

TEST REPORT

of

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

FCC ID: TQ8-IBU-4E14
IC Certification: 5074A-IBU4E14

Equipment Under Test : SMART KEY ECU
Model Name : IBU-4E14
Variant Model Name(s) : -
FCC Applicant : HYUNDAI MOBIS CO., LTD.
IC Applicant : Hyundai MOBIS Co., Ltd
Manufacturer : HYUNDAI MOBIS CO., LTD.
Date of Receipt : 2023.01.17
Date of Test(s) : 2023.01.20 ~ 2023.02.08
Date of Issue : 2023.02.10

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.
- 3) This test report cannot be reproduced, except in full, without prior written permission of the Company.
- 4) The data marked ※ in this report was provided by the customer and may affect the validity of the test results.

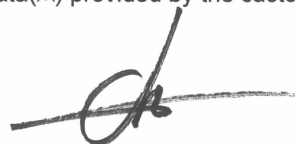
We are responsible for all the information of this test report except for the data(※) provided by the customer.

Tested by:



Taek Kim

Technical
Manager:



Jinhyoung Cho

SGS Korea Co., Ltd. Gunpo Laboratory

INDEX

<u>Table of Contents</u>	Page
1. General Information -----	3
2. Field Strength of Fundamental and Radiated Spurious Emissions -----	10
3. 20 dB Bandwidth -----	31
4. Occupied Bandwidth-----	35

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

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1.2. Details of Applicant

FCC Applicant : HYUNDAI MOBIS CO., LTD.
 FCC Address : 203, Teheran-ro, Gangnam-gu, Seoul, South Korea, 135-977
 IC Applicant : Hyundai MOBIS Co., Ltd
 IC Address : 203, Teheran-ro, Gangnam-gu, Seoul, Korea (Republic Of), 135-977
 Contact Person : Choe, Seung-hoon
 Phone No. : +82 31 260 0098

1.3. Details of Manufacturer

Company : HYUNDAI MOBIS CO., LTD.
 Address : 203, Teheran-ro, Gangnam-gu, Seoul, South Korea, 135-977

1.4. Description of EUT

Kind of Product		SMART KEY ECU
Model Name		IBU-4E14
Serial Number		001
Power Supply		DC 12.0 V
Frequency Range		Tx: 125 kHz, Rx: 433.92 MHz
Antenna Type	Tx	Coil Antenna
	Rx	PCB Pattern Antenna
Antenna Part Number		SSB Antenna: 93502-T6000 LF Antenna: 95460-L2500
H/W Version		1.00
S/W Version		1.00

1.5. Declarations by the manufacturer

- The EUT has 7 transmit antenna and 1 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	103210	Dec. 07, 2022	Annual	Dec. 07, 2023
Signal Generator	R&S	SMBV100A	255834	May 25, 2022	Annual	May 25, 2023
DC Power Supply	R&S	HMP2020	020089489	May 17, 2022	Annual	May 17, 2023
Preamplifier	H.P.	8447F	2944A03909	Aug. 04, 2022	Annual	Aug. 04, 2023
EMI Test Receiver	R&S	ESCI 7	100911	Feb. 23, 2022	Annual	Feb. 23, 2023
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 23, 2021	Biennial	Aug. 23, 2023
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	390	Feb. 21, 2022	Annual	Feb. 21, 2023
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.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/3 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	RFONE	MWX221-NMSNMS (4 m)	J1023142	Oct. 04, 2022	Semi- Annual	Apr. 04, 2023
Coaxial Cable	Qualwave Inc.	QA500-18-NN-10 (10 m)	22200114	Oct. 04, 2022	Semi- Annual	Apr. 04, 2023

1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

Applied standard: FCC Part 15 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.

1.8. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013).

1.9. 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) - (AMP (dB))

1.10. Measurement Uncertainty

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

Parameter	Uncertainty	
20 dB Bandwidth	3.90 kHz	
Radiated Emission, 9 kHz to 30 MHz	H	3.40 dB
	V	3.40 dB
Radiated Emission, below 1 GHz	H	4.50 dB
	V	5.10 dB

All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicate a 95 % level of confidence.

1.11. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL003803	2023.02.10	Initial

1.12. Duty Cycle of EUT

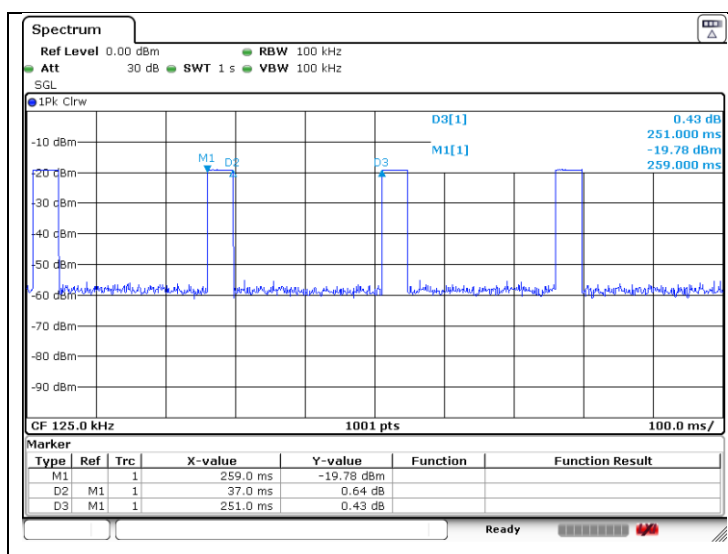
Antenna Type	Duty Cycle (%)
INT1 Antenna	14.74
INT2 Antenna	14.74
TRK Antenna	14.74
BMP Antenna	14.74
DRV Antenna	14.74
AST Antenna	14.74
SSB Antenna	60.63

Remark;

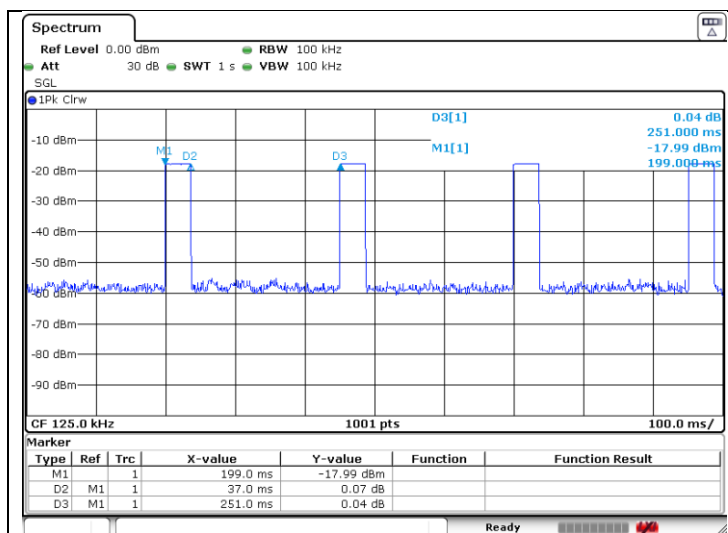
- Duty Cycle (%) = (Tx on time / Tx on + off time) x 100

- Test plots

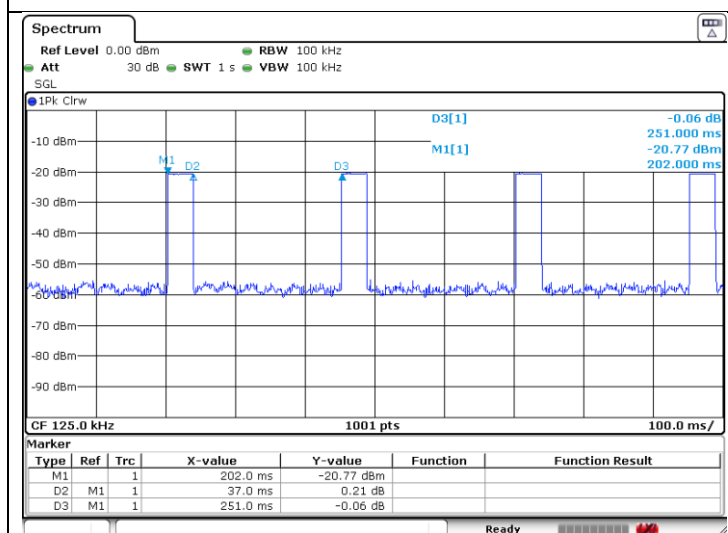
INT1 Antenna



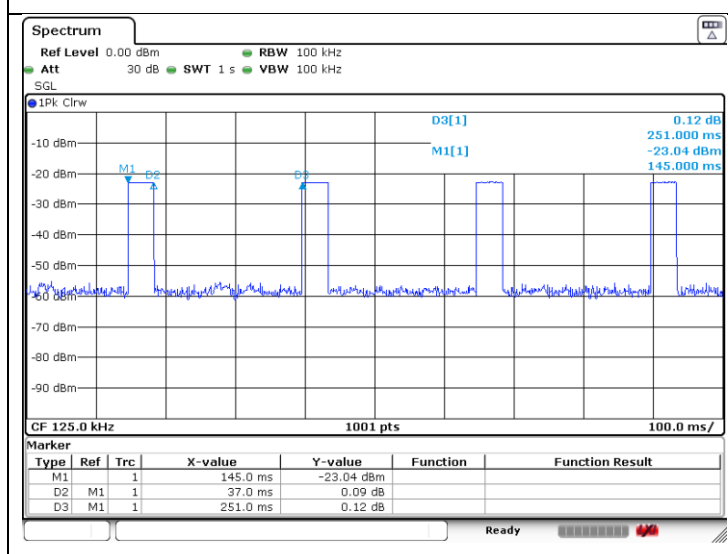
INT2 Antenna



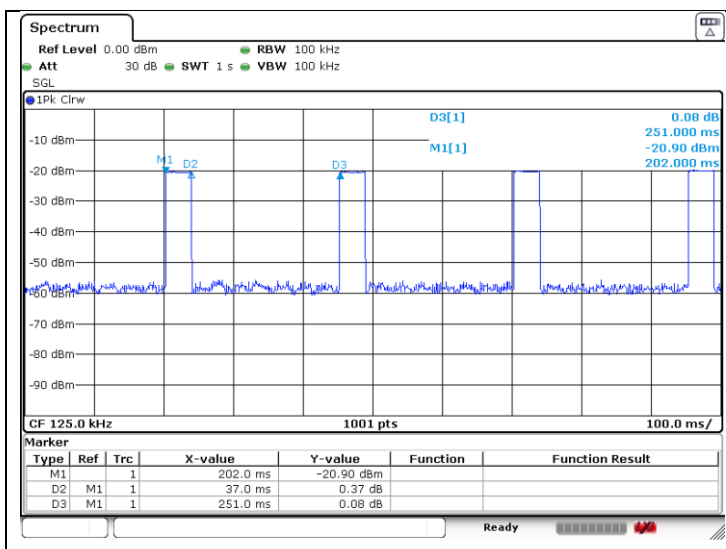
TRK Antenna



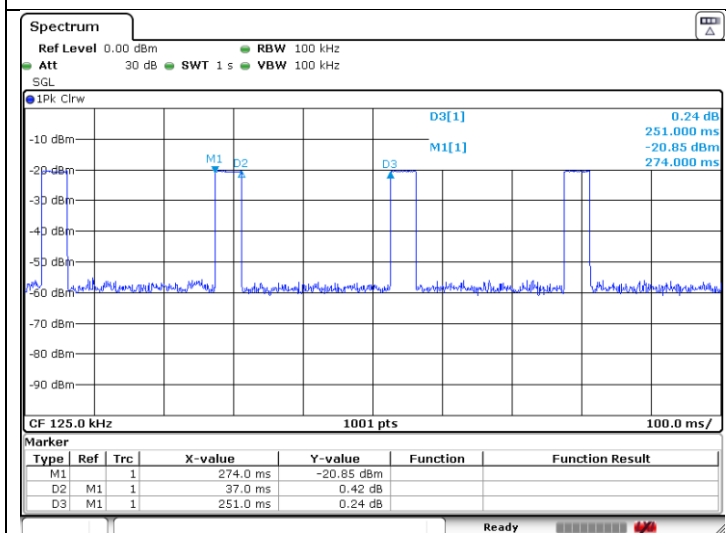
BMP Antenna



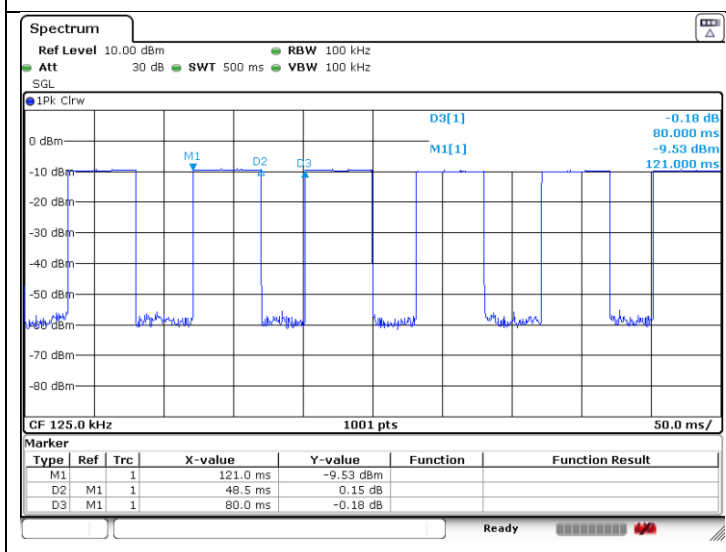
DRV Antenna



AST Antenna



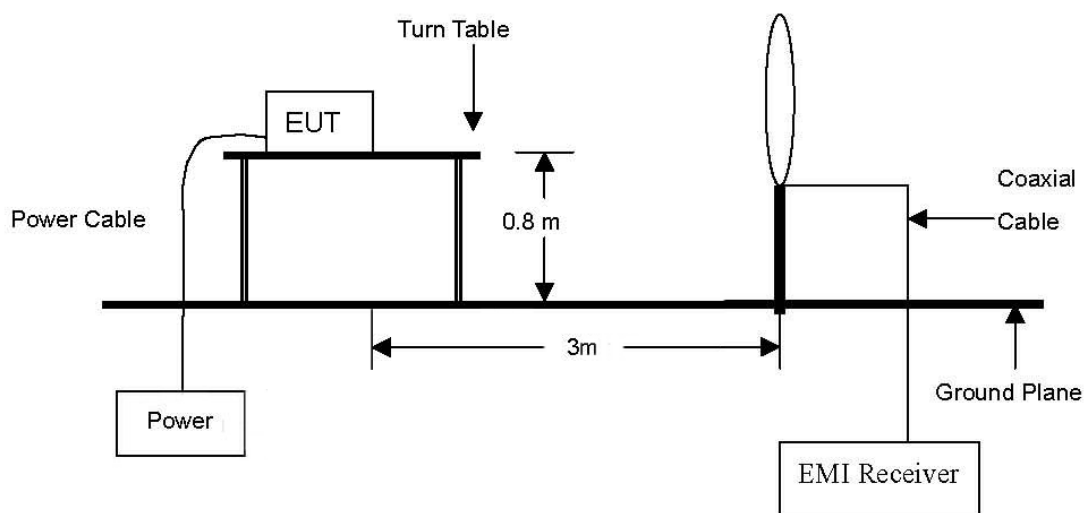
SSB Antenna



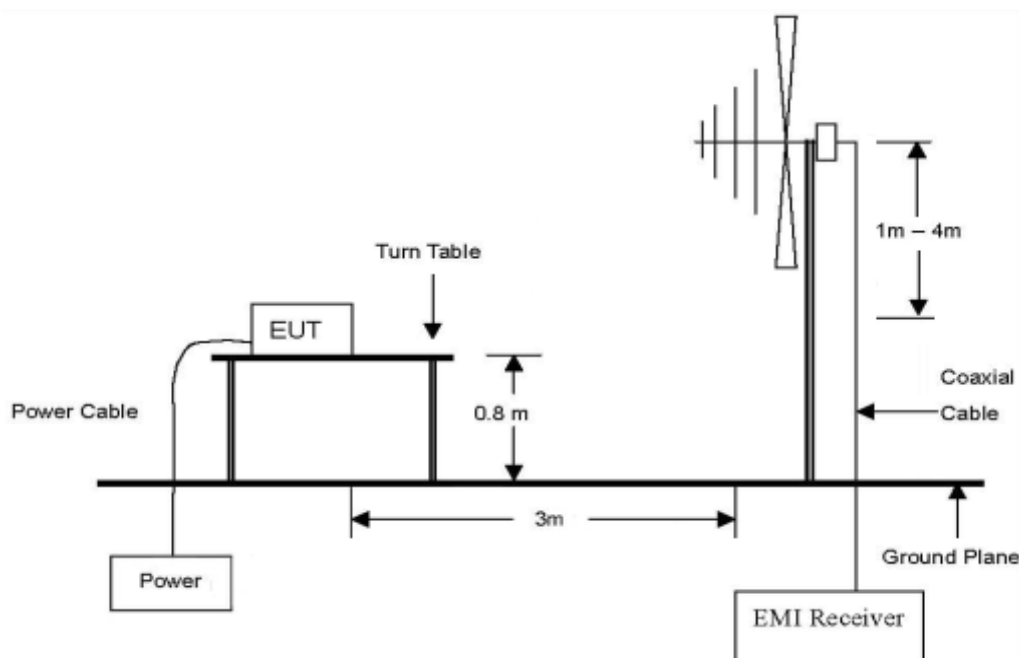
2. Field Strength of Fundamental and Radiated Spurious Emissions

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

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.

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.

Note ;

- Definition of DUT Axis

The test orthogonal plan of EUT was investigated with three axis described in the test setup photo.

The Z-axis was worst-case, all radiated testing of EUT was performed with Z-axis.

2.4. Field Strength of Fundamental 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.

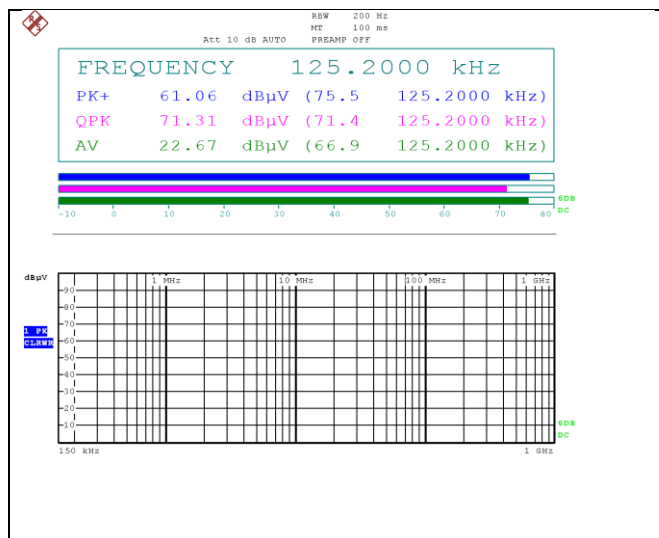
Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m	Limit (dBμV/m) at 300 m	Margin (dB)
INT1 Antenna									
0.125	66.90	Average	H	17.90	0.04	84.84	4.84	25.67	20.83
INT2 Antenna									
0.125	65.90	Average	H	17.90	0.04	83.84	3.84	25.67	21.83
TRK Antenna									
0.125	68.60	Average	H	17.90	0.04	86.54	6.54	25.67	19.13
BMP Antenna									
0.125	61.10	Average	H	17.90	0.04	79.04	-0.96	25.67	26.63
DRV Antenna									
0.125	67.70	Average	H	17.90	0.04	85.64	5.64	25.67	20.03
AST Antenna									
0.125	67.60	Average	H	17.90	0.04	85.54	5.54	25.67	20.13
SSB Antenna									
0.125	70.20	Average	H	17.90	0.04	88.14	8.14	25.67	17.53

Remark;

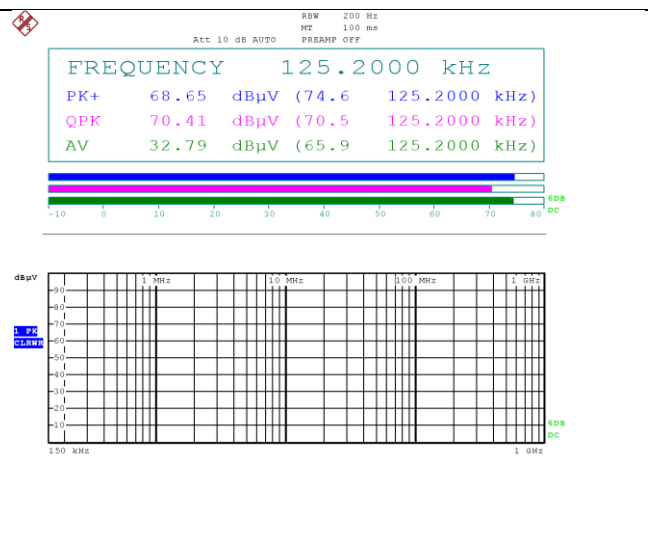
1. According to §15.31(f)(2) 300 m Result (dBμV/m) = 3 m Result (dBμV/m) - 40log (300/3) (dBμV/m).
2. According to §15.209(d), the measurements were tested by using Quasi peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1 000 MHz in these three bands on measurements employing 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 μV/m = (1/377 Ω) × 1 μA/m]
The FCC limits are same to the IC limits.
5. Actual (dBμV/m) at 3 m = Reading (dBμV) + AF (dB/m) + CL (dB).

- Test plots

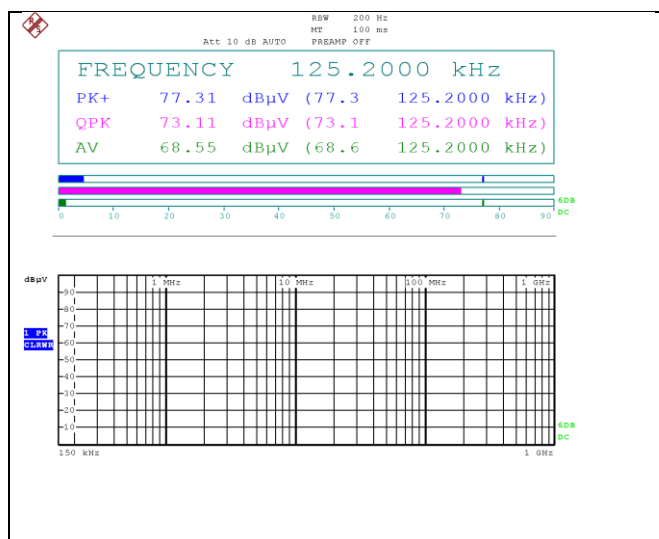
INT1 Antenna



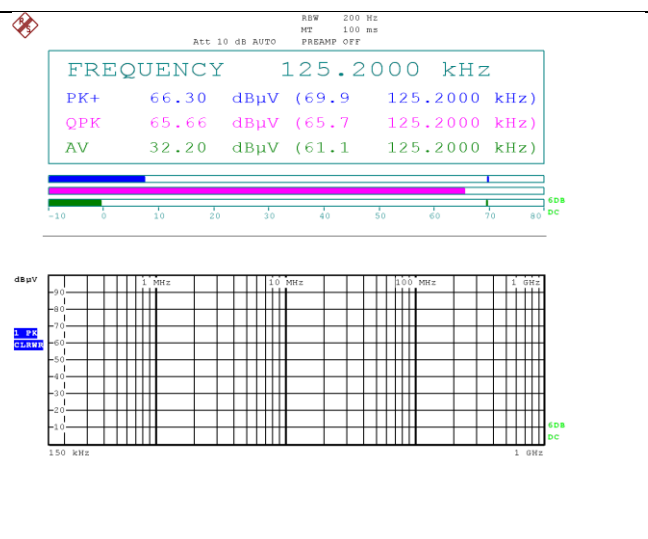
INT2 Antenna



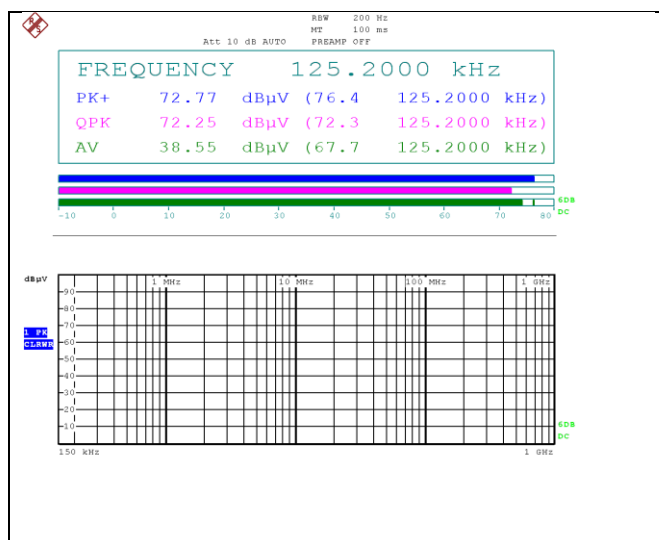
TRK Antenna



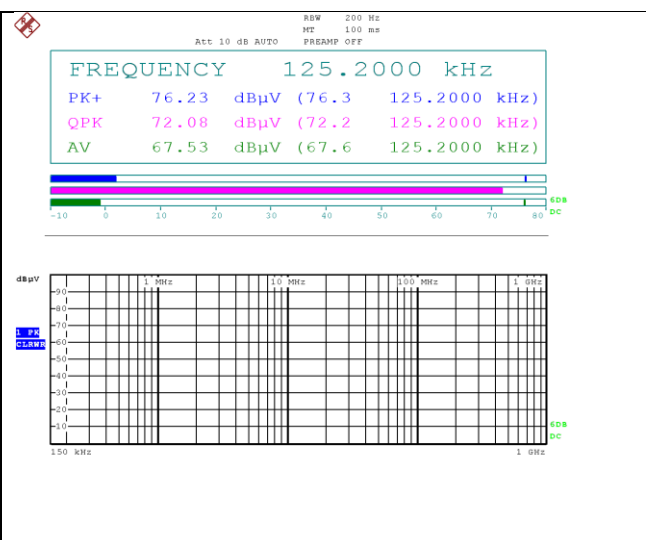
BMP Antenna



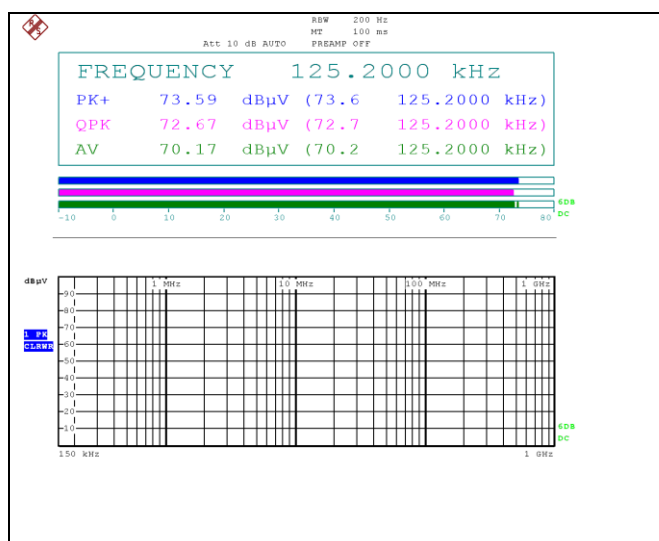
DRV Antenna



AST 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.

INT1 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)
0.019	27.50	Average	H	18.38	0.02	45.90	-34.10	42.03	76.13
0.250	31.50	Average	H	17.90	0.05	49.45	-30.55	19.65	50.20
0.376	33.30	Average	H	17.94	0.06	51.30	-28.70	16.10	44.80

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)
125.79	33.40	Peak	H	19.12	-26.63	25.89	43.50	17.61
180.23	35.20	Peak	H	19.52	-26.43	28.29	43.50	15.21
216.36	38.30	Peak	H	21.15	-26.35	33.10	46.00	12.90
320.52	33.00	Peak	H	23.62	-25.79	30.83	46.00	15.17
397.63	31.40	Peak	H	25.61	-25.27	31.74	46.00	14.26
Above 400.00	Not detected	-	-	-	-	-	-	-

INT2 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)
0.011	22.90	Average	H	18.58	0.02	41.50	-38.50	46.78	85.28
0.018	26.40	Average	H	18.40	0.02	44.82	-35.18	42.50	77.68
0.250	38.90	Average	H	17.90	0.05	56.85	-23.15	19.65	42.80
0.376	33.60	Average	H	17.94	0.06	51.60	-28.40	16.10	44.50

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)
58.62	29.80	Peak	V	22.88	-27.30	25.38	40.00	14.62
125.79	33.90	Peak	H	19.12	-26.63	26.39	43.50	17.11
196.36	36.50	Peak	H	21.24	-26.35	31.39	43.50	12.11
320.52	32.10	Peak	H	23.62	-25.79	29.93	46.00	16.07
481.05	30.70	Peak	V	26.74	-26.08	31.36	46.00	14.64
586.54	30.50	Peak	H	28.76	-25.95	33.31	46.00	12.69
Above 600.00	Not detected	-	-	-	-	-	-	-

TRK 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)
0.019	27.70	Average	H	18.38	0.02	46.10	-33.90	42.03	75.93
0.249	38.40	Average	H	17.90	0.05	56.35	-23.65	19.68	43.33
0.375	33.30	Average	H	17.94	0.06	51.30	-28.70	16.12	44.82

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)
125.79	33.40	Peak	H	19.12	-26.63	25.89	43.50	17.61
151.01	32.40	Peak	H	18.00	-26.71	23.69	43.50	19.81
208.36	37.40	Peak	H	21.03	-26.29	32.14	43.50	11.36
320.52	32.90	Peak	H	23.62	-25.79	30.73	46.00	15.27
392.90	34.40	Peak	H	25.42	-25.31	34.51	46.00	11.49
485.05	30.20	Peak	V	26.90	-26.13	30.97	46.00	15.03
Above 500.00	Not detected	-	-	-	-	-	-	-

BMP 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)
0.010	26.10	Average	H	18.60	0.02	44.72	-35.28	47.60	82.88
0.018	25.40	Average	H	18.40	0.02	43.82	-36.18	42.50	78.68
0.250	39.30	Average	H	17.90	0.05	57.25	-22.75	19.65	42.40
0.376	33.80	Average	H	17.94	0.06	51.80	-28.20	16.10	44.30

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)
125.79	33.20	Peak	H	19.12	-26.63	25.69	43.50	17.81
181.32	40.90	Peak	H	19.63	-26.43	34.10	43.50	9.40
215.39	42.80	Peak	H	21.12	-26.34	37.58	43.50	5.92
394.72	33.10	Peak	H	25.49	-25.29	33.30	46.00	12.70
477.41	31.20	Peak	V	26.60	-26.09	31.71	46.00	14.29
Above 500.00	Not detected	-	-	-	-	-	-	-

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)
0.019	28.40	Average	H	18.38	0.02	46.80	-33.20	42.03	75.23
0.250	39.40	Average	H	17.90	0.05	57.35	-22.65	19.65	42.30
0.375	34.20	Average	H	17.94	0.06	52.20	-27.80	16.12	43.92

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)
59.59	28.70	Peak	V	22.68	-27.28	24.10	40.00	15.90
125.79	34.70	Peak	H	19.12	-26.63	27.19	43.50	16.31
177.32	36.70	Peak	H	19.33	-26.51	29.52	43.50	13.98
192.23	36.50	Peak	H	20.72	-26.44	30.78	43.50	12.72
320.52	30.10	Peak	H	23.62	-25.79	27.93	46.00	18.07
396.66	32.90	Peak	H	25.57	-25.27	33.20	46.00	12.80
Above 400.00	Not detected	-	-	-	-	-	-	-

AST 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)
0.019	27.40	Average	H	18.38	0.02	45.80	-34.20	42.03	76.23
0.249	38.50	Average	H	17.90	0.05	56.45	-23.55	19.68	43.23
0.376	33.50	Average	H	17.94	0.06	51.50	-28.50	16.10	44.60

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)
58.62	30.20	Peak	V	22.88	-27.30	25.78	40.00	14.22
125.91	32.90	Peak	H	19.11	-26.63	25.38	43.50	18.12
194.78	43.20	Peak	H	21.08	-26.39	37.89	43.50	5.61
392.66	32.30	Peak	H	25.41	-25.31	32.40	46.00	13.60
481.54	31.10	Peak	V	26.76	-26.08	31.78	46.00	14.22
Above 500.00	Not detected	-	-	-	-	-	-	-

SSB 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)
0.019	28.90	Average	H	18.38	0.02	47.30	-32.70	42.03	74.73
0.250	42.30	Average	H	17.90	0.05	60.25	-19.75	19.65	39.40
0.376	35.60	Average	H	17.94	0.06	53.60	-26.40	16.10	42.50

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)
58.13	33.00	Peak	V	22.97	-27.31	28.66	40.00	11.34
137.67	37.20	Peak	H	18.20	-26.66	28.74	43.50	14.76
171.26	38.90	Peak	H	19.10	-26.67	31.33	43.50	12.17
197.81	37.50	Peak	H	21.38	-26.33	32.55	43.50	10.95
320.64	31.40	Peak	V	23.63	-25.78	29.25	46.00	16.75
395.69	34.20	Peak	H	25.53	-25.28	34.45	46.00	11.55
Above 400.00	Not detected	-	-	-	-	-	-	-

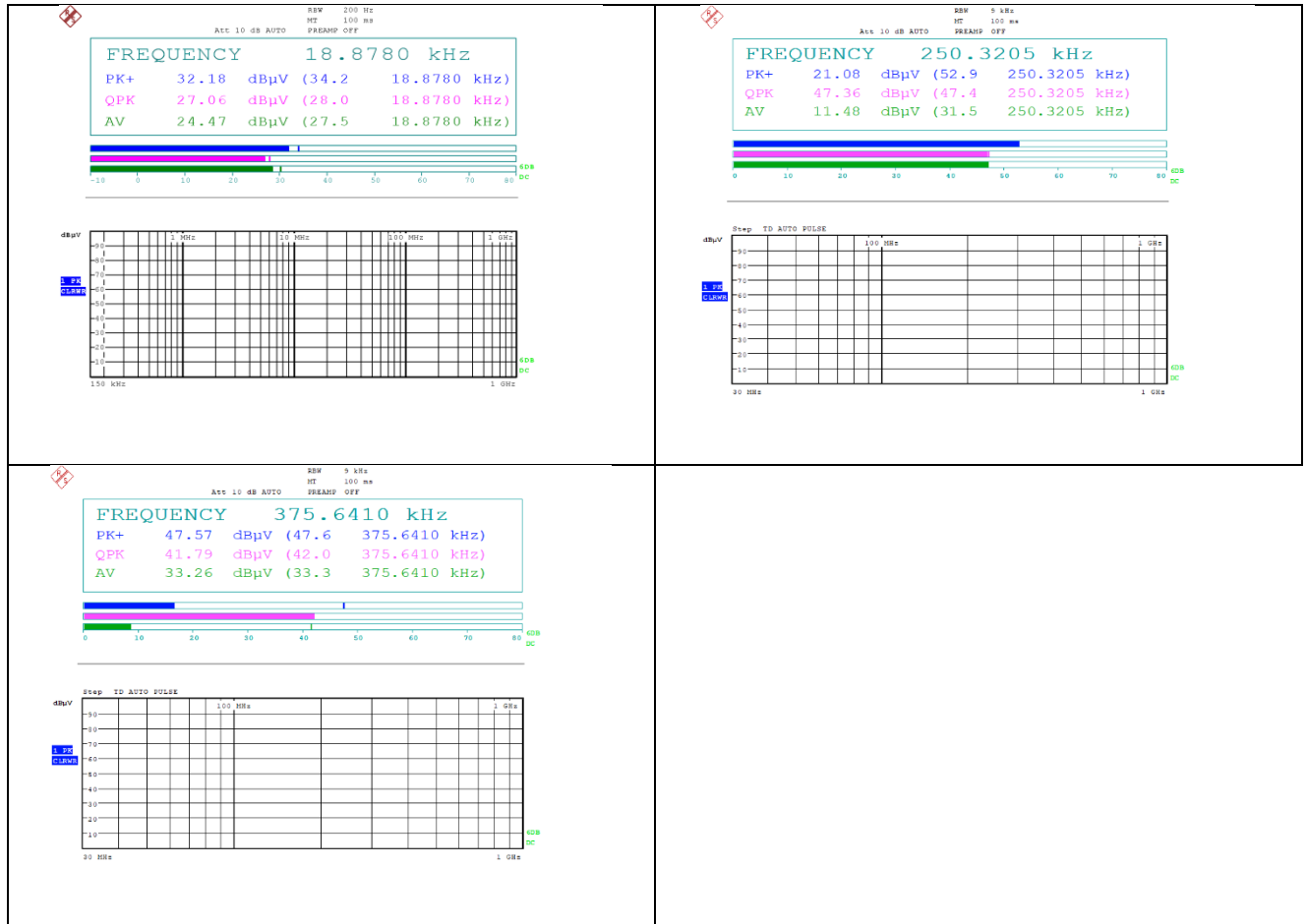
Remark;

- According to §15.31(f)(2)
 - 300 m Result (dBμV/m) = 3 m Result (dBμV/m) - 40log (300/3) (dBμV/m)
 - 30 m Result (dBμV/m) = 3 m Result (dBμV/m) - 40log (30/3) (dBμV/m)
- 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 (dBμV/m)
 - 490 kHz to 1 705 kHz: 20log (24 000 / F (kHz)) at 30 m (dBμV/m)
- 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.
- 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 μV/m = (1/377 Ω) × 1 μA/m]
The FCC limits are same to the IC limits.
- The limit above was calculated based on table of §15.209 (a).
- Actual (dBμV/m) at 3 m = Reading (dBμV) + AF (dB/m) + CL (dB) or
Reading (dBμV) + AF (dB/m) + CL (dB) - AMP (dB).

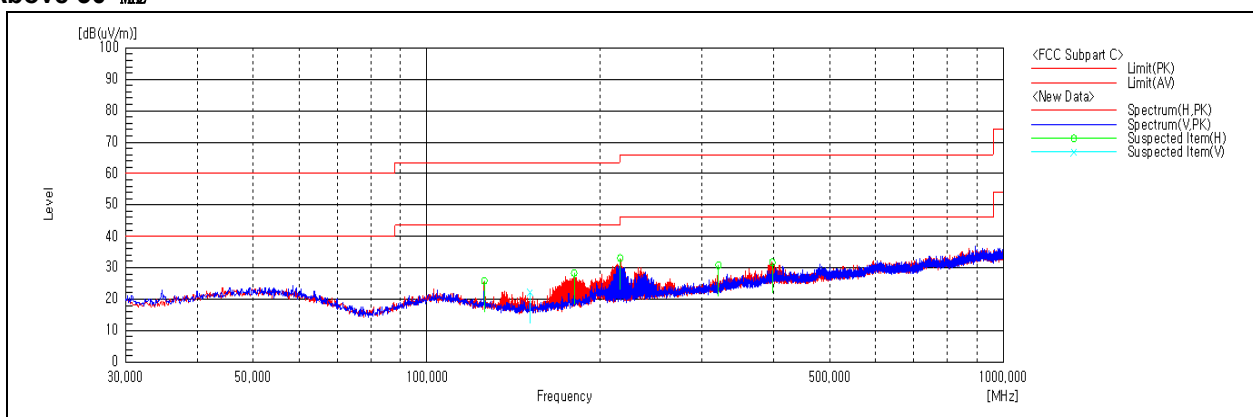
- Test plots

INT1 Antenna

Below 30 MHz



Above 30 MHz

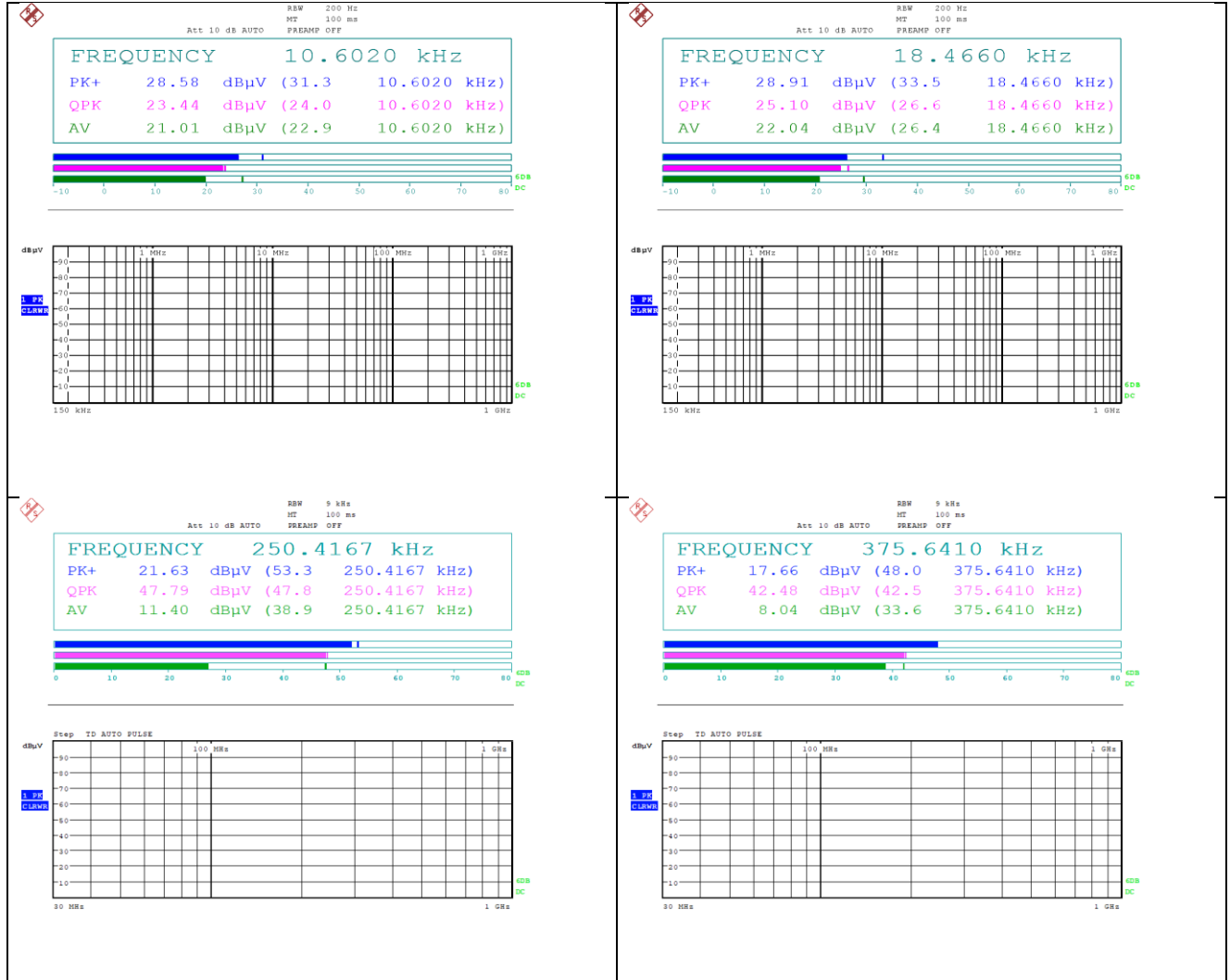


Remark;

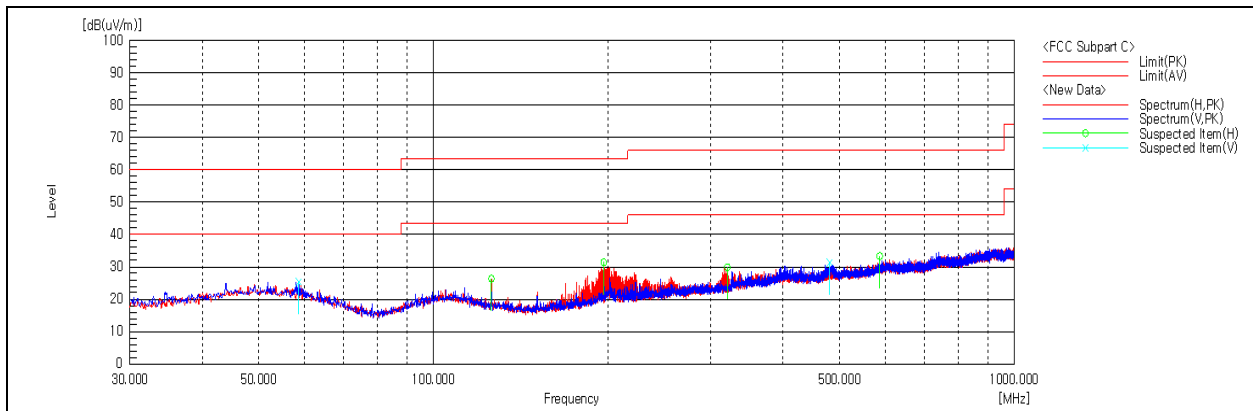
- Traces shown in the plot were made by using a peak detector.

INT2 Antenna

Below 30 MHz



Above 30 MHz

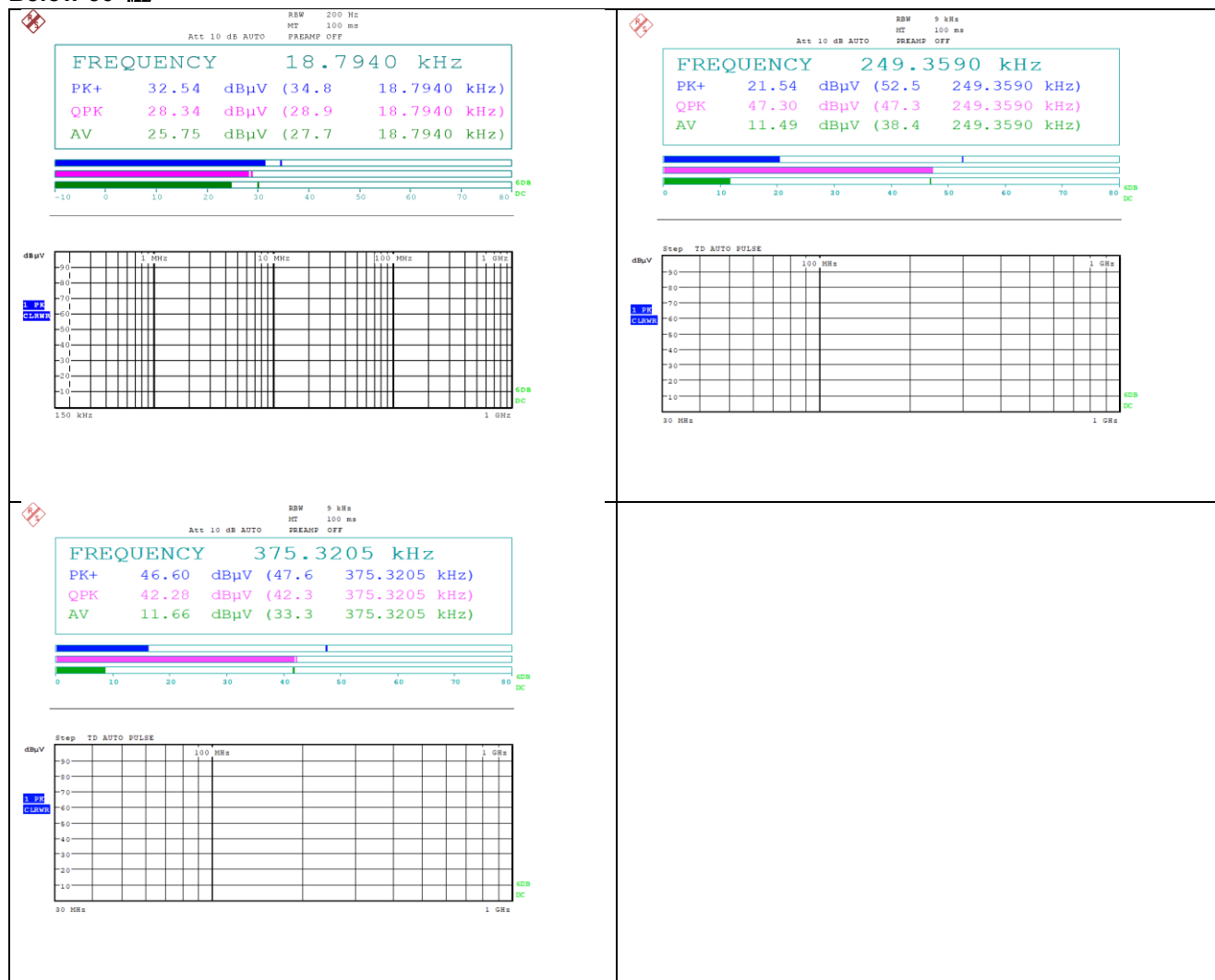


Remark;

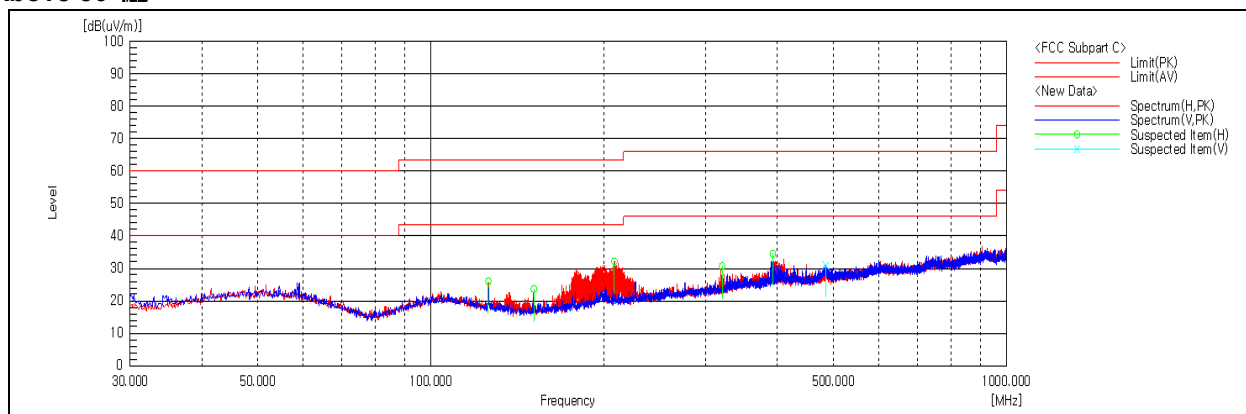
- Traces shown in the plot were made by using a peak detector.

TRK Antenna

Below 30 MHz



Above 30 MHz

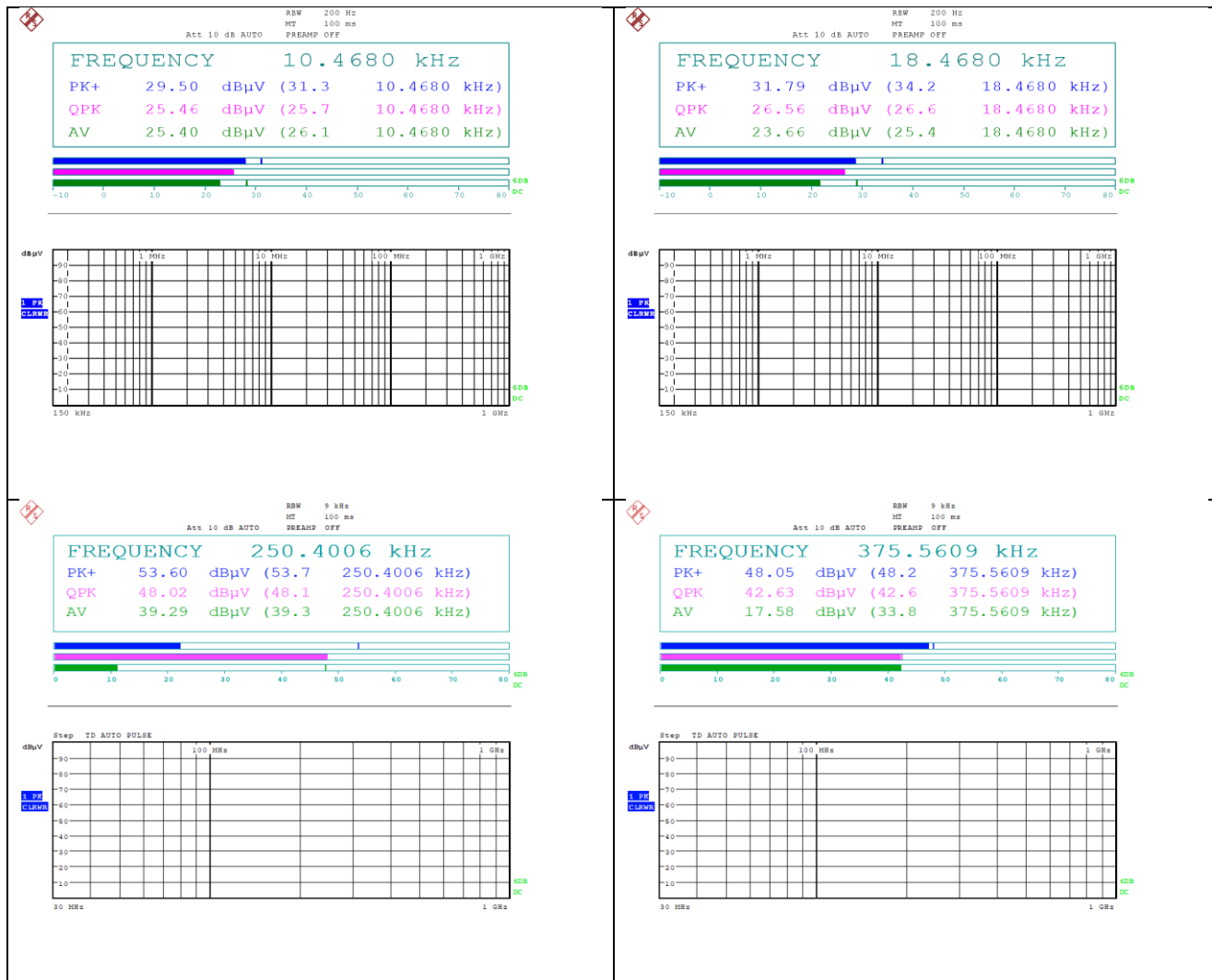


Remark;

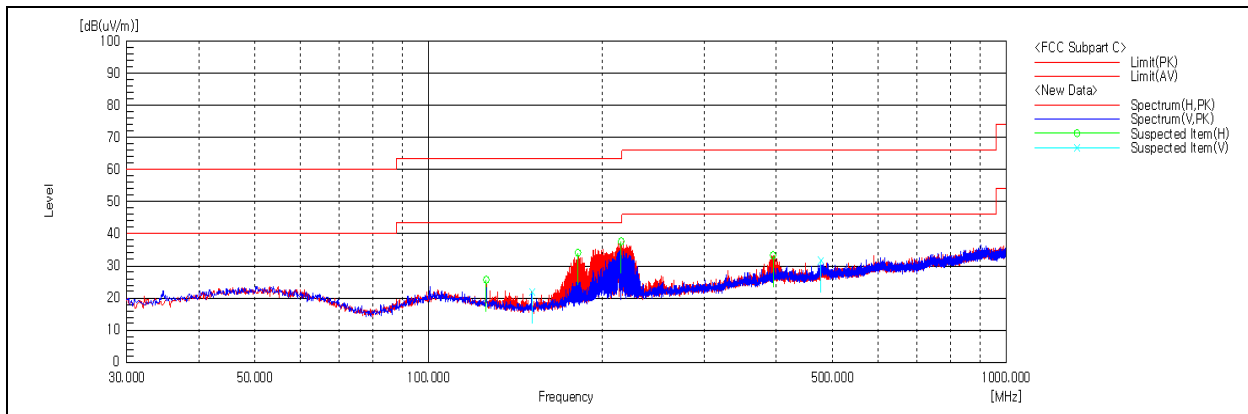
- Traces shown in the plot were made by using a peak detector.

BMP Antenna

Below 30 MHz



Above 30 MHz



Remark;

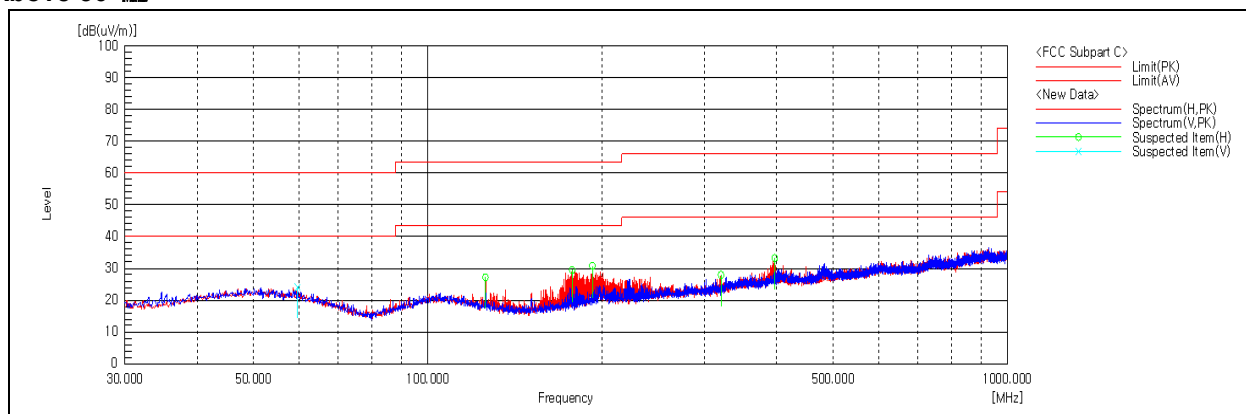
- Traces shown in the plot were made by using a peak detector.

DRV Antenna

Below 30 MHz



Above 30 MHz

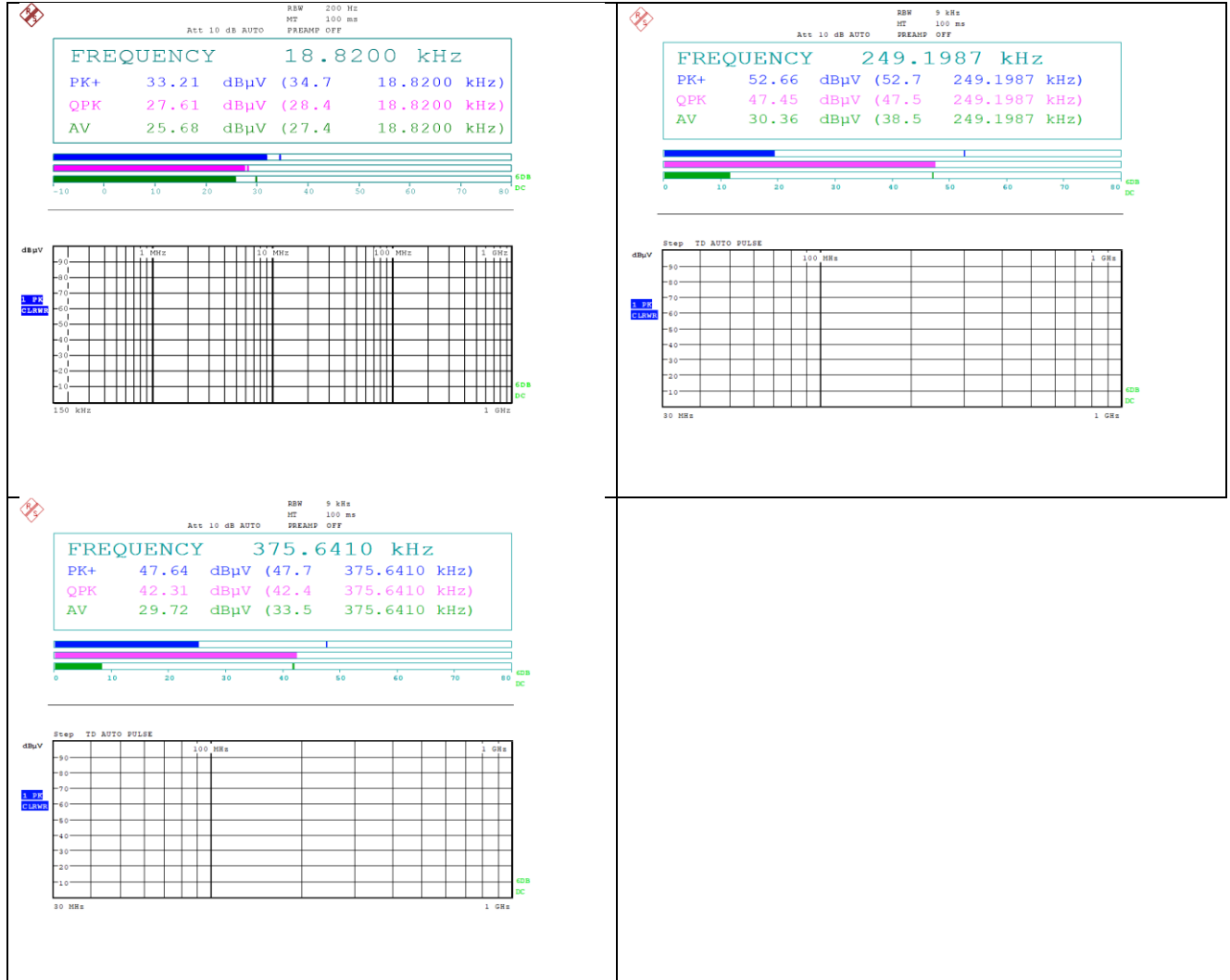


Remark;

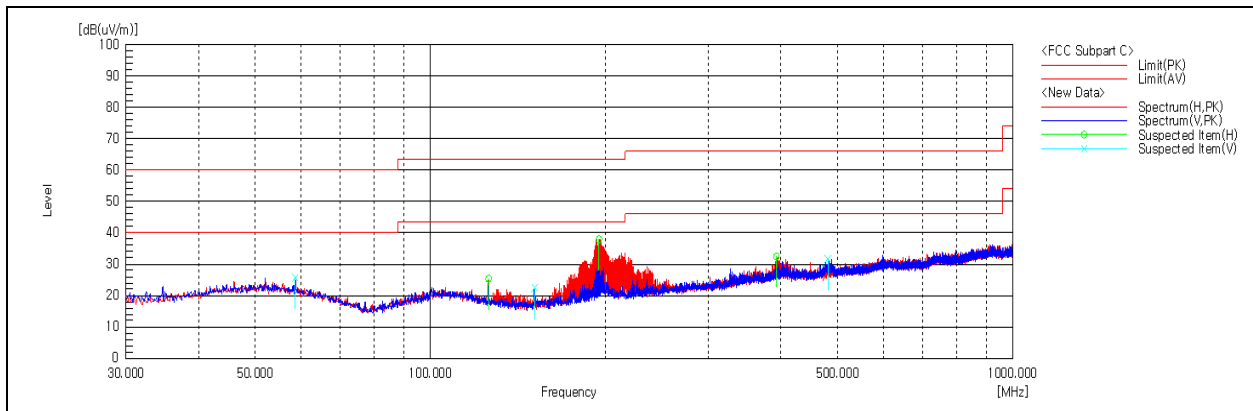
- Traces shown in the plot were made by using a peak detector.

AST Antenna

Below 30 MHz



Above 30 MHz

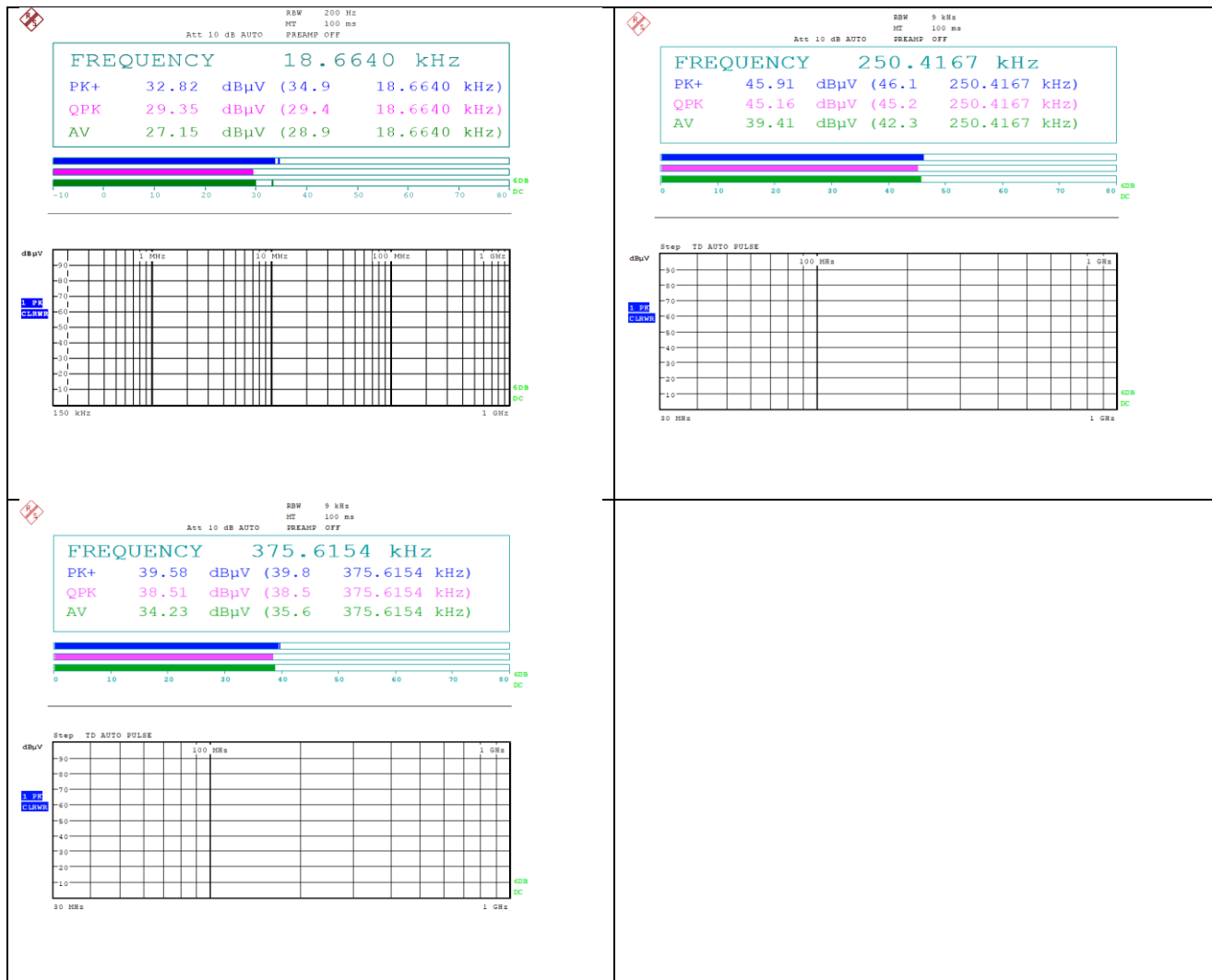


Remark;

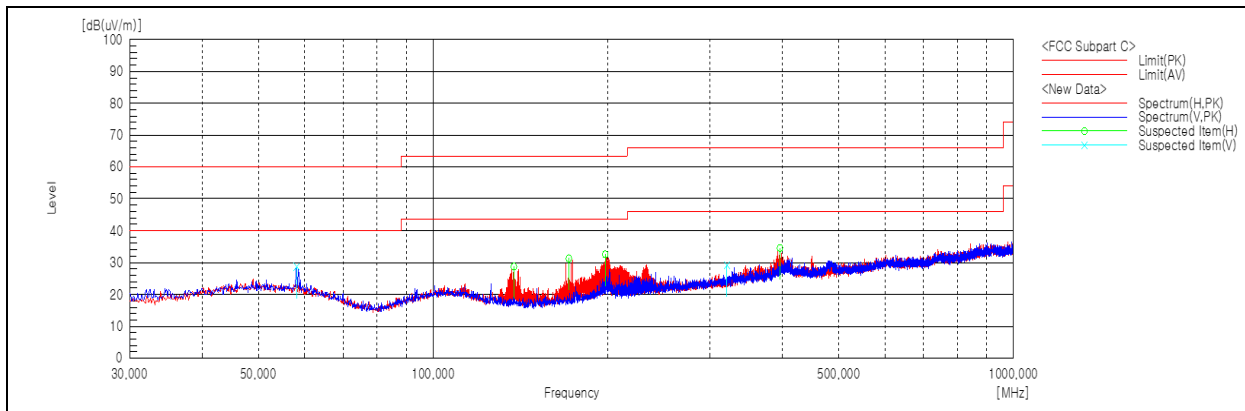
- Traces shown in the plot were made by using a peak detector.

SSB Antenna

Below 30 MHz



Above 30 MHz

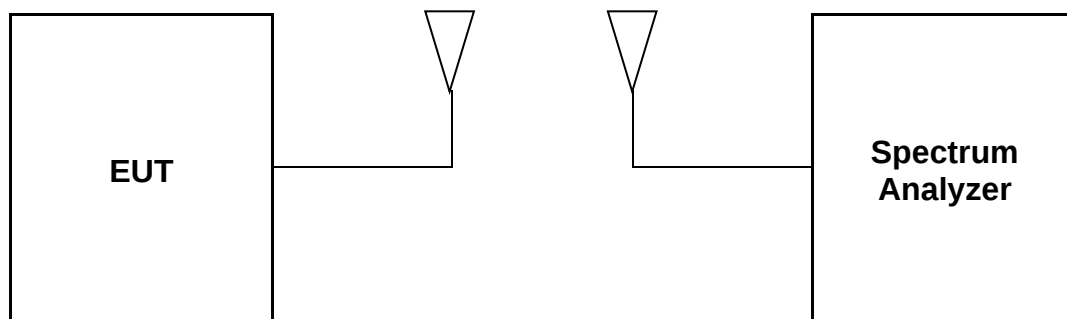


Remark;

- 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

- a. Span = set to capture all products of the modulation process, including the emission skirts.
 RBW = 200 Hz, VBW = 200 Hz, Sweep = auto, Detector = peak, Trace = max hold.
- b. 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.

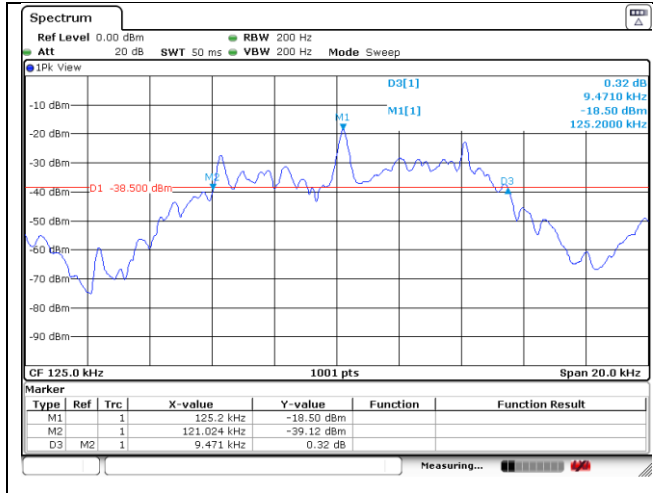
3.4. Test Result

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

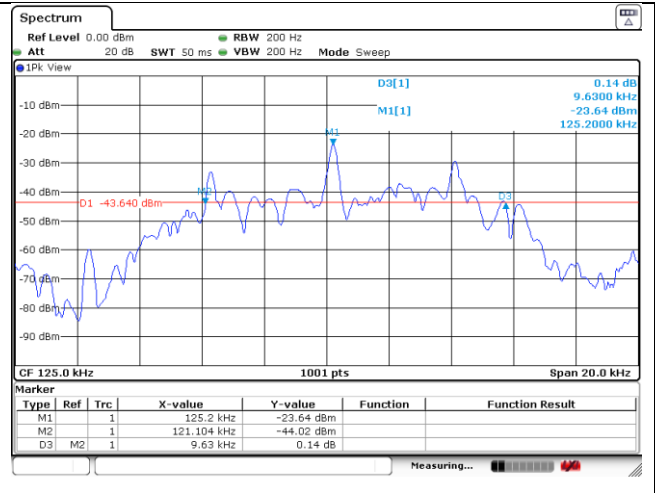
Test Antenna	Frequency (kHz)	20 dB Bandwidth (kHz)	Limit
INT1 Antenna	125	9.471	Reporting proposed only
INT2 Antenna	125	9.630	
TRK Antenna	125	9.411	
BMP Antenna	125	10.989	
DRV Antenna	125	9.311	
AST Antenna	125	9.151	
SSB Antenna	125	1.042	

- Test plots

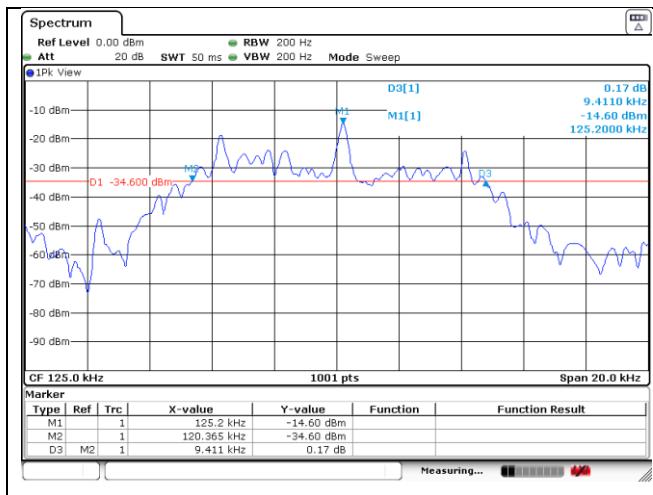
INT1 Antenna



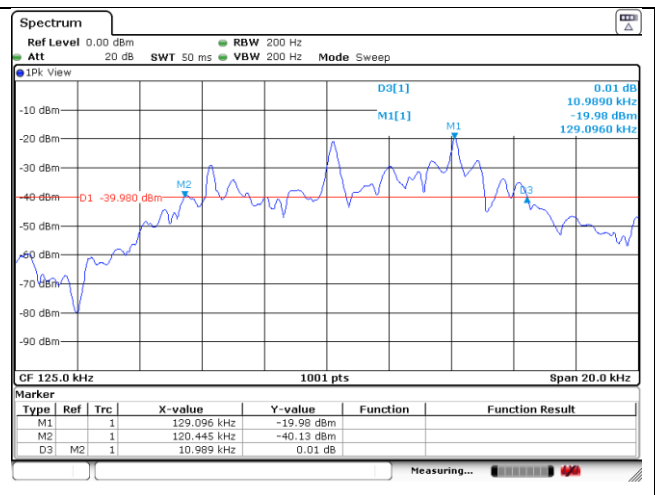
INT2 Antenna



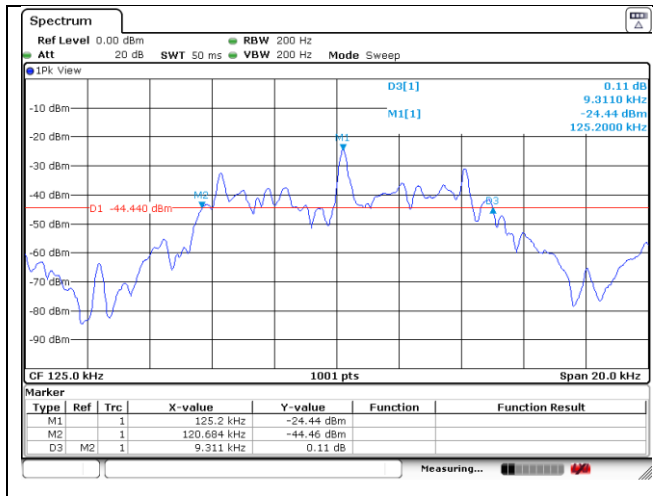
TRK Antenna



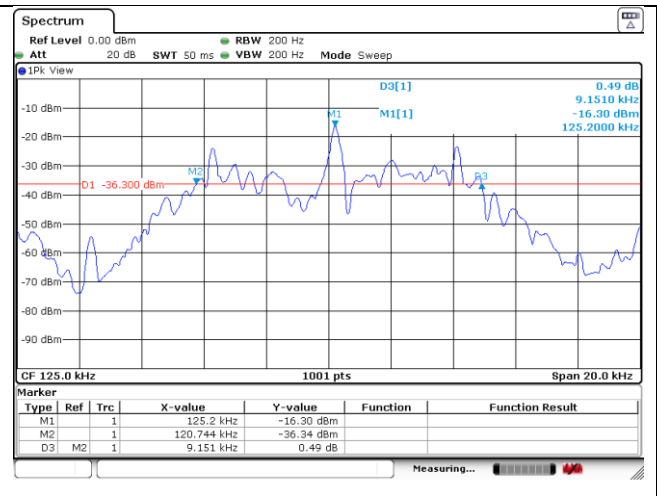
BMP Antenna



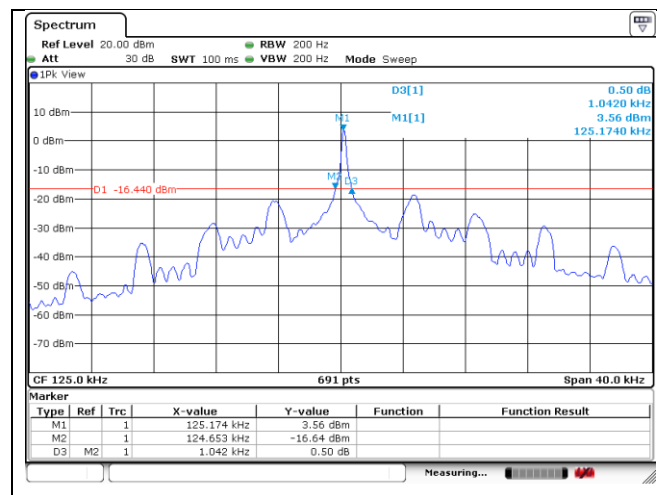
DRV Antenna



AST Antenna

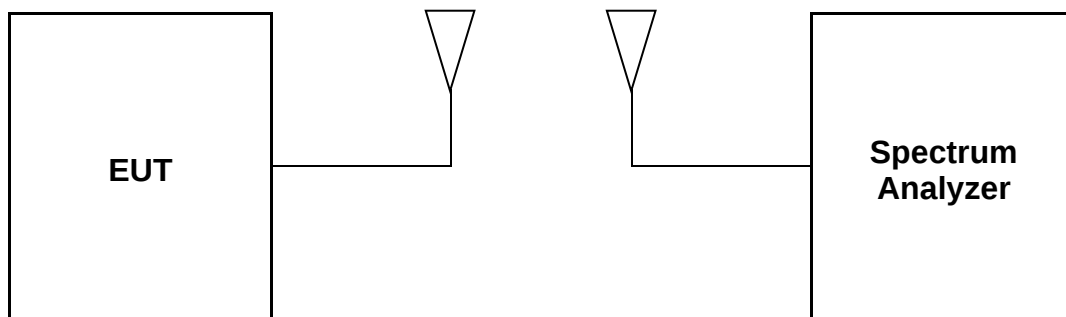


SSB Antenna



4. Occupied Bandwidth

4.1. Test Setup



4.2. Limit

None; for reporting purposed only

4.3. Test Procedure

1. Set the spectrum analyzer as Span = set to capture all products of the modulation process, including the emission skirts, RBW = 200 Hz, VBW = 200 Hz, Detector = peak, Trace mode = max hold.
2. Measure lowest and highest frequencies are placed in a running sum until 0.5 % and 99.5 % of the total is reached.
3. Record the SPAN between the lowest and the highest frequencies for the 99 % occupied bandwidth.

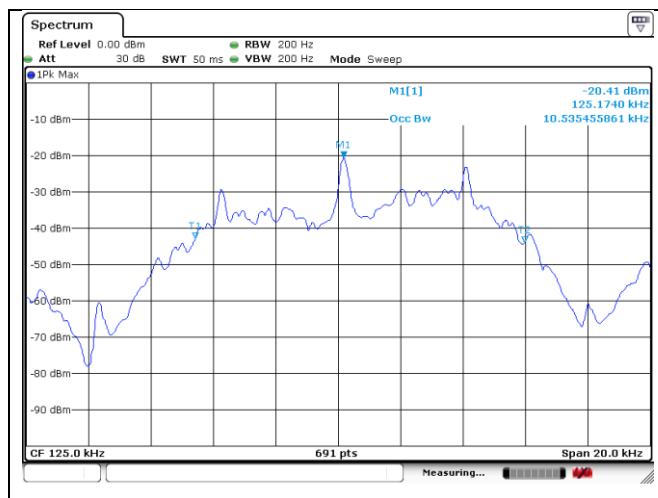
4.4. Test Result

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

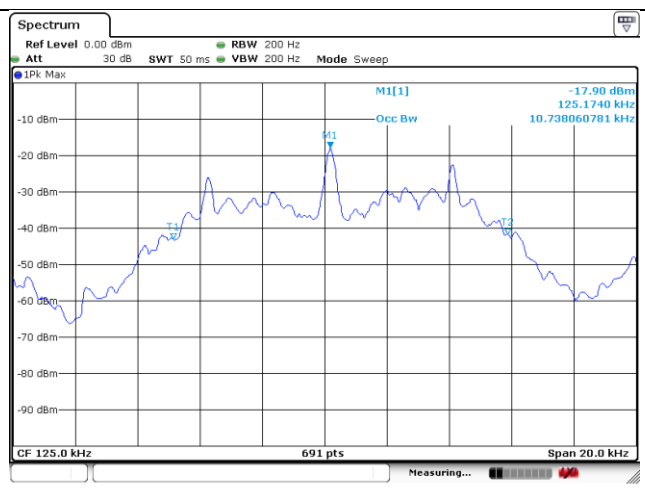
Test Antenna	Frequency (MHz)	Occupied Bandwidth (kHz)	Limit
INT1 Antenna	125	10.535	Reporting proposed only
INT2 Antenna	125	10.738	
TRK Antenna	125	10.246	
BMP Antenna	125	10.622	
DRV Antenna	125	10.304	
AST Antenna	125	10.362	
SSB Antenna	125	13.777	

- Test plots

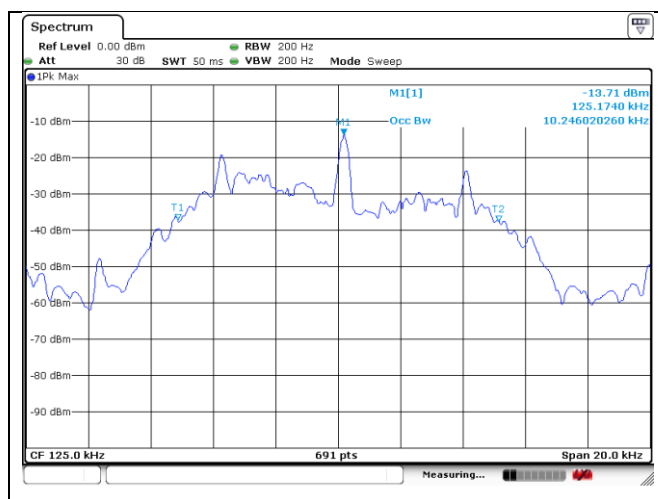
INT1 Antenna



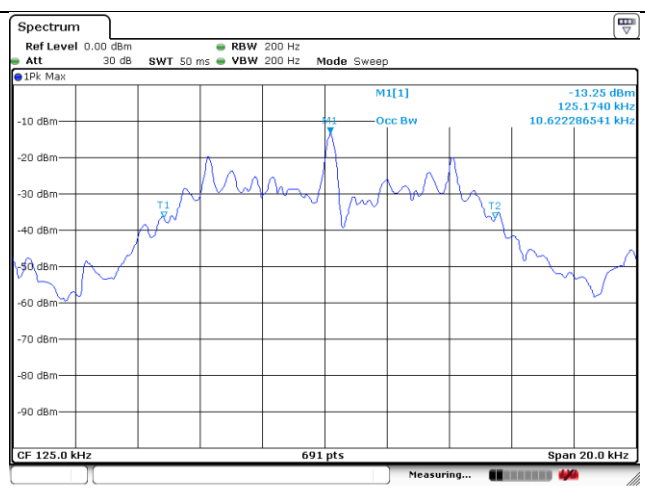
INT2 Antenna



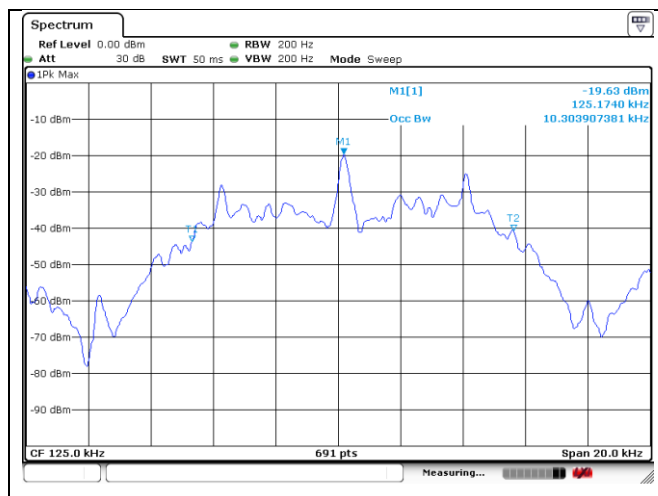
TRK Antenna



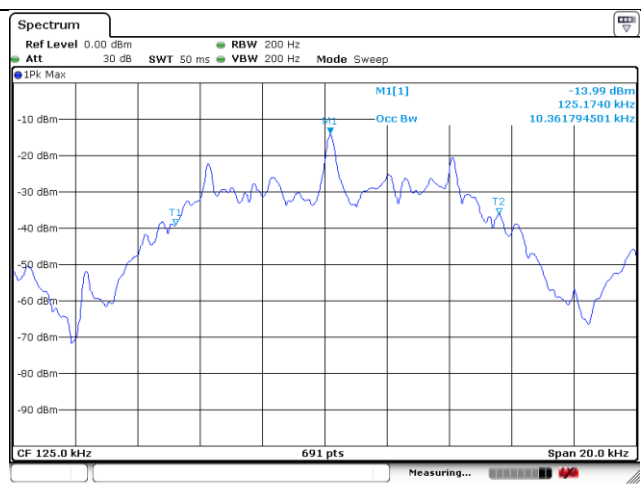
BMP Antenna



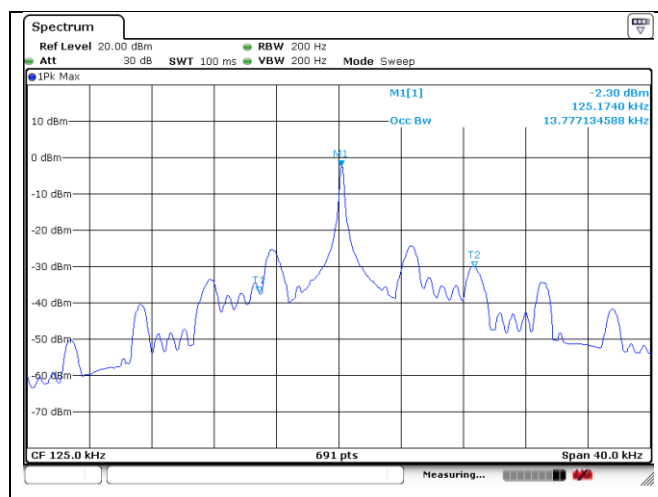
DRV Antenna



AST Antenna



SSB Antenna



- End of the Test Report -