Issuing Laboratory:
Intertek Testing Services Hong Kong Limited

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HOKLAS 005
TEST

TEST REPORT

Report Number: 15050764HKG-001

Application
for
Original Grant of 47 CFR Part 15 Certification

Room Sensor Unit

FCC ID: VSMWT830TC15

Prepared and Checked by:

Signed on file

Josie Yao
Engineer

Approved by:

Koo Wai Ip
Assistant Supervisor
July 07, 2015

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GENERAL INFORMATION

Applicant Name:	World Excel Company Ltd.
Applicant Address:	Room B, 26/F., Capital Trade Centre, 62 Tsun Yip Street, Hong Kong
FCC Specification Standard:	FCC Part 15, October 1, 2013 Edition
FCC ID:	VSMWT830TC15
FCC Model(s):	WT830/TC
Type of EUT:	Digital Transmission System
Description of EUT:	Room Sensor Unit
Serial Number:	N/A
Sample Receipt Date:	May 14, 2015
Date of Test:	May 14, 2015 to May 26, 2015
Report Date:	July 07, 2015
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%

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2/F., Garment Centre, 576 Castle Peak Road, Kowloon, Hong Kong.
Tel: (852) 2173 8888 Fax: (852) 2785 5487 Website: www.hk.intertek-etlsemko.com

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EXHIBIT 1
SUMMARY OF TEST RESULTS & STATEMENT OF COMPLIANCE

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1.0 Summary of Test Results

Test Items	FCC Part 15 Section	Results	Details see section
Antenna Requirement	15.203	Pass	2.1
Max. Conducted Output Power (peak)	15.247(b)(3)&(4)	Pass	4.1
Min. 6dB RF Bandwidth	15.247(a)(2)	Pass	4.2
Max. Power Density (peak)	15.247(e)	Pass	4.3
Out of Band Antenna Conducted Emission	15.247(d)	Pass	4.4
Radiated Emission in Restricted Bands and Spurious Emissions	15.247(d), 15.209 & 15.109	Pass	4.6
AC Power Line Conducted Emission	15.207 & 15.107	NA	4.7

Note: Pursuant to FCC Part 15 Section 15.215(c), the 20dB 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.

1.1 Statement of Compliance

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

FCC Part 15, October 1, 2013 Edition

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EXHIBIT 2
GENERAL DESCRIPTION

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2.0 General Description

2.1 Product Description

The WT830/TC is a Room Sensor Unit. It operates at frequency range of 918MHz to 924MHz with 25 channels. It is powered on by 3.0VDC (2 x 1.5 AAA Batteries). The EUT can be communicated with the Zone Output Unit (ZN020/TC). In OFF mode, zone damper will be off and the EUT only display room temperature. In ON mode, the EUT display the set point value at the top left corner. User can press up/ down to change set point. The EUT can also enter Internal Setting mode, add/drop mode by pressing the relating button by following the User Manual.

The antenna(s) used in the EUT is Integral.

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

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2.2 Test Methodology

Both AC power line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (2009). Preliminary radiated scans and all radiated measurements were performed in Open Area Test Sites. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application. Antenna port conducted measurements were performed according to ANSI C63.10 (2009) and KDB Publication No. 558074 D01 v03r03 (09-June-2015).

2.3 Test Facility

The open area test site, AC Power Line conducted measurement facility, and antenna port conducted measurement facility used to collect the radiated data, AC Power Line conducted data, and conductive data are at Intertek Testing Services Hong Kong Ltd., which is located at World-Wide Industrial Centre 43-47 Shan Mei Street, Fo Tan ShaTin, New Territories, Hong Kong. This test facility and site measurement data have been fully placed on file with the FCC.

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EXHIBIT 3
SYSTEM TEST CONFIGURATION

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3.0 System Test Configuration

3.1 Justification

For radiated emissions testing, the equipment under test (EUT) was setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, all cables (if any) were manipulated to produce worst case emissions.

The EUT is power by 3.0 VDC (2 x 1.5 AAA Batteries).

For the measurements, the EUT was attached to a plastic stand if necessary and placed on the wooden turntable. If the EUT attached to peripherals, they were connected and operational (as typical as possible).

The signal was maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization were varied during the search for maximum signal level. The antenna height was varied from 1 to 4 meters. Radiated emissions were taken at three meters unless the signal level was too low for measurement at that distance. If necessary, a pre-amplifier was used and/or the test was conducted at a closer distance.

For any intentional radiator powered by AC power line, measurements of the radiated signal level of the fundamental frequency component of the emission was performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

Radiated emission measurement for transmitter were performed 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 to 40 GHz, whichever is lower.

Emission that are directly caused by digital circuits in the transmit path and transmitter portion were measured, and the limit are according to FCC Part 15 Section 15.209. Digital circuitries used to control additional functions other than the operation of the transmitter are subject to FCC Part 15 Section 15.109 Limits.

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3.1 Justification – Cont'd

Detector function for radiated emissions was in peak mode. Average readings, when required, were 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 section 4.2.3.

Determination of pulse desensitization was made according to *Hewlett Packard Application Note 150-2, Spectrum Analysis... Pulsed RF.* The effective period (Teff) was referred to Exhibit 4.6.3. With the resolution bandwidth 1MHz and spectrum analyzer IF bandwidth 3dB, the pulse desensitization factor was 0dB.

The EUT along with its peripherals were placed on a 1.0m(W)x1.5m(L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. The EUT power cord connected to one LISN (Line impedance stabilization network), which provided 50ohm coupling impedance for measuring instrument. Meanwhile, the peripheral or support equipment power cords connected to a separate LISN. The ac powers for all LISNs were obtained from the same power source. The LISN housing, measuring instrument case, reference ground plane, and vertical ground plane were bounded together. The excess power cable between the EUT and the LISN was bundled. Power cords of non-EUT equipment (peripherals) were not bundled. AC power cords of peripheral equipments draped over the rear edge of the table, and routed them down onto the floor of the ac power line conducted emission test site to the second LISN.

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

Different data rates have been tested. Worst case is reported only.

All relevant operation modes have been tested, and the worst case data is included in this report.

3.2 EUT Exercising Software

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

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3.3 Details of EUT and Description of Accessories

N/A

3.4 Measurement Uncertainty

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

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EXHIBIT 4
TEST RESULTS

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4.0 Test Results

4.1 Maximum Conducted (peak) Output Power at Antenna Terminals

The antenna port of the EUT was connected to the input of a spectrum analyzer.

☒ The antenna power of the EUT was connected to the input of a spectrum analyzer.
Power was read directly and cable loss correction was added to the reading to the obtain power at the EUT antenna terminals. The measurement procedure 9.1.1 was used.

☐ The EUT should be configured to transmit continuously (at a minimum duty cycle of 98%) at full power over the measurement duration. The measurement procedure AVG1 was used.

Antenna Gain = 0 dBi			
Frequency (MHz)		Output in dBm	Output in mWatt
Low Channel:	918	6.43	4.397
High Channel:	924	6.54	4.509

Cable loss : 0.5 dB

Cable loss, external attenuation: ☒ included in OFFSET function
☐ added to SA raw reading

max. conducted (peak) output level = 6.54 dBm

Maximum antenna gain = 0 dBi

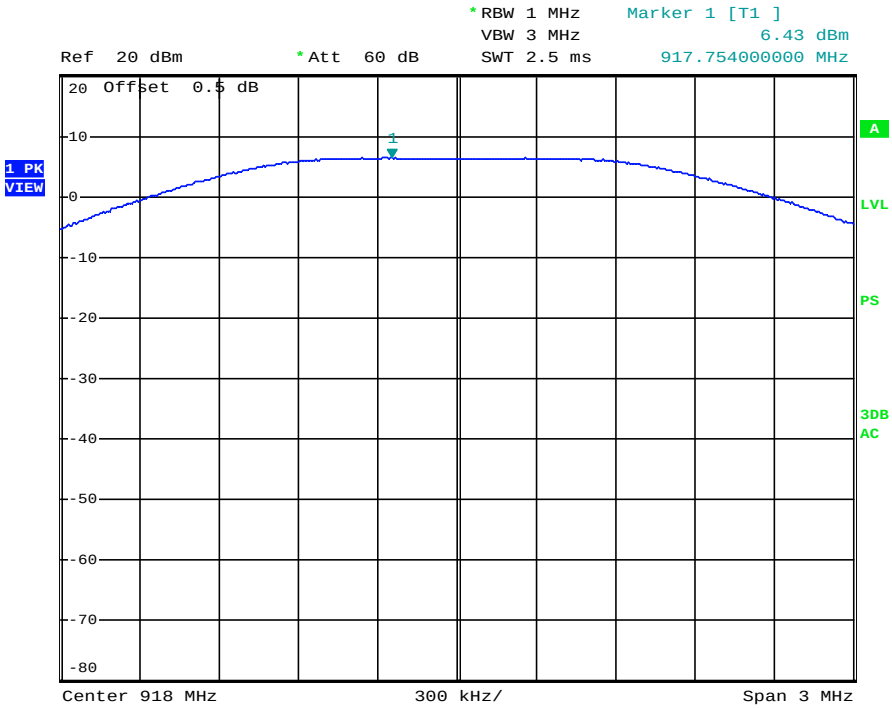
Limits:
☒ 1W (30dBm) for antennas with gains of 6dBi or less

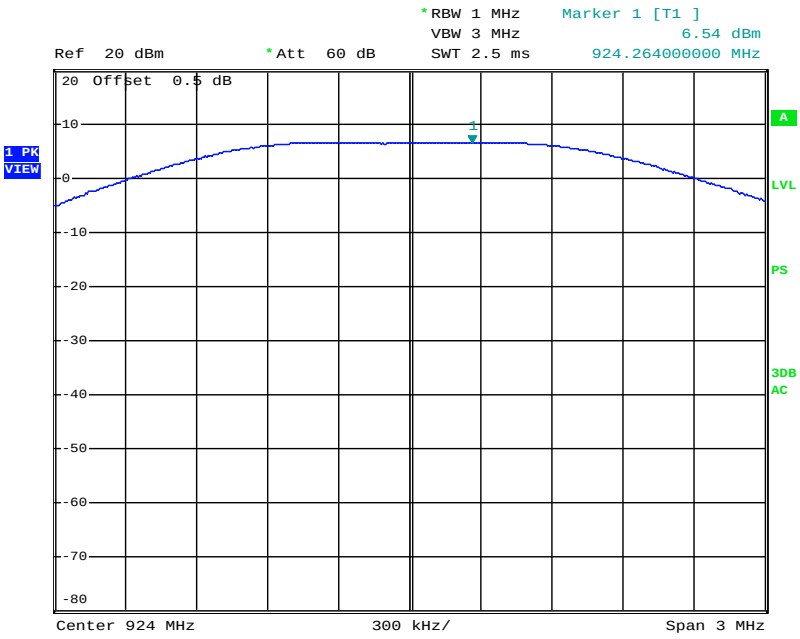
☐ ___W (___dBm) for antennas with gains more than 6dBi

The plots of conducted output power are saved as below.

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Plots of maximum output power





Date: 28.MAY.2015 06:49:33

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4.2 Minimum 6dB RF Bandwidth

The antenna port of the EUT was connected to the input of a spectrum analyzer. The EBW measurement procedure was used. A PEAK output reading was taken, a DISPLAY line was drawn 6dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

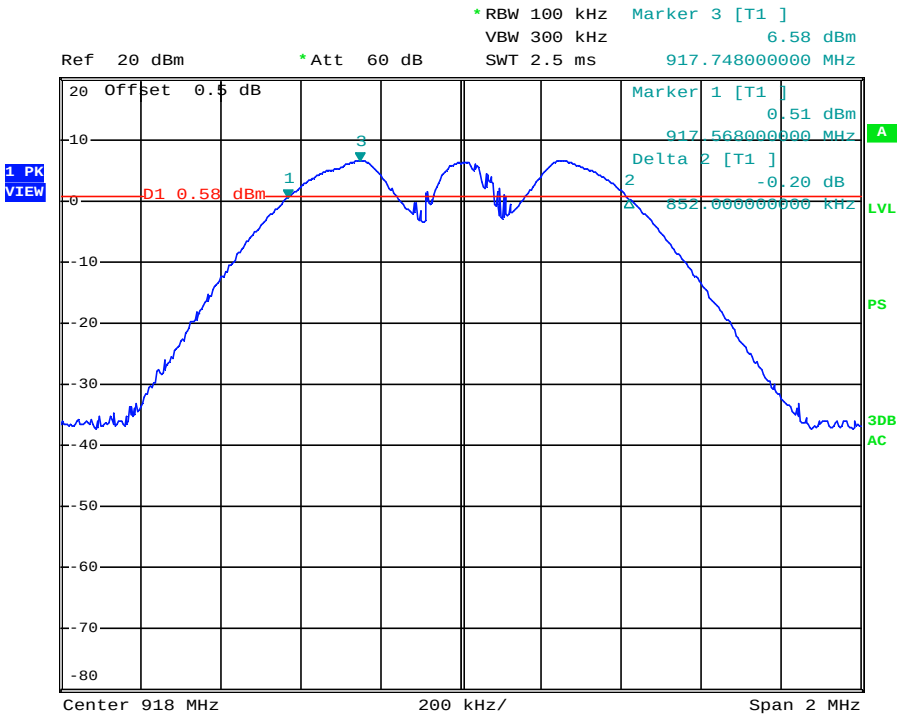
Frequency (MHz)		6 dB Bandwidth (kHz)
Low Channel:	918	852
High Channel:	924	852

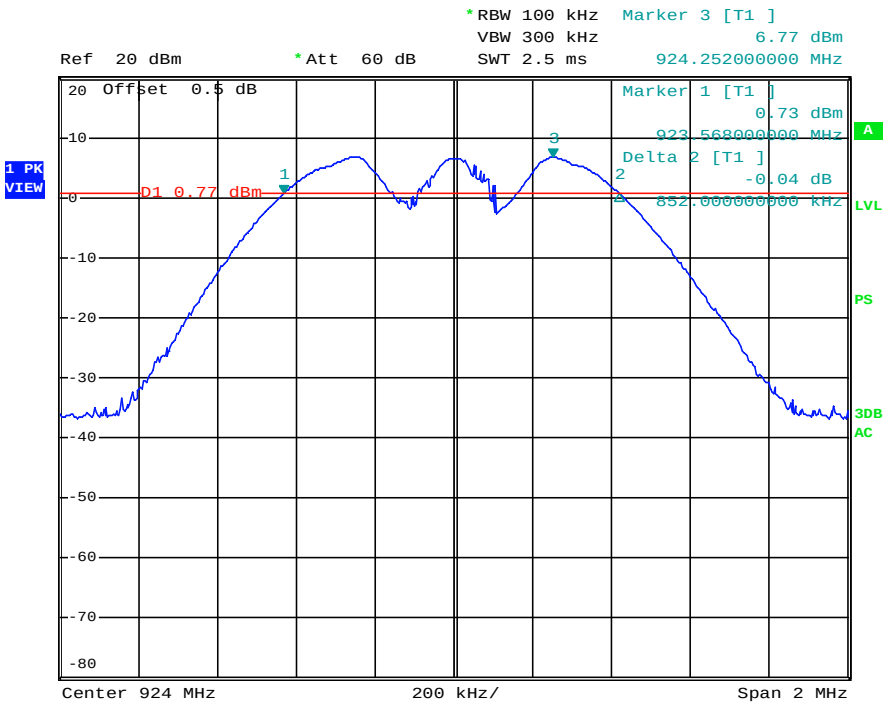
Limits
6 dB bandwidth shall be at least 500kHz

The plots of 6dB RF bandwidth and occupied bandwidth are saved as below.

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Plots of 6dB RF bandwidth





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Maximum Power Spectral Density

Antenna output of the EUT was coupled directly to spectrum analyzer. The measurement procedure 10.2 PKPSD (peak PSD) was used. If an external attenuator and/or cable was used, these losses are compensated for using the OFFSET function of the analyser.

Frequency (MHz)		PSD in 100kHz (dBm)
Low Channel:	918	6.47
High Channel:	924	6.69

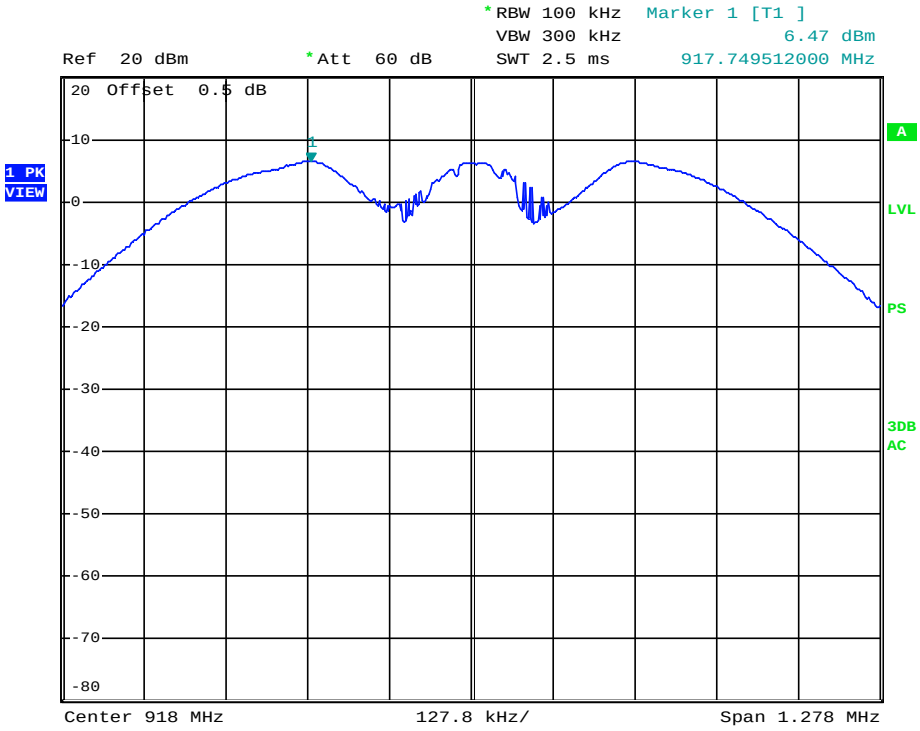
Cable Loss: 0.5 dB

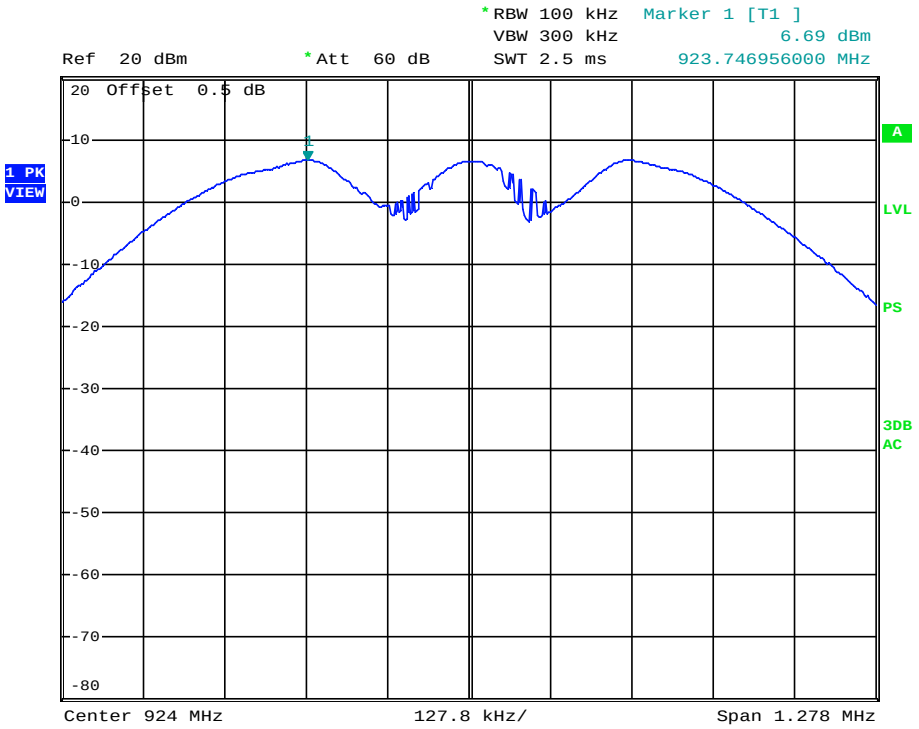
Limit: 8dBm in 3kHz

The plots of power spectral density are as below.

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Plots of power spectral density





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4.3 Out of Band Conducted Emissions

The maximum conducted (peak) output power was used to demonstrate compliance as described in 9.1. Then the display line (in red) shown in the following plots denotes the limit at 20dB below maximum measured in-band peak PSD level in 100 KHz bandwidth.

The measurement procedures under sections 11 of KDB558074 D01 v03r03 (09-June-2015) were used.

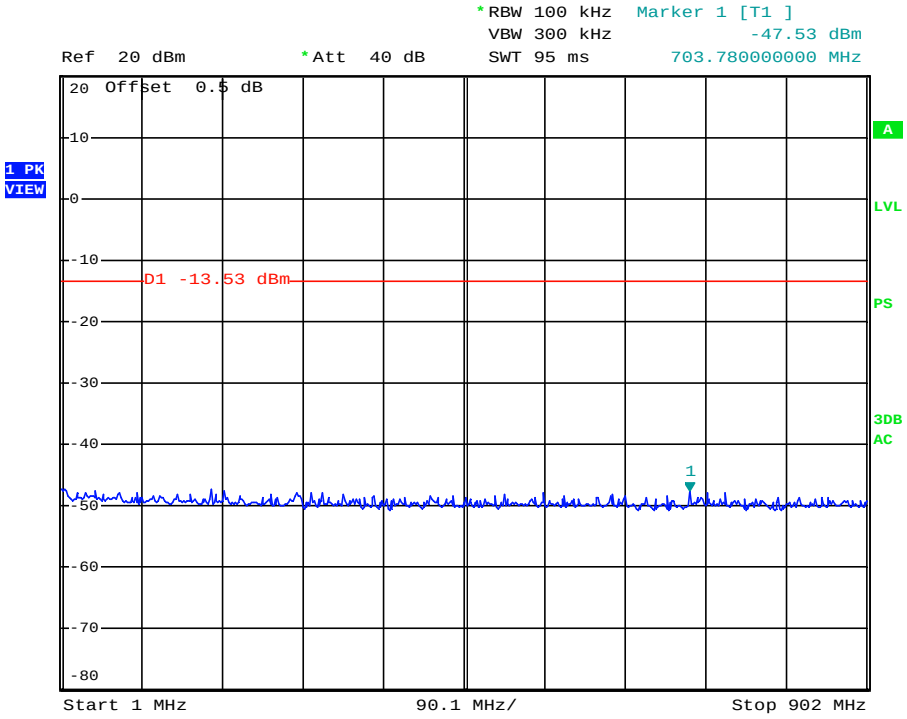
Limits:
All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20 dB below the maximum measured in-band peak PSD level.

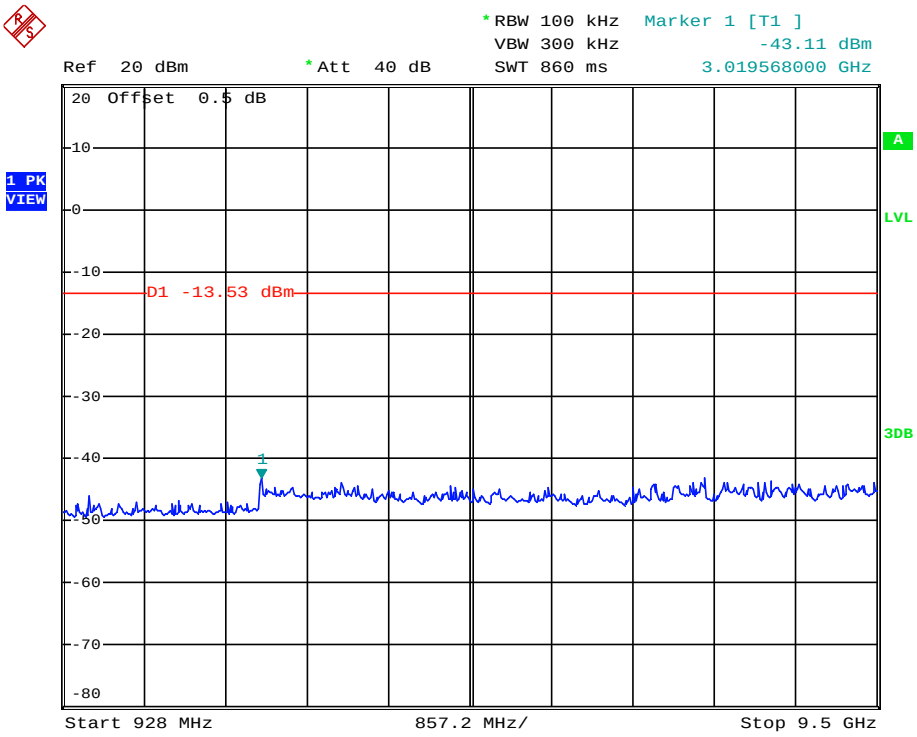
The plots of reference level measurement and out of band conducted emissions are as below.

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Plots of out of band conducted emissions

Lowest channel

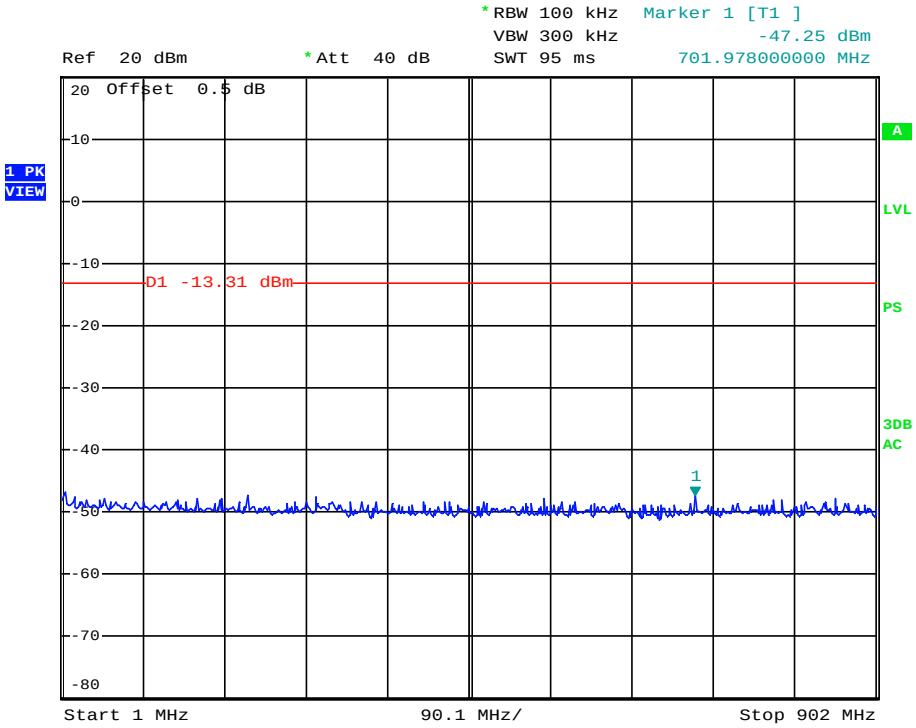


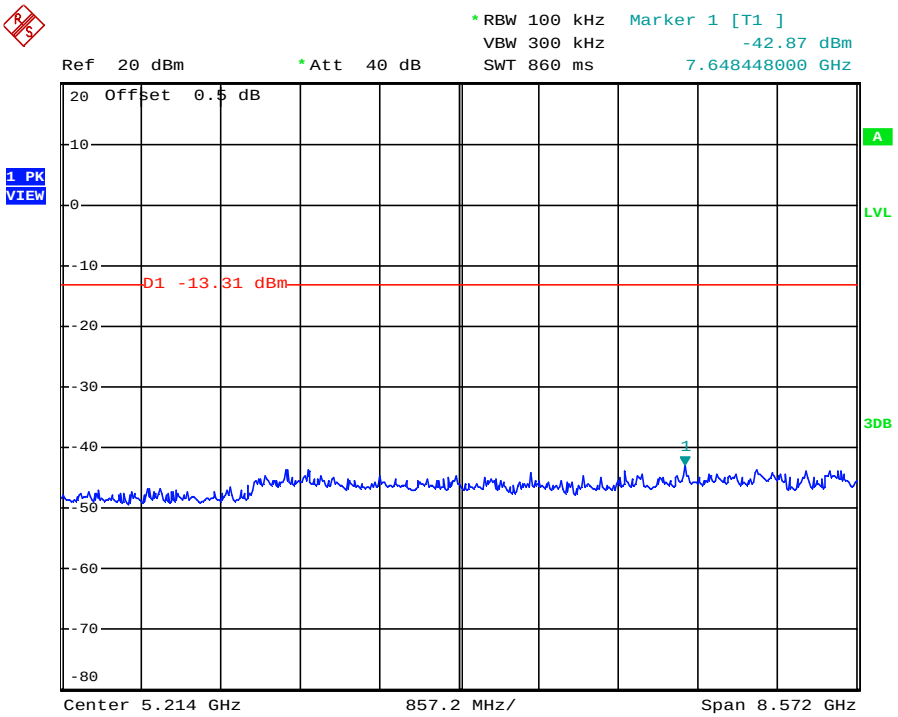


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Plots of out of band conducted emissions

Highest channel





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4.4 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + 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
PD = Pulse Desensitization in dB
AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

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

Example
Assume a receiver reading of 62.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29.0 dB is subtracted. The pulse desensitization factor of the spectrum analyzer is 0.0 dB, and the resultant average factor is -10.0 dB. The net field strength for comparison to the appropriate emission limit is 32.0 dBμV/m. This value in dBμV/m is converted to its corresponding level in μV/m.

RA = 62.0 dBμV
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0.0 dB
AV = -10 dB

FS = 62.0 + 7.4 + 1.6 – 29.0 + 0.0 + (-10.0) = 32.0 dBμV/m

Level in μV/m = Common Antilogarithm [(32.0 dBμV/m)/20] = 39.8 μV/m

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4.5 Transmitter Radiated Emissions in Restricted Bands and Spurious Emissions

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.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

4.6.1 Radiated Emission Configuration Photograph

Worst Case Restricted Band Radiated Emission
at

54.344 MHz

The worst case radiated emission configuration photographs are saved with filename: config photos.pdf

4.6.2 Radiated Emission Data

The data in tables 1-10 list the significant emission frequencies, the limit and the margin of compliance.

Judgement -

Passed by 12.4 dB margin compare with average limit

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Mode: TX-Channel 01

Table 1

Radiated Emission Data

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Average Factor (dB)	Calculated at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	***2754.000***	***53.2***	***33***	***30.4***	***50.6***	***22.4***	***28.2***	***54.0***	***-25.8***
H	***3672.000***	***53.4***	***33***	***33.3***	***53.7***	***22.4***	***31.3***	***54.0***	***-22.7***
H	***4590.000***	***53.9***	***33***	***34.9***	***55.8***	***22.4***	***33.4***	***54.0***	***-20.6***
H	***7344.000***	***26.1***	***33***	***37.9***	***53.4***	***22.4***	***31.0***	***54.0***	***-23.0***
H	***8262.000***	***30.0***	***33***	***39.0***	***58.4***	***22.4***	***36.0***	***54.0***	***-18.0***
H	***9180.000***	***25.5***	***33***	***40.4***	***55.3***	***22.4***	***32.9***	***54.0***	***-21.1***

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)
H	***2754.000***	***53.2***	***33***	***30.4***	***50.6***	***74.0***	***-23.4***
H	***3672.000***	***53.4***	***33***	***33.3***	***53.7***	***74.0***	***-20.3***
H	***4590.000***	***53.9***	***33***	***34.9***	***55.8***	***74.0***	***-18.2***
H	***7344.000***	***48.5***	***33***	***37.9***	***53.4***	***74.0***	***-20.6***
H	***8262.000***	***52.4***	***33***	***39.0***	***58.4***	***74.0***	***-15.6***
H	***9180.000***	***47.9***	***33***	***40.4***	***55.3***	***74.0***	***-18.7***

NOTES: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance 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 radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission 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.

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Mode: TX-Channel 13

Table 2

Radiated Emission Data

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Average Factor (dB)	Calculated at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	***2763.000***	***53.2***	***33***	***30.4***	***50.6***	***22.4***	***28.2***	***54.0***	***-25.8***
H	***3684.000***	***53.4***	***33***	***33.3***	***53.7***	***22.4***	***31.3***	***54.0***	***-22.7***
H	***4605.000***	***53.9***	***33***	***34.9***	***55.8***	***22.4***	***33.4***	***54.0***	***-20.6***
H	***7368.000***	***26.2***	***33***	***37.9***	***53.5***	***22.4***	***31.1***	***54.0***	***-22.9***
H	***8289.000***	***30.3***	***33***	***39.0***	***58.7***	***22.4***	***36.3***	***54.0***	***-17.7***

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)
H	***2763.000***	***53.2***	***33***	***30.4***	***50.6***	***74.0***	***-23.4***
H	***3684.000***	***53.4***	***33***	***33.3***	***53.7***	***74.0***	***-20.3***
H	***4605.000***	***53.9***	***33***	***34.9***	***55.8***	***74.0***	***-18.2***
H	***7368.000***	***48.6***	***33***	***37.9***	***53.5***	***74.0***	***-20.5***
H	***8289.000***	***52.7***	***33***	***39.0***	***58.7***	***74.0***	***-15.3***

NOTES: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance 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 radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission 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.

Intertek Testing Services Hong Kong Ltd.
2/F., Garment Centre, 576 Castle Peak Road, Kowloon, Hong Kong.
Tel: (852) 2173 8888 Fax: (852) 2785 5487 Website: www.hk.intertek-etlsemko.com

Mode: TX-Channel 25

Table 3

Radiated Emission Data

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Average Factor (dB)	Calculated at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	***2772.000***	***53.3***	***33***	***30.4***	***50.7***	***22.4***	***28.3***	***54.0***	***-25.7***
H	***3696.000***	***52.5***	***33***	***33.3***	***52.8***	***22.4***	***30.4***	***54.0***	***-23.6***
H	***4620.000***	***54.5***	***33***	***34.9***	***56.4***	***22.4***	***34.0***	***54.0***	***-20.0***
H	***7392.000***	***27.5***	***33***	***37.9***	***54.8***	***22.4***	***32.4***	***54.0***	***-21.6***
H	***8316.000***	***30.9***	***33***	***39.0***	***59.3***	***22.4***	***36.9***	***54.0***	***-17.1***

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)
H	***2772.000***	***53.3***	***33***	***30.4***	***50.7***	***74.0***	***-23.3***
H	***3696.000***	***52.5***	***33***	***33.3***	***52.8***	***74.0***	***-21.2***
H	***4620.000***	***54.5***	***33***	***34.9***	***56.4***	***74.0***	***-17.6***
H	***7392.000***	***49.9***	***33***	***37.9***	***54.8***	***74.0***	***-19.2***
H	***8316.000***	***53.3***	***33***	***39.0***	***59.3***	***74.0***	***-14.7***

NOTES: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance 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 radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission 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.

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Mode: Normal Mode

Table 13

Radiated Emission Data

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
V	54.344	32.6	16	11.0	27.6	40.0	-12.4
V	95.768	30.7	16	12.0	26.7	43.5	-16.8
H	***131.344***	***28.8***	***16***	***14.0***	***26.8***	***43.5***	***-16.7***
H	***119.564***	***28.5***	***16***	***14.0***	***26.5***	***43.5***	***-17.0***
H	150.235	28.3	16	14.0	26.3	43.5	-17.2
H	203.464	28.6	16	16.0	28.6	43.5	-14.9

NOTES: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance 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 radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

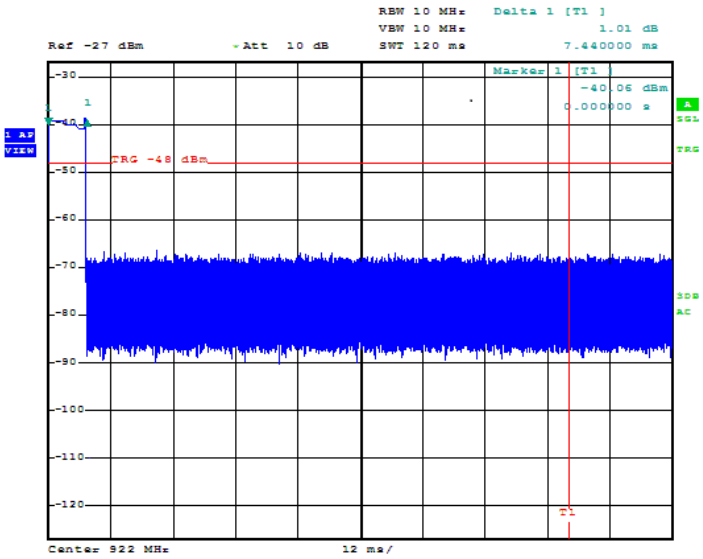
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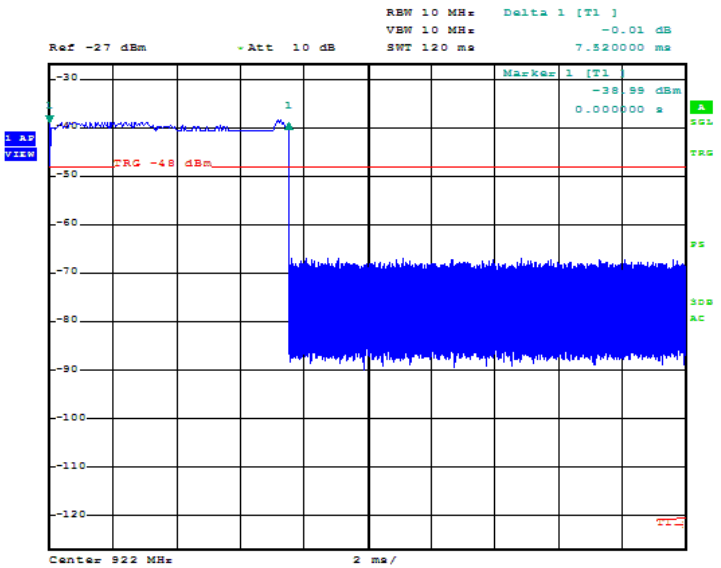
4.6.3 Transmitter Duty Cycle Calculation

Duty Cycle (DC) = (Maximum ON time in _7.52_ms) / (_100_ ms)

= (_7.52_ ms x _1_) / _100_ms

Duty Cycle Correction, dB = 20* log (DC)
= 20* log (0.0752)
= __22.4_dB





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4.7 AC Power Line Conducted Emission

☒ Not applicable – EUT is only powered by battery for operation.

☐ EUT connects to AC power line. Emission Data is listed in following pages.

☐ Base Unit connects to AC power line and has transmission. Handset connects to AC power line but has no transmission. Emission Data of Base Unit is listed in following pages.

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EXHIBIT 5
EQUIPMENT LIST

Intertek Testing Services Hong Kong Ltd.
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5.0 **Equipment List**

1) Radiated Emissions Test

Equipment	EMI Test Receiver	EMI Test Receiver
Registration No.	EW-3095	EW-2251
Manufacturer	R&S	R&S
Model No.	ESCI	ESCI
Calibration Date	Oct. 16, 2014	Dec. 04, 2014
Calibration Due Date	Oct. 16, 2015	Dec. 04, 2015

Equipment	Double Ridged Guide Antenna (1GHz - 18GHz)	BiConiLog Antenna
Registration No.	EW-1133	EW-3061
Manufacturer	EMCO	EMCO
Model No.	3115	3412E
Calibration Date	Apr. 30, 2014	Jul.17, 2014
Calibration Due Date	Oct. 30, 2015	Jul.17, 2015

2) Conductive Measurement Test

Equipment	Spectrum Analyzer
Registration No.	EW-2249
Manufacturer	R&S
Model No.	FSP30
Calibration Date	Nov. 19, 2014
Calibration Due Date	Nov. 19, 2015

END OF TEST REPORT

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