The static machines are sized for a standard power with low operating voltage, while the windings are splitted in more sections to allow the maximum number of possible combinations.
For special requirements, the transformers can be also realized with different sizing powers and operating voltages.
An educational terminal board, to which the inside windings are connected, shows a clear synoptical diagram with industrial conventional indications.

Educational objectives:

Among the main practical tests that can be performed, we remind:

- Ohmic resistance of windings
- Transformation ratio
- Polarity and connection group
- No-load test
- Short-circuit test
- External characteristics
- Conventional efficiency

DL 10100 THREE-PHASE TRANSFORMER

Core-type transformer with splitted windings.
It can be also used with single phase supply.
Specifications:

- Rated power: 300 VA
- Primary voltage: 2 x 21 V (phase)
- Secondary voltage: 2 x 12 V (phase)
- Frequency: 50/60 Hz

DL 10103 SINGLE-PHASE TRANSFORMER

Shell-type transformer with splitted windings.
It can be also used as auto-transformer.
Specifications:
Transformer

- Rated power: 50 VA
- Primary voltages: 24/42/48 V
- Secondary voltages: 2 x 21 V

Autotransformer

- Rated power: 50 VA
- Voltage: 42 V / 24-48 V
- Secondary voltages: 2 x 21 V
- Frequency: 50/60 Hz

DL 10103TG SINGLE-PHASE TRANSFORMER TRAINER

It allows the analysis of the behaviour and of the characteristics of a single-phase transformer.
It is composed of a supply, measurement and load unit and of a dissectible transformer.
Specifications:
Transformer

- Rated power: 200 VA
- Primary voltages: 42 V / 21 V
- Secondary voltages: 2 x 12 V
- Frequency: 50/60 Hz

Supply and measurement unit

- 2 ac variable outputs: 0-48V, 5A/0-10V, 10A
- 2 dc variable outputs: 0-40V, 5A/0·5V, 10A
- 2 ac/dc ammeters: 1-5-10A
- 2 ac/dc voltmeters: 3-15-75V
- 1 wattmeter switchable on the primary and on the secondary: 1-5-10A, 3-15-75V
- Power supply: 220 V, 50/60 Hz

The electric motors are sized for a standard power with low operating voltage and are of the self-protected type, with coupling half-joint.
When special requirements have to be satisfied, the motors call be also realized with special voltages and/or frequencies.
An educational terminal board, to which the inside windings are connected, shows a clear synoptical diagram with industrial conventional indications.

Educational objectives:
- Measurement of the ohmic resistance of the windings
- Measurement of the transformation ratio with slip-ring motor
- No-load test
- Short-circuit test with locked rotor
- Construction of Heyland circular diagram
- Conventional efficiency
- Real efficiency and electromechanical characteristics through direct tests with either electromagnetic brake or braking dc generator
- Slip measurement

DL 10120 SLIP RING MOTOR

Induction motor with both stator and rotor three-phase windings.
It can operate also as a synchronous machine.

Specifications:
- Power: 200 W
- Voltage: 24/42 V ?/Y
- Current: 10, 4/6 A
- Speed: 2800 rpm, 50 Hz

Accessories:
DL 10120RHD3 Starting Rheostat
DL 10125 Starting and synchronization unit

DL 10115 SQUIRREL CAGE MOTOR

Induction motor with three-phase stator winding and buried squirrel cage in the rotor.

Specifications:
- Power: 200W
- Voltage: 24/42 V ?/Y
- Current: 9.7/5.6 A
- Speed: 2850 rpm, 50 Hz

Accessories:
DL 10116 Star-Delta Switch Unit

DL 10180 SQUIRREL CAGE 2-SPEED MOTOR

Induction motor with Dahlander type three-phase stator winding to realize either 2 or 4 poles and squirrel cage rotor

Specifications:
- Power: 130/200 W
- Voltage: 42 V
- Current: 5/7 A
- Speed: 1350/2700 rpm, 50 Hz

Accessories:
DL 10185 Pole Switching Unit

SINGLE PHASE MOTOR

The electric motors are sized for a standard power with low operating voltage and are of the self-protected type, with coupling half-joint.
When special requirements have to be satisfied, the motors can be also realized with special voltages and/or frequencies.
An educational terminal board, to which the inside windings are connected, shows a clear synoptical diagram with industrial conventional indications.

Educational objectives:
• Measurement through direct tests of:
- Mechanical characteristics (torque versus speed)
- Electromechanical characteristics (torque, speed, input, current, efficiency, and power factor as a function of the output power).

DL 10130 SPLIT-PHASE MOTOR

Single-phase squirrel cage asynchronous motor; possible operation with either permanent or starting external capacitor.
Specifications:
- Power: 180 W (110 W)
- Voltage: 42 V
- Current: 7 A
- Speed: 2800 rpm, 50 HZ

Accessories:
DL 10135 CAPACITOR UNIT

DL 10150 UNIVERSAL MOTOR

Single-phase commutator motor with inductor winding in series to the rotor; it can operate either with ac or dc power supply.
Specifications:
- Power: 130 Wac/170 Wdc
- Voltage: 42 Vac and Vdc
- Current: 8 Aac/7.5 Adc
- Speed: 3000 rpm dc, 3350 rpm ac, 50 HZ

DL 10170 REPULSION MOTOR

Single-phase commutator motor with short-circuited rotor.
Specifications:
- Power: 30 W
- Voltage: 42 V
- Current: 6 A
- Speed: 3000 rpm dc, 50 HZ

DL 10160 SHADED POLES MOTOR

Single-phase squirrel cage shaded poles asynchronous motor of limited power.
Specifications:
- Power: 10 W
- Voltage: 42 V
- Current: 2.3 A
- Speed: 1300 rpm, 50 HZ

The electric motors are sized for a standard power with low operating voltage and are of the self-protected type, with coupling half-joint.
When special requirements have to be satisfied, the motors can be also realized with special voltages and/or frequencies.
An educational terminal board, to which the inside windings are connected, shows a clear synoptical diagram with industrial conventional indications.

Educational objectives:

- Measurement of the ohmic resistance of winding
- Magnetization characteristic
- No-load losses through the auxiliary motor method
- Short-circuit characteristic
- Conventional efficiency
- External and regulation characteristics of the alternator through direct and indirect methods in accordance with Behn Eschemburg or Potier
- Mains parallel and regulation of the active and reactive power exchange
- Mordey "V" curve of synchronous motor
- Electromechanical characteristics of the synchronous motor through direct method

DL 10190 THREE-PHASE SYNCHRONOUS MACHINE

Machine with smooth inductor and three-phase stator armature winding for operation either as alternator or synchronous motor.

Specifications:

- Alternator: 200 VA
- Motor: 200W
- Voltage: 24/42 V Δ/Y
- Current: 4.7/2.7 A
- Speed: 3000 rpm, 50 Hz
- Excitation: 20 V / 1.5 A

Accessories:
DL 10310 PARALLEL BOARD

DL 10270 RELUCTANCE MOTOR

Three-phase synchronous motor with cage rotor without dc excitation.

Specifications:

- Power: 100 W
- Voltage: 26/45 V Δ/Y
- Current: 9.2/5.3 A
- Speed: 3000 rpm, 50 Hz

DIRECT CURRENT MACHINES

The electric motors are sized for a standard power with low operating voltage and are of the self-protected type, with coupling half-joint.
When special requirements have to be satisfied, the motors can be also realized with special voltages and/or frequencies.
An educational terminal board, to which the inside windings are connected, shows a clear synoptical diagram with industrial conventional indications.

Educational objectives:

- Resistance of windings
- Mechanical and iron losses
- Conventional efficiency
- Magnetization, external and regulation characteristic of the generators
- Electromechanical characteristics of the motors through direct method
- Electronic speed control of motors

DL 10220 COMPOUND EXCITATION MOTOR

It can also operate as generator.

Specifications:

- Power: 200 W
- Voltage: 42 V
- Speed: 3000 rpm
- Excitation: 36 V / 0.3 A

Accessories:
DL 10200RHD STARTING RHEOSTAT
DL 10205 EXCITATION RHEOSTAT

DL 10210 SERIES EXCITATION MOTOR

It can also operate as generator.

Specifications:

- Power: 150 W
- Voltage: 42 V
- Speed: 2430 rpm

Accessories:
DL 10200RHD STARTING RHEOSTAT
DL 10206 EXCITATION RHEOSTAT

DL 10200 SHUNT EXCITATION MOTOR

It can also operate as generator.

Specifications:

- Power: 200 W
- Voltage: 42 V
- Speed: 3000 rpm
- Excitation: 37 V / 0.3 A

Accessories:
DL 10200RHD STARTING RHEOSTAT
DL 10205 EXCITATION RHEOSTAT

DL 10240 COMPOUND EXCITATION GENERATOR

It can also operate as motor.

Specifications:

- Power: 170 W
- Voltage: 42 V
- Current: 4 A
- Speed: 2800 rpm
- Excitation: 25 V / 0.3 A

Accessories:
DL 10205 EXCITATION RHEOSTAT

DL 10230 SERIES EXCITATION GENERATOR

It can also operate as motor.

Specifications:

- Power: 145 W
- Voltage: 40 V
- Current: 3.4 A
- Speed: 3000 rpm

Accessories:
DL 10206 EXCITATION RHEOSTAT

DL 10250 SHUNT EXCITATION GENERATOR

It can also operate as motor.

Specifications:

- Power: 160 W
- Voltage: 40 V
- Current: 4 A
- Speed: 2800 rpm
- Excitation: 40 V / 0.36 A

Accessories:
DL 10205 EXCITATION RHEOSTAT

DL 10300A ELECTROMAGNETIC BRAKE

Smooth roll rotor and salient pole stator.
Provided with water level, arms, weight and balance weight for measuring the output torque of the motor.
Possibility of assembling a load cell.

Accessories:

DL 10305 POWER SUPPLY
Variable power supply unit for brake DL 10300A.
Power supply: 220 V, 50/60 Hz.

DL 10260 DC DYNAMOMETER

Direct current generator in which the frame is free to swing around its axis.
Provided with water level, arms, weight and balance weight for measuring the output torque of the motor.
Possibility of assembling a load cell.

Accessories:

DL 10040R RESISTIVE LOAD
DL 10305 POWER SUPPLY
Variable power supply unit for brake DL 10300A.
Power supply: 220 V, 50/60 Hz.

DL 10050 MECHANICAL POWER DIGITAL MEASURING UNIT

Suitable for direct measurement of motor output torque through load cell and of rotating speed through optical transducer, with mechanical power display; provided with direct current variable power supply for the excitation of the braking systems.
Digital readout of measured quantities and conditioning to voltage levels directly compatible with plotters.
Interfaceable for data acquisition and automatic plotting of the electromechanical characteristics of the machines.
Connector for overspeed protection of motors for connection to power supply unit.

Specifications:

- Torque: .999 Nm (1 mV/dgt)
- Speed: 6000 rpm (1 mV/rpm)
- Power: 300 W (1 mV/W)
- Dc output: 0 - 36 V, 2 A
- Power supply: 220 V, 50/60 Hz

DL 10060N ELECTRIC POWER DIGITAL MEASURING UNIT

Measurement in direct current of: voltage, current, power and energy.
Measurement in alternate current of: voltage, current, power, active energy, reactive energy, apparent energy, cosphi and frequency.

Specifications:

- Dc voltage: 50 V
- Dc current: 20 A
- Ac voltage: 50 V
- Ac current: 20 A
- Ac power: 1000 W

Power supply: 90-260 V, 50/60 Hz
Communication: RS485 with MODBUS RTU protocol

DL 2006CN TORQUE MEASURING UNIT

Suitable for measuring the motor output torque through load cell arranged on brake unit.

- Power supply: 220 V, 50/60 HZ
- Digital read out and analog output proportional to the measured value

DL 2006D LOAD CELL

Resistance electronic strain gauge with 100 N range, to be arranged on the brake unit to detect the mechanical torque.

DL 2025DN ELECTRONIC TACHOMETER

Suitable for measuring the revolving speed through optical transducer fixed to the base DL 10400.
Digital read out and analog output proportional to the measured value.
Complete with connector for protection against overspeed to be connected to the power supply unit
Power supply: 220 V, 50/60 Hz.

DL 2026R OPTICAL TACHOMETER

- Suitable for measuring the revolving speed with digital read out.
- Measuring range: 0 to 19,999 rpm.
- Power supply: 4 x 1.5 V batteries (UM 3)Complete with 5 reflectors

DL 2026 CONTACT TACHOMETER

- Suitable for measuring the revolving speed with digital read out.
- Measuring range: 0 to 19,999 rpm.
- Power supply: 4 x 1.5 V batteries (UM 3).

DL 10040 LOADS AND RHEOSTATS MODULE

Suitable for single or three-phase ohmic-capacitive, resistive and ohmic-inductive step variable loads. Complete with continuously variable rheostats for half torque starting of three-phase motors and direct current motors.

Specifications:

- Max. power: 3 x (45 VAcap + 60 W + 45 VAind)

DL 10040C CAPACITIVE LOAD

- Single and three-phase capacitive step variable loads.
- Max. power: 3 x 85 VAR

DL 10040R RESISTIVE LOAD

- Single and three-phase resistive step variable loads.
- Max. power: 3 x 100 W

DL 10040L INDUCTIVE LOAD

- Single and three-phase inductive step variable loads.
- Max. power: 3 x 85 VAR

DL 10200RHD STARTING RHEOSTAT

Step variable rheostat for half-torque starting the DC motors of the laboratory.

DL 10205 EXCITATION RHEOSTAT

Suitable for the shunt excitation of the DC machines and of the synchronous machines of the laboratory.

DL 10206 EXCITATION RHEOSTAT

Suitable for the series excitation of the DC machines of the laboratory.

DL 10116 STAR/DELTA STARTER

Star/delta starter for three-phase squirrel cage induction motor.

DL 10120RHD3 STARTING RHEOSTAT

Step variable three-phase rheostat for 50% torque starting the slip ring motors of the laboratory.

DL 10125 STARTING AND SYNCHRONIZATION UNIT

Rotor starter for three-phase slip ring motors and excitation device for synchronization with the mains.
Power supply: 220 V, 50/60 Hz.

DL 10185 POLE CHANGING UNIT

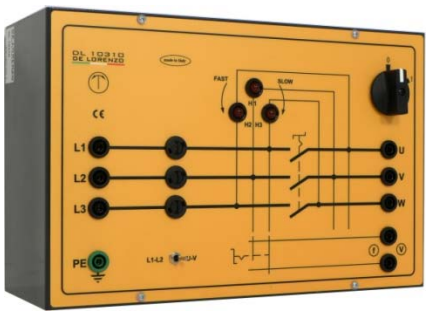
Switch to change the pole number on Dahlander motors.

DL 10135 CAPACITOR UNIT

Set of capacitors for starting or steady state running of the splitted phase motor.

DL 10310 PARALLEL BOARD

Rotating light synchronoscope to perform the parallel connection between Synchronous generators or between the alternator and the mains.



DL 10410 FLYWHEEL

Used in deceleration tests on rotating machines for the calculation of mechanical iron and copper losses at different excitations.

DL 10305 POWER SUPPLY FOR BRAKE

Suitable for the autonomous excitation of the electromagnetic brake DL 10300A or of the dc dynamometer DL 10260. Output voltage: 0-48 V, 2A max. Power supply: 220V, 50/60Hz.

DL 10400 UNIVERSAL BASE

Metal structure, fire varnished, suitable for mounting the machine or the group under test. Complete with optical transducer for rotating speed detection and with anti-vibration rubber feet.

DL 10016 POWER SUPPLY MODULE

Suitable for supplying variable alternate and rectified direct current, in order to carry on easily all the test on the electric machines of the Microlab laboratory and in general in an electric measuring laboratory.
Provided with start push-button with remote control switch, stop push-button, key unlocked emergency mushroom head push-button and differential magnetothermal protection on the mains sockets.
Connector for overspeed protection of the motors.
The control devices and the connecting terminals are arranged on the front panel.

Specifications:

- Output voltages
- Variable ac: 3 x 0-46V, 10A
  3 x 0-26V, 14A
- Standard fixed ac: 220V, 10A
- Variable dc: 0-46V, 14A
  0-32V, 14A
  0-42V, 5A

Power supply: 3x380V + N, 50/60 Hz

The test and measurements performed on both static and rotating electric machines can be organized to realize a personal computer based automatic acquisition and processing system, using the measurement and control units of the Microlab laboratory already arranged for interfacing.
The flexibility of the system can be appreciated when considering its modularity and the possibility to realize different configurations.
For the practical set up of the automatic or semi- automatic systems a data acquisition unit (DL 1893) with multifunction board is required besides the motor-driven (DL 10017, DL 10045 and DL 10306) and measuring (DL 10050 and DL 10060N) units, programmed from the computer through a suitable software package.

DL 8330SW SOFTWARE FOR AUTOMATIC DATA ACQUISITION

Software able to modify the parameter under control through motor driven devices and to record the test data through measuring units arranged for interfacing, with data post processing for graph or table display.

DL 1893 INTERFACE UNIT

Used to interconnect real world signals to a data acquisition system.
Input/output 2 mm terminals.

Specifications:

- Power supply from USB, < 100mA
- 2 relay outputs
- 2 analogue outputs, serial 8 bit D/A converter
  Output: -10/+10 V
- 8 analogue inputs, 12 bit A/D converter
  Input: -10/+10 V
- Max speed of conversion: 10 kHz

DL 10017 MOTOR DRIVEN POWER SUPPLY UNIT

Suitable for supplying variable alternate and rectified direct current, in order to carry on easily all the tests on the electric machines of the Microlab laboratory and in general in an electric measuring laboratory.
Provided with start push-button with remote control switch, stop push-button, key-unlocked emergency mushroom head push-button and differential magnetothermal protection on the main sockets.
Connector for overspeed protection of the motors.
Manual control or automatic control through the DL 1893 unit.
The control devices and the connecting terminals are arranged on the front panel.

Specifications:

- Output voltages (* programmable)
  - variable ac: 3 x 0 - 46 V, 10 A *
    3 x 0 - 26 V, 14 A *
  - standard fixed ac: 220 V, 10 A
  - variable dc: 0 - 46 V, 14 A *
    0 - 32 V, 14 A *
    0 - 42 V, 5 A

Power supply: 3 x 380 V + N, 50/60 Hz.

DL 10045 MOTOR DRIVEN RESISTIVE LOAD UNIT

Suitable to realize single or three-phase resistive loads with manual operation or automatic operation through the DL 1893 unit.

Resistance: 3 x 60 Ohm
Series resistance: 3 x 7.2 Ohm
Current: 3 x 3.3 A
Power supply: 220 V, 50/ 60 Hz

DL 10306 MOTOR DRIVEN POWER SUPPLY UNIT

Suitable to supply with variable voltage the brake assemblies with manual operation or automatic operation through the DL 1893 unit.

Dc output: 0 - 48 V, 2 A max.
Power supply: 220 V, 50/60 Hz

DL 10050 MECHANICAL POWER DIGITAL MEASURING UNIT

Suitable for direct measurement of motor output torque through load cell and of rotating speed through optical transducer, with mechanical power display; provided with direct current variable power supply for the excitation of the braking systems.
Digital readout of measured quantities and conditioning to voltage levels directly compatible with plotters.
Interfaceable for data acquisition and automatic plotting of the electromechanical characteristics of the machines.
Connector for overspeed protection of motors for connection to power supply unit.

Specifications:

- Torque: .999 Nm (1 mV/dgt)
- Speed: 6000 rpm (1 mV/rpm)
- Power: 300 W (1 mV/W)
- Dc output: 0 - 36 V, 2 A
- Power supply: 220 V, 50/60 Hz

DL 10060N ELECTRIC POWER DIGITAL MEASURING UNIT

Measurement in direct current of: voltage, current, power and energy.
Measurement in alternate current of: voltage, current, power, active energy, reactive energy, apparent energy, cosphi and frequency.

Specifications:

- Dc voltage: 50 V
- Dc current: 20 A
- Ac voltage: 50 V
- Ac current: 20 A
- Ac power: 1000 W

Power supply: 90-260 V, 50/60 Hz
Communication: RS485 with MODBUS RTU protocol

DL 2315C SINGLE PHASE SEMICONTROLLED BRIDGE CONTROL UNIT

Suitable for the speed control of direct current motors with independent excitation.
The control is obtained through the regulation of the conduction period of a thyristor bridge of the single-phase semi controlled type, both in open and closed loop. The control loops are: speed, current and armature voltage.

Specifications:

- Motor Power: 300 W
- Converter power: 420 W
- Armature voltage: 0-42 V
- Armature current: 10 A max
- Excitation Voltage : 42 V, 1 A
- Insulation transformer.
- Complete with measurement and connection leads and educational manual
- Power supply: 220 V, 50/60 HZ

Suggested accessories

- Dc motor DL 10220
- Electromagnetic brake DL 10300A
- Excitation rheostat DL 10305
- Base DL 10400
- 2 channel oscilloscope
- Function generator
- Digital multimeter
- DC ammeters

Examples of performable exercises:

- Regulation with compensation of the armature voltage drop
- Tachometric regulation
- Study of the transfer function and of the pulse response of the current and speed loop
- Study of the single-phase semicontrolled bridge

BASES FOR FAULT SIMULATION

Bases to be mounted on the terminal boxes of the electric machines and capable of creating typical faults through internal microswitches. The faults are searched without power supply through simple continuity measurements.

DL 10100FF FAULT SIMULATOR FOR THREE-PHASE TRANSFORMER

Suitable for simulating interruptions and short circuits in one phase of the three-phase transformer DL 10100

DL 10115FF FAULT SIMULATOR FOR SQUIRREL CAGE MOTOR

Suitable for simulating interruptions and short circuits in the stator winding of the DL 10115 motor.

DL 10120FF FAULT SIMULATOR FOR SLIP RING MOTOR

Suitable for simulating interruptions and short circuits in the stator winding and interruption of one rotor phase of the DL 10120 motor.

DL 10130FF FAULT SIMULATOR FOR CAPACITOR MOTOR

Suitable for simulating interruptions in the main and auxiliary windings, inversion of the main winding of the DL 10130 motor and short circuit of the capacitor.

DL 10220FF FAULT SIMULATOR FOR COMPOUND MOTOR

Suitable for simulating interruptions in the armature, series and shunt excitation windings and inversion of the shunt winding of the DL 10220 motor.