

TEST REPORT

KCTL Inc.

65, Sinwon-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 443-390, Korea
TEL: 82 70 5008 1021
FAX: 82 505 299 8311

Report No.: KCTL15-FR0089

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KCTL
<http://www.kctl.co.kr>

1. Applicant

Name: CHANG SHIN INFOTEL CO.,LTD.
Address: 3F, Yonhap News Bldg, 64, Deadeok-Daero, 168beon-gil,
seo-gu, Deajeon, South Korea

2. Sample Description:

FCC ID: 2ABZV-SG-2100
Type of equipment: Access Controlled Security System with Zigbee & RFID
Basic Model: SG-2100



3. Date of Test: December 7 ~ December 10, 2015

4. Test method used: FCC Part 15 Subpart C 15.225

5. Test Results

Test Item: Refer to page 6
Result: Refer to page 7 ~ page 18
Measurement Uncertainty: Refer to page 6

This result shown in this report refers only to the sample(s) tested unless otherwise stated.

Affirmation	Tested by	Technical Manager
	 Name: NAM, TAEK YONG	 Name: SON, MIN GI

2015. 12. 11

KCTL Inc. Testing Laboratory

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1. Client information

Applicant: CHANG SHIN INFOTEL CO.,LTD.
Address: 3F, Yonhap News Bldg, 64, Deadeok-Daero, 168beon-gil, seo-gu,
Deajeon, South Korea
Telephone number: +82-42-532-1551
Facsimile number: +82-42-532-1766
Contact person: Chan Hyuk Ryu / chryu@csinfotel.com

Manufacturer: CHANG SHIN INFOTEL CO.,LTD.
Address: 3F, Yonhap News Bldg, 64, Deadeok-Daero, 168beon-gil, seo-gu,
Deajeon, South Korea

2. Laboratory information

Address

KCTL Ltd.

65 Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea

Telephone Number: 82-70-5008-1016 Facsimile Number: 82-505-299-8311

Certificate

KOLAS No.: 231

FCC Site Designation No.: KR0040

FCC Site Registration No.: 687132

VCCI Site Registration No.: R-3327, G-198, C-3706, T-1849

IC Site Registration No.:8035A-2

SITE MAP



3. Description of E.U.T.

3.1 Basic description

Applicant:	CHANG SHIN INFOTEL CO.,LTD.
Address of Applicant	3F, Yonhap News Bldg, 64, Deadeok-Daero, 168beon-gil, seo-gu, Deajeon, South Korea
Manufacturer	CHANG SHIN INFOTEL CO.,LTD.
Address of Manufacturer	3F, Yonhap News Bldg, 64, Deadeok-Daero, 168beon-gil, seo-gu, Deajeon, South Korea
Type of equipment	Access Controlled Security System with Zigbee & RFID
Basic Model	SG-2100
Serial number	N/A

3.2 General description

Operating Frequency	13.560 MHz
Frequency Range	2 405 MHz ~ 2 480 MHz (Zigbee), 13.560 MHz (RFID 13.56)
Type of Modulation	O-QPSK (Zigbee), ASK (RFID 13.56)
Number of Channels	6 ch (Zigbee), 1 ch (RFID 13.56)
Type of Antenna	PCB Pattern Antenna
Power supply	DC 48 V(PoE), DC 12 V
Operating Temperature	-20℃ ~ 50℃
Product SW/HW version	1.0
Radio SW/HW version	1.0
Test SW Version	Teraterm_version 2.3
RF power setting in TEST SW	N/A

Note : The above EUT information was declared by the manufacturer.

3.3 Test frequency

Frequency	13.560 MHz
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4. Summary of test results

4.1 Standards & results

Rule Reference	Parameter	Status
15.203	Antenna Requirement	C
15.225 (a)	In-band Fundamental Emission	C
15.225 (b)	In-band Spurious Emission	C
15.225 (c)	In-band Spurious Emission	C
15.225 (d) 15.209	Out-of-band Spurious Emission	C
15.225 (e)	Frequency Stability Tolerance	C
15.207	Conducted Emissions	C
Note: C=complies NC= Not complies NT=Not tested NA=Not Applicable		

4.2 Uncertainty

Measurement Item	Expanded Uncertainty $U = kU_c (k = 2)$	
Radiated Spurious Emissions	30 MHz ~ 300 MHz:	+ 4.94 dB, - 5.06 dB
		+ 4.93 dB, - 5.05 dB
	300 MHz ~ 1 000 MHz:	+ 4.97 dB, - 5.08 dB
		+ 4.84 dB, - 4.96 dB
Conducted Emissions	9 kHz ~ 150 kHz:	3.75 dB
	150 kHz ~ 30 MHz:	3.36 dB

5. Test results

5.1 Antenna Requirement

5.1.1 Regulation

According to §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.1.2 Result

-Complied

The PCB Pattern Antenna is permanantly attached on PCB board.

5.2 In-band Fundamental Emission

5.2.1 Minimum Standard

15.225 (a) The field strength of any emission within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

5.2.2 Measurement Procedure

Test Procedure The Radiated Electric Field Strength intensity has been measured on semi anechoic chamber with a ground plane and at a distance of 3m.

Frequency : From 9 kHz to 30 MHz at distance 3m The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

Frequency : From 30 MHz to 1 GHz 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 1 GHz).

Frequency	9 - 90 kHz	90 - 110 kHz	150 - 490 kHz	490 kHz - 30 MHz	30 MHz -1 GHz
Detector type	PK/AV	QP	PK/AV	QP	QP
IF bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz

* Part 15 Section 15.31 (f)(2) (9 kHz - 30 MHz)

[Limit at 3m]=[Limit at 300m]-40 x log(3[m]/300[m])

[Limit at 3m]=[Limit at 30m]-40 x log (3[m]/30[m])

5.2.3 Test Result

* DC 12 V

- Complies

Voltage [v]	Frequency [MHz]	Reading [dBμV]	Correction Factor [dB]	field strength dBuV/m at 3 m	Limit dBuV/m at 3 m	Margin [dB]
12	13.560	67.0	-12.2	54.8	124	69.2

* DC 48 V(PoE)

- Complies

Voltage [v]	Frequency [MHz]	Reading [dBμV]	Correction Factor [dB]	field strength dBuV/m at 3 m	Limit dBuV/m at 3 m	Margin [dB]
48	13.560	78.3	-12.2	66.1	124	57.9

Note: Field strength limit was calculated with 40 dB/dec

5.3 In-band Spurious Emission

5.3.1 Regulation

15.225 (b) With in the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

15.225 (c) With in the bands 13.110-13.410 MHz and 13.710-14.010 MHz, the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

5.3.2 Test Result

* DC 12 V

- **Complied**

Measurement Distance: 3 m

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
QP DATA.							
13.351	9.0	43.2	H	-12.2	80.5	31.0	49.5
13.553	9.0	65.4	H	-12.2	90.5	53.2	37.3
13.568	9.0	64.6	H	-12.2	90.5	52.4	38.1
13.773	9.0	44.1	H	-12.2	80.5	31.9	48.6

* DC 48 V(PoE)

- **Complied**

Measurement Distance: 3 m

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
QP DATA.							
13.347	9.0	52.5	H	-12.2	80.5	40.3	40.2
31.553	9.0	66.0	H	-12.2	90.5	53.8	36.7
13.568	9.0	65.0	H	-12.2	90.5	52.8	37.7
13.773	9.0	54.6	H	-12.2	80.5	42.4	38.1

Margin (dB) = Limit – Actual

[Result = Reading – Amp Gain + AF + CL]

1. H = Horizontal, V = Vertical Polarization

2. AF/CL = Antenna Factor and Cable Loss

5.4 Out-of-band Spurious Emission

5.4.1 Regulation

15.225 (d) The Field Strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in 15.209

Frequency (MHz)	Field Strength ($\mu V/m$)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30(29.54 dB $\mu V/m$)	30
30.0-88.0	100(40 dB $\mu V/m$)	3
88-216	150(43.5 dB $\mu V/m$)	3
216-960	200 (46 dB $\mu V/m$)	3
Above 960	500 (53.98 dB $\mu V/m$)	3

5.4.2 Measurement Procedure

The spurious emissions from the EUT will be measured on an 10 m Anechoic chamber in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna.

The antenna was positioned 3, 10 or 30 meters horizontally from the EUT.

Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions.

In the case where larger measuring distances are required the results will extrapolated based on the values measuring on the closer distances according to Section 15.31 (f) (2) [2].

The final measurement will be performed with an EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used according to Section 15.209 (d) [2].

The final level, expressed in dB $\mu V/m$, is arrived at by taking the reading from the EMI receiver (Level dB μV) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has to be compared with the relevant FCC limit. The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: ResBW: 200 Hz

150 kHz – 30 MHz: ResBW: 9 kHz

The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.

The EUT was placed on the top of the 0.8 meter height, 1 x 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.

The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 1 000 MHz using the BILOG antenna. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 10 m chamber. The EUT was tested at a distance 3 meters.

Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

5.4.3 Test Result

* DC 12 V

-Complied

Measurement Distance: 3 m

-Below 30 MHz

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
QP DATA.							
0.33	0.2	70.30	H	-13.50	97.23	56.80	40.43
0.99	9.0	53.40	H	-13.50	67.69	39.90	27.79
25.22	9.0	41.00	V	-11.40	69.50	29.60	39.90

-Above 30 MHz

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
QP DATA.							
189.81	120	48.50	H	-18.70	43.5	29.80	13.70
249.95	120	55.40	H	-16.90	43.5	38.50	7.50
265.95	120	50.90	H	-16.10	46.0	34.80	11.20
325.49	120	46.60	H	-14.00	46.0	32.60	13.40
352.53	120	47.60	H	-13.20	46.0	34.40	11.60
374.96	120	46.20	H	-12.60	46.0	33.60	12.40
499.97	120	43.00	V	-9.50	46.0	33.50	12.50
625.10	120	40.80	V	-6.20	46.0	34.60	11.40

Margin (dB) = Limit – Actual

[Result] = Reading – Amp Gain + AF + CL

1. H = Horizontal, V = Vertical Polarization

2. AF/CL = Antenna Factor and Cable Loss

* The spurious emission at the frequency does not fall in the restricted bands.

** The measured result is within the test standard limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95 % level of confidence. However, the result indicates that compliance is more probable than non-compliance.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

* DC 48 V(PoE)

-Complied

Measurement Distance: 3 m

-Below 30 MHz

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
QP DATA.							
0.33	0.2	70.40	H	-13.50	97.23	56.90	40.33
1.00	9.0	53.00	H	-13.50	67.69	39.50	28.19
23.13	9.0	47.60	V	-11.60	69.50	36.00	33.50

-Above 30 MHz

Frequency [MHz]	Receiver Bandwidth [kHz]	Reading [dB(μV)]	Pol. [V/H]	Factor [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
QP DATA.							
30.61	120	51.70	V	-18.80	40.0	32.90	7.10
68.92	120	49.10	H	-18.60	40.0	30.50	9.50
249.95	120	61.10	H	-16.90	46.0	44.20	1.80
265.95	120	50.70	H	-16.10	46.0	34.60	11.40
298.33	120	47.90	H	-14.90	46.0	33.00	13.00
374.95	120	56.90	H	-12.60	46.0	44.30	1.70
499.97	120	45.60	V	-9.50	46.0	36.10	9.90
624.97	120	41.50	V	-6.20	46.0	35.30	10.70

Margin (dB) = Limit – Actual

[Result] = Reading – Amp Gain + AF + CL

1. H = Horizontal, V = Vertical Polarization

2. AF/CL = Antenna Factor and Cable Loss

* The spurious emission at the frequency does not fall in the restricted bands.

** The measured result is within the test standard limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95 % level of confidence. However, the result indicates that compliance is more probable than non-compliance.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

5.5 Frequency tolerance

5.5.1 Regulation

15.225 (e) The frequency tolerance of the carrier signal shall be maintained within ± 0.01 % of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.5.2 Test Result

* DC 12 V

- **Complied**

VOLTAGE [%]	POWER [V]	TEMP [°C]	FREQ [Hz]	FREQ.DEV [Hz]	Deviation [%]
100	12	20	13 560 128	-128	-0.000 94
		-20	13 560 274	-274	-0.002 02
		-10	13 560 275	-275	-0.002 03
		0	13 560 271	-271	-0.002 00
		10	13 560 208	-208	-0.001 53
		20	13 560 197	-197	-0.001 45
		25	13 560 186	-186	-0.001 37
		30	13 560 167	-167	-0.001 23
		40	13 560 149	-149	-0.001 10
		50	13 560 119	-119	-0.000 88
85	10.2	20	13 560 162	-162	-0.001 19
115	13.8	20	13 560 137	-137	-0.001 01

* DC 48 V(PoE)

- **Complied**

VOLTAGE [%]	POWER [V]	TEMP [°C]	FREQ [Hz]	FREQ.DEV [Hz]	Deviation [%]
100	48	20	13 560 138	-138	-0.001 02
		-20	13 560 274	-274	-0.002 02
		-10	13 560 273	-273	-0.002 01
		0	13 560 266	-266	-0.001 96
		10	13 560 207	-207	-0.001 53
		20	13 560 204	-204	-0.001 50
		25	13 560 180	-180	-0.001 33
		30	13 560 173	-173	-0.001 28
		40	13 560 142	-142	-0.001 05
		50	13 560 100	-100	-0.000 74
85	10.2	20	13 560 165	-165	-0.001 22
115	13.8	20	13 560 139	-139	-0.001 03

5.6 Conducted Emission

5.6.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

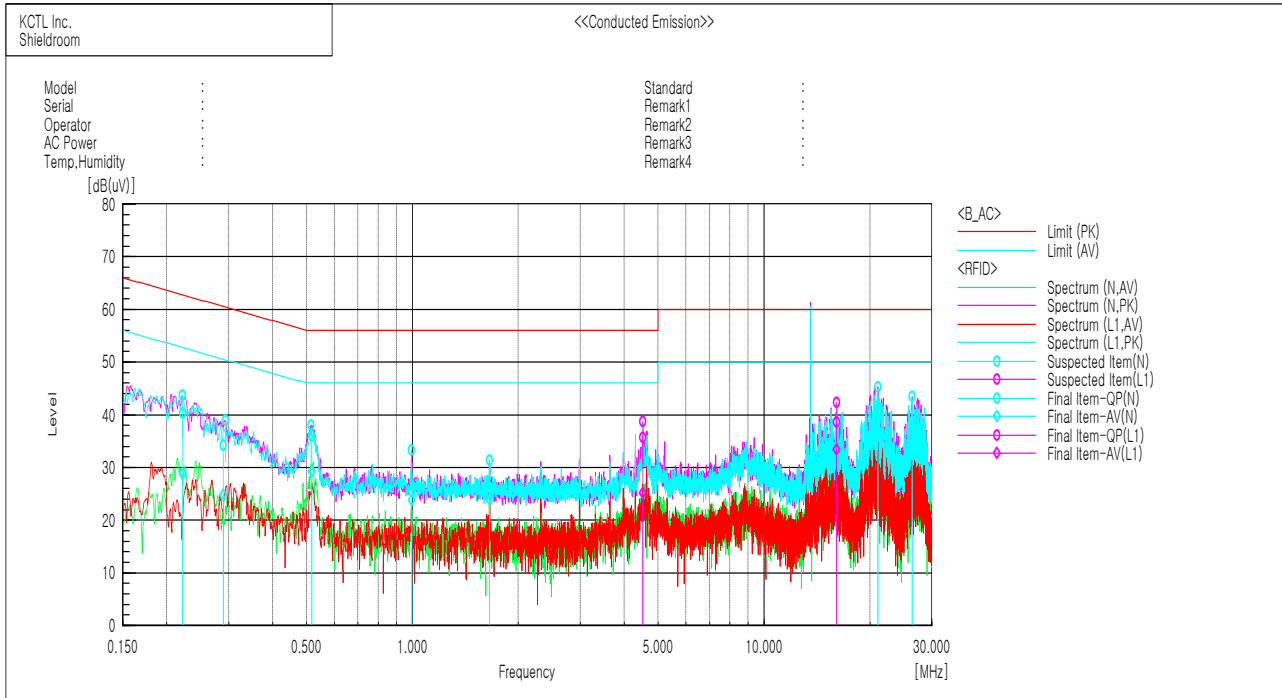
5.6.2 Measurement Procedure

- 1) The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
- 2) Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω /50 μ H LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
- 3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
- 4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
- 5) The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

5.6.3 Test Result

- Complied

Figure4. The plot of Conducted Emission



Final Result

--- N Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.22186	30.3	18.8	10.0	40.3	28.8	62.7	52.7	22.4	23.9
2	0.28927	24.3	14.9	9.9	34.2	24.8	60.5	50.5	26.3	25.7
3	0.51727	26.0	19.2	10.0	36.0	29.2	56.0	46.0	20.0	16.8
4	0.99547	15.6	13.8	9.9	25.5	23.7	56.0	46.0	30.5	22.3
5	1.65524	15.3	14.2	9.7	25.0	23.9	56.0	46.0	31.0	22.1
6	21.06755	31.9	26.2	9.7	41.6	35.9	60.0	50.0	18.4	14.1
7	26.35014	28.8	22.9	9.7	38.5	32.6	60.0	50.0	21.5	17.4

--- L1 Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	4.51983	26.2	15.7	9.5	35.7	25.2	56.0	46.0	20.3	20.8
2	16.09713	28.8	23.5	9.8	38.6	33.3	60.0	50.0	21.4	16.7

6. Test equipment used for test

	Description	Manufacturer	Model No.	Serial No.	Next Cal Date.
■	Spectrum Analyzer	R & S	FSV30	100808	16.09.02
■	Temp & Humid Chamber	ESPEC CORP.	SH-661	92004048	16.03.06
■	Test Receiver	ESCI	100001	R&S	16.08.04
■	DC Power Supply	AGILENT	E3632A	MY40004399	16.01.06
■	Signal Generator	R & S	SMR40	100007	16.06.15
■	Amplifier	SONOMA INSTRUMENT	310	186280	16.09.01
■	Loop Antenna	R & S	HFH2-Z2	861971/003	17.03.03
■	Bi-Log Antenna	SCHWARZBECK	VULB9163	552	16.06.14
■	Attenuator	AGILENT	8491A	MY52460424	16.07.13
■	Turn Table	Innco Systems	DT2000S-1t	79	-
■	Antenna Mast	Innco Systems	MA4000-EP	303	-
■	Two-Line-V-network	R & S	ESH3-Z6	100051	16.09.03
■	EMI Test Receiver	R & S	ESR7	101078	16.07.10
■	AC POWER SUPPLY	KIKUSUI	PCR2000W	GB001619	16.10.12