TEST REPORT

Part 15 Subpart C 15.225

Equipment under test FaceTech Access Control Terminal

Model name FTTA05

FCC ID 2AJCYFTTA05

Applicant KUMHO PETROCHEMICAL Co., Ltd.

Manufacturer Maxannewtech Co., Ltd.

Date of test(s) 2016.08.01 ~2016.09.20

Date of issue 2016.09.21

Issued to

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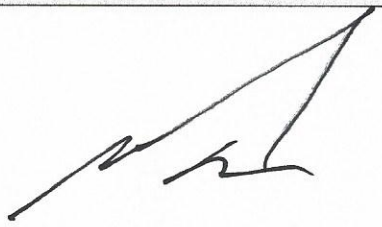
Test and report completed by :	**Report approval by :**
	
Kwang-Yeol Choo Test engineer	Jeff Do Technical manager

Revision history

Revision	Date of issue	Test report No.	Description
-	2016.09.09	KES-RF-16T0078	Initial
R1	2016.09.21	KES-RF-16T0078-R1	Retest a AC Conducted emissions

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1. General information

Applicant:	KUMHO PETROCHEMICAL Co., Ltd.
Applicant address:	East wing, Signature Tower, 100, Cheonggyecheon-ro, Jung-gu, Seoul, Korea
Test site:	KES Co., Ltd.
Test site address:	C-3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
FCC/IC rule part(s):	15.225
Model:	FTTA05
FCC ID:	2AJCYFTTA05
Test device serial No.:	☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	Facetech Access Control Terminal
Frequency range	13.5605 ㎒
Modulation technique	ASK
Number of channels	1
Antenna specification	Antenna type: PCB

1.2. Test frequency/Channel operation

Ch.	Frequency (㎒)
01	13.5605

1.3. Information about derivative model

N/A

1.4. Device modifications

N/A

2. Summary of tests

Reference	Parameter	Status
15.225(a)	The field strength of fundamental	Pass
15.225(b)(c)	The field strength of spurious emission(In-band)	Pass
15.225(d) 15.209	The field strength of spurious emission(Out-band)	Pass
15.225(e)	The frequency tolerance	Pass
2.1049	20 ㏈ bandwidth	Pass
15.207(a)	AC Conducted emission	Pass

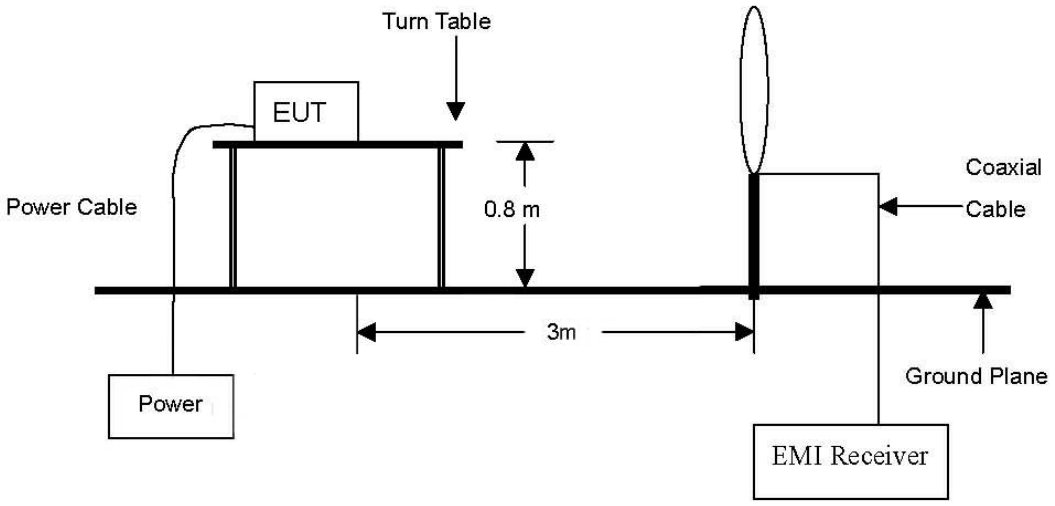
Test procedures;
The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 ㎑ to 40 ㎓ (ANSI C63.10-2013)

3. Test results

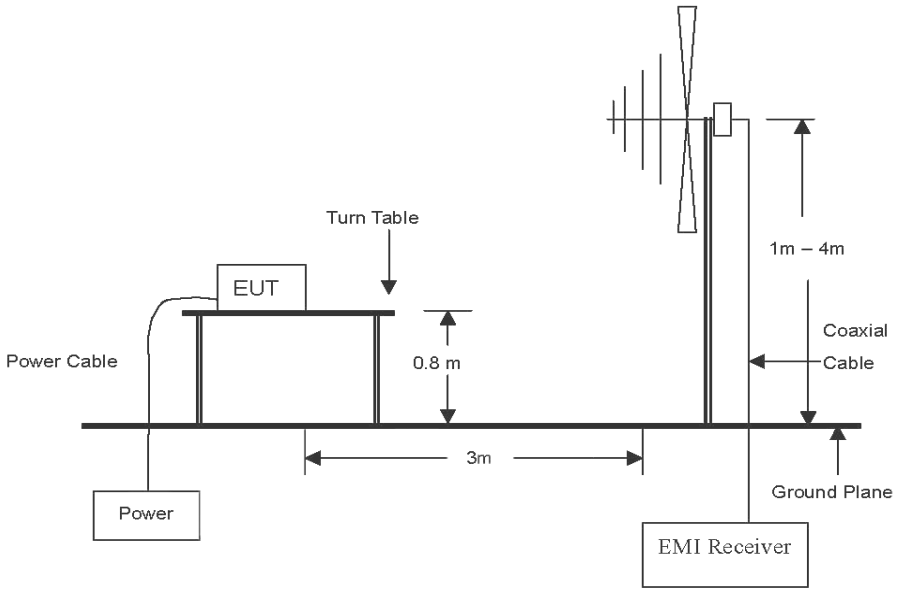
3.1. Radiated spurious emissions

Test setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



Test procedure

[9 ㎑ to 30 ㎒]

The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter Open Area Test Site. The table was rotated 360 degrees to determine the position of the highest radiation. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Quasi-peak function and specified bandwidth with maximum hold mode.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 ㎐ for Quasi-peak detection (QP) at frequency below 9 ㎑~ 150 ㎑.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 ㎑ for Quasi-peak detection (QP) at frequency below 150 ㎑~ 30 ㎒.

[30 ㎒ to 1 ㎓]

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.
The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.

Limit

In the section 15.209:

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2400 / F(㎑)
0.490 ~ 1.705	30	24000 / F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 ㎒, 76 ~ 88 ㎒, 174 ~ 216 ㎒ or 470 ~ 806 ㎒. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

In the section 15.225:

(a) The field strength of any emissions within the band 13.553 ~ 13.567 ㎒ shall not exceed 15,848 microvolts/meter (= 84 ㏈㎶/m) at 30 meters.

(b) Within the bands 13.410 ~ 13.553 ㎒ and 13.567 ~ 13.710 ㎒, the field strength of any emissions shall not exceed 334 microvolts/meter (=50.5 ㏈㎶/m) at 30 meters.

(c) Within the bands 13.110 ~ 13.410 ㎒ and 13.710 ~ 14.010 ㎒ the field strength of any emissions shall not exceed 106 microvolts/meter (=40.5 ㏈㎶/m) at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110 ~ 14.010 ㎒ band shall not exceed the general radiated emission limits in § 15.209.

Test results for fundamental

Operating frequency: 13.5605 ㎒

Distance of measurement: 3 meter

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Distance factor (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
13.5605	35.61	H	20.81	0.42	40	16.84	84.00	67.16
13.5605	32.31	V	20.81	0.42	40	13.54	84.00	70.46

Test results for in-band & out-band(9 ㎑ to 30 ㎒)

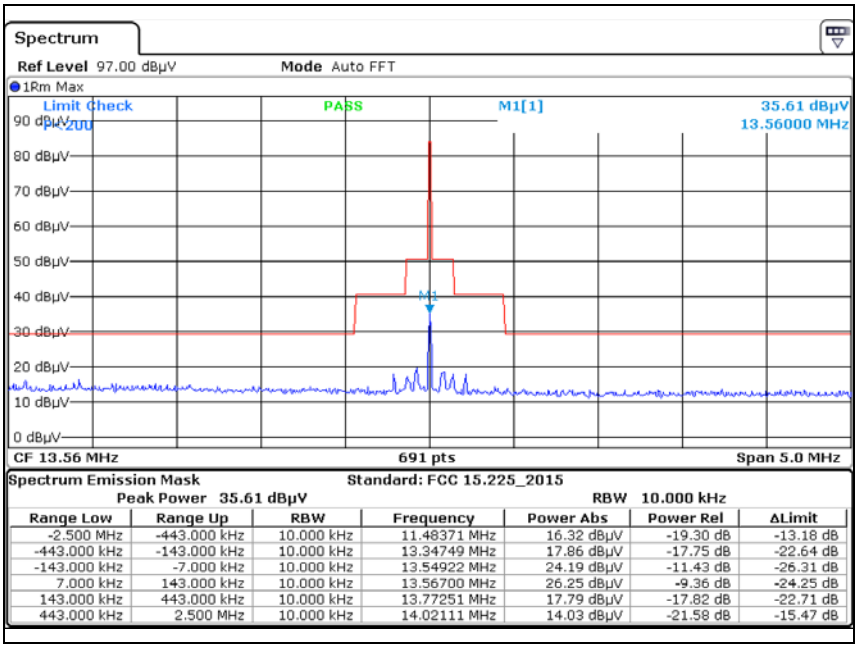
Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Distance factor (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
12.237	22.13	V	20.73	0.42	40	3.28	29.54	26.26
13.216	18.42	V	20.79	0.42	40	-0.37	40.50	40.87
13.549	24.19	H	20.81	0.42	40	5.42	50.50	45.08
13.567	26.25	H	20.81	0.42	40	7.48	50.50	43.02
13.773	17.79	H	20.83	0.42	40	-0.96	40.50	41.46
14.021	14.03	H	20.84	0.42	40	-4.71	29.54	34.25
14.126	15.85	V	20.85	0.42	40	-2.88	29.54	32.42

Note.

1. All measurements were performed using a loop antenna. The antenna was positioned in three orthogonal positions (X front, Y side, Z top) and the position with the highest emission level was recorded.
2. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
3. Measurements were performed at 3m and the data was extrapolated to the specified measurement distance of 30m using the square of an inverse linear distance extrapolation factor (40 ㏈/decade) as specified in §15.31(f)(2). Extrapolation Factor = 20 log10(30/3)^2 = 40 ㏈.
4. The spectrum was investigated from 9 ㎑ up to 30 ㎒ using the loop antenna. Only the emissions shown in the table above were found to be significant.
5. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector.
6. Actual = Reading + Ant. factor + Cable loss - Distance factor
7. Margin [dB] = Limit [dB㎶//m] - Field Strength Level [dB㎶//m]

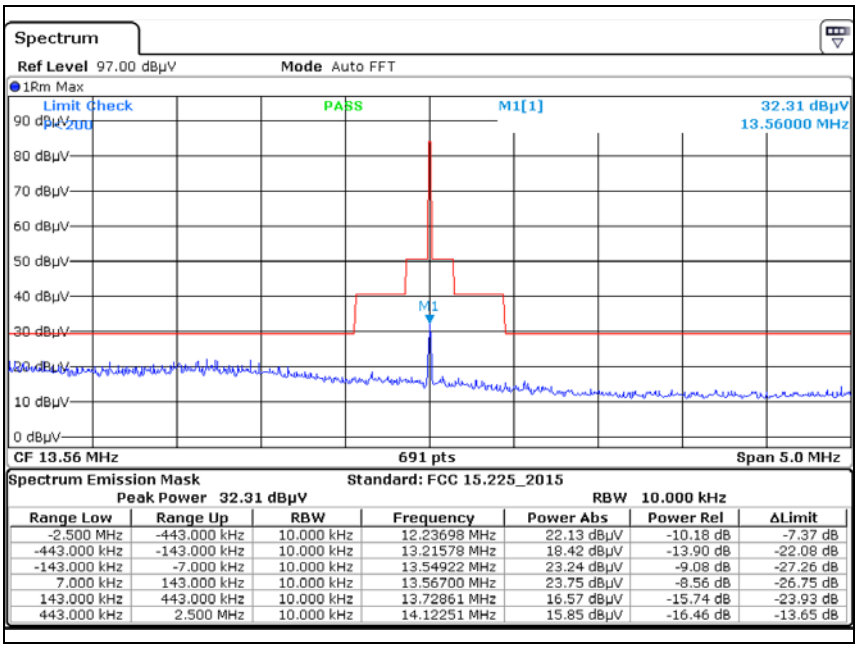
Radiated Emissions (9 ㎑ ~ 30 ㎒) plot

Horizontal



Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-2.500 MHz	-443.000 kHz	10.000 kHz	11.48371 MHz	16.32 dBµV	-19.30 dB	-13.18 dB
-443.000 kHz	-143.000 kHz	10.000 kHz	13.34749 MHz	17.86 dBµV	-17.75 dB	-22.64 dB
-143.000 kHz	-7.000 kHz	10.000 kHz	13.54922 MHz	24.19 dBµV	-11.43 dB	-26.31 dB
7.000 kHz	143.000 kHz	10.000 kHz	13.56700 MHz	26.25 dBµV	-9.36 dB	-24.25 dB
143.000 kHz	443.000 kHz	10.000 kHz	13.77251 MHz	17.79 dBµV	-17.82 dB	-22.71 dB
443.000 kHz	2.500 MHz	10.000 kHz	14.02111 MHz	14.03 dBµV	-21.58 dB	-15.47 dB

Vertical



Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-2.500 MHz	-443.000 kHz	10.000 kHz	12.23698 MHz	22.13 dBµV	-10.18 dB	-7.37 dB
-443.000 kHz	-143.000 kHz	10.000 kHz	13.21578 MHz	18.42 dBµV	-13.90 dB	-22.08 dB
-143.000 kHz	-7.000 kHz	10.000 kHz	13.54922 MHz	23.24 dBµV	-9.08 dB	-27.26 dB
7.000 kHz	143.000 kHz	10.000 kHz	13.56700 MHz	23.75 dBµV	-8.56 dB	-26.75 dB
143.000 kHz	443.000 kHz	10.000 kHz	13.72861 MHz	16.57 dBµV	-15.74 dB	-23.93 dB
443.000 kHz	2.500 MHz	10.000 kHz	14.12251 MHz	15.85 dBµV	-16.46 dB	-13.65 dB

Note : Only the worst case plots for Radiated Emissions.

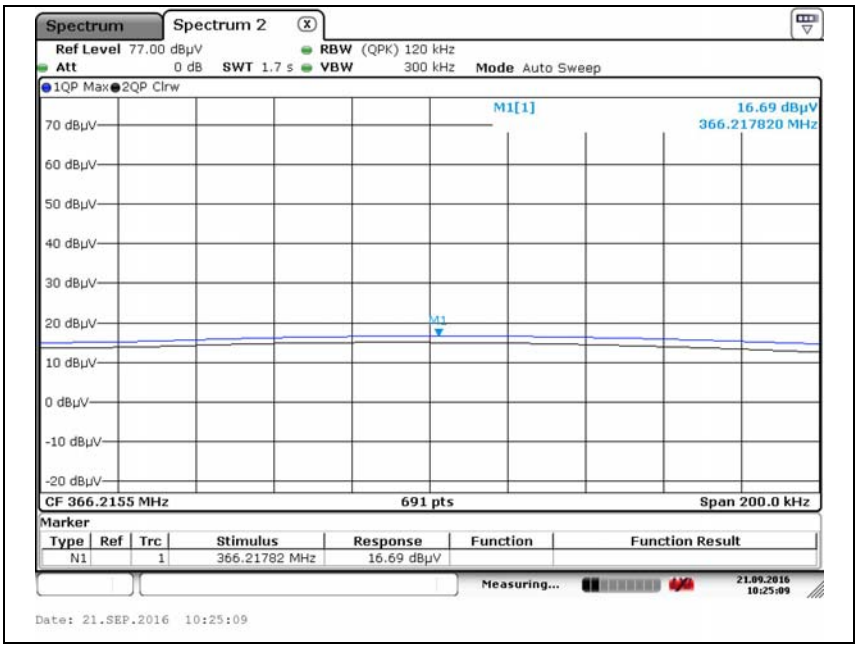
Test results (Below 1 000 ㎒)

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
100.81	15.39	V	11.51	2.90	29.80	43.50	13.70
117.30	16.76	H	9.93	3.12	29.81	43.50	13.69
150.28	18.11	V	8.21	3.57	29.89	43.50	13.61
233.70	12.34	H	12.05	4.52	28.91	46.00	17.09
366.22	16.69	V	14.92	5.81	37.42	46.00	8.58
570.29	8.99	H	18.65	7.58	35.22	46.00	10.78

Note.

1. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector for emissions below 960 ㎒.
2. Both Vertical and Horizontal polarities of the receive antenna were evaluated with the worst case emissions being reported. Below 30 ㎒ the loop antenna was positioned in 3 orthogonal planes (X front, Y side, Z top) to determine the orientation resulting in the worst case emissions.
3. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
4. The spectrum is measured from 9 ㎑ to the 10th harmonic and the worst-case emissions are reported.
5. No spurious emissions levels were found to be greater than the level of the fundamental.

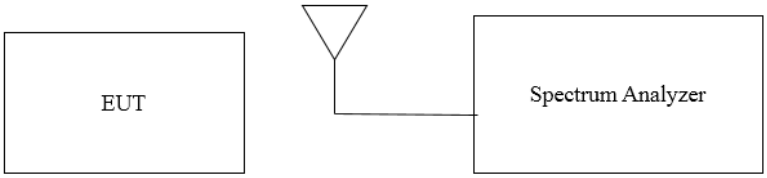
Radiated Emissions (30 ㎒ ~ 1000 ㎒) plot



Note : Only the worst case plots for Radiated Emissions.

3.2 20 dB bandwidth

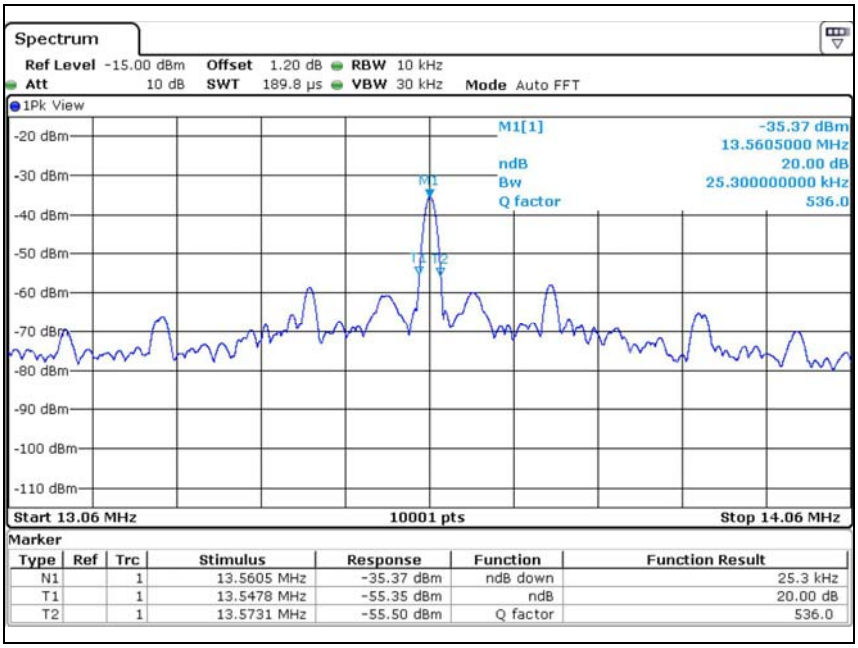
Test setup



Test procedure

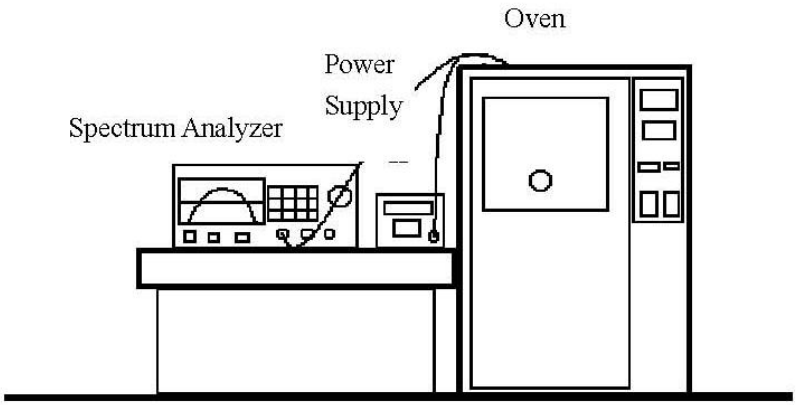
ANSI C63.10-2013 – Section 6.9.2

1. Spectrum analyzer frequency is set to the nominal EUT channel center frequency.
2. RBW = 1~5% OBW
3. VBW ≥ 3 x RBW
4. Reference level set to keep signal from exceeding maximum input mixer for linear operation.
5. Detector = Peak
6. Trace mode = Max hold
7. Sweep = Auto couple
8. The trace was allowed to stabilize
9. Using the marker-delta function, determine the "-20 dB down amplitude" using [(highest in band spectral density) – 20 dB]
10. Set a marker at the lowest frequency of the envelope of the spectral density, such that the marker is at or slightly below the "-20 dB down amplitude" determined in Step 9.
11. Reset Marker-delta function and move the marker to other side of the emission until the delta marker amplitude is the same level as reference amplitude. The marker delta frequency reading at this point is the specified emission bandwidth.



3.3. Frequency tolerance

Test setup



Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The transmission time was measured with the spectrum analyzer using RBW=1 ㎑, VBW=1 ㎑.
3. Set the temperature of chamber to -20℃. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the chamber, turn the EUT on and measure the EUT operating frequency.
4. Repeat step 2 with a 10℃ decreased per stage until the highest temperature 50℃ is measured, record all measured frequencies on each temperature step.

Limit

According to FCC Part 15 Section 15.225 (e),
The frequency tolerance of the carrier signal shall be maintained within +/-0.01 % of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test results

Test voltage (%)	Test voltage (V)	Temperature (℃)	Measure frequency (㎒)	Frequency deviation (㎐)	Deviation (%)
100 %	AC 120	-20	13.560 528	28	0.000 206
100 %		-10	13.560 514	14	0.000 103
100 %		0	13.560 550	50	0.000 369
100 %		10	13.560 550	50	0.000 369
100 %		20	13.560 507	7	0.000 052
100 %		30	13.560 528	28	0.000 206
100 %		40	13.560 514	14	0.000 103
100 %		50	13.560 507	7	0.000 052
85 %	AC 102	20	13.560 504	4	0.000 029
115 %	AC 138	20	13.560 510	10	0.000 074

3.4. AC conducted emissions

Limit

According to 15.207(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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall 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 frequencies ranges.

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

Note:

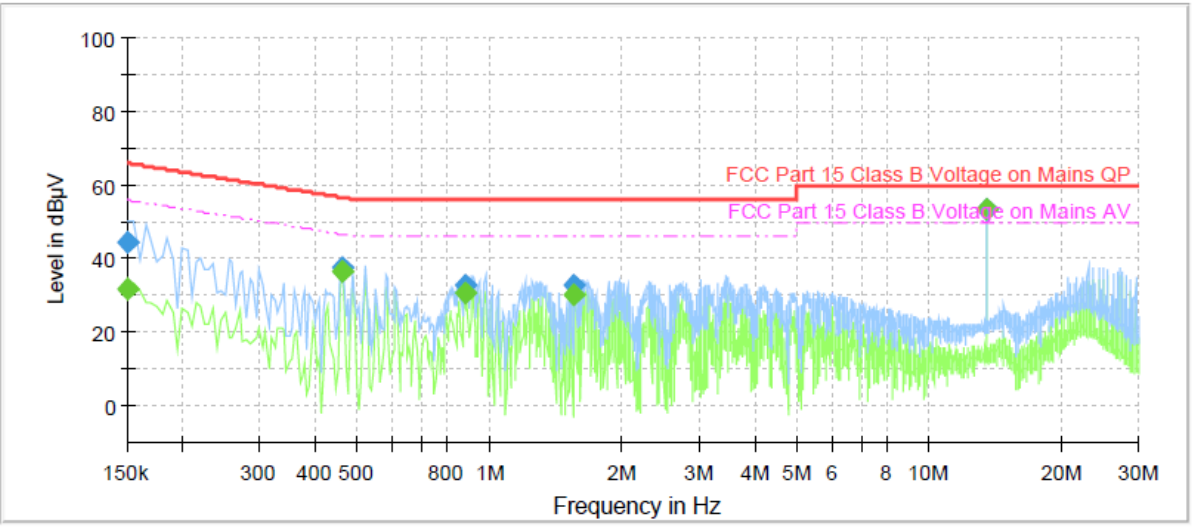
1. All AC line conducted spurious emission are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and the appropriate frequencies. All data rates and modes were investigated for conducted spurious emission. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.
2. Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).

Test results - Unterminated the Antenna

Test Report

Common Information

Test Description:	Conducted Emission
Model No.:	FTTA05
Mode	OP
Operator Name:	KES



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	---	31.72	56.00	24.28	1000.0	9.000	L1	9.7
0.150000	44.26	---	66.00	21.74	1000.0	9.000	L1	9.7
0.460000	---	36.77	46.69	9.92	1000.0	9.000	L1	9.8
0.460000	37.72	---	56.69	18.97	1000.0	9.000	L1	9.8
0.885000	---	30.97	46.00	15.03	1000.0	9.000	L1	9.9
0.885000	32.99	---	56.00	23.01	1000.0	9.000	L1	9.9
1.560000	---	30.03	46.00	15.97	1000.0	9.000	L1	10.0
1.560000	32.89	---	56.00	23.11	1000.0	9.000	L1	10.0
13.560000	---	53.34	50.00	-3.34	1000.0	9.000	L1	9.9
13.560000	53.33	---	60.00	6.67	1000.0	9.000	L1	9.9

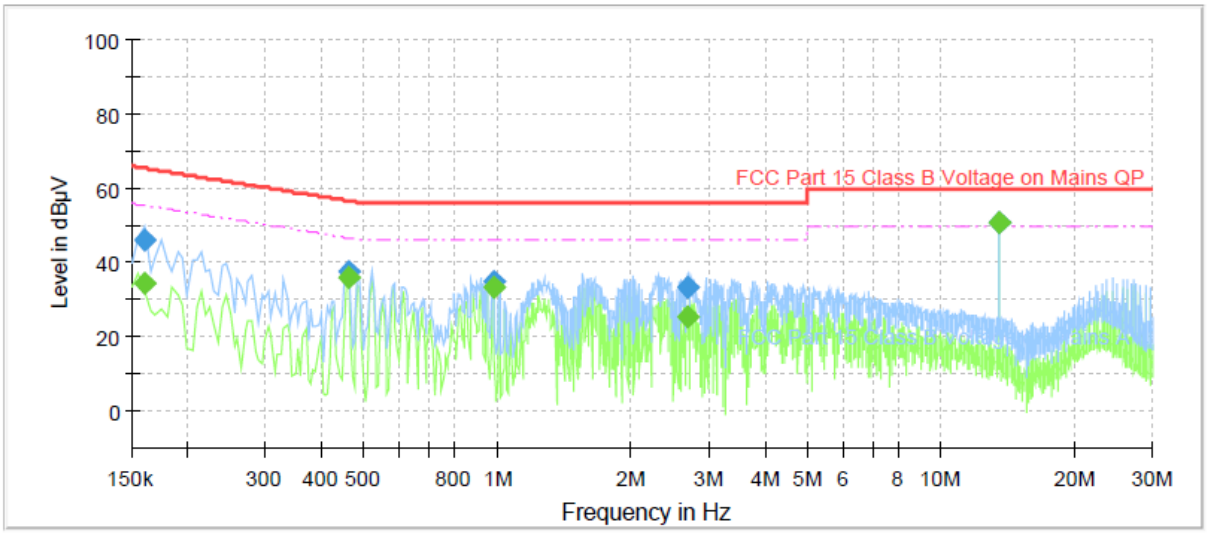
Note; Hot Line

Test results - Unterminated the Antenna

Test Report

Common Information

Test Description:	Conducted Emission
Model No.:	FTTA05
Mode	OP
Operator Name:	KES



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.160000	---	34.59	55.46	20.87	1000.0	9.000	N	9.7
0.160000	45.96	---	65.46	19.50	1000.0	9.000	N	9.7
0.460000	---	36.19	46.69	10.50	1000.0	9.000	N	9.8
0.460000	37.63	---	56.69	19.06	1000.0	9.000	N	9.8
0.980000	---	33.62	46.00	12.38	1000.0	9.000	N	9.9
0.980000	34.84	---	56.00	21.16	1000.0	9.000	N	9.9
2.680000	---	25.67	46.00	20.33	1000.0	9.000	N	10.0
2.680000	33.16	---	56.00	22.84	1000.0	9.000	N	10.0
13.560000	---	50.65	50.00	-0.65	1000.0	9.000	N	9.9
13.560000	50.67	---	60.00	9.33	1000.0	9.000	N	9.9

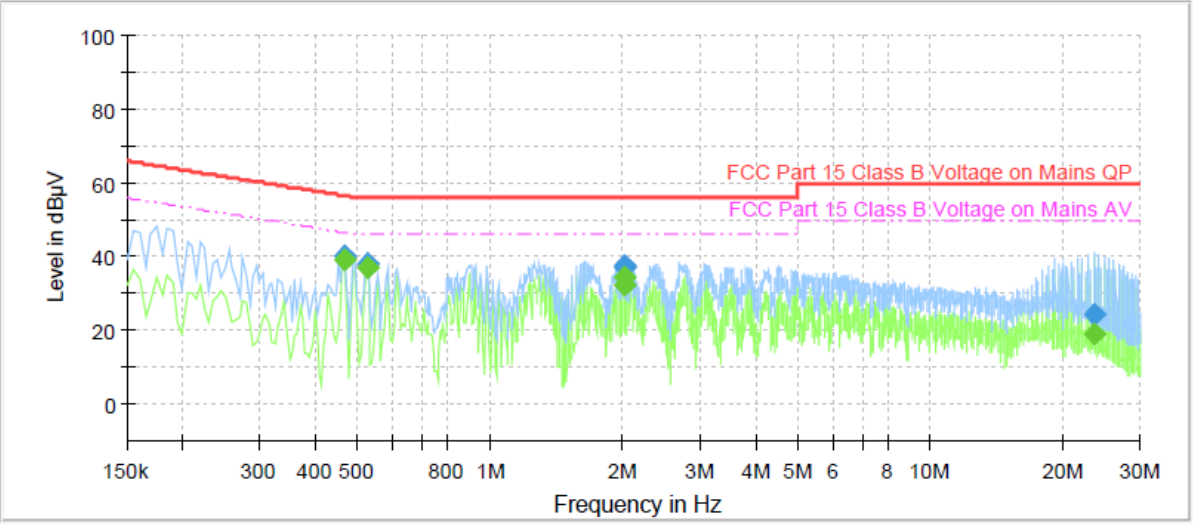
Note; Neutral Line

Test results - Terminated the Antenna

Test Report

Common Information

Test Description:	Conducted Emission
Model No.:	FTTA05
Mode	
Operator Name:	KES



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.465000	---	38.92	46.60	7.68	1000.0	9.000	L1	9.8
0.465000	40.49	---	56.60	16.11	1000.0	9.000	L1	9.8
0.525000	---	37.00	46.00	9.00	1000.0	9.000	L1	9.8
0.525000	38.28	---	56.00	17.72	1000.0	9.000	L1	9.8
2.025000	---	32.13	46.00	13.87	1000.0	9.000	L1	10.0
2.025000	37.33	---	56.00	18.67	1000.0	9.000	L1	10.0
2.030000	---	34.23	46.00	11.77	1000.0	9.000	L1	10.0
2.030000	37.56	---	56.00	18.44	1000.0	9.000	L1	10.0
23.510000	---	19.07	50.00	30.93	1000.0	9.000	L1	10.3
23.510000	24.59	---	60.00	35.41	1000.0	9.000	L1	10.3

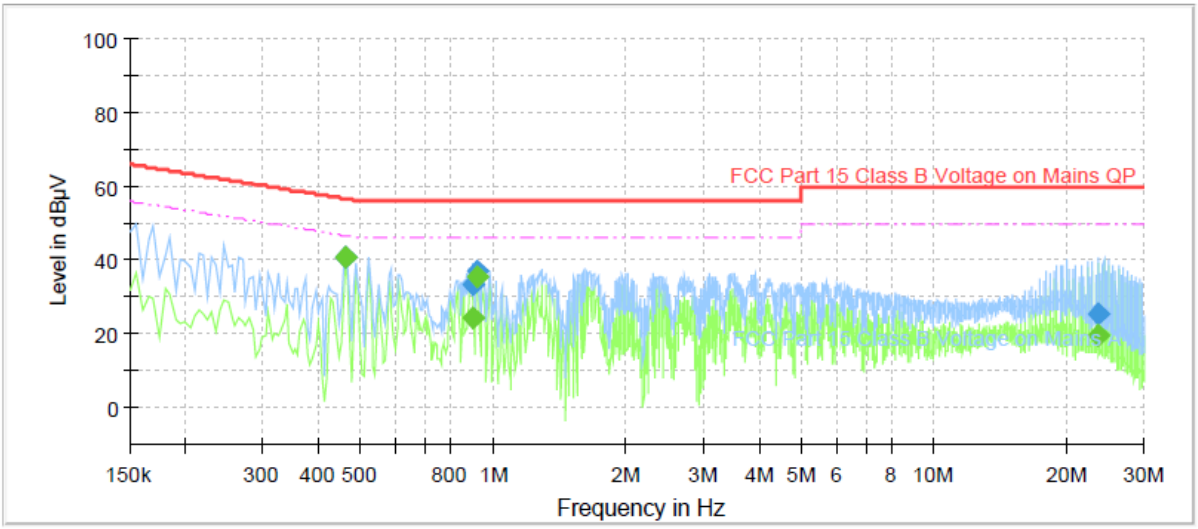
Note; Hot Line

Test results - Terminated the Antenna

Test Report

Common Information

Test Description:	Conducted Emission
Model No.:	FTTA05
Mode	
Operator Name:	KES



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.460000	---	40.59	46.69	6.10	1000.0	9.000	N	9.8
0.460000	41.00	---	56.69	15.69	1000.0	9.000	N	9.8
0.900000	---	24.35	46.00	21.65	1000.0	9.000	N	9.9
0.900000	33.43	---	56.00	22.57	1000.0	9.000	N	9.9
0.920000	---	35.45	46.00	10.55	1000.0	9.000	N	9.9
0.920000	37.08	---	56.00	18.92	1000.0	9.000	N	9.9
23.585000	---	19.77	50.00	30.23	1000.0	9.000	N	10.3
23.585000	25.45	---	60.00	34.55	1000.0	9.000	N	10.3

Note; Neutral Line

Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	100736	1 year	2017.07.06
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2017.01.25
Trilog-broadband antenna	Schwarzbeck	VULB 9163	9168-713	2 years	2017.05.15
Loop Antenna	R&S	HFH2-Z2.335.4711.52	826532	2 years	2017.03.03
EMI Test Receiver	R&S	ESR3	101781	1 year	2017.05.03
EMI Test Receiver	R&S	ESU26	100552	1 year	2017.04.24
EMI Test Receiver	R&S	ESR3	101783	1 year	2017.05.03
LISN	R&S	ENV216	101137	1 year	2017.02.04
Temperature chamber	TABAI	MC711P	112000492	1 year	2017.01.21
AC Power Source	HP	6813A	3729A00754	1 year	2017.01.21

Peripheral device

Device	Manufacturer	Model No.	Serial No.
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