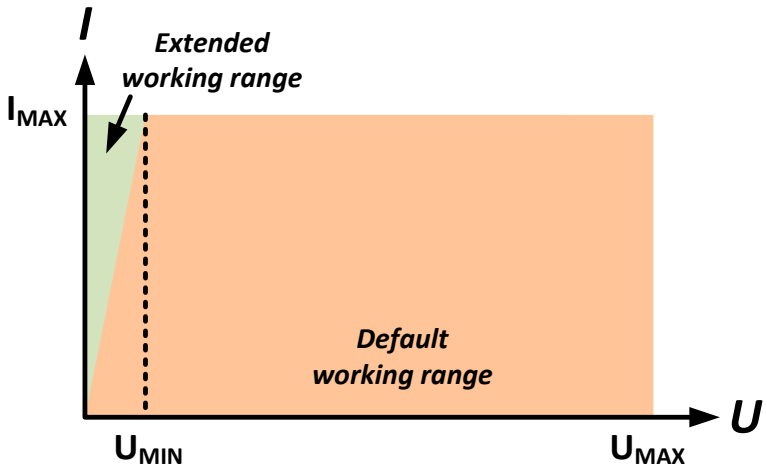
APPLICATION NOTE:
ZERO VOLT OPERATION WITH AN ELECTRONIC LOAD

Elektro-Automatik

1. Preamble

Due to the so-called R_{DS-ON} of field effect transistors (FET), electronic load have a specific and unavoidable minimum internal resistance which causes a certain minimum DC input voltage (U_{MIN}) in order for the load to be able to sink its full rated current. Below this minimum voltage the available current would decrease on a linear scale.

To operate an electronic load with its full current even below that U_{MIN}, a trick must be used which involves an auxiliary power supply device. This DC source helps to compensate U_{MIN}. It results in an bigger working range, as depicted in this principle view diagram:



2. Areas of application

- Tests of single battery cells, for example Lithium with 3.6 V
- Production end test of fuel cells
- Acquisition of voltage characteristics curves down to 0 V

3. Validity

The below described method of zero Volt operation and the related setup are valid for following device series of EA Elektro-Automatik:

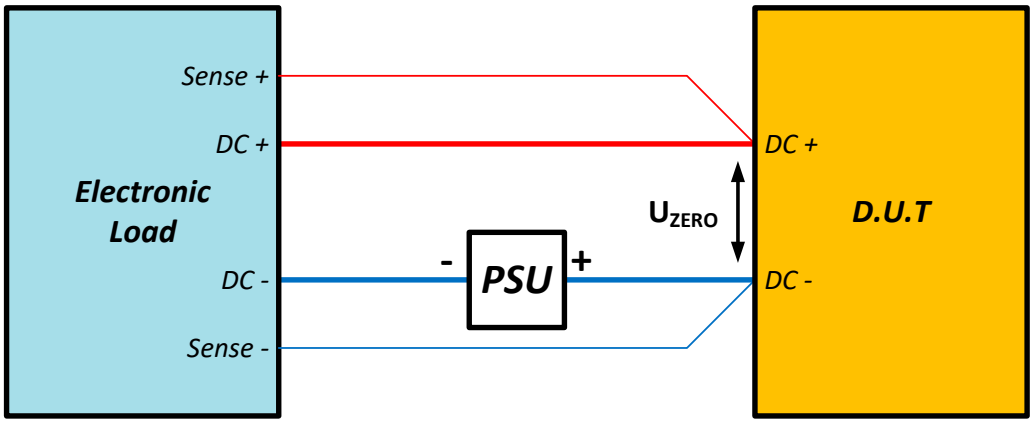
- PSB 9000
- PSB 10000
- ELR 10000

4. Auxiliary power supply requirements

The output voltage can either be fixed or variable, but must not be higher than 5% of the rated voltage of the PSB/ELR device. The typical working range for zero Volt is here still below the already low U_{MIN}, so the auxiliary power supply should be one with a low voltage rating or at least one that is very stable at low output voltage. It must also be capable of supplying the same or higher current than the D.U.T.

5. Test application setup

The auxiliary power supply (PSU, see schematic drawing below) is connected in series to the D.U.T in the negative DC line, as depicted below. The electronic load would by default show its own DC input voltage, which is higher than the one of the D. U. T. In order to accomplish that the load shows the D.U.T's voltage instead and also uses it for correct regulation in constant voltage and constant resistance mode, the remote sensing inputs of the load should be directly connected to the D.U.T's DC output. The power supply also serves as kind of a false polarity protection for the load.



6. Application example

A fuel cell shall be loaded until its output voltage collapses to almost zero. It's required that the electronic load's current capability is higher than that of the cell.

A PSB 9080-360 with 80 V rating, 360 A maximum current and 15 kW of power shall be the electronic load. The D.U.T is the fuel cell with its typically low output voltage of 0.5...1 V. Without the help of further equipment, this PSB 9000 model would require at least 1.1 V of DC input voltage to be able to draw the full 360 A. The D.U.T voltage is unfortunately below that minimum.

It suffices to adjust the auxiliary power supply (PSU) to 2 or 3 V. The electronic load would be adjusted to 0 V, full power and any start current which is low enough to load the fuel cell only as much so it can maintain its regular output voltage. The auxiliary power supply would furthermore be adjusted to 360 A or higher, in case it has an adjustable current limit. After switching the DC output of the auxiliary power supply and the DC input of the load on, the electronic load would draw the adjusted start current. After this the current of the electronic load could be gradually increased while watching the cell's output voltage sink down to zero Volt. The electronic load should then change into CV mode. At this point the current capability of the cell at zero Volt is determined.

The load would show the cell voltage on its display as actual voltage, with a resolution of 10 mV for this model and including a tolerance of ≤0.1%[1] (PSB 9000 series devices) of 80 V, which is max. 80 mV . This means, that the cell voltage could be shown as „0 V" while it probably would never reach exact 0 V. It could also be vice versa, when the cell voltage is actually already down to a few millivolts while still being displayed with a much higher value. Thus, when working in the range below 80 mV, the actual voltage display of the PSB wouldn't be precise enough anymore and the use of an external voltage multimeter would be highly recommended.

1 Valid for PSB 9000 series devices. Models from series PSB 10000 and ELR 10000 have a 0.05% voltage tolerance.

Elektro-Automatik

support@elektroautomatik.com
www.elektroautomatik.com
+49 (02162) 3785-0