

NCC

低功率射頻電機型式試驗報告

申請者: Shure Incorporated

地址: 5800 West Touhy Avenue, Niles, IL 60714-4608, USA

產品名稱(英文): Digital Handheld Transmitter

型號.: ADX2FD G62

廠牌: SHURE

測試標準: 低功率射頻電機技術規範(107)

參考法規: ANSI C63.10-2013

結果: Complies

測試日期: December 18, 2017 ~ February 28, 2018

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修訂記錄

報告編號	版本	描述	發行日期
1802TW0104-T2	1.0	Original Report	2018-02-28

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1. 一般資訊

申請者	Shure Incorporated
申請者地址	5800 West Touhy Avenue, Niles, IL60714-4608, USA
製造商	Shure Incorporated
製造商地址	5800 West Touhy Avenue, Niles, IL60714-4608, USA
實驗室	台灣曼瑞檢測科技有限公司
實驗室地址	33377 台灣桃園市龜山區復興二路 38 號
實驗室資訊	1. MRT facility is a FCC registered (Reg. No. 291082) test facility with the site description report on file and is designated by the FCC as an Accredited Test Film. 2. MRT facility is an IC registered (MRT Reg. No. 21723-1) test laboratory with the site description on file at Industry Canada. 3. MRT Lab is accredited to ISO 17025 by the Taiwan Accreditation Foundation (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC, Industry Taiwan, EU and TELEC Rules.
實驗室測試環境條件	溫度 (°C) : 20-35 / 濕度 (%RH) : 30-65

2. 產品描述

2.1. 產品資訊

產品名稱	Digital Handheld Transmitter
產品型號	ADX2FD G62
商標	SHURE
頻率範圍	2405~ 2480MHz
調製類型	O-QPSK
通道間隔	5MHz
電池信息 (備註)	
可充電鋰電池	Model: SB920 P/N: 1620B0138 OUTPUT: 3.6Vdc, 2500mAh,9.0Wh

備註：待測物使用 Shure SB920 可充電電池來供電。

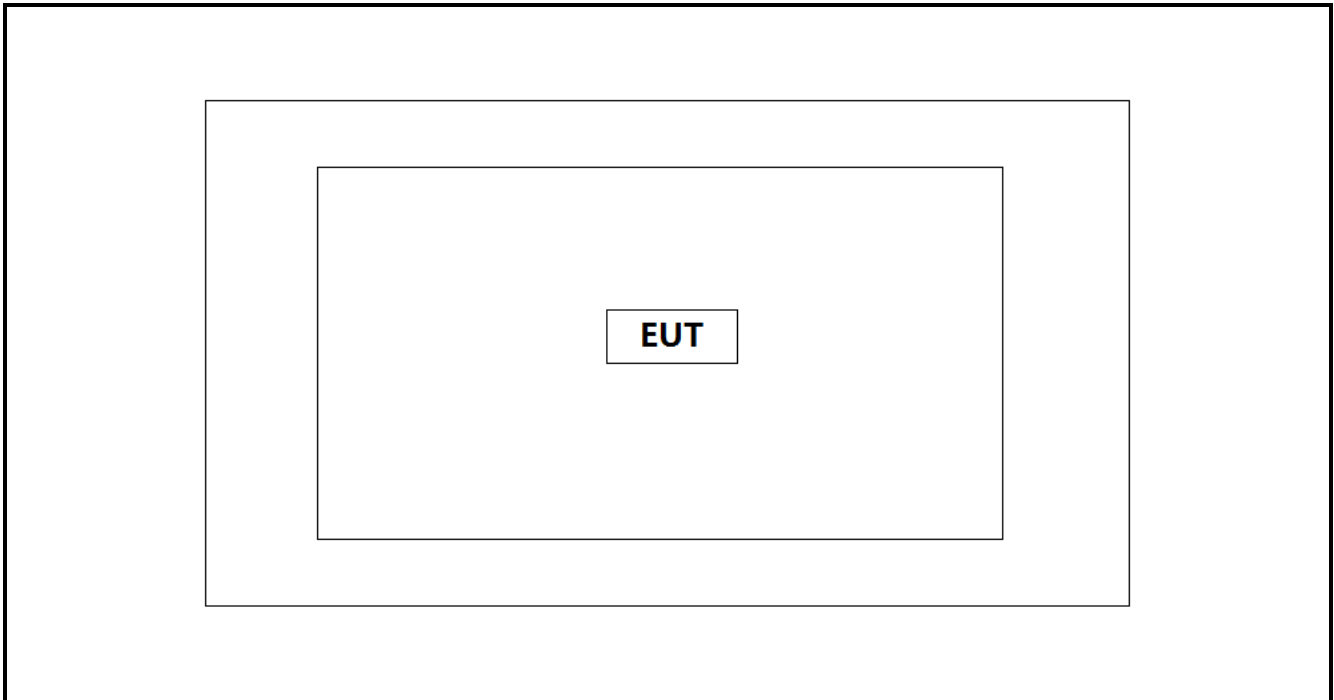
2.2. 操作頻率

Channel	Frequency	Channel	Frequency	Channel	Frequency
11	2405 MHz	12	2410 MHz	13	2415 MHz
14	2420 MHz	15	2425 MHz	16	2430 MHz
17	2435 MHz	18	2440 MHz	19	2445 MHz
20	2450 MHz	21	2455 MHz	22	2460 MHz
23	2465 MHz	24	2470 MHz	25	2475 MHz
26	2480 MHz	--	--	--	--

2.3. 測試模式

Test Mode
Mode 1: Transmit by 802.15.4

2.4. 測試架設示意圖



2.5. 操作程式

The test utility software used during testing was “putty.exe” and choose the related script file to download into the EUT, then start to test.

3. 測試設備明細

Conducted Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR3	MRTTWA00045	1 year	2018/03/17
Two-Line V-Network	R&S	ENV216	MRTTWA00019	1 year	2018/03/23
Two-Line V-Network	R&S	ENV216	MRTTWA00020	1 year	2018/03/23
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2018/06/08

Radiated Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2018/03/02
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2018/03/16
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2018/04/06
Broadband Amplifier	SCHWARZBECK	BBV 9721	MRTTWA00006	1 year	2018/04/06
Active Loop Antenna	SCHWARZBECK	FMZB 1519B	MRTTWA00002	1 year	2018/04/06
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2018/04/06
Broadband Horn antenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2018/04/06
Broadband Horn antenna	SCHWARZBECK	BBHA 9170	MRTTWA00004	1 year	2018/04/06
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2018/06/08

Conducted Test Equipment - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Interval
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2018/07/10
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00014	1 year	2018/03/18
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00015	1 year	2018/03/18
Programmable Temperature & Humidity Chamber	TEN BILLION	TTH-B3UP	MRTTWA00036	1 year	2018/05/11
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2018/06/08

EMI Test Software

Software	Manufacturer	Version No.
e3	Audix	9.160520a
EMI	Quietek	V3

4. 量測不確定度

電源傳導量測
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 150kHz~30MHz: 3.46dB
輻射干擾量測
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 4.22dB

5. 測試結果

產品名稱
型號

Digital Handheld Transmitter
ADX2FD G62

章節	量測項目	限制值	測試結果	測試數據
2.3	電源傳導	低功率射頻電機技術規範 2.3 節	符合	第 5.1 章節
3.10.1.2	峰值傳導輸出功率	$\leq 30.00\text{dBm}$	符合	第 5.2 章節
3.10.1.3	天線之要求	低功率射頻電機技術規範 3.10.1.3 節	符合	第 5.3 章節
3.10.1.5	帶外發射限制	$\leq 20\text{dBc (Peak)}$	符合	第 5.4 章節
2.7	輻射電場強度	低功率射頻電機技術規範 2.8 節	符合	第 5.5 章節
2.7	頻帶邊緣	$\leq 74\text{dBuV/m (Peak)}$ $\leq 54\text{dBuV/m (Average)}$	符合	第 5.6 章節
3.10.1.6(2)(A)	佔用頻寬	$\geq 500\text{KHz}$	符合	第 5.7 章節
3.10.1.6(2)(B)	功率頻譜密度	$\leq 8\text{dBm}$	符合	第 5.8 章節

Note:

- 1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 2) Test Items “帶外發射限制” & “佔用頻寬” have been assessed single transmission, and showed the worst test data in this report.

5.1. 電源端點干擾測試

5.1.1. 量測方法

待測物放置於1m*2m*0.8m之非導體桌面並離垂直牆面40cm（落地型產品置於地上），將待測物之電源線接至電源阻抗網路器(LISN)，同時保持待測物至LISN距80公分，並將電源線多餘部份以30至40公分之八字形捆綁於電源線中央並離地40cm，於在正常工作狀態下，執行待測物之火線(Line)及地線(neutral)各一次量測。

電源端點場強之測量範圍由 0.15MHz - 30MHz，所量測之讀值皆為準尖峰值(Quasi-Peak Value)及平均值(Average Value)。場強接收機之解析頻寬為9kHz。

備註：經初測驗證過，電源端點干擾測試對測試頻道數並無差異，因此檢附其中一個測試頻道之測試數。

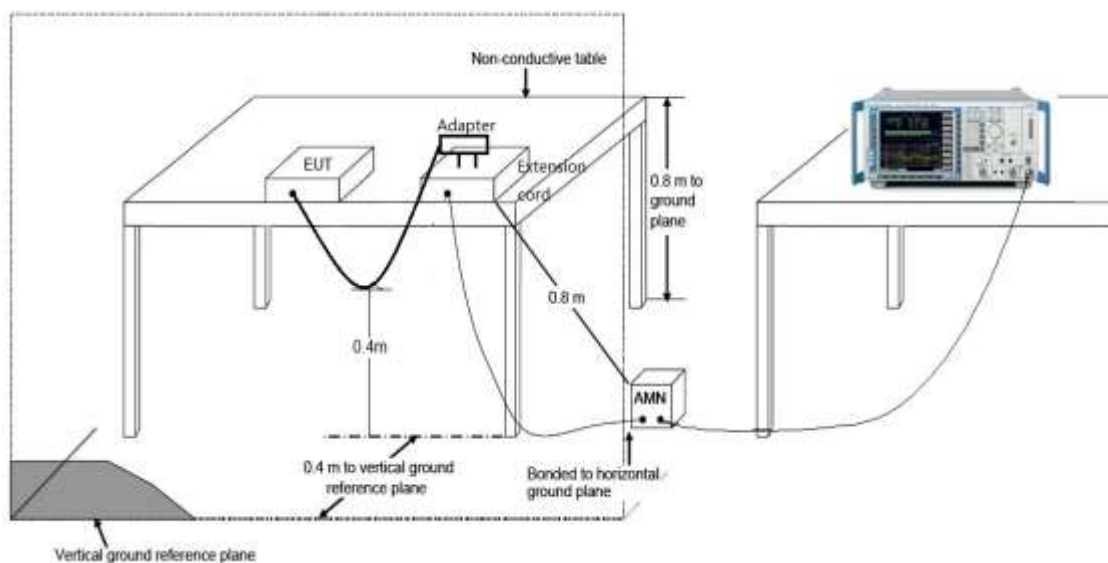
5.1.2. 限制要求

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150kHz至30MHz之射頻電壓(在電源端子每一電源線對接地點)應小於或等於下表所列之限值。測量時應經過50微亨利(μH)及50歐姆(Ω)之電源線阻抗模擬網路(LISN)。頻率重疊處，以較低限值為準。

Frequency 頻率範圍 MHz	傳導限制值(dBuV)	
	準尖峰值	平均值
0.15 - 0.50	66-56 ^(註)	56-46 ^(註)
0.50-5.0	56	46
5.0 - 30	60	50

註：隨頻率之對數遞減

5.1.3. 測試架構圖



5.1.4. 電源端點測試結果

測試樣品為電池供電，所有這個測試項目對它不適用。

5.2. 峰值傳導輸出功率

5.2.1. 量測方法

待測物之天線埠經由適當之衰減直接連至頻譜分析儀 RF 輸入端，設定頻譜分析儀之解析度頻寬大於 6dB 發射頻寬或使用峰值功率表。除使用上述測量方式外，並得使用以最大傳導輸出功率作為測量方式。

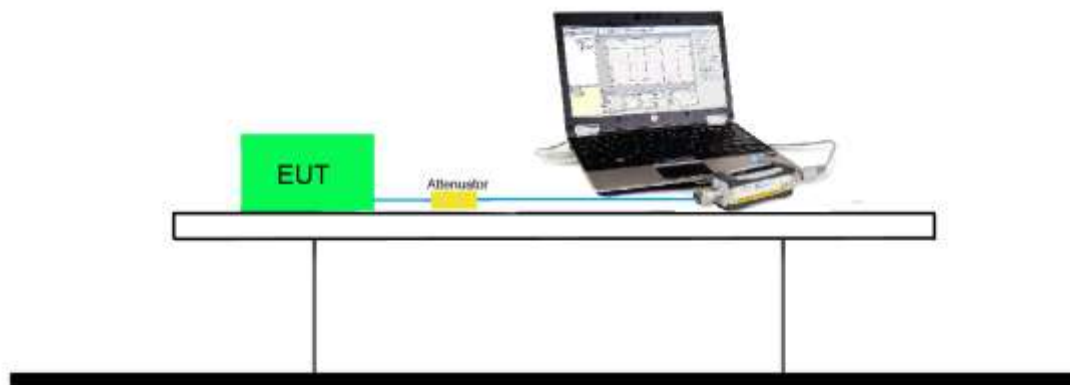
5.2.2. 限制要求

國家通訊傳播委員會低功率射頻電機技術規範之第3.10.1.2節 峰值傳導輸出功率：

- (1) 操作於 2400 MHz~2483.5 MHz 者
 - (A) 至少使用 75 個跳頻頻道之跳頻系統：1 W(含)以下。
 - (B) 除(A)外，依 3.10.1.6 (1)(A)(a)之跳頻系統：0.125 W(含)以下。
 - (C) 數位調變技術系統：1 W(含) 以下。
- (2) 操作於5725 MHz~5850 MHz 之所有跳頻系統：1 W(含)以下。

除使用附件二之峰值輸出功率測量方式外，並得使用以最大傳導輸出功率 (Maximum Conducted Output Power)作為測量方式。

5.2.3. 測試架構圖



5.2.4. 峰值傳導輸出功率測試結果

待測物名稱	Digital Handheld Transmitter	測試日期	2017/12/20
待測物型號	ADX2FD G62	溫度 / 濕度	23°C / 46%
測試場地	SR1	測試工程師	Kevin

Test Result of Peak Output Power

Test Mode	Modulation Mode	Channel No.	Freq. (MHz)	Peak Power (dBm)		Limit (dBm)	Result
				Ant A	Ant B		
802.15.4	O-QPSK	11	2405	4.77	4.77	≤ 30.00	Pass
802.15.4	O-QPSK	18	2440	5.71	5.75	≤ 30.00	Pass
802.15.4	O-QPSK	26	2480	7.19	7.18	≤ 30.00	Pass

Test Result of Average Output Power (Reporting Only)

Test Mode	Modulation Mode	Channel No.	Freq. (MHz)	Average Power (dBm)		Limit (dBm)	Result
				Ant A	Ant B		
802.15.4	O-QPSK	11	2405	4.46	4.47	≤ 30.00	Pass
802.15.4	O-QPSK	18	2440	5.45	5.48	≤ 30.00	Pass
802.15.4	O-QPSK	26	2480	6.92	6.88	≤ 30.00	Pass

5.3. 天線之要求

5.3.1. 限制要求

依據國家通訊傳播委員會低功率射頻電機技術規範之第3.10.1.4節規定，天線之規格可不受下述規定之限制。

低功率射頻電機之發射機或收發信機所使用之天線，應為全固定、半固定式或以獨特之耦合(unique coupling)方式連接機體。製造者可設計供使用者因損壞而替換之天線，但不得設計或使用原認證以外之天線或可供引接各類電纜之標準天線插座或電氣連接頭，如：BNC、F type、N type、M type、UG type、RCA、SMA、SMB...等及其他各類工業或通訊標準接頭。

5.3.2. 天線樣式

此接收机其天線為PIFA Antenna & Helical Antenna，(檢附天線規格書)

Antenna	Antenna Type	Frequency Band (MHz)	Manufacturer	Model	Max Antenna Gain (dBi)
A	Helical	2400 ~ 2500	Shure Incorporated	N/A	4.5
B	PIFA	2400 ~ 2500		N/A	-3.0

5.4. 帶外發射限制

5.4.1. 量測方法

待測物之天線埠經由適當之衰減直接連至頻譜分析儀 RF 輸入端，

- (1) 頻率掃描範圍足以檢測頻帶內的發射波峰位準以及由受測物產生之最低頻率到第 10 次諧波的所有混附發射，通常需要分幾段以涵蓋全部頻率範圍。
- (2) 解析頻寬為 100 kHz，視訊頻寬不小於解析頻寬。
- (3) 掃描時間為自動，檢波功能為峰值，訊號軌跡為最大保留(Max Hold)。
- (4) 將標記設定於任何欲紀錄之波峰上，所顯示之位準值必須符合指定之限制值。

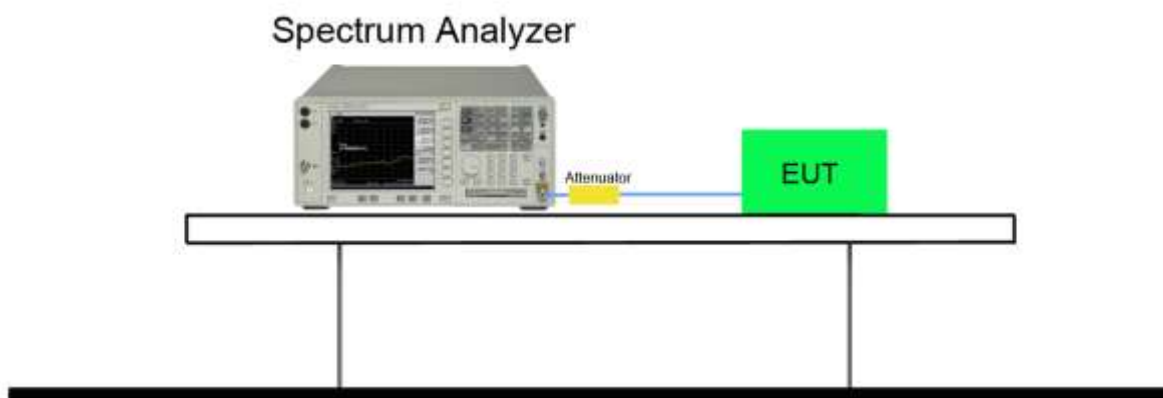
5.4.2. 限制要求

依據國家通訊傳播委員會低功率射頻電機技術規範之第 3.10.1.5 節規定。

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。

5.4.3. 測試架構圖



5.4.4. 帶外輻射測試結果

待測物名稱	Digital Handheld Transmitter	測試日期	2018/01/24
待測物型號	ADX2FD G62	溫度 / 濕度	23°C / 58%
測試場地	SR1	測試工程師	Kevin Ker

Test Mode	Channel No.	Frequency (MHz)	Limit	Result
802.15.4	11	2405	20dBc	Pass
802.15.4	18	2440	20dBc	Pass
802.15.4	26	2480	20dBc	Pass

802.15.4 Out-of-Band Emissions - Ant B

Channel 11 (2405MHz)

100kHz PSD Reference Level



Low Band Edge



Spurious Emission



Note: The value of the display line is -20.78dBm.

Channel 18 (2440MHz)

100kHz PSD Reference Level



Spurious Emission



Note: The value of the display line is -19.89dBm.

Channel 26 (2480MHz)

100kHz PSD Reference Level



High Band Edge



Spurious Emission



Note: The value of the display line is -19.16dBm.

5.5. 輻射電場強度

5.5.1. 量測方法

待測物置於非導體桌面（落地型產品置於地上），受測物使用交流電源時，將其與任何配件設備之電源線連接至位於旋轉桌的交流電源。受測物使用電池時，測試時應裝置新電池或充電完全的電池。受測物與配件設備之電源線無須束綁，桌面上受測設備的所有電源線由桌子的後緣垂下沿旋轉桌表面接至交流插座。落地型設備的交流電源線可以方便的型態走線。桌面可 360 度旋轉，接收天線置於距待測物 3m 距離，高度可在 1 至 4 公尺間變動，以量測待測物之最大輻射電場強度，接收天線並應於水準及垂直極化方向各量測一次。（待測物擺設方式根據 ANSI C63.10-2014 版本，待測物放置桌中心，1G 以下擺設高度為 80cm/1G 以上擺設高度為 150cm）

- (1) 任一頻率小於或等於 1000 MHz 之訊號,使用 CISPR 準峰值檢波器
- (2) 任一頻率大於1000 MHz 之訊號，使用平均值檢波器測量(RBW:1MHz,VBW:10Hz)，當規定之發射限制值為平均值時(含1000 MHz 以下)，受測訊號藉由峰值檢波器(RBW:1MHz,VBW:3MHz)所測量之峰值，亦須符合峰值發射限制值，其峰值發射限制值為最大容許平均值加20 dB。

5.5.2. 限制要求

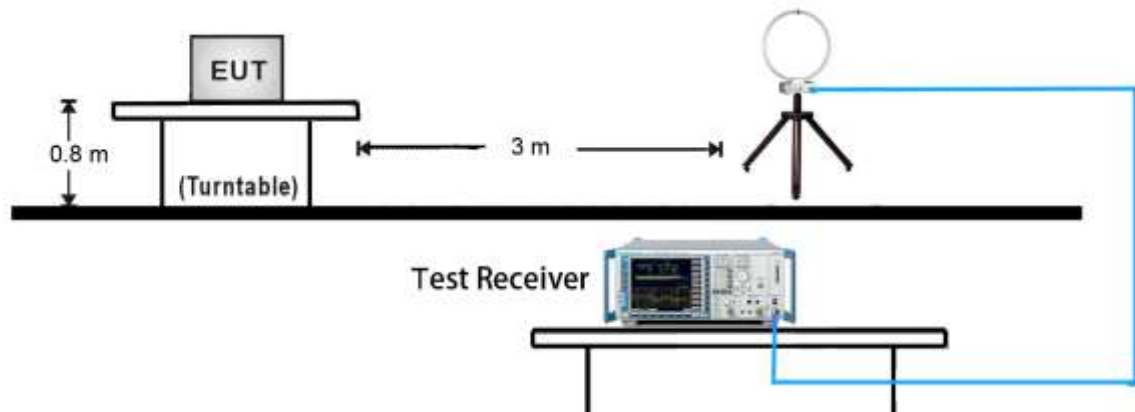
其電場強度不得超過下表之限值，且其不必要之發射皆不得大於主波發射強度。各頻段重疊處，以較嚴格之限制值為準。

頻 率(MHz)	電場強度(uV/m)	測距(m)
0.009 - 0.490(含)	2,400/f(KHz)	300
0.490 (不含) - 1.705 (含)	24,000/f(KHz)	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
960 (不含)以上	500	3

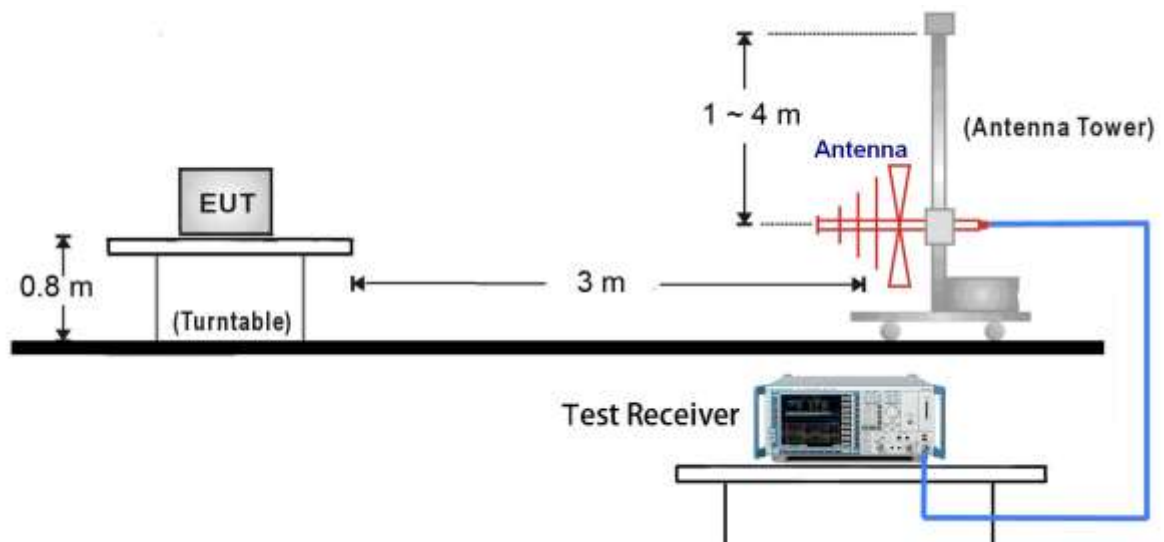
上表規定之電場強度，頻率在 9-90kHz 千赫(kHz)、110-490 千赫(kHz)以及 1000 兆赫(MHz)以上之發射，其量測以平均值檢波器為基準，且須符合低功率射頻電機技術規範第 5.14 節之規定；其他頻率之發射，應以 CISPR 準峰值(quasi-peak) 檢波器測量；非以上表所指定之距離測量時須符合低功率射頻電機技術規範第 5.5 節之規定，而輻射發射之量測頻率範圍須符合低功率射頻電機技術規範第 5.12 節之規定。

5.5.3. 測試架構圖

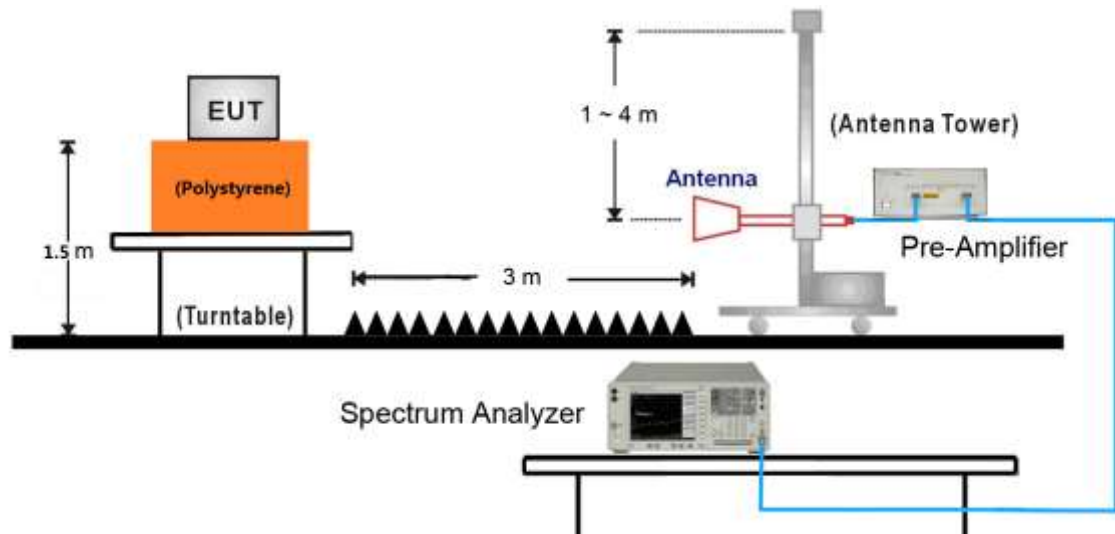
Under 30MHz Test Setup:



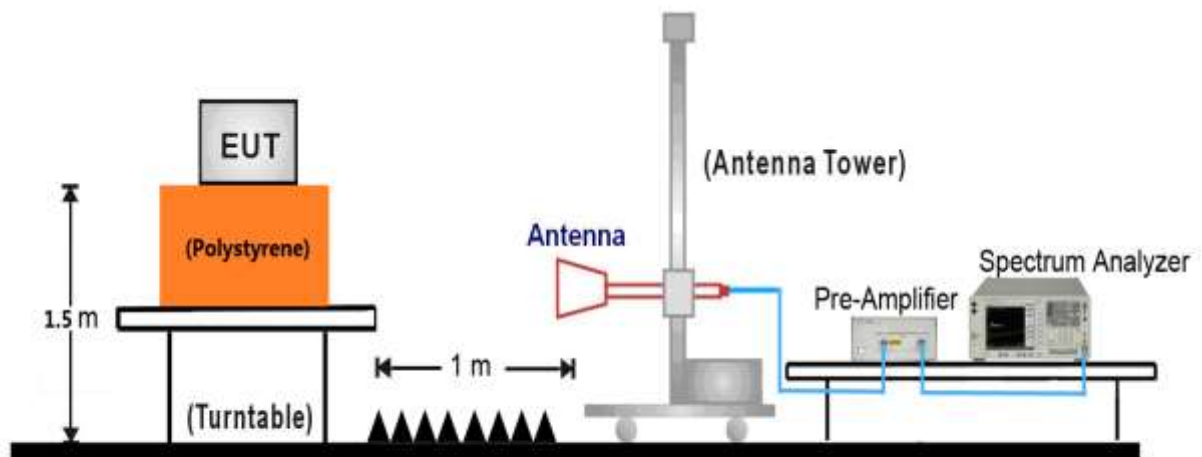
Under 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:



18GHz ~25GHz Test Setup:



5.5.4. 輻射電場強度測試結果

待測物名稱	Digital Handheld Transmitter	溫度	23°C
測試工程師	Kevin	濕度	51 %
測試場地	AC1	測試日期	2017/12/26
測試模式	802.15.4 - Ant A	測試頻道	11
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	4808.0	39.2	3.7	42.9	74.0	-31.1	Peak	Horizontal
	7621.5	34.1	12.6	46.7	74.0	-27.3	Peak	Horizontal
*	8658.5	32.5	13.6	46.1	77.8	-31.7	Peak	Horizontal
*	9712.5	34.2	14.7	48.9	77.8	-28.9	Peak	Horizontal
	4808.0	38.5	3.7	42.2	74.0	-31.8	Peak	Vertical
	7621.5	34.0	12.6	46.6	74.0	-27.4	Peak	Vertical
*	8616.0	33.0	13.5	46.5	77.8	-31.3	Peak	Vertical
*	9678.5	34.7	14.6	49.3	77.8	-28.5	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (97.8dBμV/m) or FCC 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

待測物名稱	Digital Handheld Transmitter	溫度	23°C
測試工程師	Kevin	濕度	51 %
測試場地	AC1	測試日期	2017/12/26
測試模式	802.15.4 - Ant A	測試頻道	18
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	4884.5	36.8	3.7	40.5	74.0	-33.5	Peak	Horizontal
	7613.0	34.4	12.6	47.0	74.0	-27.0	Peak	Horizontal
*	8658.5	32.5	13.6	46.1	76.8	-30.7	Peak	Horizontal
*	9848.5	33.1	16.1	49.2	76.8	-27.6	Peak	Horizontal
	4672.0	36.7	3.5	40.2	74.0	-33.8	Peak	Vertical
	7366.5	32.6	12.5	45.1	74.0	-28.9	Peak	Vertical
*	8828.5	32.1	14.0	46.1	76.8	-30.7	Peak	Vertical
*	10103.5	34.4	15.7	50.1	76.8	-26.7	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (96.8dBμV/m) or FCC 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

待測物名稱	Digital Handheld Transmitter	溫度	23°C
測試工程師	Kevin	濕度	51 %
測試場地	AC1	測試日期	2017/12/26
測試模式	802.15.4 - Ant A	測試頻道	26
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	4816.5	36.6	3.7	40.3	74.0	-33.7	Peak	Horizontal
	7740.5	35.5	12.4	47.9	74.0	-26.1	Peak	Horizontal
*	8701.0	32.9	13.8	46.7	74.3	-27.6	Peak	Horizontal
*	10027.0	34.0	15.4	49.4	74.3	-24.9	Peak	Horizontal
	4689.0	34.9	3.5	38.4	74.0	-35.6	Peak	Vertical
	7562.0	33.8	12.8	46.6	74.0	-27.4	Peak	Vertical
*	8565.0	33.0	13.3	46.3	74.3	-28.0	Peak	Vertical
*	9780.5	33.6	14.9	48.5	74.3	-25.8	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (94.3dBμV/m) or FCC 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

待測物名稱	Digital Handheld Transmitter	溫度	23°C
測試工程師	Kevin	濕度	51 %
測試場地	AC1	測試日期	2017/12/26
測試模式	802.15.4 - Ant B	測試頻道	11
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	4808.0	39.1	3.7	42.8	74.0	-31.2	Peak	Horizontal
	5386.0	36.5	4.0	40.5	74.0	-33.5	Peak	Horizontal
*	7213.5	37.3	12.1	49.4	82.8	-33.4	Peak	Horizontal
*	9746.5	35.7	14.8	50.5	82.8	-32.3	Peak	Horizontal
	4629.5	37.5	3.3	40.8	74.0	-33.2	Peak	Vertical
	7528.0	34.1	12.8	46.9	74.0	-27.1	Peak	Vertical
*	8828.5	32.2	14.0	46.2	82.8	-36.6	Peak	Vertical
*	9712.5	34.7	14.7	49.4	82.8	-33.4	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (102.8dBμV/m) or FCC 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

待測物名稱	Digital Handheld Transmitter	溫度	23°C
測試工程師	Kevin	濕度	51 %
測試場地	AC1	測試日期	2017/12/26
測試模式	802.15.4 - Ant B	測試頻道	18
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	4876.0	39.7	3.7	43.4	74.0	-30.6	Peak	Horizontal
	7545.0	33.8	12.8	46.6	74.0	-27.4	Peak	Horizontal
*	8582.0	32.8	13.4	46.2	82.9	-36.7	Peak	Horizontal
*	9721.0	34.8	14.7	49.5	82.9	-33.4	Peak	Horizontal
	4876.0	38.1	3.7	41.8	74.0	-32.2	Peak	Vertical
	7630.0	35.4	12.6	48.0	74.0	-26.0	Peak	Vertical
*	8616.0	32.6	13.5	46.1	82.9	-36.8	Peak	Vertical
*	9780.5	34.6	14.9	49.5	82.9	-33.4	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (102.9dBμV/m) or FCC 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

待測物名稱	Digital Handheld Transmitter	溫度	23°C
測試工程師	Kevin	濕度	51 %
測試場地	AC1	測試日期	2017/12/26
測試模式	802.15.4 - Ant B	測試頻道	26
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	4816.5	37.6	3.7	41.3	74.0	-32.7	Peak	Horizontal
	7502.5	34.5	12.8	47.3	74.0	-26.7	Peak	Horizontal
*	8599.0	33.1	13.4	46.5	83.1	-36.6	Peak	Horizontal
*	9644.5	34.1	14.4	48.5	83.1	-34.6	Peak	Horizontal
	4646.5	37.9	3.4	41.3	74.0	-32.7	Peak	Vertical
	7647.0	34.5	12.5	47.0	74.0	-27.0	Peak	Vertical
*	8803.0	32.5	14.0	46.5	83.1	-36.6	Peak	Vertical
*	9746.5	34.0	14.8	48.8	83.1	-34.3	Peak	Vertical

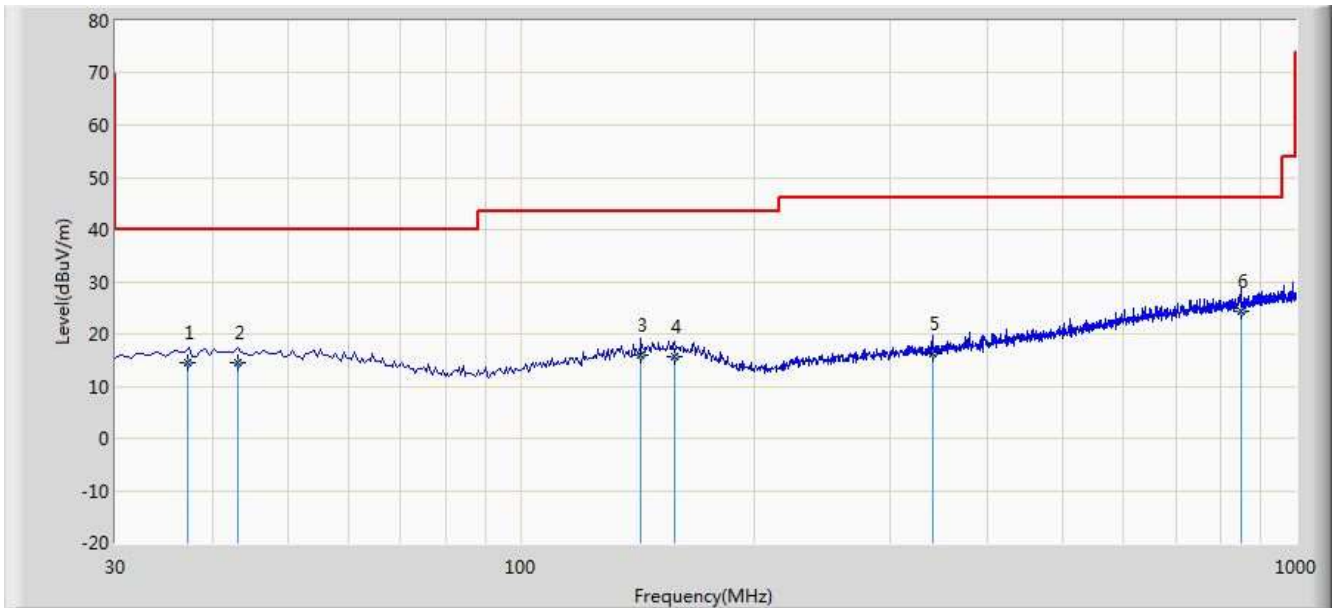
Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (103.1dBμV/m) or FCC 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

The Worst Case of Radiated Emission below 1GHz:

Site: AC1	Time: 2018/01/31 - 19:57
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: VULB 9168 _20-2000MHz	Polarity: Horizontal
EUT: Digital Handheld Transmitter	Power: By Battery
Worst Mode: Transmit by 802.15.4 at Channel 2480MHz, Ant B	

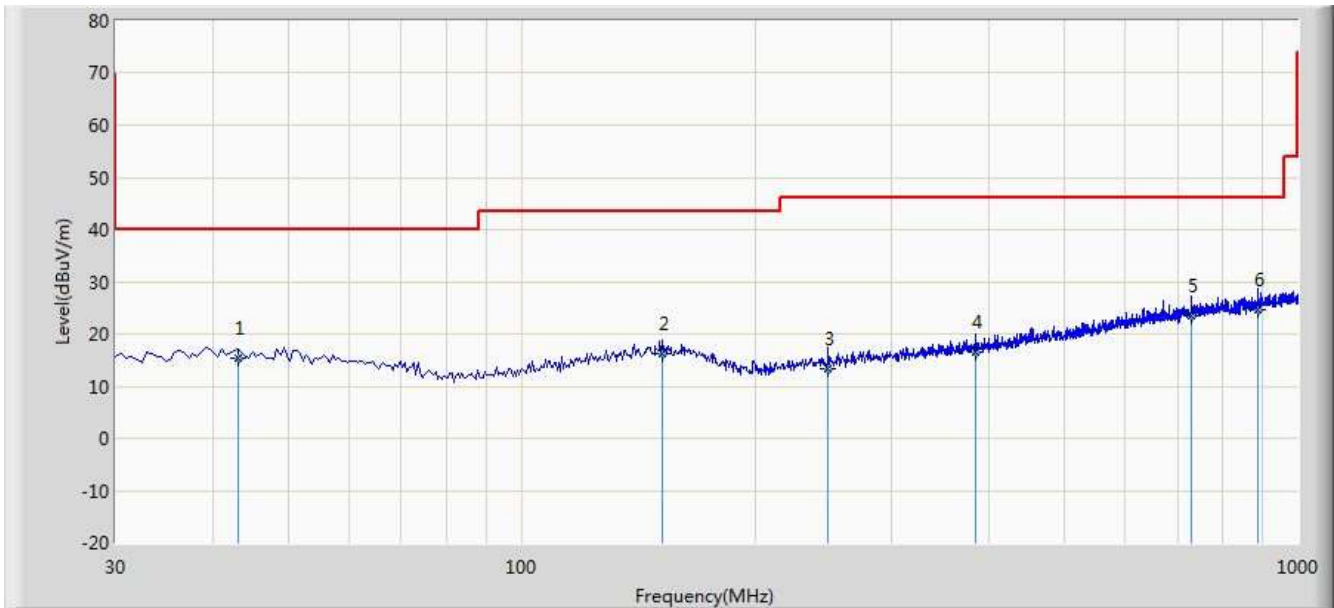


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			37.200	14.556	0.300	-25.444	40.000	14.255	QP
2			43.130	14.433	0.020	-25.567	40.000	14.413	QP
3			143.020	15.820	1.020	-27.680	43.500	14.800	QP
4			158.020	15.508	0.210	-27.992	43.500	15.298	QP
5			339.940	16.309	0.940	-29.691	46.000	15.369	QP
6		*	851.590	24.295	0.530	-21.705	46.000	23.765	QP

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2018/01/31 - 19:57
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: VULB 9168 _20-2000MHz	Polarity: Vertical
EUT: Digital Handheld Transmitter	Power: By Battery
Worst Mode: Transmit by 802.15.4 at Channel 2480MHz, Ant B	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			43.070	15.448	1.030	-24.552	40.000	14.418	QP
2			151.830	16.197	0.910	-27.303	43.500	15.287	QP
3			248.210	13.193	0.200	-32.807	46.000	12.993	QP
4			385.200	16.578	0.280	-29.422	46.000	16.298	QP
5			730.230	23.549	1.020	-22.451	46.000	22.529	QP
6		*	889.920	24.651	0.370	-21.349	46.000	24.281	QP

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Caution: There is the ambient noise within frequency range 9kHz~30MHz and 18GHz~40GHz, the permissible value is not show in the report.

5.6. 頻帶邊緣

5.6.1. 量測方法

待測物置於非導體桌面（落地型產品置於地上），受測物使用交流電源時，將其與任何配件設備之電源線連接至位於旋轉桌的交流電源。受測物使用電池時，測試時應裝置新電池或充電完全的電池。受測物與配件設備之電源線無須束綁，桌面上受測設備的所有電源線由桌子的後緣垂下沿旋轉桌表面接至交流插座。落地型設備的交流電源線可以方便的型態走線。桌面可360度旋轉，接收天線置於距待測物3m距離，高度可在1至4公尺間變動，以量測待測物之最大輻射電場強度，接收天線並應於水準及垂直極化方向各量測一次。（待測物擺設方式根據 ANSI C63.10-2014版，待測物放置桌中心，1G以下擺設高度為80cm/1G以上擺設高度為150cm）

- (1) 任一頻率小於或等於1000 MHz 之訊號,使用CISPR準峰值檢波器
- (2) 任一頻率大於1000 MHz 之訊號，使用平均值檢波器測量(RBW:1MHz,VBW:10Hz)，當規定之發射限制值為平均值時(含1000 MHz 以下)，受測訊號藉由峰值檢波器(RBW:1MHz,VBW:3MHz)所測量之峰值，亦須符合峰值發射限制值，其峰值發射限制值為最大容許平均值加20 dB。

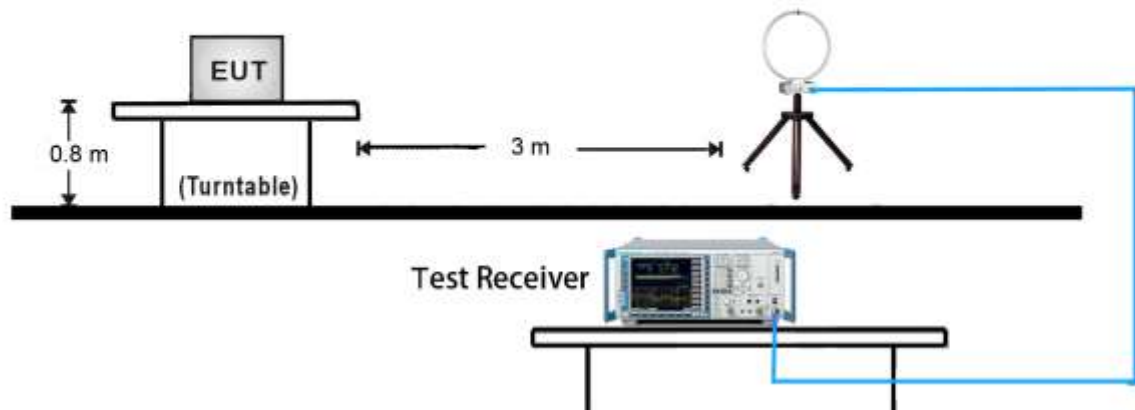
5.6.2. 限制要求

除低功率射頻電機技術規範另有規定外，任何低功率射頻電機之主波皆不得使用下表所列各頻段之頻率。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低功率射頻電機技術規範之第2.8節限制規定。

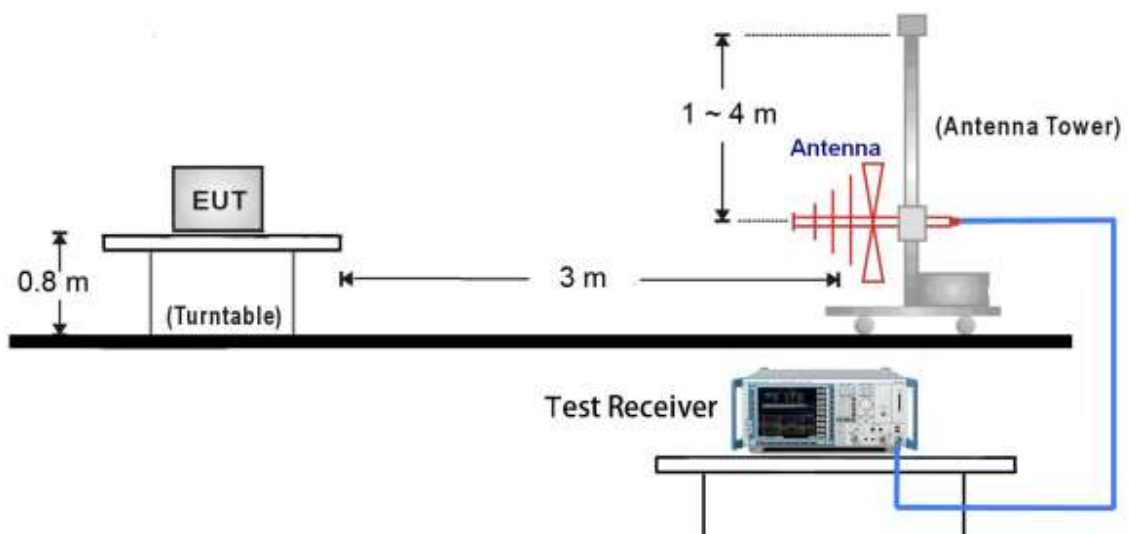
頻 率(MHz)	頻 率(MHz)	頻 率(MHz)	頻 率(MHz)	頻 率(MHz)
0.090~0.110	25.500~25.700	703.00~748.00	2310.0~2390.0	13250~13400
0.490~0.510	37.475~38.275	758.00~803.00	2483.5~2900.0	14470~14500
2.172~2.198	73.500~75.400	825.00~915.00	3260.0~3267.0	15350~16200
3.013~3.033	108.00~138.00	930.00~1240.0	3332.0~3339.0	17700~21400
4.115~4.198	149.90~150.05	1300.0~1427.0	3345.8~3358.0	22010~23120
5.670~5.690	156.70~156.90	1435.0~1626.5	3500.0~4400.0	23600~24000
6.200~6.300	162.01~167.17	1660.0~1785.0	4500.0~5250.0	31200~31800
8.230~8.400	167.72~173.20	1805.0~1880.0	5350.0~5460.0	36430~36500
12.265~12.600	240.00~285.00	1885.0~1900.0	7250.0~7750.0	38600 以上
13.340~13.430	322.00~335.40	1905.0~1985.0	8025.0~8500.0	
14.965~15.020	399.90~410.00	2010.0~2025.0	9000.0~9200.0	
16.700~16.755	485.00~510.00	2110.0~2170.0	9300.0~9500.0	
19.965~20.020	608.00~614.00	2200.0~2300.0	10600~12700	

5.6.3. 測試架構圖

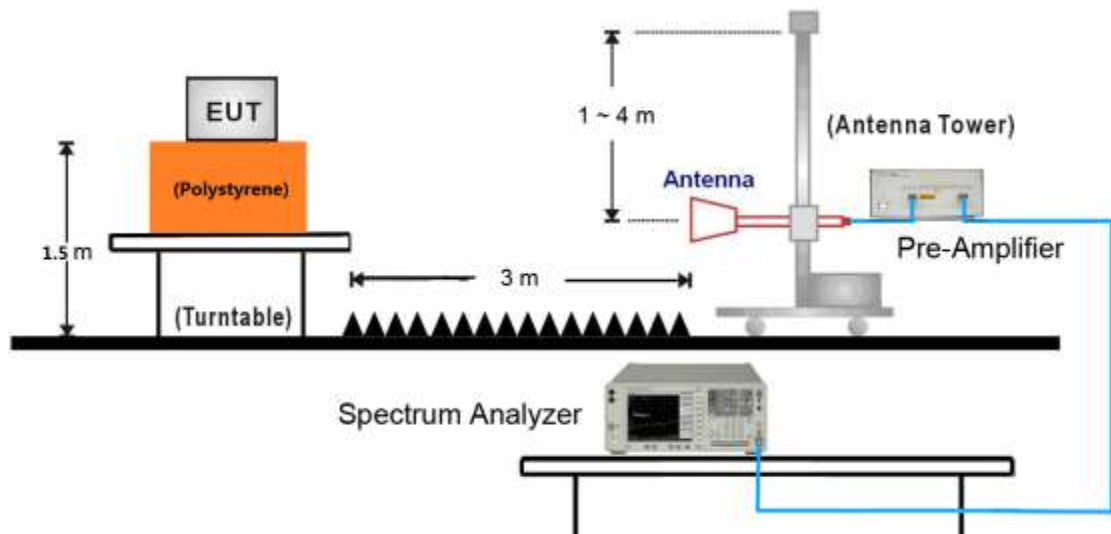
Under 30MHz Test Setup



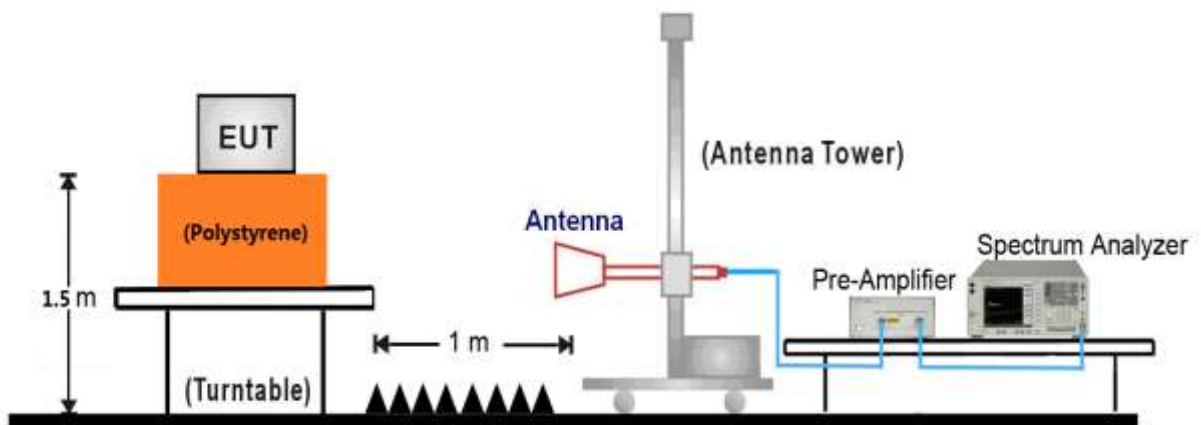
Under 1GHz Test Setup



1GHz ~ 18GHz Test Setup:

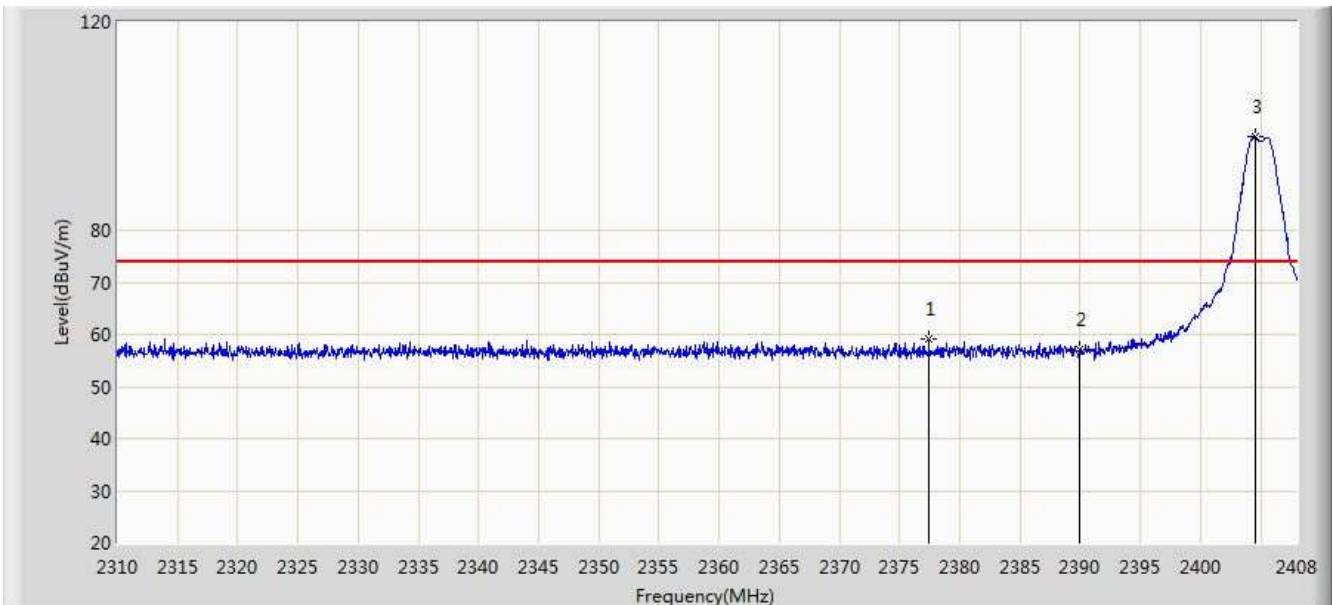


18GHz ~25GHz Test Setup:



5.6.4. 頻帶邊緣測試結果

Site: AC1	Time: 2018/01/31 - 02:12
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1GHz_18GHz	Polarity: Horizontal
EUT: Digital Handheld Transmitter	Power: By Battery
Test Mode: Transmit by ZigBee at Channel 2405MHz, Ant A	



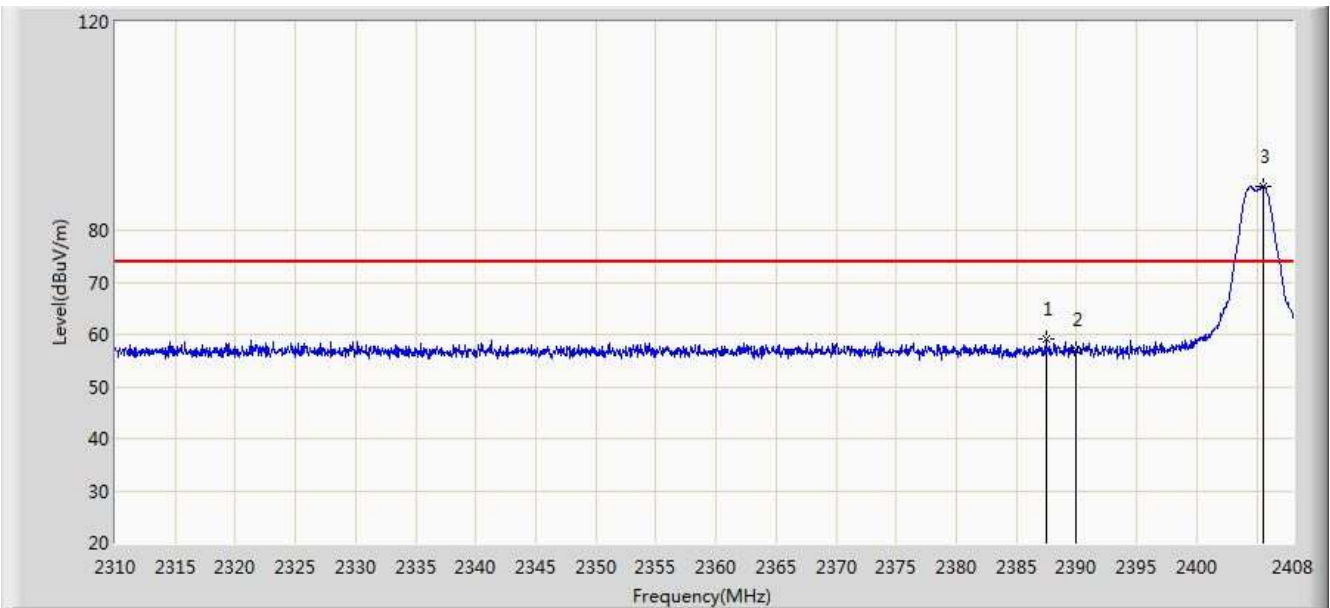
No	Frequency (MHz)	Reading Level (dBuV)	Factor (dB)	Duty cycle Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
1	2377.424	26.661	32.572	N/A	59.233	74.000	-14.767	PK
	2377.424	26.661	32.572	-43.030	16.203	54.000	-37.797	AV
2	2390.000	24.530	32.554	N/A	57.084	74.000	-16.916	PK
	2390.000	24.530	32.554	-43.030	14.054	54.000	-39.946	AV
3	2404.619	65.307	32.535	N/A	97.842	N/A	N/A	PK
	2404.619	65.307	32.535	-43.030	54.812	N/A	N/A	AV

Note: For PK Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

For AV Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Duty Cycle Factor (dB) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2018/01/31 - 02:16
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1GHz_18GHz	Polarity: Vertical
EUT: Digital Handheld Transmitter	Power: By Battery
Test Mode: Transmit by ZigBee at Channel 2405MHz, Ant A	



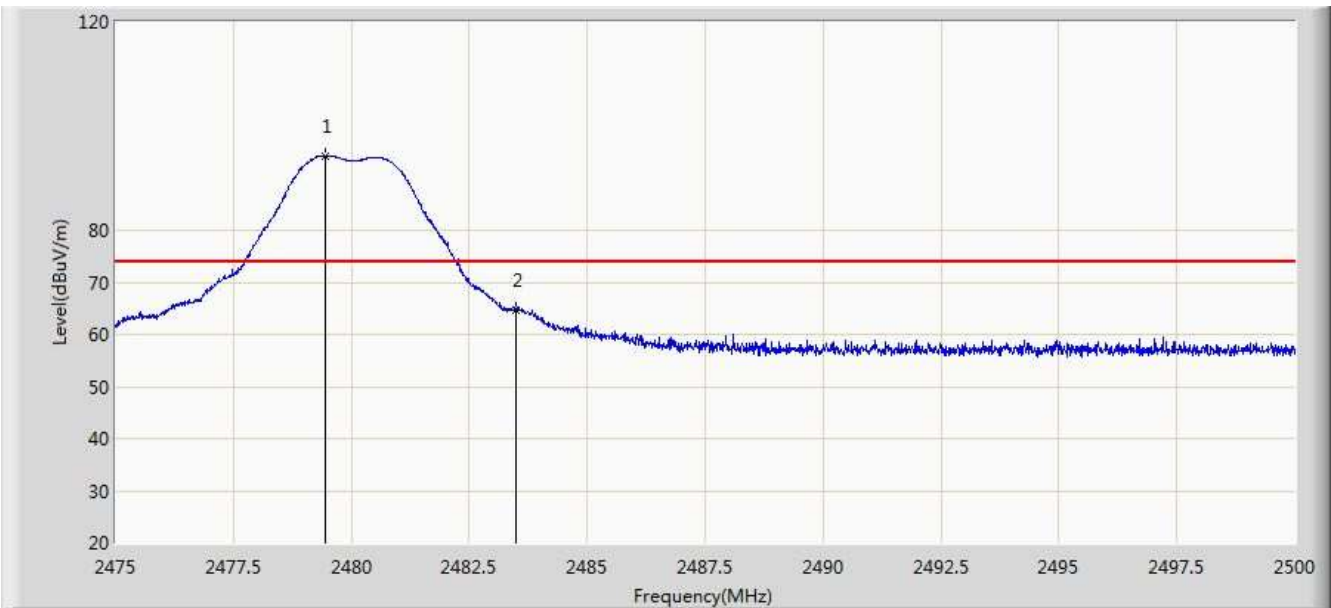
No	Frequency (MHz)	Reading Level (dBuV)	Factor (dB)	Duty cycle Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
1	2387.469	26.563	32.558	N/A	59.121	74.000	-14.879	PK
	2387.469	26.563	32.558	-43.030	16.091	54.000	-37.909	AV
2	2390.000	24.645	32.554	N/A	57.199	74.000	-16.801	PK
	2390.000	24.645	32.554	-43.030	14.169	54.000	-39.831	AV
3	2405.501	55.977	32.534	N/A	88.511	N/A	N/A	PK
	2405.501	55.977	32.534	-43.030	45.481	N/A	N/A	AV

Note: For PK Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

For AV Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Duty Cycle Factor (dB) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2018/01/31 - 02:20
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1GHz_18GHz	Polarity: Horizontal
EUT: Digital Handheld Transmitter	Power: By Battery
Test Mode: Transmit by ZigBee at Channel 2480MHz, Ant A	



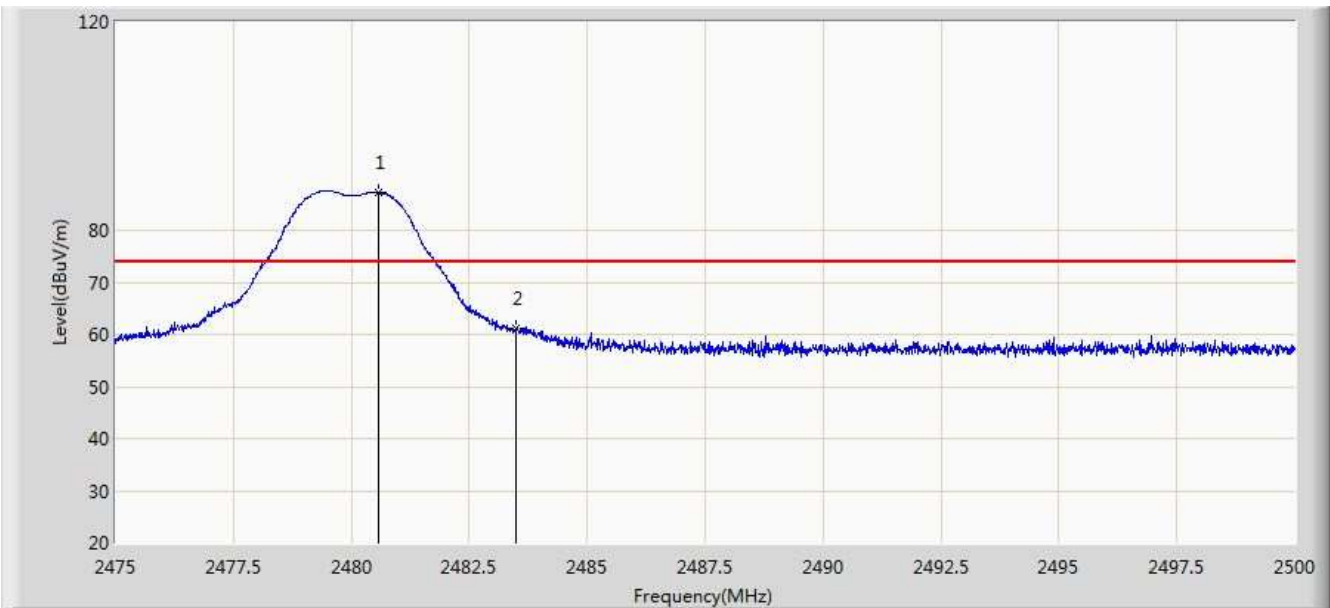
No	Frequency (MHz)	Reading Level (dBuV)	Factor (dB)	Duty cycle Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
1	2479.462	61.709	32.568	N/A	94.277	N/A	N/A	PK
	2479.462	61.709	32.568	-43.030	51.247	N/A	N/A	AV
2	2483.500	32.134	32.580	N/A	64.715	74.000	-9.285	PK
	2483.500	32.134	32.580	-43.030	21.684	54.000	-32.316	AV

Note: For PK Value: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

For AV Value: Measure Level (dBμV/m) = Reading Level (dBμV) + Duty Cycle Factor (dB) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2018/01/31 - 02:31
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1GHz_18GHz	Polarity: Vertical
EUT: Digital Handheld Transmitter	Power: By Battery
Test Mode: Transmit by ZigBee at Channel 2480MHz, Ant A	



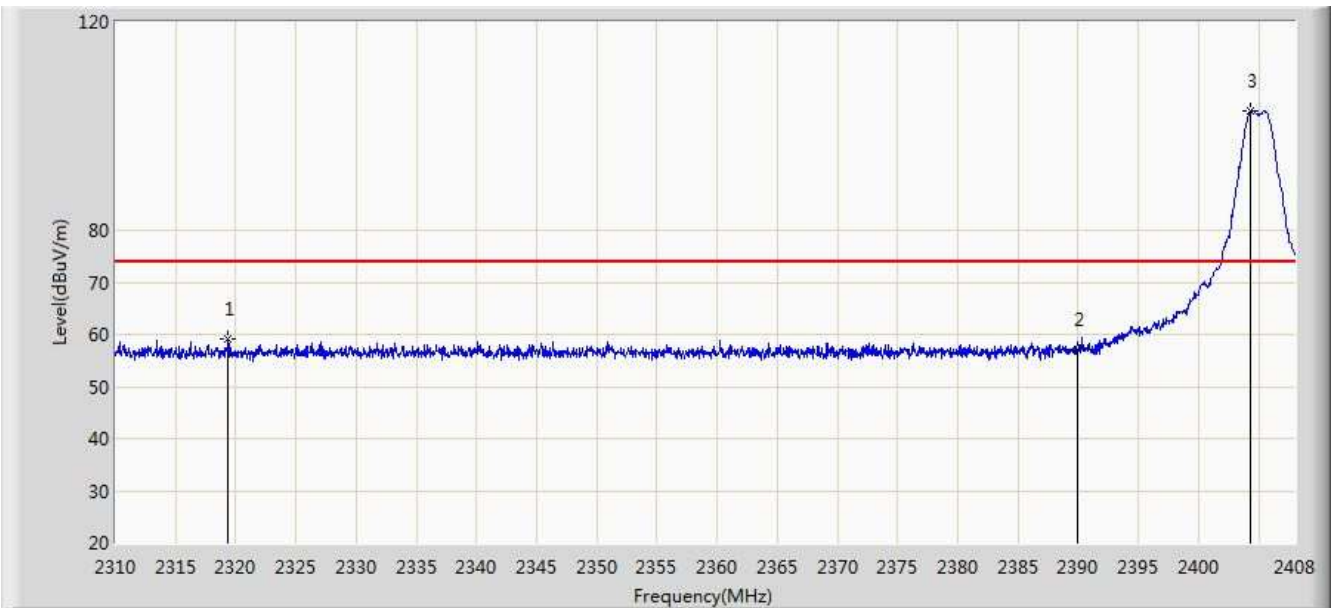
No	Frequency (MHz)	Reading Level (dBuV)	Factor (dB)	Duty cycle Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
1	2480.562	54.698	32.572	N/A	87.270	N/A	N/A	PK
	2480.562	54.698	32.572	-43.030	44.240	N/A	N/A	AV
2	2483.500	28.494	32.580	N/A	61.075	74.000	-12.925	PK
	2483.500	28.494	32.580	-43.030	18.044	54.000	-35.956	AV

Note: For PK Value: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

For AV Value: Measure Level (dBμV/m) = Reading Level (dBμV) + Duty Cycle Factor (dB) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

ite: AC1	Time: 2018/01/31 - 02:36
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1GHz_18GHz	Polarity: Horizontal
EUT: Digital Handheld Transmitter	Power: By Battery
Test Mode: Transmit by ZigBee at Channel 2405MHz, Ant B	



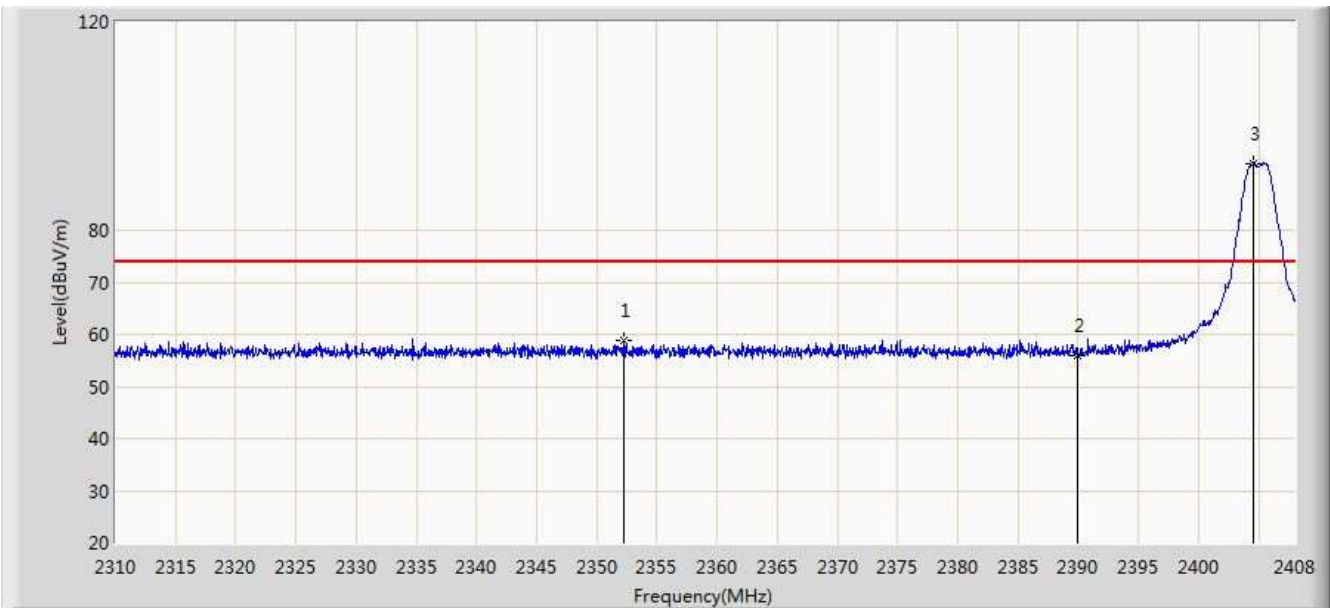
No	Frequency (MHz)	Reading Level (dBuV)	Factor (dB)	Duty cycle Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
1	2319.359	26.532	32.739	N/A	59.270	74.000	-14.730	PK
	2319.359	26.532	32.739	-43.030	16.241	54.000	-37.759	AV
2	2390.000	24.435	32.554	N/A	56.989	74.000	-17.011	PK
	2390.000	24.435	32.554	-43.030	13.959	54.000	-40.041	AV
3	2404.374	70.247	32.535	N/A	102.782	N/A	N/A	PK
	2404.374	70.247	32.535	-43.030	59.752	N/A	N/A	AV

Note: For PK Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

For AV Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Duty Cycle Factor (dB) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2018/01/31 - 02:40
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1GHz_18GHz	Polarity: Vertical
EUT: Digital Handheld Transmitter	Power: By Battery
Test Mode: Transmit by ZigBee at Channel 2405MHz, Ant B	



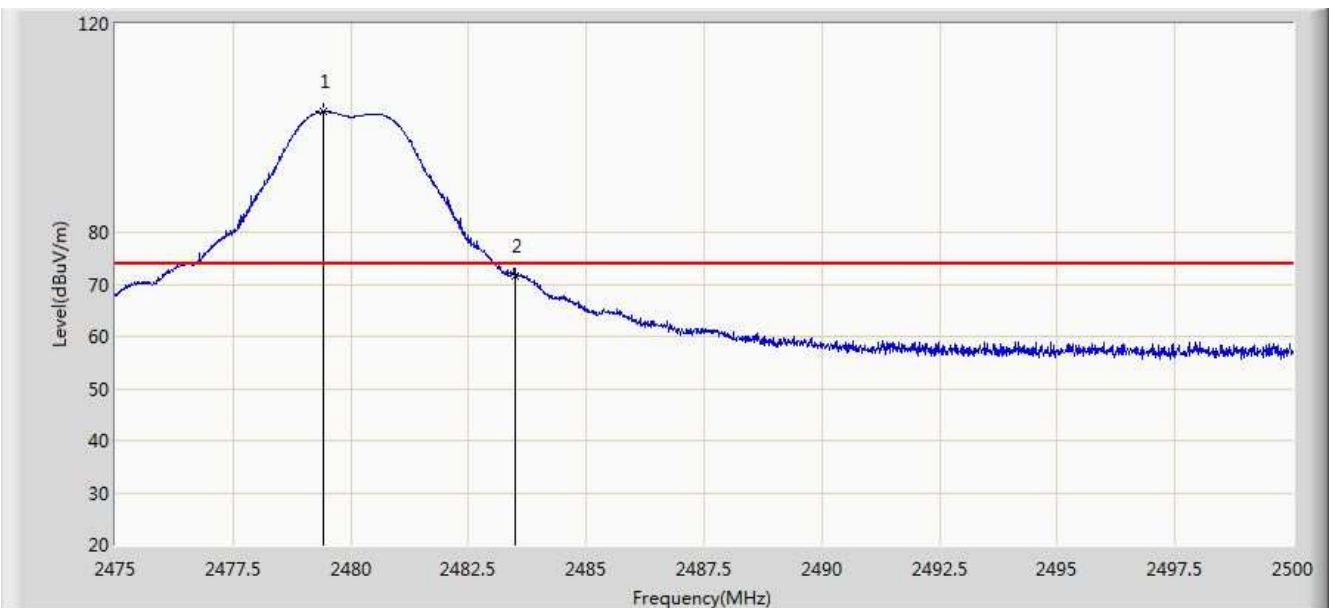
No	Frequency (MHz)	Reading Level (dBuV)	Factor (dB)	Duty cycle Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
1	2352.189	26.218	32.616	N/A	58.834	74.000	-15.166	PK
	2352.189	26.218	32.616	-43.030	15.804	54.000	-38.196	AV
2	2390.000	23.499	32.554	N/A	56.053	74.000	-17.947	PK
	2390.000	23.499	32.554	-43.030	13.023	54.000	-40.977	AV
3	2404.619	60.303	32.535	N/A	92.838	N/A	N/A	PK
	2404.619	60.303	32.535	-43.030	49.808	N/A	N/A	AV

Note: For PK Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

For AV Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Duty Cycle Factor (dB) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2018/01/31 - 02:42
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1GHz_18GHz	Polarity: Horizontal
EUT: Digital Handheld Transmitter	Power: By Battery
Test Mode: Transmit by ZigBee at Channel 2480MHz, Ant B	



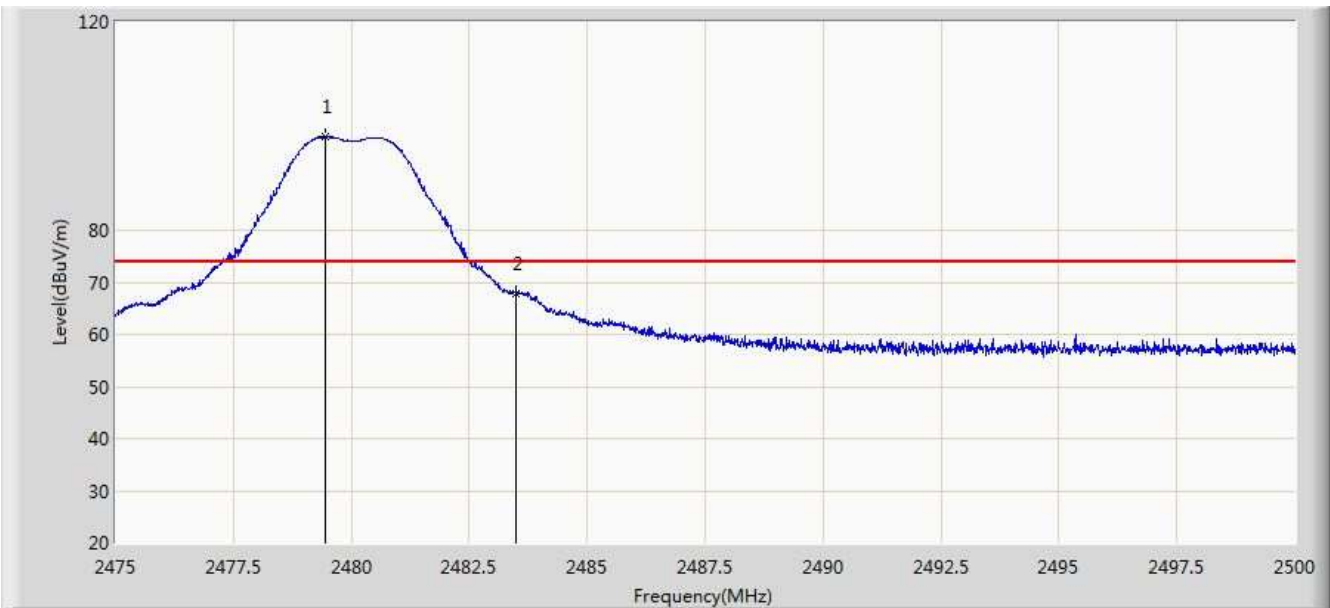
No	Frequency (MHz)	Reading Level (dBuV)	Factor (dB)	Duty cycle Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
1	2479.413	70.528	32.568	N/A	103.096	N/A	N/A	PK
	2479.413	70.528	32.568	-43.030	60.066	N/A	N/A	AV
2	2483.500	39.125	32.580	N/A	71.706	74.000	-2.294	PK
	2483.500	39.125	32.580	-43.030	28.675	54.000	-25.325	AV

Note: For PK Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

For AV Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Duty Cycle Factor (dB) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2018/01/31 - 02:47
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1GHz_18GHz	Polarity: Vertical
EUT: Digital Handheld Transmitter	Power: By Battery
Test Mode: Transmit by ZigBee at Channel 2480MHz, Ant B	



No	Frequency (MHz)	Reading Level (dBuV)	Factor (dB)	Duty cycle Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
1	2479.462	65.287	32.568	N/A	97.855	N/A	N/A	PK
	2479.462	65.287	32.568	-43.030	54.825	N/A	N/A	AV
2	2483.500	35.343	32.580	N/A	67.924	74.000	-6.076	PK
	2483.500	35.343	32.580	-43.030	24.893	54.000	-29.107	AV

Note: For PK Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

For AV Value: Measure Level (dBuV/m) = Reading Level (dBuV) + Duty Cycle Factor (dB) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Duty Cycle Factor Calculate

Figure 1. Communicating with AD610 - 3 packets in 2 second interval

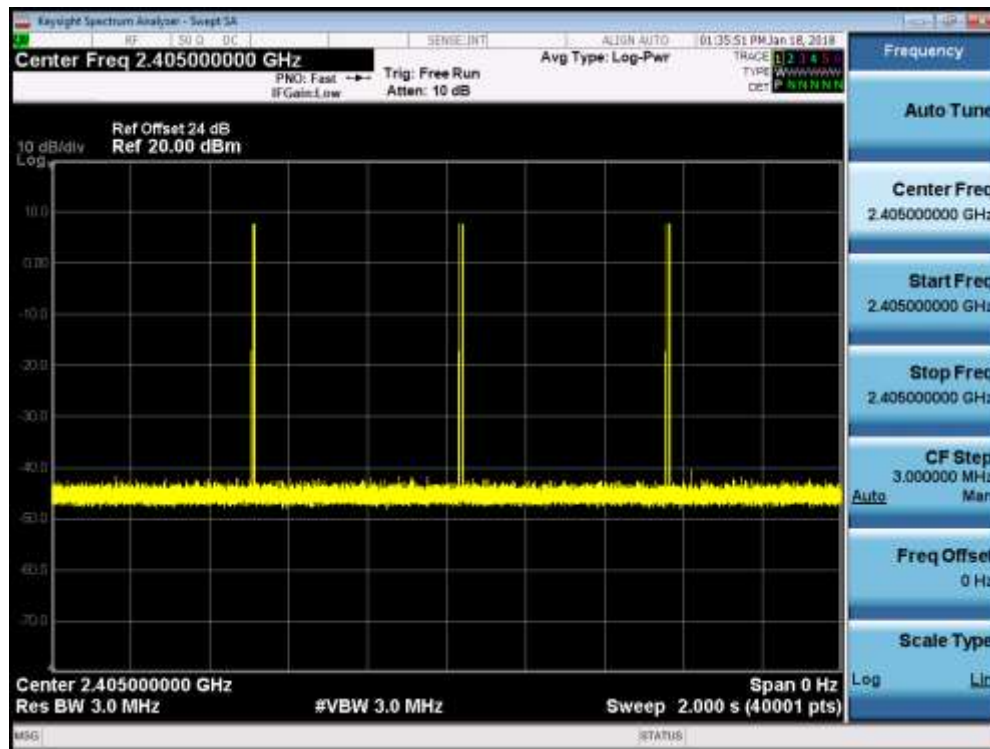


Figure 2. Communicating with AD610 - 5 packets in 2 second interval

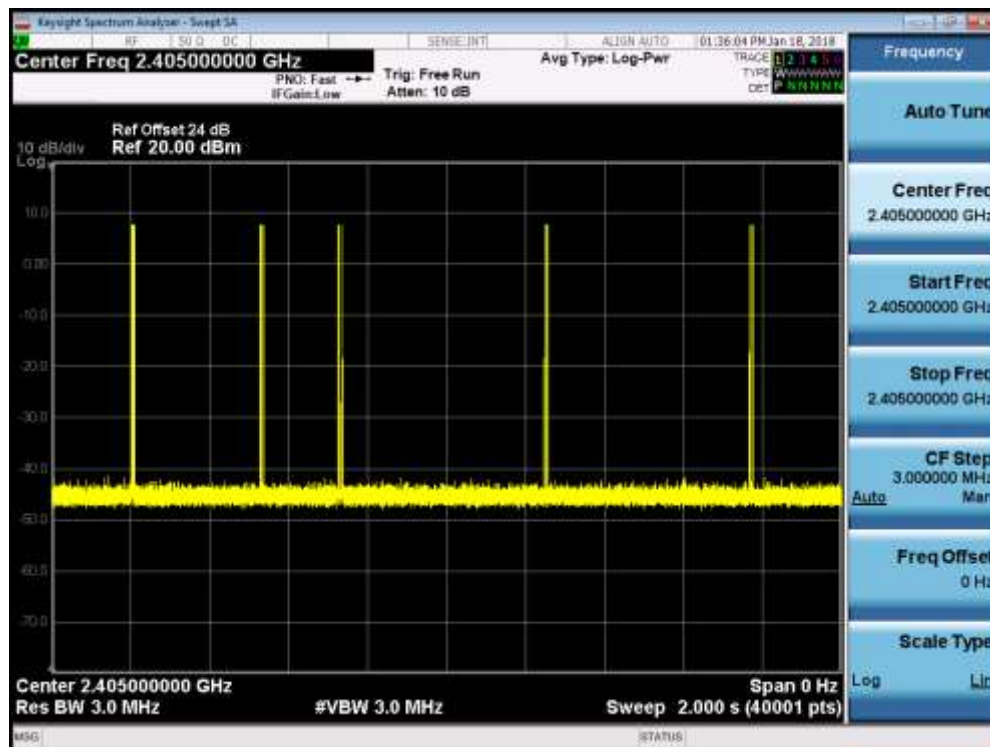


Figure 3. Communicating with AD610 - 5 packets in 2 second interval

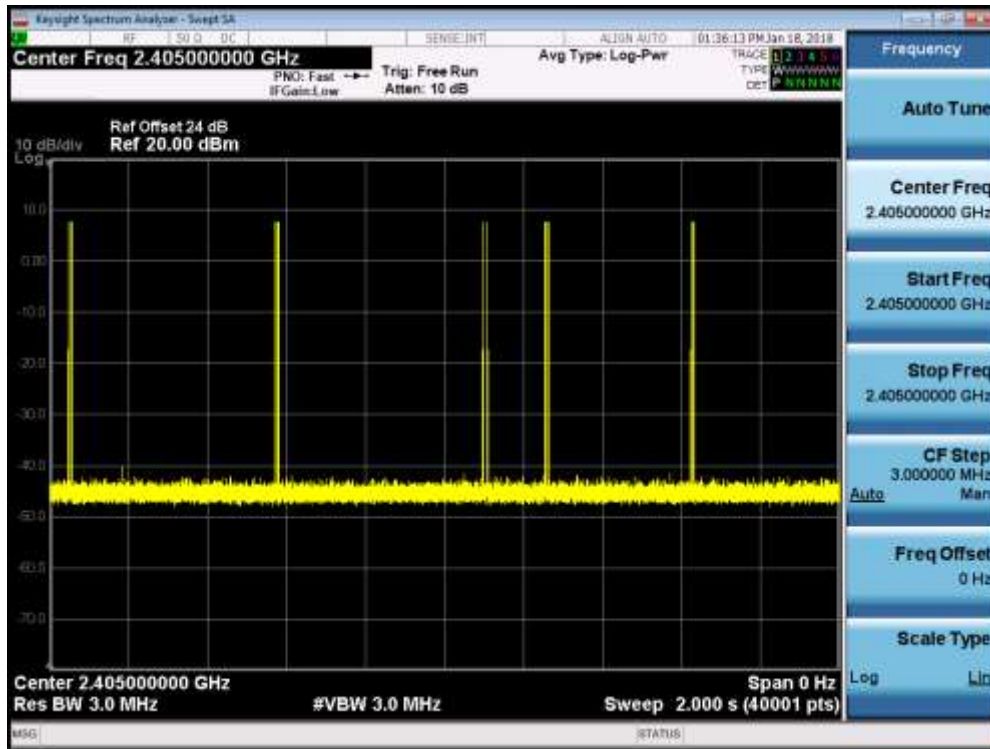


Figure 4. Communicating with AD610 - 5 packets in 2 second interval

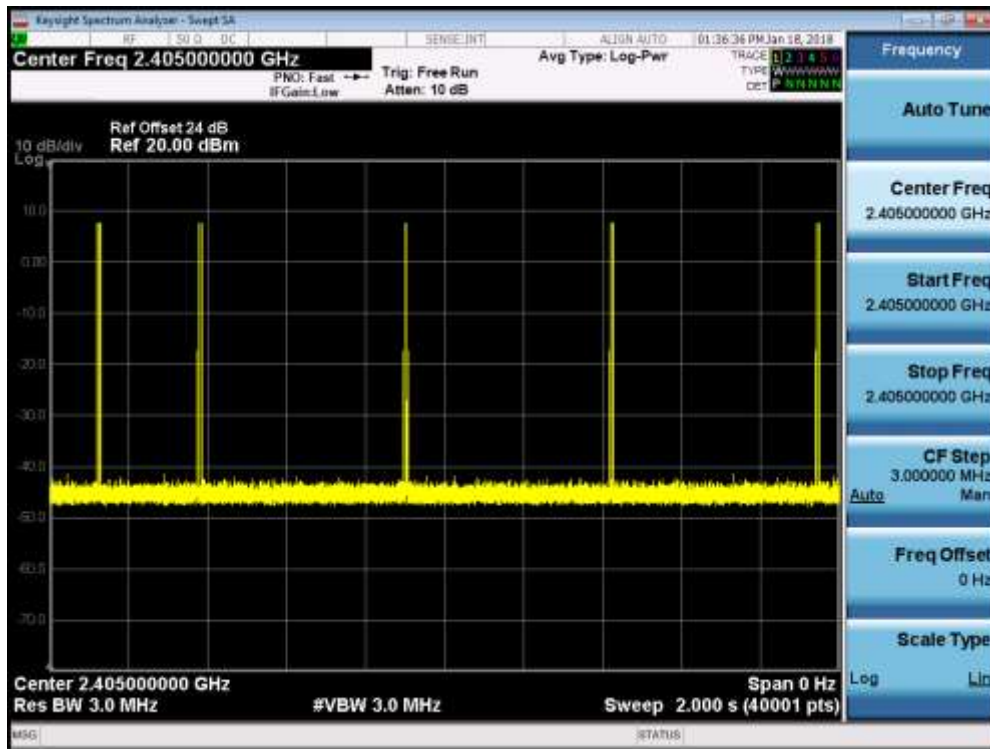


Figure 5. Communicating with AD610 - 4 packets in 2 second interval

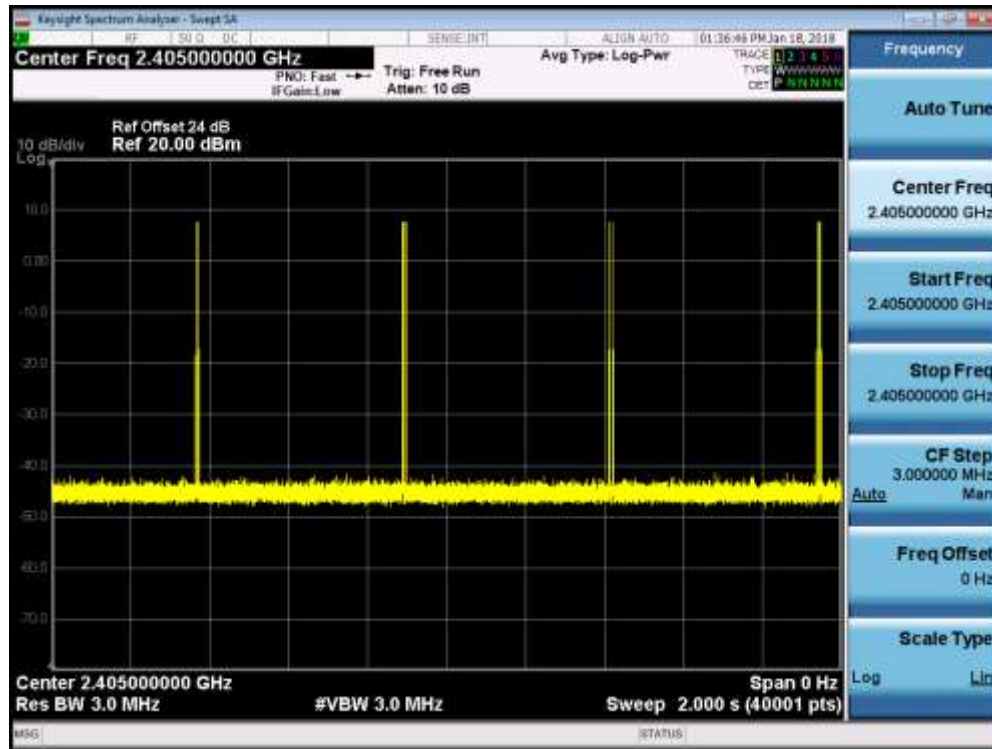


Figure 6. Communicating with AD610 - 4 packets in 2 second interval

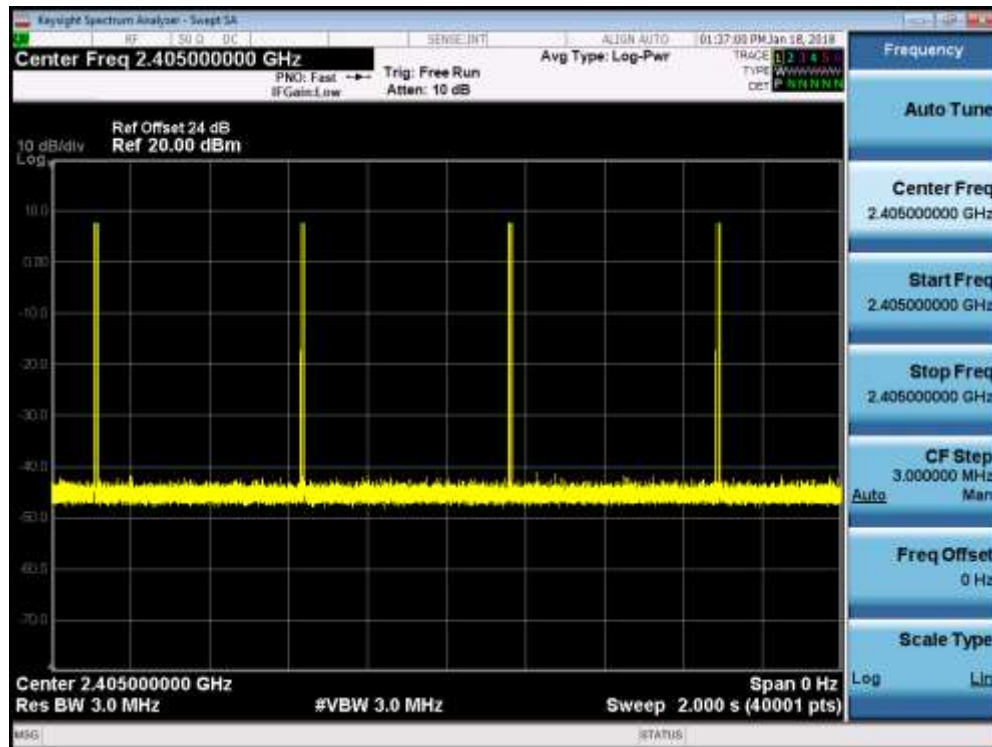


Figure 7. Communicating with AD610 - 4 packets in 2 second interval

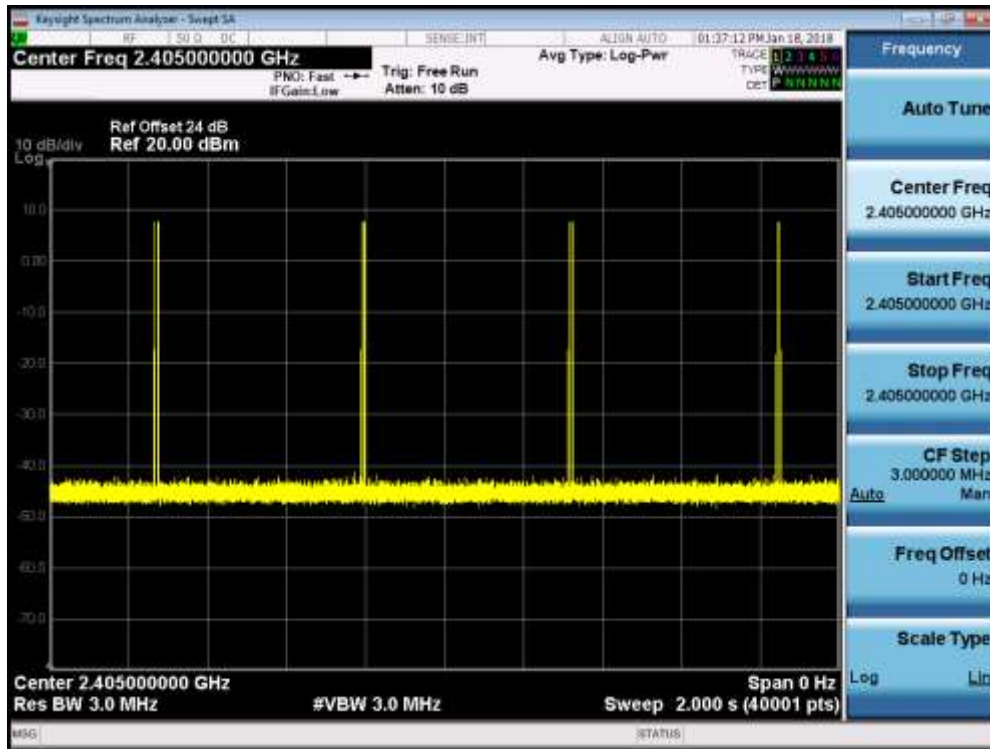


Figure 8. Communicating with AD610 - 4 packets in 2 second interval

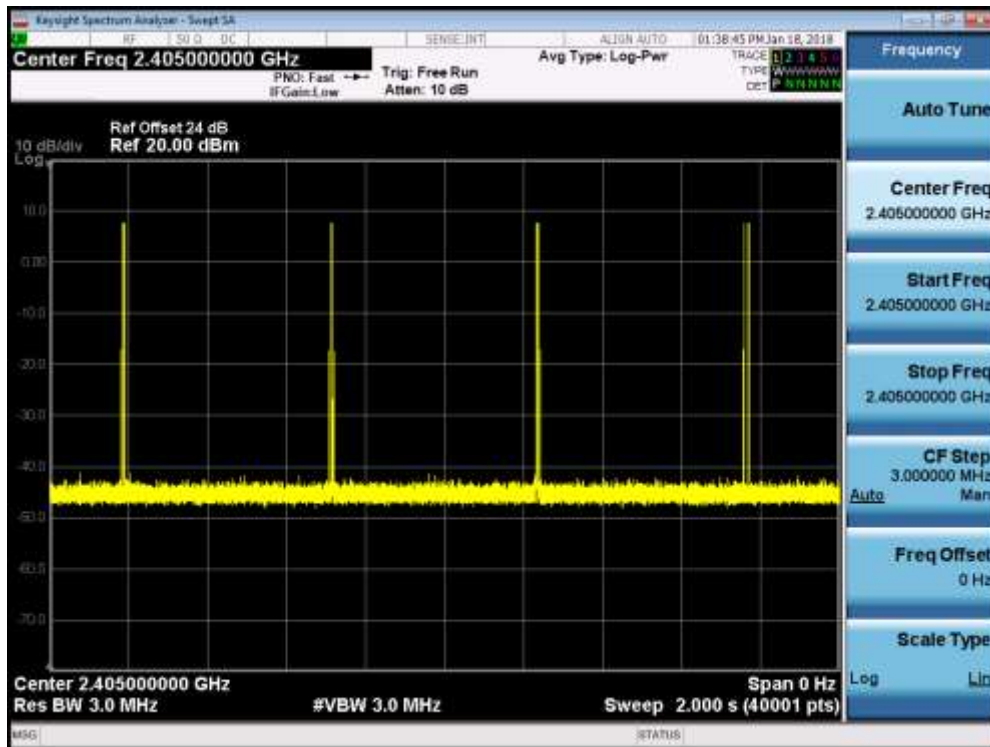


Figure 9. Communicating with AD610 - 4 packets in 2 second interval

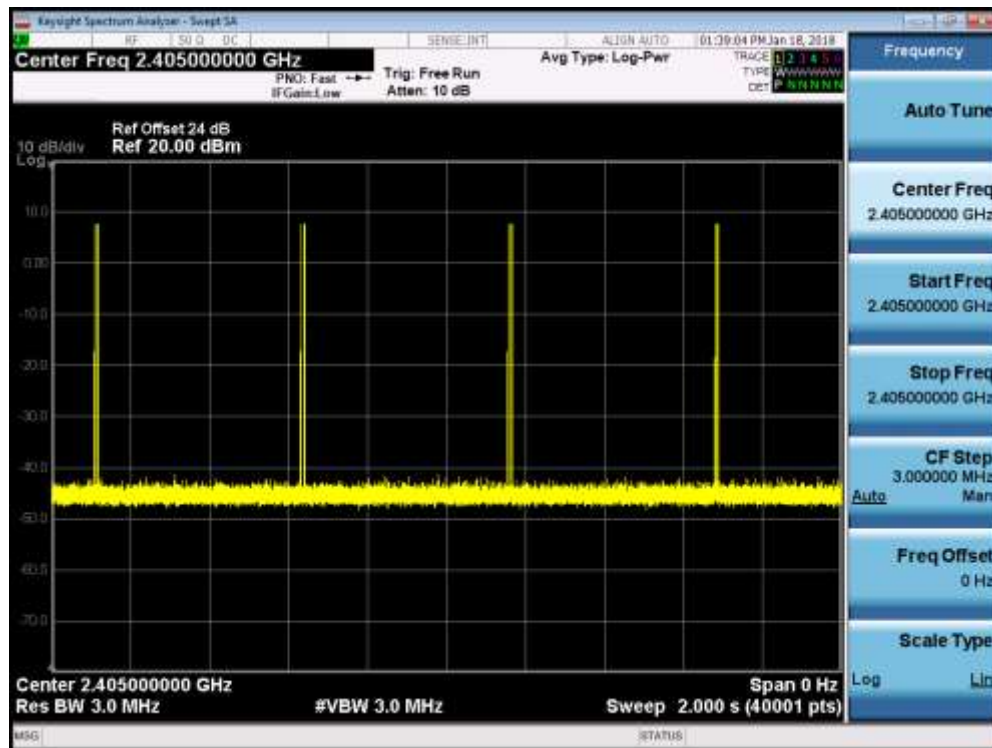


Figure 10. Communicating with AD610 - 4 packets in 2 second interval

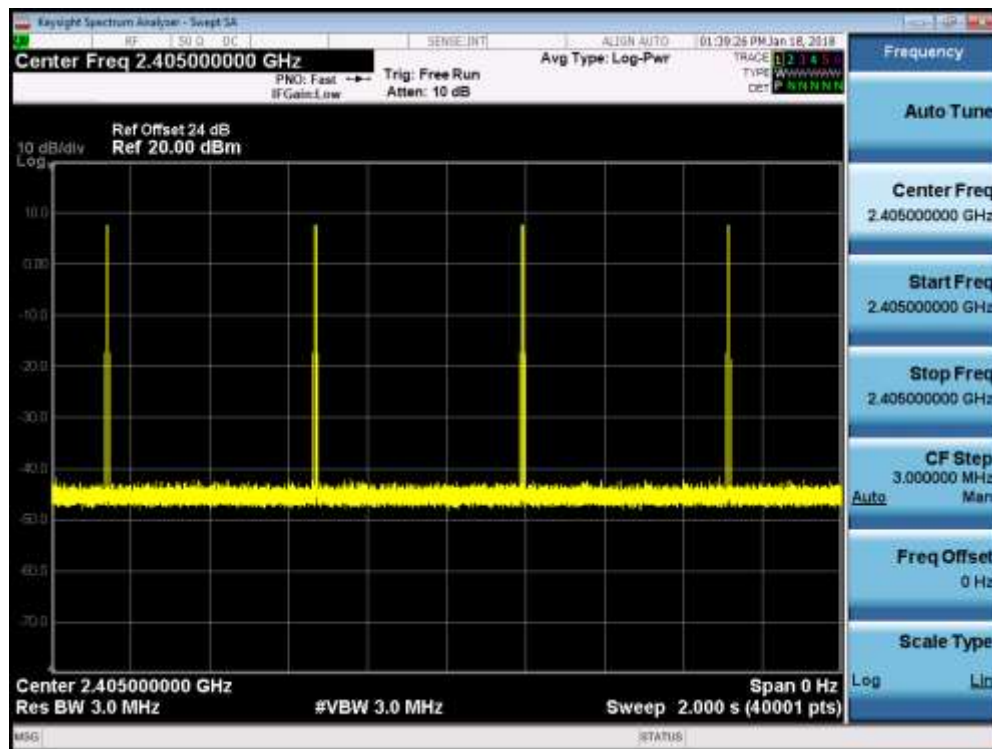
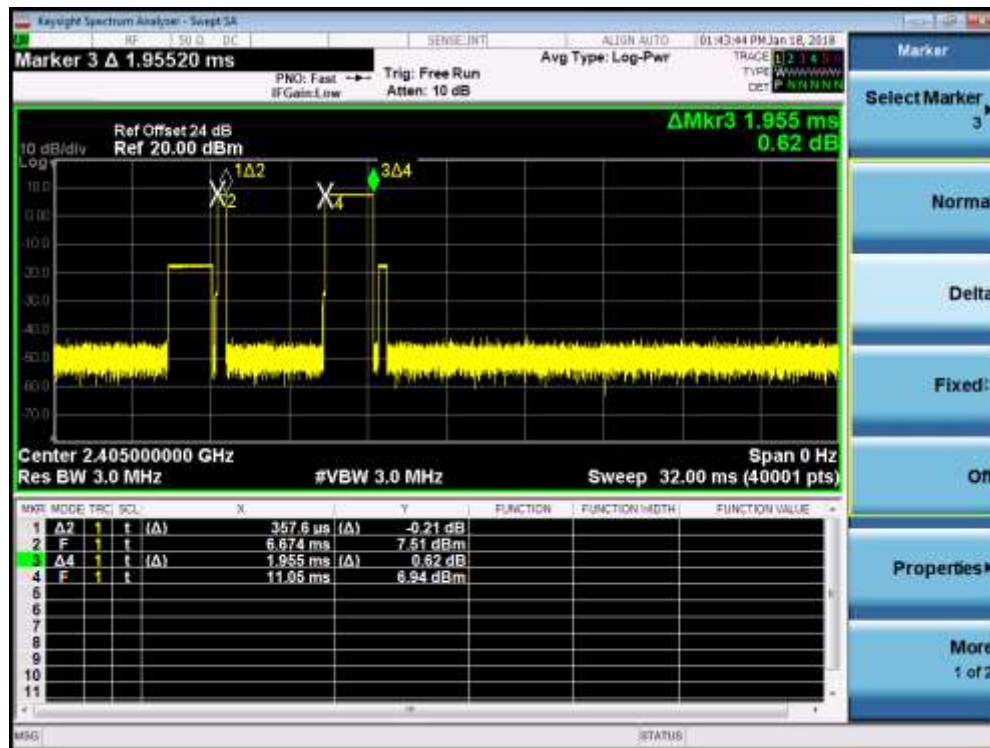


Figure 11 - Typical packet duration



Duty Cycle Calculations

Packet Count Distribution

Using the counted packets of several consecutive measurements, a standard deviation (SDEV) measurement was calculated. In order to ensure statistical validity of measurements, $\text{Mean} + 3 \times \text{SDEV}$ was used for final calculation of the duty cycle (Table 1)

Figure#	# packets
1	3
2	5
3	5
4	5
5	4
6	4
7	4
8	4
9	4
10	4
Mean	4.20
STDEV	0.63
Mean+3*STDEV	6.10

Table 1 - Packet count distribution

Duty Cycle

The duty cycle calculation is shown in Table 2 below.

# of Packets		Single Packet Duration (ms)	Total PA-ON Time in 2 sec. Interval (ms)	Duty Cycle (%)
Mean out of packets	4.20	0.3576+1.955	9.71	0.49
Mean+3*STDEV	6.10	0.3576+1.955	14.11	0.71

Table 2 - Duty cycle calculations

No Packets 2sec: = 6.10

Single Packet Period: = (0.3576+1.955) =2.3126 ms

No Packets 100ms:= $\frac{\text{No_Packets_2sec} \times 100\text{ms}}{2000\text{ms}} = 0.305$

$\delta := \frac{\text{No_Packets_100ms} \times \text{Single_Packet_Period}}{100\text{ms}} = 0.00705$

Duty Cycle Correction (dB) = $20 \times \log(\delta) = -43.03$

5.7. 佔用頻寬

5.7.1. 量測方法

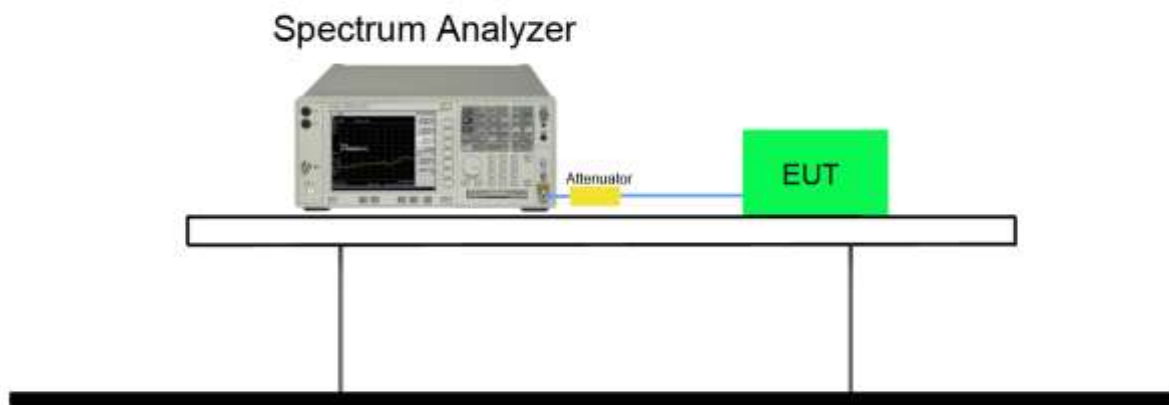
待測物之天線埠經由適當之衰減直接連至頻譜分析儀RF輸入端，頻譜分析儀之設定,參考如下:

- (1) 解析頻寬為100 kHz，視訊頻寬不小於解析頻寬。
- (2) 掃描時間為自動，檢波功能為峰值，訊號軌跡為最大保留(Max Hold)。
- (3) 將標記設定於任何欲紀錄之波峰上，所顯示之位準值必須符合指定之限制值。

5.7.2. 限制要求

6dB頻寬至少應有500kHz。

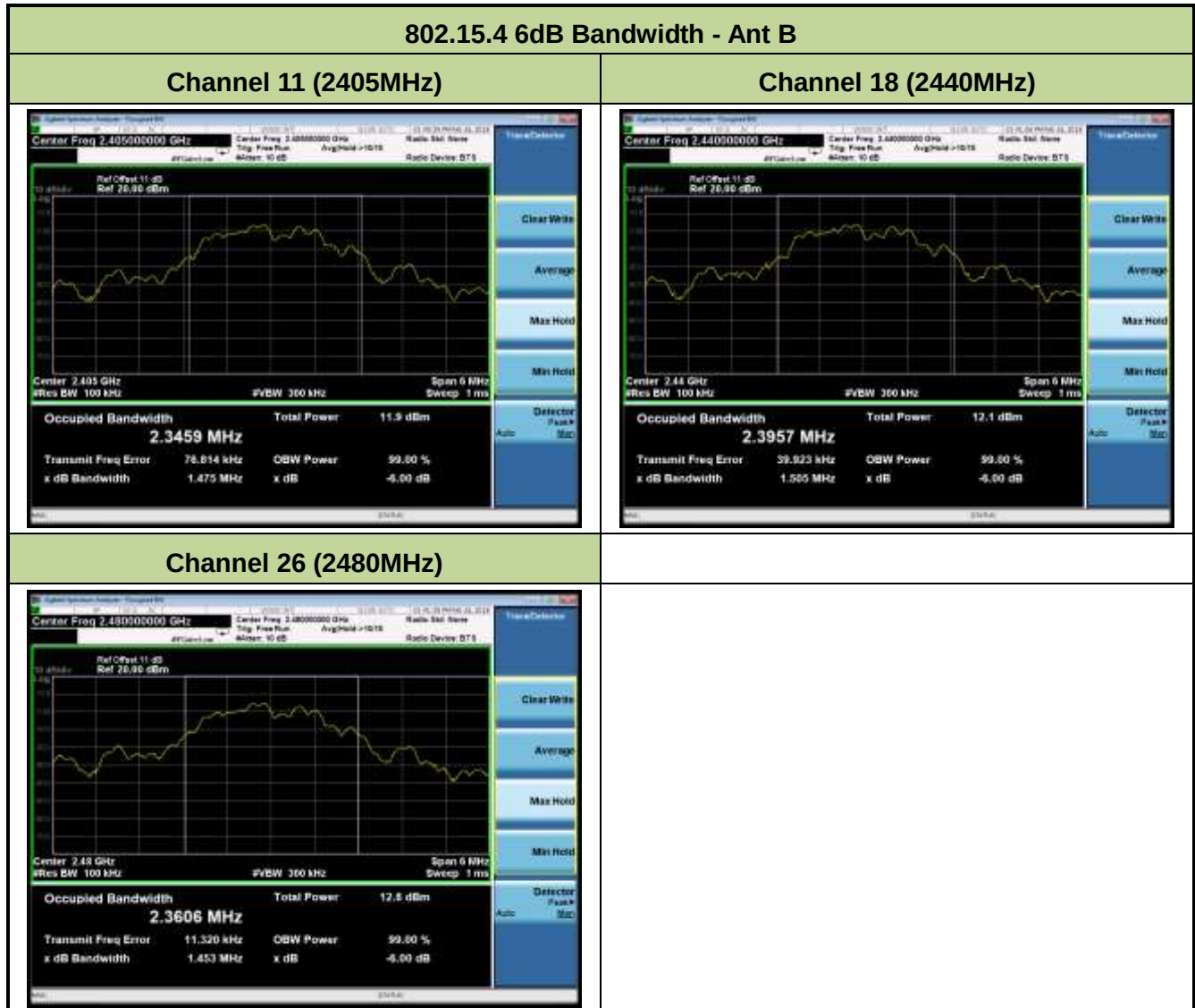
5.7.3. 測試架構圖



5.7.4. 佔用頻寬測試結果

待測物名稱	Digital Handheld Transmitter	測試日期	2018/02/26
待測物型號	ADX2FD G62	溫度 / 濕度	21°C / 58%
測試場地	SR1	測試工程師	Kevin

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.15.4	O-QPSK	11	2405	1.48	≥ 0.5	Pass
802.15.4	O-QPSK	18	2440	1.51	≥ 0.5	Pass
802.15.4	O-QPSK	26	2480	1.45	≥ 0.5	Pass



5.8. 功率頻譜密度

5.8.1. 量測方法

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。所測得之峰值位準必須應小於或等於8 dBm。

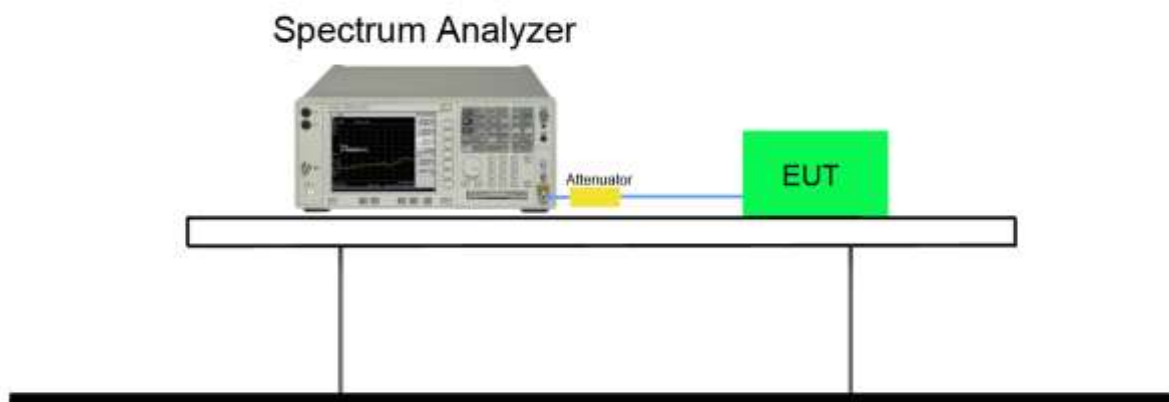
若受測裝置之頻譜線間隔小於3 kHz，測量時應將解析頻寬降低以使頻譜線間隔大於3kHz，所測得之數據再藉加總3 kHz 頻帶內所有個別頻譜線之功率(即標準化至3 kHz)以決定是否符合規定。

5.8.2. 限制要求

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。

若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。

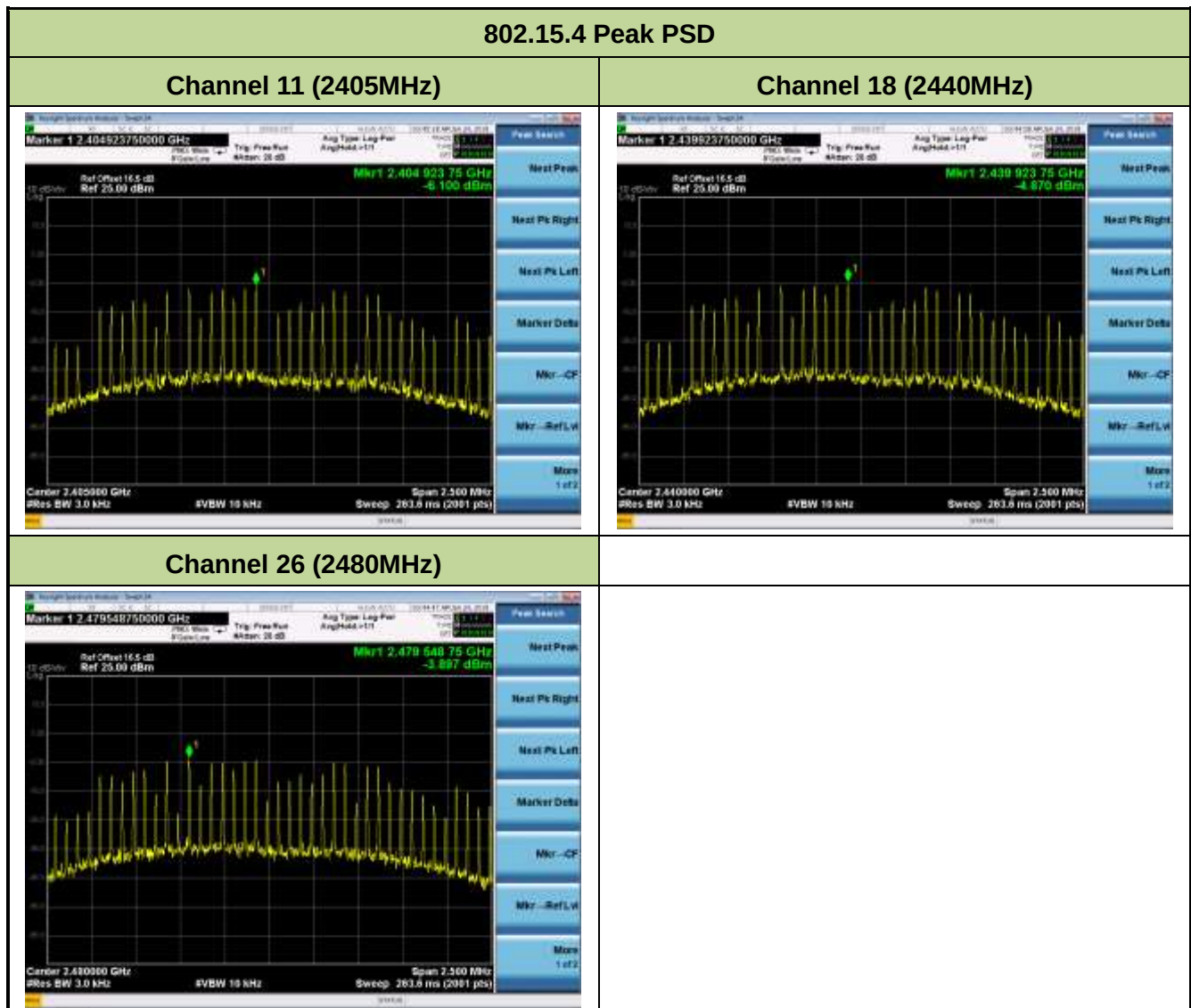
5.8.3. 測試架構圖



5.8.4. 功率頻譜密度測試結果

待測物名稱	Digital Handheld Transmitter	測試日期	2018/01/24
待測物型號	ADX2FD G62	溫度 / 濕度	23°C / 52%
測試場地	SR1	測試工程師	Kevin

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	PSD Result (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
802.15.4	O-QPSK	11	2405	-6.100	≤ 8	Pass
802.15.4	O-QPSK	18	2440	-4.870	≤ 8	Pass
802.15.4	O-QPSK	26	2480	-3.897	≤ 8	Pass



End