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HA7062D Phase Noise Analyzer

Tune Voltage — LO1 — LO Output — LO Input

ch1 Baseband Input

Power Supply — DUT Input — DUT ch1 Input

DUT — Tune Voltage — DUT ch2 Input

ch2 Baseband Input

LO2 — Tune Voltage — LO Input — LO Output

OFF — ON — POWER

REAL TIME CROSS CORRELATION

CE

RoHS

HA7062D

PHASE NOISE ANALYZER

10MHz to 26GHz

Optional to 40GHz

Cross Correlation

Real Time Data Acquisition

PRELIMINARY DATA SHEET

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4TECT

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HA7062D
PHASE NOISE ANALYZER

PRODUCT SUMMARY

The **HA7062D** *Real Time* **Phase Noise Analyzer** is born from Holzworth's history of industry leading phase noise analyzers with proven accuracy, high reliability, automation and flexibility. The real time engine covers the full measurement bandwidth with extremely fast measurement speeds to reduce product development time and optimizes ATE manufacturing throughput.

MEASURED NOISE FLOORS: Like the HA7062D, competitive designs provide a *measurement confidence factor*, which is often misinterpreted as the noise floor of the instrument. Holzworth is the only company that has architected the instrument's front end so that the noise floors limits can actually be <u>measured</u> (refer to pages 7-10).

UNPARALLELED ANALOG PERFORMANCE: The HA7062D has high speed digital processors for speed, but the proven accuracy and speed starts with the analog front end. A key component of the analog front end is a pair of Holzworth HSX Series RF Synthesizers as the test system's internal LOs. These ultra low noise RF sources not only complement the dual core FFT engine to provide one of the most advanced phase noise analyzers available, but they are also made available to the user at the front panel's *LO Output* ports.

REPEATABLE DATA: Holzworth's fully shielded, fan-less 1U chassis eliminates ground loops and troublesome microphonics for uncompromised performance and repeatability. See it for yourself knowing that Holzworth encourages running head-head tests with the competition. Contact Holzworth directly for availability of an evaluation unit in your area.

<u>REAL TIME</u> <u>FULL BANDWIDTH</u> DATA ACQUISITION
ANSI Z540 CALIBRATED ACCURACY <u>0.1Hz - 100MHz</u>
VERSATILE - <u>RECONFIGURABLE</u> FRONT END
MEASURE: PM / AM / BASEBAND / SPURIOUS / JITTER / PULSE
SIMULTANEOUS/ <u>ISOLATED</u> AM/PM MEASUREMENTS
AUTOMATED RESIDUAL MEASUREMENTS
<u>MEASURABLE</u> ULTRA LOW PHASE NOISE FLOORS
3 YEAR MANUFACTURER WARRANTY

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HA7062D
PHASE NOISE ANALYZER

PRODUCT SUMMARY - BLOCK DIAGRAM

VERSATILE: The HA7062D is a result of more than a decade of product development reflecting 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.
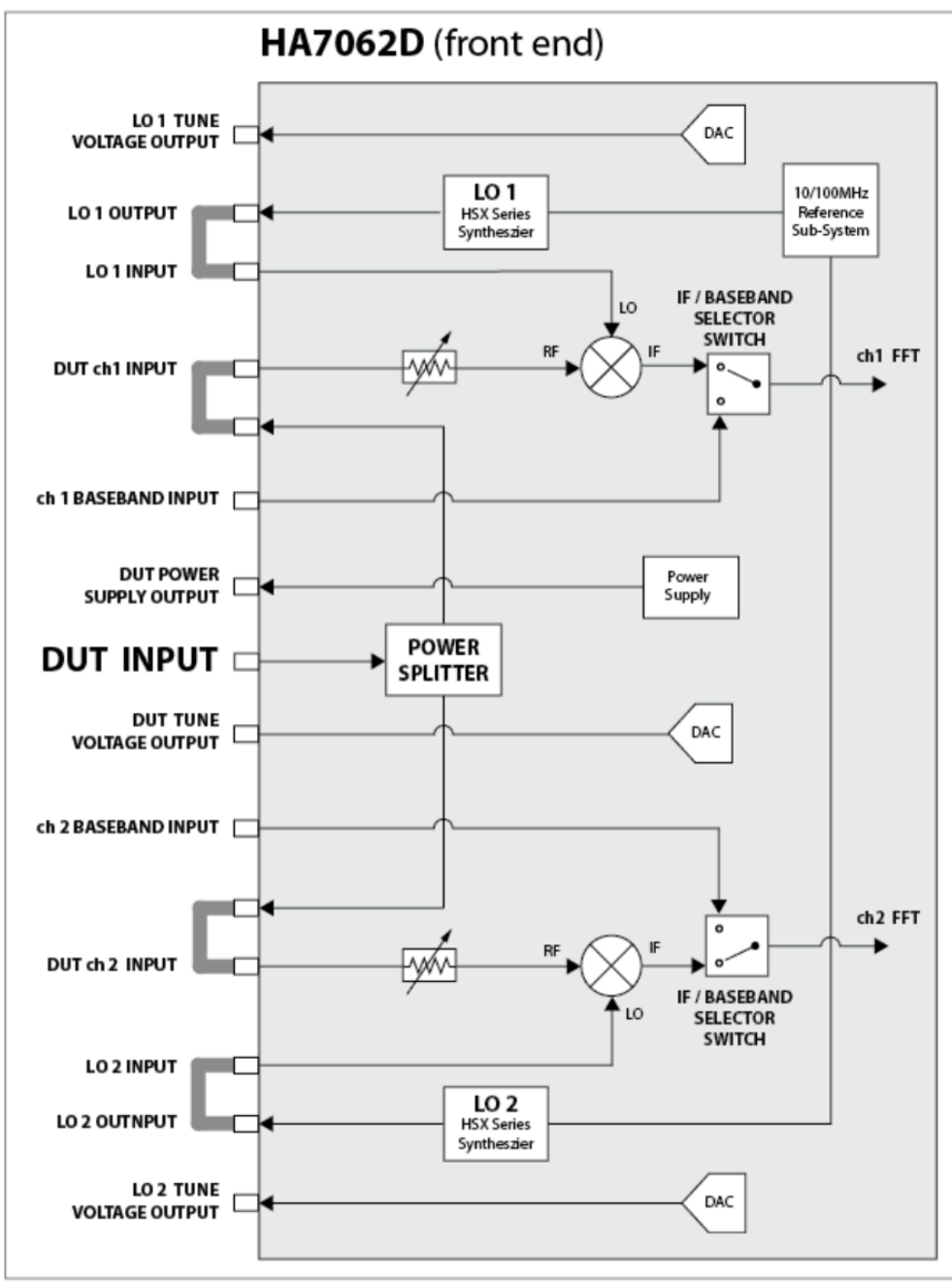

Figure 1: HA7062D Front End Block Diagram

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HA7062D
PHASE NOISE ANALYZER

SPECIFICATIONS - ELECTRICAL

The specifications outlined here capture the baseline performance and features that are currently available from the HA7062D phase noise analyzer. The highly reliable hardware is capable of additional functionality for custom requirements. Inquire with Holzworth Instrumentation or your local sales representative.

RF INPUT (DUT/LO)

DESCRIPTION	SPECIFICATION
RF Input Connector	2.92mm (female), 50 ohm
RF Input Frequency Range (standard)	10MHz to 26GHz
RF Frequency Extension (40GHz)	Available 2019
RF Input Measurement Level	-5dBm to +20dBm (Holzworth pre-amplifier available for <0dBm)
Input Damage Level	+22dBm
Input VSWR	< 2.0:1

PHASE NOISE MEASUREMENTS

DESCRIPTION	SPECIFICATION
RF Input Frequency Range	10MHz to 26GHz
RF Frequency Extension (40GHz)	Option: OPT-CC40 (available 2019)
RF Tracking Range	±10ppm (typical), ± 5ppm (specified)
Offset Frequency Range	0.1 Hz – 100 MHz (ANSI z540.1)

Phase Noise Uncertainty
    1 Hz to 1 kHz offset
    1 kHz to 1 MHz offset
    1 MHz to 100 MHz offset
	
	± 4 dB (to be updated with improved uncertainty resulting from z540.1 calibration statistics)
	± 2 dB (to be updated with improved uncertainty resulting from z540.1 calibration statistics)
	± 2 dB (to be updated with improved uncertainty resulting from z540.1 calibration statistics)

Cross-Correlation Noise Floor	Refer to pages 7-10 for measured noise floor data

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PHASE NOISE ANALYZER

SPECIFICATIONS - ELECTRICAL (continued)

TABLE 1: MEASUREMENT SPEED (SAMPLE TIME) vs. MINUMUM OFFSET

1 Cross-Correlation							
128 Samples		**256 Samples**		**512 Samples**		**1024 Samples**	
-	-	**0.1Hz**	32s	**0.1Hz**	60s	**0.1Hz**	112s
1Hz	12s	**1Hz**	18s	**1Hz**	33s	**1Hz**	61s
10Hz	6s	**10Hz**	8s	**10Hz**	13s	**10Hz**	22
100Hz	4s	**100Hz**	5s	**100Hz**	7s	**100Hz**	10s
1kHz	4s	**1kHz**	4s	**1kHz**	6s	**1kHz**	8s
10kHz	4s	**10kHz**	4s	**10kHz**	5s	**10kHz**	7s
100kHz	4s	**100kHz**	4s	**100kHz**	5s	**100kHz**	6s
1MHz	4s	**1MHz**	4s	**1MHz**	4s	**1MHz**	5s

10 Cross-Correlations							
128 Samples		**256 Samples**		**512 Samples**		**1024 Samples**	
-	-	**0.1Hz**	186s	**0.1Hz**	370s	**0.1Hz**	732s
1Hz	67s	**1Hz**	96s	**1Hz**	189s	**1Hz**	371s
10Hz	19s	**10Hz**	28s	**10Hz**	52s	**10Hz**	100s
100Hz	6s	**100Hz**	8s	**100Hz**	13s	**100Hz**	20s
1kHz	4s	**1kHz**	5s	**1kHz**	7s	**1kHz**	9s
10kHz	4s	**10kHz**	4s	**10kHz**	6s	**10kHz**	8s
100kHz	4s	**100kHz**	4s	**100kHz**	6s	**100kHz**	7s
1MHz	4s	**1MHz**	4s	**1MHz**	5s	**1MHz**	6s

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	0dB	5dB	10dB	15dB	20dB

INTERNAL TIME BASE (10MHz Reference)

DESCRIPTION	SPECIFICATION
Frequency Uncertainty / Stability	< ± 1Hz at 10MHz (±100 ppb) At time of shipment. Factory calibrated at +21C.
Frequency Temperature Effects	< 10ppb
Frequency Aging Rate	< 100ppb/yr
10MHz External Lock Range	± 20Hz (typical), ± 10Hz (specified). 10MHz is for frequency counters only.

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POWER METER ACCURACY

PARAMETER	MIN	TYPICAL	MAX	COMMENTS
Input Power Meter Accuracy		±0.25dB	±2dB	

ANSI z540 CALIBRATION

DESCRIPTION	SPECIFICATION
Frequency Offset Range	0.1Hz - 100MHz
DUT Frequency Input Range	10MHz - 26GHz Standard 10MHz – 40GHz Optional

MEASUREMENT MODES

MODE	DESCRIPTION
Internal LO Mode	Internal synthesized LO sources. Auto tune and phase lock.
External LO Mode	User supplied LO sources. Auto calibration of LO sources and auto phase lock.
Additive Mode	External Signal Source required. Use with model HX5100-x Automated Phase Shifters
AM Noise Measurements	Measure AM Noise to observe potential AM to PM conversion
Pulsed Signal Measurements	Sample and Hold feature allows for non-triggered pulse measurements
Spurious Analysis Toolbox	Provides spurious performance data based on a user settable Spur Threshold

SPECIFICATIONS

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NOISE FLOOR MEASUREMENT SETUP

The unique architecture of the HA7062D allows for direct access to key internal modules in order to measure the actual noise floor of the analyzer at any given frequency 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/core while measuring two non-correlated frequency sources at the frequency of interest. Refer to Figure 2, below.

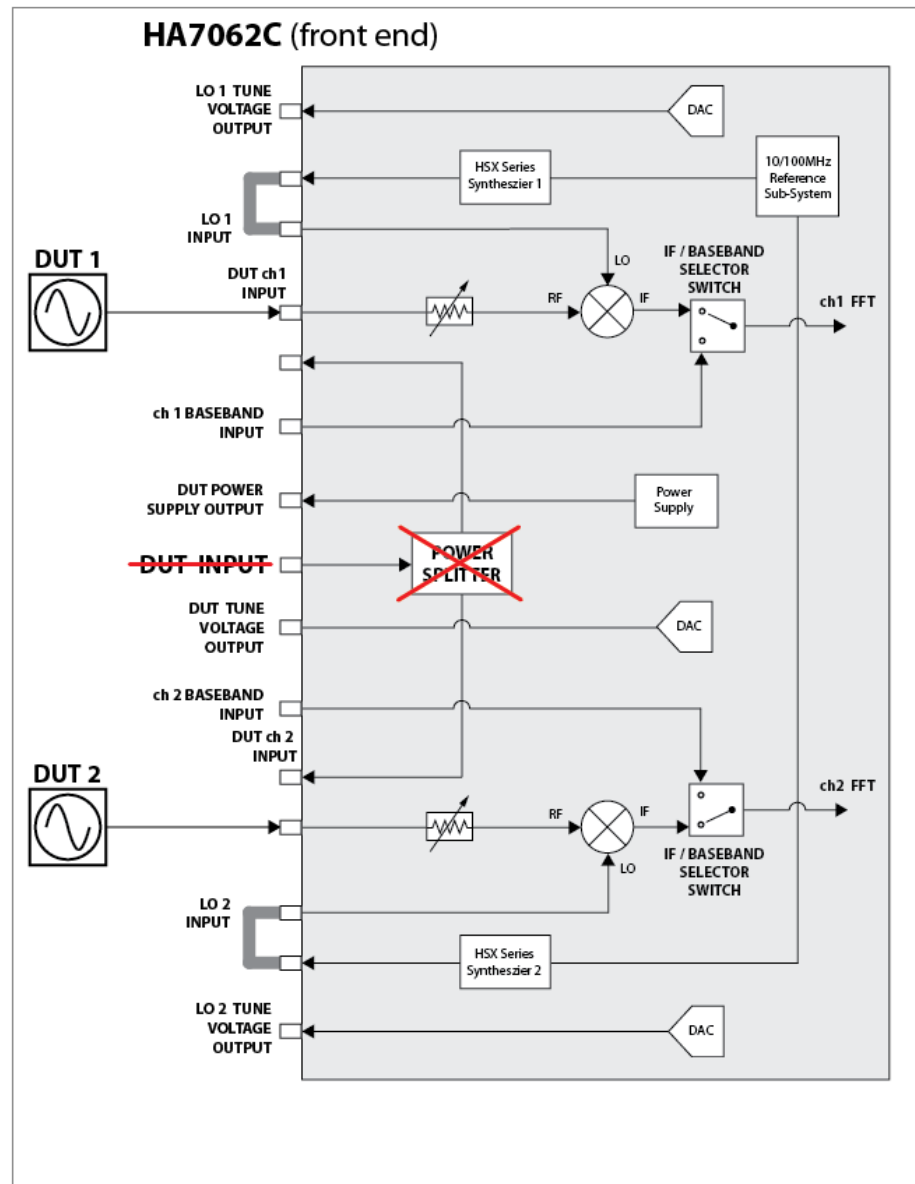**Figure 2: HA7062D Noise Floor Measurement Block Diagram**

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NOISE FLOOR DATA

The data contained in this section demonstrates the noise floor capability of the HA7062D at five different frequencies covering the base operating range of the instrument (10MHz, 100MHz, 1GHz, 3GHz and 6GHz). The three plots in each figure reflect the actual noise floor for 1, 10 or 100 correlations. Further improvement in the noise floor can be achieved by utilizing more correlations (refer to Table 2, located on page 5).

All data contained in this section was acquired using a minimum offset frequency of 1Hz. For reference, the data acquisition times for each measurement are as follows:

1 correlation: < 10s
10 correlations: < 90s
100 correlations: < 15 min

NOTE: Setting the instrument to a higher minimum offset frequency will further improve the measurement speed.
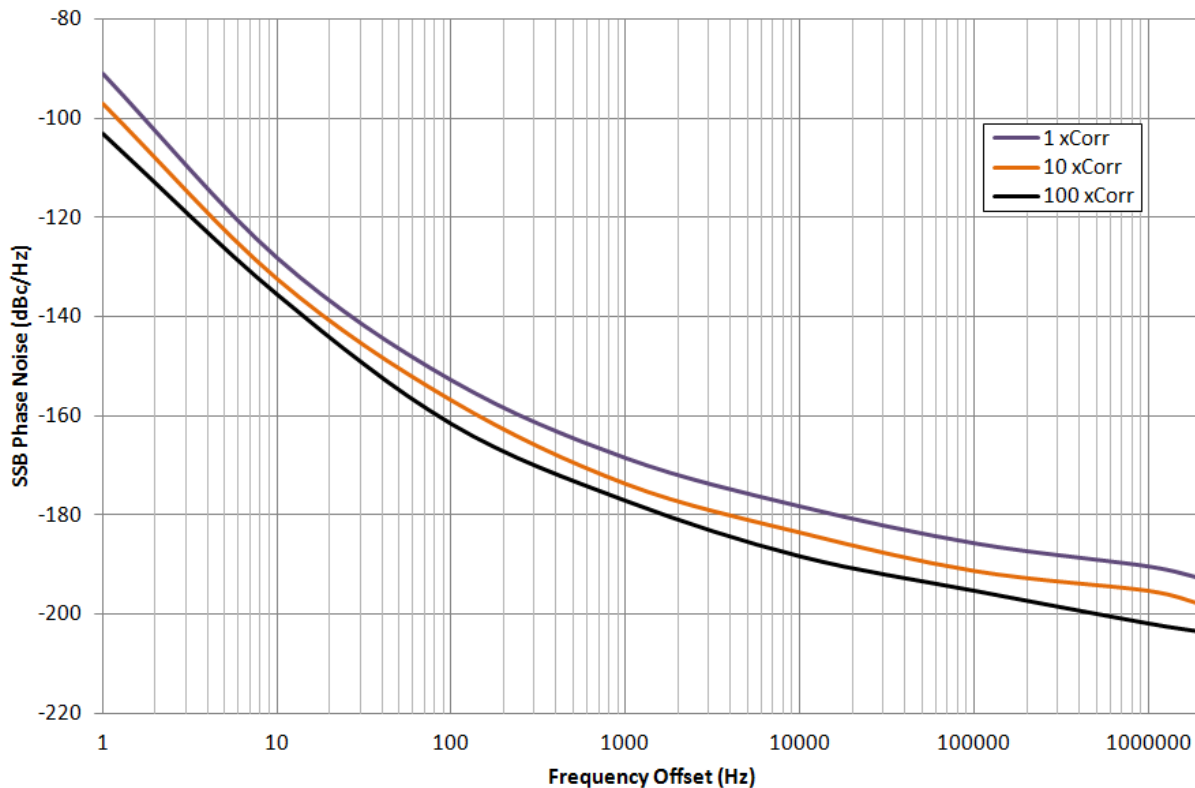

Figure 3: 10MHz Noise Floor Measurements

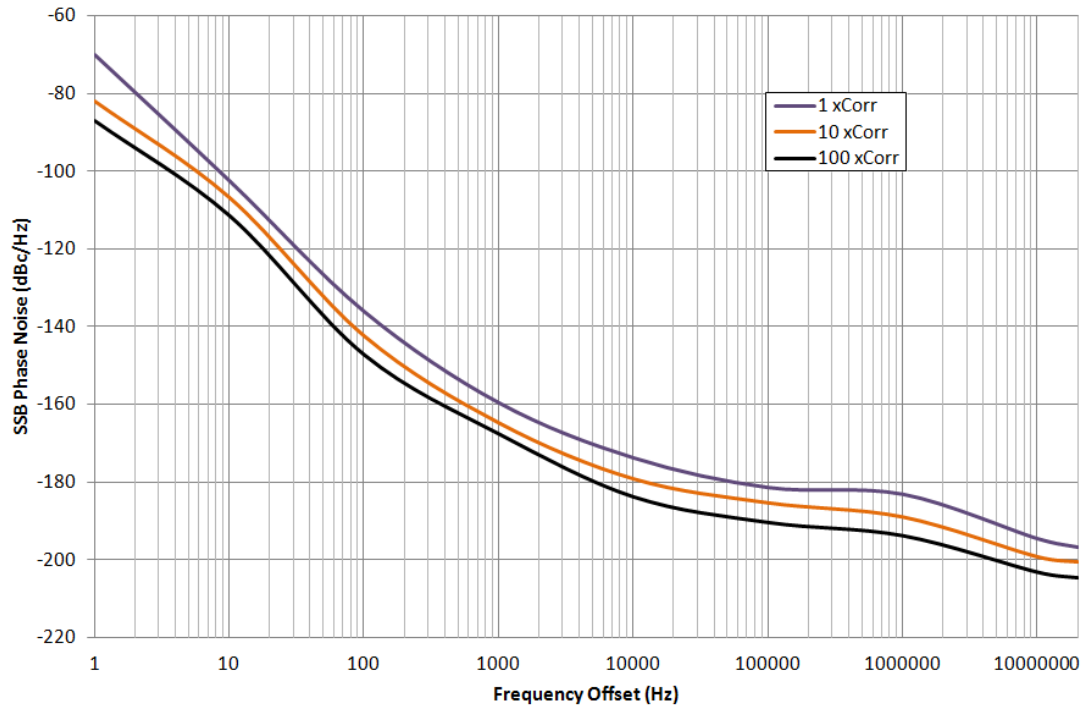## NOISE FLOOR DATA (continued)

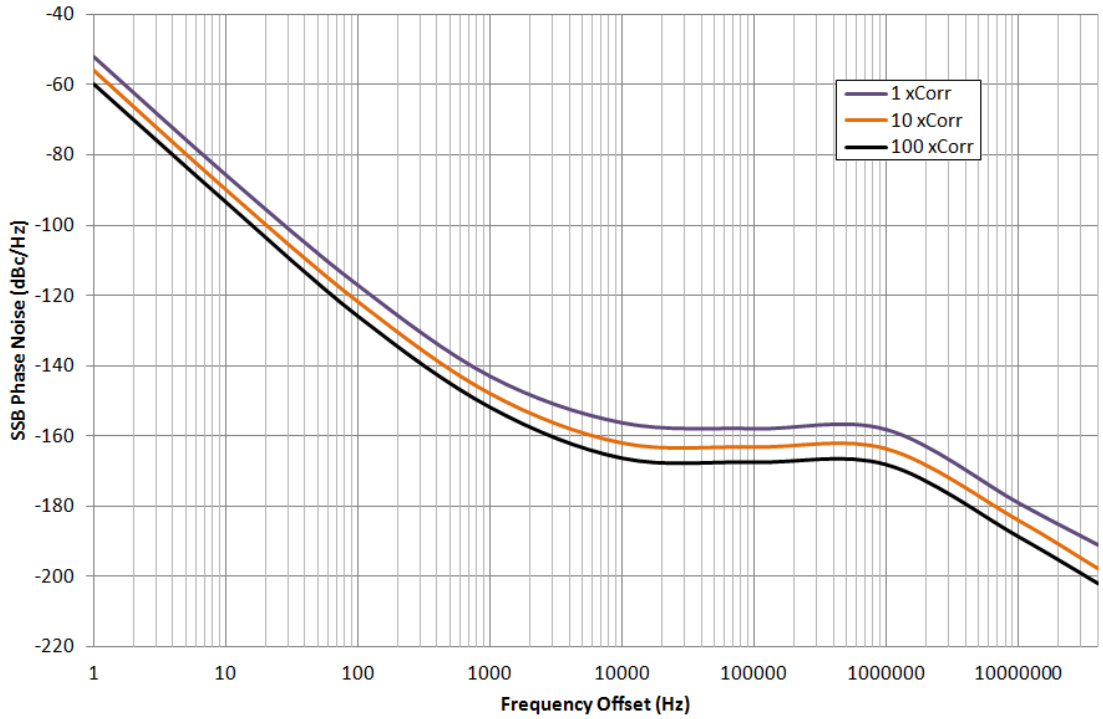**Figure 4: 100MHz Noise Floor Measurements**

Figure 5: 1GHz Noise Floor Measurements

NOISE FLOOR DATA (continued)
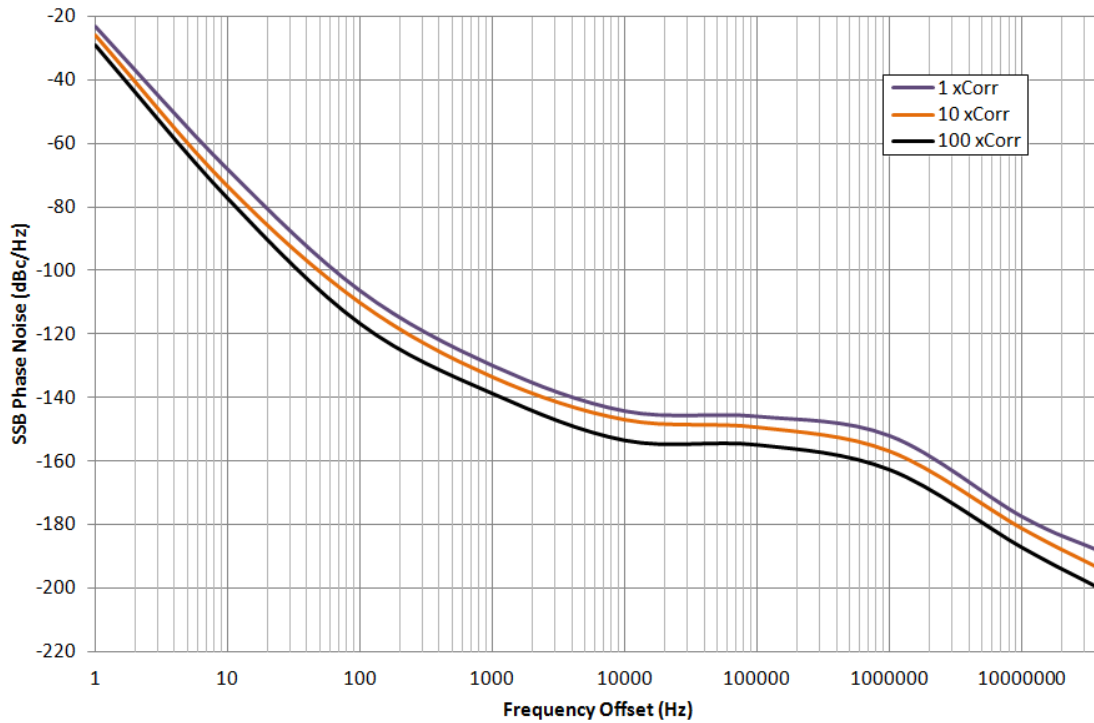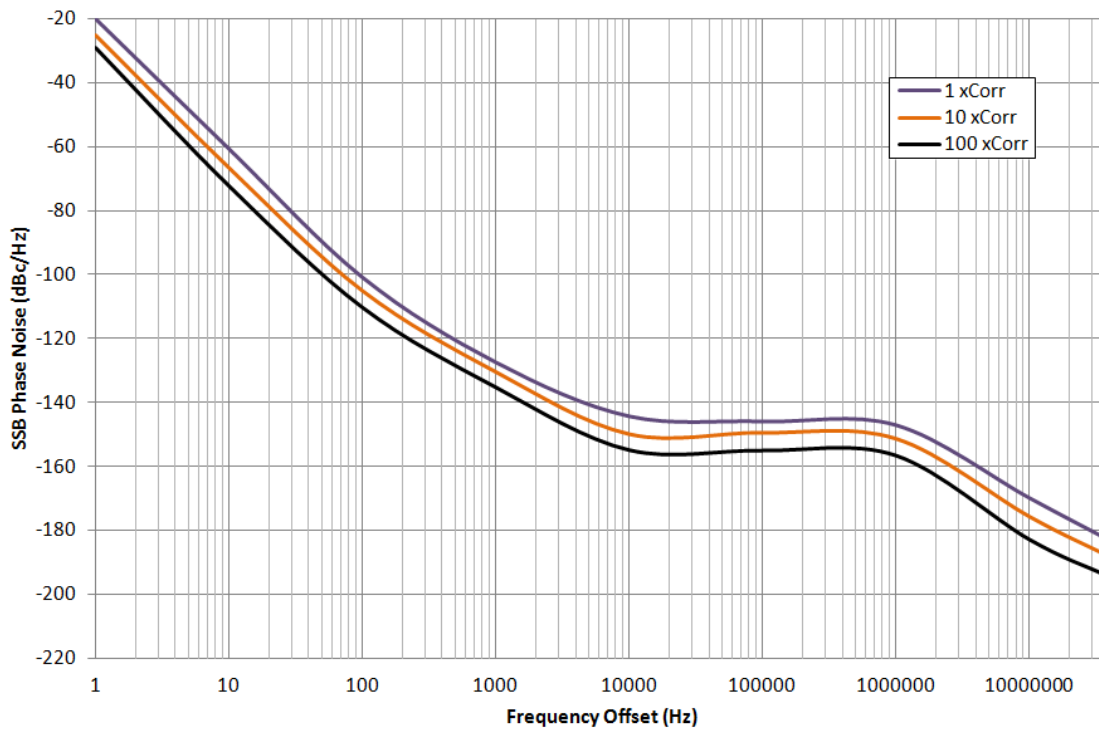
Figure 6: 3GHz Noise Floor Measurements

Figure 7: 6GHz Noise Floor Measurements

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CONFIGURATION

FRONT PANEL

The HA7062D 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 straight forward absolute phase noise measurements of a frequency source.

DESCRIPTION	SPECIFICATION
Front Panel Connector(s) Type	2.92mm, 50ohm

DUT Input
    Frequency Range (standard)
    Power Level Range
    Input Damage Level
	10MHz to 26GHz 10MHz to 40GHz (OPT-CC40)
	-5dBm to +20dBm
	+22dBm

DUT Tune Voltage
    Voltage Tune Range
    Max Current
	For Vcc control of some DUTs.
	    -10V to +12V
	    5mA

DUT Power Supply
    Voltage Supply Range
    Maximum Current
	Integrated power supply.
	    0V to +12V
	    250mA

LO1/LO2 Input(s)
    Frequency Range (standard)
    Power Level Range
    Input Damage Level
	Connect to *LO1/LO2 Output(s)* for standard operation.
	    10MHz to 6GHz
	    +7dBm to +12dBm
	    > +22dBm

LO1/LO2 Output(s)
    Frequency Range (standard)
    Power Level Range
	CW sources for residual measurements. Connect to *LO1/LO2 Input(s)* for standard operation.
	    10MHz to 6GHz (0.001Hz step size)
	    0dBm to +10dBm (0.01dB step size)

LO1/LO2 Tune Voltage
    Voltage Tune Range
    Max Current
    Tuning Sensitivity
	For independent Vcc control of external LO sources during External LO Mode of operation.
	    -10V to +12V
	    5mA
	    TBD

DUT ch1/ch2 Input(s)
    Frequency Range (standard)
    Power Level Range
    Input Damage Level
	Allows bypass of DUT power splitter for direct access to the phase detector of each channel.
	    10MHz to 6GHz
	    0dBm to +14dBm
	    > +16dBm

ch1/ch2 Splitter Bypass Output(s)	Connect jumper cable to ch1/ch2 *DUT Input(s)* for standard operation.

ch1/ch2 Baseband Input(s)
    Frequency Range
    Power Level Range
    Input Damage Level
	DC to 40MHz
	± 1Vdc
	± 2Vdc, or 50mA (whichever is greater)

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REAR PANEL

| DESCRIPTION	SPECIFICATION

Reference Output Port
    Connector Type
    Output Frequency
    Output Level
    Output Waveform
	
	SMA, 50ohm
	10MHz ±10Hz
	+5dBm ±2dBm
	Sinusoid

10MHz Reference Input Port
    Connector Type
    Input Frequency
    Input Level
	ONLY FOR FREQUENCY COUNTERS - DOES NOT AFFECT MEASUREMENT SENSITIVITY
	SMA, 50ohm
	10MHz ±10Hz
	0dBm to +10dBm (Sinusoid or Square)

AC Power Input
    Connector Type
    AC Input Rating
	International Power Supply
	IEC 320-C13
	90-260V$_{AC}$, 50-60Hz. Specify country at time of order for proper power cord.

Data I/O Interface
    Connectivity
    Storage
	
	USB B-Type (virtual comm. port), Ethernet, RS-232, GPIB
	SD Card Reader

CONFIGURATION
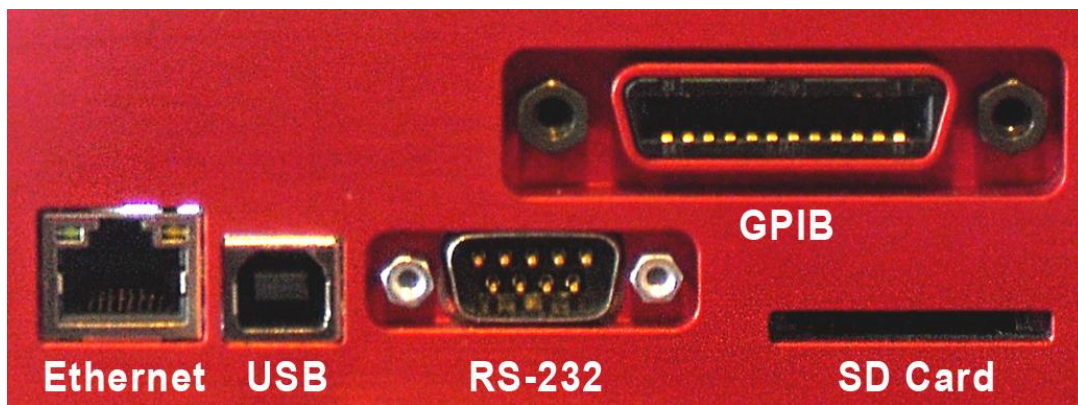
Figure 8: HA7062C Communication Ports

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MECHANICAL DIMENSIONS

The HA7062D has a 1U high, rack mountable chassis form factor. The fan-less design was adopted to eliminate the potential for microphonics. 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).

17.00
(432)

TOP

15.00
(381)

1.75
(44.45)

holzworth instrumentation   HA7062D Phase Noise Analyzer   OFF   ON

Tune Voltage LO1   Power Supply   DUT Input DUT Tune Voltage   LO2 Tune Voltage

LO Output   LO Input   ch1 Baseband Input   DUT ch1 Input   DUT ch2 Input   ch2 Baseband Input   LO Input LO Output   POWER

JUMPER   JUMPER   JUMPER   JUMPER
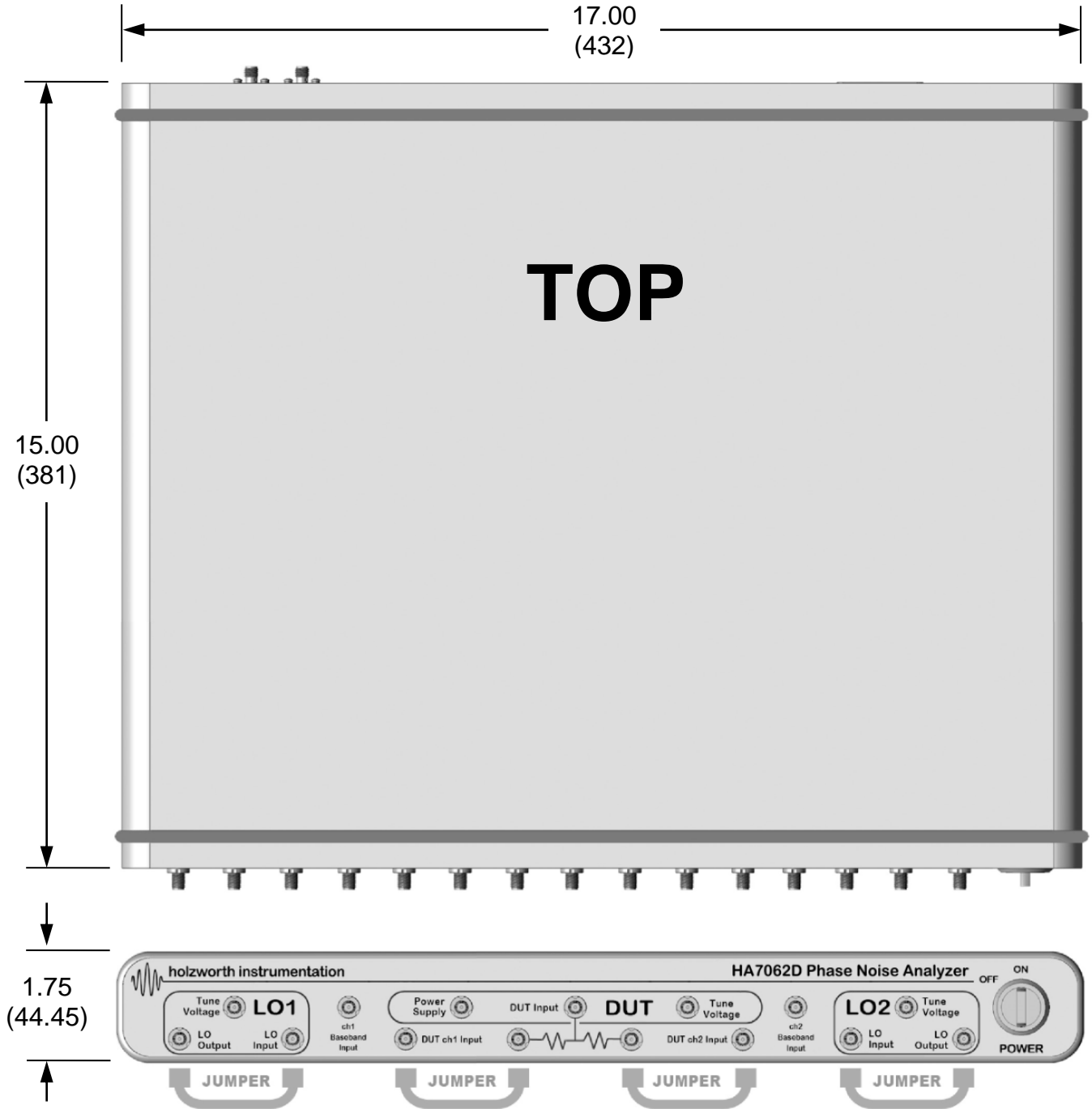
CONFIGURATION

CONFIGURATION (continued)

AC POWER SUPPLY
The HA7062D utilizes an ultra-clean, international, switching power supply. Units ship with a country specific, AC supply cable. Please specify country of end use at the time of purchase.

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

CONFIGURATION (continued)

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
OPT-CC40	10MHz - 40GHz Cross Correlation Measurements	ACCESSORY
HX5100-x	Electronic Phase Shifter PAIR, Additive Measurements, 1 Octave Bandwidth, Specify fc	ACCESSORY
CASE-1U	Ruggedized Carrying Case with TSA security lock	ACCESSORY
RACK-1U	19" Rack mount bracket kit for HA7000 Series. 90 degree rear bracket.	ACCESSORY
RACK2-1U	19" Rack mount bracket kit for HA7000 Series. Straight rear bracket.	ACCESSORY

INCLUDED HARDWARE AND CERTIFICATIONS

Each standard product delivery includes specific, standard hardware and certifications.

| TYPE	DESCRIPTION	COMMENTS
HARDWARE	**HA7062D PHASE NOISE ANALYZER**	DELIVERABLE
HARDWARE	**AC Power Cord (7ft/2.1m). Specify country of end use.**	DELIVERABLE
HARDWARE	**Ethernet Cable (10ft/3m)**	DELIVERABLE
HARDWARE	**USB Cable (6ft/1.8m)**	DELIVERABLE
CERTIFICATE	**ANSI z540.1 CALIBRATION CERTIFICATE (0.1Hz - 40Mhz)**	DELIVERABLE
WARRANTY	**3 YEAR MANUFACTURER'S WARRANTY**	NON-APPLICABLE
CERTIFICATE	**CE COMPLIANCE CERTIFICATE** *DIRECTIVE: 2004/108/EC, TEST STANDARD: EN 61326-1: 2006*	WEB DOWNLOAD
CERTIFICATE	**RoHS COMPLIANCE CERTIFICATE** *DIRECTIVE: 2002/95/EC*	WEB DOWNLOAD
CERTIFICATE	**WEEE COMPLIANCE STATEMENT** *DIRECTIVE: 2002/96/EC*	WEB DOWNLOAD

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HA7062D OPERATION

All data processing is performed internally on the HA7062D. Measurement settings can be changed using serial commands sent to the HA7062D via any of the included communication options (see *CONFIGURATION* on page 12). Measurement results can be read back directly from the instrument, eliminating the use of the GUI software. This capability provides unparalleled operational flexibility, ideal for ATE applications.

Purchase of an HA7062D includes access to the C++ based GUI for hardware operation and viewing/saving data. All software upgrades and functionality additions are freely available for the life of the instrument at no additional cost to the user.

HA7062D SOFTWARE

The HA7062D GUI offers an extremely user-friendly means to utilize the full functionality of the HA7062D on any Windows-based PC. Absolute, Additive, Jitter, AM Noise, and more can be performed using the intuitive software GUI. Refer to the software menu summaries on page 17.
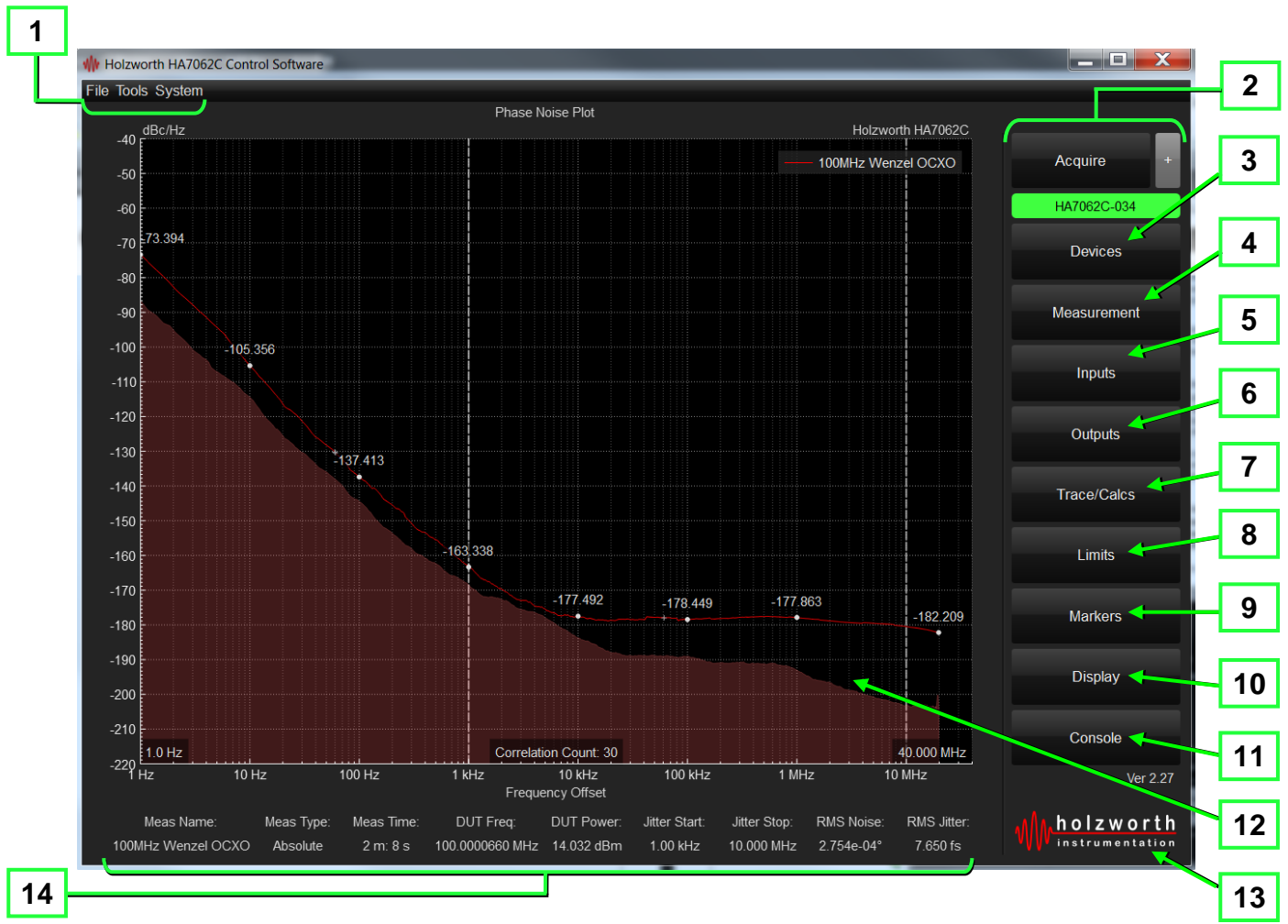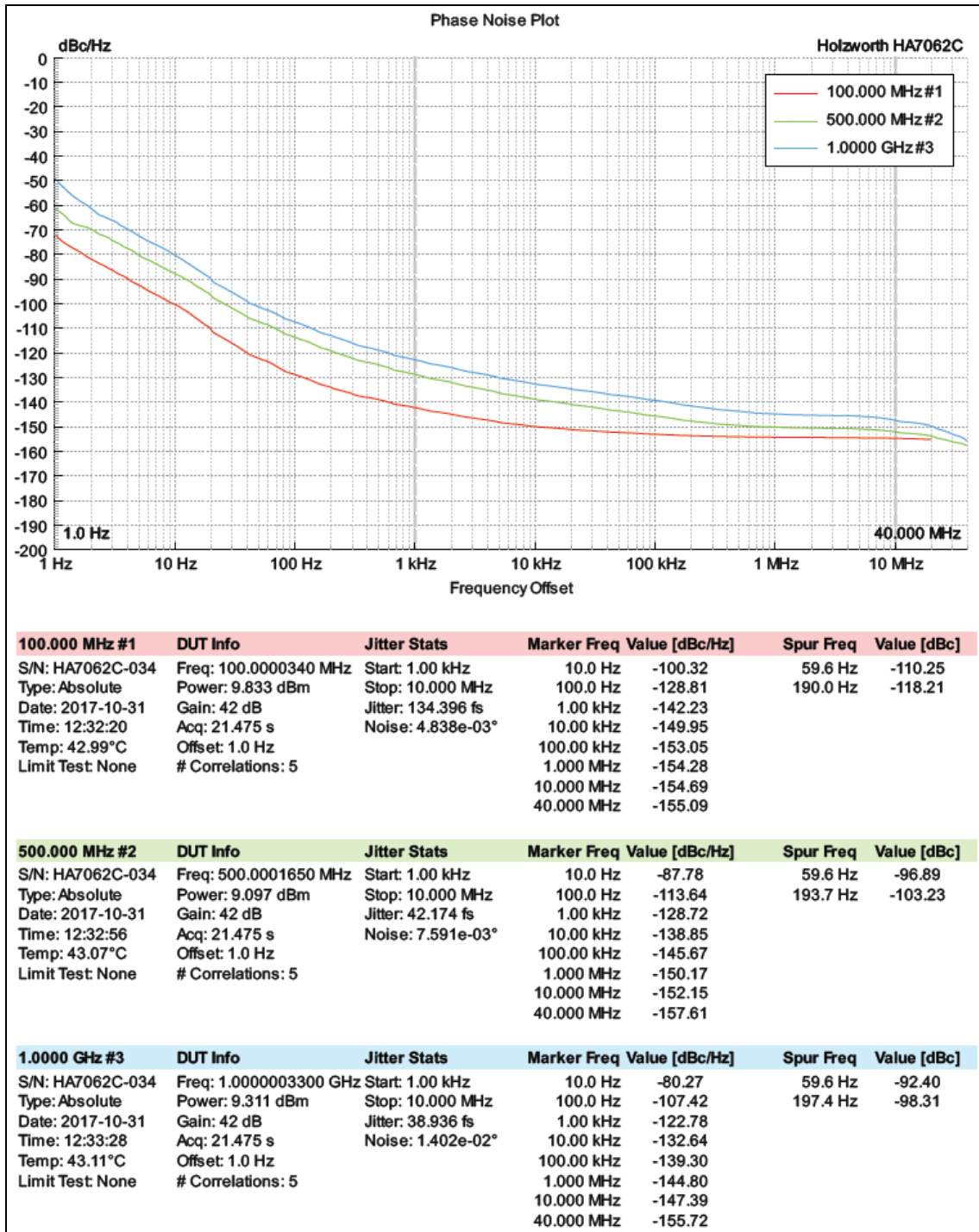

SOFTWARE

HA7062C SOFTWARE (continued)

The software menus indicated on page 16 are summarized as follows:

1. **File:** Save, load, export, import data; and generate reports. The report generator captures the current plot and any measurement statistics (see page 18).

   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 HA7062D 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. **Inputs:** Used to verify DUT/LO power and frequency, calibrate and make adjustments for both internal and external LO sources.

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

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

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

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

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 logo shockwave 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 currently of a specifically selected data trace.

SOFTWARE

HA7062C 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 currenly 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.

100.000 MHz #1

	DUT Info	Jitter Stats	Marker Freq	Value [dBc/Hz]	Spur Freq	Value [dBc]
S/N: HA7062C-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: HA7062C-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: HA7062C-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		

SOFTWARE

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3 YEAR WARRANTY

All Holzworth phase noise analyzer products come with a standard 3 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 manufactured in the USA.