

TEST REPORT

Report No.: 17061917HKG-003

FLIR Commercial Systems, Inc.

Application For Certification
(Original Grant)

FCC ID: IWK-RH200W-T

IC: 1590A-RH200WT

Transmitter

PREPARED AND CHECKED BY:

APPROVED BY:

Signed On File
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Date: October 26, 2017

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TEST REPORT

GENERAL INFORMATION

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Manufacturer:	CCL Electronics Ltd.
Manufacturer Address:	Unit 1-3, 9/F., Wang Lung Industrial Building, 11 Lung Tak Street, Tsuen Wan, Hong Kong.
Brand Name:	FLIR Systems, Inc.
Model / HVIN:	RH200W-T
PMN:	RH200W-T
Type of EUT:	Transmitter
Description of EUT:	Wireless Hygro-Thermometer Transmitter
Serial Number:	N/A
FCC ID / IC:	IWK-RH200W-T / 1590A-RH200WT
Date of Sample Submitted:	June 27, 2017
Date of Test:	June 27, 2017 to October 25, 2017
Report No.:	17061917HKG-003
Report Date:	October 26, 2017
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%

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SUMMARY OF TEST RESULT

TEST SPECIFICATION	REFERENCE	RESULTS
Transmitter Field Strength, Bandwidth and Timing Requirement	15.231(e) / RSS-210 A1.1.5	Pass

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

FCC Part 15, October 1, 2016 Edition

RSS-210 Issue 9, August 2016

RSS-Gen Issue 4, November 2014

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) is a transmitter for Remote door bell operating at 433MHz which is operated by a crystal. The EUT is powered by 1 x 3.0V (2 x AA batteries). Each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

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 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 new 3.0VDC (2 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 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 27 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 433.918 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 3.0 dB

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RADIATED EMISSIONS

Model: RH200W-T

Date of Test: October 25, 2017

Worst-Case Operating Mode: Transmitting

Table 1
Pursuant to FCC Part 15 Section 15.231e / RSS-210 A1.1.5 Requirement

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp (dB)	Antenna factor (dB)	Average Factor (dB)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	433.918	68.0	16	25.0	7.1	69.9	72.9	-3.0
V	867.836	21.2	16	31.0	7.1	29.1	52.9	-23.8
H	1301.754	40.0	33	26.1	7.1	26.0	54.0	-28.0
H	1735.672	41.3	33	27.2	7.1	28.4	52.9	-24.5
V	2169.590	38.9	33	29.4	7.1	28.2	52.9	-24.7
H	2603.508	37.4	33	30.4	7.1	27.7	52.9	-25.2
H	3037.426	36.8	33	31.9	7.1	28.6	52.9	-24.3
H	3471.344	35.1	33	31.9	7.1	26.9	52.9	-26.0
H	3905.262	33.9	33	33.3	7.1	27.1	54.0	-26.9
V	4339.180	30.5	33	34.8	7.1	25.2	54.0	-28.8

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)
V	433.918	68.0	16	25.0	77.0	92.9	-15.9
V	867.836	21.2	16	31.0	36.2	72.9	-36.7
H	1301.754	40.0	33	26.1	33.1	74.0	-40.9
H	1735.672	41.3	33	27.2	35.5	72.9	-37.4
V	2169.590	38.9	33	29.4	35.3	72.9	-37.6
H	2603.508	37.4	33	30.4	34.8	72.9	-38.1
H	3037.426	36.8	33	31.9	35.7	72.9	-37.2
H	3471.344	35.1	33	31.9	34.0	72.9	-38.9
H	3905.262	33.9	33	33.3	34.2	74.0	-39.8
V	4339.180	30.5	33	34.8	32.3	74.0	-41.7

- 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. 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.
 5. 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 and Canada.

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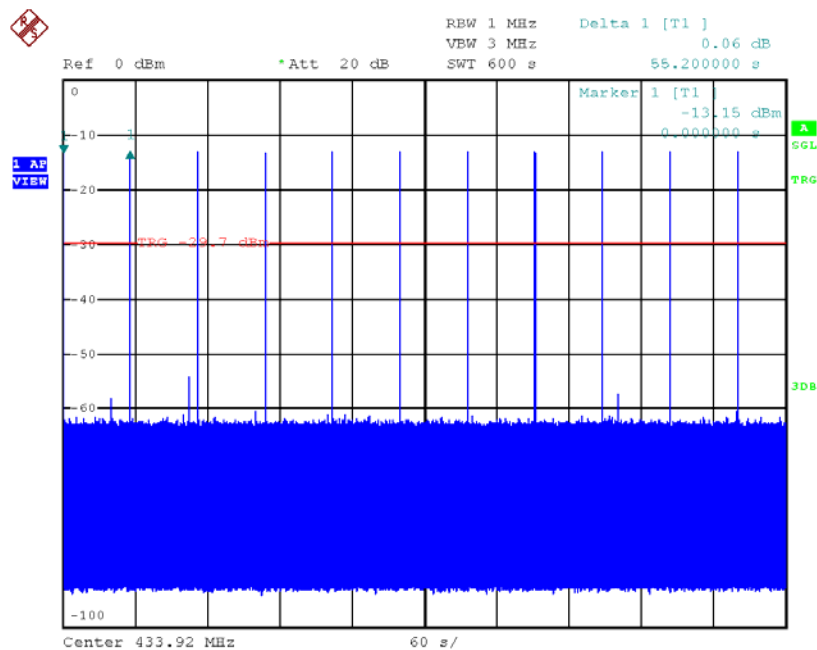
8.0 MISCELLANEOUS INFORMATION

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).

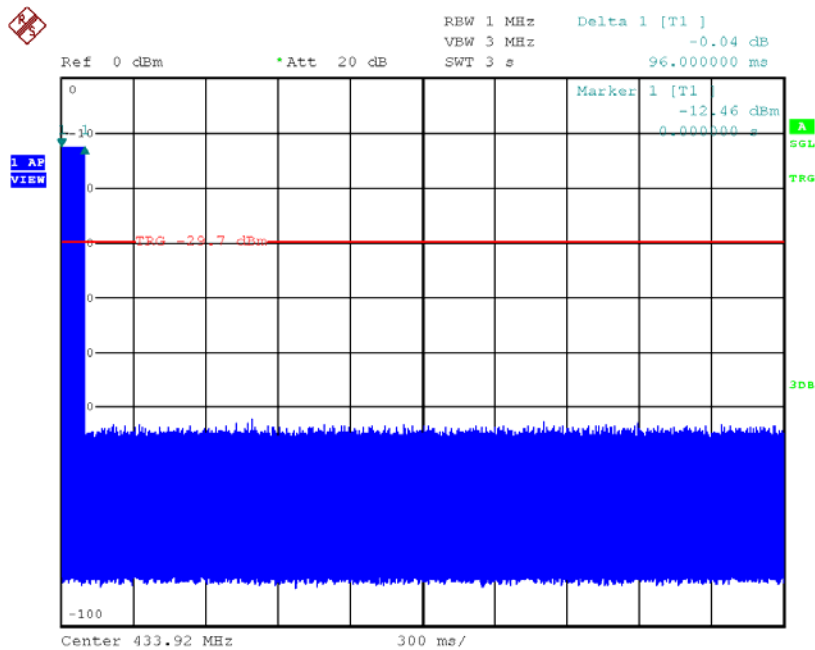
Timing Plot - Pursuant to FCC Part 15 Section 15.231(e) - In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Result:

- 1) Each transmission shall not be greater than one second (Pass)
- 2) Silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds. (Pass)

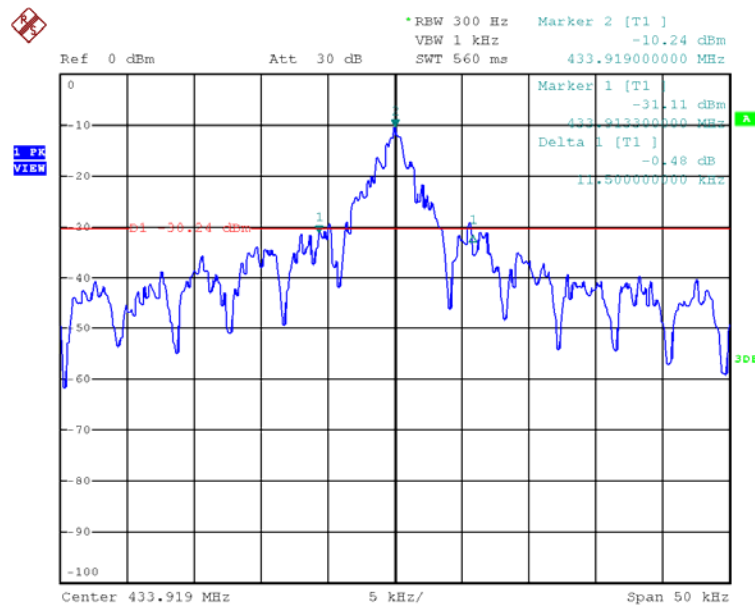


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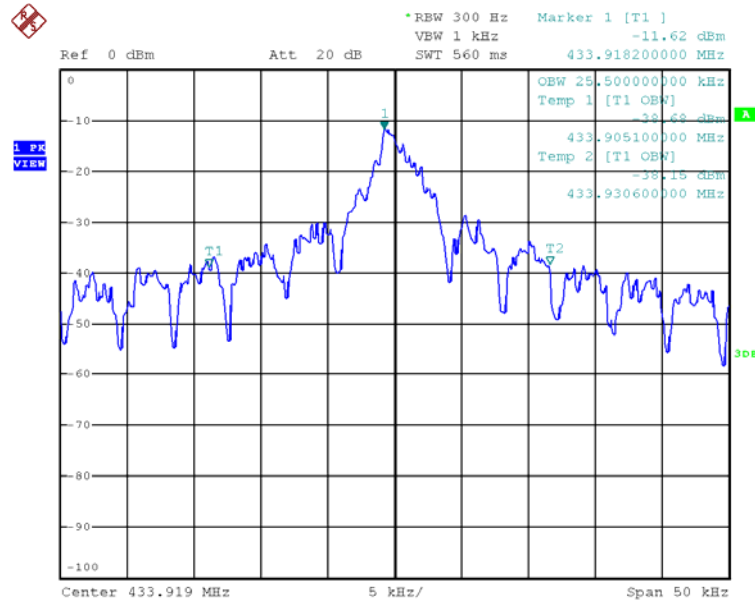
8.1 Measured Bandwidth

For FCC, the plot shows the fundamental emission when modulated. From the plot, the bandwidth is observed to be 11.5kHz, at 20dBc where the bandwidth limit is 1082.5kHz.



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For IC, The 99% bandwidth of momentarily operated devices shall be less or equal to 0.25% of the centre frequency for devices operating between 70MHz and 900MHz. From the plot, the bandwidth is observed to be 25.5kHz, at 99% bandwidth limit is 1082.5kHz.



8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 44.1ms 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 = 100ms

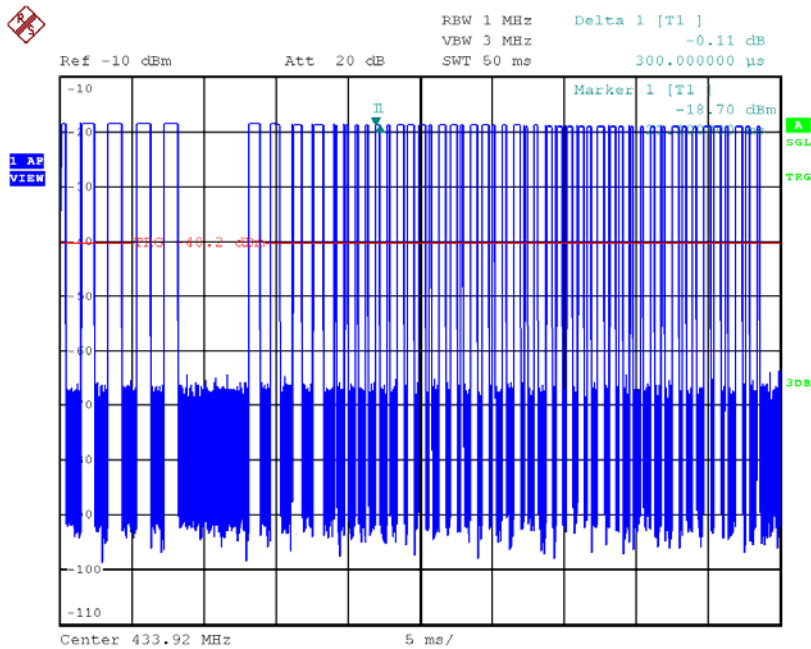
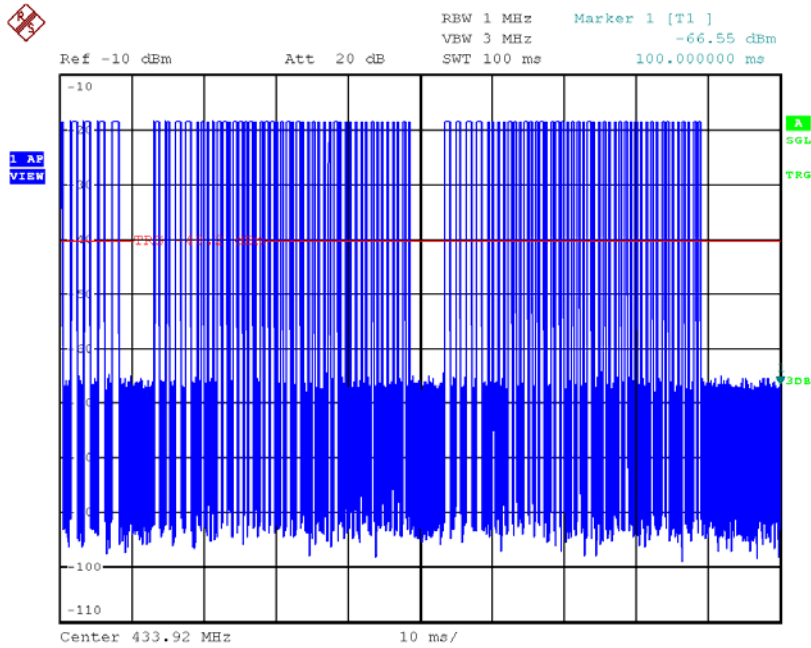
Effective period of the cycle = $(0.3\text{ms} \times 23 + 0.5\text{ms} \times 18 + 1\text{ms} \times 4) \times 2 + 0.3\text{ms} \times 1 + 1\text{ms} \times 4 = 44.1\text{ms}$

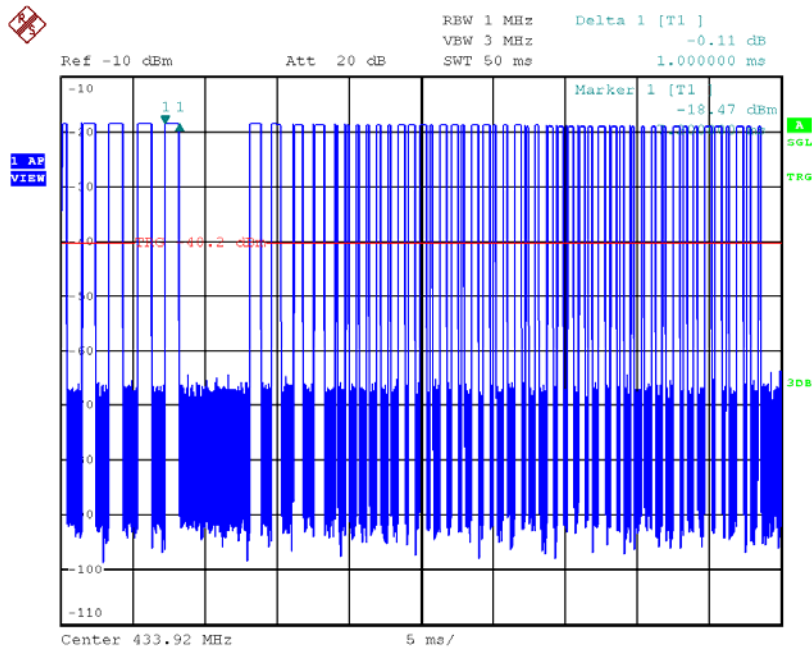
$DC = 44.1 / (44.1/100) = 0.441$

Therefore, the averaging factor is found by $20\log 0.441 = -7.1 \text{ dB}$

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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.

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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).

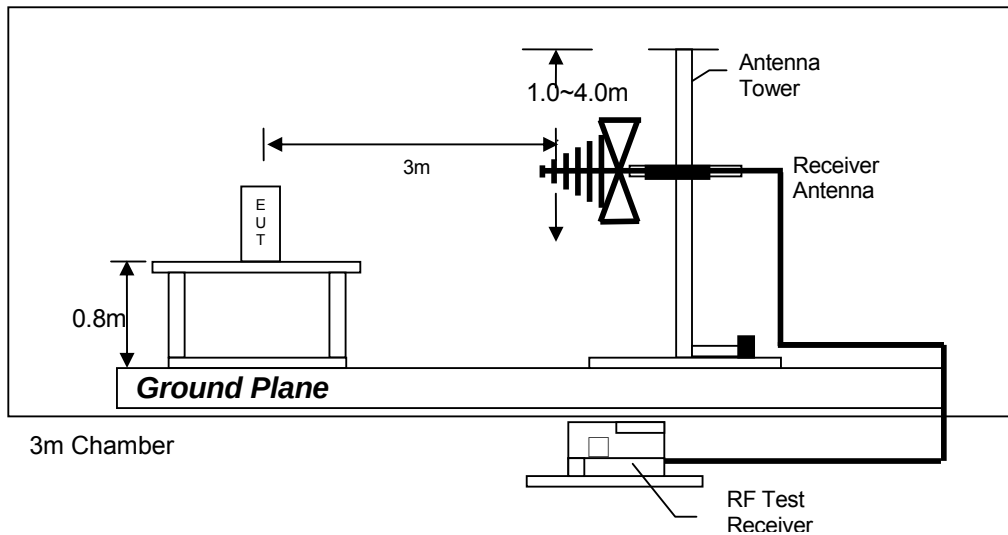
The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion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

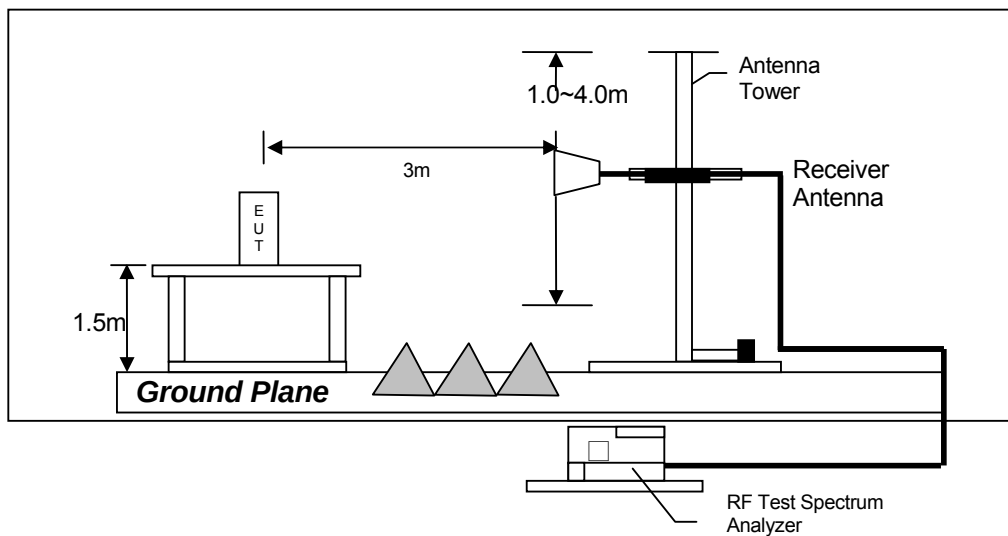
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8.4.1 Radiated Emission Test Setup

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

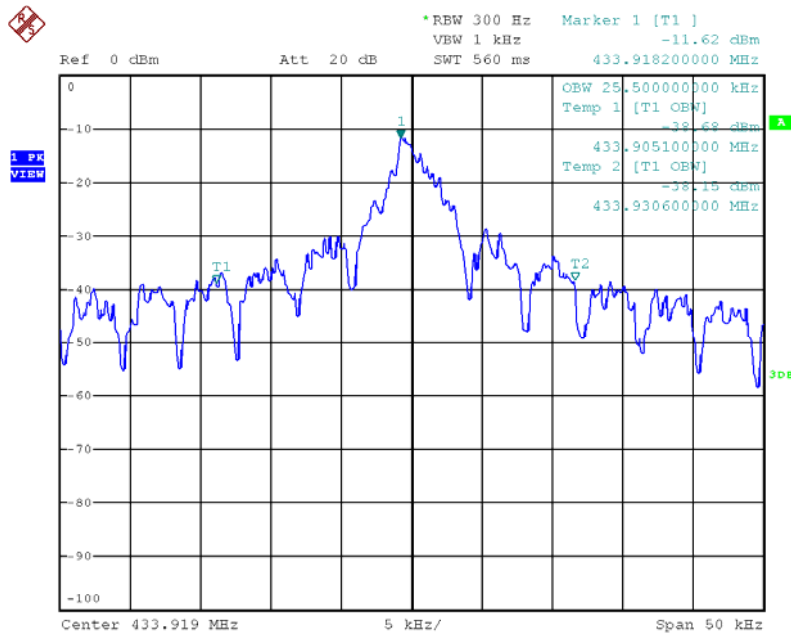
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8.5 Occupied Bandwidth

Occupied Bandwidth Results:

Frequency (MHz)	Occupied Bandwidth (kHz)
433MHz	25.50

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	SPECTRUM ANALYZER	LOG PERIODIC ANTENNA
Registration No.	EW-3156	EW-3281	EW-0447
Manufacturer	R&S	R&S	EMCO
Model No.	ESR26	FSV40	3146
Calibration Date	Dec. 06, 2016	Dec. 19, 2016	May 18, 2016
Calibration Due Date	Dec. 06, 2017	Dec. 19, 2017	Nov. 18, 2017

EQUIPMENT	BICONICAL ANTENNA	DOUBLE RIDGED GUIDE ANTENNA	PYRAMIDAL HORN ANTENNA
Registration No.	EW-0571	EW-0194	EW-0905
Manufacturer	EMCO	EMCO	EMCO
Model No.	3104C	3115	3160-09
Calibration Date	May 18, 2016	Aug. 10, 2016	Feb. 12, 2016
Calibration Due Date	Nov. 18, 2017	Feb. 10, 2018	Aug. 12, 2017

EQUIPMENT	14m RF Cable (1GHz to 26.5GHz)	12m Double Shield RF Cable	RF Cable (up to 40GHz)
Registration No.	EW-2781	EW-2074	EW-3155
Manufacturer	GREATBILLION	RADIALL	N/A
Model No.	SMA	N(m)-RG142	1-40 GHz
Calibration Date	Sept. 25, 2017	Jan. 20, 2017	Dec. 05, 2016
Calibration Due Date	Sept. 25, 2018	Dec. 07, 2017	Dec. 05, 2017

EQUIPMENT	RF Pre-amplifier 3 pcs (9kHz to 40GHz)
Registration No.	EW-3006c
Manufacturer	SCHWARZBECK
Model No.	BBV 9718
Calibration Date	23-Mar-2017
Calibration Due Date	23-Mar-2018

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10.0 EQUIPMENT LIST (Cont'd)

2) Bandedge Measurement

EQUIPMENT	Spectrum Analyzer
Registration No.	EW-2249
Manufacturer	R&S
Model No.	FSP30
Calibration Date	Dec. 23, 2016
Calibration Due Date	Nov, 27. 2017

END OF TEST REPORT