ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No.	**: E14OR-032**
AGR No	**: A147A-028**
Applicant	**: A & E Tools**
Address	**: 5501 21st Street, Racine, WI 53406, USA**
Manufacturer	**: FINE INSTRUMENTS CORPORATION**
Address	**: 30, Songdomirae-ro, Yeonsu-gu, Incheon, 406-840, Korea**
Type of Equipment	**: Transmitter**
FCC ID.	**: 2ADBN13810-1**
Model Name	**: 13810-1**
Serial number	**: N/A**
Total page of Report	**: 27 pages (including this page)**
Date of Incoming	**: September 22, 2014**
Date of issue	**: October 17, 2014**

SUMMARY

The equipment complies with the regulation; **FCC Part 15 Subpart C Section 15.249.**

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Prepared by: Ki-Hong, Nam / Senior Engineer, ONETECH Corp.

Approved by: Gea-Won, Lee / Managing Director, ONETECH Corp.

HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)
EMC Testing Div. : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

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Revision History

Issue Report No.	Issued Date	Revisions	Effect Section
E14OR-032	October 17, 2014	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

APPLICANT	: A & E Tools
ADDRESS	: 5501 21st Street, Racine, WI 53406, USA
CONTACT PERSON	: Maximilian N. Knoell / V.P. Marketing & Product Management
TELEPHONE NO	: +262-898-5909
FCC ID	: 2ADBN13810-1
MODEL NAME	: 13810-1
BRAND NAME	: LANG TOOLS
SERIAL NUMBER	: N/A
DATE	: October 17, 2014

EQUIPMENT CLASS	**DXX – Low Power Communications Transmitter**
KIND OF EQUIPMENT	Transmitter
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2009
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.249
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	No
FINAL TEST WAS CONDUCTED ON	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

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2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.249 (a)	Field Strength of Emission	Met the Limit / PASS
15.249 (c)	Measurement distance	Met the Requirement / PASS
15.249 (d)	Emissions Radiated Outside of the Specified Frequency Band	Met the Limit / PASS
15.249 (e)	Radiated Emissions above 1 000 MHz	Met the Limit / PASS
15.209	Radiated Emission Limits, General Requirement	Met the Limit / PASS
15.207	Conducted Limits	N/A (See Note)
15.203	Antenna Requirement	Met the Requirement / PASS

Note: This test is not performed because the EUT is operated by DC battery.

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in section 2.1.

2.5 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.10: 2009 at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 301-14, Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862 Korea.

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-4617/ G-666/ T-1842 IC (Industry Canada) – Registration No. Site# 3736-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation No. 85

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

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3. GENERAL INFORMATION

3.1 Product Description

The A & E Tools, Model: 13810-1 (referred to as the EUT in this report) is an Transmitter. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Portable Device
OPERATING FREQUENCY	915 MHz
RATED RF OUTPUT POWER	0 dBm
ANTENNA TYPE	Wire Antenna
MODULATION	GFSK
LIST OF EACH OSC. OR CRY. FREQ.(FREQ. >= 1 MHz)	4.0 MHz
RATED SUPPLY VOLTAGE	DC 4.5 V

3.2 Model Differences

-. None

4. EUT MODIFICATIONS

-. None

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5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	N/A	13810-1	N/A
RF Board	N/A	N/A	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested: None

5.3 Mode of operation during the test

The EUT was set to 915 MHz and then transmitted maximum power during the testing. For getting maximum emission from
the EUT, the EUT was moved through XY, XZ, and YZ planes.

5.4 Configuration of Test System

Line Conducted Test **:** It is not need to test this requirement, because the EUT shall be operated by DC battery.

Radiated Emission Test **:** Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2009 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m open area test site.
The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

According to section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Construction:

The antenna of the EUT is a wire antenna on the main board in the EUT, so no consideration of replacement by the user.

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6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
It is not need to test this requirement, because the power of the EUT is supplied by battery.	

6.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
TX Mode	X

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7. RADIATED EMISSION TEST

7.1 Test set-up

The radiated emissions measurements were on the 3 m, semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from up to 10 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

Test set-up photos are included in appendix I.

7.2 Measurement uncertainty

Radiated emission electric field intensity, 0.15 MHz ~ 30 MHz : ± 2.61 dB

Radiated emission electric field intensity, 30 MHz ~ 300 MHz : ± 4.43 dB

Radiated emission electric field intensity, 300 MHz ~ 1 000 MHz : ± 3.80 dB

Radiated emission electric field intensity, 1 000 MHz ~ 3 000 MHz: ± 4.40 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2. The measurement uncertainty is given with a confidence of 95 % with the coverage factor, k = 2.

7.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
☐ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Nov. 18, 2013(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2014(1Y)
☐ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 28, 2014(1Y)
☐ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Nov. 05, 2013(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 28, 2014(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Jan. 20, 2014(1Y)
■ -	MA240	HD GmbH	Antenna Master	N/A	N/A
■ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DS420S	HD GmbH	Turn Table	N/A	N/A
■ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	879 285/26	Dec. 11, 2012(2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 05, 2014(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Sep. 05, 2013(2Y)
☐ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Sep. 05, 2013(2Y)
■ -	83051A	Agilent	Microwave System Preamplifer	3950M00201	Apr. 30, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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7.4 Final Result of Measurement

7.4.1 Field Strength of the Fundamental Frequency

7.4.1.1 Test Data

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249(a)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Operating Condition : TX mode

Distance : 3 m

Radiated Emissions			Ant	Correction Factors			Total	FCC Limit	
Carrier Freq. (MHz)	Reading (dBµV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Pre-Amp (dB)	Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
915.00	84.14	Peak	H	27.20	7.10	43.10	75.34	93.98	18.64
	83.39	Peak	V				74.59	93.98	19.39

*Remark: To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes, but the worst plane data were recorded in the report.

Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss – Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Project Engineer

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7.4.1.2 Test Data with 13810-2

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249(a)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Operating Condition : TX mode

Distance : 3 m

Radiated Emissions			Ant	Correction Factors			Total	FCC Limit	
Carrier Freq. (MHz)	Reading (dBμV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Pre-Amp (dB)	Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
915.00	84.34	Peak	H	27.20	7.10	43.10	75.54	93.98	18.44
	83.44	Peak	V				74.64	93.98	19.34

*Remark: To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes, but the worst plane data were recorded in the report.

Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss – Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Project Engineer

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7.4.1.3 Test Data with 13810-3

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249(a)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Operating Condition : TX mode

Distance : 3 m

Radiated Emissions			Ant	Correction Factors			Total	FCC Limit	
Carrier Freq. (MHz)	Reading (dBμV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Pre-Amp (dB)	Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
915.00	84.42	Peak	H	27.20	7.10	43.10	75.62	93.98	18.36
	83.51	Peak	V				74.71	93.98	19.27

*Remark: To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes, but the worst plane data were recorded in the report.

Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss – Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Project Engineer

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7.4.2 Emissions Radiated Outside of the Specified Frequency Bands

7.4.2.1 Test Data

7.4.2.1.1 Test Data for Harmonic

Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249(a)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Operating Condition : TX mode

Distance : 3 m

Radiated Emissions			Ant	Correction Factors			Total	FCC Limit	
Carrier Freq. (MHz)	Reading (dBµV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Pre-Amp (dB)	Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1 830.00	62.93	Peak	H	31.20	9.50	42.40	61.23	73.98	12.75
	40.11	Average	H				38.41	53.98	15.57
	61.85	Peak	V				60.15	73.98	13.83
	38.49	Average	V				36.79	53.98	17.19
Other frequencies were not found up to 10 GHz.									

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical, “*” Frequency fall in restricted band

Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss – Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Project Engineer

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7.4.2.1.2 Test Data for Frequency range: 30 MHz ~ 1 000 MHz

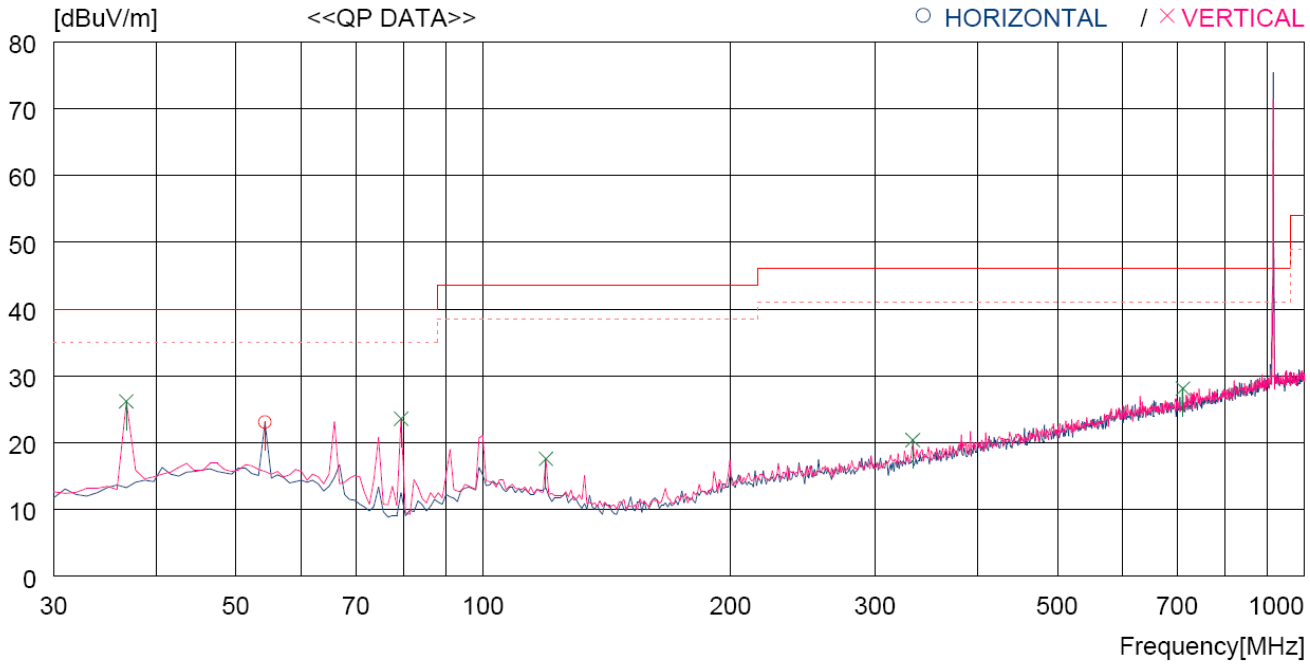
Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	54.250	34.2	14.7	7.4	33.2	23.1	40.0	16.9	100	300
----- Vertical ------										
2	36.790	38.4	13.9	7.1	33.2	26.2	40.0	13.8	200	0
3	79.470	40.4	8.6	7.7	33.1	23.6	40.0	16.4	200	82
4	119.240	31.1	11.5	8.1	33.1	17.6	43.5	25.9	200	3
5	333.610	28.2	15.5	9.7	33.0	20.4	46.0	25.6	100	359
6	710.935	28.9	20.9	11.6	33.3	28.1	46.0	17.9	298	0

Tested by: Tae-Ho, Kim / Project Engineer

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7.4.2.1.3 Test Data for Below 30 MHz

Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)

Frequency range : 9 kHz ~ 30 MHz

Measurement distance : 3 m

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Detector : CISPR Quasi-Peak (Resolution Bandwidth: 9 kHz)

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

7.4.2.1.4 Test Data above 1 GHz except for harmonic

-. Test Date : October 10, 2014

- . Humidity Level : 45 % R.H.

-. Temperature : 22.3 ℃

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 10 GHz

-. Measurement distance : 3 m

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

Tested by: Tae-Ho, Kim / Project Engineer

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7.4.2.1.5 Band Edge

-. Test Date : October 10, 2014

-. Resolution bandwidth : 100 kHz for Peak and Quasi-Peak Mode

-. Video bandwidth : 100 kHz for Peak and Quasi-Peak Mode

-. Measurement distance : 3 m

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Pre-Amp (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
901.87	37.42	Peak	H	23.50	12.40	32.50	40.82	53.98	13.16
928.12	37.75	Peak	V				41.15	53.98	12.83

Remark. Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss – Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Project Engineer

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7.4.2.2 Test Data with 13810-2

7.4.2.2.1 Test Data for Harmonic

Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249(a)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Operating Condition : TX mode

Distance : 3 m

Radiated Emissions			Ant	Correction Factors			Total	FCC Limit	
Carrier Freq. (MHz)	Reading (dBµV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Pre-Amp (dB)	Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1 830.00	62.82	Peak	H	31.20	9.50	42.40	61.12	73.98	12.86
	40.02	Average	H				38.32	53.98	15.66
	61.63	Peak	V				59.93	73.98	14.05
	38.30	Average	V				36.60	53.98	17.38
Other frequencies were not found up to 10 GHz.									

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical, “*” Frequency fall in restricted band

Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss – Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Project Engineer

HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)
EMC Testing Div. : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

7.4.2.2.2 Test Data for Frequency range: 30 MHz ~ 1 000 MHz

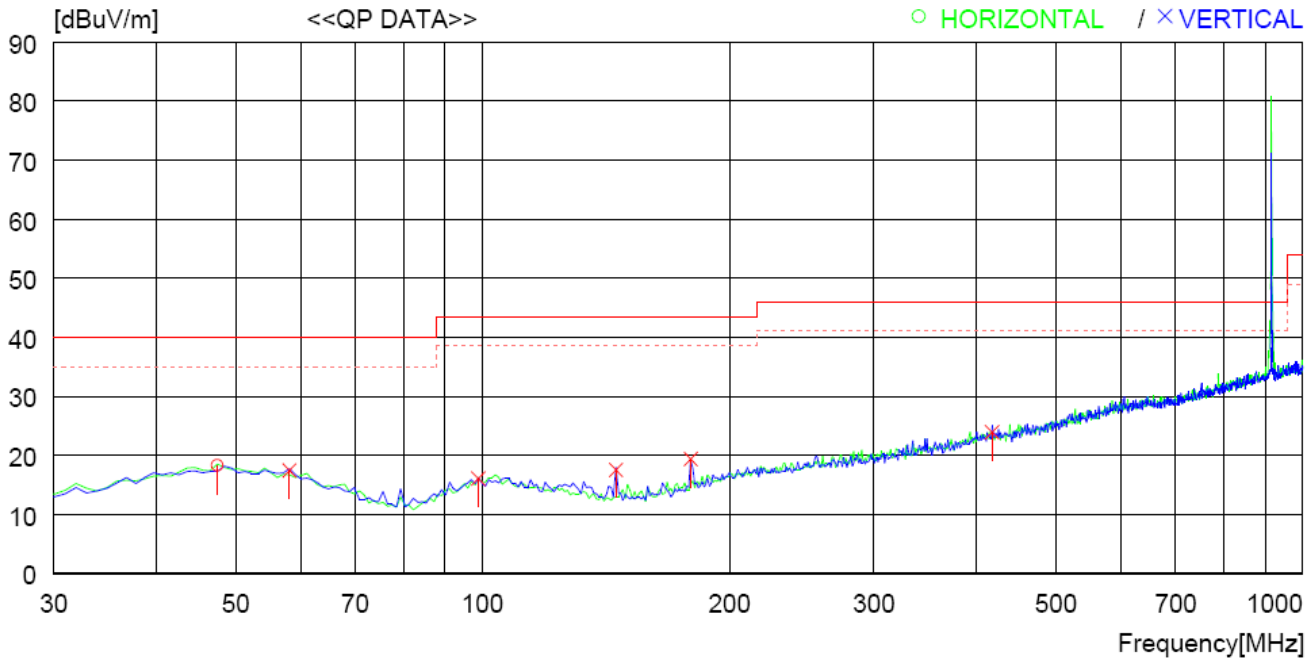
Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	47.460	29.8	14.3	7.2	33.0	18.3	40.0	21.7	400	272
----- Vertical ------										
2	58.130	30.0	13.1	7.4	33.1	17.4	40.0	22.6	200	292
3	98.870	29.5	11.5	8.2	33.1	16.1	43.5	27.4	300	278
4	145.430	33.6	8.1	8.9	33.0	17.6	43.5	25.9	100	320
5	179.380	33.5	9.4	9.4	32.9	19.4	43.5	24.1	100	359
6	418.001	29.4	15.8	11.7	33.0	23.9	46.0	22.1	200	1

Tested by: Tae-Ho, Kim / Project Engineer

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7.4.2.2.3 Test Data for Below 30 MHz

Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)

Frequency range : 9 kHz ~ 30 MHz

Measurement distance : 3 m

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Detector : CISPR Quasi-Peak (Resolution Bandwidth: 9 kHz)

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

7.4.2.2.4 Test Data above 1 GHz except for harmonic

-. Test Date : October 10, 2014

- . Humidity Level : 45 % R.H.

-. Temperature : 22.3 ℃

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 10 GHz

-. Measurement distance : 3 m

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

Tested by: Tae-Ho, Kim / Project Engineer

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7.4.2.2.5 Band Edge

-. Test Date : October 10, 2014

-. Resolution bandwidth : 100 kHz for Peak and Quasi-Peak Mode

-. Video bandwidth : 100 kHz for Peak and Quasi-Peak Mode

-. Measurement distance : 3 m

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Pre-Amp (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
901.75	37.54	Peak	H	23.50	12.40	32.50	40.94	53.98	13.04
928.20	37.92	Peak	V				41.32	53.98	12.66

Remark. Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss – Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Project Engineer

HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)
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7.4.2.3 Test Data with 13810-3

7.4.2.3.1 Test Data for Harmonic

Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249(a)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Operating Condition : TX mode

Distance : 3 m

Radiated Emissions			Ant	Correction Factors			Total	FCC Limit	
Carrier Freq. (MHz)	Reading (dBµV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Pre-Amp (dB)	Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1 830.00	62.74	Peak	H	31.20	9.50	42.40	61.04	73.98	12.94
	40.21	Average	H				38.51	53.98	15.47
	61.98	Peak	V				60.28	73.98	13.70
	38.32	Average	V				36.62	53.98	17.36
Other frequencies were not found up to 10 GHz.									

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical, “*” Frequency fall in restricted band

Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss – Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Project Engineer

HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)
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7.4.2.3.2 Test Data for Frequency range: 30 MHz ~ 1 000 MHz

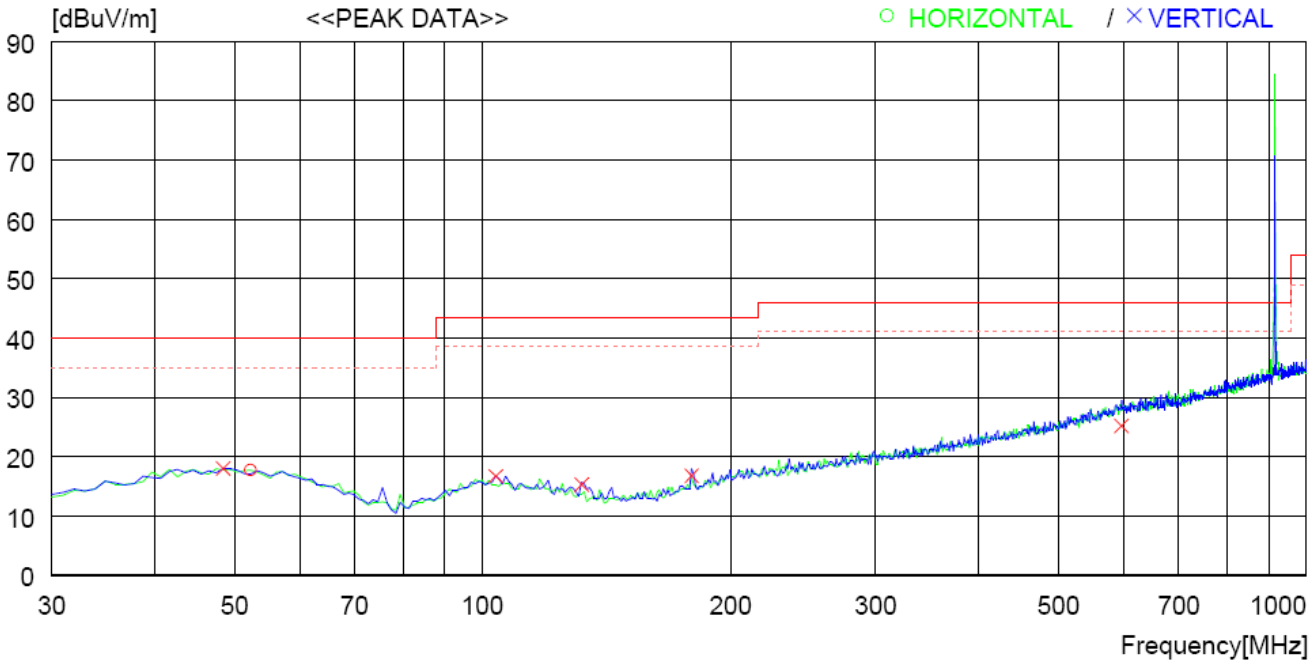
Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ [MHz]	READING PEAK [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	52.310	29.5	13.9	7.3	33.0	17.7	40.0	22.3	100	138
----- Vertical -----										
2	48.430	29.4	14.3	7.3	33.0	18.0	40.0	22	300	25
3	103.720	30.1	11.4	8.3	33.1	16.7	43.5	26.8	300	0
4	131.850	31.2	8.8	8.4	33.1	15.3	43.5	28.2	100	38
5	179.380	32.1	9.4	8.4	33.1	16.8	43.5	26.7	100	0
6	596.478	30.6	18.9	8.7	33.0	25.2	46.0	20.8	400	195

Tested by: Tae-Ho, Kim / Project Engineer

HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)
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7.4.2.3.3 Test Data for Below 30 MHz

Humidity Level : 45 % R.H. Temperature: 22.3 ℃

Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)

Frequency range : 9 kHz ~ 30 MHz

Measurement distance : 3 m

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

Result : PASSED

EUT : Transmitter Date: October 10, 2014

Detector : CISPR Quasi-Peak (Resolution Bandwidth: 9 kHz)

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

7.4.2.3.4 Test Data above 1 GHz except for harmonic

-. Test Date : October 10, 2014

- . Humidity Level : 45 % R.H.

-. Temperature : 22.3 ℃

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 10 GHz

-. Measurement distance : 3 m

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

Tested by: Tae-Ho, Kim / Project Engineer

HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)
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7.4.2.3.5 Band Edge

-. Test Date : October 10, 2014

-. Resolution bandwidth : 100 kHz for Peak and Quasi-Peak Mode

-. Video bandwidth : 100 kHz for Peak and Quasi-Peak Mode

-. Measurement distance : 3 m

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Pre-Amp (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
901.82	37.62	Peak	H	23.50	12.40	32.50	41.02	53.98	12.96
928.12	37.70	Peak	V				41.10	53.98	12.88

Remark. Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss – Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Project Engineer

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8. 20 dB BANDWIDTH

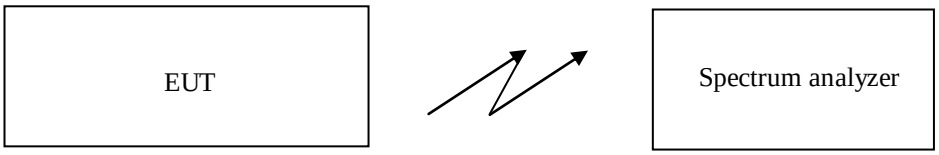
8.1 Operating environment

Temperature : 22.3 ℃

Relative humidity : 45 % R.H.

8.2 Test set-up

The output signal of EUT was received by the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.



8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)
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8.4 Test data for Bandwidth

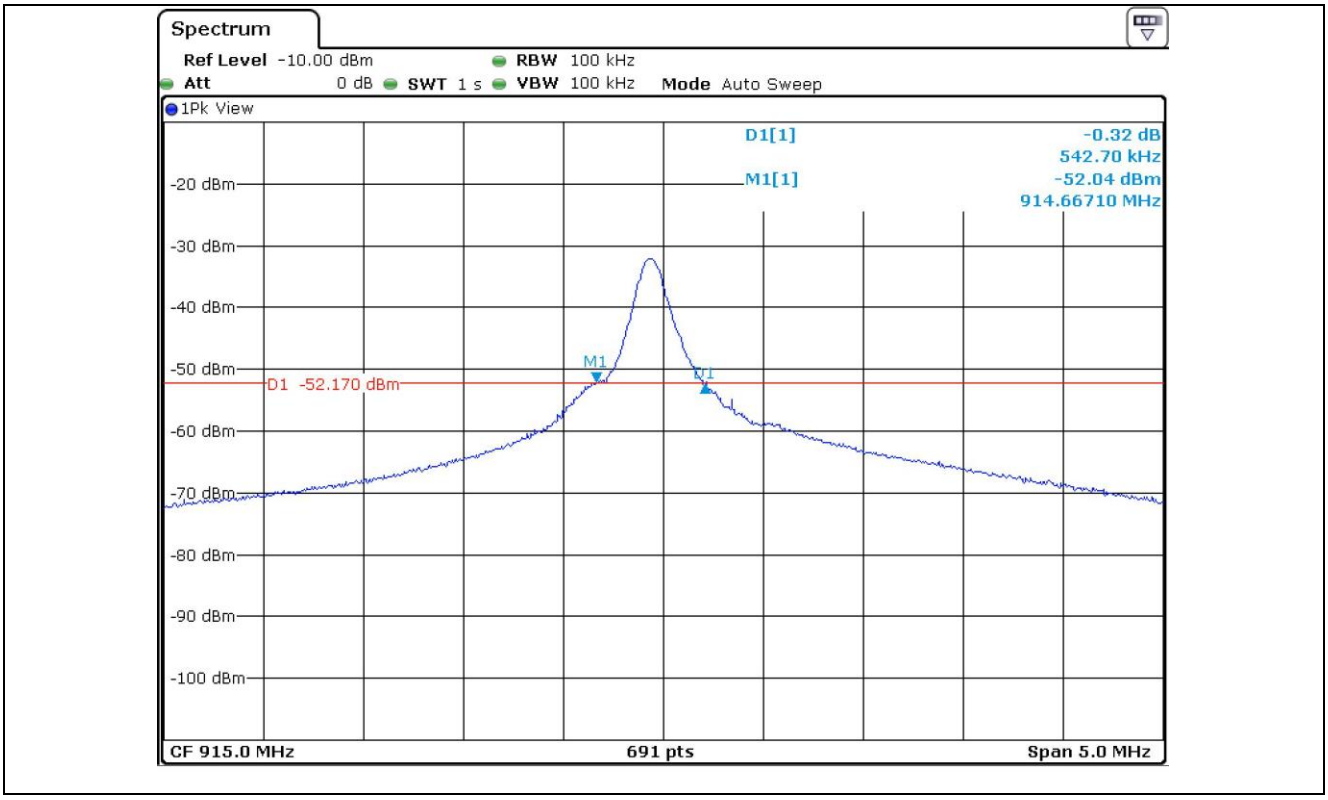
-. Test Date : October 10, 2014

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.215(c)

Operating Freq. (MHz)	20 dB Bandwidth (MHz)	Result
915	0.542 0	Met the requirement / PASS

Remark: See next page for 20 dB Bandwidth test data.

The 20 dB bandwidth is within the assigned frequency band from 902.0 MHz to 928.0 MHz.



Tested by: Tae-Ho, Kim / Project Engineer

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