

Holzworth
HA7163A
50 GHz DOWNCONVERTER



HA7163A



50 GHz DOWNCONVERTER

COMPATIBLE WITH:

- HA7062C and HA7162C PHASE NOISE ANALYZERS
- HA7062D and HA7162D PHASE NOISE ANALYZERS

REAL TIME DATA ACQUISITION

HA7163A 50 GHz Downconverter

PRODUCT SUMMARY



The HA7163A 50 GHz Downconverter extends the frequency range of Holzworth's HA7162C and HA7162D Real Time Phase Noise Analyzers to 50 GHz. The 2x 1U chassis configuration operates as a single phase noise test system. The HA7163A and HA7162C/D connect via RF cabling on the front panels, along with an RS-232 connection on the rear panel so there is no need for independent control. Users communicate via a single Ethernet, USB, or GPIB connection to the test system.

MEASURED NOISE FLOORS: Holzworth phase noise analysis solutions offer the unique feature to measure the true noise floor of each phase noise analyzer, while alternative options provide a confidence factor calculation that is often misinterpreted as being the actual noise floor. The HA7162C and HA7162D Real Time Phase Noise Analyzer products were designed to provide direct access to the phase detectors (mixers) to enable measurement of the analyzer's true noise floor. The HA7163A also offers this feature as a factory configured option.

UNPARALLELED ANALOG PERFORMANCE: The HA7163A utilizes Holzworth ultra low noise HSX series synthesizers to down-convert incoming signals into an acceptable range for the phase noise analyzer. The phase noise analyzers utilize real time dual FFT engines at its core, but everything begins at the ultra-low noise analog front end. A key component of the analyzer's analog front end is another pair of Holzworth HSX Series RF Synthesizers as the analyzer's internal LO's. These ultra-low noise RF sources (LOs) complement the extremely fast and low noise measurement capability. The test system provides user access to 2x 6 GHz synthesizers and 2x 24 GHz synthesizers for general purpose use.

KEY SPECIFICATIONS AND FEATURES

- Real-Time Full Bandwidth Data Acquisition
- Versatile - Reconfigurable Front End
- Measure: PM / AM / Baseband / Spurious / Jitter
- Isolated AM / PM
- Automated Residual Measurements
- Outstanding Accuracy

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PRODUCT SUMMARY-BLOCK DIAGRAM

VERSATILE: The HA7163A is a result of more than a decade of product development that reflects valuable customer feedback and Holzworth's direct experience with measuring phase noise in our own manufacturing environment. The end result goes well beyond accuracy, reliability and speed. The reconfigurable front end allows users to tailor the analyzer for their specific measurement needs.

The HA7163A is designed to seamlessly integrate with either the HA7162C or the HA7162D Real Time Phase Noise Analyzer products. Specific RF jumper cable connections are required at the front panel with an I/O jumper cable connector at the rear panel. With the two units properly connected, they become one unit and operate via a single application GUI.

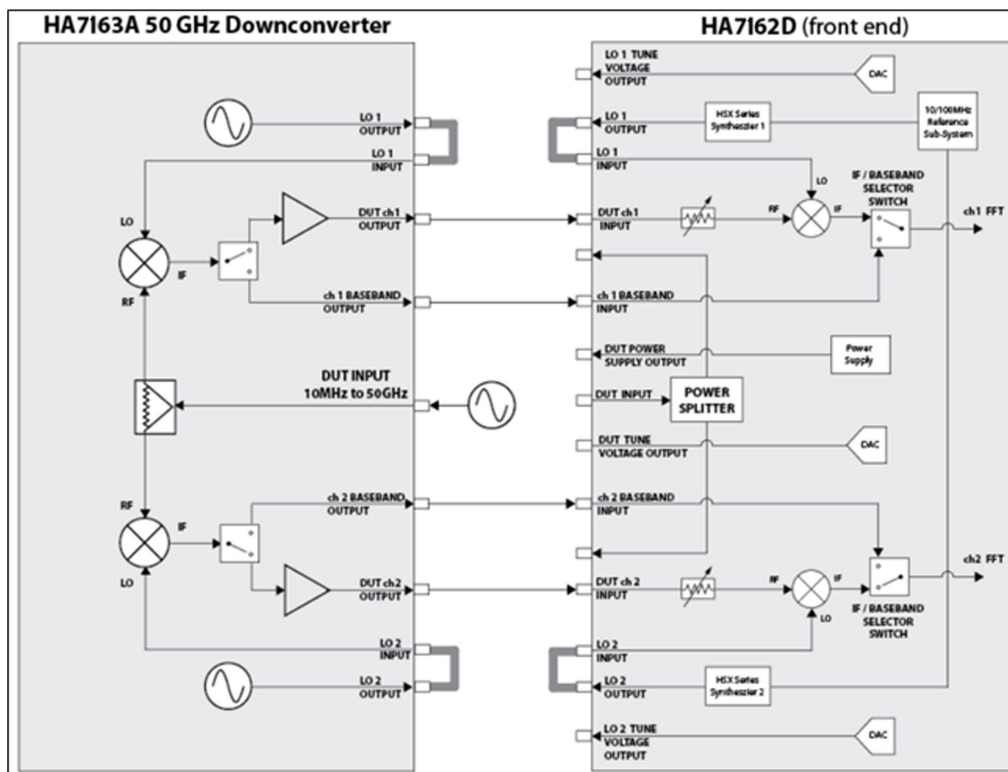


Figure 1: With the HA7163A integration kit, a user will also receive either a benchtop bracket kit or a communications rack installation kit. Both kits are designed to securely house the HA7163A and the HA7162C/D for ease of integration and/or mobility.

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HA7163A SPECIFICATIONS

MEASUREMENT MODES

MODE	DESCRIPTION
Absolute	Internal synthesized LO sources. Auto tune and phase lock. Connect DUT Signal direct to HA7163A.
Absolute with External LOs	External LO Inputs available on HA7163A and HA7162D/HA7162C
Additive/Residual	External Signal Source and phase shifters required.
AM Noise	Characterize AM noise of RF input signal
Baseband	Baseband measurements out to 100MHz offset (with HA7162D)
Spurious Analysis Toolbox	Provides spurious performance data based on a user settable Spur Threshold.

DUT INPUT

DESCRIPTION	SPECIFICATION
DUT Input Connector	2.4mm (female), 50 ohm
DUT Input Frequency Range	
Absolute Measurements	10 MHz to 50 GHz
Residual (Additive) Measurements	1 GHz to 50 GHz (can be reconfigured to measure to 10MHz DUT input) ¹
AM Measurements	10 MHz to 50 GHz
External LO PM Measurements	1 GHz to 50 GHz
Baseband Measurements	0.1 Hz to 100 MHz
DUT Input Measurement Level	
10 MHz to 6 GHz	-20 dBm to +20 dBm (Subtract 10 dBm from lower limit for typical sensitivity)
>6 GHz to 18 GHz	-10 dBm to +20 dBm (Subtract 10 dBm from lower limit for typical sensitivity)
>18 GHz to 32 GHz	- 0 dBm to +20 dBm (Subtract 10 dBm from lower limit for typical sensitivity)
>32 GHz to 50 GHz	+10 dBm to +20 dBm (Subtract 10 dBm from lower limit for typical sensitivity)
DUT Input Damage Level	+22 dBm
RF Tracking Range	±10ppm (typical), ± 5ppm (specified)
Cross-Correlation Noise Floor	Refer to pages 8-9 for measured noise floor data.

¹ Additive/Residual measurements in the frequency range of 10 MHz to 1 GHz can be performed using the DUT input port of the HA7062C/D.

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HA7163A SPECIFICATIONS (cont.)

MEASUREMENT BANDWIDTH & UNCERTAINTY

DESCRIPTION	SPECIFICATION
Offset Frequency Range (w/ HA7162D)	
PM Measurements	0.1Hz to 100 MHz
AM Measurements	0.1Hz to 1 MHz
Baseband Measurements	0.1Hz to 100 MHz
Offset Frequency Range (w/ HA7162C)	
PM Measurements	0.1Hz to 40 MHz
AM Measurements	0.1Hz to 1 MHz
Baseband Measurements	0.1Hz to 40 MHz
Phase Noise Uncertainty (Absolute Measurements)	
1 Hz to 10 Hz offset	± 4 dB
10 Hz to 1 kHz offset	± 3 dB
1 kHz to 100 MHz offset	± 2 dB
Phase Noise Uncertainty (Additive Measurements)	
1 Hz to 1 kHz offset	± 3 dB
1 kHz to 100 MHz offset	± 2 dB

DUT CH1 / DUT CH2 OUTPUTS (IF FREQUENCY OUTPUTS)

DESCRIPTION	SPECIFICATION
DUT Output Connectors	SMA (female), 50 ohm
DUT Output Frequency (IF Frequency)	DC to 400 MHz
IF Gain	
Standard	Auto Select
User Selectable	6 dB, 12 dB, 24 dB, 36 dB, 48 dB

LO INPUTS

DESCRIPTION	SPECIFICATION
LO Input Connector	2.4mm (female), 50 ohm
LO Input Frequency Range	1 GHz to 50 GHz
LO Input Level	+15 dBm to +19 dBm

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HA7163A SPECIFICATIONS (cont.)

LO OUTPUTS

The HA7163A internal LOs are from Holzworth's HSX Series RF Synthesizers and are available to the user as general purpose CW signal sources via the front panel. Removing the LO jumper cables provides direct access to these signal sources.

DESCRIPTION	SPECIFICATION
LO Output Connector	SMA (female), 50 ohm
LO Output Frequency Range	10 MHz to 24 GHz
LO Output Power	
10 MHz < f ≤ 16.0 GHz	-30 dBm to +18 dBm
16.0 GHz < f ≤ 20.0 GHz	-30 dBm to +16 dBm
20.0 GHz < f ≤ 24.0 GHz	-30 dBm to +14 dBm

INTERNAL TIME BASE (10 MHz Reference Module for internal frequency counter)

DESCRIPTION	SPECIFICATION
Adjust-to-Nominal	< ± 1Hz at 10MHz (±100 ppb) At time of shipment.
Temperature Effects	+/- 20 ppb
Aging Rate	< 100ppb/yr

POWER METER ACCURACY

PARAMETER	MIN	TYPICAL	MAX	COMMENTS
Input Power Meter Accuracy		±3 dB	±4 dB	10 MHz to 50 GHz with Internal LOs

ISO17025 CALIBRATION

DESCRIPTION	SPECIFICATION
Frequency Offset Range	
HA7162C	1 Hz – 40 MHz
HA7162D	1 Hz – 100 MHz

AC POWER & DATA I/O

DESCRIPTION	SPECIFICATION
AC Power Input	International AC Power Supply
Connector Type	IEC 320-C13
AC Input Rating	100-240VAC, 47-63Hz. Specify country at time of order for proper power cord.
Data I/O Interface	Ethernet, USB, and GPIB available to control the HA7163A as a standalone downconverter or a dual CW source.

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SPECIFICATIONS – MEASUREMENT SPEED/CROSS CORRELATION

NOTE: Measurement times shown below are total data acquisition time. Data acquisition time does not include data transfer time to PC. Utilizing an Ethernet/LAN connection is recommended to best take advantage of the data acquisition speed of the instrument.

TABLE 1: DATA ACQUISITION SPEED

Improvement factor: $\text{dB} = 5\log N$ (N = No. of correlations)

1 Cross-Correlation									
64 Samples		128 Samples		256 Samples		512 Samples		1024 Samples	
-	-	-	-	0.1 Hz	17 s	0.1 Hz	34 s	0.1 Hz	1 m, 8 s
1 Hz	1.1 s	1 Hz	2.2 s	1 Hz	4.3 s	1 Hz	8.6 s	1 Hz	17 s
10 Hz	0.3 s	10 Hz	0.5 s	10 Hz	1.1 s	10 Hz	2.2 s	10 Hz	4.3 s
100 Hz	0.1 s	100 Hz	0.1 s	100 Hz	0.3 s	100 Hz	0.5 s	100 Hz	1.1 s
1 kHz	<0.1 s	1 kHz	<0.1 s	1 kHz	0.1 s	1 kHz	0.1 s	1 kHz	0.3 s
10 kHz	<0.1 s	10 kHz	<0.1 s	10 kHz	<0.1 s	10 kHz	<0.1 s	10 kHz	<0.1 s
100 kHz	<0.1 s	100 kHz	<0.1 s	100 kHz	<0.1 s	100 kHz	<0.1 s	100 kHz	<0.1 s
1 MHz	<0.1 s	1 MHz	<0.1 s	1 MHz	<0.1 s	1 MHz	<0.1 s	1 MHz	<0.1 s

10 Cross-Correlations									
64 Samples		128 Samples		256 Samples		512 Samples		1024 Samples	
-	-	-	-	0.1 Hz	2 m, 51 s	0.1 Hz	5 m, 42 s	0.1 Hz	11 m, 24 s
1 Hz	11 s	1 Hz	21 s	1 Hz	43 s	1 Hz	1 m, 25 s	1 Hz	2 m, 51 s
10 Hz	2.7 s	10 Hz	5.4 s	10 Hz	11 s	10 Hz	22 s	10 Hz	43 s
100 Hz	0.7 s	100 Hz	1.3 s	100 Hz	2.7 s	100 Hz	5.4 s	100 Hz	11 s
1 kHz	0.2 s	1 kHz	0.3 s	1 kHz	0.7 s	1 kHz	1.3 s	1 kHz	2.7 s
10 kHz	<0.1 s	10 kHz	<0.1 s	10 kHz	0.1 s	10 kHz	0.2 s	10 kHz	0.3 s
100 kHz	<0.1 s	100 kHz	<0.1 s	100 kHz	<0.1 s	100 kHz	<0.1 s	100 kHz	<0.1 s
1 MHz	<0.1 s	1 MHz	<0.1 s	1 MHz	<0.1 s	1 MHz	<0.1 s	1 MHz	<0.1 s

TABLE 2: CROSS-CORRELATIONS vs. PHASE NOISE IMPROVEMENT

Improvement factor: $\text{dB} = 5\log N$ (N = No. of correlations)

Number of Correlations	1	10	100	1,000	10,000
dB Improvement	0 dB	5 dB	10 dB	15 dB	20 dB

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MEASURED NOISE FLOORS – MEASUREMENT SETUP

Holzworth and some alternate brand phase noise analyzers offer a cross correlation confidence factor, which is a noise floor approximation based on the DUT data being acquired. This confidence factor is often confused with being the noise floor of the instrument, but it is not the actual noise floor. Holzworth offers the unique feature to measure the true noise floor of the phase noise analysis products.

The HA7162C and HA7162D test systems were designed to provide direct access to the phase detectors (mixers) to enable measurements of the actual noise floor of the analyzer at any given frequency. The HA7163A offers this feature as a factory configured option.

To perform a noise floor measurement, the internal power splitter is bypassed to directly access the phase detectors of each channel while measuring two non-coherent frequency sources.

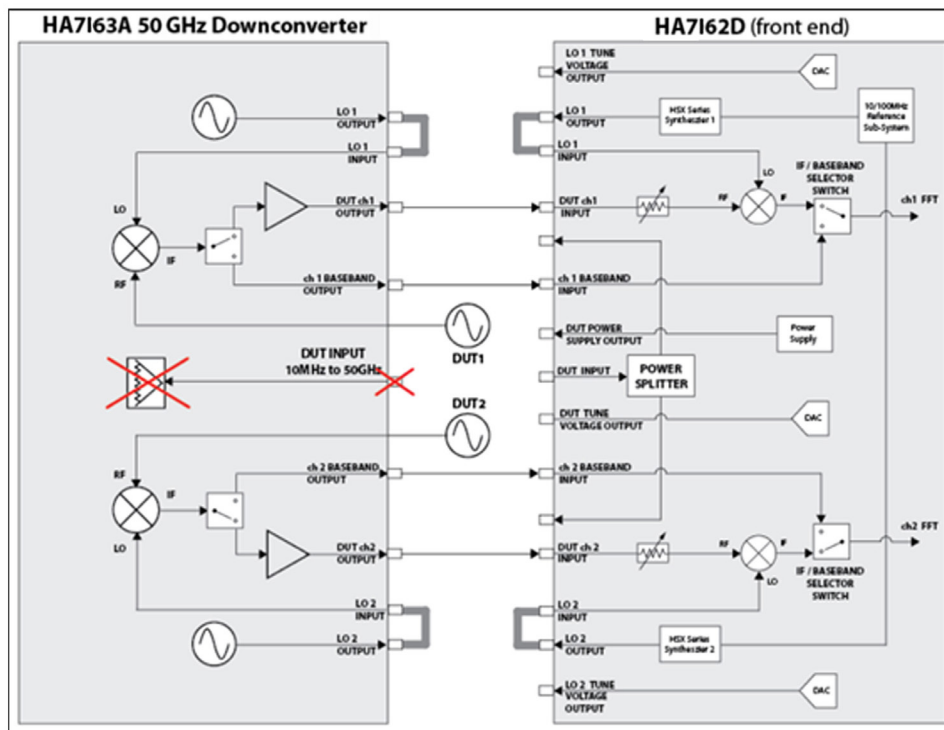


Figure 3: Noise Floor Measurement Block Diagram

For HA7163A units that do not include the option for phase detector access, Holzworth performs these measurements at predetermined frequency points, prior to product shipment.

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MEASURED NOISE FLOORS – DATA

The data contained in this section demonstrates the noise floor capability of the HA7163A when used in conjunction with an HA7162C/D at 12 GHz, 24 GHz, and 50 GHz. The plots reflect the actual noise floor for 10 correlations. For DUT frequencies below 6 GHz, the noise floors mirror those of the HA7162C/D (refer to each product specification). Further improvement in the noise floor can be achieved by utilizing more correlations (refer to Table 2, located on page 7).

The data contained in this section was acquired using a minimum offset frequency of 1Hz and data resolution of 256 points per decade. For reference, the data acquisition times for different number of correlations over a measurement bandwidth of 1Hz to 100MHz are approximated as follows:

1 correlation: 4.3s

10 correlations: 43s

100 correlations: 7 min, 9s

NOTE: Setting the instrument to a greater minimum offset frequency and/or a lower data resolution setting will further improve the measurement speeds.

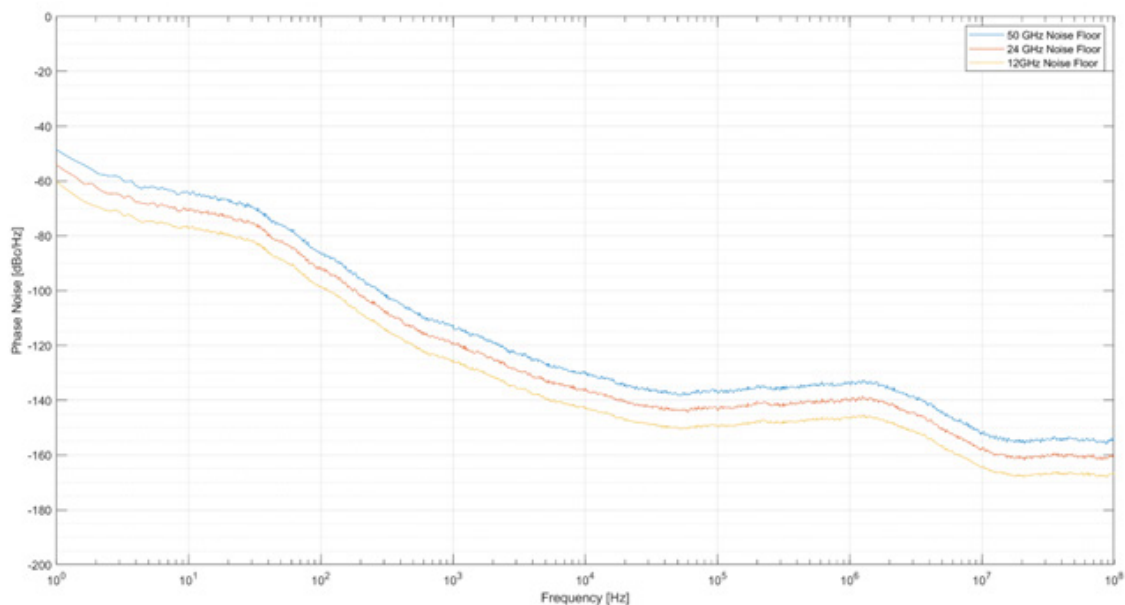


Figure 4: Measured Noise Floor

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EXTERNAL LO MODE (cont.)

EXTERNAL LO's for DOWNCONVERSION – HA7163A LO INPUTS

DESCRIPTION	SPECIFICATION
LO Input Connector	2.4mm (female), 50 ohm
LO Input Frequency Range	1 GHz to 50 GHz
LO Input Level	+15 dBm to +19 dBm
IF Frequency Range	DC to 400 MHz

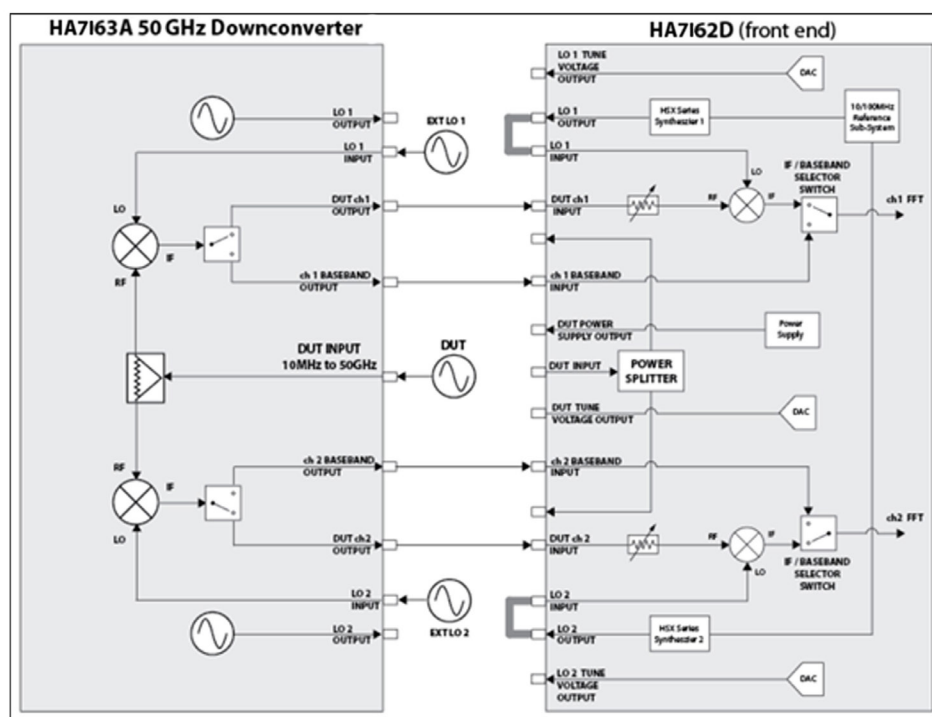


Figure 6: Absolute Measurement Using External Local Oscillators.

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ADDITIVE MODE

STANDARD OPERATION - 1 GHz to 50 GHz

For standard operation in additive mode refer to the specifications and block diagram below. Refer to holzworth.com for the HA7162D/HA7162C datasheets for additive measurement specifications and measurement setups < 1 GHz. Holzworth offers the HX5100 Electronic Phase Shifter products for automating additive / residual measurements.

DESCRIPTION	SPECIFICATION
Input Frequency Range	1 GHz to 50 GHz
LO Input Level	+10 dBm to +19 dBm

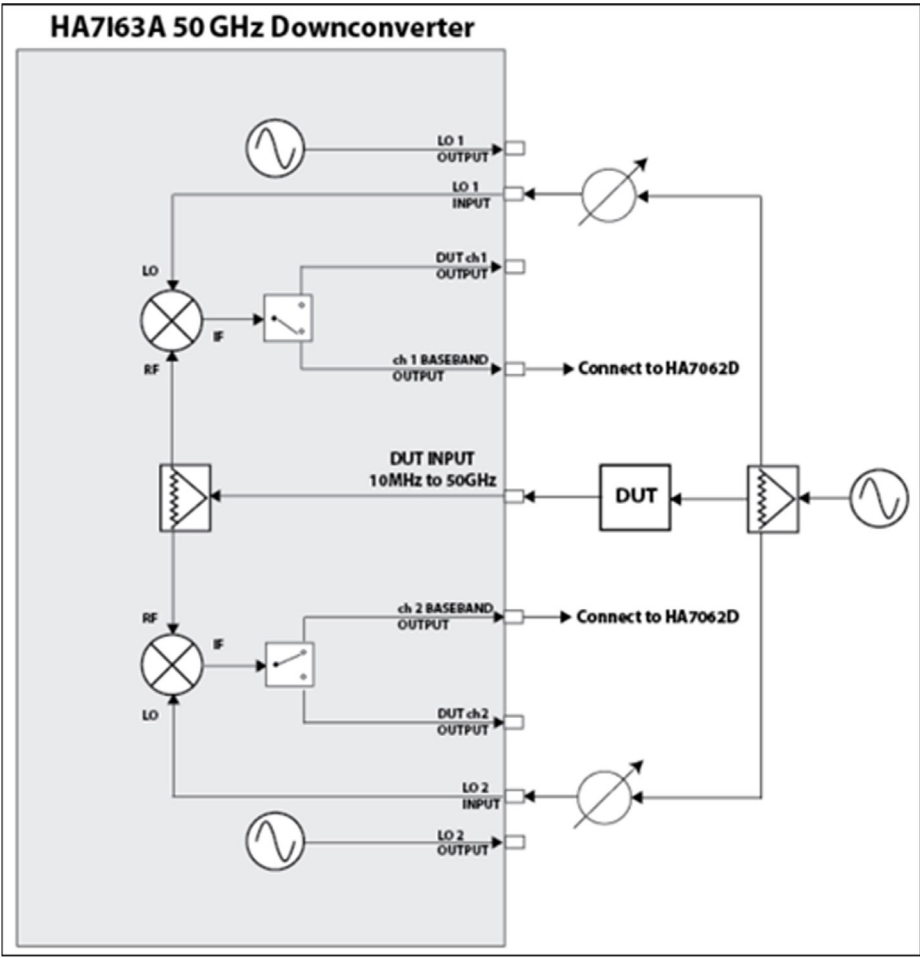


Figure 7: Additive Noise Measurement Setup

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CONFIGURATION

MECHANICAL DIMENSIONS

All Holzworth Analyzer/Downconverter products come in a 1U high, rack mountable chassis form factor. Holzworth offers brackets for bench top operation and rack mount applications. The drawing below illustrates the size of a single chassis. The HA7162D front panel is currently shown below.

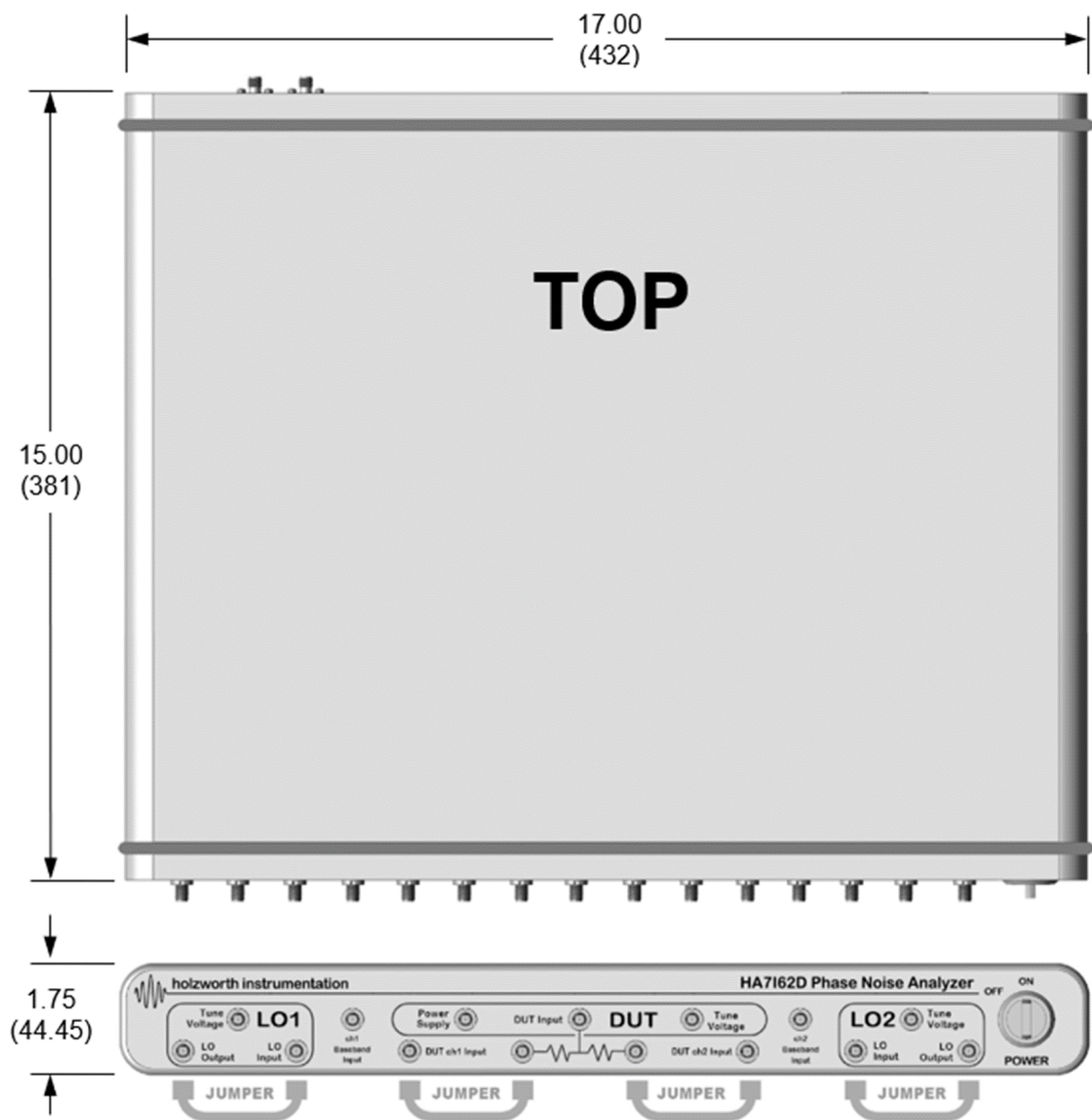


Figure 8: Front panel dimensions HA7162D

DIMENSIONS (L X W X H)	1U high, 19" rack mount: 15 in x 17 in x 1.75 in (381 mm x 431.8 mm x 44.5 mm)
WEIGHT	25 lbs. (11.34 kilograms) MAXIMUM

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CONFIGURATION (cont.)

PHYSICAL

Dimensions (L x W x H) each chassis	1U high, 19" rack mount: 15in x 17in x 1.75in (381mm x 431.8mm x 44.5mm)
Weight (per chassis)	25 lb (11.34 kilograms) MAXIMUM

ENVIRONMENTAL

DESCRIPTION	SPECIFICATION (BY DESIGN)
Operating Environment Temperature Humidity Altitude Vibration	+10C to +40C 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

HA7163A 50 GHz Downconverter CONFIGURATION (cont.)

OPTIONS & ACCESSORIES

Holzworth offers options and accessories to optimize the analyzer for an intended application. Specify all required options and/or accessories when requesting a quotation or placing a purchase order.

PART No.	DESCRIPTION	CLASSIFICATION
HX5100-x	Electronic Phase Shifter PAIR, Additive Measurements, 1 Octave Bandwidth, Specify fc	ACCESSORY
CASE-1U	Ruggedized Carrying Case with TSA security lock	ACCESSORY

INCLUDED HARDWARE

TYPE	DESCRIPTION
HARDWARE	HA7163A 50 GHz Downconverter
HARDWARE	AC Power Cord (7ft/2.1m). Specify country of end use.
HARDWARE	Ethernet Cable (10ft/3m)
HARDWARE	USB Cable (6ft/1.8m)

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GENERAL OPERATION

While using the HA7163A, all data processing is performed internally on the coupled HA7162C/D. Measurement settings can be changed using serial commands sent to the HA7162C/D via any of the included communication options. Measurement results can be read back directly from the instrument, eliminating the use of the application GUI. This capability provides unparalleled operational flexibility, ideal for ATE applications.

Purchase of Holworth phase noise analysis products includes full access to the C++ based GUI for hardware operation and viewing/saving data. All software/firmware upgrades and functionality additions are freely available for the life of the instrument at no additional cost to the user.

SOFTWARE

The Holworth software team has designed an industry leading interface to provide an extremely user-friendly means to utilize the full functionality of the HA7163A + HA7162C/D on any Windows-based PC. In addition, any software/firmware updates are made available at no charge. Refer to the software menu summaries on page 16 for an overview of the GUI.



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SOFTWARE (cont.)

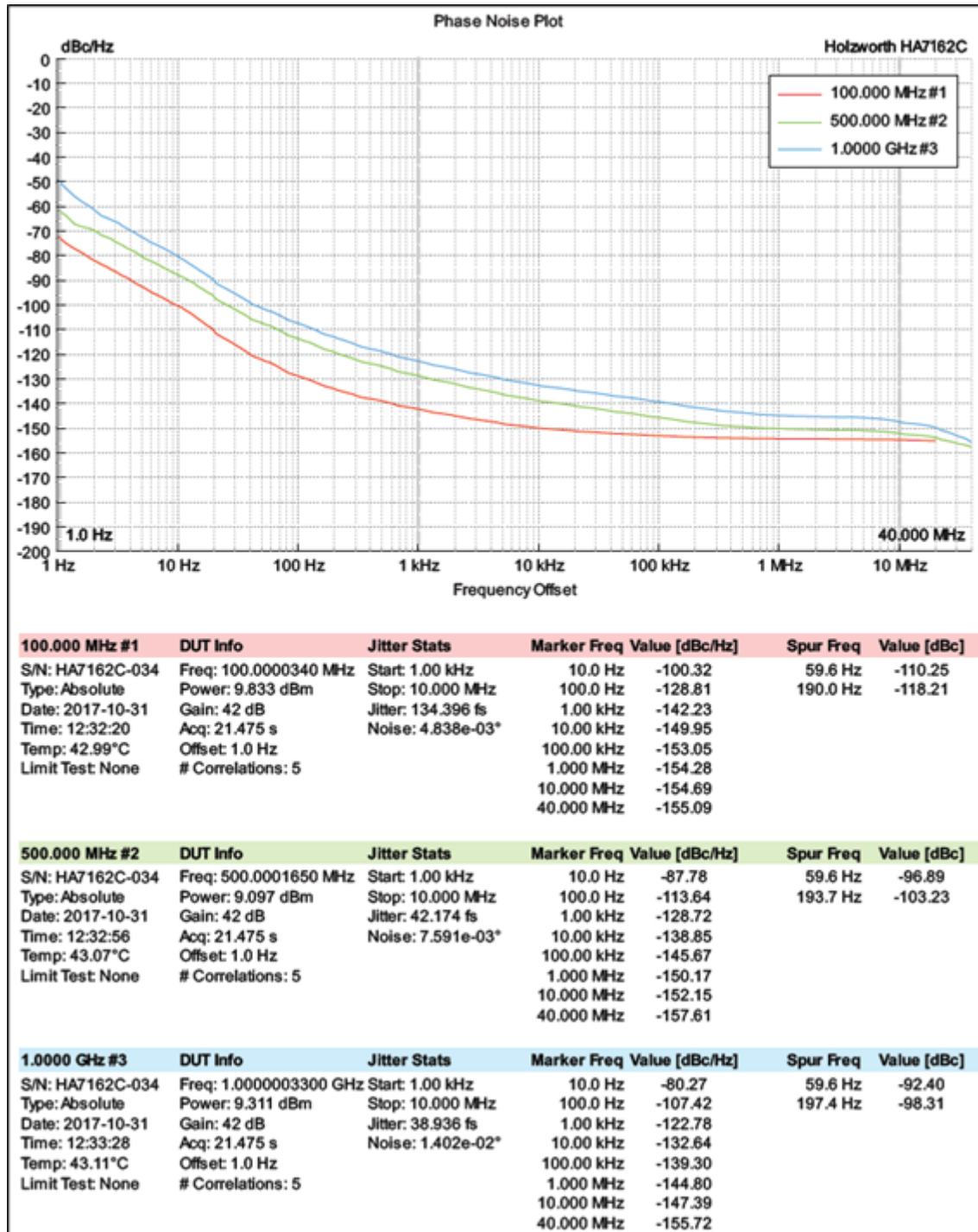
The software menus identified on the previous page are described below.

1. **File:** Save, load, export, import data; and generate reports. The report generator captures the current plot and any measurement statistics (see page 17).
Tools: Quick access to the Tune Voltage outputs on the analyzer and displays input frequency and power for either LO1, LO2, or the DUT port. DC Monitor available for monitoring phase detector output.
System: Create instrument setting presets (saving time for commonly used measurement setups), view/save measurement debug files, and manually perform firmware updates.
2. **Acquire / +:** The 'Acquire' button initiates/stops a phase noise measurement. When the '+' button is depressed, selecting 'Acquire' will overlay new data trace's to any existing data captured in the plot area.
3. **Devices:** 'Devices' allows the user to view any HA7162C/D analyzer connected to the PC via Ethernet or USB. Instruments are listed by serial number and IP address or COM port. Connect to an instrument by clicking on it.
4. **Measurement:** Make changes to measurement type, offset range, jitter parameters, number of correlations, etc.
5. **Inputs:** Measure DUT/LO input power and frequency, calibrate and make adjustments for both internal and external LO sources.
6. **Outputs:** Provides voltage control for the DUT Power Supply, DUT Tune Voltage, External LO Tune range and Internal LO frequency/power levels.
7. **Trace/Calcs:** Access to data trace smoothing and spur removal functions.
8. **Limits:** Apply test limit lines to the plot area to create pass/fail conditions.
9. **Markers:** Adjust the number of data markers, their locations and marker interpolation.
10. **Display:** Provides access to plot data plot area modifications. Used to edit the x/y axis ranges, plot title, axis titles, trace names, plot export options, etc.
11. **Console:** The Console displays a log of instrument/measurement activity while also allowing the user to send commands directly to the instrument.
12. **Data Plot Area:** Displays acquired data: PM, AM, baseband, spurious, etc.
13. **Status Indicator:** The Holzworth shockwave logo doubles as a status bar/indicator while measurements are in progress. A measurement countdown timer is also displayed above the shockwave.
14. **Measurement Statistics:** Displays statistics of an active measurement or the currently selected data trace in the plot area.

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SOFTWARE REPORT GENERATION

The automated report generation tool is a convenient feature for quickly generating a preformatted report that captures all traces and applicable data that is currently being displayed by the GUI. Each data trace actively contained in the plot area will be included in the report and color coordinated with its corresponding data. the plot area will be included in the report and color coordinated with its corresponding data.



HA7163A 50 GHz Downconverter **WARRANTY**

All Holzworth phase noise analyzer products come with a standard 1 year 100% product warranty covering manufacturing defects and workmanship. All product repairs and maintenance must be performed by Holzworth Instrumentation. Holzworth reserves the right to invalidate the warranty for any product that has been tampered with or used improperly. Refer to Holzworth Terms & Conditions of Sales for more details.

Holzworth products are proudly designed and assembled in the USA



CONTACT INFORMATION

Contact Holzworth directly for a product quotation, a product demonstration, or for technical inquiries.

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