

# Bode-plot 100 User Guide

Bode-plot 100 User Guide



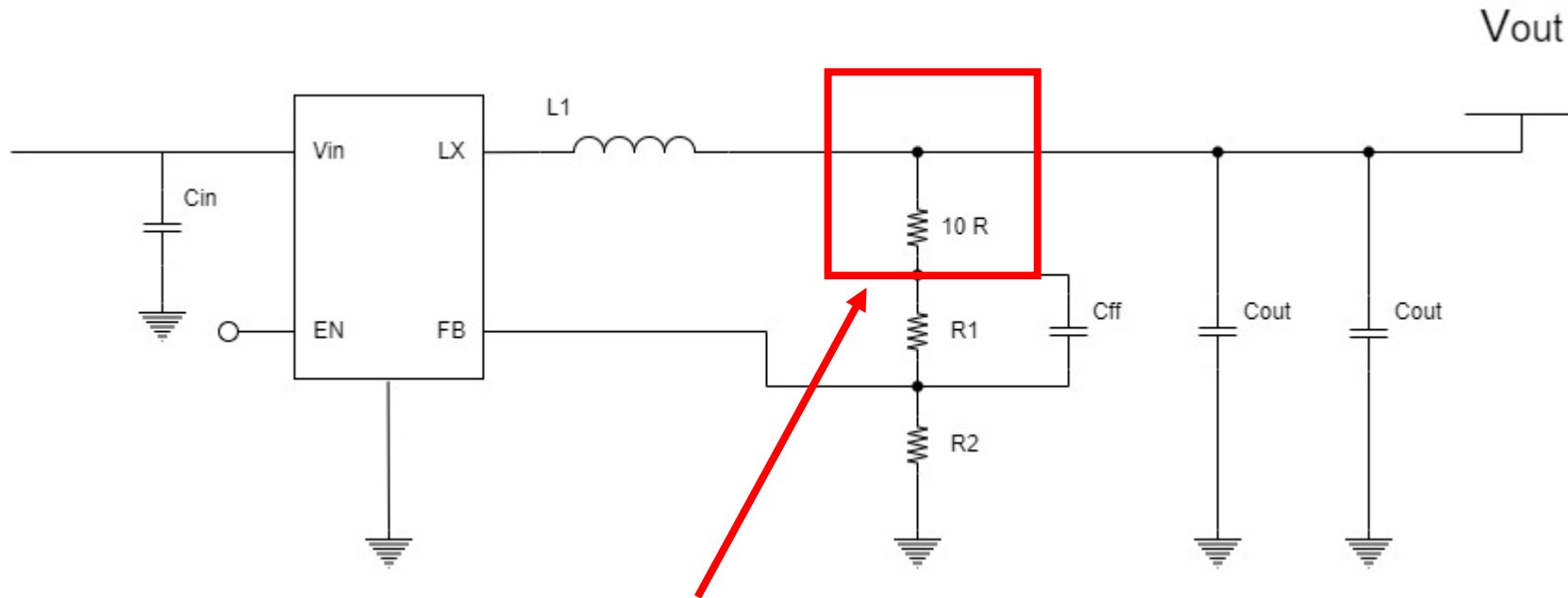
Reported : FAE Dept.

Date : Jan. 18<sup>th</sup> 2024

Update : Jan. 22<sup>th</sup> 2024

# 為什麼要量測 Gain & Phase Margin

- 在電源系統不同的負載條件下，會有不同的動態響應，為了確保在各種操作下系統都能夠正常運作且不失去穩定性，所以才會需要去量測Bode plot中的 Gain & Phase Margin，去驗證電路的穩定及反應速度。

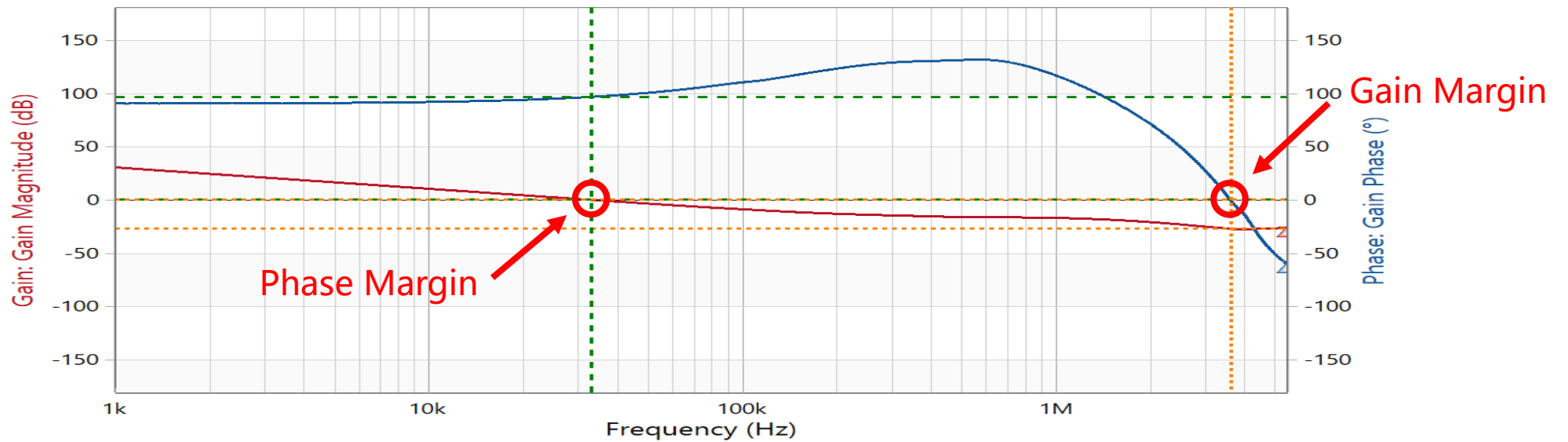


- 在電源回授的地方，串接一個 $10R$ (或小電阻 $10\sim 50\text{ ohm}$ )，接外部的交流訊號進來，利用外部擾度訊號來觀察整個系統的反應。

# Phase Margin & Gain Margin 定義/標準/影響

	Frequency	Gain	Phase	
Cursor 1	33.192 kHz	0 dB	96.632 °	🗑️
Cursor 2	3.643351 MHz	-27.078 dB	0 °	🗑️
Delta C2-C1	3.610159 MHz	-27.078 dB	-96.632 °	🗑️

- 藍線為Phase
- 紅線為Gain



	定義	標準	影響
相位邊限(P.M.) Phase Margin	Gain 0 dB時 Phase離0°還有幾度	Buck $\geq 45^\circ$ LDO $\geq 30^\circ$	是否穩定
增益邊限(G.M.) Gain Margin	Phase 0°時 Gain負多少dB的絕對值	$ G.M.  \geq 6$ or 10 dB	高頻雜訊干擾

# Bode-plot 硬體設備介紹

**AENEAS**

- 1. 下列為量測Gain/Phase 所需要的硬體設備



*Bode 100*  
multi functional test set



Wide-range AC power supply  
including mains input plugs for  
different national standards



USB Cable



4 pc. BNC 50  $\Omega$  cables with 500  
mm length (m-m)



**B-WIT 100 Wideband**



**Injection Transformer**

# Bode-plot 設備說明

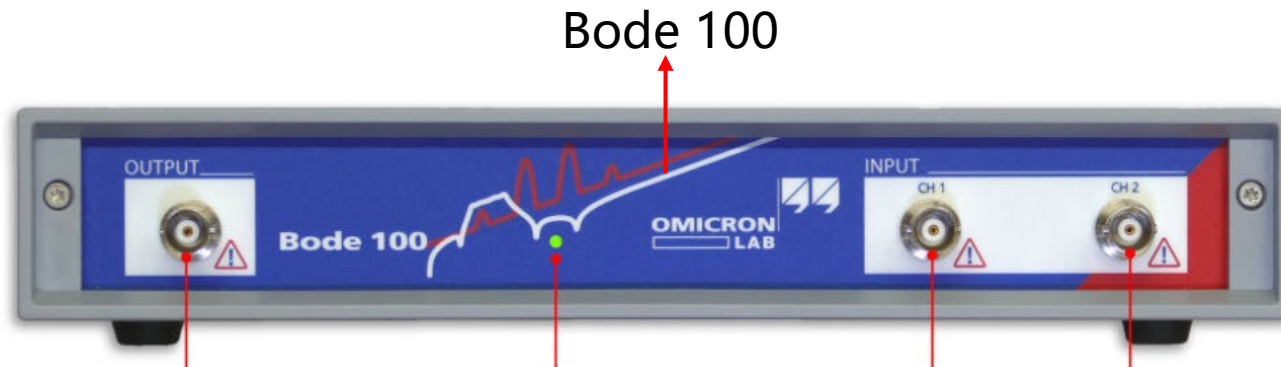
接地端

B-WIT 100

兩端子將信號  
注入要測試的  
demo中



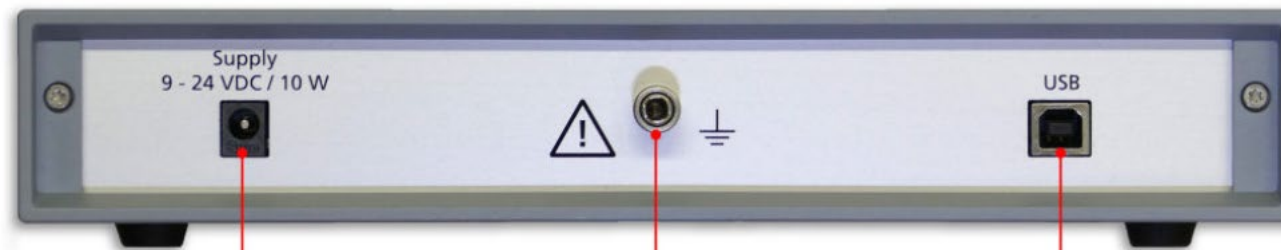
與Bode 100  
輸出端連接



輸出信號

Green LED主機上電  
指示燈變綠色

CH1,CH2是輸入信號  
通道，請接在欲測量  
的信號點



直流電源輸入

接地連接器

USB連接器

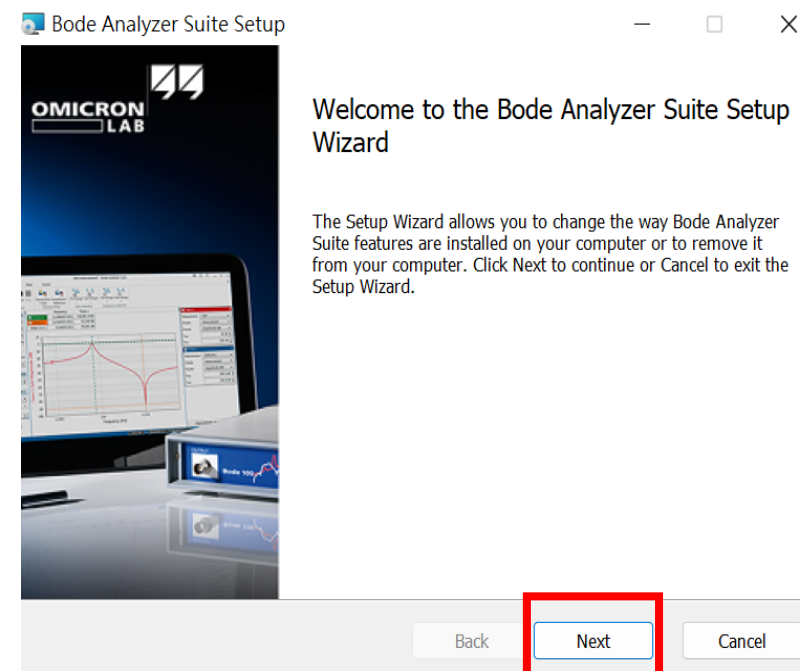
# Bode-plot 軟體安裝

- 2.軟體安裝請上到工程部NAS 路徑如下

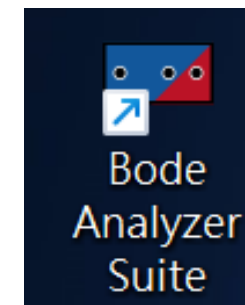
D:\FAE Sync\999-Temp\Tools\Bode-100\Setup  
FAE Sync > 999-Temp > Tools > Bode-100 >

名稱	狀態
Documentation	☁
Setup	☁
Bode-100-Quick-Start-Guide-ENU10060304	✓
Bode-100-User-Manual-ENU10060508	✓
BodeAnalyzerSuite_3.24 (1)	☁
BodeAnalyzerSuite_3.25_SR1	☁
Default setting	✓
<b>Setup</b>	☁

- 3.開始安裝按下Next



- 4.安裝好請點擊Bode Analyzer Suite 開啟程式



- 5.一開始進入Bode Analyzer Suite 起始畫面

**Bode Analyzer Suite 3.25 SR1**

New measurement

Recent

- junior.bode3 D:\Peter\Bode-plot\Junior
- Default setting.bode3 D:\Peter\Bode-plot\Leon
- junior.bode3 D:\Peter
- junior.bode3 D:\Peter\Fae Team\(\QQ)Junior哥\B...
- ImpAdapt\_Inductor.bode3 C:\Users\peter.pan\AppData\Roam...

Open other file

Read user manual

Options

About

新測量

近期開啟的  
程式設定

設定選項

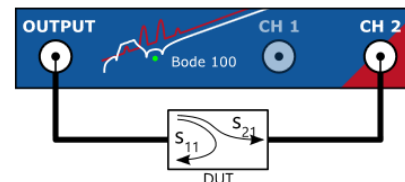
## Welcome, please select a measurement type...

Vector Network Analysis | Impedance Analysis | Advanced

### Transmission / Reflection

Measure S-parameters (S21, S11) with 50  $\Omega$  termination.  
Measure Gain with internal or external reference.

⚠ Do not exceed 3.3 V<sub>rms</sub> at the output (50  $\Omega$ ).  
Do not exceed 7 V<sub>rms</sub> at Channel 2 input (50  $\Omega$ ).

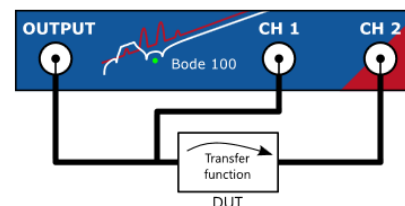


No supported device

### Gain / Phase

Measure transfer function (Gain/Phase) from CH1 to CH2.

⚠ By default, the inputs are set to high impedance and are ac-coupled.  
Do not exceed 50 V<sub>dc</sub> at the inputs.  
Do not exceed 3.3 V<sub>rms</sub> at the output (50  $\Omega$ ).



No supported device

### > Reflection with external coupler

量測Gain/Phase  
請選擇此處

# Bode-plot 軟體設備配置

- 6.若成功連線，請點選Select measurement，倘若連線失敗，請檢察USB Cable 線是否有確實安裝好，然後再試一次。

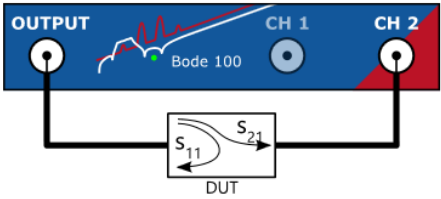
Vector Network Analysis | Impedance Analysis | Advanced

▼ Transmission / Reflection

Measure S-parameters (S21, S11) with 50  $\Omega$  termination.  
Measure Gain with internal or external reference.

⚠ Do not exceed 3.3 V<sub>rms</sub> at the output (50  $\Omega$ ).  
Do not exceed 7 V<sub>rms</sub> at Channel 2 input (50  $\Omega$ ).

No supported device

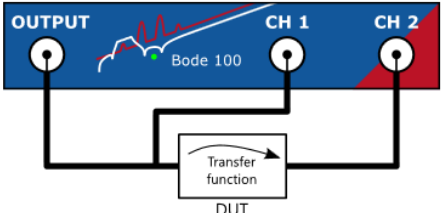


▼ Gain / Phase

Measure transfer function (Gain/Phase) from CH1 to CH2.

⚠ By default, the inputs are set to high impedance and are ac-coupled.  
Do not exceed 50 V<sub>dc</sub> at the inputs.  
Do not exceed 3.3 V<sub>rms</sub> at the output (50  $\Omega$ ).

No supported device



裝置未連線成功

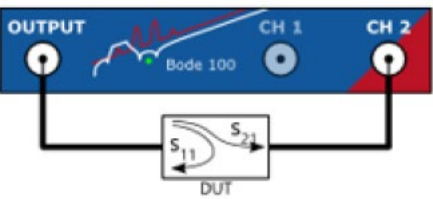
Vector Network Analysis | Impedance Analysis | Advanced

▼ Transmission / Reflection

Measure S-parameters (S21, S11) with 50  $\Omega$  termination.  
Measure Gain with internal or external reference.

⚠ Do not exceed 3.3 V<sub>rms</sub> at the output (50  $\Omega$ ).  
Do not exceed 7 V<sub>rms</sub> at Channel 2 input (50  $\Omega$ ).

Select measurement

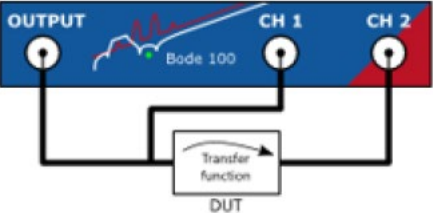


▼ Gain / Phase

Measure transfer function (Gain/Phase) from CH1 to CH2.

⚠ By default, the inputs are set to high impedance and are ac-coupled.  
Do not exceed 50 V<sub>dc</sub> at the inputs.  
Do not exceed 3.3 V<sub>rms</sub> at the output (50  $\Omega$ ).

Select measurement



裝置成功連線

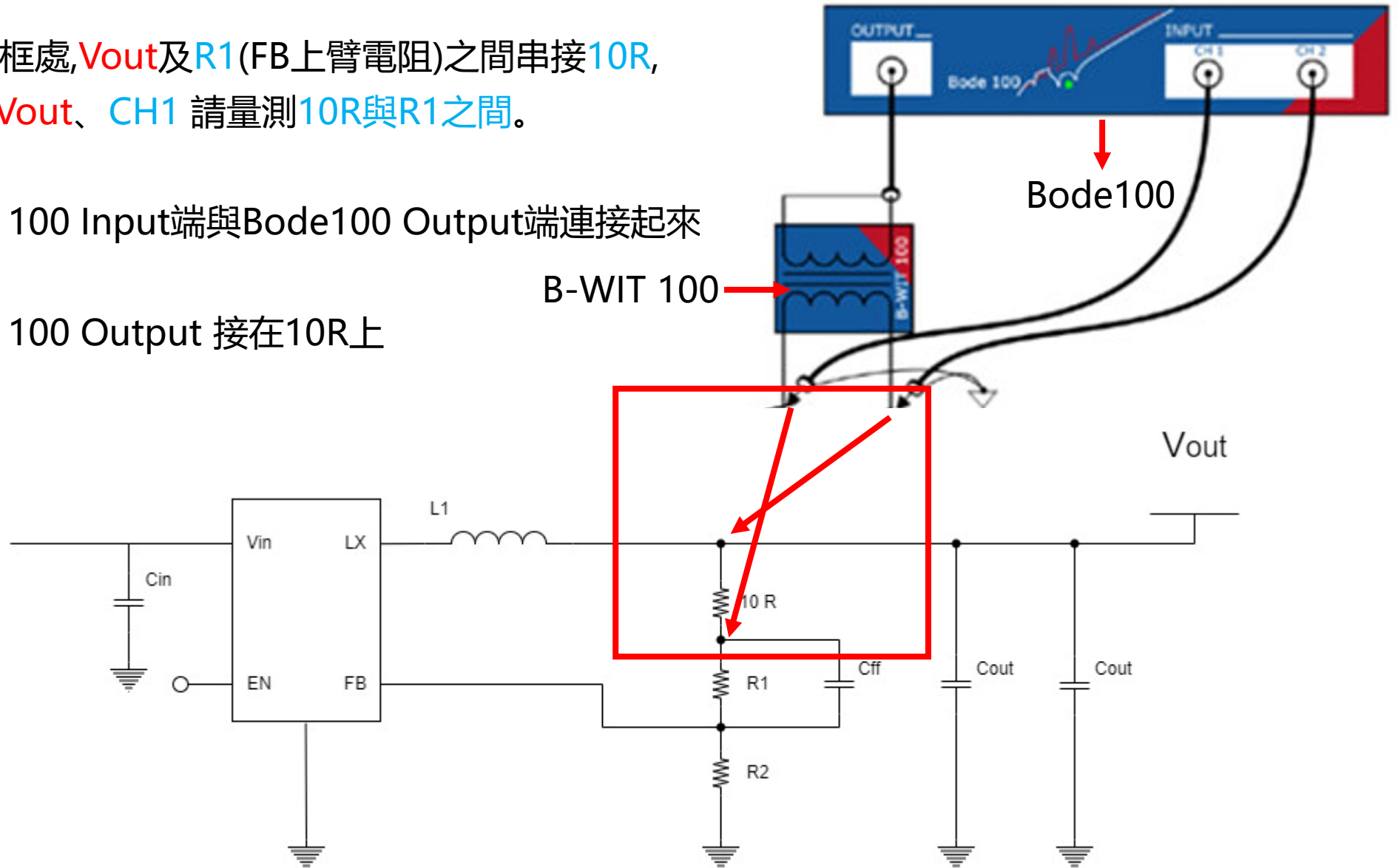


# Bode-plot 與被量測線路接線示意圖

- 7. 在上圖紅框處,  $V_{out}$  及  $R1$  (FB上臂電阻) 之間串接  $10R$ ,  $CH2$  請量測  $V_{out}$ 、 $CH1$  請量測  $10R$  與  $R1$  之間。

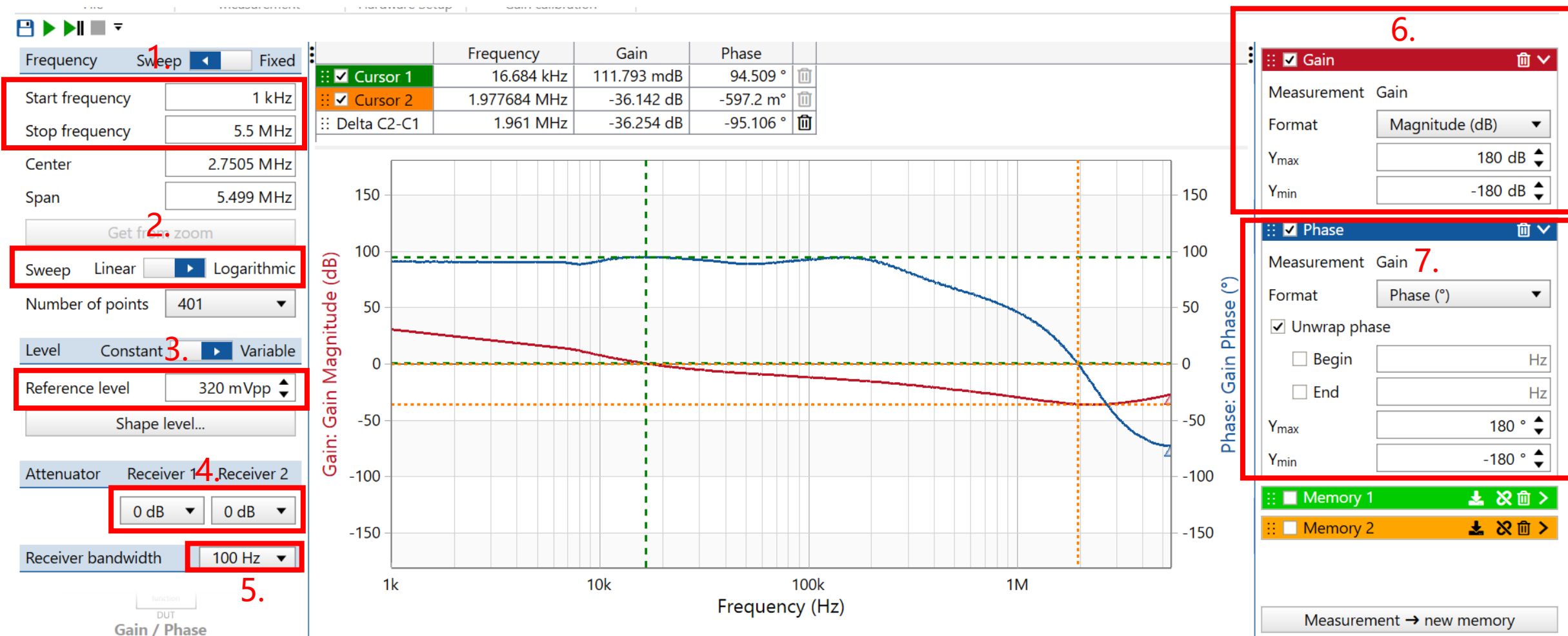
- 8. 將 B-WIT 100 Input 端與 Bode100 Output 端連接起來

- 9. 將 B-WIT 100 Output 接在  $10R$  上



# Bode-plot 100 軟體介面參數

- 10.進入Bode-plot 操作介面，準備設定各參數便於量測。



# Bode-plot 100 軟體參數介紹

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Frequency Sweep  Fixed

Start frequency

Stop frequency  1.

- 設定波德圖掃描頻段(依照測試調整)

Sweep Linear   Logarithmic

Number of points  2.

- 選擇Linear Or logarithmic 後,建議選擇Logarithmic, 下方為採樣點個數

Level Constant   Variable

Reference level  3.

Shape level...

- 調整擾動訊號大小,建議從-20dB (100mV) 依照測試條件調整dB值大小

Attenuator Receiver 1 Receiver 2

4.

- 設定衰減dB(Attenuators,請設各20dB)

Receiver bandwidth  5.

- 接收頻寬(Receiver bandwidth,請按照測試環境需求該改速度)



# Bode-plot 100 軟體參數介紹

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6.

Gain

Measurement Gain

Format Magnitude (dB)

Y<sub>max</sub> 180 dB

Y<sub>min</sub> -180 dB

- 設定Gain圖表上下限

7.

Phase

Measurement Gain

Format Phase (°)

Unwrap phase

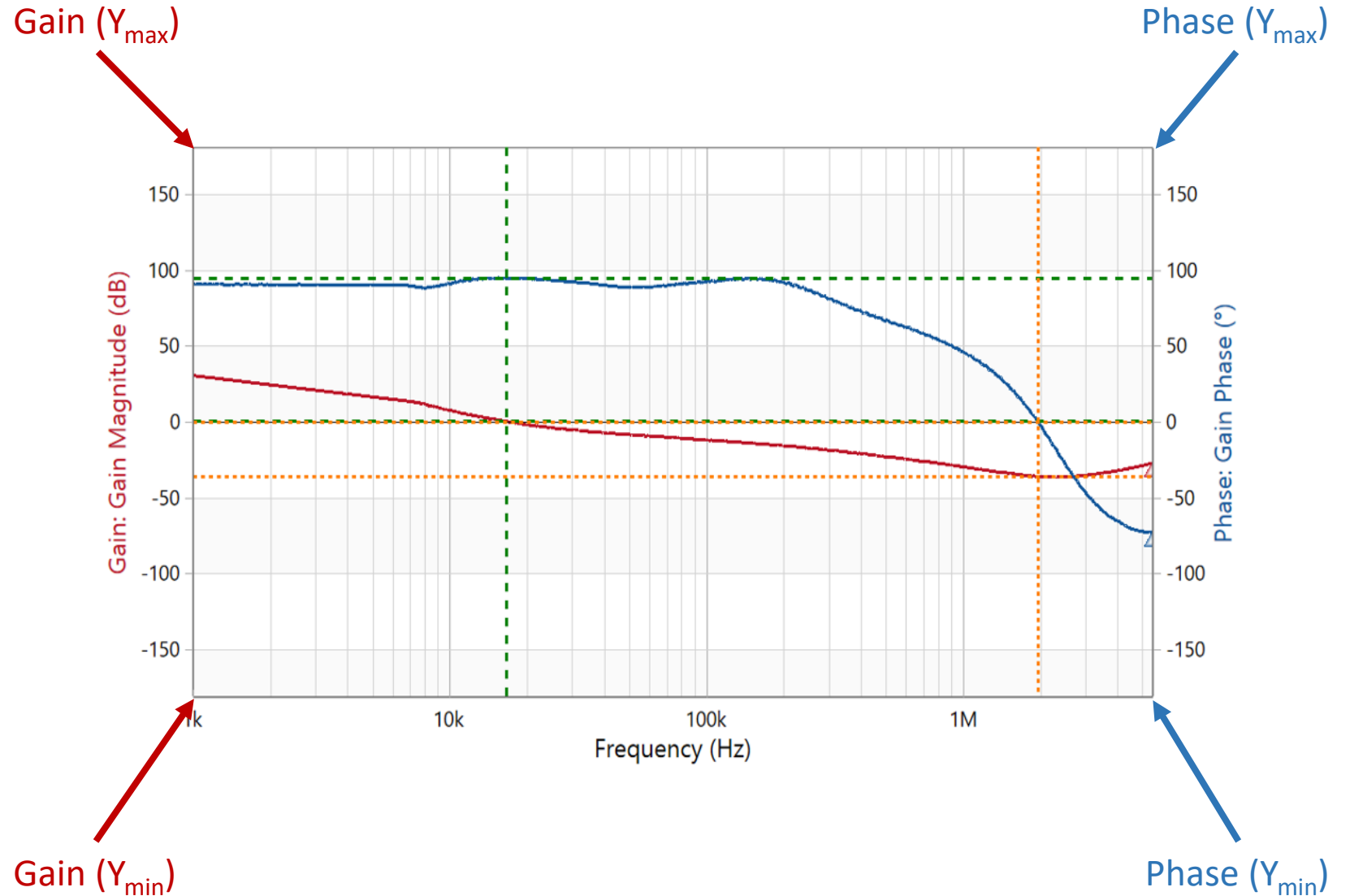
Begin Hz

End Hz

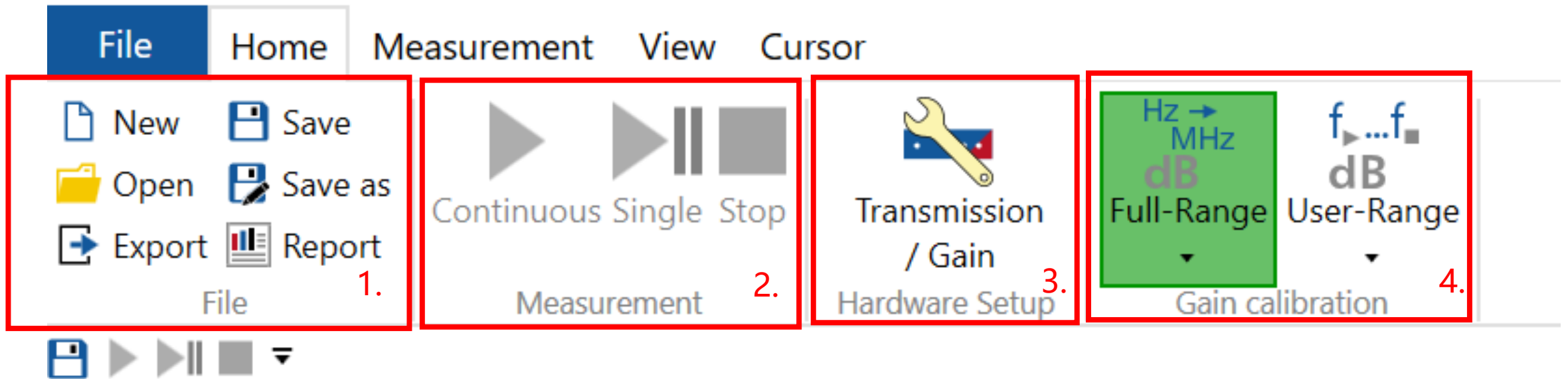
Y<sub>max</sub> 180 °

Y<sub>min</sub> -180 °

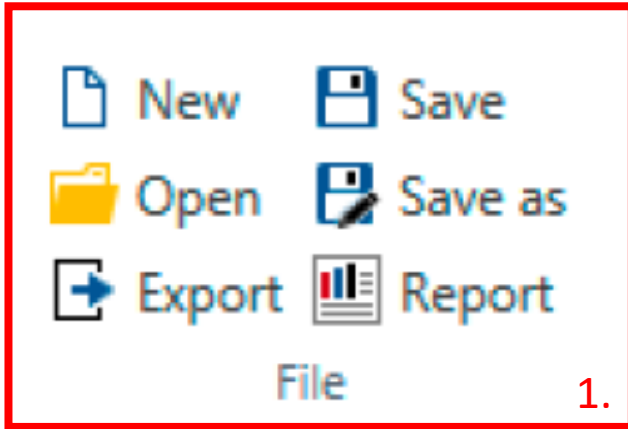
- 設定Phase圖表上下限



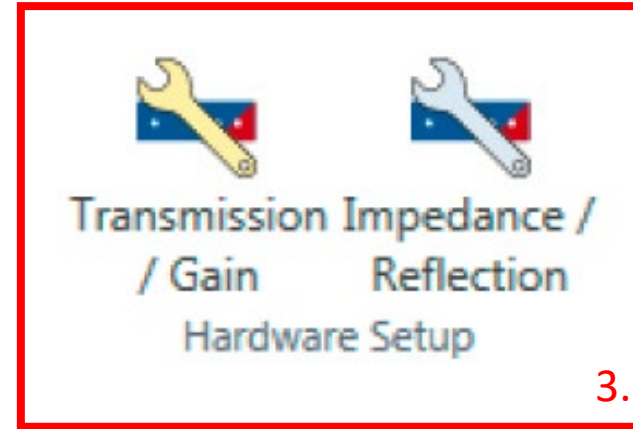
- 11.Bode-plot 操作介面, 介紹工具列以及如何使用。



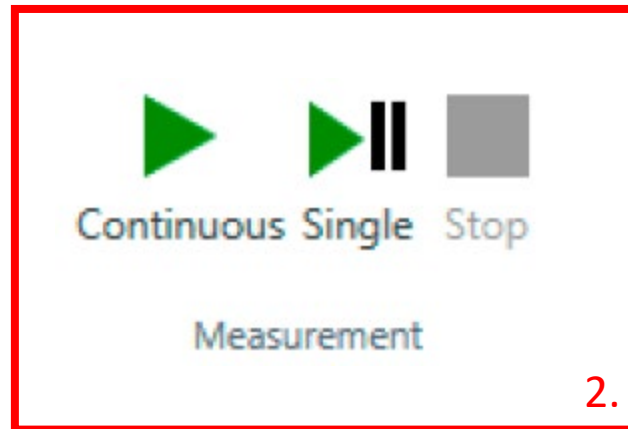
# Bode-plot 100 軟體介面工具列介紹



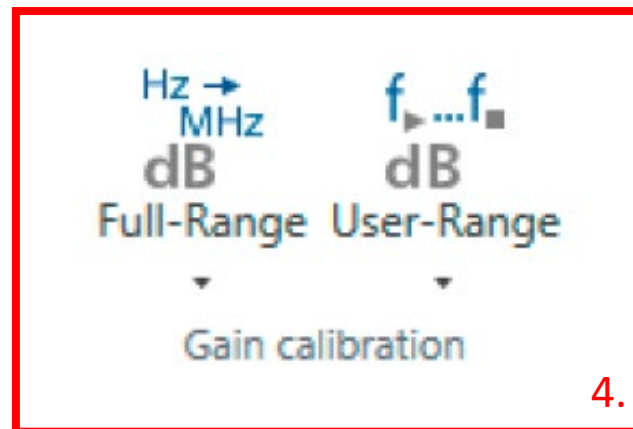
- 建立新測量(New)、
- 開啟不同的測量文件(Open)、
- 匯出測量數據(Export)、
- 儲存目前的文件(Save)、
- 另存為(Save as)、
- 建立PDF報告(Report)、



- Bode-plot硬體設定

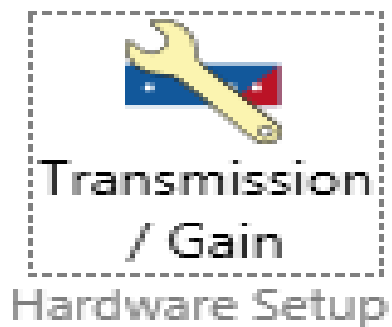
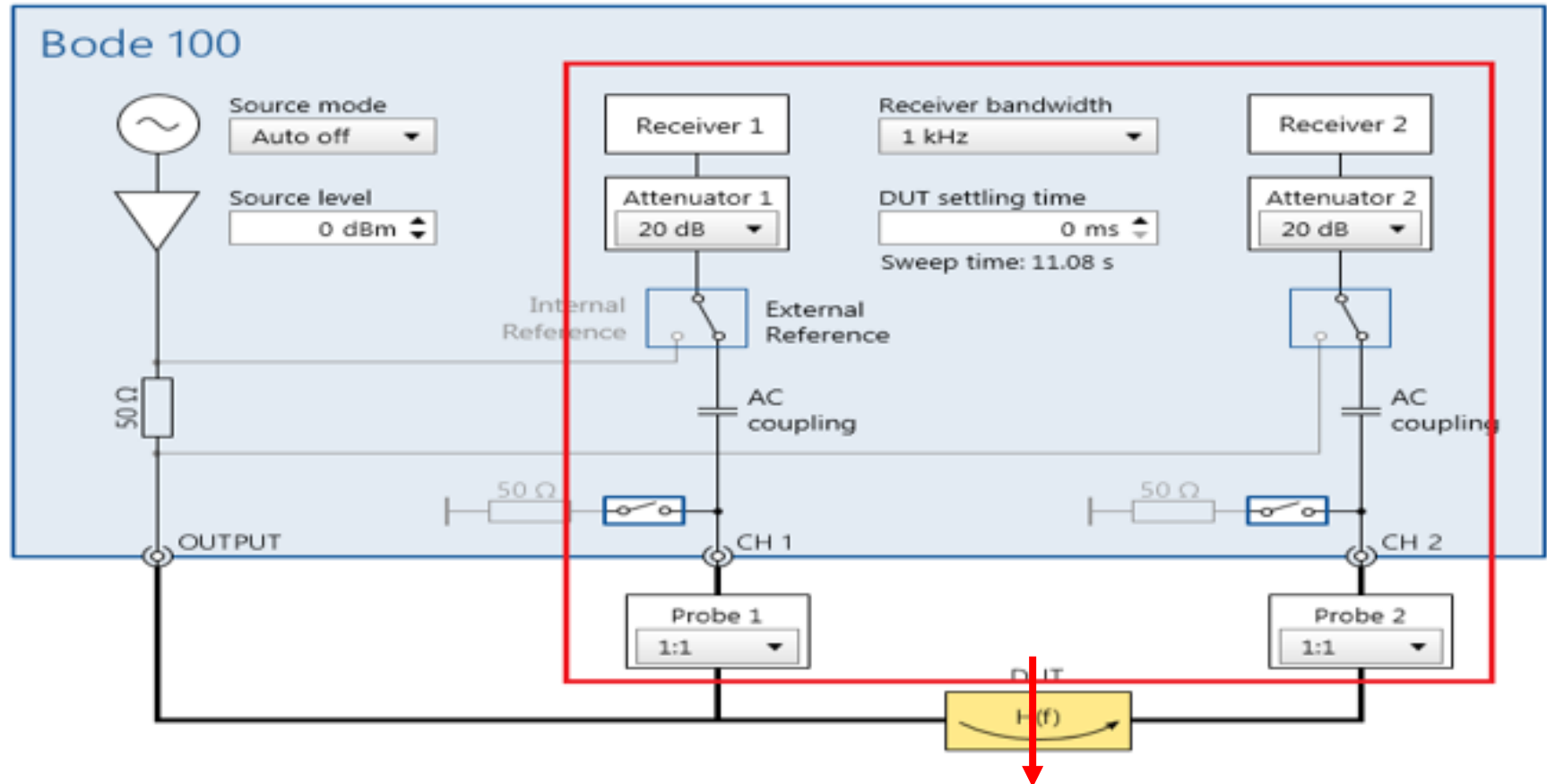


- 連續開始測量(Continuous)、
- 執行一次單次測量(Single)、
- 停止正在運作的測量(Stop)、



- 校正
- 全範圍:執行全範圍
- 使用者範圍:執行使用者範圍

# Bode-plot 100 硬體參數設定與介紹



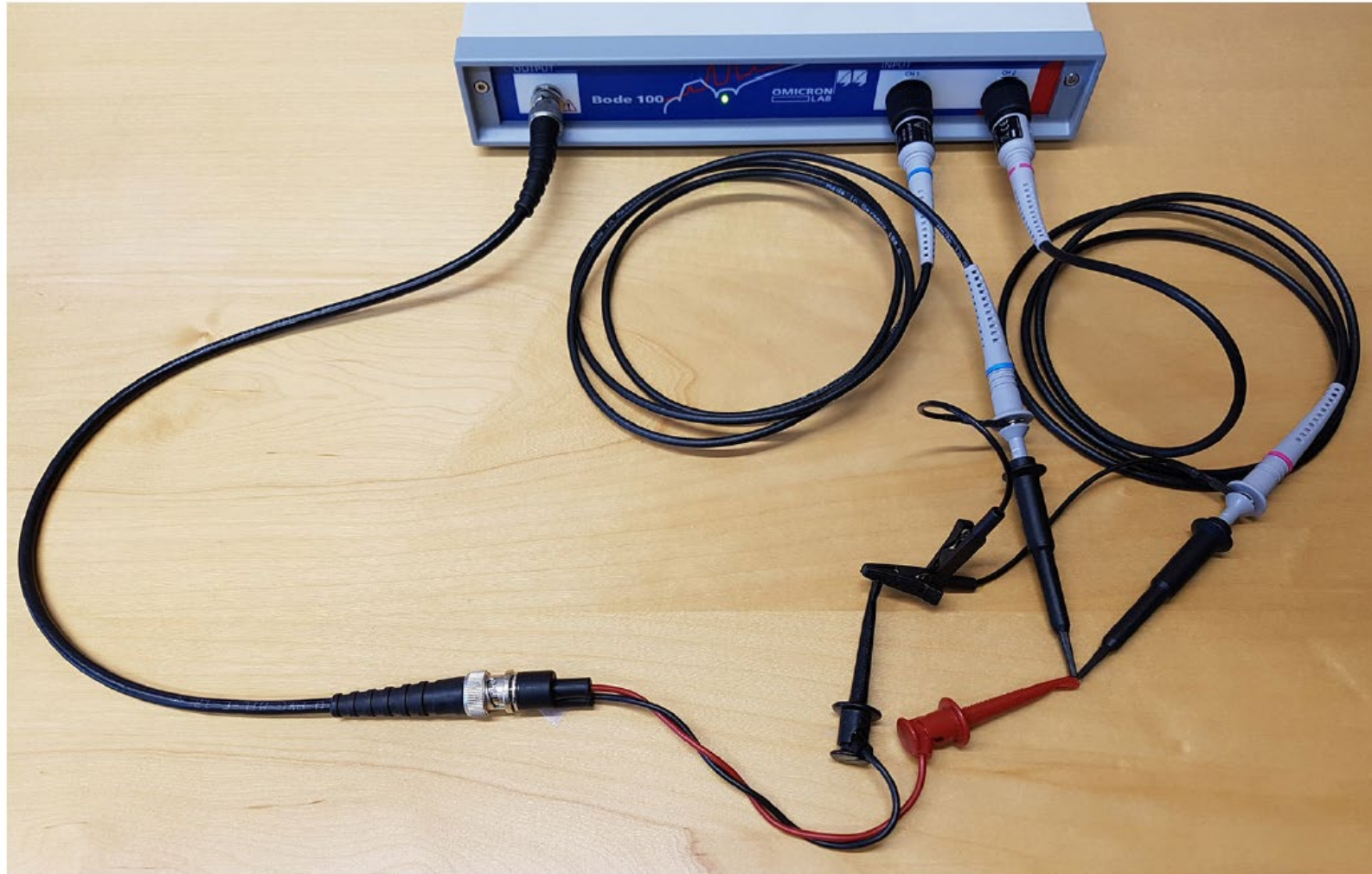
請點選圖示  
Transmission/Gain

- P.S 當Noise 無法透過校準消除時,減小 attenuators dB值及減小receiver bandwidth 頻寬,來達到消除 Noise 。

- 設定衰減dB(Attenuators,請設各20dB)
- 接收頻寬(Receiver bandwidth,影響測試速度, 請按照測試環境需求該改速度)
- 探棒倍率(若使用示波器探棒請改為10:1, 反之使用自製治具請改為1:1)。

# Bode-plot 100 校正介紹

- 12.依照測試需求設定測試參數並執行校正,請將CH1及CH2正端接擾動輸出紅棒,負端接擾動輸出黑棒,此校正不需要被測裝置。

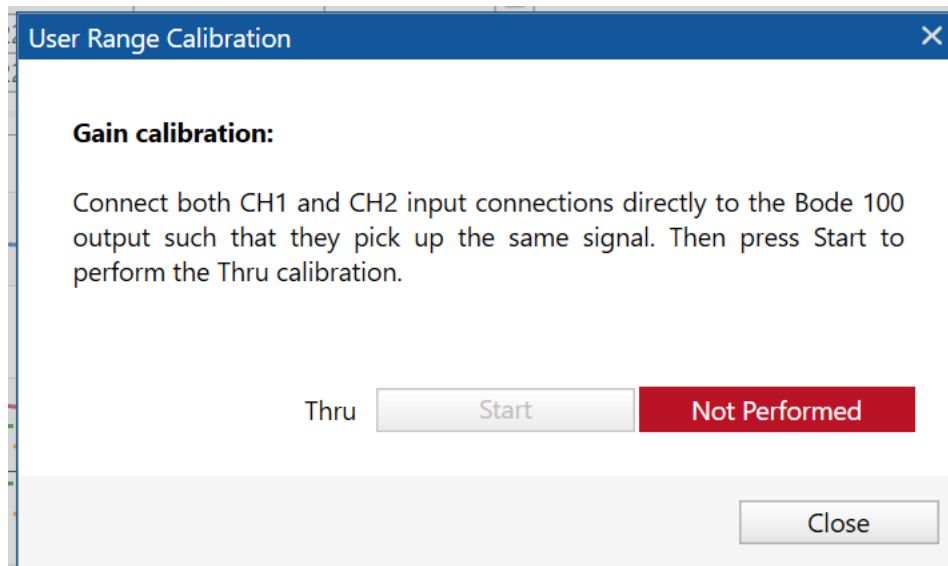




# Bode-plot 100 校正介紹

- 13. 點擊 User Range  會出現下列圖示

- 14. 校準狀態顯示未執行或裝置未連接




- 15. 設定好後按下 Start, 會開始執行校正



- 16. 完成校正後, 會出現下列圖示, 代表已經校正完成。

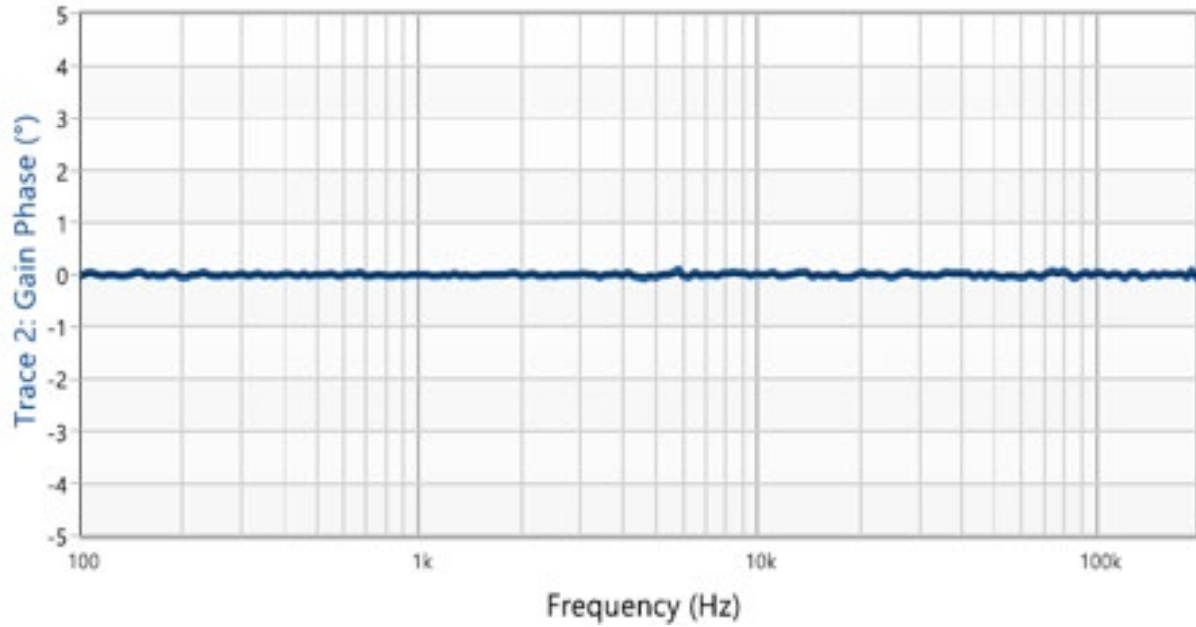


- 17. 接下來請回到軟體畫面按下  此動作是要確認 Gain 與 Phase 都已經校正歸零完成

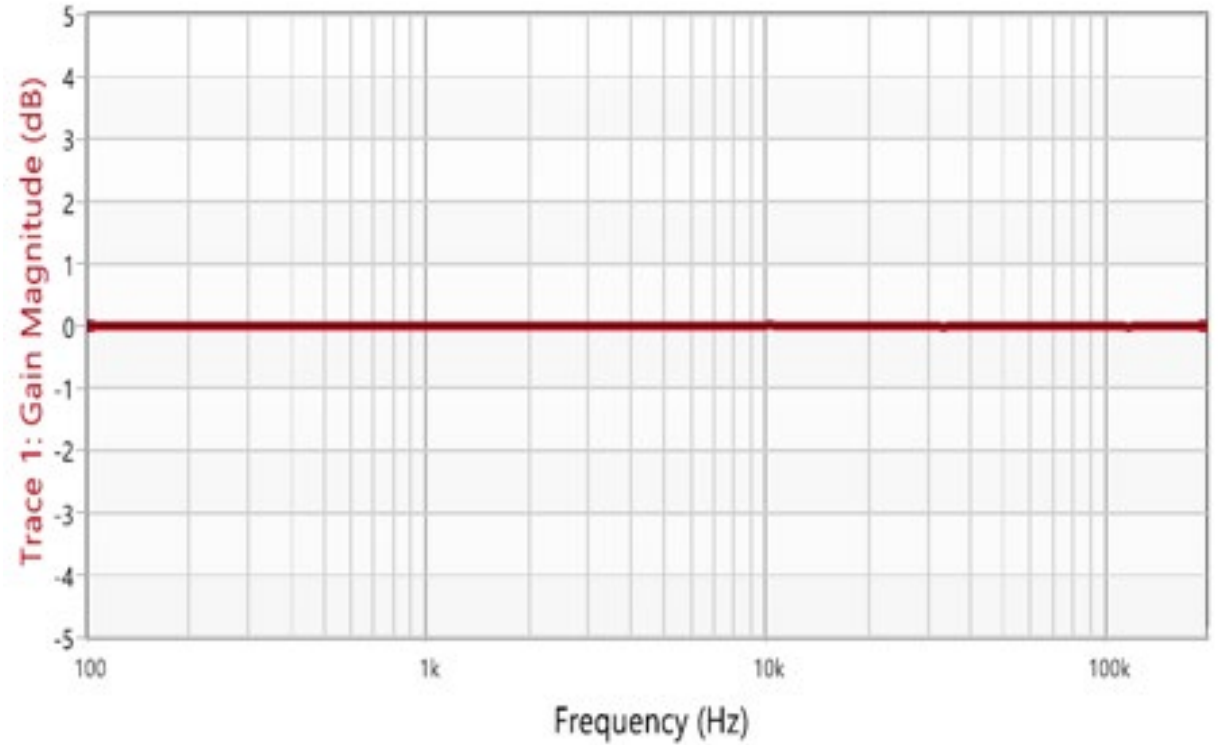
- 18. Gain 及 Phase 會出現似近 0dB 和 0 度的圖, 請看下一頁。

# Bode-plot 100 校正介紹

Gain 0 dB



Phase 0 °



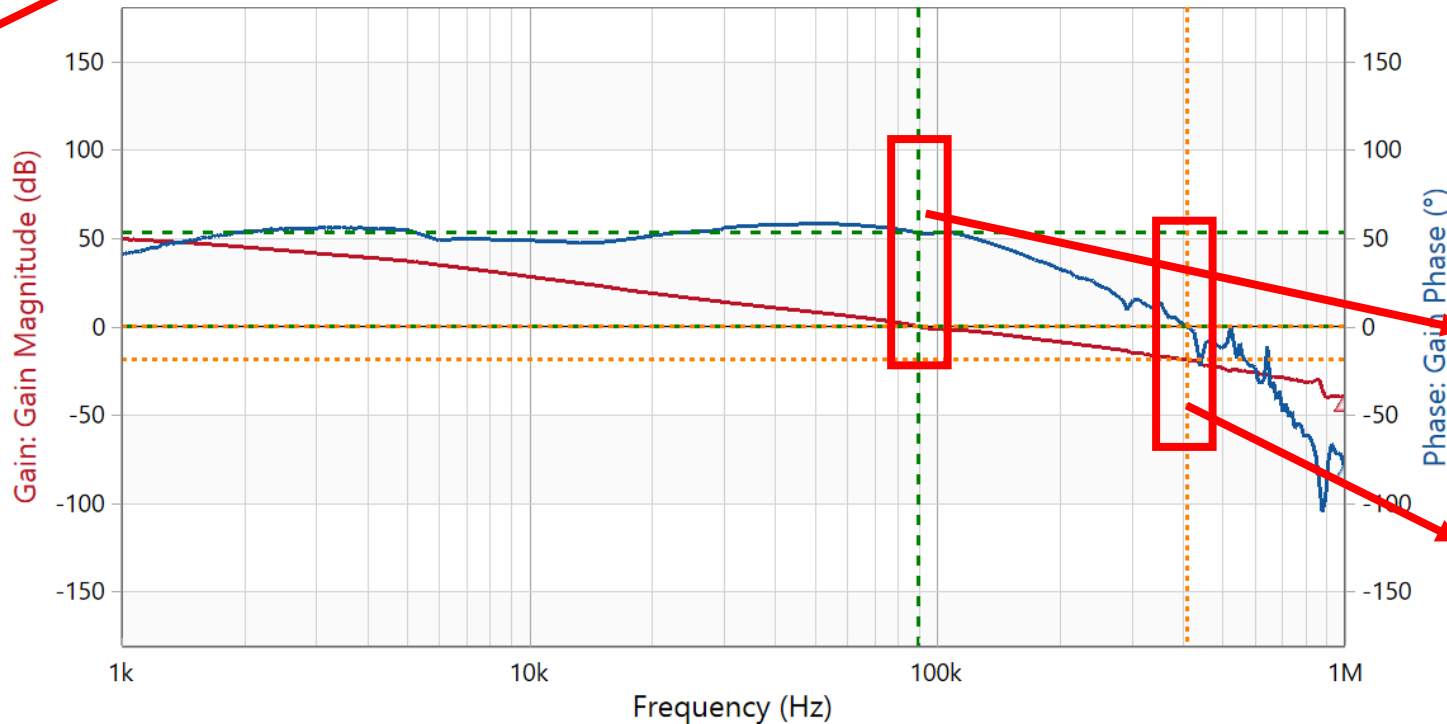


# Bode-plot 100 量測 Gain & Phase Margin

19.執行測試

	Frequency	Gain	Phase
Cursor 1	89.835 kHz	0 dB	52.97 °
Cursor 2	411.741 kHz	-18.982 dB	0 °
Delta C2-C1	321.906 kHz	-18.982 dB	-52.97 °

頻寬

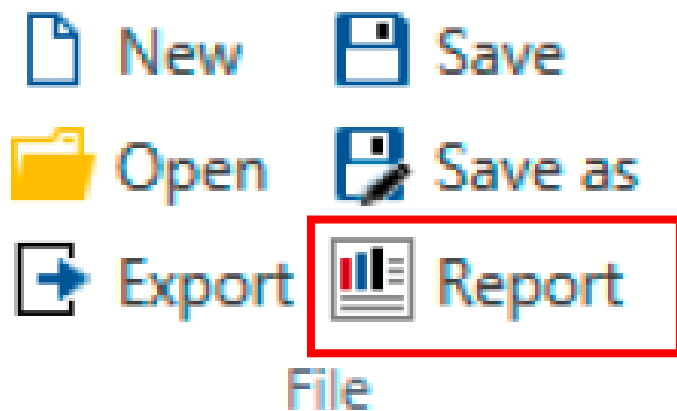


Gain為0時  
Phase相位為52.97°  
Phase為0時  
Gain增益為-18.892dB

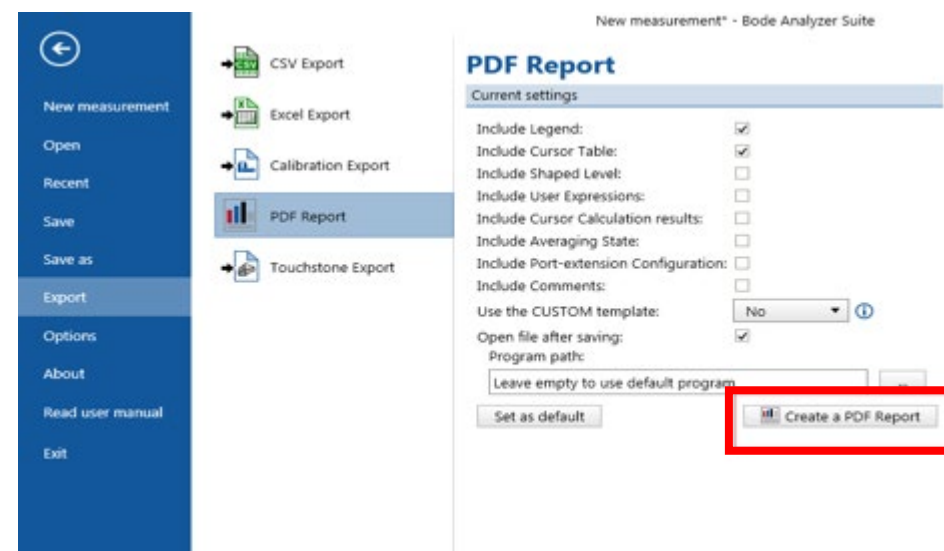
- 系統的頻寬(BW)為89.835kHz, Phase相位為52.97°, Gain增益為-18.892dB。
- 由此可以得出結論電路元件參數設定符合系統穩定性要求

# Bode-plot 100 生成 PDF report介紹

- 20.生成報告



- 點選圖紅框(Report)



- 選擇Create a PDF Report  Create a PDF Report  
可產生測試報告(PDF)



*Thank You!*

