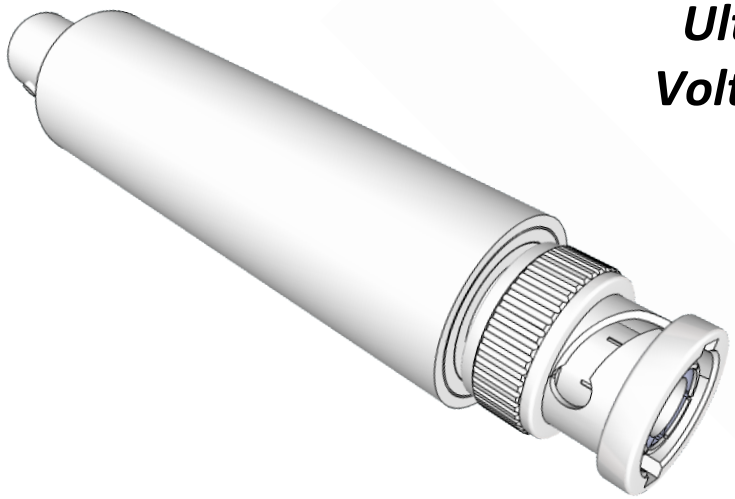
Entube-SE

Specification Sheet for Verivolt Ultra-Compact, Low-Cost Voltage Divider for Single-Ended Measurements



Overview

The Entube-SE is a voltage transducer designed for high quality single ended measurements in a very compact form factor, and without need for power supplies. This series covers the ranges of ±100V, ±200V, ±300V, ±400V, ±500V, ±750V, ±1000V, ±2000V, ±3000V, ±4000V and ±5000V, with up to 80kHz customizable bandwidth and 0.2% of signal accuracy.

The Entube-SE operates as voltage divider with an anti-aliasing filter at its output. It generates a ±5V or ±10V scaled down version of its input signal. This signal can then be processed by most computer based measurement platforms.

The Entube-SE series form factor allows for very high channel densities, while delivering high performance for a low cost. Please ask about OEM options.

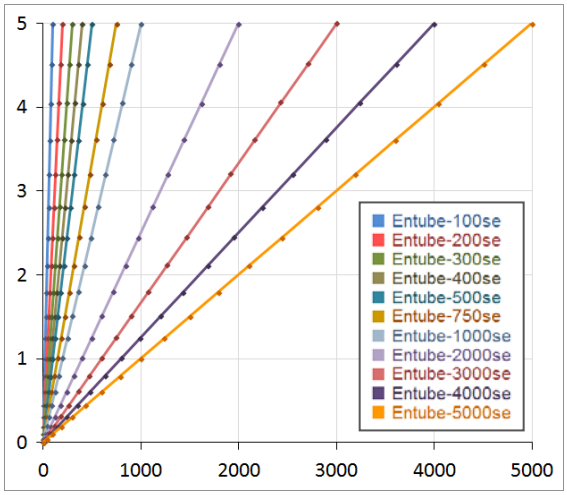
Applications

Verivolt Entube-SE is the ideal voltage sensing technology for the monitoring, characterization, fault detection and transient recording of medium voltage assets such as :

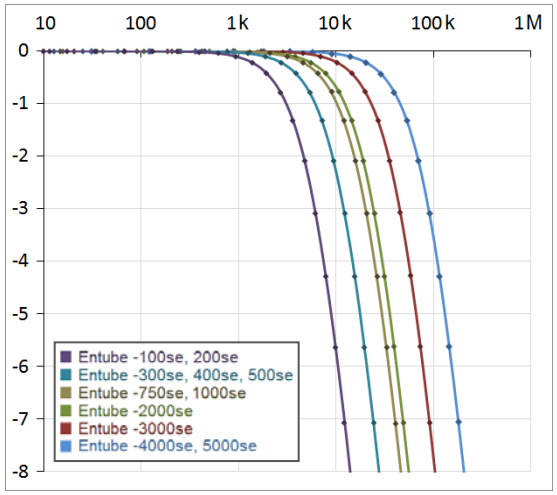
- Motors, Generators, Transformers, Inverters
- Power plants, Substations, Power distribution systems
- Railway transportation systems, Building power monitoring

Specifications

Electrical	
Accuracy	±0.2%
Bandwidth (-3dB point)	
Entube -100SE, -200SE	85kHz
Entube -300SE, -400SE, -500SE	45kHz
Entube -750SE, -1000SE	25kHz
Entube -2000SE	20kHz
Entube -3000SE	12kHz
Entube -4000SE, -5000SE	6kHz



Sensor Linearity V_{out} (V) vs. V_{in} (V)



Frequency Response (dB vs. Hz)

Integrated sensor noise (Referenced to input)	
Entube-100SE	< 30 µV
Entube-200SE	< 60 µV
Entube-300SE	< 100 µV
Entube-400SE	< 130 µV
Entube-500SE	< 170 µV
Entube-750SE	< 220 µV
Entube-1000SE	< 290 µV
Entube-2000SE	< 950 µV
Entube-3000SE	< 1.6 mV
Entube-4000SE	< 1.8 mV
Entube-5000SE	< 2.1 mV
Input-Output non-linearity	< 40 ppm
Output voltage	±10V or ±5V
Gain temperature drift	±25 ppm/°C
Max total phase shift at 60Hz	< 0.05°
Output type	Single-ended signal

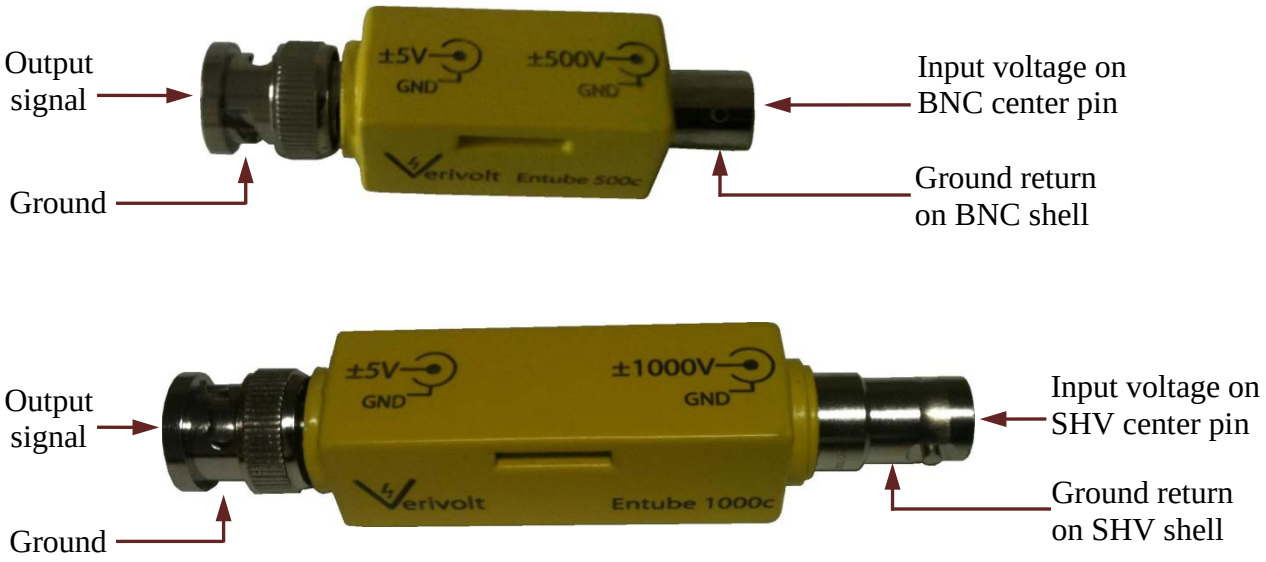
Gain (Using 5V standard output voltage and no load. See page 6)	
Entube-100SE	5/100 = 0.05
Entube-200SE	5/200 = 0.025
Entube-300SE	5/300 = 0.01666666
Entube-400SE	5/400 = 0.0125
Entube-500SE	5/500 = 0.01
Entube-750SE	5/750 = 0.00666666
Entube-1000SE	5/1000 = 0.005
Entube-2000SE	5/2000 = 0.0025
Entube-3000SE	5/3000 = 0.00166666
Entube-4000SE	5/4000 = 0.00125
Entube-5000SE	5/5000 = 0.001
Input dynamic range (Single-ended Voltage)	
Entube-100SE	100V
Entube-200SE	200V
Entube-300SE	300V
Entube-400SE	400V
Entube-500SE	500V
Entube-750SE	750V
Entube-1000SE	1000V
Entube-2000SE	2000V
Entube-3000SE	3000V
Entube-4000SE	4000V
Entube-5000SE	5000V
Input impedance	
Entube -100SE, -200SE	> 1 MΩ
Entube -300SE, -400SE, -500SE	> 2 MΩ
Entube -750SE, -1000SE	> 3 MΩ
Entube -2000SE	> 10 MΩ
Entube -3000SE	> 20 MΩ
Entube -4000SE, -5000SE	> 30 MΩ
Output Offset Voltage (Referenced to input)	< ±10μV
Mechanical	
Input connector	BNC or SHV
Output connector	BNC (plug)
Outer Dimensions (Refer to mechanical drawing for details)	0.68”x0.68”x2.5” BNC 0.68”x0.68”x3.5” SHV
Weight	34 g (1.2 oz)
Environmental	
Operating temperature	– 25 to 70 °C
Storage temperature	– 40 to 80 °C

Input and Output connectors

The input connector of the sensor is where the high voltage is applied. It is very important to have the polarity of the input signal connected in the way that is intended. The input connector is a jack BNC on the Entube-100SE, 200SE, 300SE, 400SE and 500SE., and a jack SHV for the models Entube-750SE, 1000SE, 2000SE, 3000SE, 4000SE and 5000SE.

All models of the Entube-SE series use a male BNC connector to output their signal. Recognize this connector by its free-moving shell and the ±5V or ±10V writing next to it.

The figure below illustrates the two form factors of the Entube-SE series. On the upper halve is an Entube-500SE, and on the lower halve an Entube-1000SE. Both types use a BNC plug as output (left side), and BNC or SHV jacks for their input (right side).



Connecting Ground

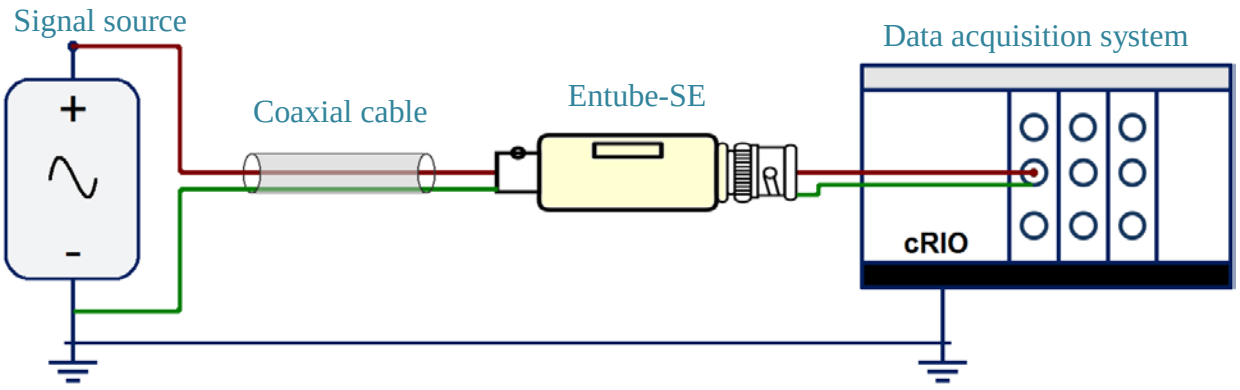
The shell of the input and output connectors should be connected to the ground of the system. This ground should be common between the data acquisition system and the voltage source. For safety reasons, it is important to connect both grounding points before applying any voltage at the input. This will assure that the sensor is grounded and not floating at high potential. Also, ground should be the first point to connect and the last point to disconnect from the sensor. For proper functioning, at least one of the two grounding points should be connected.

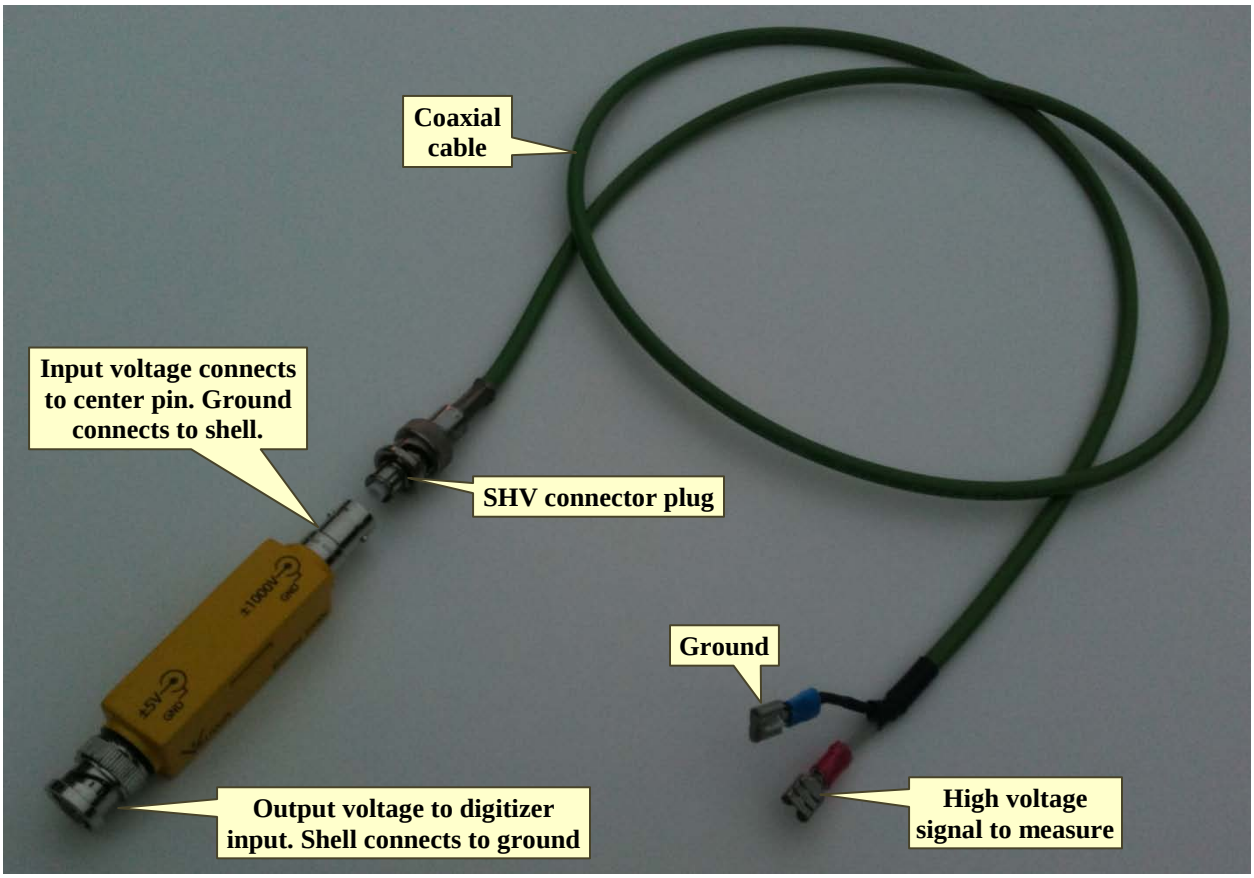
Due to the hazardous nature of high voltages, it is recommended to test your system at a low voltage, before running it at full capacity.

Connecting to the Signal Source and the Digitizer

The recommended system layout is a star configuration, with the input signal and the system ground routed to the input of the sensor through a coaxial cable. Connect the center conductor to the high voltage source terminal and the cable shield to ground. To minimize noise pick up select a ground point close to the signal source, but without compromising isolating distance.

The Entube-SE can then be connected straight into the input of a digitizer, or as an extension of a coaxial cable. In the case that the digitizer has screw terminal inputs, an adapter from BNC to flying leads can be purchased from Verivolt or from a third party supplier.





Compensating Sensor Gain for Digitizer Input Impedance

At the output of the Entube-SE there is a protection resistor that limits the amount of current that can flow out of the sensor. This resistor increases the output impedance of the sensor, but it is needed to protect the data acquisition card in case of a large surge on the voltage at the input of the sensor. As a result, if the input impedance of the data acquisition module is not very high, a small shift on the effective gain will occur.

The corrected scaling ratio (S) of the sensor is given by the following equation:

$$S = S_{Nominal} \cdot \left(1 + \frac{R_{Output\ Resistor}}{R_{Digitizer}}\right)$$

For example, the nominal scaling ratio of the Entube500c with output range of 5V is 100. The output impedance (protection resistance) of this sensor is 20kΩ, thus, the corrected scaling ratio for a digitizer with a 1MΩ input impedance is

$$S = 100 \cdot \left(1 + \frac{20k}{1M}\right) = 102$$

For a digitizer with 10MΩ input impedance this becomes

$$S = 100 \cdot \left(1 + \frac{20k}{10M}\right) = 100.2$$

For higher digitizer input impedance this effect might be considered too small and be ignored.

The table below summarizes the output impedance for every model, and the corrected scaling ratio for the three standard digitizer input impedances.

Model	Input : Output Voltage	Nominal Scaling Ratio	Scaling Ratio for 1MΩ DAQ	Scaling Ratio for 10MΩ DAQ	Scaling Ratio for 1GΩ DAQ
Entube-100SE-5	100 : 5	20	21	20.1	20.001
Entube-100SE-10	100 : 10	10	11	10.1	10.001
Entube-200SE-5	200 : 5	40	41	40.1	40.001
Entube-200SE-10	200 : 10	20	21	20.1	20.001
Entube-300SE-5	300 : 5	60	62	60.2	60.002
Entube-300SE-10	300 : 10	30	32	30.2	30.002
Entube-400SE-5	400 : 5	80	82	80.2	80.002
Entube-400SE-10	400 : 10	40	42	40.2	40.002
Entube-500SE-5	500 : 5	100	102	100.2	100.002
Entube-500SE-10	500 : 10	50	52	50.2	50.002
Entube-750SE-5	750 : 5	150	153	150.3	150.003
Entube-750SE-10	750 : 10	75	78	75.3	75.003
Entube-1000SE-5	1000 : 5	200	203	200.3	200.003
Entube-1000SE-10	1000 : 10	100	103	100.3	100.003
Entube-2000SE-5	2000 : 5	400	410	401	400.01
Entube-2000SE-10	2000 : 10	200	210	201	200.01

Entube-3000SE-5	3000 : 5	600	620	602	600.02
Entube-3000SE-10	3000 : 10	300	320	302	300.02
Entube-4000SE-5	4000 : 5	800	830	803	800.03
Entube-4000SE-10	4000 : 10	400	430	403	400.03
Entube-5000SE-5	5000 : 5	1000	1030	1003	1000.03
Entube-5000SE-10	5000 : 10	500	530	503	500.03

High Channel Density Arrangements

The compact form factor of the Entube-SE sensor makes it the ideal solution for high density applications. Verivolt offers a series of connectivity modules that interface the Verivolt sensors to several of National Instruments digitizers.

The figure on the right shows a connectivity board that can host up to 32 Entube-SE sensors and interface their output to the NI-9205 digitizer. This board can be purchased on wall mounted format, DIN rail mounted format, or encased for a 19” rack.

Please contact Verivolt for connectivity options.