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Programming Manual

UTG4000A Series Function/Arbitrary Waveform Generator

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Warranty and Statement

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Product functions may be changed or supplemented if software upgrade occurs. Please go to UNI-T official website for latest related manuals or contact UNI-T for software upgrade.

Statement

Certification

UNI-T certifies that the Product accords to the National Product Standard, Industry Standard, ISO9001: 2008 Standard and ISO14001: 2004 standard, and that complies with associated standards from the members of other international standard organizations.

Contact Us

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Introduction to SCPI

SCPI (Standard Commands for Programmable Instruments) is a standardized programming language formed based on current IEEE 488.1 and IEEE 488.2 standards and following multiple standards such as the rule of floating point arithmetic in IEEE754 standard, 7-digit numbering symbols (equivalent to ASCII programming) of information exchange in ISO646, and more. The SCPI command format, symbols, parameters and abbreviations are introduced in this section

Command format

SCPI command (a tree structure) includes multiple sub-systems, with each constructed by a root key and one or several hierarchic keys. **Command line starts with colon ":" typically; keys are separated by colon ":", key is followed by optional parameter setting. Command key and first parameter are separated by space. The character string of command must ends with a <Line Feed> (<NL>) character. Adding a question mark "?" behind a command line means function query generally.**

Symbols

The four symbols below are not the contents of SCPI command, which are not sent along with command, but used as an auxiliary instruction of the command parameters.

- Curly Brackets { }

  Curly brackets include multiple optional parameters typically, one of which must be selected when sending commands.
  Example: DISPlay:GRID:MODE { FULL | GRID | CROSS | NONE} command.

- Vertical Bar |

  Vertical line is used to separate multiple parameter options, one of which must be selected when sending commands.
  Example: DISPlay:GRID:MODE { FULL | GRID | CROSS | NONE} command.

- Square Brackets [ ]

  The content (command key) included in square brackets is negligible. If the parameter is neglected, it will be set as default value by the instrument.
  Example: For MEASure:NDUTy? [<source>] command, [<source>] represents the current channel.

- Angle Brackets < >

  The parameter in angle brackets must be substituted by a valid value.
  Example: Send DISPlay:GRID:BRIGhtness <count> in the form of DISPlay:GRID:BRIGhtness 30

Parameters

There are 5 types of parameters contained in the command introduced by this Manual, including Boolean, integer, float, discrete, and ASCII character string.

- **Boolean**

  Take the parameter value as "ON"（1） or "OFF"（0）. Example: :SYSTem:LOCK {{1|ON}|{0|OFF}}.

- **Integer**

  Unless otherwise specified, any integer within the valid value can be taken as the parameter. Note: Do not set the parameter as decimal format, otherwise, abnormality can occur. Example: Any integer in the range of 0 to 100 can be taken as the parameter < count > in :DISPlay:GRID:BRIGhtness <count> command.

- **Float**

  Unless otherwise specified, any value in the valid scope can be taken as the parameter.
  Example: For CH1, the value taken as the parameter <offset> in CHANnel1:OFFSet <offset> command is float

- **Discrete**

  Only several specified values or characters can be taken as the parameters. Example: The parameters of :DISPlay:GRID:MODE {FULL|GRID|CROSS|NONE} command can be taken as FULL, GRID, CROSS and NONE only.

- **ASCII character string**

  The parameter of character string include all ASCII character sets actually. The character string must starts or ends with paired quotation marks; single quotes or double quotes can be used. The separator of quotation marks can also be used as a part of character string. Type twice and make sure no any character is added in the middle. Taking IP setting as example: SYST:COMM:LAN:IPAD "192.168.1.10".

Abbreviations

All commands can identify capital and small letters. Capital or small letters in whole can be used. If abbreviation is to be used, then all capital letters in the command format must be typed.

Data Return

Data return is categorized into single data return and mass data return. Single data returns the corresponding parameter type, and float return is represented by scientific notation. For the part before e, the data of three digit places behind decimal are retained; while for e, data of three digit places are retained. The mass data return must meet the data of character string of IEEE 488.2 # format, and the format is:'#'+ Number of character positions occupied by length[fixed as a character] + ASCII value of valid data length + Valid data + End mark['\n']. For example, #3123xxxxxxxxxxxxxxxxxxx\n represents a format of valid mass data return with 123 bytes, and the digit "3" in it means that "123" occupies 3 character positions.

Details about SCPI

IEEE488.2 Generic Command

*IDN?

- Command format:
  *IDN?
- Functional description:
  Used to query manufacturer name, product model, serial number, and software version number.
- Return format:
  Manufacturer name, product model, serial number, and software version number separated by period.
  Note: The model number returned shall be consistent with the information of nameplate.
- Example:
  UNI-T Technologies, UTG4000, 000000001, 00.00.01

*RST

- Command format:
  *RST
- Functional description:
  Used to restore factory setting and clear all error information and send the buffer of the receiving array.

SYSTem

Used to perform most basic operations on the signal source, primarily including full keyboard locking and system data setting.

:SYSTem:LOCK

- Command format:
  :SYSTem:LOCK {{1|ON}|{0|OFF}}
  :SYSTem:LOCK?
- Functional description:
  Used to lock or unlock full keys of keyboard.
- Return format:
  Query returning the lock state of full keyboard. 0 denotes unlocked; 1 denotes locked.
- Example:

:SYSTem:LOCK ON	Full keyboard locked
:SYSTem:LOCK OFF	Full keyboard unlocked
:SYSTem:LOCK?	Query returning 1, denoting locked

:SYSTem:CONFigure

- Command format:
  :SYSTem:CONFigure <file>
  :SYSTem:CONFigure?
- Functional description:
  Used to read and write the configuration file. Send the command first and then the configuration file data to signal source.
  <file> represents the configuration file.

- **Return format:**
  Query returning the current configuration file data of signal source.
- **Example:**
  :SYSTem:CONFigure Write configuration file data to signal source and load it
  :SYSTem:CONFigure? Query returning the binary stream of current configuration file data of signal source

:SYSTem:PHASe:MODe

- **Command format:**
  :SYSTem:PHASe:MODe?
- **Functional description:**
  The acquisition of controlling the phase modes between channels.
- **Return format:**
  Query returning the phase modes between channels.
- **Example:**
  :SYSTem:PHASe:MODe? Query returning SYNChronization

:SYSTem:LANGuage

- **Command format:**
  :SYSTem:LANGuage {ENGLish|SIMChinese|TRAChinese|KOREan}
  :SYSTem:LANGuage?
- **Functional description:**
  Control system language.
- **Return format:**
  Query returning system language.
- **Example:**
  :SYSTem:LANGuage SIMChinese Set simplified Chinese as system language
  :SYSTem:LANGuage? Query returning SIMChinese

:SYSTem:BEEP

- **Command format:**
  :SYSTem:BEEP {{1|ON}|{0|OFF}}
  :SYSTem:BEEP?
- **Functional description:**
  Control the switch of the buzzer of system.
- **Return format:**
  Query returning the state of the switch of buzzer.
- **Example:**
  :SYSTem:BEEP ON Turn on buzzer
  :SYSTem:BEEP? Query returning 1

:SYSTem:NUMBer:FORMat

- **Command format:**
  :SYSTem:NUMBer:FORMat {COMMa|SPACe}
  :SYSTem:NUMBer:FORMat?
- **Functional description:**
  Control the separator of the format of system number

- **Return format:**
  Query returning the separator of the format of system number.
- **Example:**

:SYSTem:NUMBer:FORMat COMMa	Set the number format as comma
:SYSTem:NUMBer:FORMat?	Query returning COMMa

:SYSTem:BRIGhtness

- **Command format:**
  :SYSTem:BRIGhtness { 30|40|50|60|70|80|90|100}
  :SYSTem:BRIGhtness?
- **Functional description:**
  Control the backlight brightness of the system
- **Return format:**
  Query returning the backlight brightness of the system
- **Example:**

:SYSTem:BRIGhtness 30	Set the backlight brightness of the system as 30%
:SYSTem:BRIGhtness?	Query returning 30

:SYSTem:SLEEP:TIMe

- **Command format:**
  :SYSTem:SLEEP:TIMe { CLOSe | 5MIN | 15MIN | 30MIN | 60MIN}
  :SYSTem:SLEEP:TIMe?
- **Functional description:**
  Control the sleep time (unit: minute) of the system.
- **Return format:**
  Query returning the sleep time
- **Example:**

:SYSTem:SLEEP:TIMe 5 MIN	Set the system to sleep automatically after 5 minutes.
:SYSTem:SLEEP:TIMe?	Query returning 5MIN

:SYSTem:CYMometer

- **Command format:**
  :SYSTem:CYMometer {{1 | ON} | {0 | OFF}}
  :SYSTem:CYMometer?
- **Functional description:**
  Control the switch state of the cymometer of system.
- **Return format:**
  Query returning the switch state of the cymometer of the system. 0 denotes OFF; 1 denotes ON.
- **Example:**

:SYSTem:CYMometer ON	Turn on the cymometer of the system
:SYSTem:CYMometer?	Query returning 1

:SYSTem:CYMometer:FREQuency?

- **Command format:**
  :SYSTem:CYMometer:FREQuency?
- **Functional description:**
  Acquire the current frequency measured by cymometer.

- Return format:
  Query returning the acquisition of the current frequency (unit: Hz) measured by cymometer. Returning data by scientific notation.
- Example:
  :SYSTem:CYMometer:FREQuency? Query returning 2e+3

:SYSTem:CYMometer:PERiod?

- Command format:
  :SYSTem:CYMometer:PERiod?
- Functional description:
  Acquire the current period measured by cymometer.
- Return format:
  Query returning the acquisition of the current period (unit: s) measured by cymometer. Returning data by scientific notation.
- Example:
  :SYSTem:CYMometer:PERiod? Query returning 2e-3

:SYSTem:CYMometer:DUTY?

- Command format:
  :SYSTem:CYMometer:DUTY?
- Functional description:
  Acquire the current duty cycle measured by cymometer.
- Return format:
  Query returning the acquisition of the current duty cycle (unit: %) measured by cymometer.
- Example:
  :SYSTem:CYMometer:DUTY? Query returning 20, representing the duty cycle is 20%

:SYSTem:CYMometer:PWIDTh?

- Command format:
  :SYSTem:CYMometer:PWIDTh?
- Functional description:
  Acquire the current positive pulse width measured by cymometer.
- Return format:
  Query returning the acquisition of the current positive pulse width (unit: s) measured by cymometer.
- Example:
  :SYSTem:CYMometer:PWIDTh? Query returning 1e-3, representing the duty cycle is 1 millisecond.

:SYSTem:CYMometer:NWIDTh?

- Command format:
  :SYSTem:CYMometer:NWIDTh?
- Functional description:
  Acquire the current negative pulse width measured by cymometer.
- Return format:
  Query returning the acquisition of the current negative pulse width (unit: s) measured by cymometer.
- Example:
  :SYSTem:CYMometer:NWIDTh? Query returning 1e-3, representing the duty cycle is 1 millisecond.

CHANnel Command

Used to set related functions of the channels of signal source.

:CHANnel<n>:MODE

- **Command format:**
  :CHANnel<n>:MODE {CONTinue | MODulation| SWEep| BURSt }
  :CHANnel<n>:MODE?
- **Functional description:**
  Set the modes of the signal of designated channel to CONTinue, MODulation, SWEep, and BURSt respectively.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the mode of the signal of designated channel.
- **Example:**

:CHANnel1:MODE MODulation	Set the mode of the signal of channel 1 to modulation
:CHANnel1:MODE?	Query returning MODulation

:CHANnel<n>:OUTPut

- **Command format:**
  :CHANnel<n>:OUTPut {{1 | ON} | {0 | OFF}}
  :CHANnel<n>:OUTPut?
- **Functional description:**
  Set turning on/off the output of designated channel.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the output state of designated channel. 0 denotes OFF; 1 denotes ON.
- **Example:**

:CHANnel1:OUTPut ON	Set turning on the output of channel 1
:CHANnel1:OUTPut?	Query returning 1

:CHANnel<n>:INVersion

- **Command format:**
  :CHANnel<n>:INVersion {{1 | ON} | {0 | OFF}}
  :CHANnel<n>:INVersion?
- **Functional description:**
  Set turning on/off the inversion of designated channel.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the inversion state of designated channel. 0 denotes OFF; 1 denotes ON.
- **Example:**

:CHANnel1:INVersion ON	Set turning on the inversion output of channel 1
:CHANnel1:INVersion?	Query returning 1

:CHANnel<n>:OUTPut:SYNC:INVersion

- **Command format:**
  :CHANnel<n>:OUTPut:SYNC:INVersion {{1 | ON} | {0 | OFF}}
  :CHANnel<n>:OUTPut:SYNC:INVersion?

- **Functional description:**
  Set the channel to output inversion synchronously.
  Note: There is only one synchronous output port with the equipment, and synchronous output can be turned on for one channel only.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the inversion state of designated channel. 0 denotes OFF; 1 denotes ON.
- **Example:**

:CHANnel1:OUTPut:SYNC:INVersion ON	Set the channel 1 to output inversion synchronously.
:CHANnel1:OUTPut:SYNC:INVersion?	Query returning 1

:CHANnel<n>:LIMit:ENABle

- **Command format:**
  :CHANnel<n>:LIMit:ENABle {{1|ON}|{0|OFF}}
  :CHANnel<n>:LIMit:ENABle?
- **Functional description:**
  Set the amplitude limiting switch of designated channel.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the amplitude limiting state of designated channel.
- **Example:**

:CHANnel1:LIMit:ENABle ON	Set turning on the amplitude limit of channel 1
:CHANnel1:LIMit:ENABle?	Query returning 1

:CHANnel<n>:LIMit:LOWer

- **Command format:**
  :CHANnel<n>:LIMit:LOWer {<voltage>}
  :CHANnel<n>:LIMit:LOWer?
- **Functional description:**
  Set the lower limit of the amplitude limit of designated channel.
  <voltage> represents voltage, and the unit is the designated unit of current channel.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the lower limit of the amplitude limit of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:LIMit:LOWer 2	Set the lower limit of the amplitude limit of channel 1 to 2V
:CHANnel1:LIMit:LOWer?	Query returning 2e+0

:CHANnel<n>:LIMit:UPPer

- **Command format:**
  :CHANnel<n>:LIMit:UPPer {<voltage>}
  :CHANnel<n>:LIMit:UPPer?
- **Functional description:**
  Set the upper limit of the amplitude limit of designated channel.
  <voltage> represents voltage, and the unit is the designated unit of current channel.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the upper limit of the amplitude limit of designated channel. Returning by scientific

notation.

- Example:

:CHANnel1:LIMit:UPPer 2	Set the upper limit of the amplitude limit of channel 1 to 2V
:CHANnel1:LIMit:UPPer?	Query returning 2e+0

:CHANnel<n>:AMPLitude:UNIT

- Command format:

  :CHANnel<n>:AMPLitude:UNIT {VPP | DBM | VRMS}

  :CHANnel<n>:AMPLitude:UNIT?
- Functional description:

  Set the unit of the output amplitude of designated channel.

  <n>: Channel number. The value of n is taken as 1 and 2.
- Return format:

  Query returning the unit of the output amplitude of designated channel.
- Example:

:CHANnel1:AMPLitude:UNIT VPP	Set the unit of the output amplitude of channel 1 as 1
:CHANnel1:AMPLitude:UNIT?	Query returning VPP

:CHANnel<n>:LOAD

- Command format:

  :CHANnel<n>:LOAD <resistance>

  :CHANnel<n>:LOAD?
- Functional description:

  Set the output load of designated channel.

  <resistance> represents the load resistance (unit: Ω)

  <n>: Channel number. The value of n is taken as 1 and 2.

  Note: The resistance range is 1~10000, and 10000 corresponds to high resistance.
- Return format:

  Query returning the load resistance of designated channel. Returning by scientific notation.
- Example:

:CHANnel1:LOAD 50	Set the output load of channel 1 to 50Ω
:CHANnel1:LOAD?	Query returning 50e+0

:CHANnel<n>:PSK:PNCode

- Command format:

  :CHANnel<n>:PSK:PNCode <code>

  :CHANnel<n>:PSK:PNCode?
- Functional description:

  Set the PN code of designated channel. The command is valid for the waveforms of PN code function under the modulations of binary phase shift keying and quadri phase shift keying.

  <code> represents PN code, as shown below:

  {PN7|PN9|PN15|PN21}

  <n>: Channel number. The value of n is taken as 1 and 2.
- Return format:

  Query returning the PN code under the modulations of binary phase shift keying and quadri phase shift keying of designated channel.
- Example:

:CHANnel1:PSK:PNCode PN9	Set the PN code of channel 1 as PN9
:CHANnel1:PSK:PNCode?	Query returning PN9

:CHANnel<n>:QAM:PNCode

- **Command format:**
  :CHANnel<n>:QAM:PNCode <code>
  :CHANnel<n>:QAM:PNCode?
- **Functional description:**
  Set the PN code of designated channel. The command is valid for the waveforms of PN code function of quadrature modulation.
  <code> represents PN code, as shown below:
  {PN7|PN9|PN11|PN15|PN17|PN21|PN23|PN25}
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the PN code of designated channel.
- **Example:**

:CHANnel1:QAM:PNCode PN9	Set the PN code of channel 1 as PN9
:CHANnel1:QAM:PNCode?	Query returning PN9

:CHANnel<n>:TRIGger:SOURce

- **Command format:**
  :CHANnel<n>:TRIGger:SOURce {INTernal|EXTRise|MANual}
  :CHANnel<n>:TRIGger:SOURce?
- **Functional description:**
  Set the trigger source of designated channel. The command is valid for sweep frequency and burst function only.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the trigger source of designated channel.
- **Example:**

:CHANnel1:TRIGger:SOURce INTernal	Set the internal trigger source of channel 1
:CHANnel1:TRIGger:SOURce?	Query returning INTernal

:CHANnel<n>:TRIGger:OUTPut

- **Command format:**
  :CHANnel<n>:TRIGger:OUTPut {CLOSe|RISe|FALL}
  :CHANnel<n>:TRIGger:OUTPut?
- **Functional description:**
  Set the trigger output state of designated channel. The command is valid for sweep frequency and burst function only.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the trigger output state of designated channel.
- **Example:**

:CHANnel1:TRIGger:OUTPut RISe	Set the trigger output mode of rising edge of channel 1
:CHANnel1:TRIGger:OUTPut?	Query returning RISe

Continuation

:CHANnel<n>:BASE:WAVe

- **Command format:**
  :CHANnel<n>:BASE:WAVe { SINe | SQUare | PULSe | RAMP | ARB | NOISe | DC | HARMonic }
  :CHANnel<n>:BASE:WAVe?
- **Functional description:**
  Set the types of fundamental wave of designated channel. The types include sine wave, square wave, pulse wave, ramp wave, arbitrary wave, noise, direct current, and harmonic binary sequence.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the type of fundamental wave of designated channel.
- **Example:**

:CHANnel1:BASE:WAVe SINe	Set the basic type of channel 1 as sine wave
:CHANnel1:BASE:BWAVe?	Query returning SINe

:CHANnel<n>:BASE:FREQuency

- **Command format:**
  :CHANnel<n>:BASE:FREQuency {<freq>}
  :CHANnel<n>:BASE:FREQuency?
- **Functional description:**
  Set the output frequency of designated channel.
  <freq> represents frequency value, and the unit is Hz. (1e-6s ~ Maximum frequency that the current waveform allows)
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the output frequency of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:BASE:FREQuency 2000	Set the output frequency of channel 1 as 2KHz
:CHANnel1:BASE:FREQuency?	Query returning 2e+3

:CHANnel<n>:BASE:PERiod

- **Command format:**
  :CHANnel<n>:BASE:PERiod { <period>}
  :CHANnel<n>:BASE:PERiod?
- **Functional description:**
  Set the output period of designated channel.
  <period> represents the period (unit: s)
  For sine wave, the range is (current allowable maximum time ~ 1000s)
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the upper limit of the amplitude limit of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:BASE:PERiod 0.002	Set the output period of channel 1 to 2ms
:CHANnel1:BASE:PERiod?	Query returning 2e-3

:CHANnel<n>:BASE:PHASe

- **Command format:**
  :CHANnel<n>:BASE:PHASe {<phase>}
  :CHANnel<n>:BASE:PHAse?
- **Functional description:**
  Set the output phase of designated channel.
  <phase> represents phase (unit: °), with range at -360~360.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the output phase of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:BASE:PHAse 20	Set the output phase of channel 1 as 20°
:CHANnel1:BASE:PHAse?	Query returning 2e1

:CHANnel<n>:BASE:AMPLitude

- **Command format:**
  :CHANnel<n>:BASE:AMPLitude {<amp>}
  :CHANnel<n>:BASE:AMPLitude?
- **Functional description:**
  Set the output amplitude of designated channel.
  <amp> represents voltage (the unit is the designated unit of current channel). 1mVpp ~ maximum value under current load.
  If the current unit is VPP, then, maximum value under current load = current load * 20/(50 + current load)
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the output amplitude of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:BASE:AMPLitude 2	Set the output amplitude of channel 1 as 2V
:CHANnel1:BASE:AMPLitude?	Query returning 2e+0

:CHANnel<n>:BASE:OFFSet

- **Command format:**
  :CHANnel<n>:BASE:OFFSet {<voltage>}
  :CHANnel<n>:BASE:OFFSet?
- **Functional description:**
  Set the output DC offset of designated channel.
  <voltage> represent voltage (unit: V). The range is: 0~±Maximum DC under current load.
  Maximum DC under current load = Current load * 10/(50 + Current load) – Current AC minimum/2;
  AC minimum is 2mVpp. 0 is taken as the value in DC mode;
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the output DC offset of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:BASE:OFFSet 2	Set the output DC offset of channel 1 as 2V
:CHANnel1:BASE:OFFSet?	Query returning 2e+0

:CHANnel<n>:BASE:HIGH

- **Command format:**
  :CHANnel<n>:BASE:HIGH { <voltage>}
  :CHANnel<n>:BASE:HIGH?
- **Functional description:**
  Set the high value of the signal output of designated channel.
  <voltage> represents voltage. The unit is the designated unit of current channel.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the high value of the signal output of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:BASE:HIGH 2	Set the high value of the signal output of channel 1 to 2V
:CHANnel1:BASE:HIGH?	Query returning 2e+0

:CHANnel<n>:BASE:LOW

- **Command format:**
  :CHANnel<n>:BASE:LOW { <voltage>}
  :CHANnel<n>:BASE:LOW?
- **Functional description:**
  Set the low value of the signal output of designated channel.
  <voltage> represents voltage. The unit is the designated unit of current channel.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the low value of the signal output of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:BASE:LOW 2	Set the low value of the signal output of channel 1 to 2V
:CHANnel1:BASE:LOW?	Query returning 2e+0

:CHANnel<n>:BASE:DUTY

- **Command format:**
  :CHANnel<n>:BASE:DUTY { <duty>}
  :CHANnel<n>:BASE:DUTY?
- **Functional description:**
  Set the duty cycle of the signal output of designated channel.
  <duty> represents duty cycle (unit: %). The range is 0~100.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the duty cycle of the signal output of designated channel. Returning data by scientific notation.
- **Example:**

:CHANnel1:BASE:DUTY 20	Set the duty cycle of the signal output of channel 1 to 20%
:CHANnel1:BASE:DUTY?	Query returning 2e1

:CHANnel<n>:BASE:ARB

- **Command format:**

:CHANnel<n>:BASE:ARB <source>,<filename>
:CHANnel<n>:BASE:ARB?

- **Functional description:**

Set the designated channel to load arbitrary wave data of a certain file under the arbitrary wave source of fundamental wave.
<n>: Channel number. The value of n is taken as 1 and 2.
<source>: {INTernal|EXTernal|USER}, there are three types including internal, external, and self-defined.
<filename>: The file name of arbitrary waveform.

- **Example:**

:CHANnel1:BASE:ARB INTernal, "test.bsv"

:CHANnel<n>:RAMP:SYMMetry

- **Command format:**

:CHANnel<n>:RAMP:SYMMetry { < symmetry >}
:CHANnel<n>:RAMP:SYMMetry?

- **Functional description:**

Set the symmetry of the ramp signal output of designated channel.
< symmetry > represents symmetry (unit: %). The range is 0~100.
<n>: Channel number. The value of n is taken as 1 and 2.

- **Return format:**

Query returning the symmetry of the ramp signal output of designated channel.

- **Example:**

:CHANnel1:RAMP:SYMMetry 20	Set the symmetry of the ramp signal of channel 1 to 20%
:CHANnel1:RAMP:SYMMetry?	Query returning 20

:CHANnel<n>:PULSe:RISe

- **Command format:**

:CHANnel<n>:PULSe:RISe {<width>}
:CHANnel<n>:PULSe:RISe?

- **Functional description:**

Set the pulse width of rising edge of signal pulse of designated channel.
<width> represents pulse width (unit: s).
<n>: Channel number. The value of n is taken as 1 and 2.

- **Return format:**

Query returning the pulse width of rising edge of signal pulse of designated channel. Returning by scientific notation.

- **Example:**

:CHANnel1:PULSe:RISe 0.002	Set the pulse width of rising edge of signal of channel 1 to 2ms
:CHANnel1:PULSe:RISe?	Query returning 2e-3

:CHANnel<n>:PULSe:FALL

- **Command format:**

:CHANnel<n>:PULSe:FALL {<width>}
:CHANnel<n>:PULSe:FALL?

- **Functional description:**

Set the pulse width of falling edge of signal pulse of designated channel.
<width> represents pulse width (unit: s).
<n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

Query returning the pulse width of falling edge of signal pulse of designated channel. Returning by scientific notation.

- Example:

:CHANnel1:PULSe:FALL 0.002	Set the pulse width of falling edge of signal of channel 1 to 2ms
:CHANnel1:PULSe:FALL?	Query returning 2e-3

:CHANnel<n>:HARMonic:TYPe?

- Command format:

:CHANnel<n>:HARMonic:TYPe {ODD|EVEN|ALL|USER}
:CHANnel<n>:HARMonic:TYPe?

- Functional description:

Set the harmonic type of designated channel.
<n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

Query returning the harmonic type of designated channel.

- Example:

:CHANnel1:HARMonic:TYPe ODD	Set the harmonic type of channel 1 as odd harmonic
:CHANnel1:HARMonic:TYPe?	Query returning ODD

:CHANnel<n>:HARMonic:TOTal:ORDer?

- Command format:

:CHANnel<n>:HARMonic:TOTal:ORDer <order>
:CHANnel<n>:HARMonic:TOTal:ORDer?

- Functional description:

Set the maximum harmonic order of designated channel.
< order >: Harmonic order, with range at 2~16.
<n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

Query returning the maximum harmonic order of designated channel. Returning integer data.

- Example:

:CHANnel1:HARMonic:TOTal:ORDer 2	Set the maximum harmonic order of channel 1 to 2
:CHANnel1:HARMonic:TOTal:ORDer?	Query returning 2

:CHANnel<n>:HARMonic:USER:TYPe?

- Command format:

:CHANnel<n>:HARMonic:USER:TYPe #H<order>
:CHANnel<n>:HARMonic:USER:TYPe?

- Functional description:

Set the self-defined harmonic type of designated channel.
< order >: Self-defined harmonic type. #H represents hexadecimal number. X0111 1111 1111 1111 digits represent harmonic switch respectively.
<n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

Query returning the self-defined harmonic type of designated channel. Returning integer data.

- Example:

:CHANnel1:HARMonic:USER:TYPe #H7FFF Set the self-defined harmonic type of channel 1
:CHANnel1:HARMonic:USER:TYPe? Query returning 32767

:CHANnel<n>:HARMonic:ORDer?

- Command format:

:CHANnel<n>:HARMonic:ORDer <order>
:CHANnel<n>:HARMonic:ORDer?

- Functional description:

Set the harmonic order of designated channel.
< order >: Harmonic order, with range at 2~16.
<n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

Query returning the harmonic order of designated channel. Returning integer data.

- Example:

:CHANnel1:HARMonic:ORDer 2 Set the harmonic order of channel 1 to 2
:CHANnel1:HARMonic:ORDer? Query returning 2

:CHANnel<n>:HARMonic:ORDer<m>:AMPLitude?

- Command format:

:CHANnel<n>:HARMonic:ORDer<m>:AMPLitude <amp>
:CHANnel<n>:HARMonic:ORDer<m>:AMPLitude?

- Functional description:

Set the amplitude of designated harmonic order under designated channel.
< amp > represent amplitude (unit: Vpp).
<n>: Channel number. The value of n is taken as 1 and 2.
<m> represent harmonic order, with the value of m taken as 2~16.

- Return format:

Query returning the amplitude of designated harmonic order under designated channel. Returning by scientific notation.

- Example:

:CHANnel1:HARM:ORDER2:AMPL 0.02 Set the amplitude of order 2 under channel 1 to 20mVpp
:CHANnel1:HARM:ORDER2:AMPL? Query returning 2e-2

:CHANnel<n>:HARMonic:ORDer<m>:PHASe?

- Command format:

:CHANnel<n>:HARMonic:ORDer<m>:PHASe <phase>
:CHANnel<n>:HARMonic:ORDer<m>:PHASe?

- Functional description:

Set the phase value of designated harmonic order under designated channel.
<phase> represents phase value (unit: °)
<n>: Channel number. The value of n is taken as 1 and 2.
<m>: Harmonic order. The value of m is taken as 2~16.

- Return format:

Returning the phase value of designated harmonic order under designated channel. Returning by scientific notation.

- Example:

:CHANnel1:HARM:ORDer2:PHASe 20 Set the phase value of order 2 under channel 1 to 20°

:CHANnel1:HARM:ORDer2:PHASe? Query returning 2e+1

:CHANnel<n>:ARB:MODe

- **Command format:**
  :CHANnel<n>:ARB:MODe {DDS | POINTS }
  :CHANnel<n>:ARB:MODe?
- **Functional description:**
  Set the output modes of arbitrary wave of designated channel. The modes include DDS mode and pointwise mode.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query the mode of arbitrary wave of designated channel.
- **Example:**
  :CHANnel1:ARB:MODe DDS Set the mode of arbitrary wave of channel 1 to DDS mode
  :CHANnel1:ARB:MODe? Query returning DDS

Modulation

:CHANnel<n>:MODulate:TYPe

- **Command format:**
  :CHANnel<n>:MODulate:TYPe <type>
  :CHANnel<n>:MODulate:TYPe?
- **Functional description:**
  Set the modulation type of the signal of designated channel.
  <type>: {AM|FM|PM|ASK|FSK|PSK|BPSK|QPSK|OSK|QAM|PWM|SUM}
  The types include amplitude modulation, frequency modulation, phase modulation, amplitude-shift keying, frequency-shit keying, phase-shift keying, binary phase shift keying, quadri phase shift keying, oscillation keying, quadrature amplitude modulation, pulse width modulation, and summation modulation.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the modulation type of the signal of designated channel.
- **Example:**
  :CHANnel1:MODulate:TYPe AM Set the signal of channel 1 as AM modulation
  :CHANnel1:MODulate:TYPe? Query returning AM

:CHANnel<n>:MODulate:WAVe

- **Command format:**
  :CHANnel<n>:MODulate:WAVe { SINe|SQUare|UPRamp|DNRamp|ARB|NOISe }
  :CHANnel<n>:MODulate:WAVe?
- **Functional description:**
  Set the types of modulation wave of the signal of designated channel. The types include sine wave, square wave, upper triangular, lower triangular, arbitrary wave, and noise.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the type of modulation wave of the signal of designated channel.
- **Example:**

:CHANnel1:MODulate:WAVe SINe	Set the type of modulation wave of the signal of channel 1 to sine wave.
:CHANnel1:MODulate:WAVe?	Query returning SINe

:CHANnel<n>:MODulate:SOURce

- **Command format:**
  :CHANnel<n>:MODulate:SOURce { INTernal|EXTernal }
  :CHANnel<n>:MODulate:SOURce?
- **Functional description:**
  Set the modulation sources of designated channel. There are two types including internal and external.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the modulation source of designated channel.
- **Example:**

:CHANnel1:MODulate:SOURce INTernal	Set the modulation source of channel 1 as internal.
:CHANnel1:MODulate:SOURce?	Query returning INTernal

:CHANnel<n>:MODulate:FREQuency

- **Command format:**
  :CHANnel<n>:MODulate:FREQuency {<freq>}
  :CHANnel<n>:MODulate:FREQuency?
- **Functional description:**
  Set the modulation frequency of the signal of designated channel.
  <freq> represents frequency (unit: Hz).
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the modulation frequency of the signal of designated channel. Returning sampling by scientific notation.
- **Example:**

:CHANnel1:MODulate:FREQuency 2000	Set the modulation frequency of the signal of channel 1 to 2KHz
:CHANnel1:MODulate:FREQuency?	Query returning 2e+3

:CHANnel<n>:MODulate:IQMap

- **Command format:**
  :CHANnel<n>:MODulate: IQMap {<IQ TYPE>}
  :CHANnel<n>:MODulate: IQMap?
- **Functional description:**
  Set the IQ types of designated QAM as:
  QAM4, QAM8, QAM16, QAM32, QAM64, QAM128, and QAM256
  < IQ TYPE > represents the IO mapping type.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the IQ type of designated channel.
- **Example:**

:CHANnel1:MODulate:IQMap QAM32	Set the IQ mapping type of channel 1 as QAM32
:CHANnel1:MODulate:IQMap?	Query returning QAM32

:CHANnel<n>:MODulate:ARB

- **Command format:**
  :CHANnel<n>:MODulate:ARB <source>,<filename>
  :CHANnel<n>:MODulate:ARB?
- **Functional description:**
  Set the designated channel to load arbitrary wave data of a certain file under the arbitrary wave source.
  <n>: Channel number. The value of n is taken as 1 and 2.
  <source>: {INTernal|EXTernal|USER}, there are three types including internal, external, and self-defined.
  <filename>: The file name of arbitrary waveform.
- **Example:**
  :CHANnel1:MODulate:ARB INTernal, "test.bsv"

:CHANnel<n>:MODulate:DEPTh

- **Command format:**
  :CHANnel<n>:MODulate:DEPTh { <depth>}
  :CHANnel<n>:MODulate:DEPTh?
- **Functional description:**
  Set the modulation depth of designated channel.
  <depth> represents modulation depth (unit: %). 0% ~ 100%, and the depth of AM is 0% ~ 120%.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the modulation depth of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:MODulate:DEPTh 50	Set the modulation depth of channel 1 to 50%
:CHANnel1:MODulate:DEPTh?	Query returning 5e1

:CHANnel<n>:MODulate:RATio

- **Command format:**
  :CHANnel<n>:MODulate:RATio <ratio>
  :CHANnel<n>:MODulate:RATio?
- **Functional description:**
  Set the modulation ratio of designated channel. The command is only valid for the modulation type with ratio function.
  < ratio > represents ratio (unit: Hz).
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the modulation ratio of designated channel. Returning by scientific notation.
- **Example:**

:CHANnel1:MODulate:RATio 100	Set the ratio of channel 1 to 100Hz
:CHANnel1:MODulate:RATio?	Query returning 1e+2

:CHANnel<n>:FM:FREQuency:DEV

- **Command format:**
  :CHANnel<n>:FM:FREQuency:DEV { <freq>}
  :CHANnel<n>:FM:FREQuency:DEV?
- **Functional description:**

Set the frequency deviation of designated channel.
<freq> represents frequency deviation (unit: Hz). 0Hz ~ Current fundamental frequency
<n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

Query returning the frequency deviation of designated channel. Returning by scientific notation.

- Example:

:CHANnel1:FM:FREQuency:DEV 2000	Set the frequency offset of channel 1 to 2KHz
:CHANnel1:FM:FREQuency:DEV?	Query returning 2e+3

:CHANnel<n>:PM:PHASe:DEV

- Command format:

:CHANnel<n>:PM:PHASe:DEV { <phase>}
:CHANnel<n>:PM:PHASe:DEV?

- Functional description:

Set the output phase deviation of designated channel.
< phase > represents phase deviation (unit:°), with range at 0~360.
<n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

Query returning the output phase offset of designated channel. Returning data by scientific notation.

- Example:

:CHANnel1:PM:PHASe:DEV 30	Set the phase offset of channel 1 to 30°
:CHANnel1:PM:PHASe:DEV?	Query returning 3e1

:CHANnel<n>:PWM:DUTY

- Command format:

:CHANnel<n>:PWM:DUTY { <duty>}
:CHANnel<n>:PWM:DUTY?

- Functional description:

Set the designated channel to output the duty cycle under pulse width modulation.
< duty > represents duty cycle (unit: %), with range at 0~100.
<n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

Query returning the pulse width deviation under pulse width modulation of designated channel. Returning data by scientific notation.

- Example:

:CHANnel1:PWM:DUTY 10	Set the duty cycle of channel 1 to 10%
:CHANnel1:PWM:DUTY?	Query returning 1e+1

:CHANnel<n>:FSK:FREQuency

- Command format:

:CHANnel<n>:FSK:FREQuency { <freq>}
:CHANnel<n>:FSK:FREQuency?

- Functional description:

Set the designated channel to output the frequency hopping of MFSK. The command is valid only when the modulation mode is designated in advance.
< freq > represents frequency (unit: Hz).
<n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

Query returning the output of frequency hopping of designated channel. Returning data by scientific

notation.

- Example:

:CHANnel1:FSK:FREQ 2000	Set channel 1 to output 2KHz frequency hopping
:CHANnel1:FSK:FREQ?	Query returning 2e+3

:CHANnel<n>:PSK:PHASe<m>

- Command format:

  :CHANnel<n>:PSK:PHASe<m> { < phase >}

  :CHANnel<n>:PSK:PHASe<m>?

- Functional description:

  Set the designated channel to output the phase value of multiple-phase shift keying. The command is valid only when the modulation mode is designated in advance.

  < phase> represents phase (unit:°), with range at -360°~+360°

  <n>: Channel number. The value of n is taken as 1, 2, 3, and 4.

  <m>: Phase No.. The value of PSK is taken as 1.

- Return format:

  Query returning the phase value of PSK of designated channel. Returning data by scientific notation.

- Example:

:CHANnel1:PSK:PHAS1 90	Set the output phase of channel 1 to 90°
:CHANnel1:PSK:PHAS1?	Query returning 9e+1

:CHANnel<n>:OSK:TIMe

- Command format:

  :CHANnel<n>:OSK:TIMe { <time>}

  :CHANnel<n>:OSK:TIMe?

- Functional description:

  Set the oscillation time of oscillation keying of designated channel under modulation mode.

  < time > represents the oscillation time (unit: s)

  <n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

  Query returning the oscillation time of oscillation keying of designated channel under modulation mode. Returning data by scientific notation.

- Example:

:CHANnel1:OSK:TIMe 2ms	Set the oscillation time of oscillation keying of channel 1 to 2ms
:CHANnel1:OSK:TIMe?	Query returning 2e-3

Sweep

:CHANnel<n>:SWEep:TYPe

- Command format:

  :CHANnel<n>:SWEep:TYPe { LINe|LOG}

  :CHANnel<n>:SWEep:TYPe?

- Functional description:

  Set the sweep modes of designated channel. The modes include linear sweep and logarithmic sweep.

  <n>: Channel number. The value of n is taken as 1 and 2.

- Return format:

  Query returning the sweep mode of designated channel.

- Example:

:CHANnel1:SWEep:TYPe LINe	Set channel 1 to linear sweep mode.
:CHANnel1:SWEep:TYPe?	Query returning LINe

:CHANnel<n>:SWEep:FREQuency:STARt

- Command format:
  :CHANnel<n>:SWEep:FREQuency:STARt <freq>
  :CHANnel<n>:SWEep:FREQuency:STARt?
- Functional description:
  Set the start frequency of the sweep of designated channel.
  < freq > represents frequency (unit: Hz).
  <n>: Channel number. The value of n is taken as 1 and 2.
- Return format:
  Query returning the start frequency of the sweep of designated channel. Returning data by scientific notation.
- Example:

:CHANnel1:SWE:FREQ:STAR 2000	Set the start frequency of the output sweep of channel 1 to 2KHz
:CHANnel1:SWE:FREQ:STAR?	Query returning 2e+3

:CHANnel<n>:SWEep:FREQuency:STOP

- Command format:
  :CHANnel<n>:SWEep:FREQuency:STOP <freq>
  :CHANnel<n>:SWEep:FREQuency:STOP?
- Functional description:
  Set the stop frequency of the sweep of designated channel.
  < freq > represents frequency (unit: Hz).
  <n>: Channel number. The value of n is taken as 1 and 2.
- Return format:
  Query returning the stop frequency of the output sweep of designated channel. Returning data by scientific notation.
- Example:

:CHANnel1:SWE:FREQ:STOP 2000	Set the stop frequency of the output sweep of channel 1 to 2KHz
:CHANnel1:SWE:FREQ:STOP?	Query returning 2e+3

:CHANnel<n>:SWEep:TIMe

- Command format:
  :CHANnel<n>:SWEEP:TIMe <time>
  :CHANnel<n>:SWEEP:TIMe?
- Functional description:
  Set the sweep time of designated channel when sweeping frequency.
  < time > represents time (unit: s), with range at 1ms ~ 500s
  <n>: Channel number. The value of n is taken as 1 and 2.
- Return format:
  Query returning the sweep time of designated channel when sweeping frequency sweep. Returning data by scientific notation.
- Example:

:CHANnel1:SWEEP:TIMe 2	Set the sweep time of channel 1 to 2S when sweeping frequency
:CHANnel1:SWEEP:TIMe?	Query returning 2e+0

:CHANnel<n>:SWEep:TRIGger

- **Command format:**
  :CHANnel<n>:SWEep:TRIGger
- **Functional description:**
  Trigger the sweep output of designated channel. The parameter is valid only when set as manual trigger in triggering mode.
- **Example:**

:CHANnel1:SWEep:TRIGger	Trigger the output of sweep signal once

Burst

:CHANnel<n>:BURSt:TYPe

- **Command format:**
  :CHANnel<n>:BURSt:TYPe {NCYC|GATe|INFinit}
  :CHANnel<n>:BURSt:TYPe?
- **Functional description:**
  Set the burst types of designated channel. The types include N cycle, gate, and infinite.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the burst type of designated channel.
- **Example:**

:CHANnel1:BURSt:TYPe NCYC	Set the burst type of channel 1 as N cycle
:CHANnel1:BURSt:TYPe?	Query returning 2e+0

:CHANnel<n>:BURSt:PERiod

- **Command format:**
  :CHANnel<n>:BURSt:PERiod <period >
  :CHANnel<n>:BURSt:PERiod?
- **Functional description:**
  Set the burst period of designated channel.
  < period > represents time (unit: s).
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the burst period of designated channel. Returning data by scientific notation.
- **Example:**

:CHANnel1:BURSt:PERiod 5ms	Set the burst period of channel 1 to 5ms
:CHANnel1:BURSt:PERiod?	Query returning 5e-3

:CHANnel<n>:BURSt:PHASe

- **Command format:**
  :CHANnel<n>:BURSt:PHASe <phase>
  :CHANnel<n>:BURSt:PHASe?
- **Functional description:**
  Set the burst phase of designated channel.
  < phase > represents phase (unit:°), with range at 0 ~ 360
  <n>: Channel number. The value of n is taken as 1 and 2.

- **Return format:**
  Query returning the burst phase of designated channel. Returning data by scientific notation.
- **Example:**
  :CHANnel1:BURSt:PHASe 18 Set the burst phase of channel 1 to 18°
  :CHANnel1:BURSt:PHASe? Query returning 1.8e+1

:CHANnel<n>:BURSt:CYCLes

- **Command format:**
  :CHANnel<n>:BURSt:CYCLes <cycles>
  :CHANnel<n>:BURSt:CYCLes?
- **Functional description:**
  Set the burst cycle of designated channel.
  < cycles > represents cycles. An integer data.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the burst cycle of designated channel.
- **Example:**
  :CHANnel1:BURSt:CYCLes 2 Set the burst cycle of designated channel to 2
  :CHANnel1:BURSt:CYCLes? Query returning 2

:CHANnel<n>:BURSt:GATe:POLarity

- **Command format:**
  :CHANnel<n>:BURSt:GATe:POLarity {POSitive|NEGative}
  :CHANnel<n>:BURSt:GATe:POLarity?
- **Functional description:**
  Set the burst polarity of the gate of designated channel. The polarities include positive and negative.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Return format:**
  Query returning the burst polarity of the gate of designated channel.
- **Example:**
  :CHANnel1:BURSt:GATe:POLarity POSitive Set the burst polarity of the gate of channel 1 to positive
  :CHANnel1:BURSt:GATe:POLarity? Query returning POSitive

:CHANnel<n>:BURSt:TRIGger

- **Command format:**
  :CHANnel<n>:BURSt:TRIGger
- **Functional description:**
  Trigger the burst output of designated channel. The parameter is valid only when set as manual trigger in triggering mode.
  <n>: Channel number. The value of n is taken as 1 and 2.
- **Example:**
  :CHANnel1:BURSt:TRIGger Trigger the output of burst signal once

WARB command

Used to write file command of arbitrary waveform, including writing configuration for basic arbitrary waveform and modulated arbitrary waveform.

WARB<n>:MODulate

- **Command format:**
  WARB<n>:MODulate <arb file>
- **Functional description:**
  Used to write modulated arbitrary waveform. There are maximum 4k points for waveform data. Send the command and then send the file data of arbitrary waveform to signal source.
  <arb file> represents the file name of arbitrary waveform. The command supports data of .bsv format only.
- **Example:**
  WARB1:MODulate Write the file of modulated arbitrary waveform of channel 1

WARB<n>:CARRier

- **Command format:**
  AWG:WARB<n>:CARRier <arb file>
- **Functional description:**
  Used to write fundamental arbitrary waveform. There are maximum 4k points for waveform data. Send the command and then send the file data of arbitrary waveform to signal source.
  <arb file> represents the file of arbitrary waveform. The command supports data of .bsv format only.
- **Example:**
  WARB1: CARRier Write the file of fundamental arbitrary waveform of channel 1

DIGital command

Used to output digital communication signals, such as UART, SPI, I2C, etc.

:DIGital

- **Command format:**
  :DIGital {{1 | ON} | {0 | OFF}}
  :DIGital?
- **Functional description:**
  Set the designated channel to turn on/off the digital communication signal function.
- **Return format:**
  Query returning turning on/off the digital communication signal function. 0 denotes OFF; 1 denotes ON.
- **Example:**
  :DIGital ON Turn on the digital communication signal function
  :DIGital? Query returning 1

:DIGital:TYPe

- **Command format:**
  :DIGital:TYPe {UART|IIC|SPI|DArb }
  :DIGital:TYPe?
- **Functional description:**
  Set the designated channel to output the types of digital communication signal. The types include UART, IIC, SPI, and DArb.
- **Return format:**
  Query returning the output of the types of digital communication signal.

- Example:

  :DIGital:TYPe UART Set the type of the communication signal as UART
  :DIGital:TYPe? Query returning UART

:DIGital:FORMat

- Command format:

  :DIGital:FORMat { DEC|HEX|CHAR }
  :DIGital:FORMat?
- Functional description:

  Set the designated channel to output the data format of digital communication signal. The formats include decimal data, hexadecimal data, and ASCII data.
- Return format:

  Query returning the output of the data format of digital communication signal of designated channel.
- Example:

  :DIGital:FORMat HEX Set the data format of digital communication signal as hexadecimal data.
  :DIGital:FORMat? Query returning HEX

:DIGital:AS

- Command format:

  :DIGital:AS {{1 | ON} | {0 | OFF}}
  :DIGital:AS?
- Functional description:

  Set the designated channel to output the sending modes of digital communication signal. OFF denotes sending manually; ON denotes sending automatically.
- Return format:

  Query returning turning ON/OFF the automatic sending mode for the digital communication signal of designated channel. 1 denotes ON; 0 denotes OFF.
- Example:

  :DIGital:AS ON Set the sending mode of digital communication signal as automatic mode
  :DIGital:AS? Query returning 1

:DIGital:AS:INTerval

- Command format:

  :DIGital:AS:INTerval <time>
  :DIGital:AS:INTerval?
- Functional description:

  Set the designated channel to output the interval of digital communication signal automatically.
  <time> represents the interval (unit: s)
- Return format:

  Query returning the output of the interval of digital communication signal of designated channel. Returning data by scientific notation.
- Example:

  :DIGital:AS:INTerval 10ms Set the interval of automatic output of digital communication signal to 10ms
  :DIGital:AS:INTerval? Query returning 1e-2

:DIGital:TRIGger

- **Command format:**
  :DIGital:TRIGger
- **Functional description:**
  Trigger sending digital communication signal of designated channel. The function is valid in manual signal sending mode.
- **Example:**

:DIGital:TRIGger	Trigger sending digital signal once

:DIGital:DATA

- **Command format:**
  :DIGital:DATA <data>
  :DIGital:DATA?
- **Functional description:**
  Set the designated channel to output the data of digital communication signal automatically.
  <data>: Binary data of byte stream.
- **Return format:**
  Query returning the output of the data of digital communication signal of designated channel. Returning binary data of byte stream.
- **Example:**

:DIGital:DATA	Write the data of digital communication signal to the signal source
:DIGital:DATA?	Query returning binary data of byte stream

UART

:DIGital:UART:BAUDrate

- **Command format:**
  :DIGital:UART:BAUDrate <baudrate>
  :DIGital:UART:BAUDrate?
- **Functional description:**
  Set the designated channel to output the baud rate of digital UART communication signal.
  <baudrate> represents baud rate (unit: bps). The data type is integer.
- **Return format:**
  Query returning the output of the baud rate of digital UART communication signal of designated channel. Returning integer data.
- **Example:**

:DIGital:UART:BAUDrate 115200	Set the baud rate of UART communication signal to 115200
:DIGital:UART:BAUDrate?	Query returning 115200

:DIGital:UART:DATa

- **Command format:**
  :DIGital:UART:DATa <bit >
  :DIGital:UART:DATa?
- **Functional description:**
  Set the designated channel to output the data bit of digital UART communication signal.
  <bit > represent data bit. The data type is integer and the range is 4~8.

- Return format:
  Query returning the output of the data bit of digital UART communication signal of designated channel. Returning integer data.
- Example:
  :DIGital:UART:DATa 4 Set the data bit of UART communication signal to 4
  :DIGital:UART:DATa? Query returning 4

:DIGital:UART:STOP

- Command format:
  :DIGital:UART:STOP <bit >
  :DIGital:UART:STOP?
- Functional description:
  Set the designated channel to output the stop bit of digital UART communication signal of designated channel.
  <bit > represents stop bit. The data type is integer and the range is 1~2.
- Return format:
  Query returning the output of the stop bit of digital UART communication signal of designated channel. Returning integer data.
- Example:
  :DIGital:UART:STOP 1 Set the stop bit of UART communication signal to 1
  :DIGital:UART:STOP? Query returning 1

:DIGital:UART:PARity

- Command format:
  :DIGital:UART:PARity {NONE|EVEN|ODD}
  :DIGital:UART:PARity?
- Functional description:
  Set the designated channel to output the parity bits of digital UART communication signal. The parity bits include: "No parity bit", "Odd parity bit", and "Even parity bit".
- Return format:
  Query returning the output of the parity bit of digital UART communication signal of the designated channel. Returning integer data.
- Example:
  :DIGital:UART:PARity NONE Set the parity bit of the UART communication signal to "No parity bit"
  :DIGital:UART:PARity? Query returning NONE

IIC

:DIGital:IIC:CLOCk

- Command format:
  :DIGital:IIC:CLOCk <freq>
  :DIGital:IIC:CLOCk?
- Functional description:
  Set the designated channel to output the clock of digital IIC communication signal.
  <freq> represents the clock (unit: Hz).
- Return format:
  Query returning the output of the clock of digital IIC communication signal of designated channel. Returning by scientific notation.

- Example:

:DIGital:IIC:CLOCk 1000	Set the clock of IIC communication signal to 1KHz
:DIGital:IIC:CLOCk?	Query returning 1e+3

:DIGital:IIC:ADDRess

- Command format:

  :DIGital:IIC:ADDRess <address>

  :DIGital:IIC:ADDRess?
- Functional description:

  Set the designated channel to output the address of digital IIC communication signal.

  <address> represents address. The data type is integer.
- Return format:

  Query returning the output of the address of digital IIC communication signal of designated channel.
- Example:

:DIGital:IIC:ADDRess 3	Set the address of IIC communication signal to 3
:DIGital:IIC:ADDRess?	Query returning 3

SPI

:DIGital:SPI:CLOCk

- Command format:

  :DIGital:SPI:CLOCk <freq>

  :DIGital:SPI:CLOCk?
- Functional description:

  Set the designated channel to output the clock of digital SPI communication signal.

  <freq> represents clock (unit: Hz).
- Return format:

  Query returning the output of the clock of digital SPI communication signal. Returning by scientific notation.
- Example:

:DIGital:SPI:CLOCk 1000	Set the clock of SPI communication signal to 1KHz
:DIGital:SPI:CLOCk?	Query returning 1e+3

DISPlay command

Used for signal source to display related information.

:DISPlay:DATA?

- Command format:

  :DISPlay:DATA?
- Functional description:

  Used to query the current image data on the device screen.
- Return format:

  Query the returned image data. The returned data meets the binary data in IEEE 488.2 # format.
- Example:

:DISPlay:DATA?	Query returning image data
	Data format: #800012345+ bitmap data

Operating Instructions

This section describes some problems and solutions that occur during programming. If problems below occur, please handle with that according to the corresponding instructions.

Programming Preparation

The programming preparation only applies to those programming that using developing tools "Visual Studio" and "LabVIEW" in Windows operating system.

Please confirm that the VISA library of NI has been installed to your computer (available at https://www.ni.com/en-ca/support/downloads/drivers/download.ni-visa.html), the default installation path is C:\Program Files\IVI Foundation\VISA.

To establish communication with PC via the USB or LAN port of the instrument, please use USB cable to connect the USB DEVICE port at rear panel of the instrument to the USB port of PC, or use LAN data cable to the LAN port at rear panel of the instrument to the LAN port of PC.

VISA Programming

Some programming examples are described in this section. Through these examples, you will learn how to use VISA and control the instrument by the command of programming manual. More applications can be developed through the examples below:

VC++

- Environment：Window system, Visual Studio.
- Description: Access to the instrument through USBTMC and TCP/IP, and query the device information by sending "*IDN?" command in NI-VISA.
- Steps

1. Open Visual Studio software, and create a VC++ win32 console project.
2. Set the project environments that recall NI-VISA library to static library and dynamic library respectively.

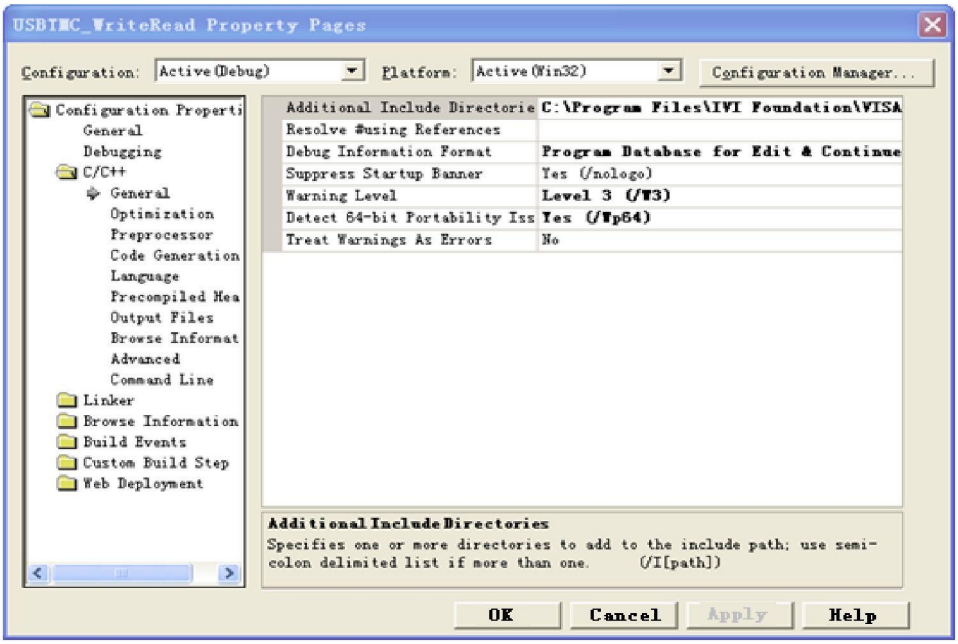
a) Static library

Find visa.h, visatype.h, and visa32.lib files in NI-VISA installation path, then copy them to the root path of VC++ project and add to the project. Add two lines of codes below in projectname.cpp file:

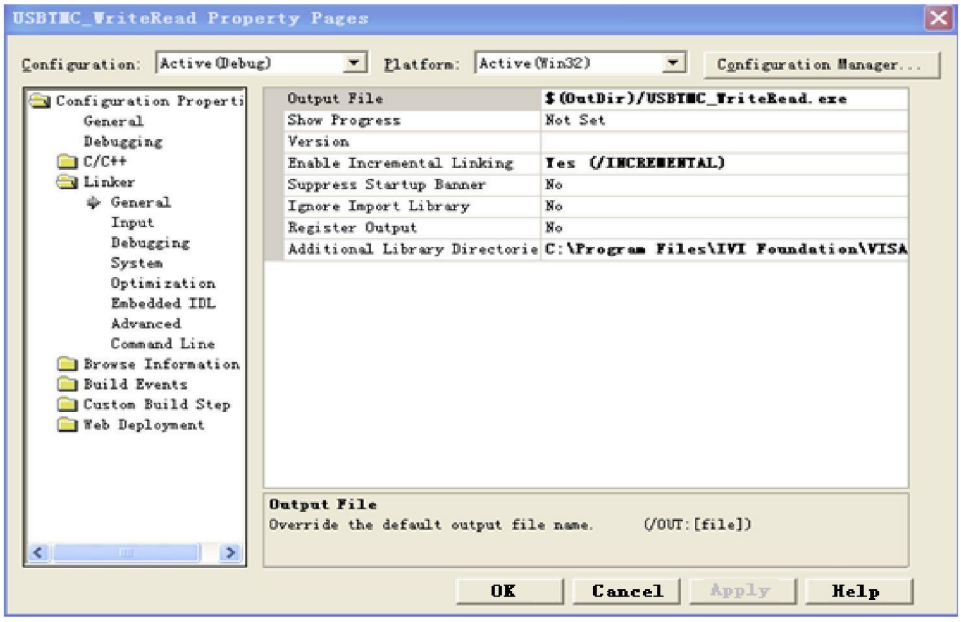
```
#include "visa.h"
#pragma comment(lib,"visa32.lib")
```

b) Dynamic library

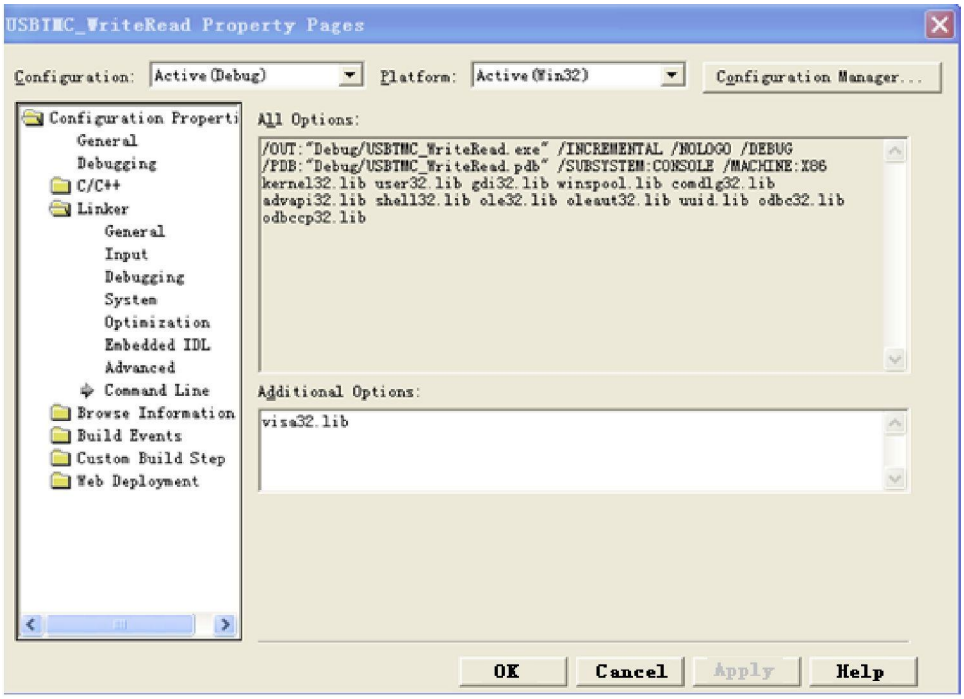
Click "project>>properties", select "c/c++---General" on the left side of the properties dialog box, then set the value of the option "Additional Include Directories" as the installation path of NI-VISA, (For example, C:\ProgramFiles\IVI Foundation\VISA\WinNT\include), as shown in the Figure below.



Select "Linker-General" on the left side of the properties dialog box, then set the value of the option "Additional Library Directories" as the installation path of NI-VISA, (For example, C:\Program Files\IVI Foundation\VISA\WinNT\include), as shown in the Figure below.



Select "Linker-Command Line" on the left side of the properties dialog box, then set the value of the option "Additional" as visa32.lib, as shown in the Figure below.



Add visa.h file on the projectname.cpp file:

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

1. Source code

a) USBTMC

```
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.
```

```
* 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;
ViUInt32 numInstrs;
ViFindList findList;
ViStatus status;
char instrResourceString[VI_FIND_BUFLEN];
unsigned char buffer[100];
int i;
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.");
    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 instrument.
            *We will now use the viPrintf function to send the device the string "*IDN?\n",
            *asking for the device's identification. */
            char * cmmand = "*IDN?\n";
            status = viPrintf(instr, cmmand);
            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[ ])
    {
        usbtmc_test();
        return 0;
    }
```

b) TCP/IP

```
    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[] = "::inst0::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("\nMesseage read from device: %*s\n", 0, 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;
}
```

C#

- Environment: Window system, Visual Studio.
- Description: Access to the instrument via USBTMC and TCP/IP, and query the device information by sending "*IDN?" command in NI-VISA.
- Steps

1. Open the Visual Studio software and create a C# console project.
2. Add the C# references (Ivi.Visa.dll"and "NationalInstruments.Visa.dll)of VISA.
3. Source code

a) USBTMC

```
class Program
{
    void usbtmc_test()
    {
        using (var rmSession = new ResourceManager())
        {
            var resources = rmSession.Find("USB?*INSTR");
            foreach (string s in resources)
            {
                try
                {
                    var mbSession = (MessageBasedSession)rmSession.Open(s);
                    mbSession.RawIO.Write("*IDN?\n");
                    System.Console.WriteLine(mbSession.RawIO.ReadString());
                }
                catch (Exception ex)
                {
                    System.Console.WriteLine(ex.Message);
                }
            }
        }

        void Main(string[ ] args)
        {
            usbtmc_test();
        }
}
```

b) TCP/IP

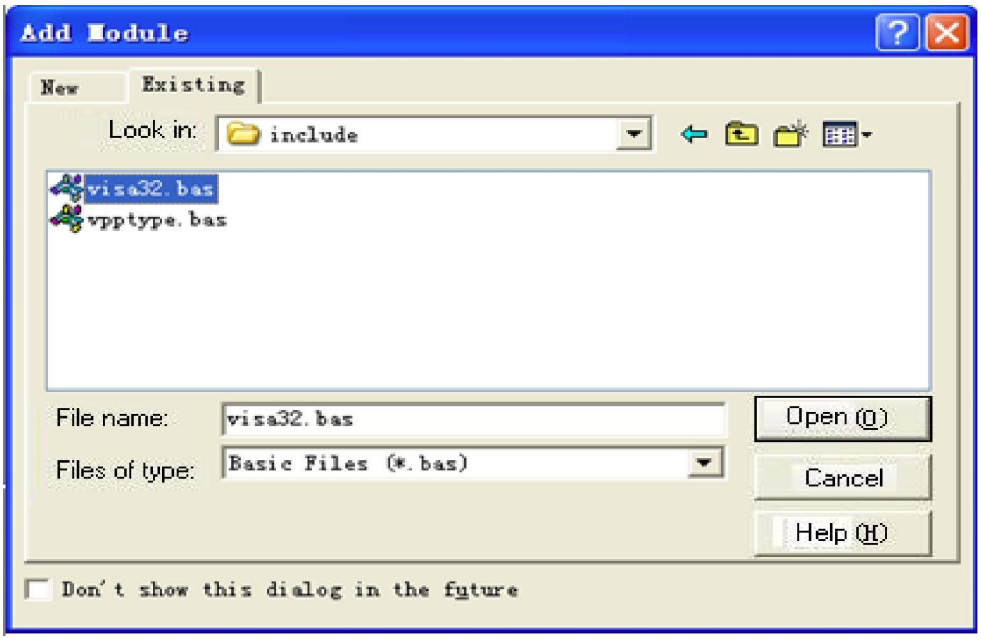
```
class Program
  {
    void tcp_ip_test(string ip)
    {
        using (var rmSession = new ResourceManager())
        {
            try
```

```
            {
                var resource = string.Format("TCPIP0::{0}::inst0::INSTR", ip);
                var mbSession = (MessageBasedSession)rmSession.Open(resource);
                mbSession.RawIO.Write("*IDN?\n");
                System.Console.WriteLine(mbSession.RawIO.ReadString());
            }
            catch (Exception ex)
            {
                System.Console.WriteLine(ex.Message);
            }
        }
    }

    void Main(string[] args)
    {
        tcp_ip_test("192.168.20.11");
    }
}
```

VB

- Environment: Window system, Microsoft Visual Basic 6.0
- Description: Access to the instrument via USBTMC and TCP/IP, and query the device information by sending "*IDN?" command in NI-VISA.
- Steps

1. Open the Visual Basic software and create a standard application project.
2. Set recalling the project environment of NI-VISA library: Click Existing tab of Project>>Add Existing Item, search the visa32.bas file in the "include" file folder on the NI-VISA installation path, then add the file. As shown in the Figure below.



3. Source code

a) USBTMC

```
PrivateFunction usbtmc_test() AsLong
```

```
' 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 AsLong
Dim instrsesn AsLong
Dim numInstrs AsLong
Dim findList AsLong
Dim retCount AsLong
Dim status AsLong
Dim instrResourceString AsString *VI_FIND_BUFLEN
Dim Buffer AsString * MAX_CNT
Dim i AsInteger

' 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
ExitFunction
EndIf

' 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) Then
    resultTxt.Text = "An error occurred while finding resources."
    viClose(defaultRM)
    usbtmc_test = status
ExitFunction
EndIf

' 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)
EndIf
        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
EndIf

' 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
EndIf

' 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." + CStr(i + 1)
Else
        resultTxt.Text = "Read from device: " + CStr(i + 1) + " " + Buffer
EndIf
        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
EndFunction
```

b) TCP/IP

```
PrivateFunction tcp_ip_test(ByVal ip AsString) AsLong
Dim outputBuffer AsString * VI_FIND_BUFLEN
Dim defaultRM AsLong
Dim instrsesn AsLong
```

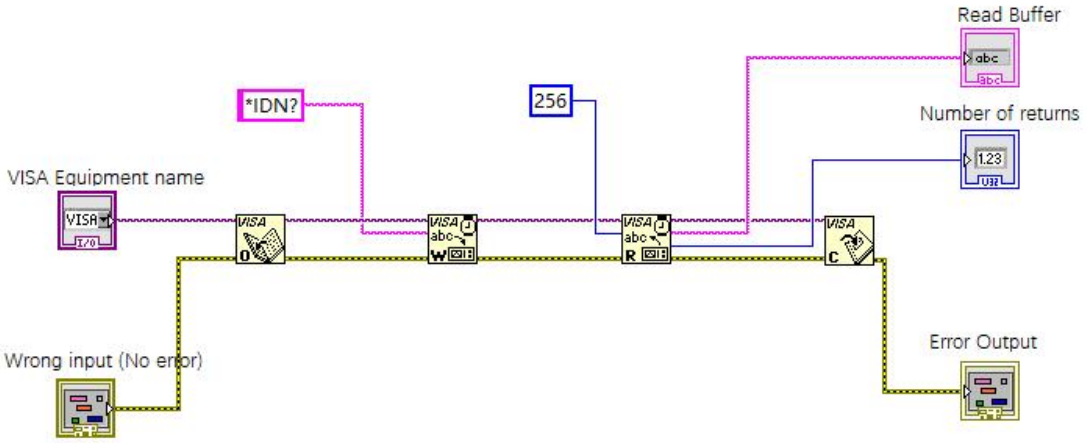
```
    Dim status AsLong
    Dim count AsLong

    ' First we will need to open the default resource manager.
    status = viOpenDefaultRM(defaultRM)
    If (status < VI_SUCCESS) Then
        resultTxt.Text = "Could not open a session to the VISA Resource Manager!"
        tcp_ip_test = status
    ExitFunction
    EndIf

    ' Now we will open a session via TCP/IP device
    status = viOpen(defaultRM, "TCPIP0::" + ip + "::inst0::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
    ExitFunction
    EndIf
    status = viWrite(instrsesn, "*IDN?", 5, count)
    If (status < VI_SUCCESS) Then
        resultTxt.Text = "Error writing to the device."
    EndIf
        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
    EndIf
        status = viClose(instrsesn)
        status = viClose(defaultRM)
        tcp_ip_test = 0
EndFunction
```

LabVIEW

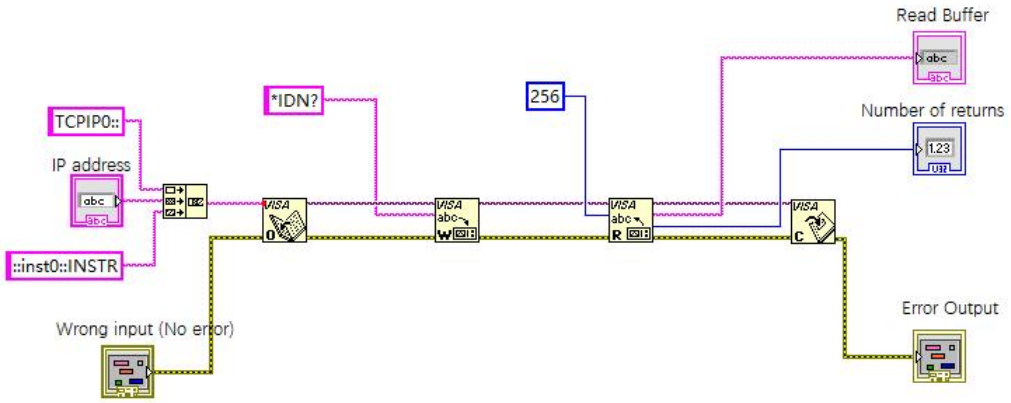
- Environment: Window system, LabVIEW.
- Description: Access to the instrument via USBTMC and TCP/IP, and query the device information by sending "*IDN?" command in NI-VISA.
- Steps

1. Open the LabVIEW software and create a VI file.
2. Add a control, right-click the interface of front panel, then select and add VISA resource name, wrong input, wrong output and partial indicators.
3. Open the block diagram interface, right-click the VISA resource name, then select and add the functions below from the VISA panel of the popup menu: VISA Write, VISA Read, VISA Open, and VISA Close
4. VI opens a VISA session of USBTMC device, and writes the *IDN? command for the device and reads back the response value. VI will close the VISA session after all communications are completed. As

shown in the Figure below.



5. Communicating with the device via TCP/IP resembles USBTMC, but the VISA Write and VISA READ functions shall be set as synchronous I/O. The default setting of LabVIEW is asynchronous IO. Right-click the node, then select "Synchronous I/O Mode>>Synchronous" form the shortcut menu, so as to achieve writing or reading data synchronously. As shown in the Figure below.



MATLAB

- Environment: Window system, MATLAB.
- Description: Access to the instrument via USBTMC and TCP/IP, and query the device information by sending "*IDN?" command in NI-VISA.
- **Steps**

1. Open the MATLAB software, then click File>>New>>Script on the Matlab interface to create an empty M file.
2. Source code

a) USBTMC

```
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::0x5345::0x1234::SN20220718::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
```

b) TCP/IP

```
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',['TCPIP0::','192.168.20.11','::inst0::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
```

Python

- Environment: Window system, Python3.8, PyVISA 1.11.0
- Description: Access to the instrument via USBTMC and TCP/IP, and query the device information by sending "*IDN?" command in NI-VISA.
- Steps

1. Install python, open the Python batch compiler, and create an empty test.py file.
2. Install PyVISA by using the pip install PyVISA command. If failure to install occurs, please access the link below for operating instructions: https://pyvisa.readthedocs.io/en/latest/
3. Source code

a) USBTMC

```
import pyvisa
rm = pyvisa.ResourceManager()
rm.list_resources()
my_instrument = rm.open_resource('USB0::0x5345::0x1234::SN20220718::INSTR')
print(my_instrument.query('*IDN?'))
```

b) TCP/TP

```
import pyvisa
rm = pyvisa.ResourceManager()
rm.list_resources()
my_instrument = rm.open_resource('TCPIP0::192.168.20.11::inst0::INSTR')
print(my_instrument.query('*IDN?'))
```

Examples of Programming

Configuring sine wave

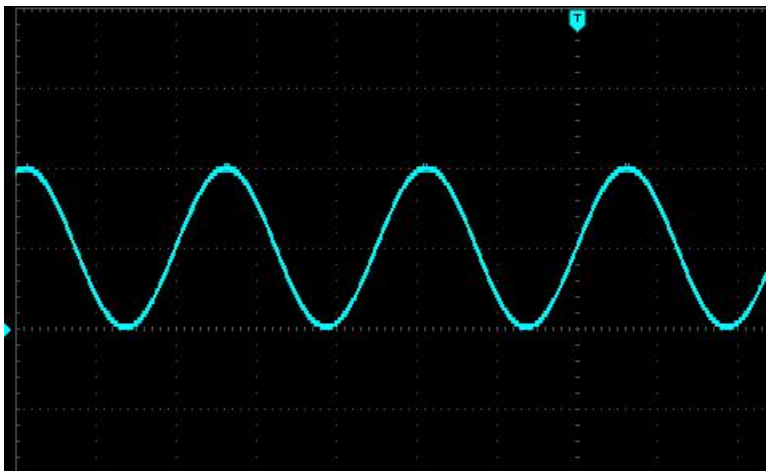
This section introduces how to configure sine wave function.

Description

For sine wave, there are amplitude, offset, and phase relative to synchronous pulse. The amplitude and offset of a sine wave can be set by using high and low voltage values.

Examples

The waveform below can be set by SCIP command series, and the high and low levels can be used to replace :CHANnel1:BASE:AMPLitude and :CHANnel1:BASE:OFFSet.



The commands below can generate the sine wave as shown above.

```
:CHANnel1:MODe CONTinue
:CHANnel1:BASE:WAVe SINe
:CHANnel1:BASE:FREQuency 2000
:CHANnel1:BASE:HIGH 2
:CHANnel1:BASE:LOW 0
:CHANnel1:BASE:PHAse 20
:CHANnel1:OUTPut ON
```

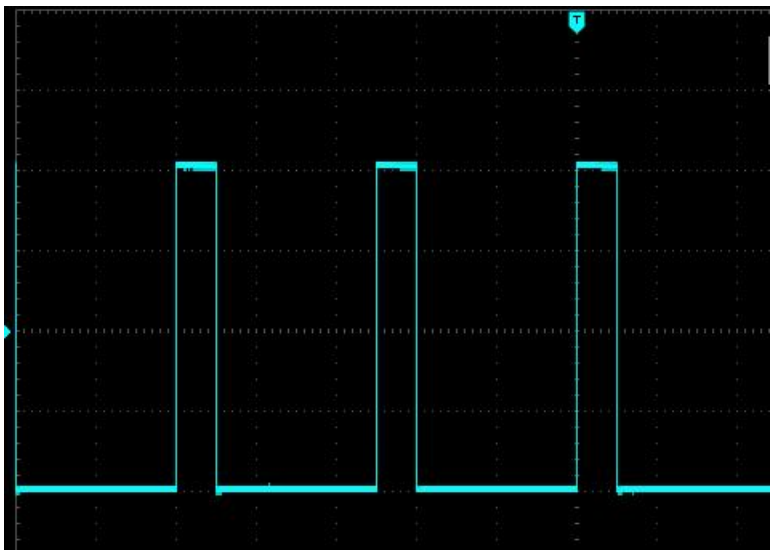
Configuring square wave

Description

For square wave, there are amplitude, offset, phase relative to synchronous pulse, duty cycle, and period. The amplitude and offset of a square wave can be set by using high and low voltage values.

Examples

The waveform below can be set by SCPI command series.



The commands below can generate the square wave as shown above.
:CHANnel1:MODe CONTinue
:CHANnel1:BASE:WAVe SQUare
:CHANnel1:BASE:FREQuency 40000
:CHANnel1:BASE:AMPLitude 2
:CHANnel1:BASE:OFFSet 0
:CHANnel1:BASE:PHAse 90
:CHANnel1:BASE:DUTY 20
:CHANnel1:OUTPut ON

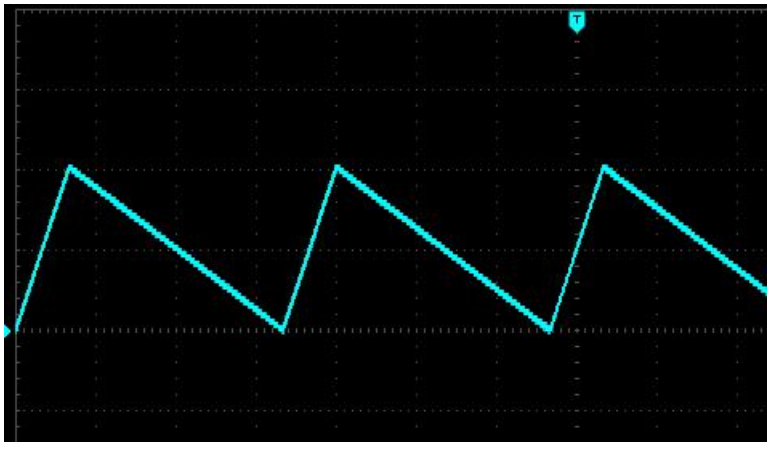
Configuring sawtooth wave

Description

For sawtooth wave, there are amplitude, offset, phase relative to synchronous pulse, and symmetry used to create triangular waveform and other similar waveforms. The amplitude and offset of a sawtooth wave can be set by using high and low voltage values.

Examples

The waveform below can be set by SCPI command series, and the high and low levels can be used to replace :CHANnel1:BASE:AMPLitude and :CHANnel1:BASE:OFFSet.



The commands below can generate the sawtooth wave as shown above.

:CHANnel1:MODe CONTinue
:CHANnel1:BASE:WAVe RAMP
:CHANnel1:BASE:FREQuency 30000
:CHANnel1:BASE:HIGH 2
:CHANnel1:BASE:LOW 0
:CHANnel1:BASE:PHAse 90
:CHANnel1:RAMP:SYMMetry 20
:CHANnel1:OUTPut ON

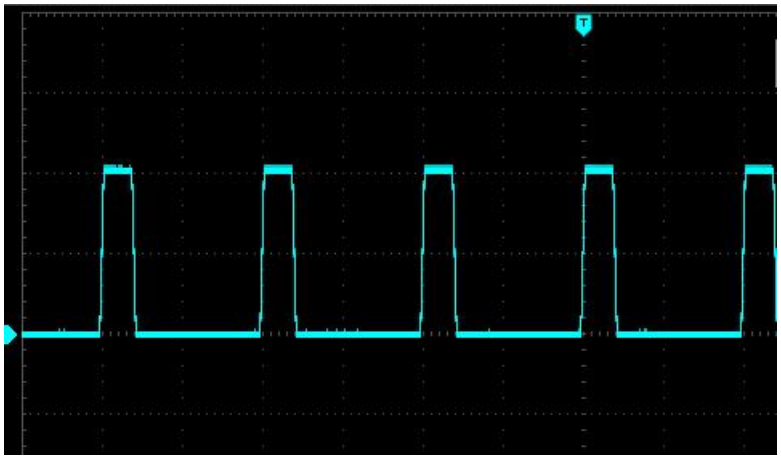
Configuring pulse wave

Description

For pulse width, there are amplitude, offset, and phase relative to synchronous pulse. It also adds edge slop and duty cycle (or pulse width). The amplitude and offset of a pulse wave can be set by using high and low voltage values.

Examples

The waveform below can be set by SCPI command series, and the high and low levels can be used to replace :CHANnel1:BASE:AMPLitude and :CHANnel1:BASE:OFFSet.



The commands below can generate the pulse wave as shown above.

:CHANnel1:MODe CONTinue
:CHANnel1:BASE:WAVe PULSe
:CHANnel1:BASE:FREQuency 100000
:CHANnel1:BASE:HIGH 2
:CHANnel1:BASE:LOW 0
:CHANnel1:BASE:PHAse 270
:CHANnel1:BASE:DUTY 20
:CHANnel1:PULSe:RISe 0.0000002
:CHANnel1:PULSe:FALL 0.0000002
:CHANnel1:OUTPut ON

Configuring arbitrary wave

This section introduces how to configure arbitrary wave.

Description

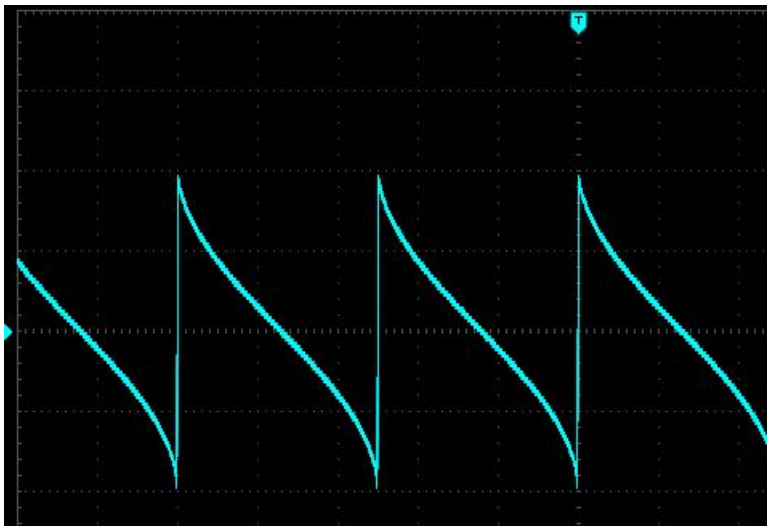
For harmonic wave, there are frequency, amplitude, offset, and phase. It also adds mode and waveform file.

Examples

The codes below can load and modify built-in arbitrary waveforms.

```
:CHANnel1:MODe CONTinue
:CHANnel1:BASE:WAVe ARB
:CHANnel1:ARB:MODe DDS
:CHANnel1:BASE:ARB INTernal,"ACos.bsv"
:CHANnel1:BASE:FREQuency 200000
:CHANnel1:BASE:AMPLitude 2
:CHANnel1:BASE:OFFSet 0
:CHANnel1:BASE:PHAse 90
:CHANnel1:OUTPut ON
```

The waveform generated from these commands is shown in the Figure below.



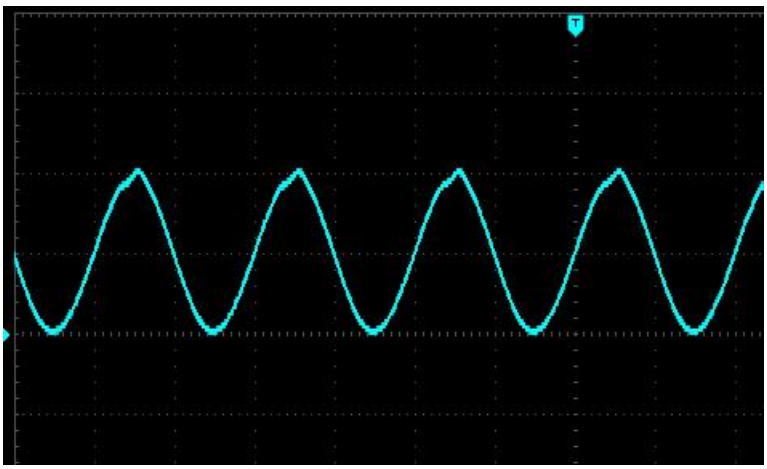
Configuring harmonic wave

Description

For harmonic wave, there are amplitude, offset, and phase. It also adds total harmonic order, harmonic amplitude, and harmonic phase. The amplitude and offset of a harmonic wave can be set by using high and low voltage values.

Examples

The waveform below can be set by SCPI command series, and the high and low levels can be used to replace :CHANnel1:BASE:AMPLitude and :CHANnel1:BASE:OFFSet.



The commands below can generate the harmonic wave as shown above.

:CHANnel1:MODe CONTinue
:CHANnel1:BASE:WAVe HARMonic
:CHANnel1:BASE:FREQuency 1000
:CHANnel1:BASE:HIGH 1
:CHANnel1:BASE:LOW 0
:CHANnel1:BASE:PHAse 90
:CHANnel1:HARMonic:TOTal:ORDer 10
:CHANnel1:HARMonic:TYPe ALL
:CHANnel1:HARM:ORDER2:AMPL 0.02
:CHANnel1:HARM:ORDer2:PHASe 20
:CHANnel1:HARM:ORDER3:AMPL 0.01
:CHANnel1:HARM:ORDer3:PHASe 30
:CHANnel1:OUTPut ON

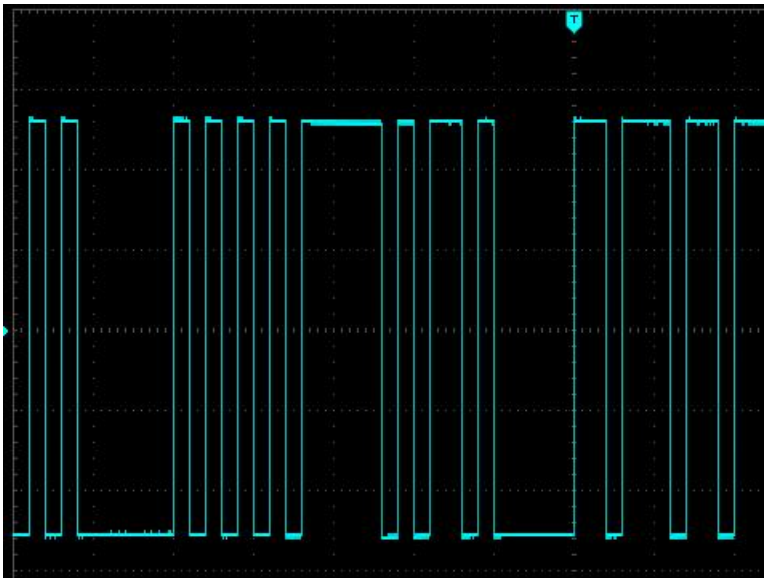
Configuring pseudo-random wave

Description

For pseudo-random wave, there are bit rate, offset, edge time, symbol, and other attributes. The amplitude and offset of a pseudo-random wave can be set by using high and low voltage values.

Example

The waveform below can be set by SCPI command series, and the high and low levels can be used to replace :CHANnel1:BASE:AMPLitude and :CHANnel1:BASE:OFFSet.



The commands below can generate the harmonic wave as shown above.

:CHANnel1:MODe CONTinue
:CHANnel1:BASE:WAVe PRBS
:CHANnel1:PRBS:BITRatio 1000000
:CHANnel1:BASE:HIGH 1
:CHANnel1:BASE:LOW 0
:CHANnel1:PNCode PN9
:CHANnel1:OUTPut ON

Appendix 1：<key> list

Keyword of Key Command	Functional descriptions	LED Light
MOD	Modulation	
SWEep	Sweep	
BURSt	Burst	
SINe	Sine Wave	
SQUare	Square Wave	
RAMP	Ramp Wave	
PULSe	Pulse Wave	
ARB	Arbitrary Wave	
HARMonic	Harmonic Wave	
NOISe	Noise	
DC	Direct Current	
CH1	Channel 1 Key	√
CH2	Channel 2 key	√
UTILity	System	
RIGHT	Direction Key (Right)	
LEFT/BACKspace	Direction Key/Backspace	
OK	Confirmation Key	
UP	Direction Key (Up)	
DOWN	Direction Key (Down)	
NUM0	Numeric Key (Number: 0)	
NUM1	Numeric Key (Number: 1)	
NUM2	Numeric Key (Number: 2)	
NUM3	Numeric Key (Number: 3)	
NUM4	Numeric Key (Number: 4)	
NUM5	Numeric Key (Number: 5)	
NUM6	Numeric Key (Number: 6)	
NUM7	Numeric Key (Number: 7)	
NUM8	Numeric Key (Number: 8)	
NUM9	Numeric Key (Number: 9)	
DOT	Decimal Point (Number Key)	
SYMBOL	Symbol (Numeric Key)	

Appendix 2: State (unlocked/locked) of buttons

Order of bits	Buttons	State
0	MOD	0 for Unlocked; 1 for Locked
1	SWEep	0 for Unlocked; 1 for Locked
2	BURSt	0 for Unlocked; 1 for Locked
3	SINe	0 for Unlocked; 1 for Locked
4	SQUare	0 for Unlocked; 1 for Locked
5	RAMP	0 for Unlocked; 1 for Locked
6	PULSe	0 for Unlocked; 1 for Locked
7	ARB	0 for Unlocked; 1 for Locked
8	HARMonic	0 for Unlocked; 1 for Locked
9	NOISe	0 for Unlocked; 1 for Locked
10	DC	0 for Unlocked; 1 for Locked
11	CH1	0 for Unlocked; 1 for Locked
12	CH2	0 for Unlocked; 1 for Locked
13	UTILity	0 for Unlocked; 1 for Locked
14	RIGHT	0 for Unlocked; 1 for Locked
15	LEFT/BACKspace	0 for Unlocked; 1 for Locked
16	OK	0 for Unlocked; 1 for Locked
17	UP	0 for Unlocked; 1 for Locked
18	DOWN	0 for Unlocked; 1 for Locked
19	NUM0	0 for Unlocked; 1 for Locked
20	NUM1	0 for Unlocked; 1 for Locked
21	NUM2	0 for Unlocked; 1 for Locked
22	NUM3	0 for Unlocked; 1 for Locked
23	NUM4	0 for Unlocked; 1 for Locked
24	NUM5	0 for Unlocked; 1 for Locked
25	NUM6	0 for Unlocked; 1 for Locked
26	NUM7	0 for Unlocked; 1 for Locked
27	NUM8	0 for Unlocked; 1 for Locked
28	NUM9	0 for Unlocked; 1 for Locked
29	DOT	0 for Unlocked; 1 for Locked
30	SYMBOL	0 for Unlocked; 1 for Locked