TEST REPORT

of

FCC Part 15 Subpart C §15.209

FCC ID: CQOED04270

Equipment Under Test	:	Smart Key ECU
Model Name	:	ED04270
Applicant	:	DENSO KOREA ELECTRONICS CORPORATION
Manufacturer	:	DENSO KOREA ELECTRONICS CORPORATION
Date of Receipt	:	2017.07.20
Date of Test(s)	:	2017.08.01 ~ 2017.08.17
Date of Issue	:	2017.08.18

In the configuration tested, the EUT complied with the standards specified above.

Tested By: **Jinhyoung Cho** **Date:** **2017.08.18**

Technical Manager: **Harim Lee** **Date:** **2017.08.18**

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1. General information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807

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
Fax No. : +82 31 688 0921

1.2. Details of Applicant

Applicant : DENSO KOREA ELECTRONICS CORPORATION
Address : 3, Cheomdan Industry, Masanhappo-gu, Chang-won-Si, Gyungsangnam-do, Korea
Contact Person : Kang, Sung-Won
Phone No. : +82 55 600 9340

1.3. Details of Applicant

Applicant : DENSO KOREA ELECTRONICS CORPORATION
Address : 3, Cheomdan Industry, Masanhappo-gu, Chang-won-Si, Gyungsangnam-do, Korea

1.4. Description of EUT

Kind of Product		Smart Key ECU
Model Name		ED04270
Power Supply		DC 12.0 V
Frequency Range		Tx: 134.20 ㎑, Rx: 433.92 ㎒
Antenna Type	**Tx**	External Type (Coil Antenna)
	Rx	Internal Type
Operating Temperature		-30 ℃ ~ 80 ℃

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. 10, 2017	Annual	Jun. 10, 2018
Signal Generator	R&S	SMBV100A	255834	Jun. 15, 2017	Annual	Jun. 15, 2018
DC Power Supply	R&S	HMP2020	020089489	May 28, 2017	Annual	May 28, 2018
Test Receiver	R&S	ESU26	100109	Feb. 17, 2017	Annual	Feb. 17, 2018
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 19, 2015	Biennial	Aug. 19, 2017
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.

1.7. Sample calculation

Where relevant, the following sample calculation is provided:
Field strength level (dBμV/m) = Measured level (dBμV) + Antenna factor (dB) + Cable loss (dB)

1.8. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD		
Section in FCC Part 15	**Test Item**	**Result**
15.209	Radiated emission, Spurious Emission and Field Strength of Fundamental	Complied
2.1049	20 dB Bandwidth	Complied

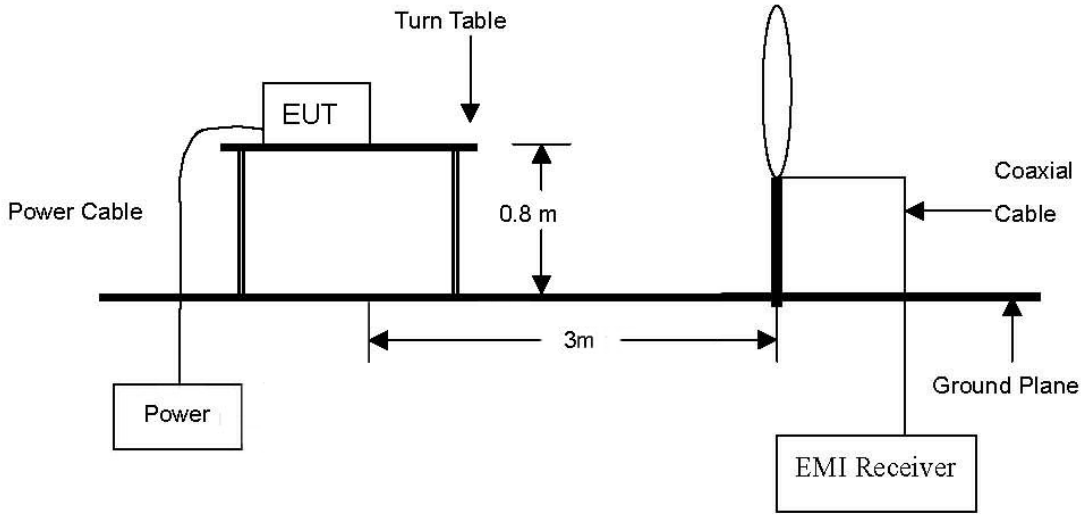
1.9. Test Report Revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL011743	2017.08.18	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 from 9 ㎑ to 30 ㎒ Emissions.



2.2. Limits

2.2.1. Radiated emission limits, general requirements

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

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 ㎑ to 30 ㎒

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. 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.
c. 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.
d. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
e. 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.

Note;

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 meter open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788 D01 Radiated Test Site v01.

2.4. Field Strength of Fundamental Test Result

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

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical. The field strength of spurious emission was measured in one orthogonal EUT position (x-axis). Definition of DUT for a orthogonal plane was described in the test setup photo.

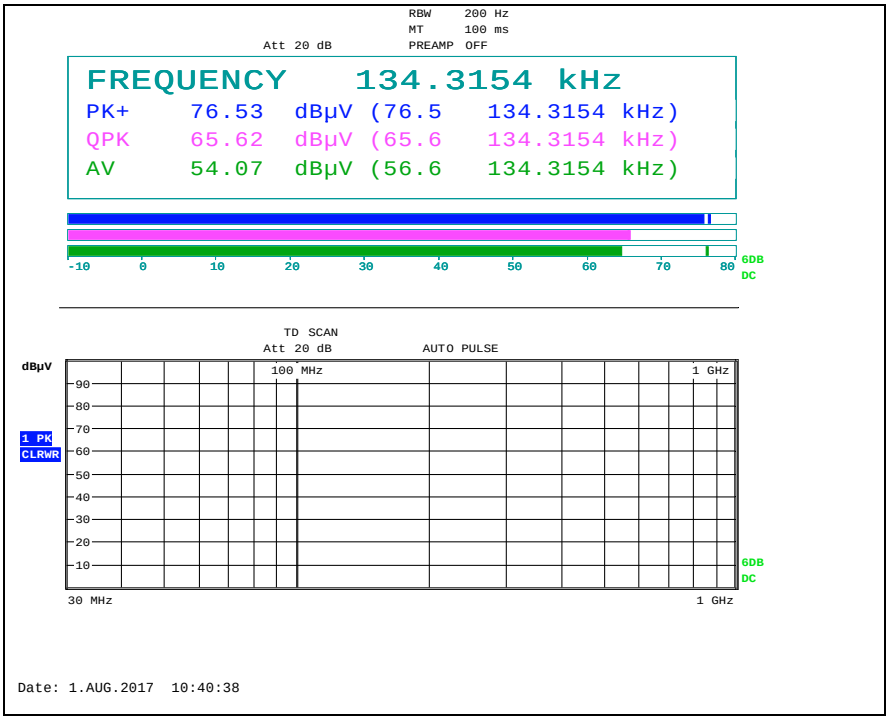
Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m	Limit (dB㎶/m) at 300 m	Margin (dB)
DRV Antenna									
0.134	56.60	Average	H	19.42	0.05	76.07	-3.93	25.06	28.99
AST Antenna									
0.134	56.50	Average	H	19.42	0.05	75.97	-4.03	25.06	29.09
BUM Antenna									
0.134	58.50	Average	H	19.42	0.05	77.97	-2.03	25.06	27.09
INT Antenna									
0.134	61.90	Average	H	19.42	0.05	81.37	1.37	25.06	23.69
INT3 Antenna									
0.134	61.80	Average	H	19.42	0.05	81.27	1.27	25.06	23.79
TNK Antenna									
0.134	62.10	Average	H	19.42	0.05	81.57	1.57	25.06	23.49
SSB Antenna									
0.135	40.70	Average	H	19.41	0.05	60.16	-19.84	25.00	44.84

Note;

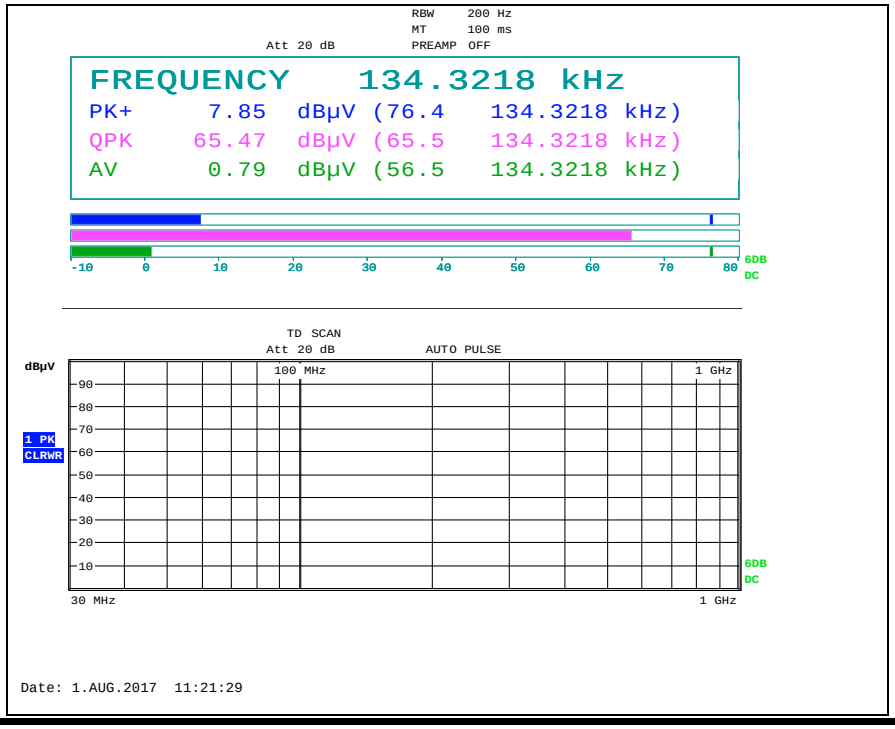
1. According to §15.31 (f)(2) 300 m Result (dB㎶/m) = 3 m Result (dB㎶/m) - 40log(300/3) (dB㎶/m).
2. According to §15.209 (d), the measurements were tested by using Quasi peak detector except for the frequency bands 9 – 90 ㎑, 110 – 490 ㎑ and above 1 ㎓ in these three bands on measurements employing an average detector.
3. The limit above was calculated based on table of §15.209 (a).

Test plot

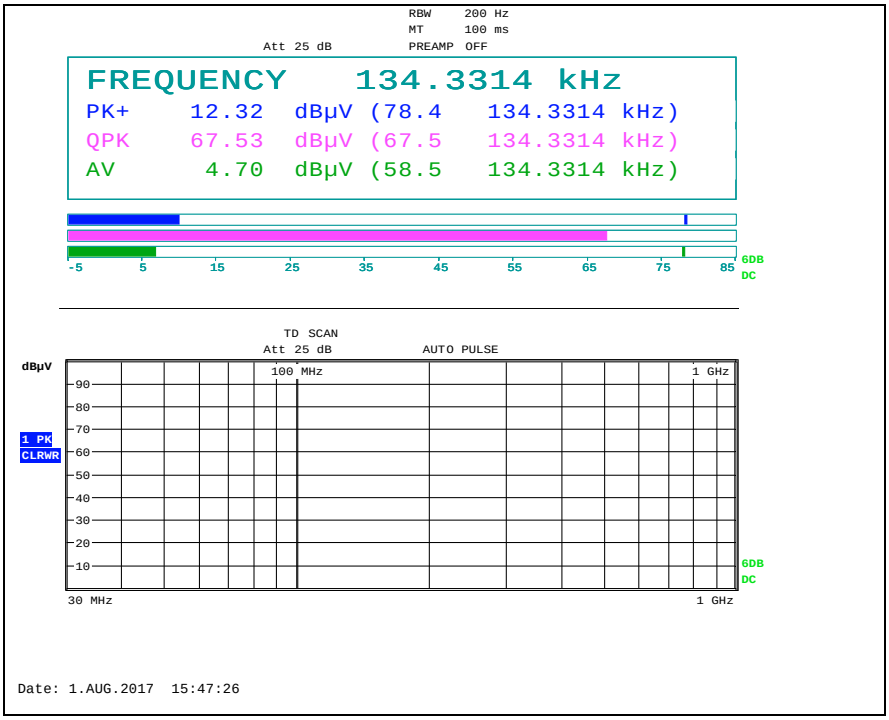
- DRV Antenna



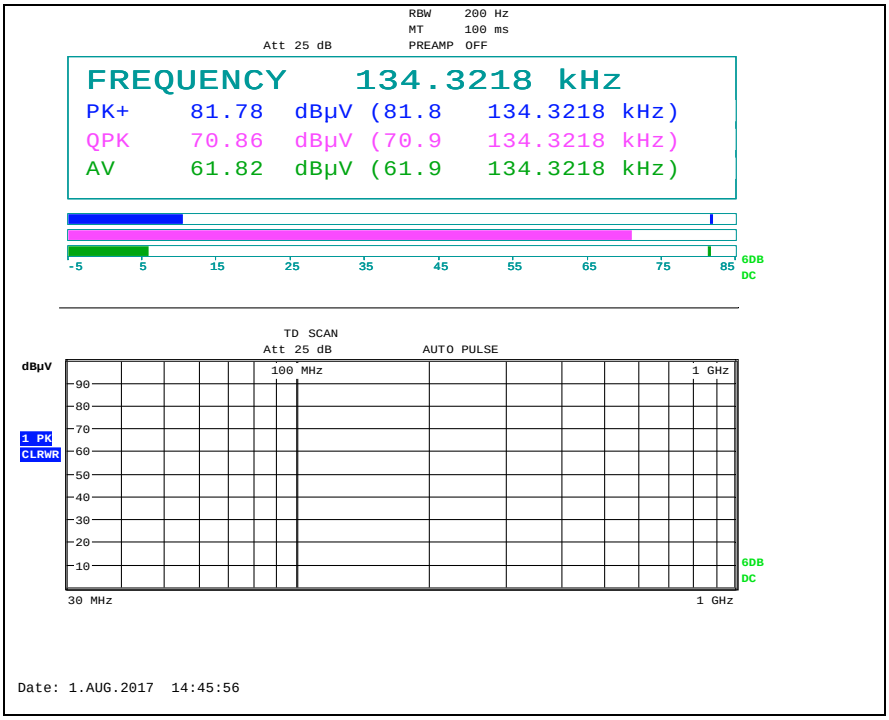
- AST Antenna



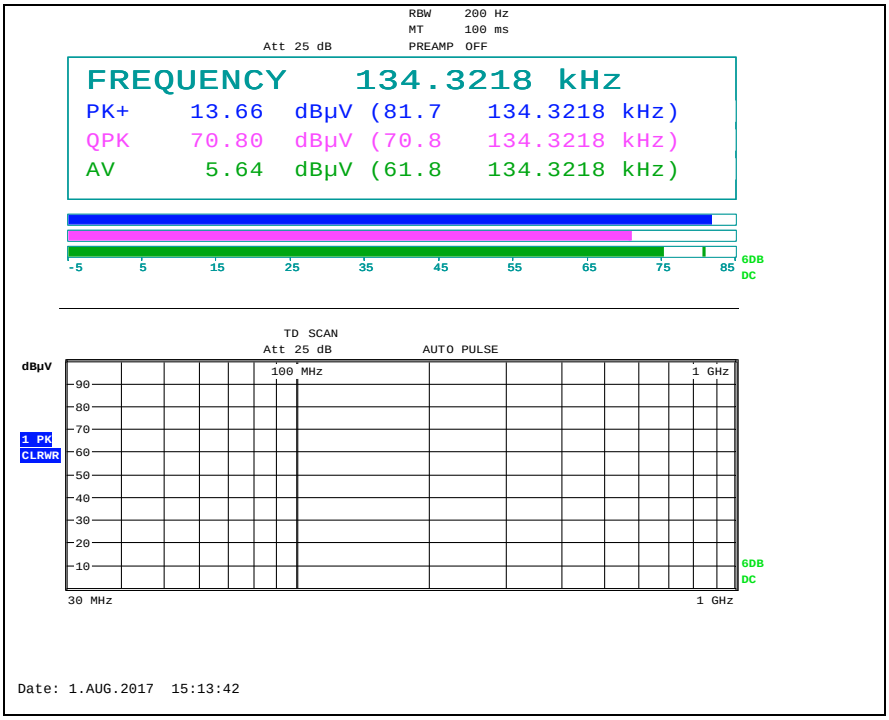
- BUM Antenna



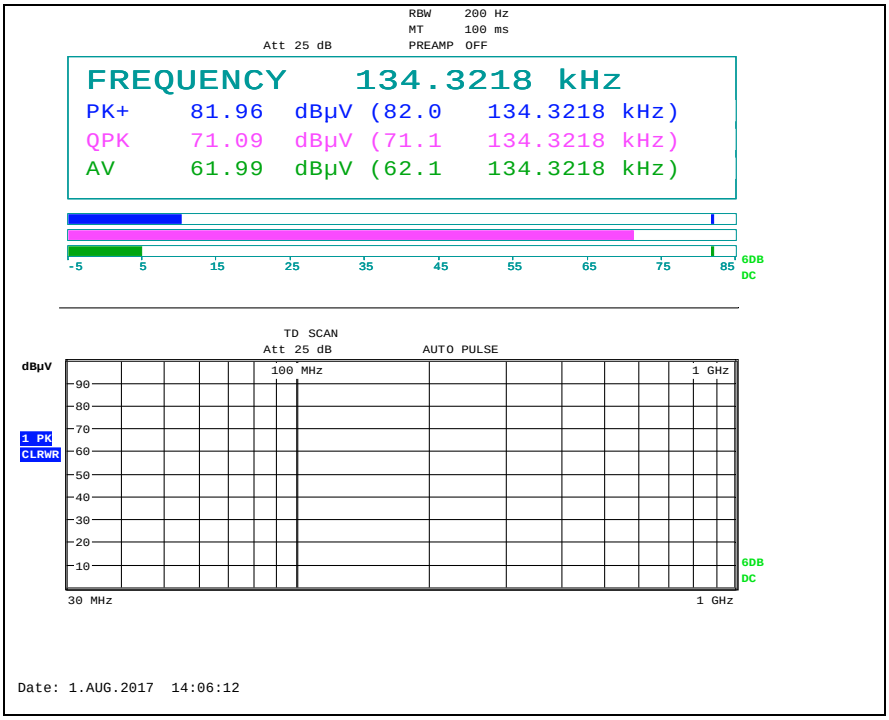
- INT Antenna



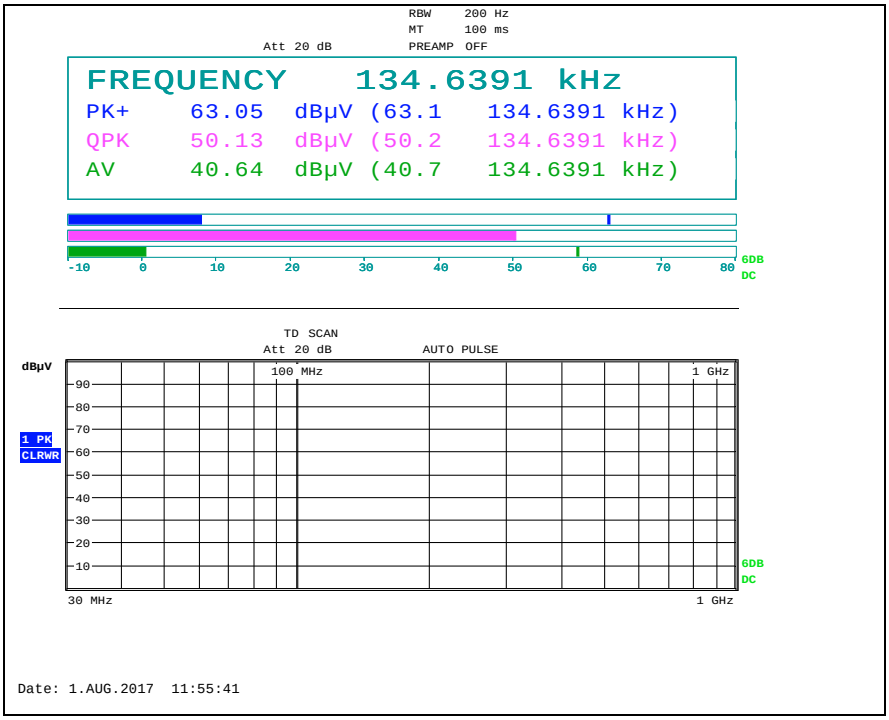
- INT3 Antenna



- TNK Antenna



- SSB Antenna



2.5. Spurious Emission Test Result

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

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m	Limit (dB㎶/m) at 300 m	Margin (dB)
DRV Antenna									
0.019	28.90	Average	H	19.52	0.01	48.43	-31.57	42.03	73.60
Above 1.000	Not detected	-	-	-	-	-	-	-	-
AST Antenna									
0.019	27.40	Average	H	19.52	0.01	46.93	-33.07	42.03	75.10
Above 1.000	Not detected	-	-	-	-	-	-	-	-
BUM Antenna									
0.019	28.80	Average	H	19.52	0.01	48.33	-31.67	42.03	73.70
Above 1.000	Not detected	-	-	-	-	-	-	-	-
INT Antenna									
0.019	28.40	Average	H	19.52	0.01	47.93	-32.07	42.03	74.10
Above 1.000	Not detected	-	-	-	-	-	-	-	-
INT3 Antenna									
0.019	28.90	Average	H	19.52	0.01	48.43	-31.57	42.03	73.60
Above 1.000	Not detected	-	-	-	-	-	-	-	-

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m	Limit (dB㎶/m) at 300 m	Margin (dB)
TNK Antenna									
0.018	27.10	Average	H	19.54	0.01	46.65	-33.35	42.50	75.85
Above 1.000	Not detected	-	-	-	-	-	-	-	-
SSB Antenna									
0.019	27.80	Average	H	19.52	0.01	47.33	-32.67	42.03	74.70
Above 1.000	Not detected	-	-	-	-	-	-	-	-

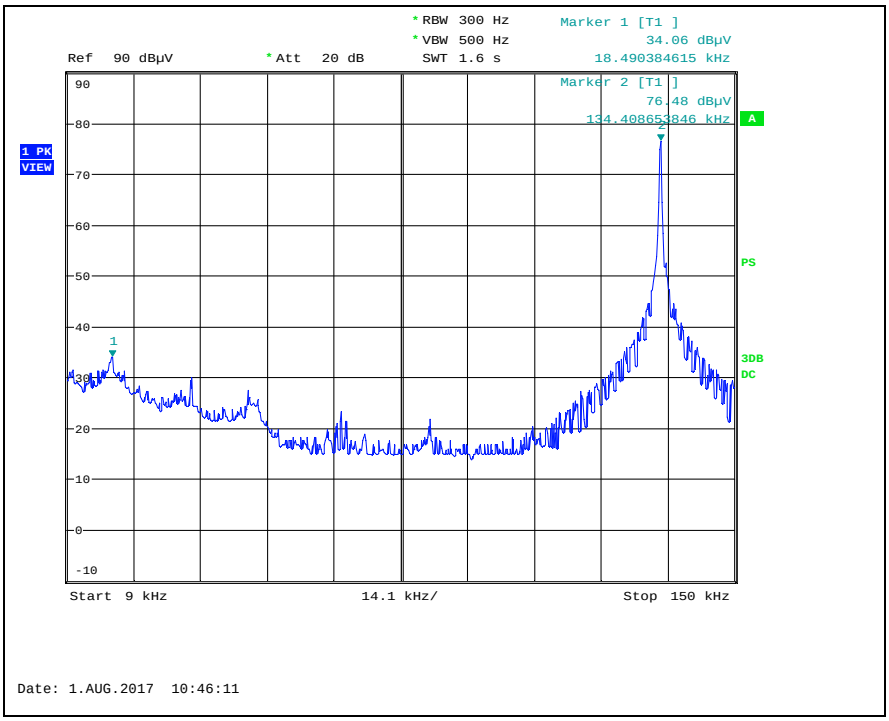
Note;

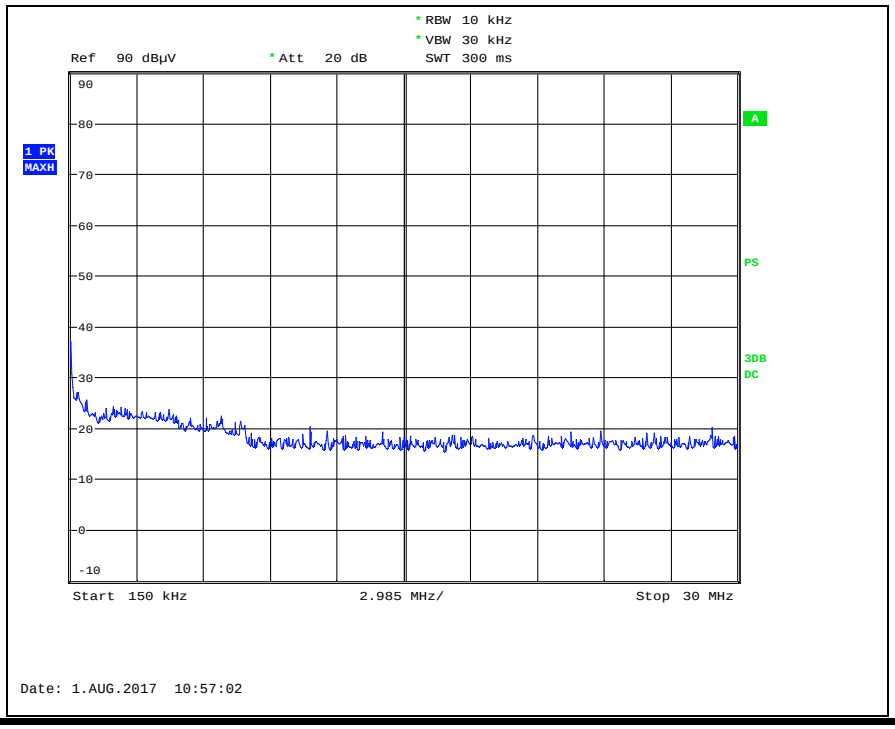
1. According to §15.31 (f)(2)
   - 300 m Result (dB㎶/m) = 3 m Result (dB㎶/m) - 40log(300/3) (dB㎶/m)
2. According to field strength table of general requirement in §15.209 (a), field strength limits below 1.705 ㎒ were calculated as below.
   - 9 ㎑ to 490 ㎑ : 20log(2 400 / F (㎑)) at 300 m (dB㎶/m)
   - 490 ㎑ to 1 705 ㎑ : 20log(24 000 / F (㎑)) at 30 m (dB㎶/m)
3. According to §15.209 (d), the measurements were tested by using Quasi peak detector except for the frequency bands 9 – 90 ㎑, 110 – 490 ㎑ and above 1 ㎓ in these three bands on measurements employing an average detector.

Test plots

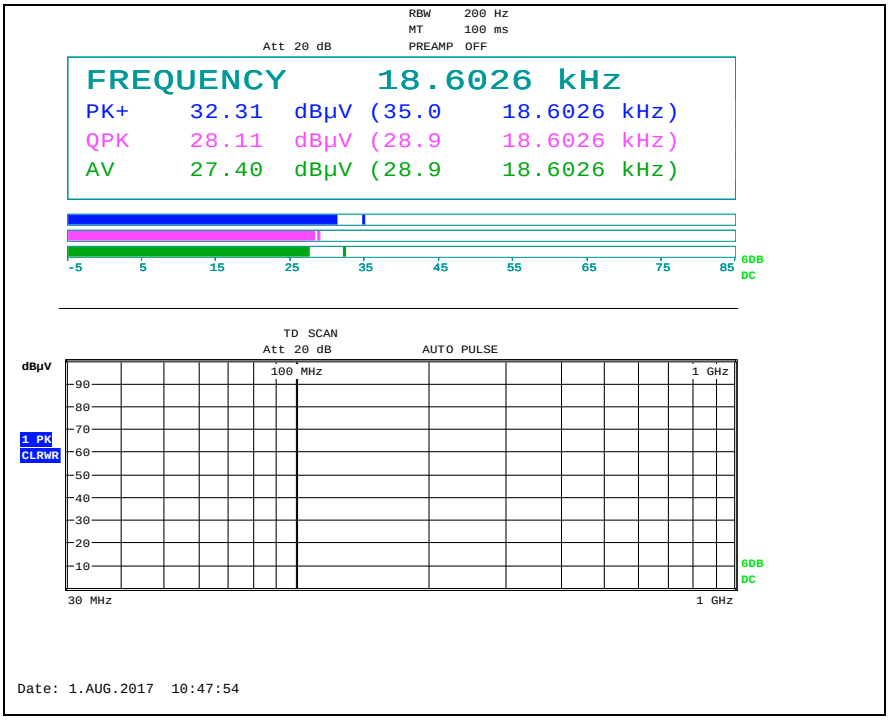
- DRV Antenna

Scanning plots below 30 ㎒



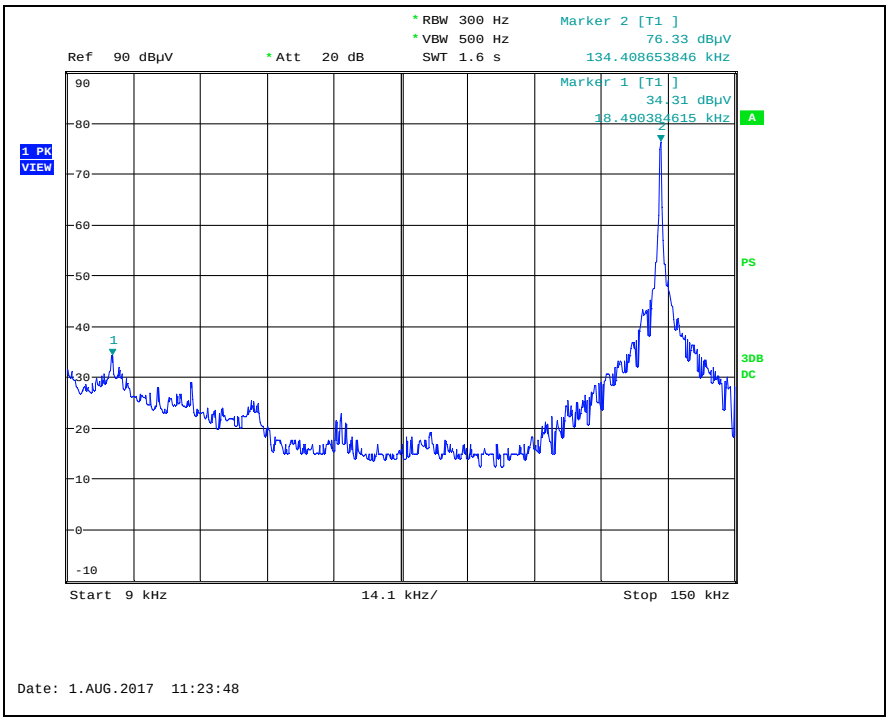


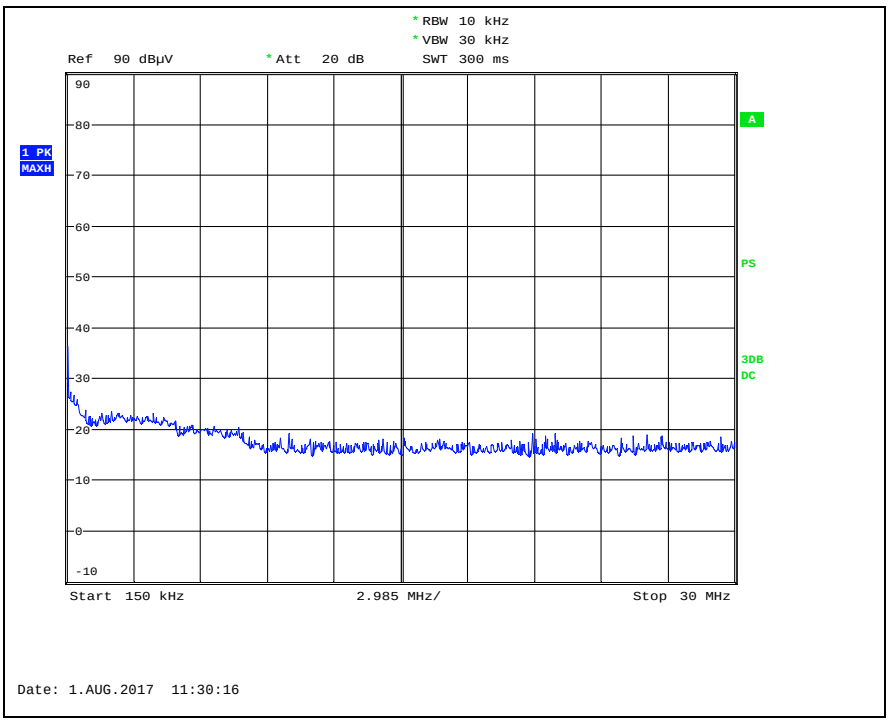
Measured plots below 30 ㎒



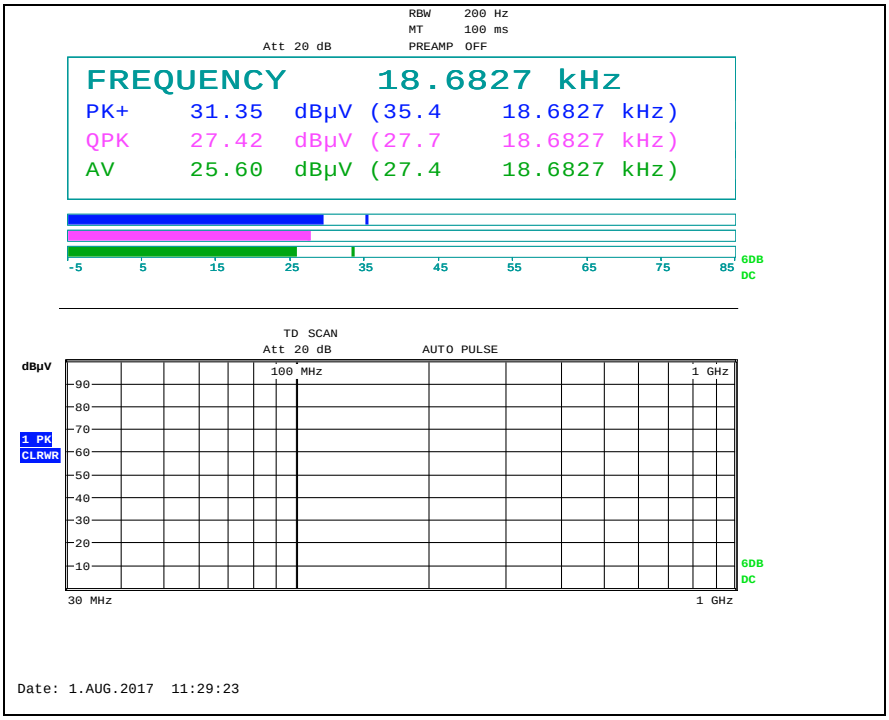
- AST Antenna

Scanning plots below 30 ㎒



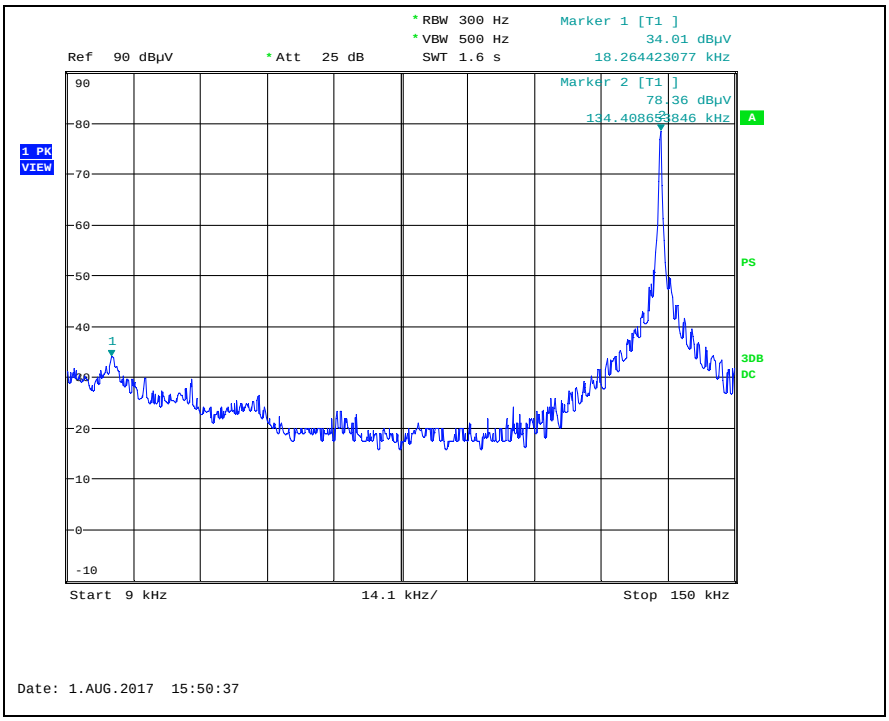


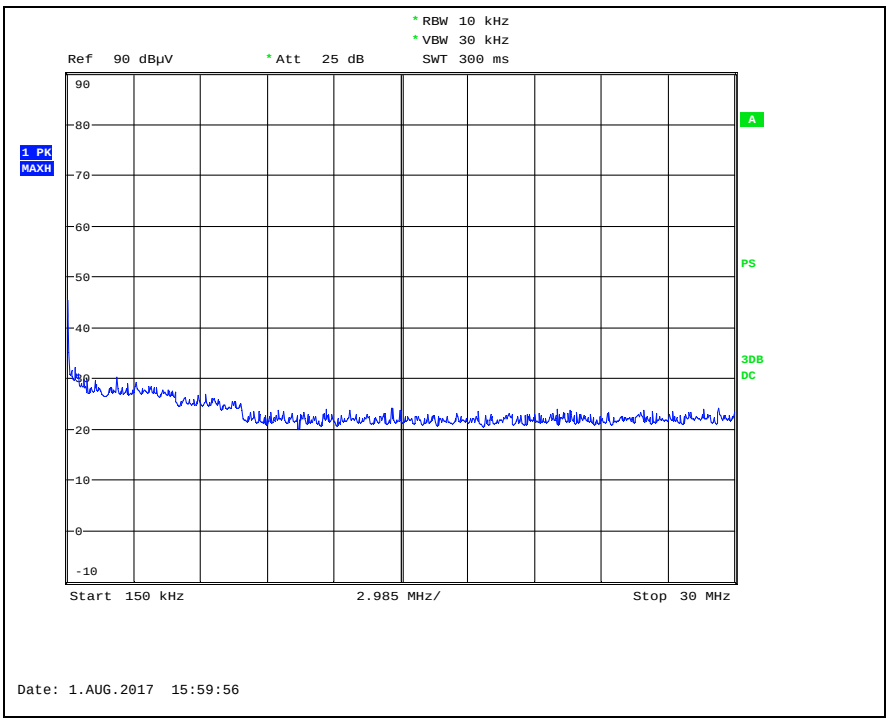
Measured plots below 30 ㎒



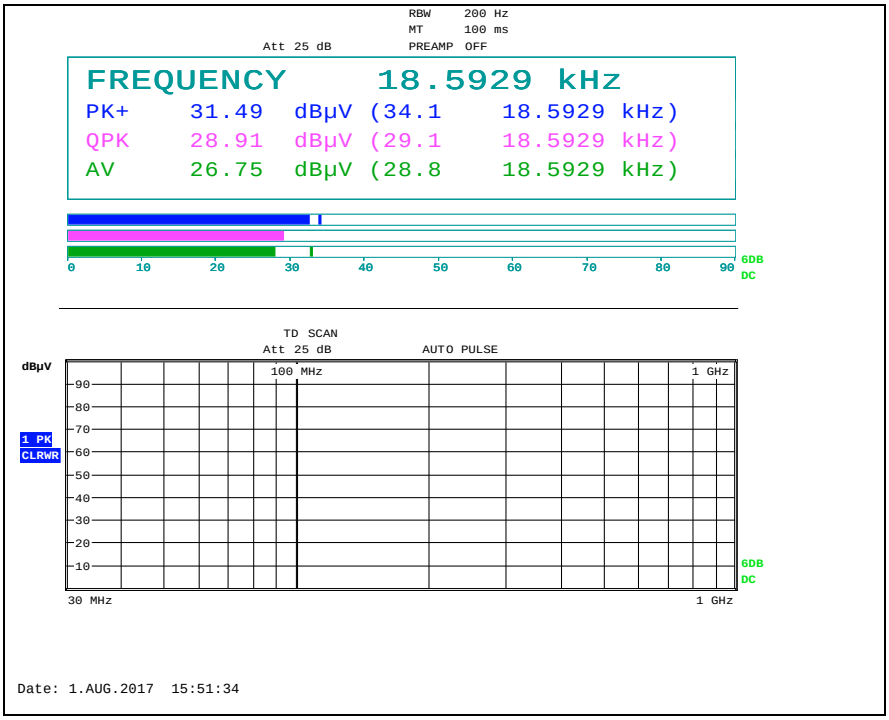
- BUM Antenna

Scanning plots below 30 ㎒





Measured plots below 30 ㎒



- INT Antenna

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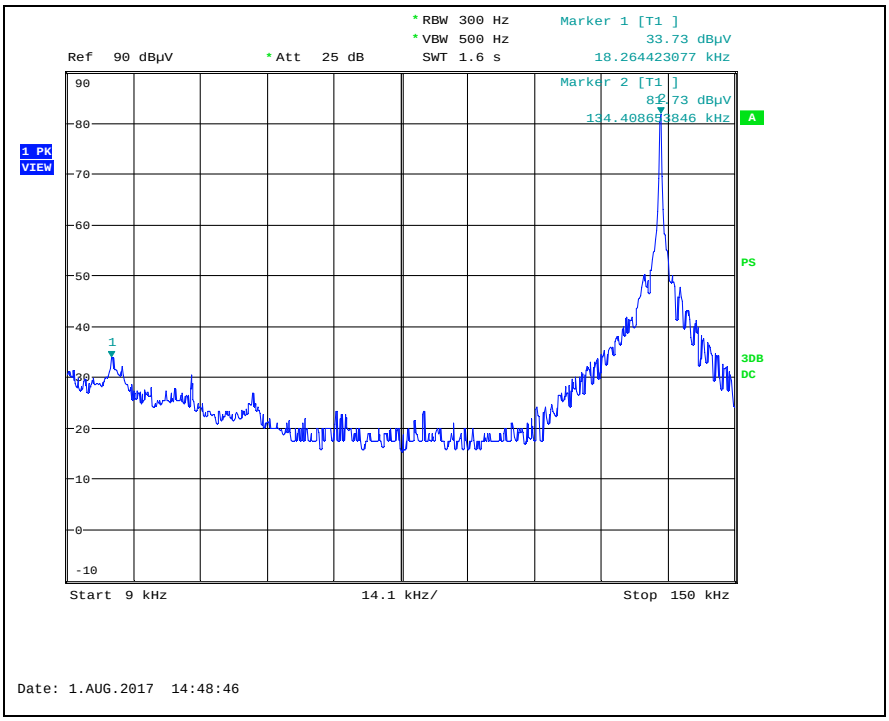

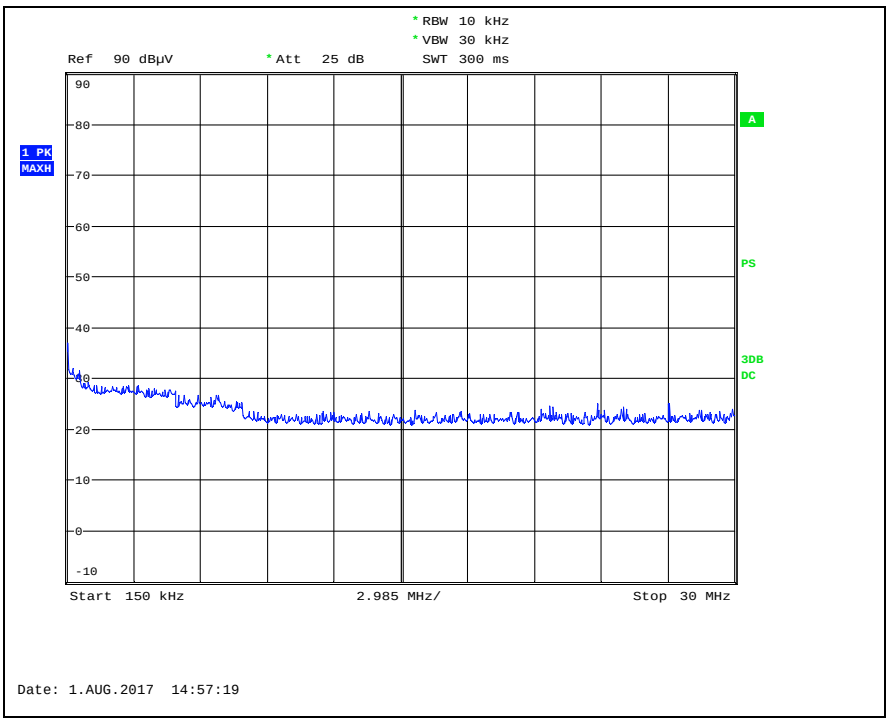

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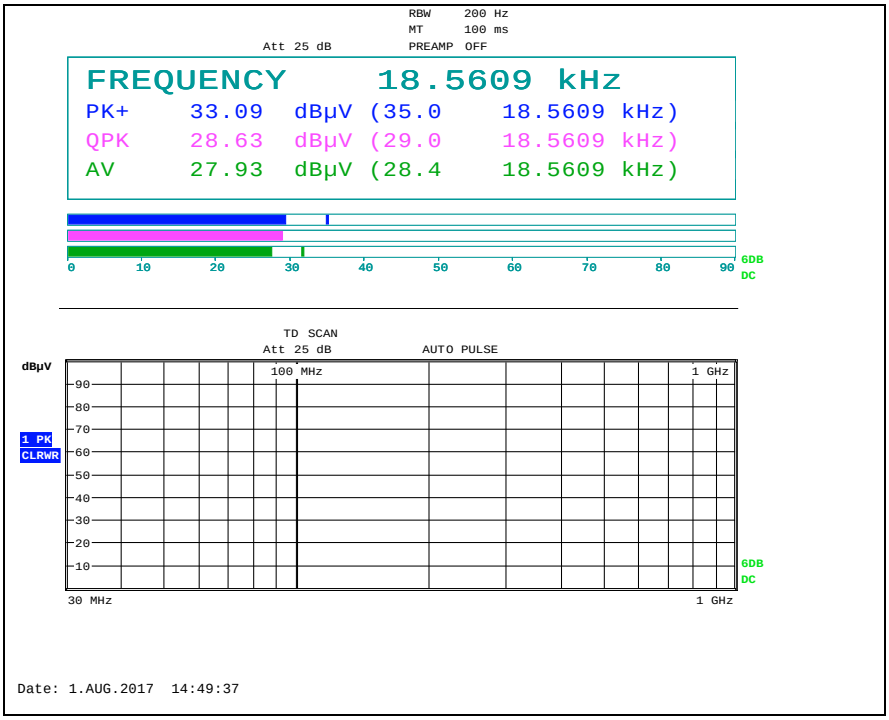
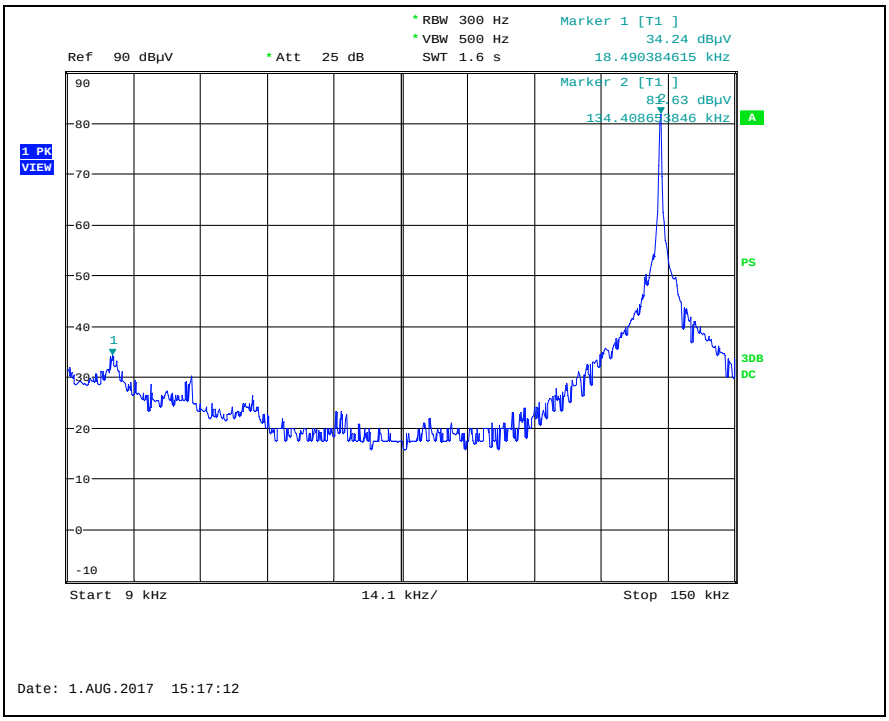
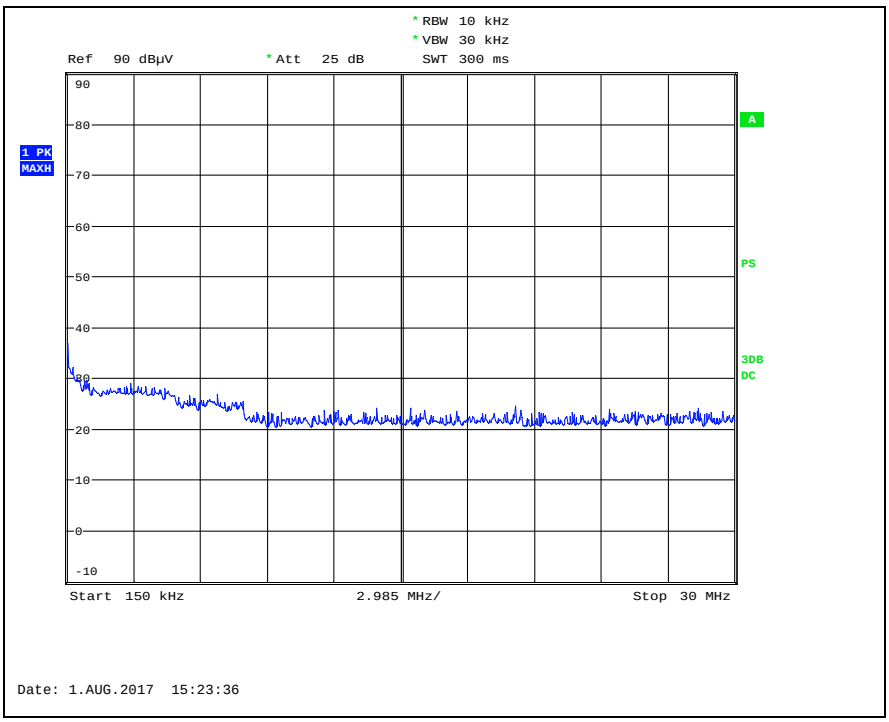


- INT3 Antenna

Scanning plots below 30 ㎒





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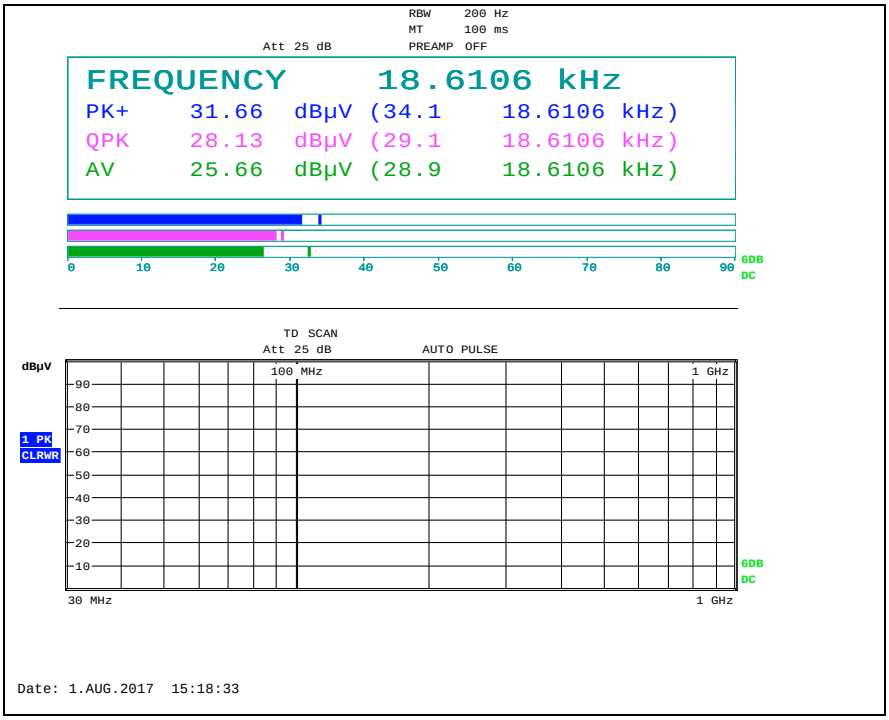
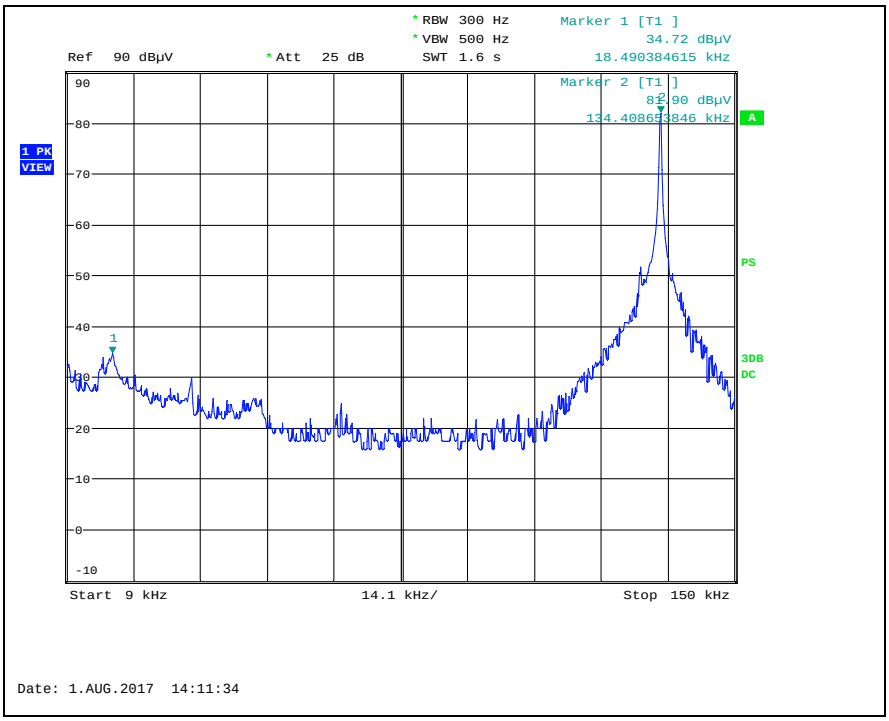
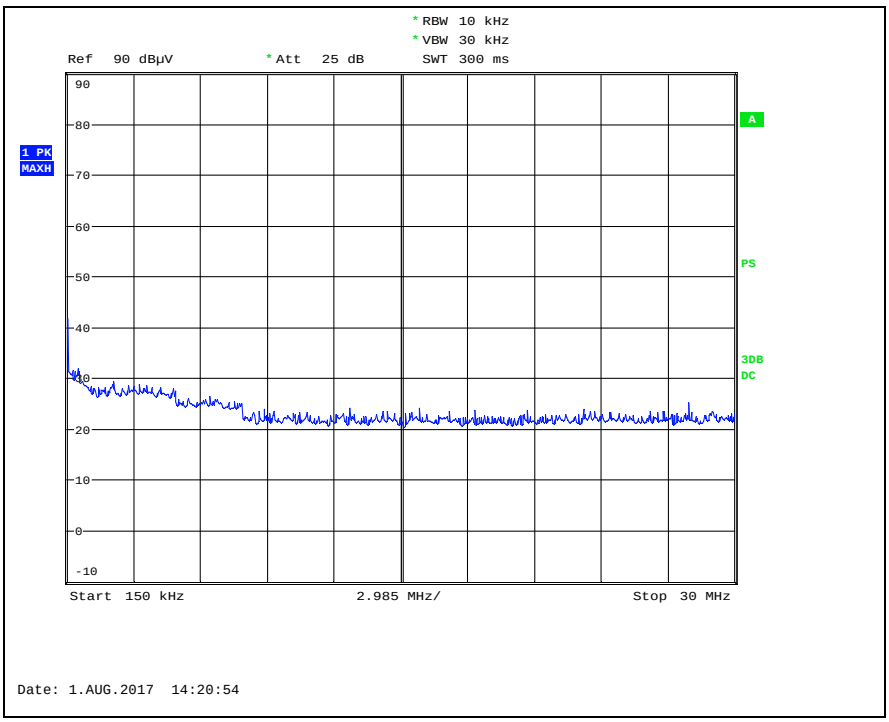


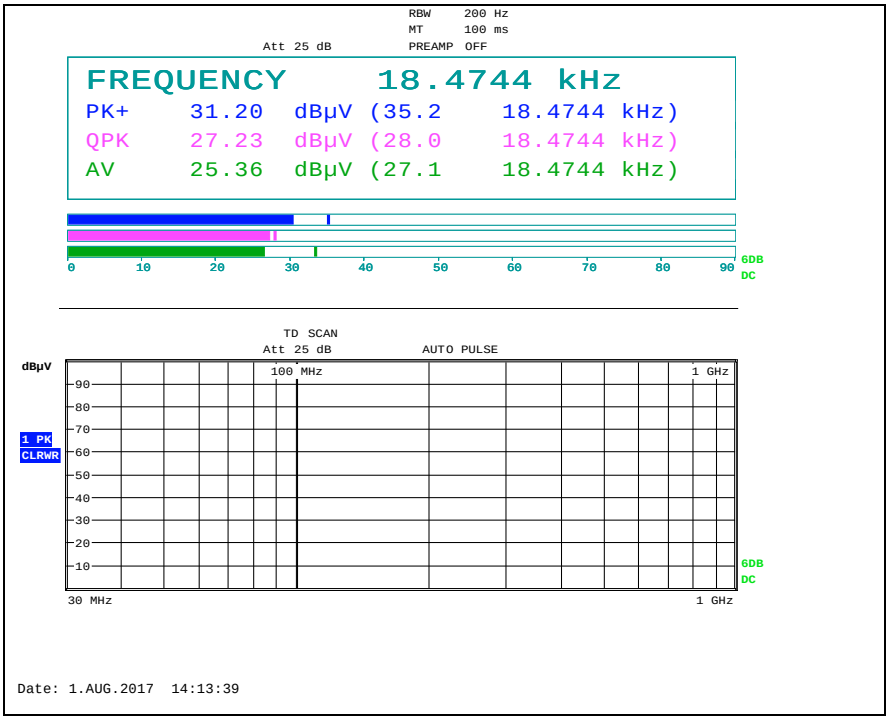
- TNK Antenna

Scanning plots below 30 ㎒



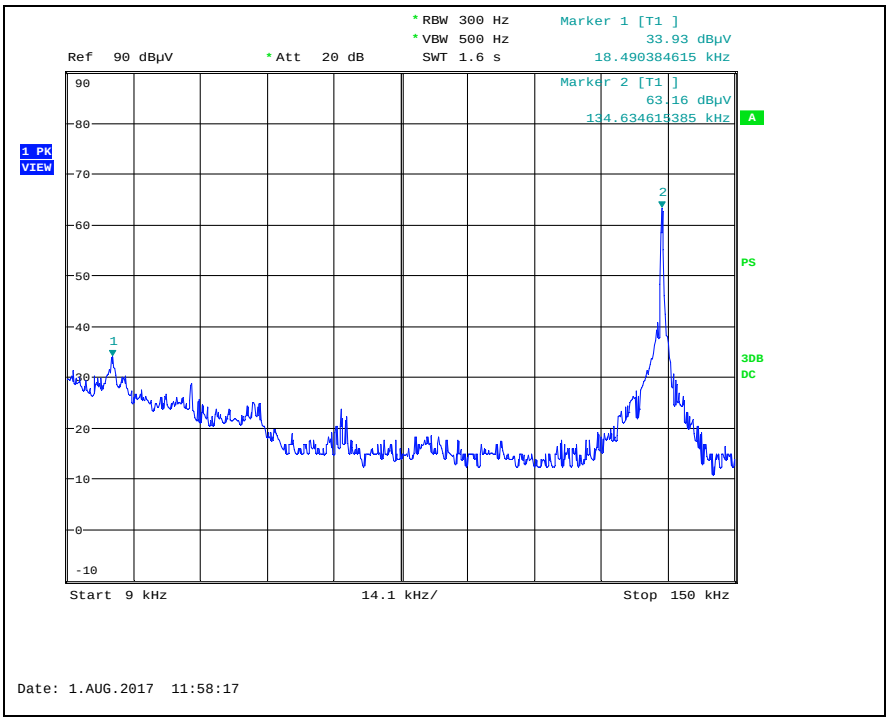


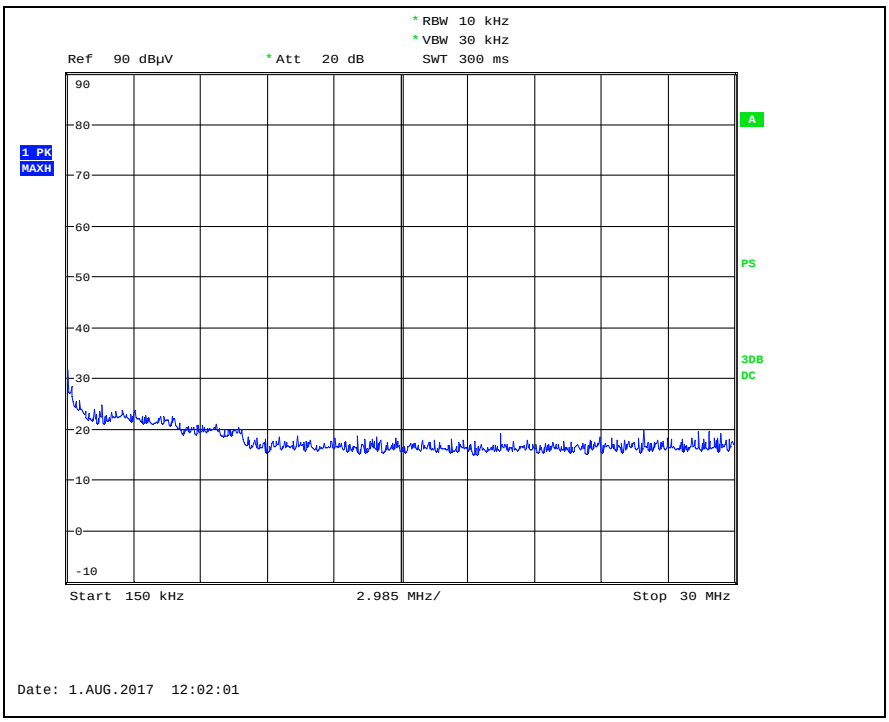
Measured plots below 30 ㎒



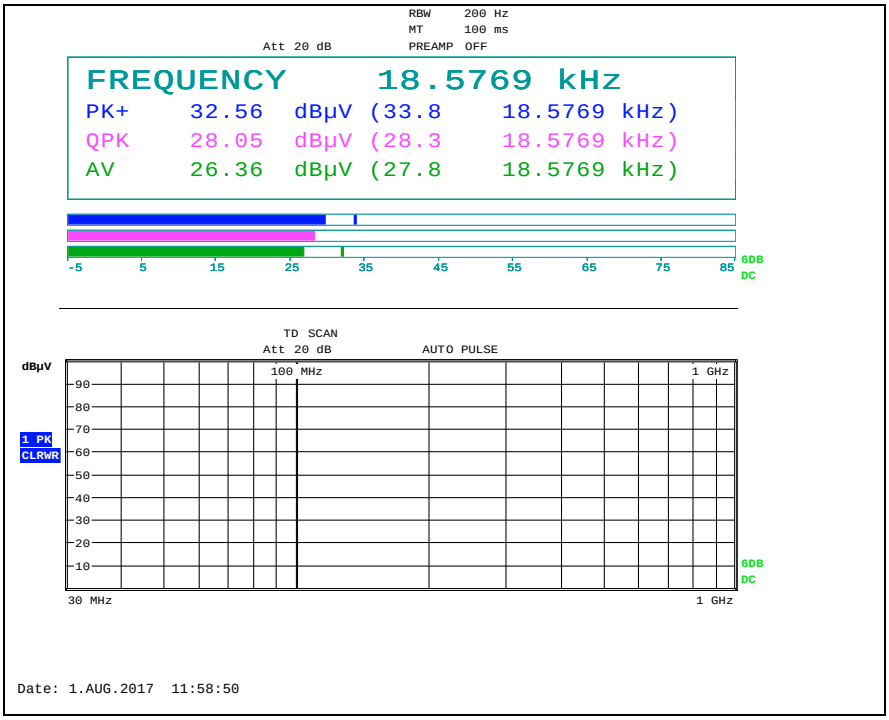
- SSB Antenna

Scanning plots below 30 ㎒



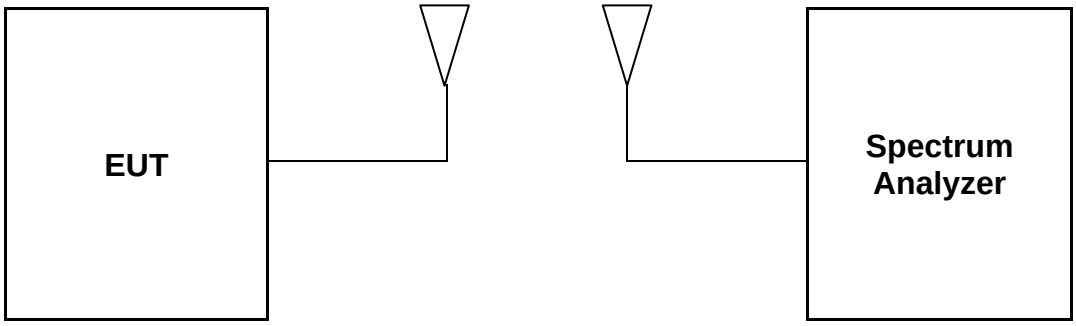


Measured plots below 30 ㎒



3. 20 dB Bandwidth

3.1. Test Setup



3.2. Limits

None; for reporting purposed only

3.3. Test Procedure

a. Span = approximately 2 to 3 times the 20 dB bandwidth, RBW = greater than 1 % of the 20 dB bandwidth, VBW = RBW, 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.

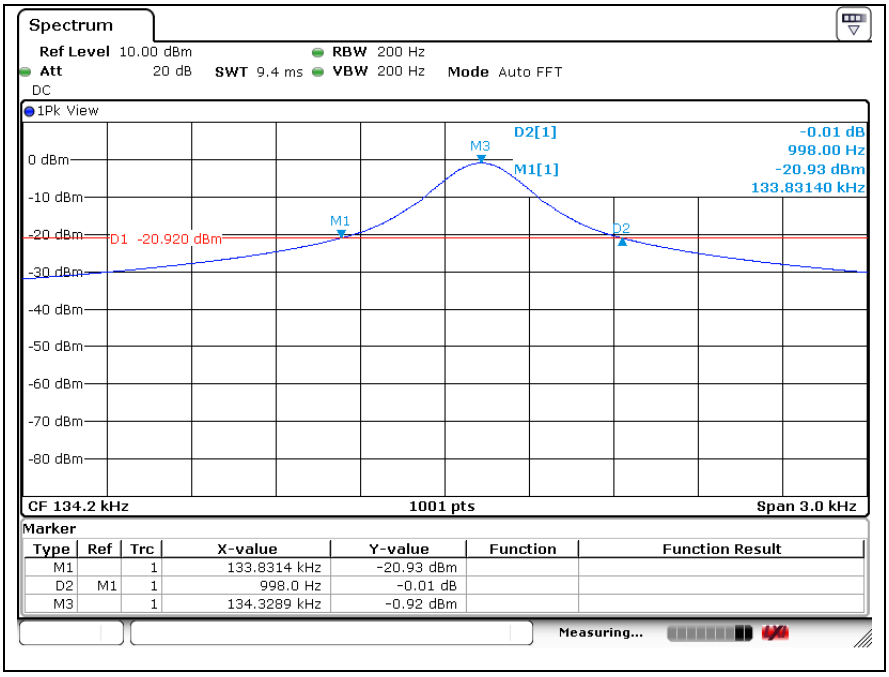
3.4. Test Result

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

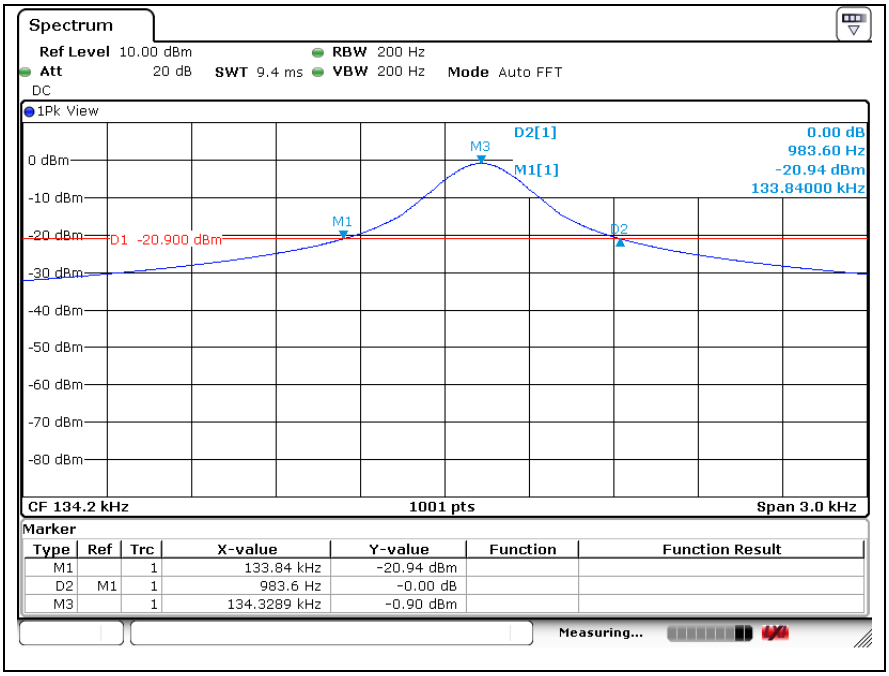
Test Antenna	Carrier Frequency (㎑)	20 dB Bandwidth (㎑)	Limit
DRV Antenna	134.329	0.998	Reporting proposed only
AST Antenna	134.329	0.984	
BUM Antenna	134.329	0.999	
INT Antenna	134.329	0.999	
INT3 Antenna	134.332	0.999	
TNK Antenna	134.329	1.014	
SSB Antenna	134.644	1.008	

Test plots

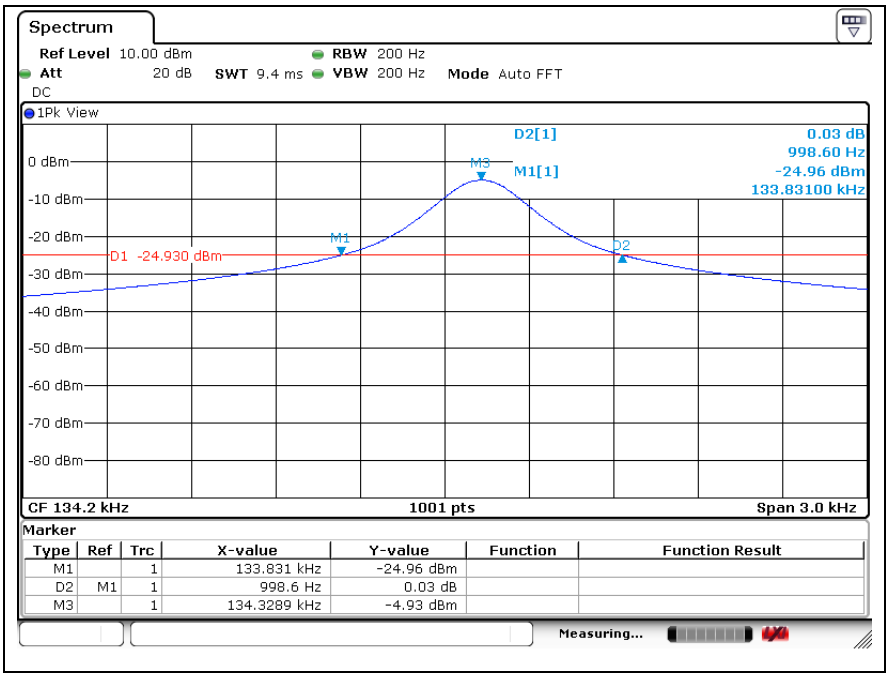
- DRV Antenna



- AST Antenna



- BUM Antenna



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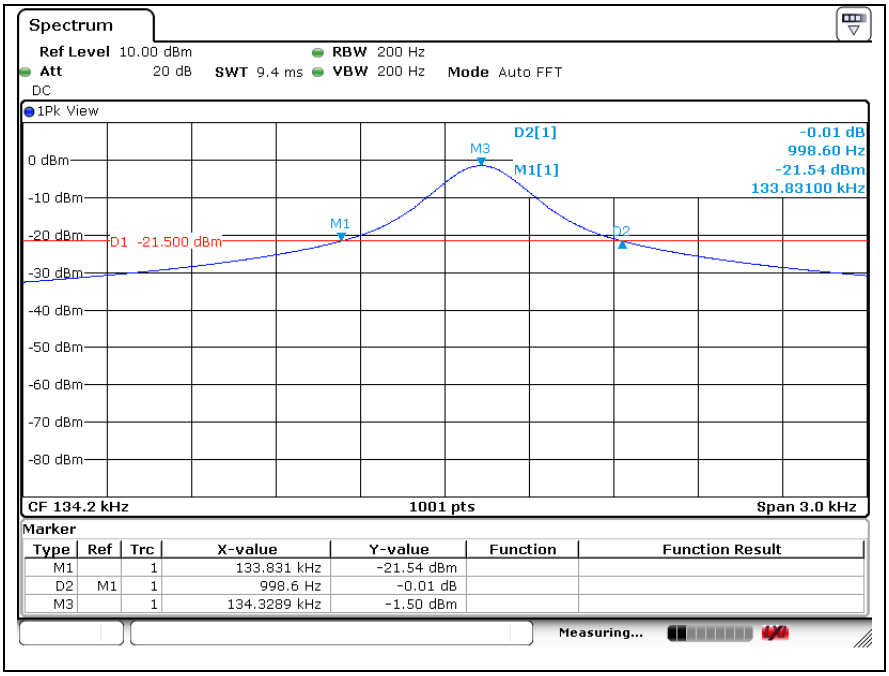
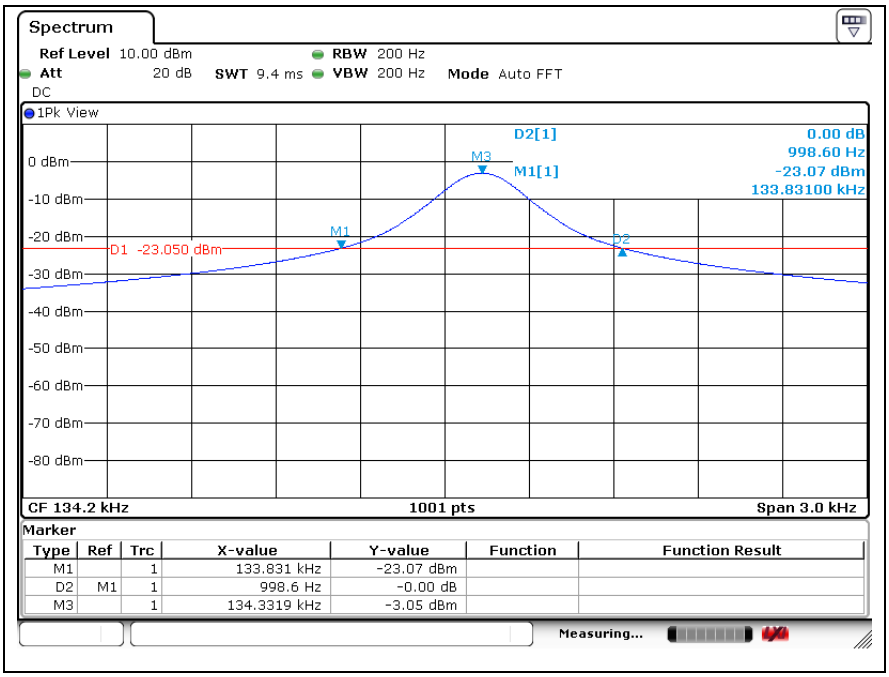
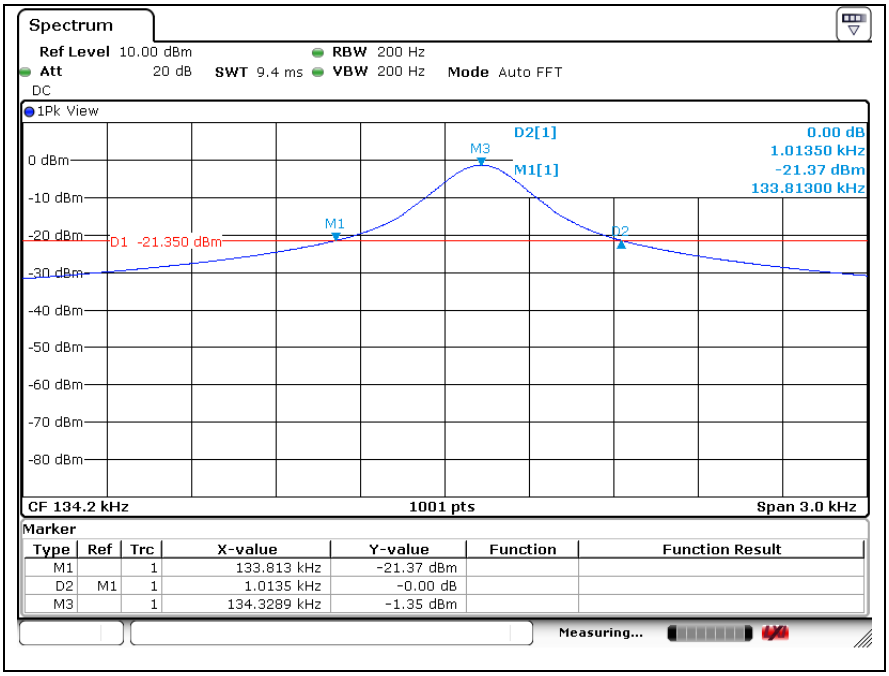


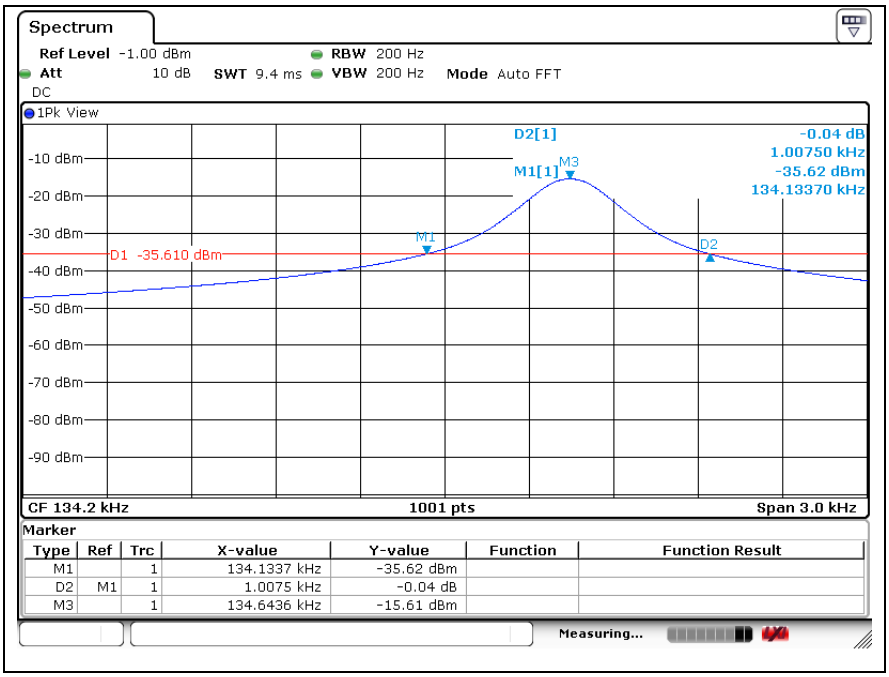
- INT3 Antenna



- TNK Antenna



- SSB Antenna



- End of the Test Report -