SET OF MODULAR ELECTRIC MACHINES

Mod. KMEC-1/EV

INTRODUCTION

This set of modular machines is proposed as "first approach" in a Laboratory of Electric Machines; it has been designed to assembly and test a large number of electrical machine (motors and generators) using few base components. In fact, with this set it is possible to study:

- the components of each type of machine,
- the mechanical assembly of these components,
- the electric connections of these components,
- the power supply of the various windings; and
- applying the measurement instruments to detect the most important parameters;

Further experiments can be developed by using real electrical machines of industrial type, with the relative instrumentation (such as our machines of "COMPACT" and "POWER" lines by Elettronica Veneta), and using the our computer-aided measurement systems such as system mod. CEM-U/EV.

TRAINING PROGRAM

This set enables to expound the following training program on the machines of the table included in this leaflet:

- Measurement of the resistance of windings and correction for temperature
- Mechanical assembly of the various machines of the list with the proper care for alignments and the respect of the air gap
- Electrical connections of the machines of the list. In detail, as regards DC machines, the connections with separate, shunt, series, additive compound and subtractive compound excitation will be examined
- Influence of the position of brushes on DC motors
- For all the motors, when the brake is provided, detection of electromechanical characteristics: Torque, RPM and efficiency of motors
- Detection and measurement of the characteristics of DC generators and calculation of the output power
- The same for the three-phase alternators, with R-L-C load. Measurement of power factor. The "Prime Mover" unit is recommended to drive the generators

COMPONENTS OF THE SET (see summary table)

The components of this set are "multi-purpose" (that is, a component is valid for different machines). This set includes:

- **1 Universal power supply unit** with instrument for electrical parameters, mod. KMEC-PS/EV
- **1 Universal Load / starter** mod. KMEC-LS/EV
- **1 Universal base with protections**, mod. KMEC/EV
- A **set of cables** of different lengths and colours, with safety terminals of 4 mm
- **Set of components** used to assemble the following machines:
  - **Three-phase squirrel-cage motor:** consisting of Stator and Rotor
  - **Three-phase wound-rotor motor:** consisting of Stator, Rotor and of slip ring holder
  - **Three-phase synchronous motor:** consisting of Stator, Rotor and of slip ring holder
  - **Three-phase Dahlander motor:** consisting of Stator and Rotor
  - **Three-phase reluctance motor:** consisting of Stator and specific Rotor
  - **Single-phase split-phase motor:** consisting of Stator and Rotor
  - **Single-phase motor with centrifugal circuit breaker:** consisting of Stator, Rotor and of circuit breaker holder
  - **DC motors** (separate, shunt, series and compound excitation): consisting of Stator, Rotor and of brush holder
  - **Universal motor:** consisting of Stator, Rotor and of brush holder
  - **Repulsion motor:** consisting of Stator and Rotor
  - **Three-phase generator (alternator):** consisting of Stator, Rotor and of slip ring holder.
  - **DC generator (dynamo):** consisting of Stator, Rotor and of brush holder.
  - **Single-phase generator:** consisting of Stator and Rotor.

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TECHNICAL SPECIFICATIONS:

POWER SUPPLY UNIT WITH DIGITAL INSTRUMENTS MOD. KMEC-PS/EV

This unit is universal for all the KMEC machines and it can output all the necessary AC and DC voltages. Moreover it is provided with the necessary electric instruments for the measurements of the parameters of the machines: a multifunction instrument for AC (V, I, W, VAr, VA, Frequency, Power Factor, THD% etc..., per phase, and equivalent for the three phases) – 20 A max., and 2 instruments for DC (V, I, W) – 20 A max. Output voltages:
- 0-48 VAC/10 A
- 0-48 VDC/10 A
- 24/42 VAC - 16/10 A
- 21-0-21 VDC/10 A

Protections with TMCB + overall ELCB and fuses on the very low voltage outputs, Safety terminals of 4 mm; with 3 single-phase universal sockets of 230 V – 10/16 A and a 3ph universal socket of 3x400 V/N/PE - 16 A

Supply voltage: 3 x 400 V-50/60 Hz

LOAD / STARTER MOD. KMEC-LS/EV

This unit is the variable R-L-C load for the generators. This separate unit enables the step variation of the load. Capacitors for single-phase motors are included.

It also includes a three-phase rheostat for starting DC motors, the wound-rotor motor and for the start with stator resistance.

Resistive load: 7 steps with max. 260 W (possibility of star, delta and AC/DC single-phase connections)

Inductive load: 7 steps with max. 260 VA at 50 Hz (possibility of star, delta and single-phase connections)

Capacitive load: 7 steps with max. 260 VA at 50 Hz (possibility of star, delta and single-phase connections). 22-45-68-90-113-136-160 µF (per phase) can be applied to single-phase motors, with possibility of doubling and tripling these values by the parallel connection of 2 or 3 phases.

Starting rheostat: three-phase rheostat 0...30 Ω / 3...1 A per phase.

BASE WITH PROTECTIONS MOD. KMEC/EV

Over this base, common to all set, it is possible to place up to two machines with the related mechanical protections. This base of anodized aluminium is provided with slides to simplify the assembly of the components, the coupling between the machines and the application of the protections for the couplings.

Dimensions: 800 x 200 x 320 (h) mm

SET OF COMPONENTS including (refer to the table):

Stators: three-phase, DC, single-phase

Rotors: cage, wound, DC, reluctance

Holders:
- 2 pairs of holders for rotors with pads
- Brush holder for slip ring rotor
- Brush holder for DC rotor with adjustable neutral plane
- Centrifugal circuit breaker

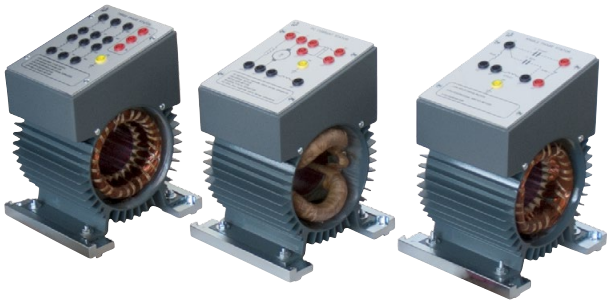
Average power of the machines: 200 W.

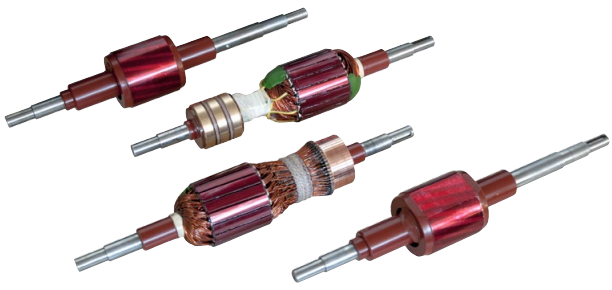
Voltages of the machines: 42 Vdc, or 42 Vac

RPM: 3000, rated value for DC machines. AC machines have 2 and 4 poles.

ACCESSORIES INCLUDED IN THE SET:

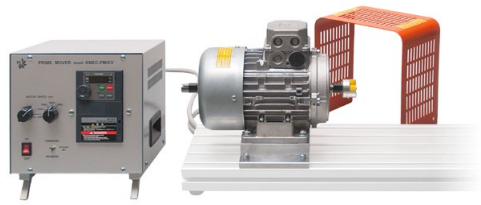
This set includes the connecting cables (of different lengths and colours: red, black, blue and yellow) with safety terminals of 4 mm.





OPTIONAL ACCESSORIES

PRIME MOVER Mod. KMEC-PM/EV (suggested for generators)



This unit drives the generators of the list, supplying a constant speed, variable continuously from 0 to 3600 RPM. This separate unit consists of a three-phase squirrel-cage motor powered by a microprocessor inverter with vector control mode to keep its speed constant with any load. The motor can be easily and quickly coupled to the generators.

Inverter: 750 VA - 230 Vac
Three-phase squirrel-cage motor: 500 W - 2 poles
Power supply: 230 V - 50 Hz - 1000 W

BRAKE Mod. KMEC-B/EV (suggested for motors)

This unit is a variable mechanical load for the motors. This separate unit includes an **eddy current brake**, its power supply unit and the instruments and accessories (RPM and force probes) for measuring the Torque and RPM. Starting from these data the unit can calculates the actual mechanical power output by the motor.

Torque max: 1.5 Nm @ 3600 RPM
Power supply: 230 V - 50 Hz - 700 W

ROTOR ROTATION-BLOCKING DEVICE Mod. KMEC-S/EV

The device can be used in two different ways:

- to block the rotor of the asynchronous cage motor during short-circuit tests
- to keep and rotate the rotor wound in the stator winding to set up a three-phase shifter.

A crank with handle allows a precise and irreversible change of the rotor position.
A graduated scale (degrees and cosφ) identifies the adjusted angular displacement and the phase shift between the stator and the rotor tern.
Simple pairing to the rotor (coupling and shaft Ø 14 mm with hex key) and setting on the KMEC universal base.

CUSTOMIZED CONFIGURATIONS

Upon customer request we can also supply single machines. **In this case, the Power Supply Unit and the Support + Protections must always be included.**

THEORETICAL–EXPERIMENTAL HANDBOOKS

Handbook including the theory of the KMEC machines, instructions for their assembly, coupling and the electrical connections, as well as a series of exercises for each machine.

KMEC-1/EV MACHINES - SUMMARY TABLE

MACHINE	STATORS			ROTORS				HOLDERS			RLC LOAD KMEC-LS	OPTIONAL	
	THREE-PHASE	DC	SINGLE-PHASE	CAGE	WOUND	DC	RELUCT	RING	BRUSH.	C.SWIT		PRIME MOVER KMEC-PM	BRAKE KMEC-B
SQUIRREL-CAGE MOTOR	X			X									X
WOUND ROTOR MOTOR	X				X			X					X
SYNCHRONOUS MOTOR	X				X			X					X
DAHLANDER MOTOR	X			X									X
RELUCTANCE MOTOR	X						X						
SPLIT-PHASE MOTOR			X	X							C		X
CENTRIFUGAL SWITCH MOTOR			X	X						X	C		X
DC MOTORS (all)		X				X			X				X
UNIVERSAL MOTOR		X				X			X				
REPULSION MOTOR		X				X			X				
TRADITIONAL 3-PHASE GENERATOR	X				X			X			X	X	
INVERSE 3-PHASE GENERATOR (1)		X			X			X			X	X	
DC GENERATORS (all)		X				X			X		X	X	
SINGLE-PHASE GENERATOR			X		X			X			X	X	
PHASE SPLITTER	X				X			X			X		

(1): Stator-excited alternator C: includes capacitors for single-phase motors