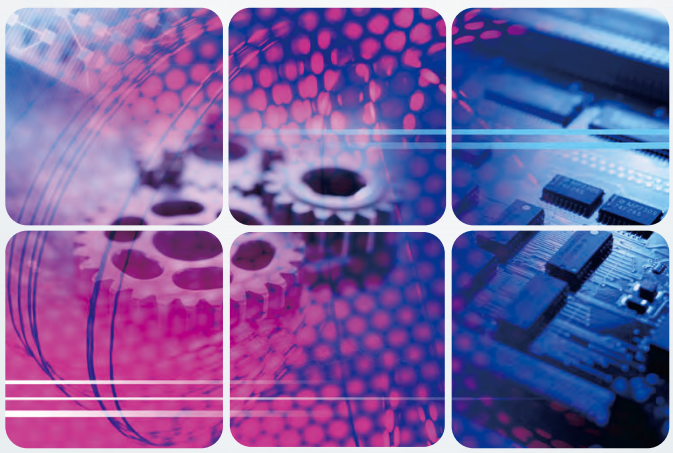
Electrical Machine / Power Electronics



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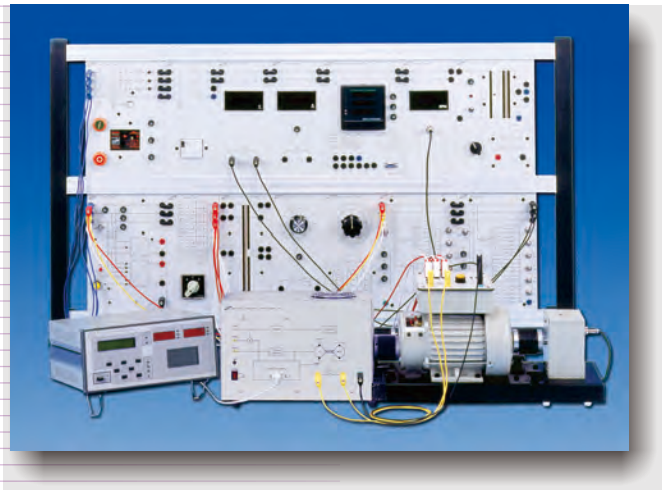
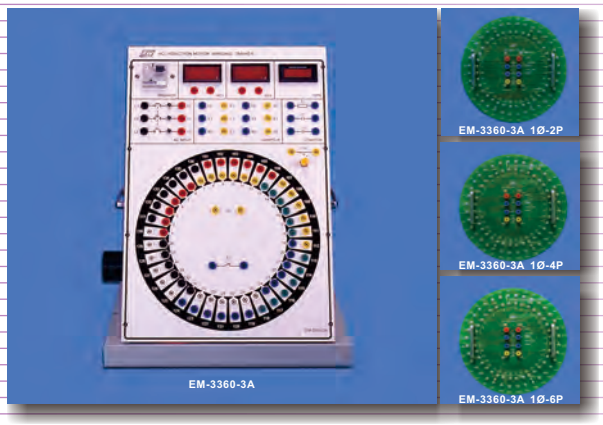
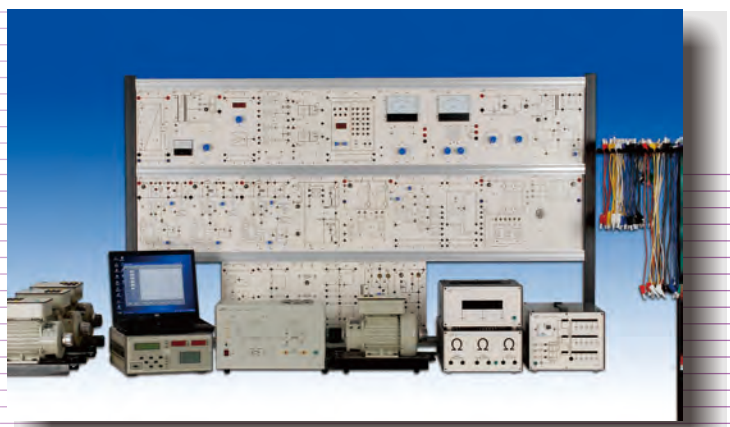
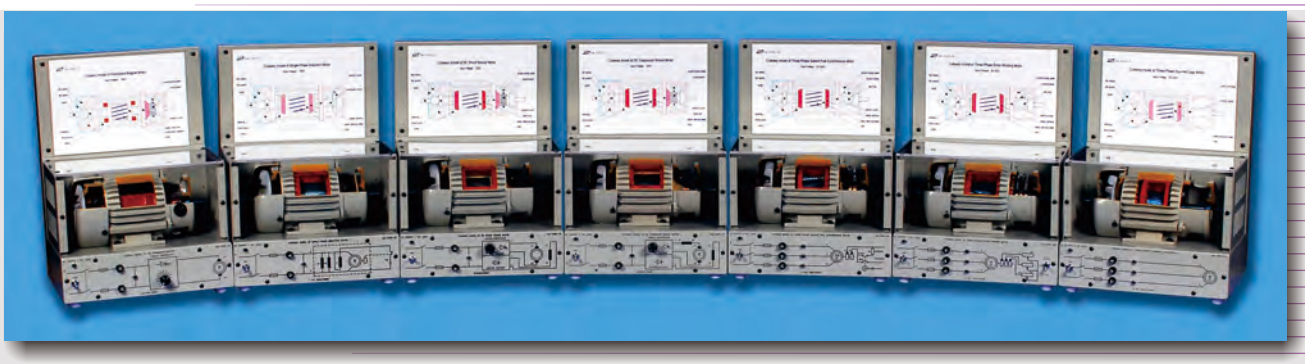




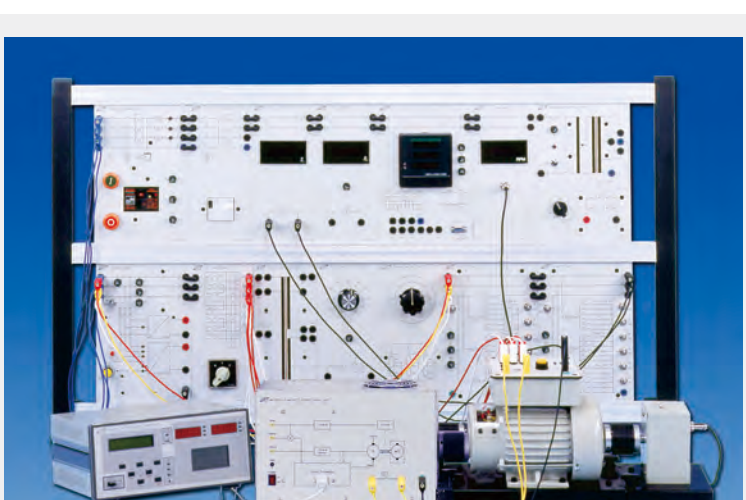




Electrical Machine / Power Electronics

Contents

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

1. Modular design provides flexible experimental requirement
2. Each Module panel height compatible with DIN A4 standard
3. Using 4 mm safety sockets and plugs
4. Each DC/AC power supply equipped with overload protection
5. Rotary machine and brake with overheating protection
6. Adopting digitized and microprocessor-based measuring instrument to provide high-accuracy measurement
7. Brake with constant speed/constant torque function, easy to operate
8. Drawing complete T/N curve
9. Connecting to PC, measuring and drawing characteristic curve available
10. 300W-grade designed equipment suitable for learning the theory and characteristics of electrical machines
11. Stand-alone machine design equipped with two shaft ends and aluminum alloy base for coupling to other machines
12. Training panel uses 5 mm isolation bakelite, printed component symbol, value and function, easy to connect
13. Fully protected system safe to connect various kind of machines
14. Providing powerful computer measuring software for saving graphic file, drawing and printing characteristic curves
15. 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 : 180V DC
      b. Rated current : 2.7A
      c. Rated speed : 2500 rpm
      d. Rated power : 0.4 KW

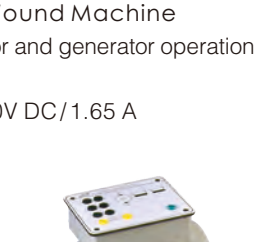
2. EM-3330-1B DC Multifunction Machine (option)
   (1) This machine can serve as shunt, series, compound wound machine.
   (2) As a shunt wound motor
      a. Rated voltage/current : 220V DC/1.76 A
      b. Rated speed : 1770 rpm
      c. Rated power : 0.25 KW
   (3) As a separately excited generator
      a. Rating voltage/current : 170V DC/1.2 A
      b. Excitation voltage/current : 200V DC/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 : 220V AC, 50Hz/60 Hz
   (2) Ratings
   a. Rated current : 2.37 A
   b. Rated speed : 1430 rpm(50Hz); 1680 rpm(60Hz)
   c. Rated power : 0.3 KW
   d. Power factor : 0.89
   e. Starting capacitor : 75 μF
   f. Operating capacitor : 12 μF

4. EM-3330-1D DC Shunt Wound Machine
   (1) This machine can be used for motor and generator operation
   (2) Ratings for motor operation
   a. Rated voltage/current : 220V DC/1.65 A
   b. Rated speed : 1800 rpm
   c. 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
   a. Rated voltage/current : 220V DC/1.65 A
   b. Rated speed : 1800 rpm
   c. 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
   a. Rated voltage/current : 220V DC/1.65 A
   b. Rated speed : 1800 rpm
   c. 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
   a. Rated voltage/current : △ 220V AC/1.17 A
   b. Excitation voltage : 60V DC(50 Hz) ; 55V DC(60 Hz)
   c. Rated speed : 1500 rpm(50 Hz) ; 1800 rpm(60 Hz)
   d. Rated power : 0.3 KW
   e. Power factor : 1.0
   (3) Ratings for generator operation
   a. Rated voltage/current : △ 220V AC/0.8 A
   b. Excitation voltage : 90V DC(50Hz) ; 66V DC(60Hz)
   c. Rated speed : 1500 rpm(50 Hz) ; 1800 rpm(60 Hz)
   d. Rated power : 0.3 KW
   e. Power factor : 1.0

8. EM-3330-3B Three-phase Rotor Winding Motor
   (1) Rated voltage : △ 220V AC, 50Hz/60 Hz
   (2) Rated current : 2.0 A
   (3) Rated speed : 1410 rpm(50 Hz) ; 1630 rpm(60 Hz)
   (4) Rated power : 0.35 KW
   (5) Power factor : 0.7

9. EM-3330-3C Three-phase Squirrel-Cage Motor
   (1) Rated voltage : △ 220V AC , 50Hz/60 Hz
   (2) Rated current : 1.4 A
   (3) Rated speed : 1420 rpm(50 Hz) ; 1670 rpm(60 Hz)
   (4) Rated power : 0.3 KW
   (5) Power factor : 0.82

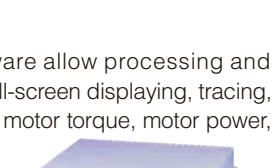
10. EM-3320-1C Magnetic Powder Brake Unit

(1) Power supply : 110V/220V AC
(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 : 12V DC/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

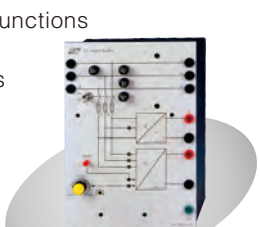
(1) Power supply : 110V/220V AC
(2) Connecting to magnetic powder brake unit via dedicated cable
(3) 4-digit 7-segment LED Display : 2 sets
a. Display speed (S), torque (T) and power (P) of the motor under test
b. Display control voltage (V) and current (I) applied to magnetic powder brake unit
(4) LCD 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 Wi and max power Wm : 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.



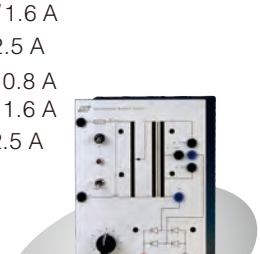
12. EM-3310-1A DC Power Supply Module

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



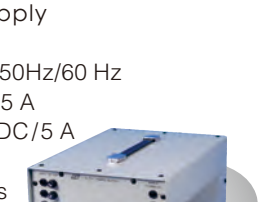
13. EM-3310-1C Synchronous Machine Exciter Module

(1) Modular design
(2) Working voltage : 220V AC, 50Hz/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



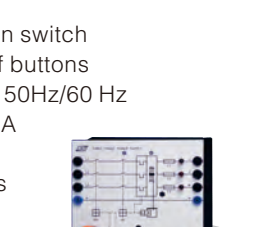
14. EM-3310-1D AC / DC Power Supply

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



15. EM-3310-1E Three-phase Power Supply Module

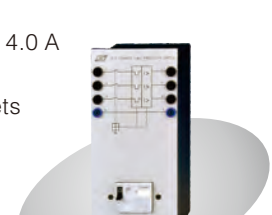
(1) Modular design
(2) Overcurrent/leakage protection switch
(3) Start and emergency power off buttons
(4) Working voltage : 3ø 220V AC, 50Hz/60 Hz
(5) Rated output : 3ø 220V AC/10 A
(6) Fuse protection
(7) Terminals : 4mm safety sockets
(8) Temperature indicator



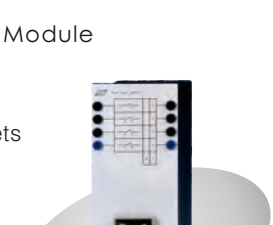
EM-3320-1A (Magnetic Powder Brake Unit) is replaced by EM-3320-1C (Magnetic Powder Brake Unit), and EM-3310-1B (Three-phase Power Supply Module) is replaced by EM-3310-1E (Three-phase Power Supply Module). It is not acceptable to mix and match the old version with the new version.

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.

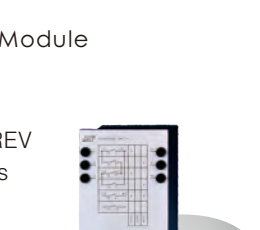
16. EM-3310-2A 3-P Current Limit Protection Switch Module
    (1) Modular design
    (2) Switch load : 400V AC / 10 A
    (3) Current setting range : 2.5A ~ 4.0 A
        (adjustable current limit)
    (4) Terminals : 4 mm safety sockets



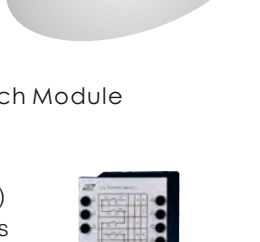
17. EM-3310-2B Four-pole Switch Module
    (1) Modular design
    (2) Switch load : 400V AC/15 A
    (3) Terminals : 4 mm safety sockets



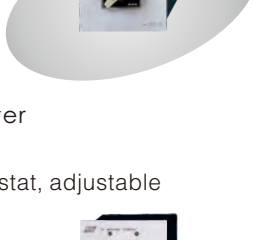
18. EM-3310-2C Reversing Switch Module
    (1) Modular design
    (2) Switch load : 400V AC/10 A
    (3) Switch positions : FOR-STOP-REV
    (4) Terminals : 4 mm safety sockets



19. EM-3310-2D Y / △Starting Switch Module
    (1) Modular design
    (2) Switch load : 400V AC/15 A
    (3) Switch positions : 0-1-2 (0-Y-△)
    (4) Terminals : 4 mm safety sockets

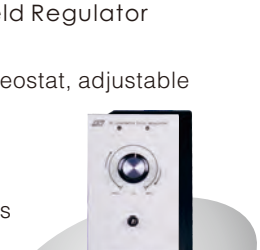


20. EM-3310-4A DC Machine Starter
    (1) Modular design
    (2) Resistance : 47Ω circular rheostat, adjustable
    (3) Current : 1.4 A
    (4) Rated power : 100 W
    (5) Fuse protection
    (6) Terminals : 4 mm safety sockets

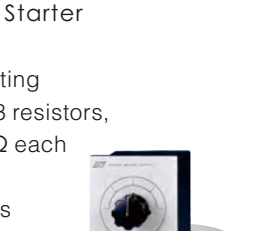


21. EM-3310-4B DC Motor Field Regulator
    (1) Modular design
    (2) Resistance : 2.2 KΩ circular rheostat, adjustable
    (3) Current : 150 mA
    (4) Rated power : 50 W
    (5) Fuse protection
    (6) Terminals : 4 mm safety sockets

22. EM-3310-4D DC Generator Field Regulator
    (1) Modular design
    (2) Resistance : 2.2 KΩ circular rheostat, adjustable
    (3) Current : 150 mA
    (4) Rated power : 50 W
    (5) Fuse protection
    (6) Terminals : 4 mm safety sockets

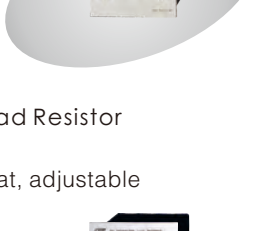


23. EM-3310-4E Winding Machine Starter
    (1) Modular design
    (2) Control three-phase motor starting
    (3) Starting impedance : 5 steps, 3 resistors,
        0 ~ 1.65Ω each
    (4) Rated current : 3A
    (5) Terminals : 4 mm safety sockets



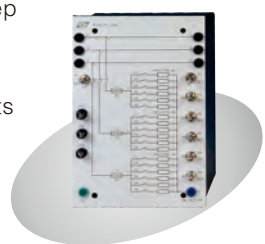
24. EM-3310-4F Reactive Compensator
    (1) Modular design
    (2) Capacitors : 2 μF/450 V x 3
        3 μF/450 V x 3
    (3) Terminals : 4 mm safety sockets

25. EM-3310-4H DC Generator Load Resistor
    (1) Modular design
    (2) Resistor : 1 KΩ circular rheostat, adjustable
    (3) Rated power : 300 W
    (4) Fuse protection
    (5) Terminals : 4 mm safety sockets



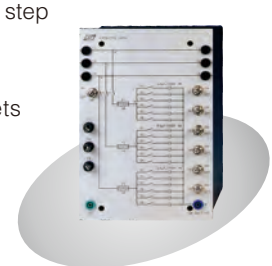
26. EM-3310-4R Resistive Load

(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



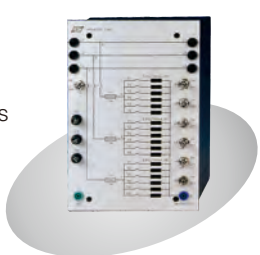
27. EM-3310-4C Capacitive Load

(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 : 0 ~ 10 A DC
(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 : 220V AC, 50Hz/60Hz
(8) Terminals : 4 mm safety sockets

31. EM-3310-3B Digital DCV Meter

(1) Modular design
(2) Measurement range: 0 ~ 600V DC
(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 : 220V AC, 50Hz/60Hz
(8) Terminals : 4 mm safety sockets

32. EM-3310-3C Digital ACA Meter

(1) Modular design
(2) Measurement range : 0 ~ 10 A AC
(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 : 220V AC, 50Hz/60Hz
(8) Terminals : 4 mm safety sockets

33. EM-3310-3D Digital ACV Meter

(1) Modular design
(2) Measurement range : 0 ~ 600V AC
(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 : 220V AC, 50Hz/60Hz
(8) Terminals : 4 mm safety sockets

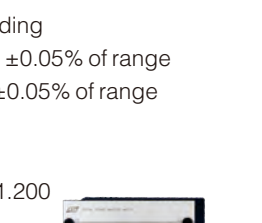
34. EM-3310-3E Digital Three-phase Watt Meter

(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 : 220V AC, 50Hz/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 : ± 1% ± 1 digit
(5) Resolution : 0.01 V
(6) Power source : 220V AC, 50Hz/60Hz
(7) Terminals : 4 mm safety sockets

36. EM-3310-3G Digital RPM Meter
(1) Modular design
(2) Display : 5 digits
(3) Measurement range : 0 ~ 99999 rpm
(4) Accuracy : ± 0.1% ± 1 digit
(5) Power source : 220V AC, 50Hz/60Hz

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 : 35V ~ 600V(L~L)
b. Current : 0.05A ~ 5A
c. Frequency : 45Hz ~ 65Hz
(3) Accuracy : (at 23 ± 5°C sine wave)
a. Voltage : ±0.1% of reading ; ±0.15% of range
b. Current : ±0.1% of reading ; ±0.15% of range
c. Watt : ±0.2% of reading ; ±0.3% of range
d. Var : ±0.2% of reading ; ±0.3% of range
e. Power factor : ±0.5% of range
f. PF polarity : "+" lagging, "–" leading
g. Watt hour : ±0.25% of reading ; ±0.05% of range
h. Var hour : ±0.25% of reading ; ±0.05% of range
i . Hz : ±0.2% of reading
(4) CT. PT scaling : 1 ~ 9999
(5) Factors : setting for REF: 0.800 ~ 1.200
(6) Power supply : 220V AC
(7) Communication port :
RS-232(standard), RS-485(option)
(8) Terminals : 4 mm safety sockets



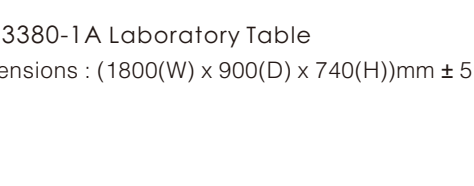
38. EM-3340-1A Single-phase Transformer Unit
(1) Input voltage : 0~110V~190V~220V AC
(2) Output voltage :
0~12V~24V/5A
0~110V~190V~220V/1A

39. EM-3340-3A Three-phase Transformer Unit
(1) Rated power : 250 VA
(2) Input voltage : 3ø 220V AC
(3) Output voltage : 63.5V AC*6

40. EM-3340-3B System Transformer
(1) Rated power : 1.5 KVA
(2) Primary : depend on the local line voltage
(3) Secondary : 3ø 220V AC
(4) Frequency : 50Hz/60Hz

※ 3ø power (source) is required when operating this system.
※ The System Transformer EM-3340-3B must be included if 3ø 220V is not available.

41. EM-3380-1A Laboratory Table
Dimensions : (1800(W) x 900(D) x 740(H))mm ± 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, (40x20x2)mm, protected against corrosion. Horizontal sections contains of anodized aluminum profiles.
(4) Frames dimension :
(1800(W) x 730(H) x 250(D))mm ± 5% (EM-3380-2A)
(1800(W) x 1060(H) x 250(D))mm ± 5% (EM-3380-2B)

43. EM-3390-1A Connecting Lead Holder

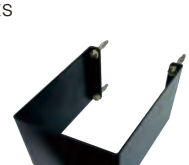
(1) Mobile type with 5-foot tubular steel base and five casters
(2) Height :
1400mm, iron plate suitable with 20 connecting leads slots

44. EM-3390-2A Coupling

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

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

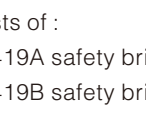
(1) Material : plate coating
(2) A guard attachable to avoid contact with electrical machines rotating parts

47. EM-3390-3A Connecting Leads Set

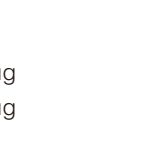
(1) 4mm safety plugs with leads
(2) Max. rating current : 19A
(3) Consists of :
Connecting leads (25cm), Black/White/Blue/Yellow/Red
Connecting leads (50cm), Red/Black/Yellow/Blue/White/Green
Connecting leads (100cm), Red/Yellow/Blue/White/Green
Connecting leads (150cm), Black/White/Blue/Yellow/Red

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 -△ connection
     - Y -Z connection
     - △-Y connection
     - △-△ connection
     - △- 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-△ 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 3ø 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 (option)			▲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	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	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/△ 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)	(1)	2
33.	EM-3310-3D Digital ACV Meter	3									(1)	(1)	(1)	(1)	(1)	3
34.	EM-3310-3E Digital Three-phase Watt Meter										(1)	(1)	(1)	(1)	(1)	(1)
35.	EM-3310-3F Digital Power Factor Meter										(1)	(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	1
41.	EM-3380-1A Laboratory Table	*1	*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	1
43.	EM-3390-1A Connecting Lead Holder	1	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	2
45.	EM-3390-2B Coupling Guard		1	1	2	2	1	2	1	2	1	1	1	1	2	2
46.	EM-3390-2C Shaft End Guard		1	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	1
48.	EM-3390-4A Safety Bridging Plugs Set	1	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	1

EM-3350

Cutaway Model of Electrical Machine

Cutaway models are made from normal electrical machines. The stator is cut away by 1/4 over the entire length for an optimum view of the internal construction of the machine and it is still operating. The cutaway surfaces are protected against corrosion.

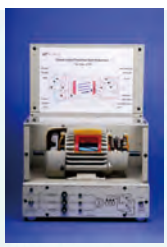
EM-3350-1A
DC Permanent-magnet Motor

EM-3350-1C
Single-phase Induction Motor

EM-3350-1D
DC Shunt Wound Motor

EM-3350-1F
DC Compound Wound Motor

EM-3350-3A
Three-phase Salient Pole
Synchronous Motor



EM-3350-3B
Three-phase Rotor Winding Motor

EM-3350-3C
Three-phase Squirrel Cage Motor

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

EM-3360

AC Induction Motor Winding Training System

EM-3360-3A

EM-3360 AC Induction Motor Winding Training System can be configured for various poles as the self-starting three-phase induction motor and single-phase induction motor which is used with the resistor or capacitor starting.

Students can learn the different types of motor winding through the simple winding connection. In addition, with external load torque provided by Magnetic Powder Brake Unit(EM-3320-1C), Brake Controller(EM-3320-1N) and Three-phase Power Supply(EM-3310-1E), students can see the characteristics of different types of motor.

● Features

1. Use 4mm safety socket terminal
2. The clearly- printed winding set codes and colorful wire on top allow user to do winding and operation easily
3. The power input with the motor circuit breaker
4. Easy linking to brake controller unit for measure and draw the characteristics of each winding motor through PC
5. Plug-in panel helps teachers complete the experiments easily and quickly (optional)

● Specifications

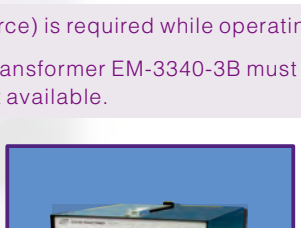
1. Induction motor
   (1) Input voltage : 3ø 220V, 50Hz/60Hz
   (2) Rated current : 1.2A
   (3) Output power : 0.3KW
   a. The motor main body can be connected to the Magnetic Powder Brake Unit by direct couple.
   b. The motor with thermal switch for overheating protection.
   c. With single-phase starting resistor, starting capacitor and running capacitor, simulation centrifugal switch.
2. AC Voltmeter : 0 ~ 600V
3. AC Ammeter : 0 ~ 6A
4. Tachometer : 0.1 ~ 9999 rpm

● EM-3340-3B System Transformer

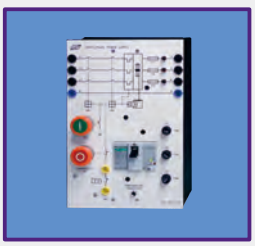
1. Rated power : 1.5KVA
2. Primary : Depend on the local line voltage
3. Secondary : 3Ø, 220V AC
4. Frequency : 50Hz/60Hz

※ 3ø power(source) is required while operating this system.

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



Measurement of Different Types Motor Characteristics



EM-3310-1E
Three-phase Power Supply

+

EM-3320-1N
Brake Controller

+

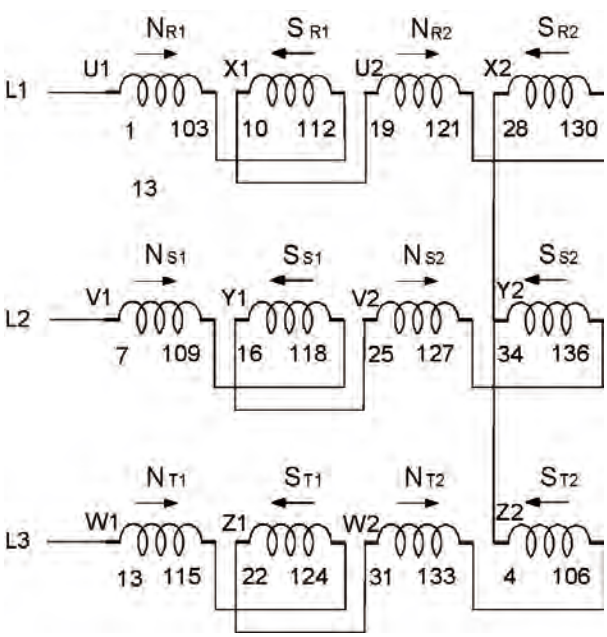
EM-3320-1C
Magnetic Powder Brake Unit

—

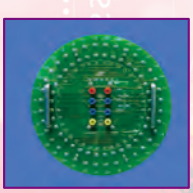
EM-3360-3A
AC Induction Motor Winding Trainer

Winding Example

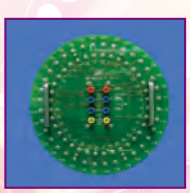
Topics：Learning the winding of three-phase 4 pole induction motor



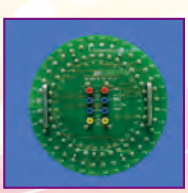
Plug-in Panel (Optional)



EM-3360-3A 1Ø-2P-A



EM-3360-3A 1Ø-4P-A



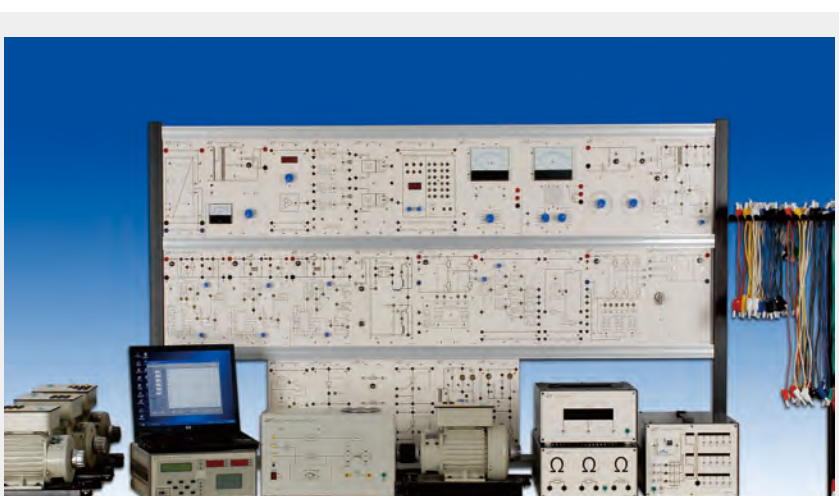
EM-3360-3A 1Ø-6P-A

List of Experiment

1. Single-phase 2-pole induction motor
   - With optional panel EM-3360-3A, 1ø2P-A
   - With EM-3310-1E, EM-3320-1N and EM-3320-1C for external mechanical load:
     - Capacitor start induction motor
     - Capacitor run induction motor
2. Single-phase 4-pole induction motor
   - With optional panel EM-3360-3A, 1ø4P-A
   - With EM-3310-1E, EM-3320-1N and EM-3320-1C for external mechanical load:
     - Capacitor start induction motor
     - Capacitor run induction motor
3. Single-phase 6-pole induction motor
   - With optional panel EM-3360-3A, 1ø6P-A
   - With EM-3310-1E, EM-3320-1N and EM-3320-1C for external mechanical load:
     - Capacitor start induction motor
     - Capacitor run induction motor
4. Three-phase 2-pole induction motor
   - With EM-3310-1E, EM-3320-1N and EM-3320-1C for external mechanical load:
     - Series-Wye-Connected induction motor
     - Series-Delta-Connected induction motor
     - Parallel-Wye-Connected induction motor
5. Three-phase 4-pole induction motor
   - With EM-3310-1E, EM-3320-1N and EM-3320-1C for external mechanical load:
     - Series-Wye-Connected induction motor
     - Series-Delta-Connected induction motor
     - Parallel-Wye-Connected induction motor
6. Three-phase 6-pole induction motor
   - With EM-3310-1E, EM-3320-1N and EM-3320-1C for external mechanical load:
     - Series-Wye-Connected induction motor

PE-5000

Power Electronics Training System



The PE-5000 Power Electronics Training System consists of 28 experimental modules, a three-phase squirrel cage motor, load, control and measuring devices. It includes single-phase rectifiers, three-phase rectifiers, DC choppers, inverters and application experiments.

Features

The PE-5000 is the combination of power, electronics and control. It has wide applications of solid-state electronics to the control and conversion of electric power. Popular circuits of power electronics contain rectifiers, choppers and inverters. The experimental modules of PE-5000 include converter, power supply, load, control and testing modules. These experimental modules and instruments are introduced and demonstrated in the subsequent experiments.

List of Experiments

Chapter 1 :
Basic Measurement and Characteristic of SCR and TRIAC

1-1: Three-Phase source voltage measurement
1-2: Digital storage oscilloscope and differential amplifier
1-3: SCR characteristic and measurement
1-4: TRIAC characteristic and measurement

Chapter 2 :
Single-Phase Rectifiers and AC Voltage Controller (AC→DC、AC→AC)

2-0: Trigger pulse measurement
2-1: Single-Phase Half-Wave uncontrolled rectifier
2-2: Single-Phase Full-Wave uncontrolled rectifier
2-3: Single-Phase Half-Wave controlled rectifier
2-4: Single-Phase Full-Wave controlled rectifier
2-5:Symmetrical Single-Phase Full-Wave Semi-Controlled rectifier
2-6: Asymmetrical Single-Phase Full-Wave Semi-Controlled rectifier
2-7: Single-Phase Semi-Controlled AC voltage controller
2-8: Single-Phase Full-Controlled AC voltage controller

Chapter 3 :
Three-Phase Rectifiers and AC Voltage Controller (AC→DC、AC→AC)

3-1: Three-Phase Half-Wave uncontrolled rectifier
3-2: Three-Phase Full-Wave uncontrolled rectifier
3-3: Three-Phase Half-Wave controlled rectifier
3-4: Three-Phase Full-Wave Semi-Controlled rectifier
3-5: Three-Phase Full-Wave Full-Controlled rectifier
3-6: Three-Phase Full-Wave Semi-Controlled AC voltage controller
3-7: Three-Phase Full-Wave Full-Controlled AC voltage controller

Chapter 4 :
DC Choppers (DC→DC)

4-0: IGBT characteristic measurement
4-1: DC PWM controller
4-2: Single-Quadrant DC chopper
4-3: Two-Quadrant DC chopper
4-4: Four-Quadrant DC chopper
4-5: SCR DC chopper

Chapter 5 :
Inverters (AC→DC→AC)

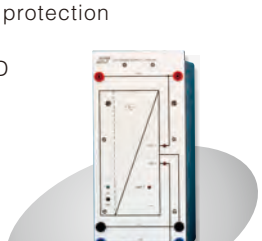
5-1: Single-Phase PWM controller
5-2: Single-Phase inverter
5-3: Three-Phase PWM controller
5-4: Three-Phase inverter

Chapter 6 :
Applications of Power Electronics

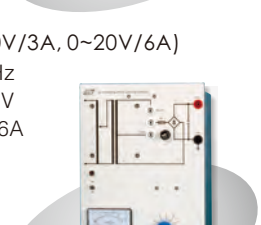
6-0: Power MOSFET characteristic measurement
6-1: Buck switching power supply
6-2: Boost switching power supply
6-3: Buck-Boost switching power supply
6-4: Flyback switching power supply
6-5: Electronic ballast

Specifications

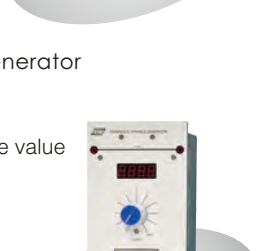
1. PE-5310-1A DC Power Supply (±15V/2A)
   (1) Short circuit & over temperature protection
   (2) Overcurrent indicator : LED
   (3) Over temperature indicator : LED
   (4) Rated output : ±15V/2A
   (5) Power indicator : LED
   (6) Operation power supply :
   220V AC , 50Hz/60Hz



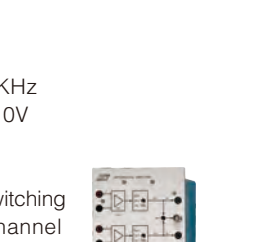
2. PE-5310-1B DC Power Supply (0~40V/3A, 0~20V/6A)
   (1) Input voltage : 220V AC, 50Hz/60Hz
   (2) 2 output voltage : 0~40V DC, 0~20V
   (3) Rated current : 0~40V/3A, 0~20V/6A
   (4) Overload protection



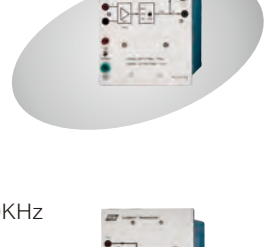
3. PE-5310-2A Reference Variable Generator
   (1) Vc range : 0V~ +10V, -10V~+10V
   (2) Linear scale : 0~100%
   (3) 7-segment display for displaying the value of output control voltage Vc
   (4) Operation power supply : ±15V



4. PE-5310-2B Differential Amplifier
   (1) 4 Channels output and input
   (2) Measuring voltage (Max.) : 700Vp
   (3) Output voltage (Max.) : 10Vp
   (4) Measuring frequency (Max.) : 200KHz
   (5) Input voltage range : 500V, 100V, 10V
   (6) Output voltage range : 10V
   (7) Output terminal : common ground
   a. 2 BNC sockets for oscilloscope, switching switch to selected measuring channel (A/B, C/D)
   b. 4 mm terminal for module connection
   (8) Operation power supply :
   220V AC , 50Hz/60Hz



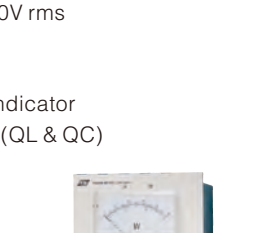
5. PE-5310-2C Current Transducer
   (1) Hall current sensor
   (2) Measuring frequency (Max.) : 200KHz
   (3) Current measuring :
   a. Input : 20Ap, output 10V
   b. Input : 5Ap, output 10V
   c. Input : 1Ap, output 10V
   (4) Overcurrent indicator
   (5) Operation power supply :
   220V AC , 50Hz/60Hz



6. PE-5310-2D Three-phase Angle Controller
   (1) Pulse output : Electric isolation, directly drives up to 6 thyristors
   (2) Trigger angle : 0~180°
   (3) Control input signal : 0~10V DC
   (4) Rectification angle : 0~90° adjustable
   (5) Convert angle : 0~180° adjustable
   (6) Mode select :
   Single pulse & continuous pulse
   (7) Operation power supply : ±15V

7. PE-5310-3A RMS Meter
   (1) Measuring range :
   a. Current : 0.1/0.3/1/3/10/30 A
   b. Voltage : 3/10/30/100/300/1000V
   (2) 3 Measuring types :
   a. RMS AC+DC : Total RMS value
   b. RMS AC : Ripple RMS value
   c. AV AC+DC : Arithmetic mean value
   (3) Overload protection
   (4) ± Value indicator : LED
   (5) Accuracy : 2%. Full scale
   (6) Operation power supply :
   220V AC, 50Hz/60Hz

8. PE-5310-3B Power Meter (0.3W-30KW)
   (1) Measuring range : 0.3W~30KW
   a. Current : 0.1/0.3/1/3/10/30 A rms
   b. Voltage : 3/10/30/100/300/1000V rms
   (2) Frequency range : 0~20KHz
   (3) Overload protection
   (4) Overcurrent & over voltage LED indicator
   (5) Reactive power ± value indicator (QL & QC)
   (6) Accuracy : 2% full scale
   (7) Output terminal :
   Measuring full scale 100%=1V
   (8) Operation power supply :
   220V AC, 50Hz/60Hz



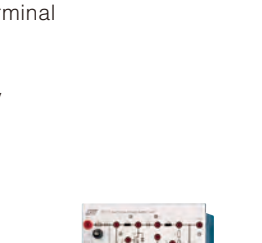
9. PE-5310-3C Resistor Load Unit
   (1) Bench top type
   (2) 3 load resistors, each one 100Ω
   (3) Rated current : 2.5A
   (4) Rated power : 625W

10. PE-5310-3D Resistor Load
    (1) 2 resistors load :
        a. 5~50Ω/120W
        b. 10~100Ω/120W
    (2) Overcurrent protection

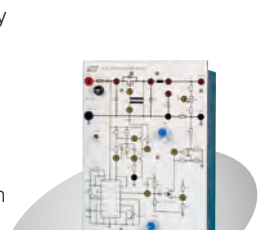
11. PE-5310-3E Inductive Load Unit
    (1) Bench top type
    (2) Load indicator : 50mH x 2/200mH
    (3) Rated current : 5A

12. PE-5310-4A Flyback Switching Power Supply
    (1) Test point :
        a. Switching control IC output signal
        b. Current feedback signal
        c. Voltage feedback signal
        d. Switching power component terminal
    (2) Switching frequency up to 40KHz
    (3) Converter control : Isolation feedback converter
    (4) Input voltage : 95V~250V AC
    (5) Output : 45W, up to 80% efficiency
    (6) Output voltage ripple : 5%
    (7) Output voltage regulation : 5%
    (8) Output voltage : 12V ~ 15V DC,
        adjustable by R18
    (9) Rated current : 2A Max.
        overload & short circuit protection
    (10) Switching power component : MOSFET

13. PE-5310-4B Boost Switching Power Supply
    (1) Test point :
        a. Switching control IC output signal
        b. Current feedback signal
        c. Voltage feedback signal
        d. Switching power component terminal
    (2) Switching frequency : 40KHz
    (3) Input voltage : 10V ~ 16V DC
    (4) Output : 60W, up to 85% efficiency
    (5) Output voltage ripple : 5%
    (6) Output voltage regulation : 5%
    (7) Output voltage : 18V ~ 30V DC,
        adjustable
    (8) Rated current : 2A Max.
        overload & short circuit protection
    (9) Switching power component : MOSFET

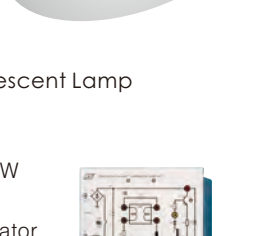


14. PE-5310-4C Buck Switching Power Supply
    (1) Test point :
        a. Switching control IC output signal
        b. Current feedback signal
        c. Voltage feedback signal
        d. Switching power component terminal
    (2) Switching frequency : 40KHz
    (3) Input voltage : 17V~ 30V DC
    (4) Output : 45W, up to 85% efficiency
    (5) Output voltage ripple : 5%
    (6) Output voltage regulation : 5%
    (7) Output voltage : 10V ~ 15V DC,
        adjustable
    (8) Rated current : 2A Max.
        overload & short circuit protection
    (9) Switching power component :
        MOSFET

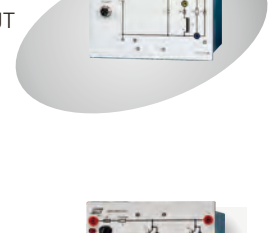


15. PE-5310-4D Buck-Boost Switching Power Supply
    (1) Test point :
        a. Switching control IC output signal
        b. Current feedback signal
        c. Voltage feedback signal
        d. Switching power component terminal
    (2) Switching frequency : ⩾40KHz
    (3) Input voltage : 20V ~ 30V DC
    (4) Output : 60W, up to 85% efficiency
    (5) Output voltage ripple : ⩽5%
    (6) Output voltage regulation : ⩽5%
    (7) Output voltage : 25V ~ 30V DC,
        adjustable
    (8) Rated current : 2A Max.
        overload & short circuit protection
    (9) Switching power component :
        MOSFET

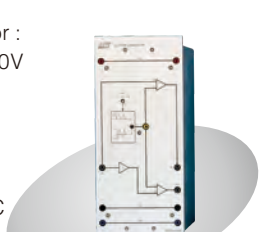
16. PE-5310-4E Electronic Ballast Fluorescent Lamp
    (1) Switching frequency : 10KHz
    (2) Input voltage range : 220V AC
    (3) Type of lamp : 35cm long tube 10W
    (4) Control mode : half-bridge
        self-excitation feedback multivibrator
    (5) Output current : 2A Max. with overflow
        and short circuit protection
    (6) Switching power component : BJT



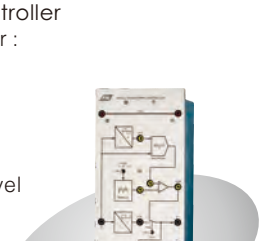
17. PE-5310-4F IGBT Drive Set
    (1) Input voltage : 20~300V DC
    (2) Output voltage : 20~300Vp
    (3) Drive circuit :
        Photo couple and drive circuit
    (4) Output device : IGBT, 800V/60A
    (5) Current protector



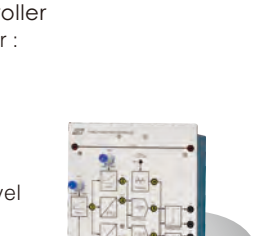
18. PE-5310-4G DC PWM Generator
    (1) Triangular wave(carrier) generator :
        a. Amplitude : 0~10V or -10V~+10V
        b. Frequency : 1K, 10K, 15KHz
    (2) PWM signal generator :
        2 x PWM control signal
    (3) IP input : -10V~+10V DC
    (4) Operation power supply : ±15V DC



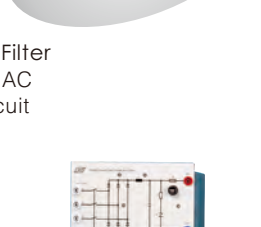
19. PE-5310-4H Single-phase PWM Controller
    (1) Triangular wave(carrier) generator :
        a. Amplitude : -10V~+10V
        b. Frequency : 1K, 5K, 15KHz
    (2) Sine wave signal generator
    (3) Multiplex
    (4) PWM Signal generator : 2 x TTL level
    (5) Square wave signal generator
    (6) IP input : 0V~+10V DC
    (7) Operation power supply : ±15V DC



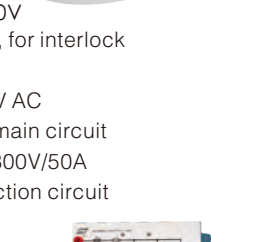
20. PE-5310-4I Three-phase PWM Controller
    (1) Triangular wave(carrier) generator :
        a. Amplitude : -10V~+10V
        b. Frequency : 5K, 10K, 20KHz
    (2) Sine wave signal generator
    (3) Multiplex
    (4) PWM Signal generator : 6 x TTL level
    (5) Square wave signal generator
    (6) IP input : -10V~+10V DC
    (7) Operation power supply : ±15V DC



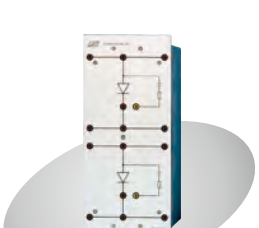
21. PE-5310-4J Three-phase Rectifier & Filter
    (1) Power input : 1Ø or 3Ø, 20V~220V AC
    (2) With Inductor & capacitor filter circuit
    (3) Surge protection in voltage circuit
    (4) Output voltage :
        28V~310V DC (Max.) / 10A(Max.)



22. PE-5310-4K Universal Inverter 3 x 230V
    (1) 6 x TTL level signal input : > 2.5μS, for interlock & dead time control
    (2) Power input : 1Ø or 3Ø, 20V~220V AC
    (3) With photo-couple, isolation and main circuit
    (4) Output power component : IGBT 800V/50A
    (5) With adjustable overcurrent protection circuit
    (6) Output capacity : 220V/ 1.5KV
    (7) Operation power supply :
        220V AC, 50Hz/60Hz



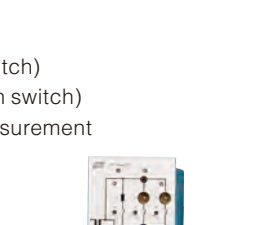
23. PE-5310-5A Power Diode Set
    (1) Rated voltage : 1200V
    (2) Rated current : 40A



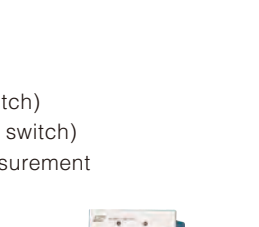
24. PE-5310-5B Fuse Set
    (1) Module design
    (2) 3 x D-Type fuses, 500V/6A

25. PE-5310-5C Thyristor (800V/10A)
    (1) Rated voltage : 800V
    (2) Rated current : 10A
    (3) With RC surge buffer protection circuit

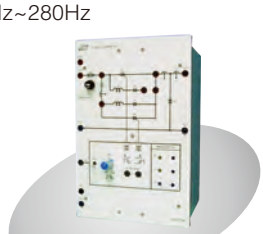
26. PE-5310-5D SCR/TRIAC Set
    (1) SCR : 800V/16A
    (2) TRIAC : 600V/12A
    (3) Load lamp : 2 x 24V/10W (with switch)
    (4) Load inductor : 1 x 50m H/1A(with switch)
    (5) With current/voltage transfer measurement
    (6) With trigger control adjustable
    (7) Operation power supply :
        220V AC, 50Hz/60Hz



27. PE-5310-5E MOSFET / IGBT Set
    (1) IGBT : 800V/50A
    (2) MOSFET : 100V/48A
    (3) Load lamp : 2 x 24V/10W (with switch)
    (4) Load inductor : 1 x 50mH/1A(with switch)
    (5) With current/voltage transfer measurement
    (6) With trigger control adjustable
    (7) With external signal input
    (8) Operation power supply : +15V DC



28. PE-5310-5F SCR DC Chopper Set
(1) Operating voltage : ±15V, 0.4A
(2) Input voltage range : 50V~300V DC
(3) Maximum output current : 5A
(4) Chopping frequency range : 220Hz~280Hz
(5) Min. duty cycle : 0.1
(6) Max. duty cycle : 0.8
(7) External input : 0~10V DC

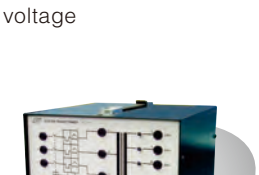


29. PE-5340-3A Isolating Transformer
(1) Benchtop type
(2) Output voltage : 3Ø, 4W, Y type connected, 110/164/190/220V line-to-line voltage output
(3) Rated capacity : 1.5KVA
(4) Input : 3Ø, 220V AC, 50Hz/60Hz

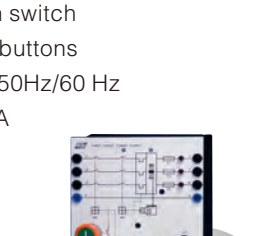
30. EM-3340-3B System Transformer
(1) Rated power : 1.5KVA
(2) Primary : Depend on the local line voltage
(3) Secondary : 3Ø, 220V AC
(4) Frequency : 50Hz/60Hz

※ 3Ø power (source) is required while operating this system.

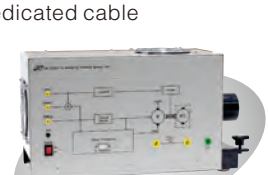
※ The System Transformer EM-3340-3B must be included if 3Ø 220V is not available.



31. 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 220V AC, 50Hz/60 Hz
(5) Rated output : 3Ø 220V AC/10 A
(6) Fuse protection
(7) Terminals : 4mm safety sockets
(8) Temperature indicator



32. EM-3320-1C Magnetic Powder Brake Unit
(1) Power supply : 110/220V AC
(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 pluse /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 : 12V DC/0.29A
(10) Analog DC output :
a. Torque output (1V / 1 kg-m)
b. Speed output (1V / 1000 rpm)
c. Power output (1V / 1 KW)



33. EM-3320-1N Brake Controller
(1) Power Supply : 110/220V AC
(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 mode :
a. Open-loop control mode
Manual on loading and unloading power to brake automatic loading and unloading power, brake selectable initial torque Wi and Max. torque Wm : 0 ~ 0.999 kg-m
Selectable loading time : 1 sec ~ 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)
(10) or RS-485 (Option) port
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.

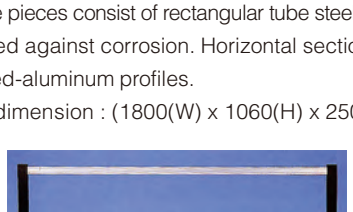
EM-3320-1A (Magnetic Powder Brake Unit) is replaced by EM-3320-1C (Magnetic Powder Brake Unit), and EM-3310-1B (Three-phase Power Supply Module) is replaced by EM-3310-1E (Three-phase Power Supply Module). It is not acceptable to mix and match the old version with the new version.

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.

34. 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 : 180V DC
b. Rated current : 2.7 A
c. Rated speed : 2500 rpm
d. Rated power : 0.4 KW

35. EM-3330-3C Three-phase Squirrel Cage Motor
(1) Rated voltage : △ 220V AC, 50Hz/60 Hz
(2) Rated current : 1.4 A
(3) Rated speed : 1670 rpm(60Hz); 1420 rpm(50Hz)
(4) Rated power : 0.3 KW
(5) Power factor : 0.82

36. EM-3380-2B Experimental Frame
(1) The experimental frame described below is suitable for demonstration with 297 mm high experimental panels.
(2) The experimental frame can be secured to benches or back uprights and removed at any time.
(3) The side pieces consist of rectangular tube steel, (60x30x2)mm, protected against corrosion. Horizontal sections contains of anodized-aluminum profiles.
(4) Frame dimension : (1800(W) x 1060(H) x 250(D))mm, ±5%



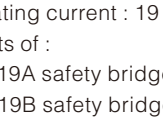
37. EM-3390-2A Coupling
(1) Material : Rubber
(2) Coupling sleeve for mechanical connection between two electrical machines

38. EM-3390-2B Coupling Guard
(1) Material : Plate coating
(2) A guard attachable for contact-proof with electrical machines rotating parts

39. EM-3390-2C Shaft End Guard
(1) Material : Plate coating
(2) A guard attachable to avoid contact with electrical machines rotating parts

40. 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

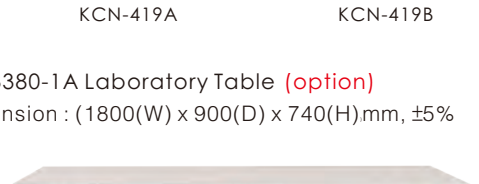
41. EM-3390-4A Safety Bridging Plugs Set
(1) 4mm safety bridge plugs, 19 mm spacing
(2) Max. rating current : 19 A
(3) Consists of :
KCN-419A safety bridge plug
KCN-419B safety bridge plug



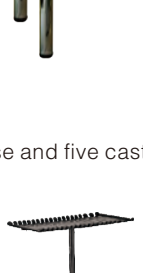
KCN-419A

KCN-419B

42. EM-3380-1A Laboratory Table (option)
Dimension : (1800(W) x 900(D) x 740(H)mm, ±5%



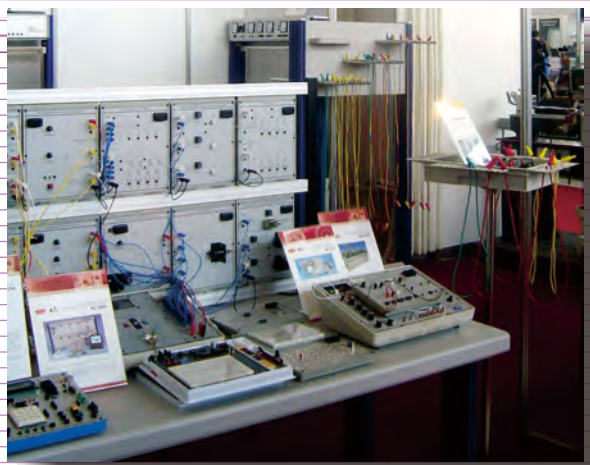
43. EM-3390-1A Connecting Lead Holder
(1) Mobile type with 5-foot tubular steel base and five casters
(2) Height :
1400mm, iron plate suitable with 20 connecting leads slots.



Overview of Equipment Required

		Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Total
1.	PE-5310-1A DC Power Supply (±15V/2A)		1	1	1	1	1	1
2.	PE-5310-1B DC Power Supply (0-40V/3A, 0-20V/6A)						1	1
3.	PE-5310-2A Reference Variable Generator		1	1	1	1		1
4.	PE-5310-2B Differential Amplifier	1	1	1	1	1	1	1
5.	PE-5310-2C Current Transducer		1	1	1	1		1
6.	PE-5310-2D Three-phase angle Controller		1	1				1
7.	PE-5310-3A RMS Meter	1	1	1	1	1	1	1
8.	PE-5310-3B Power Meter (0.3W-30KW)		1				1	1
9.	PE-5310-3C Resistor Load Unit		1	1	1	1		1
10.	PE-5310-3D Resistor Load						1	1
11.	PE-5310-3E Inductive Load Unit		1	1	1	1		1
12.	PE-5310-4A Flyback Switching Power Supply						1	1
13.	PE-5310-4B Boost Switching Power Supply						1	1
14.	PE-5310-4C Buck Switching Power Supply						1	1
15.	PE-5310-4D Buck-Boost Switching Power Supply						1	1
16.	PE-5310-4E Electronic Ballast Fluorescent Lamp						1	1
17.	PE-5310-4F IGBT Drive Set				1	1		1
18.	PE-5310-4G DC PWM Generator				1			1
19.	PE-5310-4H Single-phase PWM Controller					1		1
20.	PE-5310-4I Three-phase PWM Controller					1		1
21.	PE-5310-4J Three-phase Rectifier & Filter				1	1		1
22.	PE-5310-4K Universal Inverter 3x230V					1		1
23.	PE-5310-5A Power Diode Set		2	3				3
24.	PE-5310-5B Fuse Set		1	1	1	1		1
25.	PE-5310-5C Thyristor (800V/10A)		2	3				3
26.	PE-5310-5D SCR/TRIAC Set	1						1
27.	PE-5310-5E MOSFET / IGBT Set				1		1	1
28.	PE-5310-5F SCR DC Chopper Set				1			1
29.	PE-5340-3A Isolating Transformer	1	1	1	1	1	1	1
30.	EM-3340-3B System Transformer	1	1	1	1	1	1	1
31.	EM-3310-1E Three-phase Power Supply Module	1	1	1	1	1	1	1
32.	EM-3320-1C Magnetic Powder Brake Unit				1	1		1
33.	EM-3320-1N Brake Controller				1	1		1
34.	EM-3330-1A DC Permanent-magnet machine				1			1
35.	EM-3330-3C Three-phase Squirrel Cage Motor					1		1
36.	EM-3380-2B Experimental Frame	1	1	1	1	1	1	1
37.	EM-3390-2A Coupling				1	1		1
38.	EM-3390-2B Coupling Guard				1	1		1
39.	EM-3390-2C Shaft End Guard				1	1		1
40.	EM-3390-3A Connecting Leads Set	1	1	1	1	1	1	1
41.	EM-3390-4A Safety Bridging Plugs Set	1	1	1	1	1	1	1
42.	EM-3380-1A Laboratory Table (Option)	1	1	1	1	1	1	1
43.	EM-3390-1A Connecting Lead Holder	1	1	1	1	1	1	1

Note : A digital storage oscilloscope is required while doing above experiments which is optional.



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