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# Power Engineering | Smart Grid | Micro Grid

**Training systems on the generation, distribution and management of electrical energy:**

- Power engineering training system, distribution training system
- Energy generation training system, renewable energy generation training system
- Transformer training system, high-voltage transmission lines training system, protective systems training system
- Energy management training system, smart grid training systems

The Lucas-Nülle training systems have been designed in anticipation of the newest developments:

- Smart measuring instruments provided with various communication interfaces (e.g. LAN, RS485, USB) and control elements
- SCADA Power Engineering Lab software for the intelligent control and evaluation of "smart grids" using Soft PLC
- SCADA software designed for educational purposes
- Permits investigation of dynamically alternating loads and power generation inside the laboratory
- Intelligent energy management
- Modular integration of renewable energies into a smart grid using protective engineering
- Wind power plant with doubly-fed asynchronous generator (DFIG) and synchronisation to the grid
- Interactive multimedia training course

# "Smart Grids" - Intelligent power supply networks

**"Smart Grids" - Intelligent power supply networks**

In the future, new technology will better equip power grids for the demands of tomorrow. More flexible grid management should make the increasing proportion of renewable energy sources compatible with conventional infrastructures associated with power stations. The variety and number of these decentralised power plants require a revision in how we manage power grids – so-called intelligent networks or "smart grids":

- Improved coordination of energy requirements and energy generation, e.g. via intelligent switching of loads depending on the energy available
- Using modern IT technology, like the internet, sensors, control systems and wireless transmission devices
- "Smart metering" – digital current meters measure electricity consumption where customers are connected to the grid
- Shifting household consumption away from peak load periods
- Starting flexible applications such as washing machines outside peak load periods, at the initiation of a utility provider

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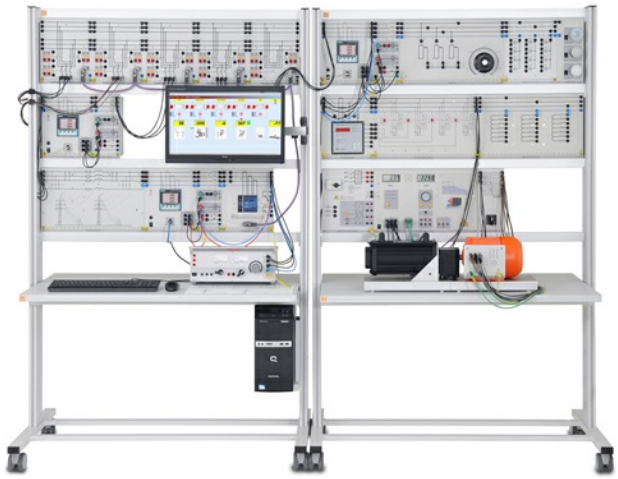
- Interactive multimedia training course

**Training system on the generation, transmission, distribution, protection and management of electrical energy:**

- Energy management, smart grid training system
- Energy generation, regenerative energy generation
- High-voltage transmission lines, protective systems

# ESG 1 Smart Grid Trainer

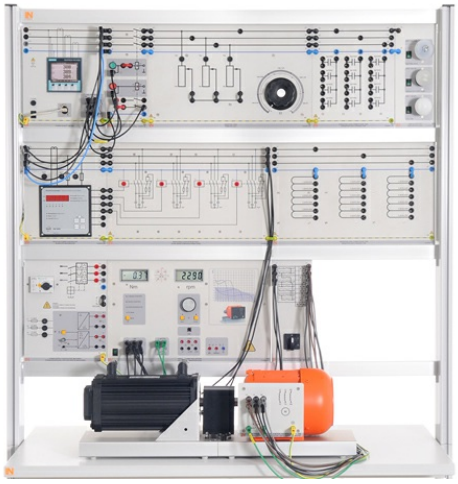


**ESG 1 Smart Grid Trainer**

# ESG 1.2  Complex loads, power consumption measurement and peak load monitoring

**ESG 1.2  Complex loads, power consumption measurement and peak load monitoring**

## Training contents:



Training contents:

- Three-phase consumers with star and delta connections (R, L, C, RL, RC and RLC loads)
- Measurement with active and reactive energy meters:

- for symmetric and asymmetric RL loads

- in the event of a phase failure

- in the event of over-compensation (RC load)

- for active loads

- in the event of energy-flow reversal

- Determination of the first and second power maxima
- Determination of the power maximum in the event of an asymmetric load
- Recording of load profiles

**Dynamic loads**

Training contents:

- Dynamic, three-phase load (asynchronous motor)
- Power measurement in the case of energy-flow reversal

**Manual and automatic compensation of reactive power**

Training contents:

- Operating an asynchronous machine and recording its characteristic parameters
- Calculating parameters for compensation capacitors
- Compensation using various capacitors
- Determining stage power
- Manual compensation of reactive power
- Automatic identification of a reactive power controller‘s connections
- Automatic compensation of reactive power

## Equipment set comprising the following:

| Pos. | Product name | Bestell-Nr. | Anz. |
|---|---|---|---|
| 1 | **Lamp board 230V** | CO3208-1L | 1 |
| 2 | **Inductive load, three-phase, 1kW** | CO3301-3D | 1 |
| 3 | **Capacitive load, three-phase, 1kW** | CO3301-3E | 1 |

| | | | |
|---|---|---|---|
| 4 | **Variable Ohmic load, three-phase, 1kW** | CO3301-3F | 1 |
| 5 | **Three-phase asynchronous motor, squirrel-cage, 1 kW,, 690/400 V** | SE2683-1R | 1 |
| 6 | **Star-Delta switch** | CO3212-2D | 1 |
| 7 | **Reactive power controller** | CO3301-5C | 1 |
| 8 | **Switchable Capacitor Battery** | CO3301-5E | 1 |

## Additionally required, dynamic servo machine test stand:

| Pos. | Product name | Bestell-Nr. | Anz. |
|---|---|---|---|
| 9 | **Servo machine test stand for 1kW machines incl. software ActiveServo (D,GB,F,E)** | CO3636-6Y | 1 |
| 10 | **Rubber coupling sleeve, 1kW** | SE2662-6A | 1 |
| 11 | **Coupling guard 1 kW with LED lighting** | SE2662-7D | 1 |

## Power supply:

| Pos. | Product name | Bestell-Nr. | Anz. |
|---|---|---|---|
| 12 | **Three-phase supply for electrical machines** | CO3212-5V | 1 |
| 13 | **Motor protection switch, 3 pole, 1.8-2.5A** | CO3212-1P | 1 |
| 14 | **Power switch module** | CO3301-5P | 2 |
| 15 | **Multiple socket outlet, 6 fold, with illuminated switch** | ST8010-4J | 1 |

## Measuring instruments:

| Pos. | Product name | Bestell-Nr. | Anz. |
|---|---|---|---|
| 16 | **Three-phase power quality meter, display and long-term memory** | CO5127-1S | 1 |

## Media:

| Pos. | Product name | Bestell-Nr. | Anz. |
|---|---|---|---|
| 17 | **Interactive Lab Assistant: Energy management** | SO2800-3Y | 1 |
| 18 | **Interactive Lab Assistant: Asynchronous machines 1 kW** | SO2805-2C | 1 |

## Accessories:

| Pos. | Product name | Bestell-Nr. | Anz. |
|---|---|---|---|
| 19 | **Patch cable Cat5E 1x 1 m yellow, 2x 2 m yellow** | LM9057 | 1 |
| 20 | **USB 2.0 Ethernet adapter, 10/100** | LM8257 | 1 |
| 21 | **5-Port Ethernet Switch** | LM9988 | 1 |
| 22 | **Safety connecting plug 4mm with tap (2x), black, 1000V/32A CAT II** | SO5126-3R | 40 |
| 23 | **Safety connecting plug 4mm with tap (2x), blue, 1000V/32A CAT II** | SO5126-3V | 5 |
| 24 | **Safety connecting plug 4mm with tap (2x), gr/ye, 1000V/32A CAT II** | SO5126-3W | 5 |
| 25 | **Set of safety measurement cables, 4mm (31 leads)** | SO5148-1L | 1 |
| 26 | **Set of 4 safety measurement leads, 4 mm, length 10m, includes fastening set** | SO5148-1Z | 1 |
| 27 | **Mobile aluminum experiment stand, 3 levels, power strip with 6 sockets, 49"x28"x79" WxDxH (1250x700x1995mm)** | ST7200-4C | 1 |
| 28 | **Protected power distribution for working stations** | ST8008-8N | 1 |

## Additionally recommended:

| Pos. | Product name | Bestell-Nr. | Anz. |
|---|---|---|---|
| 29 | **Display for Energy Management equipment** | CO3301-7C | 1 |
| 30 | **Monitor holder for flat screen monitor of weight up to 15kg / 33lbs** | ST8010-4T | 1 |
| 31 | **Keyboard adapter for flat screen monitor holders** | ST8010-4G | 1 |
| 32 | **Protection cover for three-level experiment trolleys** | ST8010-9Y | 1 |