Proficiency Test Program

APLAC T061 Electromagnetic Interference

(Part I: Circulation of Asia Pacific Area)

January 2011

Voluntary EMC Laboratory Accreditation Center Inc.

CONTENTS

1. Introduction

Electro-magnetic interference emission level of electric and electronics products, especially in view of the protection of radio services, are strictly limited by the mandated regulations in each country and area.

This PT program has received approval by APLAC PT Committee in 2008. 78 EMC testing laboratories participated to this program in total. 38 laboratories of them were nominated from the accreditation bodies of APLAC members and 40 laboratories were nominated from EA, IAAC and other accreditation bodies outside APLAC.

The program started in October, 2008. The circulation schedule was divided to six blocks in consideration of the check period of artifact and the program will be expected to finish by May 2011. Currently, 5th round is proceeding.

So far, tests at 38 laboratories nominated from 14 accreditation bodies in APLAC and one body in EA had been conducted and their data were already submitted. All laboratories nominated from the APLAC members have completed their tests by the third round. The data up to the third round were summarized and evaluated in this report (Part I).

However, it is necessary to report that the accident occurred in the artifact during the round. A soldering point for the antenna balun connection in the artifact cracked during the circulation of second-round. The new balun was installed in the artifact before starting of Round-3.
Therefore, the merged data of the first round and the second round and the data of the third round were separately evaluated in the report.

Four participated laboratories where the influence of the soldering crack greatly appeared in their data were excluded from the evaluation. From our review of the submitted data, however, we decided to evaluate five frequencies data except 15.1 MHz of the conducted emission and four frequencies above 300 MHz of the radiated emission, because the soldering crack in the circuit was judged not to have influenced the rest of participated laboratories in Round-1 and Round-2.

And as for five laboratories in Round-1/Round-2 and two laboratories in Round-3, they have reported wrong frequencies data at lower three frequencies in the conducted emission measurement.
In addition, one laboratory in Round-2 and also one laboratory in Round-3 were not able to measure some specific frequencies because of the influence of an ambient noise, etc.
The data of those frequencies were excluded from the evaluation. Details are explained in the Table 1 through Table 18.

The data of Round-3 will be re-evaluated in the final report together with the data of Rounds conducted afterwards.

2. Objectives

The main objective of the program is to evaluate the competence of EMC testing laboratories in appropriately maintaining characteristics of their measuring facilities and instruments used for measurement of radiated and conducted electromagnetic interference.

In this program, one comb generator was circulated as an artifact to all participated laboratories to compare their measurement data, that is the commonly accepted method of inter laboratory comparison. Test results from participants were evaluated according to the statistical techniques outlined in ISO/IEC 17043:2010[(1)] and APLAC PT 002[(2)]. Z-Score was used as a numerical indicator to assess individual participant's competence.
However, we took an additional treatment with the difference from median value. The "Difference from Median Value in dB" was evaluated along with Z-Score because Z-Score values become small when the measured data intervals from the various participating test laboratories spread uniformly and oppositely a single Z-score can easily exceed a value of three if the overall interval is small. This condition is very commonly seen in EMI Testing data whenever measured data is collected in logarithmic units - such as the dBμV and dBμV/m units used in EMI Testing. Because the logarithmic data must first be converted to linear units- i.e., into μV or μV/m, as appropriate before the Z-Score calculations are performed. Consequently, the "Differences from Median Value in dB" are also taken into account to decide if a high Z-Score is meaningful.

3. Artifact of this program

It is indispensable to perform two different tests of the radiated emission and conducted emission measurement to evaluate the competence of the participated testing laboratories. Therefore, an impulsive noise generator (comb generator) is circulated to the participated laboratories as EUT (Equipment Under Test) for this program. It can be operated by AC mains voltage from 100 V to 240 V. For the present proficiency testing program, the operating voltage of artifact was specified to AC 100 V±3 V. Also for the measurement of radiated emission measurement, a VHF-LISN (Very High Frequency – Line Impedance Stabilization Network) was supplied by VLAC to stabilize the common mode impedance between the AC mains cables and ground at the test site. A VHF-LISN was circulated together with the artifact.
The comb generator selected as the artifact for APLAC T061 program has the following specifications.

Basic frequency: 15.1 MHz
Frequency step: 15 MHz
Range of comb generator: 15 MHz to 1 GHz
Rated voltage: AC100 V to AC240 V

4. Tests Procedure

4.1 Measurement method

The measurement method based on CISPR22 [(3)] has been instructed to be followed if not specified in this program.
In case of test arrangement of radiated emission measurement, EUT was instructed to be connected through the VHF-LISN as shown in Figure 1.
Test arrangement of the conducted emission measurement was instructed to be based on CISPR 22 and the AC mains power 100 V specified in this program was supplied to EUT via the AMN (Artificial Mains Network) equipped in the test site.

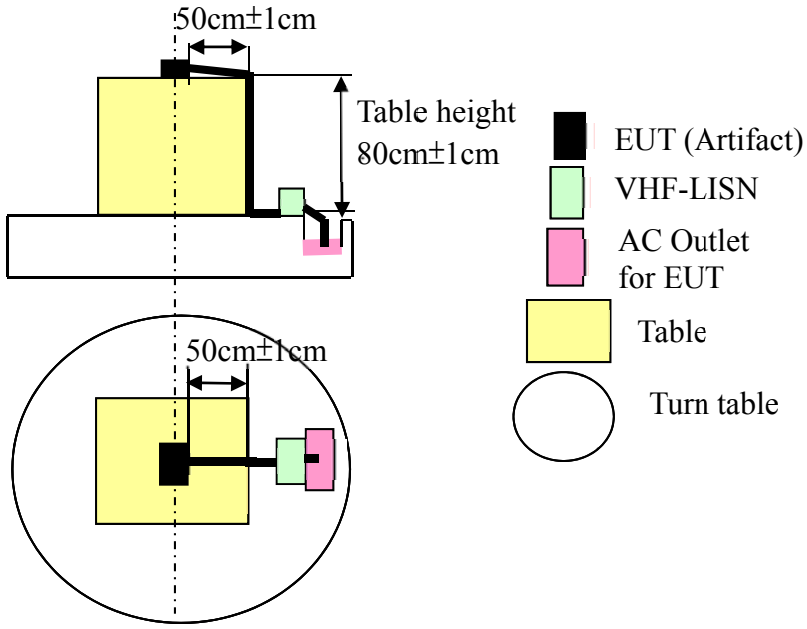

Figure 1 Test arrangement of radiated emission measurement

4.2 **Measurement frequency**

(1) Radiated emission (Electric field strength) measurement at 3 meters distance
Maximum radiated emission level at 10 frequencies of 45.4 MHz, 60.5 MHz, 75.6 MHz, 105.9 MHz, 151.3 MHz, 212.0 MHz, 317.3 MHz, 453.4 MHz, 740.7 MHz and 981.8 MHz have been instructed to measure in two conditions of horizontal and vertical polarization.

(2) Conducted emission (Voltage) measurement at AC mains port
Conducted emission level at 6 frequencies of 219 kHz, 439 kHz, 2.62 MHz, 3.71 MHz, 7.45 MHz and 15.1 MHz have been instructed to measure the maximum disturbance voltage of each AC mains line at the output terminal of AMN equipped in the test site.

4.3 **Measurement uncertainty**

As for the measurement uncertainty for the conducted emission and radiated emission measurements described in CISPR22, the calculation basis has been provided in the CISPR16-4-2[(4)] standard. However, it takes into account only of the measurement uncertainty related to the measurement instrumentation and it is not including the whole of measurement uncertainty, so called Standards Compliance Uncertainty, for instance the operating condition, test arrangement of EUT and measurement procedure.

Measurement Instrumentation Uncertainty described in CISPR16-4-2:2003 are as follows,
Conducted disturbance measurement: 3.6 dB
Radiated disturbance measurement: 5.2 dB

5. Test results

Each participant was given a unique laboratory code and the code is used throughout the program to keep the confidentiality.
Alphabetic small letter 22 characters, were randomly allocated to the participated laboratories in Round-1 and Round-2.

The number of 1 through 18 was randomly allocated to the participated laboratories in Round-3 and the number of 19 through 58 will be reserved to the participated laboratories in Round-4 and afterwards.
Data of Round-3 are scheduled to be evaluated again by the statistical technique together with data of Round-4 and afterwards in the final report, as the number of Round-3 data for the evaluation in this report is small.

Test results received from participants are presented in Table 1 through Table 9 for Round-1 + Round-2, and in Table 10 through Table 18 for Round-3.

5.1 Result of Round-1 + Round-2

After receiving data of Round-1 and Round-2, we found the data submitted from four testing laboratories in Round-2 were shown quite different values from other laboratories data. After the circulation of Round-2, we investigated the artifact and found that a soldering point of connection for the antenna balun circuit in the artifact cracked during Round-2 and they tested in that condition.
Therefore, all data of four laboratories where the influence of the crack greatly appeared in the data were excluded from the evaluation. However, the data of five frequencies except 15.1 MHz of the conducted emission measurement and the data of 4 frequencies above 300 MHz were evaluated for the rest of participated laboratories in Round-1 and Round-2, since the data of those frequencies were judged not to be influenced by the soldering crack.
In addition, as for five laboratories in Round-1 and Round-2, they have reported the wrong frequencies data at lower three frequencies in the conducted emission measurement.
Also one laboratory in Round-2 was not able to measure some frequencies because of the influence of an ambient noise for the conducted emission measurement.
The data of those frequencies were excluded from the evaluation of the laboratory.
Test results are presented in Figure 2 through Figure 10 and Table 1 through Table 12.

Table 1: Basic data of conducted emission measurement
Table 2: Basic data of Horizontal polarization radiated emission measurement
Table 3: Basic data of Vertical polarization radiated emission measurement
Table 4: Data of the conducted emission measurement (in dBμV)
Table 5: Data of the Horizontal Polarization radiated emission measurement (in dBμV/m)
Table 6: Data of the Vertical Polarization radiated emission measurement (in dBμV/m)
Table 7: Z-score of the conducted emission measurement
Table 8: Z-score of the Horizontal Polarization radiated emission measurement
Table 9: Z-score of the Vertical Polarization radiated emission measurement
Table 10: Difference from the median value of the conducted emission measurement
Table 11: Difference from the median value of Horizontal Polarization radiated emission measurement
Table 12: Difference from the median value of Vertical Polarization radiated emission measurement

5.2 Statistical Evaluation of Round-1 + Round-2

As described in the introduction, the accident occurred in the artifact during the round. Crack and repair of soldering in the circuit of the artifact occurred in the half way of Round-2.

It was able to be assumed for the crack to have caused the soldering removal in the internal circuit of the artifact in the second round by the deviation from a median value of the measuring data. Therefore, all data of four participated laboratories where the influence of the removal of soldering greatly appeared in the data was excluded from the evaluation.
However, about the test data other than these four laboratories, the five frequencies data except 15.1 MHz of the conducted emission and 4 frequencies above 300 MHz of the radiated emission judged for soldering removal not to be influenced were evaluated toRound-1 and Round-2.

The statistical evaluation was performed to see the validity of measurement data from both the Z-score and the deviation from median value.

Z-Score is interpreted as follows:

(a)	$\|z\| \leq 2.0$	Satisfactory
(b)	$2.0 < \|z\| < 3.0$	Questionable
(c)	$3.0 \leq \|z\|$	Doubtful; shall be reviewed

Differences from the median value is interpreted as follows,

(d)	$\|d\| \leq 6.0$ dB	Satisfactory
(e)	$6.0 \text{ dB} < \|d\|$	Doubtful; shall be reviewed

From the above two evaluation factors, the following conditions are considered to be 'unsatisfactory'.

(c) and (e)	$3.0 \leq \|z\|$ and $6.0 \text{ dB} < \|d\|$	Unsatisfactory

Measurement data submitted from participants are presented in Table 4 through Table 6.

Z-Scores of individual participant were presented in Table 7 through Table 9.

Differences from median value were presented in Table 10 through Table 12.

Basic data of Round-1 + Round-2

(1) Conducted emission measurement

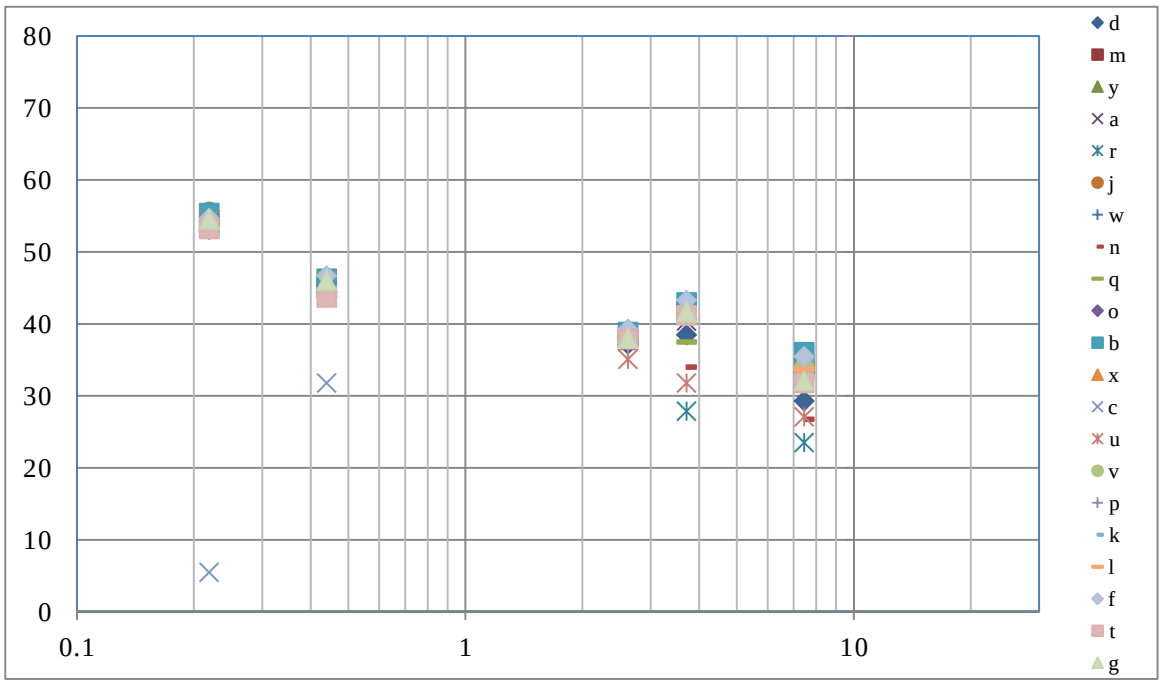

Fig. 2 Conducted emission measurement result in dBµV

Table 1 Basic data of conducted emission measurement

Frequency (MHz)	Q1	Q2	Q3	IQR	N-IQR	Robust CV	Average	Standard Deviation
	Linear value (µV)						Log. value (dBµV)	
0.219	458.6706	500.9128	526.6327	67.96	50.38	10.06	51.00	11.77
0.439	164.1370	180.9286	195.7836	31.65	23.46	12.97	44.37	3.35
2.62	78.1189	80.0756	83.8980	5.78	4.28	5.35	38.02	0.96
3.71	99.6600	120.3650	125.8925	26.23	19.45	16.16	39.86	3.97
7.45	39.9299	48.9811	54.6170	14.69	10.89	22.23	32.57	3.29

NOTE:

Q1, Q2, Q3, IQR and N-IQR described in Table 1, Table 2, and Table 3 consist of the following definitions.

Q1: 25th percentile (or 1st quartile) of the participant results

Q2: 50th percentile (or 2nd quartile) of the participant results

Q3: 75th percentile (or 3rd quartile) of the participant results

IQR: Inter Quartile Ratio

N-IQR: Normalized IQR = 0.7413 x (Q3 – Q1)

Robust CV: Robust Coefficient of Variation = N-IQR x 100 / Q2 (%)

Z-score is calculated by the following formula,

Z-score = (Result – Q2) / N-IQR

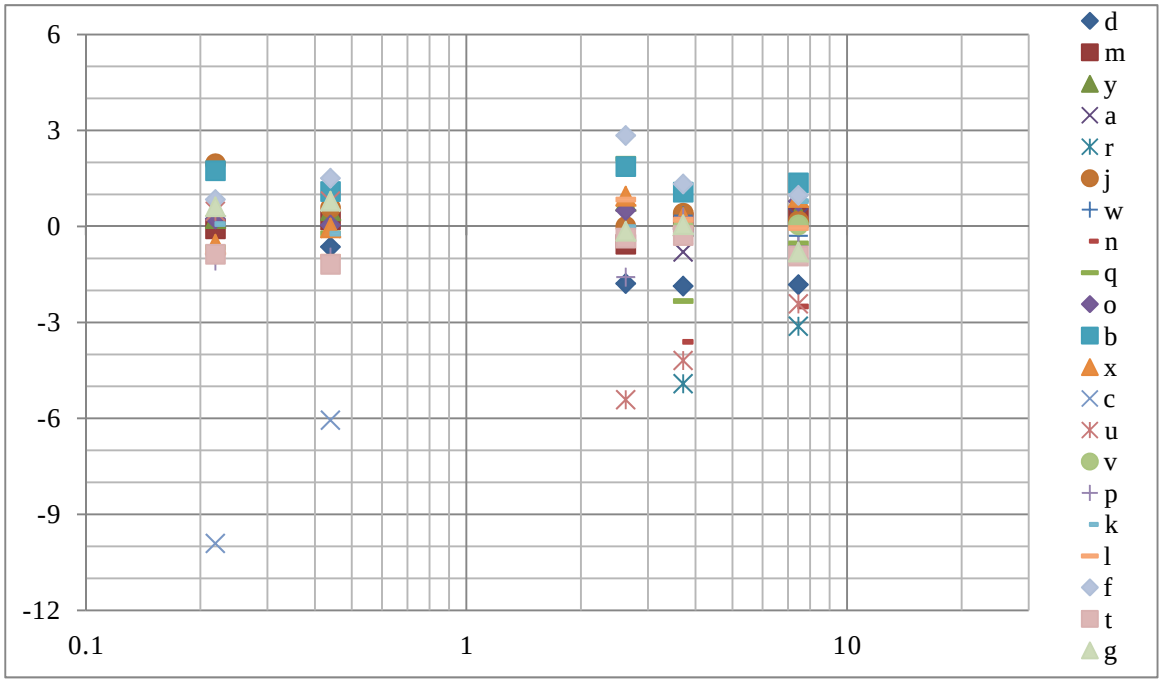

Fig. 3 Z-score by linear data of the conducted emission measurement

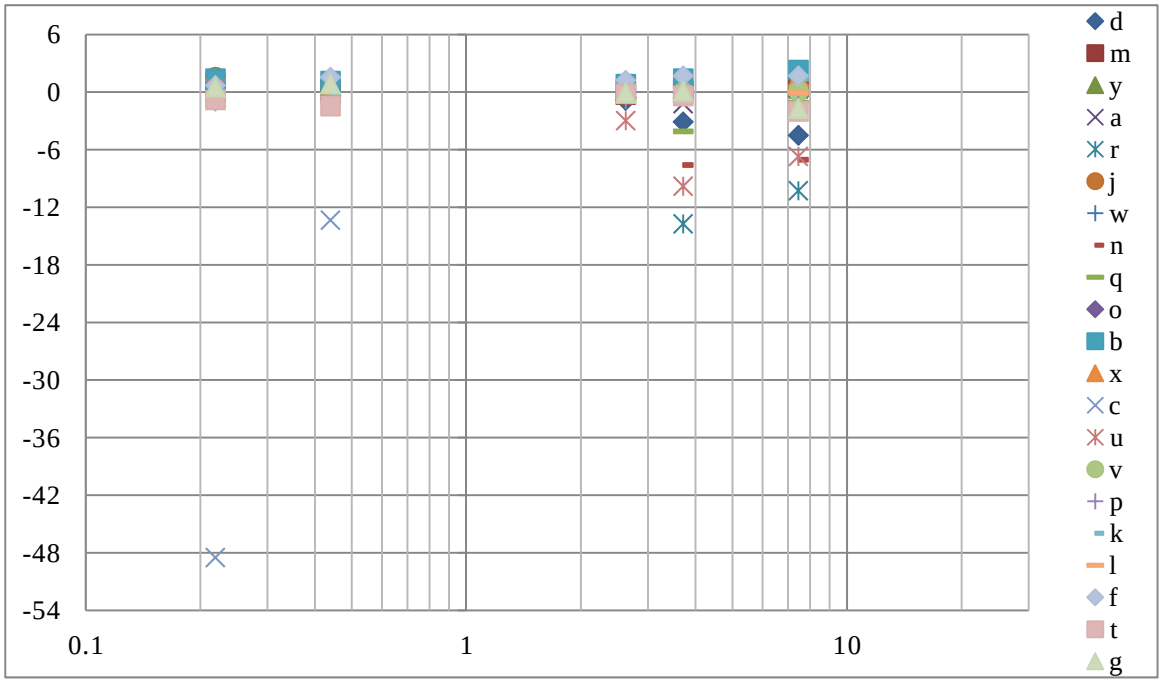

Fig. 4 Difference from the median value of conducted emission measurement

(2) Horizontal Polarization radiated emission measurement

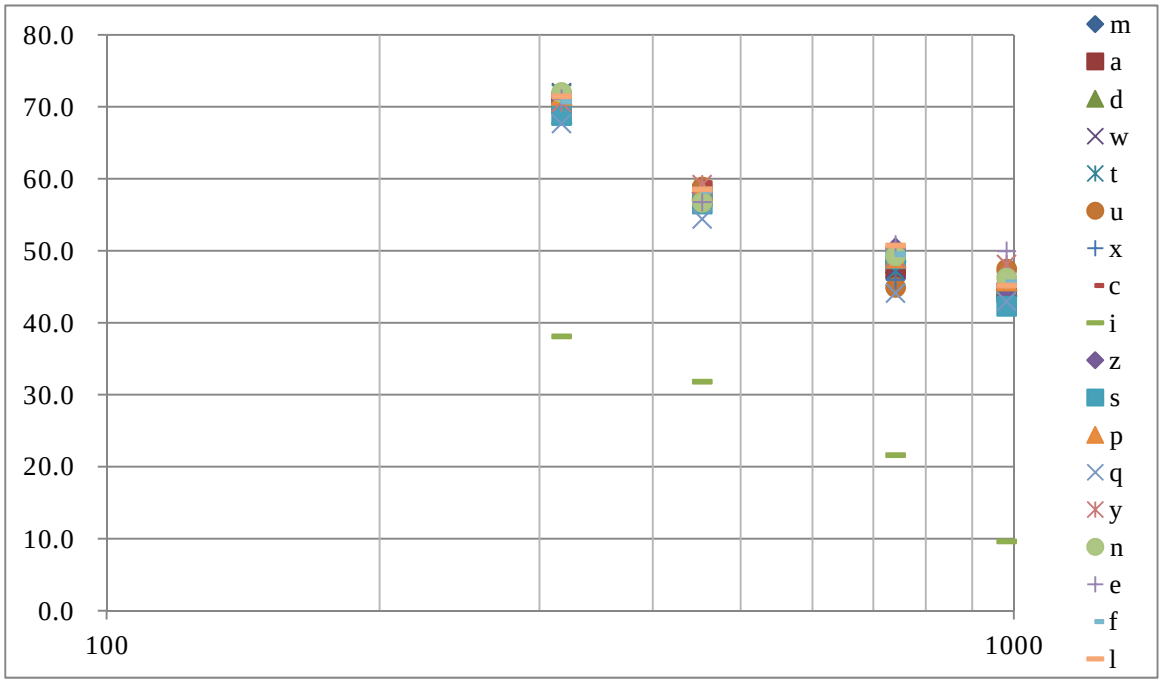

Fig. 5 Horizontal Polarization radiated emission measurement result in dBμV/m

Table 2 Basic data of Horizontal polarization radiated emission

Frequency (MHz)	Q1	Q2	Q3	IQR	N-IQR	Robust CV	Average	Standard Deviation
	Linear value (μV/m)						Log. value (dBμV/m)	
317.3	2527.2540	2870.8110	3189.7408	662.49	491.10	17.11	67.10(69.02)*	8.08(1.72)*
453.4	872.7996	977.2372	1008.6846	135.88	100.73	10.31	57.56(59.51)*	8.18(1.55)*
740.7	204.5350	262.2497	330.1835	125.65	93.14	35.52	46.60(48.33)*	7.55(2.56)*
981.8	196.7968	259.8223	285.6185	88.82	65.84	25.34	46.17(47.85)*	7.24(2.09)*

()*: The values when laboratory (code: i) was exempted as an outlier data.

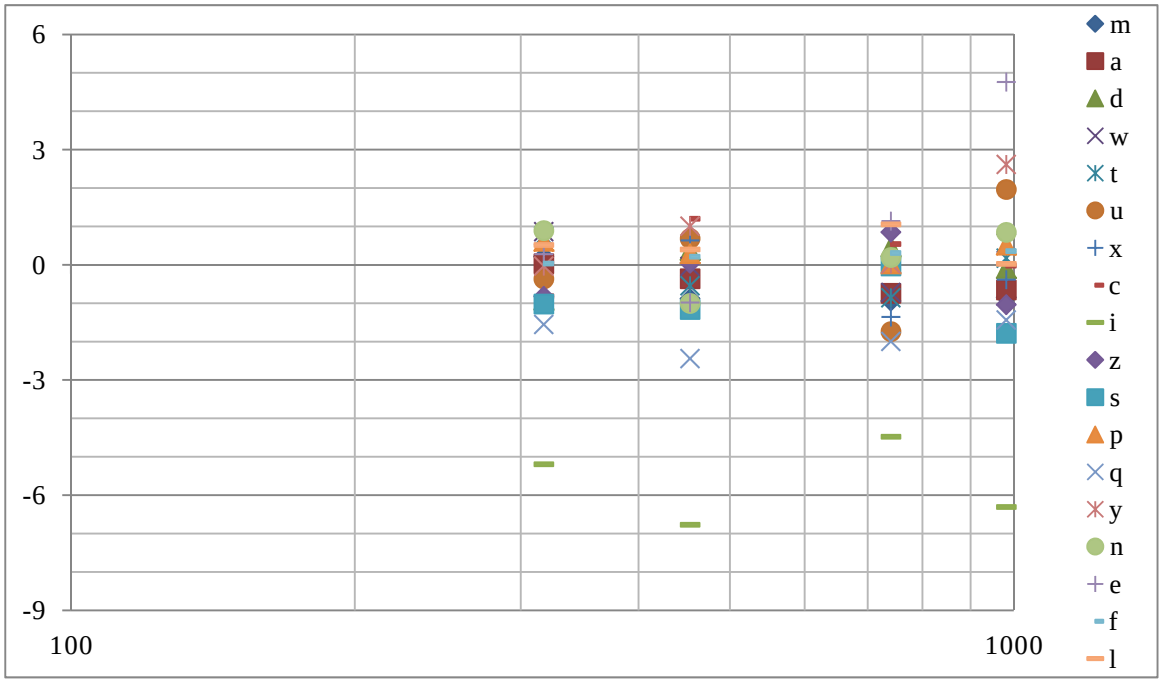

Fig. 6 Z-score by linear data of Horizontal Polarization radiated emission measurement

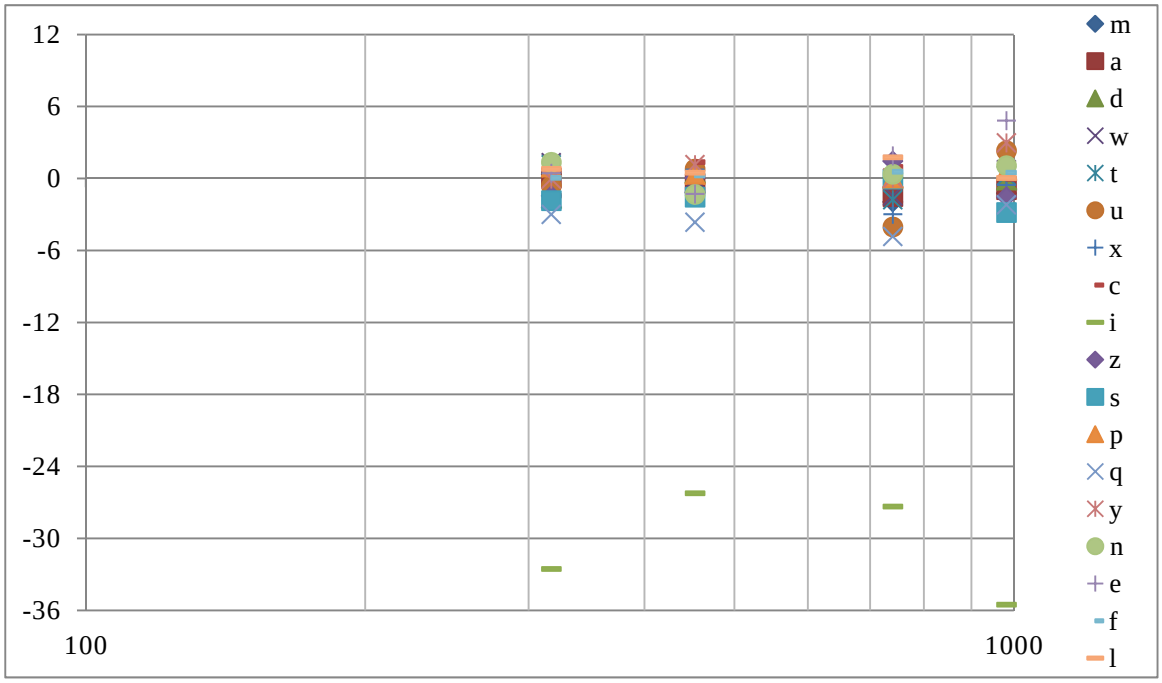

Fig. 7 Difference from the median value of Horizontal Polarization radiated emission measurement

(3) Vertical Polarization radiated emission measurement

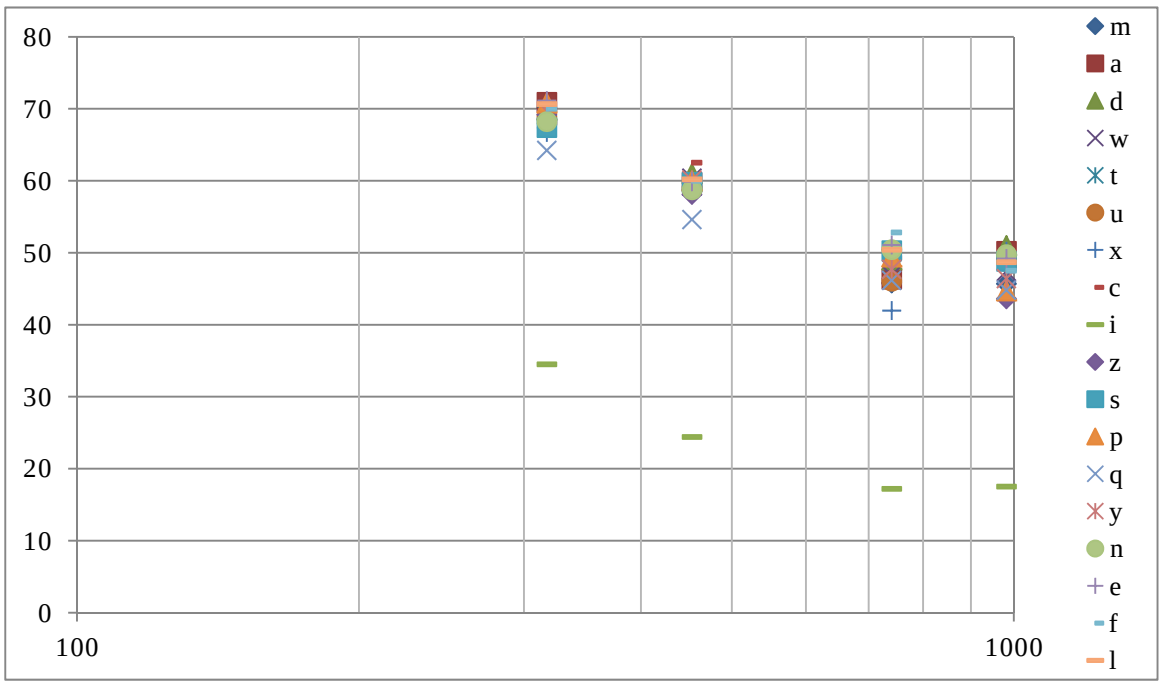

Fig. 8 Vertical Polarization radiated emission measurement result in dBμV/m

Table 3 Basic data of Vertical polarization radiated emission

Frequency (MHz)	Q1	Q2	Q3	IQR	N-IQR	Robust CV	Average	Standard Deviation
	Linear value (μV/m)						Log. value (dBμV/m)	
317.3	2834.7951	3408.0597	3698.8733	864.08	640.54	18.79	68.54(70.33)*	7.49(1.28)*
453.4	691.4497	798.9272	842.8499	151.40	112.23	14.05	56.34(57.78)*	6.07(1.21)*
740.7	225.1099	280.2252	305.8737	80.76	59.87	21.37	46.84(48.32)*	6.40(1.94)*
981.8	158.0516	180.5106	195.9981	37.95	28.13	15.58	43.37(45.36)*	8.38(1.83)*

()*: The values when laboratory (code: i) was exempted as an outlier data.

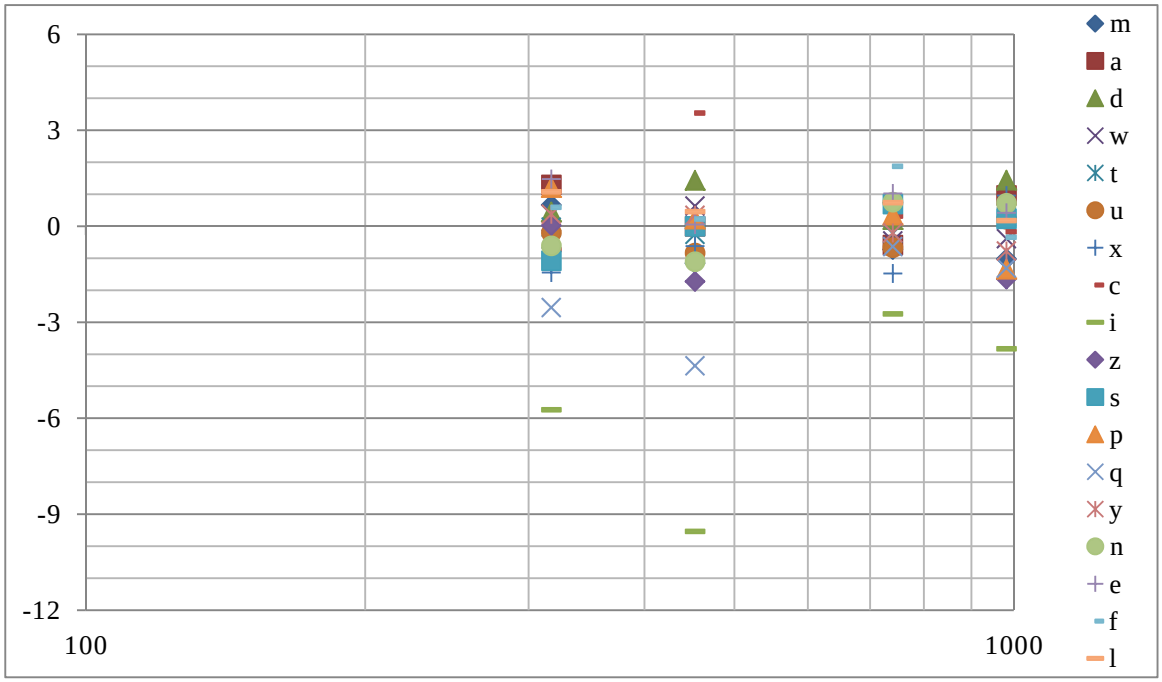

Fig. 9 Z-score by linear value of Vertical Polarization radiated emission measurement

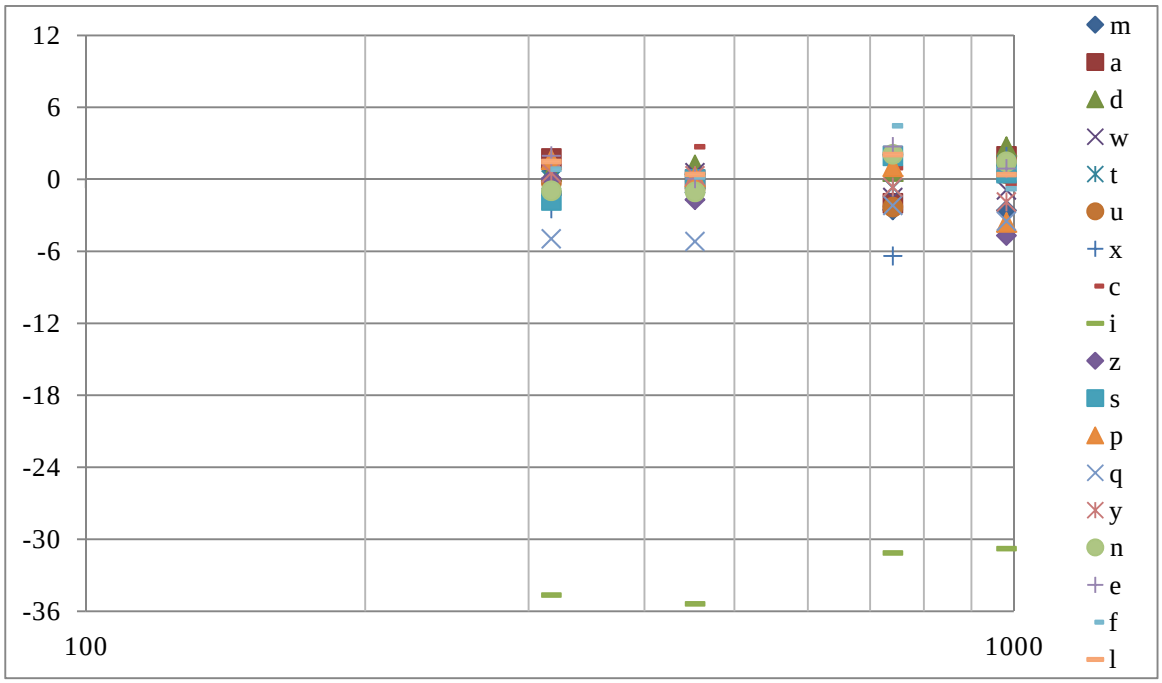

Fig. 10 Difference from the median value of the Vertical Polarization radiated emission measurement

The charts for Z-score and difference from median value are summarized as follows:

Chart 1-1: Z-score of the conducted emission measurement, 219 kHz
Chart 1-2: Z-score of the conducted emission measurement, 439 kHz
Chart 1-3: Z-score of the conducted emission measurement, 2.62 MHz
Chart 1-4: Z-score of the conducted emission measurement, 3.71 MHz
Chart 1-5: Z-score of the conducted emission measurement, 7.45 MHz

Chart 2-1: Z-score of the radiated emission measurement, Horizontal Polarization 317.3 MHz
Chart 2-2: Z-score of the radiated emission measurement, Horizontal Polarization 453.4 MHz
Chart 2-3: Z-score of the radiated emission measurement, Horizontal Polarization 740.7 MHz
Chart 2-4: Z-score of the radiated emission measurement, Horizontal Polarization 981.8 MHz

Chart 3-1: Z-score of the radiated emission measurement, Vertical Polarization 317.3 MHz
Chart 3-2: Z-score of the radiated emission measurement, Vertical Polarization 453.4 MHz
Chart 3-3: Z-score of the radiated emission measurement, Vertical Polarization 740.7 MHz
Chart 3-4: Z-score of the radiated emission measurement, Vertical Polarization 981.8 MHz

Chart 4-1: Difference from Median Value of the conducted emission measurement, 219 kHz
Chart 4-2: Difference from Median Value of the conducted emission measurement, 439 kHz
Chart 4-3: Difference from Median Value of the conducted emission measurement, 2.62 MHz
Chart 4-4: Difference from Median Value of the conducted emission measurement, 3.71 MHz
Chart 4-5: Difference from Median Value of the conducted emission measurement, 7.45 MHz

Chart 5-1: Difference from Median Value of the radiated emission measurement, H-pol, 317.3 MHz
Chart 5-2: Difference from Median Value of the radiated emission measurement, H-pol, 453.4 MHz
Chart 5-3: Difference from Median Value of the radiated emission measurement, H-pol, 740.7 MHz
Chart 5-4: Difference from Median Value of the radiated emission measurement, H-pol, 981.8 MHz

Chart 6-1: Difference from Median Value of the radiated emission measurement, V-pol, 317.3 MHz
Chart 6-2: Difference from Median Value of the radiated emission measurement, V-pol, 453.4 MHz
Chart 6-3: Difference from Median Value of the radiated emission measurement, V-pol, 740.7 MHz
Chart 6-4: Difference from Median Value of the radiated emission measurement, V-pol, 981.8 MHz

(Round-1 + Round-2)

Table 4: Data of the conducted emission measurement (in dBμV) *(1): mistake of measuring frequency. *(2): High ambient noise in the system.

Freq. (MHz)	Laboratory Code																				
	a	b	c	d	f	g	j	k	l	m	n	o	p	q	r	t	u	v	w	x	y
0.219	*(1)	55.4	5.5	53.2	54.7	54.5	55.6	54.1	53.2	53.9	*(1)	54.2	53.0	53.4	*(1)	53.2	54.4	*(1)	*(1)	53.5	54.2
0.439	*(1)	46.3	31.8	44.4	46.7	46.0	45.8	44.9	44.0	45.4	*(1)	45.2	44.0	44.9	*(1)	43.7	46.0	*(1)	*(1)	45.1	45.7
2.62	*(1)	38.9	*(2)	37.2	39.3	38.0	38.1	38.1	38.5	37.8	*(1)	38.3	37.3	39.0	*(1)	37.9	35.1	*(1)	*(1)	38.5	38.4
3.71	40.4	43.0	*(2)	38.5	43.3	41.7	42.2	41.3	41.9	41.8	34.0	41.5	42.0	37.5	27.9	41.2	31.8	41.6	42.1	42.0	41.6
7.45	34.3	36.1	*(2)	29.3	35.5	32.1	34.1	35.2	33.7	34.3	26.7	35.2	32.5	32.7	23.5	31.8	27.1	33.9	33.2	35.4	34.6

Table 5: Data of the radiated emission measurement (in dBμV/m) *(3): defective operation of artifact
(Horizontal Polarization)

Freq. (MHz)	Laboratory Code																					
	a	b	c	d	e	f	i	k	l	m	n	p	q	r	s	t	u	v	w	x	y	z
317.3	70.7	*(3)	69.2	69.0	71.1	70.7	38.1	*(3)	71.5	71.0	72.0	71.6	67.7	*(3)	68.8	71.8	70.0	*(3)	72.0	68.8	70.6	69.2
453.4	57.6	*(3)	59.4	58.5	56.8	58.3	31.8	*(3)	58.5	56.9	56.7	58.4	54.4	*(3)	56.5	57.4	58.9	*(3)	58.0	58.8	59.2	58.1
740.7	47.5	*(3)	49.9	49.8	50.8	49.5	21.6	*(3)	50.7	47.0	49.3	49.0	44.1	*(3)	48.9	47.2	44.9	*(3)	47.5	46.0	49.0	50.4
981.8	44.2	*(3)	45.1	45.0	50.0	45.6	9.6	*(3)	45.2	43.9	46.2	45.8	42.9	*(3)	42.3	45.4	47.5	*(3)	45.9	44.6	48.1	43.6

Table 6: Data of the radiated emission measurement (in dBμV/m) *(3): defective operation of artifact
(Vertical Polarization)

Freq. (MHz)	Laboratory Code																					
	a	b	c	d	e	f	i	k	l	m	n	p	q	r	s	t	u	v	w	x	y	z
317.3	70.9	*(3)	68.0	69.8	71.1	70.0	34.5	*(3)	70.6	70.1	68.2	70.8	64.2	*(3)	67.4	69.1	68.9	*(3)	68.5	66.7	69.7	69.2
453.4	59.8	*(3)	62.5	61.0	59.9	60.0	24.4	*(3)	60.2	58.7	58.8	60.0	54.6	*(3)	59.8	59.6	59.0	*(3)	60.4	59.2	60.1	58.1
740.7	46.4	*(3)	49.3	49.0	51.1	52.8	17.2	*(3)	50.4	45.8	50.4	49.4	46.2	*(3)	50.3	47.7	46.0	*(3)	46.8	42.0	47.7	50.4
981.8	50.2	*(3)	47.9	51.0	49.2	47.5	17.5	*(3)	48.7	45.7	49.8	44.7	44.8	*(3)	48.8	48.9	48.8	*(3)	47.4	50.2	46.4	43.6

Table 7: Z-score of the conducted emission measurement *(1): mistake of measuring frequency *(2): High ambient noise in the system

Freq. (MHz)	Laboratory Code																			
	a	b	c	d	f	g	j	k	l	m	n	o	p	q	r	t	u	v	w	x	y
0.219	*(1)	1.75	-9.91	-0.87	0.84	0.62	1.96	0.07	-0.83	-0.07	*(1)	0.24	-1.08	-0.66	*(1)	-0.87	0.47	*(1)	*(1)	-0.55	0.25
0.439	*(1)	1.09	-6.05	-0.64	1.51	0.79	0.58	-0.23	-0.95	0.21	*(1)	0.04	-0.96	-0.22	*(1)	-1.19	0.79	*(1)	*(1)	-0.04	0.49
2.62	*(1)	1.87	*(2)	-1.78	2.84	-0.15	0.00	-0.02	0.84	-0.55	*(1)	0.50	-1.59	2.11	*(1)	-0.36	-5.41	*(1)	*(1)	0.95	0.79
3.71	-0.80	1.07	*(2)	-1.86	1.33	0.06	0.42	-0.24	0.20	0.13	-3.61	-0.08	0.28	-2.33	-4.92	-0.29	-4.19	-0.01	0.34	0.28	0.01
7.45	0.27	1.36	*(2)	-1.82	0.97	-0.80	0.17	0.79	-0.05	0.28	-2.50	0.79	-0.63	-0.54	-3.12	-0.93	-2.42	0.05	-0.29	0.91	0.43

Table 8: Z-score of the radiated emission measurement *(3): defective operation of artifact
(Horizontal Polarization)

Freq. (MHz)	Laboratory Code																				
	a	b	c	d	e	f	i	k	l	m	n	p	q	r	s	t	u	v	w	x	y	z
317.3	0.03	*(3)	-0.82	-0.92	0.28	0.03	-5.20	*(3)	0.51	0.22	0.89	0.61	-1.55	*(3)	-1.02	0.75	-0.37	*(3)	0.87	-1.02	-0.03	-0.82
453.4	-0.36	*(3)	1.20	0.38	-0.98	0.21	-6.77	*(3)	0.40	-0.88	-1.00	0.29	-2.44	*(3)	-1.16	-0.54	0.69	*(3)	-0.04	0.63	1.01	0.04
740.7	-0.74	*(3)	0.54	0.47	1.14	0.31	-4.48	*(3)	1.05	-0.94	0.19	0.03	-2.00	*(3)	-0.03	-0.86	-1.74	*(3)	-0.72	-1.36	0.03	0.85
981.8	-0.65	*(3)	-0.02	-0.10	4.76	0.36	-6.31	*(3)	0.02	-0.85	0.85	0.51	-1.44	*(3)	-1.78	0.17	1.96	*(3)	0.56	-0.39	2.62	-1.04

Table 9: Z-score of the radiated emission measurement *(3): defective operation of artifact
(Vertical Polarization)

Freq. (MHz)	Laboratory Code																				
	a	b	c	d	e	f	i	k	l	m	n	p	q	r	s	t	u	v	w	x	y	z
317.3	1.30	*(3)	-0.73	0.45	1.48	0.59	-5.74	*(3)	1.08	0.67	-0.61	1.21	-2.54	*(3)	-1.07	-0.03	-0.20	*(3)	-0.40	-1.44	0.37	0.03
453.4	0.00	*(3)	3.54	1.44	0.06	0.23	-9.54	*(3)	0.46	-1.15	-1.10	0.23	-4.36	*(3)	0.00	-0.25	-0.83	*(3)	0.63	-0.62	0.34	-1.72
740.7	-0.59	*(3)	0.32	0.21	1.03	1.87	-2.74	*(3)	0.74	-0.72	0.76	0.35	-0.63	*(3)	0.70	-0.22	-0.66	*(3)	-0.46	-1.47	-0.21	0.74
981.8	0.97	*(3)	-0.17	1.44	0.42	-0.34	-3.83	*(3)	0.17	-1.02	0.72	-1.34	-1.31	*(3)	0.24	0.30	0.22	*(3)	-0.39	0.96	-0.77	-1.65

Table 10: Difference from the median value of conducted emission measurement (in dB) *(1): mistake of measuring frequency.
*(2): High ambient noise in the system.

Freq. (MHz)	Laboratory Code																				
	a	b	c	d	f	g	j	k	l	m	n	o	p	q	r	t	u	v	w	x	y
0.219	*(1)	1.4	-48.5	-0.8	0.7	0.5	1.6	0.1	-0.8	-0.1	*(1)	0.2	-1.0	-0.6	*(1)	-0.8	0.4	*(1)	*(1)	-0.5	0.2
0.439	*(1)	1.1	-13.4	-0.8	1.6	0.8	0.6	-0.3	-1.1	0.2	*(1)	0.0	-1.2	-0.3	*(1)	-1.5	0.8	*(1)	*(1)	-0.1	0.5
2.62	*(1)	0.8	*(2)	-0.9	1.2	-0.1	0.0	0.0	0.4	-0.3	*(1)	0.2	-0.8	0.9	*(1)	-0.2	-3.0	*(1)	*(1)	0.4	0.4
3.71	-1.2	1.4	*(2)	-3.1	1.7	0.1	0.6	-0.4	0.3	0.2	-7.6	-0.1	0.4	-4.1	-13.7	-0.4	-9.8	0.0	0.5	0.4	0.0
7.45	0.5	2.3	*(2)	-4.5	1.7	-1.7	0.3	1.4	-0.1	0.5	-7.1	1.4	-1.3	-1.1	-10.3	-2.0	-6.7	0.1	-0.6	1.6	0.8

Table 11: Difference from the median value of radiated emission measurement (in dB) *(3): defective operation of artifact
(Horizontal Polarization)

Freq. (MHz)	Laboratory Code																				
	a	b	c	d	e	f	i	k	l	m	n	p	q	r	s	t	u	v	w	x	y	z
317.3	0.0	*(3)	-1.5	-1.7	0.4	0.0	-32.6	*(3)	0.8	0.3	1.3	0.9	-3.0	*(3)	-1.9	1.1	-0.6	*(3)	1.3	-1.8	-0.1	-1.5
453.4	-0.4	*(3)	1.4	0.5	-1.3	0.3	-26.3	*(3)	0.5	-1.2	-1.3	0.4	-3.7	*(3)	-1.6	-0.7	0.8	*(3)	0.0	0.7	1.2	0.1
740.7	-1.5	*(3)	0.9	0.8	1.9	0.5	-27.4	*(3)	1.8	-2.0	0.3	0.0	-4.8	*(3)	-0.1	-1.8	-4.0	*(3)	-1.5	-3.0	0.0	1.5
981.8	-0.9	*(3)	0.0	-0.1	4.8	0.5	-35.5	*(3)	0.0	-1.2	1.1	0.7	-2.2	*(3)	-2.8	0.2	2.3	*(3)	0.7	-0.5	3.0	-1.5

Table 12: Difference from the median value of radiated emission measurement (in dB) *(3): defective operation of artifact
(Vertical Polarization)

Freq. (MHz)	Laboratory Code																				
	a	b	c	d	e	f	i	k	l	m	n	p	q	r	s	t	u	v	w	x	y	z
317.3	1.7	*(3)	-1.2	0.6	2.0	0.8	-34.7	*(3)	1.5	0.9	-1.0	1.6	-5.0	*(3)	-1.8	0.0	-0.3	*(3)	-0.6	-2.5	0.5	0.0
453.4	0.0	*(3)	2.7	1.2	0.1	0.2	-35.4	*(3)	0.4	-1.1	-1.1	0.2	-5.2	*(3)	0.0	-0.2	-0.8	*(3)	0.6	-0.6	0.3	-1.7
740.7	-2.0	*(3)	0.9	0.6	2.7	4.5	-31.2	*(3)	2.1	-2.6	2.1	1.1	-2.2	*(3)	2.0	-0.7	-2.3	*(3)	-1.5	-6.4	-0.6	2.1
981.8	1.9	*(3)	-0.4	2.7	0.9	-0.8	-30.8	*(3)	0.4	-2.6	1.5	-3.6	-3.5	*(3)	0.5	0.6	0.5	*(3)	-0.9	1.9	-1.9	-4.7

Chart Data of Round-1 + Round-2

[Z-score of the conducted emission measurement]

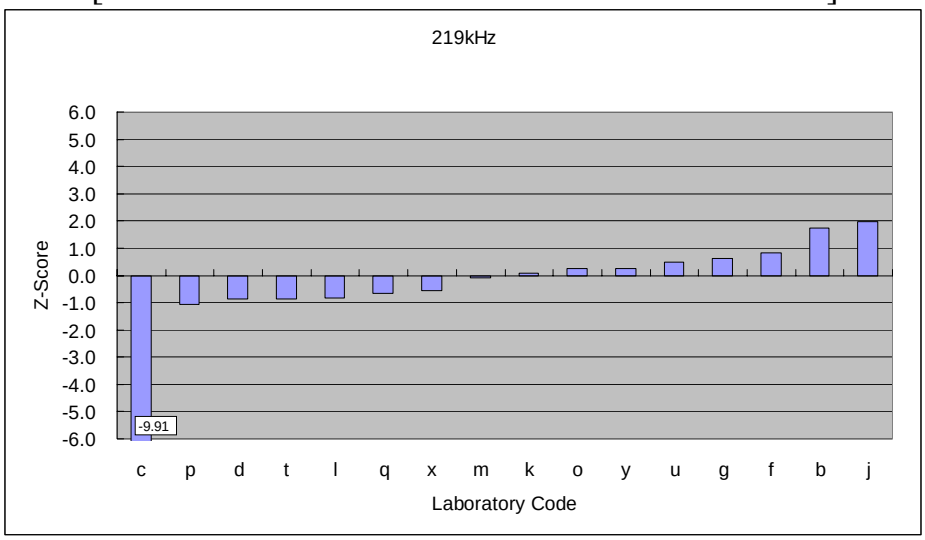

Chart 1-1: Z-score of the conducted emission measurement, 219 kHz

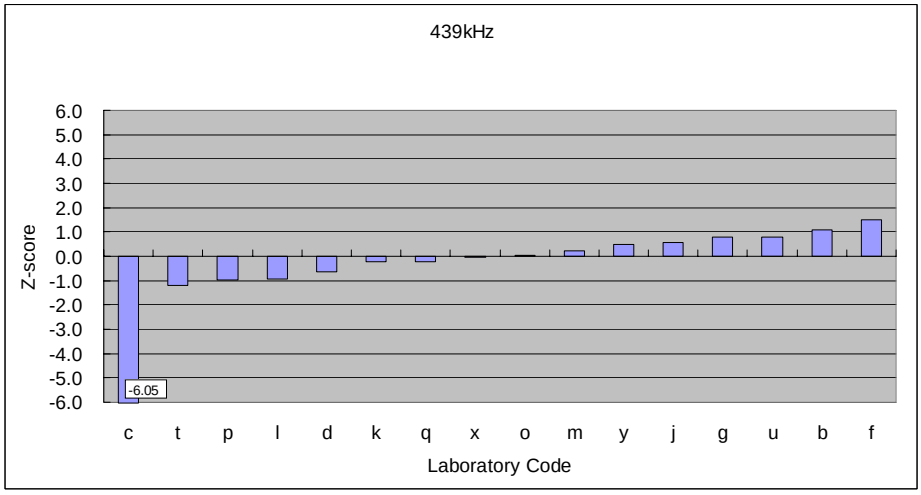

Chart 1-2: Z-score of the conducted emission measurement, 439 kHz

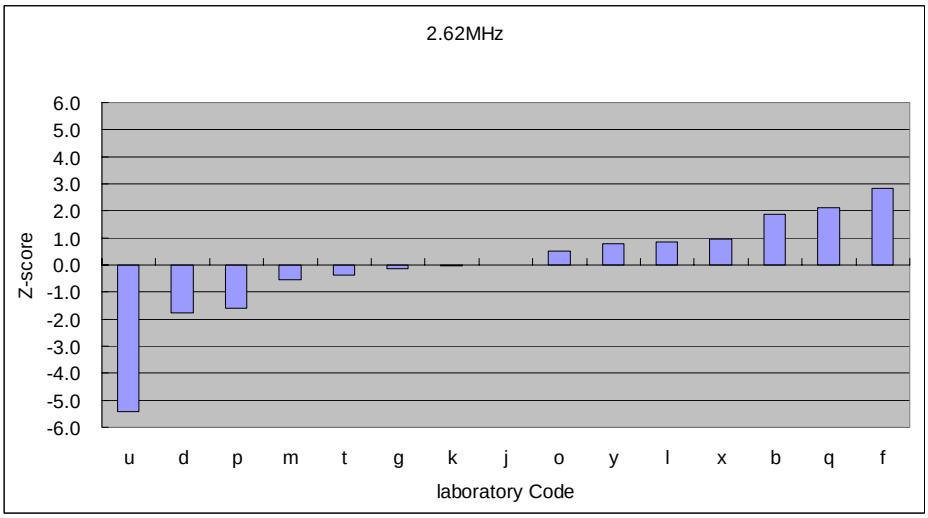

Chart 1-3: Z-score of the conducted emission measurement, 2.62 MHz

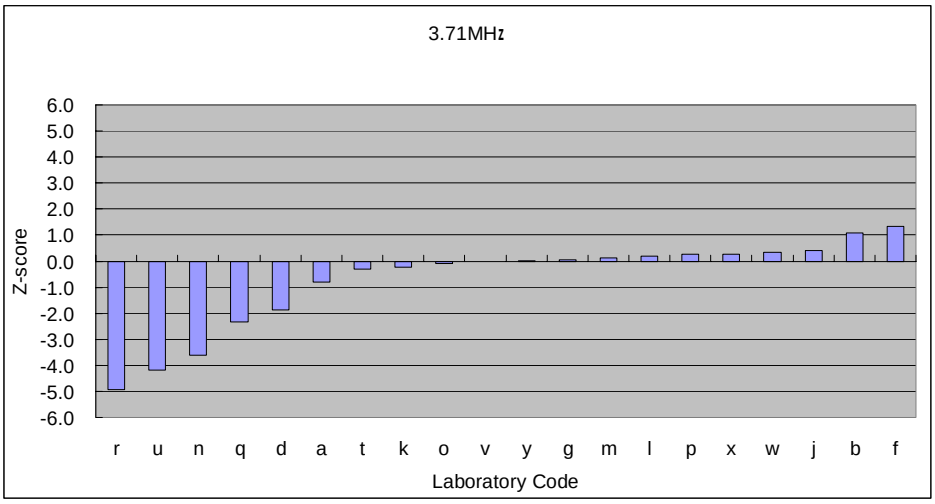

Chart 1-4: Z-score of the conducted emission measurement, 3.71 MHz

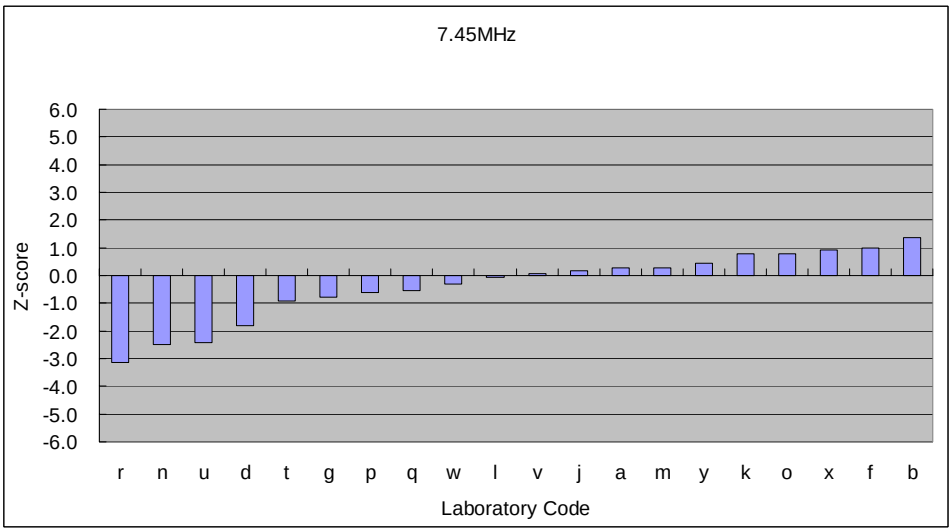

Chart 1-5: Z-score of the conducted emission measurement, 7.45 MHz

[Z-score of the radiated emission measurement]
(Horizontal Polarization)]

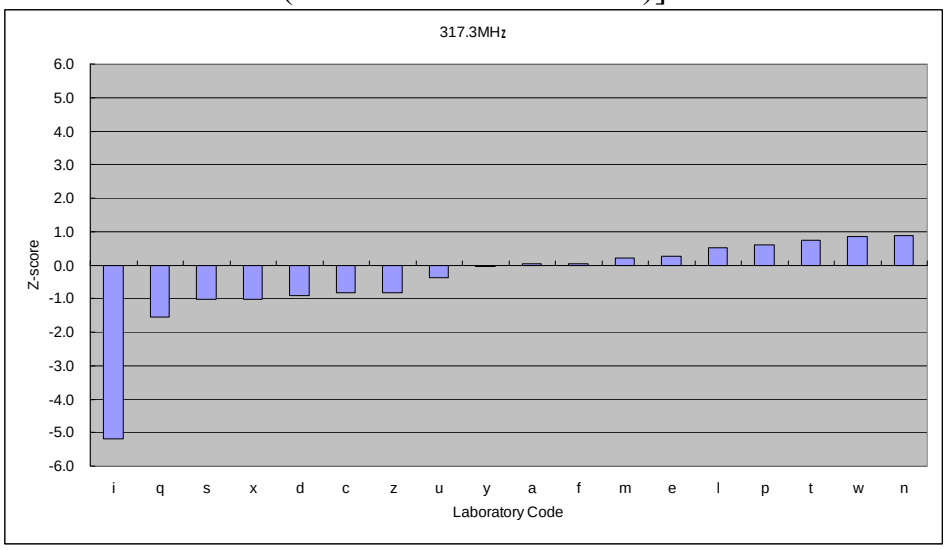

Chart 2-1: Z-score of the radiated emission measurement, Horizontal Polarization, 317.3 MHz

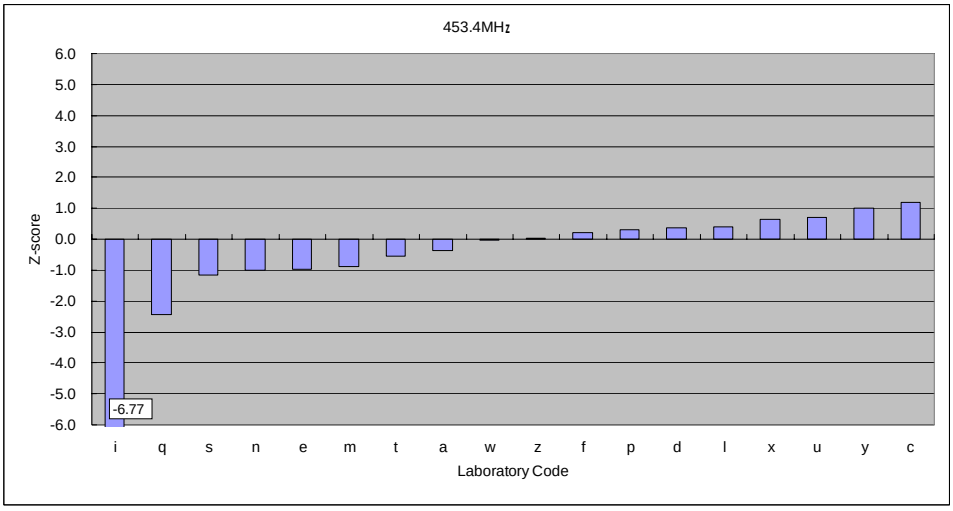

Chart 2-2: Z-score of the radiated emission measurement, Horizontal Polarization, 453.4 MHz

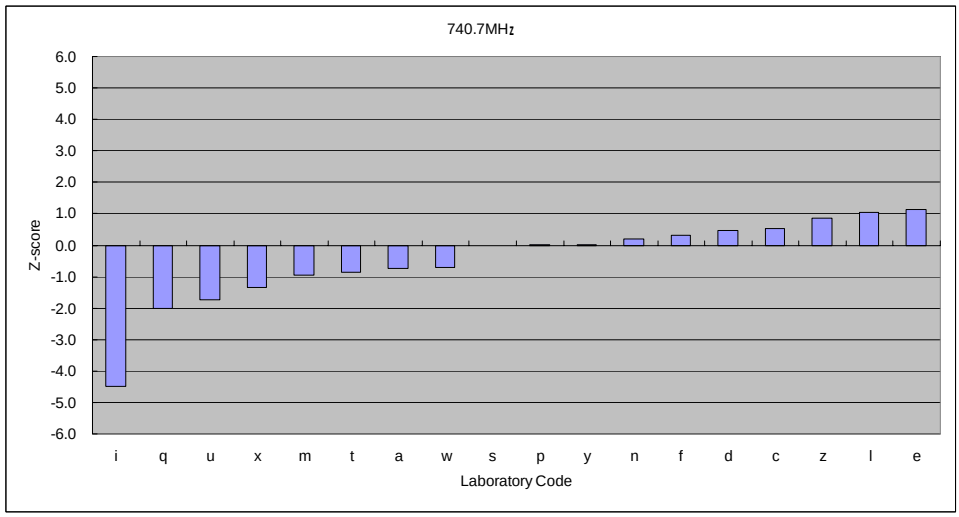

Chart 2-3: Z-score of the radiated emission measurement, Horizontal Polarization, 740.7 MHz

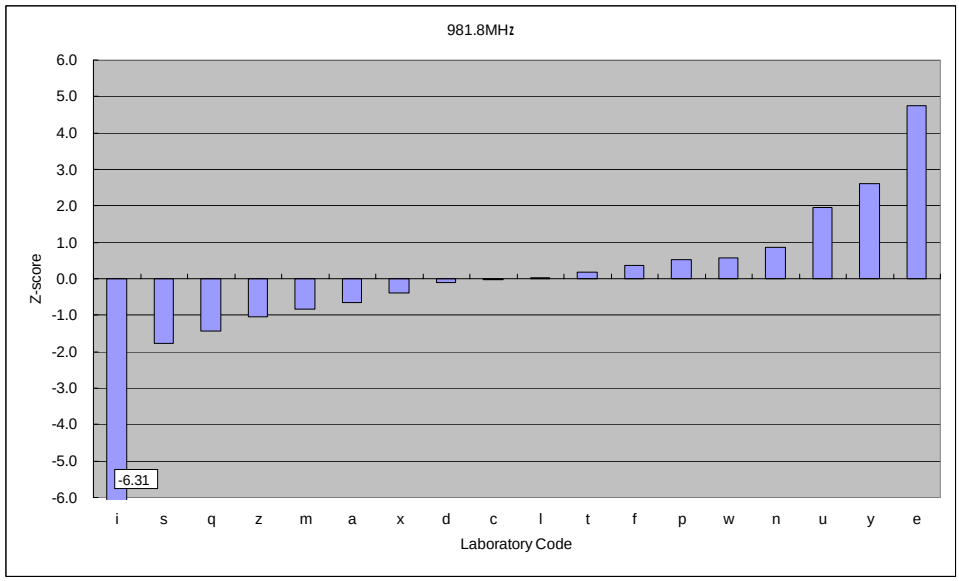

Chart 2-4: Z-score of the radiated emission measurement, Horizontal Polarization, 981.8 MHz

[Z-score of the radiated emission measurement]
(Vertical Polarization)]

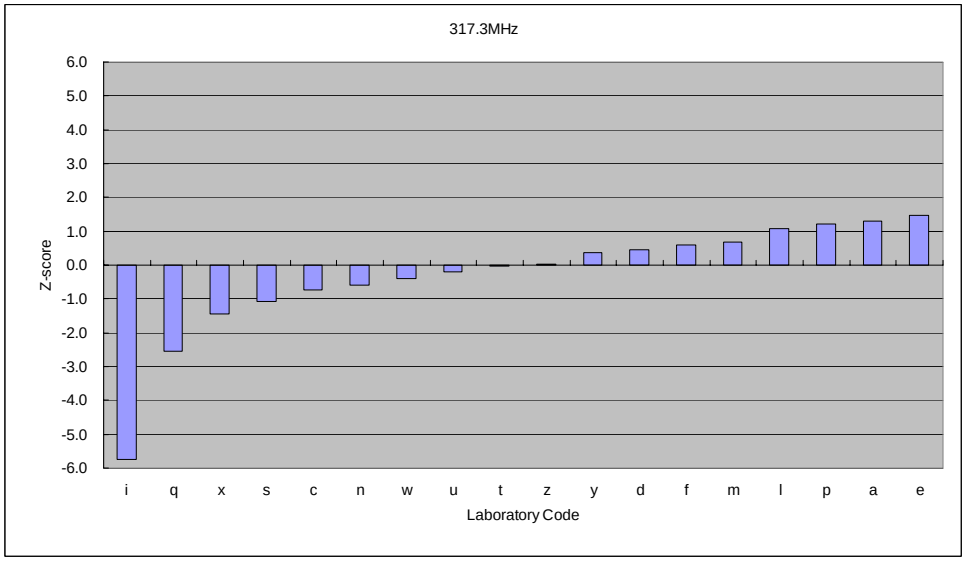

Chart 3-1: Z-score of the radiated emission measurement, Vertical Polarization, 317.3 MHz

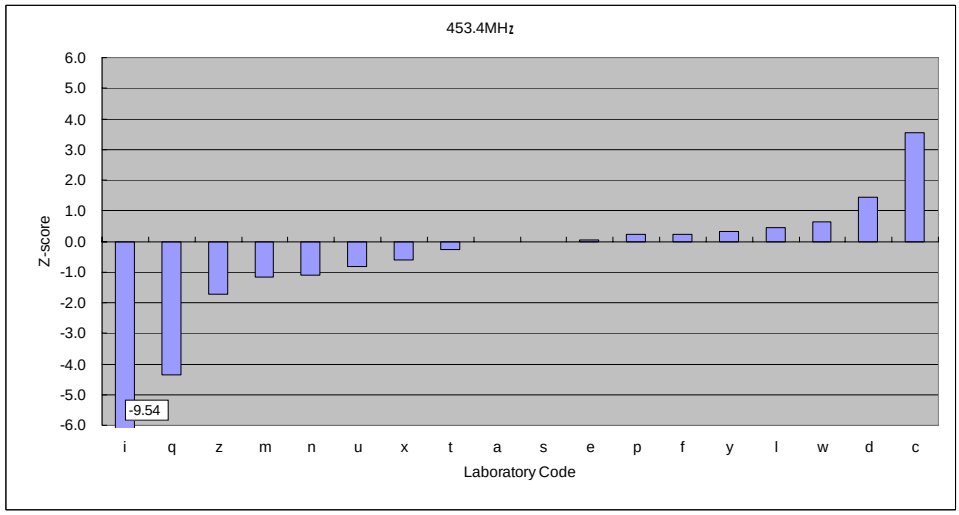

Chart 3-2: Z-score of the radiated emission measurement, Vertical Polarization, 453.4 MHz

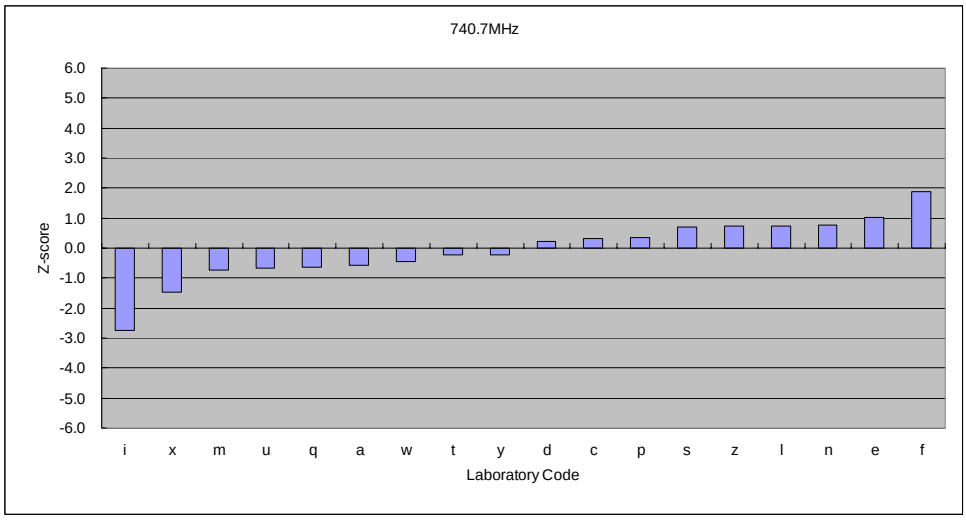

Chart 3-3: Z-score of the radiated emission measurement, Vertical Polarization, 740.7 MHz

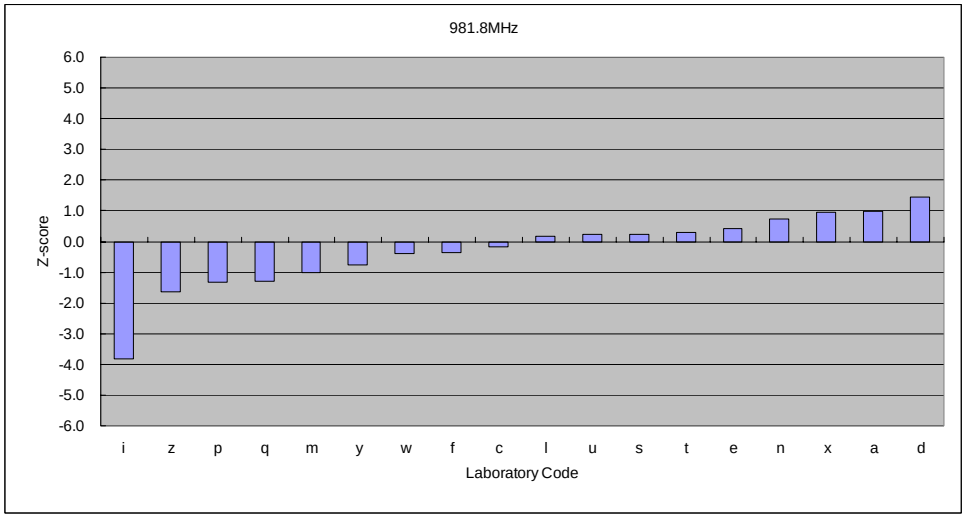

Chart 3-4: Z-score of the radiated emission measurement, Vertical Polarization, 981.8 MHz

[Difference from median Value of the conducted emission measurement]

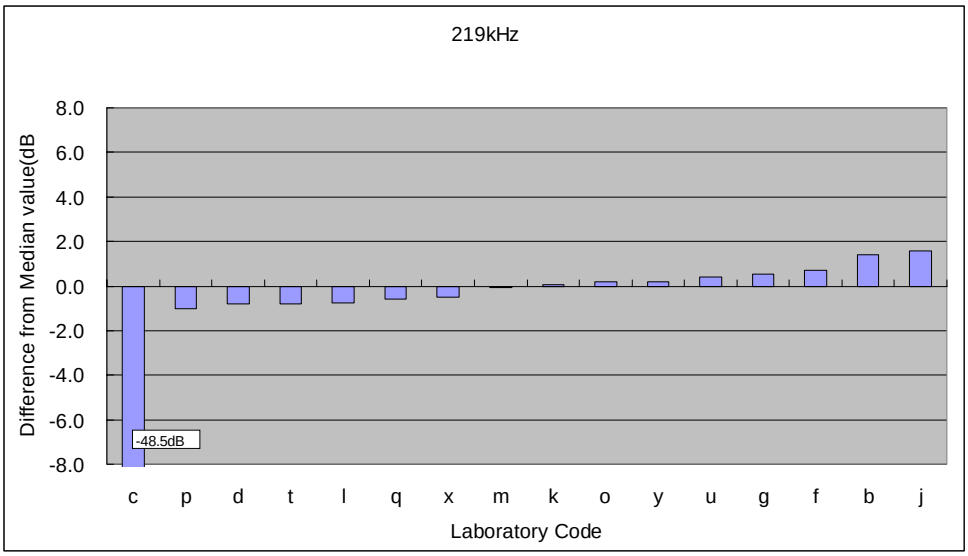

Chart 4-1: Difference from Median Value of the conducted emission measurement, 219 kHz

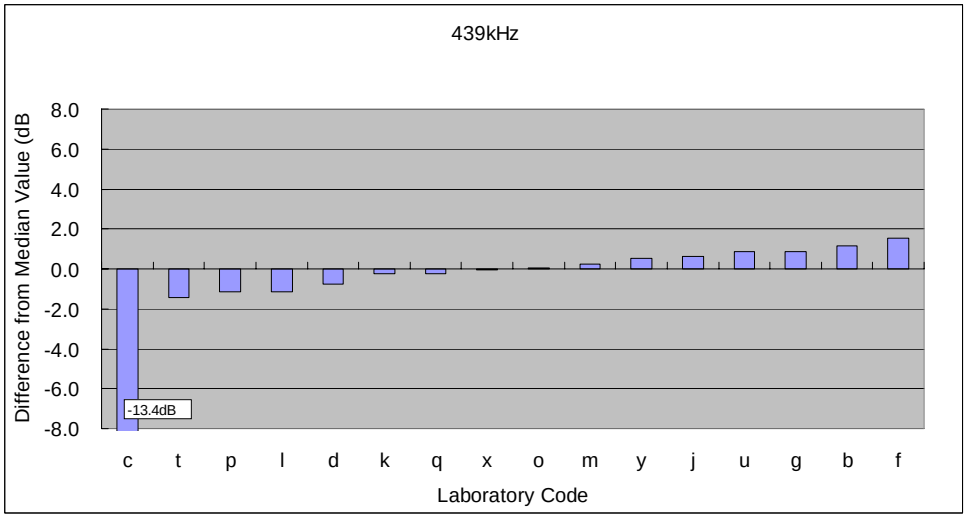

Chart 4-2: Difference from Median Value of the conducted emission measurement, 439 kHz

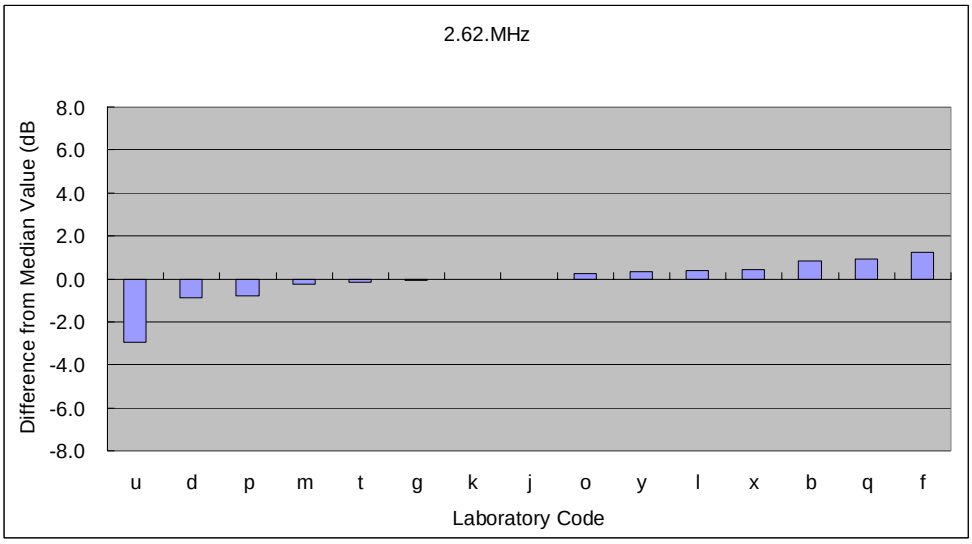

Chart 4-3: Difference from Median Value of the conducted emission measurement, 2.62 MHz

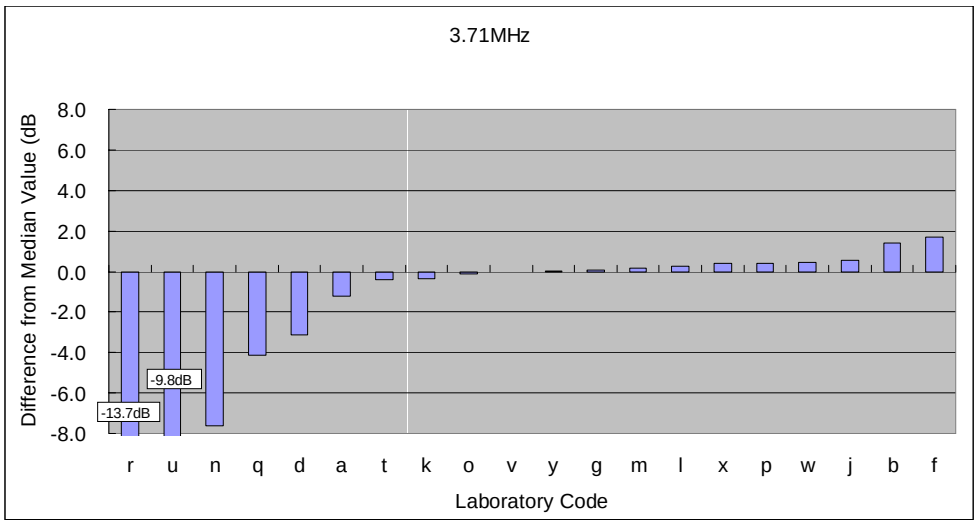

Chart 4-4: Difference from Median Value of the conducted emission measurement, 3.71 MHz

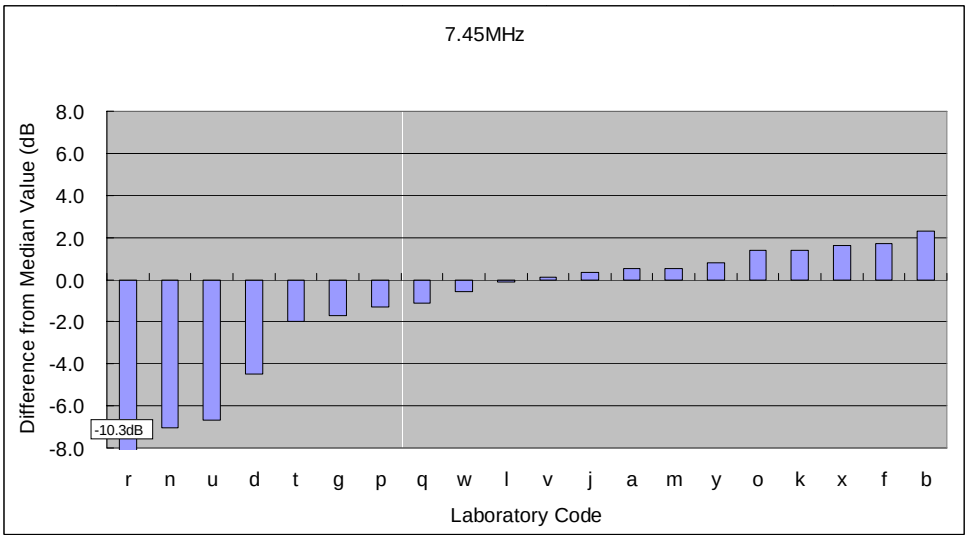

Chart 4-5: Difference from Median Value of the conducted emission measurement, 7.45 MHz

[Difference from Median Value of radiated emission measurement]
(Horizontal Polarization)

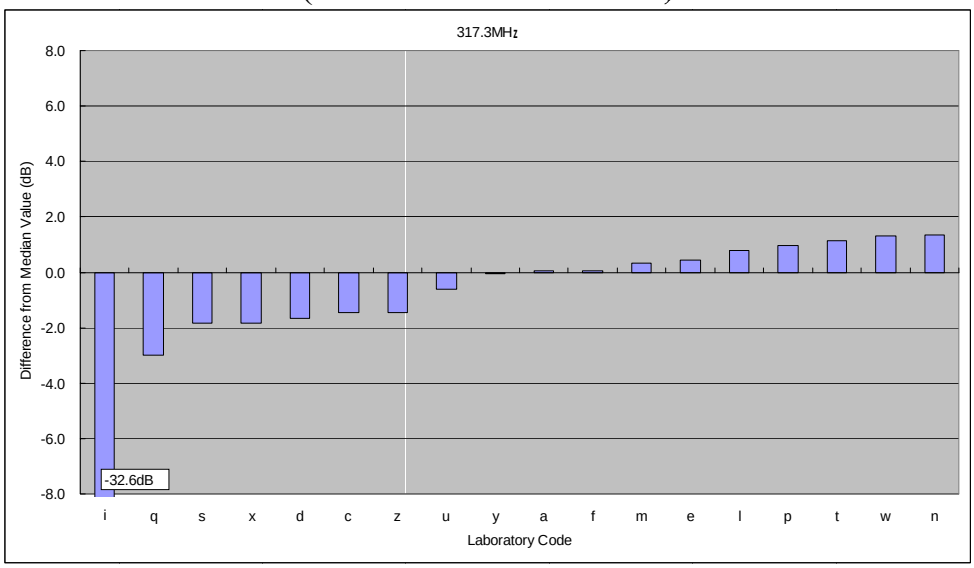

Chart 5-1: Difference from Median Value of the radiated emission measurement, H-pol., 317.3 MHz

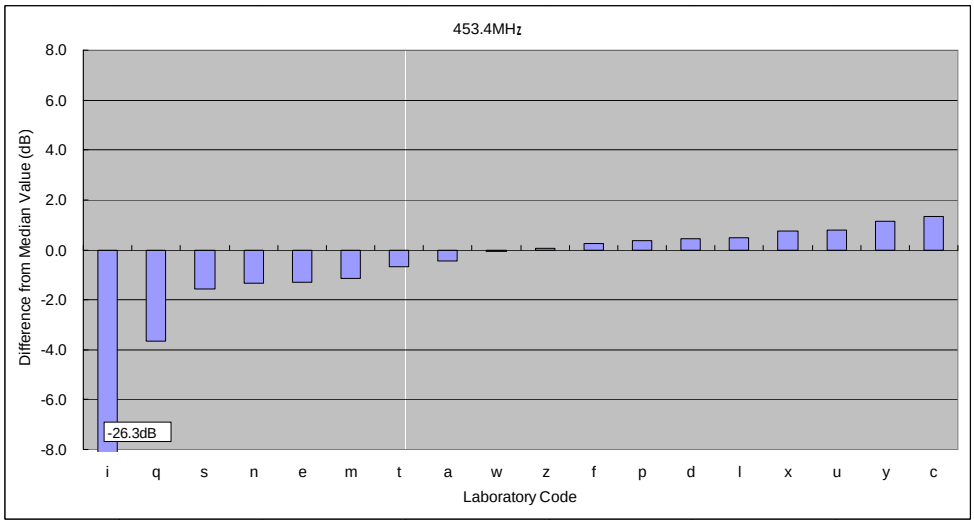

Chart 5-2: Difference from Median Value of the radiated emission measurement, H-pol., 453.4 MHz

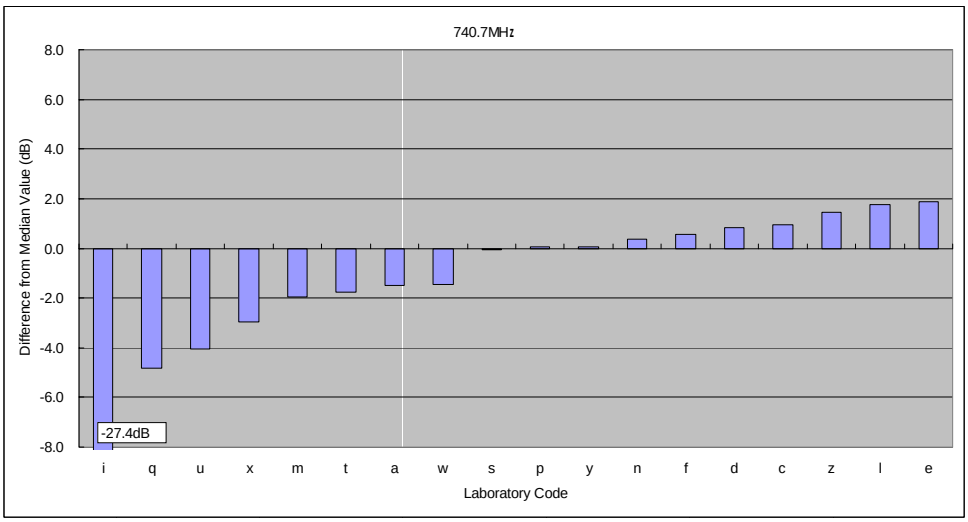

Chart 5-3: Difference from Median Value of the radiated emission measurement, H-pol., 740.7 MHz

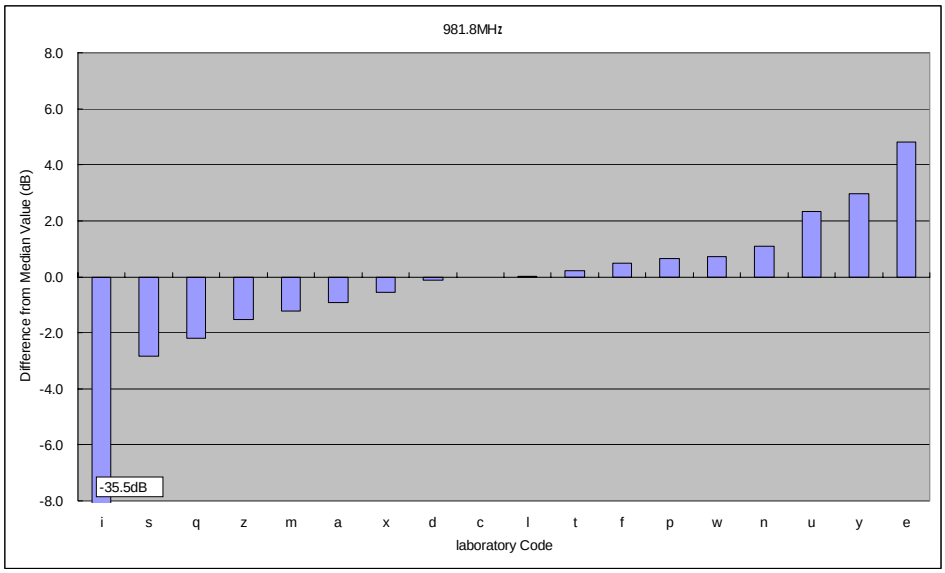

Chart 5-4: Difference from Median Value of the radiated emission measurement, H-pol., 981.8 MHz

[Difference from Median Value of the radiated emission measurement]
(Vertical Polarization)

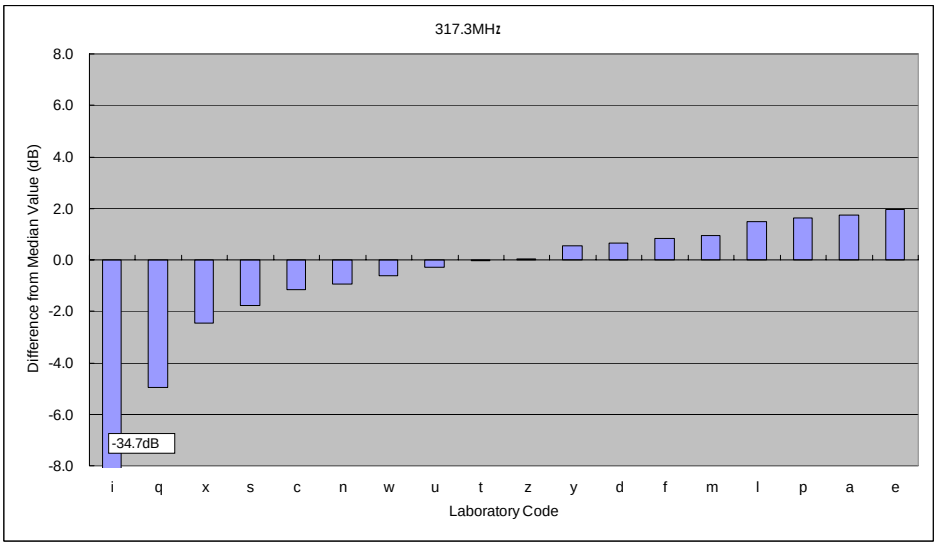

Chart 6-1: Difference from Median Value of the radiated emission measurement, V-pol., 317.3 MHz

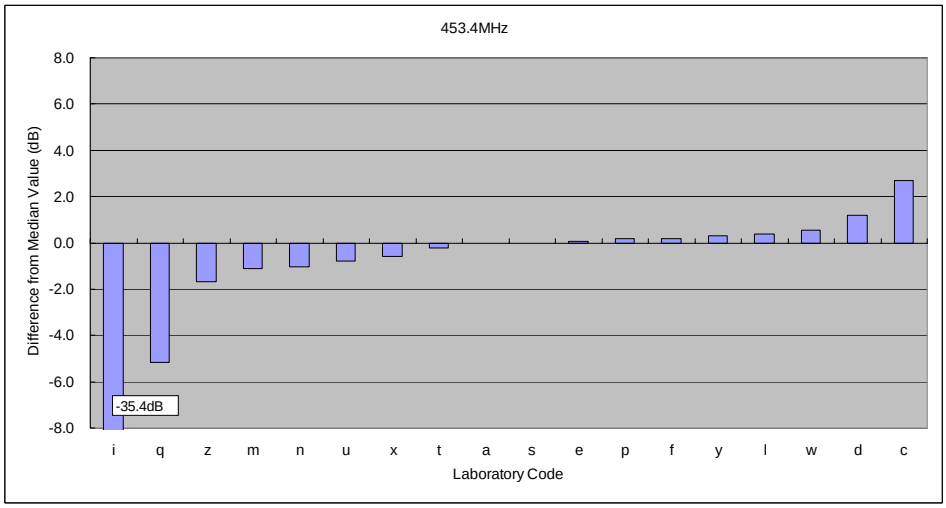

Chart 6-2: Difference from Median Value of the radiated emission measurement, V-pol., 453.4 MHz

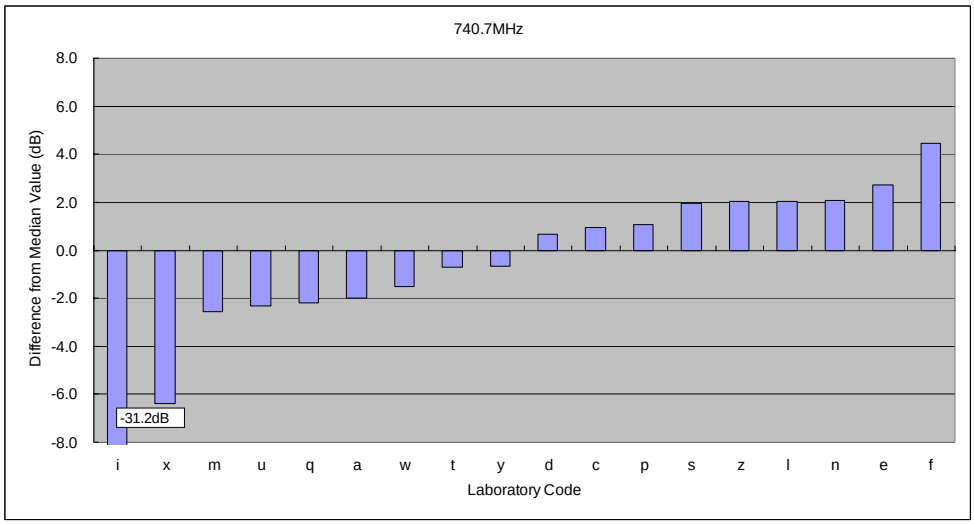

Chart 6-3: Difference from Median Value of the radiated emission measurement, V-pol., 740.7 MHz

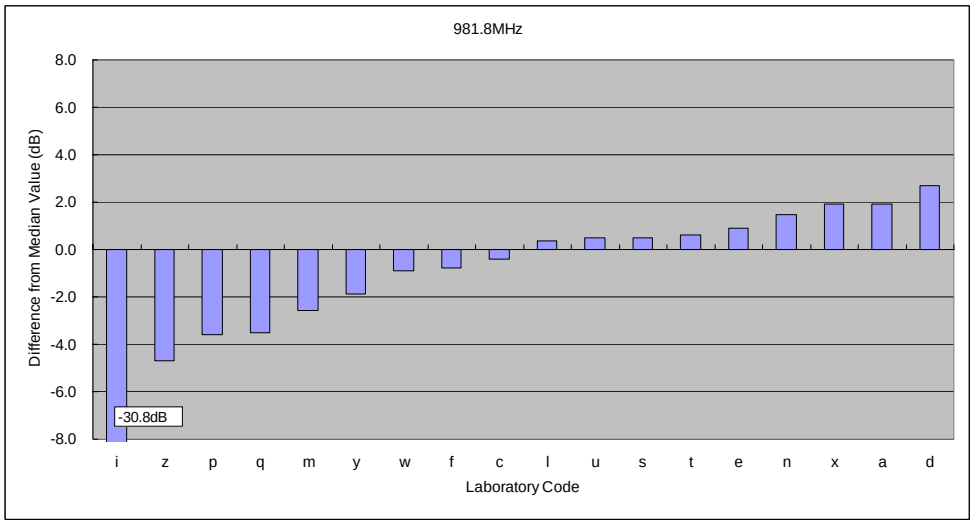

Chart 6-4: Difference from Median Value of the radiated emission measurement, V-pol., 981.8 MHz

5.3 Result of Round-3

Two laboratories in Round-3 reported the data of wrong frequencies at the lower three frequencies in the conducted emission.

In addition, one laboratory in Round 3 was not able to measure some specific frequencies because of the influence of an ambient noise, etc.

The data of those frequencies were excluded from the evaluation of the laboratories.

The data of Round-3 will be re-evaluated in the final report together with the data of Rounds conducted afterwards.

Test results received from participants are presented in Figure 11 through Figure 19 and Table 13 through Table 24.

Table 13 Basic data of conducted emission measurement
Table 14 Basic data of Horizontal polarization radiated emission
Table 15 Basic data of Vertical polarization radiated emission
Table 16: Data of the conducted emission measurement (in dBμV)
Table 17: Data of the Horizontal Polarization radiated emission measurement (in dBμV/m)
Table 18: Data of the Vertical Polarization radiated emission measurement (in dBμV/m)
Table 19: Z-score of the conducted emission measurement
Table 20: Z-score of the radiated emission measurement in Horizontal Polarization
Table 21: Z-score of the radiated emission measurement in Vertical Polarization
Table 22: Difference from the median value of conducted emission measurement
Table 23: Difference from the median value of Horizontal Polarization radiated emission measurement
Table 24: Difference from the median value of Vertical Polarization radiated emission measurement

5.4 Statistical Evaluation of Round-3

Z-Score is interpreted as follows:

(a)	$\|z\| \leq 2.0$	Satisfactory
(b)	$2.0 < \|z\| < 3.0$	Questionable
(c)	$3.0 \leq \|z\|$	Doubtful; shall be reviewed

Differences from the median value

(d)	$\|d\| \leq 6.0$ dB	Satisfactory
(e)	6.0 dB < $\|d\|$	Doubtful; shall be reviewed

From the above two evaluation factors, the following conditions are considered to be 'unsatisfactory' .

(c) and (e)	$3.0 \leq \|z\|$ and 6.0 dB < $\|d\|$	Unsatisfactory

Measurement data submitted from participants are presented in Table 16 through Table 18.

Z-Scores of individual participant were presented in Table 19 through Table 21.

Differences from median value were presented in Table 22 through Table 24.

Basic data of Round-3

(1) Conducted emission measurement

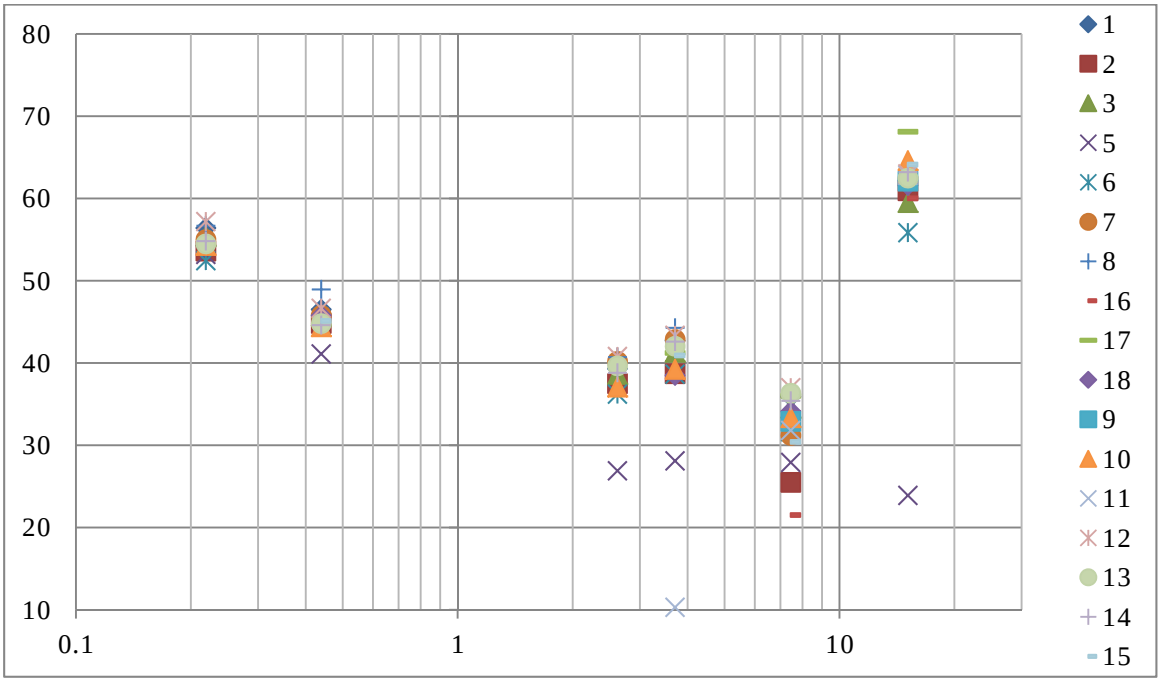

Fig. 11 Conducted emission measurement result in dBμV

Table 13 Basic data of conducted emission measurement

Frequency (MHz)	Q1	Q2	Q3	IQR	N-IQR	Robust CV	Average	Standard Deviation
	Linear value (μV)						Log. value (dBμV)	
0.219	498.3919	549.5409	624.7686	126.38	93.68	17.05	54.86	1.42
0.439	169.8244	179.8871	194.9845	25.16	18.65	10.37	45.27	1.70
2.62	73.1374	87.0964	99.2453	26.11	19.35	22.22	37.79	3.72
3.71	85.1138	110.9175	134.8963	49.78	36.90	33.27	34.43(41.25)*1	13.28(1.88)*1
7.45	36.2660	46.4833	62.3735	26.11	19.35	41.64	32.44	4.10
15.1	1114.2945	1327.3945	1407.6672	293.37	217.48	16.38	59.96(62.22)*2	9.34(2.51)*2

()*1: The values when laboratory (code 5, 9, 11, 16) was exempted as outliers

()*2: The values when laboratory (code 5) was exempted as an outlier data.

NOTE:

Q1, Q2, Q3, IQR and N-IQR described in Table 13, Table 14, and Table 15 consist of the following definitions.

Q1: 25th percentile (or 1st quartile) of the participant results
Q2: 50th percentile (or 2nd quartile) of the participant results
Q3: 75th percentile (or 3rd quartile) of the participant results
IQR: Inter Quartile Ratio
N-IQR: Normalized IQR = 0.7413 x (Q3 – Q1)
Robust CV: Robust Coefficient of Variation = N-IQR x 100 / Q2 (%)

Z-score is calculated by the following formula,

Z-score = (Result – Q2) / N-IQR

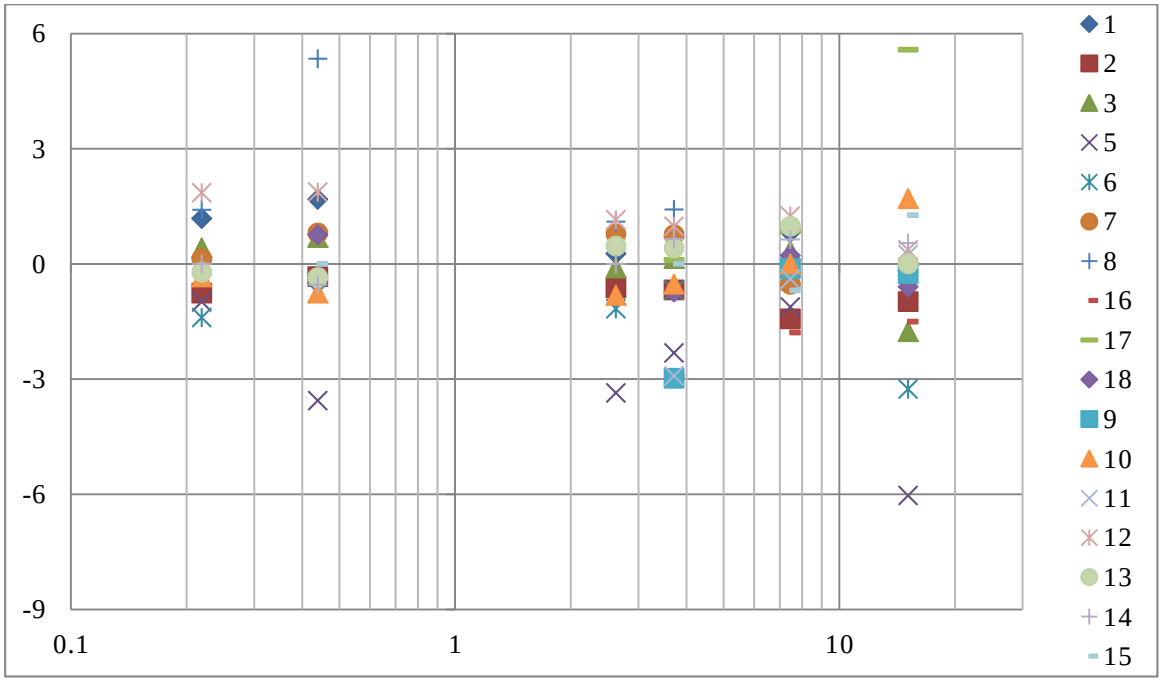

Fig. 12 Z-score by linear data of the conducted emission measurement

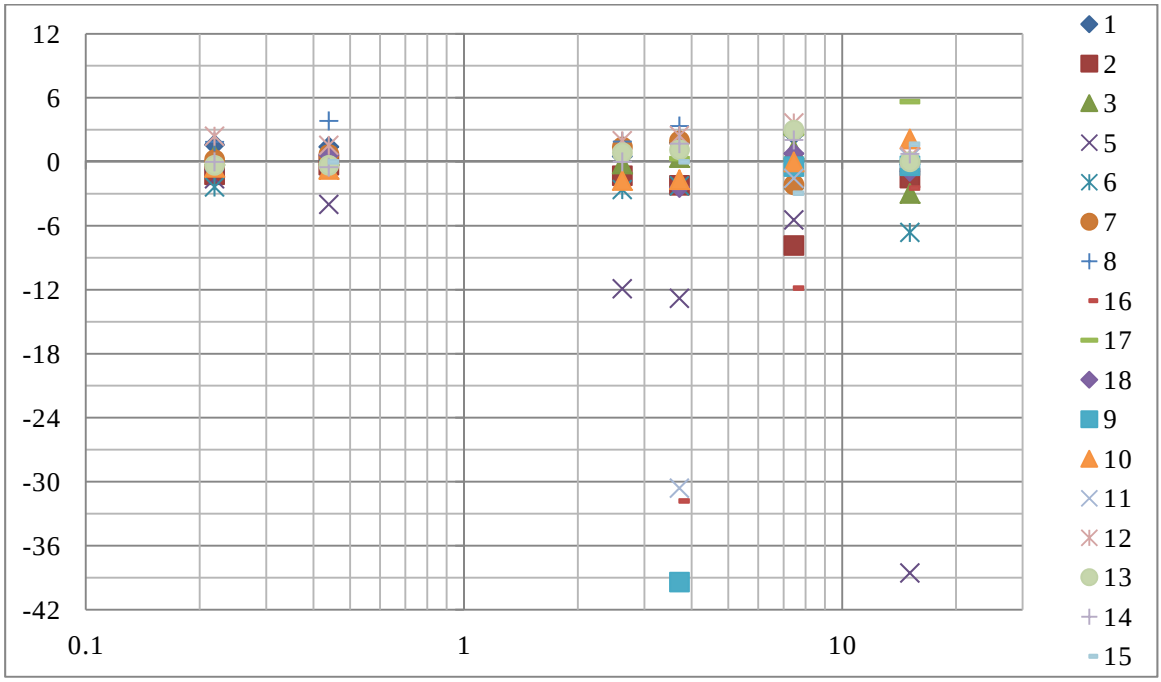

Fig. 13 Difference from the median value of conducted emission measurement

(2) Horizontal Polarization radiated emission measurement

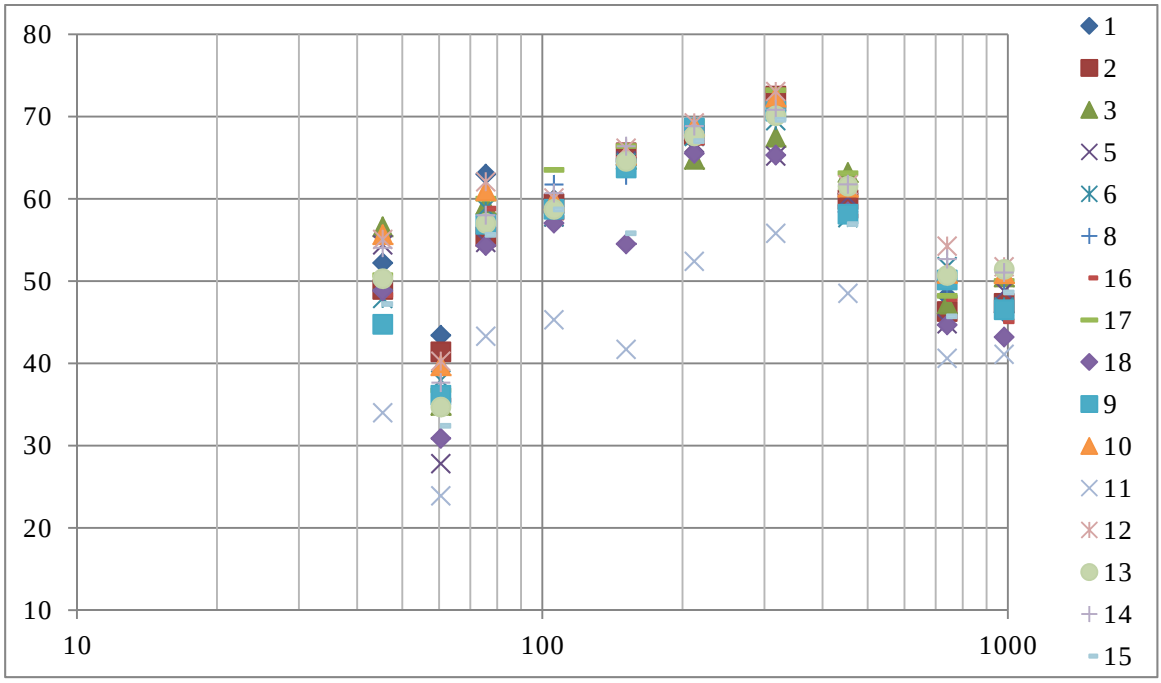

Fig. 14 Horizontal Polarization radiated emission measurement result in dBμV/m

Table 14 Basic data of Horizontal polarization radiated emission

Frequency (MHz)	Q1	Q2	Q3	IQR	N-IQR	Robust CV	Average	Standard Deviation
	Linear value (μV/m)						Log. value (dBμV/m)	
45.4	257.0189	318.8888	508.8273	251.81	186.67	58.54	49.92(50.98)*	5.26(3.39)*
60.5	51.1186	62.6002	83.3213	32.20	23.87	38.13	35.56(36.34)*	4.85(3.92)*
75.6	599.1306	779.0820	941.9286	342.80	254.12	32.62	57.25(58.18)*	4.36(2.53)*
105.9	776.2471	864.7688	999.4843	223.24	165.49	19.14	58.46(59.40)*	3.88(1.69)*
151.3	1501.3679	1694.3423	1858.7892	357.42	264.96	15.64	62.23(63.60)*	6.27(3.45)*
212	2187.7616	2401.6217	2714.0532	526.29	390.14	16.24	66.67(67.62)*	3.89(1.28)*
317.3	2831.8804	3418.4292	3668.6932	836.81	620.33	18.15	69.25(70.15)*	4.17(2.39)*
453.4	996.9169	1047.4061	1200.2385	203.32	150.72	14.39	59.52(60.25)*	3.41(1.94)*
740.7	203.0916	257.0396	345.0636	141.97	105.24	40.94	48.34(48.86)*	3.36(2.79)*
981.8	209.8840	272.2882	338.9201	129.04	95.65	35.13	48.06(48.53)*	3.00(2.48)*

()*: The values when laboratory (code: 11) was exempted as an outlier data.

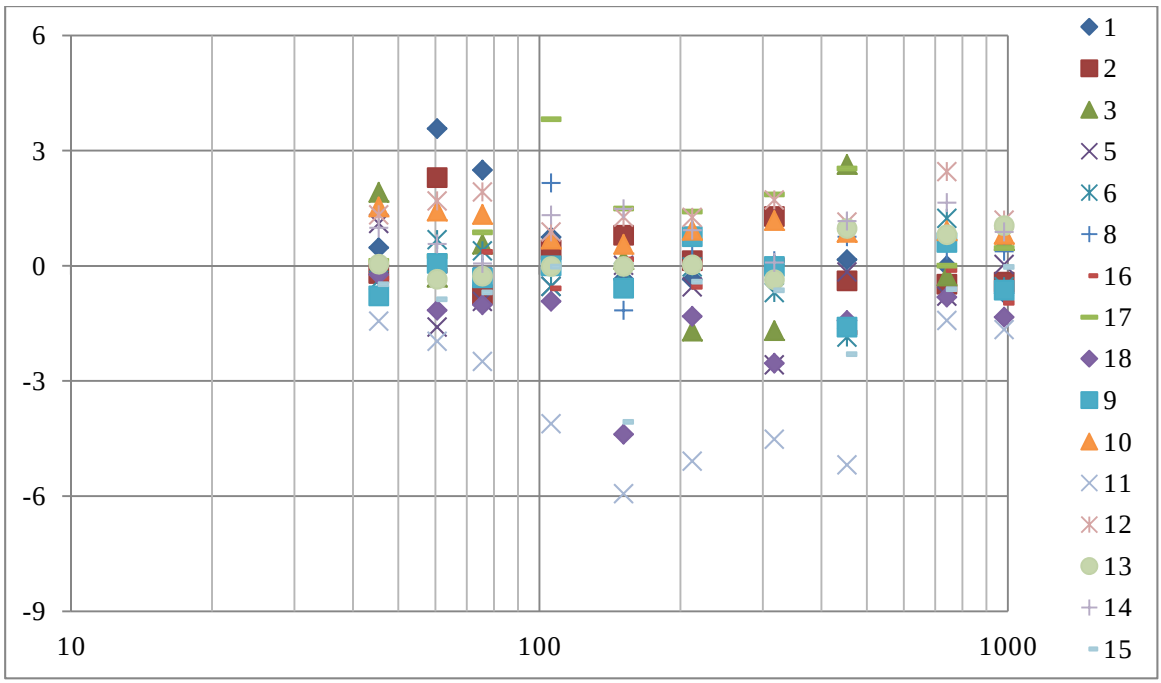

Fig. 15 Z-score by linear data of Horizontal Polarization radiated emission measurement

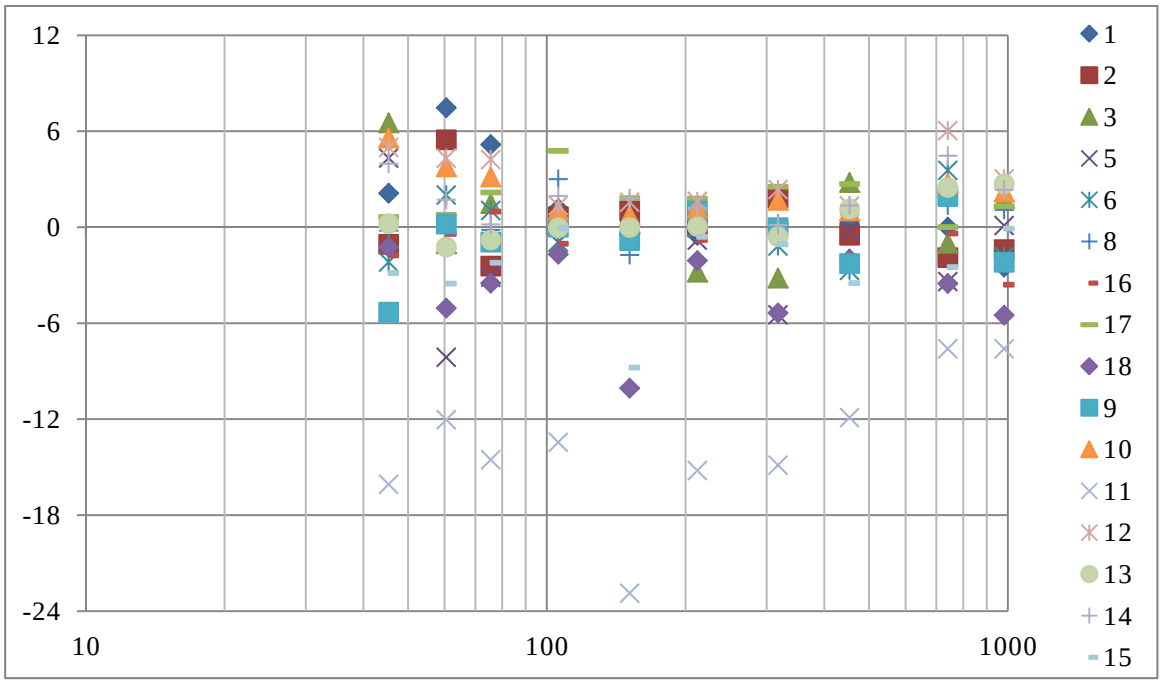

Fig. 16 Difference from the median value of Horizontal Polarization radiated emission measurement

(3) Vertical Polarization radiated emission measurement

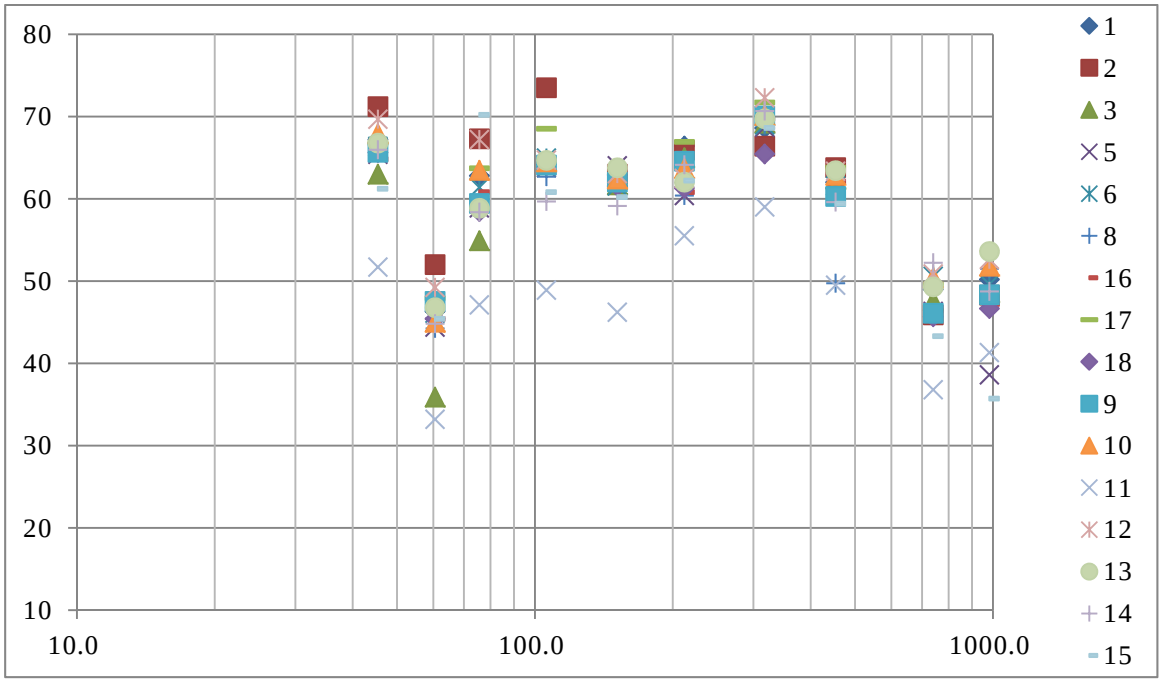

Fig. 17 Vertical Polarization radiated emission measurement result in dBμV/m

Table 15 Basic data of Vertical polarization radiated emission

Frequency (MHz)	Q1	Q2	Q3	IQR	N-IQR	Robust CV	Average	Standard Deviation
	Linear value (μV/m)						Log. value (dBμV/m)	
45.4	1831.0156	2032.9510	2236.3642	405.35	300.48	14.78	65.39(66.30)*	4.19(2.32)*
60.5	171.8247	186.3160	223.1805	51.36	38.07	20.43	44.97(45.76)*	4.41(3.30)*
75.6	866.8920	1016.4807	1500.5646	633.67	469.74	46.21	60.76(61.67)*	5.22(3.98)*
105.9	1455.1307	1678.2629	1717.9084	262.78	194.80	11.61	63.61(64.66)*	4.97(3.14)*
151.3	1174.8976	1241.0439	1400.4107	225.51	167.17	13.47	61.06(62.05)*	4.02(1.25)*
212	1144.2037	1372.3096	1715.0306	570.83	423.15	30.84	62.79(63.28)*	2.76(2.09)*
317.3	2691.5348	2882.3723	3188.3908	496.86	368.32	12.78	68.65(69.29)*	2.98(1.69)*
453.4	993.7439	1273.5031	1430.1415	436.40	323.50	25.40	60.41(61.19)*	4.44(3.47)*
740.7	200.4791	260.8608	312.6374	112.16	83.14	31.87	47.48(48.20)*	3.61(2.41)*
981.8	225.6346	270.7118	336.6546	111.02	82.30	30.40	47.59(48.01)*	4.83(3.85)*

()*: The values when laboratory (code: 11) was exempted as an outlier data.

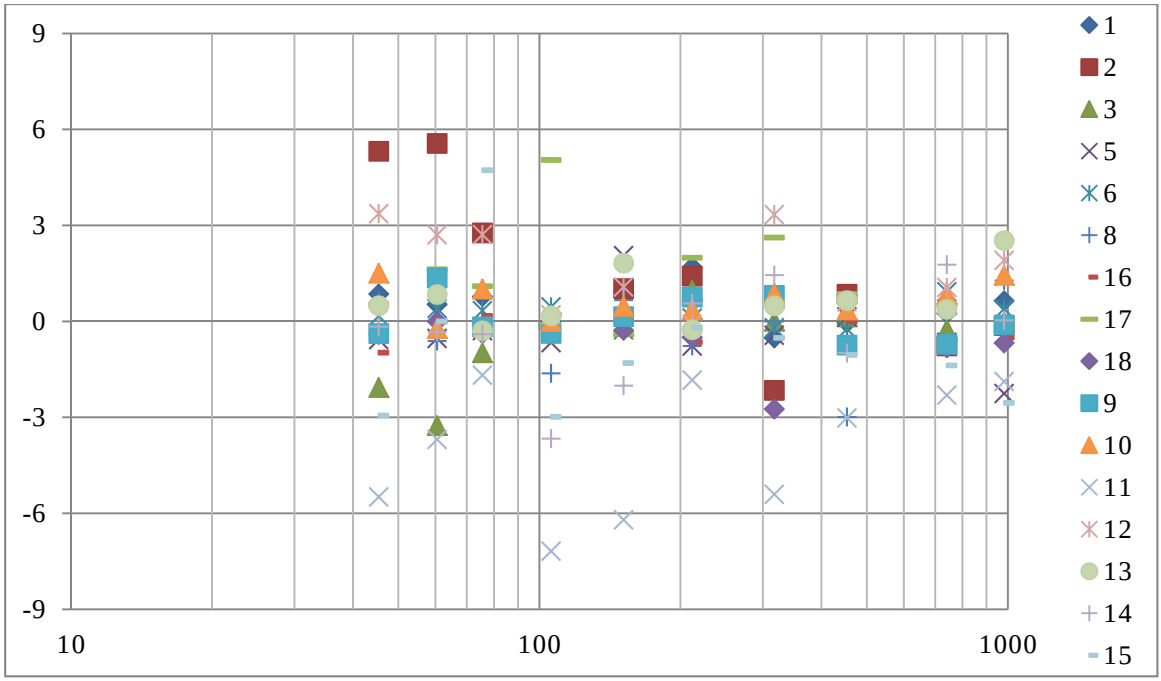

Fig. 18 Z-score by linear value of Vertical Polarization radiated emission measurement

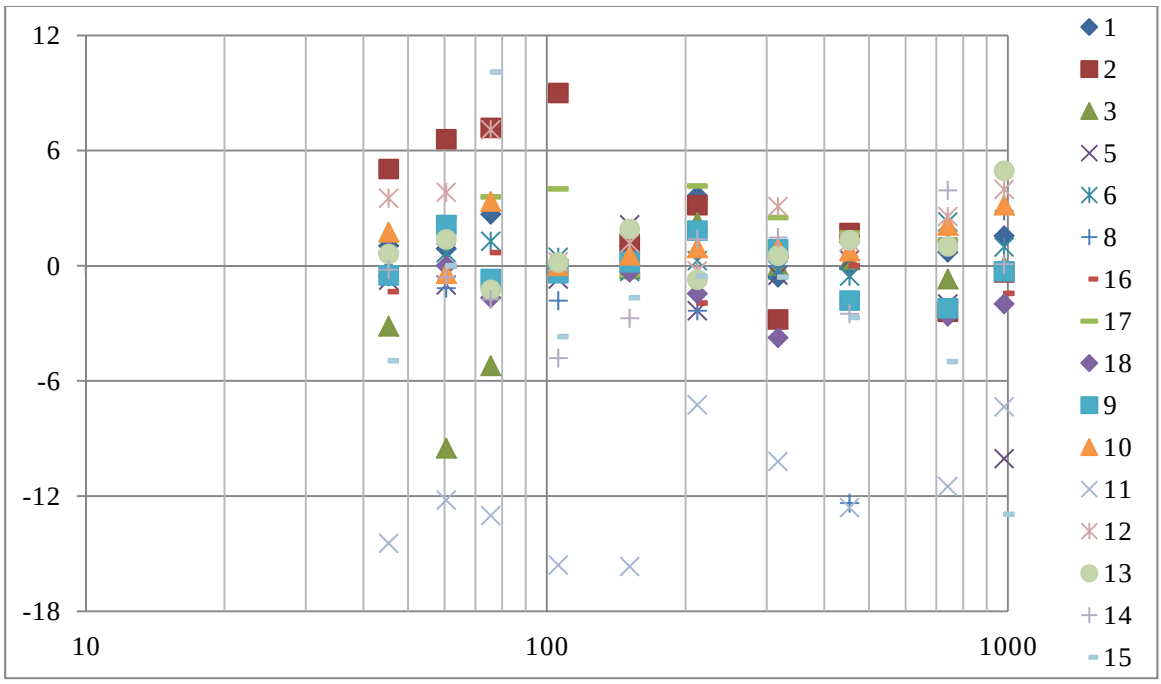

Fig. 19 Difference from the median value of the Vertical Polarization radiated emission measurement

The charts for Z-score and difference from median value are summarized as follows:

(Round-3)

Table 16 Measurement Data of the conducted emission measurement (in dBμV) *(1): mistake of measuring frequency

Freq. (MHz)	Laboratory Code																
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0.219	56.4	53.6	55.4	53.2	52.4	55.0	56.7	*(1)	54.3	*(1)	57.2	54.5	54.8	*(1)	*(1)	*(1)	*(1)
0.439	46.5	44.8	45.7	41.1	44.4	45.8	48.9	*(1)	44.4	*(1)	46.6	44.8	44.6	45.1	*(1)	*(1)	45.8
2.62	39.3	37.5	38.6	26.9	36.2	40.2	40.7	*(1)	37.1	*(1)	40.8	39.7	38.8	*(1)	*(1)	*(1)	*(1)
3.71	42.7	38.7	41.3	28.1	38.6	42.9	44.3	1.5	39.2	10.3	43.4	42.0	42.6	40.9	9.1	41.2	38.5
7.45	35.9	25.5	34.5	27.9	31.6	31.2	36.1	32.9	33.3	31.8	37.0	36.3	35.4	30.4	21.5	36.0	34.1
15.1	62.2	60.9	59.5	23.9	55.8	62.5	62.6	62.1	64.6	62.8	63.0	62.5	63.2	64.1	60.0	68.1	61.6

Table 17 Measurement Data of the radiated emission measurement (in dBμV/m) *(2): High ambient noise in the system
(Horizontal Polarization) *(4): No data submission

Freq. (MHz)	Laboratory Code																
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18
45.4	52.2	49.0	56.6	54.4	47.9	*(4)	49.9	44.8	55.6	34.0	55.1	50.3	54.0	47.2	48.3	50.7	48.8
60.5	43.4	41.4	34.9	27.8	37.9	*(4)	35.7	36.1	39.7	23.9	40.3	34.7	37.6	32.4	35.5	36.7	30.9
75.6	63.0	55.4	59.3	54.7	58.9	*(4)	57.7	56.9	61.0	43.3	62.1	57.0	58.0	55.6	58.8	60.0	54.3
105.9	59.9	59.4	*(2)	57.8	57.8	*(4)	61.7	58.7	59.8	45.3	60.1	58.7	60.7	58.7	57.7	63.5	57.1
151.3	64.1	65.6	64.8	64.6	64.4	*(4)	62.8	63.7	65.3	41.7	66.2	64.6	66.4	55.8	64.8	66.4	54.5
212.0	67.1	67.8	64.8	66.8	67.6	*(4)	68.3	68.6	68.8	52.4	69.2	67.7	68.8	67.0	66.8	69.4	65.5
317.3	70.7	72.5	67.5	65.2	69.5	*(4)	70.9	70.7	72.4	55.8	73.0	70.1	70.8	69.6	70.9	73.2	65.3
453.4	60.6	59.9	63.2	60.2	57.7	*(4)	61.3	58.1	61.4	48.5	61.7	61.5	61.8	56.9	57.9	63.1	58.4
740.7	48.2	46.3	47.2	44.8	51.8	*(4)	49.6	50.1	51.0	40.6	54.2	50.7	52.7	45.7	47.8	48.2	44.7
981.8	46.2	47.3	50.5	48.8	46.9	*(4)	49.8	46.5	50.9	41.1	51.7	51.4	51.0	48.6	45.1	50.0	43.2

Table 18 Measurement Data of the radiated emission measurement (in dBμV/m) *(2): High ambient noise in the system
(Vertical Polarization) *(4): No data submission *(5): Misentry of data

Freq. (MHz)	Laboratory Code																
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18
45.4	67.2	71.2	63.0	65.4	66.4	*(4)	66.9	65.7	67.9	51.7	69.7	66.8	66.0	61.2	64.8	66.8	65.6
60.5	46.3	52.0	35.9	44.4	46.1	*(4)	44.2	47.5	45.0	33.2	49.2	46.8	44.8	45.4	45.4	47.9	45.4
75.6	62.8	67.3	54.9	58.9	61.4	*(4)	59.3	59.4	63.5	47.1	67.2	58.9	58.4	70.2	60.8	63.7	58.5
105.9	64.5	73.5	*(2)	63.8	64.9	*(4)	62.7	64.1	64.5	48.9	64.7	64.7	59.7	60.8	64.7	68.5	64.2
151.3	62.9	63.0	61.7	64.0	61.6	*(4)	62.6	62.0	62.4	46.2	63.1	63.8	59.1	60.2	61.4	61.4	61.5
212.0	66.4	65.9	65.0	60.4	63.0	*(4)	60.4	64.6	63.7	55.5	62.5	62.0	64.1	62.2	60.8	66.9	61.3
317.3	68.6	66.4	69.2	68.7	69.0	*(4)	69.2	70.1	70.1	59.0	72.3	69.7	70.7	68.6	69.7	71.7	65.5
453.4	62.0	63.8	62.4	62.4	61.6	*(4)	49.7	60.3	62.9	49.5	63.4	63.4	59.6	59.4	62.1	63.8	*(5)
740.7	49.0	45.9	47.6	46.3	50.6	*(4)	49.7	46.1	50.4	36.8	50.9	49.3	52.2	43.3	46.4	49.6	45.7
981.8	50.2	48.3	48.6	38.6	49.6	*(4)	51.5	48.4	51.8	41.3	52.6	53.6	48.7	35.7	47.2	48.7	46.7

Table 19 Z-score of the conducted emission measurement *(1): mistake of measuring frequency

Freq. (MHz)	Laboratory Code																
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0.219	1.19	-0.76	0.42	-0.99	-1.40	0.14	1.41	*(1)	-0.34	*(1)	1.86	-0.21	0.00	*(1)	*(1)	*(1)	*(1)
0.439	1.69	-0.33	0.69	-3.56	-0.75	0.81	5.34	*(1)	-0.76	*(1)	1.87	-0.35	-0.54	0.00	*(1)	*(1)	0.76
2.62	0.27	-0.63	-0.10	-3.36	-1.16	0.79	1.10	*(1)	-0.82	*(1)	1.15	0.47	0.00	*(1)	*(1)	*(1)	*(1)
3.71	0.69	-0.67	0.14	-2.32	-0.69	0.77	1.42	-2.97	-0.53	-2.92	0.98	0.42	0.65	0.00	-2.93	0.11	-0.73
7.45	0.82	-1.43	0.34	-1.12	-0.43	-0.53	0.89	-0.12	0.00	-0.39	1.25	0.98	0.64	-0.69	-1.79	0.86	0.22
15.1	-0.18	-0.98	-1.76	-6.03	-3.26	0.00	0.11	-0.25	1.70	0.24	0.37	0.01	0.54	1.27	-1.51	5.58	-0.59

Table 20 Z-score of the radiated emission measurement *(2): High ambient noise in the system, *(4): No data submission
(Horizontal Polarization)

Freq. (MHz)	Laboratory Code																
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18
45.4	0.47	-0.20	1.91	1.10	-0.38	*(4)	-0.04	-0.78	1.54	-1.44	1.33	0.04	0.99	-0.48	-0.32	0.13	-0.23
60.5	3.57	2.30	-0.29	-1.59	0.68	*(4)	-0.06	0.06	1.43	-1.97	1.69	-0.35	0.57	-0.88	-0.13	0.24	-1.16
75.6	2.49	-0.75	0.56	-0.93	0.39	*(4)	-0.06	-0.31	1.34	-2.49	1.92	-0.27	0.06	-0.69	0.36	0.87	-1.02
105.9	0.75	0.41	*(2)	-0.53	-0.53	*(4)	2.16	0.00	0.70	-4.11	0.88	-0.02	1.32	-0.02	-0.59	3.82	-0.92
151.3	-0.34	0.80	0.16	0.01	-0.16	*(4)	-1.16	-0.58	0.56	-5.94	1.27	-0.01	1.48	-4.07	0.16	1.49	-4.39
212	-0.35	0.14	-1.70	-0.55	-0.03	*(4)	0.52	0.76	0.93	-5.09	1.26	0.03	0.93	-0.42	-0.55	1.41	-1.32
317.3	0.01	1.29	-1.69	-2.58	-0.70	*(4)	0.13	-0.01	1.18	-4.52	1.71	-0.36	0.09	-0.64	0.14	1.86	-2.54
453.4	0.16	-0.39	2.64	-0.16	-1.86	*(4)	0.76	-1.59	0.87	-5.18	1.14	0.97	1.17	-2.31	-1.74	2.53	-1.42
740.7	0.00	-0.48	-0.27	-0.79	1.24	*(4)	0.41	0.61	0.91	-1.42	2.45	0.81	1.64	-0.61	-0.11	0.00	-0.81
981.8	-0.71	-0.42	0.66	0.03	-0.55	*(4)	0.38	-0.63	0.82	-1.66	1.19	1.05	0.88	-0.03	-0.97	0.46	-1.34

Table 21 Z-score of the radiated emission measurement *(2): High ambient noise in the system, *(4): No data submission
(Vertical Polarization) *(5): Misentry of data

Freq. (MHz)	Laboratory Code																
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18
45.4	0.86	5.32	-2.06	-0.57	0.16	*(4)	0.62	-0.38	1.51	-5.49	3.37	0.49	-0.16	-2.94	-0.98	0.52	-0.41
60.5	0.53	5.56	-3.26	-0.53	0.40	*(4)	-0.61	1.36	-0.22	-3.69	2.71	0.84	-0.33	0.00	0.00	1.63	0.00
75.6	0.77	2.77	-0.98	-0.29	0.33	*(4)	-0.19	-0.17	1.01	-1.68	2.71	-0.30	-0.40	4.72	0.17	1.10	-0.38
105.9	0.00	15.67	*(2)	-0.66	0.45	*(4)	-1.63	-0.37	0.00	-7.19	0.20	0.17	-3.67	-2.99	0.20	5.04	-0.28
151.3	0.93	1.03	-0.15	2.06	-0.27	*(4)	0.66	0.15	0.47	-6.20	1.07	1.82	-2.01	-1.30	-0.40	-0.40	-0.28
212	1.69	1.42	0.96	-0.77	0.10	*(4)	-0.77	0.76	0.36	-1.84	-0.10	-0.26	0.56	-0.20	-0.65	1.99	-0.50
317.3	-0.52	-2.15	0.00	-0.43	-0.20	*(4)	0.00	0.82	0.87	-5.41	3.34	0.49	1.45	-0.52	0.47	2.62	-2.74
453.4	-0.05	0.85	0.14	0.14	-0.24	*(4)	-2.99	-0.74	0.36	-3.01	0.61	0.65	-0.99	-1.05	0.00	0.85	*(5)
740.7	0.25	-0.77	-0.25	-0.65	0.93	*(4)	0.55	-0.71	0.84	-2.31	1.06	0.38	1.77	-1.38	-0.62	0.49	-0.83
981.8	0.64	-0.13	-0.02	-2.26	0.39	*(4)	1.28	-0.11	1.44	-1.88	1.91	2.53	0.03	-2.55	-0.51	0.02	-0.67

Table 22 Difference from the median value of conducted emission measurement (in dB) *(1): mistake of measuring frequency

Freq. (MHz)	Laboratory Code																
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0.219	1.6	-1.2	0.6	-1.6	-2.4	0.2	1.9	*(1)	-0.5	*(1)	2.4	-0.3	0.0	*(1)	*(1)	*(1)	*(1)
0.439	1.4	-0.3	0.6	-4.0	-0.7	0.7	3.8	*(1)	-0.7	*(1)	1.5	-0.3	-0.5	0.0	*(1)	*(1)	0.7
2.62	0.5	-1.3	-0.2	-11.9	-2.6	1.4	1.9	*(1)	-1.7	*(1)	2.0	0.9	0.0	*(1)	*(1)	*(1)	*(1)
3.71	1.8	-2.2	0.4	-12.8	-2.3	2.0	3.4	-39.4	-1.7	-30.6	2.5	1.1	1.7	0.0	-31.8	0.3	-2.4
7.45	2.6	-7.8	1.2	-5.4	-1.7	-2.2	2.7	-0.4	0.0	-1.5	3.6	3.0	2.1	-2.9	-11.8	2.7	0.8
15.1	-0.3	-1.5	-3.0	-38.6	-6.6	0.0	0.2	-0.4	2.1	0.3	0.5	0.0	0.7	1.6	-2.5	5.6	-0.9

Table 23 Difference from the median value of radiated emission measurement (in dB) *(2): High ambient noise in the system
(Horizontal Polarization) *(4): No data submission

Freq. (MHz)	Laboratory Code																
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18
45.4	2.1	-1.1	6.5	4.3	-2.2	*(4)	-0.2	-5.3	5.6	-16.1	5.0	0.2	4.0	-2.9	-1.8	0.6	-1.3
60.5	7.5	5.5	-1.0	-8.1	2.0	*(4)	-0.2	0.2	3.8	-12.0	4.3	-1.2	1.7	-3.5	-0.4	0.8	-5.1
75.6	5.2	-2.4	1.5	-3.1	1.0	*(4)	-0.2	-0.9	3.1	-14.5	4.2	-0.8	0.2	-2.2	1.0	2.2	-3.5
105.9	1.2	0.7	*(2)	-0.9	-0.9	*(4)	3.0	0.0	1.1	-13.4	1.4	0.0	2.0	0.0	-1.0	4.8	-1.7
151.3	-0.5	1.0	0.2	0.0	-0.2	*(4)	-1.7	-0.8	0.7	-22.9	1.6	0.0	1.8	-8.8	0.2	1.8	-10.1
212	-0.5	0.2	-2.8	-0.8	0.0	*(4)	0.7	1.0	1.2	-15.2	1.6	0.0	1.2	-0.6	-0.8	1.8	-2.1
317.3	0.0	1.8	-3.2	-5.5	-1.2	*(4)	0.2	0.0	1.7	-14.9	2.4	-0.6	0.1	-1.1	0.2	2.5	-5.4
453.4	0.2	-0.5	2.8	-0.2	-2.7	*(4)	0.9	-2.3	1.0	-11.9	1.3	1.1	1.4	-3.5	-2.5	2.7	-2.0
740.7	0.0	-1.9	-1.0	-3.4	3.6	*(4)	1.3	1.9	2.8	-7.6	6.0	2.5	4.5	-2.5	-0.4	0.0	-3.5
981.8	-2.5	-1.4	1.8	0.1	-1.9	*(4)	1.1	-2.2	2.2	-7.6	3.0	2.7	2.3	-0.1	-3.6	1.3	-5.5

Table 24 Difference from the median value of radiated emission measurement (in dB) *(2): High ambient noise in the system
(Vertical Polarization) *(4): No data submission *(5): Misentry of data

Freq. (MHz)	Laboratory Code																
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18
45.4	1.0	5.0	-3.2	-0.8	0.2	*(4)	0.8	-0.5	1.7	-14.5	3.5	0.6	-0.2	-5.0	-1.4	0.6	-0.5
60.5	0.9	6.6	-9.5	-1.0	0.7	*(4)	-1.2	2.1	-0.4	-12.2	3.8	1.4	-0.6	0.0	0.0	2.5	0.0
75.6	2.7	7.2	-5.2	-1.2	1.3	*(4)	-0.8	-0.7	3.3	-13.0	7.1	-1.3	-1.8	10.1	0.7	3.6	-1.7
105.9	0.0	9.0	*(2)	-0.7	0.4	*(4)	-1.8	-0.4	0.0	-15.6	0.2	0.2	-4.8	-3.7	0.2	4.0	-0.3
151.3	1.0	1.1	-0.2	2.1	-0.3	*(4)	0.8	0.2	0.5	-15.7	1.2	1.9	-2.7	-1.7	-0.5	-0.5	-0.3
212	3.7	3.2	2.3	-2.4	0.3	*(4)	-2.4	1.8	0.9	-7.3	-0.3	-0.7	1.4	-0.5	-2.0	4.2	-1.5
317.3	-0.6	-2.8	0.0	-0.5	-0.2	*(4)	0.0	0.9	0.9	-10.2	3.1	0.5	1.5	-0.6	0.5	2.5	-3.8
453.4	-0.1	1.7	0.3	0.3	-0.6	*(4)	-12.4	-1.8	0.8	-12.6	1.3	1.3	-2.5	-2.7	0.0	1.7	*(5)
740.7	0.7	-2.4	-0.7	-2.0	2.3	*(4)	1.4	-2.2	2.1	-11.5	2.6	1.0	3.9	-5.0	-1.9	1.3	-2.6
981.8	1.6	-0.4	0.0	-10.1	1.0	*(4)	2.9	-0.3	3.2	-7.4	4.0	5.0	0.1	-13.0	-1.5	0.1	-2.0

Chart Data of Round-3

[Z-score of the conducted emission measurement]

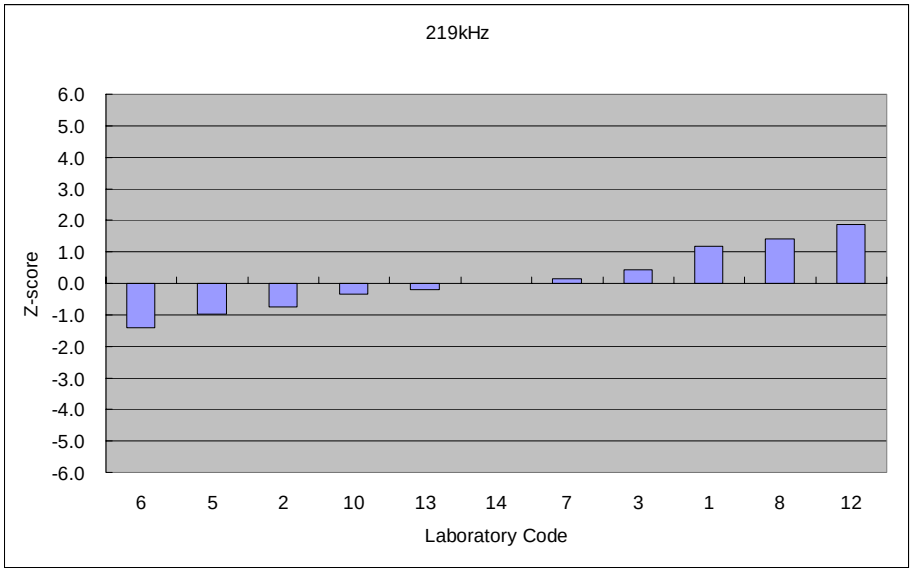

Chart 7-1: Z-score of the conducted emission measurement, 219 kHz

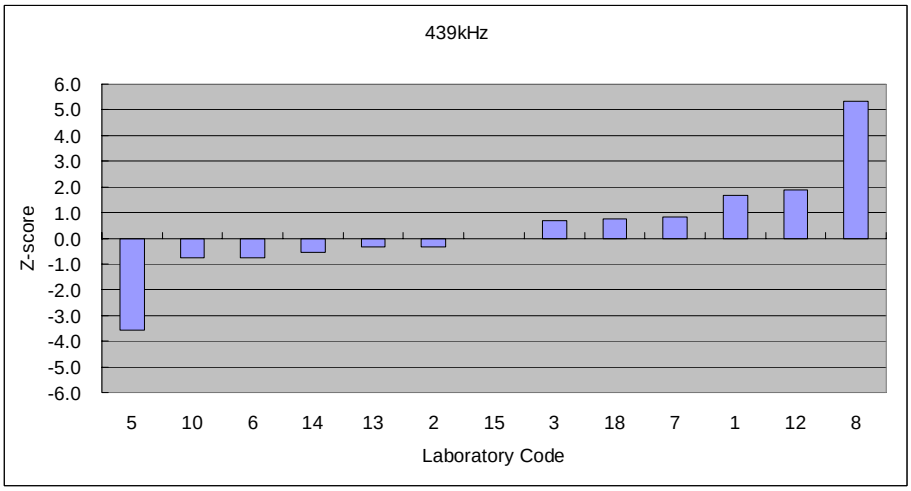

Chart 7-2: Z-score of the conducted emission measurement, 439 kHz

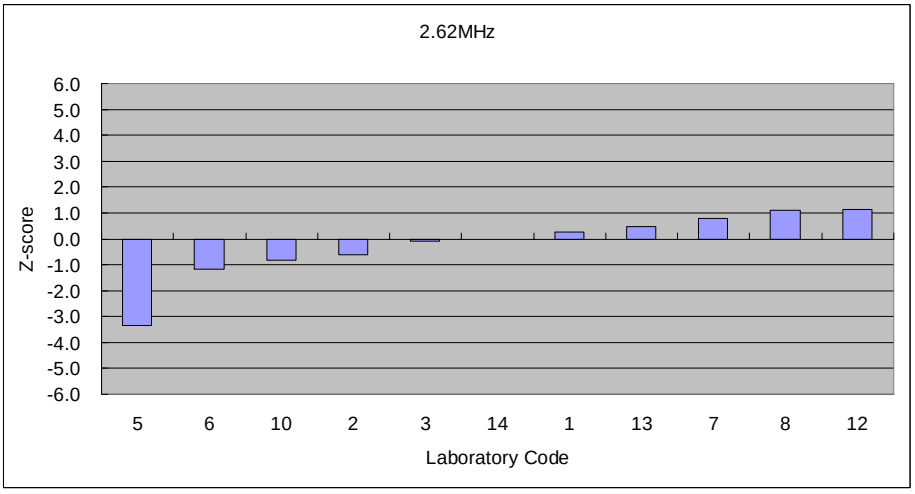

Chart 7-3: Z-score of the conducted emission measurement, 2.62 MHz

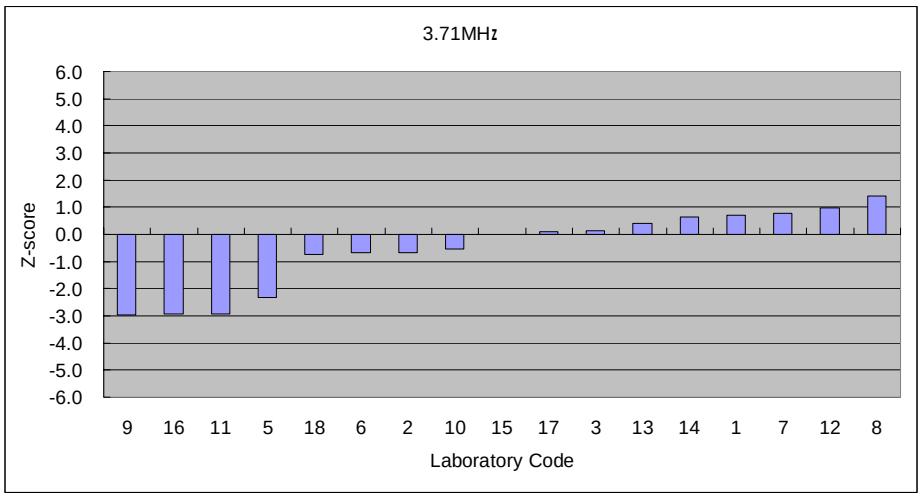

Chart 7-4: Z-score of the conducted emission measurement, 3.71 MHz

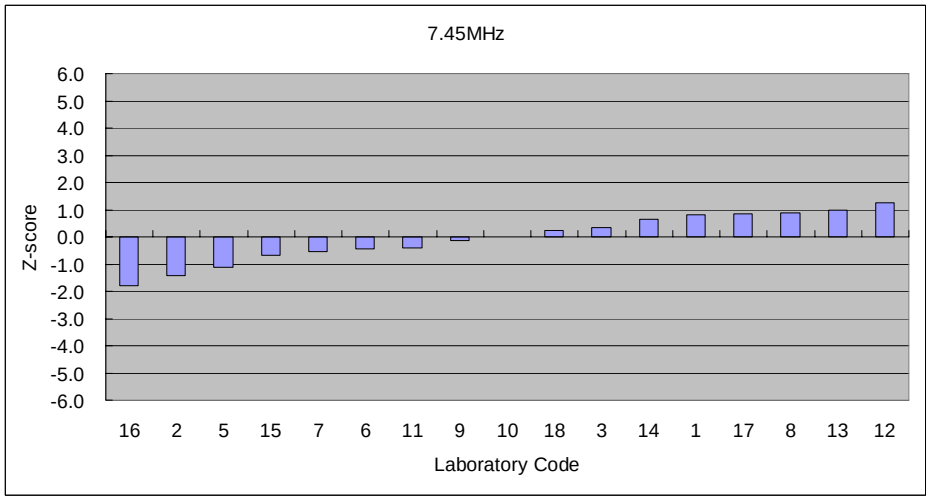

Chart 7-5: Z-score of the conducted emission measurement, 7.45 MHz

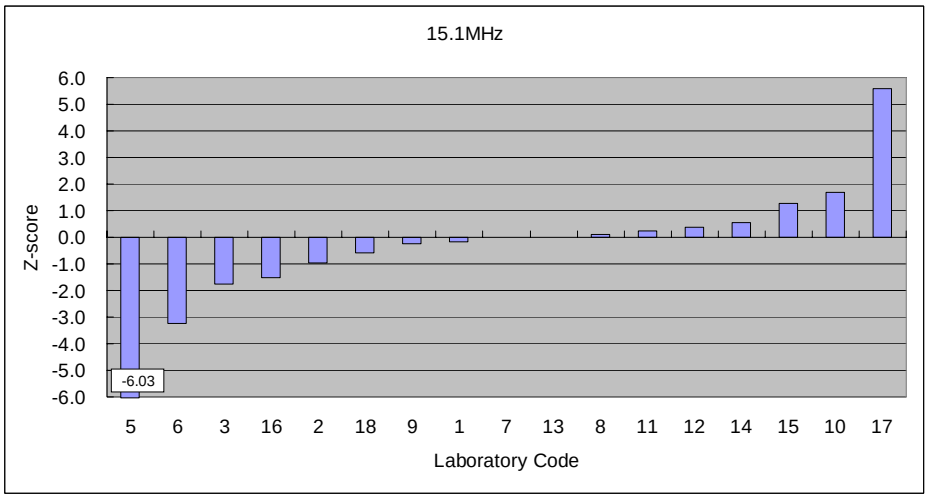

Chart 7-6: Z-score of the conducted emission measurement, 15.1 MHz

[Z-score of the radiated emission measurement]
(Horizontal Polarization)]

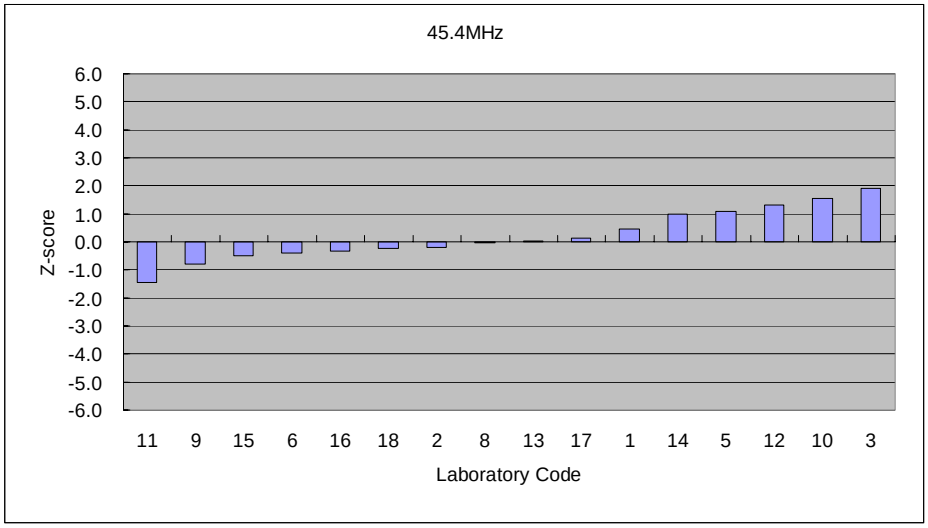

Chart 8-1: Z-score of the radiated emission measurement, Horizontal Polarization, 45.4 MHz

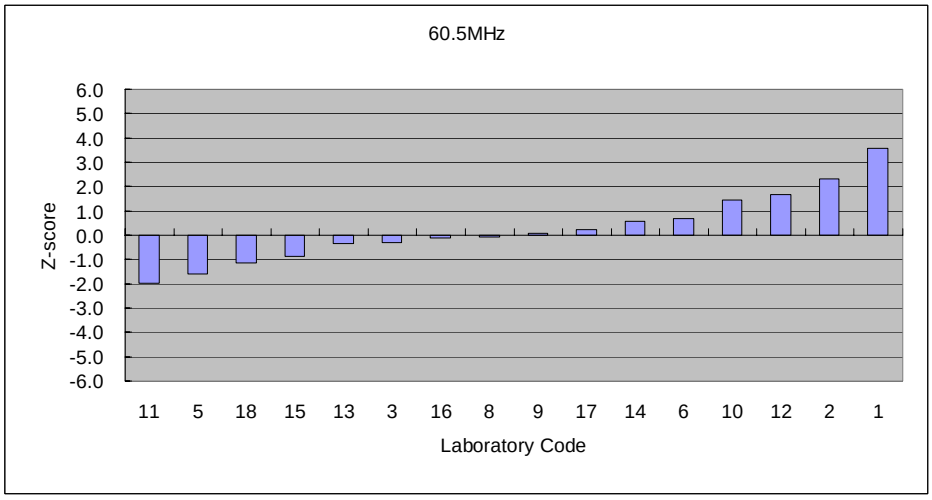

Chart 8-2: Z-score of the radiated emission measurement, Horizontal Polarization, 60.5 MHz

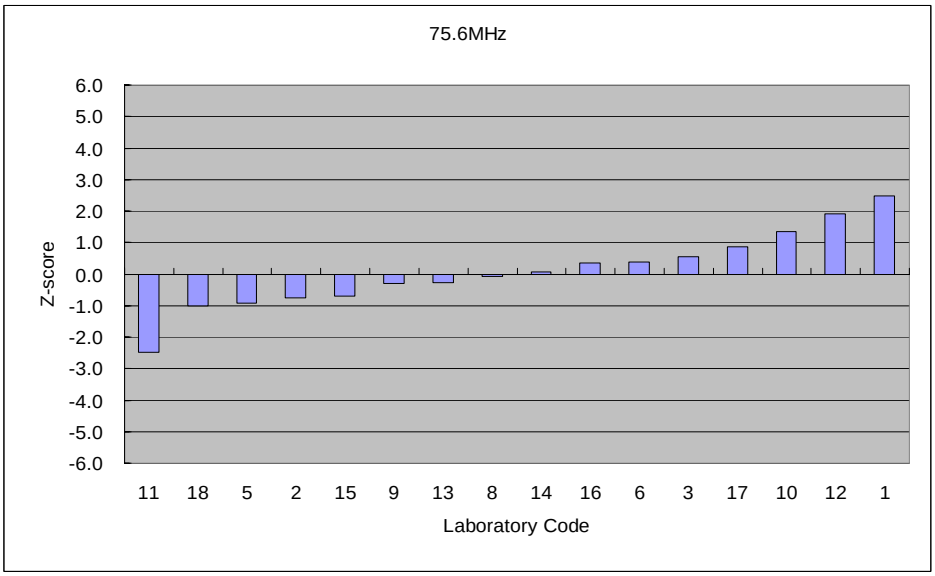

Chart 8-3: Z-score of the radiated emission measurement, Horizontal Polarization, 75.6 MHz

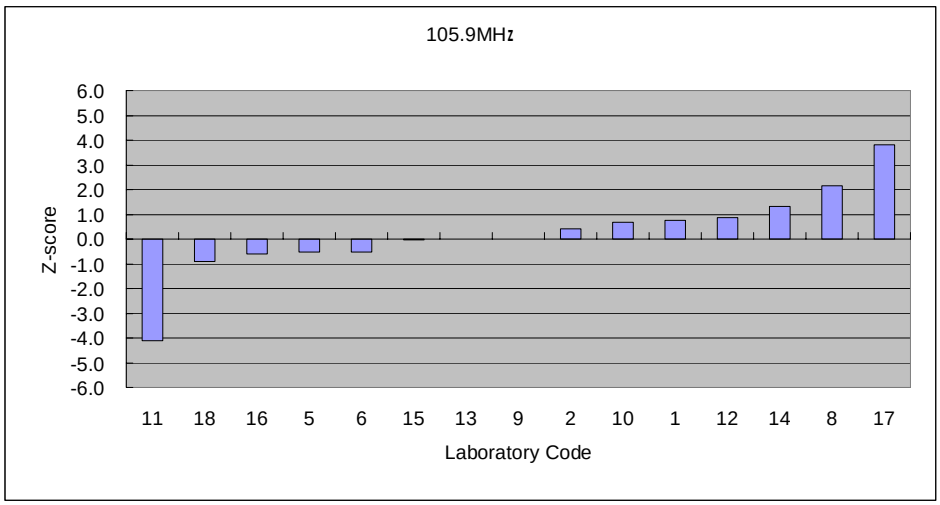

Chart 8-4: Z-score of the radiated emission measurement, Horizontal Polarization, 105.9 MHz

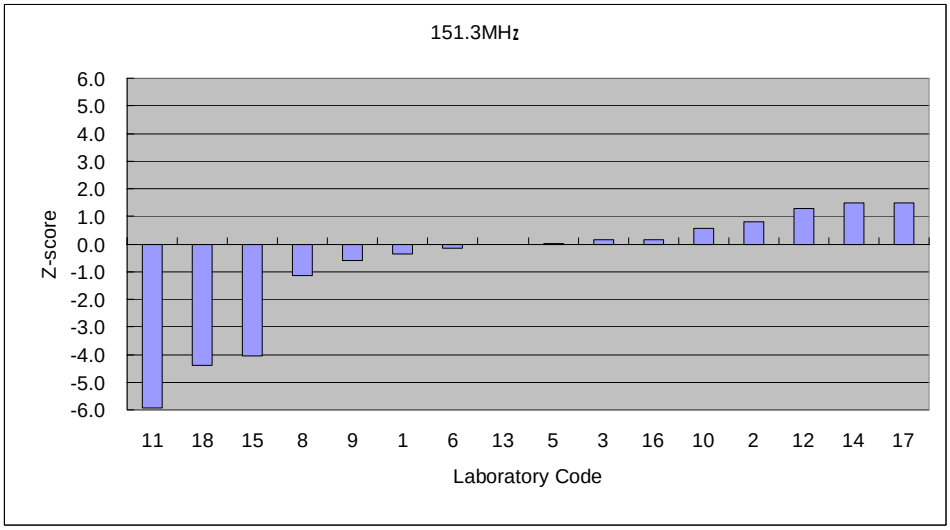

Chart 8-5: Z-score of the radiated emission measurement, Horizontal Polarization, 151.3 MHz

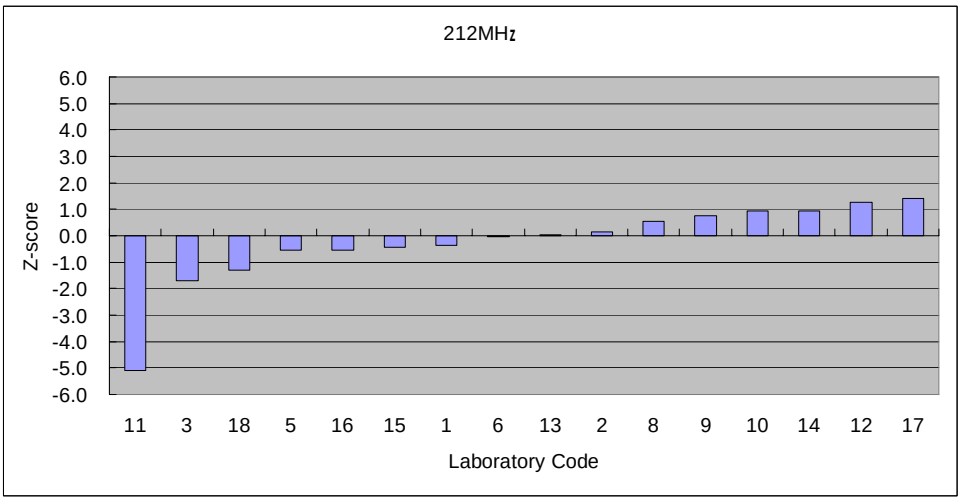

Chart 8-6: Z-score of the radiated emission measurement, Horizontal Polarization, 212.0 MHz

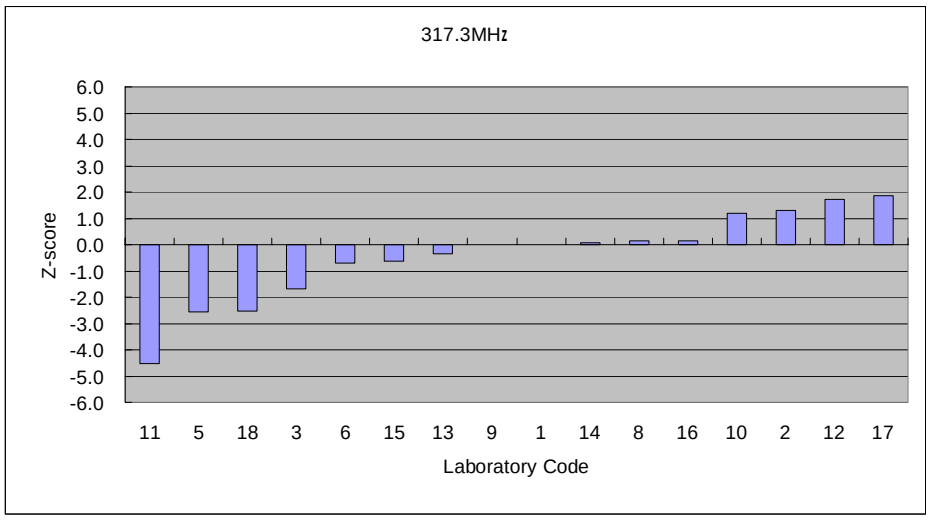

Chart 8-7: Z-score of the radiated emission measurement, Horizontal Polarization, 317.3 MHz

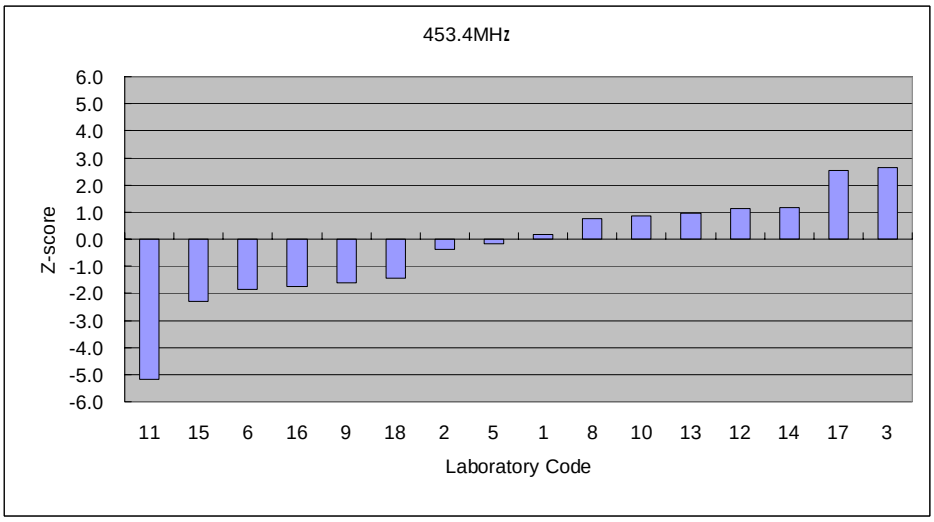

Chart 8-8: Z-score of the radiated emission measurement, Horizontal Polarization, 453.4 MHz

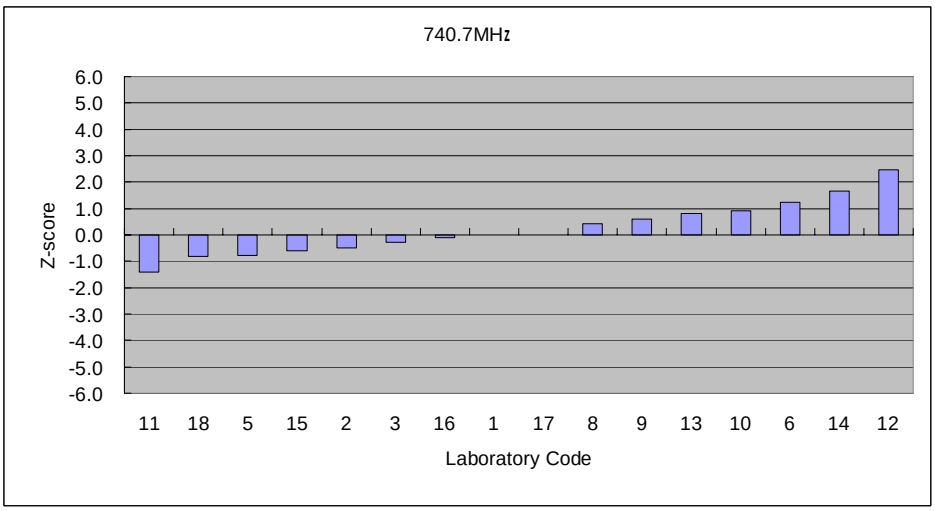

Chart 8-9: Z-score of the radiated emission measurement, Horizontal Polarization, 740.7 MHz

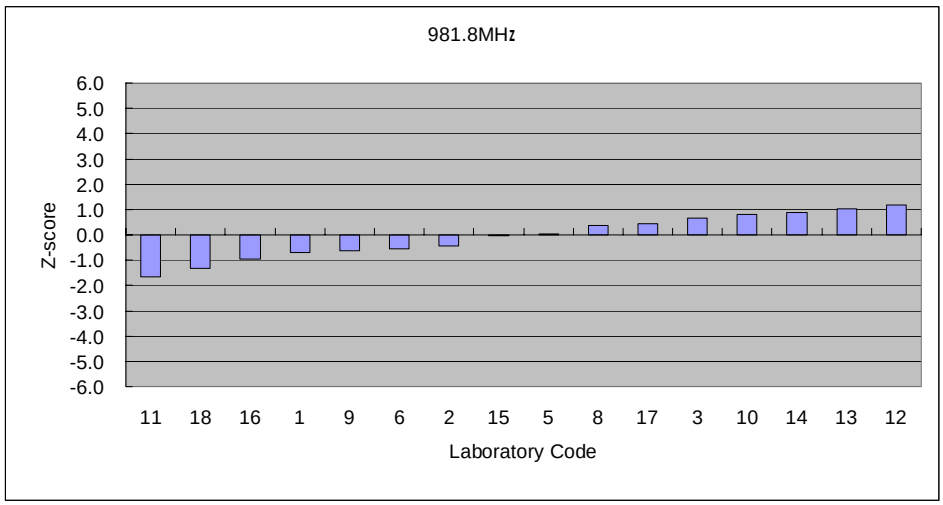

Chart 8-10: Z-score of the radiated emission measurement, Horizontal Polarization, 981.8 MHz

[Z-score of the radiated emission measurement]
(Vertical Polarization)]

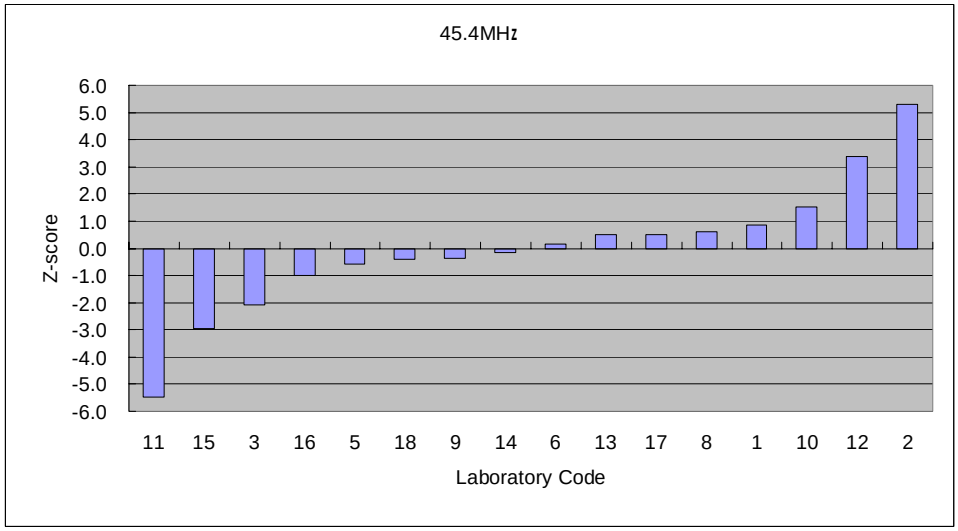

Chart 9-1: Z-score of the radiated emission measurement, Vertical Polarization, 45.4 MHz

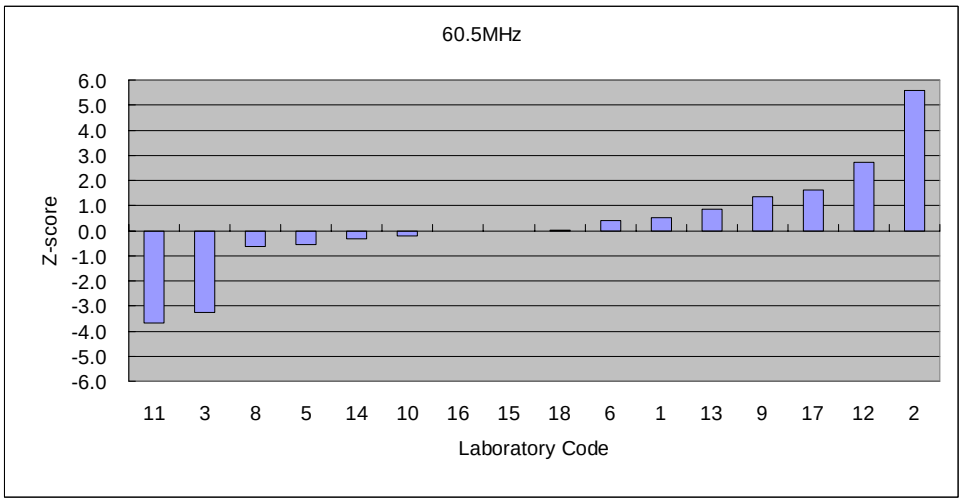

Chart 9-2: Z-score of the radiated emission measurement, Vertical Polarization, 60.5 MHz

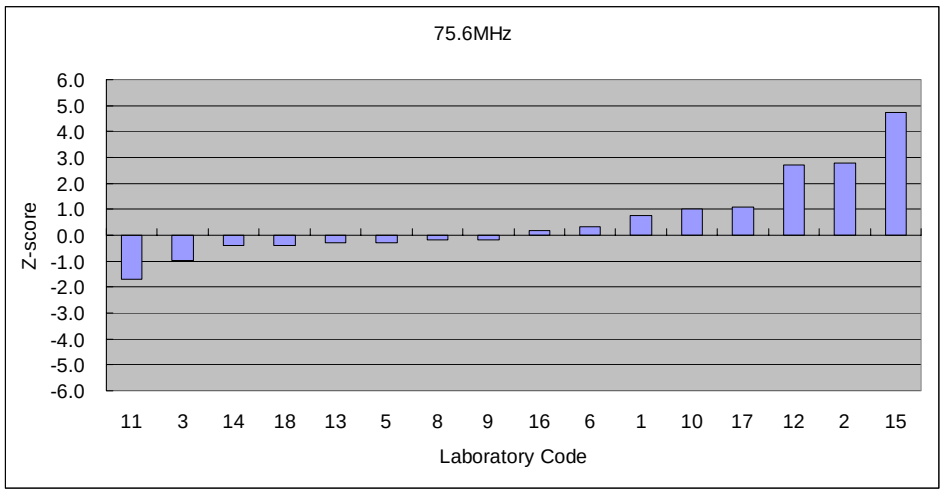

Chart 9-3: Z-score of the radiated emission measurement, Vertical Polarization, 75.6 MHz

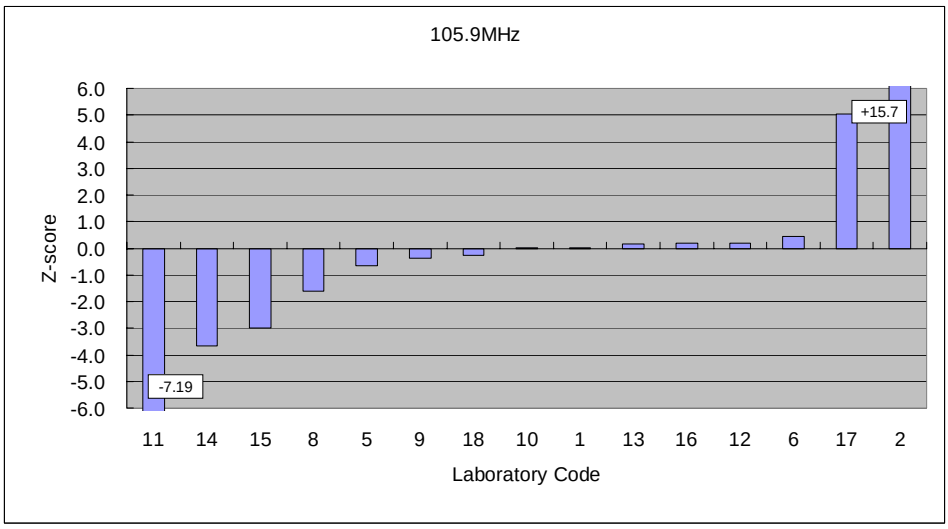

Chart 9-4: Z-score of the radiated emission measurement, Vertical Polarization, 105.9 MHz

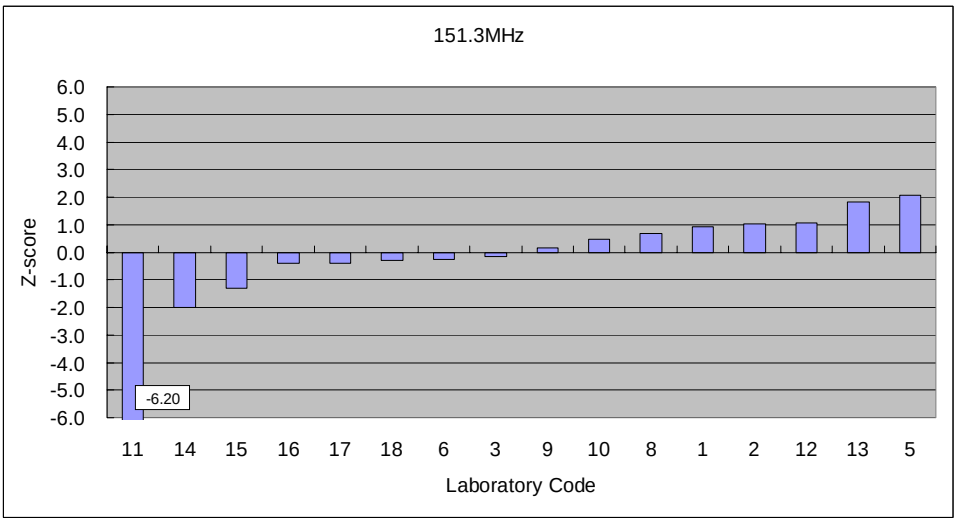

Chart 9-5: Z-score of the radiated emission measurement, Vertical Polarization, 151.3 MHz

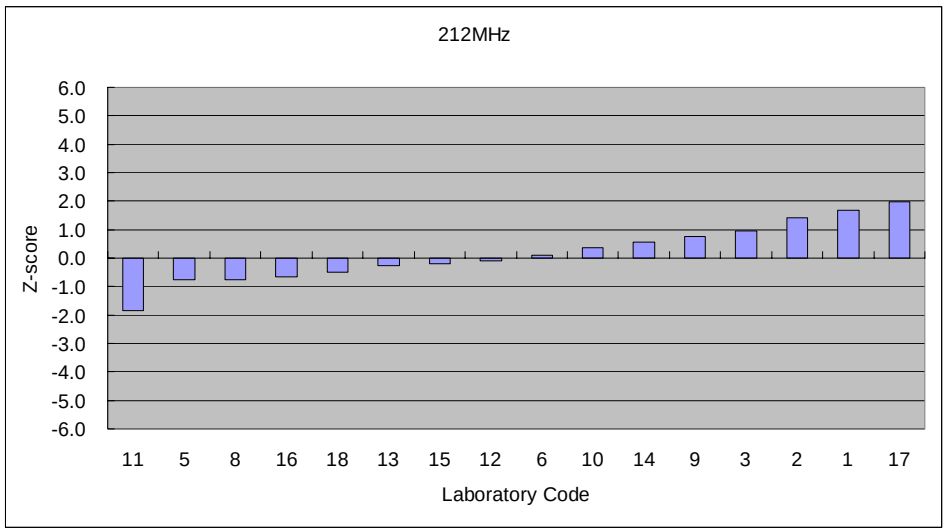

Chart 9-6: Z-score of the radiated emission measurement, Vertical Polarization, 212.0 MHz

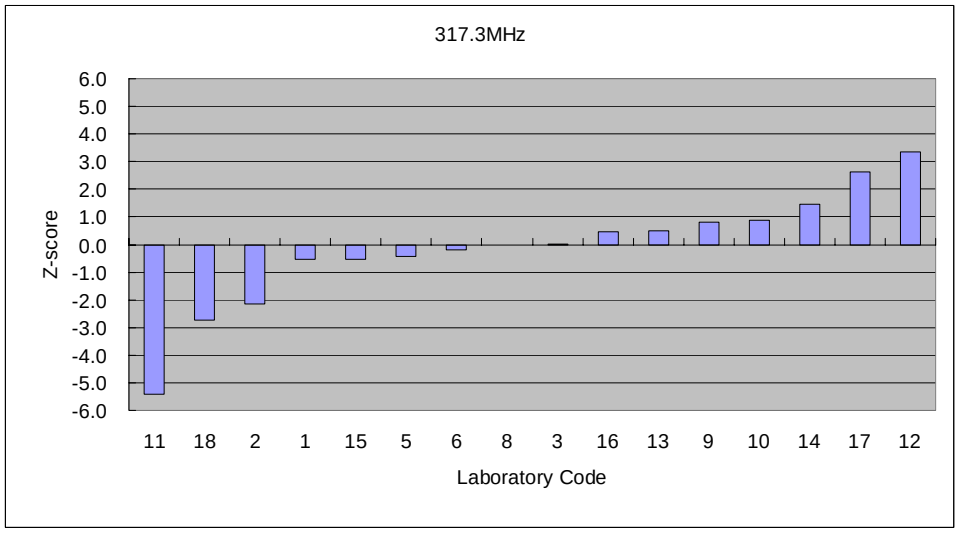

Chart 9-7: Z-score of the radiated emission measurement, Vertical Polarization, 317.3 MHz

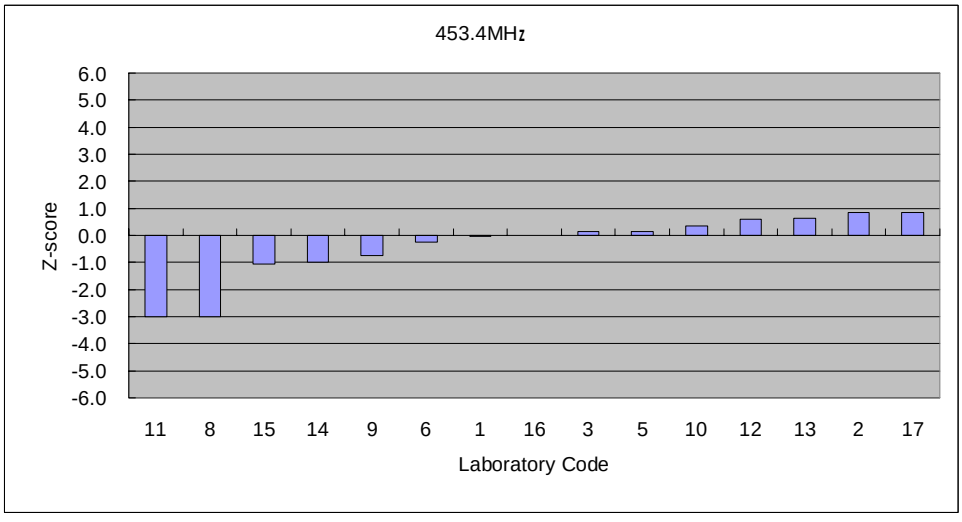

Chart 9-8: Z-score of the radiated emission measurement, Vertical Polarization, 453.4 MHz

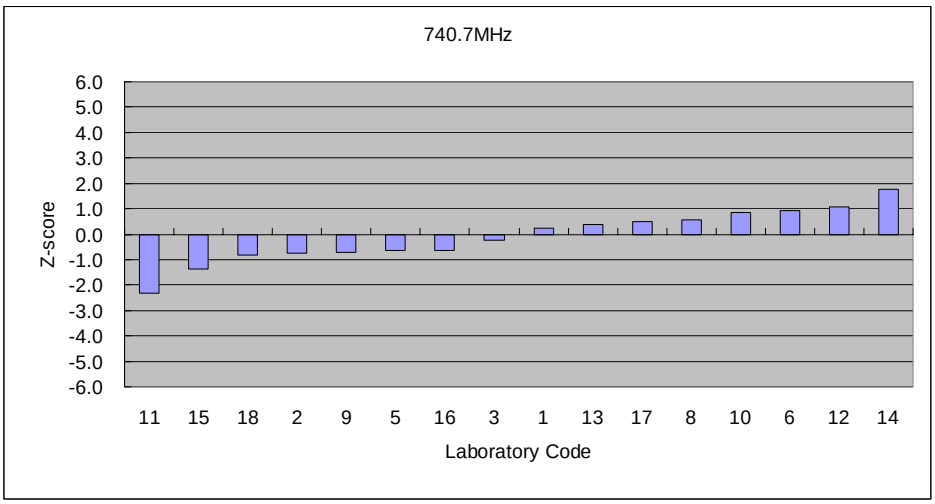

Chart 9-9: Z-score of the radiated emission measurement, Vertical Polarization, 740.7 MHz

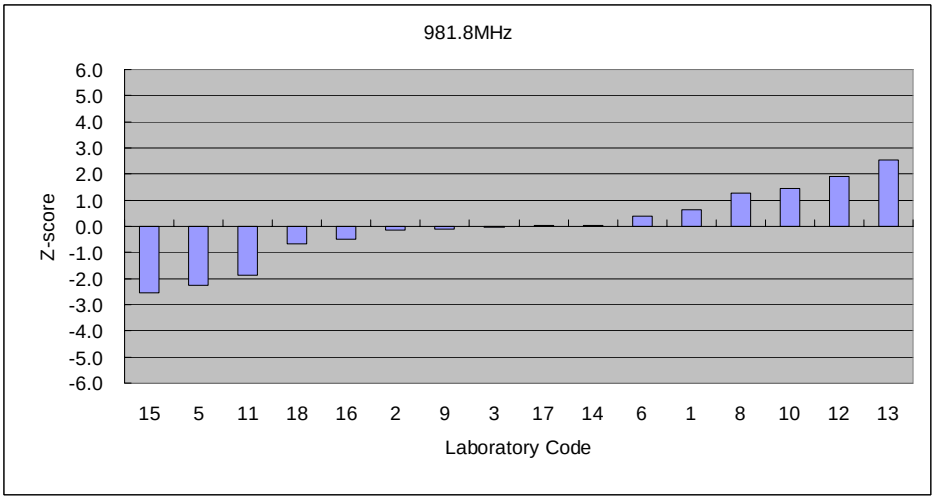

Chart 9-10: Z-score of the radiated emission measurement, Vertical Polarization, 981.8 MHz

[Difference from median Value of the conducted emission measurement]

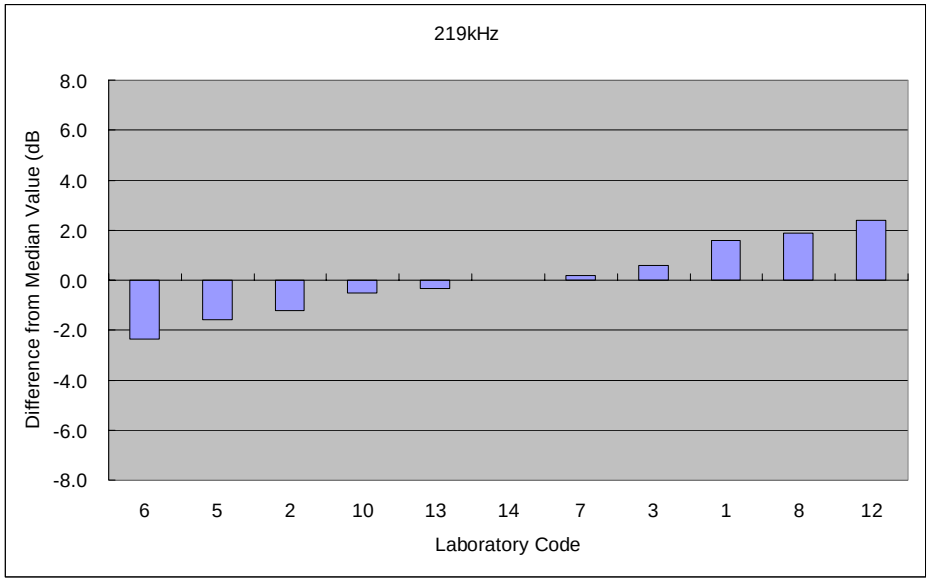

Chart 10-1: Difference from Median Value of the conducted emission measurement, 219 kHz

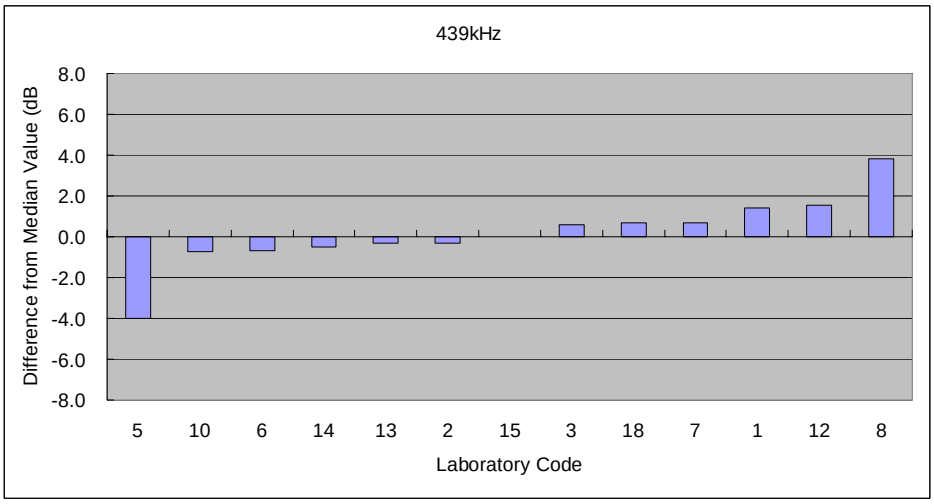

Chart 10-2: Difference from Median Value of the conducted emission measurement, 439 kHz

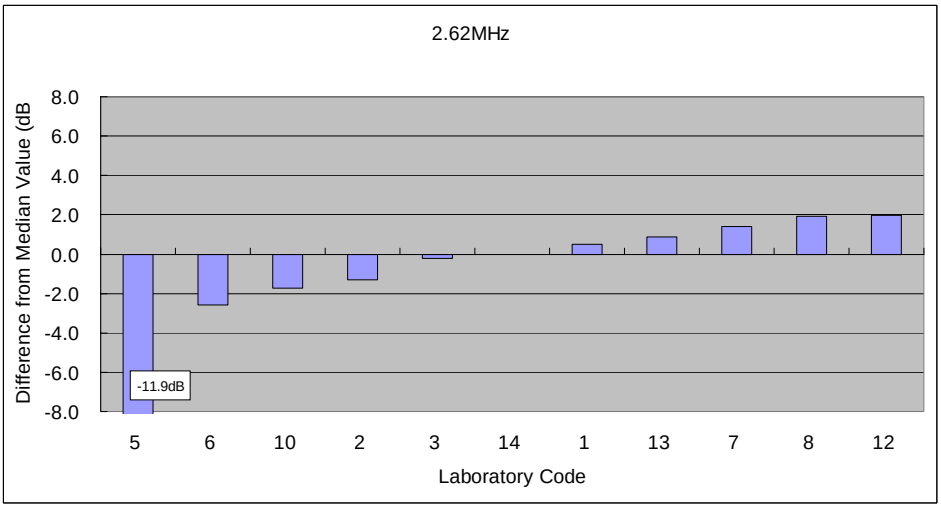

Chart 10-3: Difference from Median Value of the conducted emission measurement, 2.62 MHz

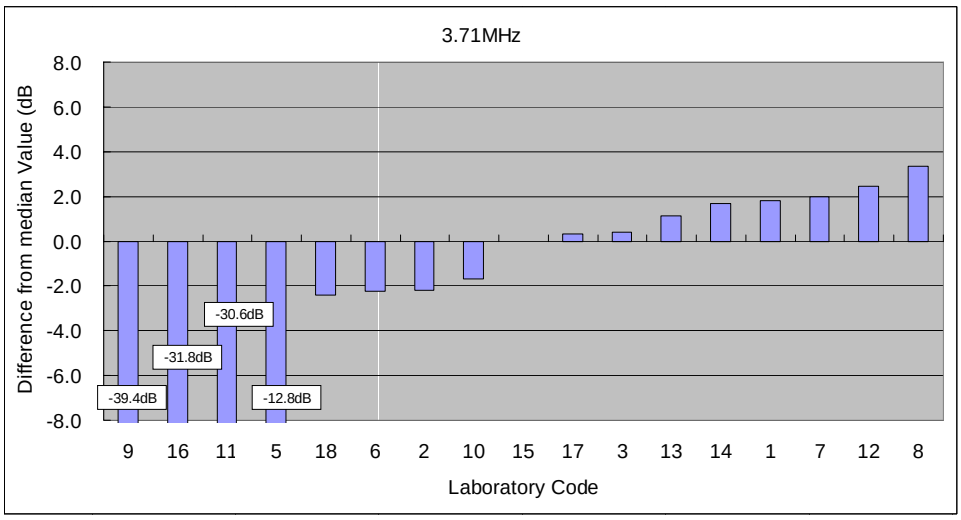

Chart 10-4: Difference from Median Value of the conducted emission measurement, 3.71 MHz

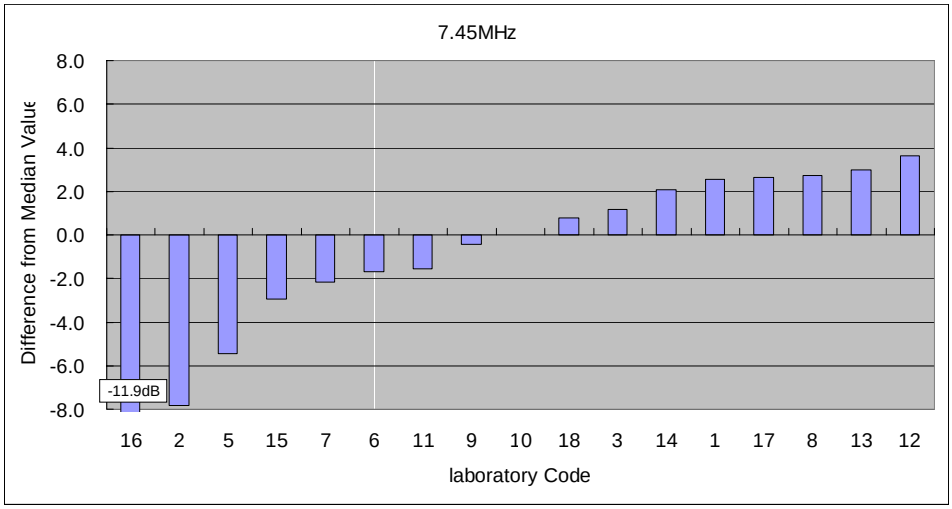

Chart 10-5: Difference from Median Value of the conducted emission measurement, 7.45 MHz

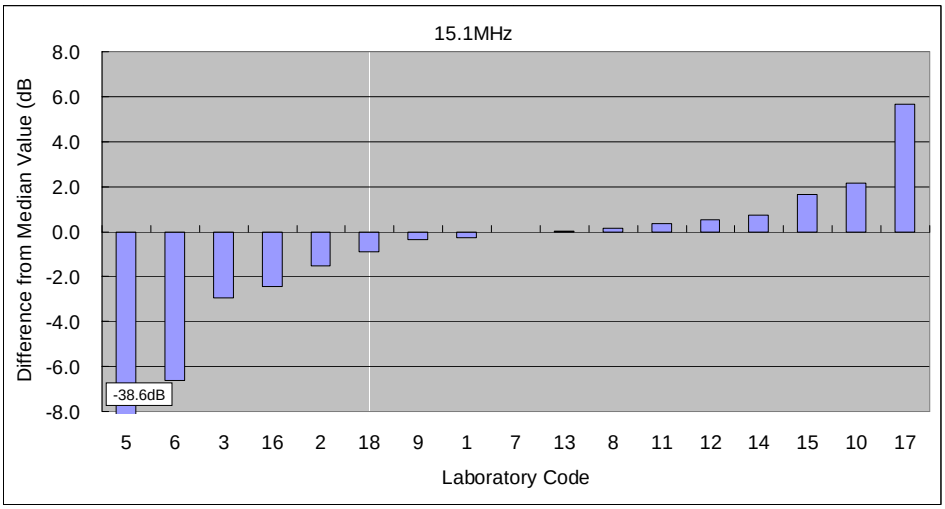

Chart 10-6: Difference from Median Value of the conducted emission measurement, 15.1 MHz

[Difference from Median Value of radiated emission measurement]
(Horizontal Polarization)

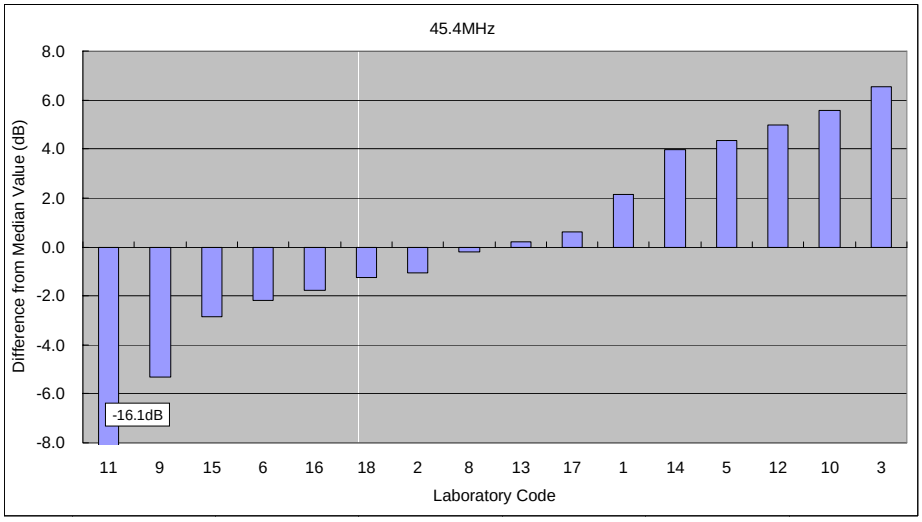

Chart 11-1: Difference from Median Value of the radiated emission measurement, H-pol., 45.4 MHz

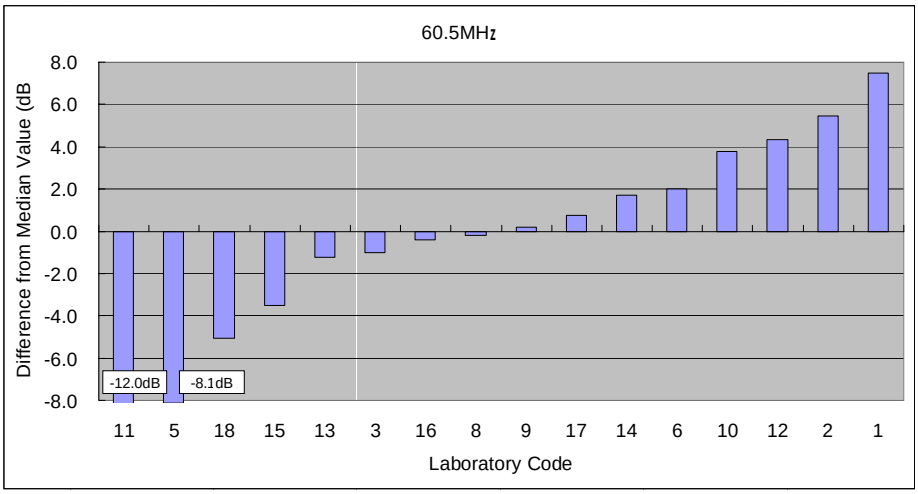

Chart 11-2: Difference from Median Value of the radiated emission measurement, H-pol., 60.5 MHz

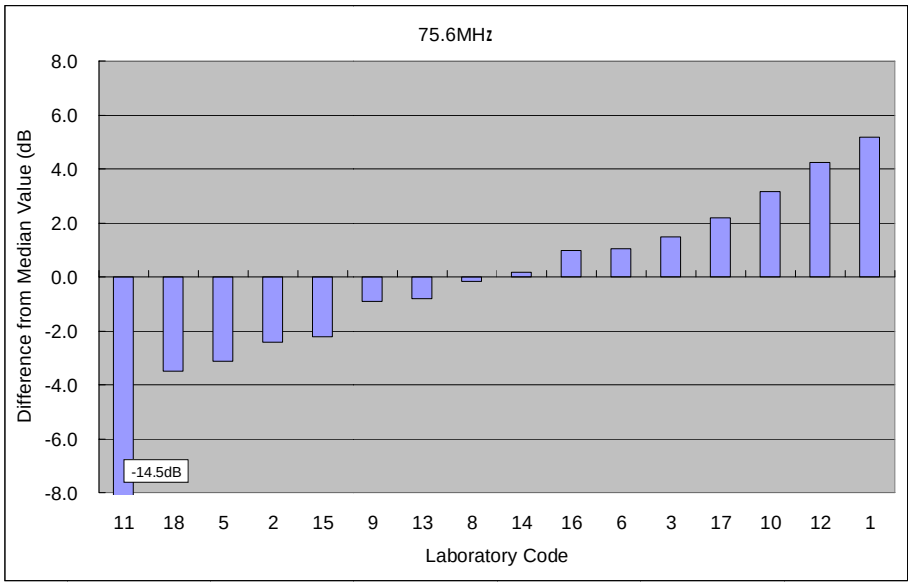

Chart 11-3: Difference from Median Value of the radiated emission measurement, H-pol., 75.6 MHz

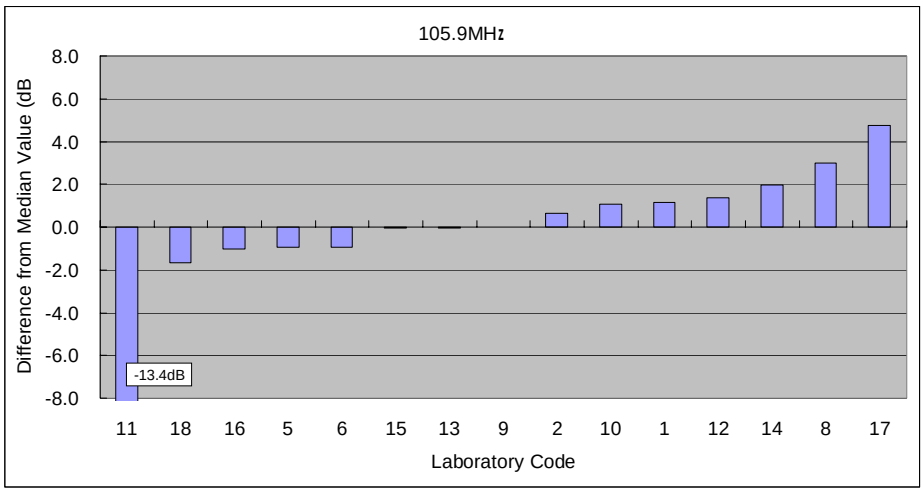

Chart 11-4: Difference from Median Value of the radiated emission measurement, H-pol., 105.9 MHz

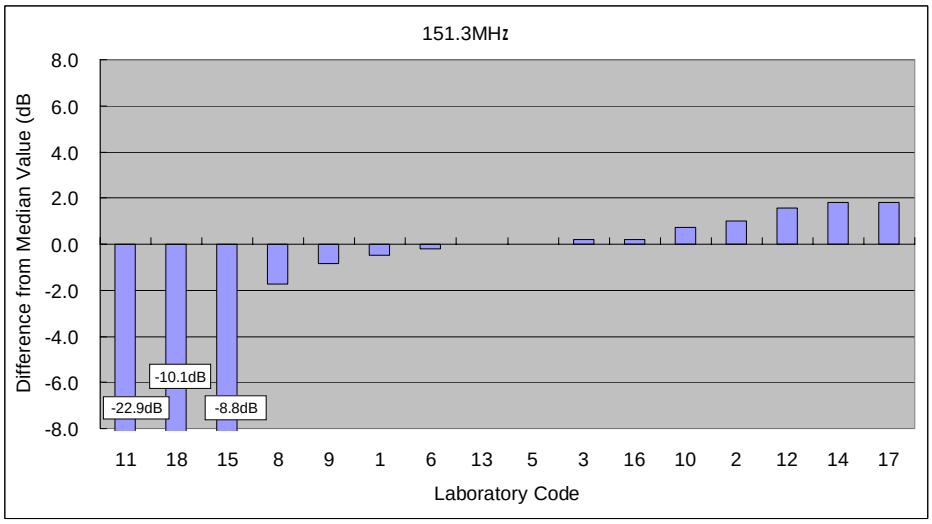

Chart 11-5: Difference from Median Value of the radiated emission measurement, H-pol., 151.3 MHz

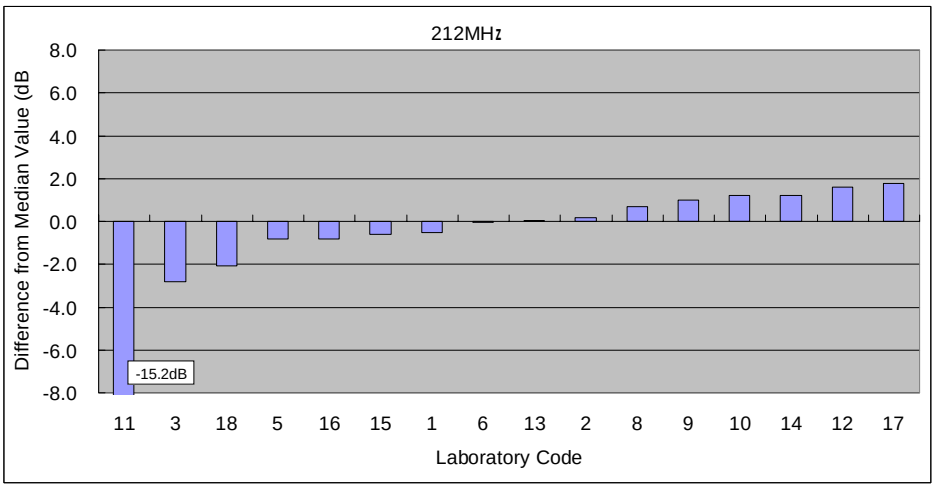

Chart 11-6: Difference from Median Value of the radiated emission measurement, H-pol., 212.0 MHz

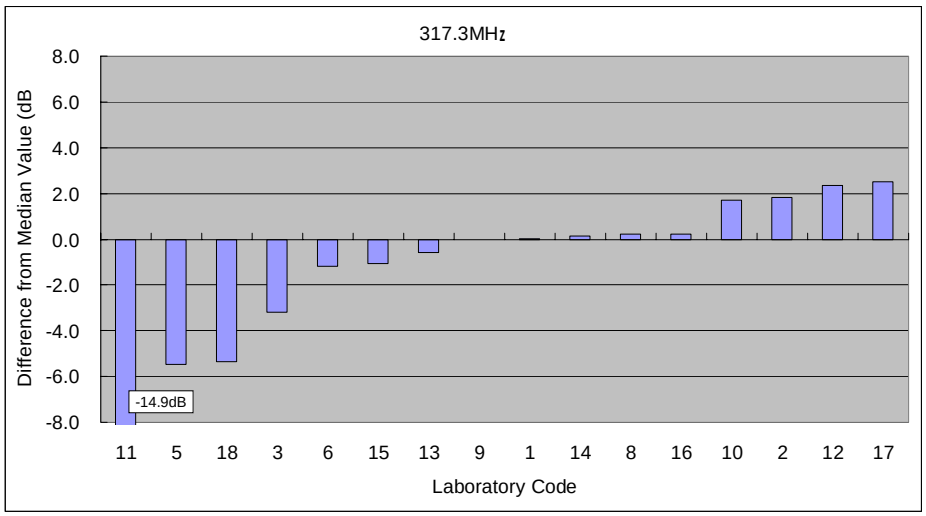

Chart 11-7: Difference from Median Value of the radiated emission measurement, H-pol., 317.3 MHz

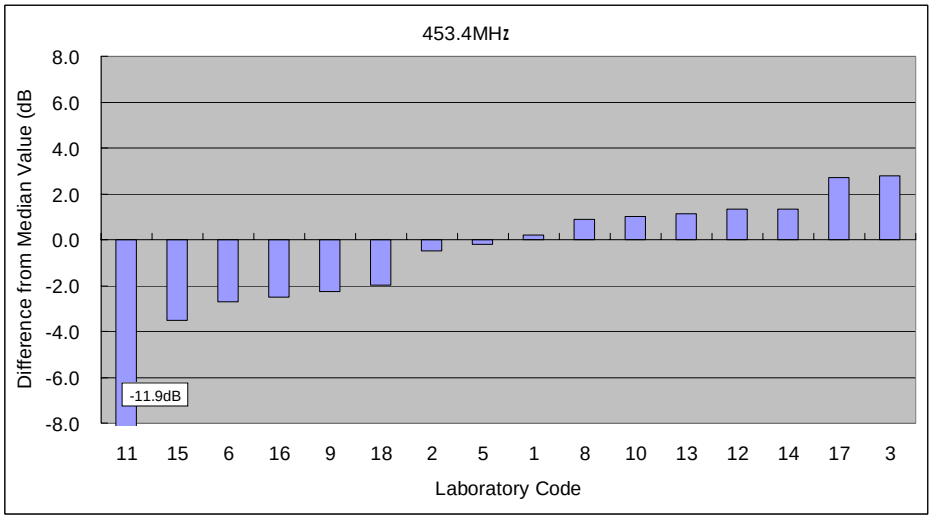

Chart 11-8: Difference from Median Value of the radiated emission measurement, H-pol., 453.4 MHz

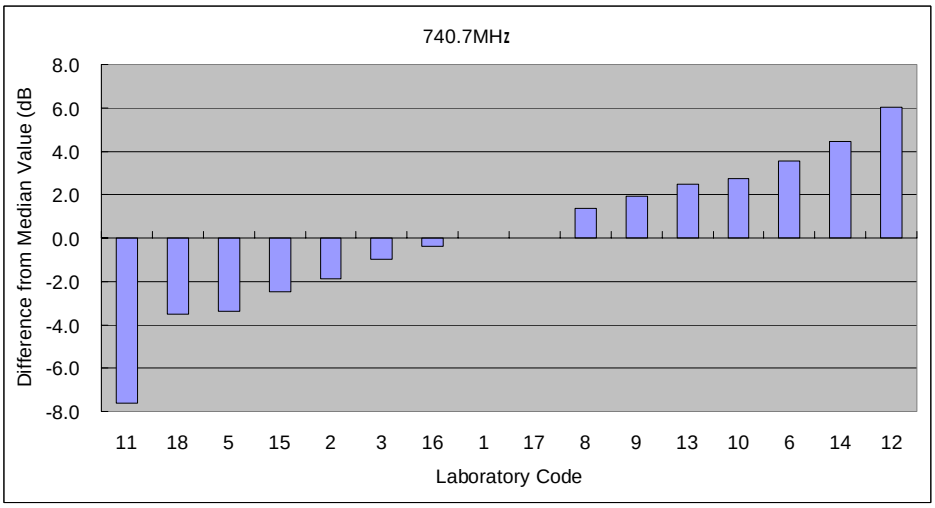

Chart 11-9: Difference from Median Value of the radiated emission measurement, H-pol., 740.7 MHz

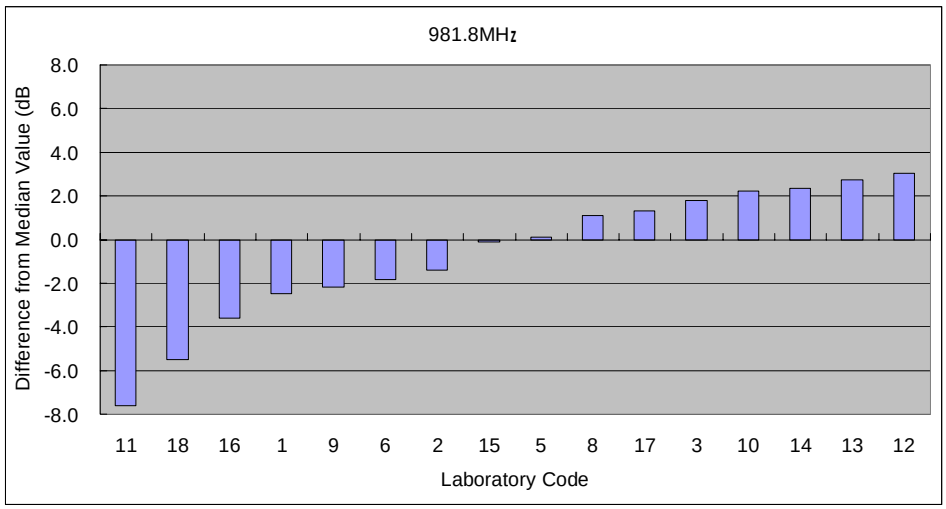

Chart 11-10: Difference from Median Value of the radiated emission measurement, H-pol., 981.8 MHz

[Difference from Median Value of the radiated emission measurement]
(Vertical Polarization)

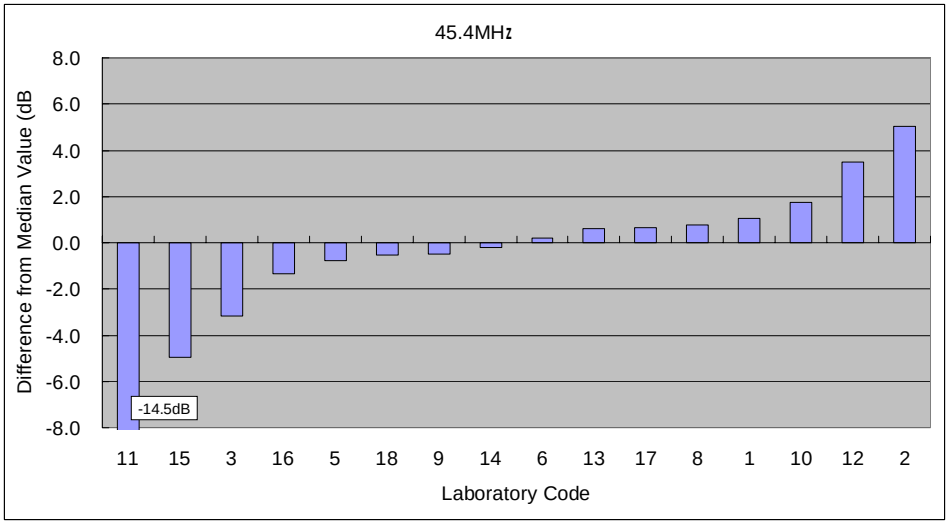

Chart 12-1: Difference from Median Value of the radiated emission measurement, V-pol., 45.4 MHz

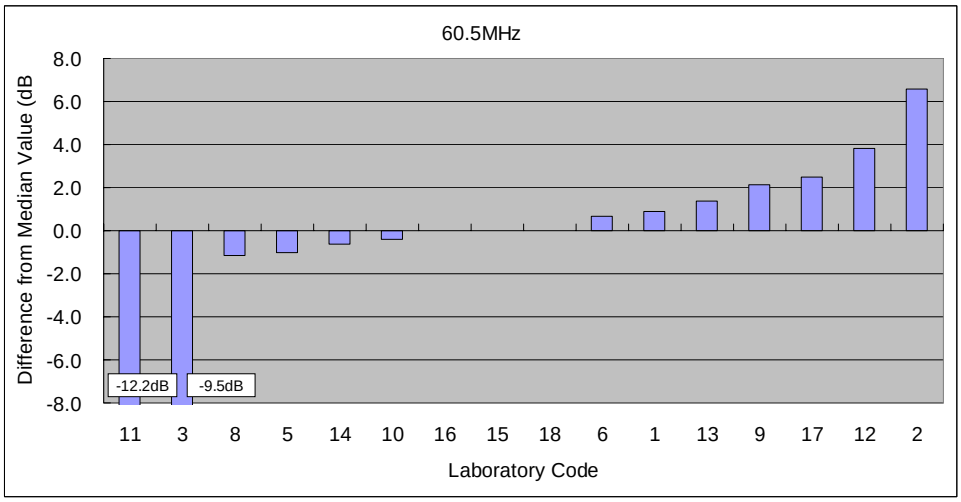

Chart 12-2: Difference from Median Value of the radiated emission measurement, V-pol., 60.5 MHz

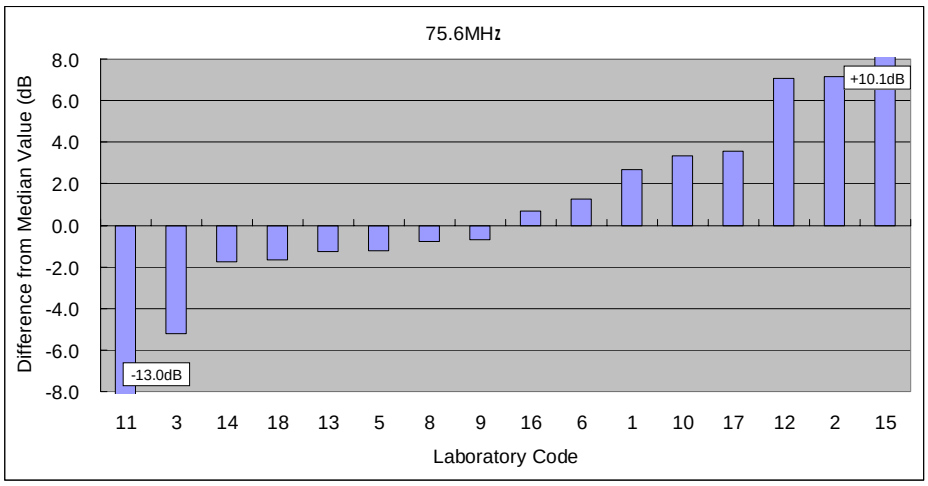

Chart 12-3: Difference from Median Value of the radiated emission measurement, V-pol., 75.6 MHz

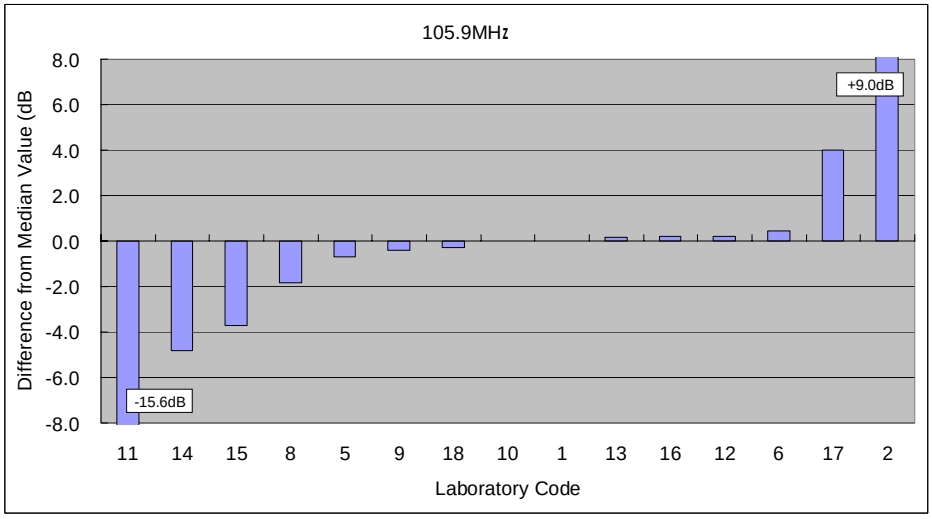

Chart 12-4: Difference from Median Value of the radiated emission measurement, V-pol., 105.9 MHz

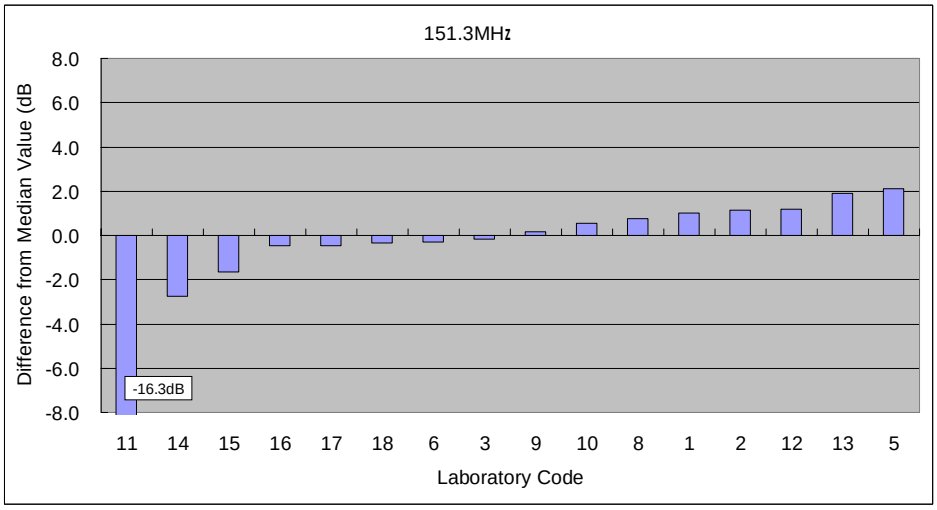

Chart 12-5: Difference from Median Value of the radiated emission measurement, V-pol., 151.3 MHz

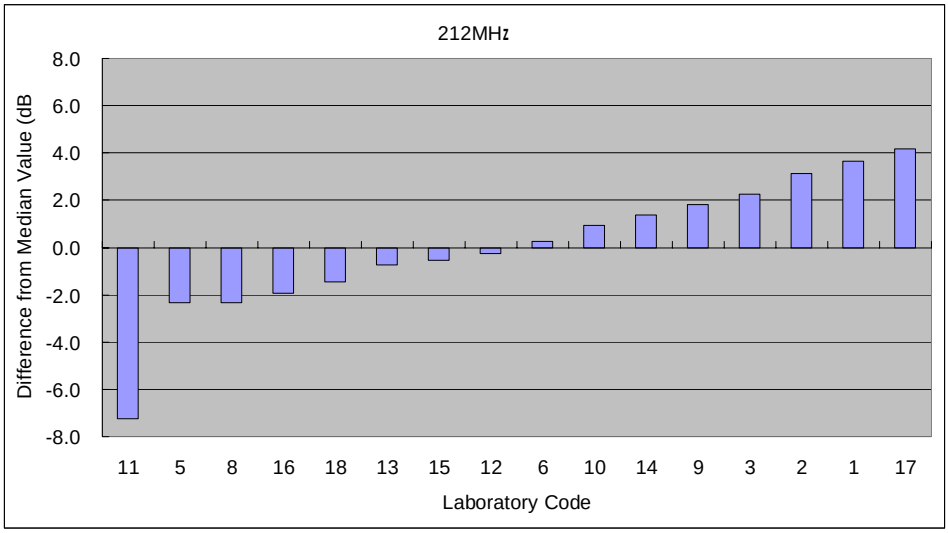

Chart 12-6: Difference from Median Value of the radiated emission measurement, V-pol., 212.0 MHz

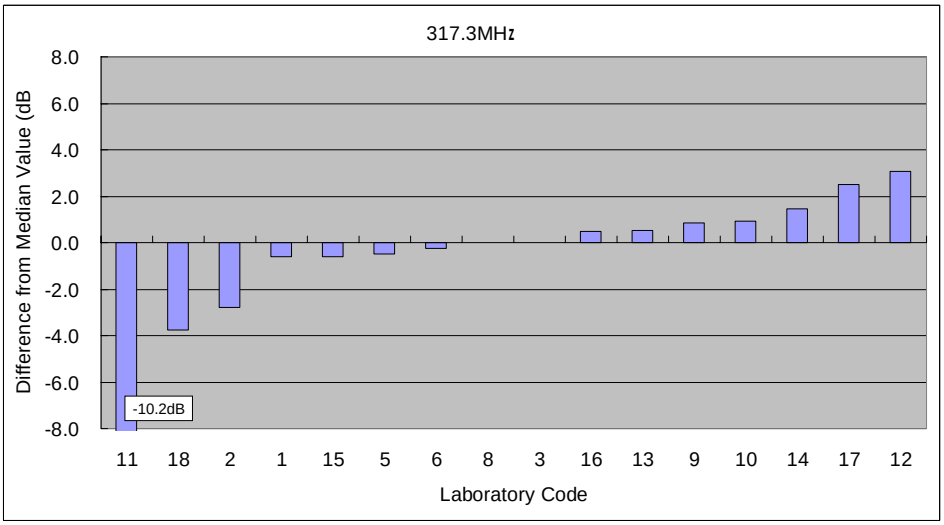

Chart 12-7: Difference from Median Value of the radiated emission measurement, V-pol., 317.3 MHz

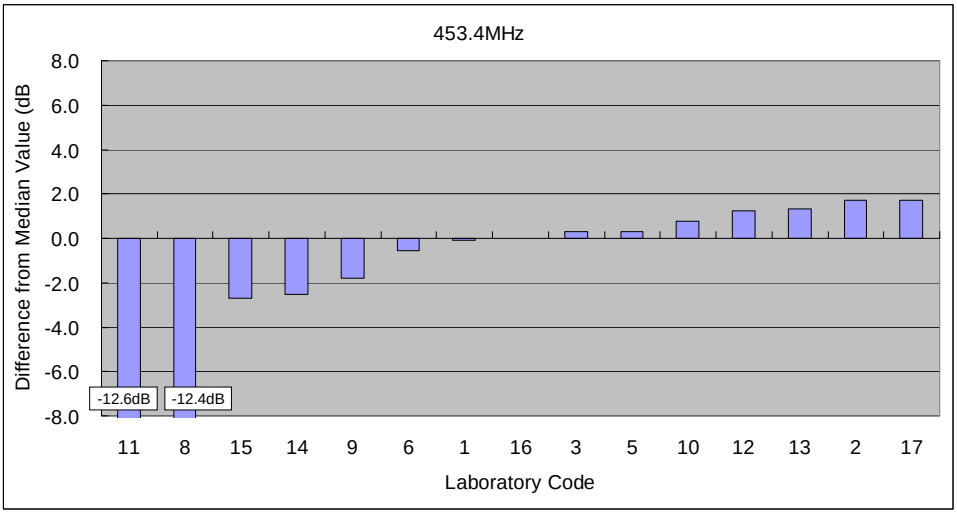

Chart 12-8: Difference from Median Value of the radiated emission measurement, V-pol., 453.4 MHz

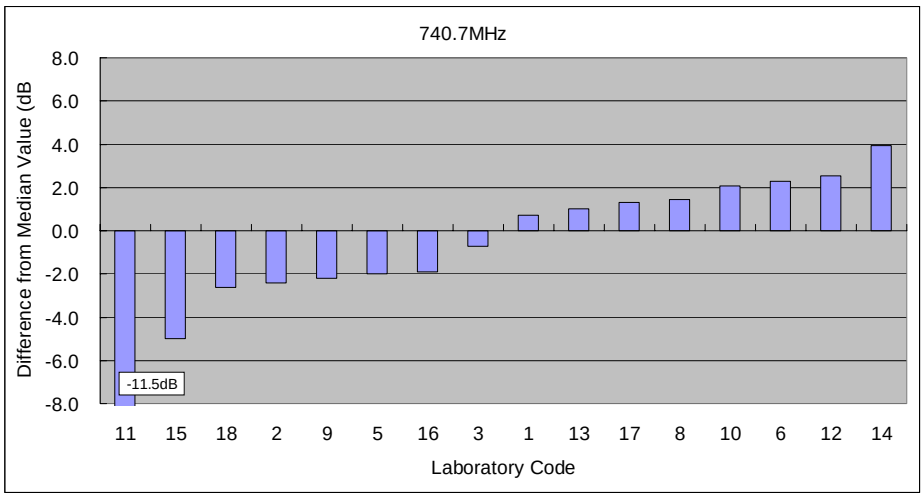

Chart 12-9: Difference from Median Value of the radiated emission measurement, V-pol., 740.7 MHz

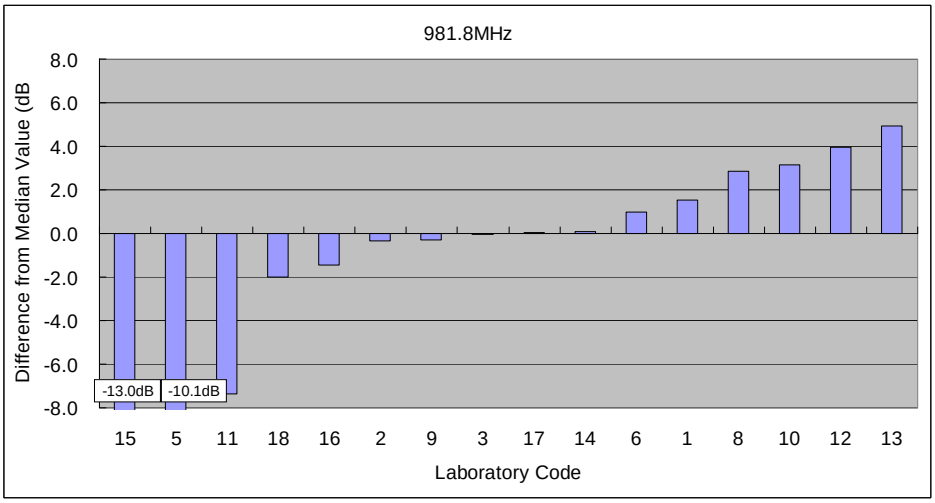

Chart 12-10: Difference from Median Value of the radiated emission measurement, V-pol., 981.8 MHz

6. Evaluation of the results

6.1 Evaluation result of Round 1 & Round 2

As the evaluation result of Round 1 and Round 2, for the conducted emission measurement, Table 25 shows the test site of which the Z score calculated with linear data exceeds 3, or within 2 to 3, and also shows the test site which has the difference from median value over 6 dB with absolute value. And for the radiated emission measurement, Table 26 and 27 show the test site of which the Z score calculated with dB data exceeds 3, or within 2 to 3, and also show the test site which has the difference from median value over 6 dB with absolute value.

Table 25 Round-1 + Round-2: evaluation result of conducted emission measurement

Frequency (MHz)	3≦|Z score|＞2	|Z score|＞3	|Difference from median value|＞6dB
0.219		c	c
0.439		c	c
2.62	q, f	u	
3.71	q	r, u, n	r, u, n
7.45	n, u	r	r, n,u

Note (1): The laboratory code surrounded by square frame is shown under both conditions of more than three Z scores and more than 6dB of the difference from median value. The laboratory should take an action as the unsatisfactory result.

Table 26 Round-1 + Round-2: evaluation result of Horizontal Polarization radiated emission measurement

Frequency (MHz)	3≦|Z score|＞2	|Z score|＞3	|Difference from median value|＞6dB
317.3		i	i
453.4	q	i	i
740.7		i	i
981.8	y	i, e	i

Note (1): The laboratory code surrounded by square frame is shown under both conditions of more than three Z scores and more than 6dB of the difference from median value. The laboratory should take an action as the unsatisfactory result.

Table 27 Round-1 + Round-2: Vertical Polarization radiated emission measurement

Frequency (MHz)	3≦|Z score|＞2	|Z score|＞3	|Difference from median value|＞6dB
317.3	q	i	i
453.4		i, q, c	i
740.7	i		i, x
981.8		i	i

Note (1): The laboratory code surrounded by square frame is shown under both conditions of more than three Z scores and more than 6dB of the difference from median value. The laboratory should take an action as the unsatisfactory result.

6.2 Evaluation of Round 3

As the evaluation result of Round 3, for the conducted emission measurement, Table 28 shows the test site of which the Z score calculated with linear data exceeds 3, or within 2 to 3, and also shows the test site which has the difference from median value over 6 dB with absolute value. And for the radiated emission measurement, Table 29 and 30 show the test site of which the Z score calculated with dB data exceeds 3, or within 2 to 3, and also show the test site which has the difference from median value over 6 dB with absolute value.

Table 28 conducted emission measurement

Frequency (MHz)	3≧|Z score|＞2	|Z score|＞3	|Difference from median value|＞6dB
0.219			
0.439		5, 8	
2.62		5 (1)	5
3.71	5, 9, 11, 16		5, 9, 11, 16
7.45			2, 16
15.1		5, 6, 17	5, 6

Note (1): The laboratory code surrounded by square frame is shown under both conditions of more than three Z scores and more than 6dB of the difference from median value. The laboratory should take an action as the unsatisfactory result.

Table 29 Horizontal Polarization radiated emission measurement

Frequency (MHz)	3≧|Z score|＞2	|Z score|＞3	|Difference from median value|＞6dB
45.4			3, 11
60.5	2	1	1, 5, 11
75.6	1, 11		11
105.9	8	11 (1), 17	11
151.3		11, 15, 18	11, 15, 18
212.0		11	11
317.3	5, 16	11	11
453.4	3, 15, 17	11	11
740.7	12		11, 12
981.8			11

Note (1): The laboratory code surrounded by square frame is shown under both conditions of more than three Z scores and more than 6dB of the difference from median value. The laboratory should take an action as the unsatisfactory result.

Table 30 Vertical Polarization radiated emission measurement

Frequency (MHz)	3≦|Z score|＞2	|Z score|＞3	|Difference from median value| ＞6dB
45.4	3, 15	2, [11] (1), 12	[11]
60.5	12	[2], [3], [11]	[2], [3], [11]
75.6	2, 12	[15]	2, 11, 12, [15]
105.9	15	[2], [11], 14, 17	[2], [11]
151.3	5, 14	[11]	[11]
212.0			11
317.3	2, 17, 18	[11], 12	[11]
453.4	8	[11]	8, [11]
740.7	11		11
981.8	5, 13, 15		5, 11, 15

Note (1): The laboratory code surrounded by square frame is shown under both conditions of more than three Z scores and more than 6dB of the difference from median value. The laboratory should take an action as the unsatisfactory result.

7. Remarks

Efforts and supports from all ABs and participants to this program are gratefully noted. Special thanks are also extended to APLAC PT Committee.

For further comments, participants are welcome to contact the organizers in the following address:

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3-5 Azabudai 2-chome, Minato-ku, Tokyo 106-0041, Japan
e-mail: osabe@vlac.co.jp

8. References

(1) ISO/IEC 17043:2010 “Conformity Assessment - General requirements for proficiency testing.”

(2) APLAC PT 002:2008 “Testing Inter laboratory Comparisons”

(3) CISPR 22: “Information technology equipment - Radio disturbance characteristic - Limits and methods of measurement”

(4) CISPR 16-4-2: “Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-2: Uncertainties, statistics and limit modeling - Uncertainty in EMC measurements”

APPENDIX I: Timeline of the Program

Round-1

Circulation period	Accreditation Body	Number of participated laboratory
2008/10/20-10/31	KOLAS	2
2008/11/10-12/5	TAF	4
2008/12/15-12/19	KAN	1

Round-2

Circulation period	Accreditation Body	Number of participated laboratory
2009/1/11-1/16	MASM	1
2009/1/26-2/20	SAC	3(Conducted 2)
2009/3/2-3/27	HKAS	4
2009/4/6-4/10	SIRIM	1
2009/4/20-5/15	CNAS	4
2009/5/18-5/22	FINAS-CN	1
2009/6/8-6/12	BAV	1

Round-3

Circulation period	Accreditation Body	Number of participated laboratory
2009/7/13-7/31	IANZ	3
2009/8/10-9/18	NATA	4
2009/9/21-10/23	A2LA	3
2009/10/28-11/24	NVLAP	4
2009/12/7-2/10	SCC	3

APPENDIX II: The characteristics of participated test laboratories

(1) Round 1 + Round 2: The characteristics of radiated emission test sites

CODE	Test Facility	Antenna(VHF)		Antenna(UHF)		EMI Receiver		Pre amplifier		Test table	Measurement Uncertainty (dB)
		Mfr.	Model No.	Mfr.	Model No.	Mfr.	Model No.	Mfr.	Model No.		
a	SAC	Schaffner	CBL6112D	Schaffner	CBL6112D	R&S	ESIB26	TOYO	310N	PVC	4.82 ~ 5.03
b	SAC	EMCO	EMCO 3142C	EMCO	EMCO 3142C	R&S	ESCI 3			Wood	1.1 ~ 2.5
c	SAC	EMCO	EMCO 3142B	EMCO	EMCO 3142B	R&S	ESIB-40	R&S	Buit in ESIB-40	Wood	5.2
d	OATS	Schwarzbeck	VULB 9160	Schwarzbeck	VULB 9160	R&S	ESVS10	HP	8447F	Wood	4.9
e	SAC	EMCO	3141	EMCO	3141	R&S	ESI 26			Wood	4.906
f	SAC	EMCO	3142B	EMCO	3142B	R/S	R/S			Wood	5.2
i	?	R&S	HE300	R&S	HE300	R&S	PR100			Wood	0.02 ~ 0.3
k	SAC	Schaffner	CBL6112B	Schaffner	CBL6112B	R&S	?			Wood	4.63
l	SAC(3m)	Schaffner-Chase	CBL6112B	Schaffner-Chase	CBL6112B	R&S	ESI 26			Wood	4.1
m	SAC	TESEQ	CBL6112D	TESEQ	CBL6112D	Schaffner	SCR3511	Sonoma	310	Wood	-
n	SAC	ETS	3109	ETS	3148	R&S	ESIB40			Wood	4.5
p	SAC	TDK	HLP-3003C	TDK	HLP-3003C	Schaffner	SMR 4503	Sonoma	310N	Wood	2.75 ~ 3.22
q	SAC	EMCO	3109	EMCO	3146	R&S	ESCI			FRP	4.02 ~ 4.3
r	SAC	R&S	HK116	R&S	HL223	R&S	ESU26			FRP	5.08 ~ 5.1
s	SAC(10m)	Schaffner	CBL6112B	Schaffner	CBL6112B	R&S	ESMI	Schaffner	CPA9231A	Fiber	4.6
t	SAC	Schaffner	CBL6112B	Schaffner	CBL6112B	R&S	ESCI			FRP	2.6
u	OATS	Schaffner	CBL6112B	Schaffner	CBL6112B	R&S	ESI7	HP	8447D	Wood	4.96 ~ 4.97
v	SAC	R&S	HK116	R&S	HL223	R&S	ESU26			PVC	5.08 ~ 5.1
w	SAC(10m)	Schaffner	CBL6112B	Schaffner	CBL6112B	R&S	ESCI			FRP	2.6
x	OATS	Chase	CBL6112B	Chase	CBL6112B	R&S	ESVS30			FRP	3.72 ~ 3.82
y	SAC	R&S	HL-562	R&S	HL-562	R&S	ESIB26	Miteq	AFS4-00100300 -20-23P-6	Form	4.95 ~ 5.29
z	SCA(3m)	Schaffner	CBL6112B	Schaffner	CBL6112B	R&S	ESMI	Agilent	87405B	Fiber	4.6

(2) Round 1 + Round 2: The characteristics of conducted emission test sites

CODE	Test Facility	AMN		EMI Receiver		Ground reference	Test height	Measurement Uncertainty (dB)
		Mfr.	Model No.	Mfr.	Model No.			
a	Shielded room	FCC Inc.	50-100-4-02	R&S	ESCI	Vertical	80cm	3.55
b	Shielded room	R&S	ESH3-Z5	R&S	ESHS30	Vertical	80cm	2.74
c		Japan	PTE-2	R&S	PR100	Horizontal	80cm	0.07 ~ 0.15
d	Shielded room	Schaffner	NNB41	Schaffner	SCR3511	Vertical	80cm	-
f	Shielded room	R&S	ENV216	R&S	ESS	Horizontal	40cm	3.46
g	Shielded room	R&S	ESH3-Z5	R&S	ESIB7	Vertical	80cm	3.6
j	Shielded room	EMCO	3825/2	R&S	ESI7	Vertical	80cm	3.69
k	Shielded room	R&S	ESH3-Z5	R&S	ESCS30	Vertical	80cm	3.44
l	Shielded room	R&S	ESH3-Z5	R&S	ESIB40	Horizontal	40cm	2.9
m	Shielded room	R&S	ENV216	R&S	ESCI	Vertical	80cm	3.5
n	Shielded room	R&S	ENV 216	R&S	ESCI 3	Vertical	80cm	1.1 ~ 2.4
o	Shielded room	R&S	ESH3-Z5	R&S	ESCS30	Vertical	80cm	3.0
p	Shielded room	EMCO	3825/2	R&S	ESCI	Vertical	80cm	2.9
q	Shielded room	EMCO	4825/2	R&S	ESIB7	Vertical	80cm	3.97
r	Shielded room	FCC Inc.	50-100-4-02	R&S	ESCI	Vertical	80cm	3.55
t	Shielded room	R&S	ESH3-Z5	R&S	ESCI	Vertical	80cm	3.6
u	Shielded room	Schaffner	NNB41	R&S	ESI	Vertical	80cm	3.0
v	Shielded room	Schaffner	NNB41	Schaffner	SCR3511	Horizontal	80cm	2.82
w	Shielded room	Kyoritsu	KNW-407	R&S	ESCS30	Vertical	80cm	2.4
x	Shielded room	R&S	ESH3-Z5	R&S	ESCS30	Vertical	80cm	3.38
y	Shielded room	Schwarzbeck	ESH3-Z5	R&S	ESPI7	Vertical	80cm	+3.4/-3.1

(3) Round 3: The characteristics of radiated emission test sites

Laboratory CODE	Test Facility	Antenna(VHF)		Antenna(UHF)		EMI Receiver		Pre amplifier		Test table	Measurement Uncertainty (dB)
		Mfr.	Model No.	Mfr.	Model No.	Mfr.	Model No.	Mfr.	Model No.		
1	OATS	Schwarzbeck	BBA9106	Schwarzbeck	VUSLP9111	R&S	ESCS30			Fiber glass	4.1
2	OATS	Schaffner	CBL6141A	Schaffner	CBL6141A	R&S	ESCS30			Wood	4.6
3	OATS	Schwarzbeck	FBAB 9177	EMCO	3121C	Agilent	E4445A			Wood	4.7
5	OATS	TESEQ	27626	TESEQ	27626	R&S	ESCS30			Wood	5.1
6	OATS	EMCO	3110B	EMCO	3146	HP	8546A			Plastic	4.7 - 5.1
8	SAC	Sunol	JB5	Sunol	JB5	R&S	ESIB40	R&S	ESIB40	Polystylene	4.7
9	SAC	Sunol Sciences	JB1	Sunol Sciences	JB1	HP	8542E	HP	8447D	FRP	4.94
10	SAC	Chase	CBL6111B	Chase	CBL6111B	R & S	ESMI	Agilent	8447D	Wood	3.68
11	SAC	EMCO	3108	EMCO	3147	HP	8566B	HP	8447	Wood	
12	SAC	Com-Power	AC-220	Com-Power	AC-220	R&S	ESIB-40			Styrene foam	3.33
13	SAC	Chase	CBL6111	Chase	CBL6111	HP	8566B, 85662A, 85685A, 85650A	HP	8447D	Styrene foam	4.8
14		EMC automation	30003-C	EMC automation	30003-C	HP	8546A	Sonoma	310/N11909A	Foam	4.594
15	SAC	Sunol	JBL3	Sunol	JBL3	R&S	ESU40			Plastic	4.7 - 4.9
16	SAC	Sunol Sciences	JB3	Sunol Sciences	JB3	R&S	ESIB7	HP	8447D	Wood	3.6
17	OATS	EMCO	3110B	ElectroMetrics	LPA-25	HP	HP8566B w Presel & QPA			Wood	3.87 - 4.42
18	SAC	Chase	CBL6112A	Chase	CBL6112A	Agilent	85650A	AR	LN1000	Stylene form	5.6

(4) Round 3: The characteristics of conducted emission test sites

Laboratory CODE	Test Facility	AMN		EMI Receiver		Ground reference	Test height	Measurement Uncertainty (dB)
		Mfr.	Model No.	Mfr.	Model No.			
1	Shielded room	R&S	ESH2-Z5	R&S	ESHS10	Vertical	80cm	2.3
2	Shielded room	R&S	ESH2-Z5	Narda	PMM9010	Horizontal	40cm	3
3		EMCO	3825	Agilent	E4445A	Horizontal	80cm	3.05
5	Shielded room	AFJ	LT32	R&S	ESCS30	Vertical	80cm	3.3
6	Shielded room	R&S	ESH2-Z5	HP	8565A	Vertical	80cm	3.2
7	Shielded room	R&S	ESH2-Z5	R&S	ESHS10	Vertical	80cm	1.6
8	Shielded room	EMCO	3850/2	R&S	ESCI	Vertical	80cm	2.8
9	Shielded room	FCC	50/250-25-2	R&S	ESHS20	Vertical	80cm	3.52
10		EMCO	3825/2	R&S	ESMI	Horizontal	80cm	1.52
11	Shielded room	EMCO	3825/2	HP	8568B	Vertical/Horizontal	80cm	
12	SAC	Com-Power	LI-215	HP	8566B	Vertical	80cm	0.86
13	Shielded room	EMCO	3825/2	HP	8568B/85662A/85660A	Horizontal	40cm	3.8
14		R&S	ENV216	R&S	ESU40	Vertical	80cm	2.03
15	SAC	R&S	ENV216	R&S	ESU40	Vertical	80cm	3.6 - 4.0
16	SAC	FCC	50-25-2-09	R&S	ESIB7	Vertical	80cm	2.2
17	Shielded room	FCC	50-4-02	HP	HP8566B w Presel & QPA	Vertical	80cm	3.7
18	Shielded room	FCC	50-4-02	Agilent	8566B/85650A	Vertical	80cm	3.7

APPENDIX III: Result of stability test for the Artifact

To confirm the stability of the comb generator, the output level measurement was verified a start and end of every round, first one at the before of program starting of program.
Stability tests for the Artifact were performed at the following period;

2008.09: Start of program
2008.12: After Round-1
2009.6.24: After Round-2 (The artifact had an accident during Round-2)
2009.6.25: After repaired
2010.2.10: After Round-3
The result are shown in Figure AIII.1 and AIII.2

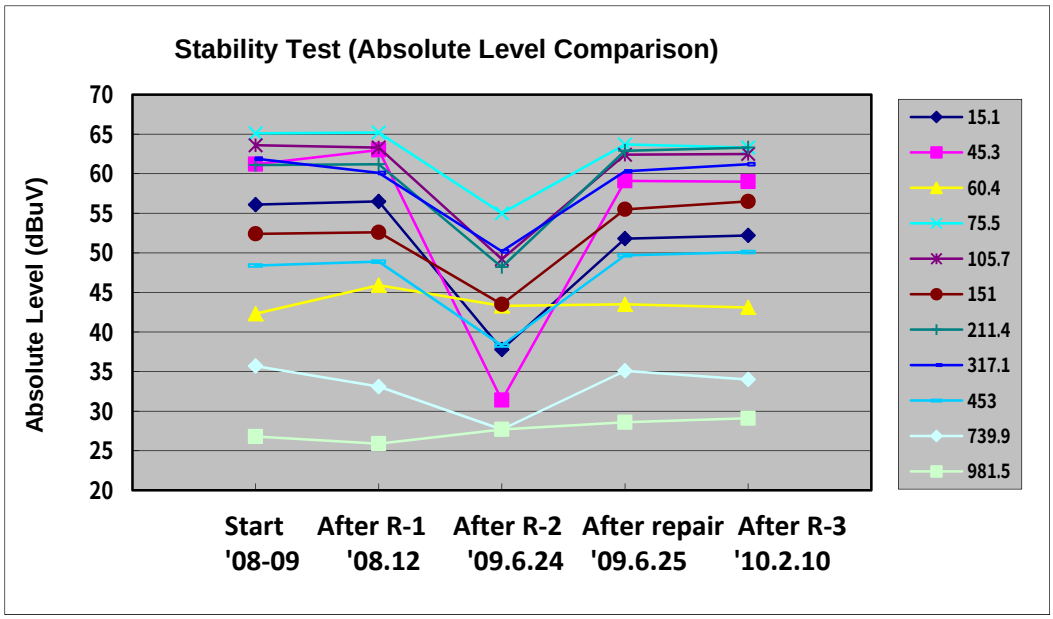

Figure III.1: Stability test result (Absolute level comparison)

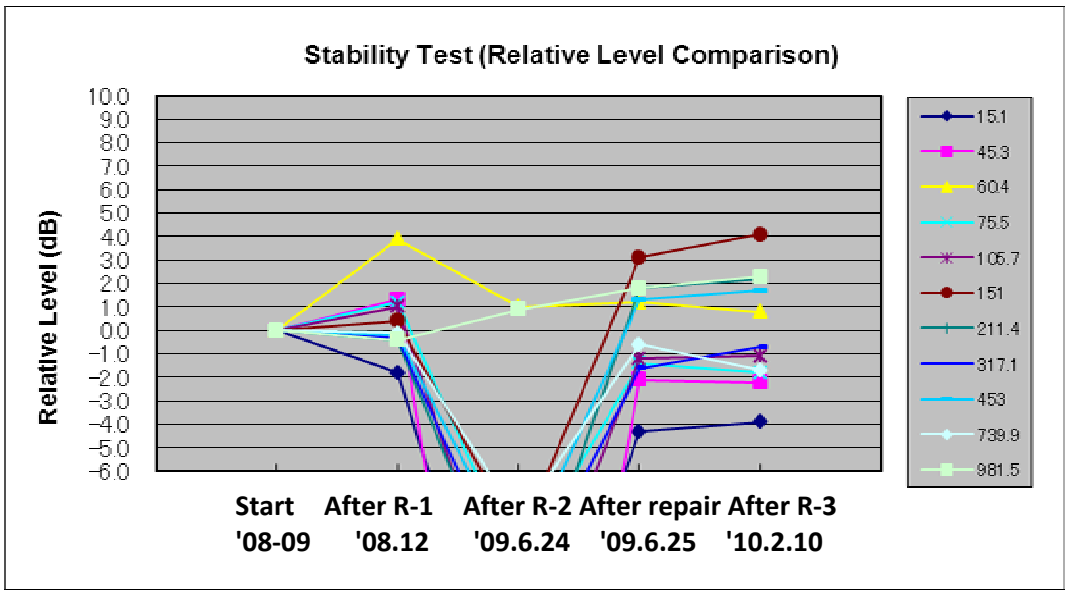

Figure III.2: Stability test result (Relative level comparison)

Stability test syatem

Radiated emission level of the comb generator set inside the G-TEM cell was measured at output terminal of the cell. Test arrangement are shown in Figure AIII.3 and Figure AIII.4

Figure III.3: Stability Test System

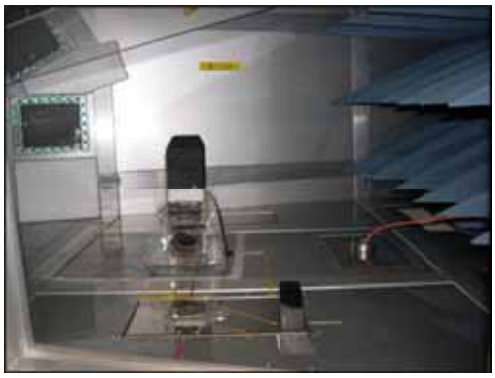

Figure III.4: Test set-up of artifact Inside of G-TEM cell

APPENDIX IV: Instructions to Accreditation Bodies

Proposal for an APLAC Proficiency Testing Program on T061: Electromagnetic Interference Testing

1. Objective of the program

The main objective of the program is to evaluate the competence of EMC testing laboratories in appropriately maintaining characteristics of their measuring facilities and instruments used for measurement of radiated and conducted electromagnetic interference.

2. Program administration

The program is organized and operated by the Voluntary EMC Laboratory Accreditation Center, Inc. of Japan (VLAC) under the auspices of the Asia-Pacific Laboratory Accreditation Cooperation (APLAC). VLAC is responsible for coordinating activities relevant to this program such as inviting participants, assigning confidential codes to participants, preparing instructions, circulating an artifact (testing sample), collecting and analyzing results and preparing final report as well as the interim reports.

3. Recruitment of participants

APLAC members as well as members of EA and IAAC and ILAC unaffiliated bodies will be invited for the program. Invitations will be sent to all APLAC members and other accreditation bodies in July 2008.

4. Participants group size and handling of artifact

Participating accreditation bodies will be asked to nominate signing up laboratories with indication whether they are accredited or not. Preference should be given to laboratories that are accredited for this test.

The number of participating laboratories will be limited to 4 per accreditation body to allow time for VLAC to collect artifact and confirm its characteristics between its circulation in one accreditation body group and the next.

One week will be given to a participating laboratory including day for receiving and forwarding artifact. Two weeks will be given to a parent accreditation body for receiving and returning artifact from/to VLAC.

5. Testing method

The program participants will be requested to carry out the following measurements at specified frequencies based on CISPR22.

The instruction on testing procedure is given in **Appendix 2**

- Measurement of radiated disturbance (Electromagnetic Field Strength at 3 m distance)
- Measurement of conducted disturbance at mains port (Disturbance voltage using AMN)

6. Testing sample

An artifact is circulated to the participating laboratories as EUT (testing sample) for this program. The artifact is an impulsive noise generator (comb generator); Model PTE-2 (Serial No. 004). It can be operated by AC mains voltage from 100V to 240V. For the proficiency testing program this time, the operating voltage of artifact will be

specified to AC 100V±3V. Also for the measurement of radiated interferences, a VHF-LISN will be supplied by VLAC to stabilize the impedance between the line and ground of AC mains at the testing site. A VHF-LISN will be circulated together with the artifact. Measurement arrangement of the artifact and VHF-LISN is also indicated in **Appendix 2**.

7. Application fee

Free of charge.

8. Program time frame

To be determined later considering the number of enrolling accreditation bodies and laboratories under them.

Provisional schedule table

July 2008 Send out the invitation letter to the accreditation bodies

August to September 2008 Accepting the application from Accreditation Body

September 2008 Inform the circulation schedule to the Accreditation Body

From October 2008 to December 2009 Circulate the artifact

January 2010 Collect all results and analysis of data

April 2010 Issue the interim report

June 2010 Issue the final report

9. Application for participation

Application window: August 1 – September 30, 2008
Please send form in **Appendix 1** filled out to the VLAC Proficiency Testing Program Office

10. Confidentiality

For this program the participated laboratory has been allocated the code number shown on the data sheet. All reference to your laboratory in reports associated with this program will be with this code number, thus ensuring confidentiality of results.

11. Office of Proficiency Testing Program

VLAC Technical Center
PT Program Department
Convenor: Mr. Kunihiro Osabe
E-mail: osabe@vlac.co.jp
Co-convenor : Ms. Junko maeda
E-mail : jmaeda@vlac.co.jp
Phone: +81-3-3568-2152
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APPENDIX V: Receipt Form for Accreditation Bodies

APLAC T061: Proficiency Testing Program on Electromagnetic Interference

Registration Form for Nominated Participating Laboratories

If your laboratories wish to participate in the APLAC T061 Proficiency Testing Program, please complete this Registration Form and email the form to the contact above **by no later than 30 September, 2008:**

Date:	
Accreditation Body Name:	
Contact Name:	
Organization:	
Shipping Address:	
Economy:	
Phone No.:	
Fax No.:	
E-mail address of contact:	
Preference of testing period in between Oct. 2008 and Dec. 2009	1st Choice of Period: (YY/MM – YY/MM) 2nd Choice of Period: (YY/MM – YY/MM) 3rd Choice of Period: (YY/MM – YY/MM)

Each accreditation body is invited to nominate up to 4 laboratories to participate in this program. One week will be given to a participating laboratory including days for receiving and forwarding artifact. Two weeks will be given to the parent accreditation body for receiving and returning the artifact from/to VLAC.

The following term will be given to a participating accreditation body depending on the number of nominated laboratories. VLAC will inform the Accreditation Bodies of the final circulation schedule decided taking into consideration of Accreditation Body's preference of testing period..

Number of nominated laboratories	Term given for the Accreditation Body
1 laboratory	3 weeks
2 laboratories	4 weeks
3 laboratories	5 weeks
4 laboratories	6 weeks

Nominated Laboratories:

Contact Person:	
Lab Name:	
Shipping Address:	
Country:	
Phone No.:	
Fax No.:	
E-mail:	
Accredited laboratory?	**YES/NO**

Contact Person:	
Lab Name:	
Shipping Address:	
Country:	
Phone No.:	
Fax No.:	
E-mail:	
Accredited laboratory?	**YES/NO**

Contact Person:	
Lab Name:	
Shipping Address:	
Country:	
Phone No.:	
Fax No.:	
E-mail:	
Accredited laboratory?	**YES/NO**

APPENDIX VI: Instruction to Participating Laboratories

APLAC T061: The Proficiency Testing Program on Electromagnetic Interference

Office of Proficiency Testing Program, VLAC

EUT (Equipment under Test) as an Artifact

An artifact is circulated to the participating laboratories as EUT (testing sample) for this program. The artifact is an impulsive noise generator (comb generator); Model PTE-2 (Serial No. 005).

It can be operated by AC mains voltage from 100V to 240V. For this proficiency testing program, operating voltage of the artifact is specified to AC 100V±2V and the frequency is recommended to use of 50Hz (60Hz operation is acceptable).

Also for the measurement of radiated disturbances, a VHF-LISN will be supplied by VLAC to stabilize the impedance between the line and ground of AC mains at the testing site. A VHF-LISN will be circulated together with the artifact.

AC power plug of the artifact and VHF-LISN are equipped with 2 flat-pin type plug (A-type).

Test items

Items to be measured by program participants using their own measuring facilities and instruments: are as follows.

- Radiated electromagnetic interference field strength at 3m distance
- Mains port conducted interference voltage using AMN

Measuring Frequencies

- Measuring frequencies specified for the Radiated EMI
  30MHz～300MHz：45.4MHz, 60.5MHz, 75.6MHz, 105.9MHz, 151.3MHz and 212.0MHz
  300MHz～1GHz：317.3MHz, 453.4MHz, 740.7MHz and 981.8MHz
  Record the readings of maximum field strength at each specified frequency ± 1%
- Measuring frequencies specified for the Mains port conducted EMI
  219kHz, 439kHz, 2.62MHz, 3.71MHz, 7.45MHz and 15.1MHz
  Record the reading of maximum voltage at each specified frequency ± 3%

Testing method

Conditions other than specified hereunder shall be in conformance with those specified in CISPR22.

Measurement of radiated EMI (Electromagnetic field strength at **3m** separation distance)

- EUT
  Model PTE-2 (Serial No. 005) combined with VHF-LISN
- Measurement procedure
  Supply AC100V power to the EUT. Set power voltage to 100V±2V.
  Record readings of maximum field strength of horizontal polarization and vertical polarization at each frequency while rotating the EUT 360 degrees and moving the receiving antenna height in the range of 1 – 4m.

Note 1: Turn the power switch ON for the EUT after adjusting power voltage to AC100V±2V

Note 2: Do not start the measurement in 30 minutes or so after the EUT power switch is turned ON

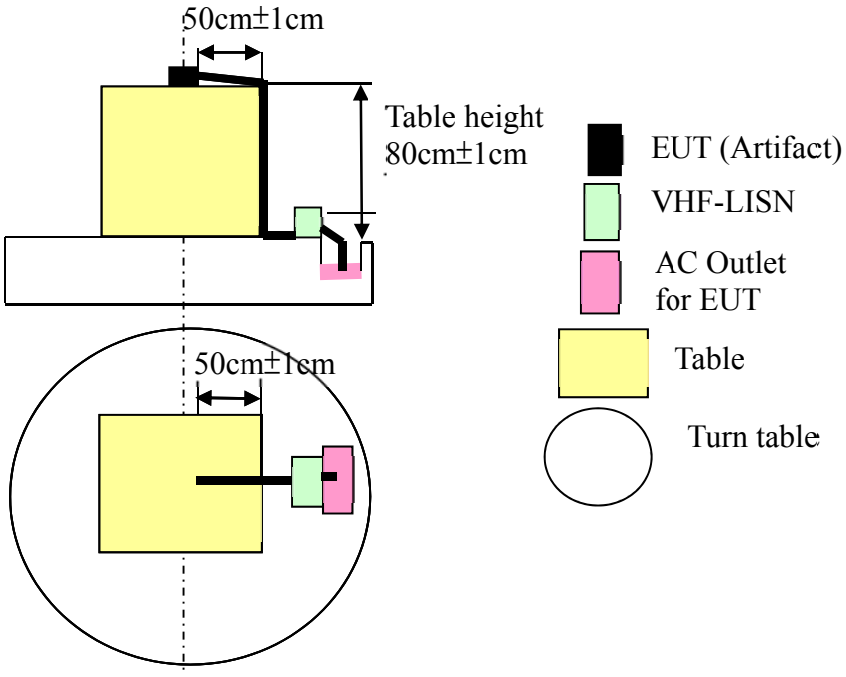
- Orientation of the EUT and testing arrangement
  Place the EUT on the EUT stand as indicated in pictures 1 and 2. Then put the loaded stand on the center of EUT table of 80cm in height to be used for the measurement of EMI by the subject laboratory. At the time of horizontal polarization measurement, set the EUT horizontally with the side displayed VLAC sign upward. At the time of vertical polarization measurement, set the EUT vertically to the position in which the character of VLAC can be normally read. Make sure the model number is not upside down. The EUT stand shall be placed on the EUT table in such a way that the side of the stand parallels the EUT table and the length of EUT power cable becomes 50cm between the EUT and the edge of the table from which the power cable dangles downward toward ground reference plane as indicated in Figure 1. (If the width of the EUT table is 1m, the EUT is put in the center point). Connect the power plug to VHF-LISN which is connected to 100V power outlet nearby. Excess length of power cable shall be laid on the ground plane. Distance between the EUT and receiving antenna shall be set based on CISPR22 standard.

  Note 3: Place VHF-LISN with the bottom plane down on the turntable electrically connected to the ground reference plane. If the surface of the turntable is electrically insulated from the body of the turntable, put VHF-LISN on a metal plane of bigger than 30cm square and secure grounding to the turntable using the metal plane.

  Test arrangement:

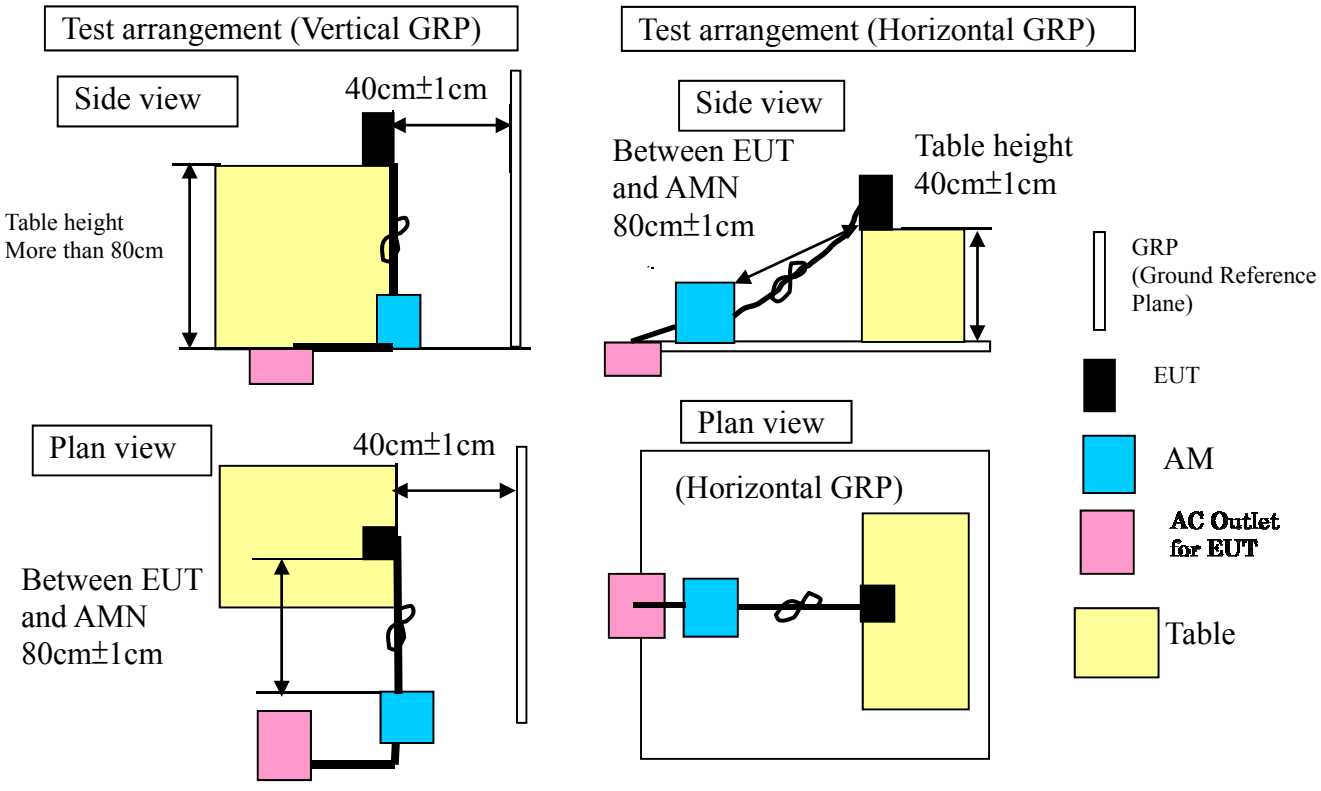
Picture 1: Horizontal polarization

Picture 2: Vertical polarization



Measurement of AC mains port conducted EMI

- EUT
  Model PTE-2 (Serial No. 005)
- Measurement procedure
  Supply AC100V power to the EUT via Artificial Mains Network (AMN) equipped with in the test site. Set power voltage to 100V±2V. Measure disturbance voltage at the specified frequency points although the frequency will be slightly fluctuated with the voltage change of power supply. **VHF-LISN attached to PTE-2 is not used for the conducted disturbance voltage measurement.**
  Record the higher value of Line1 and Line2 readings at each frequency point measured with AMN.
  Note 1: Turn the power switch ON for the EUT after adjusting power voltage to AC100V±2V. 50Hz operation is recommended (60Hz operation is acceptable).
  Note 2: Do not start the measurement in 30 minutes or so after the EUT power switch is turned ON
- Orientation of the EUT and testing arrangement
  In the case of measurement based on vertical reference plane, place the EUT vertically on the EUT stand as indicated in Picture 2. Put the loaded stand on the edge of EUT table of 80cm in height and move the EUT table so the side of EUT is 40cm away from the vertical reference plane as indicated in the left schematic of Figure 2.
  In the case of measurement based on horizontal reference plane, place the EUT vertically on the EUT stand as indicated in Picture 2. Put the loaded stand on the EUT table of 40cm in height as indicated in the right schematic of Figure 2. Describe the arrangement in the attached data sheet.
  Connect the power cable of the EUT to the AMN placed 80cm away from the EUT. Power cable shall be bundled in the middle so the total length becomes 1m.



Reporting on test results

(1) Measurement of radiated EMI (3 m)

Fill out cells of the data sheet (3 – 1 of Annex 3) with vertical and horizontal polarization readings at each frequency of 45.4MHz, 60.5MHz, 75.6MHz, 105.9MHz, 151.3MHz, 212.0MHz, 317.3MHz, 453.4MHz, 740.7MHz and 981.8MHz.

If the laboratory has uncertainty of measuring facilities and instruments calculated, please write the value of extended uncertainty in the report.

(2) Measurement of mains port conducted EMI

Fill out cells of the data sheet (3 – 2 of Annex 3) with readings at each frequency of 219kHz, 439kHz, 2.62MHz, 3.71MHz, 7.45MHz and 15.1MHz.

If the laboratory has uncertainty of measuring facilities and instruments calculated, please write the value of extended uncertainty in the report.

Statistical treatment of test results

We will statistically process test results based on ISO 15328 Robust Method. Our evaluation will be on z score in principle and additionally we will extend the evaluation of deviation from median value or the center value of a data group.

VLAC will provide participating laboratories with measurement Data Sheets (Appendix 3) for result collection. All participating laboratories are required to return the completed data sheets to their parent Accreditation Body who will then forward the collected data sheets to VLAC within two weeks after the completion of the test in the group. Late return of result sheets without justifiable reasons may be rejected and the corresponding data will not be included in the analysis.

Once all results are received, VLAC will check the data and create an interim report with them tabulated in a well-formatted table. Then VLAC will send out the report to all participating Accreditation Bodies who are then kindly requested to forward the same to the participating laboratories. Test participants are supposed to send confirmation or any clarification or correction of results to VLAC via the accreditation body within 2 weeks after receipt of the interim report.

Upon confirmations of data received from all participants, VLAC will prepare a draft report by applying z-score approach using robust median to the test data followed by statistical analysis carried out to the deviation from the center value or median value of data group. VLAC will then send the draft report to APLAC Proficiency Testing Committee for their review and comment before its general publication and distribution to participating laboratories via their parent accreditation bodies.

APPENDIX VII: Receipt Form for Participating Laboratories

Data Sheet

Appendix 3
Page 1 of 2

Accreditation Body			Registration Number: Written by VLAC	
Name of Testing laboratory				
Address				
Contact person		TEL		
		FAX		
		E-mail		

Testing item	Radiated disturbace field strength at 3 meters distance			Measurement value of AC mains voltage		
Testing standard	CISPR22 Edition 5.2		Artifact (EUT): PTE-2+VHF-LISN	Measurement voltage	AC	V
Testing facility	OATS / Semi-anechoic Chamber			AC Mains frequency		Hz
Name of Testing Facility				Measurement Instrument		
				Name of manufacturer		
Measurement date (YY/MM/DD)			Weather condition			
Measurement Engineer			Temperature	℃		
			Relative Humidity	%	Air Pressure	H.P.

Measuring Equipment	Name of Manufacturer	Model No.	Measuring Equipment	Name of Manufacturer	Model No.
Antenna(VHF)			Attenuator		
Antenna(UHF)			Pre-amplifier		
EMI Receiver			Table material	Wood・FRP・Stylene foam・other( )	

ANT Polarization	**Horizontal**				
Measurement Frequency		Max. Field Strength 1m≦h≦4m	ANT Height	Measurement Uncertainty	Ambient (Horizontal)
Specified Freq. MHz	Actual Freq. MHz	Q-Peak dB(μV/m)	cm	(dB): k=2	dB(μV/m)
45.4 (+/-1%)					
60.5(+/-1%)					
75.6(+/-1%)					
105.9(+/-1%)					
151.3(+/-1%)					
212.0(+/-1%)					
317.3(+/-1%)					
453.4(+/-1%)					
740.7(+/-1%)					
981.8(+/-1%)					

[Measurement condition of Ambient Noise]
1.EUT (Artifact): on the table
2.EUT Power Off
3. Receiving ANT height: 1m
4. ANT: Horizontal polarization

ANT Polarization	**Vertical**				
Measurement Frequency		Max. Field Strength 1m≦h≦4m	ANT Height	Measurement Uncertainty	Ambient (Vertical)
Specified Freq. MHz	Actual Freq. MHz	Q-Peak dB(μV/m)	cm	(dB): k=2	dB(μV/m)
45.4 (+/-1%)					
60.5(+/-1%)					
75.6(+/-1%)					
105.9(+/-1%)					
151.3(+/-1%)					
212.0(+/-1%)					
317.3(+/-1%)					
453.4(+/-1%)					
740.7(+/-1%)					
981.8(+/-1%)					

[Measurement condition of Ambient Noise]
1.EUT (Artifact): on the table
2.EUT Power Off
3. Receiving ANT height: 1m
4. ANT: Vertical polarization

Data Sheet

Accreditation Body		Registration Number: (Written by VLAC)	
Name of Testing laboratory			
Address			
Contact Person		TEL	
		FAX	
		E-mail	

Testing Item	Conducted Disturbance Voltage at AC Mains Port		Measurement value of AC mains voltage		
Testing Standard	CISPR22 Edition 5.2	Artifact (EUT): PTE-2	Measurement voltage	AC	V
Test facility	Shielded room/OATS/SAR		AC Mains frequency		Hz
Name of Test facility			Measurement Instrument		
			Name of manufacturer		
Measurement date (YY/MM/DD)		Weather condition			
Measurement Engineer		Temperature	℃		
		Relative Humidity	%	Air Pressur	H.P.

Measuring Equipment	Name of Manufacturer	Model No.
AMN		
EMI Receiver		
Ground Reference	Vertical ground plane / Horizontal ground plane	
Table Height	cm	

Measurement Frequency		Max. Voltage	Measurement Uncertainty (dB): k=2	Ambient	
Specified Freq.	Actual Freq.	Q-Peak dB(μV)		Q-Peak dB(μV)	
219kHz(+/-3%)					[Measurement condition of Ambient Noise] 1.EUT (Artifact): connecting to power lines 2.EUT Power Off
439kHz(+/-3%)					
2.62MHz(+/-3%)					
3.71MHz(+/-3%)					
7.45MHz(+/-3%)					
15.1MHz(+/-3%)					