

Power Electronics and Drive Technology

Line and self-commutated converter technology

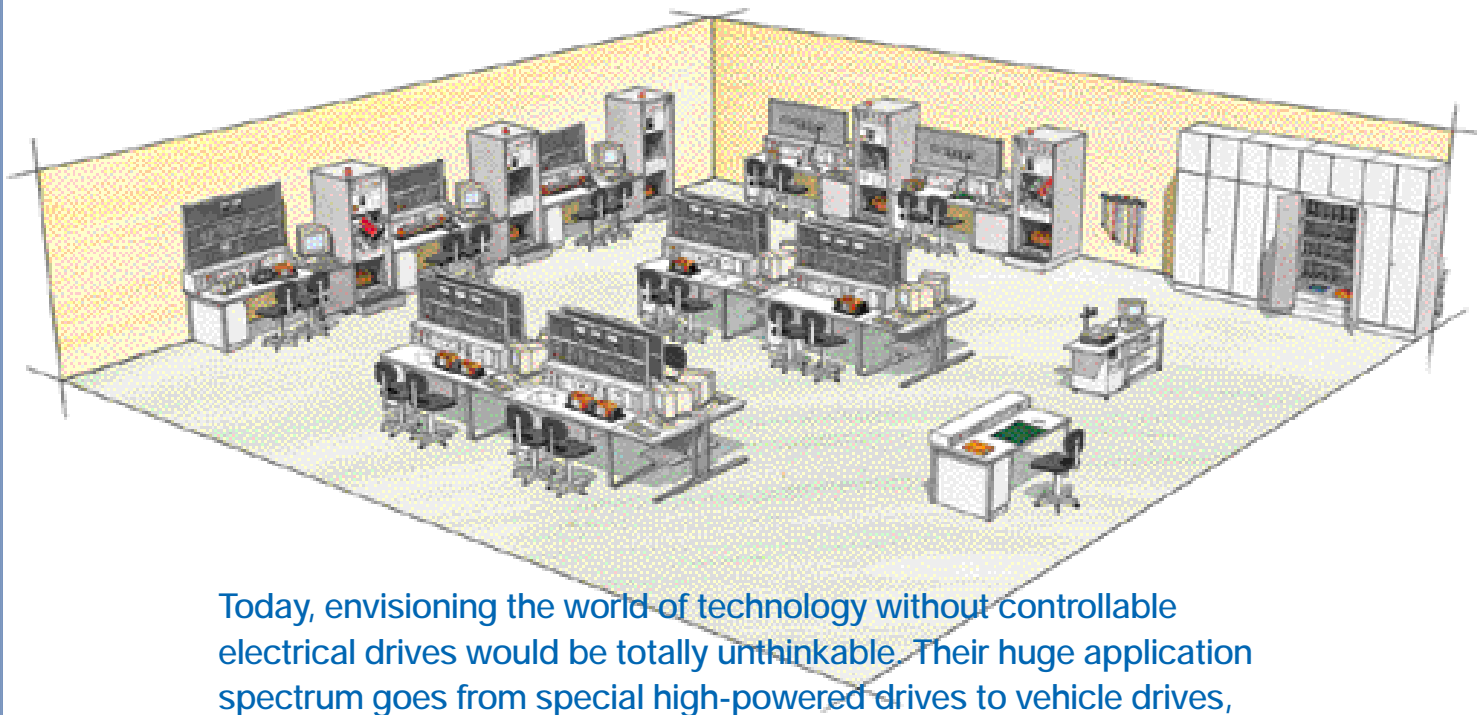


The pioneering, computer-based training system
for hands-on vocational training

EPE 10-27

Power electronics is the technology of switching and converting high levels of electrical power. Today, this is performed by power semi-conductors like diodes, thyristors and IGBTs. Continuous advances in power semiconductors and the microelectronics needed for their control have made power electronics one of the most innovative and fastest paced areas in electrical engineering and electronics.

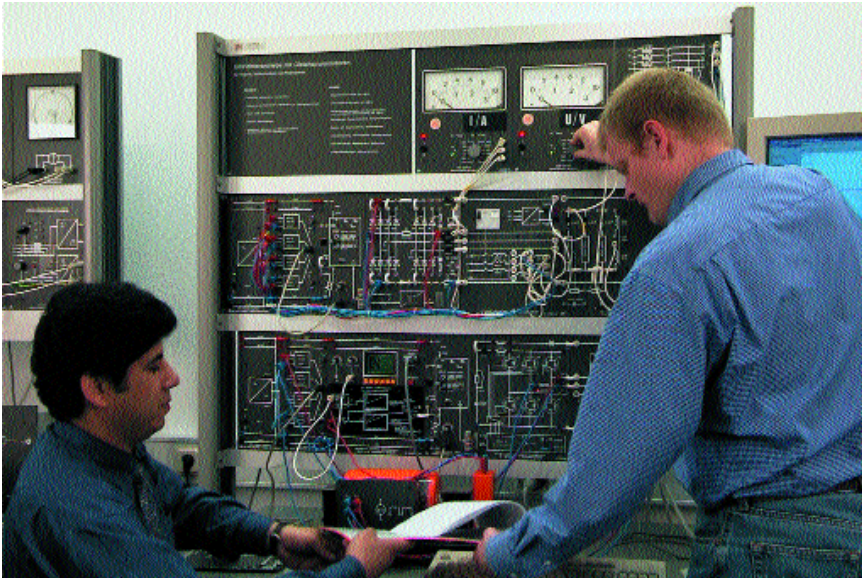
Drive technology is the primary area of application for power electronics. This area is also experiencing rapid advances.



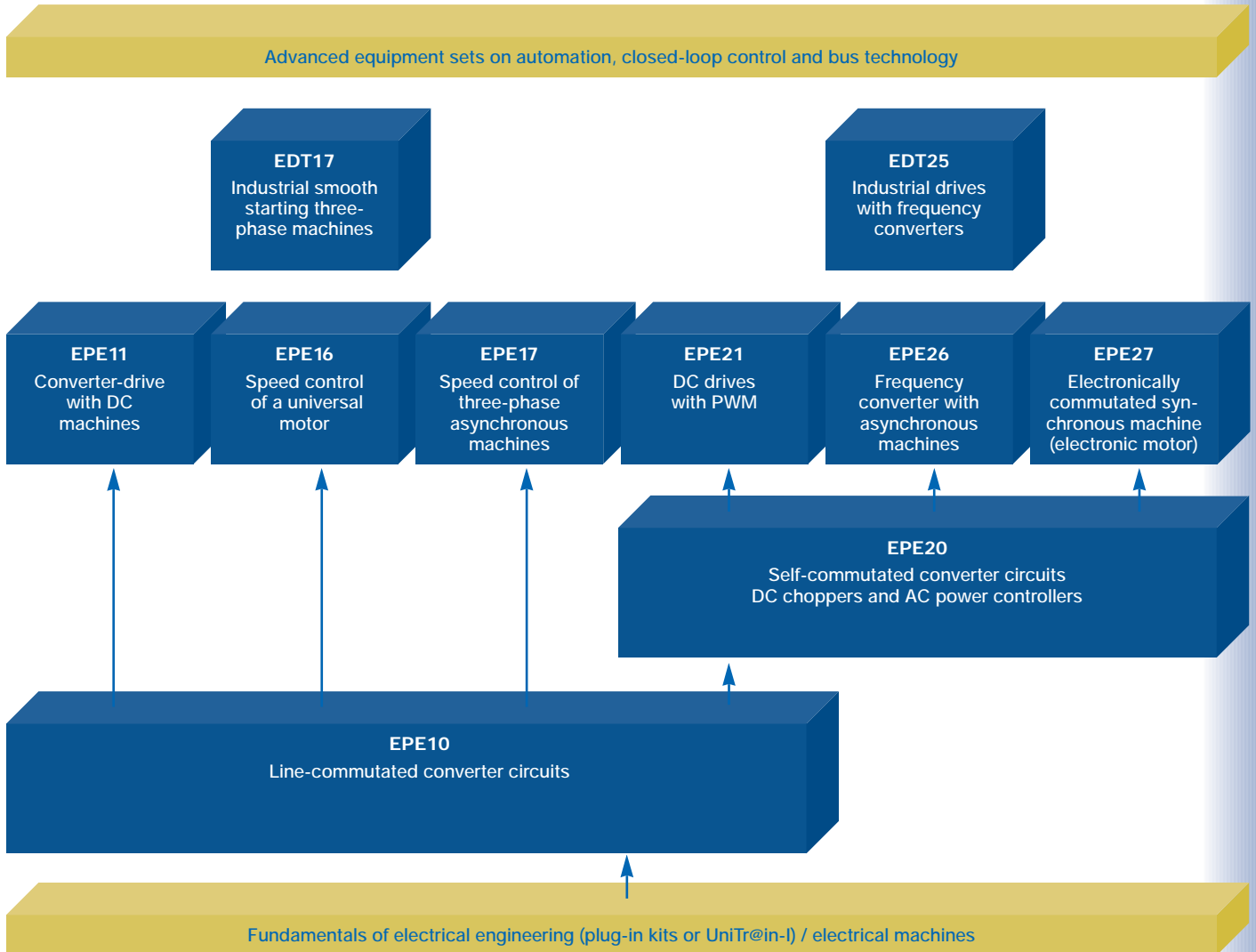
Today, envisioning the world of technology without controllable electrical drives would be totally unthinkable. Their huge application spectrum goes from special high-powered drives to vehicle drives, tooling and production machines and includes household appliances, office machines and applications in automotive technology. Besides electrical machines it is power electronics in connection with automation, automatic control and bus technology which are increasingly having an impact on the performance and potential of drive technology.

Our training system is keeping pace

The modular training systems EPE10 to EPE27 accompany you from basic static converter technology up to variable-speed drives and offer you the possibility of strategically dealing with relevant topics. The modular approach to our system and its systematic support using software make system updates, supplements or technological extensions child's play.



Student experiments broaden and deepen theoretical knowledge and lead to practical skills and competence



Building on the basic knowledge acquired in the areas of *Fundamentals of Electrical Engineering and Electrical Machines* the basics of drive technology can be explored using the power electronics equipment sets while even more advanced equipment sets can be found in *Industrial Drive Technology*.

Compact but modular

The system focuses on the essentials without limiting experiment potential. A modular extension permits the system to be expanded to include closed-loop controlled drives.

Fast

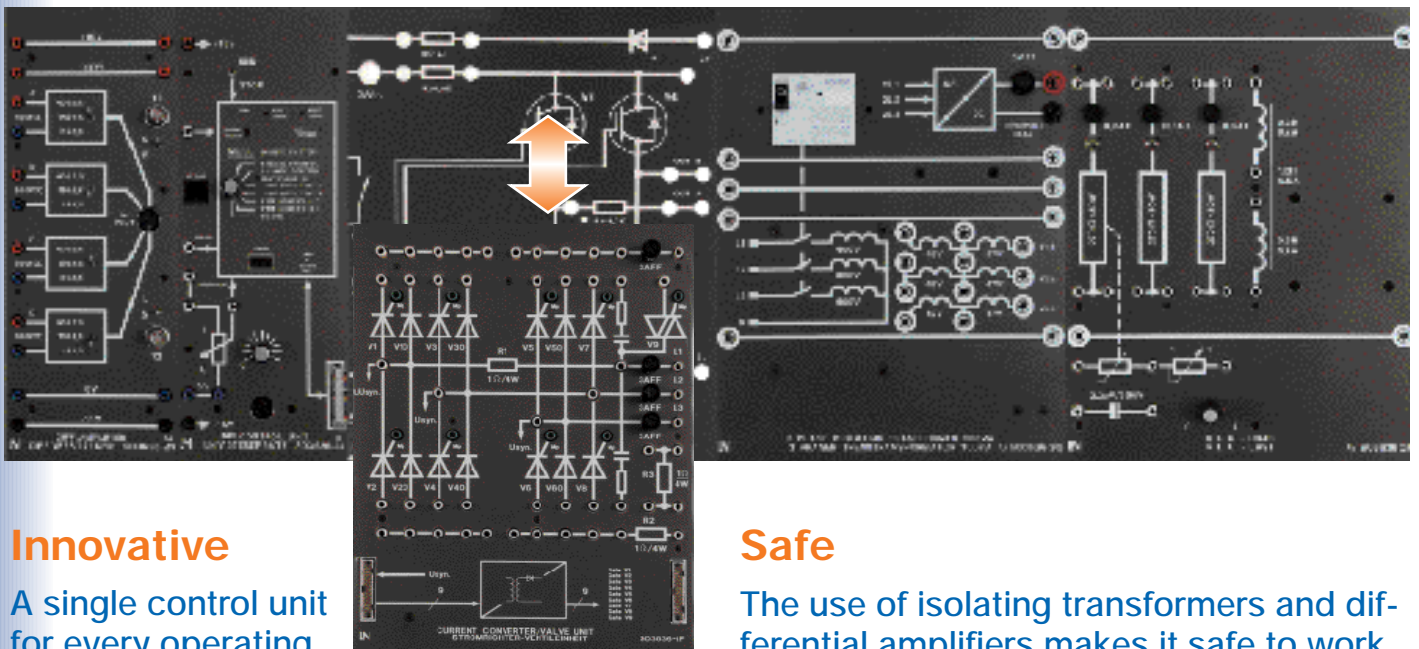
The shortest possible setup times and low error rates are the result of compact design, simple wiring and easy settings.

Designed for hands-on practice

The clear structure of the system guarantees that the application circuits can be dealt with in a didactic fashion.

Computer-based

The control unit communicates with a computer via the RS232 port. The specially-designed didactic software makes measuring and experimenting fun.



Innovative

A single control unit for every operating mode - that is only possible with micro-processor technology. A PC interface goes without saying.

Safe

The use of isolating transformers and differential amplifiers makes it safe to work with dangerous voltages. The control unit has an integrated fault diagnosis system.

Power electronics

Including more than 20 different line-commutated and five different self-commutated converter circuits, a universal RLC load, a control unit with more than ten set or reloadable operating modes.

Economic and continuously upgradeable

A few modules is all it takes to create a complex, extendable training system.

Drive technology

In combination with a controller and machines of the 0.3 kW class it is possible to assemble complete DC/AC and 3-phase drives.

Training contents EPE10: Line-commutated static converter circuits

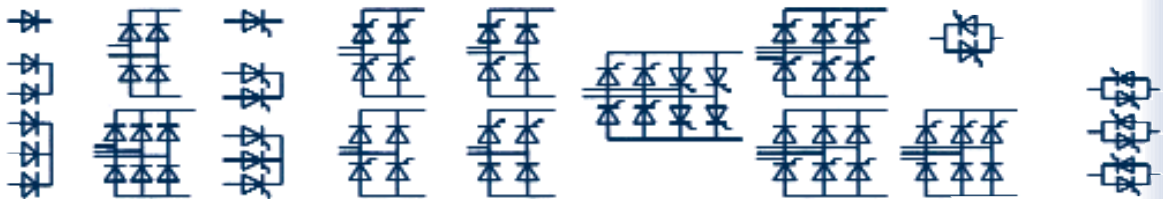
Fundamentals

Valves: diodes, thyristors, triacs; suppressor circuits, measurement techniques, rectification, resistive, capacitive and inductive loads
Control characteristics and operating graphs
Frequency analysis and examining harmonics

Control principles

Phase angle control, full-wave control, pulse group control, chopper control, rectifier operation, inverter operation, four-quadrant mode

Circuits



It is the special didactic software used in the experiment which truly makes the hardware into a complete training system.

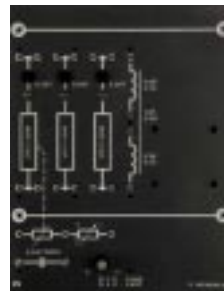
- Setting parameters and controlling the hardware, modulation
- Measurement and documentation of experiment results
- Visualization of technical interrelationships and technologies
- Time domain, frequency domain, vector representation, block circuit diagrams

System components EPE10: Line-commutated converter circuits



SO3636-1A Digital Universal Control Unit with integrated micro-processor control for line- and self-commutated converters for the assembly of DC, AC and three-phase AC power controllers including:

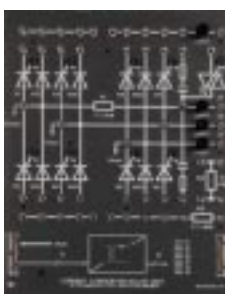
- Phase angle control
- Pulse group control
- Pulse-width modulation
- Modulation of 1- and 3-phase



SO3636-2A RLC load

- with 3 x 270 Ω resistors and 3 indicator lamps which can be switched in delta, star, serial and parallel connection,
- an inductor with center tap
- and a capacitor.

The resistors are coupled with a temperature sensor for the construction of temperature control loops.

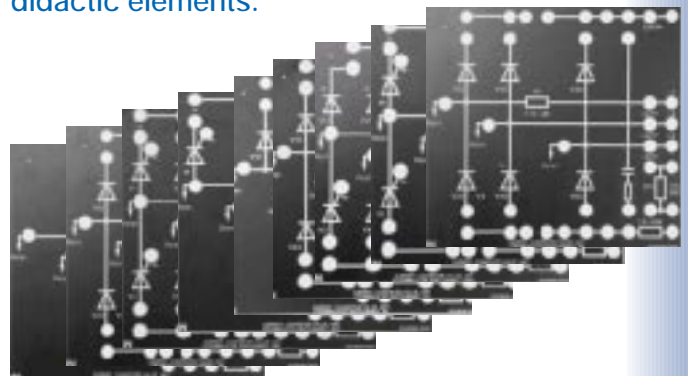


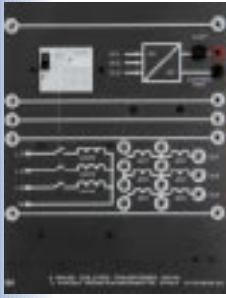
SO3636-1F Compact, universal static converters for all conventional converter circuits. Including 15 thyristors / diodes / triacs each with electrical isolation, measurement resistors, suppressor circuit, fuses and connection to the control unit via ribbon cable.

Feed: 0 to 230 V AC
Output current: 0 to 4 A

SO3636-1G Set of overlay masks (9 each)

Limits the universal converter to essential didactic elements.





SO3636-2G

3-phase transformer

Used for the power supply of all power electronic experiments using a safe mains isolated voltage. The secondary windings can be operated in star or delta connection as desired. A B6 rectifier generates a DC voltage with low ripple for the supply of a DC link or for excitation of DC machines. The transformer is thermally protected, while the rectifier is protected by a fast-blowing fuse.

generates a DC voltage with low ripple for the supply of a DC link or for excitation of DC machines. The transformer is thermally protected, while the rectifier is protected by a fast-blowing fuse.



SO3636-2V

Differential measurement amplifier

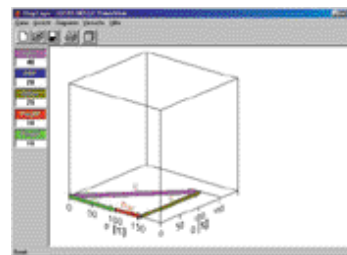
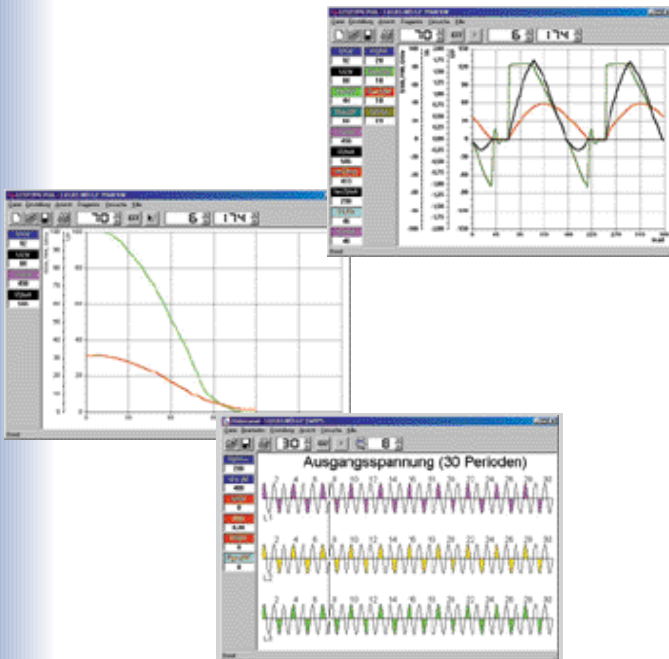
For a safe potential-free measurement of up to four contact hazardous voltages, for connection to the universal control unit and/or oscilloscope.

SO6006-1A Power Electronics

With the basic programs PHACON, SWIPS, PWM; control unit parameter setting, signal curves, control characteristics, rms values and much more in the areas of phase angle control, pulse group control, pulse width modulation

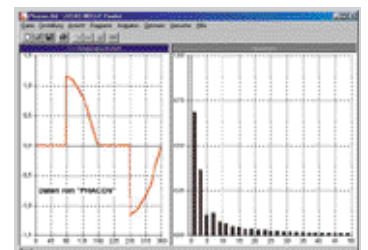
SO6006-1K PowerView Software

For three dimensional vectorial representation of the input and output power. Display of DC and AC components of the active, reactive and apparent power as numerical values in the display instruments.



SO6006-1H Fourier analysis/synthesis with DDE

Carries out analysis in the frequency domain, for example, on the curves measured and saved with PHACON, compiles spectral components into curves using animated graphics



Training contents EPE20: Self-commutated converter circuits

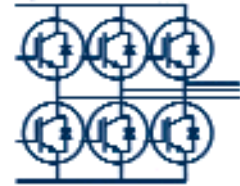
Fundamentals:

IGBT, suppressor circuit, link circuit, measurement technology, circuit concepts, free-wheeling diode, resistive, capacitive and inductive loads, Control characteristics and operating diagrams with reference limits, clock frequency, ripple, frequency analysis and harmonic analysis

Control principles

Pulse width modulation
DC controller operating in 1, 2 and 4 quadrant
Modulation of low-frequency AC voltage with pulse width modulation

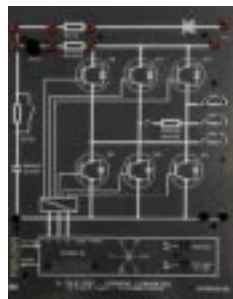
Circuits



System components EPE20: self-commutated converter circuits

Supplement to EPE10

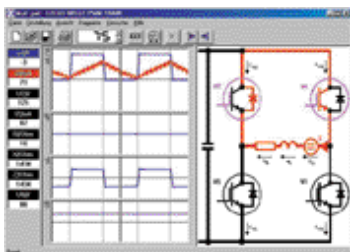
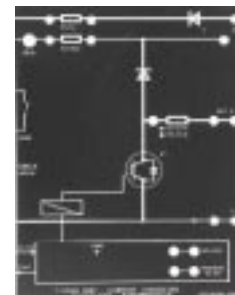
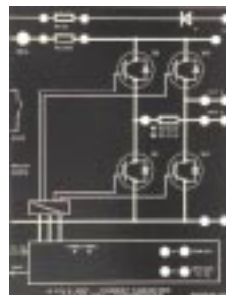
SO3636-1R 6-fold IGBT converter for the assembly of DC chopper controllers, used to generate AC and three-phase current at any given active and passive loads. Use as frequency converter-inverter, electronic commutator for load-commutated drives.



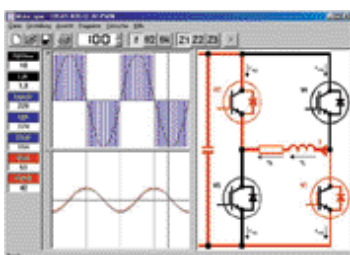
Feed: 0 up to 320 V DC
Output voltage: 0 up to 300 V
Output current: 0 up to 3 A
Control inputs via ribbon cable connection.
Rotor position encoder input,
9 measurement points for control signals, 3 current measurement resistors, electrical isolation using optocoupler

SO3636-1S Set of overlay masks (2 each)

Limits the universal converter to essential didactic elements



SO6006-1E Software PWM TRAIN to set the control unit parameters, for the measurement and display of the time characteristics of voltage and current in all of the valves and the load. With the animated circuit diagram for the display of active valves, current and free-wheeling arms. Measurement of control characteristics, rms values and much, much more.



SO6006-1P AC-PWM Software

For the graphic display of single-phase AC voltage generated with the aid of pulse width modulation and thereby demonstrating the operating principle of frequency converters. Also includes the investigation of modulation and the influence of the clock frequency and load circuit parameters.

Introducing modular drive technology

The static converter equipment sets EPE10 and EPE20 can be extended into static converter drives with the minimum of effort - simply by supplementing them with the corresponding electrical machine. Using a digital controller this system becomes a closed-loop-controlled drive. To investigate the response of drives under load in 4-quadrant mode it is necessary to use a servo brake/servo drive.

It is the special didactic software used in the experiment which truly makes the closed-loop controlled drive system into a complete training system.

- Setting hardware parameters
- Control and modulation
- Measurement and documentation of experiment results
- Visualization of technical interrelationships and technologies



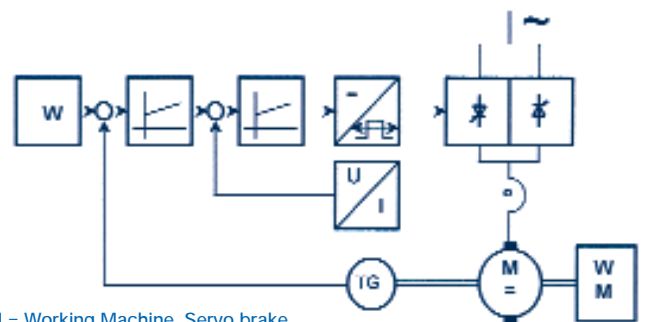
Training contents EPE11: Converter-drive with DC machines

- Open-loop speed control with one-way converter
- Open-loop speed control with two-way converter
- Four quadrant operation, energy recovery
- Closed-loop speed control, current control, cascade control, adaptive control
- Controlled system analysis, P-, PI-, PID control
- Optimization of controller parameters
- Automatic speed control in 1 to 4 quadrant operation with/without cascade current control

- 1 x SO6006-5J Software 4Q drive controller
- 1 x SO3620-1B Set of masks for digital controller
- 1 x Servo brake and drive system w. accessories

Supplement to EPE10:

- 1 x SE2662-3A DC shunt wound machine 0.3 kW
- 1 x SO3620-1A Digital universal controller



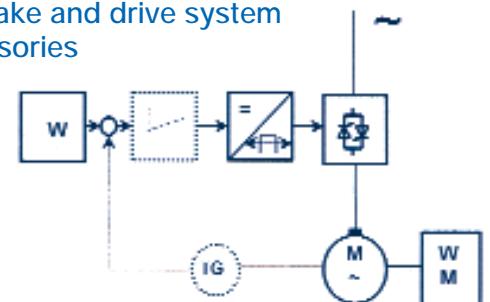
WM = Working Machine, Servo brake

Training contents EPE16: Speed control of a universal motor

- Open-loop speed control with single-phase bi-directional control connection
- Single pulse ignition, multiple pulse ignition, control range
- Voltage, current, power characteristics
- Automatic speed control
- Controlled system analysis, P, PI, PID control
- Optimization of controller parameters

Supplement to EPE10:

- 1 x SE2662-3E Universal motor 0.3 kW
- 1 x Servo brake and drive system w. accessories

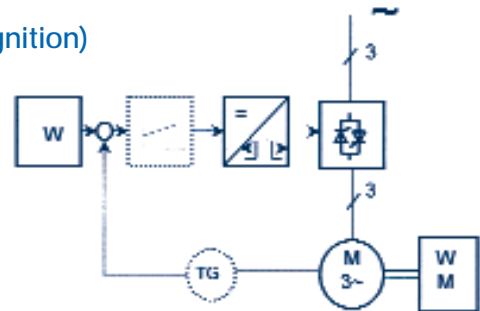


Training contents EPE17: Speed control of three-phase asynchronous machines

- Recording the voltage, current and power characteristics
- Investigation of the control range (single, and multiple pulse ignition)
- Electronic smooth starting and slip control
- Analysis of the fundamental and harmonic spectrum

Supplement to EPE10:

- 1 x SE2663-1K Three-phase motor with squirrel-cage rotor, industrial model, 0.3 kW
- 1 x Servo brake and drive system with accessories

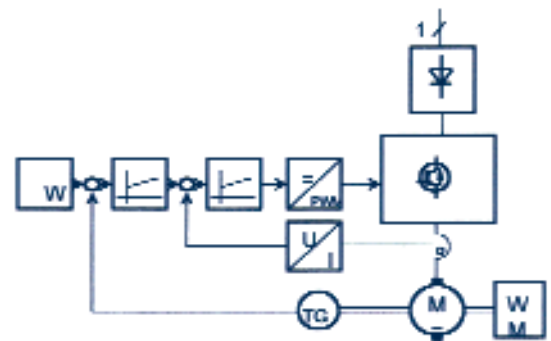


Training contents EPE21: DC drives with PWM

- Open-loop speed control with DC chopper
- Four-quadrant operation, power recovery
- Controlled system analysis, P, PI, PID control
- Controller optimisation
- Automatic speed control in 1 to 4-quadrant operation with/without secondary current control

Supplement to EPE20:

- 1 x SE2662-3A DC shunt wound machine 0.3 kW
- 1 x SO3620-1A Digital controller
- 1 x SO6006-5J Software 4Q drive controller
- 1 x SO3620-1B Set of overlay masks for digital controller
- 1x Servo brake and drive system with accessories



WM = working machine, servo brake

Training contents EPE26: Frequency converter with asynchronous machines

- Investigation of inverters with voltage and frequency control
- Investigation of inverters with space vector modulation
- Analysis of the voltage/frequency ratio
- Stator resistance compensation
- Investigation of inverter-fed drives
- Setting and optimizing parameters

SO6006-1R Software FC TRAIN

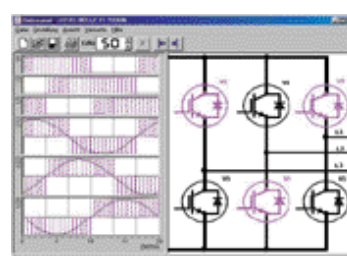
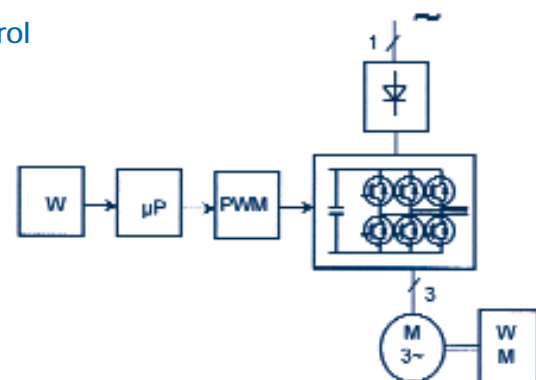
Used to convey how a three-phase frequency converter operates.

Modulation of three-phase voltage with sinusoidal curve of the fundamental wave.

To set parameters and for the operation of a frequency converter with U/f control.

Supplement to EPE20:

- 1 x SE2663-1K Three-phase motor with squirrel-cage rotor, industrial model, 0.3 kW
- 1 x SO6006-1R FC-TRAIN software
- 1 x Servo brake and drive system with accessories



Training contents EPE27: Electronically commutated synchronous machine

- Investigation of load-commutated drives
- Operating principle of servo motors with electronic commutation or brushless DC motors
- Analysis of field-orientated space vector modulation.
- Investigation of coordinate and sensor systems.

SO6006-1T VC-TRAIN/EC-TRAIN Software

VC-TRAIN, introduction into the theory of space vector modulation and experiment-based investigation of

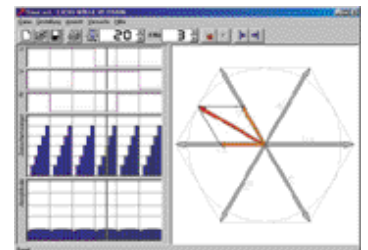
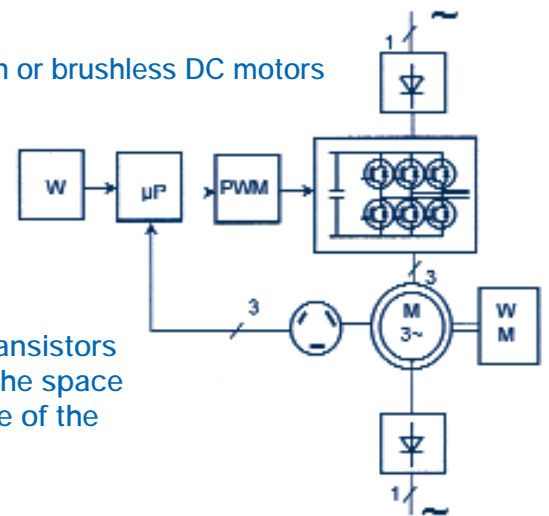
- Display of the control pulses and gate control of the power transistors
- Dynamic representation of the existing voltage vector within the space vector diagram; Display of the six base vectors, the limit curve of the voltage and the limit curve for space vector modulation.
- Single step operation or continuous operation up to 50 Hz

EC-TRAIN, for the investigation of electronically commutated synchronous machines (electronic motor)

- Demonstrates the operating principle of "load commutation" and "electronic commutation"
- How to apply space vector modulation
- Theoretical and practical approach to setting the electronic motor
- Optimization of the rotor angle
- Electronic brush displacement

Supplement to EPE20:

- 1 x SE2662-3M Three-phase synchronous machine, salient pole rotor 0.3 kW
- 1 x SE2662-6L Rotor position encoder 0.1/0.3 kW
- 1 x SO6006-1T VC/EC TRAIN software
- 1 x Servo brake and drive system with accessories



Introduction to industrial drive technology

EDT17 to EDT25 contain training sets for industrial drive technology. In contrast to EPE equipment sets the training components here are equipped with compact industrial devices. In terms of content the importance here shifts toward developing hands-on skills in working with and setting the parameters of genuine industrial equipment.

Naturally there is still the possibility of combining this system with components from automatic control technology, the digital controller and especially automation engineering.

A servo brake/servo drive is necessary to investigate the response of the loaded drive in 4-quadrants.

Training contents EDT17: Industrial smooth starting three-phase machines

The equipment set for industrial smooth starting is based on a compact industrial device.

Experiment priorities:

- Connection, putting into operation and setting the parameters of the smooth starter
- Measuring the curve of the voltage, current, speed and torque during the ramp-up time

EDT17 system components

SO3636-5Q Smooth starter, industrial model

Used for smoother starting of three-phase asynchronous machines of the 0.3 and 1.0 kW power classes. Setting possibilities for run-up time, run-down time and starting voltage
input, output voltage: 3 x 200 - 460 V / 6 A via safety sockets.



Additionally required:

- 1 x SE2663-1K Three-phase motor with squirrel-cage rotor, industrial model, 0.3 kW
- 1 x Servo brake and drive system with accessories

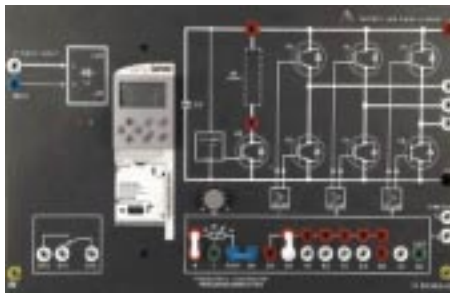
Training contents EDT25: Industrial drives with frequency converters

The industrial frequency converter equipment set is based on compact frequency converters, and is available in two models for machines in the 0.3 kW or 1.0 kW power class.

Main experiment topics include:

Connection, putting into operation, programming and setting the parameters of the frequency converter
Investigation of the operating response and verifying the proportionality between frequency and speed
Measuring the curve of the voltage, current, speed and torque, load experiments and the recording of speed-torque characteristics, optimizing the U/f characteristic and the boost function, operation with the brake chopper.

EDT25 system components



SO3636-5D Frequency converter vector 0.7 kVA

Didactically customized industrial microprocessor-controlled IGBT frequency converter with link circuit and vector control for the generation of three-phase frequency and amplitude-variable output voltage from a single-phase AC mains. Can be used for open-loop speed control and closed-control of asynchronous machines.

| | |
|-------------------|---------------------------------------|
| Nominal power: | 0.75 kW / 1.5 kVA. |
| Input voltage:: | 120 V...240 V |
| Output voltage: | 3 x 0... U_{IN} |
| Output frequency: | 0...480 Hz |
| Output current: | 0...4 A |
| Overload factor: | 150% (60s) |
| Dimensions: | H = 297 mm, W = 456 mm, D = 130 mm |
| Weight: | 3 kg |



SO3636-5V Brake resistor

For the frequency converter with DC link voltages of 320 V, for the thermal dissipation of the braking energy fed into the link circuit.

| | |
|-----------------------|--|
| Nominal resistance: | 200 Ohm |
| Max. continuous load: | 200 W |
| Dimensions: | H = 297 mm, W = 114 mm, D = 130 mm |
| Weight: | 0.5 kg |

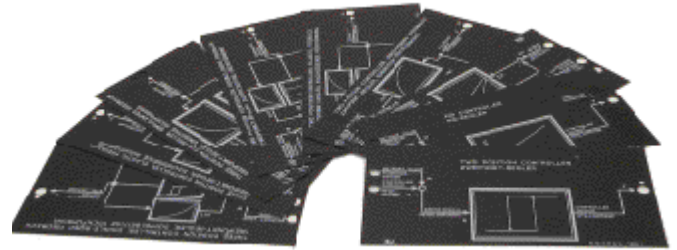
Additionally required:

- 1 x SE2663-1K Three-phase motor with squirrel-cage rotor, industrial model, 0.3 kW
- 1 x Servo brake and drive system with accessories

Hardware and software "closed loop drive control"



SO3620-1A
Digital universal controller
 With 32-bit processor, interfaces and display, for use in the area of automatic control and drive technology. Contains two independent controllers which can be used as autonomous units or cascaded as two-position, three-position, P, I, D, PI, PID or as cascade controllers (PII).



SO3620-1B Set of overlay masks (9 each)
 To visualize the operating mode of the digital universal controller



SO6006-5A
Controller configuration software

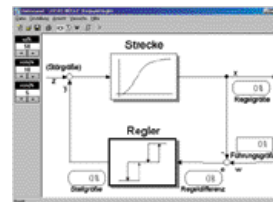
- Reads out and processes the configurations saved in the controller
- Creates new configurations or deletes existing configurations
- Writes the modified settings back into the flash memory of the controller

The investigation of the different controller and control loop responses is performed using specially designed software for the digital universal controller. These four programs put the following user-friendly configuration, measurement and evaluation features at your disposal:

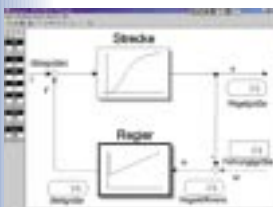
- Depicts the control loop as a block circuit diagram with standard nomenclature
- Demonstrates the principal operation and control response of the various controllers
- Plots the curves of the control variables in time graphs
- Allows for random definition of the reference and disturbance variable functions for the investigation of the controller response.
- Optimization function



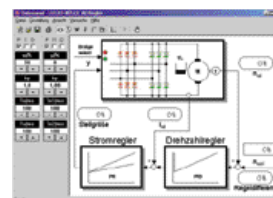
SO6006-5C
Two-position controller software package



SO6006-5E
Three-position controller software package



SO6006-5G
PID controller software package



SO6006-5J
4Q drive controller software package

Electrical machines and supplements

All machines are industrial type models designed in accordance with DIN VDE 0530, protection class IP 20, pure orange silk gloss finish (RAL 2004) mounted on a vibration-resistant black base frame. 71 mm shaft height (from base frame) for machines of the 0.3 kW power class, 90 mm for the 1 kW power class.

All of the machines are equipped with two free geared shaft ends and can be coupled securely and non-positively to multiple machine sets or to the braking system with the aid of the POWER-GRIP couplings.

The connection boxes with didactically-designed front panels (170 mm x 140 mm) facing to the front is fitted with the silk screen print containing all the DIN / IEC designated machine connections and the safety facilities set up with 4-mm safety sockets.

Temperature sensors have been integrated into the windings to protect the machines against thermal overloads. All of the rotating components can be protected against physical contact using shaft guards.

SE2662-3A DC shunt-wound machine 0.3 kW

Designed for self- and separately-excited motor and generator operation

$U = 220 \text{ V}$; $I = 1.4 \text{ A}$
 $n = 2000 \text{ min}^{-1}$; $P = 0.25 \text{ kW}$
 $U_{\text{exc}} = 220 \text{ V}$; $I_{\text{exc}} = 140 \text{ mA}$
 Size: 340 x 210 x 210 mm
 Weight: 10 kg



SE2662-3E Universal motor 0.3 kW

DC and AC voltage motor
 $n = 3000 \text{ min}^{-1}$
 $P = 0.25 \text{ kW}$
 $f = 50 \text{ Hz}$; $\cos \varphi = 0.65$
 Size: 340 x 210 x 210 mm
 Weight: 10 kg



SE2663-1K Three-phase motor with squirrel-cage, industrial model 0.3 kW

$U = 230/400 \text{ V}$ (delta/star) ;
 $I = 1.7/1 \text{ A}$; $n = 1440 \text{ min}^{-1}$;
 $P = 0.37 \text{ kW}$; $f = 50 \text{ Hz}$;
 $\cos \varphi = 0.8$
 Size: 330 x 210 x 210 mm
 Weight: 9 kg



SE2662-3M Three-phase synchronous machine 0.3 kW

Salient pole rotor model for motor and generator operation.

$U = 400 \text{ V}$ (star) ;
 $I = 0.7/0.45 \text{ A}$; $P = 0.3 \text{ kW}$;
 $f = 50 \text{ Hz}$; $\cos \varphi = 1/0.8$;
 $n = 1500 \text{ min}^{-1}$;
 $U_{\text{exc}} = 140 \text{ V}$; $I_{\text{exc}} = 0.55 \text{ A}$;
 Size: 360 x 210 x 210 mm
 Weight: 10 kg



SE2662-6L Rotor position encoder 0.1/0.3 kW

Used to detect the rotor position and control the electronic commutation in experiments concerning such topics as "the electronic motor" or "the brushless DC motor".

- Optoelectronic sampling using 3 fork-type light barriers and 180° encoding disk
- Mechanical coarse and fine setting of the commutation point
- Output signal: 3 x TTL level using cable with 25-pin D-plug



SE2662-2B Coupling guard 0.1/0.3 kW

Connectable metal screen used to protect against physical contact to rotating motor or generator shafts.
 Size: 115 x 90 x 60 mm (H x W x D)
 Weight: 0.14 kg



SE2662-2C Shaft end guard for 0.1 and 0.3 kW machines

Connectable metal screen used to protect against physical contact with rotating motor or generator shafts.
 Size: 115 x 90 x 30 mm (H x W x D)



SE2662-2A Coupling sleeve 0.1/0.3 kW

Rubber sleeve for geared ring couplings
 Material: rubber (neoprene)
 Length x diameter: 40 x 45 mm
 Weight: 0.036 kg



Hard- and software for servo brake and drive systems

The **LN Servo Drive and Brake System** is an innovative, highly dynamic testing system for electrical machines. It is capable of four-quadrant operation and can simulate working machines and flywheels and can also be used as a training system for servo technology. Superior servo technology stands out for its precision, robustness and excellent dynamic response. It applies a braking action on motors up to standstill or drives generators. It detects motor and generator torque and, in addition to this, records the speed, current and voltage of the device under test. It can also be used for the simulation of working machines and as a training system for servo technology.

Didactically customized software for optimum support when investigating electrical machines. This guarantees easy remote control and fast transfer of all measured values via serial interface and provides for graphic visualization of the measurement results.

SO3636-6R Control unit for servo brake 1.7 kW

Didactically-designed highly dynamic digital servo controller for braking and driving operations, also used for flywheel and working machine simulation, speed/torque display; four-quadrant monitor, dynamic and static four-quadrant operation in 9 different



modes, analog outputs for torque and speed signals, motor temperature and overload monitoring, integrated isolation amplifier for DUT's

current and voltage, integrated CAN-BUS; optional RS232, PROFIBUS, INTERBUS-S modules, LCD operating terminal for display and setting of parameters, servo technology training system with configurable control loops (Pos, n, I)

Technical data:

- Connection voltage: 320 V...528 V; 45 Hz...65 Hz
- Output power: 4.8 kVA
- Nominal current: 7.0 A (t < 1 min.: 10.5 A)



LM8925 RS232/485
Interface module

SO6006-4A Active ASMA software

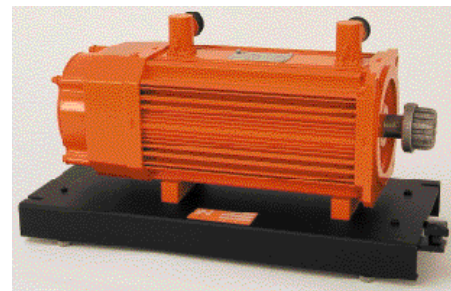
Software to record the characteristics of asynchronous machines in 4 quadrants for

- Measurement of current and voltage of the DUT and display in an oscillograph
- Measurement of speed and torque
- Computation of mechanical and electrical power level, $\cos \varphi$, slip, efficiency
- Display of all variables in 4-quadrant graph during the measurement

SE2663-6A Servo drive / servo brake 1.7 kW

Asynchronous servo motor with resolver and one free shaft end, connection mechanism for sensor and motor power feed, crossconnection-proof, monitored for thermal overload.

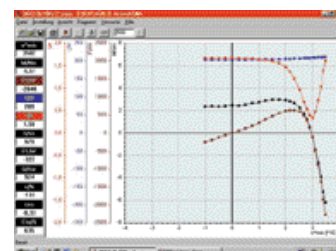
- Torque: 4.0 Nm, max.: 13.0 Nm
- Nominal power: 1.7 kW
- Nominal current: 4.4 A
- Speed: 4050 min⁻¹; max: 8000 min⁻¹



SO6006-4C Active DCMA Software

Software for recording the characteristics of DC and synchronous machines in 4 quadrant operation

- Measurement of current and voltage of the DUT and the "Online" display on the oscillograph, measurement of speed and torque
- Calculation of mechanical and electrical power levels, $\cos \varphi$, slip, efficiency



SO6006-2N SIMULOAD software

Visualizations, simulations and measurements on the working machines

- Static measurements on the working machines
- Speed/Torque graph of working machines
- Curve superimpositions
- Measurement and display of the stable operating point

SO6006-2J POSIDRIVE software

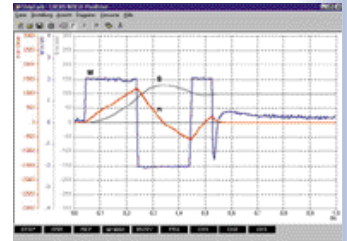
For measurements on the servo/positioning drives, investigations of dynamic positioning processes

- Definition of the desired or setpoint positions with freely selectable values for the ramp time, maximum speed, maximum torque and maintenance time.
- Single-step processing or continuous processing through to the defined positions
- Investigations of the effects of controller parameters on the positioning quality and accuracy
- Graphic recording of the relevant variables

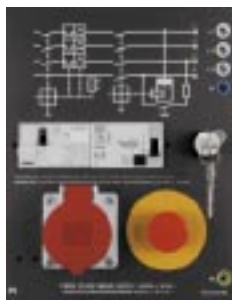
SO6006-2Q DYNAMA software

To perform dynamic measurements on electrical machines for run-up, run-down time and switching processes

- Time line graphs of all relevant variables
- Definable trigger conditions



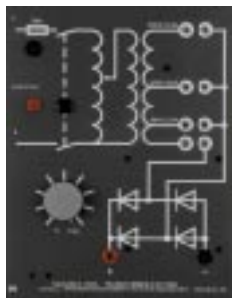
Supplementary system components: Power supplies



SO3212-1B Three-phase power supply 400 V/16 A with FCCB

Supplies the 1-3 phase line voltage L1, L2, L3, N, PE for experimenting at 5 safety sockets and CEE socket:

Motor protection switch (6.3 ... 16 A), undervoltage release, FCCB circuit breaker 30 mA EMERGENCY OFF pushbutton, key-operated switch ON, CEE socket
Power feed: 3 x 230 V / 400 V, 50 Hz via CEE plug with 1.8 m cable
Training panel: 297 x 228 x 140 mm



SO3212-5K Isolating variable transformer, exciter 0-230 V

For field excitation of DC and synchronous machines

Transformer: 0 - 230 V/0.8 A AC or DC
0 - 120 V/1.6 A AC or DC
0 - 40 V/2.5 A AC or DC

Power feed: 230V, 50 Hz via earthing pin plug with 1.5 m mains cable
Training panel: 297 x 228 x 140 mm



SO3538-8D DC power supply ± 15 V/2 A

Stabilized, controlled double voltage supply with safe extra-low voltage (SELV), continuous short-circuit proof and temperature monitoring facility, visual overload indication using LED.

Output voltages: + 15 V/2 A, - 15 V/2 A

Outputs to 8 safety sockets

Mains voltage: 230 V/50 Hz with mains connection cable

Training panel: 297 x 114 x 140 mm

| Ident no: | Designation | EPE10 | EPE11 | EPE16 | EPE17 | EPE20 | EPE21 | EPE26 | EPE27 | EPE10 -27 | EDT17 | EDT25 |
|---|--|-------|-------|-------|-------|-------|-------|-------|-------|--------------|-------|-------|
| Basic and supplementary equipment sets | | | | | | | | | | | | |
| SO3636-1A | Digital universal control unit, microprocessor-controlled | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| SO3636-1F | Static converter valve unit, 8 thyristors, 6 diodes, 1 TRIAC | 1 | 1 | 1 | 1 | | | | | 1 | | |
| SO3636-1G | Set of overlay masks for line-commutated converters (9 each) | 1 | 1 | 1 | 1 | | | | | 1 | | |
| SO3636-1R | 6-fold IGBT static converter | | | | | 1 | 1 | 1 | 1 | 1 | | |
| SO3636-1S | Overlay masks for 6-fold IGBT converters (2 each) | | | | | 1 | 1 | | | 1 | | |
| SO3636-2A | RLC load with thermal controlled system | 1 | | | | 1 | | | | 1 | | |
| SO3636-2V | Differential measurement amplifier | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| LM6120 | Connection cable 0.5 m (differential amplifier / control unit) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| SO3636-2G | 3-phase isolating transformer 300 VA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| SO3636-5D | Frequency converter, vector-type, industrial model, single-phase, 0.75 kW, LCD | | | | | | | | | | | 1 |
| SO3636-5E | Frequency converter, vector-type, industrial model, single-phase, 1.5 kW, LCD | | | | | | | | | | | 1 |
| SO3636-5V | Brake resistor 0.2 kW for frequency converter | | | | | | | | | | | 1 |
| SO3636-5W | Brake resistor 0.4 kW for frequency converter | | | | | | | | | | | 1 |
| SO3636-5Q | Smooth starter, industrial model | | | | | | | | | | 1 | |
| SO6006-1A | Power electronics software package for SO3636-1A | 1 | 1 | 1 | 1 | 1 | 1 | | | 1 | | |
| SO6006-1E | PWM-TRAIN software | | | | | 1 | | | | 1 | | |
| SO6006-1H | Fourier analysis and synthesis with DDE software | 1 | 1 | 1 | 1 | 1 | 1 | | | 1 | | |
| SO6006-1K | PowerView AddOn software for PHACON | 1 | 1 | 1 | 1 | 1 | | | | 1 | | |
| SO6006-1P | AC-PWM software | | | | | 1 | | | | 1 | | |
| SO6006-1R | FC-TRAIN software | | | | | | | 1 | | 1 | | |
| SO6006-1T | EC-TRAIN software | | | | | | | | 1 | 1 | | |
| Automatic control technology components | | | | | | | | | | | | |
| SO3620-1A | Digital universal controller, microprocessor-controlled | | 1 | (1) | (1) | | 1 | | | 1 | 1 | |
| SO3620-1B | Set of overlay masks for digital controller SO3620-1A (9 each) | | 1 | (1) | (1) | | 1 | | | 1 | 1 | |
| SO6006-5A | Controller configuration software | | | | | | | | | | | |
| SO6006-5C | Two position controller software package | | | | | | | | | | | |
| SO6006-5E | Three-position controller software package | | | | | | | | | | | |
| SO6006-5G | PID controller software package | | | (1) | (1) | | | | | (1) | | |
| SO6006-5J | 4Q drive controller software package | | 1 | | | | 1 | | | 1 | | |
| Accessories out of the area of electrical machines | | | | | | | | | | | | |
| SE2662-3A | DC shunt wound machine 0.3 kW | | 1 | | | | 1 | | | 1 | | |
| SE2662-3E | Universal motor 0.3kW | | | 1 | | | | | | 1 | | |
| SE2663-1K | Three-phase motor with squirrel-cage rotor, industrial model, 0.3 kW | | | | 1 | | | 1 | | 1 | 1 | 1 |
| SE2662-3M | Three-phase synchronous machine, salient pole rotor 0.3 kW | | | | | | | | 1 | 1 | | |
| SE2662-6L | Rotor position encoder 0.1/0.3 kW | | | | | | | | 1 | 1 | | |
| Servo brake and drive system with accessories | | | | | | | | | | | | |
| SO3636-6R | Control unit for servo brake 0.3 kW | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| SE2663-6A | Servo brake 0.3 kW | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| SE2662-2A | Coupling sleeve | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| SE2662-2B | Coupling guard | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| SE2662-2C | Shaft end guard | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| LM8925 | RS232/485 interface module | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| LM9028 | PC connection cable for RS232/485 interface module | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| SO6006-4A | Active ASMA software | | | | 1 | | | 1 | 1 | 1 | 1 | 1 |
| SO6006-4C | Active DCMA software | | 1 | 1 | | | 1 | | | 1 | 1 | 1 |
| SO6006-2N | SimuLoad software | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| SO6006-2Q | DynaMa software | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| SO6006-2J | PosiDrive software | | | | | | | | | 1 | 1 | 1 |
| Literature | | | | | | | | | | | | |
| SO5159-8D | EPE10 Line-commutated converters | 1 | | | | | | | | 1 | | |
| SO5159-8H | EPE20 Self-commutated converters | | | | | 1 | | | | 1 | | |
| SO5159-8J | EPE11 Static converter drives with DC motors | | 1 | | | | | | | 1 | | |
| SO5159-8K | EPE16 Static converter drives with universal motor | | | 1 | | | | | | 1 | | |
| SO5159-8L | EPE17 Open-loop control of a three-phase - asynchronous motor | | | | 1 | | | | | 1 | | |
| SO5159-8M | EPE21 PWM converter drives with DC motors | | | | | | 1 | | | 1 | | |
| SO5159-8N | EPE26 Frequency converter drives with three-phase asynchronous motors | | | | | | | 1 | | 1 | | |
| SO5159-8P | EPE27 Electronically commutated synchronous machine | | | | | | | | 1 | 1 | | |
| SO5159-9R | EDT17 Industrial smooth starting | | | | | | | | | | 1 | |
| SO5159-9A | EDT25 Industrial frequency converter | | | | | | | | | | | 1 |
| Accessories | | | | | | | | | | | | |
| SO3538-8D | DC power supply ±15V/2A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| SO3212-5K | Isolating variable transformer exciter 0 - 230 V | | | | | | | | | 1 | | |
| LM9040 | Serial interface cable 9/9 pin. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| SO3212-1B | Three-phase power supply 400 V / 15 A with FCCB circuit breaker | | | | | | | | | | 1 | 1 |
| SO5127-1L | Demonstration RMS meter | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| SO5148-1F | Set of safety connecting cables, 47 pcs | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| SO5126-9X | Safety bridging plugs 4 mm | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 20 | 20 |
| SO5126-9Y | Safety bridging plugs 4 mm with tap | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 |

(1) = optional