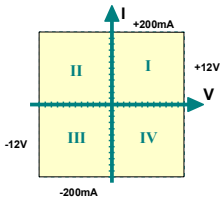
Bilt System module - BE2100

High Stability Voltage Source

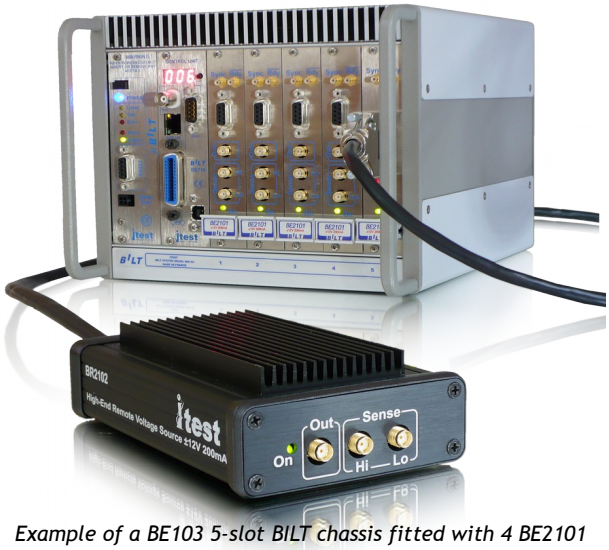
- ✔ *Voltage to ±12V, current to ±200mA*
- ✔ *High Resolution: 21 bits, 6 ½ digits*
- ✔ *Ultra Low Noise: down to 6µVp-p*
- ✔ *Clean output noise spectrum with no spike*
- ✔ *High Stability: a few µV within 24-hour*

Main features

- 3 source models:
  BE2101: standard model with no current measurement
  BE2102: remote source, no current measurement
- True 4-quadrant isolated modular DC source with sense lines



- 2 voltage ranges: ±1,2V and ±12V, current up to ±200mA
- High output and measurement resolution: 21 bits, 6½ digits
- Typical absolute accuracy: 100ppm
- Very fast warm-up time, 10 minutes max.
- 2 programmable output filters to optimize output noise and settling time
- "Ready" output signal indicates optimal accuracy reached on output voltage
- Excellent load regulation, typ. error <10µV (12V range)
- Programmable ramp or staircase waveform, synchronization between sources (external trigger
- Cost effective: up to 13 source modules in a single *Bilt* chassis, 3 chassis sizes available: 5, 8 or 13 slots



Example of a BE103 5-slot BILT chassis fitted with 4 BE2101 (front panel output) and one BE2102 (remote source)

Bilt system features

- Host connections at chassis level including Ethernet, USB, RS422, RS232 and GPIB (optional)
- Complete free software package provided, including a turnkey PC software and NI Labview drivers

LabVIEW™

- High reliability and safety: no transient during source On/Off phase or mains connection, no line perturbation, safe stop on mains default...

Application examples

- Polarization of nanoscale, mesoscopic, nanotube, graphene, molecular, quantum devices …
- Small superconducting coil
- Ultra low level pressure and temperature sensors
- High end power supplies for electronic devices, communication devices, micro-wave devices, signal converters (ADC,DAC), imaging devices, etc…
- battery replacement for ultra-low noise application

Developped in partnership with the CNRS (french national centre for scientific research) and the LPA (Laboratoire Pierre Aigrain)

BE2100 module specifications

Programming and measurement accuracy

Range switching when the source is off, with automatic range selection capability.
Accuracy specified on a 18°C-28°C ambient temperature range, slow filter, after source warm-up (warm-up time 10min max, a SCPI command returns the temperature status of the source : “warming-up” or “ready”, the source can be started if not ready, consider then a slightly reduced absolute accuracy).

Range	Resolution	24-hour stability (1)	90-day accuracy (2)	1-year accuracy (2)	Temp. coefficient (3)
± 12V(4)	12µV	±20µV±7ppm	±30µV±100ppm	±60µV±150ppm	±0,3µV±0,7ppm
± 1,2V(4)	1,2µV	±5µV±7ppm	±8µV±100ppm	±15µV±150ppm	±0,1µV±0,7ppm
± 200mA(5)	200nA	±1µA±15ppm	±15µA±150ppm	±15µA±200ppm	±0,02µA±1,5ppm

(1) Relative to absolute accuracy, ±offset±ppm of setting/measurement, 18-28°C ambient temperature range
(2) ±offset±ppm of setting/measurement
(3) add the temperature coefficient outside the specified 18-28°C ambient temperature range, (±offset±ppm of setting/measurement)/°C
(4) programming and measurement accuracy are identical
(5) current measurement available on the BE2103 model only

Noise and settling time

Two output filters are user-selectable, slow or fast, each corresponding to a different small signal settling time. When the slowest settling time is chosen, the lowest output noise is obtained.

			Settling time(2)		Noise(4)			Voltage noise density	
Range	Resolution(1)	Filter	To 99%	To noise free accuracy(3)	0,1Hz-10Hz(5)	10Hz-10kHz	10Hz-100kHz	1kHz	10kHz
± 12V	12µV (±20 bits)	fast	<5ms	<10ms	6µV+2µV/V	80µVp-p	90µVp-p	90nV/√Hz	25nV/√Hz
		slow	<16ms	<100ms	6µV+2µV/V	25µVp-p	25µVp-p	15nV/√Hz	5nV/√Hz
± 1,2V	1,2µV (±20 bits)	fast	<5ms	<10ms	1µV+3µV/V	10µVp-p	13µVp-p	10nV/√Hz	6nV/√Hz
		slow	<16ms	<100ms	1µV+3µV/V	6µVp-p	9µVp-p	6nV/√Hz	5nV/√Hz

(1) measurement and settling resolution. ±20Bits <=> 21bits on the full bipolar range.
(2) guaranteed small step settling time (step amplitude≤10% of the range), with no output capacitor, resistive load, exponential waveform
(3) Settling to 21 bits in slow mode, to 18 bits in fast mode
(4) with no output decoupling capacitor, maximum peak-to-peak noise measured within the full voltage range, -3dB bandwidth. For RMS values, divide by 6,6 (white Gaussian noise)
(5) expressed in volt peak-to-peak, noise at 0V output + noise per volt applied

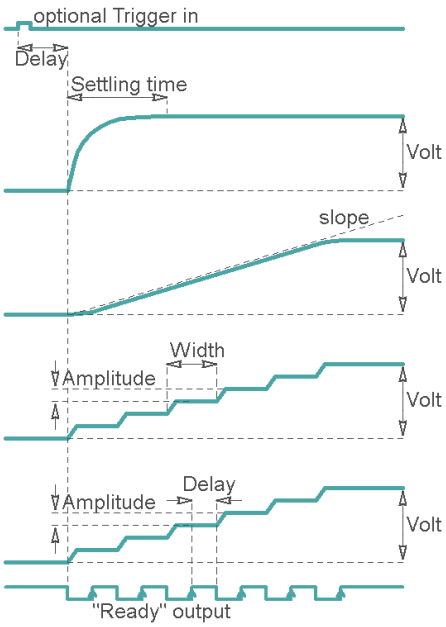
Operating area

Parameters	Conditions/Comments		Min.	Typ.	Max.
Voltage setup & measurement range	12V range		-12V		+12V
	1.2V range		-1.2V		+1.2V
Output current	guaranteed		-200mA		+200mA
Short circuit current	Indefinite short circuit duration			±250mA	
Output capacitor(1)	for stable operation and no overshoot(2)	Slow mode Fast mode	0µF 0µF		2200µF 47µF
Remote sense operating range	Max. voltage drop in the cable when sense connected, for proper operation		-0,2V		+0,2V
Output impedance	Sense not connected (internal mode)			20mΩ	
Insulation voltage(3)	Max. voltage between the earth and the source's negative terminal		-20V		20V
Operating temperature	Ambiant temperature in front of the chassis' rear fan openings		18°C		40°C

(1) connecting an output decoupling capacitor with reduce the noise bandwidth
(2) The voltage slope should be reduced to avoid any output voltage overshoot when asking for a significant voltage setting step and when using large capacitors, due to the 200mA output current limitation of the source. Simply apply the formula: $Slope < \frac{1}{4500.C}$ *, C in Farad, Slope in V/ms.*
(3) sources can be connected in serie to achieve higher voltage up to 24V

Sequential output control

The output voltage update can be performed in many ways, including the use of optional trigger input and delay functions:



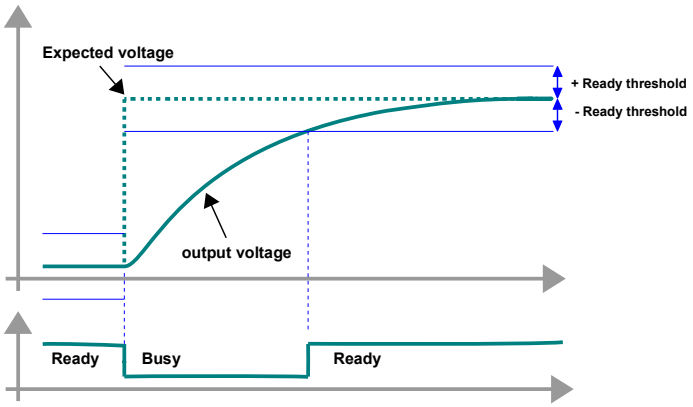
➔ single step with analog settling time
according to the internal filter (fast 10ms or slow 100ms)

➔ single step with voltage slope control
the slope value can be set down to 1,2µV / ms

➔ multi step voltage sweep
well suited for device characterization requiring linear sweep.

➔ smart synchronization
instead of using a constant duration step which has to comply with uncertain settling times or measurement times, smart synchronization allows to save time while improving reliability of the whole measurement process.

Whatever the chosen mode, a “Ready” output signal allows to optimize settling synchronization. “Ready” comparator tracks the gap between the expected voltage and the actual sensed voltage:



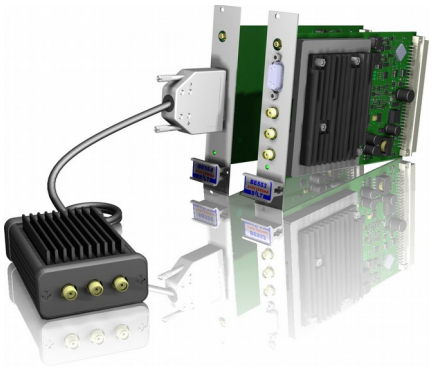
Following the actuation of a new voltage setting, it allows to trigger any measurement process as soon as the output settles within a requested amplitude.

The absolute threshold value of the comparator is to be set by the user, depending on the speed versus resolution compromise.

As the BE2100 source offers a true resolution of 21 bit, it is possible to set the threshold down to 1,2µV (using 1.2V range), and to know exactly when the output settles down to the guaranteed LSB.

BE2100 module specifications

Source models



Each BE2100 source is a single channel module to be plugged inside a Bilt chassis. Three different models using the same design are available:

- The standard models, BE2101 and BE2103, provide an isolated voltage source located inside the chassis. Sense connections will ensure long cable compensation. Unlike the BE2101, the BE2103 model is able to measure the output current.

- The remote model, BE2102, provides an isolated voltage source embedded inside a miniature case which can be located quite far from the chassis. This will maintain a very high isolation level for both DC and AC noise, between signal ground and the chassis ground. The source is delivered with a 4-meter robust shielded cable. No current measurement is available.
The case's overall dimensions are 130 x 80 x 37mm.

DC source features and protections

- ➔ The DC source output is regulated for constant sensed voltage operation
- ➔ An internal current limitation withstands indefinite overload conditions
- ➔ Sense connections with internal switch allowing to choose between internal or remote voltage sense operation
- ➔ Mains switching protection: When the source is OFF, an internal relay pulls the output down to the signal ground, avoiding any transient voltage when the chassis is powered up or down.
- ➔ Over Voltage Protection: When supplying a device requiring to keep apart from absolute voltage limits, it is possible to reduce the allowed output setting range and also the absolute working range of the internal power amplifier. Useful in case of wrong or missing sense connections.
- ➔ START and STOP synchronization: When using multiple sources, it is possible to delay the starting and the stopping of each source with respect to individual programmable delays.
- ➔ Emergency stop on alarms: internal temperature, remote probe unconnected, output short-circuit...

BE2100 module specifications

Revision History		
Rev	**Date**	**Changes**
...		
8	2015-01-07	
8.1	2016-01-25	
8.2	2020-02-17	

Standards, Calibration, Warranty and Maintenance

Bilt system is compliant with the applicable European Directives and holds the CE mark.
Any iTest product comes with a two-year parts and labour guarantee and a calibration certificate if applicable. A telephone support service is also available for the same period.
Our calibration laboratory performs according to ISO/CEI 17025 "*General requirements for the competence of testing and calibration laboratories*". All measurements are traceable to the International System of Unit.
The recommended calibration interval of this product is 1 year.
On request, Itest can proceed to scheduled calibration (in our workshop or at the customer's site).
Maintenance can also be performed on-site or in our workshop.

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