

ORIGINAL



# TEST REPORT



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**Test Report No.** : E20053-E03  
**Issue Date** : September 4, 2020

## EUT Information

<b>Applied Standard</b>	: FCC Part 15, Subpart B
<b>Trade Name</b>	: LAUREL
<b>Category</b>	: NOTE SORTER
<b>Model Name</b>	: Ks
<b>Serial Number</b>	: 0000002

JEL Limited

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## Contents



<u>Text</u>	<u>Page</u>
Contents -----	2
Statement -----	3
Configuration of the EUT -----	4
Condition of the EUT -----	5
Test Site Description -----	6
Test Procedure -----	8
List of test equipment used for the test -----	10
Test results -----	11
Radiated disturbance -----	11
Conducted disturbance -----	23
Photograph of the EUT -----	27



# Statement

**Client**

Company name : LAULEL PRECISION MACHINES CO., LTD.  
Address : 12-6, Higashitabata 1-chome, Kita-ku, Tokyo-to, 114-0013, Japan  
Telephone : +81 3 3893 1360  
Facsimile : +81 3 3894 5704

**Equipment Under Test (EUT)**

Trade name : LAUREL  
Category : NOTE SORTER  
Model name : Ks  
Serial number : 0000002  
Intended environment : Office  
Date of receipt : July 17, 2020  
EUT condition : Production model, not damaged  
Highest frequency : 1250 MHz

**Test Performed**

Test started : July 20, 2020  
Test completed : July 21, 2020  
Location : 2971 Nakabyo, Abiko-shi, Chiba-ken, 270-1121, Japan

**Test Results**

Purpose of the test : Compliance test to the following standard  
Applied standard : FCC Part 15, Subpart B  
Classification : Class A  
Results : **PASS**

**Test Results Overview**

Measurement	Results*	Test method
Radiated disturbance (30 - 6250 MHz)	Pass	ANSI C63.4:2014
Conducted disturbance (0.15 - 30 MHz)	Pass	ANSI C63.4:2014

\* : The compliance statement is based on nominal value only.

**Measurement Uncertainty**

Radiated disturbance up to 1 GHz : +4.3 [dB], -4.3 [dB] (k=2)  
Radiated disturbance above 1 GHz : +5.9 [dB], -5.9 [dB] (k=2)  
Conducted disturbance for mains port : +3.4 [dB], -3.4 [dB] (k=2)

The coverage factor k=2 yields approx. a 95 % level of confidence for near-normal distribution typical of most measurement results.  
The data shown in this test report for Measurement Uncertainty is required to present the data per aforementioned standard according to CISPR 16-4-2.

**Laboratory's Signatory**

Report number : E20053-E03  
Issue date : September 4, 2020

This test report is issued under the authority of:



Fumio Miyachi, Manager, EMC Dept.

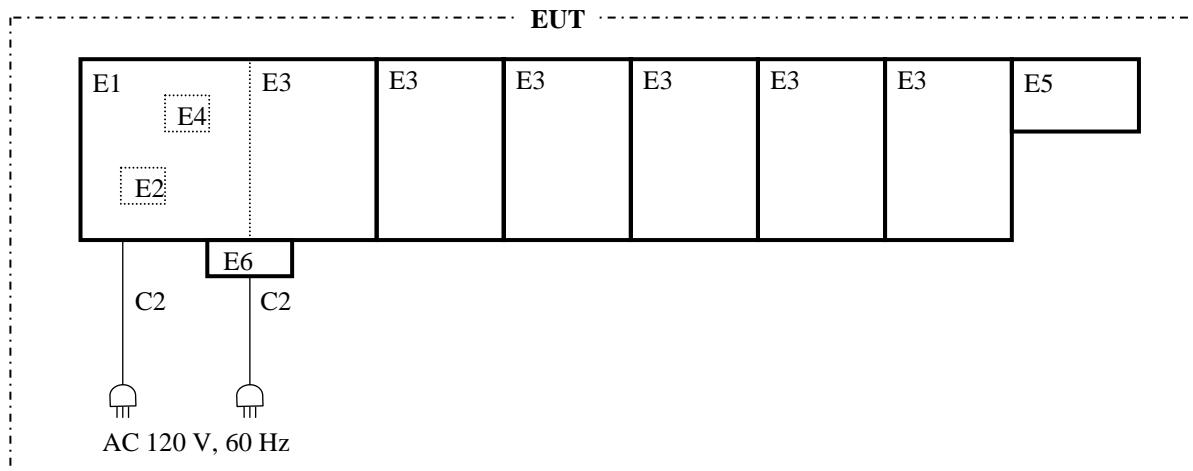
The test was supervised by:



Koji Matsuo, Test Engineer

The results in this report apply only to the sample(s) tested.

The report shall not be reproduced except in full without the written approval of JEL Limited.

**Configuration of the EUT****■ Equipment Under Test (EUT)**

ID	Category	Model name	Serial number	Manufacturer	Remarks
E1	NOTE SORTER	Ks	0000002	LAUREL PRECISION MACHINES CO., LTD.	FCC ID: 2ARVCKS Refer to note
E2	Validator	JDU-70	None	LAUREL PRECISION MACHINES CO., LTD.	-
E3	Pocket Module	KP4s	None	LAUREL PRECISION MACHINES CO., LTD.	-
E4	Security Chip	None	None	LAUREL PRECISION MACHINES CO., LTD.	-
E5	Safty Pocket	None	None	LAUREL PRECISION MACHINES CO., LTD.	-
E6	Sub Inlet	None	None	LAUREL PRECISION MACHINES CO., LTD.	-

Note: Rated input power: AC 100 - 240 V, 50 / 60 Hz, 10 A

**■ Cable List**

ID	Type	Length	Shielding	Remarks
C2	AC power cable	2.5 m	No	3-wire

**■ Dimensions of the EUT**

ID	Width	Depth	Height	Remarks
-	2150 mm	450 mm	650 mm	EUT system, Actual measurement

**Condition of the EUT****Operating Mode of the EUT**

The tests have been conducted with the following operational mode(s) of the EUT.

Name of mode in the report	Description
Ageing	Repeat the following initialization operation 1. Check all sensors 2. EUT internal I/F check 3. Drive and operation check of all motors/solenoids

 JEL use only

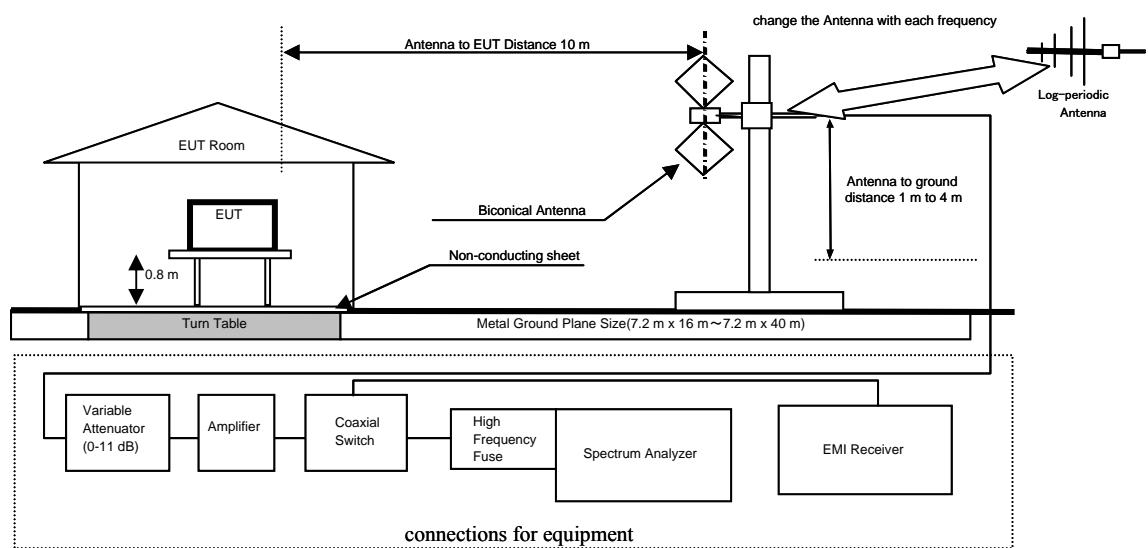
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## **Test Site Description**

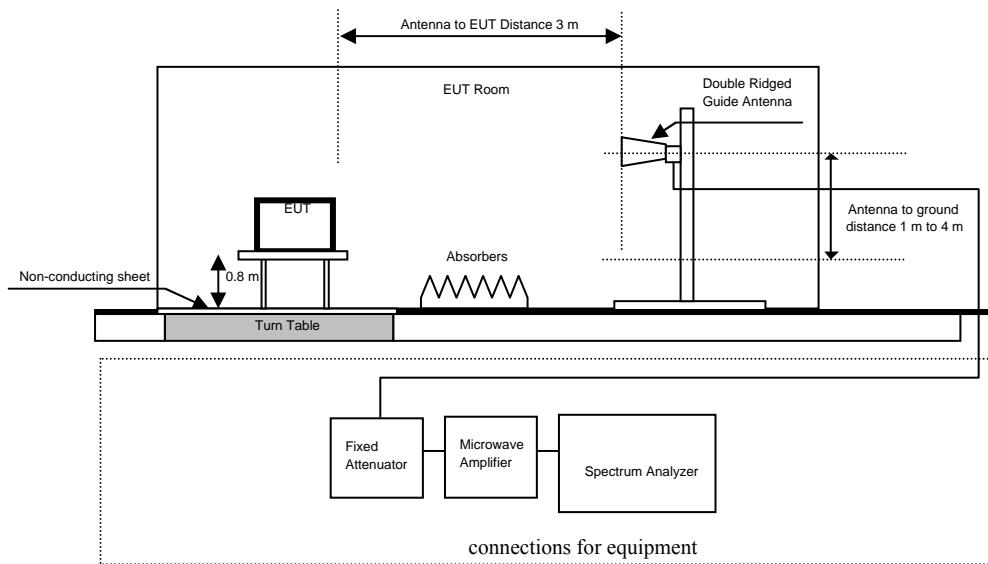
### **1-Facility**

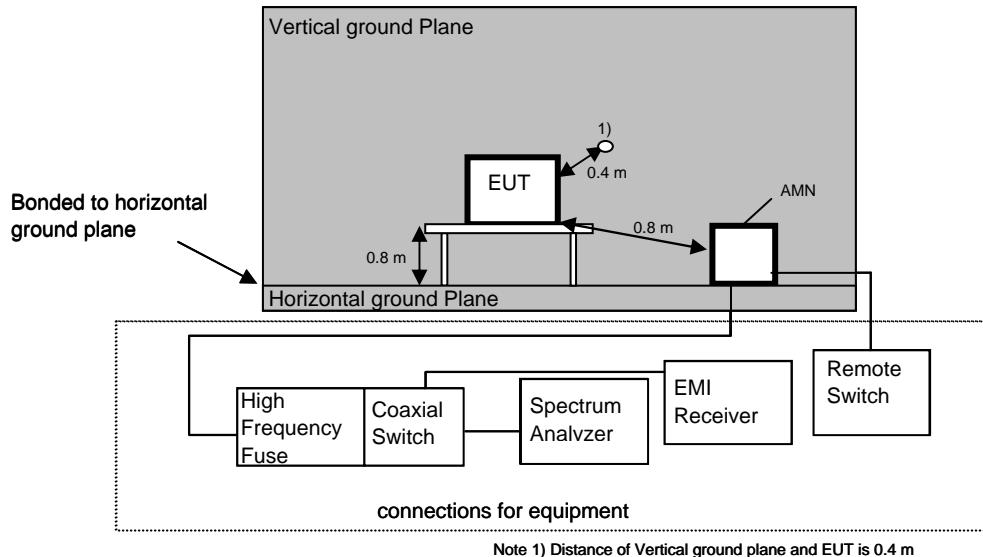
All the testing facilities are periodically serviced as a daily check for equipment and cables systems, an every 6 months facility check for the facilities and a monthly check and annual calibration for testing equipment according to ISO/IEC 17025:2017. All the testing facilities are used as the same specifications shown below. In this product, there used No.8 open test site for radiated emission and shielded room for conducted emission. There are descriptions both for radiated disturbance measurement and conducted disturbance measurement.

### **2-1 Radiated Disturbance Measurement (up to 1 GHz)**



### **2-2 Radiated Disturbance Measurement (above 1 GHz)**



**Test Site Description (Continue)****2-3 Conducted Disturbance Measurement**

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## **Test Procedure**

### **Radiated Disturbance Measurements**

#### **■ up to 1 GHz**

- Test site is met the requirements of CISPR16-1-4 and the distance between the EUT and the antenna is adjusted to 10 m.
- The turntable can be rotated 360 degrees.
- The antenna can be adjusted between 1m and 4m in height above the ground.
- The EUT is placed on the turntable covered with non-conducting sheet.
- Measurements are carried out using a spectrum analyzer with peak detectors (100 kHz bandwidth) and an EMI receiver with quasi-peak detectors (120 kHz bandwidth). (Refer to the list of test equipments used for the test.)
- Biconical antenna and logperiodic antenna are used as wideband antenna.
- The Biconical antenna is used in the frequency range of 30 MHz to 300 MHz and the Logperiodic antenna is used in the frequency range of 300 MHz to 1 GHz.
- A variable attenuator is used for verifying amplifier's linearity.
- Rotating the turntable and adjusting the height of the antenna are carried out by control buttons on the console.
- Measurement is carried out by a JEL operator as manual operation as follows:
  - search for some of high disturbance frequency points than the other points by the following settings: bandwidth 100 kHz, frequency span 10 MHz between 30 MHz and 300 MHz and frequency span 50 MHz between 300 MHz and 1 GHz.
  - search the worst direction with the maximum level of the disturbance wave in rotating the turntable 360 degrees at each searched frequency point.
  - set the height of the antenna with the maximum level of the disturbance wave from 1 m to 4 m.
  - read the disturbance level by the EMI receiver with quasi-peak detectors (120 kHz bandwidth)
  - make measurement to vertical and horizontal polarization.
  - calculate the measurement result with the following equation:  
(Measurement result = reading value + antenna factor + antenna cable loss - amp. gain)

#### **■ above 1 GHz**

- Test site is met the requirements of CISPR16-1-4 and the distance between the EUT and the antenna is adjusted to 3 m.
- The turntable can be rotated 360 degrees.
- The antenna can be adjusted between 1 m and 4 m in height above the ground.
- A double-ridged guide antenna is used for the test and is placed on a metal ground plane. The antenna height is specified in "General description of radiated disturbance measurement above 1 GHz".
- The EUT is placed on the turntable covered with non-conducting sheet.
- Measurements are carried out using a spectrum analyzer with peak detectors (RBW:1 MHz, VBW:3 MHz) and with average detectors (RBW:1 MHz, VBW:30 Hz[1 Hz]). (Refer to the list of the equipments used for the test.)
- Installed the specified wave-absorber on the ground plane between the antenna and EUT.
- A fixed attenuator is used for verifying amplifier's linearity.
- Rotating the turntable is carried out by control buttons on the console.
- Measurement is carried out by a JEL operator as manual operation as follows:
  - search for some of high disturbance frequency points than the other points by the following settings: frequency span 100 MHz between 1 GHz and 2 GHz and frequency span 500 MHz between 2 GHz and 6.25 GHz
  - search the worst direction with the maximum level of the disturbance wave in rotating the turntable 360 degrees at each searched frequency point.
  - make measurement with the antenna in fixed position or with scanning, depending on the height of EUT.
  - set the frequency span to be 5 MHz for the scanned frequency, then read the disturbance levels with Peak detector and Average detector.
  - make measurement to vertical and horizontal polarization.
  - calculate the measurement result with the following equation:  
(Measurement result = reading value + antenna factor + antenna cable loss - amp. gain)

**Test Procedure (Continue)****Conducted Disturbance Measurements**

- The measurements is carried out on horizontal ground plane in a shielded room.
- An AMN(Artificial Mains Network) with a nominal impedance (50 Ω/50 µH) as defined in CISPR16-1-2, shall be utilized.
- The AMN is grounded on a horizontal metal ground plane.
- Measurement is carried out using a spectrum analyzer with peak detectors (10 kHz bandwidth) and an EMI receiver with quasi-peak detectors and average detector.  
(Refer to the list of test equipments used for the test.)
- The shortest distance between the EUT and the AMN is 0.8 m.
- The EUT is placed on a horizontal metallic ground plane covered with non-conducting sheet.
- A remote switch is used for changing phases between Line(L) and Neutral(N).
- Measurement is carried out as manual operation as follows:
  - detect the maximized emission level using the maxhold function after setting the spectrum analyzer bandwidth 10 kHz and the frequency range from 150 kHz to 1 MHz , 1 MHz to 5 MHz and 5 MHz to 30 MHz.
  - search the maximum frequency point of the disturbance wave in each frequency range.
  - read the disturbance level of quasi-peak, average and Line(L) and Neutral(N) in 9 kHz bandwidth by the EMI receiver.
  - calculate the measurement result with the following equation.  
(Measurement result= reading value + LISN(AMN) voltage division factor + cable loss)

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**List of equipment used for the tests (Vol. 418)**

<b>Item</b>	<b>Model Name</b>	<b>Serial No.</b>	<b>Manufacturer</b>	<b>Effective Until</b>
EMI test receiver	ESVS10	100011	R&S	Jul 31, 2020
Spectrum analyzer	TR4173E	05590011	Advantest	Aug 31, 2020
Pre-amplifier	8447D Opt.010	2944A08043	HP	Feb 28, 2021
Biconical antenna	BBA9106	1196	Schwarzbeck	Jul 31, 2020
Log-periodic antenna	USLP9143	124	Schwarzbeck	Jul 31, 2020
Step Attenuator	8494B	2812A16938	HP	Feb 28, 2021
Coaxial Switch	AV210	650009	Stack Elec.	Nov 30, 2020
High frequency fuse holder	MP612A	AN013	Anritsu	Jan 31, 2021
Thermometer/Hygrometer	3-4110-01	015	Isuzu	Jun 01, 2021
EMI test receiver	FCKL1528	1528-224	Schwarzbeck	Feb 28, 2021
Spectrum analyzer	E4401B	US39240216	HP	Jan 31, 2021
Coaxial Switch	AV210	650005	Stack Elec.	Nov 30, 2020
High frequency fuse holder	MP612A	AN014	Anritsu	Jan 31, 2021
LISN (AMN)	ESH2-Z5	882394012	R&S	Aug 31, 2020
High pass filter	KFL-007	8S-1366-3	Kyoritsu	Jan 31, 2021
Microwave pre-amplifier	QLW-0118	33593938	Jel	Feb 28, 2021
Double ridge guide antenna	96001	96051502	Raven Eng.	Feb 28, 2021
Spectrum analyzer	E7405A	MY45109378	Agilent	Aug 31, 2020
Report navigation Original	EM-019	Ver. 88.0b	Jel	N/A

Note : The tests were performed on July 20 to 21, 2020.

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**Results****Radiated Disturbance Measurements (30 MHz to 1000 MHz)****Test Specification**

Applied standard : FCC Part 15, Subpart B  
Class A

**EUT**

Category : NOTE SORTER  
Model Name : Ks  
Serial Number : 0000002

**Test Condition**

Applied Power : AC 120 V, 60 Hz  
Single phase 3-wire  
Date : July 20, 2020  
Test venue : No.8 Open site  
Distance : 10 m  
Detection : Q.P.  
Temperature : 25°C  
Humidity : 80 %  
Operator : K. Matsuo

**Operating mode of EUT during the test**

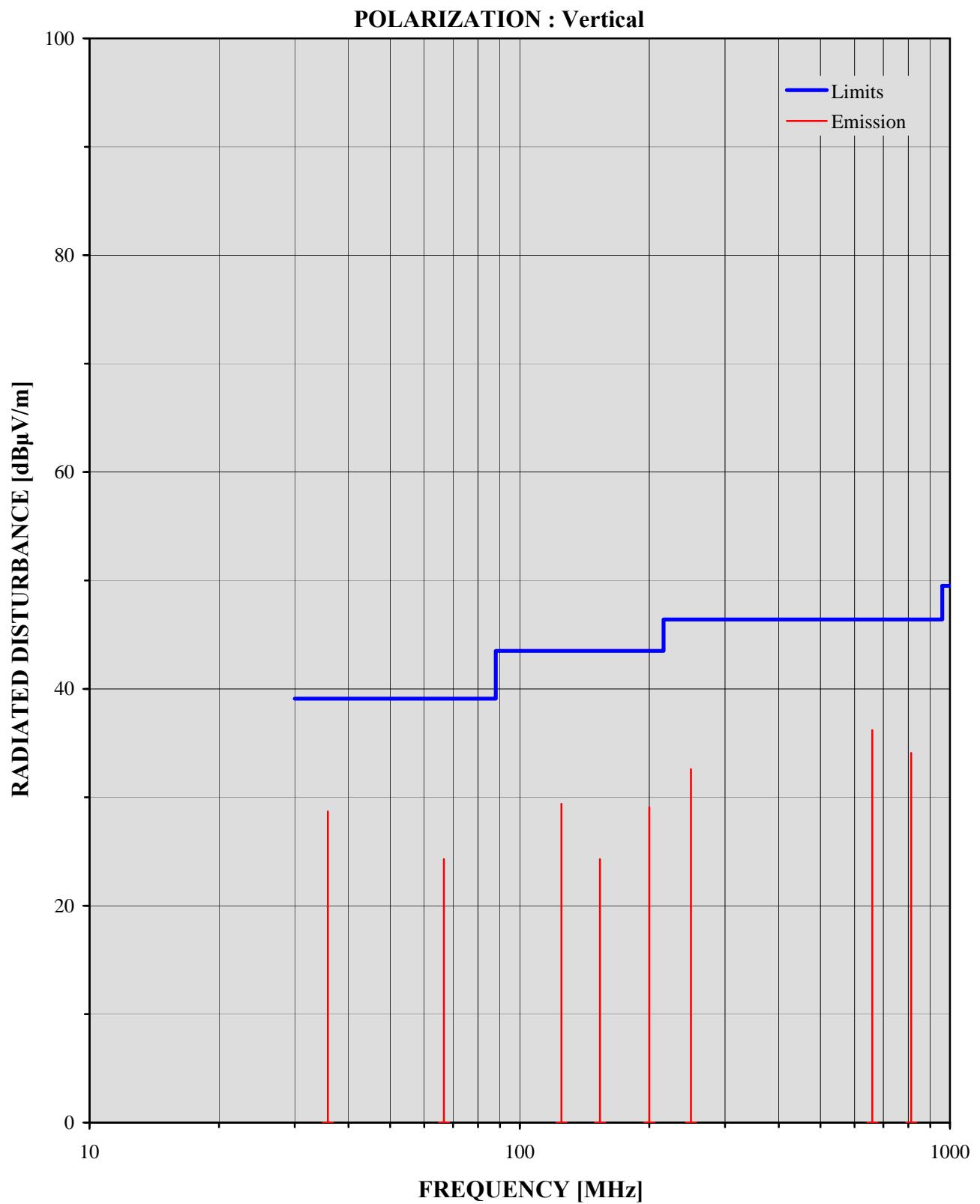
Ageing

**Polarization****Vertical**

Frequency (MHz)	Reading (dB $\mu$ V)	Cor.F. (dB/m)	DATA No. 1		(Refer to Graph 1 )
			Result (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	
35.82	32.5	-3.8	28.7	39.1	10.4
66.66	37.2	-12.9	24.3	39.1	14.8
125.00	35.0	-5.6	29.4	43.5	14.1
153.60	27.5	-3.2	24.3	43.5	19.2
200.00	30.0	-0.9	29.1	43.5	14.4
250.00	32.2	0.4	32.6	46.4	13.8
660.00	35.8	0.4	36.2	46.4	10.2
812.50	30.6	3.5	34.1	46.4	12.3

**Note**

- A sample calculation: Cor. F. (correction factor)= antenna factor + cable loss- amp.gain  
Result = Reading + Cor. F.  
Margin = Limit- Result

**Graph 1**

**Radiated Disturbance Measurements (30 MHz to 1000 MHz)****Test Specification**

Applied standard : FCC Part 15, Subpart B  
Class A

**EUT**

Category : NOTE SORTER  
Model Name : Ks  
Serial Number : 0000002

**Test Condition**

Applied Power : AC 120 V, 60 Hz  
Single phase 3-wire  
Date : July 20, 2020  
Test venue : No.8 Open site  
Distance : 10 m  
Detection : Q.P.  
Temperature : 25°C  
Humidity : 80 %  
Operator : K. Matsuo

**Operating mode of EUT during the test**

Ageing

**Polarization      Horizontal**

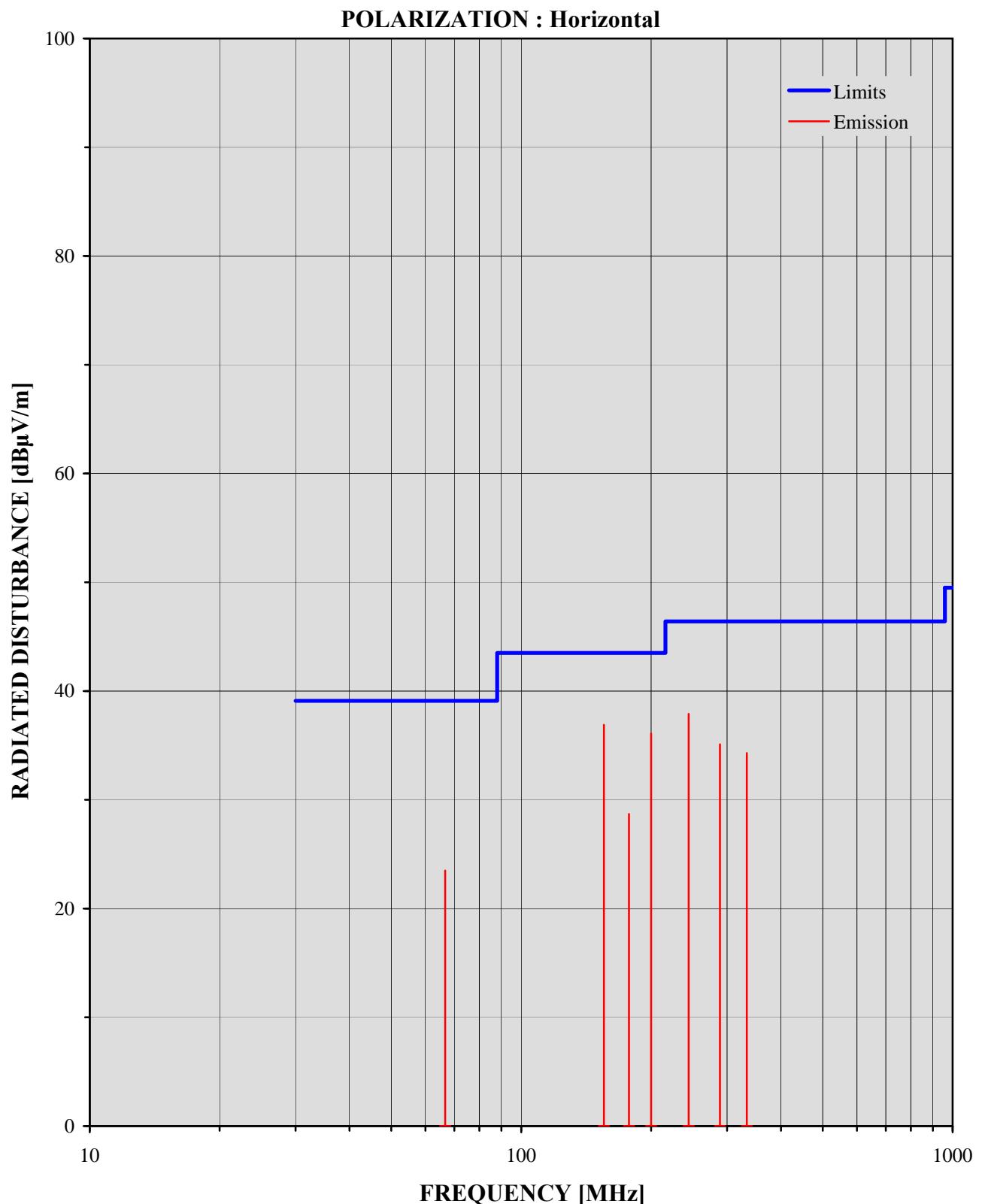
Frequency (MHz)	Reading (dB $\mu$ V)	Cor.F. (dB/m)	DATA No. 2		(Refer to Graph 2 )
			Result (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	
66.66	36.4	-12.9	23.5	39.1	15.6
155.55	40.0	-3.1	36.9	43.5	6.6
177.77	30.5	-1.8	28.7	43.5	14.8
200.00	37.0	-0.9	36.1	43.5	7.4
244.44	37.7	0.2	37.9	46.4	8.5
288.88	32.7	2.4	35.1	46.4	11.3
333.33	40.5	-6.2	34.3	46.4	12.1

**Note**

- A sample calculation: Cor. F. (correction factor)= antenna factor + cable loss- amp.gain

Result = Reading + Cor. F.

Margin = Limit- Result

**Graph 2**

**Radiated Disturbance Measurements (1 GHz to 6.25 GHz)****Test Specification**

Applied standard : FCC Part 15, Subpart B  
Class A

**EUT**

Category : NOTE SORTER  
Model Name : Ks  
Serial Number : 0000002

**Test Condition**

Applied Power : AC 120 V, 60 Hz  
Single phase 3-wire  
Date : July 20, 2020  
Test venue : No.8 Open site  
Distance : 3 m  
Detection : Peak  
Temperature : 25°C  
Humidity : 80 %  
Operator : K. Matsuo

**Operating mode of EUT during the test**

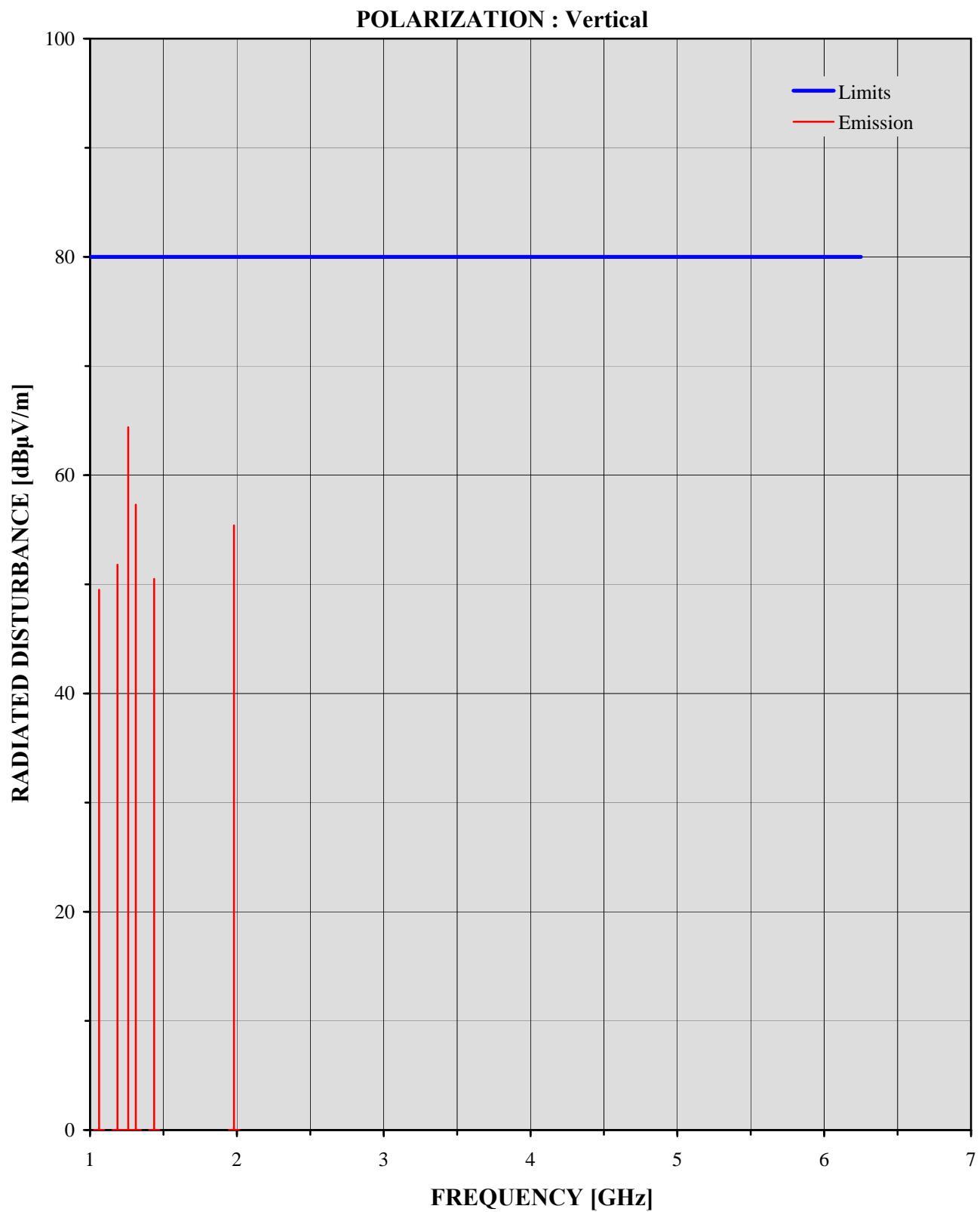
Ageing

**Polarization****Vertical**

Frequency (GHz)	Reading (dB $\mu$ V)	Cor.F. (dB/m)	DATA No. 3			(Refer to Graph 3 )
			Result (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	
1.062	60.3	-10.8	49.5	80.0	30.5	
1.187	63.4	-11.6	51.8	80.0	28.2	
1.260	76.5	-12.1	64.4	80.0	15.6	
1.312	69.7	-12.4	57.3	80.0	22.7	
1.437	63.8	-13.3	50.5	80.0	29.5	
1.980	66.9	-11.5	55.4	80.0	24.6	

**Note**

- A sample calculation: Cor. F. (correction factor)= antenna factor + cable loss- amp.gain  
Result = Reading + Cor. F.  
Margin = Limit- Result

**Graph 3**

**Radiated Disturbance Measurements (1 GHz to 6.25 GHz)****Test Specification**

Applied standard : FCC Part 15, Subpart B  
Class A

**EUT**

Category : NOTE SORTER  
Model Name : Ks  
Serial Number : 0000002

**Test Condition**

Applied Power : AC 120 V, 60 Hz  
Single phase 3-wire  
Date : July 20, 2020  
Test venue : No.8 Open site  
Distance : 3 m  
Detection : Average  
Temperature : 25°C  
Humidity : 80 %  
Operator : K. Matsuo

**Operating mode of EUT during the test**

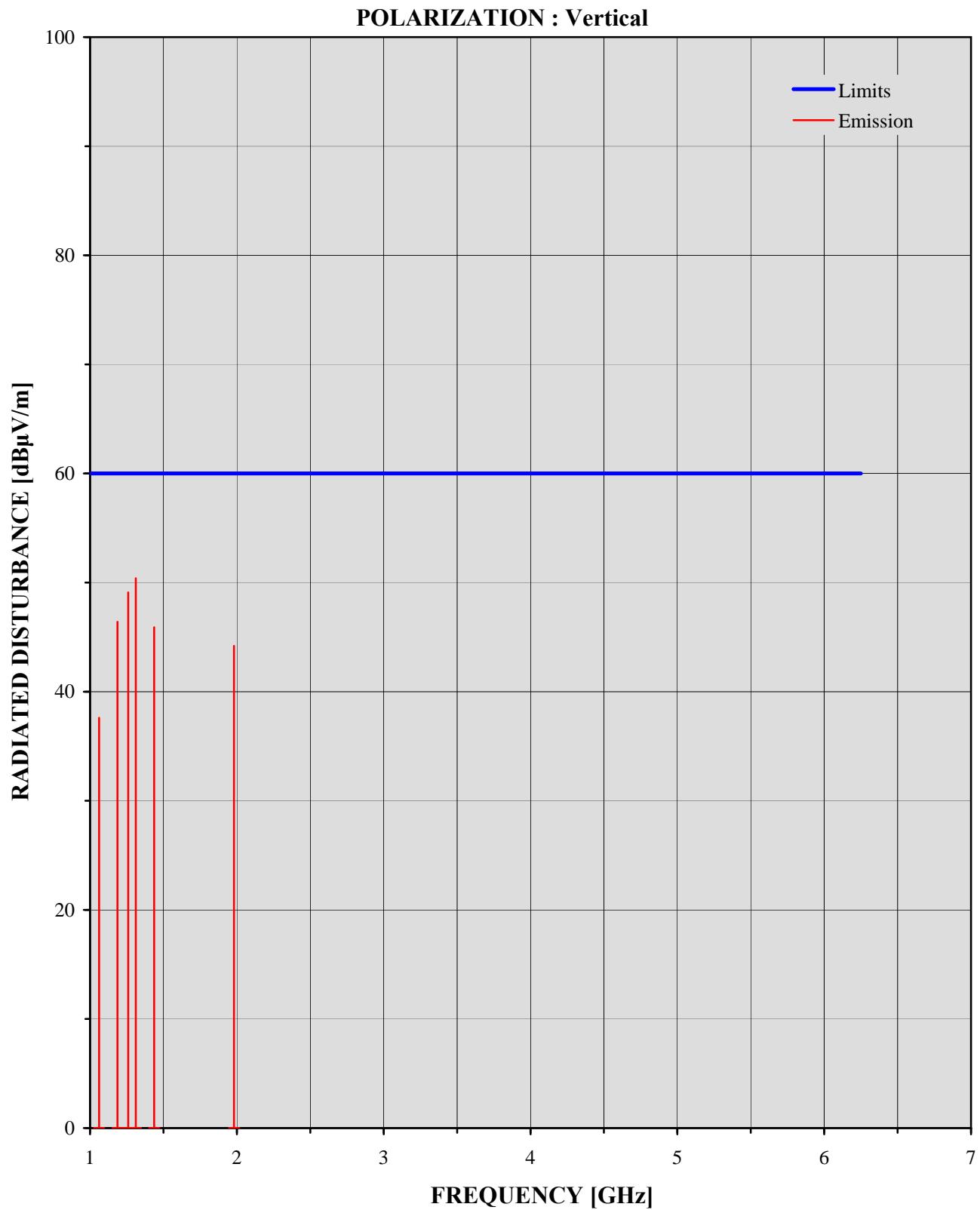
Ageing

**Polarization****Vertical**

Frequency (GHz)	Reading (dB $\mu$ V)	Cor.F. (dB/m)	DATA No. 4			(Refer to Graph 4 )
			Result (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	
1.062	48.4	-10.8	37.6	60.0	22.4	
1.187	58.0	-11.6	46.4	60.0	13.6	
1.260	61.2	-12.1	49.1	60.0	10.9	
1.312	62.8	-12.4	50.4	60.0	9.6	
1.437	59.2	-13.3	45.9	60.0	14.1	
1.980	55.7	-11.5	44.2	60.0	15.8	

**Note**

- A sample calculation: Cor. F. (correction factor)= antenna factor + cable loss- amp.gain  
Result = Reading + Cor. F.  
Margin = Limit- Result

**Graph 4**

**Radiated Disturbance Measurements (1 GHz to 6.25 GHz)****Test Specification**

Applied standard : FCC Part 15, Subpart B  
Class A

**EUT**

Category : NOTE SORTER  
Model Name : Ks  
Serial Number : 0000002

**Test Condition**

Applied Power : AC 120 V, 60 Hz  
Single phase 3-wire  
Date : July 20, 2020  
Test venue : No.8 Open site  
Distance : 3 m  
Detection : Peak  
Temperature : 25°C  
Humidity : 80 %  
Operator : K. Matsuo

**Operating mode of EUT during the test**

Ageing

**Polarization      Horizontal**

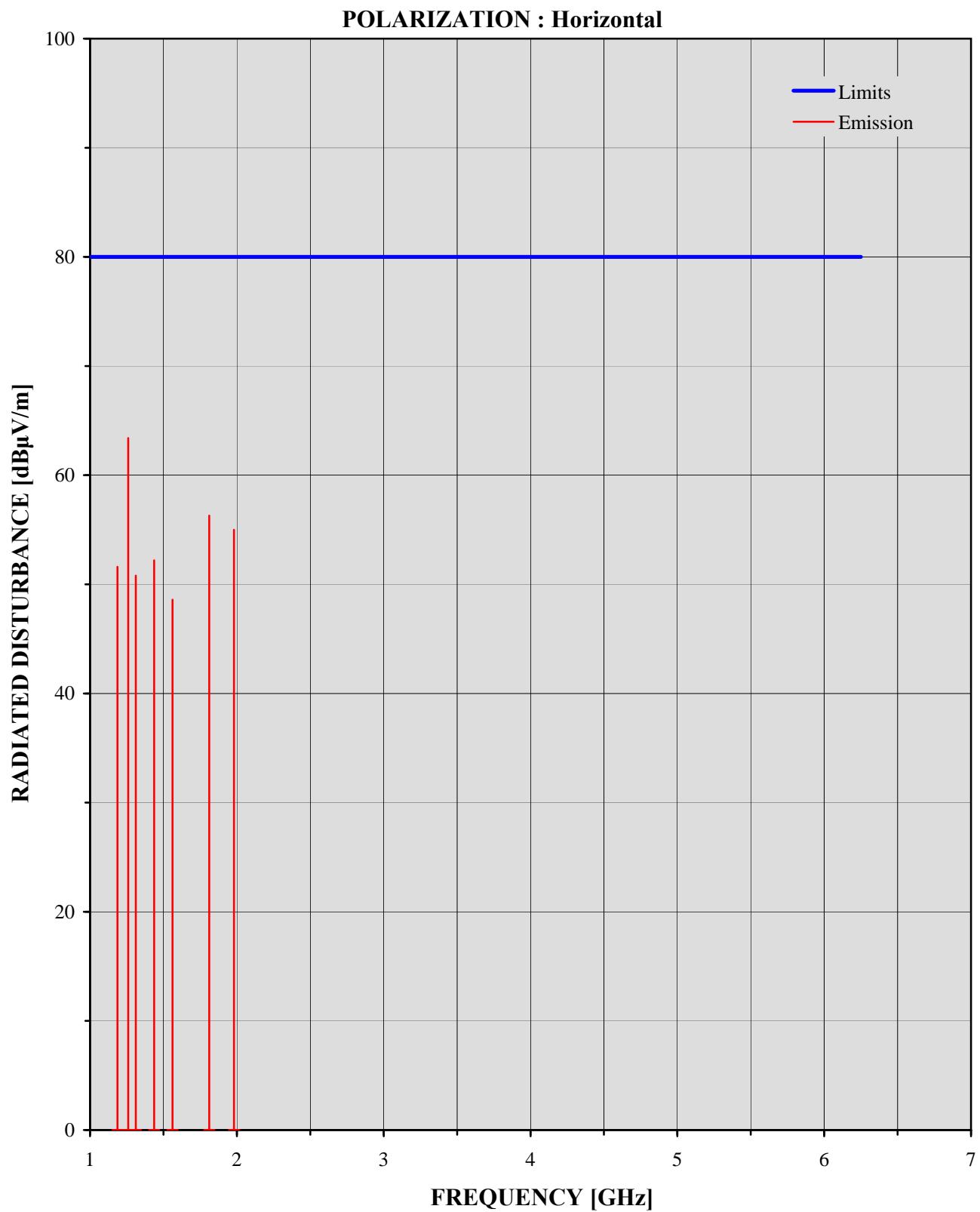
Frequency (GHz)	Reading (dB $\mu$ V)	Cor.F. (dB/m)	DATA No. 5		(Refer to Graph 5 )
			Result (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	
1.187	63.2	-11.6	51.6	80.0	28.4
1.260	75.5	-12.1	63.4	80.0	16.6
1.312	63.2	-12.4	50.8	80.0	29.2
1.437	65.5	-13.3	52.2	80.0	27.8
1.562	62.0	-13.4	48.6	80.0	31.4
1.812	68.6	-12.3	56.3	80.0	23.7
1.980	66.5	-11.5	55.0	80.0	25.0

**Note**

- A sample calculation: Cor. F. (correction factor)= antenna factor + cable loss- amp.gain

Result = Reading + Cor. F.

Margin = Limit- Result

**Graph 5**

**Radiated Disturbance Measurements (1 GHz to 6.25 GHz)****Test Specification**

Applied standard : FCC Part 15, Subpart B  
Class A

**EUT**

Category : NOTE SORTER  
Model Name : Ks  
Serial Number : 0000002

**Test Condition**

Applied Power : AC 120 V, 60 Hz  
Single phase 3-wire  
Date : July 20, 2020  
Test venue : No.8 Open site  
Distance : 3 m  
Detection : Average  
Temperature : 25°C  
Humidity : 80 %  
Operator : K. Matsuo

**Operating mode of EUT during the test**

Ageing

**Polarization      Horizontal**

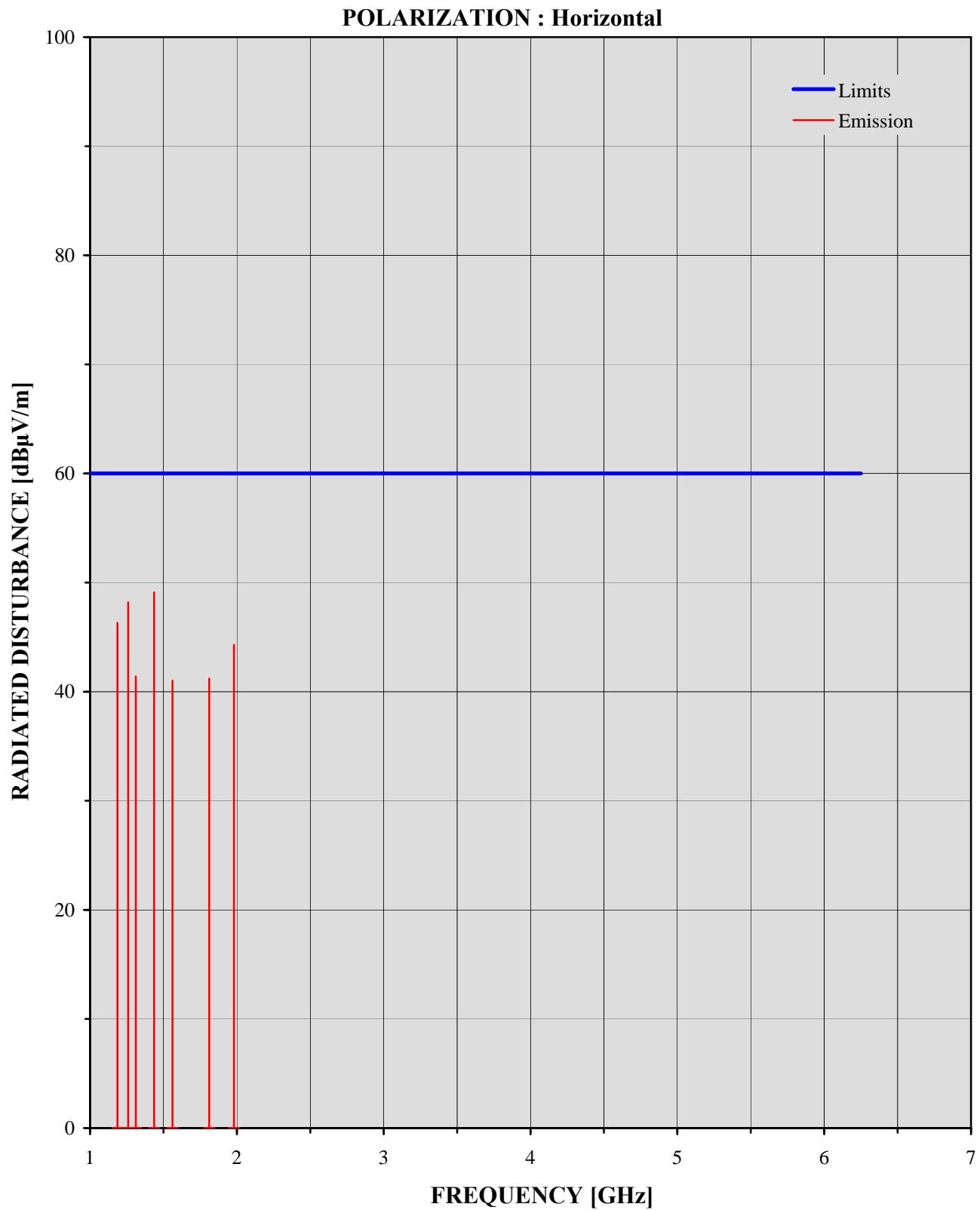
Frequency (GHz)	Reading (dB $\mu$ V)	Cor.F. (dB/m)	DATA No. 6      (Refer to Graph 6 )		
			Result (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)
1.187	57.9	-11.6	46.3	60.0	13.7
1.260	60.3	-12.1	48.2	60.0	11.8
1.312	53.8	-12.4	41.4	60.0	18.6
1.437	62.4	-13.3	49.1	60.0	10.9
1.562	54.4	-13.4	41.0	60.0	19.0
1.812	53.5	-12.3	41.2	60.0	18.8
1.980	55.8	-11.5	44.3	60.0	15.7

**Note**

- A sample calculation: Cor. F. (correction factor)= antenna factor + cable loss- amp.gain

Result = Reading + Cor. F.

Margin = Limit- Result

**Graph 6**

**Conducted Disturbance Measurements****Test Specification**

Applied standard : FCC Part 15, Subpart B  
Class A

**EUT**

Category : NOTE SORTER  
Model Name : Ks  
Serial Number : 0000002

**Test Condition**

Applied Power : AC 120 V, 60 Hz  
Single phase 3-wire  
Date : July 21, 2020  
Test venue : No.8 Open site  
Temperature : 25°C  
Humidity : 80 %  
Operator : K. Matsuo

**Operating mode of EUT during the test**

Ageing

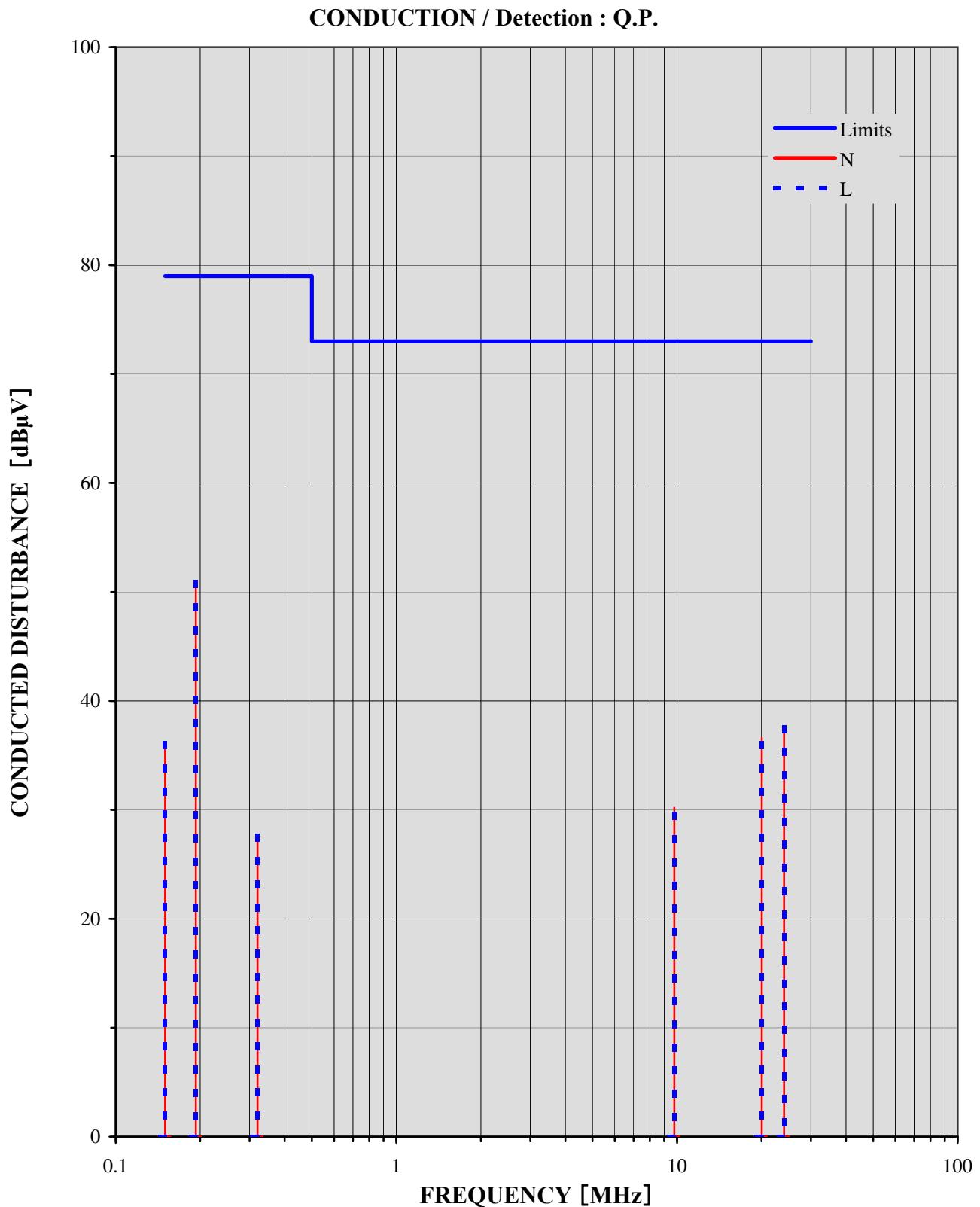
Measured AC line: C2 (I connected and tested two at the same time.)<sup>†</sup>

Frequency (MHz)	Reading (dB $\mu$ V)		Cor.F. (dB)		DATA No. 7 Result (dB $\mu$ V)		Limits (dB $\mu$ V)		(Refer to Graph 7 ) Margin (dB)	
	N L		N L		N L		N L		N L	
	0.150	26.2 26.2	9.9 9.9	36.1 36.1	79.0	42.9 42.9	0.193	40.8 41.0	9.9 9.9	50.7 50.9 79.0 28.3 28.1
0.320	17.6 17.7	9.9 9.9	27.5 27.6	79.0	51.5 51.4	9.780	19.8 19.2	10.4 10.4	30.2 29.6	73.0 42.8 43.4
20.034	25.8 25.2	10.8 10.9	36.6 36.1	73.0	36.4 36.9	24.062	27.0 26.6	10.7 11.0	37.7 37.6	73.0 35.3 35.4

**Note**

- A sample calculation: Cor. F. (correction factor)= LISN(AMN) voltage division factor + cable loss  
Result = Reading + Cor. F.  
Margin = Limit- Result

<sup>†</sup> : By the request from the client.

**Graph 7**

**Conducted Disturbance Measurements****Test Specification**

Applied standard : FCC Part 15, Subpart B  
Class A

**EUT**

Category : NOTE SORTER  
Model Name : Ks  
Serial Number : 0000002

**Test Condition**

Applied Power : AC 120 V, 60 Hz  
Single phase 3-wire  
Date : July 21, 2020  
Test venue : No.8 Open site  
Temperature : 25°C  
Humidity : 80 %  
Operator : K. Matsuo

**Operating mode of EUT during the test**

Ageing

Measured AC line: C2 (I connected and tested two at the same time.)<sup>†</sup>

Frequency (MHz)	Reading (dB $\mu$ V)		Cor.F. (dB)		DATA No. 8 Result (dB $\mu$ V)		Limits (dB $\mu$ V)		(Refer to Graph 8 ) Margin (dB)											
	N L		N L		N L		N L		N L											
	0.150	21.0 20.8	9.9 9.9	30.9 30.7	66.0	35.1 35.3	0.193	27.8 28.0	9.9 9.9	37.7 37.9	66.0 28.3 28.1									
0.320	11.0 11.0	9.9 9.9	20.9 20.9	66.0	45.1 45.1	9.780	16.3 15.8	10.4 10.4	26.7 26.2	60.0 33.3 33.8	20.034	23.0 22.4	10.8 10.9	33.8 33.3	60.0 26.2 26.7	24.062	23.4 23.7	10.7 11.0	34.1 34.7	60.0 25.9 25.3

**Note**

- A sample calculation: Cor. F. (correction factor)= LISN(AMN) voltage division factor + cable loss  
Result = Reading + Cor. F.  
Margin = Limit- Result

<sup>†</sup> : By the request from the client.

**Graph 8**