



TEST REPORT

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.: KR20-SEF0056-B Page (1) of (23)	
1. Client ◦ Name : ATTOWAVE Co., Ltd. ◦ Address : 1005, 10F Leader's Tower, 60-15 Gasan-dong, Gumchun-gu, Seoul, 153-801 Korea ◦ Date of Receipt : 2020-03-16			
2. Use of Report : -			
3. Name of Product and Model : RADAR DETECTOR / PT100			
4. Manufacturer and Country of Origin : ATTOWAVE Co., Ltd. / Korea			
5. Date of Test : 2020-03-25			
6. Test method used : ANSI C63.4:2014, FCC02-211 FCC Part 15 Subpart B, Class B			
7. FCC ID : W75-D-Y10			
8. Test Results : Refer to the test result in the test report			
Affirmation	Tested by 		Technical Manager
	Name : Byunghwan Min (Signature)		Name : Gunsu Park (Signature)
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REPORT REVISION HISTORY

Date	Revision	Page No
2020-03-30	Originally issued	-
2020-04-09	Correct a test configuration and add the correction	10, 11, 21, 23
2020-04-10	Delete correction	21, 23

Note. The report No. KR20-SEF0056-A is superseded by the report No. KR20-SEF0056-B

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1. Applicant information

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Contact name: Jeonghan Kim

Manufacturer: ATTOWAVE Co., Ltd.
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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

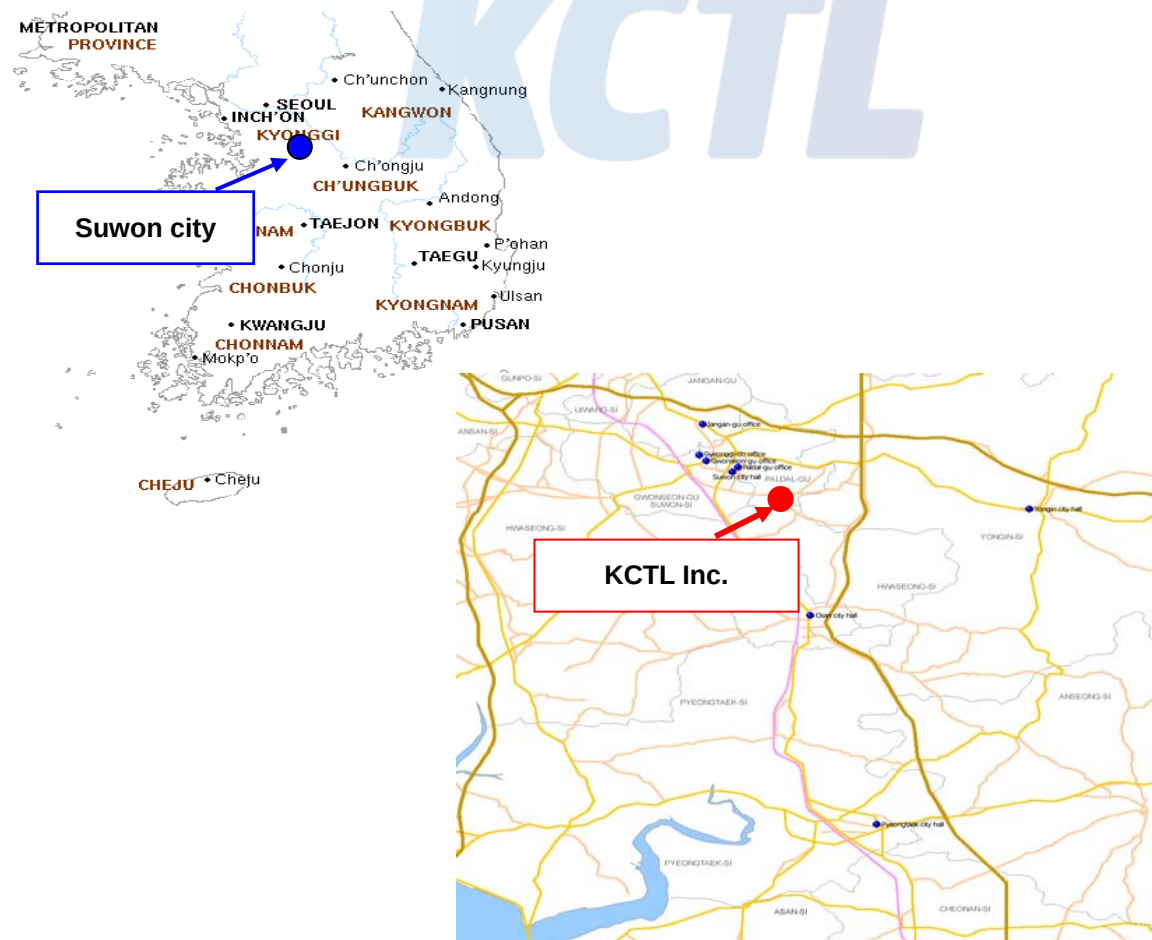
FCC Site Designation No: KR0040

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)	23.2 °C	27.1 % R.H.	-
Shielded room(CE)	22.9 °C	26.5 % 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:	3.66 dB
	150 kHz ~ 30 MHz:	3.26 dB
Shielded Room (CE#2)	9 kHz ~ 150 kHz:	3.48 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: 5.48 dB
		10 m: 5.36 dB
	1 GHz ~ 6 GHz	3 m: 6.36 dB
	6 GHz ~ 18 GHz	3 m: 6.64 dB
	18 GHz ~ 30 GHz	3 m: 6.74 dB
	30 GHz ~ 40 GHz	3 m: 6.16 dB
10 m Chamber (2F)	30 MHz ~ 300 MHz	3 m: 4.98 dB
		10 m: 4.96 dB
	300 MHz ~ 1 000 MHz	3 m: 5.16 dB
		10 m: 5.02 dB
	1 GHz ~ 6 GHz	3 m: 6.36 dB
	6 GHz ~ 18 GHz	3 m: 6.64 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 $\pm$ 0.050 GHz

K-band; 24.150 GHz $\pm$ 0.100 GHz

Ka-band (super-wide); 34.700 GHz $\pm$ 1.300 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 : 11V to 16V DC, 300 mA, negative ground

Dimensions HxWxL : 36.95 mm x 83.72 mm x 113.50 mm

4.2 Product description

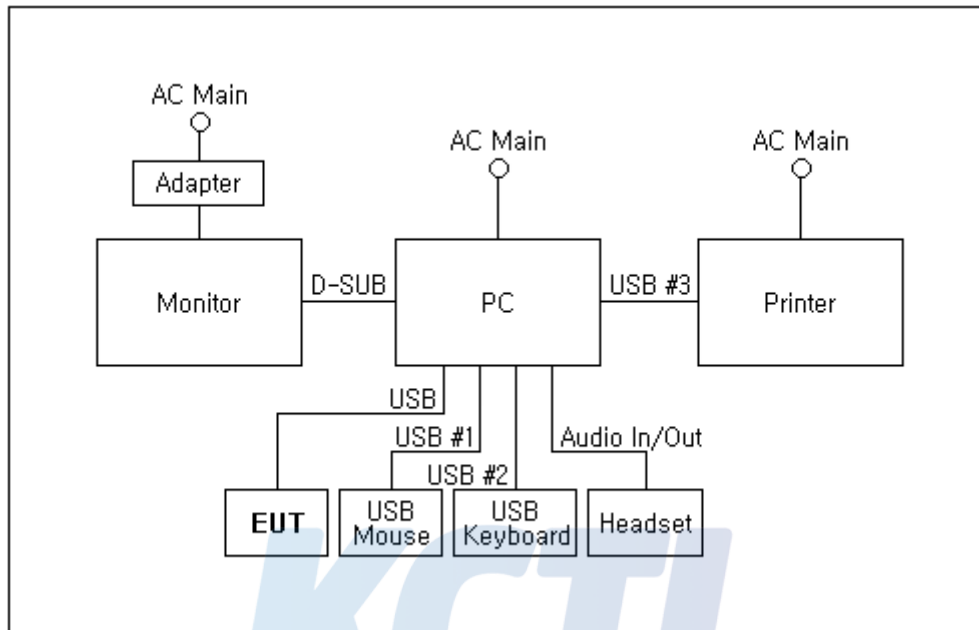
Type of product	RADAR DETECTOR
Model name (Basic)	PT100
Model name (Variant)	-
Difference	-
Serial no	-
Testing voltage	120 V, 60 Hz / DC 12 V
Input rating	DC 12 V
Internal clock frequency	22 MHz
FCC ID	W75-D-Y10
Note	-

4.3 Auxiliary equipments

Type	Model / Part #	S/N	Manufacturer
Cigar Jack #1, #2	-	-	-
DC Power Supply #1	E3632A	KR94907353	Agilent
DC Power Supply #2	E3632A	MY40004594	Agilent
PC	-	-	-
Monitor	LT24C350	ZXLQHMCD900110 J	SAMSUNG
Adapter	A4514_DDY	CN07BN44-00593 BDC07D8E0438	SAMSUNG
USB Mouse	-	-	-
USB Keyboard	K120	1833SC52GXU8	Logitech
Headset	SHS-100V/W	-	SAMSUNG
Printer	SCX-1855FW	-	SAMSUNG
RADAR Hub	-	-	-
Sensor	-	-	-
Remote Control	-	-	-

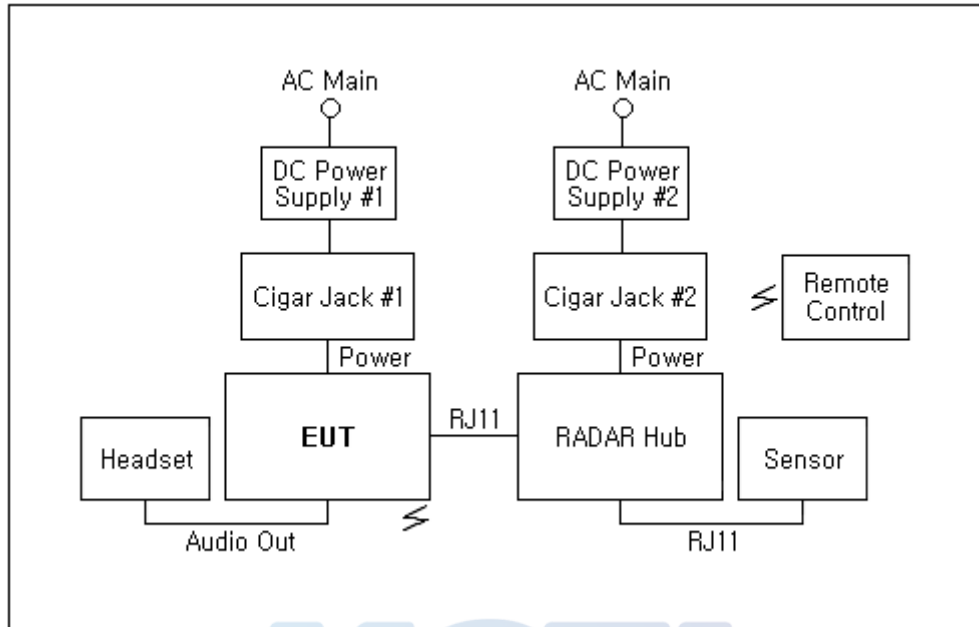
4.4 Test configuration

[Test #1]



	Start		End		Cable	
	Name	I/O port	Name	I/O port	Length (m)	Spec.
1	EUT	USB	PC	USB	1.0	Shield
2	PC	D-SUB	Monitor	D-SUB	2.0	Shield
3		USB #1	USB Mouse	-	1.5	Shield
4		USB #2	USB Keyboard	-	1.5	Shield
5		USB #3	Printer	USB	2.0	Shield
6		Audio In/Out	Headset	-	2.0	Unshield
7	Monitor	Power	Adapter	-	1.5	Unshield

[Test #2]



	Start		End		Cable	
	Name	I/O port	Name	I/O port	Length (m)	Spec.
1	EUT	Power	Cigar Jack #1	-	2.8	Unshield
2		RJ11	RADAR Hub	HOST	1.0	Unshield
3		Audio Out	Headset	-	2.0	Shield
4	RADAR Hub	Power	Cigar Jack #2	-	2.8	Unshield
5		RJ11	Sensor	-	3.0	Unshield
6	Cigar Jack #1	Power	DC Power Supply #1	-	1.5	Unshield
7	Cigar Jack #2	Power	DC Power Supply #2	-	1.5	Unshield

4.5 Operating conditions

The EUT was configured as normal intended use.

Test Mode	Normal operating
Test #1	The equipment under test was operated during the measurement under following conditions: data update mode. (Used program: K40 PT100 FW Update Tool v1.00)
Test #2	A signal is printed to the sensor using the Remote Control to check the signal on the LCD screen of the EUT, and the sound of the signal is checked by the Headset.

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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, FCC02-211 FCC Part 15 Subpart B, Class B	Pass
☒	Radiated Emission	ANSI C63.4:2014, FCC02-211 FCC Part 15 Subpart B, Class B	Pass

The data collected shows that EUT the complied with technical requirements of above rules part 15.109(h).

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6. Test results

6.1 Conducted Emissions

Test specification	ANSI C63.4:2014, FCC02-211 FCC Part 15 Subpart B, Class B		
Testing voltage	120 V, 60 Hz		
Test facility	Shielded room (CE#2)		
Date	2020-03-25		
Temperature (°C)	22.9 °C	Humidity (% R.H.)	26.5 % 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	2020.08.22	☒
TWO-LINE V-NETWORK	ENV216	101584	R&S	2020.04.05	☒
TWO-LINE V-NETWORK	NNLK8121	8121-472	SCHWARZBECK	2020.08.23	☒

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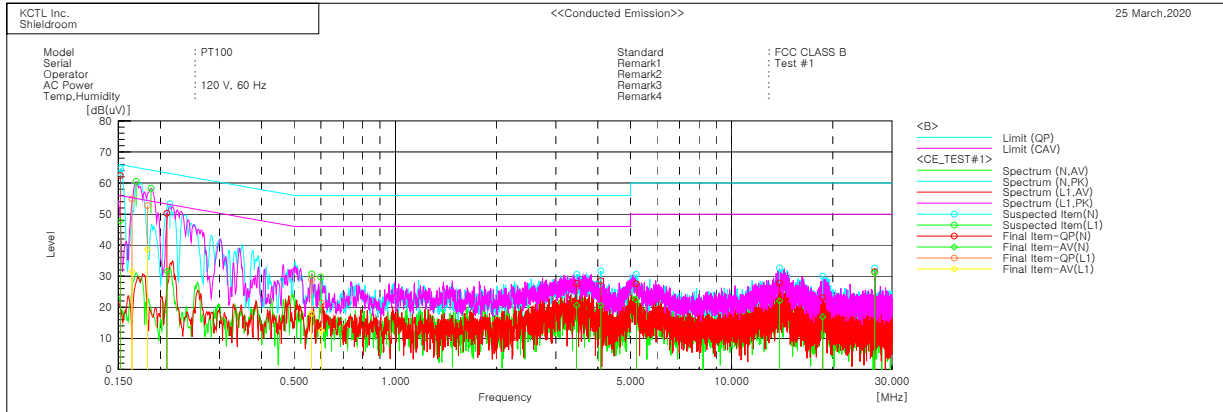
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6.1.4 Conducted emissions measurement result

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	0.15183	52.7	38.0	9.7	62.4	47.7	65.9	55.9	3.5	8.2
2	0.20914	40.4	21.8	9.8	50.2	31.6	63.2	53.2	13.0	21.6
3	3.46359	17.9	10.9	9.7	27.6	20.6	56.0	46.0	28.4	25.4
4	4.08456	18.8	10.8	9.7	28.5	20.5	56.0	46.0	27.5	25.5
5	5.20407	17.9	12.7	9.7	27.6	22.4	60.0	50.0	32.4	27.6
6	13.87974	17.9	12.1	9.9	27.8	22.0	60.0	50.0	32.2	28.0
7	18.6585	13.1	6.9	10.0	23.1	16.9	60.0	50.0	36.9	33.1
8	26.62353	21.4	21.1	10.1	31.5	31.2	60.0	50.0	28.5	18.8

--- 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	0.16487	44.8	21.5	10.0	54.8	31.5	65.2	55.2	10.4	23.7
2	0.18305	42.7	28.6	10.0	52.7	38.6	64.3	54.3	11.6	15.7
3	0.56345	19.0	8.0	9.9	28.9	17.9	56.0	46.0	27.1	28.1
4	0.60258	11.4	2.6	9.9	21.3	12.5	56.0	46.0	34.7	33.5

6.2 Radiated Emission

Test specification	ANSI C63.4:2014, FCC02-211 FCC Part 15 Subpart B, Class B		
Testing voltage	120 V, 60 Hz / DC 12 V		
Test facility	10 m Chamber (4F)		
Test distance	3 m		
Date	2020-03-25		
Temperature (°C)	23.2 °C	Humidity (% R.H.)	27.1 % R.H.
Remarks	Pass		

6.2.1 Limits of radiated emission measurement

Frequency [MHz]	Class A (dB(μ V/m)) @ 10 m	Class B (dB(μ V/m)) @ 3 m
30-88	39	40
88-216	43.5	43.5
216-960	46.4	46
Above 960	49.5	54

Note- Alternative standard: CISPR, Pub. 22

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	2020.08.22	☒
Bilog Antenna	CBL 6112D	37876	TESEQ	2020.07.20	☒
AMPLIFIER	310N	293004	SONOMA	2020.08.22	☒
ATTENUATOR	8491B	MY39270292	AGILENT	-	☒
Antenna Mast	MA4640-XP-ET	-	Innco Systems	-	☒
Turn Table	TT 3.0-3t	-	MATURO	-	☒
PREAMPLIFIER	8449B	3008A01802	AGILENT	2020.04.04	☒
DOUBLE RIDGED HORN ANTENNA	3115	00086706	ETS-LINDGREN	2020.08.27	☒
Spectrum Analyzer	FSV40	100988	R&S	2021.01.03	☐

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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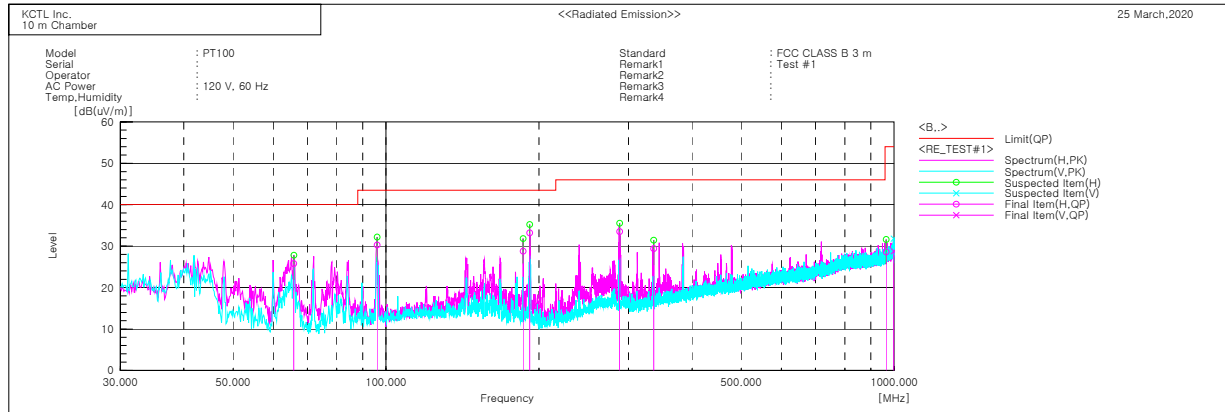
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6.2.5 Radiated emission measurement result

30 MHz ~ 1 GHz



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(μV)]	c.f [dB(1/m)]	Result QP [dB(μV/m)]	Limit QP [dB(μV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	65.824	H	42.2	-16.4	25.8	40.0	14.2	366.0	301.0
2	96.090	H	41.9	-11.6	30.3	43.5	13.2	395.0	280.0
3	186.154	H	39.9	-11.1	28.8	43.5	14.7	330.0	154.0
4	191.789	H	44.2	-11.0	33.2	43.5	10.3	341.0	149.0
5	288.389	H	38.9	-5.4	33.5	46.0	12.5	323.0	154.0
6	336.339	H	33.3	-3.9	29.4	46.0	16.6	371.0	42.0
7	964.716	H	17.6	11.0	28.6	54.0	25.4	100.0	57.0
8	998.199	V	16.8	12.0	28.8	54.0	25.2	173.0	178.0

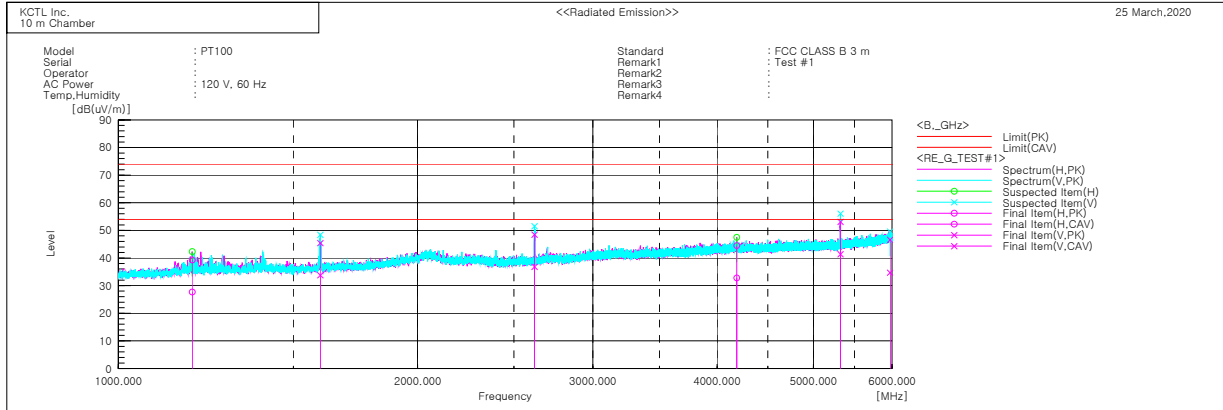
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1 GHz ~ 6 GHz



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	1186.746	H	49.4	37.8	-10.1	39.3	27.7	74.0	54.0	34.7	26.3	200.0	306.0
2	1596.550	V	52.8	41.2	-7.4	45.4	33.8	74.0	54.0	28.6	20.2	154.0	132.0
3	2621.320	V	51.9	40.2	-3.4	48.5	36.8	74.0	54.0	25.5	17.2	164.0	213.0
4	4187.461	H	41.0	29.3	3.5	44.5	32.8	74.0	54.0	29.5	21.2	181.0	244.0
5	5324.226	V	47.7	36.0	5.4	53.1	41.4	74.0	54.0	20.9	12.6	184.0	188.0
6	5971.494	V	38.4	26.5	8.2	46.6	34.7	74.0	54.0	27.4	19.3	116.0	358.0

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KP20-01372

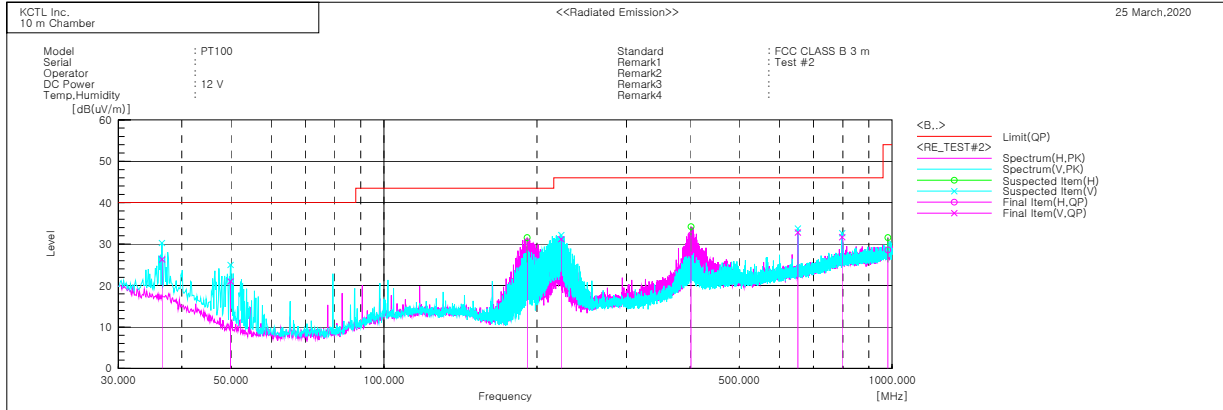
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30 MHz ~ 1 GHz



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	36.581	V	34.5	-8.2	26.3	40.0	13.7	283.0	354.0
2	49.852	V	36.1	-15.1	21.0	40.0	19.0	196.0	357.0
3	191.367	H	41.6	-11.0	30.6	43.5	12.9	400.0	120.0
4	223.289	V	40.5	-9.3	31.2	46.0	14.8	145.0	117.0
5	401.995	H	33.5	-1.3	32.2	46.0	13.8	317.0	166.0
6	652.428	V	28.2	4.6	32.8	46.0	13.2	160.0	130.0
7	797.519	V	23.6	8.1	31.7	46.0	14.3	217.0	349.0
8	980.861	H	17.1	11.5	28.6	54.0	25.4	300.0	99.0

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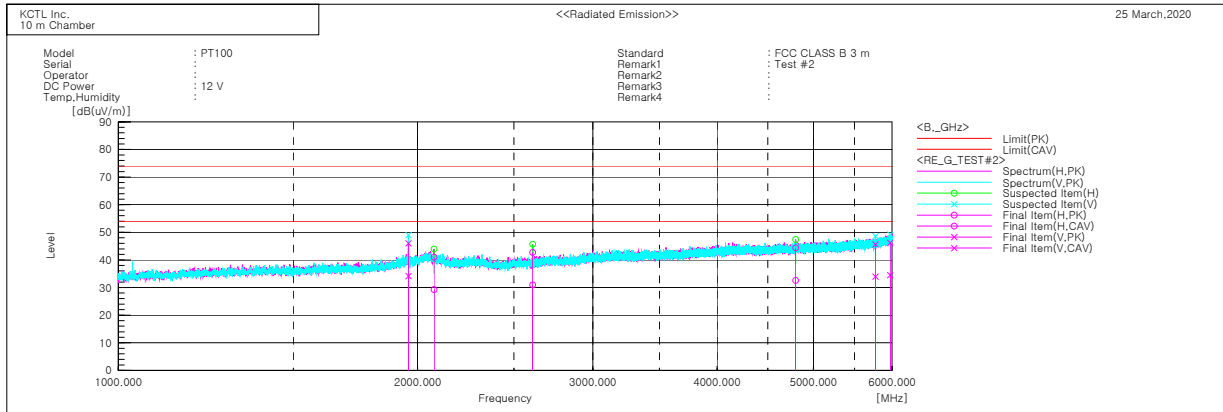
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1 GHz ~ 6 GHz



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	1957.723	V	49.9	38.1	-3.9	46.0	34.2	74.0	54.0	28.0	19.8	185.0	172.0
2	2077.587	H	43.2	31.5	-2.2	41.0	29.3	74.0	54.0	33.0	24.7	187.0	348.0
3	2610.308	H	46.2	34.5	-3.5	42.7	31.0	74.0	54.0	31.3	23.0	142.0	202.0
4	4800.109	H	40.1	28.3	4.3	44.4	32.6	74.0	54.0	29.6	21.4	181.0	353.0
5	5774.218	V	38.6	27.0	7.0	45.6	34.0	74.0	54.0	28.4	20.0	273.0	172.0
6	5974.405	V	38.0	26.3	8.2	46.2	34.5	74.0	54.0	27.8	19.5	127.0	120.0

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