

# RefleX Protection and Control

RefleX - 2002

**Impedance protection for distribution  
and sub-transmission networks**



Medium voltage  
impedance protection  
Model 2002

# RefleX impedance protection

---

## Application

The RefleX distribution impedance relay is designed to protect isolated, impedance compensated and directly-grounded medium-voltage networks. It is extremely easy to use, and the setting tools and menus are carefully designed to enable easy setting and quick and cost-effective operation. The relay offers uncomplicated and efficient protection of lines in interconnected distribution networks, or distribution networks with unreasonable long tripping times due to a high number of serial lines.

## Measurement

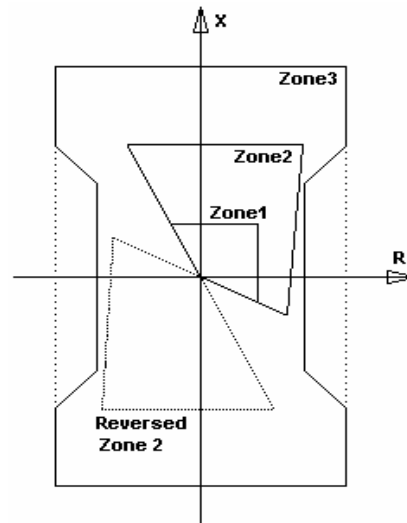
The relay includes three measuring zones, all with quadrilateral characteristics. The two first zones Z1 and Z2 can be independently set forward, backward, non-directional or off. If a zone is directional then two additional blinders are added to restrict the operation to forward (or reverse) faults. Independent settings for the R-reach and R-angle enable excellent control towards the load resistances

If necessary then the zone reach in R-direction can be further limited, thus permitting extremely high load currents independent of the initial zone settings.

Each of the three zones has six "measuring elements", each measuring one of the six loop impedances. The operation of each zone and each element is totally independent and is continuously calculated by the software.

The relay therefore forms a true "full scheme" unit.

Increased  $3I_0$  (EF current) or increased  $3U_0$  (EF voltage) are applied as additional starting criteria for the phase-ground impedance measuring loops.



## Zone blocking

Zone 2 can be blocked by an external signal. This enables the user to create inexpensive and uncomplicated blocking schemes to form simple busbar protection logic, line trip acceleration systems etc.

## Voltage memory and cross-polarisation

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

## Switch On To Fault logic (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 location.

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

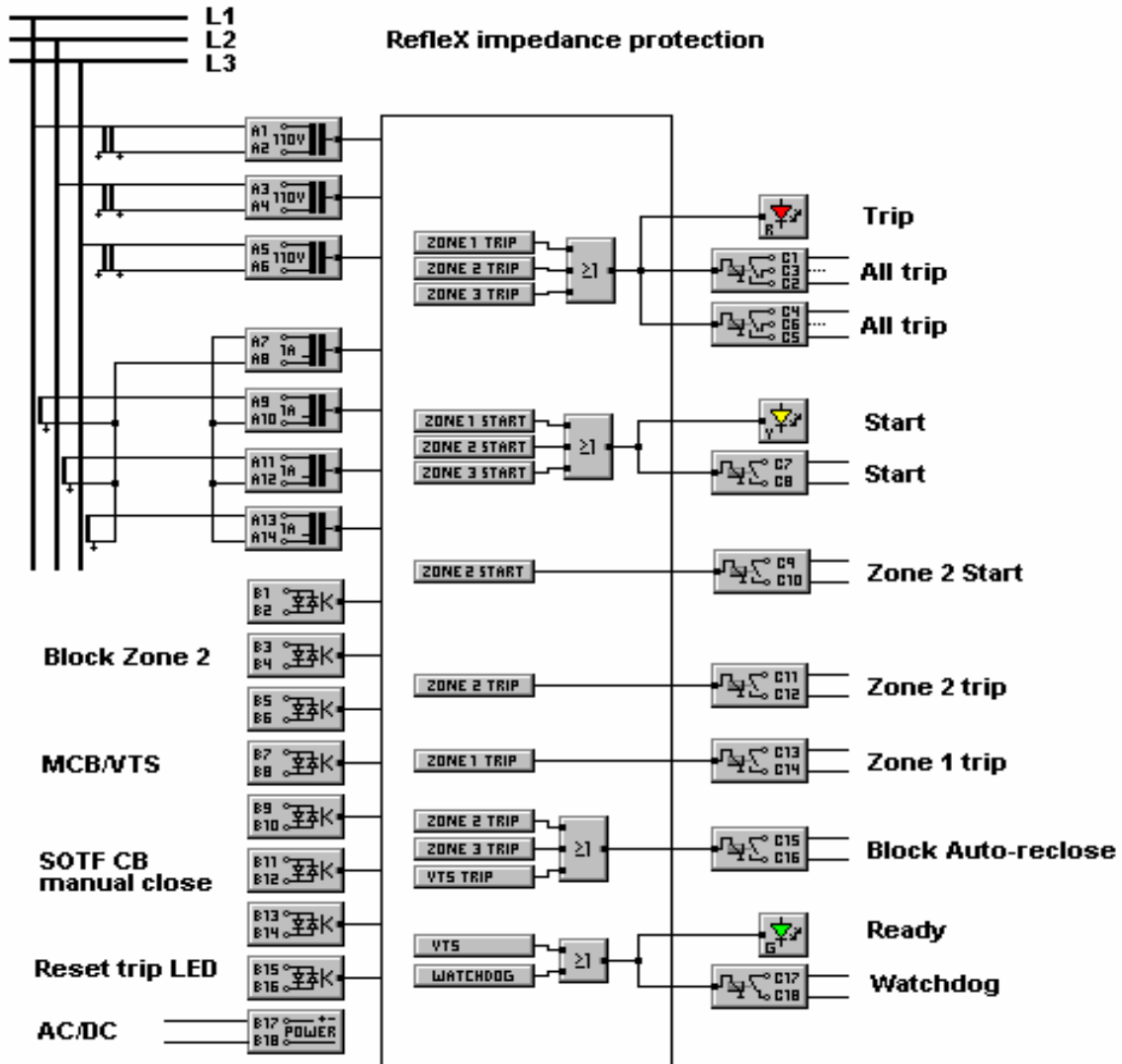
## Voltage Transformer Supervision (VTS)

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

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

# Reflex impedance protection

## Logic diagram



File: 2002\_PRD\_110.bmp

# RefleX impedance protection

<b>Impedance relay</b> <b>I1</b> 124A <b>I2</b> 120A <b>I3</b> 123A	(See separate description of sub-menu "in-service displays")	In-service display. Different displays are available. Press "enter" to toggle between displays
<b>Trip records</b>	(See separate description of sub-menu "Trip records")	Press "enter" here to view recorded data. After selecting a record use "arrow up" or "arrow down" to display additional information. Leave sub-menu by pressing "Esc".
<b>Measuring</b> <b>Set:</b> Ω/ph sec <b>VT</b> 132000/110V <b>CT</b> 1000/1A In1A	<hr/> <hr/> <hr/> <hr/>	Define measuring system and display Choose to set impedances in sec or primary values Primary / secondary VT Primary / secondary CT, Relay rated current
<b>Z1</b> t 0.0s <b>R</b> 7.65Ω X 3.55Ω <b>R</b> ∠ 85° Forward <b>kR</b> 1.2 kX 1.2	<hr/> <hr/> <hr/> <hr/>	Zone 1 settings Zone 1 delay R1 reach in ohm/ph X1 reach in ohm/ph R1 angle ref +R-axis Fwd, Rev, Non-dir, Off R1 EF compensation X1 EF compensation
<b>Z2</b> t 0.3s <b>R</b> 9.3Ω X 5.6Ω <b>R</b> ∠ 78° Forward <b>kR</b> 1.45 kX 1.35	<hr/> <hr/> <hr/> <hr/>	Zone 2 settings Zone 2 delay R2 reach in ohm/ph X2 reach in ohm/ph R2 angle ref +R-axis Fwd, Rev, Non-dir, Off R2 EF compensation X2 EF compensation
<b>Z3</b> t 2.5s <b>R</b> ± 35Ω X+ 56Ω <b>X-</b> 35Ω Zone-cut <b>kR</b> 1.5 kX 1.5	<hr/> <hr/> <hr/> <hr/>	Zone 3 settings Zone 3 delay Resistive reach Reactive forward reach Reactive reverse reach On, Off, Zone-cut R3 EF compensation X3 EF compensation
<b>Z3 zone-cut</b> <b>R</b> min 2.0Ω <b>R</b> ang 30° <b>Limit</b> Z1 Z2 Z3	<hr/> <hr/> <hr/> <hr/>	Zone-cut function settings Resistive reach for ±Rmin (min load impedance) Load sector angle Limiter active in: Z3 alone / Z1, Z2 and Z3
<b>EF detection</b> <b>3Uo</b> 22V sec <b>3Io</b> 150/0.15A <b>Solid earthing</b>	<hr/> <hr/> <hr/> <hr/>	Earth Fault detection levels Secondary voltage setting Primary / secondary current setting Powe System Earth: Solid, isolated or compensated
<b>SOTF by</b> <b>CB</b> close (high)	<hr/> <hr/> <hr/> <hr/>	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>VTS response</b> <b>Alarm and block</b>	<hr/> <hr/> <hr/> <hr/>	Voltage Transformer Supervision response Alt1: Off Alt2: Alarm Alt3: Alarm and block
<b>YMD</b> 2002-05-29 <b>HMS</b> 13:52:36 <b>Password</b> **** <b>Frequency</b> 50Hz	<hr/> <hr/> <hr/> <hr/>	Year, month, and day 24 hour clock Four-digit password (default 1111) Rated power system frequency

# RefleX impedance protection

---

## Trip-records sub-menu

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

After each 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 unique serial number.

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

**Trip records**

**Trip 333**  
**1999-12-333**  
**12:13:14.123**  
**Delay 0.3s**

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

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

**Trip 333**  
**SOTF trip**

**Trip 333**  
**VTS trip**

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".

Header (in this case looking at trip no. 333)

Date of "trip 333"

Time of "trip 333"

Delay of "trip 333"

Activated measuring loops (trip 333)

\* indicates activated measuring loops

Tripped zone (trip 333)

\* indicates the shortest zone activated

In this case zone Z2 tripped

Switch OnTo Fault

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

Voltage Transformer Supervision trip

This display appears if the "Voltage transformer supervision" has been activated. It indicates a problem in the voltage measuring circuit.

# RefleX impedance protection

## In-service displays

During commissioning of the relay the in-service display will show the primary phase currents.

Press "enter" to switch between the different in-service displays

Chosen in-service display will automatically be default in-service display

**In-service display**

```

Impedance relay
IL1      124A
IL2      120A
IL3      123A
    
```

Phase 1 primary current measurement  
 Phase 2 primary current measurement  
 Phase 3 primary current measurement

```

Impedance relay
IL1 0.12A∠ 0°
IL2 0.12A∠ -120°
IL3 0.12A∠ 120°
    
```

Phase 1 secondary current and angle measurement  
 Phase 2 secondary current and angle measurement  
 Phase 3 secondary current and angle measurement

```

Impedance relay
UL1 63.5V∠ Ref°
UL2 63.5V∠ -120°
UL3 63.5V∠ 120°
    
```

Phase 1 secondary voltage and angle measurement  
 Phase 2 secondary voltage and angle measurement  
 Phase 3 secondary voltage and angle measurement

```

R Ω/ph X Ω/ph
L12 529Ω 0Ω
L23 529Ω 0Ω
L31 529Ω 0Ω
    
```

Secondary ph-ph impedance  
 Secondary ph-ph impedance  
 Secondary ph-ph impedance

```

R X
L1N 529Ω 0Ω
L2N 529Ω 0Ω
L3N 529Ω 0Ω
    
```

Secondary ph-ground impedance  
 Secondary ph-ground impedance  
 Secondary ph-ground impedance

\* All angles are measured and displayed with reference to the UL1 voltage

# RefleX impedance protection

## 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	30-40 ms (50 Hz system frequency)
Typical reset-time for measuring system	20-30 ms (50 Hz system frequency)
Measuring limit - voltage	2 V
Measuring limit - current	0.1A (In 1A)
Measuring limit - current	0.5A (In 5A)

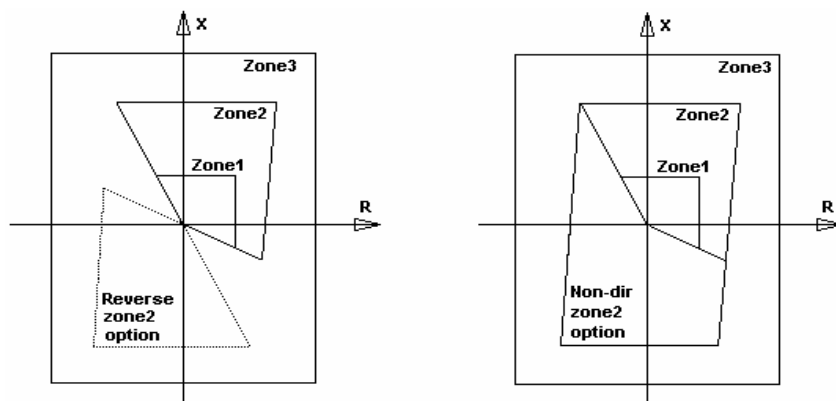
### Measuring zones, Z1, Z2

Resistive reach	In 1A	R	0.20-300 ohm/phase secondary
Resistive reach	In 5A	R	0.04-60.0 ohm/phase secondary
Resistive directional blinder angle		$R \angle$	$45^\circ - 85^\circ$
Reactive reach	In 1A	X	0.10-300 ohm/phase secondary
Reactive reach	In 5A	X	0.02-60.0 ohm/phase secondary
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 3, Z3

Resistive reach (+R and -R)	In 1A	$R \pm$	0.20-300 ohm/phase secondary
Resistive reach (+R and -R)	In 5A	$R \pm$	0.04-60.0 ohm/phase secondary
Reactive reach (fwd direction)	In 1A	$X+$	0.10-300 ohm/phase secondary
Reactive reach (fwd direction)	In 5A	$X+$	0.02-60.0 ohm/phase secondary
Reactive reach (reverse direction)	In 1A	$X-$	0.10-300 ohm/phase secondary
Reactive reach (reverse direction)	In 5A	$X-$	0.02-60.0 ohm/phase secondary
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
Resistive reach (R min)	In 1A	$R \pm$	0.20-+R and -R ohm/phase secondary
Resistive reach (+R and -R)	In 5A	$R \pm$	0.04-+R and -R ohm/phase secondary

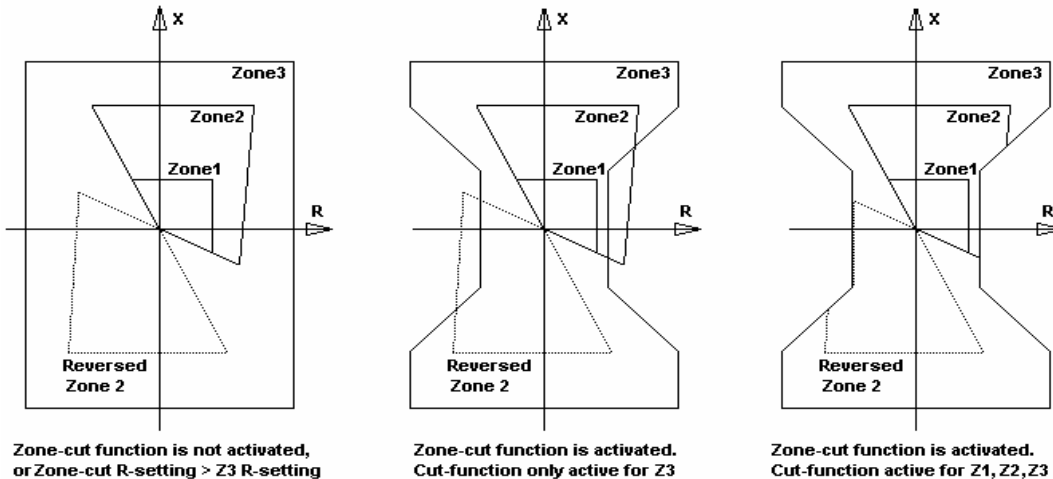
### Characteristics



# RefleX impedance protection

## Zone cut function (additional load blinders). Settings:

Zone-cut blinder angles R ang  $\pm 0^\circ-60^\circ$   
 Zone-cut impedances In 1A R min  $\pm 1.00-300$  ohm/phase secondary  
 Zone-cut impedances In 5A R min  $\pm 0.20-60.0$  ohm/phase secondary  
 The zone cut function modifies zone 3 by reducing the R-reach in chosen sectors . The function has no effect if the zone-cut impedance setting is higher than the resistive Z3 reach (+R and -R)  
 The zone cut setting angles in the examples below are  $\pm 45^\circ$  referred to the R-axis.



## Earth Fault detection

Current setting	In 1A	3Io	0.10-0.99A and 1.00A
Current setting	In 5A	3Io	0.50-5.00 A
Voltage setting		3Uo	3.00-50.0 V secondary
Resetting ratio			>0.97
System earthing			Solid or isolated/coil compensated
Priority in isolated network			L3>L2>L1 or L2>L3>L1 (acyclic)

## Other features

Voltage transformer location	Line or busbar
Activation of Switch On To Fault (SOTF)	CB close or voltage/current check
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

## Input values

Input values at In = 1A	Imax cont. = 10A	Imax 3s = 100A
Input values at In = 5A	Imax cont. = 30A	Imax 3s = 500A
Voltage inputs Un = 100/110V	Umax cont. = 300V	Umax 3s = 500V
Binary inputs	Bipolar 24-240V DC	
Power supply	24-240V DC and AC	
Permissible power supply interrupt time	100 ms	

## Password

Factory default password	1111
--------------------------	------