# Keysight AP5001A/02A/11A/12A/21A/22A/31A/32A Signal Generators and AP4001A/03A/05A/07A/11A/12A/21A/22A Frequency Synthesizers

KEYSIGHT

PROGRAMMER'S MANUAL

# Notices



## Trademark Acknowledgments

## Manual Part Number

AP50001-90003

## Edition

Edition 2, November 2025

Published by:
Keysight Technologies
1400 Fountaingrove Parkway
Santa Rosa, CA 95403

## Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT WILL CONTROL.

## Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

## U.S. Government Rights

The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at http://www.keysight.com/find/sweula. The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

# Safety Notices

**CAUTION**

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

**WARNING**

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

## Where to Find the Latest Information

Documentation is updated periodically. For the latest information about these products, including instrument software upgrades, application information, and product information, browse to one of the following URLs, according to the name of your product:

http://www.keysight.com/find/AP5001A

To receive the latest updates by email, subscribe to Keysight Email Updates at the following URL:

https://support.keysight.com

Information on preventing instrument damage can be found at:

http://www.keysight.com/find/PreventingInstrumentRepair

## Is your product software up-to-date?

Periodically, Keysight releases software updates to fix known defects and incorporate product enhancements. To search for software updates for your product, go to the Keysight Technical Support website at:

http://www.keysight.com/find/techsupport

# Product and Solution Cybersecurity

Keysight complies with multinational regulations for the cybersecurity of its own products and is committed to providing information to assist you in protecting your products and solutions from external cyber threats. For more information, see:

https://www.keysight.com/us/en/about/quality-and-security/security/product-and-solution-cyber-security.html

Keysight also recommends that you secure your IT environments using appropriate third-party tools. For instruments that run the Microsoft Windows operating system, Keysight concurs with Microsoft's recommendations for ensuring that the instrument is protected:

- Get the latest critical Windows updates

- For network-connected instruments, use an Internet firewall (in Keysight instruments, Windows Firewall is enabled by default)

- For network-connected instruments, use up-to-date antivirus and anti-spyware software

# Responsible Disclosure Program

Keysight recommends that security researchers share the details of any suspected vulnerabilities across any asset owned, controlled, or operated by Keysight (or that would reasonably impact the security of Keysight and our users) using this form:

https://www.keysight.com/us/en/contact/responsible-disclosure-program.html

# Report a Product Cybersecurity Issue

If you discover a cybersecurity issue that you suspect may involve Keysight's proprietary software, or third-party software supplied by Keysight as part of a product, or that may affect the operation of Keysight products, we encourage you to report it to us using this form:

https://www.keysight.com/us/en/about/quality-and-security/security/product-and-solution-cyber-security/report-a-product-cybersecurity-issue

# Contents

# Contents

# 1 Programming the Instrument

This section describes the following features:

# Introduction

This manual provides information for remote operation of the Keysight AP Signal Generators and Frequency Synthesizers using commands sent from an external controller via Ethernet, USB, or GPIB.This manual 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 AP signal generators/frequency synthesizers 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.

# 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 instrument.

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

# Ethernet LAN

All Keysight signal generators/frequency synthesizers are preferably remote programmed via a 10/100/1000Base-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 AP signal generator/frequency synthesizer must be connected to the LAN, and an IP address must be assigned to the AP signal generator/frequency synthesizer 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.

## Ethernet Interface Connection and Setup

The instrument fully supports the IEEE-802.3 standard. Most instrument 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 instruments 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 instruments to detect simultaneous data channel usage, called a collision, and provides for a contention protocol. When a network instrument 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 instrument 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** must 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.

## Using Sockets LAN

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

## Using and Configuring VXI-11 (VISA)

The AP signal generator/frequency synthesizer 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 Keysight 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 AP signal generator/frequency synthesizer over the LAN interface. Example programs are available on request under support@keysight.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 generators/frequency synthesizers. The NI-VISA and Agilent VISA libraries are similar implementations of VISA and have the same commands, syntax, and functions.

## Using Telnet LAN (Port 18)

Telnet provides a means of communicating with the AP signal generator/frequency synthesizer over the LAN. The Telnet client, run on a LAN connected computer, will create a session on the AP signal generator/frequency synthesizer. A connection, established between computer and AP signal generator/frequency synthesizer, generates a command line user interface.

Telnet service uses newline '\n' (0x0D hex) as line (and command) termination character.

Using the Telnet protocol to send commands to the AP signal generator/frequency synthesizer is similar to communicating with the AP signal generator/frequency synthesizer over LAN. You establish a connection with the AP signal generator/frequency synthesizer 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**.

# USB (USBTMC)

**NOTE** Applies to all instruments except the AP4003A and AP4005A.

All instruments support the following USB interface protocols:

- **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.
- **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.

## 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 the instruments. NI-VISA is configured to detect USBTMC compliant instruments. 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.

## USB-TMC Interface Connection and Setup using Keysight API

Keysight API programming interface supports direct communication to instruments using Keysight’s proprietary DLL driver libraries.

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

# GPIB Interface Connection and Setup

**NOTE** **Applies to AP4012, AP4022A, AP5011A, AP5012A, AP5021A, AP5022A, AP5031A, AP5032A - with option GPB.**

## 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 instrument from an external computer. The computer sends commands and instructions to the instrument and receives data sent from the instrument via GPIB.

You can connect up to 15 instruments in a single GPIB system.

The length of cables to connect between instruments 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 instruments (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 instrument 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 instrument connection topology from star, linear, and combined. Loop connection is not allowed.

# SCPI Commands

The Standard Commands for Programmable Instrumentation (SCPI) provides a uniform and consistent language to control programmable test and measurement instruments 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 3, “SCPI Commands,” for detailed description of supported SCPI commands.

# 2 IEEE-488 Interface Commands

The following topics can be found in this chapter:

# IEEE Command Parameter and Query Response Data Types

IEEE 488.2 defines different data formats for use in command parameters and query response messages.

## IEEE 488.2 Definite Block Data

The definite block data format transfers arbitrary byte data. It is used to transfer files (text and binary).

A definite block is prefixed by a # character, indicating the beginning of block data.

A definite block has a #<ndigits><nbytes><data>{<data>} format, where:

- # marks the beginning of block data.
- <ndigits> specifies how many decimal digits are contained in <nbytes>. <ndigits> is a decimal integer.
- <nbytes> specifies how many <data> bytes follow. <nbytes> is a decimal integer.
- <data> are the data bytes transferred.

Example of definite block data:

#2141000000000;1.0

#214...: beginning of block data

#214...: byte count is two digits wide

#214...: 14 data bytes will follow

...1000000000;1.0: 14 bytes of data (file contents)

## IEEE Mandated and Optional Command 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 an asterisk (*) at the beginning of the command keyword. These commands are used to control instrument status registers, status reporting, synchronization, and other common functions.

*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

*OPT? Option Identification Query

*RCL Memory Register State Recall Command

*RST Reset Command

*SAV Memory Register State Save Command

*SRE Service Request Enable Command

*SRE? Service Request Enable Query

*STB? Read Status Byte Query

*TRG Trigger Command

*TST? Self-Test Query

*WAI Wait-to-Continue Command

## *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.

## *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

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

## ESE?

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

**Range:** 0–255

## ESR?

The Standard Event Status Register (ESR) returns the value of the Standard Event Status Register.

## *IDN?

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

## *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 instrument to set the operation complete bit (bit 0) in the Standard Event Status Register when all pending operations have been finished.

## *OPC?

The Operation Complete (OPC) 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).

## *OPT?

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

Common returned option strings are:

| | |
|---|---|
| 520 | Basic device |
| 004 | Number of channels of the device |
| UNZ | Fast Switching |
| GPB | GPIB (IEEE 488) programming interface |

Further options are available for different AP signal generator/frequency synthesizer models. Refer to the Data Sheet for a complete list of options supported by a particular instrument.

## *RCL<reg>

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

## *RST

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

**Remarks:**

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

## *SAV <reg>

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

**Remarks:**

The save function does not save all AP signal generator/frequency synthesizer settings. Refer to the User's Guide for more information on the save function.

## *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 AP signal generator/frequency synthesizer preset or *RST. However, cycling the instrument's power will reset it to zero.

## *SRE?

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

**Range:** 0–63 & 128-191

## *STB?

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

**Range:** 0–255

## *TRG

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

## *TST?

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

0 - Indicates all tests passed.

1 - Indicates that one or more tests failed.

## *WAI

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

# 3 SCPI Commands

This chapter introduces SCPI programming that includes descriptions of the command types, hierarchical command structure, data parameters, and notational conventions. Information on AP signal generator/frequency synthesizer status system and trigger system programming is also provided.

The following topics can be found in this chapter:

# Introduction

Standard Commands for Programmable Instruments (SCPI) is an 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 AP signal generator/frequency synthesizer 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.

## SCPI Command Types

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

- "Common" commands (IEE488.2 mandated commands)
- SCPI required commands
- SCPI optional commands (per SCPI 1999.0)
- SCPI compliant commands are unique to the instrument. Not all of the commands supported by the instrument are taken from the SCPI standard; however, their syntax follows SCPI rules.

# 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 range of –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.

# 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 instrument command set are shown below.

:ABORt

:CALibration

:DISPlay

:INITiate

:MEMory

:OUTput

:SOURce

:STATus

:SYNChronous

:SYSTem

:TEST

:TRIGger

:UNIT

**NOTE** Not all command keywords are available on all instruments.

All instrument 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.

# Status System Programming

The AP signal generator/frequency synthesizer implements the Status Byte Register, the Service Request Enable Register, the Standard Event Status Register, and the Standard Event Status Enable Register.

The AP signal generator/frequency synthesizer 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.

# 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 AP signal generator/frequency synthesizer. 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 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 and positive transition filters to all 0'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 instrument 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.

# Status Group Reporting

The state of certain AP signal generator/frequency synthesizer 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 AP signal generator/frequency synthesizer 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.

# 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 instrument 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 |

# 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.

Related commands are covered by the section titled ":STATus Subsystem".

| Bit | Description |
|---|---|
| 0 | NOT USED |
| 1 | NOT USED |
| 2 | NOT USED |
| 3 | (List) sweep state. This bit is set while a (list) sweep is running. |
| 4 | NOT USED |
| 5 | Waiting for trigger state. This bit is set while the device waits for a trigger event.[a] |
| 6 | NOT USED |
| 7 | NOT USED |
| 8 | NOT USED |
| 9 | NOT USED |
| 10 | NOT USED |
| 11 | NOT USED |
| 12 | NOT USED |
| 13 | NOT USED |
| 14 | NOT USED |
| 15 | NOT USED |

a. Not used by AP5001A, or AP5002A without Options UNQ or UNZ.

# 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.

Related commands are covered by the :STATus Subsystem chapter.

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 |

# 4 SCPI Command Descriptions

# :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 |
|---|---|---|---|
| :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.

# :DISPlay Subsystem

**NOTE** Applies to AP4021A, AP5001A, AP5002A, AP5011A, AP5021A, and AP5031A only.

The :DISPlay subsystem configures the front panel display.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :DISPlay:ENABle | ON\|OFF\|1\|0 | | ON |

## DISPlay:ENABle

:DISPlay:ENABle ON|OFF|1|0

:DISPlay:ENABle?

Enables or disables the front panel display. When disabled, the display does not show any instrument information. This mode cannot be left via front panel display control. Only re-enabling the display via remote control or power cycling brings the front panel display back to normal operation. Disabling the front panel display by this command can be used to hide confidential settings. Refer to “SYSTem:LOCK” for locking the front panel without hiding instrument settings.

***RST** ON

# :INITiate Subsystem

The :INITiate subsystem controls the state of the 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 |
|---|---|---|---|
| :INITiate:CONTinuous | ON\|OFF\|1\|0 | | ON |
| :INITiate[:IMMediate] | | | |

## INITiate:CONTinuous ON|OFF|1|0

```
:INITiate:CONTinuous ON|OFF|1|0
```

```
:INITiate:CONTinuous?
```

When enabled, the trigger system continuously rearms after completion of a triggered sweep.

***RST** ON

## INITiate[:IMMediate]

```
:INITiate[:IMMediate]
```

Sets the trigger to the armed state.

# :MEMory Subsystem

This section covers common file memory commands. File memory commands related to other subsystems (e.g. MEMory:FILE:CORRection) are explained in the respective section.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :MEMory:FILE:DELete:ALL | | | |
| :MEMory:FILE:FREE:ALL? | | | |

## MEMory:FILE:DELete:ALL

`:MEMory:FILE:DELete:ALL`

Deletes all user defined data files. This includes (but is not limited to) sweep list files, flatness and phase correction tables, IQ modulation data files etc.

## MEMory:FILE:FREE:ALL

`:MEMory:FILE:FREE:ALL`

Returns two comma separated decimal values <free>, <used>.

| | |
|---|---|
| <free> | Reports the free memory size in bytes available for user data. |
| <used> | Reports the number of memory bytes used by user data. |

This query can be used to verify that no (possibly sensitive) user data is stored on the device. <used> will report zero bytes when no user data files are stored on the device.

# :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 "SELect" for default channel selection.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| OUTPut<ch>:BLANking[:STATe] | ON\|OFF\|1\|0 | | depends on device |
| OUTPut<ch>[:STATe] | ON\|OFF\|1\|0 | | OFF |

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

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

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

ON - The RF output to be turned off (blanked) during frequency changes.

OFF - Leaves RF output turned on (unblanked).

***RST** OFF

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

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

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

Turns RF output power on/off.

***RST** OFF

# [: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 |
|---|---|---|---|
| [:SOURce]:SELect | <integer> | | 1 |

### SELect

NOTE

Applies to AP4012A, AP4022A, AP5012A, AP5022A, AP5032A only.

`[: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:

:MEMory

:OUTput

:SOURce

***RST** 1

**Range** 1 to the number of channels.

# [:SOURce<ch>]:AM Subsystem (Amplitude Modulation)

**NOTE** Applies to the AP5001A, AP5002A, AP5011A, AP5012A, AP5021A, AP5022A, AP5031A, AP5032A only.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:AM:DEPTh | <float> | 1\|PCT | 0.8 |
| [:SOURce<ch>]:AM:INTernal:FREQuency | <float> | Hz | 400 Hz |
| [:SOURce<ch>]:AM:INTernal:SHAPe[a] | SINE\|SQUare\|TRiangle | | SINE |
| [:SOURce<ch>]:AM:SENSitivity | <float> | $V^{-1}$ | 0.8 $V^{-1}$ |
| [:SOURce<ch>]:AM:SOURce | INTernal\|EXTernal | | INTernal |
| [:SOURce<ch>]:AM:STATe | ON\|OFF\|1\|0 | | OFF |

a. Does not apply to the AP5011A.

## AM:DEPTh

`[:SOURce<ch>]:AM:DEPTh <float>`

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

Sets the amplitude modulation depth. This setting will be used if [:SOURce<ch>]:AM:SOURce is set to INTernal.

***RST** 0.8

**Range** 0 to 0.99

**Unit** 1|PCT

## AM:INTernal:FREQuency

`[:SOURce<ch>]:AM:INTernal:FREQuency <float>`

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

Sets the internal amplitude modulation rate.

***RST** 400 Hz

**Range** Refer to the Data Sheet.

**Unit** Hz

## AM:INTernal:SHAPe

`[:SOURce<ch>]:AM:INTernal:SHAPe SINE|SQUare|TRIangle`

`[:SOURce<ch>]:AM:INTernal:SHAPe?`

Specifies the AM modulation shape: Sine wave, square wave, or triangle wave.

***RST** SINE

## AM:SENSitivity

`[:SOURce<ch>]:AM:INTernal:SENSitivity <float>`

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

Sets the external amplitude modulation sensitivity. This setting will be used if [:SOURce<ch>]:AM:SOURce is set to EXTernal.

***RST** 0.8 $V^{-1}$

**Range** 0 to 3 $V^{-1}$

**Unit** $V^{-1}$

## AM:SOURce

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

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

Selects the amplitude modulation signal source.

| | |
|---|---|
| INTernal | An internal modulation source is applied. |
| EXTernal | The device's analog modulation input is activated. |

***RST** INTernal

## AM:STATe

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

`[:SOURce<ch>]:AM:STATe?`

Turns the amplitude modulation on or off.

***RST** OFF

# [:SOURce<ch>]:CHIRp Subsystem

**NOTE** Applies to AP4001A, AP5001A, AP5002A, AP5011A.

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

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:CHIRp:BLANking[a] | ON\|OFF\|1\|0 | | ON |
| [:SOURce<ch>]:CHIRp:COUNt[a] | INFinite\|<integer> | | INFinite |
| [:SOURce<ch>]:CHIRp:DIRection[a] | DU\|UD\|DOWN\|UP | | UP |
| [:SOURce<ch>]:CHIRp:TIME[a] | <float> | s | 100 us |

a. Devices with options WC1 and (PMR or PME) only.

Related Commands

[:SOURce<ch>]:FREQuency:CENTer

[:SOURce<ch>]:FREQuency:MODE

[:SOURce<ch>]:FREQuency:SPAN

[:SOURce<ch>]:FREQuency:STARt

[:SOURce<ch>]:FREQuency:STOP

## CHIRp:BLANking

[:SOURce<ch>]:CHIRp:BLANking ON|OFF|1|0

[:SOURce<ch>]:CHIRp:BLANking?

Enables or disables RF output blanking while waiting for the trigger signal. Blanking enabled means the RF output is off while waiting for the trigger event.

***RST** ON

## CHIRp:COUNt

[SOURce<ch>]:CHIRp:COUNt INFinite|<integer>

[SOURce<ch>]:CHIRp:COUNt?

Specifies the number of repetitions for the chirp. Set to INF for infinite repetitions.

***RST** INF

**Range** INF or 1 to max (Please refer to the Data Sheet.)

## CHIRp:DIRection

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

[:SOURce<ch>]:CHIRp:DIRection?

Sets the direction of the chirp. DU is bidirectional, direction down first. UD is bidirectional, direction up first.

***RST** UP

## CHIRp:TIME

[SOURce<ch>]:CHIRp:TIME <float>

[SOURce<ch>]:CHIRp:TIME?

Sets the time span for the chirp.

***RST** 100 µs

**Range** Please refer to the Data Sheet.

**Unit** s

## FREQuency:CENter

Sets the center frequency of a chirp.

Refer to FREQuency:CENTer for a detailed command description.

## FREQuency:MODE

Sets the frequency mode of the AP signal generator/frequency synthesizer. A chirp can be enabled by selecting chirp mode or disabled by selecting any other mode.

Refer to FREQuency:MODE for a detailed command description.

## FREQuency:SPAN

Sets the frequency span of a chirp.

Refer to FREQuency:SPAN for a detailed command description.

## FREQuency:STARt

Sets the start frequency in a chirp.

Refer to FREQuency:STARt for a detailed command description.

## FREQuency:STOP

Sets the stop frequency in a chirp.

Refer to FREQuency:STOP for a detailed command description.

# [: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 |
|---|---|---|---|
| [:SOURce]:CORRection:FLATness:MODE | LOWer\|HIGHer\| INTerpolation | | INTerpolation |
| [:SOURce]:CORRection:FLATness:PAIR | <float>,<float> | Hz, dBm\|... | 0 Hz, 0 dBm |
| [:SOURce]:CORRection:FLATness:PAIR? | <integer> | | |
| [:SOURce]:CORRection:FLATness:POINts? | | | |
| [:SOURce]:CORRection:FLATness:PRESet | | | |
| [:SOURce]:CORRection:FLATness[:STATe] | ON\|OFF\|1\|0 | | OFF |
| :MEMory:FILE:CORRection:FLATness:DATA | <"file name">,<data> | | |
| :MEMory:FILE:CORRection:FLATness:LOAD | <"file name"> | | |
| :MEMory:FILE:CORRection:FLATness:PEEK? | <"file name"> | | |
| :MEMory:FILE:CORRection:FLATness:STORe | <"file name"> | | |

## CORRection:FLATness:MODE

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

`[:SOURce]:CORRection:FLATness:MODE?`

Defines how the flatness correction value will be determined at frequency settings below, between or above the store correction pairs.

| | |
|---|---|
| LOW | Selects the pair at or below an output frequency setting. |
| HIGH | Selects the pair at or above the output frequency setting. |
| INTerpolation | Selects linear interpolation between the two pairs closest to the output frequency setting. |

***RST** INTerpolation

## CORRection:FLATness:PAIR

`[:SOURce]:CORRection:FLATness:PAIR <float>,<float>`

`[:SOURce]:CORRection:FLATness:PAIR? <integer>`

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

A frequency and amplitude pair is written in the format <frequency in Hz>, <power in dBm|...>.

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 "CORREction:FLATness:PRESet" command to clear the flatness correction list.

***RST** empty 0 Hz, 0 dBm (empty)

**Range** Please refer to the Data Sheet.

**Unit** Hz, dBm|...

## CORREction:FLATness:POINts?

`[:SOURce]:CORRection:FLATness:POINts?`

Returns the number of points in the active (loaded) flatness correction data table.

## CORREction:FLATness:PRESet

`[:SOURce]:CORRection:FLATness:PRESet`

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

The current correction data will be overwritten once this command is executed. Save the current data if needed. Refer to the "MEMory:FILE:CORRection:FLATness:STORe" command for storing user flatness files.

## CORREction:FLATness[:STATe]

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

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

Enables or disables the user-flatness corrections.

***RST** OFF

## MEMory:FILE:CORRection:FLATness:DATA

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

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

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

#214...: byte count is two digits wide

#214...: 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`

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>"`

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>"`

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.

# [:SOURce<ch>]:FCPort Subsystem

**NOTE** Applies to AP4012A only.

This subsystem provides configuration of the Fast Control Port. It is only available for AP4012A with Option UNZ.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:FCPort:CONTrol:AMPLitude | ON\|OFF\|1\|0 | | OFF |
| [:SOURce<ch>]:FCPort:CONTrol:FREQuency | ON\|OFF\|1\|0 | | OFF |
| [:SOURce<ch>]:FCPort:CONTrol:LIST | ON\|OFF\|1\|0 | | OFF |
| [:SOURce<ch>]:FCPort:MODE | 8\|8B\|8Bits\|16\|16B\|16Bits | | 16Bits |
| [:SOURce<ch>]:FCPort:STReam:IQ | ON\|OFF\|1\|0 | | OFF |

## FCPort:CONTrol:AMPLitude

`[:SOURce<ch>]:FCPort:CONTrol:AMPLitude ON|OFF|1|0`

`[:SOURce<ch>]:FCPort:CONTrol:AMPLitude?`

Enables or disables the FCP to control the RF output amplitude (output power) word. As long as FCP takes control, parameters of SCPI subsystems SOURce, TRIGger and OUTPut cannot be changed.

***RST** OFF

## FCPort:CONTrol:FREQuency

`[:SOURce<ch>]:FCPort:CONTrol:FREQuency ON|OFF|1|0`

`[:SOURce<ch>]:FCPort:CONTrol:FREQuency?`

Enables or disables the FCP to control the RF frequency word. As long as FCP takes control, parameters of SCPI subsystems SOURce, TRIGger and OUTPut cannot be changed.

***RST** OFF

## FCPort:CONTrol:LIST

`[:SOURce<ch>]:FCPort:CONTrol:LIST ON|OFF|1|0`

`[:SOURce<ch>]:FCPort:CONTrol:LIST?`

Enables or disables the FCP to control the RF frequency by selecting a frequency from a list of predefined frequencies. When FCP takes control, parameters of SCPI subsystems SOURce, TRIGger and OUTPut cannot be changed.

***RST** OFF

## FCPort:MODE

**NOTE** Applies to AP4012A only.

---

`[:SOURce<ch>]:FCPort:MODE 8|8B|8Bits|16|16B|16Bits`

`[:SOURce<ch>]:FCPort:MODE?`

Configures the FCP in 16-bit data transfer mode or in 8-bit data transfer mode. For devices with one common FCP connector (shared by all channels) this setting is common to all channels. Those devices will ignore the channel index <ch>.

***RST** 16Bits

## FCPort:STReam:IQ

`[:SOURce]:FCPort:STReam:IQ ON|OFF|1|0`

`[:SOURce]:FCPort:STReam:IQ?`

Enables or disables FCP streaming IQ data to the IQ modulator.

In order to enable streaming the baseband subsystem must be configured for FCP IQ data streaming too. See [SOURce<ch>]:BB:ARBitrary:FCPort for details.

***RST** OFF

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

**NOTE** Applies to all instruments **except** for the AP4003A, AP4005A, AP4007A, AP4011A, AP4012A.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:FM:COUPling | AC\|DC | | AC |
| [:SOURce<ch>]:FM:DEViation | <float> | Hz | 1000 Hz |
| [:SOURce<ch>]:FM:INTernal:FREQuency | <float> | Hz | 400 Hz |
| [:SOURce<ch>]:FM:INTernal:SHAPe | RD\|RU\|SINE\|SQUare\|TRIangle | | SINE |
| [:SOURce<ch>]:FM:SENSitivity | <float> | Hz/V | 1000 Hz/V |
| [:SOURce<ch>]:FM:SOURce | INTernal\|EXTernal | | EXTernal |
| [:SOURce<ch>]:FM:STATe | ON\|OFF\|1\|0 | | OFF |

## FM:COUPling

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

`[:SOURce<ch>]:FM:COUPling?`

Selects AC or DC signal coupling for the external FM modulation.

***RST** AC

## FM:DEViation

`[:SOURce<ch>]:FM:DEViation <float>`

`[:SOURce<ch>]:FM:DEViation?`

Sets the frequency modulation deviation. This setting will be used if [:SOURce<ch>]:FM:SOURce is set to INTernal.

***RST** 1000 Hz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## FM:INTernal:FREQuency

`[:SOURce<ch>]:FM:INTernal:FREQuency <float>`

`[:SOURce<ch>]:FM:INTernal:FREQuency?`

Sets the frequency modulation rate in Hz. This setting will be used if [:SOURce<ch>]:FM:SOURce is set to INTernal.

***RST** 400 Hz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## FM:INTernal:SHAPe

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

`[:SOURce]:FM:INTernal:SHAPe?`

Specifies the FM modulation shape.

| | |
|---|---|
| RD | Selects ramp down. |
| RU | Selects ramp up. |
| SINE | Selects sine wave. |
| SQUare | Selects square wave. |
| TRIangle | Selects triangle wave. |

***RST** SINE

## FM:SENSitivity

`[:SOURce<ch>]:FM:SENSitivity <float>`

`[:SOURce<ch>]:FM:SENSitivity?`

Sets the frequency modulation deviation per one volt peak amplitude signal input. This setting will be used if [:SOURce<ch>]:FM:SOURce is set to EXTernal.

***RST** 1000 Hz/V

**Range** Please refer to the Data Sheet.

**Unit** Hz/V

## FM:SOURce

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

`[:SOURce<ch>]:FM:SOURce?`

Selects the FM modulation signal source.

| | |
|---|---|
| INTernal | An internal modulation signal is applied. |
| EXTernal | The device's frequency modulation input is activated. |

***RST** EXTernal

## FM:STATe

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

[:SOURce<ch>]:FM:STATe?

Turns the frequency modulation on or off.

***RST** OFF

# [:SOURce<ch>]:FREQuency Subsystem

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:FREQuency:CENTer | <float> | Hz | 1.5 GHz |
| [:SOURce<ch>]:FREQuency[:FIXed\|CW] | <float> | Hz | 100 MHz/1 GHz |
| [:SOURce<ch>]:FREQuency:MODE | FIXed\|CW\|SWEep\|LIST\|CHIRp | | FIXed |
| [:SOURce<ch>]:FREQuency:RESolution | LOW\|HIGH | | LOW |
| [:SOURce<ch>]:FREQuency:SPAN | <float> | Hz | 1 GHz |
| [:SOURce<ch>]:FREQuency:STARt | <float> | Hz | 1 GHz |
| [:SOURce<ch>]:FREQuency:STEP | <float> | Hz | 1 GHz |
| [:SOURce<ch>]:FREQuency:STOP | <float> | Hz | 2 GHz |
| [:SOURce<ch>]:FREQuency:TRIGger | ON\|OFF\|1\|0 | | OFF |

## FREQuency:CENTer

[:SOURce<ch>]:FREQuency:CENTer <float>

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

Sets the sweep center frequency.

***RST** 1.5 GHz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## FREQuency[:FIXed|CW]

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

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

Sets the AP signal generator/frequency synthesizer output frequency for the CW frequency mode.

***RST** 100 MHz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## FREQuency:MODE

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

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

Sets the frequency mode of the AP signal generator/frequency synthesizer to CW, (list) sweep or chirp.

| | |
|---|---|
| FIXed or CW | Selects fixed frequency operation and stops an active frequency sweep or chirp. |
| SWEep or LIST | 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.<br>In SWEep mode, frequency will be determined by programmed values for the :STARt and :STOP :FREQuency subsystem commands. |
| CHIRp | This choice selects the chirp mode. A chirp is a quasi-analog sweep over limited bandwidth. Refer to the [:SOURce<ch>]:CHIRp Subsystem for configuration. **Note**: Chirp is only available on AP4001A, AP5001A, AP5002A, AP5011A |

***RST** FIXed

## FREQuency:RESolution

**NOTE** Applies to AP5012A only.

[:SOURce<ch>]:FREQuency:RESolution LOW|HIGH

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

Selects the frequency resolution. It is available only for AP5012A instruments with limited frequency resolution (hardware numbers xxx-xxx5xxxxx-xxxx, xxx-xxx6xxxxx-xxxx, xxx-xxx7xxxxx-xxxx).

| | |
|---|---|
| LOW | Selects low frequency resolution (typically 1 Hz). Low frequency resolution enables phase shifting and fast frequency switching. |
| HIGH | Selects high frequency resolution (typically 100 µHz). High frequency resolution disables phase shifting, and frequency switching is slower. |

***RST** LOW

## FREQuency:SPAN

[:SOURce<ch>]:FREQuency:SPAN <float>

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

Sets the frequency sweep span.

***RST** 1 GHz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## FREQuency:STARt

[:SOURce<ch>]:FREQuency:STARt <float>

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

Sets the first frequency point in a chirp or step sweep.

***RST** 1 GHz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## FREQuency:STEP

[:SOURce<ch>]:FREQuency:STEP <float>

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

Sets the frequency step size for sweeps and chirps.

***RST** 1 GHz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## FREQuency:STOP

[:SOURce<ch>]:FREQuency:STOP <float>

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

Sets the last frequency point in a chirp or step sweep.

***RST** 2 GHz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## FREQuency:TRIGger

[:SOURce<ch>]:FREQuency:TRIGger ON|OFF|1|0

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

ON causes frequency changes in CW mode to become effective only after receiving a trigger signal. OFF is the normal CW mode with frequency changes taking effect immediately.

***RST** OFF

# [:SOURce]:LFOutput Subsystem

**NOTE** Applies to AP5001A, AP5002A, AP5011A, AP5012A, AP5021A, AP5022A, AP5031A, and AP5032A only.

This command subsystem controls the low frequency output.

The low frequency output is global (common to all channels), so no channel selection is available. Commands with channel selection will be accepted, but the channel selection will be ignored.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce]:LFOutput:AMPLitude | <float> | V | 1 V |
| [:SOURce]:LFOutput:FREQuency | <float> | Hz | 400 Hz |
| [:SOURce]:LFOutput:SHAPe | SINE\|TRIangle\|SQUare | | SINE |
| [:SOURce]:LFOutput:SOURce | LFGenerator\|PULM\|TRIGger | | Model dependant. See command description below. |
| [:SOURce]:LFOutput:STATe | ON\|OFF\|1\|0 | | OFF |

## LFOutput:AMPLitude

**NOTE** Applies to AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce]:LFOutput:AMPLitude <float>`

`[:SOURce]:LFOutput:AMPLitude?`

Sets the low frequency generator amplitude. This setting does only take effect if [:SOURce]: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.

***RST** 1 V

**Range** Please refer to the Data Sheet.

**Unit** V

## LFOutput:FREQuency

**NOTE** Applies to AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce]:LFOutput:FREQuency <float>`

`[:SOURce]:LFOutput:FREQuency?`

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

***RST** 400 Hz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## LFOutput:SHAPe

**NOTE** Applies to AP5001A, AP5002A, AP5011A, and AP5012A only.

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

`[:SOURce]:LFOutput:SHAPe?`

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

| | |
|---|---|
| SINE | Sine wave output, amplitude is settable by the [:SOURce]:LFOutput:AMPLitude command. |
| TRIangle | Triangle wave output, amplitude is settable by the [:SOURce]:LFOutput:AMPLitude command. |
| SQUare | Square wave output, amplitude is fixed 2.5 V. |

***RST** SINE

## LFOutput:SOURce

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

`[:SOURce]:LFOutput:SOURce?`

Selects the source for the signal provided at the function output.

| | |
|---|---|
| LFGenerator | This selects the low frequency generator as the function output signal. (AP5001A, AP5002A, AP5011A, AP5012A) |
| PULM | This selects the pulse modulation video out as the function output signal. Refer to the :PLUM Subsystem for details. |
| TRIGger | This selects the trigger as the function output signal. Refer to the :TRIGger Subsystem for details. |

***RST** LFGenerator (for AP5001A, AP5002A, AP5011A, AP5012A)

***RST** TRIGer (for AP5021A, AP5022A, AP5031A, AP5032A)

## LFOutput:STATe

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

`[:SOURce]:LFOutput:STATe?`

Enables or disables the function output / low frequency generator.

***RST** OFF

# [:SOURce<ch>]:LIST Subsystem

## Sweep List Memory Channel Selection for Multi-channel Instruments

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 SELect for default channel selection.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:LIST:BLANking | ON\|OFF\|1\|0 | | ON |
| [:SOURce<ch>]:LIST:COUNt | INFinite\|<integer> | | INFinite |
| [:SOURce<ch>]:LIST:DELay | <float>{,float} | s | 8 ms,... |
| [:SOURce<ch>]:LIST:DELay:AUTO | ON\|OFF\|1\|0 | | ON |
| [:SOURce<ch>]:LIST:DELay:POINts? | | | |
| [:SOURce<ch>]:LIST:DIRection | UP\|DOWN\|RANDom | | UP |
| [:SOURce<ch>]:LIST:DWELl | <float>{,float} | s | 10 ms,... |
| [:SOURce<ch>]:LIST:DWELl:POINts? | | | |
| [:SOURce<ch>]:LIST:FREQuency | <float>{,float} | Hz | 10 MHz,... |
| [:SOURce<ch>]:LIST:FREQuency:POINts? | | | |
| [:SOURce<ch>]:LIST:MANual | <integer>\|UP\|DOWN | | 1 |
| [:SOURce<ch>]:LIST:MODE | AUTO\|MANual | | AUTO |
| [:SOURce<ch>]:LIST:PHASe | <float>{,float} | rad\|deg | 45°,... |
| [:SOURce<ch>]:LIST:PHASe:POINts? | | | |
| [:SOURce<ch>]:LIST:POWer | <float>{,float} | dBm\|... | 6 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"> | | |

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :MEMory<ch>:FILE:LIST:STORe | <"filename"> | | |

## LIST:BLANking

`[:SOURce<ch>]:LIST:BLANking ON|OFF|1|0`

`[:SOURce<ch>]:LIST:BLANking?`

Enables or disables RF output blanking while waiting for the trigger signal. Blanking enabled means the RF output is off while waiting for the trigger event.

This setting is coupled with [:SOURce<ch>:SWEep:BLANking.

***RST** ON

## LIST:COUNt

`[:SOURce<ch>]:LIST:COUNt INFinite|<integer>`

`[:SOURce<ch>]:LIST:COUNt?`

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, [:SOURce<ch>]:PHASe:MODE or [:SOURce<ch>]:POWer:MODE command is issued.

***RST** INFinite

**Range** INFinite or 1 to maximum (Please refer to the Data Sheet.)

## LIST:DELay

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

`[:SOURce<ch>]:LIST:DELay?`

Sets the delay (off) time for the current list sweep points (list in RAM). 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. If the programmed list contains one point, this setting is used for all points in the list sweep. If it contains multiple points, each point in the list sweep uses the individual programmed setting.

*RST 8 ms, 16 ms, 32 ms, 64 ms

Range Please refer to the Data Sheet.

Unit s

## LIST:DELay:AUTO

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

`[:SOURce<ch>]:LIST:DELay:AUTO?`

Enables or disables automatic off (delay) time selection. In automatic mode, delay time is selected such that the transients between sweep points are blanked and do not appear at the RF output. The automatically selected off time varies with device type. It can be queried by [:SOURce<ch>]:LIST:DELay? while automatic mode is enabled.

***RST** OFF

## LIST:DELay:POINts?

`[:SOURce<ch>]:LIST:DELay:POINts?`

Returns the number of delay time points in the current list sweep RAM.

## LIST:DIRection

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

`[:SOURce<ch>]:LIST:DIRection?`

Sets the direction of a list or step sweep.

| | |
|---|---|
| UP | Enables a sweep in an ascending order, first to last point of a list sweep. |
| DOWN | Enables a sweep in a descending (reverse) order, last to first point of a list sweep. |
| RANDom | Enables a sweep with random selection of each point played. |

***RST** UP

## LIST:DWELl

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

`[:SOURce<ch>]:LIST:DWELl?`

Sets the dwell (on) time for the current list sweep RAM points. The dwell time is the amount of time the sweep is guaranteed to hold the signal after setting the frequency and/or power for the current point. If the programmed list contains one point, this setting is used for all points in the list sweep. If it contains multiple points, each point in the list sweep uses the individual programmed setting.

***RST** 10 ms, 20 ms, 40 ms, 80 ms

**Range** Please refer to the Data Sheet.

**Unit** s

## LIST:DWELl:POINts?

`[:SOURce<ch>]:LIST:DWELl:POINts?`

Returns the number of dwell time points in the current list sweep RAM.

## LIST:FREQuency

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

`[:SOURce<ch>]:LIST:FREQuency?`

Sets the frequency values for the current list sweep points.

If the programmed list contains one point, this setting is used for all points in the list sweep. If it contains multiple points, each point in the list sweep uses the individual programmed setting.

The frequency list can only be modified while the unit is in CW mode, see "FREQuency:MODE" command. While a (list) sweep is active this command is ignored, and a settings conflict error is reported to the :SYSTem:ERRor system.

***RST** 10 MHz, 20 MHz, 30 MHz, 40 MHz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## LIST:FREQuency:POINts?

`[:SOURce<ch>]:LIST:FREQuency:POINts?`

Returns the number of frequency points in the current list sweep RAM.

## LIST:MANual

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

`[:SOURce<ch>]:LIST:MANual?`

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.

| | |
|---|---|
| <integer> | Plays the selected point. |
| UP | Plays the next point (last index plus one). The command has no effect if the last point in the list is active already. |

| | |
|---|---|
| DOWN | Plays the last point (last index minus one). The command has no effect if the first point in the list is active already. |

***RST** 1

**Range** UP|DOWN or 1 to max (Please refer to the Data Sheet.)

## LIST:MODE

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

`[:SOURce<ch>]:LIST:MODE?`

Sets the operating mode for the current list or step sweep.

| | |
|---|---|
| AUTO | Enables the selected sweep type to perform a sweep of all points. |
| MANual | Enables you to select a single sweep point. The selected point controls the frequency and/or amplitude according to the sweep type. Refer to the LIST:MANual command for selecting a sweep point. |

***RST** AUTO

## LIST:PHASe

**NOTE**

Applies to all instruments **except** the AP4003A, AP4005A, AP4007A, AP4011A, AP4012A.

`[:SOURce<ch>]:LIST:PHASe <float>{,<float>}`

`[:SOURce<ch>]:LIST:PHASe?`

Sets the phase for the current list RAM points.

If the programmed list contains one point, this setting is used for all points in the list sweep. If it contains multiple points, each point in the list sweep uses the individual programmed setting.

The phase list can only be modified while the unit is in CW mode, see the "PHASe:MODE" command. While a (list) sweep is active this command is ignored, and a settings conflict error is reported to the :SYSTem:ERRor system.

***RST** 45°, 90°, 135°, 180°

**Range** Please refer to the Data Sheet.

**Unit** rad|deg

## LIST:PHASe:POINts?

**NOTE** Applies to all instruments **except** the AP4003A, AP4005A, AP4007A, AP4011A, AP4012A.

`[:SOURce<ch>]:LIST:PHASe:POINts?`

Queries the number of phase points in the current list sweep RAM.

## LIST:POWer?

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

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

Sets the amplitude for the current list RAM points.

If the programmed list contains one point, this setting is used for all points in the list sweep. If it contains multiple points, each point in the list sweep uses the individual programmed setting.

The amplitude list can only be modified while the unit is in CW mode, see "POWer:MODE" command. While a (list) sweep is active this command is ignored and a settings conflict error is reported to the SYSTem:ERRor system.

***RST** 6 dBm, 4 dBm, 2 dBm, 0 dBm

**Range** Please refer to the Data Sheet.

**Unit** dBm|...

## LIST:POWer:POINts?

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

Queries the number of power points in the current list sweep RAM.

## LIST:PROGress?

**NOTE** Applies to AP5001A and AP5002 only.

`[:SOURce<ch>]:LIST:PROGress?`

Returns the progress of an active list sweep, 0.0...1.0.

## MEMory<ch>:FILE:LIST?

`:MEMory<ch>:FILE:LIST?`

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

Returns the file names of the available list files.

This allows enumerating all available list files.

| | |
|---|---|
| FIRSt | Returns the first available list file name. |
| LAST | Returns the last available list file name. |
| NEXT | Returns the next available list file name. After reaching the last list file this query continues returning the last list file name. |
| PREVious | Returns the previous available list file name. After reaching the first list file this query continues returning the first list file name. |

## MEMory<ch>:FILE:LIST:DATA

`:MEMory<ch>:FILE:LIST:DATA [<"filename">],<data>`

`:MEMory<ch>:FILE:LIST:DATA? [<"filename">]`

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

#221...: byte count is two digits wide #221...: 21 data bytes will follow ...130000000;1.1;0.1;0.1: 21 bytes of data.

The list itself consists of values separated by a semicolon ";" and rows separated by carriage return "\r" and/or newline "\n". Four or five columns (frequency in Hz, power in dBm, dwell time in s, delay time in s, [phase or rad] make a row. The phase ([phase in rad]) column is optional: if the list has four columns, zero RF output phase offset is used. With five columns, the phase of each point in the list can be defined individually. Each row defines one point of the list.

An 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

Deletes the specified list file. Passing ALL deletes all present list files.

## MEMory<ch>:FILE:LIST:LOAD

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

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">

Stores the current list RAM data in a list file.

# [:SOURce<ch>]:PHASe Subsystem

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:PHASe[:ADJust] | <float> | rad\|deg | 0 rad |
| [:SOURce<ch>]:PHASe:COMPensation | <float> | s | 0 s |
| [:SOURce<ch>]:PHASe:MEMory:RESTart | | | |
| [:SOURce<ch>]:PHASe:MEMory:STATe | ON\|OFF\|1\|0 | | ON |
| [:SOURce<ch>]:PHASe:MODE | FIXed\|CW\|SWEep\|LIST | | FIXed |
| [:SOURce<ch>]:PHASe:PCM:COMMit | | | |
| [:SOURce<ch>]:PHASe:STARt | <float> | rad\|deg | 0 rad |
| [:SOURce<ch>]:PHASe:STEP? | | rad | |
| [:SOURce<ch>]:PHASe:STOP | <float> | rad\|deg | 6.28 rad |

## PHASe[:ADJust]

`[:SOURce<ch>]:PHASe[:ADJust] <float>`

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

Adjusts the phase of the signal.

***RST** 0 rad

**Range** Please refer to the Data Sheet.

**Unit** rad|deg

## PHASe:COMPensation

**NOTE** Applies to the AP5012A only.

`[:SOURce<ch>]:PHASe:COMPensation <float>`

`[:SOURce<ch>]:PHASe:COMPensation?`

Sets the electrical length compensation. It compensates phase shift introduced by external transmission lines.

***RST** 0 s

**Range** Please refer to the Data Sheet.

**Unit** s

## PHASe:MEMory:RESTart

**NOTE** Applies to the AP5012A, AP5021A, AP5022A only.

`[:SOURce<ch>]:PHASe:MEMory:RESTart`

For devices with option PHS this command restarts phase memory. Phase memory aligns the output signal phase such that for any frequency a zero crossing occurs at the same reference point in time. Restart resets this reference point in time.

## PHASe:MEMory:STATe

**NOTE** Applies to the AP5012A, AP5021A, AP5022A only.

`[:SOURce<ch>]:PHASe:MEMory:STAT ON|OFF|1|0`

`[:SOURce<ch>]:PHASe:MEMory:STATe?`

Enables or disables phase memory and thus phase coherent switching.

Disabling phase memory (phase coherent switching) improves frequency switching speed for applications that do not require deterministic RF output phases. Please refer to the Data Sheet for details.

This command is available for devices featuring the PHS (phase coherent switching) only.

***RST** ON

## PHASe:MODE

**NOTE** Applies to all instruments **except** the AP4003A, AP4005A, AP4007A, AP4011A, and AP4012A.

`[:SOURce<ch>]:PHASe:MODE FIXed|CW|SWEep|LIST`

`[:SOURce<ch>]:PHASe:MODE?`

Sets the phase mode of the AP signal generator/frequency synthesizer to CW or (list) sweep.

| | |
|---|---|
| FIXed\|CW | Selects fixed phase operation and stops an active phase sweep. |
| SWEep\|LIST | Selects the swept phase mode. If sweep triggering is set to immediate along with continuous sweep mode, executing the command starts the LIST or SWEep phase sweep.<br>In SWEep mode, phase will be determined by programmed values for the :STARt and :STOP :PHASe subsystem commands.<br>Use the [:SOURce<ch>]:SWEep Subsystem commands for sweep configuration. |

***RST** FIXed

## PHASe:STARt

**NOTE** Applies to all instruments except the AP4003A, AP4005A, AP4007A, AP4011A and AP4012A.

`[:SOURce<ch>]:PHASe:STARt <float>`

`[:SOURce<ch>]:PHASe:STARt?`

Sets the first phase point in the sweep.

***RST** 0 rad

**Range** Please refer to the Data Sheet.

**Unit** rad|deg

## PHASe:STEP?

**NOTE** Applies to all instruments except the AP4003A, AP4005A, AP4007A, AP4011A and AP4012A.

`[:SOURce<ch>]:PHASe:STEP?`

Returns the phase step size for a sweep.

**Unit** rad

## PHASe:STOP

**NOTE** Applies to all instruments except the AP4003A, AP4005A, AP4007A, AP4011A and AP4012A.

`[:SOURce<ch>]:PHASe:STOP <float>`

`[:SOURce<ch>]:PHASe:STOP?`

Sets the last phase point in a sweep.

***RST** 6.28 rad

**Range** Please refer to the Data Sheet.

**Unit** rad|deg

# [:SOURce<ch>]:POWer Subsystem

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:POWer:ALC:BWIDth\|BANDwidth | LOW\|HIGH | | LOW |
| [:SOURce<ch>]:POWer:ALC:BWIDth\|BANDwidth:AUTO | ON\|OFF\|1\|0 | | ON |
| [:SOURce<ch>]:POWer:ALC:HOLD | ON\|OFF\|1\|0 | | - |
| [:SOURce<ch>]:POWer:ALC:HOLD:AUTO | ON\|OFF\|1\|0 | | ON |
| [:SOURce<ch>]:POWer:ALC:LOWNoise | ON\|OFF\|1\|0 | | OFF |
| [:SOURce<ch>]:POWer:ALC:SEARch | ON\|OFF\|1\|0\|ONCE | | ON |
| [:SOURce<ch>]:POWer:ALC[:STATe] | ON\|OFF\|1\|0 | | ON |
| [:SOURce<ch>]:POWer:ATTenuation | <float> | dB | 0 dB |
| [:SOURce<ch>]:POWer:ATTenuation:AUTO | ON\|OFF\|1\|0 | | ON |
| [:SOURce<ch>]:POWer:ATTenuation:LIST? | | | |
| [:SOURce<ch>]:POWer[:LEVel][:IMMediate][:AMPLitude] | <float> | dBm\|... | 0 dBm |
| [:SOURce<ch>]:POWer:MODE | FIXed\|CW\|LIST\|SWEep | | FIXed |
| [:SOURce<ch>]:POWer:STARt | <float> | dBm\|... | -20 dBm |
| [:SOURce<ch>]:POWer:STEP? | | dB | |
| [:SOURce<ch>]:POWer:STOP | <float> | dBm\|... | +10 dBm |

## POWer:ALC:BWIDth|BANDwidth

**NOTE** Applies to the AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce<ch>]:POWer:ALC:BWIDth LOW|HIGH`

`[:SOURce<ch>]:POWer:ALC:BANDwidth LOW|HIGH`

`[:SOURce<ch>]:POWer:ALC:BWIDth?`

`[:SOURce<ch>]:POWer:ALC:BANDwidth?`

Selects the ALC (automatic leveling control) bandwidth.

| | |
|---|---|
| LOW | Provides best noise performance and power stability but frequency and power switching time increases. |
| HIGH | Provides lower frequency and power switching time but noise and power stability degrade. |

When automatic ALC bandwidth selection is active, the device chooses the appropriate bandwidth setting automatically.

Setting the ALC bandwidth manually with this command disables automatic bandwidth selection.

Refer to the POWer:ALC:BWIDth|BANDwidth:AUTO command.

For information about how to use different ALC modes please refer to application note AN3005.

***RST** LOW

## POWer:ALC:BWIDth|BANDwidth:AUTO

**NOTE** Applies to the AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce<ch>]:POWer:ALC:BWIDth|BANDwidth:AUTO ON|OFF|1|0`

`[:SOURce<ch>]:POWer:ALC:BWIDth|BANDwidth:AUTO?`

Disables or enables automatic ALC bandwidth selection. Enabling automatic ALC bandwidth lets the device select the appropriate ALC bandwidth setting.

Refer to the POWer:ALC:BWIDth|BANDwidth command for manually setting the ALC bandwidth.

For information about how to use different ALC modes please refer to application note AN3005.

***RST** ON

## POWer:ALC:HOLD

**NOTE** Applies to all instruments **except** the AP4001A, AP4003A, AP4005A, AP4011A, AP40012A, AP4021A, AP4022A.

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

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

Sets the automatic level control into hold mode. The amplitude level control loop is open. ALC hold can improve power stability when fast sweeps or modulations are active. When automatic ALC hold mode selection is active, the device chooses the appropriate ALC hold setting automatically.

Setting the ALC hold state manually disables automatic ALC hold mode selection. Refer to the "POWer:ALC:HOLD:AUTO" command. For information about how to use different ALC modes please refer to application note AN3005.

## POWer:ALC:HOLD:AUTO

**NOTE** Applies to all instruments except the AP4001A, AP4003A, AP4005A, AP4011A, AP40012A, AP4021A, AP4022A.

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

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

Disables or enables automatic ALC hold mode selection. Enabling automatic ALC hold mode selection lets the device select the appropriate ALC hold mode setting. Refer to the "POWer:ALC:HOLD" command. For information about how to use different ALC modes please refer to application note AN3005.

***RST** ON

## POWer:ALC:LOWNoise

**NOTE** Applies to the AP5011A only.

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

`[:SOURce<ch>]:POWer:ALC:LOWNoise?`

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

– The hold set point won't be sampled again when changing the output power setting using the "POWer[:LEVel][:IMMediate][:AMPLitude]" command.

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

Switching speed (power and frequency) degrades. Sweeps and modulations are not available in low amplitude noise mode.

***RST** OFF

## POWer:ALC:SEARch

**NOTE** Applies to the AP5011A only.

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

`[:SOURce<ch>]:POWer:ALC:SEARch?`

Controls when the level correction occurs in ALC Hold On mode. See "POWer:ALC:HOLD" command.

| | |
|---|---|
| ON \| 1 | The ALC search is performed immediately when the frequency or the power is changed. |
| OFF \| 0 | No ALC search is performed unless the ALC search is set to on (ON\|1) or the ALC search is triggered manually (ONCE). |
| ONCE | Triggers an ALC search immediately. |

***RST** ON

## POWer:ALC[:STATe]

**NOTE** Applies to all instruments except the AP4001A, AP4003A, AP4005A, AP4007A, AP4011A, AP40012A, AP4021A, AP4022A.

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

`[:SOURce<ch>]:POWer:ALC[:STATe]?`

Turns the ALC (automatic leveling control) on or off. Specified output power is guaranteed only with ALC on. For information about how to use different ALC modes please refer to application note AN3005.

***RST** ON

## POWer:ATTenuation

**NOTE** Applies to all instruments except the AP4001A, AP4003A, AP4005A, AP4007A, AP4011A, AP40012A, AP4021A, AP4022A.

`[:SOURce<ch>]:POWer:ATTenuation <float>`

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

(Devices with options 1E1, 2E1, 1E2, 2E2, 3E2 only)

Sets the power range extension attenuator. This command will also turn off the automatic attenuation setting. Refer to "POWer:ATTenuation:AUTO" for details. Attenuator input RF power will be in the power range with no external attention option as specified in the Data Sheet. Typical range is -20 to +10 dBm. For example, using a "POWer:ATTenuation" value of 50 dB, the output RF power range is -70 to -40 dBm.

***RST** 0 dB

**Range** Please refer to the Data Sheet.

**Unit** dB

## POWer:ATTenuation:AUTO

**NOTE** Applies to all instruments except the AP4001A, AP4003A, AP4005A, AP4007A, AP4011A, AP40012A, AP4021A, AP4022A.

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

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

(Devices with options 1E1, 2E1, 1E2, 2E2, 3E2 only)

Turns the power range extension on or off. Turning it off allows fast power sweeps for devices featuring an extended output power range, but the programmable output power range is reduced. See "POWer:ATTenuation" for details. Turning it on will immediately restore the automatic power range extension setting for the currently active "POWer[:LEVel][:IMMediate][:AMPLitude]" output power setting.

***RST** ON

## POWer:ATTenuation:LIST?

**NOTE** Applies to all instruments except the AP4001A, AP4003A, AP4005A, AP4007A,AP4011A, AP40012A, AP4021A, AP4022A.

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

(Devices with options 1E1, 2E1, 1E2, 2E2, 3E2 only)

Returns a comma-separated list of available attenuation settings. These can be selected using the [SOURce<ch>]:POWer:ATTenuation command. For devices with options 1E2, 2E2, 3E2, it returns 2 values:

– The step in dB at which the PE attenuation can be incremented.

– The maximum attenuation in dB that can be set.

Refer to the Data Sheet for a list of available settings.

## POWer[:LEVel][:IMMediate][:AMPLitude]

`[:SOURce<ch>]:POWer[:LEVel][:IMMediate][:AMPLitude] <float>`

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

Sets the RF output power.

***RST** 0 dBm

**Range** Please refer to the Data Sheet.

**Unit** dBm|dBu|dBW|W|dBuV|dBmV|dBV|V|dBuA|dBmA|dBA|A

## POWer:MODE

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

**[:SOURce<ch>]:POWer:MODE?**

Sets the AP signal generator/frequency synthesizer power mode to CW or (list) sweep.

| | |
|---|---|
| FIXed \| CW | Selects fixed power operation and stops an active power sweep. |
| SWEep or LIST | Selects the swept power mode. If sweep triggering is set to immediate along with continuous sweep mode, executing the command starts the LIST or SWEep power sweep.<br>In SWEep mode, power will be determined by programmed values for the :STARt and :STOP :POWer subsystem commands.<br>Use the [:SOURce<ch>]:SWEep Subsystem commands for sweep configuration. |

***RST** FIXed

## POWer:STARt

[:SOURce<ch>]:POWer:STARt <float>

[:SOURce<ch>]:POWer:STARt?

Sets the first amplitude point in a sweep.

***RST** -20 dBm

**Range** Please refer to the Data Sheet.

**Unit** dBm|dBu|dBW|W|dBuV|dBmV|dBV|V|dBuA|dBmA|dBA|A

## POWer:STEP?

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

Queries the amplitude step size for a sweep.

**Unit** dB

## POWer:STOP

**[:SOURce<ch>]:POWer:STOP** <float>

**[:SOURce<ch>]:POWer:STOP?**

Sets the last amplitude point in a sweep.

***RST** 10 dBm

**Range** Please refer to the Data Sheet.

**Unit** dBm|dBu|dBW|W|dBuV|dBmV|dBV|V|dBuA|dBmA|dBA|A

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

**NOTE** Applies to all instruments except for the AP4003A, AP4005A, AP4007A, AP4011A, AP4012A.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:PM:DEViation | <float> | rad | 2.4048 rad |
| [:SOURce<ch>]:PM:INTernal:FREQuency | <float> | Hz | 400 Hz |
| [:SOURce<ch>]:PM:INTernal:SHAPe | RD\|RU\|SINE\|SQUare\|TRIangle | | SINE |
| [:SOURce<ch>]:PM:SENSitivity | <float> | rad/V | 2.4048 rad/V |
| [:SOURce<ch>]:PM:SOURce | EXTernal\|INTernal | | EXTernal |
| [:SOURce<ch>]:PM:STATe | ON\|OFF\|1\|0 | | OFF |

## PM:DEViation

`[:SOURce<ch>]:PM:DEViation <float>`

`[:SOURce<ch>]:PM:DEViation?`

Sets the phase modulation deviation. This setting will be used if [:SOURce<ch>]:PM:SOURce is set to INTernal.

***RST** 2.4048 rad

**Range** Please refer to the Data Sheet.

**Unit** rad

## PM:INTernal:FREQuency

`[:SOURce<ch>]:PM:INTernal:FREQuency <float>`

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

Sets the phase modulation rate in Hz. This setting will be used if [:SOURce<ch>]:PM:SOURce is set to INTernal.

***RST** 400 Hz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## PM:INTernal:SHAPe

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

`[:SOURce<ch>]:PM:INTernal:SHAPe?`

Specifies the PM modulation shape.

| | |
|---|---|
| RD | Selects ramp down. |
| RU | Selects ramp up. |
| SINE | Selects sine wave. |
| SQUare | Selects square wave. |
| TRIangle | Selects triangle wave. |

***RST** SINE

## PM:SENSitivity

`[:SOURce<ch>]:PM:SENSitivity <float>`

`[:SOURce<ch>]:PM:SENSitivity?`

Sets the phase modulation deviation per one volt peak amplitude signal input. This setting will be used if [:SOURce<ch>]:PM:SOURce is set to EXTernal.

***RST** 2.4048 rad/V

**Range** Please refer to the Data Sheet.

**Unit** rad/V

## PM:SOURce

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

`[:SOURce<ch>]:PM:SOURce?`

Selects the PM modulation signal source.

| | |
|---|---|
| INTernal | An internal modulation signal is applied. |
| EXTernal | The device's phase modulation input is activated. |

***RST** EXTernal

## PM:STATe

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

`[:SOURce<ch>]:PM:STATe?`

Turns the phase modulation on or off.

***RST** OFF

# [: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 input.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:PULM:BITStream[a] | <hex data> | | 0x5h |
| [:SOURce<ch>]:PULM:BITStream:BITS[a] | <integer> | | 4 |
| [:SOURce<ch>]:PULM:BITStream:DIRection[a] | MSBFirst\|LSBFirst | | MSBFirst |
| [:SOURce<ch>]:PULM:BITStream:RATE[a] | <float> | Hz | 20 Hz |
| [:SOURce<ch>]:PULM:BITStream:STARtbit[a] | <integer> | | 4 |
| [:SOURce<ch>]:PULM:BITStream:TIME[a] | <float> | s | 50 ms |
| [:SOURce<ch>]:PULM:INTernal:FREQuency[a] | <float> | Hz | 10 Hz |
| [:SOURce<ch>]:PULM:INTernal:PERiod[a] | <float> | s | 100 ms |
| [:SOURce<ch>]:PULM:INTernal:PWIDth | <float> | s | 50 ms |
| [:SOURce<ch>]:PULM:MODE | RATio\|BANDwidth\| BWIDth | | RATio |
| [:SOURce<ch>]:PULM:OUTPut:VIDeo:POLarity | NORMal\|INVerted | | NORMal |
| [:SOURce<ch>]:PULM:OUTPut:VIDeo:SOURce | <integer> | | 1 |
| [:SOURce<ch>]:PULM:POLarity | NORMal\|INVerted | | NORMal |
| [:SOURce<ch>]:PULM:SOURce | INTernal\|EXTernal\|BITStream | | Depends on the model |
| [:SOURce<ch>]:PULM:STATe | ON\|OFF\|1\|0 | | OFF |

a. Only works for AP5011A with Option PME or PMR and for all other devices only with option MOD.

## PULM:BITStream

**NOTE** Applies to the AP4001A, AP4021A, AP4022A, AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce<ch>]:PULM:BITStream <hex data>`

`[:SOURce<ch>]:PULM:BITStream?`

Sets the pulse train pattern using the variable <hex data>, in hexadecimal representation. Maximum pattern length is 512 bytes / 1024 hexadecimal digits / 4096 bits.

***RST** 0x5h

**Range** 0 to 4096 bits

## PULM:BITStream:BITS

**NOTE** Applies to the AP4001A, AP4021A, AP4022A, AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce<ch>]:PULM:BITS <integer>`

`[:SOURce<ch>]:PULM:BITS?`

Sets the number of pattern bits played.

***RST** 4

**Range** 0 to programmed pattern length in bits

## PULM:BITStream:DIRection

**NOTE** Applies to the AP4001A, AP4021A, AP4022A, AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce<ch>]:PULM:DIRection MSBFirst|LSBFirst`

`[:SOURce<ch>]:PULM:DIRection?`

Sets the pattern playback direction.

| | |
|---|---|
| MSBFirst | Selects most significant bit first. |
| LSBFirst | Selects reverse direction, least significant bit first. |

***RST** MSBFirst

## PULM:BITStream:RATE

**NOTE** Applies to the AP4001A, AP4021A, AP4022A, AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce<ch>]:PULM:RATE <float>`

`[:SOURce<ch>]:PULM:RATE?`

Sets the pattern playback bit rate.

***RST** 20 Hz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## PULM:BITStream:STARtbit

**NOTE** Applies to the AP4001A, AP4021A, AP4022A, AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce<ch>]:PULM:STARtbit <integer>`

`[:SOURce<ch>]:PULM:STARtbit?`

Sets the index of the first pattern bit played.

***RST** 4

**Range** 0 to programmed pattern length in bits

## PULM:BITStream:TIME

**NOTE** Applies to the AP4001A, AP4021A, AP4022A, AP5001A, AP5002A, AP5011A, and AP5012A only.

`[:SOURce<ch>]:PULM:TIME <float>`

`[:SOURce<ch>]:PULM:TIME?`

Sets the pattern playback bit period.

***RST** 50 ms

**Range** Please refer to the Data Sheet.

**Unit** s

## PULM:INTernal:FREQuency

`[:SOURce<ch>]:PULM:INTernal:FREQuency <float>`

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

Sets the pulse rate for the internally generated square wave.

***RST** 10 Hz

**Range** Please refer to the Data Sheet.

**Unit** Hz

## PULM:INTernal:PERiod

`[:SOURce<ch>]:PULM:INTernal:PERiod <float>`

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

Sets the pulse period for the internally generated pulse modulation. 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** 100 ms

**Range** Please refer to the Data Sheet.

**Unit** s

### PULM:INTernal:PWIDth

`[:SOURce<ch>]:PULM:INTernal:PWIDth <float>`

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

Sets the pulse width for the internally generated pulse signal. 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** 50 ms

**Range** Please refer to the Data Sheet.

**Unit** s

### PULM:MODE

**NOTE** Applies to AP5012A with Option 533 or 540 only.

`[:SOURce<ch>]:PULM:MODE RATio|BANDwidth|BWIDth`

`[:SOURce<ch>]:PULM:MODE?`

Sets the pulse modulator mode. With RATio the modulator is configured for maximum on-off-ratio but reduced modulation bandwidth (ratio priority). With BANDwidth | BWIDth the modulator is configured for maximum modulation bandwidth but reduced on-off-ratio (bandwidth priority).

***RST** RATio

### PULM:OUTPut:VIDeo:POLarity

**NOTE** Applies to all instruments **except** for the AP4001A, AP4003A, AP4005A, AP4007A, AP4011A, AP4012A, AP4021A, and AP4022A.

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

`[:SOURce<ch>]:PULM:OUTPut:VIDeo:POLarity?`

Selects the polarity of the pulse modulation video signal output.

| | |
|---|---|
| NORMal | Pulse modulation video output is high during the pulse (RF on). |
| INVerted | Pulse modulation video output is low during the pulse (RF on). |

***RST** NORMal

## PULM:OUTPut:VIDeo:SOURce

**NOTE**

Applies to all instruments **except** for the AP4001A, AP4003A, AP4005A, AP4007A, AP4011A, AP4012A, AP4021A, and AP4022A.

`[:SOURce<ch>]:PULM:OUTPut:VIDeo:SOURce <integer>`

`[:SOURce<ch>]:PULM:OUTPut:VIDeo:SOURce?`

For multi channel devices this command selects the source channel for pulse modulation video output. Refer to "LFOutput:SOURce" and "LFOutput:STATe" commands for pulse modulation video mode of the low frequency output.

***RST** 1

**Range** 1 to number of channels

## PULM:POLarity

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

`[:SOURce<ch>]:PULM:POLarity?`

Selects the polarity of the pulse modulation, regardless if the internal or external modulation source is used.

***RST** NORMal

## PULM:SOURce

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

`[:SOURce<ch>]:PULM:SOURce?`

Selects the source of the pulse modulation signal.

| | |
|---|---|
| INTernal | Selects the internal modulation AP signal generator/frequency synthesizer with programmable pulse width and repetition period. |
| EXTernal | Selects the external pulse modulation signal. |
| BITStream | Selects a programmable arbitrary pulse train. Applies to the AP4001A, AP4021A, AP4022A, AP5001A, AP5002A, AP5011A, and AP5012A only. |

***RST** INTernal

***RST** EXTernal (AP4007A only)

## PULM:STATe

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

`[:SOURce<ch>]:PULM:STATe?`

Enables or disables pulse modulation for the selected path.

***RST** OFF

# [: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.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:ROSCillator:COUT[:STATe] | ON\|OFF\|1\|0 | | OFF |
| [:SOURce<ch>]:ROSCillator:EXTernal:FREQuency | <float> | Hz | device specific |
| [:SOURce<ch>]:ROSCillator:EXTernal:VARiable :FREQuency | <float> | Hz | device specific |
| [:SOURce<ch>]:ROSCillator:INTernal:TUNing | <float> | | device specific |
| [:SOURce<ch>]:ROSCillator:LOCKed? | 1\|0 | | |
| [:SOURce<ch>]:ROSCillator:LOCKed:TEST | | | |
| [:SOURce<ch>]:ROSCillator:LOCKed:VALid? | 1\|0 | | |
| [:SOURce<ch>]:ROSCillator:OUTPut:FREQuency | <float> | Hz | device specific |
| [:SOURce<ch>]:ROSCillator:OUTPut[:STATe] | ON\|OFF\|1\|0 | | OFF |
| [:SOURce<ch>]:ROSCillator:SOURce | INTernal\|EXTernal\| SLAVe\|EXTVariable\| CIN | | INTernal |

## ROSCillator:COUT[:STATe]

**NOTE** Applies to the AP5012A only.

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

`[:SOURce<ch>]:ROSCillator:COUT[:STATe]?`

Enables or disables the high frequency reference output (CLK OUT) with a fixed 3 GHz clock. This output allows locking multiple AP5012A devices to a common reference by daisy-chaining high frequency reference inputs (CLK IN) and outputs (CLK out). This mode offers the best relative phase stability between daisy-chained AP5012A devices. The slave device must be configured for 3 GHz reference input: “ROSCillator:SOURce” CIN.

***RST** OFF

## ROSCillator:EXTernal:FREQuency

`[:SOURce<ch>]:ROSCillator:EXTernal:FREQuency <float>`

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

Conveys the expected reference frequency value of an externally applied reference to the AP signal generator/frequency synthesizer.

***RST** device specific

**Range** Please refer to the Data Sheet.

**Unit** Hz

## ROSCillator:EXTernal:VARiable:FREQuency

**NOTE** Applies to all instruments **except** the AP4003A and AP4005A.

`[:SOURce<ch>]:ROSCillator:EXTernal:VARiable:FREQuency <float>`

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

Conveys the expected reference frequency value of an externally applied reference to the signal generator/frequency synthesizer using the variable external reference system of the device. This is opposite to the standard external reference system which allows just a few specific external frequencies, the variable external reference system allows any external frequency in a specified range.

For AP4007A, AP5001A, AP5002A, the variable external reference system is generally available, for the other devices it is only available with option 1ER.

The variable external reference system is enabled by selecting it as the reference source, see: “ROSCillator:SOURce” EXTVariable.

***RST** device specific

**Range** Please refer to the Data Sheet

**Unit** Hz

## ROSCillator:INTernal:TUNing

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

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

Adjusts the internal frequency reference. An adjustment range of approx +/- 2.5 ppm can be used with when setting 0.5 +/- 0.5 increments.

***RST** device specific

**Range** 0 to 1 (0.5+/-0.5)

## ROSCillator:LOCKed?

`[:SOURce<ch>]:ROSCillator:LOCKed?`

Queries if the synthesizer is locked to the externally applied reference. It is equivalent to checking the frequency bit in "STATus:QUEStionable:CONDition?" and returns a 1 if it is locked and 0 if not.

For the AP5001A, AP5002A, and AP5012A with hardware number xxx.xxDxxxxxx-xxx, has a lock check that affects RF output performance, it requires that the lock test is initiated manually before sending this query. Otherwise the last known (possibly outdated) lock state is returned. Refer to the "ROSCillator:LOCKed:TEST" command.

## ROSCillator:LOCKed:TEST

**NOTE** **Applies to the AP5001A, AP5002A, and AP5012A only with hardware number xxx.xxDxxxxxx-xxx.**

`[:SOURce<ch>]:ROSCillator:LOCKed:TEST`

Only applicable for 10 MHz internal and external reference.

Initiates a reference oscillator locked / unlocked test that may affect RF output performance. The result can be queried by [:SOURce<ch>]:ROSCillator:LOCKed?.

## ROSCillator:LOCKed:VALid?

**NOTE** **Applies to the AP5001A, AP5002A, and AP5012A only with hardware number xxx.xxDxxxxxx-xxx.**

`[:SOURce<ch>]:ROSCillator:LOCKed:VALid?`

Returns the valid state of the lock check. It returns 0 if the reference configuration has changed since the last lock check. In case the device does not support lock check, the query always returns 1.

## ROSCillator:OUTPut:FREQuency

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

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

Selects the reference output frequency.

***RST** device specific

**Range** Please refer to the Data Sheet.

**Unit** Hz

## ROSCillator:OUTPut[:STATe]

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

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

Enables or disables the frequency reference output.

***RST** OFF

## ROSCillator:SOURce

`[:SOURce<ch>]:ROSCillator:SOURce INTernal|EXTernal|SLAVe|EXTVariable|CIN`

`[:SOURce<ch>]:ROSCillator:SOURce?`

Selects the reference clock source.

| | |
|---|---|
| INTernal | Selects the internal reference oscillator. |
| EXTernal | Selects the reference input as the reference clock source using the standard external reference system. Option 1ER is disabled (if available) which improves relative phase stability between the reference and the RF output signal.<br>See ROSCillator:EXTernal:FREQuency for the reference input clock setting. |
| SLAVe | Selects slave mode with fixed 100 MHz reference input clock. This mode allows locking multiple AP4001A, AP5001A or AP5002A instruments to a common reference by daisy-chaining reference inputs and outputs. This mode offers the best relative phase stability between daisy-chained instruments.<br>The master device must be configured for 100 MHz reference output: ROSCillator:OUTPut[:STATe] set to ON and ROSCillator:OUTPut:FREQuency set to 100 MHz. |
| EXTVariable | Instruments with Option 1ER and Model Numbers AP4007A, AP5001A, and AP5002A support external reference signals to drive the instrument clock source. Model Numbers AP4003A and AP4005A do not support the use of an external reference signal.<br>See ROSCillator:EXTernal:FREQuency for the reference input clock setting. |
| CIN | (AP5012A only)<br>Selects the high frequency reference input (CLK IN) with fixed 3 GHz clock as the reference clock source. This mode allows locking multiple AP5012A instruments to a common reference by daisy-chaining high frequency reference inputs (CLK IN) and outputs (CLK out). This mode offers the best relative phase stability between daisy-chained AP5012A instruments.<br>The master device must be configured for 3 GHz reference output ROSCillator:COUT[:STATe] |

***RST** INTernal

# [:SOURce<ch>]:SWEep Subsystem

| Command | Parameters | Unit | Default |
|---|---|---|---|
| [:SOURce<ch>]:SWEep:BLANking | ON\|OFF\|1\|0 | | ON |
| [:SOURce<ch>]:SWEep:COUNt | INFinite\|<integer> | | INFinite |
| [:SOURce<ch>]:SWEep:DELay | <float> | s | 0 s |
| [:SOURce<ch>]:SWEep:DELay:AUTO | ON\|OFF\|1\|0 | | OFF |
| [:SOURce<ch>]:SWEep:DIRection | UP\|DOWN\|RANDom | | UP |
| [:SOURce<ch>]:SWEep:DWELl | <float> | s | 400 µs |
| [:SOURce<ch>]:SWEep:POINts | <integer> | | 2 |
| [:SOURce<ch>]:SWEep:PROGress? | | | |
| [:SOURce<ch>]:SWEep:SPACing | LINear\|LOGarithmic | | LINear |

| Related Commands |
|---|
| [:SOURce<ch>]:FREQuency:CENTer |
| [:SOURce<ch>]:FREQuency:MODE |
| [:SOURce<ch>]:FREQuency:SPAN |
| [:SOURce<ch>]:FREQuency:STARt |
| [:SOURce<ch>]:FREQuency:STOP |
| [:SOURce<ch>]:PHASe:MODE |
| [:SOURce<ch>]:PHASe:STARt |
| [:SOURce<ch>]:PHASe:STOP |
| [:SOURce<ch>]:POWer:MODE |
| [:SOURce<ch>]:POWer:STARt |
| [:SOURce<ch>]:POWer:STOP |

## SWEep:BLANking

`[:SOURce<ch>]:SWEep:BLANking ON|OFF|1|0`

`[:SOURce<ch>]:SWEep:BLANking?`

Enables or disables RF output blanking while waiting for the trigger signal. Blanking enabled means the RF output is off while waiting for the trigger event.

This setting is coupled with [:SOURce<ch>]:LIST:BLANking.

***RST** ON

## SWEep:COUNt

`[:SOURce<ch>]:SWEep:COUNt InFinite|<integer>`

`[:SOURce<ch>]:SWEep:COUNt?`

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

***RST** INFinite

**Range** INFinite or 2 to maximum count (Please refer to the Data Sheet.)

## SWEep:DELay

`[:SOURce<ch>]:SWEep:DELay <float>`

`[:SOURce<ch>]:SWEep:DELay?`

Sets the delay time for the step sweep points. This is the amount of time the sweep pauses with RF off before playing the next point. The total amount of time spent per point equates to dwell time + delay time.

***RST** 0 s

**Range** Please refer to the Data Sheet.

**Unit** s

## SWEep:DELay:AUTO

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

`[:SOURce<ch>]:SWEep:DELay:AUTO?`

Enables or disables automatic off (delay) time selection. In automatic mode, delay time is selected such that the transients between sweep points are blanked and do not appear at the RF output. The automatically selected off time varies with device type. It can be queried by [:SOURce<ch>]:SWEep:DELay? while automatic mode is enabled.

***RST** OFF

## SWEep:DIRection

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

`[:SOURce<ch>]:SWEep:DIRection?`

Sets the direction of a step sweep.

| | |
|---|---|
| UP | The sweep moves from start to stop. |
| DOWN | The sweep moves from stop to start. |

| | |
|---|---|
| RANDom | The sweep plays random points within the start and stop interval. |

***RST** UP

## SWEep:DWELl

`[:SOURce<ch>]:SWEep:DWELl <float>`

`[:SOURce<ch>]:SWEep:DWELl?`

Sets the dwell time for the step sweep points. The dwell time is the on time. This is the amount of time the sweep plays the current point with RF on. The total amount of time spent per point equates to dwell time + delay time.

***RST** 50 µs

**Range** Please refer to the Data Sheet.

**Unit** s

## SWEep:POINts

`[:SOURce<ch>]:SWEep:POINts <integer>`

`[:SOURce<ch>]:SWEep:POINts?`

Defines the number of step sweep points.

***RST** 2

**Range** 2 to maximum (Please refer to the Data Sheet.)

## SWEep:PROGress?

**NOTE** Applies to AP5001A and AP5002A only.

`[:SOURce<ch>]:SWEep:PROGress?`

Returns the progress of an active sweep. The returned value is in the range of 0.0 to 1.0, with 0.0 indicating the sweep is at the start and 1.0 indicating it is at the stop.

## SWEep:SPACing

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

`[:SOURce<ch>]:SWEep:SPACing?`

Enables the instrument linear or logarithmic sweep modes.

| | |
|---|---|
| LINear | Selects linear steps adding the same step size to each point. |
| LOGarithmic | Selects logarithmic steps multiplying each point with the same factor. Only available on selected instruments. |

Logarithmic step is supported for frequency sweeps only. Power and phase sweeps support linear mode only (linear in dB for power sweeps) and ignore this setting. The instrument uses the specified start frequency, stop frequency, and number of points for both linear and logarithmic sweeps.

***RST** LINear

## Related Commands:

### FREQuency:CENter

Sets the center frequency of a step sweep.

Refer to “FREQuency:CENTer” for a detailed command description.

### FREQuency:MODE

Sets the frequency mode of the instrument. A frequency sweep can be enabled by selecting sweep mode or disabled by selecting any other mode.

Refer to "FREQuency:MODE" for a detailed command description.

### FREQuency:SPAN

Sets the frequency span of a step sweep.

Refer to "FREQuency:SPAN" for a detailed command description.

### FREQuency:STARt

Sets the start frequency in a step sweep.

Refer to "FREQuency:STARt" for a detailed command description.

### FREQuency:STOP

Sets the stop frequency in a step sweep.

Refer to "FREQuency:STOP" for a detailed command description.

### PHASe:MODE

NOTE

Applies to all instruments **except** for the AP4003A, AP4005A, AP4007A, AP4011A, AP4012A only.

Sets the phase mode of the signal generator. A phase sweep can be enabled by selecting sweep mode or disabled by selecting any other mode.

Refer to "PHASe:MODE" for a detailed command description.

### PHASe:STARt

NOTE

Applies to all instruments **except** for the AP4003A, AP4005A, AP4007A, AP4011A, AP4012A only.

Sets the start phase in a step sweep.

Refer to "PHASe:STARt" for a detailed command description.

### PHASe:STOP

NOTE

Applies to all instruments **except** for the AP4003A, AP4005A, AP4007A, AP4011A, AP4012A only.

Sets the stop phase in a step sweep.

Refer to "PHASe:STOP" for a detailed command description.

### POWer:MODE

Sets the amplitude mode of the instrument. An amplitude sweep can be enabled by selecting sweep mode or disabled by selecting any other mode.

Refer to "POWer:MODE" for a detailed command description

### POWer:STARt

Sets the start amplitude in a step sweep.

Refer to "POWer:STARt" for a detailed command description.

### POWer:STOP

Sets the stop amplitude in a step sweep.

Refer to "POWer:STOP" for a detailed command description.

# :STATus Subsystem

This subsystem controls the status-reporting structures. Refer to "Operation Status Group" and "Questionable Status Group" for a description of the individual status bits.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :STATus:OPERation:CONDition? | | | |
| :STATus:OPERation:ENABle | <integer> | | 0 |
| :STATus:OPERation[:EVENt]? | | | |
| :STATus:OPERation:NTR | <integer> | | 0 |
| :STATus:OPERation:PTR | <integer> | | 0 |
| :STATus:PREset | | | |
| :STATus:QUEStionable:CONDition? | | | |
| :STATus:QUEStionable:ENABle | <integer> | | 0 |
| :STATus:QUEStionable[:EVENt]? | | | |
| :STATus:QUEStionable:NTR | <integer> | | 0 |
| :STATus:QUEStionable:PTR | <integer> | | 0 |

## STATus:OPERation:CONDition?

`:STATus:OPERation:CONDition?`

Returns the contents of the operation status condition register.

## STATus:OPERation:ENABle

`:STATus:OPERation:ENABle <integer>`

`:STATus:OPERation:ENABle?`

Sets the enable bit mask of the operation status event register. Enabled event bits add to the sum bit in the status byte.

***RST** 0

**Range** 0 to 65535

## STATus:OPERation[:EVENt]?

`:STATus:OPERation[:EVENt]?`

Returns the contents of the operation status event register and clears it.

## STATus:OPERation:NTR

`:STATus:OPERation:NTR <integer>`

`:STATus:OPERation:NTR?`

Sets the negative transition filter bit mask of the operation status event register.

***RST** 0

**Range** 0 to 65535

## STATus:OPERation:PTR

`:STATus:OPERation:PTR <integer>`

`:STATus:OPERation:PTR?`

Sets the positive transition filter bit mask of the operation status event register.

***RST** 0

**Range** 0 to 65535

## STATus:PRESet

`:STATus:PRESet`

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

## STATus:QUEStionable:CONDition?

`:STATus:QUEStionable:CONDition?`

Returns the contents of the questionable status condition register.

## STATus:QUEStionable:ENABle

`:STATus:QUEStionable:ENABle <integer>`

`:STATus:QUEStionable:ENABle?`

Sets the enable mask of the questionable status event register. Enabled event bits add to the sum bit in the status byte.

***RST** 0

**Range** 0 to 65535

## STATus:QUEStionable[:EVENt]?

`:STATus:QUEStionable [:EVENt]?`

Returns the contents of the questionable status event register and clears it.

## STATus:QUEStionable:NTR

`:STATus:QUEStionable:NTR <integer>`

`:STATus:QUEStionable:NTR?`

Sets the negative transition filter bit mask of the questionable status event register.

***RST** 0

**Range** 0 to 65535

## STATus:QUEStionable:PTR

`:STATus:QUEStionable:PTR <integer>`

`:STATus:QUEStionable:PTR?`

Sets the positive transition filter bit mask of the questionable status event register.

***RST** 0

**Range** 0 to 65535

# :SYSTem Subsystem

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :SYSTem:ERRor:ALL? | | | |
| :SYSTem:ERRor[:NEXT]? | | | |
| :SYSTem:FIRMware:DATA | <data> | | |
| :SYSTem:FIRMware:UPDate? | | | |
| :SYSTem:LOCK | | | |
| :SYSTem:LOCK:RELease | | | |
| :SYSTem:PRESet | | | |
| :SYSTem:STABle? | | | |
| :SYSTem:TEMPerature? | | °C | |
| :SYSTem:UPTime? | | | |
| :SYSTem:VERSion? | | | |

## SYSTem:ERRor:ALL?

`:SYSTem:ERRor:ALL?`

Queries 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.

If the error queue is empty, 0 (no error) is returned.

## SYSTem:ERRor[:NEXT]?

`:SYSTem:ERRor[:NEXT]?`

Queries 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. This query clears the returned error from the instrument's error queue.

If the error queue is empty, 0 (no error) is returned.

## SYSTem:FIRMware:DATA

`:SYSTem:FIRMware:DATA <data>`

Sends a firmware package to the device. The firmware package file content is sent in the 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:

#18xxxxxxxx

#18...: byte

#18...: 8 data bytes will follow ...xxxxxxxx: 8 bytes of data

The data itself are the binary contents of the firmware package file.

This command does not install the firmware package uploaded. To verify and install the package, issue a :SYSTem:FIRMware:UPDate? query.

## SYSTem:FIRMware:UPDate?

**:SYSTem:FIRMware:UPDate?**

Checks and installs a firmware package uploaded with :SYSTem:FIRMware:DATA. Data integrity and device compatibility of the firmware package is checked. A success or failure code is returned and in case of success the update process starts:

| | |
|---|---|
| 0 | The firmware package is not valid (it is not compatible to this device or data is corrupted). The device continues to operate normally. Please check if the firmware package uploaded is valid for this device and if the correct block data format outlined in :SYSTem:FIRMware:DATA is used. |
| 1 | The firmware package is valid and the update process starts. The connection can now be closed. The update process takes up to a few minutes. After it completes, the device restarts automatically. |

## SYSTem:LOCK

**NOTE** Applies to the AP4021A, AP5001A, AP5002A, AP5011A, AP5021A, AP5031A only.

**:SYSTem:LOCK**

Locks (disables) front panel control. Instrument settings are still shown on the front panel, so locking the device will not hide possible confidential information like the frequency setting. Refer to “DISPlay:ENABle” for full display disable mode hiding all settings. The Local button on the front panel will unlock (re-enable) front panel control.

## SYSTem:LOCK:RELease

**NOTE** Applies to the AP4021A, AP5001A, AP5002A, AP5011A, AP5021A, AP5031A only.

`:SYSTem:LOCK:RELease`

Unlocks (re-enables) front panel control.

## SYSTem:PRESet

`:SYSTem:PRESet`

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

## SYSTem:STABle?

`SYSTem:STABle?`

Queries if the instrument has reached a stable operating temperature.

| | |
|---|---|
| 0 | The device has not yet reached a stable operating temperature. |
| 1 | The device has yet reached a stable operating temperature. |

## SYSTem:TEMPerature?

`:SYSTem:TEMPerature?`

Returns the instrument's internal temperature (average from all temperature sensors).

**Unit** °C

## SYSTem:UPTime?

`:SYSTem:UPTime?`

Returns the amount of time that the instrument has been running since the last power-on.

For example: 10h:30m:45s

## SYSTem:VERSion?

`:SYSTem:VERSion?`

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

# :SYSTem:COMMunicate Subsystem

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :SYSTem:COMMunicate:GPIB:ADDRess | <"string"> | | "1" |
| :SYSTem:COMMunicate:LAN:CONFig | DHCP\|MANual\|AUTO | | AUTO |
| :SYSTem:COMMunicate:LAN:DEFaults | | | |
| :SYSTem:COMMunicate:LAN:GATEway | <"ipv4string"> | | automatic |
| :SYSTem:COMMunicate:LAN:IP | <"ipv4string"> | | automatic |
| :SYSTem:COMMunicate:LAN:MSESsion | ON\|OFF\|1\|0 | | OFF |
| :SYSTem:COMMunicate:LAN:PORT | <integer> | | 18 |
| :SYSTem:COMMunicate:LAN:RESTart | | | |
| :SYSTem:COMMunicate:LAN:RTMO | INFinite\|<float> | | INFinite |
| :SYSTem:COMMunicate:LAN:SUBNet | <"ipv4string"> | | automatic |
| :SYSTem:COMMunicate:QUERy:ECHO | ON\|OFF\|1\|0 | | OFF |
| :SYSTem:COMMunicate:VXI:RTMO | INFinite\|<float> | | INFinite |

## SYSTem:COMMunicate:GPIB:ADDRess

**NOTE** Applies to the AP4012A, AP4022A, AP5011A, AP5012A, AP5021A, AP5022A, AP5031A, AP5032A with option GPIB.

`:SYSTem:COMMunicate:GPIB:ADDRess <"string">`

`:SYSTem:COMMunicate:GPIB:ADDRess?`

Sets the AP instrument's GPIB device address. The address has SCPI string format. Example command to set address 10.
:SYSTem:COMMunicate:GPIB:ADDRess "10".

***RST** unchanged, "1" on factory preset

**Range** 1 to 30

## SYSTem:COMMunicate:LAN:CONFig

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

`:SYSTem:COMMunicate:LAN:CONFig?`

Sets the instruments internet protocol (IP) address.

| | |
|---|---|
| DHCP | The user assigns an IP address to the AP signal generator/frequency synthesizer. |

| | |
|---|---|
| MANual | The network assigns an IP address to the AP signal generator/frequency synthesizer. Requests will be repeated continuously with infinite timeout until a valid address has been assigned. |
| AUTO | The network assigns an IP address to the AP signal generator/frequency synthesizer with a fallback to Auto-IP if DHCP request continue to fail for more than 10 seconds. |

***RST** unchanged, AUTO on factory preset

## SYSTem:COMMunicate:LAN:DEFaults

```
:SYSTem:COMMunicate:LAN:DEFaults
```

Restores the instrument's LAN settings to their factory default values.

The default mode is :SYSTem:COMMunicate:LAN:CONFig AUTO. In this mode the instrument uses DHCP to retrieve an IP address and falls back to auto IP if DHCP fails.

## SYSTem:COMMunicate:LAN:GATEway

```
:SYSTem:COMMunicate:LAN:GATEway <"ipv4string">
```

```
:SYSTem:COMMunicate:LAN:GATEway?
```

Sets the gateway for local area network (LAN) access to the AP signal generator/frequency synthesizer from outside the current sub-network. The query returns the current setting, not the saved setting.

The expected format for <"ipv4string"> is four decimal octets separated by periods, surrounded by quotation marks. Example command: :SYST:COMM:LAN:GATE "192.168.1.1".

In :SYSTem:COMMunicate:LAN:CONFig DHCP|AUTO mode this setting is configured automatically.

***RST** unchanged, automatic in :SYSTem:COMMunicate:LAN:CONFig DHCP|AUTO mode

**Range** "0.0.0.0" to "255.255.255.255"

## SYSTem:COMMunicate:LAN:IP

```
:SYSTem:COMMunicate:LAN:IP <"ipv4string">
```

```
:SYSTem:COMMunicate:LAN:IP?
```

Sets the instrument's local area network (LAN) internet protocol (IP) address for your IP network connection.

The expected format for <"ipv4string"> is four decimal octets separated by periods, surrounded by quotation marks. Example command: :SYST:COMM:LAN:IP "192.168.1.100".

In :SYSTem:COMMunicate:LAN:CONFig DHCP|AUTO mode this setting is configured automatically.

***RST** unchanged, automatic in :SYSTem:COMMunicate:LAN:CONFig DHCP|AUTO mode

**Range** “0.0.0.0” to “255.255.255.255”

## SYSTem:COMMunicate:LAN:MSESsion

`:SYSTem:COMMunicate:LAN:MSESsion ON|OFF|1|0`

`:SYSTem:COMMunicate:LAN:MSESsion?`

Enables multi-session for LAN communications. If it is enabled, up to 20 communication sockets can be opened to the device. If it is disabled, only a single LAN connection is possible.

***RST** unchanged, OFF on factory preset

## SYSTem:COMMunicate:LAN:PORT

:SYSTem:COMMunicate:LAN:PORT <integer>

:SYSTem:COMMunicate:LAN:PORT?

Allows you to change the port on which the device is listening to incoming LAN connections. The default port is 18.

***RST** unchanged, 18 on a factory preset

**Range** 1 to 65535

## SYSTem:COMMunicate:LAN:RESTart

`:SYSTem:COMMunicate:LAN:RESTart`

Restarts the network to enable changes that have been made to the LAN setup.

## SYSTem:COMMunicate:LAN:RTMO

`:SYSTem:COMMunicate:LAN:RTMO INFinite|<float>`

`:SYSTem:COMMunicate:LAN:RTMO?`

Sets the LAN reconnect timeout in seconds or INFinite timeout. After the LAN connection is inactive for the configured timeout, a new connection can be established (reconnect). INFinite timeout disables reconnect. Finite or zero timeout enables reconnect. Non-zero finite timeout protects against undesired connection attempts.

***RST** unchanged, INFinite on power up

**Range** INFinite|0 to 1e6 s

## SYSTem:COMMunicate:LAN:SUBNet

`:SYSTem:COMMunicate:LAN:SUBNet <"ipv4string">`

`:SYSTem:COMMunicate:LAN:SUBNet?`

Sets the Instrument's local area network (LAN) subnet mask address for your internet protocol (IP) network connection.

The expected format for <"ipv4string"> is four decimal octets separated by periods, surrounded by quotation marks. Example command: :SYST:COMM:LAN:SUBN "255.255.255.0".

In :SYSTem:COMMunicate:LAN:CONFig DHCP|AUTO mode this setting is configured automatically.

***RST** unchanged, automatic in :SYSTem:COMMunicate:LAN:CONFig DHCP|AUTO mode

**Range** "0.0.0.0" to "255.255.255.255"

## SYSTem:COMMunicate:QUERy:ECHO

`:SYSTem:COMMunicate:QUERy:ECHO ON|OFF|1|0`

`:SYSTem:COMMunicate:QUERy:ECHO?`

Enables or disables the query echo for unknown queries. When enabled, every query is always answered, eliminating the timeout that would otherwise occur waiting for a response to a malformed or unknown query.

The query echo for unknown queries is a newline "\n" termination character (empty string). Answers to known queries remain unchanged.

***RST** OFF

## SYSTem:COMMunicate:VXI:RTMO

`:SYSTem:COMMunicate:VXI:RTMO INFinite|<float>`

`:SYSTem:COMMunicate:VXI:RTMO?`

Sets the VXI-11 reconnect timeout in seconds or INFinite timeout. After the VXI-11 connection is inactive for the configured timeout, a new connection can be established (reconnect). INFinite timeout disables reconnect. Finite or zero timeout enables reconnect. Non-zero finite timeout protects against undesired connection attempts.

***RST** unchanged, INFinite on power up

**Range** INFinite | 0 to 1e6 s

# :TEST Subsystem

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :TEST:FAST? | | | |
| :TEST:FULL? | | | |
| :TEST:FULL:REPort? | | | |

## TEST:FAST?

**:TEST:FAST?**

Initiates the internal fast self-test and returns one of the following results:

The self-test is a slow operation. It may be necessary to increase the query timeout in the remote programming application

| | |
|---|---|
| 0 | All tests passed. |
| 1 | One or more tests failed. |

## TEST:FULL?

**:TEST:FULL?**

Initiates the internal full self-test and returns the sum of one or more of the following result flags:

| | |
|---|---|
| 0 | All tests passed. |
| -1 | ALC (automatic level control) is out of range. |
| -2 | Frequency synthesis section unlocked. |
| -4 | FPGA subsystem failure. |
| -8 | Vector modulator failure. |
| -16 | Other failure. |

The self-test is a slow operation. It may be necessary to increase the query timeout in the remote programming application

## TEST:FULL:REPort?

**:TEST:FULL:REPort?**

Returns a text file containing information gathered by the internal full self-test.

The text file is transferred in IEEE 488.2 definite block data format.

# :TRIGger Subsystem

Triggers control the playback by telling the AP signal generator/frequency synthesizer when to play the signal.

Depending on the trigger settings for the AP signal generator/frequency synthesizer, the waveform playback can occur once, continuously, or the device 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 AP signal generator/frequency synthesizer 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 AP signal generator/frequency synthesizer requires only a single trigger. In this situation, the device 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:

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

   NORMal: trigger edge starts sweeps

   POINt: trigger edge plays the next point

   GATE: trigger level starts/stops sweep

2. Setting the waveform's response to triggers:

   CONTinuous: repeatedly accepts trigger events

   SINGle: uses only one trigger event

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

4. Setting the trigger polarity when using an external source.

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :TRIGger:OUTPut:MODE | NORMal\|GATE\|POINt\|VALid | | NORMal |
| :TRIGger:OUTPut:POLarity | NORMal\|INVerted | | NORMal |
| :TRIGger:OUTPut[:VALid]:SOURce | ALL\|<integer> | | 1 |
| :TRIGger[:SEQuence]:DELay | <float> | s | 0 s |
| :TRIGger[:SEQuence]:ECOunt | <integer> | | 1 |
| :TRIGger[:SEQuence][:IMMediate] | | | |
| :TRIGger[:SEQuence]:SLOPe | POSitive\|NEGative\|NP\|PN | | POSitive |

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :TRIGger[:SEQuence]:SOURce | IMMediate\|KEY\|EXT\|BUS | | IMMediate |
| :TRIGger[:SEQuence]:TYPE | NORMal\|GATE\|POINt | | NORMal |

## TRIGger:OUTPut:MODE

**NOTE** Applies to all instruments **except** for the AP4001A, AP4003A, AP4005A, AP4007A and AP4011A only.

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

`:TRIGGer:OUTPut:MODE?`

Sets the trigger output signal mode.

Note that the low frequency output must be configured for trigger output by sending the [:SOURce]:LFOutput:SOURce TRIGger and [:SOURce]:LFOutput:STATe ON commands.

| | |
|---|---|
| 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). |

***RST** NORMal

## TRIGger:OUTPut:POLarity

**NOTE** Applies to all instruments **except** for the AP4001A, AP4003A, AP4005A, AP4007A and AP4011A only.

`:TRIGGer:OUTPut:POLarity NORMal|INVerted`

`:TRIGGer:OUTPut:POLarity?`

Sets the trigger output signal polarity.

Note that the low frequency output must be configured for trigger output by sending the [:SOURce]:LFOutput:SOURce TRIGger and [:SOURce]:LFOutput:STATe ON commands.

| | |
|---|---|
| NORMal | The idle state of the trigger output signal is low. A high pulse or high signal is played upon trigger events or when the RF output signal is valid. |

| | |
|---|---|
| INVerted | The idle state of the trigger output signal is high. A low pulse or low signal is played upon trigger events or when the RF output signal is valid. |

***RST** NORMal

## TRIGger:OUTPut[:VALid]:SOURce

**NOTE**

Applies to all instruments **except** for the AP4001A, AP4003A, AP4005A, AP4007A and AP4011A only.

`:TRIGGer:OUTPut[:VALid]:SOURce ALL|<integer>`

`:TRIGGer:OUTPut[:VALid]:SOURce?`

Selects the source channel for the trigger output and the RF output valid signal.

| | |
|---|---|
| ALL | In :TRIGger:OUTPut:MODE VALid mode: 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). In all other :TRIGger:OUTPut:MODE modes: the trigger output is set while any of the individual channels trigger output signals is set (logical “or” over all channels). |
| <integer> | Depending on :TRIGger:OUTPut:MODE the trigger output is set while RF output of the selected channel is valid (settled) or while the selected channels trigger output signal is set. |

***RST** 1

**Range** ALL|1 to number of channels

## TRIGger[:SEQuence]:DELay

`:TRIGger[:SEQuence]:DELay <float>`

`:TRIGger[:SEQuence]:DELay?`

Sets the amount of time to delay the instrument response to a trigger event.

The delay is a path (time) delay between when the instrument 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.

***RST** 0 s

**Range** Please refer to the Data Sheet.

**Unit** s

## TRIGger[:SEQuence]:ECOunt

`:TRIGGer[:SEQuence]:ECOunt <integer>`

`:TRIGGer[:SEQuence]:ECOunt?`

Sets a modulus counter on consecutive trigger events. Setting the value to N means that only every Nth trigger event will be considered. Setting it to 1 will use every trigger event that does not occur during a running sweep.

***RST** 1

**Range** 1 to 255

## TRIGger:[SEQuence][:IMMediate]

`:TRIGger[:SEQuence][:IMMediate]`

Triggers the device immediately if it is configured to wait for trigger events.

Immediate triggering is forced regardless of the selected trigger source.

## TRIGger[SEQuence]:SLOPe

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

`:TRIGger[:SEQuence]:SLOPe?`

Sets the polarity for an external trigger signal while using the continuous, single triggering mode.

| | |
|---|---|
| POSitive\|NEGative | In normal or point mode selected by :TRIGger[:SEQuence]:TYPE NORMal\|POINT the trigger system reacts to the rising (positive) or falling (negative) edge of the external trigger signal.<br>In gated mode selected by :TRIGger[:SEQuence]:TYPE GATE the trigger is active while the external signal is high (positive) or low (negative). For example, when you select POSitive, the waveform responds (plays) during the high state of the trigger signal. |
| NP\|PN | (Available on selected instruments only). In normal or point mode selected by :TRIGger[:SEQuence]:TYPE NORMal\|POINT the trigger system reacts to both rising and falling edges of the trigger signal. NP selects falling, PN selects rising edge first. |

When the Instrument receives multiple trigger occurrences when only one is required, the AP signal generator/frequency synthesizer uses the first trigger and ignores the rest.

***RST** POSitive

## TRIGger[:SEQuence]:SOURce

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

`:TRIGger[:SEQuence]:SOURce?`

Sets the trigger source.

| | |
|---|---|
| IMMediate | No waiting for a trigger event occurs. |
| KEY | This choice enables manual triggering by pressing the front-panel RF on/off.<br>Applies to AP4021A, AP5001A, AP5002A, AP5011A, AP5021A only. |
| EXTernal | This choice enables the triggering of a sweep event by an externally applied signal at the TRIG IN connector. |
| BUS | This choice enables triggering over the remote control interface using the :TRIGer[:SEQuence][:IMMediate], *TRG or GET (group execute trigger) commands. |

***RST** IMMediate

## TRIGger[:SEQuence]:TYPE

`:TRIGger[:SEQuence]:TYPE NORMal|GATE|POINt`

`:TRIGger[:SEQuence]:TYPE?`

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** NORMal

# :UNIT Subsystem

| Command | Parameters | Unit | Default |
|---|---|---|---|
| :UNIT:POWer | DBM\|DBMW\|DM\|DBUW\|DBW\|DB\|DBUA\|DBMA\|DBA\|DBUV\|DBMV\|DBV\|UW\|MW\|W\|UV\|MV\|V\|UA\|MA\|A | | DBM/W |

## UNIT:POWer

`:UNIT:POWer`
**DBM | DBMW | DM | DBUW | DBW | DB | DBUA | DBMA | DBA | DBUV | DBMV | DBV | UW | MW | W | UV | MV | V | UA | MA | A**

`:UNIT:POWer?`

This command sets the default unit for power setting commands and queries. All units listed below can be appended to all power setting commands. Example: POW 100MV.

| | |
|---|---|
| DBM\|DBMW\|DM | Sets dBm (decibels with reference to 1 mW) as the default unit. |
| DBUW | Sets dBuW (decibels with reference to 1 µW) as the default unit. |
| DBW\|DB | Sets dBW (decibels with reference to 1 W) as the default unit. |
| DBUA | Sets dBµA (decibels with reference to 1 µA into 50 Ω load) as the default unit. |
| DBUA | Sets dBµA (decibels with reference to 1 µA into 50 Ω load) as the default unit. |
| DBMA | Sets dBmA (decibels with reference to 1 mA into 50 Ω load) as the default unit. |
| DBA | Sets dBA (decibels with reference to 1 A into 50 Ω load) as the default unit. |
| DBUA | Sets dBµA (decibels with reference to 1 µA into 50 Ω load) as the default unit. |
| DBUV | Sets dBµV (decibels with reference to 1 µV into 50 Ω load) as the default unit. |
| DBMV | Sets dBmV (decibels with reference to 1 mV into 50 Ω load) as the default unit. |
| DBV | Sets dBV (decibels with reference to 1 V into 50 Ω load) as the default unit. |
| UW | Sets µW as the default unit. |
| MW | Sets mW as the default unit |
| W | Sets W as the default unit. |
| UV | Sets µV into 50 Ω load as the default unit. |
| MV | Sets mV into 50 Ω load as the default unit. |

| | |
|---|---|
| V | Sets V into 50 Ω load as the default unit. |
| UA | Sets µA into 50 Ω load as the default unit |
| MA | Sets mA into 50 Ω load as the default unit. |
| A | Sets A into 50 Ω load as the default unit. |

***RST** DBMW

Edition 2, November 2025

AP5001-90003

www.keysight.com