

TEST REPORT

Report No.: 18040975HKG-003

MGA Entertainment (HK) Ltd.

Application For Certification
(Original Grant)

FCC ID: LU9646997RX

Transceiver

Prepared and Checked by:

Approved by:

Signed On File

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Date: May 02, 2018

TEST REPORT

GENERAL INFORMATION

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Manufacturer:	MGA Entertainment (HK) Ltd.
Manufacturer Address:	6th Floor, YHC Tower, 1 Sheung Yuet Road, Kowloon Bay, Kowloon, Hong Kong.
Brand Name:	646997 RC Dozer Racer
Model:	646997
Additional Model:	646997E4C
Type of EUT:	Transceiver
Description of EUT:	646997 RC Dozer Racer
Serial Number:	N/A
FCC ID:	LU9646997RX
Date of Sample Submitted:	April 18, 2018
Date of Test:	April 18, 2018 to April 25, 2018
Report No.:	18040975HKG-003
Report Date:	May 02, 2018
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%

TEST REPORT**SUMMARY OF TEST RESULT**

Test Specification	Reference	Results
Radiated Emission	15.249, 15.209	Pass
Radiated Emission on the Bandedge		
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, 2016 Edition

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 expected variations in temperature and supply voltage were considered.

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TEST REPORT

1.0 GENERAL DESCRIPTION

1.1 Product Description

The Equipment Under Test (EUT) operates at frequency range of 2420MHz to 2465MHz, with the following 25 channels used: 2420MHz, 2422MHz, 2424MHz, 2426MHz, 2428MHz, 2430MHz, 2431MHz, 2433MHz, 2435MHz, 2437MHz, 2439MHz, 2441MHz, 2443MHz, 2445MHz, 2446MHz, 2447MHz, 2449MHz, 2451MHz, 2453MHz, 2455MHz, 2457MHz, 2459MHz, 2461MHz, 2463MHz and 2465MHz. The EUT is power by 4 x 1.5V AA batteries. After switch on the EUT, model: 646997, the car will be moved forward or backward, turned left or right based on the switch pressed in the controller. The car shape can also be changed by the different switch pressed in controller.

The Model: 646997E4C is the same as the Model: 646997 in hardware aspect. The difference in model number serves as marketing strategy. The models are different in packaging only.

Antenna Type: Internal, Integral

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

1.2 Related Submittal(s) Grants

The Certification procedure of this EUT's (Car) corresponding transceiver (Controller with FCC ID: LU9646997TX) is being processed as the same time of this application.

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 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.

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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 DC 6.0V (4 x 1.5V AA batteries).

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

There was no special software to exercise the device. Once the unit is powered up, it transmits the RF signal continuously.

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.

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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 $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

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 $\text{dB}\mu\text{V}/\text{m}$

RR = RA - AG - AV in $\text{dB}\mu\text{V}$

LF = CF + AF in dB

Assume a receiver reading of 52.0 $\text{dB}\mu\text{V}$ 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 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

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

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

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

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

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

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

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

$$FS = RR + LF$$

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

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

TEST REPORT**3.2 Radiated Emission Configuration Photograph**

The worst case in radiated emission was found at 4930 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 12.3 dB

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RADIATED EMISSIONS

Model: 646997

Date of Test: April 25, 2018

Worst-Case Operating Mode: Transmitting

Table 1
Pursuant to FCC Part 15 Section 15.249 Requirement

Lowest Channel

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
H	2420.000	87.3	33	29.4	83.7	21.7	62.0	94.0	-32.0
H	2400.000	55.7	33	29.4	52.1	21.7	30.4	54.0	-23.6
H	4840.000	58.3	33	34.9	60.2	21.7	38.5	54.0	-15.5
H	7260.000	41.6	33	37.9	46.5	21.7	24.8	54.0	-29.2
V	9680.000	42.3	33	40.4	49.7	21.7	28.0	54.0	-26.0
V	12100.000	43.9	33	40.5	51.4	21.7	29.7	54.0	-24.3
V	14520.000	47.2	33	38.4	52.6	21.7	30.9	54.0	-23.1

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
H	2420.000	87.3	33	29.4	83.7	114.0	-30.3
H	2400.000	55.7	33	29.4	52.1	74.0	-21.9
H	4840.000	58.3	33	34.9	60.2	74.0	-13.8
H	7260.000	41.6	33	37.9	46.5	74.0	-27.5
V	9680.000	42.3	33	40.4	49.7	74.0	-24.3
V	12100.000	43.9	33	40.5	51.4	74.0	-22.6
V	14520.000	47.2	33	38.4	52.6	74.0	-21.4

NOTES: 1. 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.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

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Model: 646997

Date of Test: April 25, 2018

Worst-Case Operating Mode: Transmitting

Table 2
Pursuant to FCC Part 15 Section 15.249 Requirement

Middle Channel

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
H	2447.000	87.9	33	29.4	84.3	21.7	62.6	94.0	-31.4
V	4894.000	58.9	33	34.9	60.8	21.7	39.1	54.0	-14.9
V	7341.000	42.4	33	37.9	47.3	21.7	25.6	54.0	-28.4
H	9788.000	41.1	33	40.4	48.5	21.7	26.8	54.0	-27.2
V	12235.000	44.1	33	40.5	51.6	21.7	29.9	54.0	-24.1
H	14682.000	47.0	33	38.4	52.4	21.7	30.7	54.0	-23.3

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
H	2447.000	87.9	33	29.4	84.3	114.0	-29.7
V	4894.000	58.9	33	34.9	60.8	74.0	-13.2
V	7341.000	42.4	33	37.9	47.3	74.0	-26.7
H	9788.000	41.1	33	40.4	48.5	74.0	-25.5
V	12235.000	44.1	33	40.5	51.6	74.0	-22.4
H	14682.000	47.0	33	38.4	52.4	74.0	-21.6

NOTES: 1. 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.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

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Model: 646997

Date of Test: April 25, 2018

Worst-Case Operating Mode: Transmitting

Table 3
Pursuant to FCC Part 15 Section 15.249 Requirement

Highest Channel

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Average Factor (dB)	Calculated at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
H	2465.000	88.4	33	29.4	84.8	21.7	63.1	94.0	-30.9
H	2483.500	56.0	33	29.4	52.4	21.7	30.7	54.0	-23.3
H	4930.000	59.8	33	34.9	61.7	21.7	40.0	54.0	-14.0
H	7395.000	43.1	33	37.9	48.0	21.7	26.3	54.0	-27.7
V	9860.000	42.0	33	40.4	49.4	21.7	27.7	54.0	-26.3
V	12325.000	43.8	33	40.5	51.3	21.7	29.6	54.0	-24.4
H	14790.000	47.2	33	38.4	52.6	21.7	30.9	54.0	-23.1

Polarization	Frequency (MHz)	Reading (dB μ V)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dB μ V/m)	Peak Limit at 3m (dB μ V/m)	Margin (dB)
H	2465.000	88.4	33	29.4	84.8	114.0	-29.2
H	2483.500	56.0	33	29.4	52.4	74.0	-21.6
H	4930.000	59.8	33	34.9	61.7	74.0	-12.3
H	7395.000	43.1	33	37.9	48.0	74.0	-26.0
V	9860.000	42.0	33	40.4	49.4	74.0	-24.6
V	12325.000	43.8	33	40.5	51.3	74.0	-22.7
H	14790.000	47.2	33	38.4	52.6	74.0	-21.4

NOTES: 1. 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.
6. Measurement Uncertainty is ± 5.3 dB 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.

TEST REPORT**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).

TEST REPORT**PEAK MEASUREMENT**

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

8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 0.412ms for a digital “1” bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

8.3 Calculation of Average Factor

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 100 ms

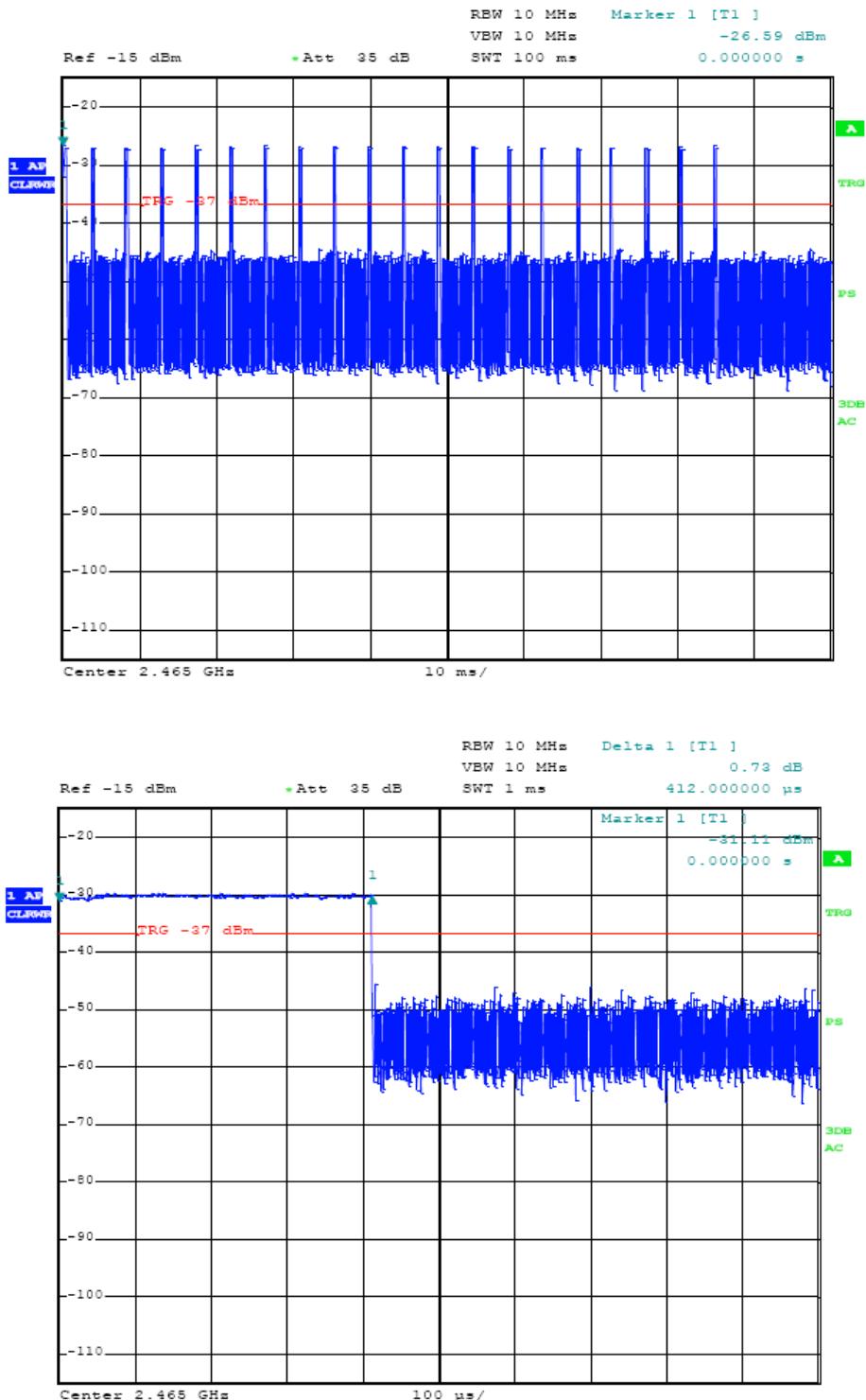
Effective period of the cycle = $20 * 0.412 = 8.24$ ms

$DC = 8.24 / 100 = 0.0824$

Therefore, the averaging factor is found by $20\log 0.0824 = -21.7$ dB.

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AVERAGE FACTOR



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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.

TEST REPORT**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).

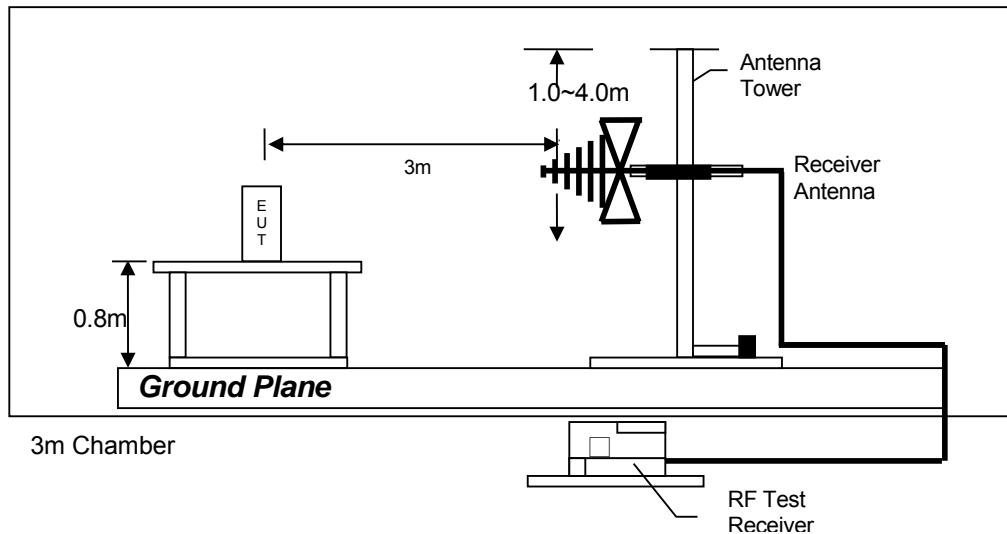
The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion 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.

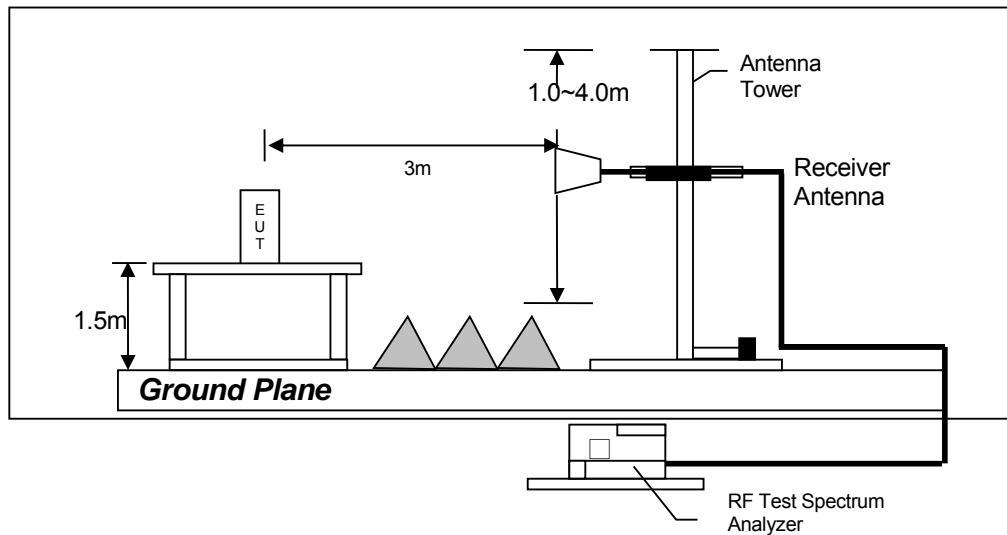
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8.4.1 Radiated Emission Test Setup

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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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	Log Periodic Antenna	Biconical Antenna
Registration No.	EW-3156	EW-1042	EW-2512
Manufacturer	R&S	EMCO	EMCO
Model No.	ESCI	3146	3104C
Calibration Date	November 10, 2017	June 19, 2017	November 16, 2016
Calibration Due Date	November 10, 2018	December 19, 2019	May 16, 2018

Equipment	Double Ridged Guide Antenna	14m Double Shield Rf Cable (20MHz To 6GHz)	Rf Cable 14m (1GHz To 26.5GHz)
Registration No.	EW-1133	EW-2505	EW-2781
Manufacturer	EMCO	RADIALL	GREATBILLION
Model No.	3115	nm / br5d / sma 14m	SMA m/SHF5MPU /SMA m ra14m,26G
Calibration Date	May 24, 2018	October 30, 2017	September 25, 2017
Calibration Due Date	November 24, 2018	October 30, 2018	September 25, 2018

Equipment	Solid State Low Noise Preamplifier Assembly (1 - 18)GHz
Registration No.	EW-3229
Manufacturer	BONN ELEKTRO
Model No.	BLMA 0118-5G
Calibration Date	January 30, 2018
Calibration Due Date	January 30, 2019

2) Bandedge Measurement

Equipment	Spectrum Analyzer
Registration No.	EW-2329
Manufacturer	R&S
Model No.	FSP3
Calibration Date	September 28, 2017
Calibration Due Date	September 28, 2018

END OF TEST REPORT