Basel Precision Instruments

Low-Noise High-Resolution DAC II

lowest noise and drift available, outstanding resolution

- 1.2 µV step-size, 24-bit resolution
- 12 or 24 independent DAC channels
- Selectable bandwidth of 100 Hz or 100 kHz for each DAC channel
- User-defined arbitrary waveform generators (AWG), 24-bit resolution at 100 kHz
- Predefined waveforms: sine, triangle, sawtooth, ramp, pulse, Gaussian-noise
- Four independent and versatile RAMP-generators
- Up to 10 mA output current per DAC channels
- Pico-amp gate leakage measurement box
- External and internal synchronization
- QCoDeS/Python driver and LabVIEW user interface; TCP/IP and RS232

Basel Precision Instruments GmbH, Klingelbergstrasse 82, 4056 Basel, Switzerland, info@baspi.ch, https://baspi.ch

Model	LNHR DAC No longer available	LNHR DACII-12 New	LNHR DACII-24 New
Product #	SP927	SP1060-12	SP1060-24
Number of independent DAC channels	8	12	24
Resolution	24-bit		
Output voltage range / step size	±10 V range / 1.2 µV step size		
Leakage current detection	pA detection is possible using ad-on gate leakage box		
Integrated output voltage noise	75 Hz BW: typ. 0.5 µVrms	100 Hz BW: typ. 0.3 µVrms 100 kHz BW: typ. 4 µVrms	
Temperature drift (for entire ±10 V output range)	< 10 ppm/ °C (from voltage output)	typ. 1 µV/ °C + 1.5 ppm/ °C (ppm from actual voltage output)	
Drift over 8 hours at constant temperature	< 10 µV		
Bandwidth	75 Hz	switchable between 100 Hz and 100 kHz for each DAC channel	
Arbitrary waveform generation (AWG)		2 AWGs assigned to any channel	4 AWGs assigned to any channel
		34'000 memory points; update-rate at 10 µs per point or longer	
Predefined standard waveforms		Sine, triangle, sawtooth, ramp, pulse, gaussian-noise	
Ramping function		4 independent ramp generators with adaptive scan feature (gate compensation)	
Output current	±1 mA nominal	±10 mA max on each channel ± 25 mA max on each 12-channel board	
Grounding	Output ground is isolated from housing and computer interface		
External bias voltage between DAC output ground & housing	20 V max		
Output impedance	500 Ω	50 Ω	
Dimensions and weight	48 x 10 x 43 cm 7.5 Kg	48 x 10 x 35 cm 7.5 Kg	

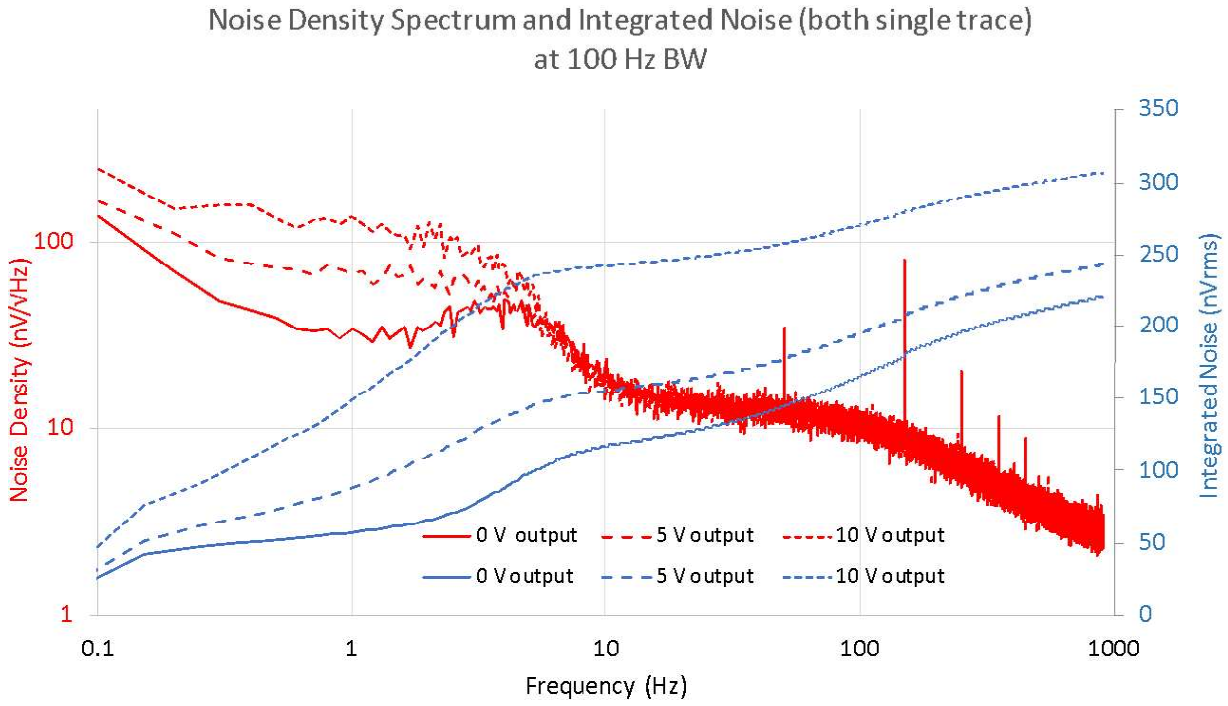
Applications

Applying ultra-stable DC bias-voltages and high-resolution voltage sweeps with very low fluctuations:

- driving high-ohmic gates in low-temperature quantum experiments
- applying source-drain voltages in quantum transport measurements
- controlling highly ESD sensitive samples, such as Josephson junctions or quantum dots

Noise Density Spectrum and Integrated Noise (single trace)

The outstanding noise performance of the LNHR DACII is shown in the plot below. The noise density spectrum (red) and the integrated noise (blue) are plotted at 0 V, 5 V, and 10 V output in the low-bandwidth setting (BW = 100 Hz). Please refer to the user manual for the high bandwidth setting (100 kHz) data. For this single trace measurement, the integrated noise from 0.1 Hz to 100 Hz is ~170 nVrms at 0 V output; even better than the 300 nV stated in the table above. The European mains-frequency of 50 Hz and some of its harmonics can be identified on the noise density spectrum. However, these peaks do not add significantly to the total noise as seen on the integrated noise. For frequencies above 100 Hz the noise density drops due to 100 Hz LP-filter and approaches the noise floor of 1 nV/√Hz at 900 Hz originating from the differential amplifier used for measurements.



Grounding, noise management and device protection

The LNHR DAC is a designed to optimize the grounding scheme for low-noise setups and to protect the device:

- ground loops are avoided; DAC channel output ground is isolated from the housing and computer interface; ground is provided by the shield of the cable coming from the experiment
- low-noise measurements are performed with the DAC connected to the mains AC voltage without a need for batteries
- DAC channels are connected directly to the device; excellent noise and resolution specs render further filtering and dividing unnecessary
- the DAC is built for devices with high sensitivity to electrostatic charge; in the unlikely event of power failure or computer crash the device is protected by the DAC

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Gate Leakage Current Measurement Box

gate leakage monitoring with pico-amp sensitivity

- Monitors leakage currents during a running experiment without increasing noise or deteriorating stability
- Measures currents from pico-amps to micro-amps
- Two, remote-controllable, gain settings: 1 V/nA and 1 V/µA
- Sets off alarm at the onset of leakage
- Remote-controllable bypass/measure switch

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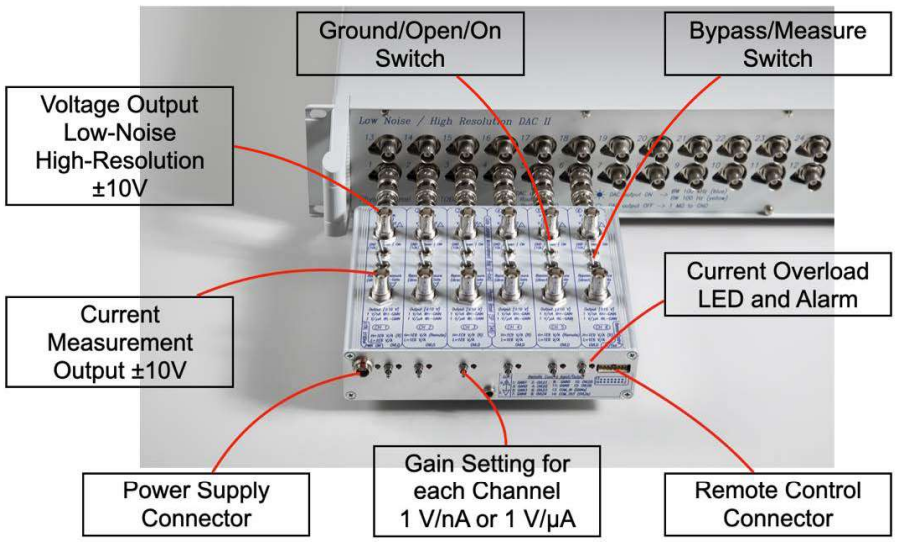
Model	SP1046
Number of channels per box	6
Detection range	pA to 10 µA
Gain	1 V/nA or 1 V/µA
Bandwidth	10 Hz
With remote control and current overload alarm	



The Gate Leakage Current Measurement Box (SP1046) is an accessory to Basel Precision Instruments' LNHR DACII

The LNHR DAC II (shown below) is a low-noise high-resolution voltage source, offering 12 or 24 independent DAC channels, with outstanding noise and stability performance & AWG functionality.