ELECTRIC MACHINES LABORATORY

Automatic test and measurement system

The tests and measurements that can be performed on both static and rotating electrical machines can be organized in order to realize an automatic data acquisition and processing system through a personal computer, using the measurement and control units of the laboratory that are already suitable for interfacing.

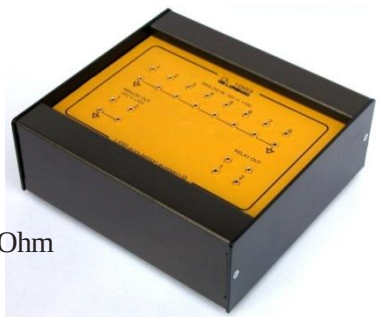
SOFTWARE BASED CONFIGURATIONS

Code	Description
DL 30052	Mechanical power measuring unit
DL 2006E	Load cell
DL 2031M	Optical transducer
DL 1031	Electric power measuring unit
DL 10065N	Electric power measuring unit

Code	Description
DL 30045	Motor driven resistive load
DL 30017/30019	Motor driven power supply
DL 1067S	Motor driven power supply with automatic regulation
DL 1893	Interface unit
DL 8330SW	Data acquisition and processing software

DL 1893
INTERFACE UNIT

Data acquisition unit with 8 analogue channels. Equipped with 2 relays and 2 analogue outputs. It is possible to acquire continuous signals or slowly variable up to 100Hz.



Technical Features

• Direct power supply from USB, total consumption less than 100mA.
• Nr. 2 relay outputs.
• Nr. 2 analogue outputs, with:
- Serial D/A converter 8 bit
- Output levels: -10/+10 V

- • Nr. 8 analogue inputs, with:
- - Input levels: -10/+10 V
- - High impedance input amplifier: > 1MOhm
- - A/D converter 12 bit
- - Self calibration and self zeroing
- - Max speed of conversion: 10 kHz

Software for the Electrical Machines Laboratory DL 8330SW

This eTraining Package covers all the study subjects and the experiment activities that are performed in a computer controlled electrical machines laboratory.
It works with the following types of machines:

- Single-phase and three-phase transformers
- Direct current machines
- Synchronous machines
- Asynchronous machines

It is divided in 2 sections, hereunder described:
Educational section:
In this section we illustrate, through WEB pages, the test to be performed by providing all the information relevant to:

- General diagram of the test
- Insertion of the instruments
- Operation modes
- Quantities to be acquired by the instruments and quantities to be calculated
- Characteristic graphs for the test

- Operation section:

In this section we illustrate how the instruments must be connected and how to start the program for controlling the execution of the test.
The above program provides:

- a Control Window, that allows to insert the name of the student and the characteristic data of the machine; moreover, it contains the controls to operate during the automatic and semi-automatic tests;
- a Window with the diagram of the measurement system,

that contains the block diagram of the measurement system, with the indications of the quantities coming from the instruments, updated in real time;

- a Spreadsheet Window, that contains an electronic sheet where the values of the measurements taken during the execution of the tests are collected.
- once the test is competed, it is possible to open several Graph Windows, where it is possible to visualize in graphical form the data that have been gathered.

During the AUTOMATIC execution of the test the user controls the start of the test and the program automatically varies the conditions of the system and acquires the interesting quantities. In this case it is necessary to use an interface module (DL 1893) and motor driven modules that are controlled through computer; it is also necessary, of course, to have digital measurement modules for the experiment data acquisition and transfer.
During the SEMI-AUTOMATIC execution of the test the user manually sets up the value of the quantities of the system (through non motor driven power supplies, variac, etc.) and controls the acquisition of the interesting variables through the program.

The software allows a complete graphic processing of the results that have been obtained. It is possible to open at the same time several different graphs.

These graphs can be of two types: time graphs (showing the behaviour with time of the interesting quantities) or XY type graphs, where it is possible to select the quantities to show in the X and Y axes.
Moreover, the software allows to print all the data of the test for what concerns: data of the student and of the machine under test, data from the electronic spreadsheet, graphs.

Software for the Electrical Machines Virtual Laboratory - DL EMV

This eTraining Package transforms the Computer to an Electrical Machines Laboratory, where it is possible to perform all the educational activities which are related to the study and the experiments on the machines, without the need to have any hardware: everything is virtually simulated by PC.
It covers the following types of machines:

- Single-phase and three-phase transformers
- Direct current machines
- Synchronous machines
- Asynchronous machines

It is divided in 3 sections as follows:

- Study:

In the section relevant to the study of the electrical machines the following subjects are illustrated by means of the Internet World Wide Web hypertextual technique:

- their operating principle
- their basic structure
- their characteristics

In this section multimedia tools (drawings, images, photos) and hypertextual techniques are widely used to illustrate the various components of the electrical machines and to provide, every time, the simplest path for the use of the information.

- Design:

In the section relevant to the design, we simulate, virtually by PC, the process of designing and manufacturing the electrical machine.
Once inserted the main design parameters (e.g., rated power, rated current, frequency, etc.), the computer proceeds step by step to dimensioning the machine. Drawings of the electrical and mechanical details and cross-sections of the inside complete this section to illustrate in detail the construction process.
All the data (set up parameters and calculated results) can be saved in a personal file that forms an electrical machines database.
The data can then be used for the practical realization of the machines.
For each machine it is necessary to input the design parameters while the manufacturing parameters are consequently calculated. All these parameters are used for the performance of the tests and for the actual realization of the electrical machine, if so required.

- Operating tests:

In the section relevant to the operating tests the program simulates, on the computer, the performance of the typical tests on the designed machine: no-load test, short-circuit test, load test, etc.
This allows an immediate check on the design targets of the machine, without actually constructing the machine.
In this phase the machine can be coupled to other machines in the database (for instance, for the load test).
Each test is complete with the relevant description that illustrates the purpose of the test and the relevant operating mode.
During the execution of the test it is possible to check on the monitor the values of the quantities which are acquired by means of virtual instrumentation and it is possible to draw the typical graphs, by selecting the interesting quantities.

On the static and rotating electrical machines it is possible to perform the following tests:

TRANSFORMERS

- No-load test
- Short-circuit test
- Measurement of the winding resistance
- Measurement of the transformation ratio
- Direct test

DIRECT CURRENT MACHINES

- Measurement of the internal resistance
- Magnetization characteristic of a dc generator
- External characteristic of a dc generator
- Regulation characteristic of a dc generator
- No-load test of a dc motor
- Direct test of a dc motor with an electromagnetic brake
- Direct test of a dc motor with a dc
- dynamometer

SYNCHRONOUS MACHINES

- Magnetization characteristic
- Short-circuit characteristic
- Measurement of the winding resistance
- External characteristics
- Regulation characteristics

ASYNCHRONOUS MACHINES

- No-load test of a three-phase asynchronous motor
- Short-circuit test of a three-phase asynchronous motor
- Measurement of the internal resistance of a three-phase asynchronous motor
- Measurement of the transformation ratio of a three phase asynchronous motor
- Direct test of a three-phase asynchronous motor with an electromagnetic brake
- Direct test of a three-phase asynchronous motor with a dc dynamometer

Required PC configuration:
Operating system: Windows 95/98/Me/NT-4/2000/XP
CD-ROM driver
USB port for the connection of the interface unit DL 1893

SINGLE-PHASE MOTORS

DL 30130 – SPLIT-PHASE MOTOR

Single-phase squirrel cage asynchronous motor; possible operation with either permanent or only for starting external capacitor.

Technical features:
Power: 220 W (370 W)
Voltage: 220 V
Current: 3.6 A (3 A)
Speed: 2720 rpm, 50 Hz

Accessories
DL 30135
STARTING CAPACITOR UNIT
DL 30135R
STARTING RESISTOR UNIT
DL 30135L
STARTING INDUCTOR UNIT

DL 30140 – CAPACITOR MOTOR

Single-phase squirrel cage asynchronous motor with splitted phases and running capacitor.

Technical Features:
Power: 370 W
Voltage: 220 V
Current: 3 A
Speed: 2720 rpm, 50 Hz

DL 30150 – UNIVERSAL MOTOR

Single-phase collector motor with inductor winding in series to the winding of the rotor; able to operate either with ac or dc power supply.

Technical Features:
Power: 260 Wac / 260 W dc
Voltage: 220 Vac/ 220 V dc
Current: 3,5 Aac / 3 Adc
Speed: 3000 rpm, 50 Hz

DL 30170 – REPULSION MOTOR

Single-phase collector motor with short-circuited rotor.

Technical Features:
Power: 250 W Voltage: 220 V
Current: 3.8 A
Speed: 3000 rpm, 50 Hz

Educational objectives
- Measurement through direct methods of the following characteristics:
• mechanical characteristic (torque as a function of the speed)
• electromechanical characteristic (torque, speed, input current, efficiency and power factor as a function of the output power)

THREE-PHASE ASYNCHRONOUS MOTORS

DL 30115 – SQUIRREL CAGE THREE-PHASE ASYNCHRONOUS MOTOR

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

Technical Features:

Power: 370 W
Voltage: 220/380 V Δ/Y
Current: 2/1.1 A Δ/Y Speed: 2650 rpm, 50 Hz

Accessories

DL 2035
STAR/DELTA STARTER

DL 30120 – SLIP RING THREE-PHASE ASYNCHRONOUS MOTOR

Induction motor with both stator and rotor three-phase windings.

Technical Features:

Power: 370 W
Voltage: 220/380 V Δ/Y
Current: 2.7/1.6 A
Speed: 2800 rpm, 50 Hz

Accessories

DL 30120RHD3
STARTING UNIT
DL 30125
STARTING AND SYNCHRONIZATION UNIT

DL 30180 – THREE-PHASE 2-SPEED SQUIRREL CAGE ASYNCHRONOUS MOTOR

2 or 4 pole induction motor with Dahlander-type three-phase stator winding and squirrel cage rotor.

Technical Features:

Power: 300/450 W
Voltage: 380 V
Current: 1.1/1.35 A
Speed: 1350/2650 rpm, 50 Hz

Accessories

DL 2036
POLE SWITCHING UNIT

DL 30270D - THREE-PHASE 2-SPEED SQUIRREL CAGE ASYNCHRONOUS MOTOR

2 or 8 pole induction motor with three-phase split stator windings and squirrel cage rotor.

Technical Features:

Power: 150/370 W
Voltage: 380 V
Current: 0.75/1.15 A
Speed: 680/2800 rpm, 50 Hz

Accessories

DL 30275
POLE SWITCHING UNIT

Educational objectives

- Measurement of the ohmic resistance of the windings
- Measurement of transformation ratio with slip-ring motor
- No-load test
- Short-circuit test with locked rotor
- Drawing of the Heyland circular diagram
- Conventional efficiency
- Real efficiency and electromechanical Characteristics through direct tests with the electromagnetic brake, the powder brake or the dynamometer
- Slip measurement

DIRECT CURRENT MACHINES

DL 30220
DIRECT CURRENT MOTOR COMPOUND EXCITATION

It can be also used as a generator.

Technical Features:
Power: 300 W
Voltage: 220 V
Speed: 3000 rpm
Excitation: 140 V / 0.12 A

Accessories
DL 30200RHD
STARTING RHEOSTAT
DL 30205
EXCITATION RHEOSTAT

DL 30210
DIRECT CURRENT MOTOR SERIES EXCITATION

It can be also used as a generator.

Technical Features:
Power: 300 W
Voltage: 220 V
Speed: 2800 rpm

Accessories
DL 30200RHD
STARTING RHEOSTAT
DL 30206
EXCITATION RHEOSTAT

DL 30200
DIRECT CURRENT MOTOR SHUNT EXCITATION

It can be also used as a generator.

Technical Features:
Power: 300 W
Voltage: 220 V
Speed: 3000 rpm
Excitation: 160 V / 0,25 A

Accessories
DL 30200RHD
STARTING RHEOSTAT
DL 30205
EXCITATION RHEOSTAT

DL 30240 – DIRECT CURRENT GENERATOR COMPOUND EXCITATION

It can be also used as a motor.

Technical Features:
Power: 260 W
Voltage: 220 V
Current: 1.18 A
Speed: 2800 rpm
Excitation: 190 V / 0.1 A

Accessories
DL 30205
EXCITATION RHEOSTAT

DL 30230 - DIRECT CURRENT GENERATOR SERIES EXCITATION

It can be also used as a motor.

Technical Features:
Power: 260 W
Voltage: 220 V
Current: 1.18 A
Speed: 3000 rpm

Accessories
DL 30206
EXCITATION RHEOSTAT

DL 30250 - DIRECT CURRENT GENERATOR SHUNT EXCITATION

It can be also used as a motor.

Technical Features:
Power: 260 W
Voltage: 220 V
Current: 1.18 A
Speed: 2800 rpm
Excitation: 190 V / 0,2 A

Accessories
DL 30205
EXCITATION RHEOSTAT

DL 30220P - DIRECT CURRENT POLIEXCITATION MACHINE

Suitable for series, shunt or compound excitation motor or generator.

Accessories
DL 30200RHD
STARTING RHEOSTAT
DL 30205
STARTING RHEOSTAT FOR THE SHUNT OR COMPOUND CONFIGURATION
DL 30206
STARTING RHEOSTAT FOR THE SERIES CONFIGURATION

Educational objectives
- *Winding resistance*
- *Mechanical and iron losses*
- *Conventional efficiency*
- *Magnetization, external and regulation characteristics of the generators*
- *Electromechanical characteristics of the motors through the direct method*
- *Electronic control of the speed of the motors*

THREE-PHASE SYNCHRONOUS MACHINES

DL 30190 – THREE-PHASE SYNCHRONOUS MACHINE

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

Technical Features:
As alternator: Power: 300 VA
As motor: Power: 300 W
Voltage: 220/380 V Δ/Y
Current: 0,8/0,46 A Δ/Y
Speed: 3000 rpm
Excitation:110 V / 0,2 A

Accessories
DL 30195
STARTING AND SYNCHRONIZATION RHEOSTAT
DL 1030
PARALLEL BOARD

DL 30270 – RELUCTANCE MOTOR

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

Technical Features:
Power: 100 W
Voltage: 220/380 V Δ/Y
Current: 1,1/0,6 A Δ/Y
Speed: 3000 rpm , 50 Hz

Educational objectives
- Measurement of the ohmic resistance of the windings
- Magnetization characteristic
- No-load losses through the method of the auxiliary motor
- 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 the direct method
-Alternator voltage stabilization

TRANSFORMERS

DL 30103 – SINGLE-PHASE TRANSFORMER

Core-type transformer with split windings.
It can also be used as an auto-transformer.

Technical Features:
As a transformer:
Rated power: 300 VA
Primary voltages: 127/220/380 V
Secondary voltages: 2 x 110 V

As an auto-transformer:
Rated power: 300 VA
Voltage: 127/220/380 V
Frequency: 50/60 Hz

DL 30100 – THREE-PHASE TRANSFORMER

Column-type transformer with split windings.
It can also be used with a single-phase supply.

Technical Features:
Power: 300 VA
Primary voltage: 2 x 110V (phase)
Secondary voltage: 2 x 110 (phase)
Frequency: 50/60 Hz

Educational objectives
- Ohm resistance of the windings
- Transformation ratio
- Polarity and connection group
- No- load test
- short-circuit test
- External characteristics
- Conventional efficiency

DL 30300
EDDY-CURRENT 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.

Technical Features:
Maximum supply voltage: 250 Vdc
Maximum speed: 5000 rpm
Maximum power: 450 W

DL 30300P
POWDER BRAKE

Electromagnetic brake.
Provided with water level, arms, weight and balance weight for measuring the output torque of the motor.
Possibility of assembling a load cell.
The brake includes an axial cooling fan that is supplied by the mains voltage.

Technical Features:
Maximum supply voltage: 20 Vdc
Maximum speed: 4000 rpm
Maximum power: 400 W

DL 30260
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.

Technical Features (as a brake):
Maximum power: 450 W
Voltage: 190 Vdc
Current: 2.4 A
Maximum speed: 3000 rpm

Accessories
DL 30040R RESISTIVE LOAD

POWER SUPPLY MODULES

Suitable for supplying fixed and variable alternating current and fixed and variable rectified direct current, in order to easily carry out all the tests on the electrical machines of the laboratory and in general in an electric measurement laboratory.
Provided with start push-button with remote control switch, stop push-button, key-unlocked emergency mushroom head pushbutton and differential magneto-thermal protection on the main sockets.
Connector for the overspeed protection of the motors and thermal protection.
The control devices and the safety connecting terminals, according to the IEC standards, are arranged on the front panel, clearly interconnected through a silk-screened synoptical diagram.

Output voltages:	**DL 30016**	**DL 30017** *(motor driven)*	**DL 30018**	**DL 30019** *(motor driven)*
Variable ac	3x0÷380 V, 2 A	3x0÷380 V, 2 A (*)	3x0÷380 V, 2 A	3x0÷380 V, 2 A (*)
	3x0÷240 V, 3 A	3x0÷240 V, 3 A (*)	3x0÷240 V, 3 A	3x0÷240 V, 3 A (*)
Fixed ac	3x380 V+N, 10 A	3x380 V+ N, 10 A	3x380 V, 2 A	3x220 V+ N, 10 A
	3x220 V, 3 A		3x220 V+N, 10 A	
Standard fixed ac	220 V, 3 A	220 V, 10 A	127 o 220 V, 10 A	127 o 220 V, 10 A
Variable dc	0÷240 V, 4 A	0÷240 V, 4 A (*)	0÷240 V, 4 A	0÷240 V, 4 A (*)
	0÷225 V, 1 A	0÷225 V, 1 A	0÷225 V, 1 A	0÷225 V, 1 A
Fixed dc	220 V, 4 A		220 V, 4 A	
Power supply	3x380 V+N, 50/60 Hz	3x380 V+N, 50/60 Hz	3x220 V+N, 50/60 Hz	3x220 V+N, 50/60 Hz

(*) = programmable

Other power supplies

DL 1067S – MOTOR-DRIVEN POWER SUPPLY UNIT WITH AUTOMATIC REGULATION

Suitable for power supplying with variable voltage the braking systems and the excitation of the machines through manual or automatic operation.

Technical Features:

- DC output: 0 to 210 V, 2 A
- Automatic regulation of excitation to keep a constant voltage
- Power supply: 220 V, 50/60 Hz

DL 1054 - POWER SUPPLY UNIT

Suitable for power supplying with variable voltage the braking systems and the excitation of the machines.

Technical Features:

Output: 0÷120V, 2 A or 0÷220V, 1 A
Power supply: 220 V, 50/60 Hz

DL 10305 – POWER SUPPLY FOR THE POWDER BRAKE

Suitable for power supplying with variable voltage the powder brake.

Technical Features:

Output: 0÷10V, 2 A o 0÷20V, 2 A
Power supply: 220 V, 50/60 Hz

Electrical measurement

DL 10065N
ELECTRICAL POWER DIGITAL MEASURING UNIT

Measurement of dc voltage, current, power and energy.
Measurement of AC voltage, current, power, active energy, reactive energy, apparent energy, power factor and frequency.

Main technical features:

Direct voltage:	300 V
Direct current:	20 A
Alternate voltage:	450 V
Alternate current:	20 A
Power:	9000 W
Single phase power supply:	90-260 V, 50/60 Hz

Communication: RS485 with protocol MODBUS RTU

Mechanical measurement

DL 2006CN
TORQUE MEASURING UNIT

Suitable to measure the motor output torque through a load cell arranged on the braking system.
Digital readout and analogue output proportional to the measured value.
Power supply: 220 V, 50/60 Hz

DL 30052
MECHANICAL POWER DIGITAL MEASURING UNIT

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 brakes or of the dynamometer.
Digital readout of the measured quantities and their conditioning to voltage levels that are directly compatible with a plotter or that can be interfaced for data acquisition and automatic plotting of the electromechanical characteristics of the machines.
Connector for over speed protection of the motors through the connection to the power supply module.

Technical Features:

Torque: 0 ÷1.999 Nm (1 mV/dgt)
Speed: 6000 rpm (1 mV/ rpm)
Power: 600 W (1 mV/W)
Dc output: 0 ÷220 V, 0.6 A
Power supply: 220 V, 50/60 Hz

MEAUSURING UNITS

DL 2006E
LOAD CELL

Resistance electronic strain-gauge with 150 N range,
to be mounted on the braking system to measure the mechanical torque.

Speed measurement

DL 2025DN
ELECTRONIC TACHOMETER

Suitable to measure the revolving speed through tachometric or optical transducer mounted on the machine.
Digital readout and analogue output proportional to the measured value.
Complete with built-in connector for over speed protection to be connected to the power supply unit.
Power supply: 220 V, 50/60 Hz

DL 2031M
OPTICAL TRANSDUCER

Suitable to measure the revolving speed through a slotted optical switch with encoder disc, that can be also used for stroboscopic measurements.
Connector for the transfer of the signal to the electronic tachometer DL 2025D.
Prearranged for its assembling on the machines of the laboratory..

DL 2026
CONTACT TACHOMETER

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

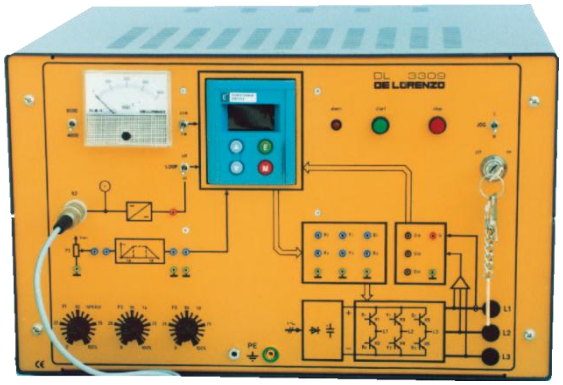
DL 2026R
OPTICAL TACHOMETER

Suitable for measuring the revolving speed with digital readout.
Measuring range: 50 to 19,999 rpm.
Power supply: 4 x 1.5 V batteries (UM 3), included.
Complete with 5 reflectors.

DL 3309
SPEED CONTROL OF AC MOTORS

The objective of this unit is to demonstrate the PWM technique for piloting a three-phase inverter used for the variable frequency control of the speed in a three-phase asynchronous motor.
Digital control inverter programmable from keyboard with on screen guide.
The speed control can be realized through manual control of a potentiometer or through closed loop tachometric control.
The acceleration and deceleration ramps can be separately regulated from 5 to 15 seconds approx.
Inversion of the sense of rotation. Instrument for the rotation speed.

Technical Features:
Power: 550 W
Maximum output voltage: 3 x 220 V
Rated current: 3 A
Output frequency: 0 to 240 Hz
V/F ratio: constant/squared.
Direct current braking.
Protections against minimum/maximum supply voltage, thermal protection and limitation of the output current.
Power supply: 1 x 220 V + N, 50/60 Hz.



Accessories

DL 30115	SQUIRREL CAGE THREE-PHASE ASYNCHRONOUS MOTOR
DL 30300	EDDY-CURRENT BRAKE
DL 1054	POWER SUPPLY FOR THE BRAKE
DL 1013A	BASE

DL 3315
SPEED CONTROL OF DC MOTORS

Semi-controlled single phase bridge. Suitable for the control of the speed of independently excited dc motors.
The control is performed by regulating the conduction period of a single-phase semi-controlled thyristor bridge both in open and closed loop.
The controller consists of three control loops: speed, current and armature voltage.

Technical Features:
Power of the motor: 550 W max.
Power of the converter: 900 W max.
Armature voltage: 0 ÷ 180 V
Armature current: 5 A max.
Excitation voltage: 200 V, 0.5 A
Power supply: 220 V, 50 Hz

Accessories

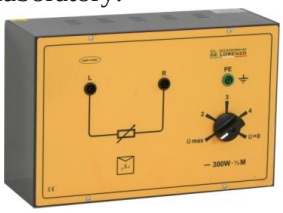
DL 30200	DIRECT CURRENT MOTOR SHUNT EXCITATION
DL 30300	EDDY CURRENT BRAKE
DL 1054	POWER SUPPLY FOR THE BRAKE
DL 1013A	BASE

Suggested

DL 2315T	ISOLATING TRANSFORMER

ACCESSORIES

DL 30200RHD – STARTING RHEOSTAT
Step-variable rheostat for the half torque starting of the dc motors of the laboratory.

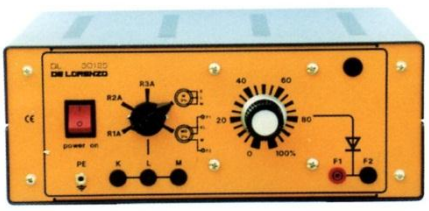


DL 30120RHD3 - STARTING RHEOSTAT
Step-variable three-phase rheostat for the half torque starting of the slip ring motors of the laboratory.

DL 30205 – EXCITATION RHEOSTAT
Suitable for the shunt excitation of the dc machines and of the synchronous machines of the laboratory.

DL 30206 - EXCITATION RHEOSTAT
Suitable for the series excitation of the dc machines of the laboratory.

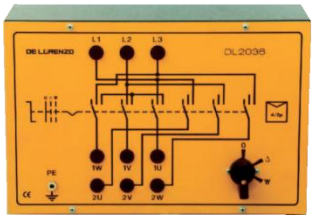
DL 30125 – MODULO DI AVVIAMENTO E SINCRONIZZAZIONE
Starting rheostat for the three-phase slip ring induction motors and excitation device for the synchronization of the motor with the mains.



DL 30195 - STARTING AND SYNCHRONIZATION UNIT
Starting rheostat for the three-phase synchronous machines and excitation device for the synchronization with the mains.

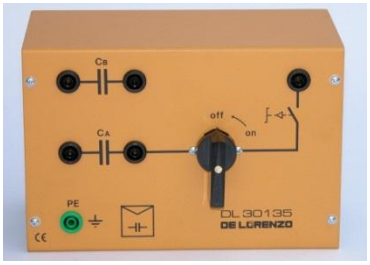
DL 2035 – STAR/DELTA STARTER
Star/delta starter for the three-phase squirrel-cage induction motors.

DL 2036 – POLE CHANGING UNIT
Switch to change the number of poles in Dahlander type motors.



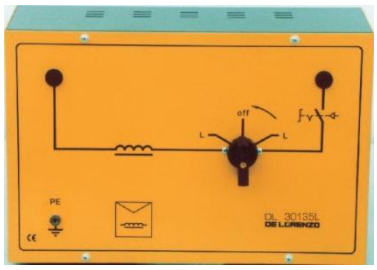
DL 30275 - POLE SWITCHING UNIT
Switch to change the number of poles in motors with two separate windings.

DL 30135 – CAPACITOR UNIT
Set of capacitors for either starting or steady-state running of the split-phase motor.



DL 30135R - RESISTOR UNIT
Auxiliary resistor for the starting of the split-phase motor.

DL 30135L
INDUCTOR UNIT
Auxiliary inductor for the starting of the split-phase motor.

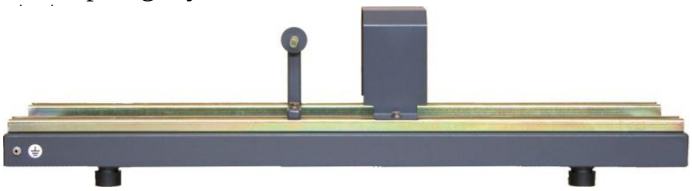


DL 1030
PARALLEL BOARD
Rotating light synchronoscope, complete with the accessories that are required to perform the parallel connection between synchronous generators or between the alternator and the mains.

DL 30410
FLYWHEEL
Used in the deceleration tests on rotating machines for the calculation of the mechanical iron and copper losses at different excitations.

DL 1020
THREE-PHASE TRANSFORMER
Used for the fine regulation of the voltage in the short circuit test of an induction motor.

DL 1013A
UNIVERSAL BASE
Duralumin alloy varnished structure mounted on anti vibration rubber feet, provided with slide guides for the fixing of one or two machines and with a coupling guard.
Complete with a device for the locking of the rotor of the slip ring asynchronous machines in the short circuit.



DL 1013B

DL 1013B
UNIVERSAL BASE
Duralumin alloy varnished structure mounted on anti vibration rubber feet, provided with slide guides for the fixing of up to three machines, and in particular of the flywheel, and with a coupling guard.
Complete with a device for the locking of the rotor of the slip ring asynchronous machines in the short circuit test.

DL 1155A

CONNECTING LEADS

5 red leads, ø 4 mm., length 25 cm., section 0.75 mm^2
5 black leads, ø 4 mm., length 25 cm., section 0.75 mm^2
5 red leads, ø 4 mm., length 200 cm., section 0.75 mm^2
5 black leads, ø 4 mm., length 200 cm., section 0.75 mm^2
5 red leads, ø 4 mm., length h 50 cm., section 1.5 mm^2
5 black leads, ø 4 mm., length 50 cm., section 1.5 mm^2
4 red leads, ø 4 mm., length 100 cm., section 1.5 mm^2
4 black leads, ø 4 mm., length 100 cm., section 1.5 mm^2
4 red leads, ø 4 mm., length 200 cm., section 1.5 mm^2
4 black leads, ø 4 mm., length 200 cm., section 1.5 mm^2
2 yellow-green leads, ø 4 mm., l. 50 cm., section 1.5 mm^2
2 yellow-green leads, ø 4 mm., l. 100 cm., section 1.5 mm^2
2 yellow-green leads, ø 4 mm., l. 200 cm., section 1.5 mm^2

The set of leads is also available with safety plugs and sections of 0.75 mm2 and 2.5 mm2 instead of 0.75 mm2 and 1.5 mm2 with the code **DL 1155A-SC**.

LOADS AND RHEOSTATS

DL 30040C - CAPACITIVE LOAD

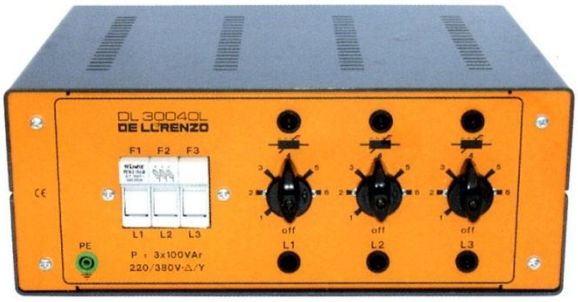
Single or three-phase capacitive step-variable load.
Max. power: 3 x 105 VAr
Max. voltage: 220/380 V Δ/Y

DL 30040R - RESISTIVE LOAD

Single or three-phase resistive step-variable load.
Max power: 3 x 110 W
Max. voltage: 220/380 V Δ/Y

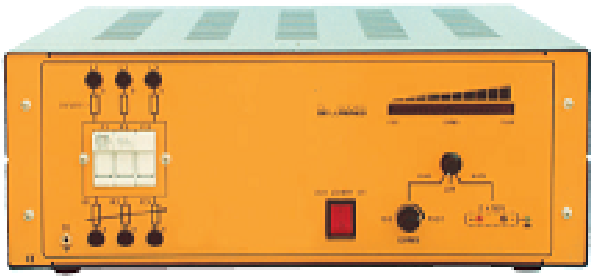
DL 30040L - INDUCTIVE LOAD

Single or three-phase inductive step-variable load.
Max. power: 3 x 100 VAr
Max. voltage: 220/380 V Δ/Y



DL 30045 – MOTOR-DRIVEN RESISTIVE LOAD

Suitable for realizing resistive single or three-phase resistive loads through manual or automatic operation.
Resistance: 3 x (3300÷480) Ω
Current: 3 x 0.46 A
Power supply: 220 V, 50/60 Hz



DL 1001-1
WORKING BENCH
Large size bi-laminated wooden top and square legs with adjustable feet.
Dimensions: 2000 x 1000 x 900 h mm.

DL 1001F1
SINGLE 10 / 16 A SOCKET HOLDER
Socket holder with a 10/16 A socket.

DL 1001F2
DOUBLE 10 / 16 A SOCKET HOLDER
Socket holder with two 10/16 A sockets.

DL 1001EV1
SHELF FRAME
Fire varnished tubular steel frame with shelves, suitable to house up to six 4Ux19" units.
It can be arranged on the working bench.

DL 1150
STOOL
Turnable and vertically adjustable.
On request, with back.

DL 1016
CABINET
Fire varnished steel-plate and provided with key-locked doors. It can be arranged under the work bench.

DL 1015-2
TROLLEY
Tubular steel frame with two shelves and rubber casters. Suitable for supporting and moving the machines of the laboratory

DL 1015-4
TROLLEY
Tubular steel frame with shelves and rubber casters. Suitable for supporting and moving computer, printer and plotter.

DL 1151
DESK
Large size bi-laminated wooden top and square legs with adjustable feet.
Complete with two chests of three drawers.

DL 1153
CHAIR
Chair with wooden back and armrests.

DL 1196
HOLDER FOR LEADS
Metallic frame to hold the connecting leads.

CUT-AWAY MACHINE

De Lorenzo is able to provide the machines of the laboratory also in a cut-away version.
To order them, just add to the code of the machine the suffix SEZ (for example: if DL 30115 is the code of the machine, DL 30115SEZ is the code of the same machine in the cutaway version).