
Keysight

AP4001A, AP4003A, AP4005A, AP4007A,
AP4011A, AP4012A, AP4021A, AP4022A
Frequency Synthesizer

Notices

© Keysight Technologies, Inc. 2025

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Keysight Technologies, Inc. as governed by United States and international copyright laws.

Trademark Acknowledgments

Manual Part Number

AP4001-90002

Edition

Edition: September 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:

<https://www.keysight.com/find/ap4001a>

<https://www.keysight.com/find/ap4003a>

<https://www.keysight.com/find/ap4005a>

<https://www.keysight.com/find/ap4007a>

<https://www.keysight.com/find/ap4011a>

<https://www.keysight.com/find/ap4012a>

<https://www.keysight.com/find/ap4021a>

<https://www.keysight.com/find/ap4022a>

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/PreventingInstrumentDamage>

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 environment 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

1 Quick Start

Introduction	10
Models Covered in this Manual.	10
Available Casing	11
Data Connections	13
Signal Connections	13
Transportation	13
Safety Information	14
Safety Symbols	14
Instrument Markings	14
General Safety Considerations	17
Technical Specifications.	18
Minimum Distances.	18
Energizing and De-Energizing	24
Protective Earth.	26
Proper Operating Conditions	26
Environmental Information	26
Getting Started	27
Included Material	27
System Requirements	27
Initial Inspection	27
Unpacking the Instrument	28
Starting the Instrument.	28
Connecting the Instrument.	28
Shutting Down the Signal Generator	30

2 Using the Graphical User Interface (GUI)

Start the Signal Generator GUI	32
Menus.	33

Contents

CONTROL Menu	33
CW Menu	34
SWEEP Menu	35
MODULATION Menu	36
REFERENCE Menu	37
TRIGGER Menu	38
LF OUT Menu (only AP4001A, AP4021A, AP4022A)	39
Simultaneously Controlling Multiple Signal Generators from one PC.	39
Store and Load Instrument States	40
Setting Network Configuration.	41
Multi-Session Option	41
Device Port Setting	42
Connecting two devices using a non-default port and non-default network interface	42
Firmware Upgrade	43

3 Front Panel Operation (For the AP4021A only)

RF 50 Ω Connector	47
Rotary Button	47
Front Panel Settings	47
CW Menu	47
Sweep Menu	48
Modulation Submenus.	50
Reference Submenu.	53
Trigger Submenu	53
Configuration	54

4 Additional Information

Remote Programming the Signal Generator	58
Maintenance and Warranty Information	59
Adjustments and Calibration	59
Cleaning	59
Repair	59

Contents

Warranty Information	59
Returning an Instrument for Service	60
Calling Keysight Technologies	60
Locations for Keysight Technologies	60
Service Options	61
Packaging the Instrument.	61

1 Quick Start

The following topics can be found in this section:

“Introduction” on page 10

“Safety Information” on page 14

“Technical Specifications” on page 18

“Getting Started” on page 27

Introduction

The devices described in this manual are signal generators that produce electromagnetic microwave signals. The frequency and power range depends on the chosen device model and options. The devices can produce different types of modulations, such as AM, FM, PM Pulse or Chirp.

They can be used in a variety of applications such as research and development or manufacturing and testing of electronic components.

Device specific parameters are covered by the related data sheet that can be downloaded at:

AP4001A FS2 Frequency Synthesizer, 20 GHz, [Data Sheet](#)

AP4003A FS2 Frequency Synthesizer, 100 kHz to 22 GHz, [Data Sheet](#)

AP4005A FS2 Frequency Synthesizer, 1 MHz to 40 GHz, [Data Sheet](#)

AP4007A FS2 Frequency Synthesizer, 8 kHz to 20 GHz, [Data Sheet](#)

AP4011A FS1 Frequency Synthesizer, 8 kHz to 20 GHz, [Data Sheet](#)

AP4012A FS1 Frequency Synthesizer, 8 kHz to 20 GHz, [Data Sheet](#)

AP4021A FS1 Frequency Synthesizer, 40 GHz, [Data Sheet](#)

AP4022A FS1 Frequency Synthesizer, 40 GHz, [Data Sheet](#)

Models Covered in this Manual

- AP4001A FS2
- AP4003A FS2
- AP4005A FS2
- AP4007A FS2
- AP4011A FS1
- AP4012A FS1
- AP4021A FS1
- AP4022A FS1

Available Casing

Refer to the Data Sheet for Front and Rear Panel connector descriptions.

Ultra Compact Case

Figure 1-1 AP4001A and AP4011A in an Ultra Compact Case



Compact Portable Case (CPC)

Figure 1-2 AP4021A Compact Portable Case (with front panel)



AP4003A Module

Figure 1-3

AP4003A in a Module Case



AP4005A Module

Figure 1-4

AP4005A in a Module Case



AP4007A Module

Figure 1-5

AP4007A in a Module Case



1U Case

Figure 1-6 AP4012A 1U Case



1U HI Case (HI)

Figure 1-7 AP4022A 1U HI Case



Data Connections

The devices may only be connected to a network or a computer by using a shielded LAN cable. Unless shorter lengths are prescribed, a maximum length of 3 m must not be exceeded for the LAN and the USB connection.

Signal Connections

In general, all connections between the signal generator and another device should be made as short as possible and must be well shielded. It is recommended to use a high-quality cable with low loss especially for frequencies above 20 GHz.

Transportation

The devices must only be transported with the packaging supplied by the manufacturer. The device can be lifted up or transported in any orientation.

Safety Information

The following pieces of information are important to prevent personal injury, loss of life or damage to the equipment. Please read them carefully. If the device is used in a manner not specified by this manual, the protection provided by the device may be impaired.

Safety Symbols

In this manual, the following symbols are used to warn the reader about risks and dangers.

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.

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.

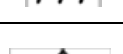
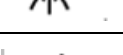
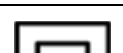
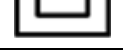
NOTE

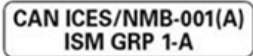
This product has been designed and tested in accordance with accepted industry standards and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Instrument Markings

The table below lists the definitions of markings that may be on or with the product. Familiarize yourself with each marking and its meaning before operating the signal generator.

Marking	Description
	This symbol marks the standby position of the power line switch.
	This symbol marks the ON position of the power line switch.
	This symbol marks the OFF position of the power line switch.

Marking	Description
	This symbol indicates that the input power required is AC.
	This symbol indicates DC voltage
	This symbol indicates a three-phase alternating current.
	This symbol indicates Frame or chassis Terminal.
	The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instruction in the documentation.
	This symbol indicates the presence of a laser device.
	This symbol indicates the surface can be hot.
	This symbol indicates the product is sensitive to electrostatic discharge.
	This symbol identifies the Protective Conductor terminal.
	This symbol indicates the equipment is protected throughout by double or reinforced insulation.
	The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven). It indicates that the product complies with all the relevant directives.
	The UK conformity mark is a UK government owned mark. Products showing this mark comply with all applicable UK regulations.
	The Keysight email address is required by EU directives applicable to our product.
	The CSA mark is a registered trademark of the CSA International.

Marking	Description
CAN ICES/NMB-001(A)	Canada EMC label. Interference-Causing Equipment Standard for industrial, scientific and medical (ISM) equipment. Matériel industriel, scientifique et médical (ISM).
	CE/ICES/ISM label. (Old mark for reference only.) This is a space saver label that combines three markings - CE with CAN ICES and ISM (see above) and ISM (see below).
	This is a space saver label that combines three markings - CE with CAN ICES and ISM (see above) and ISM (see below).
	The RCM mark is a registered trademark of the Australian Communications and Media Authority.
	This is a space saver label that combines two markings - CAN ICES and ISM.
ISM 1-A	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 5).
	South Korean Certification (KC) mark. It includes the marking's identifier code.
	The crossed-out wheeled bin symbol indicates that separate collection for waste electric and electronic equipment (WEEE) is required, as obligated by the EU DIRECTIVE and other National legislation. Please refer to www.keysight.com/go/takeback to understand your trade-in options with Keysight, in addition to product takeback instructions.
	China Restricted Substance Product Label. The EPUP (environmental protection use period) number in the center indicates the time period during which no hazardous or toxic substances or elements are expected to leak or deteriorate during normal use and generally reflects the expected useful life of the product.
	Universal recycling symbol. This symbol indicates compliance with the China standard GB 18455-2001 as required by the China RoHS regulations for paper/fiberboard packaging.
IP x y	This mark indicates the product has been designed to meet the requirements of "IP x y", where "x" is the solid particle protection and "y" is the liquid ingress protection.

General Safety Considerations

FCC Notice

This equipment has been tested and found to comply with the limits for a Class A device, pursuant to **Part 15 of the FCC Rules**. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area may cause harmful interference in which case the user will be required to correct the interference at his or her expense.

WARNING

If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as nickel) may be released. For this reason, the product may only be disassembled or opened by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.

Technical Specifications

Minimum Distances

WARNING

Safety of any system incorporating the equipment is the responsibility of the assembler of the system.

CAUTION

For adequate cooling, the minimum distances between the device and another object, such as walls, rack cabinet walls or other equipment must be respected.

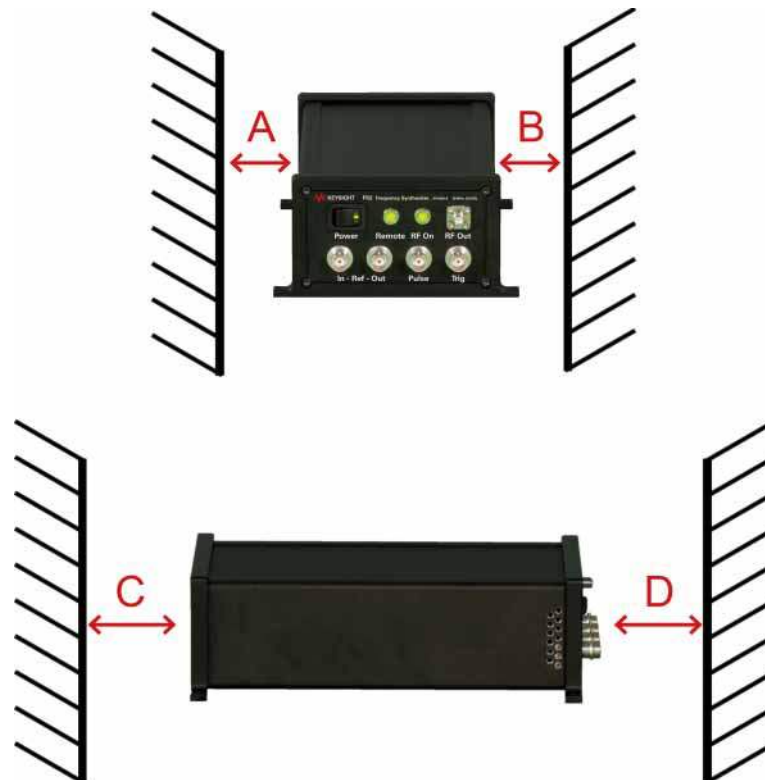
For adequate cooling, the minimum distances between the device and another object, such as walls, rack cabinet walls or other equipment must be respected.

Ultra Portable Case

- A: 50 mm
- B: 50 mm
- C: 50 mm
- D: 50 mm

Figure 1-8

AP4001A and AP4011A Case

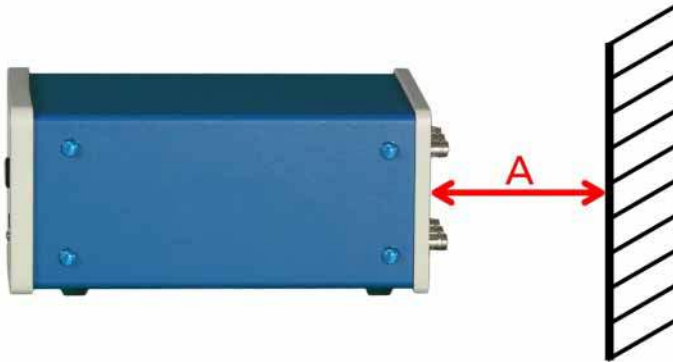


Compact Portable Case

- A: 150 mm

Figure 1-9

Minimum distance for the CPC

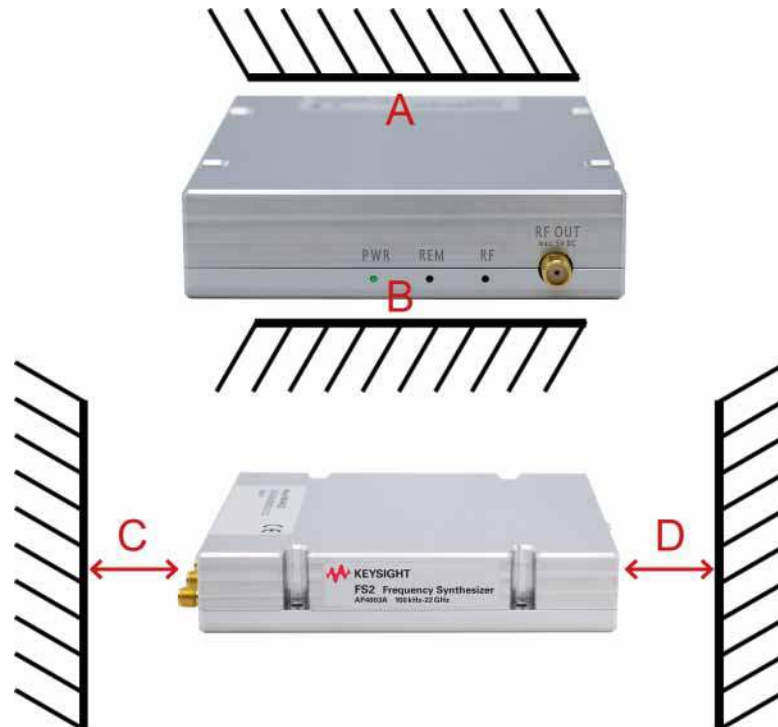


AP4003 Module Case

- A: 0 mm
- B: 0 mm
- C: 50 mm
- D: 50 mm

Figure 1-10

AP4003A Module Case

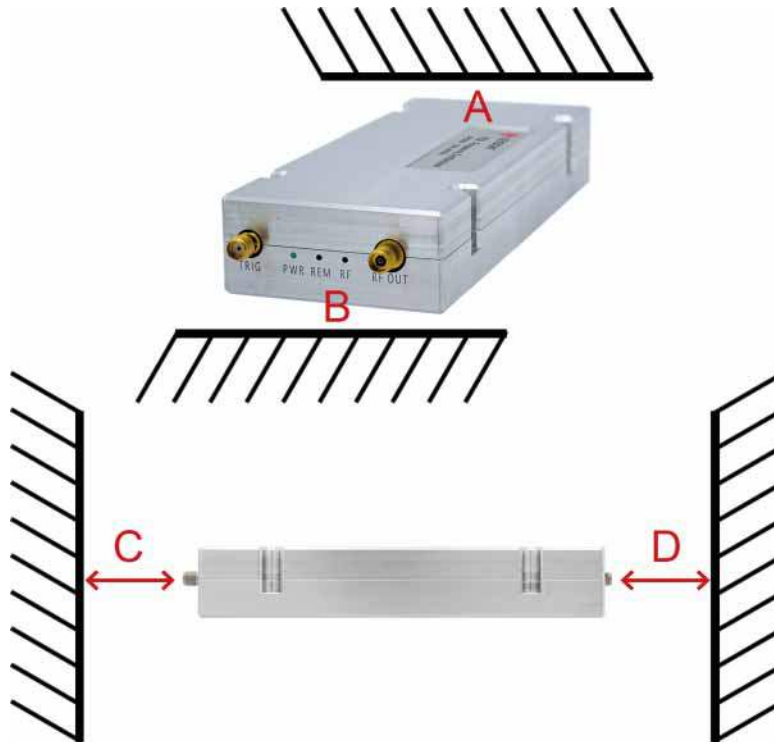


AP4005A Module Case

- A: 0 mm
- B: 0 mm
- C: 50 mm
- D: 50 mm

Figure 1-11

AP4005A Module Case

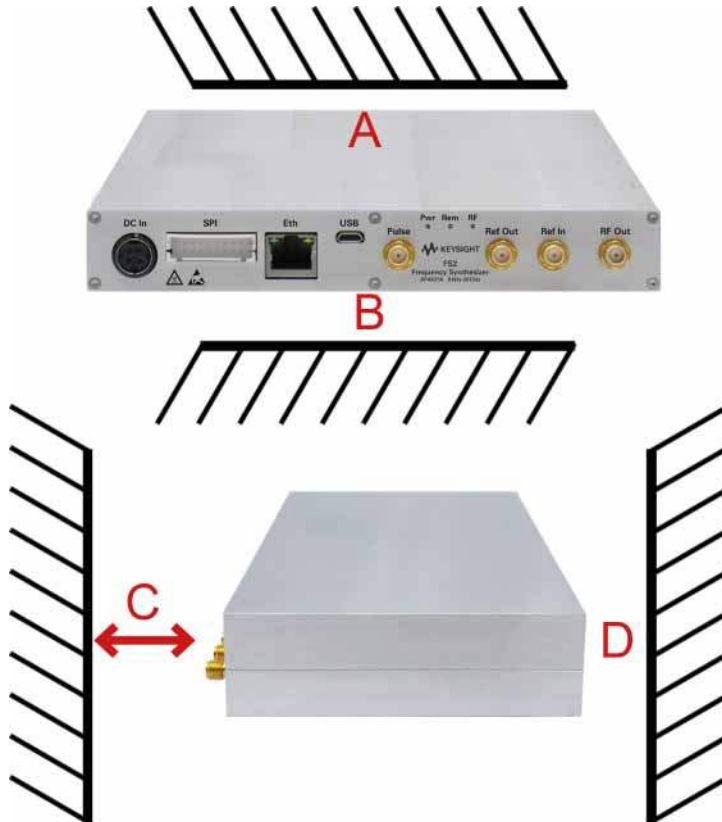


AP4007A Module Case

- A: 0 mm
- B: 0 mm
- C: 50 mm
- D: 0 mm

Figure 1-12

AP4007A Module Case

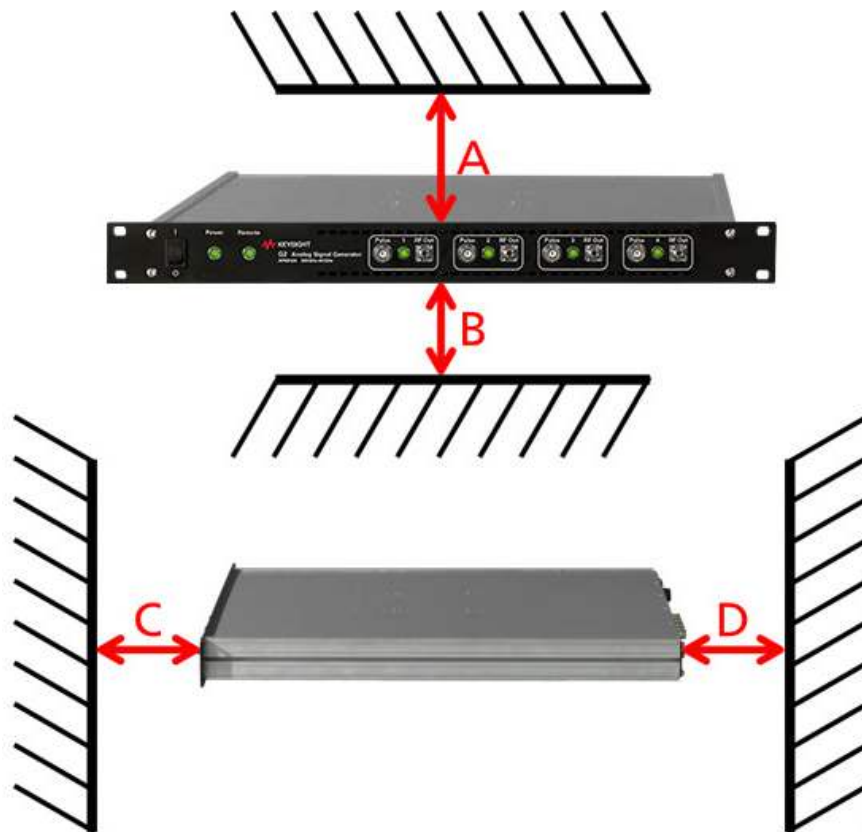


1U Enclosure

- A: 1 mm
- B: 35 mm
- C: 50 mm
- D: 50 mm

Figure 1-13

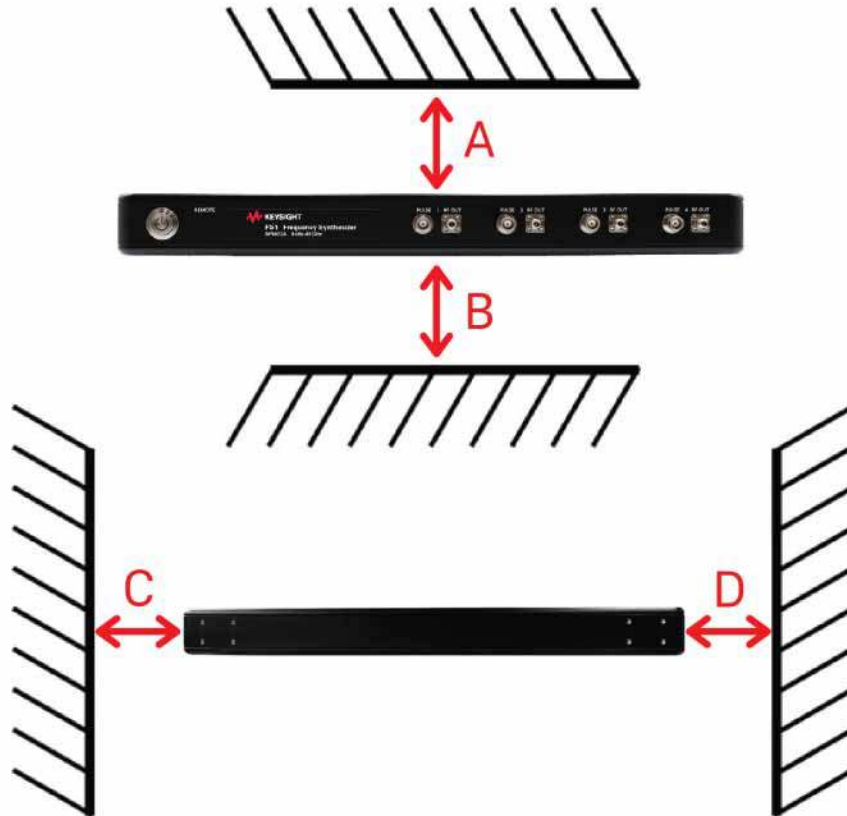
Minimum distance for the 1U



1U HI Enclosure

- A: min. 1 mm
- B: min. 1 mm
- C: 50 mm
- D: 50 mm

Figure 1-14 Minimum distance for the 1U HI



Energizing and De-Energizing

To energize the device, apply the following voltage to the following connector.

CAUTION

Always use the three-prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord can cause product damage.

CAUTION

Only use the power adapter supplied with the equipment. The use of other devices is not permitted.

CAUTION

Install the instrument so that the detachable power cord is readily identifiable and is easily reached by the operator. The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument.

NOTE

The main power cord is the system disconnecting device. It disconnects the mains circuits from the mains supply.

Position of the power connector on the right.

Figure 1-15

AP4021A



Figure 1-16 AP4001A and AP4011A



Figure 1-17 AP4003A



Figure 1-18 AP4005A



Figure 1-19 AP4007A



Figure 1-20 AP4012A



Figure 1-21 AP4022A



Protective Earth

It is prohibited to use the instruments without adequate protective earth connection. Before powering on, ensure that the device is properly connected to protective earth.

WARNING

The Mains wiring, and connectors shall be compatible with the connector used in the premise electrical system. Failure to ensure adequate earth grounding by not using the correct components may cause product damage, and serious injury.

Proper Operating Conditions

The devices are designed for use in dry and clean environments.

WARNING

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in normal conditions (in which all means for protection are intact) only.

NOTE

Operating temperature range, storage and transportation temperature range and operating and storage altitude are device specific. Refer to the instrument's data sheet.

In case of condensation 2 hours are to be allowed for drying prior operation. Operation is only allowed from a 3-terminal mains connector with a safety ground connection and mains plug used in your specific country. For sufficient ventilation, ensure open ventilation holes.

Environmental Information

- Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately. Contact the Keysight customer service center for environmentally responsible disposal of the product.
- Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via Keysight service center.

Getting Started

Included Material

Your signal generator kit contains the following items:

- Signal Generator
- Universal power adaptor (AC 100 – 240 V) with corresponding country specific plugs (depending on the instrument)
- Ethernet Cable

Power Requirements

Input Voltage Frequency and Current (Power adaptor) 100-240 V 50-60 Hz, 1.5A

WARNING

This is a Safety Protection Class I Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

CAUTION

The instruments power adapter is auto-ranging. Be sure the supply voltage is within +/-10% of the specified rating.

System Requirements

The Keysight graphical user interface requires at least the minimum system requirements to run one of the supported operating systems.

Operating system

Windows 2000 SP4, XP SP2, Vista, 7, 8, 10, 11

Remote connection

10/100/1000M Ethernet or USB 2.0 Port

Initial Inspection

Inspect the shipping container for damage. If container is damaged, retain it until contents of the shipment have been verified against the packing list and instruments have been inspected for mechanical and electrical operation.

Unpacking the Instrument

Remove the instrument materials from the shipping containers. Save the containers for future use.

For a list of material included in the standard package, please refer the **“Included Material”** section.

Starting the Instrument

This section describes installation instructions and verification tests.

Applying Power

Place the instrument on the intended workbench and connect the appropriate DC power supply to the receptacle on the rear of the unit. Make sure you use the included DC power supply.

CAUTION

Using supplies other than those provided by Keysight may lead to malfunction and damage of the Instrument.

Press the on/off switch on the rear panel or front panel, or the power plug for a module (AP4003A, AP4005A, AP4007A). For an AP4021A, the front panel display will illuminate, or for the other instruments, the power on indicator LED will illuminate. The AP4021A will initialize and momentarily display the model number, firmware revision and product serial number. The display will then switch to the factory default display setting, showing preset frequency (100 MHz) and power, phase lock status (of internal reference) and instrument connectivity status (Ethernet IP or USB identifier).

NOTE

The instrument booting process may take up to 60 seconds (depending on configuration) to complete.

Connecting the Instrument

Connecting to LAN

Connect the instrument to your local area network (LAN) using the Ethernet cable. By default, the instrument is configured to accept its dynamic IP number from the DHCP server of your network. If it is configured properly, your network router will assign a dynamic IP number to the instrument. Your instrument is now ready to receive remote commands.

Direct Connectivity to Host Via Ethernet Cable (no router)

You can connect the instrument to your computer with the Ethernet cable without using a local area network with DHCP server. To work properly, the network controller (NIC) of your computer must be set to an IP address following the ZEROCONF standard, beginning with 169.254.xxx.xxx (excluding 169.254.1.0 and 169.254.254.255) and network mask 255.255.0.0 to match

the ZEROCONF IP that the signal generator will assign itself after DHCP timeout. Any fixed address in the above-mentioned range is admissible as well. The generators ZEROCONF address cannot be predicted as it is assigned dynamically, however the ZEROCONF address assignment process ensures it will not conflict with any other address used in the network.

Connection from a NIC that is configured to use DHCP is also possible. After a pre-set timeout, the NIC will assume that no DHCP is available and self-assign a default IP that will fall into the range 169.254.xxx.xxx.

Alternatively, you may assign the instrument a fixed IP. Please refer to a later section of this manual to learn how to do this.

Connecting through USB

Connect the (powered on) instrument to the computer using a quality USB type-A to type-B cable. If properly connected, the computer host should automatically recognize your instrument as a USBTMC device.

NOTE

If you want to work with the Keysight GUI, it must be installed with USB support selected. Then the GUI will detect all attached devices automatically. Open the GUI and follow the instructions given in **“Using the Graphical User Interface (GUI)”**.

Alternatively, a VISA runtime environment (NI, Keysight or comparable) must be installed.

Use VISA Write to send the *IDN? Query and use VISA Read to get the response. The USBTMC protocol supports service request and triggers.

Connecting through GPIB

Connect the instrument to the GPIB controller using the rear panel GPIB connector (option GPIB is required). Once connected properly, use VISA Write to send the *IDN? query and use VISA Read to get the response. The protocol supports service request, triggers and other GPIB specific operations.

Installing the Signal Generator's Remote Client

Keysight's graphical user interface provides an intuitive control of the instruments. It runs under the Windows operating system with minimum requirements. The DLL is embedded in the GUI application and requires the Microsoft .NET™ framework to be installed. To install the GUI on the computer, download it from Keysight.com.

The self-extracting setup provides easy installation and uninstallation of the software. The setup program guides you in a few steps though the installation process. In case the NET framework is not installed on your current Windows operating system, the setup procedure will assist you automatically to install the required version. For this you will need an active Internet connection.

Troubleshooting the LAN Interconnection

Software does not install properly

- Make sure the Microsoft .NET Framework was properly installed during the UI installation process.

Software cannot detect any instrument

- Make sure you have connected both computer and instrument to a common network.
- If a direct connection is used you may need to reset your computer Ethernet controller (depending on the configuration). Note that in this case detection of the instrument can take a considerable amount of time if your computer is configured to work with an external DHCP server. In some cases, the detection may even fail completely. Configure your computer network controller to an appropriate fixed IP instead.
- Make sure that your software firewall enables the GUI to setup a TCP/IP connection via the LAN. Under Windows 7/10, open the Control Panel under Settings in your Start menu. Then go to Windows Firewall. Select Exceptions and then add Program. If the GUI is in this list, choose it and select OK otherwise browse for the path to GUI installation directory. Finally close all open dialogs by selecting OK. Now your Windows Firewall will not block requests from the GUI.

Shutting Down the Signal Generator

Press the on/off switch on the rear panel to turn off or in case of a module disconnect the power plug.

2 Using the Graphical User Interface (GUI)

This section describes the following features:

“Start the Signal Generator GUI” on page 32

“Menus” on page 33

“Simultaneously Controlling Multiple Signal Generators from one PC” on page 39

“Store and Load Instrument States” on page 40

“Setting Network Configuration” on page 41

“Firmware Upgrade” on page 43

Start the Signal Generator GUI

Keysight's graphical user interface provides an intuitive control of the signal generator. It runs under any Windows operating system. Make sure the software is installed correctly and the computer's firewall is configured properly. The GUI's dynamic link library (DLL) uses the Microsoft .NET framework. The GUI offers additional functionality that is not available on the instrument front panel.

After successful installation of the software double-click the software shortcut that has been created on your desktop.

After start, the GUI will automatically detect existing Keysight instruments that are connected to the computer (network) via local area network or USB. In the CONTROL tab (see **Figure 2-1**) the detected instruments are listed. Clicking on one of the devices will instantly establish connection. Clicking on an alternate device will disconnect the old device and reconnect to the new device. Scan Instruments button will enable automated scanning for new instruments. Disconnect/Connect button will establish and terminate connection.

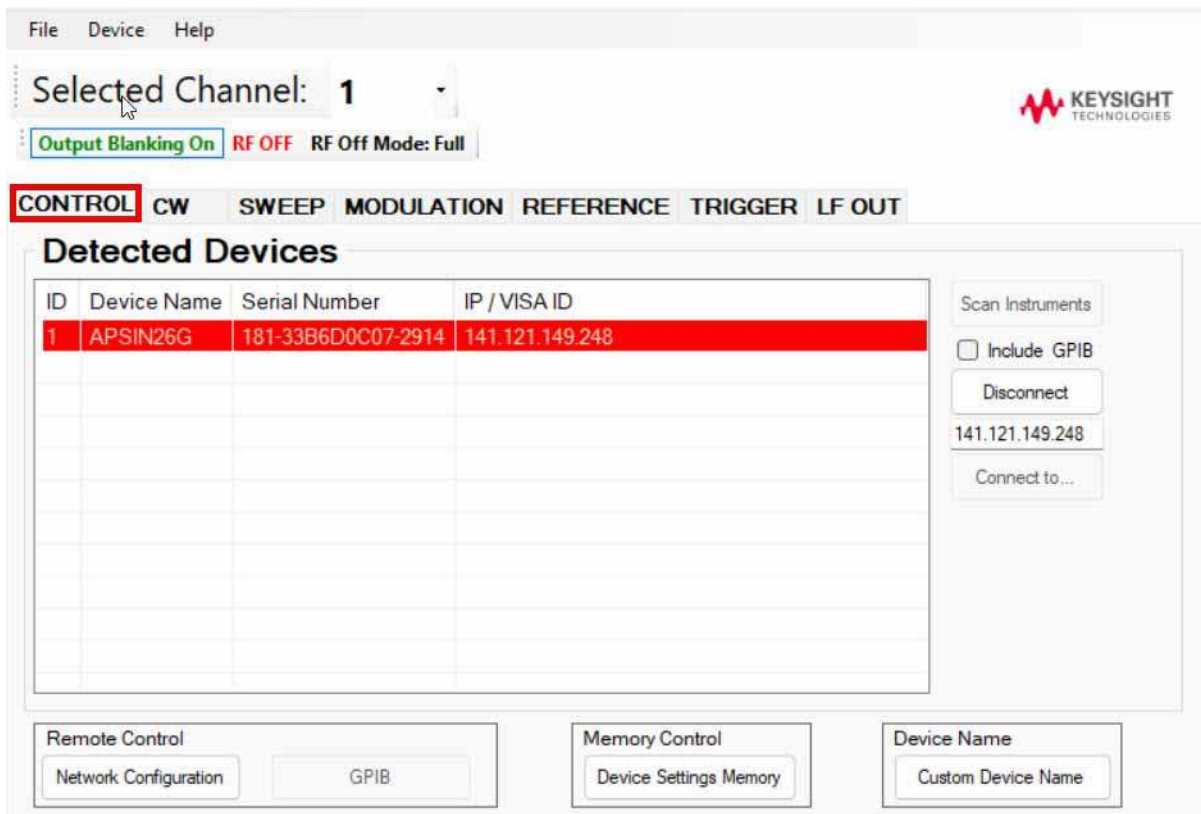
Menus

The GUI provides the following menus:

- Control
- CW
- Sweep
- Modulation
- Reference
- Trigger
- LF Out

CONTROL Menu

Figure 2-1 Control Display



- Scans and establishes connection to instrument.
- Configures the remote interface (LAN, USB).
- Saves, loads and manages instrument memory states.

CW Menu

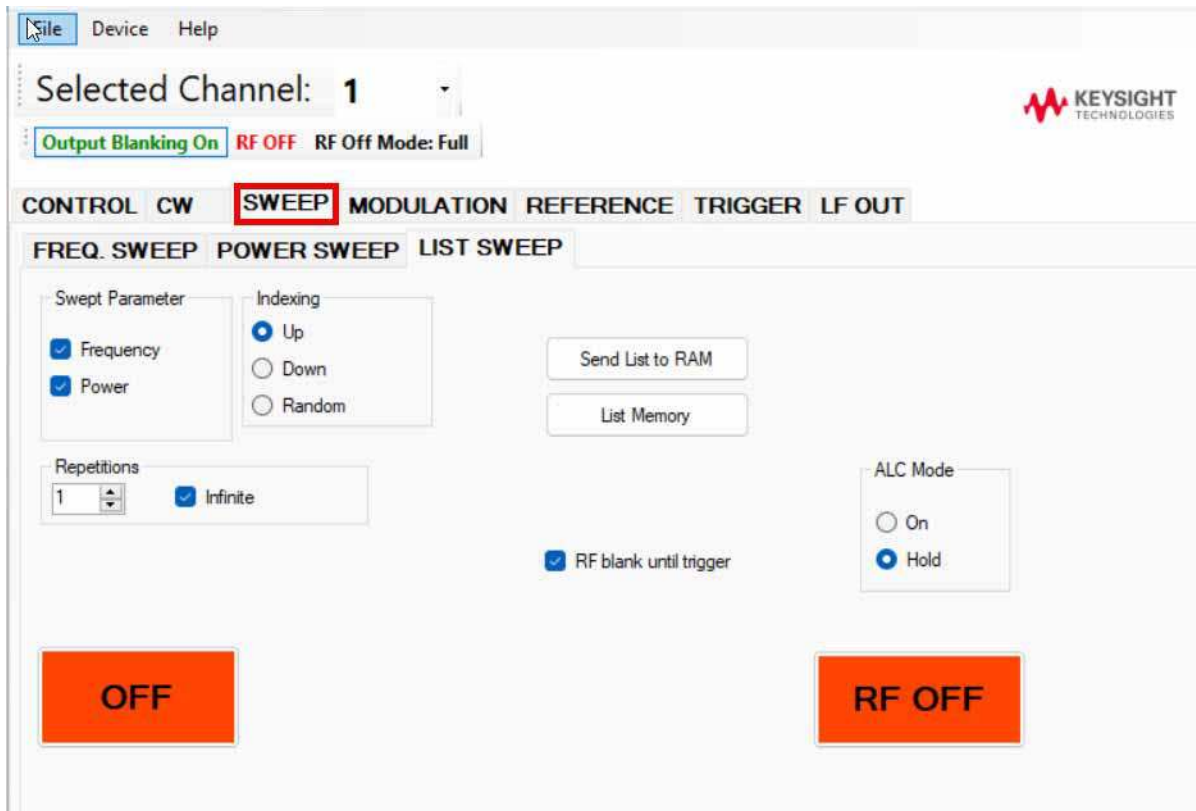
Figure 2-2 CW Display



- Sets the correct frequency and phase.
- Sets output power.
- Enables or disables the RF output power.
- Enables or disables the modulation signal.

SWEEP Menu

Figure 2-3 Sweep Display

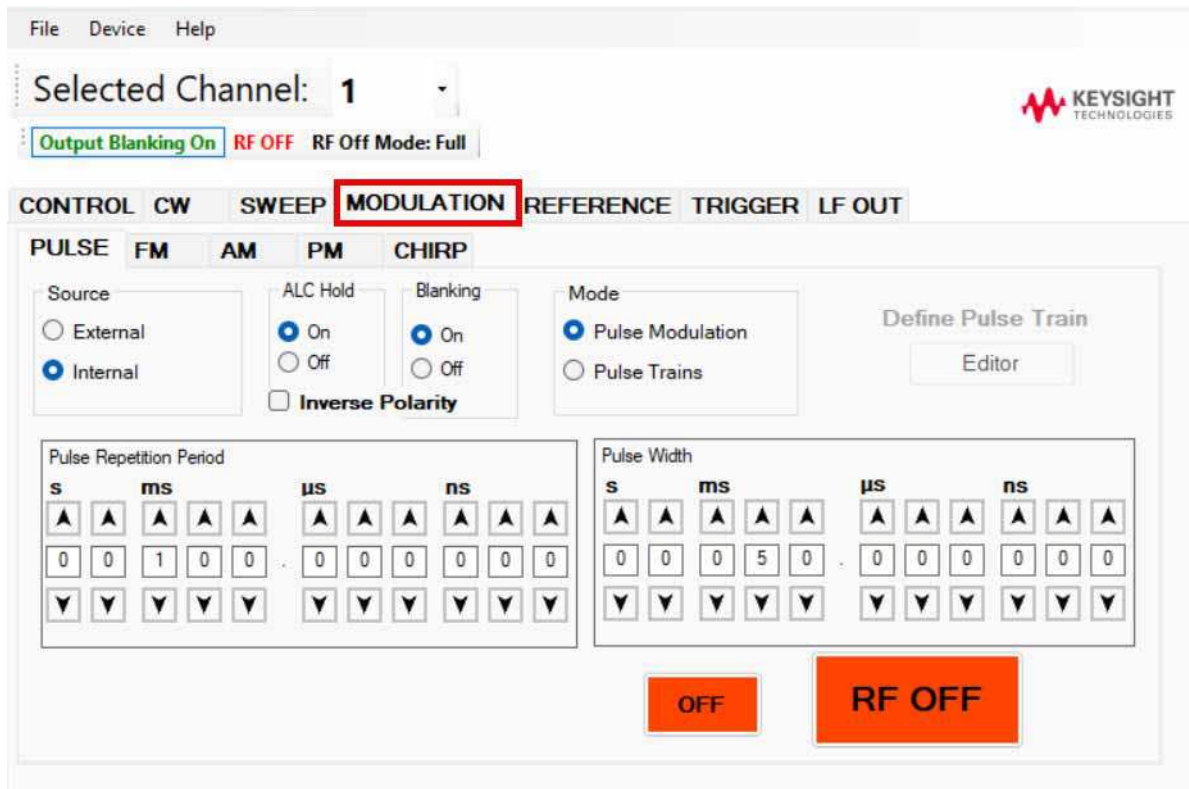


Depending on the connected device, you can select the following functions:

- Sweep over frequency range.
- Sweep over power range.
- Program a frequency and/or power sweep based on a predefined list.
- Synchronize sweeps on multi-channel devices with synchronization capability.

MODULATION Menu

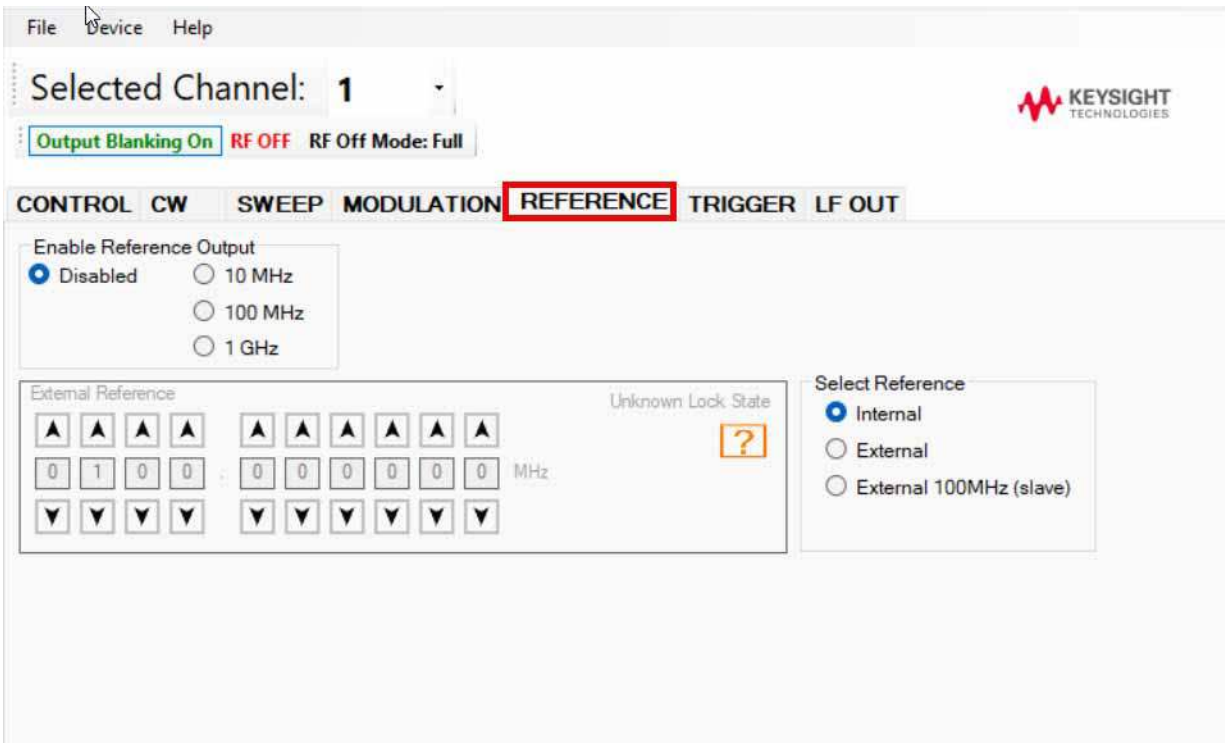
Figure 2-4 Modulation Display



- Enables or disables pulse modulation.
- Enables or disables frequency modulation (only AP4001A, AP4021A, AP4022A).
- Enables or disables phase modulation (only AP4001A, AP4021A, AP4022A).
- Enables or disables chirp modulation (only AP4001A, AP4021A, AP4022A).

REFERENCE Menu

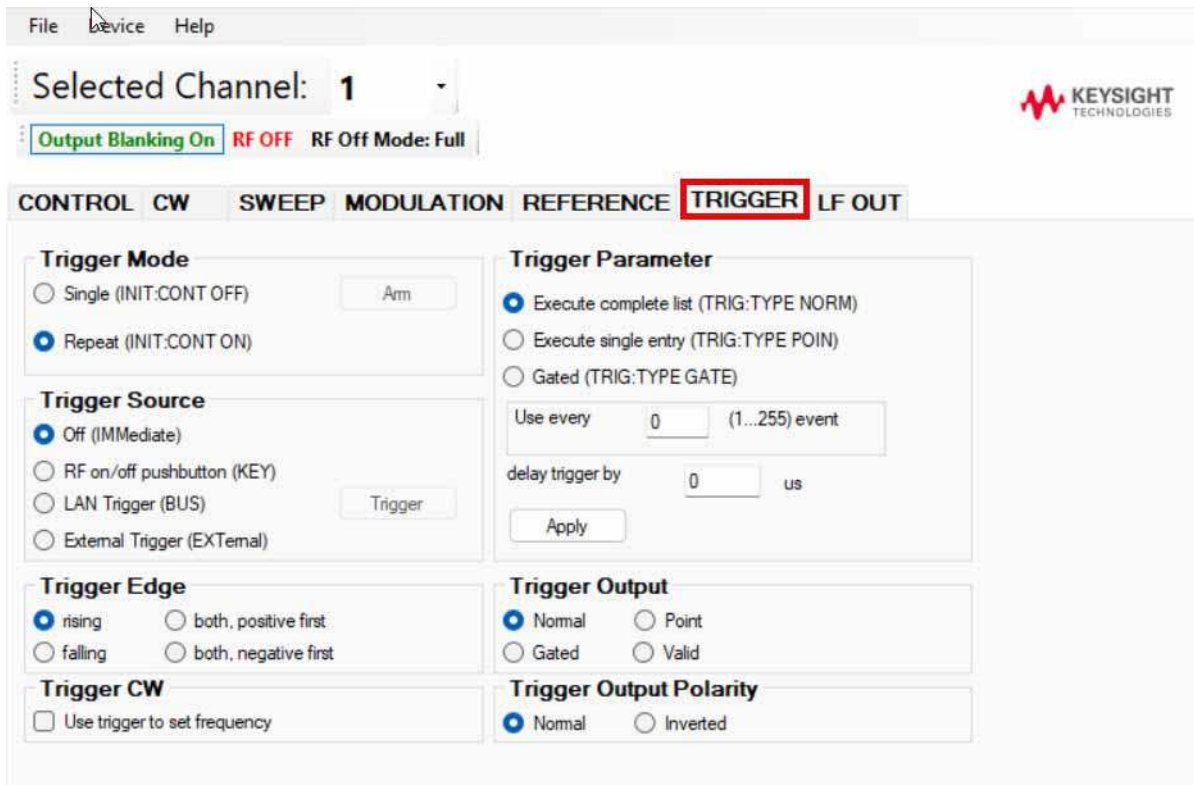
Figure 2-5 Reference Display



- Changes the reference source.
- Configures the reference frequency output.

TRIGGER Menu

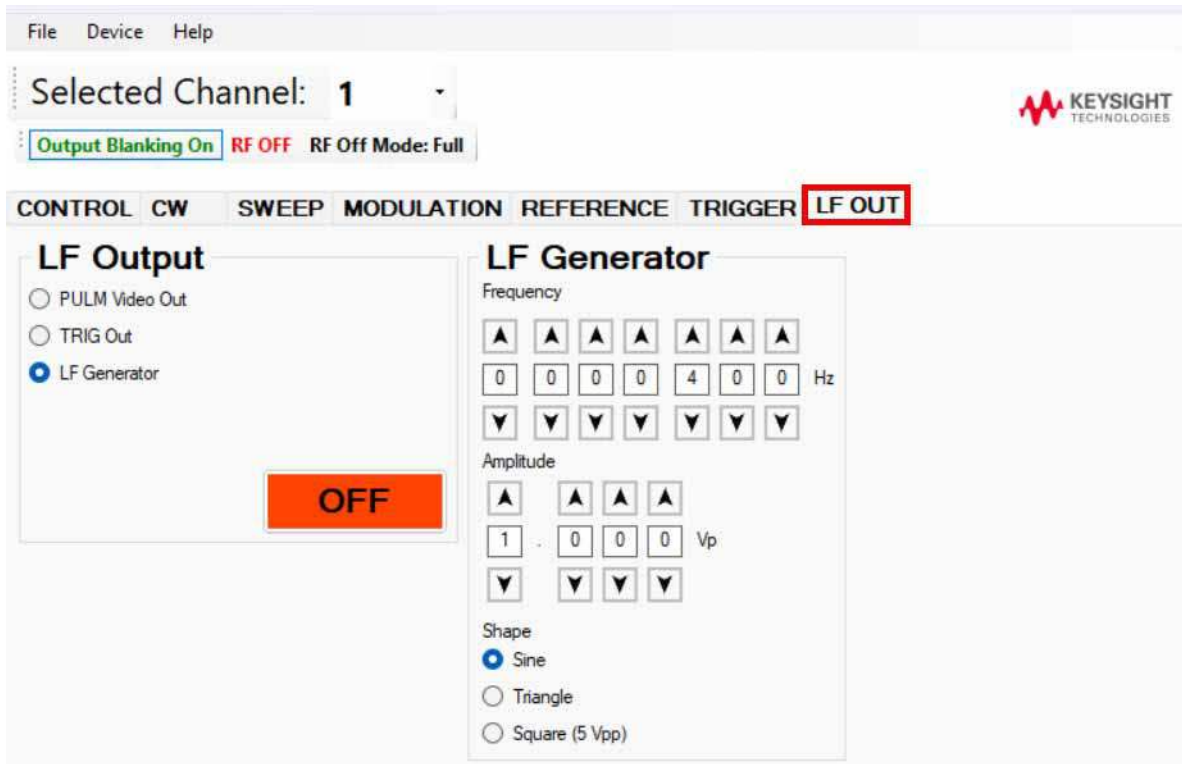
Figure 2-6 Trigger Display



- Configures the trigger system of the device used for sweeps.

LF OUT Menu (only AP4001A, AP4021A, AP4022A)

Figure 2-7 LF Out Display



- Configures the low frequency generator.
- Selects the source for the multifunction output port.

Simultaneously Controlling Multiple Signal Generators from one PC

You can easily control multiple Keysight instruments from a single computer but you need to start a separate GUI for every instrument as only one instrument is controlled by the GUI at one time.

Store and Load Instrument States

Multiple memory states are available to store instant instrument settings. By clicking on the **Device Settings Memory** button, the currently saved memory settings are displayed and can be loaded or overwritten as shown in **Figure 2-8**. To modify or enter a state, click on the appropriate line and select if the current instrument settings should be stored in or loaded from the selected memory state.

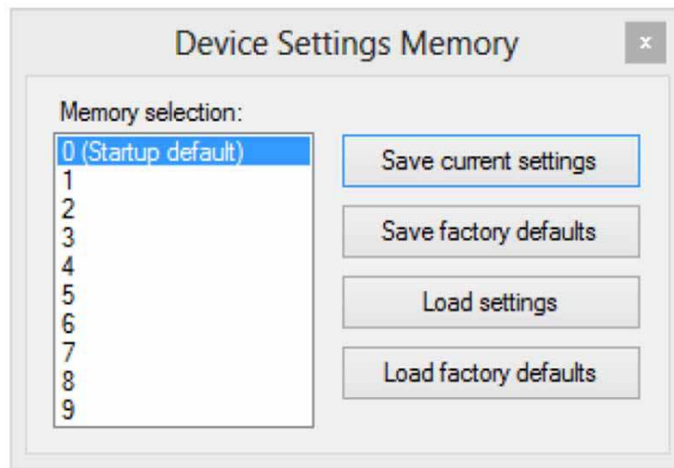
NOTE

Memory 0 is used as the default state when the instrument is powered up.

The memory states can also be accessed via the front panel menu.

Figure 2-8

Memory Settings Submenu



Setting Network Configuration

The **Device > Network Configuration** dialog allows configuring the LAN settings as shown in **Figure 2-9**. You may choose from three distinct network addressing modes: setting to Auto will check for a DHCP server on the network but if this fails, will fall back to assigning an address automatically using zeroconf. Setting to DHCP will check for a DHCP server on the network with no fallback option if one doesn't exist. Setting to manual will require the user to supply all network settings for the device manually. Additionally, the device name can be modified as desired. The unit serial number and firmware revision are displayed at the bottom of the dialog box.

Figure 2-9 Network Configuration Submenu

The image shows a 'Network Configuration' dialog box. It has a title bar 'Network Configuration'. Inside, there's a section 'Addressing Mode' with three radio buttons: 'Manual', 'DHCP only', and 'Auto (DHCP/Zeroconf)'. The 'Auto (DHCP/Zeroconf)' option is selected. Below this are text input fields for 'IP Address:' (192.168.1.125), 'Netmask:' (255.255.255.0), 'Gateway:' (192.168.1.1), and 'Port:' (18). There is a checkbox for 'Multi-Session:' which is currently unchecked, with '(enable)' text next to it. Below these are read-only fields for 'Device Name:' (APUASYN20), 'MAC Address:' (70:B3:D5:0B:B0:0A), 'Serial:' (315-3L1030000-0001), and 'Firmware:' (0.0.0). At the bottom are 'Save' and 'Cancel' buttons.

Multi-Session Option

The **Multi-Session** checkbox allows you to enable the device to be accessed from more than one instance of the UI. This allows users on multiple computers on the network to connect to and configure the device simultaneously. It is the user's responsibility to manage access conflicts while this mode is enabled (i.e. two users changing the same option from different PCs).

Device Port Setting

The **Port** option allows the listening TCP port to be customized for the device. The default setting for all devices is port 18. If changed, the device will no longer be accessible using this port number. Any instances of the UI (or other VISA applications connecting to the device over a network) will need to modify their destination port number to match the device to connect to.

Connecting two devices using a non-default port and non-default network interface

There are two options for connecting to a device when its default listening port has been changed.

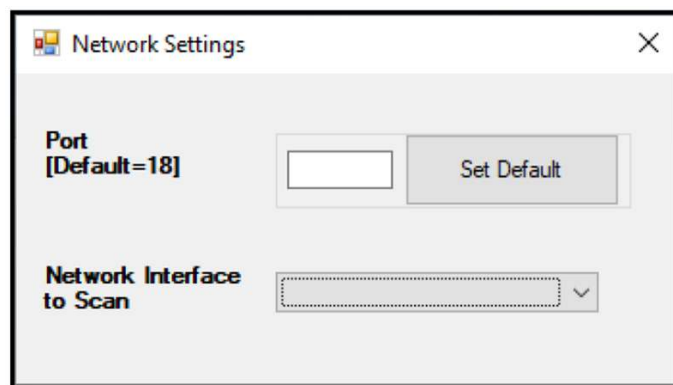
1. Specify a temporary connection port:

Select the **File** menu > **Connection Settings** > **Specify Connection Port**. This will cause a new setting 'Custom Port' to be displayed on the 'Control' tab of the UI (see [Figure 2-10](#)). The connection port to use can then be entered (within the range of permissible TCP port numbers). Beware that this setting will overwrite the default port until it is removed. To remove, select **Specify Connection Port** again – this will remove the 'Custom Port' setting from the UI and revert to using the current default port. Deleting the port number from the Custom Port text box will also cause the UI to revert to using the default port.

2. Change the application's default port setting:

The global default port to use for connections can be changed by selecting **File** > **Connection Settings** > **Change Default Settings**. A default port can be entered into the dialog box and set by clicking **Set Default**. Only permissible TCP ports can be entered here. If the new default port is accepted, the '[Default=]' text above will display the new setting. Beware that the new default setting will now persist until changed again, including after restarting the UI or rebooting your system.

Figure 2-10 Default communication port and interface of the GUI



Firmware Upgrade

CAUTION

Do not disconnect and power off the instrument during a firmware update.

A firmware upgrade of the instrument can be done directly via the GUI. First make sure you are connected to the right instrument and have the correct firmware binary file (.tar) ready. Then select the **Device** menu > **Update Firmware** and select the appropriate binary file that you have received from Keysight or downloaded from the Keysight website. The update will take a few minutes and after completion your instrument will reboot. Reconnect to the instruments after booting is completed and continue with the updated firmware.

Using the Graphical User Interface (GUI) Firmware Upgrade

3 Front Panel Operation (For the AP4021A only)

The following topics can be found in this chapter:

“RF 50 Ω Connector” on page 47

“Rotary Button” on page 47

“Front Panel Settings” on page 47

“CW Menu” on page 47

“Sweep Menu” on page 48

“Modulation Submenus” on page 50

“Reference Submenu” on page 53

“Trigger Submenu” on page 53

“Trigger Out” on page 54

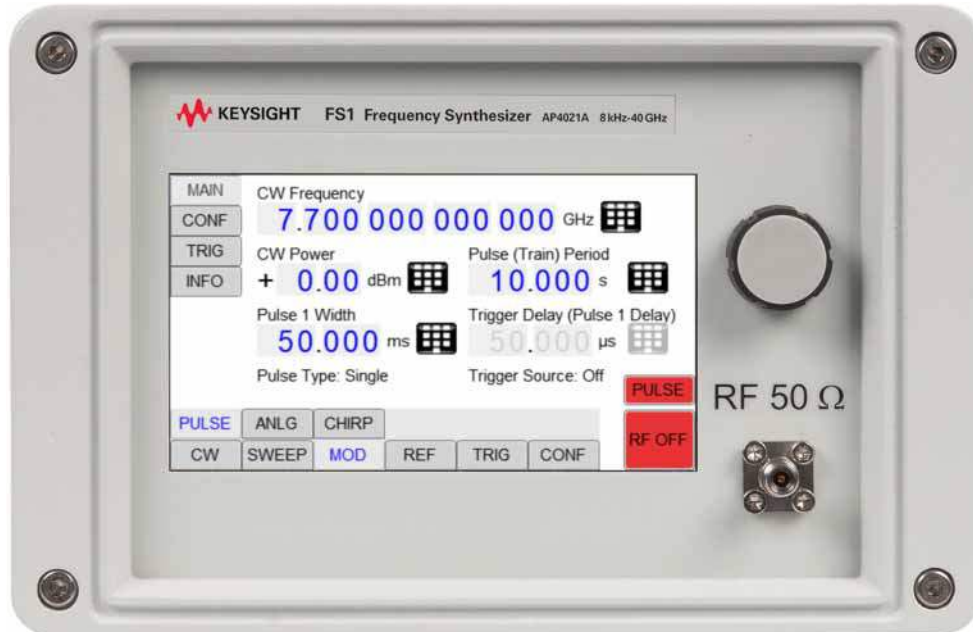
“Configuration” on page 54

“Preset Settings Submenu” on page 54

Front Panel Operation (For the AP4021A only)

The front panel display allows you to access many of the AP4021A and functions. However, the GUI interface allows you access all available functions.

Figure 3-1 Front panel with touch display



RF 50 Ω Connector

Depending on your model number, the female SMA connector or the male 2.92 mm connector provides the output for RF signals. The impedance is 50 Ω . The damage levels for RF and DC are specified in the data sheet.

Rotary Button

The rotary button is used to switch between cursor positions and to continuously change values at the cursor position.

The currently active display position is shown by the cursor (underline symbol, or different background color). The cursor does not move beyond the field of the currently selected parameter. Rotate the front panel knob to modify the value. Clockwise rotation increases the parameter and counter-clockwise rotation decreases the parameter. The parameter value will continue to increase or decrease by the amount of the selected resolution until it reaches the maximum or minimum limit of the parameter.

Front Panel Settings

The following sections describe how to control the instrument via the front panel.

CW Menu

The Main display or CW Menu is shown after the instrument has successfully booted and is ready. The menu keys are displayed at the bottom of the screen. You can set the CW frequency, power level and phase from the CW menu.

Figure 3-2 Front Panel CW Panel 2 Display

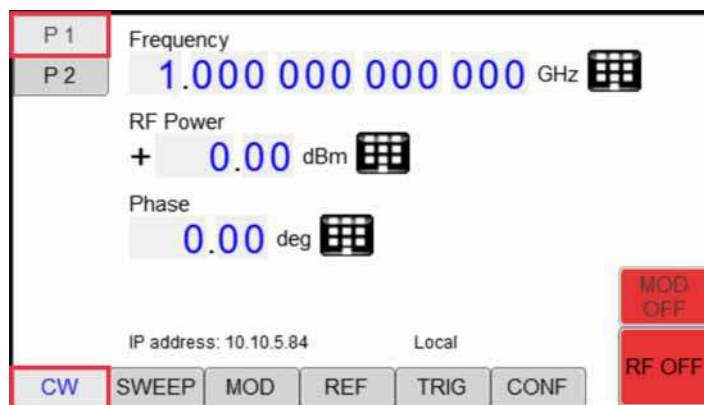
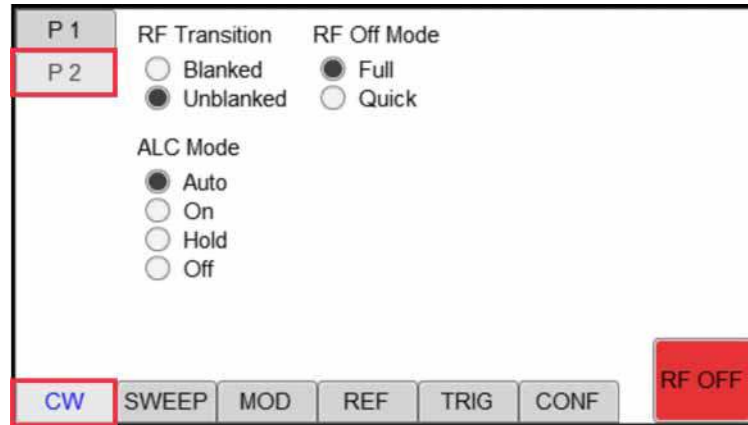


Figure 3-3

Front Panel CW Panel 1 Display



Sweep Menu

The Sweep menu on the instrument front panel has three submenus. The Configuration submenu provides additional settings for the Frequency and Power submenus.

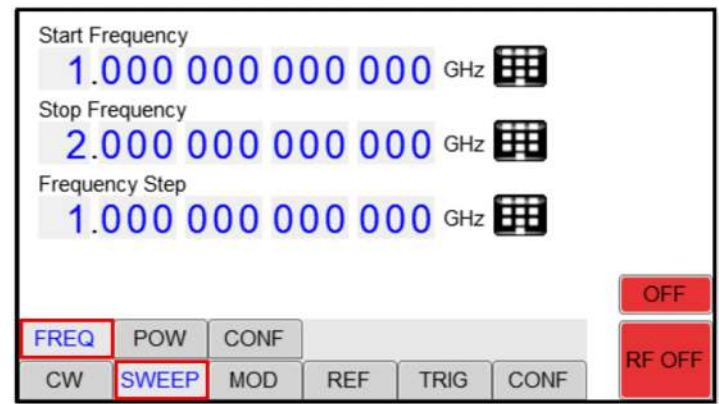
- Frequency
- Power
- Configuration

The Configuration submenu provides additional settings for the Frequency and Power submenus.

Frequency Submenu

The front panel **Sweep** > Frequency submenu, allows you to specify the start/stop frequency and the step size. The **Sweep** > **Conf** submenu allows you to set the number of points, dwell time, and off time repetition mode between INFinite, and 1 (single repetition). The sweep is started by pressing the **RF On/Off** button.

Figure 3-4 Front Panel Sweep > Frequency Display

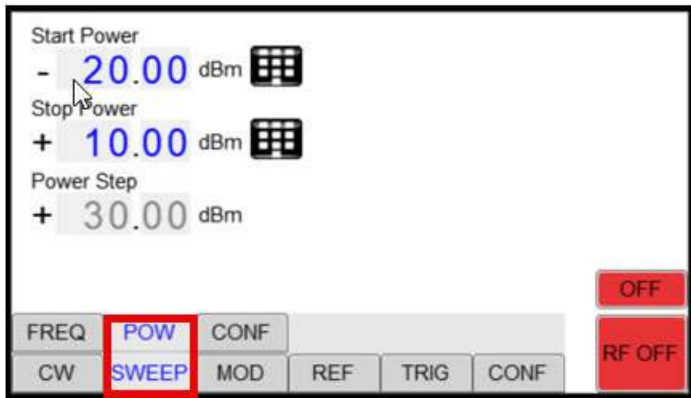


Power Sweep Submenu

The front panel **Sweep >Power** submenu, allows you to specify the start/stop power and the step size. The **Sweep > Conf** submenu allows you to set the number of points, dwell time, and off time repetition mode between INFinite, and 1 (single repetition). The sweep is started by pressing the **RF On/Off** button.

The remote GUI allows you to set the same settings above plus, Sweep Mode, RF blank until trigger, and ALC Mode.

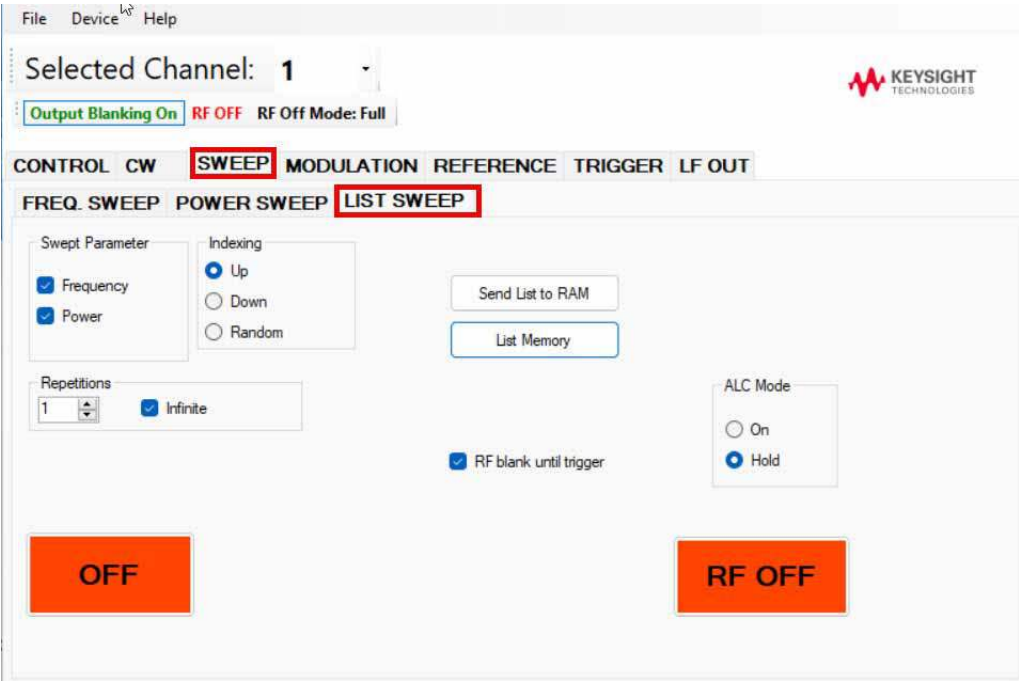
Figure 3-5 Front Panel Sweep > Power Display



List Sweep Submenu (only available on the remote GUI)

The List Sweep submenu access the parameters to sweep (frequency and power) and the direction the list should be played. Additionally, the number of repetitions of the list can be entered and the ALC can be set on or off. Use List Memory a to define each list point and load or save to List memory or Sent the List to RAM.

Figure 3-6 GUI Sweep > List Display



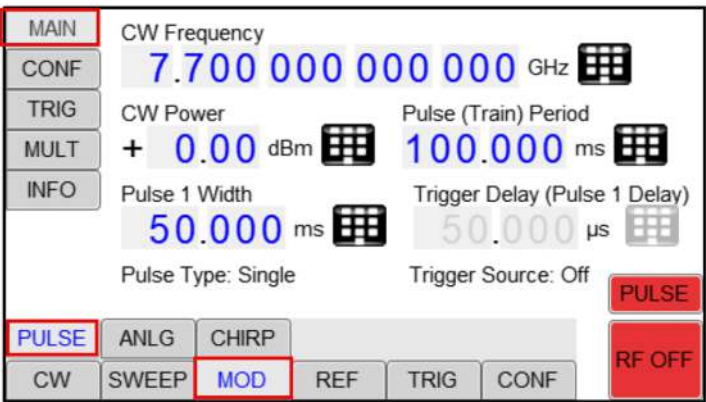
Modulation Submenus

Pulse Modulation Submenu

In the pulse modulation submenu the pulse width, pulse period and pulse trigger can be configured in the following tabs:

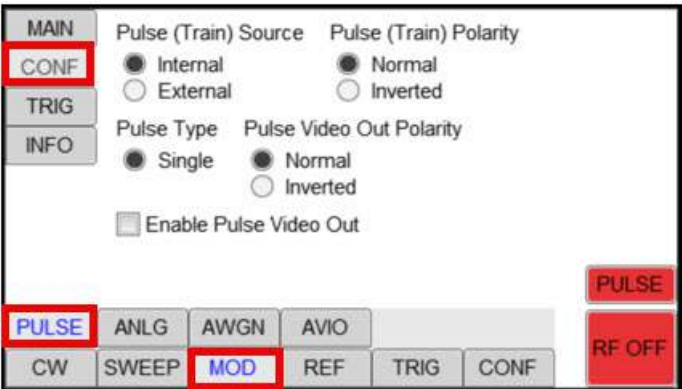
- Main

Figure 3-7 Modulation Pulse Submenu Main



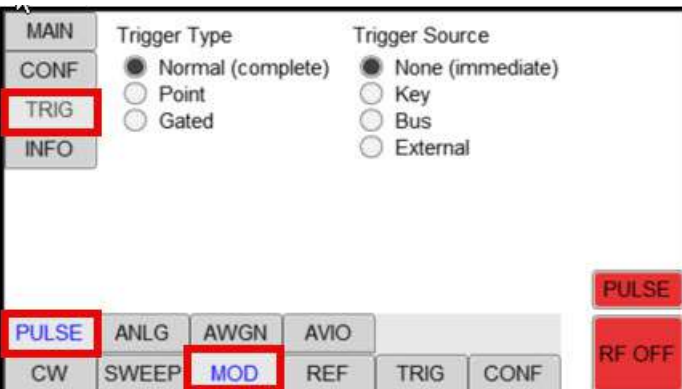
- CONFiguration

Figure 3-8 Modulation Pulse Submenu Configuration



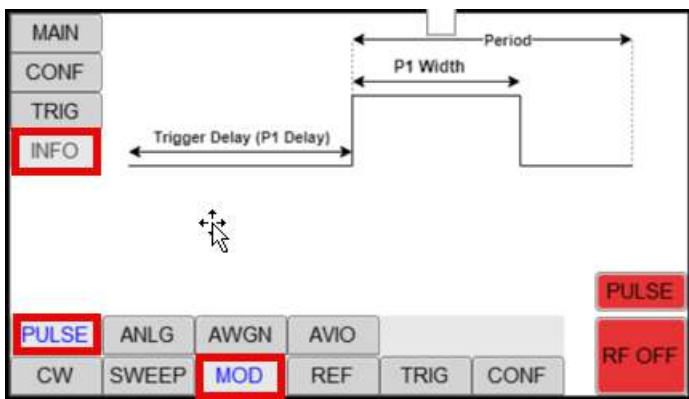
– TRIGger

Figure 3-9 Modulation Pulse Submenu Trigger



– INFO

Figure 3-10 Modulation Pulse Submenu Info



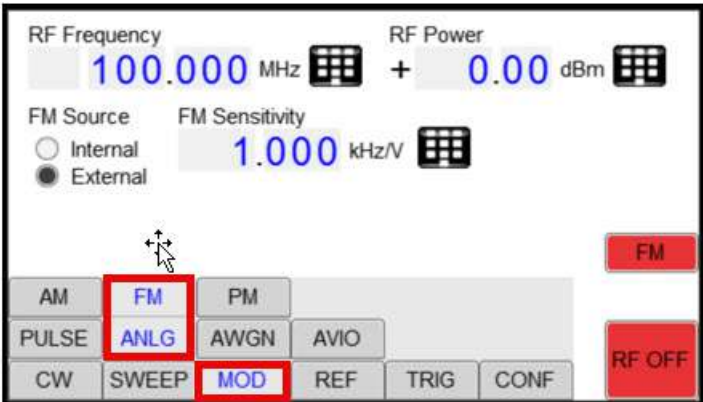
Analog Modulation Submenu

The Analog Modulation Submenu allows you to access the parameters for AM, FM and PM modulation.

Frequency Modulation Submenu (only AP4001A, AP4021A, AP4022A)

In the frequency modulation submenu the internal and external frequency modulation can be accessed. It is possible to change between internal and external modulation source and to change modulation parameters such as modulation rate, depth or sensitivity.

Figure 3-11 Modulation Analog Submenu FM



PM (Phase) Modulation Submenu (only AP4001A, AP4021A, AP4022A)

In the phase modulation submenu the internal and external phase modulation can be accessed. It is possible to change between internal and external modulation source and change modulation parameters.

Figure 3-12 Modulation Analog Submenu Phase



Reference Submenu

In the Reference menu the internal or external reference source and the reference output signal can be selected and configured.

Figure 3-13

Reference

The Reference Submenu interface displays two columns of radio button options. The 'Reference Source' column includes 'Internal' (selected), 'External 10 MHz', 'External 100 MHz', and 'External variable'. The 'Reference Output' column includes 'Off' (selected) and '100 MHz'. At the bottom, a row of function buttons includes 'CW', 'SWEEP', 'MOD', 'REF' (highlighted with a red box), 'TRIG', and 'CONF'. A red 'RF OFF' button is located on the right side.

Reference Source	Reference Output
☒ Internal	☒ Off
☐ External 10 MHz	☐ 100 MHz
☐ External 100 MHz	
☐ External variable	

CW SWEEP MOD **REF** TRIG CONF RF OFF

Trigger Submenu

Trigger In

In this menu the trigger system can be configured like trigger source, trigger edge, etc.

Figure 3-14

Trigger Submenu In

The Trigger Submenu In interface displays four columns of radio button options. 'Trigger Type' includes 'Normal (complete)' (selected), 'Point', and 'Gated'. 'Trigger Source' includes 'None (immediate)' (selected), 'Key', 'Bus', and 'External'. 'Trigger Init Mode' includes 'Single' (selected) and 'Continuous'. 'Trigger Edge' includes 'Rising' (selected) and 'Falling'. At the bottom, a row of function buttons includes 'CW', 'SWEEP', 'MOD', 'REF', 'TRIG' (highlighted with a red box), and 'CONF'. Above this row are 'IN' (highlighted with a red box) and 'OUT' buttons. A red 'RF OFF' button is on the right, with a 'TRIG' button above it.

Trigger Type	Trigger Source	Trigger Init Mode	Trigger Edge
☒ Normal (complete)	☒ None (immediate)	☒ Single	☒ Rising
☐ Point	☐ Key	☐ Continuous	☐ Falling
☐ Gated	☐ Bus		
	☐ External		

IN OUT CW SWEEP MOD REF **TRIG** CONF TRIG RF OFF

Trigger Out

In the Trigger Out Submenu the FUNCT OUT output can be configured at the rear panel of the instrument.

On the first screen the source for the FUNCT OUT can be selected. Choose LF Generator for the low frequency generator, Trigger Output to enable the instrument trigger output and Pulse Video to enable the pulse video output. If LF Generator is selected, you can configure the frequency, amplitude and waveform.

Figure 3-15

Trigger Submenu Out (LF OUTPUT)

Output Source

☐ Pulse Video

☐ Trigger Output

☒ LF Generator

Pulse Output Polarity

☒ Normal

☐ Inverted

☐ Square (5 Vpp)

Frequency

10.000 Hz

Amplitude

1.000 Vp

IN OUT

CW SWEEP MOD REF TRIG CONF

OFF

RF OFF

Configuration

The Configuration submenu is divided into the following tabs:

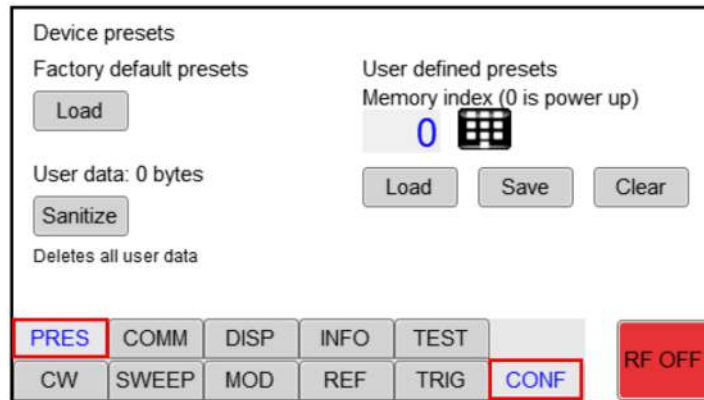
- PRESet
- COMMunication
- DISPlay
- INFO
- TEST

Preset Settings Submenu

In the Preset Settings submenu, specific settings can be stored to the instrument or loaded from the instrument. You can also restore the factory default settings.

Figure 3-16

Configure Submenu Preset tab



Communication Submenu

In the Communication submenu, IP address, subnet mask and DHCP can be configured.

Display Submenu

In the Display submenu, configuration of the instrument via the display can be disabled or enabled.

Info Submenu

In the Info Submenu, information about the device is shown (serial number, firmware version, and options installed).

Test Submenu

The Test Submenu allows you to perform a self test on the instrument.

Front Panel Operation (For the AP4021A only)
Front Panel Settings

4 Additional Information

[“Remote Programming the Signal Generator” on page 58](#)

[“Maintenance and Warranty Information” on page 59](#)

[“Returning an Instrument for Service” on page 60](#)

Remote Programming the Signal Generator

The signal generator can be remotely programmed by using SCPI commands. Please refer to the Programmer's Manual for details available on Keysight's website. There are also examples in different programming languages that can be used.

Maintenance and Warranty Information

Adjustments and Calibration

To maintain optimum measurement performance, the instrument should be calibrated every 24 months. It is recommended that the instruments be returned to Keysight or to an authorized calibration facility. For more information please contact our Customer Service Department as indicated on www.keysight.com.

Cleaning

WARNING

To prevent electrical shock, disconnect the instrument from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

Any further maintenance or deep cleaning of the device must be performed by Keysight Technologies or its authorized repair specialists.

Repair

The signal generator contains no user-serviceable parts. Repair or calibration of the signal generator requires specialized test equipment and must be performed by Keysight or its authorized repair specialists.

Warranty Information

All Keysight instruments are warranted against defects in material and workmanship for a period of two years from the date of shipment. Keysight will, at its option, repair or replace products that prove to be defective during the warranty period, provided they are returned to Keysight and provided the preventative maintenance procedures are followed. Repairs necessitated by misuse of the product are not covered by this warranty. No other warranties are expressed or implied, including but not limited to implied warranties of merchantability and fitness for a particular purpose. Keysight is not liable for consequential damages.

Returning an Instrument for Service

Calling Keysight Technologies

Keysight Technologies has offices around the world to provide you with complete support for your instrument. To obtain servicing information or to order replacement parts, contact the nearest Keysight Technologies office listed below. In any correspondence or telephone conversations, refer to your instrument by its product number, full serial number, and software revision.

Locations for Keysight Technologies

Online assistance: <http://www.keysight.com/find/assist>

Americas

Canada
1 877 894 4414

Latin America
(305) 269 7500

United States
1 800 829 4444

Asia Pacific

Australia
1 800 629 485

China
800 810 0189

Hong Kong
800 938 693

India
1 800 112 929

Japan
0 120 (421) 345

Korea
080 769 0800

Malaysia
1 800 888 848

Singapore
1 800 375 8100

Taiwan
0800 047 866

Thailand
1 800226 008

Europe & Middle East

Austria
43 (0) 1 360 277 1571

Belgium
32 (0) 2 404 93 40

Denmark
45 70 13 15 15

Finland
358 (0) 10 855 2100

France
0825 010 700*
*0.125 Euros/minute

Germany
49 (0) 7031 464 6333

Ireland
1890 924 204

Israel
972-3-9288-504/544

Italy
39 02 92 60 8484

Netherlands
31 (0) 20 547 2111

Spain
34 (91) 631 3300

Sweden
0200-88 22 55

Switzerland
0800 80 53 53

United Kingdom
44 (0) 118 9276201

Other European Countries: <http://www.keysight.com/find/contactus>

Service Options

Keysight Technologies offers several optional maintenance plans to service your instrument after the warranty has expired. Call your Keysight Technologies office for full details.

If you want to service the instrument yourself after the warranty expires, you can download the service documentation that provides all necessary troubleshooting and maintenance information from the Keysight web page.

Packaging the Instrument

Use original packaging or comparable. It is best to pack the unit in the original factory packaging materials if they are available.

WARNING

Instrument damage can result from using packaging materials other than those specified. Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the equipment or prevent it from shifting in the carton. They cause equipment damage by generating static electricity and by lodging in the instrument louvers, blocking airflow.

NOTE

M9484C Rear Panel and Front Panel jumper cables (PN: W1312-20511 and W1312-20516) come with protective caps to protect them from impact damage during shipping. When returning an instrument for service, reinsert the protective caps (if available) or remove the cables and place them in a separate protective bag.

You can repack the instrument with commercially available materials, as follows:

Table 4-1

Step	Notes
1. Wrap the instrument in anti-static plastic to reduce the possibility of damage caused by electrostatic discharge	
2. Use a strong shipping container.	The carton must be both large enough and strong enough to accommodate the instrument. A double-walled, corrugated cardboard carton with 159 kg (350 lb) bursting strength is adequate. Allow at least 3 to 4 inches on all sides of the instrument for packing material.

Table 4-1

Step	Notes
3. Surround the equipment with three to four inches of packing material and prevent the equipment from moving in the carton.	If packing foam is not available, the best alternative is plastic bubble-pack. This material looks like a plastic sheet filled with 1-1/4 inch air bubbles. Use the pink-colored bubble which reduces static electricity. Wrapping the equipment several times in this material should both protect the equipment and prevent it from moving in the carton.
4. Seal the shipping container securely with strong nylon adhesive tape.	
5. Mark the shipping container "FRAGILE, HANDLE WITH CARE" to assure careful handling.	
6. Retain copies of all shipping papers.	

