

Nr.	Experiment	Basic configuration						Options					
		DL 10280	DL 10281	DL 10282	DL 10283	DL 10284	DL 10285	DL 10185	DL 10310	DL 10300A DL 10284	DL 10116	DL 10125	
1	Flux produced by the poles	x	x	x									
2	Main magnetic field	x	x	x									
3	Intensity of the magnetic field	x	x	x									
4	Induced voltage	x	x	x									
5	Interpole effect	x	x	x									
6	No-load magnetic neutral axis	x	x	x									
7	Rotating magnetic field	x	x	x	x								
8	3-phase squirrel cage motor, 2 poles, 24 VΔ	x	x	x						x			
9	3-phase squirrel cage motor, 2 poles, 42 VY	x	x	x	x					x			
10	3-phase squirrel cage motor, 2 poles, 24 VΔΔ	x	x	x						x			
11	3-phase squirrel cage motor, 2 poles, 42 VYY	x	x	x						x			
12	3-phase squirrel cage motor, 4 poles, 24 VΔ	x	x	x						x	x		
13	3-phase squirrel cage motor, 4 poles, 42 VY	x	x	x						x			
14	3-phase Dahlander motor, 4/2 poles, 42 VΔ/Y	x	x	x						x			
15	Split phase motor	x	x	x	x					x			
16	Capacitor start and run motor	x	x	x	x					x			
17	3-phase motor with wound rotor, 2 poles, 42 VYY	x	x	x	x					x			
18	Phase shifter	x	x	x	x	x							
19	Induction regulator	x	x	x	x	x							
20	3-phase synchronous induction motor, 2 poles, 24 VΔ	x	x	x						x		x	
21	3-phase synchronous induction motor, 2 poles, 24 VΔΔ	x	x	x						x		x	
22	DC motor with separate excitation	x	x	x	x					x			
23	DC motor with shunt excitation	x	x	x	x					x			
24	DC motor with series excitation	x	x	x	x					x			
25	DC motor with compound excitation, long shunt	x	x	x	x					x			
26	DC motor with compound excitation, short shunt	x	x	x	x					x			
27	Single phase series motor	x	x	x						x			
28	Repulsion motor	x	x	x	x					x			
29	Synchronous motor winding resistance	x	x	x									
30	Synchronous motor no-load test	x	x	x	x								
31	Synchronous motor short-circuit characteristics	x	x	x	x								
32	Synchronous motor short-circuit test	x	x	x	x								
33	Synchronous motor Behn-Eschenberg's method	It uses the data from experiments 29, 30 and 31											
34	Synchronous motor load test	x	x	x	x								
35	Synchronous motor conventional efficiency	It uses the data from experiments 29, 30, 32 and 33											
36	Parallel connection of the alternator with the mains	x	x	x	x								
37	Alternator as synchronous motor	x	x	x	x							x	
38	DC generator winding resistance	x	x	x									
39	DC generator test of the no-load motor (Swinburne)	x	x	x	x								
40	DC generator no-load e.m.f.	x	x	x								x	
41	DC generator excitation characteristics	x	x	x								x	
42	Separate excitation dynamo	x	x	x	x							x	
43	Shunt excitation dynamo	x	x	x	x							x	
44	Series excitation dynamo	x	x	x	x							x	
45	Compound excitation dynamo	x	x	x	x							x	

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OPENLAB

Assembly System for Rotating Electric Machines

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ISO 9001:2008

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Assembly System for Rotating Electric Machines

OPENLAB THIS SYSTEM IS A COMPLETE SET OF COMPONENTS AND MODULES SUITABLE FOR ASSEMBLING THE ROTATING ELECTRIC MACHINES, BOTH FOR DIRECT CURRENT AND FOR ALTERNATING CURRENT. STUDENTS CAN PERFORM A CRITICAL AND WELL ANALYZED ASSEMBLY, IN ORDER TO UNDERSTAND THE PRODUCTION TECHNIQUES BEFORE PERFORMING PRACTICAL TESTS OF THE OPERATING CHARACTERISTICS. THE SYSTEM IS SUPPLIED AT LOW VOLTAGES IN ORDER TO PREVENT THE RISK OF ACCIDENTS. HOWEVER, THE MACHINES HAVE FULLY INDUSTRIAL FEATURES.

The OPENLAB system, in its basic configuration, is composed of:

- A set of components DL 10280
- A power supply module DL 10281
- A measurement module DL 10282
- A loads and rheostat module DL 10283
- An adapter bracket DL 10284
- A locking and rotating device DL 10285
- A parallel board DL 10310
- A pole changing module DL 10185

and the following options are suggested:

- Electromagnetic Brake DL 10300A
- Star/Delta Starter DL 10116
- Starting and Synchronization DL 10125
- Drive Motor DL 10200
- Fault Simulators DL 10280FF

An automatic data acquisition and processing system can be setup by substituting/adding a few modules from the Microlab laboratory, as detailed in the table that you will find inside this brochure.

APPLICATIONS

- Assembly, operation and tests on electric machines and, in particular:
 - Study of the magnetic field
 - Principles of the electromagnetic induction
 - Separately shunt, series and com-pound excited dc motors
 - Separately shunt, series and com-pound excited dc generators
 - Induction motors: three-phase slip ring and squirrel cage, single-phase repulsion and with capacitor
 - Dahlander connection

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Assembly System for Rotating Electric

DL 10280 - SET OF COMPONENTS

It includes the following components:

1. Base plate
2. Supports with bearing
3. Coupling joints
4. Flexible coupling
5. Electronic speed transducer
6. Assembling screws
7. Wrenches
8. DC stator
9. AC stator
10. Rotor with commutator
11. Brush holder with 2 brushes
12. Cage rotor
13. Ring rotor
14. Brush holder with 6 brushes.

Besides, a magnetic probe is foreseen to display the magnetic fields and a transparent covering, for safety reasons, prevents students from the accidental contact with the rotating parts.

The **AC STATOR** is composed of a metal frame supporting the laminated magnetic circuit, because interested by a flux variable in time, and the electrical winding. The sheet iron pack is 60 mm long, with internal diameter of 80 mm and external one of 150 mm and it presents 24 half-closed slots inside of which there is a double three-phase winding: the beginnings and the ends of the different phases are shown outside the stator on a suitable educational terminal board. The winding is a double layer one of the long coil lap type, with winding span 6 (1÷7). Every slot contains two coils of 19 turns each of enamelled wire of diameter 1.12 mm.

The **SQUIRREL CAGE ROTOR** is composed of a shaft to which a pack of magnetic sheet irons is fixed, where the slots suitable to contain the rotor winding are set. The sheet iron pack is 60 mm long, with external diameter of about 78 mm.

To avoid the phenomenon of the motor crawling in starting phase and to reduce the noise, the slots are inclined as regards the stator ones. The rotor winding is composed of the squirrel cage.

The cage is carried out by setting in every rotor slot some conducting bars that are closed in short-circuit at both ends by means of some conducting rings. The rotor winding can be therefore considered a multi-phase winding, with a single conductor for pole-phase, so it does not present an its proper pole number but it assumes one that is equal to the stator winding one.

The **RING ROTOR** is composed of a shaft to which the collector rings and a magnetic sheet iron pack are fixed: the iron pack has 21 semi-closed slots suitable to contain the winding. The sheet iron pack is 60 mm long, with external diameter of about 78 mm. To avoid a noisy mechanical running the rotor slots are inclined as regards the sta-

tor ones. The rotor winding is composed of coils and it is two pole three-phase.

The winding is a double layer one of the long coil lap type, with winding span 9 (1÷10). Every slot contains two coils of 8 turns each of enamelled wire of diameter 1.5 mm.

The winding is star connected and it is subordinate to the collector rings while the star centre is internal and not accessible.

The terminals of the rotor winding are accessible by means of the collector rings on which the bushes supported by a brush holder graze.

The **DC STATOR** is composed of a metal frame supporting the laminated magnetic circuit, with 2 main poles and 2 interpoles, and the electrical windings. The sheet iron pack is 60 mm long, with internal diameter of 80 mm. On the poles the coils are wound whose terminals are shown on a suitable educational terminal board.

The **DC ROTOR** is composed of a shaft to which the segment commutator is fixed and of a magnetic sheet iron pack where 20 semi-closed slots suitable to contain the electrical winding are set.

The sheet iron pack is 60 mm long, with external diameter of about 80 mm. The winding is a double layer one of the long coil lap type, with winding span 9 (1÷10).

Every slot contains two coils with two sections of 5+5 turns carried out with enamelled wire of diameter 1.12 mm.

The winding is subordinate to the 40 segments of the commutator on which two brushes supported by a brush holder graze.

The brushes are subordinate to terminals set on two external boards that show the synoptic of the rotor winding.

DL 10281 - Power Supply

Outputs in ac:

- Three-phase: 24 V/14 A, 42V/10A
- Single-phase: 0 – 48 V/5 A, 0 – 10 V/12A

Outputs in dc:

- 32 V/14 A, 42 V/10 A, 0 – 40 V/5 A, 0 – 8 V/12 A

Three-phase power supply from mains. Complete with over-speed protection

DL 10282 - Electric and Speed Measurement

- 2 analog voltmeters, three ranges: 3–5–75 Vdc/ac
- 2 analog ammeters, three ranges: 1.5–5–15 Adc/ac
- 1 speed meter: 0 - 4000 rpm

Single-phase power supply from mains. Complete with speed meter and output for overspeed protection.

DL 10283 – Loads and Rheostat

- Resistors: 3x15 0hm, 90 W each, 1 0hm + (0 - 2 0hm), 80 W
- Capacitors: 3 x 80 uF, 150 V
- Rheostat: 0 - 80 0hm, 1 A

DL 10284 – Adapter Bracket

Necessary for connecting the locking device, the brake or the drive motor.

DL 10285 – Locking and Rotating

Suitable for locking and rotating the rotor of slip-ring induction motors to obtain an induction regulator and phase transformer.

DL 10185 – Pole Changing

Switch to change the number of poles on Dahlander motors.

DL 10310 – Parallel Board

Rotating light synchroscope to perform the parallel connection between synchronous generators or between the alternator and the mains.

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OPTIONS

With the OPENLAB system it is possible to perform load tests by adding an electromagnetic brake, to synchronize slip ring motors by adding a suitable module, to keep constant the speed of the motors by adding a drive motor or to use a star/delta starter for further tests on electric machines.

DL 10300A – Electromagnetic Brake

Smooth roll rotor and salient pole stator. Complete with water level, arms, weight and balance weight for measuring the output torque of the motor.

DL 10116 – Star/Delta Starter

For three-phase squirrel cage induction motors.

DL 10125 – Starting and Synchronization

Rotor starter for three-phase slip ring motors and excitation device for synchronization with the mains.

DL 10200 – Drive Motor

Direct current shunt excitation motor. Power: 200W. Speed: 3000 rpm

FAULT SIMULATORS

DL 10280FF – Fault Simulators

Set of 4 masks to insert simulated faults in the machines of the OPENLAB system.

The set includes:

- FAULT SIMULATOR FOR A THREE-PHASE CAGE MOTOR
 - Short-circuit between two phases
 - Break-up of a stator phase
 - Break-up of two phases
 - Internal short-circuit
- FAULT SIMULATOR FOR A DAHLANDER MOTOR
 - Short-circuit between two phases
 - Break-up of a stator phase
 - Internal short-circuit

- FAULT SIMULATOR FOR A SINGLE-PHASE CAPACITOR MOTOR
 - Unsuccessful starting of the motor
- FAULT SIMULATOR FOR A COMPOUND EXCITED DC MOTOR
 - Unsuccessful starting of the motor
 - Break-up of a stator phase
 - Shunt excitation circuit reversal

AUTOMATIC DATA ACQUISITION AND PROCESSING

DL 1893 – Interface to PC DL 8330SW – Data acquisition and processing software

It is also possible to perform tests and measurements on the electric machines of the OPENLAB system through a data acquisition and processing system composed of a dedicated software in LabView environment, an interface to PC and a set of suitable motor driven modules for the control of the parameter and interfaceable modules for the acquisition of data.

The following table shows the changes in modules that is necessary to make to the system in order to obtain a fully automatic data acquisition and processing system with the OPENLAB components. All the substituting modules come from the De Lorenzo Microlab electric machines laboratory.

INSTEAD OF:	YOU SHOULD USE (FROM THE MICROLAB LABORATORY):
DL 10280 Set of components	DL 10280 Set of components
DL 10281 Power supply	DL 10017 Motor driven power supply
DL 10282 Measurement module	DL 10050 Mechanical power measurement
	DL 10060 Electrical power measurement
DL 10283 Loads/rheostats module	DL 10045 Motor driven resistive load
DL 10284 Adapter bracket	DL 10284 Adapter bracket
DL 10285 Locking and rotating device	DL 10285 Locking and rotating device
DL 10185 Pole changing module	DL 10185 Pole changing module
DL 10310 Parallel board	DL 10310 Parallel board
DL 10300A Electromagnetic brake	DL 10300A Electromagnetic brake
DL 10116 Star-delta starter	DL 10116 Star-delta starter
DL 10125 Starter and synchronizer	DL 10125 Starter and synchronizer
	DL 10306 Motor driven power supply for the brake
	DL 1893 Interface to PC
	DL 8330SW Data acquisition and processing software

