Programmer's Manual V1.43

Signal Generator Models

APSIN, APGEN, APSYN, APMS

WARRANTY

All Anapico instruments are warranted against defects in material and workmanship for a period of two years from the date of shipment. AnaPico will, at its option, repair or replace products that prove to be defective during the warranty period, provided they are returned to Anapico and provided the preventative maintenance procedures are followed. Repairs necessitated by misuse of the product are not covered by this warranty. No other warranties are expressed or implied, including but not limited to implied warranties of merchantability and fitness for a particular purpose. Anapico is not liable for consequential damages. The warranty on the internal rechargeable batteries (option B3) is one year from the date of shipment. Battery replacement is available through Anapico and its distributors.

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1   Introduction

This manual provides information for remote operation of the Anapico Signal Generators using commands sent from an external controller via Ethernet, USB, or GPIB. It includes the following:

- A general description of the LAN and the bus data transfer and control functions

- A general description of how to establish connection via LAN, USB, or GPIB

- A listing of the IEEE-488 Interface Function Messages recognized by the signal generator with a description of its response

- A complete listing and description of all the Standard Commands for Programmable Instruments (SCPI) commands that can be used to control signal generator operation with examples of command usage

2 Programming the instrument

All instruments described in this manual can be accessed through LAN, USB or GIPB interface. All interfaces use standard SCPI command set to pass commands to the device.

While LAN is the preferred interface for Anapico instruments, GPIB is only optionally available for some models.

2.1 Ethernet LAN

All Anapico signal generators are preferably remotely programmed via a 10/100Base-T LAN interface and LAN-connected computer using one of several LAN interface protocols. The LAN allows instruments to be connected together and controlled by a LAN based computer. LAN and its associated interface operations are defined in the IEEE 802.2 standard.

All instruments support the following LAN interface protocols:

- **Socket based LAN:** The application programming interface (API) provided with the instrument supports general programming using the LAN interface under Windows operating system.

- **VXI-11**

- **Telephone Network** (TELNET): TELNET is used for interactive, one command at a time instrument control.

- **Internet protocol** optionally supported

For LAN operation, the signal generator must be connected to the LAN, and an IP address must be assigned to the signal generator either manually or by using DHCP client service. Your system administrator can tell you which method to use. Most current LAN networks use DHCP.

DHCP Configuration

If the DHCP server uses dynamic DNS to link the hostname with the assigned IP address, the hostname may be used in place of the IP address. Otherwise, the hostname is not usable.

2.1.1 Ethernet Interface Connection and Setup

The instrument fully supports the IEEE-802.3 standard. Most front panel functions (except power on/off) can be remotely controlled via a network server and an Ethernet connection. The instrument firmware supports the TCP/IP network protocol.

Ethernet uses a bus or star topologies where all of the interfacing devices are connected to a central cable called the bus or are connected to a hub. Ethernet uses the CSMA/CD access method to handle simultaneous transmissions over the bus. CSMA/CD stands for *Carrier Sense Multiple Access/Collision Detection*. This standard enables network devices to detect simultaneous data channel usage, called a *collision*, and provides for a contention protocol. When a network device detects a collision, the CSMA/CD standard dictates that the data will be retransmitted after waiting a random amount of time. If a second collision is detected, the data is again retransmitted after waiting twice as long. This is known as exponential back off.

The TCP/IP setup requires the following:

• IP Address: Every computer/electronic device in a TCP/IP network requires an IP address. An IP address has four numbers (each between 0 and 255) separated by periods.

For example: 192.168.1.50 is a valid IP address.

• Subnet Mask: The subnet mask distinguishes the portion of the IP address that is the network ID from the portion that is the station ID. The subnet mask 255.255.0.0, when applied to the IP address given above, would identify the network ID as 192.168 and the station ID as 1.50. All stations in the same local area network should have the same network ID, but different station IDs.

• Default Gateway: A TCP/IP network can have a gateway to communicate beyond the LAN identified by the network ID. A gateway is a computer or electronic device that is connected to two different networks and can move TCP/IP data from one network to the other. A single LAN that is not connected to other LANs requires a default gateway setting of 0.0.0.0. If you have a gateway, then the default gateway would be set to the appropriate value of your gateway.

• MAC Address: A MAC address is a unique 48-bit value that identifies a network interface card to the rest of the network. Every network card has a unique MAC address permanently stored into its memory.

Interface between the instrument and other devices on the network is connected to a network via a category five (CAT-5) interface cable . This cable uses four twisted pairs of copper insulators terminated into an RJ45 connector. CAT-5 cabling is capable of supporting frequencies up to 100 MHz and data transfer speeds up to 1 Gbps, which accommodates 1000Base-T, 100Base-T, and 10Base-T networks.

Generally, a VISA I/O library (like NI-VISA™) is used on the server side to facilitate the communications. A VISA installation on the controller is a prerequisite for remote control over LAN interface. VISA is a standardized software interface library providing input and output functions to communicate with instruments. For more information about VISA refer to the VISA library supplier's documentation.

Only the IP address or the device name is required for link setup. The IP address/device name is part of the "visa resource string" used by the programs for identification and control of the instrument. The visa resource string has the form:

TCPIP::ipaddr::inst0::INSTR

ipaddr has to be replaced by the IP address or the computer name of the instrument.

For instance, if the instrument has the IP address 192.168.1.50, *TCPIP::192.168.1.50::inst0::INSTR* is the valid resource name. Specification of **inst0** in the resource name is optional. In this example, also

TCPIP::192.168.1.50::INSTR is therefore a valid resource name.

TCPIP designates the network protocol used and **INSTR** indicates that the VXI-11 protocol is used. If several instruments are connected to the network, each instrument has its own IP address and associated resource name. The controller identifies these instruments by means of the resource name.

2.1.2 Using Sockets LAN

Sockets LAN is a method used to communicate with the signal generator over the LAN interface using the Transmission Control Protocol/Internet Protocol (TCP/IP). A socket is a fundamental technology used for computer networking and allows applications to communicate using standard mechanisms built into network hardware and operating systems. The method accesses a port on the signal generator from which bidirectional communication with a network computer can be established.

Sockets LAN can be described as an internet address that combines Internet Protocol (IP) with a device port number and represents a single connection between two pieces of software. The socket can be accessed using code libraries packaged with the computer operating system. Two common versions of socket libraries are the Berkeley Sockets Library for UNIX systems and Winsock for Microsoft operating systems.

Your signal generator implements a socket Applications Programming Interface (API) that is compatible with Berkeley socket for UNIX systems and Winsock for Microsoft systems. The signal generator is also compatible with other standard sockets APIs. The signal generator can be controlled using predefined SCPI functions once the socket connection is established in your program. Socket connection is available on **port 18**.

2.1.3 Using and Configuring VXI-11 (VISA)

The signal generator supports the LAN interface protocol described in the VXI-11 standard. VXI-11 is an instrument control protocol based on Open Network Computing/Remote Procedure Call (ONC/RPC) interfaces running over TCP/IP.

A range of standard software such as NI-VISA or Agilent IO Config is available to setup the computer-signal generator interface for the VXI- 11 protocol. Please refer to the applicable software user manual and documentation for information on running the program and configuring the VXI-11 interface. The program is used to configure the LAN client. Once the computer is configured for a LAN client, you can use the VXI- 11 protocol and the VISA library to send SCPI commands to the signal generator over the LAN interface. Example programs are available on request under support@anapico.com.

VISA is an IO library used to develop IO applications and instrument drivers that comply with industry standards. It is recommended to use the VISA library for programming the signal generator.. The NI-VISA and Agilent VISA libraries are similar implementations of VISA and have the same commands, syntax, and functions.

2.1.4 Using Telnet LAN (Port 18)

Telnet provides a means of communicating with the signal generator over the LAN. The Telnet client, run on a LAN connected computer, will create a login session on the signal generator. A connection, established between computer and signal generator, generates a user interface display screen with ">" prompts on the command line.

Using the Telnet protocol to send commands to the signal generator is similar to communicating with the signal generator over LAN. You establish a connection with the signal generator and then send or

receive information using predefined commands. Communication is interactive: one command at a time. The telnet service is available on **port 18**.

Once a telnet session to the device is established, the echo can be enabled by typing

SYST:COMM:SOCK:ECHO ON

Following this command a prompt ">>" should become visible.

2.2 USB (USBTMC)

All instruments support the following USB interface protocols:

1) **USBTMC class device via VISA**: **USBTMC** stands for **USB Test & Measurement Class**. USBTMC is a protocol built on top of USB that allows GPIB-like communication with USB devices. From the user's point of view, the USB device behaves just like a GPIB device. USBTMC allows instrument manufacturers to upgrade the physical layer from GPIB to USB while maintaining software compatibility with existing software such as instrument drivers and any application that uses VISA. This is also what the VXI-11 protocol provides for TCP/IP.

2) **USBTMC with IVI drivers:** the application programming interface (API) provided with the instrument supports general programming using the USB interface under Windows operating system using the IVI drivers.

2.2.1 USB-TMC Interface Connection and Setup using VISA

USBTMC stands for USB Test & Measurement Class. USBTMC is a protocol built on top of USB that allows GPIB-like communication with USB devices. From the user's point of view, the USB device behaves just like a GPIB device. For example, you can use VISA Write to send the *IDN? query and use VISA Read to get the response. The USBTMC protocol supports service request, triggers and other GPIB specific operations.

USBTMC upgrades the physical layer from GPIB to USB while maintaining software compatibility with existing software such as instrument drivers and any application that uses VISA. This is also what the VXI-11 protocol provides for TCP/IP.

NI-VISA 3.0 or later allows you to communicate as a controller to APSIN devices. NI-VISA is configured to detect USBTMC compliant instruments such as the APSIN. To use such a device, plug it in and Windows should detect the new hardware and launch the New Hardware Wizard. Instruct the wizard to search for the driver, which in this case is NI-VISA. If NI-VISA is properly installed, the device will be installed as a USB Test & Measurement Class Device. Open Measurement & Automation Explorer (MAX). The new device will appear in MAX under Device and Interfaces » USB Devices. You can then use this resource name as you would use any GPIB resource.

2.2.2 USB-TMC Interface Connection and Setup using Anapico API

Anapico API programming interface supports direct communication to instruments using Anapico's proprietary DLL driver libraries.

Please contact Anapico for more detailed documentation, programming samples, and updates on the DLL library.

2.3 GPIB Interface Connection and Setup

2.3.1 General GPIB information

GPIB (General Purpose Interface Bus) is an interface standard for connecting computers and peripherals, which supports the following international standards: IEEE 488.1, IEC-625, IEEE 488.2, and JIS-C1901. The GPIB interface allows you to control the APPH from an external computer. The computer sends commands and instructions to the APPH and receives data sent from the APPH via GPIB.
 You can connect up to 15 devices in a single GPIB system.
The length of cables to connect between devices must be 4 m or less. The total length of connecting cables in a single GPIB system must be 2 m × the number of connected devices (including the controller) or less. You cannot construct the system in which the total cable length exceeds 20 m. The number of connectors connected to an individual device must be 4 or less. If you connect 5 or more connectors, excessive force is applied to the connector part, which may result in failure.

You can choose the device connection topology from star, linear, and combined. Loop connection is not allowed.

2.4 SCPI Commands

The Standard Commands for Programmable Instrumentation (SCPI) provides a uniform and consistent language to control programmable test and measurement devices in instrumentation

systems. The SCPI Standard is built on the foundation of IEEE-488.2, Standard Codes and Formats. It requires conformance to IEEE-488.2, but is pure software standard. SCPI syntax is ASCII text, and therefore can be attached to any computer test language such as BASIC, C, or C++. It can also be used with Test Application Environments such as LabWindows/CVI, LabVIEW™, or Matlab®. SCPI is hardware independent. SCPI strings can be sent over any instrument interface. It works equally well over USB-TMC, GPIB, RS-232, VXIbus or LAN networks.

Please see the chapter 4 for detailed description of supported SCPI commands.

3 IEEE-488 Interface Commands

3.1 IEEE Mandated and Optional Common Commands

The required common commands are IEEE-488.2 mandated commands that are defined in the IEEE-488.2 standard and must be implemented by all SCPI compatible instruments. These commands are identified by the asterisk (*) at the beginning of the command keyword. These commands are used to control instrument status registers, status reporting, synchronization, and other common functions.

Commands declared mandatory by *IEEE 488.2*.

*CLS Clear Status Command

*ESE Standard Event Status Enable Command

*ESE? Standard Event Status Enable Query

*ESR? Standard Event Status Register Query

*IDN? Identification Query

*OPC Operation Complete Command

*OPC? Operation Complete Query

*RST Reset Command

*SRE Service Request Enable Command

*SRE? Service Request Enable Query

*STB? Read Status Byte Query

*TST? Self-Test Query

*WAI Wait-to-Continue Command

Optional common commands described by *IEEE 488.2*

*OPT? Option Identification Query

3.1.1 *CLS

The Clear Status (CLS) command clears the status byte by emptying the error queue and clearing all the event registers including the Data Questionable Event Register, the Standard Event Status Register, the Standard Operation Status Register and any other registers that are summarized in the status byte.

3.1.2 *ESE <data>

The Standard Event Status Enable (ESE) command sets the Standard Event Status Enable Register. The variable <data> represents the sum of the bits that will be enabled.

Range 0–255

Remarks The setting enabled by this command is not affected by signal generator preset or *RST. However, cycling the signal generator power will reset this register to zero.

3.1.3 *ESE?

The Standard Event Status Enable (ESE) query returns the value of the Standard Event Status Enable Register.

NOTE: Reading the Standard Event Status Register clears it

Remarks: The Register is not affected by signal generator preset or *RST. However, cycling the signal generator power will reset this register to zero.

3.1.4 *IDN?

The Identification (IDN) query outputs an identifying string. The response will show the following information: <company name>, <model number>, <serial number>, <firmware revision>

3.1.5 *OPC

The Operation Complete (OPC) command sets bit 0 in the Standard Event Status Register when all pending operations have finished.

The Operation Complete command causes the device to set the operation complete bit (bit 0) in the Standard Event Status Register when all pending operations have been finished.

3.1.6 *OPC?

The Operation Complete (OPC) query returns the ASCII character 1 in the Standard Event Status Register when all pending operations have finished.

This query stops any new commands from being processed until the current processing is complete. This command blocks the communication until *all* operations are complete (i.e. the timeout setting should be longer than the longest sweep).

3.1.7 *OPT?

The options (OPT) query returns a comma-separated list of all currently installed instrument options on the signal generator.

Returned option strings are:

0	Basic device
B3	Rechargeable battery pack
PE|PE2|PE3	Extended power range
AVIO	ILS and VOR modulations
GPIB	GPIB (IEEE 488) programming interface

3.1.8 *RCL <reg>

The Recall (RCL) command recalls the state from the specified memory register <reg>.

3.1.9 *RST

The Reset (RST) command resets most signal generator functions to factory- defined conditions.

Remarks Each command shows the [*RST] default value if the setting is affected.

3.1.10 *SAV <reg>

The Save (SAV) command saves signal generator settings to the specified memory register <reg>.

Remarks The save function does not save all signal generator settings. Refer to the *User's Guide* for more information on the save function.

3.1.11 *SRE <data>

The Service Request Enable (SRE) command sets the value of the Service Request Enable Register. The variable <data> is the decimal sum of the bits that will be enabled. Bit 6 (value 64) is ignored and cannot be set by this command.

Range 0–255

The setting enabled by this command is not affected by signal generator preset or

*RST. However, cycling the signal generator power will reset it to zero.

3.1.12 *SRE?

The Service Request Enable (SRE) query returns the value of the Service Request Enable Register.

Range 0–63 & 128-191

3.1.13 *STB?

The Read Status Byte (STB) query returns the value of the status byte including the master summary status (MSS) bit.

Range 0–255

3.1.14 *TRG

The Trigger (TRG) command triggers the device if LAN is the selected trigger source, otherwise, *TRG is ignored.

3.1.15 *TST?

The Self-Test (TST) query initiates the internal self- test and returns one of the following results:

0 This shows that all tests passed.

1 This shows that one or more tests failed.

3.1.16 *WAI

The Wait- to- Continue (WAI) command causes the signal generator to wait until all pending commands are completed, before executing any other commands.

4 SCPI Commands

This chapter provides an introduction to SCPI programming that includes descriptions of the command types, hierarchical command structure, data parameters, and notational conventions. Information on APSIN status system and trigger system programming is also provided.

4.1 Introduction

Standard Commands for Programmable Instruments (SCPI) is the new instrument command language for controlling instruments that goes beyond *IEEE 488.2* to address a wide variety of instrument functions in a standard manner. SCPI promotes consistency, from the remote programming standpoint, between instruments of the same class and between instruments with the same functional capability. For a given measurement function such as frequency or voltage, SCPI defines the specific command set that is available for that function. Thus, two oscilloscopes made by different manufacturers could be used to make frequency measurements in the same way. It is also possible for a SCPI counter to make a frequency measurement using the same commands as an oscilloscope. SCPI commands are easy to learn, self-explanatory and account for both novice and expert programmer's usage. Once familiar with the organization and structure of SCPI, considerable efficiency gains can be achieved during control program development, independent of the control program language selected.

A key to consistent programming is the reduction of multiple ways to control similar instrument functions. The philosophy of SCPI is for the same instrument functions to be controlled by the same SCPI commands. To simplify learning, SCPI uses industry-standard names and terms that are manufacturer and customer supported.

The advantage of SCPI for the ATE system programmer is reducing the time learning how to program new SCPI instruments after programming their first SCPI instrument.

Programmers who use programming languages such as BASIC, C, FORTRAN, etc., to send instrument commands to instruments will benefit from SCPI. Also, programmers who implement instrument device drivers for ATE program generators and/or software instrument front panels will benefit by SCPI's advantages. SCPI defines instrument commands, parameters, data, and status. It is not an application package, programming language or software intended for instrument front panel control.

SCPI is designed to be layered on top of the hardware-independent portion of *IEEE 488.2.*

4.2 SCPI Command Types

SCPI commands, which are also referred to as SCPI instructions, are messages to the instrument to perform specific tasks. The APSIN command set includes:

— "Common" commands (IEE488.2 mandated commands)

— SCPI required commands

— SCPI optional commands (per SCPI 1999.0)

— SCPI compliant commands that are unique to the APSIN. Not all of the commands supported by the instrument are taken from the SCPI standard; however, their syntax follows SCPI rules.

4.3 SCPI Command Syntax

Typical SCPI commands consist of one or more keywords, parameters, and punctuation. SCPI command keywords can be a mixture of upper and lower case characters. Except for common commands, each keyword has a long and a short form. In this manual, the long form is presented with the short form in upper case and the remainder in lower case. Unrecognized versions of long form or short form commands, or improper syntax, will generate an error.

Structure of a Command Line

A command line may consist of one or several commands. It is terminated by an EOI together with the last data byte.

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon. A colon ":" at the beginning of a command marks the root node of the command tree.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels. The colon following the semicolon must be omitted in this case.

Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description.

Numerical values Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the values must be in the value range –9.9E37 to 9.9E37. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed.

Units In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Boolean Parameters Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically false) is represented by OFF or the numerical value 0. ON or OFF is returned by a query.

4.4 Hierarchical Command Structure

All SCPI commands, except the common commands, are organized in a hierarchical structure similar to the inverted tree file structure used in most computers. The SCPI standard refers to this structure as "the Command Tree." The command keywords that correspond to the major instrument control functions are located at the top of the command tree. The command keywords for the APSIN SCPI command set are shown below.

:ABORt

:DIAGnostic

:DISPlay

:INITiate

:OUTput

:SOURce

:STATus

:SYSTem

:TRIGger

:UNIT

All APSIN SCPI commands, except the :ABORt command, have one or more subcommands (keywords) associated with them to further define the instrument function to be controlled. The subcommand keywords may also have one or more associated subcommands (keywords). Each subcommand level adds another layer to the command tree. The command keyword and its associated subcommand keywords form a portion of the command tree called a command subsystem.

4.5 Status System Programming

The APSIN implements the status byte register, the Service Request Enable Register, the Standard Event Status Register, and the Standard Event Status Enable Register.

The APSIN status system consists of the following SCPI-defined status reporting structures:

- The Instrument Summary Status Byte

- The Standard Event Status Group

- The Operation Status Group

- The Questionable Status Group

The following paragraphs describe the registers that make up a status group and explain the status information that each status group provides.

4.6 Status Registers

In general, a status group consists of a condition register, a transition filter, an event register, and an enable register. Each component is briefly described in the following paragraphs.

Condition Register

The condition register is continuously updated to reflect the current status of the APSIN. There is no latching or buffering for this register, it is updated in real time. Reading the contents of a condition register does not change its contents.

Transition Filter

The transition filter is a special register that specifies which types of bit state changes in the condition register will set corresponding bits in the event register. Negative transition filters (NTR) are used to detect condition changes from True (1) to False (0); positive transition filters (PTR) are used to detect condition changes from False (0) to True (1). Setting both positive and negative filters True allows an event to be reported anytime the condition changes. Transition filters are read-write. Transition filters are unaffected by queries or *CLS (clear status) and *RST commands. The command :STATus:PRESet sets all negative transition filters to all 0's and sets all positive transition filters to all 1's.

Event Register

The event register latches transition events from the condition register as specified by the transition filter. Bits in the event register are latched, and once set they remain set until cleared by a query or a *CLS command Event registers are read only.

Enable Register

The enable register specifies the bits in the event register that can produce a summary bit. The APSIN logically ANDs corresponding bits in the event and enable registers, and ORs all the resulting bits to obtain a summary bit. Summary bits are recorded in the Summary Status Byte. Enable registers are read-write. Querying an enable register does not affect it. The command :STATus:PRESet sets the Operation Status Enable register and the Questionable Status Enable register to all 0's.

4.7 Status Group Reporting

The state of certain APSIN hardware and operational events and conditions can be determined by programming the status system. Three lower status groups provide status information to the Summary Status Byte group. The Summary Status Byte group is used to determine the general nature of an

event or condition and the other status groups are used to determine the specific nature of the event or condition.

Summary Status Byte Group

The Summary Status Byte group, consisting of the Summary Status Byte Enable register and the Summary Status Byte, is used to determine the general nature of an APSIN event or condition. The bits in the Summary Status Byte provide the following:

Operation Status Group

The Operation Status group, consisting of the Operation Condition register, the Operation Positive Transition register, the Operation Negative Transition register, the Operation Event register and the Operation Event Enable register.

4.8 Standard Event Status Group

The Standard Event Status group, consisting of the *Standard Event Status register* (an Event register) and the *Standard Event Status Enable register*, is used to determine the specific event that set bit 5 of the Summary Status Byte.

The bits in the *Standard Event Status register* provide the following:

Bit   Description

0   Set to indicate that all pending APSIN operations were completed following execution of the "*OPC" command.

1   Request control

2   Set to indicate that a query error has occurred. Query errors have SCPI error codes from –499 to –400.

3   Set to indicate that a device-dependent error has occurred. Device-dependent errors have SCPI error codes from –399 to –300 and 1 to 32767.

4   Set to indicate that an execution error has occurred. Execution errors have SCPI error codes from –299 to –200.

5   Set to indicate that a command error has occurred. Command errors have SCPI error codes from –199 to –100.

6   User request

7   Power on

Standard Event Status Enable register (ESE commands)

4.9 Operation Status Group

The Operation Status group, consisting of the Operation Condition register, the Operation Positive Transition register, the Operation Negative Transition register, the Operation Event register, and the Operation Event Enable register, is used to determine the specific condition that set bit 7 in the Summary Status Byte. The bits in the Operation Event register provide the following:

4.10 Questionable Status Group

The Questionable Status group, consisting of the Questionable Condition register, the Questionable Positive Transition register, the Questionable Negative Transition register, the Questionable Event register, and the Questionable Event Enable register, is used to determine the specific condition that set bit 3 in the Summary Status Byte.

The bits in the *Questionable Status register* provide the following:

Bit   Description

0   NOT USED.

1   NOT USED.

2   NOT USED.

3   Output power level inaccurate or out of range.

4   Device temperature out of operating range.

5   Output frequency inaccurate or out of range.

6   NOT USED.

7   Modulation inaccurate or out of range.

8   NOT USED.

9   NOT USED.

10   NOT USED.

11   NOT USED.

12   NOT USED.

13   NOT USED.

14   NOT USED.

15   NOT USED.

5 SCPI Command Description

5.1 :ABORt Subsystem

The :ABORt command is a single command subsystem. There are no subcommands or associated data parameters, as shown below. The :ABORt command, along with the :TRIGger and :INITiate commands, comprise the Trigger group of commands.

Command	Parameters	Unit (default)	Remark
:ABORt			

:ABORt

:ABORt

This command causes the List or Step sweep in progress to abort. Even if INIT:CONT[:ALL] is set to ON, the sweep will not immediately re-initiate.

5.2 :INITiate Subsystem

The :INITiate subsystem controls the state of the APSIN trigger system. The subsystem commands and parameters are described below. The :INITiate commands, along with the :ABORt and :TRIGger commands, comprise the Trigger Group of commands.

Command	Parameters	Unit (default)	Remark
:INITiate[:IMMediate]		ON	
:INITiate:CONTinuous	ON|OFF|1|0	OFF	

:INITiate[:IMMediate]

Sets trigger to the armed state.

:INITiate:CONTinuous ON|OFF|1|0

Continuously rearms the trigger system after completion of a triggered sweep.

5.3 :OUTPut Subsystem

Channel selection for multi-channel devices

Commands applying to a single channel use the <ch> field. Commands that are common to all channels have no <ch> field.

The target channel of such commands under the OUTPut subsystem can be defined by appending the channel index to the OUTPut node: <ch> is 1 to number of channels.

If <ch> is omitted, the command targets the currently selected default channel.

Default channel selection

Default output channel is coupled to default source channel. Refer to **[SOURce:]SELect** for default channel selection.

Command	Parameters	Unit (default)	Remark
OUTPut<ch>[:STATe]	ON|OFF|1|0	OFF	
OUTPut<ch>:BLANking[:STATe]	ON|OFF|1|0	OFF	

[:STATe] ON|OFF|1|0

:OUTPut<ch>[:STATe] ON|OFF|1|0

:OUTPut<ch>[:STATe]?

Turns RF output power on/off.

:BLANking[:STATe] ON|OFF|1|0

:OUTPut<ch>:BLANking[:STATe] ON|OFF|1|0

:OUTPut<ch>:BLANking[:STATe]?

ON causes the RF output to be turned off (blanked) during frequency changes. OFF leaves RF output turned on (unblanked).

5.4 [SOURce<ch>] Subsystem

Channel selection for multi-channel devices

Commands applying to a single channel use the <ch> field. Commands that are common to all channels have no <ch> field.

The target channel of such commands under the SOURce subsystem can be defined by appending the channel index to the SOURce node: <ch> is 1 to number of channels.

If <ch> is omitted, the command targets the currently selected default channel.

Command	Parameters	Unit (default)	Remark
[SOURce]:SELect	1 to number of channels	1	

:SELect

[SOURce]:SELect <channel>

[SOURce]:SELect?

For multi-channel devices, this command sets the default channel. Any command with channel index <ch> omitted applies to the default channel. This command sets the default channel of the following systems:

> SOURce
>
> OUTPut

*RST 1.

Range 1 to number of channels.

5.5 [SOURce<ch>]:FREQuency Subsystem

Command	Parameters	Unit (default)	Remark

[SOURce<ch>]:FREQuency:FIXed | CW	fmin to fmax	Hz	
[SOURce<ch>]:FREQuency:MODE	FIX|CW|SWEep|LIST|CHIR	FIXed	
[SOURce<ch>]:FREQuency:STARt	fmin to fmax	Hz	
[SOURce<ch>]:FREQuency:STOP	fmin to fmax	Hz	
[SOURce<ch>]:FREQuency:STEP[:LINear]?		Hz	
[SOURce<ch>]:FREQuency:STEP:LOGarithmic?			

:FREQuency[:CW]

[SOURce<ch>]:FREQuency[:CW] <value><unit>

[SOURce<ch>]:FREQuency[:CW]?

This command sets the signal generator output frequency for the CW frequency mode.

*RST 100 MHz

Range Please refer to the *Data Sheet*.

:FREQuency:MODE

[SOURce<ch>]:FREQuency:MODE FIX\|CW\|SWEep\|LIST\|CHIRp

[SOURce<ch>]:FREQuency:MODE?

This command sets the frequency mode of the signal generator to CW, (list) sweep or chirp.

FIX \| CW   Stops a frequency sweep or chirp.

SWEep or LIST   This choice selects the swept frequency mode. If sweep triggering is set to
                      immediate along with continuous sweep mode, executing the command starts
                      the LIST or SWEep frequency sweep. In SWEep mode, frequency will be
                      determined by programmed values for the :STARt and :STOP :FREQuency
                      subsystem commands. In LIST mode, frequency is determined by
                      programmed values for :LIST:FREQuency.

CHIRp   This choice selects the chirp mode. A chirp is a quasi-analog sweep over limited bandwidth. Refer to the **[SOURce]:CHIRp subsystem for configuration.**

:FREQuency:STARt

[SOURce<ch>]:FREQuency:STARt <value><unit>

[SOURce<ch>]:FREQuency:STARt?

This command sets the first frequency point in a chirp or step sweep.

*RST The preset value is 1 GHz. Please refer to the *Data Sheet*.

Range Please refer to the *Data Sheet*.

:FREQuency:STOP

[SOURce<ch>]:FREQuency:STOP <value><unit>

[SOURce<ch>]:FREQuency:STOP?

This command sets the last frequency point in a chirp or step sweep.

*RST The preset value is 2 GHz.

Range Please refer to the *Data Sheet*.

FREQuency:STEP[:LINear]

[SOURce<ch>]:FREQuency:STEP[:LINear]?

This query returns the step size in Hz for a linear step sweep.

FREQuency:STEP:LOGarithmic

[SOURce<ch>]:FREQuency:STEP:LOGarithmic?

This query returns the step size (step factor) for a logarithmic step sweep.

5.6 [SOURce<ch>]:CHIRp Subsystem

The :CHIRp Subsystem allows to run ultrafast quasi-analog frequency sweeps. The frequency can either increase or decrease linear.

Command	Parameters	Unit (default)	Remark
[SOURce<ch>]:CHIRp:TIME	<val>	s	
[SOURce<ch>]:CHIRp:COUNt	INFinite | <val>	INF	
[SOURce<ch>]:CHIRp:DIR	DU|UD|DOWN|UP	UP	

:CHIRp:COUNt

[SOURce<ch>]:CHIRp:COUNt INF inite| <value>

[SOURce<ch>]:CHIRp:COUNt?

This command specifies the number of repetitions for the chirp. Set to INF for infinite repetitions.

:CHIRp:TIME

[SOURce<ch>]:CHIRp:TIME <value> <unit>

[SOURce<ch>]:CHIRp:TIME?

Sets the time span for the chirp.

:CHIRp:DIRection

[SOURce<ch>]:CHIRp:DIRection UD|DU|DOWN|UP

[SOURce<ch>]:CHIRp:DIRection?

This command sets the direction of the chirp. DU is bidirectional, direction down first. UD is bidirectional, direction up first.

5.7 [SOURce<ch>]:PHASe Subsystem

Command	Parameters	Unit (default)	Remark
[SOURce<ch>]:PHASe:REFerence			
[SOURce<ch>]:PHASe[:ADJust]	<value>	0 radians	

:PHASe:REFerence

[SOURce<ch>]:PHASe:REFerence

This command sets the current output phase as a zero reference. Subsequent phase adjustments are set relative to the new reference.

:PHASe[:ADJust]

[SOURce<ch>]:PHASe[:ADJust] <value><unit>

[SOURce<ch>]:PHASe[:ADJust]?

This command adjusts the phase of the signal. The query will only return values in radians.

*RST The preset value is 0.

5.8 [SOURce<ch>]:POWer Subsystem

Command	Parameters	Unit (default)	Remark
[SOURce<ch>]:POWer[:LEVel][:IMMediate][:AMPLitude]	<value>	dBm	
[SOURce<ch>]:POWer:MODE	FIXed|LIST|SWEep	FIXed	
[SOURce<ch>]:POWer:STARt	<value>	dBm	
[SOURce<ch>]:POWer:STOP	<value>	dBm	
[SOURce<ch>]:POWer:STEP?		dB	
[SOURce<ch>]:POWer:ALC	ON|OFF|1|0	ON	
[SOURce<ch>]:POWer:ALC:LOWN	ON|OFF|1|0	OFF	
[SOURce<ch>]:POWer:ALC:HOLD	ON|OFF|1|0	OFF	
[SOURce<ch>]:POWer:ATTenuation	<value>	dB	
[SOURce<ch>]:POWer:ATTenuation:AUTO	ON|OFF|1|0	ON	
[SOURce<ch>]:POWer:ATTenuation:LIST?			

[:LEVel][:IMMediate][:AMPLitude]

[SOURce<ch>]:POWer[:LEVel][:IMMediate][:AMPLitude] <value><unit>

[SOURce<ch>]:POWer[:LEVel][:IMMediate][:AMPLitude]?

This command sets the RF output power.

:MODE

[SOURce<ch>]:POWer:MODE CW|LIST|SWEep

[SOURce<ch>]:POWer:MODE?

This command sets the signal generator power mode to fixed or swept.

FIX   This choice stops a power sweep, allowing the signal generator to operate at
                             a fixed power level. Refer to **[:LEVel][:IMMediate][:AMPLitude]** command
                             for setting the output power level.

LIST or SWEep   This choice selects the swept power mode. If sweep triggering is set to
                             immediate along with continuous sweep mode, executing the command starts
                             the LIST or STEP power sweep.

:STARt

[SOURce<ch>]:POWer:STARt <value><unit>

[SOURce<ch>]:POWer:STARt?

This command sets the first amplitude point in a step sweep.

Range

:STOP

[SOURce<ch>]:POWer:STOP <value><unit>

[SOURce<ch>]:POWer:STOP?

This command sets the last amplitude point in a step sweep.

Range

:STEP

[SOURce<ch>]:POWer:STEP[:LINear]?

This query returns the step size in dB for a linear step sweep.

:ALC

[SOURce<ch>]:POWer:ALC ON|OFF|1|0

[SOURce<ch>]:POWer:ALC?

This command turns the automatic power level control on and off.

*RST The preset value is 1

:ALC:LOWN

[SOURce<ch>]:POWer:ALC:LOWN ON | OFF | 1 | 0

[SOURce<ch>]:POWer:ALC:LOWN?

This command enables or disables the low amplitude noise mode providing up to 1/1000 dB output power resolution. When enabled, the automatic levelling control will work in a mode similar to hold. In opposite to the hold mode:

-   The hold setpoint won't be sampled again when changing the output power setting using the [SOURce<ch>]:POWer[:LEVel][:IMMediate][:AMPLitude] command.

-   The hold setpoint won't be sampled again when turning RF on or off using the OUTPut<ch>[:STATe] command.

:ALC:HOLD

[SOURce<ch>]:POWer:ALC:HOLD ON|OFF|1|0

[SOURce<ch>]:POWer:ALC:HOLD?

(Devices with option PE only)

This command sets the automatic level control into hold mode. The amplitude level control loop is open.

*RST The preset value is 0

:ATTenuation

[SOURce<ch>]:POWer:ATTenuation <value>

[SOURce<ch>]:POWer:ATTenuation?

(Devices with option PE only)

This command sets the power range extension attenuator. This command will also turn off automatic attenuation setting. Refer to **[SOURce<ch>]:POWer:ATTenuation:AUTO OFF** for details. Attenuator input RF power shall be -30…+10 dBm, e.g. using a [SOURce]:POWer:ATTenuation value of 50 dB, the output RF power range is -80…-40 dBm.

*RST The preset value is 0

:ATTenuation:AUTO

[SOURce<ch>]:POWer:ATTenuation:AUTO ON|OFF|1|0

[SOURce<ch>]:POWer:ATTenuation:AUTO?

(Devices with option PE only)

This command turns the power range extension on or off. Turning it off allows fast power sweeps for devices featuring an extended output power range.

*RST The preset value is 0

:ATTenuation:LIST?

[SOURce<ch>]:POWer:ATTenuation:LIST?

(Devices with option PE only)

This query returns a comma-separated list of available attenuation settings. These can be selected using the **[SOURce<ch>]:POWer:ATTenuation** command.

Refer to datasheet for a list of available settings.

5.9 [SOURce]:CORRection Subsystem

The flatness correction system provides power correction over frequency. Gain or loss of external components can be compensated.

Flatness correction is global and common to all channels.

Command	Parameters	Unit (default)	Remark
[:SOURce]:CORRection:FLATness:MODE	LOWer|HIGHer|INTerpolation	INT	
[:SOURce]:CORRection:FLATness:PAIR	<value>,<value>	N/A	
[:SOURce]:CORRection:FLATness:POINts?		N/A	
[:SOURce]:CORRection:FLATness:PRESet		N/A	
[:SOURce]:CORRection:FLATness[:STATe]	ON|OFF|1|0	N/A	
[:MEMory]:FILE:CORRection:FLATness:DATA	<"file name">,<data>	N/A	
[:MEMory]:FILE:CORRection:FLATness:LOAD	<"file name">	N/A	
[:MEMory]:FILE:CORRection:FLATness:PEEK?	<"file name">	N/A	FW 0.4.95
[:MEMory]:FILE:CORRection:FLATness:STORe	<"file name">	N/A	

FLATness:MODE

[:SOURce]:CORRection:FLATness:MODE LOWer|HIGHer|INTerpolation

No Query?

This command defines how the flatness correction value will be determined at frequency settings below, between or above the store correction pairs. LOWer selects the pair at or below an output frequency setting. HIGHer selects the pair at or above the output frequency setting. INTerpolation selects linear interpolation between the two pairs closes to the output frequency setting

The query returns the currently selected mode.

*RST INT

:FLATness:PAIR

[:SOURce]:CORRection:FLATness:PAIR <freq.>[<freq suffix>], <corr.>[<corr suffix>]

[:SOURce]:CORRection:FLATness:PAIR? <point>

This command form adds or changes a frequency and amplitude correction pair. The maximum number of points that can be entered is 3201.

The query form returns the frequency and amplitude correction pair at the given point index. The index ranges from 0 to the number of points minus 1.

Use the :FLATness:PRESet command to clear the flatness correction list.

Range Frequency range varies and is model dependent. Please refer to the instrument's

Data Sheet.

:FLATness:POINts

 [:SOURce]:CORRection:FLATness:POINts?

This query returns the number of points in the active (loaded) flatness correction data table.

:FLATness:PRESet

 [:SOURce]:CORRection:FLATness:PRESet

This command presets the user- flatness correction to a factory- defined setting that consists of one point.

CAUTION The current correction data will be overwritten once this command is executed. Save the current data if needed. Refer to :**FLATness:STORe** command for storing user- flatness files.

:FLATness[:STATe]

 [:SOURce]:CORRection:FLATness[:STATe] ON|OFF|1|0

[:SOURce]:CORRection:FLATness[:STATe]?

This command enables or disables the user- flatness corrections.

*RST 0

:MEMory:FILE:CORRection:FLATness:DATA

:MEMory:FILE:CORRection:FLATness:DATA {<"filename">},<data>

:MEMory:FILE:CORRection:FLATness:DATA? {<"filename">}

The command writes data to a flatness correction file.

The query returns flatness correction file data.

Data sent or received has IEEE488.2 definite block data format:

> #<num_digits><byte_count><data byte>{<data_byte}

>> <num_digits> specifies how many digits are contained in <byte_count>.

>> <byte_count> specifies how many data bytes follow in <data_bytes>.

Example of definite block data:

> #2141000000000;1.0

>> #**2**14**…**: byte count is two digits wide

>> #2**14**…: 14 data bytes will follow

>> …**1000000000;1.0**: 14 bytes of data

The flatness correction data itself consists of values separated by semicolon ";" and rows separated by carriage return "\r" and/or newline "\n". Two values (frequency in Hz, power correction in dBm) make a row. Each row defines one flatness correction point.

Example of two points flatness correction (first point 100 MHz, +1 dB; second point 200 MHz, -1 dB):

> 100000000;1.0\r\n

> 200000000;-1.0;\r\n

: MEMory:FILE:CORRection:FLATness:LOAD

:MEMory:FILE:CORRection:FLATness:LOAD "<file name>"

This command loads a user- flatness correction file. The "<file name>" variable is the name of the file located in the directory USERFLAT. The directory path is implied in the command and need not be specified in the variable name.

: MEMory:FILE:CORRection:FLATness:PEEK

:MEMory:FILE:CORRection:FLATness:PEEK? "<file name>"

This query checks a flatness correction data file. If the file exists, the number of correction points is returned. If there is no such file, 0 is returned.

: MEMory:FILE:CORRection:FLATness:STORe

 :MEMory:FILE:CORRection:FLATness:STORe "<file name>"

This command stores the current user- flatness correction data to a file named by

the:FLATness:STORe command.:CORRection:FLATness:STORe command. The directory path is implied in the command and need not be specified in the "<file name>" variable.

5.10 [SOURce<ch>]:ROSCillator Subsystem

The ROSCillator subsystem configures internal or external frequency reference.

Reference configuration is global and common to all channels for standard multi-channel devices. For those devices channel index <ch> is ignored and shall be omitted.

Some devices provide optional per channel configuration. Refer to the datasheet.

Command	Parameters	Unit (default)	Remark
[SOURce<ch>]:ROSCillator:EXTernal:FREQuency	<val>	10 MHz	
[SOURce<ch>]:ROSCillator:LOCKed?			
[SOURce<ch>]:ROSCillator:OUTPut:STATe	ON|OFF|1|0	OFF	
[SOURce<ch>]:ROSCillator:SOURce	INTernal| EXTernal| SLAVe	INT	
[SOURce<ch>]:ROSCillator:INTernal:TUNing	<val>	N/A	
[SOURce<ch>]:ROSCillator:OUTPut:FREQuency	<val>	10 MHz	

: EXTernal:FREQuency

[SOURce<ch>]:ROSCillator:EXTernal:FREQuency <val>

[SOURce<ch>]:ROSCillator:EXTernal:FREQuency?

This command conveys the expected reference frequency value of an externally applied reference the signal generator. The variable <val> is expressed in units of MHz.

*RST 10 MHz

Range 1 to 250 MHz

: LOCKed?

[SOURce<ch>]:ROSCillator:LOCKed?

This command queries if the synthesizer is locked to the externally applied reference.

:OUTPut:STATe

[SOURce<ch>]:ROSCillator:OUTPut:STATe ON|OFF|1|0

[SOURce<ch>]:ROSCillator:OUTPut:STATe?

This command enables or disables the 10 frequency reference output.

*RST OFF

: SOURce

[SOURce<ch>]:ROSCillator:SOURce INT|EXT|SLAVe

No query?

This command selects either an internal or external reference for the waveform clock. Slave mode uses a 100 MHz external reference directly. Slave mode is intended to use another APSIN device's reference (reference output setting 100 MHz).

*RST INT

: SOURce

[SOURce<ch>]:ROSCillator: INTernal:TUNing <val>

This command is used to adjust the internal frequency reference. An adjustment range of approx +/- 2.5 ppm can be used with when setting 0.5 +/- 0.5

*RST INT

Range 0 to 1

: OUTPut:FREQuency

[SOURce<ch>]:ROSC:OUTPut:FREQuency <value> <unit>

[SOURce<ch>]:ROSC:OUTPut:FREQuency?

This command selects the reference output frequency. Only 10 MHz or 100 MHz can be set.

5.11 [SOURce<ch>]:LIST Subsystem

Sweep list memory channel selection for multi-channel devices

The target channel of sweep list memory commands under the MEMory subsystem can be defined by appending the channel index to the MEMory node: <ch> is 1 to number of channels.

If <ch> is omitted, the command targets the currently selected default channel.

Sweep list memory default channel selection

Default sweep list memory channel is coupled to default source channel. Refer to **[SOURce:]SELect** for default channel selection.

Command	Parameters	Unit (default)	Remark
[SOURce<ch>]:LIST:COUNt	INFinite | <value>	INFinite	
[SOURce<ch>]:LIST:DIRection	UP|DOWN|RANDom	UP	
[SOURce<ch>]:LIST:DWELl	<value>	s	
[SOURce<ch>]:LIST:DELay	<value>	s	
[SOURce<ch>]:LIST:DELay:AUTO	ON|OFF|1|0	ON	
[SOURce<ch>]:LIST:FREQuency:POINts?			
[SOURce<ch>]:LIST:FREQuency	<value>{,<value>}	Hz	
[SOURce<ch>]:LIST:MANual	<value>|UP|DOWN		
[SOURce<ch>]:LIST:MODE	AUTO | MANual		
[SOURce<ch>]:LIST:POWer	<value>{,<value>}	dBm	
[SOURce<ch>]:LIST:POWer:POINts?			

[SOURce<ch>]:LIST:PROGress?			
MEMory<ch>:FILE:LIST?	FIRSt|LAST|NEXT|PREVious		
MEMory<ch>:FILE:LIST:DATA	{<"filename">},<data>		
MEMory<ch>:FILE:LIST:DELete	<"filename">|ALL		
MEMory<ch>:FILE:LIST:LOAD	<"filename">		
MEMory<ch>:FILE:LIST:STORe	<"filename">		

:LIST:COUNt INFinite | <value>

[SOURce<ch>]:LIST:COUNt INFinite | <value>

[SOURce<ch>]:LIST:COUNt?

This command sets the number of list repetitions being played after triggering a list sweep. If set to INFinite, the list sweep will be repeated until a [SOURce<ch>]:FREQuency:MODE or [SOURce<ch>]:POWer:MODE command is issued.

*RST INFinite

Range INFinite or 2-65535

:LIST:DIRection

[SOURce<ch>]:LIST:DIRection UP|DOWN|RANDom

[SOURce<ch>]:LIST:DIRection?

This command sets the direction of a list or step sweep. UP This choice enables a sweep in an ascending order:

• first to last point for a list sweep

• start to stop for a step sweep

DOWN This choice reverses the direction of the sweep.

*RST UP

:LIST:DWELl

[SOURce<ch>]:LIST:DWELl <value>{,<value>}

[SOURce<ch>]:LIST:DWELl?

This command sets the dwell time for the current list sweep RAM points. Dwell time is used when IMMediate is the trigger source. The dwell time is the amount of time the sweep is guaranteed to pause after setting the frequency and/or power for the current point.

The setting enabled by this command is not affected by signal generator power- on, preset, or *RST.

The variable <value> is expressed in units of seconds.

:LIST:DELay

[SOURce<ch>]:LIST:DELay <value>{,<value>}

[SOURce<ch>]:LIST:DELay?

This command sets the off time for the current list sweep RAM points. Off time is used when IMMediate is the trigger source. The off time is the amount of time the output is guaranteed to be blanked after setting the frequency and/or power for the current point to suppress output transients during a frequency change.

The setting enabled by this command is not affected by signal generator power- on, preset, or *RST.

The variable <value> is expressed in units of seconds.

:LIST:DELay:AUTO

 [SOURce<ch>]:LIST:DELay:AUTO ON|OFF|1|0

Query?

This command enabled the automatic blanking of the output during transients between two frequency steps.

*RST ON

:LIST:FREQency:POINts

 [SOURce<ch>]:LIST:FREQ:POINts?

This command queries the signal generator for the number of frequency points in the current list sweep RAM.

:LIST:FREQuency

[SOURce<ch>]:LIST:FREQuency <value>{,<value>}

[SOURce<ch>]:LIST:FREQuency?

This command sets the frequency values for the current list sweep points.

The maximum number of list sweep points is 3'501.

The variable <value> is expressed in units of Hertz.

The setting enabled by this command is not affected by signal generator power- on, preset, or *RST.

Range Please consult the *Data Sheet*.

:LIST:MANual

[SOURce<ch>]:LIST:MANual <value>|UP|DOWN

[SOURce<ch>]:LIST:MANual?

This command sets a list or step sweep point as the current sweep point controlling the frequency and power output. If list or step mode is controlling frequency or power, or both, then the indexed point in the respective list(s) will be used.

Entering a value with this command will have no effect, unless MANual is the selected mode. Refer to **:LIST:MODE** command for setting the proper mode.

If the point selected is beyond the length of the longest enabled list, then the point will be set to the maximum possible point and an error will be generated.

Range 1–3'501

:LIST:MODE

[SOURce<ch>]:LIST:MODE AUTO|MANual

[SOURce<ch>]:LIST:MODE?

This command sets the operating mode for the current list or step sweep.

AUTO   This choice enables the selected sweep type to perform a sweep of all points.

MANual   This choice enables you to select a single sweep point. The selected point controls the frequency and/or amplitude according to the sweep type. Refer to **:LIST:MANual** command for selecting a sweep point.

*RST AUTO

:LIST:POWer

[SOURce<ch>]:LIST:POWer <value>{,<value>}

[SOURce<ch>]:LIST:POWer?

This command sets the amplitude for the current list RAM points.

:LIST:POWer:POINts

 [SOURce<ch>]:LIST:POWer:POINts?

This command queries the number of power points in the current list sweep RAM.

:LIST:PROGgress

[SOURce<ch>]:LIST:PROGgress?

This query returns the progress of an active list sweep, 0.0…1.0.

:MEMory<ch>:FILE:LIST

:MEMory<ch>:FILE:LIST? FIRSt|LAST|NEXT|PREVious

This query returns the file names of the available list files. FIRSt and LAST return the first/last list file name. NEXT and PREVious return the file name of the next/previous list. This allows to enumerate all available list files. After reaching the last or first list file, NEXT or PREVious continue returning the names of the last or first list file.

:MEMory<ch>:FILE:LIST:DATA

:MEMory<ch>:FILE:LIST:DATA {<"filename">},<data>

:MEMory<ch>:FILE:LIST:DATA? {<"filename">}

The command writes data to a list file. If the file name is omitted, data will be loaded to the list RAM. The RAM list will be played when enabling the list mode.

The query returns list file data. If the file name is omitted, list RAM data will be returned.

Data sent or received has IEEE488.2 definite block data format:

> #<num_digits><byte_count><data byte>{<data_byte}
>
> > <num_digits> specifies how many digits are contained in <byte_count>.
> >
> > <byte_count> specifies how many data bytes follow in <data_bytes>.

Example of definite block data:

> #221130000000;1.1;0.1;0.1
>
> > #**2**21…: byte count is two digits wide
> >
> > #2**21**…: 21 data bytes will follow
> >
> > …**130000000;1.1;0.1;0.1**: 21 bytes of data

The list itself consists of values separated by semicolon ";" and rows separated by carriage return "\r" and/or newline "\n". Four values (frequency in Hz, power in dBm, dwell time in s, delay time in s) make a row. Each row defines one point of the list.

Example of a two points list (first point 130 MHz, 1.1 dBm, 100 ms on, 100 ms off; second point 130 MHz, 1 dBm, 100 ms on, 100 ms off):

> 130000000;1.1;0.1;0.1\r\n
>
> 140000000;1;0.1;0.1\r\n

:MEMory<ch>:FILE:LIST:DELete

:MEMory<ch>:FILE:LIST:DELete <"filename">|ALL

This command deletes the specified list file. Passing ALL deletes all present list files.

:MEMory<ch>:FILE:LIST:LOAD

:MEMory<ch>:FILE:LIST:LOAD <"filename">

This command loads a list file to the list RAM. The RAM list will be played when enabling the list mode.

:MEMory<ch>:FILE:LIST:STORe

:MEMory<ch>:FILE:LIST:STORe <"filename">

This command stores the current list RAM data in a list file.

5.12 [SOURce]:LFOutput Subsystem

Low frequency output control.

The low frequency output is global. No channel selection available.

Command	Parameters	Unit (default)
[SOURce]:LFOutput:AMPLitude	<value>	1 V
[SOURce]:LFOutput:FREQuency	<value>	400 Hz
[SOURce]:LFOutput:STATe	ON|OFF|1|0	OFF
[SOURce]:LFOutput:SHAPe	SINE|TRIangle|SQUare	SINE
[SOURce]:LFOutput:SOURce	LFGenerator|PULM|TRIGger	LFG

:LFOutput:AMPLitude

[SOURce]:LFOutput:AMPLitude <value>

[SOURce]:LFOutput:AMPLitude?

This command sets the low frequency generator amplitude. This setting does only take effect if :LFOutput:SOURce is set to LFGenerator and LFOutput:SHAPe is either set to SINE or TRIangle. Using any other setting, the output amplitude is fixed 2.5 V.

The variable <value> is expressed in units of Volt.

Range 0-2.5

*RST 1

:LFOutput:FREQuency

[SOURce]:LFOutput:FREQuency <value>

[SOURce]:LFOutput:FREQuency?

This command sets the low frequency generator frequency. This setting does only take effect if :LFOutput:SOURce is set to LFGenerator.

The variable <value> is expressed in units of Hertz.

Range 10-5000000

*RST 400

:LFOutput:STATe

[SOURce]:LFOutput:STATe ON|OFF|1|0

[SOURce]:LFOutput:STATe?

This command sets the function output / low frequency generator state.

*RST OFF

:LFOutput:SHAPe

[SOURce]:LFOutput:SHAPe SINE|TRIangle|SQUare

[SOURce]:LFOutput:SHAPe?

This command sets the low frequency generator waveform. This setting does only take effect if :LFOutput:SOURce is set to LFGenerator.

SINE   Sine wave output, amplitude is selectable by the :LFOutput:AMPLitude setting.

TRIangle   Triangle wave output, amplitude is selectable by the :LFOutput:AMPLitude setting.

SQUare   Square wave output, amplitude is fixed 2.5 V.

*RST SINE

:LFOutput:SOURce

[SOURce]:LFOutput:SOURce LFGenerator|PULM|TRIGger

[SOURce]:LFOutput:SOURce?

This command sets the low frequency generator waveform. This setting does only take effect if :LFOutput:SOURce is set to LFGenerator.

LFGenerator   This selects the low frequency generator as the function output signal.

PULM   This selects the pulse modulation video out as the function output signal.

TRIGger   This selects the trigger as the function output signal. Refer to the **TRIGger** system for
               details.

*RST LFG

5.13 [SOURce<ch>]:SWEep Subsystem

Command	Parameters	Unit (default)	Remark
[SOURce<ch>]:SWEep:COUNt	INFinite|<value>	INFinite	
[SOURce<ch>]:SWEep:DIRection	UP|DOWN|RANDom	UP	
[SOURce<ch>]:SWEep:POINts	2 to 65535		
[SOURce<ch>]:SWEep:DWELl	<value>	s	
[SOURce<ch>]:SWEep:DELay	<value>	s	
[SOURce<ch>]:SWEep:DELay:AUTO	ON|OFF|1|0	ON	
[SOURce<ch>]:SWEep:PROGress?			
[SOURce<ch>]:SWEep:SPACing	LINear|LOGarithmic		
[SOURce<ch>]:FREQuency:MODE	FIXed|CW|SWEep|LIST		
[SOURce<ch>]:FREQuency:STARt	fmin to fmax	Hz	
[SOURce<ch>]:FREQuency:STOP	fmin to fmax	Hz	
[SOURce<ch>]:POWer:MODE	FIXed|LIST|SWEep		
[SOURce<ch>]:POWer:STARt	<value>	dBm	
[SOURce<ch>]:POWer:STOP	<value	dBm	

:SWEep:COUNt INFinite | <value>

[SOURce<ch>]:SWEep:COUNt Infinite | <value>

[SOURce<ch>]:SWEep:COUNt?

This command sets the number of sweep repetitions being played after triggering a sweep. If set to INFinite, the sweep will be repeated until a [SOURce]:FREQuency:MODE or [SOURce]:POWer:MODE command is issued.

*RST INFinite

Range INFinite or 2-65535

:SWEep:DIRection UP|DOWN|RANDom

[SOURce<ch>]:SWEep:DIRection UP | DOWN | RANDom

Query?

:SWEep:POINts

[SOURce<ch>]:SWEep:POINts <value>

[SOURce<ch>]:SWEep:POINts?

This command defines the number of step sweep points.

*RST 101

Range 2–65535

:SWEep:DWELl

[SOURce<ch>]:SWEep:DWELl <value>

[SOURce<ch>]:SWEep:DWELl?

This command sets the dwell time for the current step sweep points. Dwell time is used when IMMediate is the trigger source. The dwell time is the amount of time the sweep is guaranteed to pause after setting the frequency and/or power for the current point.

The setting enabled by this command is not affected by signal generator power- on, preset, or *RST.

The variable <value> is expressed in units of seconds (default: 1000 □S).

:SWEep:DELay

[SOURce<ch>]:SWEep:DELay <value>

[SOURce<ch>]:SWEep:DELay?

This command sets the off time for the current step sweep points. Off time is used when IMMediate is the trigger source. The off time is the amount of time the sweep is guaranteed to pause after setting the frequency and/or power for the current point.

The setting enabled by this command is not affected by signal generator power- on, preset, or *RST.

The variable <value> is expressed in units of seconds (default: 300 □S).

:SWEep:PROGgress

[SOURce<ch>]:SWEep:PROGgress?

This query returns the progress of an active sweep, 0.0…1.0.

:SWEep:SPACing

[SOURce<ch>]:SWEep:SPACing LINear | LOGarithmic

[SOURce<ch>]:SWEep:SPACing?

This command enables the signal generator linear or logarithmic sweep modes. These commands require the signal generator to be in step mode.

The instrument uses the specified start frequency, stop frequency, and number of points for both linear and log sweeps.

*RST LIN

:STARt

[SOURce<ch>]:POWer:STARt <value><unit>

[SOURce<ch>]:POWer:STARt?

This command sets the first amplitude point in a step sweep.

*RST ?

Range Refer to **[:LEVel][:IMMediate][:AMPLitude]** command for the output power ranges.

:STOP

[SOURce<ch>]:POWer:STOP <value><unit>

[SOURce<ch>]:POWer:STOP?

This command sets the last amplitude point in a step sweep.

*RST ?

Range Refer to **[:LEVel][:IMMediate][:AMPLitude]** command for the output power ranges.

5.14 [SOURce]:AM Subsystem (Amplitude Modulation)

Command	Parameters	Unit (default)
[SOURce<ch>]:AM:DEPTh	<value>	0.8 (80 PCT)
[SOURce<ch>]:AM:INTernal:FREQuency	<value>	400 Hz
[SOURce<ch>]:AM:SENSitivity	<value>	0.8 V (80 PCT/V^{-1})
[SOURce<ch>]:AM:SOURce	INTernal | EXTernal	INT
[SOURce<ch>]:AM:STATe	ON|OFF|1|0	OFF

:AM:DEPTh

[SOURce<ch>]:AM[:DEPTh]: <value>

[SOURce<ch>]:AM[:DEPTh]:?

This command sets the amplitude modulation depth. This setting will be used if :AM:SOURce is set to INTernal.

*RST 0.8

Range 0-0.99

:AM:INTernal:FREQuency

[SOURce<ch>]:AM:INTernal:FREQuency <value><unit>

[SOURce<ch>]:AM:INTernal:FREQuency?

This command sets the internal amplitude modulation rate.

*RST 400 Hz

Range 10 Hz to 50'000 Hz

:AM:SENSitivity

[SOURce<ch>]:AM:INTernal:SENSitivity <value>

[SOURce<ch>]:AM:INTernal: SENSitivity?

This command sets the external amplitude modulation sensitivity. This setting will be used if :AM:SOURce is set to EXTernal.

*RST 0.8 V^{-1}

Range 0 to 3 V^{-1}

:AM:SOURce

[SOURce<ch>]:AM:SOURce INTernal|EXTernal

[SOURce<ch>]:AM: SOURce?

This command selects the amplitude modulation signal source. If INTernal is selected, an internal modulation source is applied. If EXTernal is selected, the device's AM input (at the rear panel) is activated.

*RST INT

:AM:STATe

[SOURce<ch>]:AM:STATe 0|1|OFF|ON

[SOURce<ch>]:AM: STATe?

This command turns the amplitude modulation on or off.

*RST OFF

The RF carrier is modulated when you have set the signal generator's AM modulation state to ON. Whenever amplitude modulation is enabled, the **AM on** is in the display.

5.15 [SOURce<ch>]:FM Subsystem (Frequency Modulation)

Command	Parameters	Unit (default)
[SOURce<ch>]:FM:DEViation	<value>	1000 Hz
[SOURce<ch>]:FM:SENSitivity	<value>	1000 Hz/V
[SOURce<ch>]:FM:INT:FREQuency	<value>	400 Hz
[SOURce<ch>]:FM:INTernal:SHAPe	RD|RU|SINE|SQUare|TRIangle	SINE
[SOURce<ch>]:FM:SOURce	INTernal | EXTernal	EXT
[SOURce<ch>]:FM:STATe	ON|OFF|1|0	OFF
[SOURce<ch>]:FM:COUPling	DC | AC	AC

:FM:DEViation

[SOURce<ch>]:FM:DEViation <value>

[SOURce<ch>]:FM: DEViation?

This command sets the frequency modulation deviation. This setting will be used if :FM:SOURce is set to INTernal.

The variable <value> is expressed in units of Hertz.

*RST 1000

:FM:SENSitivity

[SOURce<ch>]:FM:SENSitivity <value>

[SOURce<ch>]:FM: SENSitivity?

This command sets the frequency modulation deviation per one volt peak amplitude signal input. This setting will be used if :FM:SOURce is set to EXTernal.

The variable <value> is expressed in units of Hertz per Volt.

*RST 1000

:FM:INT:FREQuency

[SOURce<ch>]:FM:**INT:FREQuency** <value>

[SOURce<ch>]:FM:**INT:FREQuency?**

This command sets the frequency modulation rate in Hz. This setting will be used if :FM:SOURce is set to INTernal.

The variable <value> is expressed in Hertz.

*RST 400

:FM:INT:SHAPe

[SOURce]:FM:INT:SHAPe RD|RU|SINE|SQUare|TRIangle

[SOURce]:FM:INT:SHAPe?

This command specifies the FM modulation shape. RD selects Ramp-Down and RU ramp up. Standard waveforms available are SINE, SQUare and TRIangle.

:FM:SOURce

[SOURce<ch>]:FM:SOURce EXTernal | INTernal

[SOURce<ch>]:FM:SOURce?

This command selects the FM modulation signal source. If INTernal is selected, an internal modulation source is applied. If EXTernal is selected, the device's □M input (at the rear panel) is activated.

*RST EXT

:FM:STATe

[SOURce<ch>]:FM:STATe ON|OFF|1|0

[SOURce<ch>]:FM:STATe?

This command turns the frequency modulation on or off.

*RST OFF

:FM::COUPling

[SOURce<ch>]:FM:COUPling DC | AC

[SOURce<ch>]:FM:COUPling?

This command selects to signal coupling for the external FM modulation.

*RST AC

5.16 [SOURce<ch>]:PM Subsystem (Phase Modulation)

Command	Parameters	Unit (default)
[SOURce<ch>]:PM:DEViation	<value>	2.4048 rad
[SOURce<ch>]:PM:SENSitivity	<value>	2.4048 rad/V
[SOURce<ch>]:PM:INTernal:FREQuency	<value>	400 Hz
[SOURce<ch>]:PM:INTernal:SHAPe	RD|RU|SINE|SQUare|TRIangle	SINE
[SOURce<ch>]:PM:SOURce	EXTernal	INTernal	EXT
[SOURce<ch>]:PM:STATe	ON|OFF|1|0	OFF

:PM:DEViation

[SOURce<ch>]:PM:DEViation<value>

[SOURce<ch>]:PM:DEViation?

This command sets the phase modulation deviation. This setting will be used if :PM:SOURce is set to LFGenerator.

The variable <value> is expressed in units of radians.

*RST 2.4048

:PM:SENSitivity

[SOURce<ch>]:PM:SENSitivity <value>

[SOURce<ch>]:PM: SENSitivity?

This command sets the phase modulation deviation per one volt peak amplitude signal input. This setting will be used if :PM:SOURce is set to EXTernal.

The variable <value> is expressed in units of radians per Volt.

*RST 2.4048

:PM:INTernal:FREQuency

[SOURce<ch>]:PM:INTernal:FREQuency <value>

[SOURce<ch>]:PM:INTernal:FREQuency?

This command sets the phase modulation rate in Hz. This setting will be used if :PM:SOURce is set to INTernal.

The variable <value> is expressed in Hertz.

*RST 400

:PM:INT:SHAPe

[SOURce<ch>]:PM:INT:SHAPe RD|RU|SINE|SQUare|TRIangle

[SOURce<ch>]:PM:INT:SHAPe?

This command specifies the PM modulation shape. RD selects Ramp-Down and RU ramp up. Standard waveforms available are SINE, SQUare and TRIangle.

:PM:SOURce

[SOURce<ch>]:PM:SOURce EXTernal | INTernal

[SOURce<ch>]:PM:SOURce?

This command selects the PM modulation signal source. If INTernal is selected, an internal modulation source is applied. If EXTernal is selected, the device's □M input (at the rear panel) is activated.

*RST EXT

:PM:STATe

[SOURce<ch>]:PM:STATe ON|OFF|1|0

[SOURce<ch>]:PM:STATe?

This command turns the phase modulation on or off.

*RST OFF

5.17 [SOURce<ch>]:PULM Subsystem (Pulse Modulation)

This additional functionality provides pulse modulation of the RF output signal delivered to the load by an internal or external modulation signal. The INTernal selection accesses the internally generated modulation input while EXTernal selects the external pulse (rear panel connector) input.

Command	Parameters	Unit (default)
[SOURce<ch>]:PULM:POLarity	NORMal | INVerted	NORMal
[SOURce<ch>]:PULM:INTernal:FREQuency	<frequency>	Hz
[SOURce<ch>]:PULM:INTernal:PERiod	<period>	s
[SOURce<ch>]:PULM:INTernal:PWIDth	<num>	s
[SOURce<ch>]:PULM:SOURce	INTernal|EXTernal|BITStream	INT
[SOURce<ch>]:PULM:STATe	ON|OFF|1|0	OFF
[SOURce<ch>]:PULM:MODE	FIXed | LIST	FIXed
[SOURce<ch>]:PULM:BITStream	<hex data>	5h
[SOURce<ch>]:PULM:BITStream:BITS	<value>	4
[SOURce<ch>]:PULM:BITStream:DIRection	MSBFirst | LSBFirst	MSBFirst
[SOURce<ch>]:PULM:BITStream:RATE	<frequency>	Hz
[SOURce<ch>]:PULM:BITStream:STARtbit	<value>	0
[SOURce<ch>]:PULM:BITStream:TIME	<time>	s

.:**PULM:POLarity**

[SOURce<ch>]:PULM:POLarity NORMal|INVerted

[SOURce<ch>]:PULM:POLarity?

This command selects the polarity of the pulse modulation, regardless if the internal or external modulation source is used.

*RST Normal

:PULM:INTernal:FREQuency

[SOURce<ch>]:PULM:INTernal:FREQuency <frequency>

[SOURce<ch>]:PULM:INTernal:FREQuency?

This command sets the pulse rate for the internally- generated square wave using the variable *<frequency>*.

*RST 400 Hz

Range INT: 0.1 Hz – 100 kHz, EXT: 0.1 Hz–10 MHz

:PULM:INTernal:PERiod

[SOURce<ch>]:PULM:INTernal:PERiod <period>

[SOURce<ch>]:PULM:INTernal:PERiod?

This command sets the pulse period for the internally generated pulse modulation using the variables *<value>.*

If the entered value for the pulse period is equal to or less than the value for the pulse width, the pulse width changes to a value that is less than the pulse period.

*RST 2.5 ms

Range 200 ns – 10 s

:PULM:INTernal:PWIDth

[SOURce<ch>]:PULM:INTernal:PWIDth <num>

[SOURce<ch>]:PULM:INTernal:PWIDth?

This command sets the pulse width for the internally generated pulse signal.

This command sets the pulse width for the internally- generated pulse modulation using the variable *<num>.*

If the entered value for the pulse width is equal to or greater than the value for the pulse period, the pulse width changes to a value that is less than the pulse period.

*RST 1.25 ms

Range 50 nS to PERiod

:PULM:SOURce

[SOURce<ch>]:PULM:SOURce INTernal|EXTernal|BITStream

[SOURce<ch>]: PULM:SOURce?

If set

*RST INTernal

:PULM:STATe

[SOURce<ch>]:PULM:STATe ON|OFF|1|0

[SOURce<ch>]:PULM:STATe?

This command enables or disables pulse modulation for the selected path.

*RST 0

:PULM:MODE

[SOURce<ch>]:PULM:MODE FIXed | LIST

[SOURce<ch>]:PULM:MODE?

This command sets the modulation mode. With "FIXed", the normal ON/OFF modulation can be performed. With LIST, an arbitrary bit pattern can be loaded that will be used to modulate the carrier. LIST mode is available with pulse train option.

*RST FIXed

5.18 [SOURce]:ILS Subsystem

This subsystem provides ILS glideslope and localizer signal generation. It is only available to devices featuring the avionics modulations extension (AVIO).

Command	Parameters	Unit (default)
[SOURce]:ILS:GS[:STATe]	ON|OFF|1|0	OFF
[SOURce]:ILS:GS:AM0[:DEPTh]	<value>	0.4 (40 PCT)
[SOURce]:ILS:GS:AM1[:DEPTh]	<value>	0.4 (40 PCT)
[SOURce]:ILS:GS:TEST	DDM0|UP|DOWN|FLAG	DDM0
[SOURce]:ILS:LOCalizer[:STATe]	ON|OFF|1|0	OFF
[SOURce]:ILS:LOCalizer:AM0[:DEPTh]	<value>	0.2 (20 PCT)
[SOURce]:ILS:LOCalizer:AM1[:DEPTh]	<value>	0.2 (20 PCT)
[SOURce]:ILS:LOCalizer:TEST	DDM0|LEFT|RIGHT|FLAG	DDM0

:ILS:GS[:STATe]

[SOURce]:ILS:GS[:STATe] ON|OFF|1|0

[SOURce]:ILS:GS[:STATe]?

This command enables or disables the ILS glide slope modulation.

*RST OFF

:ILS:GS:AM0[:DEPTh]

[SOURce]:ILS:GS:AM0[:DEPTh] <value>

[SOURce]:ILS:GS:AM0[:DEPTh]?

This command sets the 90 Hz glide slope amplitude modulation depth.

*RST 0.4

:ILS:GS:AM1[:DEPTh]

[SOURce]:ILS:GS:AM1[:DEPTh] <value>

[SOURce]:ILS:GS:AM1[:DEPTh]?

This command sets the 150 Hz glide slope amplitude modulation depth.

*RST 0.4

:ILS:GS:TEST

[SOURce]:ILS:GS:TEST DDM0|UP|DOWN|FLAG

This command selects a predefined ILS glide slope test setting.

*RST DDM0

:ILS:LOC[:STATe]

[SOURce]:ILS:LOC[:STATe] ON|OFF|1|0

[SOURce]:ILS:LOC[:STATe]?

This command enables or disables the ILS localizer modulation.

*RST OFF

:ILS:LOCalizer:AM0[:DEPTh]

[SOURce]:ILS:LOCalizer:AM0[:DEPTh] <value>

[SOURce]:ILS:LOCalizer:AM0[:DEPTh]?

This command sets the 90 Hz localizer amplitude modulation depth.

*RST 0.2

:ILS:LOCalizer:AM1[:DEPTh]

[SOURce]:ILS:LOCalizer:AM1[:DEPTh] <value>

[SOURce]:ILS:LOCalizer:AM1[:DEPTh]?

This command sets the 150 Hz localizer amplitude modulation depth.

*RST 0.2

:ILS:LOC:TEST

[SOURce]:ILS:LOC:TEST DDM0|LEFT|RIGHT|FLAG

This command selects a predefined ILS localizer test setting.

*RST DDM0

5.19 [SOURce]:VOR Subsystem

This subsystem provides VOR signal generation. It is only available to devices featuring the avionics modulations extension (AVIO).

Command	Parameters	Unit (default)
[SOURce]:VOR[:STATe]	ON|OFF|1|0	OFF
[SOURce]:VOR:BEARing	<value>	0 rad
[SOURce]:VOR:TEST	NORTh|SOUTh|EAST|WEST|1|2	NORTh

:VOR[:STATe]

[SOURce]:ILS:GS[:STATe] ON|OFF|1|0

[SOURce]:ILS:GS[:STATe]?

This command enables or disables the VOR modulation.

*RST OFF

:VOR[:STATe]

[SOURce]:VOR:BEARing <value> [RAD|DEG]

[SOURce]:VOR:BEARing?

This command sets the VOR bearing in radians. Append DEG to set the bearing in degrees.

*RST OFF

:VOR:TEST

[SOURce]:ILS:GS:TEST NORTh|SOUTh|EAST|WEST|1|2

This command selects a predefined VOR test setting.

*RST NORTh

5.20:TRIGger Subsystem

Triggers control the playback by telling the APSINX000 when to play the signal.

Depending on the trigger settings for the APSINX000, the waveform playback can occur once, continuously, or the APSINX000 may start and stop playing the waveform repeatedly (GATE mode). A trigger signal comprises both positive and negative signal transitions (states), which are also called high and low periods. You can configure the APSINX000 to trigger on either state of the trigger signal. It is common to have multiple triggers, also referred to as trigger occurrences or events, occur when the signal generator requires only a single trigger. In this situation, the APSINX000 recognizes the first trigger and ignores the rest.

When you select a trigger mode, you may lose the signal from the RF output until you trigger the waveform.

There are four parts to configuring the trigger:

Choosing the trigger type which controls the waveform's transmission.

1) NORMal : trigger edge initiates/stops sweeps

2) GATE : trigger level starts/stops sweep

Setting the waveform's response to triggers:

1. CONTinuous : repeatedly accepts trigger events

2. SINGle : uses only one trigger event

3. Selecting the trigger source which determines how the APSINX000 receives its trigger signal, internally or externally. The GATE choice requires an external trigger.

Setting the trigger polarity when using an external source

Command	Parameters	Unit	Remark

		(default)	
TRIGger[:SEQuence]:TYPE	NORMal|GATE|POINt	N/A	
TRIGger[:SEQuence]:SOURce	IMMediate|KEY|EXT|BUS	IMM	
TRIGger[:SEQuence]:DELay	<value>	0 s	
TRIGger[:SEQuence]:SLOPe	POSitive|NEGative|NP|PN	POS	
TRIGger[:SEQuence]:ECOunt	<value>	1	
TRIGger:OUTPut:POLarity	NORMal|INVerted	NORM	
TRIGger:OUTPut:MODE	NORMal|GATE|POINt|VALid	NORM	
TRIGger:OUTPut:VALid:SOURce	ALL|<value>	1	

:TRIGger:TYPE

TRIGger[:SEQuence]:TYPE NORMal | GATE | POINT

TRIGger[:SEQuence]:TYPE?

This command sets the trigger type that controls the waveform's playback.

The following list describes the trigger type command choices:

NORMal   Upon triggering, the waveform sequence plays according to settlings defined
                by :INITiate:CONTinuous (only once or repeatedly)

GATE   An external trigger signal repeatedly starts and stops the waveform's
                playback. The time duration for playback depends on the duty period of the
                trigger signal and the gate polarity selection. The waveform plays during the
                inactive state and stops during the active polarity selection state. The active
                state can be set high or low. The gate mode works only with an external
                trigger source.

POINt   Upon triggering, only a single point of the sweep (list) is played.

*RST NORM

:TRIGger[:SEQuence]:SOURce

TRIGger[:SEQuence]:SOURce IMMediate|KEY|EXTernal|BUS

TRIGger[:SEQuence]:SOURce?

This command sets the trigger source.

IMMediate	No waiting for a trigger event occurrs
KEY	This choice enables manual triggering by pressing the front-panel **RFon/off**.
EXTernal	This choice enables the triggering of a sweep event by an externally applied signal at the MOD IN connector.
BUS	This choice enables triggering over the LAN using the *TRG or GET commands.

*RST IMM

:TRIGger[:SEQuence]:DELay

TRIGger[:SEQuence]:DELay <value>

TRIGger[:SEQuence]:DELay?

This command sets the amount of time to delay the APSIN response to an external trigger.

The delay is a path (time) delay between when the APSIN receives the trigger and when it responds to the trigger. The delay does not occur until you turn it on. You can set the delay value either before or after turning it on.

:TRIGger[SEQuence]:SLOPe

TRIGger[:SEQuence]:SLOPe POSitive|NEGative|NP|PN

TRIGger[:SEQuence]:EXTernal:SLOPe?

This command sets the polarity for an external trigger signal while using the continuous, single triggering mode. The POSitive and NEGative selections correspond to the high (positive) and low (negative) states of the external trigger signal. For example, when you select POSitive, the waveform responds (plays) during the high state of the trigger signal. When the APSIN receives multiple trigger occurrences when only one is required, the signal generator uses the first trigger and ignores the rest. The Commands NP and PN select both edges with negative first or positive first.

*RST POS

:TRIGger[:SEQuence]:ECOunt

TRIGGer[:SEQuence]:ECOunt <value>

TRIGGer[:SEQuence]:ECOunt?

This command sets a modulo on consecutive trigger events. Setting the value to N means that only every Nth trigger event will be considered. Setting it to one means will use every trigger event that does not occur during a running sweep.

*RST 1

Range 1 to 255

:TRIGger:OUTPut:POLarity

TRIGGer:OUTPut:POLarity NORMal|INVerted

TRIGGer:OUTPut:POLarity?

This command sets the trigger output signal polarity. Note that the trigger output must be enabled by sending the [:SOURce]:LFOutput:SOURce TRIGger command.

*RST NORM

:TRIGger:OUTPut:MODE

TRIGGer:OUTPut:MODE NORMal|GATE|POINt|VALid

This command sets the trigger output signal mode.

NORMal	The trigger output signal is pulsed once whenever playing a waveform sequence is triggered.
GATE	The trigger output signal is set when playing a waveform sequence is triggered, and reset when playing stops.
POINt	The trigger output signal is pulsed for each point of the sweep (list) playing.
VALid	The trigger output is set while the RF output signal at one or multiple channels is valid (settled).

Note that the trigger output must be enabled by sending the [:SOURce]:LFOutput:SOURce TRIGger command.

*RST NORM

:TRIGger:OUTPut:VALid:SOURce

TRIGGer:OUTPut:VALid:SOURce ALL|<value>

This command selects the source channel for the RF output valid signal.

ALL   The trigger output is set while RF output of all currently enabled channels is
                            valid (settled) and reset while any of the outputs has no valid RF signal
                            (transient).

<value>   The trigger output is set while RF output of channel <value> is valid (settled).

*RST 1

Range 1 to number of channels

5.21 :STATus Subsystem

This subsystem controls the status-reporting structures.

Command	Parameters	Unit (default)	Remark
:STATus:OPERation[:EVENt]?			
:STATus:OPERation:CONDition?			
:STATus:OPERation:ENABle	<value>		
:STATus:OPERation:PTR	<value>		
:STATus:OPERation:NTR	<value>		
:STATus:PREset			
:STATus:QUEStionable[:EVENt]?			
:STATus:QUEStionable:CONDition?			
:STATus:QUEStionable:ENABle	<value>		
:STATus:QUEStionable:PTR	<value>		
:STATus:QUEStionable:NTR	<value>		

:OPERation?

:STATus:OPERation[:EVENt]?

This query returns the contents of the operation status event register and clears it.

:OPERation:CONDition?

:STATus:OPERation:CONDition?

This query returns the contents of the operation status condition register.

:OPERation:ENABle

:STATus:OPERation:ENABle

This command sets the enable mask of the operation status event register.

:OPERation:PTR

:STATus:OPERation:PTR

This command sets the positive transition filter of the operation status event register.

:OPERation:NTR

:STATus:OPERation:NTR

This command sets the negative transition filter of the operation status event register.

:PRESet

:STATus:PRESet

Disables all status events, clears all negative transition filters and sets all positive transition filters.

:QUEStionable?

:STATus:QUEStionable [:EVENt]?

This query returns the contents of the questionable status event register and clears it.

:QUEStionable:CONDition?

:STATus:QUEStionable:CONDition?

This query returns the contents of the questionable status condition register.

:QUEStionable:ENABle

:STATus:QUEStionable:ENABle

This command sets the enable mask of the questionable status event register.

:QUEStionable:PTR

:STATus:QUEStionable:PTR

This command sets the positive transition filter of the questionable status event register.

:QUEStionable:NTR

:STATus:QUEStionable:NTR

This command sets the negative transition filter of the questionable status event register.

5.22 :SYSTem Subsystem

Command	Parameters	Unit (default)	Remark
:SYSTem:ERRor[:NEXT]?			
:SYSTem:ERRor:ALL?			
:SYSTem:PRESet			
:SYSTem:VERSion?			
:SYSTem:LOCK			
:SYSTem:LOCK:RELease			

:ERRor?

:SYSTem:ERRor[:NEXT]?

Return Parameters: Integer error number

Query command is a request for the next entry in the instrument's error queue. Error messages in the queue contain an integer in the range [–32768, 32768] denoting an error code and associated descriptive text.

:ERRor:ALL?

:SYSTem:ERRor:ALL?

Return Parameters: List of integer error number

Query command is a request for the all entries in the instrument's error queue. Error messages in the queue contain an integer in the range [–32768, 32768] denoting an error code and associated descriptive text. This query clears the instrument's error queue.

:PRESet

:SYSTem:PRESet

Resets most signal generator functions to factory- defined conditions. This command is similar to the
*RST command.

:VERSion?

:SYSTem:VERSion?

Returns the SCPI version number that the instrument software complies with [1999.0]

:LOCK

:SYSTem:LOCK

Locks (disables) front panel control.

:LOCK:RELease

:SYSTem:LOCK:RELease

Unlocks (enables) front panel control.

5.23 [:SYSTem:COMMunicate] Subsystem

Command	Parameters	Unit (default)
:SYSTem:COMMunicate:LAN:CONFig	DHCP|MANual|AUTO	AUTO
:SYSTem:COMMunicate:LAN:DEFaults		
:SYSTem:COMMunicate:LAN:GATeway	\<ipstring\>	"0.0.0.0"
:SYSTem:COMMunicate:LAN:IP	\<ipstring\>	
:SYSTem:COMMunicate:LAN:RESTart		
:SYSTem:COMMunicate:LAN:SUBNet	\<ipstring\>	"255.255.255.0"

:LAN:CONFig

:SYSTem:COMMunicate:LAN:CONFig DHCP|MANual|AUTO

:SYSTem:COMMunicate:LAN:CONFig?

This command sets the signal generator's internet protocol (IP) address.

MANual   The user assigns an IP address to the signal generator.

DHCP   The network assigns an IP address to the signal generator. Requests will be repeated
              continuously with infinite timeout until a valid address has been assigned.

AUTO   The network assigns an IP address to the signal generator with a fallback to Auto-IP if
              DHCP request continue to fail for more than 10 seconds.

:LAN:DEFaults

:SYSTem:COMMunicate:LAN:DEFaults

This command restores the instrument's LAN settings to their factory default values.

:LAN:GATeway

:SYSTem:COMMunicate:LAN:GATeway \<ipstring\>

:SYSTem:COMMunicate:LAN:GATeway?

This command sets the gateway for local area network (LAN) access to the signal generator from outside the current sub- network. The query returns the current setting, not the saved setting.

:LAN:IP

:SYSTem:COMMunicate:LAN:IP <ipstring>

:SYSTem:COMMunicate:LAN:IP?

This command sets the signal generator's local area network (LAN) internet protocol (IP) address for your IP network connection.

:LAN:RESTart

:SYSTem:COMMunicate:LAN:RESTart

This command restarts the network to enable changes that have been made to the LAN setup.

:LAN:SUBNet

:SYSTem:COMMunicate:LAN:SUBNet <ipstring>

:SYSTem:COMMunicate:LAN:SUBNet?

This command sets the signal generator's local area network (LAN) subnet mask address for your internet protocol (IP) network connection.

5.24 UNIT Subsystem

Command	Parameters	Unit (default)	Remark
UNIT:POWer	W|V|DBM|DB	DBM	

UNIT:POWer

UNIT:POWer W|V|DBM|DB

*RST DBM