任意ファンクションジェネレータ

AFG-3000 シリーズ
英文プログラミングマニュアル

ユーザーマニュアル

GW INSTEK PART NO. 82FG-30820M01

ISO-9001 CERTIFIED MANUFACTURER GW INSTEK

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201101 編集

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Establishing a Remote Connection

The AFG-3000 supports USB, RS232 and GPIB remote connections.

Configure USB interface

USB configuration	PC side connector	Type A, host
	AFG-3000 side connector	Type B, slave
	Speed	1.1/2.0 (full speed)

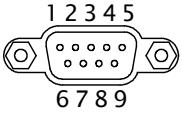
Panel Operation

1. Press the Utility key followed by Interface (F2) and USB (F3).

2. Connect the USB cable to the rear panel USB B (slave) port.

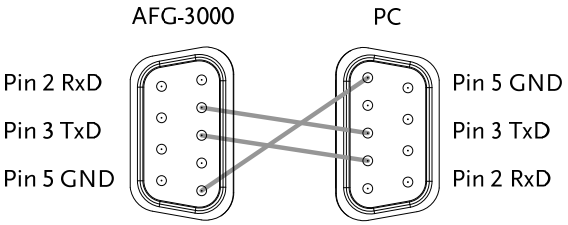
3. When the PC asks for the USB driver, select XXXXXX.inf included in the software package or download the driver from the GW website, www.gwinstek.com.

Configure RS232 interface

RS-232C configuration	Connector	DB-9, Male
	Baud rate	9600, 19200, 38400, 57600, 115200
	Parity	None/8Bits, Odd/7Bits, Even/7Bits
	Stop bits	1 (fixed)
Pin assignment		2: RxD (Receive data) 3: TxD (Transmit data) 5: GND 4, 6 ~ 9: No connection

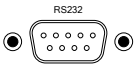
PC connection

Use the Null Modem connection as in the below diagram.



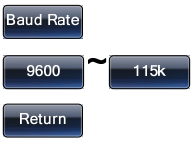
Panel Operation

1. Connect the RS-232 cable to the rear panel RS-232 port.

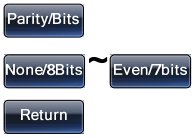


2. Press the Utility key followed by Interface (F2) and RS-232 (F2).

1. Press Baud Rate (F1) and choose a baud rate (F1)~(F5). Press return



2. Press Parity/Bits (F2) and choose a parity (F1)~(F3). Press return.



Configure GPIB interface

GPIB configuration	Connector	24 pin Female
	GPIB address	1-30

GPIB constraints

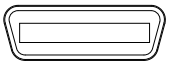
- Maximum 15 devices altogether, 20m cable length, 2m between each device
- Unique address assigned to each device
- At least 2/3 of the devices turned On
- No loop or parallel connection

Pin assignment

Pin1	Data line 1	Pin13	Data line 5
Pin2	Data line 2	Pin14	Data line 6
Pin3	Data line 3	Pin15	Data line 7
Pin4	Data line 4	Pin16	Data line 8
Pin5	EOI	Pin17	REN
Pin6	DAV	Pin18	Ground
Pin7	NRFD	Pin19	Ground
Pin8	NDAC	Pin20	Ground
Pin9	IFC	Pin21	Ground
Pin10	SRQ	Pin22	Ground
Pin11	ATN	Pin23	Ground
Pin12	Shield (screen)	Pin24	Signal ground

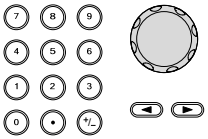
Panel Operation

1. Connect the GPIB cable to the rear panel GPIB port.



2. Press the Utility key followed by Interface and GPIB. Press Address (F1).

3. Use the scroll wheel or number pad to choose an address.



4. Press Done (F5) to confirm.

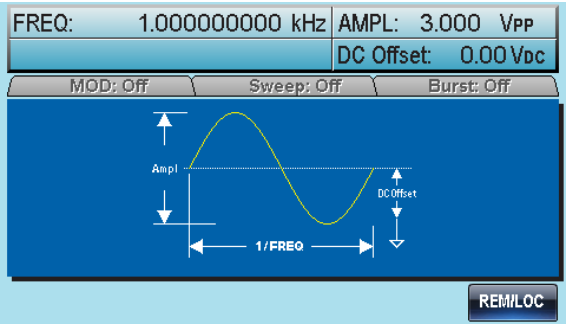
Remote control terminal connection

Terminal application	Invoke the terminal application such as MTTTY (Multi-Threaded TTY). For RS-232C, set the COM port, baud rate, stop bit, data bit, and parity accordingly. To check the COM port No, see the Device Manager in the PC. For WinXP, Control panel → System → Hardware tab.
Functionality check	Run this query command via the terminal. *idn? This should return the Manufacturer, Model number, Serial number, and Firmware version in the following format. GW INSTEK, AFG-3081, SN:XXXXXXXX,Vm.mm Note: ^j or ^m can be used as the terminal character when using a terminal program.
PC Software	The proprietary PC software, downloadable from GWInstek website, can be used for remote control.

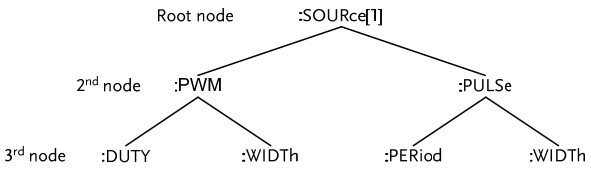
Display

When a remote connection is established all panel keys are locked bar F6.

1. Press REM/LOCK (F6) to return the function generator to local mode.



Command Syntax

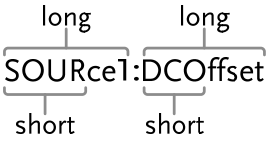
Compatible standard	• IEEE488.2, 1992 (fully compatible) • SCPI, 1994 (partially compatible)
Command Tree	The SCPI standard is an ASCII based standard that defines the command syntax and structure for programmable instruments. Commands are based on a hierarchical tree structure. Each command keyword 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] root node and the :PWM and :PULSe sub nodes. 
Command types	Commands can be separated in to three distinc types, simple commands, compound commands and queries.

Simple	A single command with/without a parameter
Example	*OPC
Compound	Two or more commands separated by a colon (:) with/without a parameter
Example	SOURce: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 Format		1: command header 2: single space 3: parameter 4: message terminator
Square Brackets []	Commands that contain squares brackets indicate that the contents are optional. The function of the command is the same with or without the square bracketed items. Brackets are not sent with the command. For example, the frequency query below can use any of the following 3 forms: SOURce1:FREQuency? [MINimum|MAXimum] SOURce1:FREQuency? MAXimum SOURce1:FREQuency? MINimum SOURce1:FREQuency?	
Braces {}	Commands that contain braces indicate one item within the braces must be chosen. Braces are not sent with the command.	
Angled Brackets <>	Angle brackets are used to indicate that a value must be specified for the parameter. See the parameter description below for details. Angled brackets are not sent with the command.	
Bars |	Bars are used to separate multiple parameter choices in the command format.	

Parameters

Type	Description	Example
<Boolean>	Boolean logic	0, 1/ON,OFF
<NR1>	integers	0, 1, 2, 3
<NR2>	decimal numbers	0.1, 3.14, 8.5
<NR3>	floating point	4.5e-1, 8.25e+1
<NRf>	any of NR1, 2, 3	1, 1.5, 4.5e-1

	<NRf+> <Numeric>	NRf type with a suffix including MINimum, MAXimum or DEFault parameters.	1, 1.5, 4.5e-1 MAX, MIN,
	<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, UHZ
	<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: SOURce[1]:DCOffset? SOURce[1]:OUTPut? →SOURce1:DCOffset?;OUTPut?
	Colon + Semicolon (:;)	A colon and semicolon can be used to combine commands from different node levels. For example: SOURce1:PWM:SOURce? SOURce:PULSe:WIDTh? →SOURce1:PWM:SOURce?:;SOURce:PULSe:WIDTh?
	Comma (,)	When a command uses multiple parameters, a comma is used to separate the parameters. For example: SOURce:APPLy:SQUare 10KHZ, 2.0 VPP, -1V

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System Commands

SYSTem:ERRor? — System Query

Description	Reads an error from the error queue. See page 117 for details regarding 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.	

*IDN? — System Query

Description	Returns the function generator manufacturer, model number, serial number and firmware version number in the following format: GW INSTEK,AFG-3081,SN:XXXXXXXX,Vm.mm
Query Syntax	**IDN?**
Return parameter	<string>
Example	***IDN?** GW INSTEK,AFG-3081,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.	

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?** AFG-3000 VX.XXX_XXXX FPGA:XXXX BootLoad:XXXX

Returns the year (2010) and version for that year (1).

*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-3000, 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.

*WAI — System Command

Description	This command waits until all pending operations have completed before executing additional commands. I.e. when the OPC bit is set.
Note	This command is only used for triggered sweep and burst modes.
Syntax	***WAI**

SYSTem:LANGuage — System Command

Description	Sets or queries the display language. Select the language shown on the function generator front-panel display. Only one language can be enabled at a time. SYSTem:LANGuage? query returns "Chinese" or "English".	
Note	Only one language can be set.	
Syntax	**SYSTem:LANGuage {CHINese|ENGlish}**	
Example	**SYST:LANG ENG** Sets the display language to English.	
Query Syntax	**SYSTem:LANGuage?**	
Return Parameter	CHIN	Chinese
	ENG	English
Query Example	**SYST:LANG?** **ENG** The current language is English.	

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?**

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.

Interface Configuration Commands

SYSTem:INTerface — System Command

Description	Selects the remote interface. RS-232 is the factory default.
Note	There is no interface query.
Syntax	**SYSTem:INTerface {GPIB|RS232|USB}**
Example	**SYST:INT USB** Sets the interface to USB.

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 (RS-232).
Syntax	**SYSTem:REMote**
Example	**SYST:REM**

Apply Commands

The APPLy command has 8 different types of outputs (Sine, Square, Ramp, Pulse, Noise, Triangle, DC, 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.

The Apply command will set the trigger source to immediate and disable burst, modulation and sweep modes. Turns on the output command SOURce[1]:OUTP ON. The termination setting will not be changed.

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]: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. The VOLT:UNIT command can be used to set the units when no unit is specified with the Apply 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.

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

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.

SOURce[1]: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]:APPLy:SINusoid [<frequency> [,<amplitude> [,<offset>]]]	
Parameter	<frequency>	1uHz~80MHz(3081)/ 50MHz(3051)
	<*amplitude*>	10mV~10V (50Ω) (3.536 Vrms)
	<offset>	0~4.99V (50Ω)
Example	**SOUR1:APPL:SIN 2KHZ,MAX,MAX** Sets frequency to 2kHz and sets the amplitude and offset to the maximum.	

SOURce[1]: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]:APPLy:SQUare [<frequency> [,<amplitude> [,<offset>]]]	
Parameter	<frequency>	1uHz~80MHz(3081)/ 50MHz(3051)
	<*amplitude*>	10mV~10V (50Ω)

	<offset>	0~4.99V (50Ω)
Example	**SOUR1:APPL:SQU 2KHZ,MAX,MAX** Sets frequency to 2kHz and sets the amplitude and offset to the maximum.	

SOURce[1]: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]:APPLy:RAMP [<frequency> [,<amplitude> [,<offset>]]]**	
Parameter	<frequency>	1uHz~1MHz
	<*amplitude*>	10mV~10V (50Ω)
	<offset>	0~4.99V (50Ω)
Example	**SOUR1:APPL:RAMP 2KHZ,MAX,MAX** Sets frequency to 2kHz and sets the amplitude and offset to the maximum.	

SOURce[1]:APPLy:PULSe

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.
Note	The PW settings from the SOURce[1]:PULS: WIDT command are preserved. Edge and pulse width may be adjusted to supported levels. Repetition rates will be approximated from the frequency. For accurate repetition rates, the period should be adjusted using the SOURce[1]:PULS:PER command

Syntax	**SOUR[1]:APPLy:PULSe [<frequency> [,<amplitude> [,<offset>]]]**	
Parameter	<frequency>	500uHz~50MHz
	<amplitude>	10mV~10V (50Ω)
	<offset>	0~4.99V (50Ω)
Example	**SOUR1:APPL:PULS 1KHZ,MIN,MAX** Sets frequency to 1kHz and sets the amplitude to minimum and the and offset to the maximum.	

SOURce[1]:APPLy:NOISe

Source Specific Command

Description	Outputs Gaussian noise with a 50 MHz 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]:APPLy:NOISe [<frequency|DEFault> [,<amplitude> [,<offset>]]]**

Parameter	<frequency>	Not applicable
	<amplitude>	10mV~10V (50Ω)
	<offset>	0~4.99V (50Ω)
Example	**SOUR1:APPL:NOIS DEF, 3.0, 1.0** Sets the amplitude to 3 volts with an offset of 1 volt.	

SOURce[1]:APPLy:TRIangle

Source Specific Command

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

Syntax	**SOURce[1]:APPLy:TRIangle [<frequency> [,<amplitude> [,<offset>]]]**	
Parameter	<frequency>	1uHz~1MHz
	<*amplitude*>	10mV~10V (50Ω)
	<offset>	0~4.99V (50Ω)
Example	**SOUR1:APPL:TRI 2khz, 3.0, 1.0** Sets the frequency to 1 MHz with an amplitude of 3 volts and with an offset of 1 volt.	

SOURce[1]:APPLy:DC

Source Specific Command

Description	Outputs a triangle wave from the selected channel when the command has executed. Frequency, amplitude and offset can also be set.	
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	**SOUR[1]:APPLy:DC [<frequency|DEFault> [,<amplitude>|DEFault> [,<offset>]]]**	
Parameter	<frequency>	Not applicable
	<*amplitude*>	Not applicable
	<offset>	±5V (50Ω), ±10V (open)
Example	**SOUR1:APPL:DC DEF, DEF, 1.0** Sets the DC offset to 1 volt.	

SOURce[1]: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]:APPLy:USER [<frequency> [,<amplitude> [,<offset>]]]**	
Parameter	<frequency>	1uHz~100MHz
	<amplitude>	0~10V (50Ω)
	<offset>	0~5V (50Ω)
Example	**SOUR1:APPL:USER**	

SOURce[1]: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]:APPLy?**	
Return Parameter	<string>	Function, frequency, amplitude, offset
Example	**SOUR1:APPL?** SIN +5.0000000000000E+03,+3.0000E+00,-2.50E+00 Returns a string with the current function and parameters, Sine, 5kHz, 3 Vpp, -2.5V offset.	

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[1]:FUNCtion

Source Specific Command

Description	The FUNCtion command selects and outputs the selected output. The User parameter outputs an arbitrary waveform previously set by the SOURce[1]: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	Tri	Ramp	Pulse	Noise	ARB
AM	✓	✓	✓	✓	✓	×	✓
FM	✓	✓	✓	✓	×	×	×
PWM	×	✓	×	×	×	×	×
FSK	✓	✓	✓	✓	✓	×	×
SWEEP	✓	✓	✓	✓	×	×	×
BRUST	✓	✓	✓	✓	×	×	×

Syntax	**SOURce[1]:FUNCtion {SINusoid|SQUare|RAMP| PULSe|NOISe|TRIAngle|DC| USER}**
Example	**SOUR1:FUNC SIN** Sets the output as a sine function.
Query Syntax	**SOURce[1]:FUNCtion?**
Return Parameter	SIN, SQU, RAMP, PULS, NOIS, DC, TRI, USER — Returns the current output type.
Example	**SOUR1:FUNC?** SIN Current output is sine.

SOURce[1]:FREQuency

Source Specific Command

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

Sine, Square	1uHz~80MHz(3081)/ 50MHz(3051)
Ramp, Triangle	1uHz~80MHz(3081)/ 50MHz(3051)
Pulse	50uHz~50MHz
Noise, DC	Not applicable

	User	1uHz~100MHz
	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. The duty cycle of square waveforms depends on the frequency settings. 20% to 80% (*frequency* < 25 MHz) 40% to 60% (25 MHz < *frequency* < 50 MHz) 50% (*frequency* > 50 MHz) If the frequency is changed and the set duty cycle cannot support the new frequency, the highest duty cycle available at that frequency will be used. A "settings conflict" error will result from the above scenario.	
Syntax	**SOURce[1]:FREQuency {<frequency>|MINimum|MAXimum}**	
Example	**SOUR1:FREQ MAX** Sets the frequency to the maximum for the current mode.	
Query Syntax	**SOURce[1]:FREQuency?**	
Return Parameter	<NR3>	Returns the frequency for the current mode.
Example	**SOUR1:FREQ? MAX** +1.0000000000000E+03 The maximum frequency that can be set for the current function is 1MHz.	

SOURce[1]:AMPlitude

Description	Sets the output amplitude for the SOURce[1]:FUNCtion command. The query command returns the current amplitude settings.
Note	The maximum and minimum amplitude depends on the output termination. The default amplitude for all functions is 100 mVpp (50Ω). 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. $\|V_{offset}\| < V_{max} - Vpp/2$ 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]:AMPlitude command is used. Alternatively, the VOLT:UNIT command can be used to set the amplitude units for all commands.
Syntax	**SOURce[1]:AMPlitude {< amplitude> |MINimum|MAXimum}**

Example	**SOUR1:AMP MAX** Sets the amplitude to the maximum for the current mode.	
Query Syntax	**SOURce[1]:AMPlitude? {MINimum|MAXimum}**	
Return Parameter	<NR3>	Returns the amplitude for the current mode.
Example	**SOUR1:AMP? MAX** +5.0000E+00 The maximum amplitude that can be set for the current function is 5 volts.	

SOURce[1]: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. $\|V_{offset}\| < V_{max} - Vpp/2$ 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. When trying to set a DC voltage, the SOURce[1]: FUNC DC should be used prior to setting an offset.
Syntax	**SOURce[1]:DCOffset {< offset> |MINimum|MAXimum}**

Example	**SOUR1:DCO MAX** Sets the offset to the maximum for the current mode.	
Query Syntax	**SOURce[1]:DCOffset? {MINimum|MAXimum}**	
Return Parameter	<NR3>	Returns the offset for the current mode.
Example	**SOUR1:DCO?** +3.0000E+00 The offset for the current mode is set to +3 volts.	

SOURce[1]:SQUare:DCYCle

Source Specific Command

Description	Sets or queries the duty cycle for square waves only. The setting is remembered if the function mode is changed. The default duty cycle is 50%.
Note	The duty cycle of square waveforms depend on the frequency settings. 20% to 80% (*frequency* < 25 MHz) 40% to 60% (25 MHz < *frequency* < 50 MHz) 50% (*frequency* > 50 MHz) If the frequency is changed and the set duty cycle cannot support the new frequency, the highest duty cycle available at that frequency will be used. A "settings conflict" error will result from the above scenario. For square waveforms, the Apply command and AM/FM modulation modes ignore the duty cycle settings.
Syntax	**SOURce[1]:SQUare:DCYCle {< percent> |MINimum|MAXimum}**
Example	**SOUR1:SQU:DCYC MAX**

	Sets the duty cycle to the highest possible for the current frequency.	
Query Syntax	**SOURce[1]:SQUare:DCYCle? {MINimum|MAXimum}**	
Return Parameter	<NR3>	Returns the duty cycle as a percentage.
Example	**SOUR1:SQU:DCYC?** +5.00E+01 The duty cycle is set 50%.	

SOURce[1]: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%.
Note	For ramp waveforms, the Apply command and AM/FM modulation modes ignore the current symmetry settings.
Syntax	**SOURce[1]:RAMP:SYMMetry {< percent> |MINimum|MAXimum}**
Example	**SOUR[1]:RAMP:SYMM MAX** Sets the symmetry to the 100%.
Query Syntax	**SOURce[1]:RAMP:SYMMetry? {MINimum|MAXimum}**
Return Parameter	<NR3> Returns the symmetry as a percentage.
Example	**SOUR1:RAMP:SYMMetry?** +1.0000E+02 The symmetry is set as 100%.

OUTPut

Source Specific Command

Description	Enables/Disables or queries the front panel output. The default is set to off.	
Note	If the output is overloaded by an external voltage, the output will turn off and an error message will be displayed. 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.	
Syntax	**OUTPut {OFF|ON}**	
Example	**OUTP ON** Turns the output on.	
Query Syntax	**OUTPut?**	
Return Parameter	1	ON
	0	OFF
Example	**OUTP?** **1** The output is currently on.	

OUTPut: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:LOAD {DEFault|INFinity}**	
Example	**OUTP:LOAD DEF** Sets the output termination to 50Ω.	
Query Syntax	**OUTPut:LOAD?**	
Return Parameter	DEF	Default
	INF	INFinity
Example	**OUTP:LOAD?** **DEF** The output is set to the default of 50Ω.	

SOURce[1]:VOLTage:UNIT

Source Specific Command

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

	DBM	dBm

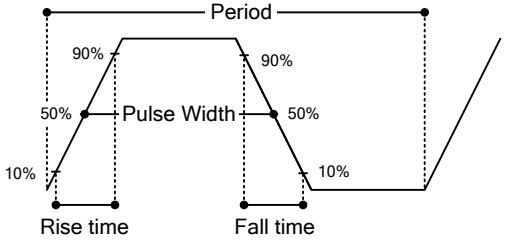
Example **SOUR1:VOLT:UNIT?**

VPP

The amplitude units are set to Vpp.

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 rise time, fall time, period and pulse width.



SOURce[1]:PULSe:PERiod

Source Specific Command

Description	Sets or queries the pulse period. The default period is 1 ms.
Note	The pulse period must be greater than the pulse width and edge time(1.6x) combined. Pulse Width + (1.6 * Edge Time) < Period If the edge time or pulse width are too great, they will automatically be reduced to fit the period by the function generator. The PULSe:PERiod function will change the period for all functions, not just for the pulse waveforms. If a different function is chosen and the current period is out of range, the period will be automatically adjusted to suit the new function.
Syntax	**SOURce[1]:PULSe:PERiod {<seconds>|MINimum|MAXimum}**
Example	**SOUR1:PULS:PER MIN** Sets the period to the minimum time allowed.
Query Syntax	**SOURce[1]:PULSe:PERiod? [MINimum|MAXimum]**
Return Parameter	<seconds> 20 ns ~ 2000 seconds

Example	**SOUR1:PULS:PER?** +1.0000E+01 The period is set to 10 seconds.

SOURce[1]:PULSe:WIDTh

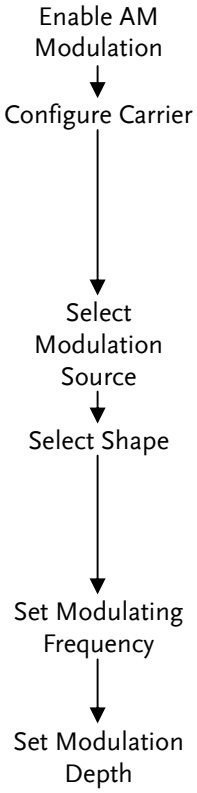
Source Specific Command

Description	Sets or queries the pulse width. The default pulse width is 100us. The minimum pulse width is affected by the period time. If the period is over 20 or 200 seconds, then the minimum pulse width is 1us and 10us, respectively. Pulse width is defined as the time from the rising to falling edges (at a threshold of 50%).
Note	The pulse width cannot be less than the edge time times 1.6. Pulse Width > 1.6 * Edge Time The pulse width must be less than the period minus the edge time (x1.6). Pulse Width < Period – (1.6 *Edge Time)
Syntax	**SOURce[1]:PULSe:WIDTh {<seconds>|MINimum|MAXimum}**
Example	**SOUR1:PULS:WIDT MAX** Sets the pulse width to the maximum allowed.
Query Syntax	**SOURce[1]:PULSe:WIDTh? [MINimum|MAXimum]**
Return Parameter	<seconds> 8 ns ~ 2000 seconds
Example	**SOUR1:PULS:WIDT? MIN** +8.0000E-09 The pulse width is set to 8 nanoseconds.

Amplitude Modulation (AM) Commands

AM Overview

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



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

SOURce[1]:AM:STATe

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]:AM:STATe {OFF|ON}**	
Example	**SOUR1:AM:STAT ON** Enables AM modulation.	
Query Syntax	**SOURce[1]:AM:STATe?**	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	**SOUR1:AM:STAT?** **1** AM modulation mode is currently enabled.	

SOURce[1]: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 ± 5V from the MOD INPUT terminal on the rear panel. For example, if modulation depth is set to 100%, then the maximum amplitude is +5V, and the minimum amplitude is -5V.
Syntax	**SOURce[1]:AM:SOURce {INTernal|EXTernal}**
Example	**SOUR1:AM:SOUR EXT**

Sets the modulation source to external.

Query Syntax	**SOURce[1]:AM:SOURce?**	
Return Parameter	INT	Internal
	EXT	External
Example	**SOUR1:AM:SOUR?**	
	INT	
	The modulation source is set to internal.	

SOURce[1]:AM:INTernal:FUNCtion

Source Specific Command

Description	Sets the shape of the modulating waveform from sine, square, triangle, upramp and dnramp. The default shape is sine.			
Note	Square and triangle waveforms have a 50% duty cycle. Upramp and dnramp have a symmetry of 100% and 0%, respectively.			
Syntax	**SOURce[1]:AM:INTernal:FUNCtion {SINusoid|SQUare|TRIangle|UPRamp|DNRamp}**			
Example	**SOUR1:AM:INT:FUNC SIN**			
	Sets the AM modulating wave shape to sine.			
Query Syntax	**SOURce[1]:AM:INTernal:FUNCtion?**			
Return Parameter	SIN	Sine	UPRAMP	Upramp
	SQU	Square	DNRAMP	Dnramp
	TRI	Triangle		
Example	**SOUR1:AM:INT:FUNC?**			
	SIN			
	The shape for the modulating waveform is Sine.			

SOURce[1]:AM:INTernal:FREQuency

Source Specific Command

Description	Sets the frequency of the internal modulating waveform only. The default frequency is 100Hz.

Syntax	**SOURce[1]:AM:INTernal:FREQuency {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	2 mHz~ 20 kHz
Example	**SOUR1:AM:INT:FREQ +1.0000E+02** Sets the modulating frequency to 100Hz.	
Query Syntax	**SOURce[1]:AM:INTernal:FREQuency? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	**SOUR1:AM:INT:FREQ? MIN** **+1.0000E+02** Returns the minimum frequency allowed.	

SOURce[1]:AM:DEPTh

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 ±5V, regardless of the modulation depth. The modulation depth of an external source is controlled using the ±5V MOD INPUT terminal on the rear panel, and not the SOURce[1]:AM:DEPTh command.
Syntax	**SOURce[1]:AM:DEPTh {<depth in percent>|MINimum|MAXimum}**
Parameter	<depth in percent> 0~120%
Example	**SOUR1:AM:DEPT 50** Sets the modulation depth to 50%.
Query Syntax	**SOURce[1]:AM:DEPTh? [MINimum|MAXimum]**
Return Parameter	<NR3> Return the modulation depth as a percentage.

Example **SOUR1:AM:DEPT?**

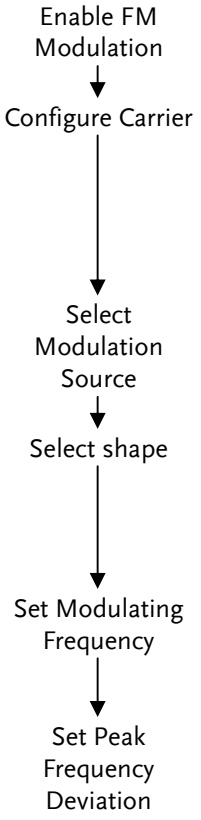
+1.0000E+02

The modulation depth is 100%.

Frequency Modulation (FM) Commands

FM Overview

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



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

SOURce[1]:FM:STATe

Source Specific Command

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]:FM:STATe {OFF|ON}**	
Example	**SOUR1:FM:STAT ON** Enables FM modulation.	
Query Syntax	**SOURce[1]:FM:STATe?**	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	**SOUR1:FM:STAT?** **1** FM modulation mode is currently enabled.	

SOURce[1]:FM: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 ± 5V from the MOD INPUT terminal on the rear panel. For example, if modulation depth is set to 100%, then the maximum amplitude is +5V, and the minimum amplitude is -5V.
Syntax	**SOURce[1]:FM:SOURce {INTernal|EXTernal}**

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

SOURce[1]:FM:INTernal:FUNCtion

Source Specific Command

Description	Sets the shape of the modulating waveform from sine, square, triangle, upramp and dnramp. The default shape is sine.			
Note	Square and triangle waveforms have a 50% duty cycle. Upramp and dnramp have a symmetry of 100% and 0%, respectively.			
Syntax	**SOURce[1]:FM:INTernal:FUNCtion {SINusoid|SQUare|TRIangle|UPRamp|DNRamp}**			
Example	**SOUR1:FM:INT:FUNC SIN**			
	Sets the FM modulating wave shape to sine.			
Query Syntax	**SOURce[1]:FM:INTernal:FUNCtion?**			
Return Parameter	SIN	Sine	UPRAMP	Upramp
	SQU	Square	DNRAMP	Dnramp
	TRI	Triangle		
Example	**SOUR1:FM:INT:FUNC?**			
	SIN			
	The shape for the modulating waveform is Sine.			

SOURce[1]:FM:INTernal:FREQuency

Source Specific Command

Description	Sets the frequency of the internal modulating waveform only. The default frequency is 10Hz.	
Syntax	**SOURce[1]:FM:INTernal:FREQuency {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	2 mHz~ 20 kHz
Example	**SOUR1:FM:INT:FREQ +1.0000E+02** Sets the modulating frequency to 100Hz.	
Query Syntax	**SOURce[1]:FM:INTernal:FREQuency? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	**SOUR1:FM:INT:FREQ? MAX** **+2.0000E+04** Returns the maximum frequency allowed.	

SOURce[1]: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 ±5V MOD INPUT terminal on the rear panel. A positive signal (>0~+5V) will increase the deviation (up to the set frequency deviation), whilst a negative voltage will reduce the deviation.
Note	The relationship of peak deviation to modulating frequency and carrier frequency is shown below. Peak deviation = modulating frequency – carrier frequency. The carrier frequency must be greater than or

equal to the peak deviation frequency. The sum of the deviation and carrier frequency must not exceed the maximum frequency for a specific carrier shape. 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.

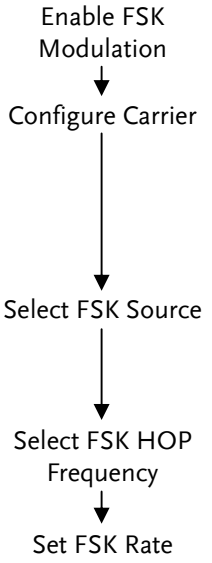
For square wave carrier waveforms, the deviation may cause the duty cycle frequency boundary to be exceeded. In these conditions the duty cycle will be adjusted to the maximum allowed and a "settings conflict" error will be generated.

Syntax	**SOURce[1]:FM:DEViation {<peak deviation in Hz>|MINimum|MAXimum}**	
Parameter	<peak deviation in Hz>	DC~80MHz(3081)/ 50MHz(3051) DC~1MHz (Ramp)
Example	**SOUR1:FM:DEV MAX** Sets the frequency deviation to the maximum value allowed.	
Query Syntax	**SOURce[1]:FM:DEViation? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the frequency deviation in Hz.
Example	**SOURce[1]:FM:DEViation? MAX** **+8.0000E+04** The maximum frequency deviation for the current function is 80MHz.	

Frequency-Shift Keying (FSK) Commands

FSK Overview

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



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

SOURce[1]:FSKey:STATe

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	**SOURce[1]:FSKey:STATe {OFF|ON}**

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

SOURce[1]: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]:FSKey:SOURce {INTernal|EXTernal}**	
Example	**SOUR1:FSK:SOUR EXT**	
	Sets the FSK source to external.	
Query Syntax	**SOURce[1]:FSKey:SOURce?**	
Return Parameter	INT	Internal
	EXT	External
Example	**SOUR1:FSK:SOUR?**	
	INT	
	The FSK source is set to internal.	

SOURce[1]: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]:FSKey:FREQuency {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	1 uHz~ 80 MHz(3081)/ 50MHz(3051)
Example	**SOUR1:FSK:FREQ +1.0000E+02** Sets the FSK hop frequency to to 100Hz.	
Query Syntax	**SOURce[1]:FSKey:FREQuency? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	**SOUR1:FSK:FREQ? MAX** **+8.0000E+07** Returns the maximum hop frequency allowed.	

SOURce[1]:FSKey:INTernal:RATE

Source Specific Command

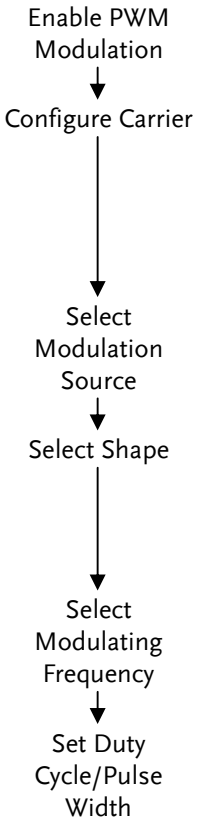
Description	Sets or queries the FSK rate for internal sources only.	
Note	External sources will ignore this command.	
Syntax	**SOURce[1]:FSKey:INTernal:RATE {<rate in Hz> |MINimum|MAXimum}**	
Parameter	<rate in Hz>	2 mHz~100 kHz
Example	**SOUR1:FSK:INT:RATE MAX** Sets the rate to the maximum (100kHz).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

Returns the maximum FSK rate allowed.

Pulse Width Modulation (PWM) Commands

PWM Overview

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



1. Turn on PWM modulation using the SOURce[1]: PWM:STATe ON command.
2. Use the APPLy command to select a pulse waveform. Alternatively, the FUNC, FREQ, AMPl, and DCOffs commands can be used to create a pulse waveform with a designated frequency, amplitude and offset.
3. Select an internal or external modulation source using the SOURce[1]:PWM:SOUR command.
4. Use the SOURce[1]: PWM:INT:FUNC command to select a sine, square, upramp, dnramp or triangle modulating waveshape. For internal sources only.
5. Set the modulating frequency using the SOURce[1]:PWM:INT:FREQ command. For internal sources only.
6. Use the SOURce[1]:PWM:DUTY command to set the duty cycle or Pulse Width.

SOURce[1]:PWM:STATe

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

SOURce[1]: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]:PWM:SOURce {INTernal|EXTernal}**	
Example	**SOUR1:PWM:SOUR EXT** Sets the PWM source to external.	
Query Syntax	**SOURce[1]:PWM:SOURce?**	
Return Parameter	INT	Internal
	EXT	External

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

SOURce[1]:PWM:INTernal:FUNction

Source Specific Command

Description	Sets the shape of the modulating waveform from sine, square, triangle, upramp and dnramp. The default shape is sine.
Note	Square and triangle waveforms have a 50% duty cycle. Upramp and dnramp have a symmetry to 100% and 0%, respectively. Carrier must be a pulse or PWM waveform.
Syntax	**SOURce[1]:PWM:INTernal:FUNction {SINusoid|SQUare|TRIangle|UPRamp|DNRamp}**
Example	**SOUR1:PWM:INT:FUN SIN** Sets the PWM modulating wave shape to sine. .
Query Syntax	**SOURce[1]:PWM:INTernal:FUNction?**

Return Parameter				
	SIN	Sine	UPRAMP	Upramp
	SQU	Square	DNRAMP	Dnramp
	TRI	Triangle		

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

SOURce[1]:PWM:INTernal:FREQuency

Source Specific Command

Description	Sets the modulating waveform frequency for internal sources. The default frequency is set to 10Hz.
Syntax	**SOURce[1]:PWM:INTernal:FREQuency {<frequency>|MINimum|MAXimum}**

Parameter	<frequency>	2 mHz~ 20 kHz
Example	**SOUR1:PWM:INT:FREQ MAX**	
	Sets the frequency to the maximum value.	
Query Syntax	**SOURce[1]:PWM:INTernal:FREQuency?**	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	**SOUR1:PWM:INT:FREQ? MAX**	
	+2.0000E+04	
	Returns the modulating frequency. (20kHz)	

SOURce[1]:PWM:DUTY

Source Specific Command

Description	Sets or queries the duty cycle deviation. The default duty cycle is 50%.	
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 ±5V MOD INPUT terminal on the rear panel. A positive signal (>0~+5V) will increase the deviation (up to the set duty cycle deviation), whilst a negative voltage will reduce the deviation.	
Syntax	**SOURce[1]: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]:PWM:DUTY?**	
Return Parameter	<NR3>	Returns the deviation in %.

Example

SOUR1:PWM:DUTY?

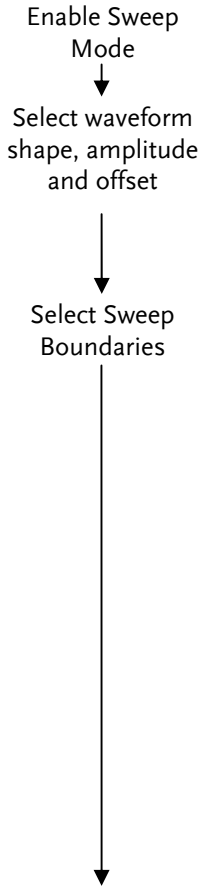
+3.0000E+01

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.



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

Start~Stop	Use the SOURce[1]:FREQ:STAR and SOURce[1]:FREQ:STOP to set the start and stop frequencies. To sweep up or down, set the stop frequency higher or lower than the start frequency.
Span	Use the SOURce[1]:FREQ:CENT and SOURce[1]:FREQ:SPAN commands to set the center frequency and the frequency span. To sweep up or down, set the span as positive or negative.

4. Choose Linear or Logarithmic spacing using the SOURce[1]:SWE:SPAC command.

Select Sweep Time
↓
Select the sweep trigger source
↓
Select the marker frequency

5. Choose the sweep time using the SOURce[1]:SWE:TIME command.
6. Select an internal or external sweep trigger source using the SOURce[1]:SOUR command.
7. To output a marker frequency from the SYNC terminal, use The SOURce[1]:MARK:FREQ command. To enable marker frequency output, use the SOURce[1]:MARK ON command.

The marker frequency can be set to a value within the sweep span.

SOURce[1]:SWEep:STATe

Source Specific Command

Description	Sets or disables Sweep mode. By default Sweep is disabled. FM 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]:SWEep:STATe {OFF|ON}**	
Example	**SOUR1:SWE:STAT ON** Enables sweep mode.	
Query Syntax	**SOURce[1]:SWEep:STATe?**	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	**SOUR1:SWE:STAT?** **1** Sweep mode is currently enabled.	

SOURce[1]: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]:FREQuency:STARt {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	100uHz~ 80MHz(3081)/ 50MHz(3051) 100uHz~ 1MHz (Ramp)
Example	**SOUR1:FREQ:STAR +2.0000E+03** Sets the start frequency to 2kHz.	
Query Syntax	**SOURce[1]:FREQuency:STARt? [MINimum| MAXimum]**	
Return Parameter	<NR3>	Returns the start frequency in Hz.
Example	**SOUR1:FREQ:STAR? MAX** **+8.0000E+07** Returns the maximum start frequency allowed.	

SOURce[1]: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]:FREQuency:STOP {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	100uHz~ 80MHz(3081)/ 50MHz(3051) 100uHz~ 1MHz (Ramp)

Example	**SOUR1:FREQ:STOP +2.0000E+03** Sets the stop frequency to 2kHz.	
Query Syntax	**SOURce[1]:FREQuency:STOP? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the stop frequency in Hz.
Example	**SOUR1:FREQ:STOP? MAX** **+8.0000E+07** Returns the maximum stop frequency allowed.	

SOURce[1]: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]:FREQuency:CENTer {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	100uHz~ 80MHz(3081)/ 50MHz(3051) 100uHz~ 1MHz (Ramp)
Example	**SOUR1:FREQ:CENT +2.0000E+03** Sets the center frequency to 2kHz.	
Query Syntax	**SOURce[1]:FREQuency:CENTer? [MINimum|MAXimum]**	
Return Parameter	<NR3>	Returns the stop frequency in Hz.
Example	**SOUR1:FREQ:CENT? MAX** **+8.0000E+06** Returns the maximum center frequency allowed, depending on the span.	

SOURce[1]: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]:FREQuency:SPAN {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	100uHz~ 80MHz(3081)/ 50MHz(3051)100uHz~ 1MHz (Ramp)
Example	**SOUR1:FREQ:SPAN +2.0000E+03** Sets the frequency span to 2kHz.	
Query Syntax	**SOURce[1]:FREQuency:SPAN? [MINimum| MAXimum]**	
Return Parameter	<NR3>	Returns the frequency span in Hz.
Example	**SOUR1:FREQ:SPAN?** **+2.0000E+03** Returns the frequency span for the current sweep.	

SOURce[1]:SWEep:SPACing

Source Specific Command

Description	Sets linear or logarithmic sweep spacing. The default spacing is linear.
Syntax	**SOURce[1]:SWEep:SPACing {LINear|LOGarithmic}**
Example	**SOUR1:SWE:SPAC LIN** Sets the spacing to linear.

Query Syntax	**SOURce[1]:SWEep:SPACing?**	
Return Parameter	LIN	Linear spacing
	LOG	Logarithmic spacing
Example	**SOUR1:SWE:SPAC?**	
	LOG	
	The spacing is currently set as linear.	

SOURce[1]:SWEep:TIME

Source Specific Command

Description	Sets or queries the sweep time. The default sweep time is 1 second.	
Note	The function generator automatically determines the number of frequency points that are used for the sweep based on the sweep time.	
Syntax	**SOURce[1]:SWEep:TIME {<seconds>|MINimum|MAXimum}**	
Parameter	<seconds>	1 ms ~ 500 s
Example	**SOUR1:SWE:TIME +1.0000E+00**	
	Sets the sweep time to 1 second.	
Query Syntax	**SOURce[1]:SWEep:TIME? {<seconds>| MINimum|MAXimum}**	
Return Parameter	<NR3>	Returns sweep time in seconds.
Example	**SOUR1:SWE:TIME?**	
	+2.0000E+01	
	Returns the sweep time (20 seconds).	

SOURce[1]: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 ouput 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.
Syntax	**SOURce[1]: SWEep:SOURce {IMMediate|EXTernal|MANual}**
Example	**SOUR1: SWE:SOUR EXT** Sets the sweep source to external.
Query Syntax	**SOURce[1]: SWEep:SOURce?**

Return Parameter		
	IMM	Immediate
	EXT	External
	MANual	Manual

Example	**SOUR1:SWE:SOUR?** **IMM** The sweep source is set to immediate.

OUTPut[1]:TRIGger:SLOPe

Source Specific Command

Description	Configures the trigger output signal (TTL) as a positive or negative slope. A positive slope will output a pulse with a rising edge and a negative slope will output a pulse with a falling edge.

Note	The Trig out signal depends on the selected trigger source.	
	Trigger Source	Description
	Immediate	A square wave is output from the Trig out terminal with a 50% duty cycle at the start of every sweep.
	External	Trigger Output is disconnected.
	Manual	A pulse (>1 us) is output from the Trig out terminal at the start of each sweep.
Syntax	**OUTPut[1]:TRIGger:SLOPe {POSitive|NEGative}**	
Example	**OUTP1:TRIG:SLOP NEG** Sets the Trig out signal as negative edge.	
Query Syntax	**OUTPut[1]:TRIGger:SLOPe?**	
Return Parameter	POS	Positive edge
	NEG	Negative edge
Example	**OUTP1:TRIG:SLOP?** **NEG** The Trig out signal is set to negative edge.	

OUTPut[1]:TRIGger

Source Specific Command

Description	Turns the trigger out signal on or off from the Trig out terminal on the rear panel. When set to on, a trigger signal (TTL) is output at the start of each pulse. The default is setting is off.	
Syntax	**OUTPut[1]:TRIGger {OFF|ON}**	
Example	**OUT OUTP1:TRIG ON** Enables the Trig out signal.	
Query Syntax	**OUTPut[1]:TRIGger?**	
Return Parameter	0	Disabled
	1	Enable

Example	**OUTP1:TRIG?** **1** The Trig out signal is enabled.

SOURce[1]:MARKer:FREQuency

Source Specific Command

Description	Sets or queries the marker frequency. The default marker frequency is 500 Hz. The marker frequency is used to output a SYNC signal from the SYNC terminal on the front panel. The SYNC signal goes logically high at the start of each sweep and goes low at the marker frequency.	
Note	The marker frequency must be between the start and stop frequencies. If the marker frequency is set to a value that is out of the range, the marker frequency will be set to the center frequency and a "settings conflict" error will be generated.	
Syntax	**SOURce[1]:MARKer:FREQuency {<frequency>|MINimum|MAXimum}**	
Parameter	<frequency>	100 uHz ~ 80 MHz(3081)/ 50MHz(3051)100 uHz ~ 1 MHz (Ramp)
Example	**SOUR1:MARK:FREQ +1.0000E+03** Sets the marker frequency to 1 kHz.	
Query Syntax	**SOURce[1]:MARKer:FREQuency? [MINimum| MAXimum]**	
Return Parameter	<NR3>	Returns the marker frequency in Hz.
Example	**SOUR1:MARK:FREQ? MAX** **+1.0000E+03** Returns the marker frequency (1 kHz).	

Description	Turns the marker frequency on or off. The default is off.		
Note	MARKer ON	The SYNC signal goes logically high at the start of each sweep and goes low at the marker frequency.	
	MARKer OFF	The SYNC terminal outputs a square wave with a 50% duty cycle at the start of each sweep.	
Syntax	**SOURce[1]:MARKer {OFF|ON}**		
Example	**SOUR1:MARK ON** Enables the marker frequency.		
Query Syntax	**SOURce[1]:MARKer?**		
Return Parameter	0		Disabled
	1		Enabled
Example	**SOUR1:MARK?** **1** The marker frequency is enabled.		

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.

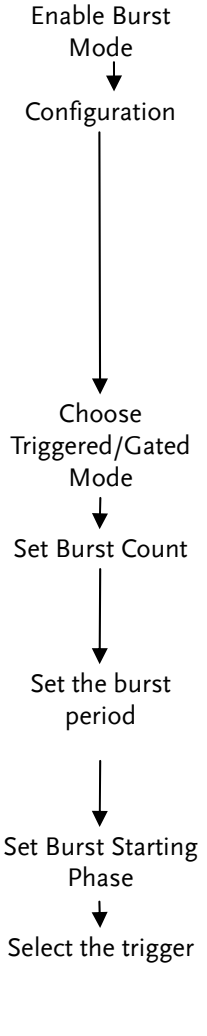
*assuming the Trigger polarity is not inverted.

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.

	Function		
Burst Mode & Source	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.



1. Turn on Burst mode using the SOURce[1]:BURS:STAT ON command.
2. Use the APPLy command to select a sine, square, ramp, pulse or triangle burst waveform*. Alternatively, the FUNC, FREQ, AMPl, and DCOffs commands can be used to create the burst waveform* with a designated frequency, amplitude and offset.

   *2 mHz minimum for internally triggered bursts.
3. Use the SOURce[1]: BURS:MODE command to select from triggered or gated burst modes.
4. Use the SOURce[1]:BURS:NCYC command to set the burst count. This command is only for triggered burst mode only.
5. Use the SOURce[1]:BURS:INT:PER command to set the burst period/cycle. This command is only applicable for triggered burst mode (internal trigger).
6. Use the SOURce[1]:BURS:PHAS command to set the burst starting phase.
7. Use the SOURce[1]:BURS:TRIG:SOUR command to select the trigger source for triggered burst mode only.

SOURce[1]: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]:BURSt:STATe {OFF|ON}**	
Example	**SOUR1:BURS:STAT OFF** Turns burst mode on.	
Query Syntax	**SOURce[1]:BURSt:STATe?**	
Return Parameter	0	Disabled
	1	Enabled
Example	**SOUR1:BURS:STAT?** **OFF** Burst mode is off.	

SOURce[1]: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]:BURSt:MODE {TRIGgered|GATed}**	
Example	**SOUR1:BURS:MODE TRIG** Sets the burst mode to triggered.	
Query Syntax	**SOURce[1]:BURSt:MODE?**	
Return Parameter	TRIG	Triggered mode
	GAT	Gated mode

Example	**SOUR1:BURS:MODE?** **TRIG** The current burst mode is triggered.	

SOURce[1]: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 25 MHz.	
Syntax	**SOURce[1]:BURSt:NCYCles{< # cycles> |INFinity|MINimum |MAXimum}**	
Parameter	<# cycles>	1~1,000,000 cycles.
	INFinity	Sets the number to continuous.
	MINimum	Sets the number to maximum allowed.
	MAXimum	Sets the number to minimum allowed.
Example	**SOUR1:BURS:NCYCl INF** Sets the number of burst cycles to continuous (infinite).	
Query Syntax	**SOURce[1]: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? +1.0000E+02 The burst cycles are set to 100.

SOURce[1]: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 10 ms. 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]:BURSt:INTernal:PERiod {<seconds>|MINimum|MAXimum}
Parameter	<seconds > 1 us ~ 500 seconds
Example	SOUR1:BURS:INT:PER +1.0000E+01 Sets the period to 10 seconds.
Query Syntax	SOURce[1]:BURSt:INTernal:PERiod? [MINimum|MAXimum]
Return Parameter	<NR3> Returns the burst period in seconds.
Example	SOUR1:BURS:INT:PER? +1.0000E+01 The burst period is 10 seconds.

SOURce[1]:BURSt:PHASe

Source Specific Command

Description	Sets or queries the starting phase for the burst. The default phase is 0 degrees. At 0 degrees, sine square and ramp waveforms are at 0 volts. In gated burst mode, waveforms are continuously output (burst) when the Trig signal is true. The voltage level at the starting phase is used to determine the voltage level of the signal in-between bursts.
Note	The phase command is not used with pulse waveforms.
Syntax	**SOURce[1]:BURSt:PHASe {<angle>|MINimum|MAXimum}**
Parameter	<angle> -360 ~ 360 degrees
Example	**SOUR1:BURS:PHAS MAX** Sets the phase to 360 degrees.
Query Syntax	**SOURce[1]:BURSt:PHASe? [MINimum|MAXimum]**
Return Parameter	<NR3> Returns the phase angle in degrees.
Example	**SOUR1:BURS:PHAS?** **+1.2000E+01** The burst phase is 120 degrees.

SOURce[1]:BURSt:TRIGger:SOURce

Source Specific Command

Description	Sets or queries the trigger source for triggered burst mode. In trigged 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.
Syntax	**SOURce[1]:BURSt:TRIGger:SOURce {IMMediate|EXTernal|MANual}**
Example	**SOUR1:BURS:TRIG:SOUR EXT** Sets the burst trigger source to external.
Query Syntax	**SOURce[1]:BURSt:TRIGger:SOURce?**

Return Parameter		
	IMM	Immediate
	EXT	External
	MANual	Manual

Example	**SOUR1:BURS:TRIG:SOUR?** **IMM** The burst trigger source is set to immediate.

SOURce[1]:BURSt:TRIGger:DELay

Source Specific Command

Description	The DELay command is used to insert a delay (in seconds) before a burst is output. The delay starts after a trigger is received. The default delay is 0 seconds.

Syntax	**SOURce[1]: BURSt:TRIGger:DELay {<seconds>|MINimum|MAXimum}**	
Parameter	<seconds>	0~85 seconds
Example	**SOUR1:BURS:TRIG:DEL +1.0000E+01** Sets the trigger delay to 10 seconds.	
Query Syntax	**SOURce[1]:BURSt:TRIGger:DELay? [MINimum|MAXimum]**	
Return Parameter	<NRf>	Delay in seconds
Example	**SOUR1:BURS:TRIG:DEL +1.0000E+01** The trigger delay is 10 seconds.	

SOURce[1]:BURSt:TRIGger:SLOPe

Source Specific Command

Description	Sets or queries the trigger edge for externally triggered bursts from the Trigger INPUT terminal on the rear panel. By default the trigger is rising edge (Positive).	
Syntax	**SOURce[1]:BURSt:TRIGger:SLOPe {POSitive|NEGative}**	
Parameter	POSitive	rising edge
	NEGative	falling edge
Example	**SOUR1:BURS:TRIG:SLOP NEG** Sets the trigger slope to negative.	
Query Syntax	**SOURce[1]:BURSt:TRIGger:SLOPe?**	
Return Parameter	POS	rising edge
	NEG	falling edge
Example	**SOUR1:BURS:TRIG:SLOP NEG** The trigger slope is negative.	

SOURce[1]: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]: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]:BURSt:GATE:POLarity?**	
Return Parameter	NORM	Normal(High) logical level
	INV	Inverted (low) logical level
Example	**SOUR1:BURS:GATE:POL?** **INV** The true state is inverted(logically low).	

Description	Sets or queries the trigger edge of the trigger output signal. The signal is output from the trigger out terminal on the rear panel. The default trigger output slope is positive.	
Note	The trigger output signal on the rear panel depends on the burst trigger source or mode:	
	Immediate	50% duty cycle square wave is output at the start of each burst.
	External	Trigger output disabled.
	Gated mode	Trigger output disabled.
	Manual	A >1 ms pulse is output at the start of each burst.
Syntax	**SOURce[1]:BURSt:OUTPut:TRIGger:SLOPe {POSitive|NEGative}**	
Parameter	POSitive	Rising edge.
	NEGative	Falling edge.
Example	**SOUR1:BURS:OUTP:TRIG:SLOP POS** Sets the trigger output signal slope to positive (rising edge).	
Query Syntax	**SOURce[1]:BURSt:OUTPut:TRIGger:SLOPe?**	
Return Parameter	POS	Rising edge.
	NEG	Falling edge.
Example	**SOUR1:BURS:OUTP:TRIG:SLOP?** **POS** The trigger output signal slope to positive.	

OUTPut:TRIGger

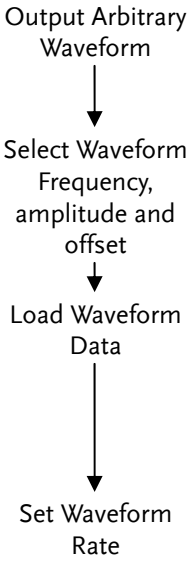
Source Specific Command

Description	Sets or queries the trigger output signal on or off. By default the signal is disabled. When enabled, a TTL compatible square wave is output. This function applies to sweep as well as burst mode.	
Syntax	**OUTPut[1]:TRIGger {OFF|ON}**	
Parameter	OFF	Turns the output off.
	ON	Turns the output on.
Example	**OUTP1:TRIG ON** Turns the output on.	
Query Syntax	**OUTPut[1]:TRIGger?**	
Return Parameter	0	Disabled
	1	Enabled
Query Example	**OUTP1:TRIG?** **1** The trigger output is enabled.	

Arbitrary Waveform Commands

Arbitrary Waveform Overview

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



1. Use the SOURce[1]:FUNCtion USER command to output the arbitrary waveform currently selected in memory.
2. Use the APPLy command to select frequency, amplitude and DC offset. Alternatively, the FUNC, FREQ, AMPl, and DCOffs commands can be used.
3. Waveform data (1 to 1,048,576 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.

Rate = Hz × # points

Range:	Rate:	10uHz ~ 200MHz
	Frequency:	10uHz ~ 100MHz
	# points:	1~1,048,576

SOURce[1]:FUNCtion USER

Source Specific Command

Description	Use the SOURce[1]:FUNCtion USER command to output the arbitrary waveform currently selected in memory. The waveform is output with the current frequency, amplitude and offset settings.
Syntax	**SOURce[1]:FUNCtion USER**
Example	**SOUR1:FUNC USER** Selects and outputs the current waveform in memory.

DATA:DAC

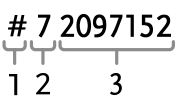
Source Specific Command

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 32767is 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:



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>	
	<value>	Decimal or integer values ±32767

Example

DATA:DAC VOLATILE, #216 Binary Data

The command above downloads 5 data values (stored in 16 bytes) using the binary block format.

DATA:DAC VOLATILE, 1000, 32767, 2048, 0, -2048, -32767

Downloads the data values (32767, 2048, 0, -2048, -32767) to address 1000.

SOURce[1]:ARB:EDIT:COPY

Source Specific Command

Description	Copies a segment of a waveform to a specific starting address.	
Syntax	**SOURce[1]:ARB:EDIT:COPY [<start>[,<length>[,<paste>]]]**	
Parameter	<start>	Start address: 0~1048,576
	<length>	0 ~ 1048,576
	<paste>	Paste address: 0~1048,576
Example	**SOUR1:ARB:EDIT:COPY 1000, 256, 1257** Copies 256 data values starting at address 1000 and copies them to address 1257.	

SOURce[1]: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]:ARB:EDIT:DELete [<STARt>[,<LENGth>]]**	
Parameter	<STARt>	Start address: 0~1048,576
	<LENGth>	0 ~ 1048,576
Example	**SOURce1:ARB:EDIT:DEL 1000, 256** Deletes a section of 256 data points from the waveform starting at address 1000.	

SOURce[1]: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]:ARB:EDIT:DELete:ALL**
Example	**SOUR1:ARB:EDIT:DEL:ALL** Deletes all user waveforms from memory.

SOURce[1]: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]:ARB:EDIT:POINt [<address> [, <data>]]**	
Parameter	<address>	Address of data point: 0~1,048,576
	<data>	Value data: ± 32,767
Example	**SOUR1:ARB:EDIT:POIN 1000, 32767** Creates a point on the arbitrary waveform at address 1000 with the highest amplitude.	

SOURce[1]: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]:ARB:EDIT:LINE [<address1>[,<data>[,<address2>[,<data2>]]]]**	
Parameter	<addrress1>	Address of data point1: 0~1,048,576
	<data1>	Value data2: ± 32,767
	<address2>	Address of data point2: 0~1,048,576

	<data2>	Value data2: ± 32,767
Example	**SOUR1:ARB:EDIT:LINE 40, 50, 100, 50** Creates a line on the arbitrary waveform at 40,50 to 100,50.	

SOURce[1]:ARB:EDIT:PROTect

Source Specific Command

Description	Protects a segment of the arbitrary waveform from deletion or editing.	
Syntax	**SOURce[1]:ARB:EDIT:PROTect [<STARt>[,<LENGth>]]**	
Parameter	<STARt>	Start address: 0~1048,576
	<LENGth>	0 ~ 1048,576
Example	**SOUR1:ARB:EDIT:PROT 40, 50** Protects a segment of the waveform from address 40 for 50 data points.	

SOURce[1]:ARB:EDIT:PROTect:ALL

Source Specific Command

Description	Protects the arbitrary waveform currently in non-volatile memory/ currently being output.
Syntax	**SOURce[1]:ARB:EDIT:PROTect:ALL**
Example	**SOUR1:ARB:EDIT:PROT:ALL**

SOURce[1]:ARB:EDIT:UNProtect

Source Specific Command

Description	Uprotects the arbitrary waveform currently in non-volatile memory/currently being output.
Syntax	**SOURce[1]:ARB:EDIT:UNProtect**
Example	**SOUR1:ARB:EDIT:UNP**

SOURce[1]:ARB:BUILt:SINusoid

Source Specific Command

Description	Creates a sinusoid with a specified start address, length and scale.	
Syntax	**SOURce[1]:ARB:BUILt:SINusoid [<STARt>[,<LENGth>[,<SCALe>]]]**	
Parameter	<STARt>	Start address*: 0~1048,576
	<LENGth>	Length*: 0 ~ 1048,576
	<SCALe>	Scale: ±32767
	* Start + Length ≤ 1,048,576	
Example	**SOUR1:ARB:BUIL:SIN 1000, 1000, 100**	
	Creates a sin wave 1000 points in length with a scale of 100 and a start address of 1000.	

SOURce[1]:ARB:BUILt:SQUare

Source Specific Command

Description	Creates a square wave with a specified start address, length and scale.	
Syntax	**SOURce[1]:ARB:BUILt:SQUare [<STARt>[,<LENGth>[,<SCALe>]]]**	
Parameter	<STARt>	Start address*: 0~1048,576
	<LENGth>	Length*: 0 ~ 1048,576
	<SCALe>	Scale: ±32767
	* Start + Length ≤ 1,048,576	
Example	**SOUR1:ARB:BUIL:SQU 1000, 1000, 100**	
	Creates a square wave 1000 points in length with a scale of 100 and a start address of 1000.	

SOURce[1]:ARB:BUILt:RAMP

Source Specific Command

Description	Creates a ramp wave with a specified start address, length and scale.	
Syntax	**SOURce[1]:ARB:BUILt:RAMP[<STARt>[,<LENGth>[,<SCALe>]]]**	
Parameter	<STARt>	Start address*: 0~1048,576
	<LENGth>	Length*: 0 ~ 1048,576
	<SCALe>	Scale: ±32767
	* Start + Length ≤ 1,048,576	
Example	**SOUR1:ARB:BUIL:RAMP 1000, 1000, 100** Creates a ramp wave 1000 points in length with a scale of 100 and a start address of 1000.	

SOURce[1]:ARB:BUILt:SINC

Source Specific Command

Description	Creates a sinc wave with a specified start address, length and scale.	
Syntax	**SOURce[1]:ARB:BUILt:SINC [<STARt>[,<LENGth>[,<SCALe>]]]**	
Parameter	<STARt>	Start address*: 0~1048,576
	<LENGth>	Length*: 0 ~ 1048,576
	<SCALe>	Scale: ±32767
	* Start + Length ≤ 1,048,576	
Example	**SOUR1:ARB:BUIL:SINC 1000, 1000, 100** Creates a sinc wave 1000 points in length with a scale of 100 and a start address of 1000.	

SOURce[1]:ARB:BUILt:EXPRise

Source Specific Command

Description	Creates an exponential rise wave with a specified start address, length and scale.	
Syntax	**SOURce[1]:ARB:BUILt:EXPRise [<STARt>[,<LENGth>[,<SCALe>]]]**	
Parameter	<STARt>	Start address*: 0~1048,576
	<LENGth>	Length*: 0 ~ 1048,576
	<SCALe>	Scale: ±32767
	* Start + Length ≤ 1,048,576	
Example	**SOUR1:ARB:BUIL:EXPR 1000, 1000, 100**	
	Creates a exponential rise wave 1000 points in length with a scale of 100 and a start address of 1000.	

SOURce[1]:ARB:BUILt:EXPFail

Source Specific Command

Description	Creates a DC waveform with a specified start address, length and scale.	
Syntax	**SOURce[1]:ARB:BUILt:EXPFail [<STARt>[,<LENGth>[,<SCALe>]]]**	
Parameter	<STARt>	Start address*: 0~1048,576
	<LENGth>	Length*: 0 ~ 1048,576
	<SCALe>	Scale: ±32767
	* Start + Length ≤ 1,048,576	
Example	**SOUR1:ARB:BUIL:EXPF 1000, 1000, 100**	
	Creates an exponential fall wave 1000 points in length with a scale of 100 and a start address of 1000.	

SOURce[1]:ARB:BUILt:DC

Source Specific Command

Description	Creates an exponential fall wave with a specified start address, length and scale.	
Syntax	**SOURce[1]:ARB:BUILt:DC [<STARt>[,<LENGth>[,<SCALe>]]]**	
Parameter	<STARt>	Start address*: 0~1048,576
	<LENGth>	Length*: 0 ~ 1048,576
	<SCALe>	Scale: ±32767
	* Start + Length ≤ 1,048,576	
Example	**SOUR1:ARB:BUIL:DC 1000, 1000, 100**	
	Creates an exponential fall wave 1000 points in length with a scale of 100 and a start address of 1000.	

SOURce[1]:ARB:OUTPut:MARKer

Source Specific Command

Description	Define a section of the arbitrary waveform for marker output. The marker is output from the SYNC terminal on the front panel.	
Syntax	**SOURce[1]:ARB:OUTPut:MARKer [<STARt>[,<LENGth>]]**	
Parameter	<STARt>	Start address*: 0~1048,576
	<LENGth>	Length*: 0 ~ 1048,576
	* Start + Length ≤ currently output arbitrary waveform	
Example	**SOUR1:ARB:OUTP:MARK 1000, 1000**	
	The marker output is for a start address of 1000 with a length of 1000.	

SOURce[1]: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]:ARB:OUTPut [<STARt>[,<LENGth>]]**	
Parameter	<STARt>	Start address*: 0~1048,576
	<LENGth>	Length*: 0 ~ 1048,576
	* Start + Length ≤ currently output arbitrary waveform	
Example	**SOUR1:ARB:OUTP 20 200**	
	Outputs the current arbitrary waveform in memory.	

Save and Recall Commands

Up to 10 different instrument states can be stored to non-volatile memory (memory locations 0~9).

*SAV		Instrument Command
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}**	
Example	***SAV 0**	
	Save the instrument state to memory location 0.	

*RCL	Instrument Command
Description	Recall previously saved instrument states from memory locations 0~9.
Syntax	***RCL {0|1|2|3|4|5|6|7|8|9}**
Example	***RCL 0** Recall instrument state from memory location 0.

MEMory:STATe:DELete	Instrument Command
Description	Delete memory from a specified memory location.
Syntax	**MEMory:STATe:DELete {0|1|2|3|4|5|6|7|8|9}**
Example	**MEM:STAT:DEL 0** Delete instrument state from memory location 0.

MEMory:STATe:DELete ALL	Instrument Command
Description	Delete memory from all memory locations, 0~9.
Syntax	**MEMory:STATe:DELete ALL**
Example	**MEM:STAT:DEL ALL** Deletes all the instrument states from memory locations 0~9.

Error Messages

The AFG-3000 has a number of specific error codes. Use the SYSTem:ERRor command to recall the error codes. For more information regarding the error queue, see page 117.

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

-112 Program mnemonic too long

A command header contains more than 12 characters:

OUTP:SYNCHRONIZATION ON

-113 Undefined header

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

SOUR1:AMM:DEPT MIN

-123 Exponent too large

Numeric exponent exceeds 32,000. Example:

SOURce[1]:BURSt:NCYCles 1E34000

-124 Too many digits

The mantissa (excluding leading 0's) contains more than 255 digits.

-128 Numeric data not allowed

An unexpected numeric character was received in the command. Example: a numeric parameter is used instead of a character string.

SOURce1:BURSt:MODE 123

-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

-148 Character data not allowed

A parameter was used in the command where not allowed. Example: A discrete parameter was used where a numeric parameter was expected.

SOUR1:MARK:FREQ ON

-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'

-161 Invalid block data

Invalid block data was received. Example: The number of bytes sent with the DATA:DAC command doesn't correlate to the number of bytes specified in the block header.

-168 Block data not allowed

Block data was received where block data is not allowed. Example:

SOURce1:BURSt: NCYCles #10

-170~178 expression errors

Example: The mathematical expression used was not valid.

Execution Errors

-211 Trigger ignored

A trigger was received but ignored. Example: Triggers will be ignored until the function that can use a trigger is enabled (burst, sweep, etc.).

-223 Too much data

Data was received that contained too much data. Example: An arbitrary waveform with over 1,048,576 points cannot be used.

-221 Settings conflict; turned off infinite burst to allow immediate trigger source

Example: Infinite burst is disabled when an immediate trigger source is selected. Burst count set to 1,000,000 cycles.

-221 Settings conflict; infinite burst changed trigger source to MANual

Example: The trigger source is changed to immediate from manual when infinite burst mode is selected.

-221 Settings conflict; burst period increased to fit entire burst

Example: The function generator automatically increases the burst period to allow for the burst count or frequency.

-221 Settings conflict; burst count reduced

Example: The burst count is reduced to allow for the waveform frequency if the burst period is at it's maximum.

-221 Settings conflict; trigger delay reduced to fit entire burst

Example: The trigger delay is reduced to allow the current period and burst count.

-221 Settings conflict;triggered burst not available for noise

Example: Triggered burst cannot be used with noise.

-221 Settings conflict;amplitude units changed to Vpp due to high-Z load

Example: If a high impedance load is used, dBm units cannot be used. The units are automatically set to Vpp.

-221 Settings conflict;trigger output disabled by trigger external

Example: The trigger output terminal is disabled when an external trigger source is selected.

-221 Settings conflict;trigger output connector used by FSK

Example: The trigger output terminal cannot be used in FSK mode.

-221 Settings conflict;trigger output connector used by burst gate

Example: The trigger output terminal cannot be used in gated burst mode.

-221 Settings conflict;trigger output connector used by trigger external

Example: The trigger output connector is disabled when the trigger source is set to external.

-221 Settings conflict;frequency reduced for pulse function

Example: When the function is changed to pulse, the output frequency is automatically reduced if over range.

-221 Settings conflict;frequency reduced for ramp function

Example: When the function is changed to ramp, the output frequency is automatically reduced if over range.

-221 Settings conflict;frequency made compatible with burst mode

Example: When the function is changed to burst, the output frequency is automatically adjusted if over range.

-221 Settings conflict;frequency made compatible with FM

Example: When the function is changed to FM, the frequency is automatically adjusted to suit the FM settings.

-221 Settings conflict;burst turned off by selection of other mode or modulation

Example: Burst mode is disabled when sweep or a modulation mode is enabled.

-221 Settings conflict;FSK turned off by selection of other mode or modulation

Example: FSK mode is disabled when burst, sweep or a modulation mode is enabled.

-221 Settings conflict;FM turned off by selection of other mode or modulation

Example: FM mode is disabled when burst, sweep or a modulation mode is enabled.

-221 Settings conflict;AM turned off by selection of other mode or modulation

Example: AM mode is disabled when burst, sweep or a modulation mode is enabled.

-221 Settings conflict; sweep turned off by selection of other mode or modulation

Example: Sweep mode is disabled when burst or a modulation mode is enabled.

-221 Settings conflict;not able to modulate this function

Example: A modulated waveform cannot be generated with dc voltage, noise or pulse waveforms.

-221 Settings conflict;not able to sweep this function

Example: A swept waveform cannot be generated with dc voltage, noise or pulse waveforms.

-221 Settings conflict;not able to burst this function

Example: A burst waveform cannot be generated with the dc voltage function.

-221 Settings conflict;not able to modulate noise, modulation turned off

Example: A waveform cannot be modulated using the noise function.

-221 Settings conflict;not able to sweep pulse, sweep turned off

Example: A waveform cannot be swept using the pulse function.

-221 Settings conflict;not able to modulate dc, modulation turned off

Example: A waveform cannot be modulated using the dc voltage function.

-221 Settings conflict;not able to sweep dc, modulation turned off

Example: A waveform cannot be swept using the dc voltage function.

-221 Settings conflict;not able to burst dc, burst turned off

Example: The burst function cannot be used with the dc voltage function.

-221 Settings conflict;not able to sweep noise, sweep turned off

Example: A waveform cannot be swept using the noise function.

-221 Settings conflict;pulse width decreased due to period

Example: The pulse width has been adjusted to suit the period settings.

-221 Settings conflict;amplitude changed due to function

Example: The amplitude (VRM / dBm) has been adjusted to suit the selected function. For the AFG-3000, a typical square wave has a much higher amplitude (5V Vrms) compared to a sine wave (~3.54) due to crest factor.

-221 Settings conflict;offset changed on exit from dc function

Example: The offset level is adjusted on exit from a DC function.

-221 Settings conflict;FM deviation cannot exceed carrier

Example: The deviation cannot be set higher than the carrier frequency

-221 Settings conflict;FM deviation exceeds max frequency

Example: If the FM deviation and carrier frequency combined exceeds the maximum frequency plus 100 kHz, the deviation is automatically adjusted.

-221 Settings conflict;frequency forced duty cycle change

Example: If the frequency is changed and the current duty cannot be supported at the new frequency, the duty will be automatically adjusted.

-221 Settings conflict;offset changed due to amplitude

Example: The offset is not a valid offset value, it is automatically adjusted, considering the amplitude.

|offset| ≤ max amplitude – Vpp/2

-221 Settings conflict;amplitude changed due to offset

Example: The amplitude is not a valid value, it is automatically adjusted, considering the offset.

Vpp ≤ 2X (max amplitude -|offset|)

-221 Settings conflict;low level changed due to high level

Example: The low level value was set too high. The low level is set 1 mV less than the high level.

-221 Settings conflict;high level changed due to low level

Example: The high level value was set too low. The high level is set 1 mV greater than the low level.

-222 Data out of range;value clipped to upper limit

Example: The parameter was set out of range. The parameter is automatically set to the maximum value allowed.

SOURce[1]:FREQuency 80.1MHz.

-222 Data out of range;value clipped to lower limit

Example: The parameter was set out of range. The parameter is automatically set to the minimum value allowed.

SOURce[1]:FREQuency 0.1uHz.

-222 Data out of range;period; value clipped to ...

Example: If the period was set to a value out of range, it is automatically set to an upper or lower limit.

-222 Data out of range;frequency; value clipped to ...

Example: If the frequency was set to a value out of range, it is automatically set to an upper or lower limit.

-222 Data out of range;user frequency; value clipped to upper limit

Example: If the frequency is set to a value out of range for an arbitrary waveform using, SOURce[1]: APPL: USER or SOURce[1]: FUNC:USER, it is automatically set to the upper limit.

-222 Data out of range;ramp frequency; value clipped to upper limit

Example: If the frequency is set to a value out of range for a ramp waveform using, SOURce[1]: APPL: RAMP or SOURce[1]:FUNC:RAMP, it is automatically set to the upper limit.

-222 Data out of range;pulse frequency; value clipped to upper limit

Example: If the frequency is set to a value out of range for a pulse waveform using, SOURce[1]: APPL:PULS or SOURce[1]:FUNC:PULS, it is automatically set to the upper limit.

-222 Data out of range;burst period; value clipped to ...

Example: If the burst period was set to a value out of range, it is automatically set to an upper or lower limit.

222 Data out of range;burst count; value clipped to ...

Example: If the burst count was set to a value out of range, it is automatically set to an upper or lower limit.

-222 Data out of range; burst period limited by length of burst; value clipped to upper limit

Example: The burst period must be greater than burst count divided by the frequency + 200 ns. The burst period is adjusted to satisfy these conditions.

burst period > 200 ns + (burst count/burst frequency).

-222 Data out of range; burst count limited by length of burst; value clipped to lower limit

Example: The burst count must be less than burst period * the waveform frequency when the the trigger source is set to immediate (SOURce[1]: TRIG:SOUR IMM). The burst count is automatically set to the lower limit.

-222 Data out of range;amplitude; value clipped to ...

Example: If the amplitude was set to a value out of range, it is automatically set to an upper or lower limit.

-222 Data out of range;offset; value clipped to ...

Example: If the offset was set to a value out of range, it is automatically set to an upper or lower limit.

-222 Data out of range;frequency in burst mode; value clipped to ...

Example: If the frequency was set to a value out of range in burst mode. The burst frequency is automatically set to an upper or lower limit, taking the burst period into account.

-222 Data out of range;frequency in FM; value clipped to ...

Example: The carrier frequency is limited by the frequency deviation (SOURce[1]: FM:DEV). The carrier frequency is automatically adjusted to be less than or equal to the frequency deviation.

-222 Data out of range;marker confined to sweep span; value clipped to ...

Example: The marker frequency is set to a value outside the start or stop frequencies. The marker frequency is automatically adjusted to either the start or stop frequency (whichever is closer to the set value).

-222 Data out of range;FM deviation; value clipped to ...

Example: The frequency deviation is outside of range. The deviation is automatically adjusted to an upper or lower limit, depending on the frequency.

-222 Data out of range;trigger delay; value clipped to upper limit

Example: The trigger delay was set to a value out of range. The trigger delay has been adjusted to the maximum (85 seconds).

-222 Data out of range; trigger delay limited by length of burst; value clipped to upper limit

Example: The trigger delay and the burst cycle time combined must be less than the burst period.

-222 Data out of range;duty cycle; value clipped to ...

Example: The duty cycle is limited depending on the frequency.

Duty Cycle	Frequency
50%	> 50MHz
40%~60%	25 MHz ~ 50MHz
20%~80%	< 25 MHz

-222 Data out of range; duty cycle limited by frequency; value clipped to upper limit

Example: The duty cycle is limited depending on the frequency. When the frequency is greater than 50 MHz, the duty cycle is automatically limited to 50%.

-313 Calibration memory lost;memory corruption detected

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

-314 Save/recall memory lost;memory corruption detected

Indicates that a fault (check sum error) has occurred with the non-volatile memory that stores the save/recall files.

-315 Configuration memory lost;memory corruption detected

Indicates that a fault (check sum error) has occurred with the non-volatile memory that stores the configuration settings.

-350 Queue overflow

Indicates that the error queue is full (over 20 messages generated, and not yet read). No more messages will be stored until the queue is empty. The queue can be cleared by reading each message, using the *CLS command or restarting the function generator.

-361 Parity error in program message

Indicates that there is a RS232 parity setting mismatch between the host PC and the function generator.

-362 Framing error in program message

Indicates that there is a RS232 stop bit setting mismatch between the host PC and the function generator.

-363 Input buffer overrun

Indicates that too many characters have been sent to the function generator via RS232. Ensure handshaking is used.

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 or bytes for a data block.

SCPI Status Registers

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

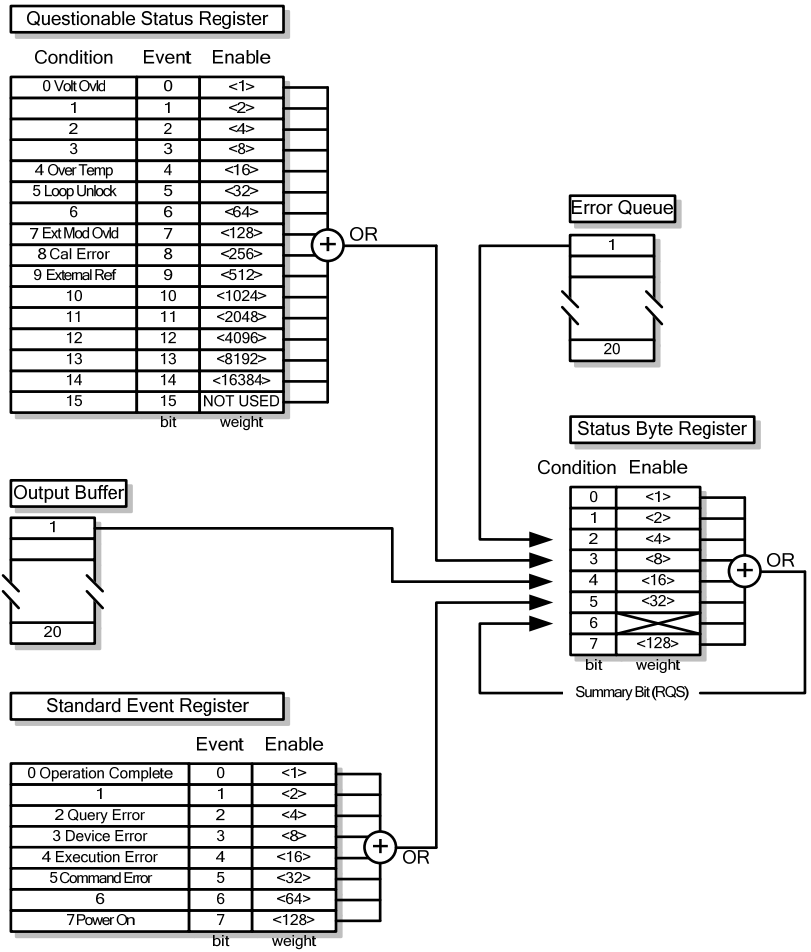
As well as the output and error queues.

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-3000 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.

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