Keysight
AP5041A G3 and AP5042A G3
Vector Signal Generator

KEYSIGHT

USER'S MANUAL

Notices

Trademark Acknowledgments

Manual Part Number

AP5041-90002

Edition

Edition 1, February 2025
Supersedes, None

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/us/en/support/AP5041A/ap5041a-g3-vector-signal-generator-up-to-40-ghz.html

https://www.keysight.com/us/en/support/AP5042A/ap5042a-g3-vector-signal-generator-up-to-40-ghz.html

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 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 Quick Start

The following topics can be found in this section:

Introduction

Today, digital modulation schemes are widely used in communication systems, and the increasing need for data bandwidth has pushed the signal purity and modulation bandwidth requirements for modern vector signal sources. Other applications with similar performance requirements include radio surveillance, interference analysis, radar signal analysis, and electronic warfare.

Addressing these demanding requirements, Keysight's AP5041A and AP5042A vector signal generators (VSGs) provide frequency coverage to 40 GHz and are available as single output desktop units or rack-mount instruments with multiple phase-coherent outputs. They offers a cost-effective and flexible tool for generating high-quality, complex, wideband, digitally modulated signals.

Among others, the following use cases are supported:

- Upload multiple formats of IQ Data into instrument memory. The AP5041A and AP5042A internal AWG can play selected sections of the RAM upon a user trigger.
- Use the AP5041A and AP5042A to synthesize and play predefined digital modulation formats.
- Use the fast control port (FCP) interface to live stream and play digital IQ data.
- Use FCP to control the AP5041A and AP5042A for ultra fast frequency hopping.

The AP5041A and AP5042A operate with an ultra stable temperature compensated frequency reference (OCXO) that can be phase locked to an external reference.

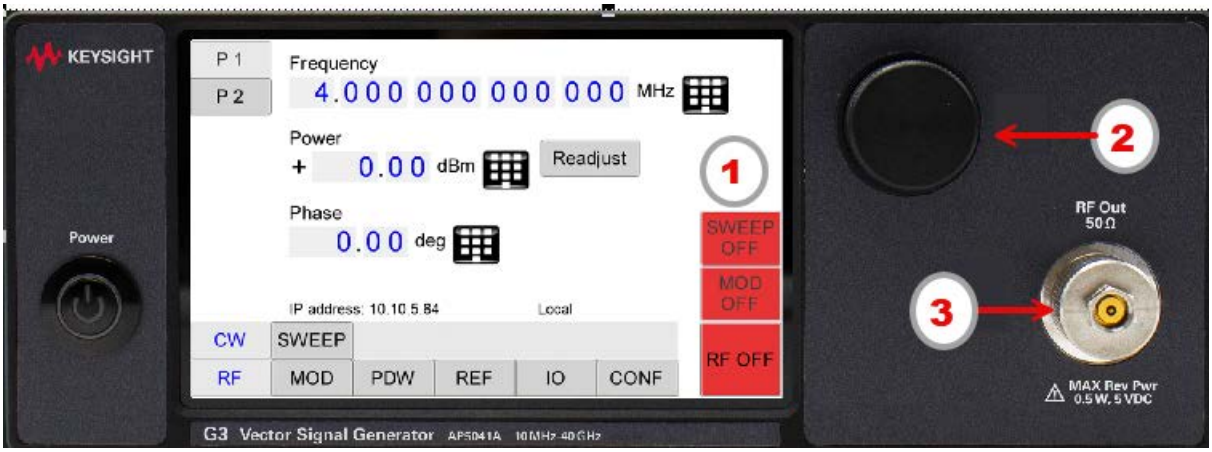
The compact unit allows for full front panel control via touch a touch panel display, and PC GUI software supported operation via Ethernet, USB, FCP and GPIB communication ports.

Models Covered in this Manual

- AP5041A G3 Desktop
- AP5042A G3 2U Rack Mount Enclosure

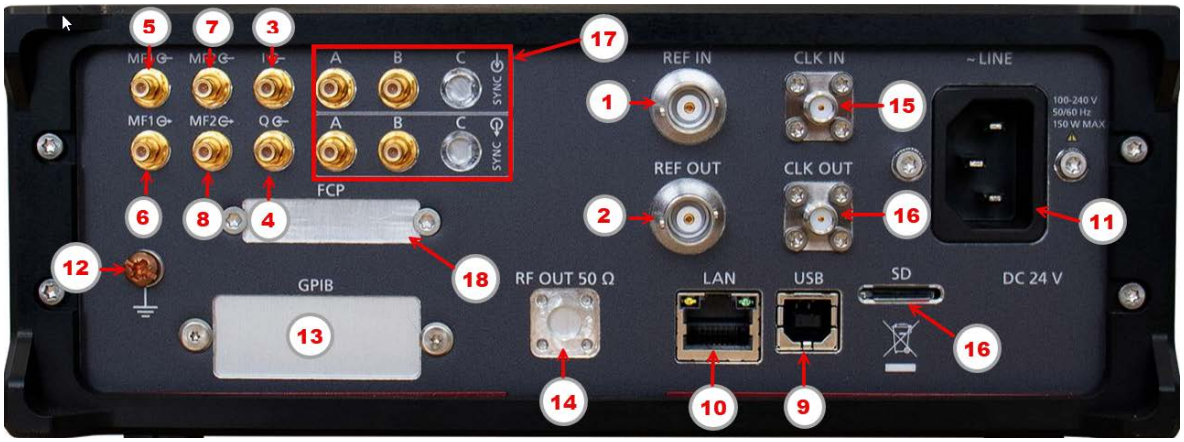
AP5041A G3 Desktop Front and Rear Panel Connectors

Figure 1-1 AP5041A front panel (with touch display)



1. Touch Display - shows information on the current function, such as frequency, power, and reference.
2. Rotary Button - used to change the value selected on the display.
3. RF 50 Ω - provides the output for generated signals. The impedance is 50 Ω. Please refer to the data sheet for more details.

Figure 1-2 AP5041A rear panel

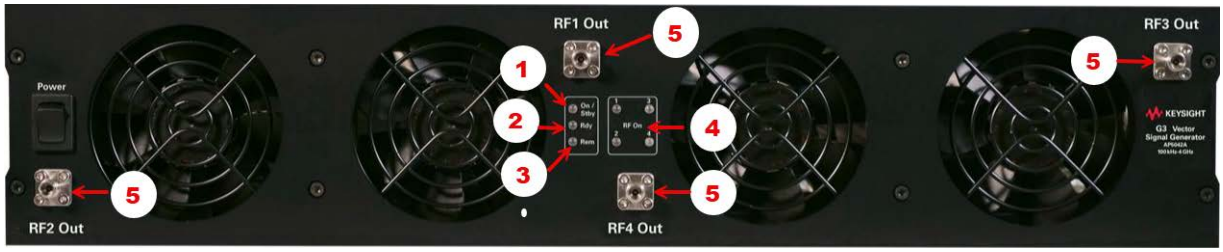


1. REF Input - input for the reference signal (BNC female connector).
2. REF Output - output for the reference signal (BNC female connector).
3. I Input - input for analog in-phase signals (BNC female connector).
4. Q Input - input for analog quadrature signals (BNC female connector).
5. MF1 Input - multifunction input (BNC female connector).
6. MF1 Output - multifunction output (BNC female connector).

7. MF2 Input - multifunction input (BNC female connector).
8. MF2 Output - multifunction output (BNC female connector).
9. USB-B - used to connect the device to a computer.
10. LAN - used to connect the device to the network.
11. AC Power - Connector for AC power
12. Ground Screw - used to connect the device to ground reference.
13. GPIB - for Option GPIB.
14. RF OUT - provides the output for generated signals. The impedance is 50 Ω. Please refer to the data sheet for more details.
15. CLK IN - proprietary port for multi-instrument synchronization.
16. CLK OUT - proprietary port for multi-instrument synchronization.
17. SYNC connectors. SYNC OUT ports from the primary instrument are connected to the SYBNC IN port to the follower unit.
    - "A" Time stamp reference signal
    - "B" Communication, forward channel
    - "C" Communication, return channel (for future use)
18. SD Card

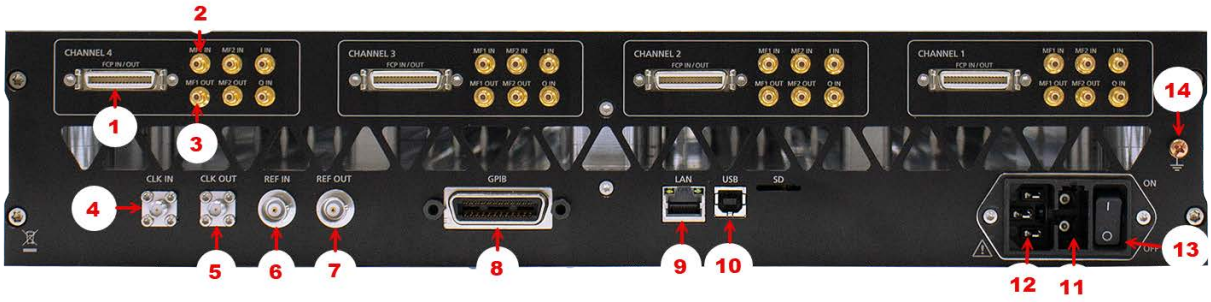
AP5042A G3 2U Front and Rear Panel Connectors

Figure 1-3 AP5042A front panel



1. Power LED - indicates whether the instrument is on our off.
2. Ready LED - indicates that the boot process is completed and the instrument is ready to use.
3. Remote LED - when on, indicates the instrument is connected to a computer.
4. RF LED (1 through 4) - indicates whether the RF signal is on or off.
5. RF OUT (1 through 4) - provides the output for generated signals. The impedance is 50 Ω. Please refer to the data sheet for more details.

Figure 1-4 AP5042A rear panel



1. FCP - Fast control port, see Application note AN6002.
2. MF1 Input - multifunction input (BNC female connector).
3. MF1 Output - multifunction output (BNC female connector).
4. CLK IN - proprietary port for multi-instrument synchronization.
5. CLK OUT - proprietary port for multi-instrument synchronization.
6. REF IN - output for the reference signal (BNC female connector).
7. REF OUT - input for the reference signal (BNC female connector).
8. GPIB - for Option GPIB.
9. LAN - connects the instrument to a network.
10. USB -B - connects the instrument to a computer.
11. Fuse Holder - Provides an exchangeable fuse.
12. AC Power - Connector for AC power
13. ON/Off Switch - Turns the instrument on or off.
14. Ground Screw - Used to connect the device to a ground reference.

Minimum Distances

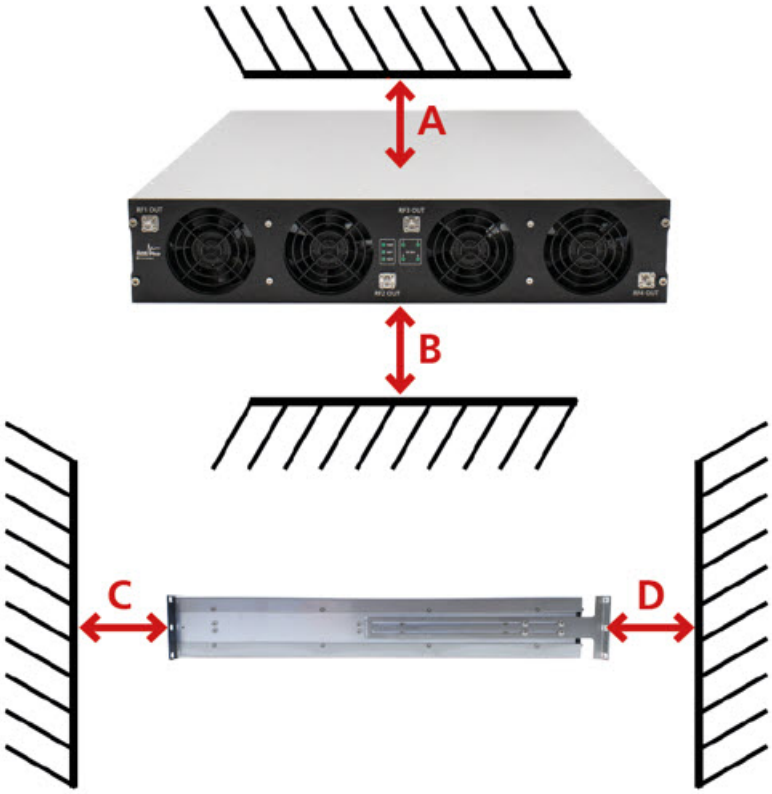
WARNING Safety of any system incorporating the equipment is the responsibility of the assembler of the system.

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

2U

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

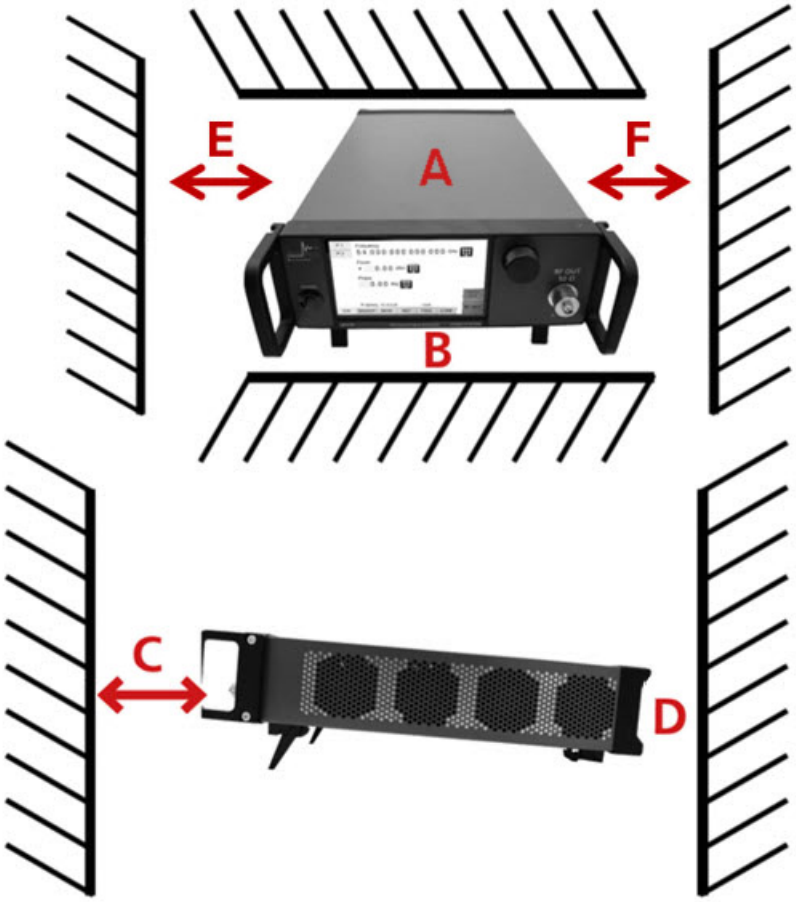
Figure 1-5 Minimum distance for the 2U



Desktop

- A: 0 mm
- B: 0 mm
- C: 50 mm
- D: 50 mm
- E: 150 mm
- F: 150 mm

Figure 1-6 Minimum distance for the Desktop



Energizing and de-Energizing

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

WARNING Use Keysight supplied power cord or one with same or better electrical rating.

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.

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 Before switching on this instrument, make sure the supply voltage is in the specified range.

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.

NOTE The instrument can operate with mains supply voltage fluctuations up to ± 10% of the nominal voltage.

Position of the power connector on the right.

Figure 1-7 AP5041A

Figure 1-8 AP5042A

The 2U rack mount case has a fuse that is accessible from the outside. To change the fuse, pull out the mains plug, open the fuse holder in the middle of the power entry module on the back panel. Replace the old fuse with a new one. It is forbidden to repair defect fuses or to bridge them by any means. Use only a fuse with the rating specified on the instrument's fuse rating plate.

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 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.

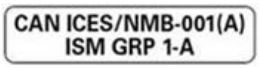
NOTE This product has been designed and tested in accordance with accepted industry standards and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

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 indicate the presence of a laser device.
	This symbol indicates the surface can be hot.
	This symbol indicated 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
CA N ICE S/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 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.

Getting Started

Included Material

Your signal generator kit contains the following items:

- Signal Generator
- Country specific plugs
- Ethernet Cable

Power Requirements

Input Voltage, Frequency, and Current	100-240 V 50-60 Hz, 2 A

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.

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

CAUTION The instrument's 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 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 plug into power.

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

For the AP5041A only, press the power button and the instrument 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).

For the AP5042A only, press the line on/off switch. on the rear panel and the front panel display will illuminate.

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)” on page 61.

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

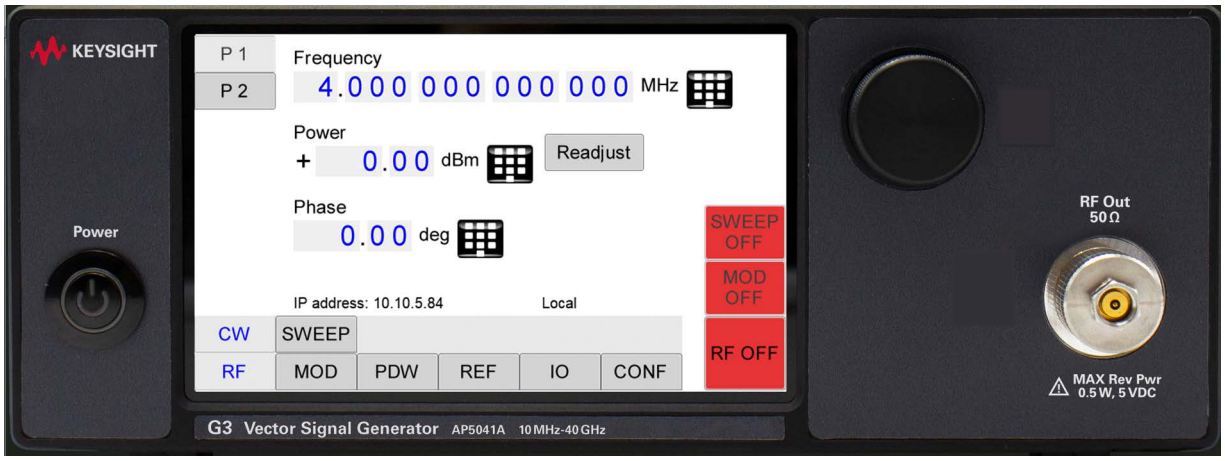
Press the on/off switch on the rear panel to turn off.

2 Front Panel Operation (Applies to the AP5041A only)

The following topics can be found in this chapter:

The front panel display allows you to access many of the AP5041A functions. However, the GUI interface allows you access all available functions.

Figure 2-1 Front panel with touch display



RF 50 Ω Connector

Depending on your model number, the female Type N 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.

Refer to the data sheet for more information.

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.

RF > CW Menu

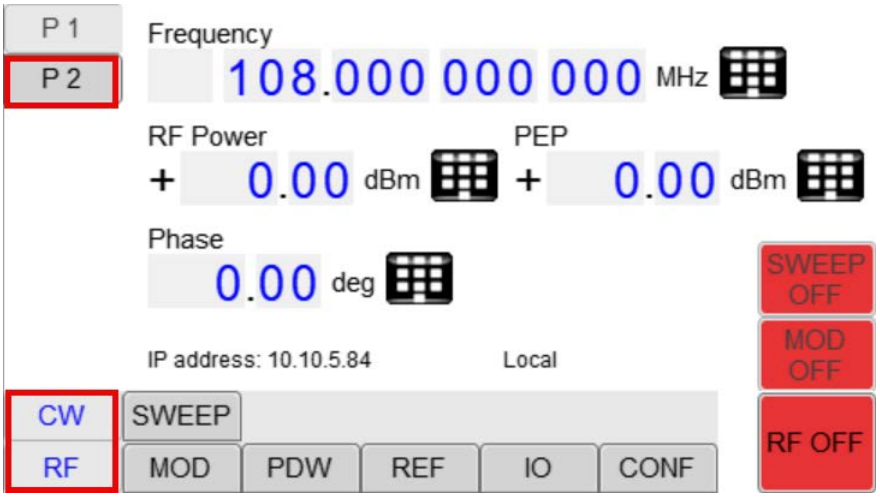
The Main display or CW Menu is shown after the instrument has successfully booted and is ready. The menu keys are displayed at the bottom of the screen. You can set the CW frequency, power level and phase from the CW menu.

NOTE

P1 and P2 work as a toggle switch. Therefore, if you are currently viewing P2 and want to go to P1 then press P2 again.

Figure 2-2 Panel 2 Display

Figure 2-3 Panel 1 Display



RF > 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

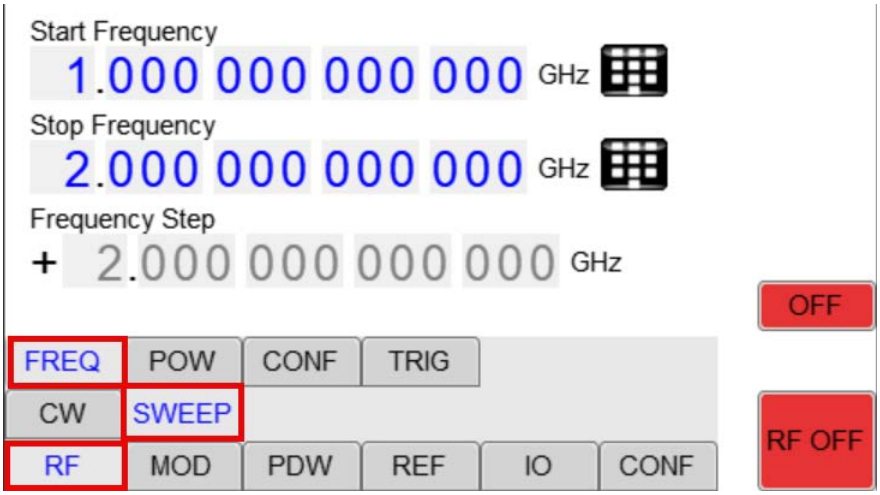
  The Configuration submenu provides additional settings for the Frequency and Power submenus.

- Trigger

RF > Sweep > 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 2-4 Frequency Display

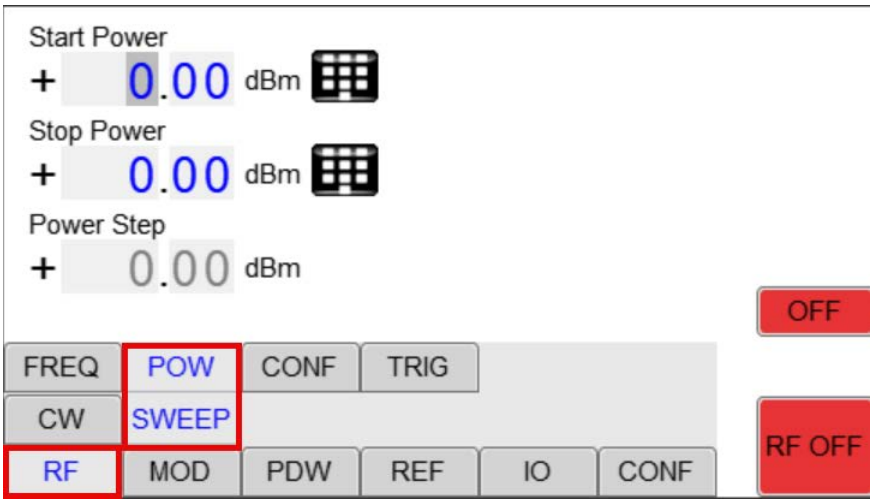


RF > Sweep >Power Submenu

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 2-5 Power Display



RF > Sweep > Configuration Submenu

Figure 2-6 Panel 1 Configuration Display

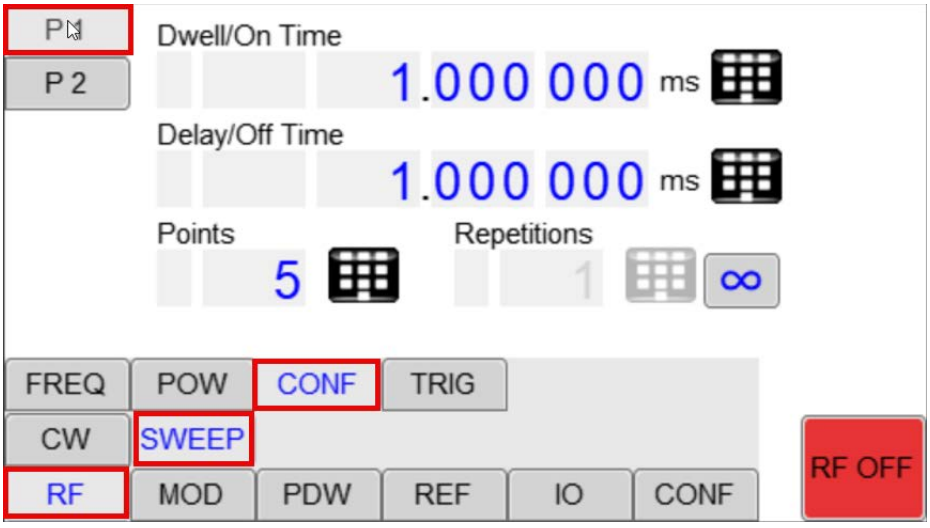
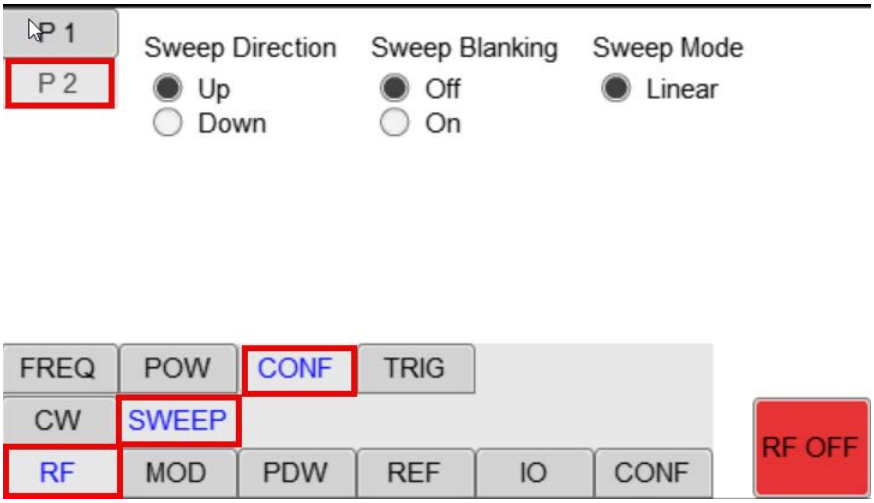


Figure 2-7 Panel 2 Configuration Display



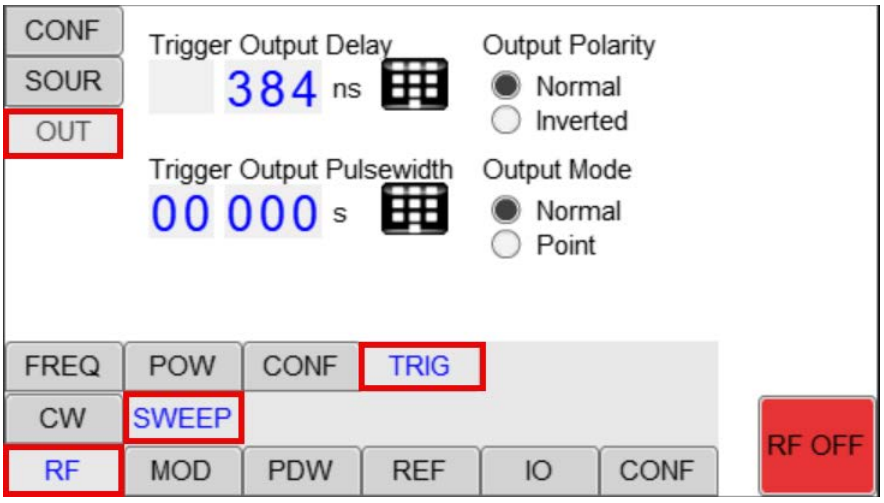
RF > Sweep > Trigger Submenu

- Out
- Source
- Configure

RF > Sweep Trigger > Out Submenu

The Trigger Out submenu accesses the trigger output delay, pulse width, polarity, and output mode.

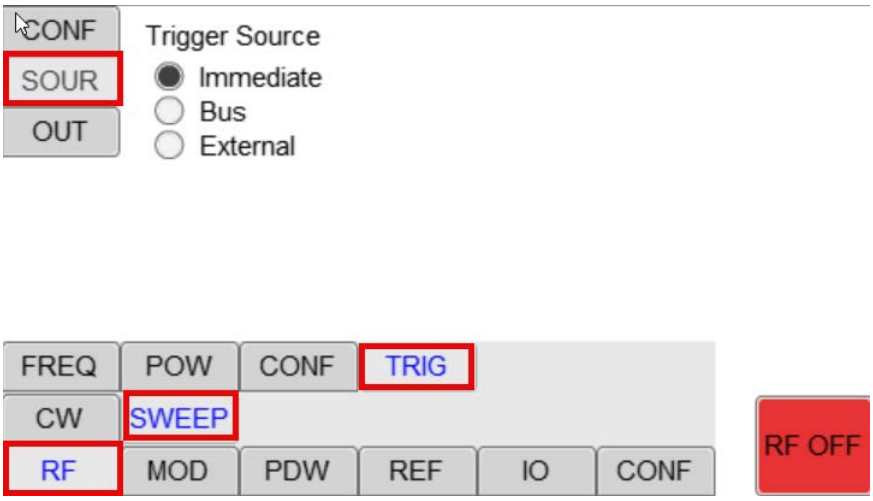
Figure 2-8 Out Display



RF > Sweep Trigger > Source Submenu

The Trigger Source is used to set the source to Immediate, Bus, or External. Additional settings for the External source can be specified for MF 1 or MF2 and triggered on the positive or negative edge.

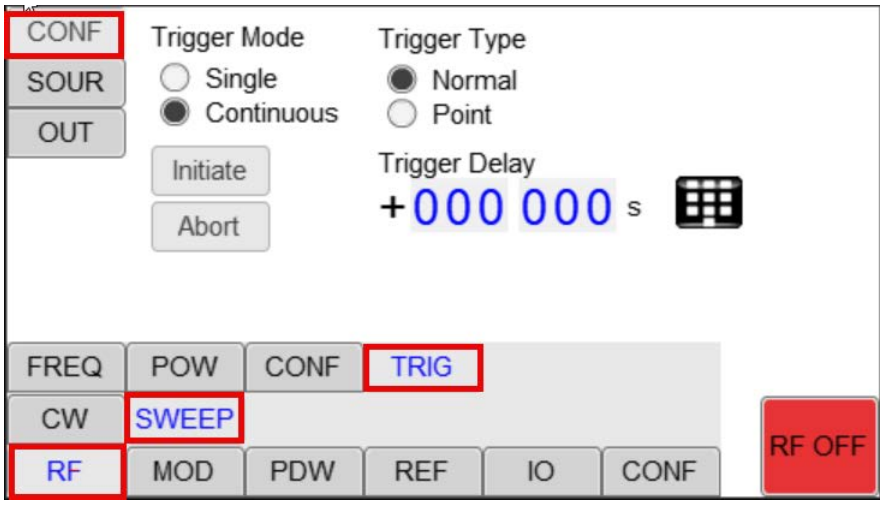
Figure 2-9 Source Display



RF > Sweep >Trigger > Configure Submenu

The Configure submenu is used set the trigger mode, type and delay.

Figure 2-10 Configure Display



Modulation Submenus

The modulation section gives access to most settings related to available modulations. The different types of modulations are grouped in submenus, which include but may not be limited to:

- Arbitrary modulation
  - Waveform modulation
  - Waveforms on SD memory (AP5041A Option 006)
  - Fast control port, external digital I/Q data streaming (AP5041A Option FCP)
- Analog modulations (AP5041A Option UNT for AM, FM, and phase modulation. AP5041A Option PMR for limited Pulse modulation or AP5041A PME for Pulse modulation.)

  Including AM, FM, PM, and Pulse modulation settings
- Differential external analog IQ inputs (AP5041A Option EXT)
- Additive white Gaussian noise modulation (AP5042A Option 403)
- AVIO modulations (AP5041A Option 302)

  Including settings for VOR, ILS, and DME
- Digital modulations (AP5041A Option 431)

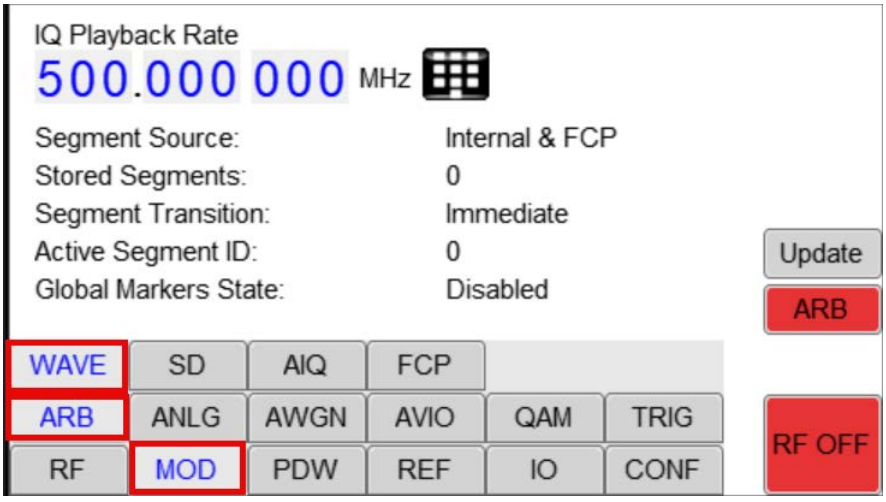
Modulation > ARB Submenu

Sets the parameters for an arbitrary modulation.

- WAVE
- SD
- FCP

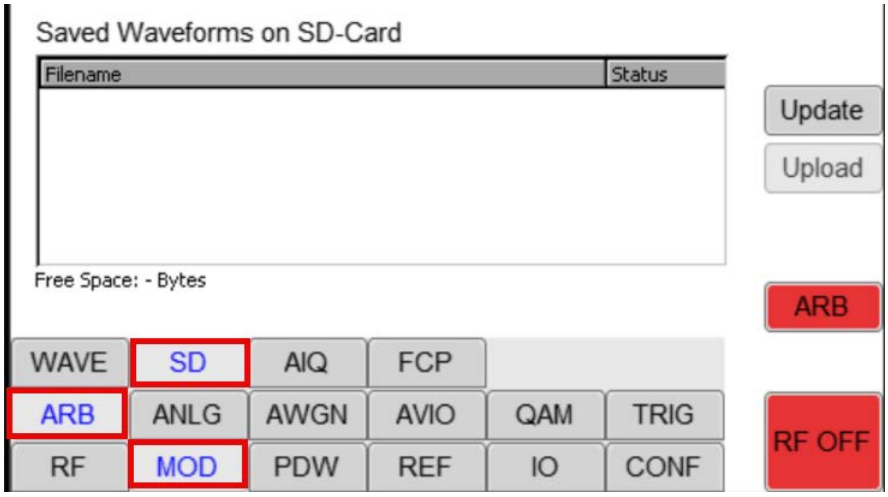
Modulation > ARB > WAVE Submenu

Figure 2-11 WAVE Display



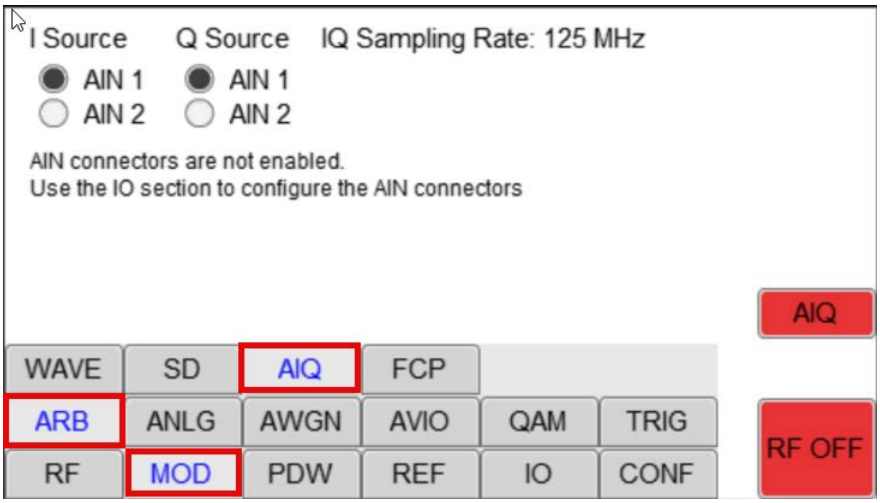
Modulation > ARB > SD Submenu

Figure 2-12 Secure Digital (SD) Card Display



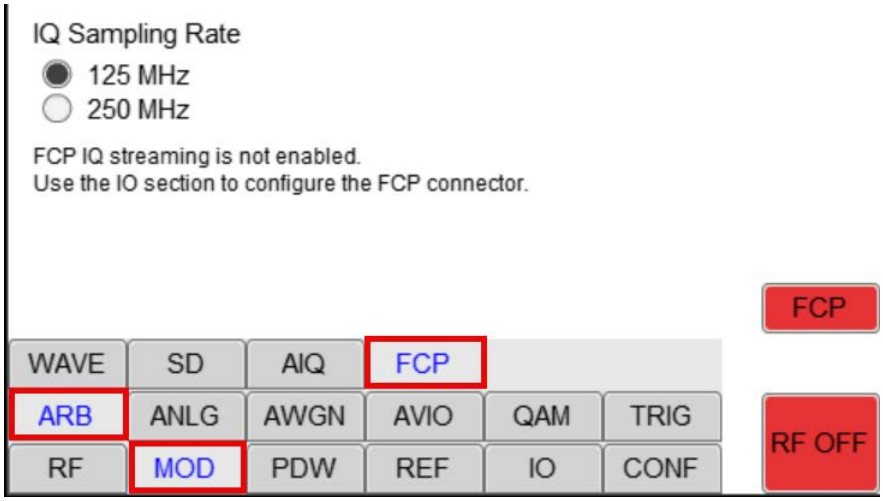
Modulation > ARB > AIQ Submenu

Figure 2-13 AIQ (Analog In-phase and Quadrature) Display



Modulation > ARB > FCP Submenu

Figure 2-14 FCP (Fast Control Port) Display



Modulation > ANLG Submenu

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

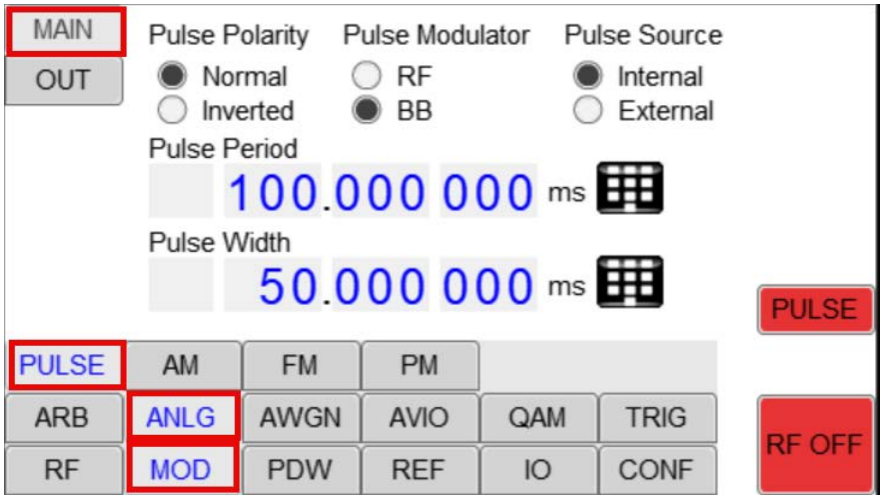
Modulation Analog > Pulse Modulation Submenu

NOTE Main and Out work as a toggle switch. Therefore, if you are currently viewing Out and want to go to Main then press Out again.

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

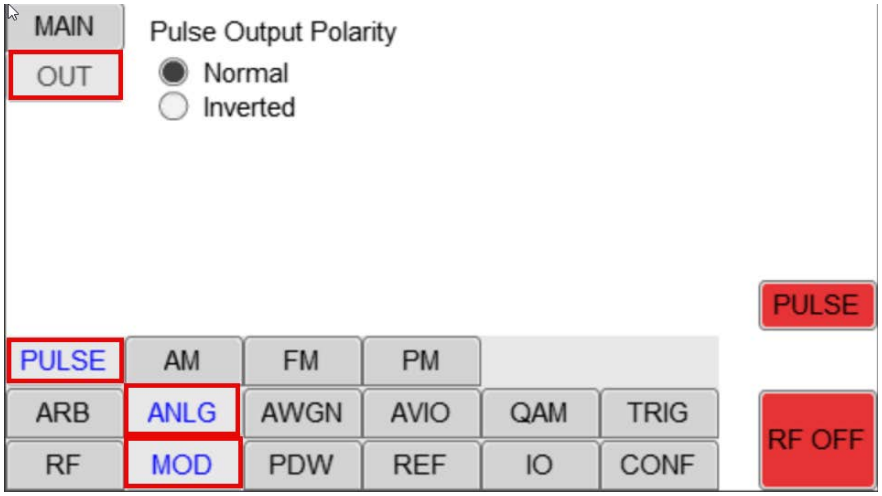
– Main

Figure 2-15 Main Display



– OUT

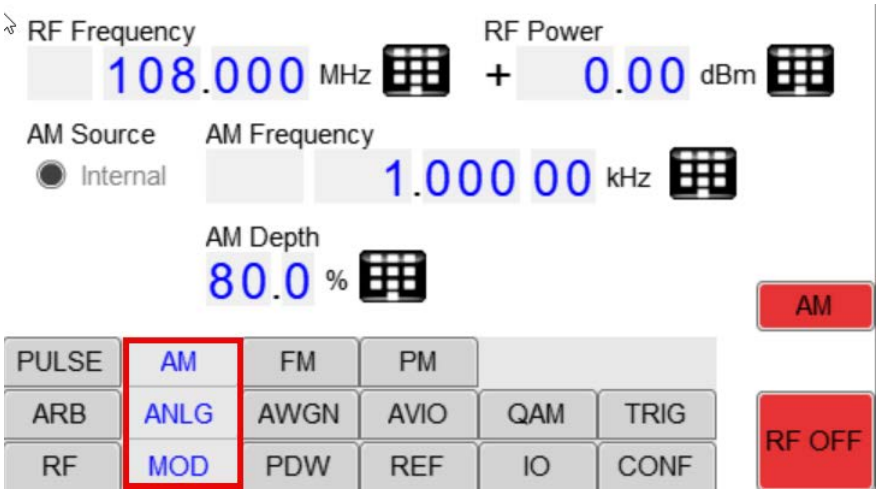
Figure 2-16 OUT Display



Modulation > ANLG > AM (Amplitude Modulation) Submenu

In the amplitude modulation submenu the internal amplitude modulation can be accessed.

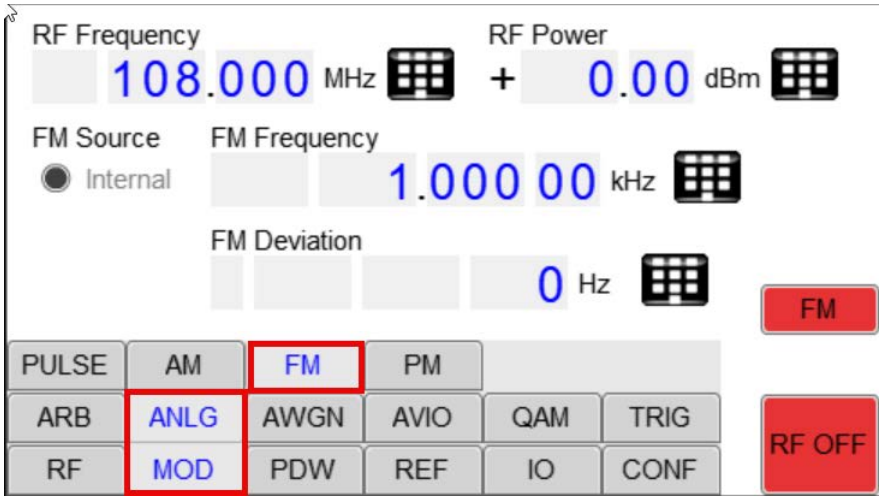
Figure 2-17 AM Display



Modulation > ANLG > FM (Frequency Modulation) Submenu

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.

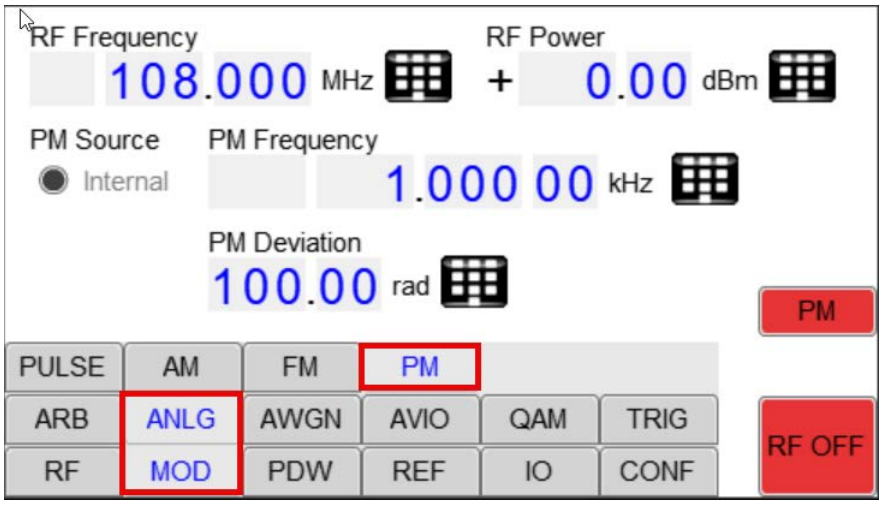
Figure 2-18 FM Display



Modulation > ANLG > PM (Phase Modulation) Submenu

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 2-19 Phase Display



Modulation > AWGN Submenu

Figure 2-20 AWGN Display

Modulation > AVIO > VOR (Very High Frequency) Submenu

Figure 2-21 AVIO VOR Main Display

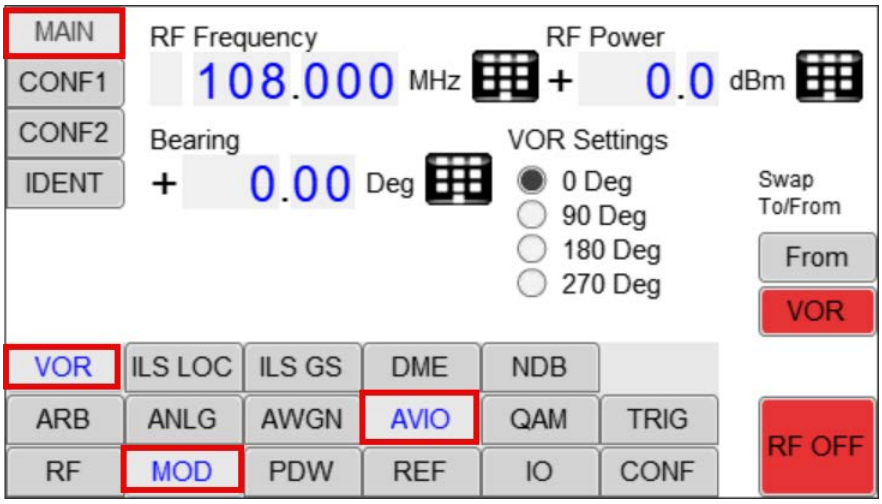


Figure 2-22 AVIO VOR CONF1 Display

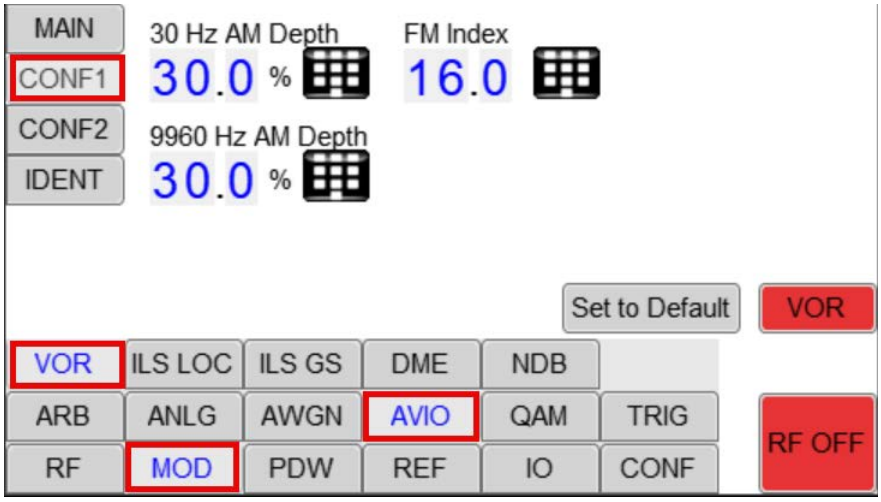


Figure 2-23 AVIO VOR CONF2 Display

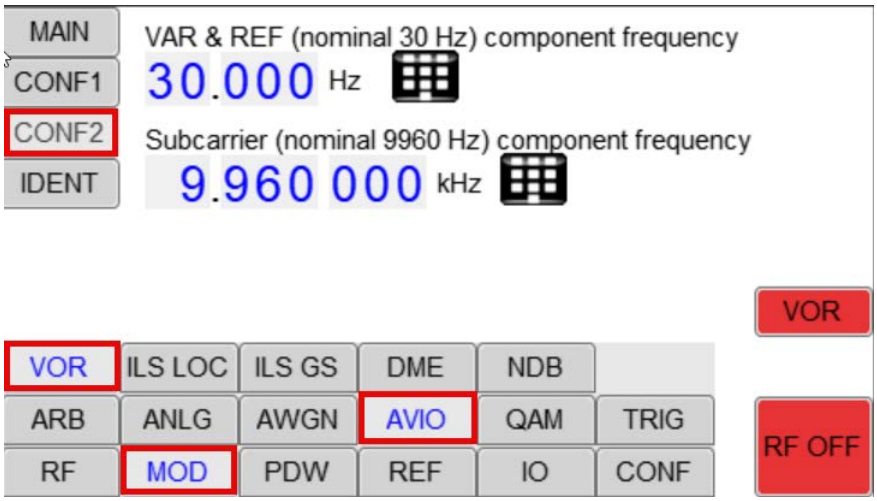
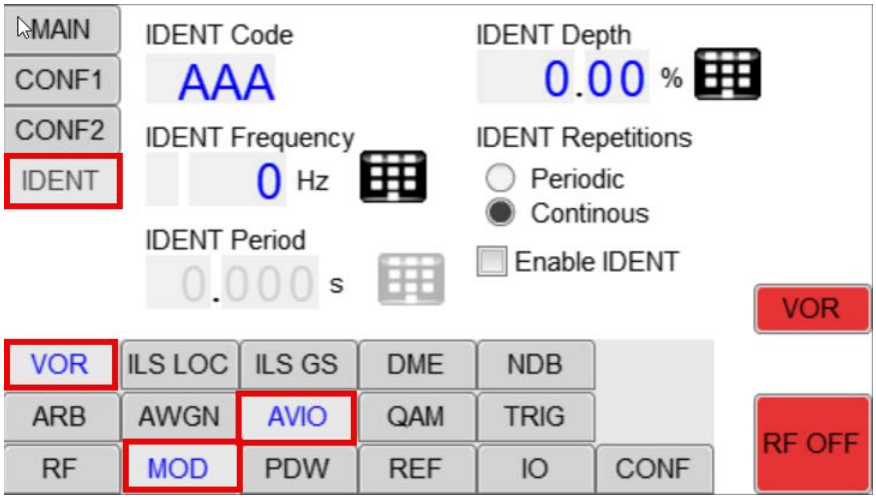


Figure 2-24 AVIO VOR IDENT Display



Modulation > AVIO > ILS (Instrument Landing System) LOC (Localizer) Submenu

Figure 2-25 AVIO > ILS LOC > MAIN Display

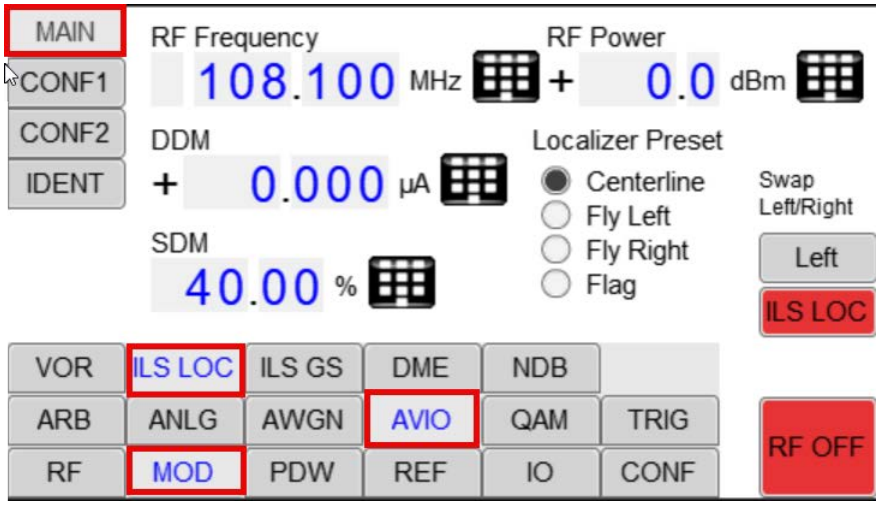


Figure 2-26 AVIO > ILS LOC > CONF1 Display

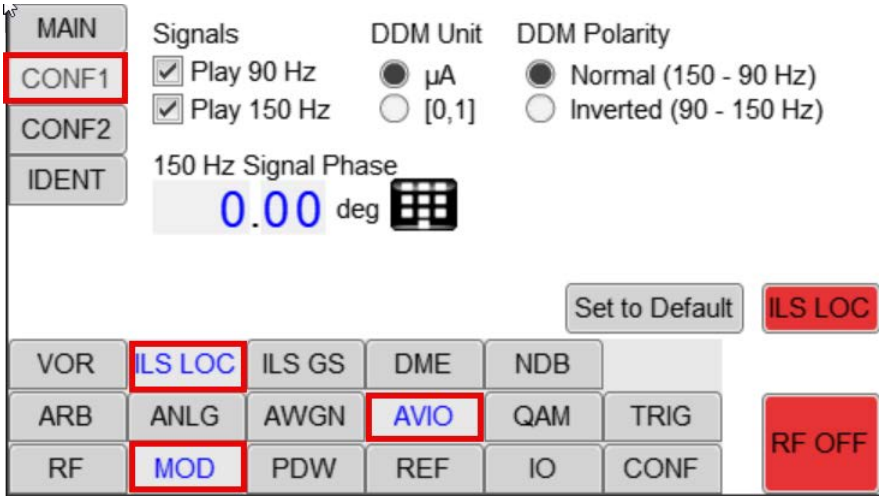


Figure 2-27 AVIO > ILS LOC > CONF2 Display

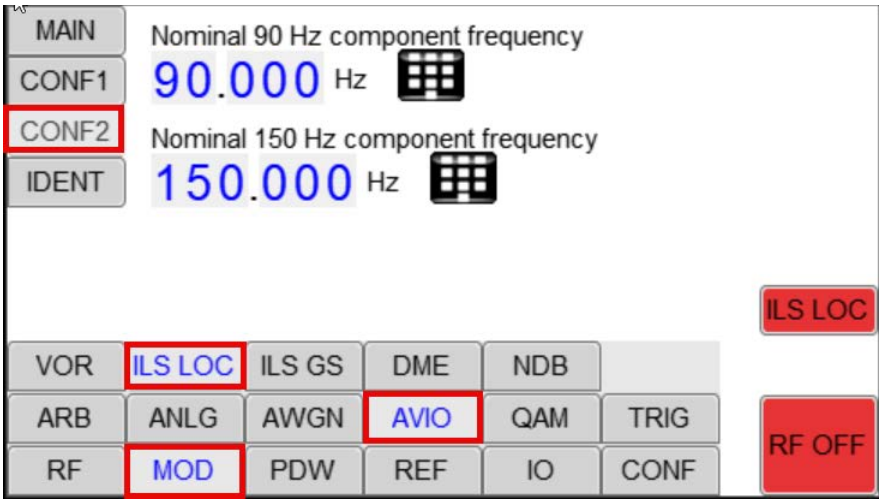
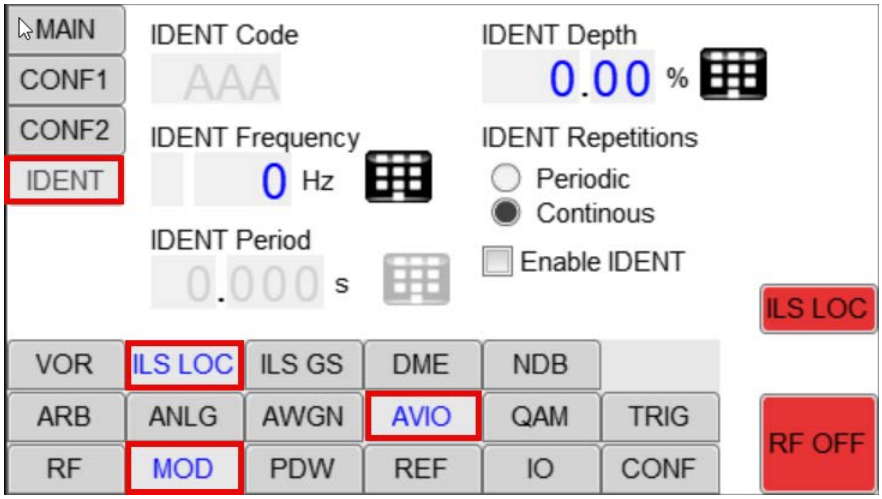


Figure 2-28 AVIO > ILS LOC > IDENT Display



Modulation > AVIO > ILS (Instrument Landing System) GS (Glideslope) Submenu

Figure 2-29 AVIO > ILS GS > MAIN Display

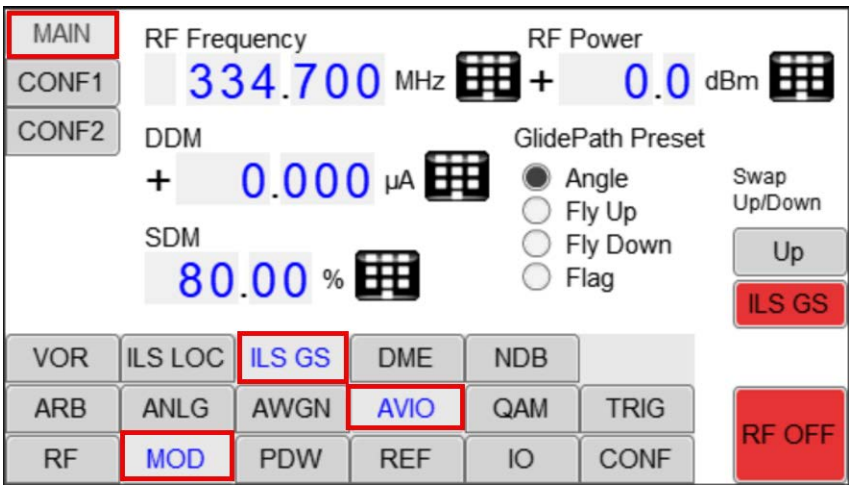


Figure 2-30 AVIO > ILS GS > CONF1 Display

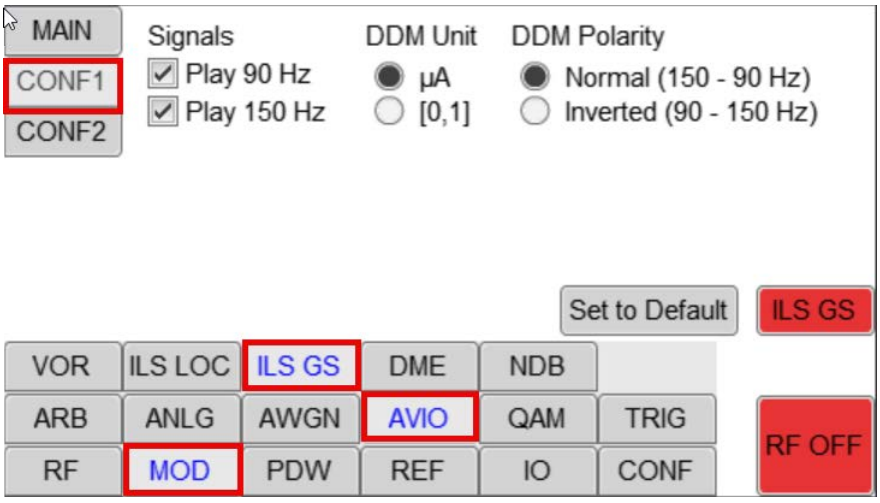
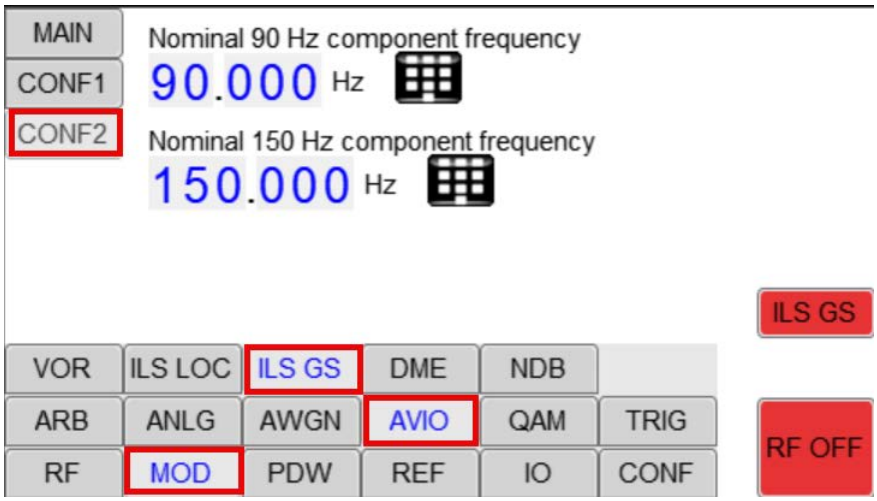


Figure 2-31 AVIO > ILS GS > CONF2 Display



Modulation > AVIO > DME (Distance Measuring Equipment) Submenu

Figure 2-32 AVIO > DME > MAIN Display

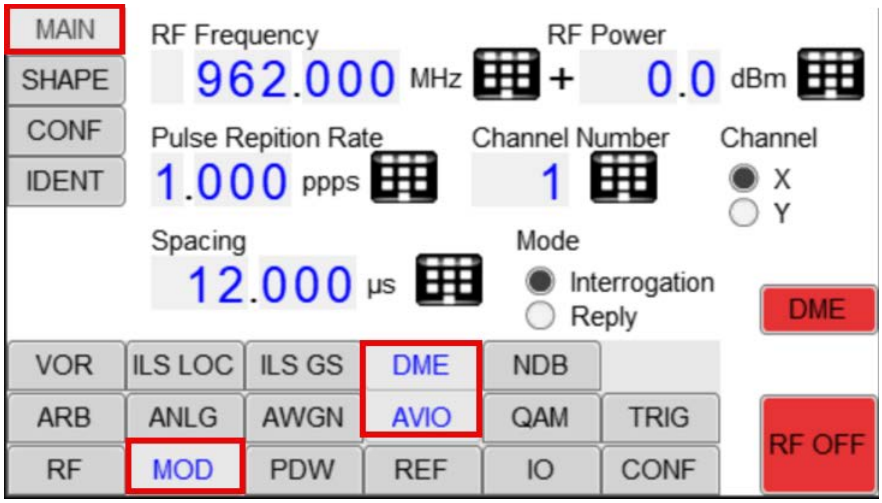


Figure 2-33 AVIO > DME > SHAPE Display

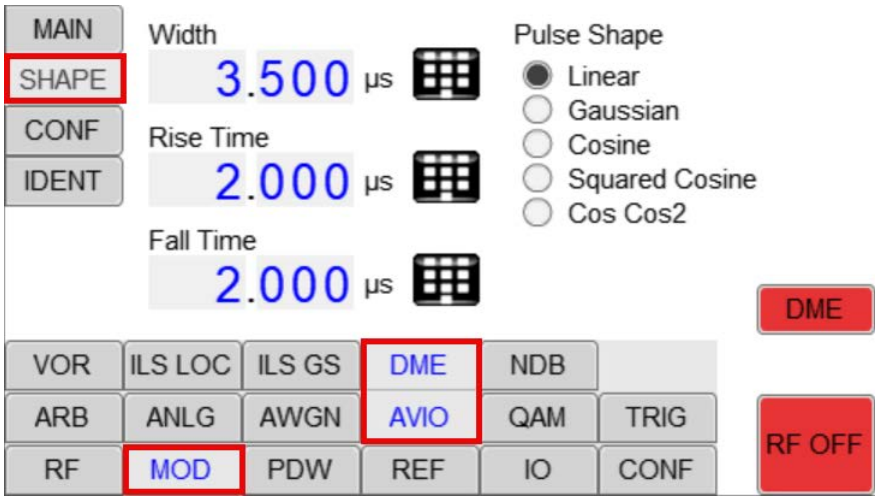


Figure 2-34 AVIO > DME > CONF2 Display

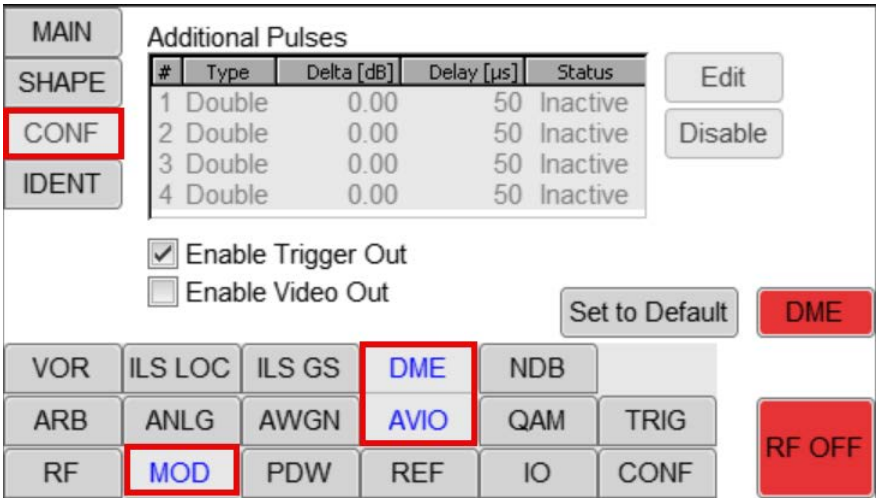
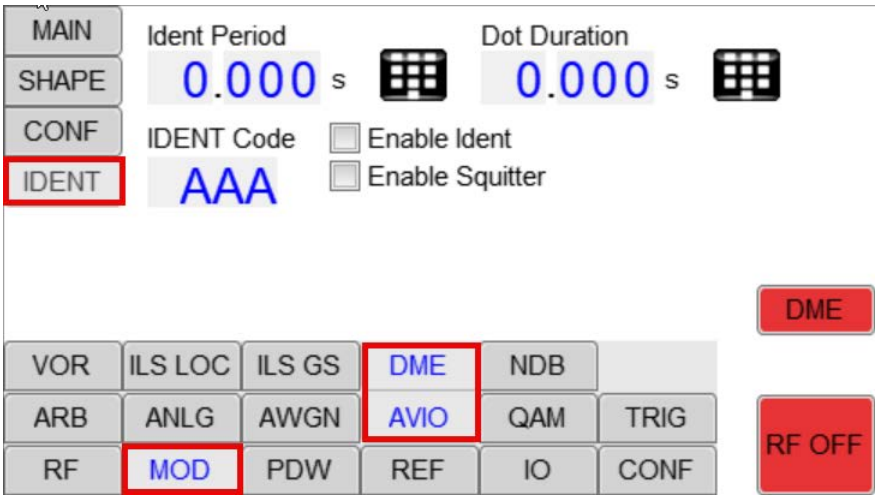


Figure 2-35 AVIO > ILS GS > IDENT Display



Modulation > AVIO > NDB (Non Direction Beacon) Submenu

Figure 2-36 AVIO > NDB > MAIN Display

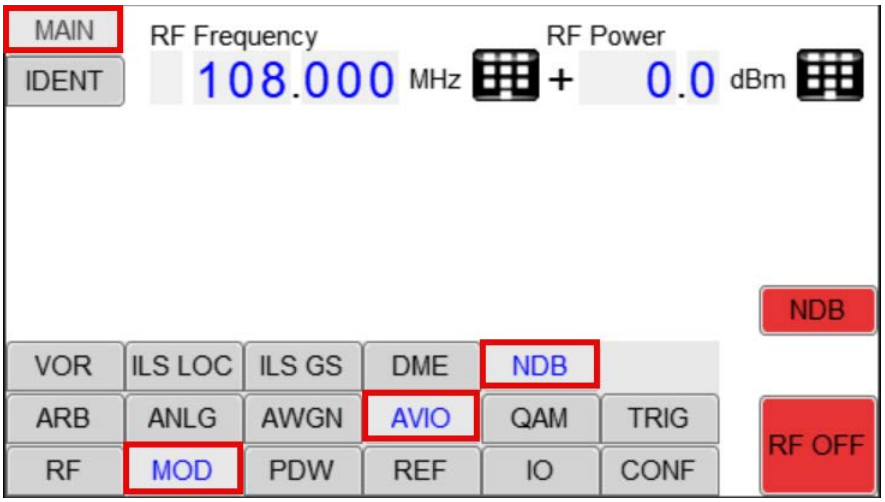
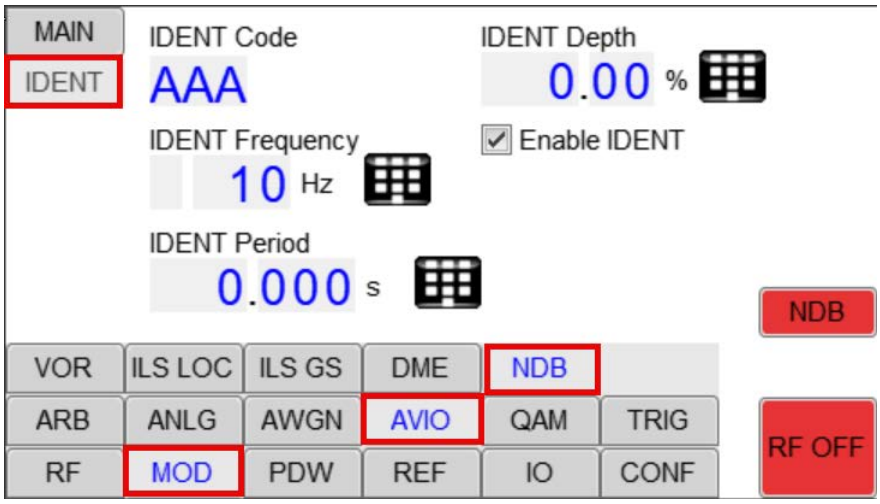
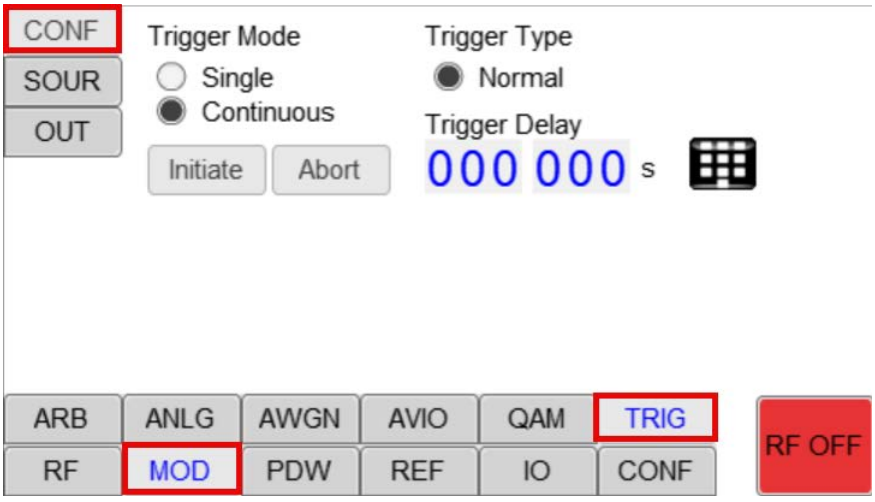


Figure 2-37 AVIO > NDB > IDENT Display



Modulation > QAM

Figure 2-38 QAM Display



Modulation > Trigger

Figure 2-39 Configure Display

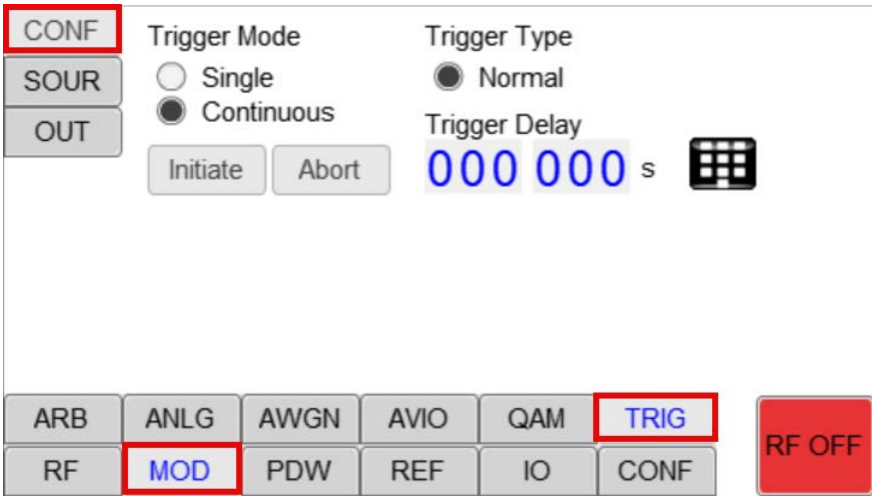


Figure 2-40 Source Display

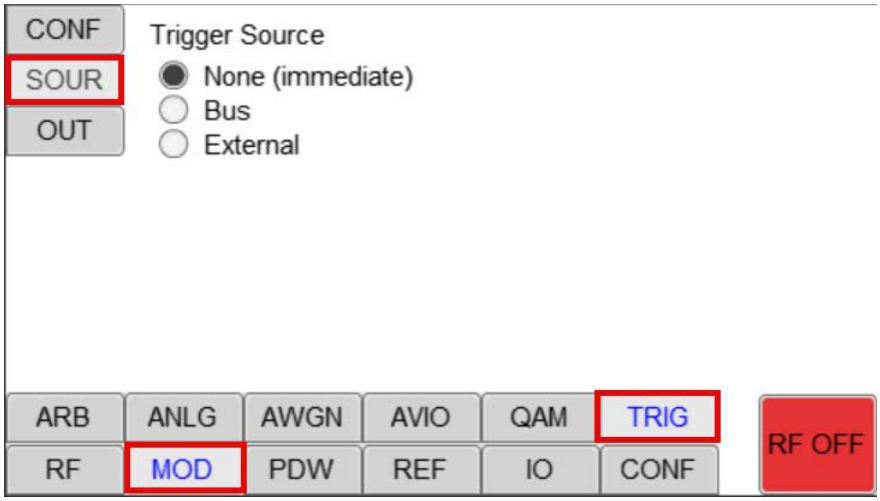
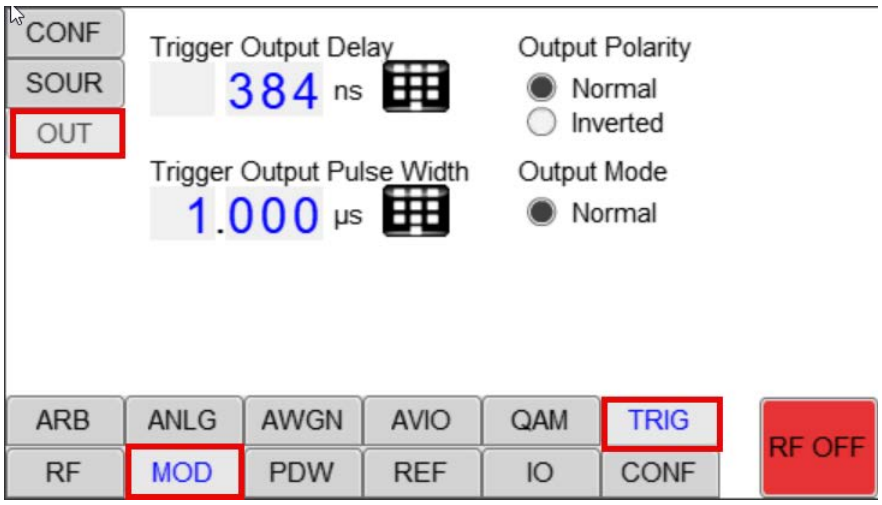


Figure 2-41 Out Display

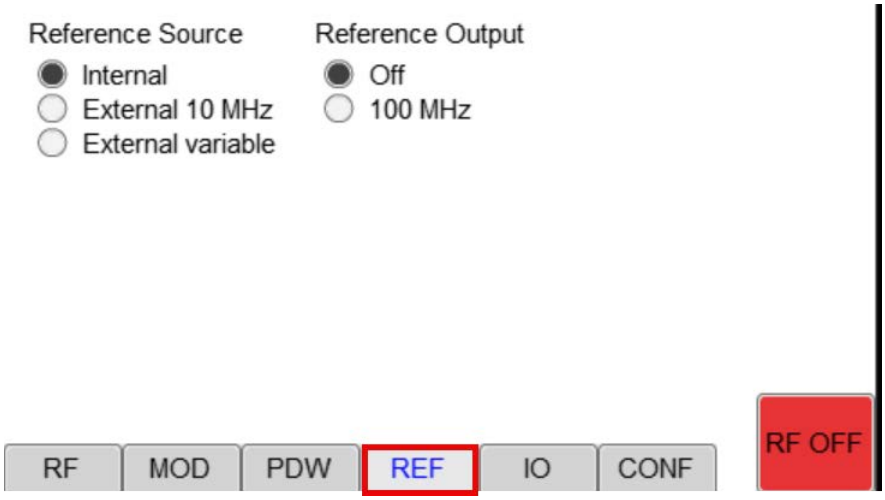


The Sweep Trigger Subsystem provides the trigger parameters for the select modulation.

Reference Submenu

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

Figure 2-42 Reference



Input Output (IO) Submenu

This menu includes configurations for input and output ports of the device. Submenus included here, are:

– Multifunction Output - Select the signal to be output at each of the multifunction ports.

– Fast Control Port (Option FCP) - Configure the FCP interface to interpret received signals appropriately.

– Analog Input Port (Option EXT) - Configure the analog input interface and set gain and offset for applied input signals.

IO > MFO (Multi Function Output)

NOTE MF 1 and MF 2 work as a toggle switch. Therefore, if you are currently viewing MF 2 and want to go to MF 1 then press MF 2 again.

Figure 2-43 MFO > MF1 Display

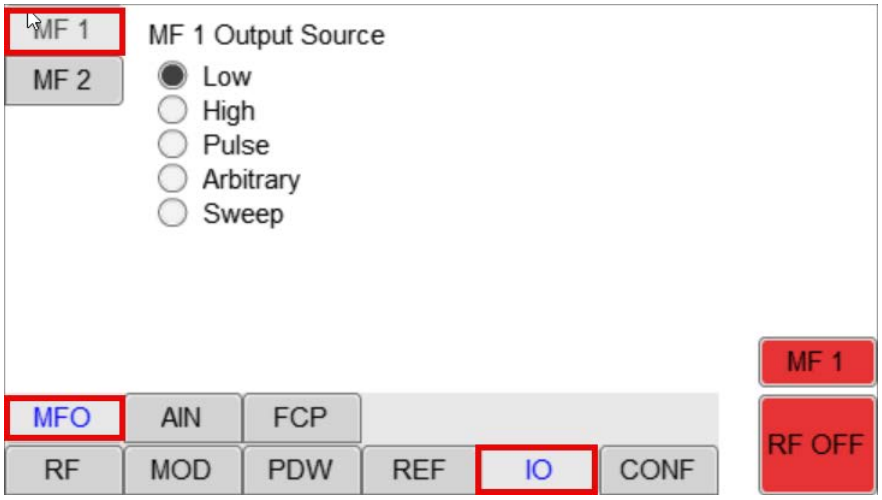
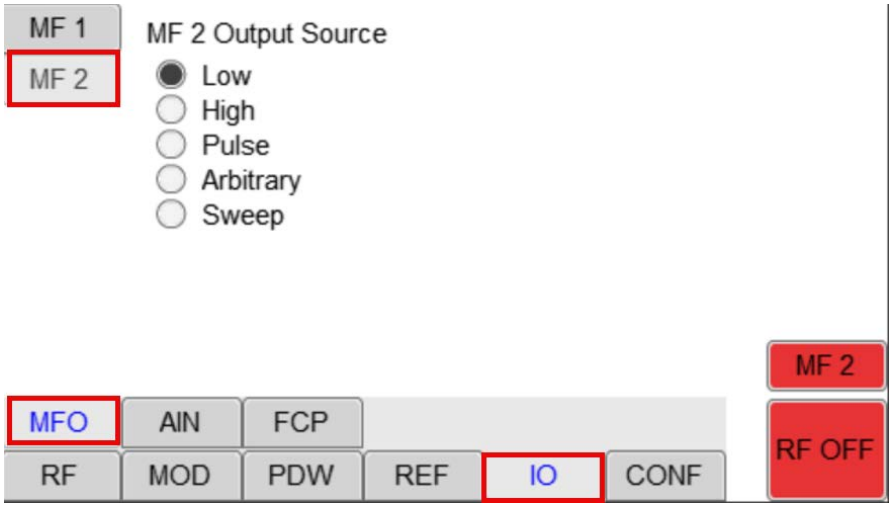


Figure 2-44 MFO > MF 2 Display



IO > AIN (Analog Input) > MF 2 Submenu

NOTE AIN 1 and AIN 2 work as a toggle switch. Therefore, if you are currently viewing AIN 2 and want to go to AIN 1 then press AIN 2 again.

Figure 2-45 AIN > AIN1 Display

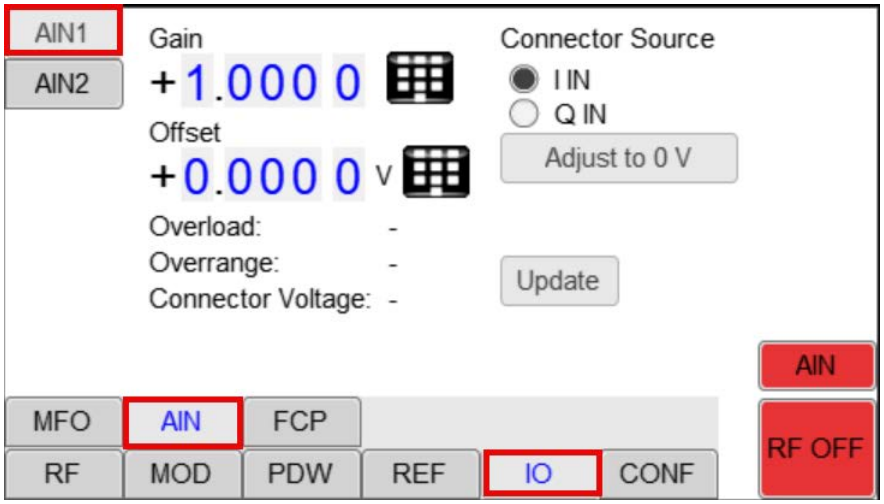
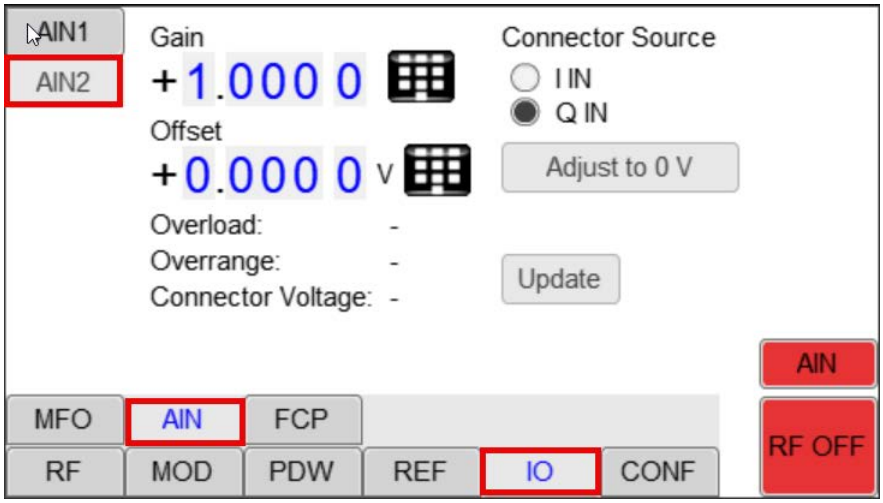


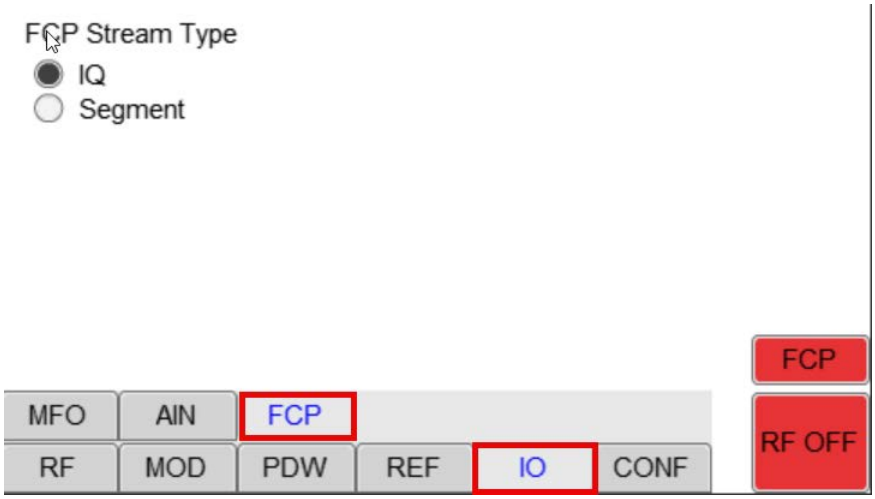
Figure 2-46 AIN > AIN2 Display



IO > FCP (Fiber Channel Protocol) Submenu

This menu is available for both MF1 and MF2.

Figure 2-47 FCP Display



Configuration

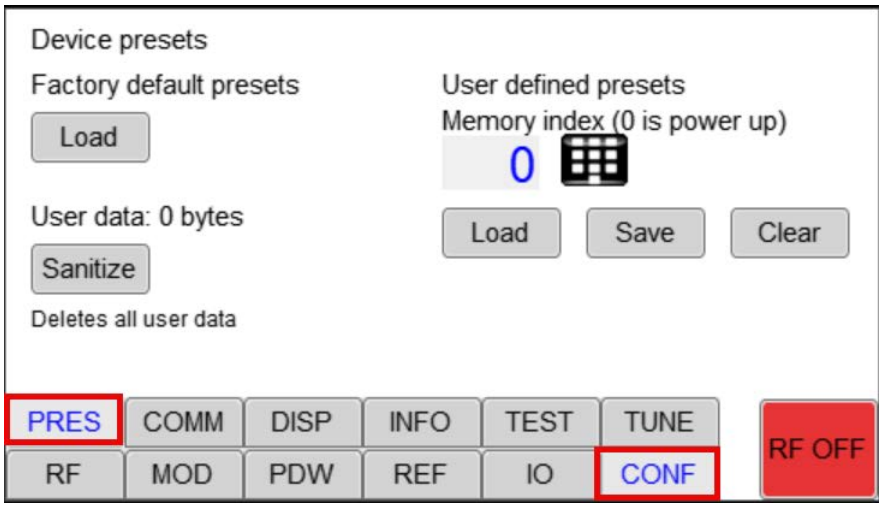
The Configuration submenu is divided into the following submenus:

- PRESet
- COMMunication
- DISPlay
- INFO
- TEST

Configuration > Preset 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.

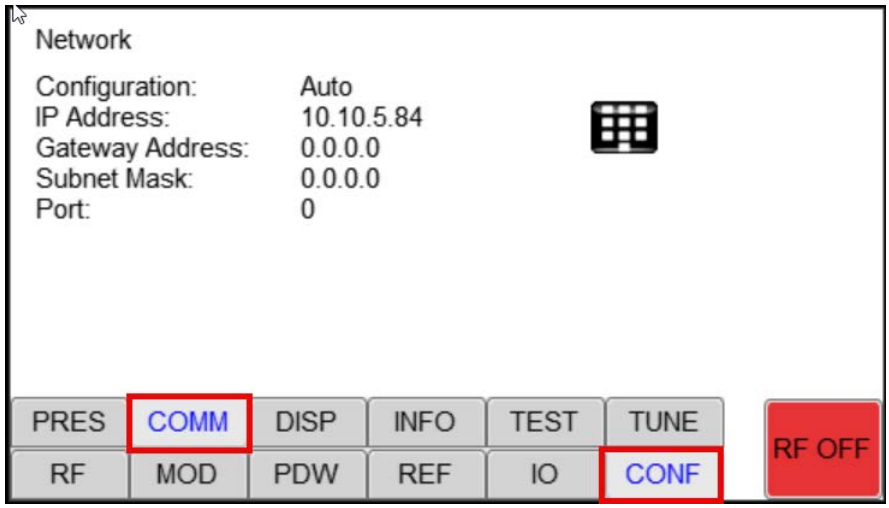
Figure 2-48 Preset Display



Configuration > Communication Submenu

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

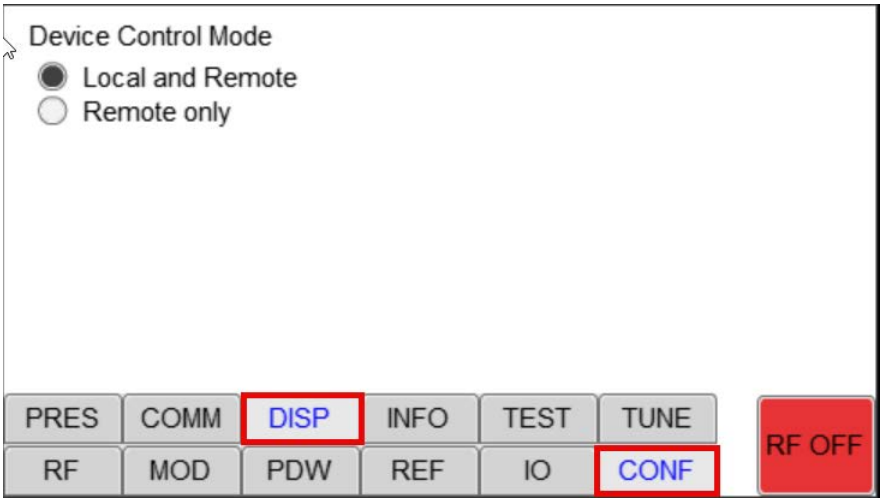
Figure 2-49 Communication Display



Configuration > Display Submenu

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

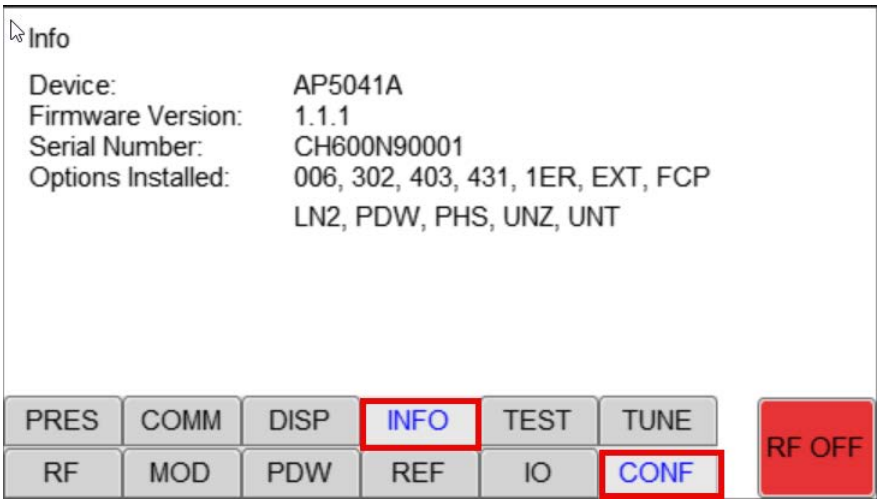
Figure 2-50 Display



Configuration > Info Submenu

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

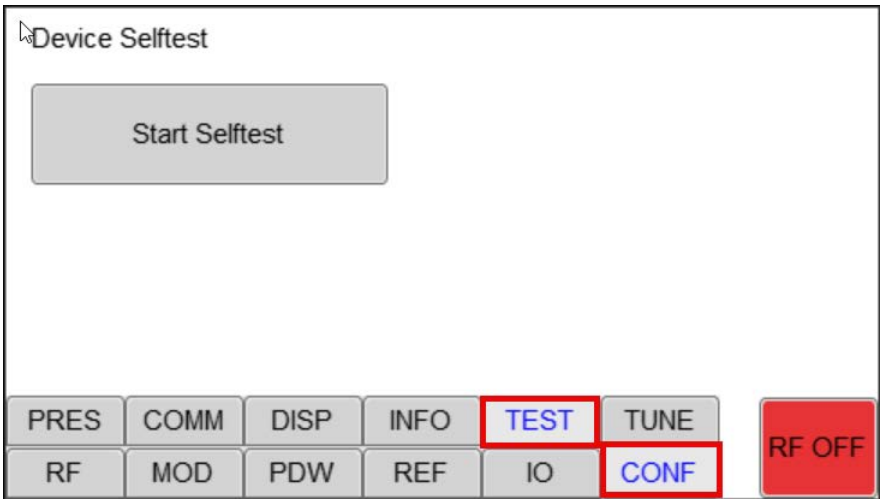
Figure 2-51 Info Display



Configuration > Test Submenu

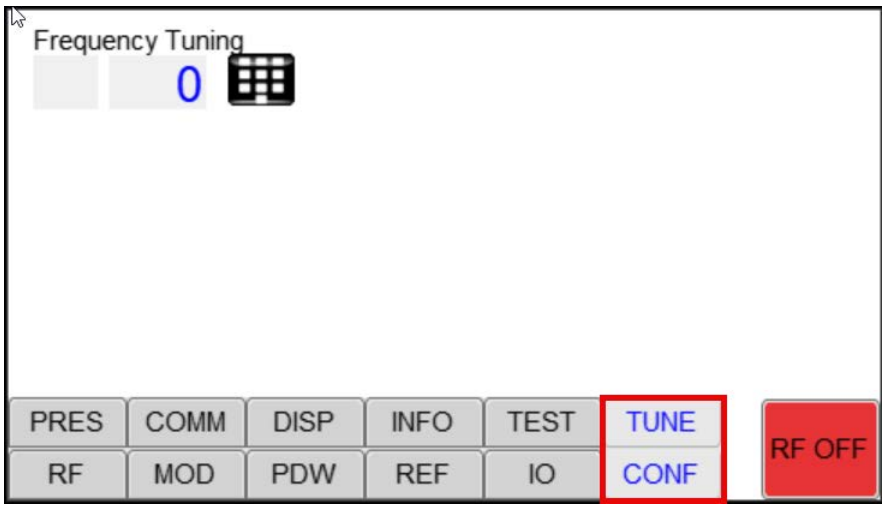
The Test Submenu allows you to perform a self test on the instrument.

Figure 2-52 Test Display



Configuration > Tune Submenu

Figure 2-53 Tune Display



Allows you to adjust frequency tuning.

3 Using the Graphical User Interface (GUI)

This section describes the following features:

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.

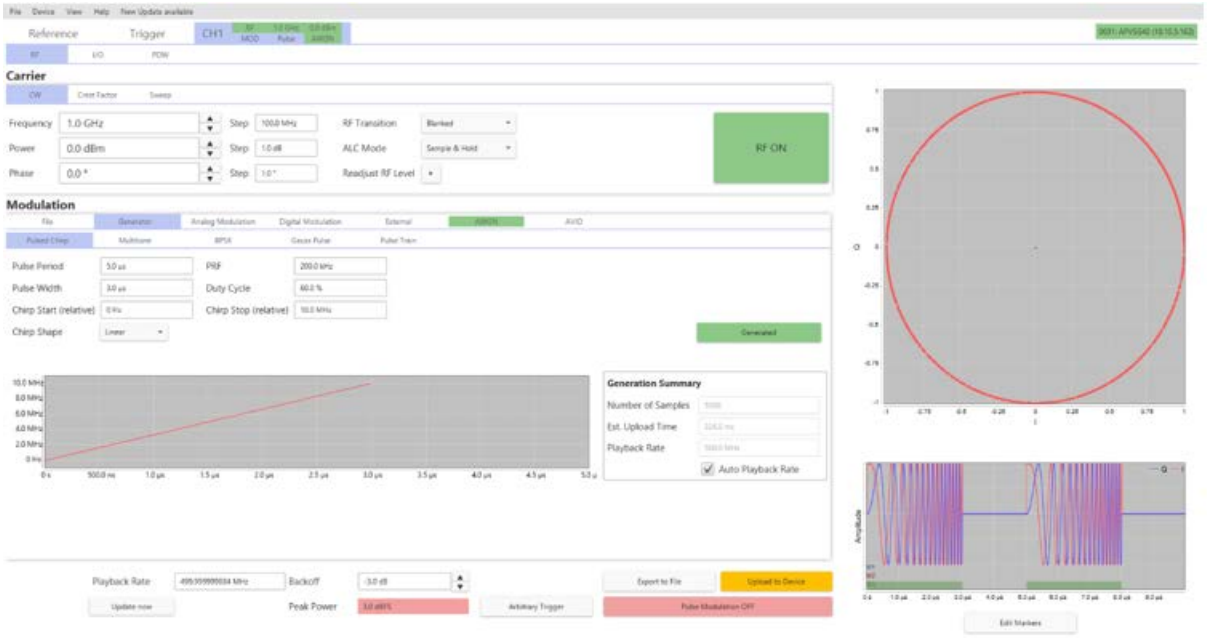
Get the latest version of the Vector Signal Generator GUI at:

https://www.keysight.com/us/en/support/AP5041A/ap5041a-g3-vector-signal-generator-up-to-40-ghz.html#drivers

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 3-1) 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.

Figure 3-1 Vector Signal Generator GUI



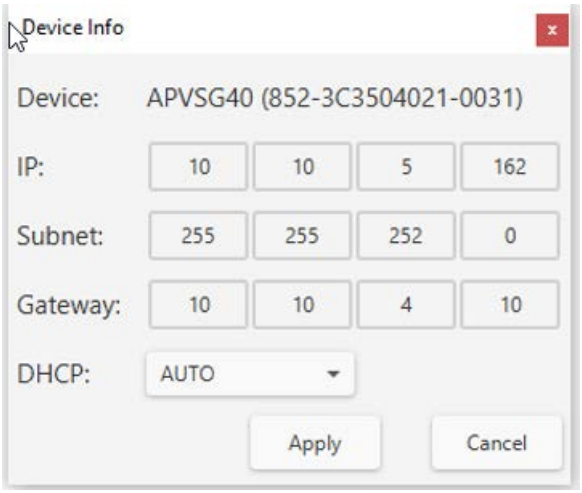
Simultaneously controlling Multiple Signal Generators from one PC

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

Setting Network Configuration

The Device > Network Configuration menu allows configuring the LAN settings. 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 as shown below. Additionally, the device name can be modified as desired. The unit's serial number and firmware revision are displayed at the bottom of the dialog box.

Figure 3-2 Network Configuration dialog box



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 to Devices Using a Non-default Port

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

– Specify a temporary port

1. From the main menu, select **Device** > **Info** > **Connection Settings** > **Specify Connection Port**.

   This will cause a new setting **Custom Port** to be displayed on the 'Control' tab of the UI.

2. 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.

3. To remove, select **Specify Connection Port**.

   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.

– Change the application's default port setting

1. The global default port used for connections can be changed by selecting menu 'Info' -> 'Connection Settings' -> 'Change Default Port' (see figure 6-d).

2. The global default port used for connections can be changed by selecting **Device** > **Info** > **Connection Settings** > **Change Default Port**.

3. Enter the default port into the dialog box and select **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.

Setting the GPIB Address

If the instrument has the GPIB option installed, the GPIB address can be changed in the GPIB submenu in the Control tab. Valid GPIB addresses range from 1 to 30.

To verify GPIB functionality, use the VISA Assistant available with the Keysight IO Library or the Getting Started Wizard available with the National Instrument IO Library. These utility programs enable you to communicate with the signal generator and verify its operation over GPIB. For information and instructions on running these programs refer to the Help menu available in each utility.

Upgrading the Firmware

CAUTION **Do not disconnect and power off the device during a firmware upgrade.**

A firmware upgrade of the instrument can be done directly via the GUI.

1. Make sure you are connected to the correct instrument and have the correct firmware binary file (.tar) ready.
2. Select **Controller** > **Update Firmware**.
   https://www.keysight.com/us/en/lib/software-detail/instrument-firmware-software/ap504xa-firmware.html

   The update will take a few seconds. After completion, your instrument will reboot. Reconnect to the instruments after booting is completed and continue with the updated firmware.

Remotely Programing the Signal Generator

The signal generator can be remotely programmed with the use of SCPI commands. Please refer to the Programmer's Manual for details.

https://www.keysight.com/us/en/support/AP5041A/ap5041a-g3-vector-signal-generator-up-to-40-ghz.html#

AP5041A/42A Operation via the GUI

The single channel signal generator may be operated via the graphical user interface (GUI) or directly from the front panel (AP5041A only). The multichannel models are operated via the GUI. All models can optionally be remotely controlled with SCPI commands, as described in section “Remotely Programing the Signal Generator” on page 65.

The following section descibes basic functions of the device are explained. Examples demonstrate a selection of modulated signals that can be generated with the APVSG. The GUI is used to control the signal generator in the examples.

Menus

The GUI provides the following menus:

- RF
- IO (Input Output)
- Carrier
- Crest Factor
- Modulation
    - Generator
    - Pulse Train
    - Analog Modulation
    - Digital Modulation
    - External Modulation
    - AWGN Modulation
    - AVIO Modulation
    - Arbitrary
- Sweep

RF Tab

Use the RF dialog to set the parameters of the carrier and modulation signal and to turn RF on and off.

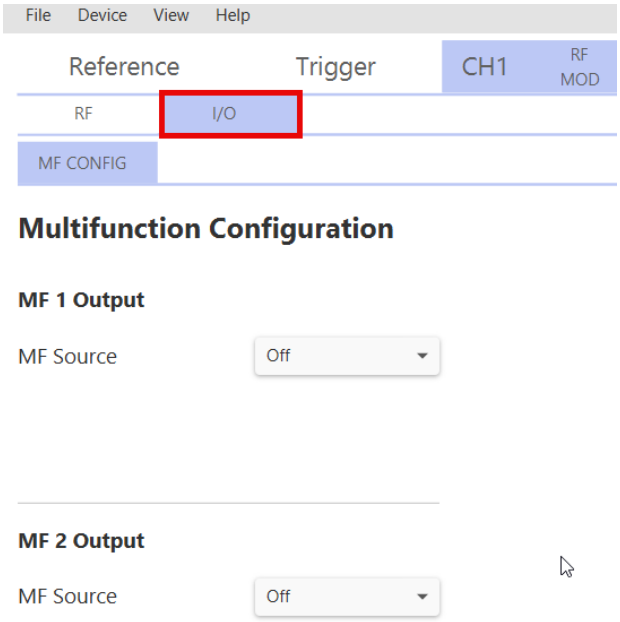
IO (Input Output) Tab

Use the IO dialog to configure MF outputs 1 and 2. Choices are:

MF (Multi Functional) Configuration

- Off - Inactivates the output
- Low - Sets the output to logical low
- High - Sets the output to logical high
- Pulse - If Pulse is chosen in Analog Modulation mode, the modulation pulses will appear the output.
- Arbitrary - sets either Marker or Trigger signals at the output. Marker signals must be defined for the replayed segment selected in the Segment tab. The arbitrary trigger can be configured in the modulation section.

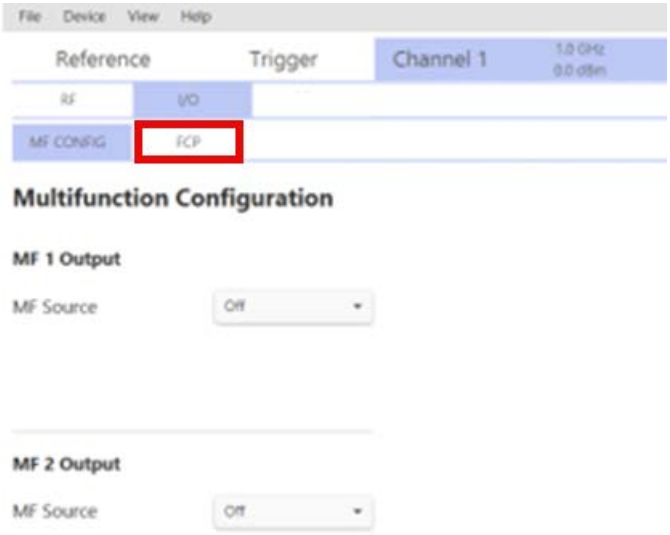
– Sweep - when the carrier sweep is active, either the valid state of the RF output or the sweep trigger can be provided at the multifunction output. The sweep trigger can be configured in the **RF** > **Carrier** > **Sweep** tab.



FCP

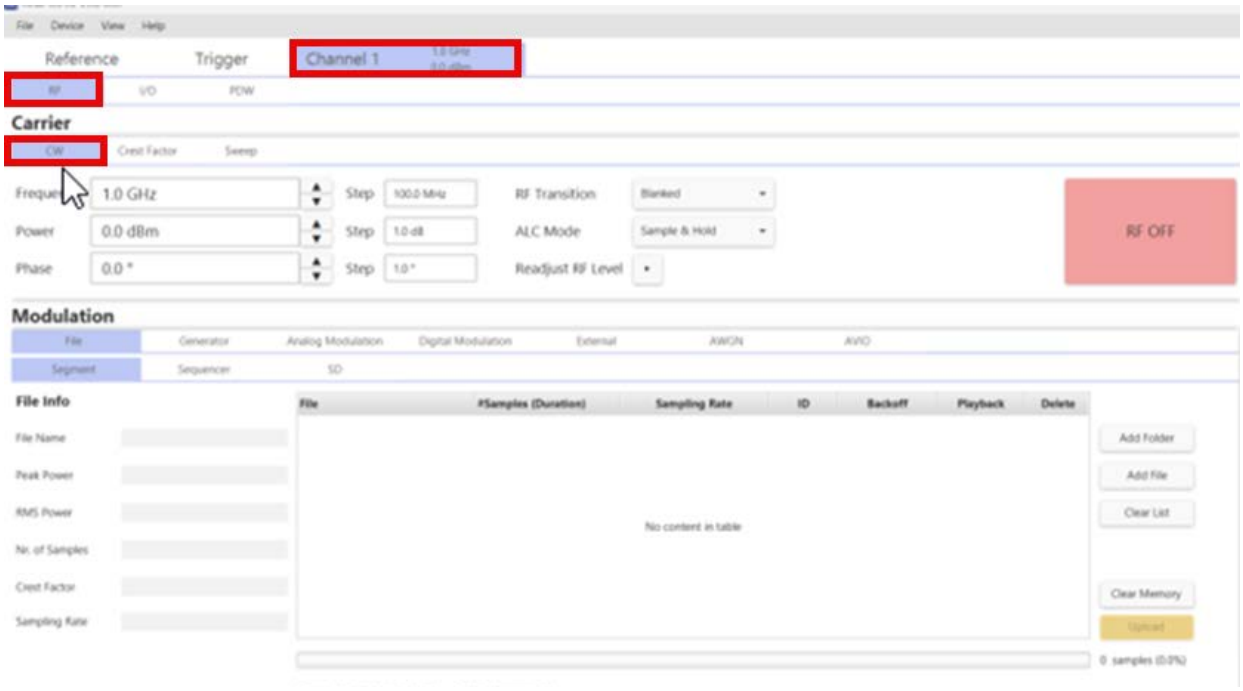
Used to set up the fast control port (option FCP). Refer to application note:

– Fast-Control-Port-with-MDR-26-Pin-Connector.pdf



Carrier Section

The vector signal generator can generate unmodulated as well as modulated carriers. The carrier must be defined in the Carrier section of the GUI. Next you can select from a variety of modulation signals in the Modulation section.



You can vary the Power, Frequency and Phase carrier setting by entering the value in the text box, or by using the up and down arrows. You can change Step size by entering the appropriate value. The RF ON/OFF button will be Green when on, and red when off.

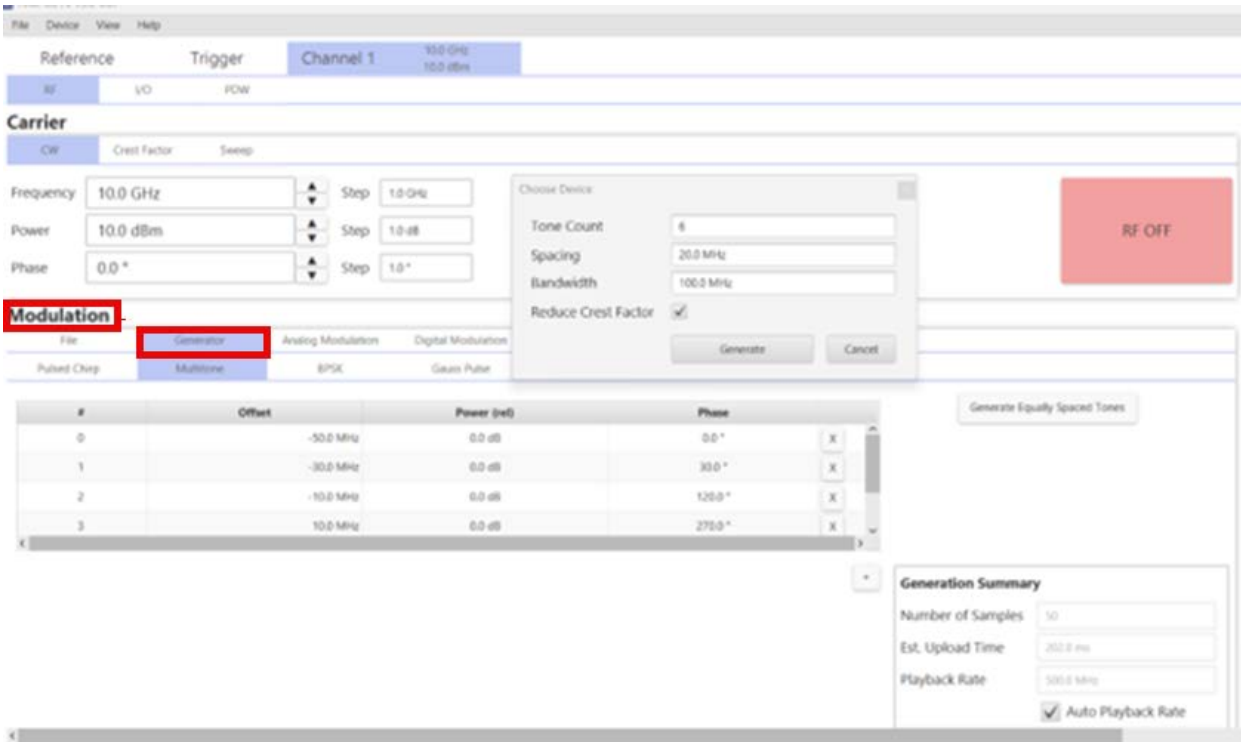
Crest Factor Section

Allows you to define or retrieve the crest factor (peak-to-average ratio in dB) of the modulated signal:

- Manual - specify the value for the maximum crest factor.
- Automatic - depending on the chosen modulation the calculated and automatically set crest factor will be provided (for AM, FM, PM and DME, ILS, VOR for Option 302)
- AWGN - provides the crest factor of the Gaussian noise if the additive noise is enabled.
- Total - provides the combined crest factor of the modulated carrier and AWGN, if enabled.
- Refresh - updates the actual crest factor values after modulation has been changed.

Refer to the G3-Vector-Signal-Generator-RF-Output-Modes application note.

Modulation Section



Generator Tab

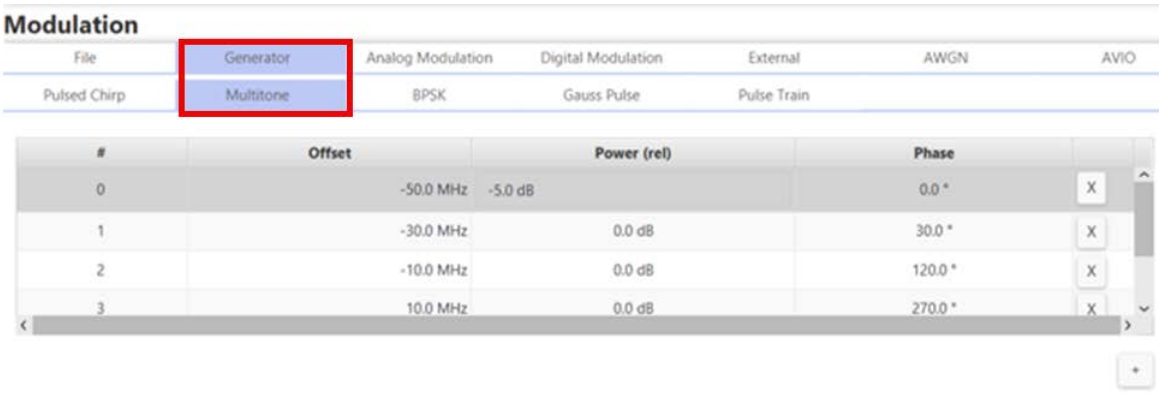
Allows you to choose between the following internally generated modulations:

- Pulsed chirp (chirped carrier bursts)
- Multitone
- BPSK (binary phase shift keying)
- Gauss pulse
- Pulse train

Example: Multitone generation

1. Select the **CW** tab and set the appropriate carrier parameters.
2. In the **Generator** tab, select **Multitone**.
3. Open the **Generate Equally Spaced Tones** window and set number of tones and either Spacing or Bandwidth
4. Select **Reduce Crest Factor** if required.
5. Tone frequencies and relative powers are displayed (scroll down if not all tones are visible on the screen).
6. Change relative power by manually entering the desired value in the **Power (rel)** field.

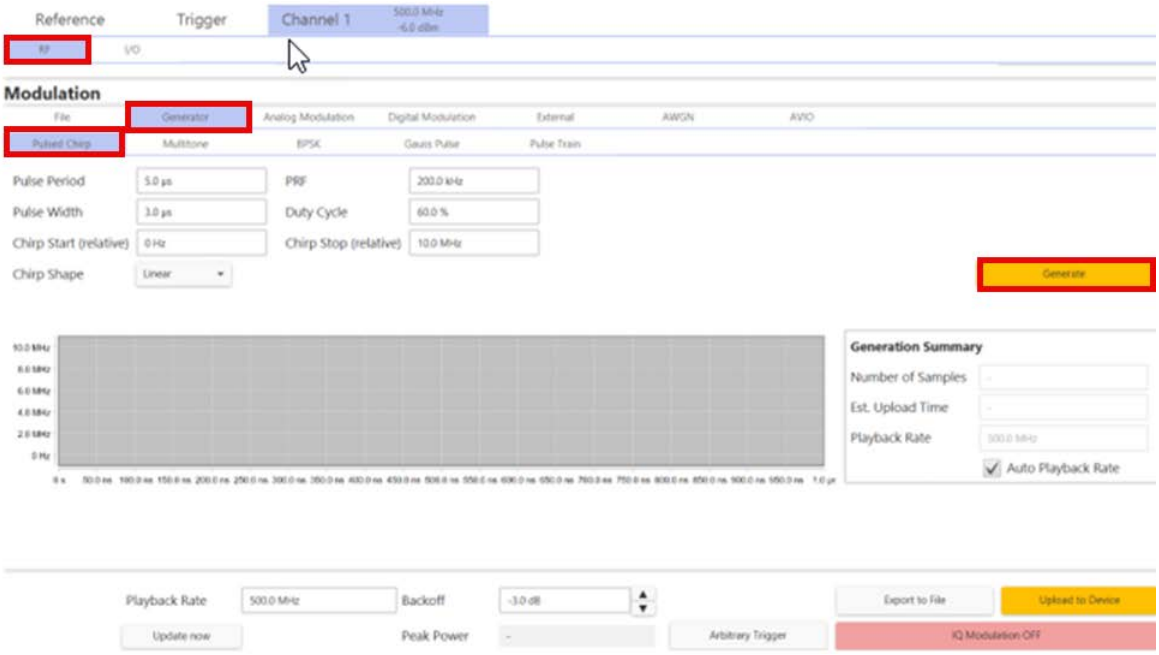
7. Add more carriers by selecting the **+** button and enter **Offset**, **Power (rel)**, and **Phase** as required.
8. Remove a particular carrier by selecting the **x** button next to that carrier.



9. Select RF Off to toggle on the RF Output.

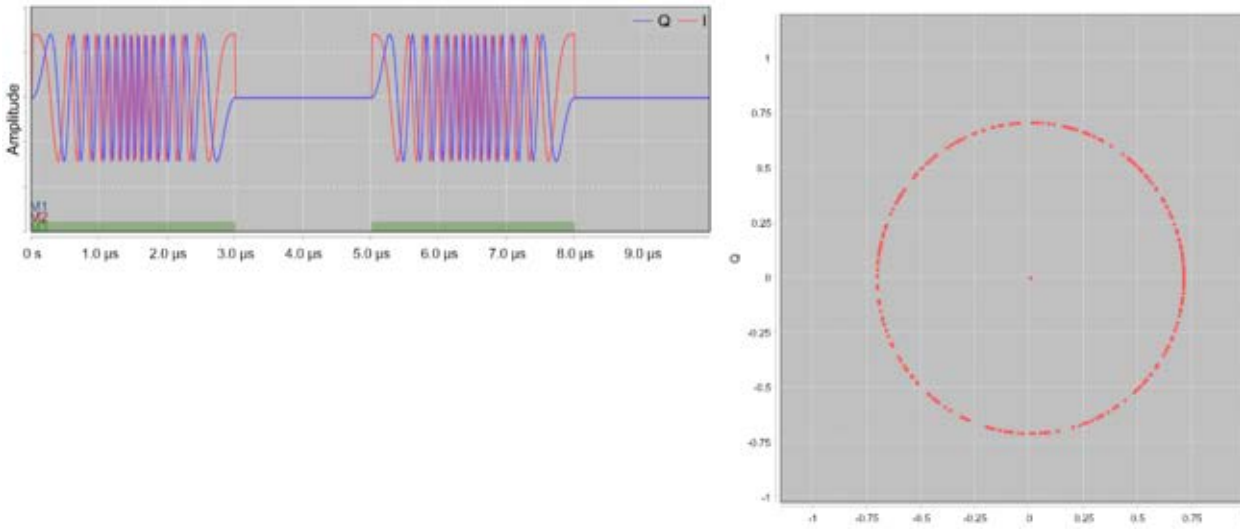
Example: Pulsed chirp

1. Select **CW** and appropriate carrier parameters in the Carrier section.
2. In the **Modulation** > **Generator** tab, select **Pulsed Chirp** and specify the pulse parameters, as shown below.



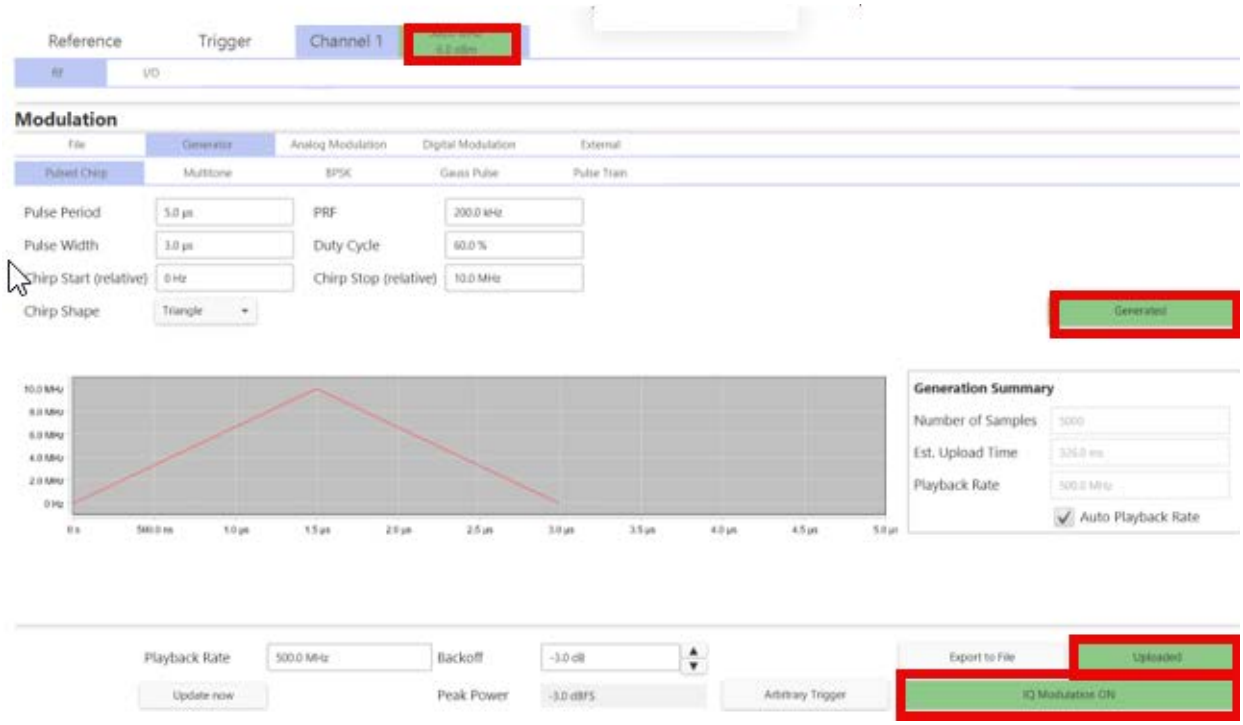
3. Select the **Generate** button.

The frequency deviation vs. time is shown below, representing I and Q modulation signals vs. time and an IQ phaser plot In the Generation Preview area, the number of samples and the estimated upload time is also provided.



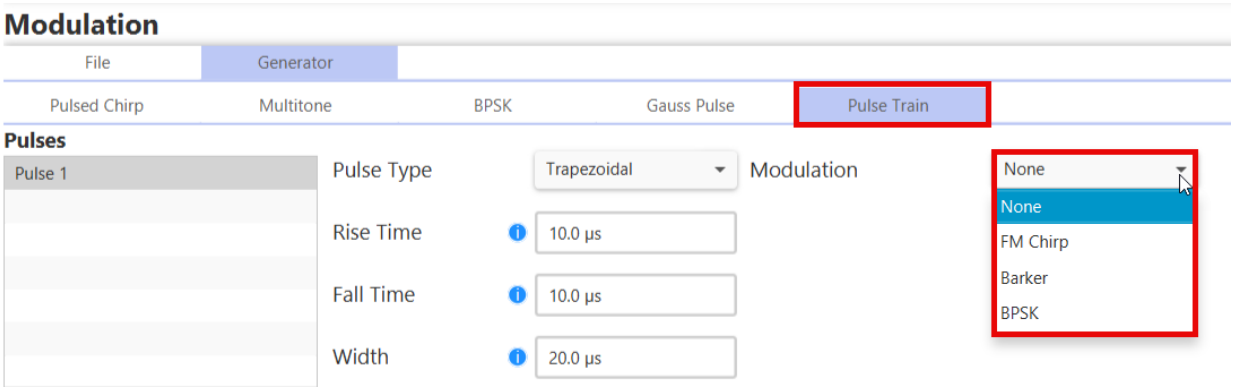
4. Select **Upload to Device** to upload the generated modulation.
5. Select the **IQ Modulation** to turn on IQ Modulation.

6. Select the RF button to turn RF output on. Notice that the frequency and power fields in the Channel tab turn green.



Pulse Train Modulation

A pulse modulation of the previously specified carrier can be defined. None means simple amplitude modulation. Other modulation formats are FM Chirp, Barker and BPSK (binary phase shift keying).



– Pulse Type - Two modulation types are available: Trapezoidal and Raised Cosine.

– Pulses - In this list pulse sections can be defined.

- Patterns - In this list pulse sections defined in the Pulse list ma be concatenated arbitrarily (including repetitions) to define various pulse patterns defining modulation signals.
- PRI - Pulse repetition interval also you to set the period of the pulse train.
- Peak Power - Indicates the maximum instantaneous power of the modulation signal.
- Back off - Sets the difference in dB between DAC full scale power and peak instantaneous power of the actual modulated signal.
- Upload to Device - Uploads the IQ data to generate the modulation signal.
- Arbitrary Trigger - Refer to the "General Modulation Functions" on page 79.

Analog Modulation

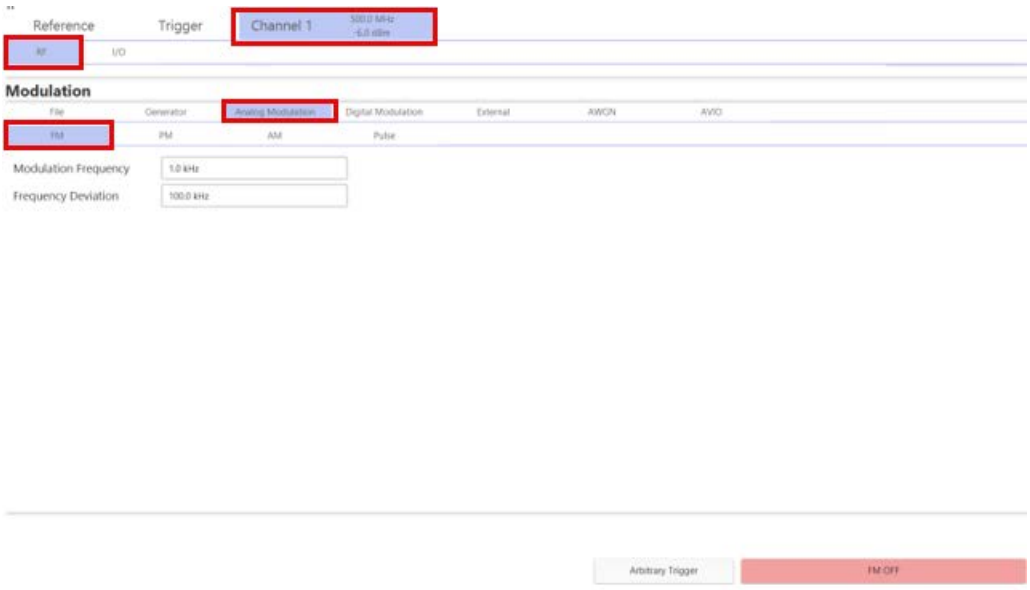
In the Analog Modulation tab (Option UNT, Internal analog modulations) you may choose between the following internally or externally generated modulations:

- FM (frequency modulation)
- PM (phase modulation)
- AM (amplitude modulation)
- Pulse (pulse modulation)

Example FM

1. Select the **CW** section and set the appropriate carrier parameters.
2. From the Modulation section, select the **Analog Modulation** tab > **FM**.

3. Set the **Modulation Frequency** and **Frequency Deviation** as required.



4. Select the FM off button to turn on modulation of the carrier.
5. Select the RF off button to turn on the RF output.

For **Pulse** modulation, additional parameters can be defined.

Other Analog Modulation Settings

– Pulse Polarity - A (rectangular) modulating pulse is basically defined by its width and duty cycle. The width defines the time interval for 100% amplitude and the rest of the period, defined by the duty cycle determines the 0% amplitude time interval. This describes Normal pulse polarity, whereas for Inverted pulse polarity the roles of 100% and 0% amplitude are exchanged.

– Pulse Modulator - When "BB" (baseband) is selected, fast pulse modulation with 8 ns resolution is performed. High extinction ratio, the modulation bandwidth is 400 MHz, steep pulse slope with pulse jitter around ±1ns.

  RF mode yields slower switching but significantly lower pulse jitter in the ps range.

– Pulse Output Polarity - the pulse at the MF1 or MF2 output can be inverted with the respect to the defined pulse polarity.

– Arbitrary Trigger, Playback Rate, Auto Playback Rate, Update Now, refer to the “General Modulation Functions” on page 79.

Digital Modulation

Custom Digital Modulation (Option 431 - Internal digital modulation schemes) tab you can choose between the following internally generated modulations:

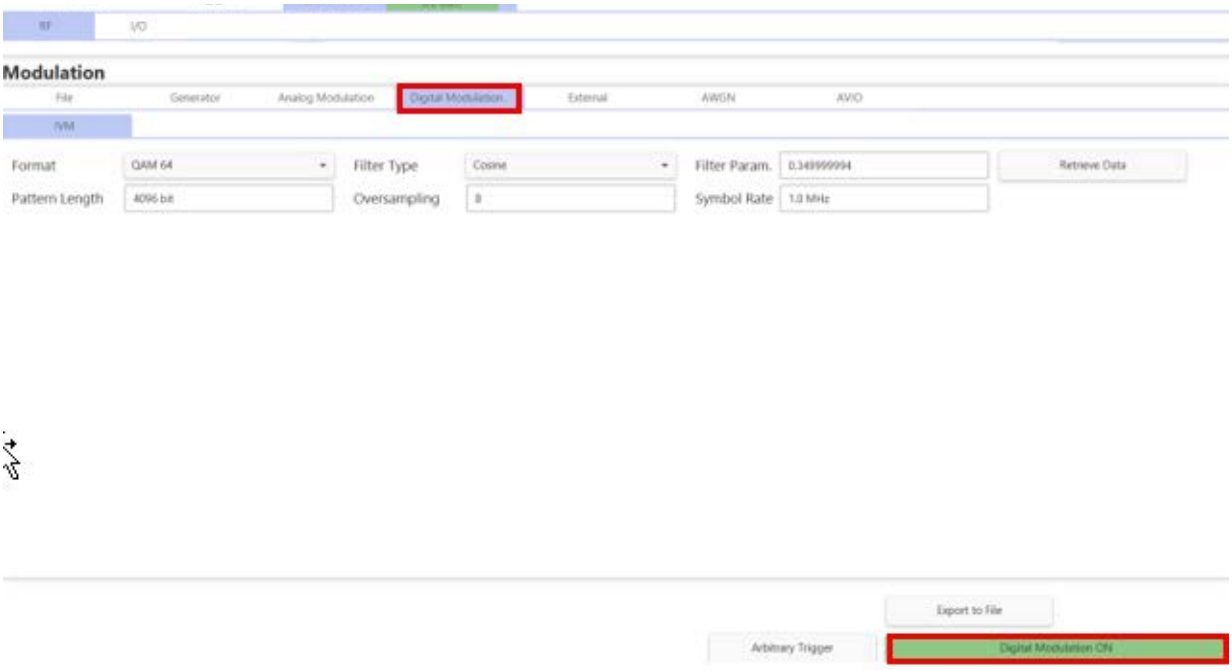
- QAM 8
- QAM 16
- QAM 32
- QAM 64
- QAM 128
- QAM 256
- QAM 512
- QAM 1024
- QAM 2048
- QAM 4096

With a maximum symbol rate of 500 MHz

Example: QAM 64 (quadrature amplitude modulation with 64 different states)

1. Select the **CW** section and set the appropriate carrier parameters.
2. From the Modulation section, select the **Digital Modulation** tab.
3. In the Modulation area, select the Format dropdown and select **QAM 64**.
4. Specify the QAM 64 parameters:
   - Filter Type
   - Filter Param
   - Pattern Length
   - Oversampling
   - Symbol Rate
5. Select the **Digital Modulation** off button to turn on modulation of the carrier.

6. Select the RF off button to turn on the RF output. Notice that both the RF button and Digital Modulation button act as a toggle and turn green when turned on.



For Arbitrary Trigger, Playback Rate, Auto Playback Rate, and Update Now, refer to the “General Modulation Functions” on page 79.

External Modulation

External modulation is possible with Option FCP via Fast Control Port (FCP). Refer to:
application-notes/G3-Vector-Signal-Generator-Fast-Control-Port.pdf

An external analog I/Q modulation input (Option EXT) accepts externally supplied analog I and Q modulation signals from the I IN and Q IN (for each channel) connectors. Refer to:

application-notes/G3-Vector-Signal-Generator-Analog-Inputs.pdf

For Arbitrary Trigger, Playback Rate, Auto Playback Rate, Update Now, refer to the “General Modulation Functions” on page 79.

AWGN Modulation

Additive white Gaussian noise, Option 403.

Refer to:

application-notes/G3-Vector-Signal-Generator-Additive-White-Gaussian-Noise.pdf

Arbitrary Waveform Modulation

In the “Segment” tab, waveform files can be uploaded to a specific segment in the instrument’s memory. Each waveform file contains IQ samples that can be used to modulate the carrier signal. When played back, segments are repeated periodically.

These segments can be concatenated in arbitrary number and order in the **Sequencer** tab, thereby forming sequences of segments that can be replayed.

Accepted file formats: qi,.qid,.wvd, csv,.tdms, iq.tar, and others.

Refer to:

application-notes/G3-Vector-Signal-Generator-Memory-Segmentation.pdf

For Arbitrary Trigger, Playback Rate, Auto Playback Rate, Update Now, refer to the “General Modulation Functions” on page 79.

Upload to SD

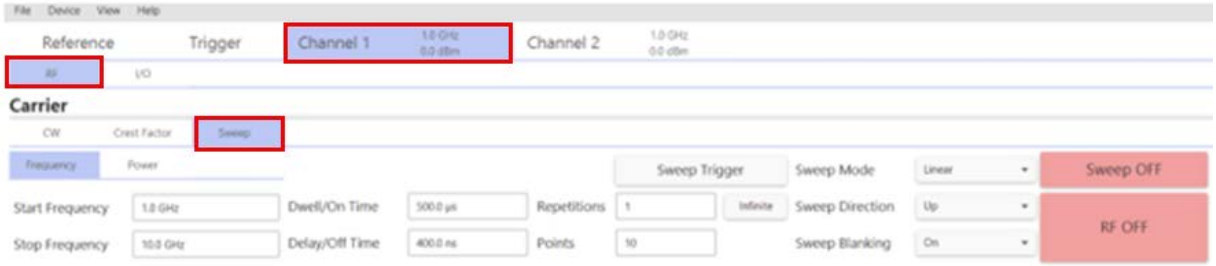
The G3 Vector Signal Generator can be optionally configured to have an external SD card slot (Option 006). The inserted SD card functions as a permanent data storage of the device. This enables you to upload IQ data files directly from the SD card to the signal generator. The waveforms on the signal generator are then available to be replayed like any other segment on the device.

Refer to:

application-notes/G3-Vector-Signal-Generator-Permanent-Data-Storage-SD.pdf

application-notes/G3-Vector-Signal-Generator-Keysight-IQ-Data-Format-and-Device-Upload.pdf

Sweep

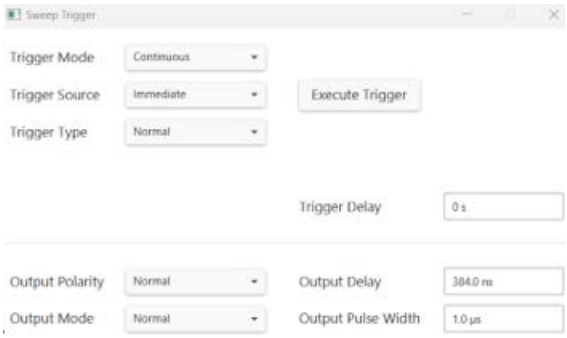


- **Start Frequency** and **Stop Frequency** is used to define the sweep range
- **Sweep Mode** is always Linear
- **Sweep Direction** is Up or Down
- **Sweep Blanking** - if turned on, suppresses potential artifacts occurring between the end of a sweep step and the beginning of the new sweep step.

– **Repetitions** - set the number of repetitions and toggle both the Sweep and RF buttons to On.

– **Dwell/On Time** and **Dwell/Off Time** - define the time the signal generator stays at a certain frequency point and is muted suppressed before moving to the next frequency point, respectively.

– **Sweep Trigger** - used to set the source to Immediate, Bus, or External. Additional settings for the External source can be specified for MF 1 or MF 2 and triggered on the positive or negative edge. It also accesses the trigger output delay, pulse width, polarity, and output mode.



General Modulation Functions

Functions that are available for various modulations are listed below.

Arbitrary Trigger

A pulse train or other modulation may be started as soon as a trigger event happens. The internal trigger may act immediately (Immediate) or via Bus (SCPI command). An external trigger can be chosen from one of the available trigger input connectors (MF1, MF2), i.e. as soon as the trigger slope (Positive or Negative, Single or Continuous) of the defined external trigger source appears at the respective selected connector.

The trigger may also be executed manually by selecting the Execute Trigger button. A trigger delay (Trigger Delay) can also be defined.

Playback Rate

Each modulation signal has its own sampling rate that is either set automatically or given in the QI Metafile. If no information is given, a default sampling rate of 500 MHz is assumed. The playback rate is set according to the sampling rate and may be changed (changing the modulation signal and frequency bandwidth accordingly).

Auto Playback Rate

Sets the sampling and playback rate automatically when generating a modulation.

Update Now

Updates the Playback Rate after a change is made.

Export to File

Custom IQ modulation signal data may be exported to a file in internal memory and selected segments of the memory can be played back to modulate the output signal.

The trigger signal can be selected to for the MF1 OUT or MF2 OUT connector, as described in section "IO (Input Output) Tab" on page 67. The arbitrary trigger output signal's, polarity, width, and additional delay may be set with the Output Polarity, Output Pulse Width and Output Delay buttons, respectively.

For details on signal levels and timing, refer to:

application-notes/G3-Vector-Signal-Generator-Keysight-IQ-Data-Format-and-Device-Upload.pdf

Signal Levels and Timing

For details on signal levels and timing, refer to the AP5041A or AP5042A data sheet.

data-sheets/G3-Vector-Signal-Generator-Model-AP5041.pdf

data-sheets/G3-Vector-Signal-Generator-Model-AP5042A.pdf

Logging

From the **Help** menu, select **Activate** to view and save logging information for your session.

4 Additional Information

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

WARNING No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

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.

To contact Keysight for sales and technical support, refer to support links on the following Keysight websites: http://www.keysight.com/find (product specific information and support, software and documentation updates) http://www.keysight.com/find/assist (worldwide contact information for repair and service).

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 repackage 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.	

Edition 1, February 2025

AP5041-90002

www.keysight.com