任意波形信號發生器

AFG-2000 系列

使用手冊

固緯料號 NO. 82AFB21200E01



ISO-9001 認證企業

GW INSTEK

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安全說明

本章節包含操作和存儲信號發生器時必須遵照的重要安全說明。在操作前請詳細閱讀以下內容，確保安全和最佳化的使用。

安全符號

這些安全符號會出現在本使用手冊或儀器上。

警告	警告：產品在某一特定情況下或實際應用中可能對人體造成傷害或危及生命
注意	注意：產品在某一特定情況下或實際應用中可能對產品本身或其它產品造成損壞
	高壓危險
	注意: 請參考使用手冊
	保護導體端子
	接地端子
	表面高溫危險
	雙層絕緣



勿將電子設備作為未分類的市政廢棄物處理。請單獨收集處理或聯繫設備供應商

安全指南

通常 注意	• 勿將重物置於儀器上 • 勿將易燃物置於儀器上 • 避免嚴重撞擊或不當放置而損壞儀器 • 避免靜電釋放至儀器 • 請使用匹配的連接線，切不可用裸線連接 • 若非專業技術人員，請勿自行拆裝儀器 (測量等級) EN 61010-1:2010 規定了如下測量等級，AFG-2000系列屬於等級II • 測量等級 IV：測量低電壓設備電源 • 測量等級 III：測量建築設備 • 測量等級 II： 測量直接連接到低電壓設備的電路 • 測量等級 I： 測量未直接連接電源的電路
電源 警告	• 交流輸入電壓: 100 ~ 240V AC, 50 ~ 60Hz • 將交流電源插座的保護接地端子接地，避免電擊觸電
保險絲 警告	• 保險絲類型: F1A/250V. • 請專業技術人員更換保險絲 • 請更換指定類型和額定值的保險絲 • 更換前請斷開電源插座和所有測試導線 • 更換前請查明保險絲的熔斷原因
清潔儀器	• 清洁前先切断电源 • 以中性洗滌劑和清水沾濕軟布擦拭儀器。不要直接將任何液體噴灑到儀器上 • 不要使用含苯，甲苯，二甲苯和丙酮等烈性物質的化學藥品或清潔劑

操作環境	• 地點: 室內，避免陽光直射，無灰塵，無導電污染(下注)，避免強磁場 • 相對濕度: < 80% • 海拔: < 2000m • 溫度: 0℃~40℃ (污染等級) EN 61010-1:2010 規定了如下污染程度。AFG-2000 系列屬於等級 2。 污染指“可能引起絕緣強度或表面電阻率降低的外界物質，固體，液體或氣體(電離氣體)”。 • 污染等級 1：無污染或僅乾燥，存在非導電污染，污染無影響 • 污染等級 2：通常只存在非導電污染，偶爾存在由凝結物引起的短暫導電 • 污染等級 3：存在導電污染或由於凝結原因使乾燥的非導電性污染變成導電性污染。此種情況下，設備通常處於避免陽光直射和充分風壓條件下，但溫度和濕度未受控制
存儲環境	• 地點: 室內 • 相對濕度: < 70% • 溫度: -10℃~70℃
處理 	勿將電子設備作為未分類的市政廢棄物處理。請單獨收集處理或聯繫設備供應商。請務必妥善處理丟棄的電子廢棄物，減少對環境的影響

英制電源線

在英國使用信號發生器時，確保電源線符合以下安全說明。

注意: 導線/設備連接必須由專業人員操作。

警告: 此裝置必須接地

重要: 導線顏色應與下述規則保持一致:

綠色/黃色:	接地
藍色:	零線
棕色:	火線(相線)



導線顏色可能與插頭/儀器中所標識的略有差異，請遵循如下操作:

顏色為綠色/黃色的線需與標有字母“E”，或接地標誌⏚，或顏色為綠色/黃綠色的接地端子相連。

顏色為藍色的線需與標有字母“N”，或顏色為藍色或黑色的端子相連。

顏色為棕色的線需與標有字母“L”或“P”，或者顏色為棕色或紅色的端子相連。

若有疑問，請參照本儀器提供的用法說明或與經銷商聯繫。

T 電纜/儀器需有符和額定值和規格的 HBC 保險絲保護：保險絲額定值請參照儀器說明或使用手冊。如: 0.75mm^2 的電纜需要 3A 或 5A 的保險絲。保險絲型號與連接方法有關，大的導體通常應使用 13A 保險絲。

將帶有裸線的電纜、插頭或其它連接器與火線插座相連非常危險。若已確認電纜或插座存在危險，必須關閉電源，拔下電纜、保險絲和保險絲座。並且根據以上標準立即更換電線和保險絲。

產品介紹

本章節介紹了信號發生器的主要特點、外觀以及一些基本功能的操作。詳細內容見操作章節。

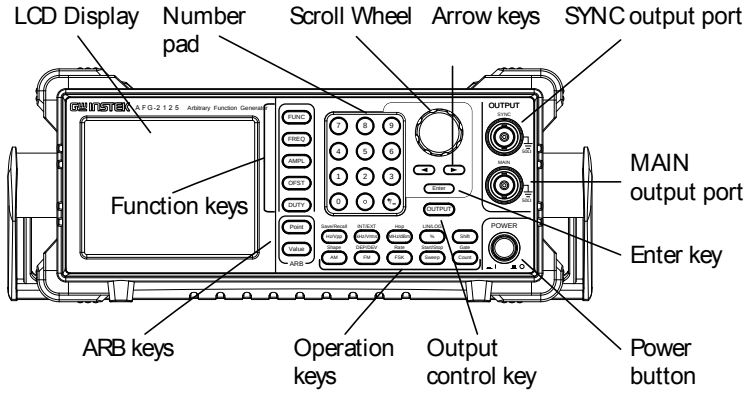
主要特點

型號	AFG-2005	AFG-2105	AFG-2012	AFG-2112	AFG-2025	AFG-2125
頻率範圍	0.1Hz~5MHz		0.1Hz~12MHz		0.1Hz~25MHz	
輸出波形	正弦波, 方波, 三角波, 雜訊波, ARB					
幅值範圍	0.1Hz~20MHz 1 mVpp~10 Vpp (接 50Ω) 2 mVpp~20 Vpp (開路)					
	20MHz~25MHz 1 mVpp~5 Vpp (接 50Ω) 2 mVpp~10 Vpp (開路)					
可調偏置	✓	✓	✓	✓	✓	✓
可調占空比	✓	✓	✓	✓	✓	✓
SYNC (TTL)輸出	✓	✓	✓	✓	✓	✓
存儲/調取	✓	✓	✓	✓	✓	✓
掃描操作	—	✓	—	✓	—	✓
AM	—	✓	—	✓	—	✓
FM	—	✓	—	✓	—	✓
FSK	—	✓	—	✓	—	✓
計頻器	—	✓	—	✓	—	✓
ARB	✓	✓	✓	✓	✓	✓
USB 介面	✓	✓	✓	✓	✓	✓

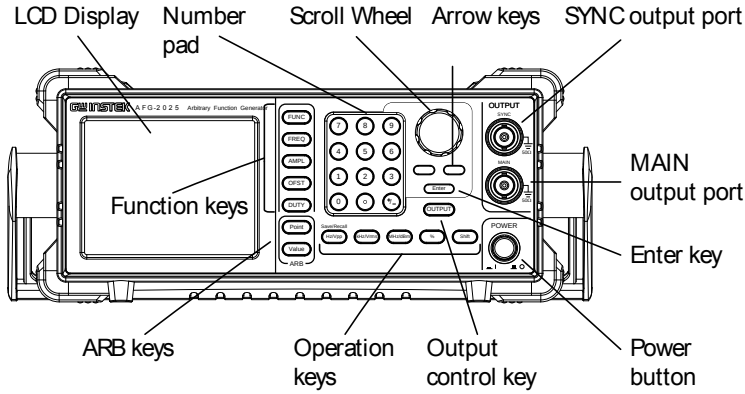
性能	• 使用 FPGA 的 DDS 技術提供高解析度波形 • 25MHz DDS (直接數位合成)信號輸出系列 • 0.1Hz 分辨率 • 任意波形能力 20 MSa/s 采样率 10 MHz 重复率 4 k-点波形长度 10-bit 幅值分辨率 10 組 4k 波形記憶體
特點	• 正弦波, 方波, 三角波, 雜訊波 • Int/Ext AM, FM, FSK 調製 • 調製/掃描信號輸出 • 存儲/調取 10 組設置記憶體 • 輸出超載保護 • PC 軟體編輯 ARB (任意波形)
介面	• USB 標準介面 • 3.5” LCD

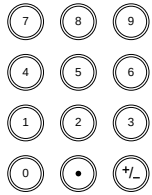
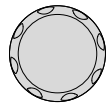
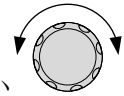
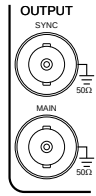
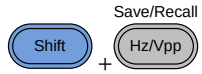
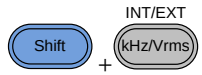
面板介紹

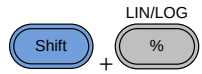
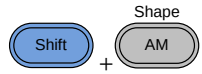
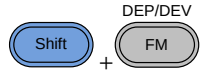
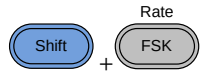
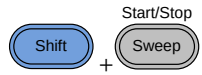
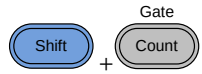
AFG-2105/2112/2125 前面板

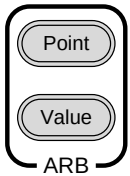


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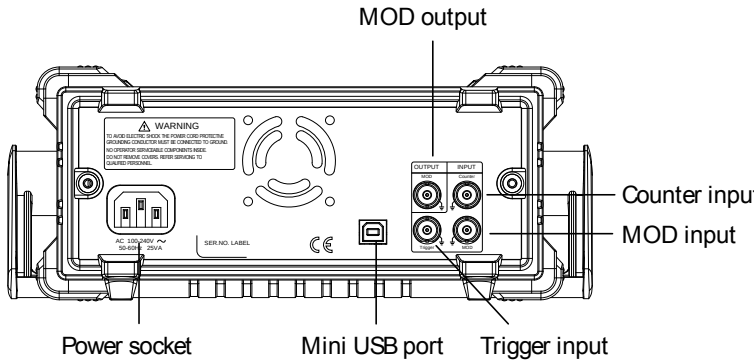
LCD display	3.5”, 三色 LCD 顯示	
Keypad		用於輸入數值和參數，常與方向鍵和可調旋鈕一起使用
Scroll Wheel		用於編輯數值和參數，步進 1 位。與方向鍵一起使用  減小 增大
Arrow keys		編輯參數時，用於選擇數位
Output ports		SYNC 輸出埠(50Ω 阻抗) 主輸出埠(50Ω 阻抗)
Enter key		用於確認輸入值
Power button		啟動/關閉儀器電源
Output control key		啟動/關閉輸出
Operation keys		選擇單位 Hz 或 Vpp
		存儲或調取波形
		選擇單位 kHz 或 Vrms
		設置調製和 FSK 功能的內部源或外部源*

	選擇單位 MHz 或 dBm
	設置 FSK 調製的“跳變”頻率*
	選擇單位%
	設置線性或對數掃描*
	用於選擇操作鍵的第二功能
	AM 鍵用於啟動/關閉 AM 調製*
	選擇調製波形*
	FM 鍵用於啟動/關閉 FM 調製*
	選擇調製深度或頻偏*
	選擇 FSK 調製*
	設置 AM, FM, FSK 調製率和掃描率*
	選擇掃描功能*
	設置起始或停止頻率*
	啟動/關閉計頻器*
	設置計頻器門限時間*

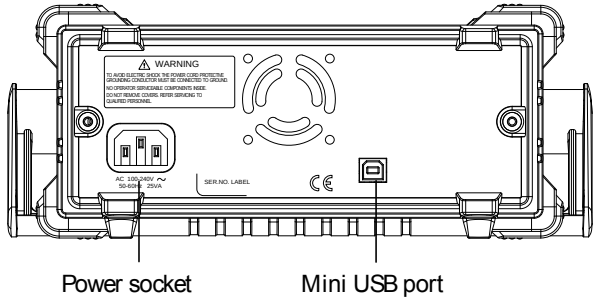
ARB edit keys		任意波形編輯按鍵 Point 鍵設置 ARB 的點數 Value 鍵設置所選點的幅值
Function keys		FUNC 鍵用於選擇輸出波形類型: 正弦波, 方波, 三角波, 雜訊波, ARB
		設置波形頻率
		設置波形幅值
		OFST 設置波形的 DC 偏置
		設置方波和三角波的占空比

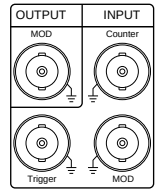
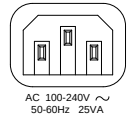
*功能/特點僅限 AFG-2105/2112/2125

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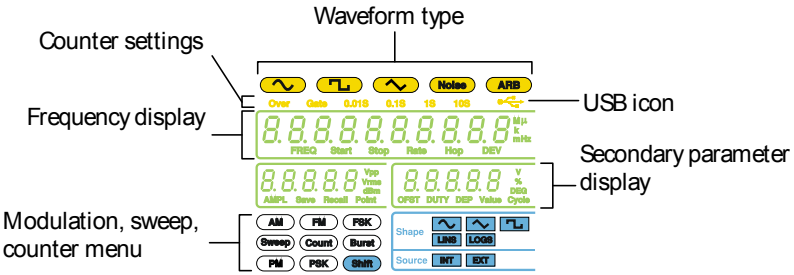


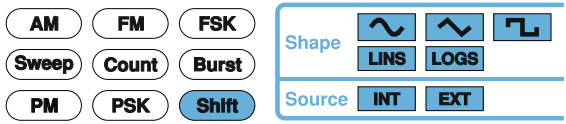
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MOD output		調製輸出埠
Counter input		計頻器輸入埠
MOD input		調製輸入埠
Trigger input		觸發輸入埠
Mini USB B port		與 PC 相連，用於遠程控制
Power Socket Input		電源輸入: 100~240V AC 50~60Hz

顯示



Waveform type	 按 Function 鍵迴圈顯示不同輸出波形
Counter settings	Over Gate 0.01S 0.1S 1S 10S 計頻器門限時間設置*
USB icon	顯示 USB 介面狀態
Frequency Display	 顯示主波形的頻率設置
Secondary parameter display	 顯示波形的第二參數和設置
Modulation, sweep, counter menu	 顯示調製、掃描和計頻器功能以及調製波形和調製源*

*功能/特點僅限 AFG-2105/2112/2125

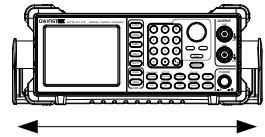
設置信號發生器

背景

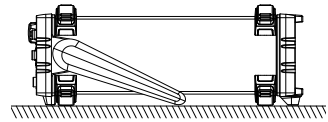
本節介紹了如何調整信號發生器的把手以及如何開機。

調整把手

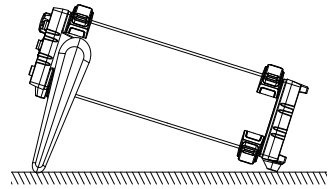
將把手拉至側面並旋轉



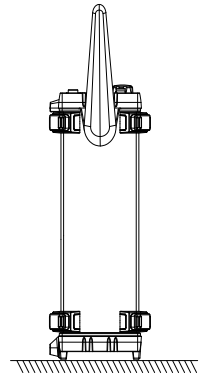
水準放置 AFG



或傾斜放置

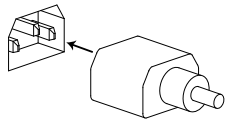


把手垂直放置以方便手提



開機

1. 將電源線接入後面板插座



2. 按下位於前面板的電源開關



3. 儀器啟動並載入預設設置(見**錯誤! 尚未定義書籤。**頁默認設置)



信號發生器準備就緒。

快速操作

本章節介紹了 AFG-2000 的快捷方式和預設出廠設置，方便用戶快速入門。參數、設置和限制的詳情見操作章節(32 頁)或規格(133 頁)。

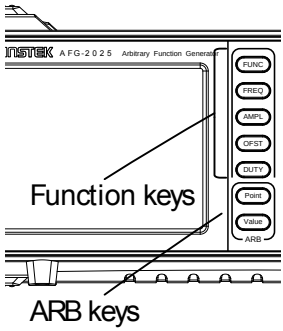
如何使用數位輸入 18
選擇波形 20
正弦波 20
方波 20
三角波 21
ARB 22
ARB - 點 22
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如何使用數位輸入

背景

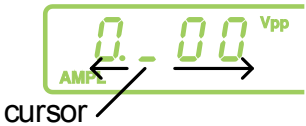
AFG-2000 有三種主要的數位輸入方法: 數位鍵盤, 方向鍵和可調旋鈕。下面將為您介紹如何使用數字輸入來編輯參數。

1. 首先按 Function 鍵或 ARB 鍵。該鍵變亮

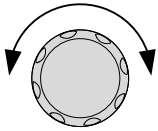


2. 使用方向鍵將游標移至需要編輯的數位





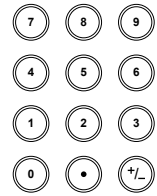
3. 使用可調旋鈕編輯數值。
如，以 0.1V 步進增大參數值。
順時針增大數值，逆時針減小數值



4. 按 Enter 鍵確認新參數值



5. 或者, 使用數位鍵設置參數值



6. 選擇數值單位
(Hz, kHz, MHz, Vpp, Vrms, dBm, %)

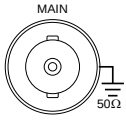


選擇波形

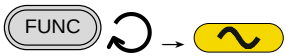
正弦波

如: 正弦波, 10kHz, 1Vpp, 2Vdc

Output



1. 重複按 **FUNC** 鍵選擇正弦波



2. 按 **FREQ > 1 > 0 > kHz**



3. 按 **AMPL > 1 > Vpp**



4. 按 **OFST > 2 > Vpp**



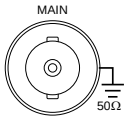
5. 按 **OUTPUT** 鍵



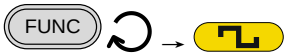
方波

如: 方波, 10kHz, 3Vpp, 75%占空比

Output



1. 重複按 **FUNC** 鍵選擇方波



2. 按 **FREQ > 1 > 0 > kHz**



3. 按 **AMPL > 3 > Vpp**



4. 按 **DUTY > 7 > 5 > %**

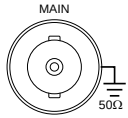


5. 按 Output 鍵 

三角波

如: 三角波, 10kHz, 3Vpp, 25%對稱性

Output



1. 重複按 **FUNC** 鍵選擇三角波 

2. 按 **FREQ > 1 > 0 > kHz** 

3. 按 **AMPL > 3 > Vpp** 

4. 按 **DUTY > 2 > 5 > %** 

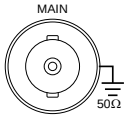
5. 按 **OUTPUT** 鍵 

ARB

ARB – 點

如: 2 ARB 點, 10 kHz, 1Vpp

Output



1. 重複按 **FUNC** 鍵選擇 ARB 波



2. 按 **FREQ > 1 > 0 > kHz**



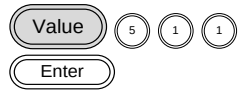
3. 按 **AMPL > 1 > Vpp**



4. 按 **Point > 0 > Enter**



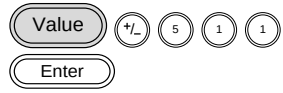
5. 按 **Value > 5 > 1 >1 > Enter**



6. 按 **Point > 1 > Enter**



7. 按 **Value > ± > 5 > 1 >1 > Enter**
(-511)



8. 按 **OUTPUT** 鍵

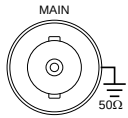


調製

AM (僅 2100 系列)

如: AM 調製。100Hz 調製方波。1 Vpp, 1kHz 正弦載波。70%調製深度。內部源。

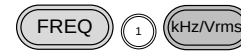
Output



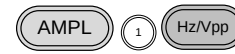
1. 重複按 **FUNC** 鍵選擇正弦波



2. 按 **FREQ > 1 > kHz**



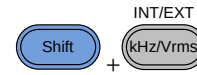
3. 按 **AMPL > 1 > Vpp**



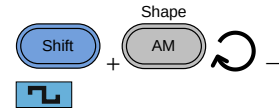
4. 按 **AM**



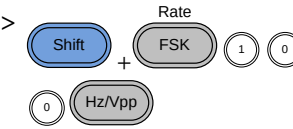
5. 按 **Shift > INT/EXT > 選擇 INT 源**



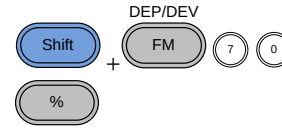
6. 重複按 **Shift > Shape 選擇 Square wave**



7. 按 **Shift > Rate > 1 > 0 > 0 > Hz**



8. 按 **Shift > DEP/DEV> 7 > 0 > %**



9. 按 **OUTPUT** 鍵



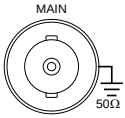
10. 再按 **AM** 取消 AM 功能



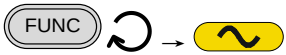
FM (僅 2100 系列)

如: FM 調製。100Hz 調製方波。1Vpp, 1kHz 正弦載波。100 Hz 頻偏。內部源。

Output



1. 重複按 **FUNC** 鍵選擇正弦波



2. 按 **FREQ > 1 > kHz**



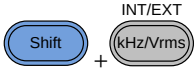
3. 按 **AMPL > 1 > Vpp**



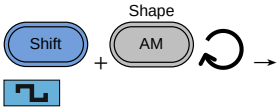
4. 按 **FM**



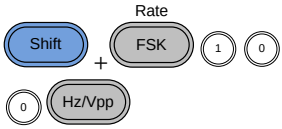
5. 按 **Shift > INT/EXT > 選擇 INT 源**



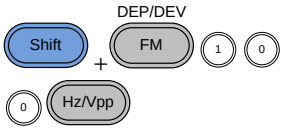
6. 重複按 **Shift > Shape 選擇 Square wave**



7. 按 **Shift > Rate > 1 > 0 > 0 > Hz**



8. 按 **Shift > DEP/DEV> 1 > 0 > 0> Hz**



9. 按 **OUTPUT** 鍵



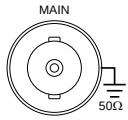
10. 再按 **FM** 取消 FM 功能



FSK 調製(僅 2100 系列)

如: FSK 調製。10Hz 跳變頻率。1Vpp, 1kHz 三角波載波。100 Hz 頻率(調製頻率)。內部源。

Output



1. 重複按 **FUNC** 鍵選擇三角波



2. 按 **FREQ > 1 > kHz**



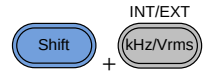
3. 按 **AMPL > 1 > Vpp**



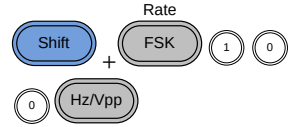
4. 按 **FSK**



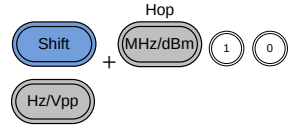
5. 按 **Shift > INT/EXT > 選擇 INT** 源



6. 按 **Shift > Rate > 1 > 0 > 0 > Hz**



7. 按 **Shift > Hop > 1 > 0 > Hz**



8. 按 **OUTPUT** 鍵



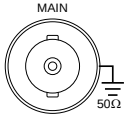
9. 再按 **FSK** 取消 FSK 功能



掃描(僅 2100 系列)

如: 頻率掃描。起始頻率 1Hz, 停止頻率 1MHz。1Hz 頻率。1Vpp。線性掃描。

Output



1. 重複按 **FUNC** 鍵選擇三角波



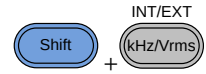
2. 按 **AMPL > 1 > Vpp**



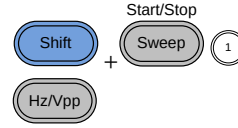
3. 按 **Sweep**



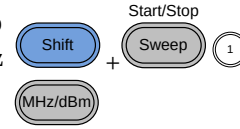
4. 按 **Shift > INT/EXT > 選擇 INT 源**



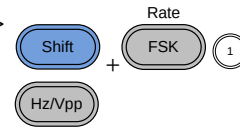
5. 按 **Shift > Start/Stop** 選擇 **Start> 1 > Hz**



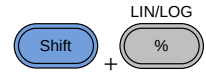
6. 按 **Shift > Start/Stop** 選擇 **Stop> 1 > MHz**



7. 按 **Shift > Rate > 1 > Hz**



8. 按 **Shift > LIN/LOG > 選擇 LINS**



9. 按 **OUTPUT** 鍵



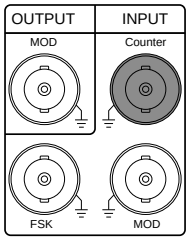
10. 再按 **Sweep** 取消掃描功能



計數器(僅 2100 系列)

如: 計頻功能, 門限時間 1s。

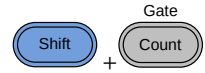
Input



1. 按 **Count** 鍵



2. 重複按 **Shift** > **Gate** 選擇 **1S** 門限時間



3. 將信號接入計頻器輸入端

4. 再按 **Count** 取消計頻功能

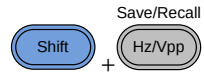


存儲/調取

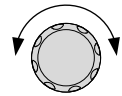
存儲

如: 存儲波形

1. 按 **Shift > Save/Recall**。選擇 **Save**



2. 旋轉可調旋鈕，選擇存儲編號



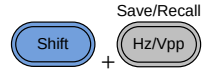
3. 按 **Enter** 確認



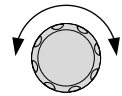
調取

如: 調取波形

1. 按 **Shift > Save/Recall**。選擇 **Recall**



2. 旋轉可調旋鈕，選擇調取編號



3. 按 Enter 確認



默認設置

開機後顯示預設設置。

輸出設置	功能	正弦波
	頻率	1kHz
	幅值	100mVpp
	偏置	0.00Vdc
	輸出單位	Vpp
	輸出端	50Ω
調製 (AM/FM/FSK)	載波	1kHz 正弦波
	調製波形	100Hz 正弦波
	AM 深度	100%
	FM 頻偏	10Hz
	FSK 跳變頻率	100Hz
	FSK 頻率	500Hz
	調製狀態	關閉
掃描	起始/停止頻率	100Hz/1kHz
	掃描時間	1s
	掃描頻率	100Hz
	掃描類型	線性
	掃描狀態	關閉
系統設置	斷電調用	啟動
	顯示模式	啟動
	錯誤佇列	已清除

	記憶體設置(ARB)	無更改
	輸出	關閉
介面設置	USB	CDC
校準	校準菜單	加密

操作

本章節介紹了如何輸出基本波形以及創建 ARB 波形。AFG-2105/2112/2125 還可以完成如調製、掃描、FSK 和計頻器等高端功能。

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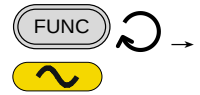
選擇波形

AFG-2000 可以輸出 4 種標準波形: 正弦波, 方波, 三角波和雜訊波。

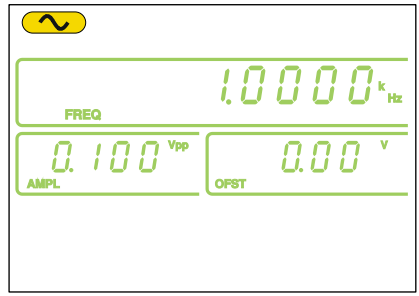
正弦波, 方波, 三角波, 雜訊波

面板操作

1. 重複按 **FUNC** 鍵選擇標準波形(正弦波, 方波, 三角波, 雜訊波)



如:
正弦波



注意 輸出標準波形前，調製、FSK、掃描和計頻功能不能使用。

設置頻率

面板操作

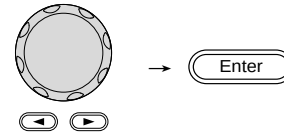
1. 按 **FREQ** 鍵



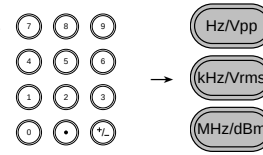
2. 頻率顯示區域 FREQ 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯頻率

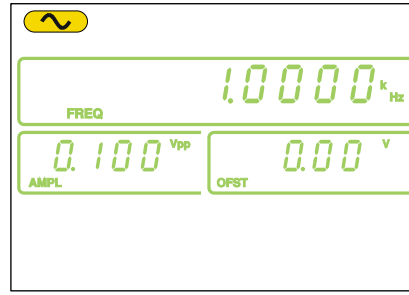


使用 **keypad** 和 **unit** 鍵輸入新頻率



範圍	正弦波	0.1Hz ~ 25MHz*
	方波	0.1Hz ~ 25MHz*
	三角波	0.1Hz ~ 1MHz
	AFG-2005/2105 為 5MHz, AFG-2012/2112 為 12MHz*	

如:
FREQ = 1kHz



設置幅值

面板操作

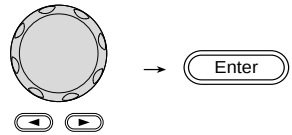
1. 按 **AMPL** 鍵



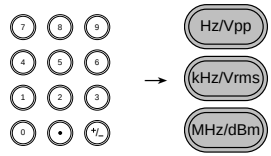
2. 第二顯示區域 AMPL 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯幅值

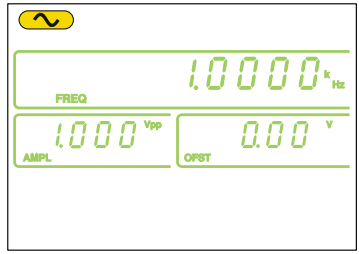


使用 **keypad** 和 **unit** 鍵輸入新幅值



範圍	空載	2mVpp~20Vpp 2mVpp~10Vpp (20MHz – 25MHz)
	50Ω 負載	1mVpp~10Vpp 1mVpp~5Vpp (20MHz – 25MHz)

如:
AMPL= 1Vpp



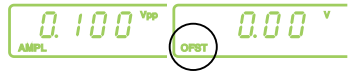
設置 DC 偏置

面板操作

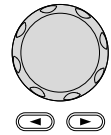
1. 按 **OFST** 鍵



2. 第二顯示區域 OFST 圖示閃爍

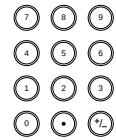


3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯偏置



→ Enter

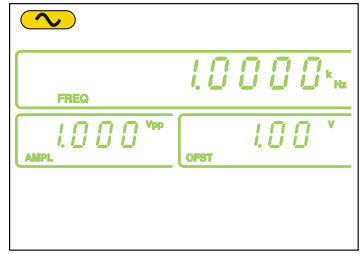
使用 **keypad** 和 **Vpp** 鍵輸入新偏置



→ Hz/Vpp

範圍	空載 (AC+DC)	±10Vpk ±5 Vpk (20MHz–25MHz)
	50Ω 負載(AC+DC)	±5 Vpk ±2.5 Vpk (20MHz–25MHz)

如:
OFST= 1VDC



設置占空比/對稱性

背景

DUTY 鍵設置標準方波或三角波的占空比或對稱性。

面板操作

1. 選擇一個方波或三角波

Page **錯誤! 尚未定義書籤。**

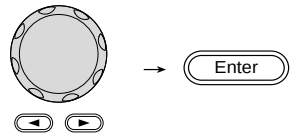
2. 按 **DUTY** 鍵

DUTY

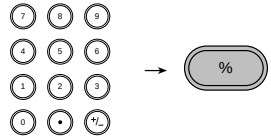
3. 第二顯示區域 DUTY 圖示閃爍



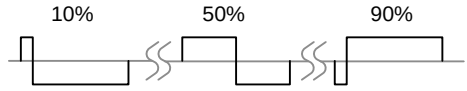
4. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯占空比/對稱性



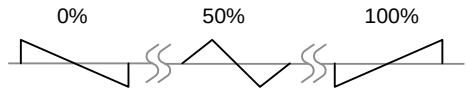
使用 **keypad** 和**%**鍵輸入新的占空比/對稱性



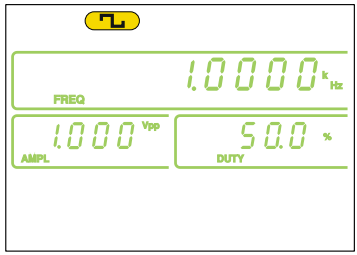
占空比範圍	≤ 100kHz	1.0% ~ 99.9%
	≤ 5MHz	20.0% ~ 80.0%
	≤ 10MHz	40.0 ~ 60.0%
	≤ 25MHz	50.0% (fixed)



對稱性範圍	所有頻率	0% ~ 100%



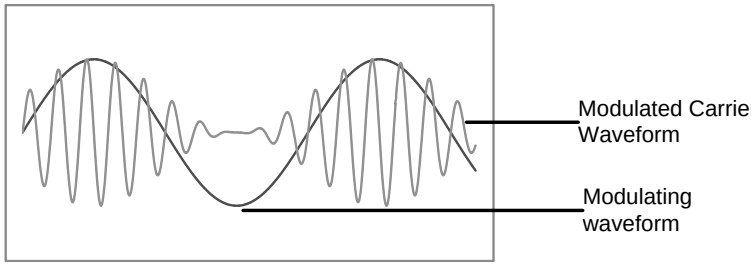
如:
DUTY= 50.0%



幅值調製(AM)
(AFG-2100 系列)

AM 波形由載波和調製波組成。載波幅值與調製波幅值有關。AFG-2100 信號發生器可以設置載波頻率、幅值、偏置電壓以及內部或外部調製源。

AM 調製僅適合 AFG-2105, AFG-2112 和 AFG-2125 信號發生器。



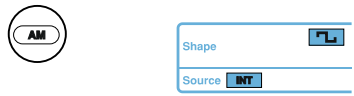
選擇 AM 調製

面板操作

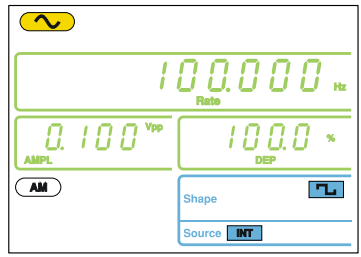
1. 按 **AM** 鍵



2. 螢幕顯示調製、掃描和計數功能表。AM 符號代表已啟動 AM 功能



如:
AM activated



注意 再按 AM 鍵取消 AM 調製。

AM 載波波形

背景 FUNC 鍵選擇 AM 載波波形：正弦波、方波或三角波。預設情況為正弦波。雜訊波不能作為載波波形使用。選擇載波波形前，請先選擇 AM 模式，見**錯誤! 尚未定義書籤。**頁。

選擇載波波形

1. 重複按 **FUNC** 鍵選擇載波波形(正弦波, 方波, 三角波)



範圍 AM 載波波形 正弦波, 方波, 三角波

設置載波頻率

面板操作

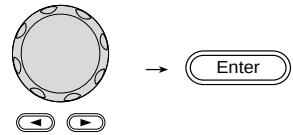
1. 按 **FREQ** 鍵



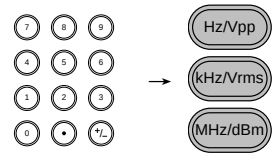
2. 頻率顯示區域 FREQ 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯頻率



使用 **keypad** 和 **unit** 鍵輸入新頻率

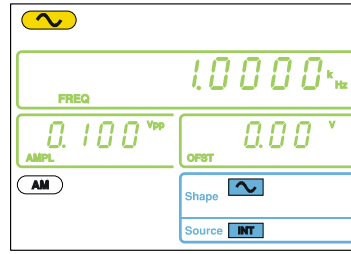


範圍

正弦波	0.1Hz ~ 25MHz*
方波	0.1Hz ~ 25MHz*
三角波	0.1Hz ~ 1MHz

*AFG-2105 為 5MHz, AFG-2112 為 12MHz

如:
FREQ = 1kHz



設置載波幅值

面板操作

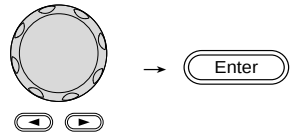
1. 按 **AMPL** 鍵



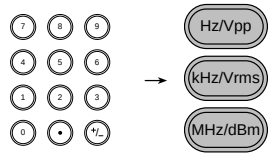
2. 第二顯示區域 AMPL 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯幅值

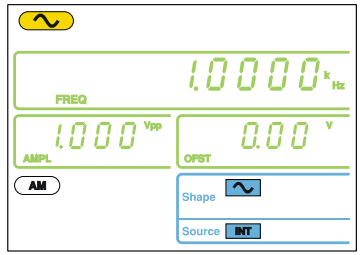


使用 **keypad** 和 **unit** 鍵輸入新幅值



範圍	空載	2mVpp~20Vpp 2mVpp~10Vpp for 20MHz – 25MHz
	50Ω 負載	1mVpp~10Vpp 1mVpp~5Vpp for 20MHz – 25MHz

如:
AMPL= 1Vpp

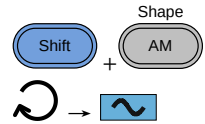


設置調製波形

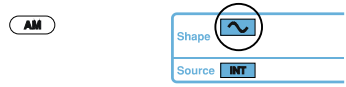
AFG-2100 的調製波形包括正弦波, 方波和三角波。默認波形為正弦波。

面板操作

1. 重複按 **Shift** + **Shape** 鍵選擇波形



2. 面板底部顯示藍色波形

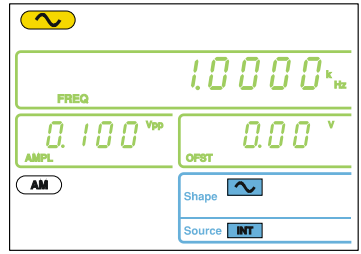


限定

方波　50%占空比

三角波　50%對稱性

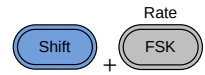
如:
Shape = Sine



設置調製頻率(Rate)

面板操作

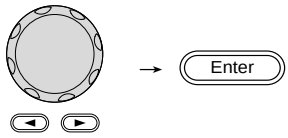
1. 按 **Shift** + **Rate** 鍵



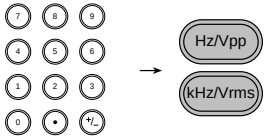
2. 頻率顯示區域 Rate 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯調製頻率

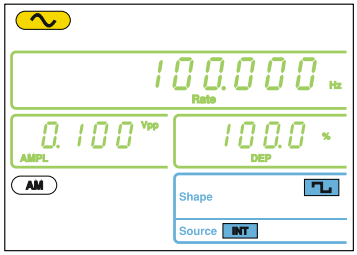


使用 **keypad** 和 **unit** 鍵輸入新的調製頻率



範圍	(內部源)	2mHz ~ 20kHz
	預設值	100Hz

如:
Rate= 100Hz

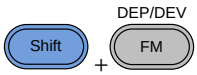


調製深度

調製深度為未調載波幅值與調製波形最小幅值偏差的比值(以百分比顯示)。換句話說， 調製深度就是調製波形與載波波形的最大幅值之比。

面板操作

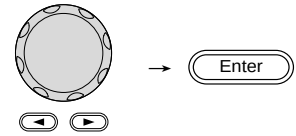
1. 按 **Shift + DEP/DEV** 鍵



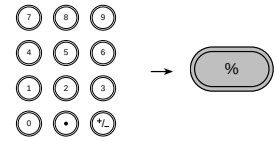
2. 第二顯示區域 DEP 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯調製深度

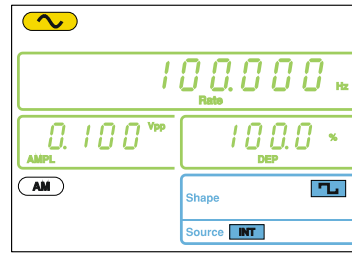


使用 **keypad** 和**%**鍵輸入新的調製深度



範圍	深度	0% ~ 120%
	預設值	100%

如:
DEP= 100%



注意

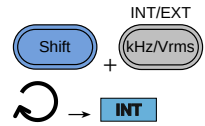
調製深度大於 100%時，輸出峰值電壓不超過±5V (50Ω 負載)。

如果選擇外部調製源, 那麼調製深度將由後面板 MOD INPUT 上的± 5V 信號電壓控制。例如, 如果調製深度設置為 100%, 那麼最大幅值為+5V, 最小幅值為-5V。

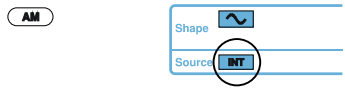
設置調製源

面板操作

1. 按 **Shift + INT/EXT** 鍵選擇調製源



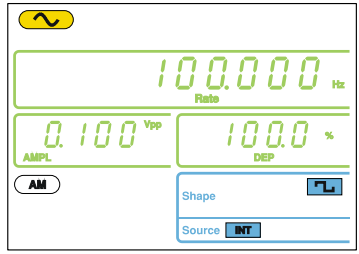
2. 螢幕底部顯示所選調制源



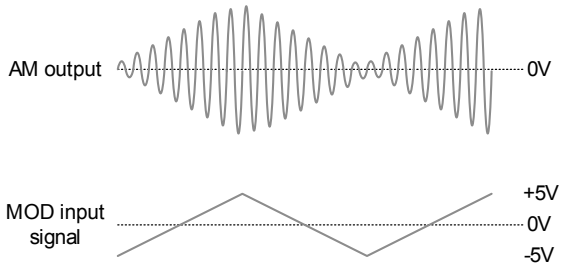
注意

如果選擇外部調製源, 那麼調製深度將由後面板 MOD INPUT 上的± 5V 信號電壓控制。例如, 如果調製深度設置為 100%, 那麼最大幅值為+5V, 最小幅值為-5V。

如:
Source = INT

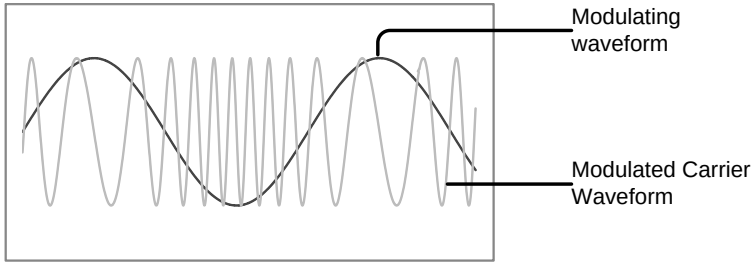


如: 外部 MOD 輸入信號



頻率調製(FM)
(AFG-2100 系列)

FM 波形由载波和调制波组成。载波的暫態頻率随调制波形的幅值而變化。FM 調製僅限於 AFG-2105, AFG-2112 和 AFG-2125。



選擇 FM 調製

面板操作

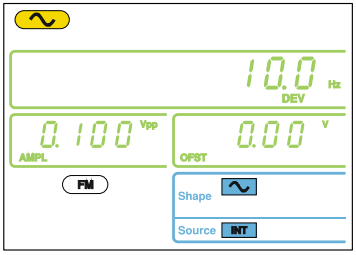
1. 按 **FM** 鍵



2. 螢幕顯示調製、掃描和計數功能表。FM 圖示表示已啟動 FM 功能



如:
FM activated



注意 再按 FM 鍵取消 FM 調製

FM 載波波形

背景 FUNC 鍵選擇 FM 載波，包括正弦波(默認載波)、方波或三角波。雜訊波不能作為載波使用。選擇載波前請啟動 FM 功能，見**錯誤! 尚未定義書籤。**頁。

選擇載波波形

1. 重複按 **FUNC** 鍵選擇載波波形(正弦波, 方波, 三角波)



範圍 FM 載波波形 正弦波, 方波, 三角波

設置載波頻率

背景

使用 AFG-2100 信號發生器時，載波頻率必須大於等於頻偏。

面板操作

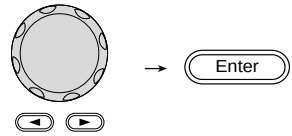
1. 按 **FREQ** 鍵



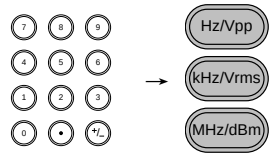
2. 頻率顯示區域 FREQ 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯載波頻率

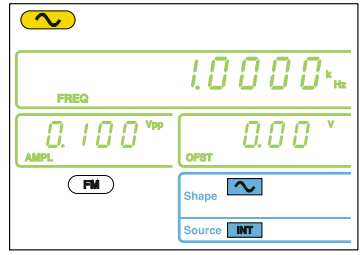


使用 **keypad** 和 **unit** 鍵輸入新的載波頻率



範圍	正弦波	0.1Hz ~ 25MHz*
	方波	0.1Hz ~ 25MHz*
	三角波	0.1Hz ~ 1MHz
	AFG-2105 為 5MHz, AFG-2112 為 12MHz*	

如:
FREQ = 1kHz



設置載波幅值

面板操作

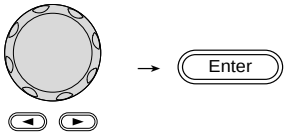
1. 按 **AMPL** 鍵



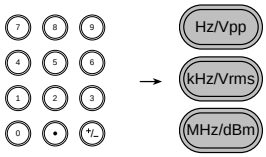
2. 第二顯示區域 AMPL 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯幅值



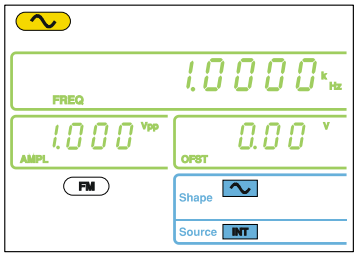
使用 **keypad** 和 **unit** 鍵輸入新幅值



範圍

空載	2mVpp~20Vpp 2mVpp~10Vpp (20MHz – 25MHz)
50Ω 負載	1mVpp~10Vpp 1mVpp~5Vpp (20MHz – 25MHz)

如:
AMPL= 1Vpp

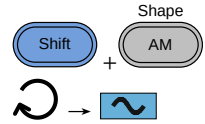


設置調製波形

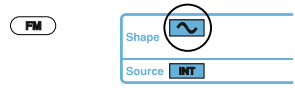
AFG-2100 的調製波形包括正弦波(預設波形)、方波和三角波。調製波形僅用作內部源。

面板操作

1. 重複按 **Shift** + **Shape** 鍵選擇波形



2. 面板底部顯示藍色波形

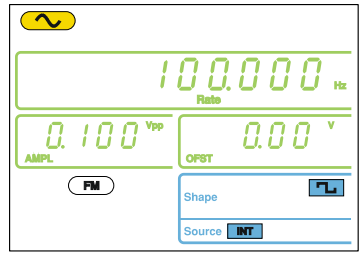


限定

方波　50%占空比

三角波　50%對稱性

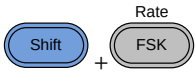
如:
Shape = Sine



設置調製頻率(Rate)

面板操作

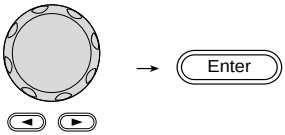
1. 按 **Shift + Rate** 鍵



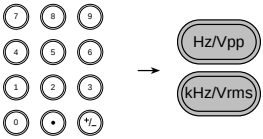
2. 頻率顯示區域 Rate 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯調製頻率

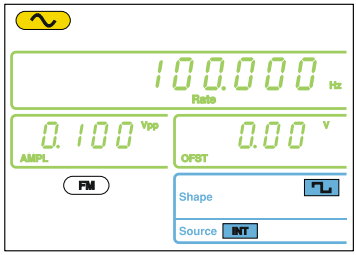


使用 **keypad** 和 **unit** 鍵輸入新的調製頻率



範圍	(內部源)	2mHz ~ 20kHz
	預設值	100Hz

如:
Rate= 100Hz

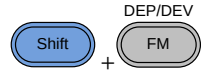


頻偏

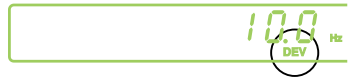
頻偏是載波與調製波的最大頻率偏差。

面板操作

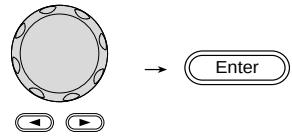
1. 按 **Shift + DEP/DEV** 鍵



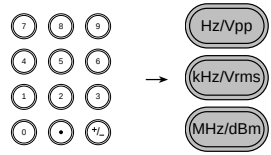
2. 頻率顯示區域 DEV 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯頻偏



使用 **keypad** 和 **unit** 鍵輸入新的頻偏



範圍		
	正弦波	DC ~ 25MHz*
	方波	DC ~ 25MHz*
	三角波	DC ~ 1MHz
	預設值	10Hz
	AFG-2105 為 5MHz, AFG-2112 為 12MHz*	

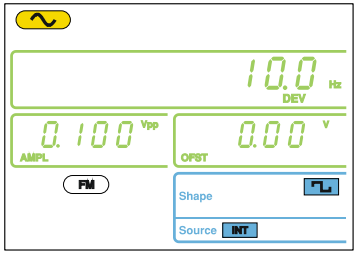
注意

頻偏必須小於等於載波頻率。

載波頻率與頻偏之和必須小於等於最大調製波頻率。

載波頻率限制允許的最大頻偏。

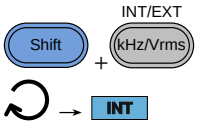
如:
DEV = 10Hz



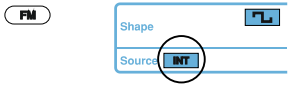
設置調製源

面板操作

1. 按 **Shift + INT/EXT** 鍵選擇調製源



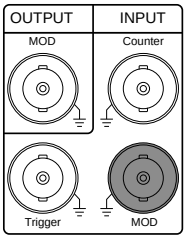
2. 螢幕底部顯示所選調制源



範圍	調製源	INT, EXT

連接
(僅 EXT 源)

對於外部源，將調製源信號連接至後面板 MOD 輸入端子。



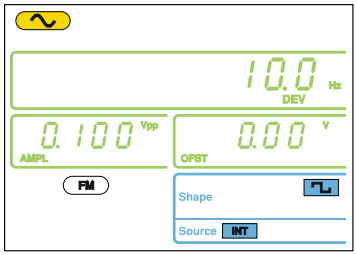
注意

如果選擇外部調製源, 那麼頻偏將由後面板 MOD INPUT 上的± 5V 信號電壓控制。頻偏與調製信號電平成比例。+5V 在載波頻率上增加設置的頻偏頻率和 -5V 在載波頻率上減少頻偏頻率.

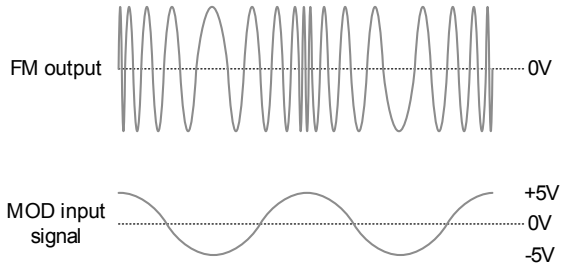
例如: 如果頻偏頻率設為 1kHz, +5V 輸入電壓將使頻率在載波頻率上增加 1kHz, 而-5V 的輸

入電壓将會使頻率在载波頻率上減少 1kHz。

如:
Source = INT



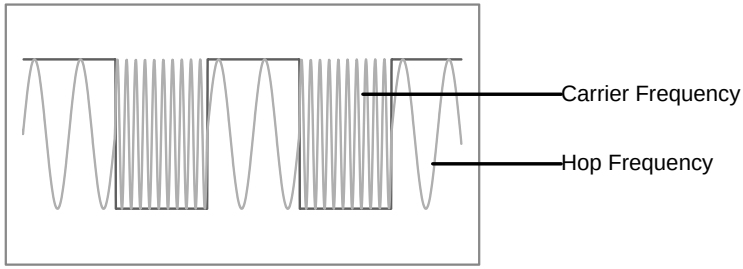
如: 外部 MOD 輸入信號



頻移鍵控(FSK)調製 (AFG-2100 系列)

FSK 調製用於在兩個預設頻率(載波頻率和跳變頻率)間交替輸出頻率。額定設置或後面板 Trigger 輸入端上的電壓准位元決定交替頻率。

FSK 調製僅限 AFG-2105, AFG-2112 和 AFG-2125。



選擇 FSK 調製

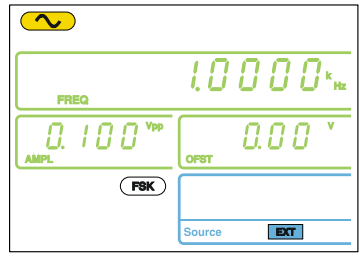
面板操作

1. 按 **FSK** 鍵 

2. 螢幕顯示調製、掃描和計數功能表。FSK 圖示表示已啟動 FSK 功能



如:
FSK activated



注意 再按 FSK 鍵取消 FSK 調製

FSK 載波波形

背景 FUNC 鍵選擇 FSK 載波，包括正弦波(默認載波)、方波或三角波。雜訊波和 ARB 不能作為載波使用。

選擇載波

1. 重複按 **FUNC** 鍵選擇載波波形(正弦波, 方波, 三角波) 

範圍	FSK 載波波形	正弦波, 方波, 三角波

FSK 載波頻率

最大載波頻率與載波波形有關。所有載波預設頻率均為 1kHz。選擇外部源時，Trigger 輸入端信號的電壓准位元控制輸出頻率。Trigger 信號

為邏輯低電平時，輸出載波頻率；信號為邏輯高電平時，輸出跳變頻率。

面板操作

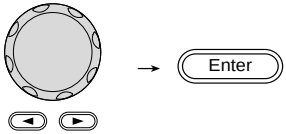
1. 按 **FREQ** 鍵



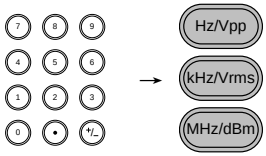
2. 頻率顯示區域 FREQ 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯頻率



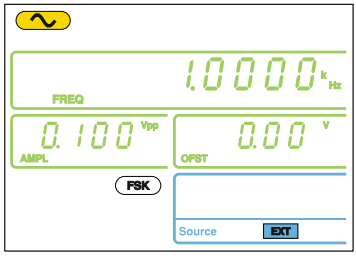
使用 **keypad** 和 **unit** 鍵輸入新的載波頻率



範圍		
	正弦波	0.1Hz ~ 25MHz*
	方波	0.1Hz ~ 25MHz*
	三角波	0.1Hz ~ 1MHz

*AFG-2105 為 5MHz, AFG-2112 為 12MHz

如:
FREQ = 1kHz



設置載波幅值

面板操作

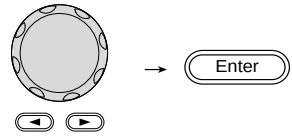
1. 按 **AMPL** 鍵



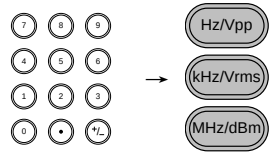
2. 第二顯示區域 AMPL 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯幅值

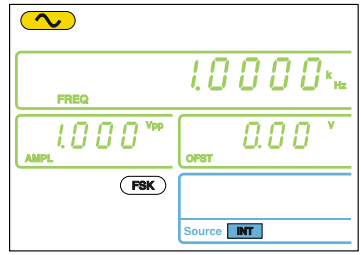


使用 **keypad** 和 **unit** 鍵輸入新的載波幅值



範圍	空載	2mVpp~20Vpp 2mVpp~10Vpp (20MHz – 25MHz)
	50Ω 負載	1mVpp~10Vpp 1mVpp~5Vpp (20MHz – 25MHz)

如:
AMPL= 1Vpp

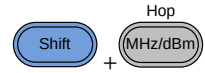


設置跳變頻率

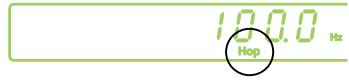
所有波形默認跳變頻率均為 100 Hz。內部調製波是占空比為 50%的方波。選擇外部源時，Trigger 輸入端信號的電壓准位元控制輸出頻率。當 Trigger 輸入信號為邏輯低電平時，輸出載波頻率；當信號為邏輯高電平時，輸出跳變頻率。

面板操作

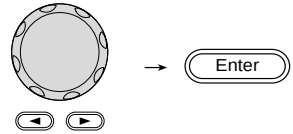
1. 按 **Shift + Hop** 鍵



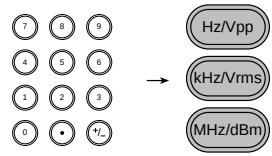
2. 頻率顯示區域 Hop 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯跳變頻率

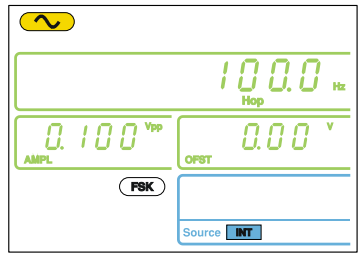


使用 **keypad** 和 **unit** 鍵輸入跳變頻率



範圍		
	正弦波	0.1Hz ~ 25MHz*
	方波	0.1Hz~ 25MHz*
	三角波	0.1Hz~ 1MHz
	預設值	100Hz
	*AFG-2105 為 5MHz, AFG-2112 為 12MHz	

如:
Hop = 100Hz

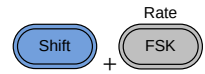


FSK 頻率

FSK 頻率是決定輸出載波頻率與跳變頻率間變化的頻率值。FSK 頻率功能僅限於內部 FSK 源。

面板操作

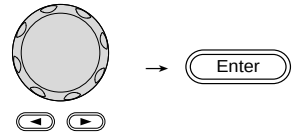
1. 按 **Shift** + **Rate** 鍵



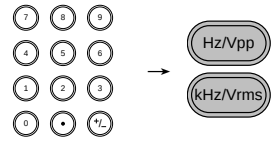
2. 頻率顯示區域閃 Rate 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯**頻率**

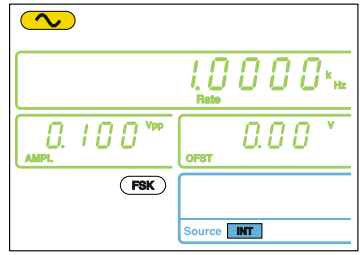


使用 **keypad** 和 **unit** 鍵輸入新的 FSK 頻率



範圍	(內部源)	2mHz ~ 20kHz
	預設值	100Hz

如:
Rate= 1KHz

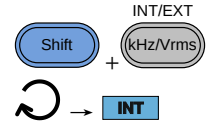


設置 FSK 源

AFG-2000 接受內部(默認)和外部 FSK 源。當選擇內部 FSK 源時，使用 FSK Rate 功能設置 FSK 頻率。當選擇外部源時，FSK 頻率與後面板 Trigger 輸入信號的頻率一致。輸入信號為邏輯低電平時，輸出載波頻率；信號為邏輯高電平時，輸出跳變頻率。

面板操作

1. 按 **Shift + INT/EXT** 鍵選擇調製源



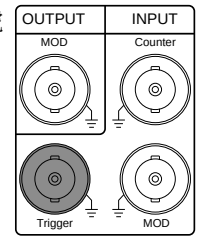
2. 螢幕底部顯示所選 FSK 源



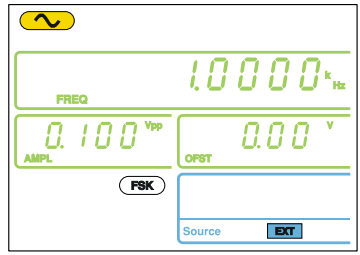
範圍	調製源	INT, EXT

連接
(僅 EXT 源)

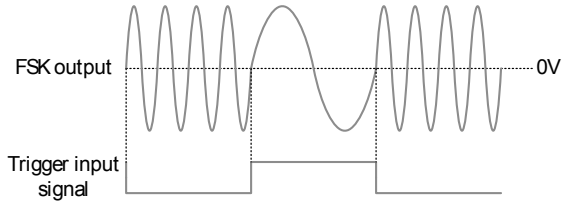
對於外部源，將 FSK 源信號連接至後面板 Trigger 輸入端子。



如:
Source = EXT

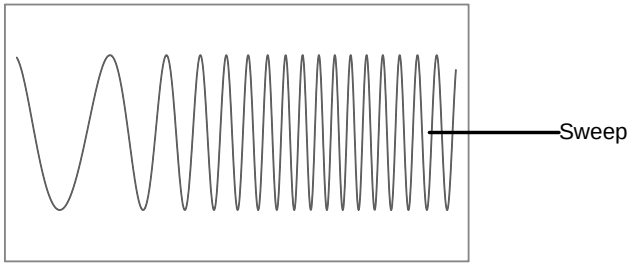


如: 外部觸發輸入信號



頻率掃描
(AFG-2100 系列)

除雜訊波和 ARB 外，信號發生器可以對正弦波、方波或三角波產生一個掃頻。在掃描模式下，信號發生器以指定步進從起始頻率到停止頻率進行掃描。選擇外部源時，只要 Trigger 輸入端接收一個 TTL 准位元脈衝，信號發生器就能輸出一次掃描。您可以選擇線性或對數間隔由高頻向低頻掃描，或由低頻向高頻掃描。掃描功能僅限於 AFG-2105, AFG-2112 和 AFG-2125。



選擇掃描

面板操作

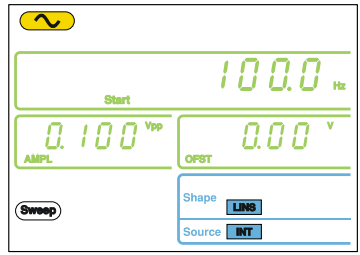
1. 按 **Sweep** 鍵



2. 螢幕顯示調製、掃描和計數功能表。Sweep 圖示表示已啟動掃描功能



如:
Sweep activated



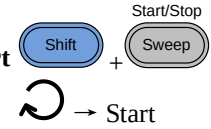
注意 再按 **Sweep** 鍵取消掃描調製

設置起始和停止頻率

起始和停止頻率限定了掃描的上下限。信號發生器從起始頻率向停止頻率掃描，然後又重定回起始頻率。在整個掃描範圍內，相位連續。

面板操作

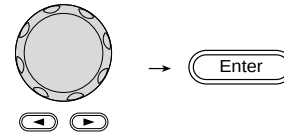
1. 按 **Shift + Start/Stop** 鍵切換起始和停止頻率。選擇 **Start** 頻率圖示



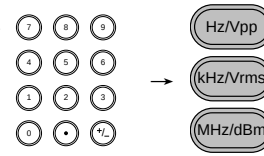
2. 選擇後，頻率顯示區域 Start 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯起始頻率



使用 **keypad** 和 **unit** 鍵輸入新的起始頻率



範圍	正弦波	0.1Hz ~ 25MHz*
	方波	0.1Hz ~ 25MHz*
	三角波	0.1Hz ~ 1MHz
	預設值	起始: 100Hz, 停止: 1kHz
	*AFG-2105 為 5MHz, AFG-2112 為 12MHz	

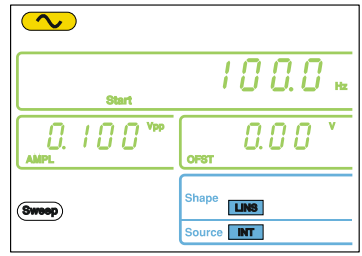
4. 停止頻率設置重複步驟 1~3

注意

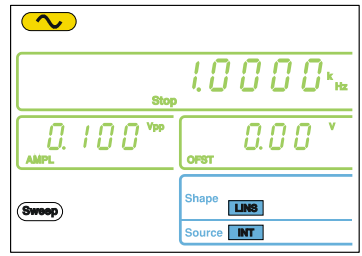
若起始頻率 < 停止頻率，掃描從低頻向高頻掃描

若起始頻率 > 停止頻率，掃描從高頻向低頻掃描

如:
Start = 100Hz



如:
Stop = 1kHz

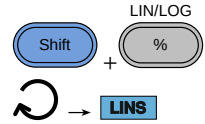


掃描模式

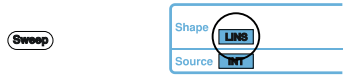
掃描模式可選擇線性(預設設置)或對數掃描。

面板操作

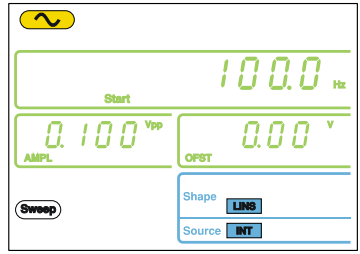
1. 按 **Shift + LIN/LOG** 鍵選擇線性(LINS)或對數(LOGS)掃描



2. 螢幕底部顯示 LINS 或 LOGS 圖示



如:
Sweep = LINS

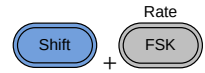


掃描頻率

從起始到停止頻率完成一次掃描所需的時間稱為掃描頻率。信號發生器自動限定掃描的離散頻率點，該數目與掃描長度有關。

面板操作

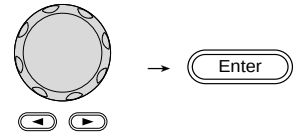
1. 按 **Shift + Rate** 鍵



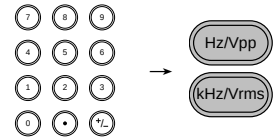
2. 頻率顯示區域 Rate 圖示閃爍



3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 鍵編輯掃描頻率

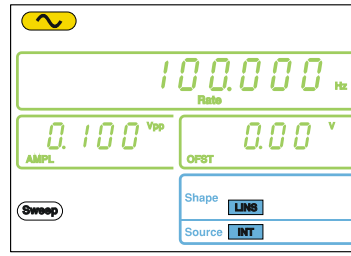


使用 **keypad** 和 **unit** 鍵輸入新掃描頻率



範圍	掃描頻率	1kHz ~ 2mHz (1ms ~ 500s)
	默認	100Hz

如:
Rate= 100Hz

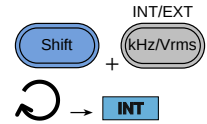


設置掃描源(觸發)

若設為外部掃描源，信號發生器在收到觸發信號後開始掃描，掃描完成後信號發生器輸出起始頻率，並等待下一次觸發。默認內部觸發源。

面板操作

1. 按 **Shift + INT/EXT** 鍵選擇觸發源



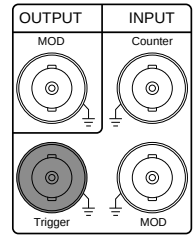
2. 螢幕底部顯示觸發源



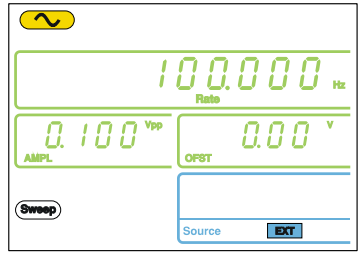
範圍	Source	INT, EXT

連接
(僅 EXT 源)

對於外部源，將掃描觸發信號連接至後面板 Trigger 輸入端子



如:
Source = EXT

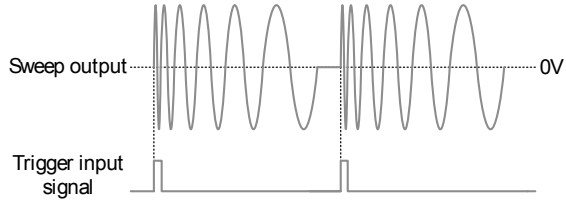


注意

選擇外部源時，每收到一個從後面板 Trigger 輸入端的觸發脈衝(TTL)，信號發生器就輸出一個掃描。

觸發週期必須大於或等於掃描時間+100nS (觸發脈衝寬度 > 100nS)。

如: 外部觸發輸入信號



創建任意波形

AFG-2000 和 AFG-2100 具備一個簡單的任意波形編輯功能。ARB 功能提供 20MHz 取樣速率、4k 資料點以及±511 點的垂直範圍。

選擇載波波形

1. 重複按 **FUNC** 鍵選擇 ARB 功能



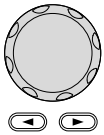
2. 按 **Point** 鍵



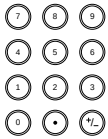
3. 第二顯示區域 Point 閃爍



4. 使用 **scroll wheel** 或 **keypad** 選擇資料點數



或



按 **Enter** 鍵確認



範圍	點:	0 ~ 4096

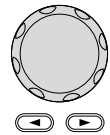
5. 按 **Value** 鍵



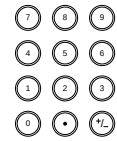
6. 第二顯示區域 Value 閃爍



7. 使用 **scroll wheel** 或 **keypad** 選擇點的垂直數值



或

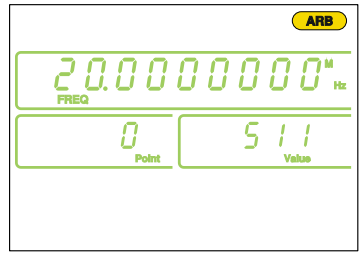


按 **Enter** 鍵確認



範圍	值: ±511 (10-bit 垂直解析度)

8. 重複 2~7 步設置 ARB 波形的其它點

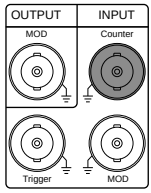
注意	波形點的水準位置與設置頻率有關。例如, 如果設置頻率為 1kHz (週期 = 1ms), 那麼每點間隔 0.01ms (1ms/取樣速率)
如: Point “0” is set to +511.	
注意	存儲 ARB 資料, 請見**錯誤! 尚未定義書籤。**頁存儲/調取章節

使用計頻器

選擇計頻功能

連接

將信號源接入後面板的 Counter 輸入埠



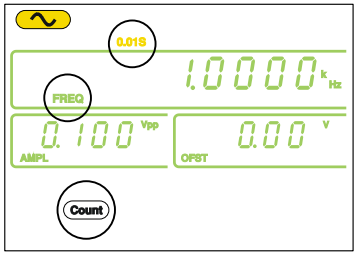
面板操作

1. 按 **Count** 鍵



2. 啟動計頻功能後，螢幕顯示當前門限時間和 Count 圖示。
   頻率顯示區域顯示輸入信號頻率

如: 1kHz 輸入頻率



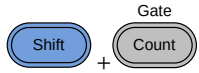
選擇門限時間

面板操作

1. 啟動 Count 功能

Page **錯誤! 尚未定義書籤。**

2. 重複按 **Shift** + **Gate** 鍵選擇所需的門限時間



範圍	門限時間	0.01s, 0.1s, 1s, 10s

3. 計數設置區域顯示當前門限時間



使用 SYNC 輸出埠

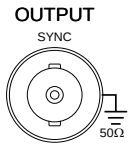
連接 SYNC 輸出埠

背景

信號發生器的 SYNC 輸出埠用於輸出同步信號。除雜訊輸出外，所有的輸出信號都能產生同步信號。

連接

使用 BNC 線將前面板的 SYNC 輸出端與期望的輸入裝置相連



注意

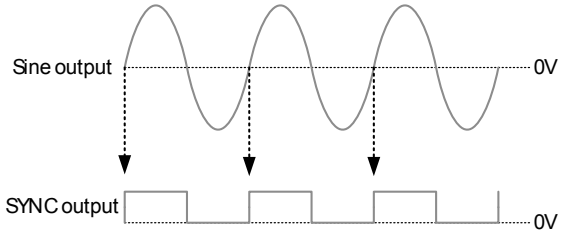
即使主輸出關閉，仍輸出 SYNC 信號

SYNC 輸出信號

對於正弦波

SYNC 輸出: TTL 方波，占空比 50%。當正弦波輸出為正時，SYNC 輸出邏輯高電平

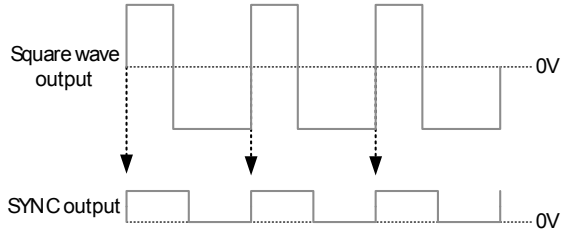
輸出圖



對於方波

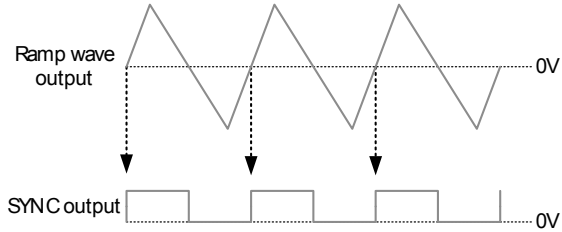
SYNC 輸出: TTL 方波， 占空比與輸出方波占空比一致。當方波輸出為正時，SYNC 輸出邏輯高電平

輸出圖



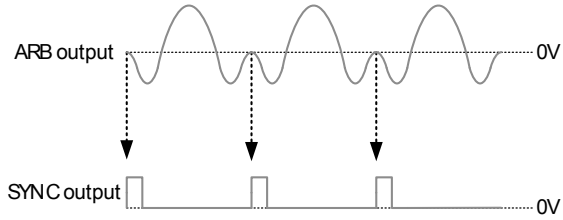
對於三角波　　SYNC 輸出: TTL 方波，占空比 50%。當三角波輸出為正時，SYNC 輸出邏輯高電平

輸出圖



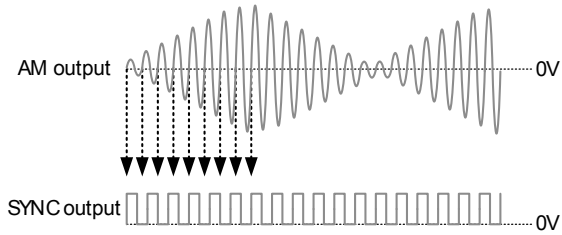
對於 ARB　　SYNC 輸出: 在每個 ARB 週期的開始輸出一個 TTL 正向脈衝(脈衝寬度 = 1/取樣速率)

輸出圖



對於 AM　　SYNC 輸出: TTL 方波，占空比 50%。當調製輸出為正時，SYNC 輸出邏輯高電平

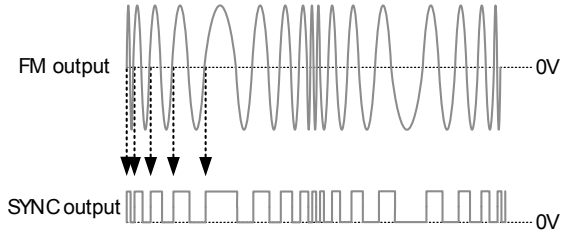
輸出圖



對於 FM

SYNC 輸出: TTL 方波，占空比 50%。當調製輸出為正時，SYNC 輸出邏輯高電平(SYNC 輸出與調製輸出頻率同步)

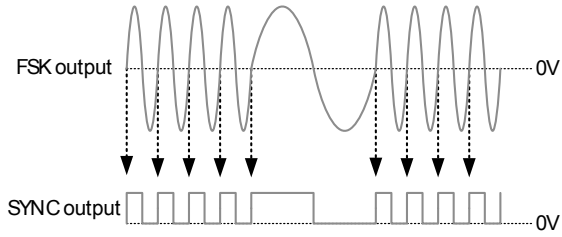
輸出圖



對於 FSK

SYNC 輸出: TTL 方波，占空比 50%。當調製輸出為正時，SYNC 輸出邏輯高電平(SYNC 輸出與調製輸出頻率同步)

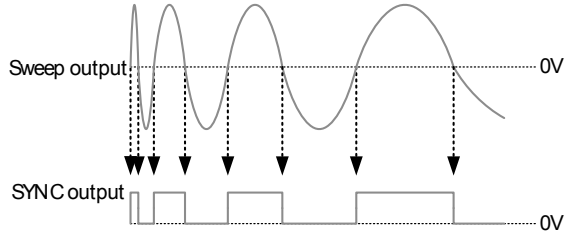
輸出圖



對於掃描

SYNC 輸出: TTL 方波波形。當掃描輸出為正時，SYNC 輸出邏輯高電平(SYNC 輸出與掃描輸出頻率同步)

輸出圖

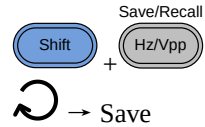


存儲和調取狀態/ARB 波形

AFG-2000 的非易失性記憶體 可存儲儀器狀態和 ARB 資料。10 組儀器狀態和 ARB 資料記憶體，位置編號為 0~19。其中 0~9 記憶體用於存儲/調取儀器狀態，10~19 記憶體用於存儲/調取 ARB 資料。
存儲的儀器狀態包括: 所選功能(含 ARB)、頻率、幅值、DC 偏置、占空比/對稱性以及所有的調製參數。

面板操作

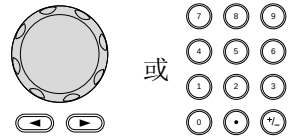
1. 按 **Shift + Save/Recall** 鍵選擇 **Save** (存儲狀態)或 **Recall** (調取狀態)



2. 第二顯示區域顯示 Save 或 Recall



3. 使用 **scroll wheel** 或 **keypad** 選擇存儲/調取編號



使用 **Enter** 鍵存儲/調取狀態



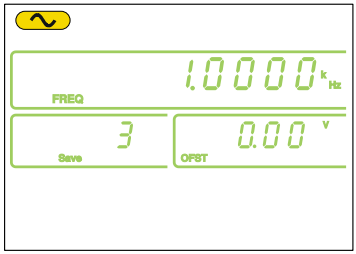
注意

儀器狀態/ARB 資料能保存至 10 組中的 0~9/10~19 中任意一個存儲位置。

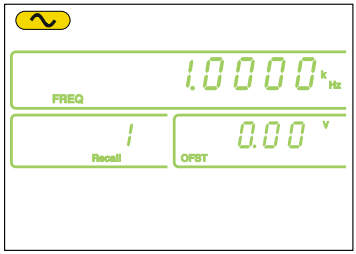
存儲狀態會覆蓋掉同一位置先前保存的狀態。調取 ARB 資料則重寫當前狀態。

存儲位置僅可以調取。

如:
存儲狀態


1.0000 kHz
FREQ
3
Save
0.00 V
OFST

如:
調取狀態


1.0000 kHz
FREQ
1
Recall
0.00 V
OFST

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選擇 USB 遠端介面

The AFG-2000 uses a USB interface for remote control. Connecting to USB

USB configuration	PC side connector	Type A, host
	AFG-2000 side connector	Type Mini B, slave
	Speed	1.1/2.0 (full speed)

Panel Operation

1. Connect the Mini USB—USB-A cable from the PC to the Mini USB port on the rear panel.



2. When the PC asks for the USB driver, select XXXXXXX.inf included in the software package or download the driver from the GW website, www.gwinstek.com.

3. The USB icon will appear when the USB connection is active.



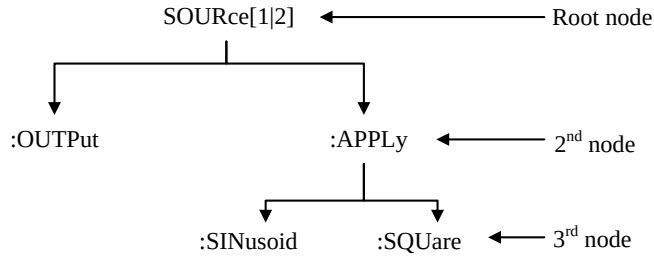
Remote control terminal connection

Terminal application	Invoke the terminal application such as Hyper Terminal. Make note of the COM port, baud rate, stop bit, data bit, and parity accordingly from the Windows Device Manager. To check the COM port settings, see the Device Manager in the PC. For WinXP, Control panel → System → Hardware tab.

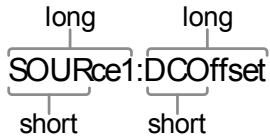
Functionality check	Run this query command via the terminal. *idn? This should return the Manufacturer, Model number, Serial number, and Firmware version in the following format. GW INSTEK, AFG-2125, SN:XXXXXXXX,Vm.mm
Note	^j and ^m can be used as the terminal character when using a terminal program.
PC Software	The proprietary PC software, downloadable from GWInstek website, can be used to download waveforms.

指令語法

Compatible standard	• IEEE488.2, 1992 (fully compatible) • SCPI, 1994 (partially compatible)
Command Tree	The SCPI standard is an ASCII based standard that defines the command syntax and structure for programmable instruments. Commands are based on a hierarchical tree structure. Each command keyword is a node on the command tree with the first keyword as the root node. Each sub node is separated with a colon. Shown below is a section of the SOURce[1] root node and the APPLy/OUTPut and SINusoid/SQUare sub nodes.



Command types	Commands can be separated into three distinct types, simple commands, compound commands and queries.	
	Simple	A single command with/without a parameter
	Example	*OPC
	Compound	Two or more commands separated by a colon (:) with/without a parameter
	Example	SOURce:APPLy:SQUare
	Query	A query is a simple or compound command followed by a question mark (?). A parameter (data) is returned. The maximum or minimum value for a parameter can also be queried where applicable.
	Example	SOURce1:FREQuency? SOURce1:FREQuency? MIN

Command forms	Commands and queries have two different forms, long and short. The command syntax is written with the short form of the command in capitals and the remainder (long form) in lower case.  The commands can be written in capitals or lower-case, just so long as the short or long forms are complete. An incomplete command will not be recognized. Below are examples of correctly written commands: LONG: SOURce1:DCOffset SOURCE1:DCOFFSET source1:dcoffset SHORT: SOUR1:DCO sour1:dco
Command Format	 1: command header 2: single space 3: parameter 4: message terminator
Square Brackets [ ]	Commands that contain squares brackets indicate that the contents are optional. The function of the command is the same with or without the square bracketed items. Brackets are not sent with the command. For example, the frequency query below can use any of the following 3 forms: SOURce1:FREQuency? [MINimum|MAXimum] SOURce1:FREQuency? MAXimum SOURce1:FREQuency? MINimum SOURce1:FREQuency?
Braces { }	Commands that contain braces indicate one item within the braces must be chosen. Braces are not sent with the command.

Angled Brackets < >	Angle brackets are used to indicate that a value must be specified for the parameter. See the parameter description below for details. Angled brackets are not sent with the command.		
Bars |	Bars are used to separate multiple parameter choices in the command format.		
Parameters	Type	Description	Example
	<Boolean>	Boolean logic	0, 1/ON,OFF
	<NR1>	integers	0, 1, 2, 3
	<NR2>	decimal numbers	0.1, 3.14, 8.5
	<NR3>	floating point	4.5e-1, 8.25e+1
	<NRf>	any of NR1, 2, 3	1, 1.5, 4.5e-1
	<NRf+> <Numeric>	NRf type with a suffix including MINimum, MAXimum or DEFault parameters.	1, 1.5, 4.5e-1 MAX, MIN, DEF
	<aard>	Arbitrary ASCII characters.	
	<discrete>	Discrete ASCII character parameters	IMM, EXT, MAN
	<frequency> <peak deviation in Hz> <rate in Hz>	NRf+ type including frequency unit suffixes.	1 KHZ, 1.0 HZ, MHZ
	<amplitude>	NRf+ type including voltage unit suffixs.	VPP, dBm, Vrms
	<offset>	NRf+ type including voltage unit suffixes.	V

	<seconds>	NRf+ type including time unit suffixes.	nS, uS, mS, S
	<percent>	NRf type	N/A
	<depth in percent>		
Message terminators	LF CR	line feed code (new line) and carriage return.	
	LF	line feed code (new line)	
Note	^j or ^m should be used when using a terminal program.		
Command Separators	Space	A space is used to separate a parameter from a keyword/command header.	
	Colon (:)	A colon is used to separate keywords on each node.	
	Semicolon (;)	A semicolon can be used to combine commands from different node levels. For example: SOURce1:PWM:SOURce? SOURce:PULSe:WIDTh? →SOURce1:PWM:SOURce?;SOURce:PULSe:WIDTh?	
	Comma (,)	When a command uses multiple parameters, a comma is used to separate the parameters. For example: SOURce:APPLy:SQUare 10KHZ,2.0 VPP,-1VDC	

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系統指令

*IDN? → Query

Description	Returns the function generator manufacturer, model number, serial number and firmware version number in the following format: GW INSTEK,AFG-2025,SN:XXXXXXXX,Vm.mm
Query Syntax	**IDN?**
Return parameter	<string>
Query Example	***IDN?** **>GW INSTEK,AFG-2025,SN:XXXXXXXX,Vm.mm** Returns the identification of the function generator.

*RST Set →

Description	Reset the function generator to its factory default state.
Note	Note the *RST command will not delete instrument save states/ARB waveforms in memory.
Syntax	***RST**

狀態寄存器指令

*CLS

Set

Description	The *CLS command clears all the event registers, the error queue and cancels an *OPC command.
Syntax	***CLS**

應用指令

The APPLy command has 5 different types of outputs (Sine, Square, Ramp, Noise, User(ARB)). The Apply command is the quickest, easiest way to output waveforms remotely. Frequency, amplitude and offset can be specified for each function.

As only basic parameters can be set with the Apply command, other parameters, such as duty and symmetry use the instrument default values.

The Apply command will set the trigger source to immediate and disable modulation and sweep modes, if active. The command also turns on the output command SOURce[1]:OUTP ON.

As the frequency, amplitude and offset parameters are in nested square brackets, the amplitude can only be specified if the frequency has been specified and the offset can only be specified if the amplitude has been set. See the syntax below for the example:

SOURce1:APPLy:<function> [<frequency> [,<amplitude> [,<offset>]]]

Output Frequency

For the output frequency, MINimum, MAXimum and DEFault can be used instead of specifying a frequency. The default frequency for all functions is set to 1 kHz.

The maximum and minimum frequency depends on the function used and the model of the frequency generator. If a frequency output that is out of range is specified, the max/min frequency will be used instead. A “-222” error will be generated from the remote terminal.

Function	Min frequency	Max frequency
Sine	0.1Hz	25MHz*
Square	0.1Hz	25MHz*
Ramp	0.1Hz	1MHz
Noise	Not applicable	Not applicable
User (ARB)	0.1Hz	20MHz*

*The AFG-2005/2105 is limited to 5MHz, the AFG-2012/2112 is limited to 12MHz.

Output Amplitude

When setting the amplitude, MINimum, MAXimum and DEFault can be used instead of specifying an amplitude. The range depends on the function being used. The default amplitude for all functions is 100 mVpp (into 50Ω).

Vrms, dBm or Vpp units can be used to specify the output units to use with the current command. Note, however, that the VOLT:UNIT command can be used to set the default units (Vrms, dBm, Vpp) for all commands. This will be applicable to the Apply command when no unit is specified. The unit default is set to Vpp.

The output amplitude can be affected by the function and unit chosen. Vpp and Vrms or dBm values may have different maximum values due to differences such as crest factor. For example, a 5Vrms square wave will be adjusted to 3.536 Vrms for a sine wave.

DC Offset voltage

The offset parameter can be set to MINimum, MAXimum or DEFault instead of a specified DC offset value. The default DC offset is 0 volts.

The maximum and minimum DC offset is limited by the output amplitude as shown below.

$|V_{offset}| < V_{max} - Vpp/2$

This means that the magnitude of the DC offset is determined by the output amplitude.

If the specified DC offset is out of range, the maximum/minimum offset will be set instead. A "-222" error will be generated from the remote terminal.

SOURce[1]:APPLy:SINusoid Set ⟶

Description	Outputs a sine wave when the command has executed. Frequency, amplitude and offset can also be set.	
Syntax	SOURce[1]:APPLy:SINusoid [<frequency> [,<amplitude> [,<offset>]]]	
Parameter	<frequency>	0.1Hz~25MHz*
	<amplitude>	1mV~10Vpp (50Ω)
	<offset>	-5V ~ +5V (50Ω)
	*AFG-2005/2105 limited to 5MHz, AFG-2012/2112 limited to 12MHz.	
Example	**SOURce1:APPL:SIN MAX, 3.0, -2.5** Outputs a 3Vpp sine wave at 25MHz (max frequency) with a -2.5V offset.	

SOURce[1]:APPLy:SQUare

Set ⟶

Description	Outputs a square wave when the command has executed. Frequency, amplitude and offset can also be set. The duty cycle is fixed to 50%.	
Syntax	SOURce[1]:APPLy:SQUare [<frequency> [,<amplitude> [,<offset>]]]	
Parameter	<frequency>	0.1Hz ~ 25MHz*
	<*amplitude*>	1mV~10V (50Ω)
	<offset>	-5V ~ +5V (50Ω)
	*AFG-2005/2105 limited to 5MHz, AFG-2012/2112 limited to 12MHz.	
Example	**SOURce1:APPL:SQU MAX, DEF, DEF** Outputs a 100mVpp (DEF) square wave at 25MHz with 0 offset (DEF).	

SOURce[1]:APPLy:RAMP

Set ⟶

Description	Outputs a ramp wave when the command has executed. Frequency, amplitude and offset can also be set. The symmetry is fixed to 100%.

Syntax	SOURce[1]:APPLy:RAMP [<frequency> [,<amplitude> [,<offset>]]]	
Parameter	<frequency>	0.1Hz~1MHz
	<*amplitude*>	1mV~10V (50Ω)
	<offset>	-5V ~ +5V (50Ω)
Example	**SOUR1:APPL:RAMP 2KHZ,MAX,MAX** Sets the frequency to 2kHz and sets the amplitude and offset to the maximum.	

SOURce[1]:APPLy:NOISe

Set ⟶

Description	Outputs Gaussian noise with a 20 MHz bandwidth. Amplitude and offset can also be set.
Note	The Frequency parameter is not used with the noise function; however a value (or DEFault) *must still* be specified. The frequency is remembered for the next function used.
Syntax	**SOURce[1]:APPLy:NOISe [<frequency|DEFault> [,<amplitude> [,<offset>]]]**

Parameter	<frequency>	0.1Hz~20MHz*
	<amplitude>	1mV~10V (50Ω)
	<offset>	-5V ~ +5V (50Ω)
	*AFG-2005/2105 limited to 5MHz, AFG-2012/2112 limited to 12MHz.	
Example	**SOURce[1|2]:APPL:NOIS DEF, 5.0, 2.0** Sets the amplitude to 5 volts with an offset of 2 volts.	

SOURce[1]:APPLy:USER

Set ⟶

Description	Outputs an arbitrary waveform that is specified from the FUNC:USER command.

Note	Frequency and amplitude values are not used with this function; however a value (or DEFault) must be specified. The values are remembered for the next function used.
Syntax	**SOURce[1]:APPLy:USER [<frequency> [,<amplitude> [,<offset>]]]**
Parameter	<frequency> 0.1Hz~10MHz <amplitude> 1mV~10V (50Ω) <offset> -5V ~ +5V (50Ω)
Example	**SOUR1:APPL:USER** Outputs the ARB waveform specified in the FUNC:USER command.

SOURce[1]:APPLy? → Query

Description	Outputs a string with the current settings.
Note	The returned string can be passed back, when appended to the Apply Command. This is intended to be used to return the function generator to a known state. I.e., SOURce[1]:APPL:<passed back string>
Query Syntax	**SOURce[1]:APPLy?**
Return Parameter	<string> Function(<NRf>), frequency(<NRf>), amplitude(<NRf>),offset(<NRf>)
Query Example	**SOUR1:APPL?** **>SIN +5.0000000000000E+03,+3.0000E+00,-2.50E+00** Returns a string with the current function and parameters, Sine, 5kHz, 3Vpp, -2.5V offset.

輸出指令

Unlike the Apply commands, the Output commands are low level commands to program the function generator.

This section describes the low-level commands used to program the function generator. Even though the APPLy command is the easiest way to program the function generator, it lacks the ability to change individual parameters. The Output commands on the other hand can be used to set individual parameters, or those parameters that cannot be programmed with the Apply command.

SOURce[1]:FUNCtion

Set → / → Query

Description	The FUNCtion command selects and outputs the selected output function. The User parameter outputs an arbitrary waveform previously set by the SOURce[1]:FUNC:USER command. The previously set frequency, amplitude and offset values are used automatically.
Note	If the function mode is changed and the current frequency setting is not supported by the new mode, the frequency setting will be altered to the next highest value. Vpp and Vrms or dBm amplitude values may have different maximum values due to differences such as crest factor. For example, if a 5Vrms square wave is changed to a sinewave, then the Vrms value is automatically adjusted to 3.536Vrms. The modulation and sweep modes can only be used with some of the basic waveforms. If a mode is not supported, the conflicting mode will be disabled. See the table below.

	Sine	Square	Ramp	Noise	ARB
AM	✓	✓	✓	×	×
FM	✓	✓	✓	×	×
FSK	✓	✓	✓	×	×

	SWEEP	✓	✓	✓	×	×

Syntax	**SOURce[1]:FUNCtion {SINusoid|SQUare|RAMP |NOISe |USER}**
Example	**SOUR1:FUNC SIN** Sets the output as a sine function.
Query Syntax	**SOURce[1]:FUNCtion?**

Return Parameter	SIN, SQU, RAMP, NOIS, USER	Returns the current output type.

Query Example	**SOUR1:FUNC?** **>SIN** Current output is sine.

SOURce[1]:FREQuency

Set → / → Query

Description	Sets the output frequency for the SOURce[1]:FUNCtion command. The query command returns the current frequency setting.
Note	The maximum and minimum frequency depends on the function mode.

Sine, Square	0.1Hz~25MHz*
Ramp	0.1Hz ~ 1MHz
Noise	Not applicable
User	0.1Hz~10MHz*

*AFG-2005/2105 limited to 5MHz, AFG-2012/2112 limited to 12MHz.

	If the function mode is changed and the current frequency setting is not supported by the new mode, the frequency setting will be altered to the next highest value. The duty cycle of square waveforms depends on the frequency settings: 1% to 99% (*frequency* < 100KHz) 20% to 80% (100KHz < *frequency* < 5 MHz) 40% to 60% (5 MHz < *frequency* < 10 MHz) 50% (*frequency* > 10 MHz) If the frequency is changed and the set duty cycle cannot support the new frequency, the highest duty cycle available at that frequency will be used. A "-221" error will be generated from the remote terminal.	
Syntax	**SOURce[1]:FREQuency {<frequency>|MINimum|MAXimum}**	
Example	**SOUR1:FREQ MAX** Sets the frequency to the maximum for the current mode.	
Query Syntax	**SOURce[1]:FREQuency?**	
Return Parameter	<NR3>	Returns the frequency for the current mode.
Query Example	**SOUR1:FREQ? MAX** **>+1.0000000000000E+03** The maximum frequency that can be set for the current function is 1MHz.	

SOURce[1]:AMPlitude

Set → Query

Description	Sets the output amplitude for the SOURce[1]:FUNCtion command. The query command returns the current amplitude settings.
Note	The maximum and minimum amplitude depends on the output termination. The default amplitude for all functions is 100 mVpp (50Ω). The offset and amplitude are related by the following equation. |V*offset*| < V*max* – Vpp/2 The output amplitude can be affected by the function and unit chosen. Vpp and Vrms or dBm values may have different maximum values due to differences such as crest factor. For example, a 5Vrms square wave will be adjusted to 3.536 Vrms for a sine wave. The amplitude units can be explicitly used each time the SOURce[1]:AMPlitude command is used. Alternatively, the VOLT:UNIT command can be used to set the amplitude units for *all* commands.
Syntax	**SOURce[1]:AMPlitude {< amplitude> |MINimum|MAXimum}**
Example	**SOUR1:AMP MAX** Sets the amplitude to the maximum for the current mode.
Query Syntax	**SOURce[1]:AMPlitude? {MINimum|MAXimum}**
Return Parameter	<NR3> Returns the amplitude for the current mode.
Query Example	**SOUR1:AMP? MAX** **>+5.0000E+00** The maximum amplitude that can be set for the current function is 5 volts.

SOURce[1]:DCOffset

Set →
→ Query

Description	Sets or queries the DC offset for the current mode.
Note	The offset parameter can be set to MINimum or MAXimum. The default offset is 0 volts. The offset is limited by the output amplitude as shown below. |V*offset*| < V*max* – Vpp/2 If the output specified is out of range, the maximum offset will be set. The maximum offset is ±5V into 50Ω).
Syntax	**SOURce[1]:DCOffset {< offset> |MINimum|MAXimum}**
Example	**SOUR1:DCO MAX** Sets the offset to the maximum for the current mode.
Query Syntax	**SOURce[1]:DCOffset? {MINimum|MAXimum}**
Return Parameter	<NR3> Returns the offset for the current mode.
Query Example	**SOUR1:DCO?** **>+3.0000E+00** The offset for the current mode is set to +3 volts.

SOURce[1]:SQUare:DCYCle

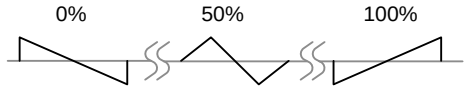
Set →
→ Query

Description	Sets or queries the duty cycle for square waves only. The setting is remembered if the function mode is changed. The default duty cycle is 50%.
Note	The duty cycle of square waveforms depend on the frequency settings. 1% to 99% (*frequency* < 100KHz) 20% to 80% (100KHz < *frequency* < 5 MHz) 40% to 60% (5 MHz < *frequency* < 10 MHz) 50% (*frequency* > 10 MHz

	If the frequency is changed and the set duty cycle cannot support the new frequency, the highest duty cycle available at that frequency will be used. A "-221" error will be generated from the remote terminal. For square waveforms, the Apply command and AM/FM modulation modes ignore the duty cycle settings.
Syntax	**SOURce[1]:SQUare:DCYCle {< percent> |MINimum|MAXimum}**
Example	**SOUR1:SQU:DCYC MAX** Sets the duty cycle to the highest possible for the current frequency.
Query Syntax	**SOURce[1]:SQUare:DCYCle? {MINimum|MAXimum}**
Return Parameter	<NR3> Returns the duty cycle as a percentage.
Query Example	**SOUR1:SQU:DCYC?** **>+5.00E+01** The duty cycle is set 50%.

SOURce[1]:RAMP:SYMMetry

Set → Query

Description	Sets or queries the symmetry for ramp waves only. The setting is remembered if the function mode is changed. The default symmetry is 100%. 0% symmetry is a ramp waveform with a negative going transition. 100% symmetry is a ramp waveform with a positive going transition. 
Note	For ramp waveforms, the Apply command and AM/FM modulation modes ignore the current symmetry settings.
Syntax	**SOURce[1]:RAMP:SYMMetry {< percent> |MINimum|MAXimum}**
Example	**SOUR[1]:RAMP:SYMM MAX** Sets the symmetry to the 100%.
Query Syntax	**SOURce[1]:RAMP:SYMMetry? {MINimum|MAXimum}**
Return Parameter	<NR3> Returns the symmetry as a percentage.
Query Example	**SOUR1:RAMP:SYMMetry?** **>+1.0000E+02** The symmetry is set as 100%.

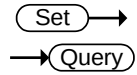
OUTPut

Set → Query

Description	Enables/Disables or queries the front panel output. The default is set to off.
Syntax	**OUTPut {OFF|ON}**
Example	**OUTP ON** Turns the output on.
Query Syntax	**OUTPut?**

Return Parameter	1	ON
	0	OFF
Query Example	**OUTP?** **>1** The output is currently on.	

SOURce[1]:OUTPut:SYNC



Description	Turns the SYNC output port on the front panel on/off. By default the SYNC port is turned on.	
Syntax	**SOURce[1]:OUTPut:SYNC{OFF|ON}**	
Example	**SOUR:OUTP:SYNC OFF** Turns the SYNC output port off.	
Query Syntax	**SOURce[1]:OUTPut:SYNC?**	
Return Parameter	1	The SYNC port is on.
	0	The SYNC port is off.
Query Example	**SOUR:OUTP:SYNC?** **>0** The SYNC output port is off.	

SOURce[1]:VOLTage:UNIT

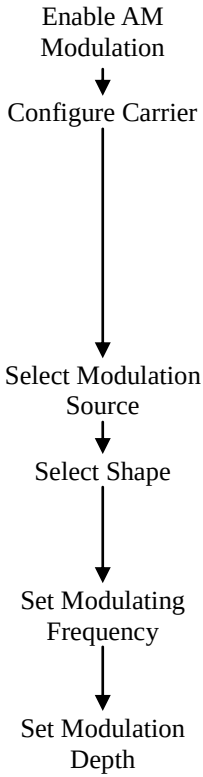
Set → / → Query

Description	Sets or queries the output amplitude units. There are three types of units: VPP, VRMS and DBM. The SOURce[1]:VOLTage:UNIT command does not set the offset units.	
Note	The units set with the VOLTage:UNIT command will be used as the default unit for all amplitude units unless a different unit is specifically used for a command, such as those used with the Apply commands.	
Syntax	**SOURce[1]:VOLTage:UNIT {VPP|VRMS|DBM}**	
Example	**SOUR1:VOLT:UNIT VPP** Sets the amplitude units to Vpp.	
Query Syntax	**SOURce[1]:VOLTage:UNIT?**	
Return Parameter	VPP	Vpp
	VRMS	Vrms
	DBM	dBm
Query Example	**SOUR1:VOLT:UNIT?** **>VPP** The amplitude units are set to Vpp.	

幅值調製(AM)指令

AM 介紹

To successfully create an AM waveform, the following commands must be executed in order.



1. Turn on AM modulation using the SOURce[1]:AM:STAT ON command
2. Use the APPLy command to select a carrier waveform. Alternatively the equivalent FUNC, FREQ, AMP, and DCO commands can be used to create a carrier waveform with a designated frequency, amplitude and offset. Sine, square or ramp can be used as the carrier wave.
3. Select an internal or external modulation source using the SOURce[1]:AM:SOUR command.
4. Use the SOURce[1]:AM:INT:FUNC command to select a Sine, Square or Ramp modulating waveform. For internal sources only.
5. Set the modulating frequency using the SOURce[1]:AM:INT:FREQ command. For internal sources only.
6. Set the modulation depth using the SOURce[1]:AM:DEPT command.

SOURce[1]:AM:STATe

Set →
→ Query

Description	Sets or disables AM modulation. By default AM modulation is disabled. AM modulation must be enabled before setting other parameters.	
Note	As only one mode is allowed at any one time, other modulation modes (inc. Sweep/FSK) will be disabled when AM modulation is enabled.	
Syntax	**SOURce[1]:AM:STATe {OFF|ON}**	
Example	**SOUR1:AM:STAT ON** Enables AM modulation.	
Query Syntax	**SOURce[1]:AM:STATe?**	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Query Example	**SOUR1:AM:STAT?** **>1** AM modulation mode is currently enabled.	

SOURce[1]:AM:SOURce

Set →
→ Query

Description	Sets or queries the modulation source as internal or external. Internal is the default modulation source.	
Note	If an external modulation source is selected, modulation depth is limited to ± 5V from the MOD input port on the rear panel. For example, if modulation depth is set to 100%, then the maximum amplitude is +5V, and the minimum amplitude is -5V.	
Syntax	**SOURce[1]:AM:SOURce {INTernal|EXTernal}**	
Example	**SOUR1:AM:SOUR EXT** Sets the modulation source to external.	
Query Syntax	**SOURce[1]:AM:SOURce?**	
Return Parameter	INT	Internal

	EXT	External
Query Example	**SOUR1:AM:SOUR?** **>INT** The modulation source is set to internal.	

SOURce[1]:AM:INTernal:FUNCtion

Set → / → Query

Description	Sets the shape of the modulating waveform from sine, square or ramp. The default shape is sine.
Note	Square waveforms have a 50% duty cycle. Ramp waveforms have a symmetry of 100%.
Syntax	**SOURce[1]:AM:INTernal:FUNCtion {SINusoid|SQUare| RAMP }**
Example	**SOUR1:AM:INT:FUNC SIN** Sets the AM modulating wave shape to sine.
Query Syntax	**SOURce[1]:AM:INTernal:FUNCtion?**

Return Parameter		
	SIN	Sine
	SQU	Square
	RAMP	Ramp

Query Example	**SOUR1:AM:INT:FUNC?** **>SIN** The shape for the modulating waveform is Sine.

SOURce[1]:AM:INTernal:FREQuency

Set → / → Query

Description	Sets the frequency of the internal modulating waveform only. The default frequency is 100Hz.	
Syntax	**SOURce[1]:AM:INTernal:FREQuency {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	2 mHz~ 20 kHz
Example	**SOUR1:AM:INT:FREQ +1.0000E+02** Sets the modulating frequency to 100Hz.	

Query Syntax	**SOURce[1]:AM:INTernal:FREQuency? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the frequency in Hz.
Query Example	**SOUR1:AM:INT:FREQ? MIN** **>+1.0000E+02** Returns the minimum frequency allowed.	

SOURce[1]:AM:DEPTh

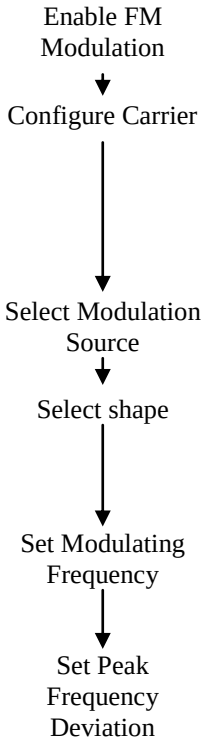
Set → Query

Description	Sets or queries the modulation depth for internal sources only. The default is 100%.	
Note	The function generator will not output more than ±5V, regardless of the modulation depth. The modulation depth of an external source is controlled using the ±5V MOD input port on the rear panel, and not the SOURce[1]:AM:DEPTh command.	
Syntax	**SOURce[1]:AM:DEPTh {<depth in percent>|MINimum|MAXimum}**	
Parameter	<depth in percent>	0~120%
Example	**SOUR1:AM:DEPT 50** Sets the modulation depth to 50%.	
Query Syntax	**SOURce[1]:AM:DEPTh? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Return the modulation depth as a percentage.
Query Example	**SOUR1:AM:DEPT?** **>+1.0000E+02** The modulation depth is 100%.	

頻率調製(FM)指令

FM 介紹

The following is an overview of the steps required to generate an FM waveform.



1. Turn on FM modulation using the SOURce[1]: FM:STAT ON command.
2. Use the APPLy command to select a carrier waveform. Alternatively, the FUNC, FREQ, AMPl, and DCOffs commands can be used to create a carrier waveform with a designated frequency, amplitude and offset.
3. Select an internal or external modulation source using the SOURce[1]:FM:SOUR command.
4. Use the SOURce[1]:FM:INT:FUNC command to select a sine, square or ramp modulating waveform. For internal sources only.
5. Set the modulating frequency using the SOURce[1]: FM:INT:FREQ command. For internal sources only.
6. Use the SOURce[1]:FM:DEV command to set the frequency deviation.

SOURce[1]:FM:STATe

Set → / → Query

Description	Sets or disables FM modulation. By default FM modulation is disabled. FM modulation must be enabled before setting other parameters.

Note	As only one mode is allowed at any one time, other modes (AM, FSK, Sweep etc.) will be disabled when FM modulation is enabled.
Syntax	**SOUR[1]:FM:STATe {OFF|ON}**
Example	**SOUR1:FM:STAT ON** Enables FM modulation.
Query Syntax	**SOURce[1]:FM:STATe?**
Return Parameter	0 Disabled (OFF) 1 Enabled (ON)
Query Example	**SOUR1:FM:STAT?** **>1** FM modulation mode is currently enabled.

SOURce[1]:FM:SOURce

Set → / → Query

Description	Sets or queries the modulation source as internal or external. Internal is the default modulation source.
Note	If an external modulation source is selected, the frequency deviation is limited to ± 5V from the MOD input port on the rear panel. For example, if frequency deviation is set to 100Hz, then +5V will increases the frequency by 100Hz.
Syntax	**SOURce[1]:FM:SOURce {INTernal|EXTernal}**
Example	**SOUR1:FM:SOUR EXT** Sets the modulation source to external.
Query Syntax	**SOURce[1]:FM:SOURce?**
Return Parameter	INT Internal EXT External
Query Example	**SOUR1:FM:SOUR?** **>INT** The modulation source is set to internal.

SOURce[1]:FM:INTernal:FUNCtion

Set → Query

Description	Sets the shape of the modulating waveform from sine, square or ramp. The default shape is sine.	
Note	Square waveforms have a 50% duty cycle. Ramp waveforms have a symmetry of 100%.	
Syntax	**SOURce[1]:FM:INTernal:FUNCtion {SINusoid|SQUare|RAMP }**	
Example	**SOUR1:FM:INT:FUNC SIN** Sets the FM modulating wave shape to sine.	
Query Syntax	**SOURce[1]:FM:INTernal:FUNCtion?**	
Return Parameter	SIN	Sine
	SQU	Square
	RAMP	Ramp
Query Example	**SOUR1:FM:INT:FUNC?** **>SIN** The shape for the modulating waveform is Sine.	

SOURce[1]:FM:INTernal:FREQuency

Set → Query

Description	Sets the frequency of the internal modulating waveform only. The default frequency is 10Hz.	
Syntax	**SOURce[1]:FM:INTernal:FREQuency {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	2 mHz ~ 20 kHz
Example	**SOUR1:FM:INT:FREQ +1.0000E+02** Sets the modulating frequency to 100Hz.	
Query Syntax	**SOURce[1]:FM:INTernal:FREQuency? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the frequency in Hz.

Query Example	**SOUR1:FM:INT:FREQ? MAX** **>+2.0000E+04** Returns the maximum frequency allowed.

SOURce[1]:FM:DEViation

Set → / → Query

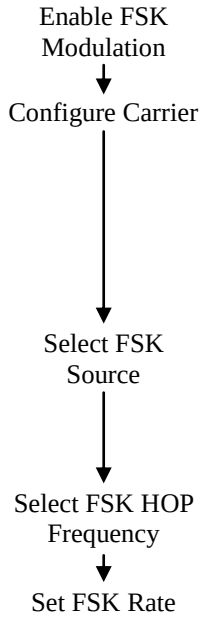
Description	Sets or queries the peak frequency deviation of the modulating waveform from the carrier waveform. The default peak deviation is 100Hz. The frequency deviation of external sources is controlled using the ±5V MOD INPUT terminal on the rear panel. A positive signal (>0~+5V) will increase the deviation (up to the set frequency deviation), whilst a negative voltage will reduce the deviation.
Note	The relationship of peak deviation to modulating frequency and carrier frequency is shown below. Peak deviation = modulating frequency – carrier frequency. The carrier frequency must be greater than or equal to the peak deviation frequency. The sum of the deviation and carrier frequency must not exceed the maximum frequency for a specific carrier shape + 1kHz. If an out of range deviation is set for any of the above conditions, the deviation will be automatically adjusted to the maximum value allowed and an "out of range" error will be generated. For square wave carrier waveforms, the deviation may cause the duty cycle frequency boundary to be exceeded. In these conditions the duty cycle will be adjusted to the maximum allowed and a "-221" error will be generated.
Syntax	**SOURce[1]:FM:DEViation {<peak deviation in Hz>|MINimum|MAXimum}**
Parameter	<peak deviation in Hz> DC ~ 25MHz* DC~1MHz (Ramp) *Limited to 12MHz for AFG-2112, 5MHz for AFG-2105.

Example	**SOUR1:FM:DEV MAX** Sets the frequency deviation to the maximum value allowed.	
Query Syntax	**SOURce[1]:FM:DEViation? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the frequency deviation in Hz.
Query Example	**SOURce[1]:FM:DEViation? MAX** **>+1.0000E+06** The maximum frequency deviation for the current function is 1MHz.	

頻移鍵控(FSK)指令

FSK 介紹

The following is an overview of the steps required to generate an FSK modulated waveform.



1. Turn on FSK modulation using the SOURce[1]: FSK:STAT ON command.
2. Use the APPLy command to select a carrier waveform. Alternatively, the FUNC, FREQ, AMPl, and DCOffs commands can be used to create a carrier waveform with a designated frequency, amplitude and offset. The carrier waveform can be sine, square or ramp.
3. Select an internal or external modulation source using the SOURce[1]:FSK:SOUR command.
4. Set the hop frequency using the SOURce[1]:FSK:FREQ command.
5. Use the SOURce[1]: FSK:INT:RATE command to set the FSK rate. The FSK rate can only be set for internal sources.

SOURce[1]:FSKey:STATe

Set → / → Query

Description	Turns FSK Modulation on or off. By default FSK modulation is off.
Note	As only one mode is allowed at any one time, other modes (AM, FM, Sweep etc.) will be disabled when FSK modulation is enabled.
Syntax	**SOURce[1]:FSKey:STATe {OFF|ON}**
Example	**SOUR1:FSK:STAT ON**

	Enables FSK modulation.	
Query Syntax	**SOURce[1]:FSKey:STATe?**	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Query Example	**SOUR1:FSK:STAT?** **>1** FSK modulation is currently enabled.	

SOURce[1]:FSKey:SOURce

Set → Query

Description	Sets or queries the FSK source as internal or external. Internal is the default source.
Note	If an external FSK source is selected, FSK rate is controlled by the Trigger input port on the rear panel.
Syntax	**SOURce[1]:FSKey:SOURce {INTernal|EXTernal}**
Example	**SOUR1:FSK:SOUR EXT** Sets the FSK source to external.
Query Syntax	**SOURce[1]:FSKey:SOURce?**

Return Parameter	INT	Internal
	EXT	External
Query Example	**SOUR1:FSK:SOUR?** **>INT** The FSK source is set to internal.	

SOURce[1]:FSKey:FREQuency

Set → Query

Description	Sets the FSK hop frequency. The default hop frequency is set to 100Hz.
Note	For FSK, the modulating waveform is a square wave with a duty cycle of 50%.
Syntax	**SOURce[1]:FSKey:FREQuency {<frequency>|MINimum|MAXimum}**

Parameter	<frequency>	0.1Hz~ 25MHz* 0.1Hz~ 1MHz (Ramp)
	*AFG-2112 limited to 12MHz, AFG-2105 limited to 5MHz.	
Example	**SOUR1:FSK:FREQ +1.0000E+02** Sets the FSK hop frequency to 100Hz.	
Query Syntax	**SOURce[1]:FSKey:FREQuency? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the frequency in Hz.
Query Example	**SOUR1:FSK:FREQ? MAX** **>+2.0000E+07** Returns the maximum hop frequency allowed.	

SOURce[1]:FSKey:INTernal:RATE

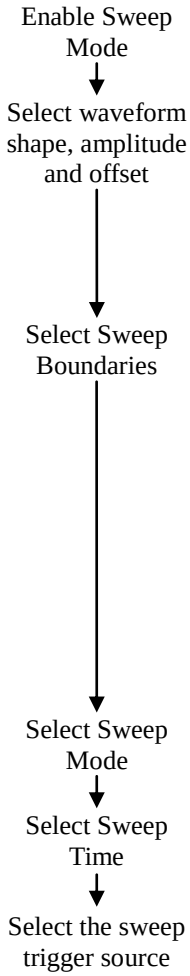
Set → → Query

Description	Sets or queries the FSK rate for internal sources only.	
Note	External sources will ignore this command.	
Syntax	**SOURce[1]:FSKey:INTernal:RATE {<rate in Hz>|MINimum|MAXimum}**	
Parameter	<rate in Hz>	2 mHz~100 kHz
Example	**SOUR1:FSK:INT:RATE MAX** Sets the rate to the maximum (100kHz).	
Query Syntax	**SOURce[1]:FSKey:INTernal:RATE? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the FSK rate in Hz.
Query example	**SOUR1:FSK:INT:RATE?** **>+1.0000E+05** Returns the FSK rate (100kHz).	

頻率掃描指令

掃描介紹

Below shows the order in which commands must be executed to perform a sweep.



1. Turn on Sweep mode using the SOURce[1]: SWE:STAT ON command.
2. Use the APPLy command to select the waveform shape. Alternatively, the FUNC, FREQ, AMPl, and DCOffs commands can be used to create a waveform (sine, square, ramp) with a designated frequency, amplitude and offset.
3. Set the frequency boundaries by setting the start and stop frequencies.

   Start~Stop Use the SOURce[1]:FREQ:STAR and SOURce[1]:FREQ:STOP to set the start and stop frequencies. To sweep up, set the stop frequency higher than the start frequency. To sweep down, set the start frequency higher than the stop frequency.
4. Choose Linear or Logarithmic spacing using the SOURce[1]:SWE:SPAC command.
5. Choose the sweep time (rate) using the SOURce[1]:SWE:TIME command.
6. Select an internal or external sweep trigger source using the SOURce[1]:SOUR command.

SOURce[1]:SWEep:STATe

Set → / → Query

Description	Sets or disables Sweep mode. By default sweep is disabled. Sweep must be enabled before setting other parameters.	
Note	Any modes will be disabled if sweep mode is enabled.	
Syntax	**SOURce[1]:SWEep:STATe {OFF|ON}**	
Example	**SOUR1:SWE:STAT ON** Enables sweep mode.	
Query Syntax	**SOURce[1]:SWEep:STATe?**	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Query Example	**SOUR1:SWE:STAT?** **>1** Sweep mode is currently enabled.	

SOURce[1]:FREQuency:STARt

Set → / → Query

Description	Sets the start frequency of the sweep. 100Hz is the default start frequency.	
Note	To sweep up set the stop frequency higher than the start frequency. Set the stop frequency lower than the start frequency to sweep down.	
Syntax	**SOURce[1]:FREQuency:STARt {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	0.1Hz ~ 25MHz* 0.1Hz ~ 1MHz (Ramp)
	*AFG-2112 limited to 12MHz, AFG-2105 limited to 5MHz.	

Example	**SOUR1:FREQ:STAR +2.0000E+03** Sets the start frequency to 2kHz.	
Query Syntax	**SOURce[1]:FREQuency:STARt? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the start frequency in Hz.
Query Example	**SOUR1:FREQ:STAR? MAX** **>+2.0000E+07** Returns the maximum start frequency allowed.	

SOURce[1]:FREQuency:STOP

Set → Query

Description	Sets the stop frequency of the sweep. 1 kHz is the default start frequency.	
Note	To sweep up set the stop frequency higher than the start frequency. Set the stop frequency lower than the start frequency to sweep down.	
Syntax	**SOURce[1]:FREQuency:STOP {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	0.1Hz ~ 25MHz* 0.1Hz ~ 1MHz (Ramp)
	*AFG-2112 limited to 12MHz, AFG-2105 limited to 5MHz.	
Query Example	**SOUR1:FREQ:STOP +2.0000E+03** Sets the stop frequency to 2kHz.	
Query Syntax	**SOURce[1]:FREQuency:STOP? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the stop frequency in Hz.
Example	**SOUR1:FREQ:STOP? MAX** **>+2.0000E+07** Returns the maximum stop frequency allowed.	

SOURce[1]:SWEep:SPACing

Set → Query

Description	Sets linear or logarithmic sweep spacing. The default spacing is linear.	
Syntax	**SOURce[1]:SWEep:SPACing {LINear|LOGarithmic}**	
Example	**SOUR1:SWE:SPAC LIN** Sets the spacing to linear.	
Query Syntax	**SOURce[1]:SWEep:SPACing?**	
Return Parameter	LIN	Linear spacing
	LOG	Logarithmic spacing
Query Example	**SOUR1:SWE:SPAC?** **>LIN** The spacing is currently set as linear.	

SOURce[1]:SWEep:TIME

Set → → Query

Description	Sets or queries the sweep time. The default sweep time is 1 second. This command is the equivalent to using the Rate function on the front panel.	
Note	The function generator automatically determines the number of frequency points that are used for the sweep based on the sweep time.	
Syntax	**SOURce[1]:SWEep:TIME {<seconds>|MINimum|MAXimum}**	
Parameter	<seconds>	1 ms ~ 500 s (equivalent to a rate of 1kHz ~ 2mHz)
Example	**SOUR1:SWE:TIME +1.0000E+00** Sets the sweep time to 1 second.	
Query Syntax	**SOURce[1]:SWEep:TIME? {<seconds>| MINimum|MAXimum}**	
Return Parameter	<NR3>	Returns sweep time in seconds.
Query Example	**SOUR1:SWE:TIME?** **>+2.0000E+01**	

Returns the sweep time (20 seconds).

SOURce[1]:SWEep:SOURce

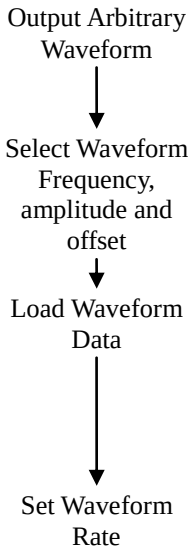
Set → / → Query

Description	Sets or queries the trigger source as immediate (internal) or external. Immediate (internal) is the default trigger source. IMMediate will constantly output a swept waveform. EXTernal will output a swept waveform after each external trigger pulse (TTL positive edge).
Note	If EXTernal is selected, the trigger period must be equal to or greater than the sweep time + 100nS.
Syntax	**SOURce[1]: SWEep:SOURce {IMMediate|EXTernal| MANual}**
Example	**SOUR1: SWE:SOUR EXT** Sets the sweep source to external.
Query Syntax	**SOURce[1]: SWEep:SOURce?**
Return Parameter	IMM Immediate EXT External
Query Example	**SOUR1:SWE:SOUR?** **>IMM** The sweep source is set to immediate.

任意波指令

任意波介紹

Use the steps below to output an arbitrary waveform over the remote interface.



1. Use the SOURce[1]:FUNCtion USER command to output the arbitrary waveform currently selected in memory.
2. Use the APPLy command to select frequency, amplitude and DC offset. Alternatively, the FUNC, FREQ, AMPl, and DCOffs commands can be used.
3. Waveform data (4k points per waveform) can be downloaded into volatile memory using the DATA:DAC command. Binary integer or decimal integer values in the range of ± 511can be used.
4. The waveform rate is the product of the number of points in the waveform and the waveform frequency.

   Rate = Frequency × # points

Range:	Rate:	0.1Hz ~ 20MHz
	Frequency:	0.1Hz ~ 10MHz
	# points:	2~4096

SOURce[1]:FUNCtion USER

Set → / → Query

Description	Use the SOURce[1]:FUNCtion USER command to output the arbitrary waveform currently selected in memory. The waveform is output with the current frequency, amplitude and offset settings. The query returns the current output.
Syntax	**SOURce[1]:FUNCtion USER**
Example	**SOUR1:FUNC USER** Selects and outputs the current waveform in memory.
Query Syntax	**SOURce[1]:FUNCtion?**
Return Parameter	SIN Sine wave SQU Square wave RAMP Ramp wave NOIS Noise wave ARB Arbitrary wave
Query Example	**SOURce[1]:FUNCtion?** **>SQU** A square waveform is the current output.

DATA:DAC

Set →

Description	The DATA:DAC command is used to download binary or decimal integer values into memory using the IEEE-488.2 binary block format or as an ordered list of values. After the values have been downloaded into memory the SOURce[1]:FUNCtion USER command can be used to output the ARB waveform in memory.
Note	The integer values (±511) correspond to the maximum and minimum peak amplitudes of the waveform. For instance, for a waveform with an amplitude of 5Vpp (0 offset), the value 511 is the equivalent of 2.5 Volts and -511 is the equivalent of -2.5V. If the integer values do not span the full output range, the peak amplitude will

be limited.

The IEEE-488.2 binary block format is comprised of three parts:



a.	Initialization character (#)
b.	Digit length (in ASCII) of the number of bytes
c.	Number of bytes

IEEE 488.2 binary block format uses two bytes to represent waveform data (16 bit integer). Therefore the number of bytes is always twice the number of data points. In the example above, the data block represents 8 data points.

Syntax

DATA:DAC VOLATILE, <start>，{<binary block>|<value>, <value>, . . . }

Parameter

<start>	Start address of the arbitrary waveform
<binary block>	Points 2~4096 in binary block format
<value>	Decimal or integer values ±511

Example1

DATA:DAC VOLATILE, 1000, #216 Binary Data

The command above downloads 8 integer points stored in 16 bytes to memory 1000 using the binary block format.

Example2

DATA:DAC VOLATILE, 1000, 511, 206, 0, -206, -511,
-206, 0, 206

The command above downloads the data values (511, 206, 0, -206, -511, -206, 0, 206) to address 1000 using the ordered list method.

存儲和調取指令

Up to 10 different instrument states can be stored to non-volatile memory (# 0~9) and up to 10 different ARB waveforms can be saved to memory locations 10~19.

*SAV

Set →

Description	Saves the current instrument state to a specified save location or an ARB waveform to the specified location. When a state is saved, all the current instrument settings, functions, modulation parameters and waveforms are also saved. Memory locations 0~9, save the instrument state only, whilst memory locations 10~19 save ARB data.	
Note	The *RST command will not delete saved instrument states from memory.	
Syntax	***SAV {NR1}**	
Parameter	0~9	Save state
	10~19	Save ARB data
Example	***SAV 0** Save the instrument state to memory location 0.	

*RCL

Set →

Description	Recall previously saved instrument states from memory locations 0~9 or recall the previously saved ARB waveforms from memory locations 10~19.	
Syntax	***RCL {NR1}**	
Parameter	0~9	Recall state
	10~19	Recall ARB data
Example	***RCL 0**	

Recall the instrument state from memory location 0 (assuming location 0 has been previously saved).

附錄

錯誤資訊

AFG-2000 具備若干錯誤代碼。一旦信號發生器設置錯誤，螢幕立刻提示錯誤資訊。

介面錯誤資訊

錯誤代碼	描述
E01	Frequency forced duty cycle change.
E02	Frequency reduced for ramp function
E03	Frequency made compatible with FM
E04	Frequency made compatible with FSK
E05	Frequency made compatible with Sweep
E06	Mod function cannot be performed under current setting
E07	Frequency over range
E08	Frequency over resolution
E09	Amplitude over range
E10	Amplitude over resolution
E11	Offset over range
E12	Offset over resolution
E13	Duty over range
E14	Duty over resolution
E15	ARB frequency over range
E16	ARB frequency over resolution

E17	ARB rate over range
E18	ARB rate over resolution
E19	ARB point over range
E20	ARB point over resolution
E21	ARB value over range
E22	ARB value over resolution
E23	Mod rate over range
E24	Mod rate over resolution
E25	Mod sym over range
E26	Mod sym over resolution
E27	AM depth over range
E28	AM depth over resolution
E29	FM deviation over range
E30	FM deviation over resolution
E31	FSK hop frequency over range
E32	FSK hop frequency over resolution
E33	Sweep frequency over range
E34	Sweep frequency over resolution
E35	Sweep rate over range
E36	Sweep rate over resolution
E37	Save setting over setting number range
E38	Recall setting over setting number range
E39	Recall set has no data
E40	Value over resolution
E41	Queue overflow

AFG-2000 系列規格

此規格適用條件：+20℃~+30℃ 操作環境下，開機 30 分鐘以上。

AFG-2000 型號		2005	2012	2025	2105	2112	2125
波形		正弦波, 方波, 三角波, 雜訊波, ARB					
任意波功能							
	取樣速率	20 MSa/s					
	重建率	10MHz					
	波形長度	4k 點					
	幅值解析度	10 bits					
	非易失性記憶體	4k 點					
頻率特性							
範圍	正弦波	0.1Hz~ 5MHz	0.1Hz~ 12MHz	0.1Hz~ 25MHz	0.1Hz~ 5MHz	0.1Hz~ 12MHz	0.1Hz~ 25MHz
	方波	0.1Hz~ 5MHz	0.1Hz~ 12MHz	0.1Hz~ 25MHz	0.1Hz~ 5MHz	0.1Hz~ 12MHz	0.1Hz~ 25MHz
	三角波, 斜波	1MHz					
解析度		0.1Hz					
精確度	穩定度	±20 ppm					
	老化率	±1 ppm/1 year					
	容差	≤ 1 mHz					
輸出特性							
幅值	範圍	1 mVpp~10 Vpp (接 50Ω) 2 mVpp~20 Vpp (開路) 20MHz-25MHz，1 mVpp~5 Vpp (接 50Ω) 20MHz-25MHz，2 mVpp~10 Vpp (開路)					
	精確度	± 2%設置值±1 mVpp (在 1 kHz)					
	解析度	1 mV 或 3 digits					
	平坦度	± 1% (0.1dB) ≤100kHz ± 3% (0.3 dB) ≤5MHz ± 5% (0.4 dB) ≤12MHz ±20%(2dB) ≤20MHz ± 5% (0.4 dB) ≤25MHz (正弦波 1 kHz)					
	單位	Vpp, Vrms, dBm					
偏移	範圍	±5 Vpk ac +dc (接 50Ω) ±10Vpk ac +dc (開路) 20MHz-25MHz，±2.5 Vpk ac +dc (接 50Ω) 20MHz-25MHz，±5Vpk ac +dc (開路)					

	精確度	2%設置值 + 5 mV+ 0.5%幅值
波形輸出	阻抗	50Ω 典型值(固定) > 300kΩ (輸出關閉)
	衰減器	—
	保護	短路保護 超載繼電器自動禁用主輸出
SYNC 輸出	准位	TTL-compatible into>1kΩ
	阻抗	50Ω 正常值
	扇出	—
	上升/下降時間	≤ 25ns
正弦波特性		
	諧波失真	–55 dBc DC ~ 200kHz, Ampl > 0.1Vpp –50 dBc 200kHz ~ 1MHz, Ampl > 0.1Vpp –35 dBc 1MHz ~ 5MHz, Ampl > 0.1Vpp –30 dBc 5MHz ~ 25MHz, Ampl > 0.1Vpp
方波特性		
	上升/下降時間	最大輸出處 ≤25ns (接 50 Ω 負載)
	過激信號	<5%
	不對稱性	1%週期 +1 ns
	可變占空比	1.0%~99.0% ≤100kHz 20.0%~80.0% ≤ 5MHz 40.0%~60.0% ≤ 10MHz 50% ≤ 25MHz
三角波特性		
	線性度	< 0.1%峰值輸出
	可變對稱性	0%~100% (0.1%解析度)
AM 調製		
	載波波形	— 正弦波, 方波, 三角波
	調製波形	— 正弦波, 方波, 三角波
	調製頻率	— 2mHz~20kHz (Int) DC~20kHz (Ext)
	深度	— 0%~120.0%
	調製源	— 內部/外部
FM 調製		
	載波波形	— 正弦波, 方波, 三角波
	調製波形	— 正弦波, 方波, 三角波
	調製頻率	— 2mHz~20kHz (Int) DC~20kHz (Ext)

	峰值偏移	—	DC~最大頻率
	調製源	—	內部/外部
掃描			
	波形	—	正弦波, 方波, 三角波
	類型	—	線性或對數
	起始/停止頻率	—	0.1Hz~最大頻率
	掃描時間	—	1ms~500s
	掃描源	—	內部/外部
FSK			
	載波波形	—	正弦波, 方波, 三角波
	調製波形	—	占空比為 50%的方波
	調製頻率	—	2mHz~100 kHz (INT) DC~100 kHz(EXT)
	頻率範圍	—	0.1Hz~最大頻率
	源	—	內部/外部
計頻器			
	範圍	—	5Hz~150MHz
	精確度	—	時基精確度±1count
	時基	—	熱機 30 分鐘後，±20ppm (23˚C ±5˚C)
	解析度	—	1Hz 的最大解析度為 100nHz，100MHz 的最大解析度為 0.1Hz
	輸入阻抗	—	1kΩ/1pf
	靈敏度	—	35mVrms ~ 30Vms (5Hz~150MHz)
存儲/調取		10 組設置存儲	
介面		USB (Device)	
顯示		LCD	
一般規格			
	電源	AC100~240V, 50~60Hz	
	功耗	25 VA (最大)	

操作環境	適合溫度: 18 ~ 28˚C 操作溫度: 0 ~ 40˚C 相對濕度: ≤ 80%, 0 ~ 40˚C ≤ 70%, 35 ~ 40˚C 安裝等級：CAT Ⅱ
海拔	2000m
存儲溫度	-10~70˚C, 濕度: ≤70%
尺寸(WxHxD)	266(W) x 107(H) x 293(D) mm
重量	約 2.5kg
附件	GTL-110× 1　　GTL-110× 2 快速入門指導×1 CD (使用手冊 + 軟體) ×1 電源線×1

EC Declaration of Conformity

We

GOOD WILL INSTRUMENT CO., LTD.
No.7-1, Jhongsing Rd., Tucheng Dist., New Taipei City 236, Taiwan

GOOD WILL INSTRUMENT (SUZHOU) CO., LTD.
No. 69, Lushan Road, Suzhou New District Jiangsu, China

declares that the below mentioned product

AFG-2005, AFG-2105, AFG-2012, AFG-2112, AFG-2025, AFG-2125

Are herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Law of Member States relating to Electromagnetic Compatibility (2004/108/EC) and Low Voltage Equipment Directive (2006/95/EC). For the evaluation regarding the Electromagnetic Compatibility and Low Voltage Equipment Directive, the following standards were applied:

◎ **EMC**

EN 61326-1 :	**Electrical equipment for measurement, control and laboratory use — EMC requirements (2006)**
Conducted and Radiated Emissions EN 55011: 2009+A1:2010	Electrostatic Discharge EN 61000-4-2: 2008
Current Harmonic EN 61000-3-2: 2006+A2:2009	Radiated Immunity EN 61000-4-3: 2006+ A2:2010
Voltage Fluctuation EN 61000-3-3: 2008	Electrical Fast Transients EN 61000-4-4: 2004+A1:2010
----------	Surge Immunity EN 61000-4-5: 2005
----------	Conducted Susceptibility EN 61000-4-6: 2008
----------	Power Frequency Magnetic Field EN 61000-4-8: 2009
----------	Voltage Dips/ Interrupts EN 61000-4-11: 2004

◎ **Safety**

Low Voltage Equipment Directive 2006/95/EC
Safety Requirements **EN 61010-1: 2010**

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