

TEST REPORT

of

FCC Part 15 Subpart C §15.209
IC RSS-210 Issue 10 and RSS-Gen Issue 5

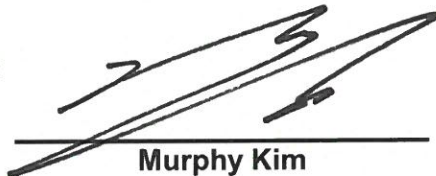
FCC ID: TQ8-IBU-4E10
IC Certification: 5074A-IBU4E10

1. Equipment Under Test : SMART KEY ECU
2. Model Name : IBU-4E10
3. Variant Model Name(s) : -
4. Applicant : Hyundai Mobis Co., Ltd.
5. Manufacturer : Hyundai Mobis Co., Ltd.
6. Date of Receipt : 2020.02.07.
7. Date of Test(s) : 2020.02.07 ~ 2020.03.27
8. Date of Issue : 2020.04.09

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

- 1) The results of this test report are effective only to the items tested.
- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.

Tested by:


Murphy Kim

Technical
Manager:


Jungmin Yang

SGS Korea Co., Ltd. Gunpo Laboratory

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

Phone No. : +82 31 688 0901

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1.2. Details of Applicant

Applicant : Hyundai Mobis Co., Ltd.

Address : 203, Teheran-ro, Gangnam-gu, Seoul, South Korea, 135-977

Contact Person : Choe, Seung-Hoon

Phone No. : +82 31 260 0098

1.3. Details of Manufacturer

Applicant : Same as applicant

Address : Same as applicant

1.4. Description of EUT

Kind of Product		SMART KEY ECU
Model Name		IBU-4E10
Power Supply		DC 12.0 V
Frequency Range		Tx: 125.00 kHz, Rx: 433.92 MHz
Antenna Type	Tx	Coil Antenna
	Rx	PCB pattern antenna

1.5. Declaration of Manufacturer

- The EUT has 7 transmit antennas and one receive antenna.
- The transmit antennas can not operate at the same time.

1.6. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Spectrum Analyzer	R&S	FSV30	103102	Jun. 05, 2019	Annual	Jun. 05, 2020
Signal Generator	R&S	SMBV100A	259067	Jun. 10, 2019	Annual	Jun. 10, 2020
DC Power Supply	Agilent	U8002A	MY50060028	Mar. 03, 2020	Annual	Mar. 03, 2021
Test Receiver	R&S	ESU26	100109	Feb. 18, 2020	Annual	Feb. 18, 2021
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 22, 2019	Biennial	Aug. 22, 2021
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	396	Mar. 21, 2019	Biennial	Mar. 21, 2021
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/3 8330516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	SUCOFLEX	104 (3 m)	MY3258414	Jan. 28, 2020	Semi-annual	Jul. 28, 2020
Coaxial Cable	SUCOFLEX	104 (10 m)	MY3145814	Jan. 28, 2020	Semi-annual	Jul. 28, 2020

1.7. Sample Calculation

Where relevant, the following sample calculation is provided:

Field strength level (dB μ V/m) = Measured level (dB μ V) + Antenna factor (dB) + Cable loss (dB)

1.8. Summary of Test Results

The EUT has been tested according to the following specifications:

Applied standard: FCC Part15 subpart C, IC RSS-210 Issue 10, RSS-Gen Issue 5			
Section in FCC	Section in IC	Test Item(s)	Result
15.209	RSS-210 Issue 10, 7.3, RSS-Gen Issue 5, 8.9	Radiated emission, Spurious Emission and Field Strength of Fundamental	Complied
2.1049	-	20 dB Bandwidth	Complied
-	RSS-Gen Issue 5 6.7	Occupied Bandwidth	Complied
15.207	RSS-Gen Issue 5 8.8	AC Power Line Conducted Emission	N/A ¹⁾

Note;

- 1) The AC power line test was not performed because the EUT use battery power for operation and which do not operate from the AC power lines.

1.9. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Occupied Bandwidth	± 9.66 kHz
Radiated Emission, 9 kHz to 30 MHz	± 3.59 dB
Radiated Emission, below 1 GHz	± 5.88 dB

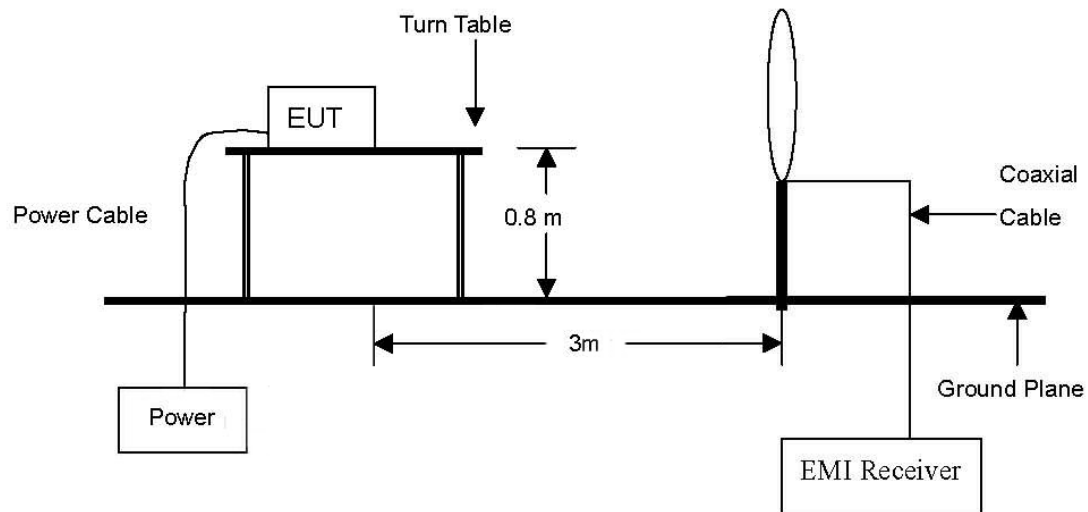
1.10. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL000534	2020.04.09.	Initial

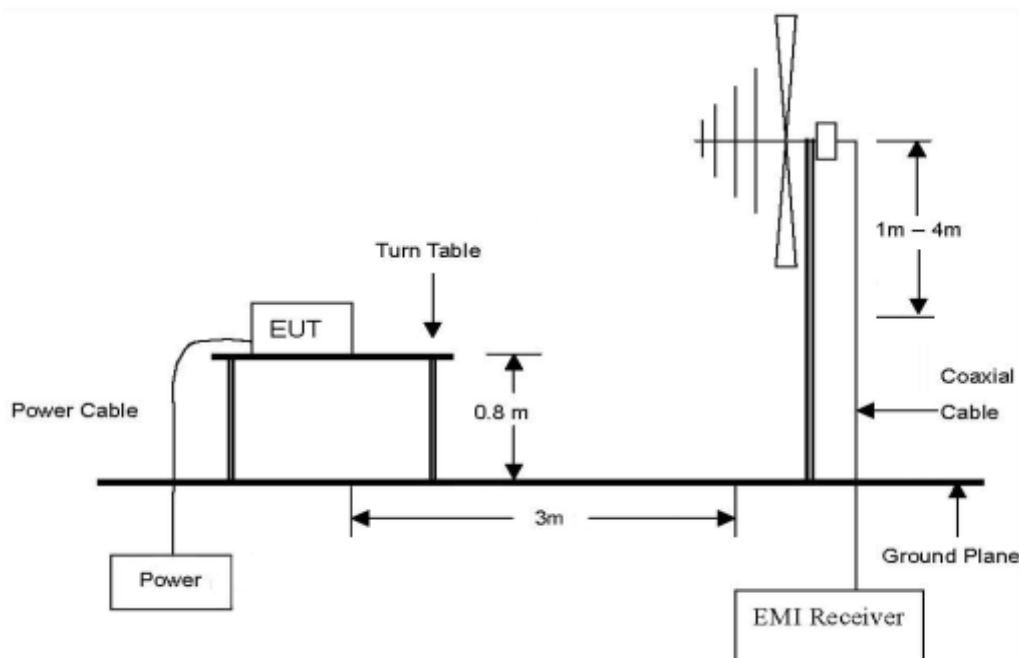
2. Field Strength of Fundamental and Spurious Emission

2.1. Test Setup

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



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



2.2. Limits

2.2.1. FCC

According to §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 (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meter)
0.009-0.490	2 400/F(kHz)	300
0.490-1.705	24 000/F(kHz)	30
1.705-30.0	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 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

According to §15.209(d), The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1 000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

2.2.2. IC

2.2.2.1. Transmitter emission limits

According to RSS-Gen Issue 5, 8.9.

Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Table 5 - General field strength limits at frequencies above 30 MHz

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3 m)
30-88	100
88-216	150
216-960	200
Above 960	500

Table 6 - General field strength limits at frequencies below 30 MHz

Frequency	Magnetic Field Strength (H-Field) ($\mu\text{A/m}$)	Measurement Distance (m)
9-490 kHz ¹	6.37/F (F in kHz)	300
490-1 705 kHz	63.7/F (F in kHz)	30
1.705-30 MHz	0.08	30

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

According to RSS-210 Issue 10, 7.3.

Transmitters whose wanted and unwanted emissions fall within the general field strength limits specified in RSS-Gen may operate licence exempt in any of the frequency bands, other than the restricted frequency bands, other than the restricted frequency bands listed in RSS-Gen and the TV bands 54-72 MHz, 76-88 MHz, 174-216 MHz and 470-602 MHz, and shall be certified under RSS-210. Under no circumstances shall the level of any unwanted emissions exceed the level of the fundamental emissions.

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10-2013.

2.3.1. Test Procedures for emission from 9 kHz to 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.
5. To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes (X, Y, Z). Worst orthogonal plan of EUT is X – axis during radiation test.

2.3.2. Test Procedures for emission from 30 MHz to 1 000 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
- c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.

2.4. Field Strength of Fundamental Test Result

Ambient temperature : $(23 \pm 1) ^\circ\text{C}$
Relative humidity : 47 % R.H.

The following table shows the highest level of radiated emissions on between polarizations of horizontal and vertical.

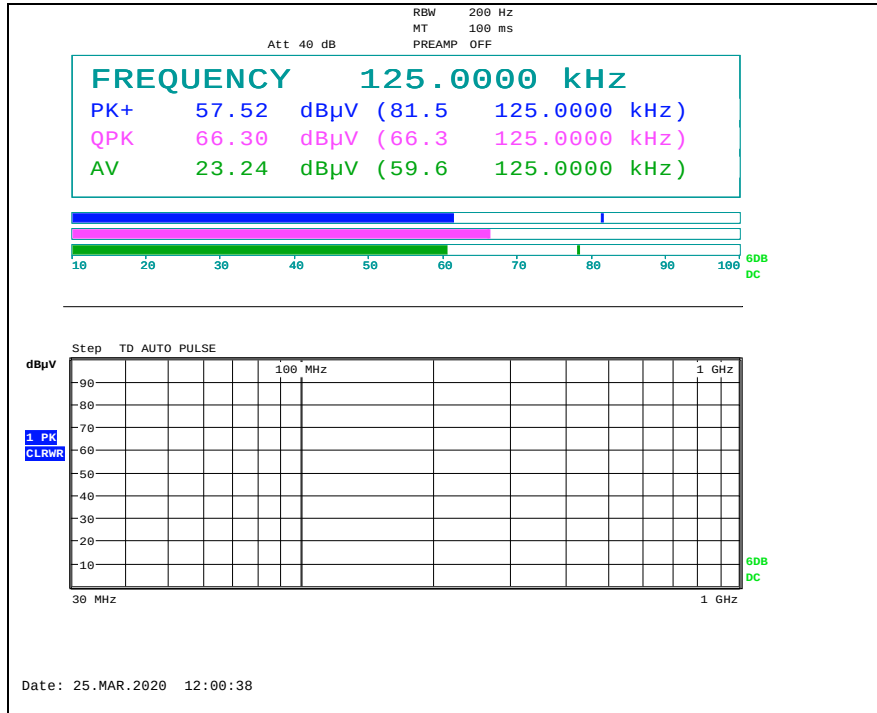
Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μV)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB $\mu\text{V/m}$) at 3 m	Actual (dB $\mu\text{V/m}$) at 300 m	Limit (dB $\mu\text{V/m}$) at 300 m	Margin (dB)
DRV Antenna									
0.125	59.60	Average	H	17.80	0.07	77.47	-2.53	25.67	28.20
AST Antenna									
0.125	60.70	Average	H	17.80	0.07	78.57	-1.43	25.67	27.10
INT1 Antenna									
0.125	60.00	Average	H	17.80	0.07	77.87	-2.13	25.67	27.80
INT2 Antenna									
0.125	61.30	Average	H	17.80	0.07	79.17	-0.83	25.67	26.50
TRK Antenna									
0.125	59.90	Average	H	17.80	0.07	77.77	-2.23	25.67	27.90
BMP Antenna									
0.125	62.50	Average	H	17.80	0.07	80.37	0.37	25.67	25.30
SSB Antenna									
0.125	67.60	Average	H	17.80	0.07	85.47	5.47	25.67	20.20

Remark;

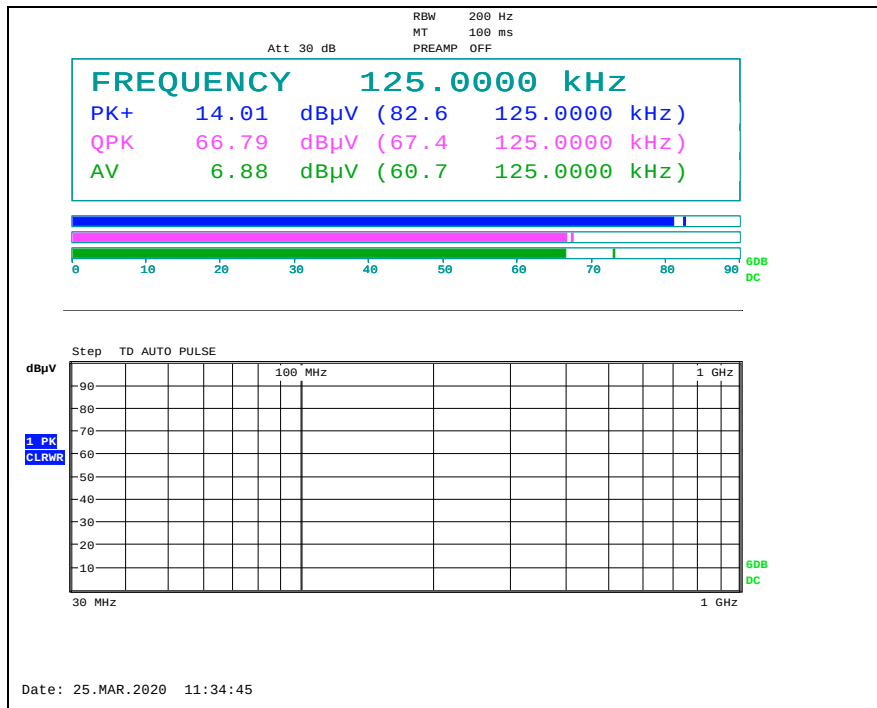
1. According to §15.31(f)(2) 300 m Result (dB $\mu\text{V/m}$) = 3 m Result (dB $\mu\text{V/m}$) - $40\log(300/3)$ (dB $\mu\text{V/m}$).
2. According to §15.209(d), the measurements were tested by using Quasi peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1 000 MHz in these three bands on measurements employing an average detector.
3. The limit above was calculated based on table of §15.209(a).
4. According to ANSI C63.10: 2013, For measurement below 30 MHz.
conversion factor from E-field to H-field is considered as free-space impedance $[1 \mu\text{V/m} = (1/377 \Omega) \times 1 \mu\text{A/m}]$
The FCC limits are same to the IC limits.
5. Actual (dB $\mu\text{V/m}$) at 3 m = Reading (dB μV) + AF (dB/m) + CL (dB).

- Test plots

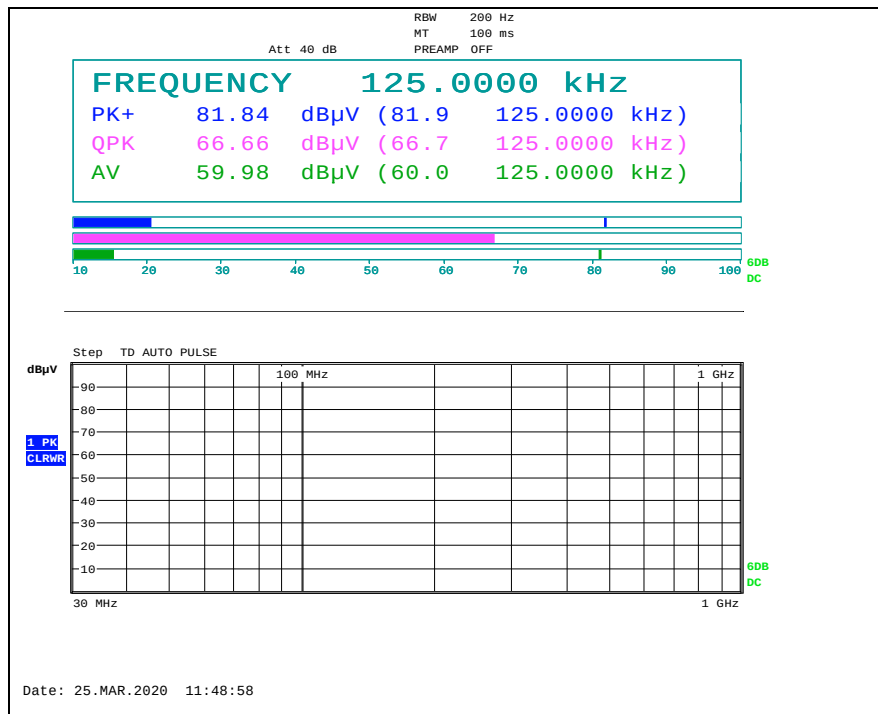
- DRV Antenna



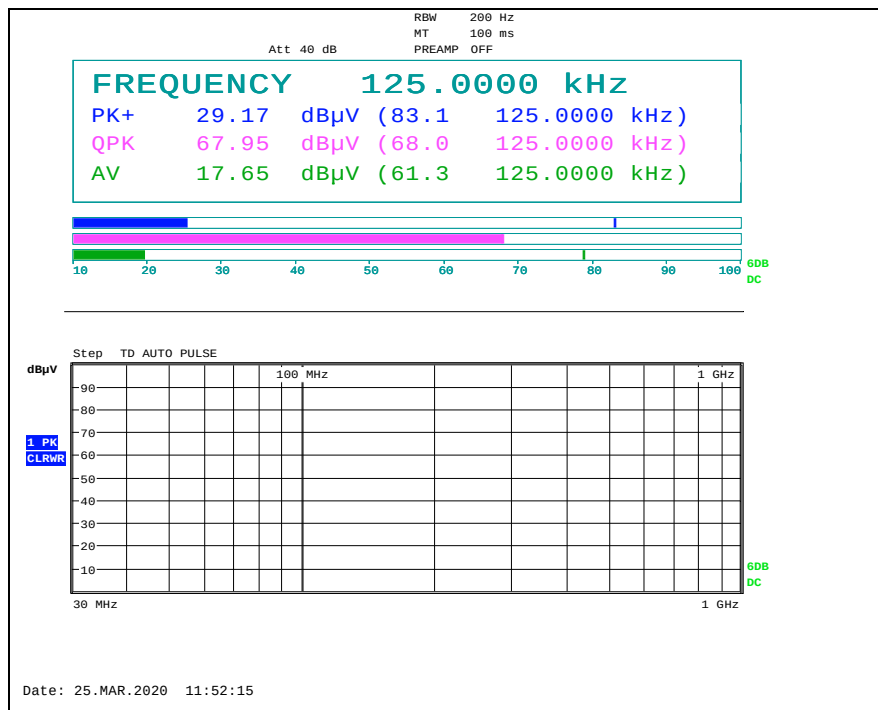
- AST Antenna



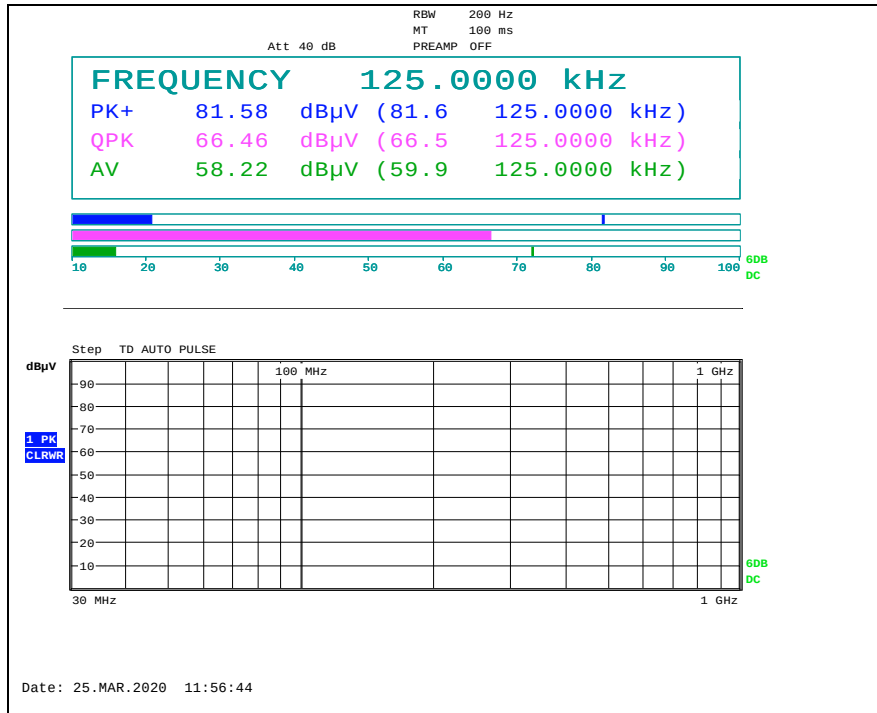
- INT1 Antenna



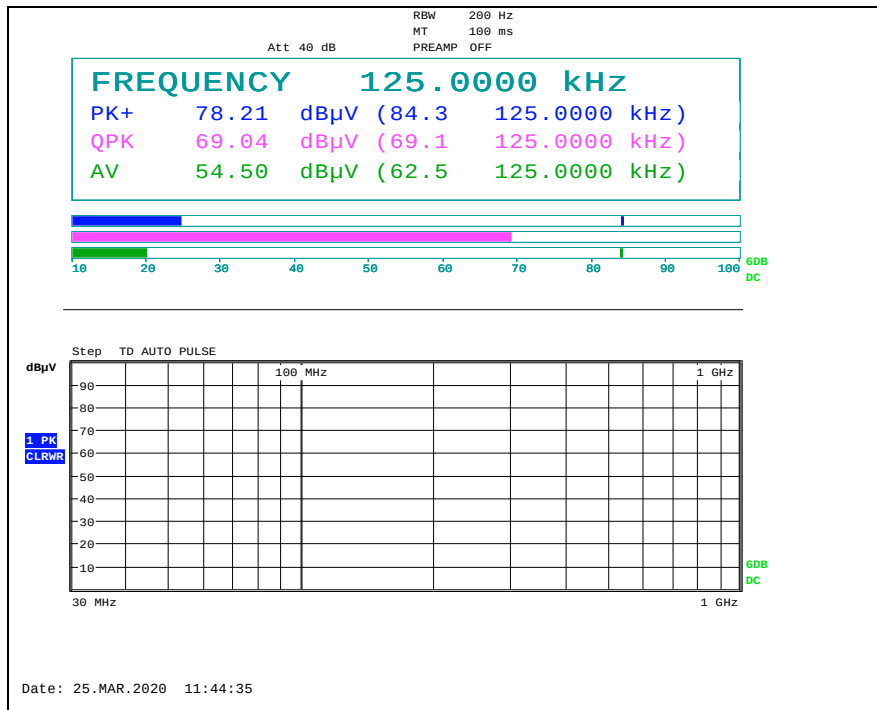
- INT2 Antenna



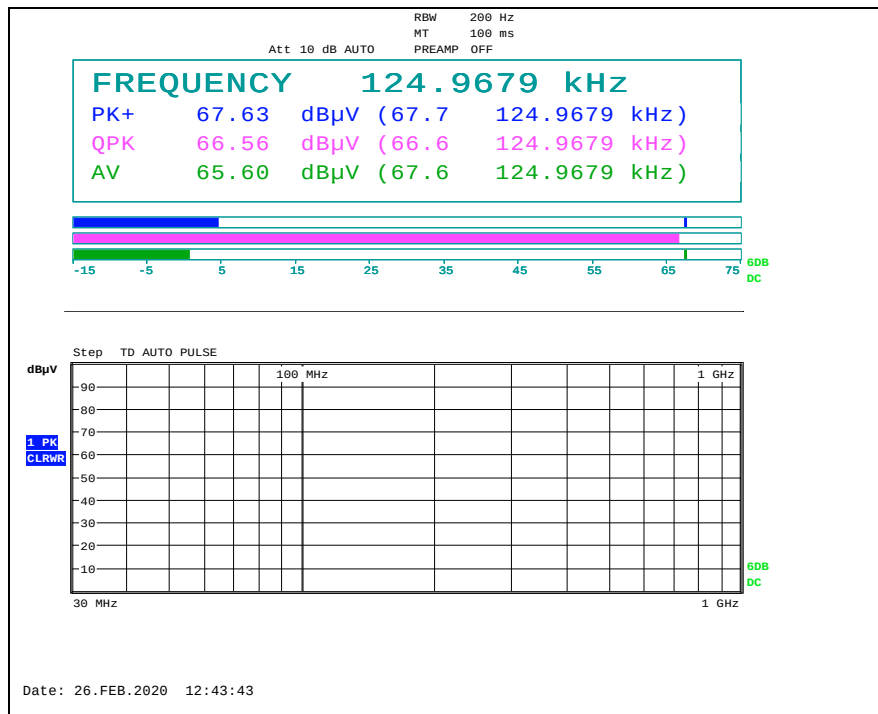
- TRK Antenna



- BMP Antenna



- SSB Antenna



2.5. Spurious Emission Test Result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

The following table shows the highest level of radiated emissions on between polarizations of horizontal and vertical.

DRV Antenna

Below 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m or 30 m	Limit (dBμV/m) at 300 m or 30 m	Margin (dB)
0.022	26.70	Average	H	18.14	0.02	44.86	-35.14	40.76	75.90
0.046	18.00	Average	H	17.88	0.03	35.91	-44.09	34.35	78.44
0.066	16.40	Average	H	17.85	0.04	34.29	-45.71	31.21	76.92
0.082	20.40	Average	H	17.83	0.05	38.28	-41.72	29.33	71.05
0.547	20.20	Quasi-Peak	H	17.74	0.24	38.18	-1.82	32.84	34.66
0.639	21.90	Quasi-Peak	H	17.81	0.27	39.98	-0.02	31.49	31.51
0.735	16.80	Quasi-Peak	H	17.89	0.31	35.00	-5.00	30.28	35.28

Above 30 MHz

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
35.62	35.60	Peak	V	17.93	-26.64	26.89	40.00	13.11
125.83	37.50	Peak	H	14.80	-25.29	27.01	43.50	16.49
276.91	36.80	Peak	H	18.74	-24.93	30.61	46.00	15.39
276.99	36.60	Peak	V	18.74	-24.93	30.41	46.00	15.59
377.75	35.40	Peak	V	20.76	-24.71	31.45	46.00	14.55
410.52	35.40	Peak	V	21.81	-24.61	32.60	46.00	13.40
Above 500.00	Not detected	-	-	-	-	-	-	-

AST Antenna
Below 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m) at 300 m or 30 m	Margin (dB)
0.022	27.30	Average	H	18.14	0.02	45.46	-34.54	40.76	75.30
0.051	14.40	Average	H	17.87	0.03	32.30	-47.70	33.45	81.15
0.074	17.40	Average	H	17.84	0.05	35.29	-44.71	30.22	74.93
0.728	17.90	Quasi-Peak	H	17.88	0.31	36.09	-3.91	30.36	34.27
1.195	11.30	Quasi-Peak	H	18.12	0.41	29.83	-10.17	26.06	36.23
2.549	12.91	Quasi-Peak	H	18.25	0.43	31.59	-8.41	29.54	37.95

Above 30 MHz

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
125.75	38.20	Peak	H	14.80	-25.29	27.71	43.50	15.79
125.87	35.50	Peak	V	14.80	-25.29	25.01	43.50	18.49
274.20	35.40	Peak	V	18.68	-24.94	29.14	46.00	16.86
277.07	39.00	Peak	H	18.74	-24.93	32.81	46.00	13.19
414.12	36.30	Peak	V	21.88	-24.61	33.57	46.00	12.43
902.48	33.20	Peak	V	28.15	-22.16	39.19	46.00	6.81

INT1 Antenna
Below 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m) at 300 m or 30 m	Margin (dB)
0.021	27.00	Average	H	18.17	0.02	45.19	-34.81	41.16	75.97
0.046	17.10	Average	H	17.88	0.03	35.01	-44.99	34.35	79.34
0.066	19.20	Average	H	17.85	0.04	37.09	-42.91	31.21	74.12
0.074	18.20	Average	H	17.84	0.05	36.09	-43.91	30.22	74.13
0.637	22.30	Quasi-Peak	H	17.81	0.27	40.38	0.38	31.52	31.14
2.271	12.30	Quasi-Peak	H	18.23	0.43	30.96	-9.04	29.54	38.58

Above 30 MHz

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
125.83	38.80	Peak	H	14.80	-25.29	28.31	43.50	15.19
138.44	36.50	Peak	H	14.10	-25.25	25.35	43.50	18.15
275.65	35.40	Peak	V	18.71	-24.93	29.18	46.00	16.82
276.78	37.00	Peak	H	18.74	-24.93	30.81	46.00	15.19
327.20	33.20	Peak	V	19.83	-24.83	28.20	46.00	17.80
409.80	34.80	Peak	V	21.80	-24.61	31.99	46.00	14.01
Above 500.00	Not detected	-	-	-	-	-	-	-

INT2 Antenna
Below 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m) at 300 m or 30 m	Margin (dB)
0.022	25.70	Average	H	18.14	0.02	43.86	-36.14	40.76	76.90
0.046	16.40	Average	H	17.88	0.03	34.31	-45.69	34.35	80.04
0.074	19.30	Average	H	17.84	0.05	37.19	-42.81	30.22	73.03
0.090	27.30	Average	H	17.81	0.05	45.16	-34.84	28.52	63.36
0.299	11.20	Average	H	17.80	0.15	29.15	-50.85	18.09	68.94
0.635	22.30	Quasi-Peak	H	17.81	0.27	40.38	0.38	31.55	31.17
1.995	13.30	Quasi-Peak	H	18.20	0.42	31.92	-8.08	29.54	37.62

Above 30 MHz

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
125.83	37.80	Peak	H	14.80	-25.29	27.31	43.50	16.19
138.32	36.50	Peak	H	14.10	-25.25	25.35	43.50	18.15
151.13	35.60	Peak	V	13.91	-25.20	24.31	43.50	19.19
276.87	35.90	Peak	H	18.74	-24.93	29.71	46.00	16.29
276.95	36.80	Peak	V	18.74	-24.93	30.61	46.00	15.39
902.48	33.00	Peak	V	28.15	-22.16	38.99	46.00	7.01

TRK Antenna
Below 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m) at 300 m or 30 m	Margin (dB)
0.022	26.20	Average	H	18.14	0.02	44.36	-35.64	40.76	76.40
0.047	17.70	Average	H	17.88	0.03	35.61	-44.39	34.16	78.55
0.066	12.70	Average	H	17.85	0.04	30.59	-49.41	31.21	80.62
0.361	10.60	Average	H	17.77	0.17	28.54	-51.46	16.45	67.91
0.903	15.90	Quasi-Peak	H	18.02	0.37	34.29	-5.71	28.49	34.20
2.444	12.40	Quasi-Peak	H	18.24	0.43	31.07	-8.93	29.54	38.47

Above 30 MHz

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
72.36	34.60	Peak	V	13.52	-25.83	22.29	40.00	17.71
112.09	39.60	Peak	H	16.39	-25.34	30.65	43.50	12.85
138.36	38.50	Peak	H	14.10	-25.25	27.35	43.50	16.15
276.95	35.90	Peak	V	18.74	-24.93	29.71	46.00	16.29
377.26	34.80	Peak	V	20.75	-24.71	30.84	46.00	15.16
416.34	34.90	Peak	V	21.93	-24.60	32.23	46.00	13.77
Above 500.00	Not detected	-	-	-	-	-	-	-

BMP Antenna
Below 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m) at 300 m or 30 m	Margin (dB)
0.023	26.10	Average	H	18.11	0.02	44.23	-35.77	40.37	76.14
0.051	17.20	Average	H	17.87	0.03	35.10	-44.90	33.45	78.35
0.082	14.90	Average	H	17.83	0.05	32.78	-47.22	29.33	76.55
0.631	19.80	Quasi-Peak	H	17.80	0.27	37.87	-2.13	31.60	33.73
1.446	13.00	Quasi-Peak	H	18.14	0.42	31.56	-8.44	24.40	32.84
2.533	13.10	Quasi-Peak	H	18.25	0.43	31.78	-8.22	29.54	37.76

Above 30 MHz

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
125.83	39.00	Peak	H	14.80	-25.29	28.51	43.50	14.99
138.40	37.50	Peak	H	14.10	-25.25	26.35	43.50	17.15
276.78	35.60	Peak	V	18.74	-24.93	29.41	46.00	16.59
276.91	35.80	Peak	H	18.74	-24.93	29.61	46.00	16.39
377.62	34.80	Peak	V	20.75	-24.71	30.84	46.00	15.16
402.68	36.20	Peak	V	21.65	-24.67	33.18	46.00	12.82
Above 500.00	Not detected	-	-	-	-	-	-	-

SSB Antenna
Below 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m) at 300 m or 30 m	Margin (dB)
0.022	27.40	Average	H	18.14	0.02	45.56	-34.44	40.76	75.20
0.046	17.00	Average	H	17.88	0.03	34.91	-45.09	34.35	79.44
0.069	20.90	Average	H	17.84	0.04	38.78	-41.22	30.83	72.05
0.293	10.50	Average	H	17.80	0.14	28.44	-51.56	18.27	69.83
0.644	17.90	Quasi-Peak	H	17.82	0.28	36.00	-4.00	31.43	35.43

Above 30 MHz

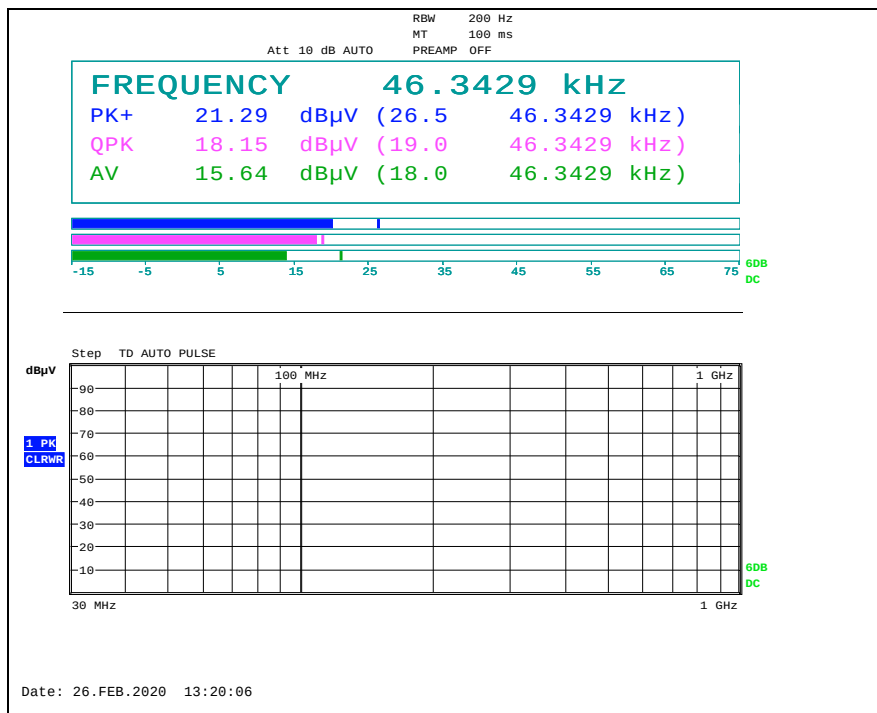
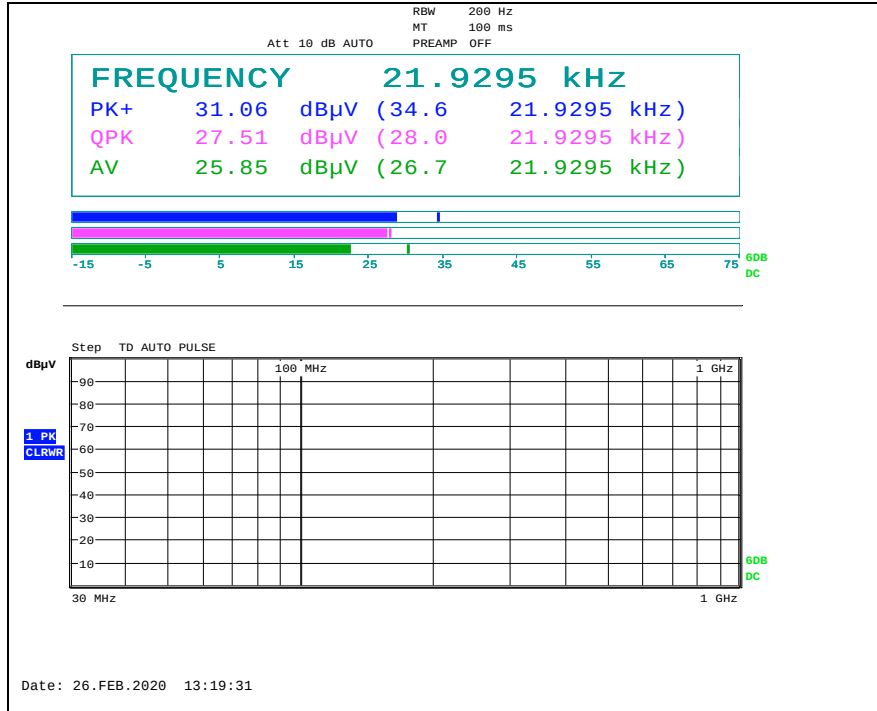
Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
125.79	34.70	Peak	V	14.80	-25.29	24.21	43.50	19.29
125.87	36.40	Peak	H	14.80	-25.29	25.91	43.50	17.59
138.48	36.40	Peak	H	14.10	-25.25	25.25	43.50	18.25
278.52	35.20	Peak	V	18.77	-24.92	29.05	46.00	16.95
301.96	35.10	Peak	H	19.20	-24.91	29.39	46.00	16.61
377.46	36.10	Peak	V	20.75	-24.71	32.14	46.00	13.86
Above 400.00	Not detected	-	-	-	-	-	-	-

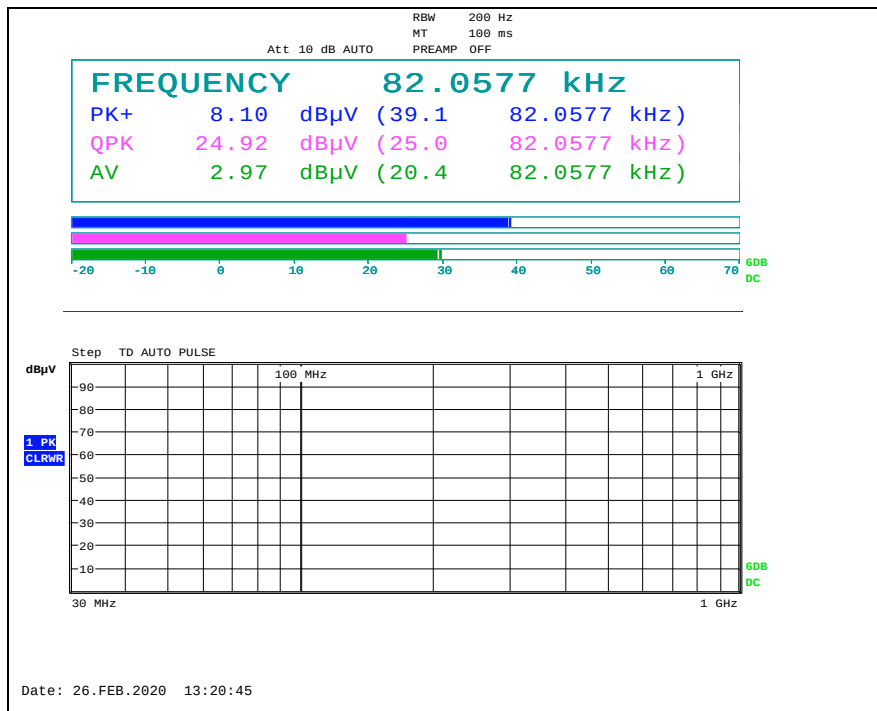
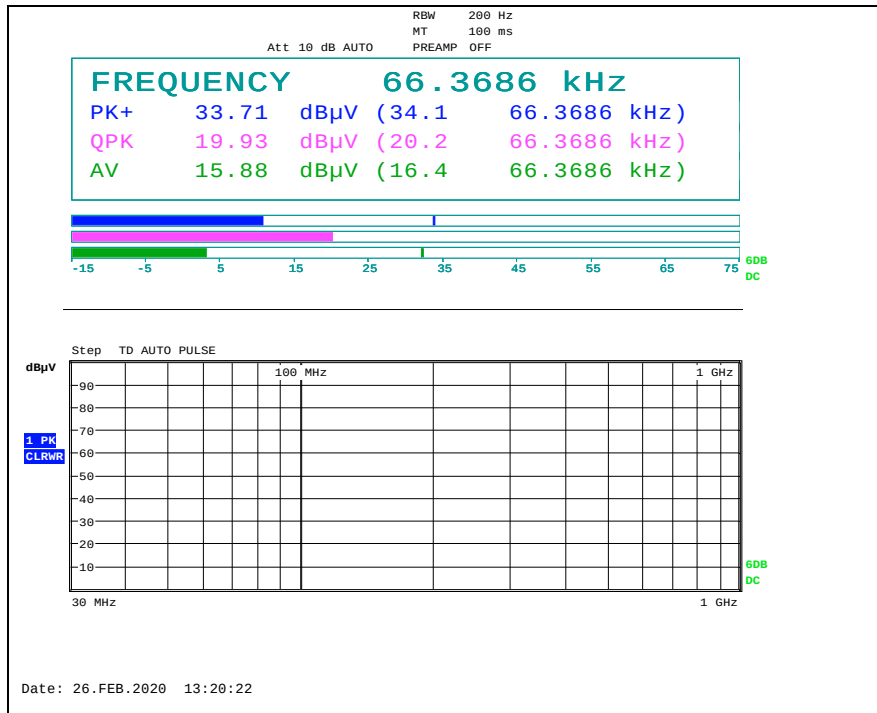
Remark;

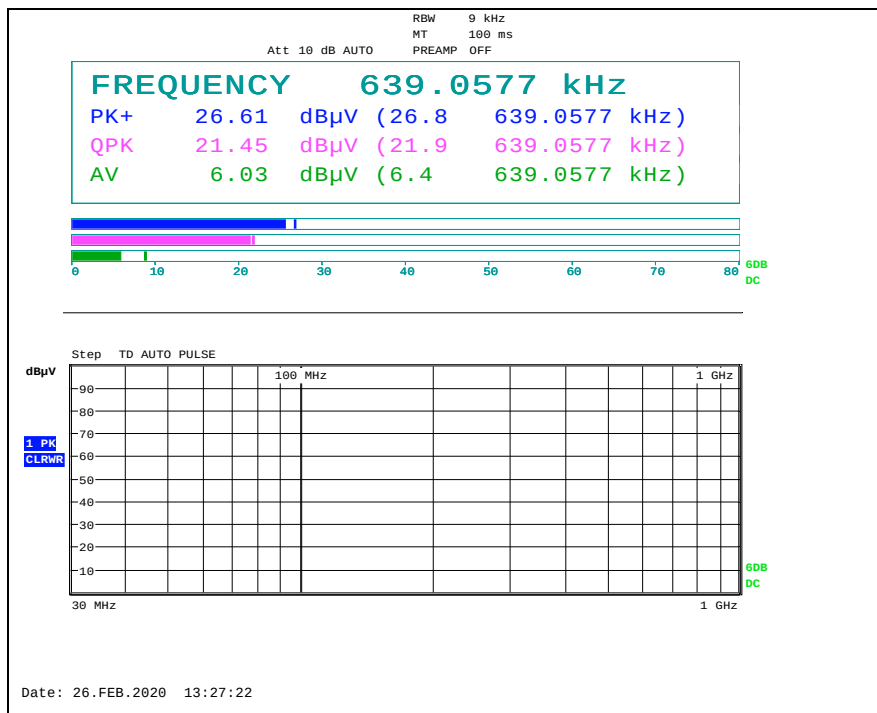
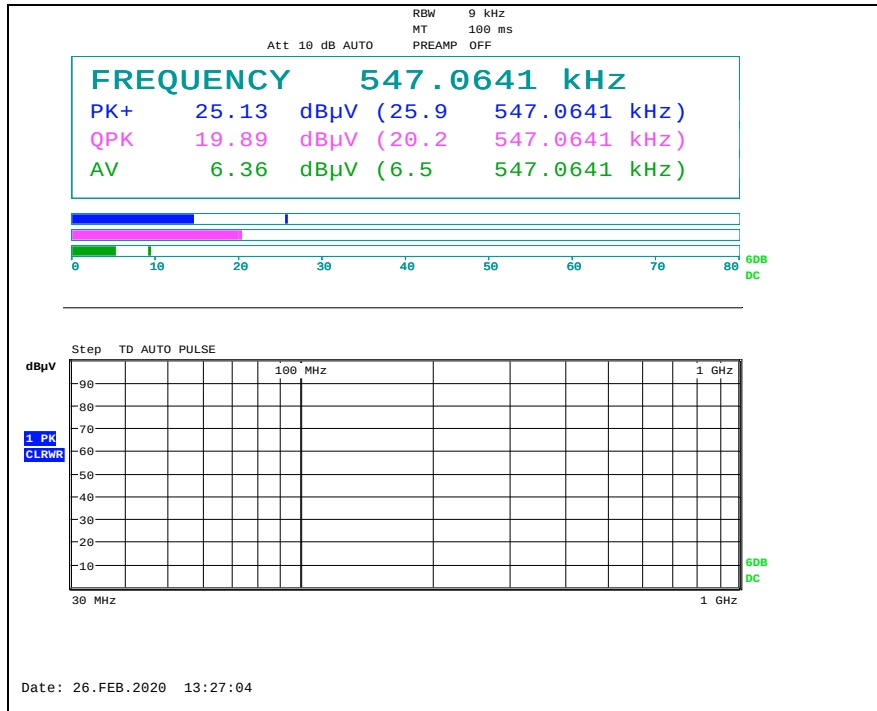
1. According to §15.31(f)(2)
 - 300 m Result (dB μ V/m) = 3 m Result (dB μ V/m) - 40log (300/3) (dB μ V/m)
 - 30 m Result (dB μ V/m) = 3 m Result (dB μ V/m) - 40log (30/3) (dB μ V/m)
2. According to field strength table of general requirement in §15.209(a), field strength limits below 1.705 MHz were calculated as below.
 - 9 kHz to 490 kHz: 20log (2 400 / F (kHz)) at 300 m (dB μ V/m)
 - 490 kHz to 1 705 kHz: 20log (24 000 / F (kHz)) at 30 m (dB μ V/m)
3. According to §15.209(d), the measurements were tested by using Quasi peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1 000 MHz in these three bands on measurements employing an average detector.
4. According to ANSI C63.10: 2013, For measurement below 30 MHz.
 conversion factor from E-field to H-field is considered as free-space impedance [1 μ V/m = (1/377 Ω) $\times$ 1 μ A/m]
 The FCC limits are same to the IC limits.
5. The limit above was calculated based on table of §15.209 (a).
6. Actual (dB μ V/m) at 3 m = Reading (dB μ V) + AF (dB/m) + CL (dB) or
 Reading (dB μ V) + AF (dB/m) + AMP (dB) + CL (dB).

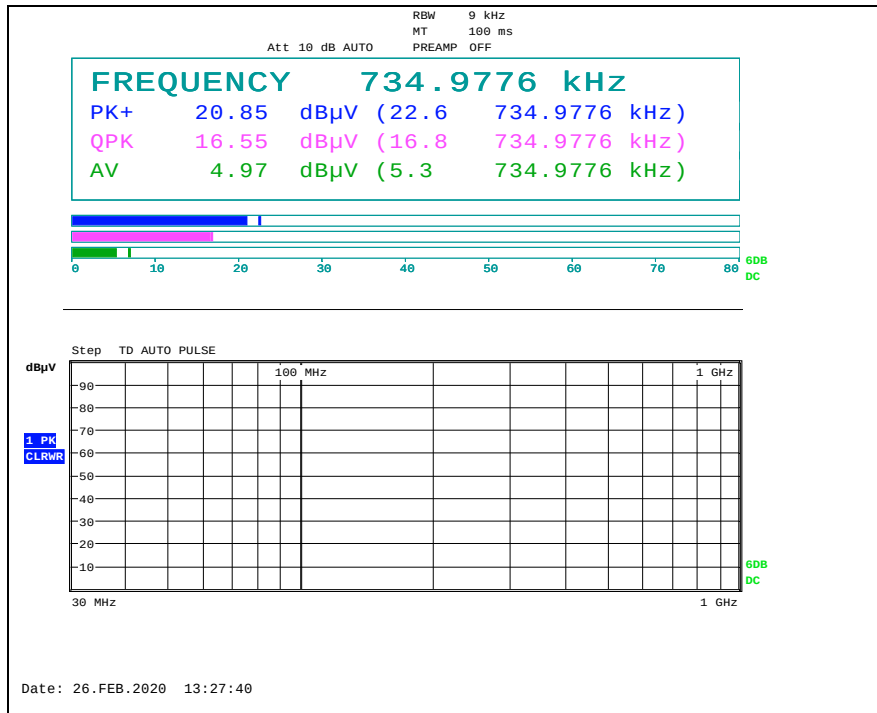
- Test plots

- DRV Antenna

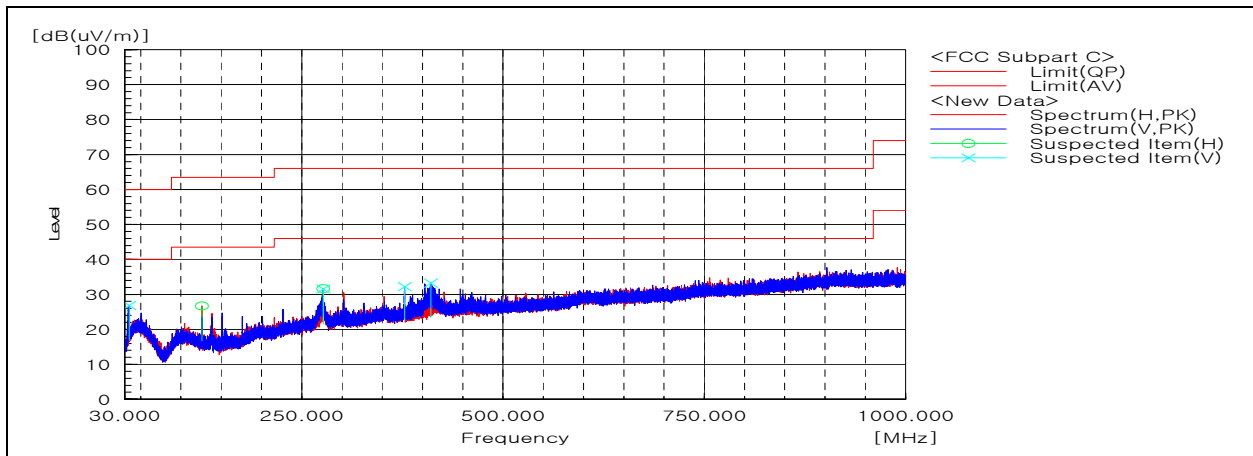








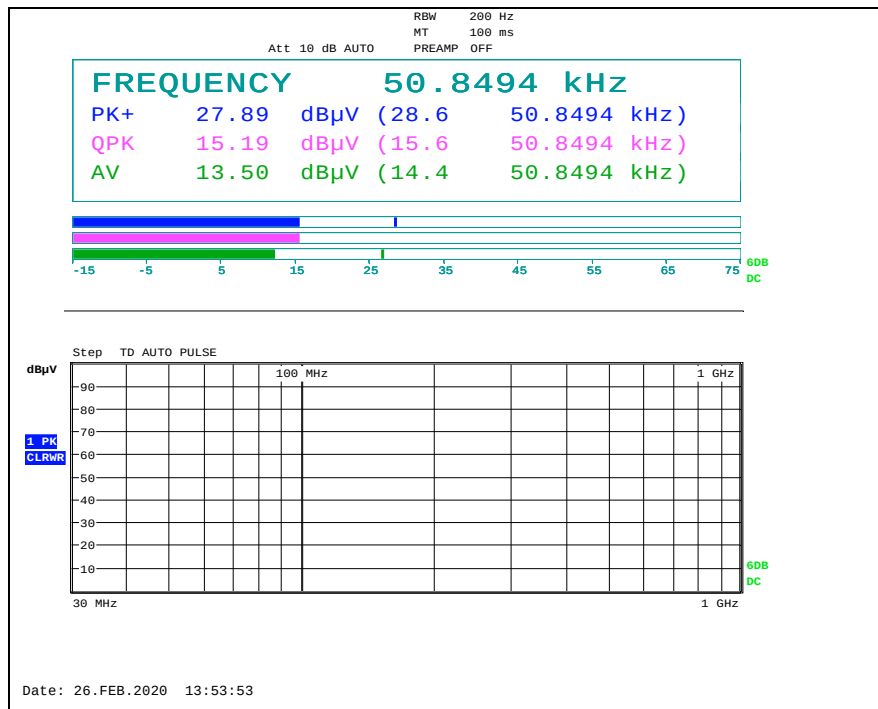
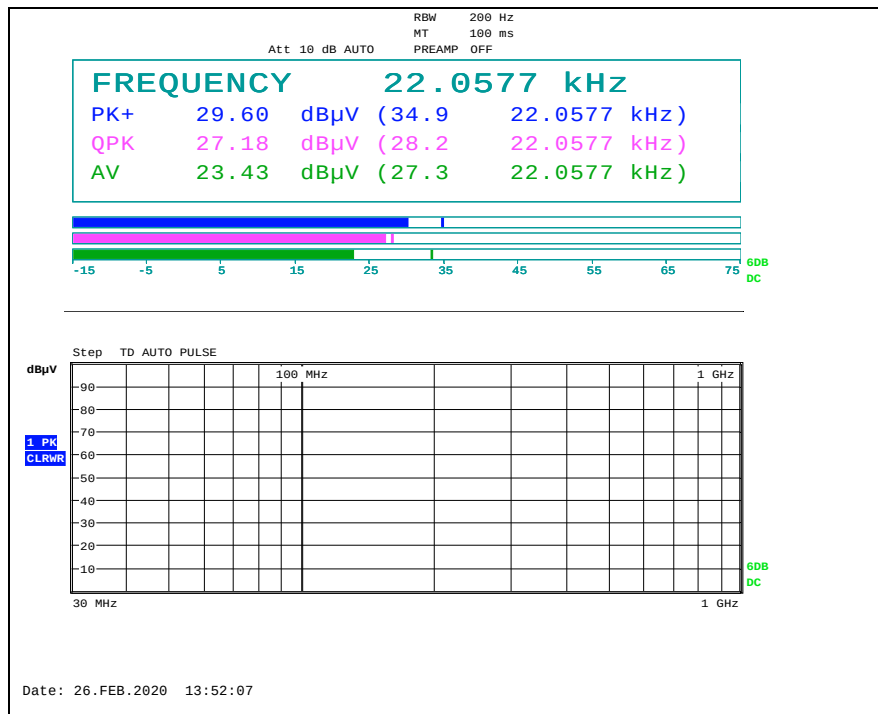
Above 30 MHz

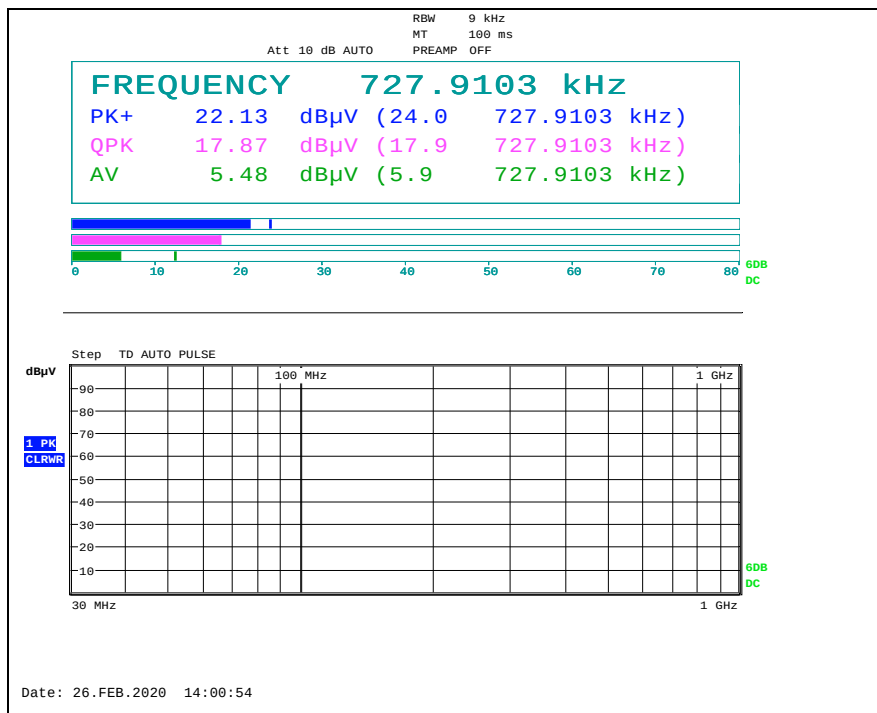
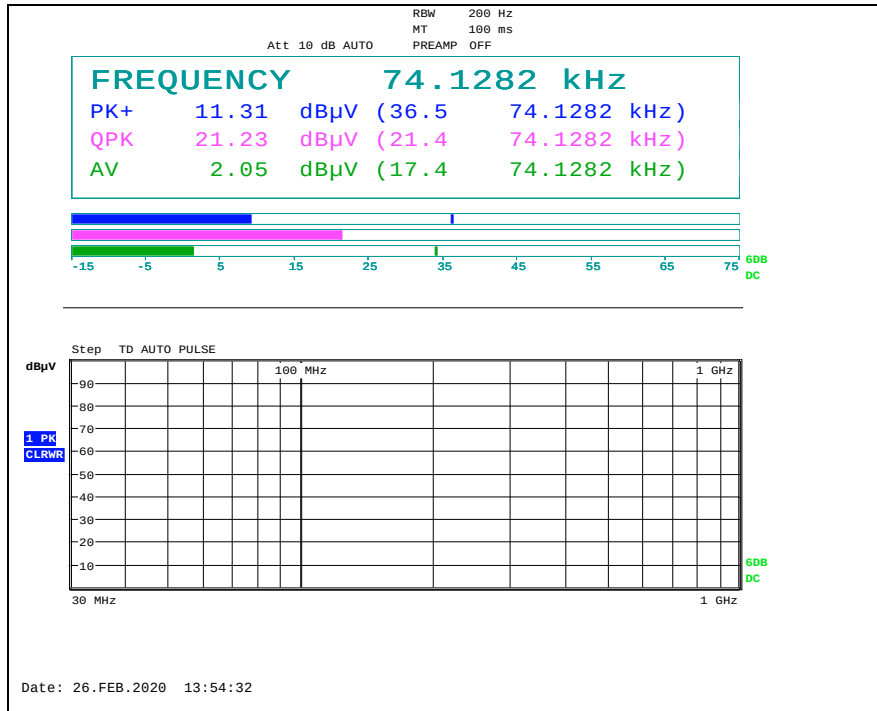


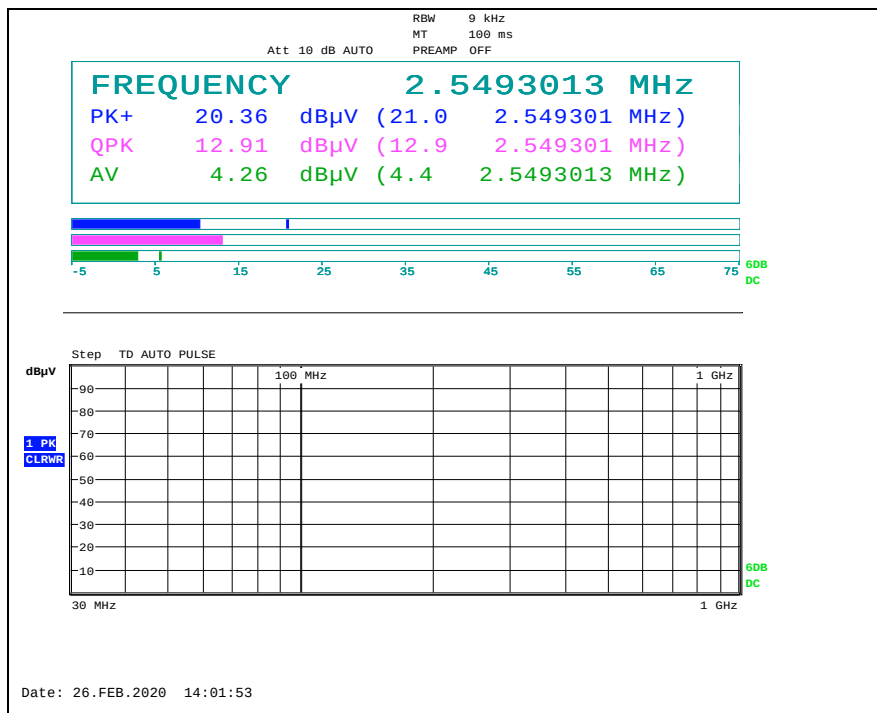
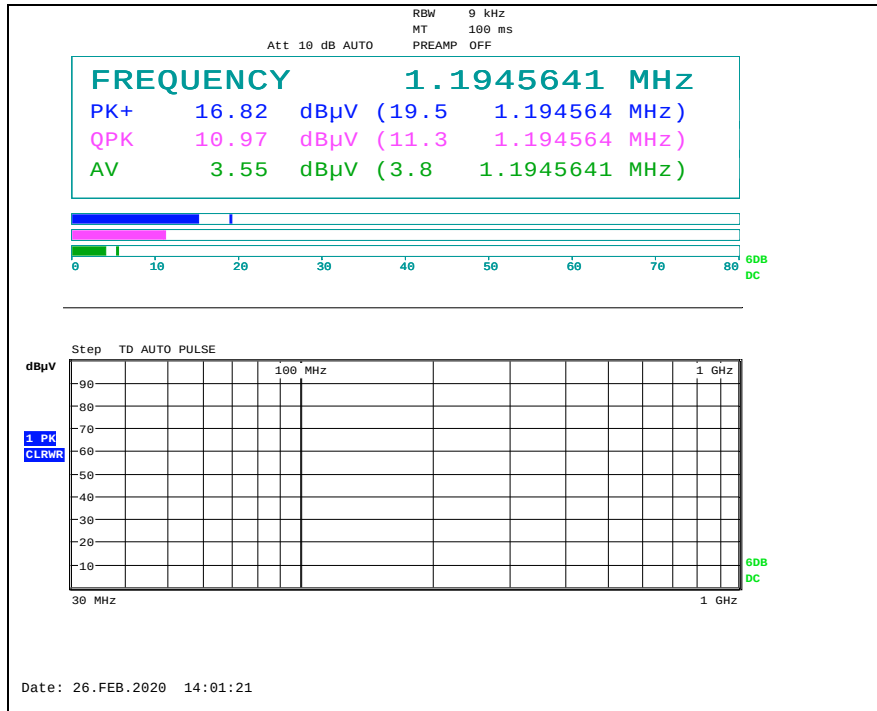
Remark;

- Traces shown in the plot were made by using a peak detector.

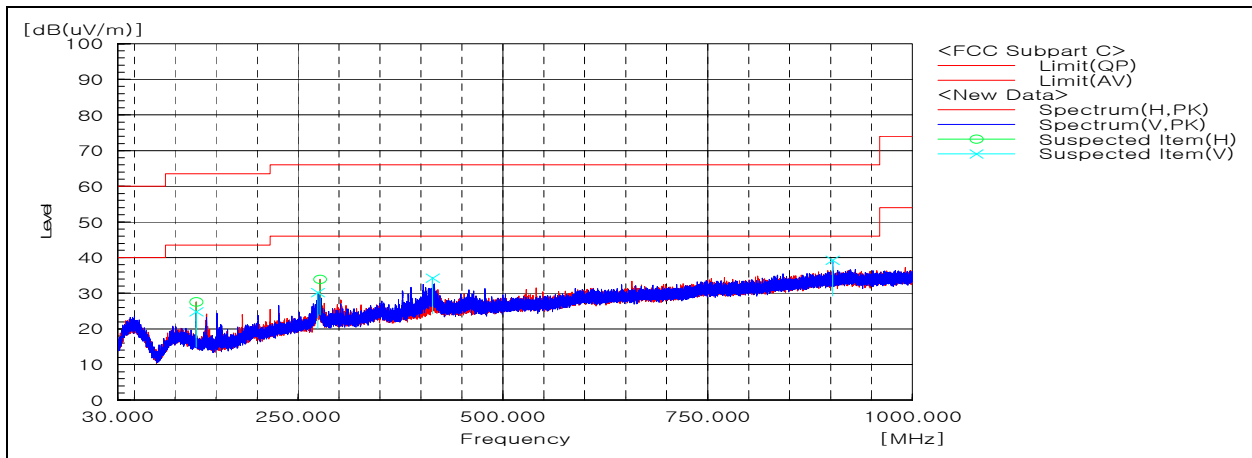
- AST Antenna







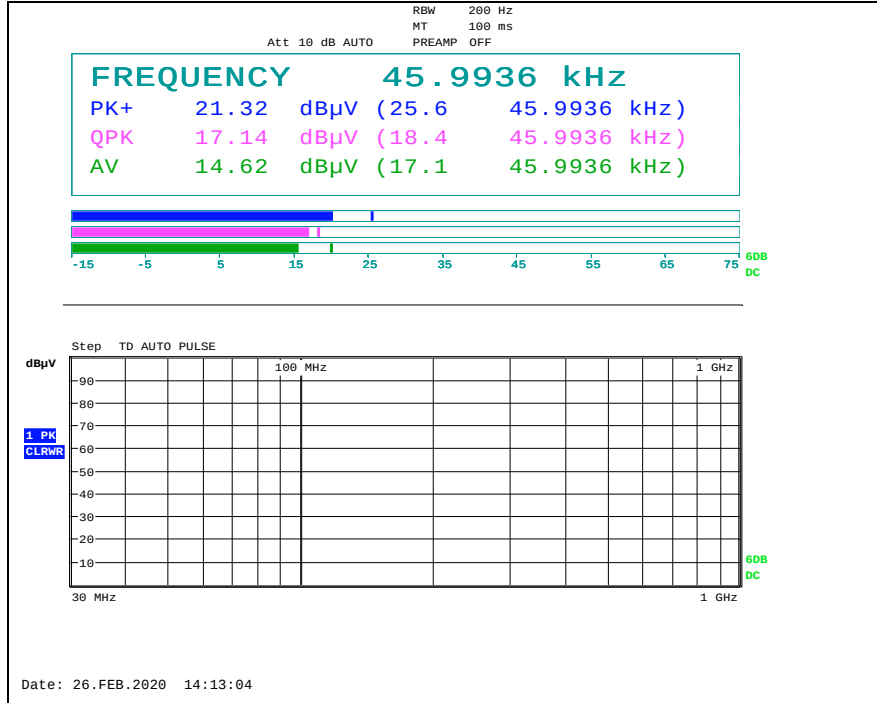
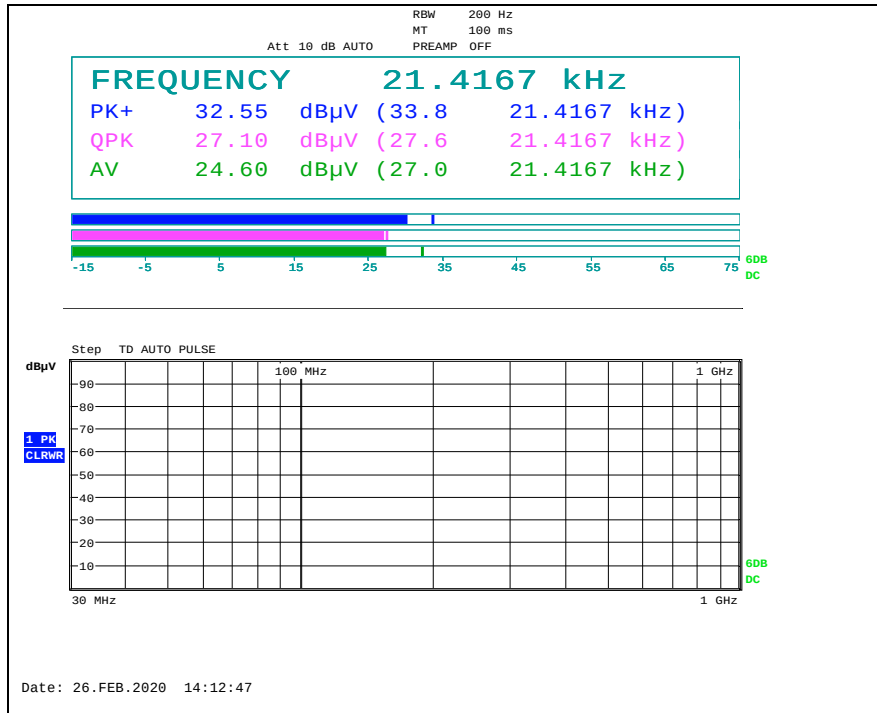
Above 30 MHz

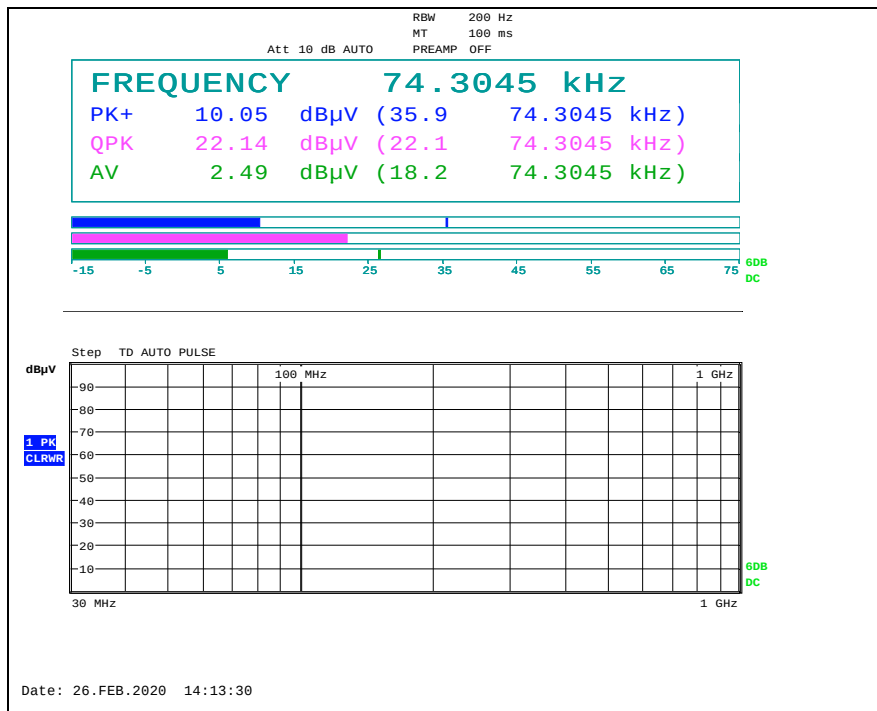
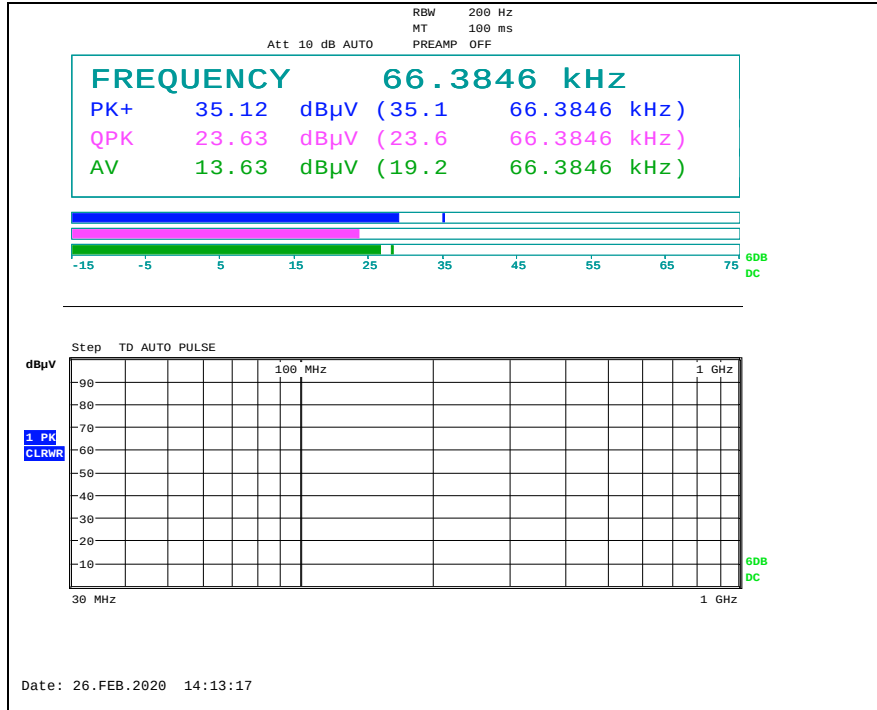


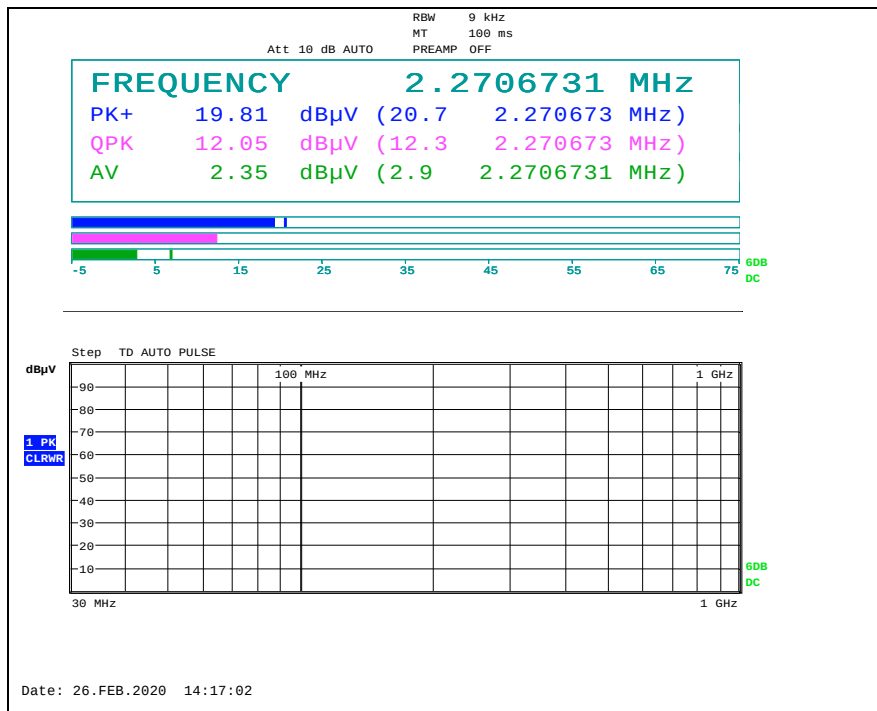
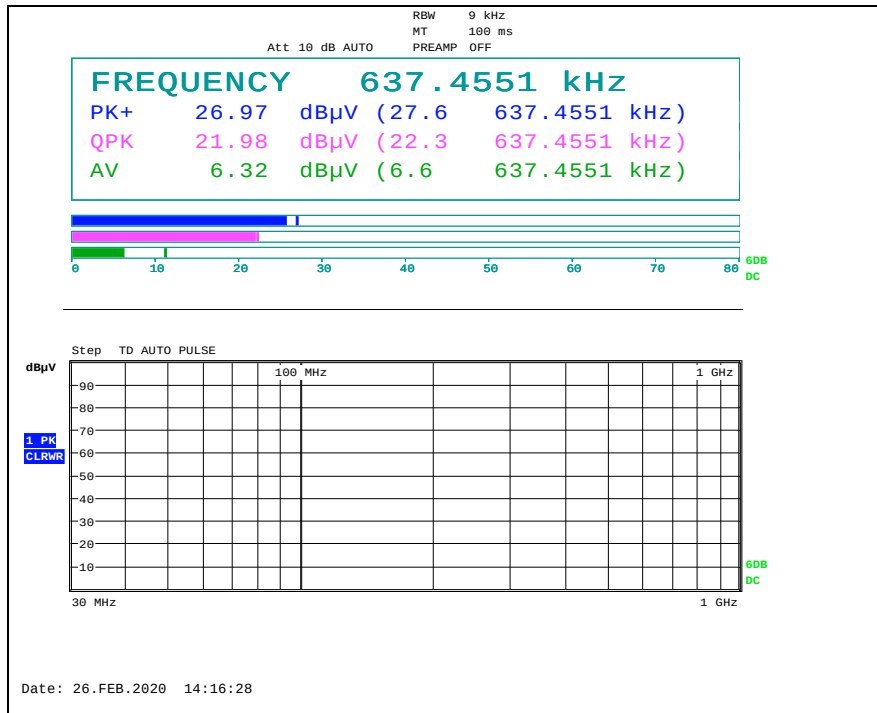
Remark;

- Traces shown in the plot were made by using a peak detector.

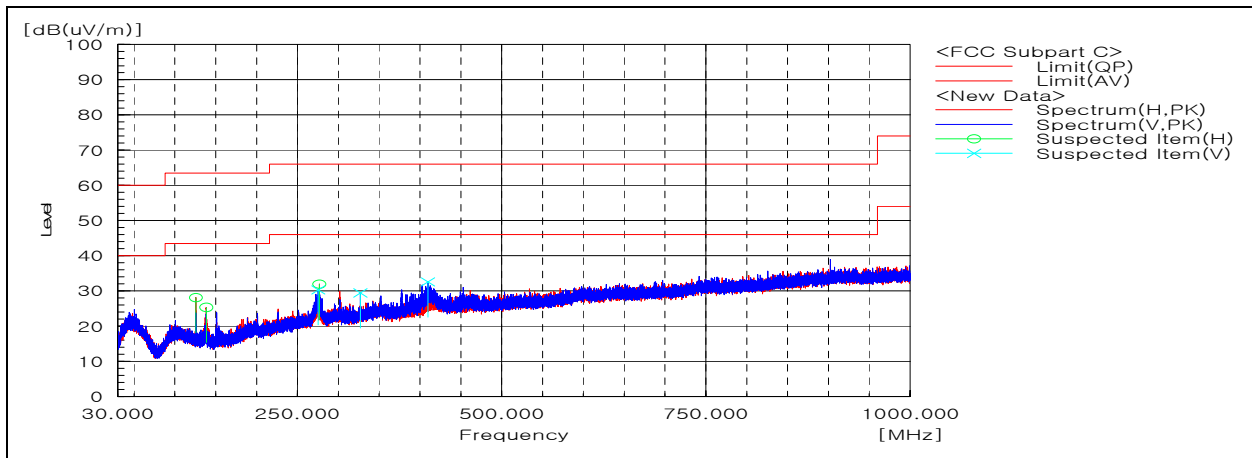
- INT1 Antenna







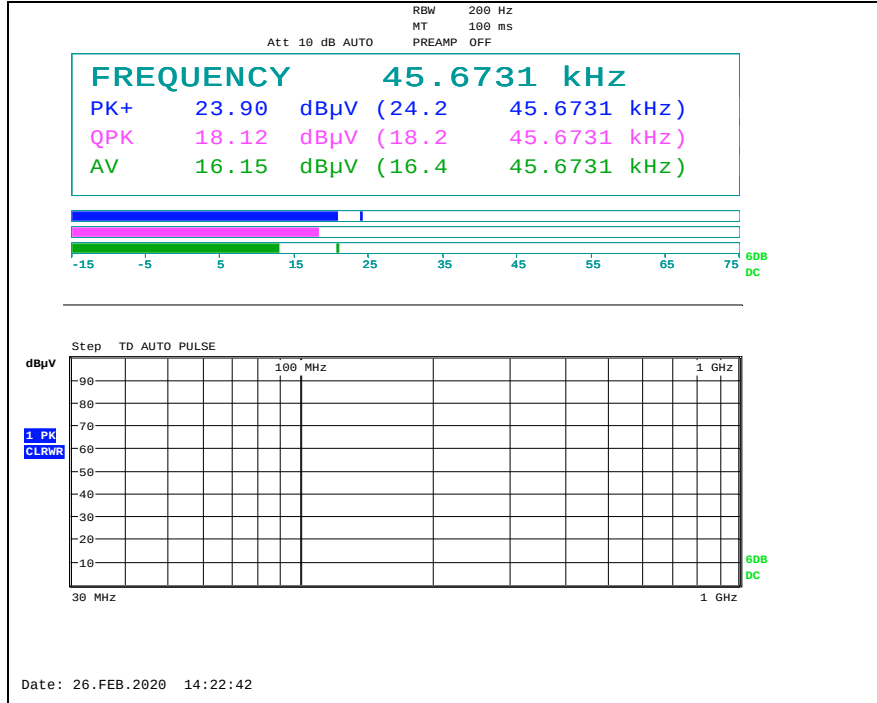
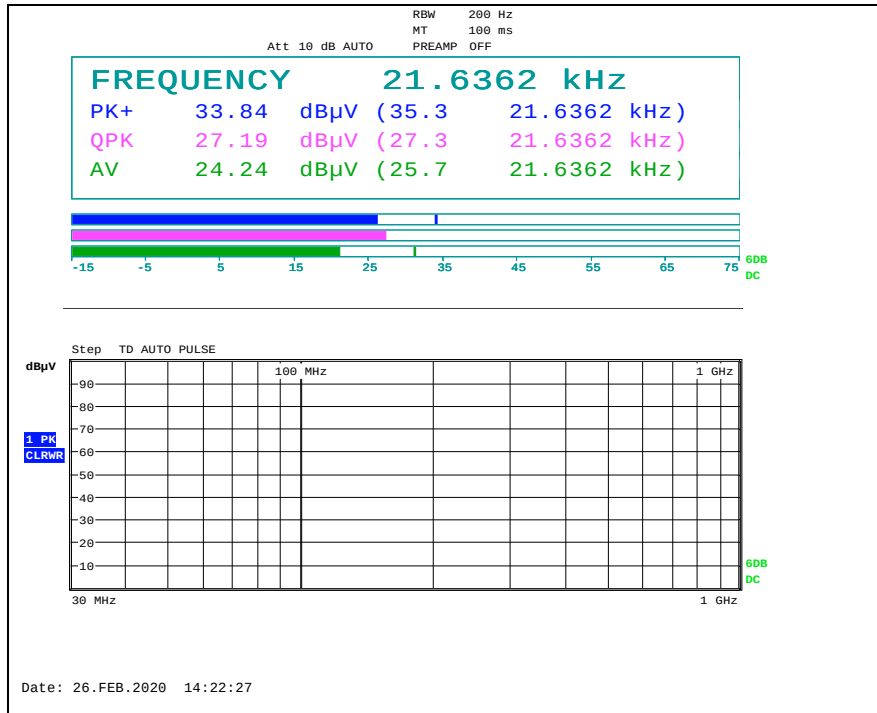
Above 30 MHz

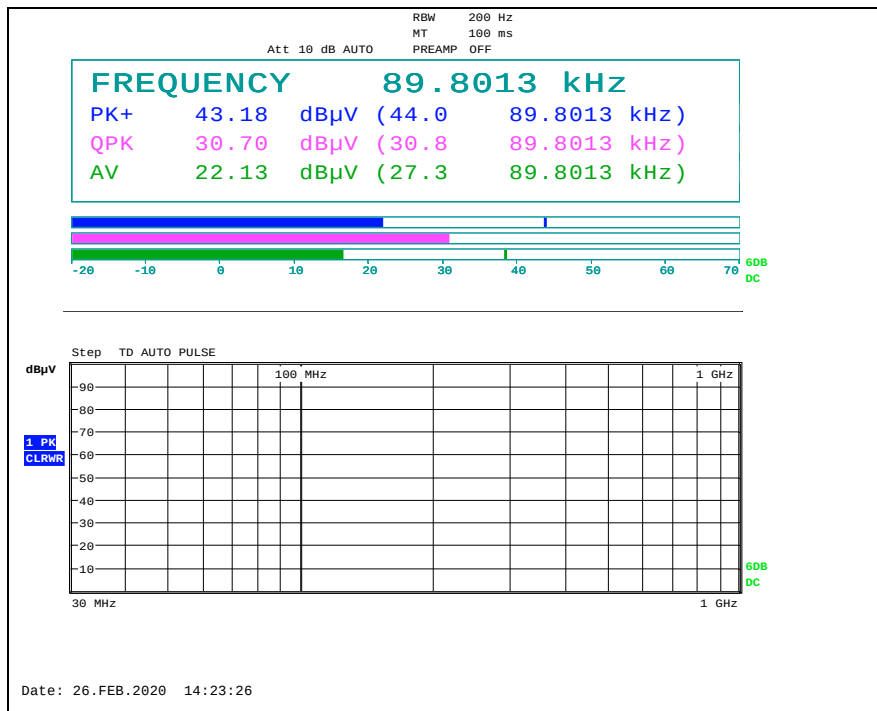
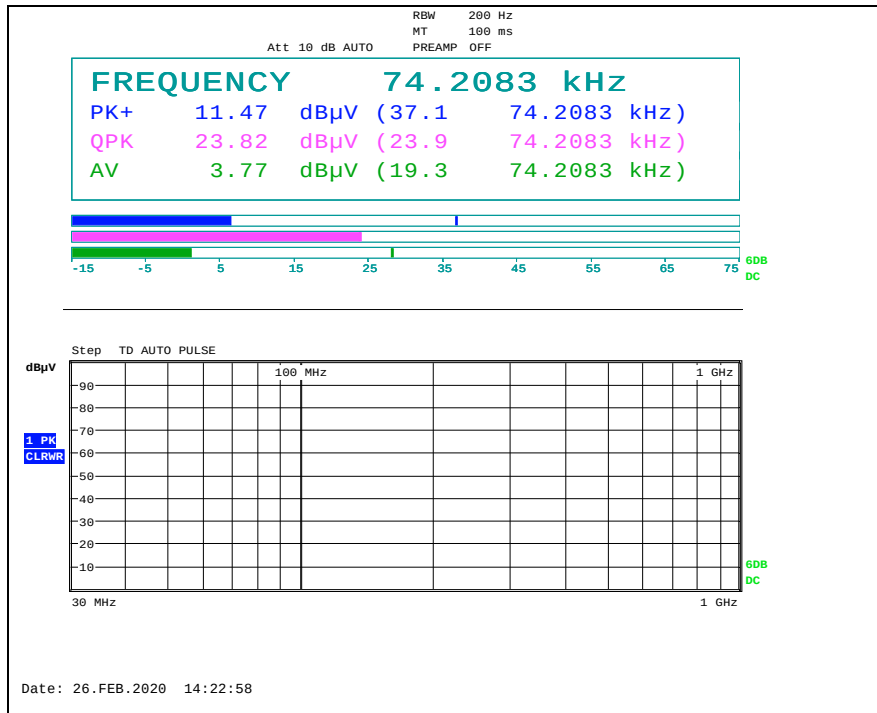


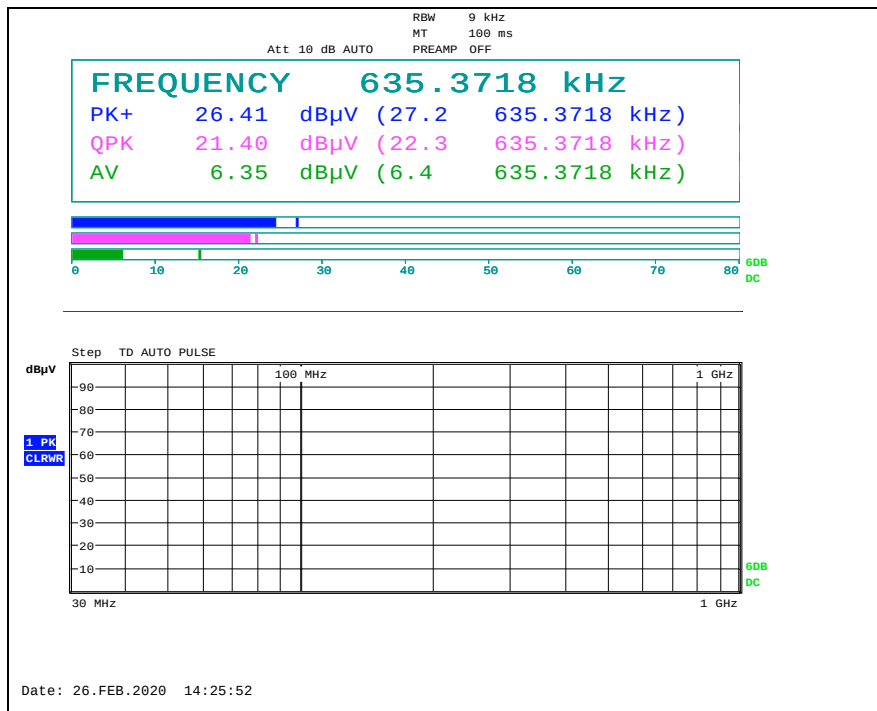
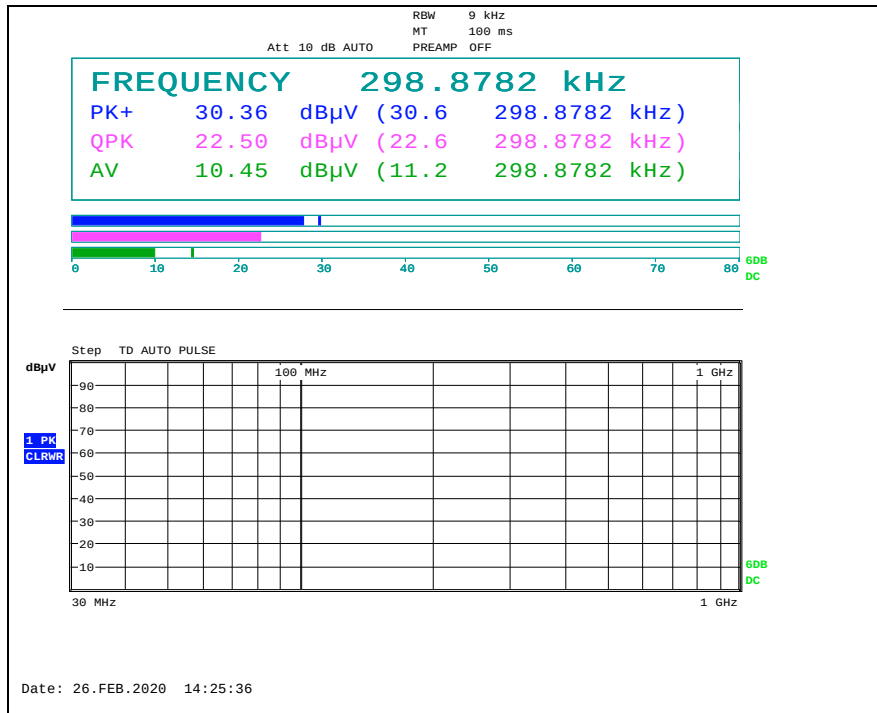
Remark;

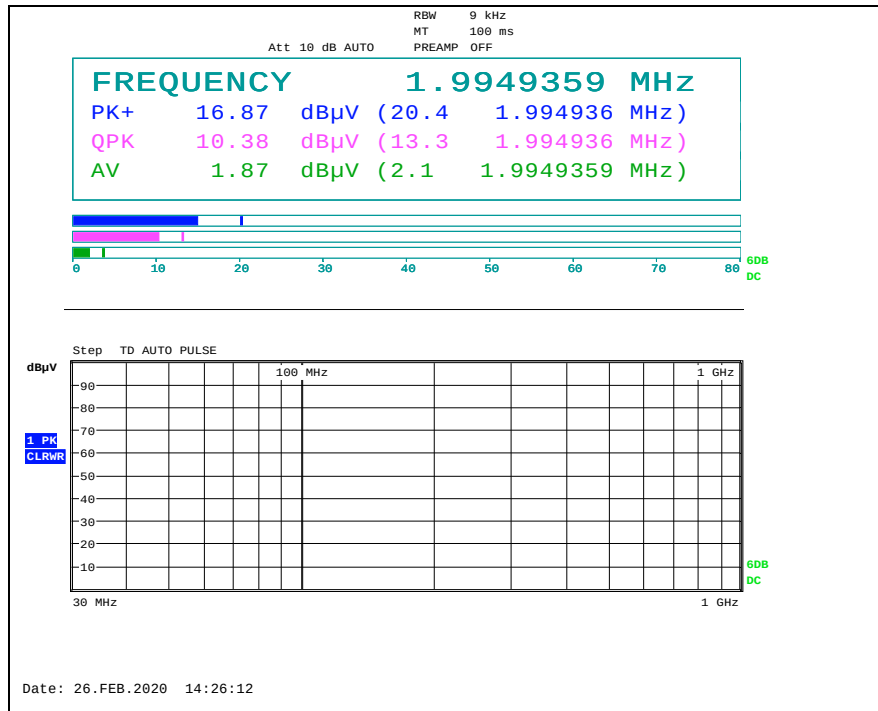
- Traces shown in the plot were made by using a peak detector.

- INT2 Antenna

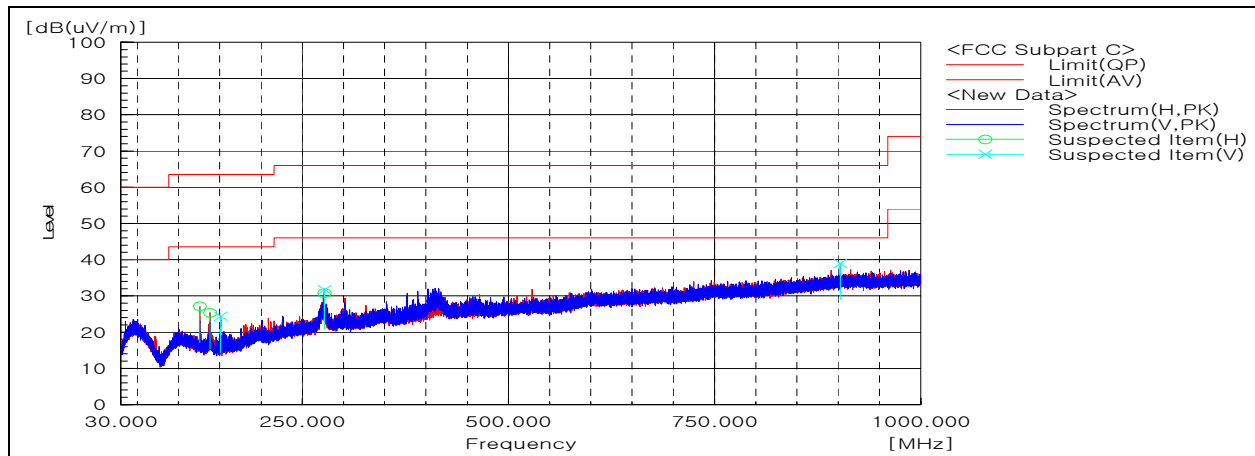








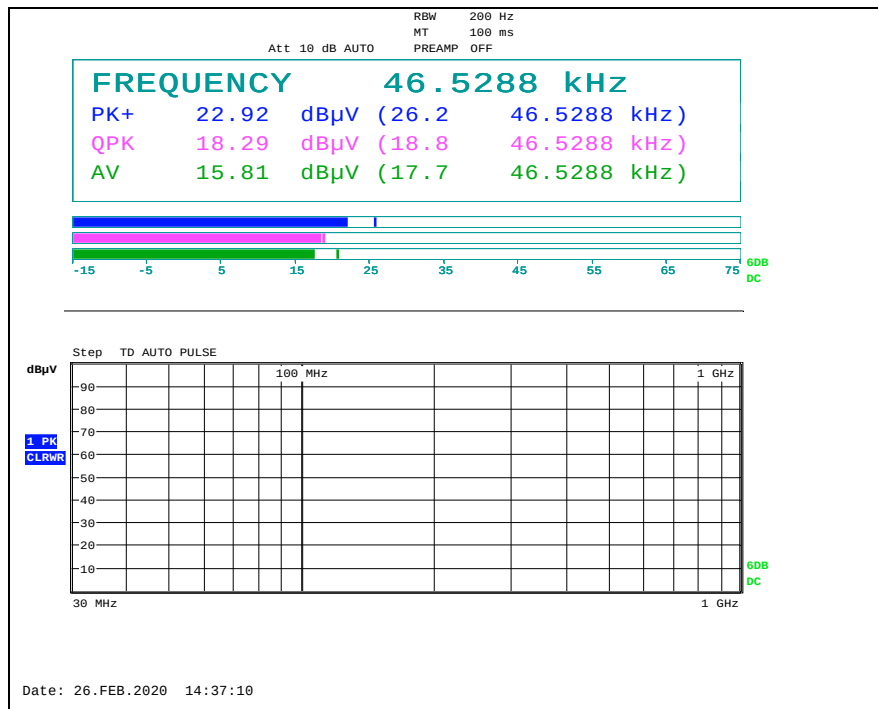
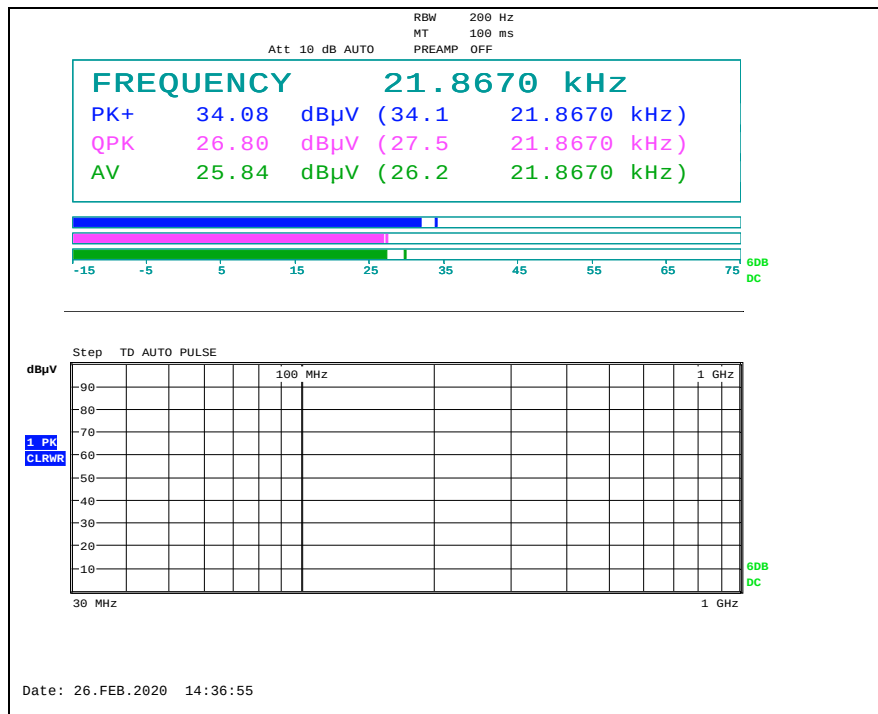
Above 30 MHz

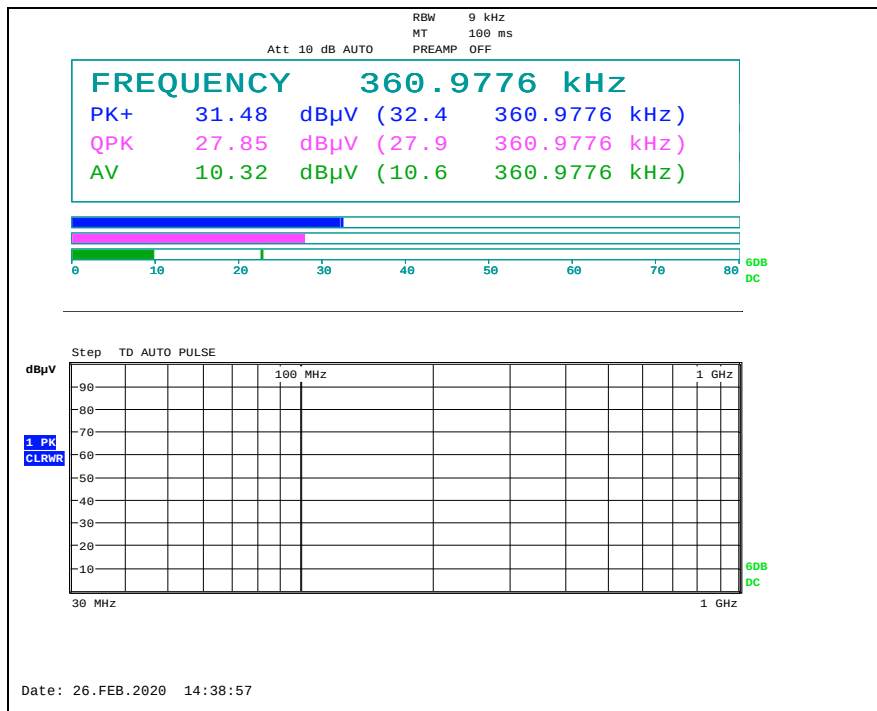
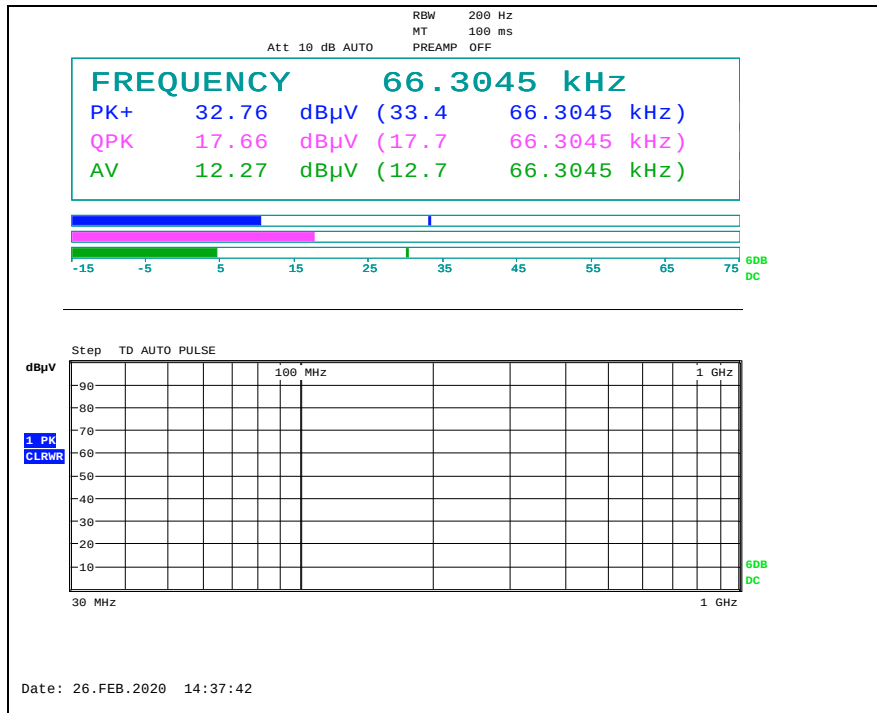


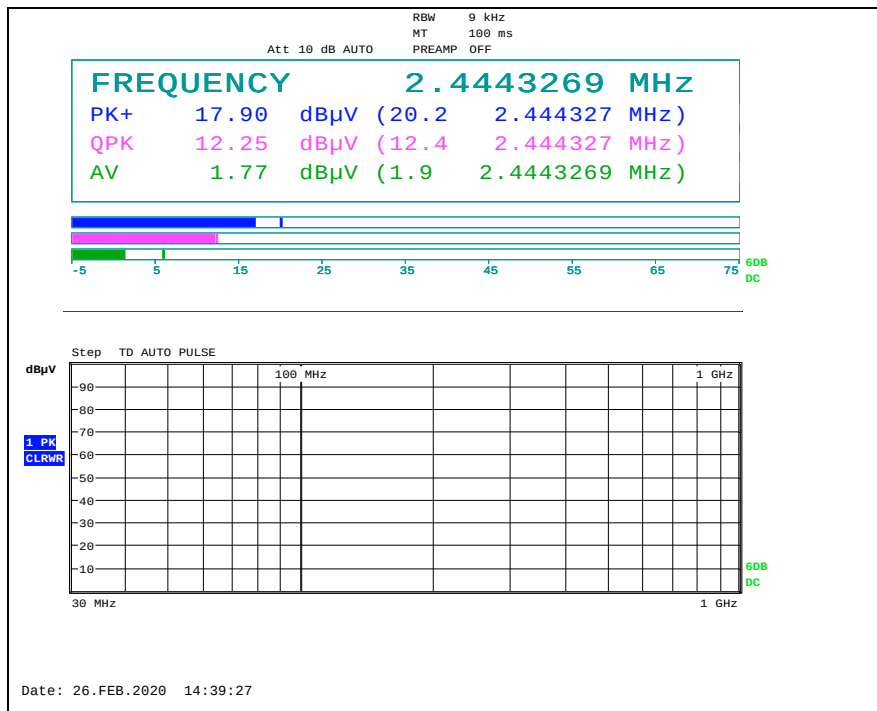
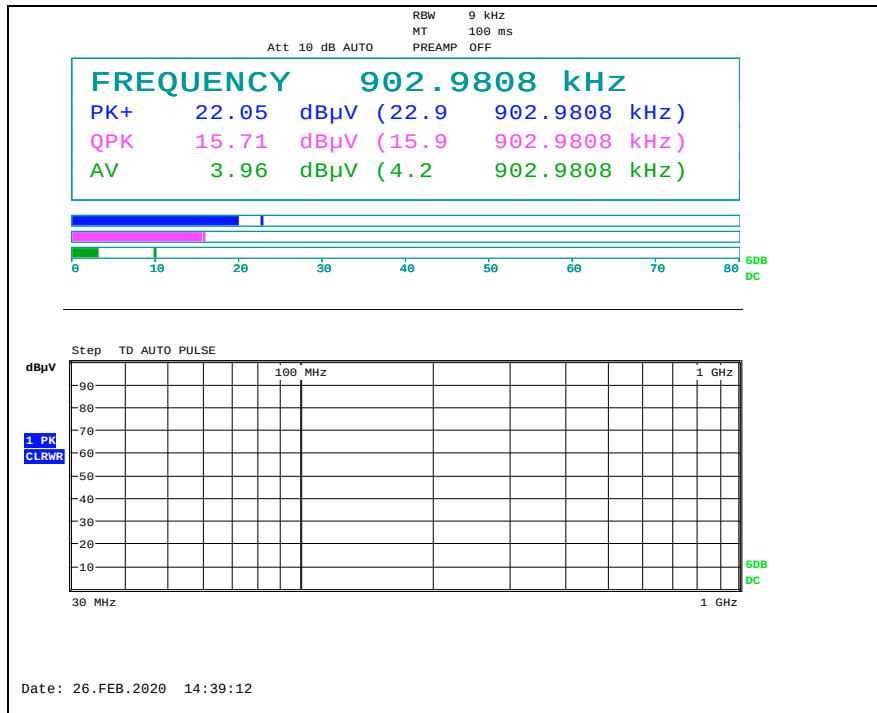
Remark;

- Traces shown in the plot were made by using a peak detector.

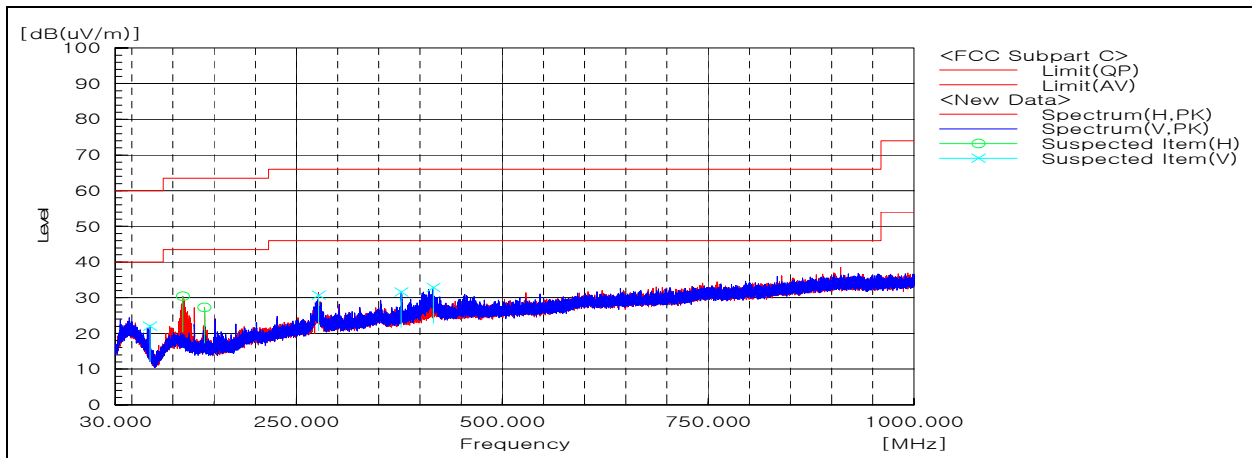
- TRK Antenna







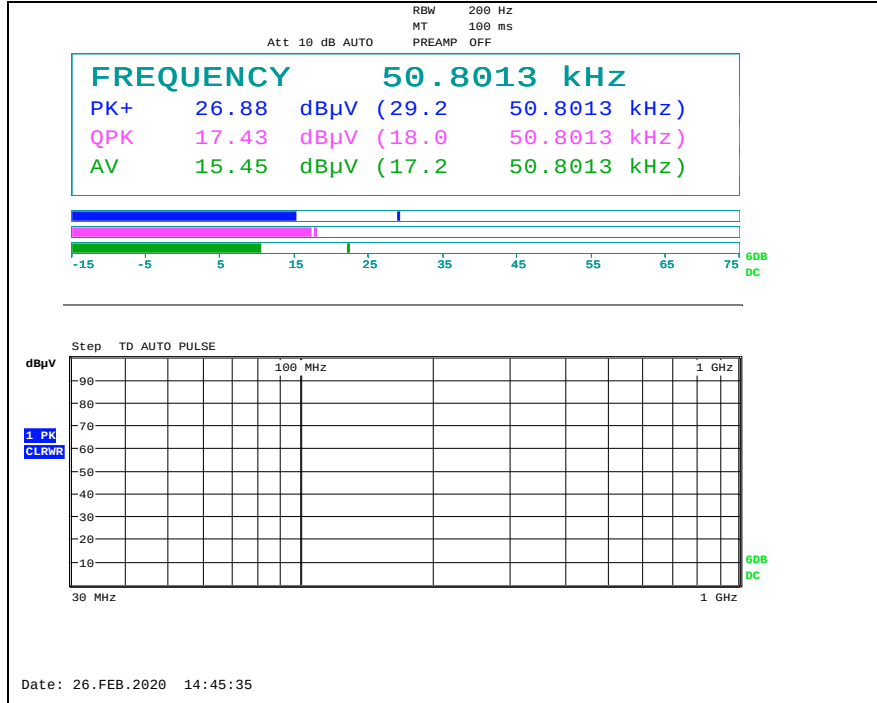
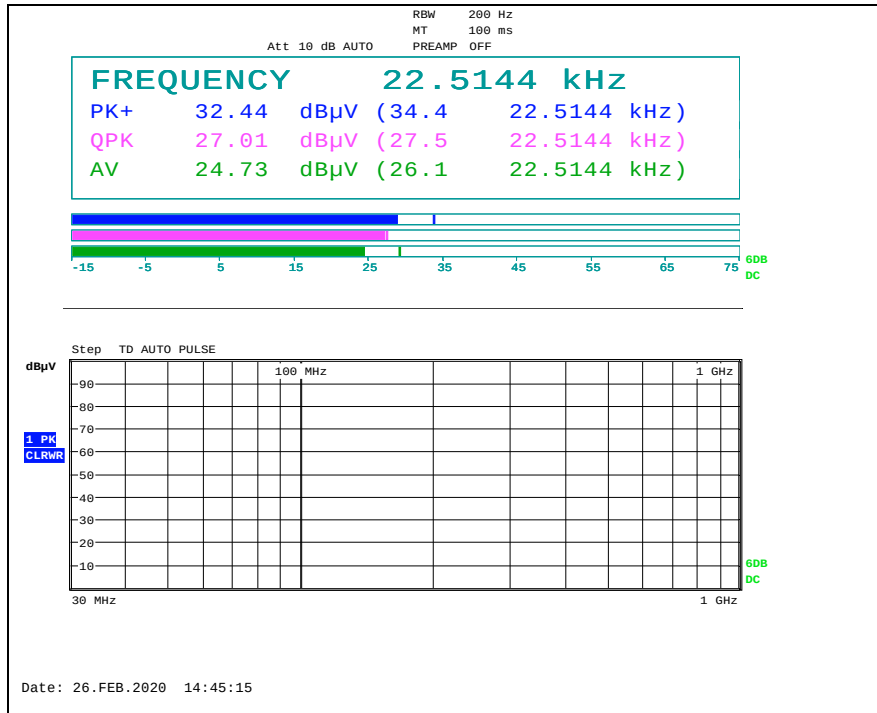
Above 30 MHz

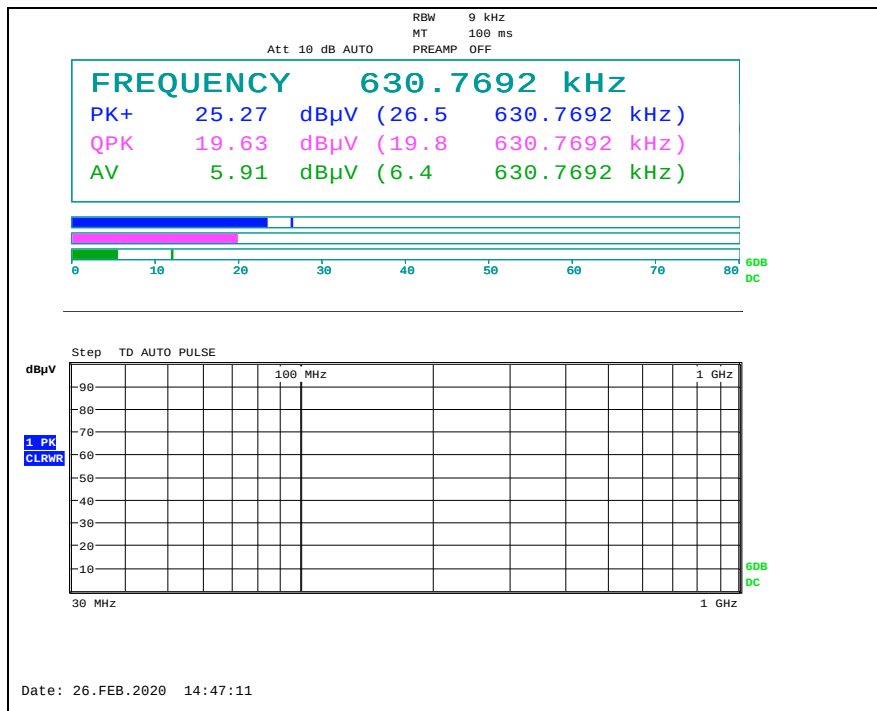
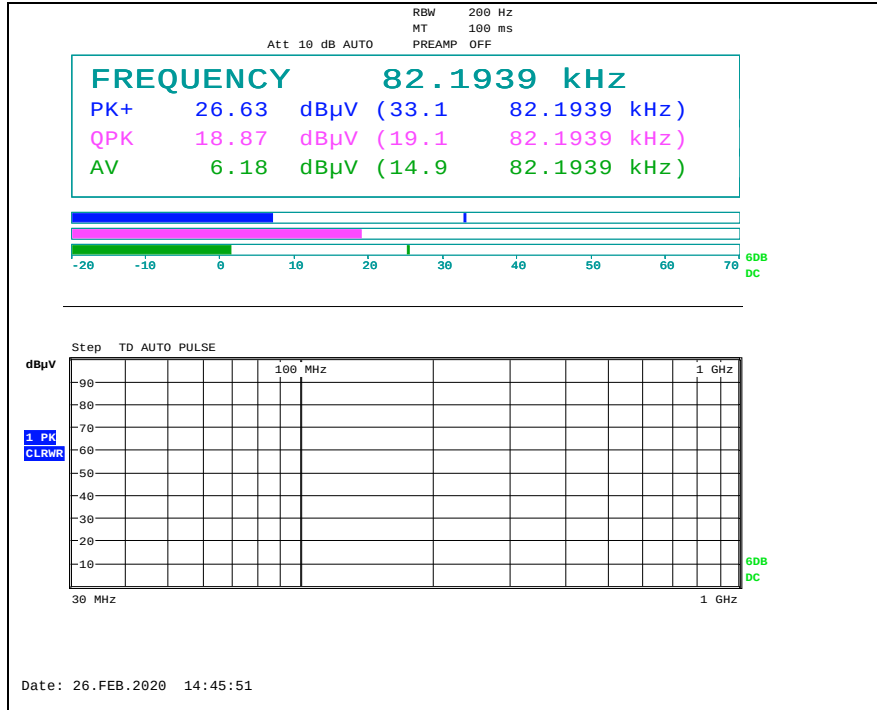


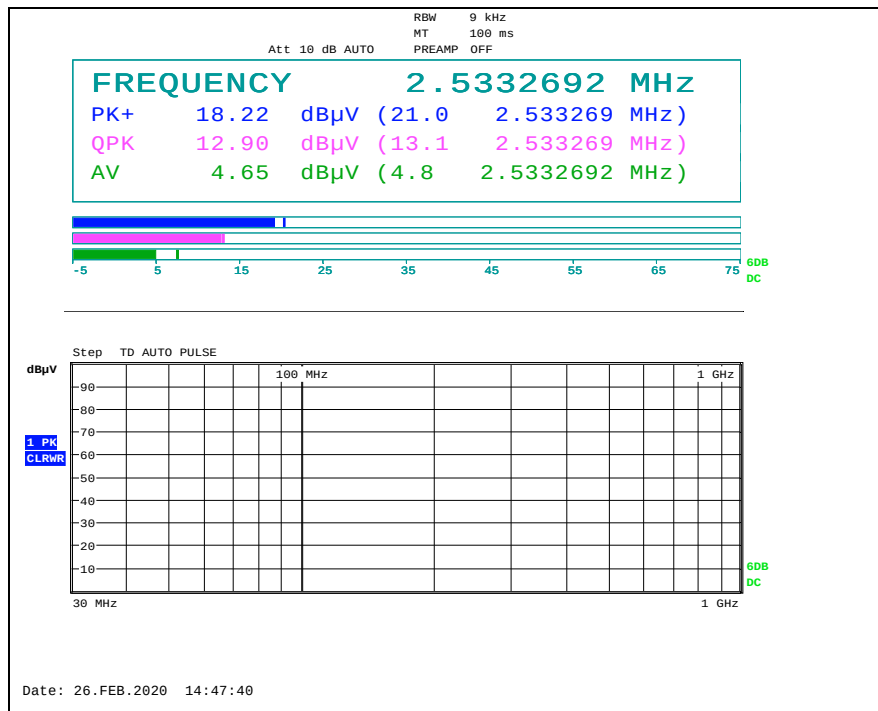
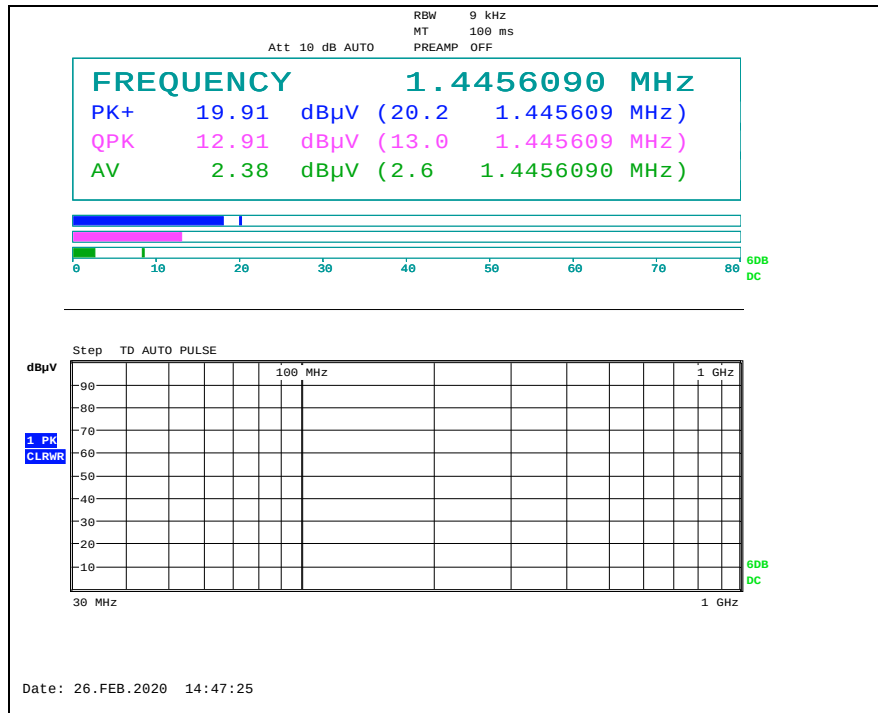
Remark;

- Traces shown in the plot were made by using a peak detector.

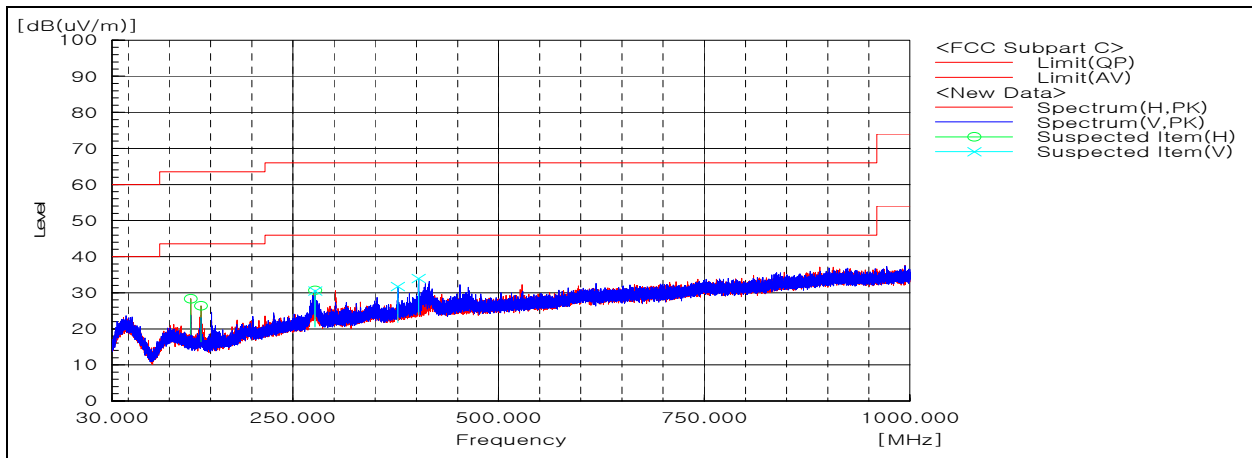
- BMP Antenna







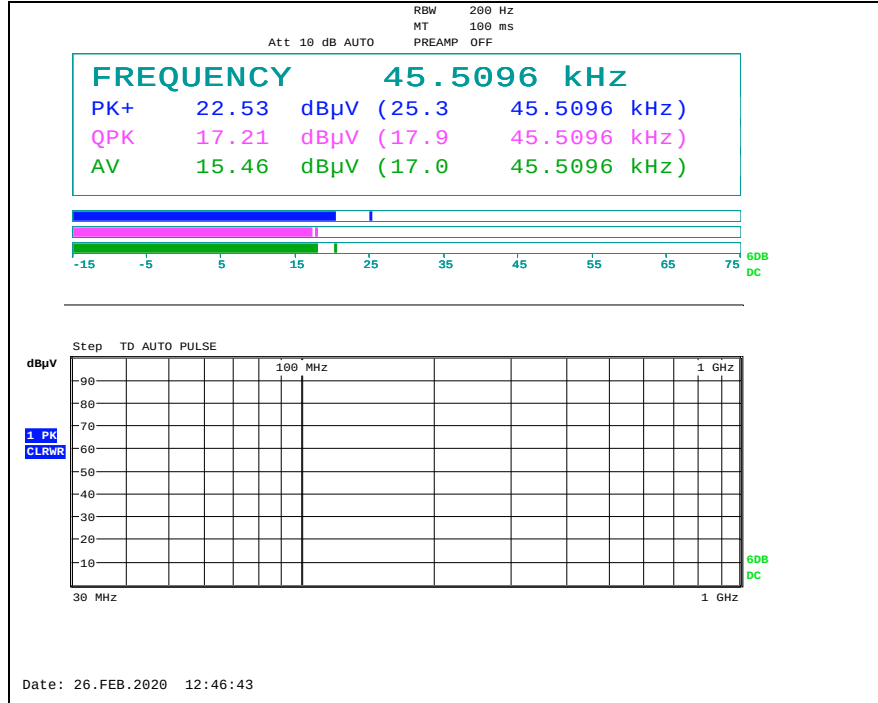
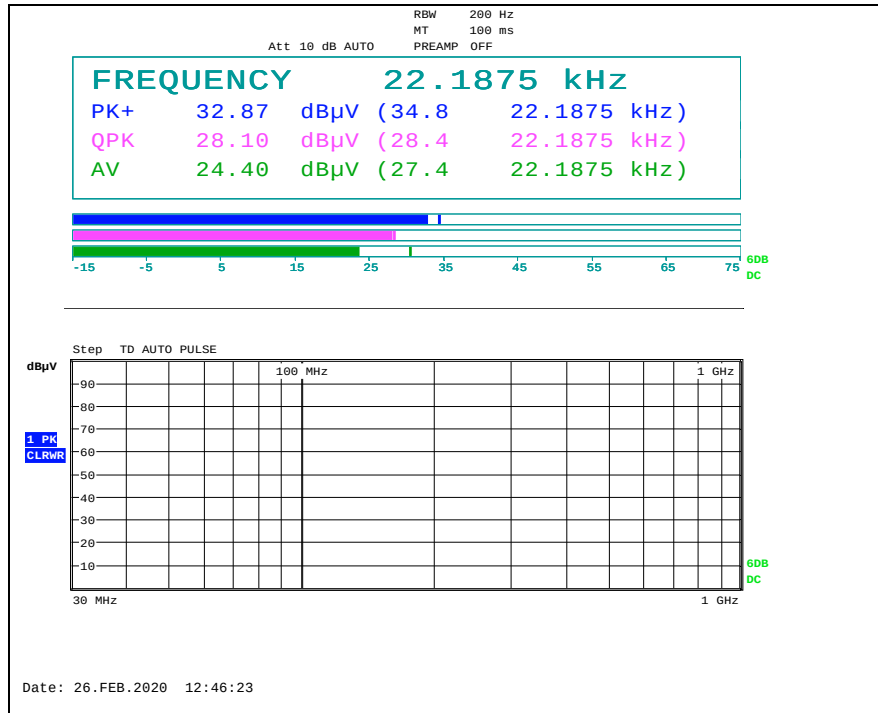
Above 30 MHz

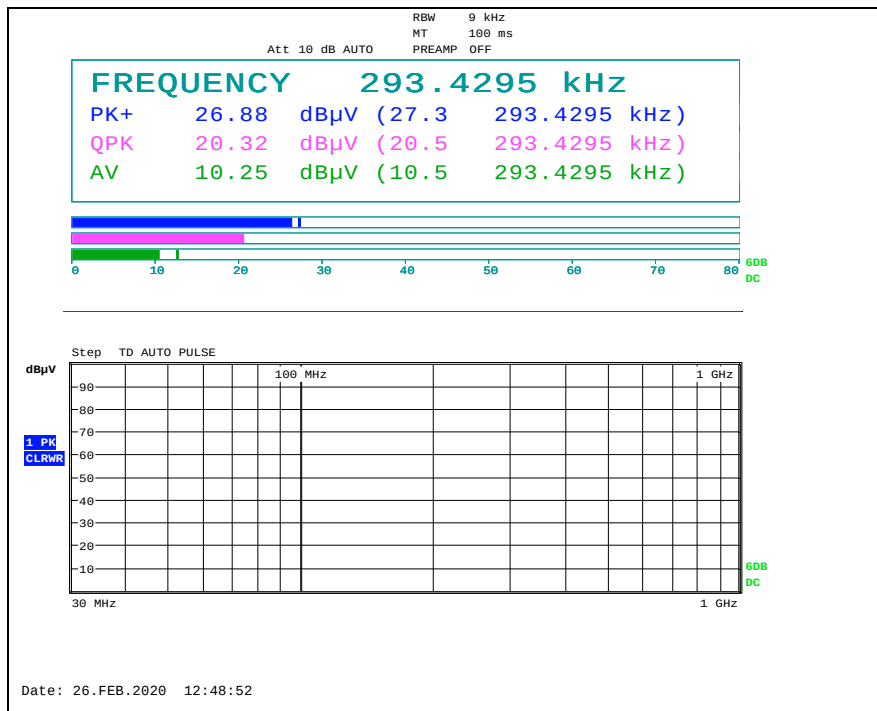
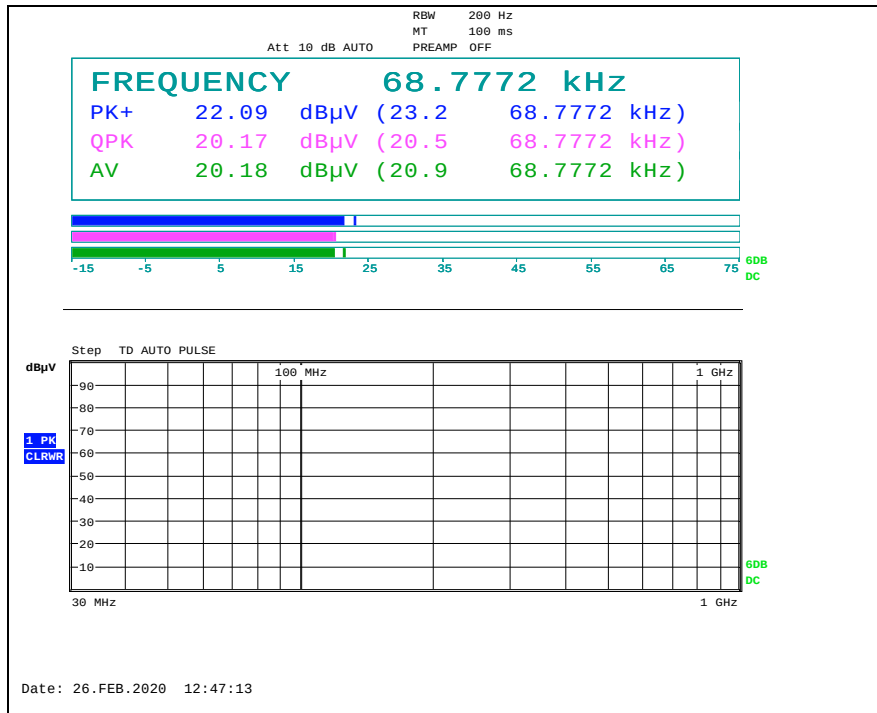


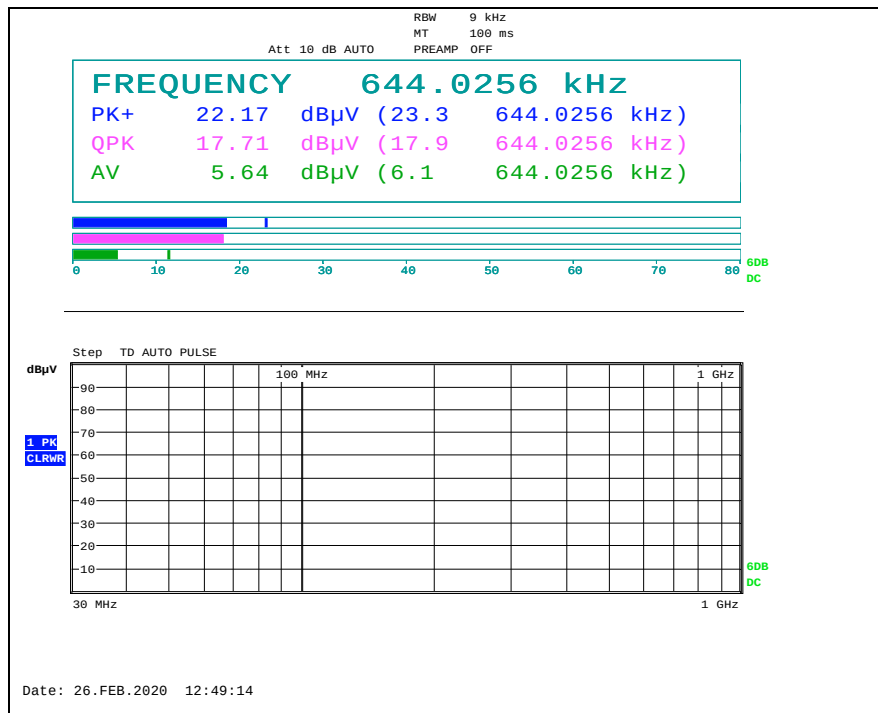
Remark;

- Traces shown in the plot were made by using a peak detector.

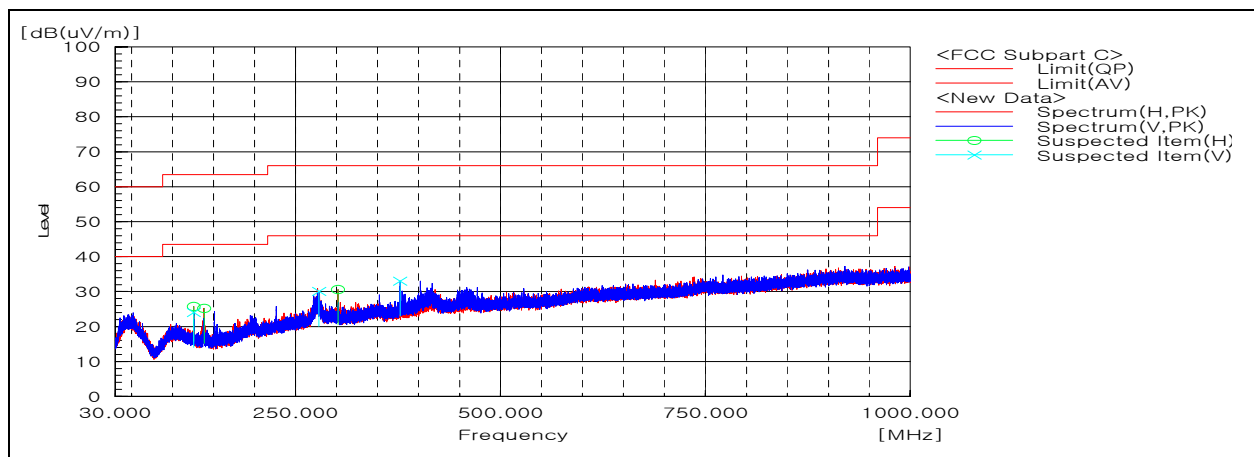
- SSB Antenna







Above 30 MHz

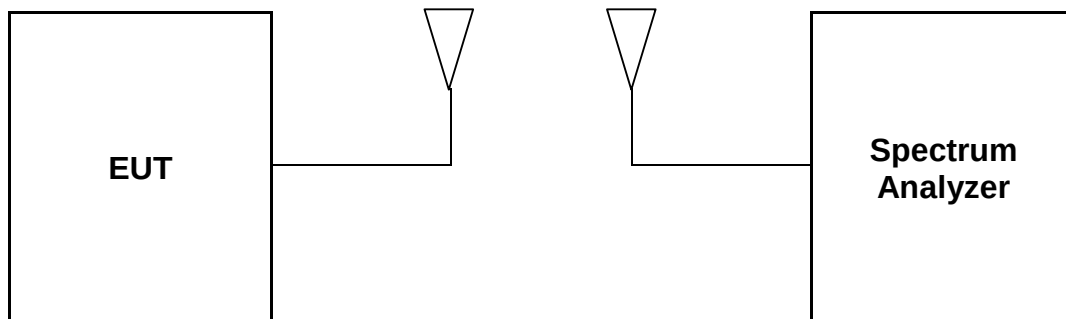


Remark;

- Traces shown in the plot were made by using a peak detector.

3. 20 dB Bandwidth

3.1. Test Setup



3.2. Limit

None; for reporting purposed only

3.3. Test Procedure

1. Span = the spectrum analyzer shall be between two times and five times the OBW, RBW = 1% to 5% of the OBW, VBW = set approximately 3 x RBW, Sweep = auto, Detector = peak, Trace = max hold.
2. The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 dB bandwidth of the emission.

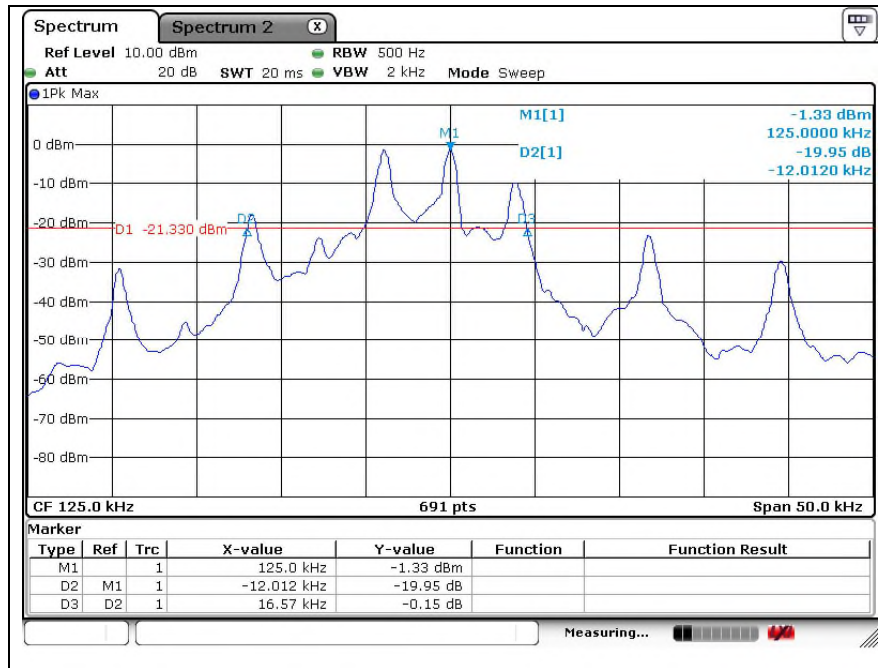
3.4. Test Result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

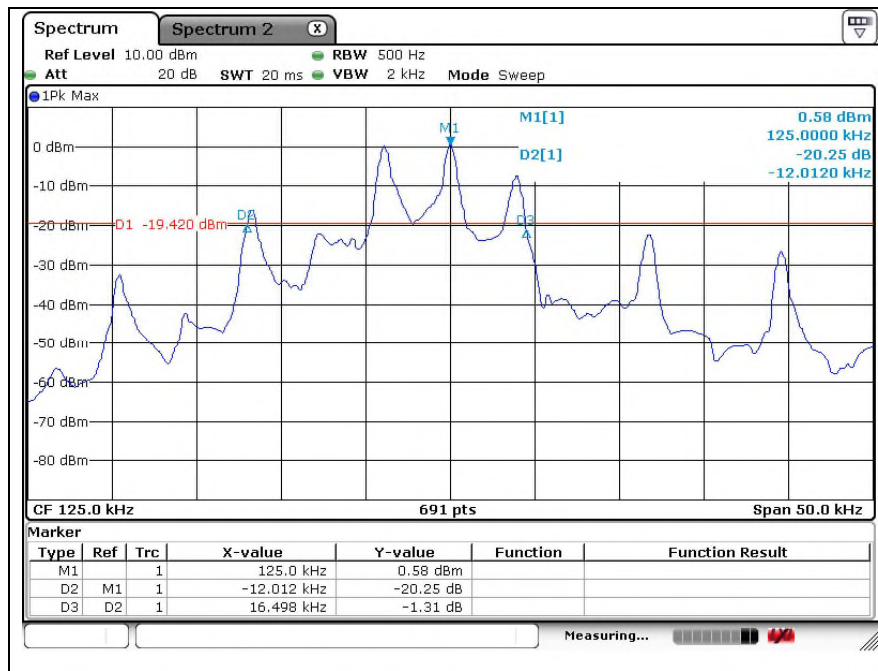
Test Antenna	Frequency (kHz)	20 dB Bandwidth (kHz)	Limit
DRV Antenna	125	16.570	Reporting proposed only
AST Antenna	125	16.498	
INT1 Antenna	125	16.498	
INT2 Antenna	125	16.353	
TRK Antenna	125	16.860	
BMP Antenna	125	16.281	
SSB Antenna	125	10.058	

- Test plots

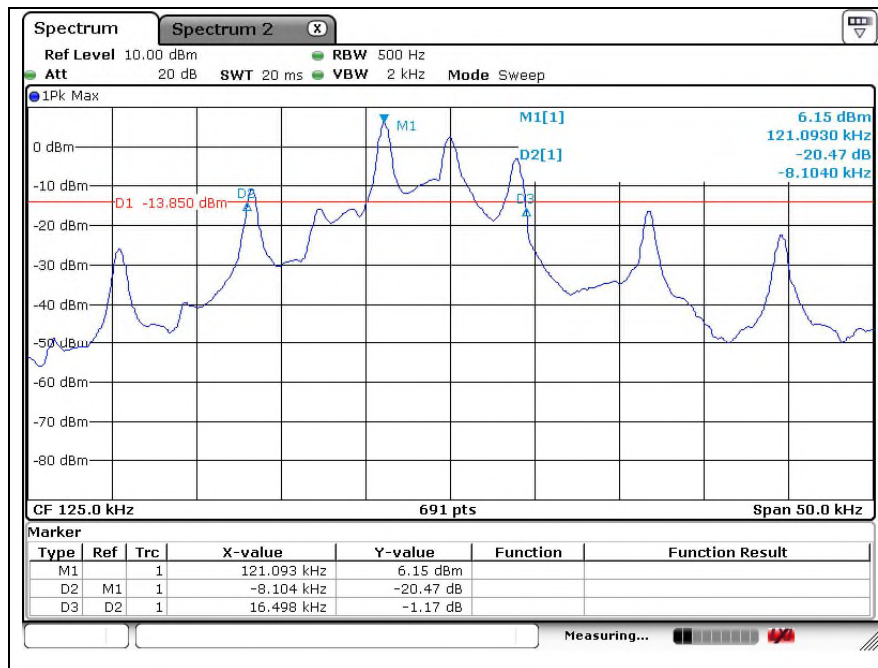
- DRV Antenna



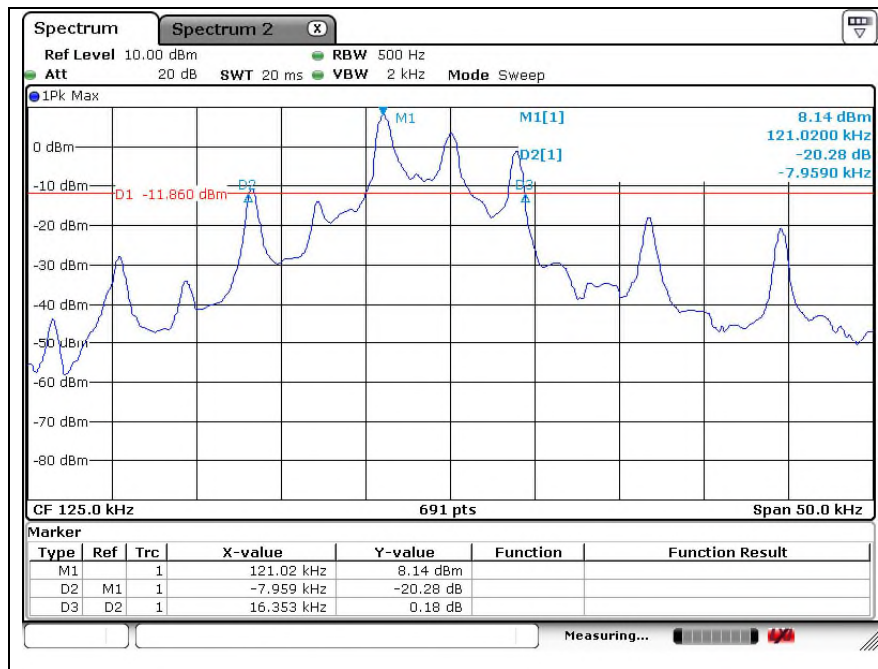
- AST Antenna



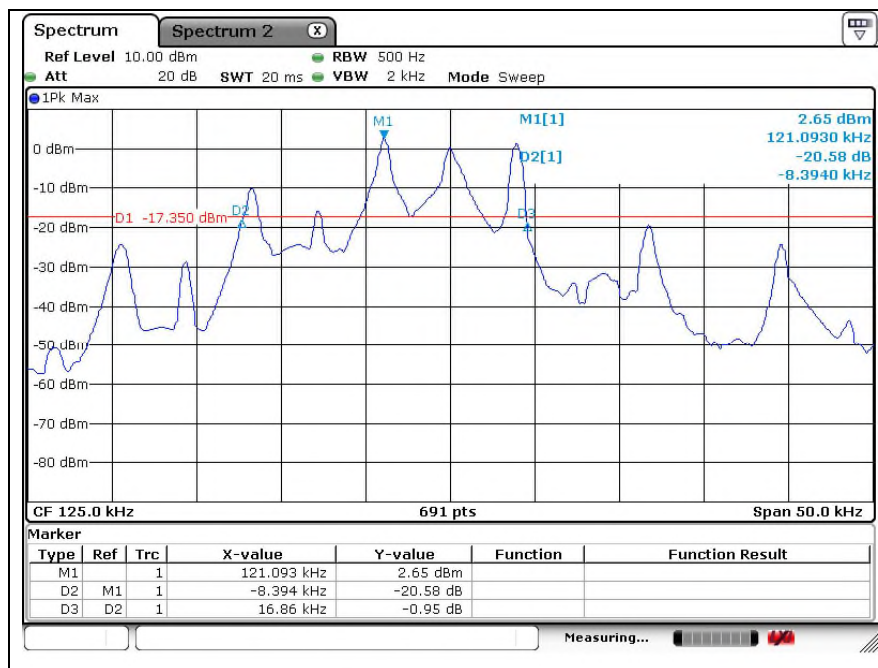
- INT1 Antenna



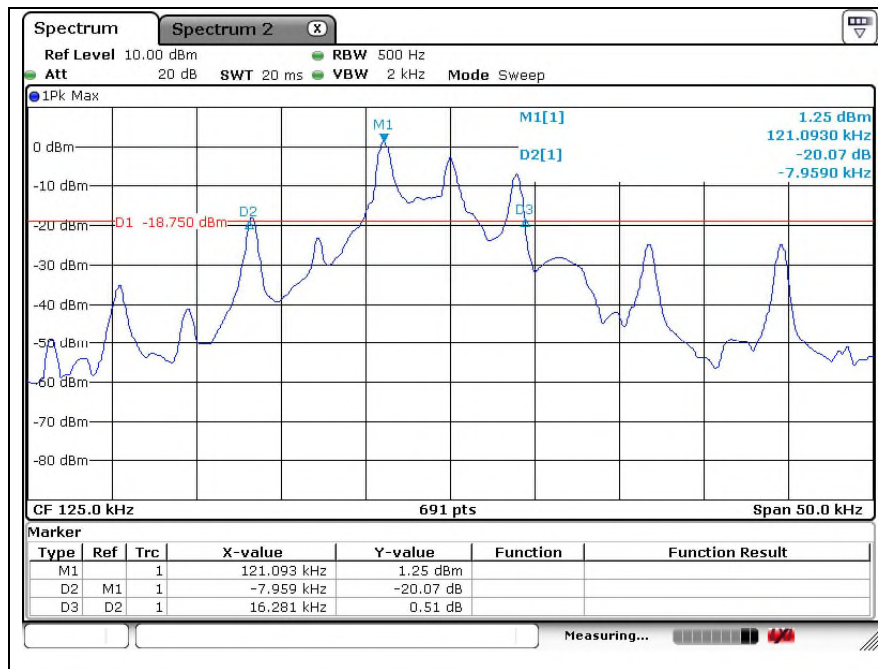
- INT2 Antenna



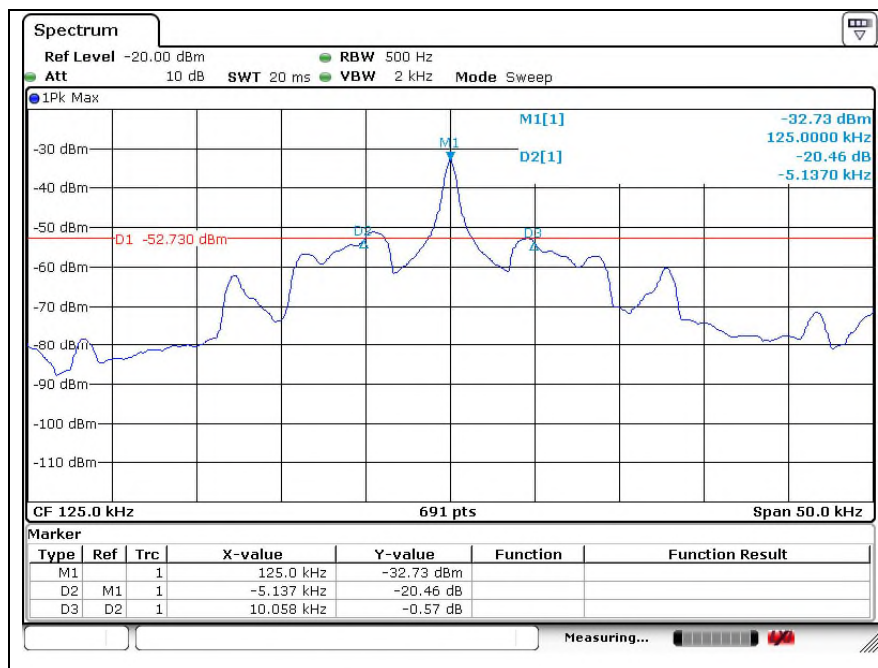
- TRK Antenna



- BMP Antenna

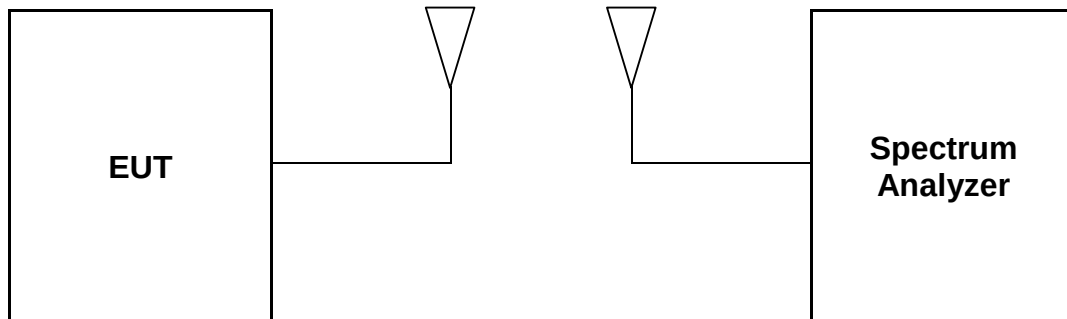


- SSB Antenna



4. Occupied Bandwidth

4.1. Test Setup



4.2. Limit

None; for reporting purposed only

4.3. Test Procedure

- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99 % emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99 % emission bandwidth).

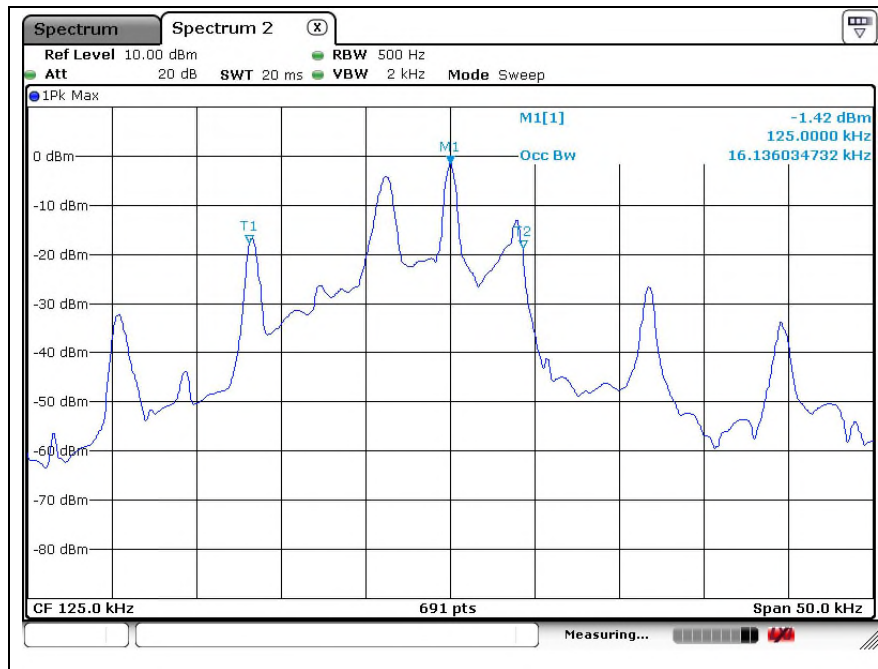
4.4. Test Result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

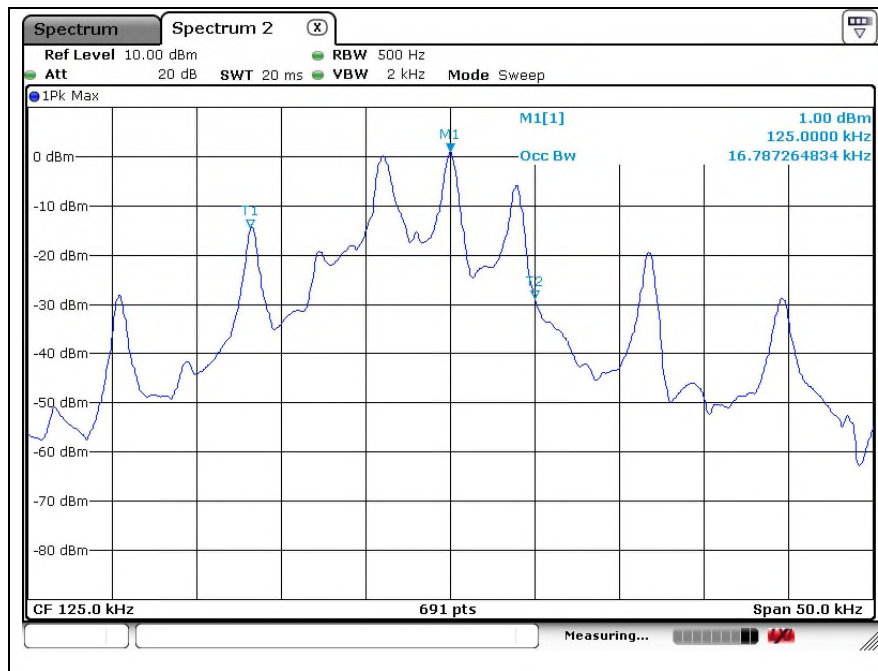
Test Antenna	Frequency (kHz)	Occupied Bandwidth (kHz)	Limit
DRV Antenna	125	16.136	Reporting proposed only
AST Antenna	125	16.787	
INT1 Antenna	125	16.281	
INT2 Antenna	125	15.412	
TRK Antenna	125	16.208	
BMP Antenna	125	10.926	
SSB Antenna	125	17.583	

- Test plots

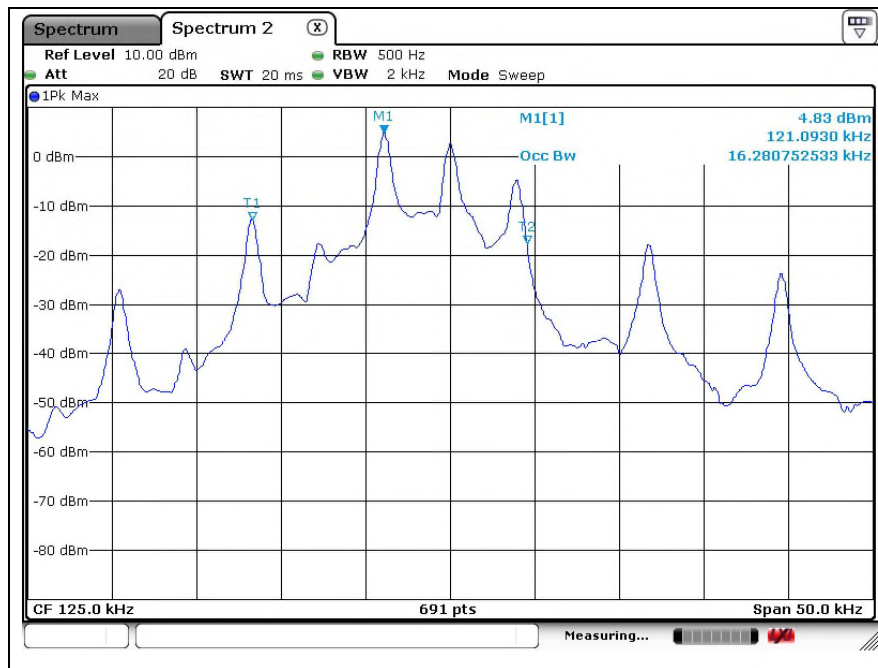
- DRV Antenna



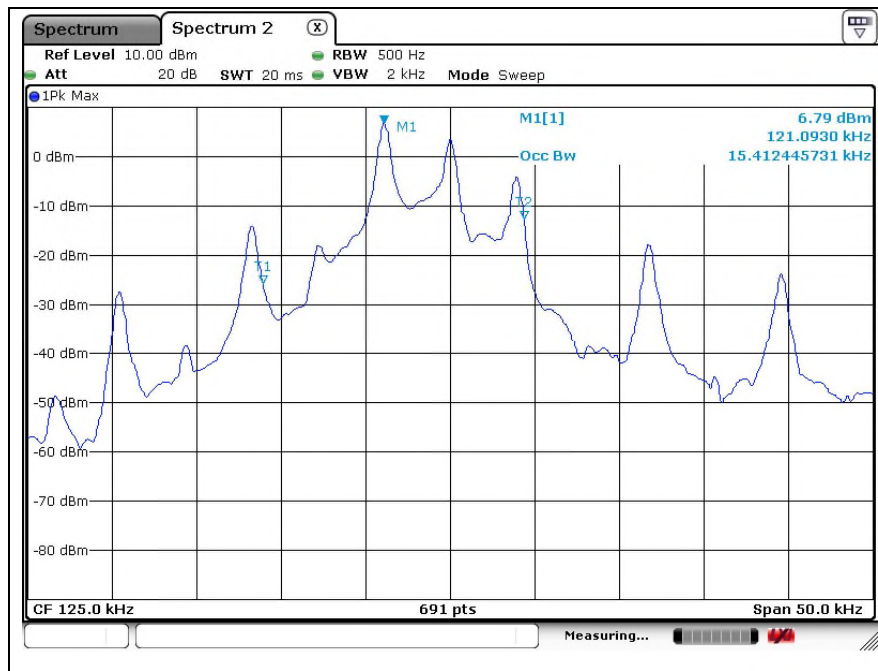
- AST Antenna



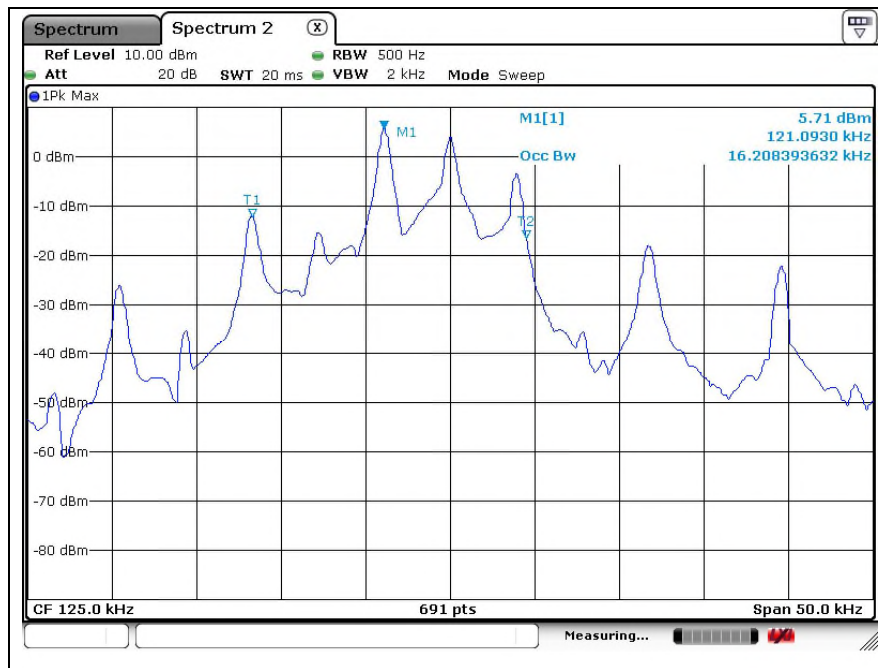
- INT1 Antenna



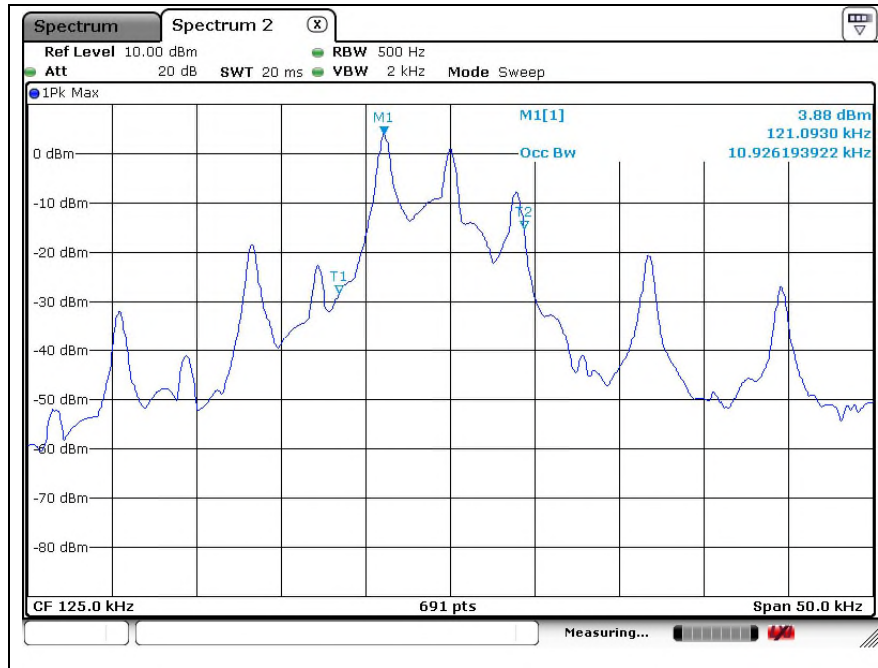
- INT2 Antenna



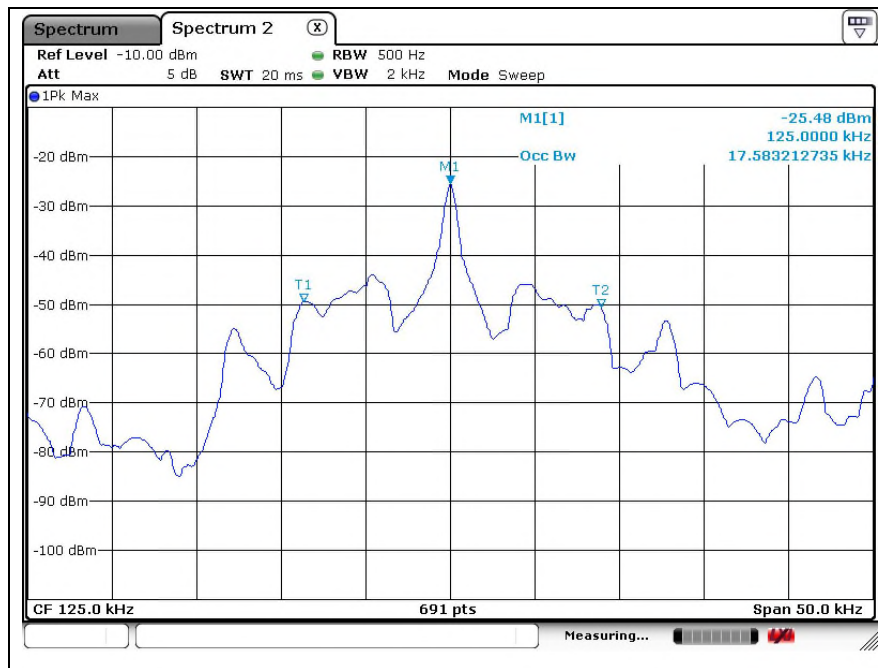
- TRK Antenna



- BMP Antenna



- SSB Antenna



- End of the Test Report -