Holzworth
HA7162D
REAL TIME
PHASE NOISE ANALYZER

The HA7162D Real Time Phase Noise Analyzer offers outstanding accuracy, very high reliability, and the ultimate configurability. With high-speed, real time dual FFT engines, the instrument has extremely fast measurement speeds to reduce product development time and optimizes ATE manufacturing throughput. The fully shielded, compact 1U chassis eliminates ground loops for uncompromised performance and repeatability. The configurable front end uniquely enables users to measure the analyzer noise floor for the greatest measurement confidence. The instrument incorporates Holzworth HSX synthesizer cores as its internal LO's which are also available as general-purpose CW sources at the front panel *LO Output* ports.

HA7162D Real Time Phase Noise Analyzer
PRODUCT SUMMARY

KEY SPECIFICATIONS AND FEATURES

- DUT Input: 10 MHz to 26 GHz (option to 40 GHz)
- Measurement Bandwidth: 0.1 Hz to 100 MHz offsets
- Measurements: Isolated AM / PM, Baseband, Spurious, Jitter
- Automated Absolute and Additive (Residual) Measurements
- Real Time Cross Correlation
- Outstanding Accuracy
- Very High Reliability
- Ultimate Configurability
- Extremely Fast Measurements from High-Speed, Real Time Dual FFT Engines
- Incorporates Holzworth HSX Synthesizer Cores as Its Internal LO's
- Two General-purpose CW Sources
- Fully Shielded Compact 1U Chassis

Unique reconfigurability to enable <u>actual instrument noise floor measurement</u> for the highest measurement confidence.

HA7162D Real Time Phase Noise Analyzer
BLOCK DIAGRAM

The external coaxial cables below ▬▬▬ can be removed. The reconfigurable front end enables users to tailor the analyzer for their specific measurement needs.
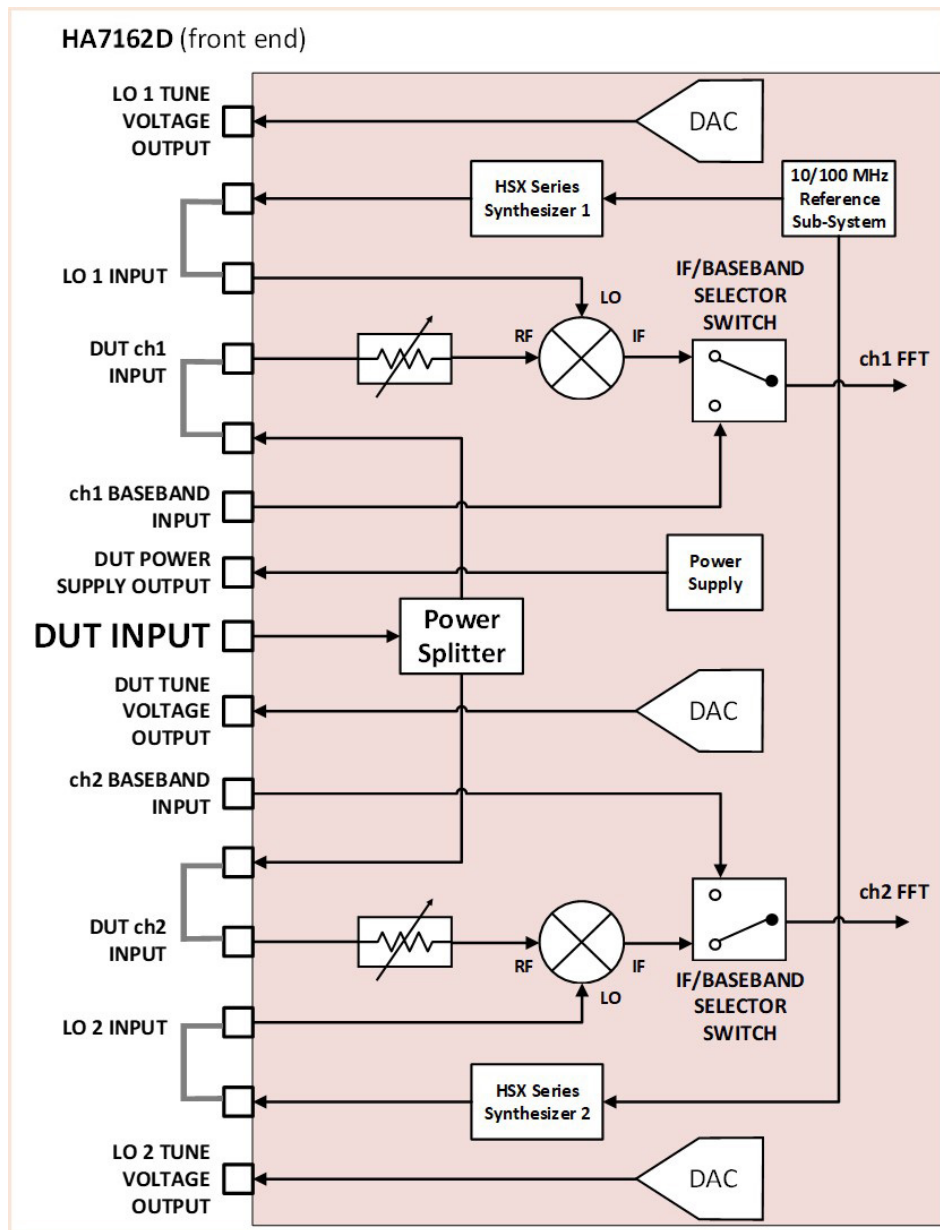

Figure 1: HA7162D Front End Block Diagram

PARAMETER	DESCRIPTION
Internal LO Mode	Internal synthesized LO sources. Auto tune and phase lock connect DUT signal directly to HA7163A (purchased separately).
External LO Mode	External LO Inputs for user supplied LO's. Auto tune and phase lock.
Additive Mode	Multi-port device measurements. External signal source and phase shifters required.
AM Noise Measurements	Characterize AM noise of RF input signal.
Spurious Analysis	Provides spurious performance data based on a user settable Spur Threshold.

PARAMETER	SPECIFICATION
DUT Input Connector Standard OPT-CC40	 2.92 mm (female), 50 Ω 2.92 mm (female), 50 Ω
DUT Input Frequency Range Standard OPT-CC40	 10 MHz to 26 GHz 10 MHz to 40 GHz
DUT Input Measurement Level 10 MHz to 32 GHz > 32 GHz to 40 GHz	 -5 dBm to +20 dBm 0 dBm to +10 dBm
DUT Input Damage Level	+22 dBm
DUT Input VSWR 10 MHz to 20 GHz > 20 GHz to 40 GHz	 < 2.0:1 (typical) < 2.5:1 (typical)
RF Tracking Range	± 5 ppm; ± 10 ppm (typical)
Cross Correlation Noise Floor	Refer to pages 8 − 10 for measured noise floor data

HA7162D Real Time Phase Noise Analyzer
MEASUREMENT BANDWIDTH AND UNCERTAINTY

PARAMETER	SPECIFICATION
Offset Frequency Range	
PM Measurements	0.1 Hz to 100 MHz[1]
AM Measurements	0.1 Hz to 1 MHz
Baseband Measurement	0.1 Hz to 100 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

[1]   For frequencies ≤ 500 MHz, offsets of up to 100, 20, 10, and 2 MHz are only available up to these limits when ≤ 20% of the carrier signal; this limitation does not apply when directly utilizing baseband inputs.

AMPLITUDE NOISE MEASUREMENTS

PARAMETER	SPECIFICATION
DUT Input Frequency Range	10 MHz to 6 GHz
Offset Frequency Range	0.1 Hz to 1 MHz

INTERNAL TIMEBASE (10 MHz Reference used for internal frequency counter)

PARAMETER	SPECIFICATION
Internal Timebase Reference	
Adjust-to-Nominal	< ± 1 Hz at 10 MHz (±100 ppb) At time of shipment.
Aging Rate	+/- 0.5 ppb per day after 30 days
	+/- 30 ppb per year after 180 days
Temperature Effects	+/- 20 ppb; over instrument internal temperature range of 0 ºC to 45 ºC

POWER METER UNCERTAINTY

PARAMETER	SPECIFICATION
Input Power Meter Uncertainty	
10 MHz to MAX FREQ	± 1 dB (typical)
Offset Frequency Range	0.1 Hz to 1 MHz

17025 ACCREDITATION

PARAMETER	SPECIFICATION
Offset Frequency Range	1 Hz to 100 MHz; settable from 0.1 Hz to 100 MHz

HA7162D Real Time Phase Noise Analyzer
MEASUREMENT SPEED AND CROSS CORRELATIONS

Measurement times shown below are total data acquisition time. Data acquisition time does not include data transfer time to a 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

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: dB = 5logN (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

HA7162D Real Time Phase Noise Analyzer
NOISE FLOOR MEASUREMENT – SETUP

The unique architecture and configurability of the HA7162D allows for direct access to key internal modules in order to measure the actual noise floor of the analyzer at any given frequency (up to 6 GHz) vs. minimum frequency offset and number of correlations. As with Holzworth, competitive phase noise analyzers offer a cross correlation confidence factor, which is an only approximation based on the data being taken at the time. The confidence factor is not the actual noise floor of the system.

To perform a noise floor measurement, the internal power splitter is bypassed to directly access the phase detector (mixer) of each channel while measuring two non-correlated frequency sources at the frequency of interest. Refer to **Figure 2**, below.
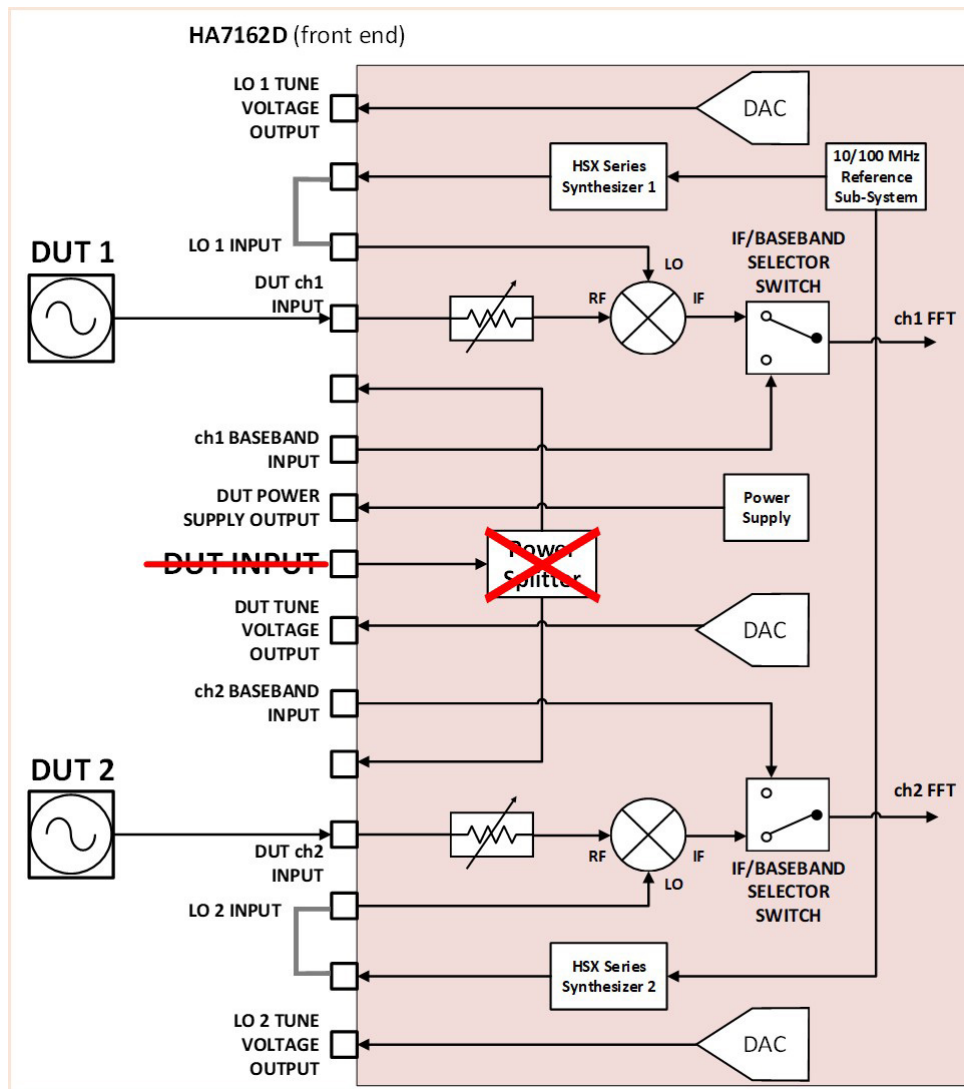

Figure 2: HA7162D Noise Floor Measurement Setup Block Diagram

HA7162D Real Time Phase Noise Analyzer
NOISE FLOOR MEASUREMENT – EXAMPLES

The data contained in this section illustrates the noise floor capability of a HA7162D at five different frequencies covering the base operating range of the instrument (10 MHz, 100 MHz, 1 GHz, 3 GHz and 6 GHz). The three plots in each figure are examples of the actual noise floor measurements with 1x, 10x and 100x correlations on a specific unit. An important note is that analyzers will exhibit varying phase noise floors from unit to unit, hence the importance of being able to measure the true noise floor of an analyzer. Further improvement in the noise floor can be achieved by utilizing additional correlations (refer to Table 2 on page 6).

All data contained in this section was acquired using a minimum offset frequency of 1 Hz and data resolution of 256 points per decade. For reference, the data acquisition times for each measurement are as follows:
1 correlation: 4.3 s
10 correlations: 43 s
100 correlations: 7 m, 9 s

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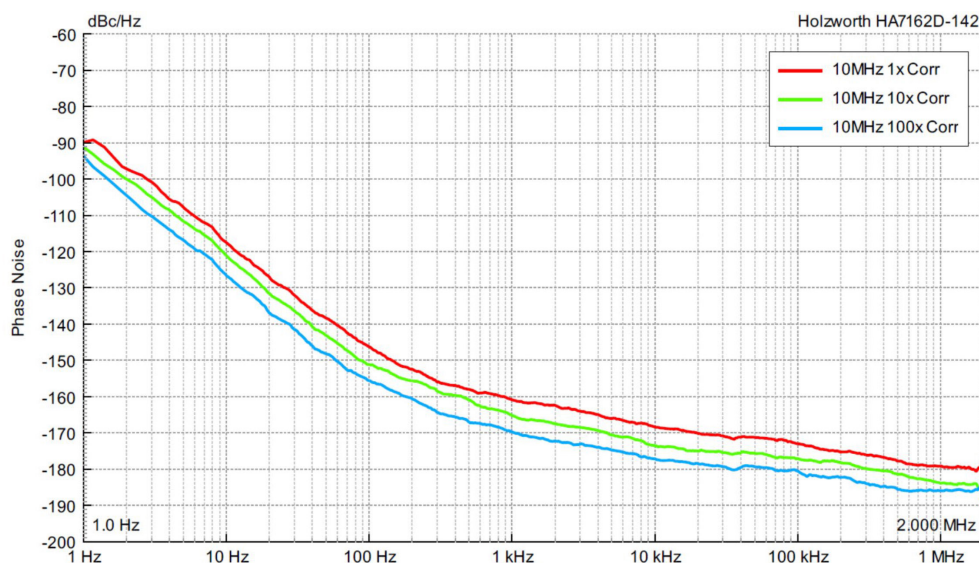

Figure 3: 10 MHz Noise Floor

Figure 4: 100 MHz Noise Floor
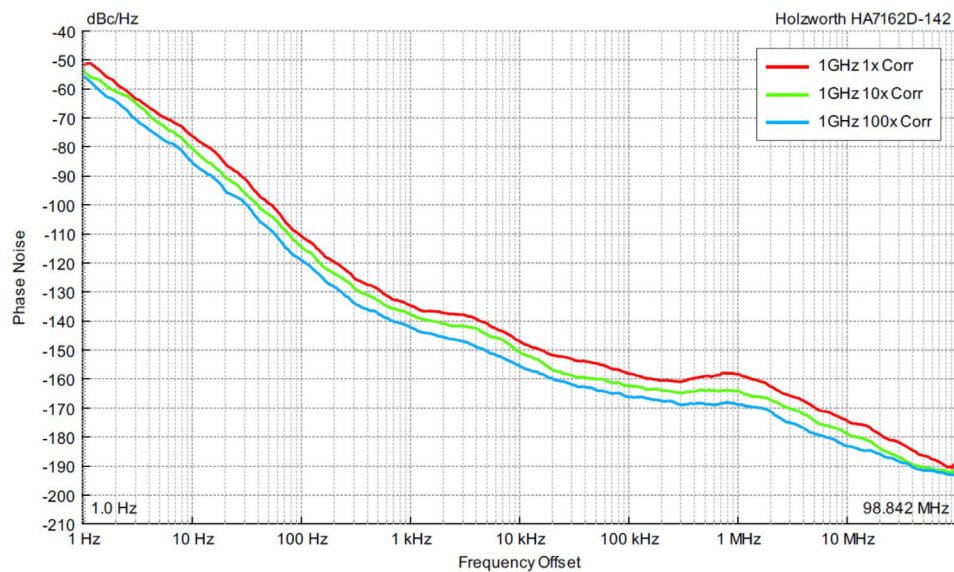
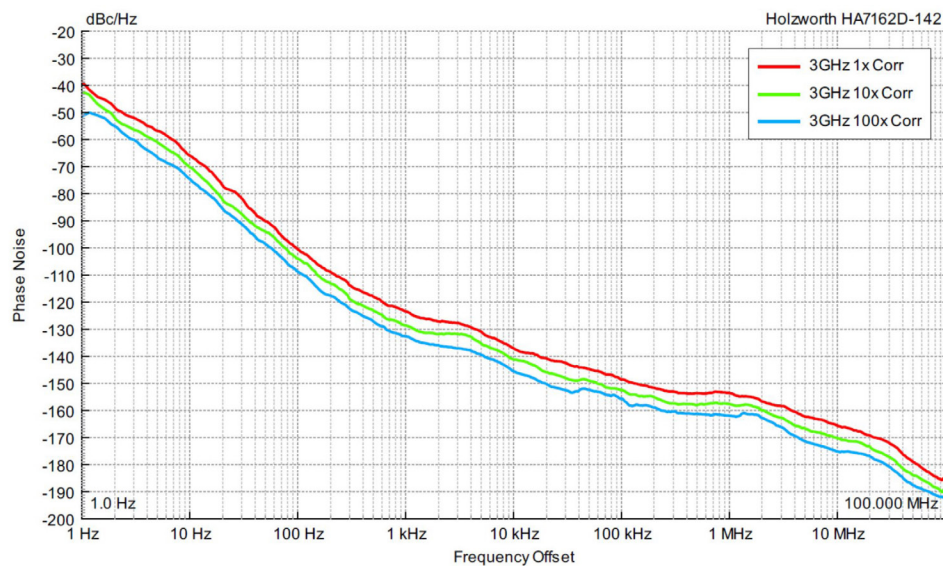**Figure 5**: 1 GHz Noise Floor
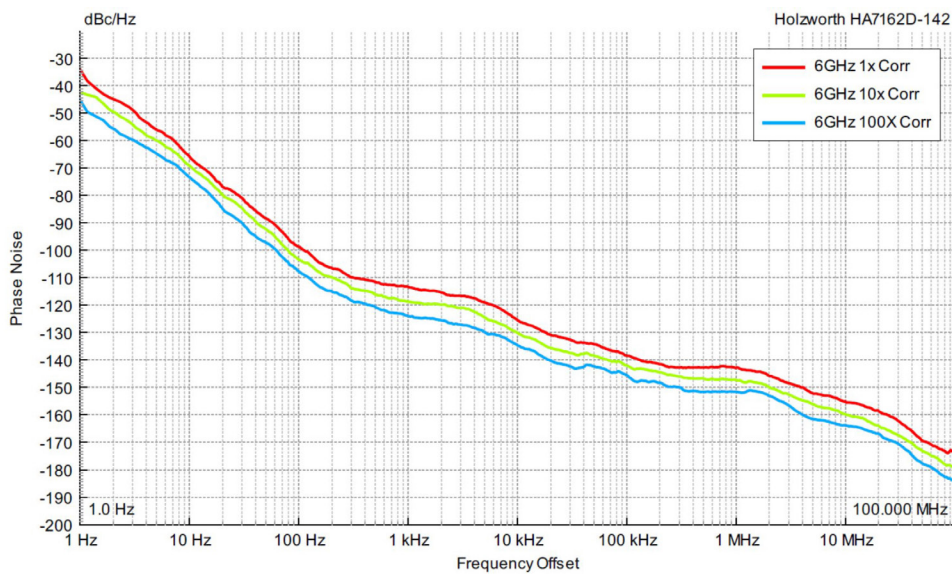
Figure 6: 3 GHz Noise Floor

Figure 7: 6 GHz Noise Floor

HA7162D Real Time Phase Noise Analyzer
CONFIGURATION

The HA7162D allows for a high level of measurement flexibility to accommodate different test scenarios by allowing the user access to various system input points. However, only the DUT Input port is necessary for making absolute phase noise measurements of a frequency source.

FRONT PANEL

INPUT/OUTPUT	DESCRIPTION
Connector Types	
DUT Input (Standard)	2.92 mm (female), 50 Ω
DUT Input (OPT-CC40)	2.92 mm (female), 50 Ω
All Others	SMA (female), 50 Ω

INPUT/OUTPUT	DESCRIPTION
DUT Input	
Frequency Range (Standard)	10 MHz to 26 GHz
Freq Range (OPT-CC40)	10 MHz to 40 GHz
Measurement Level	
10 MHz to 32 GHz	-5 dBm to +20 dBm
> 32 GHz to 40 GHz	0 dBm to +10 dBm
Damage Level	+22 dBm
DUT Tune Voltage	For Vcc control of DUTs
Voltage Tune Range	-10 VDC to 12 VDC
Max Current	5 mA
DUT Power Supply	Integrated DUT power supply
Voltage Tune Range	0 VDC to 12 VDC
Max Current	250 mA
LO1/LO2 Input	Connect to LO1/LO2 Outputs for standard operation
Frequency Range	10 MHz to 6 GHz
Power Level Range	+3 dBm to +13 dBm
Damage Level	> +16 dBm
LO1/LO2 Output	CW outputs for general purpose use; connect to LO1/LO2 Input for standard operation
Frequency Range	10 MHz to 6 GHz (0.001 Hz step size)
Power Level Range	0 dBm to +10 dBm (0.01 dB step size)
LO1/LO2 Tune Voltage	For independent Vcc control of external LO sources during External LO Mode of operation
Voltage Tune Range	-10 VDC to 12 VDC
Max Current	5 mA
DUT ch1/ch2 Input	Allows bypass of DUT power splitter for direct access to the phase detectors of each channel
Frequency Range	10 MHz to 6 GHz
Power Level Range	0 dBm to +14 dBm
Damage Level	> +16 dBm
ch1/ch2 Splitter Bypass Output	Connect coaxial cable to ch1/ch2 DUT Inputs for standard operation
ch1/ch2 Baseband Input	
Frequency Range	0.1 Hz to 100 MHz
Power Level Range	± 1 VDC
Damage Level	± 2 VDC or 50 mA (whichever is greater), +10 dBm

REAR PANEL

| INPUT/OUTPUT	DESCRIPTION
Reference Output	
Connector Type	SMA (female), 50 Ω
Output Frequency	10 MHz ± 10 Hz
Output Level	+5 dBm ±2 dBm
Output Waveform	Sinusoid
10 MHz Reference Input	For internal frequency counters only - does not affect measurement sensitivity
Connector Type	SMA (female), 50 Ω
Input Frequency	10 MHz ± 10 Hz
Input Level	0 dBm to +10 dBm (Sinusoid or square wave)
AC Power Input	Internal power supply
Connector Type	IEC 320-C13
AC Input Rating	100 to 240 VAC, 47 to 63 Hz. Specify destination country at time of order for proper power cord.
Data Interface	
Connectivit	USB Type-B (virtual COM port), Ethernet, RS-232, GPIB
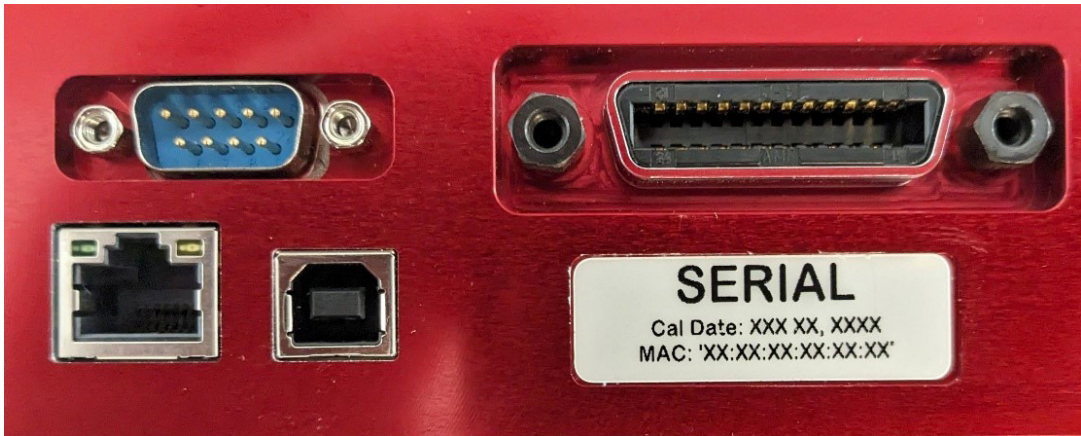
Figure 8: Communication Ports

HA7162D Real Time Phase Noise Analyzer
MECHANICAL DIMENSIONS

The HA7162D comes in a 1U high, rack mountable chassis. A universal rack mount bracket kit is an available accessory (Part No.: RACK-1U or RACK2-1U). Mechanical dimensions are listed in inches (and millimeters).
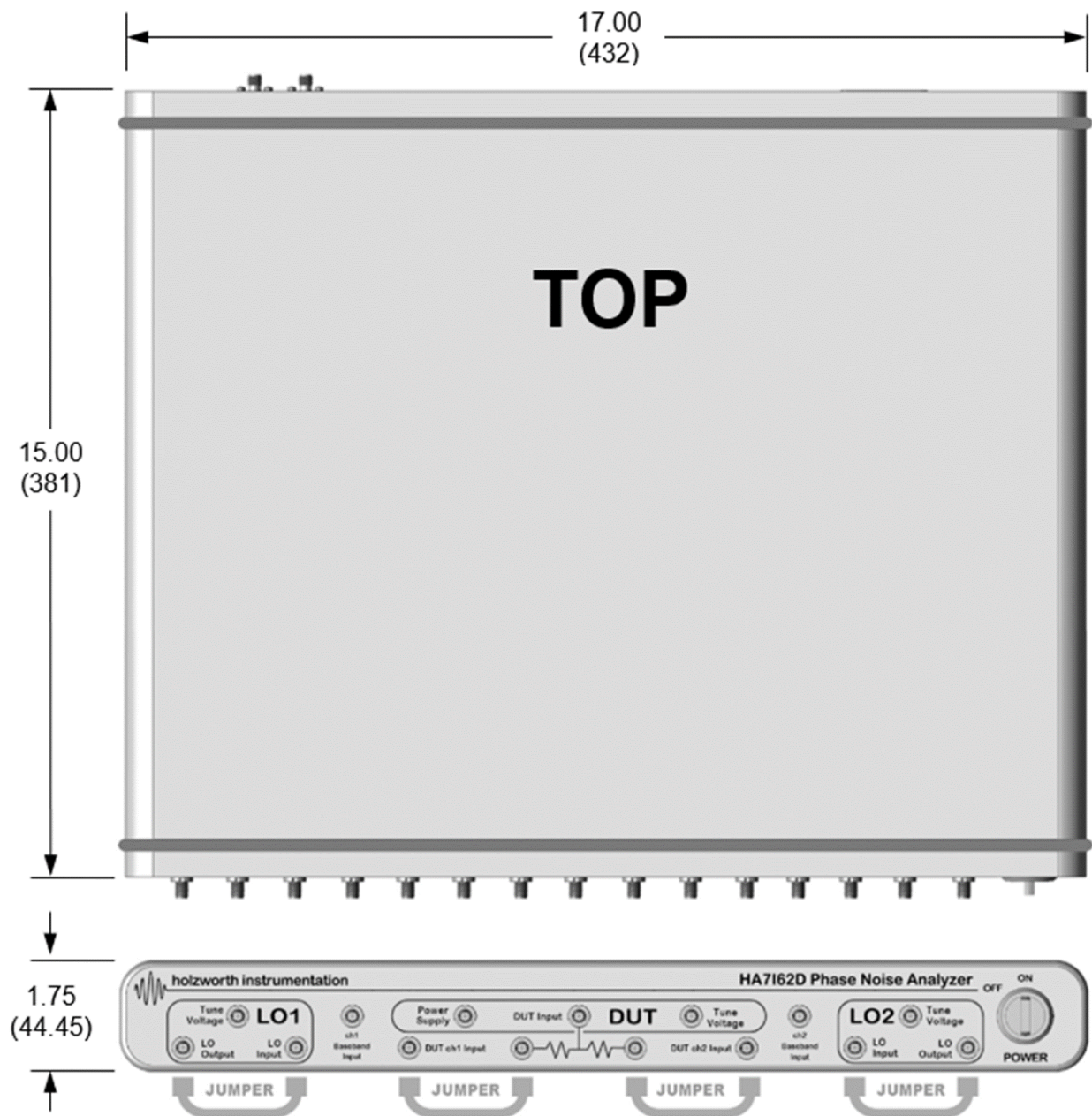
DIMENSIONS (L X W X H)	1U high, 19" rack mount: 15 in x 17 in x 1.75 in (381 mm x 431.8 mm x 44.5 mm)
WEIGHT	25 lbs. (11.34 kilograms) MAXIMUM

HA7162D Real Time Phase Noise Analyzer
ENVIRONMENTAL SPECIFICATIONS

THIS INSTRUMENT IS DESIGNED FOR INDOOR USE ONLY

Environmental specifications are based on component margins, thermal verification testing and current draw tests. Production unit performance is verified at room temperature.

PARAMETER	MIN	TYPICAL[1]	MAX	COMMENTS
Operating Temperature	0 °C		+45 °C	Internal temperature
Temperature Monitor Range	-40 °C		+85 °C	Absolute, channel dedicated sensor
AC Power Supply				
Rated Voltage	100 VAC		240 VAC	
Voltage Range	90 VAC		264 VAC	
Rated Frequency	50 Hz		60 Hz	
Frequency Range	47Hz		63 Hz	
Warm-Up Time		10 min		20 °C (ambient temp. dependent)

[1] Typical performance is "by design" and consistent with field performance data.

DESCRIPTION	SPECIFICATION (by design)
Operating Environment	
Humidity	Relative humidity 15% to 95%, <29 °C (non-condensing)
Altitude	0 to 3,048 m (0 to 10,000 feet)
Vibration	0.21 g RMS maximum, 5 Hz to 500 Hz
Storage (Non-Operating)	
Temperature	-10 °C to +60 °C
Humidity	Relative humidity 0% to 90%, <40 °C (non-condensing)
Altitude Altitude	0 to 15,240 m (0 to 50,000 feet)
Vibration	0.21 g RMS maximum, 5 Hz to 500 Hz

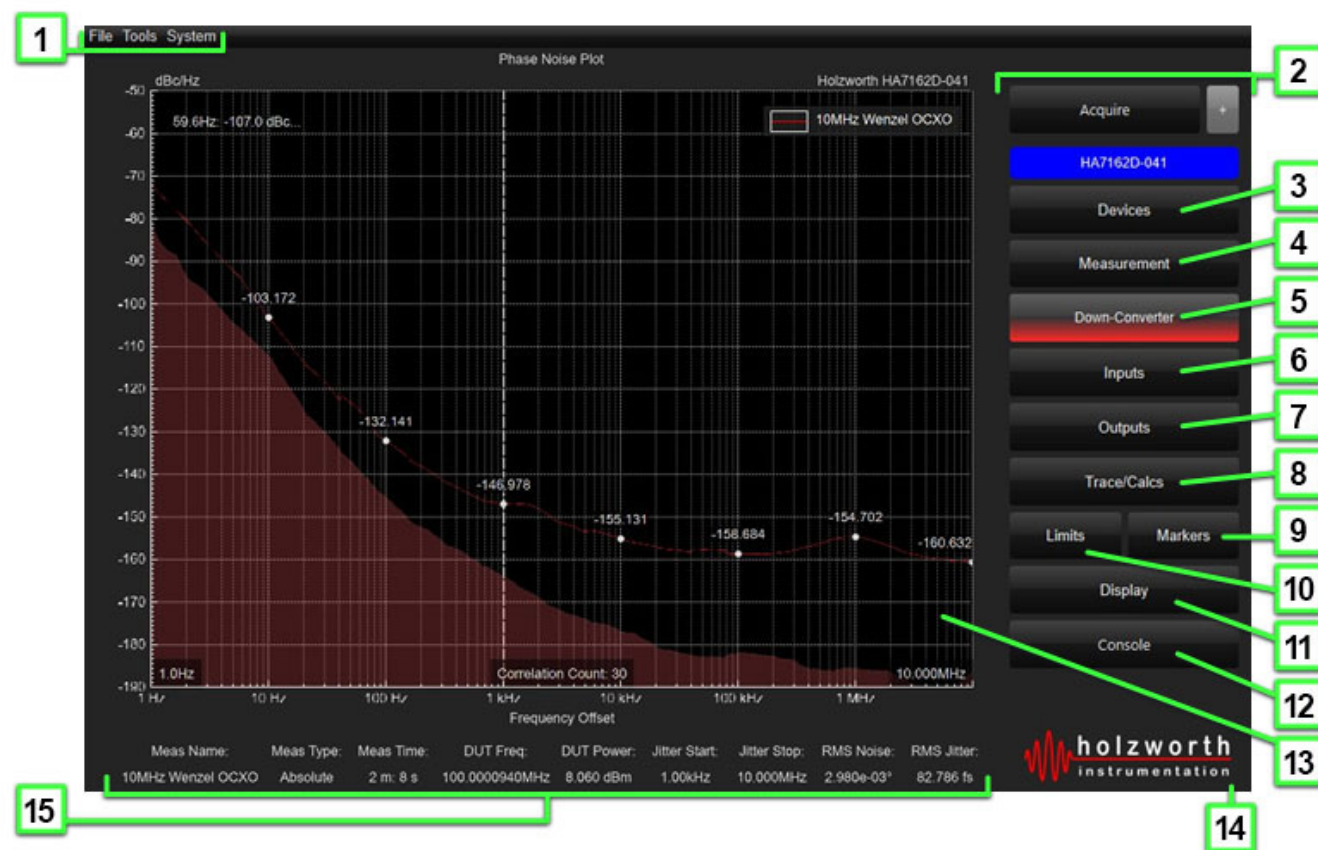| **REGULATORY COMPLIANCE**	CE compliance with the following European Union directives
	Low Voltage Directive EU 2014/35
	Electromagnetic Compatibility Directive (EMC) EU 2014/30
	RoHS Directive EU 2015/863, WEEE Directive EU 2012/19

HA7162D Real Time Phase Noise Analyzer
OPERATION (via remote commands)

The HA7162D can be controlled using serial commands via USB, LAN, RS-232 or GPIB.

OPERATION (via Graphical User Interface/GUI software)

The HA7162D complimentary GUI software offers an extremely user-friendly means to utilize the full functionality of the HA7162D on Windows-based PCs. Absolute and additive phase noise, jitter, AM noise, and more can be performed using the intuitive GUI software. For additional information, refer to the software menu summaries on the next page.
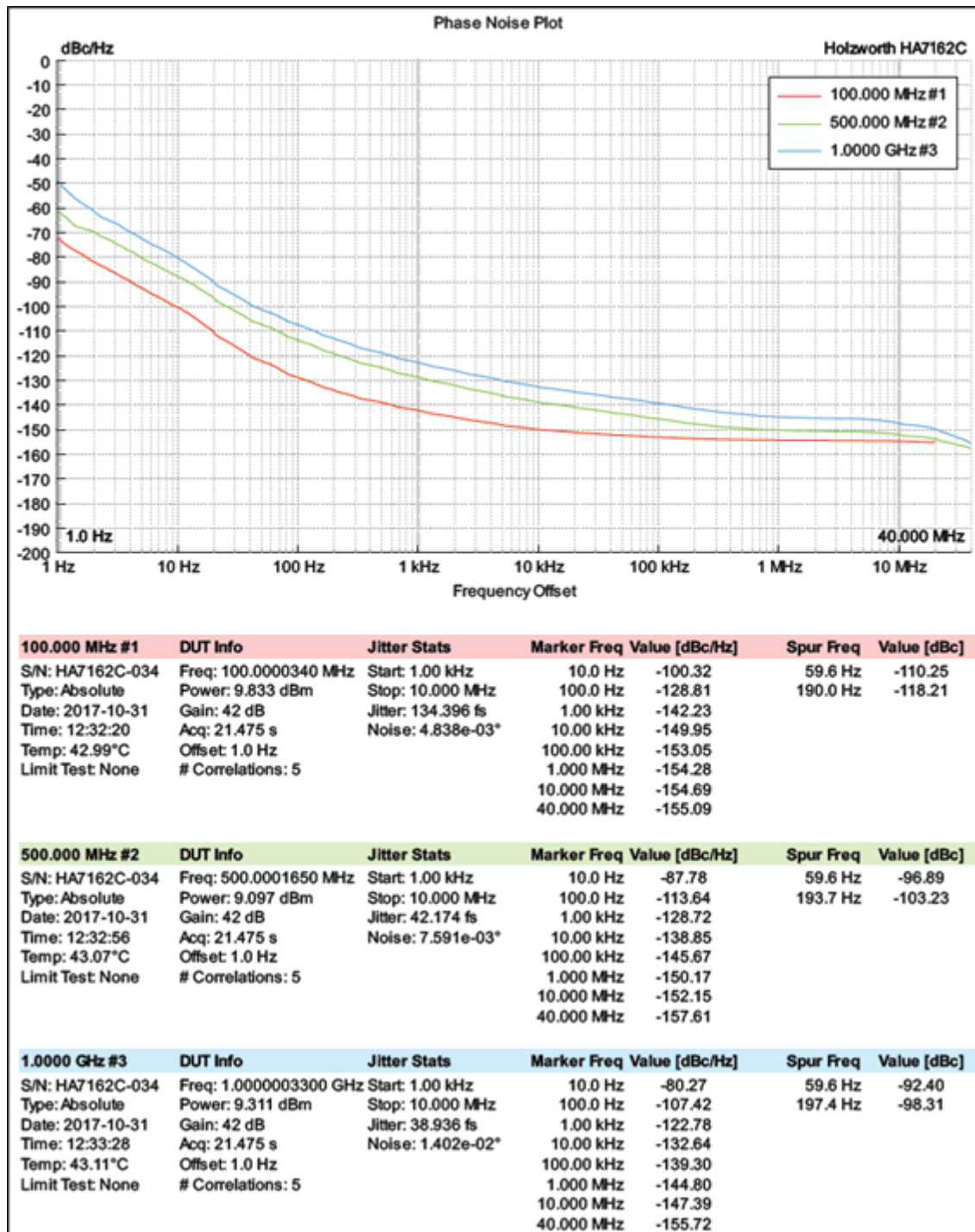
The software menus identified on the previous page are described below.

1. File: Save, load, export, import data; and generate reports. The report generator   captures the current plot and any measurement statistics (see page 20).

    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.

    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 a new measurement to the existing data captured in the plot area with each new acquisition.

3. Devices: 'Devices' allows the user to view any HA7162D analyzer directly connected to the PC (USB or Ethernet) or over a LAN connection (Ethernet only) for multi-device control. Available devices are selected by part number/serial number.

4. Measurement: Make changes to measurement type, offset range, jitter parameters, number of correlations, etc.

5. Down-Converter: Used to control the HA7162A down-converter. Note that this menu is only accessible when connected to that particular down-converter

6. Inputs: Used to verify DUT/LO power and frequency, calibrate and make adjustments for both internal and external LO sources.

7. Outputs: Provides tune control for the DUT Power Supply, DUT Tune Voltage, External LO Tune tune range and Internal LO power levels.

8. Trace/Calcs: Access to smoothing and spur removal functions to a data modify data markers. This sub-menu also contains the spurious analysis toolbox.

9. Limits: Apply test limit lines to the plot area for indicating pass/fail conditions.

10. Markers: Adjust the number of data markers, their locations and behavior.

11. 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.

12. Console: The Console displays a log of instrument/measurement activity while also allowing the user to send commands directly to the instrument.

13. Data Plot Area: Displays acquired data: PM, AM, baseband, spurious, etc.

14. Status Indicator: The Holzworth logo shockwave doubles as a status bar/indicator while measurements are in progress. A measurement countdown timer is also displayed above the shockwave.

15. Measurement Statistics: Displays statistics of an active measurement or currently of a specifically selected data trace.

OPERATION (via GUI software – Report Generation)

The GUI software contains an automated report generation tool as a convenient feature for quickly generating a preformatted report that captures all traces and applicable data of displayed data. Each data trace present in the plot area will be included in the report and color coordinated with its corresponding data.


100.000 MHz #1	DUT Info	Jitter Stats	Marker Freq	Value [dBc/Hz]	Spur Freq	Value [dBc]
S/N: HA7162C-034	Freq: 100.0000340 MHz	Start: 1.00 kHz	10.0 Hz	-100.32	59.6 Hz	-110.25
Type: Absolute	Power: 9.833 dBm	Stop: 10.000 MHz	100.0 Hz	-128.81	190.0 Hz	-118.21
Date: 2017-10-31	Gain: 42 dB	Jitter: 134.396 fs	1.00 kHz	-142.23		
Time: 12:32:20	Acq: 21.475 s	Noise: 4.838e-03°	10.00 kHz	-149.95		
Temp: 42.99°C	Offset: 1.0 Hz		100.00 kHz	-153.05		
Limit Test: None	# Correlations: 5		1.000 MHz	-154.28		
			10.000 MHz	-154.69		
			40.000 MHz	-155.09		

500.000 MHz #2	DUT Info	Jitter Stats	Marker Freq	Value [dBc/Hz]	Spur Freq	Value [dBc]
S/N: HA7162C-034	Freq: 500.0001650 MHz	Start: 1.00 kHz	10.0 Hz	-87.78	59.6 Hz	-96.89
Type: Absolute	Power: 9.097 dBm	Stop: 10.000 MHz	100.0 Hz	-113.64	193.7 Hz	-103.23
Date: 2017-10-31	Gain: 42 dB	Jitter: 42.174 fs	1.00 kHz	-128.72		
Time: 12:32:56	Acq: 21.475 s	Noise: 7.591e-03°	10.00 kHz	-138.85		
Temp: 43.07°C	Offset: 1.0 Hz		100.00 kHz	-145.67		
Limit Test: None	# Correlations: 5		1.000 MHz	-150.17		
			10.000 MHz	-152.15		
			40.000 MHz	-157.61		

1.0000 GHz #3	DUT Info	Jitter Stats	Marker Freq	Value [dBc/Hz]	Spur Freq	Value [dBc]
S/N: HA7162C-034	Freq: 1.0000003300 GHz	Start: 1.00 kHz	10.0 Hz	-80.27	59.6 Hz	-92.40
Type: Absolute	Power: 9.311 dBm	Stop: 10.000 MHz	100.0 Hz	-107.42	197.4 Hz	-98.31
Date: 2017-10-31	Gain: 42 dB	Jitter: 38.936 fs	1.00 kHz	-122.78		
Time: 12:33:28	Acq: 21.475 s	Noise: 1.402e-02°	10.00 kHz	-132.64		
Temp: 43.11°C	Offset: 1.0 Hz		100.00 kHz	-139.30		
Limit Test: None	# Correlations: 5		1.000 MHz	-144.80		
			10.000 MHz	-147.39		
			40.000 MHz	-155.72		

HA7162D Real Time Phase Noise Analyzer
ADDITIVE PHASE NOISE MEASUREMENT – SETUP

The architecture of the HA7162D greatly simplifies the additive measurement process. The block diagram below shows the basic configuration for an additive phase noise measurement for DUT inputs of up to 6GHz.

A pair of Holzworth HX5100 Electronic Phase Shifters can be used in place of mechanical phase shifters to fully automate the additive measurement. The HX5100 Phase Shifters automate the process of setting quadrature between the LO and DUT inputs by using the tune voltages of LO1 and LO2 to adjust the phase offset of each signal path.

Mechanical phase shifters can also be used in place of the HX5100 Electronic Phase Shifters. The built in Quadrature Monitor is employed for visual feedback while adjusting mechanical phase shifters.
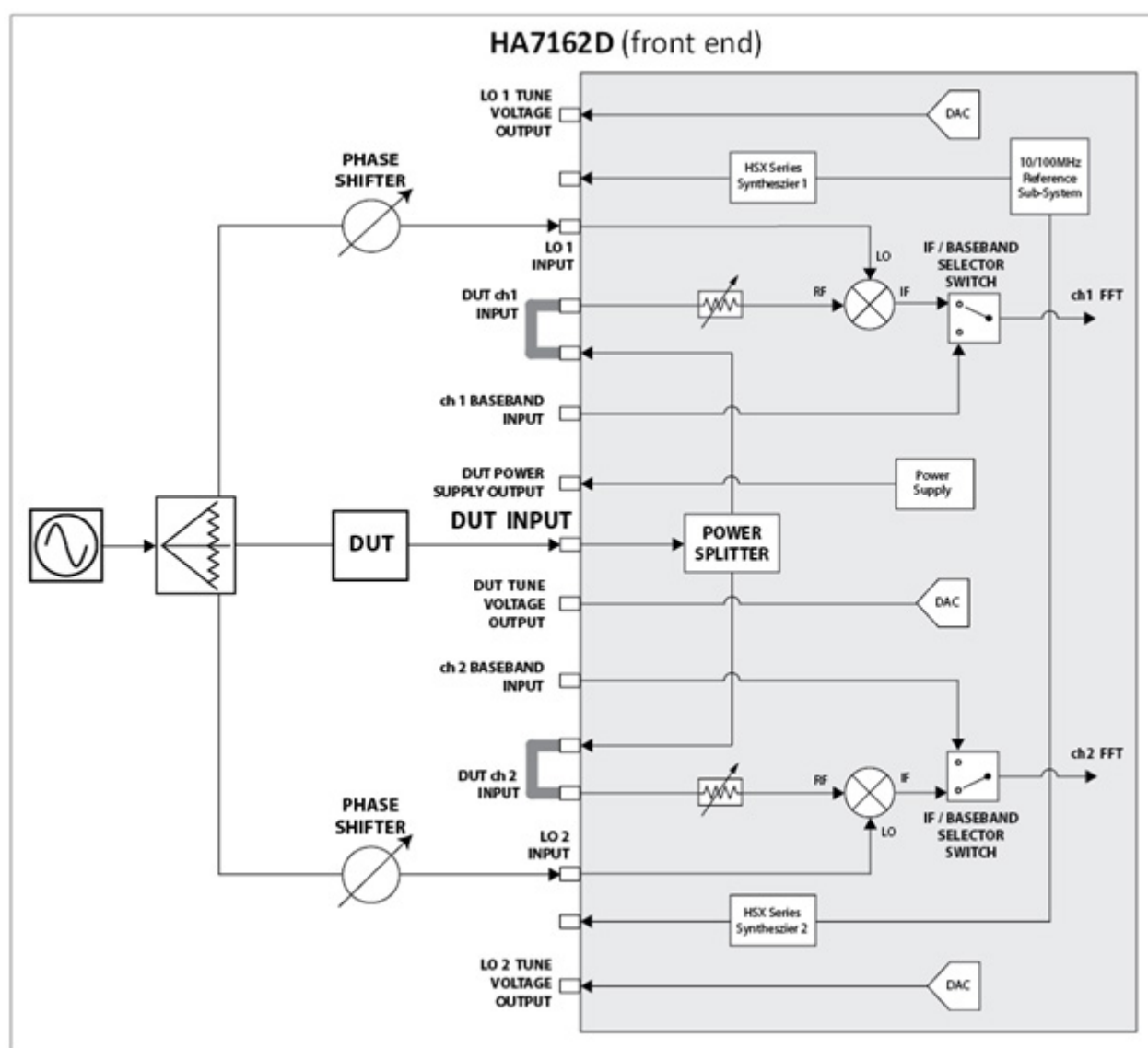
HA7162D Real Time Phase Noise Analyzer
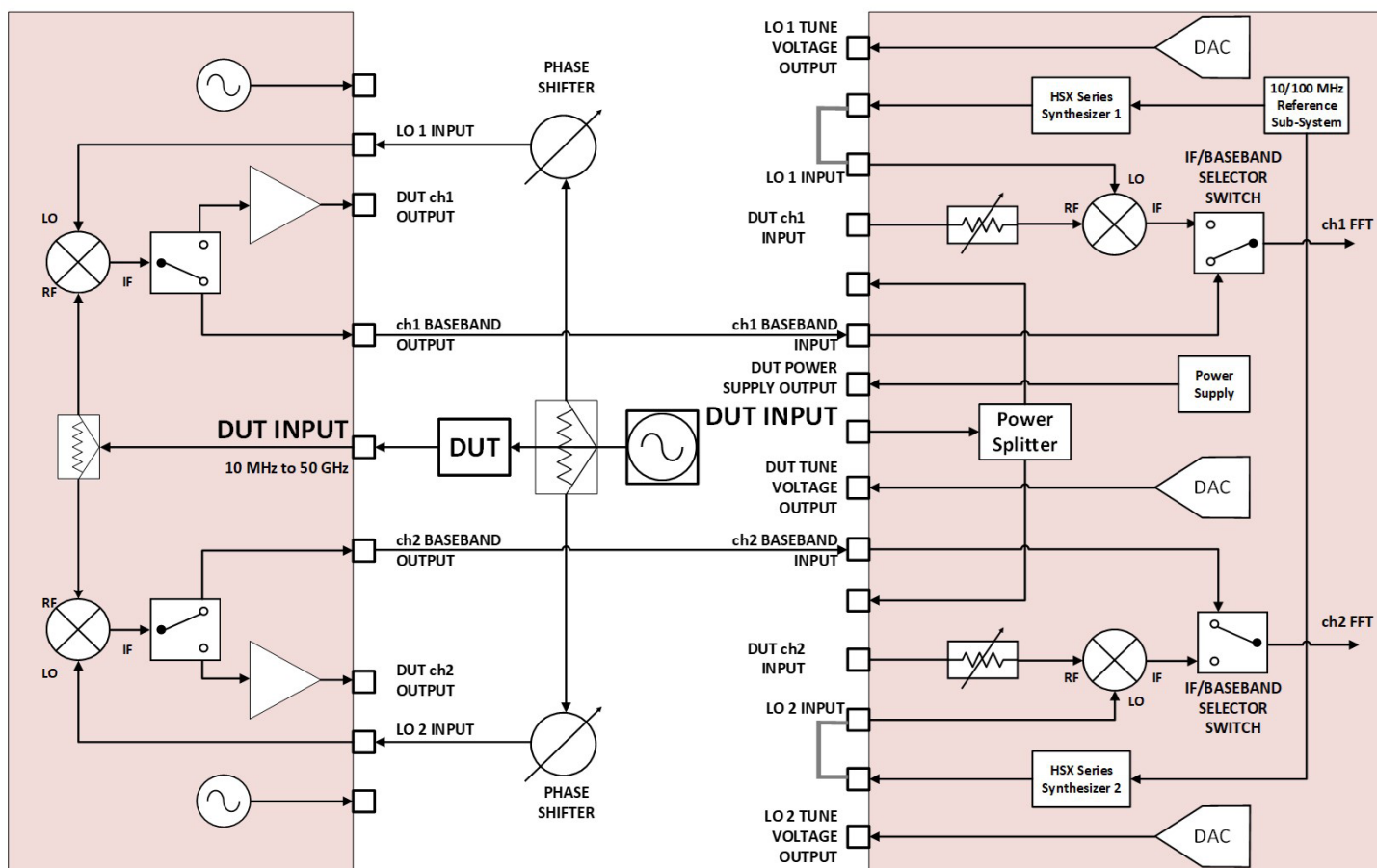## ADDITIVE PHASE NOISE MEASUREMENT (> 6 GHz) − SETUP

For additive phase noise measurements > 6 GHz, a heterodyne downconversion is required. The Holzworth HA7163A Heterodyne Downconverter is designed to manage the analog downconversion of high frequency signals. The HA7163A, paired with the HA7162D, creates a fully automated test system to 50 GHz for the most optimal absolute and residual (additive) measurement noise floors and fully automated operation.

The full HA7163A 50 GHz Downconverter specifications are available at www.holzworth.com.
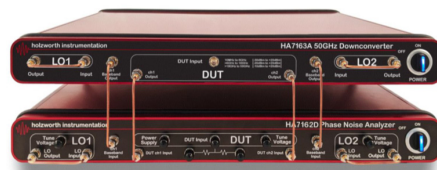

HA7163A 50 GHz Downconverter

HA7162D (front end)

HA7162D Real Time Phase Noise Analyzer
BASEBAND ADDITIVE PHASE NOISE MEASUREMENT – SETUP

The baseband inputs are yet another method for measuring additive phase noise as shown in the example below. This configuration allows for the lowest noise floor measurements possible, but does require an external set of mixers to complete the baseband downconversion.
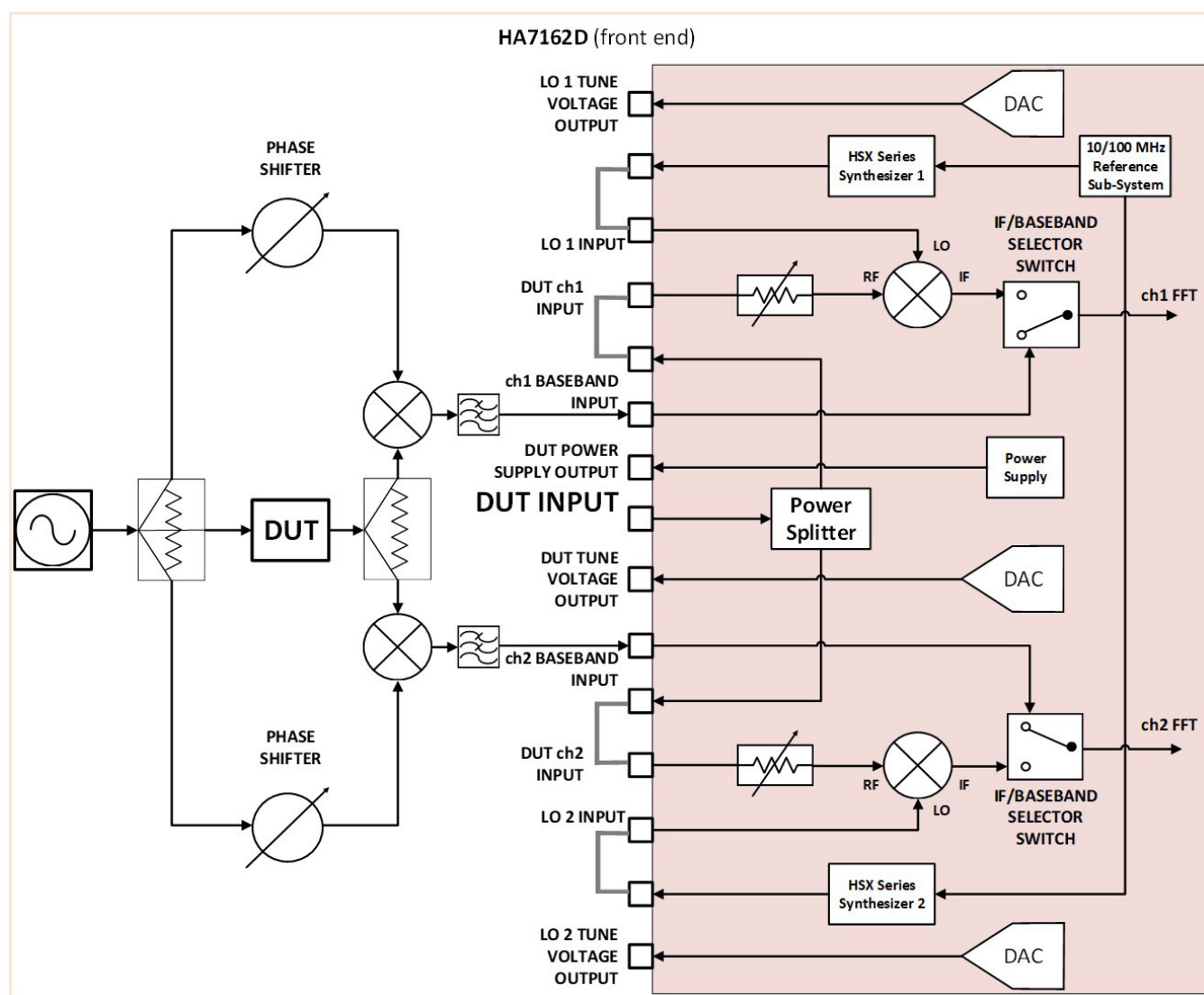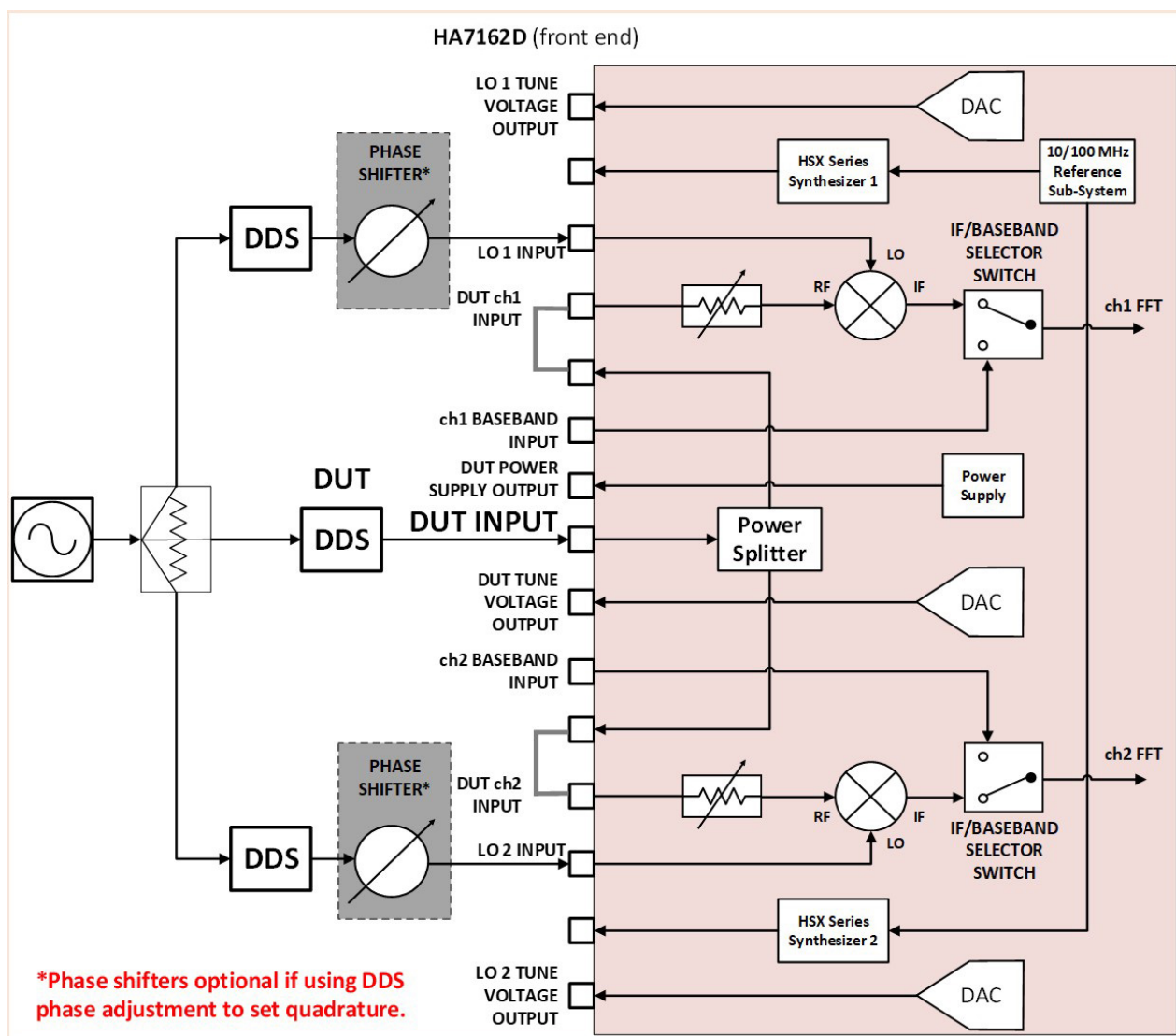
HA7162D Real Time Phase Noise Analyzer
DDS ADDITIVE PHASE NOISE MEASUREMENT – SETUP

The highly configurable front end of the HA7162D can accommodate a large number of measurement configurations. Below is a block diagram showing the HA7162D being used to measure the additive phase noise of a direct digital synthesizer (DDS).

NOTE: The same clock/signal source must be used to drive each DDS in this measurement.

HA7162D Real Time Phase Noise Analyzer
INCLUDED HARDWARE AND CERTIFICATIONS

Each product delivery includes the following hardware and certifications.

DESCRIPTION
HA7162D REAL TIME PHASE NOISE ANALYZER
AC Power Cord (7 ft/2.1 m)[1]
Ethernet Cable (10 ft/3 m)
USB Cable (6 ft/1.8 m)
CALIBRATION CERTIFICATION

[1] Nominal

ORDERING INFORMATION

HA7162D   **Real Time Phase Noise Analyzer**

ACCESSORIES	
HA7163A	50 GHz Downconverter
HA5100-x	Electronic phase shifters. For Additive measurements, 1 Octave bandwidth
RACK-1U	19" Rack Mount Bracket Kit, 90º rear bracket, 24 in max. depth
RACK2-1U	19" Rack Mount Bracket Kit, straight rear bracket, 24 in max. depth
RACK-1U-L	19" Rack Mount Bracket Kit, 90º rear bracket, 29 in max. depth
RACK2-1U-L	19" Rack Mount Bracket Kit, straight rear bracket, 29 in max. depth
CASE-1U	Carrying/storage case

HA7162D Real Time Phase Noise Analyzer
WARRANTY

All Holzworth HA7162D Real Time Phase Noise Analyzer products come with a standard 1 year 100% product warranty covering manufacturing defects. All product repairs and maintenance must be performed by Holzworth Instrumentation. Holzworth reserves the right to invalidate the warranty for any products that have 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.

Holzworth Instrumentation Sales Support
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