holzworth instrumentation

HS9000B Series Multi-Channel RF Synthesizers

CE

RoHS

User Manual 1.04

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INDEX

1.0 INTRODUCTION

Thank you for purchasing a Holzworth Instrumentation Multi-Channel RF Synthesizer. The combination of Holzworth'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 Holzworth Instrumentation Inc.

This User's Manual is a generic, quick reference guide for use with the Holzworth HS9000B Series Multi-Channel RF Synthesizer products. Refer to section 5 for specific configuration details with regards to the HS9000B Series hardware.

2.0 CERTIFICATIONS and EXEMPTIONS

2.1 CE CERTIFICATION

Holzworth 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.

2.2 ROHS EXEMPTION

Holzworth multi-channel synthesizer products are in compliance with Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the *Restriction and use of Certain Hazardous Substances in Electrical and Electronic Equipment* (RoHS Directive), with an exemption for Lead in Electronic Ceramic Parts (e.g. Piezoelectric Devices) per the Directive's Annex Paragraph 7 applied.

The HS9000B Series Multi-channel products are fully compliant in accordance to the definitions given in the directives. The exemption is made resulting from the Maximum Concentration Value of Lead (Pb) being less than 0.1% of the total weight of any multi-channel product offered by Holzworth.

3.0 PRODUCT WARRANTY

Holzworth RF synthesizers come with a 2 year 100% product warranty covering manufacturing defects. All product repairs and maintenance must be performed by Holzworth Instrumentation Inc. Holzworth reserves the right to invalidate the warranty for any products that have been tampered with or subjected to improper use. If the unit becomes damaged, please contact Holzworth Instruments or your local representative for an RMA Number & instructions prior to returning the unit for repair.

4.0 CALIBRATION NOTICE

Holzworth calibrates each channel for output frequency accuracy and output amplitude accuracy. The factory calibration is valid for 2 years from the original calibration date. Holzworth provides calibration services for applicable Holzworth products. Contact sales@holzworth.com with model number and serial number for a calibration service quotation. Holzworth also makes the calibration routine and equipment list available to customers who have the capability to perform on site calibration. Contact support@holzworth.com for more information.

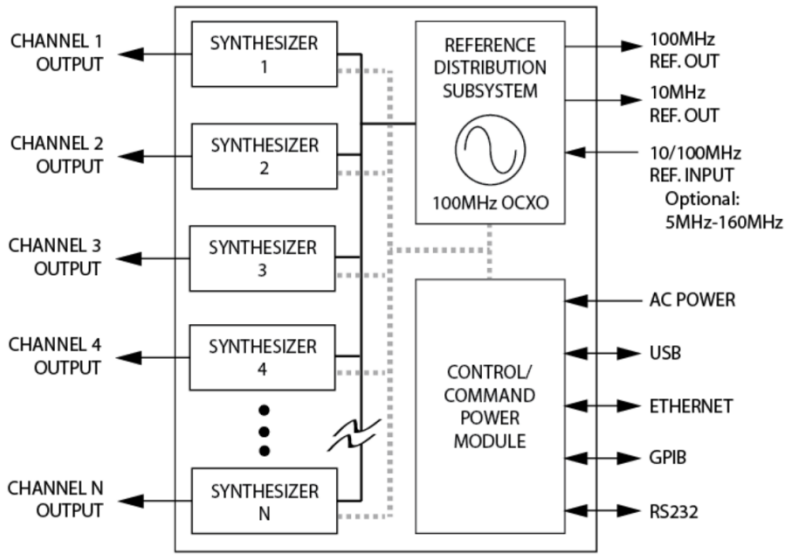
5.0 HS9000B SERIES CONFIGURATION GUIDE

5.1 CONFIGURATION SUMMARY

The Holzworth HS9000B Series multi-channel platform is designed to achieve optimal channel-to-channel stability across all integrated channel synthiesizers via a conductively cooled, fan-less enclosure. Specific attention is paid to phase coherency between the independely controllable channels.

The HS9000B Series is a unique platform allowing the user to specify custom configurations for a COTS product. Units are loaded with anywhere from 1 to 8 channels (up to 6.7GHz), with the 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.

Each RF output is driven by a separate, internally loaded synthesizer module. Up to 8 independently tunable synthesizers can be specified per 1U chassis allowing for the highest integrated channel density available in its class. With an average power dissipation of 7 Watts per channel, the HS9000B series is highly efficient.



Holzworth Multi-channel RF Synthesizers offer the benefits of a 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, Holzworth's proprietary architecture creates precisely synthesized signals that exhibit both instantaneous and long term stability. Temperature variations between the channels remain the only contribution to drift. The thermally optimized, fan-less chassis was specifically developed for maintaining the lowest possible channel-to-channel thermal gradients.

Holzworth 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, Holzworth synthesizers also come standard with thermal monitor outputs to track the relative channel temperature of each loaded channel.

5.2 HARDWARE CONFIGURATION

The HS9000B Series synthesizer platform is a user defined platform. The configuration is setup at the Holzworth factory based on the configuration defined by the end user. Three primary categories define the final configuration of a unit: the number of channels, loaded channel frequencies, and loaded options/accessories.

5.1.1 Number of Channels

The HS9000B part number signifies the number of independent channels available in the unit. The current revision of the design is revision B. A seven channel unit is defined as an HS9007B, a four channel as HS9004B, etc.

No. Channels	1	2	3	4	5	6	7	8
Part Number	HS9001B	HS9002B	HS9003B	HS9004B	HS9005B	HS9006B	HS9007B	HS9008B

5.1.2 Loaded Channel Frequencies

The channel frequencies are defined at the time of a product purchase order. To identify what channel frequencies are loaded, refer to the “Loaded Options” designator scribed into the front panel of the instrument.

Frequency Range	Number of Channels per Frequency Range							
	1x	2x	3x	4x	5x	6x	7x	8x
CMOS 5MHz - 500MHz	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 - 6.7GHz	OPT-E1	OPT-E2	OPT-E3	OPT-E4	OPT-E5	OPT-E6	OPT-E7	OPT-E8
10MHz - 12.5GHz	OPT-X1	OPT-X2	OPT-X3	OPT-X4	N/A	N/A	N/A	N/A
10MHz - 20GHz	OPT-F1	OPT-F2	OPT-F3	OPT-F4	N/A	N/A	N/A	N/A

5.1.3 Loaded Options & Available Accessories

Additional factory loaded options are also defined in the “Loaded Options” designator on the front panel. These options further customize the HS9000B Series to an application and are loaded at the factory when the unit is initially built. Accessories are external to the HS9000B platform and can be ordered separately.

TYPE	Part Number	Description
OPTION	OPT-EXTMOD-x	Channel dedicated, external modulation input. x= 1, 2, 3… (up to 6 channels)
OPTION	OPT-FW100	100us freq. switching speed lockout for EAR99 (Channel Options Xn and Fn)
OPTION	OPT-REFX	Utilize ext. ref. source at any 100kHz increment in range of 5MHz -160MHz
ACCESSORY	RACK-1U	19" Rack Mount Bracket Kit, 90° Rear Brackets
ACCESSORY	RACK2-1U	19" Rack Mount Bracket Kit, Straight Rear Brackets

5.1.4 PART NUMBER EXAMPLE

Ordering a 6 channel synthesizer with 1x CMOS channel, 2x 3GHz channels, 3x 6.7GHz channels, and a high performance OCXO would result in the following configuration:

		Description:
Part Number:	**HS9006B**	6 ch, Multi-Channel RF Synthesizer
Options:	**OPT-CMOS1**	1x CMOS Channel (5MHz to 500MHz)
	OPT-C2	2x 3GHz Channels
	OPT-E3	3x 6.7GHz Channels

5.2 OPTION SPECIFICATIONS

5.2.1 OPT-EXTMOD-x

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.

5.2.2 OPT-FW100

Frequency switching speed locked out to 100us for EAR99. Applicable to channel options Xn and Fn only.

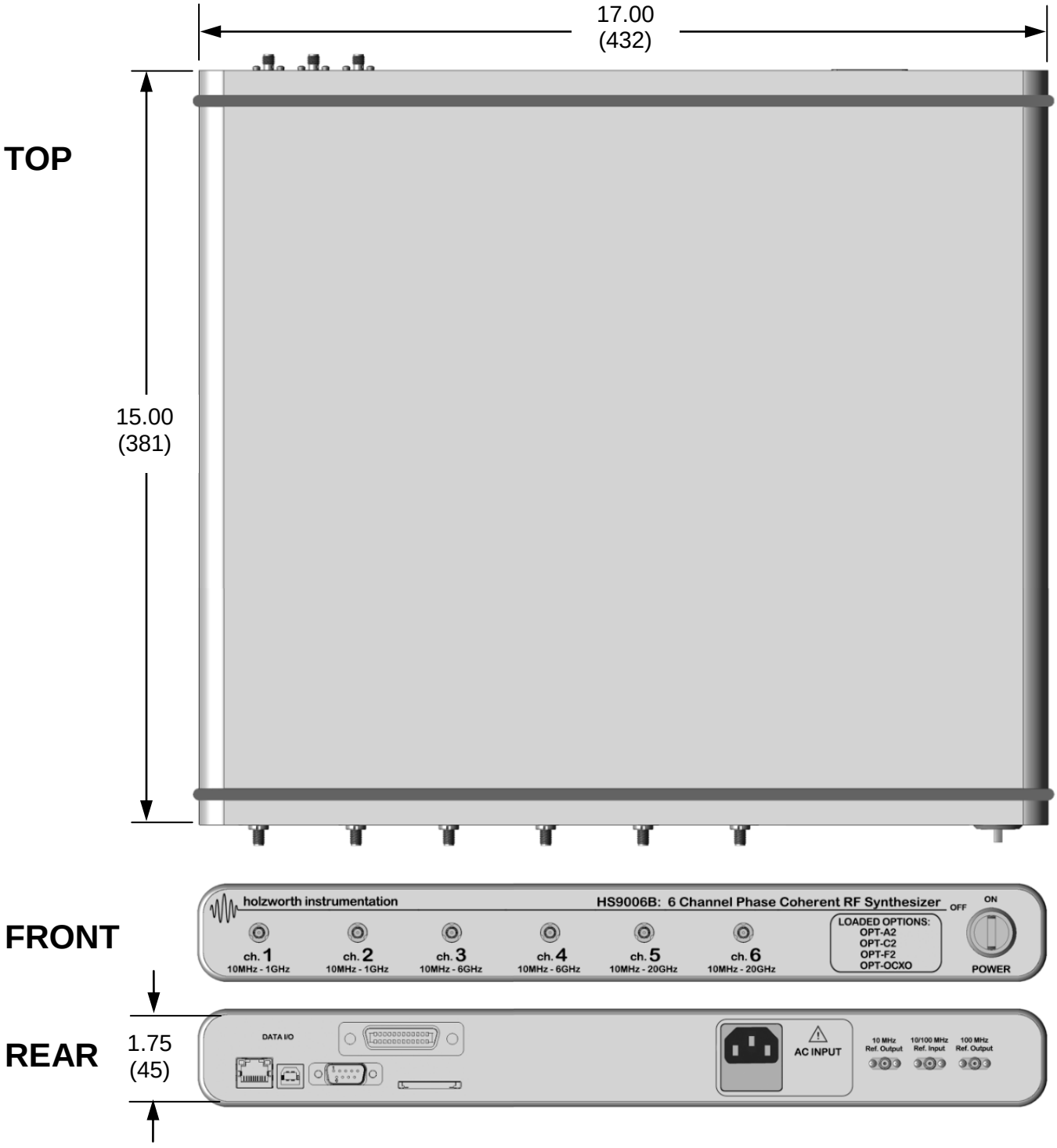
5.2.3 OPT-REFX

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.

5.3 MECHANICAL CONFIGURATION

The HS9000B Series 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).



5.4 ENVIRONMENTAL SPECIFICATIONS

Environmental specifications are based on component margins, thermal verification testing and current draw tests. Production unit performance is not verified over temperature.

PARAMETER	MIN	TYPICAL	MAX	COMMENTS
Operating Temperature	0 C		+55 C	
Temperature Monitor Range	-40 C		+85 C	Absolute, channel dedicated outputs
Channel Operating Temperature*	+35 C	+40 C	+45 C	Amplitude accuracy valid range
AC Power Supply	100 V_{AC}		240 V_{AC}	47 – 63Hz
Power Consumption **Chassis** **Channel (per)** **12 or 20GHz Channel (per)**		 5 W 7 W 15 W		
Warm-Up Time		10 min	20 min	20 C (ambient temp. dependent)

[1] Specifications are subject to change per the discretion of Holzworth Instrumentation, Inc

***NOTE:** Amplitude accuracy may vary when operated outside of channel operating temperature specified in section 6.3. Internal channel temperature should be monitored using the ":TEMP?" command (see Appendix A). External cooling is recommended to regulate internal temperature depending on ambient operating conditions and number of integrated channels.

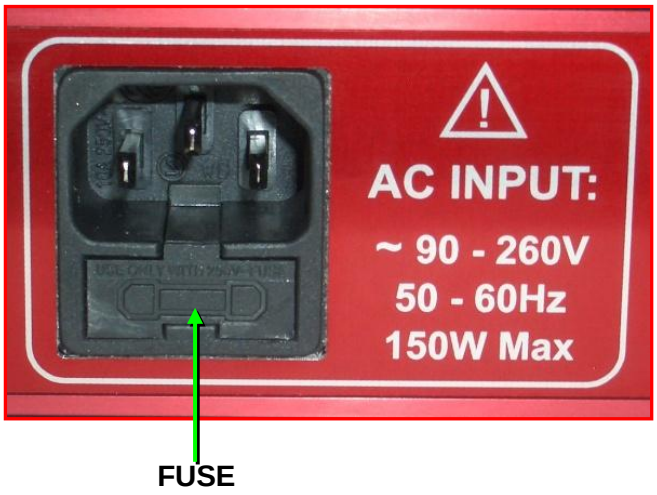
DESCRIPTION	SPECIFICATION (by design)
Operating Environment **Humidity** **Altitude** **Vibration**	 RH 20% to 80% at wet bulb temp. <29C (non-condensing) 0 to 2,000m (0 to 6,561 feet) 0.21 G-rms maximum, 5Hz to 500Hz
Storage (Non-Operating) **Temperature** **Humidity** **Altitude** **Vibration**	 -10C to + 60C RH 20% to 80% at wet bulb temp. <40C (non-condensing) 0 to 4,572m (0 to 15,000 feet) 0.5 G-rms maximum, 5Hz to 500Hz

6.0 MULTI-CHANNEL INSTALLATION

Prior to use of an HS9000B Series Multi-Channel Synthesizer users will need to be setup with the basic hardware and software.

6.1 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 final 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 located in the service tray on the power cord receptacle (rear panel). A spare fuse is provided inside the service tray.

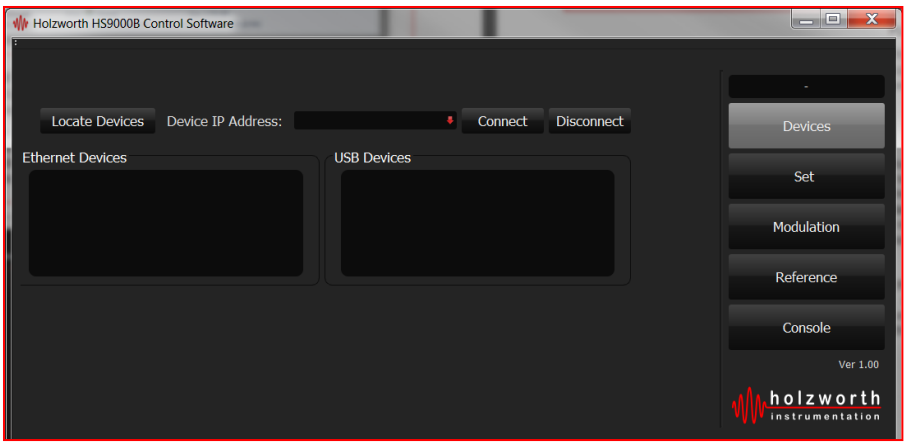
6.2 HS9000B SERIES APPLICATION GUI

The Holzworth HS9000B Series 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. Simply double click the executable file to launch the GUI. If the USB drive was lost another can be mailed or software can be downloaded using the URL below.

HS9000B Application GUI:
http://www.holzworth.com/software/Synthesizers/HS9000B/HS9000B.zip

7.0 HS9000B SYNTHESIZER COMMUNICATION

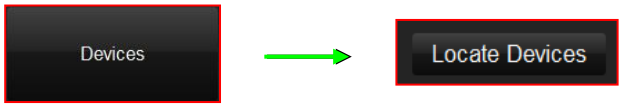
The application GUI can be used to control HS9000B synthesizers via Ethernet or USB communication. Custom, user created applications can be used to control the HS9000B via Ethernet, USB, RS-232, or GPIB communication. This section covers Ethernet and USB control with the GUI, where connections are established in the Devices menu (shown below).



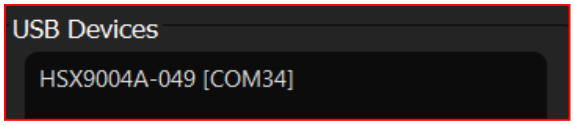
7.1 USB, RS-232, AND GPIB COMMUNICATION

With the HS9000B 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.

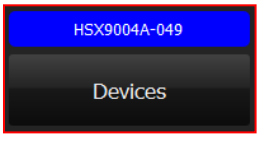
Click the **Devices** button on the right side of the GUI, followed by the **Locate Devices** button in the menu:



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:



In order to create a custom USB software interface or application to control Holzworth Synthesizers, the user must determine the COM port the instrument is using. The COM port associated with the USB connection to the HS9000B can be identified by using the application GUI as shown above or via the Windows Device Manager.

7.1.1 USB Communication Troubleshooting

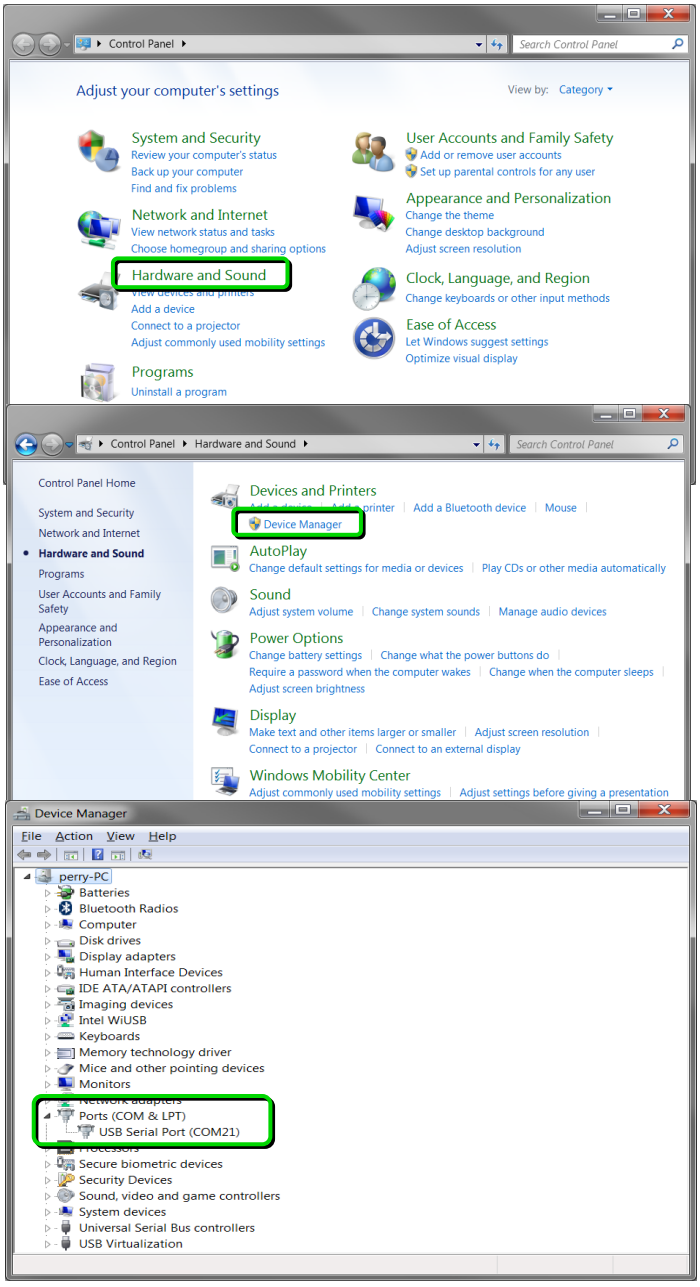
Follow the steps below to determine the instrument COM port via Windows Device Manager.

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 Holzworth application GUI please unplug the USB cable and power cycle the synthesizer. Wait 5-10 seconds for the synthesizer to initialize an 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.

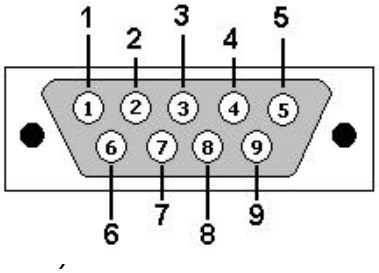
Device drivers: http://www.holzworth.com/software/Synthesizers/HSX/CDM21228_Setup.zip

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 Holzworth Support for further assistance.

7.1.2 RS-232 Hardware Specifications



1. Connector: DB9 Male Shrouded.
2. Logic Level: ±5V
3. Baud Rate: 115200 FIXED.
4. Bit Structure: 8 Data Bits, 1 Stop Bit, No Parity, No Flow Control
5. Carriage Return: Carriage return (ASCII Cc
6. 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

7.1.3 GPIB Communication

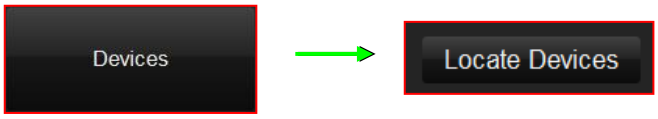
The Holzworth HS9000B synthesizers are GPIB capable. GPIB configuration commands are listed in Appendix C.

7.2 ETHERNET COMMUNICATION

7.2.1 LAN Connection

Communication with the HS9000B 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. "HS9000B-123") and the **TCP port (9760)**. Use the Holzworth Ethernet Finder software to locate and modify IP address settings on the instrument.

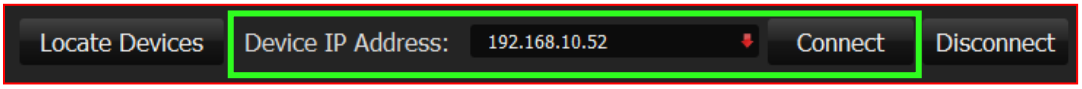
To search for devices, click the **Devices** button and then click **Locate Devices** in the sub menu.



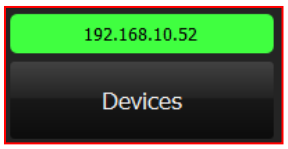
The software will then scan for instruments connected via Ethernet and via serial port. It will display Ethernet devices as shown below:

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.



7.2.2 DHCP

When the HS9000B is connected to a network with a DHCP server, the network settings will be auto-assigned per the servers configuration.

If the HS9000B 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

7.2.3 Assigning a Static IP Address

The most efficient way to assign the instrument a static IP address is to use the Console in the Holzworth GUI. The Console can be used to send the commands from Appendix B 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 section **7.1** and **7.2**, respectively.

Once a connection has been established, launch the Console**.** Now users can begin sending the ASCII commands from Appendix B. 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.
    - :IP:ADDR:<value>
2. Send the command to change the subnet address.
    - :IP:SUBNET:<value>
3. Send the command to change the gateway if necessary.
    - :IP:GATEWAY:<value>
4. Send the command to change from DHCP to Static.
    - :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.

7.3 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 are more than one, end each Holzworth process, re-launch the GUI, and attempt to establish a connection.

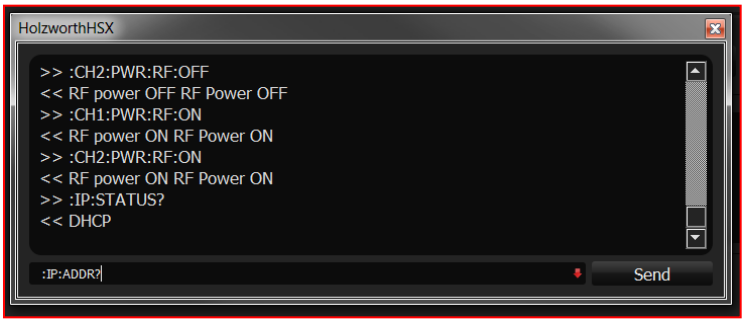
7.3.1 Ethernet Reset via USB & Console Window

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



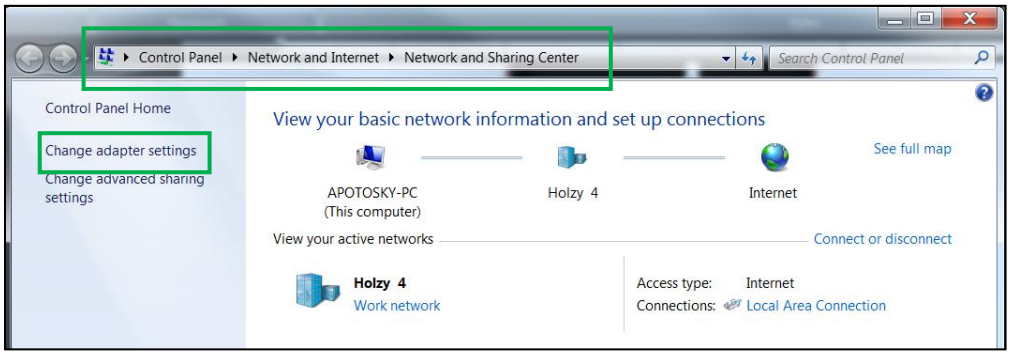
5. Begin by querying with the :IP:STATUS? command. Change status and/or re-configure the static network settings as necessary.

6. Power cycle the HS9000B if prompted. Any status change from DHCP to Static or vice versa will require a power cycle.

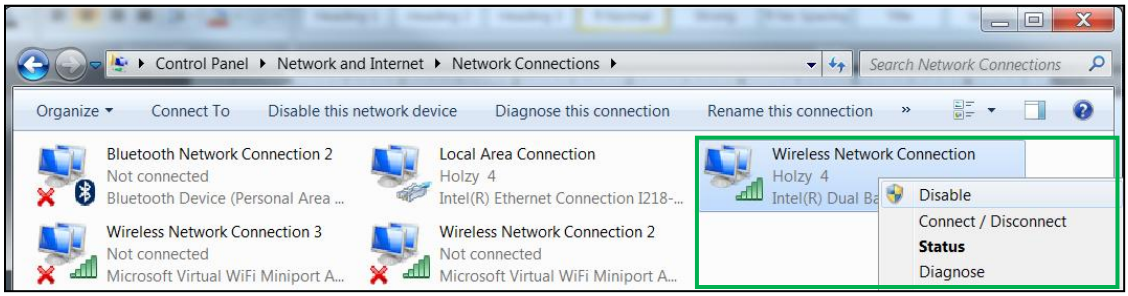
7.3.2 Miscellaneous Ethernet Troubleshooting

1. Ensure that the Holzworth 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 HA7062 and select Disable.

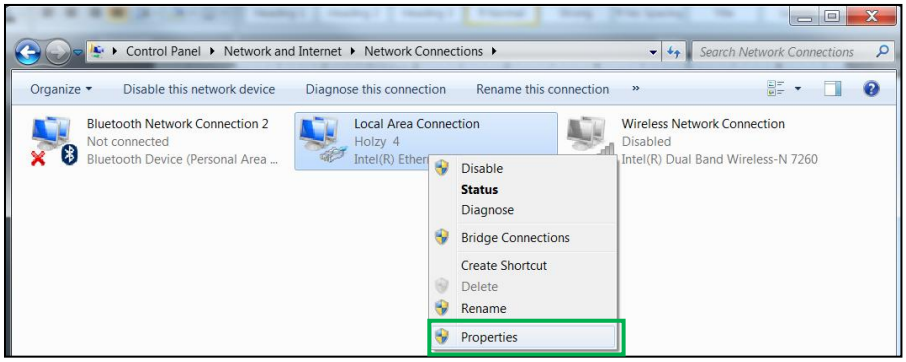


4. Close and re-launch the application GUI. Attempt to establish a connection with the HS9000B.

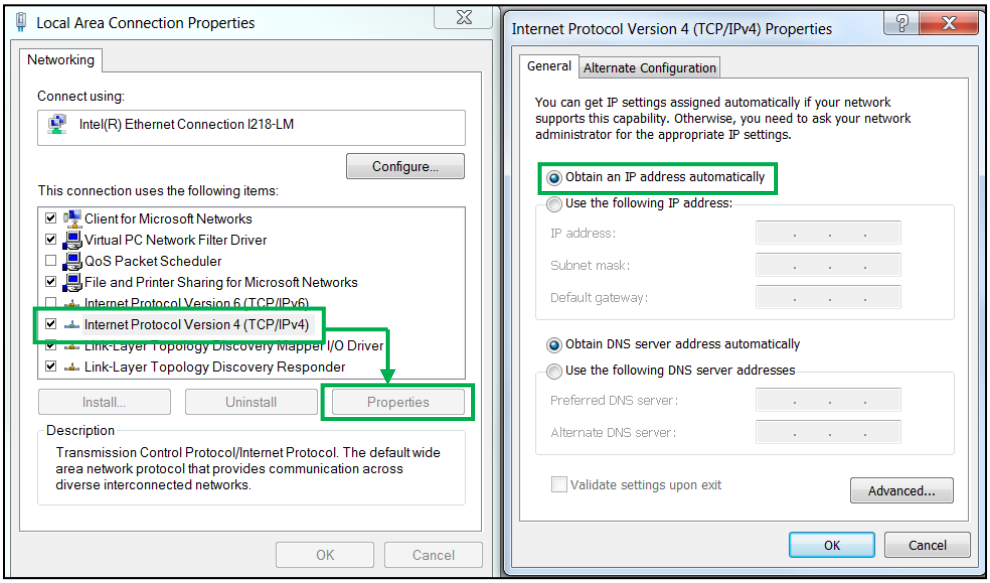
5. If connection remains unsuccessful, reset the PC network adapter in use to DHCP ('Obtain IP address automatically') and reset the synthesizer to DHCP using either method in the previous two sections.

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.

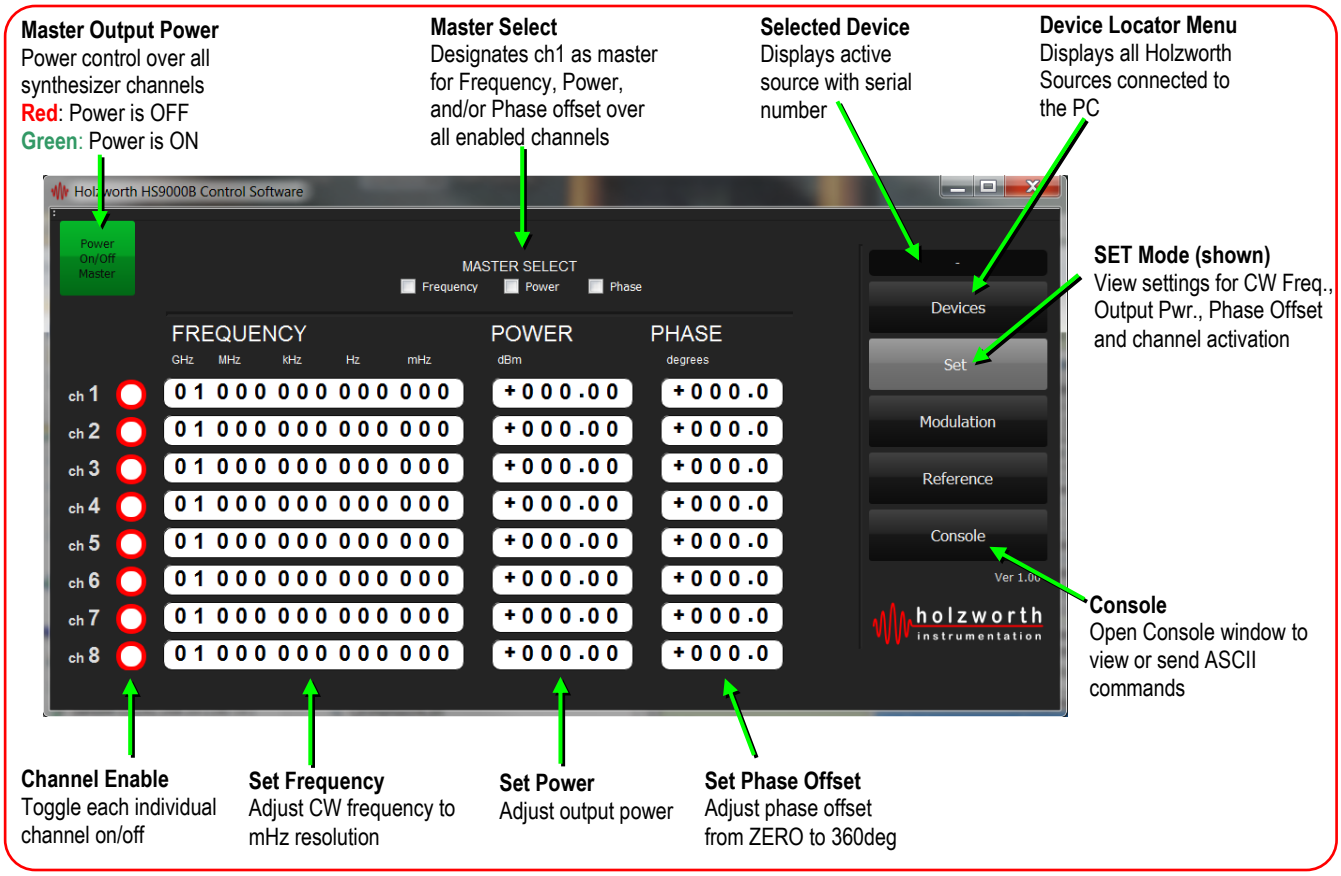
7. Close and re-launch the application GUI. Attempt to establish a connection to the HS9000B.

8. For further assistance please contact Holzworth Support.

8.0 APPLICATION GUI OPERATION

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

8.1 "SET" MENU



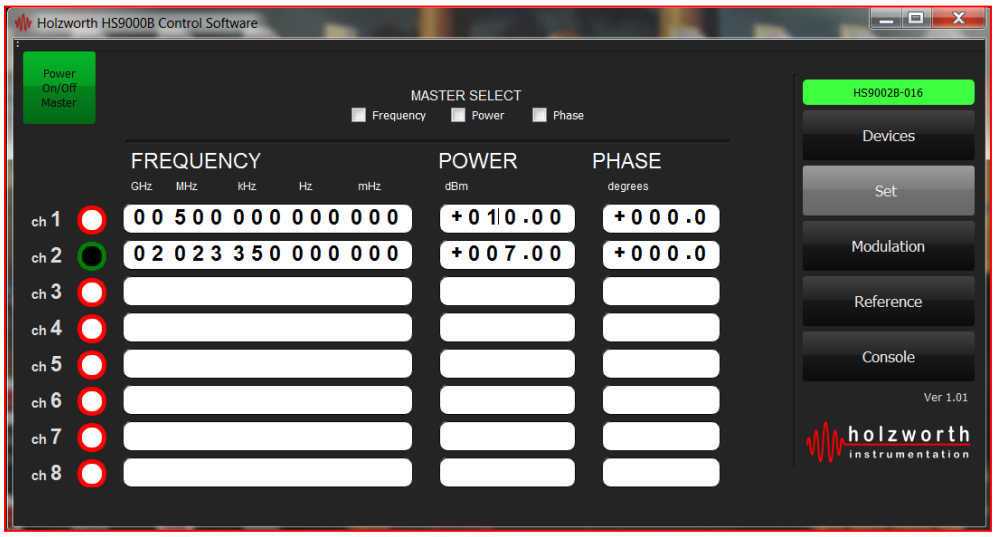
8.1.1 Keyboard Functions

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

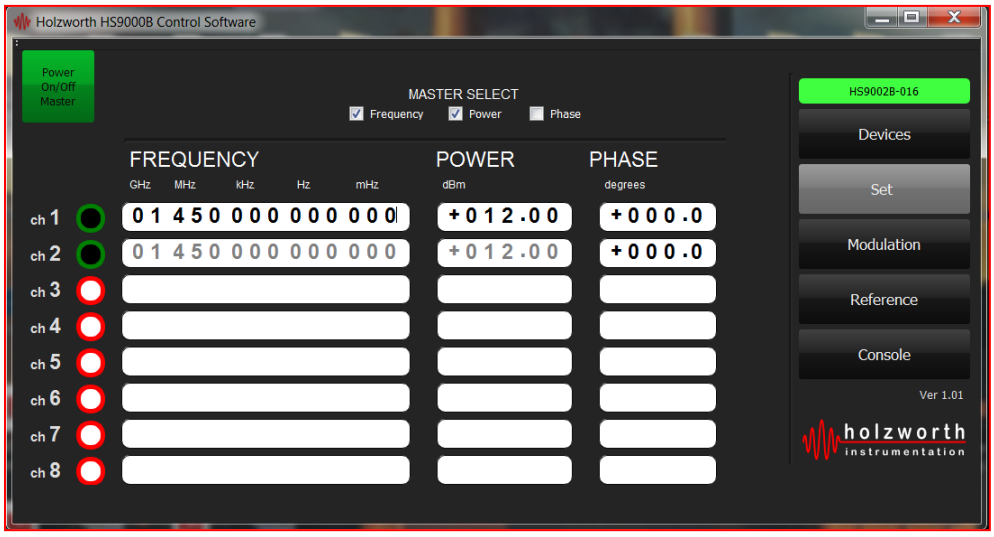
8.1.2 Channel Enable Function

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.



8.1.3 Master Select Function

The Master Select function allows for 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.



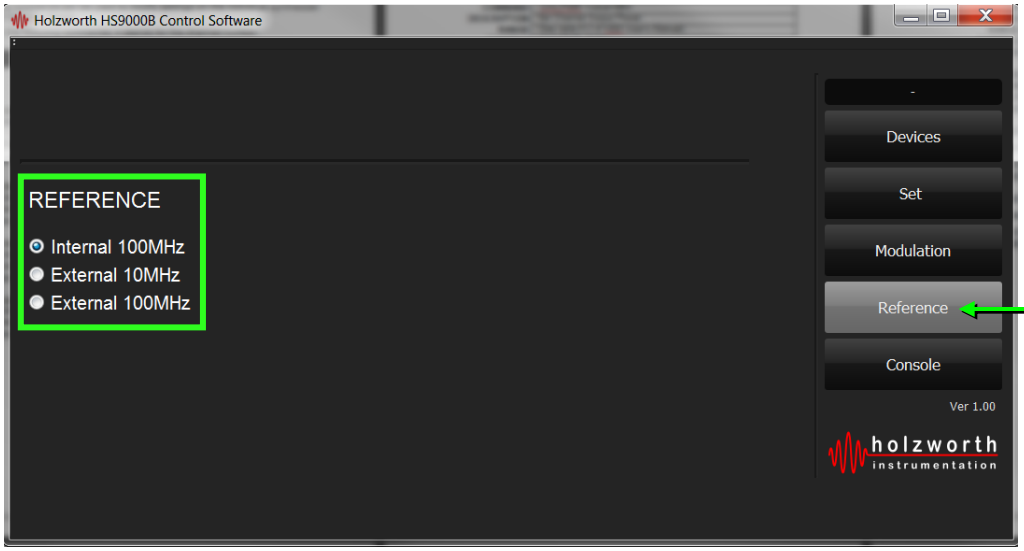
NOTE that the GUI does not specifically identify each channel frequency range, but the frequency limits of each loaded channel is auto-detected and hard set for each channel.

Unavailable Channels

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.

8.2 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.

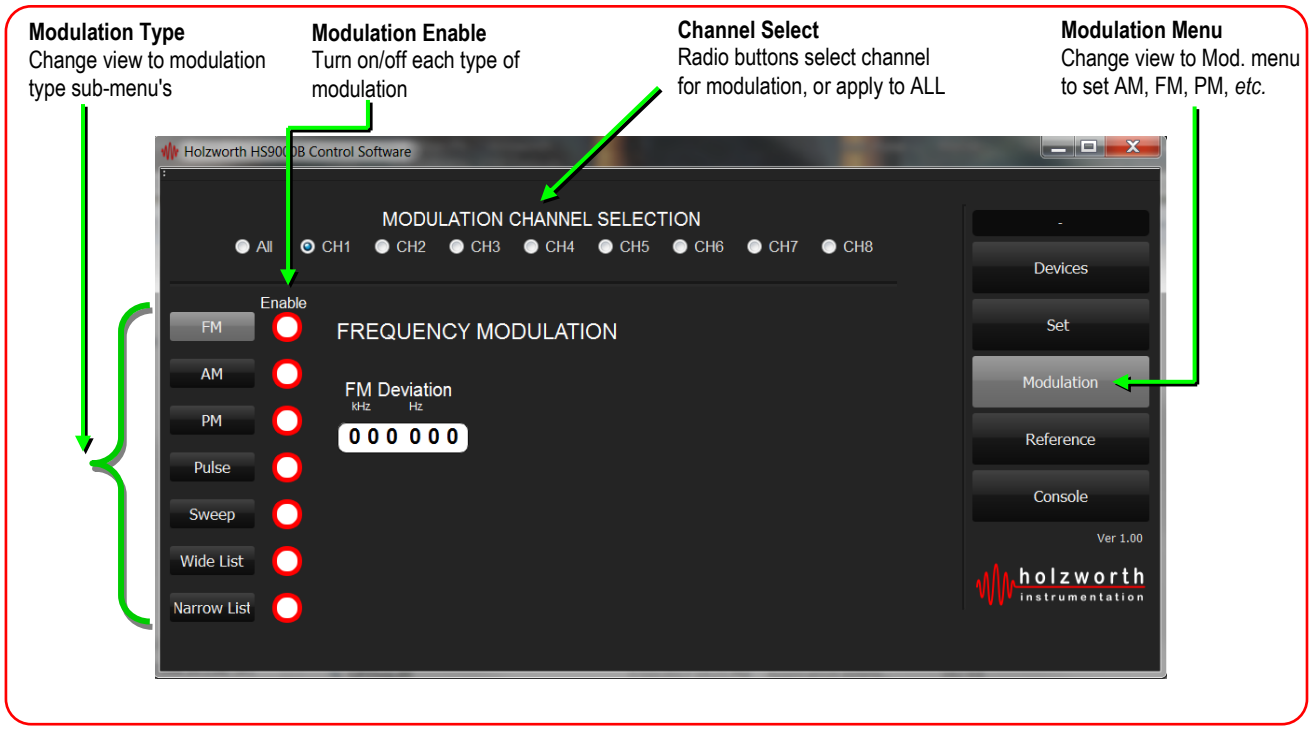


8.2.1 Setting OPT-REFX Frequency

If the HS9000B 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

8.3 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.



8.3.1 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 6.7GHz)		
Risetime (T_r) fc < 512MHz fc > 512 MHz	 10ns (typical) 35ns (typical)	
Falltime (T_f) fc < 512MHz fc > 512 MHz	 8ns (typical) 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 6.7GHz)		
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 (12.5 and 20GHz channels)		
Risetime (T_r)	<20 ns	
Falltime (T_f)	<20 ns	
On/Off Ratio 10MHz to 2GHz 2GHz to 5GHz 5GHz to 18GHz	 > 60dB > 50dB > 90dB	
Minimum Pulse Width	50 ns	
ALC Loop Deviation (ALC disabled)	1dB difference from ALC enabled	

8.3.2 Frequency Modulation(channels up to 6.7GHz, 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 (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 0V: Zero Deviation from Carrier - 1V: Maximum Negative Deviation

8.3.3 Phase Modulation (channels up to 6.7GHz, 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 0V: Zero Deviation from Carrier - 1V: Maximum Negative Deviation

8.3.4 Amplitude Modulation (channels up to 6.7GHz, external mod. stimulus)

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

PARAMETER	PERFORMANCE	COMMENTS
AMPLITUDE MODULATION (Analog)		
AM Depth Type	Linear	
Depth Maximum Resolution Depth Accuracy	 5% to 75% <3% of Maximum Depth 5% of Maximum Depth	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 0V: 50% of Maximum Depth - 1V: Maximum Depth

8.3.5 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.

8.3.6 List Mode (channels up to 6.7GHz)

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. Refer to section 8.3 for triggered list mode.

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 of 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*.

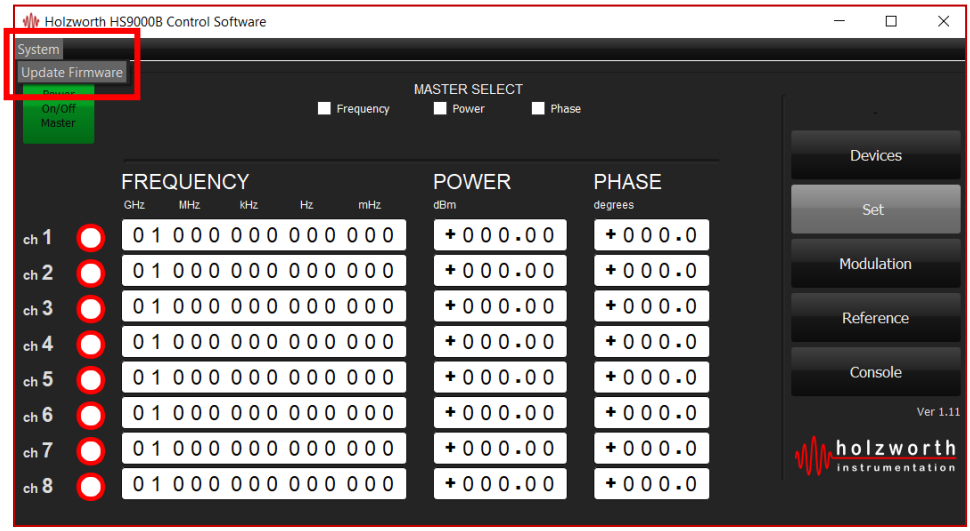
8.4 FIRMWARE UPDATES

HS9000B firmware can be updated via a USB connection by following the instructions below. Updates are performed using the Holzworth application GUI.

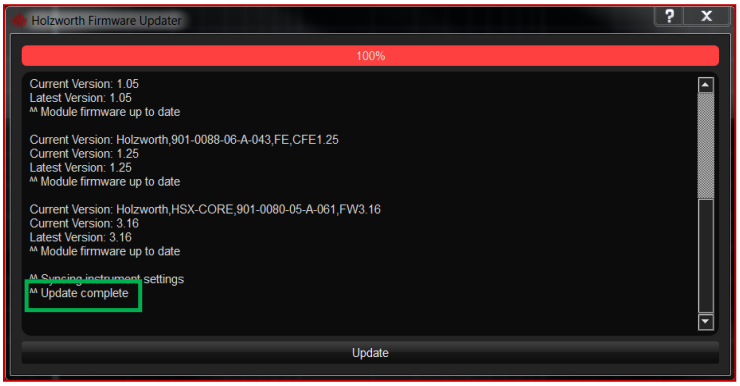
1. Ensure the PC is connected to the internet in order to download the latest software and to check for firmware updates. Download the latest software and extract all files from the .zip file. Double click the .exe file to launch the application GUI.

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.



9.0 RF INPUTS/OUTPUTS

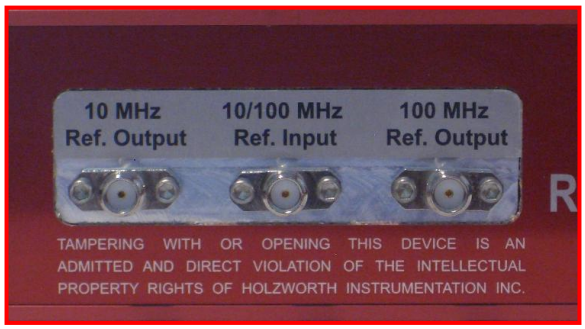
The HS9000B Series Multi-Channel RF Synthesizers are CW work horses. They are designed to do an excellent job of providing highly stable, phase coherent signals with pure spectrums and highly accurate output power amplitude control.

9.1 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 $25V_{DC}$ (+10dBm or 10mW).

9.2 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 the *internal* reference (free running).

9.2.1 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.

9.2.2 Reference Output Summary

Holzworth 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: Internal 100MHz OCXO (>20Hz OS) External 10MHz (<20Hz OS)	Divided from: Internal 100MHz OCXO (>20Hz OS) External 10MHz (<20Hz OS)
100MHz Signal applied	ACTIVE	Based on: Internal 100MHz OCXO (>20Hz OS) External 100MHz (<20Hz OS)	Divided from: Internal 100MHz OCXO (>20Hz OS) External 100MHz (<20Hz OS)

10.0 CONTACT INFORMATION

Contact Holzworth directly for product support. A list of US Sales Representatives and non-US Distribution partners are listed on the Holzworth website.

Holzworth Instrumentation Sales Support

Phone: +1.303.325.3473 (option 1)

Email: sales@holzworth.com

Holzworth Instrumentation Technical Support

Phone: +1.303.325.3473 (option 2)

Email: support@holzworth.com

www.HOLZWORTH.com

APPENDIX A: PROGRAMMING COMMANDS

The Holzworth Instrumentation HS9000B Series Synthesizers allow users to communication 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.

USB 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,HSM6001A,M1009-001,FW3.31,HS9002A-112

(Manufacturer, Device Name, Board #, Firmware version, Instrument Serial #)

Read Temperature

:TEMP? Query the temperature of the channel

Example TX: :CHn:TEMP?
RX: Temp = 40C

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 HS9000 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: 100.1 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

:REF:EXT:10MHz Set external 10MHz reference

Example TX: :REF:EXT:10MHz

RX: Reference Set to 10MHz External, PLL Enabled

: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

:REF:PLL? Query PLL Lock Status

Example TX: :REF:PLL?

RX: 1 PLL Locked <or> 0 PLL Unlocked <or>
0 PLL Disabled, External 100MHz <or>
0 PLL Disabled, Internal 100MHz

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

APPENDIX B: ETHERNET CONFIGURATION COMMANDS

All commands are ASCII commands. One command at a time may be issued over TCP. The ASCII commands begin with a colon (:) or asterisk (*).

The TCP buffer size is 100 bytes, but the default should be 64 bytes. Bytes sent beyond 64 will be ignored.

The commands on the following pages relate to the settings on the HCM5 module. To send commands to the HS9000B synthesizer channels, refer to Appendix B. The same ASCII commands sent over USB can also be sent over TCP.

If a command is not understood, the module will have in its buffer:

Invalid Command

The format for describing the command instruction is as follows:

:COMMAND:<value>		A Description of the command here.
	<value>	Defined here, if any, queries typically have no value
Example	TX:	Example ASCII sent in transmission
	RX:	Example ASCII received back, if a receive transmission is made

Host Software

A variety of host software can be used to communicate with the HS9000B via USB, Ethernet, RS-232, or GPIB.

Holzworth GUI – The Holzworth provided Multi-Channel application GUI can be used to detect HS9000B synthesizers connected via Ethernet or USB.

Terminal programs – Any terminal emulation program can be used to communicate with the HS9000B.

Custom applications – Any programming language or environment which provides network access can be used to communicate with the HS9000B.

Network Configuration

The HS9000B synthesizers supports static IP address and DHCP. The default setup is DHCP. The network parameters can be configured using the Holzworth Ethernet Configuration GUI or the commands listed in the instruction set on the following pages.

In the event the static IP network parameters are incorrectly set and the module cannot be found on the network, establish a USB connection and use the Holzworth Ethernet Reset GUI to reset the synthesizer to DHCP mode.

UDP Discovery packets are accepted over port 30303. Send the request “Discovery: Who is out there?” to receive a list of Holzworth devices on the network.

The HS9000B accepts TCP requests over port 9760. All instructions to the synthesizers or the HCM5 module should be sent via a TCP socket connection.

TCP data communication can be established using the device IP address or the device host name. The host name is the complete serial number of the HS9000B synthesizer. An example host name is HS9005B-309.

Ethernet Configuration Commands

:IP:STATUS:<value> Set IP status to Static IP or DHCP

<value> STATIC <or> DHCP

Example TX: :IP:STATUS:STATIC

RX: DHCP status changed. Restart Device

:IP:STATUS? Query IP status

Example TX: :IP:STATUS?

RX: Static IP Address <or> DHCP

:IP:ADDR:<value> Set Static IP Address

<value> IP Address

Example TX: :IP:ADDR:192.168.10.11

RX: Static IP address changed

:IP:ADDR? Query Static IP Address

Example TX: :IP:ADDR?

RX: 192.168.10.11

:IP:GATEWAY:<value> Set Gateway IP Address for Static IP

<value> Gateway IP Address

Example TX: :IP:GATEWAY:192.160.10.1

RX: Gateway address changed.

:IP:GATEWAY? Query Gateway Address

Example TX: :IP:GATEWAY?

RX: 192.160.10.1

:IP:SUBNET:<value> Set Subnet for Static IP Address

<value> IP Address

Example TX: :IP:SUBNET:255.255.0.0

RX: Subnet address changed

:IP:SUBNET? Query Subnet Address

Example TX: :IP:SUNET?

RX: 255.255.0.0

APPENDIX C: 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"

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