

# E4727B / W7802B Advanced Low-Frequency Noise Analyzer / Measurement Bundle Software

30 mHz to 100 MHz, 200 V, 100 mA

# W7801B WGFMU Measurement Bundle Software

1 mHz to 16 MHz, 10 V, 10 mA

## Measure Semiconductor's Flicker(1/f) Noise and RTN with wafer mapping

The Keysight E4727B/W7802B is a turn-key solution to measure flicker (1/f) noise and RTN (Random Telegraph Noise) of a semiconductor's device. The Keysight W7801B is bundle software to control Keysight B1530A (WGFMU). These solutions can control semi-auto probe stations and get mass wafer mapping noise data automatically.



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# Introduction

Electrical noise is inherent in every circuit and may be caused by current flowing through a resistor or transistor, or even leakage current through a tantalum capacitor. As a classical limitation of electronics, this noise must be managed. A systems engineer must understand the overall system sensitivity to noise, and then derive the key contributors. A typical key contributor might be a component like a semiconductor device, sensor, or passive component. How do we quantify the noise of these constituent parts? The Keysight E4727B Advanced Low-Frequency Noise Analyzer (A-LFNA) enables a closer, deeper look at noise in components, individual devices, and integrated circuits, both packaged and at the wafer level. A device modeling engineer may now leverage the A-LFNA's rare combination of industry-leading noise sensitivity ( $-185 \text{ dBV}^2/\text{Hz}$ ) to characterize devices at high voltages (to 200 V) and down to ultra-low frequencies (to 30 mHz). Thanks to seamless integration with PathWave WaferPro Express software, one may program and sequence high-speed DC, capacitance, and RF measurements, all the while automating wafer prober control. The resulting noise data may be used to develop device models with the help of state-of-the-art device modeling tools like Model Builder Pro (MBP) and Integrated Circuit Characterization and Analysis Program (IC-CAP). These models can then be passed along to circuit designers, who may then push the envelope in low-noise circuitry.

The applications for wafer-level  $1/f$  noise measurements are numerous; however, a few important ones are listed as follows.

- **Process design kit development.** Semiconductor device foundries enable fabless design centers to design components such as transceivers for mobile phones, frequency synthesizers, analog-to-digital converters, and much more. To make this possible, the foundries must provide Process Design Kits (PDKs) with simulation models of the primitive devices. The simulation models must include noise effects on transistors (BJT, CMOS, etc.) and resistors. The noise models must be across all possible bias currents, temperatures, and device geometries.
- **Manufacturing statistical process control and reliability.** As an example, manufacturers of GaN devices may use noise measurements across their wafers as an early indicator of device reliability. Those devices that exhibit more noise are likely to fail sooner. Now we have a nondestructive way of assessing reliability, quite in contrast with standard accelerated life testing. Furthermore, for circuit applications where noise is a critical parameter, wafer-level measurements may be used to track the evolution of noise performance across days, weeks, and months of manufacturing.
- **IC noise specification.** Integrated circuit manufacturers of operational amplifiers and linear voltage regulators often need to characterize input referred voltage noise as a critical specification in their datasheets. One wafer may contain > 10 thousand such circuits. To efficiently measure and map circuit performance across the wafer (and even across lots of wafers), the probe and signal conditioning circuitry must be placed close to the device under test to improve grounding and minimize external noise influences.

# Overview

The E4727B hardware has been designed for both on-wafer and discrete device/circuit measurements and consists of a module paired with a PXIe computer and digitizer. The module is connected to a DC source measurement unit (SMU) such as the B1500A to enable both flexible and clean device biasing and noise signal conditioning. An SMU is used to apply bias and measure DC operating points. However, when measuring noise, the noise contribution must be filtered out. The voltage noise taken from the device output is amplified and analyzed using high-speed digitization with customized FPGA. One possible configuration of noise measurement is shown below, although many others are possible. The variable resistance, switching, and filtering functions are included in the A-LFNA module.

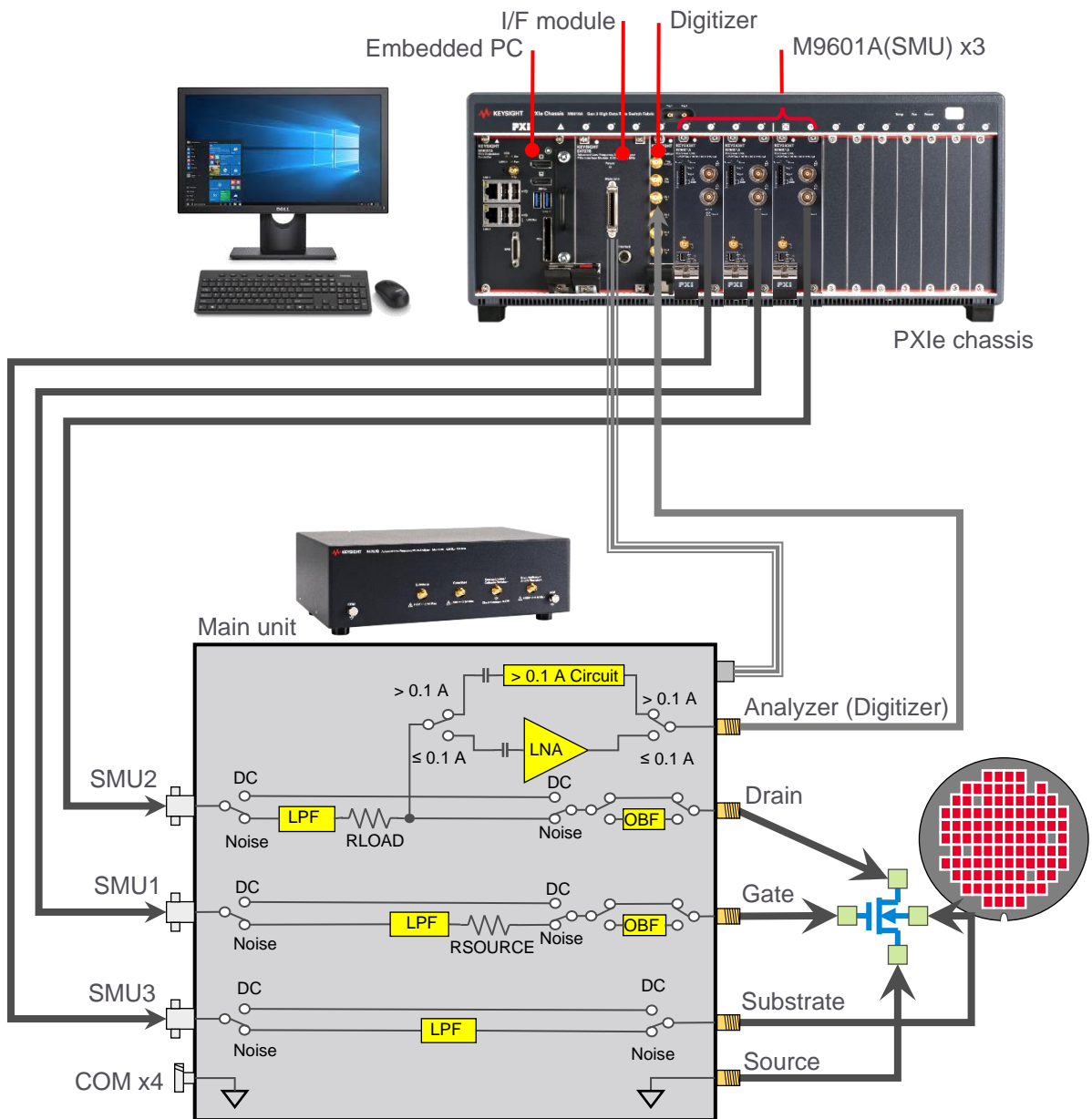
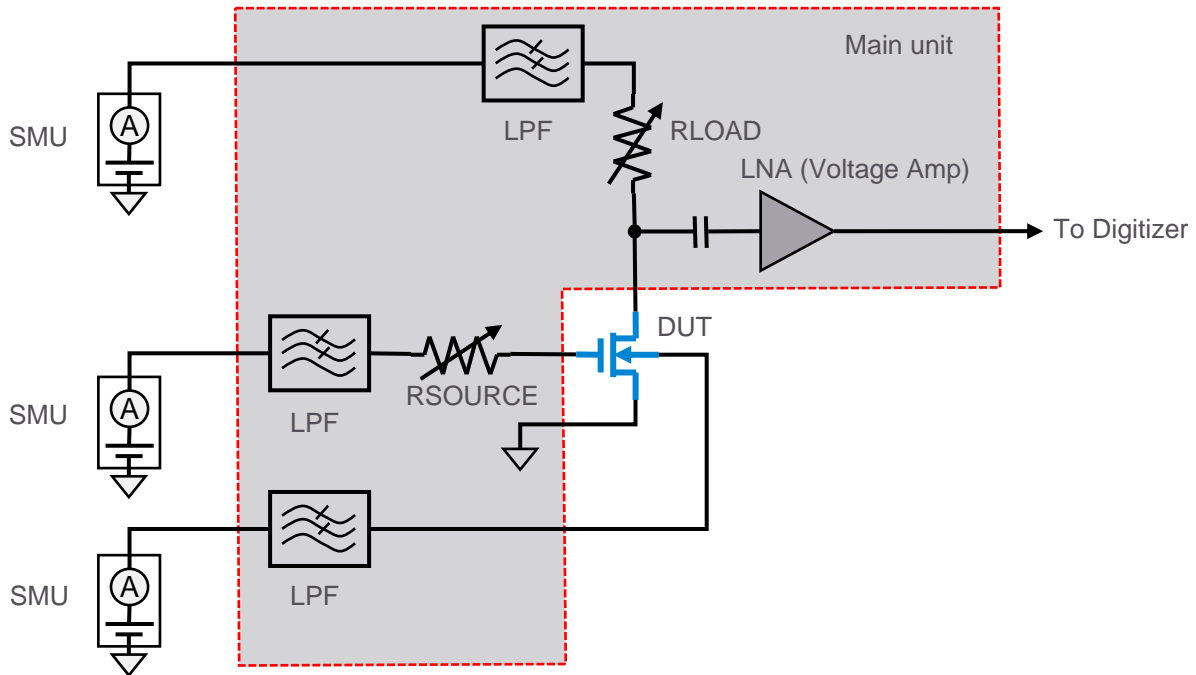


Figure 1. Simplified block diagram of E4727B system which indicates LNA, LPF, and OBF (Oscillation Block Filter)

Different device types require different source and load impedance terminations. The E4727B is the only analyzer in the industry to offer 23 impedance values ranging from 0 ohms to 100 MΩ. The A-LFNA software can judiciously select RSOURCE and RLOAD based on device type (FET, BJT, Diode, Resistor, etc.) and measured DC characteristics.



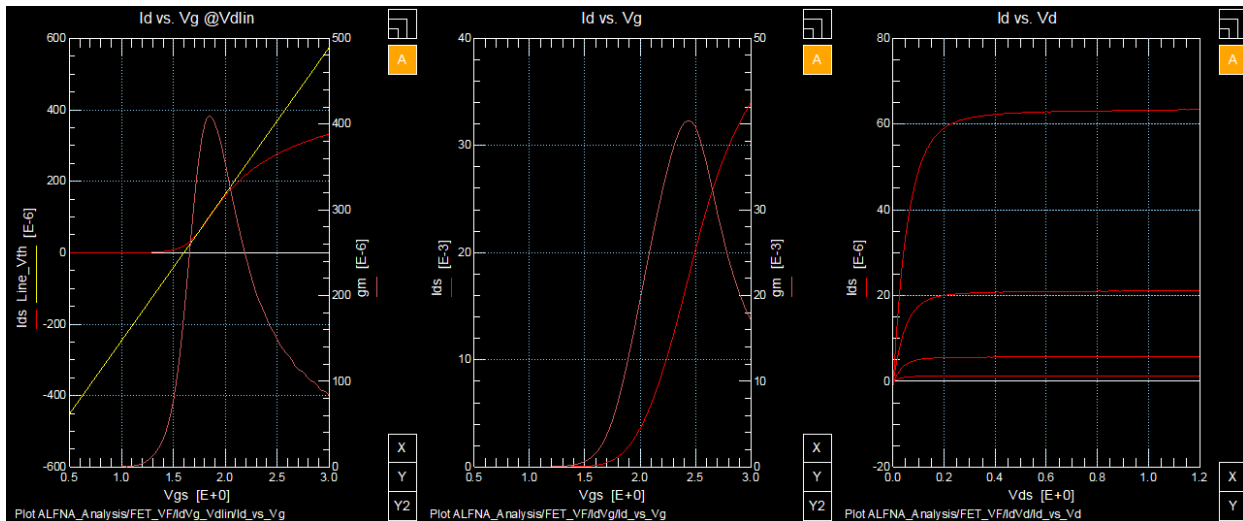
**Figure 2.** Equivalent circuit for Noise measurement

The PXIe chassis system controller comes equipped with the A-LFNA software integrated with PathWave WaferPro Express, enabling fast and flexible instrument and prober control. Thus, the engineer may now automate multi-bias, multi-device DC, and noise measurements. Measurement speed and accuracy may be adjusted by setting the degree of hardware averaging. The factory-provided measurement routines offer a rich set of biasing schemes that can be copied and modified to suit specific needs.

# Measurement Capabilities

## DC measurement

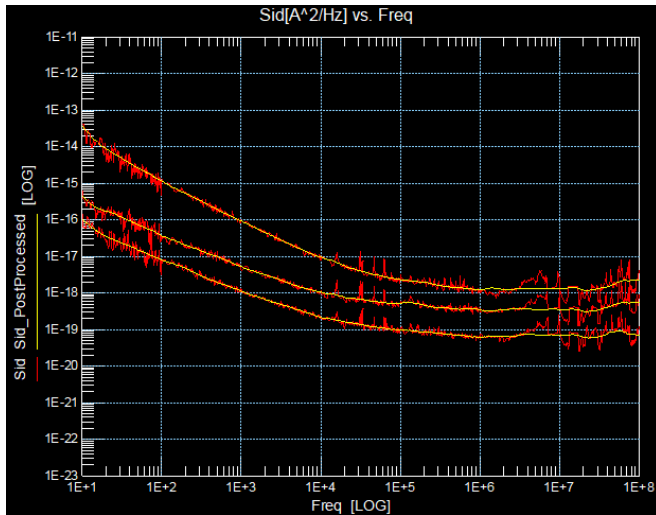
- Accurate DC measurement when used with supported semiconductor parameter analyzers - up to 0.1 A and 200 V.
- Device types supported: FETs, BJTs, Diodes, and Resistors.



**Figure 3.** Example of DC measurement of FET. The  $V_{th}$  is extracted by gm max method under linear region  $V_{ds}(=0.05\text{ V})$  in the left plot and  $g_m$  and  $r_{out}$  are extracted from the middle and right plot under saturation region  $V_{ds}(=1.0\text{ V})$ , respectively

## Flicker(1/f) noise measurement

- Device types supported: FETs, BJTs, Diodes, Resistors, and Circuits (Op-Amps, comparators, etc.)
- Analysis frequency range from 30 mHz to 100 MHz
- Measures noise down to  $1\text{E-}28 \text{ A}^2/\text{Hz}$  (Typ.)
- Measures noise down to 30 pA bias current (Typ.)
- Current/voltage/power range of up to 0.1 A / 200 V / 10 W, respectively
- Available > 0.1 A current by external DC Power Supply



(a) Sid vs. Freq for NMOS on a wafer



(b)  $e_n$  vs. Freq for packaged Operational Amplifier

Figure 4. 1/f noise example data up to 100 MHz for wafer device and packaged device

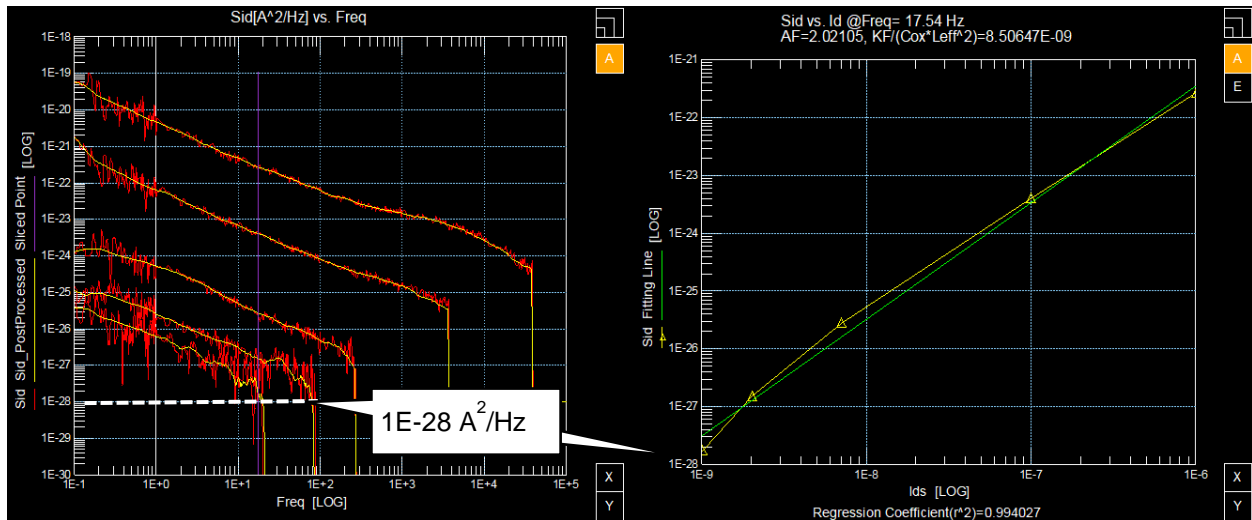


Figure 5.  $1\text{E-}28 \text{ A}^2/\text{Hz}$  noise current density example of 1/f Noise measurement

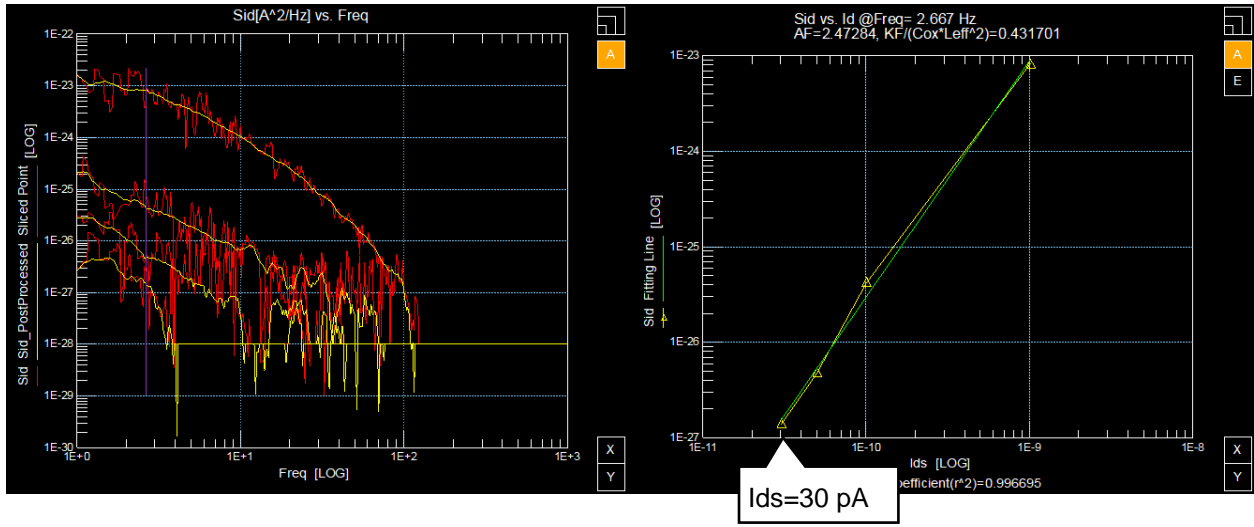


Figure 6. 30 pA bias current example of 1/f Noise measurement



# RTN measurement

- Time domain representations of noise
- Histograms of current and voltage
- Device types supported: FETs, BJTs, Diodes, Resistors, and Circuits (Op-Amps, comparators, etc.)
- 2.0 ns minimum time step
- Up to 16 million points sampling size
- Available RTN data analysis of B1530 software (not supported by Keysight since the code is open source)

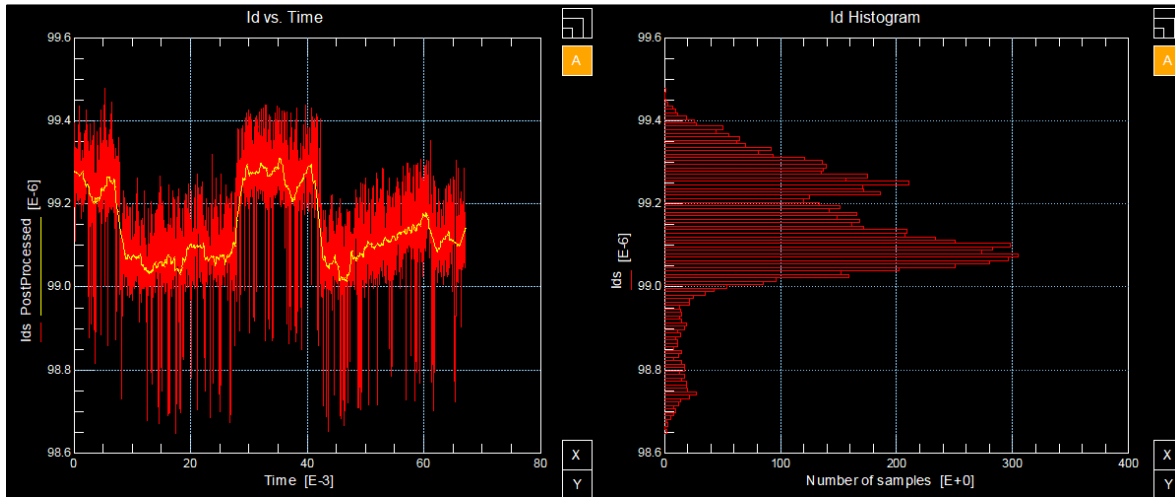


Figure 7. Example of RTN measurement

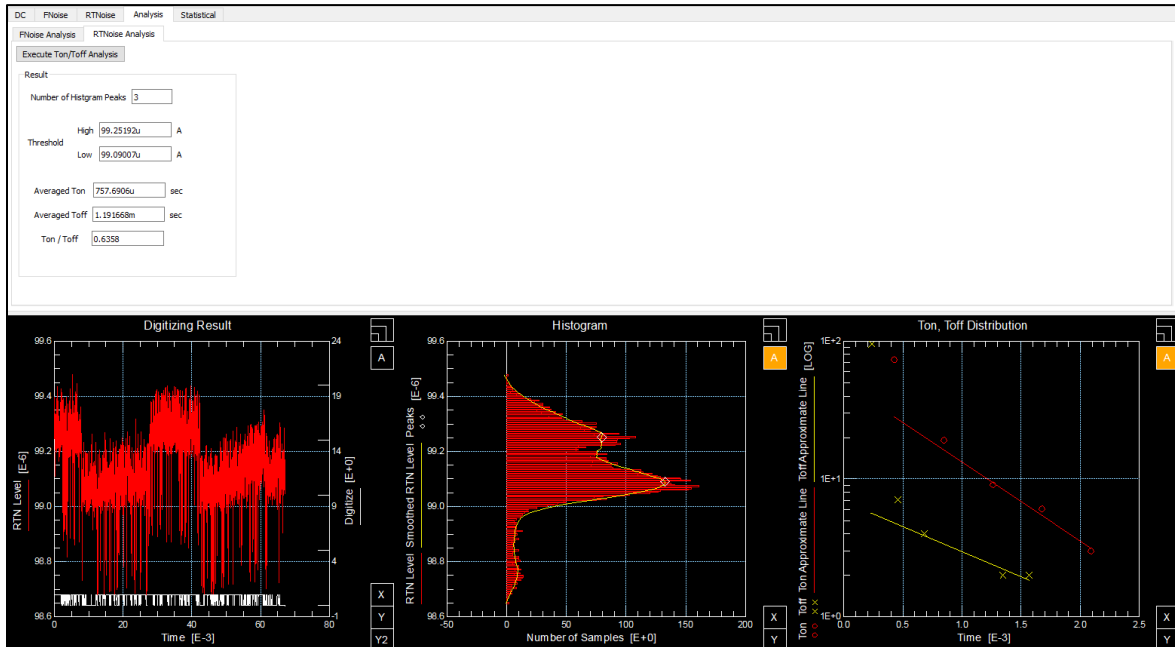


Figure 8. Ton and Toff RTN data analysis

## Over 0.1A bias noise measurement

- 0.1 A bias current using external DC Power Supply
- Jig and DC parameter data over 0.1 A need independently

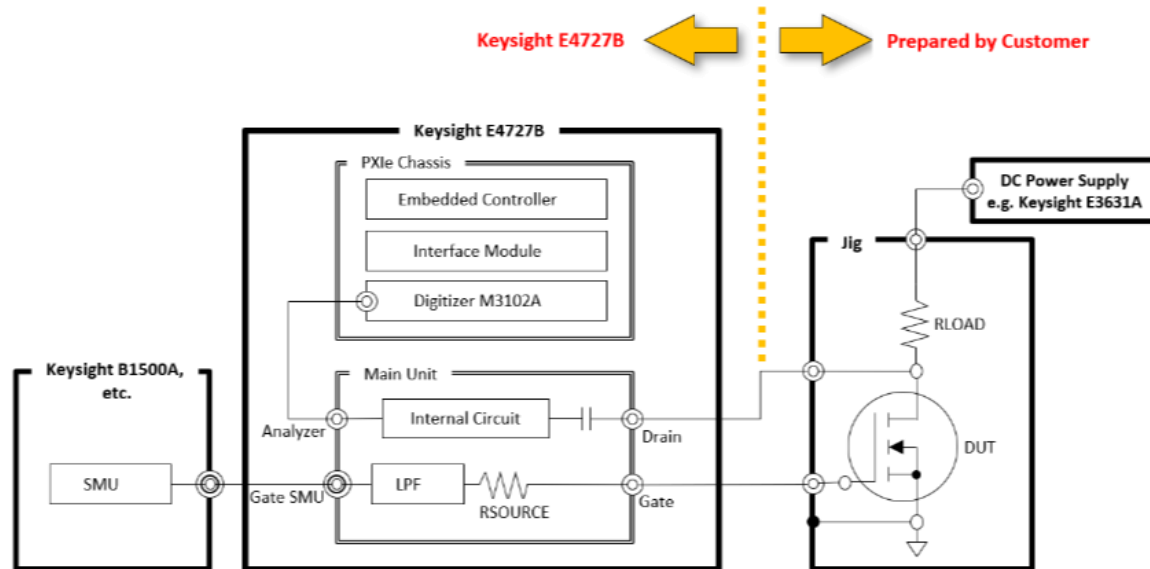


Figure 9. Diagram of > 0.1 A measurement

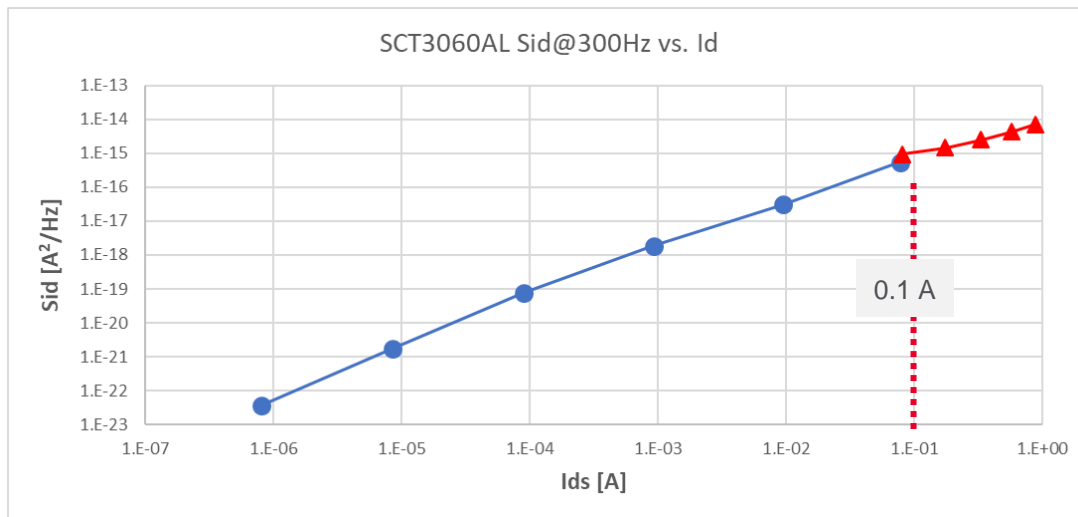


Figure 10. Example of up to 1 A measurement

# E4727B Specifications

## System specifications

Specifications			
Measurable DUT			FET BJT Diode Resistor Circuit
Number of DUT terminals	FET, BJT		3 (FET-3T, BJT-3T) 4 (FET-4T, BJT-4T) 5 (FET-5T, BJT-5T) 6 (FET-6T, BJT-6T)
	Diode, Resistor		2 (DIODE-2T, RESISTOR-2T) 3 (DIODE-3T, RESISTOR-3T)
	Circuit		1 (CIRCUIT-1T)
DUT structure			Wafer and Package
Maximum analog bandwidth			30 mHz – 100 MHz
Frequency domain measurement	Frequency	Minimum	30 mHz
		Maximum	100 MHz
Time domain measurement (RTN)	Sampling frequency	Maximum	500 MHz
		Sampling interval <sup>1</sup>	Minimum
	Maximum		8.59 s
	Sampling number <sup>2</sup>	Minimum	1,024 (=2 <sup>10</sup> )
Maximum		16,777,216 (=2 <sup>24</sup> )	
Maximum bias in DC measurement	Drain		± 200 V, ± 0.1 A
	Gate, substrate		± 50 V, ± 0.1 A
Maximum bias in noise measurement	Drain		± 200 V, ± 0.1 A ± 200 V, > ± 0.1 A
	Gate, substrate		± 50 V, ± 0.1 A
Minimum bias current			30 pA (Typ.)
Minimum noise current density			1E-28 A <sup>2</sup> /Hz (Typ.)
1/f noise measurement accuracy			± 1.5 dB
1/f noise measurement repeatability			± 2.0 dB
ESD protection			All terminals

1. The sampling interval for RTN measurement is calculated by  $1/(500\text{MHz}/2^n)$  with  $n=0\sim 32$  range.

2. The sampling number for RTN measurement is calculated by  $2^n$  with  $n=10\sim 24$  range.

## PXIe interface module (E4727B-100)

Specifications	
Dimensions	3U/3 slots



# Main unit (E4727B-200)

LNA		Specifications		
Number of LNAs	3			
	LNA1 (VAMP_ULF)	LNA2 (VAMP_LF)	LNA3 (VAMP_HF)	
LNA type	Voltage	Voltage	Voltage	
Operating frequency	30 mHz – 1 MHz	1 Hz – 1 MHz	1 Hz – 100 MHz	
Voltage gain	59 dB @ 10 kHz	59 dB @ 10 kHz	47 dB @ 1 MHz	
Input-referred noise voltage <sup>1</sup>	-185 dBV <sup>2</sup> /Hz (=0.56 nV/√Hz) @10 kHz	-185 dBV <sup>2</sup> /Hz (=0.56 nV/√Hz) @10 kHz	-178 dBV <sup>2</sup> /Hz (=1.3 nV/√Hz) @1 MHz	
Input-referred noise current	100 fA/√Hz @10 kHz	100 fA/√Hz @10 kHz	100 fA/√Hz @10 kHz	
Corner frequency	15 Hz	100 Hz	200 Hz	
Maximum input voltage	± 200 Vdc	± 200 Vdc	± 200 Vdc	
Output impedance	220 Ω	220 Ω	220 Ω	
LPF		Specifications		
Number of LPFs	2			
	LPF1 (LPF_ULF)	LPF2 (LPF_LF/HF)		
Cut-off frequency	0.03 Hz	0.4 Hz		
Series resistance	3.8 kΩ	294 Ω		
RSOURCE and RLOAD		Specifications		
	RSOURCE	RLOAD		
Resistor values	0 – 100 MΩ (23 selections)	0 – 100 MΩ (23 selections)		
Resistance accuracy of parts	± 0.5 %	± 0.5 %		

1. Measured by Keysight M3102A



## Test fixture (E4727B-300)

### Specifications

IC Socket Type	DIP (300 mils and 600 mils)
IC Socket Lead Pitch	2.54 mm (100 mils)
IC Socket Pin Number	28



## M9601A Add-On

### Specifications

M9601A	PXIe Precision Source/Measure Unit		
Maximum sampling rate	1.25 MSa/s		
Minimum current measurement resolution	10 fA		
Maximum voltage and current	Maximum voltage	Maximum current	Maximum power
	±21 V	±315 mA <sup>1</sup>	6.6 W
	±105 V	±105 mA <sup>1</sup>	11 W
	±210 V <sup>1</sup>	±50 mA	10.5 W

1. The maximum voltage and current are limited to ±200 V and ±100 mA by E4727B's specification.



## Furnished accessories (E4727-60001, E4727-60002)

Description	Quantity	Comment
<b>E4727-60001</b>		
Cable, MDR 40pin, 2 m	1 ea.	
<b>E4727-60002 (Kit accessory)</b>		
E4727-60003	Coaxial cable, SMA(m)-SMA(m), 1 m	1 ea. Main unit – Digitizer
E4727-60004	Coaxial cable, SMA(m)-SMA(m), 0.2 m	4 ea. Main unit – Test fixture
E4727-60005	Coaxial cable (double-shielding), SMA(m)-SSMC(plug), 0.25 m	Main unit - Probe
E4727-60006	Coaxial cable (double-shielding), SMA(m)-SSMC(plug), 0.5 m	
E4727-60016	Coaxial cable (single-shielding), SMA(m)-SSMC(plug), 0.25 m	
E4727-60017	Coaxial cable (single-shielding), SMA(m)-SSMC(plug), 0.5 m	
E4727-20001	Adapter, SMAP-BNCJ	
E4727-20002	Adapter, TXAJ-BNCP	
E4727-20003	Short plug, SMA(m)	1 ea. Use for calibration

## Furnished accessories for M9601A Add-On

Description	Quantity (n = number of M9601As)	Comment
PX0101A-001	BNC to Ferrule Terminal Cable, 1.5m	Interlock of M9601A – E4727-60018
PX0101A-002	BNC to Ferrule Terminal Cable, 3m	
PX0102A-001	Low Noise Triaxial Cable, 1.5m	Force and Sense of M9601A – Main unit
PX0102A-002	Low Noise Triaxial Cable, 3m	
PX0103A-001	Triaxial to SMB Cable, 1.5m	Not used in A-LFNA
PX0103A-002	Triaxial to SMB Cable, 3m	
E4727-60018	Interlock Adapter Cable, A-LFNA with M9601A	1 ea. <sup>1</sup> PX0101A – I/F module or Test fixture

1. E4727-60018 is included in Z2082E-582(Bundle kit 6).

# W7802B: PathWave WaferPro Express A-LFNA Measurement and Programming bundle Software

The A-LFNA software and user interface are built on top of the PathWave WaferPro Express measurement platform. Engineers may now manage and automate the full wafer-level characterization in a measurement system that is both flexible and expandable. Just as before, those using PathWave WaferPro Express can program and sequence high-speed DC, capacitance, and RF as parameter measurements, all the while automating wafer prober control. Now with the noise measurement module, they can add noise measurements and analysis to the test suite.

The A-LFNA's built-in measurement routines make DC and noise measurements turnkey. For example, to measure noise on an N-Type MOSFET, the system automatically chooses the source and load impedances that will best expose the intrinsic device noise. The engineer can accept these recommended settings or make changes, and a noise measurement is initiated. The A-LFNA then measures noise power spectral density (1/f noise) and noise in the time domain (RTN). The resulting data is plotted using a "multiplot" data display window. Various windows tabs help facilitate common tasks such as evaluating the device's DC operating point and measuring the slope of the power spectral density curve.

## Key features

- Seamless integration with PathWave WaferPro Express measurement platform
- Advanced data display and analysis, enabling noise data comparisons and modeling for the bias current
- Automated control of all major wafer probing systems
- LFNA module features DC measurements, 1/f noise, random telegraph noise, and data analysis
- Flexible hardware averaging for throughput-accuracy tradeoffs
- Multiple built-in biasing schemes for flicker noise characterization
- Environmental noise removal by software, Auto Denoise
- Measured data compatible with Keysight device modeling software
- The guided system calibration procedure
- PEL and Python measurement routine language support
- Ton and Toff analysis for RTN data independent from B1530A (WGFMU) software

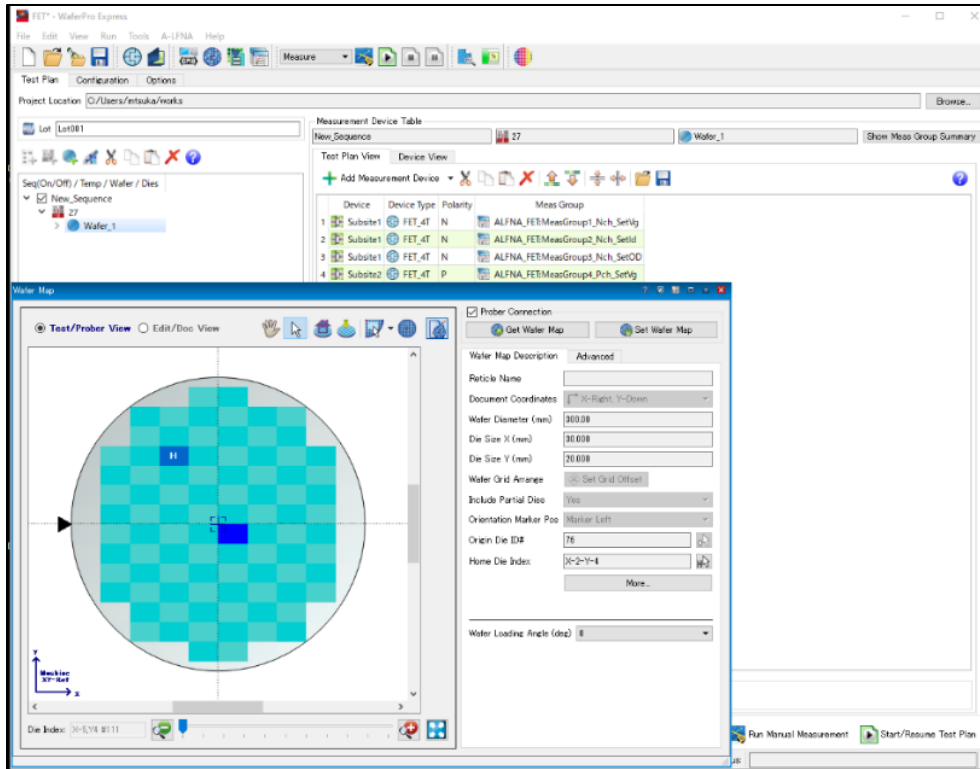


Figure 11. PathWave WaferPro Express screenshot

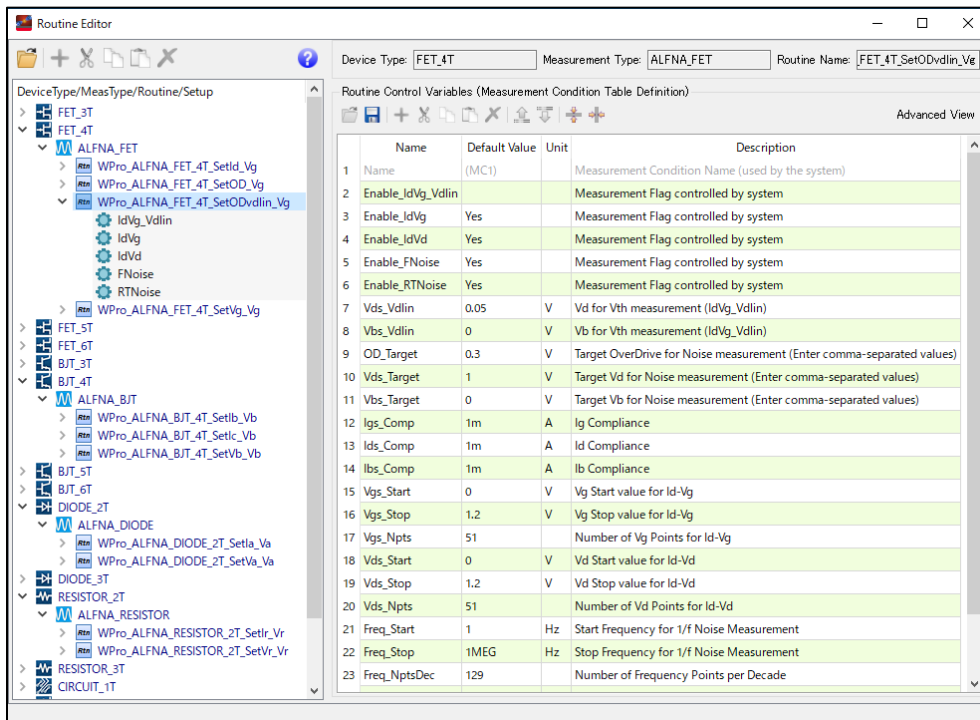


Figure 12. Built-in Routine to setup 1/f noise and RTN measurement condition



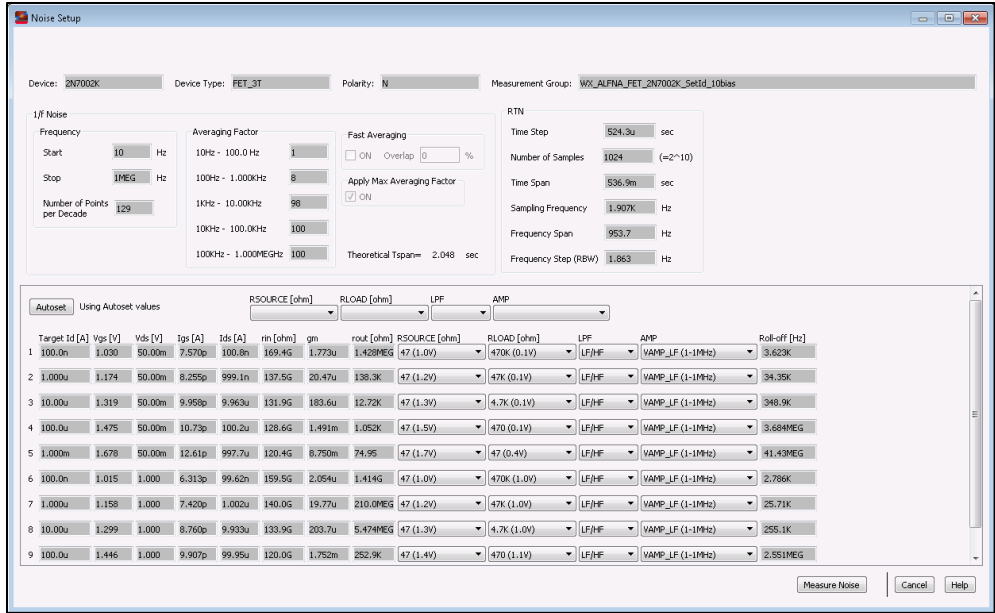


Figure 13. Setup window to configure external conditions (RSOURCE RLOAD, LPF, and LNA) to measure noise

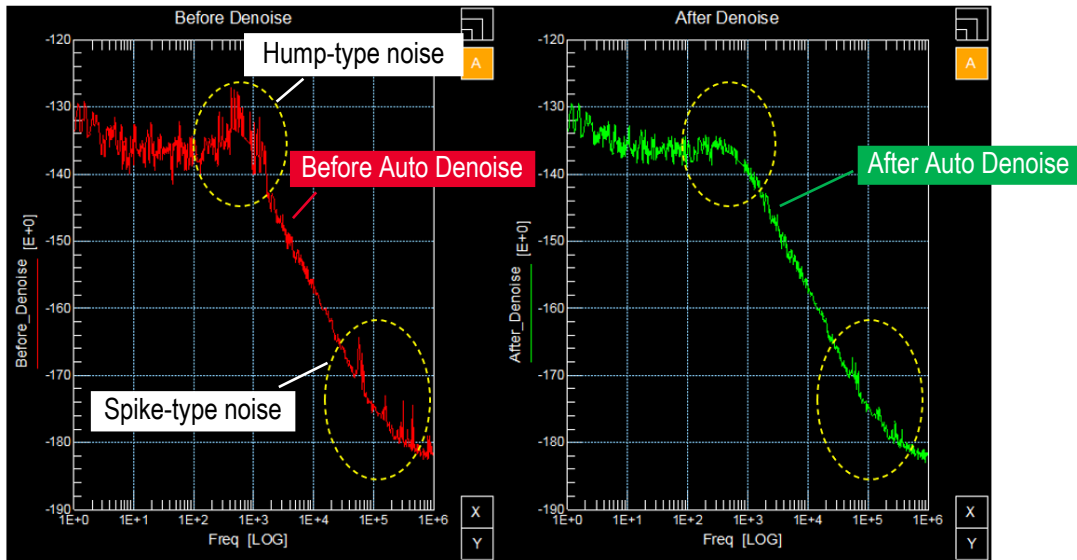


Figure 14. Example of Auto Denoise

# Measurement Functions

## Built-in biasing schemes

Device Type	Biasing scheme	Description	W7802B PathWave WaferPro Express A-LFNA measurement and programing bundle	W7801B PathWave WaferPro Express WGFMU measurement bundle
FET	SetVg	Defines Vgs, Vds, and Vbs as bias conditions	• <sup>1</sup>	•
	SetId	Defines Ids, Vds, and Vbs as bias conditions. Vgs is determined automatically to achieve target Ids	•	•
	SetOD	Defines threshold voltage (Vth) based on constant-current or gm_max and an offset voltage. Vgs will be automatically set offset from Vth. The Vth is measured under same Vds with noise measurement.	•	•
	SetODvdlin	Defines threshold voltage (Vth) based on constant-current or gm_max and an offset voltage. Vgs will be automatically set offset from Vth. The Vth is measured different Vds from noise measurement.	•	•
BJT	SetVb	Defines Vbe, Vce and Vse as bias conditions	•	
	SetIb	Defines Ib and Vc and Vse as bias conditions. Vbe is determined automatically to achieve target Ib.	•	
	SetIc	Defines Ic, Vc and Vse as bias conditions. Vbe is determined automatically to achieve target Ic.	•	
Diode	SetVa	Defines Vac and Vsub as bias conditions	•	
	SetIa	Defines Iac (diode current) and Vsub as bias conditions. Vac is determined automatically to achieve target Iac.	•	
Resistor	SetVr	Defines Vr and Vsub as bias conditions	•	
	SetIr	Defines Ir and Vsub as bias conditions. Vr is determined automatically to achieve target Ir.	•	

1. Over 0.1A measurement can be used in only this biasing scheme.

# External Instrument Control

## Supported external instruments

Instrument	Model Number	Comment
DC Source/Monitor	Keysight M9601A <sup>1</sup>	Add-On <span style="float: right;">Recommended</span>
	Keysight E5260A <sup>2</sup>	E5290A HSPMU
		E5291A MPSMU
	Keysight E5270B <sup>2</sup>	E5280B HPSMU
		E5281B MPSMU
E5287A HRSMU		
Keysight B1500A <sup>2</sup>	B1510A HPSMU	
	B1511A/B MPSMU	
	B1517A HRSMU	
Digitizer	Keysight M3102A	Option CLF, M20, FP1, K41
Waveform generator	Keysight 33621A	Option GPB

1. Required PXIe SMU M9601A Add-On (Z2082E-582/-583)

2. Required Accessory for E5260A/E5270B/B1500A Add-On (Z2082E-571)

Recommend using Keysight 82357B(USB-GPIB Interface) for stable GP-IB communication. Keysight 82357B is included in Z2082E-571.

## Supported semi- and fully-automatic probe stations

Any probe station not listed below table is perfectly acceptable for A-LFNA by developing the driver.

Vendor	Model Number	Software
FormFactor Inc. (ex-Cascade, ex-SUSS)	PA200, PA300	ProberBench Nucleus Velox
	Summit 12000, 200	
	S300, Elite 300	
	CM300, CM300xi-ULN	
MPI corporation	TS2000-SE, TS3000-SE	SENTIO

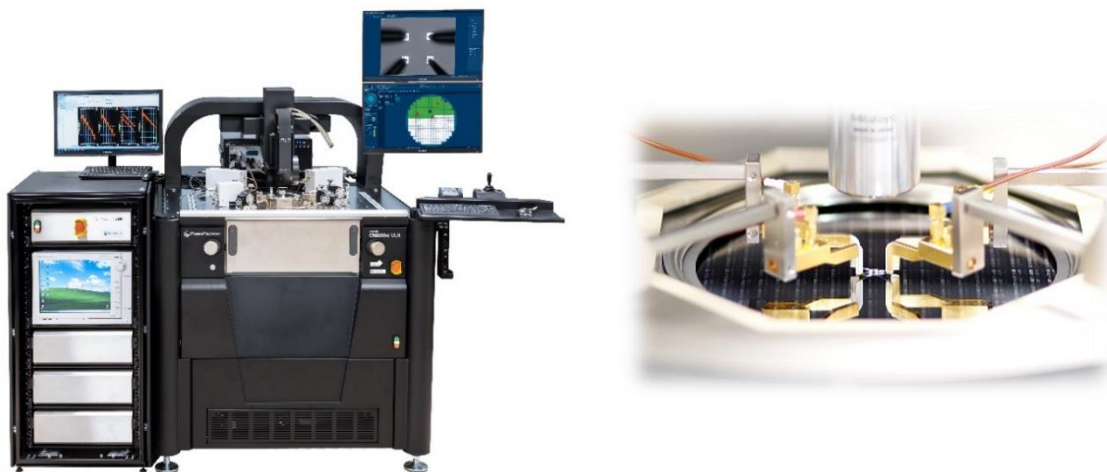


Figure 15. FormFactor's new Ultra Low Noise probe station (CM300xi-ULN)

# Minimum Requirement for Non-Keysight PXIe Hardware

## PXIe chassis

### Specifications

Standards compliance				
	PXI-5 PXI Express hardware specification			
	PXI-1 hardware specification rev 2.2			
	PICMG EXP.0 R2.0 specification			
Backplane				
Module size	3U			
Hybrid compatible slots	4			
PXIe system slot	1 (with three system expansion slots)			
Module compatibility	PXIe, PXI-Hybrid, PXI-1 (J1 only), and cPCI (J1 only)			
System slot link configuration	2-Link (x8, x16)			
Backplane speed	PCIe revision 2.0 (Gen 2)			
	PCIe revision 3.0 (Gen 3)			
Backplane pin current capacity				
Slot	+3.3 V	+5 V	+12 V	-12 V
System controller slot	9 A	9 A	11 A	0 A
System timing/PXIe slot	6 A	0 A	4 A	0 A
PXIe hybrid slot	6 A	6 A	4 A	1 A






## PXIe controller (PC)

### Specifications

Operating system	Windows 10 (64-bit)
Memory	16 GB
Interface	GP-IB

# Environmental Specifications

## Specifications

Specification condition		
Temperature	25 °C ± 5 °C	
Humidity	30% - 80% RH	
Warming up time	Minimum 40 minutes	
Calibration period	1 year	
Temperature range		
Operating	10 – 40 °C	
Storage	-30 – 70 °C	
Humidity range		
Operating	20 - 70% RH, no condensation	
Storage	20 - 90% RH, no condensation	
Altitude		
Operating	0 m to 2000 m	
Power requirement		
AC voltage	100 - 240 V (± 10%)	
Line frequency	50/60 Hz	
Maximum Volt-amps (VA)	1000 VA	
Regulatory compliance		
EMC	IEC/EN 61326-1	
	CISPR Pub 11 Group 1, class A Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.	
	AS/NZS CISPR 11	
	ICES/NMB-001 This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada.	
	South Korean Class A EMC declaration: This equipment has been conformity assessed for use in business environments. In a residential environment this equipment may cause radio interference.	
<div style="border: 1px solid black; padding: 5px; margin: 5px auto; width: fit-content;"> <p>사용자 안내문</p> <p>이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.</p> </div> <p>※ 사용자 안내문은 “업무용 방송통신기자재”에만 적용한다.</p>		
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	 UKCA	UK Conformity Assessed
	 CSAus	CSA Group Certification for US and Canada
	 RCM	Electromagnetic compatibility, Australian Communications Media Authority
	 KCC	South Korean Certification Compliance (KCC) mark. R-R-Kst-RP20669

# Dimensions and Weight

Model number	Description	Dimensions W × D × H (mm) (Excluding protruding object)	Weight
Keysight E4727B-100	PXIe interface module	3U/3 slots	0.30 kg
Keysight E4727B-200	Main unit	298 × 192 × 104.3	8.9 kg
Keysight E4727B-300	Test fixture	120 × 120 × 103.6	1.1 kg
Keysight M9010A	PXIe 10 slot chassis	322.5 × 552.5 × 194.8	14.0 kg
Keysight M9019A	PXIe 18 slot chassis	444.4 × 466.0 × 194.8	13.5 kg
Keysight M9038A	PXIe Embedded controller	3U/4 slots	1.18 kg
Keysight M3102A	PXIe Digitizer	3U/1 slot	0.35 kg
Keysight M9601A	PXIe SMU	3U/2 slots	0.55 kg
Keysight 33621A	Waveform generator	261.1 × 303.2 × 103.8	3.5 kg

# Automated RTN Solution Using W7801B and B1500A

W7801B (PathWave WaferPro Express WGF MU Measurement bundle) efficiently performs at a low cost and automated RTN measurement on the wafer using the B1500A Semiconductor Device Analyzer with the B1530A Waveform Generator/Fast Measurement Unit (WGF MU). It can improve the efficiency of RTN measurement and data analysis including wafer prober control.

## Key features

- Automated measurement without programming
- Auto prober control
- Wafer mapping
- Single data display for multi-decade in the frequency domain
- Upgradeable from your existing B1500A

## RTN and 1/f noise measurement system comparison

		W7802B PathWave WaferPro Express A-LFNA measurement and programming bundle	W7801B PathWave WaferPro Express WGF MU measurement bundle
Measurement hardware		E4727B A-LFNA	B1500A with B1530A WGF MU
Target device		FET, BJT, Diode, Resistor, Circuit	FET
Device terminal number		3, 4, 5, 6	3
Maximum bias voltage		± 200 V	± 10 V
Maximum bias current		± 100 mA	± 10 mA
Noise floor		1E-28 A <sup>2</sup> /Hz	1E-25 A <sup>2</sup> /Hz
Analog frequency bandwidth		30 mHz – 100 MHz	1 mHz – 16 MHz
Frequency domain measurement	Min frequency	30 mHz	1 mHz
	Max frequency	100 MHz	16 MHz
Time domain measurement (RTN)	Max sampling frequency	500 MHz	200 MHz
	Min sampling interval	2 ns	5 ns <sup>1</sup>
	Max sampling interval	8.59 s	1.342 s <sup>1</sup>
	Min sampling number	1,024 (=2 <sup>10</sup> )	1,024 (=2 <sup>10</sup> )
	Max sampling number	16,777,216(=2 <sup>24</sup> )	2,097,152(=2 <sup>21</sup> )
Controller PC		M9038A embedded controller	Windows PC
GP-IB interface		M9038A built-in GP-IB interface (Micro-D 25pin)	USB GP-IB interface (Keysight 82357B, NI GPIB-USB-HS)

1. The arbitral sampling interval from 5ns to 1.342s is available for WGF MU.

# Measurement example

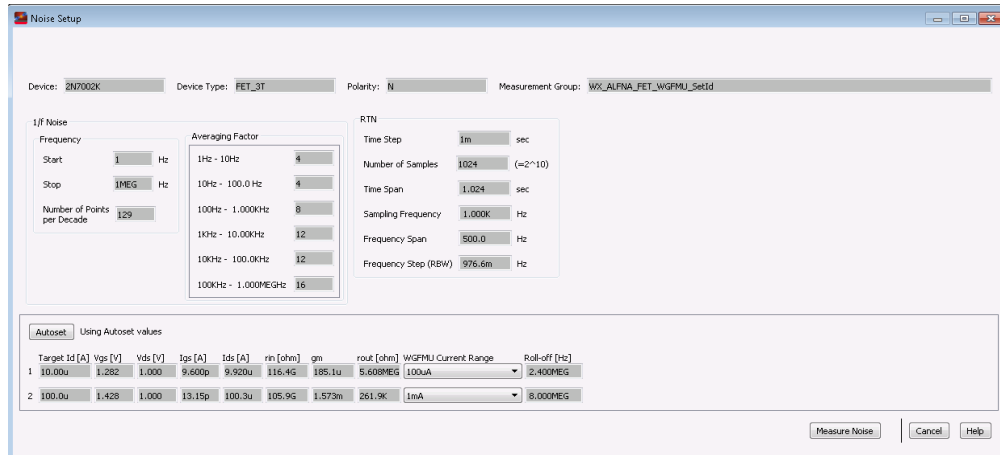


Figure 16. Setup window to set Current Range of WGFMU



Figure 17. Example of WGFMU measurement

## For more information on WGFMU

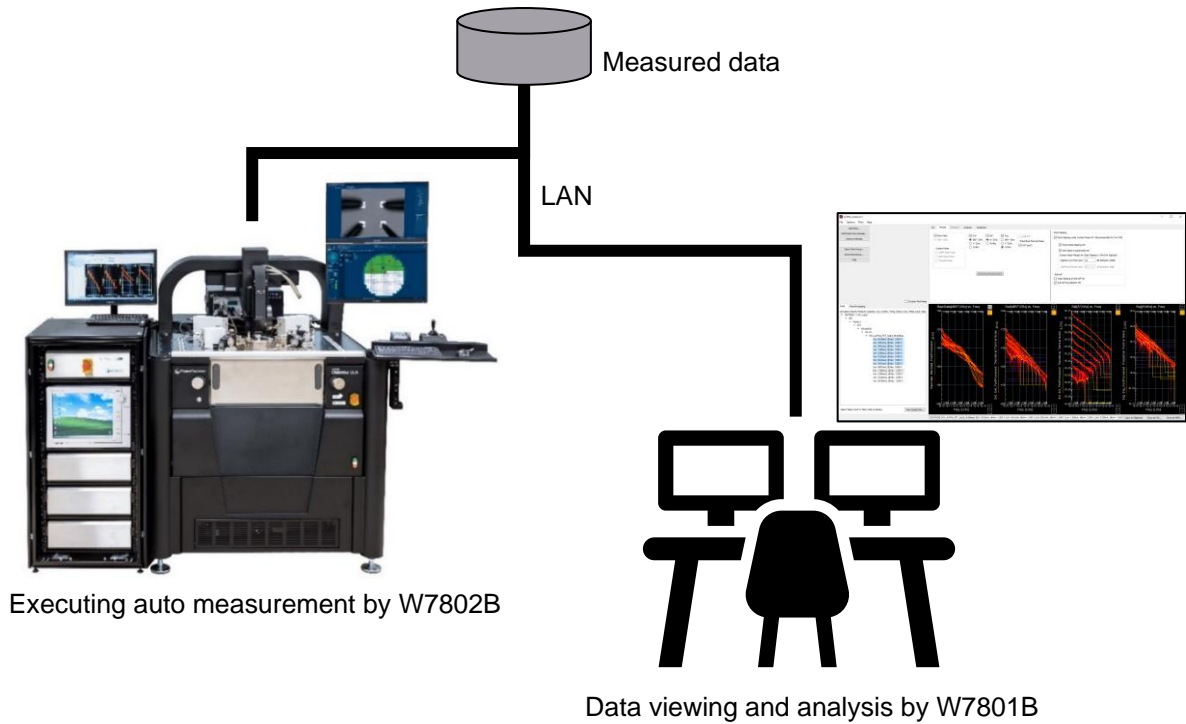
<https://www.keysight.com/us/en/assets/7018-02077/application-notes/5990-3705.pdf>

<https://www.keysight.com/us/en/assets/7018-03960/technical-overviews/5991-2443.pdf>



# Data Viewing from Your Desk by W7801B

The software W7802B has the capability of both measurement and data viewing/analysis. But the license is occupied while measurement, and the user cannot use it for data viewing/analysis at the same time. It is possible to use data viewing independent from measurement by using W7801B. The W7802B is used for measurement and data viewing/analysis is possible from your desk by W7801B. A very efficient operation is possible by adding W7801B.



**Figure 18.** Effective use of W7801B for more efficient work

# Ordering Information

## Automated noise measurement with A-LFNA

### Hardware

Z2082E-567	Bundle kit 1				
Z2082E-568	Bundle kit 2				
Z2082E-569	Bundle kit 3				
Z2082E-580	Bundle kit 4				
		<b>Bundle kit 1</b>	<b>Bundle kit 2</b>	<b>Bundle kit 3</b>	<b>Bundle kit 4</b>
E4727B-100	PXle interface module	1 ea.	1 ea.	1 ea.	1 ea.
E4727B-200	Main unit	1 ea.	1 ea.	1 ea.	1 ea.
E4727B-300	Test fixture	1 ea.	1 ea.	1 ea.	1 ea.
M3102A	Keysight digitizer	1 ea.	1 ea.	1 ea.	
-CH4	Four channels	1 ea.	1 ea.	1 ea.	
-CLF	Fixed sampling clock, low jitter	1 ea.	1 ea.	1 ea.	
-M20	Memory, 2 GB	1 ea.	1 ea.	1 ea.	
-FP1	Enabled FPGA programming	1 ea.	1 ea.	1 ea.	
-K41	FPGA, Xilinx 7K410T	1 ea.	1 ea.	1 ea.	
M9010A	PXle 10 slot chassis	1 ea.			
M9019A	PXle 18 slot chassis		1 ea.		
M9038A	PXle embedded controller: Intel i7, 32 GB RAM, 512 GB SSD	1 ea.	1 ea.		
-M64	Memory upgrade to 64GB	1 ea.	1 ea.		
-W16	Windows 10 IoT Enterprise LTSC (64-bit)	1 ea.	1 ea.		
Y1205A	Thunderbolt 3 Cable and Clamp Kit	1 ea.	1 ea.		
Y1206A	USB Keyboard and Optical Mouse	1 ea.	1 ea.		
Y1212A	PXI slot blockers: qty 5	1 ea.	3 ea.		
Y1260A	GP-IB cable	1 ea.	1 ea.		
Y1269A	Display Port to HDMI adapter	1 ea.	1 ea.		
10833A	GP-IB cable, 1 m	1 ea.	1 ea.		
10833C	GP-IB cable, 4 m	1 ea.	1 ea.		
<b>Accessory</b>					
E4727-60001	Cable, MDR 40pin, 2 m	1 ea.	1 ea.	1 ea.	1 ea.
E4727-60002	Kit accessory E4727B	1 ea.	1 ea.	1 ea.	1 ea.

## Software

W7802B	PatheWave WaferPro Express A-LFNA measurement and programming bundle software license		
		<b>Node-locked</b>	<b>Floating Single Site</b>
6-months KeysightCare software license		R-V4E-001-F	R-V4E-002-F
12-months KeysightCare software license		R-V4E-001-L	R-V4E-002-L
24-months KeysightCare software license		R-V4E-001-X	R-V4E-002-X
36-months KeysightCare software license		R-V4E-001-Y	R-V4E-002-Y
12-months KeysightCare software support subscription		R-V6E-001-L	R-V6E-002-L
24-months KeysightCare software support subscription		R-V6E-001-X	R-V6E-002-X
36-months KeysightCare software support subscription		R-V6E-001-Y	R-V6E-002-Y
60-months KeysightCare software support subscription		R-V6E-001-Z	R-V6E-002-Z
<b>Service</b>			
E4727S	Onsite installation and training, etc.		

## PXIe SMU M9601A Add-On

### Hardware

Z2082E-582	Bundle kit 6		
Z2082E-583	Bundle kit 7 <sup>1</sup>		
		<b>Bundle kit 6</b>	<b>Bundle kit 7</b>
M9601A	PXIe Precision Source/Measure Unit, 1.25 MSa/s, 10 fA, 210 V, 315 mA	3 ea.	1 ea.

### Accessory

PX0101A-001	BNC to Ferrule Terminal Cable, 1.5m	3 ea.	1 ea.
PX0101A-002	BNC to Ferrule Terminal Cable, 3m	3 ea.	1 ea.
PX0102A-001	Low Noise Triaxial Cable, 1.5m	6 ea.	2 ea.
PX0102A-002	Low Noise Triaxial Cable, 3m	6 ea.	2 ea.
PX0103A-001	Triaxial to SMB Cable, 1.5m	3 ea.	1 ea.
PX0103A-002	Triaxial to SMB Cable, 3m	3 ea.	1 ea.
E4727-60018	Interlock Adapter Cable, A-LFNA with M9601A	1 ea.	

1. Z2082E-583(Bundle kit 7) is additional M9601A for 5 or 6 terminals devices measurement to add to Z2082E-582 Bundle kit.

## Case examples to purchase M9601A Add-On

Case Example	Owned Hardware	Measurable Device	Order List
New user who wants to measure 4 terminals devices	None	FET-3T, -4T BJT-3T, -4T DIODE-2T, -3T RESISTOR-2T, -3T	<ul style="list-style-type: none"> <li>• Z2082E-567, 1 ea.</li> <li>• Z2082E-582, 1 ea.</li> </ul>
New user who wants to measure 6 terminals devices	None	FET-3T, -4T, -5T <sup>1</sup> , -6T <sup>1</sup> BJT-3T, -4T, -5T <sup>1</sup> , -6T <sup>1</sup> DIODE-2T, -3T RESISTOR-2T, -3T	<ul style="list-style-type: none"> <li>• Z2082E-567, 1 ea.</li> <li>• Z2082E-582, 1 ea.</li> <li>• Z2082E-583, 2 ea.</li> </ul>
New user who wants to measure 2 terminals devices	None	DIODE-2T RESISTOR-2T	<ul style="list-style-type: none"> <li>• Z2082E-567, 1 ea.</li> <li>• Z2082E-583, 1 ea.</li> <li>• 16493J-002 <sup>3</sup>, 1 ea.</li> <li>• 16435A <sup>3</sup>, 1 ea.</li> </ul>
Existing E4727A user	E4727A Hardware	FET-3T, -4T BJT-3T, -4T DIODE-2T, -3T RESISTOR-2T, -3T	<ul style="list-style-type: none"> <li>• Z2082E-582, 1 ea.</li> </ul>
Existing E4727A user who has extra Substrate modules	E4727A Hardware with extra two Substrate modules	FET-3T, -4T, -5T <sup>2</sup> , -6T <sup>2</sup> BJT-3T, -4T, -5T <sup>2</sup> , -6T <sup>2</sup> DIODE-2T, -3T RESISTOR-2T, -3T	<ul style="list-style-type: none"> <li>• Z2082E-582, 1 ea.</li> <li>• Z2082E-583, 2 ea.</li> </ul>
Existing E4727B user who has 18 slots PXIe Chassis	E4727B Hardware with M9019A (18 slots)	FET-3T, -4T BJT-3T, -4T DIODE-2T, -3T RESISTOR-2T, -3T	<ul style="list-style-type: none"> <li>• Z2082E-582, 1 ea.</li> </ul>
Existing E4727B user who has 10 slots PXIe Chassis	E4727B Hardware with M9010A (10 slots)	FET-3T, -4T BJT-3T, -4T DIODE-2T, -3T RESISTOR-2T, -3T	<ul style="list-style-type: none"> <li>• M9019A, 1 ea.</li> <li>• Z2082E-582, 1 ea.</li> </ul>

1. The Main unit (E4727B-200) does not have LPF for the extra Substrate2 and Substrate3 terminals. The M9601A's output should be connected to the device terminal directly.
2. The Substrate module of E4727A can be used. The E4727A Substrate module is obsolete.
3. 16493J-002: Interlock cable (3m) for B1500A, E5260A, or E5270B.  
16435A: Interlock cable adapter 350mm BNC cable.  
The three cables (PX0101A, 16435A, and 16493J) should be connected between the Test fixture or I/F module and M9601A.

## Waveform Generator 33621A Add-On

### Hardware

Z2082E-584	Bundle kit 8	
		<b>Bundle kit 8</b>
33621A	Waveform generator 33600A Series, 120 MHz, 1-channel	1 ea.
-000	Standard TCXO Timebase	1 ea.
-GPB	GPIB interface module for 33600A Trueform Series Waveform Generators- installed	1 ea.
-Z54	ANSI/NCSL Z540.3-2006 Calibration	1 ea.

## Accessory for E5260A/E5270B/B1500A Add-On

### Hardware

Z2082E-571	Bundle kit 9	
		<b>Bundle kit 9</b>
16494B-002	Kelvin-Triaxial cable, 3 m	3 ea.
16493J-002	Interlock cable, 3 m	1 ea.
82357B	USB/GPIB interface	1 ea.

# Automated noise measurement with WGF MU (typical configuration example)

## Hardware

B1500A	Semiconductor device analyzer mainframe
B1500A-A00	Empty package for custom solution (require 2 SMUs at least)
B1500A-A30/A31	WGF MU add-on package or WGF MU add-on package with connector adapters
B1500A-A3P	WGF MU probe cable kit

## Software

W7801B	PathWave WaferPro Express WGF MU measurement bundle software license	
	<b>Node-locked</b>	<b>Floating Single Site</b>
6-months KeysightCare software license	R-V4E-001-F	R-V4E-002-F
12-months KeysightCare software license	R-V4E-001-L	R-V4E-002-L
24-months KeysightCare software license	R-V4E-001-X	R-V4E-002-X
36-months KeysightCare software license	R-V4E-001-Y	R-V4E-002-Y
12-months KeysightCare software support subscription	R-V6E-001-L	R-V6E-002-L
24-months KeysightCare software support subscription	R-V6E-001-X	R-V6E-002-X
36-months KeysightCare software support subscription	R-V6E-001-Y	R-V6E-002-Y
60-months KeysightCare software support subscription	R-V6E-001-Z	R-V6E-002-Z

## Service

E4727S	Onsite installation and training, etc.
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