RADIO TEST REPORT

Test Report No. : 10309424H-A

Applicant	:	**ALPS ELECTRIC CO., LTD.**
Type of Equipment	:	**Immobilizer base station**
Model No.	:	**TWK1A0028**
Test regulation	:	**FCC Part 15 Subpart C: 2014**
FCC ID	:	**CWTWK1A0028**
Test Result	:	**Complied**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Date of test: June 16 and 18, 2014

Representative test engineer:
Masatoshi Nishiguchi
Engineer
Consumer Technology Division

Approved by:
Masanori Nishiyama
Manager
Consumer Technology Division

NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap

REVISION HISTORY

Original Test Report No.: 10309424H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10309424H-A	June 25, 2014	-	-

UL Japan, Inc.
Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
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SECTION 1: Customer information

Company Name	:	ALPS ELECTRIC CO., LTD.
Address	:	6-3-36, Nakazato, Furukawa, Osaki-city, Miyagi-pref, 989-6181, Japan
Telephone Number	:	+81-229-23-5111
Facsimile Number	:	+81-229-23-5129
Contact Person	:	Toshiya Ikarashi

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Immobilizer base station
Model No.	:	TWK1A0028
Serial No.	:	Refer to Section 4, Clause 4.2
Receipt Date of Sample	:	June 10, 2014
Country of Mass-production	:	Mexico
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model No: TWK1A0028 (referred to as the EUT in this report) is the Immobilizer base station.

General Specification

Clock frequency in the system	:	4MHz

Radio Specification

Equipment Type	:	Transceiver
Frequency of operation	:	125kHz
Type of modulation	:	ASK
Antenna Type	:	Loop Antenna
Method of Frequency Generation	:	Ceramic Resonator
Operating voltage (inner)	:	DC 12.0V
Operating Temperature	:	-40 to +85 deg. C

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C: 2014, final revised on May 1, 2014 and effective June 2, 2014
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted Emission Section 15.209 Radiated emission limits, general requirements

FCC 15.31 (e)
This test was performed with the New Battery (DC 12V) and the constant voltage was supplied to this EUT during the tests. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the vehicle. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.2 Procedures and results

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	Conducted Emission	<FCC> ANSI C63.4:2003 7. AC powerline conducted emission measurements <IC> RSS-Gen 7.2.4	<FCC> Section 15.207 <IC> RSS-Gen 7.2.4	-	N/A *1)	N/A	N/A
2	Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> RSS-Gen 4.8, 4.11	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 7.2.5	Radiated	N/A	18.7dB 0.12500MHz 0 deg. PK with Duty factor	Complied
3	Electric Field Strength of Spurious Emission	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> RSS-Gen 4.9, 4.11	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 7.2.5	Radiated	N/A	1.1dB 48.283MHz, Vertical, QP	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> -	<FCC> Reference data <IC> -	Radiated	N/A	N/A	N/A

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

3.3 Addition to standard

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99% Occupied Band Width	RSS-Gen 4.6.1	RSS-Gen 4.6.1	Radiated	N/A	N/A	N/A

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI
The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

Test room (semi-anechoic chamber)	**Radiated emission**						
	(3m*)(±dB)				**(1m*)(±dB)**		**(0.5m*)(±dB)**
	9kHz -30MHz	30MHz -300MHz	300MHz -1GHz	1GHz -10GHz	10GHz -18GHz	18GHz -26.5GHz	26.5GHz -40GHz
No.1	4.0dB	5.1dB	5.0dB	5.1dB	6.0dB	4.9dB	4.3dB
No.2	3.9dB	5.2dB	5.0dB	4.9dB	5.9dB	4.7dB	4.2dB
No.3	4.3dB	5.1dB	5.2dB	5.2dB	6.0dB	4.8dB	4.2dB
No.4	4.6dB	5.2dB	5.0dB	5.2dB	6.0dB	5.7dB	4.2dB

*3m/1m/0.5m = Measurement distance

Radiated emission test(3m)
[Electric Field Strength of Fundamental Emission]
The data listed in this test report has enough margin, more than the site margin.

[Electric Field Strength of Spurious Emission]
The data listed in this report meets the limits unless the uncertainty is taken into consideration.

3.5 Test Location

UL Japan, Inc. Ise EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999 Facsimile : +81 596 24 8124

	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7m	7.0 x 6.0m	No.1 Power source room
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.3 Preparation room
No.3 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.4 Preparation room
No.4 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9m	6.0 x 6.0m	-
No.6 shielded room	-	4.0 x 4.5 x 2.7m	4.0 x 4.5 m	-
No.6 measurement room	-	4.75 x 5.4 x 3.0m	4.75 x 4.15 m	-
No.7 shielded room	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	3.1 x 5.0 x 2.7m	N/A	-
No.9 measurement room	-	8.0 x 4.6 x 2.8m	2.4 x 2.4m	-
No.11 measurement room	-	6.2 x 4.7 x 3.0m	4.8 x 4.6m	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Data of EMI, Test instruments, and Test set up

Refer to APPENDIX.

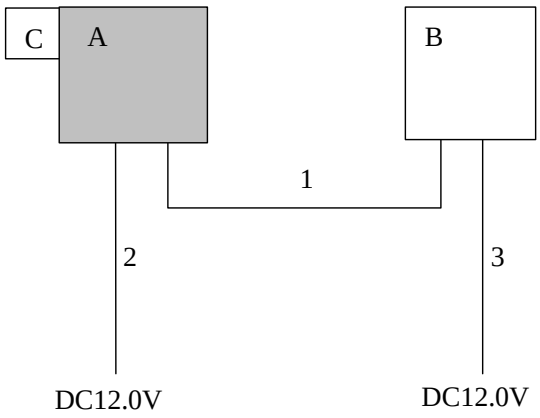
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

Test mode	Remarks
Transmitting mode (Tx)	125kHz

Justification : The system was configured in typical fashion (as a user would normally use it) for testing.

4.2 Configuration and peripherals



* Cabling and setup were taken into consideration and test data was taken under worse case conditions.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Immobilizer base station	TWK1A0028	14060907	ALPS ELECTRIC CO., LTD.	EUT
B	Jig Box	-	14060908	ALPS ELECTRIC CO., LTD.	-
C	Transponder	-	F2	ALPS ELECTRIC CO., LTD.	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	1.25	Unshielded	Unshielded	-
2	DC Cable	2.20	Unshielded	Unshielded	-
3	DC Cable	2.00	Unshielded	Unshielded	-

SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure
The Radiated Electric Field Strength intensity has been measured on No. 3 semi anechoic chamber with a ground plane and at a distance of 3m.

Frequency : From 9kHz to 30MHz at distance 3m
The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for vertical polarization (antenna angle: 0deg., 45deg., 90deg., 135 deg., and 180 deg.) and horizontal polarization.
*Refer to Figure 1 about Direction of the Loop Antenna.

Frequency : From 30MHz to 1GHz at distance 3m
The measuring antenna height varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for both vertical and horizontal antenna polarization.

Measurements were performed with a QP, PK, and AV detector.
The radiated emission measurements were made with the following detector function of the test receiver (below 1GHz).

	From 9kHz to 90kHz and From 110kHz to 150kHz	From 90kHz to 110kHz	From 150kHz to 490kHz	From 490kHz to 30MHz	From 30MHz to 1GHz
Detector Type	PK/AV	QP	PK/AV	QP	QP
IF Bandwidth	200Hz	200Hz	9kHz	9kHz	120kHz
Distance factor *1)	-80dB	-80dB	-80dB	-40dB	-

*1) -80dB = 40 x log (3m/300m)
-40dB = 40 x log (3m /30m)

- The carrier level was measured at each position of all three axes X, Y and Z, and the position that has the maximum noise was determined.
With the position, the noise levels of all the frequencies were measured.

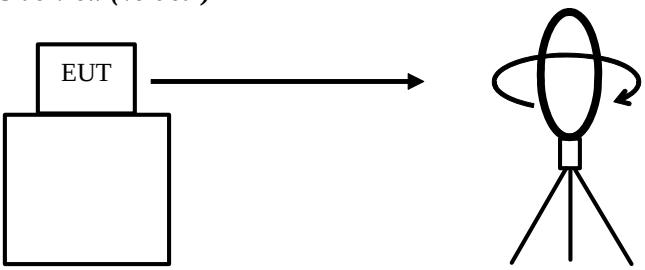
This EUT has two modes which transponder is attached to the EUT or not. The worst case was confirmed with and without transponder, as a result, the test without transponder was the worst case. Therefore the test without transponder was performed only.

Test data : APPENDIX 1
Test result : Pass

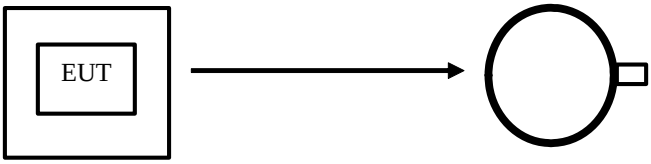
Date: June 16, 2014 Test engineer: Takumi Shimada
June 18, 2014 Masatoshi Nishiguchi

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

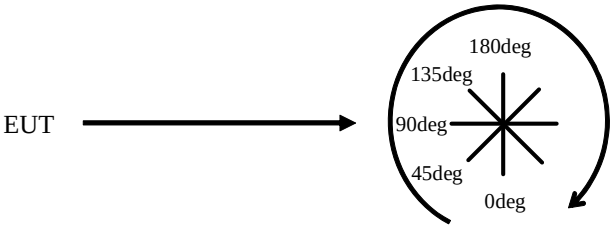


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

SECTION 6: -26dB Bandwidth

Test Procedure

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26dB Bandwidth	100kHz	1kHz	3kHz	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1
Test result : Pass

SECTION 7: 99% Occupied Bandwidth

Test Procedure

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
99% Occupied Bandwidth	Enough width to display 20dB Bandwidth	1 % of Span	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1
Test result : Pass

APPENDIX 1: Data of EMI test

Radiated Emission below 30MHz (Fundamental and Spurious Emission)

Test place	Ise EMC Lab. No.3 Measurement Room
Order No.	10309424H
Date	06/16/2014
Temperature/ Humidity	25 deg. C / 40% RH
Engineer	Takumi Shimada
Mode	Tx 125kHz

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	93.8	19.5	-74.1	32.3	-	6.9	45.6	38.7	Fundamental
0	0.25000	PK	67.2	19.3	-74.0	32.2	-	-19.7	39.6	59.3	
0	0.37500	PK	67.5	19.5	-74.0	32.2	-	-19.2	36.1	55.3	
0	0.50000	QP	36.7	19.5	-34.0	32.2	-	-10.0	33.6	43.6	
0	0.62500	QP	40.6	19.3	-34.0	32.2	-	-6.3	31.7	38.0	
0	0.75000	QP	35.1	19.4	-34.0	32.2	-	-11.7	30.1	41.8	
0	0.87500	QP	34.0	19.6	-34.0	32.2	-	-12.6	28.7	41.3	
0	1.00000	QP	33.6	19.6	-34.0	32.2	-	-13.0	27.6	40.6	
0	1.12500	QP	34.8	19.6	-34.0	32.2	-	-11.8	26.5	38.3	
0	1.25000	QP	31.9	19.6	-33.9	32.2	-	-14.6	25.6	40.2	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier)

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	93.8	19.5	-74.1	32.3	0.0	6.9	25.6	18.7	
0	0.25000	PK	67.2	19.3	-74.0	32.2	0.0	-19.7	19.6	39.3	
0	0.37500	PK	67.5	19.5	-74.0	32.2	0.0	-19.2	16.1	35.3	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier) + Duty factor *

* Since the peak emission result satisfied the average limit, the peak emission result with Duty Factor was calculated as Duty 100%.

Result of the fundamental emission at 3m without Distance factor

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	93.8	19.5	5.9	32.2	-	87.0	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amprifier)

* All spurious emissions lower than this result.
* The pre amplifier used for carrier frequency measurement was not saturated.

Radiated Emission above 30MHz (Spurious Emission)

DATA OF RADIATED EMISSION TEST

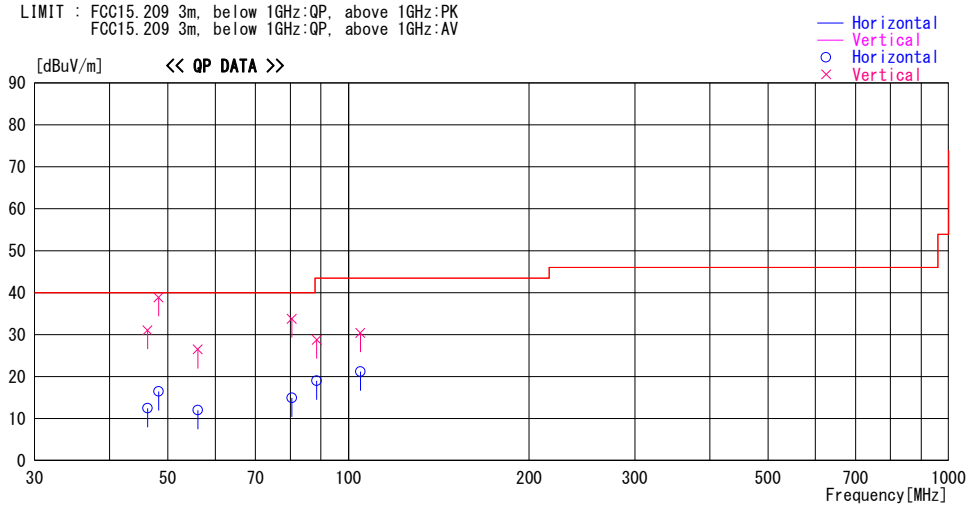
UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2014/06/18

Report No. : 10309424H

Temp./Humi. : 25deg. C / 52% RH
Engineer : Masatoshi Nishiguchi

Mode / Remarks : Tx 125kHz Worst-axis(Hori:X Vert:X)

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
FCC15.209 3m, below 1GHz:QP, above 1GHz:AV



Frequency	Reading	DET	Antenna Factor	Loss& Gain	Level	Angle	Height	Polar.	Limit	Margin	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
48.283	29.9	QP	11.5	-24.9	16.5	118	349	Hori.	40.0	23.5	
48.283	52.3	QP	11.5	-24.9	38.9	159	100	Vert.	40.0	1.1	
46.268	25.2	QP	12.2	-24.9	12.5	272	347	Hori.	40.0	27.5	
46.268	43.8	QP	12.2	-24.9	31.1	271	100	Vert.	40.0	8.9	
56.100	27.8	QP	9.0	-24.8	12.0	351	356	Hori.	40.0	28.0	
56.100	42.3	QP	9.0	-24.8	26.5	122	100	Vert.	40.0	13.5	
80.473	32.8	QP	6.4	-24.3	14.9	9	360	Hori.	40.0	25.1	
80.473	51.7	QP	6.4	-24.3	33.8	129	111	Vert.	40.0	6.2	
88.523	35.3	QP	7.9	-24.2	19.0	197	211	Hori.	43.5	24.5	
88.523	45.1	QP	7.9	-24.2	28.8	102	123	Vert.	43.5	14.7	
104.700	34.5	QP	10.8	-24.1	21.2	101	291	Hori.	43.5	22.3	
104.700	43.7	QP	10.8	-24.1	30.4	188	100	Vert.	43.5	13.1	

CHART:WITH FACTOR ANT TYPE: -30MHz:LOOP, 30-300MHz:BICONICAL, 300MHz-1000MHz:LOGPERIODIC, 1000MHz-:HORN
CALCULATION:Result=Reading + ANT Factor + Loss (Cable + ATTEN. - AMP)

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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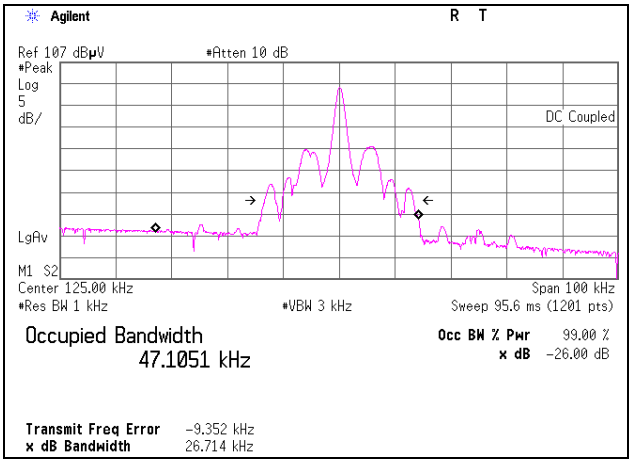
-26dB Bandwidth and 99% Occupied Bandwidth

Test place	Ise EMC Lab. No.3 Measurement Room
Order No.	10309424H
Date	06/16/2014
Temperature/ Humidity	25 deg. C / 40% RH
Engineer	Takumi Shimada
Mode	Tx 125kHz

-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
26.714	47.1051



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APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2014/02/27 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2014/02/20 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MRENT-116	Spectrum Analyzer	Agilent	E4440A	MY46187620	RE	2014/03/05 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2013/08/20 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2013/10/30 * 12
MCC-112	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(3m)/ sucoform141-PE(1m)/ 421-010(1.5m)/ RFM-E321(Switcher)	-/00640	RE	2013/07/23 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2013/07/22 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2014/03/14 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2014/04/14 * 12
MRENT-114	Spectrum Analyzer	Agilent	E4440A	MY46187105	RE	2013/11/11 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2013/10/13 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	174	RE	2013/10/13 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2013/07/23 * 12

The expiration date of the calibration is the end of the expired month.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test Item:

RE: Spurious emission