

**ERP-UB. Protection Relays Test Unit**  
(common for the relays modules type "ERP")

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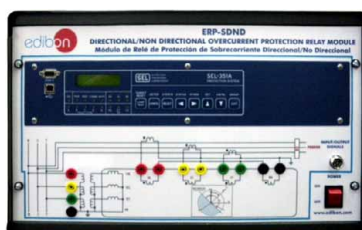


### Relays Modules

(for use with the Protection Relays Test Unit (ERP-UB))



**ERP-SFT. Overcurrent and Earth Fault Protection Relay Module**



**ERP-SDND. Directional/Non Directional Overcurrent Protection Relay Module**



**ERP-PDF. Differential Protection Relay Module**



**ERP-MA. Feeders Management Relay Module**



**ERP-PD. Distance Protection Relay Module**



**ISO 9000: Quality Management**  
(for Design, Manufacturing,  
Commercialization and After-sales service)



**European Union Certificate**  
(total safety)

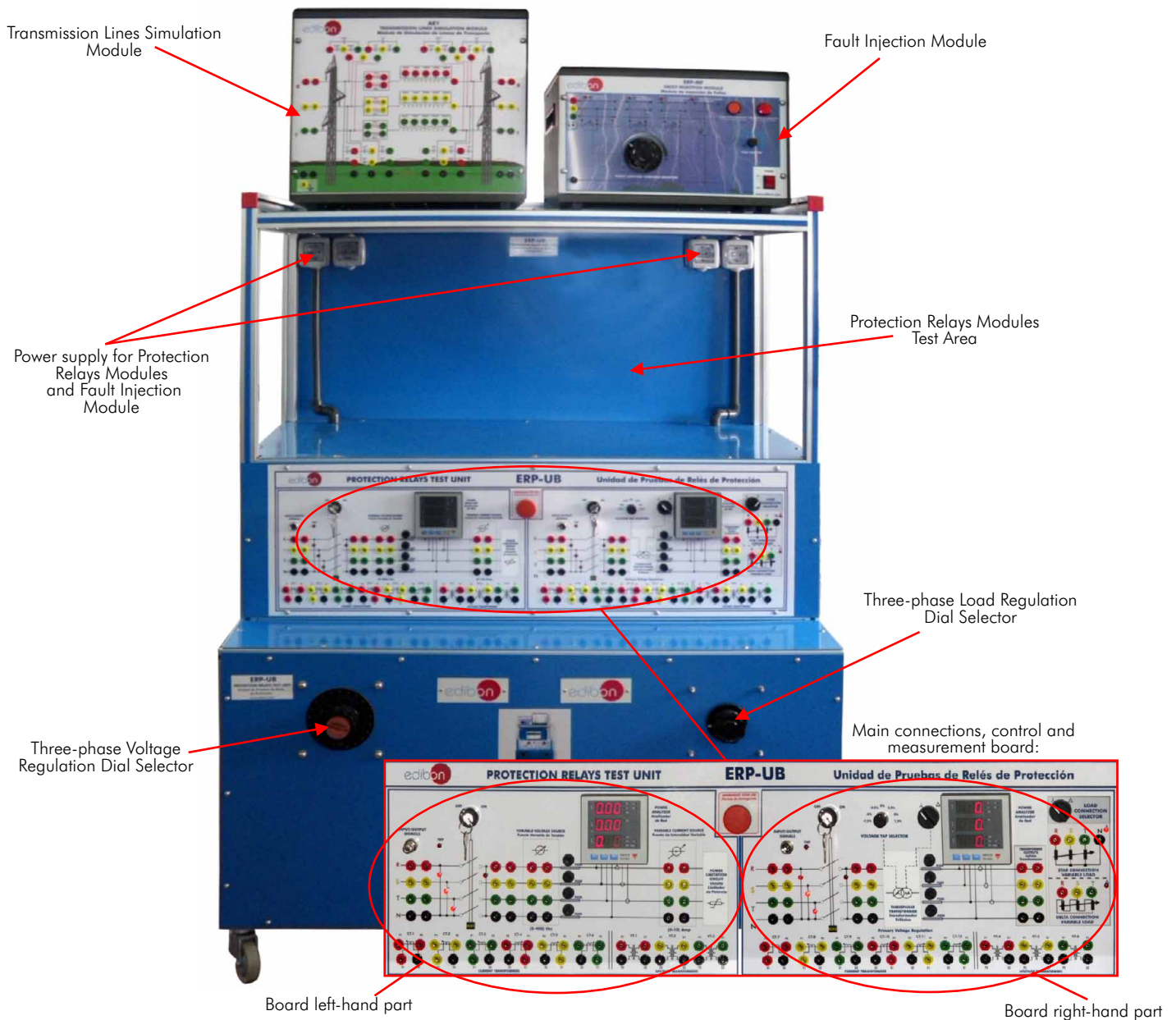


**Certificates ISO 14000 and ECO-Management and Audit Scheme**  
(environmental management)



**Worlddidac Quality Charter Certificate**  
(Worlddidac Member)

## ERP-UB. Protection Relays Test Unit



### DESCRIPTION

This is a teaching unit which gives students theoretical and practical experience with several industrial application relays.

The numerous devices, inputs and outputs, along with a modular structure, allow to use the ERP-UB for a wide range of protection applications simulation and real test of industrial application numerical relay system.

It includes experiments investigating earth fault, overcurrent, differential, directional, feeder management, overvoltage, undervoltage and distance numerical protection. The unit uses real industrial protection equipment and techniques.

This unit also covers relay setting and tripping characteristics, as well as grading and discrimination under fault conditions, and it allows students to compare individual relays characteristics and simultaneous comparison of any two relays to introduce the topic of discrimination and protection coordination.

Instrumentation, power supplies, power transformers, current transformers, voltage transformers and load resistors are incorporated in the unit and has an user-friendly desk space for users to work on.

The relays are housed in modern, portable enclosures.

The test unit will support up to two relays at once. These can be different relays or both the same type.

The relays are programmed either directly or using software, because this unit includes relays support software which enables users to program the relays modules on a suitable computer (computer no included) using software.

Student connect the relays to the console by plugging leads into terminals on the front panels, thus perform experiments and practices using the unit to set test conditions and control and monitor relay behaviour.

The unit and relay front panels have schematic diagrams which help users carry out and understand the experiments.

Each part of the ERP-UB is correctly identified in order to facilitate the operation and fast identification of installations problems.

ERP-UB unit designed for comprehensive investigations into the theory and practice of electrical power system protection.

This unit is common for the relays modules type "ERP" and can use one or more relays.

Floor-standing unit, mounted in anodized aluminium structure and panels in painted steel (epoxy paint), enabling wide range of protection relay investigations.

It uses genuine industrial application relays, not simulations, with full range of safety features incorporated throughout.

Diagrams on the unit enable students to set up and perform practices and experiments with minimal supervision.

Comprehensive controls, transformers, supplies and instrumentation.

Modern, ergonomic and practical design which includes desk space for users or students to work on, and mounting area for relays.

It is supplied with relay support software.

Selection of up-to-date numerical protection relays, specially adapted for educational use. (See available relays).

This Unit consists of this main parts:

Main connections, control and measurement board:

This board has two parts: left hand, right hand and common emergency stop switch in the centre of them.

Elements of the board left hand part:

Input/Output signals exchange connector and relay trip indicator.

Fixed three-phase voltage output terminals.

Power supply security connection key switch.

Second fixed three-phase voltage output terminals.

Variable three-phase voltage output terminals. (0-400 Vac).

Measurements power analyzer.

Variable three-phase current output terminals. (0-10 Amp.).

Six current transformers with transformation relation  $50/5$  CT = 10.

Three voltage transformers with transformation relation:

Primary =  $400/\sqrt{3}$ .

Secondary =  $110\sqrt{3}$ .

PT = Primary/Secondary = 3.64.

Emergency stop switch.

Elements of the board right hand part:

Input/Output signals exchange connector and relay trip indicator.

Fixed three-phase voltage output terminals.

Power supply security connection key switch.

Second fixed three-phase voltage output and transformer input terminals.

Transformer Primary Voltage Tap Changer® selector.

Transformer Secondary connection type selector. Wye/Star.

Measurements power analyzer.

Transformer three-phase voltage output terminals.

Load connection type selector. Wye/Star.

Wye and Star Load terminal connectors.

Six current transformers with transformation relation  $10/5$  CT = 2.

Three voltage transformers with transformation relation:

Primary =  $400/\sqrt{3}$ .

Secondary =  $110\sqrt{3}$ .

PT = Primary/Secondary = 3.64.

Emergency stop switch.

Three-phase Voltage Regulation Dial Selector.

Three-phase Load Regulation Dial Selector.

Unit Power Supply and Protection:

Three-phase Power Supply.

Current Source Overload Thermal Protection.

Left Board Part Magnetothermal Protection.

Right Board Part Magnetothermal Protection.

Left Board Part Voltage Measurement Circuit Protection.

Right Board Part Voltage Measurement Circuit Protection.

Control Circuits Magnetothermal Protection.

**Continue...**

**Transmission Lines Simulation Module:**

Module in steel box with carrying handles (dimensions: 490 x 450 x 470 mm. approx., weight: 10 Kg. approx.)

This module represents basic concepts of the Electric Energy high-voltage three-phase transmission lines operation. It simulates a value modifying concentrated parameter line that allows different configurations and consists on three conductor line (R, S, T) and a Neutral or return line (N).

Each of the phases is represented, following the concentrated parameters theoretical model, through a resistance series association and inductance, along with a parallel association between each one of them in a capacitance effect.

A way to reduce the earth short circuit current is to have impedance in the neutral-to-ground connections. This impedance has no repercussion in the normal functioning of the network but they introduce a repercussion in the increase of  $3 \times Z_0$  (impedance on the zero sequence component), which reduces the short circuit current.

The return line is simulated through small value impedance that has a resistive-inductive characteristic. To simplify the effect, being a despicable inductance, it will be simulated with a pure  $10 \Omega$  resistance.

The phases have two terminals at the input and two at the output, and they are connected at the interior. Through one of them the module will be supplied. Through the last one the natural circuit will continue to the load module, the bar module, the transformer, etc. There are additional terminals for assembly of protection relay or other parallel configurations.

The supply of this unit will be done through line terminals (R, S, and T) and the neutral (N) through a 400V three-phase supply and it will be controlled by an power-circuit breaker of 4 poles placed between the supply and the lines module.

In the phases we can distinguish different resistance and inductance values, being able to simulate different length transport lines.

The resistive part is formed by two resistance values of  $15 \Omega$  and  $33 \Omega$ , with the possibility of making parallel-series connections between them, obtaining two additions resistive values of  $10.31 \Omega$  and  $48 \Omega$ .

The inductive part consists on a multistage coil of despicable resistance. In which it is possible to choose one of the following values: 33 mH, 78 mH, 140 mH, 193 mH, 236 mH

The capacitive part will be divided into capacitance between conductors and capacitance between line and ground.

The capacitance between conductors is simulated with a pair of condensators at the beginning and at the end of the line with different values:  $0.5 \mu F$  and  $1 \mu F$  for each conductor.

The capacitance between conductor and ground is  $1 \mu F$  and  $2 \mu F$ , also at the beginning and at the end of the line.

With all this values it is possible to simulate a great number of line configurations, beginning with different line distances with different types of conductor, through the unbalanced lines with different conductors groups (Simplex, Duplex, Triplex and Cuadriplex). At the same time it is possible to simulate transient state with different short-circuits injection using the Fault Injection Module.

This module is protected with a grounding connection that comes from the metallic caging and that is accessible through a terminal in the front of the module.

**Fault Injection Module:**

Module in steel box with carrying handles (dimensions: 490 x 330 x 310 mm. approx, weight: 10 Kg.)

The module have the possibility to inject different kind of short-circuits, in any point of the ERP-UB including line module, directly or through a variable pure resistive element. Employing this element we can analyze the different protection elements functionality with different fault intensity.

The short-circuit injection possibility are:

Three-pole short-circuit.

Two-pole short-circuit.

Two-pole-ground short-circuit.

Single-pole-ground short-circuit.

Test circuits:

Configurable power transformer test circuit.

Configurable load test circuit.

Configurable measurement test circuit.

Relays test area.

**Cables and Accessories**, for normal operation.

**Manuals:**

This unit is **supplied with the following manuals**: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance, Software and Practices, including unit description and procedure.

**EXERCISES AND PRACTICAL POSSIBILITIES**

-A wide range of practices and investigations into the performance and characteristics of a variety of different industrial application relays.

**REQUIRED SERVICES**

- Electrical supply: 380/415 V three-phase and neutral electrical supply with 100 mAmp Ground differential protection.

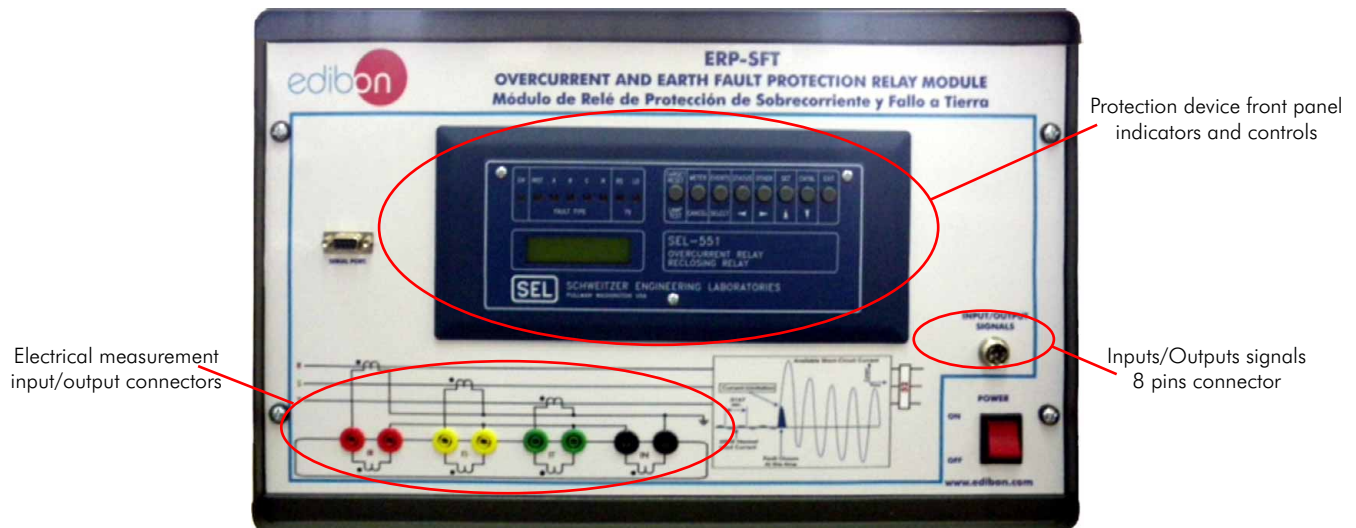
**DIMENSIONS AND WEIGHT**

- Dimensions: 1250 x 800 x 2000 mm. approx.

- Weight: 400 Kg. approx.



## ERP-SFT. Overcurrent and Earth Fault Protection Relay Module



### DESCRIPTION

For use with the Protection Relays Test Unit (ERP-UB), this relay enables investigations into protection and monitoring of transformers, transmission lines and distribution schemes.

The module mounts on the desk area of the Protection Relays Test Unit and by using a multi-core cable and safety leads connects to the test unit.

The relay is housed in a modern and robust enclosure (steel box) with carrying handles.

The relay module is based on the SEL-551/SEL-551C relay, enabling the students to set up different fault circuits on the Protection Relays Test Unit. Students will use the keypad and display on the relay module to programme it to the setting needed for the tests. They can also use the relay support software (supplied with the Protection Relays Test Unit) and computer (available separately, not included in the supply) to programme the relay module. The relay module is then connected to the fault circuits so test can be performed.

Facility to test two relay modules at the same time because there are enough connections on the Protection Relays Test Unit.

### SPECIFICATIONS

**ERP-SFT. Overcurrent and Earth Fault Protection Relay Module**, for use with the Protection Relays Test Unit (ERP-UB), to enable investigations into protection and monitoring of transformers, transmission lines and distribution schemes.

It enables a wide range of test and investigations and it demonstrates the latest relay technology.

Modern and robust enclosure (steel box) with carrying handles.

Modern industrial application overcurrent and earth fault relay presented in an educational and teaching format.

The connections are via safety sockets.

The main functions:

Phase Instantaneous Overcurrent (50P1 -50P6).

Phase Time-Overcurrent (51P1T, 51P2T).

Single-phase Instantaneous Overcurrent (50A, 50B, 50C).

Neutral Ground Instantaneous Overcurrent (50N1, 50N2).

Neutral Ground Time-Overcurrent (51N1T).

Residual Ground Instantaneous Overcurrent (50G1, 50G2).

Residual Ground Time-Overcurrent (51G1T).

Negative-Sequence Instantaneous Overcurrent (50Q1, 50Q2).

Negative-Sequence Time-Overcurrent (51Q1T, 51Q2T).

Setting Range, 5 A nominal, Instantaneous Overcurrent (OFF, 0.5-80.0 A).

Setting Range, 5 A nominal, Time- Overcurrent (OFF, 0.5-16.0 A).

One Auto-Reclosing Function 79.

Selectable blocking.

Circuit monitoring.

Trend, fault and disturbance records.

**Continue...**

The connection to the experimental circuit is via current transformers with ratio to suit the inputs of the relay.

It allows an effective demonstration of the effect of current and voltage transformer ratio, connection and rating on protective relays.

**Accuracy:**  $\pm 5\%$

**Current:** 5 A (A.C.)

**Frequency:** 50 or 60 Hz.

**Operating time:** typically 10 ms to 25 ms.

**Cables and Accessories,** for normal operation.

**Manuals:**

This unit is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance, Practices and connection information.

**EXERCISES AND PRACTICAL POSSIBILITIES**

Some Exercises and Practical Possibilities of the Unit:

- |   |  |
|---|--|
| 1.- Verification of Overcurrent Protection functionality.                 | 11.- Power Transformer Overcurrent Protection.         |
| 2.- Verification of Phase Overcurrent Elements.                           | 12.- Power Transmission Line Overcurrent Protection.   |
| 3.- Verification of Residual Ground Overcurrent Elements.                 | 13.- Load Feeder Overcurrent Protection.               |
| 4.- Verification of Phase Instantaneous Overcurrent Protection.           | 14.- Distribution System Overcurrent Protection.       |
| 5.- Verification of Phase Time-Overcurrent Protection.                    | 15.- Power Transmission System Overcurrent Protection. |
| 6.- Verification of Neutral Ground Instantaneous Overcurrent Protection.  |  |
| 7.- Verification of Neutral Ground Time-Overcurrent Protection.           |  |
| 8.- Verification of Residual Ground Instantaneous Overcurrent Protection. |  |
| 9.- Verification of Residual Ground Time-Overcurrent Protection.          |  |
| 10.- Verification of Current Transformer Measurement accuracy.            |  |

**REQUIRED SERVICES**

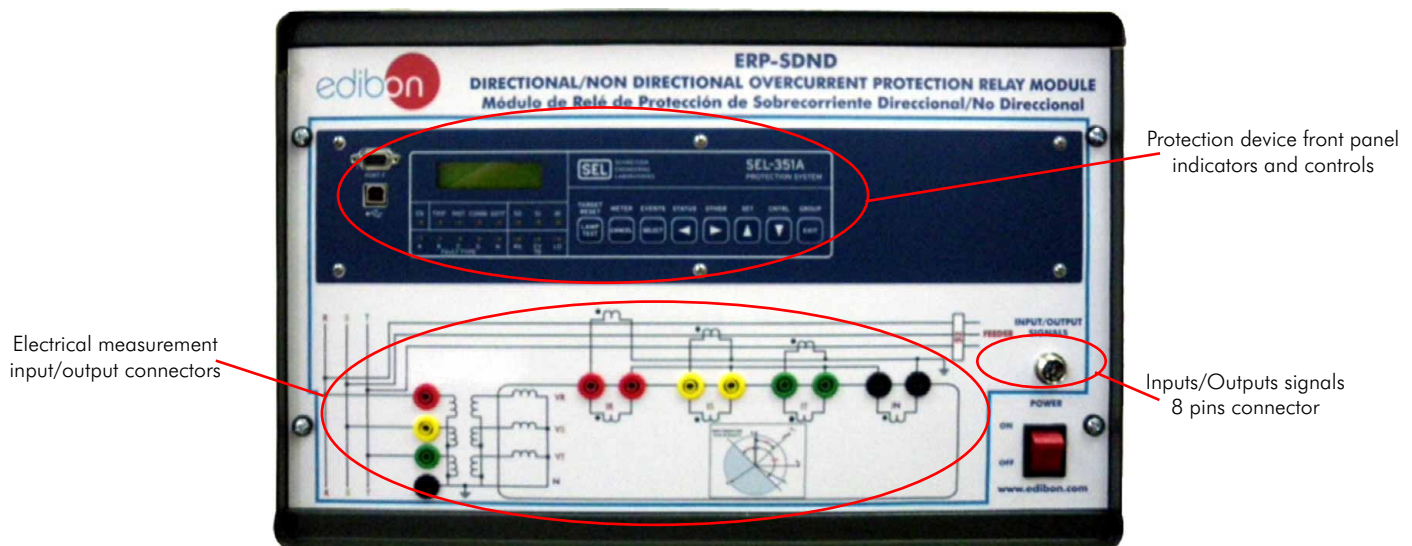
- Protection Relays Test Unit (ERP-UB).

**DIMENSIONS AND WEIGHT**

ERP-SFT Unit:

- Dimensions: 490 x 330 x 310 mm. approx.
- Weight: 10 Kg. approx.

## ERP-SDND. Directional/Non Directional Overcurrent Protection Relay Module



### DESCRIPTION

A directional/non-directional overcurrent relay presented in an educational and teaching format.

For use with the Protection Relays Test Unit (ERP-UB), this relay enables investigations into protection and monitoring of generator and transformer schemes, overhead lines, underground cables and backup on high-voltage systems.

The module mounts on the desk area of the Protection Relays Test Unit and by using a multi/core cable and safety leads connects to the test unit.

The relay is housed in a modern and robust enclosure (steel box) with carrying handles.

The relay module is based on the SEL-351 industrial application relay, enabling the students to set up different fault circuits on the Protection Relays Test Unit. Students will use the keypad and display on the relay module to programme it to the setting needed for the tests. They can also use the software (supplied with the Protection Relays Test Unit) and computer (available separately, not included in the supply) to programme the relay module. The relay module is then connected to the fault circuits so test can be performed.

Tests are performed using single relay, but there is the facility to test two relay modules at the same time because there are enough connections on the Protection Relays Test Unit.

### SPECIFICATIONS

**ERP-SDND. Directional/Non Directional Overcurrent Protection Relay Module, for use with the Protection Relays Test Unit (ERP-UB), to enable investigations into protection and monitoring of generator and transformer schemes, overhead lines, underground cables and backup on high-voltage systems.**

**It enables a wide range of test and investigations and it demonstrates the latest relay technology.**

**Modern and robust enclosure (steel box) with carrying handles.**

**Modern industrial application directional/non directional overcurrent relay presented in an educational and teaching format.**

**The connections are via safety sockets.**

**The main functions:**

The ERP-SDND Unit includes numerous phase, negative-sequence, residual-ground, and neutral overcurrent elements, as shown in the next table.

Overcurrent Element Operating Quantity	Number of Elements	Directional Control	Torque Control	Definite-Time Delay
Maximum phase current (IA, IB, or IC)	1 inverse-time (51P) 6 instantaneous (50P1-50P6)	Yes Yes, on first 4	Yes Yes, on first 4	NA Yes, on first 4
Maximum phase-phase current (IAB, IBC, or ICA)	4 instantaneous (50PP1-50PP4)	No	No	No
Independent phase current	3 inverse-time (51A, 51B, 51C)	Yes	Yes	NA
Residual-ground current (3I0)	2 inverse-time (51G1, 51G2) 6 instantaneous (50G1-50G6)	Yes Yes, on first 4	Yes Yes, on first 4	NA Yes, on first 4
Negative-sequence current (3I2)	1 inverse-time (51Q) 6 instantaneous (50Q1-50Q6)	Yes Yes, on first 4	Yes Yes, on first 4	NA Yes, on first 4
Neutral current (IN)	1 inverse-time (51N) 6 instantaneous (50N1-50N6)	Yes Yes, on first 4	Yes Yes, on first 4	NA Yes, on first 4

**Continue...**

Inverse-time overcurrent element settings include a wide and continuous pickup current range, continuous time-dial setting range, and time-current curve choices from both US (IEEE) and IEC standard curves shown in the next table.

<b>IEEE</b>	<b>IEC</b>
Moderately Inverse (U1)	Standard Inverse (C1)
Inverse (U2)	Very Inverse (C2)
Very Inverse (U3)	Extremely Inverse (C3)
Extremely Inverse (U4)	Long-Time Inverse (C4)
Short-Time Inverse (U5)	Short-Time Inverse (C5)

**Undervoltage Protection Element (27).**

**Phase Overvoltage Protection Element (59P).**

**Ground Overvoltage Protection Element (59G).**

**Negative Sequence Overvoltage Protection (59Q).**

**Creating fault and disturbance records.**

**Selectable blocking.**

**Sellogic Control Equations.**

**Event Report.**

**Sequential Events Recorder (SER).**

**Breaker Wear Monitor.**

**Station Battery Monitor.**

**DNP3 Serial LAN/WAN Outstation (Slave).**

**Modbus RTU and TPC.**

**High-Accuracy Metering.**

**Remote and Local Control Switches.**

**Wye or Delta Voltage Connection.**

**Synchrophasor Measurements.**

**Fault Locator.**

**Fast SER Protocol.**

**Directional/Definite-Time Overcurrents Elements.**

**Two Residual-Ground Time-Overcurrents Elements.**

**Six Frequency Elements.**

**Sensitive Earth Fault Protection and Directional Protection for Various System Grounding Practices.**

**Load-Encroachment Logic.**

**Synchronism Check.**

**ACSELERATOR QuickSet Compatible.**

The connection to the experimental circuit is via current transformers with ratio to suit the inputs of the relay.

It allows an effective demonstration of the effect of current and voltage transformer ratio, connection and rating on protective relays.

**Accuracy: + - 10%.**

**Current: 5 A (A. C.).**

**Frequency: 50 or 60 Hz.**

**Operating time: typically 10 ms to 25 ms.**

**Cables and Accessories,** for normal operation.

**Manuals:**

This unit is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance, Practices and connection information.



## EXERCISES AND PRACTICAL POSSIBILITIES

### Some Exercises and Practical Possibilities of the Unit:

- |  |  |
|--|--|
| 1.- Verification of Directional Protection functionality.                                    | 12.- Verification of Voltage Transformers Measurements accuracy. |
| 2.- Directional Protection with different measurement circuit conditions.                    | 13.- Distribution System Directional Protection.                 |
| 3.- Directional Protection application to Transmission Line under different load conditions. |  |
| 4.- Forward Directional Protection.  |  |
| 5.- Reverse Directional Protection.  |  |
| 6.- Non-Directional Overcurrent Protection.  |  |
| 7.- Residual Ground Time-Overcurrent Protection.   |  |
| 8.- Residual Ground Instantaneous Overcurrent Protection.                                    |  |
| 9.- Verification of Cable Undervoltage Protection.   |  |
| 10.- Verification of Cable Overvoltage Protection.   |  |
| 11.- Verification of Current Transformers Measurements accuracy.                             |  |

## REQUIRED SERVICES

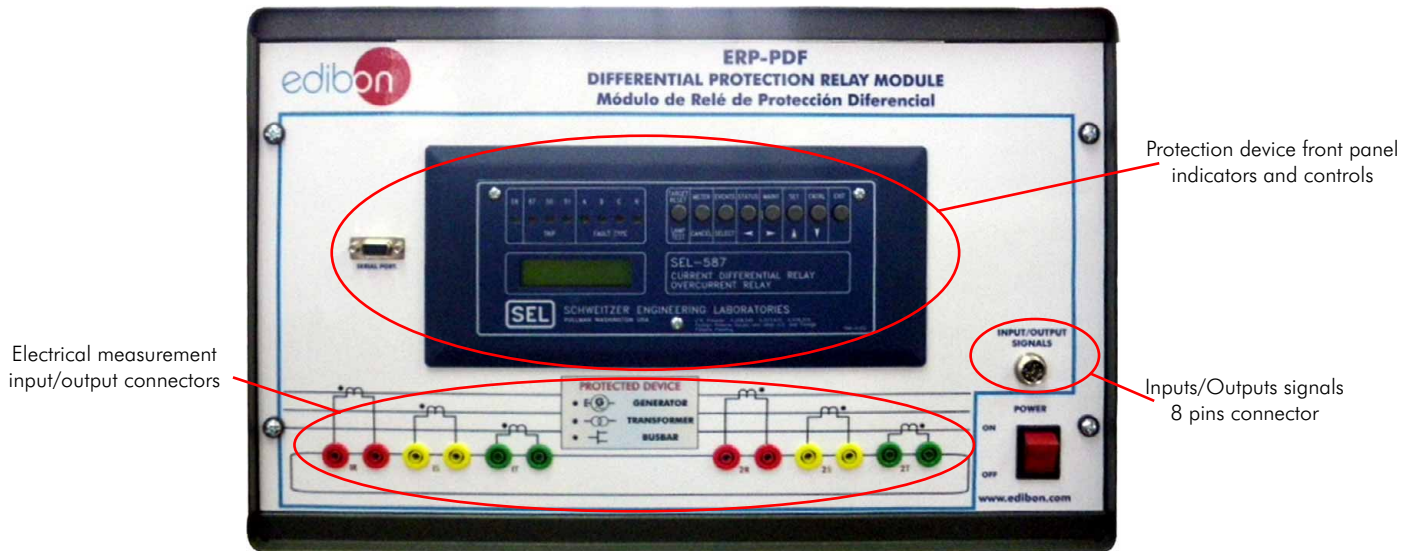
- Protection Relays Test Unit (ERP-UB).

## DIMENSIONS AND WEIGHT

### ERP-SDND Unit:

- Dimensions: 490 x 330 x 310 mm. approx.
- Weight: 10 Kg. approx.

## ERP-PDF. Differential Protection Relay Module



### DESCRIPTION

This ERP-PDF. Differential Protection Relay Module has to be used with the Protection Relays Test Unit (ERP-UB), and it enables investigations into protection of transformers, autotransformers, generators, Bus Bar and other apparatus with two windings.

A digital differential protection relay presented in an educational and teaching format.

The relay clearly demonstrates the characteristics of three-phase differential protection, and includes high stability during 'out-of-zone' faults, high-speed operation, zero-sequence current filtering for each winding, magnetising inrush restraint, amplitude and vector matching.

The module mounts on the desk area of the Protection Relays Test Unit and by using a multi-core cable and safety leads connects to the test unit.

The relay is housed in a modern and robust enclosure (steel box) with carrying handles.

The relay module is based on the SEL-587 industrial application relay, enabling the students to set up different fault circuits on the Protection and Relay Test Unit. Students will use the keypad and display on the relay module to programme it to the setting needed for the tests. They can also use the software (supplied with the Protection Relays Test Unit) and computer (available separately, not included in the supply) to programme the relay module. The relay module is then connected to the fault circuits so test can be performed.

Most tests are performed using single relays. However, there are enough connections on the Protection and Relay Test Unit to test two relay modules at the same time.

### SPECIFICATIONS

ERP-PDF. Differential Protection Relay Module, for use with Protection Relays Test Unit (ERP-UB), to enable investigations into protection of transformers, autotransformers, generators, Bus Bar and other apparatus with two windings.

It enables a wide range of test and investigations and it demonstrates the latest relay technology.

It demonstrates the characteristics of three-phase differential protection.

Modern and robust enclosure (steel box) with carrying handles.

Modern industrial application differential protection relay presented in an educational and teaching format.

The connections are via safety sockets.

The main functions:

<b>Eight Overcurrent Elements for Winding 1</b>	<b>Instantaneous</b>	<b>Definite Time</b>	<b>Inverse Time</b>
Phase	50P1H	50P1	51P1
Negative Sequence		50Q1	51Q1
Residual	50N1H	50N1	51N1
<b>Eight Overcurrent Elements for Winding 2</b>	<b>Instantaneous</b>	<b>Definite Time</b>	<b>Inverse Time</b>
Phase	50P2H	50P2	51P2
Negative Sequence		50Q2	51Q2
Residual	50N2H	50N2	51N2
Setting Ranges, 5 A Model, (A secondary)	OFF, (0.5-80)	OFF, (0.5-80)	OFF, (0.5-16)

Continue...

Sellogic Control Equations.

Event Reports.

ASCII, Bynari, and Distributed Port Switch Communications.

Phase, Ground, Negative-Sequence, Differential and Harmonic Metering.

Restrained and Unrestrained Differential Elements.

Second- and Fourth Harmonic Restraint.

Fifth-Harmonic and DC Blocking.

CT and Transformer Connection Compensation.

Connection to the primary and secondary windings of the experimental is circuit via current transformers with ratio to suit the inputs of the relay. This provides an effective demonstration of the effect of current and voltage transformer ratio, connection and rating on protective relays.

Accuracy: + - 5%.

Current: 5 A (A. C.)

Frequency: 50 or 60 Hz.

Operating time: typically 10 ms to 25 ms.

Cables and Accessories, for normal operation.

**Manuals:**

This unit is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance, Practices and connection information.

## EXERCISES AND PRACTICAL POSSIBILITIES

Some Exercises and Practical Possibilities of the Unit:

- |   |   |
|---|---|
| 1.- Verification of Differential Protection functionality.                              | 12.- Distribution Substation Bus-Bar Differential Protection. |
| 2.- Transformer Differential Protection with variable TAP's voltage regulation.         | 13.- Transmission Substation Bus-Bar Differential Protection. |
| 3.- Transformer Differential Protection with different transformer connection diagrams. | 14.- Analysis of Event Reports and Human Machine Interface.   |
| 4.- Verification of Phase Instantaneous Overcurrent Protection for Winding 1.           |   |
| 5.- Verification of Phase Definite Time-Overcurrent Protection for Winding 1.           |   |
| 6.- Verification of Phase Inverse Time-Overcurrent Protection for Winding 1.            |   |
| 7.- Verification of Phase Instantaneous Overcurrent Protection for Winding 2.           |   |
| 8.- Verification of Phase Definite Time-Overcurrent Protection for Winding 2.           |   |
| 9.- Verification of Phase Inverse Time-Overcurrent Protection for Winding 2.            |   |
| 10.- Verification of Current Transformers Measurement accuracy.                         |   |
| 11.- Power Transformer Overcurrent Protection.  |   |

## REQUIRED SERVICES

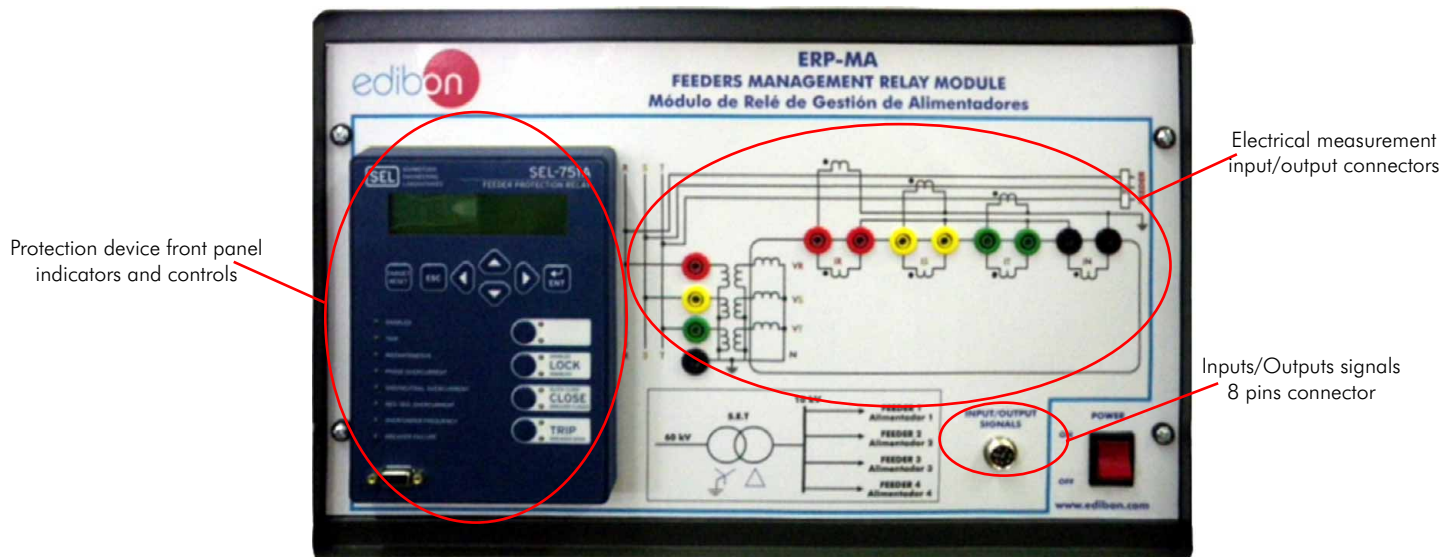
- Protection Relays Test Unit (ERP-UB).

## DIMENSIONS AND WEIGHT

ERP-PDF Unit:

- Dimensions: 490 x 330 x 310 mm. approx.
- Weight: 10 Kg. approx.

## ERP-MA. Feeders Management Relay Module



### DESCRIPTION

Feeders Management Relay Module for use with Protection Relays Test Unit (ERP-UB), which enables investigations into protection and monitoring of overhead lines, underground cables and feeders.

The module mounts on the desk area of the Protection Relays Test Unit and by using a multi-core cable and safety leads connects to the test unit.

The relay is housed in a modern and robust enclosure (steel box) with carrying handles.

The relay module is based on the SEL-751 industrial application relay, enabling the students to set up different fault circuits on the Protection Relays Test Unit. Students will use the keypad and display on the relay module to programme it to the setting needed for the tests. They can also use the software (supplied with the Protection Relays Test Unit) and computer (available separately, not included in the supply) to programme the relay module. The relay module is then connected to the fault circuits so test can be performed.

Tests are performed using single relay, but there is the facility to test two relay modules at the same time because there are enough connections on the Protection Relays Test Unit.

### SPECIFICATIONS

ERP-MA. Feeders Management Relay Module, for use with the Protection Relays Test Unit (ERP-UB), to enable investigations into protection and monitoring of overhead lines, underground cables and feeders.

It enables a wide range of test and investigations and it demonstrates the latest relay technology.

Modern and robust enclosure (steel box) with carrying handles.

Modern industrial application feeder management relay presented in an educational and teaching format.

The connections are via safety sockets.

The main functions:

Four levels of Phase Instantaneous Overcurrent Element (50P).

Four levels of Negative-Sequence Overcurrent Element (50Q).

Four levels of Residual Overcurrent Element (50G).

Four levels of Neutral Overcurrent Element (50G).

Two levels of Phase Time-Overcurrent Element (51P).

Two levels of Residual Time-Overcurrent Element (51G).

Two levels of Ground Time-Overcurrent Element (51G).

One level of Negative-Sequence Time-Overcurrent Element (51Q).

Phase to Ground Overvoltage (59G).

Phase to Phase Overvoltage (59P).

Negative-Sequence Overvoltage (59Q).

Residual Overvoltage (59G).

Phase to Ground Undervoltage (27G).

Phase to Phase Undervoltage (27P).

Continue...

Six levels of Secure Overfrequency (81O).

Six levels of Secure Underfrequency (81U).

Two levels of Negative Power Flow with Definite Time Delay (32).

Two levels of Positive Power Flow with Definite Time Delay (32).

Station Battery Monitor.

Breaker Wear Monitoring.

Synchrophasor Protocol.

Peak Demand and Demand Metering.

Auto-Reclosing.

Creating fault and disturbance records.

The connection to the experimental circuit is via current transformers with ratio to suit the inputs of the relay.

It allows an effective demonstration of the effect of current and voltage transformer ratio, connection and rating on protective relays.

Accuracy:  $\pm 10\%$ .

Current: 5 A (A. C.)

Frequency: 50 or 60 Hz

Operating time: typically 10 ms to 25 ms.

Cables and Accessories, for normal operation.

**Manuals:**

This unit is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance, Practices and connection information.

## EXERCISES AND PRACTICAL POSSIBILITIES

Some Exercises and Practical Possibilities of the Unit:

- |  |  |
|--|--|
| 1.- Verification of the Feeder Management Relay functionality.         | 14.- Verification of Negative (reverse) Power Flow Protection Element. |
| 2.- Phase Overcurrent Element of the Feeder Management Relay.          | 15.- Protection of Distribution Feeder Example.                        |
| 3.- Residual Ground Overcurrent Element of the Feeder Management Relay | 16.- Protection of Overhead Transmission Line Example.                 |
| 4.- Overvoltage Element of the Feeder Management Relay                 |  |
| 5.- Undervoltage Element of the Feeder Management Relay.               |  |
| 6.- Verification of Phase Instantaneous Overcurrent Protection.        |  |
| 7.- Verification of Phase Time-Overcurrent Protection.                 |  |
| 8.- Verification of Residual Overcurrent Element.                      |  |
| 9.- Verification of Residual Time-Overcurrent Element.                 |  |
| 10.- Verification of Neutral Overcurrent Element.                      |  |
| 11.- Verification of Overfrequency Protection Element.                 |  |
| 12.- Verification of Underfrequency Protection Element.                |  |
| 13.- Verification of Positive (forward) Power Flow Protection Element. |  |

## REQUIRED SERVICES

- Protection Relays Test Unit (ERP-UB).

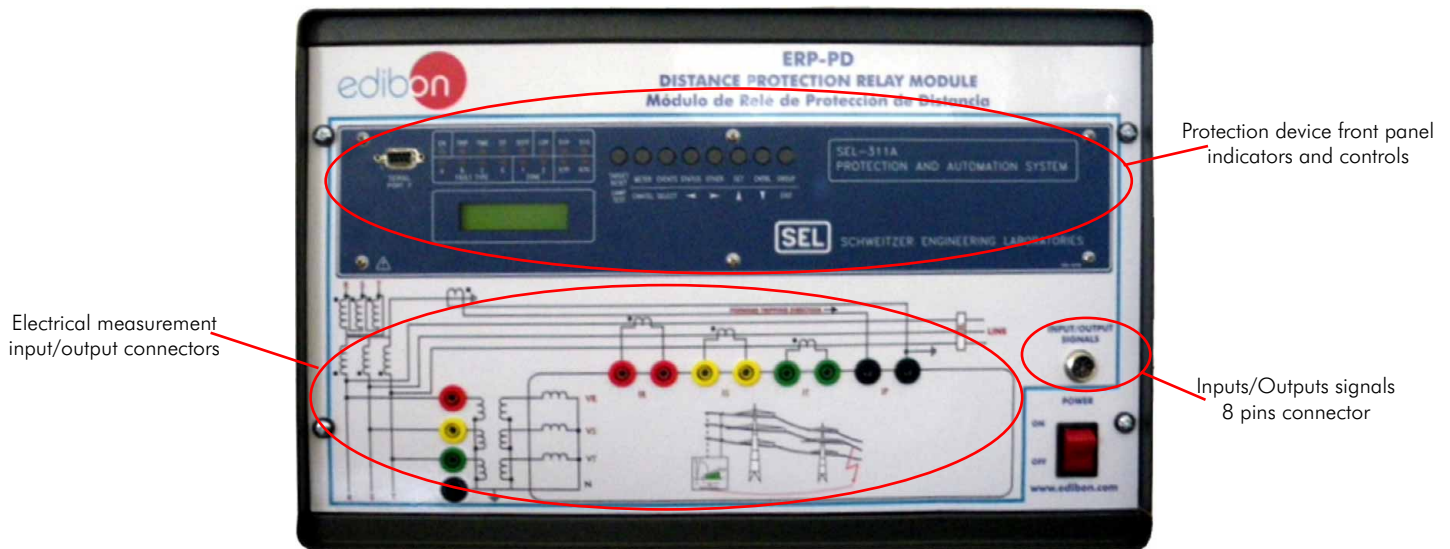
## DIMENSIONS AND WEIGHT

ERP-MA Unit:

- Dimensions: 490 x 330 x 310 mm. approx.
- Weight: 10 Kg. approx.



## ERP-PD. Distance Protection Relay Module



### DESCRIPTION

ERP-PD. Distance Protection Relay Module, for use with the Protection Relays Test Unit (ERP-UB), enables investigations into protection and monitoring of overhead transmission lines and underground cables.

The module mounts on the desk area of the Protection Relays Test Unit and by using a multi-core cable and safety leads connects to the test unit.

The relay is housed in a modern and robust enclosure (steel box) with carrying handles.

The relay module is based on the SEL-311 industrial application relay, enabling the students to set up different fault circuits on the Protection Relays Test Unit. Students will use the keypad and display on the relay module to programme it to the setting needed for the tests. They can also use the software (supplied with the Protection Relays Test Unit) and computer (available separately, not included in the supply) to programme the relay module. The relay module is then connected to the fault circuits so test can be performed.

Tests are performed using single relay, but there is the facility to test two relay modules at the same time because there are enough connections on the Protection Relays Test Unit.

### SPECIFICATIONS

For use with the Protection Relays Test Unit (ERP-UB), to enable investigations into protection and monitoring of overhead transmission lines and underground cables.

It enables a wide range of test and investigations and it demonstrates the latest relay technology.

Modern and robust enclosure (steel box) with carrying handles.

Modern industrial application distance protection relay presented in an educational and teaching format.

The connections are via safety sockets.

The main functions:

- Two zones of Phase Mho Distance Protection Element (21P).
- Two zones of Ground Mho Distance Protection Element (21G).
- Directional Phase Overcurrent Protection Element (67P).
- Directional Ground Overcurrent Protection Element (67G).
- Phase Overcurrent Protection Element (50P).
- Ground Overcurrent Protection Element (50G).
- Phase Time-Overcurrent Protection Element (51P).
- Ground Time-Overcurrent Protection Element (51G).
- Event Reports.
- Breaker Wear Monitor.
- Fault Locator.
- Local Display.
- Synchronphasors.
- Load Encroachment.
- Metering and Monitoring Functions.

**Continue...**

Creating fault and disturbance records.

Blocking of any one protection element.

The connection to the experimental circuit is via current transformers with ratio to suit the inputs of the relay.

It allows an effective demonstration of the effect of current and voltage transformer ratio, connection and rating on protective relays.

Accuracy:  $\pm 10\%$ .

Current: 5 A (A. C.).

Frequency: 50 or 60 Hz.

Operating time: typically 10 ms to 25 ms.

**Cables and Accessories**, for normal operation.

**Manuals:**

This unit is **supplied with the following manuals**: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance, Practices and connection information.

**EXERCISES AND PRACTICAL POSSIBILITIES**

Some Exercises and Practical Possibilities of the Unit:

- |  |  |
|--|--|
| 1.- Verification of Line Distance Protection functionality.  | 12.- Overhead Transmission Line Distance Protection.     |
| 2.- Line Distance Protection with different measurement circuit conditions.                                    | 13.- Distance Protection Event Reports Analysis.         |
| 3.- Line Distance Protection with different Line Loads conditions.   | 14.- Distance Protection Relay Human Machine Interface.  |
| 4.- Verification of Phase Instantaneous Overcurrent Element.   | 15.- Distance Protection Relay Configuration.            |
| 5.- Verification of Ground Instantaneous Overcurrent Element.  | 16.- Distance Protection of Simple Power System Example. |
| 6.- Verification of Phase Time-Overcurrent Protection Element.   |  |
| 7.- Verification of Ground Time-Overcurrent Protection Element.  |  |
| 8.- Verification of Current Transformer Measurement accuracy.  |  |
| 9.- Verification of Current Transformers Connection Diagram.   |  |
| 10.- Verification of Voltage Transformers Measurement Accuracy and Connection Diagram for Distance Protection. |  |
| 11.- Overhead Transmission Line Parameters Estimation for Distance Protection.                                 |  |

**REQUIRED SERVICES**

- Protection Relays Test Unit (ERP-UB).

**DIMENSIONS AND WEIGHT**

ERP-PD Unit:

- Dimensions: 490 x 330 x 310 mm. approx.
- Weight: 10 Kg. approx.

\* Specifications subject to change without previous notice, due to the convenience of improvements of the product.



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REPRESENTATIVE: