

# RefleX Protection and Control

RefleX - 2005

**Medium voltage impedance protection**  
**Full scheme measuring system**  
**3+1 measuring zones**  
**Teleprotection schemes**  
**Single-pole trip**



Impedance protection  
Single-pole trip  
Model 2005

## Application

The RefleX medium voltage impedance relay is designed to protect medium-voltage and high-voltage power lines and other types of HV equipment like transformers etc. The relay is extremely easy to use, and its setting tools and menus are especially designed to enable easy setting and quick, cost-efficient operation.

## Measurement

The relay includes four measuring zones, all with characteristics of the quadrilateral type

The three first zones Z1, Z2 and Z3 can be independently set forward, backward, non-directional or off.

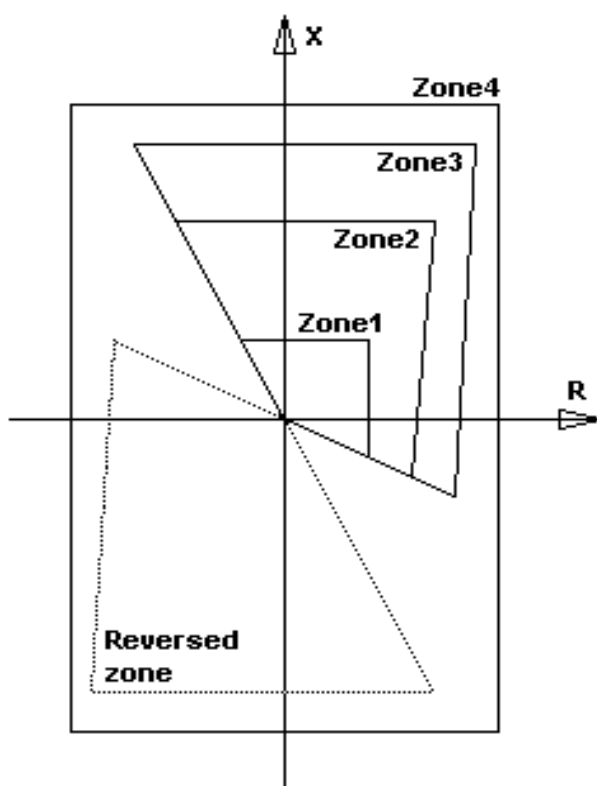
Where a zone is directional two additional blinders are added to limit the operation to forward or reverse faults.

Independent settings for the R-blinder reach and angle enables excellent control towards load resistance.

Each of the four zones has six measuring elements, connected to measure one of the six loop impedances.

Operation of each zone and each element is totally independent and is calculated by the software. The relay therefore forms a true "full scheme" unit.

In addition to phase selector operation increased  $3I_0$  (EF current) or increased  $3U_0$  (EF voltage) are used as starting criteria for the phase-ground impedance measuring loops.



## Voltage memory and cross-polarization

To ensure correct directional measurement during 3-phase close-up faults a 4-cycle post-fault memory is used. During unsymmetrical faults cross-polarization is applied to enable undisturbed directional measurement.

## Teleprotection - Permissive Underreach (PUR)

A PUR teleprotection scheme is integrated in the relay. When the relay receives a carrier signal from the opposite line-end, the Zone2 is accelerated (Z2 delay is bypassed) to enable fast tripping. This scheme allows for fast tripping during far-end line-faults in interconnected power systems.

The relay will send a carrier signal to the opposite line-end during Zone 1 faults.

## **Teleprotection - Permissive Overreach (POR) with current reversal guard**

A POR teleprotection scheme is integrated in the relay. When the relay receives a carrier signal from the opposite line-end, Zone2 is accelerated (Z2 delay is bypassed) to enable fast tripping. This scheme allows for fast tripping during far-end line-faults in interconnected power systems. The relay will send a carrier signal to the opposite line-end during Zone 2 faults or when the circuit breaker is open.

A current reversal guard will prevent the healthy line from tripping in a faulted parallel feeder circuit.

## **Switch On To Fault (SOTF)**

When the SOTF logic is primed, it will remove the directional check from the Zone2 measurement and make the zone non-directional. The SOTF signal will also bypass the Zone2 time delay. This ensures that the relay can trip instantaneously when switched on (from dead) to a zero voltage fault at the relay point.

The function can be activated either by internal measurement or by an external signal.

## **Power Swing Blocking (PSB)**

When the PSB unit detects a power swing and operates, and one or more zones are selected for blocking, all 6 elements in the selected zone or zones will be prevented from operating.

## **Voltage Transformer Supervision (VTS)**

When the VTS unit detects a faulty VT supply and operates, and the user has selected VTS blocking, all 6 elements in each zone will be prevented from operation.

The function can be activated either by internal measurement or by external activation (MCB contact).

## **Watchdog functions (system supervision)**

The supervision function will alert the user by turning the green LED off and by closing the WatchDog contact (C17-C18):

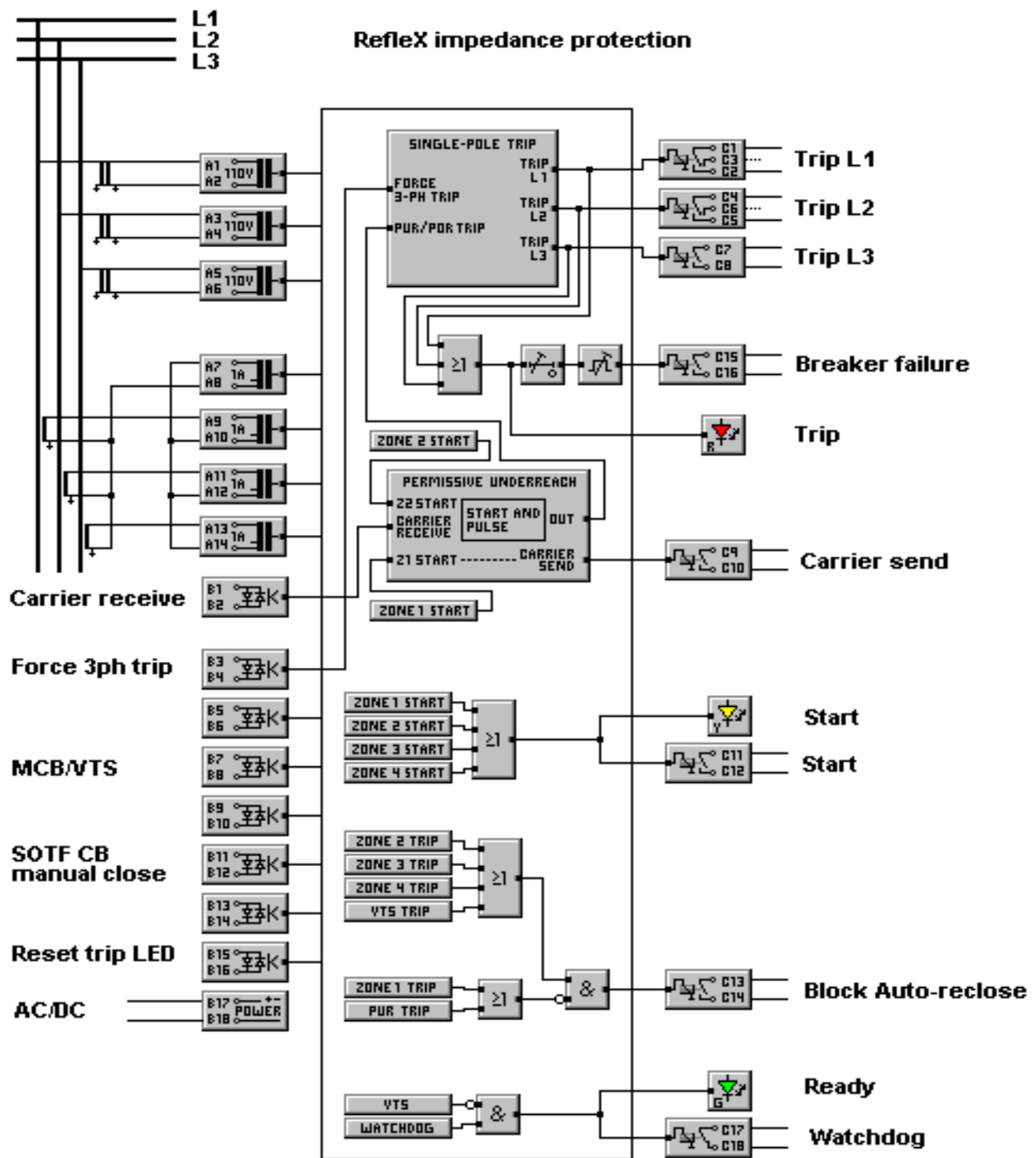
- When power supply is interrupted for more than 100ms

- When a fault occurs in one or more of the relay processors or memory.

- After VTS detection

# RefleX medium voltage Impedance Protection

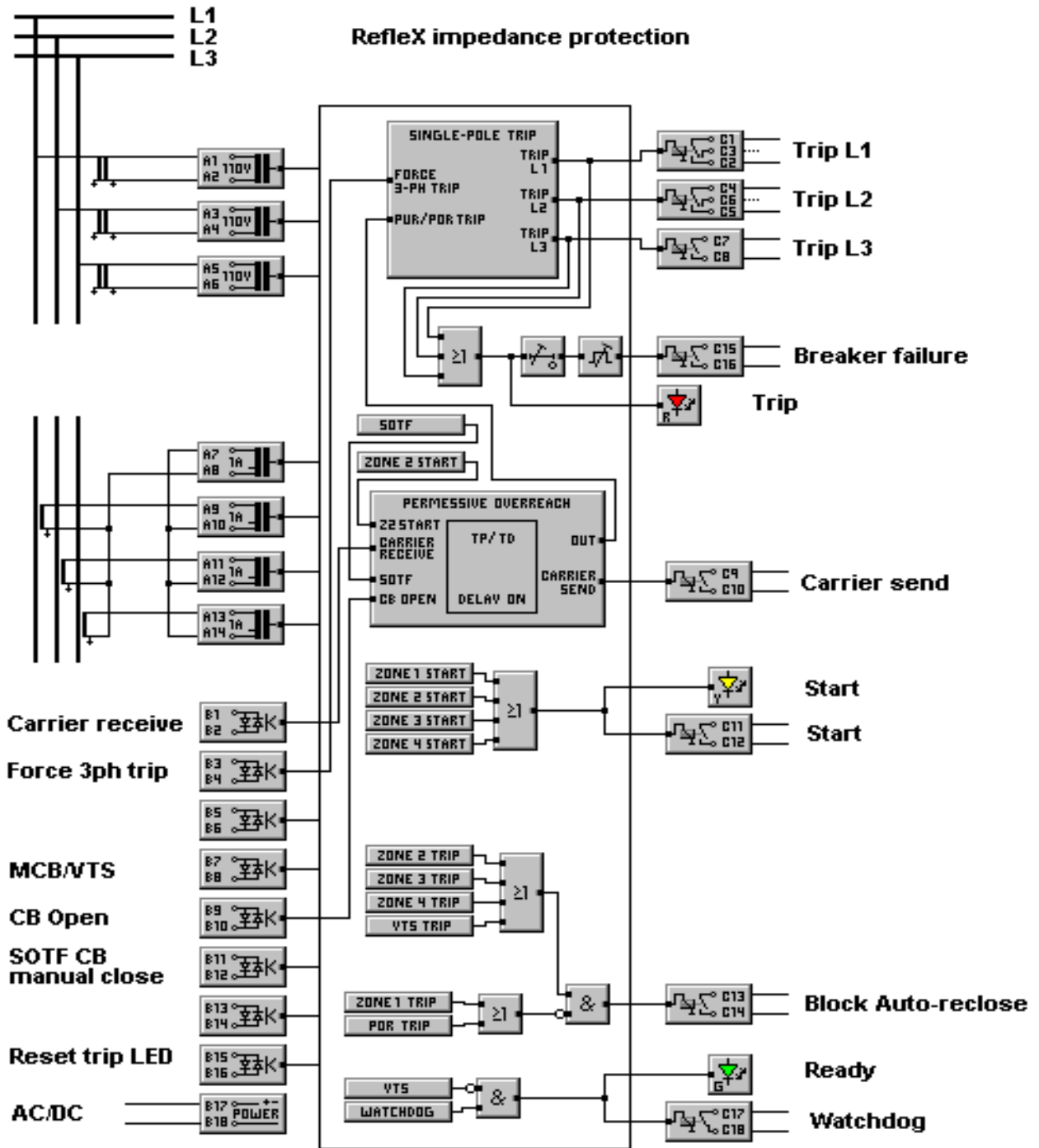
## Input/output logic diagram with PUR teleprotection



File: 2005\_PRD\_PURb.bmp

# RefleX medium voltage Impedance Protection

## Input/output logic diagram with POR teleprotection



File: 2005\_PRD\_100b\_POR.bmp

# RefleX medium voltage Impedance Protection

<b>Impedance relay</b>	
I1	124A
I2	120A
I3	123A

<b>Trip records</b>
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(A separate description of the sub-menu "Trip Records" is found in another section of this document)

<b>Measuring</b>	
Set:Ω/ph sec	
VT	132000/110V
CT	1000/1A In1A

In-service display  
 Displaying current in phase 1  
 Displaying current in phase 2  
 Displaying current in phase 3

Press "enter" here to display stored trip records  
 After selecting a record use "arrow up" or "arrow down" to display additional information.  
 Leave sub-menu by pressing "Esc".

Define measuring system and display  
 Choose to set impedances in sec or primary values  
 Primary/secondary VT  
 Primary/secondary CT, Relay rated current

Z1	t 0.0s
R 7.65Ω	X 3.55Ω
R∠ 85°	Forward
kR 1.2	kX 1.2

Zone1 settings  
 R1 reach in ohm/ph  
 R1 angle ref +R-axis  
 R1 EF compensation

Zone1 delay  
 X1 reach in ohm/ph  
 Fwd, Rev, Non-dir, Off  
 X1 EF compensation

Z2	t 0.3s
R 9.3Ω	X 5.6Ω
R∠ 78°	Forward
kR 1.45	kX 1.35

Zone2 settings  
 R2 reach in ohm/ph  
 R2 angle ref +R-axis  
 R2 EF compensation

Zone2 delay  
 X2 reach in ohm/ph  
 Fwd, Rev, Non-dir, Off  
 X2 EF compensation

Z3	t 0.6s
R 7.65Ω	X 3.55Ω
R∠ 78°	Reverse
kR 1.5	kX 1.5

Zone3 settings  
 R3 reach in ohm/ph  
 R3 angle ref +R-axis  
 R3 EF compensation

Zone3 delay  
 X3 reach in ohm/ph  
 Fwd, Rev, Non-dir, Off  
 X3 EF compensation

Z4	t 2.5s
R± 35Ω	X+ 56Ω
X- 35Ω	On
kR 1.5	kX 1.5

Zone 4 settings  
 Resistive reach  
 Reactive reverse reach  
 R4 EF compensation

Zone 4 delay  
 Reactive fwd reach  
 On (non-direct.), Off  
 X4 EF compensation

<b>EF detection</b>	
3Uo 22V secondary	
3Io 150/0.15A	
Solid earthing	

Earth Fault detection levels  
 Secondary voltage setting  
 Primary/secondary current setting  
 Power System Earthing : Solid

<b>Teleprotection</b>	
POR	
tp	20 ms
td	50 ms

Teleprotection scheme  
 Alt1: PUR (Permissive underreach)  
 Alt2: POR, Set pickup and dropout times .  
 Alt3: Off

<b>SOTF by</b>	
CB close (high)	

Switch On To Fault activated by  
 Alt1: I/U level (internal logic)  
 Alt2: CB close (high) (high=high opto-input)  
 Alt3: CB close (low) (low=low opto input)

<b>Power Swing</b>	
Block Z1 Z2 Z3	

Power Swing response  
 Block Z1.... / Block off (8 combinations of zones Z1, Z2 and Z3 are accepted e.g. "Block Z1 Z3")

<b>VTS response</b>	
Alarm and block	

Voltage Transformer Supervision response  
 Alt1: Off  
 Alt2: Alarm  
 Alt3: Alarm and block

<b>Single-pole Trip</b>	
Applies to	
Z1	Z2 Z3

Single-pole trip selection  
 Defines for which zones single-pole trip is active (16 combinations of zones Z1,Z2,Z3,and Z4 are accepted, e.g. "Z1 Z2 Z3")

YMD	2002-05-29
HMS	13:52:36
Password	****
Frequency	50Hz

Year, month, and day  
 24 hour clock  
 Four-digit password (default 1111)  
 Rated power system frequency

# RefleX medium voltage Impedance Protection

## Trip-records sub-menu

All displays show recordings subsequent to relay tripping. The last five recordings are always stored.

After a relay trip the display showing date and time of the trip automatically appears.

By using arrow up/arrow down the user may access all relevant information in the displays below.

Each trip is automatically assigned a separate serial number

Only trip records (displays) with active information is stored and/or displayed after a trip.

**Trip records**

**Trip 333**  
2002-12-24  
12:13:14.123  
Delay 0.3s

This display is part of the main menu  
After selecting a record use "arrow up" or "arrow down" to display additional information.  
Leave trip records by pressing "Esc".

**Trip 333**  
L1-N      L1-L2  
L2-N\*    L2-L3\*  
L3-N\*    L3-L1

Header (in this case looking at trip no. 333)  
Date of "trip 333"  
Time of "trip 333"  
Delay of "trip 333"

Phase indication (trip 333)  
\* indicates faulted phases

**Trip 333**  
Z1      Z2\*  
Z3      Z4

Tripped zone (trip 333)  
\* indicates tripped zones  
In this case zone Z2 tripped

**Trip 333**  
Carrier send  
Carrier receive

Carrier aided trip  
This display only appears after carrier send and/or carrier receive signals. Only the activated function(-s) are displayed.

**Trip 333**  
SOTF trip

Switch Onto Fault  
This display appears only after a "Switch On To Fault" trip

**Trip 333**  
PS block

Power Swing Blocking  
This display appears only after a "Power Swing Blocking" function.

**Trip 333**  
VTS trip

Voltage Transformer Supervision  
This display appears only after a "Voltage Transformer Supervision" trip

**Trip 333**  
CB Trip: 68 ms

Circuit breaker (CB) trip time  
This display appears after any trip.  
Measure the circuit breaker trip time.

# RefleX medium voltage Impedance Protection

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## Technical data

### All zones

Measuring scheme	Full-scheme impedance protection
Measuring elements	Six independent elements per zone
Minimum operating current	$0.1 * I_n$
Resetting ratio	1.03
Typical trip time	35 ms (50 Hz system frequency)
Typical reset-time for measuring system	25 ms (50 Hz system frequency)
Measuring limit - voltage	3V
Measuring limit - current	0.1A (In 1A)
Measuring limit - current	0.5A (In 5A)

### Measuring zones, Z1, Z2, Z3

Resistive reach	R	1.00-300.0 ohm/phase secondary (In 1A)
Resistive reach	R	0.20-60 ohm/phase secondary (In 5A)
Resistive directional blinder angle	$R\angle$	$45^\circ - 85^\circ$
Reactive reach	X	0.50-300 ohm/phase secondary (In 1A)
Reactive reach	X	0.10-60.0 ohm/phase secondary (In 5A)
Resistive EF compensation factor	kR	0.10-2.50 (remember to cover arc resistance)
Reactive EF compensation factor	kX	0.10-2.50
Zone trip delay	t	0.00-9.99 s and $\infty$
Measuring direction - operational status		Forwards, backwards, non-directional, off
Fixed directional blinders		$-30^\circ$ and $+120^\circ$

### Measuring zone Z4

Resistive reach (R+ and R-)	$R_{\pm}$	1.00-300.0 ohm/phase secondary (In 1A)
Resistive reach (R+ and R-)	$R_{\pm}$	0.20-60 ohm/phase secondary (In 5A)
Reactive reach (forwards direction)	$X_+$	0.50-300 ohm/phase secondary (In 1A)
Reactive reach (forwards direction)	$X_+$	0.10-60.0 ohm/phase secondary (In 5A)
Reactive reach (reverse direction)	$X_-$	0.50-300 ohm/phase secondary (In 1A)
Reactive reach (reverse direction)	$X_-$	0.10-60.0 ohm/phase secondary (In 5A)
Resistive EF compensation factor	kR	0.10-2.50
Reactive EF compensation factor	kX	0.10-2.50
Zone trip delay	t	0.00-9.99 s and $\infty$
Zone operational status		On (non-directional) or off

### Earth Fault detection

Current setting	$3I_o$	0.10-0.99 and 1.0 A secondary (In 1A)
Current setting	$3I_o$	0.50-5.00 A secondary (In 5A)
Voltage setting	$3U_o$	3.00-50.0 V secondary
Resetting ratio		$>0.97$
System earthing		Solid

### Power Swing

Power swing block		Independent for Z1, Z2 and/or Z3
PSB - inner characteristic		Zone 4
PSB - outer characteristic		$1.3 * \text{zone 4 impedances}$
Delay between inner and outer characteristic		40 ms

# RefleX medium voltage Impedance Protection

## Other features

Coverage for close-up faults	Memory voltage and cross polarization
Voltage transformer location	Line or busbar
Voltage Transformer Supervision (VTS)	Voltage measurement with MCB option
Activation of Switch On To Fault (SOTF)	CB close or voltage/current check
Teleprotection scheme logic	Permissive Underreach and Overreach
Selectable impedance setting method in relay menu	Selectable in primary or secondary ohms/ph
Pulse-extension circuit for trip outputs	200 ms pulse
Trip LED reset	External input
Rated power system frequency	50 and 60 Hz

## Password

Factory default password	1111
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## Characteristics

