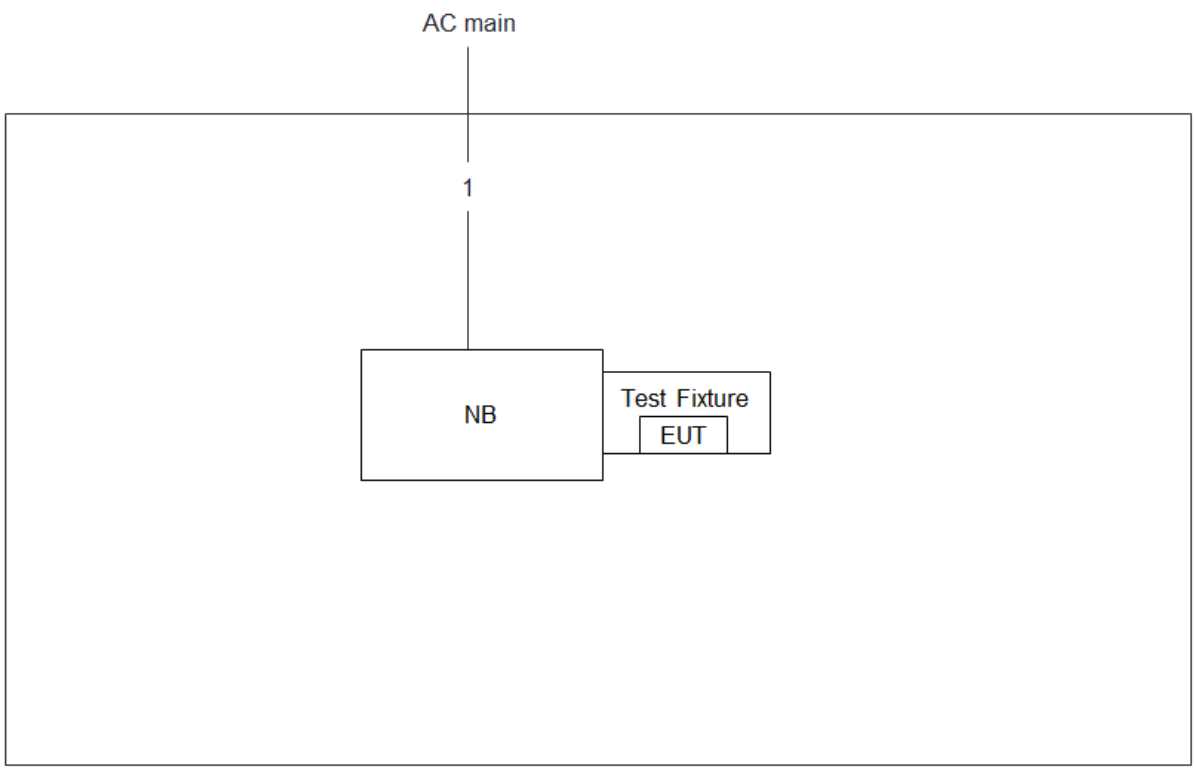
Item	Connection	Shielded	Length
1	Power cable	No	2.6m
2	Audio cable	No	1.8m
3	USB cable	Yes	1.8m

Test Setup Diagram - Radiated Test < 1GHz



Item	Connection	Shielded	Length
1	Power cable	No	2.6m
2	Audio cable	No	1.1m
3	USB cable	Yes	1.8m

Test Setup Diagram - Radiated Test > 1GHz



Item	Connection	Shielded	Length
1	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

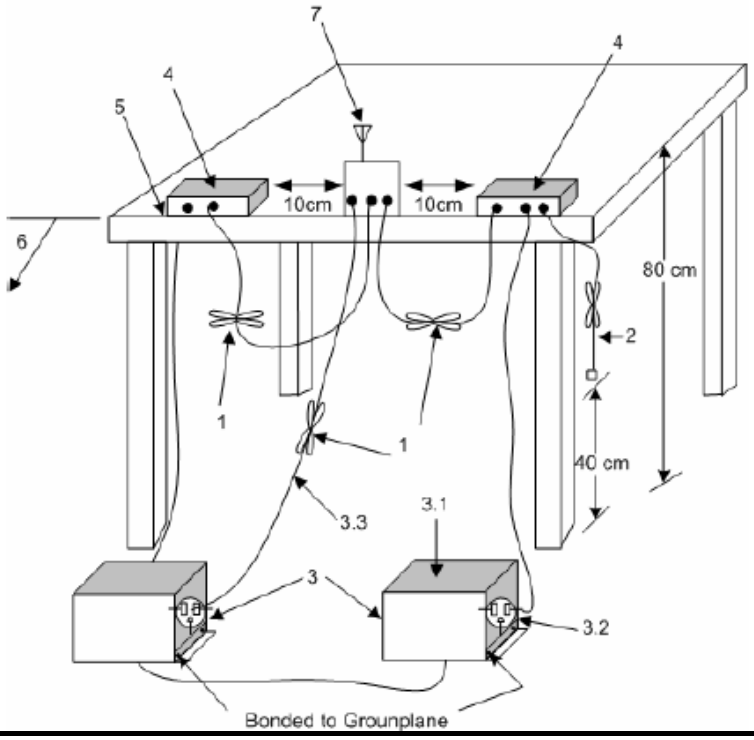
Refer a test equipment and calibration data table in this test report.

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

AC Power-line Conducted Emissions



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 ≥ 500 kHz.

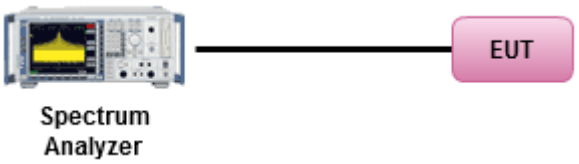
3.2.2 Measuring Instruments

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:	
	☒ Refer as FCC KDB 558074, clause 8.1 Option 1 for6 dB bandwidth measurement.
	☐ Refer as FCC KDB 558074, clause 8.2 Option 2 for6 dB bandwidth measurement.
	☐ Refer as ANSI C63.10, clause 6.9.1 for occupied bandwidth testing.

3.2.4 Test Setup

Emission Bandwidth


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		
	▪ If $G_{TX} \leq 6$ dBi, then $P_{Out} \leq 30$ dBm (1 W)	
	▪ Point-to-multipoint systems (P2M): If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)$ dBm	
	▪ Point-to-point systems (P2P): If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)/3$ dBm	
	▪ Smart antenna system (SAS):	
		- Single beam: If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)/3$ dBm
		- Overlap beam: If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)/3$ dBm
		- Aggregate power on all beams: If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)/3 + 8$dB 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	
	☐ Refer as FCC KDB 558074, clause 9.1.1 Option 1 (RBW ≥ EBW method).
	☐ Refer as FCC KDB 558074, clause 9.1.2 Option 2 (peak power meter for VBW ≥ DTS BW)
▪ Maximum Conducted Output Power	
	[duty cycle ≥ 98% or external video / power trigger]
	☐ Refer as FCC KDB 558074, clause 9.2.2.2 Method AVGSA-1 (spectral trace averaging).
	☐ 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
	☐ Refer as FCC KDB 558074, clause 9.2.2.4 Method AVGSA-2 (spectral trace averaging).
	☐ 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
	☒ Refer as FCC KDB 558074, clause 9.2.3 Method AVGPM-G (using an RF average power meter).
▪ For conducted measurement.	
	▪ 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: $P_{total} = P_1 + P_2 + \ldots + P_n$ (calculated in linear unit [mW] and transfer to log unit [dBm]) $EIRP_{total} = P_{total} + DG$

3.3.4 Test Setup

Maximum Conducted Output Power (Power Meter)

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

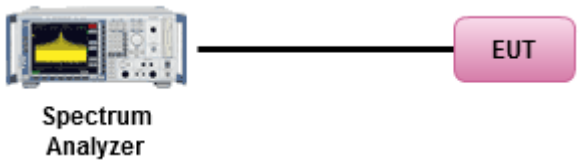
3.4.2 Measuring Instruments

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).		
	☒ Refer as FCC KDB 558074, clause 10.2 Method PKPSD (RBW=3-100kHz; Detector=peak).	
	[duty cycle ≥ 98% or external video / power trigger]	
	☐ Refer as FCC KDB 558074, clause 10.3 Method AVGPSD-1 (spectral trace averaging).	
	☐ 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	
	☐ Refer as FCC KDB 558074, clause 10.5 Method AVGPSD-1 Alt (spectral trace averaging).	
	☐ 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:	
		☒ 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.
		☐ 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,
		☐ 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

Power Spectral Density


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.	

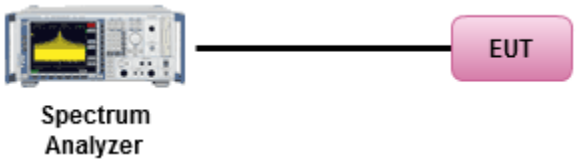
3.5.2 Measuring Instruments

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

Emissions in Non-restricted Frequency Bands


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 below30 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.

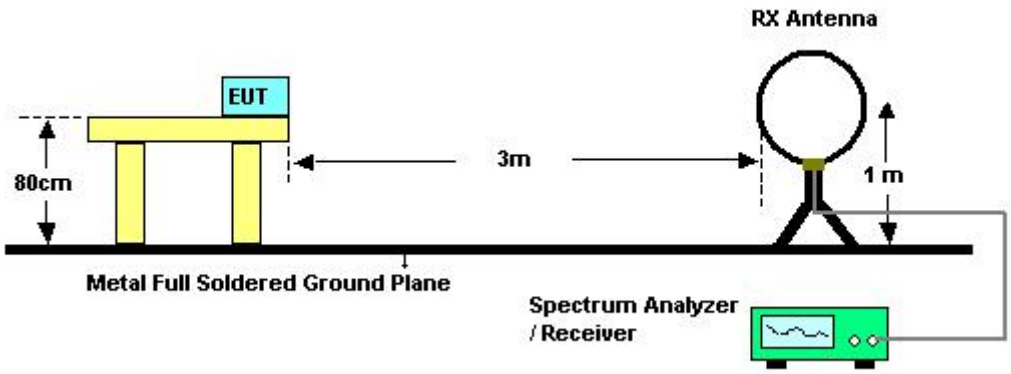
3.6.3 Test Procedures

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

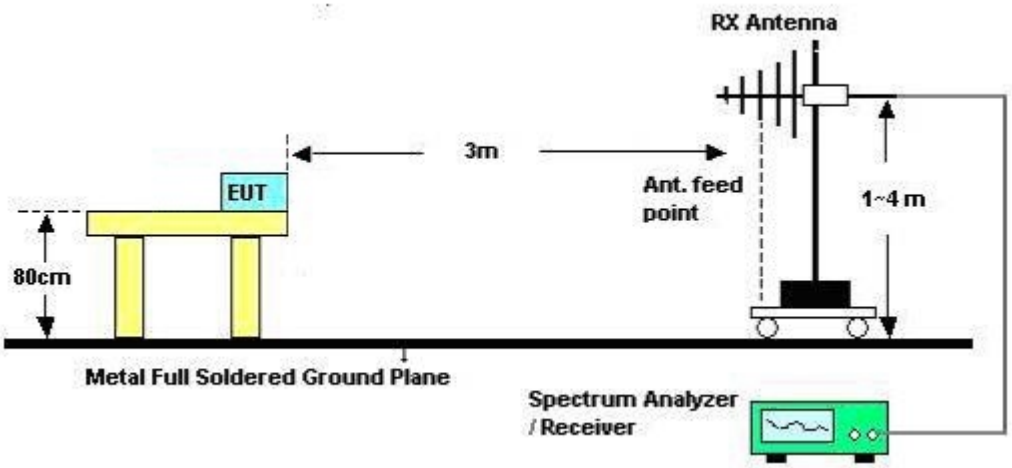
3.6.4 Test Setup

Transmitter Radiated Emissions

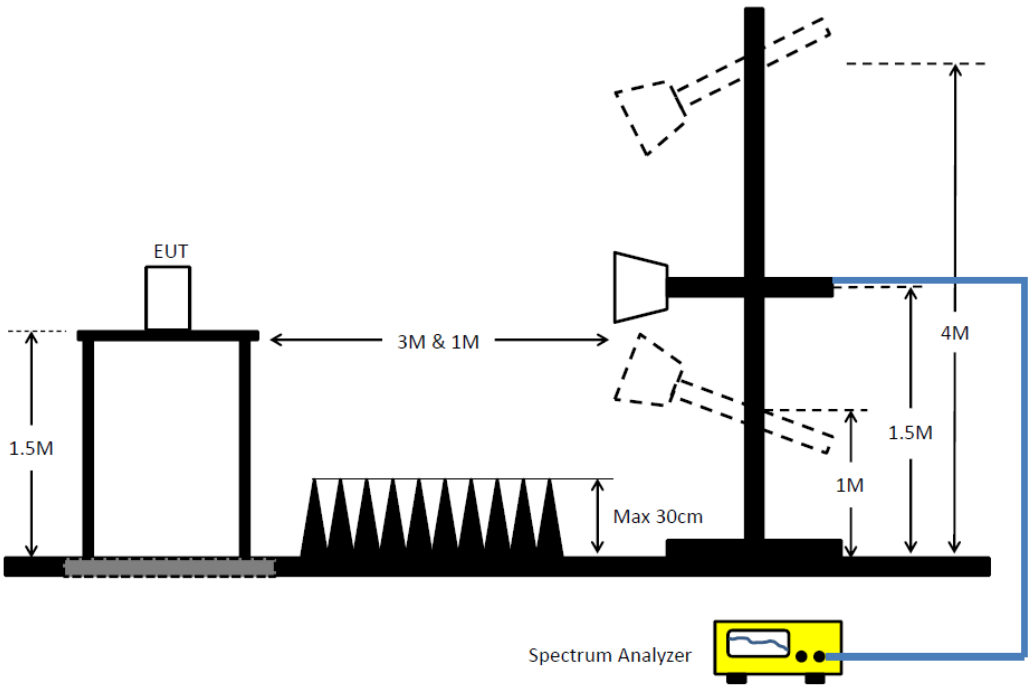
9kHz ~30MHz



30MHz~1GHz



Above 1GHz



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. 27, 2016	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 08, 2015	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Dec. 23, 2015	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	TESEQ	CBL6112D	37880	20MHz ~ 2GHz	Aug. 30, 2016	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 16, 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)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Oct. 27, 2015	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-1	N/A	30 MHz ~ 1 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-1	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	Nov. 02, 2015	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-17	N/A	1 GHz ~ 18 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-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	Nov. 02, 2015	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	Nov. 02, 2015	Radiation (03CH01-CB)

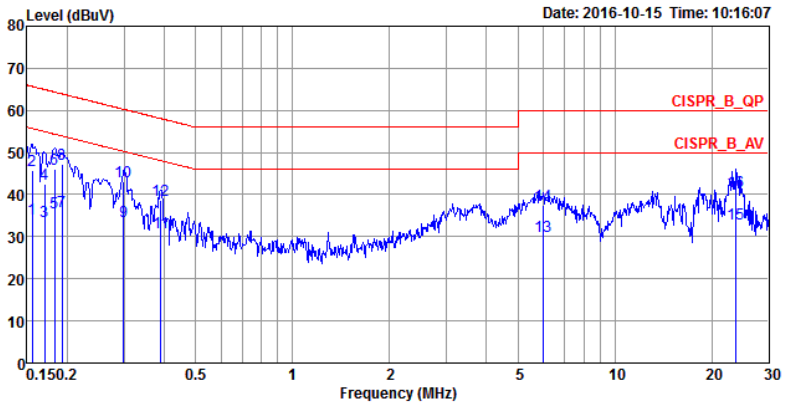
Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
RF Cable-high	Woken	High Cable-40G-2	N/A	18GHz ~ 40 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
Test Software	Audix	E3	6.2009-l0-7	N/A	N/A	Radiation (03CH01-CB)
Spectrum analyzer	R&S	FSV40	100979	9kHz~40GHz	Dec. 09, 2015	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)
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	MY54320014	50MHz~18GHz	Apr. 20, 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.

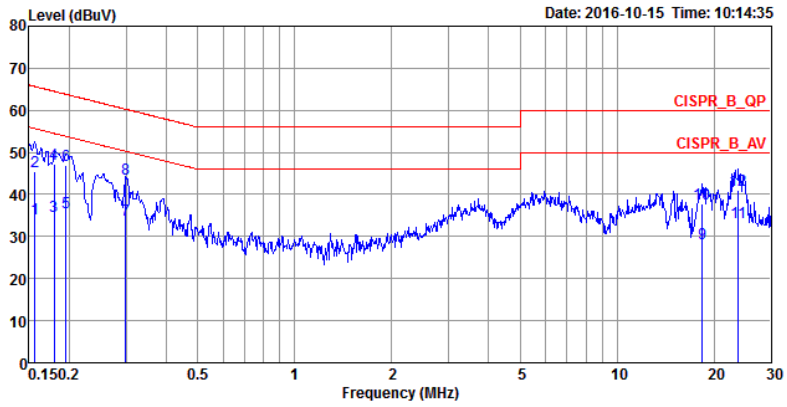
AC Power-line Conducted Emissions Result			
Operating Mode	1	**Power Phase**	Neutral
Operating Function	Normal Link		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.1557	34.37	-21.32	55.69	24.19	10.02	0.16	NEUTRAL	Average
2	0.1557	45.74	-19.95	65.69	35.56	10.02	0.16	NEUTRAL	QP
3	0.1703	33.52	-21.42	54.94	23.33	10.02	0.17	NEUTRAL	Average
4	0.1703	42.57	-22.37	64.94	32.38	10.02	0.17	NEUTRAL	QP
5	0.1825	35.83	-18.54	54.37	25.73	9.92	0.18	NEUTRAL	Average
6	0.1825	45.96	-18.41	64.37	35.86	9.92	0.18	NEUTRAL	QP
7	0.1924	35.97	-17.96	53.93	25.86	9.92	0.19	NEUTRAL	Average
8	0.1924	47.33	-16.60	63.93	37.22	9.92	0.19	NEUTRAL	QP
9	0.2987	33.72	-16.56	50.28	23.71	9.92	0.09	NEUTRAL	Average
10	0.2987	43.15	-17.13	60.28	33.14	9.92	0.09	NEUTRAL	QP
11	0.3893	30.96	-17.12	48.08	21.02	9.92	0.02	NEUTRAL	Average
12	0.3893	38.65	-19.43	58.08	28.71	9.92	0.02	NEUTRAL	QP
13	5.9925	30.21	-19.79	50.00	20.05	10.04	0.12	NEUTRAL	Average
14	5.9925	37.51	-22.49	60.00	27.35	10.04	0.12	NEUTRAL	QP
15	23.7616	33.16	-16.84	50.00	22.49	10.41	0.26	NEUTRAL	Average
16	23.7616	40.69	-19.31	60.00	30.02	10.41	0.26	NEUTRAL	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	1	**Power Phase**	Line
Operating Function	Normal Link		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.1565	34.34	-21.31	55.65	24.15	10.02	0.17	LINE	Average
2	0.1565	45.53	-20.12	65.65	35.34	10.02	0.17	LINE	QP
3	0.1796	34.85	-19.65	54.50	24.75	9.92	0.18	LINE	Average
4	0.1796	47.16	-17.34	64.50	37.06	9.92	0.18	LINE	QP
5	0.1955	35.62	-18.18	53.80	25.51	9.92	0.19	LINE	Average
6	0.1955	46.98	-16.82	63.80	36.87	9.92	0.19	LINE	QP
7	0.2987	33.87	-16.41	50.28	23.86	9.92	0.09	LINE	Average
8	0.2987	43.55	-16.73	60.28	33.54	9.92	0.09	LINE	QP
9	18.4258	28.29	-21.71	50.00	17.78	10.28	0.23	LINE	Average
10	18.4258	37.79	-22.21	60.00	27.28	10.28	0.23	LINE	QP
11	23.7616	33.29	-16.71	50.00	22.62	10.41	0.26	LINE	Average
12	23.7616	41.12	-18.88	60.00	30.45	10.41	0.26	LINE	QP

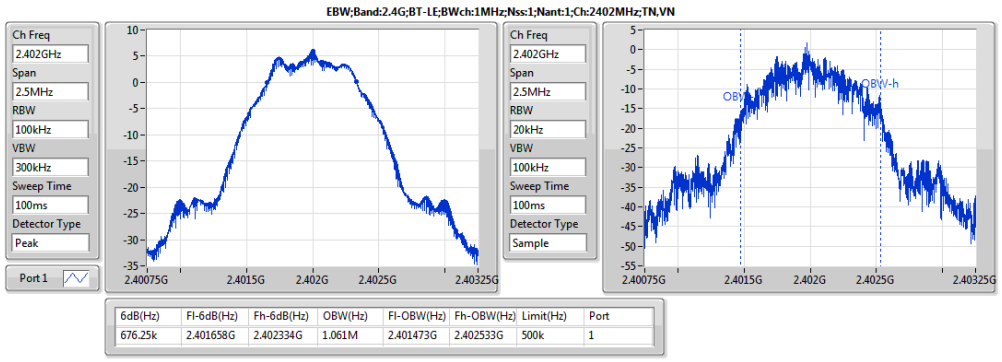
Note 1: “>20dB” means emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found emissions (No emissions were detected.)

Summary

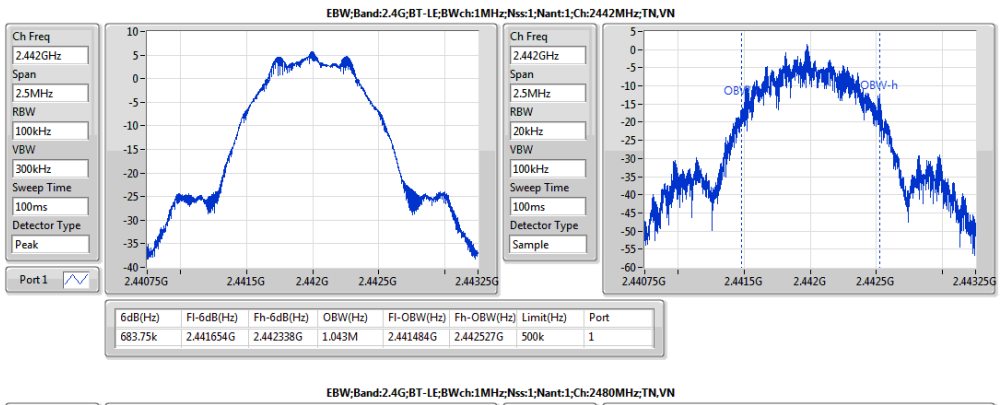
Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
2.4G;BT-LE;Nss1;Ntx1	683.75k	1.061M	1M06F1D	668.75k	1.043M

Result

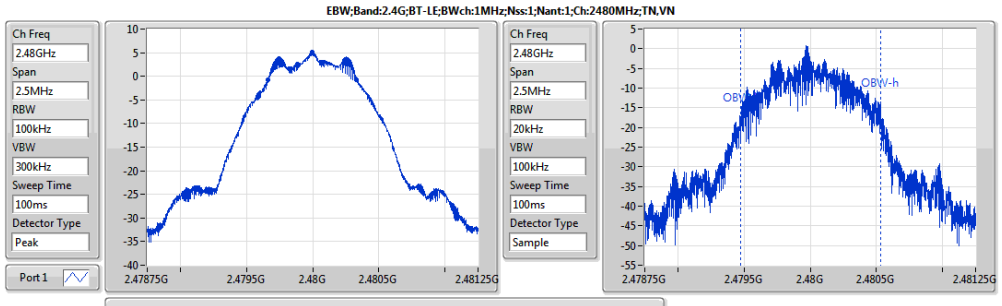
Mode	Result	Limit (Hz)	P1-N dB (Hz)	P1-OBW (Hz)
2.4G;BT-LE;Nss1;Ntx1;2402	Pass	500k	676.25k	1.061M
2.4G;BT-LE;Nss1;Ntx1;2442	Pass	500k	683.75k	1.043M
2.4G;BT-LE;Nss1;Ntx1;2480	Pass	500k	668.75k	1.054M



6dB(Hz)	Fl-6dB(Hz)	Fh-6dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
676.25k	2.401658G	2.402334G	1.061M	2.401473G	2.402533G	500k	1



6dB(Hz)	Fl-6dB(Hz)	Fh-6dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
683.75k	2.441654G	2.442338G	1.043M	2.441484G	2.442527G	500k	1



6dB(Hz)	Fl-6dB(Hz)	Fh-6dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
668.75k	2.479664G	2.480333G	1.054M	2.479475G	2.48053G	500k	1

Summary

Mode	Sum (dBm)	Sum (W)	EIRP (dBm)	EIRP (W)
2.4G;BT-LE;Nss1;Ntx1	5.53	0.00357	9.03	0.008

Result

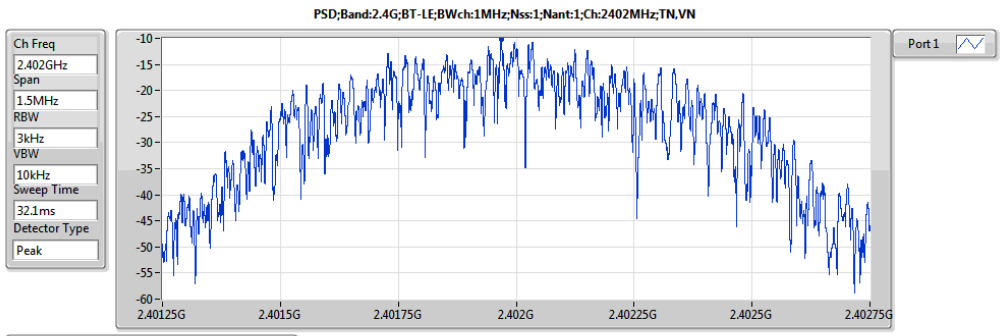
Mode	Result	DG (dBi)	Sum (dBm)	Sum Lim. (dBm)	EIRP (dBm)	EIRP Lim. (dBm)	P1 (dBm)
2.4G;BT-LE;Nss1;Ntx1;2402	Pass	3.50	5.53	30.00	9.03	36.00	5.53
2.4G;BT-LE;Nss1;Ntx1;2442	Pass	3.50	4.89	30.00	8.39	36.00	4.89
2.4G;BT-LE;Nss1;Ntx1;2480	Pass	3.50	5.05	30.00	8.55	36.00	5.05

Summary

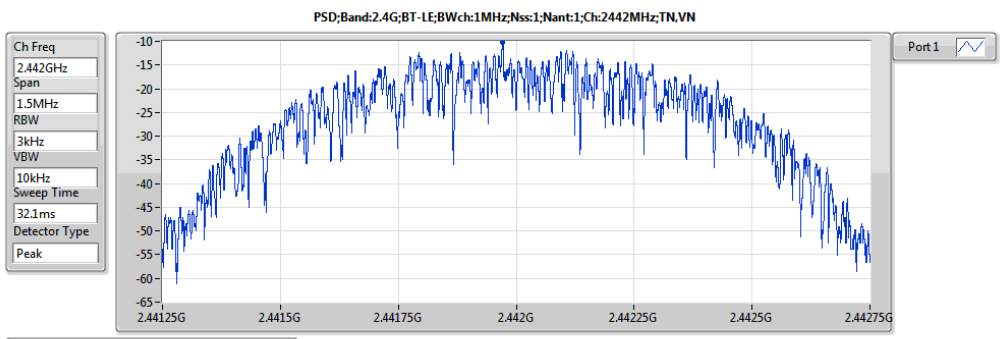
Mode	PD (dBm/RBW)	EIRP.PD (dBm/RBW)
2.4G;BT-LE;Nss1;Ntx1	-10.25	-6.75

Result

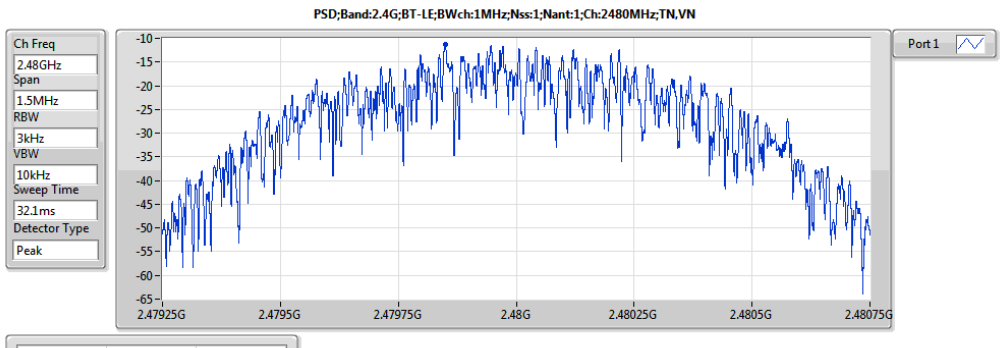
Mode	Result	Meas.RBW (Hz)	Lim.RBW (Hz)	BWCF (dB)	DG (dBi)	PD (dBm/RBW)	PD.Limit (dBm/RBW)	EIRP.PD (dBm/RBW)	EIRP.PD.Lim (dBm/RBW)	P1 (dBm/RBW)
2.4G;BT-LE;Nss1;Ntx1;2402	Pass	3k	3k	0.00	3.50	-10.26	8.00	-6.76	Inf	-10.26
2.4G;BT-LE;Nss1;Ntx1;2442	Pass	3k	3k	0.00	3.50	-10.25	8.00	-6.75	Inf	-10.25
2.4G;BT-LE;Nss1;Ntx1;2480	Pass	3k	3k	0.00	3.50	-11.35	8.00	-7.85	Inf	-11.35



Sum.Max	PD	P1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
-10.26	-10.26	-10.26



Sum.Max	PD	P1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
-10.25	-10.25	-10.25



Sum.Max	PD	P1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
-11.35	-11.35	-11.35

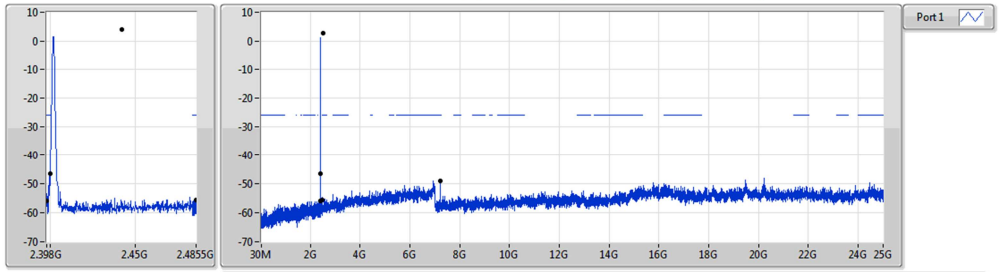
Summary

Mode	Result	Ref (Hz)	Ref (dBm)	Limit (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Port
2.4G;BT-LE;Nss1;Ntx1;2402	Pass	2.401837G	3.98	-26.02	2.398G	-55.88	2.399988G	-46.46	2.4855G	-55.72	7.205102G	-49.11	1

Result

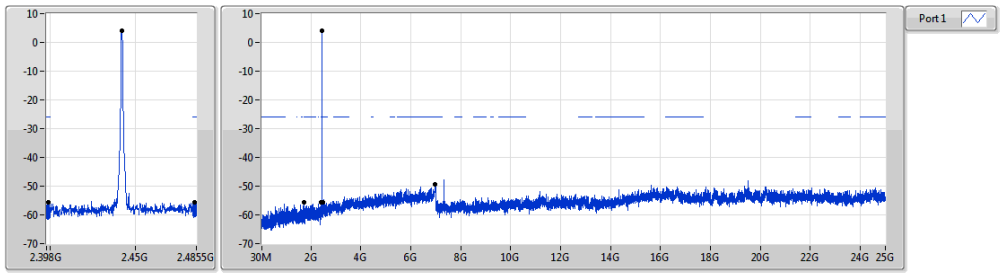
Mode	Result	Ref (Hz)	Ref (dBm)	Limit (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Port
2.4G;BT-LE;Nss1;Ntx1;2402	Pass	2.401837G	3.98	-26.02	2.398G	-55.88	2.399988G	-46.46	2.4855G	-55.72	7.205102G	-49.11	1
2.4G;BT-LE;Nss1;Ntx1;2442	Pass	2.441917G	3.98	-26.02	1.724304G	-55.70	2.399012G	-55.62	2.484692G	-55.56	6.965886G	-49.22	1
2.4G;BT-LE;Nss1;Ntx1;2480	Pass	2.48016G	3.98	-26.02	2.079504G	-55.95	2.399928G	-56.07	2.483956G	-52.15	6.982771G	-48.34	1

CSE in non-restricted band;PK;Band:2.4G;BT-LE;BWch:1MHz;Nss:1;Nant:1;Ch:2402MHz;TN,VN



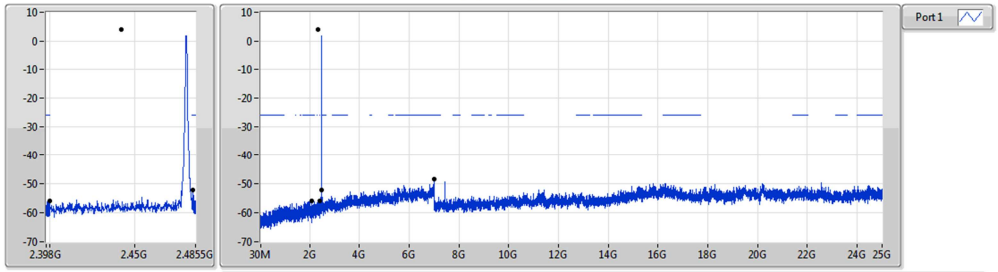
Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
2.401837G	3.98	-26.02	2.398G	-55.88	2.399988G	-46.46	2.4855G	-55.72	7.205102G	-49.11	1

CSE in non-restricted band;PK;Band:2.4G;BT-LE;BWch:1MHz;Nss:1;Nant:1;Ch:2442MHz;TN,VN



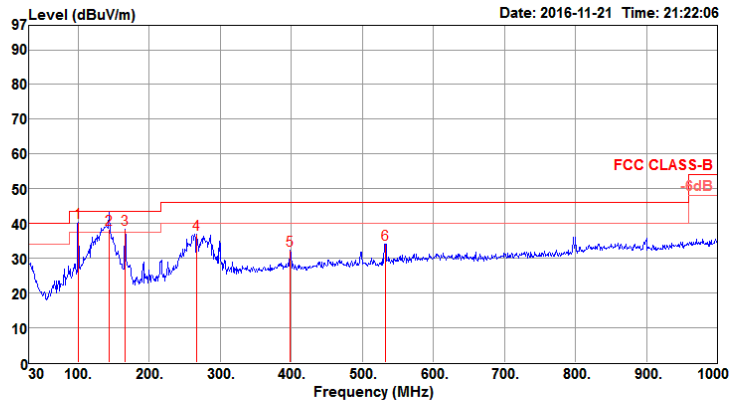
Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
2.441917G	3.98	-26.02	1.724304G	-55.70	2.399012G	-55.62	2.484692G	-55.56	6.965886G	-49.22	1

CSE in non-restricted band;PK;Band:2.4G;BT-LE;BWch:1MHz;Nss:1;Nant:1;Ch:2480MHz;TN,VN



Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
2.48016G	3.98	-26.02	2.079504G	-55.95	2.399928G	-56.07	2.483956G	-52.15	6.982771G	-48.34	1

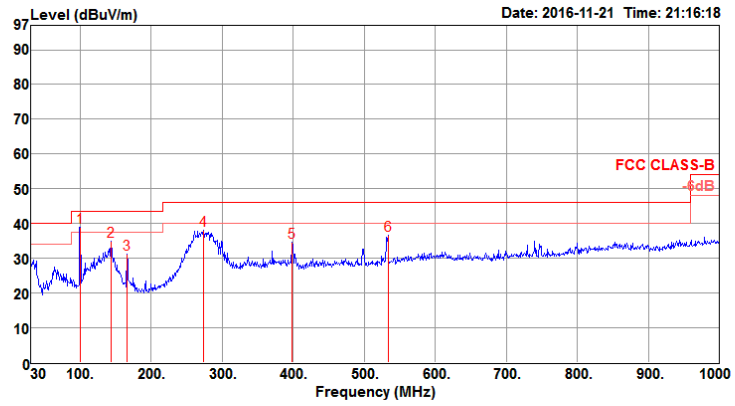
RSE below 1GHz Result			
Operating Mode	3	**Polarization**	Horizontal
Operating Function	Normal Link		



	Freq	Level	Limit Line	Over Limit	Read Level	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	99.84	40.44	43.50	-3.06	50.24	1.58	16.90	28.28	100	271	Peak	HORIZONTAL
2	143.49	38.41	43.50	-5.09	47.40	1.67	17.35	28.01	100	236	QP	HORIZONTAL
3	165.80	38.26	43.50	-5.24	48.19	1.75	16.22	27.90	125	307	Peak	HORIZONTAL
4	266.68	36.87	46.00	-9.13	42.92	2.03	19.52	27.60	100	192	Peak	HORIZONTAL
5	398.60	32.23	46.00	-13.77	35.88	2.36	22.27	28.28	125	246	Peak	HORIZONTAL
6	532.46	34.00	46.00	-12.00	35.81	2.66	24.31	28.78	100	160	Peak	HORIZONTAL

Note 1: “>20dB” means emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found emissions (No emissions were detected.)

RSE below 1GHz Result			
Operating Mode	3	**Power Phase**	Vertical
Operating Function	Normal Link		



	Freq	Level	Limit Line	Over Limit	Read Level	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	99.84	38.82	43.50	-4.68	48.62	1.58	16.90	28.28	100	284	Peak	VERTICAL
2	143.49	34.84	43.50	-8.66	43.83	1.67	17.35	28.01	150	139	Peak	VERTICAL
3	165.80	31.10	43.50	-12.40	41.03	1.75	16.22	27.90	125	109	Peak	VERTICAL
4	273.47	37.93	46.00	-8.07	44.17	2.05	19.30	27.59	100	231	Peak	VERTICAL
5	398.60	34.60	46.00	-11.40	38.25	2.36	22.27	28.28	100	217	Peak	VERTICAL
6	533.43	36.77	46.00	-9.23	38.53	2.67	24.35	28.78	150	255	Peak	VERTICAL

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.)

Radiated Emissions (1GHz~10th Harmonic)

For Test Mode: Mode 1

Configurations	GFSK CH 0 / Chain 1

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	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	4803.87	50.78	74.00	-23.22	44.38	6.26	33.08	32.94	175	187	Peak	HORIZONTAL
2	4804.01	41.42	54.00	-12.58	35.02	6.26	33.08	32.94	175	187	Average	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	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	4803.94	41.65	54.00	-12.35	35.25	6.26	33.08	32.94	165	180	Average	VERTICAL
2	4804.29	50.33	74.00	-23.67	43.93	6.26	33.08	32.94	165	180	Peak	VERTICAL

Configurations	GFSK CH 20 / Chain 1

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	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	4883.96	37.33	54.00	-16.67	30.72	6.28	33.26	32.93	171	174	Average	HORIZONTAL
2	4884.29	47.05	74.00	-26.95	40.44	6.28	33.26	32.93	171	174	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	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	4883.12	48.22	74.00	-25.78	41.61	6.28	33.26	32.93	144	112	Peak	VERTICAL
2	4884.09	34.39	54.00	-19.61	27.78	6.28	33.26	32.93	144	112	Average	VERTICAL

Configurations	GFSK CH 39 / Chain 1

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	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	45.85	74.00	-28.15	39.05	6.30	33.41	32.91	144	228	Peak	HORIZONTAL
2	4960.17	32.37	54.00	-21.63	25.57	6.30	33.41	32.91	144	228	Average	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	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	4959.90	34.46	54.00	-19.54	27.66	6.30	33.41	32.91	124	193	Average	VERTICAL
2	4960.64	47.47	74.00	-26.53	40.67	6.30	33.41	32.91	124	193	Peak	VERTICAL

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.

For Test Mode: Mode 2

Configurations	GFSK CH 0 / Chain 1

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	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	4803.77	47.70	74.00	-26.30	41.45	6.26	33.08	33.09	147	272	Peak	HORIZONTAL
2	4803.99	35.01	54.00	-18.99	28.76	6.26	33.08	33.09	147	272	Average	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	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	4804.00	42.67	54.00	-11.33	36.42	6.26	33.08	33.09	150	11	Average	VERTICAL
2	4804.30	52.12	74.00	-21.88	45.87	6.26	33.08	33.09	150	11	Peak	VERTICAL

Configurations	GFSK CH 20 / Chain 1

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	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	4883.67	45.07	74.00	-28.93	38.60	6.28	33.26	33.07	150	53	Peak	HORIZONTAL
2	4884.04	32.98	54.00	-21.02	26.51	6.28	33.26	33.07	150	53	Average	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	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	4884.07	38.78	54.00	-15.22	32.31	6.28	33.26	33.07	150	354	Average	VERTICAL
2	4884.39	48.75	74.00	-25.25	42.28	6.28	33.26	33.07	150	354	Peak	VERTICAL

Configurations	GFSK CH 39 / Chain 1

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	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	33.80	54.00	-20.20	27.15	6.30	33.41	33.06	115	311	Average	HORIZONTAL
2	4960.54	46.59	74.00	-27.41	39.94	6.30	33.41	33.06	115	311	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	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	4959.96	40.51	54.00	-13.49	33.86	6.30	33.41	33.06	139	20	Average	VERTICAL
2	4960.30	50.30	74.00	-23.70	43.65	6.30	33.41	33.06	139	20	Peak	VERTICAL

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).

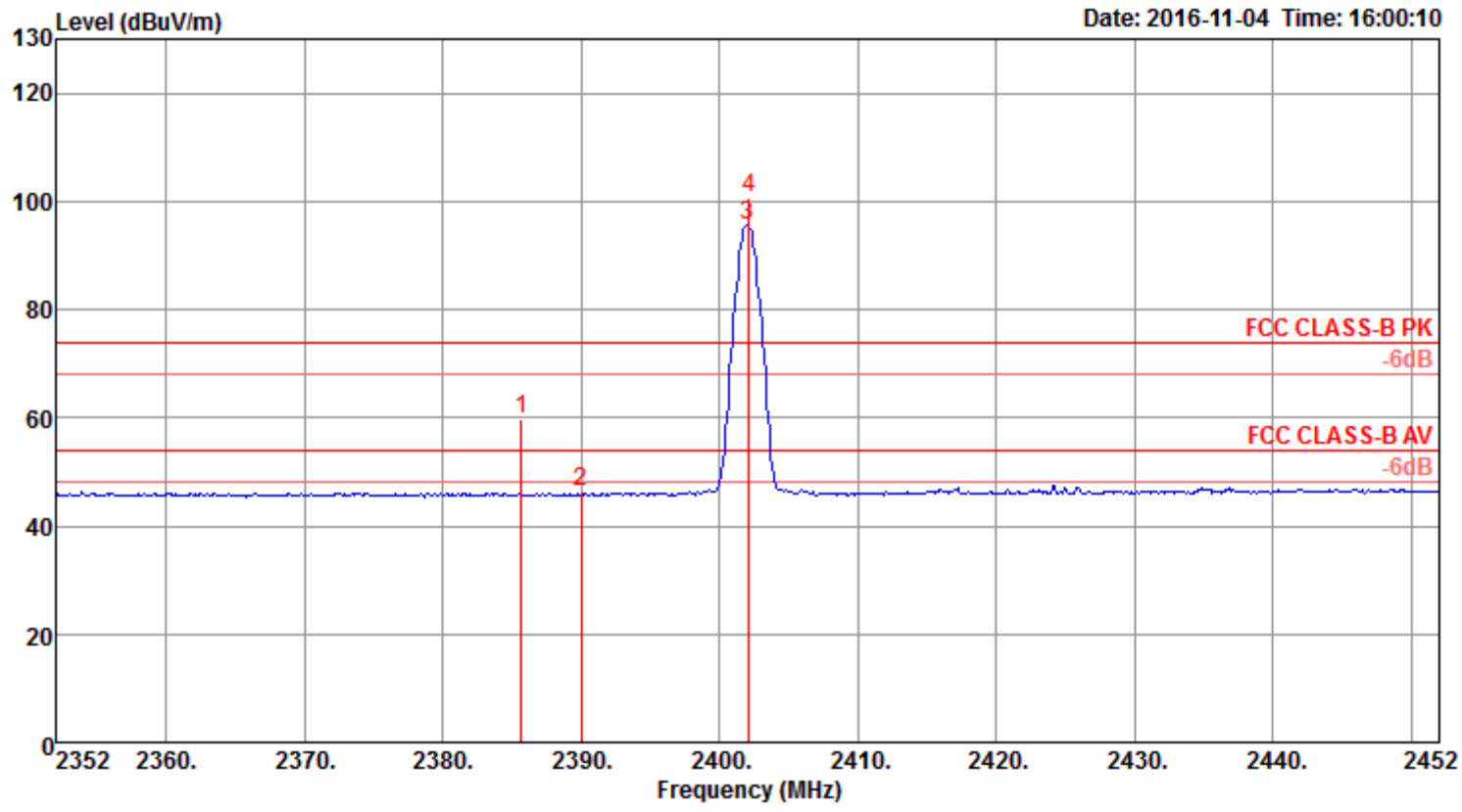
Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

Band Edge Emissions

For Test Mode: Mode 1

Configurations	GFSK CH 0, 20, 39 / Chain 1

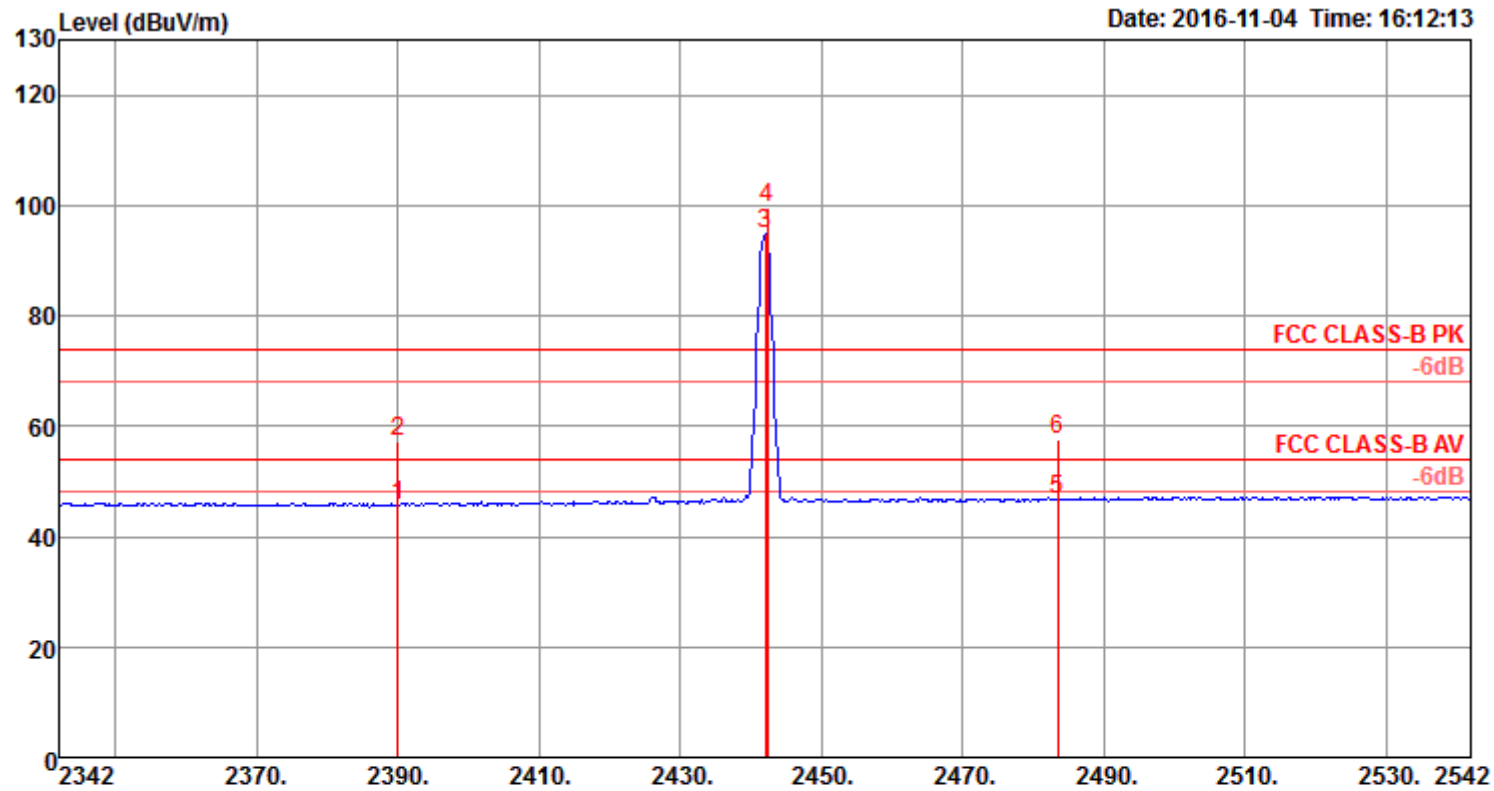
Channel 0



	Freq	Level	Limit Line	Over Limit	Read Level	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	2385.66	59.79	74.00	-14.21	27.88	3.60	28.31	0.00	198	257	Peak	VERTICAL
2	2390.00	46.18	54.00	-7.82	14.27	3.60	28.31	0.00	198	257	Average	VERTICAL
3 @	2402.00	95.76			63.81	3.61	28.34	0.00	198	257	Average	VERTICAL
4 @	2402.14	100.56			68.61	3.61	28.34	0.00	198	257	Peak	VERTICAL

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

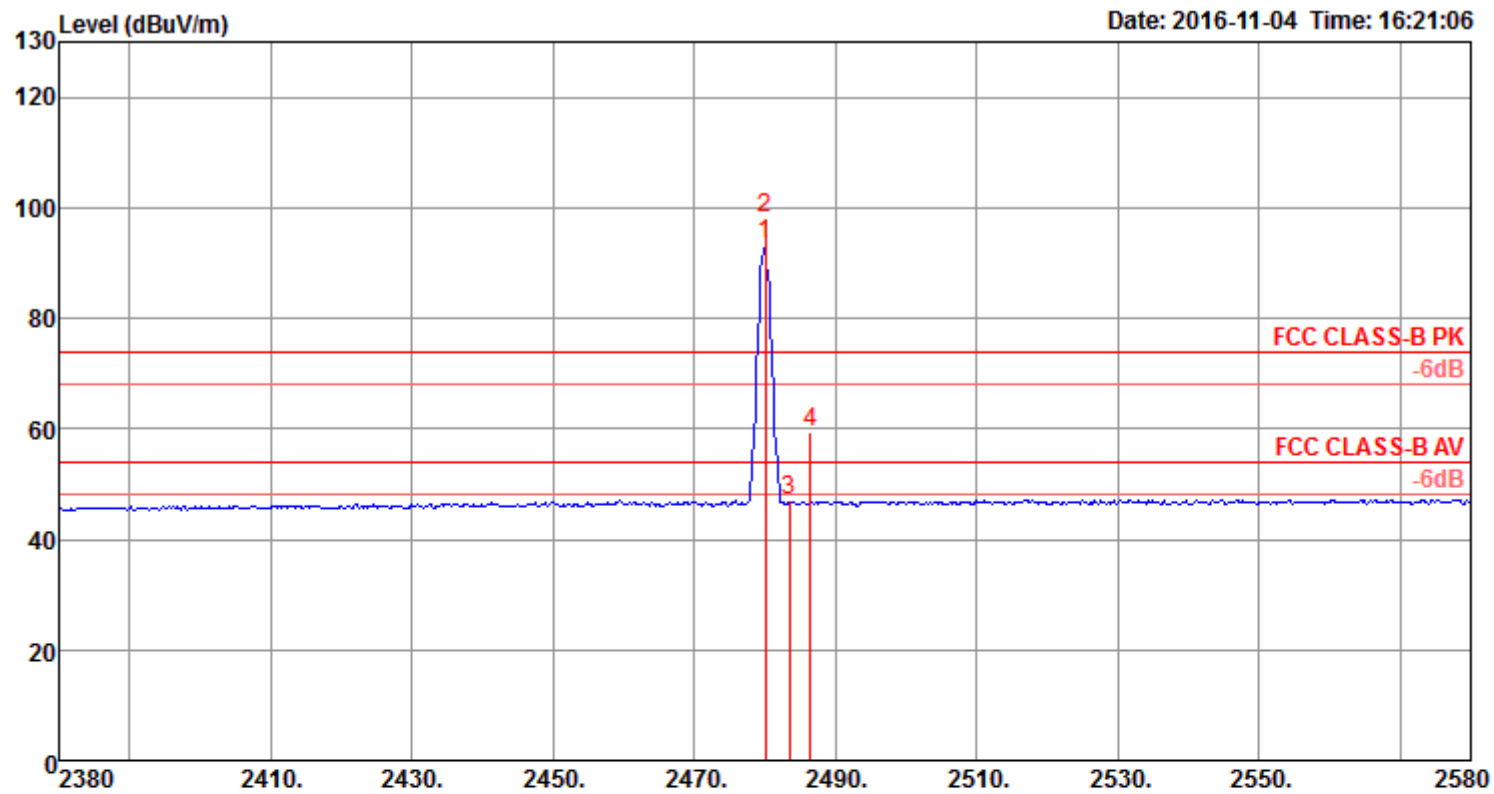
Channel 20



		Freq	Level	Limit Line	Over Limit	Read Level	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		2390.00	45.79	54.00	-8.21	13.88	3.60	28.31	0.00	211	202	Average	VERTICAL
2		2390.00	57.17	74.00	-16.83	25.26	3.60	28.31	0.00	211	202	Peak	VERTICAL
3	@	2442.00	94.99			62.94	3.64	28.41	0.00	211	202	Average	VERTICAL
4	@	2442.29	99.65			67.60	3.64	28.41	0.00	211	202	Peak	VERTICAL
5		2483.50	46.80	54.00	-7.20	14.64	3.68	28.48	0.00	211	202	Average	VERTICAL
6		2483.50	57.62	74.00	-16.38	25.46	3.68	28.48	0.00	211	202	Peak	VERTICAL

Item 3, 4 are the fundamental frequency at 2442 MHz.

Channel 39



	Freq	Level	Limit Line	Over Limit	Read Level	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 @	2480.00	93.50			61.37	3.67	28.46	0.00	224	201	Average	VERTICAL
2 @	2480.00	98.18			66.05	3.67	28.46	0.00	224	201	Peak	VERTICAL
3	2483.50	46.95	54.00	-7.05	14.79	3.68	28.48	0.00	224	201	Average	VERTICAL
4	2486.39	59.22	74.00	-14.78	27.06	3.68	28.48	0.00	224	201	Peak	VERTICAL

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

Note:

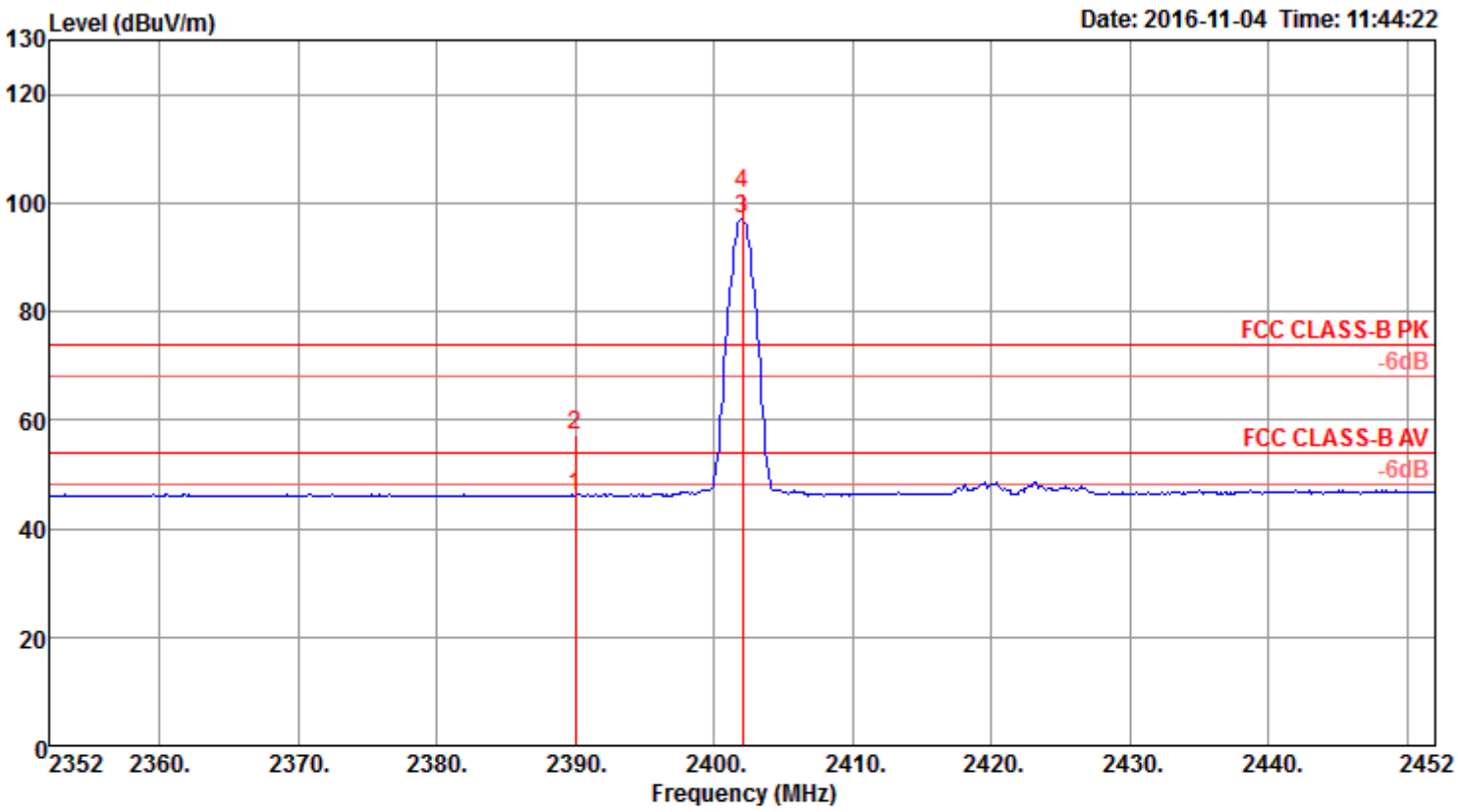
Emission level (dBuV/m) = 20 log Emission level (uV/m).

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

For Test Mode: Mode 2

Configurations	GFSK CH 0, 20, 39 / Chain 1

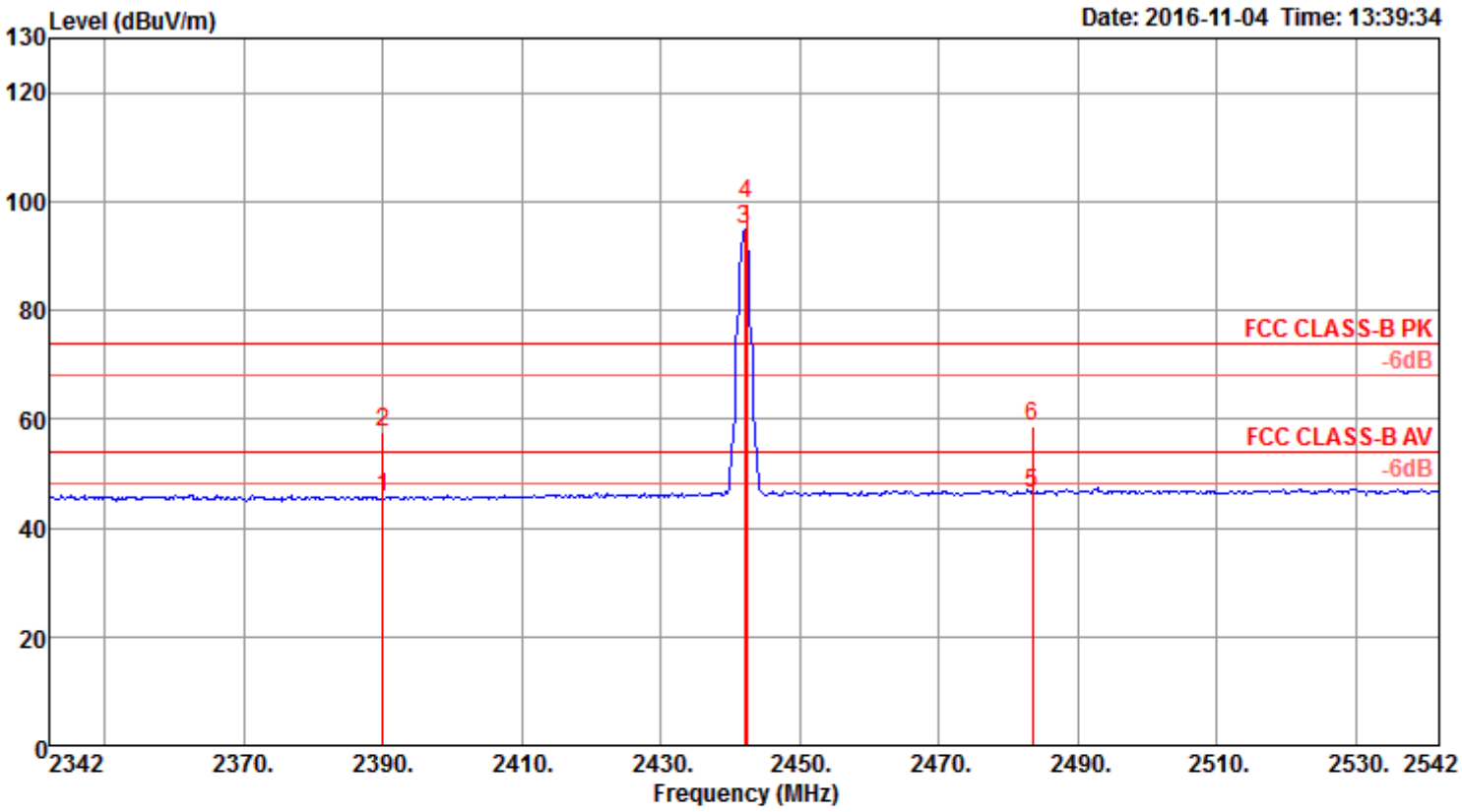
Channel 0



	Freq	Level	Limit Line	Over Limit	Read Level	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	2390.00	46.03	54.00	-7.97	14.12	3.60	28.31	0.00	112	15	Average	VERTICAL
2	2390.00	57.22	74.00	-16.78	25.31	3.60	28.31	0.00	112	15	Peak	VERTICAL
3 @	2402.00	97.07			65.12	3.61	28.34	0.00	112	15	Average	VERTICAL
4 @	2402.00	101.82			69.87	3.61	28.34	0.00	112	15	Peak	VERTICAL

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

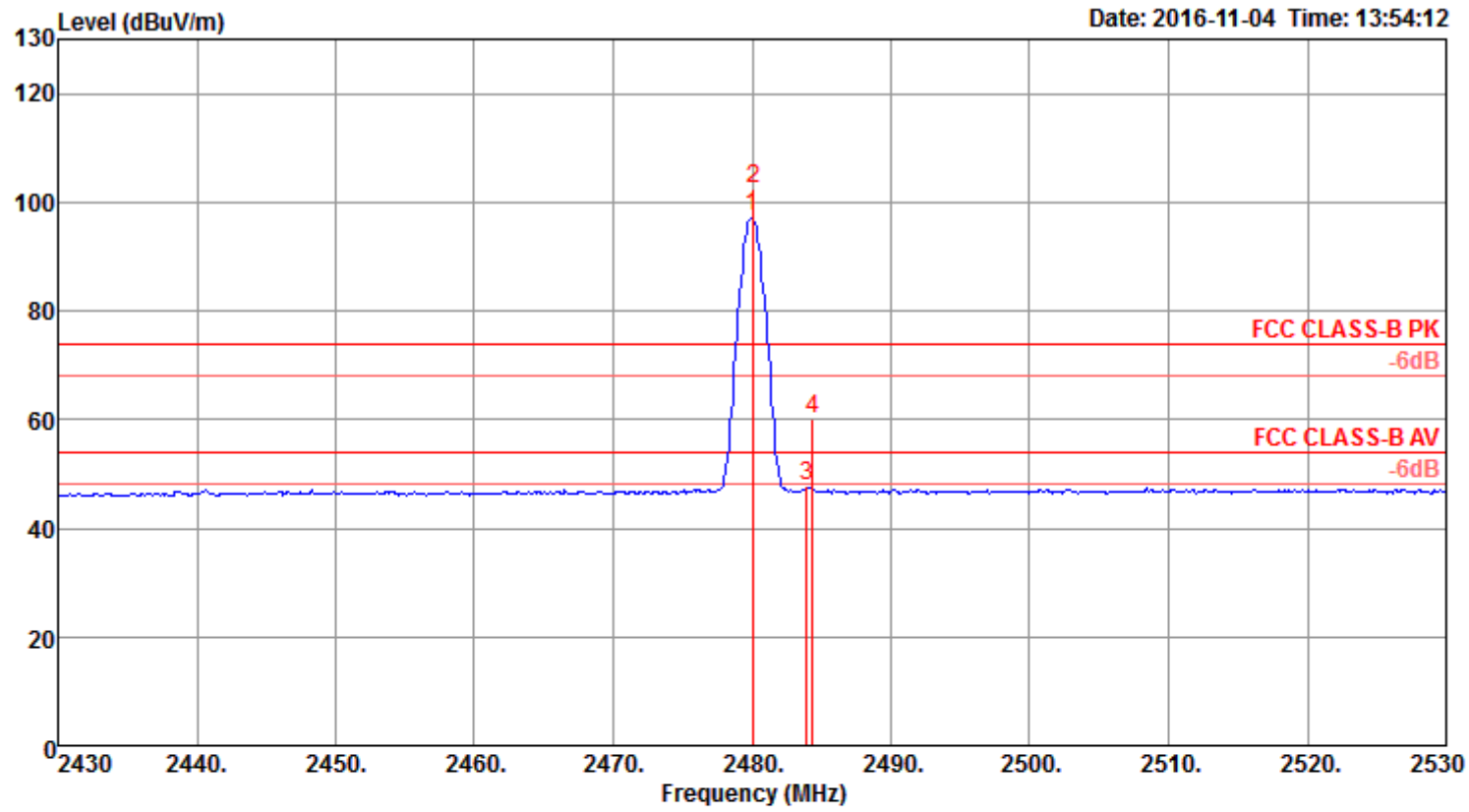
Channel 20



	Freq	Level	Limit Line	Over Limit	Read Level	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	2390.00	45.49	54.00	-8.51	13.58	3.60	28.31	0.00	100	276	Average	VERTICAL
2	2390.00	57.43	74.00	-16.57	25.52	3.60	28.31	0.00	100	276	Peak	VERTICAL
3 @	2442.00	94.94			62.89	3.64	28.41	0.00	100	276	Average	VERTICAL
4 @	2442.29	99.68			67.63	3.64	28.41	0.00	100	276	Peak	VERTICAL
5	2483.50	46.32	54.00	-7.68	14.16	3.68	28.48	0.00	100	276	Average	VERTICAL
6	2483.50	58.62	74.00	-15.38	26.46	3.68	28.48	0.00	100	276	Peak	VERTICAL

Item 3, 4 are the fundamental frequency at 2442 MHz.

Channel 39



	Freq	Level	Limit Line	Over Limit	Read Level	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 @	2480.00	97.45			65.32	3.67	28.46	0.00	105	24	Average	VERTICAL
2 @	2480.14	102.30			70.17	3.67	28.46	0.00	105	24	Peak	VERTICAL
3	2483.93	47.76	54.00	-6.24	15.60	3.68	28.48	0.00	105	24	Average	VERTICAL
4	2484.37	60.05	74.00	-13.95	27.89	3.68	28.48	0.00	105	24	Peak	VERTICAL

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.

Appendix I. Antenna List

1. Table for Filed Antenna

No.	Brand	Ant. Type	Con. Type	Peak Gain (dBi)		Model No.
				2.4GHz	5GHz	
01	LYNwave	PIFA	IPEX	3.5	5	ALA110-222050-300011
02	Walsin	DIPOLE	IPEX	3.14	5	RFDPA171320EMLB301
03	HONGLIN	PIFA	IPEX	1.58	1.21	DC33001FH00
04	LUXSHARE-ICT	PIFA	IPEX	-0.5	0.5	DC33001FC00
05	SPEEDWIRE	PIFA	IPEX	-.097	1.93	DC33001FG00
06	HONGLIN	PIFA	IPEX	-0.78	-2.39	DC33001FF00
07	LUXSHARE-ICT	PIFA	IPEX	-0.3	-0.3	DC33001FD00
08	SPEEDWIRE	PIFA	IPEX	-0.98	2.78	DC33001FE00
09	Tongda	PIFA	IPEX	TX1: 0.02 TX2: -0.46	-0.20 -0.93	TX1: T-543-9021099-A TX2: T-543-9021099-A
10	LUXSHAR E-ICT	PIFA	IPEX	TX1: -3.90 TX2: -1.70	-1.20 -2.90	TX1: DC33001FY20 TX2: DC33001FY30
11	LUXSHAR E-ICT	PIFA	IPEX	TX1: -1.80 TX2: -1.40	-0.90 -2.50	TX1: DC33001FY00 TX2: DC33001FY10
12	LUXSHAR E-ICT	PIFA	IPEX	TX1: -3.30 TX2: -2.20	-1.30 -2.60	TX1: DC33001G000 TX2: DC33001G010
13	LUXSHAR E-ICT	PIFA	IPEX	TX1: -1.60 TX2: -1.30	-1.90 -0.90	TX1: DC33001G020 TX2: DC33001G030
14	LUXSHAR E-ICT	PIFA	IPEX	TX1: -5.10 TX2: -1.30	-3.10 -0.80	TX1: DC33001G310 TX2: DC33001G300
15	Smart Approach	PIFA	IPEX	TX1: 0.60 TX2: 0.32	0.43 2.15	TX1: SE-EQFFG-006 TX2: SE-EQFFG-006
16	Foxconn	PIFA	IPEX	TX1: 0.54 TX2: 1.43	0.64 2.20	TX1: ANTP2M1-CQA23-EH TX2: ANTP2M1-CQA23-EH
17	Foxconn	PIFA	IPEX	TX1: 0.15 TX2: 1.13	-0.30 -0.64	TX1: ANTP2M1-CQA22-EH TX2: ANTP2M1-CQA22-EH
18	INPAQ	PIFA	IPEX	TX1: 0.88 TX2: 0.51	3.05 2.57	TX1: DQ60PLBLB12 TX2: DQ60PLBLB12
19	LUXSHAR E-ICT	PIFA	IPEX	TX1: -4.50 TX2: -3.40	-0.50 -0.80	TX1: DC33001G320 TX2: DC33001G330
20	Smart Approach	PIFA	IPEX	TX1: -0.29 TX2: 0.46	1.02 1.12	TX1: SE-EQFFG-005 TX2: SE-EQFFG-005

21	INNOWAVE	PIFA	IPEX	TX1: 2.82 TX2: 2.72	2.08 2.96	TX1: S79-1805520-I73 TX2: S79-1805510-I73
22	Speedwire	PIFA	IPEX	TX1: -0.03 TX2: -1.31	-0.58 -0.03	TX1: DC33001G210 TX2: DC33001G200
23	Speedwire	PIFA	IPEX	TX1: -1.88 TX2: -4.51	-0.59 -0.33	TX1: DC33001FZ00 TX2: DC33001FZ10
24	Speedwire	PIFA	IPEX	TX1: -1.55 TX2: -3.99	0.38 1.78	TX1: DC33001FZ20 TX2: DC33001FZ30
25	Speedwire	PIFA	IPEX	TX1: -1.41 TX2: -2.16	0.09 0.13	TX1: DC33001G120 TX2: DC33001G130
26	Speedwire	PIFA	IPEX	TX1: -1.27 TX2: -2.02	0.08 0.42	TX1: DC33001G100 TX2: DC33001G110
27	Speedwire	PIFA	IPEX	TX1: -1.13 TX2: -0.17	-1.95 -0.52	TX1: DC33001G220 TX2: DC33001G230
28	High-Tek	PIFA	IPEX	TX1: 1.01 TX2: -1.19	2.90 1.06	TX1: DC33001RM00 TX2: DC33001RM10
29	Tongda	PIFA	IPEX	TX1: -2.05 TX2: -1.08	1.44 1.00	TX1: DC33001RN00 TX2: DC33001RN10
30	High-Tek	PIFA	IPEX	TX1: -0.86 TX2: -2.59	0.63 -0.21	TX1: 0ACCN014021N TX2: 0ACCN014021N
31	Smart Approach	PIFA	IPEX	TX1: 0.38 TX2: 1.43	0.73 2.91	TX1: SE-ECAL1-001 TX2: SE-ECAL1-001
32	LUXSHARE-ICT	PIFA	IPEX	TX1: -3.60 TX2:-2.00	-0.60 -2.90	TX1: LA22RF826-1H TX2: LA22RF825-1H
33	Speed	PIFA	IPEX	TX1: -1.46 TX2: -1.59	0.14 2.39	TX1: F.0G.JV-0048-003-00 TX2: F.0G.JV-0048-004-00
34	Amphenol	PIFA	IPEX	TX1: 1.68 TX2: 0.18	-0.71 -1.71	TX1: 6717-FA TX2: 6719-FB
35	Speed	PIFA	IPEX	TX1: 1.50 TX2: -0.12	0.38 -0.14	TX1: M.Z2.ZV-0001-001 TX2: M.Z2.ZV-0001-002
36	LUXSHARE-ICT	PIFA	IPEX	TX1: -1.40 TX2: -3.60	-0.20 -2.80	TX1: 025.900KY.0001 TX2: 025.900KZ.0001
37	WNC	PIFA	IPEX	TX1: -0.89 TX2: 0.38	0.63 -1.41	TX1: 025.900KY.0001 TX2: 025.900KZ.0001
38	Jieng-Tai	PIFA	IPEX	TX1: 1.93 TX2: 0.15	1.23 1.39	TX1: 7KYQUTAN000372 TX2: 7KYQUTAN000372

39	TONGDA	PIFA	IPEX	TX1: 0.76 TX2: 0.66	0.75 0.85	TX1: T-543-9051117-B TX2: T-543-9051117-B