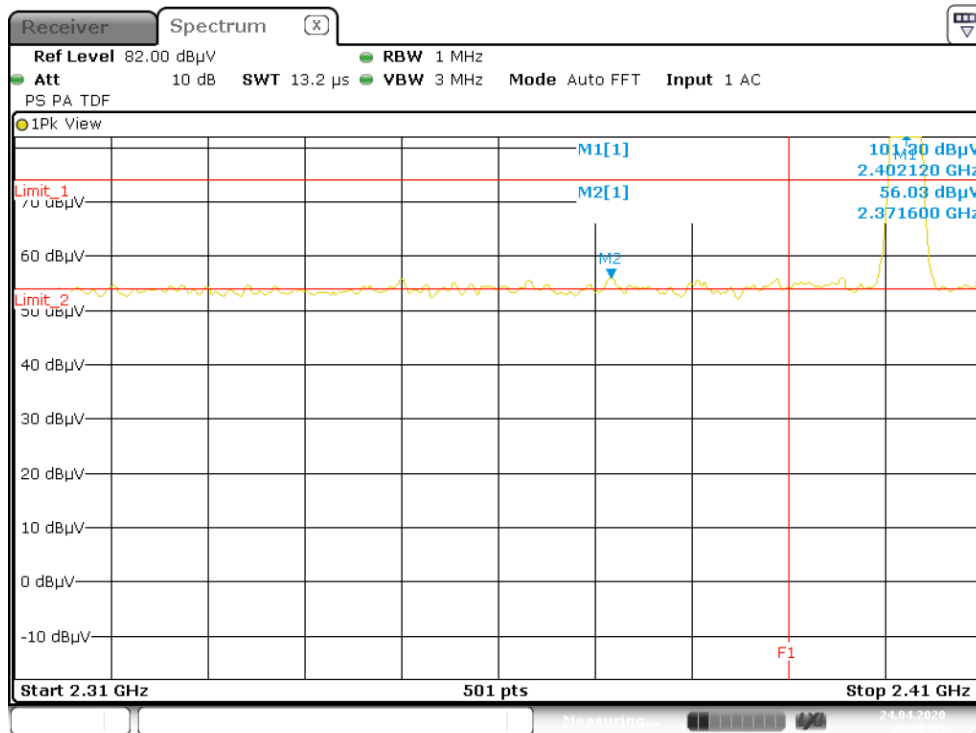
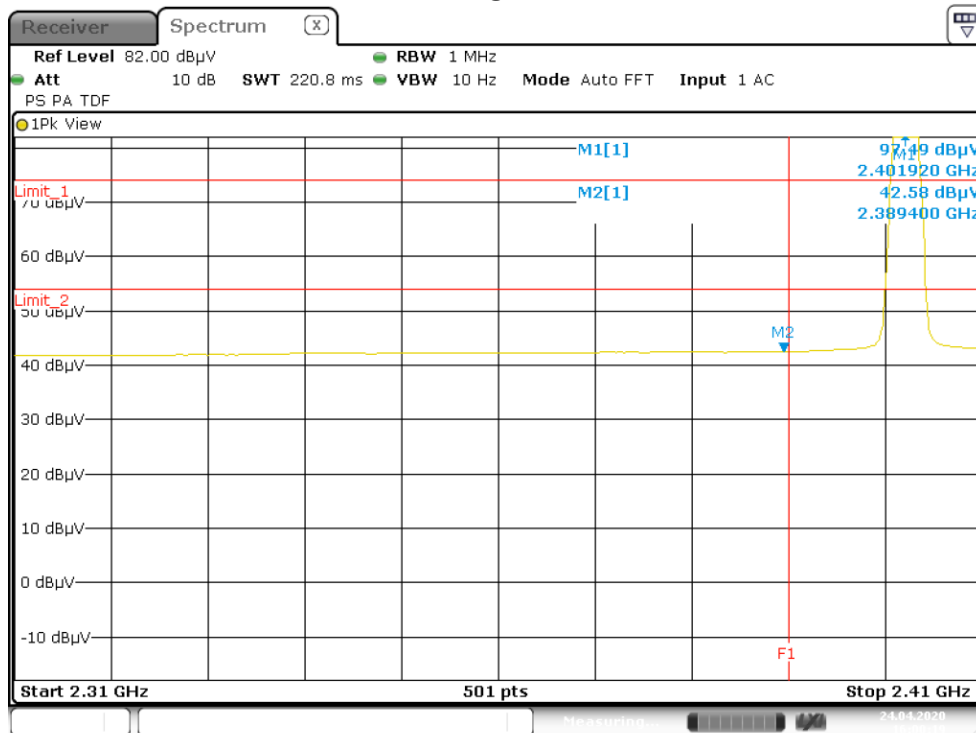


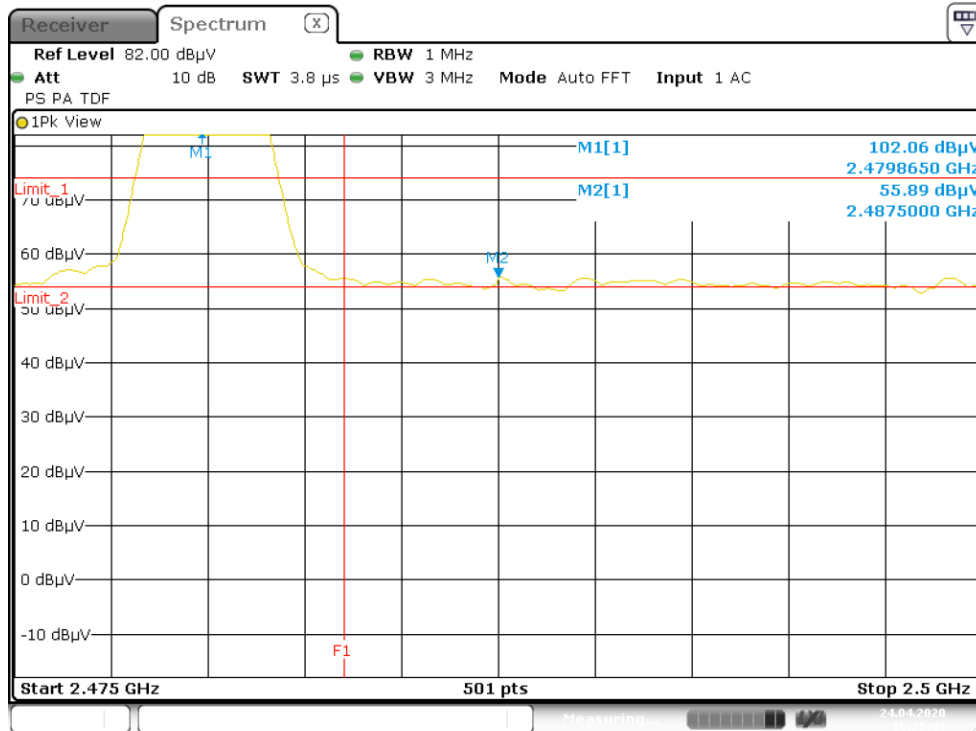
Restricted Band Bandedge @ 2DH5 Mode Ch0 PK



Restricted Band Bandedge @ 2DH5 Mode Ch0 AV

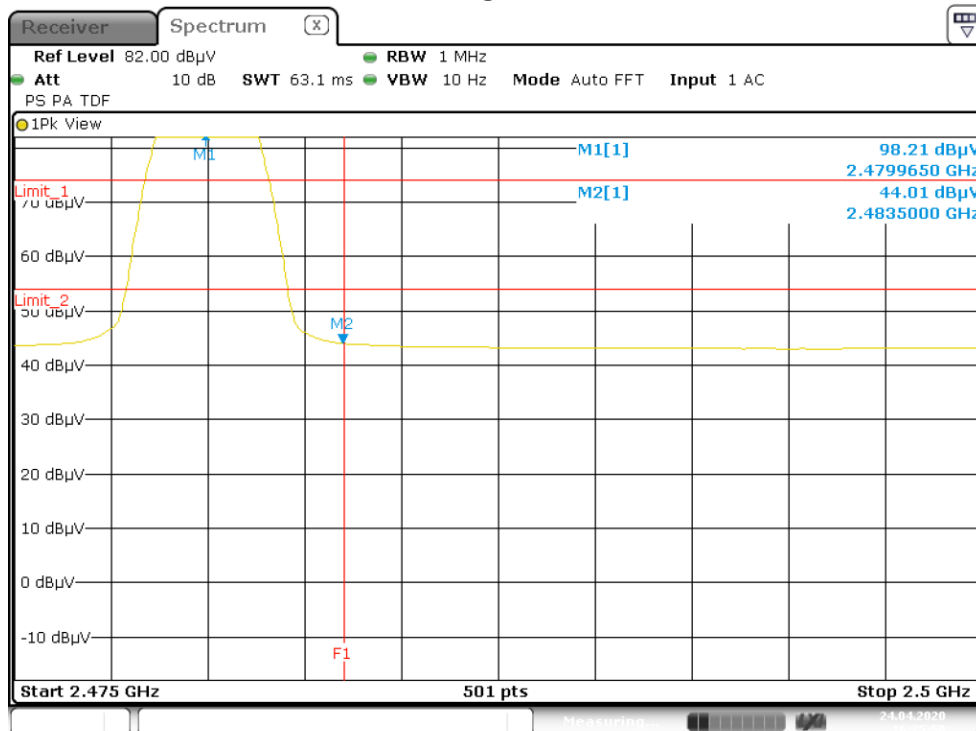


Restricted Band Bandedge @ 2DH5 Mode Ch78 PK



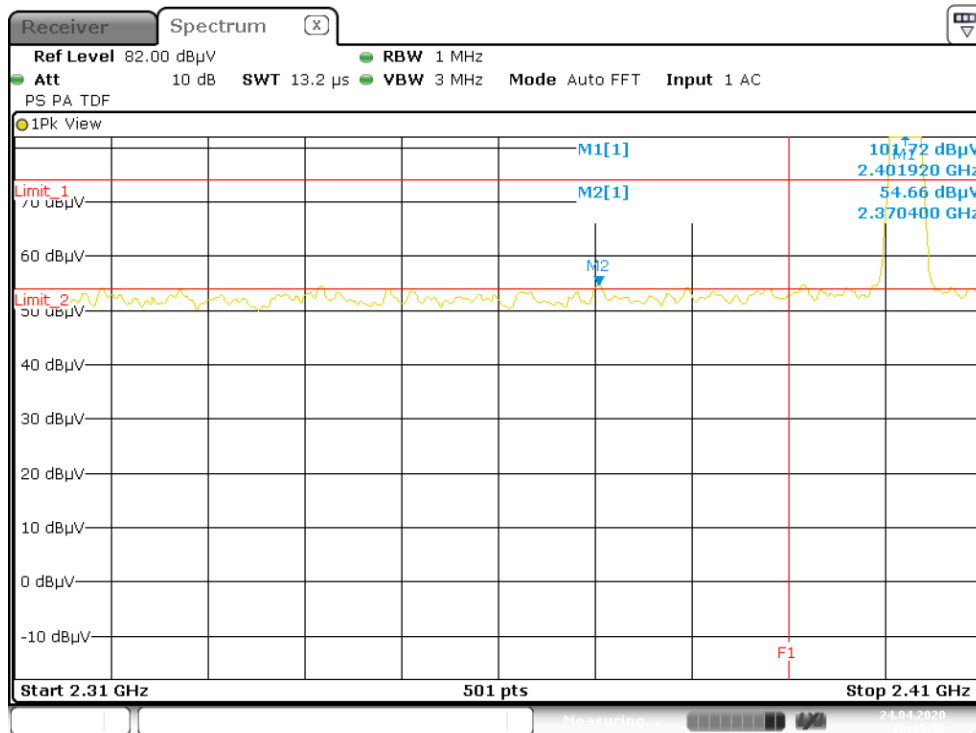
Date: 24.APR.2020 16:25:41

Restricted Band Bandedge @ 2DH5 Mode Ch78 AV

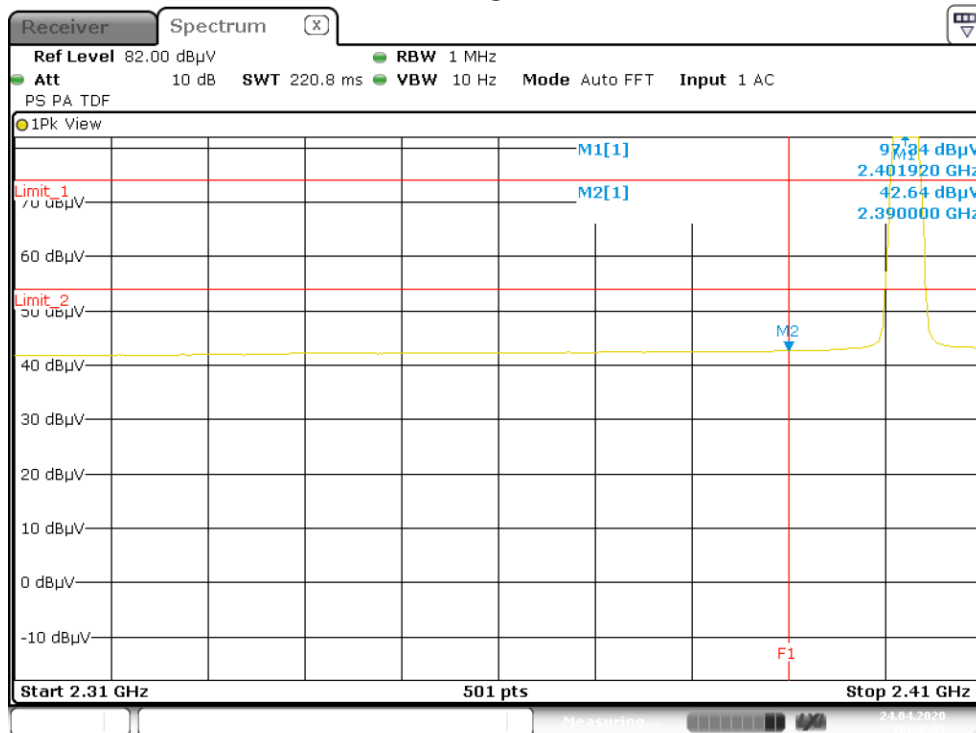


Date: 24.APR.2020 16:25:50

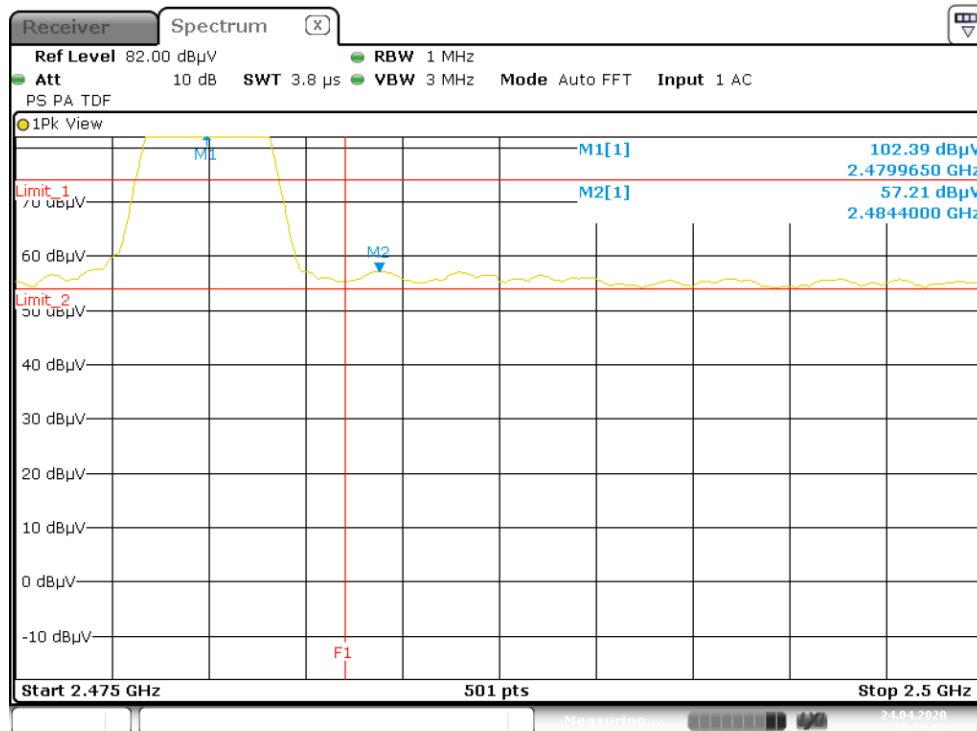
Restricted Band Bandedge @ 3DH5 Mode Ch0 PK



Restricted Band Bandedge @ 3DH5 Mode Ch0 AV

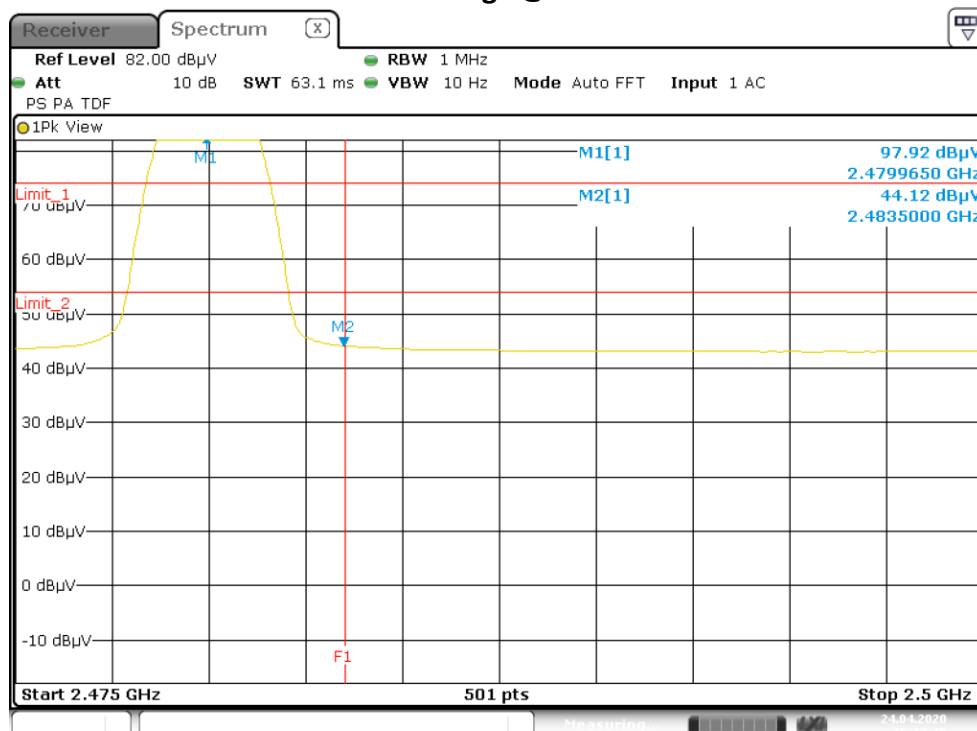


Restricted Band Bandedge @ 3DH5 Mode Ch78 PK



Date: 24.APR.2020 16:17:03

Restricted Band Bandedge @ 3DH5 Mode Ch78 AV



Date: 24.APR.2020 16:17:10

第四部份 BLE 測試項目：LP0002 3.10.1

20.佔用頻寬

20.1 適用規範

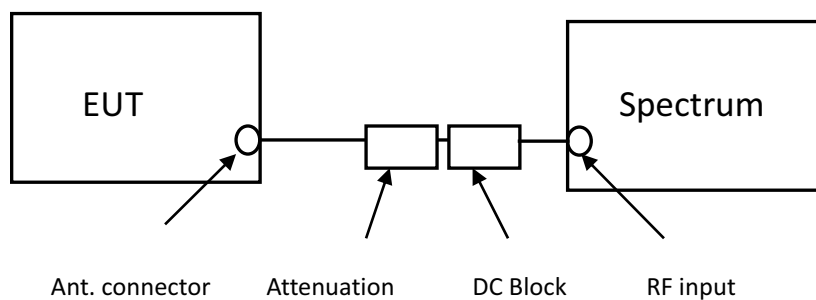
依據國家通訊傳播委員會低功率射頻電機技術規範第 3.10.1.6(2)(A)節之規定，6 dB

頻寬至少應有 500 kHz。

20.2 測試方法

此為 RF 傳導測試，將發射機之天線埠經由適當之衰減直接連接至測試儀器。

20.3 測試配置圖



20.4 測試結果

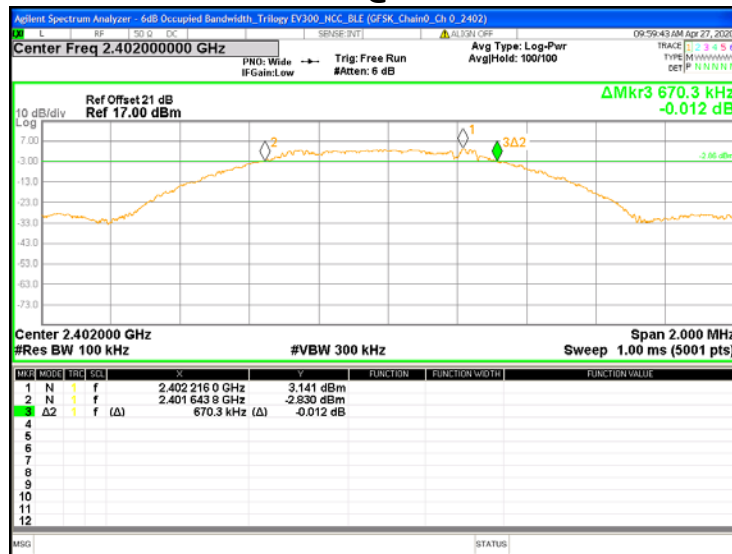
溫度 : 20 °C

相對濕度 : 60 %

Single TX

Mode	Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
BLE	0	2402	0.670	>0.5	Pass
	19	2440	0.684	>0.5	Pass
	39	2480	0.675	>0.5	Pass

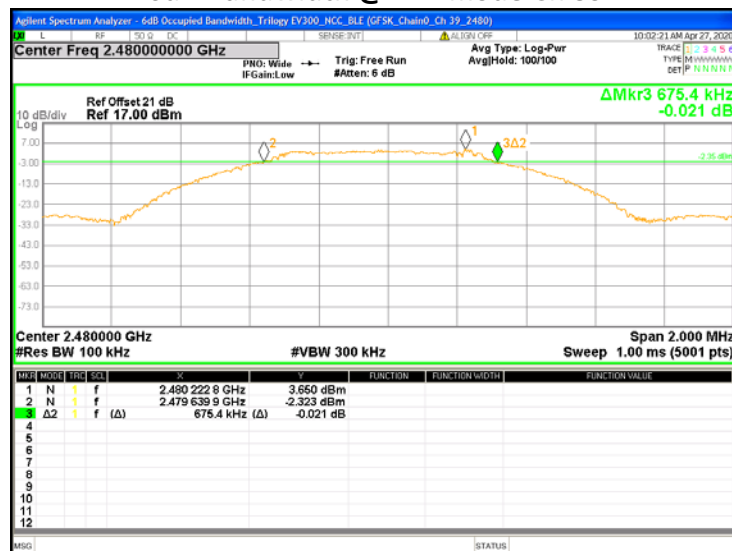
6dB Bandwidth @ BLE mode Ch 0



6dB Bandwidth @ BLE mode Ch 19



6dB Bandwidth @ BLE mode Ch 39



21. 峰值輸出功率

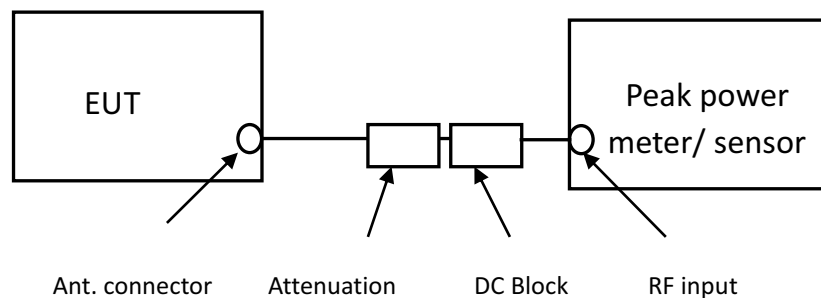
21.1 適用規範

依據國家通訊傳播委員會低功率射頻電機技術規範 3.10.1.2(1)(C)節之規定，對使用數位調變技術之低功率發射機，其峰值輸出功率不得大於 1 Watt。

21.2 測試方法

此為 RF 傳導測試，將發射機之天線埠經由適當之衰減直接連接至測試儀器。

21.3 測試配置圖



21.4 測試結果

溫度 : 20 °C

相對濕度 : 60 %

Single Tx

Mode	Channel	Frequency (MHz)	Output Power (AV) (dBm)	Total Power (AV) (mW)	Maximum power (PK) (dBm)	Maximum power (PK) (mW)	Limit (dBm)	Margin (dB)
BLE	0	2402	4.44	2.78	5.06	3.21	30	-24.94
	19	2440	4.71	2.96	5.24	3.34	30	-24.76
	39	2480	4.90	3.09	5.39	3.46	30	-24.61

22. 輻射場強干擾測試

22.1 適用規範

依據國家通訊傳播委員會低功率射頻電機技術規範之 3.10.1.5 節之要求，其他超

出頻帶外之輻射，應符合 2.8 節之一般限制要求：

頻率 (MHz)	電場強度 (微伏/公尺)	測距 (公尺)
0.009-0.490 (含)	2,400/頻率(千赫)	300
0.490 (不含)-1.705 (含)	24,000/頻率(千赫)	30
1.705 (不含)-30 (不含)	30	30
30 (含)-88 (含)	100	3
88 (不含)-216 (含)	150	3
216 (不含)-960 (含)	200	3
Above 960	500	3

備註：

1. 在交界頻率處，以數值較小者為標準。
2. 測距是指待測物最靠近天線的點到天線的距離。

22.2 測試方法

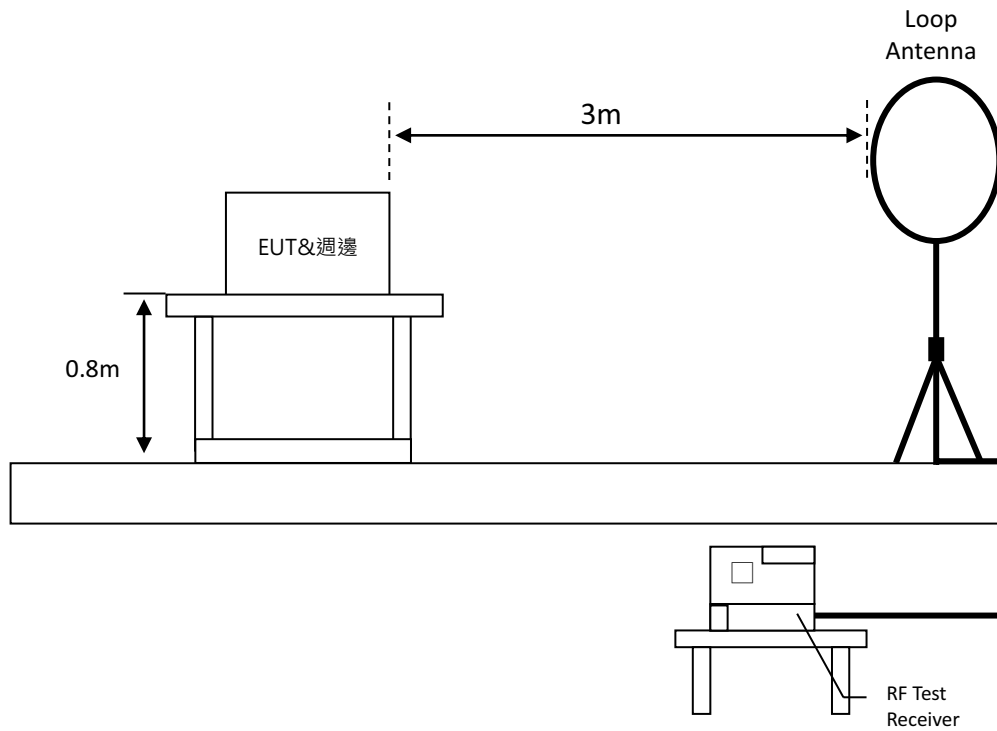
如待測物須與週邊同時操作，則待測物須與週邊同時量測。在量測時，所有之連接線皆須擺設在最大的輻射場強下。待測物放在一個距離地面 0.8 公尺、可 360° 旋轉的旋轉木桌上，待測物距離天線 3 米，天線可在距離地面 1~4 米之間升降，利用天線升降和桌子旋轉，找出待測物最大輻射場強，天線水平和垂直極化都須測量。

輻射場強量測是在 3 公尺測試距離下執行，除非輻射場強之強度太低以致於無法在此一距離下量測。至於待測物之輻射場強強度低於儀器本身背景雜訊(Noise floor)之情況，則使用一放大器(Pre-amplifier)或將測試距離拉近，而後將所有之讀值反推至 3 米之量測值。

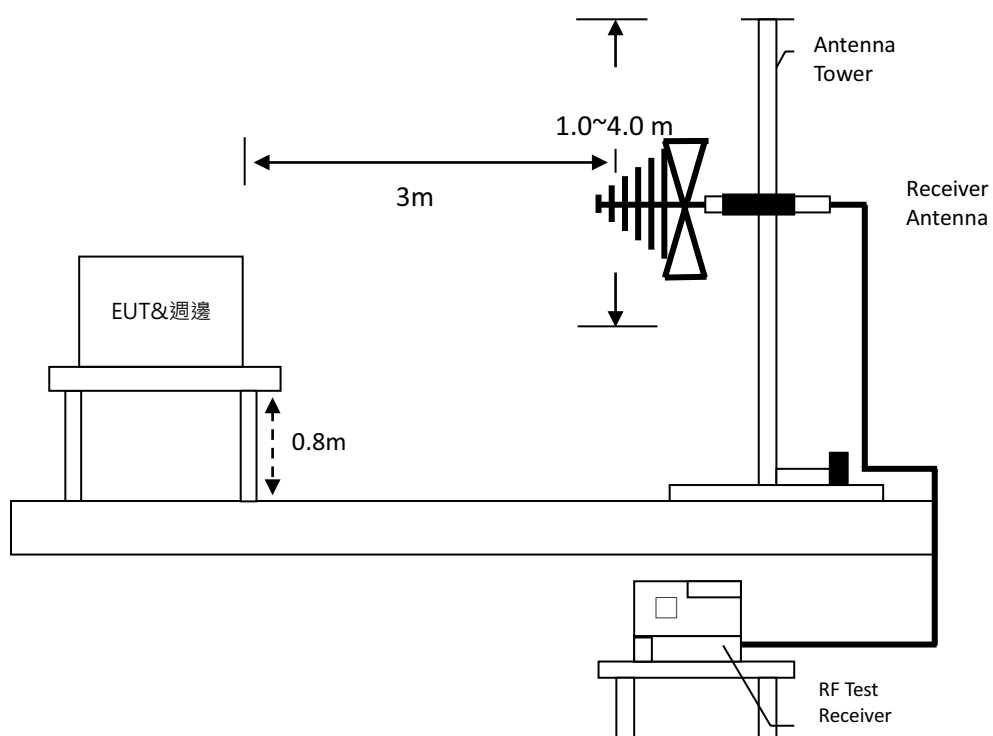
執行 30 MHz-1 GHz 的測試時使用 Bilog 天線，執行 1 GHz 以上的測試時則使用 Horn 天線，9kHz-30MHz 的測試使用 Loop 天線。

22.3 測試配置圖

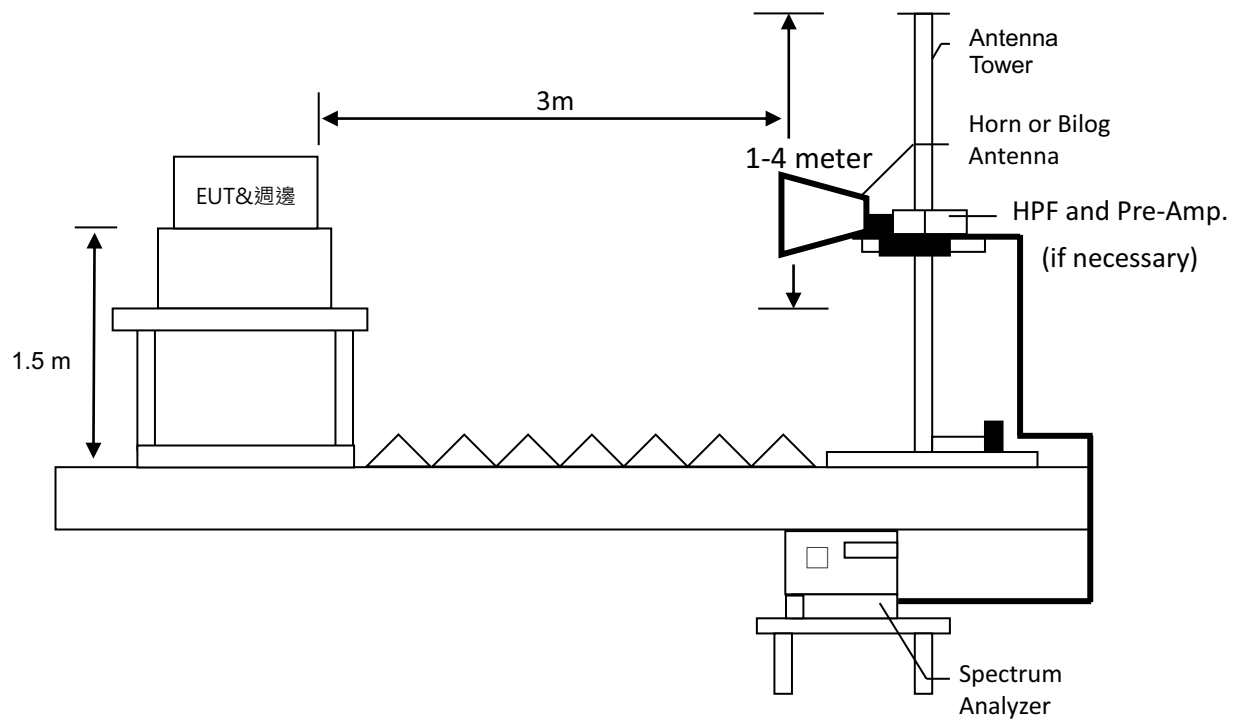
頻率範圍 9kHz - 30MHz



頻率範圍 30MHz - 1GHz



頻率範圍大於 1GHz



22.4 測試結果

22.4.1 頻率低於 1GHz

溫度 : 26 °C

相對濕度 : 54 %

9kHz-30MHz

待測物在 Channel 0, 19, 39 之測試模式下執行測試，經本實驗室證實，待測物在 Channel 19 為 EMI 最差之模式，故將其最差之讀值記錄於報告中。

測試項目 : 混附發射

Frequency (MHz)	Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
0.37	AV	18.46	27.56	46.02	96.24	-50.22
1.15	QP	18.87	25.03	43.90	66.39	-22.49
1.75	QP	18.90	16.52	35.43	69.54	-34.11
3.73	QP	19.14	11.96	31.10	69.54	-38.44
6.49	QP	19.51	11.34	30.86	69.54	-38.68
19.98	QP	21.37	10.54	31.91	69.54	-37.63

Remark: Corr. Factor = Antenna Factor + Cable Loss

30 MHz to 1 GHz

待測物在 Channel 0, 19, 39 之測試模式下執行測試，經本實驗室證實，待測物在 Channel 19 為 EMI 最差之模式，故將其最差之讀值記錄於報告中。

測試項目：混附發射

Ant. Pol. (H/V)	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Vertical	491.72	QP	26.22	9.85	36.07	46.00	-9.93
Vertical	503.36	QP	26.40	10.02	36.42	46.00	-9.58
Vertical	516.94	QP	26.66	9.74	36.40	46.00	-9.60
Vertical	530.52	QP	26.92	8.49	35.41	46.00	-10.59
Vertical	542.16	QP	27.14	7.66	34.80	46.00	-11.20
Vertical	774.96	QP	31.14	4.25	35.40	46.00	-10.60

Ant. Pol. (H/V)	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Horizontal	251.16	QP	20.62	11.15	31.76	46.00	-14.24
Horizontal	336.52	QP	22.60	11.68	34.28	46.00	-11.72
Horizontal	359.80	QP	23.18	11.40	34.59	46.00	-11.41
Horizontal	375.32	QP	23.59	9.48	33.07	46.00	-12.93
Horizontal	408.30	QP	24.46	7.45	31.90	46.00	-14.10
Horizontal	596.48	QP	28.54	5.80	34.33	46.00	-11.67

Remark: Corr. Factor = Antenna Factor + Cable Loss

22.4.2 頻率大於 1GHz

溫度 : 21 °C

相對濕度 : 62 %

測試項目 : 混附發射

Mode	Frequency	Spectrum	Ant.	Correction	Reading	Corrected	Limit	Margin
		Analyzer	Pol.	Factor		Reading	@ 3 m	
	(MHz)	Detector	(H/V)	(dB/m)	(dBμV)	(dBμV/m)	(dBμV/m)	(dB)
BLE_CH0	3585	PK	V	1.80	50.64	52.44	74	-21.56
	4804	PK	V	7.34	40.66	48.00	74	-26.00
	3585	PK	H	1.80	44.05	45.85	74	-28.15
	4804	PK	H	7.34	41.05	48.39	74	-25.61
BLE_CH19	3585	PK	V	1.80	49.23	51.02	74	-22.98
	4800	PK	V	7.33	39.24	46.58	74	-27.42
	4880	PK	V	7.54	36.11	43.65	74	-30.35
	3585	PK	H	1.80	45.79	47.59	74	-26.41
	4880	PK	H	7.54	35.59	43.13	74	-30.87
BLE_CH39	3585	PK	V	1.80	48.96	50.76	74	-23.24
	4785	PK	V	7.30	39.19	46.48	74	-27.52
	4960	PK	V	7.75	33.75	41.50	74	-32.50
	3585	PK	H	1.80	45.79	47.58	74	-26.42
	4785	PK	H	7.30	36.65	43.95	74	-30.05
	4960	PK	H	7.75	36.11	43.86	74	-30.14

Remark: Correction Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Pre_Amplifier Gain

23. 傳導雜訊干擾測試

23.1 適用規範

依據國家通訊傳播委員會低功率射頻電機技術規範 3.10.1.5 之規定，使用頻帶範圍外之任意 100 kHz 內，發射器所產生的射頻功率相較於頻帶範圍中包含最高所需功率之 100 kHz 內的射頻功率，需衰減 20 分貝(dB)。

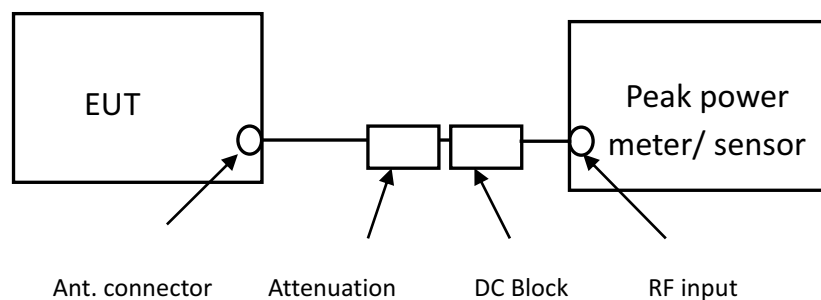
23.2 測試方法

將發射機之天線埠經由適當之衰減直接連至測試儀器。

量測範圍為：30 MHz ~ 25 GHz。

設定解析頻寬為 100 kHz，視訊頻寬大於等於解析頻寬。

23.3 測試配置圖



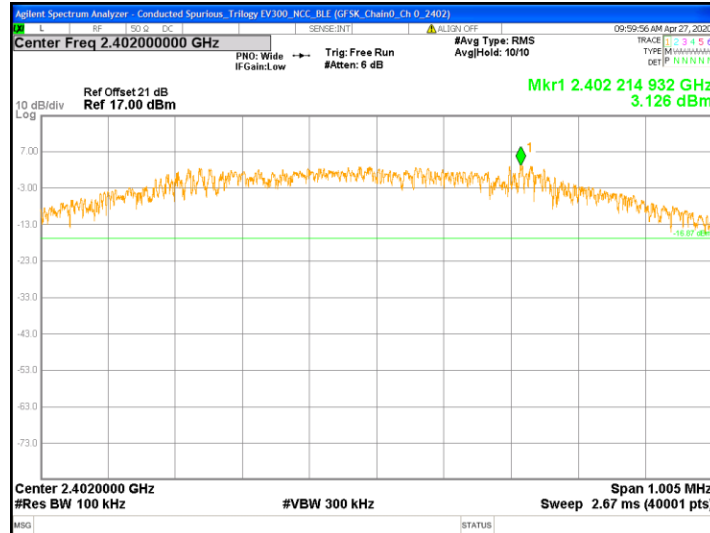
23.4 測試結果

溫度 : 20 °C

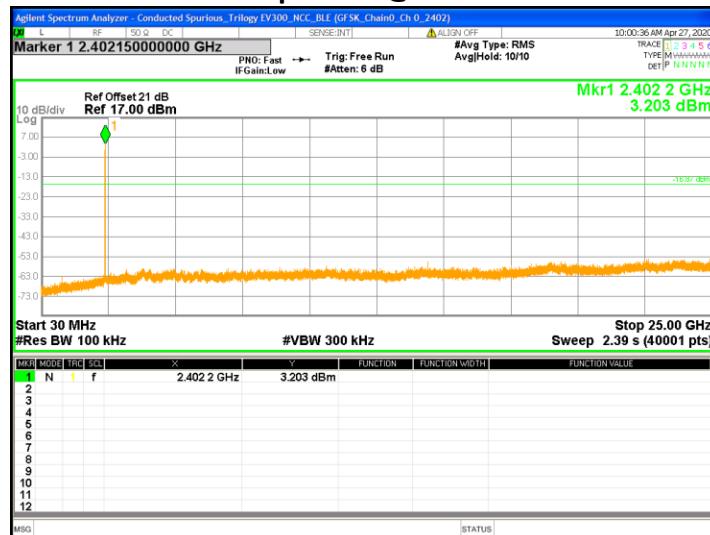
相對濕度 : 60 %

23.5 繪圖資料

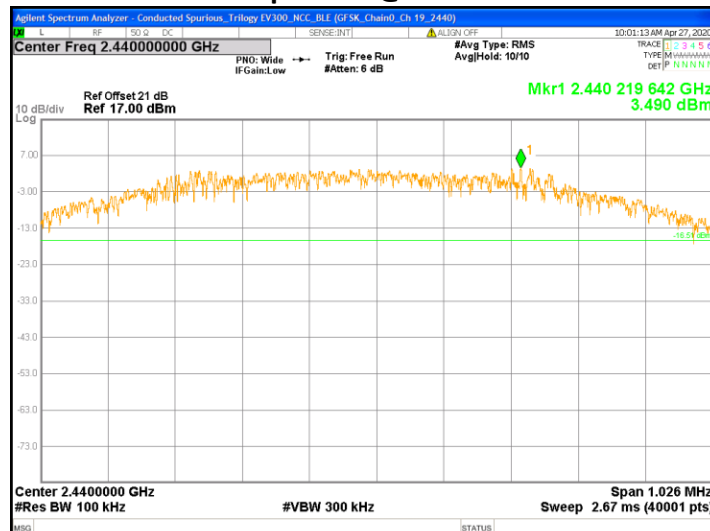
Conducted Spurious @ BLE Mode Ch 0



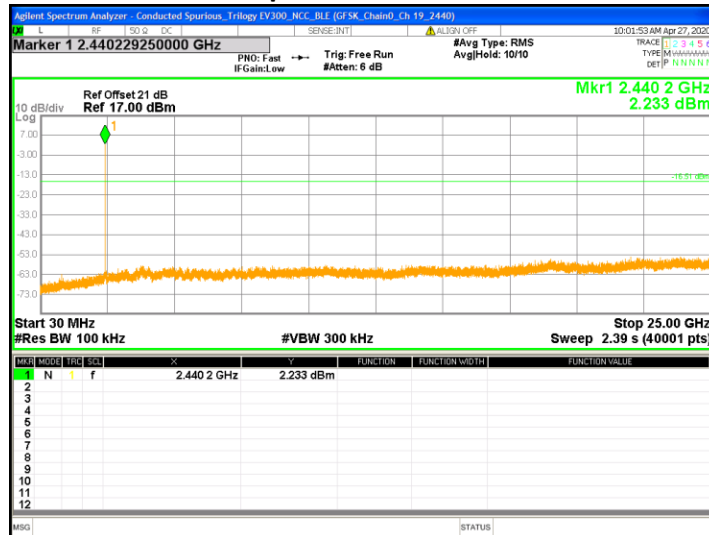
Conducted Spurious @ BLE Mode Ch 0



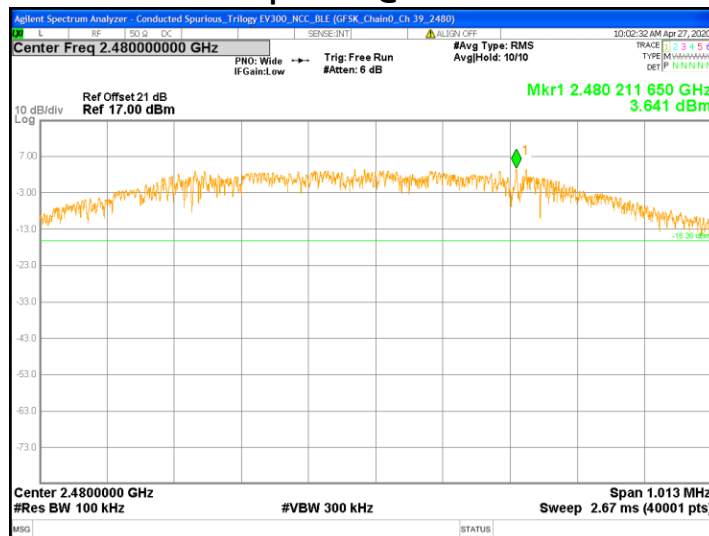
Conducted Spurious @ BLE Mode Ch 19



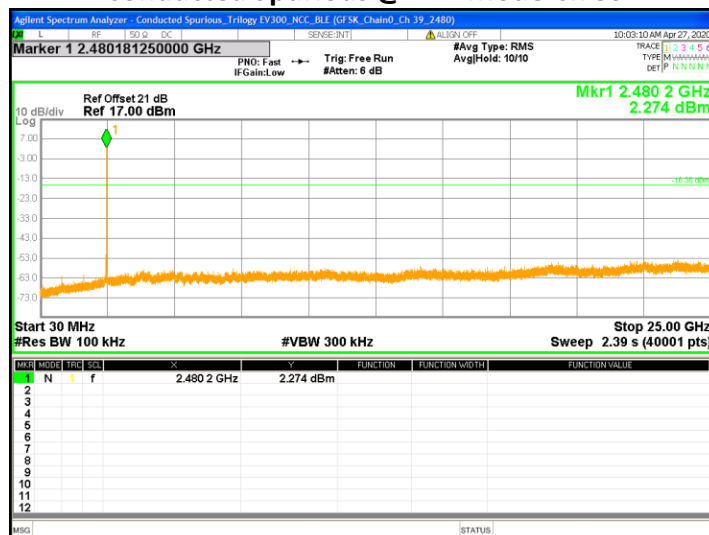
Conducted Spurious @ BLE Mode Ch 19



Conducted Spurious @ BLE Mode Ch 39



Conducted Spurious @ BLE Mode Ch 39



24. 功率密度

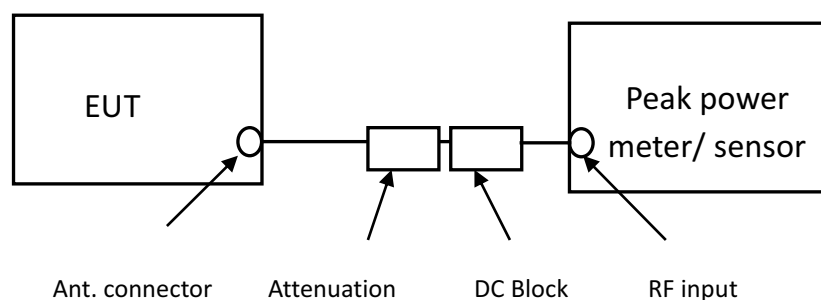
24.1 適用規範

依據國家通訊傳播委員會低功率射頻電機技術規範 3.10.1.6(2)(B)節之規定，對數位調變技術系統，在使用頻率範圍之任意 3kHz 頻寬內，由發射傳導至天線之峰值發射電功率密度在任意期間內，皆不得大於 8 dBm。

24.2 測試方法

將發射機之天線埠經由適當之衰減直接連至測試儀器。找出發射峰值並擴展於通帶內，設定解析頻寬為 3 kHz，視訊頻寬大於解析頻寬，掃描時間為頻率掃描範圍除以 3 kHz。

24.3 測試配置圖



24.4 測試結果

溫度 : 20 °C

相對濕度 : 60 %

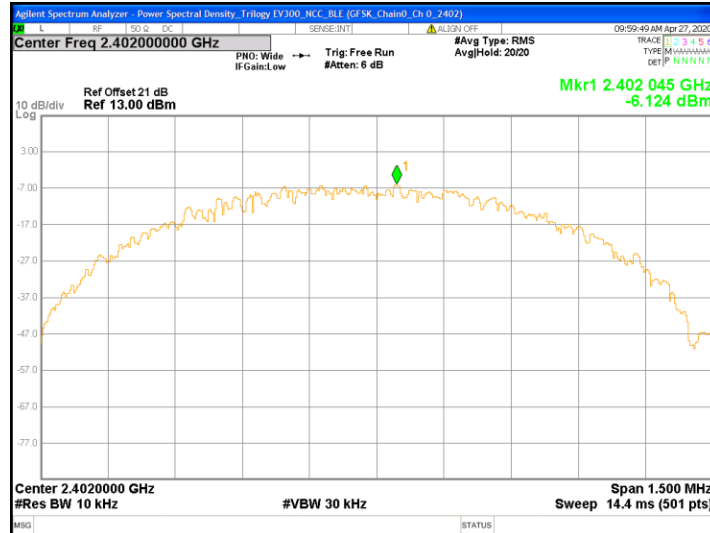
Single TX

Mode	Channel	Frequency (MHz)	RBW factor	PSD in 10kHz	PSD in 3kHz		Limit (dBm)	Margin (dB)
					(dBm)	(mw)		
BLE	0	2402	5.23	-6.12	-11.35	0.07	8	-19.35
	19	2440	5.23	-5.82	-11.05	0.08	8	-19.05
	39	2480	5.23	-5.07	-10.30	0.09	8	-18.30

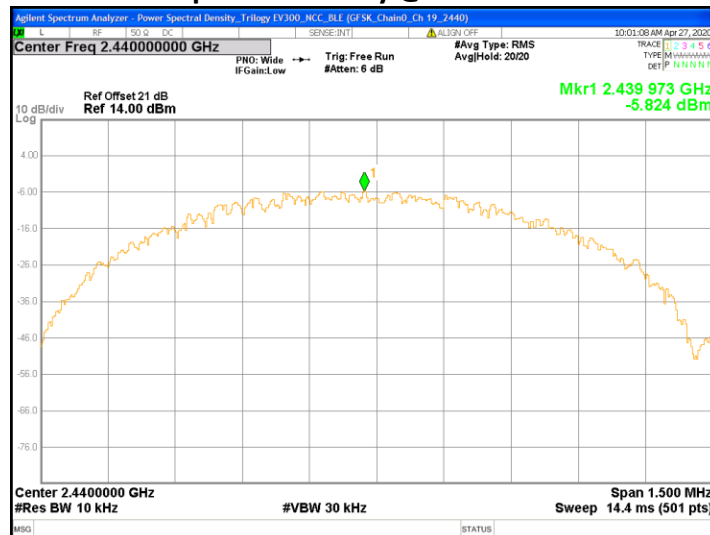
Note: Correction Factor = $10\log(10\text{kHz}/3\text{kHz})$

24.5 繪圖資料

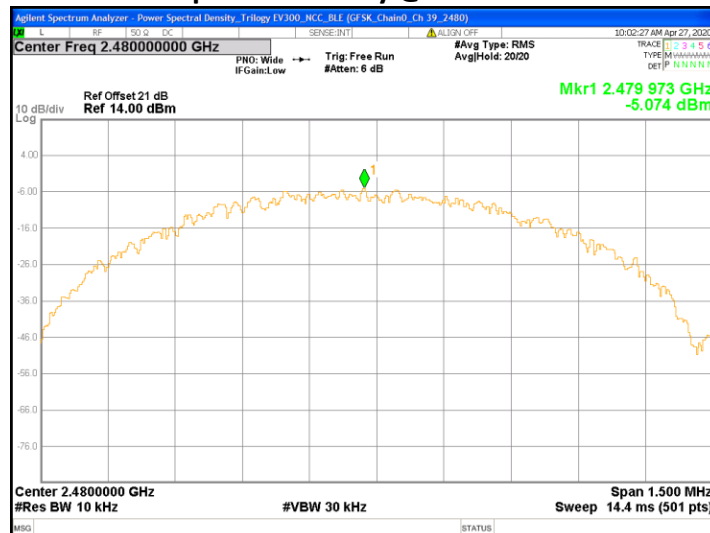
Power Spectral Density @ BLE Mode Ch 0



Power Spectral Density @ BLE Mode Ch 19



Power Spectral Density @ BLE Mode Ch 39

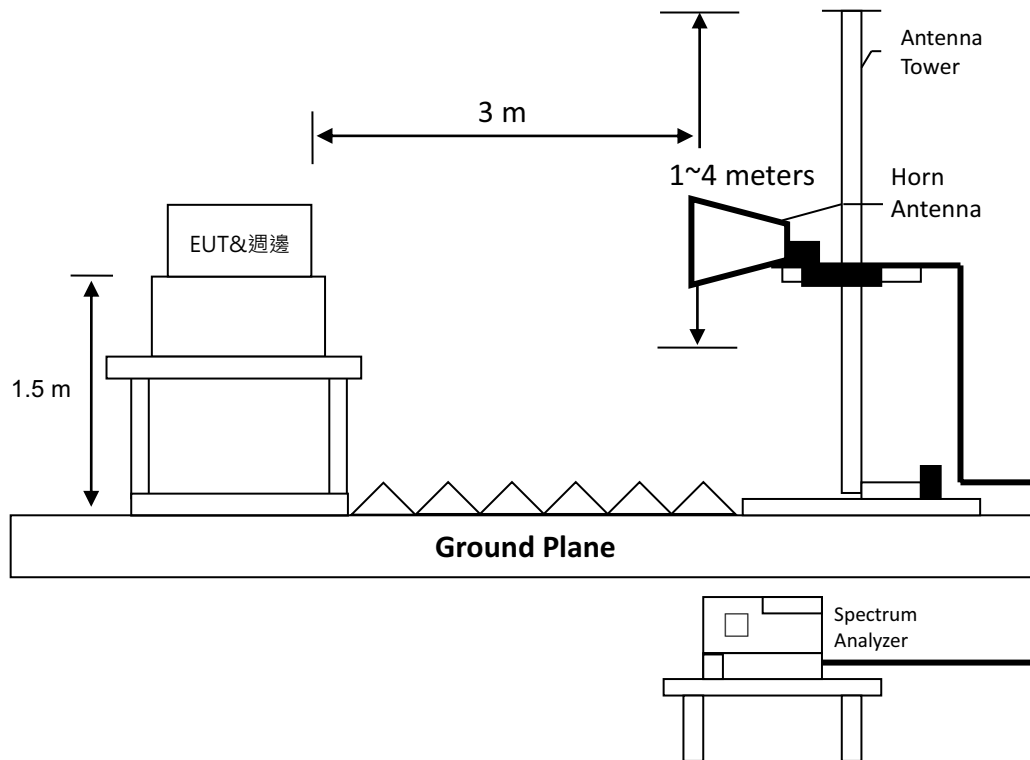


25. 頻帶邊緣測試

25.1 適用規範

依據國家通訊傳播委員會低功率射頻電機技術規範 3.10.1 節(5)之規定，使用頻帶範圍外之任意 100kHz 內，發射器所產生的射頻功率相較於頻帶範圍中包含最高所需功率之 100kHz 內的射頻功率，需衰減 20 分貝(dB)，以射頻傳導或輻射方式量測。此外，落於第 2.7 節禁用頻段之輻射發射，應符合第 2.8 節之規定。

25.2 測試配置圖



25.3 測試結果

溫度 : 23 °C

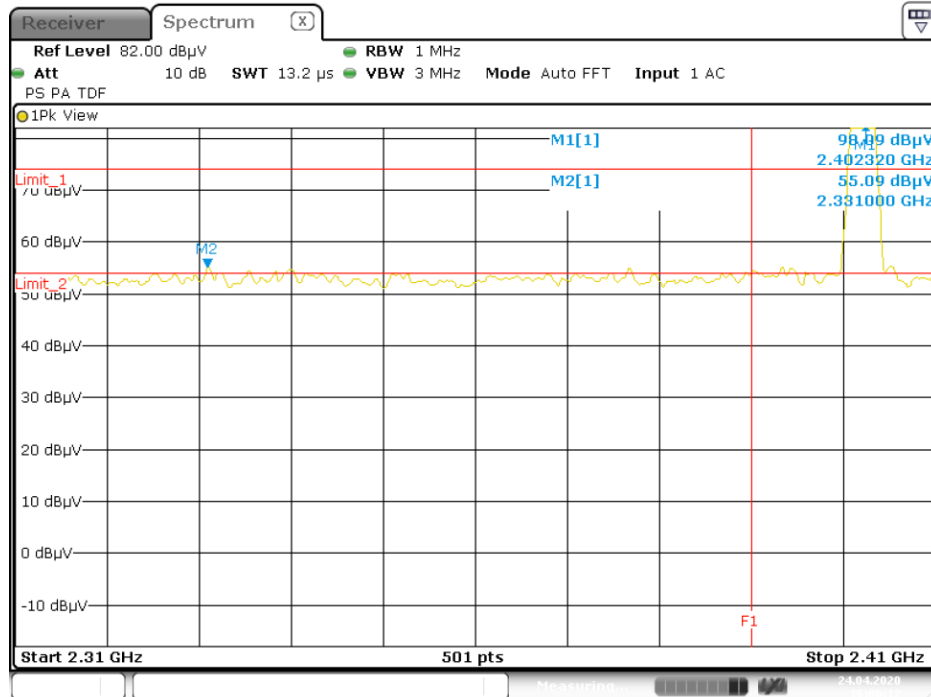
相對濕度 : 56 %

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)	Restricted band (MHz)
BLE	2331.00	PK	V	34.26	20.82	55.09	74	-18.91	2310~2390
	2389.20	AV	V	34.51	8.29	42.80	54	-11.20	
	2489.95	PK	V	34.95	21.50	56.45	74	-17.55	2483.5~2500
	2483.65	AV	V	34.92	8.27	43.19	54	-10.81	

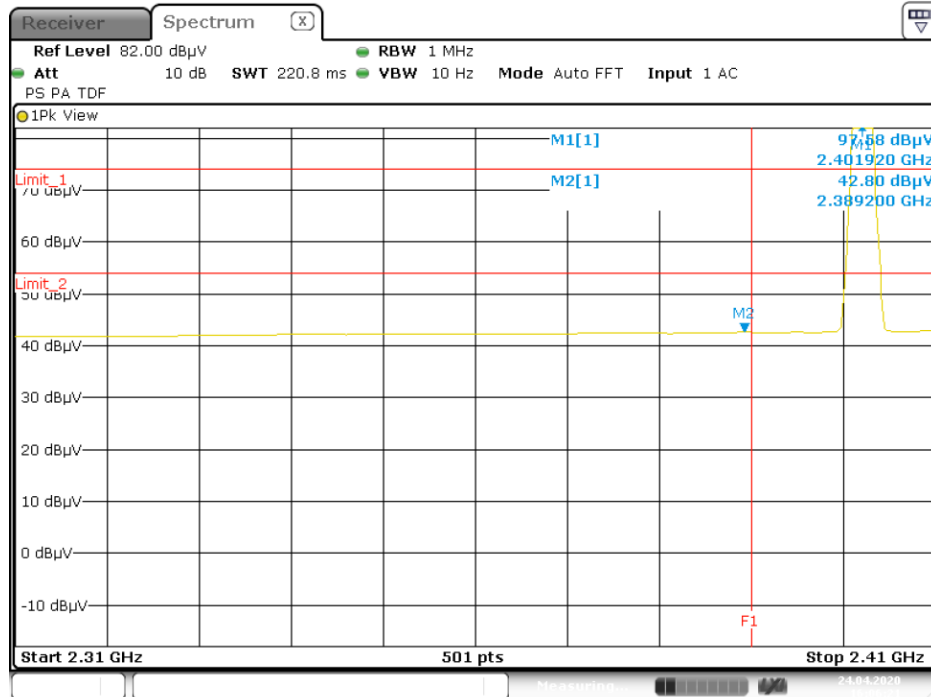
Remark: Correction Factor = Antenna Factor + Cable Loss

以上測試結果符合規範。

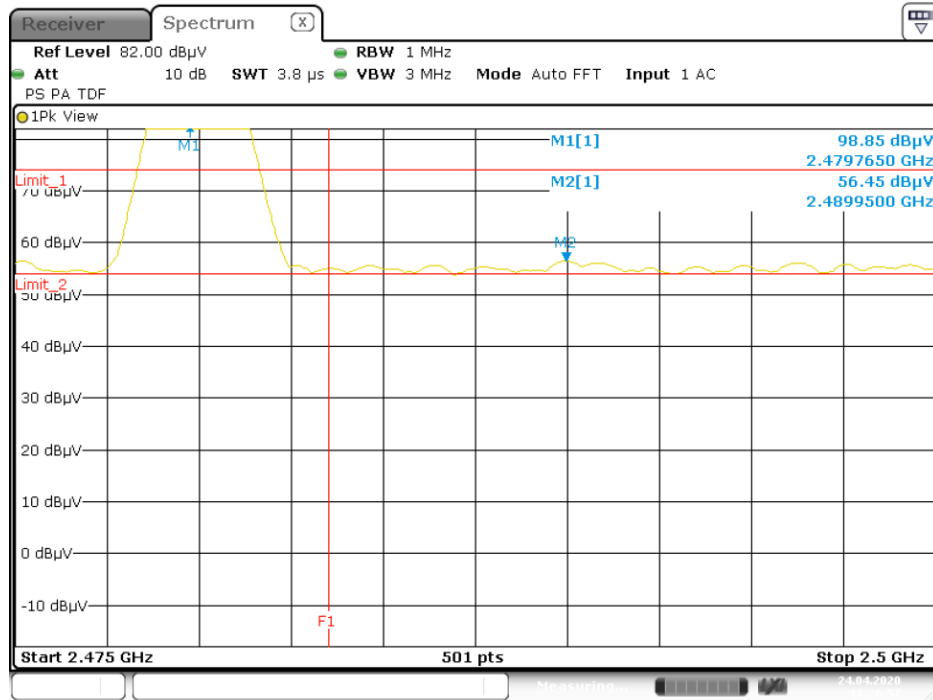
Restricted Band Bandedge @ BLE Mode Ch0 PK



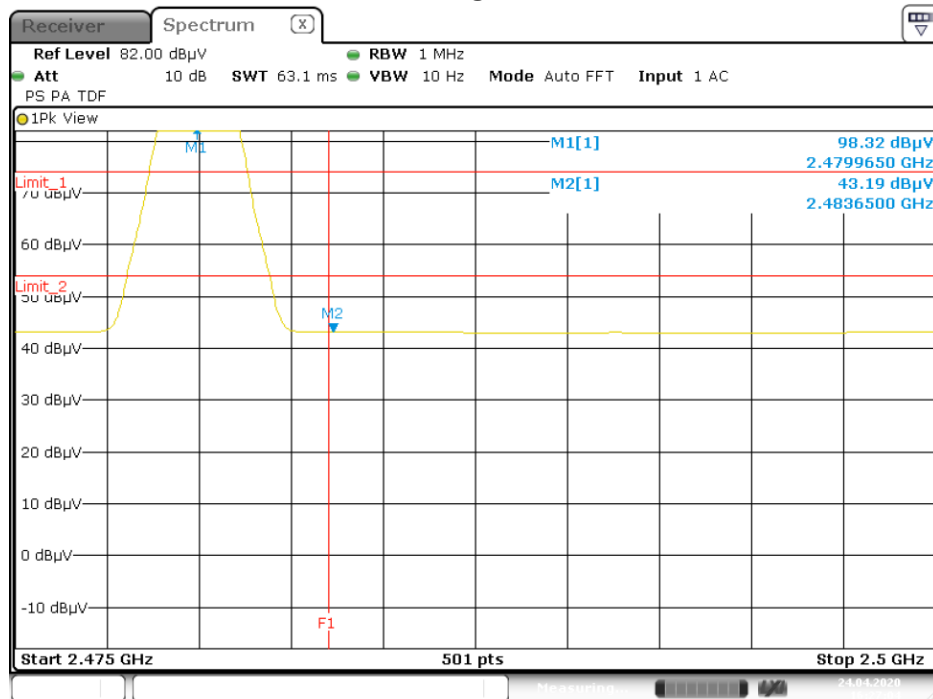
Restricted Band Bandedge @ BLE Mode Ch0 AV



Restricted Band Bandedge @ BLE Mode Ch39 PK



Restricted Band Bandedge @ BLE Mode Ch39 AV



26. 電源傳導干擾測試

26.1 適用規範

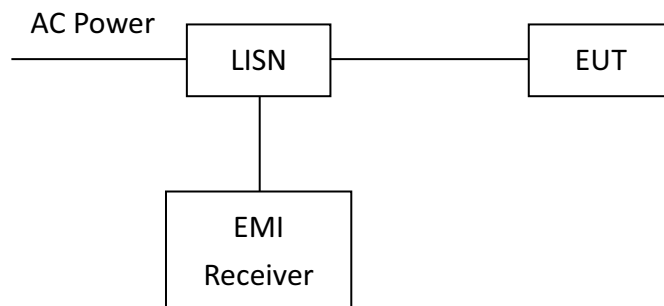
依據國家通訊傳播委員會低功率射頻電機技術規範之 2.3 節，電源傳導干擾之限制要求如下：

頻率(MHz)	傳導限制值(dBuV)	
	準峰值(Quasi-peak)	平均值(Average)
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5	56	46
5 – 30	60	50

26.2 測試方式

待測物置於 80 cm 高的檯面上，將待測物電源線接到模擬網路 (LISN) 上，再從電源模擬網路 (LISN) 接到市電電源，而電源模擬網路 (LISN) 的監測信號端則連接到 EMI 接收機上。其他週邊設備的電源線接至另一具模擬網路上。

26.3 測試配置圖



26.4 測試結果

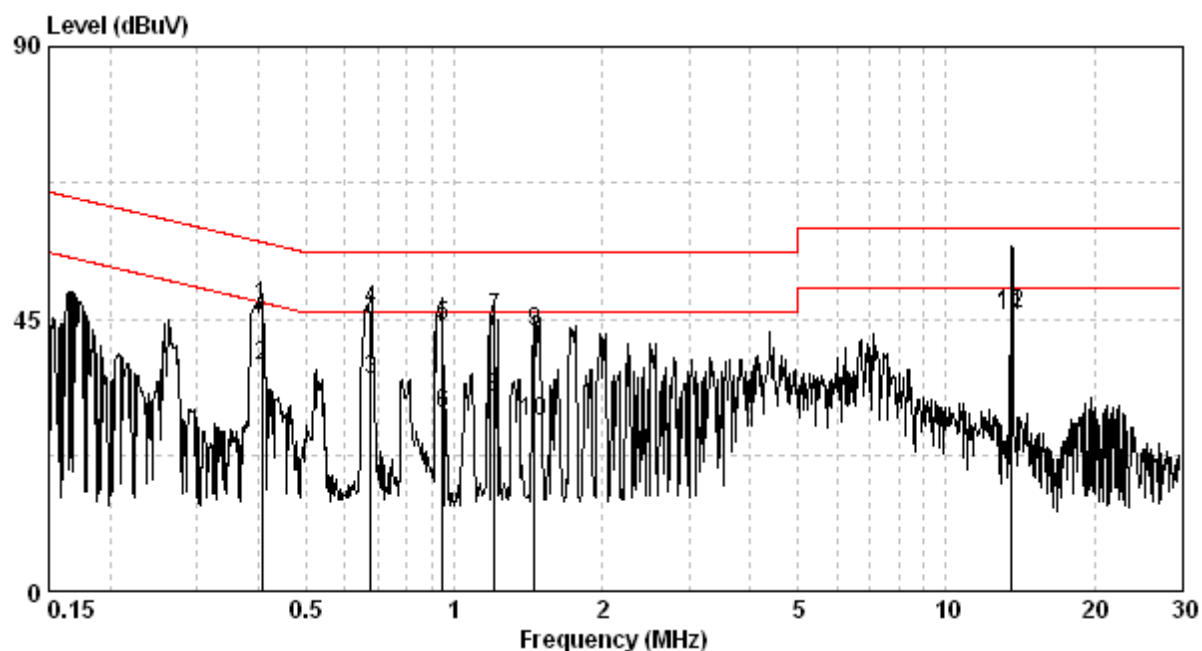
溫度 : 22 °C
相對濕度 : 58 %
大氣壓力 : 1005 hPa

相 位：火線

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB)	
								QP	AV
0.406	9.70	37.38	47.07	57.73	27.51	37.20	47.73	-10.65	-10.52
0.675	9.71	36.93	46.64	56.00	25.31	35.02	46.00	-9.36	-10.98
0.948	9.73	34.23	43.95	56.00	19.76	29.49	46.00	-12.05	-16.51
1.210	9.74	35.33	45.07	56.00	22.33	32.07	46.00	-10.93	-13.93
1.456	9.75	33.03	42.77	56.00	18.14	27.89	46.00	-13.23	-18.11
13.551	9.82	35.79	45.61	60.00	36.06	45.88	50.00	-14.39	-4.12

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)

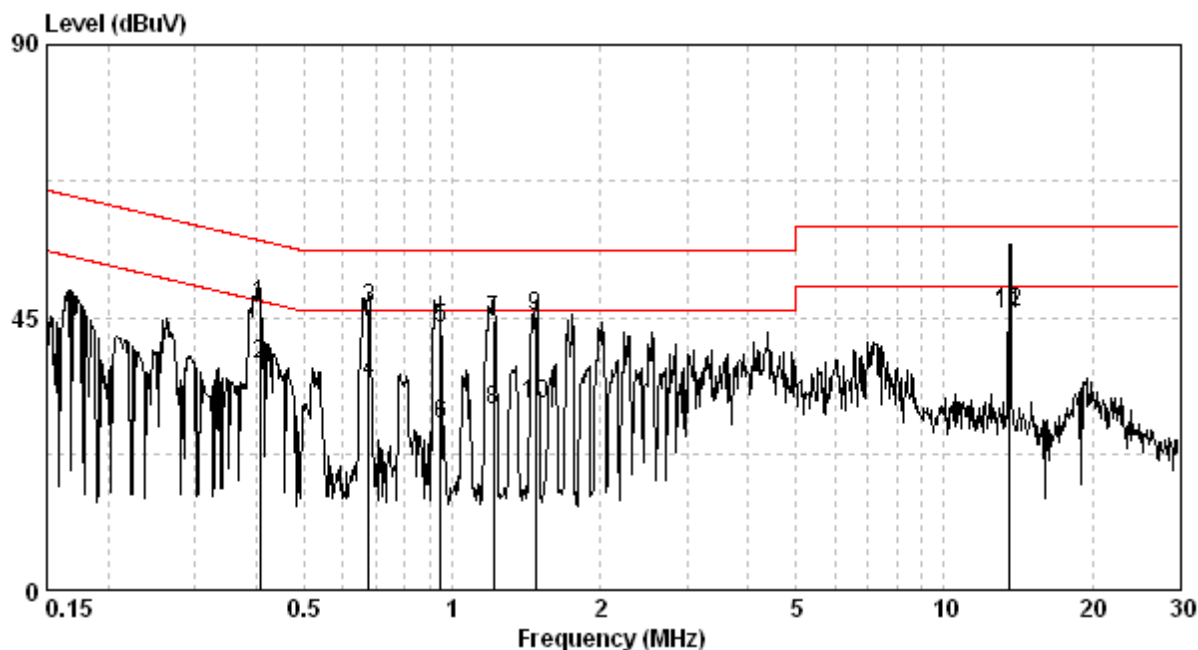


相 位 : 中性線

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB)	
								QP	AV
0.406	9.71	37.48	47.19	57.73	27.47	37.18	47.73	-10.54	-10.54
0.675	9.72	36.90	46.63	56.00	24.65	34.37	46.00	-9.37	-11.63
0.948	9.74	33.31	43.05	56.00	17.73	27.47	46.00	-12.95	-18.53
1.216	9.75	34.91	44.66	56.00	19.98	29.73	46.00	-11.34	-16.27
1.480	9.76	35.40	45.16	56.00	20.90	30.66	46.00	-10.84	-15.34
13.551	9.88	35.73	45.61	60.00	35.98	45.87	50.00	-14.39	-4.13

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



27.電波暴露量測試

27.1 適用規範

依據國家通訊傳播委員會低功率射頻電機技術規範 5.20.2.2 節之規定，若受測物於正常操作模式下，其發射機距離人體 20 公分以上者，可測試最大暴露允許值 (Maximum Permissible Exposure, MPE)以證明其符合電波暴露量之要求。(限制值如下)

(1) 職業性/可控制之暴露

頻率範圍 (MHz)	電場強度 (V/m)	磁場強度 (A/m)	功率密度 (mW/cm ²)	平均時間 (minutes)
0.3-3.0	614	1.63	*100	6
3-30	1842/f	4.89/f	*900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500	--	--	f/300	6
1,500-100,000	--	--	5.0	6

註 1：標記*表平面波等效功率密度。

註 2：f 表測試頻率，單位：百萬赫(MHz)。

(2) 一般人/不可控制之暴露

頻率範圍 (MHz)	電場強度 (V/m)	磁場強度 (A/m)	功率密度 (mW/cm ²)	平均時間 (minutes)
0.3-3.0	614	1.63	*100	30
3-30	1842/f	4.89/f	*180/f ²	30
30-300	27.5	0.073	1.0	30
300-1,500	--	--	f/1500	30
1,500-100,000	--	--	1.0	30

註 1：標記*表平面波等效功率密度。

註 2：f 表測試頻率，單位：百萬赫(MHz)。

Estimation of the expected exposure in power density can be made with the following equation:

$$S = \frac{P \times G}{4\pi \times R^2} = \frac{\text{EIRP}}{4\pi \times R^2}$$

S: power density

P: power input to the antenna

G: power gain of the antenna in the direction of interest relative to an isotropic radiator.

R: distance to the center of radiation of the antenna.

EIRP: Effective Isotropic Radiated Power

27.2 電波暴露量之評估

Mode	Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (dBm)	Output power to antenna 0 (mW)	Tune-up Power Tolerance (dB)	Max Tune-up Power (dBm)	Max Tune-up Power (mW)	Power density (mW/cm ²)	Limit of power density (mW/cm ²)
802.11b	1	2412	1.66	16.13	41.02	2.00	18.13	65.01	0.0135	1.0
	6	2437	1.66	16.40	43.65	2.00	18.40	69.18	0.0144	1.0
	11	2462	1.66	16.57	45.39	2.00	18.57	71.94	0.0150	1.0
802.11g	1	2412	1.66	18.90	77.62	2.00	20.90	123.03	0.0256	1.0
	6	2437	1.66	19.90	97.72	2.00	21.90	154.88	0.0323	1.0
	11	2462	1.66	19.01	79.62	2.00	21.01	126.18	0.0263	1.0
802.11n (HT20)	1	2412	1.66	19.10	81.28	2.00	21.10	128.82	0.0268	1.0
	6	2437	1.66	20.09	102.09	2.00	22.09	161.81	0.0337	1.0
	11	2462	1.66	19.08	80.91	2.00	21.08	128.23	0.0267	1.0

Appendix A : 量測儀器

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde & Schwarz	ESR-7	101232	2020/01/18	2021/01/16
Signal Analyzer	Agilent	N9030A	MY51380492	2019/08/21	2020/08/19
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIK	FMZB1519	1519-067	2020/04/13	2021/04/12
Broadband Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB 9168	9168-172	2019/06/05	2020/06/03
Horn Antenna	SHWARZBECK	BBHA 9120 D	9120D-456	2020/01/20	2021/01/18
Pre-Amplifier	SCHWARZBECK	BBV9718	9718-004	2019/10/16	2020/10/14
High Pass Filter	Wainwright	WHKX3.0/ 18G-12SS	N/A	2019/05/30	2020/05/28
Power Meter	Anritsu	ML2495A	0844001	2019/10/23	2020/10/21
Power Sensor	Anritsu	MA2411B	0738452	2019/10/23	2020/10/21
966-2(A) Cable	SUHNER	SMA / EX 100	N/A	2019/08/19	2020/08/17
966-2(B) Cable	SUHNER	SUCOFLEX 104P	CB0005	2019/08/19	2020/08/17
RF Cable	SUHNER	SUCOFLEX 104P	CB0006	2019/05/02	2020/04/30
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2020/02/22	2021/02/20
Temperature&Humidity Test Chamber	TERCHY	MHU-225LRU(SA)	950838	2019/05/30	2020/05/28

Note: No Calibration Required (NCR)

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Receiver	R&S	ESCI	100059	2019/11/05	2020/11/03
Two-Line V-Network	R&S	ENV216	101159	2019/06/12	2020/06/10
Two-Line -V-Network	R&S	ESH3-Z5	825562/003	2019/08/27	2020/08/25
CON-1 Shielded Room	N/A	N/A	N/A	NCR	NCR
CON-1 Cable	SUHNER	SUCOFLEX-104	26438414	2019/05/02	2020/04/30
Test software	Audix	e3	4.20040112L	NCR	NCR

Note: No Calibration Required (NCR).

Appendix B : 測試不確定度

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of $k=2$.

Item	Uncertainty
Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	4.90 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	4.89 dB
Vertically polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	4.29 dB
Horizontally polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	4.29 dB
Vertically polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Horizontally polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Vertically polarized Radiated disturbances from 26.5GHz~40GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Horizontally polarized Radiated disturbances from 26.5GHz~40GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m	3.32 dB
Emission on the Band Edge Test	4.29 dB
Minimum Emission Bandwidth	7.69 %
Maximum Conducted Output Power	1.15 dB
Power Spectral Density	1.15 dB
AC Power Line Conducted Emission	2.52 dB