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TEST REPORT

FCC Zigbee Test for FX100

APPLICANT
PASSTECH CO., LTD

REPORT NO.
HCT-RF-2105-FC043

DATE OF ISSUE
May 26, 2021

Tested by
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FCC ID
W6YFX100

Applicant	**PASSTECH CO., LTD** B-402. 215 Galmachi-ro, Jungwon-gu, Seongnam-si, Gyeonggi-do, Rep. of Korea (Zip 13217)
Eut Type Model Name	FURNITURE LOCK FX100
Peak Output Power	0.352 dBm (1.08 mW)
Modulation type	O-QPSK
FCC Classification	Digital Transmission System(DTS)
FCC Rule Part(s)	Part 15.247

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test results were applied only to the test methods required by the standard.

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	May 26, 2021	Initial Release

Engineering Statement:
The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance. measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

CONTENTS

1. EUT DESCRIPTION

Model	FX100
Additional model	FX100WR, FX200, FX200WR
EUT Type	FURNITURE LOCK
Manufacturer Name Address	PASSTECH CO., LTD B-402. 215 Galmachi-ro, Jungwon-gu, Seongnam-si, Gyeonggi-do, Rep. of Korea (Zip 13217)
Factory Name Address	PASSTECH CO., LTD B-402. 215 Galmachi-ro, Jungwon-gu, Seongnam-si, Gyeonggi-do, Rep. of Korea (Zip 13217)
Power Supply	FX100(DC) 3.0 V FX200(AC Adaptor) 100 ~ 220 V, Output DC 5V
Frequency Range	2405 MHz ~ 2480 MHz
Max. RF Output Power (Peak)	0.352 dBm (1.08 mW)
Modulation Type	O-QPSK
Number of Channels	16 Channels
Antenna Specification	Antenna type: Multilayer Chip Antenna Peak Gain : 3.5 dBi
Date(s) of Tests	May 14, 2021~ May 25, 2021

2. TEST METHODOLOGY

FCC KDB 558074 D01 15.247 Meas Guidance v05 dated August 24, 2018 entitled “guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices and the measurement procedure described in ANSI C63.10(Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’.

EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3.75 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

Conducted Antenna Terminal

See Section from 8.3.(KDB 558074 v05)

DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.
Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil,
Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.
The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.
Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

5. ANTENNA REQUIREMENTS

According to FCC 47 CFR § 15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

(1) The antennas of this E.U.T are permanently attached.

(2) The E.U.T Complies with the requirement of § 15.203

6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

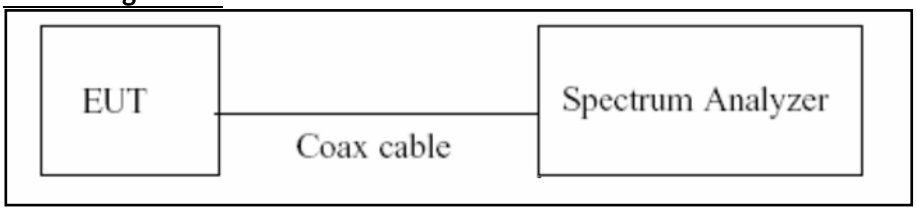
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70
Radiated Disturbance (18 GHz ~ 40 GHz)	5.05

7. DESCRIPTION OF TESTS

7.1. Duty Cycle

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.
We tested according to the zero-span measurement method, 6.0)b) in KDB 558074 v05.
The largest availble value of RBW is 8 MHz and VBW is 50 MHz.
The zero-span method of measuring duty cycle shall not be used if T ≤ 6.25 microseconds. (50/6.25 = 8)
The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are > 50/*T*.

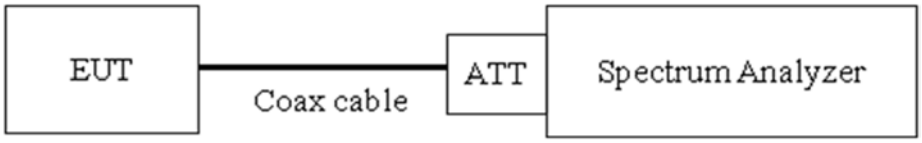
1. RBW = 8 MHz (the largest availble value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/ T_{total} and Duty Cycle Factor = 10log(1/Duty Cycle)

7.2. 6dB Bandwidth

Limit

The minimum permissible 6 dB bandwidth is 500 kHz.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Procedure 11.8.1 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Detector = Peak
4) Trace mode = max hold
5) Sweep = auto couple
6) Allow the trace to stabilize
7) We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

Test Procedure (99 % Bandwidth for IC)

The transmitter output is connected to the spectrum analyzer.

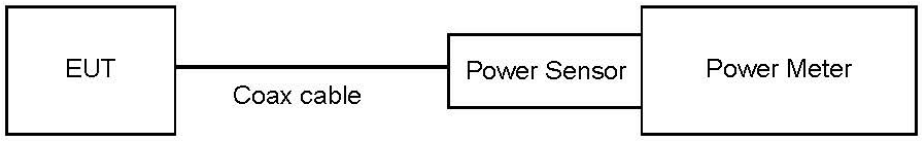
1) RBW = 1% ~ 5% of the occupied bandwidth
2) VBW ≒ 3 x RBW
3) Detector = Peak
4) Trace mode = max hold
5) Sweep = auto couple
6) Allow the trace to stabilize

7.3. Output Power

Limit

The maximum permissible conducted output power is 1 Watt.

Test Configuration



Test Procedure

The transmitter output is connected to the Power Meter.

▪ Peak Power (Procedure 11.9.1.3 in ANSI 63.10-2013)

: Measure the peak power of the transmitter.

▪ Average Power (Procedure 11.9.2.3 in ANSI 63.10-2013)

1) Measure the duty cycle.
2) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3) Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Sample Calculation

▪ Conducted Output Power(Peak) = Reading Value + ATT loss + Cable loss

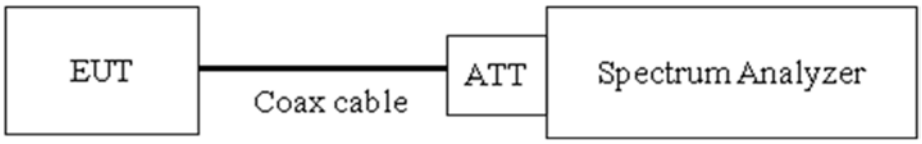
▪ Conducted Output Power(Average) = Reading Value + ATT loss + Cable loss + Duty Cycle Factor

7.4. Power Spectral Density

Limit

The transmitter power density average over 1-second interval shall not be greater than 8dBm in any 3kHz BW.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure 8.4 in KDB 558074 v05r02, Procedure 11.10 in ANSI 63.10-2013.

The spectrum analyzer is set to :

1) Set analyzer center frequency to DTS channel center frequency.
2) Span = 1.5 times the DTS channel bandwidth.
3) RBW = 3 kHz ≤ RBW ≤ 100 kHz.
4) VBW ≥ 3 x RBW.
5) Sweep = auto couple
6) Detector = peak
7) Trace Mode = max hold
8) Allow trace to fully stabilize.
9) Use the peak marker function to determine the maximum amplitude level within the RBW.
   If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Sample Calculation

▪ Power Spectral Density = Reading Value + ATT loss + Cable loss

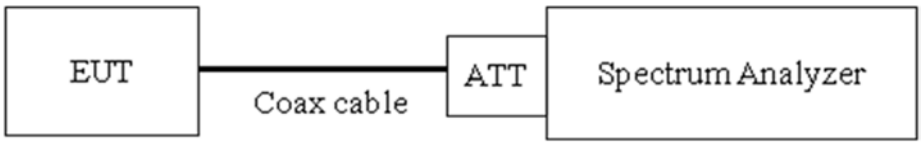
7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

Limit

The maximum conducted (Average) output power was used to demonstrate compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

[Conducted > 20 dBc]

Test Configuration



Test Procedure

The transmitter output is connected to the spectrum analyzer.

(Procedure 11.11 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Set span to encompass the spectrum to be examined
4) Detector = Peak
5) Trace Mode = max hold
6) Sweep time = auto couple
7) Ensure that the number of measurement points ≥ 2 x Span/RBW
8) Allow trace to fully stabilize.
9) Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the lowest, middle, and highest channels.

Factors for frequency

Freq(MHz)	Factor(dB)
30	21.05
100	21.10
200	21.14
300	21.19
400	21.25
500	21.25
600	21.26
700	21.27
800	21.28
900	21.30
1000	21.35
2000	21.50
2400	21.53
2412	21.55
2437	21.55
2462	21.55
2500	21.54
3000	21.64
4000	21.72
5000	21.79
5700	21.80
5800	21.87
6000	21.88
7000	22.01
8000	22.01
9000	22.09
10000	22.19
11000	22.28
12000	22.37
13000	22.38
14000	22.41
15000	22.51
16000	22.59
17000	22.80
18000	22.93
19000	22.85
20000	22.52
21000	22.65
22000	22.64
23000	22.65
24000	22.66
25000	22.76

Note : 1. 2400 ~ 2500 MHz is fundamental frequency range.

2. Factor = Attenuator loss(20dB) + Cable loss + EUT Cable loss

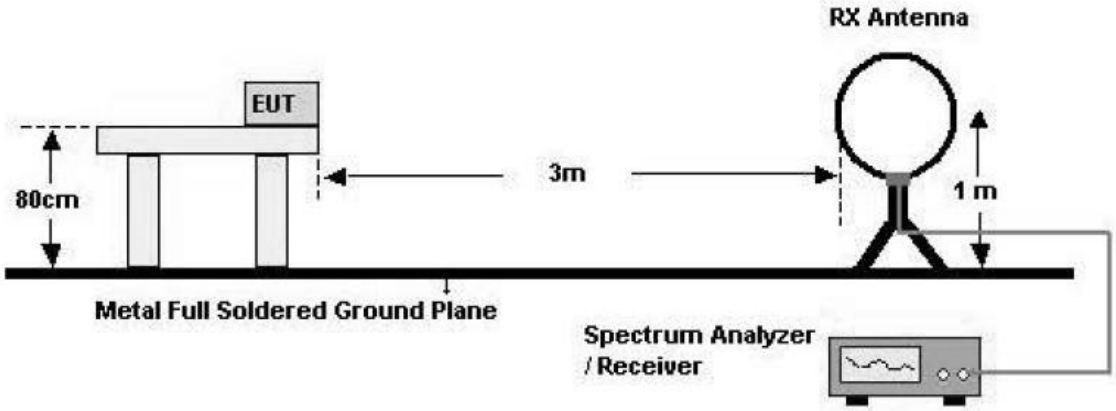
7.6. Radiated Test

Limit

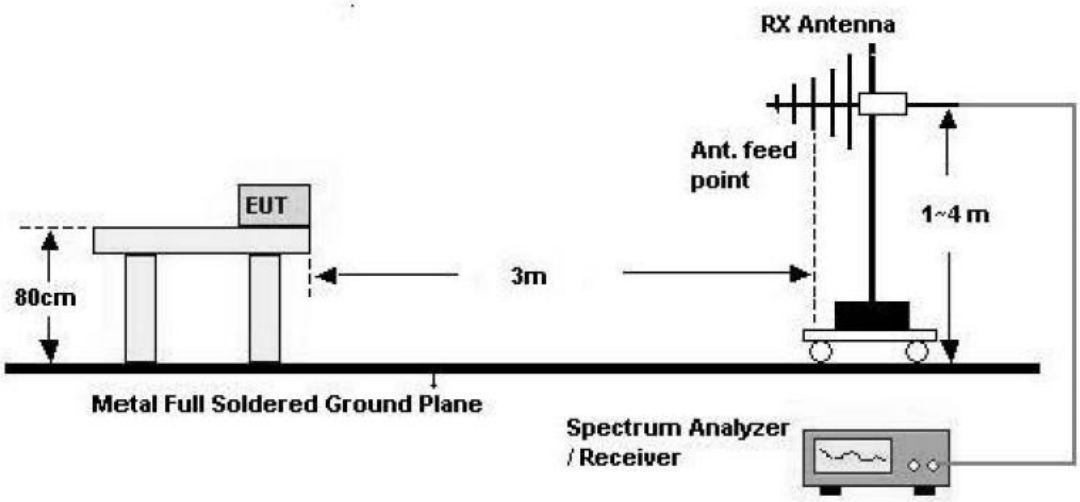
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

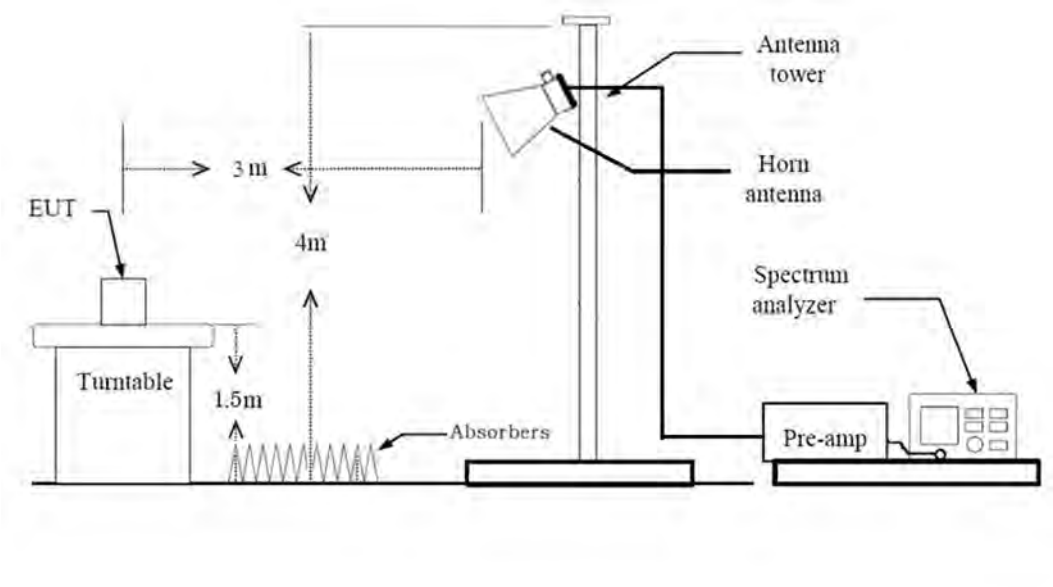
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting (Method 8.6 in KDB 558074 v05, Procedure 11.12 in ANSI 63.10-2013)
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3xRBW
   (2) Measurement Type(Average): Duty cycle ≥ 98%
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = RMS
      - Averaging type = power (*i.e.*, RMS)
      - RBW = 1 MHz

- VBW ≥ 3xRBW
- Sweep time = auto.
- Trace mode = average (at least 100 traces).

(3) Measurement Type(Average): Duty cycle < 98%, duty cycle variations are less than ±2%
- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = RMS
- Averaging type = power (*i.e.*, RMS)
- RBW = 1 MHz
- VBW ≥ 3xRBW
- Sweep time = auto.
- Trace mode = average (at least 100 traces).
- Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle.
- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.

(4) Measurement Type(Average):
- Average value of pulsed emissions
- Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determined from the peak field strength after correcting for the worst-case duty cycle as described in section 9.1.
- DCCF = $20\log_{10}$(Pulse width / Period of the pulse train)

9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total(Measurement Type : Peak)
= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

Total(Measurement Type : Average, Duty cycle < 98%)
= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)
+ Duty Cycle Factor

Test Procedure of Radiated Restricted Band Edge

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting
   (1) Measurement Type(Peak):
   - Measured Frequency Range : 2310 MHz ~ 2390 MHz/ 2483.5 MHz ~ 2500 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 1 MHz
   - VBW ≥ 3xRBW

   (2) Measurement Type(Average):
   - Average value of pulsed emissions
   - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determined from the peak field strength after correcting for the worst-case duty cycle as described in section 9.1.
   - DCCF = $20\log_{10}$(Pulse width / Period of the pulse train)
9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total(Measurement Type : Peak)
    = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

    Total(Measurement Type : Average, Duty cycle ≥ 98%)
    = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

    Total(Measurement Type : Average, Duty cycle < 98%)
    = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)
    + Duty Cycle Factor

7.7. AC Power line Conducted Emissions

Limit

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 μH/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56[a]	56 to 46[a]
0.50 to 5	56	46
5 to 30	60	50

[a]Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.

Sample Calculation

Quasi-peak(Final Result) = Reading Value + Correction Factor

7.8. Receiver Spurious Emissions

Limit

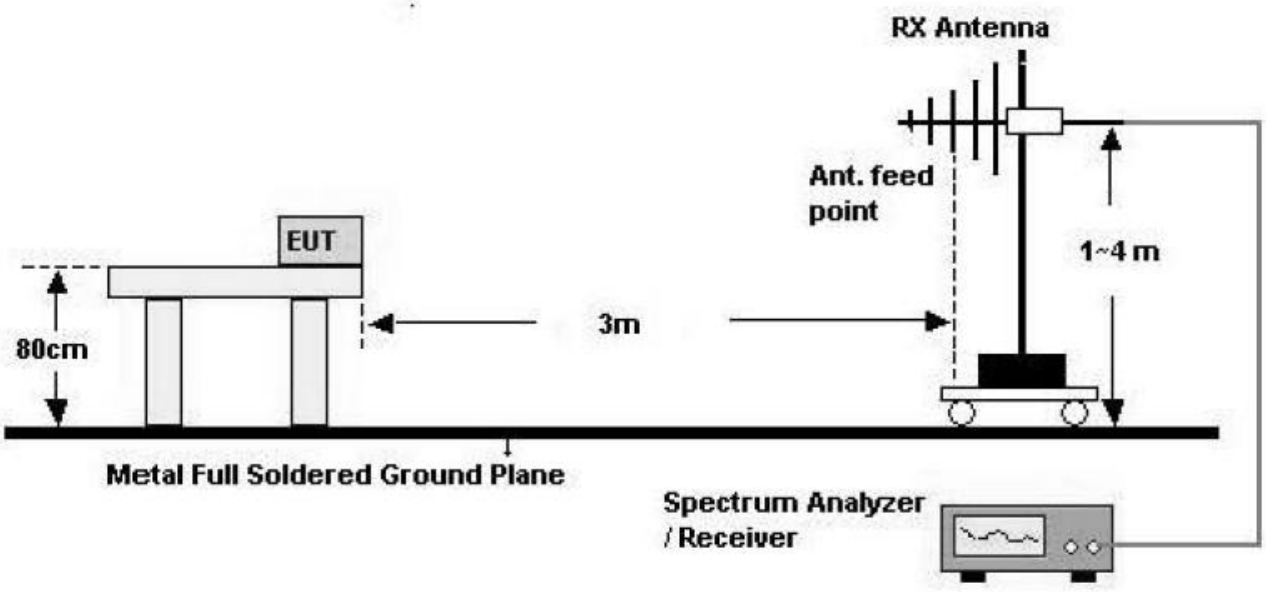
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

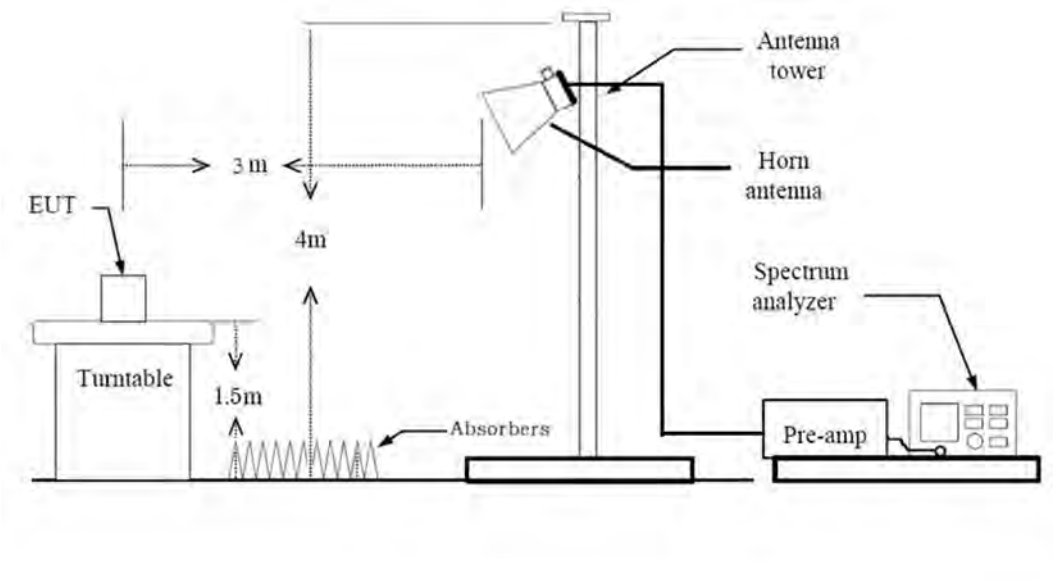
Measurements for compliance with the limits in table may be performed at distances other than 3 metres.

Test Configuration

30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.

8. Spectrum Setting

(1) Measurement Type(Peak):

- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = Peak
- Trace = Maxhold
- RBW = 1 MHz
- VBW ≥ 3xRBW

(2) Measurement Type(Average):

- We performed using a reduced video BW method was done with the analyzer in linear mode
- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = Peak
- Trace = Maxhold
- RBW = 1 MHz
- VBW ≥ 1/τ Hz, where τ = pulse width in seconds

  The actual setting value of VBW = 1 kHz

9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)

11. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

7.9. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
   - The worst case : FX100(DC)
2. EUT Axis
   - Radiated Spurious Emissions : Y
   - Radiated Restricted Band Edge : Y
3. Duty cycle factor applies only Radiated Restricted band edges(If Duty cycle < 98%).
4. All data rate of operation were investigated and the test results are worst case in lowest datarate of each mode.
   - Zigbee Mode
5. EUT were tested and the worst case results are reported.
6. FX100, FX200 were tested and the worst case results are reported.
   - Worst case : FX100(DC)

AC Power line Conducted Emissions

1. All modes of operation were investigated and the worst case configuration results are reported.
2. FX200 were tested and the worst case results are reported.
   - Worst case : FX200(AC)

Conducted test

1. The EUT was configured with data rate of highest power.
2. FX100, FX200 were tested and the worst case results are reported.
   - Worst case : FX100(DC)

8. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§ 15.247(a)(2)	> 500 kHz	Conducted	PASS
Occupied Bandwidth	N/A	N/A		N/A
Conducted Maximum Peak Output Power	§ 15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§ 15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§ 15.247(d)	Conducted > 20 dBc		PASS
AC Power line Conducted Emissions	§ 15.207	cf. Section 7.7		**PASS & See Note1**
Radiated Spurious Emissions	§ 15.247(d), 15.205, 15.209	cf. Section 7.6	Radiated	PASS
Radiated Restricted Band Edge	§ 15.247(d), 15.205, 15.209	cf. Section 7.6		PASS
Receiver Spurious Emissions	N/A	cf. Section 7.8		PASS

Note:

1. We are performed the AC Power Line Conducted Emission test for Ch.11 on Zigbee mode.
   Because Ch.11 on Zigbee mode is worst case.

9. TEST RESULT

9.1 DUTY CYCLE & DCCF

Zigbee Mode	T_{on} (ms)	T_{total} (ms)	Duty Cycle	VBW(1/T) Hz
	1.00	**1.00**	**1.0000**	1000

DCCF Plot

On time for one frame is 32 us/byte x 133 bytes = 4.256 ms

4 frames are transmitted for a total on time is 17.024 ms(4.256 ms x 4 frames)

DCCF = 20log10(Pulse width / Period of the pulse train)

=20log[(17.024)/100] = -15.3788

Duty Cycle Correction Factor	**-15.38 dB**

Note : ※ Duty cycle correction factor used (ANSI C63.10-2013 Section 7.5)

9.2 BANDWIDTH

FCC

Zigbee Mode		6dB Bandwidth [MHz]	Occupied Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.			
2405	11	1.462	2.2487	0.5
2440	18	1.532	2.2539	0.5
2480	26	1.567	2.2552	0.5

▣ Test Plots

6dB Bandwidth plot (CH 11)

6dB Bandwidth plot (CH 18)

6dB Bandwidth plot (CH 26)

9.3 OUTPUT POWER

Peak Conducted Output Power Measurements

- **FX100(DC)**

Conducted Output Power Measurements (Zigbee Mode: 2405~2480)

Mode	Channel / Freq	Measured Power(dBm)	Limit (dBm)	PLS
ZigBee	ch.11 / 2405MHz	-1.995	30	8
	ch.18 / 2440MHz	-0.439		8
	ch.26 / 2480MHz	-0.164		8

- **FX200(AC)**

Conducted Output Power Measurements (Zigbee Mode: 2405~2480)

Mode	Channel / Freq	Measured Power(dBm)	Limit (dBm)	PLS
ZigBee	ch.11 / 2405MHz	-0.725	30	4
	ch.18 / 2440MHz	0.110		3
	ch.26 / 2480MHz	0.352		4

9.4 POWER SPECTRAL DENSITY

- **FX100(DC)**

Frequency (MHz)	Channel No.	Mode	Test Result	
			PSD (dBm)	Pass/Fail
2405	11	ZigBee	-13.513	Pass
2440	18		-13.371	Pass
2480	26		-13.737	Pass

▣ Test Plots

Power Spectral Density (CH 11)

Power Spectral Density (CH 18)

Power Spectral Density (CH 26)

9.5 BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

Test Result : please refer to the plot below.

In order to simplify the report, attached plots were only the worst case channel and data rate.

▣ Test Plots

Band Edge

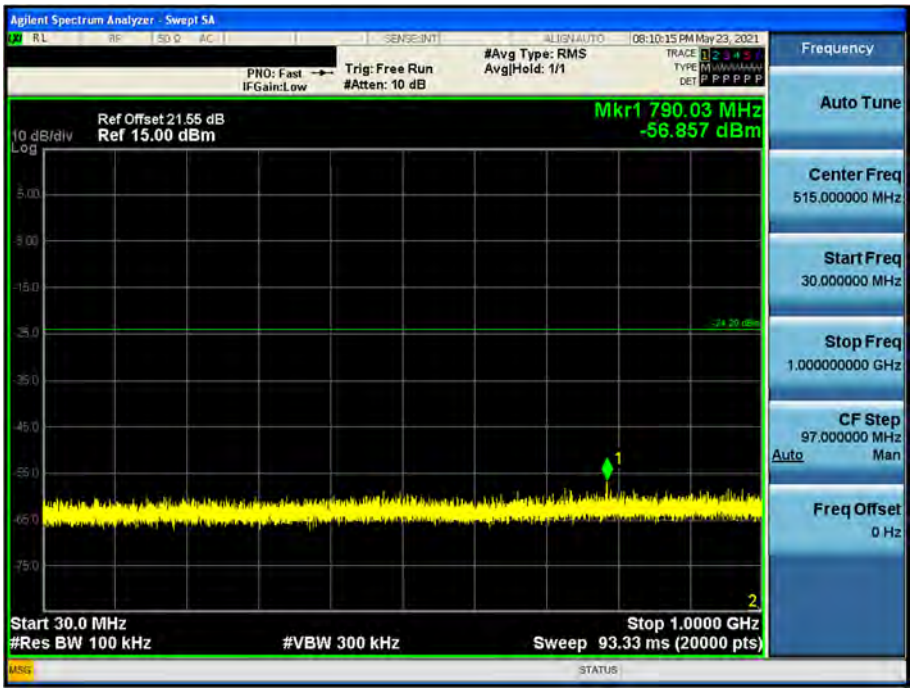
Band Edge (CH 11)

Band Edge (CH 26)

Conducted Spurious Emission

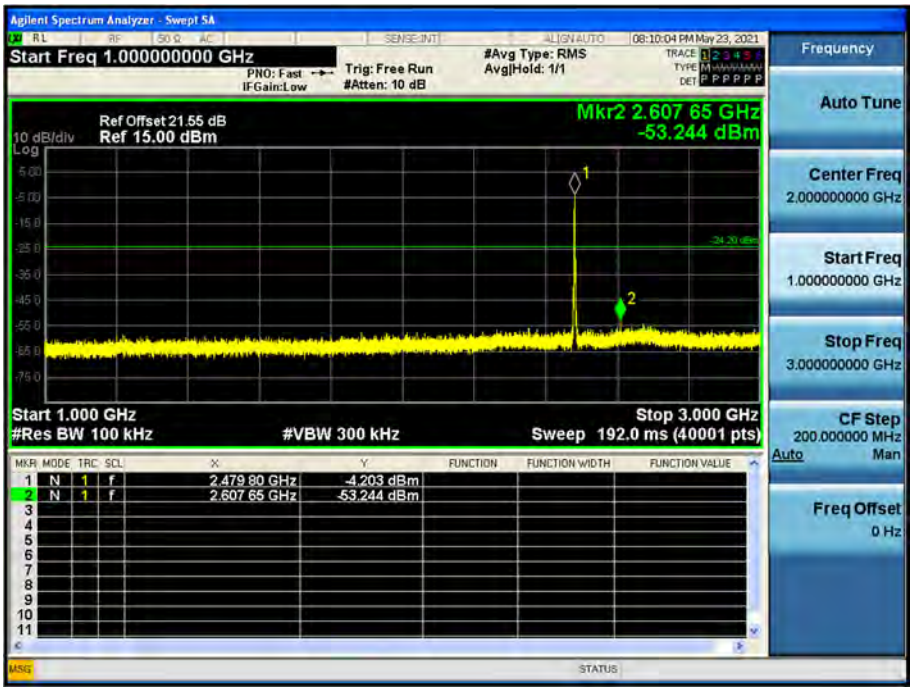
30 MHz ~ 1 GHz

Conducted Spurious Emission (CH 26)



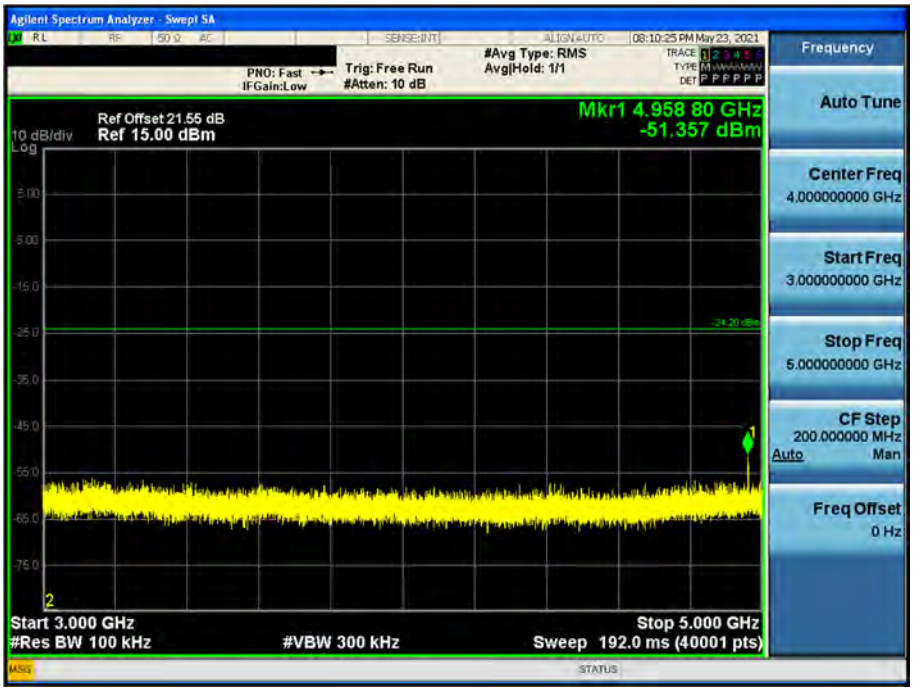
1 GHz ~ 3 GHz

Conducted Spurious Emission (CH 26)



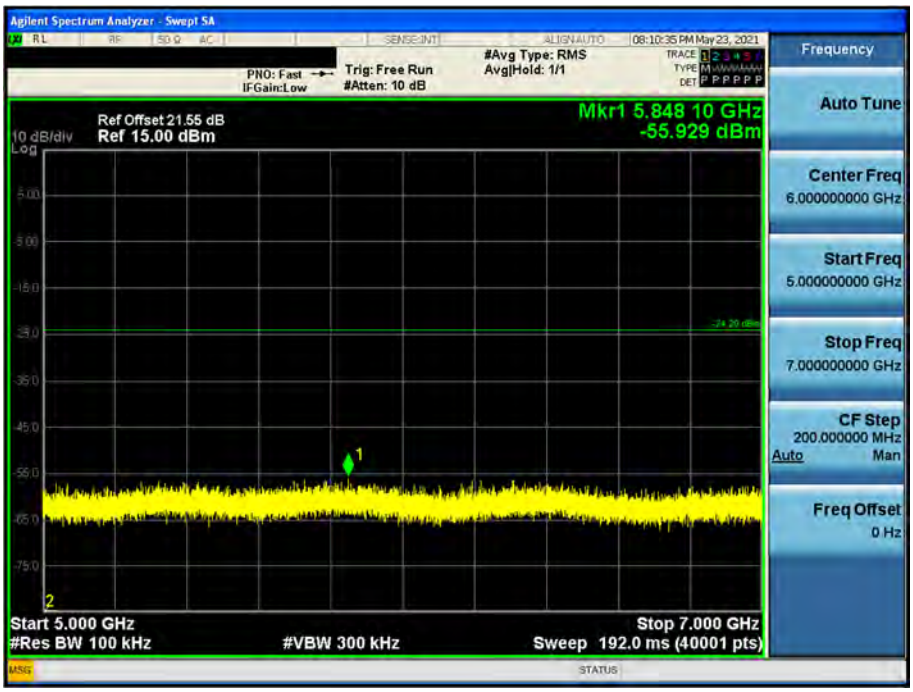
3 GHz ~ 5 GHz

Conducted Spurious Emission (CH 26)



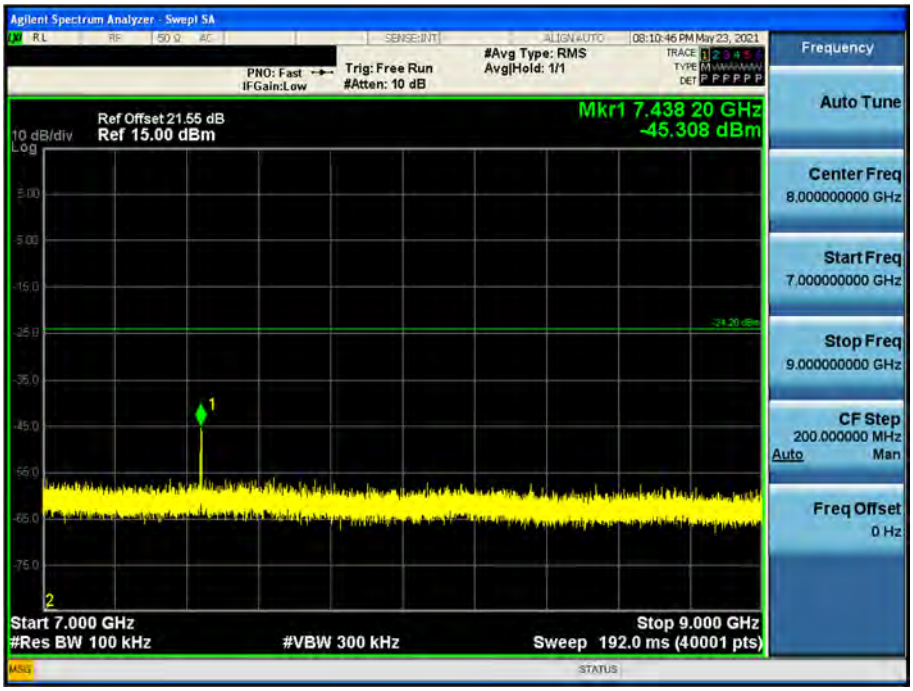
5 GHz ~ 7 GHz

Conducted Spurious Emission (CH 26)



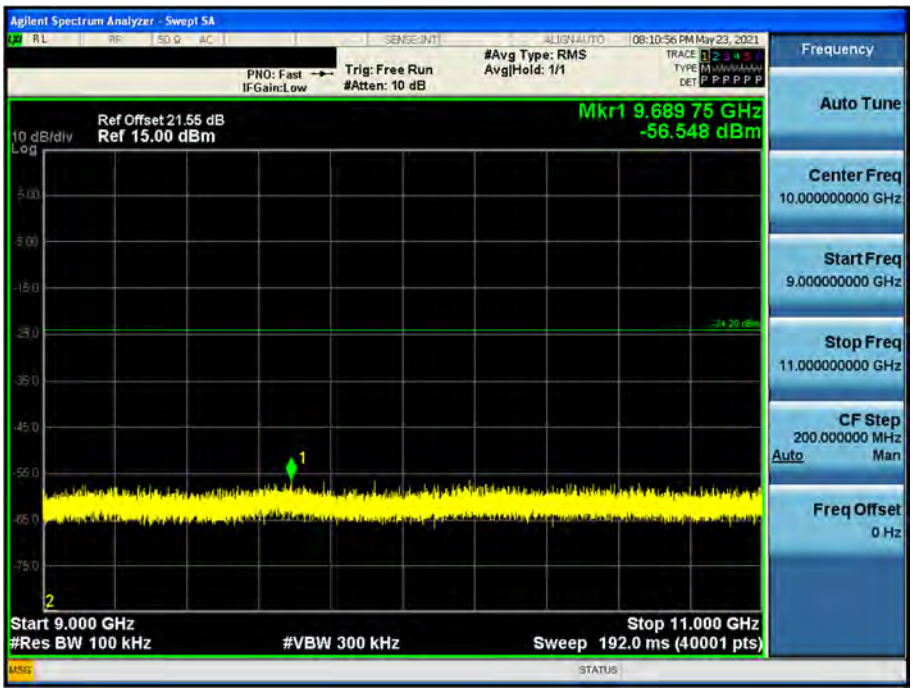
7 GHz ~ 9 GHz

Conducted Spurious Emission (CH 26)



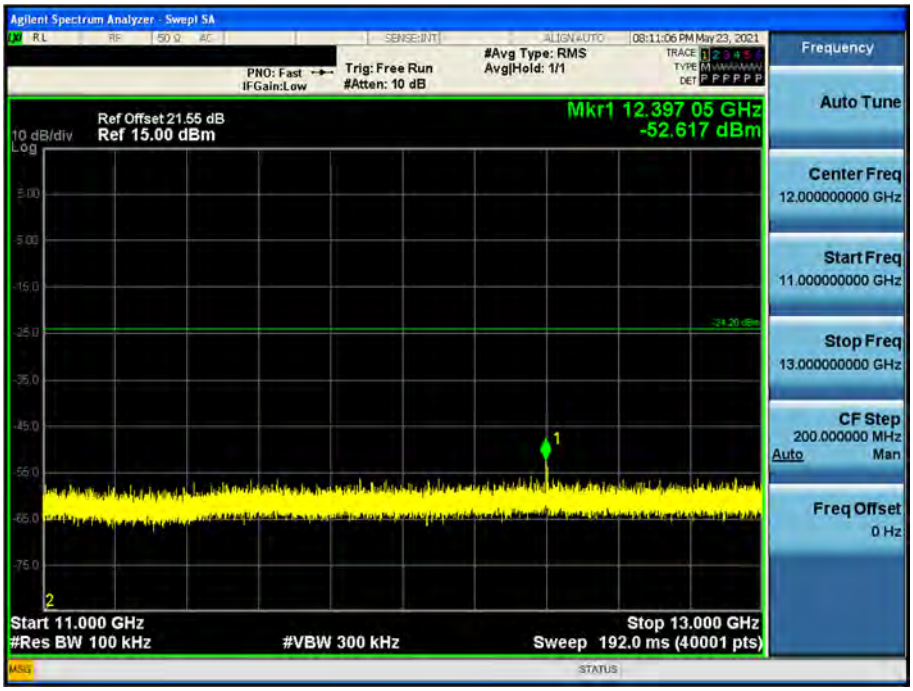
9 GHz ~ 11 GHz

Conducted Spurious Emission (CH 26)



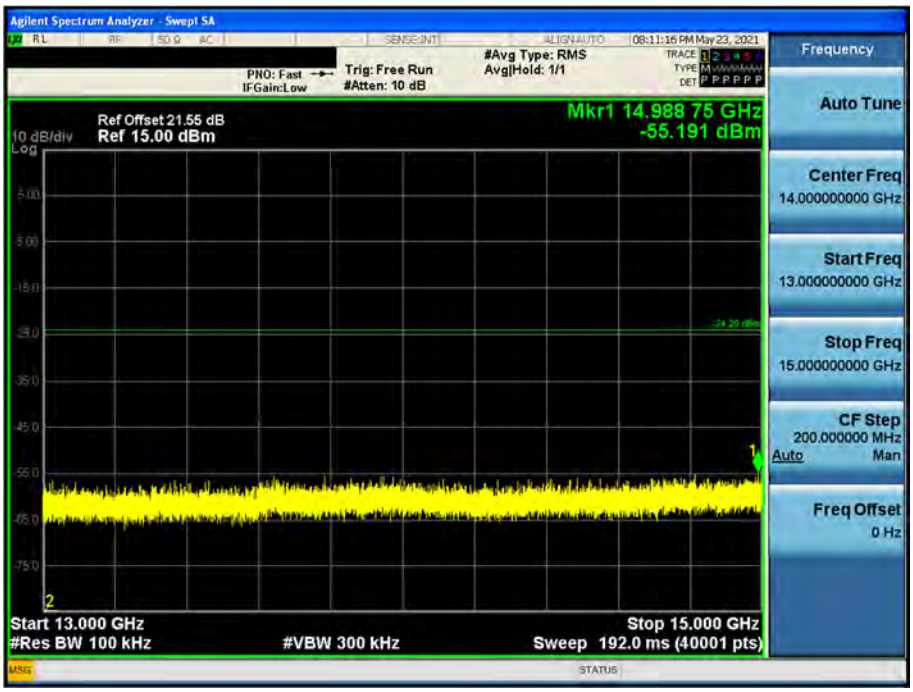
11 GHz ~ 13 GHz

Conducted Spurious Emission (CH 26)



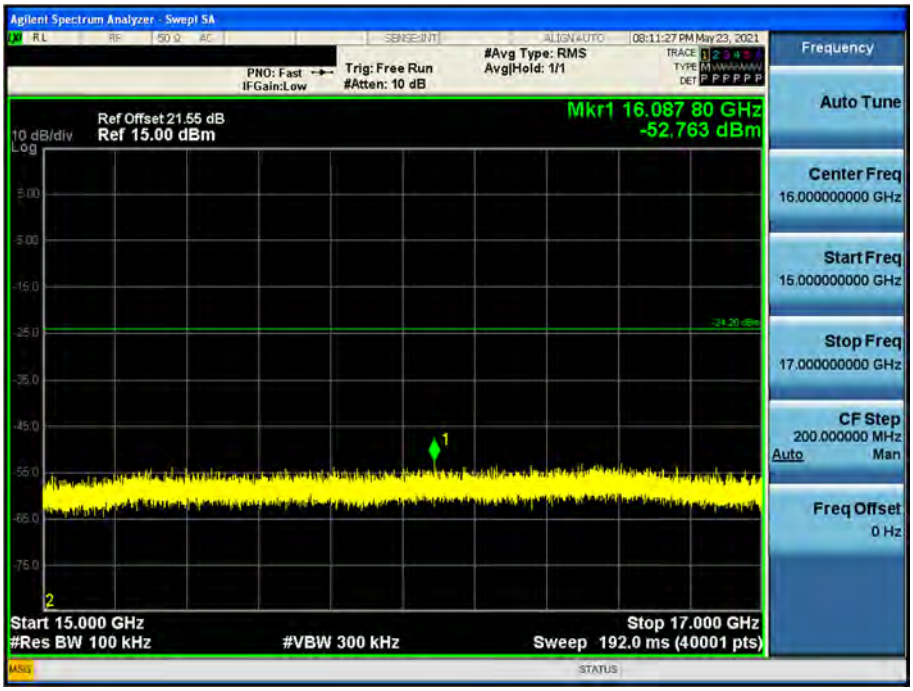
13 GHz ~ 15 GHz

Conducted Spurious Emission (CH 26)



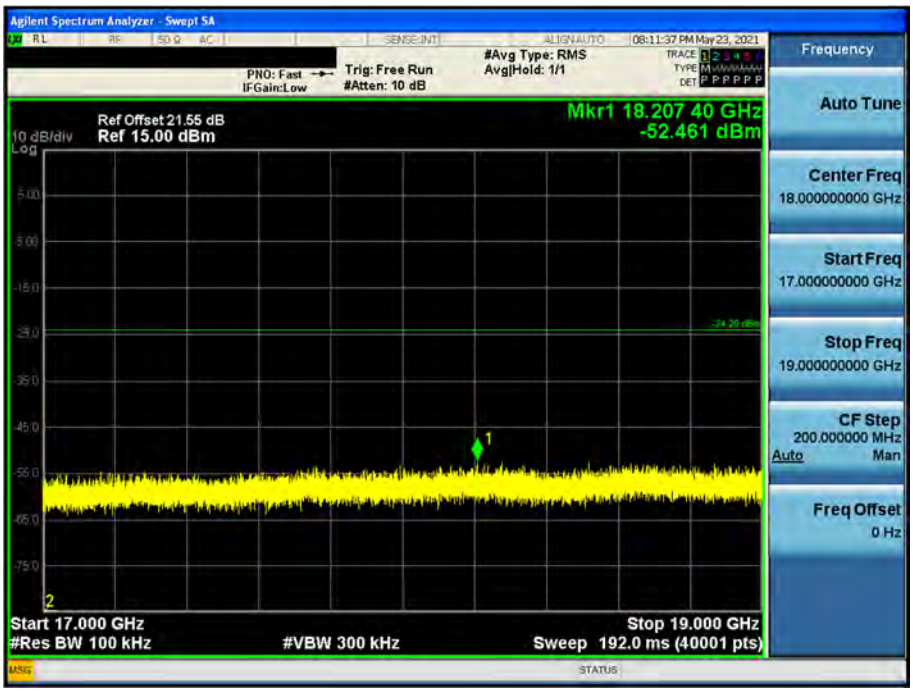
15 GHz ~ 17 GHz

Conducted Spurious Emission (CH 26)



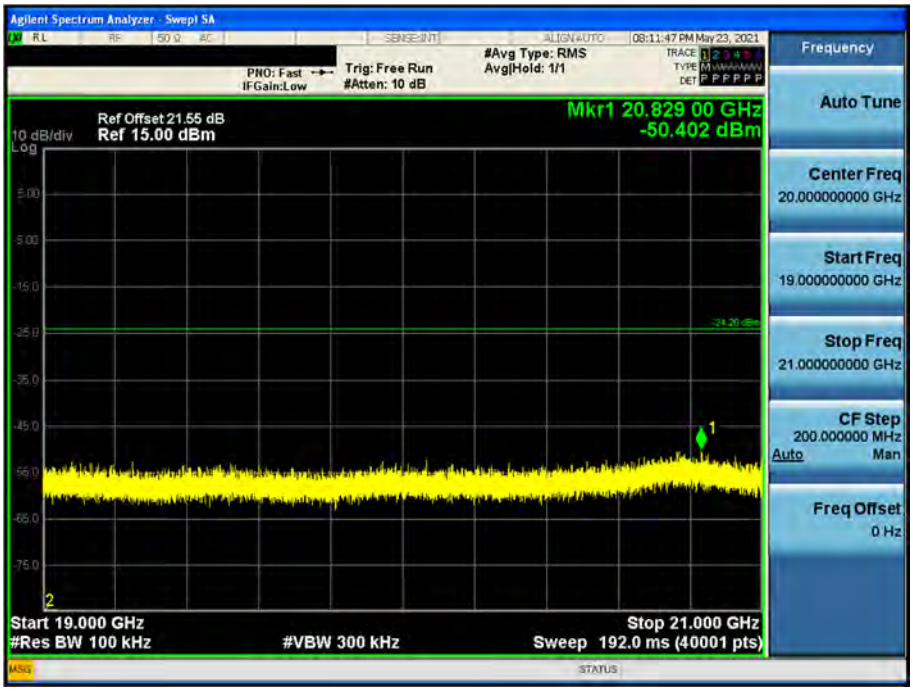
17 GHz ~ 19 GHz

Conducted Spurious Emission (CH 26)



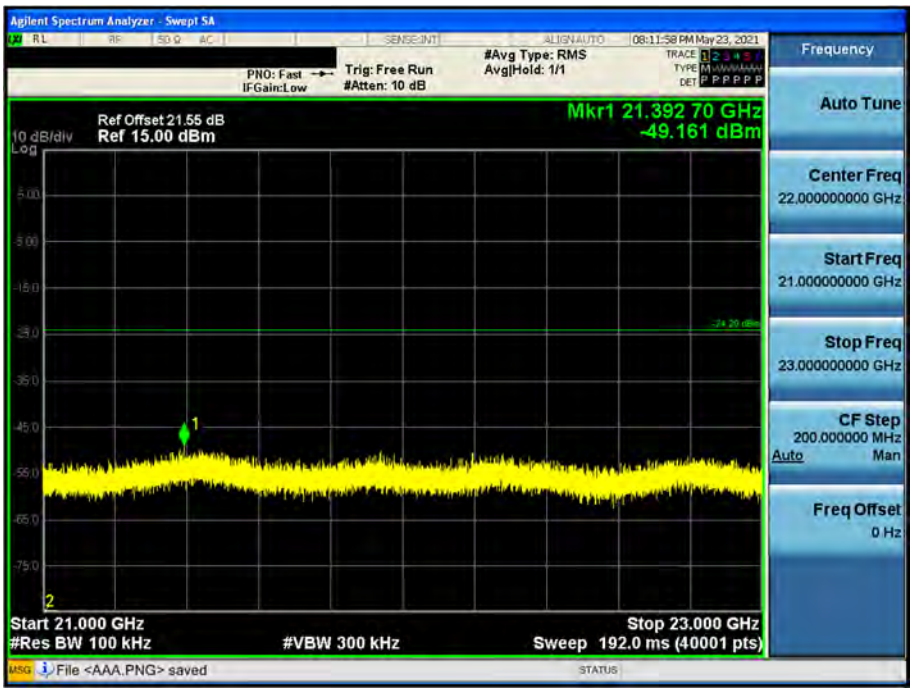
19 GHz ~ 21 GHz

Conducted Spurious Emission (CH 26)



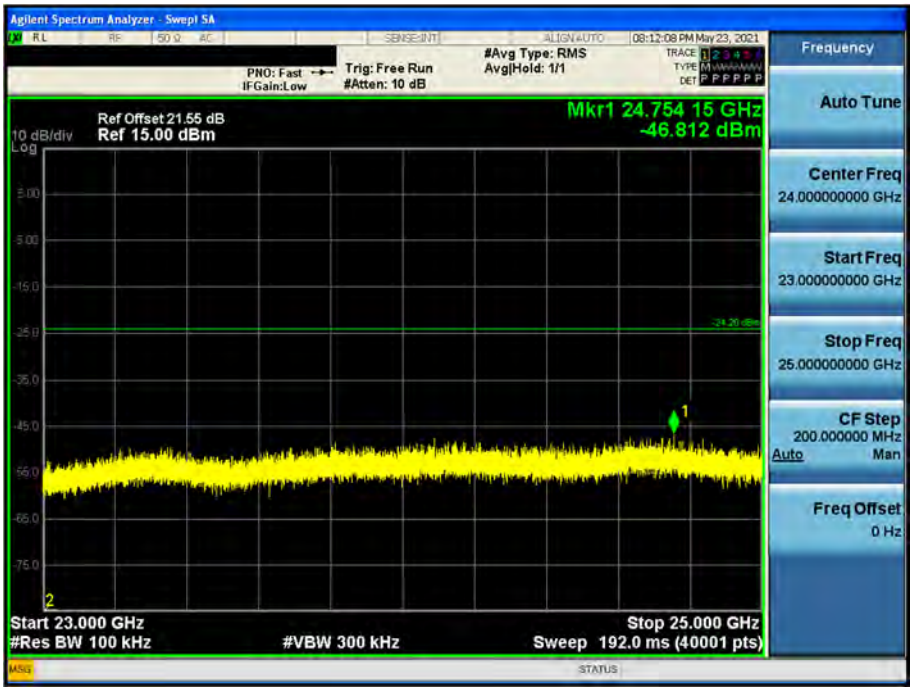
21 GHz ~ 23 GHz

Conducted Spurious Emission (CH 26)



23 GHz ~ 25 GHz

Conducted Spurious Emission (CH 26)



9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30MHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Note:

1. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Distance extrapolation factor = 40log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBuV) + Distance extrapolation factor
4. The test results for below 30 MHz is correlated to an open site.
   The result on OATS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

Frequency Range : Below 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.

Frequency Range : Above 1 GHz

- **DC Type (Main)**

Operation Mode: Zigbee
Operating Frequency 2405
Channel No. CH 11

Frequency	Reading	Duty cycle	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	dBuV	Factor	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	
4810	61.20	0.00	3.12	V	64.32	73.98	9.66	PK
4810	56.31	-15.38	3.12	V	44.05	53.98	9.93	AV
7215	54.85	0.00	9.41	V	64.26	73.98	9.72	PK
7215	48.69	-15.38	9.41	V	42.72	53.98	11.26	AV
4810	60.18	0.00	3.12	H	63.30	73.98	10.68	PK
4810	55.28	-15.38	3.12	H	43.02	53.98	10.96	AV
7215	55.41	0.00	9.41	H	64.82	73.98	9.16	PK
7215	50.00	-15.38	9.41	H	44.03	53.98	9.95	AV

Operation Mode: Zigbee
Operating Frequency 2440
Channel No. CH 18

Frequency	Reading	Duty cycle	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	dBuV	Factor	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	
4880	52.94	0.00	3.33	V	56.27	73.98	17.71	PK
4880	46.32	-15.38	3.33	V	34.27	53.98	19.71	AV
7320	48.96	0.00	10.20	V	59.16	73.98	14.82	PK
7320	41.52	-15.38	10.20	V	36.34	53.98	17.64	AV
4880	51.99	0.00	3.33	H	55.32	73.98	18.66	PK
4880	45.28	-15.38	3.33	H	33.23	53.98	20.75	AV
7320	47.64	0.00	10.20	H	57.84	73.98	16.14	PK
7320	40.69	-15.38	10.20	H	35.51	53.98	18.47	AV

Operation Mode: Zigbee

Operating Frequency 2480

Channel No. CH 26

Frequency	Reading	DCCF	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	dBuV	[dB]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	
4960	56.12	0.00	2.36	V	58.48	73.98	15.50	PK
4960	51.41	-15.38	2.36	V	38.39	53.98	15.59	AV
7440	57.50	0.00	10.72	V	68.22	73.98	5.76	PK
7440	52.52	-15.38	10.72	V	47.86	53.98	6.12	AV
4960	57.42	0.00	2.36	H	59.78	73.98	14.20	PK
4960	52.13	-15.38	2.36	H	39.11	53.98	14.87	AV
7440	56.17	0.00	10.72	H	66.89	73.98	7.09	PK
7440	51.68	-15.38	10.72	H	47.02	53.98	6.96	AV

Note:

On time for one frame is 32 us/byte x 133 bytes = 4.256 ms

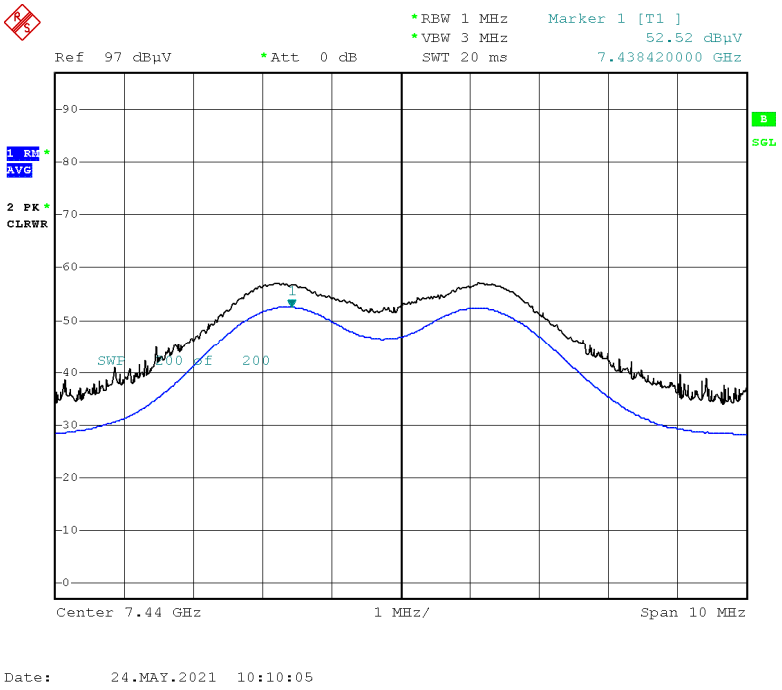
4 frames are transmitted for a total on time is 17.024 ms(4.256 ms x 4 frames)

DCCF = 20xlog(17.024 ms/100 ms) = -15.3788 dB

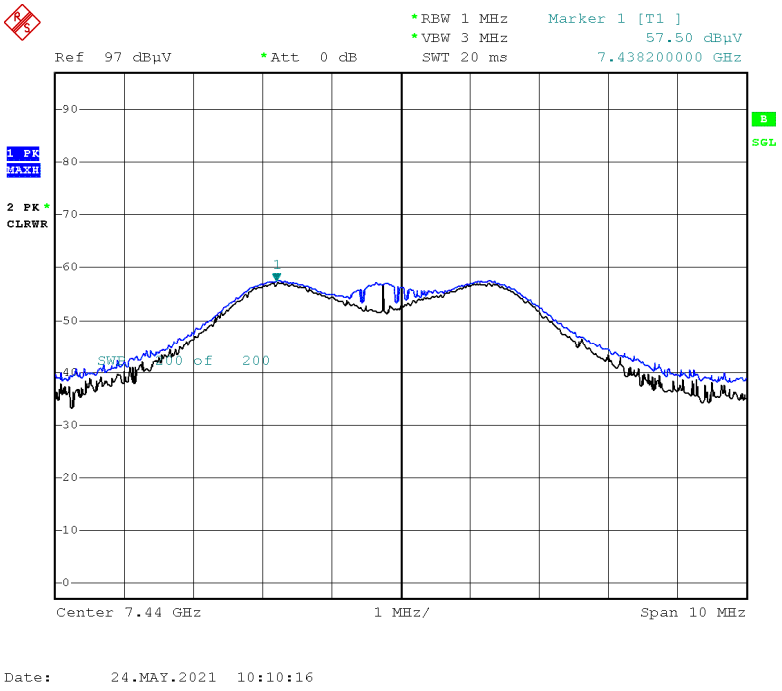
DCCF = -15.38 dB

▣ Test Plots

Radiated Spurious Emissions plot – Average Reading (CH.26 3rd Harmonic)



Radiated Spurious Emissions plot – Peak Reading (CH.26 3rd Harmonic)



Note:

Plot of worst case are only reported.

- **FX200(AC)**

Operation Mode: Zigbee

Operating Frequency 2480

Channel No. CH 26

Frequency	Reading	Duty cycle	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	dBuV	Factor	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	
7440	49.36	0.00	10.72	V	60.08	73.98	13.90	PK
7440	43.25	-15.38	10.72	V	38.59	53.98	15.39	AV

Note:

On time for one frame is 32 us/byte x 133 bytes = 4.256 ms

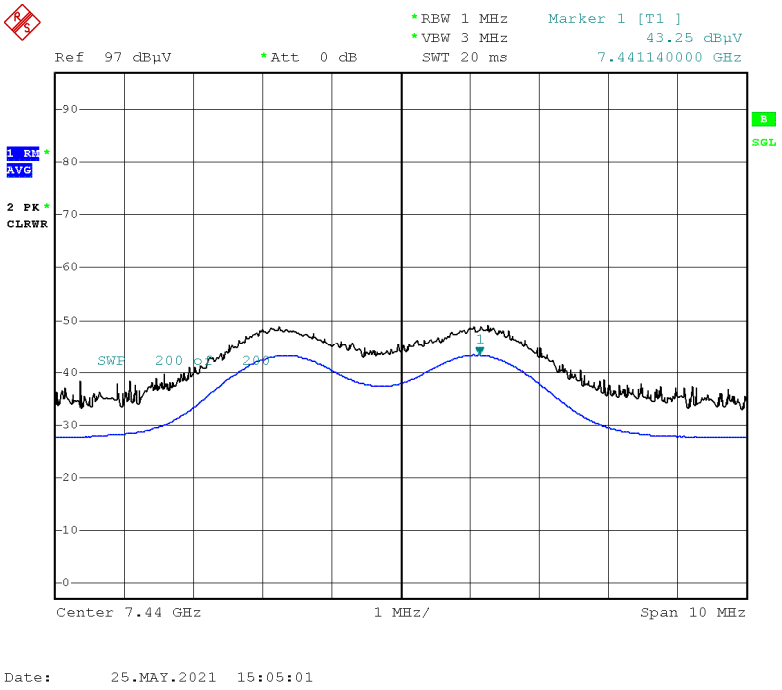
4 frames are transmitted for a total on time is 17.024 ms(4.256 ms x 4 frames)

DCCF = 20xlog(17.024 ms/100 ms) = -15.3788 dB

DCCF = -15.38 dB

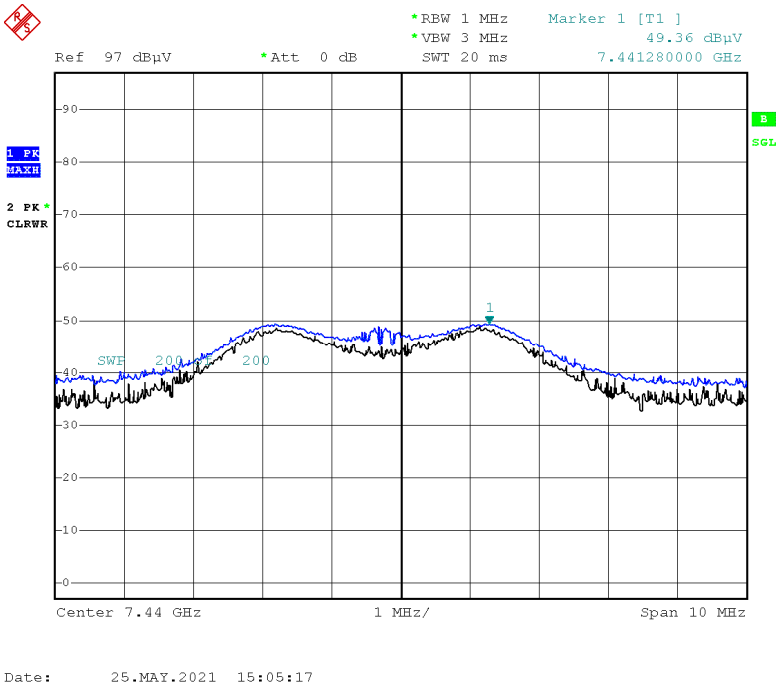
▣ Test Plots

Radiated Spurious Emissions plot – Average Reading (CH.26 3rd Harmonic)



Date: 25.MAY.2021 15:05:01

Radiated Spurious Emissions plot – Peak Reading (CH.26 3rd Harmonic)



Date: 25.MAY.2021 15:05:17

Note:

Plot of worst case are only reported.

9.7 RADIATED RESTRICTED BAND EDGES

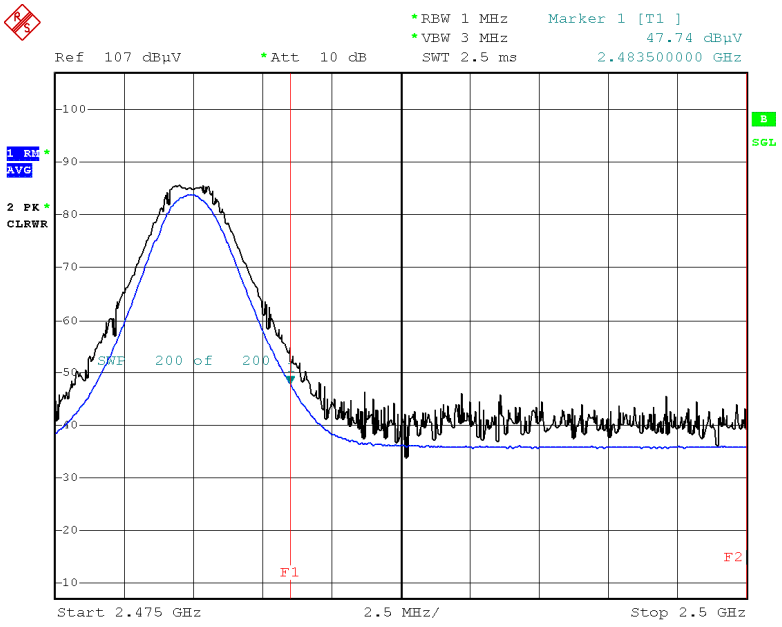
- **DC Type (Main)**

Operation Mode:	Zigbee
Operating Frequency	2405 MHz & 2480 MHz
Channel No.	11 Ch & 26 ch

Frequency	Reading	DCCF Factor	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	dBuV	[dB]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	
2390.0	48.42	0.94	H	49.36	73.98	24.62	PK	2390.0
2390.0	37.02	0.94	H	37.96	53.98	16.02	AV	2390.0
2390.0	48.27	0.94	V	49.21	73.98	24.77	PK	2390.0
2390.0	37.00	0.94	V	37.94	53.98	16.04	AV	2390.0
2483.5	54.75	1.20	H	55.95	73.98	18.03	PK	2483.5
2483.5	47.74	1.20	H	48.94	53.98	5.04	AV	2483.5
2483.5	54.09	1.20	V	55.29	73.98	18.69	PK	2483.5
2483.5	46.96	1.20	V	48.16	53.98	5.82	AV	2483.5

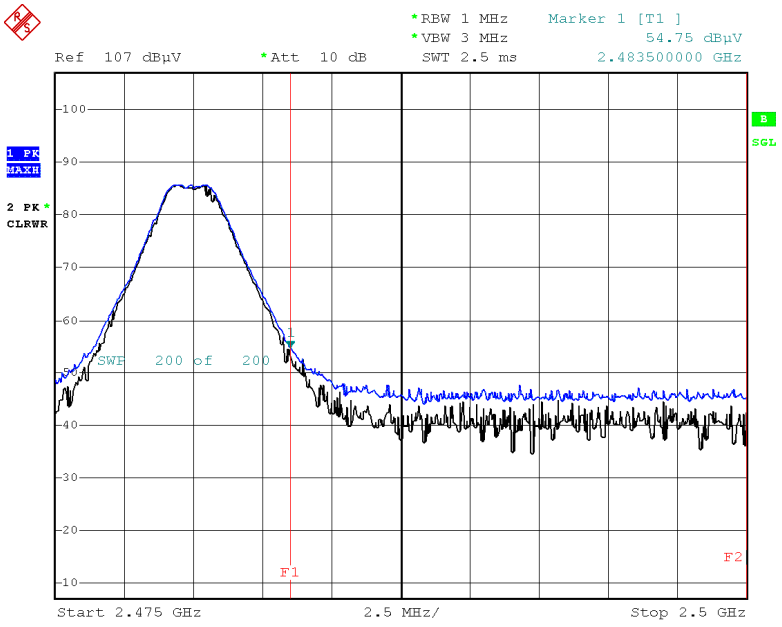
▣ Test Plots

Radiated Restricted Band Edges plot – Average Reading (CH.26: 2480 MHz)



Date: 24.MAY.2021 10:20:17

Radiated Restricted Band Edges plot – Peak Reading (CH.26: 2480 MHz)※



Date: 24.MAY.2021 10:20:27

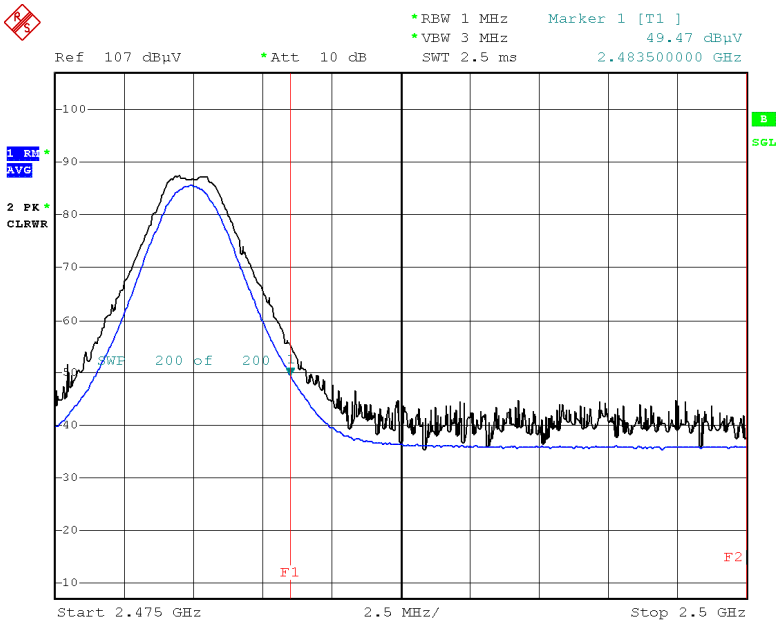
- **FX200(AC)**

Operation Mode:	Zigbee
Operating Frequency	2480 MHz
Channel No.	26 ch

Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	
2390.0	56.74	0.94	H	57.68	73.98	16.30	PK
2390.0	49.47	0.94	H	50.41	53.98	3.57	AV

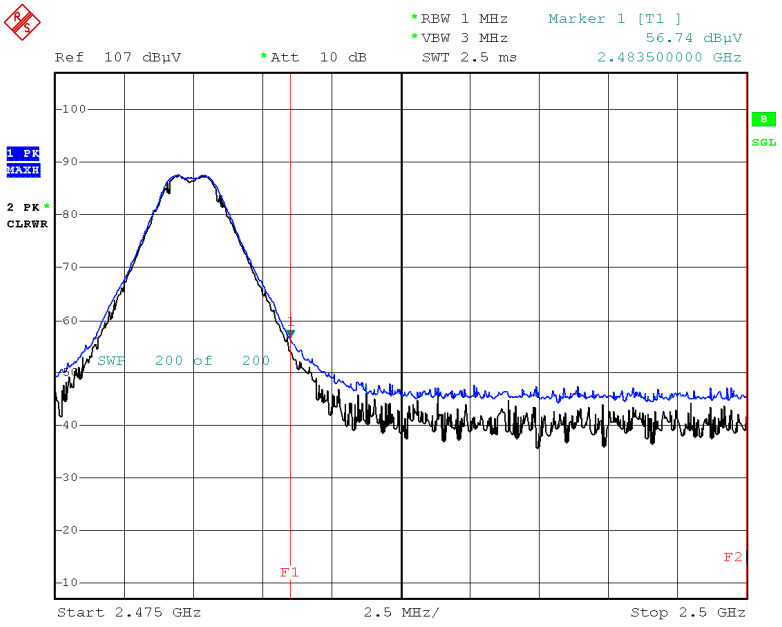
▣ Test Plots

Radiated Restricted Band Edges plot – Average Reading (CH.11: 2480 MHz)



Date: 25.MAY.2021 15:42:52

Radiated Restricted Band Edges plot – Peak Reading (CH.11: 2480 MHz)



Date: 25.MAY.2021 15:43:05

9.8 RECEIVER SPURIOUS EMISSIONS

Frequency Range : Below 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.

Frequency Range : Above 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

9.9 POWERLINE CONDUCTED EMISSIONS

Conducted Emissions (Line 1)_FX200(AC)

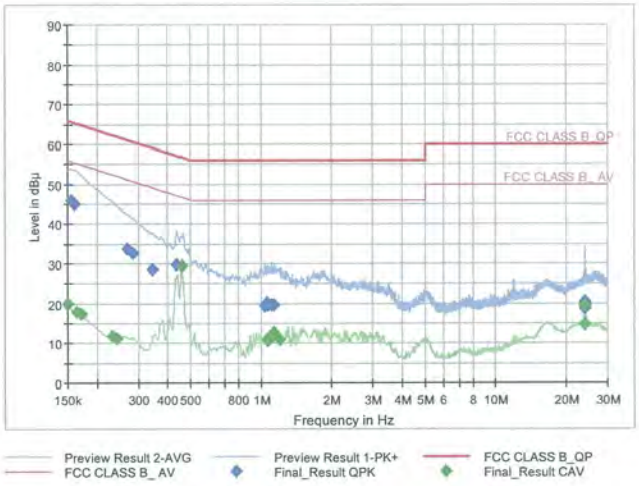
Test 1 / 2

Test Report

Common Information

EUT :	FX200
Manufacturer :	PASSTECH CO., LTD
Test Site:	SHIELD ROOM
Operating Conditions :	Zigbee_L1
Operator Name:	
Comment:	

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak	Limit (dBuV	Margin	Bandwidth	Line	Filter	Corr. (dB)
0.1545	45.90	65.75	19.85	9.000	L1	OFF	9.6
0.1613	45.06	65.40	20.34	9.000	L1	OFF	9.6
0.2693	33.85	61.14	27.29	9.000	L1	OFF	9.6
0.2850	32.72	60.67	27.95	9.000	L1	OFF	9.6
0.3458	28.67	59.06	30.39	9.000	L1	OFF	9.6
0.4380	29.84	57.10	27.26	9.000	L1	OFF	9.6
1.0378	19.36	56.00	36.64	9.000	L1	OFF	9.6
1.0490	19.50	56.00	36.50	9.000	L1	OFF	9.6
1.0670	20.29	56.00	35.71	9.000	L1	OFF	9.6
1.0738	19.71	56.00	36.29	9.000	L1	OFF	9.6
1.1075	19.57	56.00	36.43	9.000	L1	OFF	9.6
1.1368	19.58	56.00	36.42	9.000	L1	OFF	9.6
23.9878	20.60	60.00	39.40	9.000	L1	OFF	10.0
24.0013	19.05	60.00	40.95	9.000	L1	OFF	10.0
24.0080	19.63	60.00	40.37	9.000	L1	OFF	10.0
24.0125	19.80	60.00	40.20	9.000	L1	OFF	10.0
24.0305	18.98	60.00	41.02	9.000	L1	OFF	10.0
24.0485	18.80	60.00	41.20	9.000	L1	OFF	10.0

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Test 2 / 2

Final_Result_CAV

Frequency (MHz)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	19.90	56.00	36.10	9.000	L1	OFF	9.6
0.1635	17.76	55.28	37.52	9.000	L1	OFF	9.6
0.1725	17.34	54.84	37.50	9.000	L1	OFF	9.6
0.2333	11.82	52.33	40.51	9.000	L1	OFF	9.6
0.2445	11.33	51.94	40.61	9.000	L1	OFF	9.6
0.4605	29.34	46.68	17.34	9.000	L1	OFF	9.6
1.0670	10.96	46.00	35.04	9.000	L1	OFF	9.6
1.0760	10.72	46.00	35.28	9.000	L1	OFF	9.6
1.0963	11.74	46.00	34.26	9.000	L1	OFF	9.6
1.1030	11.55	46.00	34.45	9.000	L1	OFF	9.6
1.1368	12.64	46.00	33.36	9.000	L1	OFF	9.6
1.2065	10.84	46.00	35.16	9.000	L1	OFF	9.6
23.9833	19.18	50.00	30.82	9.000	L1	OFF	10.0
24.0058	14.73	50.00	35.27	9.000	L1	OFF	10.0
24.0215	19.19	50.00	30.81	9.000	L1	OFF	10.0
24.0373	14.67	50.00	35.33	9.000	L1	OFF	10.0
24.0418	14.57	50.00	35.43	9.000	L1	OFF	10.0
24.0598	19.23	50.00	30.77	9.000	L1	OFF	10.0

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Conducted Emissions (Line 2) _ FX200(AC)

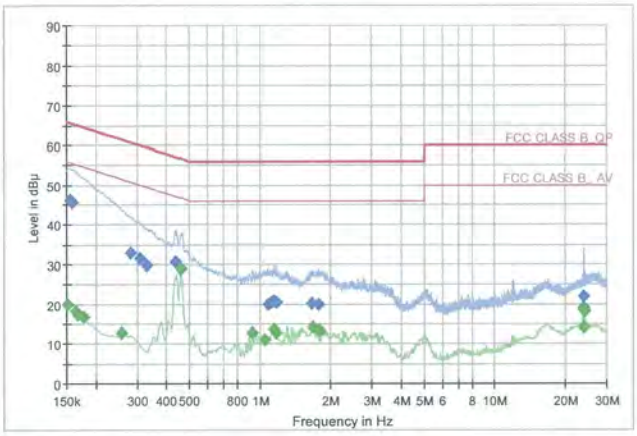
Test 1 / 2

Test Report

Common Information

EUT :	FX200
Manufacturer :	PASSTECH CO., LTD
Test Site:	SHIELD ROOM
Operating Conditions :	Zigbee_N
Operator Name:	
Comment:	

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak	Limit (dBuV	Margin	Bandwidth	Line	Filter	Corr. (dB)
0.1545	46.08	65.75	19.67	9.000	N	OFF	9.6
0.1590	45.50	65.52	20.02	9.000	N	OFF	9.6
0.2828	32.98	60.74	27.76	9.000	N	OFF	9.6
0.3075	31.48	60.04	28.56	9.000	N	OFF	9.6
0.3300	29.84	59.45	29.61	9.000	N	OFF	9.6
0.4380	30.53	57.10	26.57	9.000	N	OFF	9.6
1.0805	19.80	56.00	36.20	9.000	N	OFF	9.6
1.1188	20.38	56.00	35.62	9.000	N	OFF	9.6
1.1503	20.66	56.00	35.34	9.000	N	OFF	9.6
1.1750	20.41	56.00	35.59	9.000	N	OFF	9.6
1.6723	20.24	56.00	35.76	9.000	N	OFF	9.6
1.7803	19.84	56.00	36.16	9.000	N	OFF	9.6
23.9653	18.62	60.00	41.38	9.000	N	OFF	10.0
23.9743	18.63	60.00	41.37	9.000	N	OFF	10.0
23.9878	22.00	60.00	38.00	9.000	N	OFF	10.0
24.0103	19.18	60.00	40.82	9.000	N	OFF	10.0
24.0328	18.59	60.00	41.41	9.000	N	OFF	10.0
24.0463	18.45	60.00	41.55	9.000	N	OFF	10.0

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Test 2 / 2

Final_Result_CAV

Frequency (MHz)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1523	19.77	55.88	36.10	9.000	N	OFF	9.6
0.1635	18.03	55.28	37.25	9.000	N	OFF	9.6
0.1680	17.45	55.06	37.61	9.000	N	OFF	9.6
0.1770	16.60	54.63	38.02	9.000	N	OFF	9.6
0.2580	12.56	51.50	38.94	9.000	N	OFF	9.6
0.4605	28.99	46.68	17.70	9.000	N	OFF	9.6
0.9298	12.66	46.00	33.34	9.000	N	OFF	9.6
1.0445	10.85	46.00	35.15	9.000	N	OFF	9.6
1.1525	13.50	46.00	32.50	9.000	N	OFF	9.6
1.1773	12.60	46.00	33.40	9.000	N	OFF	9.6
1.6813	14.12	46.00	31.88	9.000	N	OFF	9.6
1.8050	13.18	46.00	32.82	9.000	N	OFF	9.6
23.9473	18.86	50.00	31.14	9.000	N	OFF	10.0
23.9608	14.16	50.00	35.84	9.000	N	OFF	10.0
23.9855	18.82	50.00	31.18	9.000	N	OFF	10.0
24.0238	18.77	50.00	31.23	9.000	N	OFF	10.0
24.0440	14.18	50.00	35.82	9.000	N	OFF	10.0
24.1003	18.27	50.00	31.73	9.000	N	OFF	10.0

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11. LIST OF TEST EQUIPMENT

Conducted Test

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216 / LISN	09/04/2020	Annual	102245
Rohde & Schwarz	ESCI / Test Receiver	06/05/2020	Annual	100033
ESPAC	SU-642 /Temperature Chamber	03/15/2021	Annual	0093008124
Agilent	N9020A / Signal Analyzer	04/16/2021	Annual	MY50210191
Agilent	N9030A / Signal Analyzer	01/11/2021	Annual	MY49431210
Agilent	N1911A / Power Meter	04/08/2021	Annual	MY45100523
Agilent	N1921A / Power Sensor	06/08/2020	Annual	MY57820067
Agilent	87300B / Directional Coupler	11/10/2020	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	05/25/2020	Annual	05001
Hewlett Packard	E3632A / DC Power Supply	06/12/2020	Annual	KR75303960
H+S	5910-N-50-010 / Attenuator(10 dB)	10/28/2020	Annual	00801
Rohde & Schwarz	EMC32 / Software	N/A	N/A	N/A
HCT CO., LTD.	FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	N/A	N/A
Rohde & Schwarz	CBT / Bluetooth Tester	05/04/2021	Annual	100422

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

Radiated Test

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Emco	2090 / Controller	N/A	N/A	060520
Ets	Turn Table	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	03/19/2020	Biennial	1513-333
Schwarzbeck	VULB 9160 / Hybrid Antenna	08/19/2020	Biennial	9160-3368
Schwarzbeck	VULB 9168 / Hybrid Antenna	09/04/2020	Biennial	9168-0895
Schwarzbeck	BBHA 9120D / Horn Antenna	11/18/2019	Biennial	9120D-1191
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	11/29/2019	Biennial	BBHA9170541
Rohde & Schwarz	FSP(9 kHz ~ 30 GHz) / Spectrum Analyzer	09/14/2020	Annual	836650/016
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/22/2020	Annual	101068-SZ
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	01/06/2021	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	02/08/2021	Annual	1
CERNEX WEINSCHEL	CBLU1183540B-01/Broadband Bench Top LNA 56-10 / Attenuator(10 dB)	12/23/2020	Annual	N/A
CERNEX Api tech.	CBL06185030 / Broadband Low Noise Amplifier 18B-03 / Attenuator (3 dB)	12/23/2020	Annual	N/A
Wainwright Instruments	WHKX10-2700-3000-18000-40SS / High Pass Filter	12/23/2020	Annual	N/A
Wainwright Instruments	WHKX8-6090-7000-18000-40SS / High Pass Filter	12/23/2020	Annual	N/A
T&M SYSTEM	COAXIAL ATTENUATOR / Thru	12/23/2020	Annual	N/A
CERNEX	CBL18265035 / Power Amplifier	12/04/2020	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	03/23/2021	Annual	25956
TESCOM	TC-3000C / Bluetooth Tester	03/09/2021	Annual	3000C000276

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
3. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5(Version : 2017).

12. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2105-FC043-P