

TEST REPORT

Report No.: 18051454HKG-003

Lenbrook Industries Ltd.

Application For Certification
(Original Grant)

FCC ID: Q20-PULSE2I

IC: 152B-PULSE2I

Transceiver

This report contains the data of Bluetooth 3.0 portion only.

Prepared and Checked by:

Approved by:

Signed On File
Wong Cheuk Ho, Herbert
Lead Engineer

Wong Kwok Yeung, Kenneth
Senior Lead Engineer
Date: October 26, 2018

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TEST REPORT

GENERAL INFORMATION

Grantee:	Lenbrook Industries Ltd.
Grantee Address:	633 Granite Court Pickering ON L1W 3K1 Canada
Contact Person:	Taresh Vadgama
Tel:	+1 9058310799 ext. 4236
Fax:	N/A
e-mail:	TVadgama@lenbrook.com
Manufacturer:	Dongguan Kwan Hong Electronic Co., Ltd
Manufacturer Address:	Kwan Hong Bldg, Xiao Bian 2nd Industrial Zone, Chang An, Dongguan, Gunagdong, China.
Brand Name:	Bluesound International
Model / HVIN:	PULSE 2i
PMN:	Premium Wireless Steaming Speaker
Additional Model:	N/A
Type of EUT:	Transceiver
Description of EUT:	Premium Wireless Steaming Speaker
Serial Number:	N/A
FCC ID / IC:	Q2O-PULSE2I / 152B-PULSE2I
Date of Sample Submitted:	June 06, 2018
Date of Test:	June 06, 2018 to October 26, 2018
Report No.:	18051454HKG-003
Report Date:	October 26, 2018
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%
Conclusion:	Test was conducted by client submitted sample. The submitted sample as received complied with the 47 CFR Part 15 / RSS-210 Issue 9 Certification.

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SUMMARY OF TEST RESULT

Test Specification	Reference	Results
Transmitter Power Line Conducted Emissions	15.207 / RSS-Gen 8.8	Pass
Radiated Emission Radiated Emission on the Bandedge	15.249, 15.209 / RSS-210 B.10, RSS-210 4.4	Pass
Radiated Emission in Restricted Bands	15.205 / RSS-210 4.1	Pass

The equipment under test is found to be complying with the following standards:

FCC Part 15, October 1, 2017 Edition

RSS-210 Issue 9, August 2016

RSS-Gen Issue 5, April 2018

- Note:
1. The EUT uses a permanently attached antenna which, in accordance to section 15.203, is considered sufficient to comply with the provisions of this section.
 2. Pursuant to FCC part 15 Section 15.215(c), the 20 dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

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1.0 GENERAL DESCRIPTION

1.1 Product Description

The Equipment-Under-Test (EUT) PULSE 2i is a Premium Wireless Steaming Speaker. The EUT contains both WLAN (WiFi) and Bluetooth modules. The Bluetooth module has Bluetooth 4.0 BLE and Bluetooth 3.0 features. The EUT can accept analog audio signal, digital audio signal and wireless audio signal via Bluetooth devices. An iOS/Android apps Bluesound installed in Smartphone can act as the remote control of the EUT. The EUT has internal power amplifiers and loudspeaker. It is powered by 100-240VAC. The EUT is powered by 100-240VAC.

For the WLAN (WiFi) module:

For 2.400-2.4835GHz:

The Equipment Under Test (EUT) operates at frequency range of 2412MHz to 2462MHz with 11 channels.

For 802.11b mode, it operates at frequency range of 2412.000MHz to 2462.000MHz with 11 channels. It transmits via Direct-sequence spread spectrum (DSSS) modulation. Maximum bit rate can be up to 11Mbps.

For 802.11g mode, it operates at frequency range of 2412.000MHz to 2462.000MHz with 11 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can be up to 54Mbps.

For 802.11n (with 20MHz bandwidth) mode, it operates at frequency range of 2412.000MHz to 2462.000MHz with 11 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 65Mbps.

For 802.11n (with 40MHz bandwidth) mode, it operates at frequency range of 2422.000MHz to 2452.000MHz with 7 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 65Mbps.

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For 5.15-5.25GHz:

The Equipment Under Test (EUT) operates at frequency range of 5180MHz to 5240MHz with 4 channels.

For 802.11a mode, it operates at frequency range of 5180.00MHz to 5250.000MHz with 4 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can be up to 54Mbps.

For 802.11n (with 20MHz bandwidth) mode, it operates at frequency range of 5180.00MHz to 5250.000MHz with 4 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 65.0Mbps.

For 802.11n (with 40MHz bandwidth) mode, it operates at frequency range of 5190.00MHz to 5230.000MHz with 2 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 135.0Mbps.

For 802.11ac (with 20MHz bandwidth) mode, it operates at frequency range of 5180.00MHz to 5250.000MHz with 4 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 86.7Mbps.

For 802.11ac (with 40MHz bandwidth) mode, it operates at frequency range of 5190.00MHz to 5230.000MHz with 2 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 180Mbps.

For 802.11ac (with 80MHz bandwidth) mode, it operates at frequency 5210MHz. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 390Mbps.

For 5.725-5.850GHz:

The Equipment Under Test (EUT) operates at frequency range of 5745MHz to 5825MHz with 5 channels.

For 802.11a mode, it operates at frequency range of 5745.00MHz to 5825.000MHz with 5 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can be up to 54Mbps.

For 802.11n (with 20MHz bandwidth) mode, it operates at frequency range of 5745MHz to 5825MHz with 5 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 216.6Mbps.

For 802.11n (with 40MHz bandwidth) mode, it operates at frequency range of 5755.00MHz to 5795.000MHz with 2 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 450Mbps.

For 802.11ac (with 20MHz bandwidth) mode, it operates at frequency range of 5745MHz to 5825MHz with 5 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 260Mbps.

For 802.11ac (with 40MHz bandwidth) mode, it operates at frequency range of 5755.00MHz to 5795.000MHz with 2 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 600Mbps.

For 802.11ac (with 80MHz bandwidth) mode, it operates at frequency 5775MHz. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 1300Mbps.

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For the Bluetooth module:

For Bluetooth 4.0 BLE mode, it occupies a frequency range from 2402MHz to 2480MHz (40 channels with channel spacing of 2MHz). It transmits via GFSK modulation.

For Bluetooth 3.0 mode, it occupies a frequency range from 2402MHz to 2480MHz (79 channels with channel spacing of 1MHz). It transmits via GFSK modulation.

The antenna(s) used in the EUT is internal, integral.

The circuit description is saved with filename: descri.pdf.

This report contains the data of Bluetooth 3.0 portion only.

1.2 Related Submittal(s) Grants

This is a single application for certification of a transceiver (Bluetooth portion).

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). All radiated measurements were performed in an 3m Chamber. Preliminary scans were performed in the 3m Chamber only to determine worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the “**Justification Section**” of this Application.

1.4 Test Facility

The 3m Chamber and conducted measurement facility used to collect the radiated data is located at Workshop No. 3, G/F., World-Wide Industrial Centre, 43-47 Shan Mei Street, Fo Tan, Sha Tin, N.T., Hong Kong. This test facility and site measurement data have been placed on file with the FCC and IC No. 2042V-1.

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2.0 SYSTEM TEST CONFIGURATION

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10 (2013).

The device was powered by 120VAC.

For maximizing emissions, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.0.

The rear of unit shall be flushed with the rear of the table.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was mounted to a plastic stand if necessary and placed on the wooden turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

For simultaneous transmission, both WiFi and Bluetooth portions are also switched on when taking radiated emission for determining worst-case spurious emission.

2.2 EUT Exercising Software

The EUT exercise program (if any) used during radiated testing was designed to exercise the various system components in a manner similar to a typical use.

2.3 Special Accessories

There are no special accessories necessary for compliance of this product.

2.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

Uncertainty and Compliance - Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

2.5 Support Equipment List and Description

1. Earphone with cable of 1.2m meter long
2. 4GB USB flash drive
(Provided by Intertek)
3. LAN cable of 1.5m long with termination
4. Power Cable of 2m long
5. Analog In coaxial cable of 1.5m long with termination
(Provided by Applicant)

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3.0 EMISSION RESULTS

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

3.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any), Average Factor (optional) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG - AV$$

where FS = Field Strength in dB μ V/m

RA = Receiver Amplitude (including preamplifier) in dB μ V

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

AV = Average Factor in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:

$$FS = RR + LF$$

where FS = Field Strength in dB μ V/m

RR = RA - AG - AV in dB μ V

LF = CF + AF in dB

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB are added. The amplifier gain of 29 dB and average factor of 5 dB are subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 52.0 \text{ dB}\mu\text{V/m}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$AV = 5.0 \text{ dB}$$

$$FS = RR + LF$$

$$FS = 18 + 9 = 27 \text{ dB}\mu\text{V/m}$$

$$RR = 18.0 \text{ dB}\mu\text{V}$$

$$LF = 9.0 \text{ dB}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(27 \text{ dB}\mu\text{V/m})/20] = 22.4 \mu\text{V/m}$$

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3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 374.986 MHz

For electronic filing, the worst case radiated emission configuration photographs are saved with filename: radiated photos.pdf.

3.3 Radiated Emission Data

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgment: Passed by 0.2 dB

3.4 Conducted Emission Configuration Photograph

The worst case in line-conducted emission was found at 0.578 MHz

For electronic filing, the worst case line-conducted configuration photographs are saved with filename: conducted photo.pdf.

3.5 Conducted Emission Data

For electronic filing, the graph and data table of conducted emission is saved with filename: conducted.pdf.

Judgment: Pass by 4.1 dB

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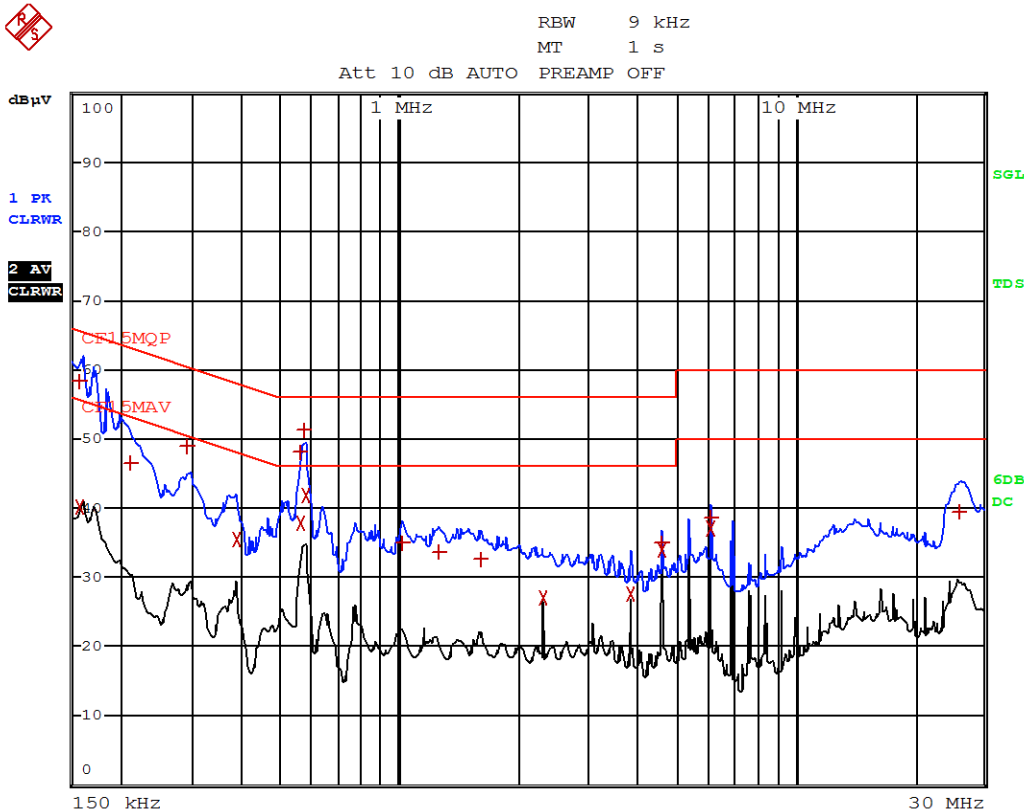
CONDUCTED EMISSION

Model: PULSE 2i

Date of Test: October 26, 2018

Worst-Case Operating Mode: WiFi + Bluetooth Audio Playing

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CF15MQP			
Trace2:	CF15MAV			
Trace3:	---			
TRACE	FREQUENCY	LEVEL	dB μ V	DELTA LIMIT
1 Quasi Peak	159 kHz	58.41	N	-7.10
2 CISPR Average	159 kHz	40.30	L1	-15.21
1 Quasi Peak	213 kHz	46.50	N	-16.58
1 Quasi Peak	294 kHz	48.99	N	-11.41
2 CISPR Average	384 kHz	35.67	N	-12.51
1 Quasi Peak	564 kHz	48.21	N	-7.78
2 CISPR Average	564 kHz	38.04	N	-7.95
1 Quasi Peak	573 kHz	51.40	N	-4.59
2 CISPR Average	577.5 kHz	41.86	N	-4.13
1 Quasi Peak	1.0185 MHz	35.13	N	-20.86
1 Quasi Peak	1.2525 MHz	33.62	N	-22.37
1 Quasi Peak	1.599 MHz	32.64	N	-23.35
2 CISPR Average	2.3055 MHz	27.07	L1	-18.93
2 CISPR Average	3.84 MHz	27.60	L1	-18.39
1 Quasi Peak	4.6095 MHz	35.04	L1	-20.95
2 CISPR Average	4.6095 MHz	33.96	L1	-12.03
1 Quasi Peak	6.144 MHz	38.60	L1	-21.40
2 CISPR Average	6.144 MHz	37.19	L1	-12.80
1 Quasi Peak	25.917 MHz	39.49	L1	-20.50



Note: Measurement Uncertainty is ± 4.2 dB at a level of confidence of 95%.

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RADIATED EMISSIONS

Model: PULSE 2i

Date of Test: October 26, 2018

Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 1
Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Lowest Channel

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	2402.000	82.0	33	29.4	78.4	94.0	-15.6
H	4804.000	36.5	33	34.9	38.4	54.0	-15.6
H	7206.000	35.9	33	37.9	40.8	54.0	-13.2
H	9608.000	31.4	33	40.4	38.8	54.0	-15.2
H	12010.000	29.7	33	40.5	37.2	54.0	-16.8
H	14412.000	30.8	33	40.0	37.8	54.0	-16.2

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
H	2402.000	106.4	33	29.4	102.8	114.0	-11.2
H	4804.000	48.3	33	34.9	50.2	74.0	-23.8
H	7206.000	45.6	33	37.9	50.5	74.0	-23.5
H	9608.000	42.8	33	40.4	50.2	74.0	-23.8
H	12010.000	45.0	33	40.5	52.5	74.0	-21.5
H	14412.000	45.2	33	40.0	52.2	74.0	-21.8

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. Average measurement method is according to ANSI C63.10
 3. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
 4. Negative sign in the column shows value below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Model: PULSE 2i
Date of Test: October 26, 2018
Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 2
Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Middle Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2442.000	81.8	33	29.4	78.2	94.0	-15.8
H	4884.000	37.3	33	34.9	39.2	54.0	-14.8
H	7326.000	34.9	33	37.9	39.8	54.0	-14.2
H	9768.000	30.8	33	40.4	38.2	54.0	-15.8
H	12210.000	30.8	33	40.5	38.3	54.0	-15.7
H	14652.000	33.1	33	38.4	38.5	54.0	-15.5

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2442.000	107.2	33	29.4	103.6	114.0	-10.4
H	4884.000	48.9	33	34.9	50.8	74.0	-23.2
H	7326.000	45.4	33	37.9	50.3	74.0	-23.7
H	9768.000	43.4	33	40.4	50.8	74.0	-23.2
H	12210.000	45.1	33	40.5	52.6	74.0	-21.4
H	14652.000	46.8	33	38.4	52.2	74.0	-21.8

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. Average measurement method is according to ANSI C63.10
 3. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
 4. Negative sign in the column shows value below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

Model: PULSE 2i
Date of Test: October 26, 2018
Worst-Case Operating Mode: Transmitting (Bluetooth 3.0)

Table 3
Pursuant to FCC Part 15 Section 15.249 / RSS-210 B10.0 Requirement

Highest Channel

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	2480.000	82.8	33	29.4	79.2	94.0	-14.8
H	4960.000	37.7	33	34.9	39.6	54.0	-14.4
H	7440.000	33.3	33	37.9	38.2	54.0	-15.8
H	9920.000	32.0	33	40.4	39.4	54.0	-14.6
H	12400.000	31.3	33	40.5	38.8	54.0	-15.2
H	14880.000	34.2	33	38.4	39.6	54.0	-14.4

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
H	2480.000	108.4	33	29.4	104.8	114.0	-9.2
H	4960.000	48.3	33	34.9	50.2	74.0	-23.8
H	7440.000	45.9	33	37.9	50.8	74.0	-23.2
H	9920.000	42.6	33	40.4	50.0	74.0	-24.0
H	12400.000	44.7	33	40.5	52.2	74.0	-21.8
H	14880.000	46.6	33	38.4	52.0	74.0	-22.0

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. Average measurement method is according to ANSI C63.10
 3. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
 4. Negative sign in the column shows value below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Model: PULSE 2i

Date of Test: October 26, 2018

Worst-Case Operating Mode: WiFi + Bluetooth Audio Playing

Table 4
Pursuant to FCC Part 15 Section 15.209 / RSS-210 4.4 Requirement

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
V	30.606	45.4	16	10.0	39.4	40.0	-0.6
V	31.394	44.4	16	10.0	38.4	40.0	-1.6
V	32.576	44.2	16	10.0	38.2	40.0	-1.8
V	43.822	44.8	16	10.0	38.8	40.0	-1.2
V	62.222	42.4	16	10.0	36.4	40.0	-3.6
V	77.196	45.5	16	6.0	35.5	40.0	-4.5
V	98.476	44.5	16	12.0	40.5	43.5	-3.0
V	101.872	41.2	16	13.0	38.2	43.5	-5.3
V	141.216	36.5	16	14.0	34.5	43.5	-9.0
V	203.175	33.6	16	16.0	33.6	43.5	-9.9
V	225.758	36.2	16	18.0	38.2	46.0	-7.8
V	249.978	33.4	16	20.0	37.4	46.0	-8.6
H	282.200	34.4	16	22.0	40.4	46.0	-5.6
H	304.784	33.4	16	22.0	39.4	46.0	-6.6
H	324.972	32.4	16	24.0	40.4	46.0	-5.6
H	374.986	37.8	16	24.0	45.8	46.0	-0.2
H	399.994	33.6	16	25.0	42.6	46.0	-3.4
H	499.995	32.2	16	26.0	42.2	46.0	-3.8
V	624.974	32.2	16	29.0	45.2	46.0	-0.8
V	750.044	27.2	16	30.0	41.2	46.0	-4.8
H	874.962	26.8	16	32.0	42.8	46.0	-3.2
H	999.970	27.0	16	33.0	44.0	54.0	-10.0

- NOTES:
1. Quasi-Peak Detector Data unless otherwise stated.
 2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
 3. Negative sign in the column shows value below limit.
 4. Horn antenna is used for the emission over 1000MHz.
 5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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4.0 EQUIPMENT PHOTOGRAPHS

For electronic filing, the photographs are saved with filename: external photos.pdf and internal photos.pdf.

5.0 PRODUCT LABELLING

For electronics filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.

6.0 TECHNICAL SPECIFICATIONS

For electronic filing, the block diagram and schematic of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

7.0 INSTRUCTION MANUAL

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States and Canada.

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8.0 MISCELLANEOUS INFORMATION

The miscellaneous information includes details of the test procedure and measured bandwidth / calculation of factor such as pulse desensitization and averaging factor (calculation and timing diagram).

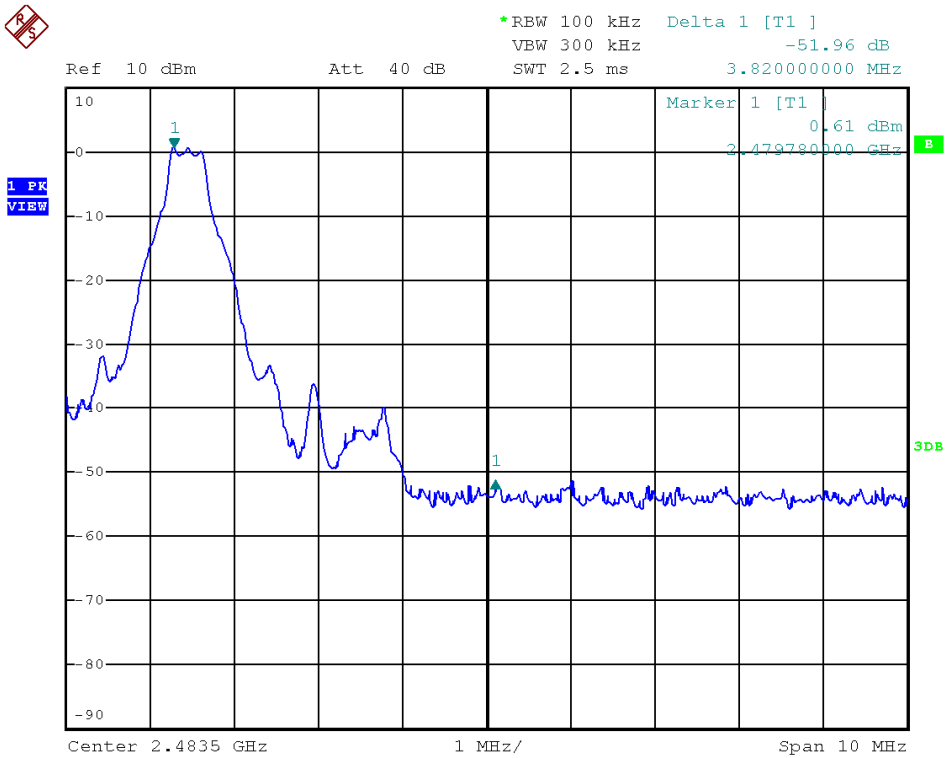
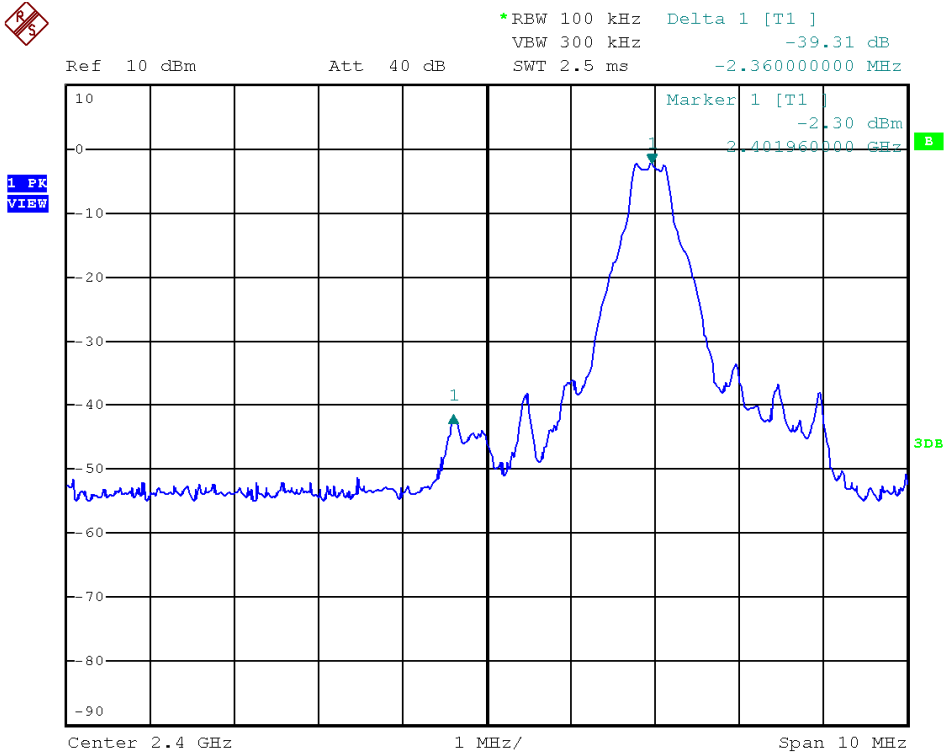
8.1 Radiated Emission on the Bandedge

From the following plots, they show that the fundamental emissions are confined in the specified band (2400MHz to 2483.5MHz). In case of the fundamental emissions are within two standard bandwidths from the bandedge, the delta measurement technique is used for determining bandedge compliance. Standard bandwidth is the bandwidth specified by ANSI C63.10 (2013) for frequency being measured.

Emissions radiated outside of the specified frequency bands, except harmonics, are attenuated by 50dB below the level of the fundamental or to the general radiated emissions limits in Section 15.209 / RSS-210 4.4, whichever is the lesser attenuation, which meet the requirement of part 15.249(d) / RSS-210 B.10.

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PEAK MEASUREMENT



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PEAK MEASUREMENT

Bandedge compliance is determined by applying marker-delta method, i.e. (Bandedge Plot).

Lower bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=102.8 dB μ V/m – 39.3 dB

=63.5 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=78.4 dB μ V/m – 39.3 dB

=39.1 dB μ V/m

Upper bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=104.8 dB μ V/m – 52.0 dB

=52.8 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=79.2 dB μ V/m – 52.0 dB

=27.2 dB μ V/m

The resultant field strength meets the general radiated emission limit in Section 15.209 / RSS-210 4.4, which does not exceed 74 dB μ V/m (Peak Limit) and 54 dB μ V/m (Average Limit).

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8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (T_{eff}) is approximately $625\mu s$ for a digital "1" bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 3MHz, so the pulse desensitivity factor is 0dB.

8.3 Calculation of Average Factor

N/A

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8.4 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services Hong Kong Ltd. in the measurements of transmitter operating under the Part 15, Subpart C rules.

The transmitting equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately 0.8m in height above the ground plane for emission measurement at or below 1GHz and 1.5m in height above the ground plane for emission measurement above 1GHz. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axis to obtain maximum emission levels. The antenna height and polarization are also varied during the testing to search for maximum signal levels. The height of the antenna is varied from one to four meters.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.3.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower. For line conducted emissions, the range scanned is 150 kHz to 30 MHz.

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8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements were made as described in ANSI C63.10 (2013).

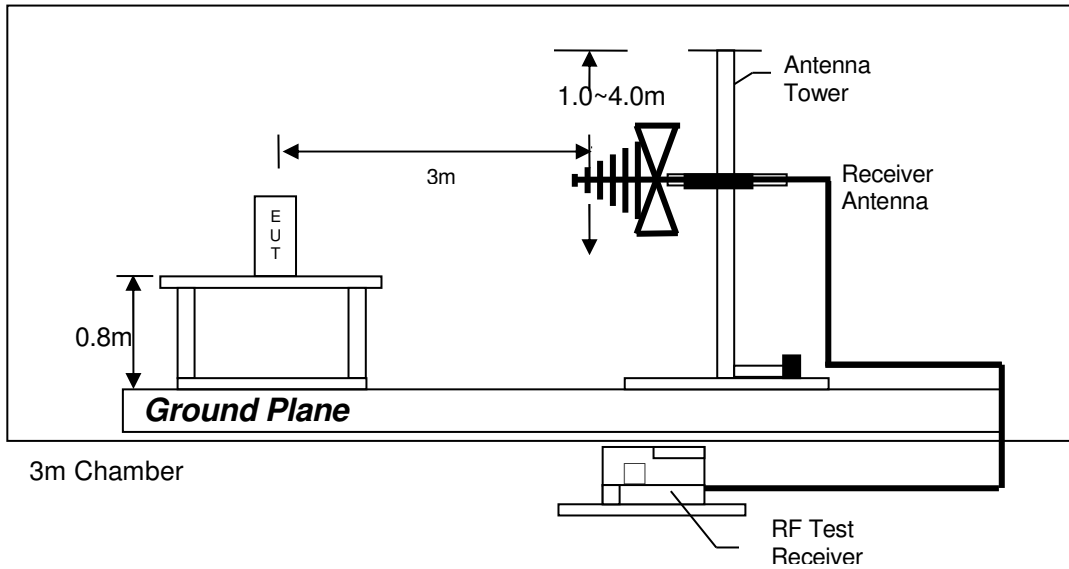
The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.1). Above 1000 MHz, a resolution bandwidth of 3 MHz is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, unless otherwise reported. Measurements taken at a closer distance are so marked.

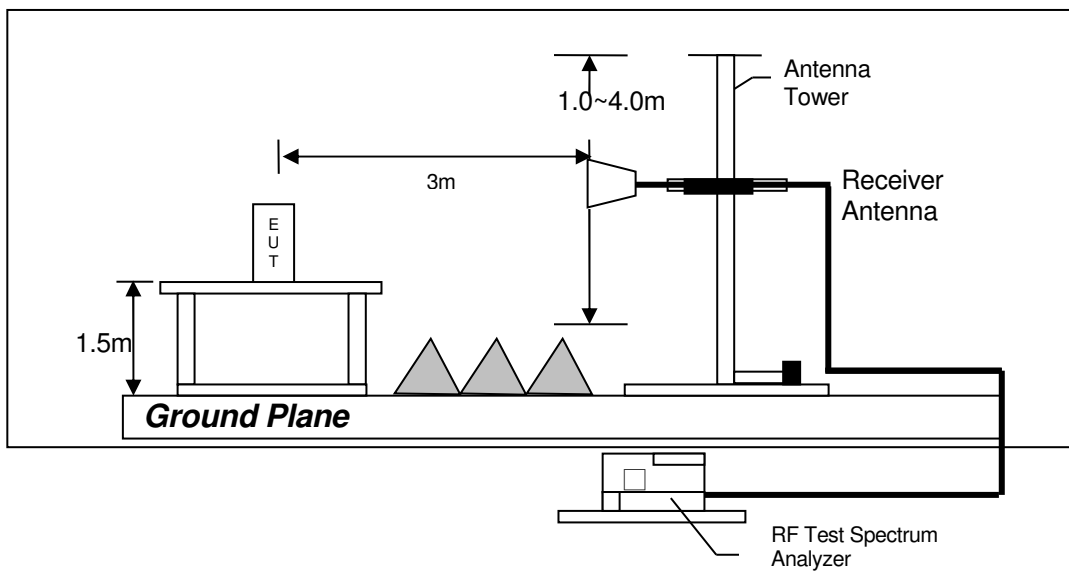
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8.4.1 Radiated Emission Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



Test setup of radiated emissions up to 1GHz



Test setup of radiated emissions above 1GHz

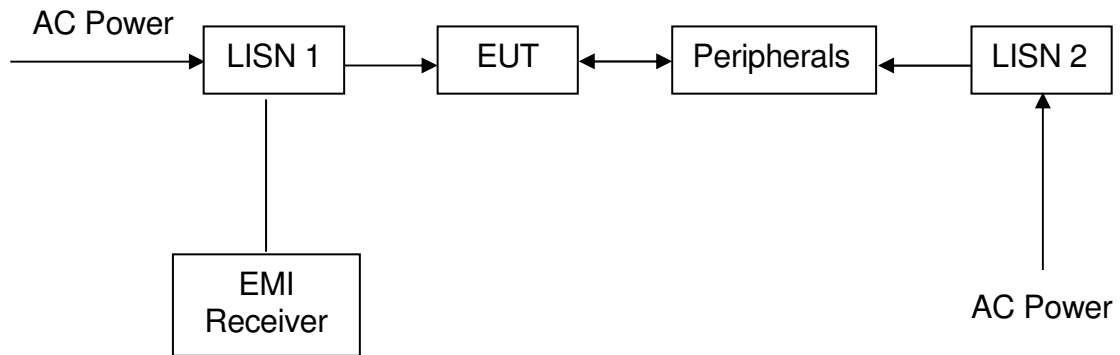
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8.4.2 Conducted Emission Test Procedures

For tabletop equipment, the EUT along with its peripherals were placed on a 1.0m(W)×1.5m(L) and 0.8m in height wooden table. For floor-standing equipment, the EUT and all cables were insulated, if required, from the ground plane by up to 12 mm of insulating material. The EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled.

All connecting cables of EUT and peripherals were moved to find the maximum emission.

8.4.3 Conducted Emission Test Setup



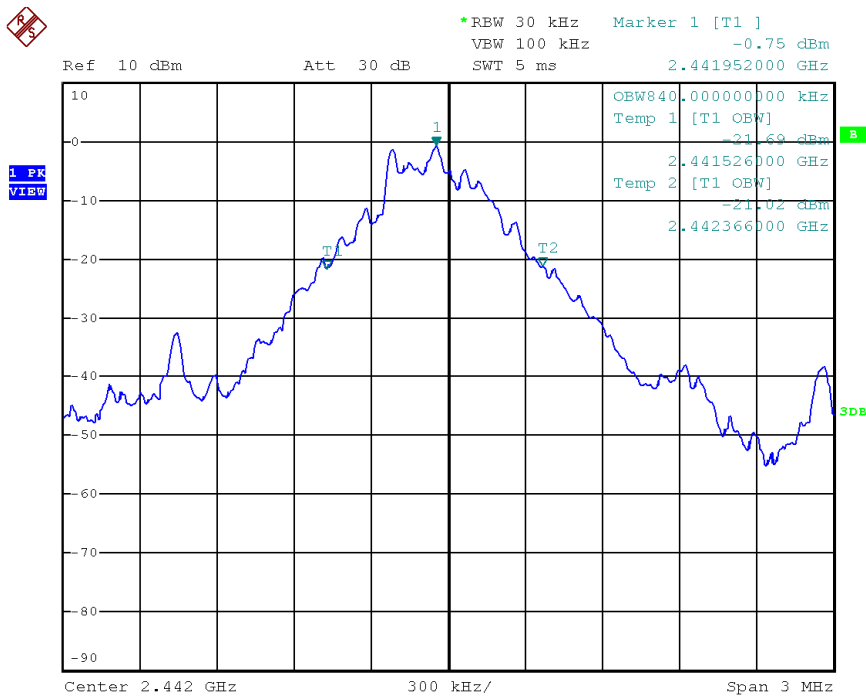
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8.5 Occupied Bandwidth

Occupied Bandwidth Results:

Bluetooth (MHz)	Occupied Bandwidth (kHz)
Low Channel: 2402	840
Middle Channel: 2442	840
High Channel: 2480	834

The worst case is shown as below



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9.0 CONFIDENTIALITY REQUEST

For electronic filing, a preliminary copy of the confidentiality request is saved with filename: request.pdf.

10.0 EQUIPMENT LIST

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Biconical Antenna	Log Periodic Antenna
Registration No.	EW-3156	EW-0954	EW-0447
Manufacturer	ROHDESCHWARZ	EMCO	EMCO
Model No.	ESR26	3104C	3146
Calibration Date	November 10, 2017	February 27, 2018	January 17, 2018
Calibration Due Date	November 10, 2018	August 27, 2019	July 17, 2019

Equipment	Active Loop H-field (9kHz to 30MHz)	12m Double Shield RF Cable (20MHz to 6GHz)	RF Cable (up to 40GHz)
Registration No.	EW-2313	EW-1852	EW-3155
Manufacturer	ELECTROMETRI	RADIALL	N/A
Model No.	EM-6876	N(m)-RG142 - N(m)	1-40 GHz
Calibration Date	March 08, 2018	January 19, 2018	January 29, 2018
Calibration Due Date	September 08, 2019	January 19, 2019	January 29, 2019

Equipment	Double Ridged Guide Antenna	Pyramidal Horn Antenna	Spectrum Analyzer
Registration No.	EW-1015	EW-0905	EW-3110
Manufacturer	EMCO	EMCO	R&S
Model No.	3115	3160-09	FSP30
Calibration Date	November 17, 2017	August 18, 2017	March 05, 2018
Calibration Due Date	May 17, 2019	February 18, 2019	March 05, 2019

Equipment	Notch Filter (cutoff frequency 2.4GHz to 2.5GHz)	Solid State Low Noise Preamplifier Assembly (1 - 18)GHz	RF Pre-amplifier (9kHz to 40GHz)
Registration No.	EW-2213	EW-3229	EW-3006
Manufacturer	MICROTRONICS	BONN ELEKTRO	SCHWARZBECK
Model No.	BRM50701-02	BLMA 0118-5G	BBV 9744
Calibration Date	May 24, 2018	January 30, 2018	April 26, 2018
Calibration Due Date	May 24, 2019	January 30, 2019	April 26, 2019

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2) Bandedge/Bandwidth Measurement

Equipment	RF Cable (up to 40GHz) 1.5m length	Spectrum Analyzer
Registration No.	EW-3104	EW-3110
Manufacturer	N/A	R&S
Model No.	SMA-M to SMA-M	FSP30
Calibration Date	July 03, 2018	March 05, 2018
Calibration Due Date	July 03, 2019	March 05, 2019

3) Conducted Emissions Test

Equipment	Artificial Mains Network	RF Cable 240cm (RG142)	EMI Test Receiver
Registration No.	EW-2501	EW-2454	EW-3156
Manufacturer	ROHDESCHWARZ	N/A	ROHDESCHWARZ
Model No.	ENV-216	bnc m st / 142 /bnc m ra 240cm	ESR26
Calibration Date	February14, 2018	March 27, 2018	November 10, 2017
Calibration Due Date	February 14, 2019	March 27, 2019	November 10, 2018

END OF TEST REPORT