TEST REPORT

The Radio Law, Article 2

Equipment under test	Foot Controller
Model name	WLF-1
Applicant	Dentium Co., Ltd.(ICT Branch)
Manufacturer	Dentium Co., Ltd.(ICT Branch)
Date of test(s)	2019.12.01 ~ 2020.01.07
Date of issue	2020.01.15

Issued to
Dentium Co., Ltd.(ICT Branch)
76, Changnyong-daero 256beon-gil,
Yeongtong-gu, Suwon-Si, Gyeonggi-Do, Korea
Tel: +82-70-7098-6932 / Fax: +82-31-8019-9131

Issued by
KES Co., Ltd.
3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,
Gyeonggi-do, 14057, Korea
473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450

Test and report completed by :	**Report approval by :**
	
Jang-yeon, Hwang Test engineer	Hyeon-Su, Jang Technical manager

Revision history

Revision	Date of issue	Test report No.	Description
-	2020.01.15	KES-RF-20T0012	Initial

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1. General information

Applicant:	Dentium Co., Ltd.(ICT Branch)
Applicant address:	76, Changnyong-daero 256beon-gil, Yeongtong-gu, Suwon-Si, Gyeonggi-Do, Korea
Test site:	KES Co., Ltd.
Test site address:	3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
J-MIC Radio law	Article 2

1.1. EUT description

Equipment under test	Foot Controller
Frequency range	2 405 ㎒ ~ 2 480 ㎒ (ZigBee)
Model:	WLF-1
Modulation technique	DSSS
Antenna specification	Antenna type : Chip antenna, Peak gain : 2.5 ㏈i
Power source	DC 3.0 V (Battery)
Number of channels	2 405 ㎒ ~ 2 480 ㎒ (ZigBee) : 16ch

1.2. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
-	-	-	-	-

1.3. Frequency/channel operations

Ch.	Frequency (㎒)
11	2405
.	.
.	.
19	2445
.	.
.	.
26	2480

Note.
This test report is prepared according to the requirements of ISO/IEC 17025.

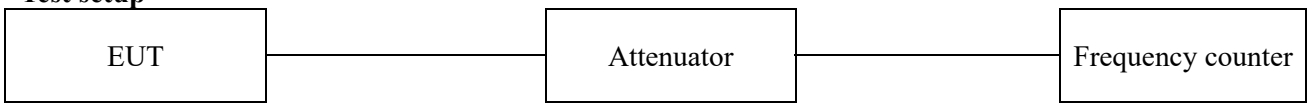
2. Summary of tests

Parameter	Test results
Frequency Tolerance	Pass
Occupied Bandwidth	Pass
RF Output Power	Pass
Transmitter Spurious Emission	Pass
Receiver Spurious Emission	Pass
Anti-Interference	Pass

3. Test results

3.1. Frequency tolerance

Test setup



Limit

Permission deviation ±50 x 10^{-6}

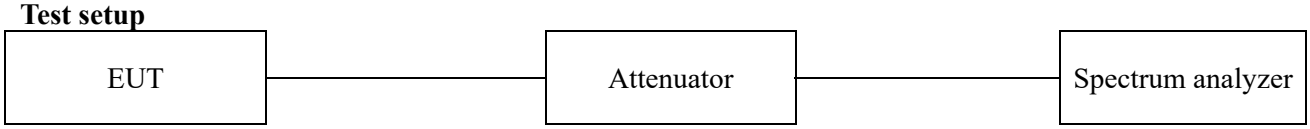
Test results

Mode: BLE

Test voltage (%)	Test voltage (V)	Frequency (㎒)	Measure frequency (㎒)	Frequency deviation (㎐)	Deviation (ppm)
90	DC 2.7	2 405	2 404.986 358	-13 642	-5.67
		2 445	2 444.986 052	-13 948	-5.70
		2 480	2 479.985 610	-14 390	-5.80
100	DC 3.0	2 405	2 404.986 490	-13 510	-5.62
		2 445	2 444.986 110	-13 890	-5.68
		2 480	2 479.985 532	-14 468	-5.83
110	DC 3.3	2 405	2 404.986 422	-13 578	-5.65
		2 445	2 444.986 166	-13 834	-5.66
		2 480	2 479.985 682	-14 318	-5.77

3.2. Occupied Bandwidth

Test setup



Limit

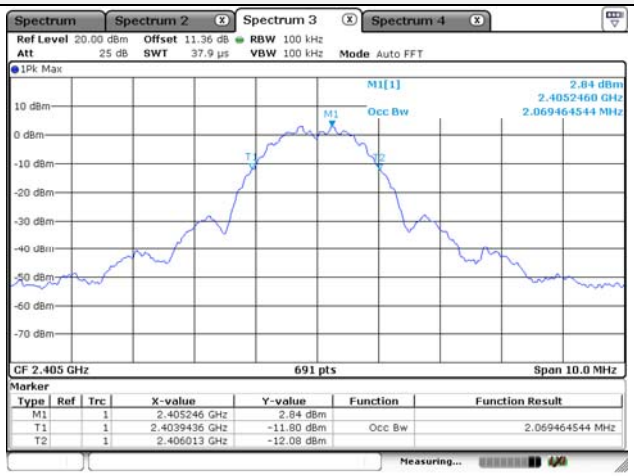
Equal or less than 26 ㎒(DSSS).

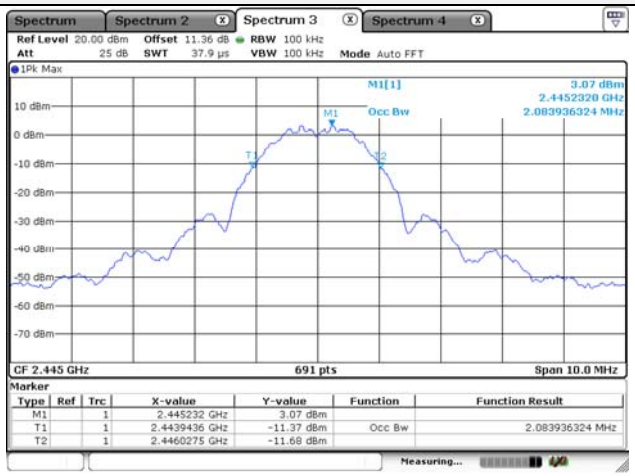
Test results

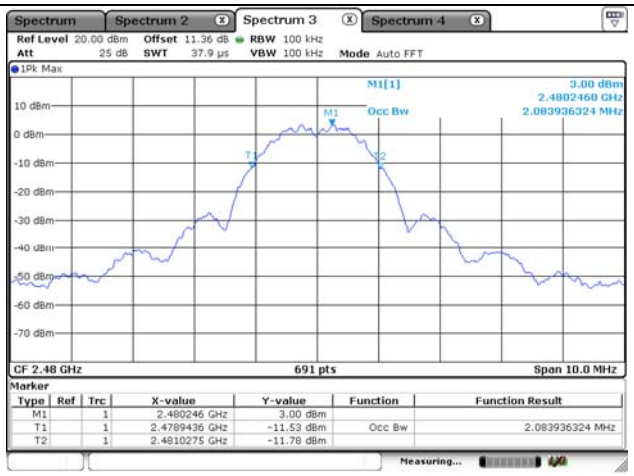
Test voltage (%)	Nominal Voltage(V)	Test mode	Occupied Bandwidth (㎒)		
			Frequency (2 405 ㎒)	Frequency (2 445 ㎒)	Frequency (2 480 ㎒)
90	DC 2.7	ZigBee	2.08	2.08	2.09
100	DC 3.0		2.07	2.08	2.08
110	DC 3.3		2.08	2.09	2.09

Test plots

ZigBee







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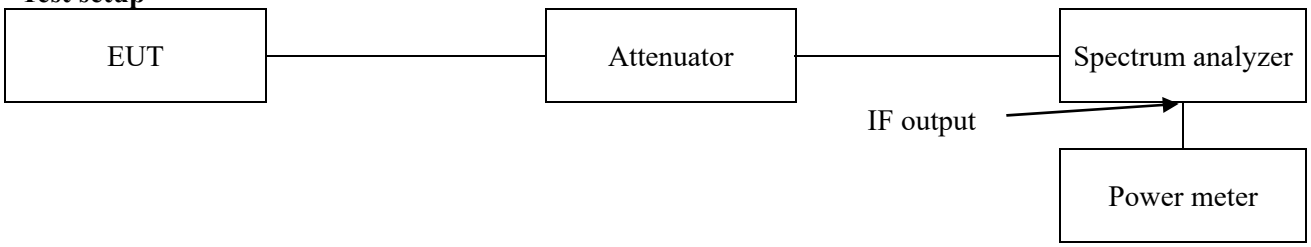
3.3. RF output power

Test setup



Limit

Rate power : 10.0 ㎽/㎒ (+20%, -80%)
Upper : 12.0 ㎽/㎒
Lower : 2.0 ㎽/㎒

Test results

Mode: BLE

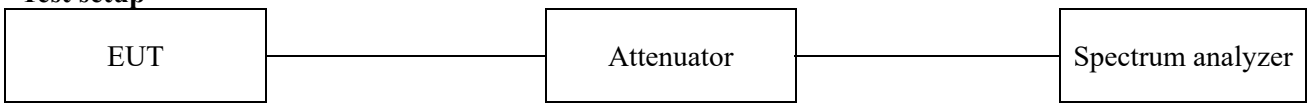
Test voltage (%)	Nominal Voltage (V)	Frequency (㎒)	Output power (dBm/㎒)	Output power (㎽/㎒)	E.I.R.P (dBm/㎒)	Deviation (%)
90	DC 2.7	2 405	4.00	2.51	6.50	-74.90
		2 445	4.41	2.76	6.91	-72.40
		2 480	4.59	2.88	7.09	-71.20
100	DC 3.0	2 405	4.00	2.51	6.50	-74.90
		2 445	4.42	2.77	6.92	-72.30
		2 480	4.58	2.87	7.08	-71.30
110	DC 3.3	2 405	4.01	2.52	6.51	-74.80
		2 445	4.44	2.78	6.94	-72.20
		2 480	4.58	2.87	7.08	-71.30

Note.

1. Output power is the result which the Burst Ratio is calculated.
2. E.I.R.P : Output power data + Ant. Max peak gain
3. Antenna gain : 2.5 ㏈i

3.4. Transmitter spurious emissions

Test setup



Limit

1. Less than 2387 ㎒ : Equal or less than 2.5㎼/㎒ (≒ -26 dBm)
2. 2387 ㎒ ~ 2400 ㎒ : Equal or less than 25㎼/㎒ (≒ -16 dBm)
3. 2483.5 ㎒ ~ 2496.5 ㎒ : Equal or less than 25㎼/㎒ (≒ -16 dBm)
4. More than 2496.5 ㎒ : Equal or less than 2.5㎼/㎒ (≒ -26 dBm)

Test results

Test item: Less than 2387 ㎒

Test voltage (%)	Nominal Voltage (V)	Mode	Frequency (㎒)	Measure frequency (㎒)	Level (dBm)
90	DC 2.7	ZigBee	2 405	1 924.30	-32.82
			2 445	1 955.30	-31.37
			2 480	1 982.80	-30.20
100	DC 3.0		2 405	1 924.30	-32.60
			2 445	1 955.30	-31.32
			2 480	1 982.80	-30.40
110	DC 3.3		2 405	1 924.30	-32.66
			2 445	1 955.30	-31.36
			2 480	1 982.80	-30.32

Test item: 2387 ㎒ ~ 2400 ㎒

Test voltage (%)	Nominal Voltage (V)	Mode	Frequency (㎒)	Measure frequency (㎒)	Level (dBm)
90	DC 2.7	ZigBee	2 405	2 399.99	-45.83
			2 445	2 396.28	-50.12
			2 480	2 399.48	-50.42
100	DC 3.0		2 405	2 399.97	-46.05
			2 445	2 396.55	-50.77
			2 480	2 396.19	-50.80
110	DC 3.3		2 405	2 399.95	-46.16
			2 445	2 397.39	-50.38
			2 480	2 391.92	-50.73

Test item: 2483.5 ㎒ ~ 2496.5 ㎒

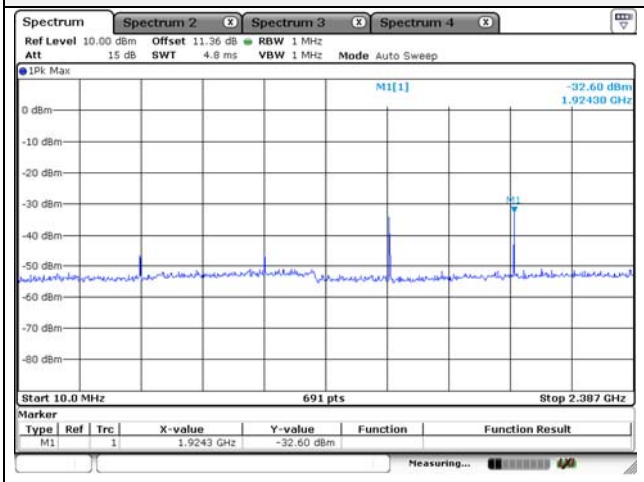
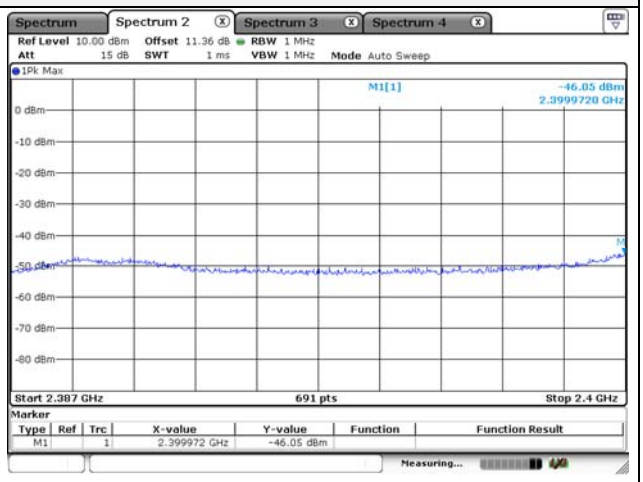
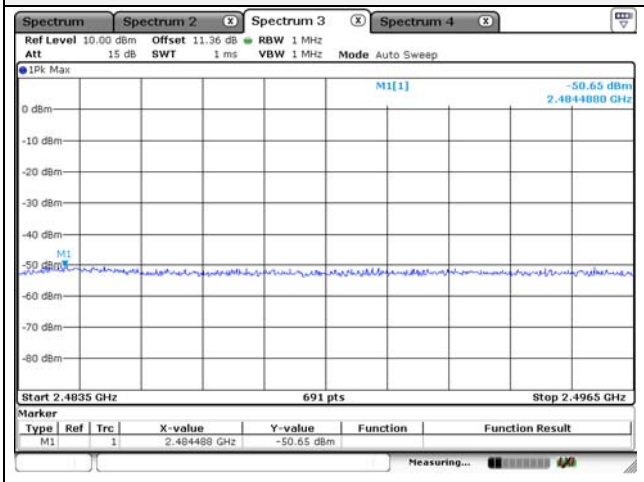
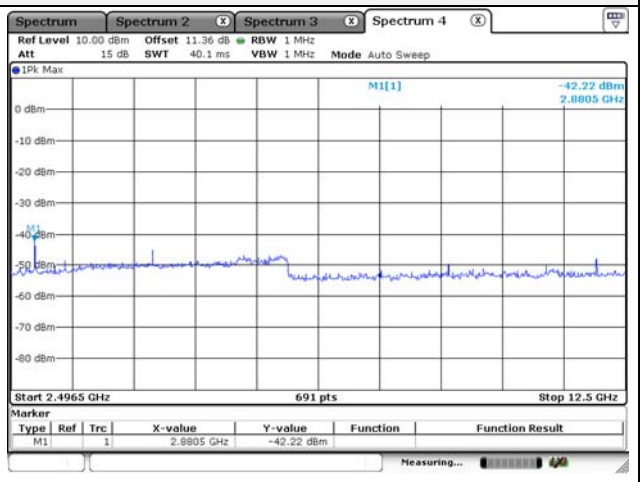
Test voltage (%)	Nominal Voltage (V)	Mode	Frequency (㎒)	Measure frequency (㎒)	Level (dBm)
90	DC 2.7	ZigBee	2 405	2 484.32	-50.41
			2 445	2 493.33	-49.95
			2 480	2 483.51	-37.28
100	DC 3.0		2 405	2 484.49	-50.65
			2 445	2 492.39	-49.91
			2 480	2 483.51	-37.10
110	DC 3.3		2 405	2 485.22	-50.76
			2 445	2 486.24	-49.99
			2 480	2 483.59	-37.47

Test item: More than 2496.5 ㎒

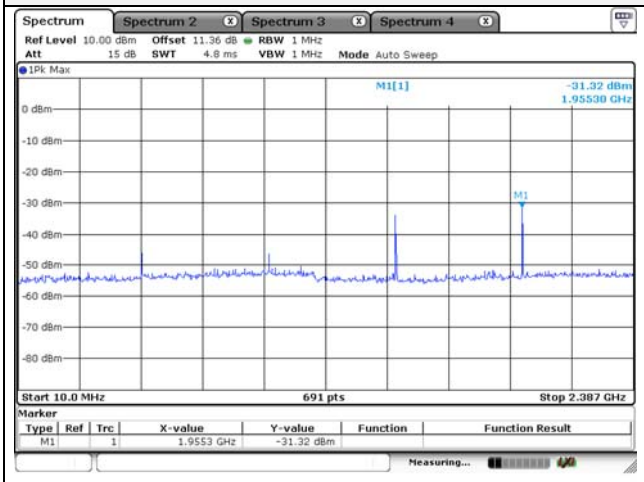
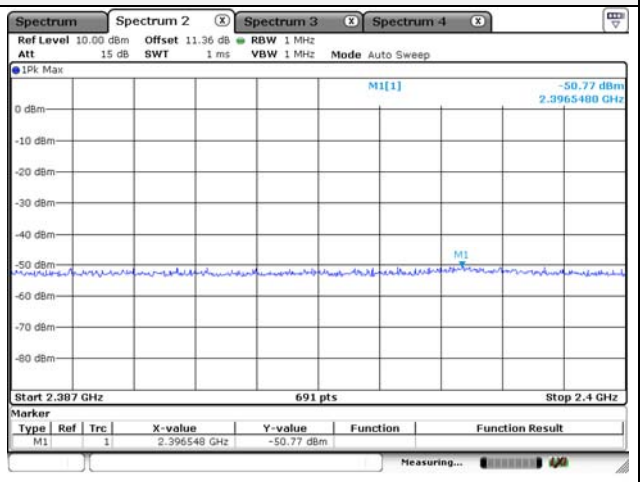
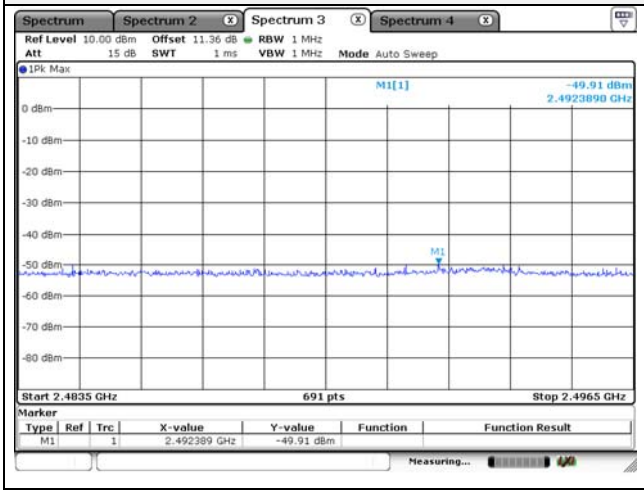
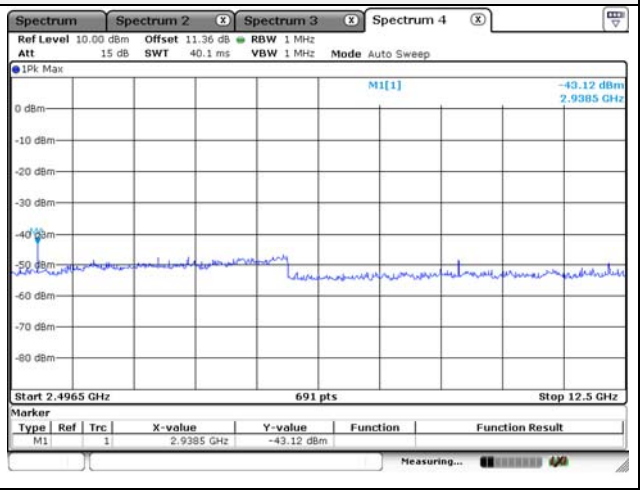
Test voltage (%)	Nominal Voltage (V)	Mode	Frequency (㎒)	Measure frequency (㎒)	Level (dBm)
90	DC 2.7	ZigBee	2 405	2 880.50	-41.72
			2 445	2 938.50	-43.46
			2 480	2 981.50	-44.89
100	DC 3.0		2 405	2 880.50	-42.22
			2 445	2 938.50	-43.12
			2 480	2 981.50	-44.81
110	DC 3.3		2 405	2 880.50	-41.53
			2 445	2 938.50	-43.76
			2 480	2 981.50	-45.11

Test plots

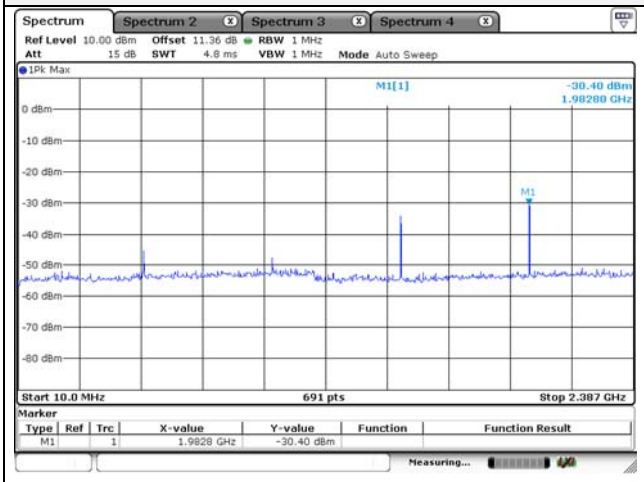
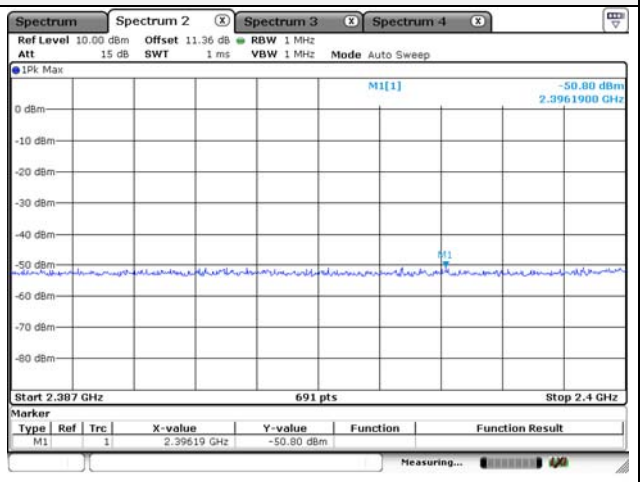
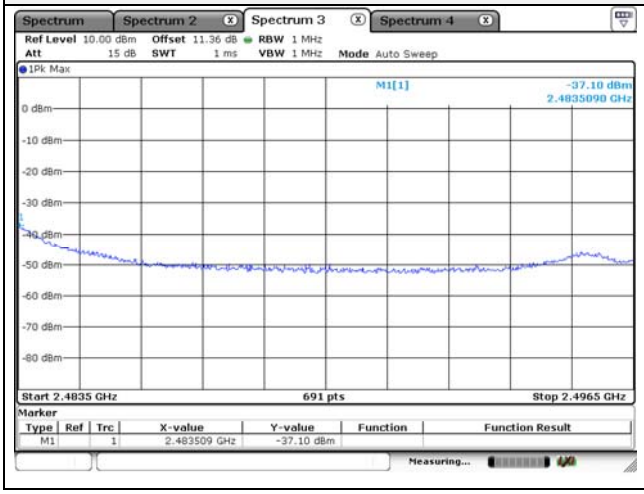
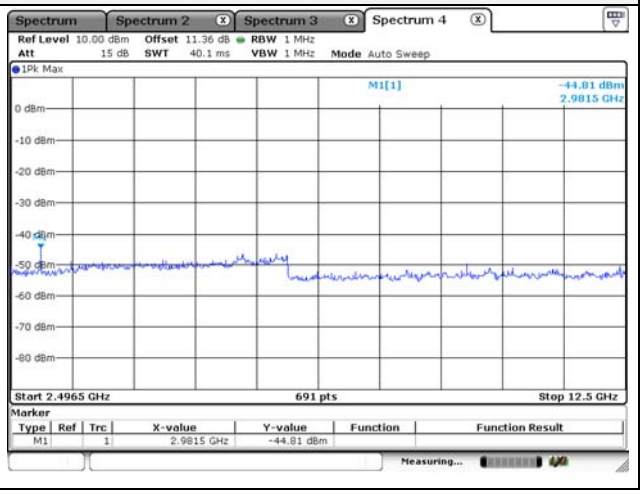
Mode: ZigBee – F1

Less than 2387 MHz	2387 MHz ~ 2400 MHz
	
2483.5 MHz ~ 2496.5 MHz	**More than 2496.5 MHz**
	

Mode: ZigBee – F2

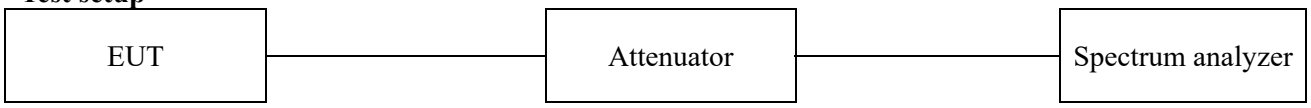
Less than 2387 MHz	2387 MHz ~ 2400 MHz
	
2483.5 MHz ~ 2496.5 MHz	**More than 2496.5 MHz**
	

Mode: ZigBee – F3

Less than 2387 MHz	2387 MHz ~ 2400 MHz
	
2483.5 MHz ~ 2496.5 MHz	**More than 2496.5 MHz**
	

3.5. Receiver spurious emissions

Test setup



Limit

1. Less than 1㎓ : Equal or less than 4 ㎼(≒ -53.98 ㏈m)
2. 1㎓ ~ less than 12.75 ㎓ : Equal or less than 20 ㎼(≒ -46.99 ㏈m)

Test results

Test item: Less than ~ 1 ㎓

Test voltage (%)	Nominal Voltage (V)	Mode	Frequency (㎒)	Measure frequency (㎒)	Level (dBm)
90	DC 2.7	ZigBee	2 405	576.60	-74.72
			2 445	576.60	-74.14
			2 480	576.60	-70.22
100	DC 3.0		2 405	576.60	-74.45
			2 445	576.60	-74.12
			2 480	576.60	-70.01
110	DC 3.3		2 405	576.60	-74.37
			2 445	576.60	-74.23
			2 480	576.60	-70.13

Test item: 1 ㎓ ~ less than 12.75 ㎓

Test voltage (%)	Nominal Voltage (V)	Mode	Frequency (㎒)	Measure frequency (㎒)	Level (dBm)
90	DC 2.7	ZigBee	2 405	6 790.00	-68.40
			2 445	6 841.00	-68.78
			2 480	6 960.00	-68.59
100	DC 3.0		2 405	6 246.00	-68.76
			2 445	6 824.00	-68.91
			2 480	6 909.00	-68.52
110	DC 3.3		2 405	6 858.00	-68.67
			2 445	6 858.00	-68.45
			2 480	6 892.00	-67.79

3.6. Anti-interference function

Test setup

Limit

The identification code shall be 48 bits long.

Test results

Test voltage (%)	Nominal Voltage (V)	Mode	Identification code	Verdict
100	DC 3.0	ZigBee	00155100000C7A70	Pass

Appendix A. Measurement equipment

Equipment 24-2 paragraph4「ハ」	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV40	101002	1 year	2020.06.24
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2020.01.15
Power Meter	Anritsu	ML2495A	1438001	1 year	2020.01.15
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2020.01.15
Attenuator	KEYSIGHT	8493C	82506	1 year	2020.01.15
DC Power Supply	Agilent	6632B	MY43004114	1 year	2020.06.24
Frequency Counter	HP	5352B	3049A01336	1 year	2020.01.15

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook computer	LG Electronics Inc.,	15ND530-GX50K	311QCFT567147

The end of test report.