# HS9100B-Series Multi-Channel RF Synthesizers


# User Manual

1.07

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# Contents

# 1 Introduction

Thank you for purchasing a Maury Microwave Multi-Channel RF Synthesizer. The combination of Maury's proprietary non-PLL synthesizer architecture and the multi-channel integration provides the user with unique product performance advantages which are currently only available from Maury Microwave Inc.

This User's Manual is a generic, quick reference guide for use with the Maury Microwave HS9100B Series Multi-Channel RF Synthesizer products. Refer to section 5 for specific configuration details regarding the HS9100B Series hardware.

# 2 Safety and Certifications

The following safety and certifications apply to Maury's Multi-Channel RF Synthesizer products.

## 2.1 SAFETY

Maury Microwave multi-channel synthesizer products comply by test and design, with the essential requirements and other relevant provisions of IEC 61010-1:2010, IEC 61010-1:2010/AMD1:2016. Testing was performed by TUV Rheinland of North America, Inc., following CB Scheme.

## 2.2 ELECTROMAGNETIC COMPATIBILITY (EMC)

Maury Microwave multi-channel synthesizer products comply by test and design, with the essential requirements and other relevant provisions of CISPR 11:2024, EN55011:2016, A1:2017, A2:201, A11:2020, ICES-003 Issue 8, FCC Part 15 B:2025, IEC 61326-1:2020, EN IEC 61326-1:2021. Testing was performed by TUV Rheinland of North America, Inc.

## 2.3 CE CERTIFICATION

Maury Microwave multi-channel synthesizer products comply by test and design, with the essential requirements and other relevant provisions of the *EMC Directive*: 2004/108/EC, and the *Electrical equipment for measurement, control and laboratory use EMC requirements* (test standard): EN 61326-1: 2006*;* as set forth by the Council of the European Union. As such, Maury Microwave multi-channel synthesizer products comply with RoHS (Directive 2011/65/EU).

# 3 Warranty

Please see Maury Microwave's warranty policy on www.maurymw.com. To avoid delays or rejection, please contact Maury Microwave at support@maurymw.com for remote diagnostics, and if required, a return material authorization (RMA) number and instructions, prior to returning any equipment.

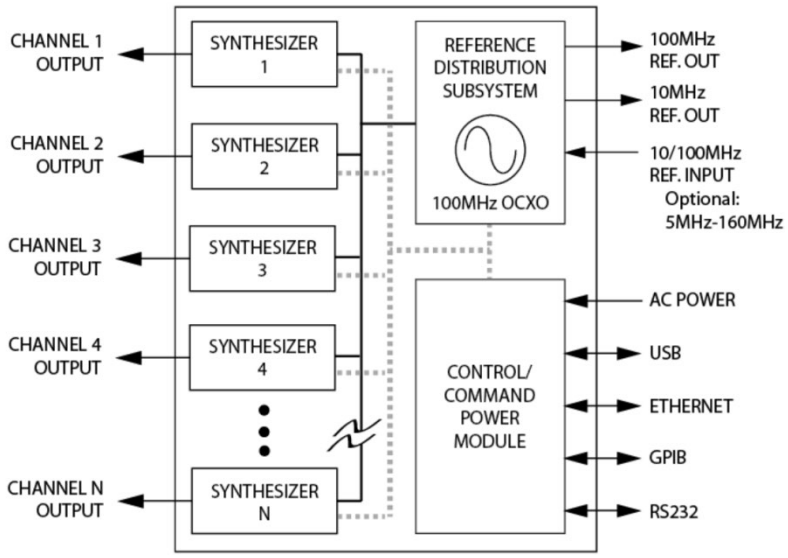
# 4 Calibration

Maury Microwave calibrates each channel for frequency, amplitude and phase accuracy. The factory calibration is valid for 1 year from the original calibration date. Maury Microwave provides calibration services for applicable products. Please contact sales@maurymw.com with model number and serial number for a calibration service quotation.

# 5 HS9100B Configuration Guide

## 5.1 CONFIGURATION SUMMARY

The HS9100B is a unique platform allowing the user to specify custom configurations for a COTS product. Units are loaded with up to 8 broadband channels, or up to 32 narrowband channels, with additional flexibility to specify each channel's frequency limits and performance options. The result is a high performance, multi-channel synthesizer that is tailored to an application with an optimal price point.




The HS9100B offers the benefits of proprietary non-PLL-based synthesis architecture. Coupling the non-PLL architecture with a centralized reference distribution subsystem enables truly phase coherent, independently settable channels. Different from traditional PLL based synthesizers, Maury's proprietary architecture creates precisely synthesized signals that exhibit both instantaneous and long-term stability.

HS9100B multi-channel designs are integrated into precision applications that range from particle accelerator timing clocks to satellite position tracking. Due to the necessity for the ultimate in signal stability, HS1900B synthesizers also come standard with thermal monitor outputs to track the relative channel temperature of each loaded channel.

## 5.2 HARDWARE CONFIGURATION

The HS9100B Series synthesizer platform is a user defined platform. Three primary categories define the final configuration of a unit: the number of channels, loaded channel frequencies, and loaded options/accessories.

### *5.2.1 Number of Channels (Chassis)*

The HS9100B part number signifies the number of independent channels available in the unit, as follows:

| No. Channels | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Part Number | HS9101B | HS9102B | HS9103B | HS9104B | HS9105B | HS9106B | HS9107B | HS9108B |

| No. Channels | 10 | 12 | 14 | 16 | 20 | 24 | 28 | 32 |
|---|---|---|---|---|---|---|---|---|
| Part Number | HS9110B | HS9112B | HS9114B | HS9116B | HS9120B | HS9124B | HS9128B | HS9132B |

### *5.2.2 Broadband Channels Frequencies*

The option model number (OPT-XX) indicates the channel frequency as follows:

| Frequency Range | Number of Channels per Frequency Range | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1x | 2x | 3x | 4x | 5x | 6x | 7x | 8x |
| CMOS 5MHz - 500 MHz | OPT-CMOS1 | OPT-CMOS2 | OPT-CMOS3 | OPT-CMOS4 | N/A | N/A | N/A | N/A |
| 10MHz – 1GHz | OPT-A1 | OPT-A2 | OPT-A3 | OPT-A4 | OPT-A5 | OPT-A6 | OPT-A7 | OPT-A8 |
| 10MHz - 2GHz | OPT-B1 | OPT-B2 | OPT-B3 | OPT-B4 | OPT-B5 | OPT-B6 | OPT-B7 | OPT-B8 |
| 10MHz - 3GHz | OPT-C1 | OPT-C2 | OPT-C3 | OPT-C4 | OPT-C5 | OPT-C6 | OPT-C7 | OPT-C8 |
| 10MHz - 4GHz | OPT-D1 | OPT-D2 | OPT-D3 | OPT-D4 | OPT-D5 | OPT-D6 | OPT-D7 | OPT-D8 |
| 10MHz - 6GHz | OPT-E1 | OPT-E2 | OPT-E3 | OPT-E4 | OPT-E5 | OPT-E6 | OPT-E7 | OPT-E8 |
| 100MHz - 12GHz | OPT-X1 | OPT-X2 | OPT-X3 | OPT-X4 | N/A | N/A | N/A | N/A |
| 100MHz - 18GHz | OPT-F1 | OPT-F2 | OPT-F3 | OPT-F4 | N/A | N/A | N/A | N/A |

### *5.2.2 Narrowband Channels and Frequencies*

The option model number (OPT-XX) indicates the channel frequency as follows:

| Frequency Range | Number of Channels per Frequency Range | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4x | 8x | 12x | 16x | 20x | 24x | 28x | 32x |
| 4 GHz – 6 GHz | OPT-0406-4 | OPT-0406-8 | OPT-0406-12 | OPT-0406-16 | OPT-0406-20 | OPT-0406-24 | OPT-0406-28 | OPT-0406-32 |

| Frequency Range | Number of Channels per Frequency Range | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2x | 4x | 6x | 8x | 10x | 12x | 14x | 16x |
| 7 GHz – 9 GHz | OPT-0709-2 | OPT-0709-4 | OPT-0709-6 | OPT-0709-8 | OPT-0709-10 | OPT-0709-12 | OPT-0709-14 | OPT-0709-16 |

### *5.2.3 Loaded Options*

Additional factory loaded options are also defined in the “Loaded Options” designator on the front panel. These options further customize the HS9100B Series to an application and are loaded at the factory when the unit is initially built.

| | | |
|---|---|---|
| OPTION | OPT-EXTMOD-x | Channel dedicated, external modulation input. x= 1, 2, 3… (up to 6 channels) |

| | | |
|---|---|---|
| OPTION | OPT-REFX | Utilize ext. ref. source at any 100kHz increment in range of 5MHz -160MHz |

Option OPT-EXTMOD-x adds a modulation input connector (SMA) to allow external modulation stimulus signals to be connected. The value for "x" determines the number of channels the input connector is added to.

Option OPT-REFX replaces the standard reference module with a reference module that allows the user to utilize various external reference frequencies. Allowable external reference frequencies with OPT-REFX are any 100kHz increment within the range of 5MHz - 160MHz.

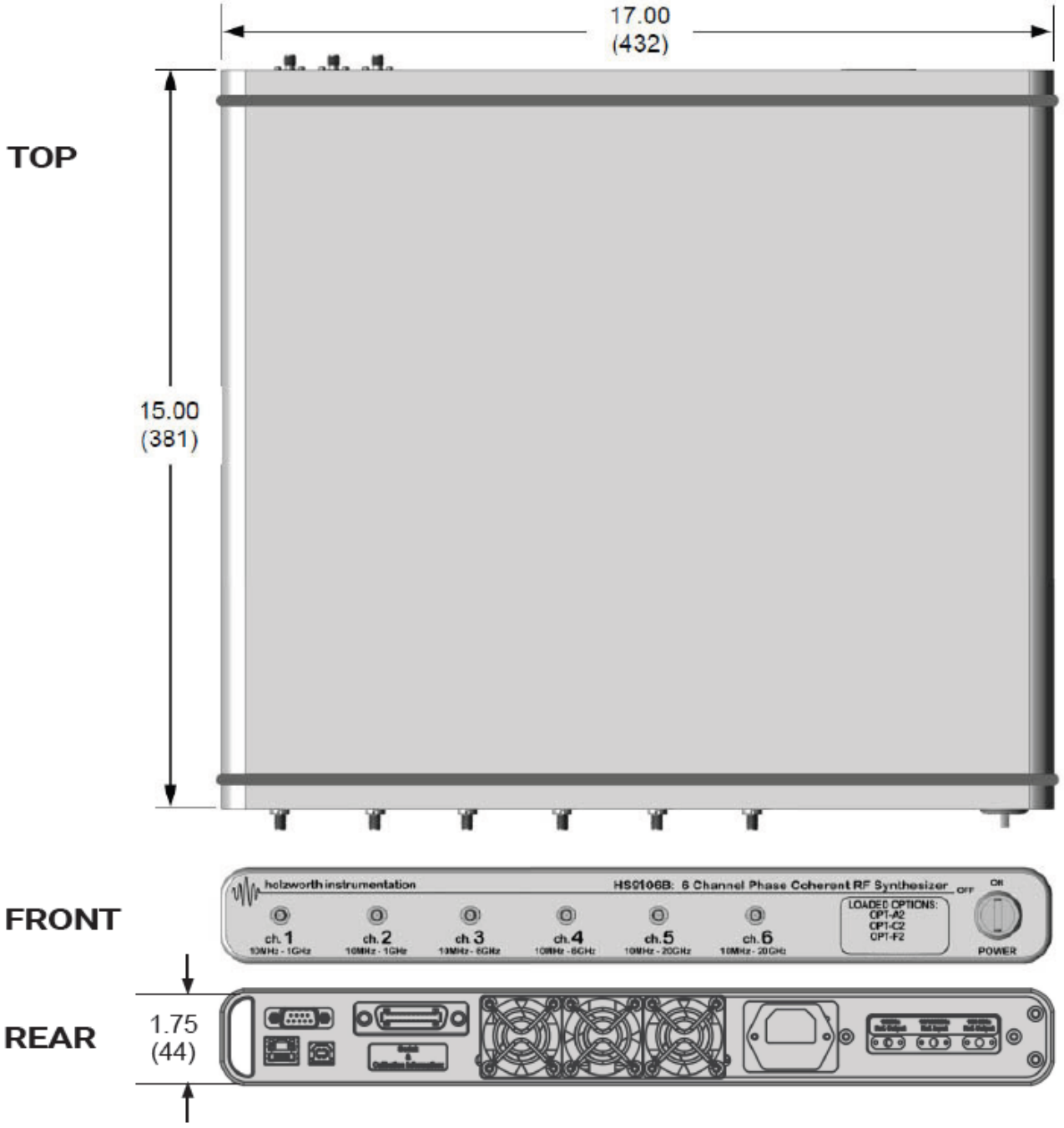
### *5.2.4 Available Accessories*

The following accessories are external to the HS9100B and can be ordered separately.

| | | |
|---|---|---|
| ACCESSORY | RACK-1U | 19" Rack Mount Bracket Kit, 90° Rear Brackets |
| ACCESSORY | RACK2-1U | 19" Rack Mount Bracket Kit, Straight Rear Brackets |

## 5.3 MECHANICAL CONFIGURATION

The HS9100B comes in a 1U high, rack mountable chassis. The example shown is of a 6-channel unit (front panel configuration may vary). A universal rack mount bracket kit is an available accessory (Part No.: RACK-1U). Mechanical dimensions are listed in inches (and millimeters).


17.00
(432)
TOP
15.00
(381)
FRONT
holzworth instrumentation
HS9106B: 6 Channel Phase Coherent RF Synthesizer
OFF
ON
ch. 1
10MHz - 1GHz
ch. 2
10MHz - 1GHz
ch. 3
10MHz - 6GHz
ch. 4
10MHz - 6GHz
ch. 5
10MHz - 20GHz
ch. 6
10MHz - 20GHz
LOADED OPTIONS:
OPT-A2
OPT-C2
OPT-F2
POWER
REAR
1.75
(44)

# 6 Specifications

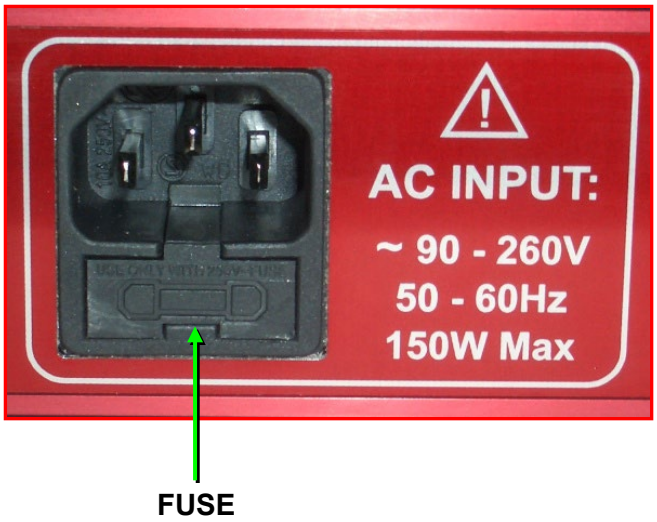
Please refer to the HS9100 Series data sheet available on www.maurymw.com for the most up-to-date electrical, mechanical and environmental specifications

# 7 Installation

Prior to use of an HS9100B Series Multi-Channel Synthesizer users will need to be set up with the basic hardware and software.

## 7.1 HARDWARE INSTALLATION

Prior to initializing the synthesizer, connect the power cord to an active AC power supply. The instrument is shipped with the appropriate power cord for the destination country/region. The master power switch located at the right side of the front panel is equipped with a blue indicator light which illuminates when the AC power is active.




**NOTE:** If the power light is not illuminated while the front panel switch is in the "ON" position, verify that there is power at the AC outlet/supply and that the fuse has not blown. A fuse is in the service tray on the power cord receptacle (rear panel). A spare fuse is provided inside the service tray.

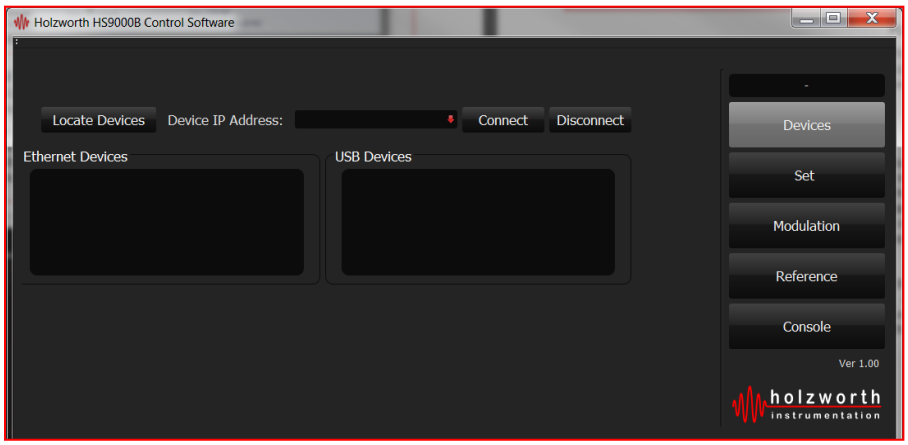
## 7.2 APPLICATION GUI

The HS9100B GUI can be run on any Windows PC; no software installation is required. The application GUI is contained on the USB drive that was included with the synthesizer or can downloaded from www.maurymw.com

# 8 HS9100B Communication

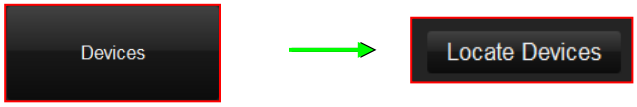
The application GUI can be used to control the HS9100B via Ethernet or USB communication. Custom, user created applications can be used to control the HS9100B via Ethernet, USB, RS-232, or GPIB communication.

This section covers Ethernet and USB control with the GUI, where connections are established in the Devices menu (shown below).

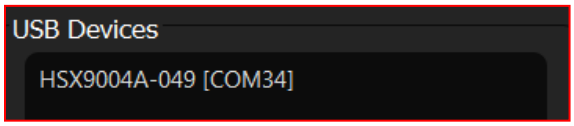



## 8.1 USB, RS-232, AND GPIB COMMUNICATION

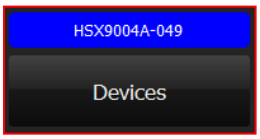
With the HS9100B USB and RS-232 communication are handled similarly in Windows. USB communication requires FTDI drivers. The drivers should install automatically when the instrument is connected.
Click the Devices button on the right side of the GUI, followed by the Locate Devices button in the menu:




The software will then scan for instruments connected via USB. It will display USB devices as shown below:




Identify the instrument by serial # and select it. If the connection is successful the window above 'Devices' will turn blue to indicate a USB connection, and it will display the instrument serial number:




To create a custom USB software interface or application, the user must determine the COM port the instrument is using. The COM port associated with the USB connection to the HS9100B can be identified by using the application GUI as shown above or via the Windows Device Manager.

### *8.1.1 USB Communication Troubleshooting*

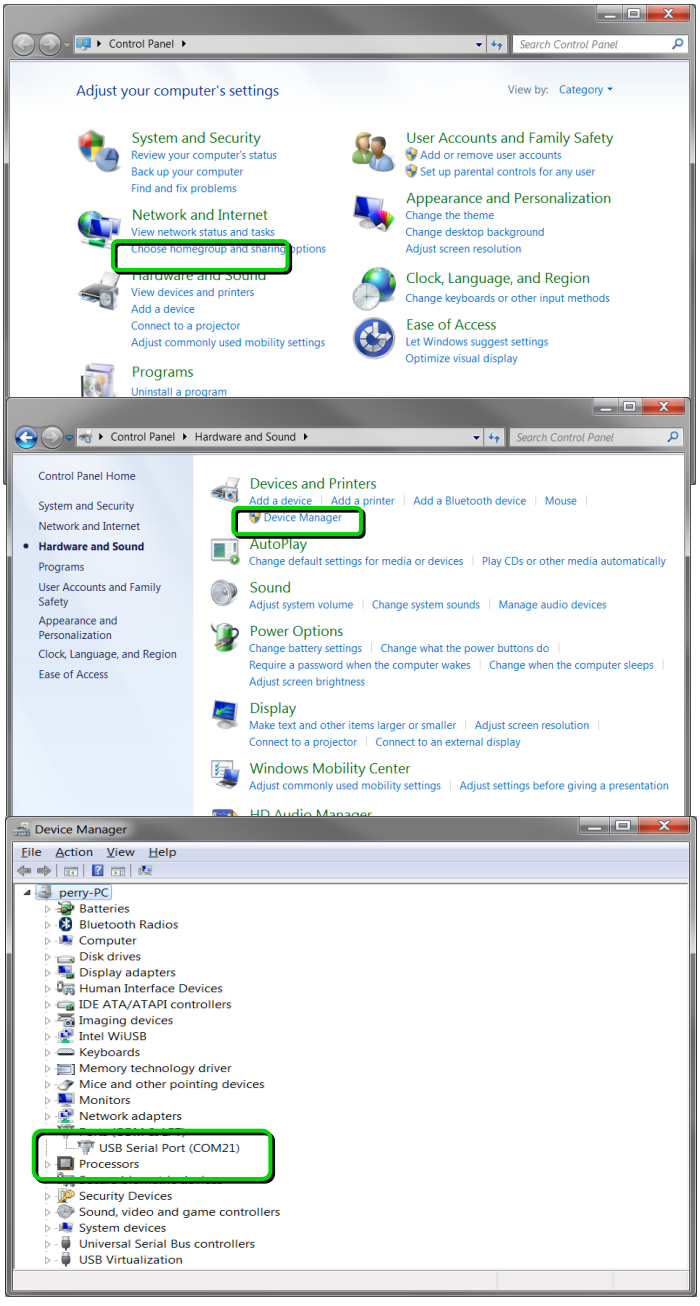
Follow the steps below to determine the COM port via Windows Device Manager.

1. Open the Windows Device Manager and check for the synthesizer in the 'Ports (COM & LPT)' category.

**STEP ONE**
Open the Windows Control panel from the start menu. Click on "Hardware and Sound"

**STEP TWO**
Under "Devices and Printers," select **Device Manager**

**STEP THREE**
Under Ports (COM & LPT) locate COM port associated with the HA7062C (identified as "USB Serial Port")



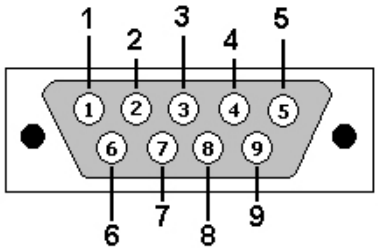

2. If the instrument is not present in Device Manager or in the application GUI please unplug the USB cable and power cycle the synthesizer. Wait 5-10 seconds for the synthesizer to initialize and re-insert the USB cable. Click Locate Devices.

3. If the synthesizer is still not detected download the device drivers may need to be manually installed. Download and extract the executable using the link below. Run the executable to ensure the proper device drivers are installed. After the executable has finished installing the drivers repeat troubleshooting Step 1.

4. Attempt to make a connection through a 'USB hub' if available. Upon connecting through a hub, it may be necessary to repeat troubleshooting Step 1.

5. Contact Maury Microwave Support at support@maurynw.com for further assistance.

### *8.1.2 RS-232 Hardware Specifications*




Connector: DB9 Male Shrouded.
Logic Level: ±5V
Baud Rate: 115200 FIXED.
Bit Structure: 8 Data Bits, 1 Stop Bit, No Parity, No Flow Control
Carriage Return: Carriage return (ASCII Code 13)
Pinout:

| PIN | Label | PIN | Label | PIN | Label |
|---|---|---|---|---|---|
| 1 | N/C | 4 | N/C | 7 | N/C |
| 2 | TX (Response Output) | 5 | GND | 8 | N/C |
| 3 | RX (Instruction Input) | 6 | N/C | 9 | N/C |

### *8.1.3 GPIB Communication*

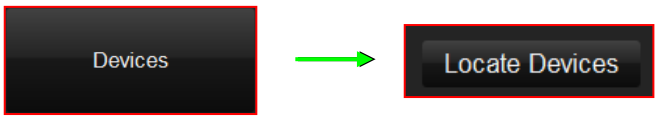
HS9100B synthesizers are GPIB capable. GPIB configuration commands are listed in Appendix A.

## 8.2 ETHERNET COMMUNICATION

### *8.2.1 LAN Connection*

Communication with the HS9100B over a LAN connection defaults to the use of DHCP. The instrument can be addressed by using either the network assigned IP address or by using the instrument serial (ex. "HS9100B-123") and the TCP port (9760).

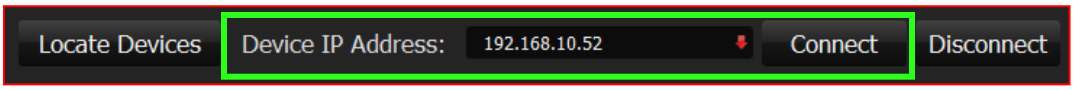
To search for devices, click the Devices button and then click Locate Devices in the sub menu.



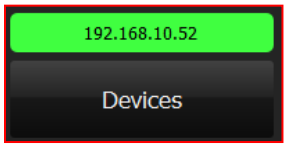

The software will then scan for instruments connected via Ethernet and via serial port. It will display Ethernet devices as shown below:


Identify the instrument by serial # or IP address and click to connect. If the connection is successful, the window above 'Devices' will turn green (Ethernet) and display the instrument serial number:

Users can also enter the instruments IP address manually to connect. Enter the IP address into the 'Device IP Address' field and then press the Connect button.




If the connection is successful, the window above 'Devices' will turn green and display the IP address.




### *8.2.2 DHCP*

When the HS9100B is connected to a network with a DHCP server, the network settings will be auto assigned by the servers configuration.

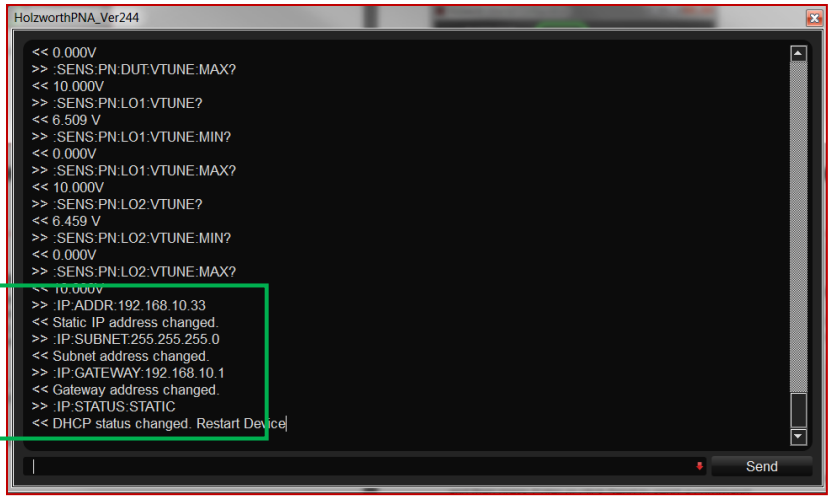
If the HS9100B is connected *directly* to a PC or to a network with no DHCP server, the instrument's default IP address will be 169.254.117.11

### *8.2.3 Assigning a Static IP Address*

The most efficient way to assign the instrument a static IP address is to use the Console in the GUI. The Console can be used to send the commands from Appendix A which are used to change the instrument from DHCP to Static, set the static IP, *etc.* Users must first establish a USB connection or a direct Ethernet connection as referenced in sections 8.1 and 8.2.1, respectively.

Once a connection has been established, launch the Console. Now users can begin sending the ASCII commands from Appendix A. The commands should be sent in the order shown in the list and the Console screenshot below.

1. Send the command to change the static IP address.
    a. :IP:ADDR:<value>
2. Send the command to change the subnet address.
    a. :IP:SUBNET:<value>
3. Send the command to change the gateway if necessary.
    a. :IP:GATEWAY:<value>
4. Send the command to change from DHCP to Static.
    a. :IP:STATUS:STATIC
5. Power cycle the instrument when prompted.




When the instrument fully powers back on (5-10 second power up) it will come up with the static IP settings and can be connected to the LAN.

### *8.2.4 Troubleshooting Ethernet Connections*

Prior to proceeding below press CTRL+ALT+DEL to open Windows Task Manager. Click the Processes tab. Ensure that there is only one instance of the application GUI open. If there is more than one, end each process, re-launch the GUI, and attempt to establish a connection.

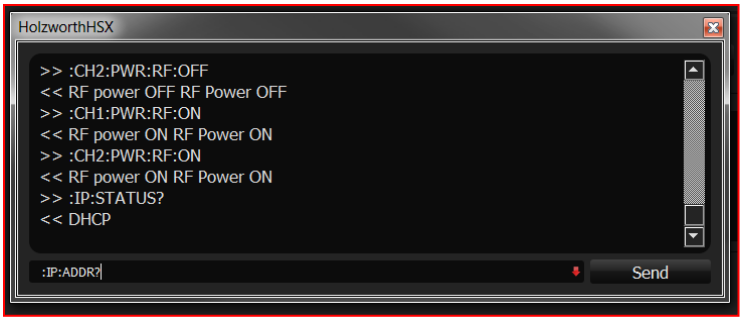
#### 8.2.4.1 Ethernet Reset via USB & Console Window

1. If the synthesizer is not discovered by the application GUI there may be static TCP/IP settings that conflict with the current network configuration. If the static settings are unknown, USB communication may be used to reset the synthesizer to DHCP or re-configure the static network settings.

2. Establish a USB connection with the synthesizer as shown in section 8.1.

3. Launch the Console window using the button at the bottom right of the GUI. The Console can be used to send ASCII commands to change static network settings or change from static mode to DHCP and vice versa.


4. Refer to Appendix A for the Ethernet configuration commands. Type commands into the text field and then press Enter or click Send to send a command.



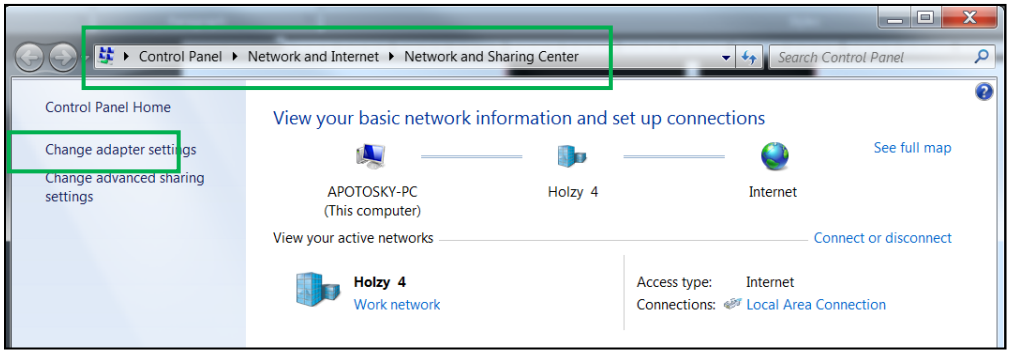

5. Begin by querying with the :IP:STATUS? command. Change status and/or re-configure the static network settings as necessary.

6. Power cycle the HS9100B if prompted. Any status change from DHCP to Static or vice versa will require a power cycle.

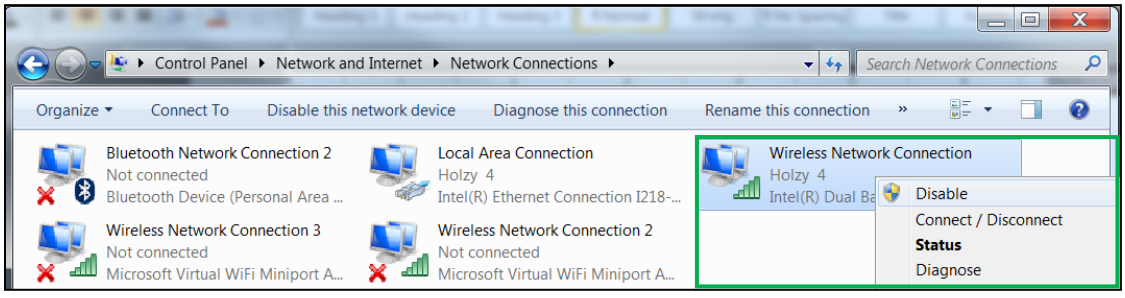
**8.2.4.2 Miscellaneous Ethernet Troubleshooting**

1. Ensure that the Maury Microwave software application is allowed through the firewall. Additionally, ensure that anti-virus software is not blocking communication.

2. Using Windows Control Panel, disable Wi-Fi and any other hard-wired network connections. Launch the Control Panel and proceed to Network and Internet, the Network and Sharing Center. Click Change Adapter Settings.




3. In the Change Adapter Settings window right click on any network connections that are not required for communication with the HS9100B and select Disable.

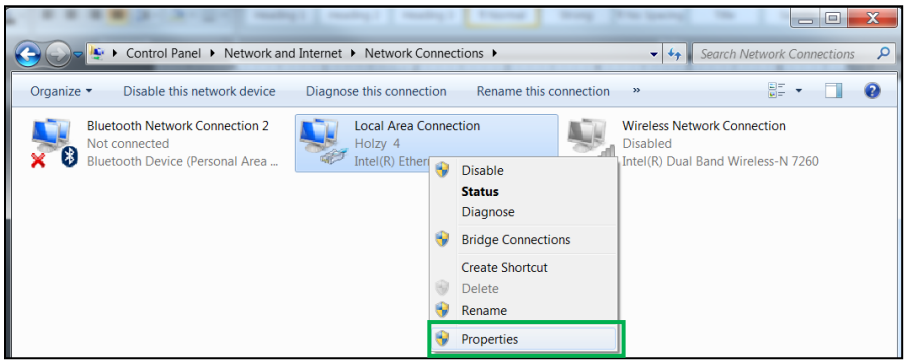



4. Close and re-launch the application GUI. Attempt to establish a connection with the HS9100B.

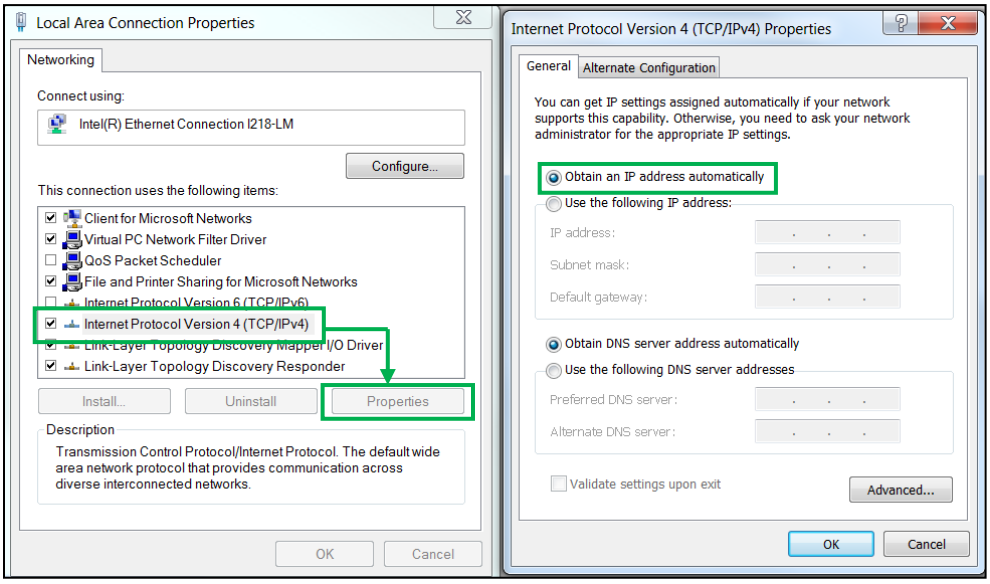
5. If connection remains unsuccessful, reset the PC network adapter to DHCP ('Obtain IP address automatically') and reset the synthesizer to DHCP using either method in the previous two sections.

6. Make a direct Ethernet connection from the PC to the synthesizer bypassing any routers or network switches.

7. Right click the network adapter the synthesizer is connected to and click Properties.




8. In Properties, left click "Internet Protocol Version 4 (TCP/IPv4)", the Properties button highlighted below will become available. Click the button and the window on the right will open. Set to 'Obtain an IP address automatically'.




With a direct Ethernet connection between the PC and synthesizer both will default to network settings that will allow communication.

The synthesizer IP address will default to 169.254.117.11 and the subnet address will default to 255.255.0.0.

The PC IP address will default to 169.254.xxx.xxx and the subnet address will default to 255.255.0.0.

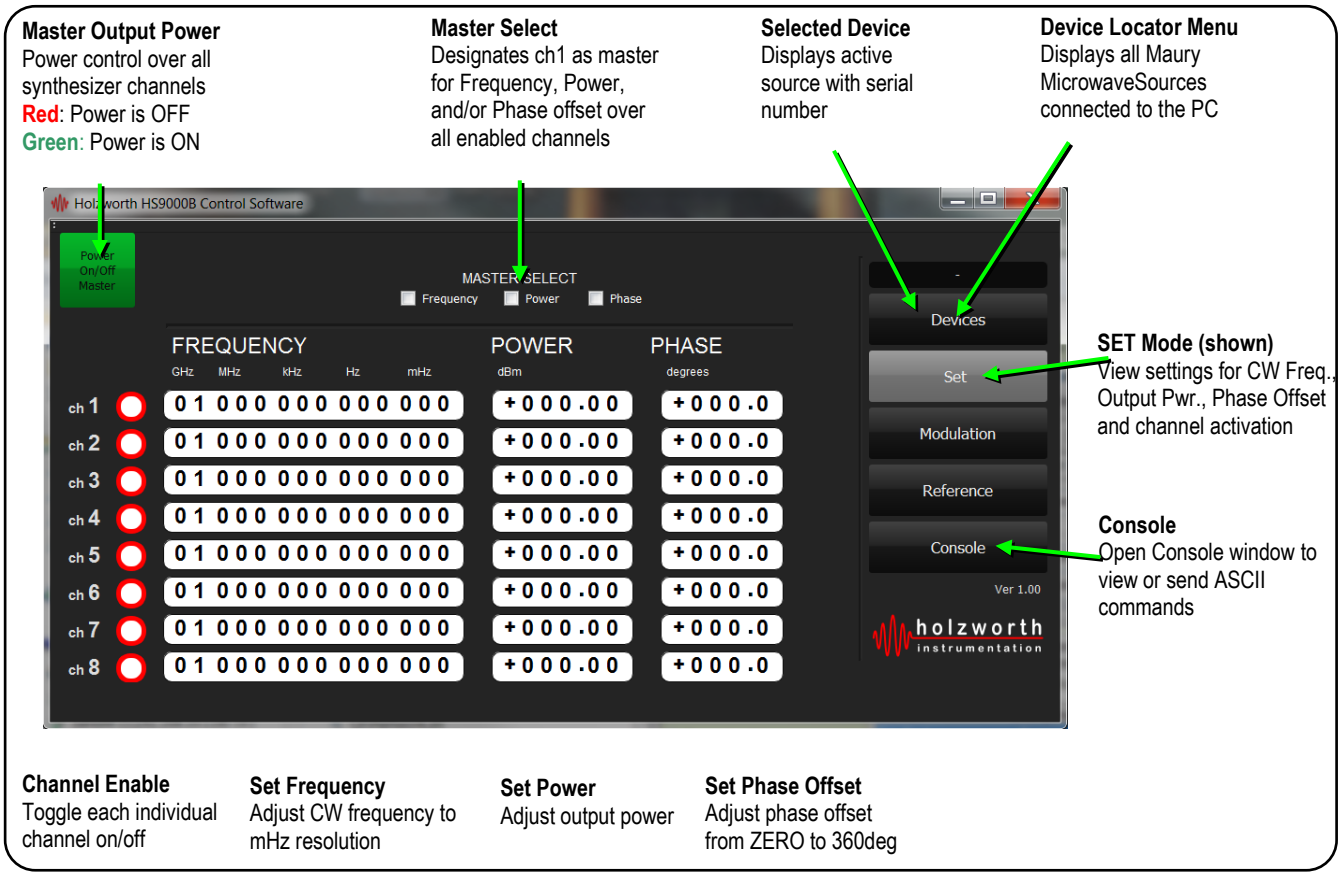
7. Close and re-launch the application GUI. Attempt to establish a connection to the HS9100B.

8. For further assistance please contact Maury Microwave Support at support@maurymw.com

# 9. Application GUI Operation

The GUI can be launched by double-clicking the executable (.exe) file provided. There is no installation required.

## 9.1 "SET" MENU



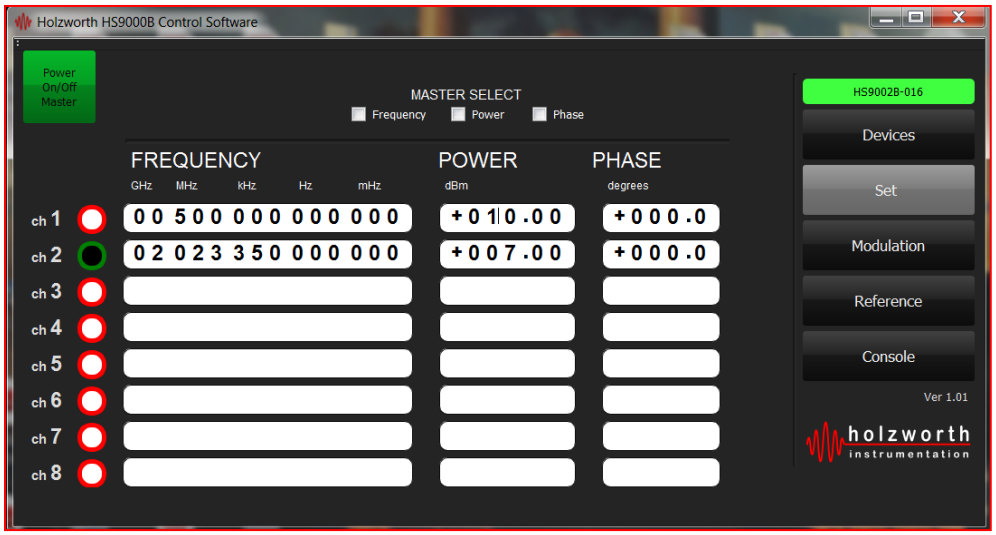

### *9.1.1 Keyboard Functions*

As a virtual instrument, the PC keyboard and mouse functions are intuitively integrated for ease of operation.

| KEY | FUNCTION |
|---|---|
| Tab | used to move the Highlighted Field indicator from left to right |
| Left/Right Arrows | used to move the Highlighted Field both left and right |
| Up/Down Arrows | used to increase/decrease the value of the Highlighted Field |
| Number Keys | used to directly enter value into active field |

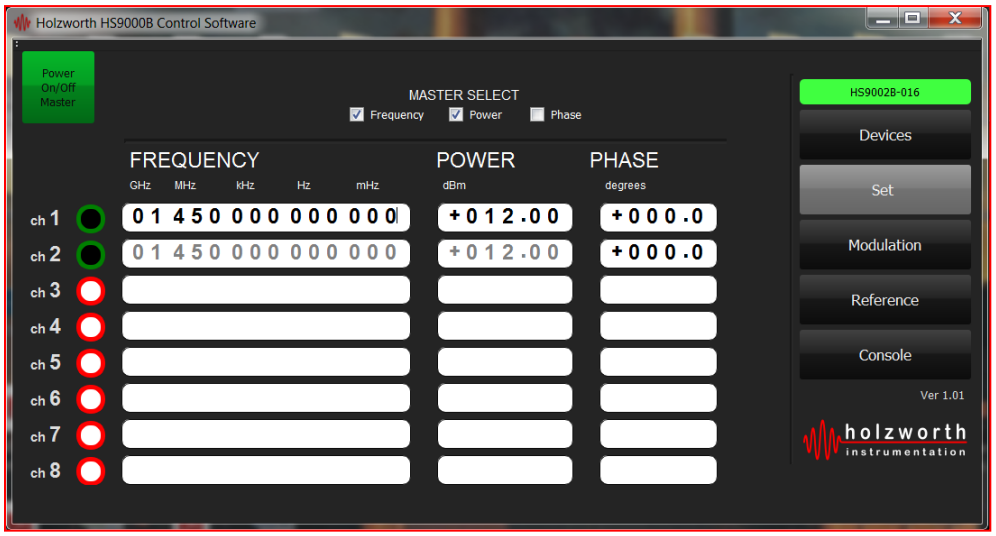
### *9.1.2 Channel Enable Function*

The channel enable function allows the user to select which channels are operating. By toggling the radio button next to the channel number, a user can independently turn each channel on or off. The example below shows Channel 2 enabled and Channel 1 disabled.




### *9.1.3 Master Select Function*

The Master Select function allows the user to select channel 1 as being the master control for any enabled channel. Under this flexible function, channel 1 will always be enabled. The user can select any combination of Frequency, Power and/or Phase Offset to be controlled via the master (channel 1). The example below shows the Master Select enabled for frequency and power, with the result being channel 1 frequency and power applied to channel 2.




NOTE that the GUI does not specifically identify each channel frequency range, but the frequency limits of each loaded channel is auto detected and hard set for each channel. In the case of operating a synthesizer equipped with less than 8 channels, only channels 1 though N will be displayed for control, the remaining channel slots will not be available.

## 9.2 REFERENCE MENU

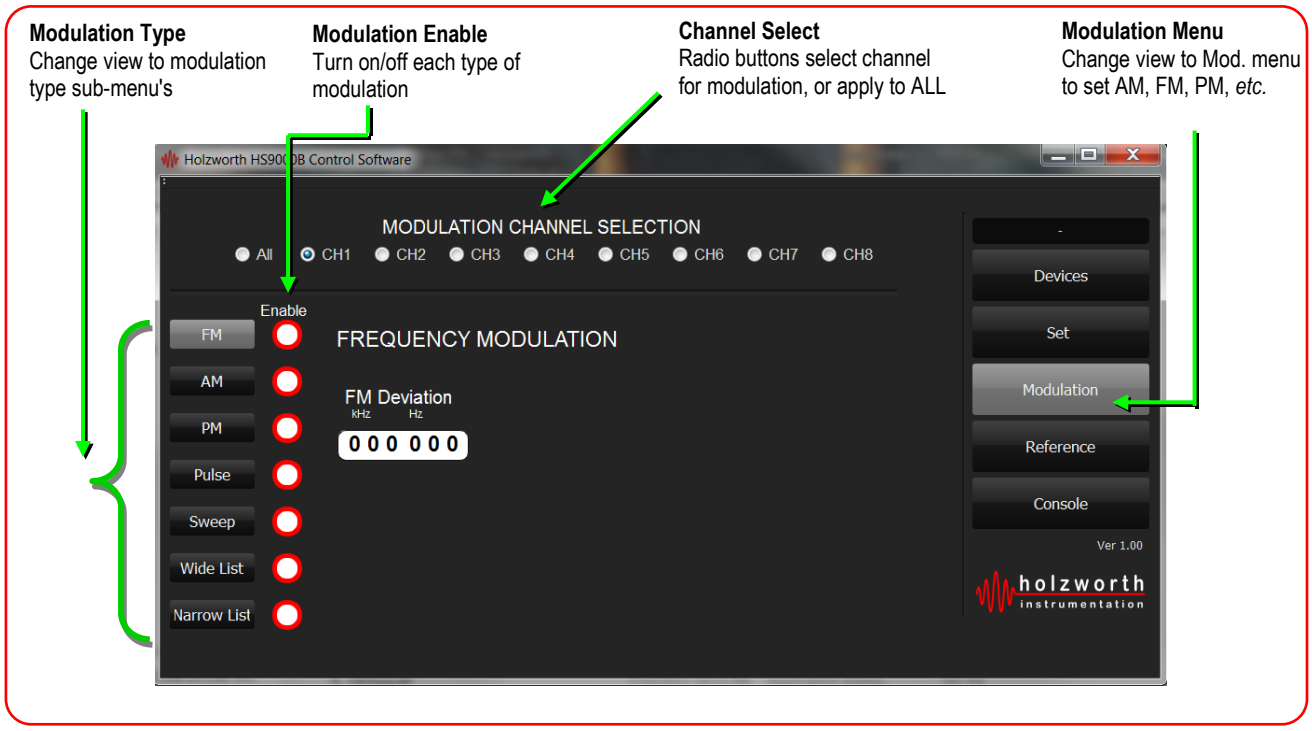
The reference menu allows user to configure the synthesizer to utilize its internal 100MHz OCXO reference or either an external 10MHz or 100MHz reference.


### *9.2.1 Setting OPT-REFX Frequency*

If the HS9100B is equipped with OPT-REFX, the radio button for 'External 100MHz' will change to a text field that allows users to manually type in the external reference frequency. As previously noted, the REFX reference frequency may be any 100kHz increment in the range of 5MHz to 160MHz

## 9.3 MODULATION MENU

The Modulation Menu allows users to enable/disable the available types of modulation. A single modulation type and its parameters can be set for ALL channels, or individual channels may be set to different modulation types and/or parameters.




### *9.3.1 Pulse Modulation*

The *PULSE* mode set button gives the user access to the pulse control panel. This allows for setting external pulse modulation, internal pulse modulation, or internal pulse modulation with trigger. Additional settings related to internal pulse modulation include: the pulse repetition rate, the pulse width, and the number of pulses.

*REPETITION RATE:* The pulse rep rate allows the user to set the time between rising edges of a pulse. This setting does not apply when using external pulse modulation.

*WIDTH:* The pulse width allows the user to set the time interval between the leading edge and trailing edge of a pulse. This setting does not apply when using external pulse modulation.

*NUMBER OF PULSES:* The number of pulses allows the user to specify the number of output pulses. This setting only applies when using internal pulse modulation with trigger. A trigger signal at the modulation input port will start the output pulsing and the counter to track the number of pulses.

| PARAMETER | PERFORMANCE | COMMENTS |
|---|---|---|
| INTERNAL "SELF" PULSE MODULATION (channels up to 6GHz) | | |
| Risetime ($T_r$)<br>fc < 512MHz<br>fc > 512 MHz | <br>10ns (typical)<br>35ns (typical) | |
| Falltime ($T_f$)<br>fc < 512MHz<br>fc > 512 MHz | <br>8ns (typical)<br>10ns (typical) | |
| On/Off Ratio | > 70dB | |

| | | |
|---|---|---|
| Minimum Pulse Width | 50ns | |
| ALC Loop Deviation (ALC disabled) | 1dB difference from ALC enabled | |

| PARAMETER | PERFORMANCE | COMMENTS |
|---|---|---|
| PULSE MODULATION w/ External Stimulus (channels up to 6GHz) | | |
| Risetime ($T_r$) | <50 ns | |
| Falltime ($T_f$) | <50 ns | |
| On/Off Ratio | > 70dB | |
| Minimum Pulse Width | <100 ns | |
| ALC Loop Deviation (ALC disabled) | 1dB difference from ALC enabled | |

| PARAMETER | PERFORMANCE | COMMENTS |
|---|---|---|
| PULSE MODULATION w/ External Stimulus (12 and 18GHz channels) | | |
| Risetime ($T_r$) | <20 ns | |
| Falltime ($T_f$) | <20 ns | |
| On/Off Ratio<br>10MHz to 2GHz<br>2GHz to 5GHz<br>5GHz to 18GHz | <br>> 60dB<br>> 50dB<br>> 90dB | |
| Minimum Pulse Width | 50 ns | |
| ALC Loop Deviation (ALC disabled) | 1dB difference from ALC enabled | |

### *9.3.2 Frequency Modulation (channels up to 6GHz, external mod. stimulus)*

The FM sub-menu allows user to set frequency deviation.

| PARAMETER | PERFORMANCE | COMMENTS |
|---|---|---|
| FREQUENCY MODULATION (Analog) | | |
| Max Deviation | 100 kHz | |
| Resolution | 0.01% or 1mHz<br>(whichever is greater) | |
| Deviation Accuracy | < ± 2% | |
| Modulation Freq. Response | DC to 20 kHz (-3dB) | DC Coupled |
| Sensitivity when using Ext. Input | ± 1V peak into 50Ω | +1V: Maximum Positive Deviation<br>0V: Zero Deviation from Carrier<br>-1V: Maximum Negative Deviation |

### *9.3.3 Phase Modulation (channels up to 6GHz, external mod. stimulus)*

The PM sub-menu allows users to set the phase deviation parameter.

| PARAMETER | PERFORMANCE | COMMENTS |
|---|---|---|
| PHASE MODULATION (Analog) | | |
| Modulation Deviation | ±1.6 deg to ±180 deg | |
| Frequency Response | DC to 20 kHz (-3dB) | DC Coupled |

| | | |
|---|---|---|
| Resolution | Frequency Dependent | See Phase Offset Specification |
| Sensitivity when using Ext. Input | ± 1V peak into 50Ω | +1V: Maximum Positive Deviation<br>0V: Zero Deviation from Carrier<br>-1V: Maximum Negative Deviation |

### *9.3.4 Amplitude Modulation (channels up to 6GHz, external mod. stimulus)*

The AM sub-menu allows users to set AM depth.

| PARAMETER | PERFORMANCE | COMMENTS |
|---|---|---|
| AMPLITUDE MODULATION (Analog) | | |
| AM Depth Type | Linear | |
| Depth<br>Maximum<br>Resolution<br>Depth Accuracy | <br>5% to 75%<br><3% of Maximum Depth<br>5% of Maximum Depth | <br>0.45 dB to 12 dB |
| Modulation Rate | DC to 10 kHz (-3dB) | DC Coupled |
| Sensitivity when using Ext. Input | ± 1V peak for indicated Depth (into 50Ω) | +1V: Maximum Amplitude<br>0V: 50% of Maximum Depth<br>-1V: Maximum Depth |

### *9.3.5 Sweep Mode*

The *SWEEP* mode set button gives the user access to the sweep function control panel. The control panel allows for setting the start/stop frequencies, dwell time (ms or µs) between points, and the number of points to use within the sweep range. The user can also set the sweep direction up/down, and set the trigger sweep mode.

*DWELL TIME:* The *DWELL TIME* setting is for controlling the delay time (in milliseconds or microseconds) in between each point in the sweep bandwidth.

Number of *POINTS:* The maximum number of points allowable for any sweep is 65535. Note that the number of points may be limited depending on the sweep bandwidth selected.

TRIGGER SWEEP *Free Running*: Selecting *Free Running* sweep mode will initiate the entire set bandwidth sweep to begin at the moment the *Sweep* radio button is selected under the *ENABLE* mode.

TRIGGER SWEEP *Ramp*: Selecting the *Ramp* sweep mode will initiate an entire set bandwidth sweep with a trigger signal at the modulation input port.

TRIGGER SWEEP *Point*: Selecting the *Point* sweep mode will initiate each individual point step in the sweep bandwidth at each trigger signal.

NOTE that once sweep mode is initiated, it will loop (restart) continuously until the routine is manually interrupted.

### *9.3.6 List Mode (channels up to 6GHz)*

Free running list mode is available on all units. NOTE that triggered list mode is only available on units that are equipped with the external modulation option, as OPT-EXTMOD provides an external stimulus input port for a trigger signal.

List mode allows for up to 3232 points (command lines) to be stored for each independent channel. Each command line allows for modification of any or all the following parameters: *Frequency* and/or *Amplitude,* and *Dwell* time in between points, if desired.

*Wide List* and *Narrow List* modes use identical load commands with limitations in the Narrow List settings, which are noted further into this section.

Selecting either *List* button will initiate a popup window with the available channels highlighted. Select the channel to be programmed for either list mode.

SELECT FILE: Once the channel has been selected, an Open file window will open for the user to select and load a preconfigured, comma delimited list file. Selecting a file or pressing the *Cancel* button will then initiate the *List Mode Control Panel* as shown below.

WIDE LIST COMMAND LINE FORMAT: A,B,C,D,E,F Comma separated (.csv).
A = Frequency value (non-restricted number of decimal places)
B = Frequency units (Hz, kHz, MHz, or GHz)
C = Amplitude value (up to 2 decimal places)
D = Amplitude units (dBm)
E = Dwell Time for each point (up to 6 decimal places)
F = Dwell Time units (ms or µs)

NOTE that setting any dwell time (E) inside the loaded list mode file, will cause the global dwell time setting (at List Mode Control Panel) to be ignored.

NARROW LIST COMMAND LINE FORMAT: A,B,E,F Comma separated (.csv).
A = Frequency value (non-restricted number of decimal places)
B = Frequency units (Hz, kHz, MHz, or GHz)
E = Dwell Time for each point (up to 6 decimal places)
F = Dwell Time units (ms or µs)

NOTE 1: As with the *Wide List Mode* command line format, setting any dwell time (E) inside the loaded list mode file, will cause the global dwell time setting (at List Mode Control Panel) to be ignored.
NOTE 2: *Narrow List Mode* list does not allow for amplitude control.
NOTE 3: The 5% frequency range limitation for *Narrow List Mode* is defined as: the center frequency ($f_c$) ± 2.5%.

IMPORT /EXPORT LIST BUTTONS
This feature set is used for list file management. The function of each button is defined as follows.

OPEN FILE: The *Open File* button is used to open a pre-formatted .csv file, if a file was not initially selected. Opening a file will load it into the *List Transfer Window*, but not onto the channel. NOTE that the file will still need to be imported to the synthesizer channel.

IMPORT LIST: Once a series of list command lines have either been manually entered into the *List Transfer Window* or via loading a preconfigured .csv file, the Import List button must be selected to finalize the loading of the list onto the synthesizer channel.

EXPORT LIST: This feature allows a user to export a list file from a synthesizer channel, into the *List Transfer Window*. It is useful for verifying that a specific list is loaded onto the channel.

SAVE TO FILE: The Save to File feature is used to save a .csv file of whatever list command line data is currently loaded in the *List Transfer Window*.

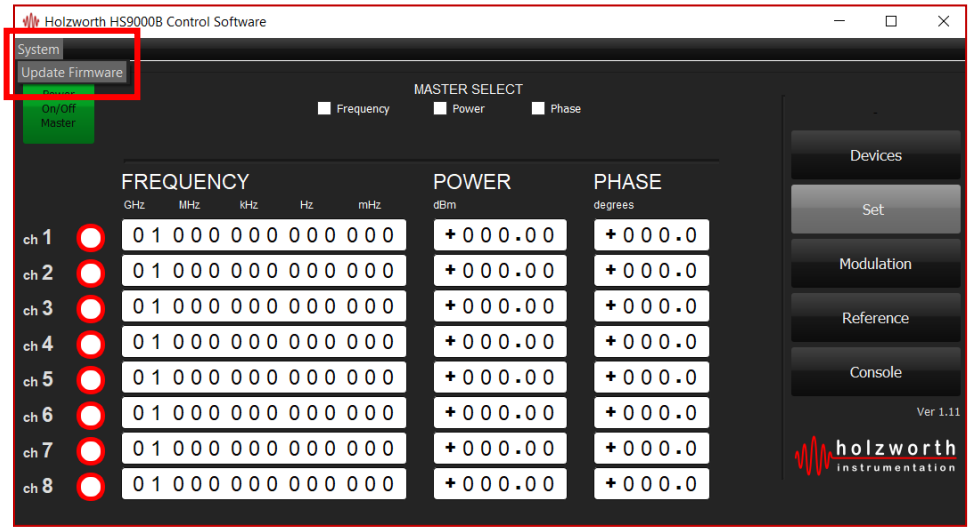
## 9.4 FIRMWARE UPDATES

HS9100B firmware can be updated via a USB connection by following the instructions below. Updates are performed using the GUI.

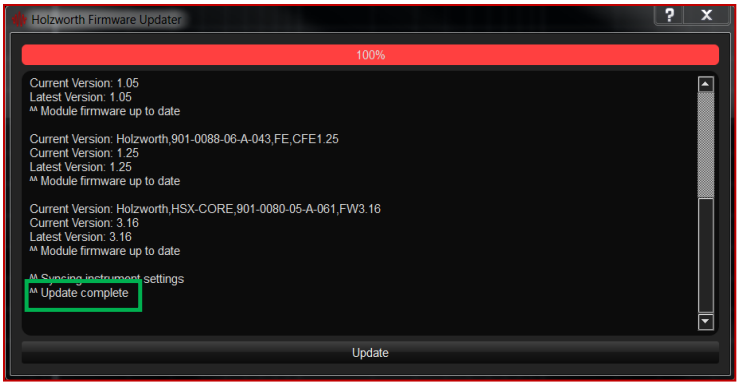
1. Ensure the PC is connected to the internet in order to download the latest software and to check for firmware updates. Download the latest software and extract all files from the .zip file. Double click the .exe file to launch the application GUI.

2. Establish a USB connection with the analyzer as shown in section 7.1.

3. Click the System button in the top left corner of the GUI. Select Update Firmware. The firmware updater window will now open. Click the Update button.




4. Do not turn off, unplug, or disconnect USB from the analyzer/PC while updates are in progress. When the progress bar reaches 100% and the updater window displays "Update complete" close the updater window.




# 10 Hardware

The HS9100B Synthesizers are CW work horses. They are designed to do an excellent job of providing highly stable, phase coherent signals with pure spectrums and highly accurate output power amplitude control.

## 10.1 RF OUTPUTS

The RF Output ports are labeled and positioned sequentially from left to right on the front panel of the instrument. The RF Output ports are protected against reflected power with a maximum damage threshold of 25$V_{DC}$ (+10dBm or 10mW).

## 10.2 REFERENCE INPUTS/OUTPUTS

The reference input and output ports are located on the right side of the rear panel.

**NOTE** that the internal reference distribution subsystem must be manually set for the type of reference being used (internal, external 10/100MHz, or OPT-REFX frequency). The factory default setting is for internal reference (free running).


### *10.2.1 10/100MHz External Reference*

When a 10MHz or 100MHz External Reference signal is applied and External 10MHz or External 100MHz is selected in software, the system enables a 20Hz digital PLL which phase locks the internal OCXO to the external reference signal. The internal OCXO remains operating in both scenarios to maintain optimal phase noise levels at >20Hz offset. The performance of the synthesized channel output signals as well as the fixed 10MHz and 100MHz Reference Output signals are based on the 10 or 100MHz external reference for offsets of <20Hz; performance is based on the integrity of the 100MHz internal OCXO at offsets of >20Hz.

This architecture is often used in laboratories and systems as a cleanup loop for 10MHz Rubidium, Cesium, GPS disciplined, *etc*. references as it provides an optimal reference signal for the internal channels as well as both the 10MHz and 100MHz reference outputs.

### *10.2.2 Reference Output Summary*

Maury Microwave multi-channel synthesizer modules supply very clean 10MHz and 100MHz Reference Outputs under all operating conditions. An outline of the reference input vs. output configuration is captured as follows:

| Reference Input | Internal 100MHz OCXO | 100MHz Reference Out | 10MHz Reference Out |
|---|---|---|---|
| None (free running) | ACTIVE | Matches Internal 100MHz OCXO | Divided from internal 100MHz OCXO. |
| 10MHz Signal applied | ACTIVE | Based on:<br>Internal 100MHz OCXO (>20Hz OS) External 10MHz (<20Hz OS) | Divided from:<br>Internal 100MHz OCXO (>20Hz OS)<br>External 10MHz (<20Hz OS) |
| 100MHz Signal applied | ACTIVE | Based on:<br>Internal 100MHz OCXO (>20Hz OS)<br>External 100MHz (<20Hz OS) | Divided from:<br>Internal 100MHz OCXO (>20Hz OS)<br>External 100MHz (<20Hz OS) |

# Appendix A: Programming Commands

The Maury Microwave HS9100B Series Synthesizers allow users to communicate with the instrument over USB, Ethernet, RS-232, or GPIB using their own application software.

The programming commands are ASCII commands, and an internal communications module will forward the commands to the appropriate synthesizer channel. The ASCII commands begin with a colon (:) or asterisk (*).

If a command is not understood, the synthesizer will have in its buffer: Invalid Command

The format for describing the command instruction is as follows:

| | | |
|---|---|---|
| :COMMAND:<value>[suffix] | | A Description of the command here. |
| | <value> | Defined here, if any, queries typically have no value |
| | [suffix] | Units, i.e. Hz or dBm. If no suffix is included it is default to whatever is in brackets [Hz]. |
| Example | TX: | Example ASCII sent in transmission |
| | RX: | Example ASCII received back |

Decimal Places:

In general, any number of usable decimal places may be entered. For example, set frequency may have up to 12 decimal places if sent in GHz. A decimal does not have to be entered.
In general, any number of usable decimal places may be entered. For example, set frequency may have up to 12 decimal places if sent in GHz. A decimal does not have to be entered.

IMPORTANT – Channel Indicator

*Preface each command with the syntax for the channel number,*

:CHn

*where "n" stands for the channel number*.

*For example, to read the frequency setting of channel 1, use the following syntax,*

:CH1:FREQ?

Any commands on this page, related to the communications bus should NOT include the channel number indicator preceding the command.

## Communication Bus Information

| | | | |
|---|---|---|---|
| :COMM:READY? | | | Query if the communications bus is ready to receive additional commands |
| Example | TX: | :COMM:READY? | |
| | RX: | Communications Bus Ready <OR> Communications Bus is Busy | |

| | | | |
|---|---|---|---|
| :ATTACH? | | | Query the number of internal channels |
| Example | TX: | :ATTACH? | |
| | RX: | :CH1:CH2 <OR> :CH1:CH2:CH3:CH4 <OR> etc | |

All commands on the following pages communicate with the synthesizer channels. The commands MUST BE prefaced with the appropriate channel indicator.

## Preset / Save / Recall/ Identify

| | | | |
|---|---|---|---|
| *RST | | | Recall Factory Preset |
| Example | TX: | :CHn*RST | |
| | RX: | Instrument Preset | |

| | | | |
|---|---|---|---|
| *RCL | | | Recall Saved State |
| Example | TX: | :CHn*RCL | |
| | RX: | State Recalled | |

| | | | |
|---|---|---|---|
| *SAV | | | Save Current State |
| Example | TX: | :CHn*SAV | |
| | RX: | State Saved | |

| | | | |
|---|---|---|---|
| :IDN? | | | Identify |
| Example | TX: | :CHn:IDN? | |
| | RX: | Holzworth,HSM18001B,901-0073-15-A-701,FW4.20,<br>(Manufacturer, Module Name, Board #, Firmware version, blank) | |

## Read Temperature

| | | | |
|---|---|---|---|
| :TEMP? | | | Query the temperature of the channel |
| Example | TX: | :CHn:TEMP? | |
| | RX: | Temp = 40.10 | |

## Set Frequency

| | | | |
|---|---|---|---|
| :FREQ:<value><suffix> | | | Set Synthesizer RF Frequency |
| | <value> | Synthesizer Dependent | |
| | <suffix> | Hz, kHz, MHz, GHz | |
| Example | TX: | :CHn:FREQ:2.105GHz | |
| | RX: | Frequency Set | |

| | | | |
|---|---|---|---|
| :FREQ? | | | Query Synthesizer RF Frequency |
| Example | TX: | :CHn:FREQ? | |
| | RX: | 22.67 MHz | |

| | | | |
|---|---|---|---|
| :FREQ:MAX? | | | Query Synthesizer Maximum RF Set Frequency |
| Example | TX: | :CHn:FREQ:MAX? | |
| | RX: | 1.024 MHz | |

| | | | |
|---|---|---|---|
| :FREQ:MIN? | | | Query Synthesizer Minimum RF Set Frequency |
| Example | TX: | :CHn:FREQ:MIN? | |
| | RX: | 0.25 MHz | |

## Set Power

| | | |
|---|---|---|
| :PWR:<value>[suffix] | | Set Synthesizer RF Power |
| | <value> | Synthesizer Dependent |
| | [suffix] | [dBm] |
| Example | TX: | :CHn:PWR:9.5dBm |
| | RX: | Power Set |

| | | |
|---|---|---|
| :PWR? | | Query Synthesizer RF Power |
| Example | TX: | :CHn:PWR? |
| | RX: | 9.50 |

| | | |
|---|---|---|
| :PWR:MAX? | | Query Synthesizer Maximum RF Set Power |
| Example | TX: | :CHn:PWR:MAX? |
| | RX: | 10.00 dBm |

| | | |
|---|---|---|
| :PWR:MIN? | | Query Synthesizer Minimum RF Set Power |
| Example | TX: | :CHn:PWR:MIN? |
| | RX: | -100.00 dbm |

## Set Phase

| | | |
|---|---|---|
| :PHASE:<value>[suffix] | | Set Synthesizer RF Phase Offset |
| | <value> | Synthesizer Dependent |
| | [suffix] | [deg] |
| Example | TX: | :CHn:PHASE:270.1deg |
| | RX: | Phase Set |

| | | |
|---|---|---|
| :PHASE? | | Query Synthesizer RF Phase Offset |
| Example | TX: | :CHn:PHASE? |
| | RX: | 270.1 |

| | | |
|---|---|---|
| :PHASE:MAX? | | Query Synthesizer Maximum RF Phase Offset |
| Example | TX: | :CHn:PHASE:MAX? |
| | RX: | 359.9deg |

| | | |
|---|---|---|
| :PHASE:MIN? | | Query Synthesizer Minimum RF Phase Offset |
| Example | TX: | :CHn:PHASE:MIN? |
| | RX: | 0.0deg |

## Set RF ON/OFF

| | | | |
|---|---|---|---|
| :PWR:RF:<value> | | | Set Synthesizer RF ON/OFF |
| | <value> | ON <or> OFF | |
| Example | TX: | :CHn:PWR:RF:ON | |
| | RX: | RF POWER ON | |

| | | | |
|---|---|---|---|
| :PWR:RF? | | | Query Synthesizer RF ON/OFF |
| Example | TX: | :CHn:PWR:RF? | |
| | RX: | ON <or> OFF | |

Most commands on the following pages are in reference to Modulation Control. Modulation is only available on HS9100 Series synthesizers that have OPT-EXTMOD installed, which includes channel dedicated modulation ports at the front panel. Internal pulse modulation, pulse rep rate, and pulse width are available without OPT-EXTMOD.

## Modulation Enable

| | | |
|---|---|---|
| :MOD? | | Query Modulation Enable Status |
| Example | TX: | :CHn:MOD? |
| | RX: | DIS <or> EXT |

| | | |
|---|---|---|
| :MOD:MODE:<value> | | Set Modulation Mode |
| | <value> | OFF <or> PULSE <or> PULSE:SRC:EXT <or> PULSE:SRC:INT <or> PULSE:SRC:INT:TRIGGER <or> FM <or> AM <or> PM <or> SWEEP:FREQ <or> LOOKUP:NARROW <or> LOOKUP:WIDE |
| Example | TX: | :CHn:MOD:MODE:PULSE:SRC:EXT |
| | RX: | External Pulse Modulation Set |

NOTE: In the value field above, PULSE or PULSE:SRC:EXT enable external pulse modulation.

| | | |
|---|---|---|
| :MOD:MODE? | | Query Modulation Mode Status |
| Example | TX: | :CHn:MOD:MODE? |
| | RX: | OFF <or> PULSE:EXT <or> PULSE:INT <or> PULSE:INT:TRIGGER <or> FM <or> AM <or> PM <or> SWEEP:FREQ <or> LOOKUP:NARROW <or> LOOKUP:WIDE |

## Set FM Deviation

| | | |
|---|---|---|
| :MOD:FM:DEV:<value>[suffix] | | Set Synthesizer FM Deviation |
| | <value> | Synthesizer Dependent |
| | [suffix] | Hz, kHz |
| Example | TX: | :CHn:MOD:FM:DEV:1.2kHz |
| | RX: | FM Deviation Set |

| | | |
|---|---|---|
| :MOD:FM:DEV? | | Query Synthesizer FM Deviation |
| Example | TX: | :CHn:MOD:FM:DEV? |
| | RX: | 0.500 kHz |

| | | |
|---|---|---|
| :MOD:FM:DEV:MAX? | | Query Synthesizer Maximum FM Deviation |
| Example | TX: | :CHn:MOD:FM:DEV:MAX? |
| | RX: | 100.000 kHz |

## Set AM Depth

| | | |
|---|---|---|
| :MOD:AM:DEPTH:<value>[suffix] | | Set Synthesizer AM Depth |
| | <value> | Synthesizer Dependent |
| | [suffix] | [percent] |
| Example | TX: | :CHn:MOD:AM:DEPTH:15 percent |
| | RX: | AM Depth Set |

| | | |
|---|---|---|
| :MOD:AM:DEPTH? | | Query Synthesizer AM Depth |
| Example | TX: | :CHn:MOD:AM:DEPTH? |
| | RX: | 60 percent |

| | | |
|---|---|---|
| :MOD:AM:DEPTH:MAX? | | Query Synthesizer Maximum AM Depth |
| Example | TX: | :CHn:MOD:AM:DEPTH:MAX? |
| | RX: | 75 percent |

## Set PM Deviation

| | | |
|---|---|---|
| :MOD:PM:DEV:<value>[suffix] | | Set Synthesizer PM Deviation |
| | <value> | Synthesizer Dependent |
| | [suffix] | [deg] |
| Example | TX: | :CHn:MOD:PM:DEV: 45 deg |
| | RX: | PM Deviation Set |

| | | |
|---|---|---|
| :MOD:PM:DEV? | | Query Synthesizer PM Deviation |
| Example | TX: | :CHn:MOD:PM:DEV? |
| | RX: | 10 deg |

| | | |
|---|---|---|
| :MOD:PM:DEV:MAX? | | Query Synthesizer Maximum PM Deviation |
| Example | TX: | :CHn:MOD:PM:DEV:MAX? |
| | RX: | 180 deg |

## Set Internal Pulse Repetition Rate

| | | |
|---|---|---|
| :MOD:PULSE:REP:<value><suffix> | | Set Internal Pulse Repetition Rate |
| | <value> | Synthesizer Dependent |
| | <suffix> | s, ms, [us] |
| Example | TX: | :CHn:MOD:PULSE:REP:45ms |
| | RX: | Pulse Rep Rate Set |

| | | |
|---|---|---|
| :MOD:PULSE:REP? | | Query Internal Pulse Repetition Rate |
| Example | TX: | :CHn:MOD:PULSE:REP? |
| | RX: | 45000.0 us |

| | | |
|---|---|---|
| :MOD:PULSE:REP:MAX? | | Query Maximum Internal Pulse Repetition Rate |
| Example | TX: | :CHn:MOD:PULSE:REP:MAX? |
| | RX: | 10000000.0 us |

## Set Internal Pulse Width

| | | |
|---|---|---|
| :MOD:PULSE:WIDTH:<value><suffix> | | Set Internal Pulse Width |
| | <value> | Synthesizer Dependent |
| | <suffix> | s, ms, [us] |
| Example | TX: | :CHn:MOD:PULSE:WIDTH:45ms |
| | RX: | Pulse Width Set |

| | | |
|---|---|---|
| :MOD:PULSE:WIDTH? | | Query Internal Pulse Width |
| Example | TX: | :CHn:MOD:PULSE:WIDTH? |
| | RX: | 45000.0 us |

| | | |
|---|---|---|
| :MOD:PULSE:WIDTH:MAX? | | Query Maximum Internal Pulse Width |
| Example | TX: | :CHn:MOD:PULSE:WIDTH:MAX? |
| | RX: | 10000000.0 us |

## Set Number of Output Pulses

| | | |
|---|---|---|
| :MOD:PULSE:NUM:<value> | | Set Number of Output Pulses for Internal Pulse Modulation |
| | <value> | Synthesizer Dependent |
| Example | TX: | :CHn:MOD:PULSE:NUM:10 |
| | RX: | Number of Output Pulses set |

| | | |
|---|---|---|
| :MOD:PULSE:NUM? | | Query Number of Output Pulses |
| Example | TX: | :CHn:MOD:PULSE:NUM? |
| | RX: | 10 |

| | | |
|---|---|---|
| :MOD:PULSE:NUM:MAX? | | Query Maximum Number of Output Pulses |
| Example | TX: | :CHn:MOD:PULSE:NUM:MAX? |
| | RX: | 65535 |

The number of output pulses only applies when using Internal Pulse Modulation with a Trigger.

## Set Frequency Sweep Start Frequency*

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:START:<value><suffix> | | Set Synthesizer Sweep Start RF Frequency |
| | <value> | Synthesizer Dependent |
| | <suffix> | Hz, kHz, MHz, GHz |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:START:100.1MHz |
| | RX: | Sweep Frequency Start Set |

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:START? | | Query Synthesizer Sweep Start RF Frequency |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:START? |
| | RX: | MHz |

* The maximum and minimum for the Sweep Start Frequency are the same as the corresponding values for the Set Frequency. Refer to the Set Frequency page for the maximum and minimum values.

## Set Frequency Sweep Stop Frequency*

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:STOP:<value><suffix> | | Set Synthesizer Sweep Stop RF Frequency |
| | <value> | Synthesizer Dependent |
| | <suffix> | Hz, kHz, MHz, GHz |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:STOP:200.1MHz |
| | RX: | Sweep Frequency Stop Set |

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:STOP? | | Query Synthesizer Sweep Stop RF Frequency |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:STOP? |
| | RX: | 200.1 MHz |

* The maximum and minimum for the Sweep Stop Frequency are the same as the corresponding values for the Set Frequency. Refer to the Set Frequency page for the maximum and minimum values.

## Set Frequency Sweep Trigger

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:TRIG:<value> | | Set Synthesizer Sweep Frequency Trigger |
| | <value> | FREE or RAMP or POINT |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:TRIG:FREE |
| | RX: | Sweep Frequency Free Running Set |

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:TRIG? | | Query Synthesizer Sweep Frequency Trigger |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:TRIG? |
| | RX: | FREQ SWEEP TRIGGER FREE <or> FREQ SWEEP TRIGGER RAMP <or> FREQ SWEEP TRIGGER POINT |

## Set Frequency Sweep Direction

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:DIR:<value> | | Set Synthesizer Sweep Frequency Direction |
| | <value> | UP or DOWN |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:DIR:UP |
| | RX: | FREQ SWEEP DIRECTION UP |

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:DIR? | | Query Synthesizer Sweep Frequency Direction |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:DIR? |
| | RX: | FREQ SWEEP DIRECTION UP or FREQ SWEEP DIRECTION DOWN |

## Set Frequency Sweep Dwell Time

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:DWL:<value> | | Set Synthesizer Sweep Dwell Time |
| | <value> | Synthesizer Dependent |
| | [suffix] | ms, [us] |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:DWL:1ms |
| | RX: | Sweep Frequency Dwell Time Set |

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:DWL? | | Query Synthesizer Sweep Dwell Time |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:DWL? |
| | RX: | 700 us |

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:DWL:MAX? | | Query Synthesizer Maximum Sweep Dwell Time |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:DWL:MAX? |
| | RX: | 10000000 us |

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:DWL:MIN? | | Query Synthesizer Minimum Sweep Dwell Time |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:DWL:MIN? |
| | RX: | 100 us |

## Set Frequency Sweep Number of Points

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:PTS:<value> | | Set Synthesizer Sweep Number of Points |
| | <value> | Synthesizer Dependent |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:PTS:50 |
| | RX: | Sweep Frequency Points Set |

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:PTS? | | Query Synthesizer Sweep Points |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:PTS? |
| | RX: | 50 |

| | | |
|---|---|---|
| :MOD:SWEEP:FREQ:PTS:MAX? | | Query Synthesizer Maximum Sweep Points |
| Example | TX: | :CHn:MOD:SWEEP:FREQ:PTS:MAX? |
| | RX: | 65535 |

## Set Wide Band List Number of Points

| | | |
|---|---|---|
| :MOD:LIST:WIDE:PTS:<value> | | Set Wide Band List Number of Points |
| | <value> | Synthesizer Dependent |
| Example | TX: | :CHn:MOD:LIST:WIDE:PTS:500 |
| | RX: | Wide Band Points Set |

| | | |
|---|---|---|
| :MOD:LIST:WIDE:PTS? | | Query Wide Band List Points |
| Example | TX: | :CHn:MOD:LIST:WIDE:PTS? |
| | RX: | 500 |

| | | |
|---|---|---|
| :MOD:LIST:WIDE:PTS:MAX? | | Query Maximum Wide Band Points |
| Example | TX: | :CHn:MOD:LIST:WIDE:PTS:MAX? |
| | RX: | 3232 |

## Set Wide Band List Values*

| | | |
|---|---|---|
| :MOD:LIST:WIDE:<point>,<freq><freq suffix>,<power>[power suffix],[dwell time][dwell suffix] | | Set Wide Band List Value (for the given point) |
| | <point> | Point location. Cannot be greater than the value set using :MOD:LIST:WIDE:PTS: |
| | <freq> | Synthesizer Dependent |
| | <freq suffix> | GHz,MHz, kHz, Hz |
| | <power> | Synthesizer Dependent |
| | [power suffix] | [dBm] |
| | [dwell time] | Synthesizer Dependent OPTIONAL |
| | [dwell suffix] | ms, [us] OPTIONAL |
| Example | TX: | :CHn:MOD:LIST:WIDE:1,100.1MHz,-1.0dBm,3.4ms |
| | RX: | Stored frequency, power, and dwell time for point 1 <or> Invalid point |

| | | |
|---|---|---|
| :MOD:LIST:WIDE?<point> | | Query Wide Band List Value (for the given point) |
| | <point> | Point location. Cannot be greater than the value set using :MOD:LIST:WIDE:PTS: |
| Example | TX: | :CHn:MOD:LIST:WIDE?1 |
| | RX: | 1001.000 MHz,-1.00,3400 us <or> Invalid Point |

*NOTE: If a dwell time is not specified with each point, then the value used for dwell time will be the value set using the Set Wide Band Dwell Time command.
The list of dwell times is not saved to the device. If the synthesizer is power cycled, then the complete list with dwell times must be reloaded.

## Set Wide Band Trigger

| | | |
|---|---|---|
| :MOD:MODE:LIST:WIDE:<value> | | Set Wide Band Trigger |
| | <value> | FREE or LIST or POINT |
| Example | TX: | :CHn:MOD:MODE:LIST:WIDE:FREE |
| | RX: | Wide Band Free Running Set |

| | | |
|---|---|---|
| :MOD:MODE:LIST:WIDE? | | Query Wide Band Trigger |
| Example | TX: | :CHn:MOD:MODE:LIST:WIDE? |
| | RX: | WIDE LIST MODE TRIGGER FREE <or> WIDE LIST MODE TRIGGER LIST <or> WIDE LIST MODE TRIGGER POINT |

## Set Wide Band Dwell Time*

| | | |
|---|---|---|
| :MOD:LIST:WIDE:DWL:<value> | | Set Wide Band Dwell Time |
| | <value> | Synthesizer Dependent |
| | [suffix] | ms, [us] |
| Example | TX: | :CHn:MOD:LIST:WIDE:1ms |
| | RX: | Wide Band Dwell Time Set |

| | | |
|---|---|---|
| :MOD:LIST:WIDE:DWL? | | Query Wide Band Dwell Time |
| Example | TX: | :CHn:MOD:LIST:WIDE:DWL? |
| | RX: | 1000 us |

| | | |
|---|---|---|
| :MOD:LIST:WIDE:DWL:MAX? | | Query Maximum Wide Band Dwell Time |
| Example | TX: | :CHn:MOD:LIST:WIDE:DWL:MAX? |
| | RX: | 10000000 us |

| | | |
|---|---|---|
| :MOD:LIST:WIDE:DWL:MIN? | | Query Minimum Wide Band Dwell Time |
| Example | TX: | :CHn:MOD:LIST:WIDE:DWL:MIN? |
| | RX: | 100 us |

*NOTE: If a dwell time is loaded with each point in Set Wide Band List Values, then the value for Set Wide Band Dwell Time will be ignored.

## Set Narrow Band List Number of Points

| | | |
|---|---|---|
| :MOD:LIST:NARROW:PTS:<value> | | Set Narrow Band List Number of Points |
| | <value> | Synthesizer Dependent |
| Example | TX: | :CHn:MOD:LIST:NARROWPTS:300 |
| | RX: | Narrow Band Points Set |

| | | |
|---|---|---|
| :MOD:LIST:NARROW:PTS? | | Query Narrow Band List Points |
| Example | TX: | :CHn:MOD:LIST:NARROW:PTS? |
| | RX: | 300 |

| | | |
|---|---|---|
| :MOD:LIST:NARROW:PTS:MAX? | | Query Maximum Narrow Band Points |
| Example | TX: | :CHn:MOD:LIST:NARROW:PTS:MAX? |
| | RX: | 3232 |

## Set Narrow Band List Values*

| | | |
|---|---|---|
| :MOD:LIST:NARROW:<point>,<freq><freq suffix>,[dwell time][dwell suffix] | | Set Narrow Band List Value (for the given point) |
| | <point> | Point location. Cannot be greater than the value set using :MOD:LIST:NARROW:PTS: |
| | <freq> | Synthesizer Dependent. All frequency values must be less than the first frequency point plus 5 percent. |
| | <freq suffix> | GHz,MHz, kHz, Hz |
| | [dwell time] | Synthesizer Dependent OPTIONAL |
| | [dwell suffix] | ms, [us] OPTIONAL |
| Example | TX: | :CHn:MOD:LIST:NARROW:2,996MHz,10us |
| | RX: | Stored frequency and dwell time for point 2 <or> Invalid point |

| | | |
|---|---|---|
| :MOD:LIST:NARROW?<point> | | Query Narrow Band List Value (for the given point) |
| | <point> | Point location. Cannot be greater than the value set using :MOD:LIST:NARROW:PTS: |
| Example | TX: | :CHn:MOD:LIST:NARROW?2 |
| | RX: | 996.0000000 MHz,10us <or> Invalid point |

*NOTE: If a dwell time is not specified with each point, then the value used for dwell time will be the value set using the Set Narrow Band Dwell Time command.
The list of dwell times is not saved to the device. If the synthesizer is power cycled, then the complete list with dwell times must be reloaded.

## Set Narrow Band Trigger

| | | |
|---|---|---|
| :MOD:MODE:LIST:NARROW:<value> | | Set Narrow Band Trigger |
| | <value> | FREE or LIST or POINT |
| Example | TX: | :CHn:MOD:MODE:LIST:NARROW:FREE |
| | RX: | Narrow Band Free Running Set |

| | | |
|---|---|---|
| :MOD:MODE:LIST:NARROW? | | Query Narrow Band Trigger |
| Example | TX: | :CHn:MOD:MODE:LIST:NARROW? |
| | RX: | NARROW LIST MODE TRIGGER FREE <or> NARROW LIST MODE TRIGGER LIST <or> NARROW LIST MODE TRIGGER POINT |

## Set Narrow Band Dwell Time*

| | | |
|---|---|---|
| :MOD:LIST:NARROW:DWL:<value> | | Set Narrow Band Dwell Time |
| | <value> | Synthesizer Dependent |
| | [suffix] | ms, [us] |
| Example | TX: | :CHn:MOD:LIST:NARROW:700us |
| | RX: | Narrow Band Dwell Time Set |

| | | |
|---|---|---|
| :MOD:LIST:NARROW:DWL? | | Query Narrow Band Dwell Time |
| Example | TX: | :CHn:MOD:LIST:NARROW:DWL? |
| | RX: | 700 us |

| | | |
|---|---|---|
| :MOD:LIST:NARROW:DWL:MAX? | | Query Maximum Narrow Band Dwell Time |
| Example | TX: | :CHn:MOD:LIST:NARROW:DWL:MAX? |
| | RX: | 10000000 us |

| | | |
|---|---|---|
| :MOD:LIST:NARROW:DWL:MIN? | | Query Minimum Narrow Band Dwell Time |
| Example | TX: | :CHn:MOD:LIST:NARROW:DWL:MIN? |
| | RX: | 6 us |

*NOTE: If a dwell time is loaded with each point in Set Narrow Band List Values, then the value for Set Narrow Band Dwell Time will be ignored.

## Reference Distribution Module Commands

| | | |
|---|---|---|
| :REF:INT:100MHz | | Set internal 100MHz reference |
| Example | TX: | :REF:INT:100MHz |
| | RX: | Reference Set to 100MHz Internal, PLL Disabled |

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| | | |
|---|---|---|
| :REF:EXT:10MHz | | Set external 10MHz reference |
| Example | TX: | :REF:EXT:10MHz |
| | RX: | Reference Set to 10MHz External, PLL Enabled |

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| | | |
|---|---|---|
| :REF:EXT:100MHz | | Set external 100MHz reference |
| Example | TX: | :REF:EXT:100MHz |
| | RX: | Reference Set to 100MHz External, Internal 100MHz Disabled |

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| | | |
|---|---|---|
| :REF:STATUS? | | Query reference status |
| Example | TX: | :REF:STATUS? |
| | RX: | Internal 100MHz <or> External 10MHz <or> External 100MHz |

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| | | |
|---|---|---|
| :REF:PLL? | | Query PLL Lock Status |
| Example | TX: | :REF:PLL? |
| | RX: | 1 PLL Locked <or> 0 PLL Unlocked <or><br>0 PLL Disabled, External 100MHz <or><br>0 PLL Disabled, Internal 100MHz |

When using an external 10MHz reference, the response will be ‘1 PLL Locked’ or ‘0 PLL Unlocked’

Ethernet CONFIGURATION COMMANDS

## ETHERNET Configuration

| | | |
|---|---|---|
| :IP:STATUS:<value> | | Toggle Instrument Static/Dynamic IP Address |
| | <value> | Static <or> DHCP |
| Example | TX: | :IP:STATUS:STATIC |
| | RX: | DHCP status changed. Restart Device |

| | | |
|---|---|---|
| :IP:STATUS? | | Query instrument IP address setting |
| Example | TX: | :IP:STATUS? |
| | RX: | "Static IP Address" or "DHCP" |

| | | |
|---|---|---|
| :IP:ADDR:<value> | | Set instrument static IP address |
| | <value> | xxx.xxx.xxx.xxx |
| Example | TX: | :IP:ADDR:192.168.10.38 |
| | RX: | Static IP address changed. |

| | | |
|---|---|---|
| :IP:ADDR? | | Query instrument static IP address |
| Example | TX: | :IP:ADDR? |
| | RX: | 192.168.010.038 |

| | | |
|---|---|---|
| :IP:GATEWAY:<value> | | Set instrument Gateway address |
| | <value> | xxx.xxx.xxx.xxx |
| Example | TX: | :IP:GATEWAY:192.168.10.1 |
| | RX: | Gateway Address changed. |

| | | |
|---|---|---|
| :IP:GATEWAY? | | Query instrument Gateway address |
| Example | TX: | :IP:GATEWAY? |
| | RX: | 192.168.010.001 |

| | | |
|---|---|---|
| :IP:SUBNET:<value> | | Set instrument Subnet address |
| | <value> | xxx.xxx.xxx.xxx |
| Example | TX: | :IP:SUBNET:255.255.255.0 |
| | RX: | Gateway Address changed. |

| | | |
|---|---|---|
| :IP:SUBNET? | | Query instrument Subnet address |
| Example | TX: | :IP:SUBNET? |
| | RX: | 255.255.255.000 |

GPIB CONFIGURATION COMMANDS

## GPIB Configuration

| | | |
|---|---|---|
| :GPIB:ADDR:<value> | | Set instrument GPIB address |
| | <value> | 0 thru 30 |
| Example | TX: | :GPIB:ADDR:17 |
| | RX: | GPIB Address: 17 |

| | | |
|---|---|---|
| :GPIB:ADDR? | | Query instrument GPIB address |
| Example | TX: | :GPIB:ADDR? |
| | RX: | GPIB Address: 17 |

| | | |
|---|---|---|
| :GPIB:EOIWLC:<value> | | Set instrument GPIB EOI with last character |
| | <value> | ON or OFF |
| Example | TX: | :GPIB:EOIWLC:OFF |
| | RX: | EOI with last character disabled |

| | | |
|---|---|---|
| :GPIB:EOIWLC? | | Query instrument GPIB EOI with last character |
| Example | TX: | :GPIB:EOIWLC? |
| | RX: | "EOI with last character enabled" OR "EOI with last character disabled" |

| | | |
|---|---|---|
| :GPIB:RESPOND:<value> | | Set instrument GPIB response status |
| | <value> | ON or OFF |
| Example | TX: | :GPIB:RESPOND:ON |
| | RX: | GPIB responds with every command |

| | | |
|---|---|---|
| :GPIB:RESPOND? | | Query instrument GPIB response status |
| Example | TX: | :GPIB:RESPOND? |
| | RX: | "GPIB only responds to queries" OR "GPIB responds with every command" |