Servo Brake and Drive System
TP 1410



A compact and powerful motor testing platform

Modern drives are characterized by the integration of electrical and mechanical components into complete systems.

In addition to the fundamentals of the rotating electrical machines, the system approach and practical relevance play a decisive role in an effective learning concept.

Enclosed in a compact housing, this equipment set incorporates a complete, flexible and convenient load and drive system, which is used to analyze the systems to be examined in different load situations.

The unique didactic concept makes a clear distinction between the unit under test and the load. The practical quick-change system makes it easy to set up and change the machines to be examined. The unit under test circuits are created using reliable and flexible A4 EduTrainer modules.

Simple tests such as the recording of a characteristic curve can be performed manually with the brake system, with no need for a PC and software. Measured values, characteristics and function mode are shown on the integrated display.

The convenient DriveLab software provides a wide range of options.

With the electric teaching machines, virtually all electric circuits and drives that exist in industry, in trade and in the home can be explained practically and effectively.

The range of drives includes systems of varying degrees of complexity, including single-phase and three-phase drives, DC drives and modern servo drives.

Training content
- Electric drive technology components
- DC drives
- AC drives
- Three-phase drives
- Special purpose machines
- Actuation with contact
- Frequency converters
- Communication technology

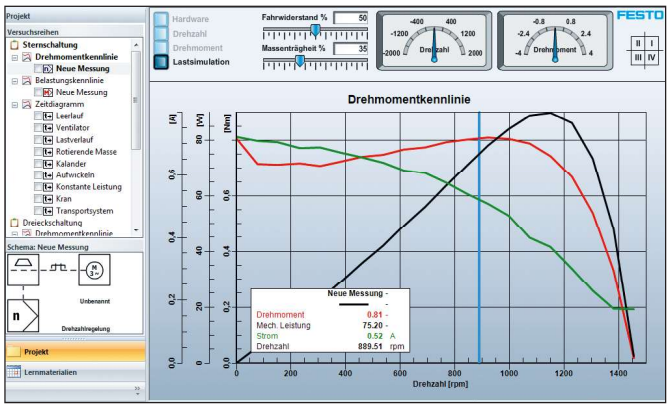
Technical data
- Input voltage: 1 AC/110 – 230 V, 50 – 60 Hz
- Control console housing with rubber feet for use in the desk
- Connection via 4 mm safety connector
- Integrated EMC filter
- Integrated braking resistor

Complete equipment set TP 1410	**8121044**

The most important components at a glance:
– 1x Servo brake and drive system
– 1x Transparent shaft cover
– 1x Coupling sleeve
– 1x DriveLab software
– 1x USB connecting cable

Possibilities of expansion:

Electric machines (next page)
Motor protection switch (see below)
Control units for electric machines (page 47)
Basic Principles of Circuits with Contacts TP 1211 (page 38)
Sinamics G120 EduTrainer TP 1410 (page 49)
IGBT Training Package for TP 1410 (page 50)
FluidSIM-Electrical Engineering (→ page 158)



The convenient and intuitive **DriveLab** software supports the automatic recording of machine characteristic curves, the parameterization of a static load and the simulation of load models for the examination of drives under realistic conditions.

The comparison and optimization of different drive concepts can be carried out in the form of project exercises.

Sample configurations provide a quick and easy-to-understand introduction.

Different load models:
– Inert load
– Pump/fan
– Hoist drive
– Calendar
– Winder drive
– Lathe
– Traversing drive



Motor Protection Switch
High-quality, industrial switching device from Siemens with 4 mm safety elbow adapters for professional protection of rotating electric machines. Mounting on 35 mm H-rail. Auxiliary contacts 1 N/O contact + 1 N/C contact.

0.35 – 0.5 A	**576284**
0.55 – 0.8 A	**573266**
1.1 – 1.6 A	**573267**
1.8 – 2.5 A	**573268**
2.2 – 3.2 A	**573269**

Recommended Learning Material

Workbooks (→ page 162)

Fundamentals of DC Machines
Campus license:

de	571781
en	571783
es	571785

Fundamentals of AC Machines
Campus license:

de	571789
en	571791
es	571793

Fundamentals of Three-Phase Current Machines
Campus license:

de	571797
en	571799
es	571801
fr	571803

Printed workbooks available upon request.

Courses on Festo LX:
→ Fundamentals of DC Machines
→ Fundamentals of AC Machines
→ Fundamentals of Three-Phase Current Machines
→ Speed Control of Three-Phase Asynchronous Motors with Frequency Converters

Optional Electric Machines for TP 1410

1



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- Sturdy special design for training purposes
- Neutral rating plate
- Over-temperature protection (NC contact) in the winding
- Fully assembled and aligned on support plate
- One shaft end, equipped with coupling piece suitable for the servo brake and drive system
- Support plate with clamping slot and quick action mounting system for profile plate
- All connections on safety sockets
- Other machines are available on request, for example a Three-Phase Reluctance Motor and a Three-Phase Motor Pole-Switchable.

1 **DC Shunt Machine**
- Power rating: 0.3 kW
- Speed: 2,000 rpm
- Armature: 220 V/1.8 A
- Field: 220 V/0.3 A

Order no. **571868**

2 **DC Series Machine**
- Power rating: 0.3 kW
- Speed: 2,000 rpm
- 220 V/1.9 A

Order no. **571869**

3 **Universal Motor**
- Power rating: 0.2 kW
- Speed: 3,000 rpm
- AC 230 V/3.0 A
- DC 140 V/2.5 A

Order no. **571871**

4 **Capacitor Motor**
- Power rating: 0.25 kW
- Speed: 1,400 rpm
- cos φ: 0.99
- AC 230 V/1.86 A
- Running/starting capacitor: 25 µF/10 µF

Order no. **8203026**

5 **Three-Phase Current Asynchronous Motor 230/400 V IE3**
- Power rating: 0.25 kW
- Speed: 1,395 rpm
- cos φ: 0,72
- Star circuit: 400 V/0,68 A
- Delta circuit: 230 V/1,19 A

Order no. **8226794**

Three-Phase Current Asynchronous Motor 400/690 V IE3
- Power rating: 0.25 kW
- Speed: 1,395 rpm
- cos φ: 0,72
- Star circuit: 690 V/0,40 A
- Delta circuit: 400 V/0,68 A

Order no. **8226654**

6 **Synchronous Machine**
- Power rating: 0.3 kW
- Speed: 1,500 rpm
- cos φ: 0,97
- Exciter: 150 V/0.95 A
- Star circuit: 400 V/0.66 A
- Delta circuit: 230 V/1.14 A

Order no. **572095**

DC Compound Machine
- Output: 0.3 kW
- Speed: 2000 r.p.m
- Armature: 220 V/1.8 A
- Field: 205 V/0.25 A

Order no. **8023977**

Three-Phase AC Multifunction Machine (AC slip ring rotor, can be synchronized)
- Output: 0.27 kW
- Speed: 1360/1500 r.p.m. 50 Hz
- cos φ: 0.7/1.0
- Star connection: 400 V/0.83 A
- Delta connection: 230 V/1.44 A
- U2: AC 107 V/1.7 A; DC 20 V/4.0 A

Order no. **8023978**

Dahlander
- Output: 0.3/0.43 kW
- Speed: 1390/2800 r.p.m 50 Hz
- cos φ: 0.73/0.8
- Double star circuit: 400 V/1.2 A
- Delta connection: 440 V/0.89 A

Order no. **8023979**

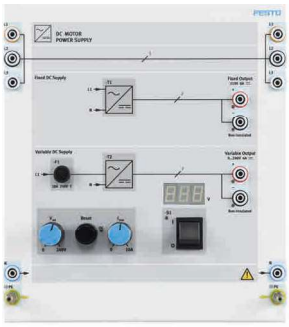
7 **Slip Ring Rotor**
- Output: 0.27 kW
- Speed: 1360 r.p.m 50 Hz
- cos φ: 0.72
- Star connection: 400 V/1.16 A
- Delta connection: 230 V/2 A
- U2: 95V

Order no. **8023980**

8 **Stand-Alone Guard for Electrical Machines**
Transparent protective cover for mounting over the rotating shafts of our electrical machines for protection against contact and for safe operation of machines in standalone mode.

Order no. **8118117**

Control Units for the Electric Machines of TP 1410



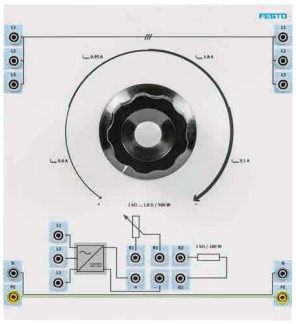
DC Motor Power Supply

The module provides electrical supplies for electrical machines where DC power is required. It provides a fixed 210 V DC power source and a variable DC power source from 0 to 240 V.

The variable DC power source voltage can be easily adjusted using the front panel knob and digital display. A second front-panel knob allows the current to be limited for certain applications.

Technical data
– Input voltage: 3 AC/400 V/50 Hz
– Fixed DC output: 210 V/8 A
– Variable DC output: 0 – 240 V/6 A, short-circuit and overload protected
– Peak current limit on the variable DC output: 0 – 10 A
– Suitable for use in A4 mounting frames
– Dimensions (H x W x D): 297 x 266 x 140 mm
– Weight: 6.1 kg

Order no. **8111319**



EduTrainer Load Resistance

The Load Resistance is used to load electrical machinery for use as generators or as starting resistors for slip ring rotors. It consists of a rheostat with an upstream protecting resistor. An additional fixed resistor can extend the load range. The rheostat is infinitely adjustable; the multi-level winding allows different maximum peak currents to be set as loads.

The 3-phase rectifier allows the load resistance to be used as a load for alternating and 3-phase current sources.

All connection locations are standardized and are laid out as safety sockets.

Technical data
– Maximum input voltage: 230 V DC, 3x 400 V AC
– Load capacity: 500 W
– Setting range: 1.8 – 1 kΩ
– Maximum current:
  1.8 – 30 Ω, 3.1 A
  30 – 56 Ω, 1.8 A
  56 – 140 Ω, 0.95 A
  140 – 1 kΩ, 0.6 A
– Protecting resistance: 1.8 Ω
– Extension resistance: 1 kΩ/180 W
– Front panel: 266 x 297 mm
– For use in an A4 frame
– Connection via 4 mm safety plugs
– Through-feed for 3 x 400 V AC

Order no. **8037136**



Motor Switches

The Motor Switches are designed for direct switch activation of electric machines. Equipped with on/off switch, polarity reversal switch and star/delta switch.

All connection locations are standardized and are routed to safety sockets or system plugs.

Technical data
– Input voltage: 3 AC/400 V
– Output voltage: 3 AC/400 V
– Load capacity: Maximum 16 A
– Front panel: 266 x 297 mm
– Desk housing with rubber feet, also suitable for use in A4 mounting frames
– Connection via 4 mm safety plug

Order no. **576309**



EduTrainer Field Rheostat

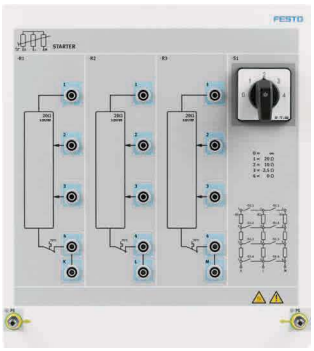
The Field Rheostat allows the field voltage of motors and generators to be reduced if a set direct voltage is used. By connecting a variable resistor upstream, an exciter field can be set. The resistor is infinitely adjustable.

All connection locations are standardized and are laid out as safety sockets.

Technical data
– Maximum input voltage: 230 V DC
– Maximum load capacity: 100 W
– Setting range 0 – 1.5 kΩ
– Maximum current:
  0 – 450 Ω, 0.5 A
  450 – 1.5k Ω, 0.25 A
– Front panel: 133 x 297 mm
– For use in an A4 frame
– Connection via 4 mm safety plugs
– Through-feed for 3 x 400 V AC

Order no. **8036772**

Control Units for the TP 1410 Electric Machines



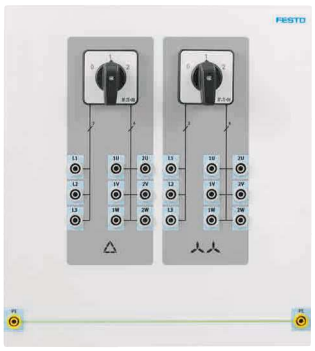
Slip Ring Starting Resistors

The module houses three identical power resistors, each with three different taps for various resistance values used for starting slip-ring motors.

Using a four-position rotary switch, resistors can be used independently or connected together in a star configuration for different resistance values. Power resistors can then be connected in steps to the rotor of a slip-ring motor. Turning the switch to a different position reduces the resistance at each tap until it reaches zero and the rotor windings are fully connected together in a resistance-free star configuration. Using 4 mm safety sockets, all taps of the resistors can be accessed to guarantee flexibility for different applications.

Technical data
- Three identical power resistors with three taps for various resistance values
- Resistance values (for each resistor): 20/10/2.5 Ω
- Rated load (for each resistor): 180 W at 20 Ω
- Dimensions (H x W x D): 297 x 266 x 140 mm

Order no.	**8109369**



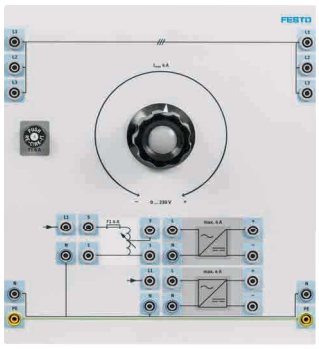
EduTrainer Dahlander Switch

The motor switches are designed for direct switch activation of electric machines.

Fitted with a Dahlander switch and switches for asynchronous motors with separate windings. The locations of all connections are standardized and are routed to safety sockets or system plugs.

Technical data
- Input voltage: 3 AC/400 V
- Output voltage: 3 AC/400 V
- Load capacity: Maximum 16 A
- Front panel: 266 x 297 mm
- Desk housing with rubber feet, also suitable for use in A4 mounting frames
- Connection via 4 mm safety plug

Order no.	**8040011**



EduTrainer Variable Transformer

Single-phase variable transformer for providing a variable alternating current. Alternatively, the device can be used via the integrated rectifier as an unsmoothed direct current source with a variable and a fixed output, e.g. for supplying electrical machinery. The integrated device circuit breaker deactivates the variable output voltage in the event of an overload or short circuit.

The locations of all connections are standardized and are routed to safety sockets or system plugs.

Technical data
- Input voltage: 1 x 230 V AC
- Output voltage: 1 AC/0 – 230 V, short-circuit and overload protected
- Max. output current: 4 A
- Rectifier load capacity: 4 A
- Front panel 266 x 297 mm
- For use in an A4 frame
- Connection via 4 mm safety plugs
- Through-feed for 3 x 400 V AC

Order no.	**8037127**



Soft Starter EduTrainer

The soft starter is an electronic motor control unit for optimizing the start and stop phases of asynchronous three-phase induction motors (soft starts and soft stops). The motor controller increases or decreases the voltage delivered to the motor during the start and stop phases in order to optimize the torque generated by the motor (acceleration torque) and the current demand (switch-on current).

This version of the EduTrainer is designed for use in the A4 mounting frame and the use of 4 mm safety lab cables. The Softstarter EduTrainer is part of learning systems described in the workbook for equipment set TP 1211.

Technical data
- Input/output power: 200 - 480 V AC (L1 – L3), 3 A, 50 – 60 Hz
- Control voltage (terminals A1-A2, 1): 24 V AC/DC
- Auxiliary contact (1 NO/NO): 24 V DC, 1 A (utilization category DC-13), 230 V AC, 3 A (utilization category AC-15)
- Compatible with devices up to 350 W
- Designed for use in the A4 mounting frame
- Dimensions (H x W x D): 297 mm x 133 mm x 140 mm

Order no.	**8121090**

Sinamics G120 EduTrainer



A safe variable-frequency drive learning solution

The next generation of the Sinamics G120 frequency converter – Optimized even further for training. Now in a completely new housing and EMC-compliant for use in laboratories without heeding installation instructions – just like that!

The G120 is well-suited as a beginner device, however its comprehensive functions offer plenty of potential for advanced users who want to implement complex drive tasks. Various bus systems, advanced safety functions and an optional encoder input permit perfect adjustment to the requirements and integration in control systems. All relevant ports are accessible on the front of the device and installed in 4 mm safety sockets or system connectors.

The motor is connected via the cable sold separately which permits EMC-compliant operation. The devices can be used flexibly – suspended in an A4 frame or on a table, and are equipped with an EMC filter with low leakage current. The corresponding control panels (BOP-2, IOP) are available as accessories.

Characteristics
- Simple parameterization via STARTER and the BOP-2 or IOP control panels
- Versatile, programmable inputs/outputs voltage/frequency characteristic curves for constant, square torque
- Encoder-free vector regulation brake functions (resistance, DC, motor holding, compound brake)
- Integrated protection/overload functions

Technical data
- 6 digital inputs, depending on the variant, 2 of which can be parameterized as failsafe inputs
- 3 digital outputs
- 1 analog input
- 2 analog outputs
- 3m USB cable included
- Connections for temperature sensor and for external braking resistor
- Input:
  1x 200-240 V AC (Order no. 8105137)
  3x 380-480 V AC (Order no. 8037819 and 8105421)
- Output:
  3x 400 V AC, 0.55 kW (Order no. 8037819) or 0.75 kW (Order no. 8105421 and 8105137)

Sinamics G120 EduTrainer - DP	**8037819**
Sinamics G120 EduTrainer - PN-F with encoder port (1 AC input)	**8105137**
Sinamics G120 EduTrainer - PN-F with encoder port (3 AC input)	**8105421**

1 **Intelligent Operator Panel (IOP-2)**
Powerful operator panel with large plain text display and menu navigation. The application wizard guides you through the startup procedure for important applications. The general startup procedure is performed with quick-startup wizards. Up to two percentages can be displayed graphically or numerically. Updatable and extendable via USB interface.

Order no.	**8022476**

1



2 **Basic Operator Panel (BOP-2)**
Operator panel with 2-line display and basic startup menu navigation. Two percentages can be numerically displayed at the same time for frequency converter diagnostics.

Order no.	**8022475**

2



3 **EMC Motor Cable**
Pre-assembled cable, prepared to connect the asynchronous machine and frequency converter with one another with EMC compliance. The shielded cable has a system plug for connecting to the converter; on the motor side, it is equipped with a shielded terminal and individual 4 mm safety plugs. Set including shield connection adapter for motor. Length: 2 m.

Order no.	**8038849**

3



4 **Set of Feet and Device Handle**
Using the frequency converter on a table is more convenient with the optional conversion set. The set comprises 2 fixed and 2 fold-out device feet, a folding device handle and the required mounting material.

Order no.	**8036788**

4



5 **Startdrive Software**
Software program for parameterization, startup, optimization, diagnostics and control

Order no.	**8105776**

5

