

## FCC Test Report

**Report No.:** RF180531D06

**FCC ID:** 2ARPT0001

**Test Model:** Inductive Interface

**Received Date:** May 31, 2018

**Test Date:** Jun. 4 to 22, 2018

**Issued Date:** Jul. 12, 2018

**Applicant:** Carl Zeiss 3D Automation GmbH

**Address:** Carl-Zeiss-Strasse 27, 73431 Aalen, Germany

**Issued By:** Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

**Lab Address:** No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan, R.O.C.

**FCC Registration /  
Designation Number:** 198487 / TW2021



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### Release Control Record

Issue No.	Description	Date Issued
RF180531D06	Original release	Jul. 12, 2018

## 1 Certificate of Conformity

**Product:** Pallet interface

**Brand:** ZEISS

**Model No.:** Inductive Interface

**Sample Status:** Engineering sample

**Applicant:** Carl Zeiss 3D Automation GmbH

**Test Date:** Jun. 4 to 22, 2018

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.209)  
ANSI C63.10: 2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

**Prepared by :**

*Annie Chang*

**Date:** Jul. 12, 2018

Annie Chang / Senior Specialist

**Approved by :**

*Rex Lai*

**Date:** Jul. 12, 2018

Rex Lai / Associate Technical Manager

## 2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.209)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -4.78dB at 0.44506MHz
15.215	Channel Bandwidth Measurement		
15.209	Radiated Emission Test	Pass	Meet the requirement of limit. Minimum passing margin is -3.08dB at 154.79MHz

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

### 2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) ( $\pm$ )
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.79 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	2.38 dB
	30MHz ~ 1000MHz	5.54 dB

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

Product	Pallet interface
Brand	ZEISS
Test Model	Inductive Interface
Sample Status	Engineering sample
Power Supply Rating	DC Power from host equipment
Modulation Type	OOK (On-Off-Keying)
Operating Frequency	1.6MHz, 4MHz, 10MHz
Number of Channel	3
Antenna Type	Coil antenna
Field Strength	36.39dBuV/m
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

1. The EUT is a temperature sensor with two RF chips as follows:

✧ 33FJ16GS402

✧ 33FJ32GP302

The above to RF chips were pre-tested and **33FJ16GS402** was the worst case for final test.

2. The emission of the simultaneous operation has been evaluated and no non-compliance was found.

#### 3.2 Description of Test Modes

3 channels are provided to this EUT:

Channel	Frequency
1	1.6MHz
2	4MHz
3	10MHz

### 3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To		Description
	RE<1G	PLC	
-	√	√	-

Where **RE<1G**: Radiated Emission below 1GHz **PLC**: Power Line Conducted Emission

#### Radiated Emission Test (Below 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
-	1 to 3	1, 2, 3	FSK

#### Power Line Conducted Emission Test:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
-	1 to 3	1	FSK

#### Antenna Port Conducted Measurement:

##### Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested by
<b>RE&lt;1G</b>	24 deg. C, 74% RH	120Vac, 60Hz (System)	James Wei
<b>PLC</b>	25 deg. C, 75% RH	120Vac, 60Hz (System)	Chiawei Lin

### 3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

#### Radiated Emission Test

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	PC	N/A	C99	N/A	N/A	Supplied by client
B.	Signal converter	N/A	MCA	N/A	N/A	Supplied by client
C.	LCD MONITOR	HP	LA2405wg	CN41210F8Z	FCC DoC Approved	Provided by Lab
D.	Terminating resister	N/A	N/A	N/A	N/A	Supplied by client

Note: All power cords of the above support units are non-shielded (1.8m).

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	I/O cable (M801)	1	0.6	N	0	Supplied by client
2.	CAN cable (X193)	1	2.5	N	0	Supplied by client
3.	D-Sub cable	1	1.8	Y	2	Supplied by client
4.	temperature sensor	1	0.15	N	0	Supplied by client

Note: The core(s) is(are) originally attached to the cable(s).

#### Power Line Conducted Emission Test:

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	LCD MONITOR	HP	LA2405wg	CN41210F8Z	FCC DoC Approved	Provided by Lab
B.	PC	N/A	C99	N/A	N/A	Supplied by client
C.	USB Keyboard	Dell	KB216t	CN-0W33XP-LO300-7CL-1904	FCC DoC Approved	Provided by Lab
D.	USB Mouse	Microsoft	1113	9170515896637	FCC DoC Approved	Provided by Lab
E.	Printer	HP	HP Officejet Pro 251dw	CN55FCV012	FCC DoC Approved	Provided by Lab
F.	MODEM	ACEEX	1414	980020538	IFAXDM1414	Provided by Lab
G.	Signal converter	N/A	MCA	N/A	N/A	Supplied by client
H.	Terminating resister	N/A	N/A	N/A	N/A	Supplied by client

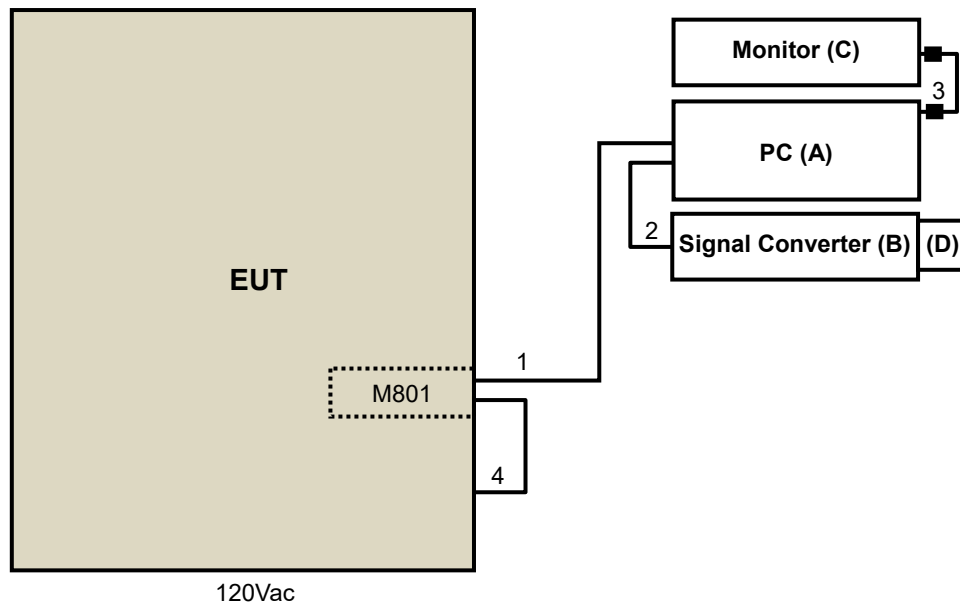
Note: All power cords of the above support units are non-shielded (1.8m).

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	D-Sub cable	1	1.8	Y	2	Supplied by client
2.	USB cable	1	1.8	Y	0	Provided by Lab
3.	USB cable	1	1.8	Y	1	Provided by Lab
4.	USB cable	1	1.5	Y	0	Provided by Lab
5.	RS232 cable	1	0.5	Y	0	Provided by Lab
6.	CAN cable (X111)	1	0.3	N	0	Supplied by client
7.	CAN cable (X160)	1	0.1	N	0	Supplied by client
8.	CAN cable (X193)	1	2.5	N	0	Supplied by client
9.	I/O cable (M801)	1	1.5	N	0	Supplied by client
10.	I/O cable (M801)	1	0.6	N	0	Supplied by client
11.	temperature sensor	1	0.8	N	0	Supplied by client
12.	temperature sensor	1	0.15	N	0	Supplied by client

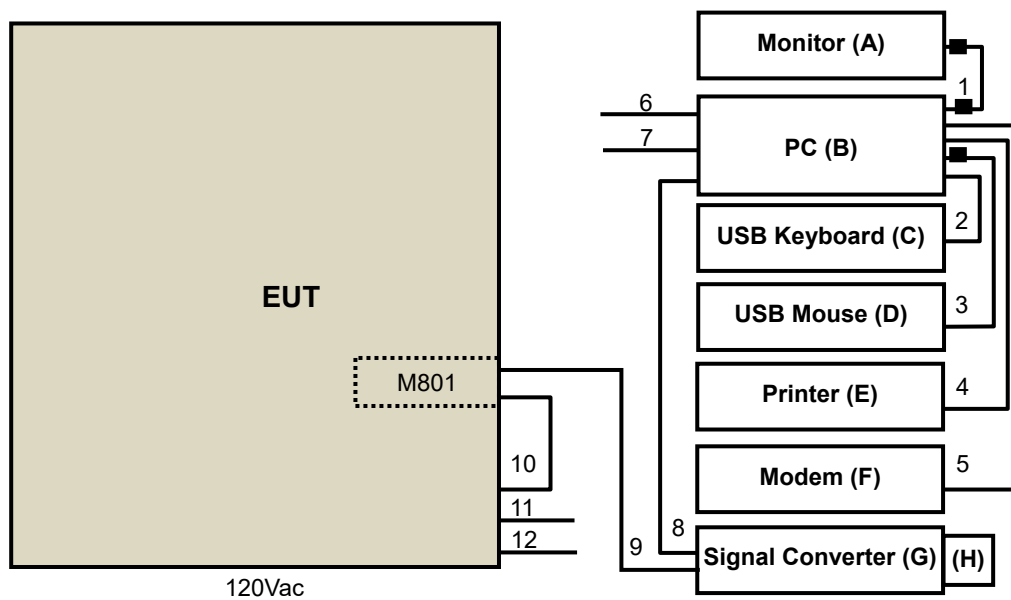
Note: The core(s) is(are) originally attached to the cable(s).

### 3.3.1 Configuration of System under Test

#### Radiated Emission Test



#### Power Line Conducted Emission Test:



### 3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

#### **FCC Part 15, Subpart C (15.209)**

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

## 4 Test Types and Results

### 4.1 Radiated Emission and Bandedge Measurement

#### 4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

#### NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

#### 4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
HP Preamplifier	8447D	2432A03504	Feb. 21, 2018	Feb. 20, 2019
HP Preamplifier	8449B	3008A01201	Feb. 22, 2018	Feb. 21, 2019
MITEQ Preamplifier	AMF-6F-260400-33-8P	892164	Feb. 21, 2018	Feb. 20, 2019
Agilent TEST RECEIVER	N9038A	MY51210129	Feb. 6, 2018	Feb. 5, 2019
Schwarzbeck Antenna	VULB 9168	139	Nov. 29, 2017	Nov. 28, 2018
Schwarzbeck Antenna	VHBA 9123	480	May 19, 2017	May 18, 2019
Schwarzbeck Horn Antenna	BBHA-9170	212	Dec. 1, 2017	Nov. 30, 2018
Schwarzbeck Horn Antenna	BBHA 9120-D1	D130	Dec. 1, 2017	Nov. 30, 2018
ADT. Turn Table	TT100	0306	NA	NA
ADT. Tower	AT100	0306	NA	NA
Software	Radiated_V7.6.15.9.5	NA	NA	NA
SUHNER RF cable With 4dB PAD	SF104	CABLE-CH6	Aug. 14, 2017	Aug. 13, 2018
SUHNER RF cable With 3dB PAD	SF102	Cable-CH8-3.6m	Aug. 14, 2017	Aug. 13, 2018
KEYSIGHT Spectrum Analyzer	N9030A	MY54490260	Jul. 26, 2017	Jul. 25, 2018
Loop Antenna EMCI	LPA600	270	Aug. 11, 2017	Aug. 10, 2019
EMCO Horn Antenna	3115	00028257	Nov. 30, 2017	Nov. 29, 2018
Highpass filter Wainwright Instruments	WHK 3.1/18G-10SS	SN 8	NA	NA
ROHDE & SCHWARZ Spectrum Analyzer	FSV40	101042	Sep. 29, 2017	Sep. 28, 2018
Anritsu Power Sensor	MA2411B	0738404	Apr. 26, 2018	Apr. 25, 2019
Anritsu Power Meter	ML2495A	0842014	Apr. 26, 2018	Apr. 25, 2019

- NOTE:**
1. The calibration interval of the above test instruments is 12/24 months. And the calibrations are traceable to NML/ROC and NIST/USA.
  2. The horn antenna and HP preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
  3. The test was performed in Chamber No. 6.

#### 4.1.3 Test Procedures

##### For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

##### For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

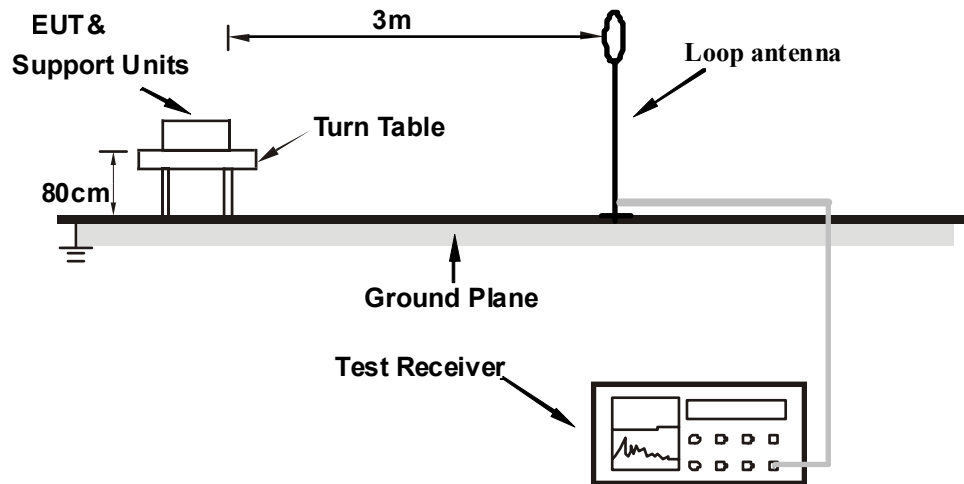
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle  $< 98\%$ ) or 10Hz (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

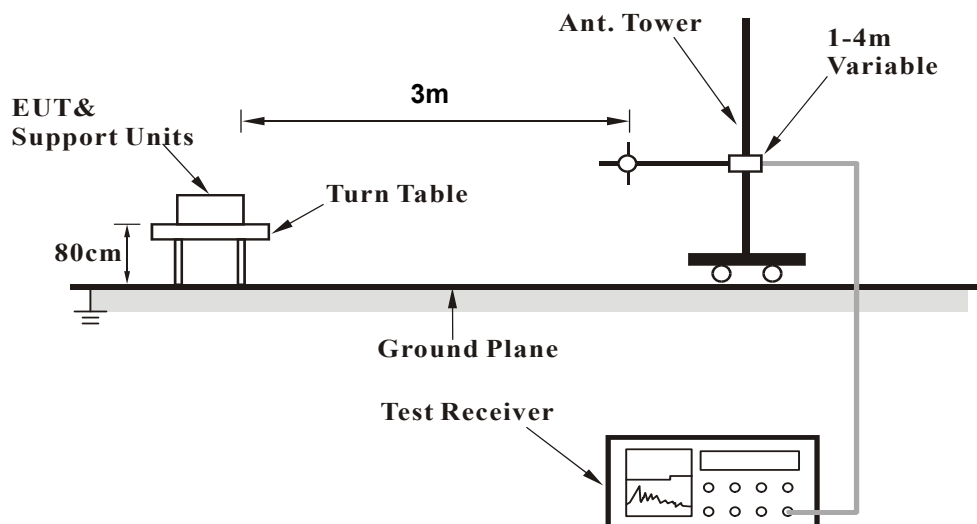
No deviation.

#### 4.1.5 Test Set Up

##### For Radiated emission below 30MHz



##### For Radiated emission 30MHz to 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.1.6 EUT Operating Conditions

- Turned on the power of all equipment.
- PC ran a test program to enable all functions.
- PC read and wrote messages to/ from HDD.
- EUT received messages from temperature sensors and sent messages to PC via signal converter.
- PC sent messages to ext. LCD Monitor. Then it displayed them on its screen.
- Steps c-e were repeated.

#### 4.1.7 Test Results

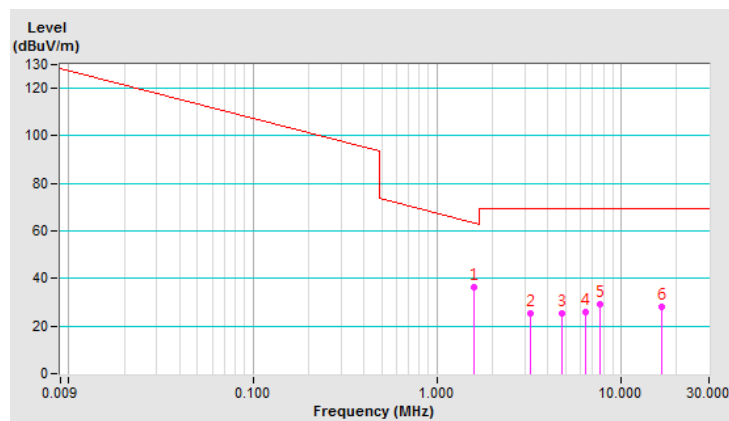
Below 30MHz Data:

Test Frequency	1.6MHz	Detector Function	Quasi-Peak
Frequency Range	9 kHz ~ 30 MHz		

Antenna Polarity & Test Distance: Loop Antenna Open At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*1.600	36.39 QP	63.52	-27.13	1.00	161	37.86	-1.47
2	3.200	25.23 QP	69.54	-44.31	1.00	241	28.62	-3.39
3	4.800	25.33 QP	69.54	-44.21	1.00	302	29.12	-3.79
4	6.400	26.00 QP	69.54	-43.54	1.00	359	29.85	-3.85
5	7.687	29.24 QP	69.54	-40.30	1.00	152	33.16	-3.92
6	16.684	28.30 QP	69.54	-41.24	1.00	271	33.24	-4.94

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. “ \* “: Fundamental frequency.
6. Loop antenna was used for all radiated emission below 30MHz.
7. Limit @3m=Limit@300m+40log(300 / 3)=Limit@300m+80
8. Limit @3m=Limit@30m+40log(30 / 3)=Limit@30m+40

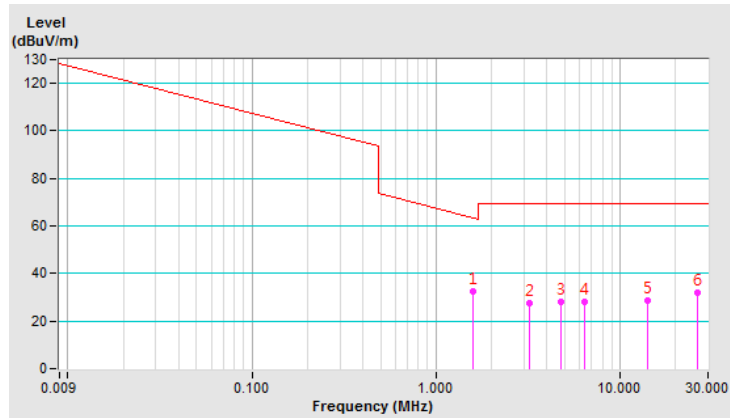


Test Frequency	1.6MHz	Detector Function	Quasi-Peak
Frequency Range	9 kHz ~ 30 MHz		

Antenna Polarity & Test Distance: Loop Antenna Close At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*1.600	32.52 QP	63.52	-31.00	1.00	312	33.99	-1.47
2	3.200	27.53 QP	69.54	-42.01	1.00	237	30.92	-3.39
3	4.800	28.16 QP	69.54	-41.38	1.00	186	31.95	-3.79
4	6.400	28.19 QP	69.54	-41.35	1.00	102	32.04	-3.85
5	14.105	28.40 QP	69.54	-41.14	1.00	144	32.67	-4.27
6	26.131	31.78 QP	69.54	-37.76	1.00	285	40.35	-8.57

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. “ \* “: Fundamental frequency.
6. Loop antenna was used for all radiated emission below 30MHz.
7. Limit @3m=Limit@300m+40log(300 / 3)=Limit@300m+80
8. Limit @3m=Limit@30m+40log(30 / 3)=Limit@30m+40

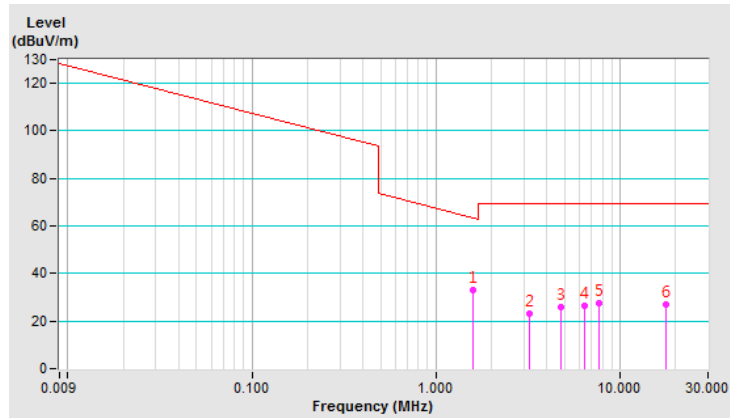


Test Frequency	1.6MHz	Detector Function	Quasi-Peak
Frequency Range	9 kHz ~ 30 MHz		

Antenna Polarity & Test Distance: Loop Antenna Ground-parallel At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*1.600	33.26 QP	63.52	-30.26	1.00	339	34.73	-1.47
2	3.200	23.05 QP	69.54	-46.49	1.00	318	26.44	-3.39
3	4.800	25.89 QP	69.54	-43.65	1.00	259	29.68	-3.79
4	6.400	26.17 QP	69.54	-43.37	1.00	195	30.02	-3.85
5	7.657	27.71 QP	69.54	-41.83	1.00	182	31.63	-3.92
6	17.884	27.21 QP	69.54	-42.33	1.00	102	32.63	-5.42

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. “ \* “: Fundamental frequency.
6. Loop antenna was used for all radiated emission below 30MHz.
7. Limit @3m=Limit@300m+40log(300 / 3)=Limit@300m+80
8. Limit @3m=Limit@30m+40log(30 / 3)=Limit@30m+40

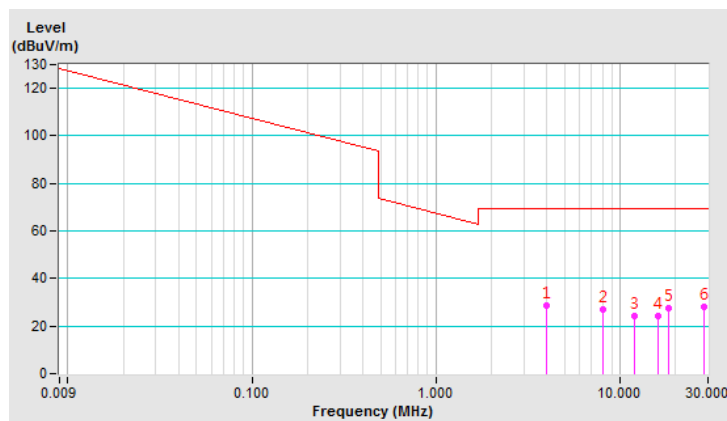


Test Frequency	4MHz	Detector Function	Quasi-Peak
Frequency Range	9 kHz ~ 30 MHz		

Antenna Polarity & Test Distance: Loop Antenna Open At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*4.000	28.66 QP	69.54	-40.88	1.00	343	32.29	-3.63
2	8.000	27.05 QP	69.54	-42.49	1.00	217	31.01	-3.96
3	12.000	24.19 QP	69.54	-45.35	1.00	145	28.55	-4.36
4	16.000	23.99 QP	69.54	-45.55	1.00	97	28.66	-4.67
5	18.363	27.64 QP	69.54	-41.90	1.00	175	33.18	-5.54
6	28.500	27.93 QP	69.54	-41.61	1.00	276	32.38	-4.45

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. “ \* ”: Fundamental frequency.
6. Loop antenna was used for all radiated emission below 30MHz.
7. Limit @3m=Limit@300m+40log(300 / 3)=Limit@300m+80
8. Limit @3m=Limit@30m+40log(30 / 3)=Limit@30m+40

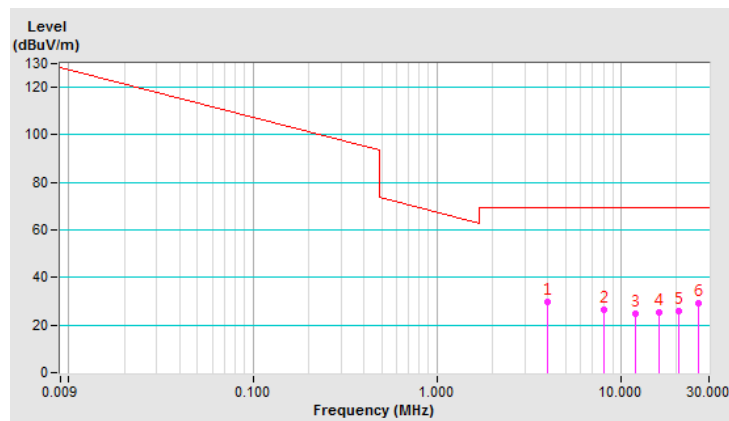


Test Frequency	4MHz	Detector Function	Quasi-Peak
Frequency Range	9 kHz ~ 30 MHz		

Antenna Polarity & Test Distance: Loop Antenna Close At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*4.000	29.82 QP	69.54	-39.72	1.00	108	33.45	-3.63
2	8.000	26.50 QP	69.54	-43.04	1.00	154	30.46	-3.96
3	12.000	24.89 QP	69.54	-44.65	1.00	202	29.25	-4.36
4	16.000	25.56 QP	69.54	-43.98	1.00	271	30.23	-4.67
5	20.553	26.01 QP	69.54	-43.53	1.00	185	31.69	-5.68
6	26.131	28.96 QP	69.54	-40.58	1.00	177	37.53	-8.57

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. “ \* “: Fundamental frequency.
6. Loop antenna was used for all radiated emission below 30MHz.
7. Limit @3m=Limit@300m+40log(300 / 3)=Limit@300m+80
8. Limit @3m=Limit@30m+40log(30 / 3)=Limit@30m+40

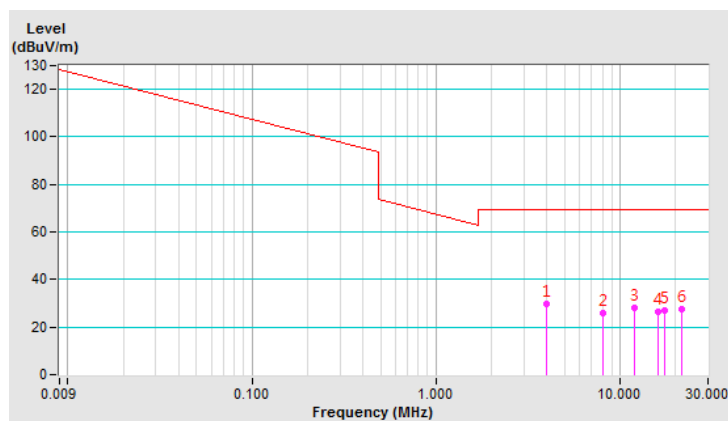


Test Frequency	4MHz	Detector Function	Quasi-Peak
Frequency Range	9 kHz ~ 30 MHz		

Antenna Polarity & Test Distance: Loop Antenna Ground-parallel At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*4.000	29.48 QP	69.54	-40.06	1.00	168	33.11	-3.63
2	8.000	26.06 QP	69.54	-43.48	1.00	239	30.02	-3.96
3	12.000	27.99 QP	69.54	-41.55	1.00	177	32.35	-4.36
4	16.000	26.63 QP	69.54	-42.91	1.00	152	31.30	-4.67
5	17.584	26.87 QP	69.54	-42.67	1.00	185	32.17	-5.30
6	21.692	27.37 QP	69.54	-42.17	1.00	56	33.26	-5.89

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. “ \* “: Fundamental frequency.
6. Loop antenna was used for all radiated emission below 30MHz.
7. Limit @3m=Limit@300m+40log(300 / 3)=Limit@300m+80
8. Limit @3m=Limit@30m+40log(30 / 3)=Limit@30m+40

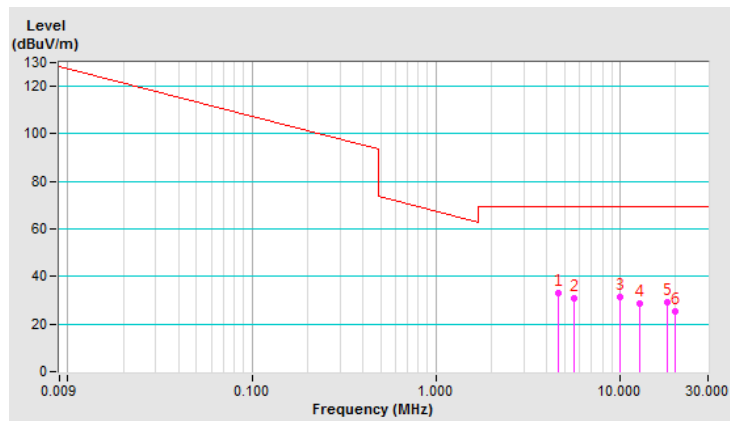


Test Frequency	10MHz	Detector Function	Quasi-Peak
Frequency Range	9 kHz ~ 30 MHz		

Antenna Polarity & Test Distance: Loop Antenna Open At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4.598	32.78 QP	69.54	-36.76	1.00	125	36.53	-3.75
2	5.617	30.60 QP	69.54	-38.94	1.00	188	34.46	-3.86
3	*10.000	31.56 QP	69.54	-37.98	1.00	105	35.81	-4.25
4	12.695	28.41 QP	69.54	-41.13	1.00	185	32.70	-4.29
5	18.094	28.93 QP	69.54	-40.61	1.00	185	34.42	-5.49
6	20.000	25.38 QP	69.54	-44.16	1.00	24	31.06	-5.68

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. “ \* “: Fundamental frequency.
6. Loop antenna was used for all radiated emission below 30MHz.
7. Limit @3m=Limit@300m+40log(300 / 3)=Limit@300m+80
8. Limit @3m=Limit@30m+40log(30 / 3)=Limit@30m+40

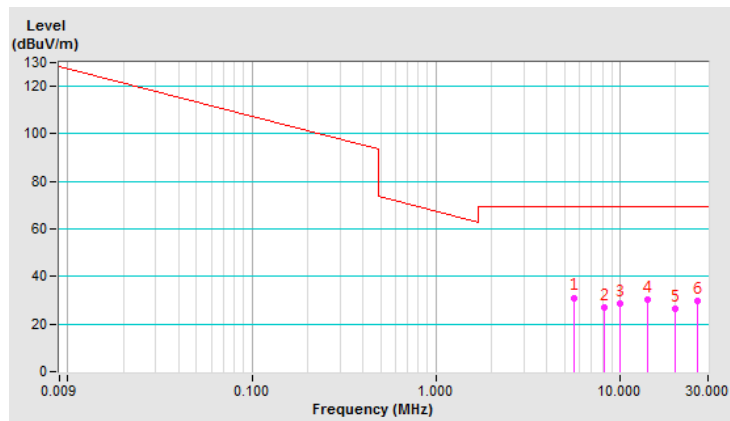


Test Frequency	10MHz	Detector Function	Quasi-Peak
Frequency Range	9 kHz ~ 30 MHz		

Antenna Polarity & Test Distance: Loop Antenna Close At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	5.617	31.10 QP	69.54	-38.44	1.00	58	34.96	-3.86
2	8.217	27.12 QP	69.54	-42.42	1.00	188	31.13	-4.01
3	*10.000	28.51 QP	69.54	-41.03	1.00	124	32.76	-4.25
4	14.105	30.23 QP	69.54	-39.31	1.00	55	34.50	-4.27
5	20.000	26.40 QP	69.54	-43.14	1.00	71	32.08	-5.68
6	26.131	29.57 QP	69.54	-39.97	1.00	167	38.14	-8.57

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. “ \* ”: Fundamental frequency.
6. Loop antenna was used for all radiated emission below 30MHz.
7. Limit @3m=Limit@300m+40log(300 / 3)=Limit@300m+80
8. Limit @3m=Limit@30m+40log(30 / 3)=Limit@30m+40

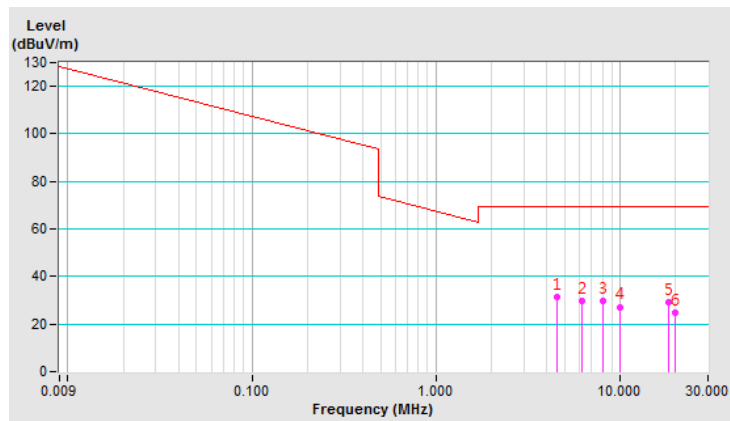


Test Frequency	10MHz	Detector Function	Quasi-Peak
Frequency Range	9 kHz ~ 30 MHz		

Antenna Polarity & Test Distance: Loop Antenna Ground-parallel At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4.568	31.34 QP	69.54	-38.20	1.00	55	35.09	-3.75
2	6.157	29.84 QP	69.54	-39.70	1.00	172	33.70	-3.86
3	8.017	29.52 QP	69.54	-40.02	1.00	186	33.48	-3.96
4	*10.010	27.23 QP	69.54	-42.31	1.00	291	31.48	-4.25
5	18.304	29.41 QP	69.54	-40.13	1.00	226	34.94	-5.53
6	20.000	24.77 QP	69.54	-44.77	1.00	305	30.45	-5.68

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. “ \* “: Fundamental frequency.
6. Loop antenna was used for all radiated emission below 30MHz.
7. Limit @3m=Limit@300m+40log(300 / 3)=Limit@300m+80
8. Limit @3m=Limit@30m+40log(30 / 3)=Limit@30m+40



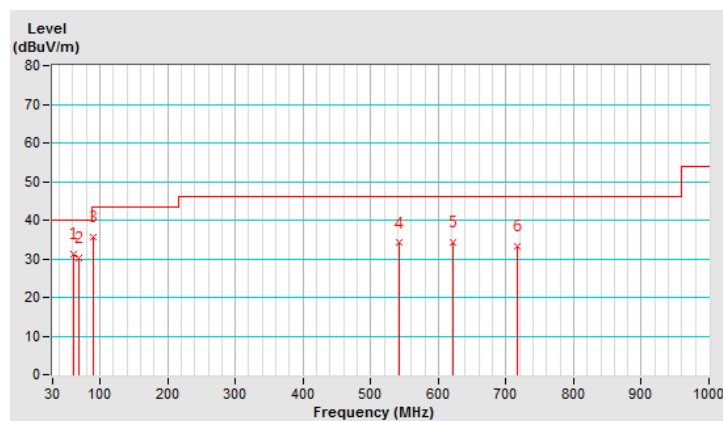
#### Below 1GHz Data:

Test Frequency	1.6MHz	Detector Function	Quasi-Peak
Frequency Range	30 MHz ~ 1GHz		

Antenna Polarity & Test Distance: Horizontal At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	61.38	31.31 QP	40.00	-8.69	2.71 H	175	39.07	-7.76
2	68.61	30.23 QP	40.00	-9.77	2.22 H	170	38.69	-8.46
3	89.46	35.54 QP	43.50	-7.96	2.03 H	196	48.19	-12.65
4	542.45	34.14 QP	46.00	-11.86	2.73 H	111	34.39	-0.25
5	621.85	34.38 QP	46.00	-11.62	2.71 H	189	32.55	1.83
6	717.00	33.23 QP	46.00	-12.77	1.84 H	50	30.17	3.06

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

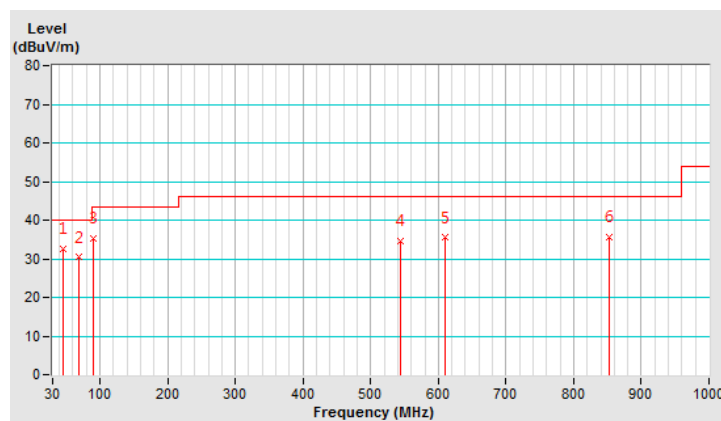


Test Frequency	1.6MHz	Detector Function	Quasi-Peak
Frequency Range	30 MHz ~ 1GHz		

Antenna Polarity & Test Distance: Vertical At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	45.67	32.53 QP	40.00	-7.47	1.55 V	296	39.87	-7.34
2	69.24	30.40 QP	40.00	-9.60	1.43 V	103	39.04	-8.64
3	89.46	35.31 QP	43.50	-8.19	1.36 V	193	47.96	-12.65
4	543.23	34.67 QP	46.00	-11.33	1.52 V	122	34.89	-0.22
5	610.40	35.43 QP	46.00	-10.57	2.28 V	205	33.98	1.45
6	853.43	35.51 QP	46.00	-10.49	1.75 V	198	30.05	5.46

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

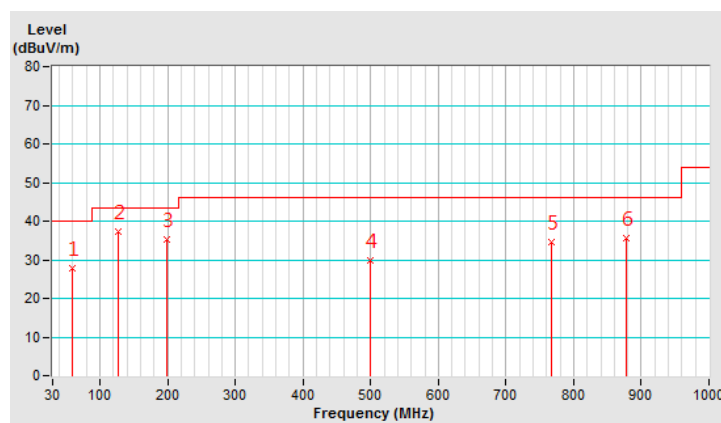


Test Frequency	4MHz	Detector Function	Quasi-Peak
Frequency Range	30 MHz ~ 1GHz		

Antenna Polarity & Test Distance: Horizontal At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	58.13	27.81 QP	40.00	-12.19	2.16 H	180	35.17	-7.36
2	126.08	37.43 QP	43.50	-6.07	1.96 H	155	46.31	-8.88
3	199.17	35.36 QP	43.50	-8.14	1.37 H	207	44.99	-9.63
4	500.45	29.77 QP	46.00	-16.23	1.82 H	12	30.76	-0.99
5	767.88	34.70 QP	46.00	-11.30	1.06 H	50	30.32	4.38
6	877.05	35.57 QP	46.00	-10.43	2.04 H	8	30.08	5.49

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

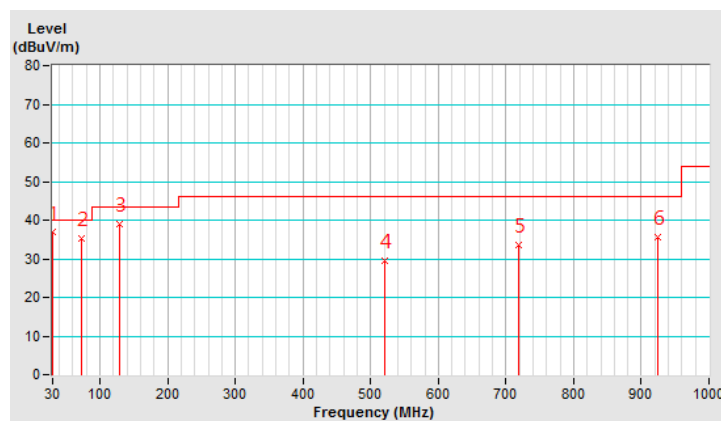


Test Frequency	4MHz	Detector Function	Quasi-Peak
Frequency Range	30 MHz ~ 1GHz		

Antenna Polarity & Test Distance: Vertical At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	30.10	36.79 QP	40.00	-3.21	1.88 V	179	45.82	-9.03
2	71.81	35.23 QP	40.00	-4.77	1.93 V	140	44.68	-9.45
3	128.65	39.03 QP	43.50	-4.47	1.54 V	266	47.64	-8.61
4	520.87	29.44 QP	46.00	-16.56	2.11 V	4	29.98	-0.54
5	718.70	33.54 QP	46.00	-12.46	1.39 V	351	30.48	3.06
6	924.83	35.65 QP	46.00	-10.35	1.25 V	188	29.06	6.59

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

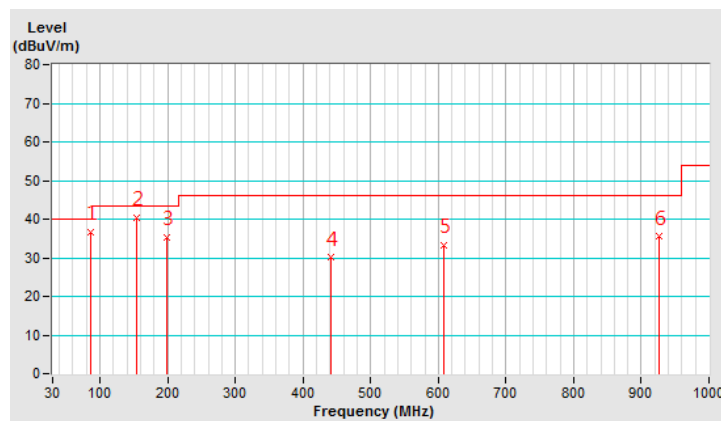


Test Frequency	10MHz	Detector Function	Quasi-Peak
Frequency Range	30 MHz ~ 1GHz		

Antenna Polarity & Test Distance: Horizontal At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	86.21	36.64 QP	40.00	-3.36	2.08 H	202	49.25	-12.61
<b>2</b>	<b>154.79</b>	<b>40.42 QP</b>	<b>43.50</b>	<b>-3.08</b>	<b>2.27 H</b>	<b>312</b>	<b>47.19</b>	<b>-6.77</b>
3	199.17	35.36 QP	43.50	-8.14	1.00 H	207	44.99	-9.63
4	440.46	30.04 QP	46.00	-15.96	1.36 H	19	32.10	-2.06
5	607.39	33.26 QP	46.00	-12.74	2.13 H	193	31.88	1.38
6	926.62	35.45 QP	46.00	-10.55	1.84 H	1	28.82	6.63

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

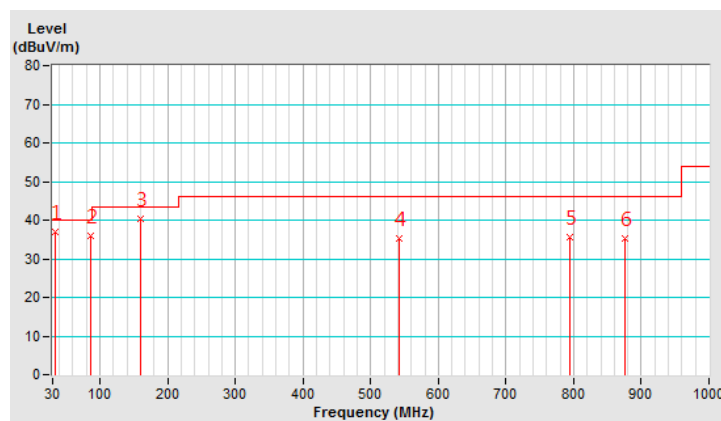


Test Frequency	10MHz	Detector Function	Quasi-Peak
Frequency Range	30 MHz ~ 1GHz		

Antenna Polarity & Test Distance: Vertical At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	33.93	36.95 QP	40.00	-3.05	1.91 V	152	45.61	-8.66
2	86.21	36.09 QP	40.00	-3.91	2.34 V	175	48.70	-12.61
3	160.71	40.50 QP	43.50	-3.00	1.63 V	0	47.25	-6.75
4	542.06	35.42 QP	46.00	-10.58	2.05 V	140	35.69	-0.27
5	794.02	35.62 QP	46.00	-10.38	1.14 V	218	31.26	4.36
6	875.26	35.41 QP	46.00	-10.59	1.22 V	218	29.89	5.52

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value



## 4.2 Conducted Emission Measurement

### 4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

- Note: 1. The lower limit shall apply at the transition frequencies.  
 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

### 4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
ROHDE & SCHWARZ TEST RECEIVER	ESR3	102413	Feb. 8, 2018	Feb. 7, 2019
ROHDE & SCHWARZ Artificial Mains Network (for EUT)	ESH2-Z5	100104	Dec. 6, 2017	Dec. 5, 2018
LISN With Adapter (for EUT)	AD10	C09Ada-001	Dec. 6, 2017	Dec. 5, 2018
ROHDE & SCHWARZ Artificial Mains Network (for peripherals)	ESH3-Z5	847265/023	Nov. 3, 2017	Nov. 2, 2018
SCHWARZBECK Artificial Mains Network (For EUT)	NNLK8129	8129229	May 3, 2018	May 2, 2019
Software	Cond_V7.3.7.4	NA	NA	NA
RF cable (JYEBAO) With 10dB PAD	5D-FB	Cable-C09.01	Feb. 21, 2018	Feb. 20, 2019
SUHNER Terminator (For ROHDE & SCHWARZ LISN)	65BNC-5001	E1-010789	May 8, 2018	May 7, 2019

- Notes: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.  
 2. The test was performed in Shielded Room No. 9.  
 3. The VCCI Site Registration No. C-1312.

#### 4.2.3 Test Procedures

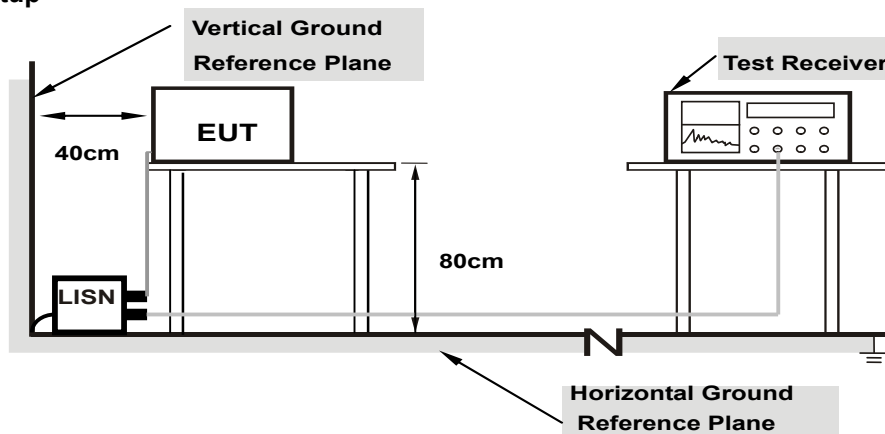
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

**NOTE:** The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

#### 4.2.4 Deviation from Test Standard

No deviation.

#### 4.2.5 Test Setup



**Note:** 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.2.6 EUT Operating Conditions

- Turned on the power of all equipment.
- PC ran a test program to enable all functions.
- PC read and wrote messages to/ from HDD.
- EUT received messages from temperature sensors and sent messages to PC via signal converter.
- PC sent messages to ext. LCD Monitor. Then it displayed them on its screen.
- PC sent messages to printer, and the printer printed them out.
- PC sent messages to modem.
- Steps c-g were repeated.

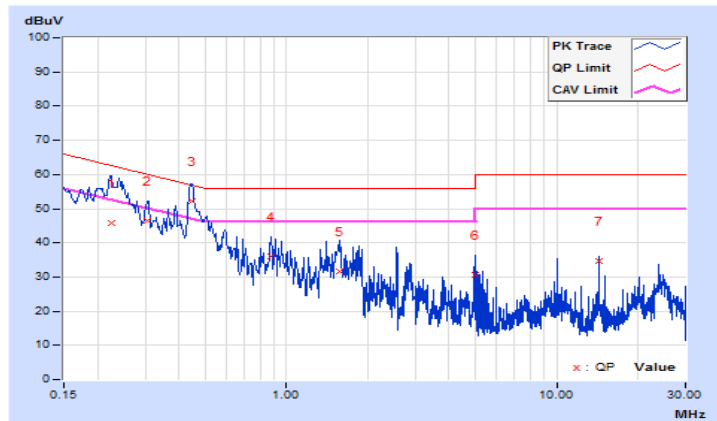
#### 4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr.	Reading Value		Emission Level		Limit		Margin	
		Factor	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
		(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.22429	10.20	35.59	25.65	45.79	35.85	62.66	52.66	-16.87	-16.81
2	0.30615	10.22	36.24	32.82	46.46	43.04	60.07	50.07	-13.61	-7.03
<b>3</b>	<b>0.44506</b>	<b>10.24</b>	<b>41.95</b>	<b>23.46</b>	<b>52.19</b>	<b>33.70</b>	<b>56.97</b>	<b>46.97</b>	<b>-4.78</b>	<b>-13.27</b>
4	0.87203	10.28	25.67	16.06	35.95	26.34	56.00	46.00	-20.05	-19.66
5	1.57134	10.38	21.19	13.15	31.57	23.53	56.00	46.00	-24.43	-22.47
6	4.97695	10.65	20.04	14.03	30.69	24.68	56.00	46.00	-25.31	-21.32
7	14.36445	11.08	23.54	22.88	34.62	33.96	60.00	50.00	-25.38	-16.04

#### REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

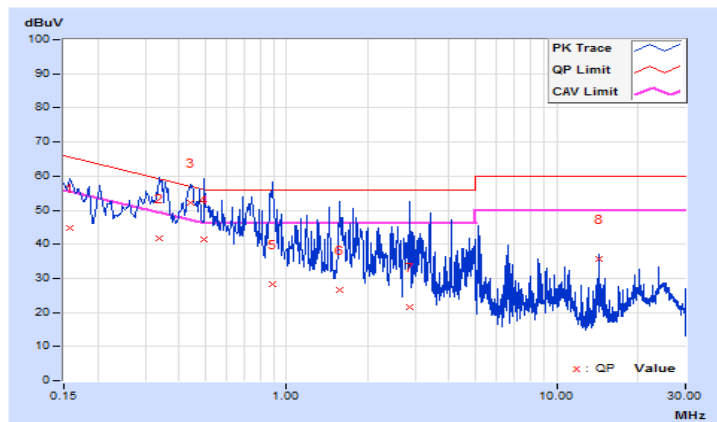


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr.	Reading Value		Emission Level		Limit		Margin	
		Factor	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
		(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15782	10.21	34.63	21.70	44.84	31.91	65.58	55.58	-20.74	-23.67
2	0.33768	10.26	31.36	13.61	41.62	23.87	59.26	49.26	-17.64	-25.39
3	0.44272	10.28	41.87	24.40	52.15	34.68	57.01	47.01	-4.86	-12.33
4	0.49799	10.29	31.13	19.72	41.42	30.01	56.03	46.03	-14.61	-16.02
5	0.88318	10.33	18.07	6.63	28.40	16.96	56.00	46.00	-27.60	-29.04
6	1.57525	10.43	16.05	5.13	26.48	15.56	56.00	46.00	-29.52	-30.44
7	2.86164	10.57	10.95	3.94	21.52	14.51	56.00	46.00	-34.48	-31.49
8	14.36836	10.99	24.83	24.68	35.82	35.67	60.00	50.00	-24.18	-14.33

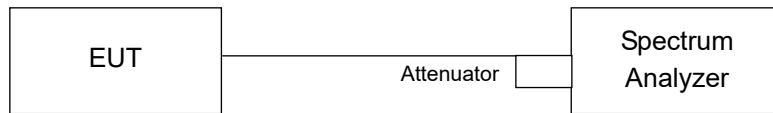
#### REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.



### 4.3 Channel Bandwidth

#### 4.3.1 Test Setup



#### 4.3.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

#### 4.3.3 Test Procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- Repeat above procedures until all frequencies measured were complete.

#### 4.3.4 Deviation from Test Standard

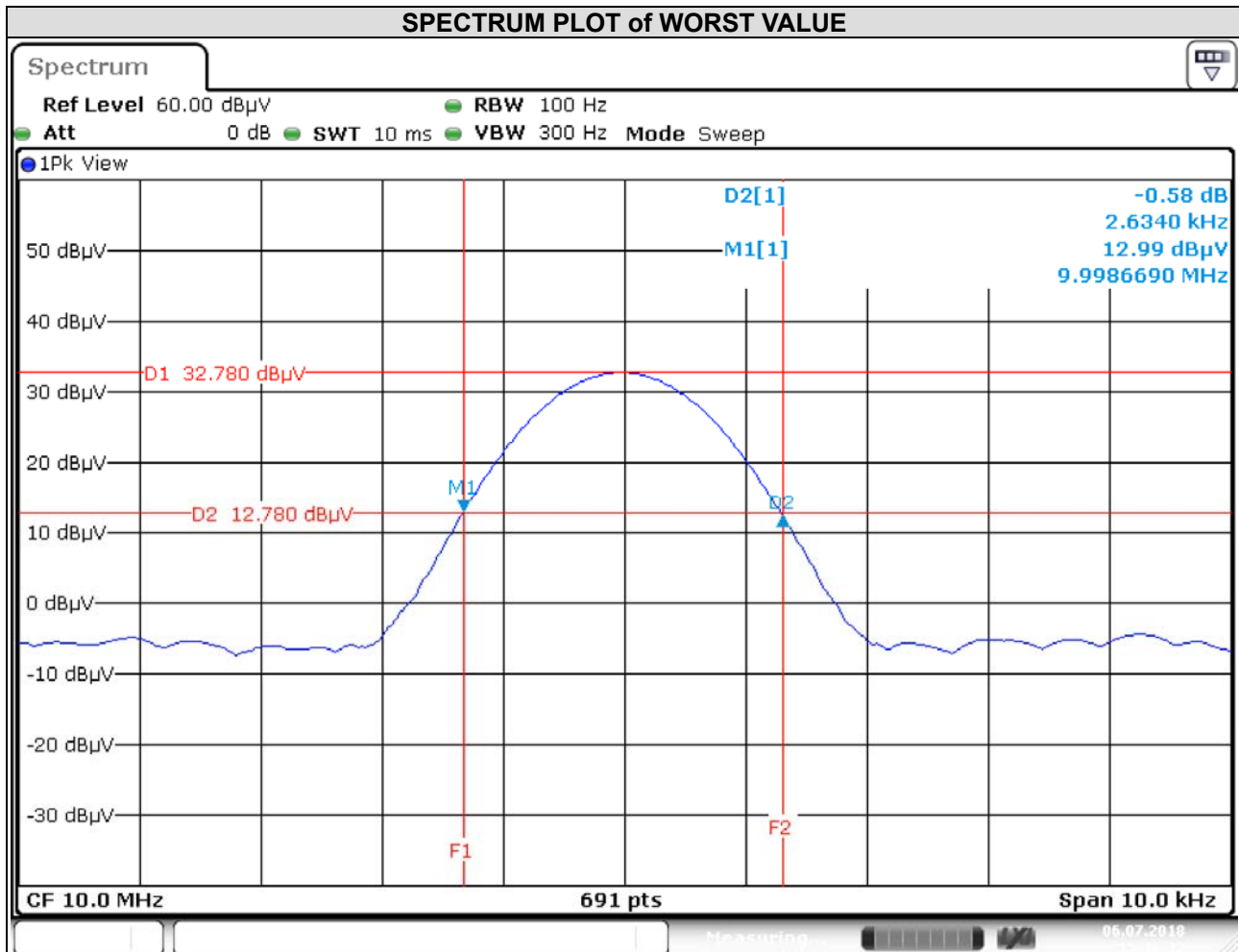
No deviation.

#### 4.3.5 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

#### 4.3.6 Test Results

CHANNEL	FREQUENCY (MHz)	20dB BANDWIDTH (kHz)
1	1.6	2.619
2	4	2.619
3	10	2.634



## 5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

## Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

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The address and road map of all our labs can be found in our web site also.

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