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1 Programming Overview

By using USB and LAN interfaces, in combination with NI-VISA and programming languages, users can remotely control the waveform generator. Through LAN interface, VXI-11, Sockets and Telnet protocols can be used to communicate with the instruments. This chapter introduces how to build communication between the instrument and the PC. It also introduces how to configure a system for remote instrument control.

1.1 Build communication via VISA

1.1.1 Install NI-VISA

Before programming, please make sure that you have properly installed the latest version of National Instruments NI-VISA Software.

NI-VISA is a communication library that enables computer communications to instrumentation. There are two available VISA packages: A full version and the Run-Time Engine. The full version includes NI device drivers and a tool named NI MAX; a user interface to control the device. While the drivers and NI MAX can be useful, they are not required for remote control. The Run-Time Engine is a much smaller file and is recommended for remote control.

For convenience, you can obtain the latest version of the NI-VISA run-time engine or full version from the National Instruments website. The installation process is similar for both versions.

Follow these steps to install NI-VISA (The full version of NI-VISA 5.4 is used in this example):

a. Download the appropriate version of NI-VISA (the Run-time engine is recommended)

b. Double click the visa540_full.exe, dialog shown as below:
c. Click Unzip, the install process will launch after unzipping files. If your computer needs to install the .NET Framework 4, it may auto start.

d. The NI-VISA install dialog is shown above. Click Next to start the installation process.
e. Set the install path, default path is "C:\Program Files\National Instruments\", you can change it, if you prefer. Click Next, dialog as shown above.

f. Click Next twice, in the License Agreement dialog, select the "I accept the above 2 License Agreement(s).", and click Next, dialog as shown below:
g. Click Next to begin installation.

h. Now the installation is complete. Reboot your PC.
1.1.2 Connect the instrument

Depending on the specific model, the arbitrary waveform generator may be able to communicate with a PC through the USB or LAN interface.

Connect the arbitrary waveform generator and the USB Host interface of the PC using a USB cable. Assuming your PC is already turned on, turn on the SDG, and then the PC will display the “Device Setup” screen as it automatically installs the device driver as shown below.

![Device Setup](image)

Wait for the installation to complete and then proceed to the next step.
1.2 Remote Control

1.2.1 User-defined Programming

Users can send SCPI commands via a computer to program and control the arbitrary waveform generator. For details, refer to the introductions in "Programming Examples".

1.2.2 Using SCPI via NI-MAX

NI-MAX is a program created and maintained by National Instruments. It provides a basic remote control interface for VXI, LAN, USB, GPIB, and Serial communications. The SDG can be controlled remotely by sending SCPI commands via NI-MAX.

1.2.3 Using SCPI over Telnet

Telnet provides a means of communicating with the SDG over the LAN. The Telnet protocol sends SCPI commands to the SDG from a PC and is similar to communicating with the SDG over USB. It sends and receives information interactively: one command at a time. The Windows operating systems use a command prompt style interface for the Telnet client. The steps are as follows:

1. On your PC, click Start > All Programs > Accessories > Command Prompt.

2. At the command prompt, type in `telnet`.

3. Press the Enter key. The Telnet display screen will be displayed.
4. At the Telnet command line, type:

```
open XXX.XXX.XXX.XXX 5024
```

Where `XXX.XXX.XXX.XXX` is the instrument’s IP address and 5024 is the port. You should see a response similar to the following:

5. At the SCPI> prompt, input the SCPI commands such as `*IDN?` to return the company name, model number, serial number, and firmware version number.
6. To exit the SCPI> session, press the Ctrl+ keys simultaneously.

7. Type \textit{quit} at the prompt or close the Telnet window to close the connection to the instrument and exit Telnet.

\section*{1.2.4 Using SCPI over Socket}

Socket API can be used to control the SDG series by LAN without installing any other libraries. This can reduce the complexity of programming.

\begin{tabular}{|l|l|}
\hline
\textbf{SOCKET ADDRESS} & IP address + port number \\
\textbf{IP ADDRESS} & SDG IP address \\
\textbf{PORT NUMBER} & 5025 \\
\hline
\end{tabular}

Please see section 4.2 "Examples of Using Sockets" for the details.
2 Introduction to the SCPI Language

2.1 About Commands & Queries

This section lists and describes the remote control commands and queries recognized by the instrument. All commands and queries can be executed in either local or remote state.

Each command or query, with syntax and other information, has some examples listed. The commands are given in both long and short format at “COMMAND SYNTAX” and “QUERY SYNTAX”, and the subject is indicated as a command or query or both. Queries perform actions such as obtaining information, and are recognized by the question mark (?) following the header.

2.2 Description

In the description, a brief explanation of the function performed is given. This is followed by a presentation of the formal syntax, with the header given in Upper-and-Lower-Case characters and the short form derived from it in ALL UPPER-CASE characters. Where applicable, the syntax of the query is given with the format of its response.

2.3 Usage

The commands and queries listed here can be used for SDGxxxx Series Arbitrary Waveform Generators.

2.4 Command Notation

The following notations are used in the commands:

&lt;&gt; Angular brackets enclose words that are used as placeholders, of which there are two types: the header path and the data parameter of a command.

:= A colon followed by an equals sign separates a placeholder, from the description of the type and range of values that may be used in a command instead of the placeholder.

{} Braces enclose a list of choices, one of which must be made.

[] Square brackets enclose optional items.

… An ellipsis indicates that the items both to its left and right may be repeated for a
## 2.5 Table of Command & Queries

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<tr>
<th>Short</th>
<th>Long Form</th>
<th>Subsystem</th>
<th>What Command/Query does</th>
</tr>
</thead>
<tbody>
<tr>
<td>*IDN</td>
<td>*IDN</td>
<td>SYSTEM</td>
<td>Gets identification from device.</td>
</tr>
<tr>
<td>*OPC</td>
<td>*OPC</td>
<td>SYSTEM</td>
<td>Gets or sets the OPC bit (0) in the Event Status Register (ESR).</td>
</tr>
<tr>
<td>*RST</td>
<td>*RST</td>
<td>SYSTEM</td>
<td>Initiates a device reset.</td>
</tr>
<tr>
<td>CHDR</td>
<td>COMM_HEADER</td>
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<td>Sets or gets the command returned format</td>
</tr>
<tr>
<td>OUTP</td>
<td>OUTPUT</td>
<td>SIGNAL</td>
<td>Sets or gets the output state.</td>
</tr>
<tr>
<td>BSWV</td>
<td>BASIC_WAVE</td>
<td>SIGNAL</td>
<td>Sets or gets the basic wave parameters.</td>
</tr>
<tr>
<td>MDWV</td>
<td>MODULATEWAVE</td>
<td>SIGNAL</td>
<td>Sets or gets the modulation parameters.</td>
</tr>
<tr>
<td>SWWV</td>
<td>SWEEPWAVE</td>
<td>SIGNAL</td>
<td>Sets or gets the sweep parameters.</td>
</tr>
<tr>
<td>BTWV</td>
<td>BURSTWAVE</td>
<td>SIGNAL</td>
<td>Sets or gets the burst parameters.</td>
</tr>
<tr>
<td>PACP</td>
<td>PARACOPY</td>
<td>SIGNAL</td>
<td>Copies parameters from one channel to the other.</td>
</tr>
<tr>
<td>ARWV</td>
<td>ARBWAVE</td>
<td>DATA</td>
<td>Changes arbitrary wave type.</td>
</tr>
<tr>
<td>SYNC</td>
<td>SYNC</td>
<td>SIGNAL</td>
<td>Sets or gets the synchronization signal.</td>
</tr>
<tr>
<td>NBFM</td>
<td>NUMBER_FORMAT</td>
<td>SYSTEM</td>
<td>Sets or gets the data format.</td>
</tr>
<tr>
<td>LAGG</td>
<td>LANGUAGE</td>
<td>SYSTEM</td>
<td>Sets or gets the language.</td>
</tr>
<tr>
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<td>SYS_CFG</td>
<td>SYSTEM</td>
<td>Sets or gets the power-on system setting way.</td>
</tr>
<tr>
<td>BUZZ</td>
<td>BUZZER</td>
<td>SYSTEM</td>
<td>Sets or gets the buzzer state.</td>
</tr>
<tr>
<td>SCSV</td>
<td>SCREEN_SAVE</td>
<td>SYSTEM</td>
<td>Sets or gets the screen save state.</td>
</tr>
<tr>
<td>ROSC</td>
<td>ROSCILLATOR</td>
<td>SIGNAL</td>
<td>Sets or gets the state of clock source.</td>
</tr>
<tr>
<td>FCNT</td>
<td>FREQCOUNTER</td>
<td>SIGNAL</td>
<td>Sets or gets the frequency counter parameters.</td>
</tr>
<tr>
<td>INVT</td>
<td>INVERT</td>
<td>SIGNAL</td>
<td>Sets or gets the polarity of current channel.</td>
</tr>
<tr>
<td>COUP</td>
<td>COUPLING</td>
<td>SIGNAL</td>
<td>Sets or gets the coupling parameters.</td>
</tr>
<tr>
<td>VOLTPRT</td>
<td>VOLTPRT</td>
<td>SYSTEM</td>
<td>Sets or gets the state of over-voltage protection.</td>
</tr>
<tr>
<td>STL</td>
<td>STORELIST</td>
<td>SIGNAL</td>
<td>Lists all stored waveforms.</td>
</tr>
<tr>
<td>WVDT</td>
<td>WVD T</td>
<td>SIGNAL</td>
<td>Sets and gets the arbitrary wave data.</td>
</tr>
<tr>
<td>VKEY</td>
<td>VIRTUALKEY</td>
<td>SYSTEM</td>
<td>Sets the virtual keys.</td>
</tr>
<tr>
<td>SYST:CO</td>
<td>SYSTEM:COMMUNI</td>
<td>SYSTEM</td>
<td>The Command can set and get system IP address.</td>
</tr>
<tr>
<td>SYST:CO</td>
<td>SYSTEM:COMMUNI</td>
<td>SYSTEM</td>
<td>The Command can set and get system</td>
</tr>
<tr>
<td>SYST:CO</td>
<td>SYSTEM:COMMUNI</td>
<td>SYSTEM</td>
<td></td>
</tr>
<tr>
<td>Short</td>
<td>Long Form</td>
<td>Subsystem</td>
<td>What Command/Query does</td>
</tr>
<tr>
<td>-------</td>
<td>-----------</td>
<td>-----------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>SRATE</td>
<td>SAMPLERATE</td>
<td>SIGNAL</td>
<td>Sets or gets the arbitrary wave mode, sampling rate and interpolation method.</td>
</tr>
<tr>
<td>HARM</td>
<td>HARMonic</td>
<td>SIGNAL</td>
<td>Sets or gets the harmonic information.</td>
</tr>
<tr>
<td>CMBN</td>
<td>CoMBiNe</td>
<td>SIGNAL</td>
<td>Sets or gets the wave combine information.</td>
</tr>
<tr>
<td>MODE</td>
<td>MODE</td>
<td>SIGNAL</td>
<td>Sets or gets the waveform phase mode.</td>
</tr>
<tr>
<td>CASCADE</td>
<td>CASCADE</td>
<td>SYSTEM</td>
<td>Set up multi-device synchronization.</td>
</tr>
<tr>
<td>IQ:CENT</td>
<td>IQ:CENTERfreq</td>
<td>SIGNAL</td>
<td>Sets the I/Q modulator center frequency.</td>
</tr>
<tr>
<td>IQ:SAMP</td>
<td>IQ:SAMPLerate</td>
<td>SIGNAL</td>
<td>Sets the I/Q sample rate.</td>
</tr>
<tr>
<td>IQ:SYMB</td>
<td>IQ:SYMBOLrate</td>
<td>SIGNAL</td>
<td>Sets the I/Q symbol rate.</td>
</tr>
<tr>
<td>IQ:AMPL</td>
<td>IQ:AMPLitude</td>
<td>SIGNAL</td>
<td>Sets the I/Q amplitude.</td>
</tr>
<tr>
<td>IQ:IQAD:G AIN</td>
<td>IQ:IQADjustment:GAIN</td>
<td>SIGNAL</td>
<td>Adjusts the ratio of I to Q while preserving the composite.</td>
</tr>
<tr>
<td>IQ:IQAD:I OFF</td>
<td>IQ:IQADjustment:I OFFSET</td>
<td>SIGNAL</td>
<td>Adjusts the I channel offset value.</td>
</tr>
<tr>
<td>IQ:IQAD:Q OFF</td>
<td>IQ:IQADjustment:Q OFFSET</td>
<td>SIGNAL</td>
<td>Adjusts the I channel offset value.</td>
</tr>
<tr>
<td>IQ:IQAD:Q SK</td>
<td>IQ:IQADjustment:QSKew</td>
<td>SIGNAL</td>
<td>Adjusts the phase angle between the I and Q vectors by increasing or decreasing the Q phase angle.</td>
</tr>
<tr>
<td>IQ:TRIG:S OUR</td>
<td>IQ:TRIGger:SOUR ce</td>
<td>SIGNAL</td>
<td>Sets the I/Q trigger source.</td>
</tr>
<tr>
<td>IQ:WAVE: BUIL</td>
<td>IQ:WAVEload:BUILD</td>
<td>SIGNAL</td>
<td>Selects the I/Q wave from built in wave list.</td>
</tr>
<tr>
<td>IQ:WAVE: USER</td>
<td>IQ:WAVEload:USERStored</td>
<td>SIGNAL</td>
<td>Select the I/Q wave from user stored waveforms.</td>
</tr>
</tbody>
</table>
3 Commands and Queries

3.1 IEEE 488.2 Common Command Introduction

The IEEE standard defines the common commands used for querying the basic information of the instrument or executing basic operations. These commands usually start with "***" and the length of the keywords of the command is usually 3 characters.

3.1.1 *IDN

**DESCRIPTION**
The *IDN? query causes the instrument to identify itself. The response is comprised of the manufacturer, model, serial number and firmware version.

**QUERY SYNTAX**
*IDN?

**RESPONSE FORMAT**
Format 1: *IDN, <device id>,<model>,<serial number>,<firmware version>, <hardware version>

Format 2: <manufacturer>,<model>,<serial number>,<firmware version>

<device id>:= “SDG”.
<manufacturer>:= “Siglent Technologies”.
<model>:= A model identifier less than 14 characters, should not contain the word “MODEL”.
<serial number>:= The serial number.
<firmware version>:= The firmware version number.
<hardware version>:= The hardware level field, containing information about all separately revisable subsystems.

**EXAMPLE**
Reads version information:
*IDN?
Return:
*IDN?
Siglent Technologies,SDG6052X, SDG6XBAX1R0034, 6.01.01.28 (It may differ from each version)

**Notes:**
1. The table below shows the available response format of the command in each SDG
Programming Guide

2. Format of `<hardware version>`: value1-value2-value3-value4-value5.
   value1: PCB version.
   value2: Hardware version.
   value3: Hardware subversion.
   value4: FPGA version.
   value5: CPLD version.

3.1.2 *OPC

**DESCRIPTION**
The *OPC (Operation Complete) command sets the OPC bit (bit 0) in the standard Event Status Register (ESR). This command has no other effect on the operation of the device because the instrument starts parsing a command or query only after it has completely processed the previous command or query. The *OPC? query always responds with the ASCII character 1 because the device only responds to the query when the previous command has been entirely executed.

**COMMAND SYNTAX**
*OPC

**QUERY SYNTAX**
*OPC?

**RESPONSE FORMAT**
Format 1: *OPC 1
Format 2: 1

Note: The table below shows the available response format of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter /command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X /X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Format</td>
<td>Format1</td>
<td>Format1</td>
<td>Format2</td>
<td>Format1</td>
<td>Format2</td>
<td>Format2</td>
</tr>
</tbody>
</table>
3.1.3 *RST

**DESCRIPTION**
The *RST command initiates a device reset and recalls the default setup.

**COMMAND SYNTAX**
*RST

**EXAMPLE**
This example resets the signal generator to the default setup:
*RST

3.2 Comm_Header Command

**DESCRIPTION**
This command is used to change the query command returned format. “SHORT” parameter returns short format. “LONG” parameter returns long format. “OFF” returns nothing.

**COMMAND SYNTAX**
Comm_HeaDeR <parameter>
<parameter>:= {SHORT,LONG,OFF}.

**QUERY SYNTAX**
Comm_HeaDeR?

**RESPONSE FORMAT**
CHDR <parameter>

**EXAMPLE**
Set query command format to long:
CHDR LONG

Read query command format:
CHDR?
Return:
COMM_HEADER LONG

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter /command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X /X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHDR</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>
3.3 Output Command

**DESCRIPTION**
This command enables or disables the output port(s) at the front panel. The query returns “ON” or “OFF” and “LOAD”, “PLRT”, “RATIO” parameters.

**COMMAND SYNTAX**

```
<channel>:OUTP ON|OFF,LOAD,<load>,PLRT,<polarity>
```

- `<channel>`: {C1, C2}.
- `<load>`: {see the note below}. The unit is ohm.
- `<polarity>`: {NOR, INVT}, in which NOR refers to normal, and INVT refers to invert.

NoiseSum: to add noise to the channel with specified signal-to-noise ratio.

```
<channel>:NOISE_ADD STATE,ON|OFF,RATIO,<S/N>.
```

or

```
<channel>:NOISE_ADD STATE,ON|OFF,RATIO_DB,<S/N(dB)>
```

- `<S/N>`: `{2.1-100000000}`.
- `<S/N(dB)>`: `{3.24886-80}`.

Max Amplitude Output: to limit the maximum amplitude output.

```
<channel>:BSWV MAX_OUTPUT_AMP, <Amplitude>
```

- `<Amplitude>`: `{1-20}`, Maximum output amplitude peak-to-peak voltages.

**QUERY SYNTAX**

```
<channel>:OUTP?
<channel>:NOISE_ADD?
<channel>:BSWV?
```

**EXAMPLE**

Turn on CH1:

```
C1:OUTP ON
```

Read CH1 output state:

```
C1:OUTP?
```

Return:

```
C1:OUTP ON,LOAD,HZ,PLRT,NOR
```

Set the load of CH1 to 50 ohm:

```
C1:OUTP LOAD,50
```

Set the load of CH1 to HiZ:
Set the polarity of CH1 to normal: 
*C1:OUTP PLRT,NOR*

Turn on NoiseSum and set the signal-to-noise ratio: 
*C1:NOISE_ADD STATE,ON,RATIO,120*

Set the maximum output amplitude: 
*C1:BSWV MAX_OUTPUT_AMP,5*

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter /command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X /X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;channel&gt;</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>LOAD</td>
<td>50, HZ</td>
<td>50~10000, HZ</td>
<td>50~100000, HZ</td>
<td>50, HZ</td>
<td>50~100000, HZ</td>
<td>50~100000, HZ</td>
</tr>
</tbody>
</table>

* "HZ" refers to High Z.*

## 3.4 Basic Wave Command

**DESCRIPTION**

This command sets or gets the basic wave parameters.

**COMMAND SYNTAX**

<channel>:BaSic_WaVe <parameter>,<value>
<channel>:= {C1, C2}.
<parameter>:= {a parameter from the table below}.
<value>:= {value of the corresponding parameter}.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WVTP</td>
<td>&lt;type&gt;</td>
<td>:= {SINE, SQUARE, RAMP, PULSE, NOISE, ARB, DC, PRBS, IQ}. If the command doesn’t set basic waveform type, WVPT will be set to the current waveform.</td>
</tr>
<tr>
<td>FRQ</td>
<td>&lt;frequency&gt;</td>
<td>:= frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values. Not valid when WVTP is NOISE or DC.</td>
</tr>
<tr>
<td>PERI</td>
<td>&lt;period&gt;</td>
<td>:= period. The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values. Not valid when WVTP is NOISE or DC.</td>
</tr>
<tr>
<td>AMP</td>
<td>&lt;amplitude&gt;</td>
<td>:= amplitude. The unit is volts, peak-to-peak &quot;Vpp&quot;. Refer to the data sheet for the range of valid values. Not valid when WVTP is NOISE or DC.</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>OFST</td>
<td>&lt;offset&gt; := offset. The unit is volts “V”. Refer to the data sheet for the range of valid values. Not valid when WVTP is NOISE.</td>
<td></td>
</tr>
<tr>
<td>SYM</td>
<td>&lt;symmetry&gt; := (0 to 100). Symmetry of RAMP. The unit is “%”. Only settable when WVTP is RAMP.</td>
<td></td>
</tr>
<tr>
<td>DUTY</td>
<td>&lt;duty&gt; := (0 to 100). Duty cycle. The unit is “%”. Value depends on frequency. Only settable when WVTP is SQUARE or PULSE.</td>
<td></td>
</tr>
<tr>
<td>PHSE</td>
<td>&lt;phase&gt; := (0 to 360). The unit is &quot;degree&quot;. Not valid when WVTP is NOISE, PULSE or DC.</td>
<td></td>
</tr>
<tr>
<td>STDEV</td>
<td>&lt;stdev&gt; := standard deviation of NOISE. The unit is volts “V”. Refer to the data sheet for the range of valid values. Only settable when WVTP is NOISE.</td>
<td></td>
</tr>
<tr>
<td>MEAN</td>
<td>&lt;mean&gt; := mean of NOISE. The unit is volts &quot;V&quot;. Refer to the data sheet for the range of valid values. Only settable when WVTP is NOISE.</td>
<td></td>
</tr>
<tr>
<td>WIDTH</td>
<td>&lt;width&gt; := positive pulse width. The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values. Only settable when WVTP is PULSE.</td>
<td></td>
</tr>
<tr>
<td>RISE</td>
<td>&lt;rise&gt; := rise time (10%~90%). The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values. Only settable when WVTP is PULSE.</td>
<td></td>
</tr>
<tr>
<td>FALL</td>
<td>&lt;fall&gt; := fall time (90%~10%). The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values. Only settable when WVTP is PULSE.</td>
<td></td>
</tr>
<tr>
<td>DLY</td>
<td>&lt;delay&gt; := pulse delay. The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values. Only settable when WVTP is PULSE.</td>
<td></td>
</tr>
<tr>
<td>HLEV</td>
<td>&lt;high level&gt; := high level. The unit is volts &quot;V&quot;. Not valid when WVTP is NOISE or DC.</td>
<td></td>
</tr>
<tr>
<td>LLEV</td>
<td>&lt;low level&gt; := low level. The unit is volts &quot;V&quot;. Not valid when WVTP is NOISE or DC.</td>
<td></td>
</tr>
<tr>
<td>BANDSTATE</td>
<td>&lt;bandwidth switch &gt; := (ON, OFF). Only settable when WVTP is NOISE.</td>
<td></td>
</tr>
<tr>
<td>BANDWIDTH</td>
<td>&lt;bandwidth value&gt; := noise bandwidth. The unit is Hertz “Hz”. Refer to the data sheet for the range of valid values. Only settable when WVTP is NOISE.</td>
<td></td>
</tr>
<tr>
<td>LENGTH</td>
<td>&lt;prbs length&gt; := (3~32). Actual PRBS length = 2(^{LENGTH} \times 1). Only settable when WVTP is PRBS.</td>
<td></td>
</tr>
<tr>
<td>EDGE</td>
<td>&lt;prbs rise/fall&gt; := rise/fall time of PRBS. The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values. Only settable when WVTP is PRBS.</td>
<td></td>
</tr>
<tr>
<td>DIFFSTATE</td>
<td>&lt;prbs&gt; := (ON, OFF). State of PRBS differential mode. Only</td>
<td></td>
</tr>
</tbody>
</table>
**QUERY SYNTAX**

<channel>: BaSic_WaVe?
<channel>:= {C1, C2}.

**RESPONSE FORMAT**

<channel>-.BSWV <parameter>
<parameter>:= {All the parameters of the current basic waveform}.

**EXAMPLE**

Change the waveform type of C1 to Ramp:

C1:BSWV WVTP,RAMP

Change the frequency of C1 to 2000 Hz:

C1:BSWV FRQ,2000

Set the amplitude of C1 to 3 Vpp:

C1:BSWV AMP,3

Return parameters of C1 from the device:

C1:BSWV?

Return:

C1:BSWV WVTP,SINE,FRQ,100HZ,PERI,0.01S,AMP,2V,OFST,0V,HLEV,1V,LLEV,-1V,PHSE,0

Set noise bandwidth of C1 to 100 MHz:

C1:BSWV BANDWIDTH,100E6

or

C1:BSWV BANDWIDTH,100000000

Set output amplitude of C1 to 3dBm:

C1:BSWV AMPDBM,3

Set the logic level of C1 to TTL_CMOS:

C1:BSWV LOGICLEVEL,TTL_CMOS

**Notes:**
1. The table below shows the availability of some command parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000 X</th>
<th>SDG5000</th>
<th>SDG1000 X</th>
<th>SDG6000 X</th>
<th>SDG6000 X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;channel&gt;</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>RISE</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>FALL</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>DLY</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>BANDSTATE</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>BANDWIDTH</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>LENGTH</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>EDGE</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>DIFFSTATE</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>BITRATE</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>LOGICLEVEL</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>AMPDBM</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

2. In SDG1000X if Wave Combine is enabled, WVTP cannot be set to SQUARE.

### 3.5 Modulate Wave Command

**DESCRIPTION**

This commend sets or gets the modulation parameters.

**COMMAND SYNTAX**

```
<channel>:MoDulateWaVe <type>
<channel>:MoDulateWaVe <parameter>,<value>
<channel>:={C1, C2}
```

- `<type>`: `{AM,DSBAM,FM,PM,PWM,ASK,FSK,PSK}`.
- `<parameter>`: `{a parameter from the table below}`.
- `<value>`: `{value of the corresponding parameter}`.
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATE</td>
<td>&lt;state&gt;</td>
<td>:= {ON, OFF}. Enable or disable modulation. STATE must be set to ON before you set or read other parameters of the modulation.</td>
</tr>
<tr>
<td>AM, SRC</td>
<td>&lt;src&gt;</td>
<td>:= {INT, EXT}. AM signal source.</td>
</tr>
<tr>
<td>AM, MDSP</td>
<td>&lt;mod wave shape&gt;</td>
<td>:= {SINE, SQUARE, TRIANGLE, UPRAMP, DNRAMP, NOISE, ARB}. AM modulation wave. Only settable when SRC is INT.</td>
</tr>
<tr>
<td>AM, FRQ</td>
<td>&lt;AM frequency&gt;</td>
<td>:= AM frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values. Only settable when SRC is INT.</td>
</tr>
<tr>
<td>AM, DEPTH</td>
<td>&lt;depth&gt;</td>
<td>:= {0 to 120}. AM depth. The unit is &quot;%&quot;. Only settable when SRC is INT.</td>
</tr>
<tr>
<td>DSBAM, SRC</td>
<td>&lt;src&gt;</td>
<td>:= {INT, EXT}. DSBAM signal source.</td>
</tr>
<tr>
<td>DSBAM, MDSP</td>
<td>&lt;mod wave shape&gt;</td>
<td>:= {SINE, SQUARE, TRIANGLE, UPRAMP, DNRAMP, NOISE, ARB}. DSB AM modulation wave. Only settable when SRC is INT.</td>
</tr>
<tr>
<td>DSBAM, FRQ</td>
<td>&lt;DSB-AM frequency&gt;</td>
<td>:= DSB AM frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values. Only settable when SRC is INT.</td>
</tr>
<tr>
<td>FM, SRC</td>
<td>&lt;src&gt;</td>
<td>:= {INT, EXT}. FM signal source.</td>
</tr>
<tr>
<td>FM, MDSP</td>
<td>&lt;mod wave shape&gt;</td>
<td>:= {SINE, SQUARE, TRIANGLE, UPRAMP, DNRAMP, NOISE, ARB}. FM modulation wave. Only settable when SRC is INT.</td>
</tr>
<tr>
<td>FM, FRQ</td>
<td>&lt;FM frequency&gt;</td>
<td>:= FM frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values. Only settable when SRC is INT.</td>
</tr>
<tr>
<td>FM, DEVI</td>
<td>&lt;FM frequency deviation&gt;</td>
<td>:= {0 to carrier frequency}. FM frequency deviation. The value depends on the difference between the carrier frequency and the bandwidth frequency. Only settable when signal source is INT.</td>
</tr>
<tr>
<td>PM, SRC,</td>
<td>&lt;src&gt;</td>
<td>:= {INT, EXT}. PM signal source.</td>
</tr>
<tr>
<td>PM, MDSP</td>
<td>&lt;mod wave shape&gt;</td>
<td>:= {SINE, SQUARE, TRIANGLE, UPRAMP, DNRAMP, NOISE, ARB}. PM modulation wave. Only settable when SRC is INT.</td>
</tr>
<tr>
<td>PM, FRQ</td>
<td>&lt;PM frequency&gt;</td>
<td>:= PM frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values. Only settable when SRC is INT.</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
<td>Range/Unit</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>PM, DEVI</td>
<td>PM phase deviation. The unit is &quot;degree&quot;. Only settable when SRC is INT.</td>
<td>[0 to 360]</td>
</tr>
<tr>
<td>PWM, SRC</td>
<td>PWM signal source.</td>
<td>[INT, EXT]</td>
</tr>
<tr>
<td>PWM, FRQ</td>
<td>PWM frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values. Only settable when SRC is INT.</td>
<td></td>
</tr>
<tr>
<td>PWM, DEVI</td>
<td>Duty cycle deviation. The unit is &quot;%&quot;. Value depends on the carrier duty cycle.</td>
<td></td>
</tr>
<tr>
<td>PWM, MDSP</td>
<td>PWM modulation wave. Only settable when SRC is INT.</td>
<td>[SINE, SQUARE, TRIANGLE, UPRAMP, DNRAMP, NOISE, ARB]</td>
</tr>
<tr>
<td>ASK, SRC</td>
<td>ASK signal source.</td>
<td>[INT, EXT]</td>
</tr>
<tr>
<td>ASK, KFRQ</td>
<td>ASK key frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values. Only settable when SRC is INT.</td>
<td></td>
</tr>
<tr>
<td>FSK, SRC</td>
<td>FSK signal source.</td>
<td>[INT, EXT]</td>
</tr>
<tr>
<td>FSK, KFRQ</td>
<td>FSK key frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values. Only settable when SRC is INT.</td>
<td></td>
</tr>
<tr>
<td>FSK, HFRQ</td>
<td>FSK hop frequency. The same with basic wave frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values.</td>
<td></td>
</tr>
<tr>
<td>PSK, SRC</td>
<td>PSK signal source.</td>
<td>[INT, EXT]</td>
</tr>
<tr>
<td>PSK, KFRQ</td>
<td>PSK key frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values. Only settable when SRC is INT.</td>
<td></td>
</tr>
<tr>
<td>CARR, WVTP</td>
<td>Carrier waveform type.</td>
<td>[SINE, SQUARE, RAMP, ARB, PULSE]</td>
</tr>
<tr>
<td>CARR, FRQ</td>
<td>Carrier frequency. The unit is Hertz &quot;Hz&quot;. Refer to the data sheet for the range of valid values.</td>
<td></td>
</tr>
<tr>
<td>CARR, PHSE</td>
<td>Carrier phase. The unit is &quot;degree&quot;.</td>
<td>[0 to 360]</td>
</tr>
<tr>
<td>CARR, AMP</td>
<td>Carrier amplitude. The unit is volts, peak-to-peak &quot;Vpp&quot;. Refer to the data sheet for the range of valid values.</td>
<td></td>
</tr>
<tr>
<td>CARR, OFST</td>
<td>Carrier offset. The unit is volts &quot;V&quot;. Refer to the data sheet for the range of valid values.</td>
<td>[0 to 100]</td>
</tr>
<tr>
<td>CARR, DUTY</td>
<td>Carrier duty cycle when the carrier is SQUARE or PULSE. The unit is &quot;%&quot;.</td>
<td>[0 to 100]</td>
</tr>
</tbody>
</table>

CARR, RISE $<\text{rise}>$ := rise time when the carrier is PULSE. The unit is seconds “s”. Refer to the data sheet for the range of valid values.

CARR, FALL $<\text{fall}>$ := fall time when the carrier is PULSE. The unit is seconds “s”. Refer to the data sheet for the range of valid values.

CARR, DLY $<\text{delay}>$ := pulse delay when the carrier is PULSE. The unit is seconds “s”. Refer to the data sheet for the range of valid values.

Notes:
1. Modulation is not available if the carrier wave is Noise.
2. Range of some parameters depends on the model. Refer to the data sheet for details.

**QUERY SYNTAX**

```
<channel>:MoDulateWaVe?
<channel>:={C1, C2}.
```

**RESPONSE FORMAT**

```
<channel>:MDWV <parameter>
<parameter>:= {all parameters of the current modulation}.
```

**EXAMPLE**

Set CH1 modulation state to on:

```
C1:MDWV STATE,ON
```

Set CH1 modulation type to AM:

```
C1:MDWV AM
```

Set modulation to AM, and the modulating wave type to sine wave:

```
C1:MDWV AM,MDSP,SINE
```

Read CH1 modulation parameters when STATE is ON:

```
C1:MDWV?
```

Return:

```
C1:MDWV AM,STATE,ON,MDSP,SINE,SRC,INT,FRQ,100HZ,
DEPTH,100,CARR,WVTP,RAMP,FRQ,1000HZ,AMP,4V,
AMPVRMS,1.15473Vrms,OFST,0V,PHSE,0,SYM,50
```

Read CH1 modulate wave parameters when STATE is OFF:

```
C1:MDWV?
```

Return:

```
C1:MDWV STATE,OFF
```
Set CH1 FM frequency to 1000 Hz:
*C1:MDWV FM,FREQ,1000*

Set CH1 carrier to SINE:
*C1:MDWV CARR,WVTP,SINE*

Set CH1 carrier frequency to 1000 Hz:
*C1:MDWV CARR,FREQ,1000*

Note: The table below shows the availability of some command parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;channel&gt;</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>&lt;type&gt;, SRC</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CARR, DLY</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CARR, RISE</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CARR, FALL</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

<type>:= {AM, FM, PM, FSK, ASK, PSK, DSBAM, PWM}.

### 3.6 Sweep Wave Command

**DESCRIPTION**

This command sets or gets the sweep parameters.

**COMMAND SYNTAX**

<channel>:SweepWave <parameter>,<value>
<channel>:= {C1, C2}
<parameter>:= {a parameter from the table below}
<value>:= {value of the corresponding parameter}

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATE</td>
<td>&lt;state&gt;:= {ON, OFF}. Enable or disable sweep. STATE must be set to ON before you set or read other parameters of the sweep.</td>
<td></td>
</tr>
<tr>
<td>TIME</td>
<td>&lt;time&gt;:= sweep time. The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values.</td>
<td></td>
</tr>
<tr>
<td>START</td>
<td>&lt;start_freq&gt;:= start frequency. The same with basic wave frequency. The unit is Hertz &quot;Hz&quot;.</td>
<td></td>
</tr>
<tr>
<td>STOP</td>
<td>&lt;stop_freq&gt;:= stop frequency. The same with basic wave frequency. The unit is Hertz &quot;Hz&quot;.</td>
<td></td>
</tr>
<tr>
<td>SWMD</td>
<td>&lt;sweep_mode&gt;:= {LINE, LOG}, in which LINE refers to Linear and</td>
<td></td>
</tr>
</tbody>
</table>
LOG refers to Logarithmic.

DIR <direction> ::= {UP, DOWN}. Sweep direction.

TRSR <trig_src> ::= {EXT, INT, MAN}. Trigger source. EXT refers to External, INT refers to Internal and MAN refers to Manual.

MTRIG ::= send a manual trigger. Only valid when TRSR is MAN.

TRMD <trig_mode> ::= {ON, OFF}. State of trigger output. If TRSR is EXT, the parameter is invalid.

EDGE <edge> ::= {RISE, FALL}. Available trigger edge. Only valid when TRSR is EXT or MAN.

CARR, WVTP <wave type> ::= {SINE, SQUARE, RAMP, ARB}. Carrier waveform type. Modulation is not available if the carrier is PULSE, NOISE or DC.

CARR, FRQ <frequency> ::= carrier frequency. The unit is Hertz "Hz". Refer to the data sheet for the range of valid values.

CARR, PHSE <phase> ::= {0 to 360}. Carrier phase. The unit is "degree".

CARR, AMP <amplitude> ::= carrier amplitude. The unit is volts, peak-to-peak "Vpp". Refer to the data sheet for the range of valid values.

CARR, OFST <offset> ::= carrier offset. The unit is volts "V". Refer to the data sheet for the range of valid values.

CARR, SYM <symmetry> ::= {0 to 100}. Carrier symmetry when the carrier is RAMP. The unit is "%".

CARR, DUTY <duty> ::= {0 to 100}. Carrier duty cycle when the carrier is SQUARE. The unit is "%".

MARK_STATE <state> ::= {ON, OFF}.

MARK_FREQ <frequency> ::= mark frequency. The unit is Hertz "Hz". The range is from the start frequency to the stop frequency.

QUERY SYNTAX
<channel>:SWeepWaVe?
<channel>:= {C1, C2}.

RESPONSE FORMAT
<channel>:SWWV <parameter>
<parameter>:= {All parameters of the current sweep wave}.

EXAMPLE
Set CH1 sweep state to ON:
C1:SWEPW STATE,ON

Set CH1 sweep time to 1 s:
C1:SWEPW TIME,1
Set CH1 stop frequency to 1000 Hz:

\[ C1:SWWV \text{ STOP,}1000 \]

Set trigger source of CH1 to Manual:

\[ C1:SWWV \text{ TRSR,}\text{MAN} \]

Send a manual trigger to CH1:

\[ C1:SWWV \text{ MTRIG} \]

Read CH2 sweep parameters when STATE is ON:

\[ C2:SWWV \]

Return:

\[ C2:SWWV \text{ STATE,ON,}1\text{S,STOP,}100\text{HZ,START,}100\text{HZ,} \text{TRSR,MAN,TRMD,OFF,SWMD,LINE,DIR,UP,CARR,WVTP,} \]
\[ \text{SQUARE,FRQ,}1000\text{HZ,AMP,}4\text{V,OFST,}0\text{V,DUTY,}50,\text{PHSE,}0 \]

Read CH2 sweep parameters when STATE is OFF:

\[ C2:SWWV \]

Return:

\[ C2:SWWV \text{ STATE,OFF} \]

Set CH1 the FreqMarker of sweep to 1kHz

\[ C1:SWWV \text{ MARK\_STATE,ON,MARK\_FREQ,}1000 \]

Note: The table below shows the availability of some command parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X /X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;channel&gt;</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRMD</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>EDGE</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

### 3.7 Burst Wave Command

**DESCRIPTION**

This commend sets or gets the burst wave parameters.

**COMMAND SYNTAX**

\[ <\text{channel}>:\text{BurstTWaVe} <\text{parameter}>,<\text{value}> \]

\[ <\text{channel}>:=\{C1, C2\}. \]

\[ <\text{parameter}>::=\{\text{a parameter from the table below}\}. \]

\[ <\text{value}>::=\{\text{value of the corresponding parameter}\}. \]

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATE</td>
<td>&lt;state&gt;</td>
<td>:= {ON, OFF}. Enable or disable burst.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STATE must be set to ON before you set or read other</td>
</tr>
</tbody>
</table>
parameters of the burst.

**PRD** <period>: burst period. Refer to the data sheet for the range of valid values. The unit is seconds "s". Not valid when:
- Carrier is NOISE
- GATENCYC is GATE (except "X" series)
- TRSR is EXT

**STPS** <start_phase>: {0 to 360}. Start phase of the carrier. The unit is "degree". Not valid when the carrier is NOISE or PULSE.

**GATENCYC** <burst_mode>: {GATE, NCYC}. Burst mode. Not valid when the carrier is NOISE.

**TRSR** <trig_src>: {EXT, INT, MAN}. Trigger source. EXT refers to External, INT refers to Internal and MAN refers to Manual.

**MTRIG** := send a manual trigger. Only when TRSR is MAN, the parameter is valid.

**DLAY** <delay>: trigger delay. The unit is seconds "s". Refer to the data sheet for the range of valid values. Available when GATENCYC is NCYC. Not valid when the carrier is NOISE.

**PLRT** <polarity>: {NEG, POS}. Gate polarity. Negative or Positive.

**TRMD** <trig_mode>: {RISE, FALL, OFF}. Trigger out mode. Available when GATENCYC is NCYC and TRSR is INT or MAN. Not valid when the carrier is NOISE.

**EDGE** <edge>: {RISE, FALL}. Available trigger edge. Only valid when TRSR is EXT or MAN.

**EDGE** <edge>: {RISE, FALL}. Available trigger edge. Available when GATENCYC is NCYC and TRSR is EXT. Not valid when the carrier is NOISE.

**TIME** <circle_time>: {INF, 1, 2, ..., M}, where M is the maximum supported Ncycle number which depends on the model; INF sets the burst to Infinite mode. Available when GATENCYC is NCYC. Not valid when the carrier is NOISE.

**CARR, WVTP** <wave_type>: {SINE, SQUARE, RAMP, ARB, PULSE, NOISE}. Carrier waveform type.

**CARR, FRQ** <frequency>: carrier frequency. The unit is Hertz "Hz". Refer to the data sheet for the range of valid values.

**CARR, PHSE** <phase>: {0 to 360}. Carrier phase. The unit is "degree".

**CARR, AMP** <amplitude>: carrier amplitude. The unit is volts, peak-to-peak "Vpp". Refer to the data sheet for the range of valid values.
### Programming Guide

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Valid Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARR, OFST</td>
<td>Carrier Offset</td>
<td>= carrier offset. The unit is volts &quot;V&quot;. Refer to the data sheet for the range of valid values.</td>
</tr>
<tr>
<td>CARR, SYM</td>
<td>Carrier Symmetry</td>
<td>= {0 to 100}. Carrier symmetry when the carrier is RAMP. The unit is &quot;%&quot;.</td>
</tr>
<tr>
<td>CARR, DUTY</td>
<td>Carrier Duty</td>
<td>= {0 to 100}. Carrier duty cycle when the carrier is SQUARE or PULSE. The unit is &quot;%&quot;.</td>
</tr>
<tr>
<td>CARR, RISE</td>
<td>Rise Time</td>
<td>= rise time when the carrier is PULSE. The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values.</td>
</tr>
<tr>
<td>CARR, FALL</td>
<td>Fall Time</td>
<td>= fall time when the carrier is PULSE. The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values.</td>
</tr>
<tr>
<td>CARR, DLY</td>
<td>Pulse Delay</td>
<td>= pulse delay when the carrier is PULSE. The unit is seconds &quot;s&quot;. Refer to the data sheet for the range of valid values.</td>
</tr>
<tr>
<td>CARR, STDEV</td>
<td>Standard Deviation</td>
<td>= standard deviation of NOISE. The unit is volts &quot;V&quot;. Refer to the data sheet for the range of valid values.</td>
</tr>
<tr>
<td>CARR, MEAN</td>
<td>Mean</td>
<td>= mean of NOISE. The unit is volts &quot;V&quot;. Refer to the data sheet for the range of valid values.</td>
</tr>
</tbody>
</table>

### QUERY SYNTAX

```
<channel>:BTWV(BursTWaVe)?
<channel>:{C1, C2}
```

### RESPONSE FORMAT

```
<channel>:BTWV <parameter>
<parameter>:={All parameters of the current burst wave.}
```

### EXAMPLE

Set CH1 burst state to ON

```
C1:BTWV STATE,ON
```

Set CH1 burst period to 1 s.

```
C1:BTWV PRD,1
```

Set CH1 burst delay to 1 s

```
C1:BTWV DLAY,1
```

Set CH1 burst to infinite

```
C1:BTWV TIME,INF
```

Read CH2 burst parameters when the STATE is ON.

```
C2:BTWV?
```

Return:

```
C2:BTWV STATE,ON,PRD,0.01S,STPS,0,TRSR,INT,
```
Read CH2 burst parameters when the STATE is OFF.

C2:BTWV?

Return:

C2:BTWV STATE,OFF

Note: The table below shows the availability of some command parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;channel&gt;</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRMD</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>EDGE</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CARR, DLY</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CARR, RISE</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CARR, FALL</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

3.8 Parameter Copy Command

**DESCRIPTION**

This command copies parameters from one channel to another.

**COMMAND SYNTAX**

ParaCoPy <destination_channel>,<src_channel>
<destination_channel>:= {C1, C2}.
<src_channel>:= {C1, C2}.

Note: The parameters C1 and C2 must be set to the device together.

**EXAMPLE**

Copy parameters from CH1 to CH2.

PACP C2,C1

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>PACP</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

3.9 Arbitrary Wave Command

**DESCRIPTION**

This command sets and gets the arbitrary waveform type.

Note: The index number in the command syntax and the response
format of query omit the character ‘M’, and directly uses the value to represent the index number.

**COMMAND SYNTAX**

- `<channel>:ArbWaVe INDEX,<index>`
- `<channel>:ArbWaVe NAME,<name>`
- `<channel>:= {C1, C2}`.
- `<index>`: the index of the arbitrary waveform from the table below.
- `<name>`: the name of the arbitrary waveform from the table below.

**QUERY SYNTAX**

- `<channel>:ARbWaVe?`
- `<channel>:= {C1, C2}`.

**RESPONSE FORMAT**

- `<channel>:ARWV INDEX,<index>,NAME,<name>`

**EXAMPLE**

Set CH1 current waveform by index 2:

`C1:ARWV INDEX,2`

Read CH1 current waveform:

`C1:ARWV?`

Return:

`C1:ARWV INDEX,2,NAME,StairUp`

Set CH1 current waveform to wave_1 by name.

`C1:ARWV NAME,wave_1`

**RELATED COMMANDS**

**STL**

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Index</th>
<th>Name</th>
<th>Index</th>
<th>Name</th>
<th>Index</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Sine</td>
<td>12</td>
<td>Logfall</td>
<td>24</td>
<td>Gmonopuls</td>
<td>36</td>
<td>Triang</td>
</tr>
<tr>
<td>1</td>
<td>Noise</td>
<td>13</td>
<td>Logrise</td>
<td>25</td>
<td>Tripuls</td>
<td>37</td>
<td>Harris</td>
</tr>
<tr>
<td>2</td>
<td>StairUp</td>
<td>14</td>
<td>Sqrt</td>
<td>26</td>
<td>Cardiac</td>
<td>38</td>
<td>Bartlett</td>
</tr>
<tr>
<td>3</td>
<td>StairDn</td>
<td>15</td>
<td>Root3</td>
<td>27</td>
<td>Quake</td>
<td>39</td>
<td>Tan</td>
</tr>
<tr>
<td>4</td>
<td>Stairud</td>
<td>16</td>
<td>X^2</td>
<td>28</td>
<td>Chirp</td>
<td>40</td>
<td>Cot</td>
</tr>
<tr>
<td>5</td>
<td>Ppulse</td>
<td>17</td>
<td>X^3</td>
<td>29</td>
<td>Twotone</td>
<td>41</td>
<td>Sec</td>
</tr>
<tr>
<td>6</td>
<td>Npulse</td>
<td>18</td>
<td>Sinc</td>
<td>30</td>
<td>Snr</td>
<td>42</td>
<td>Csc</td>
</tr>
<tr>
<td>7</td>
<td>Trapezia</td>
<td>19</td>
<td>Gaussian</td>
<td>31</td>
<td>Hamming</td>
<td>43</td>
<td>Asin</td>
</tr>
<tr>
<td>8</td>
<td>Upramp</td>
<td>20</td>
<td>Dlorentz</td>
<td>32</td>
<td>Hanning</td>
<td>44</td>
<td>Acos</td>
</tr>
<tr>
<td>9</td>
<td>Dnramp</td>
<td>21</td>
<td>Haversine</td>
<td>33</td>
<td>Kaiser</td>
<td>45</td>
<td>Atan</td>
</tr>
<tr>
<td>10</td>
<td>Exp_fall</td>
<td>22</td>
<td>Lorentz</td>
<td>34</td>
<td>Blackman</td>
<td>46</td>
<td>Acot</td>
</tr>
<tr>
<td>11</td>
<td>Exp_rise</td>
<td>23</td>
<td>Gauspuls</td>
<td>35</td>
<td>Gausswin</td>
<td>47</td>
<td>Square</td>
</tr>
</tbody>
</table>

Note: This table is just an example, the index depends on the specific model. The “STL?” command can be used to get the accurate mapping relationship between the index and name.
3.10 Sync Command

DESCRIPTION
This command sets the synchronization signal.

COMMAND SYNTAX
<channel>:SYNC <state>
<channel>:= {C1, C2}.
<state>:= {ON, OFF}.
SYNC TYPE, <TYPE>
<TYPE>:= {CH1, CH2, MOD_CH1, MOD_CH2}.

QUERY SYNTAX
<channel>:SYNC?
<channel>:= {C1, C2}.

RESPONSE FORMAT
<channel>:SYNC <state>

EXAMPLE
Turn on sync output and set the source as modulating signal of CH1:
C1:SYNC ON, TYPE, MOD_CH1

Read state of CH1 sync.
C1:SYNC?
Return:
C1:SYNC ON, TYPE, MOD_CH1

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;channel&gt;</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>INDEX</td>
<td>yes</td>
<td>yes</td>
<td>yes(only built-in wave)</td>
<td>yes(only built-in wave)</td>
<td>yes(only built-in wave)</td>
<td></td>
</tr>
<tr>
<td>NAME</td>
<td>yes</td>
<td>yes</td>
<td>yes(only user defined wave)</td>
<td>yes(only user defined wave)</td>
<td>yes(only user defined wave)</td>
<td></td>
</tr>
</tbody>
</table>
3.11 Number Format Command

**DESCRIPTION**
This command sets or gets the number format.

**COMMAND SYNTAX**
- NumBer_ForMat PNT,<pnt>,
- NumBer_ForMa SEPT,<sept>
  - <pnt>:= {Dot, Comma}. The point format.
  - <sept>:= {Space, Off, On}. The separator format.

**QUERY SYNTAX**
NBFM?

**RESPONSE FORMAT**
NBFM PNT,<pnt>, SEPT,<sept>

**EXAMPLE**
Set point format to DOT:
NBFM PNT,DOT

Set separator format to ON:
NBFM SEPT,ON

Read the number format:
NBFM?
Return:
NBFM PNT, DOT, SEPT, ON

3.12 Language Command

**DESCRIPTION**
This command sets or gets the system language.

**COMMAND SYNTAX**
- LAnGuage <language>
  - <language>:= {EN, CH, RU}, where EN is English, CH is Chinese Simplified, and RU is Russian.

**QUERY SYNTAX**
LAnGuage?

**RESPONSE FORMAT**
LAGG <language>

**EXAMPLE**
Set language to English:
LAGG EN

Read language
LAGG?
Note: The table below shows the availability of some command parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X /X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>RU</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

3.13 Configuration Command

**DESCRIPTION**
This command sets or gets the power-on system setting.

**COMMAND SYNTAX**
Sys_CFG <mode>
<mode>::= {DEFAULT, LAST}

**QUERY SYNTAX**
Sys_CFG?

**RESPONSE FORMAT**
SCFG <mode>

**EXAMPLE**
Set the power-on system setting to LAST:

```
SCFG LAST
```

3.14 Buzzer Command

**DESCRIPTION**
This command turns on or off the buzzer.

**COMMAND SYNTAX**
BUZZer <state>
<state>::= {ON, OFF}.

**QUERY SYNTAX**
BUZZer?

**RESPONSE FORMAT**
BUZZ <state>

**EXAMPLE**
Turn on the buzzer:

```
BUZZ ON
```
3.15 Screen Save Command

**DESCRIPTION**
This command turns off or sets screen save time (the unit is minutes).

**COMMAND SYNTAX**
```
SCreen_SaVe <parameter>
```

<parameter> := {OFF, 1, 5, 15, 30, 60, 120, 300}.

**QUERY SYNTAX**
```
SCreen_SaVe?
```

**RESPONSE FORMAT**
```
SCSV <parameter>
```

**EXAMPLE**
Set screen save time to 5 minutes:
```
SCSV 5
```

Read the current screen save time:
```
SCreen_SaVe?
```

Return:
```
SCSV 5MIN
```

3.16 Clock Source Command

**DESCRIPTION**
This command sets or gets the clock source.

**COMMAND SYNTAX**
```
ROSCillator <src>
```

<src> := {INT, EXT}

```
ROSC 10MOUT,ON|OFF
```

**QUERY SYNTAX**
```
ROSC?
```

**RESPONSE FORMAT**
```
ROSC <src>,10MOUT,ON|OFF
```

**EXAMPLE**
Set internal time base as the source:
```
ROSC INT
```

Enable 10MHz output:
```
ROSC 10MOUT,ON
```

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X</th>
</tr>
</thead>
</table>

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3.17 Frequency Counter Command

**DESCRIPTION**
This command sets or gets the frequency counter parameters.

**COMMAND SYNTAX**
FreqCounter <parameter>,<value>
<parameter>:= {a parameter from the table below}.
<value>:= {value of the corresponding parameter}.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATE</td>
<td>&lt;state&gt;</td>
<td>:= {ON, OFF} State of frequency counter.</td>
</tr>
<tr>
<td>FRQ</td>
<td>&lt;frequency&gt;</td>
<td>Measured frequency. The unit is Hertz “Hz”. Can’t be set.</td>
</tr>
<tr>
<td>PW</td>
<td>&lt;pos_width&gt;</td>
<td>Measured positive width. The unit is seconds “s”. Can’t be set.</td>
</tr>
<tr>
<td>NW</td>
<td>&lt;neg_width&gt;</td>
<td>Measured negative width. The unit is seconds “s”. Can’t be set.</td>
</tr>
<tr>
<td>DUTY</td>
<td>&lt;duty&gt;</td>
<td>Measured duty cycle. The unit is “%”. Can’t be set.</td>
</tr>
<tr>
<td>FRQDEV</td>
<td>&lt;freq_dev&gt;</td>
<td>Measured frequency deviation. The unit is “ppm”. Can’t be set.</td>
</tr>
<tr>
<td>REFQ</td>
<td>&lt;ref_freq&gt;</td>
<td>Expected frequency, for calculating the frequency deviation. The unit is Hz.</td>
</tr>
<tr>
<td>TRG</td>
<td>&lt;triglev&gt;</td>
<td>Trigger level. The range of valid values depends on the model. The unit is V</td>
</tr>
<tr>
<td>MODE</td>
<td>&lt;mode&gt;</td>
<td>:= {AC, DC} Coupling mode.</td>
</tr>
<tr>
<td>HFR</td>
<td>&lt;HFR&gt;</td>
<td>:= {ON, OFF} State of High Frequency Rejection.</td>
</tr>
</tbody>
</table>

**QUERY SYNTAX**
FreqCounter?

**RESPONSE FORMAT**
FCNT <parameter>
<parameter>:= {All parameters of the frequency counter}

**EXAMPLE**

Turn frequency counter on:
FCNT STATE,ON
Set reference freq to 1000 Hz:
**FCNT REFQ, 1000**

Query frequency counter information:

```
FCNT?
```

Return:

```
FCNT STATE, ON, FRQ, 10000000HZ, DUTY, 59.8568, REFQ, 1e+07HZ, TRG, 0V, PW, 5.98568e-08S, NW, 4.01432e-08S, FRQDEV, 0ppm, MODE, AC, HFR, OFF
```

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCNT</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

### 3.18 Invert Command

**DESCRIPTION**

This command sets or gets the polarity of specified channel.

**COMMAND SYNTAX**

```
<channel>: INVt <state>
```

```
<channel>::={C1, C2}.
```

```
<state>::={ON, OFF}.
```

**QUERY SYNTAX**

```
<channel>: INVt?
```

```
<channel>::={C1, C2}.
```

**RESPONSE FORMAT**

```
<channel>: INVt <state>
```

**EXAMPLE**

Set CH1 polarity to invert

```
C1: INVt ON
```

Read the polarity of CH1.

```
C1: INVt?
```

Return:

```
C1: INVt ON
```

Note: The table below shows the availability of some command parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;channel&gt;</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
### 3.19 Coupling Command

**DESCRIPTION**
This command sets or gets the channel coupling parameters. Only when TRACE is set to OFF, the other coupling parameters can be set.

**COMMAND SYNTAX**
```
COUPling <parameter>,<value>
```

- `<parameter>` := (a parameter from the table below).
- `<value>` := (value of the corresponding parameter).

**Parameters**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACE</td>
<td><code>&lt;track_enable&gt;</code> := {ON, OFF}</td>
<td>State of channel tracking.</td>
</tr>
<tr>
<td>STATE</td>
<td><code>&lt;state&gt;</code> := {ON, OFF}</td>
<td>State of channel coupling.</td>
</tr>
<tr>
<td>BSCH</td>
<td><code>&lt;bsch&gt;</code> := {CH1, CH2}</td>
<td>Base channel.</td>
</tr>
<tr>
<td>FCOUP</td>
<td><code>&lt;fcoup&gt;</code> := {ON, OFF}</td>
<td>State of frequency coupling</td>
</tr>
<tr>
<td>FDEV</td>
<td><code>&lt;frq_dev&gt;</code> := frequency deviation between the 2 channels. The unit is Hertz “Hz”.</td>
<td></td>
</tr>
<tr>
<td>FRAT</td>
<td><code>&lt;frat&gt;</code> := frequency ratio between the 2 channels.</td>
<td></td>
</tr>
<tr>
<td>PCOUP</td>
<td><code>&lt;pcoup&gt;</code> := {ON, OFF}</td>
<td>State of phase coupling</td>
</tr>
<tr>
<td>PDEV</td>
<td><code>&lt;pha_dev&gt;</code> := phase deviation between the 2 channels. The unit is “degree”.</td>
<td></td>
</tr>
<tr>
<td>PRAT</td>
<td><code>&lt;prat&gt;</code> := phase ratio between the 2 channels.</td>
<td></td>
</tr>
<tr>
<td>ACOUP</td>
<td><code>&lt;acoup&gt;</code> := {ON, OFF}</td>
<td>State of amplitude coupling</td>
</tr>
<tr>
<td>ARAT</td>
<td><code>&lt;arat&gt;</code> := amplitude ratio between the 2 channels.</td>
<td></td>
</tr>
<tr>
<td>ADEV</td>
<td><code>&lt;adev&gt;</code> := amplitude deviation between the 2 channels. The unit is volts, peak-to-peak “Vpp”.</td>
<td></td>
</tr>
</tbody>
</table>

**QUERY SYNTAX**
```
COUPling?
```

**RESPONSE FORMAT**
```
COUP <parameter>
```

- `<parameter>` := (All parameters of coupling).

**EXAMPLE**
Set coupling state to ON:
```
COUP STATE, ON
```

Set frequency coupling state to ON:
**COUP FCoup, ON**

Set frequency deviation to 5 Hz:

**COUP FDEV, 5**

Query coupling information.

**COUP?**

Return:

**COUP TRACE, OFF, FCOUP, ON, PCOUP, ON, ACOUP, ON, FDEV, 5HZ, PRAT, 1, ARAT, 2**

Note: The table below shows the availability of the command and some parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUP</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRACE</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>STATE</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>BSCH</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>FCOUP</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>FRAT</td>
<td>no</td>
<td>no</td>
<td>Yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>PCOUP</td>
<td>no</td>
<td>no</td>
<td>Yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>PRAT</td>
<td>no</td>
<td>no</td>
<td>Yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>ACOUP</td>
<td>no</td>
<td>no</td>
<td>Yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>ARAT</td>
<td>no</td>
<td>no</td>
<td>Yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>ADEV</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

### 3.20 Over-Voltage Protection Command

**DESCRIPTION**

This commend sets or gets the state of over-voltage protection.

**COMMAND SYNTAX**

VOLTPRT <state>

<state> := {ON, OFF}

**QUERY SYNTAX**

VOLTPRT?

**RESPONSE FORMAT**

VOLTPRT <state>

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUP</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRACE</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>STATE</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>BSCH</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>FCOUP</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>PRAT</td>
<td>no</td>
<td>no</td>
<td>Yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>ACOUP</td>
<td>no</td>
<td>no</td>
<td>Yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>ARAT</td>
<td>no</td>
<td>no</td>
<td>Yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>ADEV</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
3.21 Store List Command

DESCRIPTION
This command is used to read the stored waveforms list with indexes and names. If the store unit is empty, the command will return “EMPTY” string.

QUERY SYNTAX
SToreList?
SToreList? BUILDIN|USER

EXAMPLE
Read all arbitrary data saved in a SDG1000.
STL?
Return:
    STL M0, sine, M1, noise, M2, stairup, M3, stairdn, M4, stairud, M5, ppulse, M6, npulse, M7, trapezia, M8, upramp, M9, dnramp, M10, exp_fall, M11, exp_rise, M12, logfall, M13, logrise, M14, sqrt, M15, root3, M16, x^2, M17, x^3, M18, sinc, M19, gaussian, M20, dlorentz, M21, haversine, M22, lorentz, M23, gausspuls, M24, gmonopuls, M25, tripluls, M26, cardiac, M27, quake, M28, chirp, M29, twotone, M30, snr, M31, EMPTY, M32, EMPTY, M33, EMPTY, M34, hamming, M35, hanning, M36, kaiser, M37, blackman, M38, gaussiwin, M39, triangle, M40, blackmanharris, M41, bartlet, M42, tan, M43, cot, M44, sec, M45, csc, M46, asin, M47, acos, M48, atan, M49, acot, M50, EMPTY, M51, EMPTY, M52, EMPTY, M53, DDROPOUT, M54, FCLK1, M55, FSDA1, M56, EMPTY, M57, EMPTY, M58, EMPTY, M59, EMPTY

Read built-in wave data from a SDG2000X:
STL? BUILDIN
Return:
ACsch, M136, ACoth, M137, Bartlett, M138, BohmanWin, M139, ChebWin, M14, Sqrt, M140, FlattopWin, M141, ParzenWin, M142, TaylorWin, M143, TukeyWin, M144, SquareDuty01, M145, SquareDuty02, M146, SquareDuty04, M147, SquareDuty06, M148, SquareDuty08, M149, SquareDuty10, M15, Root3, M150, SquareDuty12, M151, SquareDuty14, M152, SquareDuty16, M153, SquareDuty18, M154, SquareDuty20, M155, SquareDuty22, M156, SquareDuty24, M157, SquareDuty26, M158, SquareDuty28, M159, SquareDuty30, M16, X^2, M160, SquareDuty32, M161, SquareDuty34, M162, SquareDuty36, M163, SquareDuty38, M164, SquareDuty40, M165, SquareDuty42, M166, SquareDuty44, M167, SquareDuty46, M168, SquareDuty48, M169, SquareDuty50, M17, X^3, M170, SquareDuty52, M171, SquareDuty54, M172, SquareDuty56, M173, SquareDuty58, M174, SquareDuty60, M175, SquareDuty62, M176, SquareDuty64, M177, SquareDuty66, M178, SquareDuty68, M179, SquareDuty70, M18, Sinc, M180, SquareDuty72, M181, SquareDuty74, M182, SquareDuty76, M183, SquareDuty78, M184, SquareDuty80, M185, SquareDuty82, M186, SquareDuty84, M187, SquareDuty86, M188, SquareDuty88, M189, SquareDuty90, M19, Gaussian, M190, SquareDuty92, M191, SquareDuty94, M192, SquareDuty96, M193, SquareDuty98, M194, SquareDuty99, M195, demo1_375pts, M196, demo1_16kpts, M197, demo2_3kpts, M198, demo2_16kpts, M2, StairUp, M20, Dlorentz, M21, Haversine, M22, Lorentz, M23, Gauspuls, M24, Gmonopuls, M25, Tripuls, M26, Cardiac, M27, Quake, M28, Chirp, M29, Twotone, M3, StairDn, M30, SNR, M31, Hamming, M32, Hanning, M33, kaiser, M34, Blackman, M35, Gausswin, M36, Triangle, M37, Bartlett-Hann, M38, Bartlett, M39, Tan, M4, StairUD, M40, Cot, M41, Sec, M42, Csc, M43, Asin, M44, Acos, M45, Atan, M46, Acot, M47, Square, M48, SineTra, M49, SineVer, M5, Ppulse, M50, AmpALT, M51, AttALT, M52, RoundHalf, M53, RoundsPM, M54, BlaseiWave, M55, DampedOsc, M56, SwingOsc, M57, Discharge, M58, Pahcur, M59, Combin, M6, Npulse, M60, SCR, M61, Butterworth, M62, Chebyshev1, M63, Chebyshev2, M64, TV, M65, Voice, M66, Surge, M67, Radar, M68, Ripple, M69, Gamma, M7, Trapezia, M70, StepResp, M71, BandLimited, M72, CPulse, M73, CW Pulse, M74, GateVibr, M75, LFMPulse, M76, MCNoise, M77, AM, M78, FM, M79, PFM, M8, UpRamp, M80, PM, M81, PWM, M82, EOG, M83, EEG, M84, EMG, M85, Pulseiogram, M86, ResSpeed, M87, ECG1, M88, ECG2, M89, ECG3, M9,
Dnamp, M90, ECG4, M91, ECG5, M92, ECG6, M93, ECG7, M94, ECG8, M95, ECG9, M96, ECG10, M97, ECG11, M98, ECG12, M99, ECG13

Read wave data defined by user from a SDG1000X:

STL? USER

Return:

STL WVNM, sinc_8M, sinc_3000000, sinc_1664000, ramp_8M, sinc_2000000, sinc_50000, square_8M, sinc_5000, wave1, square_1M

Note: The table below shows the availability of some command parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>STL? return</td>
<td>BUILDIN USER</td>
<td>BUILDIN USER</td>
<td>BUILDIN USER</td>
<td>BUILDIN USER</td>
<td>BUILDIN USER</td>
</tr>
<tr>
<td>BUILDIN</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>USER</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

### 3.22 Arb Data Command

**DESCRIPTION**

This command sets and gets the arbitrary waveform data.

**COMMAND SYNTAX**

```
<channel>:WVDT <index>,<parameter>,<value>
<channel>:= {C1, C2}.
<index>:= {Mn}. The waveform index. See note 2 below for the details.
<parameter>:= (a parameter from the table below).
<value>:= (value of the corresponding parameter).
```

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WVNM</td>
<td>&lt;wave_name&gt;</td>
<td>:= waveform name.</td>
</tr>
</tbody>
</table>
| TYPE       | <type> | := {0 to 5}
 0 - common
 1 - math
 2 - engineering
 3 - window
 4 - triangle function
 5 - user defined
 This parameter is not valid for the “X” series. |
**LENGTH**  
<length>  
:= the number of waveform bytes, the valid range depends on the model. See note 1 below for the details.

This parameter is not necessary in the “X” series

**FREQ**  
<frequency>  
:= frequency. The unit is Hertz “Hz”.

**AMPL**  
<amplifier>  
:= amplitude. The unit is volts, peak-to-peak “Vpp”.

**OFST**  
<offset>  
:= offset. The unit is “V”.

**PHASE**  
<phase>  
:= phase. The unit is “degree”.

**WAVEDATA**  
<wave data>  
The wave data needs to be read from a waveform file.

**QUERY SYNTAX**

Format 1: WVDT? Mn

Format 2: WVDT? USER,<wave_name>

<wave name>:= (The name of user defined waveform).

**EXAMPLE**

See section 4.1.5 for the example.

Notes:

1. The table below shows the availability of some command parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X-E</th>
<th>SDG6000X</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPE</strong></td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td><strong>&lt;length&gt;</strong></td>
<td>32KB</td>
<td>32KB</td>
<td>4B~16MB</td>
<td>32KB, 1024KB</td>
<td>4B~16MB</td>
<td>4B~16MB</td>
<td>4B~40MB</td>
</tr>
<tr>
<td><strong>USER</strong></td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

2. The table below shows the details of Mn parameters in each SDG series.

<table>
<thead>
<tr>
<th>Model</th>
<th>Description of Mn</th>
</tr>
</thead>
</table>
| **SDG800** | 0<=n<=59.  
M0~M49: build-in (32KB).  
M50~M59: user-defined (32KB). |
| **SDG1000** | 0<=n<=59.  
M0~M49: build-in (32KB).  
M50~M59: user-defined (32KB). |
| **SDG2000X** | 0<=n<=196.  
M0~M196: build-in (32KB). |
3.23 Virtual Key Command

DESCRIPTION
This command is used to simulate pressing a key on the front panel.

COMMAND SYNTAX
VirtualKEY VALUE,<value>,STATE,<state>
<value> := {a Name or Index of the virtual keys from the table below}.
<state> := {0,1}, where “1” is effective to virtual value, and “0” is useless.

<table>
<thead>
<tr>
<th>Name</th>
<th>Index</th>
<th>Name</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB_FUNC1</td>
<td>28</td>
<td>KB_NUMBER_4</td>
<td>52</td>
</tr>
<tr>
<td>KB_FUNC2</td>
<td>23</td>
<td>KB_NUMBER_5</td>
<td>53</td>
</tr>
<tr>
<td>KB_FUNC3</td>
<td>18</td>
<td>KB_NUMBER_6</td>
<td>54</td>
</tr>
<tr>
<td>KB_FUNC4</td>
<td>13</td>
<td>KB_NUMBER_7</td>
<td>55</td>
</tr>
<tr>
<td>KB_FUNC5</td>
<td>8</td>
<td>KB_NUMBER_8</td>
<td>56</td>
</tr>
<tr>
<td>KB_FUNC6</td>
<td>3</td>
<td>KB_NUMBER_9</td>
<td>57</td>
</tr>
<tr>
<td>KB_SINE</td>
<td>34</td>
<td>KB_POINT</td>
<td>46</td>
</tr>
<tr>
<td>KB_SQUARE</td>
<td>29</td>
<td>KB_NEGATIVE</td>
<td>43</td>
</tr>
<tr>
<td>KB_RAMP</td>
<td>24</td>
<td>KB_LEFT</td>
<td>44</td>
</tr>
<tr>
<td>KB_PULSE</td>
<td>19</td>
<td>KB_RIGHT</td>
<td>40</td>
</tr>
<tr>
<td>KB_NOISE</td>
<td>14</td>
<td>KB_UP</td>
<td>45</td>
</tr>
<tr>
<td>KB_ARB</td>
<td>9</td>
<td>KB_DOWN</td>
<td>39</td>
</tr>
<tr>
<td>KB_MOD</td>
<td>15</td>
<td>KB_OUTPUT1</td>
<td>153</td>
</tr>
<tr>
<td>KB_SWEEP</td>
<td>16</td>
<td>KB_OUTPUT2</td>
<td>152</td>
</tr>
<tr>
<td>KB_BURST</td>
<td>17</td>
<td>KB_KNOB_RIGHT</td>
<td>175</td>
</tr>
<tr>
<td>KB_WAVES</td>
<td>4</td>
<td>KB_KNOB_LEFT</td>
<td>177</td>
</tr>
<tr>
<td>KBUTILITY</td>
<td>11</td>
<td>KB_KNOB_DOWN</td>
<td>176</td>
</tr>
<tr>
<td>KB_PARAMETER</td>
<td>5</td>
<td>KB_HELP</td>
<td>12</td>
</tr>
<tr>
<td>KB_STORE_RECALL</td>
<td>70</td>
<td>KB_CHANNEL</td>
<td>72</td>
</tr>
</tbody>
</table>
Keys and Indices on the SDG1000/SDG800

**EXAMPLE**

`VKEY VALUE,15,STATE,1`

`VKEY VALUE,KB_SWEEP,STATE,1`

Note: The table below shows the availability of some command parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB_FUNC6</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>KB_STORE_RECAL</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>KB_HELP</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>KB_CHANNEL</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>KB_SINE</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>KB_SQUARE</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>KB_RAMP</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>KB_PULSE</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>KB_NOISE</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>KB_ARB</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>KB_UP</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>KB_DOWN</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

**3.24 IP Command**

**DESCRIPTION**

This command sets and gets the system IP address.
**3.25 Subnet Mask Command**

**DESCRIPTION**

This command sets and gets the system subnet mask.

**COMMAND SYNTAX**

```
SYSTem:COMMunicate:LAN:SMASk
"<parameter1>.<parameter2>.<parameter3>.<parameter4>"
```

- `<parameter1>`: = {an integer value between 0 and 255}.
- `<parameter2>`: = {an integer value between 0 and 255}.
- `<parameter3>`: = {an integer value between 0 and 255}.
- `<parameter4>`: = {an integer value between 0 and 255}.

**QUERY SYNTAX**

```
SYSTem:COMMunicate:LAN:SMASk?
```

**EXAMPLES**

Set subnet mask to 255.0.0.0:

```
SYST:COMM:LAN:SMAS “255.0.0.0”
```

Get subnet mask:
SYST:COMM:LAN:SMAS?
Return:
“255.0.0.0”

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYST:COMM:LAN:SMAS</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

3.26 Gateway Command

DESCRIPTION
This command sets and gets the system gateway.

COMMAND SYNTAX
SYSTem:COMMunicate:LAN:GATeway
"<parameter1>.<parameter2>.<parameter3>.<parameter4>"

<parameter1>:= {an integer value between 0 and 223}.
<parameter2>:= {an integer value between 0 and 255}.
<parameter3>:= {an integer value between 0 and 255}.
<parameter4>:= {an integer value between 0 and 255}.

QUERY SYNTAX
SYSTem:COMMunicate:LAN:GATeway?

EXAMPLES
Set Gateway to 10.11.13.5:
SYSTem:COMMunicate:LAN:GATeway “10.11.13.5”

Get gateway:
SYSTem:COMMunicate:LAN:GATeway?
Return:
“10.11.13.5”

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYST:COMM:LAN:GAT</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

3.27 Sampling Rate Command

DESCRIPTION
This command sets or gets the Arb mode, sampling rate and
interpolation method. Sampling rate and interpolation method can only be set when MODE is TARB.

**COMMAND SYNTAX**

```
<channel>:SampleRATE MODE,<mode>,VALUE, <sample rate>,INTER,<interpolation>
```

- `<channel>`:= `<C1, C2>.
- `<mode>`:= {DDS, TARB}, where TARB is TrueArb.
- `<sample rate>`:= sample rate. The unit is Sa/s.
- `<interpolation>`:= {LINE, HOLD, SINC, SINC27, SINC13}, where LINE is linear, and HOLD is zero-order hold. SINC, SINC27 and SINC13 are only for SDG6000X/X-E.

**QUERY SYNTAX**

```
<channel>:SRATE?
```

**EXAMPLES**

Get the sampling rate of CH1:

```
C1:SRATE?
```

Return:

```
C1:SRATE MODE,DDS
```

Set CH1 to TureArb mode:

```
C1:SRATE MODE,TARB
```

Set sampling rate of CH1 to 1000000Sa/s:

```
C1:SRATE VALUE,1000000
```

Set CH1 to TureArb mode and set interpolation to SINC13

```
C1:SRATE MODE,TARB,INTER,SINC13
```

Note: The table below shows the availability of the command and some parameters in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X /X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRATE</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>INTER</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

### 3.28 Harmonic Command

**DESCRIPTION**

This command sets or gets the harmonic parameters. Only available when the basic wave is SINE.

**COMMAND SYNTAX**

```
<channel>:HARMonic HARMSTATE,<state>,HARMTYPE,
```
<type>, HARMORDER, <order>, <unit>, <value>,
HARMPHASE, <phase>

<state> := <ON, OFF>.
<type> := <EVEN, ODD, ALL>.
<order> := {1, 2, ..., M}, where M is the supported maximum order.
<unit> := <HARMAMP, HARMDBC>.
<value> := amplitude of specified harmonic. The range of valid values
depends on the model. When <unit> = HARMAMP, the unit is volts,
peak-to-peak "Vpp", and when <unit> = HARMDBC, the unit is "dBc".
<phase> := {0~360}, the unit is "degree"

QUERY SYNTAX
<channel>:(HARMonic?
<channel> := {C1, C2}.

EXAMPLES
Enable the harmonic function of CH1:
C1:HARM HARMSTATE, ON

Set the 2nd harmonic of CH1 to -6 dBc:
C1:HARM HARMORDER, 2, HARMDBC, -6

Get the harmonic information of CH1:
C1:HARM?
Return:
C1:HARM, HARMSTATE, ON, HARMTYPE, EVEN, HARMORDER, 2, H
ARMAMP, 2.004748935V, HARMDBC, -6dBc, HARMPHASE, 0

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X /X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARM</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

3.29 Waveform Combining Command

DESCRIPTION
This command sets or gets the waveform combining parameters.

COMMAND SYNTAX
<channel>:= CoMBiNe <state>
<channel> := {C1, C2}.
<state> := {ON, OFF}.

QUERY SYNTAX
<channel>:= CoMBiNe?
<channel> := {C1, C2}.
RESPONSE FORMAT  
<channel>:CMBN <state>

EXAMPLES  
Turn on the waveform combining of CH1:  
C1:CMBN ON

Query the waveform combining state of CH2:  
C2:CMBN?  
Return:  
C2:CMBN OFF

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMBN</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

3.30 Mode Select Command

DESCRIPTION  
This command sets or gets the phase mode.

COMMAND SYNTAX  
MODE <parameter>  
<parameter> := {PHASE-LOCKED, INDEPENDENT}.

QUERY SYNTAX  
MODE?

RESPONSE FORMAT  
MODE <parameter>

EXAMPLE  
Set the phase mode to INDEPENDENT:  
MODE INDEPENDENT

Note: The table below shows the availability of the command in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000X</th>
<th>SDG5000</th>
<th>SDG1000X</th>
<th>SDG6000X/X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODE</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

3.31 Multi-Device Sync

DESCRIPTION  
This command set up synchronization between two or more instruments and achieve in-phase output

COMMAND SYNTAX  
CASCADE STATE,ON|OFF,MODE,<MODE>,DELAY,<DELAY>
<MODE>:={MASTER,SLAVE}
<DELAY>:=0-0.000025,UNIT=s. This parameter can only be set in slave mode

QUERY SYNTAX
CASCADE?

RESPONSE FORMAT
Return from SLAVE MODE:
CASCADE STATE,ON,MODE,SLAVE,DELAY, <DELAY>
Return from MASTER mode:
CASCADE STATE,ON,MODE,MASTER

EXAMPLE
Set the device as slave and the delay to 0.0000001s:
CASCADE STATE,ON,MODE,SLAVE,DELAY,0.0000001

3.32 IQ Commands

The table below shows the availability of IQ commands in each SDG series.

<table>
<thead>
<tr>
<th>Parameter/command</th>
<th>SDG800</th>
<th>SDG1000</th>
<th>SDG2000 X</th>
<th>SDG5000 X</th>
<th>SDG1000 X</th>
<th>SDG6000 X</th>
<th>SDG6000 X-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

3.32.1 :IQ:CENTERfreq

DESCRIPTION
This command sets center frequency of the I/Q modulator.

COMMAND SYNTAX
[:SOURce]:IQ:CENTERfreq <center_freq><unit>
<center_freq>:= the center frequency. Refer to the data sheet for the range of valid values.
<unit>:= {Hz, kHz, MHz, GHz}. The default unit is Hertz “Hz”.

QUERY SYNTAX
[:SOURce]:IQ:CENTERfreq?

RESPONSE FORMAT
<center_freq> (expressed in Hz.)

EXAMPLE
Set the center frequency to 1 kHz:
:SOURce:IQ:CENTERfreq 1000Hz
3.32.2 :IQ:SAMPlerate

DESCRIPTION
This command sets the I/Q sampling rate.

COMMAND SYNTAX
[:SOURce]:IQ:SAMPlerate <sample_rate><unit>
<sample_rate>:= sample rate. Refer to the data sheet for the range of valid values.
<unit>:= {Hz, kHz, MHz, GHz}. The default unit is Hertz “Hz”.

QUERY SYNTAX
[:SOURce]:IQ:SAMPlerate?

RESPONSE FORMAT
<sample_rate> (expressed in Hz.)

EXAMPLE
Set the sample rate to 100 kHz:
:IQ:SAMPlerate 1000000
or:
:IQ:SAMP 100kHz

3.32.3 :IQ:SYMBolrate

DESCRIPTION
This command sets the I/Q symbol rate.

COMMAND SYNTAX
[:SOURce]:IQ:SYMBolrate <symb_rate><unit>
<symb_rate>:= symbol rate. Refer to the data sheet for the range of valid values.
<unit>:= {S/s, kS/s, MS/s}. The default unit is symbols-per-second “S/s”.

QUERY SYNTAX
[:SOURce]:IQ:SYMBolrate?

RESPONSE FORMAT
<symb_rate> (expressed in S/s.)

EXAMPLE
Set the symbol rate to 1 MS/s:
:IQ:SYMB 1MS/s

3.32.4 :IQ:AMPLitude

DESCRIPTION
This command sets the I/Q amplitude.

COMMAND SYNTAX
[:SOURce]:IQ:AMPLitude <amplitude><unit>
<amplitude>:= amplitude. Refer to the data sheet for the range of valid values.
<unit> := \{V_{rms}, mV_{rms}, dBm\}. The default unit is volts, root-mean-square “V_{rms}”.

QUERY SYNTAX
[:SOURce]:IQ:AMPLitude?

RESPONSE FORMAT
<amplitude> (expressed V_{rms})

EXAMPLE
Set the I/Q amplitude (\sqrt{I^2+Q^2}) to 0.2 V_{rms}:
[:IQ]:AMPL 0.2

3.32.5  :IQ:IQADjustment:GAIN

DESCRIPTION
This command adjusts the ratio of I to Q while preserving the composite.

COMMAND SYNTAX
[:SOURce]:IQ:IQADjustment:GAIN <gain_ratio>
<gain_ratio> := Gain ratio of I to Q. The default unit is dB.

QUERY SYNTAX
[:SOURce]:IQ:IQADjustment:GAIN?

RESPONSE FORMAT
<gain_ratio> (expressed in unit of dB.)

EXAMPLE
Set the gain ratio of I/Q to 0.1 dB:
[:IQ]:IQADjustment:GAIN 0.1

3.32.6  :IQ:IQADjustment:IOFFset

DESCRIPTION
This command adjusts the I channel offset value.

COMMAND SYNTAX
[:SOURce]:IQ:IQADjustment:IOFFset <offset><unit>
<offset> := I offset.
<unit> := \{V, mV, uV\}. The default unit is volts “V”.

QUERY SYNTAX
[:SOURce]:IQ:IQADjustment:IOFFset?

RESPONSE FORMAT
<offset> (expressed V.)

EXAMPLE
Set the I offset to 1 mV:
[:IQ]:IQADjustment:IOFFset 1mV
3.32.7  :IQ:IQADjustment:QOFFset

DESCRIPTION    This command adjusts the Q channel offset value.

COMMAND SYNTAX  [:SOURce]:IQ:IQADjustment:QOFFset <offset><unit>
                <offset>:= Q offset.
                <unit>:= {V, mV, uV}. The default unit is volts “V”.

QUERY SYNTAX    [:SOURce]:IQ:IQADjustment:QOFFset?

RESPONSE FORMAT <offset> (expressed in V.)

EXAMPLE         Set the Q offset to -1 mV:
                :IQ:IQAD:QOFF -0.001V

3.32.8  :IQ:IQADjustment:QSKew

DESCRIPTION    This command adjusts the phase angle (quadrature skew) between the I and Q vectors by increasing or decreasing the Q phase angle.

COMMAND SYNTAX  [:SOURce]:IQ:IQADjustment:QSKew <angle>
                <angle>:= angle. The unit is degree.

QUERY SYNTAX    [:SOURce]:IQ:IQADjustment:QSKew?

RESPONSE FORMAT <angle> (expressed in unit of degree.)

EXAMPLE         Set the Q angle to 1 degree:
                :IQ:IQADjustment:QSKew 1.0

3.32.9  :IQ:TRIGger:SOURce

DESCRIPTION    This command sets the I/Q trigger source.

COMMAND SYNTAX  [:SOURce]:IQ:TRIGger:SOURce <src>
                <src>:= {INTernal, EXTernal, MANual}

QUERY SYNTAX    [:SOURce]:IQ:TRIGger:SOURce?

RESPONSE FORMAT <src>
EXAMPLE
Set the trigger source to INT:
:IQ:TRIGger:SOURce INTernal

3.32.10 :IQ:WAVEload:BUItin

DESCRIPTION
This command selects I/Q waveform from the built-in waveform list.

COMMAND SYNTAX
[:SOURce]:IQ:WAVEload:BUItin <wave_name>
<wave_name>:= {A waveform name from the table below}.

QUERY SYNTAX
[:SOURce]:IQ:WAVEload?

RESPONSE FORMAT
BUItin|USERstored <wave_name>

EXAMPLE
Set the I/Q waveform to built-in 2ASK:
:IQ:WAVE:BUIt 2ASK

<table>
<thead>
<tr>
<th>2ASK</th>
<th>4ASK</th>
<th>8ASK</th>
<th>BPSK</th>
<th>4PSK</th>
</tr>
</thead>
<tbody>
<tr>
<td>8PSK</td>
<td>DBPSK</td>
<td>4DPSK</td>
<td>8DPSK</td>
<td>8QAM</td>
</tr>
<tr>
<td>16QAM</td>
<td>32QAM</td>
<td>64QAM</td>
<td>128QAM</td>
<td>256QAM</td>
</tr>
</tbody>
</table>

3.32.11 :IQ:WAVEload:USERstored

DESCRIPTION
This command selects I/Q waveform from the user stored waveforms.

COMMAND SYNTAX
[:SOURce]:IQ:WAVEload:USERstored “<wave_name>”
<wave_name>:= {A waveform name from the user stored waveforms}.

QUERY SYNTAX
[:SOURce]:IQ:WAVEload?

RESPONSE FORMAT
BUItin|USERstored <wave_name>

EXAMPLE
Set the I/Q waveform to user stored UserIQ_1.arb:
:IQ:WAVEload:USERstored “UserIQ_1.arb”
3.32.12  :IQ:FrequencySampling

**DESCRIPTION**  
This command sets the I/Q Frequency sampling rate.

**COMMAND SYNTAX**  
[:SOURce]:IQ: FrequencySampling <sampling>  
< sampling >:= {500-300000000}. The unit is S/s

**QUERY SYNTAX**  
[:SOURce]:IQ:FrequencySampling?  
[:SOURce]:IQ:FrequencySamplingLimit?

**RESPONSE FORMAT**  
<sampling>  
MAX,<max_sampling>,MIN,< min_sampling >

**EXAMPLE**  
Set the I/Q frequency sampling to 2000000:  
:IQ:FrequencySampling 2000000
4 Programming Examples

This chapter gives some examples for the programmer. In these examples you can see how to use VISA or sockets, in combination with the commands described above to control the generator. By following these examples, you can develop many more applications.

4.1 Examples of Using VISA

4.1.1 VC++ Example


Description: Query the instrument information using "*IDN?" command over NI-VISA, with the access through USBTMC and TCP/IP separately.

Steps:

1. Open Visual Studio, create a new VC++ win32 console project.

2. Set the project environment to use the NI-VISA lib, there are two ways to specify NI-VISA, static or automatic:
   a) Static:
      Find the files visa.h, visatype.h and visa32.lib in NI-VISA installation path, copy them to the root path of the VC++ project, and add them into the project. In the projectname.cpp file, add the following two lines:

      ```
      #include "visa.h"
      #pragma comment(lib,\"visa32.lib\")
      ```

   b) Dynamic:
      In "project---properties---c/c++---General---Additional Include Directories" set the value to the NI-VISA installation path (e.g. C:\Program Files\IVI Foundation\VISA\WinNT\include), as shown in the figure below:
In "project---properties---Linker---General---Additional Library Directories " set the value to the NI-VISA installation path (e.g. C:\Program Files\IVI Foundation\VISA\WinNT\include), as shown in the figure below:

In "project---properties---Linker---Command Line---Additional" set the value to visa32.lib, as shown in the figure below:
Include visa.h file in the projectname.cpp file:

```c
#include <visa.h>
```

3. Coding:
   a) USBTMC:

```c
int Usbtmc_test()
{
    /* This code demonstrates sending synchronous read & write commands */
    /* to an USB Test & Measurement Class (USBTMC) instrument using */
    /* NI-VISA */
    /* The example writes the "*IDN?\n" string to all the USBTMC */
    /* devices connected to the system and attempts to read back */
    /* results using the write and read functions. */
    /* The general flow of the code is */
    /* Open Resource Manager */
    /* Open VISA Session to an Instrument */
    /* Write the Identification Query Using viPrintf */
    /* Try to Read a Response With viScanf */
    /* Close the VISA Session */
    /*****************************************************************************/
    ViSession defaultRM;
    ViSession instr;
```
```c
ViUInt32 numInstrs;
ViFindList findList;
ViStatus status;
char instrResourceString[VI_FIND_BUFLEN];
unsigned char buffer[100];
int i;
/** First we must call viOpenDefaultRM to get the manager
* handle. We will store this handle in defaultRM */
status = viOpenDefaultRM (&defaultRM);
if (status < VI_SUCCESS)
{
    printf("Could not open a session to the VISA Resource Manager!\n");
    return status;
}
/* Find all the USB TMC VISA resources in our system and store the number of
 resources in the system in numInstrs. */
status = viFindRsrc (defaultRM, "USB?*INSTR", &findList, &numInstrs,
instrResourceString);
if (status < VI_SUCCESS)
{
    printf("An error occurred while finding resources.\nPress 'Enter' to
continue.\n");
    fflush(stdin);
    getchar();
    viClose (defaultRM);
    return status;
}
/** Now we will open VISA sessions to all USB TMC instruments.
* We must use the handle from viOpenDefaultRM and we must
* also use a string that indicates which instrument to open. This
* is called the instrument descriptor. The format for this string
* can be found in the function panel by right clicking on the
* descriptor parameter. After opening a session to the
* device, we will get a handle to the instrument which we
* will use in later VISA functions. The AccessMode and Timeout
* parameters in this function are reserved for future
* functionality. These two parameters are given the value VI_NULL. */
for (i=0; i<int(numInstrs); i++)
{
    if (i > 0)
    {
        viFindNext (findList, instrResourceString);
    }
    status = viOpen (defaultRM, instrResourceString, VI_NULL, VI_NULL,
```
&instr);
    if (status<VI_SUCCESS)
    {
        printf ("Cannot open a session to the device %d.\n", i+1);
        continue;
    }

    /* * At this point we now have a session open to the USB TMC instru-
     * ment. We will now use the viPrintf function to send the device the string
     * "*IDN?\n", 
     * asking for the device's identification. */
    char * command ="*IDN?\n";
    status = viPrintf (instr, command);
    if (status<VI_SUCCESS)
    {
        printf ("Error writing to the device %d.\n", i+1);
        status = viClose (instr);
        continue;
    }

    /** Now we will attempt to read back a response from the device to
     * the identification query that was sent. We will use the viScanf
     * function to acquire the data. 
     * After the data has been read the response is displayed. */
    status = viScanf(instr, "%t", buffer);
    if (status<VI_SUCCESS)
    {
        printf ("Error reading a response from the device %d.\n", i+1);
    }
    else
    {
        printf ("\nDevice %d: %s\n", i+1, buffer);
    }
    status = viClose (instr);

} 

/** Now we will close the session to the instrument using
 * viClose. This operation frees all system resources. */
 status = viClose (defaultRM);
 printf("Press 'Enter' to exit.");
 fflush(stdin);
 getchar();
 return 0;
}

_int _tmain(int argc, _TCHAR* argv[])
Programming Guide

{ Usbtmc_test();
    return 0;
}

Run result:

b) TCP/IP:

```c
int TCP_IP_Test(char *pIP)
{
    char outputBuffer[VI_FIND_BUFLEN];
    ViSession defaultRM, instr;
    ViStatus status;
    /* First we will need to open the default resource manager. */
    status = viOpenDefaultRM (&defaultRM);
    if (status<VI_SUCCESS)
    {
        printf("Could not open a session to the VISA Resource Manager!
"n);
    }
    /* Now we will open a session via TCP/IP device */
    char head[256] ="TCPIP0::";
    char tail[] ="::INSTR";
    strcat(head,pIP);
    strcat(head,tail);
    status = viOpen (defaultRM, head, VI_LOAD_CONFIG, VI_NULL, &instr);
    if (status<VI_SUCCESS)
    {
        printf("An error occurred opening the session\n");
        viClose(defaultRM);
    }
    status = viPrintf(instr, "*idn?\n");
    status = viScanf(instr, "%t", outputBuffer);
    if (status<VI_SUCCESS)
```
{ 
    printf("viRead failed with error code: %x \n",status);
    viClose(defaultRM);
} else {
    printf ("\nMessage read from device: %s\n", outputBuffer);
} 
status = viClose (instr);
status = viClose (defaultRM);
printf("Press 'Enter' to exit.");
fflush(stdin);
getchar();
return 0;
}

int _tmain(int argc, _TCHAR* argv[]) 
{
    printf("Please input IP address: ");
    char ip[256];
    fflush(stdin);
    gets(ip);
    TCP_IP_Test(ip);
    return 0;
}

Run result:
4.1.2 VB Example

Environment: Windows 7 32-bit, Microsoft Visual Basic 6.0

Description: Query the instrument information using "IDN?" command over NI-VISA, with the access through USBTMC and TCP/IP separately.

Steps:
1. Open Visual Basic, and build a standard application program project.

2. Set the project environment to use the NI-VISA lib: Click the Existing tab of Project>>Add Existing Item, search the visa32.bas file in the "include" folder under the NI-VISA installation path and add the file, as shown in the figure below:

3. Coding:
   a) USBTMC:

```vbnet
Private Function Usbtmc_test() As Long
    ' This code demonstrates sending synchronous read & write commands
    ' to an USB Test & Measurement Class (USBTMC) instrument using
    ' NI-VISA
    ' The example writes the "*IDN?\n" string to all the USBTMC
    ' devices connected to the system and attempts to read back
    ' results using the write and read functions.
    ' The general flow of the code is
    '   Open Resource Manager
    '   Open VISA Session to an Instrument
```
' Write the Identification Query Using viWrite
' Try to Read a Response With viRead
' Close the VISA Session
Const MAX_CNT = 200

Dim defaultRM As Long
Dim instrsesn As Long
Dim numlnstrs As Long
Dim findList As Long
Dim retCount As Long
Dim status As Long
Dim instrResourceString As String * VI_FIND_BUFLEN
Dim Buffer As String * MAX_CNT
Dim i As Integer

' First we must call viOpenDefaultRM to get the manager
' handle. We will store this handle in defaultRM.
status = viOpenDefaultRM(defaultRM)
If (status < VI_SUCCESS) Then
    resultTxt.Text = "Could not open a session to the VISA Resource Manager!"
    Usbtmc_test = status
    Exit Function
End If

' Find all the USB TMC VISA resources in our system and store the
' number of resources in the system in numlnstrs.
status = viFindRsrc(defaultRM, "USB?*INSTR", findList, numlnstrs, instrResourceString)
If (status < VI_SUCCESS) Then
    resultTxt.Text = "An error occurred while finding resources."
    viClose(defaultRM)
    Usbtmc_test = status
    Exit Function
End If

' Now we will open VISA sessions to all USB TMC instruments.
' We must use the handle from viOpenDefaultRM and we must
' also use a string that indicates which instrument to open. This
' is called the instrument descriptor. The format for this string
' can be found in the function panel by right clicking on the
' descriptor parameter. After opening a session to the
' device, we will get a handle to the instrument which we
' will use in later VISA functions. The AccessMode and Timeout
' parameters in this function are reserved for future
' functionality. These two parameters are given the value VI_NULL.
For \( i = 0 \) To numInstrs
  If \( i > 0 \) Then
    status = viFindNext(findList, instrResourceString)
  End If
  status = viOpen(defaultRM, instrResourceString, VI_NULL, VI_NULL, instrsesn)
  If (status < VI_SUCCESS) Then
    resultTxt.Text = "Cannot open a session to the device " + CStr(i + 1)
    GoTo NextFind
  End If

' At this point we now have a session open to the USB TMC instrument.
' We will now use the viWrite function to send the device the string "*IDN?",
' asking for the device's identification.
status = viWrite(instrsesn, "*IDN?", 5, retCount)
If (status < VI_SUCCESS) Then
  resultTxt.Text = "Error writing to the device."
  status = viClose(instrsesn)
  GoTo NextFind
Else
  resultTxt.Text = "Read from device: " + CStr(i + 1) + " " + Buffer
End If

' Now we will attempt to read back a response from the device to
' the identification query that was sent. We will use the viRead
' function to acquire the data.
' After the data has been read the response is displayed.
status = viRead(instrsesn, Buffer, MAX_CNT, retCount)
If (status < VI_SUCCESS) Then
  resultTxt.Text = "Error reading a response from the device."
Else
  resultTxt.Text = "Read from device: " + CStr(i + 1) + " " + Buffer
End If
status = viClose(instrsesn)
Next i

' Now we will close the session to the instrument using
' viClose. This operation frees all system resources.
status = viClose(defaultRM)
Usbtmc_test = 0
End Function

b) TCP/IP:

Private Function TCP_IP_Test(ByVal ip As String) As Long
  Dim outputBuffer As String * VI_FIND_BUFLEN
First we will need to open the default resource manager.

```vbnet
Dim defaultRM As Long
Dim instrsesn As Long
Dim status As Long
Dim count As Long

status = viOpenDefaultRM(defaultRM)
If (status < VI_SUCCESS) Then
    resultTxt.Text = "Could not open a session to the VISA Resource Manager!"
    TCP_IP_Test = status
    Exit Function
End If

Now we will open a session via TCP/IP device

status = viOpen(defaultRM, "TCPIP0::" + ip + "::INSTR", VI_LOAD_CONFIG, VI_NULL, instrsesn)
If (status < VI_SUCCESS) Then
    resultTxt.Text = "An error occurred opening the session"
    viClose(defaultRM)
    TCP_IP_Test = status
    Exit Function
End If

status = viWrite(instrsesn, "*IDN?", 5, count)
If (status < VI_SUCCESS) Then
    resultTxt.Text = "Error writing to the device."
End If

status = viRead(instrsesn, outputBuffer, VI_FIND_BUFLEN, count)
If (status < VI_SUCCESS) Then
    resultTxt.Text = "Error reading a response from the device." + CStr(i + 1)
Else
    resultTxt.Text = "read from device:" + outputBuffer
End If

viClose(instrsesn)
status = viClose(defaultRM)
TCP_IP_Test = 0
End Function
```

c) Button control code:

```vbnet
Private Sub exitBtn_Click()
    End
```

Private Sub tcpipBtn_Click()
    Dim stat As Long
    stat = TCP_IP_Test(ipTxt.Text)
    If (stat < VI_SUCCESS) Then
        resultTxt.Text = Hex(stat)
    End If
End Sub

Private Sub usbBtn_Click()
    Dim stat As Long
    stat = Usbtmc_test
    If (stat < VI_SUCCESS) Then
        resultTxt.Text = Hex(stat)
    End If
End Sub

Run result:
4.1.3 MATLAB Example

Environment: Windows 7 32-bit, MATLAB R2013a

Description: Query the instrument information using "IDN?" command over NI-VISA, with the access through USBTMC and TCP/IP separately.

Steps:
1. Open MATLAB, and modify the current directory. In this demo, the current directory is modified to "D:\USBTMC_TCPIP_Demo".
2. Click File>>New>>Script in the Matlab interface to create an empty M file.
3. Coding:
   a) USBTMC:

   ```matlab
   function USBTMC_test()
   % This code demonstrates sending synchronous read & write commands
   % to an USB Test & Measurement Class (USBTMC) instrument using
   % NI-VISA

   %Create a VISA-USB object connected to a USB instrument
   vu = visa('ni','USB0::0xF4ED::0xEE3A::sdg2000x::INSTR');

   %Open the VISA object created
   fopen(vu);

   %Send the string "*IDN?", asking for the device's identification.
   fprintf(vu,'*IDN?');

   %Request the data
   outputbuffer = fscanf(vu);
   disp(outputbuffer);

   %Close the VISA object
   fclose(vu);
   delete(vu);
   clear vu;

   end
   ```

Run result:
b) TCP/IP:

Write a function TCP_IP_Test:

```matlab
function TCP_IP_test()

% This code demonstrates sending synchronous read & write commands
% to an TCP/IP instrument using NI-VISA

%Create a VISA-TCPIP object connected to an instrument
%configured with IP address.
vt = visa('ni','TCP/IP0::10.11.13.32::INSTR');

%Open the VISA object created
fopen(vt);

%Send the string "*IDN?", asking for the device's identification.
fprintf(vt, '*IDN?');

%Request the data
outputbuffer = fscanf(vt);
disp(outputbuffer);

%Close the VISA object
fclose(vt);
delete(vt);
clear vt;
end
```

**Run result:**

```
 Command Window
>> TCP_IP_test
Siglent Technologies,SDG2102X,SDG2000X,2.01.01.23R3
```

```
 Command Window
>> USBMC_test
Siglent Technologies,SDG2102X,SDG2000X,2.01.01.23R3
```
4.1.4 LabVIEW Example

Environment: Windows 7 32-bit, LabVIEW 2011

Description: Query the instrument information using "IDN?" command over NI-VISA, with the access through USBTMC and TCP/IP separately.

Steps:
1. Open LabVIEW, and create a VI file.
2. Add controls. Right-click in the Front Panel interface, select and add VISA resource name, error in, error out and some indicators from the Controls column.
3. Open the Block Diagram interface. Right-click on the VISA resource name, select and add the following functions from VISA Palette from the pop-up menu: VISA Write, VISA Read, VISA Open and VISA Close.
4. The connection is as shown in the figure below:

![Diagram](image)

5. Select the device resource from the VISA Resource Name list box and run the program.

![Program Interface](image)

In this example, the VI opens a VISA session to a USBTMC device, writes a "IDN?" command to the device, and reads back the response. After all communication is complete, the VI closes the VISA session.
6. Communicating with the device via TCP/IP is similar to USBTMC. But you need to change VISA Write and VISA Read Function to Synchronous I/O. The LabVIEW default is asynchronous I/O. Right-click the node and select Synchronous I/O Mod>>Synchronous from the shortcut menu to write or read data synchronously.

7. The connection is as shown in the figure below:

8. Input the IP address and run the program.
4.1.5 Python Example

Environment: Python2.7, PyVISA 1.4


Description: Use Python script to build an 8-point 16-bit arbitrary waveform (0x1000, 0x2000, 0x3000, 0x4000, 0x5000, 0x6000, 0x7000, 0x7fff) and save the waveform data in "wave1.bin", then download it to the instrument, finally read it back from the instrument and save it as "wave2.bin".

Below is the code of the script:

```
#!/usr/bin/env python2.7
#
# -*- coding: utf-8 -*-

import visa
import time
import binascii

#USB resource of Device
device_resource = "USB0::0xF4EC::0x1101::#15::INSTR"

#Little endian, 16-bit 2's complement
wave_points = [0x0010, 0x0020, 0x0030, 0x0040, 0x0050, 0x0060, 0x0070, 0x7fff]

def create_wave_file():
    """create a file""
    f = open("wave1.bin", "wb")
    for a in wave_points:
        b = hex(a)
        b = b[2:]
        len_b = len(b)
        if (0 == len_b):
            b = '0000'
        elif (1 == len_b):
            b = '000' + b
        elif (2 == len_b):
            b = '00' + b
        elif (3 == len_b):
            b = '0' + b
    f.write(b)
```

b = '0' + b

c = binascii.a2b_hex(b)  # Hexadecimal integer to ASCII encoded string
f.write(c)
f.close()

def send_wave_data(dev):
    """send wave1.bin to the device""
    f = open("wave1.bin", "rb")  # wave1.bin is the waveform to be sent
    data = f.read()
    print 'write bytes:', len(data)
    dev.write("C1:WVDT WVNM,wave1,FREQ,2000.0,AMPL,4.0,OFST,0.0,PHASE,0.0,WAVEDATA,%s" % (data))
    """X" series (SDG1000X/SDG2000X/SDG6000X/X-E)"
    dev.write("C1:ARWV NAME,wave1")
    f.close()

def get_wave_data(dev):
    """get wave from the device""
    f = open("wave2.bin", "wb")  # save the waveform as wave2.bin
    dev.write("WVDT? user,wave1")  # "X" series (SDG1000X/SDG2000X/SDG6000X/X-E)
    time.sleep(1)
    data = dev.read()
    data_pos = data.find("WAVEDATA," + len("WAVEDATA,"))
    print data[0:data_pos]
    wave_data = data[data_pos:]
    print 'read bytes:', len(wave_data)
    f.write(wave_data)
    f.close()

if __name__ == '__main__':
    device = visa.instrument(device_resource, timeout=5000, chunk_size = 40*1024)
    create_wave_file()
    send_wave_data(device)
    get_wave_data(device)

Output waveform:
Programming Guide
4.2 Examples of Using Sockets

4.2.1 Python Example

Python has a low-level networking module that provides access to the socket interface. Python scripts can be written for sockets to do a variety of tests and measurement tasks.

**Environment:** Windows 7 32-bit, Python v2.7.5

**Description:** Open a socket, send a query, and repeat this loop for 10 times, finally close the socket. Note that SCPI command strings must be terminated with a “\n” (new line) character in programming.

Below is the code of the script:

```python
#!/usr/bin/env python
#
-coding:utf-8 -
#
# The short script is a example that open a socket, sends a query, # print the return message and closes the socket.
#
#---------------------------------------------------------------

import socket   # for sockets
import sys  # for exit
import time # for sleep

#---------------------------------------------------------------

remote_ip = "10.11.13.40"   # should match the instrument’s IP address
port = 5025 # the port number of the instrument service
count = 0

def SocketConnect():
    try:
        #create an AF_INET, STREAM socket (TCP)
        s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
    except socket.error:
        print ('Failed to create socket.')
        sys.exit();
    try:
        #Connect to remote server
        s.connect((remote_ip , port))
    except socket.error:
        print ('failed to connect to ip ' + remote_ip)
```

---
def SocketQuery(Sock, cmd):
    try:
        # Send cmd string
        Sock.sendall(cmd)
        time.sleep(1)
    except socket.error:
        # Send failed
        print('Send failed')
        sys.exit()
    reply = Sock.recv(4096)
    return reply

def SocketClose(Sock):
    # Close the socket
    Sock.close()
    time.sleep(.300)

def main():
    global remote_ip
    global port
    global count

    # Body: send the SCPI commands *IDN? 10 times and print the return message
    s = SocketConnect()
    for i in range(10):
        qStr = SocketQuery(s, b'*IDN?\n')
        print(str(count) + ':: ' + str(qStr))
        count = count + 1
    SocketClose(s)
    input('Press “Enter” to exit')

if __name__ == '__main__':
    proc = main()
Press "Enter" to exit
5 Index

*IDN
*OPC
*RST

A
ARWV ArbWaVe

B
BSWV BaSic WaVe
BTWV BursTWaVe
BUZZ BUZZer

C
CASCADE
CHDR Comm_HeaDeR
COUP COUPling
CMBN CoMBiNe

F
FCNT FreqCouNTer

H
HARM HARMonic

I
IQ:CENT IQ:CENTerfreq
IQ:SAMP IQ:SAMPlerate
IQ:SYMB IQ:SYMBolrate
IQ:AMPL IQ:AMPLitude
IQ:IQAD:GAIN IQ:IQADjustment:GAIN
IQ:IQAD:IOFFset IQ:IQADjustment:IOFFset
IQ:IQAD:QOFFset IQ:IQADjustment:QOFFset
IQ:IQAD:QSK IQ:IQADjustment:QSKew
IQ:TRIG:SOUR IQ:TRIGger:SOURce
IQ:WAVE:BUIL IQ:WAVEload:BUILtin
IQ:WAVE:USER IQ:WAVEload:USERstored
IQ:FrequencySampling IQ:FrequencySampling
IVNT INVERT

L
LAGG  LAnGuage

MDWV  MoDulateWaVe
MODE  MODE

NBFM  NumBer_Format

OUTP  OUTPut

PACP  ParaCoPy

ROSC  ROScillator

SCFG  Sys_CFG
SCSV  SCreen_SaVe
SWWV  SweepWaVe
SYNC  SYNC
STL   StoreList
SRATE  SampleRATE

WVDT  WVDT

VOLTPRT  VOLTPRT
VKEY   VirtualKEY
About SIGLENT

SIGLENT is an international high-tech company, concentrating on R&D, sales, production and services of electronic test & measurement instruments.

SIGLENT first began developing digital oscilloscopes independently in 2002. After more than a decade of continuous development, SIGLENT has extended its product line to include digital oscilloscopes, function/arbitrary waveform generators, RF generators, digital multimeters, DC power supplies, spectrum analyzers, vector network analyzers, isolated handheld oscilloscopes, electronic load and other general purpose test instrumentation. Since its first oscilloscope, the ADS7000 series, was launched in 2005, SIGLENT has become the fastest growing manufacturer of digital oscilloscopes. We firmly believe that today SIGLENT is the best value in electronic test & measurement.