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TEST REPORT

Report No.: 19051624HKG-001

KegSpeed LLC

Application For Certification
(Original Grant)

FCC ID: 2AT3Z0100

Transmitter

Prepared and Checked by:	**Approved by:**
Signed On File Wong Cheuk Ho, Herbert Lead Engineer	Digitally signed by Kenneth Wong Location: Intertek Testing Services Hong Kong Ltd. Wong Kwok Yeung, Kenneth Senior Lead Engineer Date: July 07, 2020

TEST REPORT

GENERAL INFORMATION

Grantee:	KegSpeed LLC
Grantee Address:	12500 Pluto Lane, Austin, TX 78727, USA
Contact Person:	Tim Jones
Tel:	512-832-5847
Fax:	512-832-5847
Brand Name:	KegTracker
Model:	KS01
Type of EUT:	Transmitter
Description of EUT:	Device Mounted On Keg for Ease of Searching
Serial Number:	N/A
FCC ID:	2AT3Z0100
Date of Sample Submitted:	May 30, 2019
Date of Test:	May 30, 2019 to July 07, 2020
Report No.:	19051624HKG-001
Report Date:	July 07, 2020
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 Certification.

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SUMMARY OF TEST RESULT

Test Specification	Reference	Results
Transmitter Power Line Conducted Emissions	15.207	Pass
Radiated Emission Radiated Emission on the Bandedge	15.249, 15.209	Pass
Radiated Emission in Restricted Bands	15.205	Pass

The equipment under test is found to be complying with the following standards:
FCC Part 15, October 1, 2019 Edition

Note: 1. The EUT uses a permanently attached antenna which, in accordance to section 15.203, is considered sufficient to comply with the pervisions 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) is a KegSpeed Tracking Device which is operating in the 2.4GHz ISM band. Only three frequency channels are used as declared by the applicant (2402MHz, 2426MHz and 2480MHz). The EUT is powered by 3VDC (1 X CR2450 battery).

Antenna Type: Internal, Integral

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is a single application for certification of a transmitter.

1.3 Test Methodology

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 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.

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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 new 3.0VDC (1 x 3V “CR2450” battery).

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 unit was operated standalone and placed in the center of the turntable.

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.

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.

2.5 Support Equipment List and Description

N/A.

TEST REPORT

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 dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
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 dBµV/m
RR = RA - AG - AV in dBµV
LF = CF + AF in dB

Assume a receiver reading of 52.0 dBµV 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 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 52.0 dBµV/m
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
AV = 5.0 dB
FS = RR + LF
FS = 18 + 9 = 27 dBµV/m

RR = 18.0 dBµV
LF = 9.0 dB

Level in µV/m = Common Antilogarithm [(27 dBµV/m)/20] = 22.4 µV/m

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3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 956.856 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 6.0 dB

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RADIATED EMISSIONS

Model: KS01
Date of Test: July 07, 2020
Worst-Case Operating Mode: Transmitting

Table 1
Pursuant to FCC Part 15 Section 15.249 Requirement

Lowest Channel

Polari-zation	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)
V	2402.000	68.0	33	29.4	64.4	94.0	-29.6
V	***4804.000***	***32.5***	***33***	***34.9***	***34.4***	***54.0***	***-19.6***
V	7206.000	32.3	33	37.9	37.2	54.0	-16.8
V	9608.000	29.1	33	40.4	36.5	54.0	-17.5
H	***12010.000***	***28.7***	***33***	***40.5***	***36.2***	***54.0***	***-17.8***
H	14412.000	27.2	33	40.0	34.2	54.0	-19.8

Polari-zation	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)
V	2402.000	89.8	33	29.4	86.2	114.0	-27.8
V	***4804.000***	***41.3***	***33***	***34.9***	***43.2***	***74.0***	***-30.8***
V	7206.000	40.3	33	37.9	45.2	74.0	-28.8
V	9608.000	39.2	33	40.4	46.6	74.0	-27.4
H	***12010.000***	***38.7***	***33***	***40.5***	***46.2***	***74.0***	***-27.8***
H	14412.000	39.6	33	40.0	46.6	74.0	-27.4

NOTES:
1. Peak Detector Data unless otherwise stated. Average measurement is according to ANSI C63.10 (2013)
2. All measurements were made at 3 meters.
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.
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Model: KS01
Date of Test: July 07, 2020
Worst-Case Operating Mode: Transmitting

Table 2
Pursuant to FCC Part 15 Section 15.249 Requirement

Middle Channel

Polari-zation	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)
V	2426.000	68.4	33	29.4	64.8	94.0	-29.2
V	***4852.000***	***32.3***	***33***	***34.9***	***34.2***	***54.0***	***-19.8***
V	***7278.000***	***32.5***	***33***	***37.9***	***37.4***	***54.0***	***-16.6***
V	9704.000	30.1	33	40.4	37.5	54.0	-16.5
H	***12130.000***	***28.5***	***33***	***40.5***	***36.0***	***54.0***	***-18.0***
H	14556.000	30.8	33	38.4	36.2	54.0	-17.8

Polari-zation	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)
V	2426.000	91.6	33	29.4	88.0	114.0	-26.0
V	***4852.000***	***42.3***	***33***	***34.9***	***44.2***	***74.0***	***-29.8***
V	***7278.000***	***41.3***	***33***	***37.9***	***46.2***	***74.0***	***-27.8***
V	9704.000	40.0	33	40.4	47.4	74.0	-26.6
H	***12130.000***	***38.5***	***33***	***40.5***	***46.0***	***74.0***	***-28.0***
H	14556.000	42.2	33	38.4	47.6	74.0	-26.4

NOTES:
1. Peak Detector Data unless otherwise stated. Average measurement is according to ANSI C63.10 (2013)
2. All measurements were made at 3 meters.
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.
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Model: KS01
Date of Test: July 07, 2020
Worst-Case Operating Mode: Transmitting

Table 3
Pursuant to FCC Part 15 Section 15.249 Requirement

Highest Channel

Polari-zation	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)
V	2480.000	70.0	33	29.4	66.4	94.0	-27.6
V	***4960.000***	***32.5***	***33***	***34.9***	***34.4***	***54.0***	***-19.6***
V	***7440.000***	***32.7***	***33***	***37.9***	***37.6***	***54.0***	***-16.4***
V	9920.000	30.0	33	40.4	37.4	54.0	-16.6
H	***12400.000***	***29.5***	***33***	***40.5***	***37.0***	***54.0***	***-17.0***
H	14880.000	31.8	33	38.4	37.2	54.0	-16.8

Polari-zation	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)
V	2480.000	92.4	33	29.4	88.8	114.0	-25.2
V	***4960.000***	***42.9***	***33***	***34.9***	***44.8***	***74.0***	***-29.2***
V	***7440.000***	***42.3***	***33***	***37.9***	***47.2***	***74.0***	***-26.8***
V	9920.000	40.2	33	40.4	47.6	74.0	-26.4
H	***12400.000***	***39.5***	***33***	***40.5***	***47.0***	***74.0***	***-27.0***
H	14880.000	42.1	33	38.4	47.5	74.0	-26.5

NOTES:
1. Peak Detector Data unless otherwise stated. Average measurement is according to ANSI C63.10 (2013)
2. All measurements were made at 3 meters.
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.
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Model: KS01
Date of Test: July 07, 2020
Worst-Case Operating Mode: Operating

Table 4
Pursuant to FCC Part 15 Section 15.209 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	67.656	24.0	16	8.0	16.0	40.0	-24.0
V	***112.872***	***25.5***	***16***	***14.0***	***23.5***	***43.5***	***-20.0***
V	***131.518***	***24.8***	***16***	***14.0***	***22.8***	***43.5***	***-20.7***
V	219.634	21.2	16	17.0	22.2	46.0	-23.8
H	439.010	17.8	16	26.0	27.8	46.0	-18.2
V	623.650	19.6	16	29.0	32.6	46.0	-13.4
H	956.856	23.0	16	33.0	40.0	46.0	-6.0

NOTES:
1. Quasi-Peak Detector Data unless otherwise stated.
2. All measurements were made at 3 meters.
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.
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.

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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 , whichever is the lesser attenuation, which meet the requirement of part 15.249(d).

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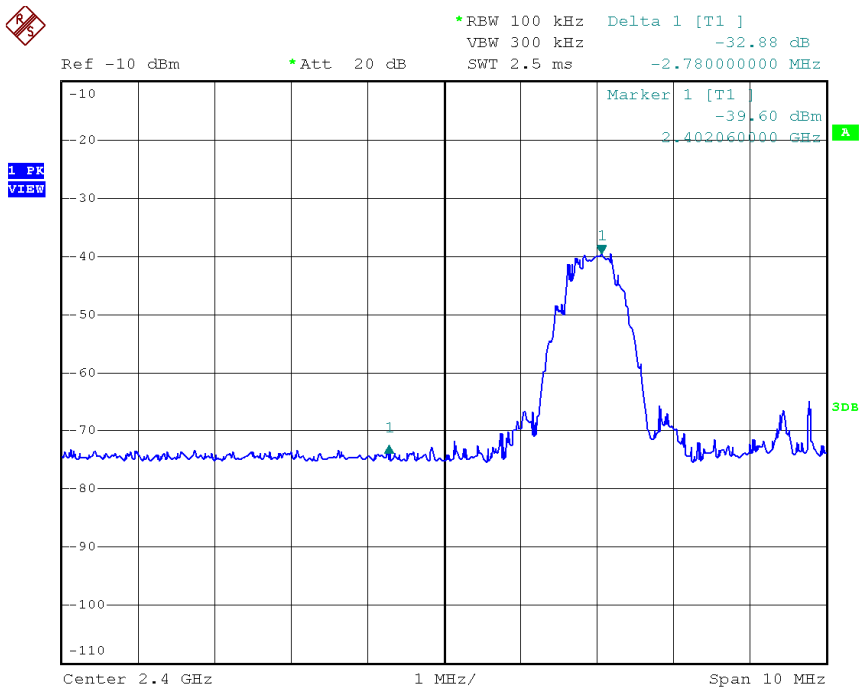
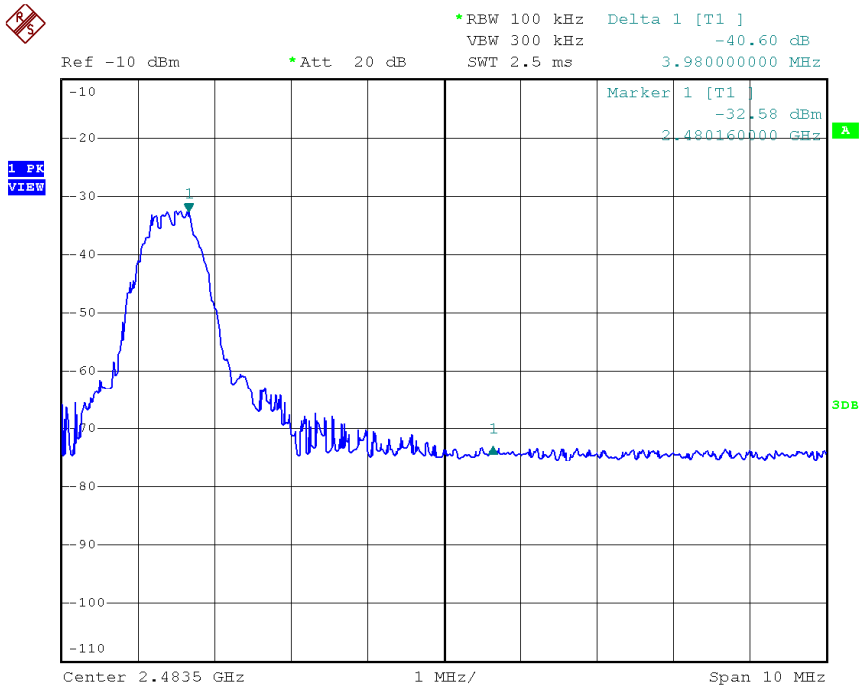
PEAK MEASUREMENT





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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

=86.2 dBµV/m – 32.9 dB
=53.3 dBµV/m

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

=64.4 dBµV/m – 32.9 dB
=31.5 dBµV/m

Upper bandedge

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

=88.8 dBµV/m – 40.6 dB
=48.2 dBµV/m

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

=66.4 dBµV/m – 40.6 dB
=25.8 dBµV/m

The resultant field strength meets the general radiated emission limit in Section 15.209, which does not exceed 74 dBµV/m (Peak Limit) and 54 dBµV/m (Average Limit).

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8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 380μs 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.

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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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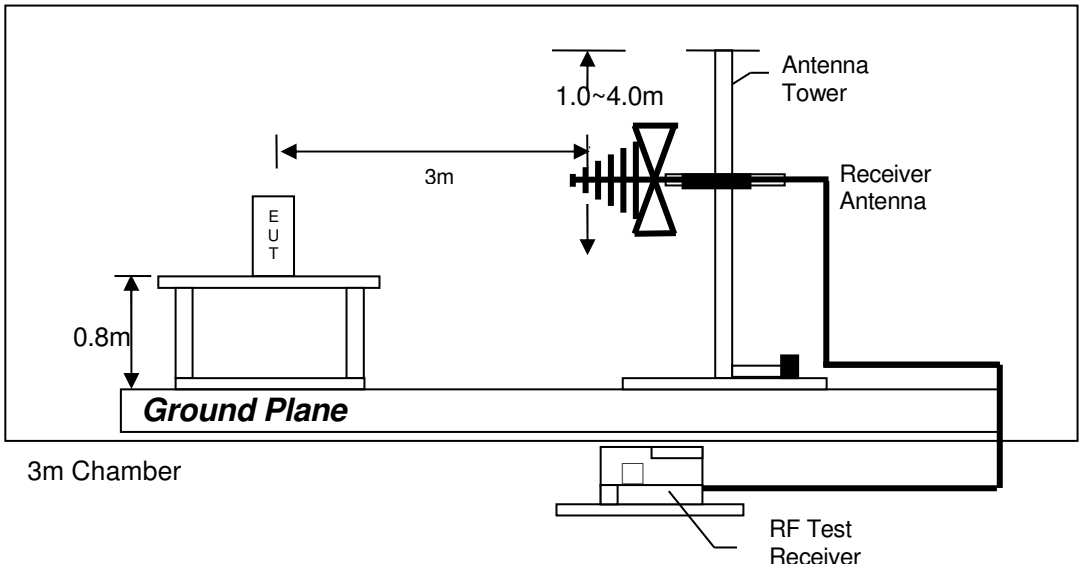
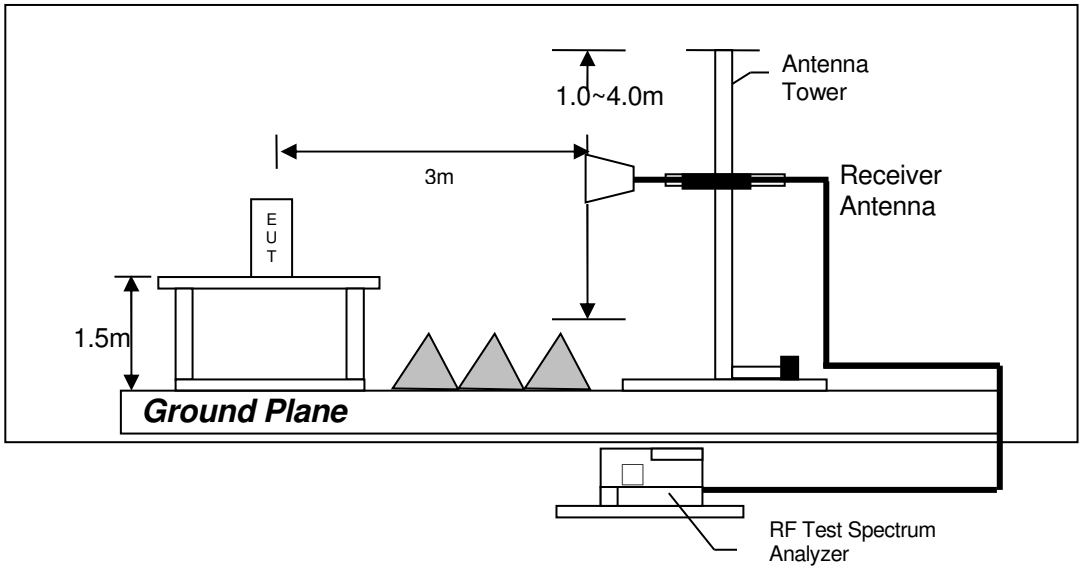
8.4.1 Radiated Emission Test Setup

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

TEST REPORT

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) 1) Radiated Emissions Test

Equipment	EMI Test Receiver	Spectrum Analyzer	Biconical Antenna
Registration No.	EW-3156	EW-2253	EW-0571
Manufacturer	R&S	ROHDESCHWARZ	EMCO
Model No.	ESR26	FSP40	3104C
Calibration Date	August 01, 2019	18 Nov 2019	July 23, 2019
Calibration Due Date	August 01, 2020	18 Nov 2020	July 23, 2021

Equipment	Log Periodic Antenna	Double Ridged Guide Antenna	14m Double Shield RF Cable (20MHz - 6GHz)
Registration No.	EW-0447	EW-1015	EW-2528
Manufacturer	EMCO	EMCO	RADIALL
Model No.	3146	3115	Nm-RG142-
Calibration Date	September 25, 2019	16 May 2019	30 Sep 2019
Calibration Due Date	March 25, 2021	16 Nov 2020	30 Sep 2020

Equipment	Active Loop H-field (9kHz to 30MHz)	RF Preamplifier (9kHz to 6000MHz)	Pyramidal Horn Antenna
Registration No.	EW-3326	EW-3424	EW-0905
Manufacturer	EMCO	SCHWARZBECK	EMCO
Model No.	6502	BBV9744	3160-09
Calibration Date	March 21, 2019	July 23, 2019	July 23, 2019
Calibration Due Date	September 21, 2020	July 23, 2020	January 23, 2021

Equipment	RF Cable 14m (1GHz to 26.5GHz)
Registration No.	EW-3151
Manufacturer	GREATBILLION
Model No.	SMA m/SHF5MPU /SMA m ra14m,26G
Calibration Date	March 04, 2020
Calibration Due Date	March 04, 2021

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2) Bandedge Measurement

Equipment	RF Cable (up to 40GHz) 1.5m length	Spectrum Analyzer
Registration No.	EW-3104	EW-2253
Manufacturer	NOSUPPLIER	ROHDESCHWARZ
Model No.	SMA-M to SMA-M	FSP40
Calibration Date	August 26, 2019	18 Nov 2019
Calibration Due Date	August 26, 2020	18 Nov 2020

END OF TEST REPORT