

# FCC Part 15 Subpart C §15.225

## Test Report

<b>Equipment Under Test</b>	Mpaio
<b>Model Name</b>	F-1020
<b>Applicant</b>	Samil CTS Co.,LTD
<b>FCC ID</b>	2ABRWF-1020
<b>Manufacturer</b>	Samil CTS Co.,LTD
<b>Date of Test(s)</b>	2014. 01. 13 ~ 2014. 01. 24
<b>Date of Issue</b>	2014. 01. 24

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

Issue to	Issue by
<p><b>Samil CTS Co.,LTD</b> Rm805, Woolim Lion's Valley 3cha, 5445 Sangdaewon-dong, Jungwon-gu, Seongnam-si, Gyeonggi-do, KOREA</p> <p>Tel.: +82-70-7094-9051 Fax: +82-31-720-5167</p>	<p><b>MOVON CORPORATION</b> 498-2, Geumeo-ro, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 449-812</p> <p>Tel.: +82-31-338-8837 Fax: +82-31-338-8847</p>

## Revision history

Revision	Date of issue	Description	Revised by
--	Jan 24, 2014	Initial	--
1	Jan 27, 2014	Revised Electric Field Strength - Fundamental Emission	Jungmoo,Her
2	Jan 28, 2014	Revised Electric Field Strength - Fundamental Emission	Jungmoo,Her



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## 1. General information

### 1.1. Details of applicant

Applicant : Samil CTS Co.,LTD  
Address : Rm805, Woolim Lion's Valley 3cha, 5445 Sangdaewon-dong, Jungwon-gu, Seongnam-si, Gyeonggi-do, KOREA  
Contact Person : Kyoung Jae, Seok  
Telephone : +82-70-7094-9051  
Fax : +82-31-720-5167

### 1.2. Summary of test results

The EUT has been tested according to the following specifications;

Section in FCC part 15	Description	Result
15.225(a)	Electric Field Strength - Fundamental Emission	C
15.225(b) (c)	Electric Field Strength - Outside the Band	C
15.225(d) / 15.209	Electric Field Strength - Spurious Emission	C
15.225(e)	Frequency Tolerance	C
15.207 / 15.107	AC Conducted Emissions	C

The sample was tested according to the following specification:

FCC Part15.225; ANSI C63.4-2003

TEST SITE REGISTRATION NUMBER:

FCC(670686)

### ※ Abbreviation

C Complied  
N/A Not applicable  
F Fail

### Approval Signatories

Test and Report Completed by :	Report Approval by :
	
Jungmoo Her Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

**2. EUT Description**

<b>Kind of product</b>	Mpaio
<b>Model Name</b>	F-1020
<b>Variant model name</b>	F-1021, F-1001, F-1000, F-1221, F-1201, F-1200
<b>Serial Number</b>	N/A
<b>Power supply</b>	DC 3.8V
<b>Frequency range</b>	13.56 MHz
<b>Modulation technique</b>	ASK
<b>Number of channels</b>	1
<b>Test Site Registration Number</b>	FCC(670686)

**2.1. Declarations by the manufacturer**

None

**2.2. Details of modification**

None

### 3. Measurement equipment

Equipment	Manufacturer	Model	Serial number	Calibration Interval	Calibration due.
EMI Test Receiver	R&S	ESIB26	100196/026	1 year	2014-12-14
Signal Generator	R&S	SMR27	100089	1 year	2014-12-13
Spectrum Analyzer	R&S	FSV-40	100832	1 year	2014-10-04
Power Meter	Agilent	E4416A	GB41290645	1 year	2014-10-04
Power Sensor	Agilent	9327A	US40441490	1 year	2014-10-04
Double Redge Horn Antenna	R&S	HF906	100236	2 year	2015-02-28
Ultra Broadband Antenna	R&S	HL562	100170	1 year	2014-12-13
Power Amplifier	MITEQ	AM-1431	1497315	1 year	2014-10-04
Power Amplifier	MITEQ	AFS43-01002600	1374382	1 year	2014-10-04
High Pass Filter	Wainwright	WHK3.0/18G-10SS	508	1 year	2014-10-04
DC Power Supply	HP	6674A	3637A01351	1 year	2014-10-04
Controller	INNCO	CO2000	co200/064/6961003/L	N/A	N/A
Antenna Master	INNCO	MA4000	MA4000/038/6961003/L	N/A	N/A
Loop Antenna	ETS LINDGREN	6502	00118166	2 year	2015-09-27

**\* Remark;**  
**Support equipment**

Description	Manufacturer	Model	Serial number
Smart Phone	Samsung	SM-N900K	-

## 4. Transmitter requirements

### 4.1. Electric Field Strength

#### Procedure: About the Fundamental Emission, Outside the Band and Spurious Emission

The Radiated Electric Field Strength intensity has been measured with a ground plane and at a distance of 3m.

→ From 9kHz to 30MHz at distance 3m

The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for each antenna angle 0deg., 45deg. and 90deg.

→ From 30MHz to 1000MHz at distance 3m

The measuring antenna height was varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for both vertical and horizontal antenna polarization.

Bandwidth settings per frequency range;

	From 9kHz to 150kHz	From 150kHz to 30MHz	From 30MHz to 1000MHz
IF Bandwidth	200Hz	9kHz	120kHz

Part 15 Section 15.31 (f)(2) (9kHz ~ 30MHz)

9kHz ~ 490kHz [Limit at 3m] = [Limit at 300m]-20log(3[m]/300[m])

490kHz ~ 30MHz [Limit at 3m] = [Limit at 30m]-20log(3[m]/30[m])

#### 4.1.1 Electric Field Strength - Fundamental Emission

Test method : Part 15.225(a)  
Tx Frequency : 13.56 MHz  
Result : **Complies**

**Measurement data:**

Freq (MHz)	Pol.	Azimut (Degree)	Reading (dB $\mu$ V/m)	T.F (dB)	Field Strength @3m (dB $\mu$ V/m)	Limit @3m (dB $\mu$ V/m)	Margin (dB)
13.56	0°	0	52.22	10.20	62.42	104	41.58
13.56	45°	0	48.31	10.20	58.51	104	45.49
13.56	90°	0	45.55	10.20	55.75	104	48.30

-- Note 1--

Field strength of 13.553MHz to 13.567MHz Limit@3m = 84dB $\mu$ V/m + 20log30m/3m  
= 104dB $\mu$ V/m

-- Note 2--

T.F(Total Factor) = Antenna Factor + Cable Loss  
Field Strength @3m = Reading + T.F

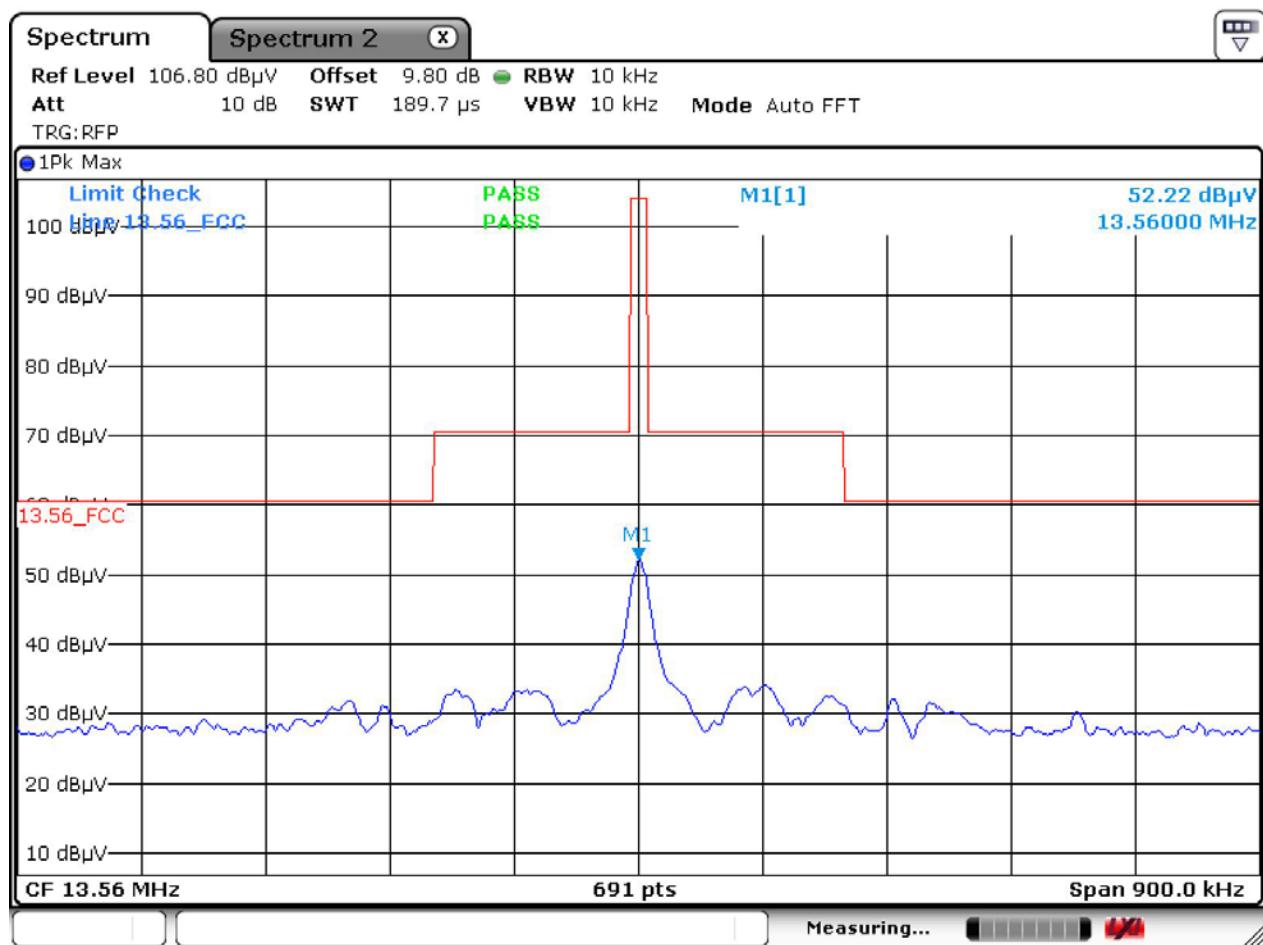
-- Note 3--

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

#### 4.1.2 Electric Field Strength - Outside the Allocated Band

Test method : Part 15.225(b) (c)  
Tx Frequency : 13.56 MHz  
Result : **Complies**

#### Measurement Data:



#### 4.1.3 Electric Field Strength – Spurious Emission

Test method : Part 15.225(d) / Part 15.209  
Tx Frequency : 13.56 MHz  
Result : **Complies**

##### Measurement Data:

Freq (MHz)	Pol.	Reading (dB $\mu$ V/m)	T.F (dB)	Field Strength @3m (dB $\mu$ V/m)	Limit @3m (dB $\mu$ V/m)	Margin (dB)
31.94	V	20.08	19.59	36.07	40.00	3.93
51.38	V	23.39	9.92	33.31	40.00	6.69
191.34	V	14.51	14.28	28.79	43.50	14.71
288.54	V	14.80	19.79	34.59	46.00	11.41
304.09	H	11.50	20.14	31.64	46.00	14.36
383.79	H	11.70	22.14	33.84	46.00	12.16
576.23	H	7.64	26.76	34.40	46.00	11.60
768.68	H	7.68	30.53	38.21	46.00	7.79

-- Note 1--

T.F(Total Factor) = Antenna Factor + Cable Loss –Amp Gain  
Field Strength @3m = Reading + T.F

-- Note 2--

No other emissions were detected at a level greater than 20dB below limit.

-- Note 3--

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

## 4.2. Frequency Tolerance

### Procedure:

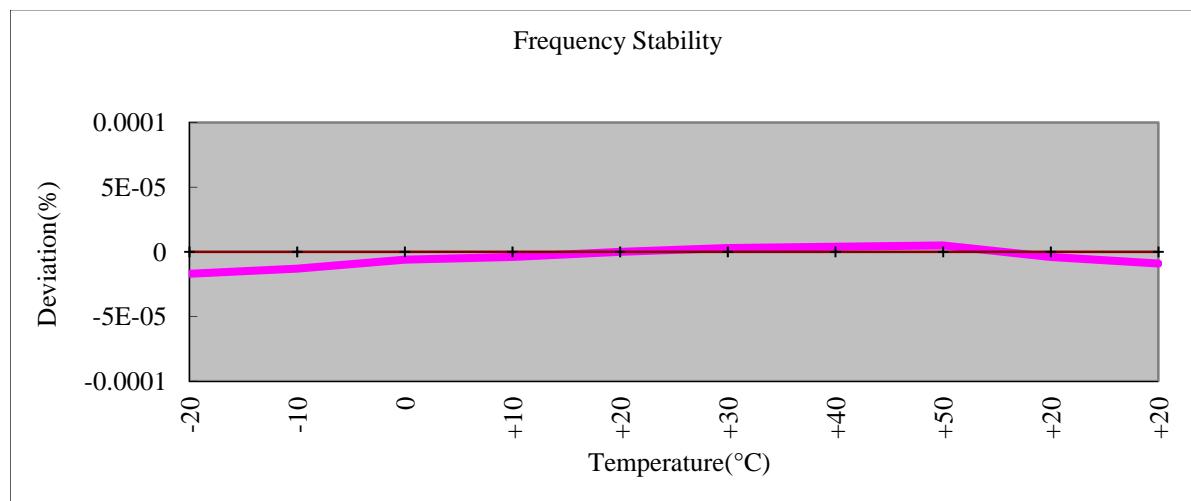
The temperature test was started after the temperature stabilization time of 30 minutes.

Test method : Part 15.225(e)  
Tx Frequency : 13.56 MHz  
Result : **Complies**

### Measurement Data:

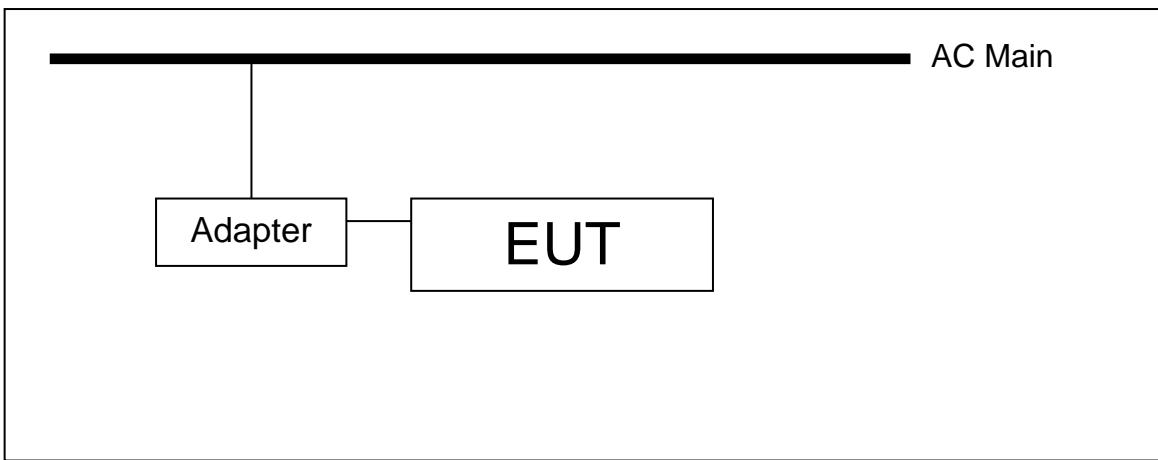
OPERATING FREQUENCY:	13,560,440	Hz
Freq. Tolerance Limit:	$\pm 0.01$	%

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQ (Hz)	Deviation (%)
100	3.80	-20	13,560,488	-0.000017
100		-10	13,560,495	-0.000013
100		0	13,560,506	-0.000006
100		10	13,560,482	-0.000004
100		20	13,560,440	0.000000
100		30	13,560,423	0.000003
100		40	13,560,409	0.000004
100		50	13,560,416	0.000005
85	3.23	20	13,560,428	-0.000004
115	4.37	20	13,560,421	-0.000009



## 5. AC Conducted power line test

## 5.1. Test setup



## 5.2. Limit

According to §15.107(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 uH/ 50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall be on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted limit (dB $\mu$ V/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

### \* Remark

Decreases with the logarithm of the frequency.

## 5.3. Test procedures

The test procedure is performed in a 6.5 m x 3.6 m x 3.6 m (L x W x H) shielded room. The EUT along with its peripherals were placed on a 1.0 m(W) x 1.5 m(L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.

The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

## 5.4. Test results

Ambient temperature: 23 °C

Relative humidity: 40 % R.H.

Frequency range: 0.15 MHz ~ 30 MHz

Measured bandwidth: 9 kHz

Freq. (MHz)	Line	Q-Peak		
		Level(dB $\mu$ N/m)	Limit(dB $\mu$ N/m)	Margin(dB)
0.18	L	64.49	49.94	50.12
0.36	L	58.73	38.03	38.20
0.47	L	56.51	40.72	40.90
0.85	L	56.00	39.98	40.23
3.57	L	56.00	40.84	40.84
8.64	L	56.00	44.36	45.18

Freq. (MHz)	Line	Average		
		Level(dB $\mu$ N/m)	Limit(dB $\mu$ N/m)	Margin(dB)
No other emissions were detected at a level greater than 20 dB below limit.				

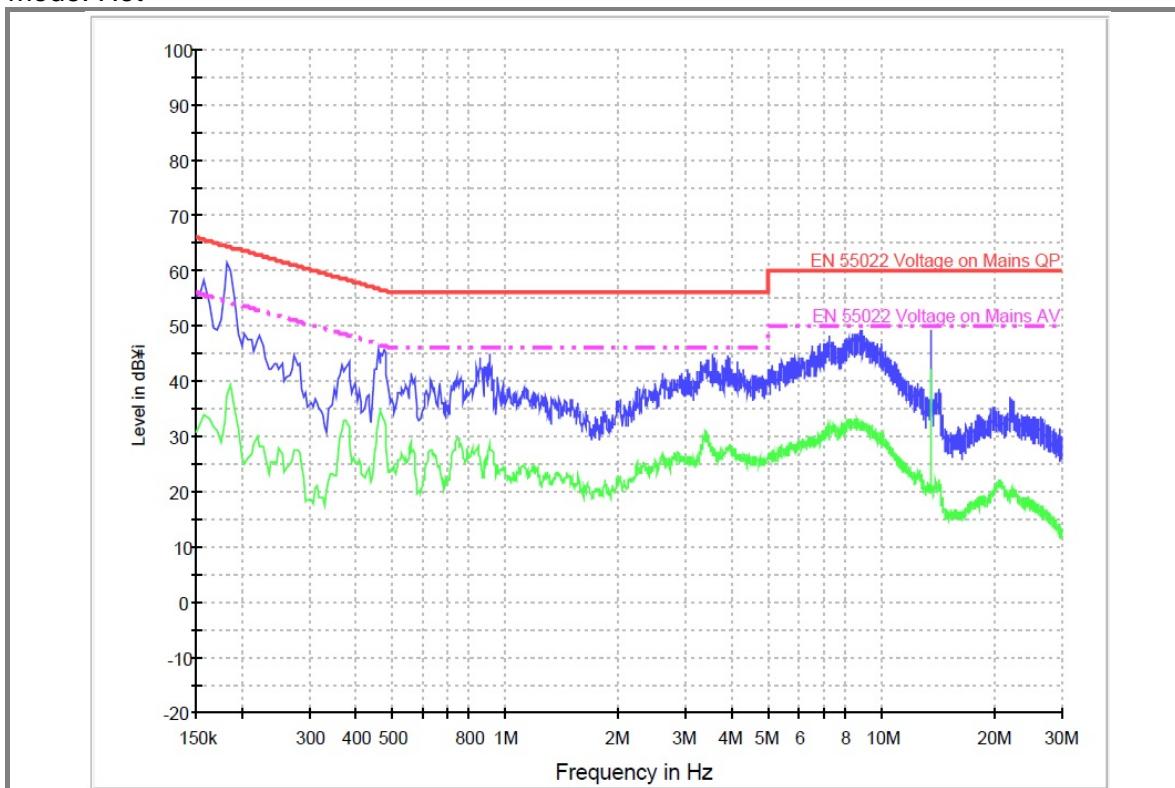
### ※ Remark

Line(H): Hot

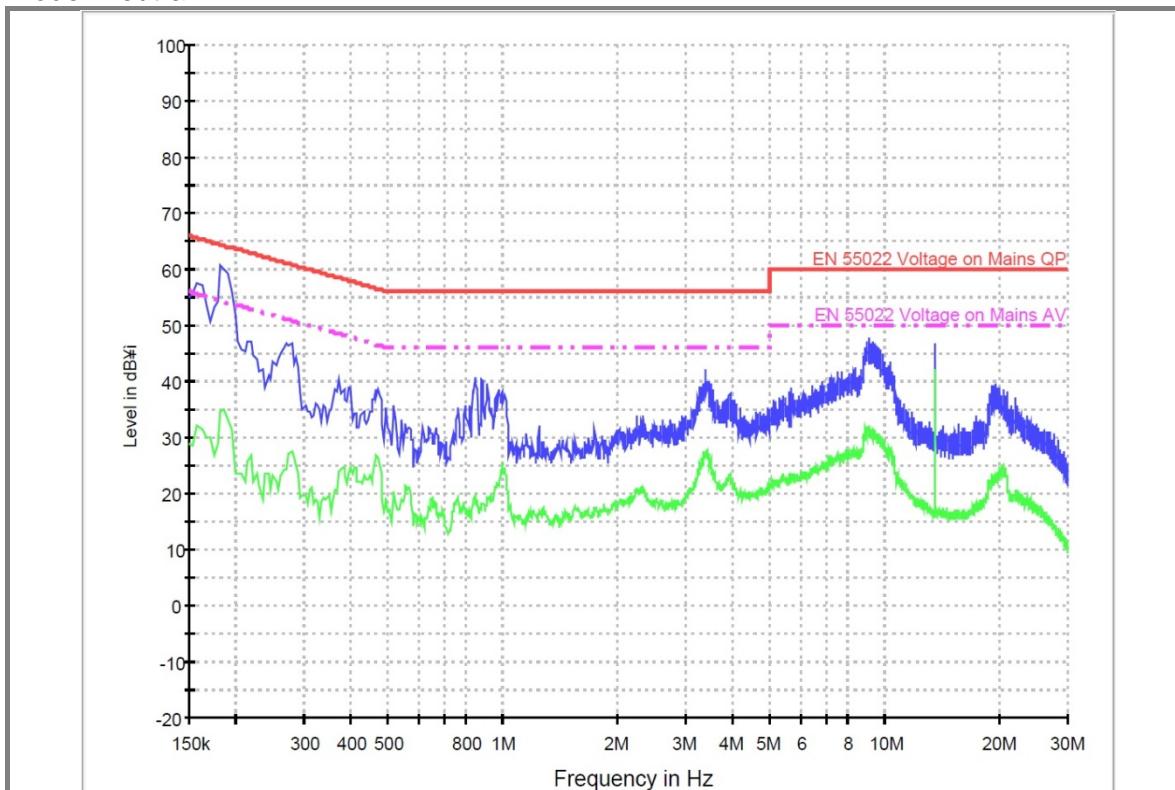
Line(N): Neutral

**Plot of conducted power line**

Test mode: Hot



Test mode: Neutral



**6. Test setup photo of EUT****Photo of radiated spurious emission at below 30 MHz****Photo of radiated spurious emission at 30 MHz ~ 1 000 MHz**

**Photo of Conducted emission at below 30 MHz**