TEST REPORT

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR22-SRF0199 Page (1) of (21)	eurofins | KCTL

1. Client

- Name : LKS GLOBAL Co., Ltd.
- Address : 3-201, Business Incubation Center,, 1, Yeonsedae-gil, Heung-eop-myeon, Wonju-si, Gangwon-do, Republic of Korea
- Date of Receipt : 2022-09-20

2. Use of Report : Certification

3. Name of Product / Model : 5.8GHz Radar Sensor / GKM-MD5G

4. Manufacturer / Country of Origin : LKS GLOBAL Co., Ltd. / Korea

5. FCC ID : 2A8VH-GKM-MD5G

6. Date of Test : 2022-09-27 to 2022-10-31

7. Location of Test : ■ Permanent Testing Lab ☐ On Site Testing
(Address:65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

8. Test method used : FCC Part 15 Subpart C, 15.249

9. Test Result : Refer to the test result in the test report

Affirmation	Tested by Name : Hosung Lee (Signature)	Technical Manager Name : Heesu Ahn (Signature)

2022-11-10

Eurofins KCTL Co.,Ltd.

REPORT REVISION HISTORY

Date	Revision	Page No
2022-11-10	Originally issued	-

General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ **Statement not required by the standard or client used for type testing**

CONTENTS

1. General information

Client	:	LKS GLOBAL Co., Ltd.
Address	:	3-201, Business Incubation Center,, 1, Yeonsedae-gil, Heung-eop-myeon, Wonju-si, Gangwon-do, Republic of Korea
Manufacturer	:	LKS GLOBAL Co., Ltd.
Address	:	3-201, Business Incubation Center,, 1, Yeonsedae-gil, Heung-eop-myeon, Wonju-si, Gangwon-do, Republic of Korea
Laboratory	:	Eurofins KCTL Co.,Ltd.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056 CAB Identifier: KR0040 ISED Number: 8035A KOLAS No.: KT231

2. Device information

Equipment under test	:	5.8GHz Radar Sensor
Model	:	GKM-MD5G
Modulation technique	:	CW
Number of channels	:	3 ch
Power source	:	DC 3.3 V
Antenna specification	:	PCB Antenna
Antenna gain		4.39 dBi
Frequency range	:	5 785 ㎒ ~ 5 815 ㎒
Software version	:	1.0
Hardware version	:	1.0
Test device serial No.	:	N/A
Operation temperature	:	-20 ℃ ~ 50 ℃

2.1. Frequency/channel operations

CW(Continuous Wave)

Ch.	Frequency (㎒)
1	5 785
2	5 800
3	5 815

Table 2.1.1. CW mode

3. Antenna requirement

Requirement of FCC part 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. 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 transmitter has permanently attached PCB Antenna (internal antenna) on board.
- The E.U.T Complies with the requirement of §15.203, §15.249.

4. Summary of tests

FCC Part section(s)	Parameter	Test Condition	Test results
15.215(c)	20 dB Bandwidth	Conducted	Pass
15.249(a)(d)(e)	Field strength of fundamental & harmonic	Radiated	Pass
			Pass
			Pass
15.207(a)	AC Conducted Emissions		Pass

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
3. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that **Z** orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in **Z** orientation
4. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.10-2013

5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

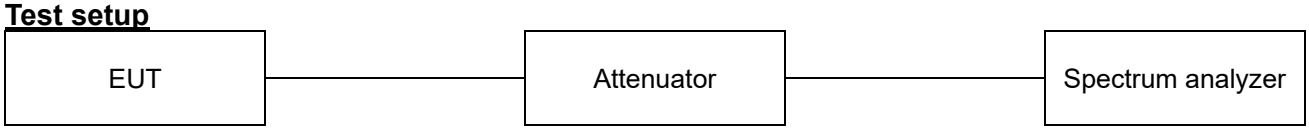
All measurement uncertainty values are shown with a coverage factor of k=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty (±)	
Conducted RF power	0.9 dB	
Conducted spurious emissions	1.1 dB	
Radiated spurious emissions	9 ㎑ ~ 30 ㎒	2.4 dB
	30 ㎒ ~ 1 000 ㎒	2.3 dB
	1 000 ㎒ ~ 18 000 ㎒	5.6 dB
	Above 18 000 ㎓	5.7 dB
Conducted emissions	9 ㎑ ~ 150 ㎑	1.6 dB
	150 ㎑ ~ 30 ㎒	1.7 dB

6. Test results

6.1. 20 dB Channel Bandwidth

Test setup



Limit

According to §15.215(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Test procedure

ANSI C63.10 - Section 6.9.3

Test settings

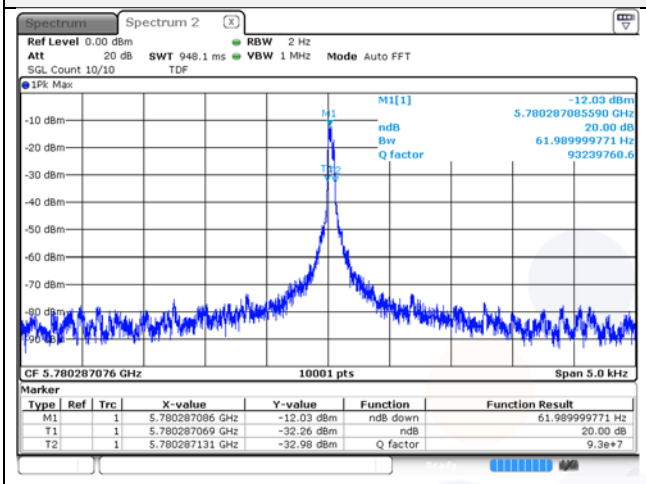
The occupied bandwidth is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by a specified ratio (or in decibels, a specified number of dB down from the reference value). Typical ratios, expressed in dB, are −6 dB, −20 dB, and −26 dB, corresponding to 6 dB BW, 20 dB BW, and 26 dB BW, respectively. In this subclause, the ratio is designated by "−xx dB." The reference value is either the level of the unmodulated carrier or the highest level of the spectral envelope of the modulated signal, as stated by the applicable requirement. Some requirements might specify a specific maximum or minimum value for the "−xx dB" bandwidth; other requirements might specify that the "−xx dB" bandwidth be entirely contained within the authorized or designated frequency band.

Test results

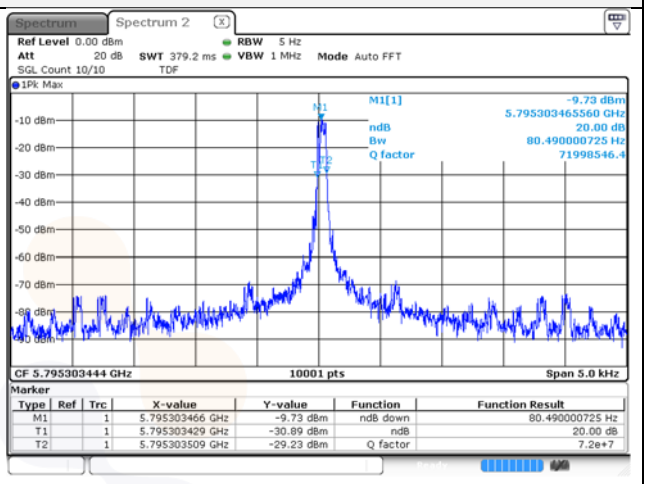
Test mode	Frequency(㎒)	20 dB Bandwidth(㎐)
CW	5 780	61.990
	5 795	80.490
	5 815	71.990

20 dB Bandwidth

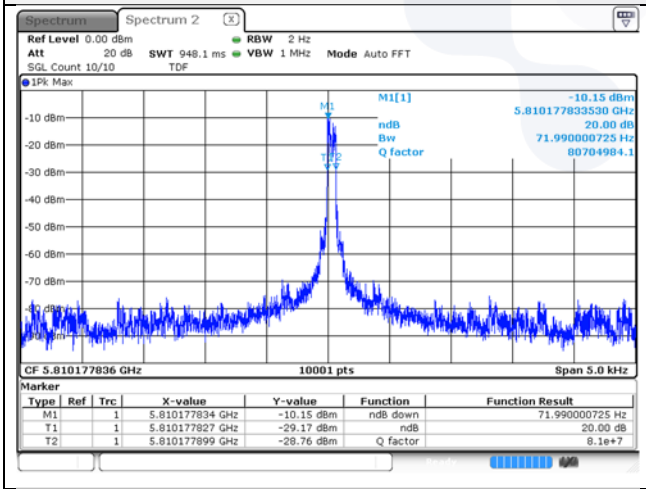
CW / Low ch.



CW / Mid ch.



CW / High ch.



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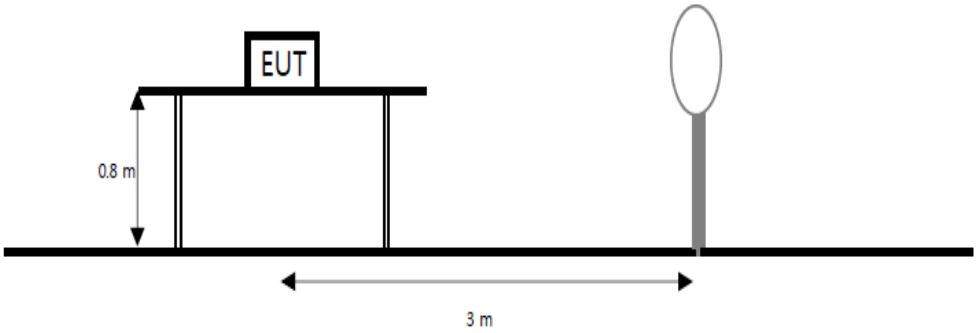
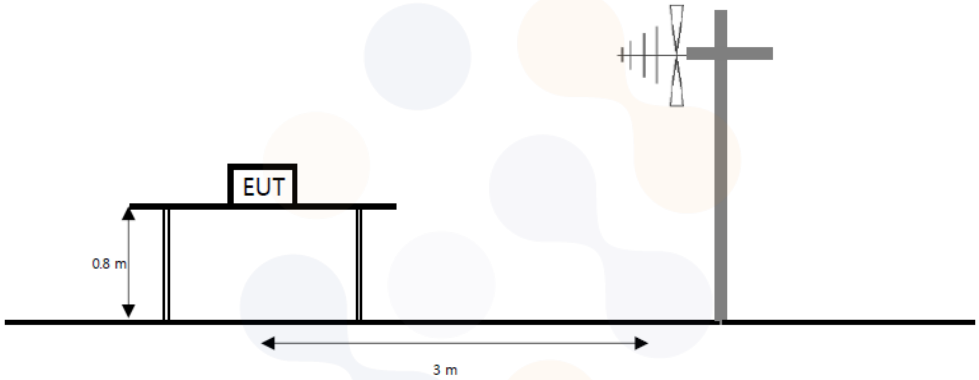
6.2. Radiated fundamental & spurious emissions

Test setup

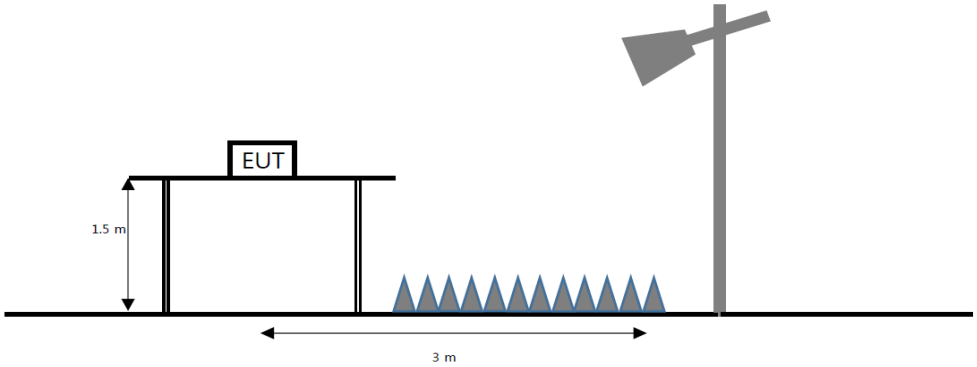
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



Limit

According to section 15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (㎒)	Field strength (㎶/m)	Measurement distance (m)
0.009 - 0.490	2 400/F(㎑)	300
0.490 - 1.705	24 000/F(㎑)	30
1.705 - 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 ㎒, 76–88 ㎒, 174–216 ㎒ or 470–806 ㎒. However, operation within these frequency bands is permitted under other sections of this part, e.g., Section15.231 and 15.241.

According to section 15.249(a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Frequency (㎒)	Field strength of fundamental (㎶/m)	Field strength of harmonics (㎶/m)
902 - 928	50	500
2400 - 2483.5	50	500
5725 - 5875	50	500
24.0 - 24.25	250	2500

(b) Fixed, point-to-point operation as referred to in this paragraph shall be limited to systems employing a fixed transmitter transmitting to a fixed remote location. Point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information are not allowed. Fixed, point-to-point operation is permitted in the 24.05-24.25 ㎓ band subject to the following conditions:

(1) The field strength of emissions in this band shall not exceed 2 500 millivolts/meter.
(2) The frequency tolerance of the carrier signal shall be maintained within ±0.001% 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.
(3) Antenna gain must be at least 33 ㏈i. Alternatively, the main lobe beamwidth must not exceed 3.5 degrees. The beamwidth limit shall apply to both the azimuth and elevation planes. At antenna gains over 33 ㏈i or beamwidths narrower than 3.5 degrees, power must be reduced to ensure that the field strength does not exceed 2 500 millivolts/meter.

(c) Field strength limits are specified at a distance of 3 meters.

Test procedure
ANSI C63.10-2013

Test settings
Peak field strength measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in table
3. VBW ≥ (3×RBW)
4. Detector = peak
5. Sweep time = auto
6. Trace mode = max hold
7. Allow sweeps to continue until the trace stabilizes

Table. RBW as a function of frequency

Frequency	RBW
9 ㎑ to 150 ㎑	200 ㎐ to 300 ㎐
0.15 ㎒ to 30 ㎒	9 ㎑ to 10 ㎑
30 ㎒ to 1 000 ㎒	100 ㎑ to 120 ㎑
> 1 000 ㎒	1 ㎒

Average field strength measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1 ㎒
3. VBW = 1/T ≥ 1 ㎐
4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
5. Detector = peak
6. Sweep time = auto
7. Trace mode = max hold
8. Trace was allowed to run for at least 50 times(1/duty cycle) traces

Notes:

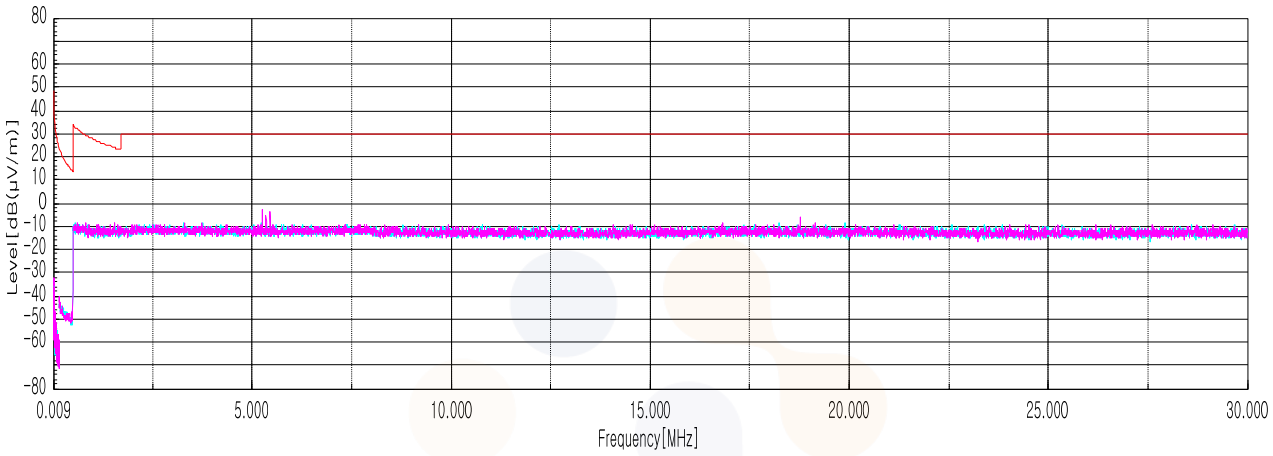
1. *f* <30 ㎒, extrapolation factor of 40 ㏈/decade of distance. F_d = 40log(D_m/Ds)
   f ≥30 ㎒, extrapolation factor of 20 ㏈/decade of distance. F_d = 20log(D_m/Ds)
   Where:
   F_d= Distance factor in ㏈
   D_m= Measurement distance in meters
   D_s= Specification distance in meters
2. Factors(㏈) = Antenna factor(㏈/m) + Cable loss(㏈) + or Amp. gain(㏈) + or F_d(㏈)
3. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ of respective limits were not reported.
4. Average test would be performed if the peak result were greater than the average limit.
5. 1) mean is fundamental and Harmonics.
6. According to part 15.31(f)(2), an extrapolation factor of 40 ㏈/decade is applied because measured distance of radiated emission is 3 m.

Test results

(Below 30 ㎒) – Worst case: 5 815 ㎒

Frequency	Pol.	Reading	Cable Loss	Amp Gain	Antenna Factor	DCCF	Result	Limit	Margin
[㎒]	[V/H]	[dB(㎶)]	[dB]	[dB]	[dB]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
No spurious emissions were detected within 20 ㏈ of the limit.									

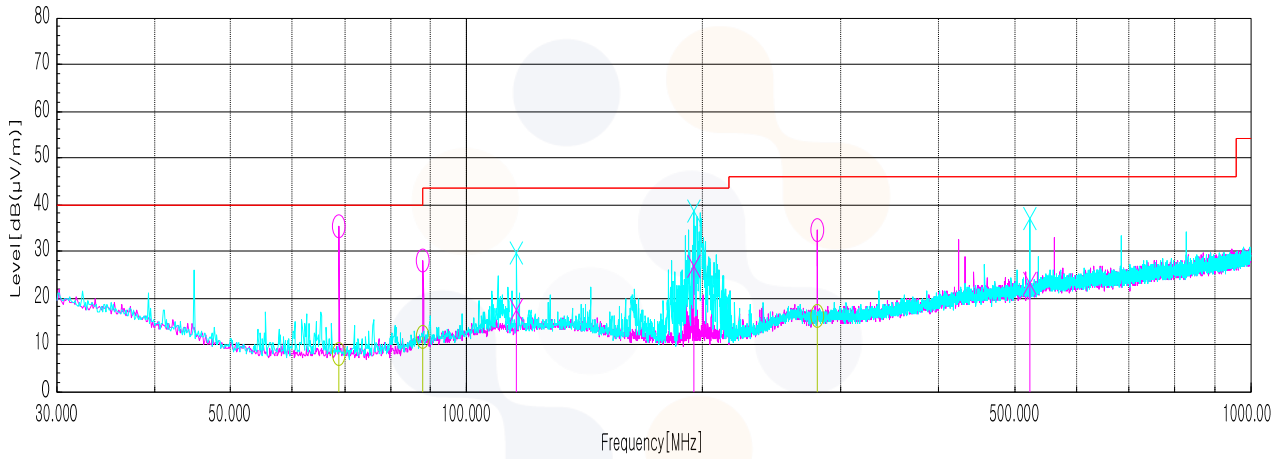
Horizontal/Vertical



(Below 1 000 ㎒)_Worst case: 5 815 ㎒

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Quasi peak data								
68.80	H	24.50	12.18	-28.69	-	7.99	40.00	32.01
88.08	H	25.10	14.72	-28.13	-	11.69	43.50	31.81
115.85[1)]	V	27.30	17.58	-27.71	-	17.17	43.50	26.33
195.14	V	37.80	15.11	-26.35	-	26.56	43.50	16.94
280.14[1)]	H	22.70	18.70	-25.36	-	16.04	46.00	29.96
523.12	V	22.40	23.40	-22.57	-	23.23	46.00	22.77

Horizontal/Vertical



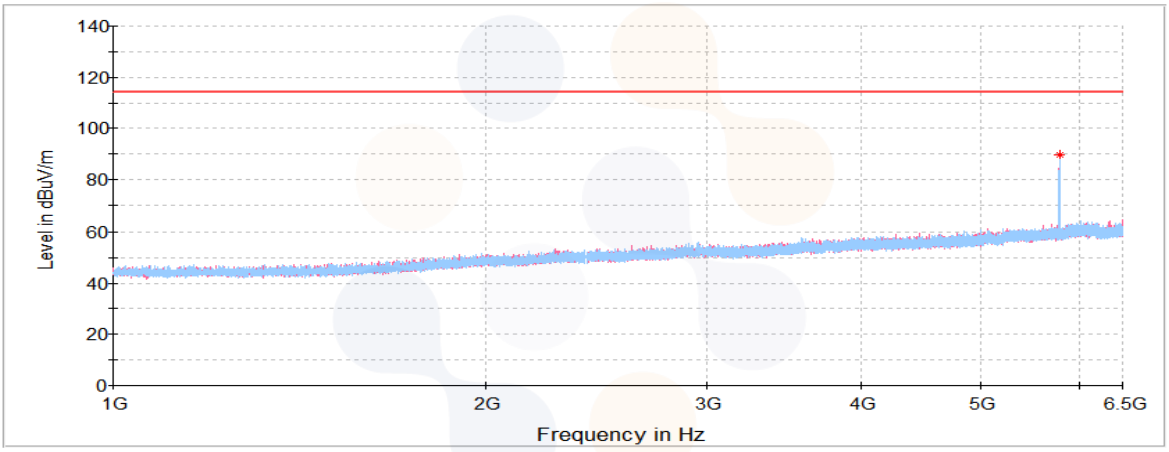
Test results

5 780 ㎒ (1 000 ~ 18 000㎒)

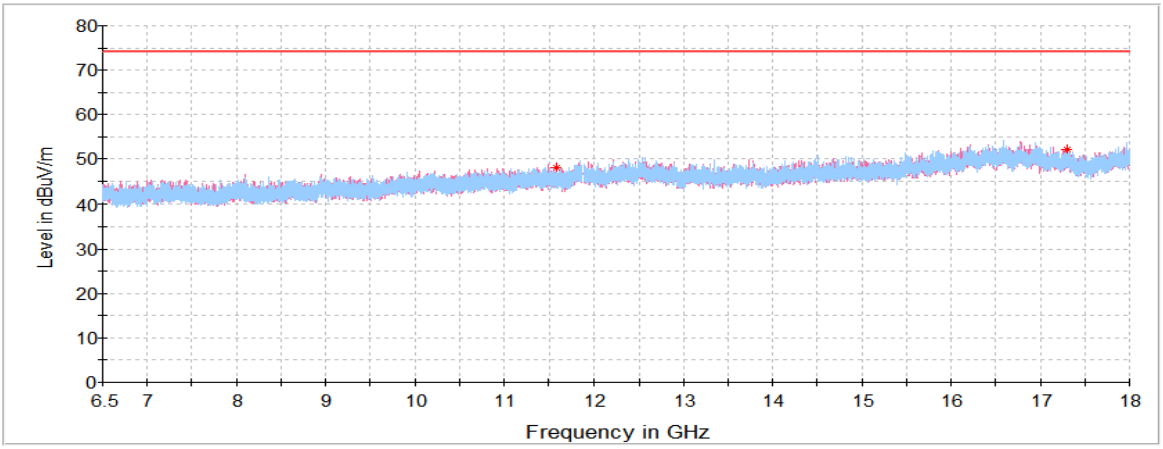
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
[㎒]	[V/H]	[dB(㎶)]	[dB]	[dB]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Peak data								
5 695.28	V	39.72	34.83	-23.05	-	51.50	101.71	50.21
5 695.28	V	39.72	34.83	-23.05	-	51.50	54.00	2.50
11 584.80[1)]	V	57.49	38.24	-47.68	-	48.05	74.00	25.95
17 294.19	V	56.00	41.17	-45.04	-	52.13	68.20	16.07
Average Data								

No spurious emissions were detected within 20 ㏈ of the limit.

Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

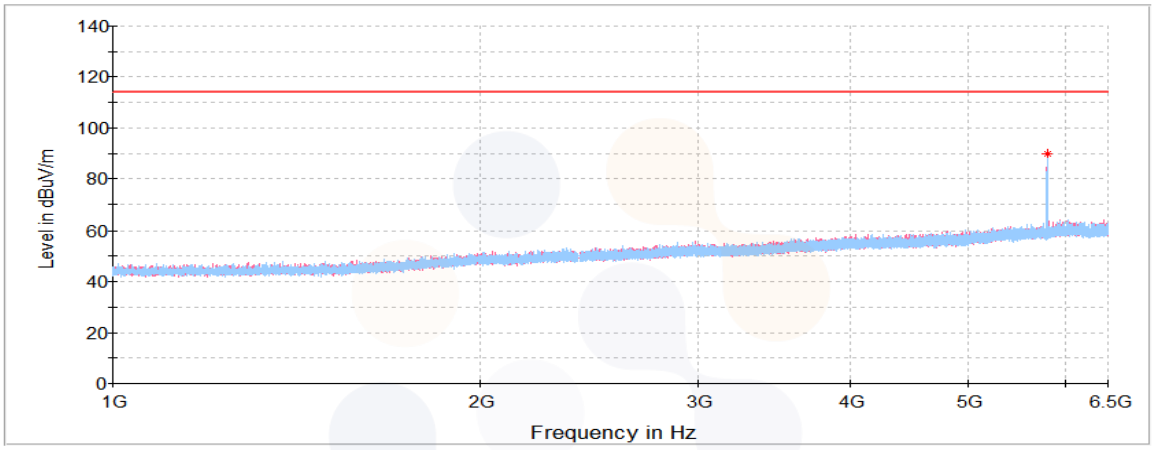


Note : Equipment's fundamental frequency, no need to evaluate it.

5 795 ㎒ (1 000 ~ 18 000㎒)

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
[㎒]	[V/H]	[dB(㎶)]	[dB]	[dB]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Peak data								
11 620.73[1)]	H	57.58	38.29	-47.69	-	48.18	74.00	25.82
17 323.30	V	57.04	41.12	-45.10	-	53.06	68.20	15.14
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



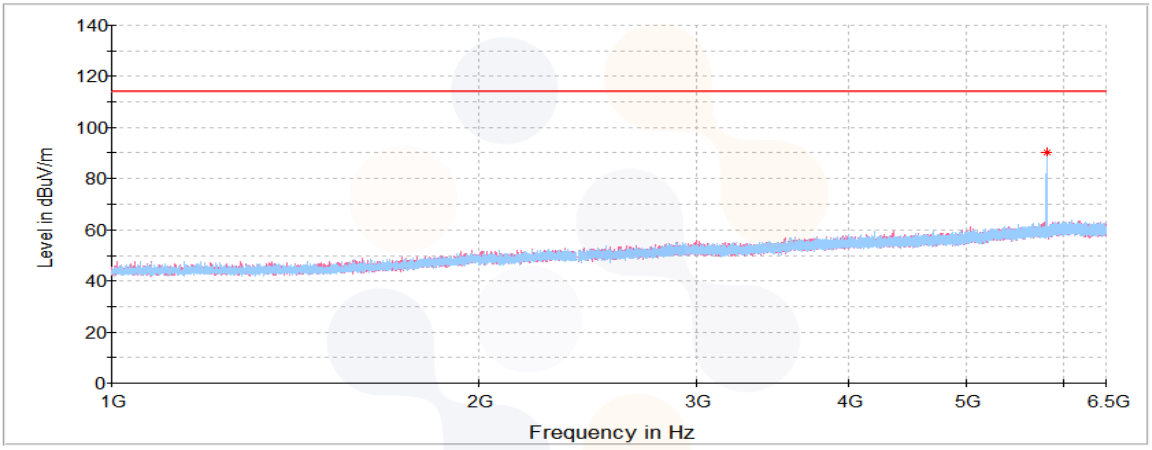
Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

Note : Equipment's fundamental frequency, no need to evaluate it.

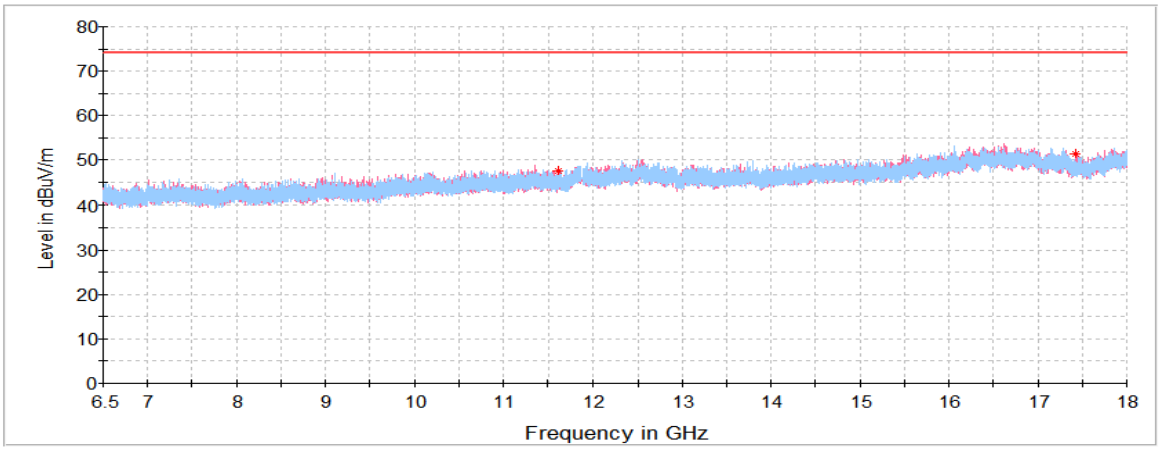
5 815 ㎒ (1 000 ~ 18 000㎒)

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
[㎒]	[V/H]	[dB(㎶)]	[dB]	[dB]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Peak data								
5 864.23	V	39.71	35.04	-22.82	-	51.93	108.21	56.29
5 864.23	V	39.71	35.04	-22.82	-	51.93	54.00	2.07
11 614.27[1)]	V	56.88	38.28	-47.69	-	47.47	74.00	26.53
17 422.13	V	55.65	40.94	-45.28	-	51.31	68.20	16.89
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓

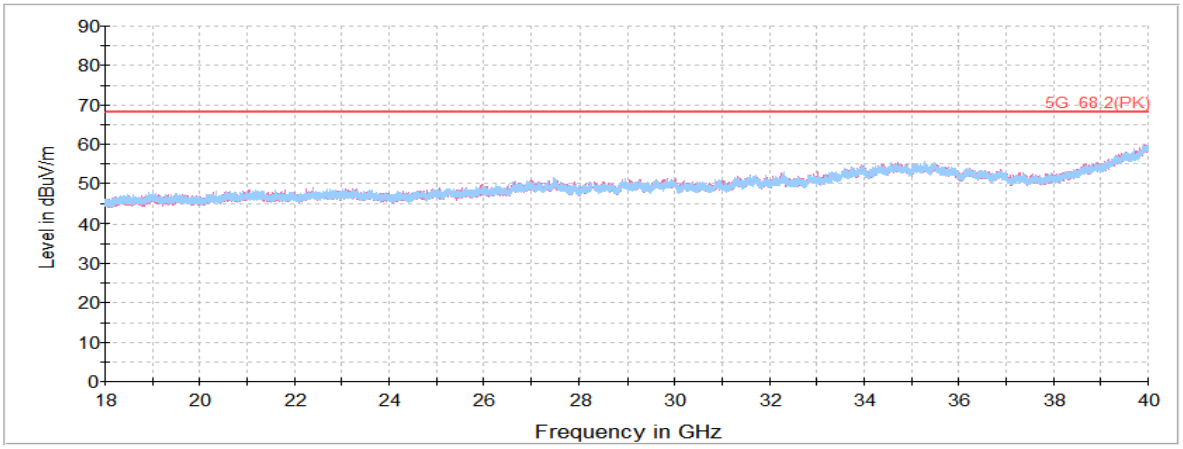


Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Note : Equipment's fundamental frequency, no need to evaluate it.

(Above 18 ㎓) –Worst case: 5 815 ㎒

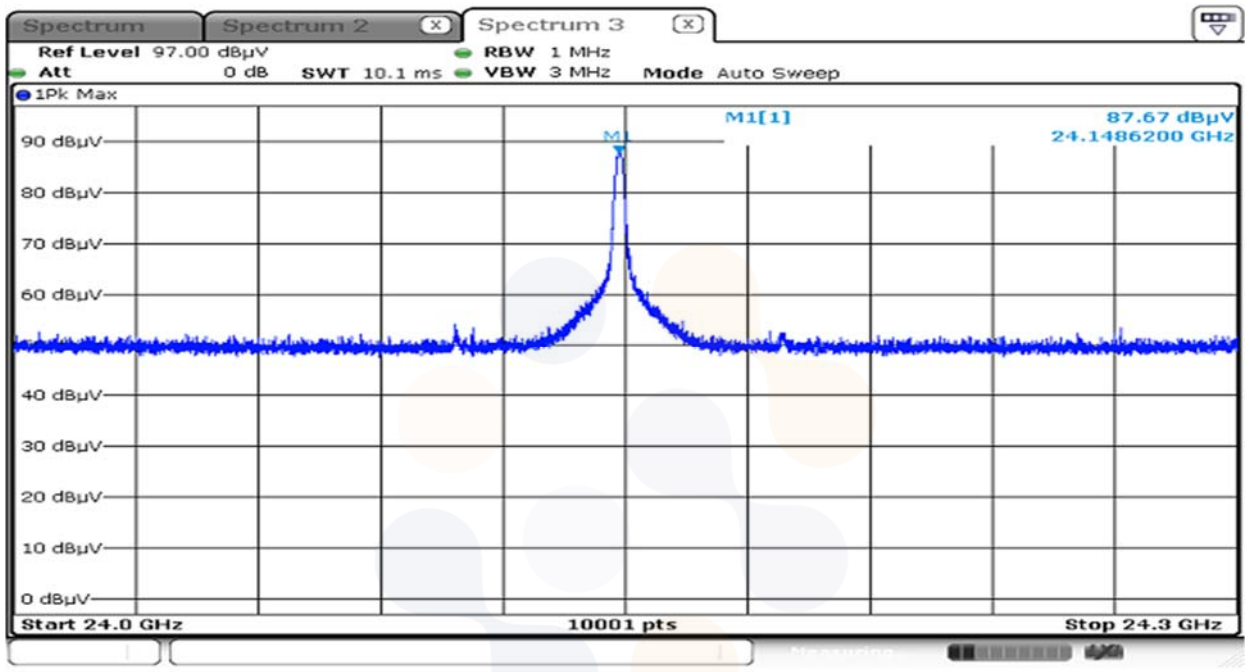
Horizontal/Vertical for 18 ㎓ ~ 26.5 ㎓


Note: The worst case was based on the lowest margin condition considering harmonic and spurious emission.

(Field strength of fundamental) –Worst case: 5 815 ㎒

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Average data								
5 810.30	V	68.51	34.97	-13.07	-	90.41	107.96	17.55

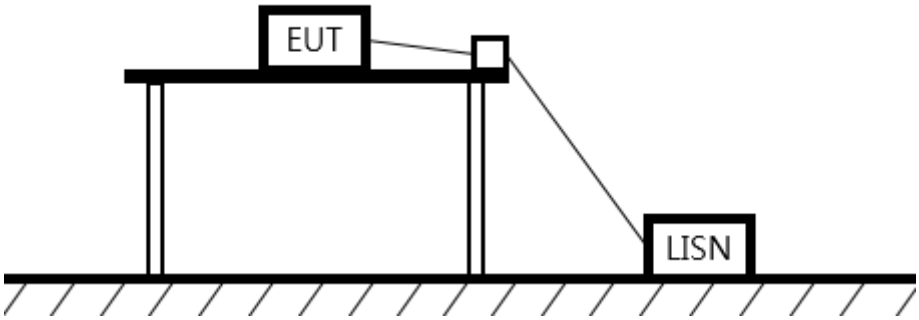
Vertical



Note : The Average limit of fundamental is 107.96 dBµV/m@3 m, and the maximum measure Peak level of fundamental is 90.41 dBµV/m@3 m which is below 107.96 dBµV/m@3 m, worst case of fundamental is recorded in this report.

6.3. AC Conducted emission

Test setup



Limit

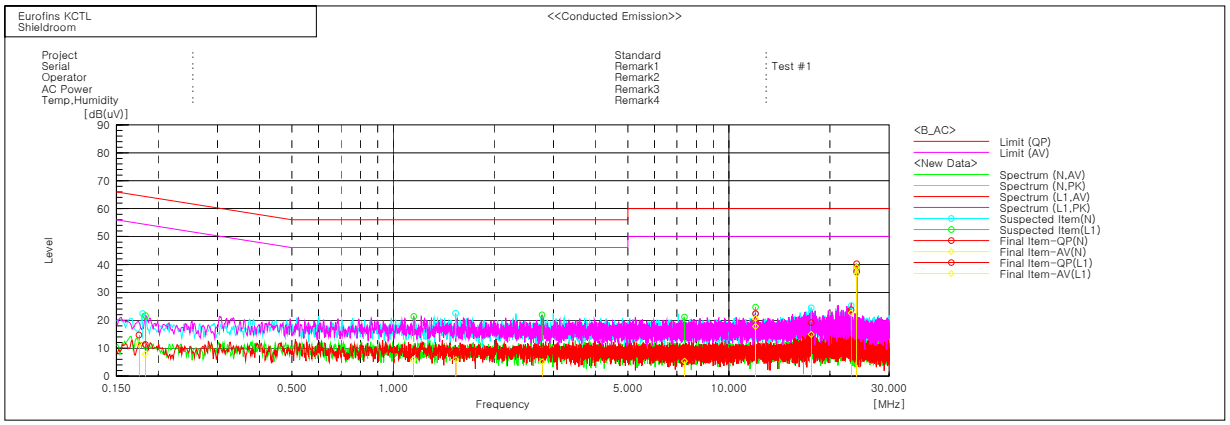
According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following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

Frequency of Emission (㎒)	Conducted limit (dB㎶/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

Measurement procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 ㎝ in which is located 40 ㎝ 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 50Ω/50μH 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 is the system) was then performed over the frequency range of 0.15 ㎒ to 30 ㎒.
5. The measurements were made with the detector set to peak amplitude within a bandwidth of 10 ㎑ or to quasi-peak and average within a bandwidth of 9 ㎑. The EUT was in transmitting mode during the measurements.

Test results- Worst case: 5 815 ㎒



Final Result

--- N Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.17508	4.6	1.5	10.1	14.7	11.6	64.7	54.7	50.0	43.1
2	1.53866	-0.6	-3.8	9.7	9.1	5.9	56.0	46.0	46.9	40.1
3	12.00155	9.6	7.9	9.9	19.5	17.8	60.0	50.0	40.5	32.2
4	17.58401	9.3	5.0	9.9	19.2	14.9	60.0	50.0	40.8	35.1
5	23.12947	13.9	12.7	9.9	23.8	22.6	60.0	50.0	36.2	27.4
6	23.99944	27.5	26.6	9.9	37.4	36.5	60.0	50.0	22.6	13.5

--- L1 Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.18305	1.3	-2.1	10.0	11.3	7.9	64.3	54.3	53.0	46.4
2	1.14806	-0.9	-3.8	9.7	8.8	5.9	56.0	46.0	47.2	40.1
3	2.77993	0.1	-4.6	9.7	9.8	5.1	56.0	46.0	46.2	40.9
4	7.37282	0.3	-4.4	9.7	10.0	5.3	60.0	50.0	50.0	44.7
5	12.00076	12.6	10.9	9.8	22.4	20.7	60.0	50.0	37.6	29.3
6	23.99992	30.2	28.9	10.0	40.2	38.9	60.0	50.0	19.8	11.1

7. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSV40	100989	23.10.14
EMI TEST RECEIVER	R&S	ESCI7	100732	23.01.19
Bi-Log Antenna	TESEQ	CBL 6112D	62438	24.08.24
Amplifier	SONOMA INSTRUMENT	310N	284608	23.08.18
ATTENUATOR	KEYSIGHT	8491B-6dB	MY39271060	24.04.27
ISOLATION TRANSFORMER	ONETECH CO., LTD	OT-IT500VA	OTR1-16026	23.03.28
Horn antenna	ETS.lindgren	3117	155787	23.09.29
Horn antenna	ETS.lindgren	3116	00086635	23.05.04
Attenuator	API Inmet	40AH2W-10	12	23.05.03
AMPLIFIER	B&Z Technologies	BZRT-00504000-481055-382525	26299-27735	23.09.19
AMPLIFIER	B&Z Technologies	BZR-0050400-551028-252525	27736	23.09.19
LOOP Antenna	R&S	HFH2-Z2	100355	24.08.10
Antenna Mast	Innco Systems	MA4640-XP-ET	-	-
Turn Table	Innco Systems	CO3000	1175/45850319/P	-
Antenna Mast	Innco Systems	MA4000-EP	303	-
Turn Table	Innco Systems	CO3000	1175/45850319/P	-
Highpass Filter	WT	WT-A1699-HS	WT160411002	23.05.03
TWO-LINE V - NETWORK	R&S	ENV216	101358	23.09.29
EMI TEST RECEIVER	R&S	ESCI3	100001	23.08.18
Vector Signal Generator	R&S	SMBV100A	257566	23.07.04
Signal Generator	R&S	SMB100A	176206	23.01.19

End of test report