



# 2017 New Products Catalog

**BK PRECISION**

# AC Power

## 9830 Series Programmable AC Sources



The 9830 Series are low distortion, single-phase AC power sources delivering a maximum of 3000 VA, 300 Vrms, 30 Arms / 97.5 Apk with the output frequency adjustable from 45 Hz – 1200 Hz. Housed in a compact 3U form factor, the AC source is capable of generating both AC, DC, and AC+DC output.

### Applications

- Pre-compliance testing according to IEC61000-3-2
- Evaluating transformers, TRIACs, SCRs, and passive components
- Simulating common power grid faults and disturbances

| Model                           | 9832                                    | 9833                 |
|---------------------------------|---|----------------------|
| Max power                       | 2000 VA                                 | 3000 VA              |
| Max voltage (rms)               | AC                                      | 150 V / 300 V / Auto |
|                                 | DC                                      | ±212 V / ±424 V      |
| Max current (rms)               | 0 – 150 V                               | 20 A                 |
|                                 | 0 – 300 V                               | 10 A                 |
| Frequency range                 | 45 – 1200 Hz                            |                      |
| Load regulation                 | ≤ 0.1 % FS (resistive load)             |                      |
| Total harmonic distortion (THD) | ≤ 0.5 % at 45 - 400 Hz (resistive load) |                      |
| Remote interfaces               | USB (USBTMC-compliant), GPIB, and LAN   |                      |

### Features & Benefits

- Measurements: Vrms, Arms, Vdc, +Apk, -Apk, inrush current, frequency, power factor, apparent power, reactive power, true power, and crest factor
- All measurements can be displayed simultaneously on a large and bright 4.3" color LCD
- Power line disturbance simulation functions using STEP, LIST, and Pulse modes
- Adjustable phase angle control
- Analog input control with a maximum bandwidth of 1.2 kHz
- Save setups and waveform data to USB flash drive
- Predefined sine, square, clipped sine and THD waveforms
- 5 user-defined waveforms
- Generate custom arbitrary waveforms on a PC and download and execute waveforms from internal memory
- List mode with 10 user-defined programs with up to 100 programmable steps each
- Digital I/O port for external triggering, action completed indicator, failure status indicator, and remote inhibit
- Comprehensive protection modes including OVP, OCP, OTP, fan failure, and key lock



A helpful tool for electricians, technicians, engineers, students, hobbyists and anyone dealing with electrical power.

### Key Features

- Calculate DC power and single- or three-phase AC true power, reactive power, and apparent power
- Delta-wye transformation calculator
- AWG size calculator to determine wire diameter, cross-sectional area, and resistance
- Voltage drop calculator
- Ampacity table for insulated conductors per NEC Table 310.6



## 9800 Series AC Power Sources



The 9800 Series is both a programmable AC source and measurement tool. These fully programmable linear AC sources deliver a maximum of 1500 VA through the universal line output terminals on the front and the output connector on the rear.

### Features & Benefits

- Displays Vrms, Irms, Ipeak, frequency, PF, apparent power, true power, and elapsed output time
- Adjustable phase angle control
- Total harmonic distortion:  $\leq 0.5\%$  at 45-500 Hz (resistive load)

- Voltage and frequency sweep mode
- List mode: 10 user-defined programs with up to 100 programmable steps each
- BNC I/O for external triggering, output status indication/control, and synchronization
- OVP/OCV/OPP/OTP protection modes and key lock function
- Pre-compliance testing for voltage dips and frequency simulations according to IEC61000-4-11 / 4-14 / 4-28
- Standard USB (USBTMC-compliant), RS232, LAN and GPIB (9803 and 9805 only) interfaces

| Model | AC Output |                                   |                                   |                 |              |                                       |                                  |
|-------|-----------|-----------------------------------|-----------------------------------|-----------------|--------------|---------------------------------------|----------------------------------|
|       | Max power | Max current (rms)                 | Max current (peak)                | Frequency range | Crest factor | Line regulation                       | Load regulation                  |
| 9801  | 300 VA    | 3 A (0-150 V),<br>1.5 A (0-300 V) | 12 A (0-150 V),<br>6 A (0-300 V)  | 45 Hz to 500 Hz | $\geq 4$     | 0.1% max for a $\pm 10\%$ line change | $\leq 0.5\%$ FS (resistive load) |
| 9803  | 750 VA    | 6 A (0-150 V),<br>3 A (0-300 V)   | 24 A (0-150 V),<br>12 A (0-300 V) |                 |              |                                       |                                  |
| 9805  | 1500 VA   | 12 A (0-150 V),<br>6 A (0-300 V)  | 48 A (0-150 V),<br>24 A (0-300 V) |                 |              |                                       |                                  |

**Power line disturbance (PLD) simulator**

With the PLD simulator, users can produce common waveform disturbances like surges, sags, spikes, and drop-outs at user-defined locations on the waveform.

## 5335B Power Meter



The 5335B is a compact, single-phase AC power meter for measuring and analyzing energy consumption and power quality up to 600 Vrms, 20 Arms, and bandwidth of 100 kHz.

### Features & Benefits

- 4.3-inch color TFT LCD
- Simultaneously measure and display up to 12 AC and DC parameters
- Front panel USB host port for data storage to a USB flash drive
- Standard USB (USBTMC), RS232, and LAN interfaces
- Integration function with automatic range switching for measuring electric energy
- External current sensor interface for measurements above 20 A
- Total harmonic distortion (THD) and harmonic measurements up to the 50th harmonic with the ability to display individual harmonic components

| Key Specifications                 |         |   |
|------------------------------------|---------|---|
| Basic voltage and current accuracy |         | $\pm(0.1\%$ of reading+<br>$0.2\%$ of range)  |
| Measurement range                  | Voltage | 0 - 600 Vrms  |
|                                    | Current | 0 - 20 Arms   |
| Input bandwidth                    |         | DC, 0.5 Hz - 100 kHz  |
| Measurements                       |         | Voltage<br>Current<br>Active power<br>Reactive power<br>Apparent power<br>Power factor<br>Phase difference<br>Frequency<br>V Max/V Min<br>A Max/A Min<br>Crest factor<br>Integration<br>Harmonic distortion factor<br>Total harmonic distortion (THD) |

### Harmonic histogram

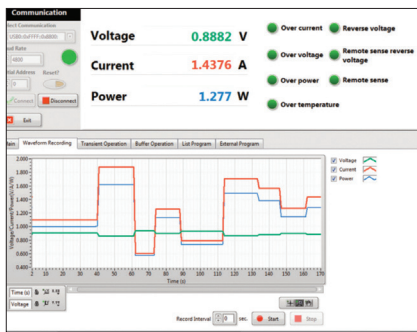
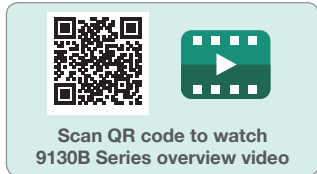


The parameters of each harmonic measured can be displayed in a bar chart.

### Applications

Measure power, electric energy bought or sold back to the power grid, standby power, and harmonics of motors, uninterruptable power supplies, battery chargers, appliances, and consumer electronics.

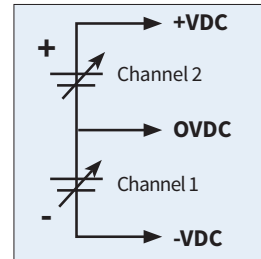
# DC Power Supplies



PC software is provided for front panel emulation, generating and executing test sequences or logging measurement data without the need to write source code.

## 9129B & 9130B Series Triple Output DC Power Supplies

These triple output linear programmable DC power supplies feature isolated outputs that can be adjusted independently or combined in series or parallel to output higher voltage or current. Additionally, these supplies can operate in tracking mode with user-configurable ratios between channels.



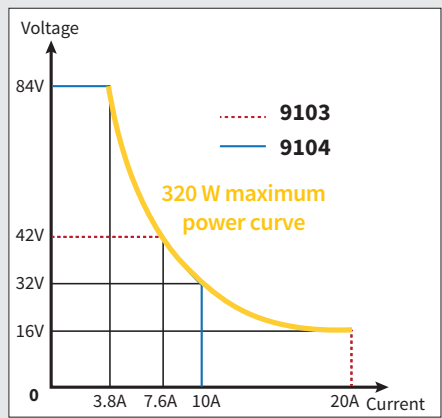
### Bipolar output configuration

The independent and isolated outputs can be used to create positive and negative outputs between channels 1 and 2. This feature is useful for powering bipolar circuits and devices.

| Model                  |           | 9129B               | 9130B     | 9131B                                  | 9132B     |
|------------------------|-----------|---------------------|-----------|--|-----------|
| Output ratings         | Ch1 & Ch2 | 30 V, 3 A           | 30 V, 3 A | 30 V, 6 A                              | 60 V, 3 A |
|                        | Ch3       | 5 V, 3 A            |           |  |           |
|                        | Power     | 195 W               | 195 W     | 375 W                                  | 375 W     |
| Ripple and noise       | Voltage   | ≤ 5 mVp-p / 1 mVrms |           | ≤ 1 mVrms                              |           |
|                        | Current   | ≤ 6 mArms           | ≤ 3 mArms | ≤ 5 mArms (ch1/ch2)<br>≤ 4 mArms (ch3) | ≤ 4 mArms |
| Programming resolution | Voltage   | 10 mV / 1 mA        |           | 1 mV / 1 mA                            |           |
|                        | Current   |                     |           |  |           |
| Load regulation        | CV        | ≤ 0.02% + 4 mV      |           | ≤ 0.01% + 3 mV                         |           |
|                        | CC        | ≤ 0.2% + 3 mA       |           | ≤ 0.1% + 3 mA                          |           |
| Remote interface       |           | USB Adapter         |           | USB (USBTMC), RS232, GPIB              |           |
| Memory locations       |           | 29                  |           | 36                                     |           |
| Remote sense           |           | --                  |           | √                                      |           |
| Output timer           |           | --                  |           | √                                      |           |



Model 9103 / 9104 output characteristics



## 9103 & 9104 Multi-Range DC Power Supplies

The 9103 and 9104 can replace multiple supplies on your bench or in your rack. Unlike conventional supplies with fixed output ratings, these power supplies automatically recalculate voltage and current limits for each setting, providing max output power in any Volt/Amp combination within the rated voltage and current limits.

### Features & Benefits

- Save up to 3 user-defined voltage and current presets for quick recall
- Output On/Off control
- Step and ramp programming function
- Analog remote control function
- USB interface
- Remote sense terminal

| Model                   | 9103                        | 9104     |
|-------------------------|-----------------------------|----------|
| Variable output voltage | 0 – 42 V                    | 0 – 84 V |
| Variable output current | 0 – 20 A                    | 0 – 10 A |
| Max power               | 320 W                       |          |
| Ripple and noise        | Voltage                     |          |
|                         | ≤ 80 mVp-p / ≤ 8 mVrms      |          |
| Voltage regulation      | Current                     |          |
|                         | ≤ 200 mA                    | ≤ 50 mA  |
| Voltage regulation      | Load (0-100% rated current) |          |
|                         | ≤ 120 mV                    | ≤ 100 mV |
|                         | Line (90-264 VAC variation) |          |
|                         | ≤ 10 mV                     |          |

# High Power Density DC Electronic Loads

## SDL Series Programmable DC Electronic Loads



The SDL Series high power/high voltage DC electronic loads offer the industry's highest power density (8 kW in 5U form factor) without sacrificing performance. The DC electronic loads can operate in constant current (CC), constant voltage (CV), constant resistance (CR), and constant power (CW) mode, and provide arbitrary and pulse generator capabilities, analog control, and standard LAN, GPIB, USB, and RS232 interfaces for remote communication.

### Special applications

The SDL Series offers a wide operating voltage range up to 1000 V making it ideal for hybrid, plug-in hybrid, and battery electric vehicle (HEV/PHEV/BEV) test applications. Using the built-in arbitrary generator, the DC loads are suitable for DC power bus simulation required for immunity testing.

### Features & Benefits

- 0.05% CC mode readback accuracy
- Intelligent PWM fan speed control reduces unnecessary fan noise and optimizes heat management
- 16-bit voltage and current measurement system
- Built in arbitrary and pulse generator for continuous, pulsed, and toggled transient operation
- Highest power density of 1.6 kW per 1U rack space
- Isolated analog control interface
- Flexible ranging options: High and Low, Manual or Auto
- Programmable slew rise and fall time
- Fast 50  $\mu$ s transient time in CC mode and 500  $\mu$ s in CV mode
- Remote inhibit and dry contact fault output
- Soft-start functionality
- Master/slave capability to increase current by paralleling multiple units with the same voltage rating
- Standard LAN, GPIB, USB, and RS232 interface supporting SCPI commands for remote control
- OVP/UVP/OCP/UCP/OPP/UPP protection

| Power  | Voltage | Current | Form factor | Weight | Model       |
|--------|---------|---------|-------------|--------|-------------|
| 4000 W | 600 V   | 150 A   | 3U          | 21 kg  | SDL-600-150 |
| 4000 W | 800 V   | 75 A    |             |        | SDL-800-75  |
| 4000 W | 1000 V  | 25 A    |             |        | SDL-1000-25 |
| 8000 W | 600 V   | 300 A   | 5U          | 33 kg  | SDL-600-300 |
| 8000 W | 800 V   | 150 A   |             |        | SDL-800-150 |
| 8000 W | 1000 V  | 50 A    |             |        | SDL-1000-50 |

## MDL302 Dual-Channel Modular DC Electronic Load



The MDL302 can support a full 300 W on each input channel with a voltage and current operating range up to 80 V/45 A, or 600 W combined, offering the industry's highest power dual-channel DC load module.



Install up to 8 MDL302 modules into the MDL Series mainframe with extension for a total of 16 x 300 W channels. The load modules can be used independently or synchronized and paralleled for increased current and power.

### Applications

The MDL302 can be used for testing multi-output AC/DC supplies, batteries, fuel cells, and photovoltaic arrays.

| Key Specifications            |   |
|-------------------------------|---|
| Operating modes               | CC/CV/CR/CW/CZ  |
| Input voltage                 | 0 – 80 V  |
| Input current                 | Low 0 – 4.5 A   |
|                               | High 0 – 45 A   |
| Input power                   | 300 W (CH1) / 300 W (CH2)   |
| Transient operation (CC mode) | Up to 25 kHz  |
| CC mode (low range)           | Resolution 1 mV   |
|                               | Accuracy $\pm (0.05\% + 0.025\% \text{ F.S.})$                                      |
| Remote interface              | GPIB, LAN, USB (USBTMC), RS232, and external analog control and monitoring terminal |
| Protection modes              | OVP/OCP/OPP/OTP   |

# DC Electronic Loads

## 8600 Series Programmable DC Electronic Loads



Model 8600-8602



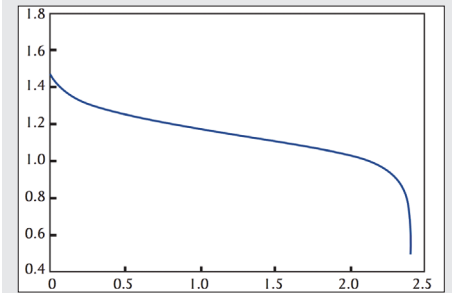
Model 8610-8622

The 8600 Series programmable DC electronic loads provide the performance of modular system DC electronic loads in a compact benchtop form factor. With fast transient operation speeds up to 25 kHz, and high 16-bit measurement resolution and accuracy, these DC loads can be used for testing and evaluating a variety of DC sources such as DC power supplies, DC-DC converters, batteries, battery chargers, and photovoltaic arrays.

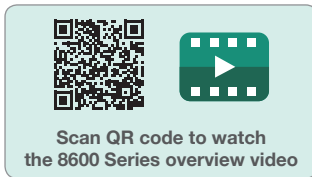
### Features & Benefits

- CC / CV / CR / CW operating modes
- Measurement speed to 50 kHz
- Remote sense function
- Adjustable slew rate in CC mode
- Standard RS232, USB (USBTMC), and GPIB interfaces supporting SCPI commands for remote control
- Analog current control and monitoring
- OVP / OCP / OPP / OTP and reverse voltage protection

### Battery test function

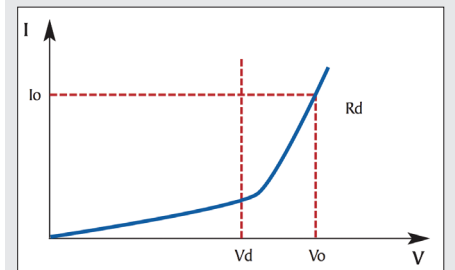


The built-in battery test function uses CC mode to calculate the battery capacity using a fixed current load discharge. Users can specify cut-off voltage level, capacity level and time stop conditions.



| Input Ratings |         |         | Form factor  | Model |
|---------------|---------|---------|--------------|-------|
| Power         | Voltage | Current |              |       |
| 150 W         | 120 V   | 30 A    | 2U half-rack | 8600  |
| 250 W         | 120 V   | 60 A    |              | 8601  |
| 200 W         | 500 V   | 15 A    |              | 8602  |
| 750 W         | 120 V   | 120 A   | 3U           | 8610  |
| 750 W         | 500 V   | 30 A    |              | 8612  |
| 1500 W        | 120 V   | 240 A   |              | 8614  |
| 1500 W        | 500 V   | 60 A    |              | 8616  |
| 3000 W        | 120 V   | 480 A   |              | 8620  |
| 2500 W        | 500 V   | 100 A   |              | 8622  |
| 4500 W        | 120 V   | 600 A   | 6U           | 8624  |
| 6000 W        | 120 V   | 720 A   |              | 8625  |

### CR-LED mode



Use the load's unique CR-LED operating mode to test LED drivers. This function allows users to configure the LED's operating resistance and forward voltage to simulate the loading behavior of typical LEDs.

# LCR & DC Resistance Meters



## Features & Benefits

- Four-terminal Kelvin type test leads included
- Low power test mode to protect DUT
- Manual or Auto ranging
- User selectable speed options
- Zero correction
- High-speed bin-sorting with statistical functions
- Comparator with pass/fail alarm beeper function
- Memory for 30 groups of parameters
- Screen capture to USB drive
- AC input power line filtering to eliminate the influence of noise on the instrument
- Handler interface

## 2800 Series DC Resistance Meters

The 2800 Series DC resistance meters feature high accuracy and resolution. The 2840 is economically priced to meet the need of applications where extended range and temperature correction are not required.

### Applications

Both meters are ideally suited for measuring contact resistance of relays, switches, interconnects, PCB traces, bonds, and cables. The 2841 adds extended range, accuracy and temperature measurement for evaluating coils, motor windings, transformers, actuators and conductive materials.



Touch screen to zoom or enter values

| Model   | 2840                           | 2841                              |
|---|--------------------------------|-----------------------------------|
| Measurement range                             | 1 $\mu\Omega$ to 20 k $\Omega$ | 0.1 $\mu\Omega$ to 110 M $\Omega$ |
| Best accuracy                                 | 0.05%                          | 0.01%                             |
| Measurement resolution                        | 1 $\mu\Omega$                  | 0.1 $\mu\Omega$                   |
| Displayed measurements                        | 1                              | 1 or 2                            |
| Measurement functions*                        | R and LPR                      | R, R-T, T, LPR, LPR-T             |
| Ranges  | 4 + Auto                       | 11 + Auto                         |
| Temperature measurements (TC and $\Delta t$ ) | --                             | ✓                                 |
| Bins  | 3                              | 10                                |
| Remote interface                              | RS232, USB (USBTMC)            | LAN, RS232, USB (USBTMC)          |

\* R – Resistance, LPR – Low Power Resistance, T - Temperature



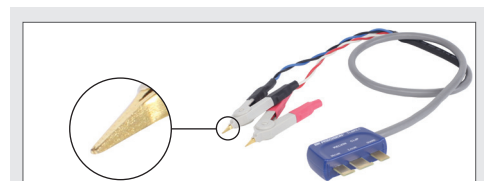
## Features & Benefits

- 40,000 counts resolution on primary and 10,000 counts resolution on secondary display
- Automatic calculation of secondary parameters D, Q,  $\theta$ , ESR and DCR
- Data Hold and Min/Max/Average recording
- USB (Virtual COM) interface and SCPI compliant commands for remote communication

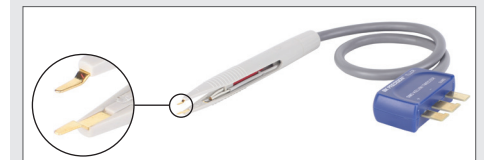
## 880 100 kHz Dual Display Handheld LCR Meter

The 880 offers many features typically found only in bench LCR meters such as test frequencies up to 100 kHz, selectable test signal levels, and 4-terminal measurement capabilities to help minimize measurement errors and improve measurement accuracy.

| Key Specifications |  |
|--------------------|--|
| Measurements       | L, C, R, G, X, Z, Y, B, G, $\theta$ , Q, D, DCR  |
| Basic accuracy     | 0.1%   |
| Test frequency     | 100 Hz, 120 Hz, 1 kHz, 10 kHz, 100 kHz           |
| Backlit display    | ✓  |
| Auto detect mode   | ✓  |
| Tolerance mode     | 1%, 5%, 10%, 20%                                 |
| Measurement rate   | 4 readings/sec (fast)<br>1.5 readings/sec (slow) |



Kelvin clip test leads (TL8KC1)



SMD tweezer (TL8SM)

Standard accessories include an AC adapter with rechargeable 9 V battery, mini USB cable, shorting plate, banana-to-alligator test leads, Kelvin clip test leads, and additional tweezer accessory for convenient measurement of SMD components.

# LCR Meters

## 894 & 895 Performance LCR Meters

The 894 and 895 are high accuracy and high precision bench LCR meters capable of measuring inductance, capacitance, and resistance with a basic accuracy of 0.05% over a frequency of up to 1 MHz. These meters feature a vivid 4.3-inch TFT LCD with five convenient display modes, auto level control (ALC), cable length compensation (1/2/4 m), and bin sorting comparator. For accurate measurements, these performance LCR meters provide Open, Short, and Load corrections.

### USB host port

Connect your USB flash drive to conveniently save data logs, settings, and screenshots.

### Intuitive user interface

Easily change test parameters using the menu-driven front panel keypad.

### Pass/Fail LED indicators



4.3" TFT color display

Model 895

### Variable test signals

The instrument provides settable voltage levels from 5 mVrms to 2 Vrms to evaluate your DUT.



### Zoom display mode

With a touch of a button, users can enlarge the display for easy viewing from a distance. The voltage and current across the DUT are also monitored in this display mode.

### List sweep

| < LIST SWEEP DISP > |          |          |         |     | MEAS DISPLAY |
|---------------------|----------|----------|---------|-----|--------------|
| MODE                | :SEQ     |          |         |     | BIN NO.      |
| No.                 | FREQ[Hz] | Cs[F]    | D [ ]   | CMP | BIN COUNT    |
| 001                 | 20.0000  | 102.797n | 0.00162 | L   |              |
| 002                 | 5.01990k | 101.775n | 0.00773 | P   |              |
| 003                 | 10.0198k | 101.408n | 0.00973 | P   |              |
| 004                 | 15.0197k | 101.149n | 0.01098 | P   |              |
| 005                 | 20.0196k | 100.946n | 0.01183 | P   |              |
| 006                 | 25.0195k | 100.780n | 0.01255 | P   |              |
| 007                 | 30.0194k | 100.637n | 0.01315 | P   |              |
| *008                | 35.0193k | 100.511n | 0.01371 | P   |              |
| 009                 | 40.0192k | 100.400n | 0.01423 | P   |              |
| 010                 | 45.0191k | 100.301n | 0.01466 | P   |              |

Use the built-in sweep function to conveniently display, analyze and store primary and secondary parameters of a component at up to 201 frequencies.

### BIN comparator

| < BIN No. DISP > |             |       | ON           |
|------------------|-------------|-------|--------------|
| FUNC             | : R-X       | RANGE | : AUTO       |
| FREQ             | : 1.000kHz  | BIAS  | : 0.00 mV    |
| LEVEL            | : 1.000 V   | SPEED | : SLOW       |
|                  |             | COMP  | : ON         |
| <b>BIN OUT</b>   |             |       |              |
| R                | : 7.08130 Ω | X     | : -1.62169kΩ |
| CAL              | : OFF       |       |              |

Use the BIN comparator function to sort components in up to 10 bin locations.

### Remote PC control

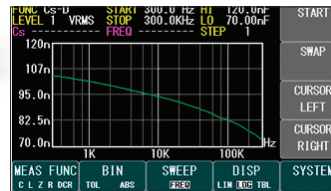
| < LAN SETUP > |                    | SYSTEM SETUP      |
|---------------|--------------------|-------------------|
| LAN Status    | : Working Properly | LAN SETUP         |
| HOST NAME     | : 89x              |                   |
| DHCP          | : OFF              |                   |
| AUTO IP       | : OFF              |                   |
| IP ADDR       | : 10. 0. 1. 55     | DEFAULT SETT INGS |
| SUBNET MASK   | : 255.255.254. 0   |                   |
| GATEWAY       | : 10. 0. 1.254     | SYSTEM RESET      |
| DNS SERVER1   | : 10. 0. 1.254     |                   |
| DNS SERVER2   | : 10. 0. 1.254     |                   |

Integrate your LCR meter into an automated test system and control it from a PC using SCPI commands via the RS232, USB, LAN, or GPIB interface.

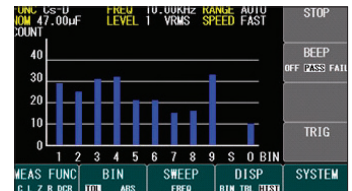


## 891 Bench LCR Meter

The 891 is a compact, precise, and versatile LCR meter capable of measuring inductors, capacitors and resistors at DC or from 20 Hz to 300 kHz, at both low and high impedance ranges. A large color display with all important parameters and measurement visible on one screen makes this meter easy to operate. The outstanding performance of the 891 makes it an invaluable tool for production, quality control, and R&D.

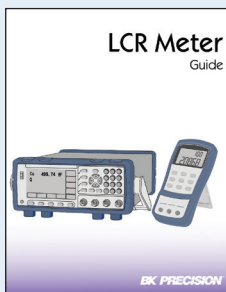


Linear and logarithmic sweep function to characterize components up to 300 kHz



Quickly sort components with 9 primary BINs, 1 secondary BIN, and 1 out BIN

| Model                         | 891                                    | 894   | 895  |               |
|-------------------------------|--|---|--|---------------|
| Measurement parameters        | L, C, R, G, X, Z, $\theta$ , Q, D, DCR | L, C, R, G, X, Z, Y, B, G, $\theta$ , Q, D, DCR |  |               |
| Basic accuracy                | 0.1%                                   |   | 0.05%  |               |
| DCR measurement range         | 0.1 $\Omega$ - 20 M $\Omega$           |   | 0.01 $\Omega$ - 100 M $\Omega$                           |               |
| Test signal                   | Frequency range                        | 20 Hz - 300 kHz                                 | 20 Hz - 500 kHz  | 20 Hz - 1 MHz |
|                               | Frequency accuracy                     | 0.1%  |  | 0.01%         |
|                               | AC level range                         | 0.5 Vrms and 1 Vrms (fixed)                     | 5 mVrms - 2 Vrms / 50 $\mu$ Arms - 20 mArms (adjustable) |               |
|                               | DC bias                                | -   | 0 V - +5V / 0 mA - +25 mA                                |               |
|                               | Output impedance                       | 100 $\Omega$ (typical)                          | 30 $\Omega$ , 50 $\Omega$ , or 100 $\Omega$              |               |
| Selectable measurement speeds | 200 ms (Fast), 800 ms (Slow)           | 13 ms (Fast), 90 ms (Med), 370 ms (Slow)        |  |               |
| Auto level control (ALC)      | -                                      |   | ✓  |               |
| Cable length compensation     | -                                      |   | ✓  |               |
| Handler interface             | -                                      |   | ✓  |               |
| Remote interface              | USB (Virtual COM), GPIB, and LAN       | RS232, USB (USBTMC), LAN, and GPIB (895 Only)   |  |               |
| Dimensions                    | 258 x 113 x 381 mm                     | 369 x 108 x 408 mm                              |  |               |
| Weight                        | 3.4 kg                                 | 5 kg  |  |               |



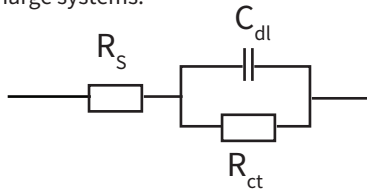
## LCR Meter Guide

Introduction to the benefits of LCR meters and the theory behind the measurements, plus related terms and example applications.

For more guides and applications, visit: [bkprecision.com/product-applications](http://bkprecision.com/product-applications)

# Battery Test Solutions

B&K Precision offers a wide array of internal resistance/impedance based battery test solutions including handheld and benchtop units for field environments, labs, quality control, and production use, as well as frequency response analyzers for complex AC impedance data analysis and charge/discharge systems.



Model of simplified Randles cell

## Battery charge/discharge solution with sequencing and data logging



| Model         | 9200/9115 and 8600/SDL Series   | 600B & 601B  | BA6010 & BA6011  | FRA8000  |
|---------------|---|--|--|--|
| Test method   | <b>Charge / Discharge</b><br>Charge and discharge battery while logging results | <b>DC Resistance</b><br>Measure open and loaded battery voltage and calculate internal DC resistance | <b>AC Impedance</b><br>Uses a 1 kHz fixed frequency AC signal to calculate battery impedance | <b>EIS (electrochemical impedance spectroscopy)</b><br>Stimulate the battery with a low-level sinusoidal AC current at a particular frequency and then measure both the stimulating AC current and the resultant AC voltage. Repeat for various frequencies. |
| Result        | V/I plots with calculated amp-hours (Ah)  | Displays remaining capacity of lead-acid battery in %  | Real-time display of voltage, impedance, phase angle and capacitance                         | Real-time display of voltage, current and impedance. Generates Nyquist and Bode plots to identify specific battery model elements.   |
| Advantages    | Measures actual capacity of a battery directly                                  | Quick, easy and repeatable measurement   | Fast measurement speed. Ability to measure battery capacitance.                              | Provides large amount of data and detailed information about individual battery model elements   |
| Disadvantages | Time consuming  | Ignores battery capacitance, resistive battery model elements lumped together                        | Individual battery model elements seen as one impedance value                                | Requires complex data analysis   |

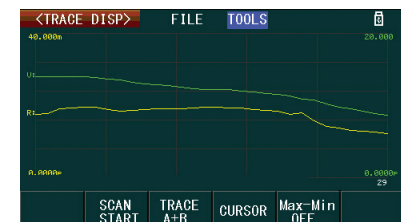
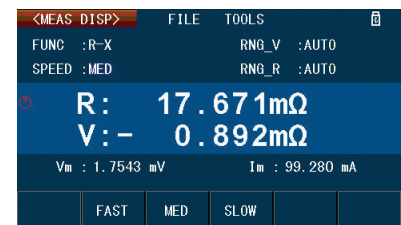
## BA6000 Series Battery Analyzers



The BA6000 Series Battery Analyzers use a 1 kHz AC constant current source to measure the battery's impedance expressed by 11 different measurement functions. With a basic voltage and impedance accuracy of 0.1% and micro-ohm resolution, these instruments are well-suited for analyzing a wide range of battery types and configurations in the lab, quality control and manufacturing environments.

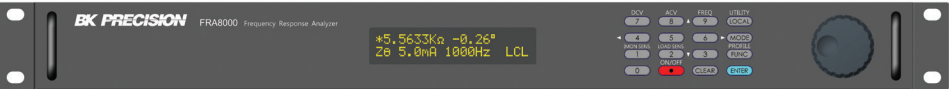
### Features & Benefits

- 4.3 inch color LCD display
- Graphing display of voltage and resistance with on-screen measurement tools
- 4-wire test fixture with monitoring for Hi drive open, Low drive open, and both open
- Compare and sort using 10 bins with statistical evaluations
- $\Delta\%$  mode for quickly determining the percent difference between batteries
- Pass/Fail indicator with audible tone
- 50 measurements per sec
- Handler interface
- Internal and external file storage



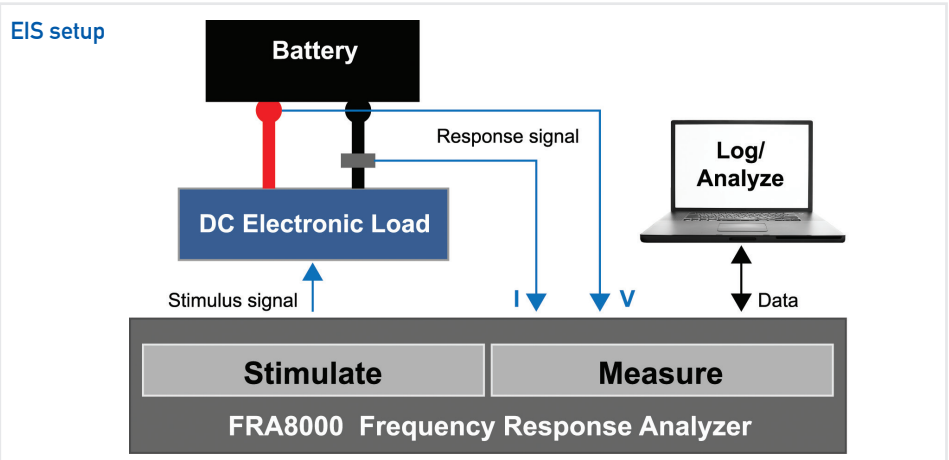
| Model  | Input voltage        | Input range  | Measurement functions                                | Test signal                    | Basic accuracy impedance | Impedance resolution | Voltage resolution | Remote interface     |
|--------|----------------------|--------------|--|--------------------------------|--------------------------|----------------------|--------------------|----------------------|
| BA6010 | 100 $\mu$ V to 60 V  | 6 V / 60 V   | R, R-V, V, R-Q, L-Q, L-R, R-X, C-D, Z-Q, Z-R and R-C | Sine wave (1 kHz $\pm$ 0.2 Hz) | 0.1%                     | 1 $\mu\Omega$        | 1 $\mu$ V          | RS232, USB, and GPIB |
| BA6011 | 100 $\mu$ V to 300 V | 30 V / 300 V |  |                                |                          |                      |                    |                      |

## FRA8000 Frequency Response Analyzer



In combination with a DC electronic load, the FRA8000 can be used to perform electrochemical impedance spectroscopy (EIS) measurements for analysis of:

- Primary and secondary batteries
- Super capacitors and fuel cells
- Corrosion and surface treatments



The FRA stimulates the battery via the DC load's analog programming input with a small sinewave signal at a specific frequency, measures the battery's voltage and current response, and calculates the complex impedance. The FRA measurement unit is capable of extracting very small signals from noisy waveforms and compare their gain and phase. The stimulus signal is swept from frequencies as low as 0.1 Hz to the desired maximum frequency.

|                                   |                              |   |
|-----------------------------------|------------------------------|---|
| <b>AC source</b>                  | Programmable frequency range | 0.1 Hz - 20 kHz   |
|                                   | Frequency resolution         | 0.01 Hz   |
|                                   | Amplitude                    | Up to 20% of DC bias setting or 1 Vrms  |
| <b>DC bias source</b>             | Range                        | 10 mV - 10 V  |
|                                   | Resolution                   | 10 mV   |
|                                   | Accuracy                     | 0.1% ± 50 mV  |
| <b>Analyzer/ measurement unit</b> | Range                        | Auto  |
|                                   | Sensitivity                  | 1 µV  |
|                                   | Dynamic range                | 120 dB  |
|                                   | Basic accuracy               | +/-2% 0.1 Hz - 9.99 Hz,<br>+/- 0.5% 10 Hz - 9999 Hz,<br>+/-1% 10 kHz - 20 kHz |

### Features & Benefits

- Sine wave generation yielding frequency errors less than 0.02 Hz
- High selectivity two stage receiver architecture for high noise immunity
- Simultaneous V/I measurement to ensure exact impedance and phase information
- Auto gain control and adjustable sampling interval to allow measurement of micro-ohm signals buried under noise without the need for auxiliary equipment
- Compatible with any DC load that has a programmable analog input to measure high-voltage or high-power battery packs
- USB, GPIB, and LAN connectivity



Nyquist diagram

### Application Software Features

- Nyquist, Bode, and V/I graphs
- Real-time display of impedance measurements and operating conditions
- Frequency sweeps with adjustable amplitude in log/linear form
- Automatic or manual scaling and shifting of screen plots for optimum viewing
- Advanced marker functions

## 600B & 601B Handheld Battery Capacity Analyzers

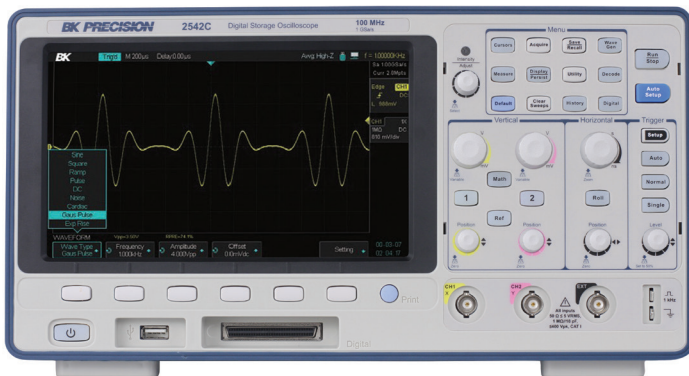
The 600B and 601B Handheld Battery Capacity Analyzers address the need to test and maintain sealed lead acid (SLA) batteries used in backup power UPS, emergency lighting, fire alarms, security systems, and many other electrical systems. By quickly characterizing a battery's response to a load resistance, these meters display the remaining battery capacity as an indicator of the battery's health.

|   |                          |                       |
|---|--------------------------|-----------------------|
| Model                                   | 600B                     | 601B                  |
| Supported SLA battery voltages          | 12 V                     | 6 V & 12 V            |
| Ah range                                | 7, 12, 24, 42, 65, & 100 | 5 - 100 in 1 Ah steps |
| No load (open circuit) voltage accuracy | ±2 counts                | ±(0.2% + 1 count)     |
| Internal resistance                     | --                       | ✓                     |
| Load voltage                            | --                       | ✓                     |

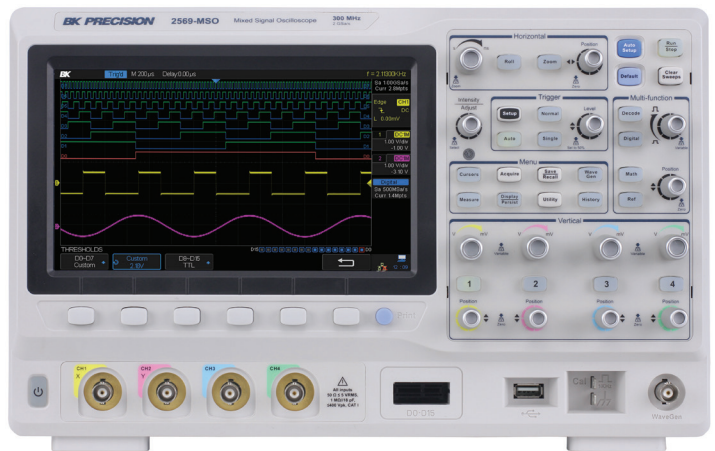


# Oscilloscopes

## 2540C & 2560 Series Digital Storage/Mixed Signal Oscilloscopes



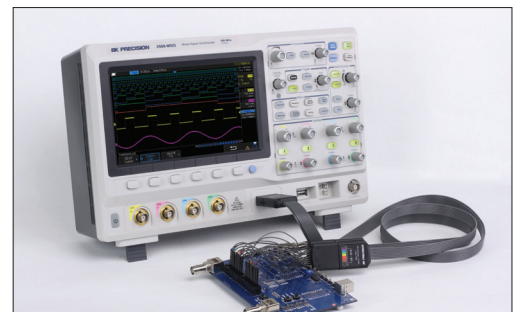
Model 2542C



Model 2569-MSO

The B&K Precision 2540C Series and 2560 Series offer 2- and 4-channel digital storage oscilloscopes (DSO) and mixed signal oscilloscopes (MSO) with bandwidth up to 300 MHz, sample rate up to 2 GSa/s, and deep memory up to 140 Mpts. Maximize productivity using extensive features such as digital filtering, waveform recorder, pass/fail limit testing, and automatic measurements.

In addition, these instruments provide a large 8" color display with 256 levels of intensity grading, which allow these units to capture and display more details of a signal for analysis.



16-channel logic probe and logic analyzer function included with MSO models.

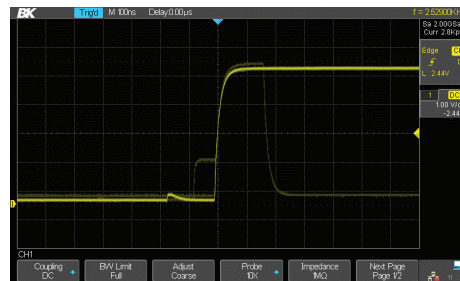
|  | 2540C Series  |           |           | 2560 Series    |          |          |          |          |          |
|--|---|-----------|-----------|----------------|----------|----------|----------|----------|----------|
| DSO Model                                    | 2540C   | 2542C     | 2544C     | 2563           | 2565     | 2566     | 2567     | 2568     | 2569     |
| MSO Model                                    | 2540C-MSO   | 2542C-MSO | 2544C-MSO | 2563-MSO       | 2565-MSO | 2566-MSO | 2567-MSO | 2568-MSO | 2569-MSO |
| Channels                                     | 2   | 2         | 2         | 4              | 4        | 2        | 4        | 2        | 4        |
| Bandwidth                                    | 70 MHz  | 100 MHz   | 200 MHz   | 70 MHz         | 100 MHz  | 200 MHz  | 200 MHz  | 300 MHz  | 300 MHz  |
| Sample rate                                  | 1 GSa/s   |           |           | 2 GSa/s        |          |          |          |          |          |
| Max record length                            | 14 Mpts   |           |           | 140 Mpts       |          |          |          |          |          |
| Waveform update rate                         | 60,000 wfms/s   |           |           | 140,000 wfms/s |          |          |          |          |          |
| Trigger types                                | Edge, Slope, Pulse, Video, Window, Interval, DropOut, Runt, Pattern   |           |           |                |          |          |          |          |          |
| Waveform math and analysis functions         | 37 Automatic Measurements, Statistics, Gating, History, Reference, FFT, Addition, Subtraction, Multiplication, Division, Integration, Differential, Square Root |           |           |                |          |          |          |          |          |
| PC connectivity                              | Standard LAN (supports SCPI) and USB device port (USBTMC compliant)   |           |           |                |          |          |          |          |          |
| <b>Available Upgrades</b>                    |   |           |           |                |          |          |          |          |          |
| 16-channel digital logic probe*              |   | ✓         |           |                |          |          | ✓        |          |          |
| Logic analyzer*                              |   | ✓         |           |                |          |          | ✓        |          |          |
| Serial bus decode and analysis package**     |   | ✓         |           |                |          |          | ✓        |          |          |
| 25 MHz function/arbitrary waveform generator |   | Standard  |           |                |          |          | ✓        |          |          |

\*Standard on MSO model. \*\*Supporting I2C, SPI, UART, RS232, CAN, and LIN Protocols.

## Features & Benefits

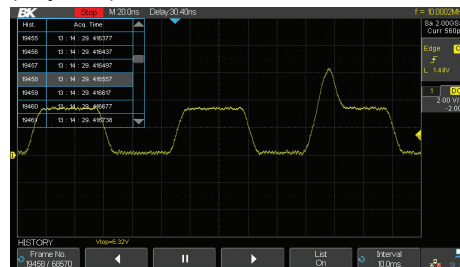
- 16 digital channels with 500 MSa/s sampling rate (enabled with MSO model)
- Large 8" widescreen display with 256-level intensity grading and color temperature display
- High speed hardware-based pass/fail testing function
- 50  $\Omega$  input coupling
- Segmented acquisition mode for storing the waveform into multiple memory segments (up to 80,000)
- Front panel USB port for convenient storing and recalling of waveform data, setups, and screenshots on a USB flash drive
- PC software that lets you remotely control the oscilloscope and capture, save, and analyze waveform data
- Advanced tools include digital filters with adjustable limits and waveform recorder mode
- Multi-language user interface and built-in context sensitive help
- 25 MHz built-in function/arbitrary waveform generator (standard on all 2540C Series models and available as an option for the 2560 Series)
- Serial bus triggering and decoding supporting I2C, SPI, UART, RS232, CAN, and LIN protocols (option)
- Built-in Logic Analyzer (option)
- Statistical functions supporting Gating, Math, History, and Ref measurements

### Fast waveform capture rate



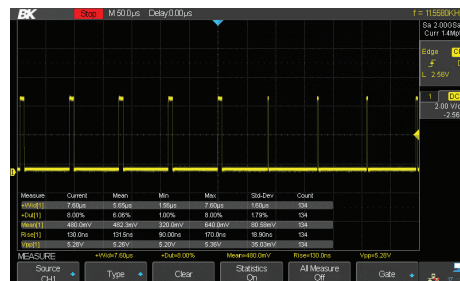
The 2540C Series delivers up to 60,000 wfms/s update rate and the 2560 Series delivers up to 140,000 wfms/s update rate to help you detect infrequent anomalies and glitches more quickly.

### History and segmented acquisition (Sequence) mode



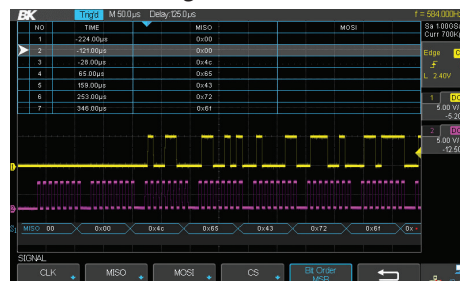
Use the instrument's History and Sequence function to record and play back waveforms to find anomalies and quickly locate the source of the problem via cursor or measurement parameters.

### Comprehensive statistical functions



Parametric statistical functions are available for displaying five parameters of any measurement: current value, mean value, minimum value, maximum value, and standard deviation.

### Serial bus decoding



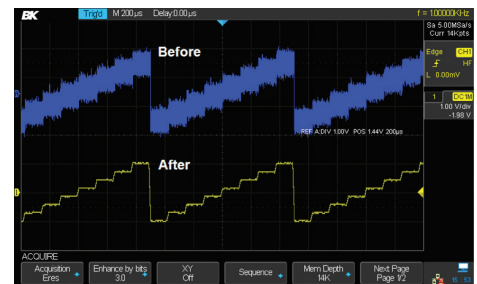
Displays the decoding through the events list. Bus protocol information can be quickly and intuitively displayed in table form.

### Record length up to 140 Mpts



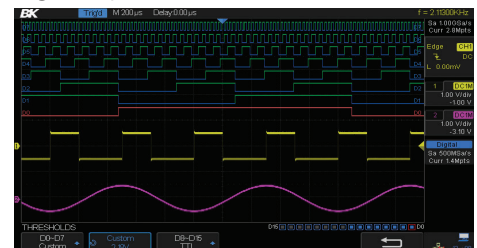
Using hardware-based Zoom technologies with record lengths of up to 14 Mpts (2540C Series) or 140 Mpts (2560 Series), users are able to capture more of their signal with higher sampling rates and quickly zoom into the event of interest.

### Eres (Enhanced Resolution) mode



Eres mode can improve the SNR effectively, without the dependence on the periodicity of the signal and stable triggering.

### Logic analyzer



4 analog channels plus 16 digital channels enable users to acquire and trigger on the waveforms, and then analyze the pattern simultaneously with one instrument.

### 25 MHz function/arbitrary waveform generator



Take advantage of the generator's 10 built-in waveforms or create up to 4 of your own arbitrary waveforms via waveform editing software.

# Oscilloscope & Recorder



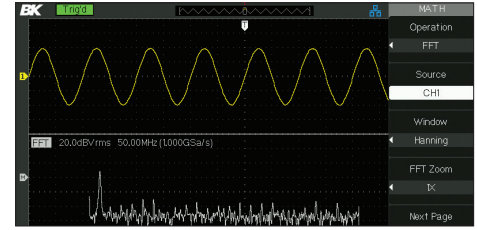
## Features & Benefits

- FFT plus four additional math functions
- Versatile triggering capabilities including pulse width, line-selectable video, slope, and alternating trigger
- Advanced tools include digital filter with adjustable limits, pass/fail testing, and waveform recorder mode
- 12 different language user interfaces and context sensitive help
- Special EDU mode allows educators to disable Auto set button, Measure menu, and Cursors menu
- PC software that lets you remotely control the digital storage oscilloscope and capture, save, and analyze waveform data

## 2190E 100 MHz Economy Digital Storage Oscilloscope

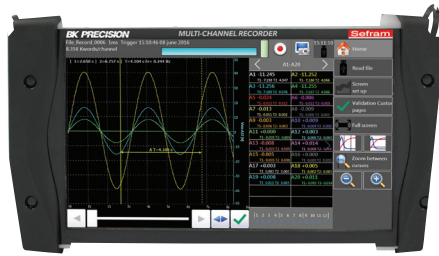
The 2190E oscilloscope combines performance and value all in one portable solution. With a large, high-resolution display, standard LAN and USBTMC-compatible USB interface, advanced triggering capabilities, and extensive features such as digital filtering, waveform recorder and 32 automatic measurements, this oscilloscope offers powerful tools in a small affordable package.

### Powerful measurement functions



Display and measure the input signal's frequency spectrum. Select one of the 4 FFT windows: Rectangular, Hanning, Hamming and Blackman. Use cursors to measure the spectral component's magnitude and frequency.

| Key Specifications |   |
|--------------------|---|
| Bandwidth          | 100 MHz   |
| Sample rate        | 1 GSa/s   |
| Memory             | 40 kpts   |
| Display            | 7" widescreen color LCD with 800 x 480 resolution   |
| I/O                | Front panel USB host port supporting USB flash drives and optional USB-to-GPIB adapter, LAN and USB (USBTMC-compliant) device port for connection to PC, Pass/Fail output |



## DAS240 Portable Multi-Channel Recorder

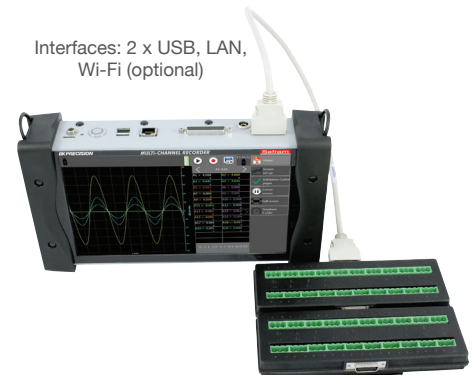
The DAS240 is a compact, light-weight multi-channel recorder designed to meet the needs for low level signal recording and process control applications. All input channels are isolated and suitable for combined measurements of voltage, temperature, humidity, logic, and pulse signals.

The DAS240 comes equipped with flexible and powerful trigger functions, e.g. trigger on event, threshold, window, and start or stop level. For more complex applications, mathematical calculations between channels are offered.

### Features & Benefits

- Current measurement with external shunt or accessory clamp
- Temperature measurement with thermocouples (all types supported) and resistance temperature detectors (RTDs) Pt100 and Pt1000
- Internal 32 GB SSD hard drive
- 4 discrete alarm outputs
- Arithmetic operation between channels
- Safety (IEC610010): 100V CAT II
- DasLab PC software for data analysis and remote control
- PC connectivity via LAN or Wi-Fi (option) for remote configuration of the recorder and data transfer to computer

Interfaces: 2 x USB, LAN, Wi-Fi (optional)



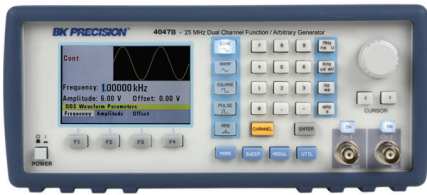
DAS240 with 2 x 20 channel extension module

| Key Specifications                              |                        |
|---|------------------------|
| Display   | 10" touchscreen        |
| Analog channels                                 | 20 (expandable to 200) |
| Range   | 1 mV to 200 V          |
| Minimum recording interval, 1 channel           | 1 ms                   |
| Minimum recording interval, Temperature channel | 2 ms                   |
| Internal memory                                 | 32 GB                  |
| Logical inputs                                  | 12                     |
| Frequency                                       | √                      |
| Pt100/Pt1000                                    | √                      |
| Resistance                                      | √                      |

# Signal Generators

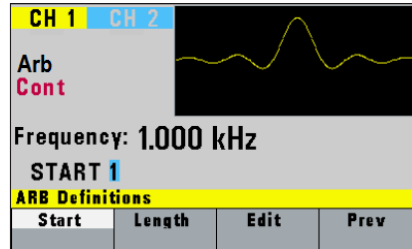
## Dual-Channel Function/Arbitrary Waveform Generators

### 4047B



The 4047B is a versatile dual-channel 25 MHz function generator with arbitrary waveform capability. It features a true point-by-point AWG (arbitrary waveform generator) architecture to produce accurate and precise arbitrary waveforms combined with a DDS architecture offering easy-to-use conventional function generator capabilities.

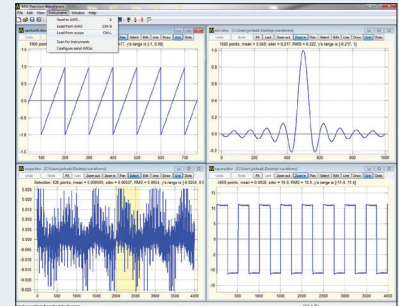
### Front panel arbitrary waveform generation



From the front panel, waveforms can be defined from scratch by entering data point-by-point or by loading and modifying predefined waveforms.



### Waveform editing software



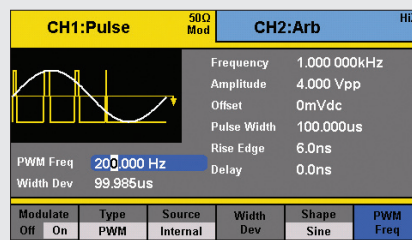
Use WaveXpress to easily generate, edit, and upload custom arbitrary waveforms to the generator via the remote interface. Generate waveforms in the software by importing a text file or define via freehand, point draw, and waveform math functions.

### 4050B Series



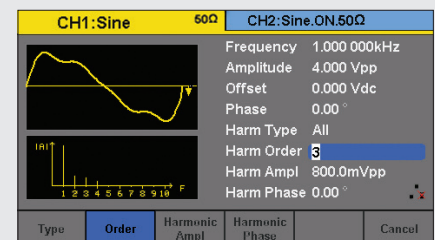
The 4050B Series dual-channel function/arbitrary waveform generators are capable of providing stable and precise sine, square, triangle, pulse, and arbitrary waveforms up to 60 MHz, using a DDS-based architecture.

### Wide variety of modulation schemes



These instruments are capable of many different types of modulation for various applications.

### Harmonics generator function



Generate up to 10 harmonics with independent amplitude and phase settings.

### Common Features

- 4.3" color LCD display
- Two fully independent channels with individual output On/Off buttons
- Synchronize the phase of both channels with the push of a button
- Low-jitter square wave generation for simulating reliable clock signals, generating triggers, or validating serial data buses
- Linear and logarithmic sweep
- Variable DC offset
- Adjustable duty cycle
- Internal/external triggering
- Gate and burst mode
- Built-in frequency counter

| Model                         | 4047B   | 4053B  | 4054B          | 4055B          |
|-------------------------------|---|--|----------------|----------------|
| Sine & Square frequency range | 0.01 Hz - 25 MHz                                    | 1 μHz - 10 MHz   | 1 μHz - 30 MHz | 1 μHz - 60 MHz |
| Amplitude                     | 0 to 10 Vpp into 50 ohms for entire frequency range | 0 to 10 Vpp into 50 ohms, ≤ 10 MHz<br>0 to 5 Vpp into 50 ohms, >10 MHz |                |                |
| Modulation                    | AM, FM, FSK, PM, PWM                                | AM, DSB-AM, FM, PM, ASK, FSK, PSK, PWM                                 |                |                |
| Vertical resolution           | 14 bit  |  |                |                |
| AWG architecture              | True point-by-point AWG                             | DDS-based AWG  |                |                |
| Sample rate                   | 125 MSa/s   | 150 MSa/s  |                |                |
| Arbitrary waveform length     | 16 kpts   |  |                |                |
| Built-in arbitrary waveforms  | 9   | 196  |                |                |
| Dedicated waveform keys       | √   | -  |                |                |
| Channel tracking              | -   | √  |                |                |
| Harmonics generator           | -   | √  |                |                |
| Ext 10 MHz reference I/O      | -   | √  |                |                |
| Remote interface              | USB (Virtual COM)                                   | LAN, USB device (USBTMC), USB host interface                           |                |                |

## About B&K Precision

For more than 60 years, B&K Precision has provided reliable and value-priced test and measurement instruments worldwide.

Our headquarters in Yorba Linda, California houses our administrative and executive functions as well as sales and marketing, design, service, and repair. Our European customers are most familiar with B&K through our French subsidiary, Sefram. Engineers in Asia know us through our B&K Precision Taiwan operation as well as our Itech brand. Our B&K Brasil office supports our expanding customer base in Brazil and other South American countries. The independent service center in Singapore services customers in Singapore, Malaysia, Vietnam, and Indonesia.



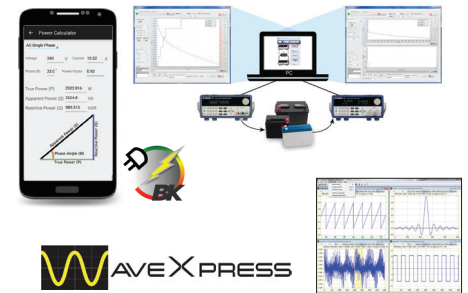
● B&K Precision group member ● Independent service center ● Service center location



## Video Library

View product overviews, demonstrations, and application videos in English, Spanish and Portuguese.

<http://www.youtube.com/user/BKPrecisionVideos>



## Product Applications

Browse all of our supported product and mobile applications.

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