任意波形信号发生器

AFG-2000 系列

使用手册

固纬料号 **NO. 82AFB21200EA1**

ISO-9001 认证企业

GW INSTEK

目录

安全说明

本章节包含操作和存储信号发生器时必须遵照的重要安全说明。在操作前请详细阅读以下内容，确保安全和最佳化的使用。

安全符号

这些安全符号会出现在本使用手册或仪器上。

 警告	警告：产品在某一特定情况下或实际应用中可能对人体造成伤害或危及生命
 注意	注意：产品在某一特定情况下或实际应用中可能对产品本身或其它产品造成损坏
	高压危险
	注意: 请参考使用手册
	保护导体端子
	接地端子
	表面高温危险
	双层绝缘

勿将电子设备作为未分类的市政废弃物处理。请单独收集处理或联系设备供应商

安全指南

通常 注意	• 勿将重物置于仪器上 • 勿将易燃物置于仪器上 • 避免严重撞击或不当放置而损坏仪器 • 避免静电释放至仪器 • 请使用匹配的连接线，切不可用裸线连接 • 若非专业技术人员，请勿自行拆装仪器 (测量等级) EN 61010-1:2010 规定了如下测量等级，AFG-2000系列属于等级II • 测量等级 IV：测量低电压设备电源 • 测量等级 III：测量建筑设备 • 测量等级 II： 测量直接连接到低电压设备的电路 • 测量等级 I： 测量未直接连接电源的电路
电源 警告	• 交流输入电压: 100 ~ 240V AC, 50 ~ 60Hz • 将交流电源插座的保护接地端子接地，避免电击触电
保险丝 警告	• 保险丝类型: F1A/250V. • 请专业技术人员更换保险丝 • 请更换指定类型和额定值的保险丝 • 更换前请断开电源插座和所有测试导线 • 更换前请查明保险丝的熔断原因
清洁仪器	• 清洁前先切断电源 • 以中性洗涤剂和清水沾湿软布擦拭仪器。不要直接将任何液体喷洒到仪器上 • 不要使用含苯，甲苯，二甲苯和丙酮等烈性物质的化学药品或清洁剂

操作环境	• 地点: 室内，避免阳光直射，无灰尘，无导电污染(下注)，避免强磁场 • 相对湿度: < 80% • 海拔: < 2000m • 温度: 0°C~40°C (污染等级) EN 61010-1:2010 规定了如下污染程度。AFG-2000 系列属于等级 2。 污染指“可能引起绝缘强度或表面电阻率降低的外界物质，固体，液体或气体(电离气体)”。 • 污染等级 1：无污染或仅干燥，存在非导电污染，污染无影响 • 污染等级 2：通常只存在非导电污染，偶尔存在由凝结物引起的短暂导电 • 污染等级 3：存在导电污染或由于凝结原因使干燥的非导电性污染变成导电性污染。此种情况下，设备通常处于避免阳光直射和充分风压条件下，但温度和湿度未受控制
存储环境	• 地点: 室内 • 相对湿度: < 70% • 温度: -10°C~70°C
处理 	勿将电子设备作为未分类的市政废弃物处理。请单独收集处理或联系设备供应商。请务必妥善处理丢弃的电子废弃物，减少对环境的影响

英制电源线

在英国使用信号发生器时，确保电源线符合以下安全说明。

注意：导线/设备连接必须由专业人员操作。

警告：此装置必须接地

重要：导线颜色应与下述规则保持一致：

绿色/黄色:	接地
蓝色:	零线
棕色:	火线(相线)

导线颜色可能与插头/仪器中所标识的略有差异，请遵循如下操作:

颜色为绿色/黄色的线需与标有字母“E”，或接地标志⏚，或颜色为绿色/黄绿色的接地端子相连。

颜色为蓝色的线需与标有字母“N”，或颜色为蓝色或黑色的端子相连。

颜色为棕色的线需与标有字母“L”或“P”，或者颜色为棕色或红色的端子相连。

若有疑问，请参照本仪器提供的用法说明或与经销商联系。

电缆/仪器需有符和额定值和规格的 HBC 保险丝保护：保险丝额定值请参照仪器说明或使用手册。如: 0.75mm^2 的电缆需要 3A 或 5A 的保险丝。保险丝型号与连接方法有关，大的导体通常应使用 13A 保险丝。

将带有裸线的电缆、插头或其它连接器与火线插座相连非常危险。若已确认电缆或插座存在危险，必须关闭电源，拔下电缆、保险丝和保险丝座。并且根据以上标准立即更换电线和保险丝。

产品介绍

本章节介绍了信号发生器的主要特点、外观以及一些基本功能的操作。详细内容见操作章节。

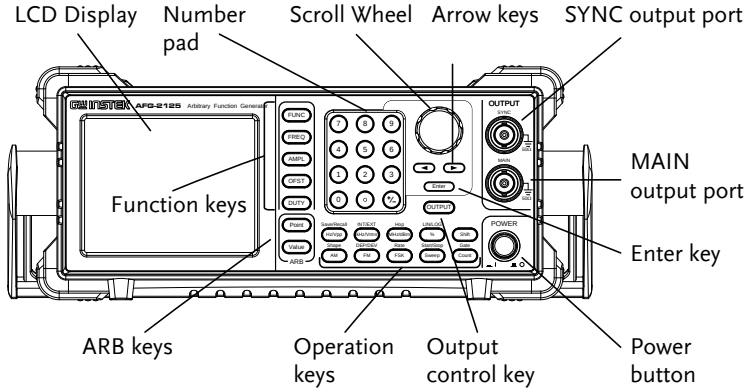
主要特点

型号	AFG-2005	AFG-2105	AFG-2012	AFG-2112	AFG-2025	AFG-2125
频率范围	0.1Hz~5MHz		0.1Hz~12MHz		0.1Hz~25MHz	
输出波形	正弦波, 方波, 三角波, 噪声波, ARB					
幅值范围	0.1Hz~20MHz 1 mVpp~10 Vpp (接 50Ω) 2 mVpp~20 Vpp (开路)					
	20MHz~25MHz 1 mVpp~5 Vpp (接 50Ω) 2 mVpp~10 Vpp (开路)					
可调偏置	✓	✓	✓	✓	✓	✓
可调占空比	✓	✓	✓	✓	✓	✓
SYNC (TTL)输出	✓	✓	✓	✓	✓	✓
存储/调取	✓	✓	✓	✓	✓	✓
扫描操作	—	✓	—	✓	—	✓
AM	—	✓	—	✓	—	✓
FM	—	✓	—	✓	—	✓
FSK	—	✓	—	✓	—	✓
计频器	—	✓	—	✓	—	✓
ARB	✓	✓	✓	✓	✓	✓
USB 接口	✓	✓	✓	✓	✓	✓

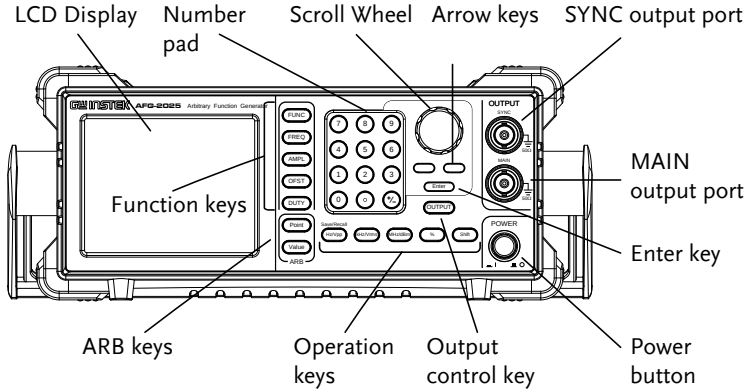
性能	• 使用 FPGA 的 DDS 技术提供高分辨率波形 • 25MHz DDS (直接数字合成)信号输出系列 • 0.1Hz 分辨率 • 任意波形能力 20 MSa/s 采样率 10 MHz 重复率 4 k-点波形长度 10-bit 幅值分辨率 10 组 4k 波形存储器
特点	• 正弦波, 方波, 三角波, 噪声波 • Int/Ext AM, FM, FSK 调制 • 调制/扫描信号输出 • 存储/调取 10 组设置存储器 • 输出过载保护 • PC 软件编辑 ARB (任意波形)
接口	• USB 标准接口 • 3.5'' LCD

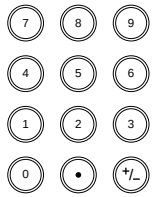
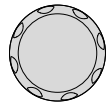
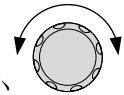
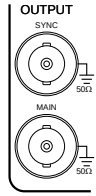
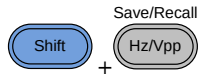
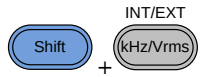
面板介绍

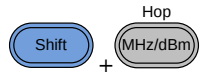
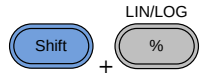
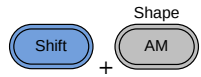
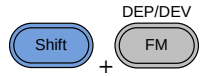
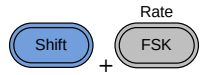
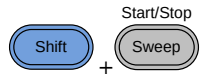
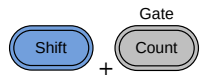
AFG-2105/2112/2125 前面板

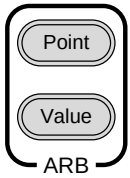


AFG-2005/2012/2025 前面板



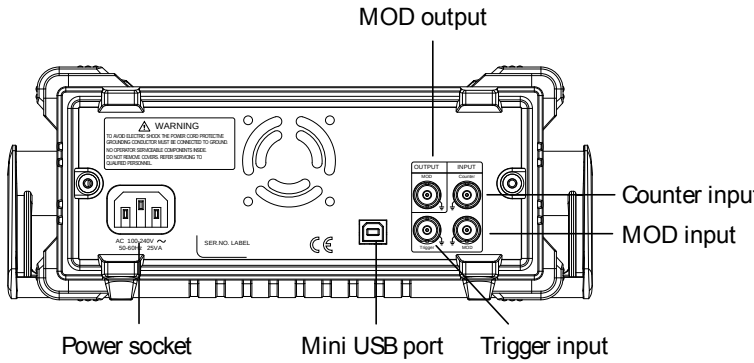
LCD display	3.5″, 三色 LCD 显示	
Keypad		用于输入数值和参数，常与方向键和可调旋钮一起使用
Scroll Wheel		用于编辑数值和参数，步进 1 位。与方向键一起使用  减小 增大
Arrow keys		编辑参数时，用于选择数位
Output ports		SYNC 输出端口(50Ω 阻抗) 主输出端口(50Ω 阻抗)
Enter key		用于确认输入值
Power button		启动/关闭仪器电源
Output control key		启动/关闭输出
Operation keys		选择单位 Hz 或 Vpp
		存储或调取波形
		选择单位 kHz 或 Vrms
		设置调制和 FSK 功能的内部源或外部源*

	选择单位 MHz 或 dBm
	设置 FSK 调制的“跳变”频率*
	选择单位%
	设置线性或对数扫描*
	用于选择操作键的第二功能
	AM 键用于启动/关闭 AM 调制*
	选择调制波形*
	FM 键用于启动/关闭 FM 调制*
	选择调制深度或频偏*
	选择 FSK 调制*
	设置 AM, FM, FSK 调制率和扫描率*
	选择扫描功能*
	设置起始或停止频率*
	启动/关闭计频器*
	设置计频器门限时间*

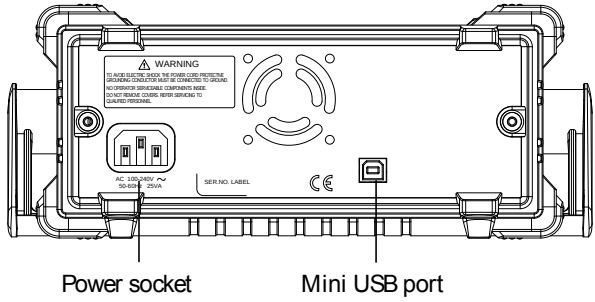
ARB edit keys		任意波形编辑键 Point 键设置 ARB 的点数 Value 键设置所选点的幅值
Function keys		FUNC 键用于选择输出波形类型: 正弦波, 方波, 三角波, 噪声波, ARB
		设置波形频率
		设置波形幅值
		OFST 设置波形的 DC 偏置
		设置方波和三角波的占空比

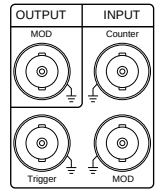
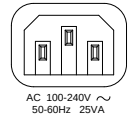
*功能/特点仅限 AFG-2105/2112/2125

AFG-2105/2112/2125 后面板

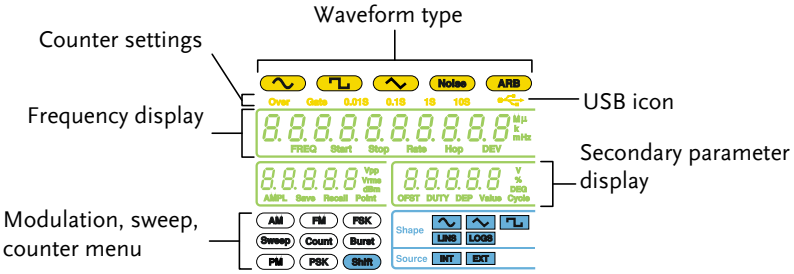


AFG-2005/2012/2025 后面板



MOD output		调制输出端口
Counter input		计频器输入端口
MOD input		调制输入端口
Trigger input		触发输入端口
Mini USB B port		与 PC 相连，用于远程控制
Power Socket Input		电源输入: 100~240V AC 50~60Hz

显示



Waveform type

按 Function 键循环显示不同输出波形

Counter settings

Over Gate 0.01S 0.1S 1S 10S

计频器门限时间设置*

USB icon

显示 USB 接口状态

Frequency Display

FREQ Start Stop Rate Hop DEV

显示主波形的频率设置

Secondary parameter display

AMPL Save Recall Point

OFST DUTY DEP Value Cycle

显示波形的第二参数和设置

Modulation, sweep, counter menu

AM FM FSK

Sweep Count Burst

PM PSK Shift

Shape LINS LOGS

Source INT EXT

显示调制、扫描和计频器功能以及调制波形和调制源*

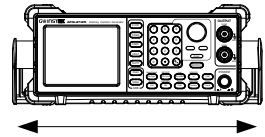
*功能/特点仅限 AFG-2105/2112/2125

设置信号发生器

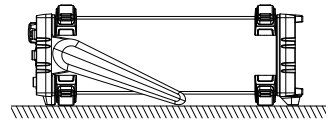
背景 本节介绍了如何调整信号发生器的把手以及如何开机。

调整把手

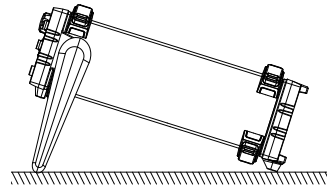
将把手拉至侧面并旋转



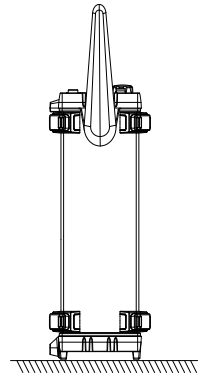
水平放置 AFG



或倾斜放置

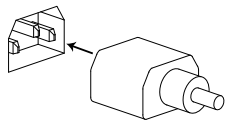


把手垂直放置以方便手提



开机

1. 将电源线接入后面板插座



2. 按下位于前面板的电源开关

3. 仪器启动并载入默认设置(见 31 页默认设置)

信号发生器准备就绪。

快速操作

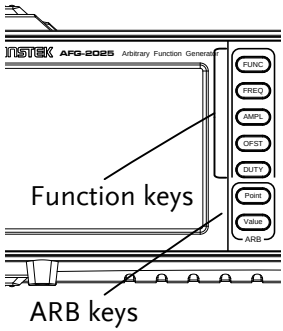
本章节介绍了 AFG-2000 的快捷方式和默认出厂设置，方便用户快速入门。参数、设置和限制的详情见操作章节(32 页)或规格(133 页)。

如何使用数字输入

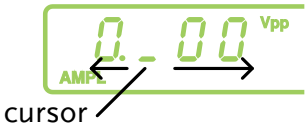
背景

AFG-2000 有三种主要的数字输入方法: 数字键盘, 方向键和可调旋钮。下面将为您介绍如何使用数字输入来编辑参数。

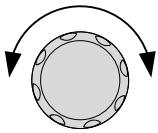
1. 首先按 Function 键或 ARB 键。该键变亮



2. 使用方向键将光标移至需要编辑的数位

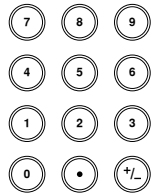


3. 使用可调旋钮编辑数值。
如，以 0.1V 步进增大参数值。
顺时针增大数值，逆时针减小数值



4. 按 Enter 键确认新参数值

5. 或者, 使用数字键设置参数值

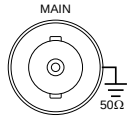


6. 选择数值单位 (Hz, kHz, MHz, Vpp, Vrms, dBm, %)

选择波形

正弦波

如: 正弦波, 10kHz, 1Vpp, 2Vdc



1. 重复按 **FUNC** 键选择正弦波

2. 按 **FREQ > 1 > 0 > kHz**

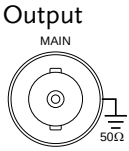
3. 按 **AMPL > 1 > Vpp**

4. 按 **OFST > 2 > Vpp**

5. 按 **OUTPUT** 键

方波

如: 方波, 10kHz, 3Vpp, 75% 占空比



1. 重复按 **FUNC** 键选择方波

2. 按 **FREQ > 1 > 0 > kHz**

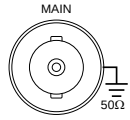
3. 按 **AMPL > 3 > Vpp**

4. 按 **DUTY > 7 > 5 > %**

5. 按 Output 键 

三角波

如: 三角波, 10kHz, 3Vpp, 25%对称性



1. 重复按 **FUNC** 键选择三角波 

2. 按 **FREQ > 1 > 0 > kHz** 

3. 按 **AMPL > 3 > Vpp** 

4. 按 **DUTY > 2 > 5 > %** 

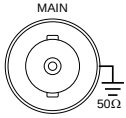
5. 按 **OUTPUT** 键 

ARB

ARB – 点

如: 2 ARB 点, 10 kHz, 1Vpp

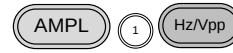
Output



1. 重复按 **FUNC** 键选择 ARB 波

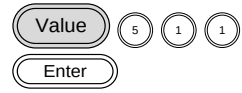
2. 按 **FREQ > 1 > 0 > kHz**

3. 按 **AMPL > 1 > Vpp**



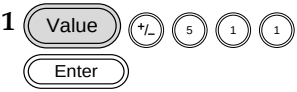
4. 按 **Point > 0 > Enter**

5. 按 **Value > 5 > 1 >1 > Enter**



6. 按 **Point > 1 > Enter**

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



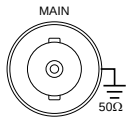
8. 按 **OUTPUT** 键

调制

AM (仅 2100 系列)

如: AM 调制。100Hz 调制方波。1 Vpp, 1kHz 正弦载波。70%调制深度。内部源。

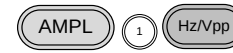
Output



1. 重复按 **FUNC** 键选择正弦波

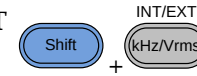
2. 按 **FREQ > 1 > kHz**

3. 按 **AMPL > 1 > Vpp**

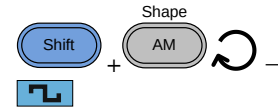


4. 按 **AM**

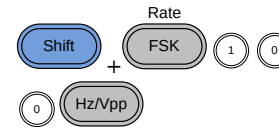
5. 按 **Shift > INT/EXT > 选择 INT** 源



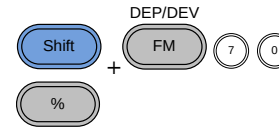
6. 重复按 **Shift > Shape** 选择 **Square wave**



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



8. 按 **Shift > DEP/DEV> 7 > 0 > %**

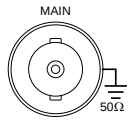


9. 按 **OUTPUT** 键

10. 再按 **AM** 取消 AM 功能

FM (仅 2100 系列)

如: FM 调制。100Hz 调制方波。1Vpp, 1kHz 正弦载波。100 Hz 频偏。内部源。



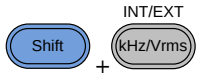
1. 重复按 **FUNC** 键选择正弦波

2. 按 **FREQ > 1 > kHz**

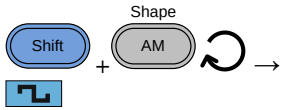
3. 按 **AMPL > 1 > Vpp**

4. 按 **FM**

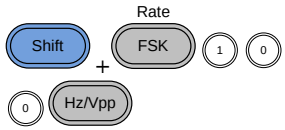
5. 按 **Shift > INT/EXT > 选择 INT** 源



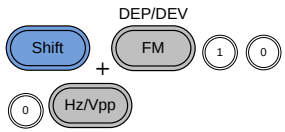
6. 重复按 **Shift > Shape** 选择 **Square wave**



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



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



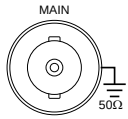
9. 按 **OUTPUT** 键 

10. 再按 **FM** 取消 FM 功能 

FSK 调制(仅 2100 系列)

如: FSK 调制。10Hz 跳变频率。1Vpp, 1kHz 三角波载波。100 Hz 频率(调制频率)。内部源。

Output

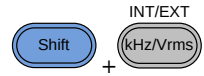


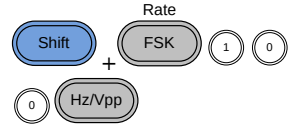
1. 重复按 **FUNC** 键选择三角波 

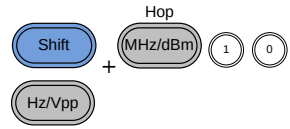
2. 按 **FREQ > 1 > kHz** 

3. 按 **AMPL > 1 > Vpp** 

4. 按 **FSK** 

5. 按 **Shift > INT/EXT > 选择 INT** 源 

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

7. 按 **Shift > Hop > 1 > 0 > Hz** 

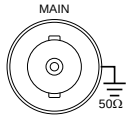
8. 按 **OUTPUT** 键 

9. 再按 **FSK** 取消 FSK 功能 

扫描(仅 2100 系列)

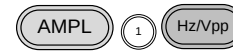
如: 频率扫描。起始频率 1Hz, 停止频率 1MHz。1Hz 频率。1Vpp。线性扫描。

Output



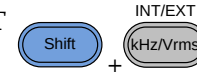
1. 重复按 **FUNC** 键选择三角波

2. 按 **AMPL > 1 > Vpp**

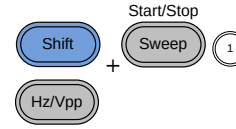


3. 按 **Sweep**

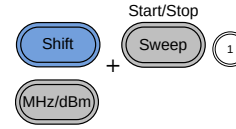
4. 按 **Shift > INT/EXT > 选择 INT** 源



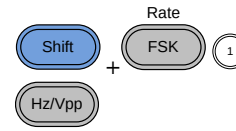
5. 按 **Shift > Start/Stop 选择 Start> 1 > Hz**



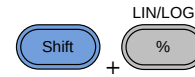
6. 按 **Shift > Start/Stop 选择 Stop> 1 > MHz**



7. 按 **Shift > Rate > 1 > Hz**



8. 按 **Shift > LIN/LOG > 选择 LINS**



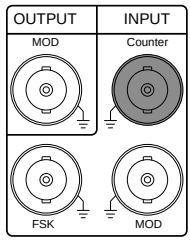
9. 按 **OUTPUT** 键

10. 再按 **Sweep** 取消扫描功能

计数器(仅 2100 系列)

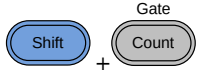
如: 计频功能, 门限时间 1s。

Input



1. 按 **Count** 键

2. 重复按 **Shift > Gate** 选择 **1S** 门限时间



3. 将信号接入计频器输入端

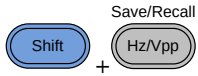
4. 再按 **Count** 取消计频功能

存储/调取

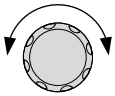
存储

如: 存储波形

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



2. 旋转可调旋钮，选择存储编号

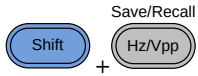


3. 按 **Enter** 确认

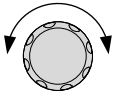
调取

如: 调取波形

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



2. 旋转可调旋钮，选择调取编号



3. 按 Enter 确认

默认设置

开机后显示默认设置。

输出设置	功能	正弦波
	频率	1kHz
	幅值	100mVpp
	偏置	0.00Vdc
	输出单位	Vpp
	输出端	50Ω
调制 (AM/FM/FSK)	载波	1kHz 正弦波
	调制波形	100Hz 正弦波
	AM 深度	100%
	FM 频偏	10Hz
	FSK 跳变频率	100Hz
	FSK 频率	500Hz
	调制状态	关闭
扫描	起始/停止频率	100Hz/1kHz
	扫描时间	1s
	扫描频率	100Hz
	扫描类型	线性
	扫描状态	关闭
系统设置	断电调用	启动
	显示模式	启动
	错误队列	已清除

	存储器设置(ARB)	无更改
	输出	关闭
接口设置	USB	CDC
校准	校准菜单	加密

操作

本章节介绍了如何输出基本波形以及创建 ARB 波形。AFG-2105/ 2112/2125 还可以完成如调制、扫描、FSK 和计频器等高端功能。

选择波形

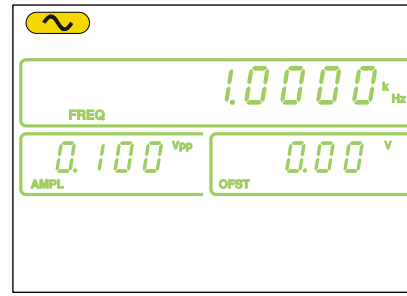
AFG-2000 可以输出 4 种标准波形: 正弦波, 方波, 三角波和噪声波。

正弦波, 方波, 三角波, 噪声波

面板操作

1. 重复按 **FUNC** 键选择标准波形(正弦波, 方波, 三角波, 噪声波)

如:
正弦波



注意 输出标准波形前，调制、FSK、扫描和计频功能不能使用。

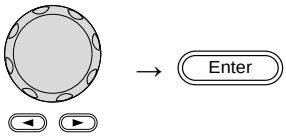
设置频率

面板操作

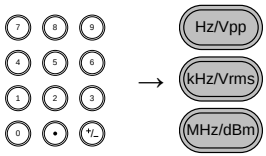
1. 按 **FREQ** 键

2. 频率显示区域 FREQ 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑频率



使用 **keypad** 和 **unit** 键输入新频率

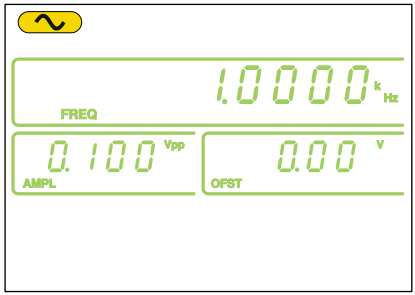


范围

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

AFG-2005/2105 为 5MHz, AFG-2012/2112 为 12MHz*

如:
FREQ = 1kHz



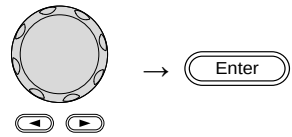
设置幅值

面板操作

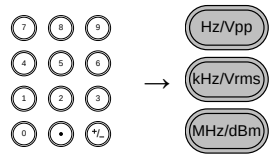
1. 按 **AMPL** 键

2. 第二显示区域 AMPL 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑幅值



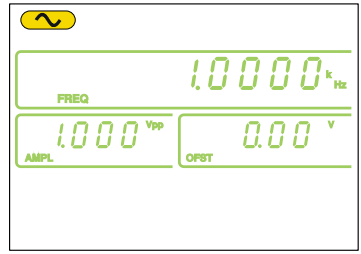
使用 **keypad** 和 **unit** 键输入新幅值



范围

空载	2mVpp~20Vpp 2mVpp~10Vpp (20MHz – 25MHz)
50Ω 负载	1mVpp~10Vpp 1mVpp~5Vpp (20MHz – 25MHz)

如:
AMPL= 1Vpp



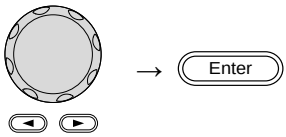
设置 DC 偏置

面板操作

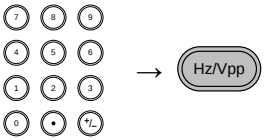
1. 按 **OFST** 键

2. 第二显示区域 OFST 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑偏置

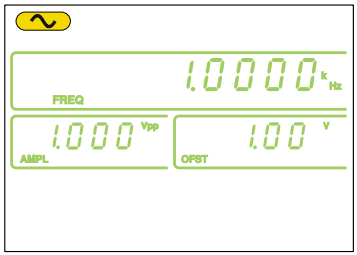


使用 **keypad** 和 **Vpp** 键输入新偏置



范围	空载 (AC+DC)	±10Vpk ±5 Vpk (20MHz–25MHz)
	50Ω 负载(AC+DC)	±5 Vpk ±2.5 Vpk (20MHz–25MHz)

如:
OFST= 1VDC



设置占空比/对称性

背景

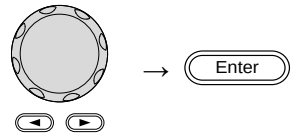
DUTY 键设置标准方波或三角波的占空比或对称性。

面板操作

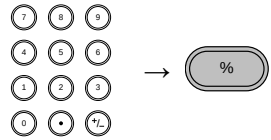
1. 选择一个方波或三角波 Page 35
2. 按 **DUTY** 键

3. 第二显示区域 DUTY 图标闪烁

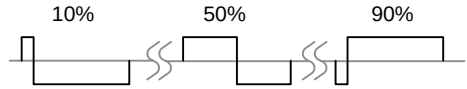
4. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑占空比/对称性



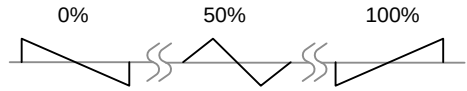
使用 **keypad** 和%键输入新的占空比/对称性



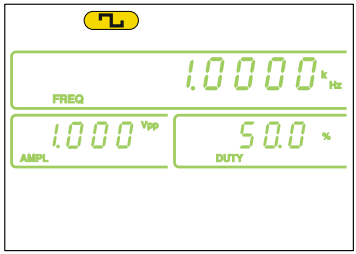
占空比范围	≤ 100kHz	1.0% ~ 99.9%
	≤ 5MHz	20.0% ~ 80.0%
	≤ 10MHz	40.0 ~ 60.0%
	≤ 25MHz	50.0% (fixed)



对称性范围	所有频率	0% ~ 100%



如:
DUTY= 50.0%



设置输出阻抗

背景

AFG-2000 的输出阻抗可设为 50Ω 或高阻。

当输出阻抗设为高阻时，有效输出是默认 50Ω 阻抗时的两倍。例如，当输出阻抗设为 50Ω 时，幅值为 10Vpp；当输出阻抗设为高阻时，幅值变为 20Vpp。

注意

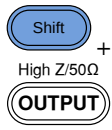
High-Z 输出阻抗不能使用 **dBm** 单位。

如果幅值单位设为 **dBm**，那么当输出阻抗设为 **High-Z** 时，幅值单位将自动切换成 **Vpp**。

如果输出阻抗设为 **High-Z**，则无法将幅值单位设成 **dBm**。必须首先将输出阻抗设回 **50Ω**。

面板操作

1. 按 **SHIFT+OUTPUT** 切换输出阻抗



2. 所选输出阻抗闪烁显示在屏幕上

50 Ω:

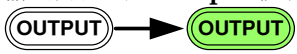
High-Z:

开启输出

面板操作

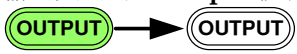
1. 按 **OUTPUT** 键输出所选波形

输出开启时，**Output** 按键灯变亮。



2. 再按 **OUTPUT** 键关闭输出

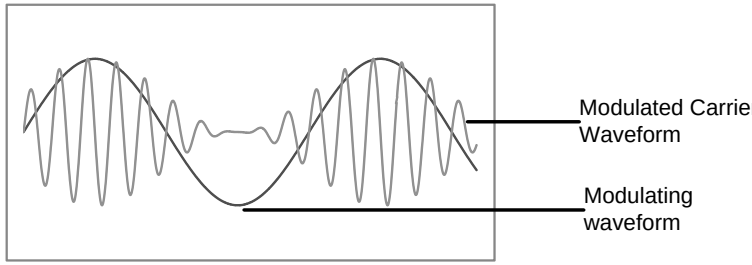
输出关闭时，**Output** 按键灯关闭。



幅值调制(AM)
(AFG-2100 系列)

AM 波形由载波和调制波组成。载波幅值与调制波幅值有关。AFG-2100 信号发生器可以设置载波频率、幅值、偏置电压以及内部或外部调制源。

AM 调制仅适合 AFG-2105, AFG-2112 和 AFG-2125 信号发生器。

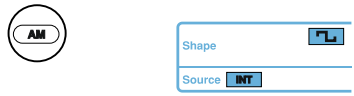


选择 AM 调制

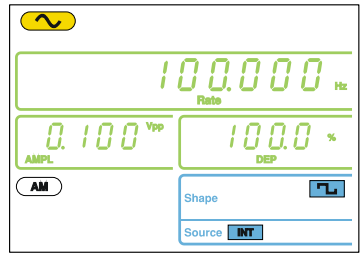
面板操作

1. 按 **AM** 键

2. 屏幕显示调制、扫描和计数菜单。AM 符号代表已激活 AM 功能



如:
AM activated



注意	再按 AM 键取消 AM 调制。

AM 载波波形

背景

FUNC 键选择 AM 载波波形：正弦波、方波或三角波。默认情况为正弦波。噪声波不能作为载波波形使用。选择载波波形前，请先选择 AM 模式，见 43 页。

选择载波波形

1. 重复按 **FUNC** 键选择载波波形(正弦波, 方波, 三角波)

范围	AM 载波波形	正弦波, 方波, 三角波

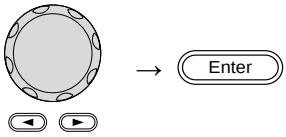
设置载波频率

面板操作

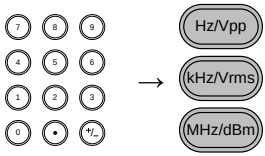
1. 按 **FREQ** 键

2. 频率显示区域 FREQ 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑频率

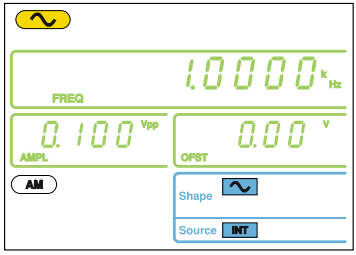


使用 **keypad** 和 **unit** 键输入新频率



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

如:
FREQ = 1kHz



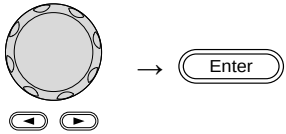
设置载波幅值

面板操作

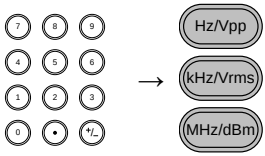
1. 按 **AMPL** 键

2. 第二显示区域 AMPL 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑幅值

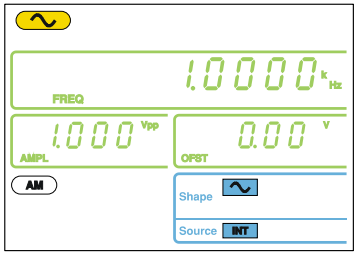


使用 **keypad** 和 **unit** 键输入新幅值



范围	空载	2mVpp~20Vpp 2mVpp~10Vpp for 20MHz – 25MHz
	50Ω 负载	1mVpp~10Vpp 1mVpp~5Vpp for 20MHz – 25MHz

如:
AMPL= 1Vpp

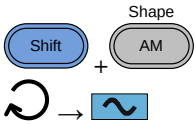


设置调制波形

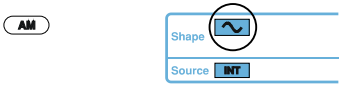
AFG-2100 的调制波形包括正弦波, 方波和三角波。默认波形为正弦波。

面板操作

1. 重复按 **Shift + Shape** 键选择波形



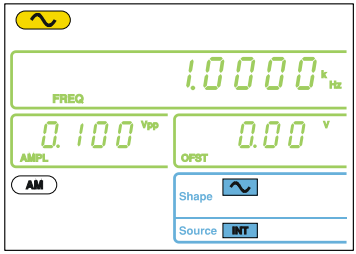
2. 面板底部显示蓝色波形



限定

方波	50%占空比
三角波	50%对称性

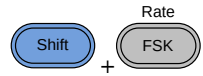
如:
Shape = Sine



设置调制频率(Rate)

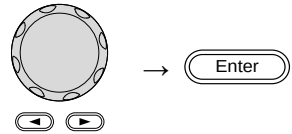
面板操作

1. 按 **Shift + Rate** 键

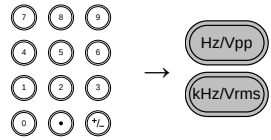


2. 频率显示区域 Rate 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑调制频率

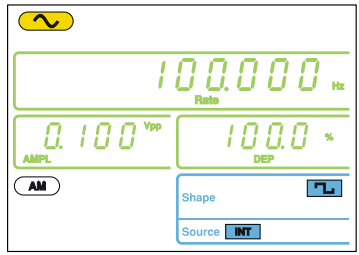


使用 **keypad** 和 **unit** 键输入新的调制频率



范围	(内部源)	2mHz ~ 20kHz
	默认值	100Hz

如:
Rate= 100Hz

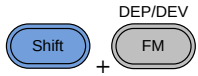


调制深度

调制深度为未调载波幅值与调制波形最小幅值偏差的比值(以百分比显示)。换句话说， 调制深度就是调制波形与载波波形的最大幅值之比。

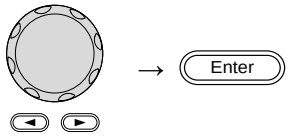
面板操作

1. 按 **Shift + DEP/DEV** 键

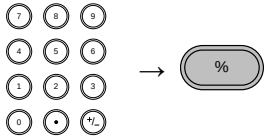


2. 第二显示区域 DEP 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑调制深度

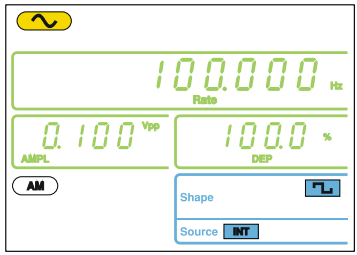


使用 **keypad** 和%键输入新的调制深度



范围	深度	0% ~ 120%
	默认值	100%

如:
DEP= 100%

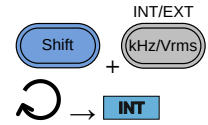


⚠注意	调制深度大于 100%时，输出峰值电压不超过±5V (50Ω 负载)。 如果选择外部调制源, 那么调制深度将由后面板 MOD INPUT 上的± 5V 信号电压控制。例如, 如果调制深度设置为 100%, 那么最大幅值为+5V, 最小幅值为-5V。

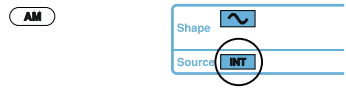
设置调制源

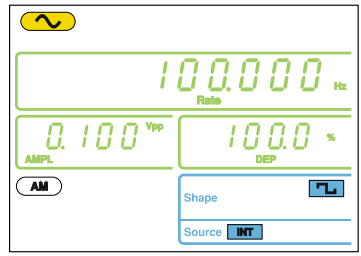
面板操作

1. 按 **Shift + INT/EXT** 键选择调制源

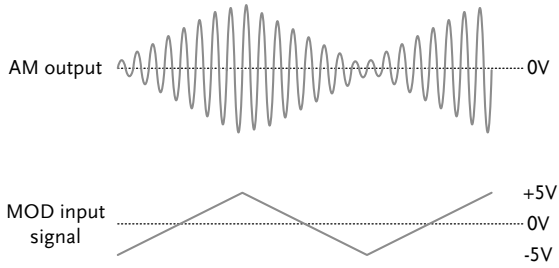


2. 屏幕底部显示所选调制源



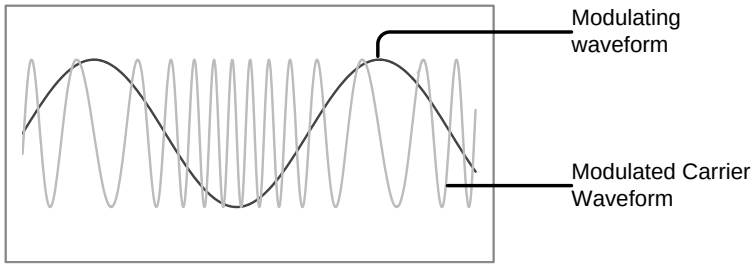
⚠注意	如果选择外部调制源, 那么调制深度将由后面板 MOD INPUT 上的± 5V 信号电压控制。例如, 如果调制深度设置为 100%, 那么最大幅值为 +5V, 最小幅值为-5V。
如: Source = INT	

如: 外部 MOD 输入信号



频率调制(FM)
(AFG-2100 系列)

FM 波形由载波和调制波组成。载波的瞬时频率随调制波形的幅值而变化。FM 调制仅限于 AFG-2105, AFG-2112 和 AFG-2125。



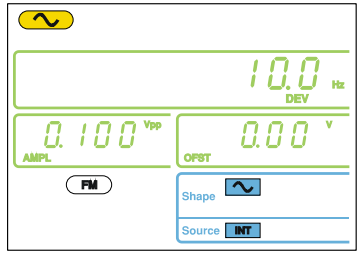
选择 FM 调制

面板操作

1. 按 **FM** 键

2. 屏幕显示调制、扫描和计数菜单。FM 图标表示已激活 FM 功能

如:
FM activated



注意 再按 FM 键取消 FM 调制

FM 载波波形

背景 FUNC 键选择 FM 载波，包括正弦波(默认载波)、方波或三角波。噪声波不能作为载波使用。选择载波前请激活 FM 功能，见 51 页。

选择载波波形

1. 重复按 **FUNC** 键选择载波波形(正弦波, 方波, 三角波)

范围	FM 载波波形	正弦波, 方波, 三角波

设置载波频率

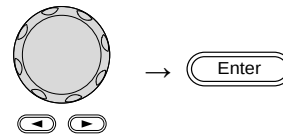
背景 使用 AFG-2100 信号发生器时，载波频率必须大于等于频偏。

面板操作

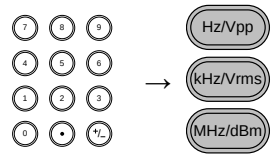
1. 按 **FREQ** 键

2. 频率显示区域 FREQ 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑载波频率



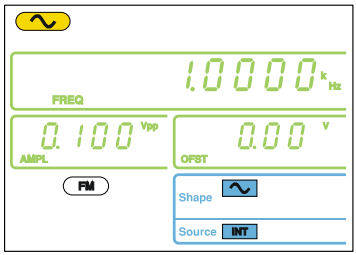
使用 **keypad** 和 **unit** 键输入新的载波频率



范围	正弦波	0.1Hz ~ 25MHz*

	方波	0.1Hz ~ 25MHz*
	三角波	0.1Hz ~ 1MHz
	AFG-2105 为 5MHz, AFG-2112 为 12MHz*	

如:
FREQ = 1kHz



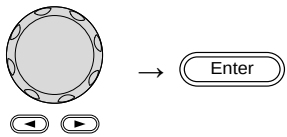
设置载波幅值

面板操作

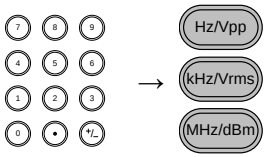
1. 按 **AMPL** 键

2. 第二显示区域 AMPL 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑幅值

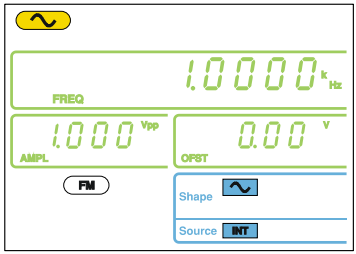


使用 **keypad** 和 **unit** 键输入新幅值



范围	空载	2mVpp~20Vpp 2mVpp~10Vpp (20MHz – 25MHz)
	50Ω 负载	1mVpp~10Vpp 1mVpp~5Vpp (20MHz – 25MHz)

如:
AMPL= 1Vpp

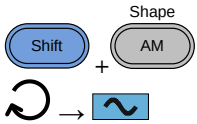


设置调制波形

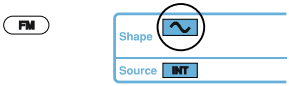
AFG-2100 的调制波形包括正弦波(默认波形)、方波和三角波。调制波形仅用作内部源。

面板操作

1. 重复按 **Shift + Shape** 键选择波形

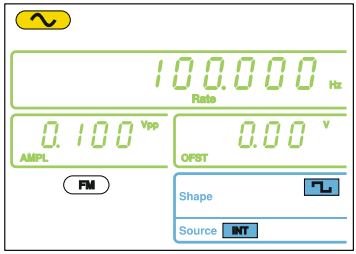


2. 面板底部显示蓝色波形



限定		
	方波	50%占空比
	三角波	50%对称性

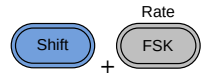
如:
Shape = Sine



设置调制频率(Rate)

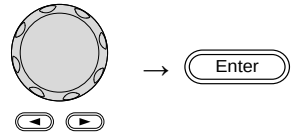
面板操作

1. 按 **Shift + Rate** 键

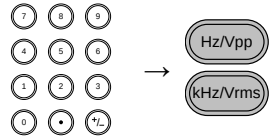


2. 频率显示区域 Rate 图标闪烁

3. 使用 **arrow keys, scroll wheel** 和 **Enter** 键编辑调制频率

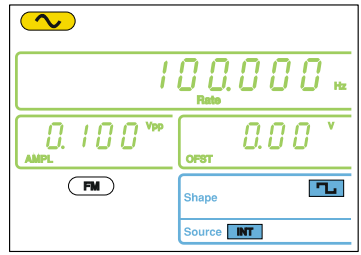


使用 **keypad** 和 **unit** 键输入新的调制频率



范围	(内部源)	2mHz ~ 20kHz
	默认值	100Hz

如:
Rate= 100Hz

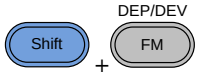


频偏

频偏是载波与调制波的最大频率偏差。

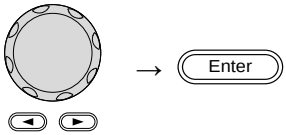
面板操作

1. 按 **Shift + DEP/DEV** 键

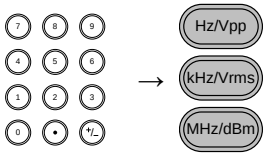


2. 频率显示区域 DEV 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑频偏



使用 **keypad** 和 **unit** 键输入新的频偏



范围		
	正弦波	DC ~ 25MHz*
	方波	DC ~ 25MHz*
	三角波	DC ~ 1MHz
	默认值	10Hz

AFG-2105 为 5MHz, AFG-2112 为 12MHz*

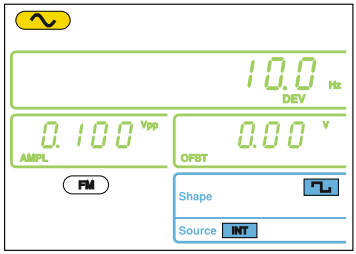
注意

频偏必须小于等于载波频率。

载波频率与频偏之和必须小于等于最大调制波频率。

载波频率限制允许的最大频偏。

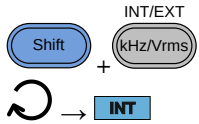
如:
DEV = 10Hz



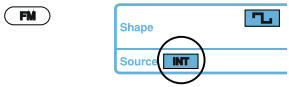
设置调制源

面板操作

1. 按 **Shift + INT/EXT** 键选择调制源



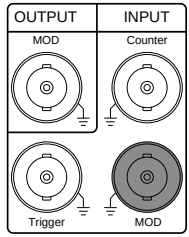
2. 屏幕底部显示所选调制源



范围	调制源	INT, EXT

连接
(仅 EXT 源)

对于外部源，将调制源信号连接至后面板 MOD 输入端子。

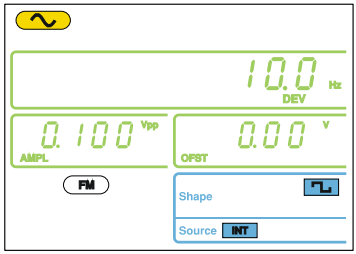


注意

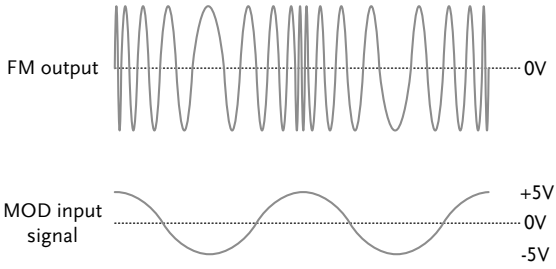
如果选择外部调制源, 那么频偏将由后面板 MOD INPUT 上的± 5V 信号电压控制。频偏与调制信号电平成比例。+5V 在载波频率上增加设置的频偏频率和 -5V 在载波频率上减少频偏频率.

例如: 如果频偏频率设为 1kHz, +5V 输入电压将使频率在载波频率上增加 1kHz, 而-5V 的输入电压将会使频率在载波频率上减少 1kHz。

如:
Source = INT



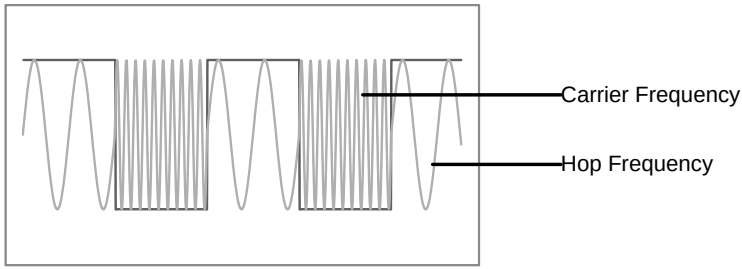
如: 外部 MOD 输入信号



频移键控(FSK)调制 (AFG-2100 系列)

FSK 调制用于在两个预设频率(载波频率和跳变频率)间交替输出频率。额定设置或后面板 Trigger 输入端上的电压准位决定交替频率。

FSK 调制仅限 AFG-2105, AFG-2112 和 AFG-2125。



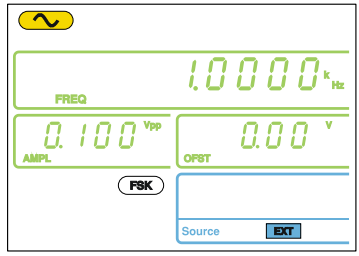
选择 FSK 调制

面板操作

1. 按 **FSK** 键

2. 屏幕显示调制、扫描和计数菜单。FSK 图标表示已激活 FSK 功能

如:
FSK activated



注意 再按 FSK 键取消 FSK 调制

FSK 载波波形

背景 FUNC 键选择 FSK 载波，包括正弦波(默认载波)、方波或三角波。噪声波和 ARB 不能作为载波使用。

选择载波

1. 重复按 **FUNC** 键选择载波波形(正弦波, 方波, 三角波)

范围 FSK 载波波形 正弦波, 方波, 三角波

FSK 载波频率

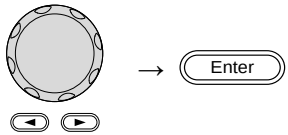
最大载波频率与载波波形有关。所有载波默认频率均为 1kHz。选择外部源时，Trigger 输入端信号的电压准位控制输出频率。Trigger 信号为逻辑低电平时，输出载波频率；信号为逻辑高电平时，输出跳变频率。

面板操作

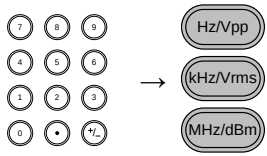
1. 按 **FREQ** 键

2. 频率显示区域 FREQ 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑频率



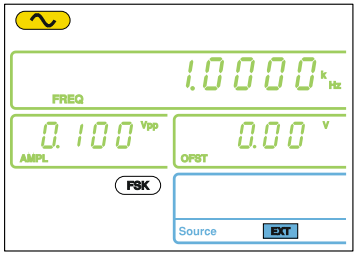
使用 **keypad** 和 **unit** 键输入新的载波频率



范围 正弦波 0.1Hz ~ 25MHz*

	方波	0.1Hz ~ 25MHz*
	三角波	0.1Hz ~ 1MHz
	*AFG-2105 为 5MHz, AFG-2112 为 12MHz	

如:
FREQ = 1kHz



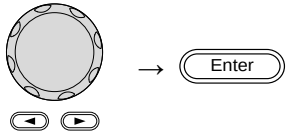
设置载波幅值

面板操作

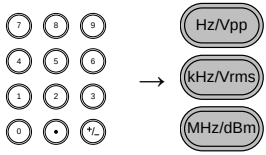
1. 按 **AMPL** 键

2. 第二显示区域 AMPL 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑幅值

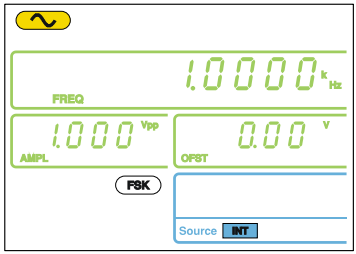


使用 **keypad** 和 **unit** 键输入新的载波幅值



范围	空载	2mVpp~20Vpp 2mVpp~10Vpp (20MHz – 25MHz)
	50Ω 负载	1mVpp~10Vpp 1mVpp~5Vpp (20MHz – 25MHz)

如:
AMPL= 1Vpp

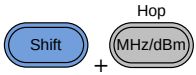


设置跳变频率

所有波形默认跳变频率均为 100 Hz。内部调制波是占空比为 50%的方波。选择外部源时，Trigger 输入端信号的电压准位控制输出频率。当 Trigger 输入信号为逻辑低电平时，输出载波频率；当信号为逻辑高电平时，输出跳变频率。

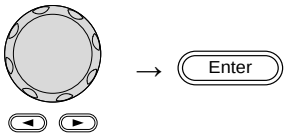
面板操作

1. 按 **Shift + Hop** 键

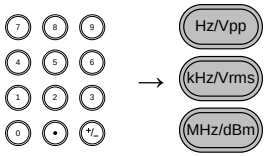


2. 频率显示区域 Hop 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑跳变频率



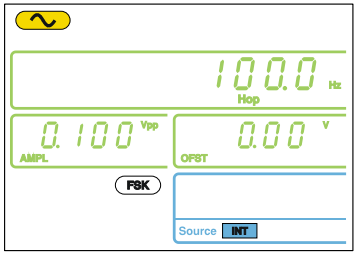
使用 **keypad** 和 **unit** 键输入跳变频率



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

	默认值	100Hz
	*AFG-2105 为 5MHz, AFG-2112 为 12MHz	

如:
Hop = 100Hz

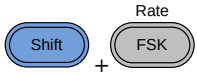


FSK 频率

FSK 频率是决定输出载波频率与跳变频率间变化的频率值。FSK 频率功能仅限于内部 FSK 源。

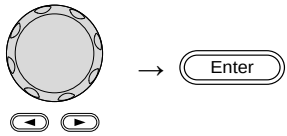
面板操作

1. 按 **Shift + Rate** 键

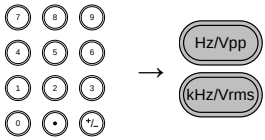


2. 频率显示区域闪 Rate 图标闪烁

3. 使用 **arrow keys, scroll wheel** 和 **Enter** 键编辑**频率**

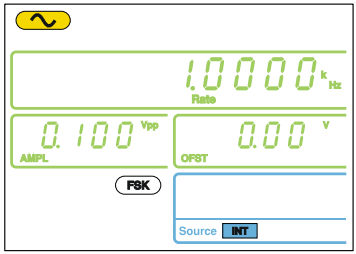


使用 **keypad** 和 **unit** 键输入新的 FSK 频率



范围	(内部源)	2mHz ~ 20kHz
	默认值	100Hz

如:
Rate= 1KHz

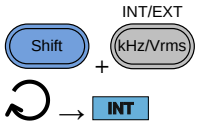


设置 FSK 源

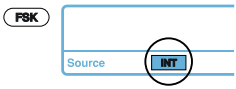
AFG-2000 接受内部(默认)和外部 FSK 源。当选择内部 FSK 源时，使用 FSK Rate 功能设置 FSK 频率。当选择外部源时，FSK 频率与后面板 Trigger 输入信号的频率一致。输入信号为逻辑低电平时，输出载波频率；信号为逻辑高电平时，输出跳变频率。

面板操作

1. 按 **Shift + INT/EXT** 键选择调制源



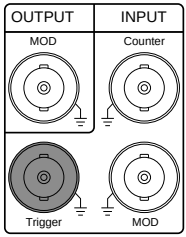
2. 屏幕底部显示所选 FSK 源



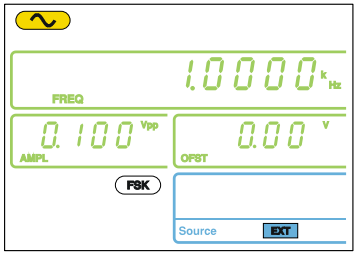
范围	调制源	INT, EXT

连接
(仅 EXT 源)

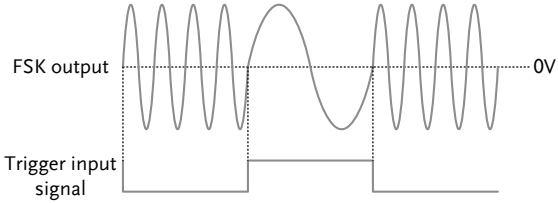
对于外部源，将 FSK 源信号连接至后面板 Trigger 输入端子。



如:
Source = EXT

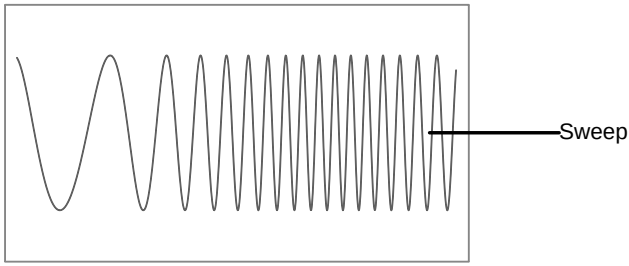


如: 外部触发输入信号



频率扫描
(AFG-2100 系列)

除噪声波和 ARB 外，信号发生器可以对正弦波、方波或三角波产生一个扫频。在扫描模式下，信号发生器以指定步进从起始频率到停止频率进行扫描。选择外部源时，只要 Trigger 输入端接收一个 TTL 准位脉冲，信号发生器就能输出一次扫描。您可以选择线性或对数间隔由高频向低频扫描，或由低频向高频扫描。扫描功能仅限于 AFG-2105, AFG-2112 和 AFG-2125。



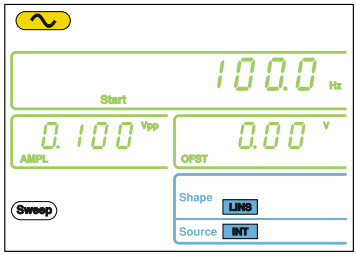
选择扫描

面板操作

1. 按 **Sweep** 键

2. 屏幕显示调制、扫描和计数菜单。Sweep 图标表示已激活扫描功能

如:
Sweep activated



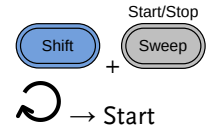
注意	再按 **Sweep** 键取消扫描调制

设置起始和停止频率

起始和停止频率限定了扫描的上下限。信号发生器从起始频率向停止频率扫描，然后又复位回起始频率。在整个扫描范围内，相位连续。

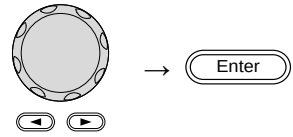
面板操作

1. 按 **Shift + Start/Stop** 键切换起始和停止频率。选择 **Start** 频率图标

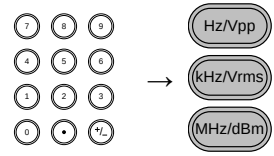


2. 选择后，频率显示区域 Start 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑起始频率



使用 **keypad** 和 **unit** 键输入新的起始频率



范围		
	正弦波	0.1Hz ~ 25MHz*
	方波	0.1Hz ~ 25MHz*
	三角波	0.1Hz ~ 1MHz
	默认值	起始: 100Hz, 停止: 1kHz
	*AFG-2105 为 5MHz, AFG-2112 为 12MHz	

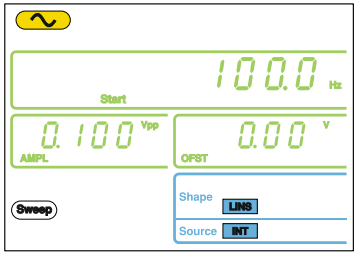
4. 停止频率设置重复步骤 1~3

注意

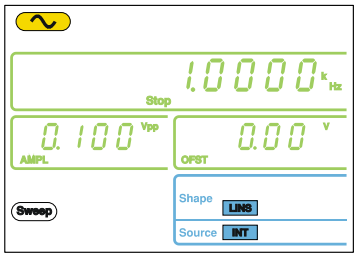
若起始频率 < 停止频率，扫描从低频向高频扫描

若起始频率 > 停止频率，扫描从高频向低频扫描

如:
Start = 100Hz



如:
Stop = 1kHz

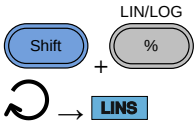


扫描模式

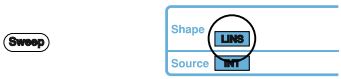
扫描模式可选择线性(默认设置)或对数扫描。

面板操作

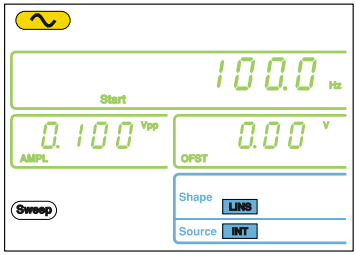
1. 按 **Shift + LIN/LOG** 键选择线性(LINS)或对数(LOGS)扫描



2. 屏幕底部显示 LINS 或 LOGS 图标



如:
Sweep = LINS

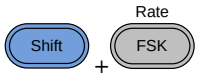


扫描频率

从起始到停止频率完成一次扫描所需的时间称为扫描频率。信号发生器自动限定扫描的离散频率点，该数目与扫描长度有关。

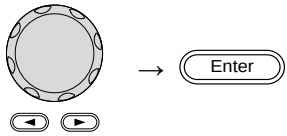
面板操作

1. 按 **Shift + Rate** 键

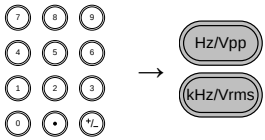


2. 频率显示区域 Rate 图标闪烁

3. 使用 **arrow keys**, **scroll wheel** 和 **Enter** 键编辑扫描频率

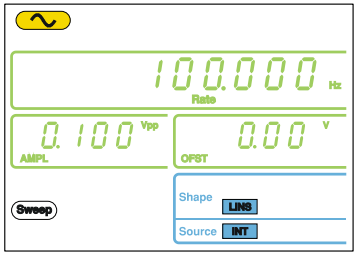


使用 **keypad** 和 **unit** 键输入新扫描频率



范围	扫描频率	1kHz ~ 2mHz (1ms ~ 500s)
	默认	100Hz

如:
Rate= 100Hz

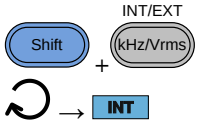


设置扫描源(触发)

若设为外部扫描源，信号发生器在收到触发信号后开始扫描，扫描完成后信号发生器输出起始频率，并等待下一次触发。默认内部触发源。

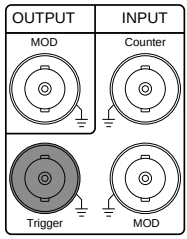
面板操作

1. 按 **Shift + INT/EXT** 键选择触发源

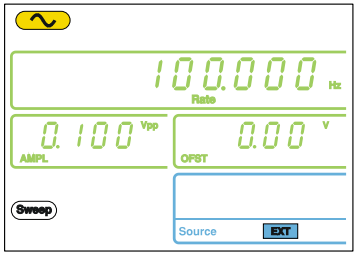


2. 屏幕底部显示触发源

范围	Source	INT, EXT
连接 (仅 EXT 源)	对于外部源，将扫描触发信号连接至后面板 Trigger 输入端子	



如:
Source = EXT

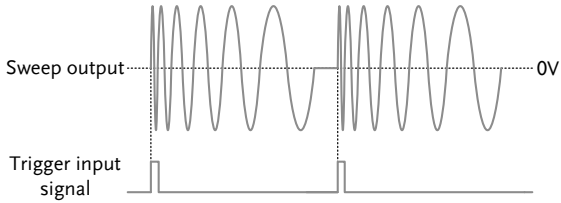


注意

选择外部源时，每收到一个从后面板 Trigger 输入端的触发脉冲(TTL)，信号发生器就输出一个扫描。

触发周期必须大于或等于扫描时间+100nS (触发脉冲宽度 > 100nS)。

如: 外部触发输入信号



创建任意波形

AFG-2000 和 AFG-2100 具备一个简单的任意波形编辑功能。ARB 功能提供 20MHz 采样率、4k 数据点以及±511 点的垂直范围。

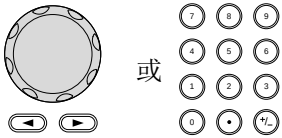
选择载波波形

1. 重复按 **FUNC** 键选择 ARB 功能

2. 按 **Point** 键

3. 第二显示区域 Point 闪烁

4. 使用 **scroll wheel** 或 **keypad** 选择数据点数



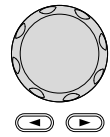
按 **Enter** 键确认

范围	点:	0 ~ 4096

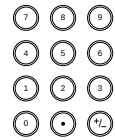
5. 按 **Value** 键

6. 第二显示区域 Value 闪烁

7. 使用 **scroll wheel** 或 **keypad** 选择点的垂直数值



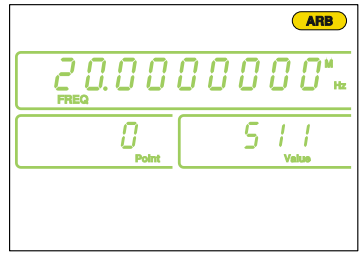
或



按 **Enter** 键确认

范围	值: ±511 (10-bit 垂直分辨率)

8. 重复 2~7 步设置 ARB 波形的其它点

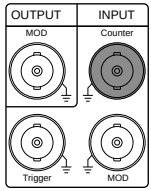
注意	波形点的水平位置与设置频率有关。例如, 如果设置频率为 1kHz (周期 = 1ms), 那么每点间隔 0.01ms (1ms/采样率)
如: Point “0” is set to +511.	
注意	存储 ARB 数据, 请见 80 页存储/调取章节

使用计频器

选择计频功能

连接

将信号源接入后面板的 Counter 输入端口

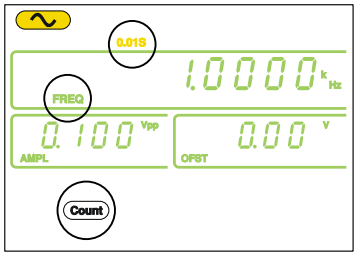


面板操作

1. 按 **Count** 键

2. 启动计频功能后，屏幕显示当前门限时间和 Count 图标。
   频率显示区域显示输入信号频率

如: 1kHz 输入频率



选择门限时间

面板操作

1. 启动 Count 功能

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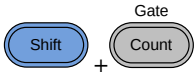
2. 重复按 **Shift + Gate** 键选择所需的门限时间



范围	门限时间	0.01s, 0.1s, 1s, 10s

3. 计数设置区域显示当前门限时间

使用 SYNC 输出端口

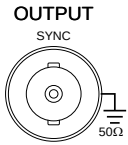
连接 SYNC 输出端口

背景

信号发生器的 SYNC 输出端口用于输出同步信号。除噪声输出外，所有的输出信号都能产生同步信号。

连接

使用 BNC 线将前面板的 SYNC 输出端与期望的输入设备相连



注意

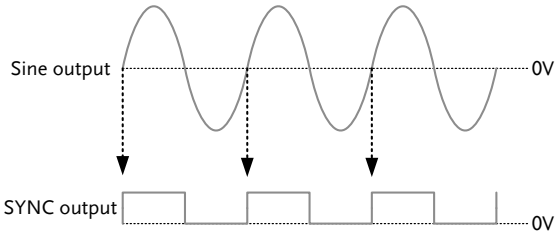
即使主输出关闭，仍输出 SYNC 信号

SYNC 输出信号

对于正弦波

SYNC 输出: TTL 方波，占空比 50%。当正弦波输出为正时，SYNC 输出逻辑高电平

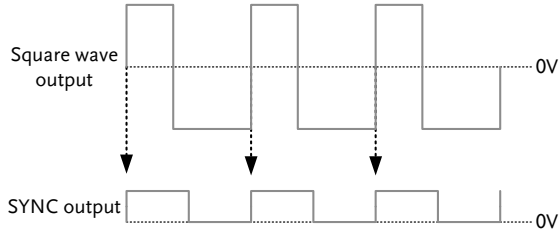
输出图



对于方波

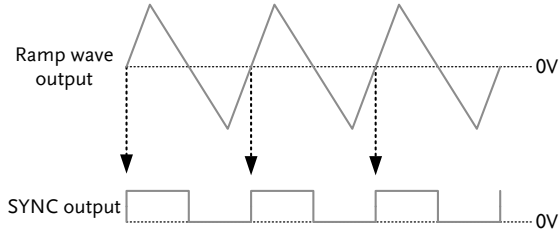
SYNC 输出: TTL 方波， 占空比与输出方波占空比一致。当方波输出为正时，SYNC 输出逻辑高电平

输出图



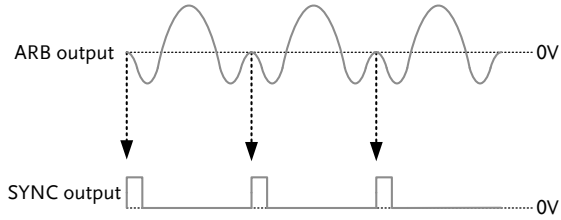
对于三角波　　SYNC 输出: TTL 方波，占空比 50%。当三角波输出为正时，SYNC 输出逻辑高电平

输出图



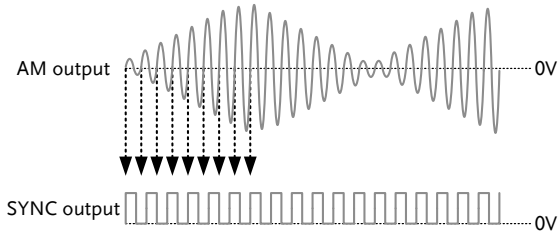
对于 ARB　　SYNC 输出: 在每个 ARB 周期的开始输出一个 TTL 正向脉冲(脉冲宽度 = 1/采样率)

输出图



对于 AM　　SYNC 输出: TTL 方波，占空比 50%。当调制输出为正时，SYNC 输出逻辑高电平

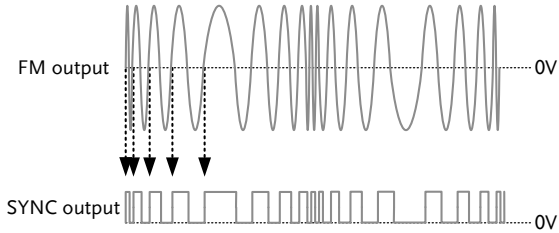
输出图



对于 FM

SYNC 输出: TTL 方波，占空比 50%。当调制输出为正时，SYNC 输出逻辑高电平(SYNC 输出与调制输出频率同步)

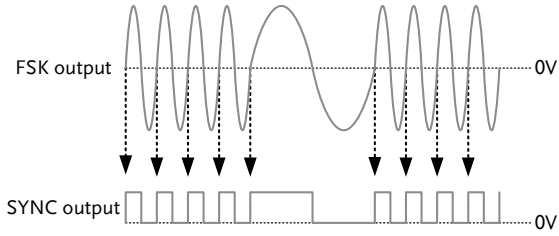
输出图



对于 FSK

SYNC 输出: TTL 方波，占空比 50%。当调制输出为正时，SYNC 输出逻辑高电平(SYNC 输出与调制输出频率同步)

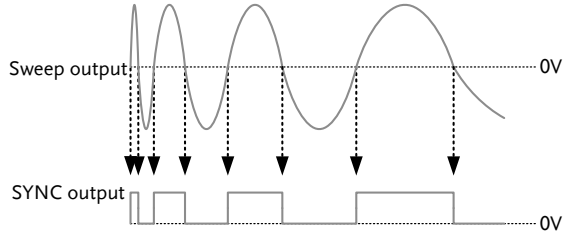
输出图



对于扫描

SYNC 输出: TTL 方波波形。当扫描输出为正时，SYNC 输出逻辑高电平(SYNC 输出与扫描输出频率同步)

输出图

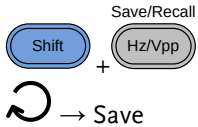


存储和调取状态/ARB 波形

AFG-2000 的非易失性存储器 可存储仪器状态和 ARB 数据。10 组仪器状态和 ARB 数据存储器，位置编号为 0~19。其中 0~9 存储器用于存储/调取仪器状态，10~19 存储器用于存储/调取 ARB 数据。
存储的仪器状态包括: 所选功能(含 ARB)、频率、幅值、DC 偏置、占空比/对称性以及所有的调制参数。

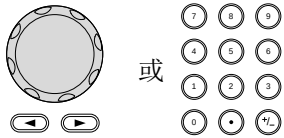
面板操作

1. 按 **Shift + Save/Recall** 键选择 **Save** (存储状态)或 **Recall** (调取状态)



2. 第二显示区域显示 Save 或 Recall

3. 使用 **scroll wheel** 或 **keypad** 选择存储/调取编号



使用 **Enter** 键存储/调取状态

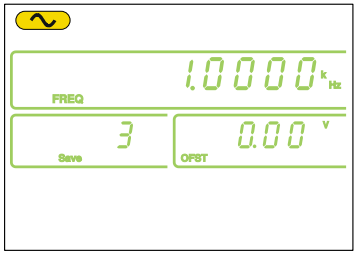
注意

仪器状态/ARB 数据能保存至 10 组中的 0~9/10~19 中任意一个存储位置。

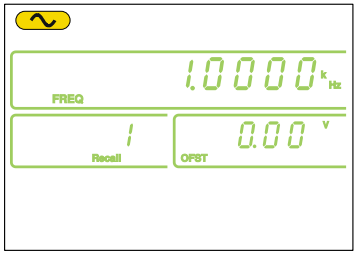
存储状态会覆盖掉同一位置先前保存的状态。调取 ARB 数据则重写当前状态。

存储位置仅可以调取。

如:
存储状态


1.0000 kHz
FREQ
3
Save
0.00 V
OFST

如:
调取状态


1.0000 kHz
FREQ
1
Recall
0.00 V
OFST

远程接口

选择 USB 远程接口

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 XXXXXX.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.

指令语法

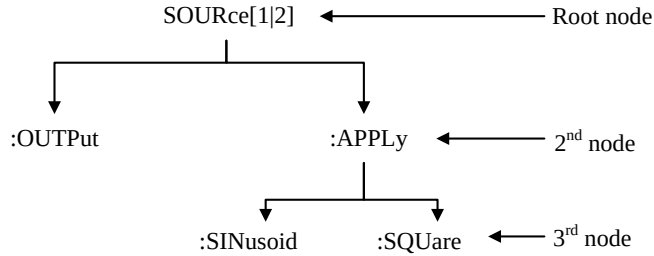
Compatible standard	• IEEE488.2, 1992 (fully compatible) • SCPI, 1994 (partially compatible)

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

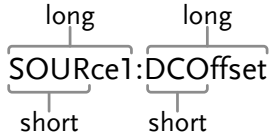
Commands can be separated into three distinct types, simple commands, compound commands and queries.

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.

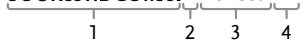


The commands can be written in capitals or lower-case, just so long as the short or long forms are complete. An incomplete command will not be recognized.

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> <depth in percent>	NRf type	N/A
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

指令列表

系统指令

*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**

状态寄存器指令

*CLS

Set →

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

应用指令

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.

输出指令

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

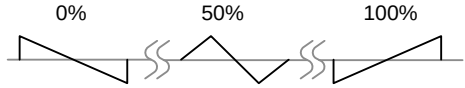
Set → Query

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

Set → Query

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

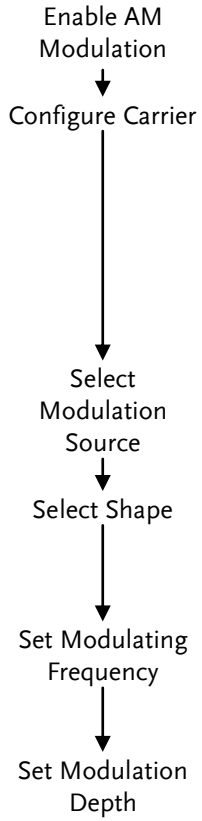
Description	Sets or queries the output amplitude units. There are three types of units: VPP, VRMS and DBM. The SOURce[1]:VOLTage:UNIT command does not set the offset units.
⚠ Note	The units set with the VOLTage:UNIT command will be used as the default unit for all amplitude units unless a different unit 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.	

幅值调制(AM)指令

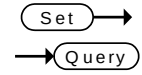
AM 介绍

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



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

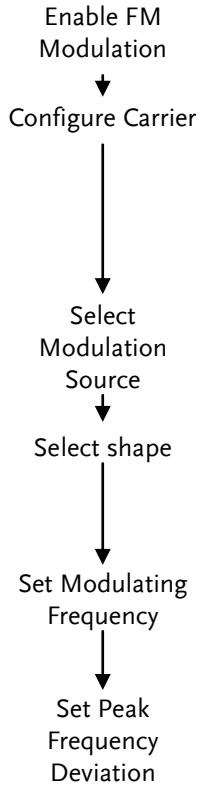
Set → Query

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%.

频率调制(FM)指令

FM 介绍

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

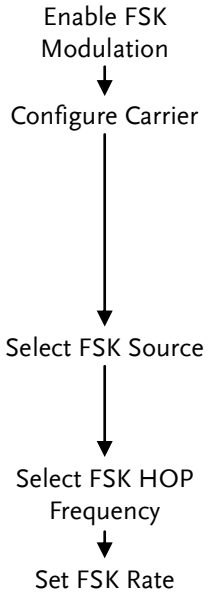
Description	Sets or queries the peak frequency deviation of the modulating waveform from the carrier waveform. The default peak deviation is 100Hz. The frequency deviation of external sources is controlled using the ±5V MOD INPUT terminal on the rear panel. A positive signal (>0~+5V) will increase the 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.	

频移键控(FSK)指令

FSK 介绍

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?**

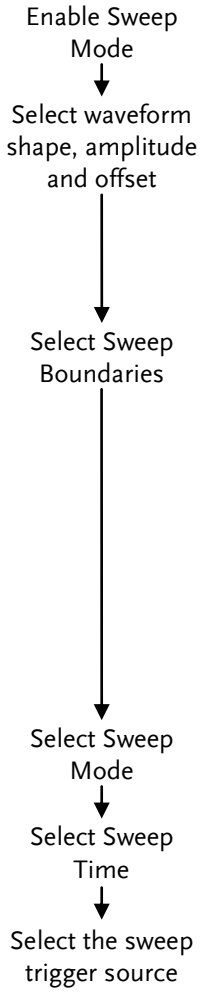
>+1.0000E+05

Returns the FSK rate (100kHz).

频率扫描指令

扫描介绍

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.	

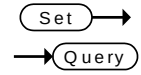
SOURce[1]:FREQuency:STARt

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



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

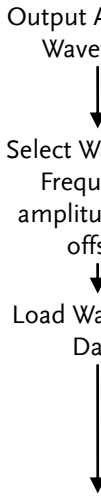
Set / Query

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

任意波介绍

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.

存储和调取指令

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).

附录

错误信息

AFG-2000 具备若干错误代码。一旦信号发生器设置错误，屏幕立刻提示错误信息。

接口错误信息

错误代码	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 系列规格

此规格适用条件：+18 ℃~+28 ℃ 操作环境下，开机 30 分钟以上。

AFG-2000 型号		2005	2012	2025	2105	2112	2125
波形		正弦波, 方波, 三角波, 噪声波, ARB					
任意波功能							
	采样率	20 MSa/s					
	重建率	10MHz					
	波形长度	4k 点					
	幅值分辨率	10 bits					
	非易失性存储器	4k 点					
频率特性							
范围	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					
分辨率		0.1Hz					
精确度	稳定度	±20 ppm					
	老化率	±1 ppm/1 year					
	容差	≤ 1 mHz					
输出特性							
幅值	范围	1 mVpp~10 Vpp (接 50Ω) 2 mVpp~20 Vpp (开路) 20MHz-25MHz，1 mVpp~5 Vpp (接 50Ω) 20MHz-25MHz，2 mVpp~10 Vpp (开路)					
	精确度	± 2%设置值±1 mVpp (在 1 kHz/接 50Ω 无直流偏移)					
	分辨率	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/接 50Ω)					
	单位	Vpp, Vrms, dBm					
偏移	范围	±5 Vpk ac +dc (接 50Ω) ±10Vpk ac +dc (开路) 20MHz-25MHz，±2.5 Vpk ac +dc (接 50Ω) 20MHz-25MHz，±5Vpk ac +dc (开路)					

	精确度	2%设置值 + 5 mV+ 0.5%幅值
波形输出	阻抗	50Ω 典型值(固定) > 300kΩ (输出关闭)
	衰减器	—
	保护	短路保护 过载继电器自动禁用主输出
SYNC 输出	准位	TTL-compatible into>1kΩ
	阻抗	50Ω 正常值
	扇出	—
	上升/下降时间	≤ 25ns
正弦波特性		
	谐波失真	≤–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/下降时间	最大输出处 ≤25ns (接 50 Ω 负载)
	过激信号	<5%
	不对称性(占空比 @50%)	1%周期 +1 ns
	可变占空比	1.0%~99.0% ≤100kHz 20.0%~80.0% ≤ 5MHz 40.0%~60.0% ≤ 10MHz 50% ≤ 25MHz
三角波特性		
	线性度	< 0.1%峰值输出
	可变对称性	0%~100% (0.1%分辨率)
AM 调制		
	载波波形	— 正弦波, 方波, 三角波
	调制波形	— 正弦波, 方波, 三角波
	调制频率	— 2mHz~20kHz (Int) DC~20kHz (Ext)
	深度	— 0%~120.0%
	调制源	— 内部/外部
FM 调制		
	载波波形	— 正弦波, 方波, 三角波
	调制波形	— 正弦波, 方波, 三角波

	调制频率	—	2mHz~20kHz (Int) DC~20kHz (Ext)
	峰值偏移	—	DC~最大频率
	调制源	—	内部/外部
扫描			
	波形	—	正弦波, 方波, 三角波
	类型	—	线性或对数
	起始/停止频率	—	0.1Hz~最大频率
	扫描时间	—	1ms~500s
	扫描源	—	内部/外部
FSK			
	载波波形	—	正弦波, 方波, 三角波
	调制波形	—	占空比为 50%的方波
	调制频率	—	2mHz~100 kHz (INT) DC~100 kHz(EXT)
	频率范围	—	0.1Hz~最大频率
	源	—	内部/外部
计频器			
	范围	—	5Hz~150MHz
	精确度	—	时基精确度±1count
	时基	—	热机 30 分钟后，±20ppm (23˚C ±5˚C)
	分辨率	—	1Hz 的最大分辨率为 100nHz，100MHz 的最大分辨率为 0.1Hz
	输入阻抗	—	1kΩ/1pf
	灵敏度	—	35mVrms ~ 30Vms (5Hz~150MHz)
存储/调取		10 组设置存储	
接口		USB (Device)	
显示		LCD	
一般规格			
	电源	AC100~240V, 50~60Hz	
	功耗	25 VA (最大)	

操作环境	适合温度: 18 ~ 28˚C 操作温度: 0 ~ 40˚C 相对湿度: ≤ 80%, 0 ~ 40˚C ≤ 70%, 35 ~ 40˚C 安装等级：CAT Ⅱ
海拔	2000m
存储温度	-10~70˚C, 湿度: ≤70%
尺寸(WxHxD)	266(W) x 107(H) x 293(D) mm
重量	约 2.5kg
附件	GTL-101× 1　　GTL-101× 2 快速入门指导×1 CD (使用手册 + 软件) ×1 电源线×1

EC Declaration of Conformity

We
GOOD WILL INSTRUMENT CO., LTD.
declare that the below mentioned product
Type of Product: Arbitrary Function Generator
Model Number: AFG-2125, AFG-2025, AFG-2112,
AFG-2012, AFG-2105 ,AFG-2005
is 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 (2014/30/EU) and Low Voltage Directive (2014/35/EU).
For the evaluation regarding the Electromagnetic Compatibility and Low Voltage Directive, the following standards were applied:

◎ **EMC**	
EN 61326-1: EN 61326-2-1:	Electrical equipment for measurement, control and laboratory use –– EMC requirements (2013)
Conducted & Radiated Emission EN 55011: 2009+A1: 2010	Electrical Fast Transients EN 61000-4-4: 2012
Current Harmonics EN 61000-3-2: 2014	Surge Immunity EN 61000-4-5: 2006
Voltage Fluctuations EN 61000-3-3: 2013	Conducted Susceptibility EN 61000-4-6: 2014
Electrostatic Discharge EN 61000-4-2: 2009	Power Frequency Magnetic Field EN 61000-4-8: 2010
Radiated Immunity EN 61000-4-3: 2006+A1: 2008+A2: 2010	Voltage Dip/ Interruption EN 61000-4-11: 2004
Low Voltage Equipment Directive 2014/35/EU	
Safety Requirements	**IEC 61010-1: 2010 (Third Edition)**

索引