



产 品 手 册

仪器型号: 固纬信号发生器AFG-4000系列编程手册

西安安泰测试科技有限公司

仪器维修|租赁|销售|测试

Arbitrary Function Generator

AFG-4000 Series

Programming Manual

GW INSTEK PART NO.



ISO-9001 CERTIFIED MANUFACTURER

GW INSTEK

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S SAFETY INSTRUCTIONS

This chapter contains important safety instructions that you must follow during operation and storage. Read the following before any operation to insure your safety and to keep the instrument in the best possible condition.

Safety Symbols

These safety symbols may appear in this manual or on the instrument.



WARNING

Warning: Identifies conditions or practices that could result in injury or loss of life.



CAUTION

Caution: Identifies conditions or practices that could result in damage to the AFG-4000 or to other properties.



DANGER High Voltage



Attention Refer to the Manual



Protective Conductor Terminal



Earth (ground) Terminal



Do not dispose electronic equipment as unsorted municipal waste. Please use a separate collection facility or contact the supplier from which this instrument was purchased.

Safety Guidelines

General Guideline



CAUTION

- Do not place any heavy object on the AFG-4000.
- Avoid severe impact or rough handling that may damaging the AFG-4000.
- Avoid discharges of static electricity on or near the AFG-4000.
- Do not block the cooling fan opening.
- Use only mating connectors, not bare wires, for the terminals.
- The instrument should only be disassembled by a qualified technician..

(Measurement categories) EN 61010 specifies the measurement categories and their requirements as follows. The AFG-4000 falls under category I.

- Measurement category IV is for measurement performed at the source of a low-voltage installation.
- Measurement category III is for measurement performed in a building installation.
- Measurement category II is for measurement performed on circuits directly connected to a low voltage installation.
- Measurement category I is for measurements performed on circuits not directly connected to Mains.

Power Supply



WARNING

- AC Input voltage rating: 100Vac-240Vac (+/- 10%)
 - Frequency: 50Hz/60Hz
 - Connect the protective grounding conductor of the AC power cord to an earth ground to prevent electric shock..
-

Fuse



WARNING

- Fuse type: F2A/250V.
- Only qualified technicians should replace the fuse.
- To ensure fire protection, replace the fuse only with the specified type and rating.
- Disconnect the power cord and all test leads before replacing the fuse.
- Make sure the cause of fuse blowout is fixed before replacing the fuse.

Cleaning the
AFG-4000

- Disconnect the power cord before cleaning the AFG-4000.
- Use a soft cloth dampened in a solution of mild detergent and water. Do not spray any liquid into the AFG-4000.
- Do not use chemicals containing harsh material such as benzene, toluene, xylene, and acetone.

Operation
Environment

- Location: Indoor, no direct sunlight, dust free, almost non-conductive pollution (Note below)
- Relative Humidity: <80%
- Altitude: < 2000m
- Temperature: 0°C to 40°C

(Pollution Degree) EN 61010-1 specify the pollution degrees and their requirements as follows. The AFG-4000 falls under degree 2.

Pollution refers to “addition of foreign matter, solid, liquid, or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity”.

- Pollution degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
- Pollution degree 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
- Pollution degree 3: Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive due to condensation which is expected. In such conditions, equipment is normally protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity is controlled.

Storage
environment

- Location: Indoor
- Relative Humidity: <70%
- Temperature: -20°C to 60°C

Disposal



Do not dispose this instrument as unsorted municipal waste. Please use a separate collection facility or contact the supplier from which this instrument was purchased. Please make sure discarded electrical waste is properly recycled to reduce environmental impact.

Power cord for the United Kingdom

When using the function generator in the United Kingdom, make sure the power cord meets the following safety instructions.

NOTE: This lead/appliance must only be wired by competent persons



WARNING: THIS APPLIANCE MUST BE EARTHED

IMPORTANT: The wires in this lead are coloured in accordance with the following code:

Green/ Yellow:	Earth
Blue:	Neutral
Brown:	Live (Phase)



As the colours of the wires in main leads may not correspond with the coloured marking identified in your plug/appliance, proceed as follows:

The wire which is coloured Green & Yellow must be connected to the Earth terminal marked with either the letter E, the earth symbol  or coloured Green/Green & Yellow.

The wire which is coloured Blue must be connected to the terminal which is marked with the letter N or coloured Blue or Black.

The wire which is coloured Brown must be connected to the terminal marked with the letter L or P or coloured Brown or Red.

If in doubt, consult the instructions provided with the equipment or contact the supplier.

This cable/appliance should be protected by a suitably rated and approved HBC mains fuse: refer to the rating information on the equipment and/or user instructions for details. As a guide, a cable of 0.75mm² should be protected by a 3A or 5A fuse. Larger conductors would normally require 13A types, depending on the connection method used.

Any exposed wiring from a cable, plug or connection that is engaged in a live socket is extremely hazardous. If a cable or plug is deemed hazardous, turn off the mains power and remove the cable, any fuses and fuse assemblies. All hazardous wiring must be immediately destroyed and replaced in accordance to the above standard.

Safety Precaution before Operation

Check Power Supply

The analyzer is equipped with a three-wire power cord in accordance with international safety standards. The product must be grounded properly before being powered on, as floating or improper ground may cause damage to the instrument or personal injury.

Make sure the grounding conductor of the function generator is grounded before turning on the instrument. After which the AC power cord can be connected. Do not use a non-ground power cord.

Allowed Variation Range of Supply Power Parameters

The function generator is compatible with 100V~240V, 50Hz-60Hz AC power. The table below lists the power requirement to run the function generator.

Power Supply Parameter	Compatible Range
Voltage	100 - 240 VAC
Frequency	50 - 60 Hz $\pm 10\%$
Power	<50VA

To prevent or lower the risk of damage to the function generator from power interference between instruments, especially from peak pulses produced by large power consumption instruments, a 220V/110V AC regulated power supply is recommended.

Power Cord Selection

The analyzer is equipped with a three-wire power cord in accordance with international safety standards. This cable grounds the analyzer cabinet when connected to an appropriate power line outlet. The cable must be rated greater than 250Vac and 2A.

**WARNING**

Improper grounding may cause damage to the instrument, or result in personal injury. Make sure the grounding conductor of the function generator is grounded before turning on the instrument.

Always use a well-grounded power source. Do not use an external power cable, power cord or an auto transformer without grounded protection. If this product is to be powered via an external auto transformer for voltage reduction, ensure that its common terminal is connected to a neutral (earthed pole) of the power supply.

Make sure the supply power is stable before turning on the analyzer to protect it from damage. Refer to “First Time to Power on” on page 12.

Electro-static Discharge (ESD) Protection

ESD is an issue often ignored by users. Damage from ESD on the instrument is unlikely to occur immediately but will significantly reduce the reliability of it. Therefore, ESD precautions should be implemented in the work environment, and applied daily.

Generally, there are two steps to manage ESD protection:

1. Conductive table mats to connect hands via wrist bands
2. Conductive ground mat to connect feet via ankle straps

Implement both protection methods will provide a good level of anti-static protection. If used alone, the protection will not be as reliable. To ensure user's safety, anti-static components should offer at least $1\text{M}\Omega$ isolation resistance.



WARNING

The above ESD protections measures cannot be used when working with over 500V!

Make good use of anti-static technology to protect components from damage:

1. Quickly ground the internal and external conductor of the coaxial cable before it is connected with the function generator.
2. Staff must wear anti-static gloves before touching the connector cord or doing any assemble work.
3. Assure all the instruments are grounded properly to avoid static storage.

First Time to Power on

Connect the three-pin AC power cord into the instrument. Insert the plug into a power socket provided with a protective ground.



WARNING

Check the power source before turning on the function generator, to protect the device from damage.

Steps

1. Press the power switch  on the bottom left of the front panel.
2. Self-initialization takes about 30 seconds, after the boot screen the function generator will default to the scanning curve.
3. After power on, let the function generator warm up for 60 minutes for stabilization to obtain the most accurate results.

G ETTING STARTED

The Getting started chapter introduces the function generator's main features, appearance, set up procedure and power-up.

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Main Features

- Provide single-channel or dual-channel output
 - AFG-4125E/ 4125AE: single channel
 - AFG-4225E/ 4235/ 4260/ 4280/ 4210H/ 4225H: dual-channel
- Built-in Sine, Square, Triangle, Ramp, Pulse, Noise, Harmonic wave, Arbitrary wave
- Min. resolution is 1uHz
- Arbitrary function
- Sampling Range
 - AFG-4225H: 1.25GSa/s
 - AFG-4235/ 4260/ 4280/ 4210H: 500MSa/s
 - AFG-4125E/ 4125AE/ 4225E: 125MSa/s
- Amplitude Resolution
 - AFG-4235/ 4260/ 4280/ 4210H/ 4225H: 16 bits
 - AFG-4125E/ 4125AE/ 4225E: 14bits
- Memory Length
 - AFG-4225E / 4235/ 4260/ 4280/ 4210H/ 4225H: 10M/per channel
 - AFG-4125E/ 4125AE: 16k/per channel
- Provide modulation: AM, DSB-AM, FM, PM, PWM, ASK, PSK, BPSK, QPSK, FSK, 3FSK, 4FSK, OSK, SUM
- Built-in sweep, burst, counter function
- Built-in Power Amplifier function (AFG-4125AE)
- Communication interface
 - AFG-4235/ 4260/ 4280/ 4210H/ 4225H provide USB, LAN interface

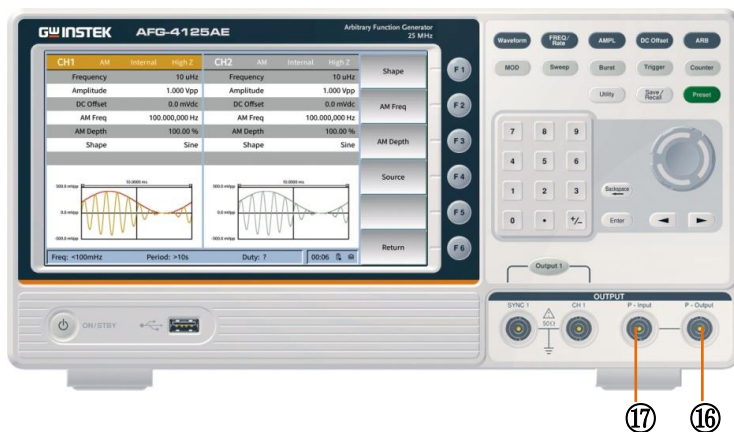
- AFG-4125E/ 4125AE/ 4225E provide USB interface
 - 8" TFT LCD Display, 800*480 resolution
 - Multi-Touch Display: AFG-4235/ 4260/ 4280/ 4210H/ 4225H
 - Without Touch Display: AFG-4125E/ 4125AE/ 4225E
-

Panel Overview

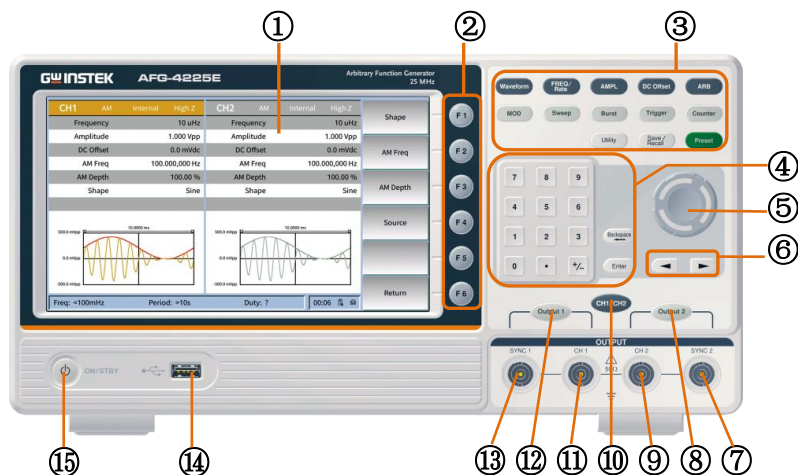
AFG-4125E Front Panel



AFG-4125AE Front Panel

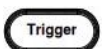
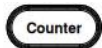
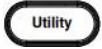
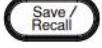
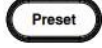


AFG-4225E/4235/4260/4280/4210H/4225H Front Panel



- 1 LCD
Display the user interface.
- 2 Menu soft keys
The F1 to F6 function keys directly correspond to the soft keys on the right-hand side of display.
- 3 Function keys

	Waveform	Basic waveform buttons, including sine waves, square waves, triangle waves, pulse waves, noise waves, and harmonics;
	FREQ/Rate	The FREQ/Rate key is used to set the frequency or sample rate.
	AMPL	AMPL sets the waveform amplitude.
	DC Offset	Sets the DC offset.
	ARB	ARB is used to set the arbitrary waveform parameters.

	MOD	Output modulation waveform;
	Sweep	Sweep sine, square, triangle or arbitrary waves;
	Burst	Generate pulse trains of sine waves, square waves, triangle waves, pulse waves, noise waves or arbitrary waves;
	Trigger	Manual trigger button;
	Counter	Frequency counter button;
	Utility	Auxiliary function button;
	Save/Recall	Save/recall function button;
	Preset	Restore factory settings button.

- 4 Numeric keyboard

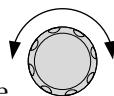


Parameter input.

- 5 Scroll Wheel



During parameter editing, turn the knob clockwise to increase, or counter clockwise to decrease the parameter values at specified steps.



Decrease Increase

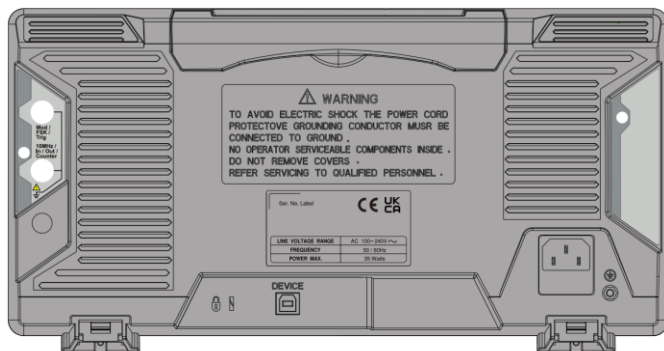
- 6 Arrow Keys



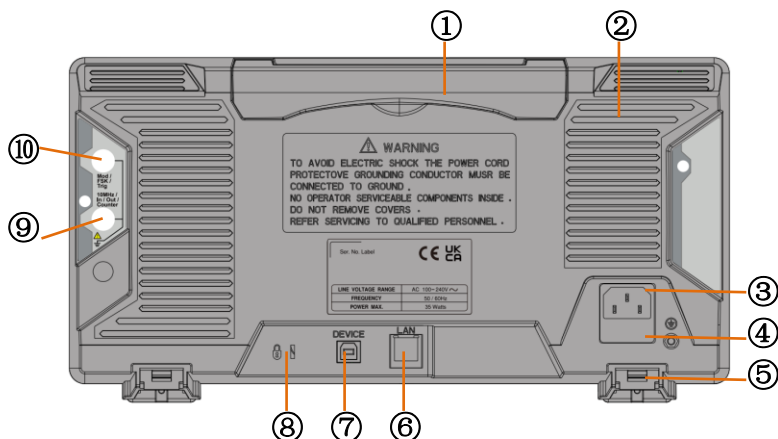
Move the cursor of the selected parameter.

- | | | |
|------------------------------------|---|--|
| 7 CH2 Synchronous output terminal |  | When Utility → CH1/2 Settings → CH2 Synchronization is set to On, this terminal outputs a synchronization signal that matches the current configuration of CH2. |
| 8 CH2 Signal output button |  | Turn on or off the output of CH2 channel waveform or synchronization signal. When the output is turned on, the button backlight lights up. |
| 9 CH2 Output |  | Output CH2 channel signal. |
| 10 CH1/CH2 |  | CH1 and CH2 channel display interface switching button. |
| 11 CH1 Output |  | Output CH1 channel signal. |
| 12 CH1 Signal output button |  | Turn on or off the output of CH1 channel waveform or synchronization signal. When the output is turned on, the button backlight lights up. |
| 13 CH1 Synchronous output terminal |  | When Utility → CH1/2 Settings → CH2 Synchronization is set to On, this terminal outputs a synchronization signal that matches the current configuration of CH1. |
| 14 USB interface |  | Connect to an external USB Host device, such as inserting a USB flash drive. |
| 15 Power button |  | Turn the power on or off. |
| 16 Power Amplifier out |  | Power Amplifier output port |
| 17 Power Amplifier in |  | Power Amplifier input port |

AFG-4125E/4125AE/4225E Rear Panel



AFG-4235/4260/4280/4210H/4225H Rear Panel



1. Handle

2. Heat sink fan

3. AC Power Input
Socket



Power input: 100-240V±10% AC

50-60Hz.

F2A/250V

4. Fuse box

5. Stool

To adjust the angle of the device.

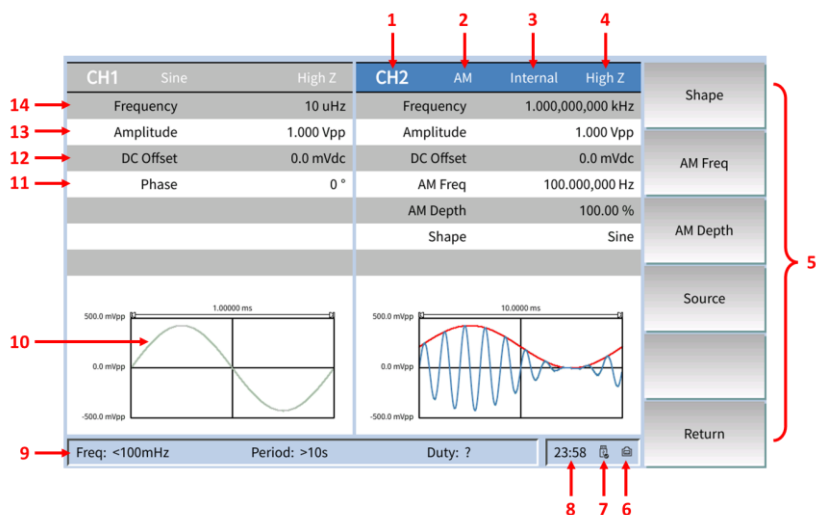
- | | | |
|-----------------------------------|---|---|
| 6. LAN Port |  | LAN interface for remote control. |
| 7. USB Device Port |  | USB type-B device port is used to connect the function generator to a PC for remote control. |
| 8. Security Lock Hole |  | Users can use the security lock (buy it by themselves) to lock the instrument at a fixed location. |
| 9. 10MHz In/Out/Counter Connector |  | Default is used to receive frequency meter input signal. When the instrument is set to the internal clock source and Utility → System Settings → Clock Output is set to on, it is used to output a 10MHz clock signal; when the instrument is set to an external clock source, it is used to receive an external 10MHz clock signal. |
| 10. Mod/FSK/Trig Connector |  | When modulating waveform, output scanning frequency, or output pulse train, the signal connected here can be used as an external signal source. |

Note: If one channel turns on AM, FM, PM, PWM or OSK, and another channel turns on ASK, FSK, PSK, frequency sweep or pulse train, and both channels are set to external trigger, the channel where the trigger source is set later can When using an external trigger, the other channel will automatically cancel the external trigger due to a different type of external modulation signal.

Boot Up

Confirm AC voltage	Before turning on the power, confirm that the input power meets the conditions of 100-240 V ($\pm 10\%$), 50/60 Hz.
Connect the AC power cord	The fuse is a 250 V, F2AL slow-blow type, and connects the AC power cord to the rear panel receptacle.
 Waring	To prevent electric shock, please make sure the instrument is properly grounded.
Power on	Press the power switch to turn on the power.
Power off	Press the power switch again, the status light will show blue, and turn off the power of the whole machine.

Display



NO Description

1	Channel Status	Display areas of CH1 and CH2. Indicate whether the corresponding channel is selected and turned on (ON/OFF). The area of the channel currently selected is highlighted and the on/off state of the channel currently turned on is "ON".
2	Current waveform or Current Modulation	
3	Trigger Source	Internal: internal modulation or internal trigger source; External: external modulation or external trigger source; Manual: Manual trigger source.
4	Output impedance	50Ω or high impedance

5	Menu	Display the operation menu corresponding to the function currently selected. For example, the "Sine" function menu is displayed in the above figure.
6	LAN status light	When the instrument is correctly connected to the LAN, this indicator will light.
7	USB status light	When the generator detects a USB storage device, this indicator will light.
8	Time	Display the current time.
9	Counter	The brief information of the counter will only be displayed when the frequency counter function is turned on and the interface currently displayed is not the frequency counter interface. When the statistic function is turned off: only display the frequency and period. When the statistic function is turned on: display the measurement parameters currently selected, the on/off status of the statistic function, the measurement values and the number of measurements.
10	Waveform	Display the currently selected waveform shape in each channel.
11	Phase	Display the current waveform phase in each channel. Press the corresponding softkey Start Phase and use the numeric keyboard or direction keys and knob to modify this parameter. The parameter that can be modified currently will be highlighted and the lightspot above the number indicates current cursor location.

12	Offset	Display the current waveform DC offset in each channel. Press the corresponding softkey Offset and use the numeric keyboard or direction keys and knob to modify this parameter. The parameter that can be modified currently will be highlighted and the lightspot above the number indicates current cursor location.
13	Amplitude	Display the current waveform amplitude in each channel. Press the corresponding softkey Ampl and use the numeric keyboard or direction keys and knob to modify this parameter. The parameter that can be modified currently will be highlighted and the lightspot above the number indicates current cursor location.
14	Frequency	Display the current waveform frequency in each channel. Press the corresponding softkey Freq and use the numeric keyboard or direction keys and knob to modify this parameter. The parameter that can be modified currently will be highlighted and the lightspot above the number indicates current cursor location.

RREMOTE INTERFACE

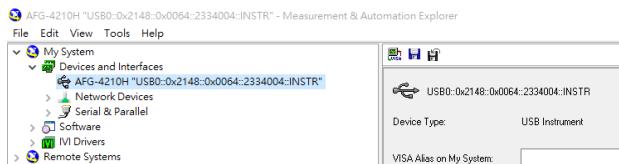
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Establishing a Remote Connection

AFG-4000 has 2 remote communication interfaces which are USB and LAN. These two communication modes can be used simultaneously.

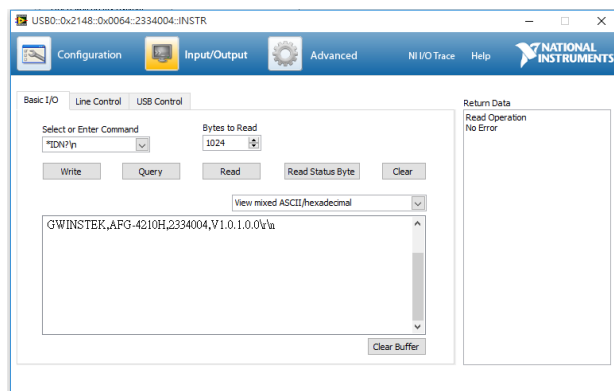
Configure USB interface

Description	Communication via USB interface, using USB Device TMC mode.	
Interface	Connect the USB cable to the rear panel USB B (slave) port.	DEVICE 
Connection and operation	1. Use the USB cable to connect the USB Device Interface on the rear panel of the signal generator to the USB interface of the PC. 2. To use USB communication, you need to use the "NI Visa" software of NI (National Instruments Corporation); 3. After connecting to the host computer through the USB slave interface on the rear panel, open the "NI Visa" software, as shown in the figure above, select View -> Refresh in the menu bar of Measurement & Automation Explorer, when the connection is successful, click on the drop-down arrow of "Devices and Interfaces" in "My System" menu, the serial number of AFG-4000 and the USB Interface number will be displayed on the right side of the page.	



Function
Measurement

Click the "Open VISA Test Panel" key on the page to pop up the VISA Test Panel, click the Input/Output key in the VISA Test Panel, in the Select or Enter Command box, you can execute all statements including query, setting, measurement, reading and etc. When requiring to query, enter the corresponding query Command and then click the "Query" key to run the Command. Enter the corresponding Command when requiring to operate setting and measurement action and then click the "Write" key. Enter the corresponding Command when requiring to operate reading action and then click the "Read" key. Refer to Command List.



Enter the query Command “*IDN?” as shown above, and the instrument identification information such as manufacturer, model, serial number and software version will be returned. The message "Read Operation No Error" is displayed in the Return Data window.

Exit remote
control mode

. Send System:Loacl Command from PC.

! NOTE: USB is a hot-swap device, which can be disconnected or connected at any time.

Configure LAN interface

Description When using the LAN interface, set the relevant parameters on the front panel.

Interface Connect the LAN cable to the rear panel LAN port.



Parameter settings

Interface:	LAN
Lan Boot Mode:	Manual
IP Address:	192.168.000.101
NetMask:	255.255.255.000
GateWay:	192.168.000.001
Mac Address:	98-89-24-52-A6-6C
Host Name:	AFG

Parameter description

Mode: Choose DHCP (obtain IP address automatically) or Manual (set IP address manually);

IP Address: ranging from 1.0.0.0 to 223.255.255.255; (excluding 127.nnn.nnn.nnn);

Subnet Mask: ranging from 1.0.0.0 to 255.255.255.255;

Gateway: ranging from 1.0.0.0 to 223.255.255.255 (excluding 127.nnn.nnn.nnn);

Exit remote control mode

.Send System:Local Command from PC



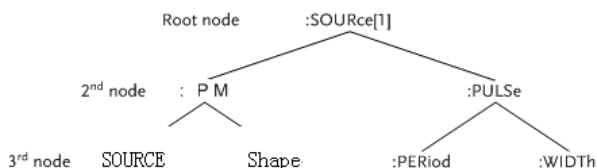
WARNING: LAN is a hot-swap device, which can be disconnected or connected at any time.

Command Syntax

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.

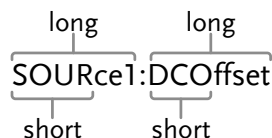
Shown below is a section of the SOURce[1 | 2 | 3 | 4] root node and the :PM and :PULSe sub nodes.



Command types	Commands can be separated in to 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	SOURce1:PULSe:WIDTh

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	SOURce1:DCOffset	< offset>	LF	1: command header
Format	1	2	3	4
				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,
	<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 peak to peak.	VPP
	<offset>	NRf+ type including volt unit suffixes.	V
	<seconds>	NRf+ type including time unit suffixes.	NS, S MS US
	<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)	
	EOI	IEEE-488 EOI (End-Or-Identify)	
 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 semi colon is used to separate subcommands that have the same node level.
		For example: <pre> SOURce[1 2]:DCOffset? SOURce[1 2]:OUTPut? →SOURce1:DCOffset?,OUTPut? </pre>
Colon + Semicolon (::)		A colon and semicolon can be used to combine commands from different node levels.
		For example: <pre> SOURce1:PM:SOURce? SOURce1:PULSe:WIDTh? →SOURce1:PM:SOURce?::SOURce: PULSe:WIDTh? </pre>
	Comma (,)	When a command uses multiple parameters, a comma is used to separate the parameters.
		For example: <pre> SOURce:APPLy:SQUare 10KHZ, 2.0 VPP, -1V </pre>

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System Commands

*IDN?

System Query

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

*RST

System Command

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

*TST?

System Query

Description	Performs a system self-test and returns a pass or fail judgment. An error message will be generated if the self test fails.
Note	The error message can be read with the SYST:ERR? query.
Query Syntax	*TST?
Return parameter	+0 Pass judgment

	+1	Fail judgment
Example	*TST? +0 The function generator passed the self-test.	

***OPC** System Command

Description	This command sets the Operation Complete Bit (bit 0) of the Standard Event Status Register after the function generator has completed all pending operations. For the AFG-4000, the *OPC command is used to indicate when a sweep or burst has completed.
Note	Before the OPC bit is set, other commands may be executed.
Syntax	*OPC

***OPC?** System Query

Description	Returns the OPC bit to the output buffer when all pending operations have completed. I.e. when the OPC bit is set.
Note	Commands cannot be executed until the *OPC? query has completed.
Query Syntax	*OPC?
Return parameter	1
Example	*OPC? 1 Returns a "1" when all pending operations are complete.

***TRG** System Command

Description	Generate a trigger event for both CH1 and CH2.
Note	Before the OPC bit is set, other commands may be executed.
Syntax	*TRG

Status Register Commands

*CLS System Command

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

*ESE System Command

Description	The Standard Event Status Enable command determines which events in the Standard Event Status Event register can set the Event Summary Bit (ESB) of the Status Byte register. Any bit positions set to 1 enable the corresponding event. Any enabled events set bit 5 (ESB) of the Status Byte register.			
Note	The *CLS command clears the event register, but not the enable register.			
Syntax	*ESE <enable value>			
Parameter	<enable value>		0~255	
Example	*ESE 20 Sets a bit weight of 20 (bits 2 and 4).			
Query Syntax	*ESE?			
Return Parameter	Bit	Register	Bit	Register
	0	Not used	4	Message Available
	1	Not used	5	Standard Event

	2	Error Queue	6	Master Summary
	3	Questionable Data	7	Not used

Example ***ESE?**
4
 Bit 2 is set.

***ESR?** System Command

Description Reads and clears the Standard Event Status Register. The bit weight of the standard event status register is returned.

Note The *CLS will also clear the standard event status register.

Query Syntax ***ESR?**

Return Parameter	Bit	Register	Bit	Register
	0	Operation Complete	4	Execution Error
	1	Not Used	5	Command Error
	2	Query Error	6	Not Used
	3	Device Error	7	Power On

Query Example ***ESR?**
5
 Returns the bit weight of the standard event status register (bit 0 and 2).

***STB?** System Command

Description Reads the Status byte condition register.

Note Bit 6, the master summary bit, is not cleared.

Syntax ***STB?**

***SRE**

System Command

Description	The Service Request Enable Command determines which events in the Status Byte Register are allowed to set the MSS (Master summary bit). Any bit that is set to "1" can cause the MSS bit to be set.
-------------	---

Note	The *CLS command clears the status byte event register, but not the enable register.
------	--

Syntax	*SRE <enable value>
--------	----------------------------------

Parameter	<enable value>	0~255
-----------	----------------	-------

Example	*SRE 12
---------	----------------

Sets a bit weight of 12 (bits 2 and 3) for the service request enable register.

Query Syntax	*SRE?
--------------	--------------

Return Parameter	Bit	Register	Bit	Register
	0	Not used	4	Message Available
	1	Not used	5	Standard Event
	2	Error Queue	6	Master Summary
	3	Questionable Data	7	Not used

Query Example	*SRE? 12
---------------	-----------------

Returns the bit weight of the status byte enable register.

System Remote Commands

SYSTem:LOCal System Command

Description	Sets the function generator to local mode. In local mode, all front panel keys are operational.
-------------	---

Syntax	SYSTem:LOCal
--------	---------------------

Example	SYST:LOC
---------	-----------------

SYSTem:REMOte System Command

Description	Disables the front panel keys and puts the function generator into remote mode
-------------	--

Syntax	SYSTem:REMOte
--------	----------------------

Example	SYST:REM
---------	-----------------

SYSTem:ERRor? System Query

Description	Reads an error from the error queue.
-------------	--------------------------------------

Query Syntax	SYSTem:ERRor?
--------------	----------------------

Return parameter	<string>	Returns an error string, <256 ASCII characters.
------------------	----------	---

Example	SYSTem:ERRor? -138 Suffix not allowed Returns an error string.
---------	--

SYSTem:VERSIon? System Query

Description	Performs a system version query. Returns a string with the instrument, firmware version, FPGA revision and bootloader.
-------------	--

Query Syntax	SYSTem:VERSIon?
--------------	------------------------

Return parameter <string>

Example

SYST:VERS?

VX.XXX_XXXX

Returns the version information.

SYSTem:LANguage

System Command

Description

Sets the language that the instrument uses to display information on the screen .

Different languages may support different types of languages .

Note

SCHinese | ENGLISH specifies which language will be used to display instrument information on the screen.

Syntax

SYSTem:LANguage {SCHinese|ENGLISH}

Example

SYSTEM:LANGUAGE ENGLISH

Specify that the instrument displays information in English.

Query Syntax

SYSTem:LANguage ?

Return parameter

SCHinese|ENGLISH

Example

SYSTem:LANguage?

ENGLISH

The current language is English.

SYSTem:BEEPer:STATe

System Command

Description

Sets the beeper ON or OFF. When the beeper is set to ON, the instrument will beep when an error message or a warning message is displayed on the screen. The instrument does not beep when an error or warning caused by remote command execution.

Syntax	SYSTem:BEEPer:STATe {ON OFF}
--------	--------------------------------

Example	SYSTEM:BEEPER:STATE ON Enable the beeper function.
---------	--

SYSTem:BEEPer:STATe?

System Query

Description	Queries the status of the beeper.
-------------	-----------------------------------

Query Syntax	SYSTem:BEEPer:STATe?
--------------	-----------------------------

Return parameter	OFF	ON
	ON	ON

Example	SYSTem:BEEPer:STATe? OFF Queries the on/off status of the beeper and the query returns OFF.
---------	---

SYSTem:BEEPer[:IMMediate]

System Command

Description	Cause the instrument to beep immediately. This command is only available when the beeper is enabled.
-------------	--

Syntax	SYSTem:BEEPer[:IMMediate]
--------	----------------------------------

Example	SYSTEM:BEEPER Cause a beep.
---------	---------------------------------------

SYSTem:RESTART

System Command

Description	Restart the instrument.
-------------	-------------------------

Syntax	SYSTem:RESTART
--------	-----------------------

Example	SYSTem:RESTART Restarts the instrument:
---------	---

DISPlay Commands

DISPlay:BRIGhtness Display Command

Description	Sets the screen brightness.
Syntax	DISPlay:BRIGhtness {<brightness> MINimum MAXimum}
Example	DISP:BRIG 51 Sets the screen brightness to 51%.

DISPlay:BRIGhtness? Display Query

Description	Queries the screen brightness.
Syntax	DISPlay:BRIGhtness?
Example	DISP:BRIG? Queries the screen brightness and the query returns 5.100000E+01

DISPlay:SAVer:DElay Display Command

Description	Sets delay time for the screen saver function. The setting range is 1 minute to 999 minutes.
Syntax	DISPlay:SAVer:DElay {<minutes> MINimum MAXimum}
Example	DISPlay:SAVer:DElay 30 Sets the delay time for the screen saver function to 30 minutes.

DISPlay:SAVer:DElay? Display Query

Description	Queries delay time for the screen saver function.
Syntax	DISPlay:SAVer:DElay? {MINimum MAXimum}

Example	DISPlay:SAVer:DElay? 10 Queries delay time for the screen saver function and the query returns 10 minutes.
---------	--

DISPlay:SAVer[:STATe]	Display Command
------------------------------	-----------------

Description	Enables or disables the screen saver function.
-------------	--

Syntax	DISPlay:SAVer[:STATe] {ON OFF}
--------	---------------------------------------

Example	DISPLAY:SAVER:STATE OFF Disables the screen saver function:.
---------	--

DISPlay:SAVer[:STATe]?	Display Query
-------------------------------	---------------

Description	Queries the on/off status of the screen saver function.
-------------	---

Syntax	DISPlay:SAVer[:STATe] ?
--------	--------------------------------

Example	DISPLAY:SAVER? 1 Queries the on/off status of the screen saver function and the query returns ON.
---------	---

DISPlay:SAVer:IMMediate	Display Command
--------------------------------	-----------------

Description	Enables the screen saver immediately without waiting.
-------------	---

Syntax	DISPlay:SAVer:IMMediate
--------	--------------------------------

Example	DISPLAY:SAVER:IMMEDIATE Sets the screen saver state to ON
---------	---

HCOPY Commands

HCOPY:SDUMP[:IMMediate] Hcopy Command

Description	Copy a screen image and saves the image file to a USB memory. The default file name is n.BMP, where n is a consecutive number from 0. The image files are saved in a folder named Model/IMAGE (Model is the instrument model) in the USB memory.
Syntax	HCOPY:SDUMP[:IMMediate]
Example	HCOPY:SDUMP:IMMEDIATE Copy the screen image and may create a file 1.BMP in a USB memory.

HCOPY:SDUMP:DATA? Hcopy Query

Description	This query-only command returns a specified length of binary data which consist a BMP screen image.
Syntax	HCOPY:SDUMP:DATA?
Example	HCOPY:SDUMP:DATA? might return the following response: #6377512xxxxx . . . where 6 indicates that the following 6 digits (377512) specify the length of the data in bytes; xxxxx ... indicates the BMP image data.

MEMory Commamds

MEMory:CATalog?

Memory Query

Description	This query-only command returns the current state of the mass storage system (USB memory).
Syntax	MEMory:CATalog?
Example	MEMory:CATalog? 21973685,16851047,"Test_folder,DIR,0","Firmware.upp,,7791","memo.txt,,2566" The USB memory includes the Test_folder folder, a Firmware.upp file, and a memo.txt file.

MEMory:DElete

Memory Command

Description	Delete a file or directory from the mass storage system. If a specified file in the mass storage is not allowed to overwrite or delete, this command causes an error. You can delete a directory if it is empty.
Syntax	MEMory:DElete <file_name>
Example	MEMory:DElete "/Test_folder/Case/Firmware.upp" Delete the Firmware.upp file from the /Test_folder/Case directory:

Apply Commands

The APPLy command has 7 different types of outputs (Sine, Square, Ramp, Pulse, Noise, Harmonic, User). The 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 use the instrument default values.

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

```
SOURce[1 | 2]:APPLy:SINusoid [<frequency> [, <amplitude>
[,<offset>] ]]
```

Output Frequency For the output frequency, MINimum, MAXimum and DEFault can be used. The default frequency for all functions is set to 1 kHz. The maximum and minimum frequency depends on the function used. If a frequency output that is out of range is specified, the max/min frequency will be used instead. A “Data out range error will be generated” from the remote terminal.

Output
Amplitude

When setting the amplitude, MINimum, MAXimum and DEFault can be used. The range depends on the function being used and the output termination (50Ω or high impedance). The default amplitude for all functions is 100 mVpp (50Ω).

If the amplitude has been set and the output termination is changed from 50Ω to high impedance, the amplitude will double. Changing the output termination from high impedance to 50Ω will half the amplitude.

Vrms, dBm or Vpp units can be used to specify the output unit to use with the current command. If the output termination is set to high impedance, dBm units cannot be used. The units will default 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 must be adjusted to 3.536 Vrms for a sine wave.

DC Offset voltage

The offset parameter can be set to MINimum, MAXimum or DEFault. The default offset is 0 volts. The offset is limited by the output amplitude as shown below.

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

If the output specified is out of range, the maximum offset will be set.

The offset is also determined by the output termination (50Ω or high impedance). If the offset

has been set and the output termination has changed from 50 Ω to high impedance, the offset will double. Changing the output termination from high impedance to 50 Ω will half the offset.

SOURce[1|2]:APPLy:SINusoid Source Specific Command

Description Outputs a sine wave from the selected channel when the command has executed. Frequency, amplitude and offset can also be set.

Syntax SOURce[1|2]:APPLy:SINusoid [<frequency> [,<amplitude> [,<offset>]]]

Parameter	<frequency>	1 μ Hz~250MHz
	<amplitude>	1 mVpp~10Vpp (50 Ω)
	<offset>	$\pm$ 5 Vpk ac +dc (50 Ω)

Example **SOUR1:APPL:SIN 2KHZ,MAX,MAX**
Sets frequency to 2kHz and sets the amplitude and offset to the maximum.

SOURce[1|2]:APPLy:SQUare Source Specific Command

Description Outputs a square wave from the selected channel when the command has executed. Frequency, amplitude and offset can also be set. The duty cycle is set to 50%.

Syntax SOURce[1|2]:APPLy:SQUare [<frequency> [,<amplitude> [,<offset>]]]

Parameter	<frequency>	1 μ Hz~50MHz
	<amplitude>	1 mVpp~10Vpp (50 Ω)
	<offset>	$\pm$ 5 Vpk ac +dc (50 Ω)

Example **SOUR1:APPL:SQU 2KHZ,MAX,MAX**
Sets frequency to 2kHz and sets the amplitude and offset to the maximum.

SOURce[1|2]:APPLy:RAMP Source Specific Command

Description	Outputs a ramp wave from the selected channel when the command has executed. Frequency, amplitude and offset can also be set. The symmetry is set to 100%.	
Syntax	SOURce[1 2]:APPLy:RAMP [<frequency> [<amplitude> [<offset>]]]	
Parameter	<frequency>	1μHz~5MHz
	<amplitude>	1mVpp~10Vpp (50Ω)
	<offset>	±5 Vpk ac +dc (50Ω)
Example	SOUR1:APPL:RAMP 2KHZ,MAX,MAX Sets frequency to 2kHz and sets the amplitude and offset to the maximum.	

SOURce[1|2]:APPLy:PULSe Source Specific Command

Description	Outputs a pulse waveform from the selected channel when the command has executed. Frequency, amplitude and offset can also be set.	
Note	The PW settings from the SOURce[1 2]:PULS:WIDT command are preserved. Edge and pulse width may be adjusted to supported levels. Repetition rates will be approximated from the frequency.	
Syntax	SOUR[1 2]:APPLy:PULSe [<frequency> [<amplitude> [<offset>]]]	
Parameter	<frequency>	1μHz~25MHz
	<amplitude>	1mV~10V (50Ω)
	<offset>	±5 Vpk ac +dc (50Ω)
Example	SOUR1:APPL:PULS 1KHZ,MIN,MAX	

Sets frequency to 1kHz and sets the amplitude to minimum and the offset to the maximum.

SOURce[1|2]:APPLy:NOISe Source Specific Command

Description	Outputs Gaussian noise (no set bandwidth). Amplitude and offset can also be set.	
Note	Frequency cannot be used with the noise function; however a value (or DEFault) must be specified. The frequency is remembered for the next function used.	
Syntax	SOURce[1 2]:APPLy:NOISe [<frequency> DEFault> [,<amplitude> [,<offset>]]]	
Parameter	<frequency> <amplitude> <offset>	Not applicable 1mV~10V (50Ω) ±5 Vpk ac +dc (50Ω)
Example	SOUR1:APPL:NOIS DEF, 3.0, 1.0 Sets the amplitude to 3 volts with an offset of 1 volt.	

SOURce[1|2]:APPLy:HARMonic Source Specific Command

Description	Outputs a sine wave with harmonic components from the selected channel when the command has executed. Frequency, amplitude and offset can also be set. The maximum frequency is limited by the highest order. Highest order n: maximum frequency is sine wave bandwidth/n.	
Syntax	SOURce[1 2]:APPLy:HARMonic [<frequency> [,<amplitude> [,<offset>]]]	

Parameter	<frequency> <amplitude> <offset>	1μHz~125MHz 1mV~10V (50Ω) ±5 Vpk ac +dc (50Ω)
Example	SOUR1:APPL:HARM 2KHZ,MAX,MAX Sets the frequency to 2kHz and sets the amplitude and offset to the maximum.	

SOURce[1|2]:APPLy:USER Source Specific Command

Description	Outputs an arbitrary waveform from the selected channel. The output is that specified from the FUNC:USER command.	
Note	Frequency and amplitude cannot be used with the DC function; however a value (or DEFault) must be specified. The values are remembered for the next function used.	
Syntax	SOURce[1 2]:APPLy:USER [<frequency> [,<amplitude> [,<offset>]]]	
Parameter	<frequency> <amplitude> <offset>	1μHz~30MHz (15MHz AFG-4125E/ 4125AE/ 4225E) 1mV~10V (50Ω) ±5 Vpk ac +dc (50Ω)
Example	SOUR1:APPL:USER 1KHZ,5.0,1.0	

SOURce[1|2]:APPLy? Source Specific Command

Description	Outputs a string with the current settings.	
Note	The string can be passed back appended to the Apply Command.	
Syntax	SOURce[1 2]:APPLy?	
Return Parameter	<string>	Function, frequency, amplitude, offset

Example	SOUR1:APPL? SIN +5.000000000000E+03 +3.0000E+00 -2.50E+00 Returns a string with the current function and parameters, Sine, 5kHz 3 Vpp -2.5V offset.
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Output Commands

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. Although the APPLY command provides the most straightforward method to program the function generator, the low-level commands give you more flexibility to change individual parameters.

	Source Specific Command
SOURce[1 2]:FUNCTION	
Description	The FUNCTION command selects and outputs the selected output. The User parameter outputs an arbitrary waveform previously set by the SOURce[1 2]:FUNC:USER command.
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 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 is automatically adjusted to 3.536. The modulation, burst 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	Squ	Ramp	Pulse	Noise	Harm	ARB
AM	✓	✓	✓	×	×	×	✓
DSBAM	✓	✓	✓	×	×	×	×
FM	✓	✓	✓	×	×	×	✓
PM	✓	✓	✓	×	×	×	✓
SUM	✓	✓	✓	×	×	×	×
PWM	×	×	×	✓	×	×	×
ASK	✓	✓	✓	×	×	×	✓
FSK	✓	✓	✓	×	×	×	✓
3FSK	✓	✓	✓	×	×	×	✓
4FSK	✓	✓	✓	×	×	×	✓
PSK	✓	✓	✓	×	×	×	✓
BPSK	✓	✓	✓	×	×	×	✓
QPSK	✓	✓	✓	×	×	×	✓
OSK	✓	×	×	×	×	×	×
SWEEP	✓	✓	✓	×	×	×	✓
BURST	✓	✓	✓	✓	✓	×	✓
Syntax	SOURce[1 2]:FUNCTION {SINusoid SQUare RAMP PULSe NOISe USER HARMonic }						
Example	SOUR1:FUNC SIN Sets the output as a sine function.						
Query Syntax	SOURce[1 2]:FUNCTION?						
Return Parameter	SIN, SQU, RAMP, PULS, NOIS, USER, HARMonic				Returns the current output type.		
Example	SOUR1:FUNC? SIN Current output is sine.						

SOURce[1 2]:FREQuency		Source Specific Command
Description	Sets the output frequency for the the SOURce[1 2] :FUNctIon command. The query command returns the current frequency setting.	
Note	The maximum and minimum frequency depends on the function mode.	

Sine	1 μ Hz~25MHz (35MHz AFG-4235 60MHz AFG-4260 80MHz AFG-4280 100MHz AFG-4210H 250MHz AFG-4225H)
Square	1uHz~5MHz (15MHz AFG-4235 30MHz AFG-4260/4280/4210H 50MHz AFG-4225H)
Ramp	1 μ Hz~1MHz (3MHz AFG-4235/4260/4280/4210H 5MHz AFG-4225H)
Pulse	1 μ Hz~5MHz (15MHz AFG-4235 25MHz AFG-4260/4280/4210H/4225H)
Noise	Not applicable
Harmonic	1 μ Hz~12.5MHz (17.5MHz AFG-4235 30MHz AFG-4260 40MHz AFG-4280 50MHz AFG-4210H 125MHz AFG-4225H)
User	1 μ Hz~15MHz (30MHz AFG-4235/4260/4280/4210H/4225H)

	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 next highest value.	
Syntax	SOURce[1 2]:FREQuency {<frequency> MINimum MAXimum}	
Example	SOUR1:FREQ MAX Sets the frequency to the maximum for the current mode.	
Query Syntax	SOURce[1 2]:FREQuency?	
Return Parameter	<NR3>	Returns the frequency for the current mode.
Example	SOUR1:FREQ? MAX +5.0000000000000E+07 The maximum frequency that can be set for the current function is 50MHz.	

SOURce[1 2]:AMPLitude		Source Specific Command
Description	The SOURce[1 2]:AMPLitude command sets the output amplitude for the selected channel. 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 1 Vpp (High z). If the amplitude has been set and the output termination is changed from 50Ω to high impedance, the amplitude will double. Changing the output termination from high impedance to 50Ω will half the amplitude. The offset and amplitude are related by the following equation. $ V_{offset} < V_{max} - V_{pp}/2$	

If the output termination is set to high impedance, dBm units cannot be used. The units will default 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 must be adjusted to 3.536 Vrms for a sine wave.

The amplitude units can be explicitly used each time the SOURce[1 | 2]:AMPLitude command is used.

Syntax	SOURce[1 2]:AMPLitude {< amplitude> MINimum MAXimum}	
Example	SOUR1:AMPL MAX Sets the amplitude to the maximum for the current mode.	
Query Syntax	SOURce[1 2]:AMPLitude? {MINimum MAXimum}	
Return Parameter	<NR3>	Returns the amplitude for the current mode.
Example	SOUR1:AMPL? MAX +8.000E+00 The maximum amplitude that can be set for the current function is 8 volts.	

SOURce[1 2]:DCOffset		Source Specific Command
Description	Sets or queries the DC offset for the current mode.	
Note	The offset parameter can be set to MINimum, MAXimum or DEFault. The default offset is 0 volts. The offset is limited by the output amplitude as shown below.	

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

If the output specified is out of range, the maximum offset will be set.

The offset is also determined by the output termination (50Ω or high impedance). If the offset has been set and the output termination has changed from 50Ω to high impedance, the offset will double. Changing the output termination from high impedance to 50Ω will half the offset.

Syntax	SOURce[1 2]:DCOffset [< offset> MINimum MAXimum]	
Example	SOUR1:DCO MAX Sets the offset to the maximum for the current mode.	
Query Syntax	SOURce[1 2]:DCOffset? {MINimum MAXimum}	
Return Parameter	<NR3>	Returns the offset for the current mode.
Example	SOUR1:DCO? +1.00E+00 The offset for the current mode is set to +1volts.	

SOURce[1|2]:RAMP:SYMMetry Source Specific Command

Description	Sets or queries the symmetry for ramp waves only. The setting is remembered if the function mode is changed. The default symmetry is 50%.	
Syntax	SOURce[1 2]:RAMP:SYMMetry [< percent> MINimum MAXimum]	
Example	SOUR1:RAMP:SYMM +5.00E+01 Sets the symmetry to the 50%.	
Query Syntax	SOURce[1 2]:RAMP:SYMMetry? {MINimum MAXimum}	

Return Parameter	<NR3>	Returns the symmetry as a percentage.
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Example **SOUR1:RAMP:SYMMetry?**
 +5.00E+01
 Sets the symmetry to the 50%.

OUTPut[1|2] Source Specific Command

Description	Enables/Disables or queries the front panel output. The default is set to off.
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Note	If the output is overloaded by an external voltage, the output will turn off. The overload must first be removed before the output can be turned on again with output command. Using the Apply command automatically sets the front panel output to on.
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Syntax	OUTPut[1 2] {OFF ON}
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Example	OUTP1 ON Turns the output on.
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Query Syntax	OUTPut[1 2]?
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Return Parameter	1	ON
	0	OFF

Example	OUTP1? 1 The channel 1 output is currently on.
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OUTPut[1|2]:LOAD Source Specific Command

Description	Sets or queries the output termination. Two impedance settings can be chosen, DEFault (50Ω) and INFinity (high impedance >10 kΩ). The output termination is to be used as a reference only. If the output termination is set 50Ω but the actual load impedance is not 50Ω, then the amplitude and offset will not be correct.	
Note	If the amplitude has been set and the output termination is changed from 50Ω to high impedance, the amplitude will double. Changing the output termination from high impedance to 50Ω will half the amplitude. If the output termination is set to high impedance, dBm units cannot be used. The units will default to Vpp.	
Syntax	OUTPut[1 2]:LOAD {DEFault INFinity}	
Example	OUTP1:LOAD DEF Sets the output termination to 50 Ω .	
Query Syntax	OUTPut[1 2]PULSe]:LOAD?	
Return Parameter	DEF	Default
	INF	INFinity
Example	OUTP1:LOAD? DEF The output is set to the default of 50 Ω .	

SOURCE[1|2]:PHASe Instrument Command

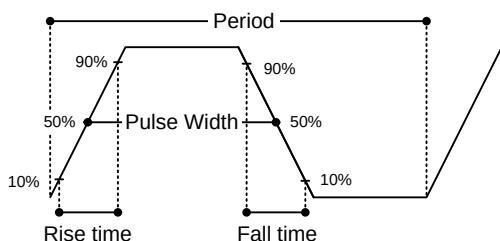
Description	Sets the phase.	
Syntax	SOURce[1 2]:PHASe {<phase> <MIN> <MAX>}	
Parameter	phase	0~360
	min	Sets the phase to the minimum value.

	max	Sets the phase to the maximum value.
Example	SOURce1:PHASe 25	Sets the phase of channel 1 to 25°.
Query Syntax	SOURce[1 2]:PHASe? {MAX MIN}	
Return Parameter	<NRf>	Returns the current phase in degrees.
Example	SOURce1:PHASe?	
	+2.500E+01	Returns the phase of channel 1 as 25°.

	SOURce[1 2]:PHASe:SYNChronize	Instrument Command
Description	Synchronizes the phase of channel 1 and channel 2.	
Syntax	SOURce[1 2]:PHASe:SYNChronize	
Example	SOURce1:PHASe:SYNChronize	
	Synchronizes the phase of channel 1	

Pulse Configuration Commands

The pulse chapter is used to control and output pulse waveforms. Unlike the APPLy command, low level control is possible including setting the leading edge time, trailing edge time, period and pulse width.



SOURCE[1 2]:PULSE:WIDTh	Source Specific Command
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Description	Sets or queries the pulse width. The default pulse width is 500us. Pulse width is defined as the time from the rising to falling edges (at a threshold of 50%).	
Note	The pulse width is restricted to the following limitations: Pulse Width $\geq$ Minimum Pulse Width Pulse Width $<$ Pulse Period - Minimum Pulse Width	
Syntax	SOURCE[1 2]:PULSe:WIDTh {<seconds> MINimum MAXimum}	
Example	SOURCE1:PULS:WIDT MAX Sets the pulse width to the maximum allowed.	
Query Syntax	SOURCE[1 2]:PULSe:WIDTh? [MINimum MAXimum]	
Return Parameter	<seconds>	≥ 48 ns (≥ 18 ns AFG-4235, ≥ 12 ns AFG-4260/4280/4210H, ≥ 7 ns AFG-4225H. limited by the current frequency setting)
Example	SOURCE1:PULS:WIDT? +2.000000000000E-08 The pulse width is set to 20 nanoseconds.	
SOURCE[1 2]:PULSe:DCYCLe		Source Specific Command

Description	Sets or queries the pulse duty cycle.
Note	The duty cycle is restricted to the following limitations: Pulse Duty Cycle $\geq 100\% \times$ Minimum Pulse Width $\div$ Pulse Period

	Pulse Duty Cycle < 100% × (1-2*Minimum Pulse Width ÷ Pulse Period)	
Syntax	SOURCE[1 2]:PULSe:DCYClE{<percent> MINimum MAXimum}	
Example	SOURCE1:PULS:DCYC MAX Sets the duty to the maximum allowed.	
Query Syntax	SOURCE1:PULSe:DCYClE? [MINimum MAXimum]	
Return Parameter	<NR3>	0.01%~99.99%(limited by the current frequency setting)
Example	SOURCE1:PULS:DCYC? +1.0000E+01 The duty cycle is set to 10%	

SOURCE[1|2]:PULSe:TRANSition:LEADIng Source Specific Command

Description	Sets or queries the pulse leading edge time. The default rise time is 1.953us. The leading and trailing edge time can be different.	
Note	The leading edge time is limited by the pulse width as noted below: Leading/Trailing Edge Time ≤ 0.625 × Pulse Width	
Syntax	SOURCE[1 2]:PULSe:TRANSition:LEADIng {<seconds> MINimum MAXimum}	
Example	SOURCE1:PULS:TRANSition:LEADIng MAX Sets the pulse transition trailing to the maximum allowed.	
Query Syntax	SOURCE[1 2]:PULSe:TRANSition:LEADIng? [MINimum MAXimum]	

Return Parameter	<seconds>	$\geq 32\text{ns}$ (8ns AFG- 4235/4260/4280/4210H, 7ns AFG-4225H. limited by the current frequency and pulse width settings)
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Example	SOURCE1:PULS:TRANSition:LEADIng? +8.0000E-08 The pulse transition trailing is set to 80 nanoseconds.
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		Source Specific Command
SOURCE[1 2]:PULSe:TRANSition:TRAlIng		
Description	Sets or queries the pulse trailing edge time. The default rise time is 10ns. The leading and trailing edge time can be different.	
Note	The trailing edge time is limited by the pulse width as noted below: Leading/Trailing Edge Time $\leq 0.625 \times$ Pulse Width	
Syntax	SOURCE[1 2]:PULSe:TRANSition:TRAlIng {<seconds> MINimum MAXimum}	
Example	SOURCE1:PULS:TRANSition:TRAlIng MAX Sets the pulse transition trailing to the maximum allowed.	
Query Syntax	SOURCE[1 2]:PULSe:TRANSition:TRAlIng? [MINimum MAXimum]	

Return Parameter	<seconds>	$\geq 32\text{ns}$ (8ns AFG- 4235/4260/4280/4210H, 7ns AFG-4225H. limited by the current frequency and pulse width settings)
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Example **SOURCE1:PULS:TRANSition:TRAILing?**
 +8.0000E-08
 The pulse transition trailing is set to 80
 nanoseconds.

Harmonic Commands

SOURCE[1 2]:HARMonic:TOTAL		Source Specific Command
Description	Sets the highest order harmonic for the harmonic output. By default this is set to 2.	
Note	SOURCE[1 2]:HARMonic:TOTAL{<id> MINimum MAXimum}	
Syntax	SOURCE[1 2]:HARMonic:TOTAL{<id> MINimum MAXimum}	
Example	SOUR1:HARMonic:TOTAL MAX Sets the highest order harmonic to the maximum allowed.	
Query Syntax	SOURCE[1 2]:HARMonic:TOTAL? [MINimum MAXimum]	
Return Parameter	<NR1>	2-16
Example	SOUR1:HARM:TOTAL? MIN 2 Returns the minimum harmonic.	

SOURce[1 2]:HARMonic:TYPE		Source Specific Command
Description	Specifies which harmonics are output; odd, even, all or user specified.	
Syntax	SOURce[1 2]:HARMonic:TYPE {EVEN ODD ALL USER,10000001}	
Example	SOURce1:HARMonic:TYPE USER,11000001 Outputs only the 2 nd and 8 th harmonic. (1 st harmonic is the fundamental frequency)	
Query Syntax	SOURce[1 2]:HARMonic:TYPE?	
Parameter /Return Parameter	<EVEN>	Output all even orders
	<ODD>	Output all odd orders
	<ALL>	Output all orders, subject to the number specified in "SOURce[1 2]:HARMonic:TOTAL" command.
	<USER X ₁ X ₂ X ₃ X ₄ X ₅ X ₆ X ₇ X ₈ >	Outputs only the specified orders, where X = Boolean (0, 1) X _x = order number.
Example	SOUR1:HARM:TYPE? EVEN Returns EVEN harmonic.	

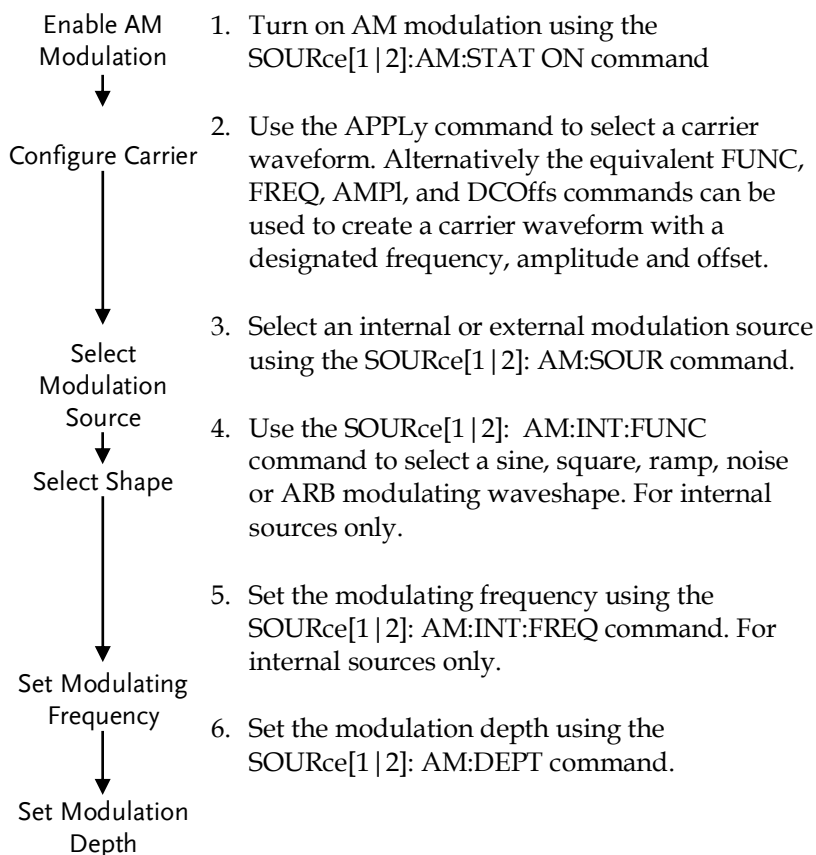
SOURce[1 2]:HARMonic:ORDER		Source Specific Command
Description	Sets or queries the amplitude and phase of each order. By default, each order is set to 1V _{pp} , with a phase of 0°.	
Syntax	SOURce[1 2]:HARMonic:ORDER {<id>,<amplitude>,<phase>}	
Example	SOURce1:HARMonic:ORDER 2,3,0,180	

	Sets the 2 nd harmonic to 3.0Vpp and a phase of 180°.	
Query Syntax	SOURce[1 2]:HARMonic:ORDEr? <id> Returns the <id>,<amplitude>,<phase>.	
Parameter /Return Parameter	<id>	<NR1> Order number: 2 -16
	<amplitude>	<NR2> Amplitude of the selected order: 1mV ~ 10V (50ohm impedance)
	<phase>	<NR3> Phase: 0 ~ 360°
Example	SOUR1:HARM:ORDE? 2 Order 2 :3.000E+00,1.800E+02 Returns the 2 nd harmonic settings as 3Vpp with a phase of 180°.	

Amplitude Modulation (AM) Commands

AM Overview

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



SOURce[1 2]:AM:STATe		Source Specific Command
Description	Sets or disables AM modulation. By default AM modulation is disabled. AM modulation must be enabled before setting other parameters.	
Note	Burst or sweep mode will be disabled if AM modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when AM modulation is enabled.	
Syntax	SOURce[1 2]:AM:STATe {OFF ON}	
Example	SOUR1:AM:STAT ON Enables AM modulation.	
Query Syntax	SOURce[1 2]:AM:STATe?	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	SOUR1:AM:STAT? 1 AM modulation mode is currently enabled.	

SOURce[1 2]:AM:SOURce		Source Specific Command
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 $\pm 1V$ from the MOD INPUT terminal on the rear panel. For example, if modulation depth is set to 100%, then the maximum amplitude is +1V, and the minimum amplitude is -1V.	
Syntax	SOURce[1 2]:AM:SOURce {INTernal EXTernal}	
Example	SOUR1:AM:SOUR EXT	

Sets the modulation source to external.

Query Syntax **SOURce[1|2]:AM:SOURce?**

Return Parameter	INT	Internal
	EXT	External

Example **SOUR1:AM:SOUR?**
INT

The modulation source is set to internal.

SOURce[1|2]:AM:INTernal:FUNCTION Source Specific Command

Description Sets the shape of the modulating waveform from sine, square, ramp, noise and ARB. The default shape is sine.

Note Square and ramp waveforms have a 50% duty cycle.

Syntax **SOURce[1|2]:AM:INTernal:FUNCTION {SINusoid|SQUare|Ramp|Noise|ARB}**

Example **SOUR1:AM:INT:FUNC SIN**

Sets the AM modulating wave shape to sine.

Query Syntax **SOURce[1|2]:AM:INTernal:FUNCTION?**

Return Parameter	SIN	Sine	NOISE	Noise
	SQU	Square	ARB	ARB
	RAMP	Ramp		

Example **SOUR1:AM:INT:FUNC?**
SIN

The shape for the modulating waveform is Sine.

SOURce[1 2]:AM:INTernal:FREQuency		Source Specific Command
Description	Sets the frequency of the internal modulating waveform only. The default frequency is 100Hz.	
Syntax	SOURce[1 2]:AM:INTernal:FREQuency {<frequency> MINimum MAXimum}	
Parameter	<frequency>	2 mHz~ 1MHz
Example	SOUR1:AM:INT:FREQ +1.0000E+02 Sets the modulating frequency to 100Hz.	
Query Syntax	SOURce[1 2]:AM:INTernal:FREQuency? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	SOUR1:AM:INT:FREQ? +1.0000000E+02 Returns the frequency to 100Hz.	

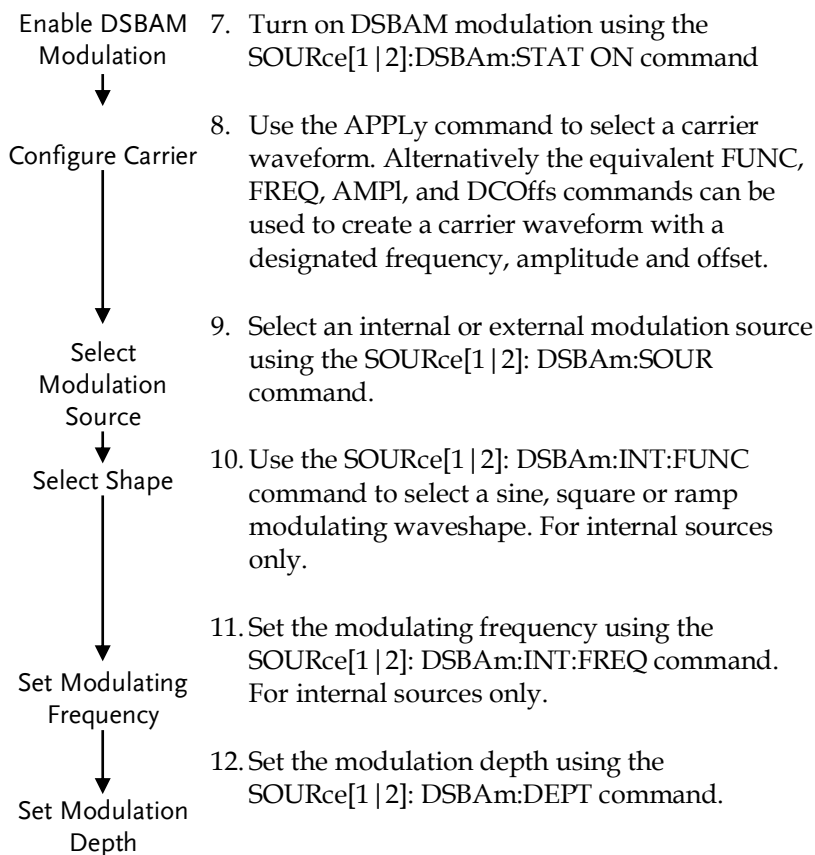
SOURce[1 2]:AM:DEPT h		Source Specific Command
Description	Sets or queries the modulation depth for internal sources only. The default is 100%.	
Note	The function generator will not output more than $\pm 5V$, regardless of the modulation depth. The modulation depth of an external source is controlled using the $\pm 1V$ MOD INPUT terminal on the rear panel, and not the SOURce[1 2]:AM:DEPT h command.	
Syntax	SOURce[1 2]:AM:DEPT h {<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 2]:AM:DEPT? [MINimum MAXimum]	
Return Parameter	<NR3>	Return the modulation depth as a percentage.
Example	SOUR1:AM:DEPT? +5.0000E+01 The modulation depth is 50%.	

Double-sideband amplitude Modulation (DSBAM) Commands

DSBAM Overview

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



SOURce[1|2]:DSBAm:STATe Source Specific Command

Description	Sets or disables DSBAM modulation. By default DSBAM modulation is disabled. DSBAM modulation must be enabled before setting other parameters.	
Note	Burst or sweep mode will be disabled if DSBAM modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when DSBAM modulation is enabled.	
Syntax	SOURce[1 2]:DSBAm:STATe {OFF ON}	
Example	SOUR1:DSBA:STAT ON Enables DSBAM modulation.	
Query Syntax	SOURce[1 2]:DSBAm:STATe?	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	SOUR1:DSBA:STAT? 1 DSBAM modulation mode is currently enabled.	

SOURce[1|2]:DSBAm:SOURce Source Specific Command

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 $\pm 1V$ from the MOD INPUT terminal on the rear panel. For example, if modulation depth is set to 100%, then the maximum amplitude is +1V, and the minimum amplitude is -1V.	
Syntax	SOURce[1 2]:DSBAm:SOURce {INTernal EXTernal}	

Example	SOUR1:DSBA:SOUR EXT	
	Sets the modulation source to external.	
Query Syntax	SOURce[1 2]:DSBAm:SOURce?	
Return Parameter	INT	Internal
	EXT	External
Example	SOUR1:DSBA:SOUR?	
	INT	
	The modulation source is set to internal.	

SOURce[1|2]:DSBAm:INTernal:FUNCtion Source Specific Command

Description	Sets the shape of the modulating waveform from sine, square and ramp. The default shape is sine.		
Note	Square and ramp waveforms have a 50% duty cycle.		
Syntax	SOURce[1 2]:DSBAm:INTernal:FUNCtion {SINusoid SQUare Ramp}		
Example	SOUR1:DSBA:INT:FUNC SIN		
	Sets the AM modulating wave shape to sine.		
Query Syntax	SOURce[1 2]:DSBAm:INTernal:FUNCtion?		
Return Parameter	SIN	Sine	
	SQU	Square	
	RAMP	Ramp	
Example	SOUR1:DSBA:INT:FUNC?		
	SIN		
	The shape for the modulating waveform is Sine.		

Source Specific Command

SOURce[1|2]:DSBAm:INTernal:FREQuency

Description	Sets the frequency of the internal modulating waveform only. The default frequency is 100Hz.	
Syntax	SOURce[1 2]:DSBAm:INTernal:FREQuency {<frequency> MINimum MAXimum}	
Parameter	<frequency>	2 mHz~ 1MHz
Example	SOUR1:DSBA:INT:FREQ +1.0000E+02 Sets the modulating frequency to 100Hz.	
Query Syntax	SOURce[1 2]:DSBAm:INTernal:FREQuency? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	SOUR1:DSBA:INT:FREQ? +1.0000000E+02 Returns the frequency to 100Hz.	

Source Specific Command

SOURce[1|2]:DSBAm:DEPTh

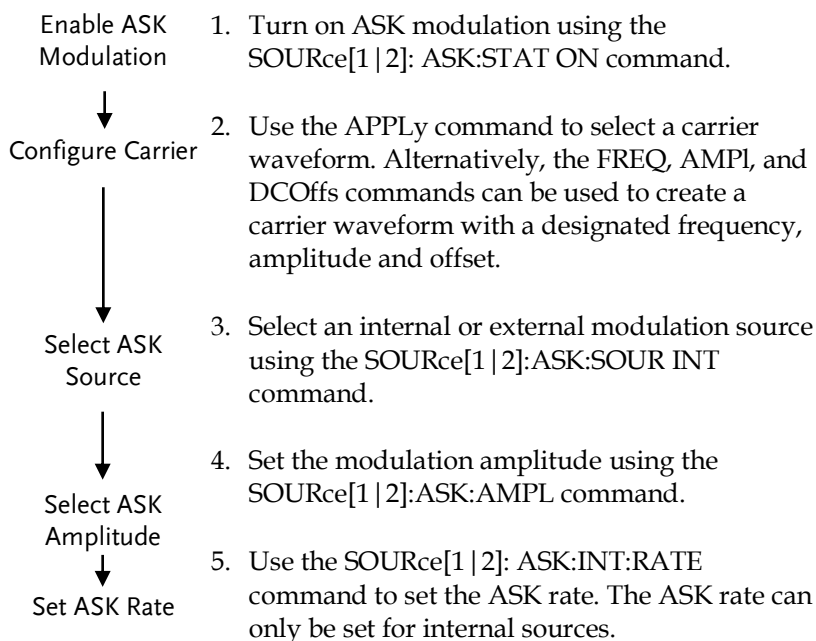
Description	Sets or queries the modulation depth for internal sources only. The default is 100%.	
Note	The function generator will not output more than $\pm 5V$, regardless of the modulation depth. The modulation depth of an external source is controlled using the $\pm 1V$ MOD INPUT terminal on the rear panel, and not the SOURce[1 2]:DSBAm:DEPT h command.	
Syntax	SOURce[1 2]:DSBAm:DEPT h {<depth in percent> MINimum MAXimum}	
Parameter	<depth in percent>	0~100%
Example	SOUR1:DSBAm:DEPT 50 Sets the modulation depth to 50%.	

Query Syntax	SOURce[1 2]:DSBAm:DEPT? [MINimum MAXimum]	
Return Parameter	<NR3>	Return the modulation depth as a percentage.
Example	SOUR1:DSBAm:DEPT? +5.0000E+01 The modulation depth is 50%.	

Amplitude Shift Keying (ASK) Commands

ASK Overview

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



SOURce[1 2]:ASKey:STATe		Source Specific Command
Description	Turn on or off the ASK modulation function of the specified channel. Query the on/off status of the ASK modulation function of the specified channel.	
Note	Burst or sweep mode will be disabled if ASK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when ASK modulation is enabled.	

Syntax	SOUR[1 2]:ASK:STATe {OFF ON}	
Example	SOUR1:ASK:STAT ON Enables ASK modulation.	
Query Syntax	SOUR1:ASK:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:ASK:STAT? ON ASK modulation mode is currently enabled.	

SOURce[1|2]:ASKey:SOURce Source Specific Command

Description	Sets or queries the ASK source as internal or external. Internal is the default source.	
Syntax	SOURce[1 2]:ASKey:SOURce {INTernal EXTernal}	
Example	SOUR1:ASK:SOUR EXT Sets the ASK source to external.	
Query Syntax	SOURce[1 2]:ASKey:SOURce?	
Return Parameter	INTernal	Internal
	EXTernal	External
Example	SOUR1:ASK:SOUR? EXTernal The ASK source is set to external.	

SOURce[1|2]:ASK:AMPlitude Source Specific Command

Description	Sets or queries the ASK amplitude. The default modultaion amplitude is set to 1V.	
Note	For ASK, the modulating waveform is a square wave with a duty cycle of 50%.	

Syntax	SOURce[1 2]:ASKey:AMPlitude {<voltage> MINimum MAXimum}	
Parameter	<amplitude>	0V~ current amplitude of the carrier waveform
Example	SOUR1:ASK:AMPlitude 0.5V Sets the ASK amplitude to 0.5V.	
Query Syntax	SOURce[1 2]:ASKey: AMPlitude? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the modulation amplitude in mV.
Example	SOUR1:ASK:AMPlitude? 5.000E+02 Returns depth to 0.5V.	

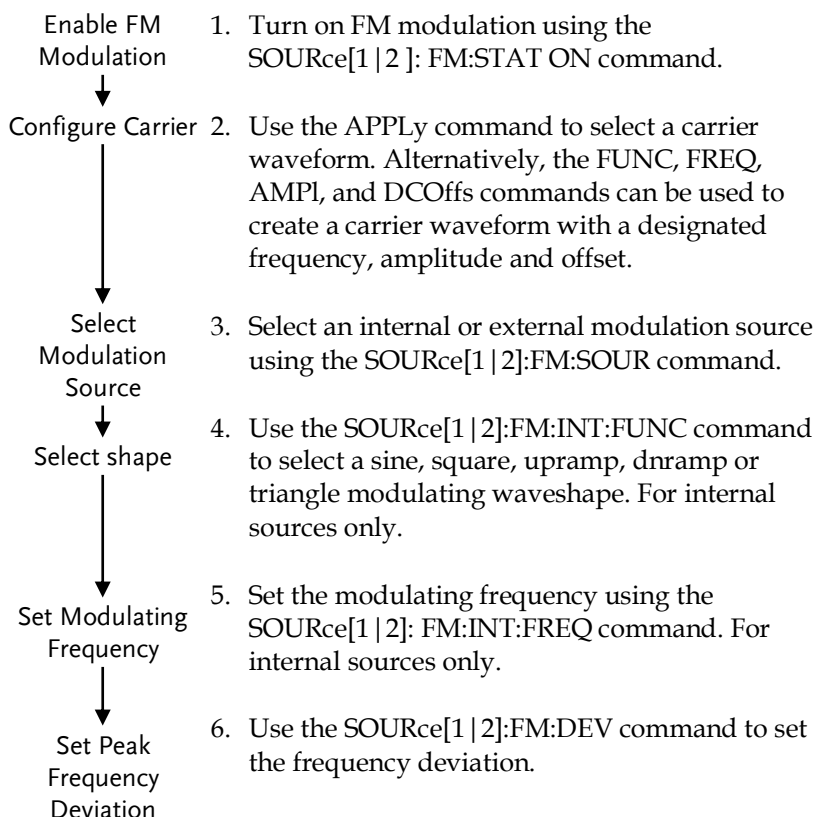
SOURce[1|2]:ASKey:INTernal RATE Source Specific Command

Description	Sets or queries the ASK rate for internal sources only.	
Note	External sources will ignore this command.	
Syntax	SOURce[1 2]:ASKey:INTernal:RATE {<rate in Hz> MINimum MAXimum}	
Parameter	<rate in Hz>	2 mHz~1MHz
Example	SOUR1:ASK:INT:RATE MAX Sets the rate to the maximum (1MHz).	
Query Syntax	SOURce[1 2]:ASKey:INTernal:RATE? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the ASK rate in Hz.
Example	SOUR1:ASK:INT:RATE? +1.0000E+06 Returns the maximum ASK rate allowed.	

Frequency Modulation (FM) Commands

FM Overview

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



Source Specific Command

SOURce[1|2]:FM:STATe

Description	Sets or disables FM modulation. By default FM modulation is disabled. FM modulation must be enabled before setting other parameters.	
Note	Burst or sweep mode will be disabled if FM modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when FM modulation is enabled.	
Syntax	SOUR[1 2]:FM:STATe {OFF ON}	
Example	SOUR1:FM:STAT ON Enables FM modulation.	
Query Syntax	SOURce[1 2]:FM:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:FM:STAT? ON FM modulation mode is currently enabled.	

Source Specific Command

SOURce[1|2]:FM:SOURce

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 $\pm 1V$ from the MOD INPUT terminal on the rear panel. For example, if modulation depth is set to 100%, then the maximum amplitude is +1V, and the minimum amplitude is -1V.	
Syntax	SOURce[1 2]:FM:SOURce {INTernal EXTernal}	

Example	SOUR1:FM:SOUR EXT Sets the modulation source to external.	
Query Syntax	SOURce[1 2]:FM:SOURce?	
Return Parameter	INTernal	Internal
	EXTernal	External
Example	SOUR1:FM:SOUR? INTernal The modulation source is set to internal.	

SOURce[1|2]:FM:INTernal:FUNCtion Source Specific Command

Description	Sets the shape of the modulating waveform from sine, square, ramp, noise and ARB. The default shape is sine.			
Note	Square and Ramp waveforms have a 50% duty cycle.			
Syntax	SOURce[1 2]:FM:INTernal:FUNCtion {SINusoid SQUare RAMP NOISe USER}			
Example	SOUR1:FM:INT:FUNC SIN Sets the FM modulating wave shape to sine.			
Query Syntax	SOURce[1 2]:FM:INTernal:FUNCtion?			
Return Parameter	SIN	Sine	NOISe	Noise
	SQUare	Square	ARB	ARB
	RAMP	Ramp		
Example	SOUR1:FM:INT:FUNC? SIN The shape for the modulating waveform is Sine.			

SOURce[1 2]:FM:INTernal:FREQuency		Source Specific Command
Description	Sets the frequency of the internal modulating waveform only. The default frequency is 100Hz.	
Syntax	SOURce[1 2]:FM:INTernal:FREQuency {<frequency> MINimum MAXimum}	
Parameter	<frequency>	2 mHz~ 1 MHz
Example	SOUR1:FM:INT:FREQ 100 Sets the modulating frequency to 100Hz.	
Query Syntax	SOURce[1 2]:FM:INTernal:FREQuency? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	SOUR1:FM:INT:FREQ? +1.0000E+02 Returns the frequency to 100Hz.	
SOURce[1 2]:FM:DEVIation		Source Specific Command
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 $\pm 1V$ MOD INPUT terminal on the rear panel. A positive signal ($>0 \sim +1V$) 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. 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.

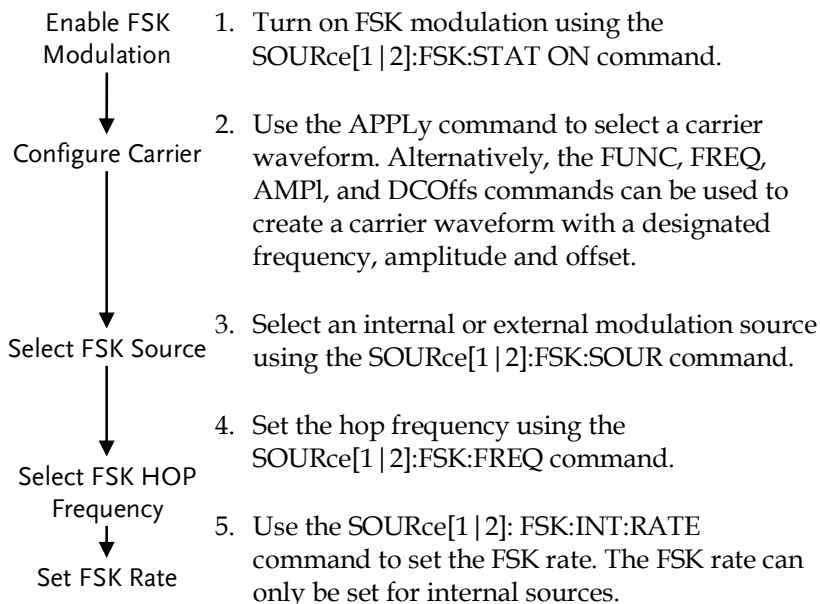
For square wave carrier waveforms, the deviation may cause the duty cycle frequency boundary to be exceeded. In these conditions the duty cycle will be adjusted to the maximum allowed and a “settings conflict” error will be generated.

Syntax	SOURce[1 2]:FM:DEVIation {<peak deviation in Hz> MINimum MAXimum}	
Parameter	<peak deviation in Hz>	DC to Max Frequency
Example	SOUR1:FM:DEV MAX Sets the frequency deviation to the maximum value allowed.	
Query Syntax	SOURce[1 2]:FM:DEVIation? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the frequency deviation in Hz.
Example	SOURce1:FM:DEVIation? MAX +1.0000E+01 Returns the maximum frequency deviation allowed.	

Frequency-Shift Keying (FSK) Commands

FSK Overview

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



<code>SOURce[1 2]:FSKey:STATe</code>		Source Specific Command
Description	Turns FSK Modulation on or off. By default FSK modulation is off.	
Note	Burst or sweep mode will be disabled if FSK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when FSK modulation is enabled.	
Syntax	<code>SOURce[1 2]:FSKey:STATe {OFF ON}</code>	
Example	<code>SOUR1:FSK:STAT ON</code>	

	Enables FSK modulation	
Query Syntax	SOURce[1 2]:FSKey:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:FSK:STAT? ON FSK modulation is currently enabled.	

SOURce[1|2]:FSKey:SOURce Source Specific Command

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 terminal on the rear panel.	
Syntax	SOURce[1 2]:FSKey:SOURce {INTernal EXTernal}	
Example	SOUR1:FSK:SOUR INT Sets the FSK source to internal.	
Query Syntax	SOURce[1 2]:FSKey:SOURce?	
Return Parameter	INTernal	Internal
	EXTernal	External
Example	SOUR1:FSK:SOUR? INTernal The FSK source is set to internal.	

SOURce[1|2]:FSKey:FREQuency Source Specific Command

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 2]:FSKey:FREQuency {<frequency> MINimum MAXimum}	
Parameter	<frequency>	1 μ Hz to Max Frequency
Example	SOUR1:FSK:FREQ +1.0000E+02 Sets the FSK hop frequency to to 100Hz.	
Query Syntax	SOURce[1 2]:FSKey:FREQuency? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	SOUR1:FSK:FREQ? +1.000000000000E+02 Returns the frequency to 100Hz.	

SOURce[1|2]:FSKey:INTernal:RATE Source Specific Command

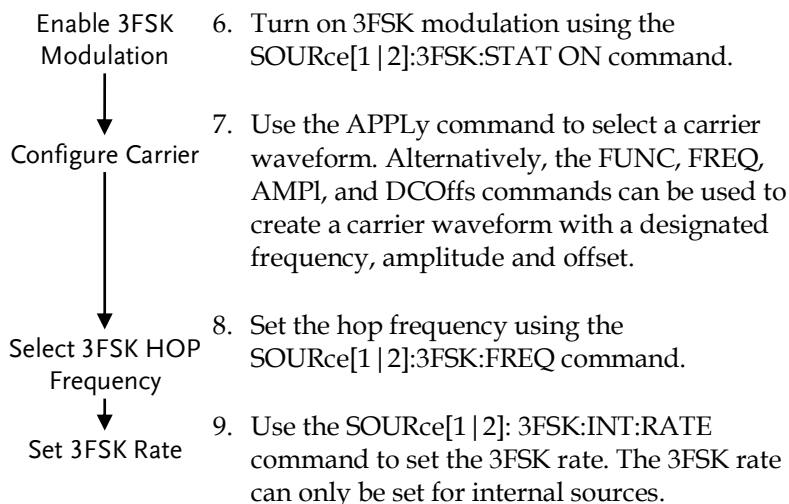
Description	Sets or queries the FSK rate for internal sources only.	
Note	External sources will ignore this command.	
Syntax	SOURce[1 2]:FSKey:INTernal:RATE {<rate in Hz> MINimum MAXimum}	
Parameter	<rate in Hz>	2 mHz~1MHz
Example	SOUR1:FSK:INT:RATE MAX Sets the rate to the maximum (1MHz).	
Query Syntax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

Example **SOUR1:FSK:INT:RATE? MAX**
 +1.000000000E+06
 Returns the maximum FSK rate allowed.

3Frequency-Shift Keying (3FSK) Commands

3FSK Overview

The following is an overview of the steps required to generate an 3FSK modulated waveform.



SOURce[1 2]:3FSKey:STATe		Source Specific Command
Description	Turns 3FSK Modulation on or off. By default 3FSK modulation is off.	
Note	Burst or sweep mode will be disabled if 3FSK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when 3FSK modulation is enabled.	

Syntax	SOURce[1 2]:3FSKey:STATe {OFF ON}	
Example	SOUR1:3FSK:STAT ON Enables 3FSK modulation	
Query Syntax	SOURce[1 2]:3FSKey:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:3FSK:STAT? ON 3FSK modulation is currently enabled.	

SOURce[1|2]:3FSKey:FREQuency Source Specific Command

Description	Sets the 3FSK hop frequency. The default hop frequency is set to 100Hz.	
Note	For 3FSK, the modulating waveform is a square wave with a duty cycle of 50%.	
Syntax	SOURce[1 2]:3FSKey:FREQuency <n>,{<frequency> MINimum MAXimum}	
Parameter	<frequency>	1 μ Hz to Max Frequency
Example	SOUR1:3FSK:FREQ 1,+1.0000E+02 Sets the 3FSK hop1 frequency to 100Hz.	
Query Syntax	SOURce[1 2]:3FSKey:FREQuency? <n>,[MINimum MAXimum]	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	SOUR1:3FSK:FREQ? 1 +1.000000000000E+02 Returns the hop1 frequency to 100Hz.	

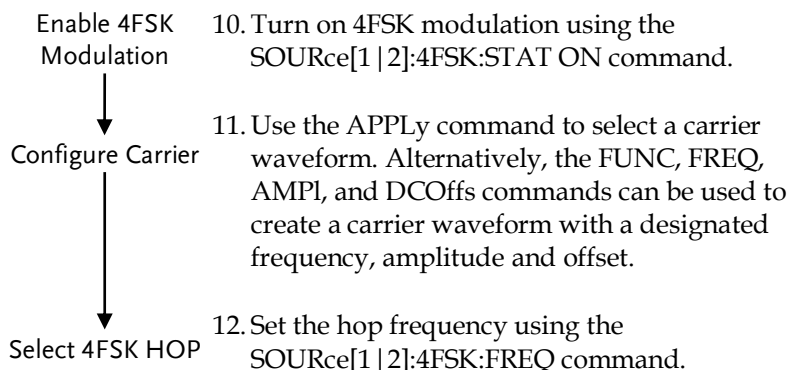
SOURce[1|2]:3FSKey:INTernal:RATE Source Specific Command

Description	Sets or queries the 3FSK rate for internal sources only.	
Syntax	SOURce[1 2]:3FSKey:INTernal:RATE {<rate in Hz> [MINimum MAXimum]}	
Parameter	<rate in Hz>	2 mHz~1MHz
Example	SOUR1:3FSK:INT:RATE MAX Sets the rate to the maximum (1MHz).	
Query Syntax	SOURce[1 2]:3FSKey:INTernal:RATE? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the 3FSK rate in Hz.
Example	SOUR1:3FSK:INT:RATE? MAX +1.000000000E+06 Returns the maximum 3FSK rate allowed.	

4Frequency-Shift Keying (4FSK) Commands

4FSK Overview

The following is an overview of the steps required to generate an 4FSK modulated waveform.



Frequency
↓
Set 4FSK Rate

13. Use the **SOURCE[1|2]:4FSK:INT:RATE** command to set the 4FSK rate. The 4FSK rate can only be set for internal sources.

SOURCE[1 2]:4FSK:STATe		Source Specific Command
Description	Turns 4FSK Modulation on or off. By default 4FSK modulation is off.	
Note	Burst or sweep mode will be disabled if 4FSK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when 4FSK modulation is enabled.	
Syntax	SOURCE[1 2]:4FSK:STATe {OFF ON}	
Example	SOURCE1:4FSK:STAT ON Enables 4FSK modulation	
Query Syntax	SOURCE[1 2]:4FSK:STATe?	
Return Parameter	OFF ON	Disabled (OFF) Enabled (ON)
Example	SOURCE1:4FSK:STAT? ON 4FSK modulation is currently enabled.	

SOURCE[1 2]:4FSK:FREQuency		Source Specific Command
Description	Sets the 4FSK hop frequency. The default hop frequency is set to 100Hz.	
Note	For 4FSK, the modulating waveform is a square wave with a duty cycle of 50%.	
Syntax	SOURCE[1 2]:4FSK:FREQuency <n>,{<frequency> MINimum MAXimum}	
Parameter	<frequency>	1 μ Hz to Max Frequency

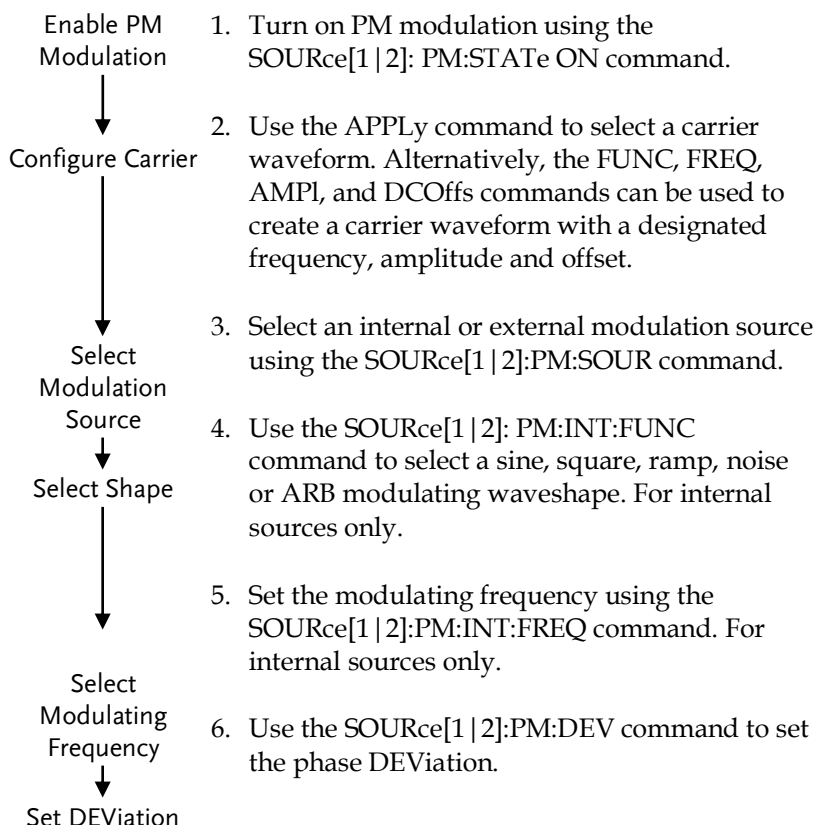
Example	SOUR1:4FSK:FREQ 1,+1.0000E+02 Sets the 4FSK hop1 frequency to 100Hz.	
Query Syntax	SOURce[1 2]:4FSKey:FREQuency? <n> [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	SOUR1:4FSK:FREQ? 1 +1.000000000000E+02 Returns the hop1 frequency to 100Hz.	

SOURce[1 2]:4FSKey:INTernal:RATE		Source Specific Command
Description	Sets or queries the 4FSK rate for internal sources only.	
Syntax	SOURce[1 2]:4FSKey:INTernal:RATE {<rate in Hz> [MINimum MAXimum]}	
Parameter	<rate in Hz>	2 mHz~1MHz
Example	SOUR1:4FSK:INT:RATE MAX Sets the rate to the maximum (1MHz).	
Query Syntax	SOURce[1 2]:4FSKey:INTernal:RATE? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the 4FSK rate in Hz.
Example	SOUR1:4FSK:INT:RATE? MAX +1.000000000E+06 Returns the maximum 4FSK rate allowed.	

Phase Modulation (PM) Commands

PM Overview

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



Source Specific Command

SOURce[1|2]:PM:STATe

Description	Turns PM Modulation on or off. By default PM modulation is off.	
Note	Burst or sweep mode will be disabled if PM modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when PM modulation is enabled.	
Syntax	SOURce[1 2]:PM:STATe {OFF ON}	
Example	SOUR1:PM:STAT ON Enables PM modulation	
Query Syntax	SOURce[1 2]:PM:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:PM:STAT? ON PM modulation is currently enabled.	

Source Specific Command

SOURce[1|2]:PM:SOURce

Description	Sets or queries the PM source as internal or external. Internal is the default source.	
Note	If an external PM source is selected, the phase modulation is controlled by the MOD INPUT terminal on the rear panel. .	
Syntax	SOURce[1 2]:PM:SOURce {INTernal EXTernal}	
Example	SOUR1:PM:SOUR INT Sets the PM source to internal.	
Query Syntax	SOURce[1 2]:PM:SOURce?	

Return Parameter	INternal	Internal
	EXternal	External

Example **SOUR1:PM:SOUR?**

INternal

The PM source is set to internal.

SOURce[1|2]:PM:INternal:FUNction Source Specific Command

Description Sets the shape of the modulating waveform from sine, square, ramp, noise and ARB. The default shape is sine.

Note Square and ramp waveforms have a 50% duty cycle.

Syntax **SOURce[1|2]:PM:INternal:FUNction**
{SINusoid|SQUare|RAMP|NOISe|USER}

Example **SOUR1:PM:INT:FUNC SIN**

Sets the PM modulating wave shape to sine. .

Query Syntax **SOURce[1|2]:PM:INternal:FUNction?**

Return Parameter	SIN	Sine	NOISe	Noise
	SQUare	Square	ARB	ARB
	RAMP	Ramp		

Example **SOUR1:PM:INT:FUNC?**

SIN

The shape for the modulating waveform is Sine.

SOURce[1|2]:PM:INternal:FREQuency Source Specific Command

Description Sets the modulating waveform frequency for internal sources. The default frequency is set to 100Hz.

Syntax **SOURce[1|2]:PM:INternal:FREQuency**
{<frequency>|MINimum|MAXimum}

Parameter	<frequency>	2 mHz~ 1MHz
Example	SOUR1:PM:INT:FREQ MAX Sets the frequency to the maximum value.	
Query Syntax	SOURce[1 2]:PM:INTernal:FREQuency?	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	SOUR1:PM:INT:FREQ? +2.0000000E+04 Returns the modulating frequency. (20kHz)	

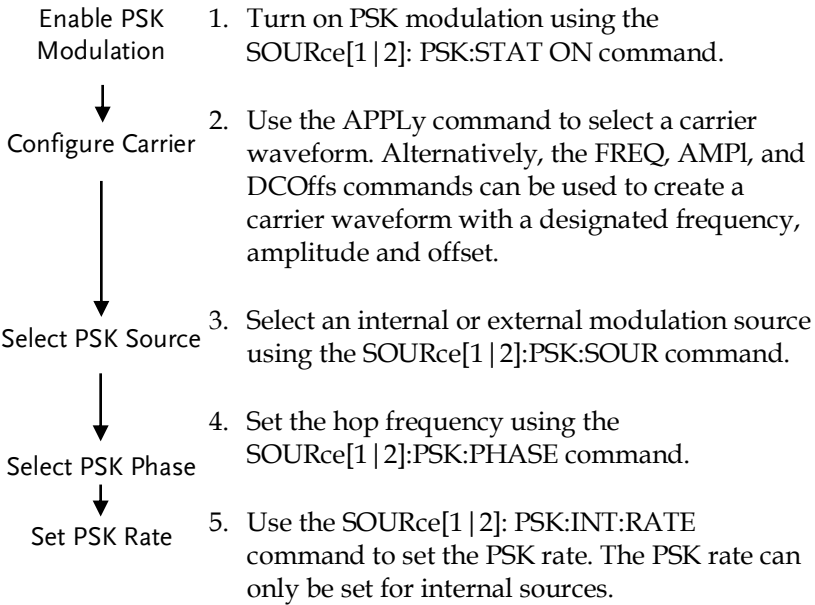
SOURce[1|2]:PM:DEVIation Source Specific Command

Description	Sets or queries the phase deviation of the modulating waveform from the carrier waveform. The default phase deviation is 0°.	
Note	For external sources, the phase deviation is controlled by the ±1V MOD Input terminal on the rear panel. If the phase deviation is set to 180 degrees, then +1V represents a deviation of 180 degrees. A lower input voltage will decrease the set phase deviation.	
Syntax	SOURce[1 2]:PM:DEVIation {< phase> minimum maximum}	
Parameter	<percent>	0°~180°
Example	SOUR1:PM:DEVIation +3.0000E+01 Sets the deviation to 30°.	
Query Syntax	SOURce[1 2]:PM:DEVIation?	
Return Parameter	<NR1>	Returns the deviation .
Example	SOUR1:PM:DEVIation? 30 The current deviation is 30°.	

Phase Shift Keying (PSK) Commands

PSK Overview

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



SOURce[1 2]:PSKey:STATe		Source Specific Command
Description	Turns PSK Modulation on or off. By default PSK modulation is off.	
Note	Burst or sweep mode will be disabled if PSK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when PSK modulation is enabled.	
Syntax	SOURce[1 2]:PSKey:STATe {OFF ON}	
Example	SOUR1:PSK:STAT ON	

	Enables PSK modulation	
Query Syntax	SOURce[1 2]:PSKey:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:PSK:STAT? ON PSK modulation is currently enabled.	

SOURce[1 2]:PSKey:SOURce		Source Specific Command
Description	Sets or queries the PSK source as internal or external. Internal is the default source.	
Note	If an external PSK source is selected, PSK rate is controlled by the Trigger INPUT terminal on the rear panel.	
Syntax	SOURce[1 2]:PSKey:SOURce {INTernal EXTernal}	
Example	SOUR1:PSK:SOUR EXT Sets the PSK source to external.	
Query Syntax	SOURce[1 2]:PSKey:SOURce?	
Return Parameter	INTernal	Internal
	EXTernal	External
Example	SOUR1:PSK:SOUR? INTernal The PSK source is set to internal.	

SOURce[1 2]:PSKey:DEVIation		Source Specific Command
Description	Sets the PSK phase deviation. The default hop frequency is set to 0°.	
Note	For PSK, the modulating waveform is a square wave with a duty cycle of 50%.	

Syntax	SOURce[1 2]:PSKey:DEVitaion {<phase> MINimum MAXimum}	
Parameter	<phase>	0~360°.
Example	SOUR1:PSK:DEV 180 Sets the PSK phase deviation to to 180°.	
Query Syntax	SOURce[1 2]:PSKey:DEViation? [MINimum MAXimum]	
Return Parameter	<DEG>	0~360°.
Example	SOUR1:PSK:DEV? MAX 360° Returns the maximum phase deviation allowed.	

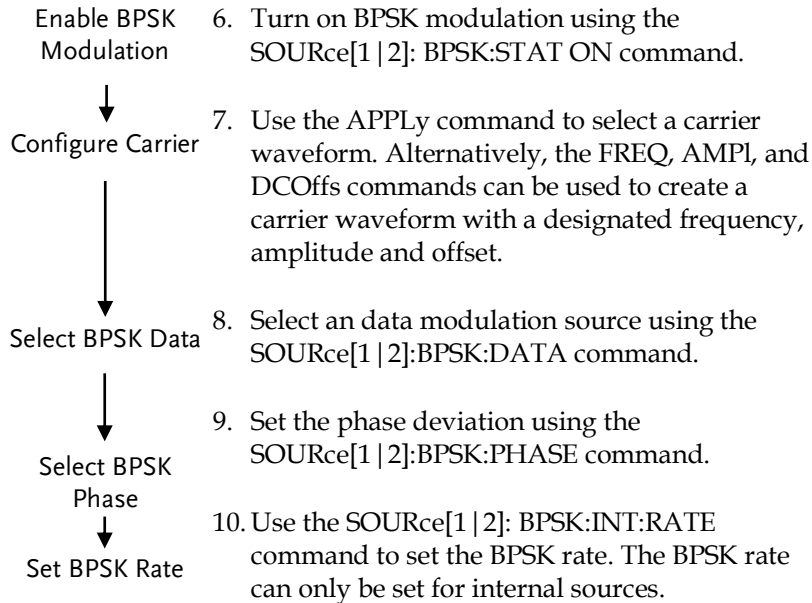
SOURce[1|2]:PSKey:INTernal RATE Source Specific Command

Description	Sets or queries the PSK rate for internal sources only.	
Note	External sources will ignore this command.	
Syntax	SOURce[1 2]:PSKey:INTernal:RATE {<rate in Hz> MINimum MAXimum}	
Parameter	<rate in Hz>	2 mHz~1MHz
Example	SOUR1:PSK:INT:RATE MAX Sets the rate to the maximum (1MHz).	
Query Syntax	SOURce[1 2]:PSKey:INTernal:RATE? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the PSK rate in Hz.
Example	SOUR1:PSK:INT:RATE? MAX +1.0000E+06 Returns the maximum PSK rate allowed.	

Binary Phase Shift Keying (BPSK) Commands

BPSK Overview

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



SOURce[1 2]:BPSKey:STATe		Source Specific Command
Description	Turns BPSK Modulation on or off. By default BPSK modulation is off.	
Note	Burst or sweep mode will be disabled if BPSK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when BPSK modulation is enabled.	
Syntax	SOURce[1 2]:BPSKey:STATe {OFF ON}	

Example	SOUR1:BPSK:STAT ON Enables BPSK modulation	
Query Syntax	SOURce[1 2]:BPSKey:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:BPSK:STAT? ON BPSK modulation is currently enabled.	

SOURce[1|2]:BPSKey:DATA Source Specific Command

Description	Sets or queries the data source of modulation signal of BPSK modulation. PN15 is the default data source.	
Syntax	SOURce[1 2]:BPSKey:DATA {01 10 PN15 PN21}	
Example	SOUR1:BPSK:DATA 01 Sets the BPSK source to 01 pattern.	
Query Syntax	SOURce[1 2]:BPSKey:SOURce?	
Return Parameter	01	01
	10	10
	PN15	PN15
	PN21	PN21
Example	SOUR1:BPSK:DATA? 01 The BPSK source is set to 01 pattern.	

SOURce[1|2]:BPSKey:PHASE Source Specific Command

Description	Sets the BPSK hop frequency. The default hop frequency is set to 180°.
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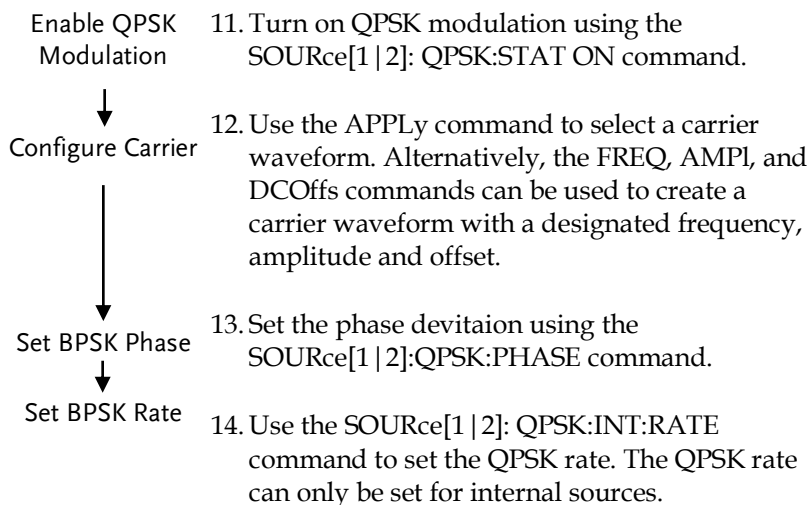
Note	For BPSK, the modulating waveform is a square wave with a duty cycle of 50%.	
Syntax	SOURce[1 2]:BPSKey:PHASe {<phase> MINimum MAXimum}	
Parameter	<phase>	0~360°.
Example	SOUR1:BPSK:PHAS 180 Sets the BPSK phase deviation to to 180°.	
Query Syntax	SOURce[1 2]:BPSKey:PHASe? [MINimum MAXimum]	
Return Parameter	<NR1>	0~360°.
Example	SOUR1:BPSK:PHAS? MAX 360 Returns the maximum phase deviation allowed.	

SOURce[1 2]:BPSKey:INTernal RATE		Source Specific Command
Description	Sets or queries the BPSK rate for internal sources only.	
Syntax	SOURce[1 2]:BPSKey:INTernal:RATE {<rate in Hz> MINimum MAXimum}	
Parameter	<rate in Hz>	2 mHz~1MHz
Example	SOUR1:BPSK:INT:RATE MAX Sets the rate to the maximum (1MHz).	
Query Syntax	SOURce[1 2]:BPSKey:INTernal:RATE? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the BPSK rate in Hz.
Example	SOUR1:BPSK:INT:RATE? MAX +1.0000E+06 Returns the maximum BPSK rate allowed.	

Quadrature Phase Shift Keying (QPSK) Commands

QPSK Overview

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



SOURce[1 2]:QPSKey:STATe		Source Specific Command
Description	Turns QPSK Modulation on or off. By default QPSK modulation is off.	
Note	Burst or sweep mode will be disabled if QPSK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when QPSK modulation is enabled.	
Syntax	SOURce[1 2]:QPSKey:STATe {OFF ON}	

Example	SOUR1:QPSK:STAT ON Enables QPSK modulation	
Query Syntax	SOURce[1 2]:QPSKey:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:QPSK:STAT? ON QPSK modulation is currently enabled.	

SOURce[1|2]:QPSKey:PHASE Source Specific Command

Description	Sets the QPSK phase deviation. The default phase deviation is set to 0°.	
Note	For QPSK, the modulating waveform is a square wave with a duty cycle of 50%.	
Syntax	SOURce[1 2]:QPSKey:PHASe <n>,{<phase> MINimum MAXimum}	
Parameter	<phase>	0~360°.
Example	SOUR1:QPSK:PHAS 1,180 Sets the QPSK phase1 deviation 180°.	
Query Syntax	SOURce[1 2]:QPSKey:PHASe? <n>,[MINimum MAXimum]	
Return Parameter	<NR1>	0~360°.
Example	SOUR1:QPSK:PHAS1? MAX 360° Returns the maximum modulating phase 1 allowed.	

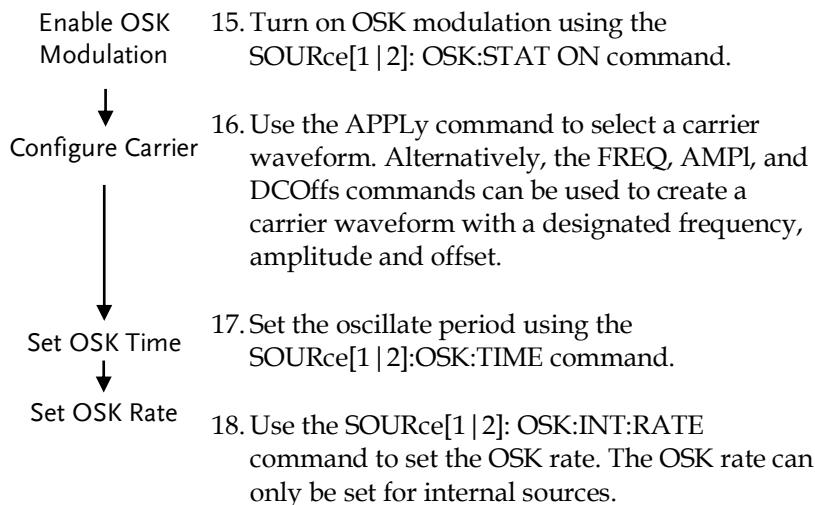
SOURce[1|2]:QPSKey:INTernal RATE Source Specific Command

Description	Sets or queries the QPSK rate for internal sources only.	
Syntax	SOURce[1 2]:QPSKey:INTernal:RATE {<rate in Hz> MINimum MAXimum}	
Parameter	<rate in Hz>	2 mHz~1MHz
Example	SOUR1:QPSK:INT:RATE MAX Sets the rate to the maximum (1MHz).	
Query Syntax	SOURce[1 2]:QPSKey:INTernal:RATE? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the BPSK rate in Hz.
Example	SOUR1:QPSK:INT:RATE? MAX +1.0000E+06 Returns the maximum QPSK rate allowed.	

Output Shift Keying (OSK) Commands

OSK Overview

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



SOURce[1 2]:OSKey:STATe		Source Specific Command
Description	Turns OSK Modulation on or off. By default OSK modulation is off.	
Note	Burst or sweep mode will be disabled if OSK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when OSK modulation is enabled.	
Syntax	SOURce[1 2]:OSKey:STATe {OFF ON}	
Example	SOUR1:OSK:STAT ON Enables OSK modulation	

Query Syntax	SOURce[1 2]:OSKey:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:OSK:STAT? ON OSK modulation is currently enabled.	

SOURce[1|2]:OSKey:TIME Source Specific Command

Description	Sets or queries the OSK oscillate period. The default oscillate period is set to 100us.	
Syntax	SOURce[1 2]:OSKey:TIME {<time> MINimum MAXimum}	
Parameter	< seconds >	8ns~249.75s.
Example	SOUR1:OSK:TIME 100 us Sets the OSK oscillate period to to 100us.	
Query Syntax	SOURce[1 2]:OSKey:TIME? [MINimum MAXimum]	
Return Parameter	<NR3 >	8ns~249.75s.
Example	SOUR1:OSK:TIME? MAX 4.75e-06 Returns the maximum oscillate period allowed.	

SOURce[1|2]:OSKey:INTernal RATE Source Specific Command

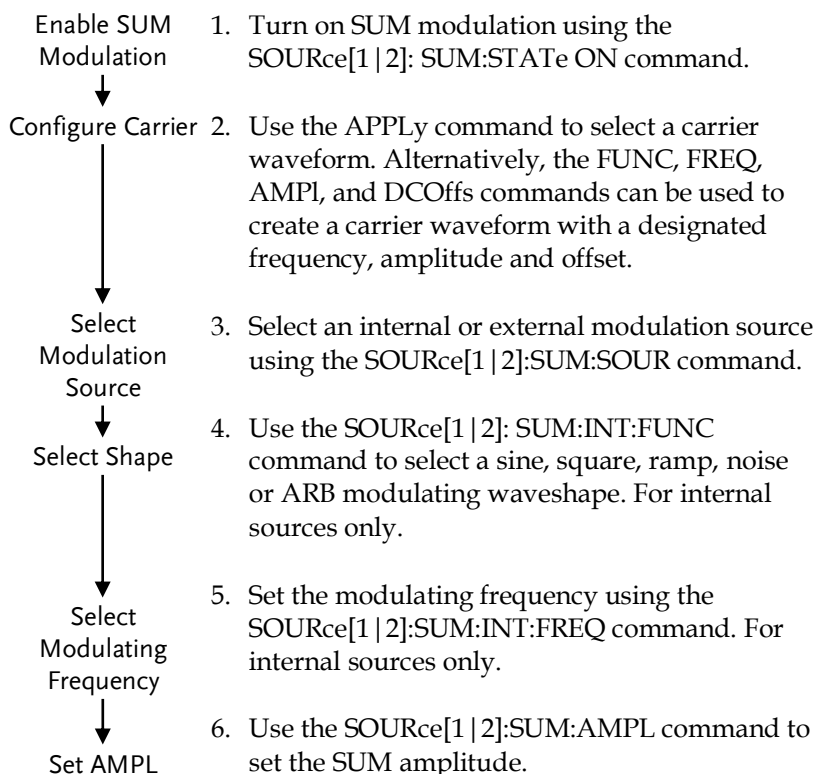
Description	Sets or queries the OSK rate for internal sources only.	
Syntax	SOURce[1 2]:OSKey:INTernal:RATE {<rate in Hz> MINimum MAXimum}	
Parameter	<rate in Hz>	2 mHz~1MHz
Example	SOUR1:OSK:INT:RATE MAX Sets the rate to the maximum (1MHz).	

Query Syntax	SOURce[1 2]:OSKey:INTernal:RATE? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the OSK rate in Hz.
Example	SOUR1:OSK:INT:RATE? MAX +1.0000E+06	
	Returns the maximum OSK rate allowed.	

SUM Modulation (SUM) Commands

SUM Overview

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



SOURce[1|2]:SUM:STATe Source Specific Command

Description	Turns SUM Modulation on or off. By default SUM modulation is off.	
Note	Burst or sweep mode will be disabled if SUM modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when SUM modulation is enabled.	
Syntax	SOURce[1 2]:SUM:STATe {OFF ON}	
Example	SOUR1:SUM:STAT ON Enables SUM modulation	
Query Syntax	SOURce[1 2]:SUM:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:SUM:STAT? ON SUM modulation is currently enabled.	

SOURce[1|2]:SUM:SOURce Source Specific Command

Description	Sets or queries the SUM source as internal or external. Internal is the default source.	
Note	If an external modulation source is selected, the SUM amplitude is limited to $\pm 5V$ from the MOD INPUT terminal on the rear panel. For example, if SUM amplitude is set to 100%, then the maximum amplitude is +5V, and the minimum amplitude is -5V.	
Syntax	SOURce[1 2]:SUM:SOURce {INTernal EXTernal}	
Example	SOUR1:SUM:SOUR INT Sets the SUM source to internal.	

Query Syntax	SOURce[1 2]:SUM:SOURce?	
Return Parameter	INTernal	Internal
	EXTernal	External
Example	SOUR1:SUM:SOUR? INTernal The SUM source is set to internal.	

SOURce[1|2]:SUM:INTernal:FUNction Source Specific Command

Description	Sets the shape of the modulating waveform from sine, square, ramp, noise and ARB. The default shape is sine.			
Syntax	SOURce[1 2]:SUM:INTernal:FUNction {SINusoid SQUare RAMP NOISe USER}			
Example	SOUR1:SUM:INT:FUNC SIN Sets the SUM modulating wave shape to sine.			
Query Syntax	SOURce[1 2]:SUM:INTernal:FUNction?			
Return Parameter	SIN	Sine	NOISe	Noise
	SQUare	Square	ARB	ARB
	RAMP	Ramp		
Example	SOUR1:SUM:INT:FUNC? SIN The shape for the modulating waveform is Sine.			

SOURce[1|2]:SUM:INTernal:FREQuency Source Specific Command

Description	Sets the modulating waveform frequency for internal sources. The default frequency is set to 100Hz.		
Syntax	SOURce[1 2]:SUM:INTernal:FREQuency {<frequency> MINimum MAXimum}		
Parameter	<frequency>	2 mHz~ 1MHz	

Example	SOUR1:SUM:INT:FREQ MAX Sets the frequency to the maximum value.	
Query Syntax	SOURce[1 2]:SUM:INTernal:FREQuency?	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	SOUR1:SUM:INT:FREQ? +2.0000000e+04 Returns the modulating frequency (20kHz).	

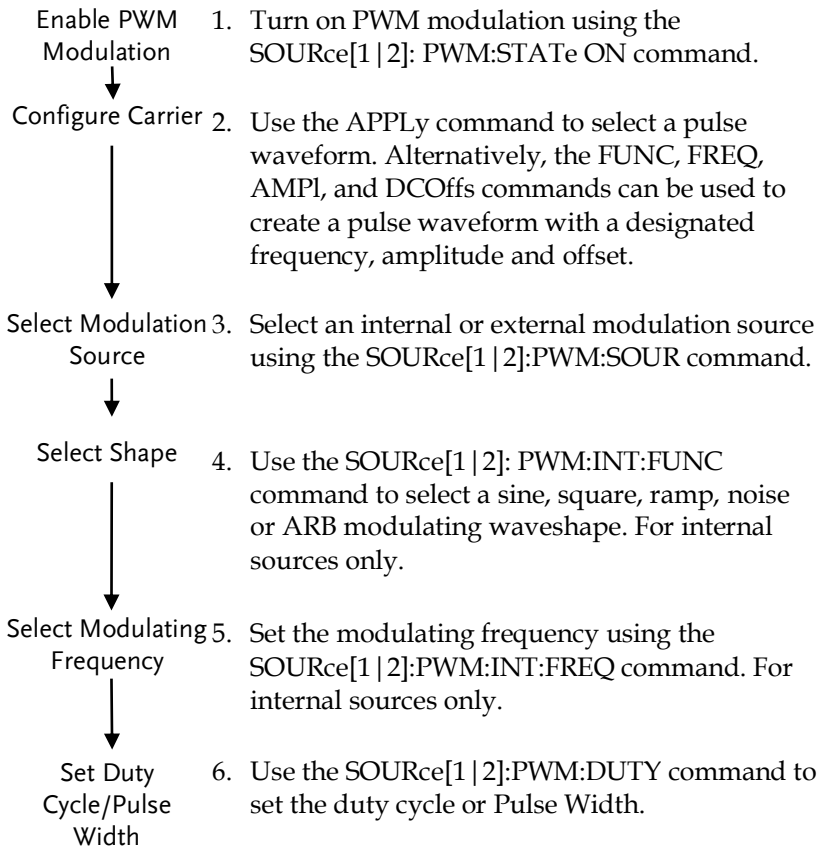
SOURce[1|2]:SUM:AMPL Source Specific Command

Description	The SUM amplitude command sets or queries the amplitude of the modulating waveform as a percentage of the carrier amplitude.	
Syntax	SOURce[1 2]:SUM:AMPL{< percent> minimum maximum}	
Parameter	<percent>	0%~100%
Example	SOUR1:SUM:AMPLitude +3.0000E+01 Sets the amplitude to 30%.	
Query Syntax	SOURce[1 2]:SUM:AMPLitude?	
Return Parameter	<NR3>	Returns the amplitude in % .
Example	SOUR1:SUM:AMPLitude? +3.000E+01 The current amplitude is 30%.	

Pulse Width Modulation (PWM) Commands

PWM Overview

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



SOURce[1 2]: PWM:STATe		Source Specific Command
Description	Turns pulse width modulation on or off. By default PWM is off.	

Note Burst or sweep mode will be disabled if PWM modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when PWM modulation is enabled.

Syntax **SOURce[1|2]:PWM:STATe {OFF|ON}**

Example **SOUR1:PWM:STAT ON**
Enables PWM modulation

Query Syntax **SOURce[1|2]:PWM:STATe?**

Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)

Example **SOUR1:PWM:STAT?**
ON
PWM modulation is currently enabled.

SOURce[1|2]:PWM:SOURce Source Specific Command

Description Sets or queries the PWM source as internal or external. Internal is the default source.

Note If an external PWM source is selected, the duty cycle/pulse width is controlled by the MOD INPUT terminal on the rear panel.

Syntax **SOURce[1|2]:PWM:SOURce {INTernal|EXTernal}**

Example **SOUR1:PWM:SOUR EXT**
Sets the PWM source to external.

Query Syntax **SOURce[1|2]:PWM:SOURce?**

Return Parameter	INTernal	Internal
	EXTernal	External

Example **SOUR1:PWM:SOUR?**
INTernal
The PWM source is set to internal.

SOURce[1|2]:PWM:INTernal:FUNction Source Specific Command

Description	Sets the shape of the modulating waveform from sine, square, ramp, noise and ARB. The default shape is sine.			
Note	Square and triangle waveforms have a 50% duty cycle. Carrier must be a pulse or PWM waveform.			
Syntax	SOURce[1 2]:PWM:INTernal:FUNction {SINusoid SQUare RAMP NOISe USER}			
Example	SOUR1:PWM:INT:FUNC SIN Sets the PWM modulating wave shape to sine.			
Query Syntax	SOURce[1 2]:PWM:INTernal:FUNction?			
Return Parameter	SIN	Sine	NOISe	Noise
	SQUare	Square	ARB	ARB
	RAMP	Ramp		
Example	SOUR1:PWM:INT:FUNC? SIN The shape for the modulating waveform is Sine.			

SOURce[1|2]:PWM:INTernal:FREQuency Source Specific Command

Description	Sets the modulating waveform frequency for internal sources. The default frequency is set to 100Hz.			
Syntax	SOURce[1 2]:PWM:INTernal:FREQuency {<frequency> MINimum MAXimum}			
Parameter	<frequency> 2 mHz~ 1MHz			
Example	SOUR1:PWM:INT:FREQ MAX Sets the frequency to the maximum value.			
Query Syntax	SOURce[1 2]:PWM:INTernal:FREQuency?			

Return Parameter	<NR3>	Returns the frequency in Hz.
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Example **SOUR1:PWM:INT:FREQ? MAX**
+1.0000e+06
Returns the modulating frequency. (1MHz)

SOURce[1|2]:PWM:DUTY Source Specific Command

Description Sets or queries the duty cycle deviation. The default duty cycle is 0%.

Note The duty cycle is limited by period, edge time and minimum pulse width.
The duty cycle deviation of an external source is controlled using the $\pm 1V$ MOD INPUT terminal on the rear panel. A positive signal ($>0 \sim +1V$) will increase the deviation (up to the set duty cycle deviation), whilst a negative voltage will reduce the deviation.

Syntax **SOURce[1|2]:PWM:DUTY {< percent>|minimum |maximum}**

Parameter <percent> 0%~100% (limited, see above)

Example **SOUR1:PWM:DUTY +3.0000E+01**
Sets the duty cycle to 30%.

Query Syntax **SOURce[1|2]:PWM:DUTY?**

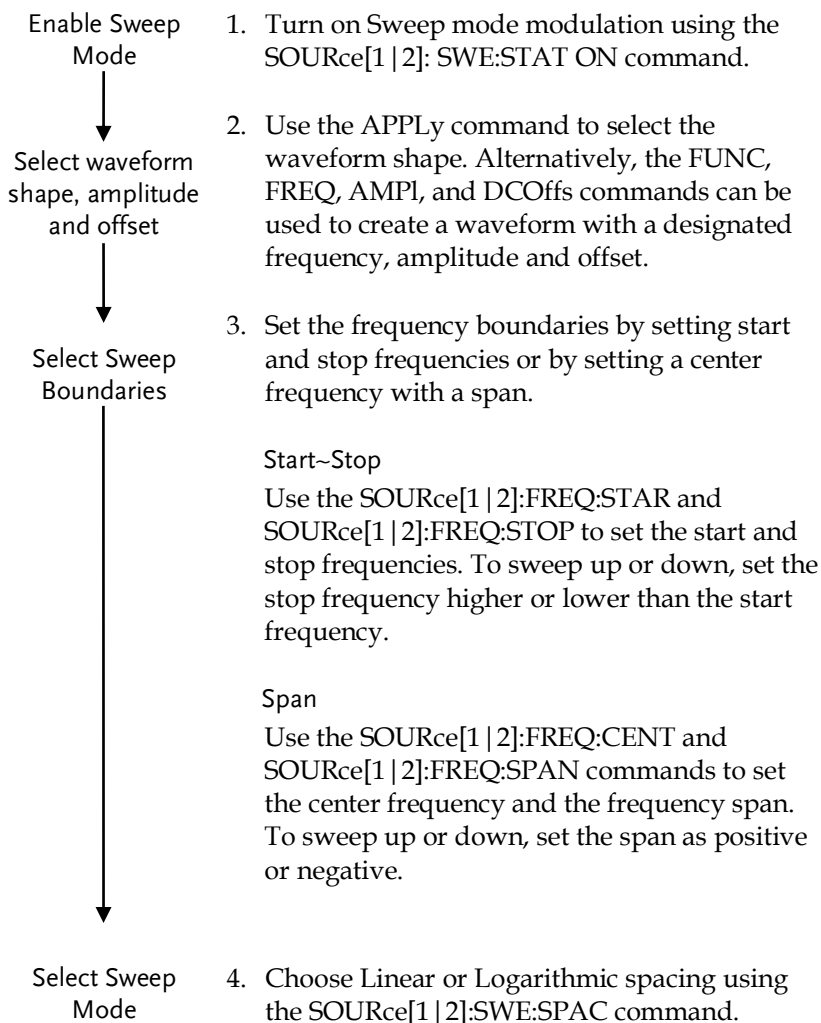
Return Parameter <NR3> Returns the duty in %.

Example **SOUR1:PWM:DUTY?**
+3.0000e+01
The current duty cycle is 30%.

Frequency Sweep Commands

Sweep Overview

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



- Select Sweep Time
↓
- Select the sweep trigger source
↓
- Choose the sweep time using the `SOURce[1 | 2]:SWE:TIME` command.
 - Select an internal or external sweep trigger source using the `SOURce[1 | 2]:SOUR` command.

SOURce[1 2]:SWEep:STATe		Source Specific Command
Description	Sets or disables Sweep mode. By default Sweep is disabled. Sweep modulation must be enabled before setting other parameters.	
Note	Any modulation modes or Burst mode will be disabled if sweep mode is enabled.	
Syntax	SOURce[1 2]:SWEep:STATe {OFF ON}	
Example	SOUR1:SWE:STAT ON Enables sweep mode.	
Query Syntax	SOURce[1 2]:SWEep:STATe?	
Return Parameter	OFF	Disabled (OFF)
	ON	Enabled (ON)
Example	SOUR1:SWE:STAT? ON Sweep mode is currently enabled.	

SOURce[1 2]:FREQuency:STARt		Source Specific Command
Description	Sets the start frequency of the sweep. 100Hz is the default start frequency.	
Note	To sweep up or down, set the stop frequency higher or lower than the start frequency.	

Syntax	SOURce[1 2]:FREQuency:STARt {<frequency> MINimum MAXimum}	
Parameter	<frequency>	1 uHz to Max Frequency
Example	SOUR1:FREQ:STAR +2.0000E+03 Sets the start frequency to 2kHz.	
Query Syntax	SOURce[1 2]:FREQuency:STARt? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the start frequency in Hz.
Example	SOUR1:FREQ:STAR? MAX +2.5000000000000e+07 Returns the maximum start frequency allowed.	

SOURce[1|2]:FREQuency:STOP Source Specific Command

Description	Sets the stop frequency of the sweep. 1 kHz is the default start frequency.	
Note	To sweep up or down, set the stop frequency higher or lower than the start frequency.	
Syntax	SOURce[1 2]:FREQuency:STOP {<frequency> MINimum MAXimum}	
Parameter	<frequency>	1 uHz to Max Frequency
Example	SOUR1:FREQ:STOP +2.0000E+03 Sets the stop frequency to 2kHz.	
Query Syntax	SOURce[1 2]:FREQuency:STOP? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the stop frequency in Hz.
Example	SOUR1:FREQ:STOP? MAX +2.5000000000000E+07 Returns the maximum stop frequency allowed.	

SOURce[1 2]:FREQuency:CENTer		Source Specific Command
Description	Sets and queries the center frequency of the sweep. 550 Hz is the default center frequency.	
Note	The maximum center frequency depends on the sweep span and maximum frequency: max center freq = max freq – span/2	
Syntax	SOURce[1 2]:FREQuency:CENTer {<frequency> MINimum MAXimum}	
Parameter	<frequency>	1uHz to Max Frequency
Example	SOUR1:FREQ:CENT +2.0000E+03 Sets the center frequency to 2kHz.	
Query Syntax	SOURce[1 2]:FREQuency:CENTer? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the stop frequency in Hz.
Example	SOUR1:FREQ:CENT? MAX +2.5000000000000E+07 Returns the maximum center frequency allowed, depending on the span.	

SOURce[1 2]:FREQuency:SPAN		Source Specific Command
Description	Sets and queries the frequency span of the sweep. 900 Hz is the default frequency span. The span frequency is equal to the stop-start frequencies.	
Note	To sweep up or down, set the span as positive or negative. The maximum span frequency has a relationship to the center frequency and maximum frequency: max freq span= 2(max freq – center freq)	

Syntax	SOURce[1 2]:FREQuency:SPAN {<frequency> MINimum MAXimum}	
Parameter	<frequency>	1 uHz to Max Frequency
Example	SOUR1:FREQ:SPAN +2.0000E+03 Sets the frequency span to 2kHz.	
Query Syntax	SOURce[1 2]:FREQuency:SPAN? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the frequency span in Hz.
Example	SOUR1:FREQ:SPAN? +2.0000000000000e+03 Returns the frequency span for the current sweep.	

SOURce[1|2]:SWEep:SPACing Source Specific Command

Description	Sets linear or logarithmic sweep spacing. The default spacing is linear.	
Syntax	SOURce[1 2]:SWEep:SPACing {LINear LOGarithmic}	
Example	SOUR1:SWE:SPAC LIN Sets the spacing to linear.	
Query Syntax	SOURce[1 2]:SWEep:SPACing?	
Return Parameter	LINear LOGarithmic	Linear spacing Logarithmic spacing
Example	SOUR1:SWE:SPAC? LINear The spacing is currently set as linear.	

SOURce[1|2]:SWEep:TIME Source Specific Command

Description	Sets or queries the sweep time. The default sweep time is 1 second.	
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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 2]:SWEep:TIME {<seconds> MINimum MAXimum}	
Parameter	<seconds>	1 ms ~ 500 s
Example	SOUR1:SWE:TIME +1.0000E+00 Sets the sweep time to 1 second.	
Query Syntax	SOURce[1 2]:SWEep:TIME? {<seconds> MINimum MAXimum}	
Return Parameter	<NR3>	Returns sweep time in seconds.
Example	SOUR1:SWE:TIME? +1.0000e+00 Returns the sweep time (1 seconds).	

SOURce[1 2]:SWEep:SOURce	Source Specific Command
---------------------------------	-------------------------

Description	Sets or queries the trigger source as immediate (internal), external or manual. 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. Manual will output a swept waveform after the trigger softkey is pressed.
-------------	---

Note	If the APPLy command was used to create the waveform shape, the source is automatically set to IMMEDIATE. The *OPC/*OPC? command/query can be used to signal the end of the sweep. If the trigger source is set to manual, the function generator starts sweeping each time a trigger command is received. To trigger the function generate from remote interface, it is necessary to send a * TRG trigger command.	
Syntax	SOURce[1 2]: SWEep:SOURce {IMMEDIATE EXTERNAL MANual}	
Example	SOUR1:SWE:SOUR IMM Sets the sweep source to internal.	
Query Syntax	SOURce[1 2]: SWEep:SOURce?	
Return Parameter	IMMEDIATE	Immediate
	EXTERNAL	External
	MANual	Manual
Example	SOUR1:SWE:SOUR? IMMEDIATE The sweep source is set to internal.	

Burst Mode Commands

Burst Mode Overview

Burst mode can be configured to use an internal trigger (N Cycle mode) or an external trigger (Gate mode) using the Trigger INPUT terminal on the rear panel. Using N Cycle mode, each time the function generator receives a trigger, the function generator will output a specified number of waveform cycles (burst). After the burst, the function generator will wait for the next trigger before outputting another burst. N Cycle is the default Burst mode.

The alternative to using a specified number of cycles, Gate mode uses the external trigger to turn on or off the output. When the Trigger INPUT signal is high*, waveforms are continuously output (creating a burst). When the Trigger INPUT signal goes low*, the waveforms will stop being output after the last waveform completes its period. The voltage level of the output will remain equal to the starting phase of the burst waveforms, ready for the signal to go high* again.

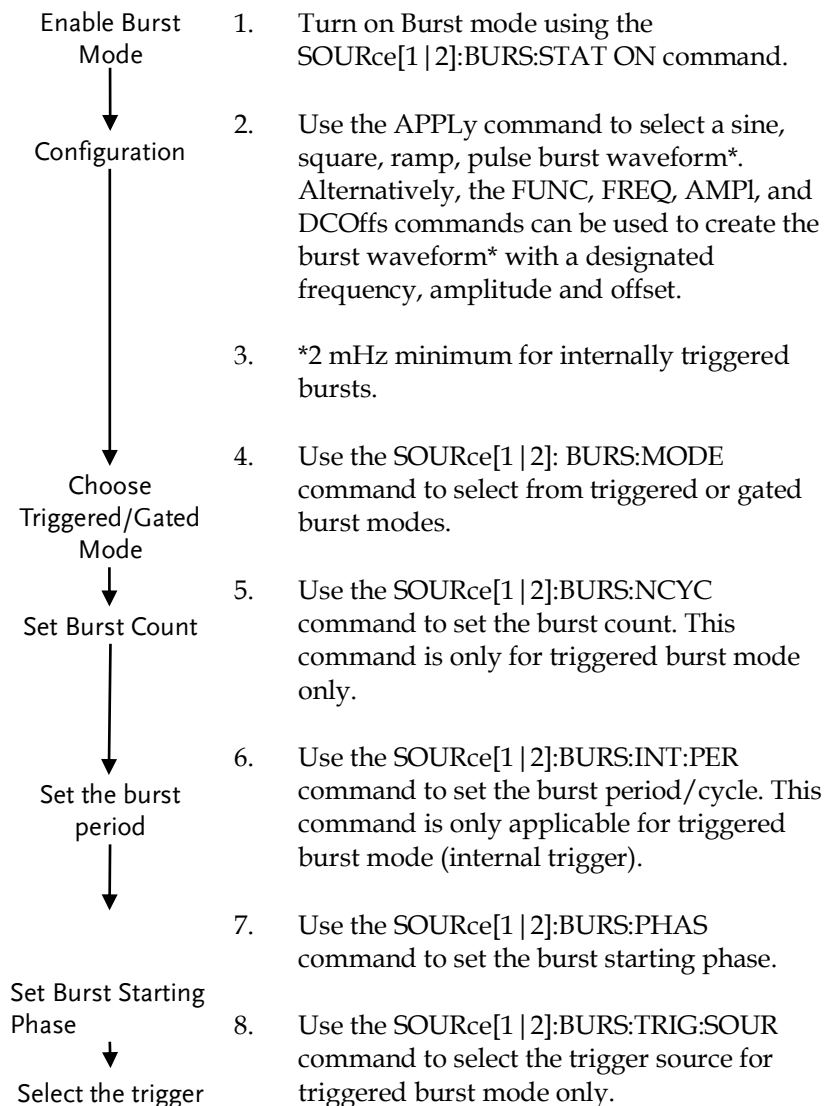
*assuming the Trigger polarity is not inverted.

Only one burst mode can be used at any one time. The burst mode depends on the source of the trigger (internal, external, manual) and the source of the burst.

Burst Mode & Source	Function		
	N Cycle*	Cycle	Phase
Triggered – IMMEDIATE, BUS	Available	Available	Available
Triggered - EXTERNAL, MANUAL	Available	Unused	Available
Gated pulse - IMMEDIATE	Unused	Unused	Available

*burst count

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



SOURce[1 2]:BURSt:STATe		Source Specific Command
Description	Turns burst mode on or off. By default burst mode is turned off.	
Note	When burst mode is turned on, sweep and any modulation modes are disabled.	
Syntax	SOURce[1 2]:BURSt:STATe {OFF ON}	
Example	SOUR1:BURS:STAT ON Turns burst mode on.	
Query Syntax	SOURce[1 2]:BURSt:STATe?	
Return Parameter	OFF Disabled ON Enabled	
Example	SOUR1:BURS:STAT? ON Burst mode is off.	

SOURce[1 2]:BURSt:MODE		Source Specific Command
Description	Sets or queries the burst mode as gated or triggered. The default burst mode is triggered.	
Note	The burst count, period, trigger source and any manual trigger commands are ignored in gated burst mode.	
Syntax	SOURce[1 2]:BURSt:MODE {TRIGGered GATed}	
Example	SOUR1:BURS:MODE TRIG Sets the burst mode to triggered.	
Query Syntax	SOURce[1 2]:BURSt:MODE?	
Return Parameter	TRIGGered Triggered mode GATed Gated mode	

Example	SOUR1:BURS:MODE? TRIGgered The current burst mode is triggered.	
	SOURce[1 2]:BURSt:NCYCles Source Specific Command	
Description	Sets or queries the number of cycles (burst count) in triggered burst mode. The default number of cycles is 1. The burst count is ignored in gated mode.	
Note	If the trigger source is set to immediate, the product of the burst period and waveform frequency must be greater than the burst count: Burst Period X Waveform frequency > burst count If the burst count is too large, the burst period will automatically be increased and a "Settings conflict" error will be generated. Only sine and square waves are allowed infinite burst above BW/2.	
Syntax	SOURce[1 2]:BURSt:NCYCles{< # cycles> INFinity MINimum MAXimum}	
Parameter	<# cycles>	1~1,000,000 cycles. INFinity Sets the number to continuous. MINimum Sets the number to minimum allowed. MAXimum Sets the number to maximum allowed.
Example	SOUR1:BURS:NCYC INF Sets the number of burst cycles to continuous (infinite).	
Query Syntax	SOURce[1 2]:BURSt:NCYCles? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the number of cycles. INF INF is returned if the number of cycles is continuous.

Example **SOUR1:BURS:NCYC?**
 +1.000000E+00
 The burst cycles are set to 1.

SOURce[1 2]:BURSt:INTernal:PERiod		Source Specific Command
Description	Sets or queries the burst period. Burst period settings are only applicable when the trigger is set to immediate. The default burst period is 1 s. During manual triggering, external triggering or Gate burst mode, the burst period settings are ignored.	
Note	The burst period must be long enough to output the designated number of cycles for a selected frequency. Burst period > burst count / (waveform frequency + 200 ns) If the period is too short, it is automatically increased so that a burst can be continuously output. A “data out of range” error will also be generated.	
Syntax	SOURce[1 2]:BURSt:INTernal:PERiod {<seconds> MINimum MAXimum}	
Parameter	<seconds>	20 ns ~ 500 seconds
Example	SOUR1:BURS:INT:PER +1.0000E+01 Sets the period to 10 seconds.	
Query Syntax	SOURce[1 2]:BURSt:INTernal:PERiod? [MINimum MAXimum]	
Return Parameter	<NR3>	Returns the burst period in milliseconds.
Example	SOUR1:BURS:INT:PER? +1.00000000e+04 The burst period is 10 seconds.	

SOURce[1 2]:BURSt:TRIGger:SOURce	Source Specific Command
----------------------------------	-------------------------

Description	Sets or queries the trigger source for triggered burst mode. In triggered burst mode, a waveform burst is output each time a trigger signal is received and the number of cycles is determined by the burst count.
-------------	--

There are three trigger sources for triggered burst mode:

Immediate	A burst is output at a set frequency determined by the burst period.
-----------	--

External	EXternal will output a burst waveform after each external trigger pulse. Any additional trigger pulse signals before the end of the burst are ignored.
----------	--

Manual	Manual triggering will output a burst waveform after the trigger softkey is pressed.
--------	--

Note If the APPLy command was used, the source is automatically set to IMMEDIATE.

The *OPC/*OPC? command/query can be used to signal the end of the burst.

If the trigger source is set to manual, the function generator outputs a burst count waveform with the specified number of cycles each time the trigger signal * TRG is received. The function generator stops and waits for the next trigger after the specified number of cycles has been output. You can configure the function generator to use an internal trigger to start a burst or send a trigger signal from the rear panel port connector by pressing the front panel key and you can also send a trigger command * TRG through the remote interface to provide an external trigger source.

Syntax **SOURce[1|2]:BURSt:TRIGger:SOURce**
{IMMEDIATE|EXTErnal|MANual}

Example **SOUR1:BURS:TRIG:SOUR IMM**
Sets the burst trigger source to internal.

Query Syntax **SOURce[1|2]:BURSt:TRIGger:SOURce?**

Return Parameter	IMMEDIATE	Immediate
	EXTErnal	External
	MANual	Manual

Example **SOUR1:BURS:TRIG:SOUR?**
IMMEDIATE

The burst trigger source is set to immediate.

SOURce[1|2]:BURSt:GATE:POLarity Source Specific
Command

Description	In gated mode, the function generator will output a waveform continuously while the external trigger receives logically true signal from the Trigger INPUT terminal. Normally a signal is logically true when it is high. The logical level can be inverted so that a low signal is considered true.	
Syntax	SOURce[1 2]:BURSt:GATE:POLarity {NORMal INVertes}	
Parameter	NORMal	Logically high
	INVertes	Logically low
Example	SOUR1:BURS:GATE:POL INV Sets the state to logically low (inverted).	
Query Syntax	SOURce[1 2]:BURSt:GATE:POLarity?	
Return Parameter	NORMal	Normal(High) logical level
	INVerted	Inverted (low) logical level
Example	SOUR1:BURS:GATE:POL? INVerted The true state is inverted(logically low).	

Arbitrary Waveform Commands

Arbitrary Waveform Overview

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

- Output Arbitrary Waveform
- ↓
- Select Waveform
1. Use the SOURce[1 | 2]:FUNCTION USER command to output the arbitrary waveform currently selected in memory.

Frequency,
amplitude and
offset

↓
Load Waveform
Data

↓
Set Waveform
Rate

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 (1 to 10240000 points per waveform) can be downloaded into volatile memory using the DATA:DAC command. Binary integer or decimal integer values in the range of ± 32767 can be used.
4. The waveform rate is the product of the number of points in the waveform and the waveform frequency.

$$\text{Rate} = \text{Hz} \times \# \text{ points}$$

Range:	Rate:	1 μ Hz ~ 62.5MHz
	Frequency:	1 μ Hz ~ 30MHz (15MHz AFG- 4125E/4125AE/4225E)
	# points:	1~10240000 (16384 AFG- 4125E/4125AE/4225E)

SOURCE[1|2]:FUNCTION USER

Source Specific
Command

Description Use the SOURCE[1 | 2]:FUNCTION USER command to output the arbitrary waveform currently selected in memory. The waveform is output with the current frequency, amplitude and offset settings.

Syntax SOURCE[1|2]:FUNCTION USER

Example SOUR1:FUNC USER

Selects and outputs the current waveform in memory.

SOURce[1|2]:DATA:DAC

Source Specific
Command

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.

Note

The integer values (± 32767) 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 32767 is the equivalent of 2.5 Volts. 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:

7 2097152

1 2 3

1. Initialization character (#)
2. Digit length (in ASCII) of the number of bytes
3. Number of bytes

IEEE 488.2 uses two bytes to represent waveform data (16 bit integer). Therefore the number of bytes is always twice the number of data points.

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

Parameter	<start>	Start address of the arbitrary waveform
	<binary block>	Decimal or integer values ± 32767
	<value>	(± 8191 AFG-4125E/4125AE/4225E)

Example DATA:DATA VOLATILE, #216 Binary Data

The command above downloads 5 data values (stored in 14 bytes) using the binary block format.

DATA:DAC VOLATILE,1000,511,1024,0,-1024,-511

Downloads the data values (511, 1024, 0, -1024, -511) to address 1000.

SOURce[1 2]:ARB:EDIT:COPY		Source Specific Command
Description	Copies a segment of a waveform to a specific starting address.	
Syntax	SOURce[1 2]:ARB:EDIT:COPY [<start>[,<length>[,<paste>]]]	
Parameter	<start> <length> <paste>	Start address: 0~10240000 (16384 AFG-4125E/4125AE/4225E) 0 ~ 10240000 (16384 AFG-4125E/4125AE/4225E) Paste address: 0~10240000 (16384 AFG-4125E/4125AE/4225E)
Example	SOUR1:ARB:EDIT:COPY 1000, 256, 1257 Copies 256 data values starting at address 1000 and copies them to address 1257.	

SOURce[1 2]:ARB:EDIT:DELeTe		Source Specific Command
Description	Deletes a segment of a waveform from memory. The segment is defined by a starting address and length.	
Note	A waveform/waveform segment cannot be deleted when output.	

Syntax	SOURce[1 2]:ARB:EDIT:DELeTe [<START>,<LENGth>]	
Parameter	<START>	Start address: 0~10240000(16384 AFG-4125E/4125AE/4225E)
	<LENGth>	0 ~ 10240000(16384 AFG-4125E/4125AE/4225E)

Example **SOURce1:ARB:EDIT:DEL 1000, 256**

Deletes a section of 256 data points from the waveform starting at address 1000.

SOURce[1|2]:ARB:EDIT:DELeTe:ALL Source Specific Command

Description Deletes all user-defined waveforms from non-volatile memory and the current waveform in volatile memory.

Note A waveform cannot be deleted when output.

Syntax **SOURce[1|2]:ARB:EDIT:DELeTe:ALL**

Example **SOUR1:ARB:EDIT:DEL:ALL**

Deletes all user waveforms from memory.

SOURce[1|2]:ARB:EDIT:POINt Source Specific Command

Description Edit a point on the arbitrary waveform.

Note A waveform/waveform segment cannot be deleted when output.

Syntax **SOURce[1|2]:ARB:EDIT:POINt [<address> [, <data>]]**

Parameter	<address>	Address of data point: 0~10240000(16384 AFG-4125E/4125AE/4225E)
	<data>	Value data: ± 32767 (± 8191 AFG-4125E/4125AE/4225E)

Example **SOUR1:ARB:EDIT:POIN 1000, 511**

Creates a point on the arbitrary waveform at address 1000 with the highest amplitude.

SOURCE[1|2]:ARB:EDIT:LINE Source Specific Command

Description	Edit a line on the arbitrary waveform. The line is created with a starting address and data point and a finishing address and data point.	
Note	A waveform/ waveform segment cannot be deleted when output.	
Syntax	SOURCE[1 2]:ARB:EDIT:LINE [<address1>[,<data>[,<address2>[,<data2>]]]]	
Parameter	<address1>	Address of data point1: 0~10240000(16384 AFG-4125E/4125AE/4225E)
	<data1>	Value data1: ±32767(±8191 AFG-4125E/4125AE/4225E)
	<address2>	Address of data point2: 0~10240000(16384 AFG-4125E/4125AE/4225E)
	<data2>	Value data2: ± 32767(±8191 AFG-4125E/4125AE/4225E)

Example **SOUR1:ARB:EDIT:LINE 40, 50, 100, 50**
Creates a line on the arbitrary waveform at 40,50 to 100,50.

SOURCE[1|2]:ARB:EDIT:PROTECT Source Specific Command

Description	Protects a segment of the arbitrary waveform from deletion or editing.
Syntax	SOURCE[1 2]:ARB:EDIT:PROTECT [<START>[,<LENGTH>]

Parameter	<START>	Start address: 0~10240000(16384 AFG- 4125E/4125AE/4225E)
	<LENGth>	0 ~ 10240000(16384 AFG- 4125E/4125AE/4225E)

Example **SOUR1:ARB:EDIT:PROT 40, 50**
 Protects a segment of the waveform from address 40 for 50 data points.

SOURce[1|2]:ARB:EDIT:PROTect:ALL Source Specific Command

Description Protects the arbitrary waveform currently in non-volatile memory/currently being output.

Syntax **SOURce[1|2]:ARB:EDIT:PROTect:ALL**

Example **SOUR1:ARB:EDIT:PROT:ALL**

SOURce[1|2]:ARB:EDIT:UNProtect Source Specific Command

Description Uprotects the arbitrary waveform currently in non-volatile memory/currently being output.

Syntax **SOURce[1|2]:ARB:EDIT:UNProtect**

Example **SOUR1:ARB:EDIT:UNP**

SOURce[1|2]:ARB:OUTPut Source Specific Command

Description Output the current arbitrary waveform in volatile memory. A specified start and length can also be designated.

Syntax **SOURce[1|2]:ARB:OUTPut [<START>[,<LENGth>]]**

Parameter	<START>	Start address*: 0~10240000(16384 AFG- 4125E/4125AE/4225E)
-----------	---------	---

<LENGth>

Length*: 0 ~
10240000(16384 AFG-
4125E/4125AE/4225E)

* Start + Length $\leq$ currently output arbitrary waveform

Example

SOUR1:ARB:OUTP 20,200

Outputs the current arbitrary waveform in memory.

COUNTER

The frequency counter function can be turned on remotely to control the frequency counter.

COUNTER:STATE Instrument Command

Description Turns the frequency counter function on or off.

Syntax **COUNter:STATe {ON|OFF}**

Parameter/ Return Parameter	ON	ON
	OFF	OFF

Example **COUNter:STATe**

ON

Turns the frequency counter on

Query Syntax **COUNter:STATe?**

Example **COUNter:STATe?**

ON

Turns on the frequency counter.

COUNter:COUPling Instrument Command

Description Sets the coupling mode of the input signal to AC or DC. Queries the coupling mode of the input signal.

Syntax **COUNter:COUPling {AC|DC}**

Parameter /Return Parameter	DC
	AC

Example **COUN:COUP DC**

Sets the coupling mode of the input signal to DC.

Syntax **COUNter:COUPling?**

Example	COUN:COUP? DC Queries the coupling mode of the input signal and the query returns DC.
---------	--

COUNter:HFR

Instrument
Command

Description	Enable or disable the high-frequency reject of the counter. The query returns the state of high-frequency reject of the counter.
-------------	--

Syntax	COUNter:HFR {ON OFF}
--------	-----------------------------

Parameter /Return Parameter	OFF	OFF
	ON	ON

Example	COUNter:HFR ON Enables the high frequency rejection function of the frequency counter.
---------	--

Syntax	COUNter:HFR?
--------	---------------------

Example	COUNter:HFR? ON Queries the on/off status of the high frequency rejection function of the frequency counter and the query returns ON.
---------	--

COUNter:SENSitivity

Instrument
Command

Description	Sets the trigger sensitivity of the frequency counter. Queries the trigger sensitivity of the frequency counter.
-------------	--

Syntax	COUNter:SENSitivity [LOW MIDDLE HIGH]
--------	--

Parameter /Return Parameter	LOW	Low is selected for the trigger sensitivity of the counter.
	MIDDLE	Middle is selected for the trigger sensitivity of the counter.
	HIGH	High is selected for the trigger sensitivity of the counter.

Example **COUN:SENS LOW**
Sets the trigger sensitivity of the frequency counter to LOW.

Syntax **COUNter:SENSitivity?**

Example **COUN:SENS?**
LOW
Queries the trigger sensitivity of the frequency counter and the query returns LOW.

COUNter:TRIGger Instrument
Command

Description Sets or queries the trigger level of the counter.

Syntax **COUNter:TRIGger {<value>|MINimum|MAXimum}}**

Parameter /Return Parameter	<NR3>	The trigger level of the counter.
	<unit>	[mV V]

Example **COUNter:TRIGger 500mV**
Sets the trigger level of the counter to 500 mV:

Syntax **COUNter:TRIGger?**

Example **COUNter:TRIGger? {MINimum|MAXimum}**
1.500000e+00
Queries the trigger level of the frequency counter and the query returns 1.500000E+00.

COUNTer:DUTYcycle?	Instrument Command
---------------------------	-----------------------

Description	This query-only command returns the measurement results for duty cycle of the counter.
-------------	--

Syntax	COUNTer:DUTYcycle?
--------	---------------------------

Example	COUNTer:DUTYcycle? +5.00e+01 Returns the Dutycycle as 50%.
---------	---

COUNTer:FREQ?	Instrument Command
----------------------	-----------------------

Description	This query-only command returns the measurement results for frequency of the counter.
-------------	---

Syntax	COUNTer:FREQ?
--------	----------------------

Example	COUNTer:FREQ? +2.00e+03 Returns the Frequency as 2KHz.
---------	---

COUNTer:PERiod?	Instrument Command
------------------------	-----------------------

Description	This query-only command returns the measurement results for period of the counter.
-------------	--

Syntax	COUNTer:PERiod?
--------	------------------------

Example	COUNTer:PER? +2.00E-07 Returns the Period as 200nS.
---------	--

COUNter:PULSewidth?

Instrument
Command

Description	This query-only command returns the measurement results for pulse width of the counter.
Syntax	COUNter:PULSewidth?
Example	COUNter:PULS? +1.04E-07 Returns the Pulse Width as 104nS.

COUPLE

The Couple commands can be used to remotely set the frequency coupling and amplitude coupling.

SOURCE[1 2]:FREQUENCY:COUPLE	Instrument Command
-------------------------------------	--------------------

Description	Enables or disables the frequency coupling.
-------------	---

Syntax	SOURCE[1 2]:FREQUENCY:COUPLE {ON OFF}
--------	--

Return/ Return parameter	1	ON
	0	Off

Example	SOURCE1:FREQUENCY:COUPLE ON Turns amplitude coupling on.
---------	--

Query Syntax	SOURCE[1 2]:FREQUENCY:COUPLE?
--------------	--------------------------------------

Example	SOURCE1:FREQUENCY:COUPLE? 1 Frequency coupling has been enabled.
---------	---

SOURCE[1 2]:AMPLITUDE:COUPLE	Instrument Command
-------------------------------------	--------------------

Description	Enables or disables the amplitude coupling.
-------------	---

Syntax	SOURCE[1 2]:AMPLITUDE:COUPLE {ON OFF}
--------	--

Example	SOURCE1:AMPLITUDE:COUPLE ON Turns amplitude coupling on.
---------	--

Query Syntax	SOURCE[1 2]:AMPLITUDE:COUPLE?
--------------	--------------------------------------

Return Parameter	1	ON
	0	Off

Example	SOURCE1:AMPLITUDE:COUPLE? 1
---------	---------------------------------------

Amplitude coupling has been enabled.

SOURce[1 2]:TRACk:STATe		Instrument Command
Description	Turns tracking on or off.	
Syntax	SOURce[1 2]:TRACk:STATe {ON OFF INVerted}	
Parameter/ Return Parameter	ON	ON
	OFF	OFF
	INVerted	INVerted
Example	SOURce1:TRACk:STATe ON Turns tracking on. Channel 2 will “track” the changes of channel 1.	
Query Syntax	SOURce[1 2]:TRACk:STATe?	
Example	SOURce1:TRACk:STATe? ON Channel tracking is turned on.	

Save and Recall Commands

Up to 16 different instrument states can be stored to non-volatile memory (memory locations 0~15).

		Instrument Command
*SAV		
Description	Saves the current instrument state to a specified save slot. When a state is saved, all the current instrument settings, functions and waveforms are also saved.	
Note	The *SAV command doesn't save waveforms in non-volatile memory, only the instrument state. The *RST command will not delete saved instrument states from memory.	
Syntax	*SAV {0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15}	
Example	*SAV 0 Save the instrument state to memory location 0.	

		Instrument Command
*RCL		
Description	Recall previously saved instrument states from memory locations 0~16.	
Syntax	*RCL {0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15}	
Example	*RCL 0 Recall instrument state from memory location 0.	

Error Messages

The AFG-4000 has a number of specific error codes. Use the `SYSTem:ERRor` command to recall the error codes. For more information regarding the error queue.

Command Error Codes

-101 Invalid character

An invalid character was used in the command string. Example: #, \$, %.

`SOURce1:AM:DEPTh MIN%`

-102 Syntax error

Invalid syntax was used in the command string. Example: An unexpected character may have been encountered, like an unexpected space.

`SOURce1:APPL:SQUare`, 1

-103 Invalid separator

An invalid separator was used in the command string. Example: a space, comma or colon was incorrectly used.

`APPL:SIN 1` 1000 OR `SOURce1:APPL:SQUare`

-108 Parameter not allowed

The command received more parameters than were expected. Example: An extra (not needed) parameter was added to a command

`SOURce1:APPL?` 10

-109 Missing parameter

The command received less parameters than expected. Example: A required parameter was omitted.

`SOURce1:APPL:SQUare`

-113 Undefined header

An undefined header was encountered. The header is syntactically correct. Example: the header contains a character mistake.

SOUR1:AMM:DEPT MIN

-131 Invalid suffix

An invalid suffix was used. Example: An unknown or incorrect suffix may have been used with a parameter.

SOURce1:SWEep:TIME 0.5 SECS

-138 Suffix not allowed

A suffix was used where none were expected. Example: Using a suffix when not allowed.

SOURce1:BURSt: NCYCles 12 CYC

-158 String data not allowed

An unexpected character string was used where none were expected. Example: A character string is used instead of a valid parameter.

SOURce1:SWEep:SPACing 'TEN'

-170~178 expression errors

Example: The mathematical expression used was not valid.

Query Errors

-410 Query INTERRUPTED

Indicates that a command was received but the data in the output buffer from a previous command was lost.

-420 Query UNTERMINATED

The function generator is ready to return data, however there was no data in the output buffer. For example: Using the APPLy command.

-430 Query DEADLOCKED

Indicates that a command generates more data than the output buffer can receive and the input buffer is full. The command will finish execution, though all the data won't be kept.

Arbitrary Waveform Errors

-770 Nonvolatile arb waveform memory corruption detected

Indicates that a fault (check sum error) has occurred with the non-volatile memory that stores the arbitrary waveform data.

-781 Not enough memory to store new arb waveform; bad sectors

Indicates that a fault (bad sectors) has occurred with the non-volatile memory that stores the arbitrary waveform data. Resulting in not enough memory to store arbitrary data.

-787 Not able to delete the currently selected active arb waveform

Example: The currently selected waveform is being output and cannot be deleted.

800 Block length must be even

Example: As block data (DATA:DAC VOLATILE) uses two bytes to store each data point, there must be an even number of bytes for a data block.

SCPI Status Register

The status registers are used to record and determine the status of the function generator.

The function generator has a number of register groups:

Questionable Status Registers

Standard Event Status Registers

Status Byte Register

As well as the output and error queues.

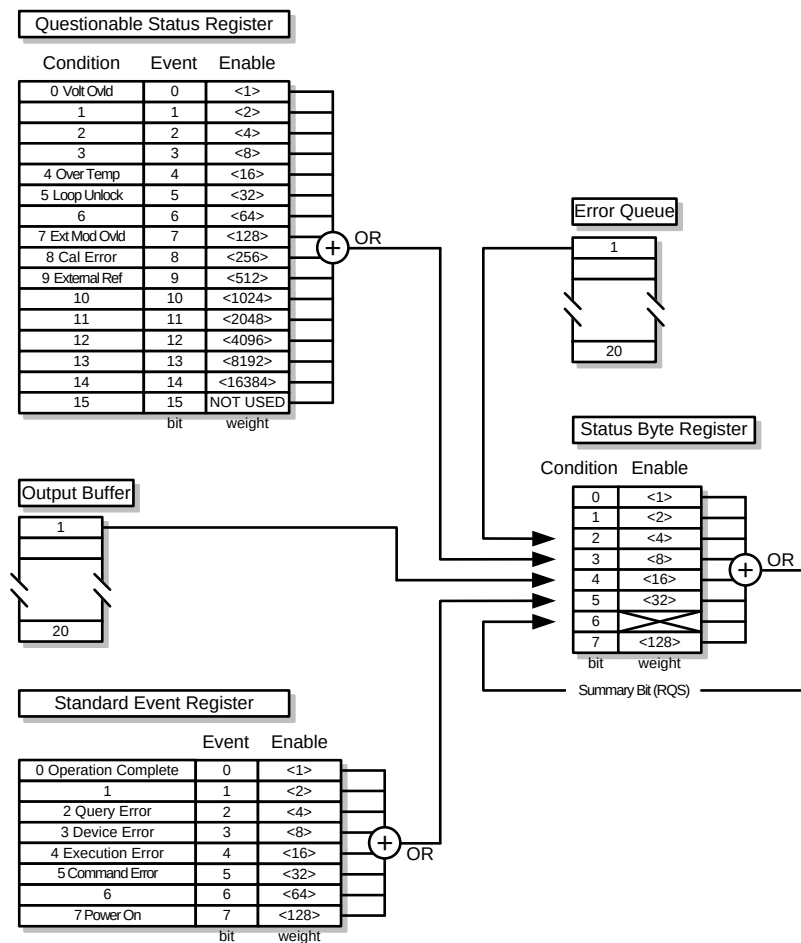
Each register group is divided into three types of registers: condition registers, event registers and enable registers.

Register types

Condition Register	The condition registers indicate the state of the function generator in real time. The condition registers are not triggered. I.e., the bits in the condition register change in real time with the instrument status. Reading a condition register will not clear it. The condition registers cannot be cleared or set.
Event Register	The Event Registers indicate if an event has been triggered in the condition registers. The event registers are latched and will remain set unless the *CLS command is used. Reading an event register will not clear it.

Enable Register	The Enable register determines which status event(s) are enabled. Any status events that are not enabled are ignored. Enabled events are used to summarize the status of that register group.
-----------------	---

AFG-4000 Status System



Questionable Status Register

Description	The Questionable Status Registers will show if any faults or errors have occurred.		
Bit Summary	Register	Bit	Bit Weight
	Voltage overload	0	1
	Over temperature	4	16
	Loop unlock	5	32
	Ext Mod Overload	7	128
	Cal Error	8	256
	External Reference	9	512

Standard Event Status Registers

Description	The Standard Event Status Registers indicate when the *OPC command has been executed or whether any programming errors have occurred.
Notes	The Standard Event Status Enable register is cleared when the *ESE 0 command is used. The Standard Event Status Event register is cleared when the *CLS command or the *ESR? command is used.

Bit Summary	Register	Bit	Bit Weight
	Operation complete bit	0	1
	Query Error	2	4
	Device Error	3	8
	Execution Error	4	16
	Command Error	5	32
	Power On	7	128
Error Bits	Operation complete	The operation complete bit is set when all selected pending operations are complete. This bit is set in response to the *OPC command.	
	Query Error	The Query Error bit is set when there is an error reading the Output Queue. This can be caused by trying to read the Output Queue when there is no data present.	
	Device Error	The Device Dependent Error indicates a failure of the self-test, calibration, memory or other device dependent error.	
	Execution Error	The Execution bit indicates an execution error has occurred.	
	Command Error	The Command Error bit is set when a syntax error has occurred.	
	Power On	Power has been reset.	

The Status Byte Register

Description	The Status Byte register consolidates the status events of all the status registers. The Status Byte register can be read with the *STB? query or a serial poll and can be cleared with the *CLS command. Clearing the events in any of the status registers will clear the corresponding bit in the Status Byte register.		
Notes	The Status byte enable register is cleared when the *SRE 0 command is used. The Status Byte Condition register is cleared when the *CLS command is used.		
Bit Summary	Register	Bit	Bit Weight
	Error Queue	2	4
	Questionable Data	3	8
	Message Available	4	16
	Standard Event	5	32
	Master Summary / Request Service	6	64
Status Bits	Error Queue	There are error message(s) waiting in the error queue.	
	Questionable data	The Questionable bit is set when an “enabled” questionable event has occurred.	
	Message Available	The Message Available bit is set when there is outstanding data in the Output Queue. Reading all messages in the output queue will clear the message available bit.	

Standard Event	The Event Status bit is set if an “enabled” event in the Standard Event Status Event Register has occurred.
----------------	---

Master Summary/Service Request bit	The Master Summary Status is used with the *STB? query. When the *STB? query is read the MSS bit is not cleared. The Request Service bit is cleared when it is polled during a serial poll.
------------------------------------	---

Output Queue

Description	The Output queue stores output messages in a FIFO buffer until read. If the Output Queue has data, the MAV bit in the Status Byte Register is set.
-------------	--

Error Queue

Description	The error queue is queried using the SYSTem:ERRor? command. The Error queue will set the “Error Queue” bit in the status byte register if there are any error messages in the error queue. If the error queue is full the last message will generate a “Queue overflow” error and additional errors will not be stored. If the error queue is empty, “No error” will be returned.
-------------	--

Error messages are stored in the error queue in a first-in-first-out order. The errors messages are character strings that can contain up to 255 characters.

EC Declaration of Conformity

We

GOOD WILL INSTRUMENT CO., LTD.

declare that the CE marking mentioned product

satisfies all the technical relations application to the product within the scope of council:

Directive: EMC; LVD; WEEE; RoHS

The product is in conformity with the following standards or other normative documents:

◎ EMC	
EN 61326-1	Electrical equipment for measurement, control and laboratory use -- EMC requirements
Conducted & Radiated Emission EN 55011 / EN 55032	Electrical Fast Transients EN 61000-4-4
Current Harmonics EN 61000-3-2 / EN 61000-3-12	Surge Immunity EN 61000-4-5
Voltage Fluctuations EN 61000-3-3 / EN 61000-3-11	Conducted Susceptibility EN 61000-4-6
Electrostatic Discharge EN 61000-4-2	Power Frequency Magnetic Field EN 61000-4-8
Radiated Immunity EN 61000-4-3	Voltage Dip/ Interruption EN 61000-4-11 / EN 61000-4-34
◎ Safety	
EN 61010-1 :	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

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