

Power & Protection Laboratory



WELCOME TO Our Creative World

We truly appreciate your continual support for our company and products. The Egyptian Company for Development of Education Technologies was established in 2008. Through this short period of time, our company became one of the most influential and competitive companies in the field, all due to the efficiency, devotion and competence of our workers.

Quality and durability is our goal, so we do commit to exceeding the international standards of Quality Management during all the phases of production.

We have a firm belief that our products will enhance and support educators and students in the world and that the key for uniqueness is to invest in the power of minds, research and sustainable development.

We also have the capability to custom produce equipment to comply with the requirements of our valued clients. We spent a lot of time listening to students and teachers.

We incorporated their complaints of other manufacturers and their remarks on their objectives to build the ultimate training solutions.

Our trainers help students reach their educational goals and curriculum objectives by supplying them with the hardware and software that facilitates thinking, creativeness and enhancement of diverse skills.

Our job does not end there; Rather, we continue monitoring our systems for life after they are sold

Our after-sale support team is always there to help students and school officials get the most out of their purchased products.

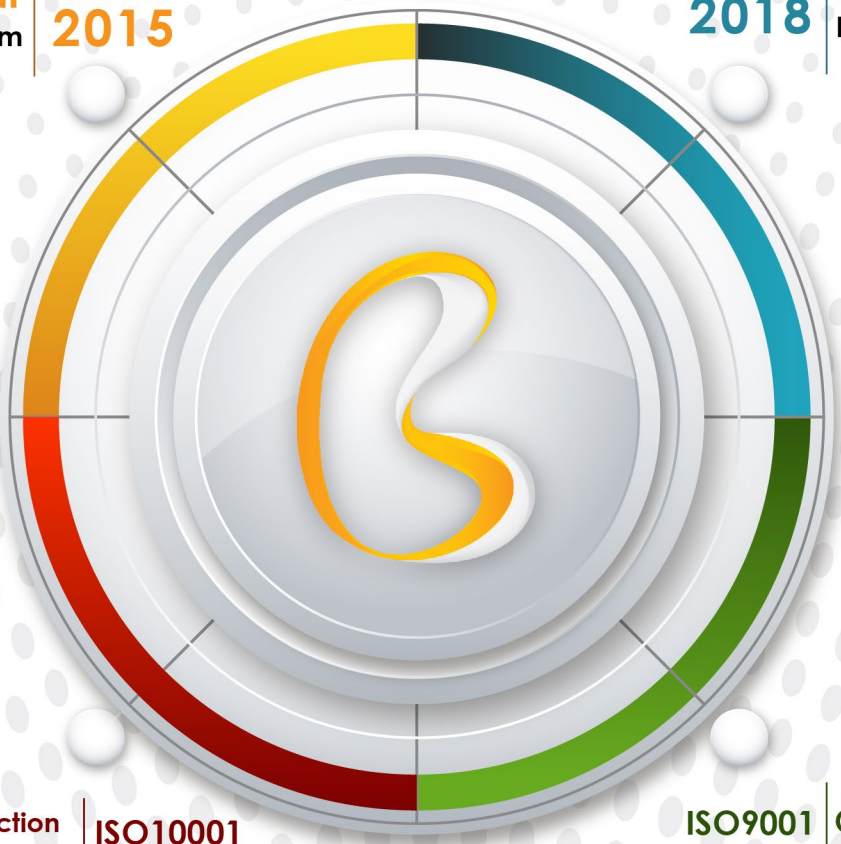
Our objective is to be the top producer of engineering/vocational training equipment in the world.

Please enjoy our catalog and let us know if you have any questions or concerns. We are always here to help! We guarantee that we will transform your classroom experience to a totally new level.

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Environmental
Management System
ISO14001
2015

ISO45001
2018
Occupational
Health & Safety



Customer Satisfaction
Management System
ISO10001
2018

ISO9001
2015
Quality Manager
System

















Contents

Power & Protection System Laboratory

PS - 001 Power Systems Laboratory 8

PS - 002 Synchronous Generator Protection Module 18

PS - 003 Step-up Substation Protection Module 24

PS - 004 Step-down Substation Protection Module 28

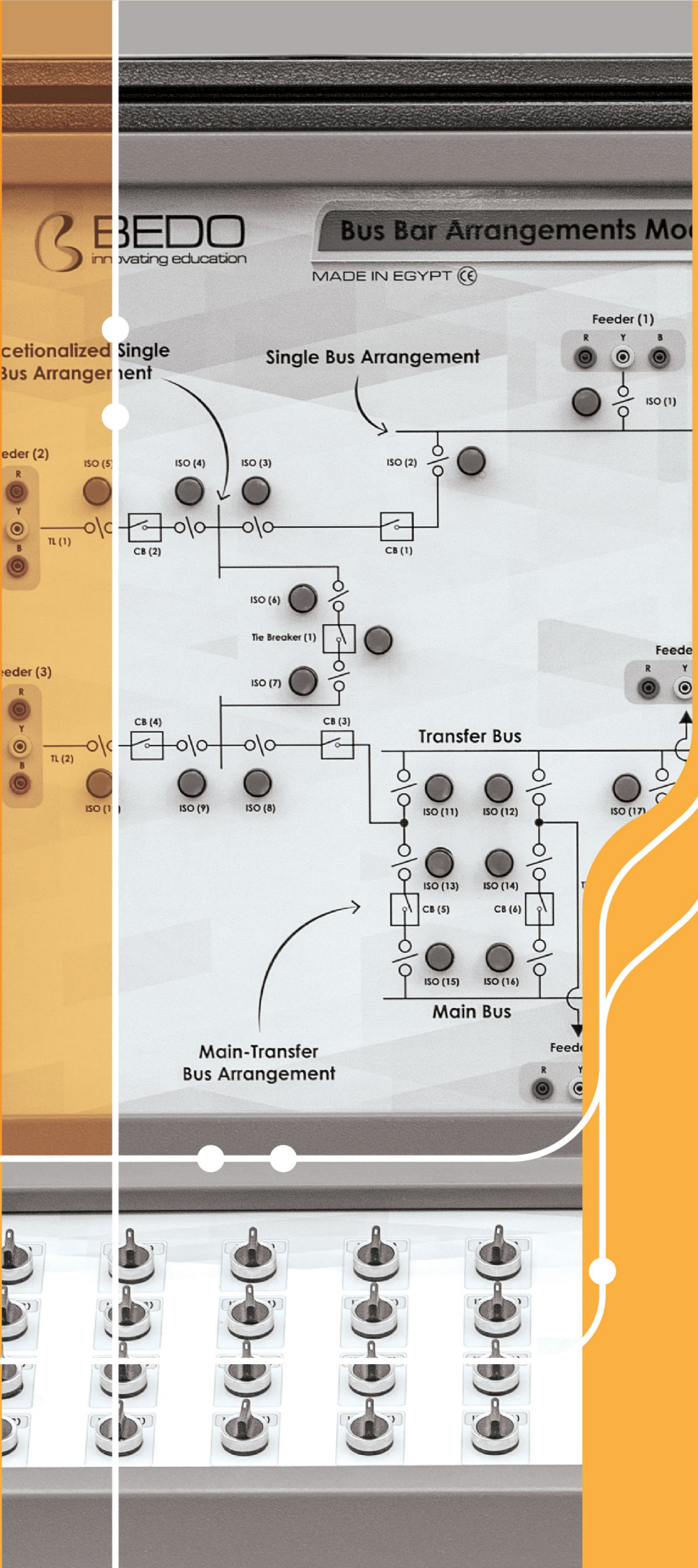
PS - 005 Load Protection Module 32

Additional Options

BI-001 Digital Content 38

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of he company's continuing product improvement program

Power & Protection Laboratory



Power System Laboratory

Power System Laboratory

PS - 001

Power Systems Laboratory

The power systems laboratory is an advanced lab that is designed to introduce trainees to fields of electrical power systems, power generation, transmission lines. The laboratory consists of modules that includes all necessary and advanced components to allow trainees to understand and study the previous fields. Also, the laboratory is supplied with experimental units of electrical machines for further experiments.



Specifications

Synchronous Machine Test Stand
Code: (PS-001.1)



The Synchronous Machine Test Stand used to calculate and demonstrate the motor efficiency, feed with variable DC supply, create circuit of electromagnetic braking and create circuit of prime mover.

Required Supply:

» Rated input voltage: 220 VAC (L + N + E)

» Rated supply current per phase: 4A

» Rated supply frequency: 50/60 Hz

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Features:

» 1kW synchronous machine mechanically coupled to a 1kW DC shunt motor

» DC shunt motor serves as prime mover (turbine) for synchronous generator

» Rotor winding terminals, as well as stator winding terminals of synchronous machine are accessible through 4mm safety terminals

» DC Excitation supply voltage is provided to excite the rotor windings of synchronous machine

» The field current and field voltage can be monitored through the DC metering panel

» The DC excitation voltage is set by adjusting the knob of an autotransformer connected to a bridge rectifier

» A load cell is attached to the test stand to send a feedback signal on the current load torque applied on the shaft

» The shaft is coupled to a DC tachogenerator that provides feedback of the current rotational speed

Generation Module

Code: (PS-001.2)



The Generation Module introduces trainees to the difference between power supplies and power generation and how the power generation is performed.

Required Supply:

» Rated input voltage: 220/380 VAC (3P+ N + E)

» Rated supply current per phase: 16A

» Rated supply frequency: 50/60 Hz

Features:

- **Auxiliary power supplies:**

» Variable DC power supply: 0 ~ 350VDC, current rating: 10 A

» Three-phase variable AC power supply: 0 ~ 290/500 VAC L-N/L-L, current rating: 6A, frequency: 50/60 Hz

» Fixed DC power supply: 350VDC, current rating: 6A

» Fixed AC power supply: 220/380 VAC L-N/ L-L, current rating: 10A, frequency: 50/60 Hz

» Low power AC power supply: 24 VAC, current rating: 2A, frequency: 50/60 Hz

- **DC Metering Panel:**

» 4-Digit seven segment display

» Configurable decimal point: 4

» Max. DC reading: 600VDC, 25A DC

» Min. DC reading: 0 VDC, 0.00A DC

» Sample rate: 3 readings / second

» Display refresh: 3 refresh / second

» Resolution: 1000mV @ 600V range, 10mA @ 15A range

» Serial communication: RS485 protocol

- **AC Power Analyzers:**

» Phase Voltage (V1, V2, V3)

» Phase angles (V1, V2, V3)

» Line Voltage (V12, V23, V31)

» Current (I1, I2, I3, In)

» Current and Voltage Unbalance

» Active Power (P1, P2, P3, Psum)

» Reactive Power (Q1, Q2, Q3, Qsum)

» Complex Power (S1, S2, S3, Ssum)

» Power Factor (PF1, PF2, PF3, PFtotal)

» Frequency (Hz)

» Load type indicator (four quadrant)

» Several types of demand calculation: total active power demand, total reactive power demand, total apparent power demand, phase A current demand, phase B current demand, and phase C current demand

» Accumulates energy for kWh, kVARh and kVAh

» Total harmonic distortion (THD)

» Total Demand distortion (TDD)

» Serial communication: TCP/IP protocol

» Resolution: 100mV @ 500V range, 10mA @ 20A range

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Step-UP Substation Module

Code: (PS-001.3)



The Step-UP substation module introduces trainees to the step up operation using a transformer with different connections (star and delta) and synchronization operation between generators using different types of synchronization devices.

Required Supply:

» Rated input voltage: 220/380 VAC (3P+ N + E)

» Rated supply current per phase: 6A

» Rated supply frequency: 50/60 Hz

Features:

» Single three-phase step-up power transformer rated at 3kVA, 380/600 VAC.

» Transformer can be connected in the following configuration: 1) star-delta, 2) star-star, 3) delta-delta, 4) delta-star)

» HV side potential transformer 900/300 VAC

» Inter-winding fault terminal on secondary side and primary side of transformer

» Can receive electrical power from three independent stand-alone synchronous generator/alternator

» Synchronization switch for each alternator

» Reference bus: Grid can be set as the reference bus or a stand-alone alternator can be set as the reference

» Synchronization method:
- Synchronoscope method
- Three-dark lamp method
- Two bright one dark lamp method

» High side and Low side AC Network analyzer:
- Input phase voltage range: 0…300V AC
- Input line voltage range: 0…500V AC
- Measuring current range: 0…10A AC
- Frequency measuring range: 45...65 Hz
- Active power per phase measurement + total active power
- Reactive power per phase measurement + total reactive power
- Apparent power per phase measurement + total apparent power
- Power factor per phase
- kWh and kVARh measurement
- Serial communication: RS485 protocol
- Resolution: 100mA @ 25A range, 100mV @ 500V range

Power Transmission Line Module

Code: (PS-001.4)



The Power Transmission Line Module simulates different types of power transmission lines with different types of loads, in addition to simulating faults of power transmission lines.

Required Supply:

» Rated input voltage: 220/380 VAC (3P+ N + E)

» Rated supply current per phase: 6A

» Rated supply frequency: 50/60 Hz

Features:

» Two independent three-phase step-down power transformer rated at 3kVA, 600/380 VAC

» Transformers can be configured as: 1) star-delta, 2) star-star, 3) delta-delta, 4) delta-star)

» Voltage regulation on HV side using 5-step tapping switch

» Two independent outgoing feeders with digital metering panel

» Load transfer on HV side through bus bar coupler (tie-breaker)

» Metering panel:
- Input phase voltage range: 0…300V AC
- Input line voltage range: 0…500V AC
- Measuring current range: 0…10A AC
- Frequency measuring range: 45...65 Hz
- Active power per phase measurement + total active power

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

- Reactive power per phase measurement + total reactive power
- Apparent power per phase measurement + total apparent power
- Power factor per phase
- kWh and kVARh measurement
- Serial communication: RS485 protocol
- Resolution: 100mA @ 25A range, 100mV @ 500V range

Three-phase Complex Load Module

Code: (PS-001.5)



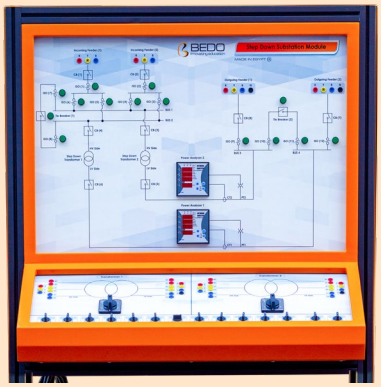
The Three-phase Complex Load Module introduces trainees to different types of loads and how to control them.

Features:

» Three phase complex load
» 1kW resistive load
» 1kVAR inductive load
» 1kVAR capacitive load
» Incremental increase in active load per phase in the following steps: 90W, 170W, 300W
» Incremental increase in lagging reactive load per phase in the following steps: 100VAR, 200VAR, 300VAR
» Incremental increase in leading reactive load per phase in the following steps: 70VAR, 150VAR, 230VAR

Step-down Substation Module

Code: (PS-001.6)



The Step-down Substation Module introduces trainees to step down transformation from 380 VAC to 220 VAC, in addition to controlling loads buses using isolators and circuit breakers.

Required Supply:

» Rated input voltage: 220/380 VAC (3P+ N + E)
» Rated supply current per phase: 6A
» Rated supply frequency: 50/60 Hz

Features:

» Two independent three-phase step-down power transformer rated at 3kVA, 600/380 VAC
» Transformers can be configured as: 1) star-delta, 2) star-star, 3) delta-delta, 4) delta-star)
» Voltage regulation on HV side using 5-step tapping switch
» Two independent outgoing feeders with digital metering panel
» Load transfer on HV side through bus bar coupler (tie-breaker)
» Metering panel:
» Input phase voltage range: 0…300V AC
» Input line voltage range: 0…500V AC
» Measuring current range: 0…10A AC
» Frequency measuring range: 45...65 Hz
» Active power per phase measurement + total active power
» Reactive power per phase measurement + total reactive power
» Apparent power per phase measurement + total apparent power
» Power factor per phase
» kWh and kVARh measurement
» Serial communication: RS485 protocol
» Resolution: 100mA @ 25A range, 100mV @ 500V range

Dynamometer Module

Code: (PS-001.7)



The Dynamometer Module is used to calculate and demonstrate the motor efficiency, feed with variable DC supply, create circuit of electromagnetic braking and create circuit of prime mover.

Required Supply:

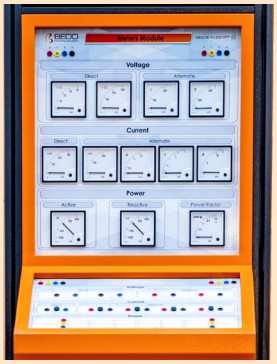
» Rated input voltage: 220/380 VAC (3P+ N + E)
» Rated supply current per phase: 10A
» Rated supply frequency: 50/60 Hz

Features:

» In motoring mode, active power input exerted by prime mover (turbine/DC shunt) can be calculated using torque meter and rotational speed indicator
» Speed of prime mover/governor (hence frequency, is controlled using a speed feedback-loop. The speed of shaft is fed back to an SCR DC drive through a DC tacho-generator or armature voltage feedback which in turn maintains the shaft speed (frequency) at set point.
» The set is provided with SCR speed control unit provides adjustable current limit, hence torque/active power limit can be set
» The set is also supplied with an IR voltage compensation to provide speed regulation throughout 60:1 speed range
» Minimum and maximum speed of prime mover can be set, as well as adjustable linear acceleration and deceleration times.
» Output torque of DC motor (prime mover) can be controlled through field weakening technique
» Field resistance control is achieved through adding a resistance in series with the field coil in an increment of 4-steps
» In brake mode, a 3-step resistive-load is provided to apply load across the DC-generator
» DC generator can be mechanically coupled with the motor under test to apply a negative electro-magnetic torque on the shaft of motor under test, in turn acts as a mechanical load on the shaft
» Torque feedback is fed to a torque indicator through a 4-wire load cell attached to the motor set, so load torque can be measured
» DC tacho-generator with a resolution of 0.06V/RPM feeds rotational speed to a speed indicator, therefore shaft speed can be measured
» DC meter panel is provided to measure the excitation voltage, armature voltage, field current and armature current fed to the DC shunt motor (prime mover/DC generator)
» 1Hp variable frequency drive is provided to supply three phase power to three phase induction motors through a linear V/F control technique.
» Touch screen is provided to set the operating base frequency, base voltage and motor poles for the VFD
» The output of the VFD can be enabled/ disabled, as well as frequency command is entered to the VFD through the virtual buttons and sliders depicted on the touch screen
» Serial Communication: RS485 protocol
» DC metering panel:
  • Sampling cycle: 50ms
  • Display method: 7 segment display (RED)
  • Voltage measuring range: 0...500V DC
  • Current measuring range: 0...10A DC
» Torque meter panel:
  • NO. OF LOAD CELLS IN PARALLEL and SUPPLY max 8 (350 ohm); 5 VDC / 120 mA
  • LINEARITY / ANALOG OUTPUT LINEARITY: < 0.01% F.S.; < 0.01% F.S.
  • THERMAL DRIFT / ANALOG OUTPUT THERMAL DRIFT: < 0.0005% F.S./°C; < 0.003% F.S./°C
  • A/D CONVERTER: 24 bit (16000000 points)
  • MEASUREMENT RANGE: ±39 mV
  • MAX SENSITIVITY OF USABLE LOAD CELLS: ±7 mV/V
  • MAX CONVERSIONS PER SECOND: 300 conversions/second

Analog Meters Module

Code: (PS-001.8)



BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

The analog meters module introduces trainees to various types of AC and DC meters and how to connect them and use them in measurements, this module can be connected to any other module to take measurements.

Features:

» Direct Voltage measurement
- 0-50V DC range
- 0-300V DC range

» Direct Current measurement
- 0-500mA DC range
- 0-10A DC range

» Alternating Voltage measurement
- 0-300V AC range
- 0-800V AC range

» Alternating Current measurement
- 0-600mA AC range
- 0-2.5A AC range

» Single phase power factor measurement
- 0.5 lag…1…0.5 lead

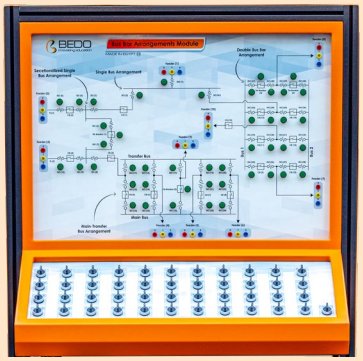
» Total three phase active power measurement
- -1000W…0…+1000W

» Total three phase reactive power measurement
- -1000VAR…0…+1000VAR

Optional Modules (Not Included):

Code: (PS-001.9)

- **Bus-bar Arrangement Module**
  Code: (PS-001.9.1)



The Bus-bar Arrangement Module is used to create an interconnected grid (a combination of loads and sources together in a wide network).

Required Supply:

» Rated input voltage: 220/380 VAC (3P+ N + E)

» Rated supply current per phase: 2A

» Rated supply frequency: 50/60 Hz

Features:

» The unit provides four types of substation topologies:
- Single Bus-bar arrangement
- Single Bus-Bar Arrangement with Bus Sectionalization
- Main and Transfer Bus Arrangement
- Double Bus Double Breaker Arrangement

» There are 10 feeders which can be connected to either three-phase loads or three-phase source

» Coupling of bus bars is achieved through tie-breaker control switch

» Power isolator can disconnect bus bar through isolator control switch

- **Auxiliary Modules**
  Code:(PS-001.9.2)



The Auxiliary Module introduces trainees to rectifier operation using diodes and how to protect diodes from over current in addition to using relays for control and self – latching principle.

Required Supply:

» Rated input voltage: 220/380 VAC (3P+ N + E)

» Rated supply current per phase: 6A

» Rated supply frequency: 50/60 Hz

Features:

» The unit provides three-phase full-bridge rectifier circuit to generate auxiliary DC supply

» Time-triggered faults can be inserted to power system modules through using timer and arc resistors

» Arc resistors can be used to generate inter-turn fault inside transformer or phase-to-ground fault

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

» Single phase ammeter is provided to measure fault current

» Time of fault is settable in the range of 0.1sec...60min

» Embedded relay latching circuit is provided to connect auxiliary contacts of relay to external contactors

» Relay is activated through Start and Reset buttons

Experiments

- Three-phase synchronous machine connected as a generator
- Determining electrical parameters of a three-phase synchronous machine
- Performance characteristics of a synchronous machine obtained by v-curves and inverted v-curves
- Relation between generated EMF and DC excitation voltage under no load condition
- Relation between governor speed and electrical frequency
- Calibrating max output torque and reference speed for prime mover (governor)
- Configuration of power transformer in different configurations (delta-star, star-star, star-delta, delta-delta)
- Synchronizing three-phase alternator with grid using digital Synchronoscope method
- Synchronizing three-phase alternator with grid using three-dark lamp method
- Synchronizing three-phase alternator with grid using two bright one dark lamp method
- Effect of Inter-turn fault on power transformer
- Leakage current due to line capacitance
- Ferranti effect due to unloaded/light load condition on the receiving end of transmission line
- Effect of line unsymmetrical fault currents on the power grid
- Configuration of power transformer in different configurations (delta-star, star-star, star-delta, delta-delta)
- Transferring of load between bus bars without interrupting power supply
- Voltage regulation to compensate for voltage drops in transmission lines or excess received line voltage
- RL load configuration:

» Parallel RL star-connected load

» Series RL star-connected load

» Parallel RL delta-connected load

» Series RL delta-connected load

- Effect of Inductive loads on line currents
- Using synchronous machines as synchronous condensers
- Power factor correction using capacitive banks

Scope of Delivery

- Power Systems Laboratory (PS - 001)
  - » Synchronous Machine Test Stand (PS - 001.1)
  - » Generation Module (PS - 001.2)
  - » Step-UP Substation Module (PS - 001.3)
  - » Power Transmission Line Module (PS - 001.4)
  - » Three-phase Complex Load Module (PS-001.5)
  - » Step-down Substation Module (PS - 001.6)
  - » Dynamometer Module (PS - 001.7)
  - » Analog Meters Module (PS - 001.8)

Options

- Digital content (BI - 01)
- Bus-bar Arrangement Module (PS - 001.9.1)
- Auxiliary Modules (PS - 001.9.2)
- Synchronous Generator Protection Module (PS - 002)
- Step-up Substation Protection Module (PS - 003)
- Step-down Substation Protection Module (PS - 004)
- Load Protection Module (PS - 005)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

BEDO
innovating education

The Egyptian Company for Developing Education Technologies **(BEDO)**



Fundamentals of Wind Energy Training Kit



Protection System Laboratory

Protection System laboratory

PS - 002

Synchronous Generator Protection Module

In the design of electrical power systems, the ANSI Standard Device Numbers ANSI/IEEE Standard denote what features a protective device supports such as a relay or circuit breaker. These types of devices protect electrical systems and components from damage when an unwanted event occurs, such as an electrical fault. Device numbers are used to identify the functions of devices. This module introduces the difference between power supplies and power generation and how the power generation is performed.



Specifications

- Phase under-voltage protection (ANSI Standard: 27P)
- Loss of prime-mover protection (ANSI Standard: 32R)
- Directional reactive overpower protection (ANSI Standard: 40/O)
- Stator thermal overload protection with inverse time characteristic (ANSI Standard: 49S)
- Non-directional instantaneous and overcurrent protection (ANSI Standard: 50P/51P)
- Earth fault instantaneous and overcurrent protection (ANSI Standard: 50N/51N)
- Over-frequency protection (ANSI Standard: 81O)
- Generator differential protection (ANSI Standard: 87G)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Technical Data

Phase under-voltage protection relay (ANSI Standard: 27P)

» Continuously monitors the three-phase output voltage of synchronous generator to warn against under-voltage condition during synchronization process

» If measured voltage moves below the set point limit, the relay contacts will change-over after the selected "Delay-OFF" has elapsed, giving an alarm or initiation signal.

» If voltage measured exceeds threshold (set point), the relay contacts will return to original state only after the reset time ("Delay-ON") has elapsed.

» Can be used in 3-wire and 4-wire network

» Offers user adjustable trip point (set point) and time delay settings.

» The set point adjustment for under-voltage is in the range of 25%

» As soon as the monitored signal moves outside of the set point limit, the time delay is activated, after which a trip will occur. The time delay prevents the relay from tripping for a predetermined period to prevent nuisance tripping.

» The relay is automatically reset once the monitored voltage rises above the set point.

» Adjustable off-delay: 0.1 …20sec

» Adjustable reset-delay: 0.1…20sec

» Adjustable under-voltage trigger range: 70% …95% (corresponding to 270V…370V AC)

» LED indicators for relay activation during under-voltage condition

» Relay output: Single change-over contact

» Contact rating: 250V AC, 8A

Loss of prime-mover protection relay (ANSI Standard: 32R)

» The protective reverse power relay will prevent a generator running in parallel with other generators from running as a motor («motoring») in case of lost prime mover torque, and will thus protect the prime mover.

» Ensure that the remaining generators connected to the system are not overloaded.

» Protects against reverse power due to an increase of the power of other generators connected to the system.

» The applied TDM (Time-Division-Multiplication) principle ensures an accurate measurement of the RMS value of the power (U × I × cos-φ), irrespective of wave form.

» Works with 3-wire and 4-wire connection.

» LED indication of fault condition

» Timer controlled tripping

» LED indication for activated relay

» Reverse power set point: (0…25%) of rated active power of synchronous generator

» Tripping time delay: 0…20sec

» Relay contact: Single change-over switch

» Contact ratings: 250V-8A (AC)

Directional reactive overpower protection relay (ANSI Standard: 40/O)

» Prevents the generator against damages caused by excessive heating due to slip frequency current flow.

» Prevent transfer of reactive load from the grid/ other alternators in parallel to a faulty generator.

» Protects against "loss of excitation", as well as "over-excitation"

» The applied TDM (Time-Division-Multiplication) principle ensures an accurate measurement of the RMS value of the reactive power (U × I × sin-φ), irrespective of wave form.

» Works with 3-wire and 4-wire connection.

» If the reactive power exceeds the set point, the output is activated. The set point value is set on the front of the relay by means of a potentiometer. If the reactive power exceeds this, a fault signal is generated, and the associated yellow LED is lit.

» Reactive power set point in case of under-excitation: (0…25%) of rated reactive power

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

- Reactive power set point in case of over-excitation: (25…125%) of rated reactive power
- Tripping time delay: 0…20sec
- Relay contact: Single change-over switch
- Contact ratings: 250V-8A AC

Stator thermal overload protection relay with inverse time characteristic (ANSI Standard: 49S)

- Differential thermal overload relay
- Phase failure sensitive
- Reset mode can either be manual or automatic.
- Pushbutton for simulating relay tripping
- Pushbutton for "Stop" and manual Reset
- Trip flag indicating overload relay tripped.
- Rated operational voltage: 0…400V AC
- Thermal protection adjustment range: 1.6A…2.5A AC
- Phase failure sensitivity tripping current: 130 % of "In" on two phases, the last phase at 0 current or 30 % of "In" on one phase, the others at "In".
- Auxiliary contact: 1 NO + 1 NC
- Tripping threshold: (1.14 +/- 0.06) x In

Non-directional instantaneous and overcurrent protection relay (ANSI Standard: 50P/51P)

- This combined short circuit and over-current relay is applied for protection of generators against both over-currents and short circuit currents (I> and I>>).
- The relay measures the highest of the 3-phase currents, providing an RMS measurement at sinusoidal currents.
- The measurement is based on average values for I>, peak values for I>>
- The set point values are set on the front of the relays by means of potentiometers.
- If a current exceeds a set point, the output is activated.
- If exceeded, a fault signal is generated, and the associated yellow LED is lit.
- Measurement of 3-phase currents
- LED indication of fault condition
- Timer-controlled tripping
- LED indication for activated relay
- When the set point is exceeded, its timer starts and will run as long as the fault condition prevails.
- If the fault disappears, the timer is reset. When the timer expires, the contact is activated and the associated red LED is lit.
- Short circuit current setting: 1.0 to 4.0 × In
- Tripping delay time for short-circuit current: 0 to 1sec
- Over-current setting: 0.5 to 1.5 × In
- Tripping delay time for over-current: 0 to 20sec
- Number of contacts: Single change-over switch per relay type
- Contact ratings: 250 V AC/24 V DC, 8 A (200,000 change-overs at resistive load)

Earth fault instantaneous and overcurrent protection relay (ANSI Standard: 50N/51N)

- Stator earth fault relay protects genset operators against electric shock in case of earth faults in the generator's stator.
- The relay also protects against loss of excitation in case of earth fault in the stator.
- Protects the voltage source and load networks against earth fault in a solid-earth, or a low-resistance TN system.
- The relay measures the leakage or a short circuit from one or more of the phases to earth.
- In order to obtain a short response time on a fault condition, the measurement is based on peak values.
- The earth fault current protection is obtained by connecting an external current transformer in the star point of the protected voltage source.
- In order to prevent malfunction due to 3rd harmonic, the relay is equipped with a special filter cutting off frequencies higher than 50/60 Hz.
- The set point values for ground currents are set on the front of the relay by means of potentiometers.
- If exceeded, a fault signal is generated, and the associated yellow LED is lit.

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

» The relay is provided with two outputs with contacts either normally energized or normally de-energized based on the supplied auxiliary power.
» Earth fault protection at two levels (instantaneous and definite-time ground-fault protection)
» Built-in filter for 3rd harmonic
» LED indication of fault condition
» Timer-controlled tripping
» LED indication for activated relay
» Earth leakage current setting: 2…20% of In
» Tripping delay time for leakage current: 0 to 20sec
» Earth short-circuit current setting:10...100% of In
» Tripping delay time for short-circuit current: 0 to 1sec
» Relay contact: 1 change-over switch per relay type
» Contact voltage rating: Max. 250V AC, 8A

Over-frequency protection relay (ANSI Standard: 81O)

» Frequency protectors offer user adjustable frequency trip point (set point)
» The set point adjustment range is centered around the nominal 50Hz or 60Hz system frequency.
» If the measured frequency moves outside the set point limit, the relay will operate, giving an alarm or initiation signal.
» The unit draws their operating power from the measuring inputs. No separate power supply is required
» When the monitored frequency exceeds the set point, the relay will energize and the LED indicator will illuminate to indicate the trip condition.
» The tripping action can be delayed through an adjustable delay knob
» The relay will automatically reset once the monitored frequency falls below the set point
» When monitoring relay is reset, the LED will extinguish and the relay contacts de-energizes.
» Operating (monitored) voltage: 220-240V AC
» Adjustable Power-on delay range: 1…10sec
» Adjustable tripping delay range: 1…10sec
» Relay output: Single change-over contact
» Contact rating: 250V AC, 8A

Generator differential protection relay (ANSI Standard: 87G)

» Protects the synchronous generator against leakage currents in the windings of the generator.
» The relay compares the differential current of each of the three phases, providing an RMS measurement at sinusoidal currents.
» The differential currents are obtained by connecting the external current transformers for each winding in parallel with inverse polarity.
» The measurement is not stabilized, implying that the relay contact is activated for disconnection of the supervised unit when the differential current of the individual phases exceeds its set point, irrespective of the amperage of these.
» The three differential currents are measured by the relay and the highest of these is selected. If this exceeds the set point, the output is activated.
» The set point value is set on the front of the relay by means of a potentiometer. If exceeded, a fault LED illuminates, however, contacts are not yet energized.
» When the set point is exceeded, if delay is set, its timer starts and will run as long as the fault condition prevails. If the fault disappears, the timer is reset.
» When the timer expires, the contact is activated and the associated relay LED indicator is lit.
» Differential current setting: 0.04 to 0.4 × In
» Tripping delay setting: 0 to 1sec
» Maximum input current: 4x In
» Relay output: 2x change-over contacts
» Contact rating: 250V AC, 8A

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Experiments

- Stator Differential Protection of a Synchronous Generator
- Loss of prime mover Protection of a Synchronous Generator
- Reactive power reverse flow Protection of a Synchronous Generator
- Synchronous generator over-excitation protection
- Over-frequency Protection of a Synchronous Generator
- Protection against earth leakage fault of a Synchronous Generator

Scope of Delivery

- Synchronous Generator Protection Module (PS - 002)

Options

- Digital content (BI-01)

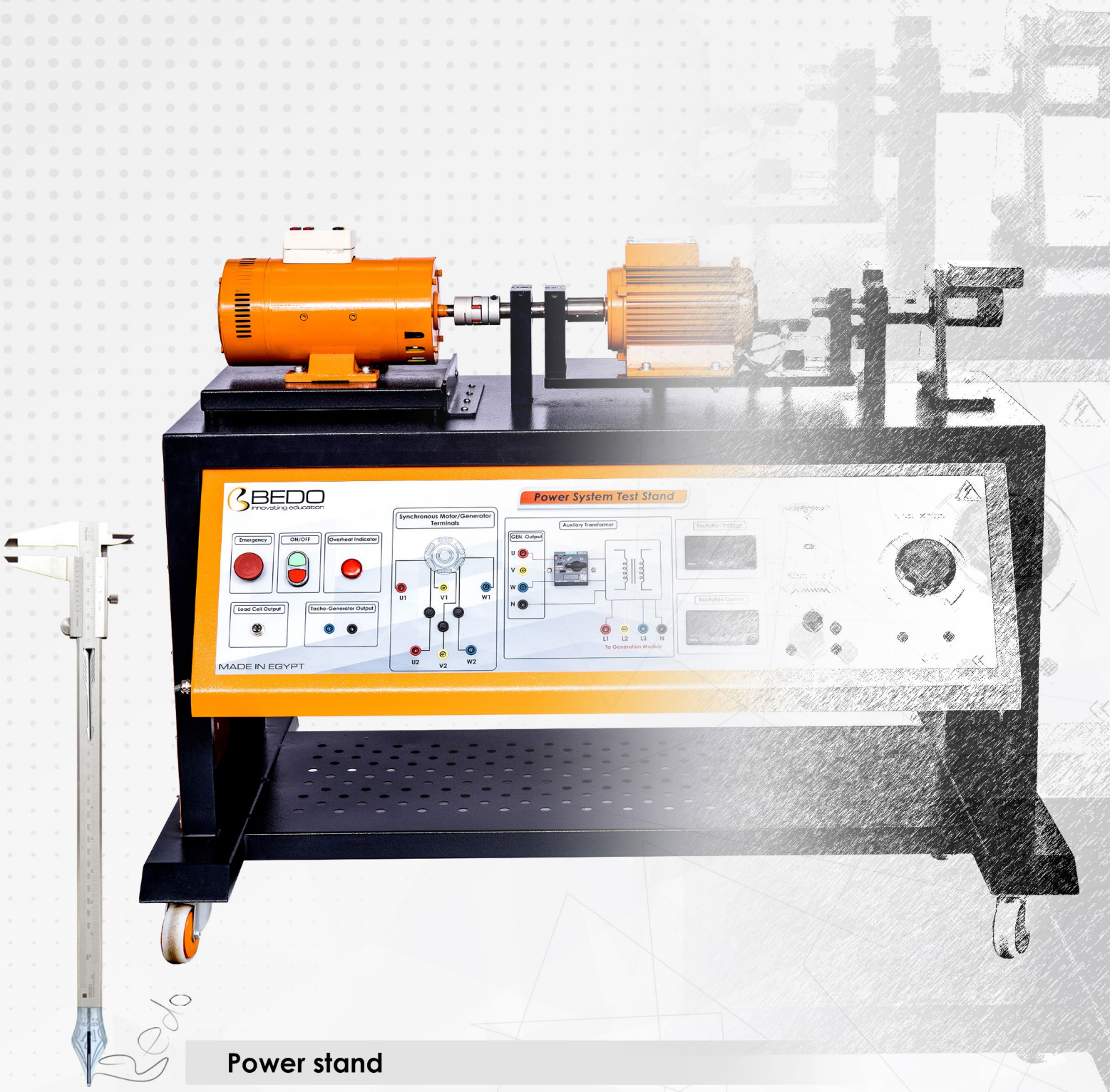
Required for Operation

- Generation Module (PS - 001.2)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

BEDO
innovating education

The Egyptian Company for Developing Education Technologies **(BEDO)**



Power stand

PS - 003

Step-up Substation Protection Module

In the design of electrical power systems, the ANSI Standard Device Numbers ANSI/IEEE Standard denote what features a protective device supports such as a relay or circuit breaker. These types of devices protect electrical systems and components from damage when an unwanted event occurs, such as an electrical fault. Device numbers are used to identify the functions of devices. This module is used to provide protection to Step Up / Synchronization Substation Module and introduce trainees to how to use the different protection relays and their connections



Specifications

- Negative sequence/ unbalanced line-current protection (ANSI Standard: 46)
- Transformer in-rush and overload protection (ANSI Standard: 49)
- Non-directional definite-time overcurrent protection (ANSI Standard: 51P)
- Earth fault definite-time overcurrent protection (ANSI Standard: 51TN)
- Phase over-voltage protection (ANSI Standard: 59P)
- Inter-turn fault protection (ANSI Standard: 87T)
- Under-frequency protection (ANSI Standard: 81U)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Technical Data

Negative sequence/ unbalanced line-current protection (ANSI Standard: 46)

» A three phase current balance protection relay continuously monitors a three phase AC current through current transformers, tripping upon an unbalanced load condition.

» The output relay trips when the monitored current is outside of the user adjustable limit and the LED ceases to illuminate indicating a fault condition.

» The relay also has a built-in time delay, used to avoid nuisance tripping.

» The output relay is set to de-energize in the unbalanced condition ensuring the protection relay is failsafe.

» The relay requires an auxiliary supply to operate.

» The unbalance trip point is adjustable from 3% to 20% of the nominal current

» The set point is adjusted through the front control knob.

» The time delay is adjustable from 0.1 to 10 seconds

» Relay output: Single change-over contact

» Contact rating: 250V AC, 5A (resistive)

Transformer in-rush and overload protection (ANSI Standard: 49)

» Differential thermal overload relay

» Phase failure sensitive

» Reset mode can either be manual or automatic.

» Pushbutton for simulating relay tripping

» Pushbutton for “Stop” and manual Reset

» Trip flag indicating overload relay tripped.

» Rated operational voltage: 0…400V AC

» Thermal protection adjustment range: 1.6A…2.5A AC

» Phase failure sensitivity tripping current: 130 % of “In” on two phase, the last phase at 0 current or 30 % of “In” on one phase, the others at “In”.

» Auxiliary contact: 1 NO + 1 NC

» Tripping threshold: (1.14 +/- 0.06) x In

Non-directional definite-time overcurrent protection (ANSI Standard: 51P)

» protection of generators against over-currents .

» The relay measures the highest of the 3-phase currents, providing an RMS measurement at sinusoidal currents.

» The measurement is based on average values for measured current.

» The set point values are set on the front of the relays by means of potentiometers.

» If a current exceeds a set point, the output is activated.

» If exceeded, a fault signal is generated, and the associated yellow LED is lit.

» Measurement of 3-phase currents

» LED indication of fault condition

» Timer-controlled tripping

» LED indication for activated relay

» When the set point is exceeded, its timer starts and will run as long as the fault condition prevails.

» If the fault disappears, the timer is reset. When the timer expires, the contact is activated and the associated red LED is lit.

» Over-current setting: 0.5 to 1.5 × In

» Tripping delay time for over-current: 0 to 20sec

» Number of contacts: Single change-over switch per relay type

» Contact ratings: 250 V AC/24 V DC, 8 A (200,000 change-overs at resistive load)

Earth fault definite-time overcurrent protection (ANSI Standard: 51TN)

» Stator earth fault relay protects genset operators against electric shock in case of earth faults in the generator’s stator.

» The relay also protects against loss of excitation in case of earth fault in the stator.

» Protects the voltage source and load networks against earth fault in a solid-earth, or a low-resistance TN system.

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company’s continuing product improvement program

» The relay measures the leakage or a short circuit from one or more of the phases to earth.

» In order to obtain a short response time on a fault condition, the measurement is based on peak values.

» The earth fault current protection is obtained by connecting an external current transformer in the star point of the protected voltage source.

» In order to prevent malfunction due to 3rd harmonic, the relay is equipped with a special filter cutting off frequencies higher than 50/60 Hz.

» The set point values for ground currents are set on the front of the relay by means of potentiometers.

» If exceeded, a fault signal is generated, and the associated yellow LED is lit.

» The relay is provided with two outputs with contacts either normally energized or normally de-energized based on the supplied auxiliary power.

» Earth fault protection at two levels (instantaneous and definite-time ground-fault protection)

» Built-in filter for 3rd harmonic

» LED indication of fault condition

» Timer-controlled tripping

» LED indication for activated relay

» Earth leakage current setting: 2…20% of In

» Tripping delay time for leakage current: 0 to 20sec

» Earth short-circuit current setting:10...100% of In

» Tripping delay time for short-circuit current: 0 to 1sec

» Relay contact: 1 change-over switch per relay type

» Contact voltage rating: Max. 250V AC, 8A

Phase over-voltage protection relay (ANSI Standard: 59P)

» Continuously monitors the three-phase output voltage of synchronous generator to warn against over-voltage condition to warn against over-excitation condition

» If measured voltage moves above the set point limit, the relay contacts will change-over after the selected "Delay-OFF" has elapsed, giving an alarm or initiation signal.

» If voltage measured falls below threshold (set point), the relay contacts will return to original state only after the reset time ("Delay-ON") has elapsed.

» Can be used in 3-wire and 4-wire network

» User can adjust trip point (set point) and time delay settings.

» The set point adjustment for over-voltage is in the range of 25%

» As soon as the monitored signal moves outside of the set point limit, the time delay is activated, after which a trip will occur. The time delay prevents the relay from tripping for a predetermined period to prevent nuisance tripping.

» The relay is automatically reset once the monitored voltage falls below the set point.

» Adjustable off-delay: 0.1 …20sec

» Adjustable reset-delay: 0.1…20sec

» Adjustable over-voltage trigger range: 105% …130% (corresponding to 410V…510V AC)

» LED indicators for relay activation during over-voltage condition

» Relay output: Single change-over contact

» Contact rating: 250V AC, 8A

Inter-turn fault protection (ANSI Standard: 87T)

» Protects the synchronous generator against leakage currents in the windings of the generator.

» The relay compares the differential current of each of the three phases, providing an RMS measurement at sinusoidal currents.

» The differential currents are obtained by connecting the external current transformers for each winding in parallel with inverse polarity.

» The measurement is not stabilized, implying that the relay contact is activated for

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

disconnection of the supervised unit when the differential current of the individual phases exceeds its set point, irrespective of the amperage of these.

» The three differential currents are measured by the relay and the highest of these is selected. If this exceeds the set point, the output is activated.

» The set point value is set on the front of the relay by means of a potentiometer. If exceeded, a fault LED illuminates, however, contacts are not yet energized.

» When the set point is exceeded, if delay is set, its timer starts and will run as long as the fault condition prevails. If the fault disappears, the timer is reset.

» When the timer expires, the contact is activated and the associated relay LED indicator is lit.

» Differential current setting: 0.04 to 0.4 × In

» Tripping delay setting: 0 to 1sec

» Maximum input current: 4x In

» Relay output: 2x change-over contacts

» Contact rating: 250V AC, 8A

Under-frequency protection (ANSI Standard: 81U)

» Frequency protectors offer user adjustable frequency trip point (set point)

» The set point adjustment range is centered around the nominal 50Hz or 60Hz system frequency.

» If the measured frequency moves outside the set point limit, the relay will operate, giving an alarm or initiation signal.

» The unit draws their operating power from the measuring inputs. No separate power supply is required

» When the monitored frequency falls below the set point, the relay will energize and the LED indicator will illuminate to indicate the trip condition.

» The tripping action can be delayed through an adjustable delay knob

» The relay will automatically reset once the monitored frequency exceeds the set point

» When monitoring relay is reset, the LED will extinguish and the relay contacts de-energizes.

» Operating (monitored) voltage: 220-240V AC

» Adjustable Power-on delay range: 1…10sec

» Adjustable tripping delay range: 1…10sec

» Relay output: Single change-over contact

» Contact rating: 250V AC, 8A

» Frequency setting: 40 to 60 Hz

Experiments

- Transformer Magnetizing Inrush current setting
- Inter-turn faults protection for a three-Phase Power Transformer
- Earth Fault Protection of a Three-Phase Power Transformer

Scope of Delivery

- Step-up Substation Protection Module (PS - 003)

Required for Operation

- Step-UP Substation Module (PS - 001.3)

Options

- Digital content (BI-01)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

PS - 004

Step-down Substation Protection Module

In the design of electrical power systems, the ANSI Standard Device Numbers ANSI/IEEE Standard denote what features a protective device supports such as a relay or circuit breaker. These types of devices protect electrical systems and components from damage when an unwanted event occurs, such as an electrical fault. Device numbers are used to identify the functions of devices. This module is used to introduce trainees to step down transformation from 380 VAC to 208 /VAC, in addition to controlling loads buses (loads transfer and bus coupling) using isolators and circuit breakers.



Specifications

- Directional active power protection (ANSI Standard: 32P)
- Negative sequence/ unbalanced voltage protection (ANSI Standard: 46)
- Non-directional definite-time overcurrent protection (ANSI Standard: 51P)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Technical Data

Directional active power protection (ANSI Standard: 32P)

» The protective reverse power relay will prevent a generator running in parallel with other generators from running as a motor («motoring») in case of lost prime mover torque, and will thus protect the prime mover.

» Ensure that the remaining generators connected to the system are not overloaded.

» Protects against reverse power due to an increase of the power of other generators connected to the system.

» The applied TDM (Time-Division-Multiplication) principle ensures an accurate measurement of the RMS value of the power (U × I × cos-φ), irrespective of wave form.

» Works with 3-wire and 4-wire connection.

» LED indication of fault condition

» Timer controlled tripping

» LED indication for activated relay

» Reverse power set point: (0…25%) of rated active power of synchronous generator

» Tripping time delay: 0…20sec

» Relay contact: Single change-over switch

» Contact ratings: 250V-8A (AC)

Negative sequence/ unbalanced voltage protection (ANSI Standard: 46)

» A three phase current balance protection relay continuously monitors a three phase AC current through current transformers, tripping upon an unbalanced load condition.

» The output relay trips when the monitored current is outside of the user adjustable limit and the LED ceases to illuminate indicating a fault condition.

» The relay also has a built-in time delay, used to avoid nuisance tripping.

» The output relay is set to de-energize in the unbalanced condition ensuring the protection relay is failsafe.

» The relay requires an auxiliary supply to operate.

» The unbalance trip point is adjustable from 3% to 20% of the nominal current

» The set point is adjusted through the front control knob.

» The time delay is adjustable from 0.1 to 10 seconds

» Relay output: Single change-over contact

» Contact rating: 250V AC, 5A (resistive)

Non-directional definite-time overcurrent protection (ANSI Standard: 51P)

» protection of generators against over-currents .

» The relay measures the highest of the 3-phase currents, providing an RMS measurement at sinusoidal currents.

» The measurement is based on average values for measured current.

» The set point values are set on the front of the relays by means of potentiometers.

» If a current exceeds a set point, the output is activated.

» If exceeded, a fault signal is generated, and the associated yellow LED is lit.

» Measurement of 3-phase currents

» LED indication of fault condition

» Timer-controlled tripping

» LED indication for activated relay

» When the set point is exceeded, its timer starts and will run as long as the fault condition prevails.

» If the fault disappears, the timer is reset. When the timer expires, the contact is activated and the associated red LED is lit.

» Over-current setting: 0.5 to 1.5 × In

» Tripping delay time for over-current: 0 to 20sec

» Number of contacts: Single change-over switch per relay type

» Contact ratings: 250 V AC/24 V DC, 8 A (200,000 change-overs at resistive load)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Experiments

- Directional Overcurrent Protection against upstream faults
- Protecting step down power transformer against overheating due to unbalanced load condition
- Relay coordination settings between protection relays

Scope of Delivery

- Step-down Substation Protection Module (PS - 004)

Options

- Digital content (BI-01)

Required for Operation

- Step-down Substation Module (PS - 001.6)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

BEDO
innovating education

The Egyptian Company for Developing Education Technologies **(BEDO)**





Transmission Line Module

PS - 005

Load Protection Module

In the design of electrical power systems, the ANSI Standard Device Numbers ANSI/IEEE Standard denote what features a protective device supports such as a relay or circuit breaker. These types of devices protect electrical systems and components from damage when an unwanted event occurs, such as an electrical fault. Device numbers are used to identify the functions of devices. This module introduces trainees to ways of protection of different types of loads (static & dynamics). It is connected before Loads Module and after Step Down Substation Protection Module.



Specifications

- Phase under voltage protection (ANSI Standard: 27P)
- Power factor / under power protection (ANSI Standard: 37P)
- Phase inversion protection (ANSI Standard: 47)
- Thermal overload protection (ANSI Standard: 49)
- Non-directional instantaneous overcurrent protection (ANSI Standard: 50P)
- Phase over-voltage protection (ANSI Standard: 59P)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Technical Data

Phase under voltage protection (ANSI Standard: 27P)

» Continuously monitors the three-phase output voltage of synchronous generator to warn against under-voltage condition during synchronization process

» If measured voltage moves below the set point limit, the relay contacts will change-over after the selected "Delay-OFF" has elapsed, giving an alarm or initiation signal.

» If voltage measured exceeds threshold (set point), the relay contacts will return to original state only after the reset time ("Delay-ON") has elapsed.

» Can be used in 3-wire and 4-wire network

» Offers user adjustable trip point (set point) and time delay settings.

» The set point adjustment for under-voltage is in the range of 25%

» As soon as the monitored signal moves outside of the set point limit, the time delay is activated, after which a trip will occur. The time delay prevents the relay from tripping for a predetermined period to prevent nuisance tripping.

» The relay is automatically reset once the monitored voltage rises above the set point.

» Adjustable off-delay: 0.1 …20sec

» Adjustable reset-delay: 0.1…20sec

» Adjustable under-voltage trigger range: 70% …95% (corresponding to 270V…370V AC)

» LED indicators for relay activation during under-voltage condition

» Relay output: Single change-over contact

» Contact rating: 250V AC, 8A

Power factor / under power protection (ANSI Standard: 37P)

» Load monitoring relay for under-power, over-power or window

» Works in 1-phase and 3-phase networks

» The operating states are indicated using colored LEDs:

- «U/t» LED: Supply voltage and starting override
- «MAX» LED: Upper threshold value
- «MIN» LED: Lower threshold value
- «I=0» LED: Load switched off
- «REL» LED: Output relay

» Mode of operation can be chosen using «FUNCTION» rotary switch

» Set of potentiometers to adjust:

- Response delay
- Lower threshold power factor value
- Upper threshold power factor value
- Starting override

» Adjustable starting override: 1…100sec

» Adjustable response delay: 0.1…40sec

» Input current range: 0.5…10A AC

» Max switching threshold P.F: 0.2 to 1

» Min switching threshold P.F: 0.1 to 0.99

» Operating voltage: 415V AC

» If the measured power factor exceeds the value set at the «MAX» controller, the set response delay (DELAY) starts (red «MAX» LED flashes). After the delay time has elapsed (red «MAX» LED is ON), output relay «R» drops out (yellow «REL» LED is OFF).

» If the measured power factor falls below the value set at the «MIN» controller (red «MAX» LED is OFF), output relay «R» picks up again (yellow «REL» LED is ON).

» If the error memory has been activated (OVER + LATCH) and the measured power factor has exceeded the value set at the «MAX» controller for longer than the set response delay, output relay «R» does not pick up if the power factor falls below the value set at the «MIN» controller. Once the error has been reset, output relay «R» picks up when the supply voltage is applied again and the measuring cycle starts again once the set starting override (START) has elapsed.

» Relay output: 2x changeover contacts

» Contact ratings: 250V-3A (AC)

Phase inversion protection (ANSI Standard: 47)

» Phase Sequence Relay monitors the order of 3 phases feeding motors.

» If R,S and T phases are in correct order, ON LED on the front panel is turned on.

» If the phase order is wrong, ON LED is turned off and the output relay is switched to OFF.

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

» Relay output: Single change-over switch
» Contact rating: 250V AC, 8A (resistive)

Thermal overload protection (ANSI Standard: 49)

» Differential thermal overload relay
» Phase failure sensitive
» Reset mode can either be manual or automatic.
» Pushbutton for simulating relay tripping
» Pushbutton for "Stop" and manual Reset
» Trip flag indicating overload relay tripped.
» Rated operational voltage: 0…400V AC
» Thermal protection adjustment range: 1.6A…2.5A AC
» Phase failure sensitivity tripping current: 130 % of "In" on two phase, the last phase at 0 current or 30 % of "In" on one phase, the others at "In".
» Auxiliary contact: 1 NO + 1 NC
» Tripping threshold: (1.14 +/- 0.06) x I**n**

Non-directional instantaneous overcurrent protection (ANSI Standard: 50P)

» This combined short circuit and over-current relay is applied for protection of generators against both over-currents and short circuit currents (I> and I>>).
» The relay measures the highest of the 3-phase currents, providing an RMS measurement at sinusoidal currents.
» The measurement is based on average values for I>, peak values for I>>
» The set point values are set on the front of the relays by means of potentiometers.
» If a current exceeds a set point, the output is activated.
» If exceeded, a fault signal is generated, and the associated yellow LED is lit.
» Measurement of 3-phase currents
» LED indication of fault condition
» Timer-controlled tripping
» LED indication for activated relay
» When the set point is exceeded, its timer starts and will run as long as the fault condition prevails.
» If the fault disappears, the timer is reset. When the timer expires, the contact is activated and the associated red LED is lit.
» Short circuit current setting: 1.0 to 4.0 × In
» Tripping delay time for short-circuit current: 0 to 1sec
» Over-current setting: 0.5 to 1.5 × In
» Tripping delay time for over-current: 0 to 20sec
» Number of contacts: Single change-over switch per relay type
» Contact ratings: 250 V AC/24 V DC, 8 A (200,000 change-overs at resistive load)

Phase over-voltage protection (ANSI Standard: 59P)

» Continuously monitors the three-phase output voltage of synchronous generator to warn against over-voltage condition to warn against over-excitation condition
» If measured voltage moves above the set point limit, the relay contacts will change-over after the selected "Delay-OFF" has elapsed, giving an alarm or initiation signal.
» If voltage measured falls below threshold (set point), the relay contacts will return to original state only after the reset time ("Delay-ON") has elapsed.
» Can be used in 3-wire and 4-wire network
» User can adjust trip point (set point) and time delay settings.
» The set point adjustment for over-voltage is in the range of 25%
» As soon as the monitored signal moves outside of the set point limit, the time delay is activated, after which a trip will occur. The time delay prevents the relay from tripping for a predetermined period to prevent nuisance tripping.
» The relay is automatically reset once the monitored voltage falls below the set point.
» Adjustable off-delay: 0.1 …20sec
» Adjustable reset-delay: 0.1…20sec
» Adjustable over-voltage trigger range: 105%…130% (corresponding to 410V…510V AC)
» LED indicators for relay activation during over-voltage condition
» Relay output: Single change-over contact
» Contact rating: 250V AC, 8A

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program

Experiments

- Preventing induction motor from rotating under no-load
- Under-power Overcurrent Protection of a Three-Phase Induction Motor
- Asymmetric voltage unbalance protection for three phase induction
- Prohibiting motor reverse rotation

Scope of Delivery

- Load Protection Module (PS - 005)

Required for Operation

- Three-phase Complex Load Module (PS-001.5)

Options

- Digital content (BI-01)

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program



Additional Options

Additional Options

BI - 01

Digital Content

Overview

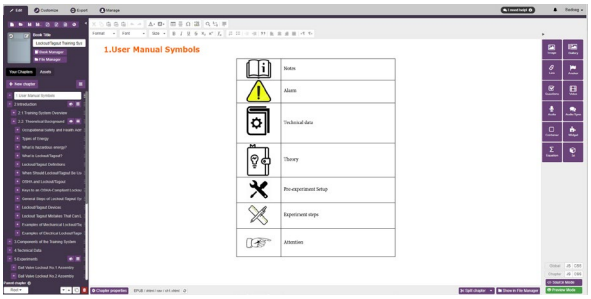
Digital content used in remote, hybrid and face-to-face instruction. Students interact with the content through synchronous and asynchronous learning on a device like a computer or even phones, it includes videos, charts, graphs, photos, and GIFS to grab learners' attention

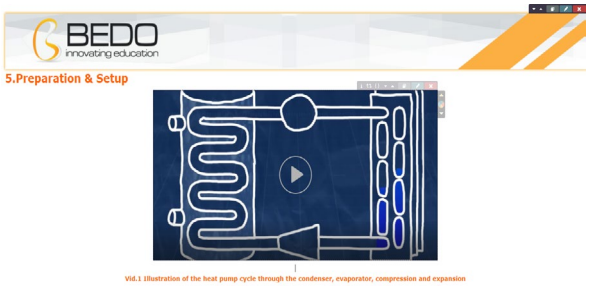


Specifications

- The digital content is easy to use and comprehend by students without the need of prior knowledge or experience.
- The provided digital content is supplied with interactive figure, videos and GIFS allowing users to get more in touch with the course content.
- The digital content supports engagement among students allowing them to interact with each other regarding the course content.
- The digital table of contents can be reached easily through the tab located at the side where students can navigate easily through the digital course.
- The digital content is compatible with different devices whether it's mobile phone, tablets or PC screens allowing users to easily access this content using any device.

BEDO ® reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program





Vid.1 Illustration of the heat pump cycle through the condenser, evaporator, compression and expansion



Vid.2 An illustration of the operation of heat pumps in summer mode and in winter mode

Software

Scope of Delivery

- Digital Content (BI-01)

+2 0106 739 9347
www.bedoeg.com
msamy@bedoeg.com
Lot 36, 4th Industrial Zone,
6th of October City, Giza, Egypt

