

Test report No. : 12208121H-B-R1
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Issued date : June 6, 2018
FCC ID : 2AOTF-0000004

### **EMI TEST REPORT**

**Test Report No.: 12208121H-B-R1** 

Applicant : M-SYSTEM CO., LTD

Type of Equipment : WIRELESS INPUT UNIT

Model No. : WL40W1F-DS2

FCC ID : 2AOTF-0000004

Test regulation : FCC Part 15 Subpart B: 2018 Class A

Test Result : Complied

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- 2. The results in this report apply only to the sample tested.
- 3. This sample tested is in compliance with the above regulation.
- 4. The test results in this report are traceable to the national or international standards.
- 5. This test report covers EMC technical requirements. It does not cover administrative issues such as Manual or non-EMC test related Requirements. (if applicable)
- 6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
- 7. 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.
- 8. This report is a revised version of 12208121H-B. 12208121H-B is replaced with this report.

Date of test:

Representative test engineer:

May 10, 2018

Shuichi Ohyama

Engineer

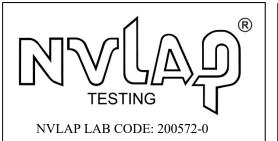
Consumer Technology Division

Approved by:

Satofumi Matsuyama

Engineer

Consumer Technology Division



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://japan.ul.com/resources/emc accredited/

The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.

There is no testing item of "Non-accreditation".

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### **REVISION HISTORY**

Original Test Report No.: 12208121H-B

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12208121H-B	May 18, 2018	-	-
1	12208121H-B-R1	June 6, 2018	P. 4	Addition of General specification of Clause 2.2
1	12208121H-B-R1	June 6, 2018	P. 7	Addition of note in Remarks of Clause 4.1
1	12208121H-B-R1	June 6, 2018	P. 7	Deletion of notes in the diagram of Clause 4.2
1	12208121H-B-R1	June 6, 2018	P. 8	Correction of Cable name (No.3 and No.4) in "List of cables used"
	<u> </u>	1		

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#### **SECTION 1:** Customer information

Company Name : M-SYSTEM CO., LTD

Address : 5-2-55 MINAMITSUMORI, NISHINARI-KU, OSAKA, 557-0063

JAPAN

Telephone Number : +81-6-6659-8258 Facsimile Number : +81-6-6659-8514 Contact Person : Juri Sugiyama

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

#### 2.1 Identification of E.U.T.

Type of Equipment : WIRELESS INPUT UNIT

Model No. : WL40W1F-DS2

Serial No. : Refer to Section 4, Clause 4.2

Rating : DC 24 V
Receipt Date of Sample : May 8, 2018
Country of Mass-production : Japan

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: WL40W1F-DS2 (referred to as the EUT in this report) is a WIRELESS INPUT UNIT.

#### **General Specification**

Clock frequency(ies) in the system : 80 MHz (max.)

#### **Radio Specification**

	IEEE802.15.4g
Frequency of operation	902 MHz - 928 MHz
Type of modulation	GFSK
Channel spacing	0.6 MHz
Antenna type	sleeve antenna (model: MH920-ANT-F(S))
	rooftop antenna (model: MH920-ANT-F(R))
Antenna Connector type	Connector for connecting antenna
Antenna Gain	3 dBi (max) (sleeve antenna)
	2 dBi (max) (rooftop antenna)
Clock frequency (maximum)	928 MHz

<sup>\*</sup> The RF module is a FCC certificated module made by Oki Electric Industry Co., Ltd. Model number:

MH920-Mod-F

(FCC ID: 2AKGW-1TD3016A1).

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#### **SECTION 3:** Test specification, procedures & results

#### 3.1 Test Specification

Test Specification : FCC Part 15 Subpart B

FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018

Title : FCC 47CFR Part15 Radio Frequency Device

Subpart B Unintentional Radiators

#### 3.2 Procedures and results

Item	Test Procedure	Limits Deviation		Worst margin Result					
Conducted emission	FCC: ANSI C63.4: 2014 7. AC power - line conducted emission measurements IC: ICES-003 Issue 6: 2016 + Amendment 1: 2017	Class A	N/A	[QP] 22.3 dB 18.67563 MHz, N [AV] 9.5 dB 18.67563 MHz, N	Complied				
Radiated emission	8. Radiated emission measurements IC: ICES-003 Issue 6: 2016 + Amendment 1: 2017	Class A	N/A	12.0 dB 454.722 MHz, QP Horizontal	Complied				
*Note: UL Japan, Inc's	EMI Work Procedure 13-EM-W042	20.							
	e e e e e e e e e e e e e e e e e e e	Symbols: Complied The data of this test item has enough margin, more than the measurement uncertainty.							

Addition to standard

No addition, exclusion nor deviation has been made from the standard.

#### 3.4 Uncertainty

#### EMI

3.3

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

#### **Conducted emission**

using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.8 dB
	0.15 MHz to 30 MHz	3.4 dB

#### **Radiated emission**

Measurement distance	Frequency	Uncertainty (+/-)	
10 m	30 MHz to 200 MHz	(Horizontal)	4.8 dB
		(Vertical)	4.9 dB
	200 MHz to 1000 MHz	(Horizontal)	5.0 dB
		(Vertical)	5.0 dB
3 m	1 GHz to 6 GHz		5.0 dB
	6 GHz to 18 GHz		5.3 dB

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#### 3.5 Test Location

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NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.6 shielded room	-	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	-	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	-	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	-	3.1 x 5.0 x 2.7	N/A	-	-
No.9 measurement room	-	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	-	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

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

#### 3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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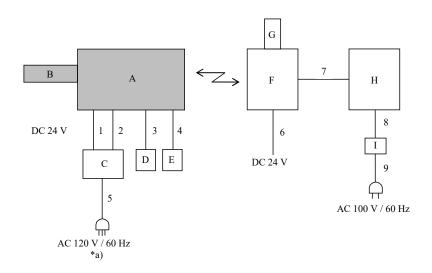
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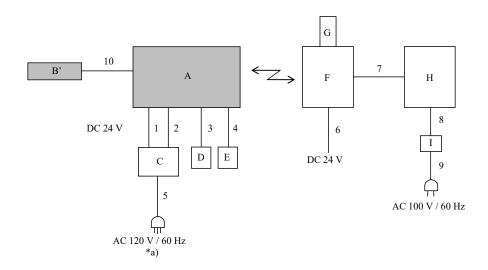
### **SECTION 4:** Operation of E.U.T. during testing

#### 4.1 **Operating Mode(s)**

Mo	ode	Remarks
1)	Communication mode	- 920 MHz band wireless communication
		- wired communication with ISO lated Pot Tarnsmitter

#### 4.2 Configuration and peripherals





<sup>\*</sup> Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

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<sup>\*</sup>a) Conducted emission test was performed on this port

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**Description of EUT and Support equipment** 

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	WIRELESS	WL40W1F-DS2	P-34961	M-SYSTEM CO., LTD	EUT
	INPUT UNIT				
В	sleeve antenna	MH920-ANT-F(S)	001	OKI	-
B'	rooftop antenna	MH920-ANT-F(R)	001	OKI	-
C	DC Power Supply	PMC35-2A	13090501	KIKUSUI	*1)
D	ISO lated Pot	B5MS	7J008671	M-SYSTEM CO., LTD	-
	Transmitter				
E	ISO lated Pot	B5MS	1L028817	M-SYSTEM CO., LTD	-
	Transmitter				
F	Wireless Gateway	WL40EW2F-R	P-34762	M-SYSTEM CO., LTD	-
G	Sleeve antenna	MH920-ANT-F(S)	-	OKI	-
Н	Laptop PC	2672-C2J	99-PPBKH	IBM	-
I	AC Adapter	08K8212	11S08K8212Z1Z7	IBM	-
			UB4160FD		

<sup>\*1)</sup> Used for Conducted Emission test only

#### List of cables used

List U	cables useu				
No.	Name	Length (m)	Shi	eld	Remarks
			Cable	Connector	
1	DC Cable	1.0	Unshielded	Unshielded	-
2	Earth cable	1.0	Unshielded	Unshielded	-
3	DC and Signal Cable	1.0	Unshielded	Unshielded	-
4	DC and Signal Cable	1.0	Unshielded	Unshielded	=
5	AC Cable	1.5	Unshielded	Unshielded	*1)
6	DC Cable	1.5	Unshielded	Unshielded	-
7	LAN Cable	3.0	Shielded	Shielded	-
8	DC Cable	1.8	Unshielded	Unshielded	-
9	AC Cable	0.9	Unshielded	Unshielded	-
10	Antenna Cable	2.5	Shielded	Shielded	-

<sup>\*1)</sup> Used for Conducted Emission test only

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#### **SECTION 5: Conducted Emission**

#### 5.1 Operating environment

Test place : No.1 semi anechoic chamber

Temperature : See data Humidity : See data

#### 5.2 Test configuration

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.

The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT and its peripherals was aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from the LISN/AMN and excess AC cable was bundled in center. I/O cables that were connected to the other peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN/AMN to the input power source. All unused 50 ohm connectors of the LISN/AMN were resistivity terminated in 50 ohm when not connected to the measuring equipment. Photographs of the set up are shown in Appendix 3.

Frequency range : 0.15 MHz - 30 MHz

EUT position : Table top EUT operation mode : See Clause 4.1

#### 5.3 Test procedure

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT within a semi anechoic chamber. The EUT was connected to a Line Impedance Stabilization Network (LISN)/ Artificial Mains network (AMN). An overview sweep with peak detection has been performed. The measurements have been performed with a quasi-peak detector and if required, with an average detector.

The conducted emission measurements were made with the following detector function of the test receiver.

Detector Type : Quasi-Peak and CISPR AV

IF Bandwidth : 9 kHz

#### 5.4 Test result

Summary of the test results: Pass

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

Date: May 10, 2018 Test engineer: Shuichi Ohyama

UL Japan, Inc. Ise EMC Lab.

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#### **SECTION 6: Radiated Emission**

#### 6.1 Operating environment

Test place : No.1 semi anechoic chamber

Temperature : See data Humidity : See data

#### 6.2 Test configuration

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.

The EUT was set on the edge of the tabletop.

Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength.

Photographs of the set up are shown in Appendix 3.

#### 6.3 Test conditions

Frequency range : 30 MHz - 200 MHz (Biconical antenna) / 200 MHz - 1000 MHz (Logperiodic antenna)

1000 MHz - 5000 MHz (Horn antenna)

Test distance : 10 m (30 MHz - 1000 MHz) / 3 m (1000 MHz - 5000 MHz)

EUT position : Table top EUT operation mode : See Clause 4.1

#### 6.4 Test procedure

The height of the measuring antenna varied between 1 and 4 m 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 with the Test Receiver. The radiated emission measurements were made with the following detector function of the Test Receiver.

Frequency	Below 1GHz	Above 1GHz *1)
Instrument used	Test Receiver	Test Receiver
IF Bandwidth	QP: BW 120 kHz	PK: BW 1 MHz, CISPR AV: BW 1 MHz

<sup>\*1)</sup> The measurement data was adjusted to a 10 m distance using the following Distance Factor. Distance Factor: 20 x log (3.8 m / 10 m) = -8.4 dB

The test was made on EUT at the normal use position.

#### 6.5 Test result

Summary of the test results: Pass

The limit is rounded down to one decimal place.

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

Date: May 10, 2018 Test engineer: Shuichi Ohyama

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#### **APPENDIX 1:** Test data

#### **Conducted Emission**

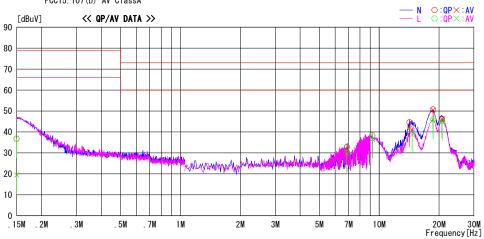
Report No. 12208121H Test place Ise EMC Lab.

Semi Anechoic Chamber No.1

Date May 10, 2018
Temperature / Humidity 25 deg. C / 34 % RH
Engineer Shuichi Ohyama

Mode Mode 1

LIMIT : FCC15.107(b) QP ClassA FCC15.107(b) AV ClassA



F	Reading	Level	Corr.	Resu	ılts	Lin	nit	Mar	gin		
Frequency	QP	AV	Factor	QP	AV	QP	AV	QP	ΑV	Phase	Comment
[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
0. 15000	23. 6	6.4	13. 1	36. 7	19.5	79.0	66. 0	42.3	46. 5	N	
6.87643	18.8	15. 9	14. 0	32. 8	29. 9	73.0	60.0	40. 2	30. 1	N	
9. 23544	24. 3	22. 5	14. 1	38. 4	36. 6	73.0	60.0	34.6	23.4	N	
14. 22884	30. 2	27. 5	14. 4	44. 6	41.9	73.0	60.0	28. 4	18. 1	N	
18.67563	36.0	35. 8	14. 7	50. 7	50. 5	73.0	60.0	22. 3	9.5	N	
20. 71669	31.4	31.4	14. 8	46. 2	46. 2	73.0	60.0	26.8	13.8	N	
0. 15000	23. 7	6.4	13. 1	36.8	19. 5	79.0	66. 0	42. 2	46.5	L	
6. 87448	18.5	15. 7	14. 0	32. 5	29. 7	73.0	60.0	40.5	30.3	L	
9. 23640	24. 3	22. 4	14. 1	38. 4	36. 5	73.0	60.0	34. 6	23. 5	L	
14. 63764	26. 6	24. 3	14. 4	41.0	38. 7	73.0	60.0	32.0	21.3	L	
18. 6771 4	31.4	31.1	14. 7	46. 1	45. 8	73.0	60.0	26.9	14. 2	L	
20. 76402	30. 3	30. 2	14. 8	45. 1	45. 0	73.0	60.0	27. 9	15.0	L	

CHART: WITH FACTOR Peak hold data. CALCULATION: RESULT = READING + C.F (LISN + CABLE + ATT) Except for the above table: adequate margin data below the limits.

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#### **Radiated emission**

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Semi Anechoic Chamber No.1

Date May 10, 2018
Temperature / Humidity 25 deg. C / 34 % RH
Engineer Shuichi Ohyama
(Below 1 GHz)

Mode Mode 1



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]	001111101110
81. 228		QP	6. 9	-30. 7		142		Vert.	39. 0	19. 2	
82. 962	36.0	QP	7. 2	-30. 7	12.5	157	400	Hori.	39. 0	26. 5	
168. 796	29. 9	QP	15. 8	-29.7	16.0	359	400	Hori.	43. 5	27. 5	
168. 649	34.0	QP	15. 8	-29.7	20. 1	0	100	Vert.	43. 5	23. 4	
250.000	41.0	QP	11.5	-28.8	23. 7	355	400	Hori.	46. 4	22. 7	
254. 509	39.6	QP	11. 7	-28.8	22. 5	63	100	Vert.	46. 4	23. 9	
300.000	43.1	QP	13. 4	-28. 3	28. 2	38	100	Vert.	46. 4	18. 2	
300.000	39. 5	QP	13. 4	-28.3	24. 6	0	326	Hori.	46. 4	21. 8	
400.000	39. 3	QP	15. 5	-27. 3	27. 5	246	100	Vert.	46. 4	18. 9	
400.000	37. 0	QP	15. 5	-27. 3	25. 2	279	318	Hori.	46. 4	21. 2	
454. 772	44. 7	QP	16.6	-26. 9	34. 4	201	281	Hori.	46. 4	12. 0	
454. 772	37. 9	QP	16. 6	-26. 9	27. 6	338	100	Vert.	46. 4	18. 8	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -:

HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + ATT - GAIN(AMP))

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#### **Radiated emission**

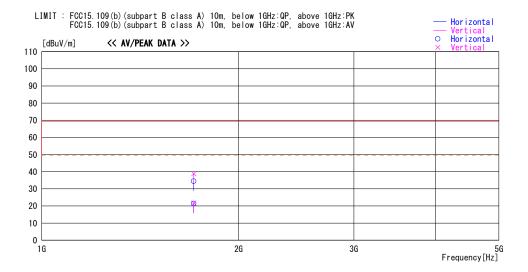
12208121H Report No. Test place Ise EMC Lab.

Semi Anechoic Chamber No.1

May 10, 2018 25 deg. C / 34 % RH Temperature / Humidity Shuichi Ohyama Engineer (Above 1 GHz)

Mode 1

Mode



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]	
1707. 609		PK	26. 4	-42. 9		82	100	Hori.	69. 5		
1707. 609	38. 0	AV	26. 4	-42. 9		82		Hori.	49. 5	28. 0	
1707. 609			26. 4	-42. 9		58		Vert.	69. 5		
1707. 609	38. 2	AV	26. 4	-42. 9	21.7	58	100	Vert.	49. 5	27. 8	
			i I								
l											
			1 1								

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -:

CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE - GAIN(AMP) + D-factor)

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#### **APPENDIX 2:** Test instruments

#### **Test Instruments**

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
CE	141290	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	12/19/2017	12/31/2018	12
CE	141537	LISN(AMN)	Schwarzbeck	NSLK8127	8127-731	7/21/2017	7/31/2018	12
CE	141925	Terminator	TME	CT-01	-	11/9/2017	11/30/2018	12
CE	141215	Coaxial Cable	Fujikura/Suhner /TSJ	5D-2W/ 3D-2W/RG400u/ RFM-E421(SW)	-/01068 (Switcher)	6/26/2017	6/30/2018	12
RE	141213	Attenuator(6dB)	Weinschel Corp	2	BK7971	11/14/2017	11/30/2018	12
RE	141198	Biconical Antenna	Schwarzbeck	BBA9106	2513	11/23/2017	11/30/2018	12
RE	141350	Coaxial Cable	Suhner/storm/ Agilent/TSJ	=	-	9/26/2017	9/30/2018	12
RE	141264	Logperiodic Antenna(200-100 0MHz)	Schwarzbeck	VUSLP9111B	911B-189	1/30/2018	1/31/2019	12
RE	141585	Pre Amplifier	MITEQ	MLA-10K01-B01 -35	1237616	2/19/2018	2/27/2019	12
RE	141511	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	253	5/21/2017	5/30/2018	12
RE	141393	Microwave Cable	Junkosha	MWX221	1604S254(1 m) / 1608S088(5 m)	8/3/2017	8/31/2018	12
RE	141576	Pre Amplifier	AGILENT	8449B	3008A01671	2/16/2018	2/28/2019	12
RE.CE	142226	Measure	KOMELON	KMC-36	-	-	-	-
RE.CE	141530	Digital Tester	Fluke Corporation	FLUKE 26-3	78030621	8/7/2017	8/31/2018	12
RE.CE	141950	EMI Test Receiver	ROHDE & SCHWARZ	ESU26	100412	6/27/2017	6/30/2018	12
RE.CE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE.CE	141998	AC1_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	9/30/2017	9/30/2018	12
RE.CE	141566	Thermo- Hygrometer	CUSTOM	CTH-201	A08Q26	1/24/2018	1/31/2019	12

<sup>\*</sup>Hyphens for Last Calibration Date, Calibration Due Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

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:

**CE:** Conducted emission **RE:** Radiated emission

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