APPLICATION NOTE:
TWO-QUADRANTS PRINCIPLE

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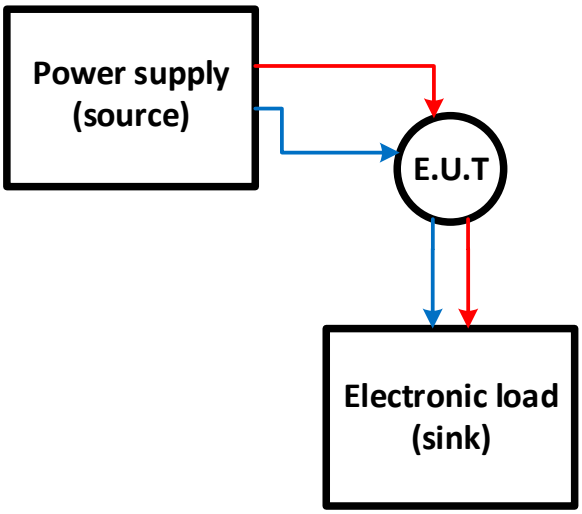
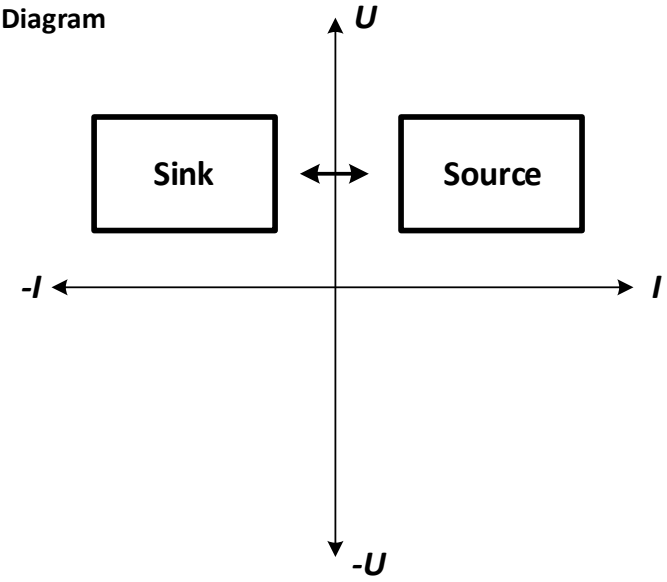
Two-quadrants operation (2QO) aka source-sink principle

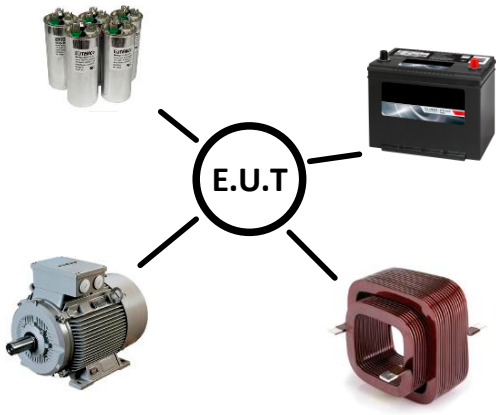
Basic connection scheme



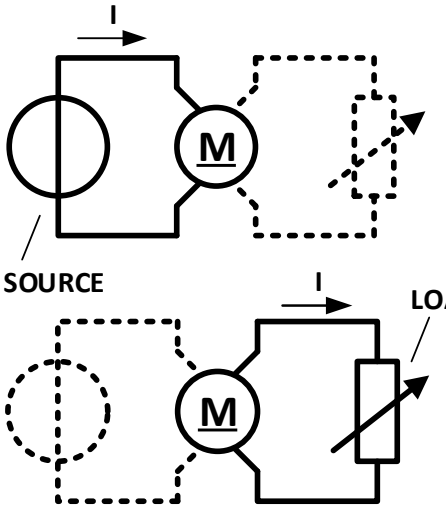
Diagram



Typical components for 2QO testing



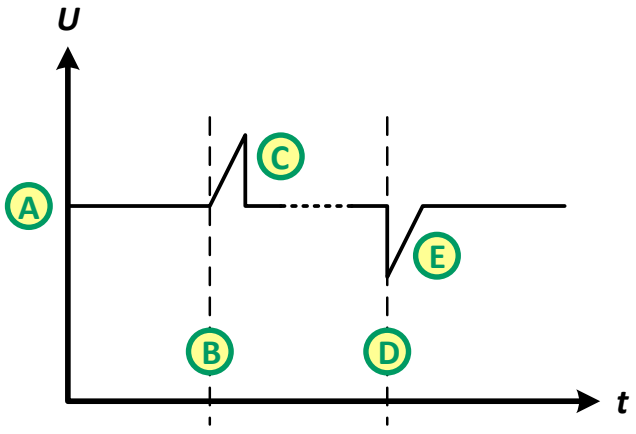
Method



E.U.T is a motor. The motor is running under test by supplying voltage and current to the E.U.T.

When switching off the power supply, the motor will regenerate excessive energy which is consumed by the load to clip the voltage

Visualisation of voltage at switchover of source to sink (example: motor)



(A) Voltage of the E.U.T while the source is active

(B) Point of switching the source off -> the motor breaks and starts to generate excessive energy.

(C) Voltage peak of regeneration before the sink (electronic load) kicks in. Transient time: < 10 ms, typical 5 ms

(D) Point of powering the motor again -> it accelerates

(E) Voltage drops for a short moment, until compensated by the source (transient time: <2 ms)

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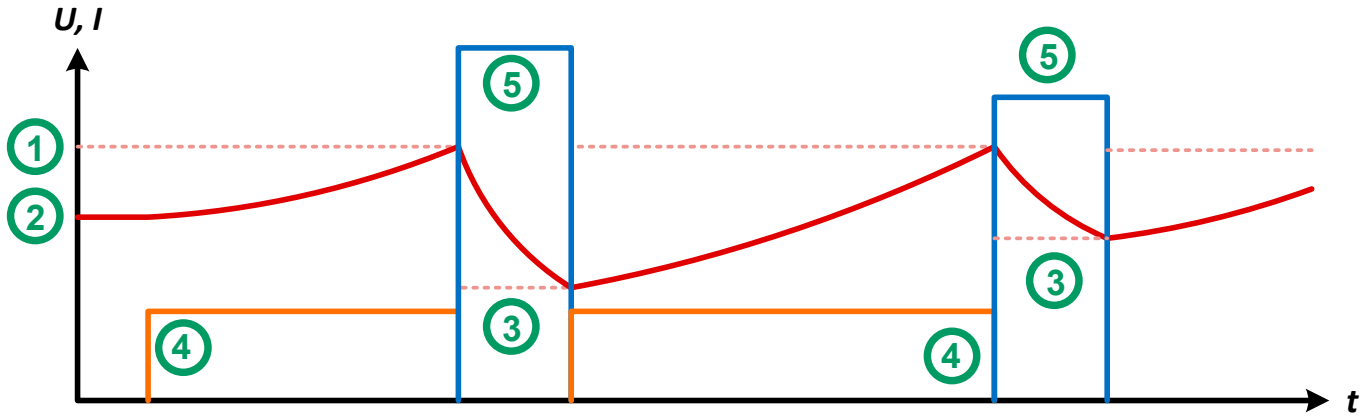
Voltage and current progression over time (example with battery)



(1) Voltage setting of source (power supply) for charging the battery (e.g. 27 V). The source charges the battery with a constant current until the max. voltage is reached and the current is almost zero.
(2) Battery & charging voltage. At the start, the battery has normal charge. During discharge phase the voltage can go down to the any given level.
(3) Voltage setting of sink (electronic load), as defined by the power supply via Share bus and thus identical to (1). It is used to discharge the battery to a certain level, e.g. 20 V
(4) Charging current
(5) Discharging current

Equipment

There is basically one question: What devices to buy for a 2QO system? Two options: either a bidirectional supply or a combination of a power supply and an electronic load. Both have advantages and disadvantages.

Combination of power supply & electronic load:
+ Seperate units, which can also be used for other purposes in different locations
+ Extendable
+ Source and sink power can be matched by selecting the proper models
- More expensive

Bidirectional supply
+ More cost effective, because less components
- Less power
- Sink power usually lower than source power
- More complicated construction, more susceptible to defects

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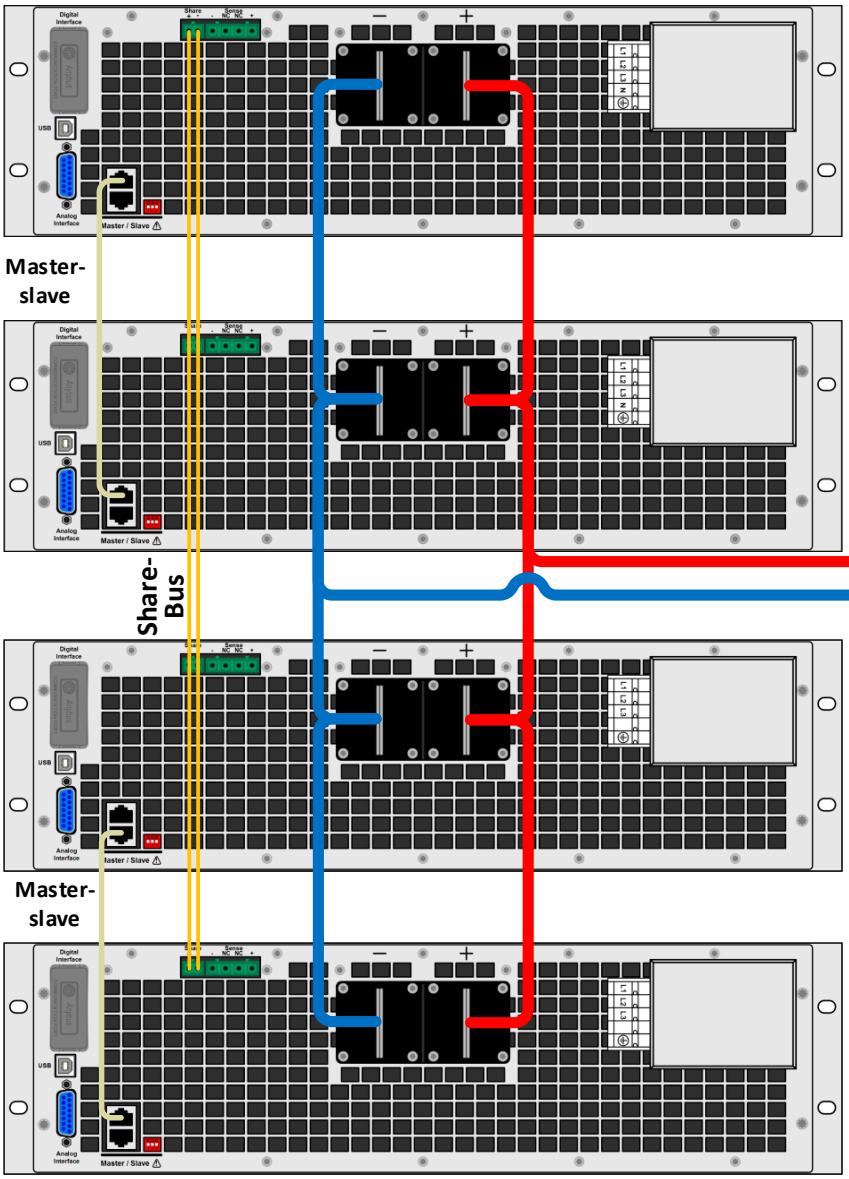
Example wiring for 2QO with ELR 9000 and PSI 9000, each as two unit master-slave system



Sink system (electronic loads ELR 9000)
Will discharge the battery (example: 24V lead-acid) down to a user-defined level (CV mode, voltage setting, for example 20 V / 100 A).
Share bus is used for voltage control. The PSI is in charge on the bus, the load is either only run in CV mode or also switched off on its DC input.
The electronic load can be run in master-slave mode to extend power.

Source system (power supplies PSI 9000)
Will charge the battery (example: 24V lead-acid) up to a user-defined level (CC mode, current/voltage setting, for example 27 V).
Share bus is used for switchover.
In order to initiate the switchover to the load, the power supply is either switched off on its DC output or the voltage is turned down.
The power supply can be run in master-slave mode to extend power.

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