

RefleX Protection and Control

RefleX - 2003

Medium voltage impedance protection
Full scheme measuring system
3+1 measuring zones
Teleprotection schemes



Medium voltage
impedance protection
2003 SOW 1.10

RefleX medium voltage Impedance Protection

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.

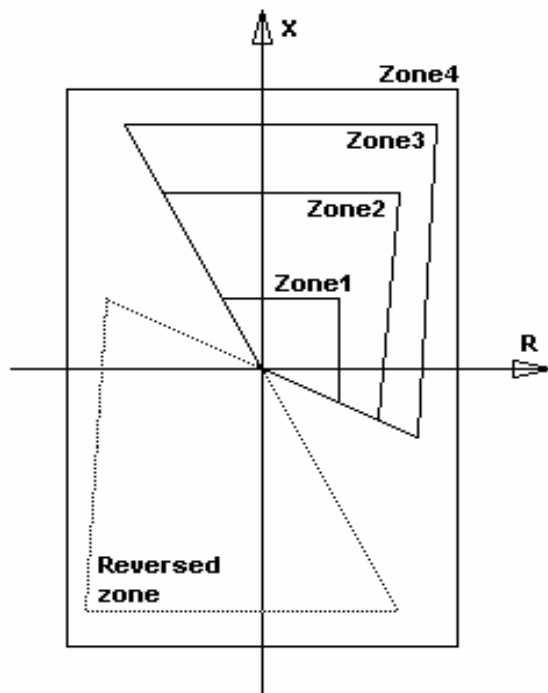
Where a zone is directional two additional blinders are added to limit the operation to forward or reverse faults.

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.

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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).

Phase Unbalance Supervision.

When the negative sequence current is larger than the setting then the unbalance function operates. The user can freely select trip time for this function.

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

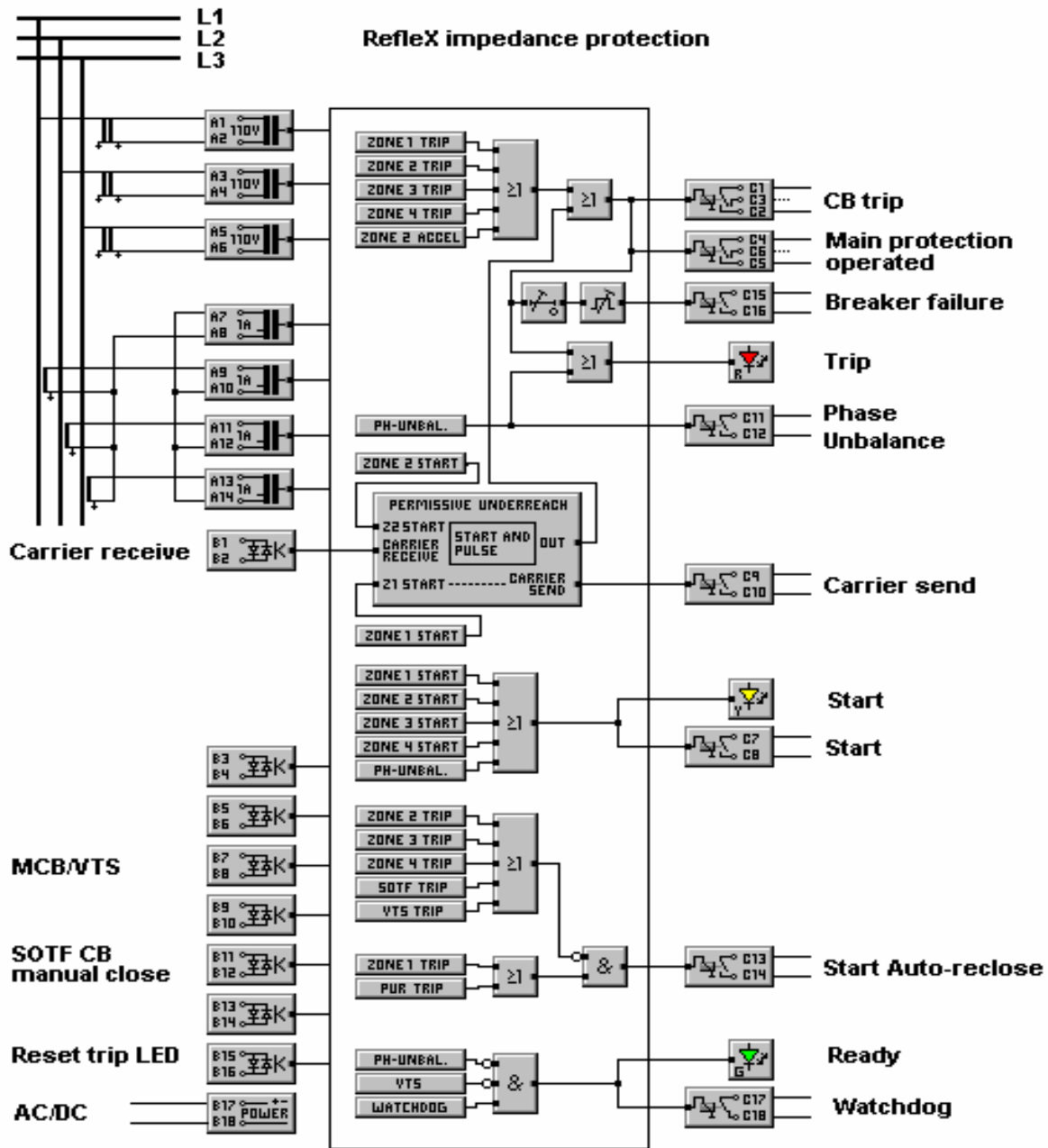
- When a fault occurs in one or more of the relay processors or memory.

- After VTS detection

- After detection of wrong direction of rotation in the current or in the voltage measurement.

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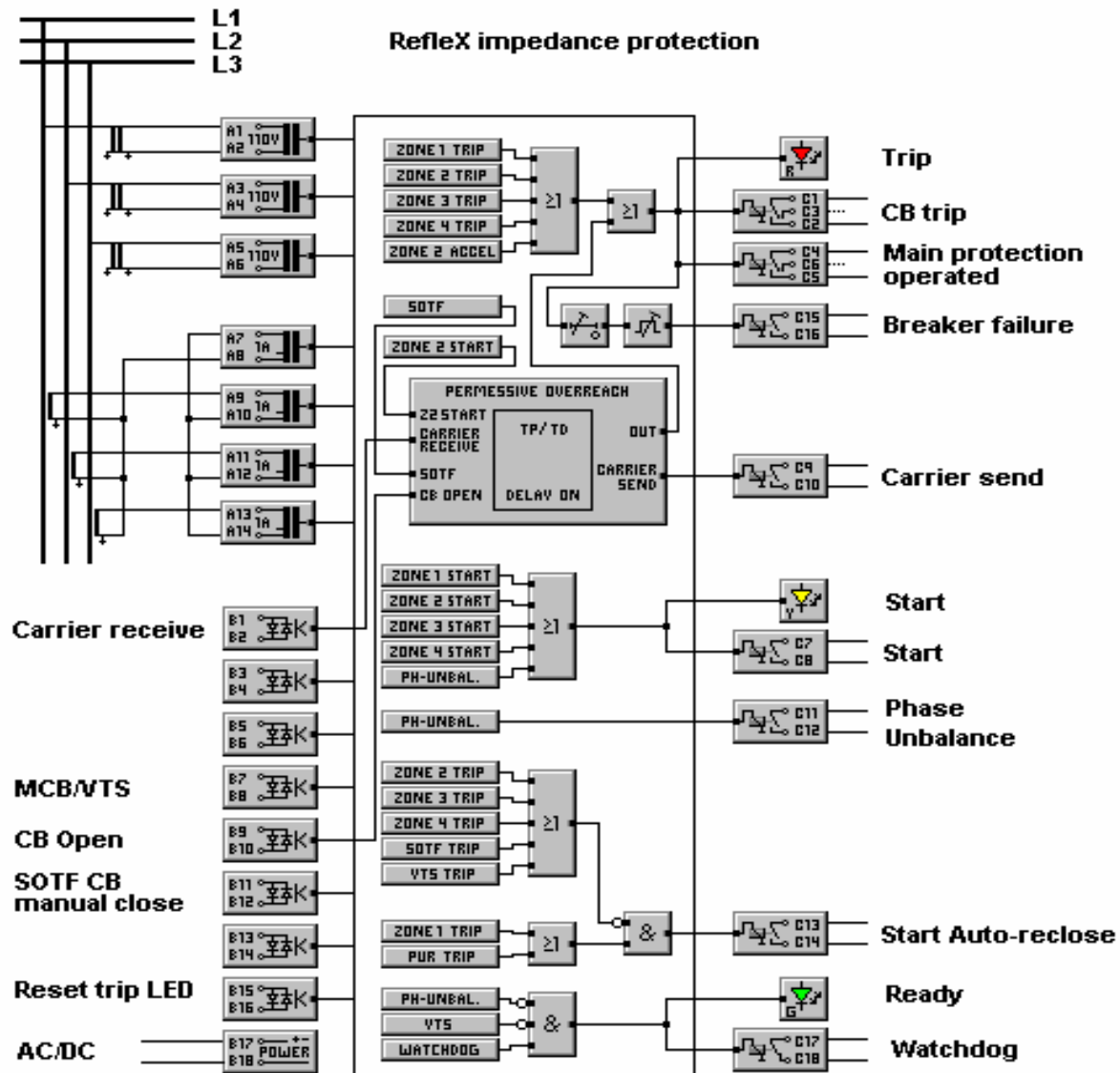
Input/output logic diagram with PUR teleprotection



File: 2003_PRD_110_PUR.bmp

RefleX medium voltage Impedance Protection

Input/output logic diagram with POR teleprotection



File: 2003_PRD_110_POR.bmp

RefleX medium voltage Impedance Protection

Impedance relay I1 124A I2 120A I3 123A		In-service display Displaying current in phase 1 Displaying current in phase 2 Displaying current in phase 3
Trip records	(A separate description of the sub-menu "Trip Records" is found in another section of this document)	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".
Measuring Set: Ω/ph sec VT 132000/110V CT 1000/1A In1A	_____ _____ _____	Define measuring system and display Choose to set impedances in sec or primary value: 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 Zone1 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
Z2 t 0.3s R 9.3Ω X 5.6Ω R∠ 78° Forward kR 1.45 kX 1.35	_____ _____ _____	Zone2 settings Zone2 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
Z3 t 0.6s R 7.65Ω X 3.55Ω R∠ 78° Reverse kR 1.5 kX 1.5	_____ _____ _____	Zone3 settings Zone3 delay R3 reach in ohm/ph X3 reach in ohm/ph R3 angle ref +R-axis Fwd, Rev, Non-dir, Off R3 EF compensation X3 EF compensation
Z4 t 2.5s R± 35Ω X+ 56Ω X- 35Ω On kR 1.5 kX 1.5	_____ _____ _____	Zone 4 settings Zone 4 delay Resistive reach Reactive fwd reach Reactive reverse reach On (non-direct.), Off R4 EF compensation X4 EF compensation
EF detection 3Uo 22V secondary 3Io 150/0.15A Solid earthing	_____ _____ _____	Earth Fault detection levels Secondary voltage setting Primary/secondary current setting Power System Earthing : Solid, isolated/compensated
Teleprotection POR tp 20 ms td 50 ms	_____ _____ _____	Teleprotection scheme Alt1: PUR (Permissive underreach) Alt2: POR, Set pickup and dropout times . Alt3: Off
SOTF by 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)
Power Swing 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")
VTS response Alarm and block	_____ _____ _____	Voltage Transformer Supervision response Alt1: Off Alt2: Alarm Alt3: Alarm and block
Ph unbalance I2 0.4 * I1 t2 0.8s	_____ _____ _____	Phase unbalance response Negative sequence current setting Time delay for phase unbalance trip.
Common #1 CB fail backup: tCBF 0.2s	_____ _____ _____	Common settings for the complete relay Breaker failure function delay
Comm. IEC ON Config. Ring Address 45 Meas. value 1.2	_____ _____ _____	IEC 60870 communication On/off Configuration Relay address Value of measurand
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".

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

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

Phase indication (trip 333)
* indicates faulted phase elements

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
Phase Unbalance
trip

Phase Unbalance
This display appears only after a "Phase Unbalance" 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 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

```

Impedance relay
I1      0.12 A
I2      0.0 * I1
    
```

Positive sequence current (I1) secondary value
 Negative sequence (I2) factor of the
 positive sequence value

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

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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 * In
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∠	45° - 85°
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 ∞
Measuring direction - operational status		Forwards, backwards, non-directional, off
Fixed directional blinders		-30° and +120°

Measuring zone Z4

Resistive reach (R+ and R-)	R±	1.00-300.0 ohm/phase secondary (In 1A)
Resistive reach (R+ and R-)	R±	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 ∞
Zone operational status		On (non-directional) or off

Earth Fault detection

Current setting	3Io	0.10-0.99 and 1.0 A secondary (In 1A)
Current setting	3Io	0.50-5.00 A secondary (In 5A)
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)

Power Swing

Power swing block		Independent for Z1, Z2 and Z3
PSB - inner characteristic		Zone 4
PSB - outer characteristic		1.3 * zone 4 impedances
Delay between inner and outer characteristic		40 ms

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Phase unbalance

Negative sequence current	I2	0.1-0.5 * I1 and ∞
Time delay	t2	0.10-99.9 s and ∞

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

Communication (IEC 60 870-5-103 protocol)

System configuration	Star or Ring
Address of protection equipment	1 to 254
Value of measurand (x In)	1.2 or 2.4
Optical fibre transmitters	Outputs D3, D5
Optical fibre receivers	Inputs D4, D6

Circuit Breaker Failure Protection (CBFP)

Trip transfer delay. Recommended setting = 0.2s	0.05 - 1.00 s
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Password

Factory default password	1111
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Characteristics

