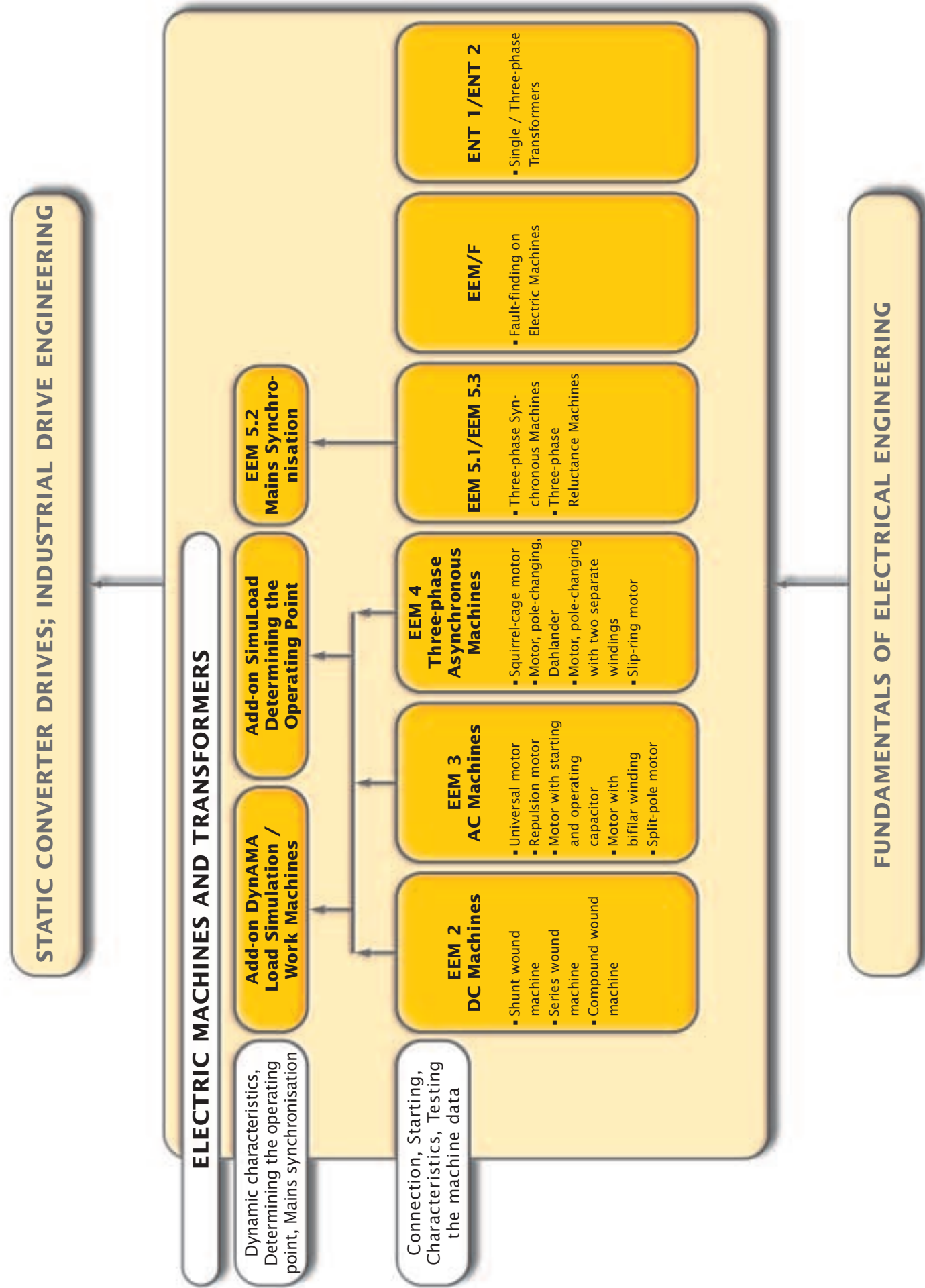


EEM Electric Machines





The progressive development in all areas of technology has resulted in increasing demands for highly skilled specialists, technicians and engineers. This applies in particular to the subject area of drive engineering. The world of today is inconceivable without the use of controllable electric drive systems. State-of-the-art drive systems are based on the application of electronics in conjunction with electric machines.

Here is where the electric machines training system is of utmost significance. In addition to straightforward

connection, the parameters and characteristics specific to particular machines, are in the foreground. By using standard industrial specifications, the knowledge gained in the laboratory can easily be applied to practical, everyday industrial situations.

The machines and control units are designed so that they can be integrated into state-of-the-art circuits and drive systems. The modular construction ensures that the exercises remain adaptable for years to come.

OVERVIEW OF THE ADVANTAGES OF THE LUCAS-NÜLLE SYSTEM



OPERATING SAFETY

All connections are made with safety-protected, shock-proof connection cables and sockets. The explicit DIN and IEC standard identification of the connections, and their location, ensure a high degree of circuit safety. All rotating parts are protected by suitable guards. The machines are protected against thermal overload by temperature sensors.

OPTIMUM HANDLING

The machines within one power category all have the same shaft height and are mounted on an anti-vibration base-plate. This ensures a straightforward, stable coupling of machines and subsidiary equipment (e.g. servo brake, gears), using rubber coupling sleeves. These sleeves produce a coupling without any backlash and ensure smooth running with a maximum transfer of power.

THE INTERIOR OF THE MACHINES

All Lucas-Nülle machines with slip-rings or brushes incorporate a transparent plastic window providing direct observation of the component parts that are typical to particular machines.

COMPETENT, SPECIALIST LITERATURE

An important ingredient of the Lucas-Nülle training systems is the comprehensive exercise literature, written by experienced trainers and professional specialists. All important details necessary for completing the exercises, are included in a straightforward, understandable manner.

PRACTICE-ORIENTED CHARACTERISTICS

The responses and characteristics correspond to those of machines having a considerably higher power rating.

The LN servo drive and brake system is a universal, highly dynamic test system for examining all electric machines and drives. The system consists of a didactically-prepared control unit and an asynchronous servo machine with integrated resolver. State-of-the-art servo and microcontroller techniques provide a very high degree of flexibility and ease of operating. Optimised systems are available for each of the power categories 300 W and 1 kW. The LN drive and brake system operates in all four quadrants, i.e. it can drive

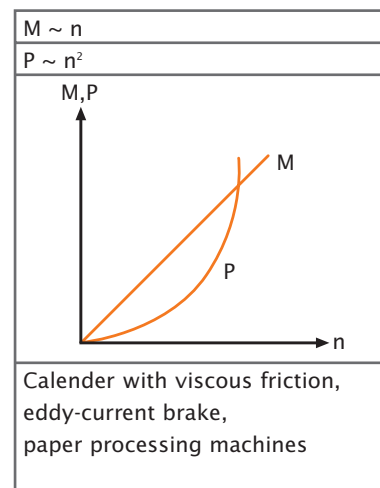
and brake machines in all operating states. The ongoing speed and torque is determined and displayed in all operating areas. The integrated isolating amplifier also provides the facility of recording the current and voltage of the machine under test.

In addition to the pure drive and braking, the following 6 pre-programmed practical models of work machines can be loaded and their parameters adjusted:

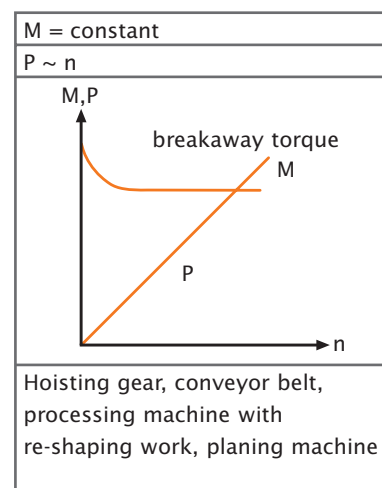


Photographs by Lenze GmbH

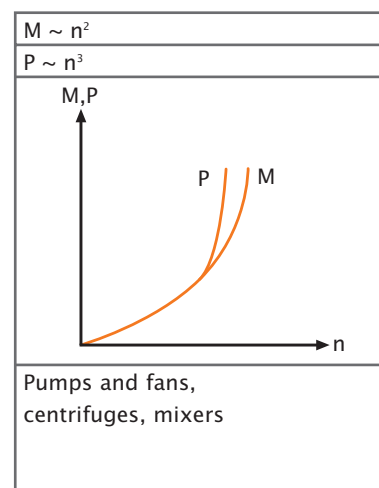
■ CALENDER



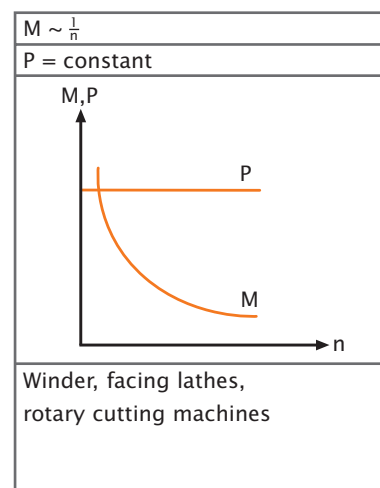
■ LIFTING DRIVE



■ FAN/PUMP



■ WINDING MACHINE DRIVE



■ INERTIA WHEEL

■ PISTON COMPRESSOR

Thus in the laboratory, conditions for examination can be created that otherwise are only possible in practice. Optimum support in experimenting, is supplied by

didactic software packages. These provide a straightforward and easy operation together with a visual display of the measured results, via the serial interface.

THE COMPONENTS

CONTROL UNIT

The digital control unit for the servo drive/servo brake is didactically constructed and designed for the classical exercises without a PC as well as for connection to a PC. The unit is operated via self-explanatory keys. Speed and torque are indicated on

large-scale analog instruments with a centre zero. Together with the 4-quadrant monitor, trends in the results can be recognised. The digital LC-Display and Operator section facilitates an exact read-out of the values and provides adjustments for the parameters.



Further features include:

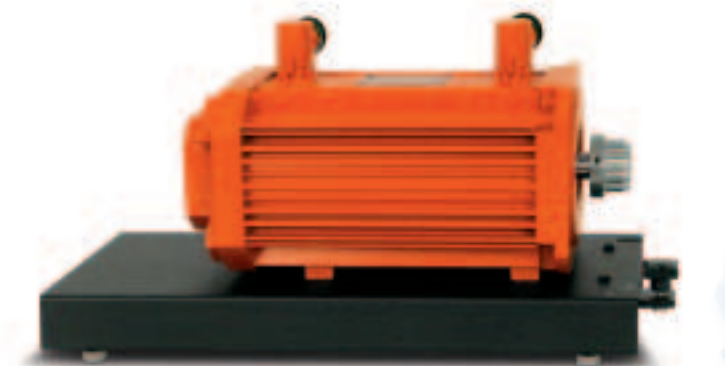
- Integrated isolating amplifier for measuring the current and voltage of the motor under test
- Monitoring the temperature of the motor under test
- Analog outputs for speed and torque
- Optional interfaces (RS232, Profibus DP, Interbus S); integrated CAN-Bus
- I/O terminal for servo applications
- Connection of the asynchronous servo via polarity-protected multi-way connector

	0.3 kW category	1 kW category
Supply voltage*:	320...528 V, 45...65 Hz	320...528 V, 45...65 Hz
Output power:	4.8 kVA	9 kVA
Nominal current:	7.0 A	13.0 A
Pulsed current:	10.5 A	19.5 A
Dimensions:	297 x 460 x 210 mm (H x W x D)	297 x 460 x 320 mm (H x W x D)
Weight:	10 kg	15 kg
Order No.:	SO3636-6R	SE2663-6D

*for other supply voltages SE2663-2B is required

BRAKE

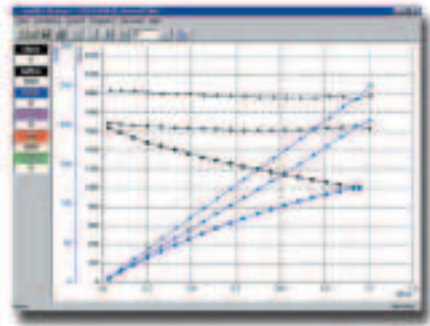
The asynchronous servo machine has sufficient torque reserves to reliably brake, drive or hold at standstill, machines and drives in all four quadrants. Coupling to the brake is by way of a toothed clutch. The integrated resolver generates a highly accurate, absolute value of the rotor position and speed. The temperature of the motor is continuously monitored via a KTY-temperature sensor. The system is drift-free and requires no calibration.



	0.3 kW category	1 kW category
Torque:	M_N : 4.6 Nm; M_{max} : 11.7 Nm	M_N : 10.8 Nm; M_{max} : 27 Nm
Nominal power:	1.7 kW	3.9 kW
Nominal current:	4.4 A	9.1 A
Nominal speed:	4050 rpm	3455 rpm
Maximum speed:	8000 rpm	8000 rpm
Resolver resolution:	65536 pulses/revolution	65536 pulses/revolution
Dimensions:	340 x 210 x 210 mm (W x H x D)	500 x 220 x 250 mm (W x H x D)
Weight:	7.5 kg	10.5 kg
Order No.:	SE2663-6A	SE2663-6E

Five different didactic software packages allow the exercises to be completed with PC support. The software packages are compiled specially for use with the servo drive and brake system and are integrated in the Windows screen interface, providing all the advantages of modern software. The packages incorporate export and print functions

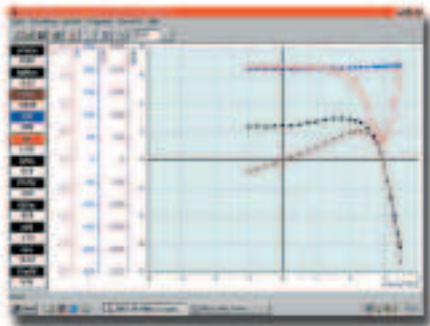
SOFTWARE ActiveDCMA



ActiveDCMA is a program for recording the characteristics of DC machines.

- Measurement, calculation and graphic display of mechanical and electrical variables (speed, torque, mechanical power, current, voltage, efficiency)

SOFTWARE ActiveASMA



ActiveASMA is a program for recording the characteristics of asynchronous, synchronous and AC machines.

- Measurement, calculation and graphic display of mechanical and electrical variables (speed, torque, mechanical power, current, voltage, active-,

so that the measured values and graphics can be used in other programs such as for example, MS Excel. All software packages have an extensive contextual online Help function and are available as 32-bit versions (Windows 95 or higher). Connection to the PC serial interface is made via an interface module.

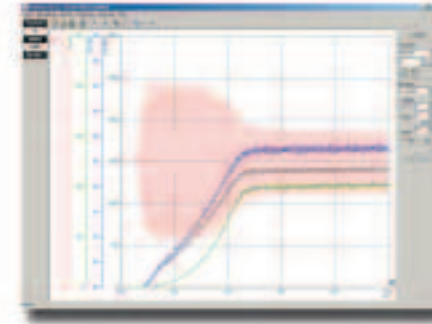
- Simultaneous display of measured and calculated values (e.g. direct display of the efficiency)
- Defining limit values for speed or torque to avoid inadmissible loading of the machine under test
- Measurement of armature voltage, armature current (as rectified mean values)
- Speed- or torque-controlled operation
- Operation in all four quadrants (showing the generator torque)
- Display of the characteristics from several exercises to enable parameter changes to be seen
- Oscilloscope function for displaying the waveforms of voltage, current and efficiency

Order No.: SO6006-4C

- apparent-, reactive powers, efficiency, power factor)
- Simultaneous display of measured and calculated values (e.g. direct display of the efficiency)
- Measurement of current and voltage (as RMS value, even with non-sinusoidal variables)
- Speed- or torque-controlled operation
- Defining limit values for speed or torque to avoid inadmissible loading of the machine under test
- Operation in all four quadrants (showing the generator torque)
- Display of the characteristics from several exercises to enable parameter changes to be seen
- Oscilloscope function for displaying the waveforms of voltage, current and efficiency

Order No.: SO6006-4A

SOFTWARE DynAMA



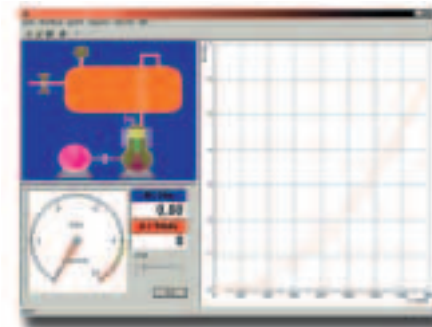
With the DynAMA program, dynamic processes such as starting or braking responses of electric machines can be examined and recorded. The measured values

are recorded as a function of time.

- Adjustments and parameter changes for 6 different load machines (inertia wheel, fan, calender, lifting drive, compressor, winding machine drive)
- Measurement, calculation and graphic display of mechanical and electrical variables (speed, torque, mechanical power, current, voltage)
- Display with different timebases and trigger conditions
- Simultaneous display of measured and calculated values (e.g. direct display of the mechanical power)
- Operation in all four quadrants

Order No.: SO6001-2Q

SOFTWARE SimuLoad

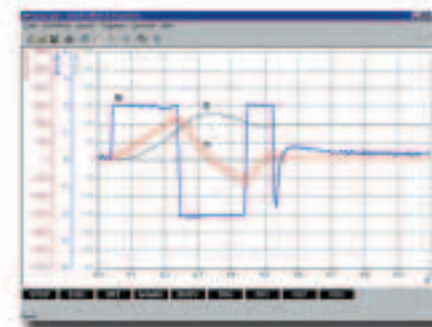


With the SimuLoad program, the static working (or operating) point can be determined. Six different loading conditions (work machines) are available, each incorporating the facilities for adjustment and parameter modification.

- Determining the working point
- Stable working point
- Speed-torque charts
- Superimposition of curves
- Operation in all four quadrants

Order No.: SO6001-2N

SOFTWARE PosiDrive



PosiDrive is a program for examining a displacement and positioning system.

- Defining Setpoint positions with freely selectable values for the ramp time, maximum speed, maximum torque and delay (waiting time)
- Single-step processing or continuous running to the specified positions
- Examining the effects of the controller parameters on the positioning accuracy
- Graphic display of the values of position, torque and speed, in a timing chart

Order No.: SO6006-2J

INTERFACE MODULE



Attachable field bus module for coupling between PC, frequency converter and servo drive amplifier.

- Connection sub-assembly for RS232/RS485
- Potential isolation to control/power section
- Suitable interface cable (LM9028)

Order No.: LM8925 + LM9028

EEM 2 DC MACHINES

Despite their declining use for industrial purposes, DC machines constitute the basis for training in the subject of electric machines. They are ideal for demonstrating the various possibilities of open- and closed-loop control systems for machines. The following training objectives are covered for shunt wound, series wound and compound wound machines:

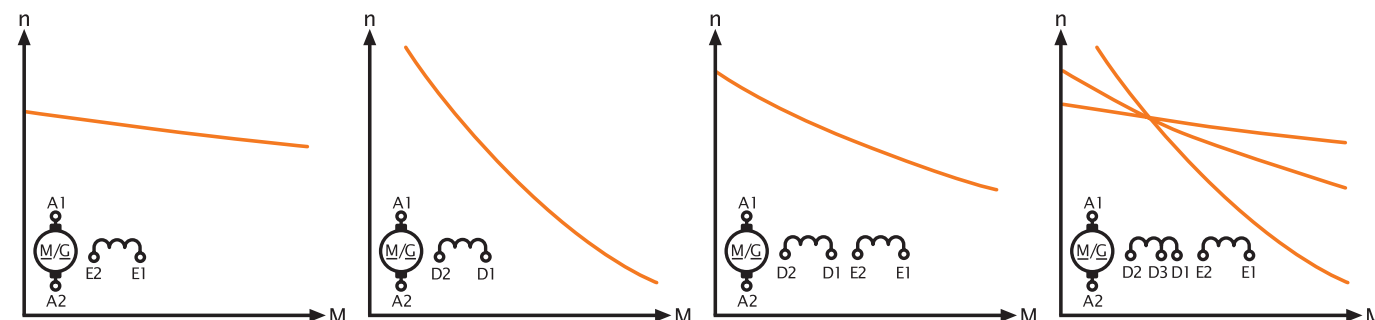
MOTOR OPERATION:

- Connecting the motor
- Comparison of shunt wound, series wound and compound wound machines
- Typical machine data
- Open-loop speed control with starter and field regulator

- Reversing the direction of rotation
- Load characteristics $\{n, I, P_1, P_2, \eta\} = f(M)$
- Evaluation of the measured results

GENERATOR OPERATION:

- Connecting the generator
- Armature voltage as a function of the exciter current
- Function and application of the field regulator
- Voltage control, self-excitation and separate excitation
- Armature current and armature voltage at constant speed and constant exciter current
- Load diagram of the generator



EEM 2 DC MACHINES

Order No.	Description	0.3 kW	1 kW
SE2662-3D	DC multi-circuit, compound wound machine, 0.3 kW	1	
SE2662-3A	DC shunt wound machine, 0.3 kW	(A)	
SE2662-3B	DC series wound machine, 0.3 kW	(A)	
SE2662-3C	DC compound wound machine, 0.3 kW	(A)	
SO3212-5F	Field regulator for DC machines, 0.1 /0.3 kW	1	
SO3212-6B	Starter for DC machines, 0.3 kW	1	
SO3212-6M	Load resistor, 0.3 kW	1	
SE2662-2A	Rubber coupling sleeve, 0.3 kW	1	
SE2662-2B	Coupling guard, 0.3 kW	1	
SE2662-2C	Shaft end guard, 0.3 kW	1	
SE2662-5D	DC multi-circuit, compound wound machine, 1 kW		1
SE2662-5A	DC shunt wound machine, 1 kW		(A)
SE2662-5B	DC series wound machine, 1 kW		(A)
SE2662-5C	DC compound wound machine, 1 kW		(A)
SO3213-6F	Field regulator for DC machines, 1 kW		1
SO3213-6B	Starter for DC machines, 1 kW		1
SE2662-6J	Load resistor, 1 kW		1
SE2662-6A	Rubber coupling sleeve, 1 kW		1
SE2662-6B	Coupling guard, 1 kW		1
SE2662-6C	Shaft end guard, 1 kW		1

Machine Test Stand, Servo Drive/Brake System:

SO3636-6R	Digital control unit for servo drive/servo brake, 0.3 kW	1	
SE2663-6A	Servo motor/servo brake, 0.3 kW	1	
SE2663-6D	Digital control unit for servo drive / servo brake, 1 kW		1
SE2663-6E	Servo motor/servo brake, 1 kW		1
LM8925	RS232/485 interface module for frequency converter & universal drive amplifier	1	1
LM9028	PC connection cable for RS232/485 interface module LM8925, l = 5 m	1	1

Software:

SO6006-4C	Software ActiveDCMA DC-machines characteristics with servo brake V1.0 (GB)	1	1
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Literature:

SO5156-9K	EEM 2 Industrial DC Multi-circuit Compound Wound Machines 0.3 kW (GB)	1	
SO5156-9R	EEM 2 Industrial DC Multi-circuit Compound Wound Machines 1.0 kW (GB)		1

Power supplies:

SO3212-1B	Three-phase supply 400 V/16 A with earth leakage circuit breaker	1	1
SO3212-5W	DC power supply 0...250 V/10 A stabilised	1	1

Measuring instruments:

SO5127-1L	Large-scale true RMS meter	2	2
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Accessories:

SO5148-1F	Set of safety connection cables 4 mm (47 pcs.)	1	1
SO5126-9X	Safety protected connection plug 19/4 mm, white	15	15
SO5126-9Z	Safety protected connection plug 19/4 mm, white, with tapping	5	5
ST7003-1CG	Table-top frame, 2 levels, W 1230 x H 740 mm, grey	1	1

(A) Alternative machine

0.3 kW category

1 kW category

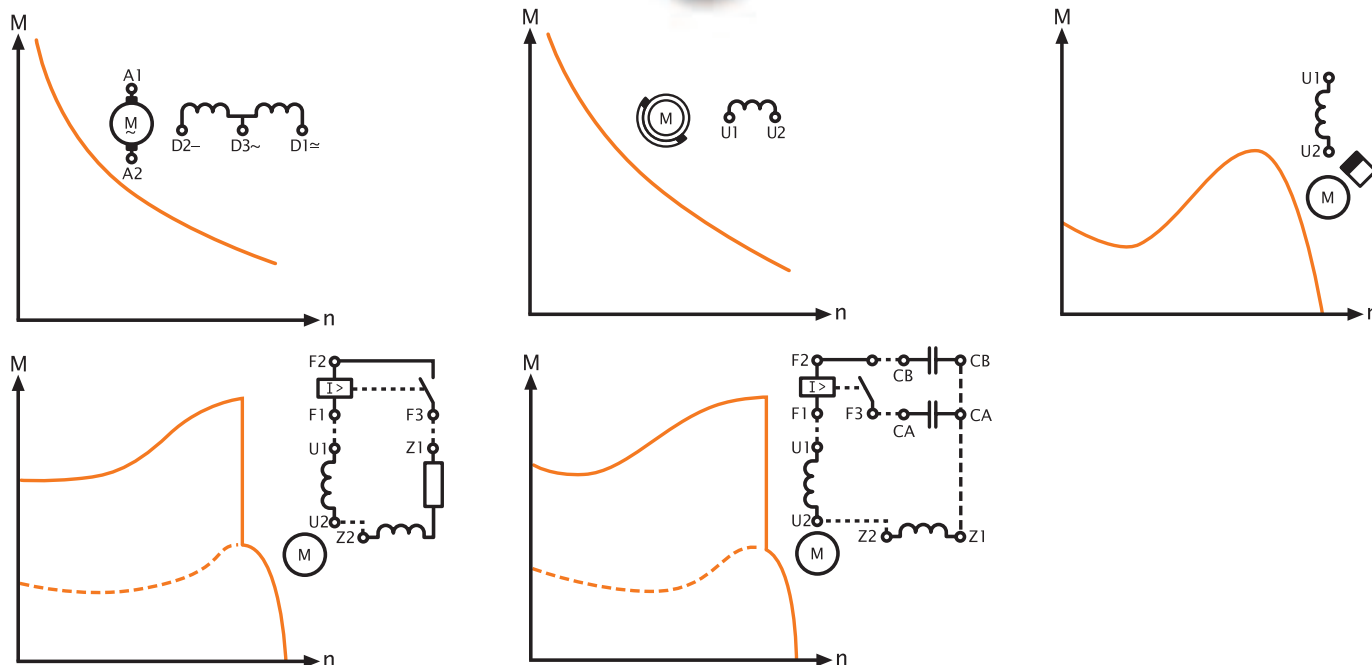
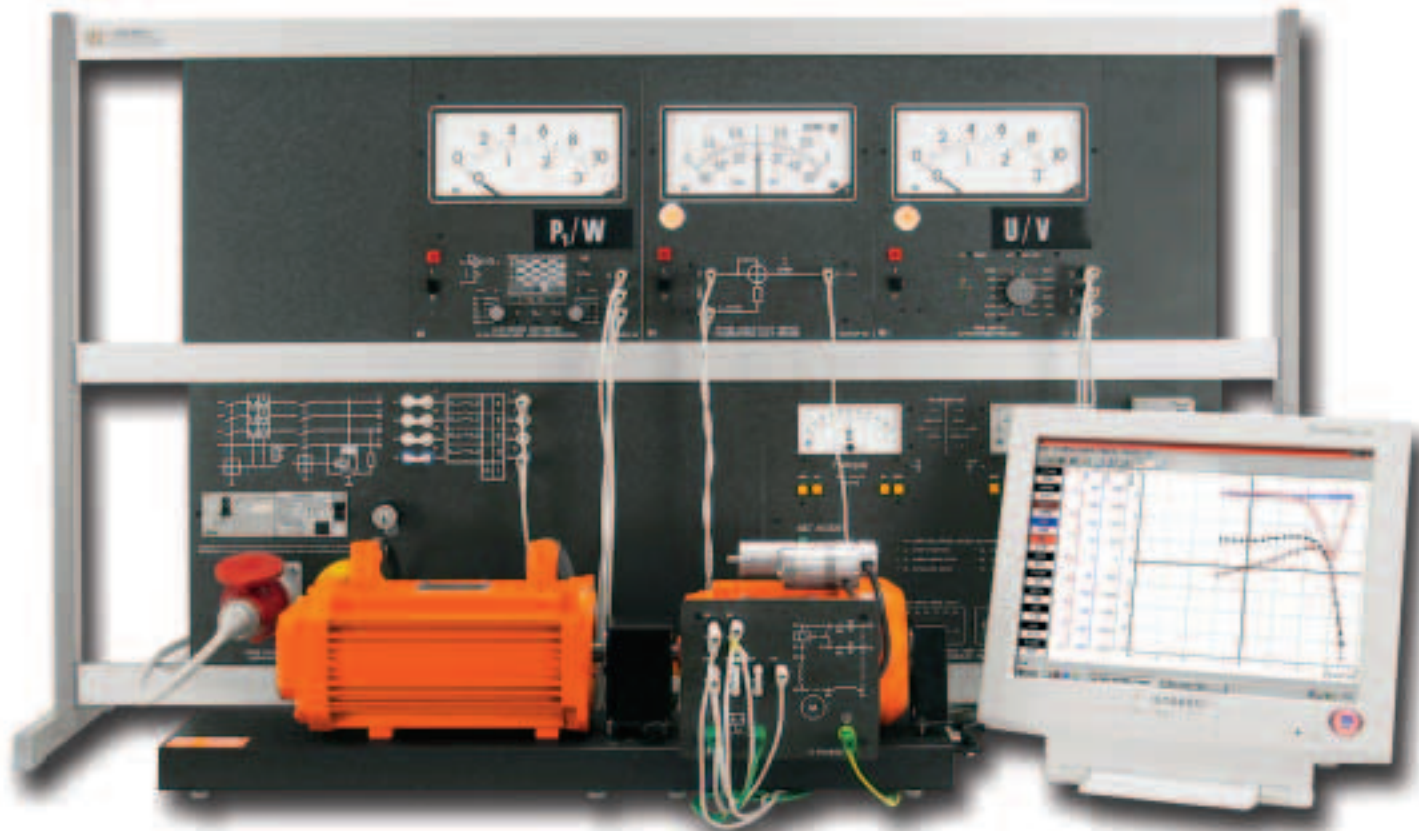
independent of the power rating

EEM 3 AC MACHINES

AC machines are available with power ratings of up to several kW's. Their main field of application is in operating mobile loads (consumers). AC machines are evident in many areas of daily life, for instance, an electric razor on to a washing machine. The subject of AC Machines covers the following types:

- Universal motors
- Repulsion motors
- Single-phase motors with bifilar starting winding

- Single-phase motors with starting and operating capacitor
 - Split-pole motors
- The training objectives cover:
- Connection and operating the motor
 - Reversing the direction of rotation
 - Recording machine-specific values and characteristic curves $\{n, I, P_1, P_2, \cos \varphi, \eta\} = f(M)$
 - Load and acceleration characteristics
 - Evaluating the measured values



EEM 3 AC MACHINES

- EEM 3.1 Universal motor**
- EEM 3.2 Repulsion motor**
- EEM 3.3 Single-phase motor with bifilar starting winding**
- EEM 3.4 Single-phase motor with starting and operating capacitor**
- EEM 3.5 Split-pole motor**

Order No.	Description	0.3 kW					1 kW			
		EEM 3.1	EEM 3.2	EEM 3.3	EEM 3.4	EEM 3.5	EEM 3.1	EEM 3.2	EEM 3.3	EEM 3.4
SE2662-3E	Universal motor, 0.3 kW	1								
SE2662-3F	AC repulsion motor, 0.3 kW		1							
SE2662-3N	AC-motor with bifilar winding, 0.3 kW			1						
SE2662-3P	AC-motor with starting and operating capacitor, 0.3 kW				1					
SE2662-1Q	Split-pole motor, 0.1 kW (only available as 100 W motor)					1				
SE2662-2A	Rubber coupling sleeve, 0.3 kW	1	1	1	1	1				
SE2662-2B	Coupling guard, 0.3 kW	1	1	1	1	1				
SE2662-2C	Shaft end guard, 0.3 kW	1	1	1	1	1				
SE2662-5E	Universal motor, 1 kW						1			
SE2662-5F	AC repulsion motor, 1 kW							1		
SE2662-5N	AC-motor with bifilar winding, 1 kW								1	
SE2662-5P	AC-motor with starting and operating capacitor, 1 kW									1
SE2662-6A	Rubber coupling sleeve, 1 kW						1	1	1	1
SE2662-6B	Coupling guard, 1 kW						1	1	1	1
SE2662-6C	Shaft end guard, 1 kW						1	1	1	1
SO3538-9P	Rectifier, 250 V/10 A	1							1	

Equipment List, Machine Test Stand, Servo Drive/Brake System:

SO3636-6R	Digital control unit for servo drive/servo brake, 0.3 kW	1	1	1	1	1				
SE2663-6A	Servo motor/servo brake, 0.3 kW	1	1	1	1	1				
SE2663-6D	Digital control unit for servo drive/servo brake, 1 kW						1	1	1	1
SE2663-6E	Servo motor/servo brake, 1 kW						1	1	1	1
LM8925	RS232/485 interface module for frequency converter & universal drive amplifier	1	1	1	1	1	1	1	1	1
LM9028	PC connection cable for RS232/485 interface module LM8925, l = 5 m	1	1	1	1	1	1	1	1	1

Software:

SO6006-4A	Software ActiveASMA asynchronous machine characteristics with servo brake V1.0 (GB)	1	1	1	1	1	1	1	1	1
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Literature:

SO5156-9L	EEM 3 Industrial AC Machines 0.3kW (GB)	1	1	1	1	1				
SO5156-9S	EEM 3 Industrial AC Machines 1.0 kW (GB)						1	1	1	1

Power supplies:

SO3212-1B	Three-phase supply 400 V/16 A with earth leakage circuit breaker	1	1	1	1	1	1	1	1	1
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Measuring instruments:

SO5127-1L	Large-scale true RMS meter	2	2	2	2	2	2	2	2	2
SO5127-1R	Large-scale electronic wattmeter	1	1	1	1	1	1	1	1	1
SO5127-1M	Large-scale power factor and phase angle meter	1	1	1	1	1	1	1	1	1

Accessories:

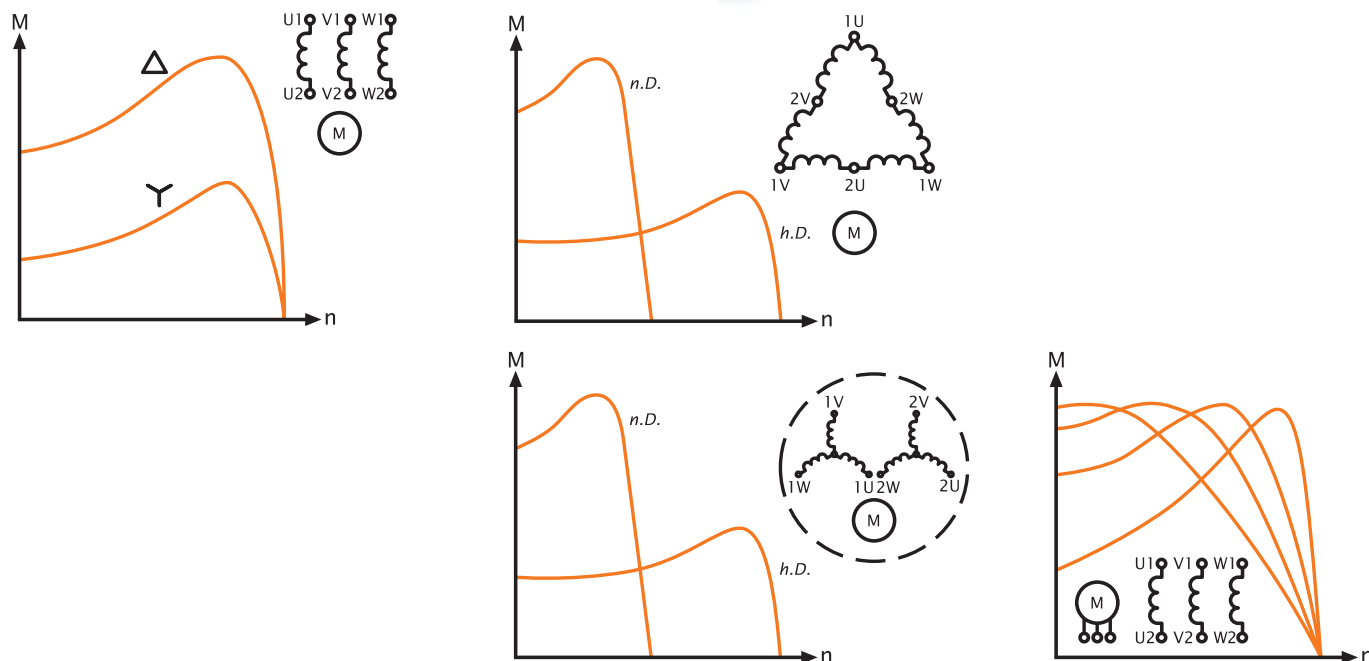
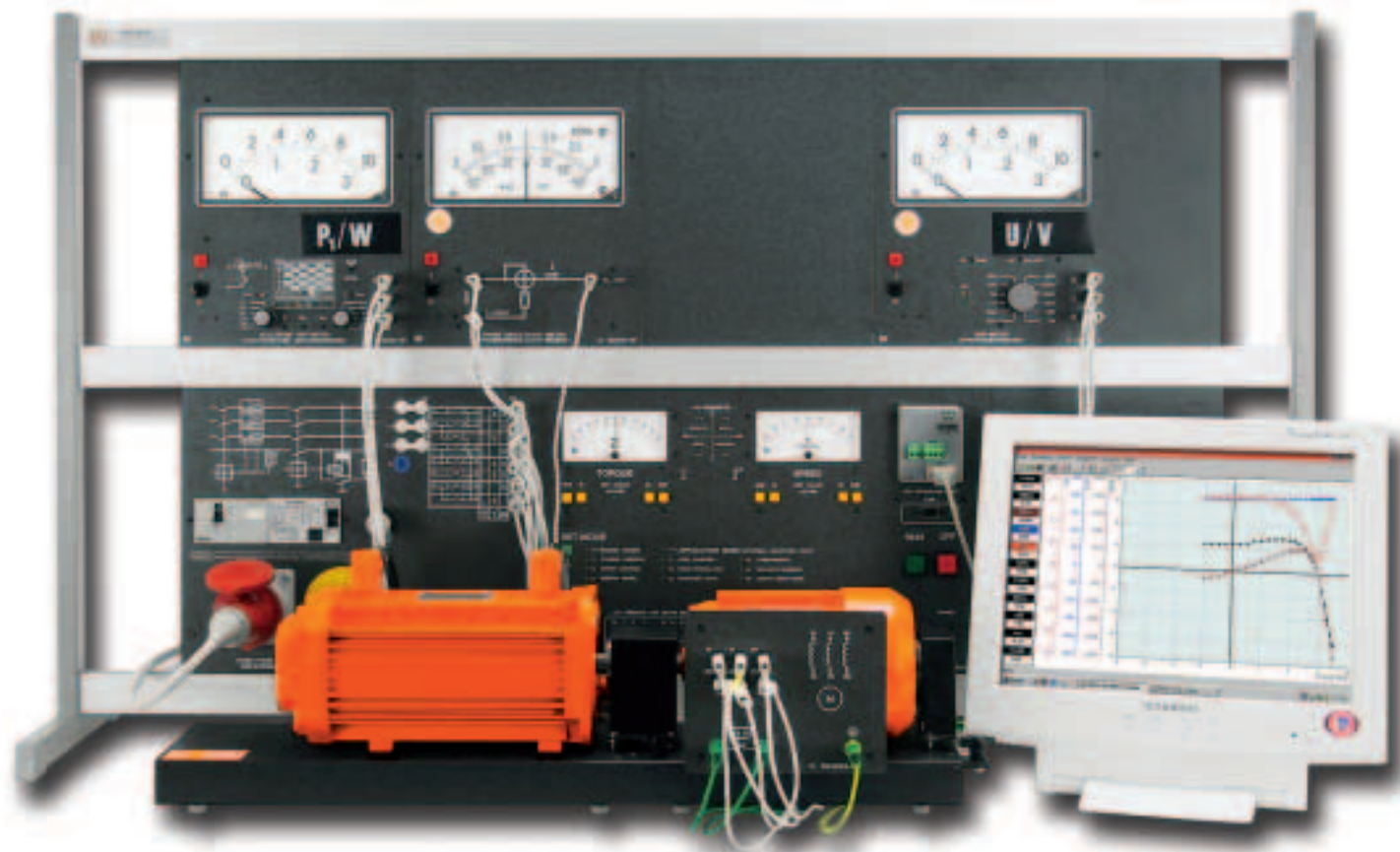
SO3212-1W	Cut-out switch, 4 pole	1	1	1	1	1	1	1	1	1
SO5148-1F	Set of safety connection cables 4 mm (47 pcs.)	1	1	1	1	1	1	1	1	1
SO5126-9X	Safety protected connection plug 19/4 mm, white	15	15	15	15	15	15	15	15	15
SO5126-9Z	Safety protected connection plug 19/4 mm, white, with tapping	5	5	5	5	5	5	5	5	5
ST7003-1CG	Table-top frame, 2 levels, W 1230 x H 740 mm, grey	1	1	1	1	1	1	1	1	1

EEM 4 THREE-PHASE ASYNCHRONOUS MACHINES

Asynchronous machines are available with power ratings up in the MW range. Due to their straightforward construction, asynchronous squirrel-cage machines are particularly widespread. The subject of Asynchronous Machines covers the following types:

- Three-phase motor with squirrel-cage rotor
- Pole-changeable three-phase motor according to Dahlander
- Pole-changeable three-phase motor with two

- separate windings
- The training objectives are:
- Connection and operating the motor
 - Reversing the direction of rotation
 - Manual switching
 - Recording machine-specific values and characteristic curves $\{n, I, P_1, P_2, \cos \varphi, \eta\} = f(M)$
 - Evaluating the measured values



EEM 4 THREE-PHASE ASYNCHRONOUS MACHINES

- EEM 4.1 Squirrel-cage rotor**
- EEM 4.2 Squirrel-cage rotor, pole-changeable according to Dahlander**
- EEM 4.3 Squirrel-cage rotor, pole-changeable with two separate windings**
- EEM 4.4 Three-phase motor with slip-rings**
- EEM 4.1 Squirrel-cage rotor**
- EEM 4.2 Squirrel-cage rotor, pole-changeable according to Dahlander**
- EEM 4.3 Squirrel-cage rotor, pole-changeable with two separate windings**
- EEM 4.4 Three-phase motor with slip-rings**

Order No.	Description	0.3 kW				1 kW			
		EEM 4.1	EEM 4.2	EEM 4.3	EEM 4.4	EEM 4.1	EEM 4.2	EEM 4.3	EEM 4.4
SE2662-3G	Three-phase asynchronous motor, 0.3 kW	1							
SE2662-3K	Three-phase asynchronous motor, pole changing, Dahlander, 0.3 kW		1						
SE2662-3L	Three-phase asynchronous motor, pole changing, two separate windings, 0.3 kW			1					
SE2662-3W	Three-phase multi-function machine, 0.3 kW				1				
SO3212-6M	Load resistor, 0.3 kW	1							
SO3212-5C	Starter for slip-ring motors, 0.1/0.3 kW					1			
SO3212-6R	Load resistor for synchronous generator, 0.3 kW						(1)		
SE2662-2A	Rubber coupling sleeve, 0.3 kW	1	1	1	1				
SE2662-2B	Coupling guard, 0.3 kW	1	1	1	1				
SE2662-2C	Shaft end guard, 0.3 kW	1	1	1	1				
SE2662-5G	Three-phase asynchronous motor with slip-ring rotor, 1 kW								1
SE2662-5K	Three-phase asynchronous machine, Dahlander, 1 kW								1
SE2662-5L	Three-phase asynchronous machine, pole changing, with 2 separate windings, 1 kW								1
SE2662-6W	Three-phase multi-function machine, 1 kW								1
SE2662-6J	Load resistance, 1 kW								1
SO3212-6D	Starter for slip-ring motors, 1 kW								1
SE2662-6K	Load resistance for synchronous generator, 1 kW								(1)
SE2662-6A	Rubber coupling sleeve, 1 kW								1
SE2662-6B	Coupling guard, 1 kW								1
SE2662-6C	Shaft end guard, 1 kW								1
SO3212-2D	Star-Delta switch	1							1
SO3212-2H	Pole reverser Dahlander		1						1
SO3212-2K	Pole reverser for 2 separate windings			1					1
SO3212-1W	Cut-out switch, 4 pole				1				1
SO3212-6E	Compensation panel, 6 x 1 μF/400V	1							1
Equipment List, Machine Test Stand, Servo Drive/Brake System:									
SO3636-6R	Digital control unit for servo drive/servo brake, 0.3 kW	1	1	1	1				
SE2663-6A	Servo motor/servo brake, 0.3 kW	1	1	1	1				
SE2663-6D	Digital control unit for servo drive/servo brake, 1 kW								1
SE2663-6E	Servo motor/servo brake, 1 kW								1
LM8925	RS232/485 interface module for frequency converter & universal drive amplifier	1	1	1	1	1	1	1	1
LM9028	PC connection cable for RS232/485 interface module LM8925, l = 5 m	1	1	1	1	1	1	1	1
Software:									
SO6006-4A	Software ActiveASMA asynchronous machine characteristics with servo brake V1.0 (GB)	1	1	1	1	1	1	1	1
Literature:									
SO5156-9M	EEM 4 Industrial Three-phase Asynchronous Motors 0.3kW (GB)	1	1	1	1				
SO5156-9T	EEM 4 Industrial Three-phase Asynchronous Motors 1kW (GB)								1
Power supplies:									
SO3212-1B	Three-phase supply 400 V/16 A with earth leakage circuit breaker	1	1	1	1	1	1	1	1
Measuring instruments:									
SO5127-1L	Large-scale true RMS meter	2	2	2	2	2	2	2	2
SO5127-1R	Large-scale electronic wattmeter	1	1	1	1	1	1	1	1
SO5127-1M	Large-scale power factor and phase angle meter	1	1	1	1	1	1	1	1
Accessories:									
SO5148-1F	Set of safety connection cables 4 mm (47 pcs.)	1	1	1	1	1	1	1	1
SO5126-9X	Safety protected connection plug 19/4 mm, white	15	15	15	15	15	15	15	15
SO5126-9Z	Safety protected connection plug 19/4 mm, white, with tapping	5	5	5	5	5	5	5	5
ST7003-1CG	Table-top frame, 2 levels, W 1230 x H 740 mm, grey	1	1	1	1	1	1	1	1

(1) Optional for the exercises dealing with a rotary transformer

Synchronous machines are primarily used as generators in power generation and as highly dynamic drives (servos). Training objectives:

- Synchronous machines
- Mains synchronisation
- Reluctance machines

EEM 5.1 SYNCHRONOUS MACHINES

Training objectives:

MOTOR OPERATION:

- Connecting the motor
- Starting
- Reversing the direction of rotation
- Excitation and load angle
- Phase shifter
- Power factor and exciter current
- Load characteristics in motor operation
- V characteristics
- Stability limits
- Under- and overexcitation
- Evaluating the measured values

GENERATOR OPERATION:

- Connecting the generator
- Voltage adjustment via the exciter current
- Load characteristics in generator operation
- Evaluating the measured values

EEM 5.2 MAINS SYNCHRONISATION

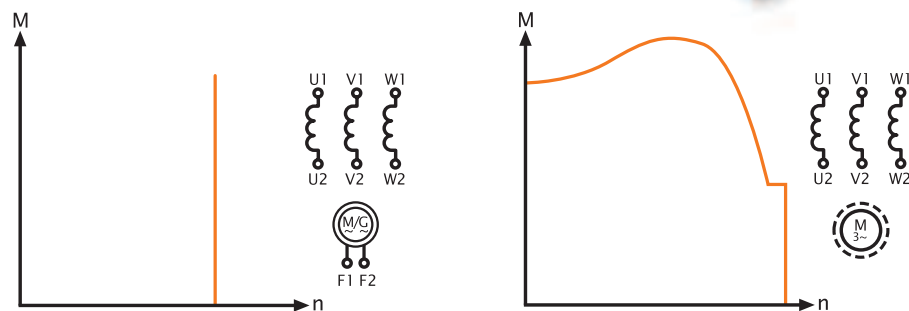
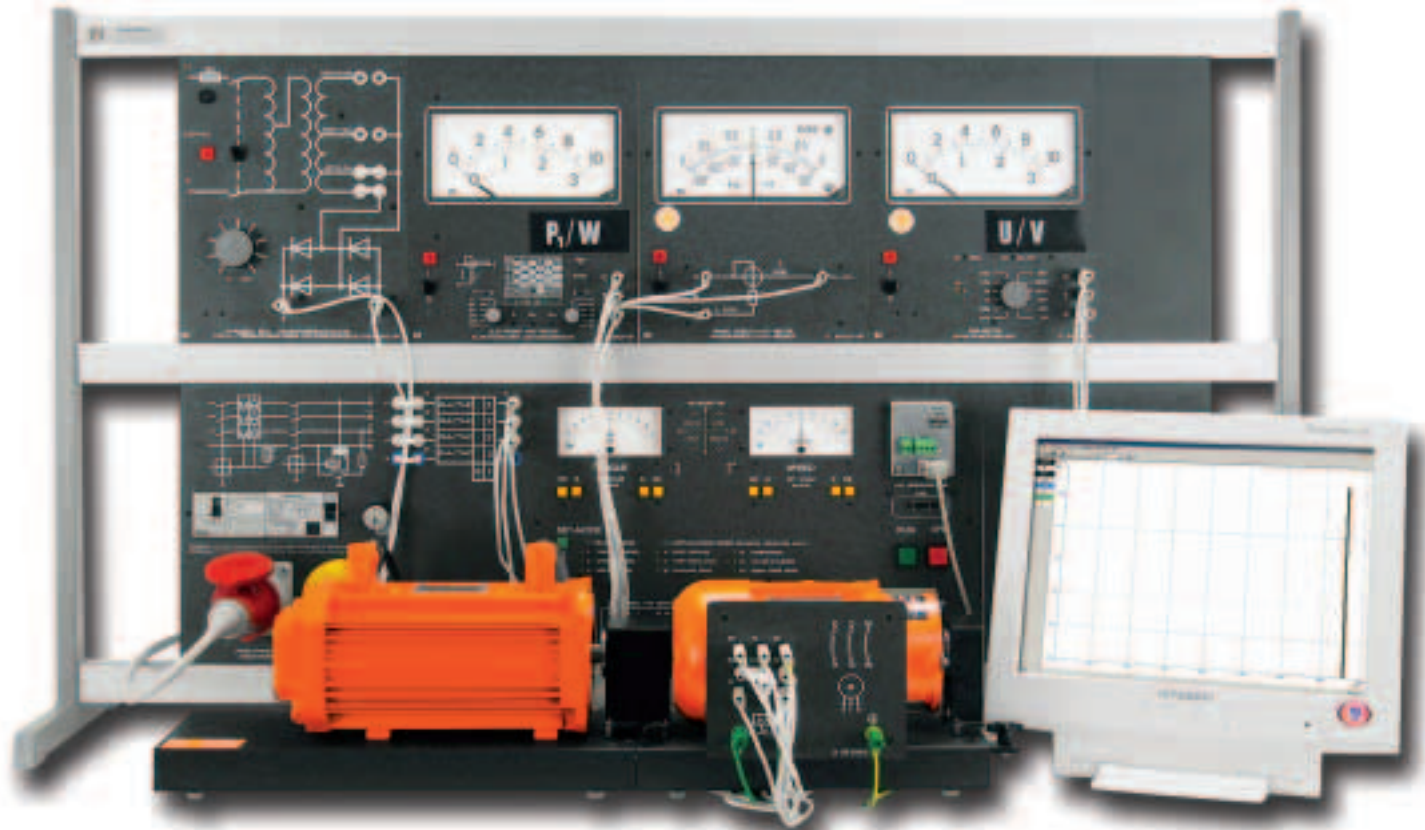
Training objectives:

- EEM 5.21 Mains synchronisation using lamps (bright, dark and synchronising circuit)
- EEM 5.22 Mains synchronisation using double frequency and double voltage meters, synchroscope and zero-voltage meter

EEM 5.3 THREE-PHASE RELUCTANCE MACHINE

Training objectives:

- Connecting the machine
- Starting
- Reversing the direction of rotation
- Load characteristics
- Evaluating the measured values



EEM 5.1 Synchronous Machines

EEM 5.21 Mains synchronisation using lamps (bright, dark and synchronising circuit)

EEM 5.22 Mains synchronisation using double frequency and double voltage meters, synchroscope and zero-voltage meter

EEM 5.3 Three-phase Reluctance Machine

EEM 5.1 Synchronous Machines

EEM 5.21 Mains synchronisation using lamps (bright, dark and synchronising circuit)

EEM 5.22 Mains synchronisation using double frequency and double voltage meters, synchroscope and zero-voltage meter

EEM 5.3 Three-phase Reluctance Machine

Order No.	Description	EEM 5.1	EEM 5.21	EEM 5.22	EEM 5.3	EEM 5.1	EEM 5.21	EEM 5.22	EEM 5.3
		0.3 kW				1 kW			
SE2662-3W	Three-phase multi-function machine, 0.3 kW	1	1	1					
SE2662-3Q	Three-phase synchronous machine with smooth-core rotor, 0.3 kW	(A)	(A)	(A)					
SE2662-3M	Three-phase synchronous machine with salient pole, 0.3 kW	(A)	(A)	(A)					
SE2662-3U	Reluctance motor, 0.3 kW				1				
SO3212-6R	Load resistor for synchronous generator, 0.3 kW	1							
SO3212-5K	Variable isolating transformer/exciter 0-230V	1	1	1					
SO3212-1J	Motor protection switch, 0.4 - 0.63 A		1	1					
SE2662-2A	Rubber coupling sleeve, 0.3 kW	1	1	1	1				
SE2662-2B	Coupling guard, 0.3 kW	1	1	1	1				
SE2662-2C	Shaft end guard, 0.3 kW	1	1	1	1				
SE2662-6W	Three-phase multi-function machine, 1 kW					1	1	1	
SE2662-5Q	Three-phase synchronous machine with smooth core rotor, 1 kW					(A)	(A)	(A)	
SE2662-5M	Three-phase synchronous machine with salient pole, 1 kW					(A)	(A)	(A)	
SE2662-6K	Load resistance for synchronous generators, 1 kW					1			
SO3212-5W	DC power supply, 0-250V/10A stabilised					1	1	1	
SO3212-1P	Motor protection switch, 1.6 - 2.5 A								1
SE2662-6A	Rubber coupling sleeve, 1 kW					1	1	1	1
SE2662-6B	Coupling guard, 1 kW					1	1	1	1
SE2662-6C	Shaft end guard, 1 kW					1	1	1	1
SO3212-6T	Synchronising panel		1						1
SO3213-1J	Synchroscope (96 x 96 mm)		1						1
SO3213-3W	Double voltmeter 2x500 V (96 x 96 mm)		1						1
SO3213-1L	Double frequency meter (96 x 96 mm)		1						1
SO3213-1K	Zero-voltage meter 400/800 V (96 x 96 mm)		1						1
SE2662-5V	Reluctance motor, 1 kW								1
SO3212-1W	Cut-out switch, 4 pole	1	1	1	1	1	1	1	1
Equipment List, Machine Test Stand, Servo Drive/Brake System:									
SO3636-6R	Digital control unit for servo drive / servo brake, 0.3 kW	1	1	1	1				
SE2663-6A	Servo motor/servo brake, 0.3 kW	1	1	1	1				
SE2663-6D	Digital control unit for servo drive/servo brake, 1 kW					1	1	1	1
SE2663-6E	Servo motor/servo brake, 1 kW					1	1	1	1
LM8925	RS232/485 interface module for frequency converter & universal drive amplifier	1	1	1	1	1	1	1	1
LM9028	PC connection cable for RS232/485 interface module LM8925, l = 5 m	1	1	1	1	1	1	1	1
Software:									
SO6006-4A	Software ActiveASMA asynchronous machine characteristics with servo brake V1.0 (GB)	1	1	1	1	1	1	1	1
Literature:									
SO5156-9C	EEM 5 Three-phase Multi-Function Machine 0.3 kW (GB)	1	1	1	1				
SO5156-8T	EEM 5 Three-phase Multi-Function Machine 1 kW (GB)					1	1	1	1
Power supplies:									
SO3212-1B	Three-phase supply 400 V/16 A with earth leakage circuit breaker	1	1	1	1	1	1	1	1
Measuring instruments:									
SO5127-1L	Large-scale true RMS meter	2	2	2	2	2	2	2	2
SO5127-1R	Large-scale electronic wattmeter	1	1	1	1	1	1	1	1
SO5127-1M	Large-scale power factor and phase angle meter	1	1	1	1	1	1	1	1
Accessories:									
SO5148-1F	Set of safety connection cables 4 mm (47 pcs.)	1	1	1	1	1	1	1	1
SO5126-9X	Safety protected connection plug 19/4 mm, white	15	15	15	15	15	15	15	15
SO5126-9Z	Safety protected connection plug 19/4 mm, white, with tapping	5	5	5	5	5	5	5	5
ST7003-1CG	Table-top frame, 2 levels, W 1230 x H 740 mm, grey	1	1	1	1	1	1	1	1

(A) Alternative for three-phase multi-function machine

EEM/F FAULT FINDING ON ELECTRIC MACHINES

Fault finding with a fault simulator by measuring the resistance of the windings and insulation. All measurements are completed in a no-voltage state. The following faults can be simulated:

- Winding breaks in the coils
- Insulation faults, winding to winding
- Insulation faults, winding to frame
- Combinations of different faults
- Fault monitoring and repair instructions



ENT 1/ENT 2 TRANSFORMERS

Transformers are used in all power classes both in industry and in domestic appliances. They are used for the conversion of voltages and current. The training system is based on transformers with a power rating of 300 VA.

Training topics covered:

- Complete and simplified equivalent circuits; measurement of the individual variables
- Transformation of current and voltage
- Measuring the Rush current using an oscilloscope
- Measurement and calculation of the no-load values
- Measurement and calculation of the short-circuit data
- Measurements with a variable load
- Determining the efficiency
- Evaluating the measured values
- Phase angle between primary and secondary windings and the effect of asymmetric loading in the circuit groups Yy, Yd, Yz, Dy



EEM/F	Fault Finding on Electric Machines	EEM/F	EEM/F
EEM/F	Fault Finding on Electric Machines	0.3 kW	1 kW
Order No.	Description		
SE2662-9D	Fault simulator for three-phase asynchronous motor	1	1
SE2662-3G	Three-phase asynchronous motor, 0.3 kW	1	
SE2662-5G	Three-phase asynchronous motor, 1 kW		1
Literature:			
SO5157-8E	EEM/F Fault Finding on Electric Machines (GB)	1	1
Measuring instruments:			
LM8501	Insulation tester for VDE 0100/610, EN61557/-1,2,4, VDE 701/240, EN344	1	1

ENT 1	Single-phase isolating transformers	ENT 1	ENT 2
ENT 2	Three-phase isolating transformers	0.3 kW	0.3 kW
Order No.	Description		
SE2662-4Q	Single-phase isolating transformer, 300 VA	1	
SE2662-4S	Single-phase economy transformer (auto-transformer), 300 VA	1	
SE2662-4U	Single-phase toroidal isolating transformer, 300 VA	1	
SE2662-4R	Three-phase isolating transformer, 300 VA		1
SE2662-8N	Ohmic load, three-phase, 14-stage, 0.3 kW	1	1
SE2662-8H	Capacitive load, three-phase, 14-stage, 1 kW	1	1
Literature:			
SO5156-5N	ENT 1 Single-phase Mains Transformers, 0.3 kW (GB)	1	
SO5156-5P	ENT 2 Three-phase Mains Transformers, 0.3 kW (GB)		1
Power supplies:			
SO3212-1B	Three-phase supply 400 V/16 A with earth leakage circuit breaker	1	1
SO5127-2Y	Foot base (pair) for 5mm panels	1	1
Measuring instruments:			
LM2319	Digital multimeter 4 3/4 digit	2	2
LM6113	4-channel isolating amplifier	1	1
LM6115	Test resistor 2A/0.5V	1	1
LM6205	Digital storage oscilloscope, incl. probes	1	1
Accessories:			
LM9034	Test lead, BNC/BNC	1	1
SO5148-1H	Set of safety connection cables 4 mm (34 pcs.)	1	1
SO5126-9X	Safety protected connection plug 19/4 mm, white	10	10
SO5126-9Z	Safety protected connection plug 19/4 mm, white, with tapping	5	5

DISMOUNTABLE THREE-PHASE MACHINE SET

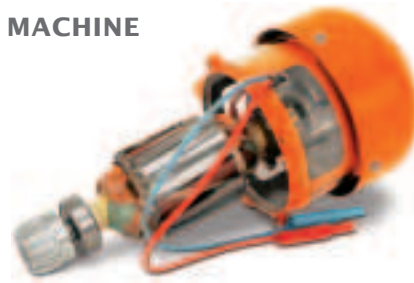


As an alternative to the standard 0.3 kW machines, the following machines can be assembled and examined using the LN three-phase machine set:

SQUIRREL-CAGE MACHINE



SYNCHRONOUS MACHINE



SLIP-RING MACHINE



RELUCTANCE MACHINE



The set consists of a standard uniform stator for all types of machine. The rotor is exchangeable. Because of the dismountable assembly, the set is particularly suitable for learning the fundamentals of machine construction and examining the differences between the various types of machine. Cut-away, sectional models are no longer required since, after assembly, the machines are fully-functional and can be coupled to a braking system.

The stator is mounted on a black anti-vibration machine base. The terminal box includes connections for the machine at 4 mm safety-protected sockets. Overlay masks adapted for the various machines show a screen-print and the connections. The various rotor types are easily exchanged and no hand tools are required. Protection against thermal overload is achieved by way of temperature sensors. The electric connections to the rotor (slip-ring rotor, synchronous machine) are made via a polarity-protected plug-in connector. All rotating parts can be protected by shaft end guards. The machines conform to the regulations according to DIN VDE 0530 and the protection class IP 20.

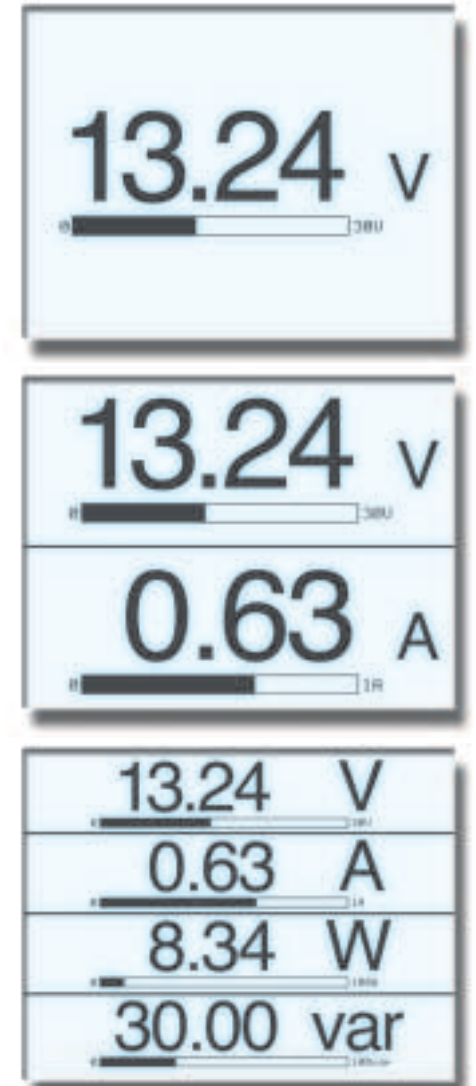
The basic equipment set includes a stator and two rotors. Thus, squirrel-cage rotor and slip-ring rotor machines can be assembled and examined. As supplementary equipment (add-on's), rotors are available for synchronous and reluctance machines.

- SE2663-3A** Basic set consisting of: stator, rotors for squirrel-cage and slip-ring machines
- SE2663-3B** Rotor for synchronous machine
- SE2663-3C** Rotor for reluctance machine

ANALOG/DIGITAL MULTIMETER

The subject of electric machines, power electronics and drive engineering places special demands on the measurements used. In addition to an efficient overload protection, the detection of the measured values must be accurate, irrespective of the waveform shapes being measured. The universal test

instrument has been specially designed to meet these demands. It replaces the use of up to 4 test instruments – it measures current/voltage, power and phase angle all on one instrument. The graphic display is suitable for individual student exercises as well as for demonstration purposes.



THE TEST INSTRUMENT IS CHARACTERISED BY THE FOLLOWING FEATURES:

- Simultaneous measurement of voltage and current, independent of wave shape, up to a maximum of 600 V, 20 A (measurement of switched-mode voltages)
- Selectable r.m.s. or arithmetic measurement
- Calculation of active, reactive and apparent powers, and power factor
- Measured values displayed with the associated units
- Electrically indestructible up to 30 A/1000 V
- Automatic or manual measurement range selection
- Large, high-contrast graphic display (5.7") with back-lighting
- Large-area indication or display of up to 4 measured values
- RS232 and USB interfaces
- Demonstration test instrument for mains operation

Order No.: S05127-1Z

DC MULTI-CIRCUIT, COMPOUND WOUND MACHINE



	0.3 kW	1 kW
Nominal voltage:	220 V	220 V
Nominal current:	1/1.2/1.2 A	5.7/6.2/5.8 A
Exciter voltage:	220 V	220 V
Exciter current:	100 mA	550 mA
Nominal speed rpm:	2000/1800/2000	2040/1650/1870
Nominal power:	0.2 kW	1 kW
Dimensions:	340 x 210 x 210	520 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	21 kg
Order No.:	SE2662-3D	SE2662-5D

DC SHUNT WOUND MACHINE



	0.3 kW	1 kW
Nominal voltage:	220 V	220 V
Nominal current:	1.4 A	6.2 A
Exciter voltage:	220 V	220 V
Exciter current:	140 mA	240 mA
Nominal speed:	2000 rpm	2100 rpm
Nominal power:	0.25 kW	1 kW
Dimensions:	340 x 210 x 210	520 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	18 kg
Order No.:	SE2662-3A	SE2662-5A

DC SERIES WOUND MACHINE



	0.3 kW	1 kW
Nominal voltage:	220 V	220 V
Nominal current:	1.5 A	6.5 A
Nominal speed:	2000 rpm	2300 rpm
Nominal power:	0.25 kW	1 kW
Dimensions:	340 x 210 x 210	520 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	18 kg
Order No.:	SE2662-3B	SE2662-5B

DC COMPOUND WOUND MACHINE



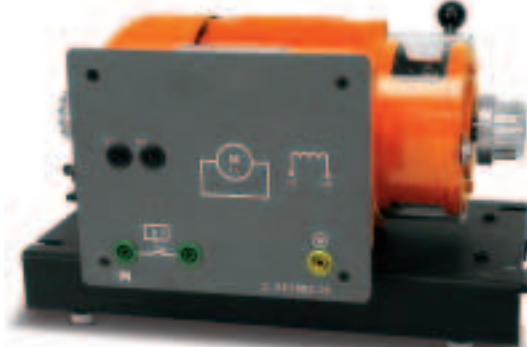
	0.3 kW	1 kW
Nominal voltage:	220 V	220 V
Nominal current:	1.4 A	6.4 A
Exciter voltage:	220 V	220 V
Exciter current:	100 mA	200 mA
Nominal speed:	2000 rpm	2150 rpm
Nominal power:	0.25 kW	1 kW
Dimensions:	340 x 210 x 210	520 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	18 kg
Order No.:	SE2662-3C	SE2662-5C

UNIVERSAL MOTOR



	0.3 kW	1 kW
Nominal voltage*:	220 V~/230 V~, 50 Hz	220 V~/230 V~, 50 Hz
Nominal current:	1.6 A~/2.2 A~	8.3 A~/7.8 A~
Nominal speed:	3000 rpm	4000/3150 rpm
Nominal power:	0.25 kW	1/0.75 kW
cos phi	0.65	0.78
Dimensions:	340 x 210 x 210	500 x 210 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	18 kg
Order No.:	SE2662-3E	SE2662-5E

SINGLE-PHASE REPULSION MOTOR



	0.3 kW	1 kW
Nominal voltage*:	230 V, 50 Hz	230 V, 50 Hz
Nominal current:	2.7 A	10.2 A
Nominal speed:	2100 rpm	2900 rpm
Nominal power:	0.25 kW	1 kW
cos phi	0.7	0.65
Dimensions:	340 x 210 x 210	500 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	18 kg
Order No.:	SE2662-3F	SE2662-5F

AC-MOTOR WITH BIFILAR WINDING



	0.3 kW	1 kW
Nominal voltage*:	230 V, 50 Hz	230 V, 50 Hz
Nominal current:	3.6 A	6.7 A
Nominal speed:	2880 rpm	2870 rpm
Nominal power:	0.37 kW	0.75 kW
cos phi:	0.73	0.77
Dimensions:	340 x 210 x 210	380 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	14 kg
Order No.:	SE2662-3N	SE2662-5N

AC-MOTOR WITH STARTING & OPERATING CAPACITOR



	0.3 kW	1 kW
Nominal voltage*:	230 V, 50 Hz	230 V, 50 Hz
Nominal current:	2.4 A	7.3 A
Nominal speed:	2815 rpm	2750 rpm
Nominal power:	0.37 kW	1.1 kW
cos phi:	0.96	0.98
Capacitor start:	25 µF	100 µF
Capacitor operation:	12 µF	25 µF
Dimensions:	340 x 210 x 210	380 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	9 kg	14 kg
Order No.:	SE2662-3P	SE2662-5P

*other voltages by request

THREE-PHASE ASYNCHRONOUS MOTOR



	0.3 kW	1 kW
Nominal voltage*:	690/400 V, 50 Hz	690/400 V, 50 Hz
Nominal current:	0.81 A/1.73 A	1.4 A/2.4 A
Nominal speed:	2800 rpm	2780 rpm
Nominal power:	0.37 kW	1 kW
cos phi:	0.84	0.83
Dimensions:	340 x 210 x 210	380 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	9 kg	13 kg
Order No.:	SE2662-3G	SE2662-5G

THREE-PHASE ASYNCHRONOUS MACHINE INDUSTRIAL VERSION



	0.3 kW	1 kW
Nominal voltage*:	400/230 V, 50 Hz	400/230 V, 50 Hz
Nominal current:	1.05/1.8 A	2.9/5 A
Nominal speed:	1360 rpm	1400 rpm
Nominal power:	0.37 kW	1 kW
cos phi:	0.8	0.74
Dimensions:	340 x 210 x 210	380 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	9 kg	14 kg
Order No.:	SE2663-1K	SE2663-1H

THREE-PHASE ASYNCHRONOUS MOTOR, POLE CHANGING, DAHLANDER



	0.3 kW	1 kW
Nominal voltage*:	400 V, 50 Hz	400 V, 50 Hz
	(double star connection)	(double star connection)
Nominal current:	0.8/1 A	2.4/3 A
Nominal speed:	1420/2860 rpm	1400/2820 rpm
Nominal power:	0.2/0.3 kW	0.75/1.1 kW
cos phi:	0.62/0.73	0.72/0.8
Dimensions:	340 x 210 x 210	380 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	9 kg	14 kg
Order No.:	SE2662-3K	SE2662-5K

THREE-PHASE ASYNCHRONOUS MOTOR, POLE CHANGING, TWO SEPARATE WINDINGS



	0.3 kW	1 kW
Nominal voltage*:	400V, 50 Hz	400 V, 50 Hz
	(double star connection)	(double star connection)
Nominal current:	0.57/0.71 A	2.5/2.7 A
Nominal speed:	1380/2750 rpm	1400/2800 rpm
Nominal power:	0.12/0.25 kW	0.9/1 kW
cos phi:	0.6/0.7	0.84/0.94
Dimensions:	340 x 210 x 210	440 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	8 kg	17 kg
Order No.:	SE2662-3L	SE2662-5L

THREE-PHASE MULTI-FUNCTION MACHINE (SLIP-RING- AND SYNCHRONOUS MACHINE)



	0.3 kW	1 kW
Nominal voltage*:	400/230 V, 50 Hz	400/230 V, 50 Hz
Nominal current:	0.87/1.5 A	2.0/3.5 A
Nominal speed:	1420/1500 rpm	1400/1500 rpm
Nominal power:	0.27 kW	0.8 kW
cos phi:	0.7	0.75
Exciter voltage:	107 V~/20 V-	130 V~/24 V-
Exciter current:	1.7 A~/4 A-	4 A~/11 A-
Dimensions:	340 x 210 x 210	500 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	20 kg
Order No.:	SE2662-3W	SE2662-6W

THREE-PHASE SYNCHRONOUS MACHINE WITH SMOOTH-CORE ROTOR



	0.3 kW	1 kW
Nominal voltage*:	400/230 V, 50 Hz	400/230 V, 50 Hz
Nominal current:	0.66/1.14 A	1.5/2.6 A
Nominal speed:	1500 rpm	1500 rpm
Nominal power:	0.3 kW	0.8 kW
cos phi:	0.97	0.8 1...0.8
Exciter voltage:	150 V-	220 V-
Exciter current:	0.95 A-	1.6 A-
Dimensions:	340 x 210 x 210	500 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	20 kg
Order No.:	SE2662-3Q	SE2662-5Q

THREE-PHASE SYNCHRONOUS MACHINE WITH SALIENT POLE



	0.3 kW	1 kW
Nominal voltage*:	400/230 V, 50 Hz	400/230 V, 50 Hz
Nominal current:	0.45/0.7 A	1.6/2.8 A
Nominal speed:	1500 rpm	1500 rpm
Nominal power:	0.3 kW	0.8 kW
cos phi:	1/0.8	1/0.8
Exciter voltage:	140 V-	220 V-
Exciter current:	0.55 A-	0.6 A-
Dimensions:	360 x 210 x 210	490 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	22 kg
Order No.:	SE 2662-3M	SE2662-5M

RELUCTANCE MOTOR



	0.3 kW	1 kW
Nominal voltage*:	400/230 V, 50 Hz	400/230 V, 50 Hz
Nominal current:	2.9/4.9 A	5.2/9 A
Nominal speed:	3000 rpm	3000 rpm
Nominal power:	0.37 kW	1.3 kW
cos phi:	0.35	0.48
Dimensions:	340 x 210 x 210	380 x 220 x 250
(in mm)	(W x H x D)	(W x H x D)
Weight:	10 kg	12 kg
Order No.:	SE2662-3U	SE2662-5V

RUBBER COUPLING SLEEVE



Rubber coupling sleeve used for the coupling of two machines; permits rapid and safe assembly; designed with internal ring gear.

	0.1/0.3 kW	1 kW
Material:	rubber (neoprene)	rubber (neoprene)
Dimensions: (in mm):	40 x 45 (length x diameter)	40 x 58 (length x diameter)
Weight:	0.1 kg	0.1 kg
Order No.:	SE2662-2A	SE2662-6A

COUPLING GUARD



Attachable metal guards used to protect against accidental physical contact with the coupling location where rotation occurs between two coupled machines.

	0.1/0.3 kW	1 kW
Material:	black steel plate, folded with function plug	black steel plate, folded with function plug
Dimensions: (in mm)	115 x 90 x 60 (H x W x D)	140 x 75 x 80 (H x W x D)
Weight:	0.1 kg	0.1 kg
Order No.:	SE2662-2B	SE2662-6B

SHAFT END GUARD



Pluggable metal cover for protection against rotating shaft ends of motors or generators.

	0.1/0.3 kW	1 kW
Material:	black steel plate, folded, closed at the sides with drilled panel and function plug	black steel plate, folded, closed at the sides with drilled panel and function plug
Dimensions: (in mm)	115 x 90 x 30 (H x W x D)	140 x 75 x 40 (H x W x D)
Weight:	0.1 kg	0.1 kg
Order No.:	SE2662-2C	SE2662-6C

SINGLE-PHASE ISOLATING TRANSFORMER 300 VA



Input voltage:	230 V, 50/60 Hz
Output voltage:	115/230 V
Power:	300 VA
Dimensions: (in mm)	227 x 245 x 280 (W x H x D) table-top unit
Weight:	4 kg
Order No.:	SE2662-4Q

SINGLE-PHASE TOROIDAL ISOLATING TRANSFORMER 300 VA



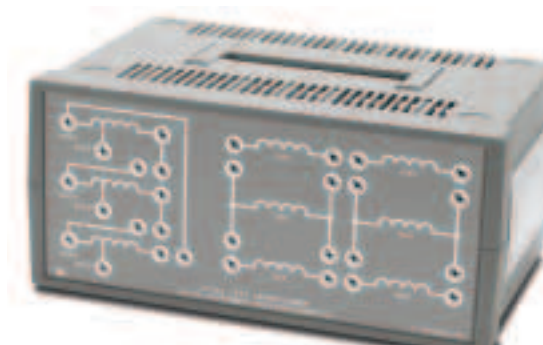
Input voltage:	230 V, 50/60 Hz
Output voltage:	115/230 V
Power:	300 VA
Dimensions: (in mm)	227 x 245 x 280 (W x H x D) table-top unit
Weight:	4 kg
Order No.:	SE2662-4U

SINGLE-PHASE ECONOMY TRANSFORMER (AUTO-TRANSFORMER) 300 VA



Input voltage:	230 V, 50/60 Hz
Output voltage:	115/230/250 V
Power:	300 VA
Dimensions: (in mm)	227 x 245 x 280 (W x H x D) table-top unit
Weight:	4 kg
Order No.:	SE2662-4S

THREE-PHASE ISOLATING TRANSFORMER 300 VA



Input voltage:	3 x 400/230 V, 50/60 Hz
Output voltage:	3 x 115/230 V
Power:	300 VA
Dimensions: (in mm)	460 x 245 x 280 (W x H x D) table-top unit
Weight:	10 kg
Order No.:	SE2662-4R

CUT-OUT SWITCH, 4 POLE



Switch position:	0-1 (Rotary switch)
Contact rating:	660 V, 12 A
Dimensions:	297 x 114 x 140 mm (H x W x D)
Weight:	0.8 kg
Order No.:	SO3212-1W

STAR-DELTA SWITCH



Switch position:	0-Y-Δ (Rotary switch)
Contact rating:	660 V, 20 A
Dimensions:	297 x 114 x 140 mm (H x W x D)
Weight:	0.8 kg
Order No.:	SO3212-2D

POLE REVERSER DAHLANDER/ POLE REVERSER TWO SEPARATE WINDINGS



3-stage rotary switch for speed setting of three-phase motors with two separate windings.

Switch position:	0-1-2 (Rotary switch)
Contact rating:	500 V, 16 A
Dimensions:	297 x 114 x 140 mm (H x W x D)
Weight:	0.8 kg
Pole reverser:	Dahlander
Order No.:	SO3212-2H
Pole reverser:	two separate windings
Order No.:	SO3212-2K

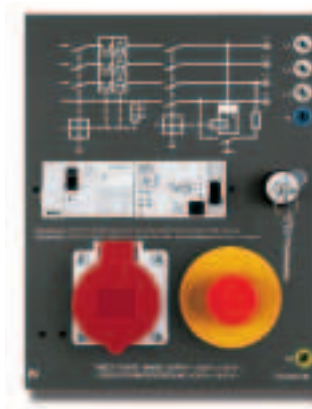
MOTOR PROTECTION SWITCH 3-POL. 0.4...0.63 A/1...1.6 A/1.6...2.5 A



Power circuit breaker incorporating thermal overload trip and undelayed overcurrent trip.

Switch position:	500 V, 10 A
Contact rating:	0.4...0.63 A adjustable
Dimensions:	297 x 114 x 125 mm (H x W x D)
Weight:	1 kg
Order No.:	SO3212-1J
Contact rating:	1.0...1.6 A adjustable
Order No.:	SO3212-1N
Contact rating:	1.6...2.5 A adjustable
Order No.:	SO3212-1P

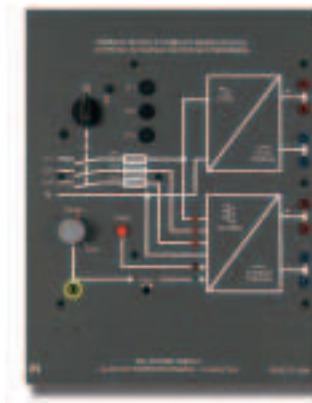
THREE-PHASE SUPPLY 400 V/16 A WITH E.L.C.B. CIRCUIT BREAKER



Mains voltage supply for single and three-phase circuits with built-in equipment protection and shock-hazard protection as well as three-phase plug for connection of additional three-phase loads.

Safety devices include:	Motor protecting switch adjustable from 6.3...16 A, Undervoltage trip, e.l.c.b. circuit breaker 30 mA, EMERGENCY-OFF pushbutton, Key-operated ON switch (two-handed operation)
Mains connection*:	3 x 230/400 V, 50 Hz via CEE plug with 1.8m cable
Outputs:	5 safety sockets 4 mm (L1, L2, L3, N, PE)
Mains output:	CEE socket
Dimensions:	297 x 228 x 140 mm (H x W x D)
Weight:	2 kg
Order No.:	SO3212-1B

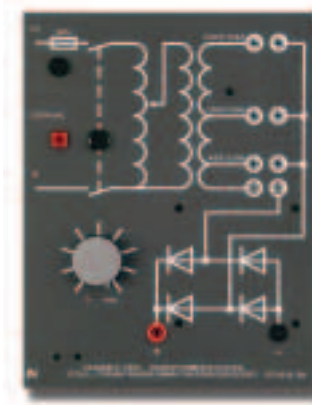
DC POWER SUPPLY, 0...250 V/10 A STABILISED



DC power supply for armature and field windings of DC machines up to 1.5 kW is stabilised and electronically protected against overload and short-circuit

Output voltage:	Controllable output voltage using thyristor half-bridge Electrical isolation between the control and the load-side Fuses: 3 fuse links 10 A, 240 V, 0...240 V- variable and 210 V-, 6 A fixed
Output current:	3...10 A (adjustable current limitation)
Mains connection*:	230/400 V, 50 Hz via CEE plug
Dimensions:	297 x 228 x 140 mm (H x W x D)
Weight:	3 kg
Order No.:	SO3212-5W

VARIABLE ISOLATING TRANSFORMER/EXCITER 0...230 V



Variable isolating transformer as exciter 0...230 V for field excitation of DC, synchronous and multi-function machines.

Output voltage:	0...230 V, 0.8 A ~/- 0...120 V, 1.6 A ~/- 0...40 V, 2.5 A ~/-
Mains connection*:	Voltage supply: 230 V, 50 Hz via mains cable
Dimensions:	297 x 114 x 125 mm (H x W x D)
Weight:	6.5 kg
Order No.:	SO3212-5K

*other voltages by request

TEST INSTRUMENTS

LARGE-SCALE TRUE R.M.S. METER



Active analog moving-coil instrument (RMS meter) for current and voltage measurement. Electrically indestructible up to 1000 V and up to 30 A.

Measurement modes:	Total rms value (RMS-AC+DC) Ripple rms value (RMS-AC) Arithmetic mean value (AV-AC+DC) moving-coil instrument class 1.5/2
Display:	Scale 1: measurement range 0-10 Scale 2: measurement range 0-3 Internal resistance: current path 10 mohm, voltage path 10 Mohm Voltage ranges: 3; 10; 30; 100; 300; 1000 V Current ranges: 0.1; 0.3; 1; 3; 10; 30 A Crest factor: 10 Measurement accuracy: 2 %
Power supply*:	230 V, 50 Hz
Dimensions:	297 x 228 x 140 mm (H x W x D)
Weight:	2 kg
Order No.:	SO5127-1L

LARGE-SCALE POWER FACTOR AND PHASE ANGLEMETER



Electrically indestructible up to 1000 V and 30 A.

Display:	Permanent moving coil instrument class 1.5 / double scale Scale 1: Measurement range cos-phi: 0 cap over 1 to 0 ind Scale 2: Measurement range phase angle: 90° cap over 0 up to 90° ind. No current - voltage range switchover Internal resistance: current path 10 mohm, voltage path 10 Mohm Measurement range: cos-phi: 0 cap. over 1 up to 0 ind., phase angle: 90° cap. over 0 up to 90° ind. Measurement accuracy: 3 %
Power supply*:	230 V, 50 Hz
Dimensions:	297 x 228 x 140 mm (H x W x D)
Weight:	2 kg
Order No.:	SO5127-1M

TEST INSTRUMENTS

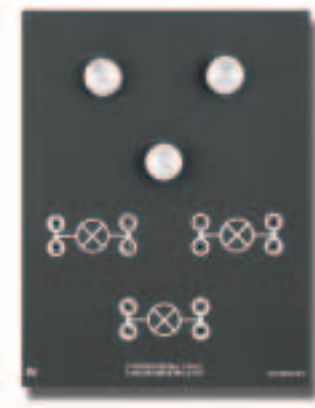
LARGE-SCALE WATTMETER



Electrically indestructible up to 1000 V and 30 A.

Display:	Overload resistant for current and voltage signals Permanent moving coil instrument class 1.5/double scales Scale 1: measurement range 0...10 Scale 2: measurement range 0...3 Active-reactive power measurement from 0.3 W (Var) up to 30 kW (kVar) Internal resistance: current path 10 mohm, voltage path 10 Mohm Crest factor: 2 Measurement accuracy: 2 % Outputs for oscilloscope
Power supply*:	230 V, 50 Hz
Dimensions:	297 x 228 x 140 mm (H x W x D)
Weight:	2 kg
Order No.:	SO5127-1R

SYNCHRONIZING PANEL



The synchronising panel (3 lamps) is used to display voltage and phase angles between generator and power supply circuit (light-dark indication).

Operating voltage*:	400 V
Dimensions:	297 x 114 x 125 mm (H x W x D)
Weight:	1 kg
Order No.:	SO3212-6T

SYNCHRONOSCOPE (96 X 96 MM)



The synchronoscope with rotation indicator for phase angle comparison of three-phase or single-phase power supply. If the machine runs too fast or too slowly, the rotation indicator turns clockwise or counterclockwise. If the phase angles coincide the indicator assumes the center position.

Nominal voltage*:	400 V
Cyclic duration factor:	15 min.
Movement:	air-core electrodynamic quotient movement
Dimensions:	297 x 228 x 125 mm (H x W x D)
Weight:	1 kg
Order No.:	SO3213-1J

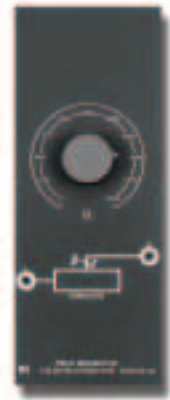
STARTERS/REGULATORS

STARTER FOR DC-MOTORS



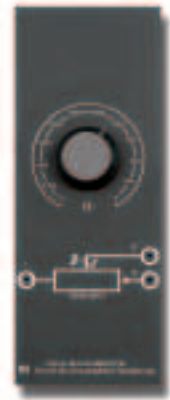
	0.3 kW	1 kW
Resistance:	0...47 ohm, linear continuously adjustable	0...16 ohm, linear continuously adjustable
Current:	max. 1.6 A	max. 7 A
Nominal power:	120 W suitable for speed setting of 50 % under full torque	250 W suitable for speed setting of 50 % under full torque
Dimensions: (in mm)	297 x 114 x 125 (H x W x D)	297 x 114 x 125 (H x W x D)
Weight:	1.4 kg	2.8 kg
Order No.:	SO3212-6B	SO3213-6B

FIELD REGULATOR FOR DC MACHINES



	0.3 kW	1 kW
Resistance:	0...2.2 kohm, linear continuously adjustable	0...680 ohm, linear continuously adjustable
Current:	max. 110 mA	max. 270 mA
Nominal power:	30 W	40 W
Dimensions: (in mm)	297 x 114 x 50 (H x W x D)	297 x 114 x 50 (H x W x D)
Weight:	2 kg	2 kg
Order No.:	SO3212-5F	SO3213-6F

FIELD REGULATOR FOR GENERATORS



	0.3 kW	1 kW
Resistance:	0...2.2 kohm, linear continuously adjustable	0...4.7 kohm, linear continuously adjustable
Current:	max. 95 mA	max. 130 mA
Nominal power:	20 W	80 W
Dimensions: (in mm)	297 x 114 x 50 (H x W x D)	297 x 114 x 50 (H x W x D)
Weight:	2 kg	2 kg
Order No.:	SO3212-5H	SO3213-6H

LOAD RESISTOR

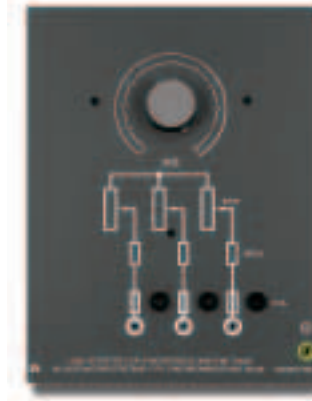


Load resistor for generator experiments.

	0.3 kW	1 kW
Resistance:	0...1 kohm continuously adjustable	0...440 ohm continuously adjustable
Current:	max. 4 A	max. 6 A
Nominal power:	300 W	1.4 kW
Dimensions: (in mm)	297 x 228 x 125 (H x W x D)	229 x 298 x 150 (H x W x D)
Weight:	2.7 kg	4.4 kg
Order No.:	SO3212-6M	SE2662-6J

STARTERS/REGULATORS

LOAD RESISTOR FOR SYNCHRONOUS GENERATOR



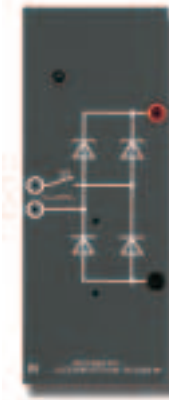
	0.3 kW	1 kW
Resistance:	3 x 0.8...5 kohm continuously adjustable	3 x 0.25...2.5 kohm continuously adjustable
Nominal power:	3 x 100 W	3 x 200 W
Cyclic duration factor:	70 %	70 %
Dimensions: (in mm)	297 x 228 x 125 (H x W x D)	430 x 160 x 275 (W x H x D)
Weight:	2.7 kg	3.8 kg
Order No.:	SO3212-6R	SE2662-6K

STARTER FOR SLIPRING MOTORS



	0.3 kW	1 kW
Resistance:	3 x 0...4 ohm adjustable in 6 steps	3 x 0...6 ohm adjustable in 6 steps
Current:	max. 3.3 A	27 A
Cyclic duration factor:	50 %	6 %
Dimensions: (in mm)	297 x 228 x 125 (H x W x D)	297 x 228 x 125 (H x W x D)
Weight:	3 kg	6 kg
Order No.:	SO3212-5C	SO3212-6D

RECTIFIER 250 V/10 A



Rectifier in bridge circuit with automatic circuit breaker.

Input voltage:	max. 230 V, 50 Hz
Output current:	max. 10 A
Dimensions: (in mm)	297 x 114 x 140 (H x W x D)
Weight:	1.8 kg
Order No.:	SO3538-9P

COMPENSATION UNIT



The compensation unit is used for step-by-step reactive power compensation of a three-phase asynchronous machine.

Capacitors:	6 x 1 μF, 450 V
Dimensions: (in mm)	297 x 114 x 140 mm (H x W x D)
Weight:	1.0 kg
Order No.:	SO3212-6E

The Lucas-Nülle GmbH company is based in Germany and can be contacted at the address given below. The company also has representatives throughout the world, thus ensuring a fast and effective advice service before purchasing, as well as an efficient network of after-sales service centres.

We can be contacted directly at our head office in Kerpen-Sindorf, Germany, or via one of our representatives, at either of the addresses given below.

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