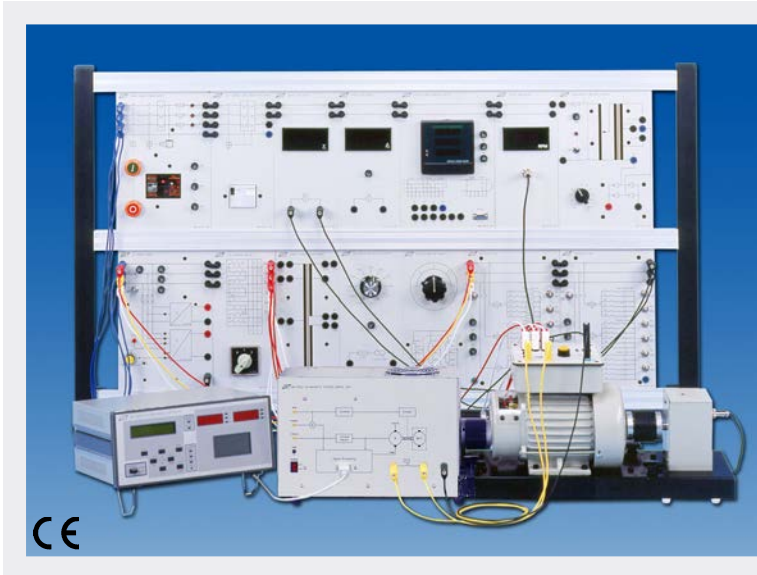




EM-3000

Electrical Machines System



The electrical machines system leads students to distinguish the mechanical similarity and difference among all electrical machinery. Students study and turn all kind of electrical machinery into circuit models for the foundation. Moreover, it enhances students ability for further application and control. Besides facilitating teaching, it makes students be familiar with a different kind of electrical mechanical test.

● Features

- Modular design provides flexible experimental requirement
- Each Module panel height compatible with DIN A4 standard
- Using 4 mm safety sockets and plugs
- Each DC/AC power supply equipped with overload protection
- Rotary machine and brake with overheating protection
- Adopting digitized and microprocessor-based measuring instrument to provide high-accuracy measurement
- Brake with constant speed /constant torque function, easy to operate
- Drawing complete T/N curve
- Connecting to PC, measuring and drawing characteristic curve available
- 300W-grade designed equipment suitable for learning the theory and characteristics of electrical machines
- Stand-alone machine design equipped with two shaft ends and aluminum alloy base for coupling to other machines
- Training panel uses 5 mm isolation bakelite, printed component symbol, value and function, easy to connect
- Fully protected system safe to connect various kind of machines
- Providing powerful computer measuring software for saving graphic file, drawing and printing characteristic curves
- For the sake of safety, the system normally operates at three-phase 220V. Different line voltages can be adjusted by system transformer.

● Specifications

1. EM-3330-1A

DC Permanent-magnet Machine

- (1) This machine can be as motor and generator operation.
- (2) Ratings for motor operation
 - a. Rated voltage : 180 Vdc
 - b. Rated current : 2.7 A
 - c. Rated speed : 2500 rpm
 - d. Rated power : 0.4 KW



2. EM-3330-1B

DC Multifunction Machine

- (1) This machine can serve as shunt, series, compound wound machine.
- (2) As a shunt wound motor
 - a. Rated voltage/current : 220 Vdc/1.76 A
 - b. Rated speed : 1770 rpm
 - c. Rated power : 0.25 KW
- (3) As a separately excited generator
 - a. Rating voltage/current : 170 Vdc/1.2 A
 - b. Excitation voltage/current : 200 Vdc/0.1 A
 - c. Rated speed : 2000 rpm
 - d. Rated power : 0.2 KW





3. EM-3330-1C

Single-phase Induction Motor

- (1) With starting and operating capacitors
Rated voltage: 220 Vac, 50/60 Hz

(2) Ratings

- Rated current : 2.37 A
- Rated speed : 1430 rpm(50Hz); 1680 rpm(60Hz)
- Rated power : 0.3 KW
- Power factor : 0.89
- Starting capacitor : 75 μ F
- Operating capacitor : 12 μ F



4. EM-3330-1D

DC Shunt Wound Machine

- (1) This machine can be used for motor and generator operation

(2) Ratings for motor operation

- Rated voltage/current : 220 Vdc/1.65 A
- Rated speed : 1800 rpm
- Rated power : 0.25 KW



5. EM-3330-1E

DC Series Wound Machine

- (1) This machine can be used for motor and generator operation

(2) Ratings for motor operation

- Rated voltage/current : 220 Vdc/1.65 A
- Rated speed : 1800 rpm
- Rated power : 0.25 KW



6. EM-3330-1F

DC Compound Wound Machine

- (1) This machine can serve as motor and generator operation

(2) Ratings for motor operation

- Rated voltage/current : 220 Vdc/1.65 A
- Rated speed : 1800 rpm
- Rated power : 0.25 KW



7. EM-3330-3A

Three-phase Salient Pole Synchronous Machine

- (1) This machine can be used for motor and generator operation

(2) Ratings for motor operation

- Rated voltage/current : Δ 220 Vac/1.17 A
- Excitation voltage : 60 Vdc(50 Hz) ; 55 Vdc(60 Hz)
- Rated speed : 1500 rpm(50 Hz) ; 1800 rpm(60 Hz)
- Rated power : 0.3 KW
- Power factor : 1.0

(3) Ratings for generator operation

- Rated voltage/current : Δ 220 Vac/0.8 A
- Excitation voltage : 90Vdc(50Hz) ; 66Vdc(60Hz)
- Rated speed : 1500 rpm(50 Hz) ; 1800 rpm(60 Hz)
- Rated power : 0.3 KW
- Power factor : 1.0



8. EM-3330-3B

Three-phase Rotor Winding Motor

- Rated voltage : Δ 220 Vac, 50/60 Hz
- Rated current : 2.0 A
- Rated speed : 1410 rpm(50 Hz) ; 1630 rpm(60 Hz)
- Rated power : 0.35 KW
- Power factor : 0.7



9. EM-3330-3C

Three-phase Squirrel-Cage Motor

- Rated voltage : Δ 220 Vac , 50/60 Hz
- Rated current : 1.4 A
- Rated speed : 1420 rpm(50 Hz) ; 1670 rpm(60 Hz)
- Rated power : 0.3 KW
- Power factor : 0.82

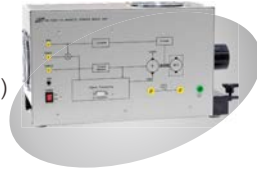




10. EM-3320-1C

Magnetic Powder Brake Unit

- (1) Power supply : 110/220Vac
- (2) Type: Forced air-cooling magnetic powder brake
- (3) Braking torque : 0.999 kg-m (9.999 N-m) max.
- (4) Speed sensing : Photoelectric type, 60 pulses/rev.
- (5) Torque sensing : Strain-gauge torque transducer, torsion bar
- (6) Temperature sensing : Thermal switch
- (7) Base unit : Integral, aluminum alloy
- (8) Connecting to controller via the dedicated cable
- (9) Cooling fan : 12Vdc/0.29 A
- (10) Analog DC outputs :
 - a. Torque output (1 V/1 kg-m)
 - b. Speed output (1 V/1000 rpm)
 - c. Power output (1 V/1 KW)



11. EM-3320-1N

Brake Controller

- (1) Power Supply : 110/220Vac
- (2) Connecting to magnetic powder brake unit via dedicated cable
- (3) 4-digit 7-segment LED Display : 2 sets
 - a. Display speed (S), torque (T) and power (P) of the motor under test
 - b. Display control voltage (V) and current (I) applied to magnetic powder brake unit
- (4) LCD character display (20x2) & Buttons for command control of entry and display
- (5) LCD graphic display (128x64)
Graphically display characteristics of brake and motor
- (6) Display range :
 - a. Torque : 0 ~ 0.999 kg-m or 0 ~ 9.999 N-m
 - b. Speed : 0 ~ 9999 rpm
 - c. Power : 0 ~ 9.999 KW
 - d. Voltage : 0 ~ 24 V
 - e. Current : 0 ~ 0.999 A
- (7) Control model :
 - a. Open-loop control mode
Manual on loading and unloading power, brake automatic loading and unloading power, brake selectable initial power W_i and max power W_m : 0 ~ 0.999 kg-m
Selectable loading time : 1 ~ 15 sec
 - b. Closed-loop control mode
Constant-torque mode
Constant-speed mode
- (8) Fault detection and indication
 - a. MAIN indicator for controller fault
 - b. BRAKE indicator for brake fault
 - c. MOTOR indicator for motor fault
- (9) Communicating with PC through RS-232 (Standard) or RS-485 (Option) port
- (10) Dedicated hardware and software allow processing and displaying data on PC such as full-screen displaying, tracing, recording, printing motor speed, motor torque, motor power, brake voltage and brake current.



12. EM-3310-1A

DC Power Supply Module

- (1) Modular design
- (2) Working voltage : 3ø 220 Vac, 50/60 Hz
- (3) Fixed output voltage : 200 Vdc/6 A max.
- (4) Adjustable output voltage : 0 ~ 240 Vdc/10 A max.
- (5) With current limiting and start functions
- (6) Fuse protection
- (7) Terminals : 4mm safety sockets



13. EM-3310-1C

Synchronous Machine Exciter Module

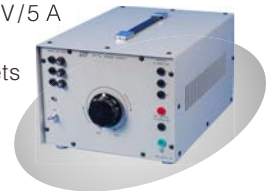
- (1) Modular design
- (2) Working voltage : 220 Vac, 50/60 Hz
- (3) Output voltage : AC 0 ~ 220 V/0.8 A
0 ~ 120 V/1.6 A
0 ~ 40 V/2.5 A
DC 0 ~ 195 V/0.8 A
0 ~ 105 V/1.6 A
0 ~ 33 V/2.5 A
- (4) Terminals : 4 mm safety socket



14. EM-3310-1D

AC / DC Power Supply

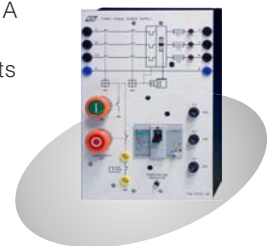
- (1) Bench-top design
- (2) Working voltage : 3ø 220 Vac, 50/60 Hz
- (3) Output voltage : 3ø 0 ~ 260 V/5 A
DC 0 ~ 230 V/5 A
- (4) Fuse protection
- (5) Terminals : 4 mm safety sockets



15. EM-3310-1E

Three-phase Power Supply Module

- (1) Modular design
- (2) Overcurrent/leakage protection switch
- (3) Start and emergency power off buttons
- (4) Working voltage : 3ø 220 Vac, 50/60 Hz
- (5) Rated output : 3ø 220 Vac/10 A
- (6) Fuse protection
- (7) Terminals : 4mm safety sockets
- (8) Temperature indicator



EM-3320-1A (Magnetic Powder Brake Unit) is replaced by EM-3320-1C (Magnetic Powder Brake Unit), and EM-3310-1B (Three-phase Power Supply Module) is replaced by EM-3310-1E (Three-phase Power Supply Module). It is not acceptable to mix and match the old version with the new version.

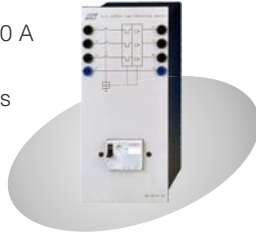
In other words, EM-3320-1C (Magnetic Powder Brake Unit) + EM-3310-1E (Three-phase Power Supply Module) must be grouped together, EM-3320-1A (Magnetic Powder Brake Unit) + EM-3310-1B (Three-phase Power Supply Module) was the right match.



16. EM-3310-2A

3-P Current Limit Protection Switch Module

- (1) Modular design
- (2) Switch load : 400 Vac / 10 A
- (3) Current setting range : 2.5 ~ 4.0 A
(Adjustable current limit)
- (4) Terminals : 4 mm safety sockets



17. EM-3310-2B

Four-pole Switch Module

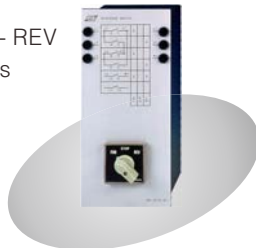
- (1) Modular design
- (2) Switch load : 400 Vac / 15 A
- (3) Terminals : 4 mm safety sockets



18. EM-3310-2C

Reversing Switch Module

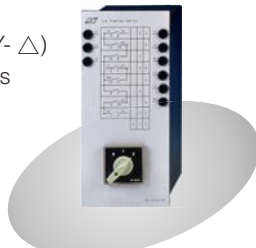
- (1) Modular design
- (2) Switch load : 400 Vac / 10 A
- (3) Switch positions : FOR - STOP - REV
- (4) Terminals : 4 mm safety sockets



19. EM-3310-2D

Y / Δ Starting Switch Module

- (1) Modular design
- (2) Switch load : 400 Vac / 15 A
- (3) Switch positions : 0 - 1 - 2 (0 - Y- Δ)
- (4) Terminals : 4 mm safety sockets



20. EM-3310-4A

DC Machine Starter

- (1) Modular design
- (2) Resistance : 47 Ω circular rheostat, adjustable
- (3) Current : 1.4 A
- (4) Rated power : 100 W
- (5) Fuse protection
- (6) Terminals : 4 mm safety sockets



21. EM-3310-4B

DC Motor Field Regulator

- (1) Modular design
- (2) Resistance : 2.2 K Ω circular rheostat, adjustable
- (3) Current : 150 mA
- (4) Rated power : 50 W
- (5) Fuse protection
- (6) Terminals : 4 mm safety sockets



22. EM-3310-4D

DC Generator Field Regulator

- (1) Modular design
- (2) Resistance : 2.2 K Ω circular rheostat, adjustable
- (3) Current : 150 mA
- (4) Rated power : 50 W
- (5) Fuse protection
- (6) Terminals : 4 mm safety sockets



23. EM-3310-4E

Winding Machine Starter

- (1) Modular design
- (2) Control three-phase motor starting
- (3) Starting impedance : 5 steps, 3 resistors,
0 ~ 1.65 Ω each
- (4) Rated current : 3A
- (5) Terminals : 4 mm safety sockets



24. EM-3310-4F

Reactive Compensator

- (1) Modular design
- (2) Capacitors : 2 μ F / 450 V x 3
3 μ F / 450 V x 3
- (3) Terminals : 4 mm safety sockets



25. EM-3310-4H

DC Generator Load Resistor

- (1) Modular design
- (2) Resistor : 1 K Ω circular rheostat, adjustable
- (3) Rated power : 300 W
- (4) Fuse protection
- (5) Terminals : 4 mm safety sockets

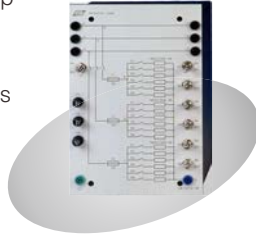




26. EM-3310-4R

Resistive Load

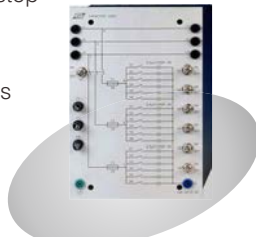
- (1) Modular design
- (2) Load resistors : 3 resistors (Y connection), 6 steps, 920Ω each step
- (3) Rated voltage : 220 V
- (4) Fuse protection
- (5) Terminals : 4 mm safety sockets



27. EM-3310-4C

Capacitive Load

- (1) Modular design
- (2) Load capacitors : 3 capacitors (Y connection), 6 steps, 2.5 μF each step
- (3) Rated voltage : 220 V
- (4) Fuse protection
- (5) Terminals : 4 mm safety sockets



28. EM-3310-4L

Inductive Load

- (1) Modular design
- (2) Load inductors : 3 inductors (Y connection), 6 steps, 1.7 H each step
- (3) Rated voltage : 220 V
- (4) Fuse protection
- (5) Terminals : 4 mm safety sockets



29. EM-3310-5B

Fuse Set

- (1) Modular design
- (2) 4 D-Type fuses, 6A/500V
- (3) Terminals : 4 mm safety sockets



30. EM-3310-3A

Digital DCA Meter

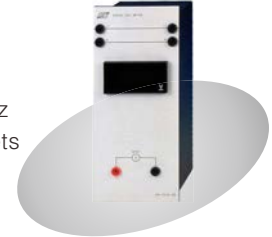
- (1) Modular design
- (2) Measurement range : DC 0 ~ 10 A
- (3) Display : 3 ½ digits 14.2 mm LED
- (4) Accuracy : ± 0.2% ± 1 digit
- (5) Resolution : 0.01 A
- (6) Input Impedance : 0.1Ω
- (7) Power source : 220 Vac, 50/60Hz
- (8) Terminals : 4 mm safety sockets



31. EM-3310-3B

Digital DCV Meter

- (1) Modular design
- (2) Measurement range: 0 ~ 600 Vdc
- (3) Display : 3 ½ digits 14.2 mm LED
- (4) Accuracy : ± 0.2% ± 1 digit
- (5) Resolution : 1 V
- (6) Input impedance : 1MΩ
- (7) Power source: 220 Vac, 50/60Hz
- (8) Terminals : 4 mm safety sockets



32. EM-3310-3C

Digital ACA Meter

- (1) Modular design
- (2) Measurement range : AC 0 ~ 10 A
- (3) Display : 3 ½ digits 14.2 mm LED
- (4) Accuracy : ± 0.3% ± 1 digit
- (5) Resolution : 0.01 A
- (6) Input impedance : 0.1Ω
- (7) Power source: 220 Vac, 50/60Hz
- (8) Terminals : 4 mm safety sockets



33. EM-3310-3D

Digital ACV Meter

- (1) Modular design
- (2) Measurement range : 0 ~ 600 Vac
- (3) Display : 3 ½ digits 14.2 mm LED
- (4) Accuracy : ± 0.2% ± 1 digit
- (5) Resolution : 1 V
- (6) Input impedance : 1MΩ
- (7) Power source : 220 Vac, 50/60Hz
- (8) Terminals : 4 mm safety sockets



34. EM-3310-3E

Digital Three-phase Watt Meter

- (1) Modular design
- (2) Power : single-/three-phase, 0 ~ 2 KW (240 V/5 A)
- (3) Display : 4 ½ digits 14.2 mm LED
- (4) Accuracy : ± 0.3% ± 3 digit
- (5) Resolution : 0.1 W
- (6) Power source : 220 Vac, 50/60 Hz
- (7) Terminals : 4 mm safety sockets





35. EM-3310-3F

Digital Power Factor Meter

- (1) Modular design
- (2) Measurement range : -0.50 ~ 1.00 ~ +0.50 (240 V/ 5 A)
- (3) Display : 3 ½ digits 14.2 mm LED
- (4) Accuracy : $\pm 1\%$ ± 1 digit
- (5) Resolution : 0.01 V
- (6) Power source : 220 Vac, 50/60Hz
- (7) Terminals : 4 mm safety sockets



38. EM-3340-1A

Single-phase Transformer Unit

- (1) Input voltage : 0 ~ 110 ~ 190 ~ 220 Vac
- (2) Output voltage :
0 ~ 12 ~ 24V/5A
0 ~ 110 ~ 190 ~ 220V/1A



36. EM-3310-3G

Digital RPM Meter

- (1) Modular design
- (2) Display : 5 digits
- (3) Measurement range : 0 ~ 99999 rpm
- (4) Accuracy : $\pm 0.1\%$ ± 1 digit
- (5) Power source : 220 Vac, 50/60Hz



39. EM-3340-3A

Three-phase Transformer Unit

- (1) Rated power : 250 VA
- (2) Input voltage : 3ϕ 220 Vac
- (3) Output voltage : 63.5 Vac *6



37. EM-3310-3H

Digital Power Analysis Meter

- (1) Display :
 - a. 4 digits (9999), 0.4" LED indicators (V, A, W, PF, Hz, Var)
 - b. 5 digits (99999), 0.4" LED indicators (WH, VarH)
- (2) Input range :
 - a. Voltage : 35 ~ 600V(L~L)
 - b. Current : 0.05 ~ 5A
 - c. Frequency : 45Hz ~ 65Hz
- (3) Accuracy : (at $23 \pm 5^\circ\text{C}$ sine wave)
 - a. Voltage : $\pm 0.1\%$ of reading ; $\pm 0.15\%$ of range
 - b. Current : $\pm 0.1\%$ of reading ; $\pm 0.15\%$ of range
 - c. Watt : $\pm 0.2\%$ of reading ; $\pm 0.3\%$ of range
 - d. Var : $\pm 0.2\%$ of reading ; $\pm 0.3\%$ of range
 - e. Power factor : $\pm 0.5\%$ of range
 - f. PF polarity : "+" lagging, "-" leading
 - g. Watt hour : $\pm 0.25\%$ of reading ; $\pm 0.05\%$ of range
 - h. Var hour : $\pm 0.25\%$ of reading ; $\pm 0.05\%$ of range
 - i. Hz : $\pm 0.2\%$ of reading
- (4) CT, PT scaling : 1 ~ 9999
- (5) Factors : Setting for REF: 0.800 ~ 1.200
- (6) Power supply : 220 Vac
- (7) Communication port :
RS-232(standard), RS-485(option)
- (8) Terminals : 4 mm safety sockets



40. EM-3340-3B

System Transformer

- (1) Rated power : 1.5 KVA
- (2) Primary : depend on the local line voltage
- (3) Secondary : 3ϕ 220 Vac
- (4) Frequency : 50/60Hz

※ 3-phase power (source) is required when operating this system.

※ The System Transformer EM-3340-3B must be included if 3-phase 220V is not available.



41. EM-3380-1A

Laboratory Table

Dimensions : 1800(W) x 900(D) x 740(H)mm $\pm 5\%$

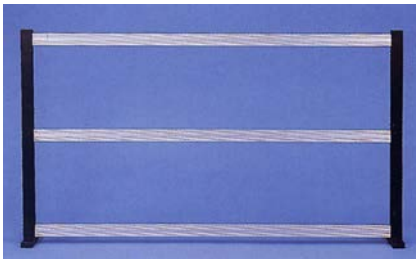




42. EM-3380-2A / EM-3380-2B

Experimental Frame

- (1) The experimental frames described below are suitable for setting test circuits panel 297 mm high for demonstration.
- (2) The experimental frames can be secured to benches back uprights and removed at any time.
- (3) The side pieces consist of rectangular tube steel, 60x30x2mm, protected against corrosion. Horizontal sections contains of anodized aluminum profiles.
- (4) Frames dimension :
 1800(W) x 730(H) x 250(D)mm \pm 5% (EM-3380-2A)
 1800(W) x 1060(H) x 250(D)mm \pm 5% (EM-3380-2B)



45. EM-3390-2B

Coupling Guard

- (1) Material : Plate coating
- (2) A guard attachable for contact-proof with electrical machines rotating parts



46. EM-3390-2C

Shaft End Guard

- (1) Material : Plate coating
- (2) A guard attachable to avoid contact with electrical machines rotating parts



47. EM-3390-3A

Connecting Leads Set

- (1) 4mm safety plugs with leads
- (2) Max. rating current : 19A
- (3) Consists of :
 Connecting leads (25cm), Black/White/Blue/Yellow/Red
 Connecting leads (50cm), Red/Black/Yellow/Blue/White/Green
 Connecting leads (100cm), Red/Yellow/Blue/White/Green
 Connecting leads (150cm), Black/White/Blue/Yellow/Red



43. EM-3390-1A

Connecting Lead Holder

- (1) Mobile type with 5-foot tubular steel base and five casters
- (2) Height :
 1400mm, iron plate suitable with 20 connecting leads slots



44. EM-3390-2A

Coupling

- (1) Material : Rubber
- (2) Coupling sleeve for mechanical connection between two electrical machines



48. EM-3390-4A

Safety Bridging Plugs Set

- (1) 4mm safety bridge plugs, 19 mm spacing
- (2) Max. rating current : 19 A
- (3) Consists of :
 KCN-419A safety bridge plug
 KCN-419B safety bridge plug



KCN-419A



KCN-419B



● Laboratory Experiments of Electrical Machines

1. Single-Phase Transformer

- (1) Polarity test
- (2) Turns ratio test
- (3) Open circuit test
- (4) Short circuit test
- (5) Load characteristic tests
 - Resistive load
 - Inductive load
 - Capacitive load

2. Three-Phase Transformer

- Three-phase connections
- Y-Y connection
 - Y- Δ connection
 - Y-Z connection
 - Δ -Y connection
 - Δ - Δ connection
 - Δ -Z connection

3. DC Machines

- (1) DC permanent-magnet motor
 - Connection and motor direction control
 - Torque-speed characteristic
- (2) DC shunt wound motor
 - Connection and motor direction control
 - Torque-speed characteristic
 - Speed control
- (3) DC separately excited generator
 - No load saturation characteristic
 - Load characteristic
- (4) DC shunt wound generator
 - No load characteristic
 - Load characteristic
- (5) DC series wound motor
 - Connection and motor direction control
 - Torque-speed characteristic
 - Speed control
- (6) DC series wound generator
 - Load characteristic
- (7) DC compound wound motor
 - Connection and direction control of DC cumulative-compound wound motor
 - Torque-speed characteristic of DC cumulative-compound wound motor
 - Speed control of DC cumulative-compound wound motor

- Connection and direction control of DC differential-compound wound motor
- Torque-speed characteristic of DC differential-compound wound motor
- Speed control of DC differential-compound wound motor
- (8) DC compound wound generator
 - Load characteristic of DC cumulative-compound wound generator
 - Load characteristic of DC differential-compound wound generator

4. Induction Machines

- (1) Single-phase induction motor
 - Torque-speed characteristic with split-phase winding starting
 - Torque-speed characteristic with capacitor starting and running
- (2) Three-phase squirrel cage induction motor
 - Connection and motor direction control
 - Y- Δ starting
 - PF correction
 - No-load characteristic
 - Blocked-rotor test
 - Torque-speed characteristic
- (3) Three-phase rotor winding induction motor
 - Connection and motor direction control
 - Blocked rotor test
 - Torque-speed characteristic
- (4) Three-phase salient pole synchronous motor
 - Connection and motor direction control
 - Excitation characteristic
 - Load characteristic
- (5) Three-phase salient pole synchronous generator
 - Armature resistance measurement
 - No load saturation and short circuit characteristic
 - Load characteristic
 - Excitation characteristic

Remark : System Transformer is provided at extra charge for the area where 3-phase 220V power is not available.



● Overview of Equipment Required

▲ : DC Multifunction machine can be used as shunt, series, compound wound machine for motor and generator operation.

* : Additionally recommended

** : Alternative of Digital RPM Meter(EM-3310-3G)

() : Alternative of Digital Power Analysis Meter(EM-3310-3H)

	Transformer Tests	DC Permanent-magnet Motor Tests	DC Shunt Wound Motor Tests	DC Separately-excited Generator Tests	DC Shunt Wound Generator Tests	DC Series Wound Motor Tests	DC Series Wound Generator Tests	DC Compound Wound Motor Tests	DC Compound Wound Generator Tests	Single-Phase Induction Motor Tests	Three-Phases Squirrel-Cage Induction Motor Tests	Three-Phases Rotor Winding Motor Tests	Three-Phases Synchronous Motor (Salient-Pole) Tests	Three-Phases Synchronous Generator (Salient-Pole) Tests	Total
1.	EM-3330-1A DC Permanent-magnet Machine	1		1	1		1		1					1	1
2.	EM-3330-1B DC Multifunction Machine		▲1	▲1	▲1	▲1	▲1	▲1	▲1						▲1
3.	EM-3330-1C Single-phase Induction Motor									1					1
4.	EM-3330-1D DC Shunt Wound Machine		1	1	1										1
5.	EM-3330-1E DC Series Wound Machine					1	1								1
6.	EM-3330-1F DC Compound Wound Machine							1	1						1
7.	EM-3330-3A Three-phase Salient Pole Synchronous Machine												1	1	1
8.	EM-3330-3B Three-phase Rotor Winding Motor											1			1
9.	EM-3330-3C Three-phase Squirrel Cage Motor										1				1
10.	EM-3320-1C Magnetic Powder Brake Unit	1	1	**1	**1	1	**1	1	**1	1	1	1	1	**1	1
11.	EM-3320-1N Brake Controller	1	1	**1	**1	1	**1	1	**1	1	1	1	1	**1	1
12.	EM-3310-1A DC Power Supply Module	1	1	1	1	1	1	1	1					1	1
13.	EM-3310-1C Synchronous Machine Exciter Module												1	1	1
14.	EM-3310-1D AC/DC Power Supply	1		1							1	1			1
15.	EM-3310-1E Three-phase Power Supply Module	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16.	EM-3310-2A 3-P Current Limit Protection Switch Module	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17.	EM-3310-2B Four-pole Switch Module										1	1	1		1
18.	EM-3310-2C Reversing Switch Module										1	1	1		1
19.	EM-3310-2D Y/Δ Starting Switch Module										1				1
20.	EM-3310-4A DC Machine Starter					1									1
21.	EM-3310-4B DC Motor Field Regulator		1					1							1
22.	EM-3310-4D DC Generator Field Regulator				1				1						1
23.	EM-3310-4E Winding Machine Starter											1			1
24.	EM-3310-4F Reactive Compensator										1				1
25.	EM-3310-4H DC Generator Load Resistor			1	1		1		1						1
26.	EM-3310-4R Resistive Load	1												1	1
27.	EM-3310-4C Capacitive Load	1												1	1
28.	EM-3310-4L Inductive Load	1												1	1
29.	EM-3310-5B Fuse Set	1									1	1			1
30.	EM-3310-3A Digital DCA Meter		1	2	3	3	2	2	2	3			1	2	3
31.	EM-3310-3B Digital DCV Meter		1	1	3	2	1	3	1	2			1	2	3
32.	EM-3310-3C Digital ACA Meter	2									(1)	(1)	(1)	(1)	2
33.	EM-3310-3D Digital ACV Meter	3									(1)	(1)	(1)	(1)	3
34.	EM-3310-3E Digital Three-phase Watt Meter										(1)	(1)	(1)	(1)	(1)
35.	EM-3310-3F Digital Power Factor Meter										(1)	(1)	(1)	(1)	(1)
36.	EM-3310-3G Digital RPM Meter			1	1		1		1					1	1
37.	EM-3310-3H Digital Power Analysis Meter									1	1	1	1	1	1
38.	EM-3340-1A Single-Phase Transformer	1													1
39.	EM-3340-3A Three-Phase Transformer	1													1
40.	EM-3340-3B System Transformer	1	1	1	1	1	1	1	1	1	1	1	1	1	1
41.	EM-3380-1A Laboratory Table	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1
42.	EM-3380-2A Experimental Frame (two-layers) EM-3380-2B Experimental Frame (three-layers)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
43.	EM-3390-1A Connecting Lead Holder	1	1	1	1	1	1	1	1	1	1	1	1	1	1
44.	EM-3390-2A Coupling		1	1	2	2	1	2	1	2	1	1	1	1	2
45.	EM-3390-2B Coupling Guard		1	1	2	2	1	2	1	2	1	1	1	1	2
46.	EM-3390-2C Shaft End Guard		1	1	1	1	1	1	1	1	1	1	1	1	1
47.	EM-3390-3A Connecting Leads Set	1	1	1	1	1	1	1	1	1	1	1	1	1	1
48.	EM-3390-4A Safety Bridging Plugs Set	1	1	1	1	1	1	1	1	1	1	1	1	1	1
49.	Experiment Manual	1	1	1	1	1	1	1	1	1	1	1	1	1	1