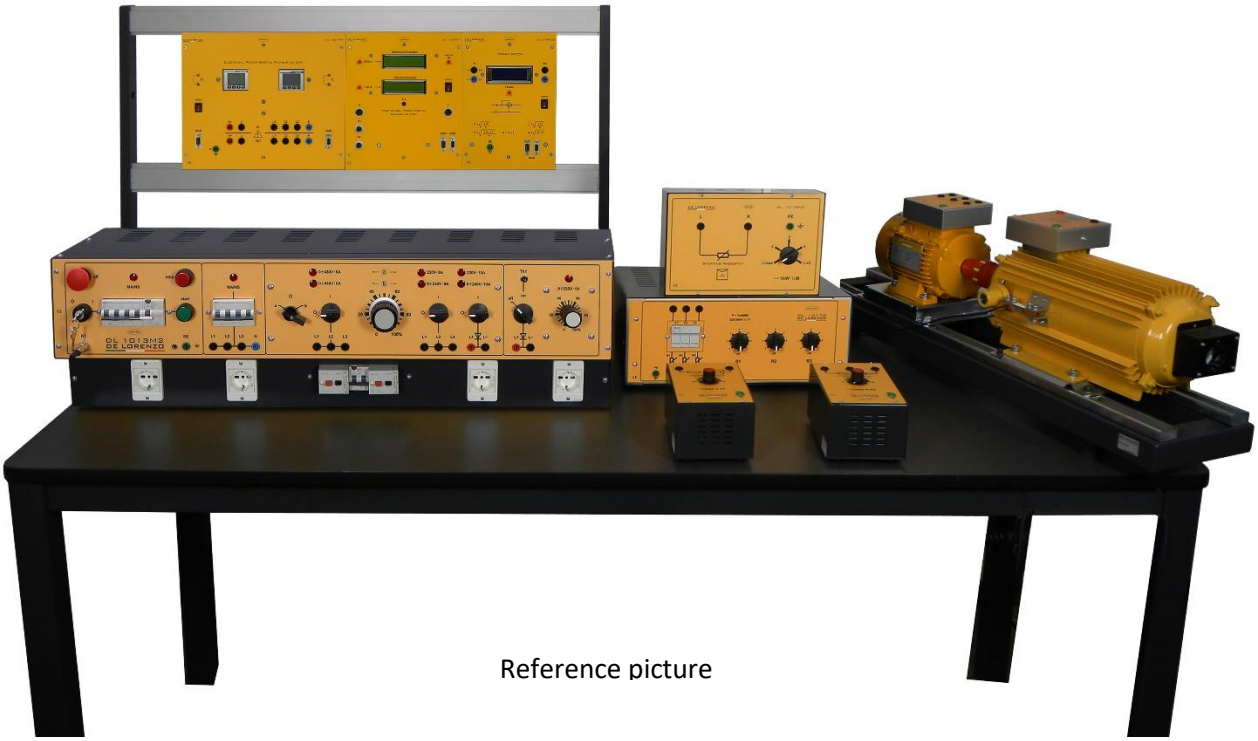
ELECTRIC MACHINES LABORATORY
DL MAC-E



Reference picture

1. INTRODUCTION

The DL MAC-E is a multipurpose bench for the study and characterization of all the electric machines in the De Lorenzo Eurolab series (0.3 kW) catalogue. The system includes all the instruments necessary to learn the operation and characteristics of each type of electric machine (motors or generators in AC or DC).

The laboratory has been designed as a modern and practice-oriented training system for vocational and engineering education. It provides a comprehensive solution to cover a standard electric machines course that can be tailored to the institute's educational needs.

The test bench is modular and can be reconfigured according to the machine under test using, as needed, the power supply, the electrical and mechanical instruments and the electromagnetic brake for the characterization of the motors or the prime mover (DC machine) for the study of generators.

2. KEY CHARCTERISTICS

The system is composed of the following main sections:

Electromagnetic brake for the characterizations of the motors with a load cell for accurate torque measurement.

A DC motor is used as a prime mover for the study of AC and DC generators and the synchronization of machines with the mains network.

A three-phase power supply with fixed and variable outputs in AC and DC that provide the electrical power to the test bench and machines under study. The power supply includes all the protections needed to create a safe work environment for the student.

Multifunction digital modules to collect all the electrical parameters (voltage and current in AC and DC, RMS values, active, reactive and apparent power and frequency) and mechanical parameters (speed, torque) needed to characterize the machine under study.

3. EXPERIMENTS

With the basic configuration of the test bench, the available instruments and brake can be used to trace the characteristic curves of the compound excitation DC motor DL 30220 that is used as a prime mover and perform the following experiments:

- Measurement of the windings resistance
- No-load losses
- Conventional efficiency
- Direct test with electromagnetic brake
- Electro-mechanic characteristic

The total list of experiments available will vary according to the machines under test. Please refer to the electric machines section for a detailed list of the available machines.

4. TEST BENCH COMPOSITION

The DL MAC-E is composed of the following modules:

CODE	DESCRIPTION	QTY
DL 30016	DC and AC power supply module Code for countries with 220V three phase power supply: **DL 30018**	**1**
DL 30220	Direct current motor compound excitation	**1**
DL 2031M	Optical transducer	**1**
DL 30200RHD	Starting rheostat	**1**
DL 30205	Excitation rheostat	**1**
DL 30300	Electromagnetic brake	**1**
DL 2006E	Load cell	**1**
DL 10055NF	Mechanic power digital measuring unit	**1**
DL 10065NF	Electric power measuring module	**1**
DL 2109D33	Digital true RMS meter	**1**
DL 1013A	Universal base for electric machines	**1**
DL 2100-3L	Three level frame	**1**
DL 1155A-SC	Connecting cables	**1**

5. TEST BENCH CONFIGURATIONS

THREE-PHASE ASYNCHRONOUS MACHINES

Introduction:
The asynchronous motor represents the most important and simple case in the area of poly-phase machines. It is the most widespread for industrial applications such as food, chemical, metallurgical industries, paper factories or water treatment and extraction systems.

Three phase asynchronous machines test bench composition:

CODE	DESCRIPTION	QTY
	Workstation	
DL MAC-E	Test bench for electric machines	**1**
	Squirrel cage three-phase asynchronous motor	
DL 30115	Squirrel cage three-phase asynchronous motor	**1**
DL 2035	Star/delta starter	**1**
	Slip ring three-phase asynchronous motor	
DL 30120	Slip ring three-phase asynchronous motor	**1**
DL 30125	Starting and synchronization unit	**1**
	Two speed squirrel cage three-phase asynchronous motor	
DL 30180	Three-phase two speed asynchronous motor	**1**
DL 2036	Pole switching unit	**1**
	Two speed separate windings three-phase motor	
DL 30270D	Two speed separate windings three-phase motor	**1**
DL 30275	Pole switching unit	**1**

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Experiment list:

NO.	EXPERIMENT	DL 30115	DL 30120	DL 30180	DL 30270D
1.	Stator Winding Resistance	V	V	V	V
2.	Rotor Winding Resistance		V		
3.	Transformation Ratio Test - Stator/Rotor		V		
4.	Transformation Ratio Test - Rotor/Stator		V		
5.	No-load Test	V	V	V	V
6.	Short-circuit Test	V	V	V	V
7.	Star/Delta Motor Starter	V			
8.	Pole Switching Test			V	V
9.	Direct Test with Electromagnetic Brake	V	V	V	V

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SINGLE-PHASE MOTORS

Introduction:

Single-phase motors, although less common in the industry than the three-phase motors, they are still used in low-power applications that use the single-phase network. At the same power, they are bulkier than three-phase motors and their performance and cosφ are much lower but are simple in construction, cheap in cost, reliable and easy to maintain and repair. Rarely used in the industry, the single-phase universal motor is the most produced in the world, popular in the field of home appliances and in that of portable equipment.

Single phase motors test bench composition:

CODE	DESCRIPTION	QTY
	Workstation	
DL MAC-E	Test bench for electric machines	**1**
	Split phase motor	
DL 30130	Split phase motor	**1**
DL 30135	Capacitor unit	**1**
	Single phase motor with capacitor	
DL 30140	Single phase motor with capacitor	**1**
	Universal motor	
DL 30150	Universal motor	**1**
	Repulsion motor	
DL 30170	Repulsion motor	**1**

Experiment list:

NO.	EXPERIMENT	DL 30130	DL 30140	DL 30150	DL 30170
1.	**Starting a split phase motor (with running, starting and two capacitors)**	V			
2.	**Direct test with electromagnetic brake for universal motor with AC power supply**			V	
3.	**Direct test with electromagnetic brake for universal motor with DC power supply**			V	
4.	**Direct Test with Electromagnetic Brake**	V	V		V

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DIRECT CURRENT MACHINES

Introduction:

The DC machines are driven from a DC power supply and they are the most versatile of all rotating electrical machines. Their speed can be easily adjusted but their construction is more complex than their AC counterparts since they need a commutator.

All the DC machines are reversible working as motors or as generators (dynamo), the real difference being the direction the power flow. They are used as motors in a wide variety of industrial drives, such as robots, machine tools, oil drilling rigs, mining, automotive systems, etc. and as generators in some power plants.

DC Motor Test Bench composition:

CODE	DESCRIPTION	QTY
	Workstation	
DL MAC-E	Test bench for electric machines	**1**
	Poly-excitation machine	
DL 30220P	Direct current poly-excitation machine	**1**
DL 30200RHD	Starting rheostat	**1**
DL 30205	Excitation rheostat	**1**
DL 30206	Excitation rheostat	**1**
DL 30040R	Resistive load	**1**
DL 2109D33	Digital true RMS meter	**1**
	Direct current motor shunt excitation	
DL 30200	Direct current motor shunt excitation	**1**
DL 30200RHD	Starting rheostat	**1**
DL 30205	Excitation rheostat	**1**
	Direct current motor series excitation	
DL 30210	Direct current motor series excitation	**1**
DL 30200RHD	Starting rheostat	**1**
DL 30206	Excitation rheostat	**1**

DC Motor experiment list:

NO.	EXPERIMENT	DL 30200	DL 30210	DL 30220P
1.	**Measurement of the windings resistance**	**V**		**V**
2.	**No-load losses**	**V**		**V**
3.	**Conventional efficiency**	**V**		**V**
4.	**Direct test with electromagnetic brake**	**V**	**V**	**V**
5.	**Electromechanic characteristic**			**V**

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DC Generator Test Bench composition:

CODE	DESCRIPTION	QTY
	Workstation	
DL MAC-E	Test bench for electric machines	**1**
	Direct current generator compound excitation	
DL 30240	Direct current generator compound excitation	**1**
DL 30040R	Resistive load	**1**
DL 2109D33	Digital true RMS meter	**1**
	Direct current generator shunt excitation	
DL 30250	Direct current generator shunt excitation	**1**
DL 30040R	Resistive load	**1**
DL 2109D33	Digital true RMS meter	**1**
	Direct current generator series excitation	
DL 30230	Direct current generator series excitation	**1**
DL 30040R	Resistive load	**1**
	Poly-excitation machine	
DL 30220P	Direct current poly-excitation machine	**1**
DL 30040R	Resistive load	**1**
DL 2109D33	Digital true RMS meter	**1**

DC Generator experiment list:

NO.	EXPERIMENT	DL 30230	DL 30240	DL 30250	DL 30220P
1.	**Measurement of the windings resistance**		**V**	**V**	**V**
2.	**Magnetization characteristic curve**		**V**	**V**	**V**
3.	**No-load losses**		**V**	**V**	**V**
4.	**External characteristic curve**		**V**	**V**	**V**
5.	**Regulation characteristic curve**		**V**	**V**	**V**
6.	**Conventional efficiency**		**V**	**V**	**V**
7.	**Direct test**	**V**			**V**

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THREE-PHASE SYNCHRONOUS MACHINES

Introduction:

The synchronous machines construction is similar to that a three-phase induction motor except the fact that the rotor is given DC supply. The speed of the rotor is the same as the rotating magnetic field.

They are commonly used as generators especially for large power systems, as synchronous motors in situations where constant speed drive is required or as an unloaded synchronous machine for power factor correction.

Three phase synchronous machines test bench composition:

CODE	DESCRIPTION	QTY
	Workstation	
DL MAC-E	Test bench for electric machines	**1**
	Three phase synchronous machine	
DL 30190	Three phase synchronous machine	**1**
DL 1030	Parallel board	**1**
DL 30040R	Resistive load	**1**
DL 30040L	Inductive load	**1**
DL 30040C	Capacitive load	**1**
	Reluctance motor	
DL 30270	Reluctance motor	**1**

Experiment list:

NO.	EXPERIMENT	DL 30190	DL 30270
1.	**Measurement of the resistance of the armature windings**	**V**	
2.	**Measurement of the resistance of the excitation winding**	**V**	
3.	**Study of the magnetization characteristic**	**V**	
4.	**Measuring the mechanical, the iron and the additional losses**	**V**	
5.	**Direct test with electromagnetic brake**		**V**
6.	**Study of short-circuit characteristic**	**V**	
7.	**Study of the external characteristics**	**V**	
8.	**Study of regulation characteristics**	**V**	
9.	**Parallel of the alternator with three-phase network**	**V**	
10.	**Study of a “V” characteristic curve**	**V**	