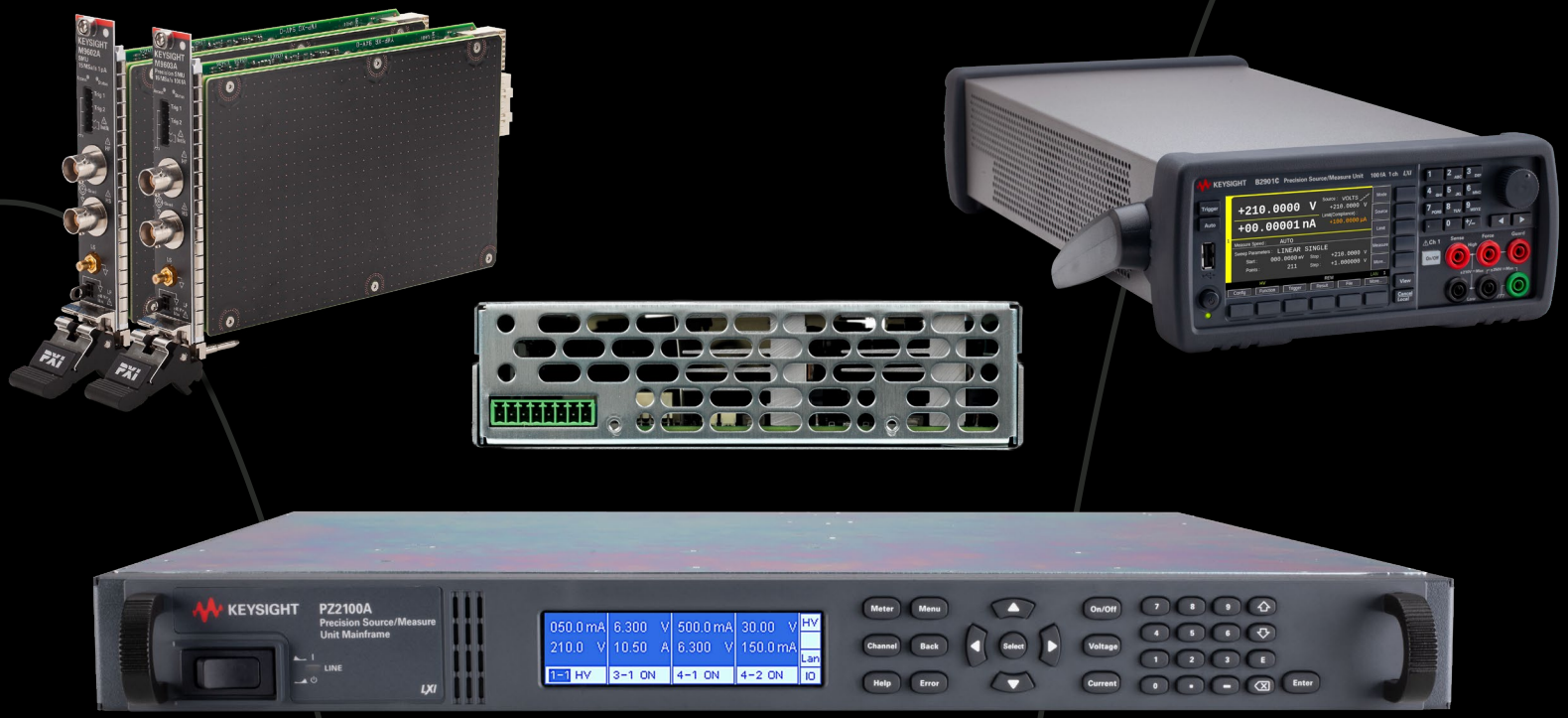
KEYSIGHT



Source Measure Units

Precise and reliable testing, from basic integrated circuits to complex systems

BUYING GUIDE

Keysight Source Measure Units

One family. Three performance grades. 3 classes.

ESSENTIAL

SM1-class

- 5.5 Digits source resolution
- 10 fA to 1 pA Minimum current measurement resolution

EXPERT

SM2-class

- 5.5 Digits source resolution
- 100 fA Minimum current measurement resolution

PRO

SM3-class

- 6.5 Digits source resolution
- 10 fA Minimum current measurement resolution

Introduction

Selecting the right source measure unit (SMU) depends on the accuracy, speed, and performance your application demands. Keysight offers three performance grades of SMUs — Essential, Expert, and Pro. This buying guide compares these grades and their specifications. Whether you are performing general-purpose device characterization, precision IV measurements, or high-speed transient analysis, each SMU grade offers a unique combination of source resolution, minimum current measurement resolution, channels, pulse current, maximum voltage, and maximum current. Use this guide to determine which SMU grade aligns with your application requirements.

Essential

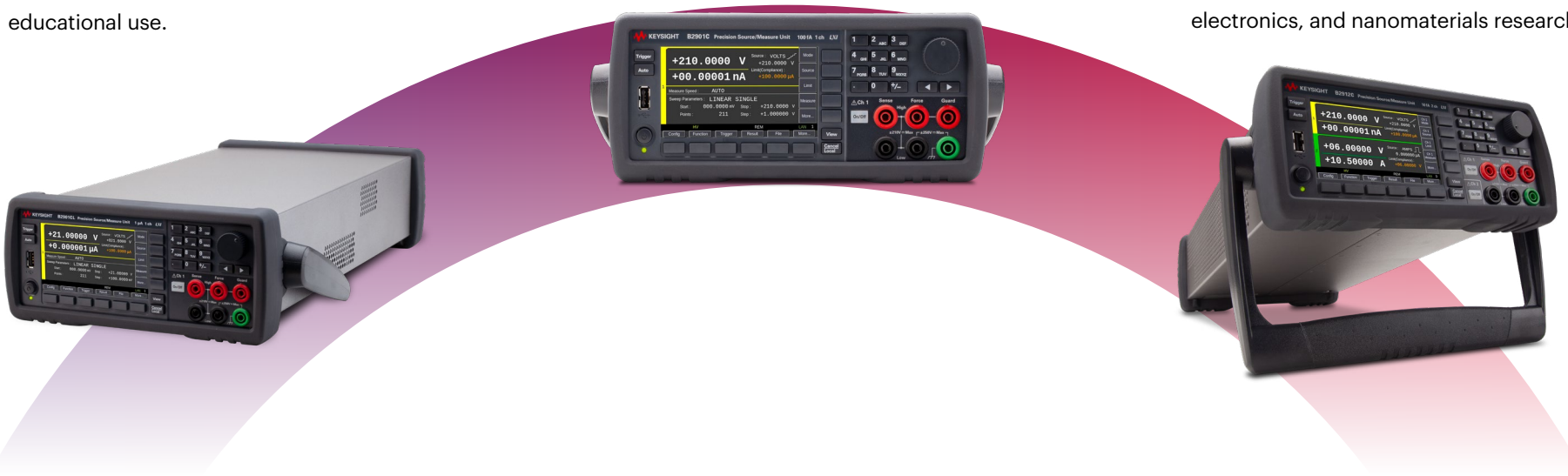
The SM1-class Essential SMUs include the B2910CL and B2901CL. Affordable and compact, Essential SMUs combine 6-instruments-in-1 and 5.5-digit source resolution, making them ideal for applications including device characterization, circuit testing, and educational use.

Expert

The SM2-class Expert SMUs include the B2902C and B2901C. For parallel IV measurements and power electronics testing in semiconductor and next-generation material applications, Expert SMUs provide 7-instruments-in-1 functionality with pulsed measurement capabilities and single- and dual-channel configurations.

Pro

The SM3-class Pro SMUs include the B2912C and B2911C. For high-speed transient analysis and accurate real-world simulation, Pro SMUs offer ultra-high precision, double the sampling rate of Expert SMUs, and 6.5-digit source resolution, designed for testing power-intensive devices in R&D, power electronics, and nanomaterials research.



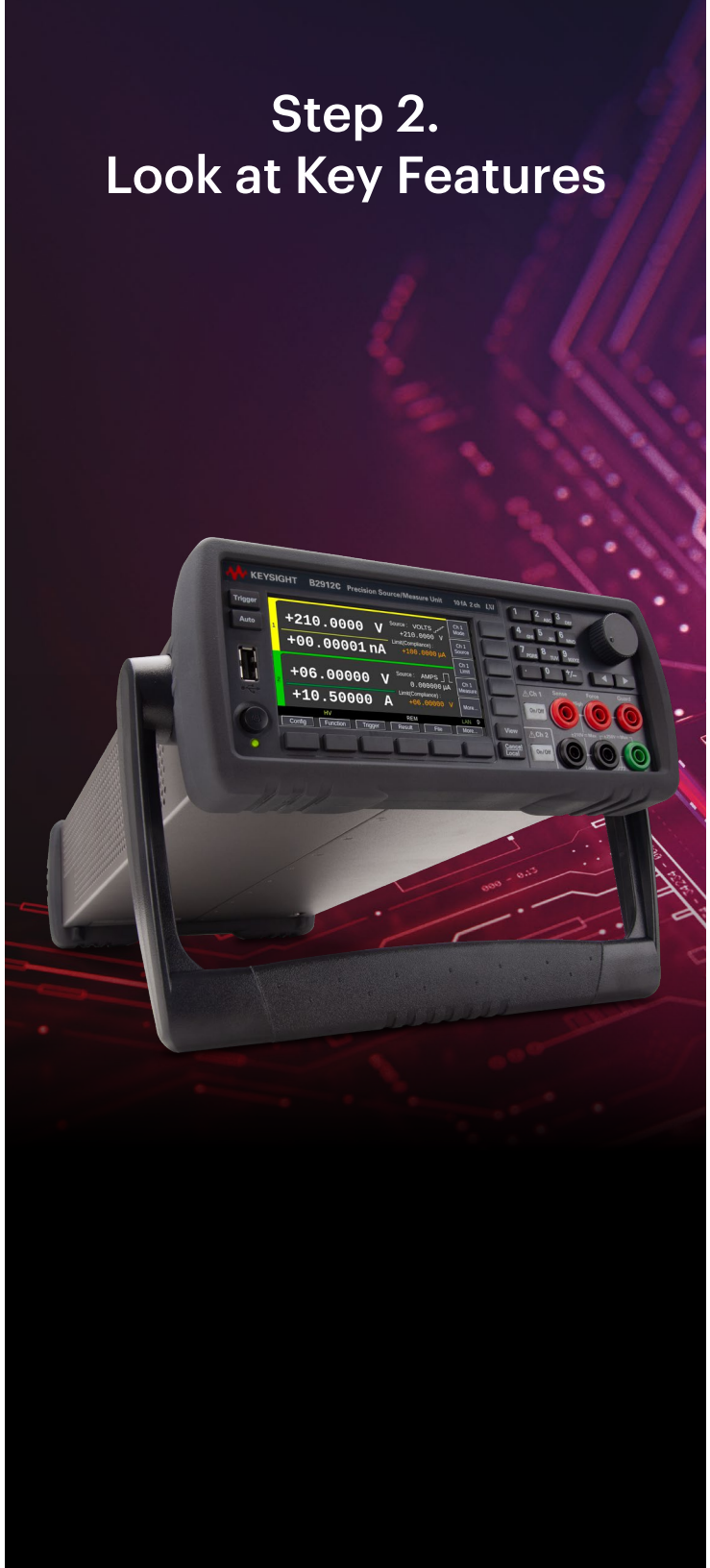
Step 1. Check the General Specifications

All Keysight SMUs enable a wide range of measurements, whether you are testing and characterizing semiconductors, materials, or electronic components. Our lineup of SMUs delivers precise voltage and current sourcing with simultaneous measurement capabilities and high-resolution measurement. With integrated functions like power supply, digital multimeter (DMM), current source, electronic load, arbitrary waveform generator (AWG), and digitizer in one instrument, Keysight SMUs simplify test setups and minimize the potential for errors. The first part of your SMU selection process will be based on source resolution, minimum current measurement resolution, and number of channels. The table below summarizes the key specifications by product grade — Essential, Expert, and Pro — to help you select the SMU that is right for your application.

Source measure unit comparison of specifications

Specifications	Essential	Expert	Pro
Class	SM1	SM2	SM3
Source resolution	5.5 digits	5.5 digits	6.5 digits
Minimum current measurement resolution	10 fA to 1 pA	100 fA	10 fA
Number of channels	1	1 to 2	1 to 2
Pulse output	No	Yes	Yes
Maximum voltage per output	21 V to 210 V	210 V	210 V
Maximum current per output	1.5 A	3.0 A DC / 10.5 A pulse	3.0 A DC / 10.5 A pulse
Maximum sample rate	5 kSa/s to 20 kSa/s	50 kSa/s	100 kSa/s
Minimum sampling interval	50 µs to 200 µs	20 µs	10 µs
	EXPLORE ESSENTIAL	EXPLORE EXPERT	EXPLORE PRO

Step 2.
Look at Key Features



Essential

Core Features

- 5.5-digit source resolution
- 6-instruments-in-1
- 4-quadrant operation
- built-in math and limits
- USB, LAN (Ethernet), and GPIB connectivity
- single-channel configuration

Key Capabilities

Reliable, high-performance electronic testing in an entry-level, compact benchtop unit provides 6-instruments-in-1 functionality, 5.5-digital source resolution, and dependable performance at an affordable price.

Expert

Core Features

- 5.5-digit source resolution
- 7-instruments-in-1
- 3.0 A DC / 10.5 A pulsed output capability
- numeric and graphical dual-view display
- 100,000 points of memory per channel
- single- and dual-channel configurations

Key Capabilities

Add power and flexibility with dual-channel options, pulsed measurement capabilities, and deeper memory to capture detailed IV curves during semiconductor and emerging materials testing.

Pro

Core Features

- 6.5-digit source resolution
- 3.0 A DC / 10.5 A pulsed output capability
- fast 100 kSa/s sampling at 10 µs intervals
- real-time roll-view display
- high-capacitance drive mode
- single- and dual-channel configurations

Key Capabilities

Delivers our highest-performance resolution, ultra-fast sampling, and highest measurement accuracy in our benchtop SMUs to capture high-precision measurements and high-speed transients when testing power-intensive devices.

Step 3. Consider Your Use Cases

While specifications are important, considering the various ways your team will use an instrument will determine which grade is best for your lab's needs. Here are a few typical use cases for each grade.

Essential: General testing and device characterization

Keysight Essential SMUs offer more than standard entry-level functionality, delivering dependable precision and versatile 6-instruments-in-1 integration for everyday measurement needs. The compact design and easy connectivity of our Essential SMUs make them ideal for device characterization, circuit testing, and academic labs, simplifying test tasks while providing reliable, cost-effective performance.

Common use cases for Essential SMUs include:

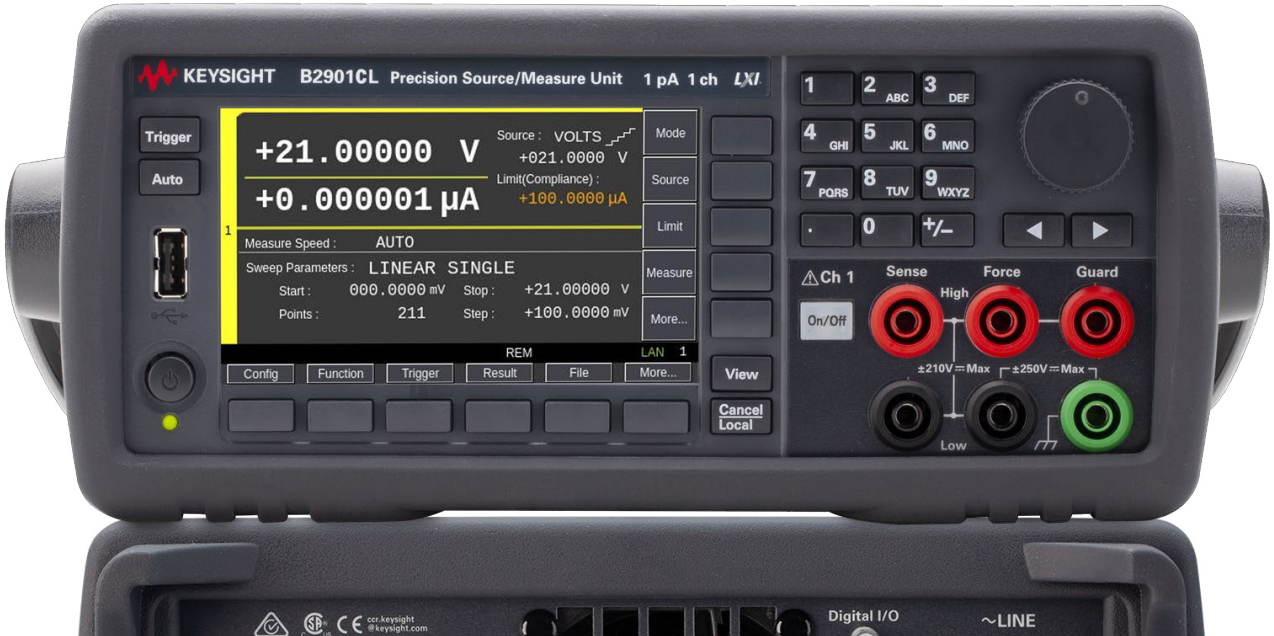
- How to Make LED IV Measurement
- How to Perform Resistance Measurements
- How to Perform Photodiode Test
- How to Automate Photonic Testing

Expert: Semiconductor testing and power validation

Keysight Expert SMUs offer expanded capabilities with pulsed output, dual channels, and deeper memory, making them well-suited for more demanding applications. Engineers benefit from faster sampling and 7-instruments-in-1 integration, ideal for capturing detailed IV curves using short pulses that minimize power and heat, protecting sensitive devices in semiconductor and next-generation materials testing.

Common use cases for Expert SMUs include:

- How to Evaluate IV Characteristics of Solar Cells
- How to Characterize Bipolar Transistors
- How to Perform a Light-Current-Voltage (LIV) Test
- How to Conduct FET IV Characterization



Consider Your Use Cases (cont.)

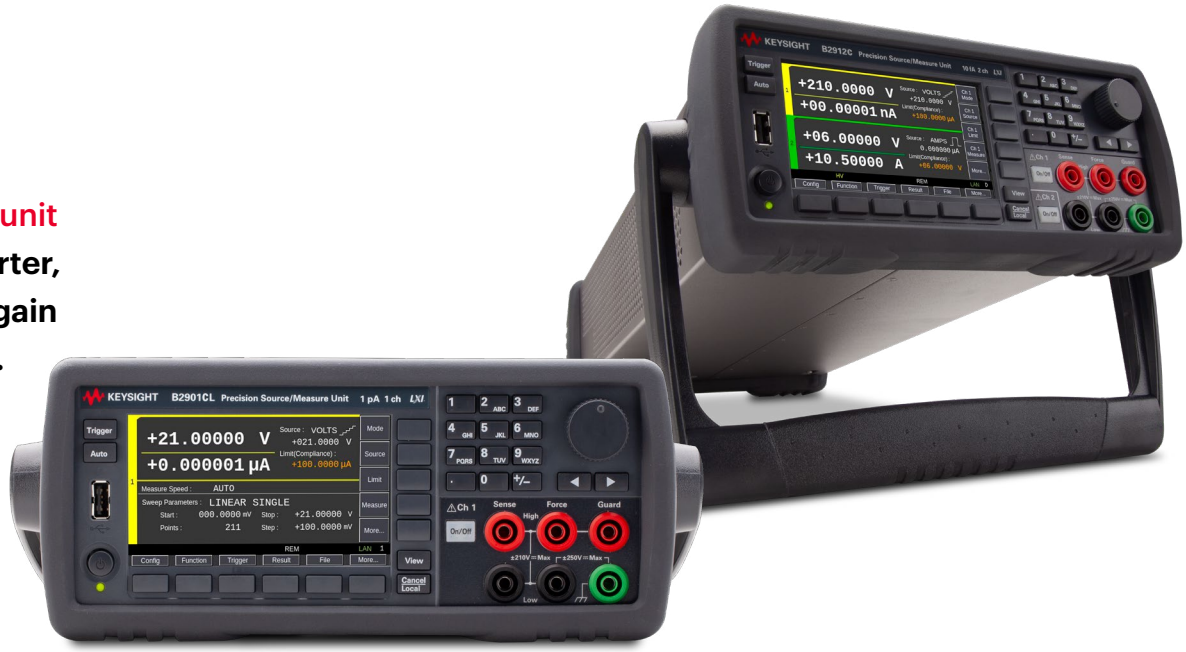
Pro: R&D and transient analysis

Keysight Pro SMUs are our highest-performance models, ideal for applications requiring ultra-high-precision measurements, high-speed transient analysis, and ultra-fast sampling. Used in cutting-edge labs, Pro SMUs capture the highest measurement accuracy when simulating real-world conditions for testing power-intensive devices in next-generation R&D, power electronics, and nanomaterial research.

Common use cases for Pro SMUs include:

- How to Make Resistance Measurements
- How to Perform Low-Current Measurements on PCBAs
- How to Characterize the LIV of Laser Diodes
- How to Perform IV Characterizations of Solar Cells

Explore more source measure unit use cases to help you test smarter, accelerate development, and gain deeper measurement insights.



Step 4. Final Key Considerations

As you look across basic features, enhanced capabilities, and your lab's typical use cases, it is good to revisit how use cases might drive each of your instrument's features. Factors to consider when choosing a source measure unit:

Source resolution

Resolution impacts the precision of your voltage and current sourcing.

Select Essential or Expert models for **5.5-digit resolution** for general-purpose use, or select Pro for **6.5-digit resolution** when maximum accuracy and stability are required, especially when working with low-level signals.

Current measurement sensitivity

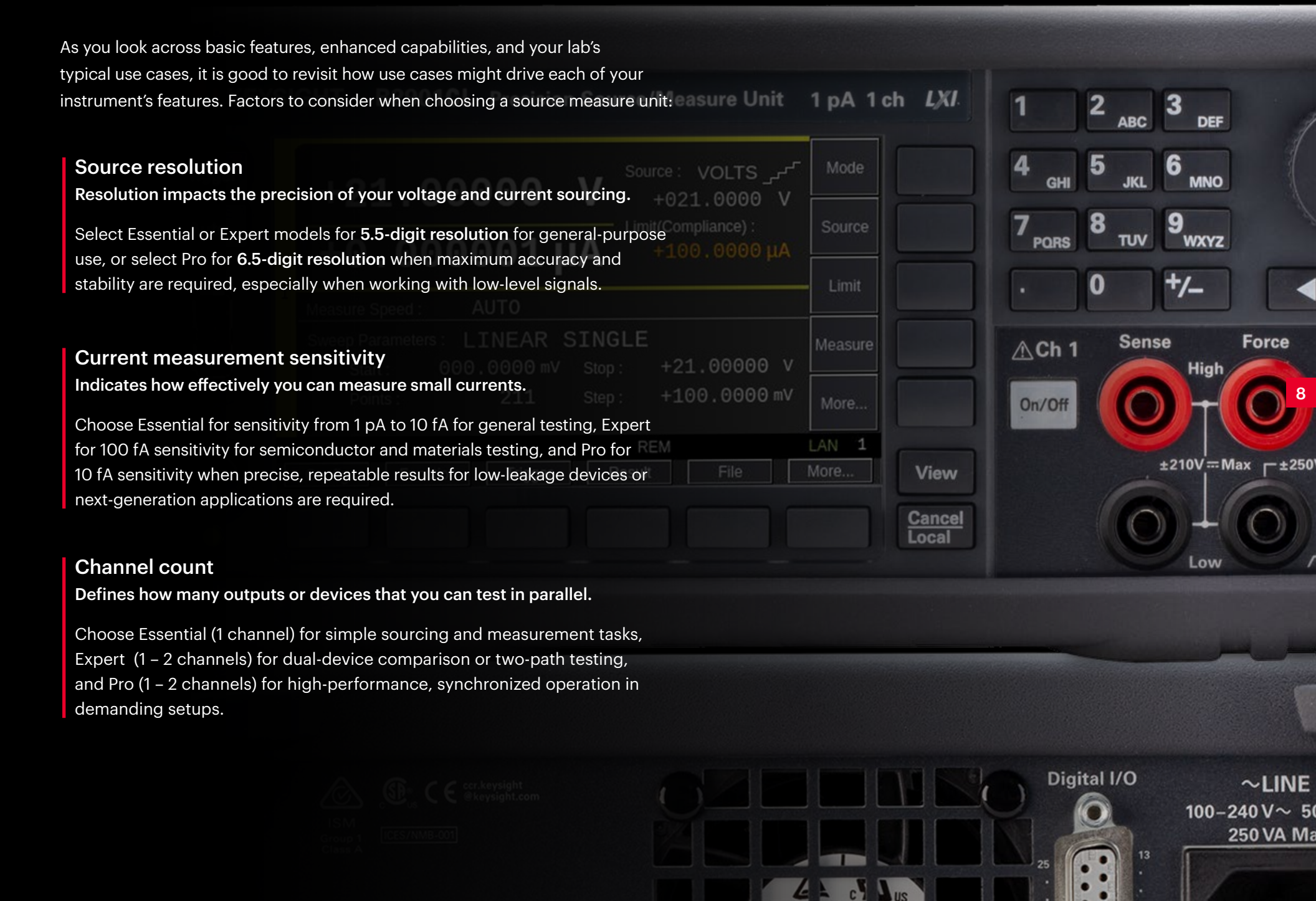
Indicates how effectively you can measure small currents.

Choose Essential for sensitivity from 1 pA to 10 fA for general testing, Expert for 100 fA sensitivity for semiconductor and materials testing, and Pro for 10 fA sensitivity when precise, repeatable results for low-leakage devices or next-generation applications are required.

Channel count

Defines how many outputs or devices that you can test in parallel.

Choose Essential (1 channel) for simple sourcing and measurement tasks, Expert (1 – 2 channels) for dual-device comparison or two-path testing, and Pro (1 – 2 channels) for high-performance, synchronized operation in demanding setups.



Final Key Considerations (cont.)

Pulse output capability

Pulsed sourcing protects sensitive devices and reduces thermal effects.

Choose Essential if you do not need this pulsed outputs. Select Expert or Pro for built-in pulsed output and control if your application includes high-speed device switching, thermal management, or energy-limited components.

Sampling rate

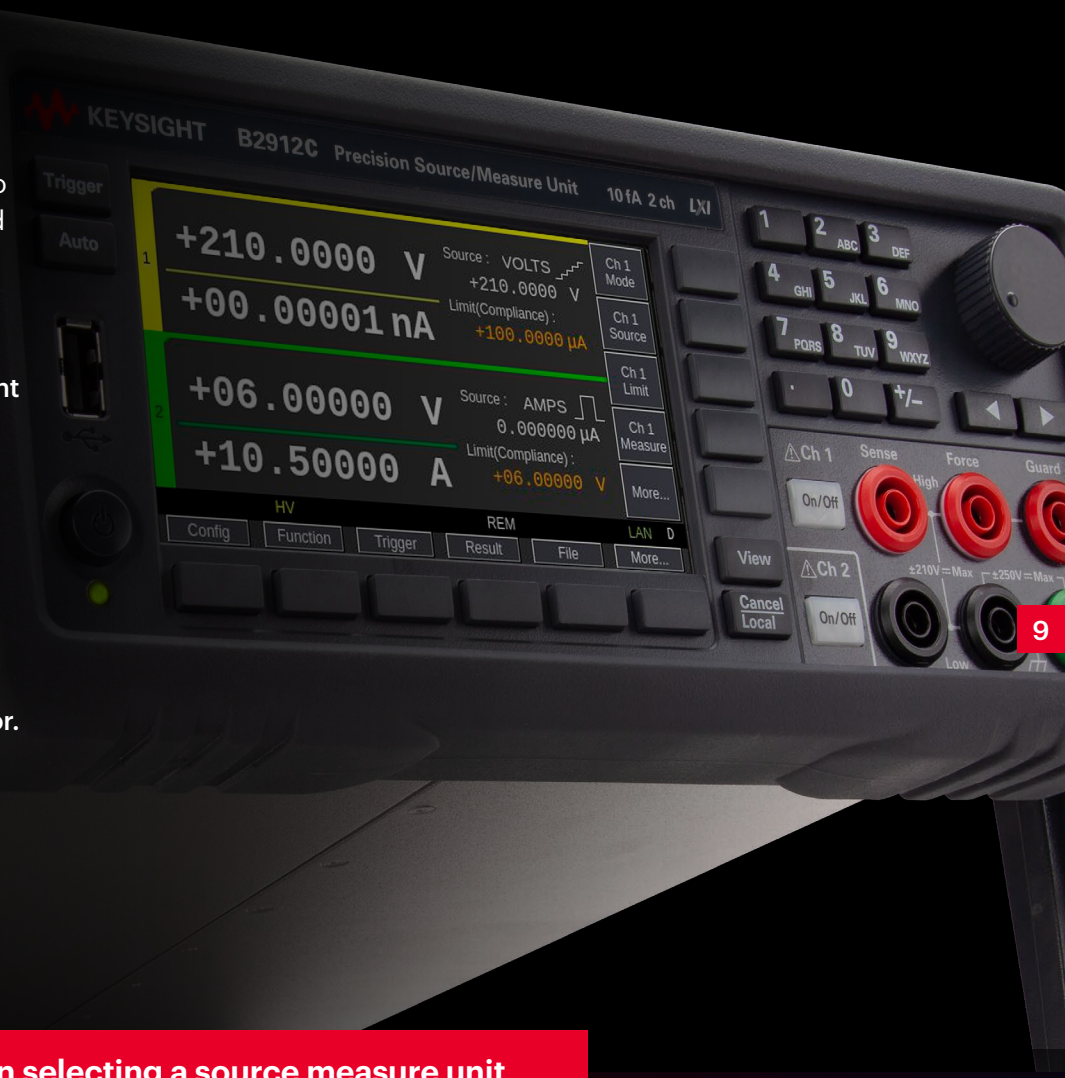
Enables faster, more precise measurements, critical for capturing transient events.

Choose Essential (up to 20 kSa/s) to manage slower, steady-state measurements, Expert (up to 50 kSa/s) for enhanced sampling rates to support transient analysis, and Pro (up to 100 kSa/s) for double the sampling rate of Expert for high-speed transients and demanding dynamic testing.

Sampling interval

Enables finer time resolution for capturing rapid changes in device behavior.

Choose Essential (50 µs to 200 µs) for slow-changing signals where precision timing is less critical, Expert (20 µs) for more detailed transient analysis such as device switching and signal integrity measurements, and Pro (10 µs) for high-speed real-time transient capture, dynamic device characterization, and fast signal monitoring.



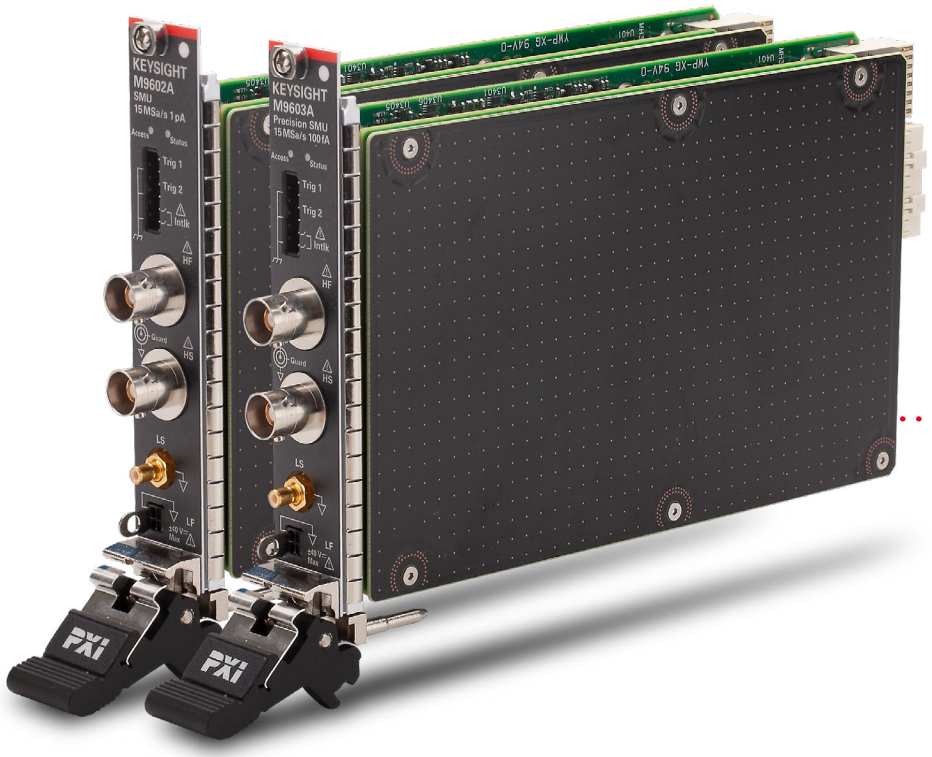
Common mistakes to avoid when selecting a source measure unit

- Choosing an insufficient sample rate leads to missed fast transients or distorted measurements.
- Underestimating current measurement sensitivity, causing errors in low-leakage device testing.
- Overlooking pulse output requirements for devices sensitive to heat or power.
- Selecting too few channels limits the ability to test multiple outputs or perform comparative analysis.
- Omitting source resolution and accuracy leads to poor results in precision applications.
- Not considering software capabilities for automation can slow down testing workflows.

Modular Source Measure Units

Keysight **modular source measure units** deliver the performance of a benchtop SMU in a compact PXIe form factor, ideal for saving space while scaling test capacity. Modular SMUs offer flexible channel configurations, fast sampling, and precision sourcing, making them well-suited for both R&D and high-volume production environments.

Mix and match modules with varying performance and capabilities to tailor the SMU to your needs.



With 11 models ranging from 8 V to 210 V, select the modular SMU that is right for your application.

Maximum voltage per output:
8 V to 210 V

Maximum sample rate:
250 kSa/s to 15 MSa/s

Number of channels:
1 to 20

Maximum current per output:
315 mA to 8 A

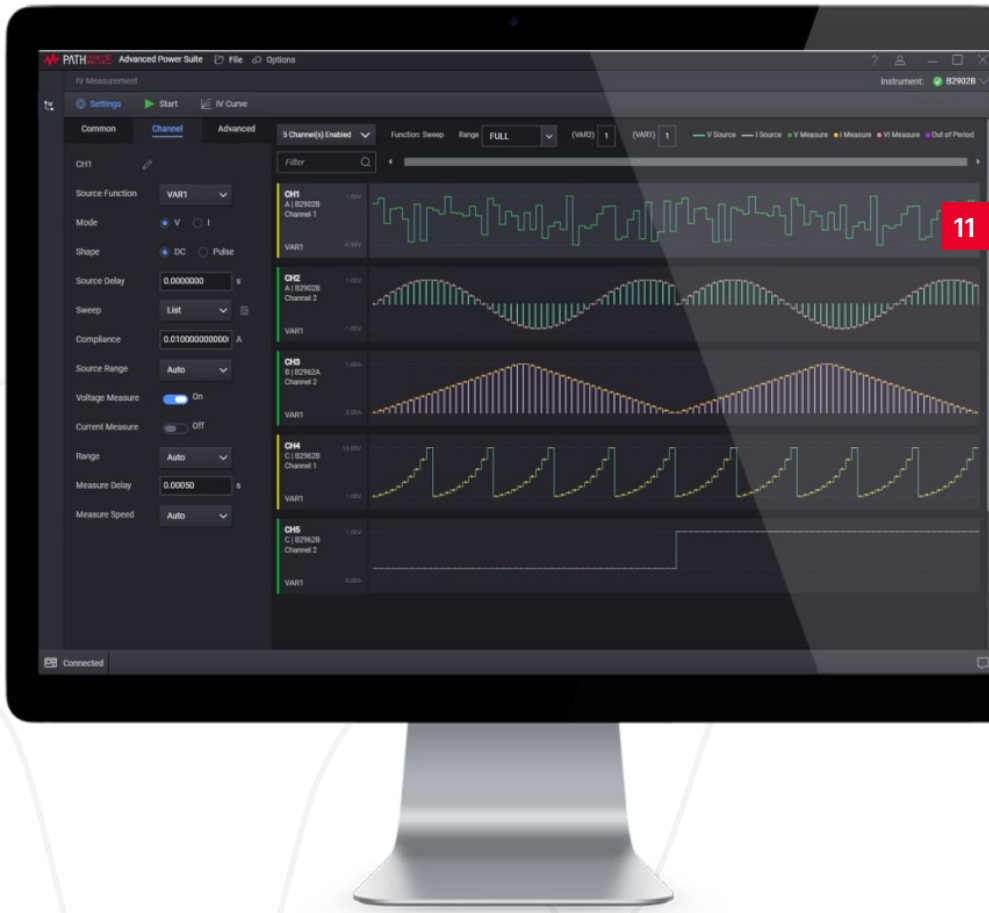
Source Measure Unit Software Functionality

Keysight SMU software provides an intuitive and powerful interface for controlling and automating SMU operations. It enables you to quickly set up tests, visualize results, and analyze data with precision. Track and record your source output to understand the impact of the power draw for specific events.

Explore the wide variety of control, automation, and application-specific software for Keysight source measure units. Perform precision IV sweeps, emulate battery behavior, and analyze power consumption with intuitive, high-performance tools.

- **Lab management and control software** enables the interconnection of all instruments via the network. It provides centralized control for educators to connect and monitor all instruments within the teaching lab seamlessly.
- **Power supply software** enables easy power supply control to set parameters, visualize IV data on a trend chart, and build automated tests.
- **IV curve measurement software** accelerates research, development, and design verification with quick and easy execution of synchronous current-voltage (IV) measurements without programming, immediate access to review test results on graphs and tables, and efficient report generation.
- **Quick I/V measurement software** helps control the PXI SMU, making it easy to set up and perform IV measurements without the need to program.

To explore the SMU software, visit our **software page**.



Why Choose Keysight?

Keysight source measure units deliver the precision, speed, and flexibility needed for accurate electronic testing — from early design to next-generation R&D. Here's why engineers choose Keysight:

High accuracy and precision

- Highly precise source and current measurement resolution to test sensitive devices.
- Captures low-level signals with accuracy and repeatability across test sessions.

Integrated functionality

- Combines a pulse generator, DMM, power supply, current source, electronic load, arbitrary waveform generator, and digitizer in one instrument.
- Eliminates the need to sync or configure multiple devices, reducing system complexity and test time.

Ultra-fast sampling

- Fast sample rates capture fast transients and dynamic behaviors.
- Ensures accurate data and prevents missed events in fast-switching devices.

Pulse output measurements

- Precise pulsed sourcing minimizes device stress, power dissipation, and thermal effects.
- Powerful pulsed current output with fast timing control, ideal for pulsed IV measurements.

Feature	Specification
Source resolution	Up to 6.5 digits
Current resolution	As low as 10 fA
Ultra-fast sampling	Up to 100 kSa/s, 10 µs intervals
Function integration	Up to 7-in-1 integration

Calibration
Ensure your test system performs to specification and meets local and global standards.

Repair
Restore equipment to original functionality and specifications with trained technicians.

KeysightCare
Innovate at speed with curated support plans and prioritized response and turnaround times.

Education
Make measurements quickly with eLearning and in-house, instructor-led training.

Keysight Support
Get 24x7 access to service requests, case management help, and technical articles.

Select the Source Measure Units That Is Right for You

Should you need more information on Keysight source measure unit offerings, visit our extensive **library of resources** to help you select the right SMU for your application. Here are some of the resources that can guide you in determining the best source measure unit for your needs:

- Selecting the Right SMU
- Bipolar Transistor Characterization
- High Channel Density Precision Bias Solution

Once you are ready, visit Keysight SMUs to select one of our popular configurations or build one to meet your specific application.

KEYSIGHT

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.