

低功率射頻電機試驗報告

申請廠商	Silicon Laboratories Finland Oy Alberga Business Park, Bertel Jungin aukio 3, 02600 Espoo, Finland
製造廠商	Silicon Laboratories International Pte Ltd
產品名稱	BLE112
廠牌	Bluegiga
型號	BLE112-A
發射功率	4.53dBm (Peak)
工作頻率	2402MHz – 2480MHz
調變方式	BT V4.0 single mode LE (GFSK)
法規	LP0002, 3.10.1 節

實驗室資訊

台灣檢驗科技股份有限公司 電子通訊實驗室

新北市新北產業園區五工路134號

認證有效期間：104年06月14日起至107年06月13日止

受理日期 民國106年03月20日

完成日期 民國106年04月05日

張俊卿

報告簽署人
張俊卿 簽章

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測試標準

國家通訊傳播委員會低功率射頻電機技術規範

民國 105 年 8 月 23 日版本

待測裝置已於台灣檢驗科技股份有限公司電子通訊實驗室，依據國家通訊傳播委員會於中華民國一百零五年八月頒佈之低功率射頻電機技術規範測試。

台灣檢驗科技股份有限公司根據此條文規範項目測試，測試各項數據皆能符合此規範規定之限度值。

台灣檢驗科技股份有限公司依低功率射頻電機技術規範審驗要點規範製作測試結果報告，測試結果評判為合格。

備註：

1. 報告中所描述之測試結果和待測設備的架構組合，均根據實際量測情況作詳實的記錄，且本測試報告僅對上述待測設備樣品負責。
2. 此份報告未經本公司同意，不得部份摘錄複製使用。

測試人員：

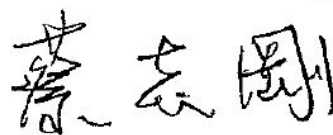


日期：

04/05/2017

斐迪翰 / 資深工程師

報告製作：

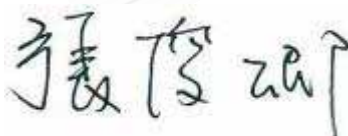


日期：

04/05/2017

蔡志剛 / 工程師

報告審核：



日期：

04/05/2017

張俊卿 / 副理

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測試實驗室資料:

實驗室認可登錄 : 中華民國實驗室認證體系

認可編號 : TAF 0513, 認可頻率範圍9kHz ~ 40GHz

認證有效期間 : 104年06月14日起至107年06月13日止

測試場地 : 桃園市龜山區(華亞科技園區)科技一路2號

實驗室名稱 : 台灣檢驗科技股份有限公司
電子通訊實驗室

實驗室地址 : 新北市新北產業園區五工路134號

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實驗室之量測不確定度

量測項目	量測不確定度 (擴充不確定度)		
傳導干擾量測	電源線	0.15-30MHz	2.586 dB
輻射干擾量測 (3m測距)	水平極化	9kHz - 30MHz	2.3dB
		30-167MHz	4.22dB
		167-500MHz	3.44dB
		0.5-1GHz	3.39dB
		1-18GHz	4.08dB
		18-40GHz	4.08dB
	垂直極化	9kHz - 30MHz	2.3dB
		30-180MHz	3.37dB
		180-417MHz	3.19dB
		0.417-1GHz	3.19dB
頻率誤差量測	範例一	2.4 GHz	290 Hz
	範例二	5 GHz	724.3 Hz
輸出功率	傳導方式	2.4 GHz	1.3 dB
		5 GHz	1.55 dB
有效輻射功率 (輻射方式)	水平極化	2.4GHz	4.21 dB
		5 GHz	4.62 dB
	垂直極化	2.4 GHz	4.42 dB
		5 GHz	4.74 dB
功率頻譜密度	傳導方式	2.4GHz	1.3dB
		5GHz	1.67dB
鄰頻道功率量測 (輻射方式)	水平極化	30-167MHz	4.22dB
		167-500MHz	3.44dB
		0.5-1GHz	3.39dB
	垂直極化	30-180MHz	3.37dB
		180-417MHz	3.19dB
		0.417-1GHz	3.19dB

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目錄

1. 一般資料	6
2. 適用規範	9
3. 受測裝置之系統說明	12
4. 量測儀器設備	13
5. 電源線傳導干擾之量測	15
6. 場強輻射之量測	18
7. 天線增益之要求	37
8. 發射頻寬之要求	38
9. 輸出峰值功率之量測	41
10. 開放頻帶邊緣 100kHz 頻寬內之限制	43
11. 功率密度之量測	50
測試照片	55
產品照片	58

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1 一般資料

1.1 產品描述

產品名稱	BLE112
型號	BLE112-A
產品商標	Bluegiga
Hardware Version	1.0
Software Version	1.0
使用電源	3.3 Vdc from DC power supply

發射頻帶	2402MHz – 2480MHz
輸出功率	4.53dBm (Peak)
調變方式	BT V4.0 Single mode LE (GFSK)
頻道數	40
天線型式/天線增益	Multilayer Chip Antenna, Gain: 0.5dBi Part No.: AT3216-B2R7HAA; Supplier: ACX

本報告針對藍芽(LE)測試。

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1.2 測試方法之依據

本測試報告之所有項目皆依據國家通訊傳播委員會低功率射頻電機技術規範(LP0002, 105.8.23 版本)如無國家標準可適用者，得依美國 EIA、IEEE ANSI 檢驗法檢驗，及美國 FCC 47 CFR Part 2 有關檢驗之規定及參考 ANSI 63.10:2013、FCC CFR 47 15.247 之檢驗法。

低功率射頻電機技術規範3.10節

項次	測試項目	適用規範	測試結果	量測設備	備註
1	場強輻射	低功率射頻電機技術規範 3.10.1.5節	請參閱6.5節	請參閱4.1節	合格
2	電源線傳導干擾	低功率射頻電機技術規範 2.3節	請參閱5.5節	請參閱4.3節	合格
3	天線增益之要求	低功率射頻電機技術規範 3.10.1.3 (1) 節	請參閱7.2節	-----	合格
4	發頻頻寬	低功率射頻電機技術規範 3.10.1.6(2) (A) 節	請參閱8.3節	請參閱4.2節	合格
5	輸出峰值功率	低功率射頻電機技術規範 3.10.1.2(1) (C) 節	請參閱9.3節	請參閱4.2節	合格
6	開放頻帶邊緣之發射	低功率射頻電機技術規範 3.10.1.5節	請參閱10.3節	請參閱4.2節	合格
7	功率密度	低功率射頻電機技術規範 3.10.1.6(2) (B) 節	請參閱11.3節	請參閱4.2節	合格

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*測試模式

RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1
RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1

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2. 適用規範

2.1 規範要求 (一般規定)

(1) 傳導之規定

依據NCC低功率射頻電機技術規範之2.3節，以市電為電源之低功率射頻電機，其傳導回電源線上頻率自 150 kHz 至 30MHz 之射頻電壓 (在電源端子每一電源線對接地點) 不得超過下表所列之限值。測量時應經過 50 μ H 及 50 Ω 之電源線阻抗模擬網路 (LISN)。頻率重疊處，以較低限值为準。

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

(2) 輻射之規定

依據NCC低功率射頻電機技術規範3.10.5之要求，其他開放頻帶外不必要之輻射需符合2.8節之一般限制要求，其電場強度不得超過下表之限值，且其不必要之發射皆不得大於主波發射強度。各頻段重疊處，以較嚴格之限制值為準。

頻率 MHz	測試距離 m	干擾限制 μ V/m	干擾限制 dB μ V/m
0.009 – 0.490	300	2,400/頻率 (kHz)	
0.490 – 1.705	30	24,000/頻率 (kHz)	
1.705 - 30	30	30	
30 - 88	3	100	40.0
88 – 216	3	150	43.5
216 – 960	3	200	46.0
960 以上	3	500	54.0

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(3) 禁用頻帶限制之規定

依據NCC低功率射頻電機技術規範2.7節之要求，任何低功率射頻電機之主波皆不得使用下表所列各頻帶內之頻率；低功率射頻電機落於下表所列頻帶內之混附發射，其電場強度必須符合第2.8節的限制規定。

頻率 (MHz)	頻率 (MHz)	頻率 (MHz)
0.090~0.110	240.00~285.00	3260.0~3267.0
0.490~0.510	322.00~335.40	3332.0~3339.0
2.172~2.198	399.90~410.00	3345.8~3358.0
3.013~3.033	485.00~510.00	3500.0~4400.0
4.115~4.198	608.00~614.00	4500.0~5250.0
5.670~5.690	703.00~748.00	5350.0~5460.0
6.200~6.300	758.00~803.00	7250.0~7750.0
8.230~8.400	825.00~915.00	8025.0~8500.0
12.265~12.600	930.00~1240.0	9000.0~9200.0
13.340~13.430	1300.0~1427.0	9300.0~9500.0
14.965~15.020	1435.0~1626.5	10600~12700
16.700~16.755	1435.0 1626.5	13250~13400
19.965~20.020	1660.0~1770.0	14470~14500
25.500~25.700	1805.0~1865.0	15350~16200
37.475~38.275	1885.0~1900.0	17700~21400
73.500~75.400	1905.0~1985.0	22010~23120
108.00~138.00	2015.0~2025.0	23600~24000
149.90~150.05	2125.0~2165.0	31200~31800
156.70~156.90	2200.0~2300.0	36430~36500
162.01~167.17	2310.0~2390.0	38600 以上
167.72~173.20	2483.5~2900.0	

- (4) 依據NCC低功率射頻電機技術規範2.11節之要求，收、發信機為成套銷售者，收、發信機應一併送審或提供經型式認證合格之對應收、發信機之送審資料；送信機之輻射電場強度不得超過第2.8節之發射規定，且不得接收、解調第2.7節所列之頻率。

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2.2 規範要求 (特殊規定)

依據NCC低功率射頻電機技術規範3.10節 數位調變 (Digitally Modulated) 之要求，使用頻率為2.4 G至2.4835 GHz 及 5.725 GHz 至5.850 GHz

(A) 峰值輸出功率之要求

依據 NCC 低功率射頻電機技術規範 3.10.1.2(1) (A)(C)之規定，操作於 2400-2483.5 兆赫 (MHz)與 5725-5850 兆赫(MHz)之所有數位調變技術系統：1 瓦(W)以下。

除使用附件二之峰值輸出功率量測方式外，並得使用以最大傳導輸出功率(Maximum Conducted Output Power)作為量測方式。

最大傳導輸出功率，定義為發射器操作在最大功率時，輸出至所有天線及天線單元 (antenna elements) 之總發射功率對信號集 (signaling alphabet) 所有符號 (symbol) 之平均值。此平均值不含發射器停止或已降低發射功率位準之任何時間區段。器材可操作於不同調變模式等多種模式時，最大傳導輸出功率為各模式之總發射功率其中最高者。

(B) 天線增益之要求

依據NCC低功率射頻電機技術規範3.10.1.3之規定，進行固定式點對點操作時，應符合下列情現之一：依據NCC低功率射頻電機技術規範3.10.1.3 (1)之規定，操作頻率為2400-2483.5 兆赫(MHz)者，其發射天線之方向性增益超過6dBi，每超過3dB應降低1dB之最大傳導輸出功率。

依據NCC低功率射頻電機技術規範3.10.1.3 (2)之規定，操作頻率為5725-5850兆赫(MHz)者，其發射天線之方向性增益超過6dBi，不需降低最大傳導輸出功率。

依據NCC低功率射頻電機技術規範3.10.1.3 (3)之規定，用於點對多點操作時，如其發射天線之方向性增益超過 6dBi，應依所超過之dB數等量降低最大傳導輸出功率。

(C) 發射限制之要求

依據NCC低功率射頻電機技術規範3.10.1.5之規定，帶外發射限制：操作頻帶範圍外之任意100 kHz 內，發射機所產生的射頻功率相較於使用頻帶範圍中包含最高所需功率之100 kHz 內的射頻功率，其衰減值限制如下：

(1) 輸出功率以附件二之峰值輸出功率方式測量者，至少須衰減20 dB，可使用射頻傳導或輻射方式測量。

(2) 輸出功率以3.10.1.2(1)(C)之最大傳導輸出功率測量方式者，至少須衰減30 dB。

此外，落於2.7 禁用頻段之輻射發射，應符合2.8 之規定。

(D) 頻寬之要求

依據NCC低功率射頻電機技術規範3.10.1.6(2) (A)規定，6dB之頻寬至少應500kHz。

(E) 功率密度之要求

依據NCC低功率射頻電機技術規範3.10.1.6(2) (B)規定，在使用頻率範圍之任意3千赫(kHz)頻寬內，由發射機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8dBm。

註：此產品為點對多點操作。

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3. 受測裝置之系統說明

裝置名稱	製造者/申請者	型號
* BLE112	Silicon Laboratories Finland Oy / Silicon Laboratories Finland Oy	BLE112-A

標記：“*”表欲申請之受測物。

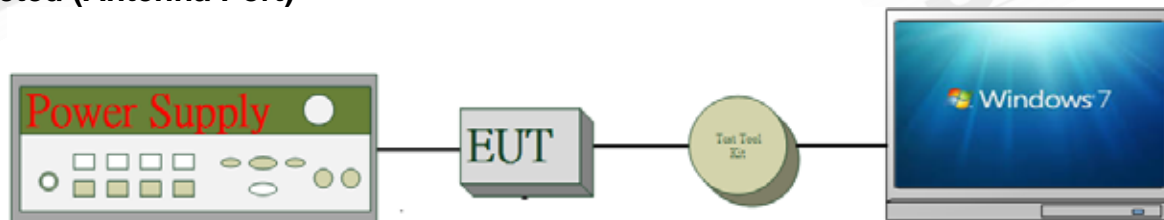
3.1 待測物與測試設備系統圖

3.1.1 量測配置圖

Conducted (Antenna Port) & Conduction (AC Power Line)



Conducted (Antenna Port)



3.2 輔助測試週邊設備名稱描述

編號	產品別	商標	型號	序號	信號線線長(米)	電源線長(米)
1.	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2.	DC Power Supply	Lenovo	E3640A	MY40005907	Un-shielding	Un-shielding
3.	Notebook	Lenovo	L430	R9-YYG88	Un-shielding	Un-shielding
4.	Test Kit	N/A	N/A	N/A	N/A	N/A

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4. 量測儀器設備

4.1. AC 電源端傳導干擾之量測儀器

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI 7	100950	12/12/2016	12/11/2017
Coaxial Cables	N/A	N30N30-1042-150cm	N/A	08/30/2016	08/29/2017
LISN	Schwarzbeck	NSLK 8127	8127-648	03/11/2016	03/10/2017
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R.	N.C.R.

4.2. 天線端傳導測試之量測儀器

SGS Conducted Room					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY54510568	04/14/2016	04/13/2017
Power Meter	Anritsu	ML2496A	1326001	06/23/2016	06/22/2017
Power Sensor	Anritsu	MA2411B	1315048	06/23/2016	06/22/2017
Power Sensor	Anritsu	MA2411B	1315049	06/23/2016	06/22/2017
Coaxial Cable 30cm	WOKEN	00100A1F1A195C	RF01	12/12/2016	12/11/2017
DC Block	PASTERNAK	PE8210	RF29	12/12/2016	12/11/2017
Splitter	RF-LAMBDA	RFLT2W1G18G	RF35	12/12/2016	12/11/2017
Attenuator	WOKEN	218FS-10	RF23	12/12/2016	12/11/2017
DC Power Supply	Agilent	E3640A	MY53140006	05/04/2016	05/03/2017

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4.3. 量測場強輻射之量測儀器

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESU 40	100363	04/12/2016	04/11/2017
Loop Antenna	ETS-Lindgren	6502	00143303	12/23/2016	12/22/2017
Broadband Antenna	TESEQ	CBL 6112D	35240	11/03/2016	11/02/2017
Horn Antenna	ETS-Lindgren	3117	00143272	12/15/2016	12/16/2017
Horn Antenna	Schwarzbeck	BBHA9170	185	07/24/2016	07/23/2017
Pre Amplifier	EMC Instruments	EMC330	980096	12/12/2016	12/11/2017
Pre Amplifier	EMC Instruments	EMC0011830	980199	12/12/2016	12/11/2017
Pre Amplifier	R&S	SCU-18	10204	12/12/2016	12/11/2017
Pre Amplifier	R&S	SCU-26	100780	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	RG 214/U	966Rx 9K-30M	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	RG 214/U SUCOFLEX 104	966Rx 30M-3G	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Rx 1G-18G	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	mini 141-12 SUCOFLEX 104	966Rx 18G-40G	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Tx 30M-18G	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	966Tx 18G-40G	12/12/2016	12/11/2017
Attenuator	WOKEN	218FS-10	RF27	12/12/2016	12/11/2017
Site NSA	SGS	966 Chamber C	SAC-C	03/02/2017	03/01/2018
Site VSWR	SGS	966 Chamber C	SAC-C	03/02/2017	03/01/2018
DC Power Supply	HOLA	DP-3003	D7070035	05/04/2016	05/03/2017
Controller	MF	MF-7802	N/A	N.C.R.	N.C.R.
Antenna Master	MF	N/A	N/A	N.C.R.	N.C.R.
Turn Table	MF	N/A	N/A	N.C.R.	N.C.R.
Test Software	World-Pallas	Dr. E	V 3.0 Lite	N.C.R.	N.C.R.

註: 以上部份設備跟量測值沒有影響，且沒有直接關聯，因此不需要進行校正。

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5. 電源線傳導干擾之量測

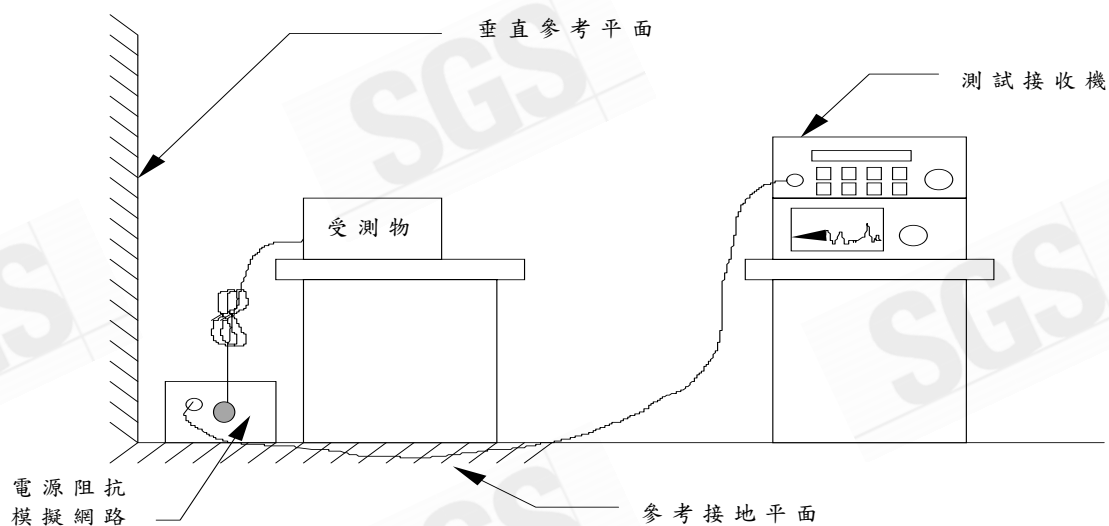
5.1. 適用標準

依據NCC低功率射頻電機技術規範2.3節之要求。

5.2. 測試方法

將待測物置於0.8米高的非金屬桌面，使其在工作狀態，待測物電源線接至電源線阻抗穩定網路上，從測試接收機記錄頻率由 0.15MHz 至 30MHz 之間之電源線傳導放射強度。

5.3. 測試配置



5.4. 干擾值之計算

電源傳導干擾電壓之計算公式如下

$$\text{結果值} = \text{儀器讀值}(QP/AV) + \text{校正因子}$$

其中校正因子為：

$$\text{饋線損失} + \text{電源阻抗模擬網路損失}$$

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5.5. 傳導干擾之量測結果:

測試設備: BLE112
6dB 頻寬: 10 kHz
量測天線: N/A

型號: BLE112-A
視訊頻寬: 10 kHz
檢測器: Average/Quasi-Peak
測試日期: Mar. 29, 2017

測試者:

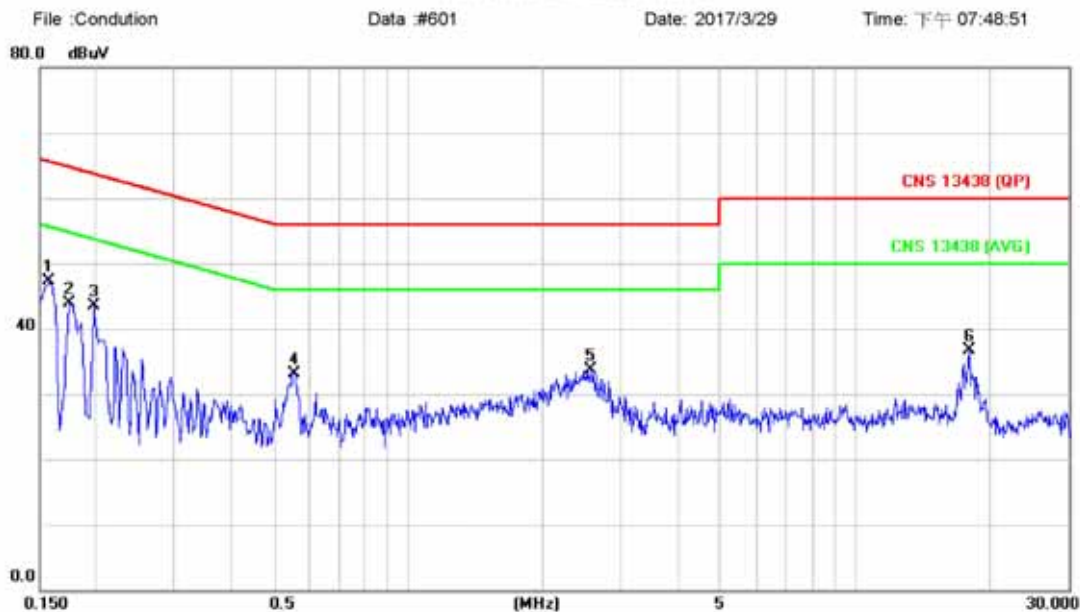
X 第 報

Site : Conduction Room
Limit: CNS 13438 (QP)
Mode: SGS
Note:

Phase: L1
Power: AC 110V/60Hz

Temperature: 20.5 °C
Humidity: 65 %

Conducted Emission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1	*	0.1580	27.51	19.75	47.26	65.57	-18.31	peak	
2		0.1740	24.09	19.75	43.84	64.77	-20.93	peak	
3		0.1980	23.79	19.74	43.53	63.69	-20.16	peak	
4		0.5580	13.24	19.94	33.18	56.00	-22.82	peak	
5		2.5580	13.82	19.97	33.79	56.00	-22.21	peak	
6		17.9580	16.28	20.35	36.63	60.00	-23.37	peak	

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Site : Conduction Room

Limit: CNS 13438 (QP)

Mode: SGS

Note:

Phase: N

Power: AC 110V/60Hz

Temperature: 20.5 °C

Humidity: 65 %

Conducted Emission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1500	29.55	19.60	49.15	66.00	-16.85	peak	
2		0.1660	24.73	19.60	44.33	65.16	-20.83	peak	
3		0.1780	22.99	19.59	42.58	64.58	-22.00	peak	
4		0.1900	22.33	19.59	41.92	64.04	-22.12	peak	
5		0.5580	13.93	19.80	33.73	56.00	-22.27	peak	
6		2.4580	13.50	19.82	33.32	56.00	-22.68	peak	

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6. 場強輻射之量測

6.1. 適用標準

依據NCC低功率射頻電機技術規範3.10.1.5之要求，其他開放頻帶外不必要之輻射干擾需符合2.8節之一般限制要求。

6.2. 量測方法

將待測物置於非金屬桌面，測試頻率1GHz以下時，使用桌高0.8 米，1GHz以上時，使用桌高1.5米，使其在工作狀態，接收天線置於 3 米外相同的高度。待測物分別要垂直或水平放置，而且桌面要 360 度旋轉，另外接收天線也要從 1.0 米至 4.0 米升降變化，以找出最大的輻射電場強度，接收天線置於水平、垂直極向各執行測試一次。

1GHz 以下先進行Peak 值量測，若Peak 以低於QP 限制值將不在進行QP 量測，否則，則進行QP 值量測，1GHz 以上先進行Peak 值量測，若Peak 以低於AV 限制值將不在進行AV值量測，否則，則進行AV 值量測。

9kHz~150kHz 測試

解析頻寬: 300Hz

視訊頻寬: 300Hz

量測天線: 6502

檢測器: Quasi-Peak

150kHz~30MHz 測試

解析頻寬: 10kHz

視訊頻寬: 10kHz

量測天線: 6502

檢測器: Quasi-Peak

1GHz 以下測試

解析頻寬: 100kHz

視訊頻寬: 100kHz

量測天線: VULB9168

檢測器: Quasi-Peak

1GHz 以上測試

量測天線: 3117

檢測器: Peak, Average

頻譜分析儀設定 Peak: RBW: 1MHz ; VBW: 1MHz , Average: RBW: 1MHz ; VBW: 10Hz

註: 輻射量測僅放最差模式 (30MHz 以上)。

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6.3. 場強度之計算

場強之計算公式如

$$\text{結果值} = \text{讀值} + \text{校正因子}$$

其中校正因子為：

天線因子+ 饋線損失 + 濾波器損失（若有使用） - 放大器增益（若有使用）
量測結果請見下頁。

註:比較H Plane、E1 Plane和E2 Plane測試值後，附上最差模式 E2 Plane 數據。

Note: Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

“F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

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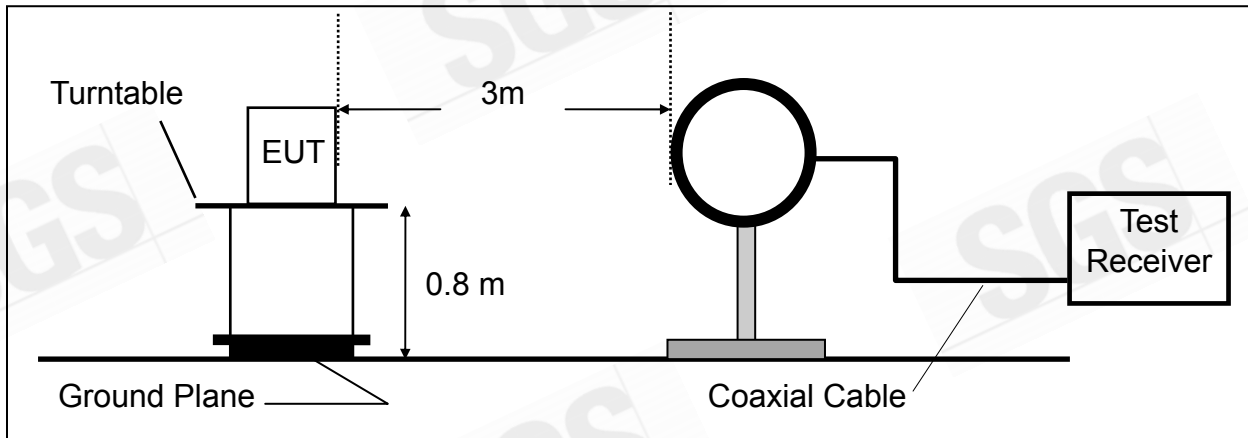
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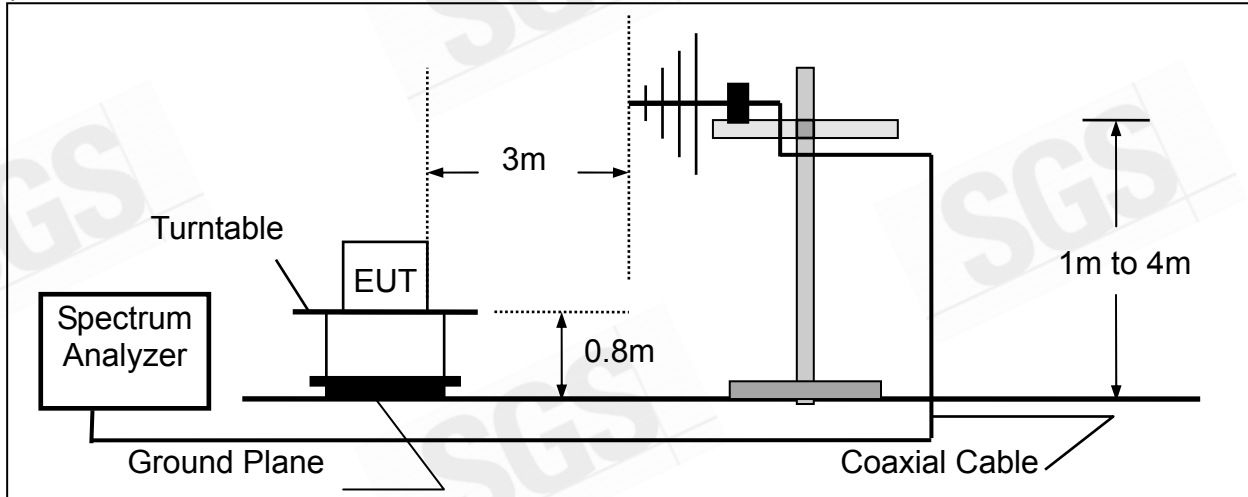
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6.4. 輻射之測試配置

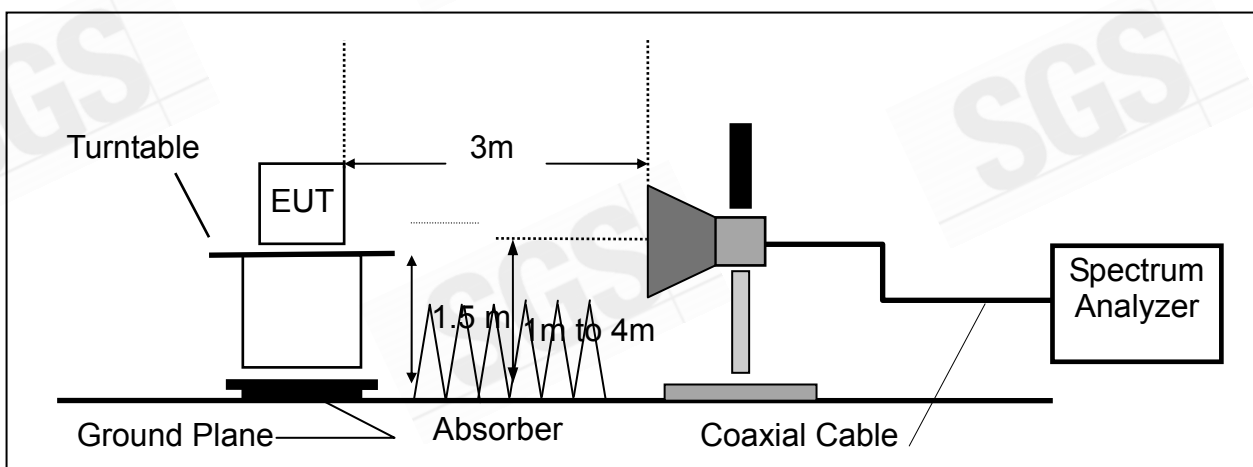
(A) 量測頻率低於 30MHz 以下之測試配置



(B) 量測頻率 30MHz 至 1000MHz 之測試配置



(C) 量測頻率 1000MHz 以上之測試配置



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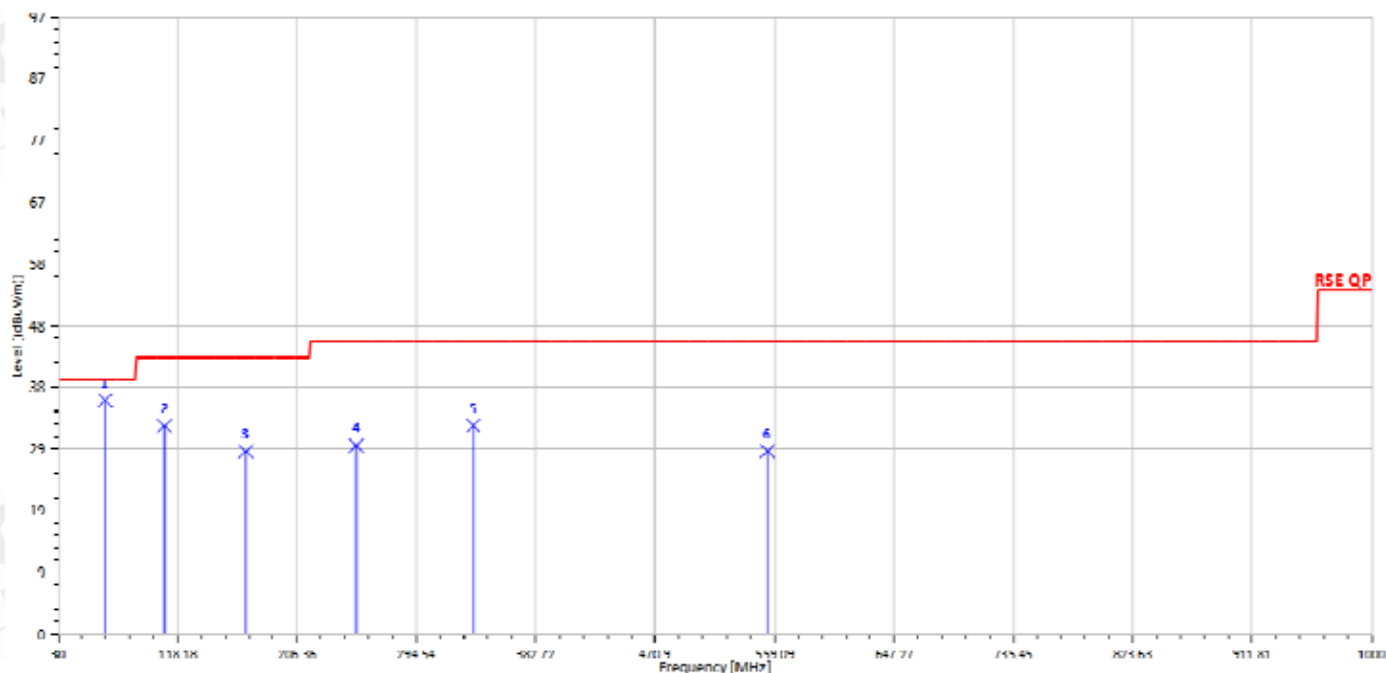
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6.5. 場強輻射之量測結果

6.5.1 發射機場強輻射之量測結果(1GHz 以下)

Operation Mode :	BT4.0	Test Date :	2017/3/22
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Tx CH LOW	Test Engineer :	Tank
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
64.92	S	Peak	55.38	-18.64	36.74	40	-3.26
108.57	S	Peak	52.37	-19.69	32.67	43.5	-10.83
168.71	S	Peak	45.06	-16.33	28.73	43.5	-14.77
250.19	S	Peak	46.68	-17.05	29.64	46	-16.36
336.52	S	Peak	47.11	-14.38	32.73	46	-13.27
553.80	S	Peak	39.15	-10.40	28.75	46	-17.25

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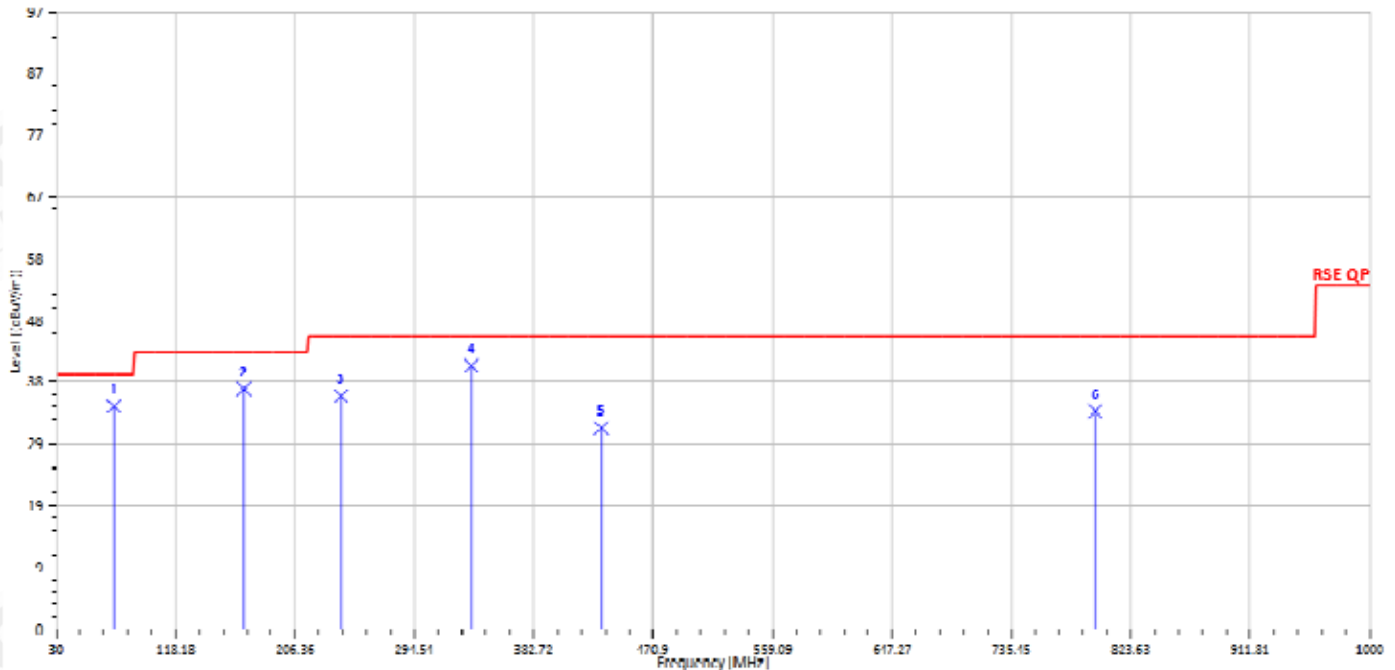
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2402 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH LOW Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
		PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
72.68	S	Peak	54.76	-19.79	34.97	40	-5.03
168.71	S	Peak	54.05	-16.33	37.72	43.5	-5.78
240.49	S	Peak	53.59	-16.97	36.62	46	-9.38
336.52	S	Peak	55.79	-14.38	41.41	46	-4.59
432.55	S	Peak	44.22	-12.60	31.62	46	-14.38
797.27	S	Peak	41.10	-6.90	34.20	46	-11.80

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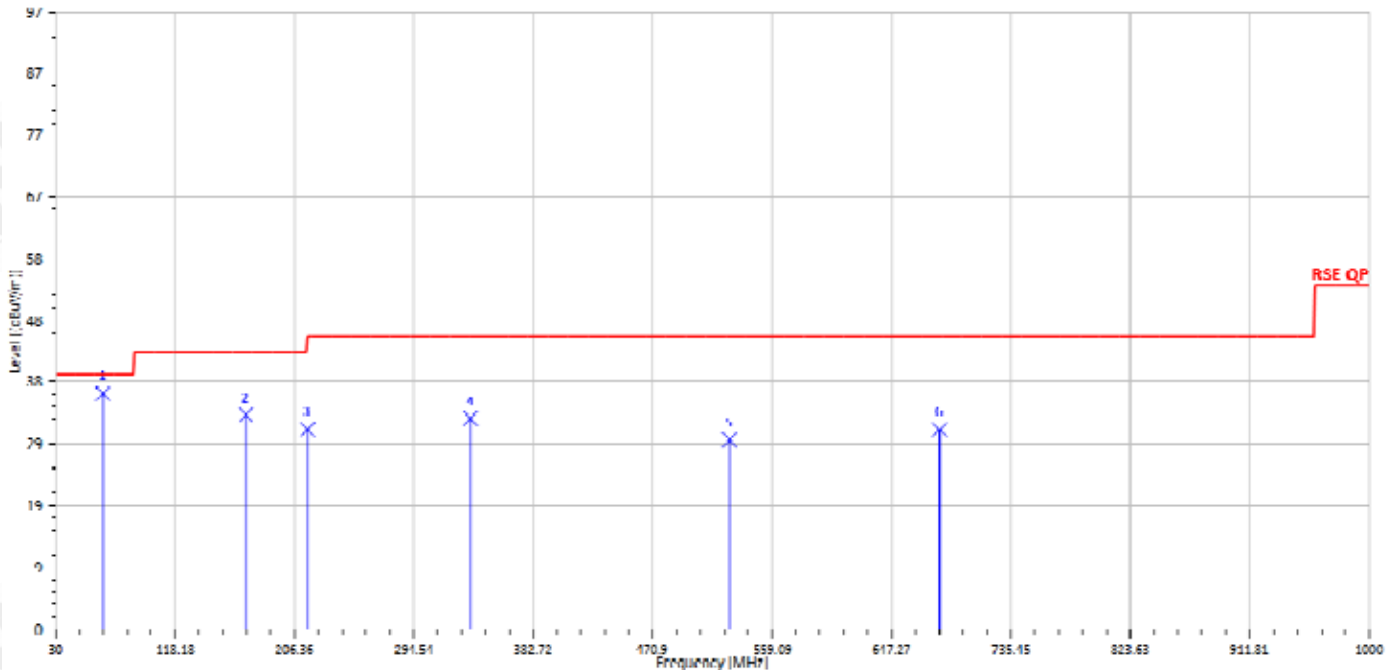
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2442 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH MID Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
64.92	S	Peak	54.67	-18.64	36.02	40	-3.98
170.65	S	Peak	50.20	-16.55	33.65	43.5	-9.85
216.24	S	Peak	49.97	-18.61	31.36	46	-14.64
336.52	S	Peak	47.50	-14.38	33.12	46	-12.88
527.61	S	Peak	40.16	-10.40	29.76	46	-16.24
682.81	S	Peak	39.77	-8.44	31.33	46	-14.67

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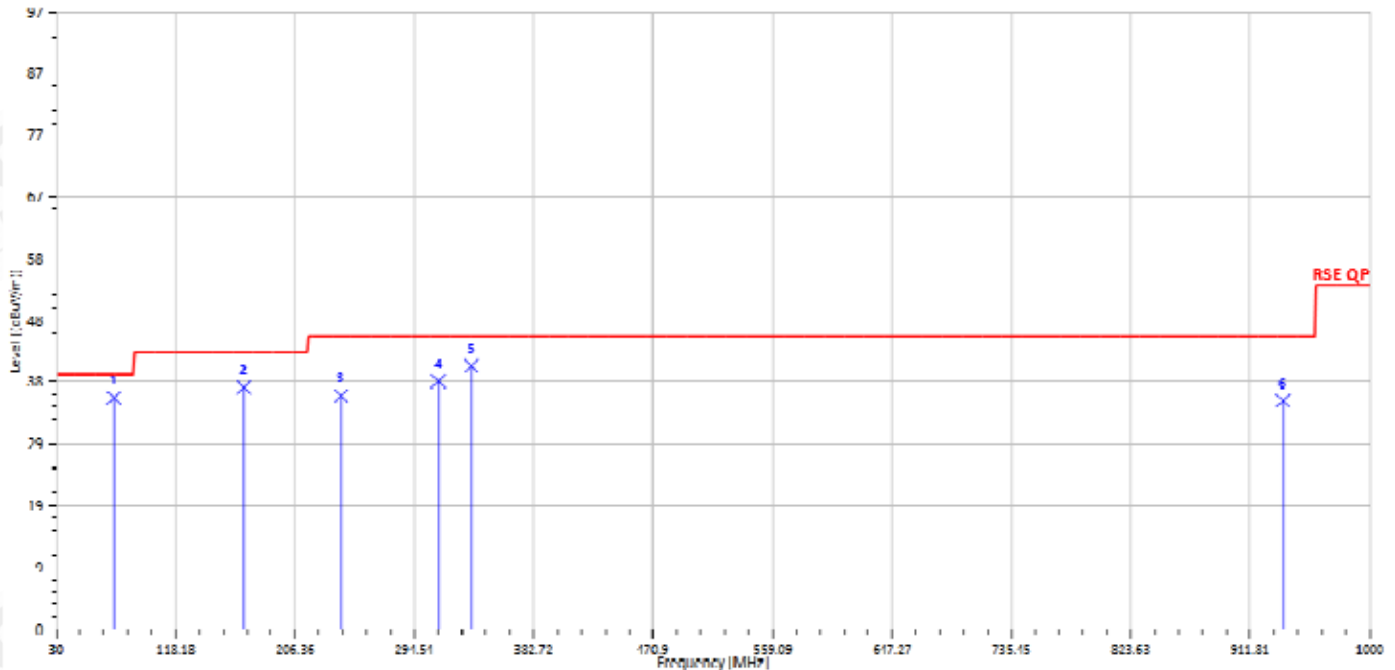
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2442 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH MID Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
72.68	S	Peak	56.14	-19.79	36.35	40	-3.65
168.71	S	Peak	54.32	-16.33	37.98	43.5	-5.52
240.49	S	Peak	53.62	-16.97	36.65	46	-9.35
312.27	S	Peak	53.95	-15.00	38.95	46	-7.05
336.52	S	Peak	55.77	-14.38	41.39	46	-4.61
935.98	S	Peak	40.48	-4.62	35.87	46	-10.13

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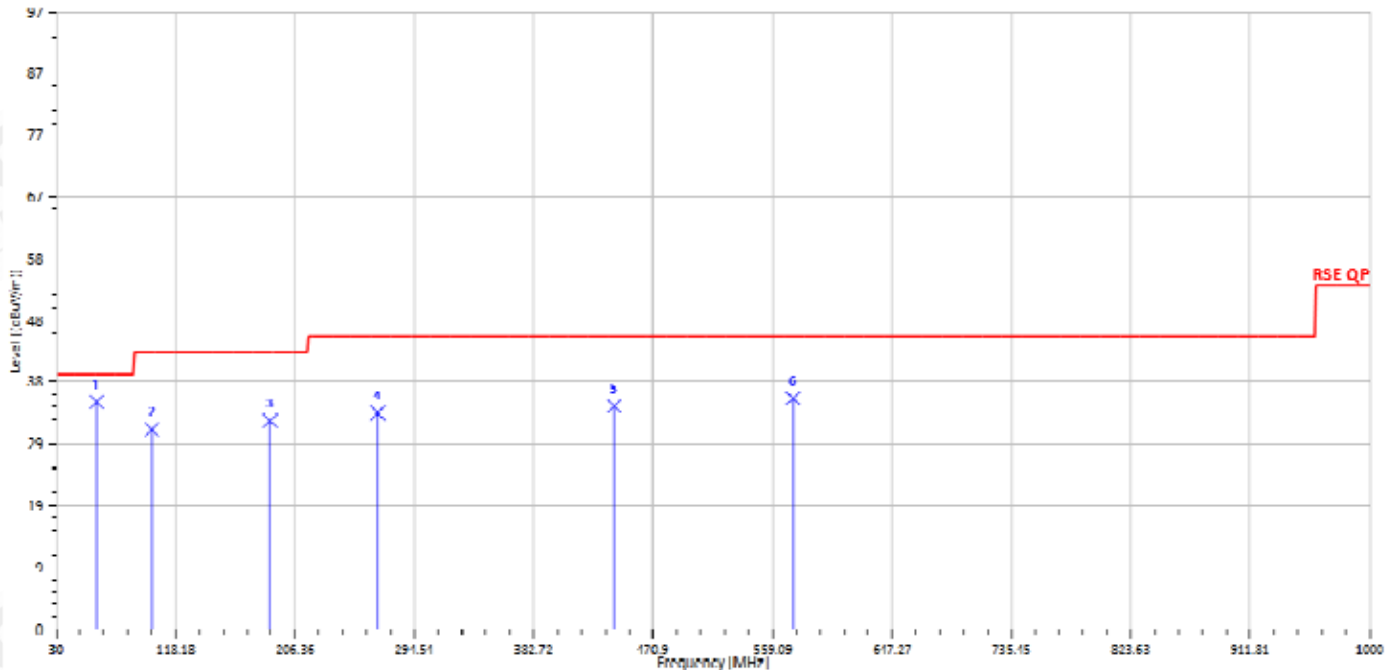
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2480 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH HIGH Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
60.07	S	Peak	53.67	-18.00	35.67	40	-4.33
100.81	S	Peak	52.68	-21.34	31.34	43.5	-12.16
188.11	S	Peak	51.36	-18.60	32.76	43.5	-10.74
267.65	S	Peak	50.53	-16.57	33.95	46	-12.05
442.25	S	Peak	47.43	-12.41	35.02	46	-10.98
574.17	S	Peak	45.59	-9.32	36.27	46	-9.73

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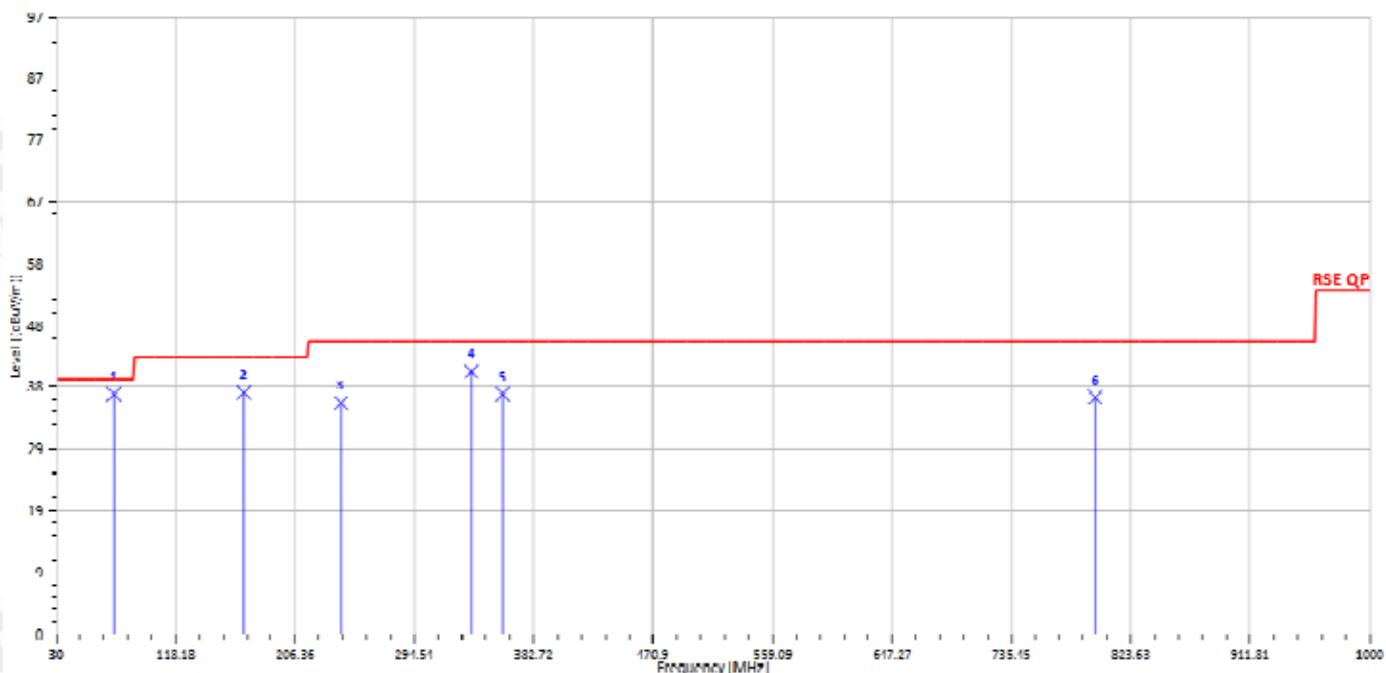
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2480 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH HIGH Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
72.68	S	Peak	56.48	-19.79	36.69	40	-3.31
168.71	S	Peak	54.28	-16.33	37.94	43.5	-5.56
240.49	S	Peak	53.29	-16.97	36.32	46	-9.68
336.52	S	Peak	55.66	-14.38	41.28	46	-4.72
359.80	S	Peak	51.73	-14.03	37.70	46	-8.30
797.27	S	Peak	44.10	-6.90	37.20	46	-8.80

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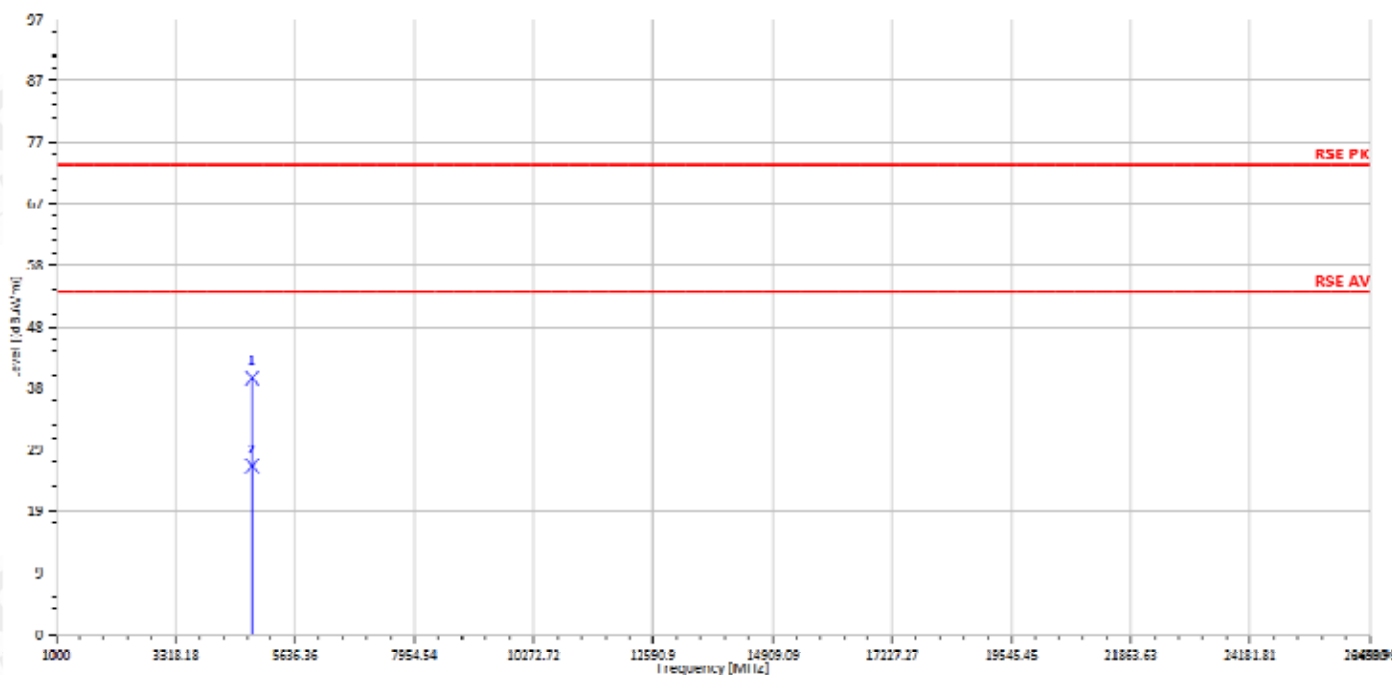
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6.5.2 發射機強輻射之量測結果(1GHz 以上)

Operation Mode :	BT4.0	Test Date :	2017/3/22
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Tx CH LOW	Test Engineer :	Tank
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
		PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4804.00	H	Peak	41.51	-1.16	40.36	74	-33.64
4804.00	H	Average	27.68	-1.16	26.52	54	-27.48

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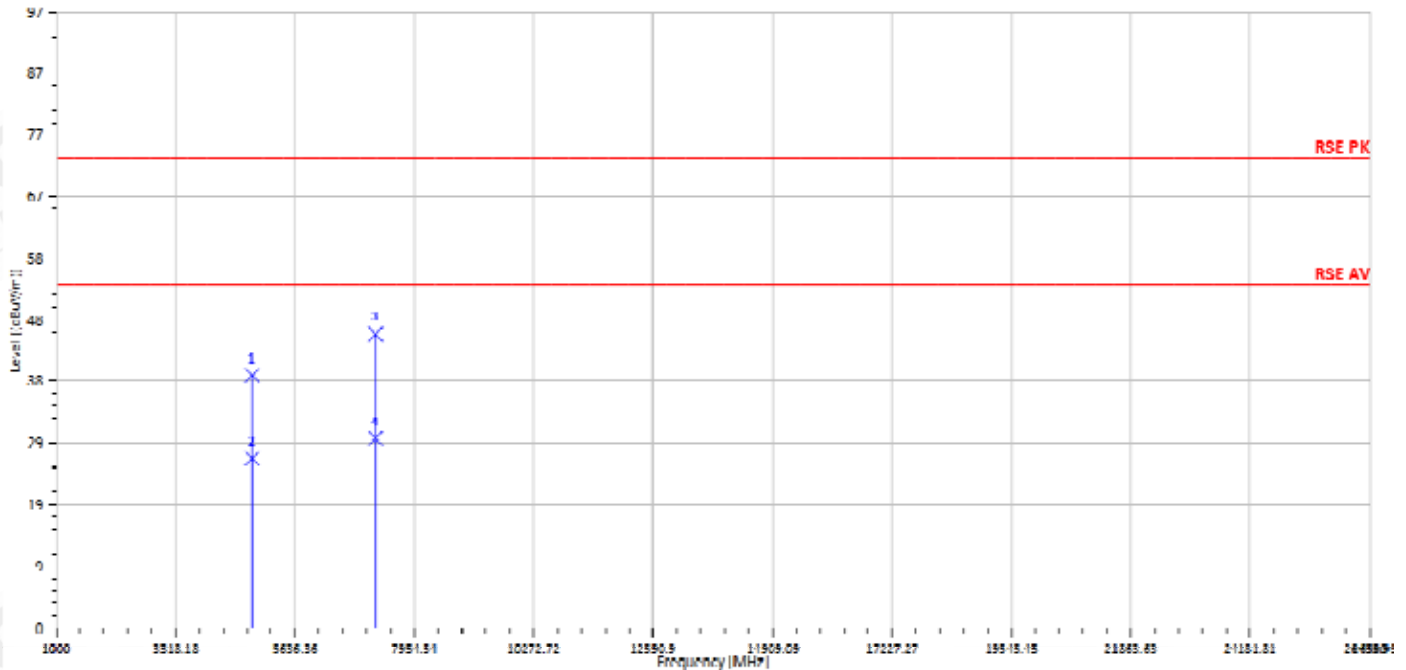
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2402 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH LOW Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	H	Peak	40.91	-1.16	39.75	74	-34.25
4804.00	H	Average	27.82	-1.16	26.67	54	-27.33
7206.00	H	Peak	40.83	5.41	46.25	74	-27.75
7206.00	H	Average	24.44	5.41	29.85	54	-24.15

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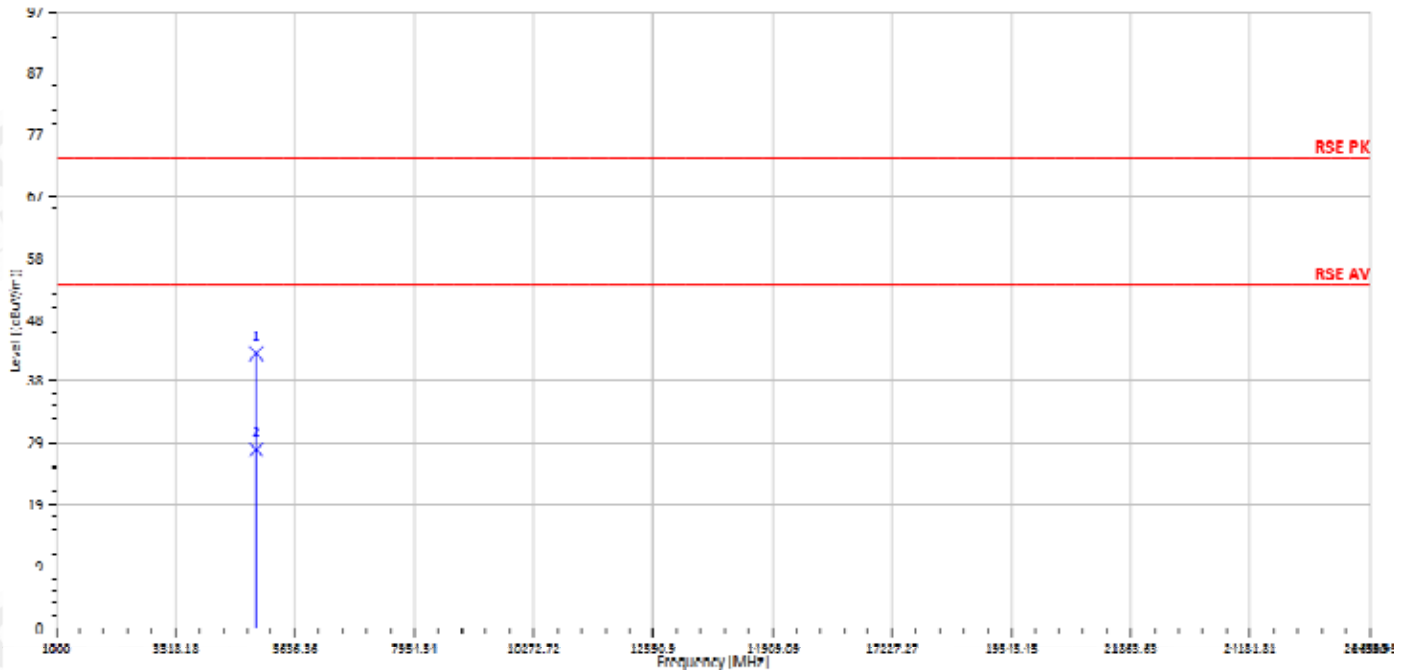
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2442 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH MID Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4884.00	H	Peak	43.90	-0.69	43.21	74	-30.79
4884.00	H	Average	28.77	-0.69	28.08	54	-25.92

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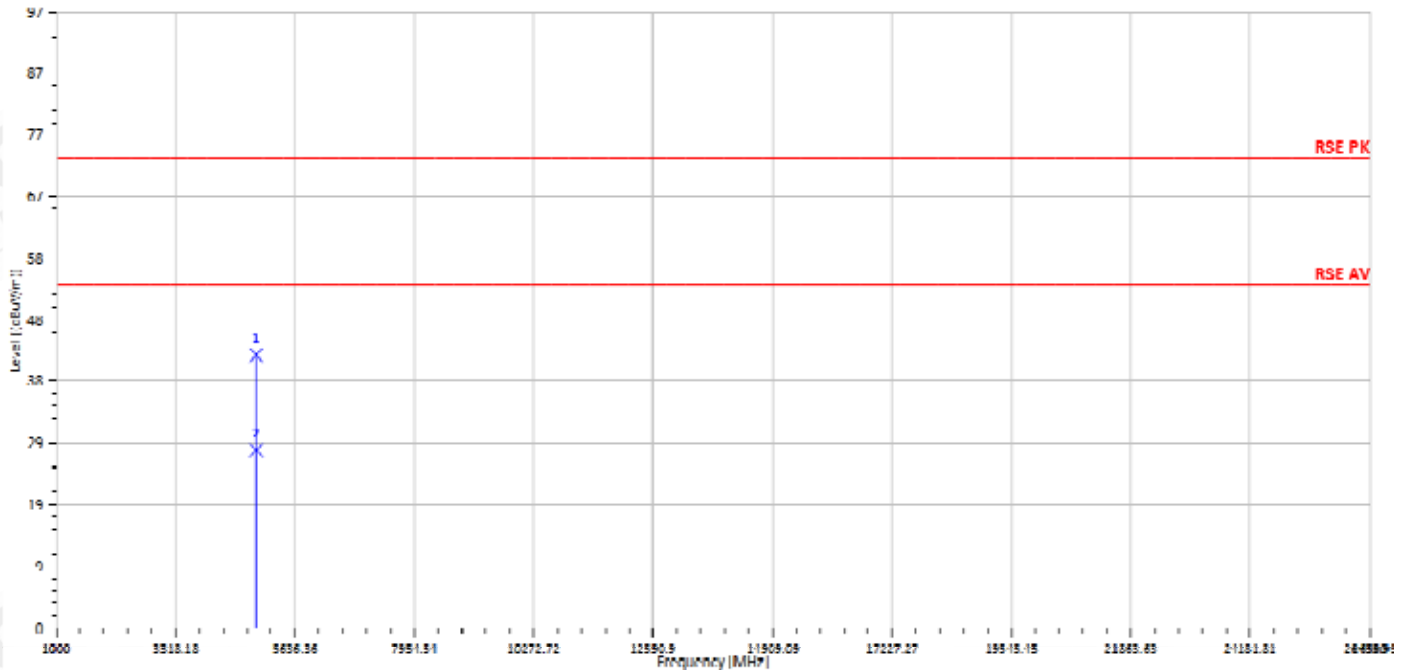
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2442 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH MID Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4884.00	H	Peak	43.65	-0.69	42.96	74	-31.04
4884.00	H	Average	28.69	-0.69	28.00	54	-26.00

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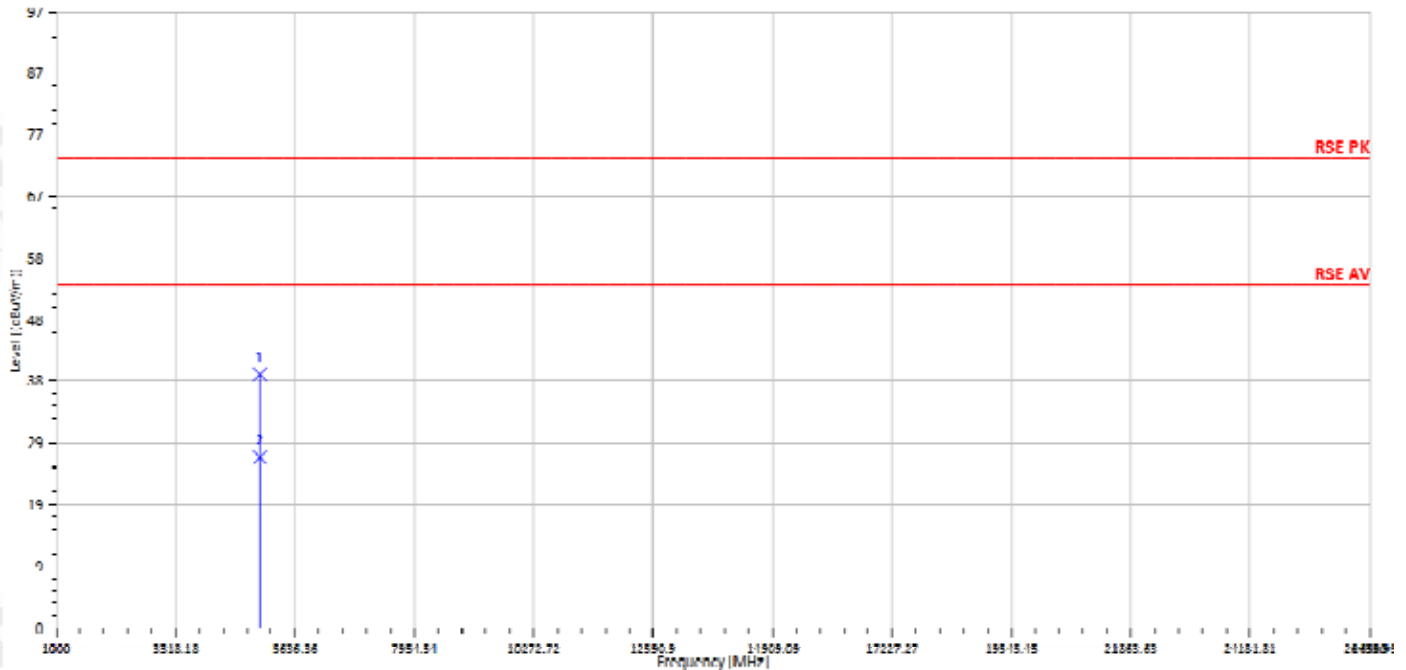
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2480 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH HIGH Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4960.00	H	Peak	40.54	-0.66	39.89	74	-34.11
4960.00	H	Average	27.49	-0.66	26.83	54	-27.17

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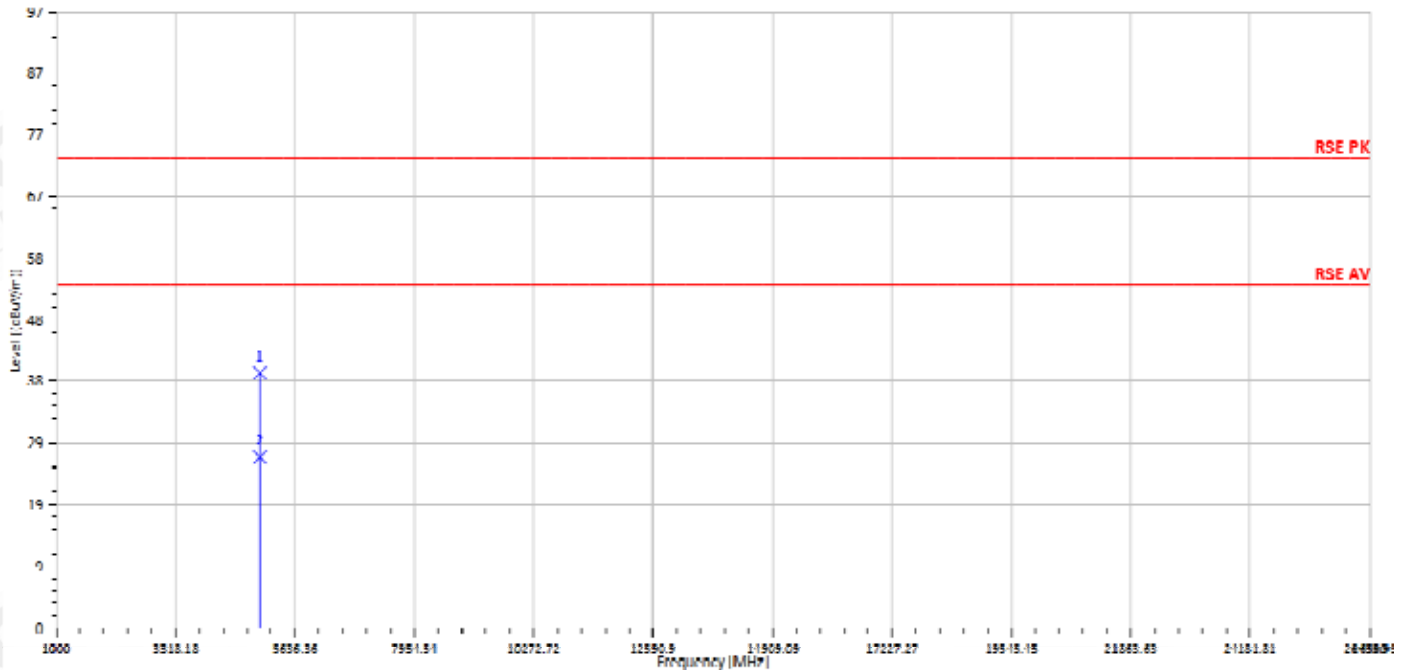
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2480 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH HIGH Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4960.00	H	Peak	40.77	-0.66	40.11	74	-33.89
4960.00	H	Average	27.51	-0.66	26.86	54	-27.15

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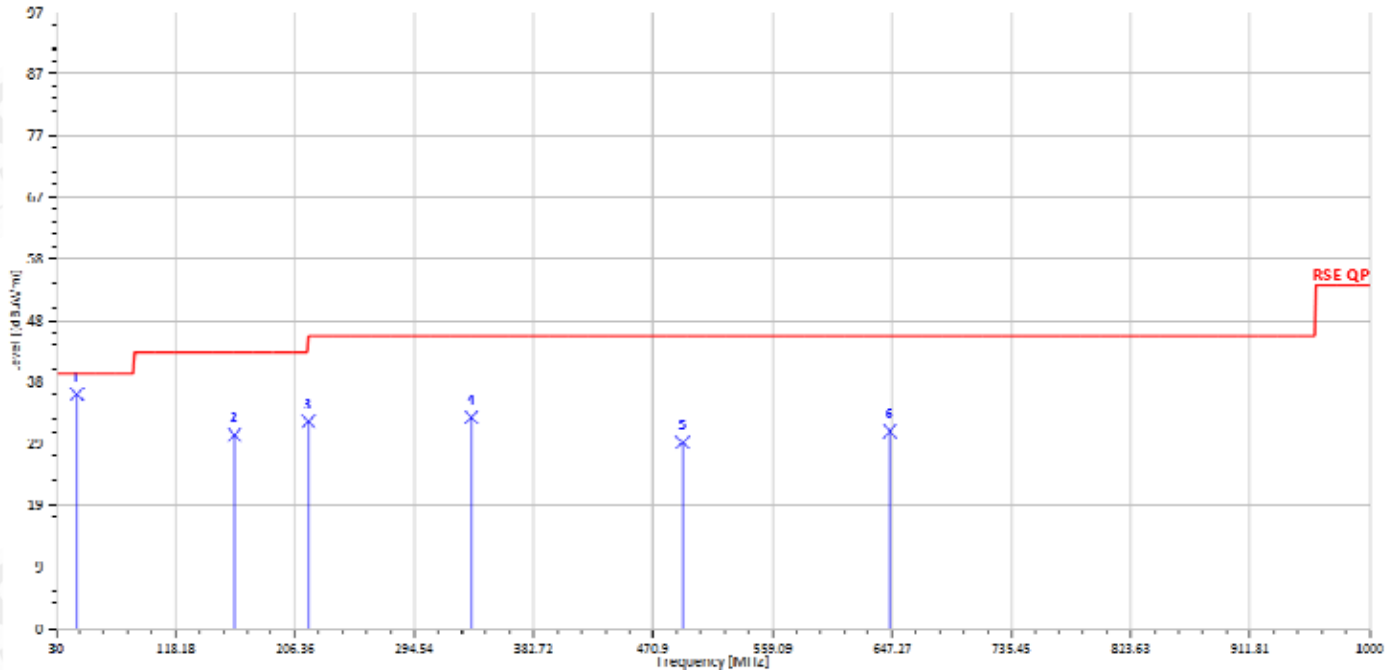
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6.5.3 接收機場強輻射之量測結果(1GHz 以下) (最差模式)

Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2442 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Rx CH MID Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
45.52	S	Peak	53.90	-17.10	36.80	40	-3.20
161.92	S	Peak	46.19	-15.71	30.48	43.5	-13.02
216.24	S	Peak	51.13	-18.61	32.52	46	-13.48
336.52	S	Peak	47.58	-14.38	33.20	46	-12.80
492.69	S	Peak	40.57	-11.31	29.26	46	-16.74
645.95	S	Peak	39.00	-7.99	31.01	46	-14.99

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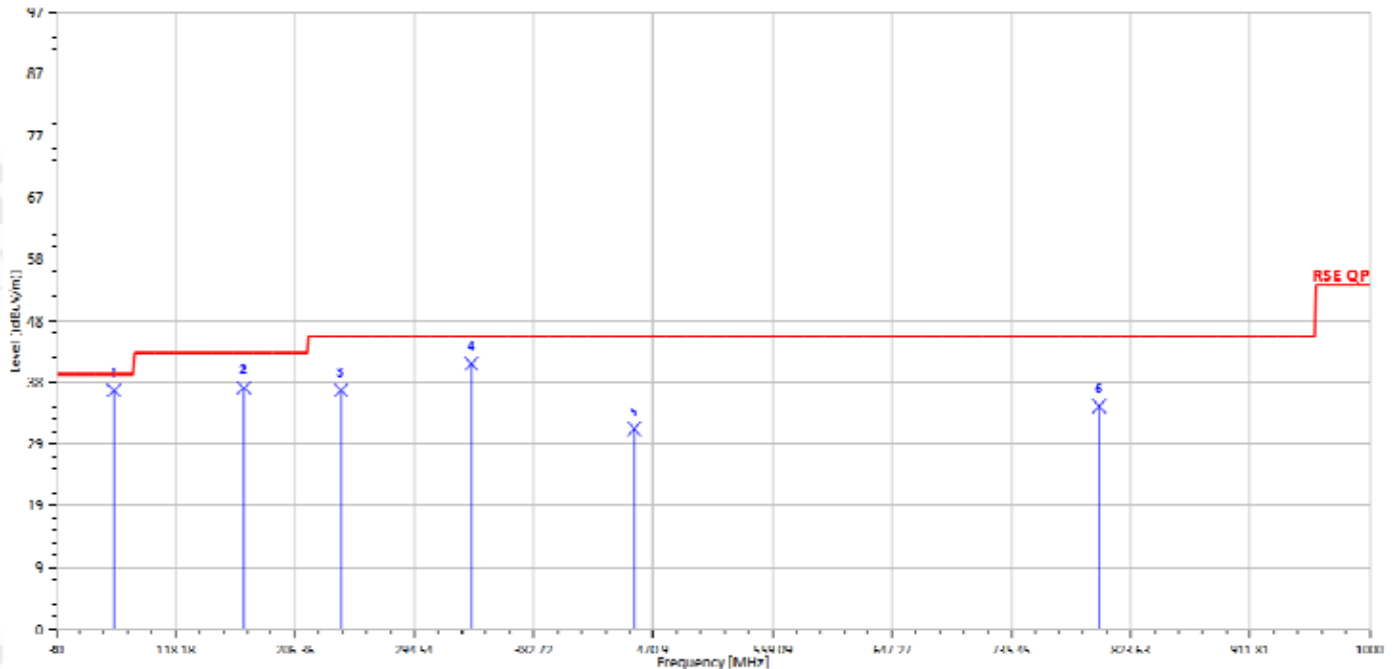
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2442 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Rx CH MID Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
72.68	S	Peak	56.32	-19.79	36.53	40	-3.47
168.71	S	Peak	54.27	-16.33	37.94	43.5	-5.56
240.49	S	Peak	54.54	-16.97	37.57	46	-8.43
336.52	S	Peak	56.09	-14.38	41.71	46	-4.29
456.80	S	Peak	42.98	-11.48	31.50	46	-14.50
800.18	S	Peak	41.98	-6.91	35.07	46	-10.93

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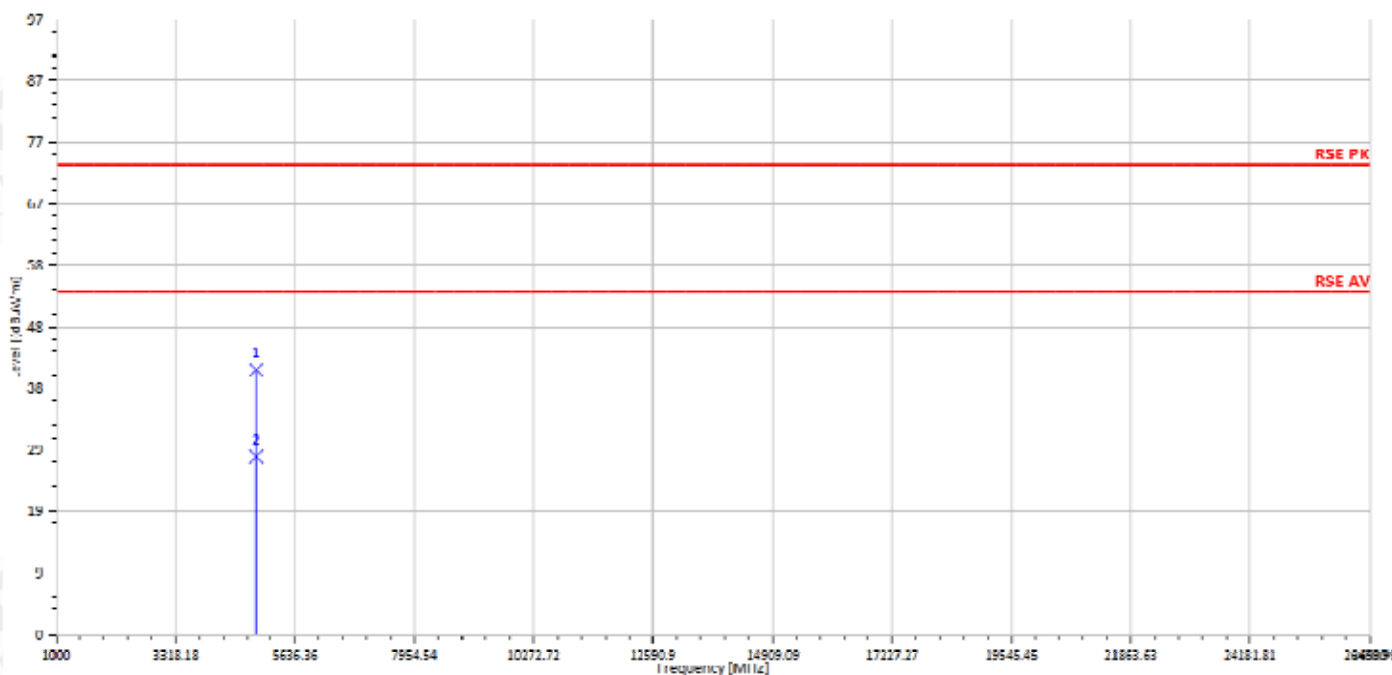
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6.5.4 接收模式場強輻射之量測結果(1GHz 以上) (最差模式)

Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2442 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Rx CH MID Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dBμV		dBμV/m	dBμV/m	
4884.00	H	Peak	42.32	-0.69	41.63	74	-32.37
4884.00	H	Average	28.65	-0.69	27.97	54	-26.03

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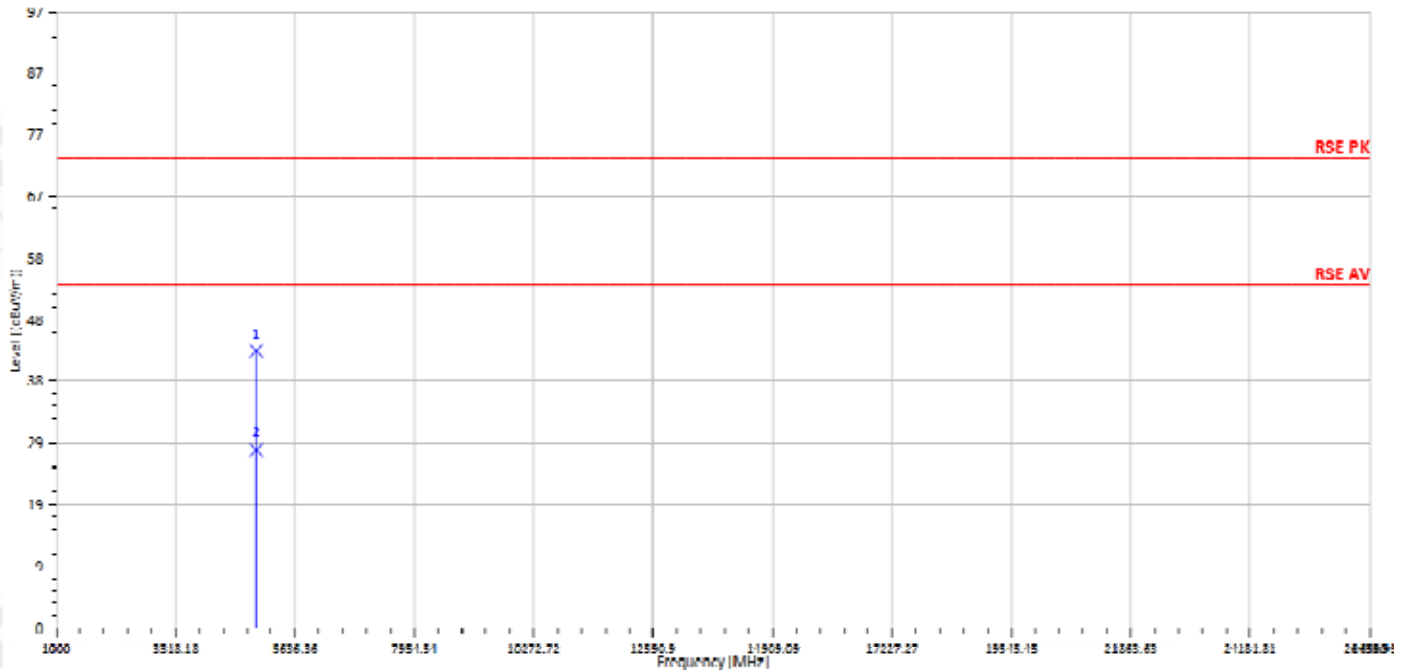
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2442 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Rx CH MID Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4884.00	H	Peak	44.29	-0.69	43.60	74	-30.40
4884.00	H	Average	28.72	-0.69	28.03	54	-25.97

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7. 天線增益之要求

7.1 適用標準

依據NCC低功率射頻電機技術規範3.10.1.3 (1)之規定，操作於2400-2483.5MHz 者，僅用於固定式點對點操作，其發射天線之方向性增益超過 6dBi，每超過3dB應降低1dB之峰值輸出功率。

依據NCC低功率射頻電機技術規範3.10.1.3 (2)之規定，操作於5725-5850MHz 者，其發射天線之方向性增益超過 6dBi，無須降低峰值輸出功率。

依據NCC低功率射頻電機技術規範3.10.1.3 (2)之規定，用於點對多點操作時，如其發射天線之方向性增益超過 6dBi，應依所超過之dB數等量降低最大傳導輸出功率。

註：固定式點對點操作使用方式，並不包括使用點對多點之系統、全向性之應用以及發射相同資訊之共同安裝的多重發射機。展頻或數位調變之發射器需要專業安裝，該設備操作者或安裝者有責任確認該系統是限用於固定式、點對點之操作，隨機所附之使用手冊必須包含此訊息以告知使用者或安裝者須負之責任。

7.2 天線增益

此裝置使用天線如下：

天線型式/天線增益	Multilayer Chip Antenna, Gain: 0.5dBi Part No.: AT3216-B2R7HAA; Supplier: ACX
-----------	--

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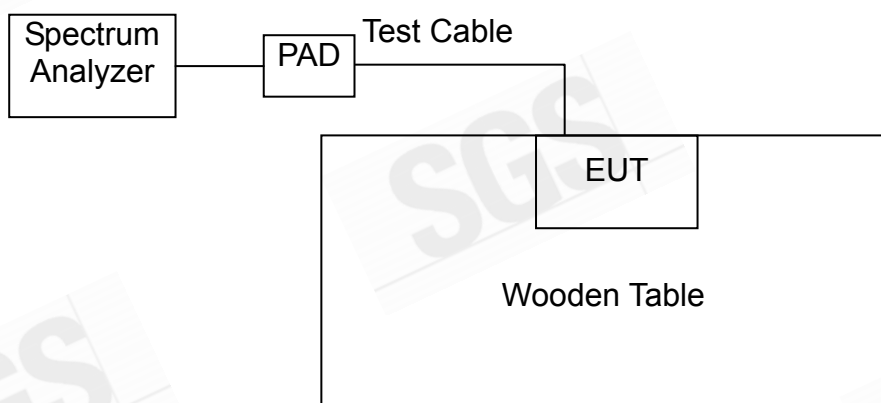
8. 發射頻寬之要求

8.1 適用標準

對使用數位調變技術之低功率發射機，依據 NCC 低功率射頻電機技術規範 3.10.1.6(2) (A)之規定，6dB 之頻寬至少應有 500kHz。

8.2 測試配置

圖 4: 發射頻寬之測試配置



8.3 量測結果

測試設備: BLE112

型號: BLE112-A

解析頻寬: 100 kHz

視訊頻寬: 300 kHz

Span: 5MHz

測試者:

BT4.0 mode

頻率 (MHz)	頻寬讀值 (kHz)	限制值 (kHz)	結果
2402	731.01	> 500	PASS
2442	732.45	> 500	PASS
2480	738.63	> 500	PASS

* offset 0.9dB

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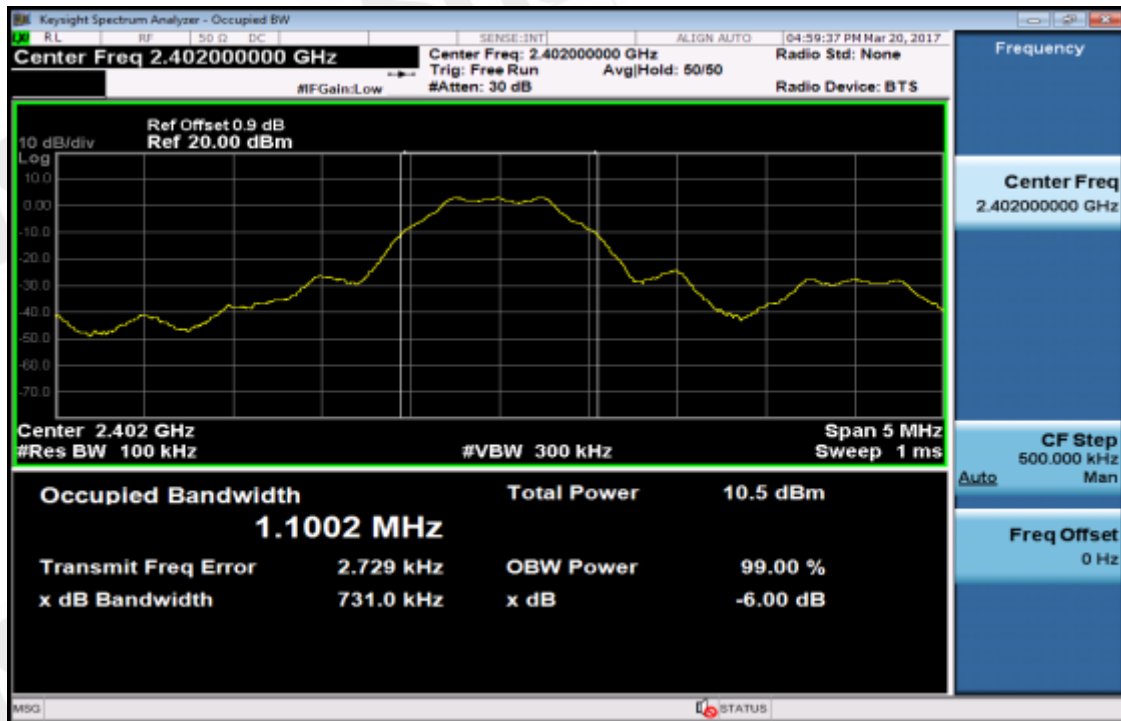
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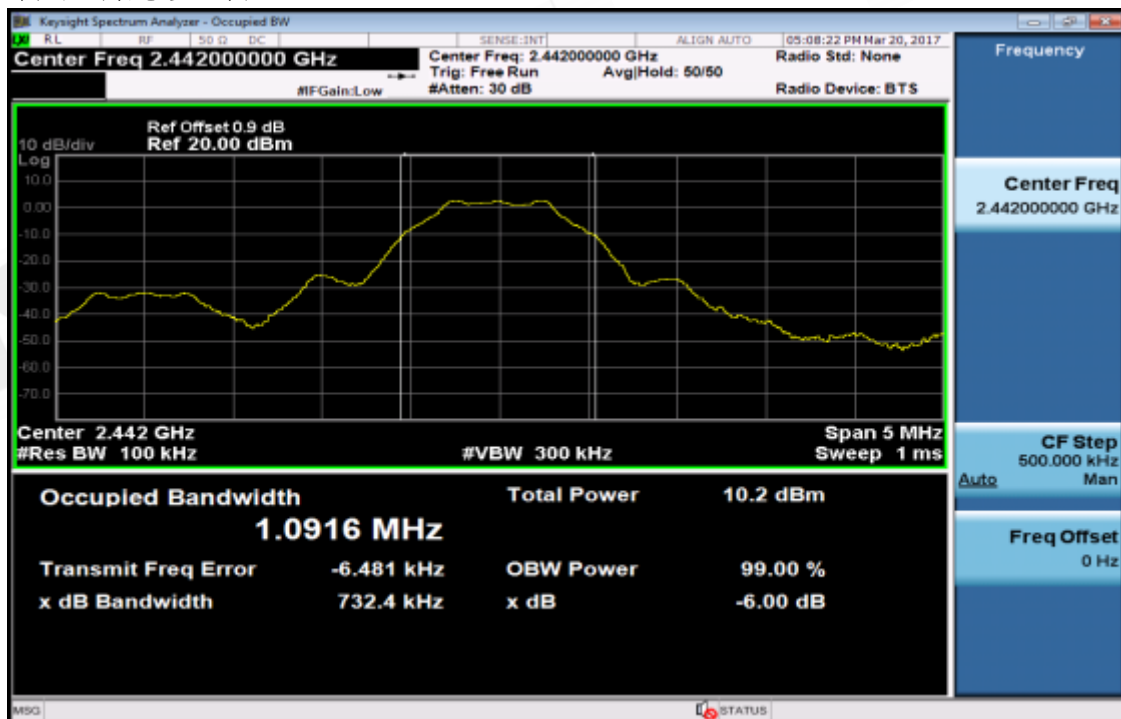
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Test Data Plot

CH Low 發射頻寬量測值



CH Mid 發射頻寬量測值



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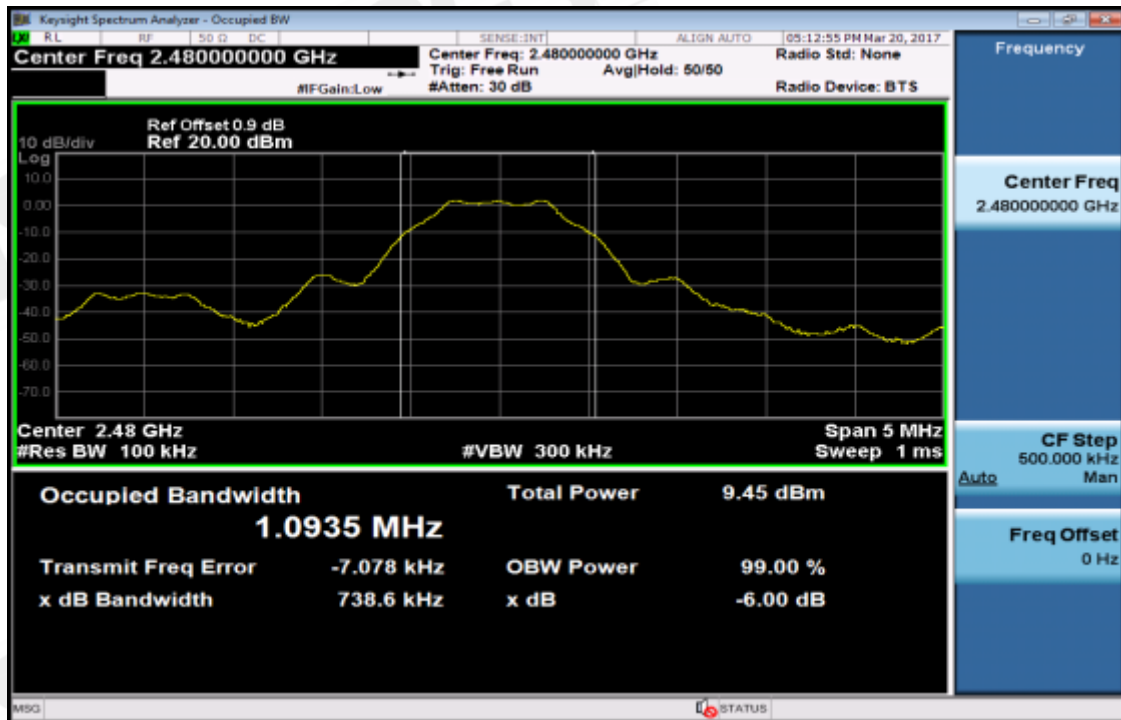
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CH High 發射頻寬量測值



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9. 輸出峰值功率之量測

9.1 適用標準

依據 NCC 低功率射頻電機技術規範 3.10.1.2(1) (A)(C)之規定，操作於 2400-2483.5MHz 與 5725-5850MHz 之所有數位調變技術系統：1 Watt(含)以下。

依據NCC低功率射頻電機技術規範3.10.1.3之規定，用於非固定式點對點操作時，若其發射天線之方向性增益超過6dBi，應依所超過之dB數等量降低峰值輸出功率。如用於固定式點對點操作時，應符合下列情現之一：

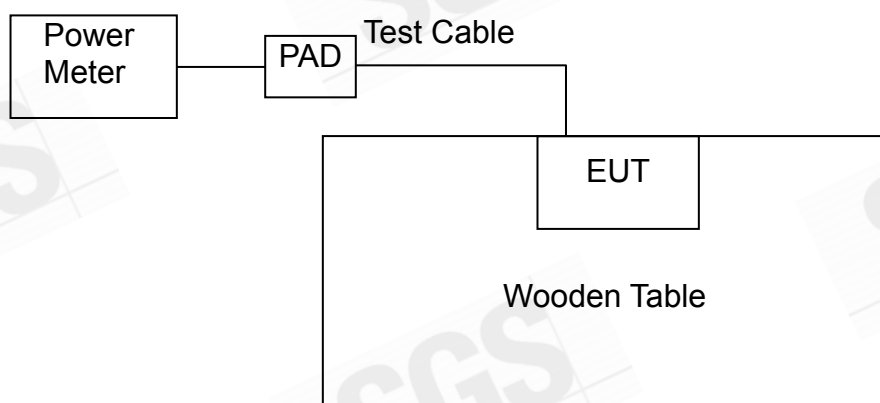
依據NCC低功率射頻電機技術規範3.10.1.3 (1)之規定，操作於2400-2483.5MHz 者，僅用於固定式點對點操作，其發射天線之方向性增益超過 6dBi，每超過3dB應降低1dB之峰值輸出功率。

依據NCC低功率射頻電機技術規範3.10.1.3 (2)之規定，操作於5725-5850MHz 者，其發射天線之方向性增益超過 6dBi，無須降低峰值輸出功率。

依據NCC低功率射頻電機技術規範3.10.1.3 (3)之規定，用於點對多點操作時，如其發射天線之方向性增益超過 6dBi，應依所超過之dB數等量降低最大傳導輸出功率。

註：固定式點對點操作使用方式，並不包括使用點對多點之系統、全向性之應用以及發射相同資訊之共同安裝的多重發射機。展頻或數位調變之發射器需要專業安裝，該設備操作者或安裝者有責任確認該系統是限用於固定式、點對點之操作，隨機所附之使用手冊必須包含此訊息以告知使用者或安裝者須負之責任。

9.2 輸出功率之測試配置



*註：此產品為點對多點操作

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9.3 輸出功率之量測結果

測試設備: BLE112

型號: BLE112-A

測試日期: Mar. 23, 2017

測試者:



BT4.0

Frequency (MHz)	Reading Power	Output Power (W)	Limit (W)
2402.00	4.53	0.00284	1
2442.00	4.05	0.00254	1
2480.00	3.57	0.00228	1
Cable loss	0.9 dB		

*Note: 由 Power Meter 量測。

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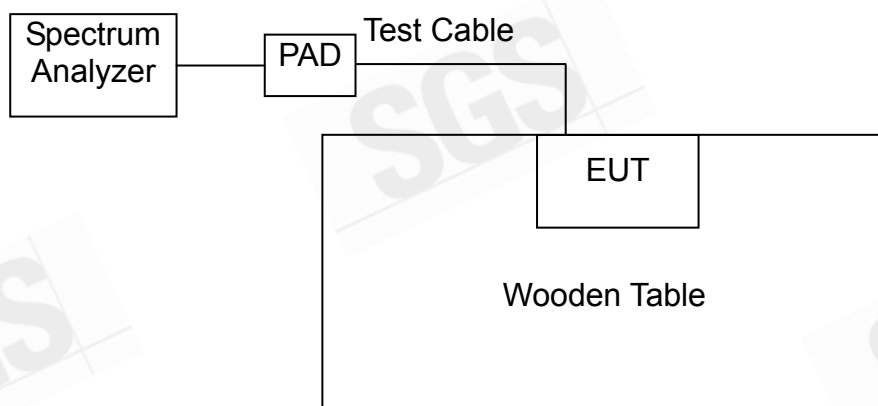
10. 開放頻帶邊緣 100KHZ 頻寬內之限制

10.1 適用標準

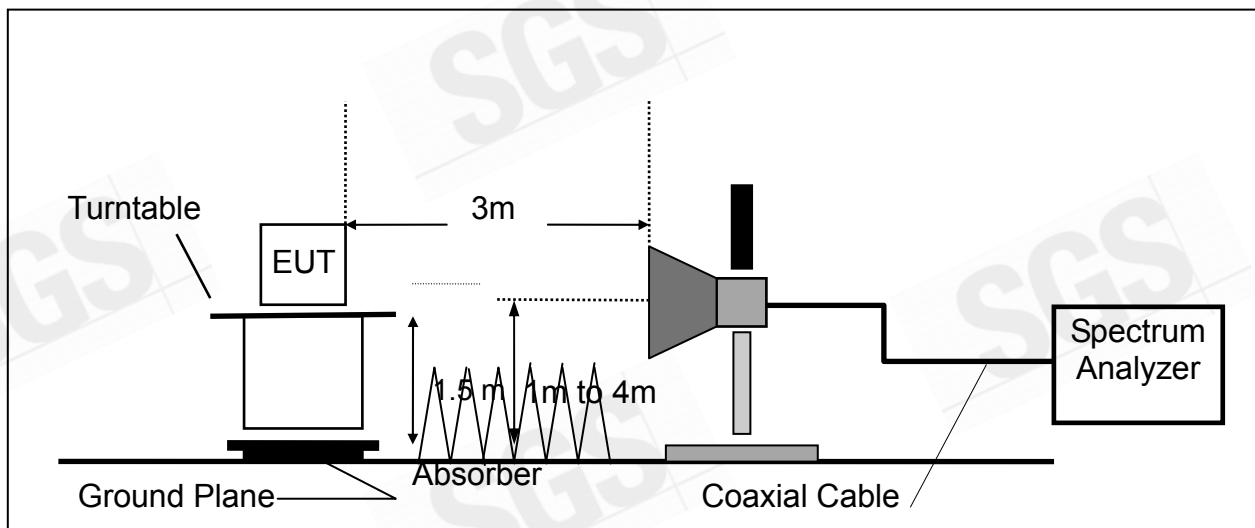
依據 NCC 低功率射頻電機技術規範 3.10.1.5 之規定，使用頻帶範圍外之任意 100kHz 內，發射器所產生的射頻功率相較於使用頻帶範圍中包含最高所需功率之 100kHz 內的射頻功率，須衰減 20 分貝 (dB)，以射頻傳導或輻射方式測量。此外，落於第 2.7 節禁用頻段之輻射發射，應符合第 2.8 節之規定。

10.2 開放頻帶邊緣之測試配置

(a) 傳導量測配置圖：



(b) 輻射量測配置圖：



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10.3 開放頻帶邊緣之量測結果

測試設備: BLE112

解析頻寬: 100 kHz

Span: Low: 100MHz / High: 25MHz

型號: BLE112-A

視訊頻寬: 300 kHz

測試者:



1. 頻帶外發射傳導量測值

發射限制測試值 CH Low (下邊緣頻帶): 在 2400.00MHz 之 100kHz 頻寬內最大值皆比主波低 20dB 以上。

發射限制測試值 CH High(上邊緣頻帶): 在 2483.50MHz 之 100kHz 頻寬內最大值皆比主波低 20dB 以上。

$Actual\ FS(dB\mu V/m) = SPA.\ Reading\ level(dB\mu V) + Factor(dB)$

$Factor(dB) = Antenna\ Factor(dB\mu V/m) + Cable\ Loss(dB) - Pre_Amplifier\ Gain(dB)$

“F”: denotes Fundamental Frequency. ; “H”: denotes Harmonic Frequency.

“E”: denotes Band Edge Frequency. ; “S”: denotes Spurious Frequency.

“---”: denotes Noise Floor.

請參考附圖。

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禁用頻帶及邊際頻帶傳導測試

CH Low



CH High



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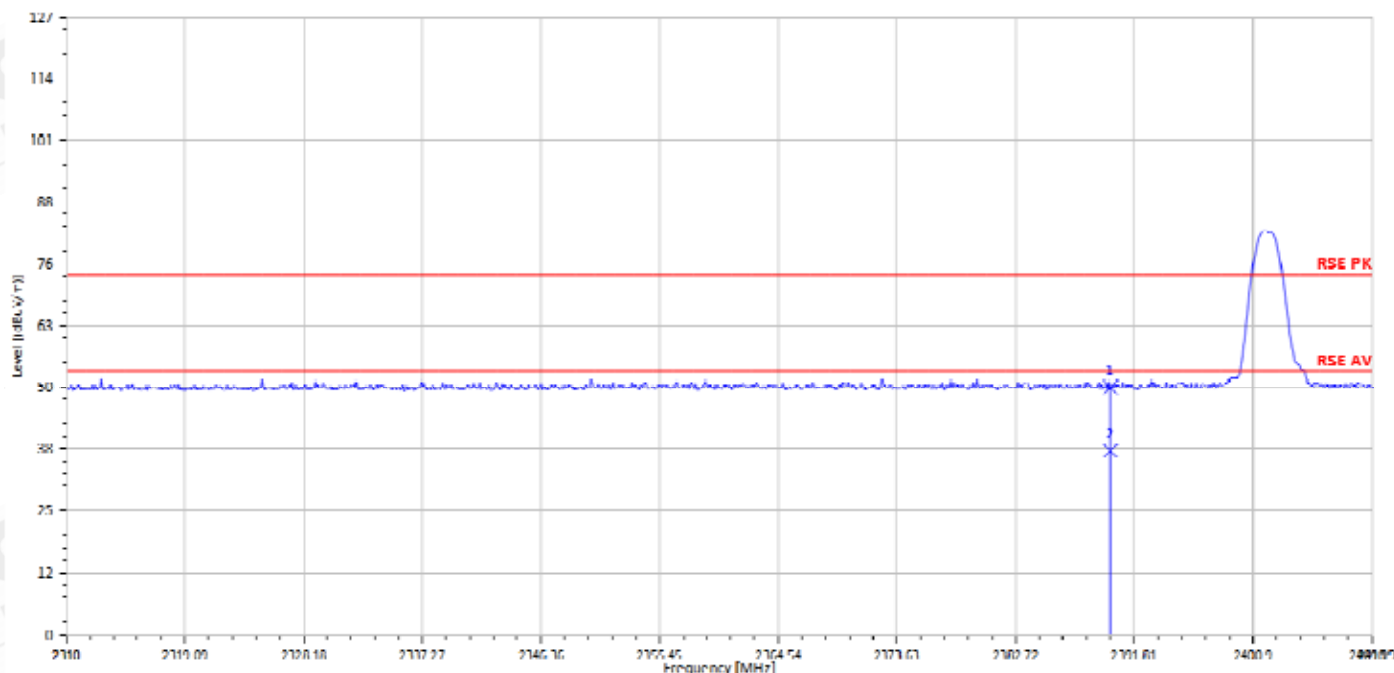
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2. 禁用頻帶輻射量測值

Channel Low

Operation Mode :	BT4.0	Test Date :	2017/3/22
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Tank
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Peak	57.56	-6.84	50.72	74	-23.28
2390.00	E	Average	44.47	-6.84	37.63	54	-16.37

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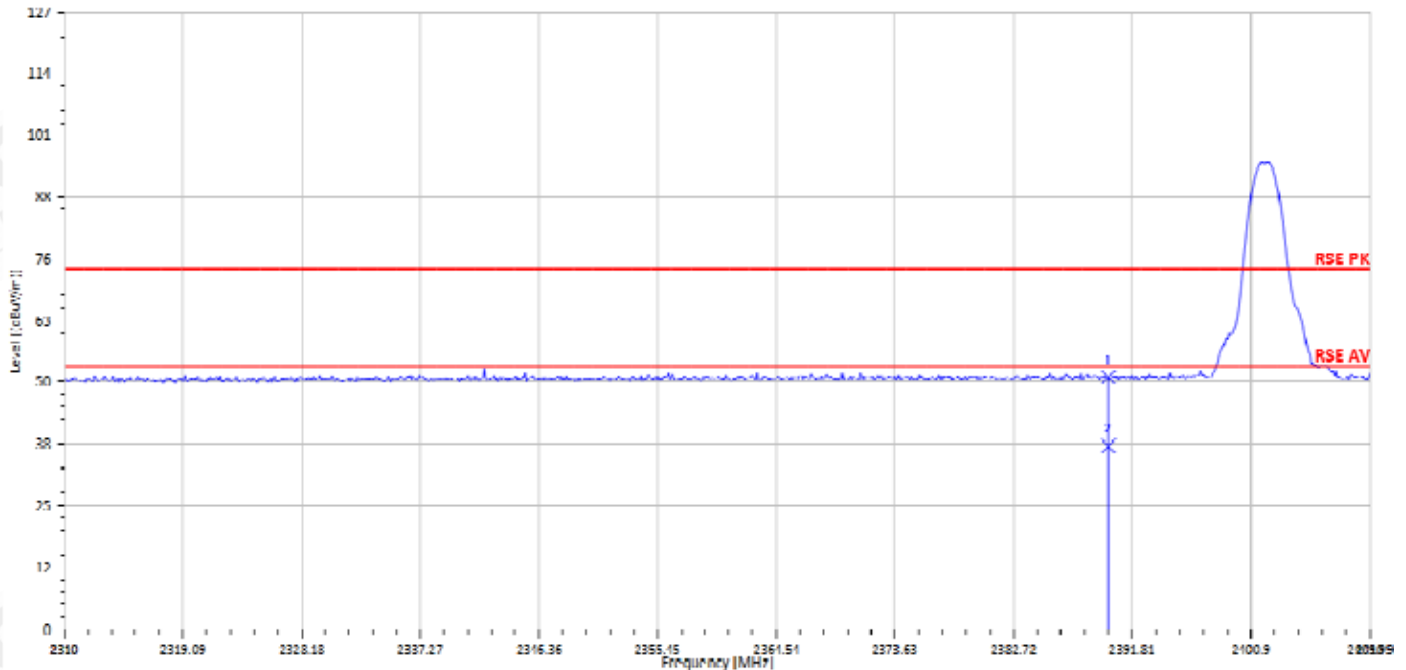
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2402 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : BE CH LOW Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
		PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Peak	58.65	-6.84	51.81	74	-22.19
2390.00	E	Average	44.49	-6.84	37.64	54	-16.36

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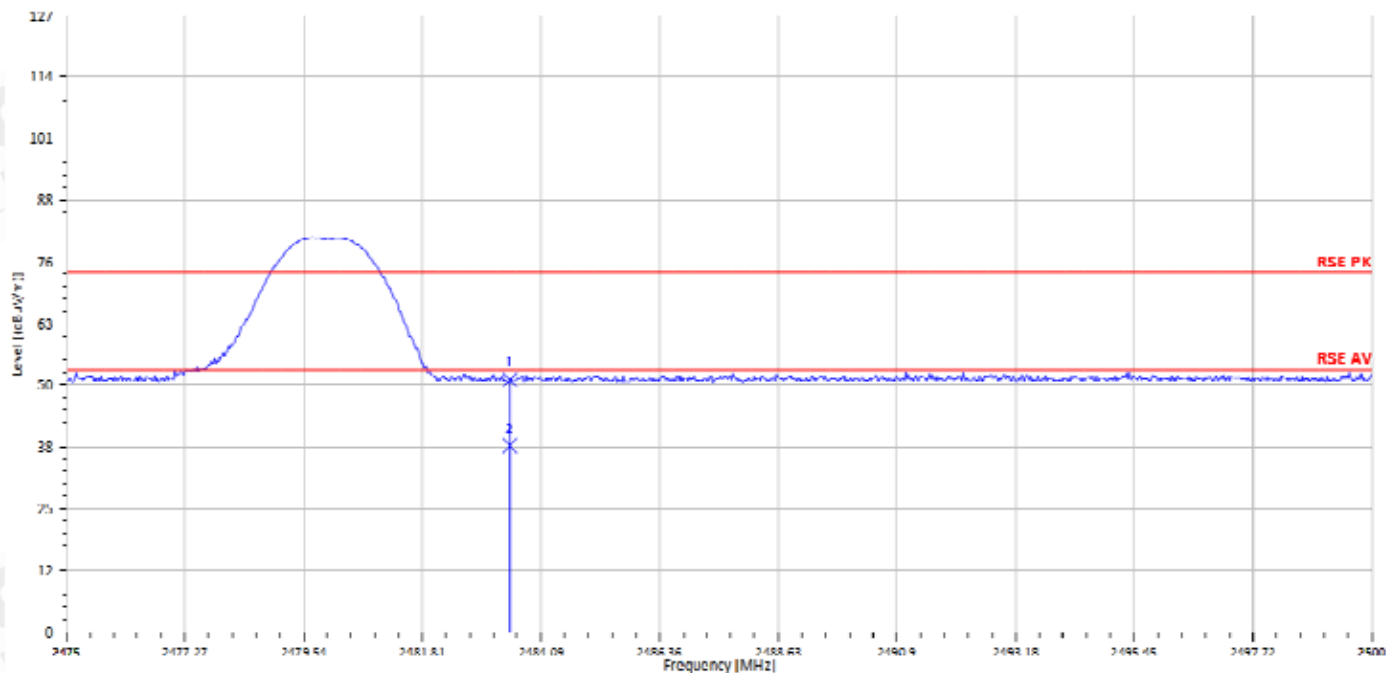
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Channel High

Operation Mode :	BT4.0	Test Date :	2017/3/22
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Tank
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Peak	58.23	-6.38	51.85	74	-22.15
2483.50	E	Average	44.74	-6.38	38.36	54	-15.64

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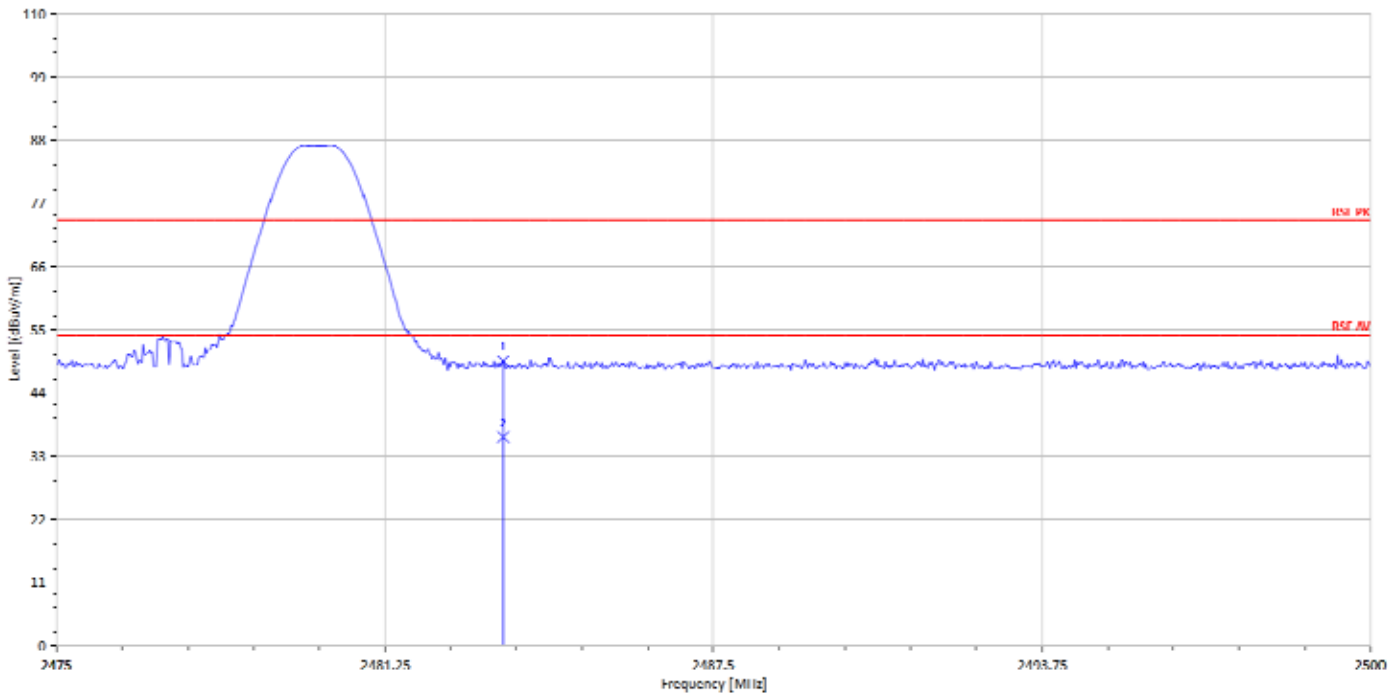
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Operation Mode : BT4.0 Test Date : 2017/3/22
 Fundamental Frequency : 2480 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : BE CH HIGH Test Engineer : Tank
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Peak	59.39	-6.38	53.00	74	-21.00
2483.50	E	Average	45.07	-6.38	38.69	54	-15.31

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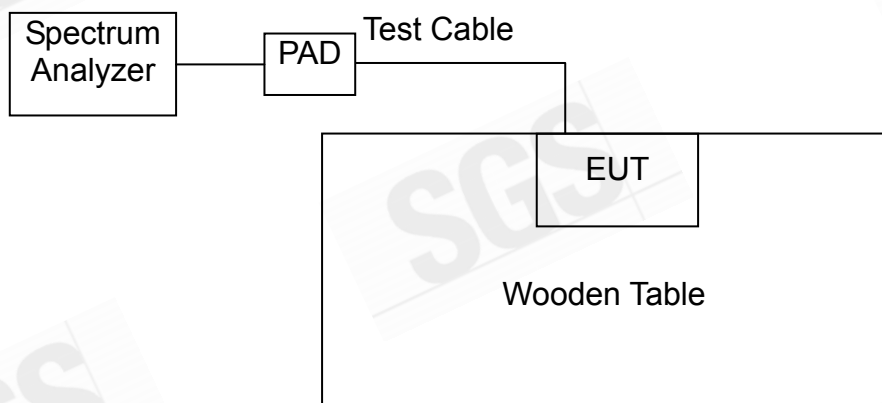
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11. 功率密度之量測

11.1 適用標準

依據 NCC 低功率射頻電機技術規範 3.10.1.6(2) (B)規定，對數位調變之展頻系統，在使用頻率範圍之任意 3kHz 頻寬內，由發射機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 8dBm。

11.2 功率密度之測試配置



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11.3 功率密度量測結果

測試設備: BLE112

解析頻寬: 3 kHz

Span: 300 kHz

型號: BLE112-A

視訊頻寬: 10 kHz

測試者:



BT4.0 mode

Frequency (MHz)	RF Power (dBm)	Maximum Limit (dBm)
2402	-13.66	8
2442	-11.21	8
2480	-14.92	8

* offset 0.9 dB

Band Edge Limit

Frequency (MHz)	RF Power Density (dBm)	Bandedge Limit = PSD - 20dB (dBm)
2402	2.95	-17.05
2480	1.80	-18.20

NOTE: cable loss as dB that offsets in the spec**NOTE: Refer to next page for plots.**

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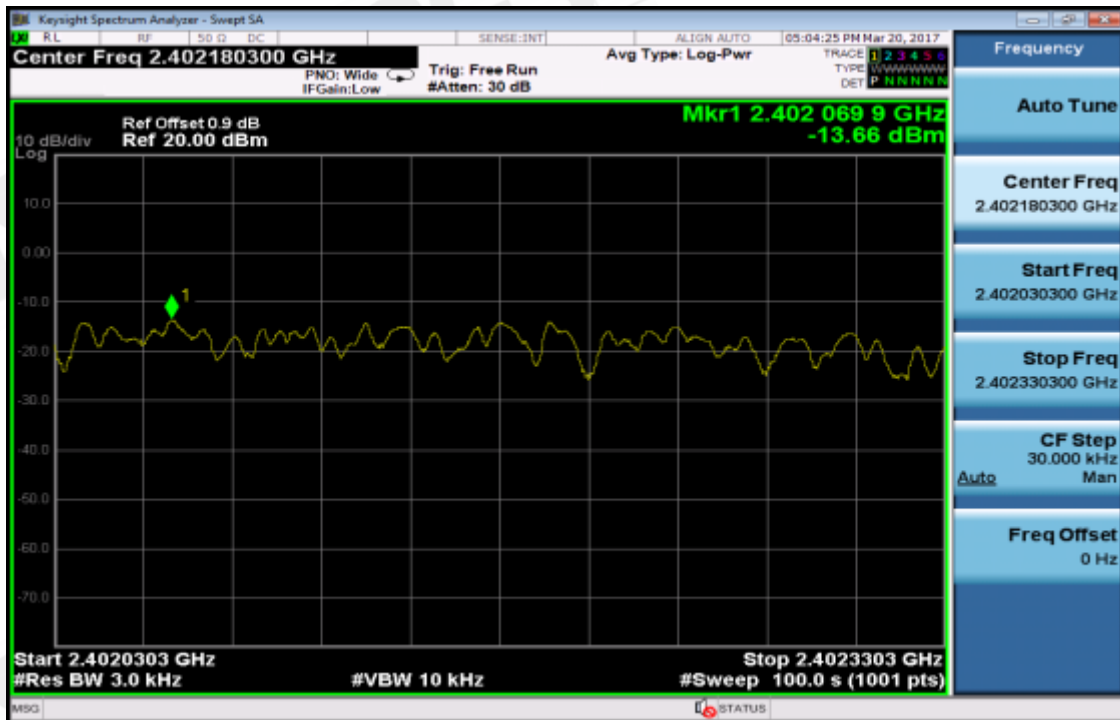
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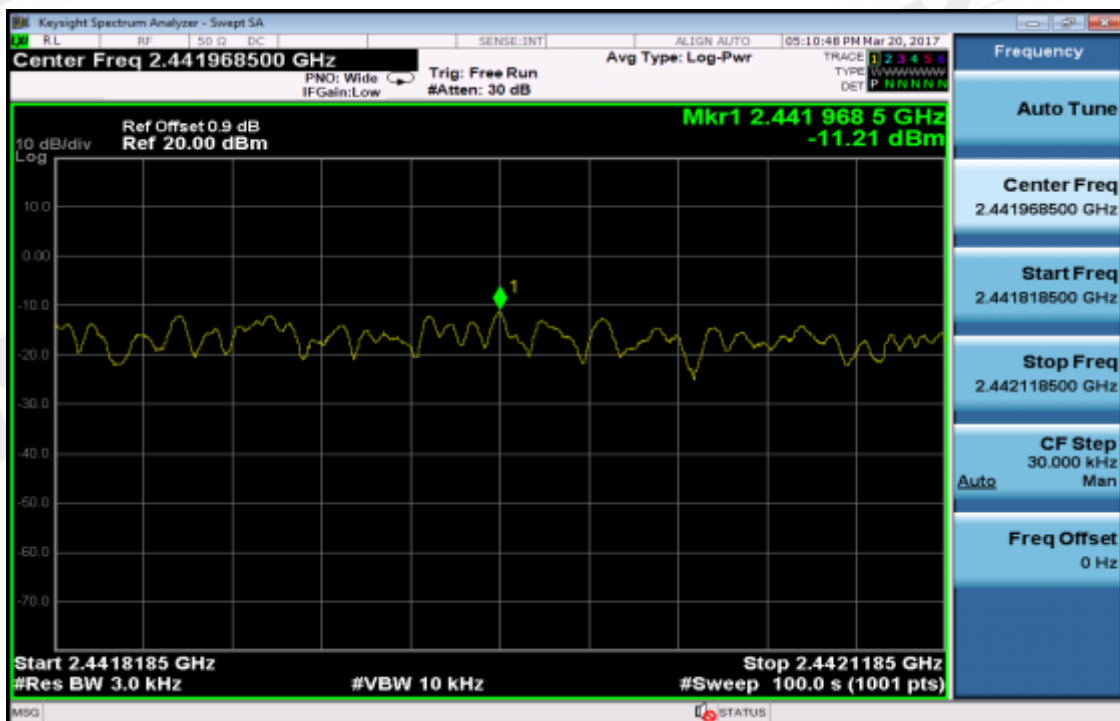
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Test Data Plot

CH Low 功率密度量測值



CH Mid 功率密度量測值



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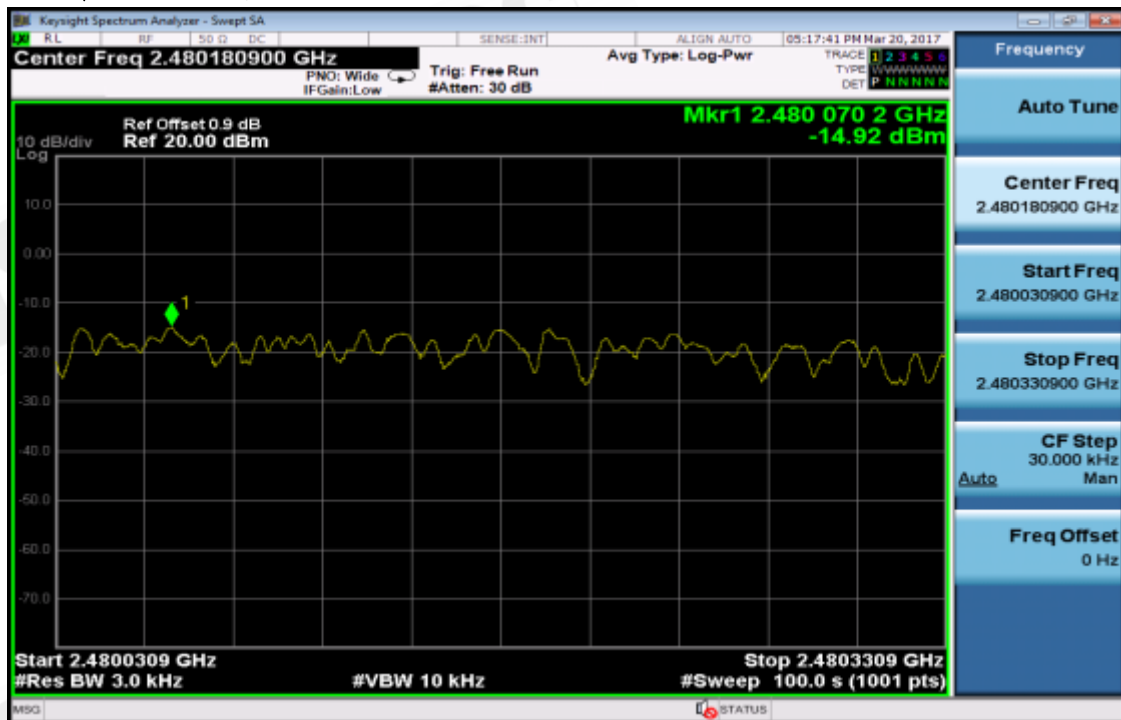
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CH High 功率密度量測值



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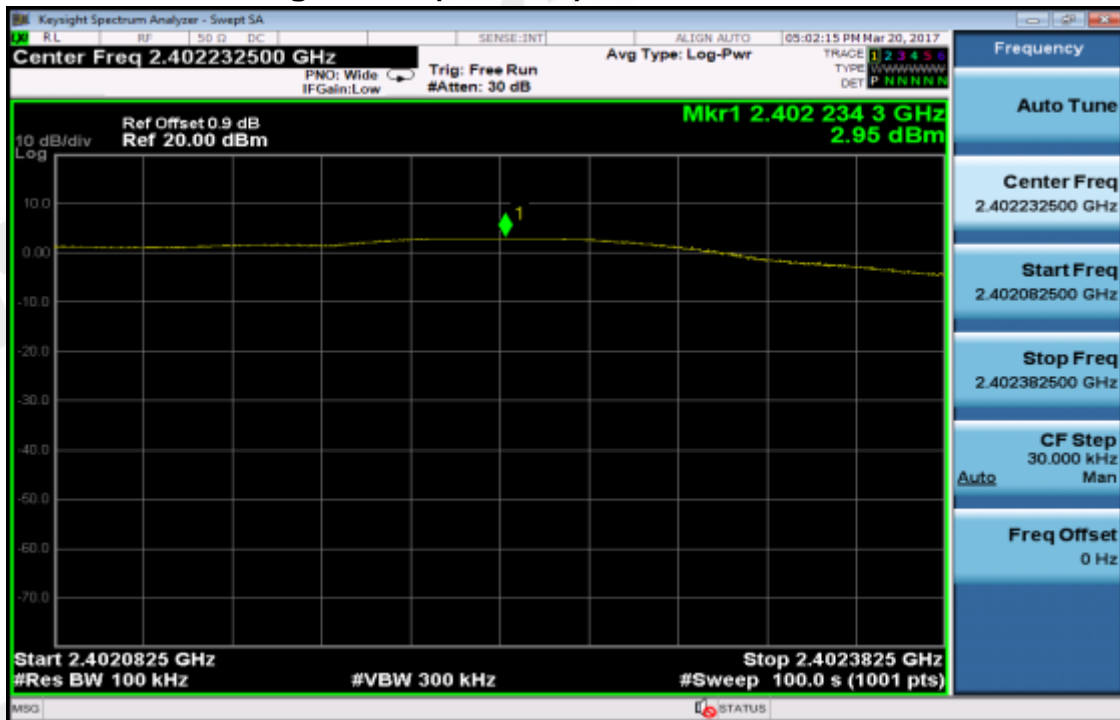
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功率密度量測 for Band Edge Limit (CH-Low)



功率密度量測 for Band Edge Limit (CH-High)



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測試照片

Radiated 量測之配置照片 (Below 1G)



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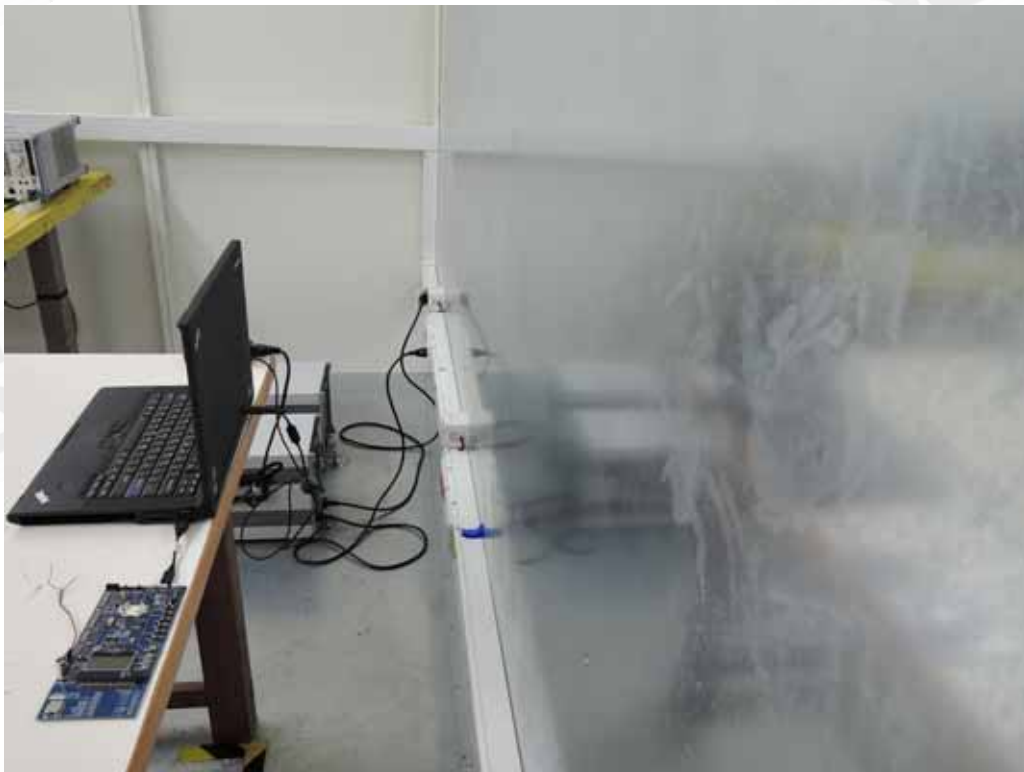
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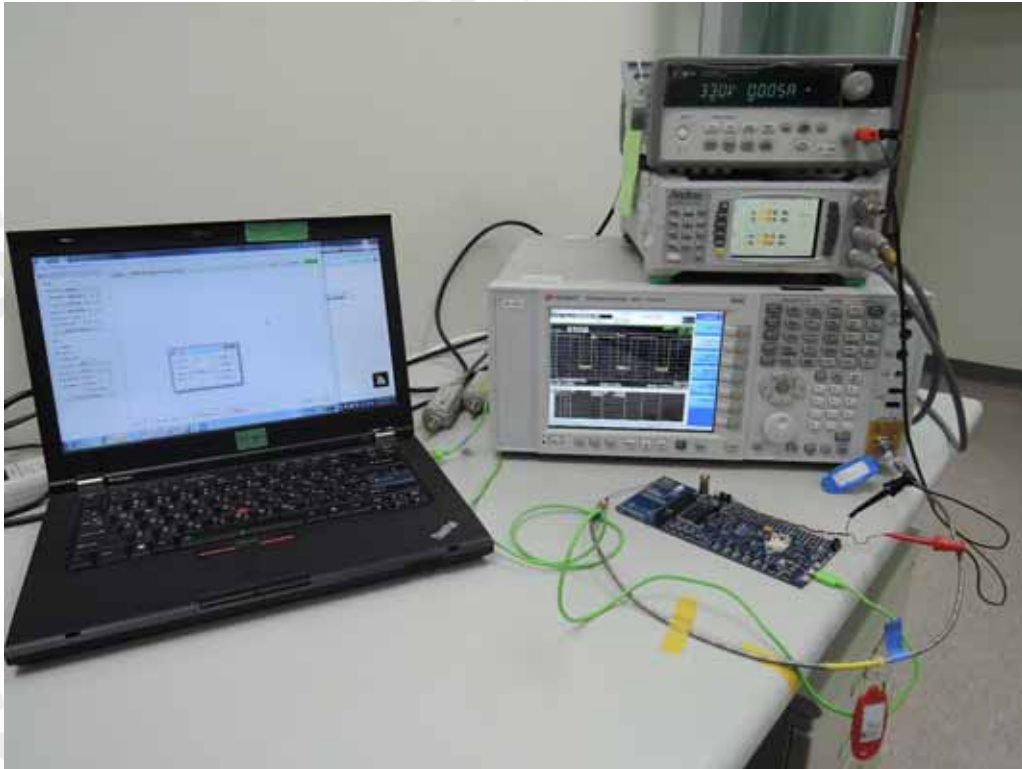
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~ End of Report ~

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