

The MFG-2000 also has a browser-based interface to remotely control the unit over a network.

Welcome Page

The Welcome Page is the home page for the browser control interface. This page lists instrument information and the LAN configuration. It also has links to the Browser Web Control and the View & Modify Configuration pages.



**Browser Web Control**

The Browser Web Control allows you to remotely control and view the unit over a LAN. The unit can be controlled via a virtual control panel using a mouse, with SCPI controls via an SCPI input box or by running SCPI commands in a file.



**View & Modify Configuration**

The View & Modify Configuration page displays all the LAN configuration settings and allows you to edit the configuration.




**Operation**

1. Configure the AFG-30XX interface to LAN and connect it to the LAN or directly to the PC (if the LAN interface is set to Auto IP).

See Page 248 for the LAN configuration details.

- 
- UTIL Interface
- LAN Remote

```
Virtual Interface: Enable
LAN Boot Mode:  AutolP
IP Address:  169.254.206.154
NetMask:  255.255.0.0
GateWay:  0.0.0.0
MacAddress:
```

- 

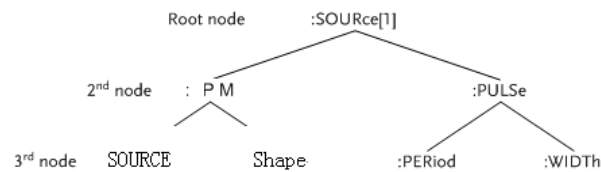
- [illegible]

## Command Syntax

Compatible standard	<ul style="list-style-type: none"> <li>• IEEE488.2, 1992 (fully compatible)</li> <li>• SCPI, 1994 (partially compatible)</li> </ul>
Command Tree	The SCPI standard is an ASCII based standard that defines the command syntax and structure for programmable instruments.

Commands are based on a hierarchical tree structure. Each command keyword is a node on the command tree with the first keyword as the root node. Each sub node is separated with a colon.


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



Command types	Commands can be separated in to three distinct types, simple commands, compound commands and queries.
Simple	A single command with/without a parameter
Example	*OPC
Compound	Two or more commands separated by a colon (:) with/without a parameter
Example	SOURce1:PULSe:WIDTh

Query	A query is a simple or compound command followed by a question mark (?). A parameter (data) is returned. The maximum or minimum value for a parameter can also be queried where applicable.
Example	SOURce1:FREQuency? SOURce1:FREQuency? MIN
Command forms	<p>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.</p> <div style="text-align: center;"> <pre>       long      long                     SOURce1:DCOffset                         short    short           </pre> </div> <p>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.</p> <p>Below are examples of correctly written commands:</p> <hr/> <p>LONG    SOURce1:DCOffset</p> <p>         SOURCE1:DCOFFSET</p> <p>         source1:dcoffset</p> <hr/> <p>SHORT   SOUR1:DCO</p> <p>         sour1:dco</p>

Command	SOURce1:DCOffset <offset>LF				1: command header
Format	1	2	3	4	2: single space
					3: parameter
					4: message terminator
Square Brackets []	<p>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.</p> <p>For example, the frequency query below can use any of the following 3 forms:</p> <p>SOURce1:FREQuency? [MINimum MAXimum]</p> <p>SOURce1:FREQuency? MAXimum</p> <p>SOURce1:FREQuency? MINimum</p> <p>SOURce1:FREQuency?</p>				
Braces {}	<p>Commands that contain braces indicate one item within the braces must be chosen. Braces are not sent with the command.</p>				
Angled Brackets <>	<p>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.</p>				
Bars	<p>Bars are used to separate multiple parameter choices in the command format.</p>				
Parameters	Type	Description	Example		
	<Boolean>	Boolean logic	0, 1/ON,OFF		
	<NR1>	integers	0, 1, 2, 3		
	<NR2>	decimal numbers	0.1, 3.14, 8.5		
	<NR3>	floating point	4.5e-1, 8.25e+1		
	<NRf>	any of NR1, 2, 3	1, 1.5, 4.5e-1		

	<NRf+> <Numeric>	NRf type with a suffix including MINimum, MAXimum or DEFault parameters.	1, 1.5, 4.5e-1 MAX, MIN,
	<aard>	Arbitrary ASCII characters.	
	<discrete>	Discrete ASCII character parameters	IMM, EXT, MAN
	<frequency> <peak deviation in Hz> <rate in Hz>	NRf+ type including frequency unit suffixes.	1 KHZ, 1.0 HZ, MHZ
	<amplitude>	NRf+ type including voltage peak to peak.	VPP
	<offset>	NRf+ type including volt unit suffixes.	V
	<seconds>	NRf+ type including time unit suffixes.	NS, S MS US
	<percent> <depth in percent>	NRf type	N/A
Message terminators	LF CR	line feed code (new line) and carriage return.	
	LF	line feed code (new line)	
	EOI	IEEE-488 EOI (End-Or-Identify)	
 Note	^j or ^m should be used when using a terminal program.		



Command Separators	Space	A space is used to separate a parameter from a keyword/command header.
	Colon (:)	A colon is used to separate keywords on each node.
	Semicolon (;)	A semi colon is used to separate subcommands that have the same node level.  For example: SOURce[1 2 3 3RF]:DCOffset? SOURce[1 2 3 3RF]:OUTPut? →SOURce1:DCOffset?;OUTPut?
	Colon + Semicolon (;:)	A colon and semicolon can be used to combine commands from different node levels.  For example: SOURce1:PM:SOURce? SOURce1:PULSe:WIDTh? →SOURce1:PM: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 380 for details regarding the error queue.	
Query Syntax	<b>SYSTem:ERRor?</b>	
Return parameter	<string>	Returns an error string, <256 ASCII characters.
Example	<b>SYSTem:ERRor?</b> <b>-138 Suffix not allowed</b> 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,MFG-2000,SN:XXXXXXXX,Vm.mm	
Query Syntax	<b>*IDN?</b>	
Return parameter	<string>	
Example	<b>*IDN?</b> GW INSTEK,MFG-2000,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	<b>*RST</b>

**\*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	<b>*TST?</b>
Return parameter	+0 <span style="background-color: #cccccc;">                    </span> Pass judgment
	+1 <span style="background-color: #cccccc;">                    </span> Fail judgment
Example	<b>*TST?</b> +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	<b>SYSTem:VERsion?</b>
Return parameter	<string> <span style="background-color: #cccccc;">                    </span>
Example	<b>SYST:VERS?</b> MFG-2000 VX.XXX_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 MFG-2000, 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	<b>*OPC</b>

**\*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	<b>*OPC?</b>
Return parameter	1
Example	<b>*OPC?1</b> 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	<b>*WAI</b>

## 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	<b>*ESR?</b>			
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	<b>*STB?</b>

**\*SRE**

## System Command

Description	The Service Request Enable Command determines which events in the Status Byte Register are allowed to set the MSS (Master summary bit). Any bit that is set to “1” can cause the MSS bit to be set.			
Note	The *CLS command clears the status byte event register, but not the enable register.			
Syntax	<b>*SRE &lt;enable value&gt;</b>			
Parameter	<enable value>		0~255	
Example	<b>*SRE 12</b>  Sets a bit weight of 12 (bits 2 and 3) for the service request enable register.			
Query Syntax	<b>*SRE?</b>			
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	<b>*SRE? 12</b>  Returns the bit weight of the status byte enable register.			

## System Remote Commands

### **SYSTem:LOCaI** System Command

---

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

Syntax	<b>SYSTem:LOCaI</b>
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Example	<b>SYST:LOC</b>
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### **SYSTem:REMOte** System Command

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

Syntax	<b>SYSTem:REMOte</b>
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Example	<b>SYST:REM</b>
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## Apply Commands

---

The APPLy command has 5 different types of outputs (Sine, Square, Ramp, Pulse, Noise, ). 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 commandOUTPut[1 | 2 | 3 | 3RF | pulse] 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 | 2 | 3 | 3RF]: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.

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

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

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

SOURCE[1 2 3 3RF]:APPLY:SINusoid		Source Specific Command
Description	Outputs a sine wave from the selected channel when the command has executed. Frequency, amplitude and offset can also be set.	
Syntax	SOURCE[1 2 3 3RF]:APPLY:SINusoid [<frequency> [,<amplitude> [,<offset>] ]]	
Parameter	<frequency>	1μHz~320MHz
	<amplitude>	1mVpp~10Vpp (50 Ω)
	<offset>	-4.99V~4.99V (50 Ω)
Example	<b>SOUR1:APPL:SIN 2KHZ,MAX,MAX</b> Sets frequency to 2kHz and sets the amplitude and offset to the maximum.	

SOURCE[1 2 3 3RF]:APPLY:SQUare		Source Specific Command
Description	Outputs a square wave from the selected channel when the command has executed. Frequency, amplitude and offset can also be set. The duty cycle is set to 50%.	
Syntax	SOURCE[1 2 3 3RF]:APPLY:SQUare [<frequency> [,<amplitude> [,<offset>] ]]	
Parameter	<frequency>	1μHz~25MHz
	<amplitude>	1mVpp~10Vpp (50Ω)
	<offset>	±5 Vpk ac +dc (50Ω)
Example	<b>SOUR1:APPL:SQU 2KHZ,MAX,MAX</b>	



Sets frequency to 2kHz and sets the amplitude and offset to the maximum.

SOURCE[1 2 3 3RF]: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	<b>SOURCE[1 2 3 3RF]:APPLY:RAMP [&lt;frequency&gt; [&lt;amplitude&gt; [&lt;offset&gt;] ]]</b>	
Parameter	<frequency>	1μHz~1MHz
	<amplitude>	1mVpp~10Vpp (50Ω)
	<offset>	±5 Vpk ac +dc (50Ω)
Example	<b>SOUR1:APPL:RAMP 2KHZ,MAX,MAX</b> Sets frequency to 2kHz and sets the amplitude and offset to the maximum.	

SOURCE[1 2 3 3RF]:APPLY:PULSe		Source Specific Command
Description	Outputs a pulse waveform from the selected channel when the command has executed. Frequency, amplitude and offset can also be set.	
Note	The PW settings from the SOURCE[1   2   3   3RF]: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   2   3   3RF]:PULS:PER command	
Syntax	<b>SOUR[1 2 3 3RF pulse]:APPLY:PULSe [&lt;frequency&gt; [&lt;amplitude&gt; [&lt;offset&gt;] ]]</b>	
Parameter	<frequency>	500μHz~25MHz

	<amplitude>	1 mV~2.5 (50Ω)
	<offset>	±5 Vpk ac +dc (50Ω)
Example	<b>SOUR1:APPL:PULS 1KHZ,MIN,MAX</b>	
	Sets frequency to 1kHz and sets the amplitude to minimum and the and offset to the maximum.	
<b>SOURce[1 2 3 3RF]:APPLy:NOISe</b>		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	<b>SOURce[1 2 3 3RF]:APPLy:NOISe</b> <b>[&lt;frequency DEFault&gt; [,&lt;amplitude&gt; [,&lt;offset&gt;] ]]</b>	
Parameter	<frequency>	Not applicable
	<amplitude>	1 mV~10V (50Ω)
	<offset>	±5 Vpk ac +dc (50Ω)
Example	<b>SOUR1:APPL:NOIS DEF, 3.0, 1.0</b>	
	Sets the amplitude to 3 volts with an offset of 1 volt.	
<b>SOURce[1 2 3 3RF]:APPLy:USER</b>		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	<b>SOURce[1 2 3 3RF]:APPLy:USER [&lt;frequency&gt; [,&lt;amplitude&gt; [,&lt;offset&gt;] ]]</b>	
Parameter	<frequency>	1μHz~100MHz
	<amplitude>	0~10V (50Ω)
	<offset>	±5 Vpk ac +dc (50Ω)
Example	<b>SOUR1:APPL:USER 1KHZ,5.0,1.0</b>	

<b>SOURce[1 2 3 3RF]:APPLy?</b>		Source Specific Command
Description	Outputs a string with the current settings.	
Note	The string can be passed back appended to the Apply Command.	
Syntax	<b>SOURce[1 2 3 3RF pulse]:APPLy?</b>	
Return Parameter	<string>	Function, frequency, amplitude, offset
Example	<b>SOUR1:APPL?</b> SIN +5.000000000000E+03,+3.0000E+00,-2.50E+00 Returns a string with the current function and parameters, Sine, 5kHz, 3 Vpp, -2.5V offset.	

## 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 2 3 3RF]: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 2 3 3RF]:FUNC:USER command.	
Note	<p>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.</p> <p>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.</p> <p>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.</p>	

	Sine	Squ	Tria	Ramp	Pulse	Noise	ARB
AM	✓	✓	✓	✓	✓	×	✓
FM	✓	✓	✓	✓	×	×	×
PM	✓	✓	✓	✓	×	×	×
ASK	✓	×	×	×	×	×	×
FSK	✓	✓	✓	✓	✓	×	×
PSK	✓	×	×	×	×	×	×
SWEEP	✓	✓	✓	✓	×	×	×
BURST	✓	✓	✓	✓	×	×	×
Syntax	SOURce[1 2 3 3RF]:FUNctIon {SINusoid SQUare RAMP  PULSe NOISe  USER}						
Example	SOUR1:FUNC SIN Sets the output as a sine function.						
Query Syntax	SOURce[1 2 3 3RF]:FUNctIon?						
Return Parameter	SIN, SQU, RAMP, PULS, NOIS, USER			Returns the current output type.			
Example	SOUR1:FUNC? ARB Current output is sine.						

<b>SOURce[1 2 3 3RF pulse]:FREQuency</b>		Source Specific Command
Description	Sets the output frequency for the the SOURce[1   2   3   3RF   pulse] :FUNctIon command. The query command returns the current frequency setting.	
Note	The maximum and minimum frequency depends on the function mode.	

	Sine, Square	1μHz~320MHz/25MHz
	Ramp	1μHz~1MHz
	Pulse	1μHz~25MHz
	Noise	Not applicable
	User	1μHz~100MHz
	<p>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.</p> <p>The duty cycle of square waveforms depends on the frequency settings.</p> <p>0.01 % to 99.99%</p> <p>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.</p>	
Syntax	<b>SOURce[1 2 3 3RF pulse]:FREQuency</b> <b>{&lt;frequency&gt; MINimum MAXimum}</b>	
Example	<b>SOUR1:FREQ MAX</b> Sets the frequency to the maximum for the current mode.	
Query Syntax	<b>SOURce[1 2 3 3RF pulse]:FREQuency?</b>	
Return Parameter	<NR3>	Returns the frequency for the current mode.
Example	<b>SOUR1:FREQ? MAX</b> +6.0000000000000E+07+1.0000000000000E+03 The maximum frequency that can be set for the current function is 60MHz.	

SOURce[1 2 3 3RF pulse]:AMPLitude	Source Specific Command
Description	<p>The SOURce[1   2   3   3RF   pulse]:AMPLitude command sets the output amplitude for the selected channel. The query command returns the current amplitude settings.</p>
Note	<p>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.</p> <p>The offset and amplitude are related by the following equation.</p> $ V_{offset}  < V_{max} - V_{pp}/2$ <p>If the output termination is set to high impedance, dBm units cannot be used. The units will default to Vpp.</p> <p>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.</p> <p>The amplitude units can be explicitly used each time the SOURce[1   2   3   3RF   pulse]:AMPLitude command is used. Alternatively, the VOLT:UNIT command can be used to set the amplitude units for all commands.</p>
Syntax	<p><b>SOURce[1 2 3 3RF pulse]:AMPLitude {&lt; amplitude&gt;  MINimum MAXimum}</b></p>

Example	<b>SOUR1:AMP MAX</b> Sets the amplitude to the maximum for the current mode.
Query Syntax	<b>SOURce[1 2 3 3RF pulse]:AMPlitude? {MINimum MAXimum}</b>
Return Parameter	<NR3> Returns the amplitude for the current mode.

**Example**      **SOUR1:AMP? MAX**  
+8.000E+00  
The maximum amplitude that can be set for the current function is 8 volts.

<b>SOURce[1 2 3 3RF pulse]:DCOffset</b>		Source Specific Command
Description	Sets or queries the DC offset for the current mode.	
Note	<p>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.</p> $ V_{offset}  < V_{max} - V_{pp}/2$ <p>If the output specified is out of range, the maximum offset will be set.</p> <p>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.</p>	
Syntax	<b>SOURce[1 2 3 3RF pulse]:DCOffset {&lt; offset&gt;  MINimum MAXimum}</b>	
Example	<b>SOUR1:DCO MAX</b>	



	Sets the offset to the maximum for the current mode.	
Query Syntax	<b>SOURce[1 2 3 3RF pulse]:DCOffset? {MINimum MAXimum}</b>	
Return Parameter	<NR3>	Returns the offset for the current mode.
Example	<b>SOUR1:DCO?</b> +1.00E+00 The offset for the current mode is set to +1volts.	

<b>SOURce[1 2 3 3RF]:SQUare:DCYcle</b>		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. 0.01% to 99.99%  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	<b>SOURce[1 2 3 3RF]:SQUare:DCYcle {&lt; percent&gt;  MINimum MAXimum}</b>	
Example	<b>SOUR1:SQU:DCYC MAX</b> Sets the duty cycle to the highest possible for the current frequency.	
Query Syntax	<b>SOURce[1 2 3 3RF]:SQUare:DCYcle? {MINimum MAXimum}</b>	

Return Parameter	<NR3>	Returns the duty cycle as a percentage.
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Example      **SOUR1:SQU:DCYC?**  
                  +9.90E+01  
                  The duty cycle is set 99%.

### **SOURce[1|2|3|3RF]: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%.
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Note	For ramp waveforms, the Apply command and AM/FM modulation modes ignore the current symmetry settings.
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Syntax	<b>SOURce[1 2 3 3RF]:RAMP:SYMMetry {&lt; percent&gt;  MINimum MAXimum}</b>
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Example	<b>SOUR1:RAMP:SYMM +5.00E+01</b> Sets the symmetry to the 50%.
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Query Syntax	<b>SOURce[1 2 3 3RF]:RAMP:SYMMetry? {MINimum MAXimum}</b>
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Return Parameter	<NR3>	Returns the symmetry as a percentage.
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Example      **SOUR1:RAMP:SYMMetry?**  
                  +5.00E+01  
                  Sets the symmetry to the 50%.

### **OUTPut** Source Specific Command

Description	Enables/Disables or queries the front panel output. The default is set to off.
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Note	If the output is overloaded by an external voltage, the output will turn off and an error message will be displayed. The overload must first be removed
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	before the output can be turned on again with output command.
	Using the Apply command automatically sets the front panel output to on.
Syntax	<b>OUTPut[1 2 3 3RF pulse] {OFF ON}</b>
Example	<b>OUTP1 ON</b> Turns the output on.
Query Syntax	<b>OUTPut[1 2 3 3RF pulse]?</b>
Return Parameter	1 ON 0 OFF
Example	<b>OUTP1?</b> 1 The channel 1 output is currently on.

	Source Specific Command
<b>OUTPut[1 2 3 3RF pulse]:LOAD</b>	
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	<b>OUTPut[1 2 3 3RF pulse]:LOAD {DEFault INFinity}</b>
Example	<b>OUTP1:LOAD DEF</b>

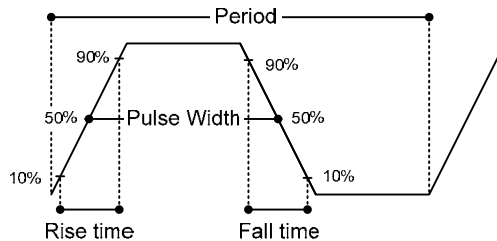
	Sets the output termination to 50Ω.	
Query Syntax	<b>OUTPut[1 2 3 3RF PULSe]:LOAD?</b>	
Return Parameter	DEF	Default
	INF	INFinity
Example	<b>OUTP1:LOAD?</b> <b>DEF</b> The output is set to the default of 50Ω.	

### **SOURCE[1|2|3|3RF|pulse]: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	<b>SOURCEPULSE:VOLTage:UNIT {VPP VRMS DBM}</b>	
Example	<b>SOURCEPULSE:VOLT:UNIT VPP</b> Sets the amplitude units to Vpp.	
Query Syntax	<b>SOURCEPULSE:VOLTage:UNIT?</b>	
Return Parameter	VPP	Vpp
	VRMS	Vrms
	DBM	dBm
Example	<b>SOURCEPULSE:VOLT:UNIT?</b> <b>VPP</b> 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 leading edge time, trailing edge time, period and pulse width.



		Source Specific Command
<b>SOURCEPULSE:PULSE:WIDTH</b>		
Description	Sets or queries the pulse width. The default pulse width is 50us.  Pulse width is defined as the time from the rising to falling edges (at a threshold of 50%).	
Note	The pulse width is restricted to the following limitations: Pulse Width $\geq$ Minimum Pulse Width Pulse Width $<$ Pulse Period - Minimum Pulse Width	
Syntax	<b>SOURCEPULSE:PULSE:WIDTH</b> <b>{&lt;seconds&gt; MINimum MAXimum}</b>	
Example	<b>SOURCEPULSE:PULS:WIDT MAX</b>  Sets the pulse width to the maximum allowed.	
Query Syntax	<b>SOURCEPULSE:PULSE:WIDTH?</b> <b>[MINimum MAXimum]</b>	
Return Parameter	<seconds>	$\geq 20$ ns (limited by the current frequency setting)

Example      **SOURCEPULSE:PULS:WIDT?**  
                  +2.000000000000E-08  
                  The pulse width is set to 20 nanoseconds.

**SOURCEPULSE:PULSe:DUTY**      Source Specific Command

Description	Sets or queries the pulse duty cycle.	
Note	The duty cycle is restricted to the following limitations: $\text{Pulse Duty Cycle} \geq 100 \times \text{Minimum Pulse Width} \div \text{Pulse Period}$ $\text{Pulse Duty Cycle} < 100 \times (1 - \text{Minimum Pulse Width} \div \text{Pulse Period})$	
Syntax	<b>SOURCEPULSE:PULSe:DCYCl{&lt;percent&gt; MINimum MAXimum}</b>	
Example	<b>SOURCEPULSE:PULS:DCYC MAX</b> Sets the duty to the maximum allowed.	
Query Syntax	<b>SOURCEPULSE:PULSe:DCYCl? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	0.01%~99.99% (limited by the current frequency setting)
Example	<b>SOURCEPULSE:PULS:PULS:DCYC?</b> +1.0000E+01 The duty cycle is set to 10%	

**SOURCEPULSE:PULSe:TRANSition :LEADIng**      Source Specific Command

Description	Sets or queries the pulse leading edge time. The default rise time is 10ns. The leading and trailing edge time can be different.	
Note	The leading edge time is limited by the pulse	

	width as noted below: Leading/Trailing Edge Time $\leq 0.625 \times$ Pulse Width
Syntax	<b>SOURCEPULSE:PULSe:TRANsition:LEADIng</b> <b>{&lt;seconds&gt; MINimum MAXimum}</b>
Example	<b>SOURCEPULSE:PULS:TRANsition:LEADIng MAX</b> Sets the pulse transition trailing to the maximum allowed.
Query Syntax	<b>SOURCEPULSE:PULSe:TRANsition:LEADIng?</b> <b>[MINimum MAXimum]</b>
Return Parameter	<seconds> $\geq 10\text{ns}$ (limited by the current frequency and pulse width settings)
Example	<b>SOURCEPULSE:PULS:TRANsition:LEADIng?</b>  +8.0000E-08 The pulse transition trailing is set to 80 nanoseconds.

<b>SOURCEPULSE:PULSe:TRANsition</b>		Source Specific Command
<b>:TRAILing</b>		
Description	Sets or queries the pulse trailing edge time. The default rise time is 10ns. The leading and trailing edge time can be different.	
Note	The trailing edge time is limited by the pulse width as noted below: Leading/Trailing Edge Time $\leq 0.625 \times$ Pulse Width	
Syntax	<b>SOURCEPULSE:PULSe:TRANsition:TRAILing</b> <b>{&lt;seconds&gt; MINimum MAXimum}</b>	
Example	<b>SOURCEPULSE:PULS:TRANsition:TRAILing MAX</b> Sets the pulse transition trailing to the maximum allowed.	

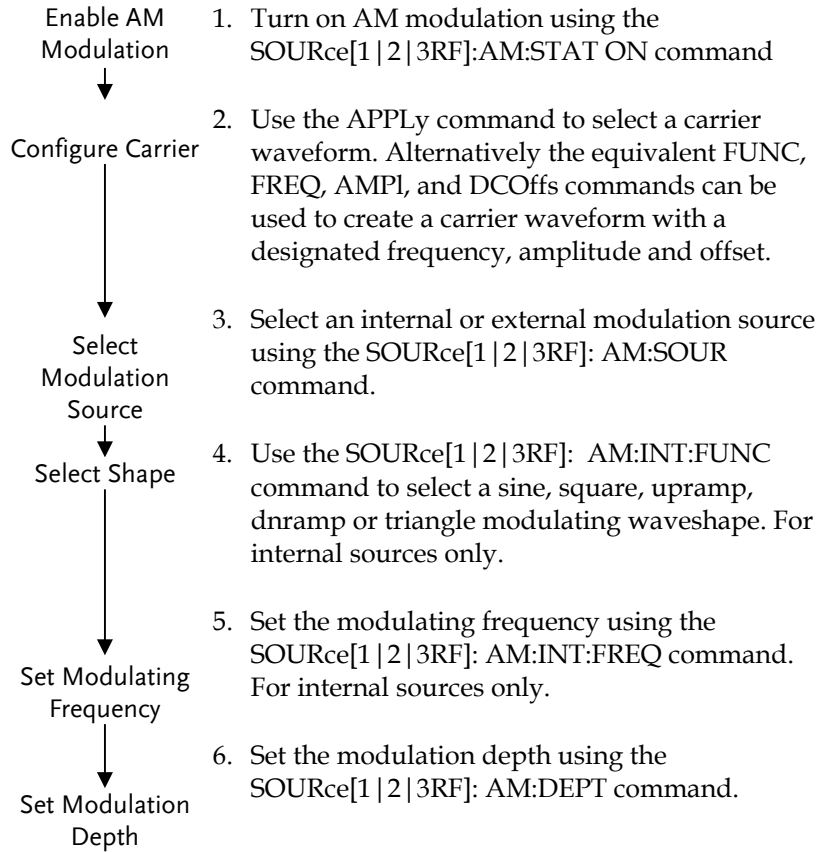
Query Syntax	<b>SOURCEPULSE:PULSe:TRANSition:TRAlIing?</b> <b>[MINimum MAXimum]</b>	
Return Parameter	<seconds>	$\geq 10\text{ns}$ (limited by the current frequency and pulse width settings)
Example	<b>SOURCEPULSE:PULS:TRANSition:TRAlIing?</b> +8.0000E-08 The pulse transition trailing is set to 80 nanoseconds.	



## Amplitude Modulation (AM) Commands

### AM Overview

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



<b>SOURce[1 2 3RF]:AM:STATe</b>		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	<b>SOURce[1 2 3RF]:AM:STATe {OFF ON}</b>	
Example	<b>SOUR1:AM:STAT ON</b> Enables AM modulation.	
Query Syntax	<b>SOURce[1 2 3RF]:AM:STATe?</b>	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	<b>SOUR1:AM:STAT?</b> <b>1</b> AM modulation mode is currently enabled.	

<b>SOURce[1 2 3RF]:AM:SOURce</b>		Source Specific Command
Description	Sets or queries the modulation source as internal or external. Internal is the default modulation source.	
Note	If an external modulation source is selected, modulation depth is limited to $\pm 5V$ 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.  The RF channel supports only the internal modulation mode.	

Syntax	<b>SOURce[1 2 3RF]:AM:SOURce {INTernal EXTernal}</b>		
Example	<b>SOUR1:AM:SOUR EXT</b> Sets the modulation source to external.		
Query Syntax	<b>SOURce[1 2 3RF]:AM:SOURce?</b>		
Return Parameter	INT		Internal
	EXT		External
Example	<b>SOUR1:AM:SOUR?</b> <b>INT</b> The modulation source is set to internal.		

SOURce[1 2 3RF]:AM:INTernal:FUNCTION			Source Specific Command	
Description	Sets the shape of the modulating waveform from sine, square, triangle, upramp and dn ramp. The default shape is sine.			
Note	Square and triangle waveforms have a 50% duty cycle. Upramp and dn ramp have a symmetry of 100% and 0%, respectively.			
Syntax	SOURce[1 2 3RF]: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 2 3RF]:AM:INTernal:FUNCTION?			
Return Parameter	SIN	Sine	UPRAMP	Upramp
	SQU	Square	DNRAMP	Dn ramp
	TRI	Triangle		
Example	SOUR1:AM:INT:FUNC?  SIN  The shape for the modulating waveform is Sine.			

# SOURce[1|2|3RF]:AM:INTernal:FREQuency

Source Specific Command

Description	Sets the frequency of the internal modulating waveform only. The default frequency is 100Hz.	
Syntax	<b>SOURce[1 2 3RF]:AM:INTernal:FREQuency {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	2 mHz~ 20 kHz
Example	<b>SOUR1:AM:INT:FREQ +1.0000E+02</b> Sets the modulating frequency to 100Hz.	
Query Syntax	<b>SOURce[1 2 3RF]:AM:INTernal:FREQuency? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	<b>SOUR1:AM:INT:FREQ?</b> <b>+1.0000000E+02</b> Returns the frequency to 100Hz.	

# SOURce[1|2|3RF]:AM:DEPTh

Source Specific Command

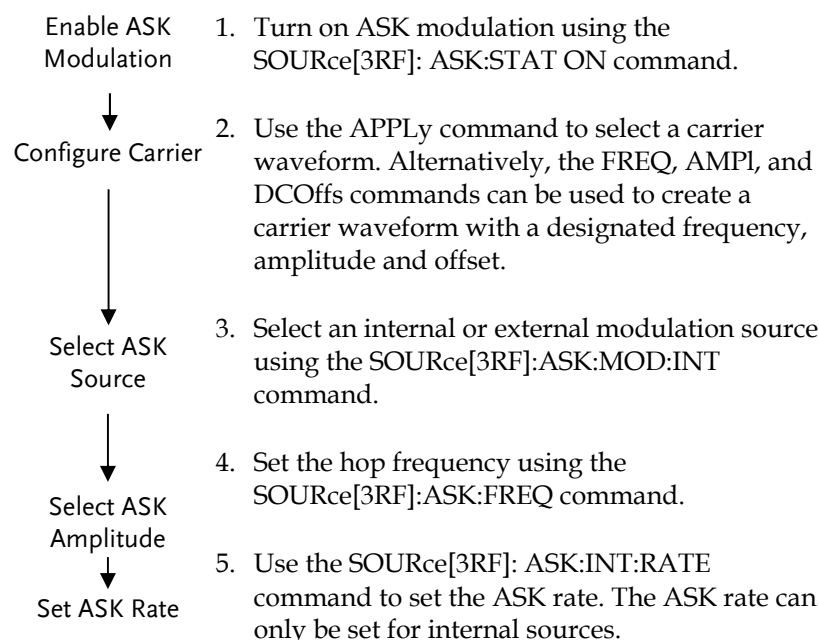
Description	Sets or queries the modulation depth for internal sources only. The default is 100%.	
Note	The function generator will not output more than $\pm 5V$ , regardless of the modulation depth.  The modulation depth of an external source is controlled using the $\pm 5V$ MOD INPUT terminal on the rear panel, and not the SOURce[1 2 3RF]:AM:DEPT h command.	
Syntax	<b>SOURce[1 2 3RF]:AM:DEPT h {&lt;depth in percent&gt; MINimum MAXimum}</b>	
Parameter	<depth in percent>	0~120%
Example	<b>SOUR1:AM:DEPT 50</b> Sets the modulation depth to 50%.	

Query Syntax	<b>SOURce[1 2 3RF]:AM:DEPT? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Return the modulation depth as a percentage.
Example	<b>SOUR1:AM:DEPT?</b> <b>+5.0000E+01</b> The modulation depth is 50%.	

# Amplitude Shift Keying (ASK) Commands

## ASK Overview

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



SOURce[3RF]:ASKey:STATe		Source Specific Command
Description	Turn on or off the ASK modulation function of the specified channel. Query the on/off status of the ASK modulation function of the specified channel.	
Note	Burst or sweep mode will be disabled if ASK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when ASK modulation is enabled.	

Syntax	<b>SOUR[3RF]:ASK:STATe {OFF ON}</b>	
Example	<b>SOURce3RF:ASK:STAT ON</b> Enables ASK modulation.	
Query Syntax	<b>SOURce[3RF]:ASK:STATe?</b>	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	<b>SOURce3RF:ASK:STAT?</b> <b>1</b> ASK modulation mode is currently enabled.	

<b>SOURce[3RF]:ASKey:SOURce</b>		Source Specific Command
Description	Sets or queries the ASK source as internal or external. Internal is the default source.	
Note	External ASK source can not be supported.	
Syntax	<b>SOURce[3RF]:ASKey:SOURce {INTernal EXTernal}</b>	
Example	<b>SOURce3RF:ASK:SOUR EXT</b> Sets the ASK source to external.	
Query Syntax	<b>SOURce[3RF]:ASKey:SOURce?</b>	
Return Parameter	INT	Internal
	EXT	External
Example	<b>SOURce3RF:ASK:SOUR?</b> <b>EXT</b> The ASK source is set to external.	

<b>SOURce[3RF]:ASK:AMPlitude</b>		Source Specific Command
Description	Sets the ASK amplitude. The default modultaion amplitude is set to 0.5V.	
Note	For ASK, the modulating waveform is a square wave with a duty cycle of 50%.	

Syntax	<b>SOURce[3RF]:ASKey:AMPlitude</b> <b>{&lt;voltage&gt; MINimum MAXimum}</b>	
Parameter	<b>&lt;amplitude&gt;</b>	0V~max
Example	<b>SOURce3RF:ASK:AMPlitude 0.5V</b> Sets the ASK amplitude to 0.5V.	
Query Syntax	<b>SOURce[3RF]:ASKey: AMPlitude?</b> <b>[MINimum MAXimum]</b>	
Return Parameter	<b>&lt;NR3&gt;</b>	Returns the depth.
Example	<b>SOURce3RF:ASK:AMPlitude</b> <b>5.000E-01</b> Returns depth to 0.5V.	

### **SOURce[3RF]:ASKey:INTernal RATE** Source Specific Command

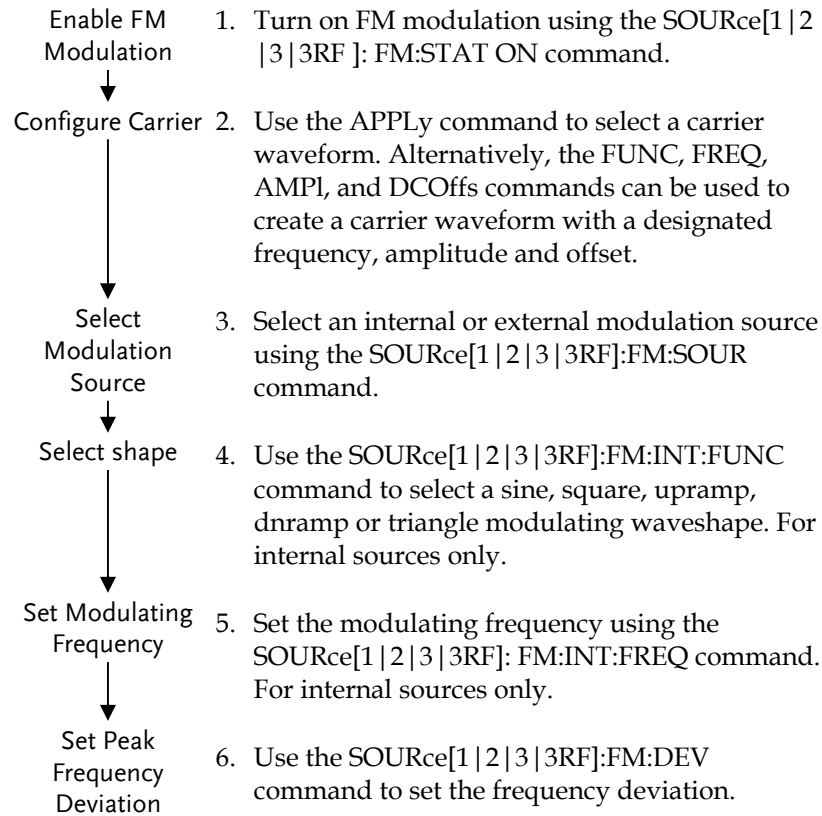
Description	Sets or queries the ASK rate for internal sources only.	
Note	External sources will ignore this command.	
Syntax	<b>SOURce[3RF]:ASKey:INTernal:RATE {&lt;rate in Hz&gt; MINimum MAXimum}</b>	
Parameter	<b>&lt;rate in Hz&gt;</b>	2 mHz~1MHz
Example	<b>SOURce3RF:ASK:INT:RATE MAX</b> Sets the rate to the maximum (1MHz).	
Query Syntax	<b>SOURce[3RF]:ASKey:INTernal:RATE?</b> <b>[MINimum   MAXimum]</b>	
Return Parameter	<b>&lt;NR3&gt;</b>	Returns the ASK rate in Hz.
Example	<b>SOURce3RF:ASK:INT:RATE?</b> <b>+1.0000E+06</b> Returns the maximum ASK rate allowed.	



## Frequency Modulation (FM) Commands

### FM Overview

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



<b>SOURce[1 2 3 3RF]:FM:STATe</b>		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	<b>SOUR[1 2 3 3RF]:FM:STATe {OFF ON}</b>	
Example	<b>SOUR1:FM:STAT ON</b> Enables FM modulation.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FM:STATe?</b>	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	<b>SOUR1:FM:STAT?</b> <b>1</b> FM modulation mode is currently enabled.	

<b>SOURce[1 2 3 3RF]:FM:SOURce</b>		Source Specific Command
Description	Sets or queries the modulation source as internal or external. Internal is the default modulation source.	
Note	If an external modulation source is selected, modulation depth is limited to $\pm 5V$ 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.  The RF channel supports only the internal modulation mode.	

Syntax	<b>SOURce[1 2 3 3RF]:FM:SOURce {INTernal EXTernal}</b>	
Example	<b>SOUR1:FM:SOUR EXT</b> Sets the modulation source to external.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FM:SOURce?</b>	
Return Parameter	INT	Internal
	EXT	External
Example	<b>SOUR1:FM:SOUR?</b> <b>INT</b> The modulation source is set to internal.	

SOURce[1 2 3 3RF]:FM:INTernal:FUNCTION			Source Specific Command
Description	Sets the shape of the modulating waveform from sine, square, triangle, upramp and dn ramp. The default shape is sine.		
Note	Square and triangle waveforms have a 50% duty cycle. Upramp and dn ramp have a symmetry of 100% and 0%, respectively.		
Syntax	SOURce[1 2 3 3RF]: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 2 3 3RF]:FM:INTernal:FUNCTION?		
Return Parameter	SIN	Sine	UPRAMP Upramp
	SQU	Square	DNRAMP Dn ramp
	TRI	Triangle	
Example	SOUR1:FM:INT:FUNC? SIN  The shape for the modulating waveform is Sine.		

**SOURce[1|2|3|3RF]:FM:INTernal:FREQuency** Source Specific Command

Description	Sets the frequency of the internal modulating waveform only. The default frequency is 10Hz.	
Syntax	<b>SOURce[1 2 3 3RF]:FM:INTernal:FREQuency {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	2 mHz~ 20 kHz
Example	<b>SOUR1:FM:INT:FREQ 100</b> Sets the modulating frequency to 100Hz.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FM:INTernal:FREQuency? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	<b>SOUR1:FM:INT:FREQ?</b> <b>+1.0000E+02</b> Returns the frequency to 100Hz.	

**SOURce[1|2|3|3RF]:FM:DEViation** Source Specific Command

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

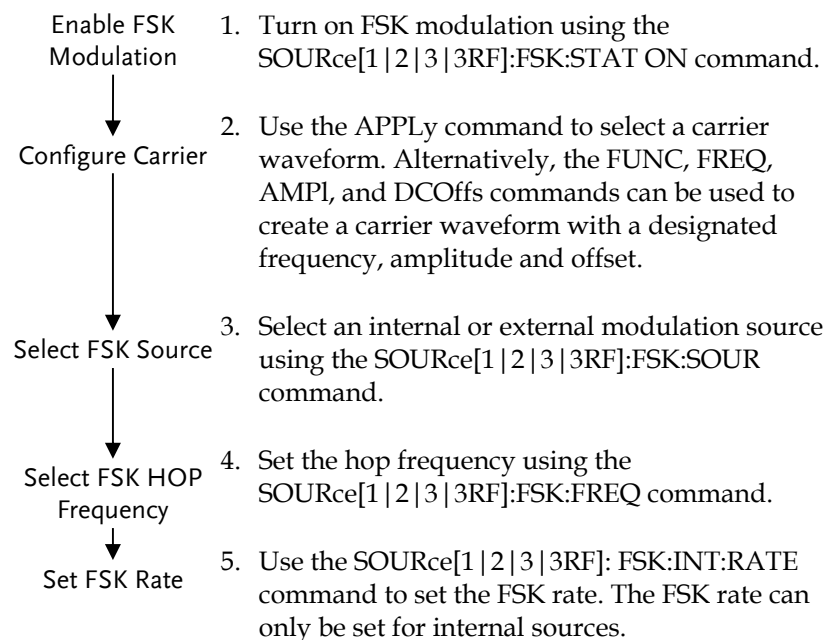
For square wave carrier waveforms, the deviation may cause the duty cycle frequency boundary to be exceeded. In these conditions the duty cycle will be adjusted to the maximum allowed and a “settings conflict” error will be generated.

Syntax	<b>SOURce[1 2 3 3RF]:FM:DEVIation {&lt;peak deviation in Hz&gt; MINimum MAXimum}</b>	
Parameter	<peak deviation in Hz>	DC to Max Frequency
Example	<b>SOUR1:FM:DEV MAX</b>  Sets the frequency deviation to the maximum value allowed.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FM:DEVIation? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the frequency deviation in Hz.
Example	<b>SOURce[1 2 3 3RF]:FM:DEVIation? MAX</b> <b>+1.0000E+01</b>  Returns the maximum frequency deviation allowed.	

## Frequency-Shift Keying (FSK) Commands

### FSK Overview

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



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

Example	<b>SOUR1:FSK:STAT ON</b>	
	Enables FSK modulation	
Query Syntax	<b>SOURce[1 2 3 3RF]:FSKey:STATe?</b>	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	<b>SOUR1:FSK:STAT?</b>	
	<b>1</b>	
	FSK modulation is currently enabled.	

<b>SOURce[1 2 3 3RF]:FSKey:SOURce</b>		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	<b>SOURce[1 2 3 3RF]:FSKey:SOURce {INTernal EXTernal}</b>	
Example	<b>SOUR1:FSK:SOUR INT</b>	
	Sets the FSK source to internal.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FSKey:SOURce?</b>	
Return Parameter	INT	Internal
	EXT	External
Example	<b>SOUR1:FSK:SOUR?</b>	
	<b>INT</b>	
	The FSK source is set to internal.	

<b>SOURce[1 2 3 3RF]:FSKey:FREQuency</b>		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	<b>SOURce[1 2 3 3RF]:FSKey:FREQuency {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	1 $\mu$ Hz to Max Frequency
Example	<b>SOUR1:FSK:FREQ +1.0000E+02</b> Sets the FSK hop frequency to to 100Hz.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FSKey:FREQuency? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	<b>SOUR1:FSK:FREQ? +1.000000000000E+02</b> Returns the frequency to 100Hz.	

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

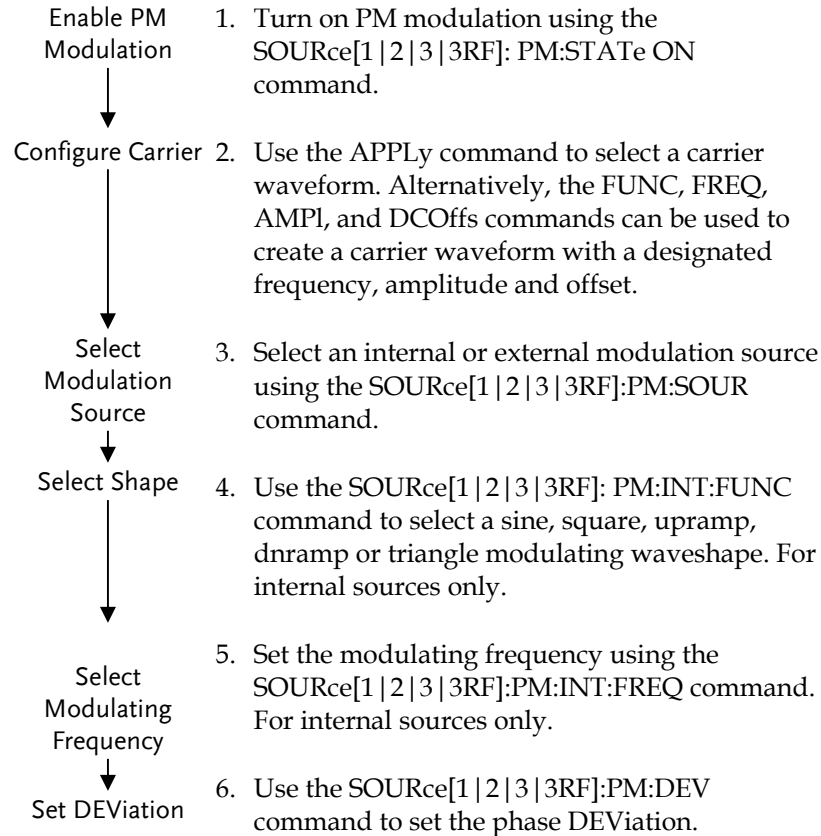
Description	Sets or queries the FSK rate for internal sources only.	
Note	External sources will ignore this command.	
Syntax	<b>SOURce[1 2 3 3RF]:FSKey:INTernal:RATE {&lt;rate in Hz&gt;  MINimum MAXimum}</b>	
Parameter	<rate in Hz>	2 mHz~100 kHz
Example	<b>SOUR1:FSK:INT:RATE MAX</b> Sets the rate to the maximum (1MHz).	
Query Syntax	<b>SOURce[1 2 3 3RF]:FSKey:INTernal:RATE? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the FSK rate in Hz.
Example	<b>SOUR1:FSK:INT:RATE? MAX +1.000000000E+05</b> Returns the maximum FSK rate allowed.	



## Phase Modulation (PM) Commands

### PM Overview

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



<b>SOURce[1 2 3 3RF]:PM:STATe</b>		Source Specific Command
Description	Turns PM Modulation on or off. By default PM modulation is off.	
Note	Burst or sweep mode will be disabled if PM modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when PM modulation is enabled.	
Syntax	<b>SOURce[1 2 3 3RF]:PM:STATe {OFF ON}</b>	
Example	<b>SOUR1:PM:STAT ON</b> Enables PM modulation	
Query Syntax	<b>SOURce[1 2 3 3RF]:PM:STATe?</b>	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	<b>SOUR1:PM:STAT?</b> <b>1</b> PM modulation is currently enabled.	

<b>SOURce[1 2 3 3RF]:PM:SOURce</b>		Source Specific Command
Description	Sets or queries the PM source as internal or external. Internal is the default source.	
Note	If an external PM source is selected, the phase modulation is controlled by the MOD INPUT terminal on the rear panel.  The RF channel supports only the internal modulation mode.	
Syntax	<b>SOURce[1 2 3 3RF]:PM:SOURce {INTernal EXTernal}</b>	
Example	<b>SOUR1:PM:SOUR INT</b> Sets the PM source to internal.	
Query Syntax	<b>SOURce[1 2 3 3RF]:PM:SOURce?</b>	

Return Parameter	INT	Internal
	EXT	External

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

**SOURce[1|2|3|3RF]:PM:INTernal:FUNction**      Source Specific Command

**Description**      Sets the shape of the modulating waveform from sine, square, triangle, upramp and dn ramp. The default shape is sine.

**Note**      Square and triangle waveforms have a 50% duty cycle. Upramp and dn ramp have a symmetry to 100% and 0%, respectively. .

**Syntax**      **SOURce[1|2|3|3RF]:PM:INTernal:FUNction**  
**{SINusoid|SQUare|TRIangle|UPRamp|DNRamp}**

**Example**      **SOUR1:PM:INT:FUN SIN**  
Sets the PM modulating wave shape to sine. .

**Query Syntax**      **SOURce[1|2|3|3RF]:PM:INTernal:FUNction?**

Return Parameter	SIN	Sine	UPRAMP	Upramp
	SQU	Square	DNRAMP	Dn ramp
	TRI	Triangle		

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

**SOURce[1|2|3|3RF]:PM:INTernal:FREQuency**      Source Specific Command

**Description**      Sets the modulating waveform frequency for internal sources. The default frequency is set to 20kHz.

Syntax	<b>SOURce[1 2 3 3RF]:PM:INTernal:FREQuency {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	2 mHz~ 20 kHz
Example	<b>SOUR1:PM:INT:FREQ MAX</b> Sets the frequency to the maximum value.	
Query Syntax	<b>SOURce[1 2 3 3RF]:PM:INTernal:FREQuency?</b>	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	<b>SOUR1:PM:INT:FREQ?</b> <b>+2.0000000E+04</b> Returns the modulating frequency. (20kHz)	

<b>SOURce[1 2 3 3RF]:PM:DEViation</b>		Source Specific Command
Description	Sets or queries the phase deviation of the modulating waveform from the carrier waveform. The default phase deviation is 180°.	
Note	For external sources, the phase deviation is controlled by the $\pm 5V$ MOD Input terminal on the rear panel. If the phase deviation is set to 180 degrees, then +5V represents a deviation of 180 degrees. A lower input voltage will decrease the set phase deviation.  The RF channel supports only the internal modulation mode.	
Syntax	<b>SOURce[1 2 3 3RF]:PM:DEViation {&lt;phase&gt; minimum  maximum}</b>	
Parameter	<percent>	0°~360°
Example	<b>SOUR1:PM:DEViation +3.0000E+01</b> Sets the deviation to 30°.	
Query Syntax	<b>SOURce[1 2 3 3RF]:PM:DEViation?</b>	
Return Parameter	<NR3>	Returns the deviation .

Example

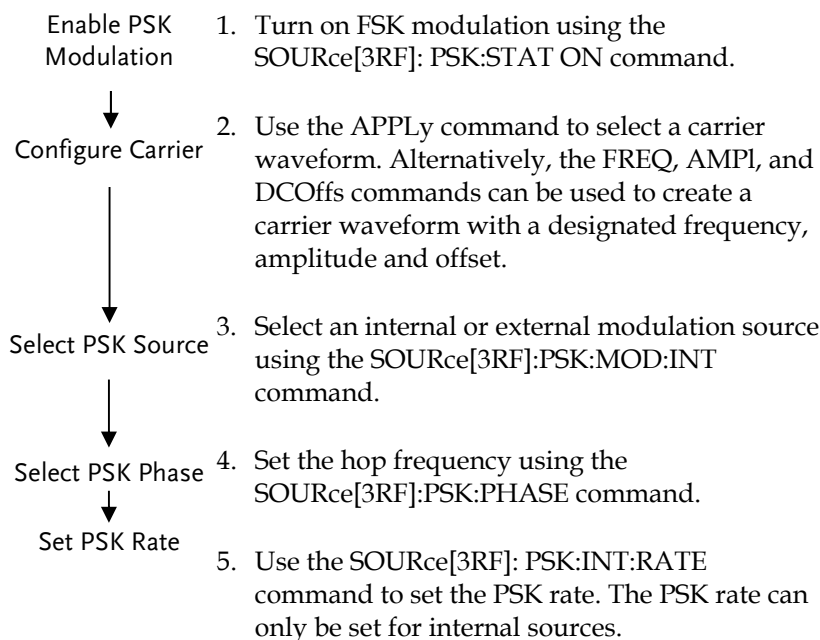
**SOUR1:PM:DEVIation?**  
**+3.0000E+01**

The current deviation is 30°.

## Phase Shift Keying (PSK) Commands

### PSK Overview

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



SOURce[3RF]:PSKey:STATe		Source Specific Command
Description	Turns PSK Modulation on or off. By default PSK modulation is off.	
Note	Burst or sweep mode will be disabled if PSK modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when PSK modulation is enabled.	
Syntax	SOURce[3RF]:PSKey:STATe {OFF ON}	

Example	<b>SOURce3RF:PSK:STAT ON</b> Enables PSK modulation	
Query Syntax	<b>SOURce[3RF]:PSKey:STATe?</b>	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)

Example      **SOURce3RF:PSK:STAT?**  
**ON**  
 PSK modulation is currently enabled.

### **SOURce[3RF]:PSKey:SOURce** Source Specific Command

Description	Sets or queries the PSK source as internal or external. Internal is the default source.	
Note	If an external PSK source is selected, PSK rate is controlled by the Trigger INPUT terminal on the rear panel.	
Syntax	<b>SOURce[3RF]:PSKey:SOURce {INTernal EXTernal}</b>	
Example	<b>SOUR3RF:PSK:SOUR EXT</b> Sets the PSK source to external.	
Query Syntax	<b>SOURce[3RF]:PSKey:SOURce?</b>	
Return Parameter	INT	Internal
	EXT	External

Example      **SOURce3RF:PSK:SOUR?**  
**INT**  
 The PSK source is set to internal.

### **SOURce[3RF]:PSKey:PHASE** Source Specific Command

Description	Sets the PSK hop frequency. The default hop frequency is set to 180°.	
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Note	For PSK, the modulating waveform is a square wave with a duty cycle of 50%.	
Syntax	SOURce[3RF]:PSKey:PHASE {<phase>   MINimum   MAXimum}	
Parameter	<phase>	0~360°.
Example	<b>SOUR3RF:PSK:DEV 180</b> Sets the PSK hop deviation to to 180°.	
Query Syntax	<b>SOURce[3RF]:PSKey:DEViation?</b> <b>[MINimum MAXimum]</b>	
Return Parameter	<percent>	0~360°.
Example	<b>SOUR1:PSK:DEV? MAX</b> <b>360°</b> Returns the maximum hop deviation allowed.	

### SOURce[3RF]:PSKey:INTernal RATE Source Specific Command

Description	Sets or queries the PSK rate for internal sources only.	
Note	External sources will ignore this command.	
Syntax	SOURce[3RF]:PSKey:INTernal:RATE {<rate in Hz>   MINimum   MAXimum}	
Parameter	<rate in Hz>	2 mHz~1MHz
Example	<b>SOURce3RF:PSK:INT:RATE MAX</b> Sets the rate to the maximum (1MHz).	
Query Syntax	<b>SOURce[3RF]:PSKey:INTernal:RATE?</b> <b>[MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the PSK rate in Hz.
Example	<b>SOURce3RF:PSK:INT:RATE? MAX</b> <b>+1.0000E+06</b> Returns the maximum PSK rate allowed.	

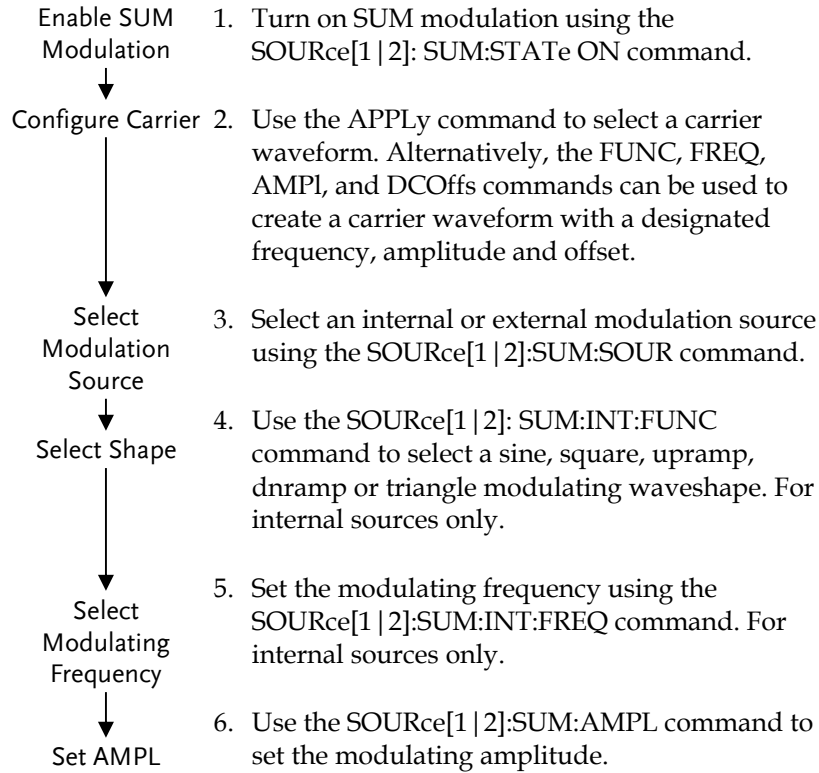


## SUM Modulation (SUM) Commands

### SUM Overview

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



<b>SOURce[1 2]:SUM:STATe</b>		Source Specific Command
Description	Turns SUM Modulation on or off. By default SUM modulation is off.	
Note	Burst or sweep mode will be disabled if SUM modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when SUM modulation is enabled.	
Syntax	<b>SOURce[1 2]:SUM:STATe {OFF ON}</b>	
Example	<b>SOUR1:SUM:STAT ON</b> Enables SUM modulation	
Query Syntax	<b>SOURce[1 2]:SUM:STATe?</b>	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	<b>SOUR1:SUM:STAT?</b> <b>1</b> SUM modulation is currently enabled.	

<b>SOURce[1 2]:SUM:SOURce</b>		Source Specific Command
Description	Sets or queries the SUM source as internal or external. Internal is the default source.	
Note	If an external SUM source is selected, the duty cycle/pulse width is controlled by the MOD INPUT terminal on the rear panel.	
Syntax	<b>SOURce[1 2]:SUM:SOURce {INTernal EXTernal}</b>	
Example	<b>SOUR1:SUM:SOUR INT</b> Sets the SUM source to internal.	
Query Syntax	<b>SOURce[1 2]:SUM:SOURce?</b>	

Return Parameter	INT	Internal
	EXT	External
Example	<b>SOUR1:SUM:SOUR?</b> <b>INT</b> The SUM source is set to internal.	

SOURCE[1 2]:SUM:INTernal:FUNction			Source Specific Command	
Description	Sets the shape of the modulating waveform from sine, square, triangle, upramp and dn ramp. The default shape is sine.			
Note	Square and triangle waveforms have a 50% duty cycle. Upramp and dn ramp have a symmetry to 100% and 0%, respectively.			
Syntax	SOURCE[1 2]:SUM:INTernal:FUNction {SINusoid SQUare TRIangle UPRamp DNRamp}			
Example	SOUR1:SUM:INT:FUN SIN  Sets the SUM modulating wave shape to sine.			
Query Syntax	SOURCE[1 2]:SUM:INTernal:FUNction?			
Return Parameter	SIN	Sine	UPRAMP	Upramp
	SQU	Square	DNRAMP	Dn ramp
	TRI	Triangle		
Example	SOUR1:SUM:INT:FUNC?  SIN  The shape for the modulating waveform is Sine.			

SOURCE[1 2]:SUM:INTernal:FREQuency		Source Specific Command
Description	Sets the modulating waveform frequency for internal sources. The default frequency is set to 20kHz.	

Syntax	<b>SOURce[1 2]:SUM:INTernal:FREQuency</b> <b>{&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	2 mHz~ 20 kHz
Example	<b>SOUR1:SUM:INT:FREQ MAX</b> Sets the frequency to the maximum value.	
Query Syntax	<b>SOURce[1 2]:SUM:INTernal:FREQuency?</b>	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	<b>SOUR1:SUM:INT:FREQ?</b> +2.0000000E+04 Returns the modulating frequency (20kHz).	

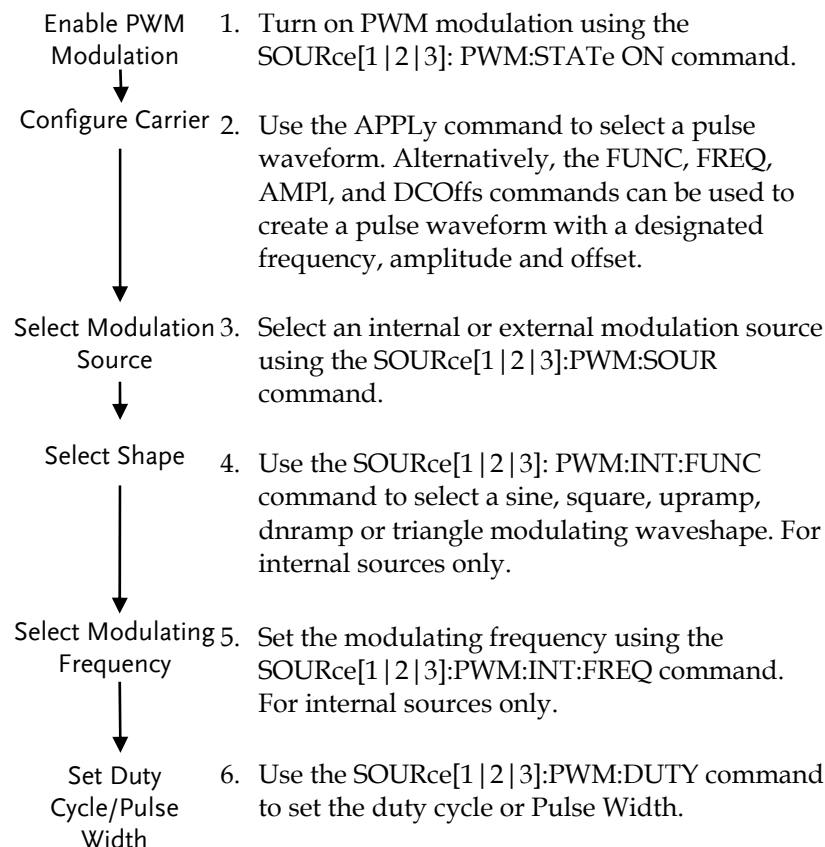
<b>SOURce[1 2]:SUM:AMPL</b>		Source Specific Command
Description	Sets or queries the amplitude of the modulating waveform from the carrier waveform. The default phase amplitude is 100%.	
Note	If an external SUM source is selected, the amplitude of the modulated waveform is controlled using the $\pm 5V$ MOD INPUT terminal on the rear panel. A positive signal ( $>0 \sim +5V$ ) will increase the AMPLitude (up to the set amplitude), whilst a negative voltage will reduce the amplitude.	
Syntax	<b>SOURce[1 2]:SUM:AMPL{&lt; percent&gt; minimum maximum}</b>	
Parameter	<percent>	0%~100%
Example	<b>SOUR1:SUM:AMPLitude +3.0000E+01</b> Sets the amplitude to 30%.	
Query Syntax	<b>SOURce[1 2]:SUM:AMPLitude?</b>	
Return Parameter	<NR3>	Returns the amplitude .

Example      SOUR1:SUM:AMPLitude?  
                 +3.000E+01  
                 The current amplitude is 30%.

# Pulse Width Modulation (PWM) Commands

## PWM Overview

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



SOURce[1 2 3]:PWM:STATe		Source Specific Command
Description	Turns pulse width modulation on or off. By default PWM is off.	

Note	Burst or sweep mode will be disabled if PWM modulation is enabled. As only one modulation is allowed at any one time, other modulation modes will be disabled when PWM modulation is enabled.	
Syntax	<b>SOURce[1 2 3]:PWM:STATe {OFF ON}</b>	
Example	<b>SOUR1:PWM:STAT ON</b> Enables PWM modulation	
Query Syntax	<b>SOURce[1 2 3]:PWM:STATe?</b>	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)
Example	<b>SOUR1:PWM:STAT?</b> <b>ON</b> PWM modulation is currently enabled.	

### **SOURce[1|2|3]: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.  The RF channel supports only the internal modulation mode.	
Syntax	<b>SOURce[1 2 3]:PWM:SOURce {INTernal EXTernal}</b>	
Example	<b>SOUR1:PWM:SOUR EXT</b> Sets the PWM source to external.	
Query Syntax	<b>SOURce[1 2 3]:PWM:SOURce?</b>	
Return Parameter	INT	Internal
	EXT	External
Example	<b>SOUR1:PWM:SOUR? INT</b>	

The PWM source is set to internal.

SOURce[1 2 3]:PWM:INTernal:FUNction		Source Specific Command
Description	Sets the shape of the modulating waveform from sine, square, triangle, upramp and dn ramp. The default shape is sine.	
Note	Square and triangle waveforms have a 50% duty cycle. Upramp and dn ramp have a symmetry to 100% and 0%, respectively.	
	Carrier must be a pulse or PWM waveform.	
Syntax	<b>SOURce[1 2 3]:PWM:INTernal:FUNction {SINusoid SQUare TRIangle UPRamp DNRamp}</b>	
Example	<b>SOUR1:PWM:INT:FUN SIN</b> Sets the PWM modulating wave shape to sine.	
Query Syntax	<b>SOURce[1 2 3]:PWM:INTernal:FUNction?</b>	
Return Parameter	SIN	Sine
	SQU	Square
	TRI	Triangle
Example	<b>SOUR1:PWM:INT:FUNC?</b> <b>SIN</b> The shape for the modulating waveform is Sine.	

SOURce[1 2 3]:PWM:INTernal:FREQuency		Source Specific Command
Description	Sets the modulating waveform frequency for internal sources. The default frequency is set to 10Hz.	
Syntax	<b>SOURce[1 2 3]:PWM:INTernal:FREQuency {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency> 2 mHz~ 20 kHz	
Example	<b>SOUR1:PWM:INT:FREQ MAX</b> Sets the frequency to the maximum value.	



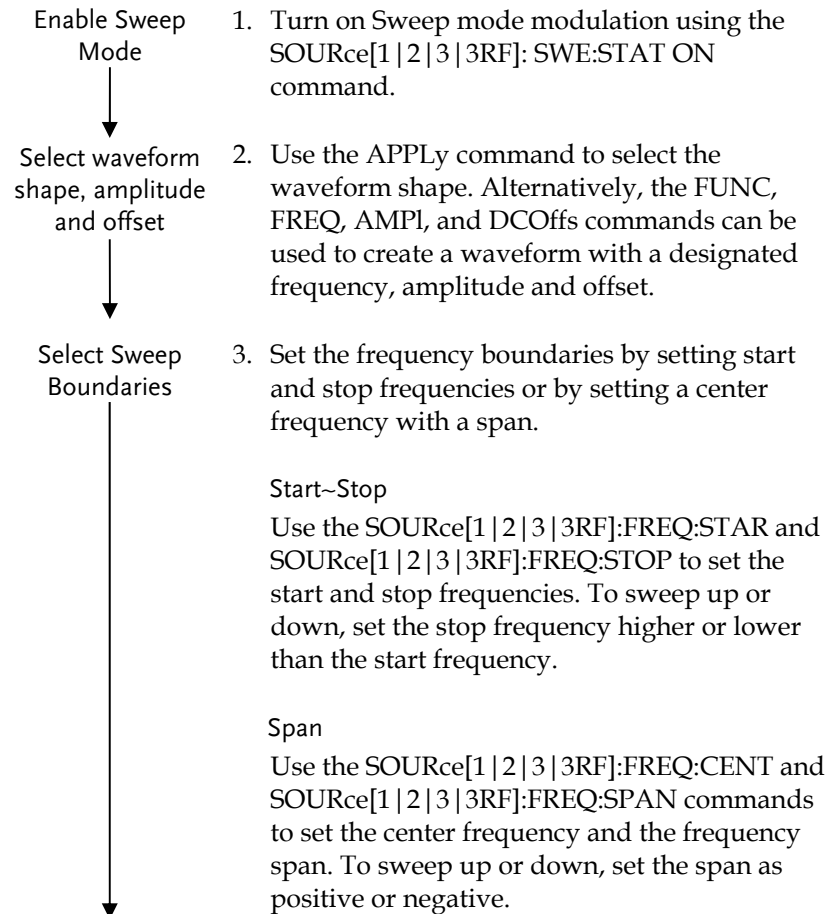
Query Syntax	<b>SOURce[1 2 3]:PWM:INTernal:FREQuency?</b>	
Return Parameter	<NR3>	Returns the frequency in Hz.
Example	<b>SOUR1:PWM:INT:FREQ? MAX</b> <b>+2.0000E+04</b> Returns the modulating frequency. (20kHz)	
<b>SOURce[1 2 3]:PWM:DUTY</b>		Source Specific Command
Description	Sets or queries the duty 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 $\pm 5V$ MOD INPUT terminal on the rear panel. A positive signal ( $>0 \sim +5V$ ) will increase the deviation (up to the set duty cycle deviation), whilst a negative voltage will reduce the deviation.	
Syntax	<b>SOURce[1 2 3]:PWM:DUTY {&lt; percent&gt; minimum maximum}</b>	
Parameter	<percent>	0%~100% (limited, see above)
Example	<b>SOUR1:PWM:DUTY +3.0000E+01</b> Sets the duty cycle to 30%.	
Query Syntax	<b>SOURce[1 2 3]:PWM:DUTY?</b>	
Return Parameter	<NR3>	Returns the deviation in %.
Example	<b>SOUR1:PWM:DUTY?</b> <b>+3.0000E+01</b> The current duty cycle is 30%.	

## Frequency Sweep Commands

### Sweep Overview

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



- |                                      |  |
|--------------------------------------|--|
| Select Sweep Mode                    | 4. Choose Linear or Logarithmic spacing using the SOURce[1   2   3   3RF]:SWE:SPAC command.  |
| Select Sweep Time<br>↓               | 5. Choose the sweep time using the SOURce[1   2   3   3RF]:SWE:TIME command.   |
| Select the sweep trigger source<br>↓ | 6. Select an internal or external sweep trigger source using the SOURce[1   2   3   3RF]:SOUR command.   |
| Select the marker frequency          | 7. To output a marker frequency from the trigger out, use The SOURce[1   2]:MARK:FREQ command. To enable marker frequency output, use the SOURce[1   2]:MARK ON command. |

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

SOURCE[1 2 3 3RF]:SWEep:STATe		Source Specific Command
Description	Sets or disables Sweep mode. By default Sweep is disabled. Sweep modulation must be enabled before setting other parameters.	
Note	Any modulation modes or Burst mode will be disabled if sweep mode is enabled.	
Syntax	SOURCE[1 2 3 3RF]:SWEep:STATe {OFF ON}	
Example	SOURCE1:SWE:STAT ON Enables sweep mode.	
Query Syntax	SOURCE[1 2 3 3RF]:SWEep:STATe?	
Return Parameter	0	Disabled (OFF)
	1	Enabled (ON)

Example            **SOUR1:SWE:STAT?**  
**1**  
Sweep mode is currently enabled.

**SOURce[1|2|3|3RF]: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	<b>SOURce[1 2 3 3RF]:FREQuency:STARt {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	1uHz to Max Frequency
Example	<b>SOUR1:FREQ:STAR +2.0000E+03</b> Sets the start frequency to 2kHz.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FREQuency:STARt? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the start frequency in Hz.
Example	<b>SOUR1:FREQ:STAR?</b> <b>+2.0000000000000E+03</b> Returns the maximum start frequency allowed.	

**SOURce[1|2|3|3RF]: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	<b>SOURce[1 2 3 3RF]:FREQuency:STOP {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	1uHz to Max Frequency

Example	<b>SOUR1:FREQ:STOP +2.0000E+03</b> Sets the stop frequency to 2kHz.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FREQuency:STOP? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the stop frequency in Hz.
Example	<b>SOUR1:FREQ:STOP? MAX</b> +2.0000000000000E+03 Returns the maximum stop frequency allowed.	

<b>SOURce[1 2 3 3RF]:FREQuency:CENTer</b>		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: $\text{max center freq} = \text{max freq} - \text{span}/2$	
Syntax	<b>SOURce[1 2 3 3RF]:FREQuency:CENTer {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	450Hz~ 25MHz 450Hz~ 1MHz (Ramp)
Example	<b>SOUR1:FREQ:CENt +2.0000E+03</b> Sets the center frequency to 2kHz.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FREQuency:CENTer? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the stop frequency in Hz.
Example	<b>SOUR1:FREQ:CENt?</b> +2.0000000000000E+03 Returns the maximum center frequency allowed, depending on the span.	

## SOURce[1|2|3|3RF]: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	<p>To sweep up or down, set the span as positive or negative.</p> <p>The maximum span frequency has a relationship to the center frequency and maximum frequency:  <math>\text{max freq span} = 2(\text{max freq} - \text{center freq})</math></p>	
Syntax	<b>SOURce[1 2 3 3RF]:FREQuency:SPAN {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	1 μHz ~25MHz 1 μHz~ 1MHz (Ramp)
Example	<b>SOUR1:FREQ:SPAN +2.0000E+03</b> Sets the frequency span to 2kHz.	
Query Syntax	<b>SOURce[1 2 3 3RF]:FREQuency:SPAN? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the frequency span in Hz.
Example	<b>SOUR1:FREQ:SPAN?</b> +2.0000000000000E+03 Returns the frequency span for the current sweep.	

## SOURce[1|2|3|3RF]:SWEep:SPACing Source Specific Command

Description	Sets linear or logarithmic sweep spacing. The default spacing is linear.	
Syntax	<b>SOURce[1 2 3 3RF]:SWEep:SPACing {LINear LOGarithmic}</b>	
Example	<b>SOUR1:SWE:SPAC LIN</b>	

	Sets the spacing to linear.	
Query Syntax	<b>SOURce[1 2 3 3RF]:SWEep:SPACing?</b>	
Return Parameter	LIN	Linear spacing
	LOG	Logarithmic spacing
Example	<b>SOUR1:SWE:SPAC?</b> <b>LIN</b> The spacing is currently set as linear.	

	<b>SOURce[1 2 3 3RF]:SWEep:TIME</b>	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	<b>SOURce[1 2 3 3RF]:SWEep:TIME {&lt;seconds&gt; MINimum MAXimum}</b>	
Parameter	<seconds>	1 ms ~ 500 s
Example	<b>SOUR1:SWE:TIME +1.0000E+00</b> Sets the sweep time to 1 second.	
Query Syntax	<b>SOURce[1 2 3 3RF]:SWEep:TIME? {&lt;seconds&gt; MINimum MAXimum}</b>	
Return Parameter	<NR3>	Returns sweep time in seconds.
Example	<b>SOUR1:SWE:TIME?</b> <b>+1.00000E+00</b> Returns the sweep time (1 seconds).	

<b>SOURce[1 2 3 3RF]:SWEep:SOURce</b>		Source Specific Command
Description	Sets or queries the trigger source as immediate (internal), external or manual. Immediate (internal) is the default trigger source. IMMEDIATE will constantly output a swept waveform. EXTERNAL will output a swept waveform after each external trigger pulse. Manual will output a swept waveform after the trigger softkey is pressed.	
Note	<p>If the APPLy command was used to create the waveform shape, the source is automatically set to IMMEDIATE.</p> <p>The *OPC/*OPC? command/query can be used to signal the end of the sweep.</p> <p>If the trigger source is set to manual, the function generator starts sweeping each time a trigger command is received. To trigger the function generate from remote interface, it is necessary to send a * TRG trigger command.</p>	
Syntax	<b>SOURce[1 2 3 3RF]: SWEep:SOURce {IMMEDIATE EXTERNAL  MANUAL}</b>	
Example	<b>SOUR1: SWE:SOUR INT</b> Sets the sweep source to internal.	
Query Syntax	<b>SOURce[1 2 3 3RF]: SWEep:SOURce?</b>	
Return Parameter	IMM	Immediate
	EXT	External
	MANual	Manual
Example	<b>SOUR1:SWE:SOUR?</b> <b>IMM</b> The sweep source is set to internal.	



OUTPut[1 2]: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	<b>OUTPut[1 2]:TRIGger:SLOPe {POSitive NEGative}</b>	
Example	<b>OUTP1:TRIG:SLOP NEG</b> Sets the Trig out signal as negative edge.	
Query Syntax	<b>OUTPut[1 2]:TRIGger:SLOPe?</b>	
Return Parameter	POS	Positive edge
	NEG	Negative edge
Example	<b>OUTP1:TRIG:SLOP?</b> <b>NEG</b> The Trig out signal is set to negative edge.	

OUTPut[1 2]: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	<b>OUTPut[1 2]:TRIGger {OFF ON}</b>	

Example	<b>OUTP1:TRIG ON</b>	
	Enables the Trig out signal.	
Query Syntax	<b>OUTPut[1 2]:TRIGger?</b>	
Return Parameter	0	Disabled
	1	Enable
Example	<b>OUTP1:TRIG?</b>	
	1	
	The Trig out signal is enabled.	

<b>SOURce[1 2]:MARKer:FREQuency</b>		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 trigger out signal from the trigger terminal on the rear panel.	
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	<b>SOURce[1 2]:MARKer:FREQuency {&lt;frequency&gt; MINimum MAXimum}</b>	
Parameter	<frequency>	1 $\mu$ Hz ~ 25 MHz 1 $\mu$ Hz ~ 1 MHz (Ramp)
Example	<b>SOUR1:MARK:FREQ +1.0000E+03</b>	
	Sets the marker frequency to 1 kHz.	
Query Syntax	<b>SOURce[1 2]:MARKer:FREQuency? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the marker frequency in Hz.
Example	<b>SOUR1:MARK:FREQ?</b>	
	+1.000000000000E+03	
	Returns the marker frequency (1 kHz).	

SOURce[1 2]:MARKer		Source Specific Command
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	<b>SOURce[1 2]:MARKer {OFF ON}</b>	
Example	<b>SOUR1:MARK ON</b> Enables the marker frequency.	
Query Syntax	<b>SOURce[1 2]:MARKer?</b>	
Return Parameter	0	Disabled
	1	Enabled
Example	<b>SOUR1:MARK?</b> <b>1</b> 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.

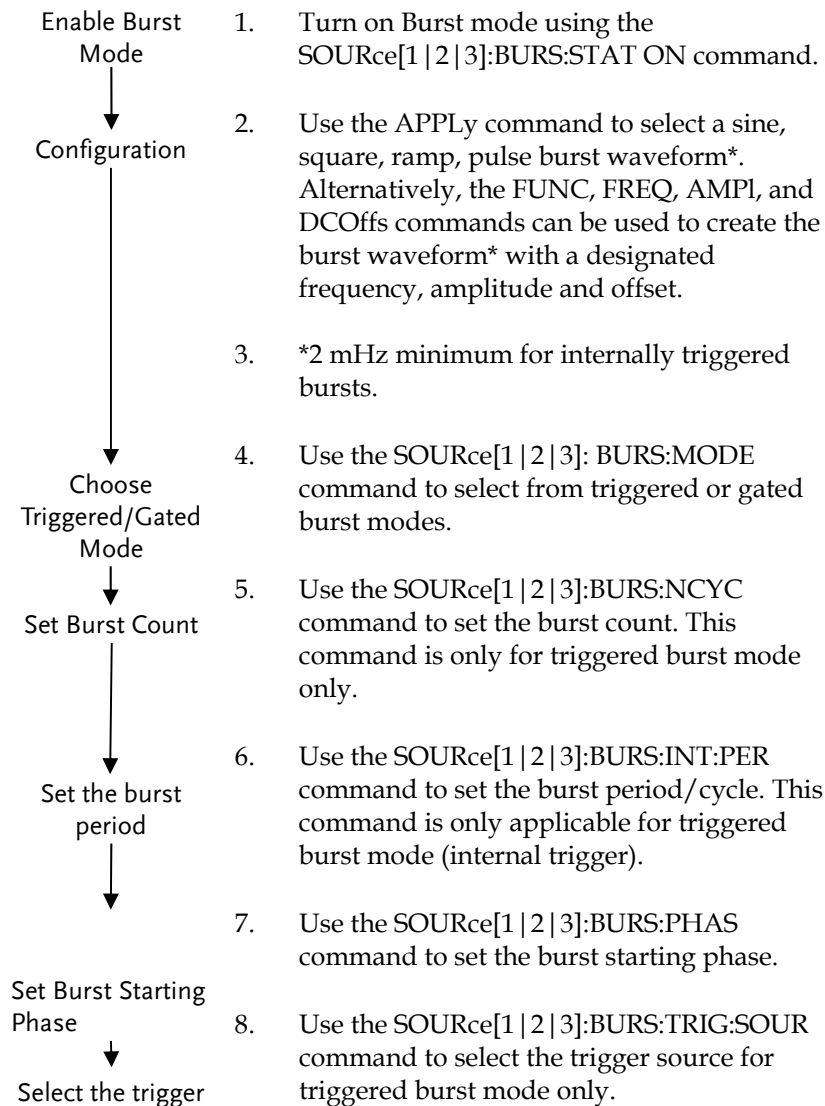
\*assuming the Trigger polarity is not inverted.

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.

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

\*burst count

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



<b>SOURce[1 2 3]:BURSt:STATe</b>		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	<b>SOURce[1 2 3]:BURSt:STATe {OFF ON}</b>	
Example	<b>SOUR1:BURS:STAT ON</b> Turns burst mode on.	
Query Syntax	<b>SOURce[1 2 3]:BURSt:STATe?</b>	
Return Parameter	0	Disabled
	1	Enabled
Example	<b>SOUR1:BURS:STAT?</b> <b>0</b> Burst mode is off.	

<b>SOURce[1 2 3]:BURSt:MODE</b>		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	<b>SOURce[1 2 3]:BURSt:MODE {TRIGgered GATed}</b>	
Example	<b>SOUR1:BURS:MODE TRIG</b> Sets the burst mode to triggered.	
Query Syntax	<b>SOURce[1 2 3]:BURSt:MODE?</b>	
Return Parameter	TRIG	Triggered mode
	GAT	Gated mode

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

<b>SOURce[1 2 3]:BURSt:NCYCles</b>		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	<p>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 &gt; burst count</p> <p>If the burst count is too large, the burst period will automatically be increased and a "Settings conflict" error will be generated.</p> <p>Only sine and square waves are allowed infinite burst above 25 MHz.</p>	
Syntax	<b>SOURce[1 2 3]:BURSt:NCYCles{&lt; # cycles&gt;  INFinity MINimum  MAXimum}</b>	
Parameter	<# cycles>	1~1,000,000 cycles.
	INFinity	Sets the number to continuous.
	MINimum	Sets the number to minimum allowed.
	MAXimum	Sets the number to maximum allowed.
Example	<b>SOUR1:BURS:NCYCl INF</b> Sets the number of burst cycles to continuous (infinite).	
Query Syntax	<b>SOURce[1 2 3]:BURSt:NCYCles? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the number of cycles.
	INF	INF is returned if the number of cycles is continuous.

Example	<b>SOUR1:BURS:NCYC?</b> +1.000000E+00 The burst cycles are set to 1.	
	<b>SOURce[1 2 3]:BURSt:INTernal:PERiod</b>	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	<b>SOURce[1 2 3]:BURSt:INTernal:PERiod {&lt;seconds&gt; MINimum MAXimum}</b>	
Parameter	<seconds >	1 ms ~ 500 seconds
Example	<b>SOUR1:BURS:INT:PER +1.0000E+01</b> Sets the period to 10 seconds.	
Query Syntax	<b>SOURce[1 2 3]:BURSt:INTernal:PERiod? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the burst period in seconds.
Example	<b>SOUR1:BURS:INT:PER?</b> +1.00000000E+01 The burst period is 10 seconds.	



SOURce[1 2 3]:BURSt:PHASe		Source Specific Command
Description	<p>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.</p> <p>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.</p>	
Note	The phase command is not used with pulse waveforms.	
Syntax	<b>SOURce[1 2 3]:BURSt:PHASe {&lt;angle&gt; MINimum MAXimum}</b>	
Parameter	<angle>	-360 ~ 360 degrees
Example	<b>SOUR1:BURSt:PHAS MAX</b> Sets the phase to 360 degrees.	
Query Syntax	<b>SOURce[1 2 3]:BURSt:PHASe? [MINimum MAXimum]</b>	
Return Parameter	<NR3>	Returns the phase angle in degrees.
Example	<b>SOUR1:BURSt:PHAS?</b> +3.600E+02 The burst phase is 360 degrees.	

SOURce[1 2 3]:BURSt:TRIGger:SOURce		Source Specific Command
Description	<p>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.</p> <p>There are three trigger sources for triggered burst mode:</p>	

	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	<p>If the APPLy command was used, the source is automatically set to IMMEDIATE.</p> <p>The *OPC/*OPC? command/query can be used to signal the end of the burst.</p> <p>If the trigger source is set to manual, the function generator outputs a burst count waveform with the specified number of cycles each time the trigger signal * TRG is received. The function generator stops and waits for the next trigger after the specified number of cycles has been output. You can configure the function generator to use an internal trigger to start a burst or send a trigger signal from the rear panel port connector by pressing the front panel key and you can also send a trigger command * TRG through the remote interface to provide an external trigger source.</p>	
Syntax	<b>SOURce[1 2 3]:BURSt:TRIGger:SOURce {IMMEDIATE EXTernal MANual}</b>	
Example	<b>SOUR1:BURSt:TRIG:SOUR INT</b> Sets the burst trigger source to internal.	
Query Syntax	<b>SOURce[1 2 3]:BURSt:TRIGger:SOURce?</b>	
Return Parameter	IMM	Immediate
	EXT	External
	MANual	Manual

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

**SOURce[1|2|3]: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|2|3]: BURSt:TRIGger:DElay**  
**{<seconds>|MINimum|MAXimum}**

**Parameter**                    <seconds>                    0~85 seconds

**Example**                    **SOUR1:BURS:TRIG:DEL +1.000E+01**  
Sets the trigger delay to 1 second.

**Query Syntax**                    **SOURce[1|2|3]:BURSt:TRIGger:DElay?**  
**[MINimum|MAXimum]**

**Return Parameter** <NRf>                    Delay in seconds

**Example**                    **SOUR1:BURS:TRIG:DEL ?**  
**+1.000E+01**  
The trigger delay is 1 second.

**SOURce[1|2|3]: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|2|3|3RF]:BURSt:TRIGger:SLOPe**  
**{POSitive|NEGative}**

**Parameter**                    POSitive                    rising edge  
NEGative                    falling edge

Example	<b>SOUR1:BURS:TRIG:SLOP NEG</b>	
	Sets the trigger slope to negative.	
Query Syntax	<b>SOURce[1 2 3]:BURSt:TRIGger:SLOPe?</b>	
Return Parameter	POS	rising edge
	NEG	falling edge
Example	<b>SOUR1:BURS:TRIG:SLOP ?</b>	
	<b>NEG</b>	
	The trigger slope is negative.	

<b>SOURce[1 2 3]:BURSt:GATE:POLarity</b>		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	<b>SOURce[1 2 3]:BURSt:GATE:POLarity {NORMAl INVertes}</b>	
Parameter	NORMAl	Logically high
	INVertes	Logically low
Example	<b>SOUR1:BURS:GATE:POL INV</b>	
	Sets the state to logically low (inverted).	
Query Syntax	<b>SOURce[1 2 3]:BURSt:GATE:POLarity?</b>	
Return Parameter	NORM	Normal(High) logical level
	INV	Inverted (low) logical level
Example	<b>SOUR1:BURS:GATE:POL?</b>	
	<b>INV</b>	
	The true state is inverted(logically low).	

Source Specific  
Command

**SOURce[1|2]:BURSt:OUTPut:TRIGger:SLOPe**

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	<b>SOURce[1 2]:BURSt:OUTPut:TRIGger:SLOPe {POSitive NEGative}</b>	
Parameter	POSitive	Rising edge.
	NEGative	Falling edge.
Example	<b>SOUR1:BURS:OUTP:TRIG:SLOP POS</b> Sets the trigger output signal slope to positive (rising edge).	
Query Syntax	<b>SOURce[1 2]:BURSt:OUTPut:TRIGger:SLOPe?</b>	
Return Parameter	POS	Rising edge.
	NEG	Falling edge.
Example	<b>SOUR1:BURS:OUTP:TRIG:SLOP?</b> <b>POS</b> The trigger output signal slope to positive.	

SOURCE[1 2]:BURSt: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	SOURCE[1 2]:BURSt:OUTPut:TRIGger {OFF ON}	
Parameter	OFF	Turns the output off.
	ON	Turns the output on.
Example	SOURCE1:BURSt:OUTPut:TRIGger ON	
Query Syntax	Turns the output on. SOURCE[1 2]:BURSt:OUTPut:TRIGger?	
Return Parameter	0	Disabled
	1	Enabled
Query Example	SOURCE1:BURSt:OUTPut:TRIG? 1	
	The trigger output is enabled.	

## Arbitrary Waveform Commands

### Arbitrary Waveform Overview

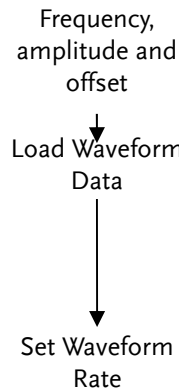
Use the steps below to output an arbitrary waveform over the remote interface.

1. Use the SOURCE[1 | 2 | 3]:FUNCTION USER command to output the arbitrary waveform currently selected in memory.

Output Arbitrary  
Waveform



Select Waveform



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 16384 points per waveform) can be downloaded into volatile memory using the DATA:DAC command. Binary integer or decimal integer values in the range of  $\pm 8191$  can be used.
4. The waveform rate is the product of the number of points in the waveform and the waveform frequency.

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

Range:	Rate:	1 $\mu$ Hz ~ 200MHz
	Frequency:	1 $\mu$ Hz ~ 100MHz
	# points:	1~16384

SOURce[1 2 3]:FUNCtion USER		Source Specific Command
Description	Use the SOURce[1   2   3]:FUNCtion USER command to output the arbitrary waveform currently selected in memory. The waveform is output with the current frequency, amplitude and offset settings.	
Syntax	SOURce[1 2 3]RF: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	<p>The integer values (<math>\pm 8192</math>) 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 8192 is the equivalent of 2.5 Volts. If the integer values do not span the full output range, the peak amplitude will be limited.</p> <p>The IEEE-488.2 binary block format is comprised of three parts:</p> <div> <div> <div># 7 2097152</div> <div>1 2 3</div> </div> <div> <ol style="list-style-type: none"> <li>1. Initialization character (#)</li> <li>2. Digit length (in ASCII) of the number of bytes</li> <li>3. Number of bytes</li> </ol> </div> </div> <p>IEEE 488.2 uses two bytes to represent waveform data (14 bit integer). Therefore the number of bytes is always twice the number of data points.</p>	
Syntax	<b>DATA:DAC VOLATILE, &lt;start&gt;, {&lt;binary block&gt; &lt;value&gt;, &lt;value&gt;, ... }</b>	
Parameter	<div>&lt;start&gt;</div> <div>&lt;binary block&gt;</div> <div>&lt;value&gt;</div>	<div>Start address of the arbitrary waveform</div> <div>Decimal or integer values <math>\pm 8192</math></div>
Example	<b>DATA:DAC VOLATILE, #216 Binary Data</b> <p>The command above downloads 5 data values (stored in 14 bytes) using the binary block format.</p>	



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

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

**SOURce[1|2|3]:ARB:EDIT:COPY** Source Specific Command

Description	Copies a segment of a waveform to a specific starting address.	
Syntax	<b>SOURce[1 2 3]:ARB:EDIT:COPY</b> <b>[&lt;start&gt;,&lt;length&gt;,&lt;paste&gt;]]]</b>	
Parameter	<start>	Start address: 0~16384
	<length>	0 ~ 16384
	<paste>	Paste address: 0~16384
Example	<b>SOUR1:ARB:EDIT:COPY 1000, 256, 1257</b> Copies 256 data values starting at address 1000 and copies them to address 1257.	

**SOURce[1|2|3]: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	<b>SOURce[1 2 3]:ARB:EDIT:DELeTe</b> <b>[&lt;STARt&gt;,&lt;LENGth&gt;]]</b>	
Parameter	<STARt>	Start address: 0~16384
	<LENGth>	0 ~ 16384
Example	<b>SOURce1:ARB:EDIT:DEL 1000, 256</b> Deletes a section of 256 data points from the waveform starting at address 1000.	

**SOURce[1|2|3]:ARB:EDIT:DELeTe:ALL** Source Specific Command

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

**Note** A waveform cannot be deleted when output.

**Syntax** **SOURce[1|2|3]:ARB:EDIT:DELeTe:ALL**

**Example** **SOUR1:ARB:EDIT:DEL:ALL**  
Deletes all user waveforms from memory.

**SOURce[1|2|3]:ARB:EDIT:POINt** Source Specific Command

**Description** Edit a point on the arbitrary waveform.

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

**Syntax** **SOURce[1|2|3]:ARB:EDIT:POINt [<address> [, <data>]]**

<b>Parameter</b>	<address>	Address of data point: 0~16384
	<data>	Value data: ± 8192

**Example** **SOUR1:ARB:EDIT:POIN 1000, 511**  
Creates a point on the arbitrary waveform at address 1000 with the highest amplitude.

**SOURce[1|2|3]:ARB:EDIT:LINE** Source Specific Command

**Description** Edit a line on the arbitrary waveform. The line is created with a starting address and data point and a finishing address and data point.

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

**Syntax** **SOURce[1|2|3]:ARB:EDIT:LINE [<address1>[,<data>[,<address2>[,<data2>]]]]**

Parameter	<address1>	Address of data point1: 0~16384
	<data1>	Value data2: $\pm 8192$
	<address2>	Address of data point2: 0~16384
	<data2>	Value data2: $\pm 8192$

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

**SOURce[1|2|3]:ARB:EDIT:PROTect**      Source Specific Command

Description	Protects a segment of the arbitrary waveform from deletion or editing.	
Syntax	<b>SOURce[1 2 3]:ARB:EDIT:PROTect</b> <b>[&lt;START&gt;[,&lt;LENGth&gt;]</b>	
Parameter	<START>	Start address: 0~16384
	<LENGth>	0 ~ 16384

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

**SOURce[1|2|3]:ARB:EDIT:PROTect:ALL**      Source Specific Command

Description	Protects the arbitrary waveform currently in non-volatile memory/currently being output.	
Syntax	<b>SOURce[1 2 3]:ARB:EDIT:PROTect:ALL</b>	
Example	<b>SOUR1:ARB:EDIT:PROT:ALL</b>	

**SOURce[1|2|3]:ARB:EDIT:UNProtect**      Source Specific Command

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

Syntax	<b>SOURce[1 2 3]:ARB:EDIT:UNProtect</b>
--------	---

Example	<b>SOUR1:ARB:EDIT:UNP</b>
---------	---------------------------

<b>SOURce[1 2 3]:ARB:NCYCles</b>	Source Specific Command
----------------------------------	-------------------------

Description	The arbitrary waveform output can be repeated for a designated number of cycles.
-------------	--

Syntax	<b>SOURce[1 2 3]:ARB:NCYCles {&lt; #cycles&gt;  INFinity MINimum  MAXimum}</b>
--------	--

Parameter	<# cycles>	1~16384 cycles
	INFinity	Sets the number of cycles to continuous.
	MINimum	Sets the number of cycles to the minimum allowed.
	MAXimum	Sets the number of cycles to the maximum allowed.

Example	<b>SOUR1:ARB:NCYC INF</b>
---------	---------------------------

Sets the number of ARB waveform output cycles to continuous (infinite).

Query Syntax	<b>SOURce[1 2 3]:ARB:NCYCles? [MINimum MAXimum]</b>
--------------	---

Return Parameter	<NR3>	Returns the number of cycles.
	INF	INF is returned if the number of cycles is continuous.

Example	<b>SOUR1:ARB:NCYC?</b>
---------	------------------------

**+1.0000E+02**

The number of ARB waveform output cycles is returned (100).

<b>SOURce[1 2]:ARB:OUTPut:MARKer</b>	Source Specific Command
--------------------------------------	-------------------------

Description	Define a section of the arbitrary waveform for marker output. The marker is output from the trigger terminal on the rear panel.
-------------	---

Syntax	<b>SOURce[1 2]:ARB:OUTPut:MARKer</b> <b>[&lt;STARt&gt;[,&lt;LENGth&gt;]]</b>	
Parameter	<STARt>	Start address*: 0~16384
	<LENGth>	Length*: 0 ~ 16384
	* Start + Length ≤ currently output arbitrary waveform	
Example	<b>SOUR1:ARB:OUTP:MARK 1000,1000</b>  The marker output is for a start address of 1000 with a length of 1000.	

<b>SOURce[1 2 3]:ARB:OUTPut</b>		Source Specific Command
Description	Output the current arbitrary waveform in volatile memory. A specified start and length can also be designated.	
Syntax	<b>SOURce[1 2 3]:ARB:OUTPut [&lt;STARt&gt;[,&lt;LENGth&gt;]]</b>	
Parameter	<STARt>	Start address*: 0~16384
	<LENGth>	Length*: 0 ~ 16384
	* Start + Length ≤ currently output arbitrary waveform	
Example	<b>SOUR1:ARB:OUTP 20,200</b>  Outputs the current arbitrary waveform in memory.	

## COUNTER

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

COUNTER:STATE		Instrument Command
Description	Turns the frequency counter function on or off.	
Syntax	<b>COUNter:STATe {ON OFF}</b>	
Parameter/ Return Parameter	1	ON
	0	OFF
Example	<b>COUNter:STATe ON</b> Turns the frequency counter on	
Query Syntax	<b>COUNter:STATe?</b>	
Example	<b>COUNter:STATe?</b>  1  Turns on the frequency counter.	

COUNter:GATe		Instrument Command
Description	Sets the gate time for the frequency counter.	
Syntax	<b>COUNter:GATe {0.01 0.1 1 10}</b>	
Return Parameter	0.01	Gate time of 0.01 seconds
	0.1	Gate time of 0.1 seconds
	1	Gate time of 1 seconds
	10	Gate time of 10 seconds
Example	<b>COUNter:GATe 1</b> Sets the gate time to 1s.	
Syntax	<b>COUNter:GATe? {max min}</b>	
Example	<b>COUNter:GATe?</b>	

+1.000E+00

Returns the gate time: 1s.

COUNter:VALue?		Instrument Command
Description	Returns the current value from the frequency counter.	
Syntax	COUNter:VALue?	
Example	<b>COUNter:VALue?</b> +5.00E+02 Returns the frequency as 500Hz.	

## PHASE

The phase command remotely controls the phase and channel synchronization.

**SOURCE[1|2|pulse]:PHASe** Instrument Command

Description	Sets the phase.	
Syntax	<b>SOURce[1 2 pulse]:PHASe {&lt;phase&gt; &lt;MIN&gt; &lt;MAX&gt;}</b>	
Parameter	phase	-180~180
	min	Sets the phase to the minimum value.
	max	Sets the phase to the maximum value.
Example	<b>SOURce1:PHASe 25</b> Sets the phase of channel 1 to 25°.	
Query Syntax	<b>SOURce[1 2 pulse]:PHASe? {MAX MIN}</b>	
Return Parameter	<NRf>	Returns the current phase in degrees.
Example	<b>SOURce1:PHASe?</b> +2.500E+01 Returns the phase of channel 1 as 25°.	

**SOURce[1|2|pulse]:PHASe:SYNChronize** Instrument Command

Description	Synchronizes the phase of channel 1 and channel 2.
Syntax	<b>SOURce[1 2 pulse]:PHASe:SYNChronize</b>
Example	<b>SOURce1:PHASe:SYNChronize</b> Synchronizes the phase of channel 1



## COUPLE

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

**SOURce[1|2]:FREQuency:COUPle:MODE** Instrument Command

Description	Set the frequency coupling mode.	
Syntax	<b>SOURce[1 2]:FREQuency:COUPle:MODE {Off Offset Ratio}</b>	
Return/ Return parameter	Off	Disables frequency coupling.
	Offset	Set frequency coupling to offset mode.
	Ratio	Sets frequency coupling to ratio mode.
Example	<b>SOURce1:FREQuency:COUPle:MODE Offset</b> Sets the frequency coupling mode to offset.	
Query Syntax	<b>SOURce[1 2]:FREQuency:COUPle:MODE?</b>	
Example	<b>SOURce1:FREQuency:COUPle:MODE?</b> Off Frequency coupling is turned off.	

**SOURce[1|2]:FREQuency:COUPle:OFFSet** Instrument Command

Description	Sets the offset frequency when the frequency coupling mode is set to offset.	
Syntax	<b>SOURce[1 2]:FREQuency:COUPle:OFFSet {frequency}</b>	
Example	<b>SOURce1:FREQuency:COUPle:OFFSet 2khz</b> Sets the offset frequency to 2kHz (the frequency of CH2 minus CH1 is 2kHz).	
Syntax	<b>SOURce[1 2]:FREQuency:COUPle:OFFSet?</b>	
Example	<b>SOURce1:FREQuency:COUPle:OFFSet?</b>	

+2.000000000000E+03

The offset of channel 2 from channel 1 is 2kHz.

<b>SOURce[1 2]:FREQuency:COUPle:RATio</b>		Instrument Command
Description	Sets the frequency coupling ratio when frequency coupling is set to ratio mode.	
Syntax	<b>SOURce[1 2]:FREQuency:COUPle:RATio {ratio}</b>	
Example	<b>SOURce1:FREQuency:COUPle:RATio 2</b> Set the frequency ratio of CH2:CH1 as 2:1.	
Query Syntax	<b>SOURce[1 2]:FREQuency:COUPle:RATio?</b>	
Example	<b>SOURce1:FREQuency:COUPle:RATio?</b> +1.666000E+00 Returns the CH2 to CH1 frequency ratio as 2.	

<b>SOURce[1 2]:AMPlitude:COUPle:STATe</b>		Instrument Command
Description	Enables or disables the amplitude coupling.	
Syntax	<b>SOURce[1 2]:AMPlitude:COUPle:STATe {ON   Off}</b>	
Example	<b>SOURce1:AMPlitude:COUPle:STATe on</b>	
Description	Turns amplitude coupling on.	
Query Syntax	<b>SOURce[1 2]:AMPlitude:COUPle:STATe?</b>	
Return Parameter	1	ON
	0	Off
Example	<b>SOURce1:AMPlitude:COUPle:STATe?</b> 1 Amplitude coupling has been enabled.	

SOURCE[1 2]:TRACK		Instrument Command
Description	Turns tracking on or off.	
Syntax	SOURCE[1 2]:TRACK {ON OFF INVERTed}	
Parameter/ Return Parameter	ON	ON
	OFF	OFF
	INVERTed	INVERTed
Example	SOURCE1:TRACK ON  Turns tracking on. Channel 2 will “track” the changes of channel 1.	
Query Syntax	SOURCE[1 2]:TRACK?	
Example	SOURCE1:TRACK?  ON  Channel tracking is turned on.	

## Save and Recall Commands

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

<b>*SAV</b>		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	<b>*SAV {0 1 2 3 4 5 6 7 8 9}</b>	
Example	<b>*SAV 0</b> Save the instrument state to memory location 0.	

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

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

MEMory:STATe:DELeTe ALL		Instrument Command
Description	Delete memory from all memory locations, 0~9.	
Syntax	<b>MEMory:STATe:DELeTe ALL</b>	
Example	<b>MEM:STAT:DEL ALL</b>  Deletes all the instrument states from memory locations 0~9.	

## Error Messages

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The MFG-2000 has a number of specific error codes. Use the SYSTem:ERRor command to recall the error codes. For more information regarding the error queue.

### Command Error Codes

---

#### -101 Invalid character

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

SOURce1:AM:DEPTh MIN%

#### -102 Syntax error

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

SOURce1:APPL:SQUare , 1

#### -103 Invalid separator

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

APPL:SIN 1 1000 OR SOURce1:APPL:SQUare

#### -108 Parameter not allowed

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

SOURce1:APPL? 10

#### -109 Missing parameter

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

SOURce1:APPL:SQUare

-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 | 2 | 3]: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 16384 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 MFG-2000, 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.

$$|\text{offset}| \leq \text{max amplitude} - V_{pp}/2$$

---

**-221 Settings conflict;amplitude changed due to offset**

---

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

$$V_{pp} \leq 2X (\text{max amplitude} - |\text{offset}|)$$

---

**-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.

SOURce1:FREQuency 60.1MHz.

---

**-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.

SOURce1:FREQuency 0.1μHz.

---

**-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 | 2 | 3]: APPL: USER or SOURce[1 | 2 | 3]: 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 | 2 | 3]: APPL: RAMP or SOURce[1 | 2 | 3]: 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 | 2 | 3]: APPL:PULS or SOURce[1 | 2 | 3]: 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.

$\text{burst period} > 200 \text{ ns} + (\text{burst count} / \text{burst frequency})$ .

---

**-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 trigger source is set to immediate (SOURce[1 | 2 | 3]: 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 | 2 | 3 | 3RF]: 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 (100 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
0.01%~99.99%(>20nS)	Full range

---

**-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 of bytes for a data block.

## SCPI Status Register

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

The function generator has a number of register groups:

Questionable Status Registers

Standard Event Status Registers

Status Byte Register

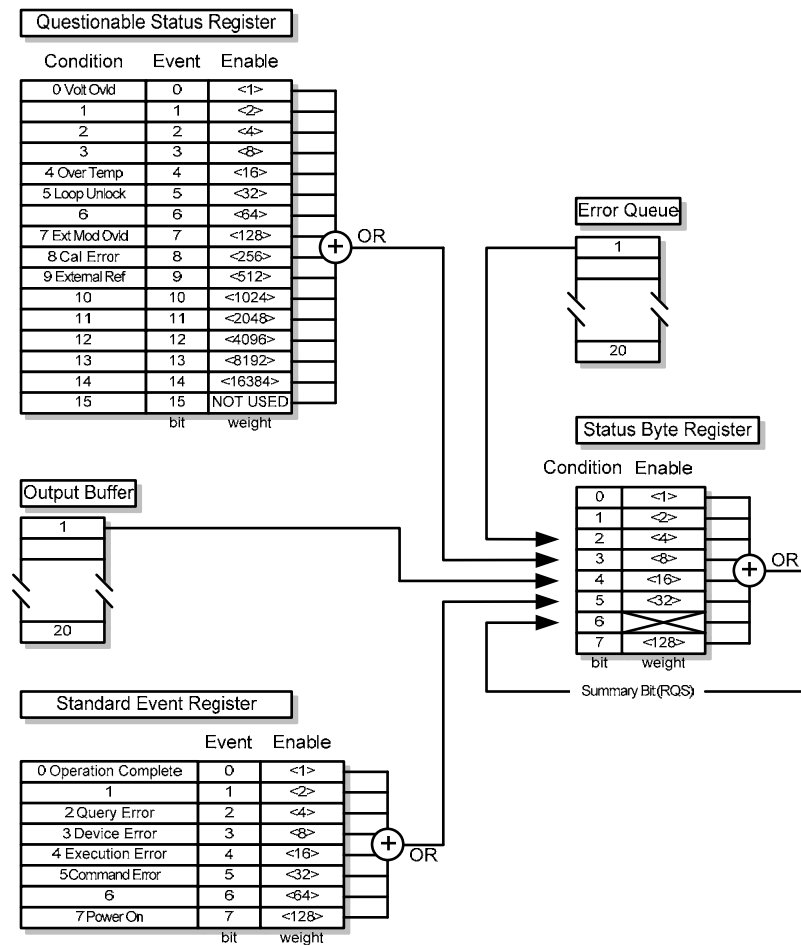
As well as the output and error queues.

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

### Register types

Condition Register	The condition registers indicate the state of the function generator in real time. The condition registers are not triggered. I.e., the bits in the condition register change in real time with the instrument status. Reading a condition register will not clear it. The condition registers cannot be cleared or set.
Event Register	The Event Registers indicate if an event has been triggered in the condition registers. The event registers are latched and will remain set unless the *CLS command is used. Reading an event register will not clear it.
Enable Register	The Enable register determines which status event(s) are enabled. Any status events that are not enabled are ignored. Enabled events are used to summarize the status of that register group.

## MFG-2000 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	<p>The Standard Event Status Enable register is cleared when the *ESE 0 command is used.</p> <p>The Standard Event Status Event register is cleared when the *CLS command or the *ESR? command is used.</p>

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	<p>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.</p> <p>Clearing the events in any of the status registers will clear the corresponding bit in the Status Byte register.</p>		
Notes	<p>The Status byte enable register is cleared when the *SRE 0 command is used.</p> <p>The Status Byte Condition register is cleared when the *CLS command is used.</p>		
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.	



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Standard Event	The Event Status bit is set if an “enabled” event in the Standard Event Status Event Register has occurred.
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Master Summary/Service Request bit	<p>The Master Summary Status is used with the *STB? query. When the *STB? query is read the MSS bit is not cleared.</p> <p>The Request Service bit is cleared when it is polled during a serial poll.</p>
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### Output Queue

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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.
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### Error Queue

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Description	<p>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.</p>
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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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# APPENDIX

The specifications apply when the function generator is powered on for at least 30 minutes under +18°C~+28°C.

## Specifications

MFG-2000 series specific functions						
	CH1	CH2	25MHz Pulse Generator	RF Generator (function with ARB)	Power Amplifier	Modulation /Sweep/Burst/Fr equency.Counter
	Function With 200MSa/sARB	Function With 200MSa/sARB				
MFG-2110	●10MHZ		•			
MFG-2120	●20MHZ		•			
MFG-2120MA	●20MHZ		•		•	•
MFG-2130M	●30MHZ		•			•
MFG-2160MF	●60MHZ		•	●160MHZ		•
MFG-2160MR	●60MHZ		•	●320MHZ		•
MFG-2230M	●30MHZ	●30MHZ	•			•
MFG-2260M	●60MHZ	●60MHZ	•			•
MFG-2260MFA	●60MHZ	●60MHZ	•	●160MHZ	•	•
MFG-2260MRA	●60MHZ	●60MHZ	•	●320MHZ	•	•

### CH1/ CH2

**Waveforms** Standard Sine,Square,Ramp,Pulse,Noise

**Arbitrary Functions** ARB function Built-in

Built-in Arbitrary waveforms, please see page 393.

Absatan,Abssine,Abssinehalf,Ampalt,Attalt,Diric.even,Diric.odd,Gauspuls,Havercosine,Haversin,N\_pulse,Negramp,Rectpuls,Roundhalf,Sawtoot,Sinetra,Sinever,Stair\_down,Stair\_ud,Stair\_up,Stepresp,Traperia,Tripuls,Airy,Bessel,Beta,Gamma,Legendre,Neemann,Arccos,Arccot,Arccsc,Arcsec,Arcsin,Arcsinh,Arctan,Arctanh,Cosh,Cot,Csc,Dlorentz,expofall,exporise,gauss,ln,lorentz,Sec,Sec h,Sinc,Sinh,Sqrt,Tan,Tanh,Xsquare,Barthannwin,Bartlett,Blackman,Bohmanwin,Chebyshev,Flattpowin,Hamming,Hann,Hanning,Kaiser,Triang,Tukeywin

Sample Rate 200 MSa/s

Repetition Rate 100MHz

Waveform Length 16k points

Amplitude Resolution 14 bits

Non-Volatile Memory 10sets 16k points(1)

User-defined output section From point 2~16384 (optional)

	User-defined output marker section	From point 2 ~ 16384(optional)
	Output mode	1~1000000 cycles or infinite mode
Frequency Characteristics		
	Range	Sine 60MHz(max) Square 25MHz(max) Triangle, Ramp 1MHz
	Resolution	1μHz
	Accuracy Stability	±20 ppm
	Aging	±1 ppm, per 1 year
	Tolerance	≤1μHz
Output Characteristics(2)		
	Amplitude Range	1mVpp to 10 Vpp (into 50Ω) 2mVpp to 20 Vpp (open-circuit)
	Accuracy	±2% of setting ±1 mVpp (at 1 kHz/into 50Ω without DC offset))
	Resolution	0.1mV or 4 digits
	Flatness	± 1% (0.1dB) ≤ 1MHz ± 3% (0.3dB) ≤ 50 MHz ± 16% (1.5dB) ≤ 60MHz(6) (sinewave relative to 1 kHz/into 50Ω)
	Units	Vpp, Vrms, dBm
Offset	Range	±5 Vpk ac +dc (into 50Ω) ±10Vpk ac +dc (Open circuit)
	Accuracy	±(1% of setting + 5mV+ 0.5% of amplitude)
Waveform Output		
	Impedance	50Ω typical (fixed) >10MΩ (output disabled)
	Protection	Short-circuit protected Overload relay automatically disables main output
	Ground Isolation	42Vpk max
Sync Output	Range	TTL-compatible into>1kΩ

	Impedance	50Ω standard
	Ground Isolation	42Vpk max
<b>Sine wave Characteristics(3)</b>		
	Harmonic distortion	-60 dBc <200kHz, Ampl>0.1 Vpp -55 dBc 200kHz~1 MHz, Ampl>0.1 Vpp -45 dBc 1MHz~10 MHz, Ampl>0.1Vpp -35 dBc 10MHz~30MHz, Ampl>0.1Vpp -27 dBc 30MHz~60MHz, Ampl>0.1Vpp
	Total harmonic distortion	< 0.1% (Ampl>1Vpp) DC~100 kHz
<b>Square wave Characteristics</b>		
	Rise/Fall Time	<15ns
	Overshoot	<5%
	Asymmetry	1% of period +5 ns
	Variable duty Cycle	0.01% to 99.99%(limited by the current frequency setting)
	Jitter	20ppm+500ps(4)
<b>Ramp Characteristics</b>		
	Linearity	< 0.1% of peak output
	Variable Symmetry	0% to 100%
<b>Pulse Characteristics</b>		
	Frequency	1uHz~25MHz
	Pulse Width	≧ 20nS(limited by the current frequency setting)
	Variable duty Cycle	0.01%~99.99%(limited by the current frequency setting)
	Overshoot	<5%
	Jitter	20ppm+500ps(4)
<b>Pulse Generator</b>		
	Amplitude	1mVpp to 2.5 Vpp (into 50Ω) 2mVpp to 5 Vpp (open-circuit)

	Offset	±1 Vpk ac +dc (into 50Ω) ±2Vpk ac +dc (Open circuit)		
	Frequency	1uHz~25MHz		
	Pulse Width	20nS~999.7ks(limited by the current frequency setting)		
	Variable duty Cycle	0.1%~99.9%(limited by the current frequency setting)		
	Leading and Trailing Edge Time(5)	10nS~20S(1ns resolution) (limited by the current frequency and pulse width settings)		
	Overshoot	<5%		
	Jitter	100ppm+500ps(4)		
RF Generator				
Arbitrary Functions				
	ARB function	Built-in		
	Sample Rate	200 MSa/s		
	Repetition Rate	100MHz		
	Waveform Length	16k points		
	Amplitude Resolution	8 bits		
	User-defined output section	From point 2~16384 (optional)		
	Jitter	20ppm+5ns		
Frequency Characteristics				
	Range	Sine	1uHz~160MHz (MFG-2XXXMF) 1uHz~320MHz (MFG-2XXXMR)	
		Square	25MHz(max)	
		Triangle, Ramp	1MHz	
	Resolutio	1μHz		
	Accuracy Stability	±20 ppm		
	Aging	±1 ppm, per 1 year		
	Tolerance	≤1μHz		
	Output Characteristics(2)			
		Amplitude(into 50Ω)	1mVpp to 2 Vpp (MFG-2XXXMF) 1mVpp to 1 Vpp (MFG-2XXXMR)	

	Accuracy	±2% of setting ±1 mVpp (at 1 kHz/into 50Ω without DC offset))
	Resolution	0.1mV or 4 digits
	Flatness	± 1% (0.1dB) ≤ 1MHz ± 3% (0.3dB) ≤ 50 MHz ± 10% (0.9dB) ≤ 160MHz ± 35% (3.5dB) ≤ 320MHz (sinewave relative to 1 kHz/into 50Ω)
	Offset	±1 Vpk ac +dc (into 50Ω) ±2Vpk ac +dc (Open circuit)
	Waveform Output	Impedance 50Ω typical (fixed) >10MΩ (output disabled)
	Sine wave Characteristics(3)	
	Harmonic Distortion(sine, 1vpp, 50Ω)	-60 dBc <200kHz -55 dBc 200kHz~1 MHz -45 dBc 1MHz~10 MHz -30 dBc 10MHz~320MHz
	Total harmonic distortion	< 0.1% (Ampl>1Vpp) DC~100 kHz
	Square wave Characteristics	
	Rise/Fall Time	<15ns
	Overshoot	<5%
	Asymmetry	1% of period +5 ns
	Variable duty Cycle	0.01% to 99.99%(limited by the current frequency setting)
	Jitter	20ppm+500ps(4)
	Ramp Characteristics	
	Linearity	< 0.1% of peak output
	Variable Symmetry	0% to 100%
	Modulation/ Sweep	
	Modulation Type	AM,ASK,FM,FSK,PM,PSK,PWM (The detail same as CH1 modulation specification)
	Sweep type	Frequency
	Source	INT/EXT (INT only for AM,FM,PM,

		PWM)
<b>PSK</b>	Carrier Waveforms	Sine, Square, Triangle, Ramp,Pulse
	Modulating Waveforms	50% duty cycle square
	Internal Frequency	2mHz to 1 MHz
	Phase Range	0° ~360.0°
	Source	Internal / External
<b>ASK</b>	Carrier Waveforms	Sine, Square, Triangle, Ramp,Pulse
	Modulating Waveforms	50% duty cycle square
	Internal Frequency	2mHz to 1 MHz
	Amplitude Range	0%~100.0%
	Source	Internal / External
<b>Power Amplifier</b>		
	Input Impedance	10KΩ
	Input voltage	1.25Vpmax
	Working Mode	Constant Voltage
	Gain	20dB
	Output Power (RL=8Ω)	20W(Square)
	Output Voltage	12.5Vpmax
	Output Current	1.6Amax
	Rise/Fall Time	<2.5uS
	FullPower Bandwidth	5Hz-100KHz
	Overshoot	5%
	Total harmonic distortion	< 0.1% (Ampl>1Vpp) 20Hz~20 kHz
	Ground Isolation	42Vpk max
<b>Advanced Functions</b>		
<b>AM Modulation</b>		
	Carrier Waveforms	Sine, Square, Triangle, Ramp, Pulse,Arb
	Modulating Waveforms	Sine, Square, Triangle,Upramp, Dnramp
	Modulating Frequency	2mHz to 20kHz (Int)DC to 20kHz (Ext)
	Depth	0% to 120.0%

	Source	Internal / External
<b>FM Modulation</b>	Carrier Waveforms	Sine, Square, Triangle, Ramp
	Modulating Waveforms	Sine, Square, Triangle, Upramp, Dnramp
	Modulating Frequency	2mHz to 20kHz (Int) DC to 20kHz (Ext)
	Peak Deviation	DC to max frequency
	Source	Internal / External
<b>PM Modulation</b>	Carrier Waveforms	Sine, Square, Triangle, Ramp
	Modulating Waveforms	Sine, Square, Triangle, Upramp, Dnramp
	Modulation Frequency	2mHz to 20kHz (Int) DC to 20kHz (Ext)
	Phase deviation	0° ~360.0°
	Source	Internal / External
<b>SUM Modulation</b>	Carrier Waveforms	Sine, Square, Triangle, Ramp
	Modulating Waveforms	Sine, Square, Triangle, Upramp, Dnramp
	Modulation Frequency	2mHz to 20kHz (Int) DC to 20kHz (Ext)
	SUM depth	0%~100.0%
	Source	Internal / External
<b>PWM Modulation</b>	Carrier Waveforms	Sine, Square, Triangle, Ramp
	Modulating Waveforms	Sine, Square, Triangle, Upramp, Dnramp
	Modulation Frequency	2mHz to 20kHz (Int) DC to 20kHz (Ext)
	Phase deviation	0%~100.0% pulse width
	Source	Internal / External
<b>FSK</b>	Carrier Waveforms	Sine, Square, Triangle, Ramp, Pulse
	Modulating Waveforms	50% duty cycle square
	Internal Frequency	2mHz to 1 MHz



	Frequency Range	1μHz to max frequency
	Source	Internal / External
<b>Sweep</b>		
	Waveforms	Sine, Square, Triangle, Ramp
	Type	Linear or Logarithmic
	Sweep direction	Sweep up or sweep down
	Start/Stop Freq	1uHz to max frequency
	Sweep Time	1ms to 500s
	Source	Internal / External
	Trigger	Single, External, Internal.
	Marker	Marker signal on falling edge(programmable)
	Source	Internal / External
<b>Burst</b>		
	Waveforms	Sine, Square, Triangle, Ramp
	Frequency	Max Frequency 25MHz
	Pulse count	1~1000000 Cycles or infinite
	Start/ Stop Phase	-360.0° ~+360.0°
	Internal Frequency	1 us~500 s
	Gate source	External Trigger
	Trigger Source	Single, External, Internal.
<b>Trigger Delay</b>	NCycle, Infinite	0s~100 s
<b>External Trigger Input</b>		
	Type	For FSK, Burst, Sweep
	Input Level	TTL Compatibility
	Slope	Rising or Falling(Selectable)
	Pulse Width	>100ns
	Input Impedance	10kΩ, DC coupled
<b>External Modulation Input</b>		
	Type	For AM,FM, PM,SUM,PWM
	Voltage Range	±5V full scale
	Input Impedance	10kΩ
	Frequency	DC to 20kHz
	Ground Isolation	42Vpk max
<b>Trigger Output</b>		
	Type	For ARB,Burst,Sweep

<b>Frequency Counter</b>	Level	TTL Compatible into 50Ω
	Pulse Width	>16ns
	Maximum Rate	25MHz
	Fan-out	≥4 TTL Load
	Impedance	50Ω Typical
	Range	5Hz to 150MHz
	Accuracy	Time Base accuracy±1count
	Time Base	±20ppm (23 °C ±5 °C)
	Resolution	The maximum resolution is: 100nHz for 1Hz, 0.1Hz for 100MHz.
<b>Dual Channel Function (CH1/CH2)</b>	Input Impedance	1kΩ/1pf
	Sensitivity	35mVrms ~ 30Vrms (5Hz to 150MHz)
	Ground Isolation	42Vpk max
	Phase	-180° ~180°
		Synchronize phase
	Track	CH2=CH1
	Coupling	Frequency(Ratio or Difference)
		Amplitude & DC Offset
	Dsolk	√
<b>Save/Recall</b>		10 Groups of Setting Memories
<b>Interface</b>		LAN, USB
<b>Display</b>		4.3" TFT LCD 480 × 3 (RGB) × 272
<b>General Specifications</b>		
	Power Source	AC100~240V, 50~60Hz or AC100~120V, AC220~240V, 50~60Hz
	Power Consumption	30W or 80W (With power amplifier)
	Operating Environment	Temperature to satisfy the specification : 18 ~ 28 °C

	Operating temperature :
	0 ~ 40 °C
	Relative Humidity:
	≤ 80%, 0 ~ 40 °C
	≤70%, 35 ~ 40 °C
	Installation category : CAT II
Operating Altitude	2000 Meters
Pollution Degree	IEC 61010 degree 2, Indoor use
Storage Temperature	-10~70 °C, Humidity: ≤70%
Dimensions (WxHxD)	266(W) x 107(H) x 293(D) mm
Weight	Approx. 2.5kg
Safety designed to	EN61010-1
Accessories	GTL-101× 1 (MFG-21XX) GTL-101× 2 (MFG-22XX) Quick Start Guide ×1 CD (user manual + software) ×1 Power cord×1

- (1). A total of ten waveforms can be stored. (Every waveform can be composed of a maximum of 16k points.)
- (2). Add 1/10th of output amplitude and offset specification per °C for operation outside of 0°C to 28°C range (1-year specification).
- (3). DC offset set to zero,
- (4). Jitter specification for RF Generator: 20ppm+5ns.
- (5). Only Pluse channel support
- (6). Only one channel output

## EC Declaration of Conformity

We

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**GOOD WILL INSTRUMENT (SUZHOU) CO., LTD.**

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declares that the below mentioned product

**MFG-2110, MFG-2120, MFG-2120MA, MFG-2130M, MFG-2230M, MFG-2260M, MFG-2160MF, MFG-2260MFA, MFG-2160MR, MFG-2260MRA**

Are here with confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Law of Member States relating to Electromagnetic Compatibility (2004/108/EC&2014/30/EU) and Low Voltage Equipment Directive EMC: 2014/30/EU, LVD: 2014/35/EU, WEEE: 2012/19/EU and RoHS: 2011/65/EU. For the evaluation regarding the Electromagnetic Compatibility and Low Voltage Equipment Directive, the following standards were applied:

### ◎ EMC

EN 61326-1: EN 61326-2-1:	Electrical equipment for measurement, control and laboratory use — EMC requirements (2013)
Conducted and Radiated Emissions EN 55011: 2009+A1:2010	Electrostatic Discharge EN 61000-4-2: 2009
Current Harmonic EN 61000-3-2: 2014	Radiated Immunity EN 61000-4-3: 2006+A1 : 2008+A2:2010
Voltage Fluctuation EN 61000-3-3: 2013	Electrical Fast Transients IEC 61000-4-4: 2012
-----	Surge Immunity EN 61000-4-5: 2006
-----	Conducted Susceptibility EN 61000-4-6: 2014
-----	Power Frequency Magnetic Field EN 61000-4-8: 2010
-----	Voltage Dips/ Interrupts IEC 61000-4-11: 2004

### ◎ Safety

Low Voltage Equipment Directive 2014/35/EU
Safety Requirements EN 61010-1: 2010(Third Edition)

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