



## BENCH FOR THE STUDY OF SINGLE-PHASE AND THREE-PHASE TRANSFORMERS



**DL MAC-TT\_EM**

**DL MAC-TT\_UM**

The DL MAC-TT is a multipurpose bench for the study and characterization of single-phase and three-phase transformers of the Eurolab series EM (0.3 kW) and Unilab series UM (1.1 kW).

The transformer is a static and reversible device which transforms the electrical energy from one circuit to another, without any direct electrical connection between two windings and without changing its frequency, with the help of an electromagnetic (mutual) induction.

Single-phase transformers are more popular than three-phase transformers in non-urban areas and are frequently used for power distribution and voltage reduction for residential and commercial applications.

Three-phase transformers are employed typically by electric power distribution grids to power large motors and large loads.

Their main parameters are: operating frequency range, primary and secondary voltage ratings, secondary current rating, operating temperature and power rating (VA).

The De Lorenzo's electric machines bench has been designed to satisfy the following basic requirements:

- The number of groups of students who must work simultaneously
- The available space of the working area
- The plan activities
- The economic advantage



The characteristic key of this bench is its total modularity which means:

- to wire each transformer with the power supply, the power meters and the loads
- to be able to buy the bare essentials
- to configure complete solutions without creating duplication of equipment

The didactic advantage is to be able to investigate the behavior of each single-phase and three-phase transformer making part of this bench that assumes the following configuration:

- autonomous basic bench, with universal power supply able to provide all the voltages, fixed and variable AC and digital measurement units in order to perform a complete course of measurements on them
- can be mounted directly on the bench in front of the main power supply with the instrumentation assembled on the frame

All transformers are built for continuous operation and withstand an overload of about 20÷30% even for long duration.

Moreover, they are built with great care and they have such low losses that could be classified as real text static machines.

Each transformer is equipped with an exhaustive instruction manual that explains all of the tests that can be performed on it. Thus, our manual can be considered a theoretical and practical "textbook".

Ultimately this bench allows measuring, through direct methods, the winding resistance, the transformation ratio, the no-load/short-circuit/load characteristics, the determination of the polarities and the connection group.

The bench also includes digital measurement modules with the possibility to acquire data through MODBUS interface and the use of a processing and acquisition software.



## EXPERIMENTS

The experiments that can be performed are:

No.	Experiment	DL MAC-TT_EM_50 DL MAC-TT_EM_60 0.3 kW (Eurolab)	DL MAC-TT_UM_50 DL MAC-TT_UM_60 1.1 kW (Unilab)
1.	Settings of the configurations (primary/secondary)	DL 30103, DL 30100	DL 1093, DL 1080
2.	Measurement of the windings resistance	DL 30103, DL 30100	DL 1093, DL 1080
3.	Measurement of the transformation ratio in no-load condition	DL 30103, DL 30100	DL 1093, DL 1080
4.	No-load test	DL 30103, DL 30100	DL 1093, DL 1080
5.	Short-circuit test	DL 30103, DL 30100	DL 1093, DL 1080
6.	Voltage, current and power ratios in load conditions	DL 30103, DL 30100	DL 1093, DL 1080
7.	Determination of the polarities	DL 30103	DL 1093
8.	Determination of the connection group	DL 30100	DL 1080



DL MAC-TT_EM_50		Transformers (0.3kW - manual) 50Hz							
List of Experiments	Modules	DL 30016	DL 10065N	DL 2109T29	DL 2109D33	DL 2100-3/3	DL 30040R	DL 30040L	DL 30040C
		DL 2628							
<b>DL 30103 – Single-phase transformer</b>									
1. Settings of the configurations (primary/secondary)									
2. Measurement of the windings resistance	✓			✓	✓				
3. Measurement of the transformation ratio in no-load condition	✓	✓		✓	✓				
4. No-load test	✓			✓	✓				
5. Short-circuit test	✓			✓	✓				✓
6. Voltage, current and power ratios in load conditions	✓	✓		✓	✓	✓	✓	✓	✓
7. Determination of the polarities	✓	✓		✓	✓				
<b>DL 30100 - Three-phase transformer</b>									
1. Settings of the configurations (primary/secondary)									
2. Measurement of the windings resistance	✓			✓	✓				
3. Measurement of the transformation ratio in no-load condition	✓	✓		✓	✓				
4. No-load test	✓	✓			✓				
5. Short-circuit test	✓	✓			✓				✓
6. Voltage, current and power ratios in load conditions	✓	✓	✓	✓	✓	✓	✓	✓	✓
7. Determination of the connection group	✓	✓		✓	✓				



DL MAC-TT_EM_60		Transformers (0.3kW - manual) 60Hz							
List of Experiments	Modules	DL 30018	DL 10065N	DL 2109T29	DL 2109D33	DL 2100-3/3	DL 30040R	DL 30040L	DL 30040C
		DL 2628							
<b>DL 30103 – Single-phase transformer</b>									
1. Settings of the configurations (primary/secondary)									
2. Measurement of the windings resistance	✓			✓	✓				
3. Measurement of the transformation ratio in no-load condition	✓	✓		✓	✓				
4. No-load test	✓			✓	✓				
5. Short-circuit test	✓			✓	✓				✓
6. Voltage, current and power ratios in load conditions	✓	✓		✓	✓	✓	✓	✓	✓
7. Determination of the polarities	✓	✓		✓	✓				
<b>DL 30100 - Three-phase transformer</b>									
1. Settings of the configurations (primary/secondary)									
2. Measurement of the windings resistance	✓			✓	✓				
3. Measurement of the transformation ratio in no-load condition	✓	✓		✓	✓				
4. No-load test	✓	✓			✓				
5. Short-circuit test	✓	✓			✓				✓
6. Voltage, current and power ratios in load conditions	✓	✓	✓	✓	✓	✓	✓	✓	✓
7. Determination of the connection group	✓	✓		✓	✓				



DL MAC-TT_UM_50		Transformers (1.1kW - manual) 50Hz							
List of Experiments	Modules	DL 1013M2	DL 10065N	DL 2109T29	DL 2109D33	DL 2100-3/3	DL 1017R	DL 1017L	DL 1017C
		DL 2628							
<b>DL 1093 – Single-phase transformer</b>									
1. Settings of the configurations (primary/secondary)									
2. Measurement of the windings resistance	✓			✓	✓				
3. Measurement of the transformation ratio in no-load condition	✓	✓		✓	✓				
4. No-load test	✓			✓	✓				
5. Short-circuit test	✓			✓	✓				✓
6. Voltage, current and power ratios in load conditions	✓	✓		✓	✓	✓	✓	✓	✓
7. Determination of the polarities	✓	✓		✓	✓				
<b>DL 1080 - Three-phase transformer</b>									
1. Settings of the configurations (primary/secondary)									
2. Measurement of the windings resistance	✓			✓	✓				
3. Measurement of the transformation ratio in no-load condition	✓	✓		✓	✓				
4. No-load test	✓	✓			✓				
5. Short-circuit test	✓	✓			✓				✓
6. Voltage, current and power ratios in load conditions	✓	✓	✓	✓	✓	✓	✓	✓	✓
7. Determination of the connection group	✓	✓		✓	✓				



DL MAC-TT_UM_60		Transformers (1.1kW - manual) 60Hz							
List of Experiments	Modules	DL 1013M3	DL 10065N	DL 2109T29	DL 2109D33	DL 2100-3/3	DL 1017R	DL 1017L	DL 1017C
									DL 2628
<b>DL 1093 – Single-phase transformer</b>									
1. Settings of the configurations (primary/secondary)									
2. Measurement of the windings resistance		✓			✓	✓			
3. Measurement of the transformation ratio in no-load condition		✓	✓		✓	✓			
4. No-load test		✓			✓	✓			
5. Short-circuit test		✓			✓	✓			✓
6. Voltage, current and power ratios in load conditions		✓	✓		✓	✓	✓	✓	✓
7. Determination of the polarities		✓	✓		✓	✓			
<b>DL 1080 - Three-phase transformer</b>									
1. Settings of the configurations (primary/secondary)									
2. Measurement of the windings resistance		✓			✓	✓			
3. Measurement of the transformation ratio in no-load condition		✓	✓		✓	✓			
4. No-load test		✓	✓			✓			
5. Short-circuit test		✓	✓			✓			✓
6. Voltage, current and power ratios in load conditions		✓	✓	✓	✓	✓	✓	✓	✓
7. Determination of the connection group		✓	✓		✓	✓			