Electromagnetic Emission

FCC MEASUREMENT REPORT

CERTIFICATION
OF
FCC PART15 Subpart B COMPLIANCE

PRODUCT	:	Keyboard
MODEL/TYPE NO	:	FC660C
FCC ID	:	RPKFC660C
TRADE NAME	:	–
APPLICANT	:	LEOPOLD CO., LTD. #1607, Yongsung Biztel, 314-1, Hanggangro-2-ga, Yongsan-gu, Seoul, Korea
FCC CLASSIFICATION	:	JBP : Part 15 Class B Computer Device Peripheral
FCC RULE PART(S)	:	FCC Part 15 Subpart B Class B
FCC PROCEDURE	:	Certification
DATES OF TEST	:	December 18, 2012
TEST REPORT No.	:	BWS-13-EF-0005
TEST LAB.	:	BWS TECH Inc. (Registration No. : 553281)

This Keyboard has been tested in accordance with the measurement procedures specified in ANSI C63.4-2009 at the BWS TECH/EMC Test Laboratory and has been shown to be complied with the electromagnetic emission limits specified in FCC Rule Part15 Subpart B Section15.107 and 15.109
I attest to the accuracy of data. All measurement herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

January 16, 2013
(Date)

Cheol-Ho, Lee
Chief Engineer
Laboratory Division

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FCC TEST REPORT

Scope – *Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC).*

1. General Information

Applicant Name	: LEOPOLD CO., LTD.
Applicant Address	: #1607, Yongsung Biztel, 314-1, Hanggangro-2-ga, Yongsan-gu, Seoul, Korea
Manufacturer Name	: LEOPOLD CO., LTD.
Manufacturer Address	: Jingwah Industrial Zone, Liangantian, Pinghu Town, Longgang District, Shenzhen 518111/China
Contact Person	: San, Kang
Phone/Fax	: Phone : +82-2-2077-1030 / Fax : +82-2-2077-1031

- **EUT Type** : Keyboard
- **Model Number** : FC660C
- **FCC Identifier** : RPKFC660C
- **S/N :** : Prototype
- **FCC Rule Part(s)** : Part 15 Subpart B Class B
- **Test Procedure** : ANSI C63.4-2009
- **Date of Tests** : December 18, 2012
- **Place of Tests** : BWS TECH Inc.
  EMC Testing Lab (FCC Registration Number : 553281)
  611-1, Maesan-ri, Mohyeon-myeon, Yongin-si, Gyeonggi-do
  449-853, Korea

  TEL: +82 31 333 5997 FAX: +82 31 333 0017
- **Test Report No.** : BWS-13-EF-0005

2. Description of Test Facility

The measurement for radiated emission test were practiced at the open area test site of BWS TECH Inc. Measurement for conducted emission test were practiced at the semi EMC Anechoic Chamber test site of BWS TECH Inc. facility located at ***611-1, Maesan-ri, Mohyeon-myeon, Yongin-si, Gyeonggi-do 449-853, Korea***. The site is constructed in conformance with the requirements of the ANSI C63.4-2009 and CISPR Publication 16. The BWS TECH measurement facility has been filed to the Commission with the FCC for 3 and 10 meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-2009 and registered to the Federal Communications Commission(Registration Number : 553281).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-2009) was used in determining radiated and conducted emissions from the LEOPOLD CO., LTD. Keyboard Model : FC660C.

3. Product Information

3.1 Equipment Description

Specifications

Item	Specifications
	USB interface model
Interface Type	USB1.1 (Cable Length 3m Max)
Key Specifications	Electric capacity(4.0mm stroke)
Cable Length	1.5 m
Dimensions	325.3mm(W) x 109.36mm(D) x 21.0mm(H)
Weight	650g

#USB cable should use a shield type.
#These specification may change without notice in order to facilitate improvements.

3.2 Variations covered by this report

Model Difference : N/A.

3.3 Additional Information Related to Testing

Test results apply only to the particular sample tested and functionality described in this test report.
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4. Description of Tests

4.1 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section 11, "Measurement of Information Technology Equipment" of ANSI C63.4-2009. The measurement were performed over the frequency range of 0.15MHz to 30MHz using a 50Ω/50uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak" amplitude within an bandwidth of 10KHz or for "quasi-peak" within a bandwidth of 9KHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1m x 1.5m x 0.8m wooden table which is placed 40cm away from the vertical wall and 1.5m away from the side wall of the chamber room. Two LISNs are bonded to bottom plane of the shielded room. The EUT is powered from the FCC LISN and the support equipment is powered from the another Com-power LISN. Power to the LISNs is filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1.2cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the Com-power LISN. All interconnecting cables more than 1m were shortened by non-inductive bundling(serpentine fashion) to a 1m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the Test Receiver to determine the frequency producing the max. Emission from the EUT. The frequency producing the max. Level was reexamined using the detector function set to the CISPR Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.15 to 30MHz. The bandwidth of the Spectrum Analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was maximized by switching power lines, varying the mode of operation or resolution, clock or data exchange speed, if applicable, whichever determined the worst-case emission. Each emission reported was calibrated using self-calibrating mode.

Photographs of the worst-case emission can be seen in photographs of conducted emission test setup.

4.2 Radiated Emission Measurement

Preliminary measurements were made at indoors 3 meter semi EMC Anechoic Chamber using broadband antennas, broadband amplifier, and spectrum analyzer to determine the emission frequencies producing the maximum EME.

Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 1000MHz using bilog antenna and above 1000MHz, linearly polarized double ridge horn antennas were used. Above 1GHz, linearly polarized double ridge horn antennas were used. The measurements were performed with three frequencies which were selected as bottom, middle and top frequency in the operating band. Emission level from the EUT with various configurations were examined on the spectrum analyzer connected with the RF amplifier and plotted graphically.

Final measurements were made outdoors open site at 3-meter test range using bilog antenna. The output from the antenna was connected, via a pre-selector or a preamplifier, to the input of the EMI Measuring Receiver and Spectrum analyzer(for above 1GHz). The detector function was set to the quasi-peak or peak mode as appropriate. The measurement bandwidth on the Field strength receiver was set to at least 120kHz (1MHz for measurement above 1GHz), with all post-detector filtering no less than 10 times the measurement bandwidth. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

Each frequency found during preliminary measurement was examined and investigated as the same set up and configuration which produced the maximum emission The EUT, support equipment and interconnecting cables were configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1m x 1.5 meter table. The turntable containing the system was rotated and the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission.

Each emission was maximized by varying the mode of operating frequencies of the EUT. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor(20dB/decade) as per section 15.31(f).

Photographs of the worst-case emission test setup can be seen in Appendix 1.

5. Test Condition

5.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the EUT and the supported equipments were installed to meet FCC requirement and operated in a manner which tends to maximize its emission level in a typical application.

Radiated Emission Test

Preliminary radiated emission tests were performed using the procedure in ANSI C63.4/2009 Clause 8.3 to determine the worst operating condition. Final radiated emission tests were conducted at 3 meter open field test site.

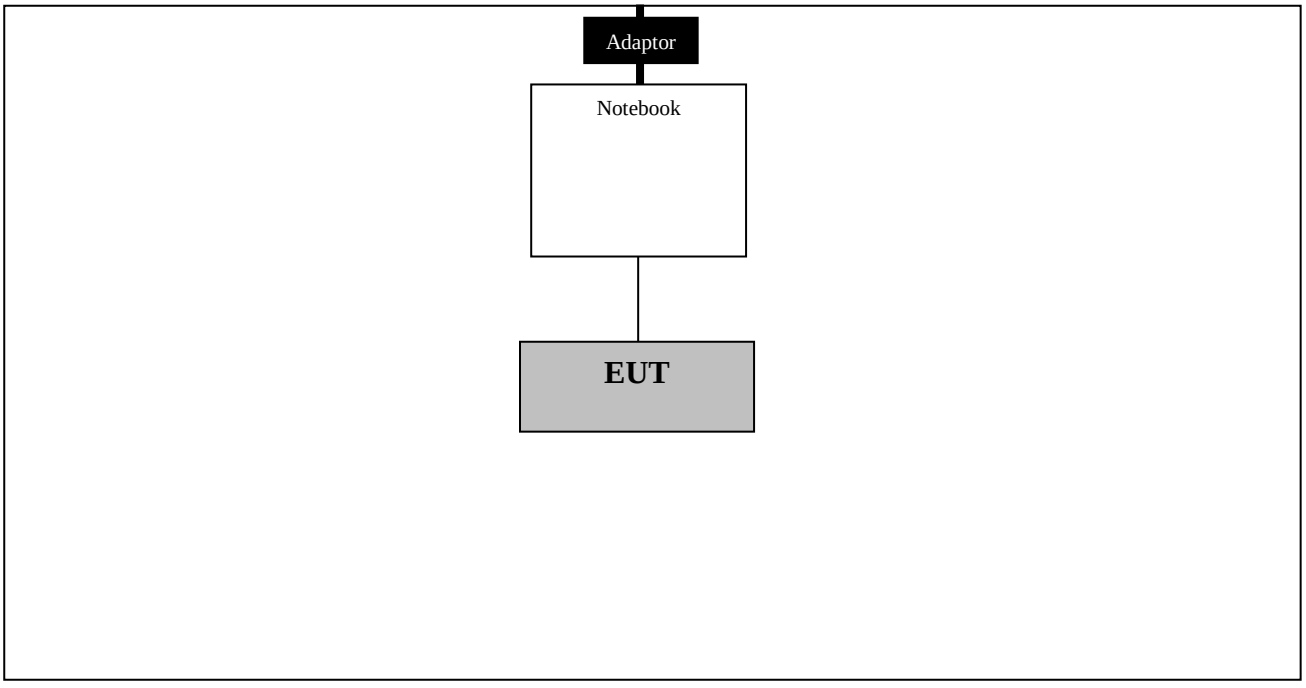
5.2 EUT operation

EUT was tested according to the following operation modes provided by the specifications given by the manufacturer, and reported the worst emissions.

Operation Modes	Worst Case Mode
Normal Operation Mode	☒

5.3 Test System layout on EUT and peripherals

Interface cable _____ Power cable ▬▬▬



5.4 Peripherals / Support Equipment Used

Following peripheral devices and interface cables were connected during the measurement:

Type of Peripheral Equipment Used:

Description	Model Name	Serial No.	Manufacturer	FCC ID
EUT	**FC660C**	**prototype**	**LEOPOLD CO., LTD.**	**RPKFC660C**
Notebook	NT-P560	ZOM793MZ300166A	SAMSUNG	N/A
Notebook Adapter	ADP-60ZHA	CNBA4400243ABZ04 01D8224	Delta Electronics Co., Ltd.	N/A

Type of Cables Used:

Device from	Device to	Type of Cable	Length(m)	Type of shield
EUT	Notebook	USB	1.0	Shielded
Notebook	Adapter	DC IN	2.0	Unshielded

6. TEST RESULTS

6.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

FCC Rule Parts	Measurement Required	Result
15.107(a)	Conducted Emission	Passed by -19.81dB
15.109(a)	Radiated Emissions	Passed by -3.60dB

The data collected shows that the LEOPOLD CO., LTD. Keyboard models : FC660C and family models comply with technical requirements of the Part 15.107 and 15.109 of the FCC Rules.

6.2 Conducted Emissions

EUT : Keyboard FC660C
Limit apply to : FCC Part15 Subpart B Class B Section 15.107(a)
Test Date : December 18, 2012
Operating Condition : Normal Operation Mode
Environment Condition : Temperature : 21 ℃ Humidity Level : 39 %RH
Result : Passed by -19.81dB

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Tabulated Conducted Emission Test Data

Detector Mode ; CISPR Quasi Peak mode (6dB Bandwidth : 9kHz).

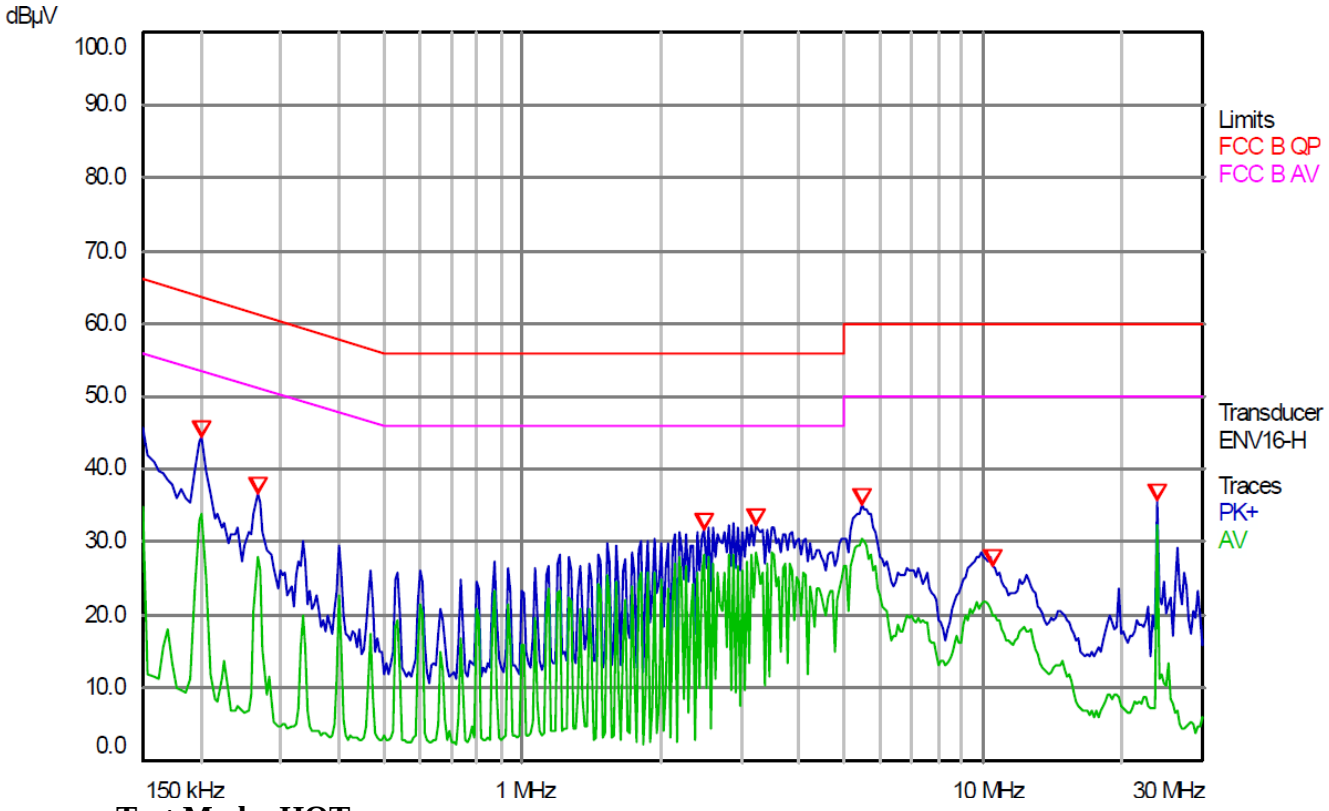
Test data sheets follow

Freq [MHz]	Correction		Phase [H/N]	Quasi-Peak Mode				Average Mode			
	AMN	C.L		Limit	Reading	Emission Level	Margin	Limit	Reading	Emission Level	Margin
				[dBuV]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dB]
0.198	0.14	0.02	N	64.70	44.73	44.89	-19.81	54.70			
0.266	0.12	0.02	N	62.70	37.39	37.53	-25.17	52.70			
2.468	0.10	0.05	N	56.00	31.47	31.62	-24.38	46.00			
3.204	0.12	0.05	H		32.28	32.45	-23.55				
5.476	0.18	0.07	H	60.00	34.75	35.00	-25.00	50.00			
10.540	0.37	0.10	N		27.01	27.48	-32.52				
24.000	0.92	0.15	H		34.77	35.84	-24.16				

NOTE:

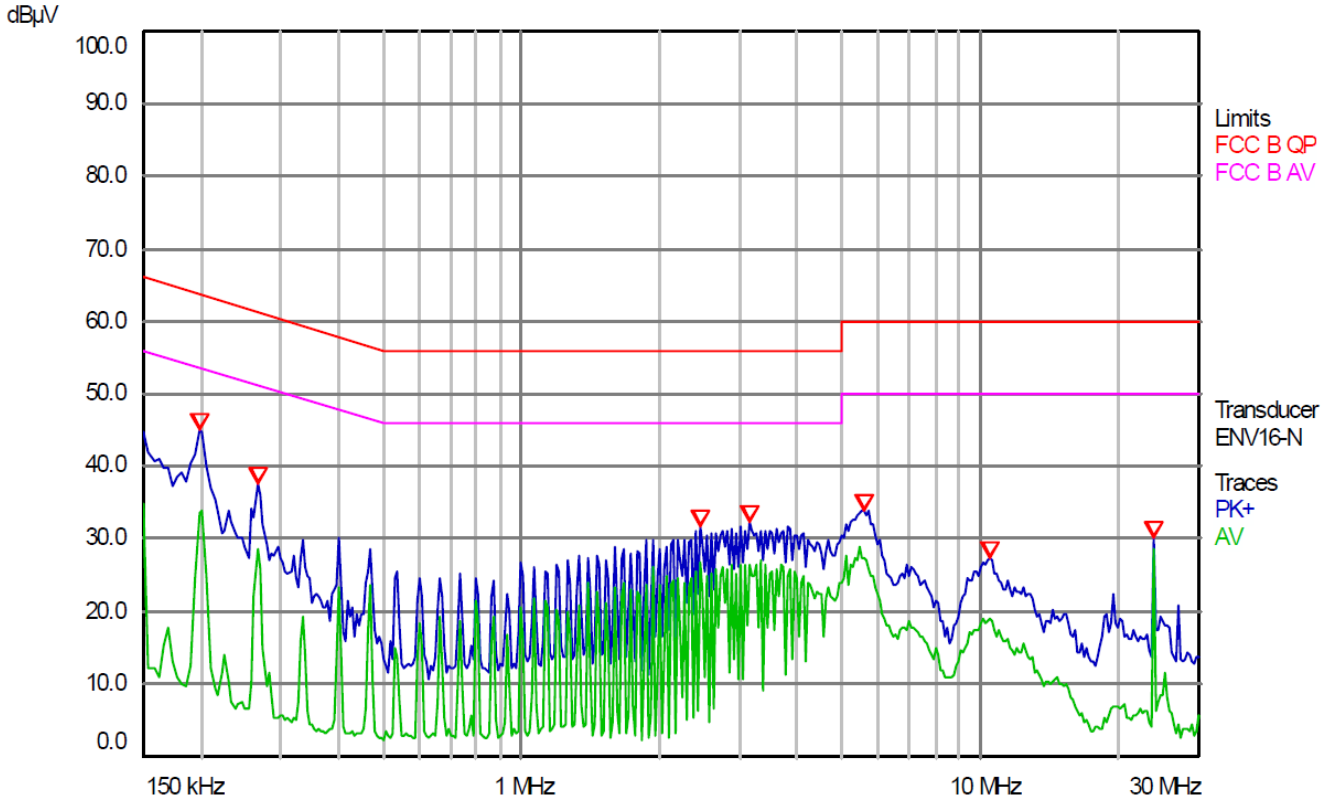
1. H : Hot Line , N :Neutral Line
2. Emission Level = Reading + Correction Factor
3. Margin = Emission Level – Limit
4. Measurement uncertainty estimated at ±3.500 dB.
   The measurement uncertainty is given with a confidence of 95.00 % with the coverage factor, k=2.

Plots of Conducted Emission Test



Test Mode: HOT
Model Name: FC660C
Classification: FCC Part 15 Subpart B Class B

Plots of Conducted Emission Test



Test Mode: NEUTRAL
Model Name: FC660C
Classification: FCC Part 15 Subpart B Class B

6.3 Radiated Emissions

EUT : Keyboard FC660C
Limit apply to : FCC Part15 Subpart B Class B Section 15.109(a)
Test Date : December 18, 2012
Operating Condition : Normal Operation Mode
Environment Condition : Temperature : -6.5 ℃ Humidity Level : 43 %RH
Result : Passed by –3.60dB

Radiated Emission Test Data

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

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

Measurement Distance : 3 meters

Frequency [MHz]	Reading [dBμV]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss +AMP Gain [dB]	Limit [dBμV/m]	Emission Level [dBμV/m]	Margin [dB]
36.25	48.42	V	11.54	-23.57	40.00	36.40	-3.60
60.92	47.19	V	11.78	-23.67	40.00	35.30	-4.70
339.59	39.51	H	13.96	-20.07	46.00	33.40	-12.60
524.55	41.26	H	18.06	-19.72	46.00	39.60	-6.40

NOTE:

1. * H : Horizontal polarization , ** V : Vertical polarization
2. Emission Level = Reading + Antenna factor + Cable loss + AMP Gain
3. Margin value = Emission Level - Limit
4. All other emissions not reported were more than 25dB below the permitted limit.
5. Measurement uncertainty estimated at ±4.728 dB.
   The measurement uncertainty is given with a confidence of 95.00 % with the coverage factor, k=2.

7. Sample Calculation and Other Information

7.1 Sample Calculations

$$dB\mu V = 20 \log 10 (\mu V/m)$$

$$\mu V = 10^{(dB\mu V/20)}$$

EX. 1.

@ 36.25 MHz Class B limit = 40.00 dBμV/m

Reading = 48.42dBμV(calibrated level)
Antenna factor + Cable Loss + AMP Gain = -12.03 dB
Total = 36.40 dBμV/m
$10^{(43.12/20)}$ = μV/m
Margin = 36.40 – 40.00 = -3.60 dB
3.60 dB ; below limit

8. TEST EQUIPMENTS LIST

The listing below denotes the test equipments utilized for the test(s).

Equipment Type	Model	Manufacture	Serial No	Cal Due Date	Use
Test Receiver	ESPI	ROHDE & SCHWARZ	100063	01. 19. 2013	☒
#1 Conducted Cable_2.6m	N/A	N/A	N/A	N/A	☒
LISN	ENV216	ROHDE & SCHWARZ	100324	01. 19. 2013	☒
Impuls-Begrenzer Pulse Limiter	ESH3-Z2	ROHDE & SCHWARZ	100092	01. 19. 2013	☒
Bilog Antenna	VULB 9160	SCHWARZBECK	9160-3122	11. 22. 2013	☒
EMI Receiver	ESVN30	ROHDE & SCHWARZ	832854/010	01. 19. 2013	☒
AMPLIFIER	8447F	H.P	2805A02893	01. 18. 2013	☒
Open Site Cable_0.5m	RG 214/U	SUHNER SWITZERLAND	509794	N/A	☒
Open Site Cable_33m	SUCOTEST 18A	Hubersuhner	8400/18A	N/A	☒
Antenna Master	JAC-3	DAIL EMC	N/A	N/A	☒
Antenna Turntable Controller	JAC-2	JAEMC	N/A	N/A	☒