

KCTL

KCTL Inc. 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.: KR21-SEF0079 Page (2) of (19)	
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REPORT REVISION HISTORY

Date	Revision	Page No
2021-06-22	Originally issued	-

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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

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1. Applicant information

Applicant: noLimits Enterprises INC
Address: 1100 Sycamore Street Floor 1, Cincinnati, OHIO,
United States 45202

Manufacturer: ATTOWAVE Co., Ltd.
Address: 1005, 10F Leader's Tower, 60-15 Gasan-dong, Gumchun-gu,
Seoul, 153-801 Korea

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2. Laboratory information

Address

KCTL Inc. (Suwon Lab.)

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea

Telephone Number: 82 31 285 0894

Facsimile Number: 82 505 299 8311

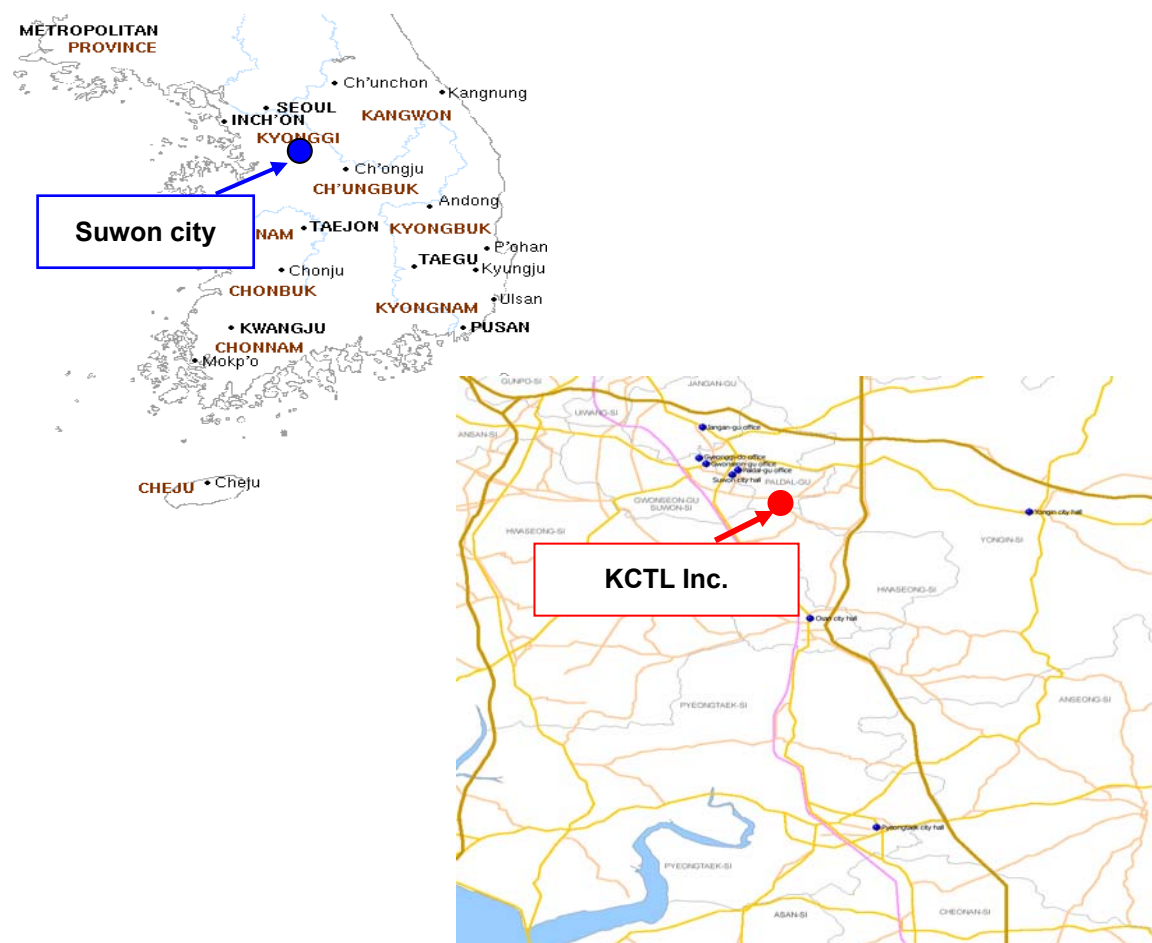
FCC Site Designation No: KR0040

VCCI Registration No.: R-20080, G-20078, C-20059, T-20056

Industry Canada Registration No. : 8035A

KOLAS NO.: KT231

SITE MAP



3. Test system configuration

3.1 Operation environment

	Temperature	Humidity	Pressure
Chamber 10 m (RE)	21.6 °C	37.2 % R.H.	-
Shielded room(CE)	21.8 °C	36.0 % R.H.	-

Test site

These testing items were performed following locations;

Test item	Test site
Conducted Emission	Shielded Room
Radiated Emission	10 m Chamber

3.2 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC.

The factors contributing to uncertainties are test receiver, cable loss, antenna factor calibration, Antenna directivity, antenna factor variation with height, antenna phase center variation, antenna frequency interpolation, measurement distance variation, site imperfection, mismatch, and system repeatability. Based on CISPR 16-4-2, the measurement uncertainty level with a 95 % confidence level was applied.

Conducted Emission measurement (Confidence level about 95 %, $k = 2$)		
Shielded Room (CE#1)	9 kHz ~ 150 kHz:	3.50 dB
	150 kHz ~ 30 MHz:	3.06 dB
Shielded Room (CE#2)	9 kHz ~ 150 kHz:	3.05 dB
	150 kHz ~ 30 MHz:	3.06 dB
Radiated Emission measurement (Confidence level about 95 %, $k = 2$)		
10 m Chamber (4F)	30 MHz ~ 300 MHz	3 m: 5.36 dB
		10 m: 5.34 dB
	300 MHz ~ 1 000 MHz	3 m: 5.46 dB
		10 m: 5.44 dB
	1 GHz ~ 6 GHz	3 m: 6.24 dB
	6 GHz ~ 18 GHz	3 m: 6.60 dB
	18 GHz ~ 30 GHz	3 m: 6.72 dB
	30 GHz ~ 40 GHz	3 m: 6.14 dB
10 m Chamber (2F)	30 MHz ~ 300 MHz	3 m: 4.88 dB
		10 m: 4.86 dB
	300 MHz ~ 1 000 MHz	3 m: 4.94 dB
		10 m: 4.94 dB
	1 GHz ~ 6 GHz	3 m: 6.28 dB

3.3 Measurement Program

These test items were performed by software programs;

Test item	Measurement Program		Used
Conducted Emission	EP5CE_V 5.4.0(TOYO)		☒
Radiated Emission	2F	EP5RE_V 4.6.0(TOYO)	☒
	4F	EP5RE_V 5.11.10(TOYO)	

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4. Description of EUT

4.1 General information

Radar

Receiver type : Dual conversion super-heterodyne

Antenna type : Linear polarized, self-contained

Detector type : Scanning frequency discriminator

Frequency operation : X-band; 10.525 GHz $\pm$ 0.025 GHz

K-band; 24.075 GHz $\pm$ 0.175 GHz

Ka-band (super-wide); 34.550 GHz $\pm$ 1.150 GHz

Laser

Receiver type : Pulsed laser signal receiver

Detector type : Digital signal pulse width discriminator

Optical sensor : Dual convex condenser lens and high speed photo diode detector,
950nm $\pm$ 150nm (nanometers)

General

Operating Temperature Range : -10° C to +70° C

Storage Temperature Range : -30° C to +95° C

Power requirements : 5V DC, 800 mA, negative ground

Dimensions HxWxL : 30.90 mm x 76.20 mm x 112.18 mm

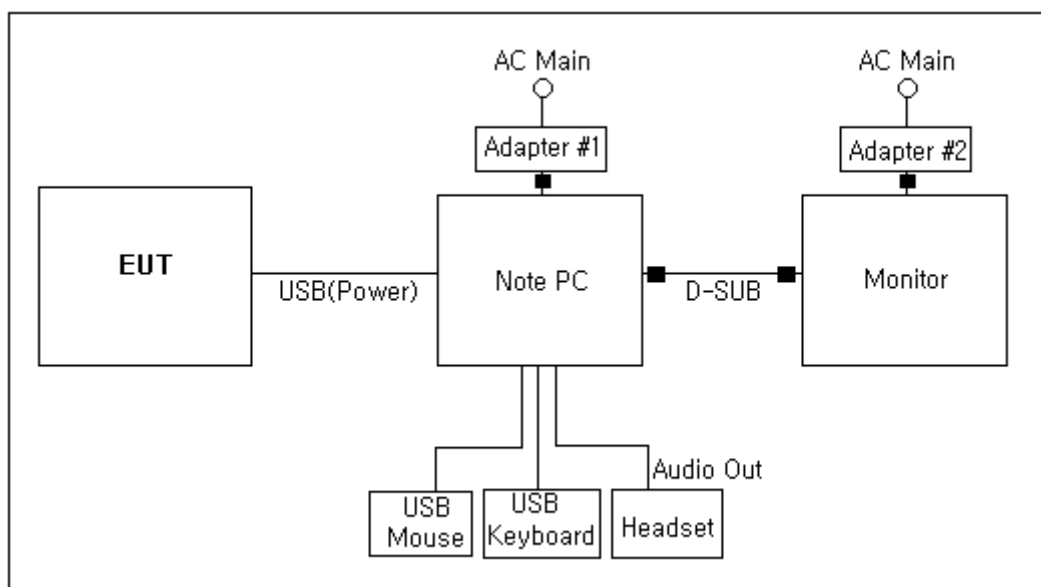
4.2 Product description

Type of product	RADAR DETECTOR
Model name (Basic)	DS1
Model name (Variant)	-
Difference	-
Serial no	-
Testing voltage	120 V, 60 Hz
Input rating	DC 12 V (Power supplied from Note PC)
Internal clock frequency	27 MHz
RF Frequency	Bluetooth_2 402 MHz ~ 2 480 MHz
Note	-The following accessory was provided by the manufacturer. 1) Bluetooth Module - FCC ID: W75-BTM0

4.3 Auxiliary equipments

Type	Model / Part #	S/N	Manufacturer
Note PC	NT271B5E-K301S	JGFE91DF600046D	SAMSUNG
Adapter #1	PA-1600-66	-	SAMSUNG
USB Mouse	1113	-	Microsoft
USB Keyboard	PKB-500	-	-
Monitor	LT24C350	ZXLQHMCD900110J	SAMSUNG
Adapter #2	A4514_DDY	CN07BN44-00593BDC07D8E0438	SAMSUNG
Headset	Jlab Bombora Over-Ear Headphones with Universal Mic	-	JLAB

4.4 Test configuration



	Start		End		Cable	
	Name	I/O port	Name	I/O port	Length (m)	Spec.
1	EUT	USB(Power)	Note PC	USB	1.5	Shield
2	Note PC	Power	Adapter #1	-	1.5	Unshield (Core)
3		D-SUB	Monitor	D-SUB	2.0	Shield (Core)
4		USB	USB Mouse	-	1.5	Shield
5		USB	USB Keyboard	-	1.5	Shield
6		Audio Out	Headset	-	2.0	Unshield
7	Monitor	Power	Adapter #2	-	1.5	Unshield (Core)

4.5 Operating conditions

The EUT was configured as normal intended use.

Test mode	Normal operating
Test #1	Check the data communication between EUT and Note PC with the DS1 version check tool program and conduct the test.

5. Summary of test results

5.1 Summary of EMI emission test results

Applied	Test items	Test method	Result
☒	Conducted Emission	ANSI C63.4:2014, Class B FCC Part 15 Subpart B	Pass
☒	Radiated Emission	ANSI C63.4:2014, Class B FCC Part 15 Subpart B	Pass

The data collected shows that EUT the complied with technical requirements of above rules part 15.107(a), (d) and 15.109(a).

6. Test results

6.1 Conducted Emissions

Testing voltage	120 V, 60 Hz		
Test facility	Shielded room (CE#2)		
Date	2021-06-12		
Temperature (°C)	21.8 °C	Humidity (% R.H.)	36.0 % R.H.
Remarks	Pass		

6.1.1 Limits of conducted emissions measurement

Frequency [MHz]	Class A (dB(μ V))		Class B (dB(μ V))	
	Quasi-peak	Average	Quasi-peak	Average
0.15 ~ 0.5	79	66	66 ~ 56 ¹⁾	56 ~ 46 ¹⁾
0.5 ~ 5	73	60	56	46
5 ~ 30	73	60	60	50

¹⁾ The limit decreases linearly with the logarithm of frequency

6.1.2 Measurement procedure

The measurements were performed in a shielded room. EUT was setup as shown in photograph and placed on a non-metallic table height of 0.8 m above the reference ground plane. The rear of table was located 0.4 m to the vertical conducted plane. EUT was power through the LISN, which was bonded to the ground plane. The LISN power was filtered. Each EUT power lead, except ground (safety) lead was individually connected through a LISN to input power source. EUT signal cables that hung closer than 0.4 m to the Horizontal metal ground 0.3 m ~ 0.4 m long. The power cord was bundles in the center. All peripheral equipment was powered from a sub LISN. The LISN and ISN were positioned 0.8 m from the EUT. Peak and Average detection were used in preliminary testing and Quasi-peak and Average detections were used at final measurement.

6.1.3 Used equipments

Equipment	Model no.	Serial no.	Makers	Next Cal. Date	Used
EMI TEST RECEIVER	ESCI	100710	R&S	2022.04.14	☒
TWO-LINE V-NETWORK	ENV216	101584	R&S	2022.04.05	☒
TWO-LINE V-NETWORK	NNLK8121	8121-472	SCHWARZBECK	2021.08.20	☐

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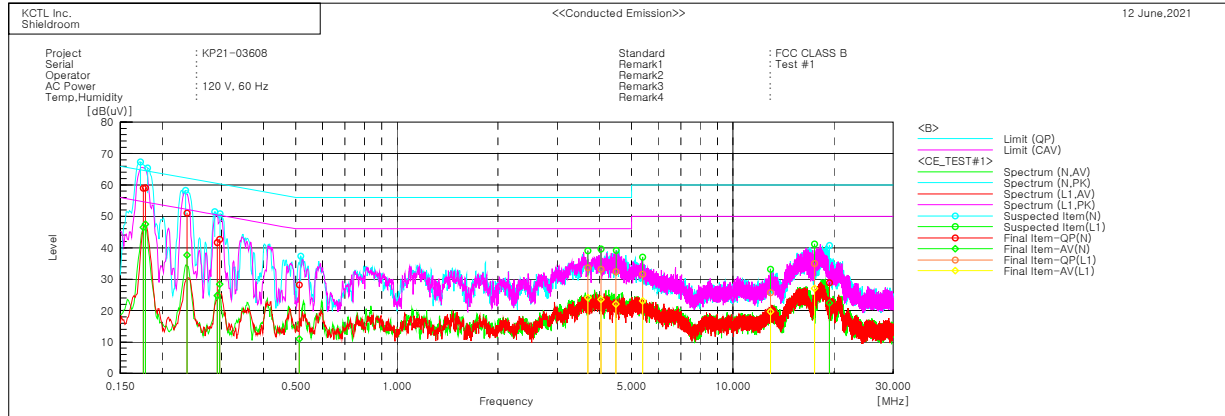
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6.1.4 Conducted emissions measurement result

AC Main



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	0.17586	48.9	36.5	10.0	58.9	46.5	64.7	54.7	5.8	8.2
2	0.17812	49.1	37.6	10.0	59.1	47.6	64.6	54.6	5.5	7.0
3	0.23715	41.5	28.0	9.6	51.1	37.6	62.2	52.2	11.1	14.6
4	0.29167	32.0	15.1	9.7	41.7	24.8	60.5	50.5	18.8	25.7
5	0.29637	33.0	18.7	9.7	42.7	28.4	60.3	50.3	17.6	21.9
6	0.51207	18.3	1.2	9.8	28.1	11.0	56.0	46.0	27.9	35.0
7	19.38161	18.9	12.5	9.9	28.8	22.4	60.0	50.0	31.2	27.6

--- 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	3.69712	23.9	14.4	9.7	33.6	24.1	56.0	46.0	22.4	21.9
2	4.05493	23.5	13.8	9.7	33.2	23.5	56.0	46.0	22.8	22.5
3	4.49165	22.7	12.4	9.7	32.4	22.1	56.0	46.0	23.6	23.9
4	5.39019	21.9	13.4	9.7	31.6	23.1	60.0	50.0	28.4	26.9
5	12.93162	15.9	9.9	9.8	25.7	19.7	60.0	50.0	34.3	30.3
6	17.50852	25.0	17.1	9.9	34.9	27.0	60.0	50.0	25.1	23.0

6.2 Radiated Emission

Testing voltage	120 V, 60 Hz		
Test facility	10 m Chamber (4F)		
Test distance	3 m		
Date	2021-06-15		
Temperature (°C)	21.6 °C	Humidity (% R.H.)	37.2 % R.H.
Remarks	Pass		

6.2.1 Limits of radiated emission measurement

	Class A at 10 m QP(dB(μV/m))		Class B at 3 m QP(dB(μV/m))	
Frequency [MHz]	FCC ¹⁾	ISED (ICES Issue 7)	FCC ¹⁾	ISED (ICES Issue 7)
30-88	39.1	40.0	40.0	40.0
88-216	43.5	43.5	43.5	43.5
216-230	46.4	46.4	46.0	46.0
230-960	46.4	47.0	46.0	47.0
Above 960	49.5	49.5	54.0	54.0

- ¹⁾: Alternative standard: CISPR, Pub. 22

- Test data in this section has been taken against the FCC 15.109(a) or (B) Limit as it is the most stringent limit.

By complying with more restrictive FCC 15.109 Limit compliance with the ICES-003 Issue 7 limit also demonstrated.

6.2.2 Measurement procedure

The test was done at a 10 m chamber with a quasi-peak detector. EUT was placed on a non-metallic table height of 0.8 m above the reference ground plane. Cables were folded back and forth forming a bundle 0.3 m to 0.4 m long and were hanged at a 0.4 m height to the ground plane.

Cables connected to EUT were fixed to cause maximum emission. 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.

6.2.3 Used equipments

Equipment	Model no.	Serial no.	Makers	Next Cal. Date	Used
EMI TEST RECEIVER	ESR7	101078	R&S	2021.08.20	☒
Bilog Antenna	CBL 6112D	37876	TESEQ	2022.12.08	☒
AMPLIFIER	310N	293004	SONOMA	2021.08.20	☒
ATTENUATOR	8491B	MY39270292	AGILENT	-	☒
Antenna Mast	MA4640-XP-ET	-	Innco Systems	-	☒
Turn Table	TT 3.0-3t	-	MATURO	-	☒
DOUBLE RIDGED HORN ANTENNA	3117	00161083	ETS-LINDGREN	2021.09.23	☒
Broadband Preamplifier	BBV9718	9718-233	SCHWARZBECK	2021.08.20	☒
SIGNAL ANALYZER	FSV40	100988	R&S	2021.12.23	☒

6.2.4 Sample calculation

The field strength is calculated adding the antenna Factor, cable loss and, Antenna pad adding, subtracting the amplifier gain from the measured reading.

The sample calculation is as follow:

$$\text{Result} = \text{M.R} + \text{C.F}(\text{A.F} + \text{C.L} + 6 \text{ dB Att} - \text{A.G})$$

M.R = Meter Reading

C.F = Correction Factor

A.F = Antenna Factor

C.L = Cable Loss

A.G = Amplifier Gain

6 dB Att = 6 dB Attenuator

If M.R is 30 dB, A.F 12 dB, C.L 5 dB, 6 dB, A.G 35 dB

The result is $30 + 12 + 5 + 6 - 35 = 18 \text{ dB } (\mu\text{V/m})$

Bilog Antenna and ATTENUATOR (6 dB) were calibrated together.

AV = CAV : Abbreviation of CISPR Average

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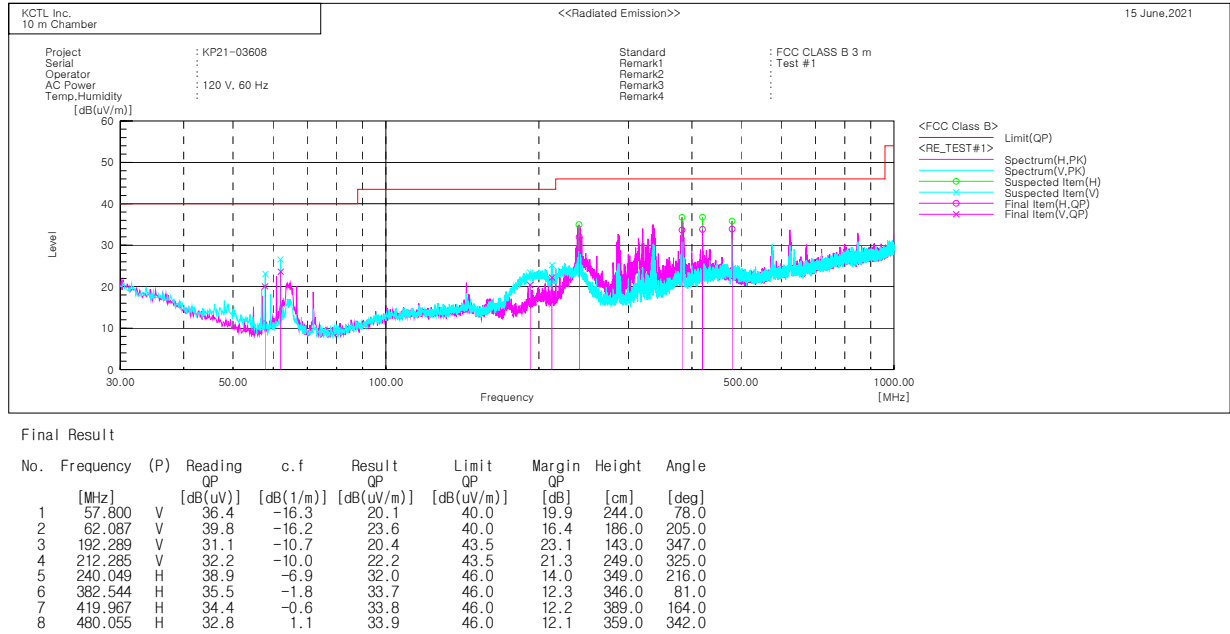
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6.2.5 Radiated emission measurement result

30 MHz ~ 1 GHz



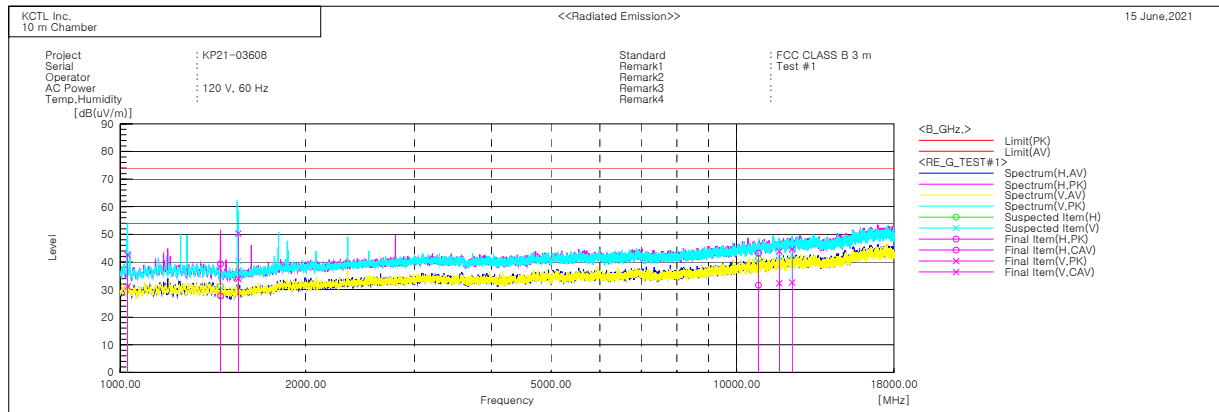
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1 GHz ~ 18 GHz



Final Result

No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]
1	1027.390	V	48.4	36.9	-5.8	42.6	31.1	74.0	54.0	31.4	22.9	362.0	118.0
2	1454.303	H	44.1	32.5	-4.8	39.3	27.7	74.0	54.0	34.7	26.3	270.0	64.0
3	1553.475	V	55.3	38.9	-5.0	50.3	33.9	74.0	54.0	23.7	20.1	197.0	187.0
4	10850.160	H	33.0	21.4	10.2	43.2	31.6	74.0	54.0	30.8	22.4	163.0	329.0
5	11725.710	V	32.3	20.7	11.6	43.9	32.3	74.0	54.0	30.1	21.7	261.0	177.0
6	12300.900	V	33.1	21.1	11.5	44.6	32.6	74.0	54.0	29.4	21.4	343.0	30.0