Susol & Metasol

Super Solution

Meta Solution

Air Circuit Breakers

Digital Trip Relay(P.S Type)
Manual

LS IS

www.lsis.com

Susol & Metasol ACB
Digital Trip Relay Manual

LS Industrial Systems

Safety Precaution

WARNING

1. Please do not operate. inspect, and install by yourself.
2. Please do not wiring operation during power-on or under operation;it may result in electric shock.
3. Please do not wiring operation with the live bus bar; it may result in electric shock or a fire and property damage by charging voltage of current transformer.
4. Please do not attempt to disassemble even when the power not applied; it may result in electric shock by charging current remained in the product.
5. Please do not wire or operate with wet hands; it may result in electric shock.
6. Please do not use any damaged cable; it may result in electric shock.
7. Please work after wearing safety gear.
8. Please work after setting up the safety caution sign.
9. Please disconnect all Input/output wires when measuring HI POT or meger.

CAUTION

■ Safety caution for installation & terminal wiring

1. Apply the rated voltage to the power supply terminal; it may result in property damage or fire.
2. Please keep away product from screws, metals, water, or oil; it may result in fire.
3. Please keep the rated load and polarity of input & output contacts; it may result in property damage or fire.
4. Specialist help shall be sought for the installation and maintenance of product; it may result in malfunction or accident.

■ Inspection item before power supply being applied

1. Check the voltage or polarity of control power supply.
2. Check the wiring condition of input/output terminal.

■ Caution for storage and handling

1. Please store at dry and clean place.
2. Please do not throw or put force on it during transport.
   It may result in malfunction or faulty operation.

■ Caution for disposal

1. Please dispose of it in accordance with industrial waste regulation.

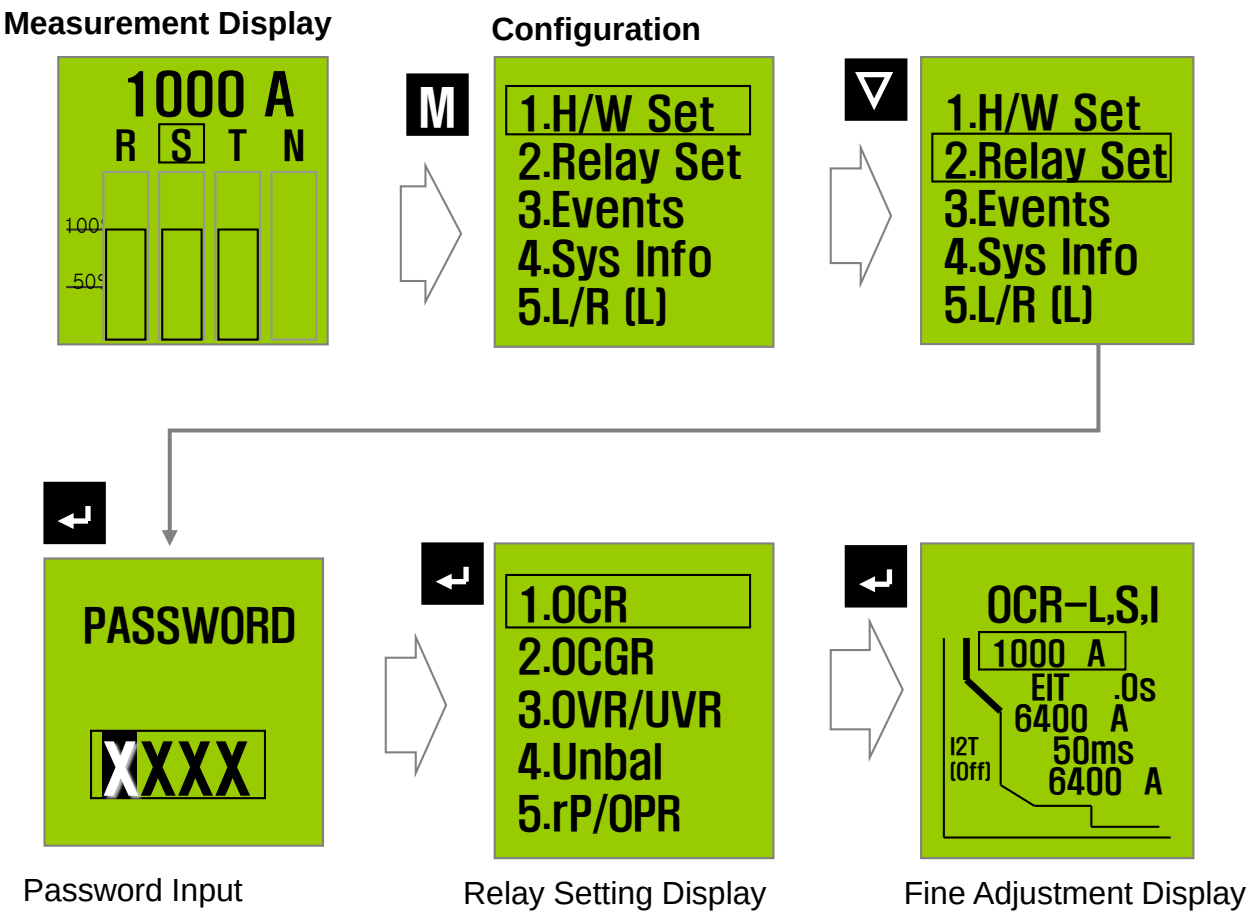
A. P/S Type Relay Setting

1. Fine Adjustment of Relay Setting Current - OCR

CAUTION

- OCR and OCGR's relay setting operate basically from Knob's setting values.
- Knob's adjusting measure is determined by its scale unit.
- In case of using current value that can not be precisely adjusted from its scale, it is recommended to use fine adjustment function.

Necessity for Fine Adjustment



Password Input

Relay Setting Display

Fine Adjustment Display

CAUTION

- When passwords has not been entered, move its cursor to the far right, then press Enter key will process to next page. Once the password was created, following above direction will not work to pass through this screen.

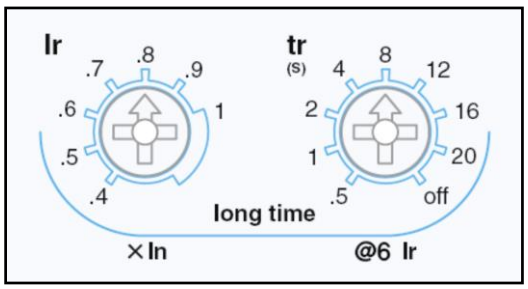
A. P/S Type Relay Setting

1. Fine Adjustment of Relay Setting Current - OCR

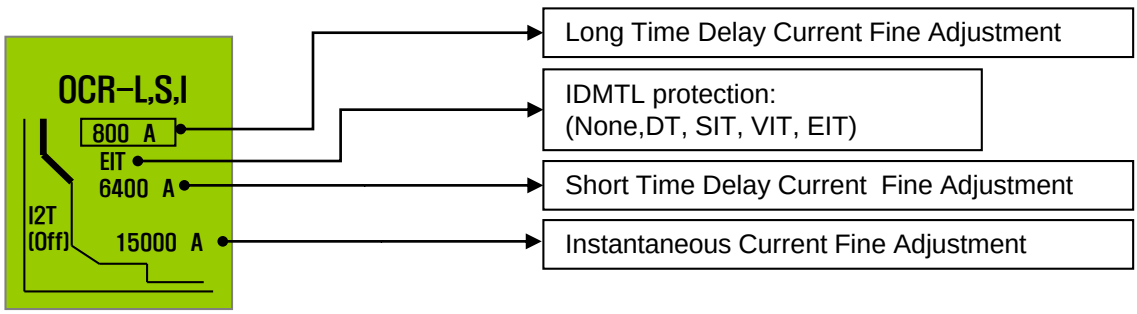
CAUTION

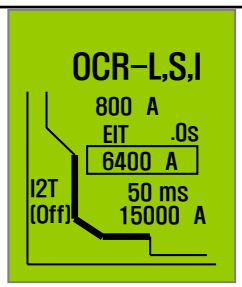
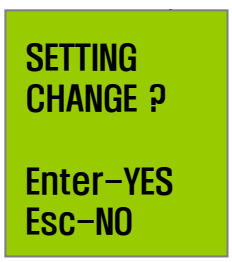
- Fine adjustment is only feasible in-between setting range of knob scale.
- During its fine adjustment process, any changes in Knob from users will reset all of pre-adjusted microscopic data.
- OCR and OCGR are managed separately. So adjusting OCR's Knob (Long, Short, Instantaneous) will not make a change in OCGR's fine adjustments

Fine Adjustment Range



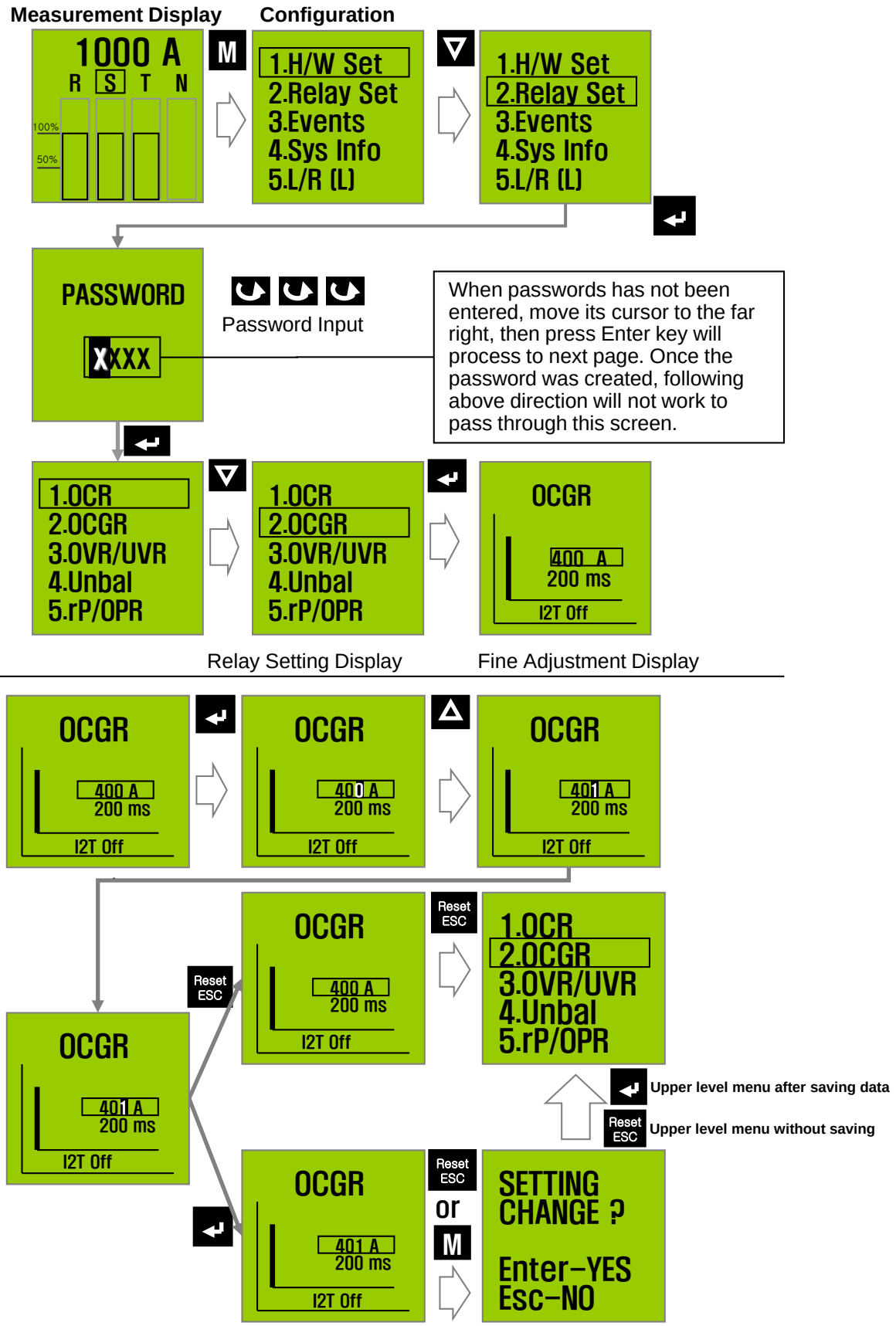
Long time delay setting knob is currently positioned at 0.8.
If In is equaled to 1000A……
Fine adjustment range is 0.8×In ~ 0.9×In-1.
Thus, fine adjustment can be taken place from 800A~ to 899A.



Display	Button	Contents
Fine Adjustment  	  	1) Move the cursor by pressing the ▼▲ button 2) If you press Enter button, the cursor blink Upper level menu after saving data Upper level menu without saving

A. P/S Type Relay Setting

1. Fine Adjustment of Relay Setting Current - OCGR



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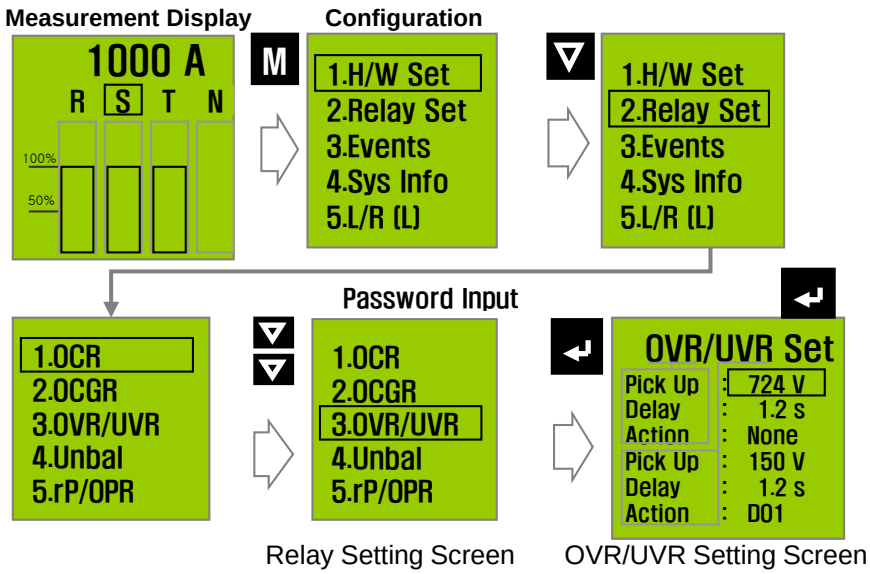
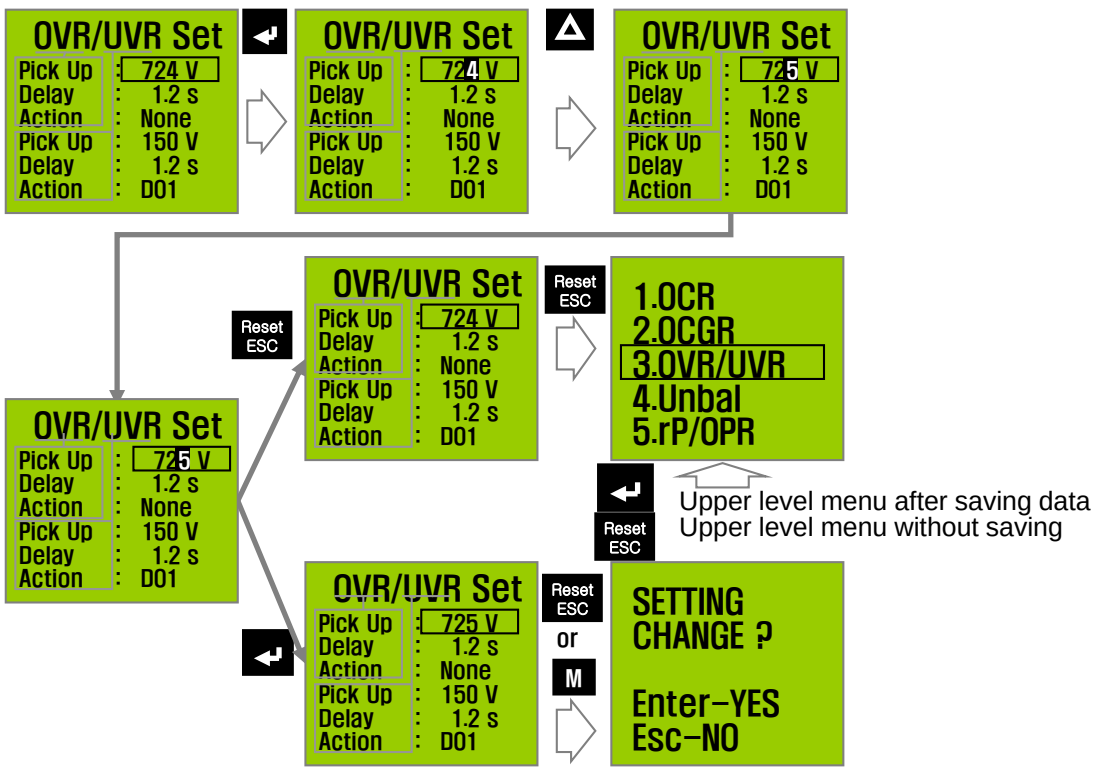
A. P/S Type Relay Setting

2. Over Voltage / Under Voltage Relay (OVR / UVR)

CAUTION

- When over/under voltage take place in any phase of 3 phase voltage, TRIP/None/DO1/DO2/ DO3/Fault will be executed.
- Under voltage relay operates where maximum voltage is above 60V among 3 phase. If all voltages from 3 phase are below 60V, Under voltage relay becomes disable.
- Each phase will be applied independently by over voltage / Under voltage relay. If all of 3 phase voltages are experiencing low voltage at once, it will record all of 3 fault events.





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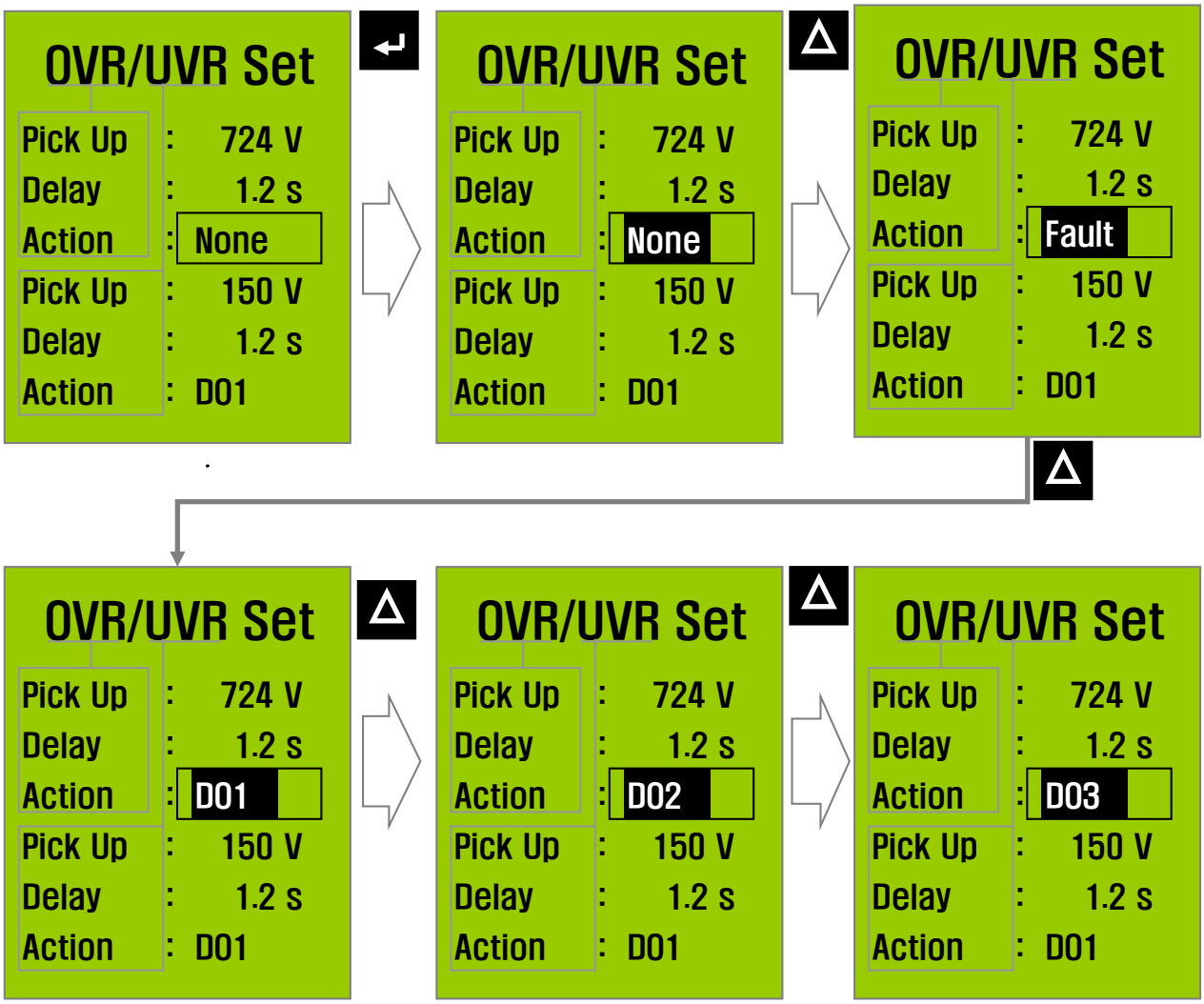
2. Over Voltage / Under Voltage Relay (OVR / UVR)

Relay Operation-Action Setting

- There are 6 kinds of action in relay operation.
1. None: Relay function was not implemented.
2. Fault: Under OVR, UVR operating condition, it records fault events only.
3. DO1: Under OVR, UVR operating condition, it records fault events, and close D01 relay.
4. DO2: Under OVR, UVR operating condition, it records fault events, and close D02 relay.
5. DO3: Under OVR, UVR operating condition, it records fault events, and close D03 relay.
6. Trip: Under OVR, UVR operating condition, it records fault events and trip ACB, but does not close DO relay(s).

Relay Setting Range

1. OVR Pick-up: UVR Pickup setting value ~ 900V
2. UVR Pick-up: 80V ~ OVR Pickup setting value -1V
3. Delay: 1.2S ~ 40S



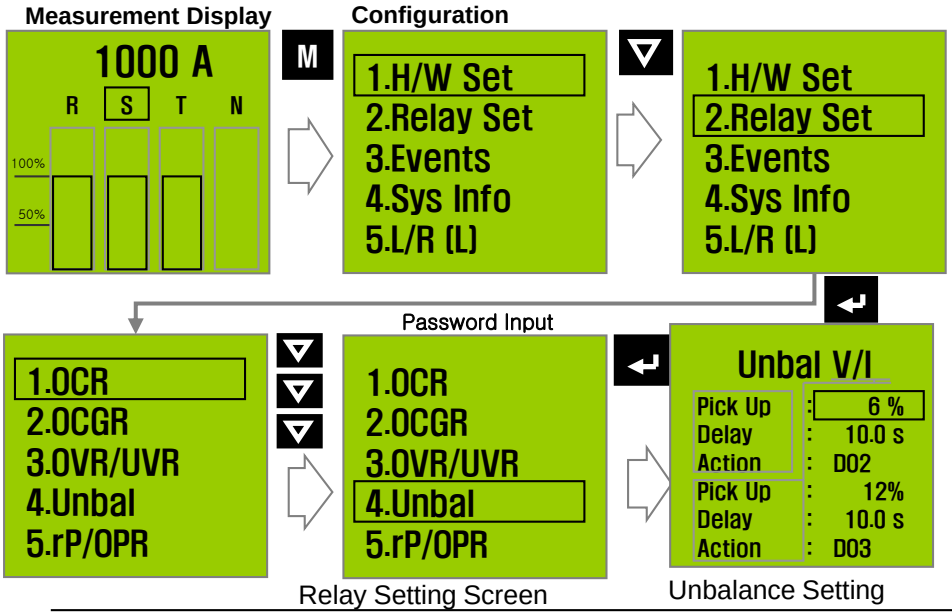
A. P/S Type Relay Setting

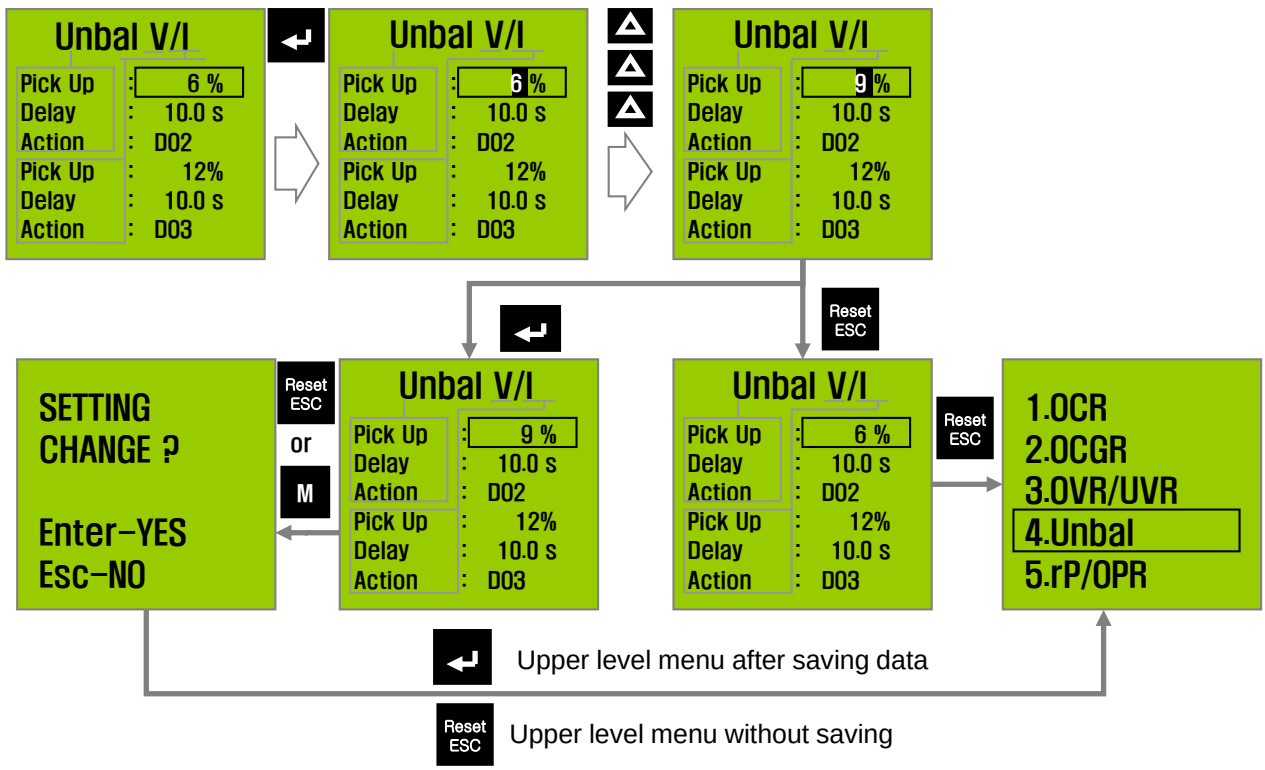
3. Voltage / Current Unbalance Type Relay (Vunbal / Iunbal)

Unbalance Type Relay

- When unbalanced value exceed its setting value in the 3 phase voltage / current, Trip / None / DO1 /DO2 / DO3 /Fault function will be executed.

1. Voltage(current) unbalance percentage =
   (negative-phase-sequence voltage(current) size) / (positive-phase-sequence voltage (current) size) * 100%
   Relay Voltage Range : above 80V ~ below 900V (minimum 1 phase among 3 phases)
   Relay Current Range : In(Rated Current) above 30% ~ below 120%





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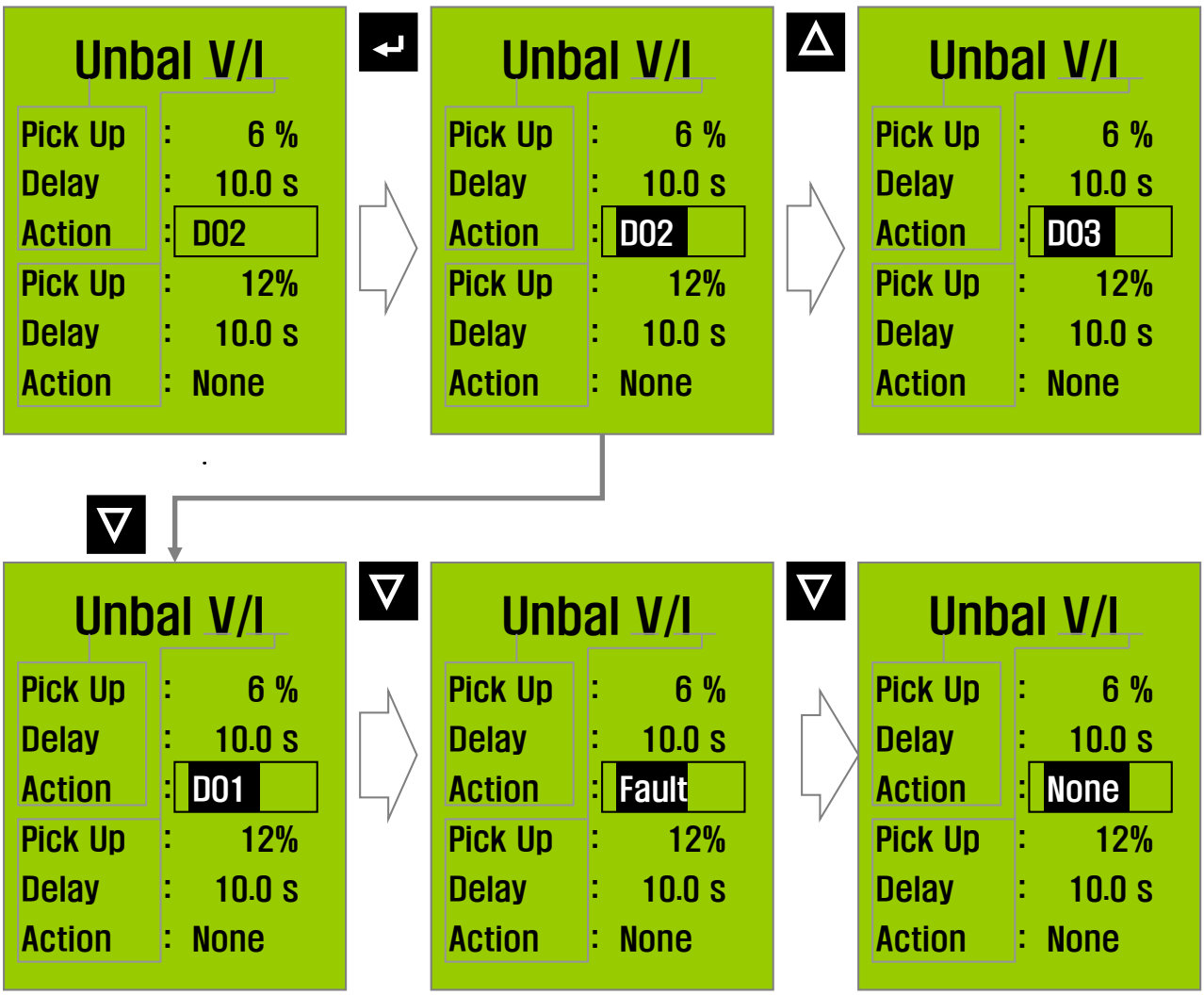
3. Voltage / Current Unbalance Relay (Vunbal / Iunbal)

Relay Operation-Action Setting

- There are 6 kinds of action in relay operation.
1. None: Relay function was not implemented.
2. Fault: Under Vunbal/Iunbal operation condition, it records fault events only.
3. DO1: Under Vunbal/Iunbal operation condition, it records fault events, and close D01 relay.
4. DO2: Under Vunbal/Iunbal operation condition, it records fault events, and close D02 relay.
5. DO3: Under Vunbal/Iunbal operation condition, it records fault events, and close D03 relay.
6. Trip: Under Vunbal/Iunbal operating condition, it records fault events, trip ACB, but does not close DO relay(s).

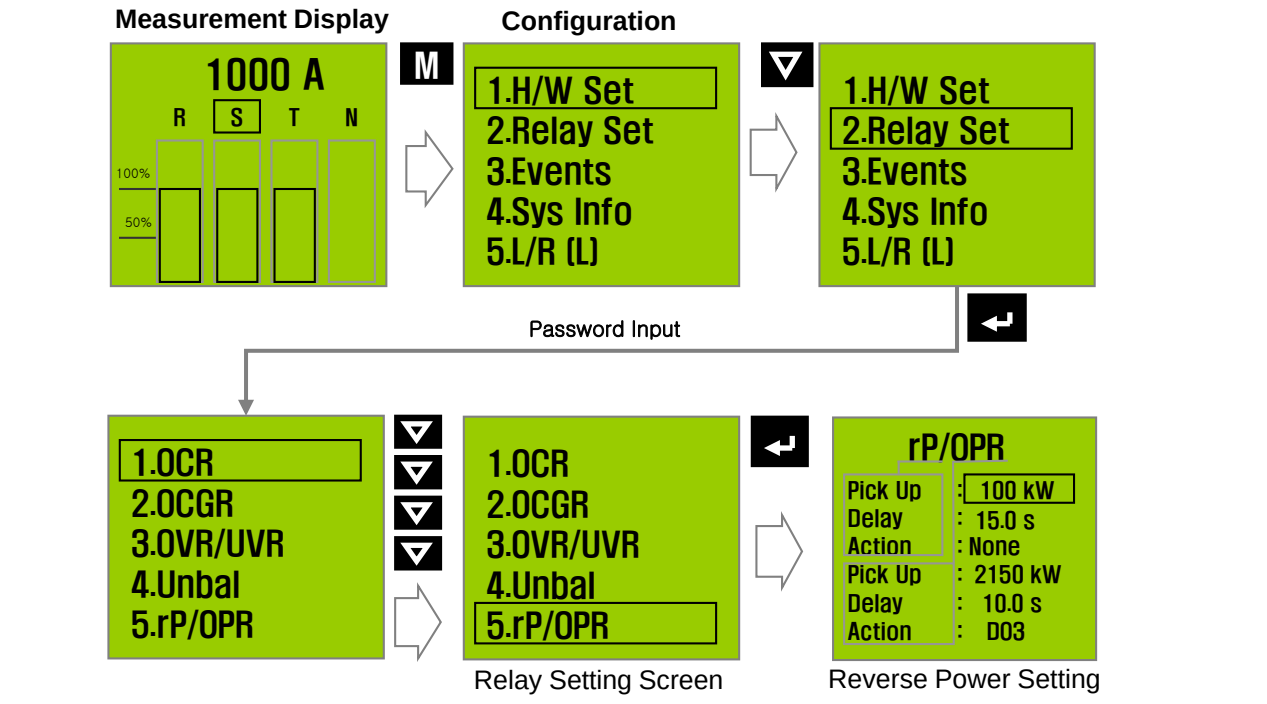


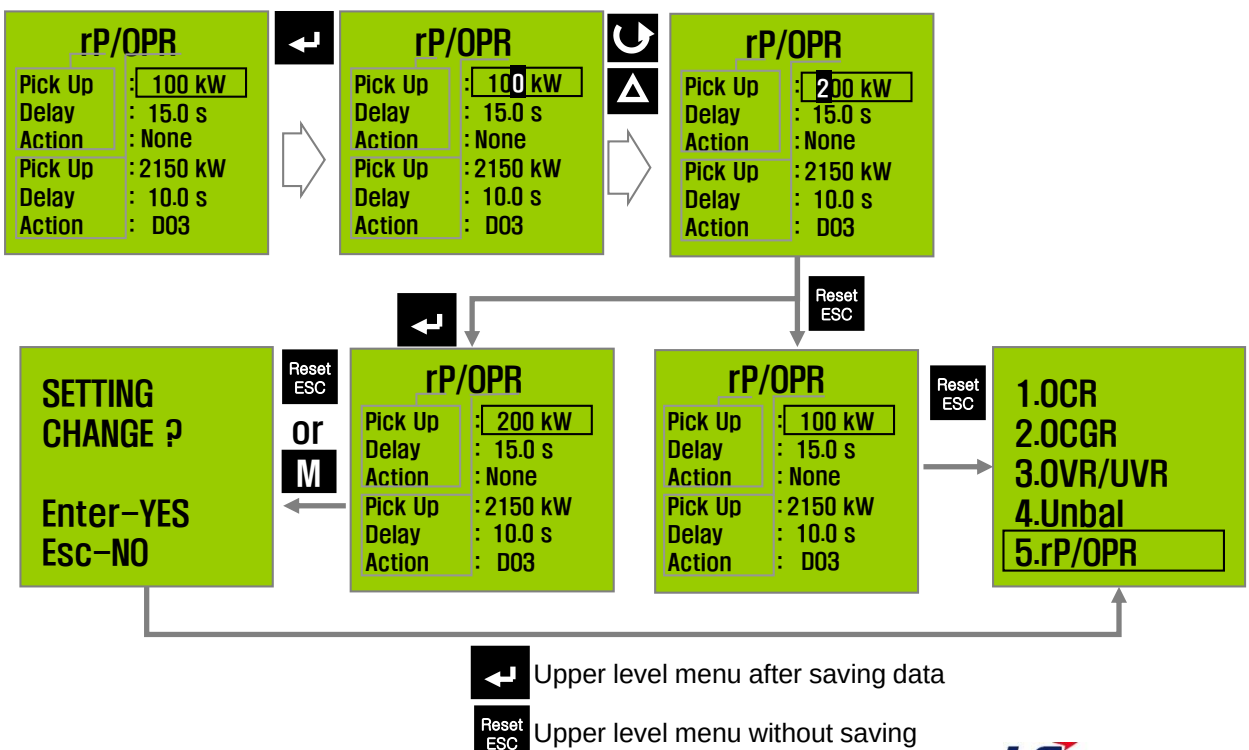
D. P/S Type Relay Setting

4. Reverse/Over Power Relay

CAUTION

- When total active power of 3 phases overflow more than its setting in reverse direction, Trip / None / DO1 / DO2 / DO3 / Fault function can be prearranged.
- Pickup Setting: Reverse Power->10~500kW(Step: 1kW) , Over Power-> 500~5000kW(Step: 1kW)
- Relay is valid between 0 ~ 60 degree of absolute phase angle (voltage-current phase difference)





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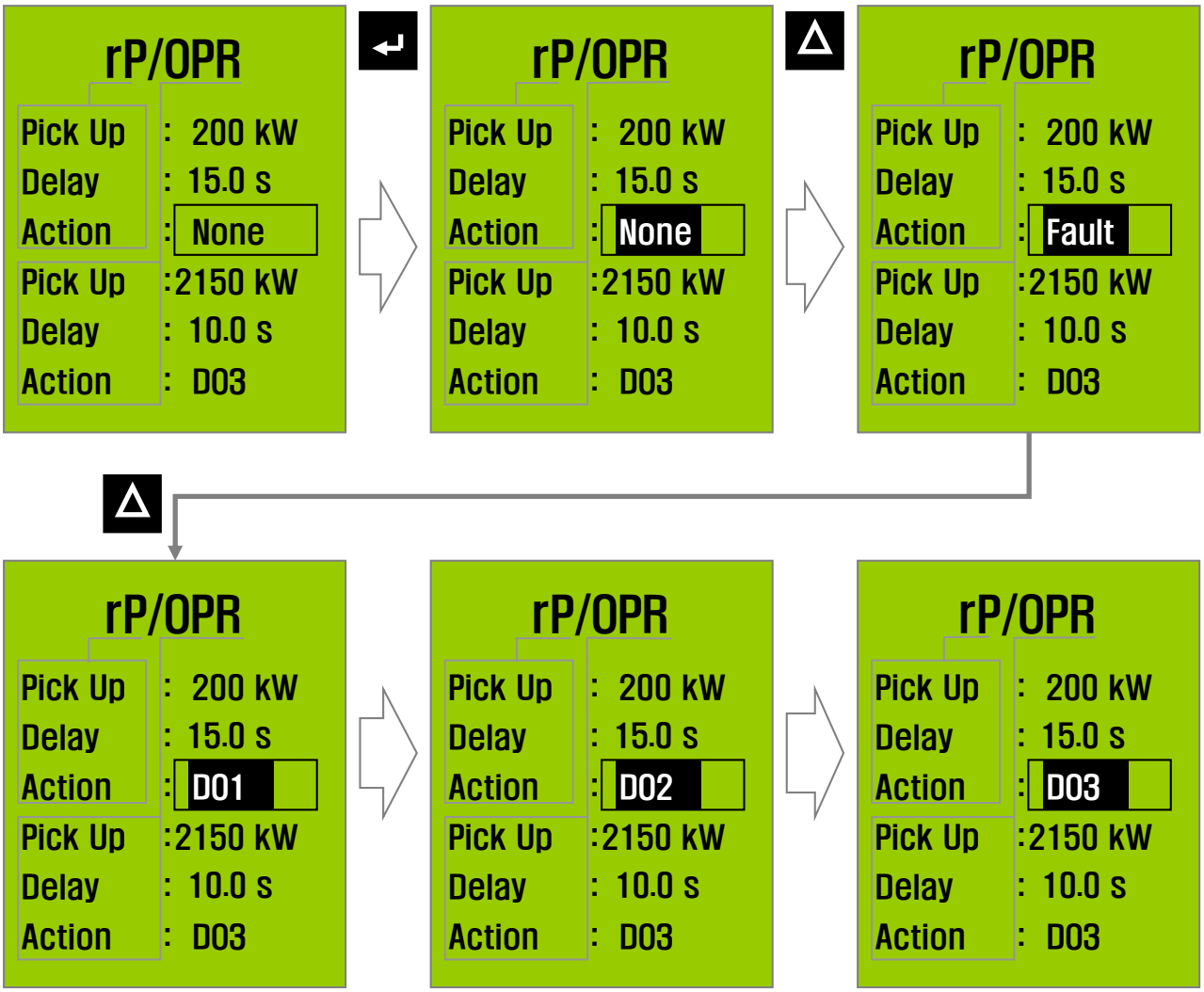
4. Reverse / Over Power

Relay Operation-Action Setting

- There are 6 kinds of action in relay operation.

1. None: Relay function was not implemented.
2. Fault: Under rP, OPR operation condition, it records fault events only.
3. DO1: Under rP, OPR operation condition, it records fault events, and close D01 relay.
4. DO2: Under rP, OPR operation condition, it records fault events, and close D02 relay.
5. DO3: Under rP, OPR operation condition, it records fault events, and close D03 relay.
6. Trip: Under rP, OPR operating condition, it records fault events, trip ACB, but does not close DO relay(s).

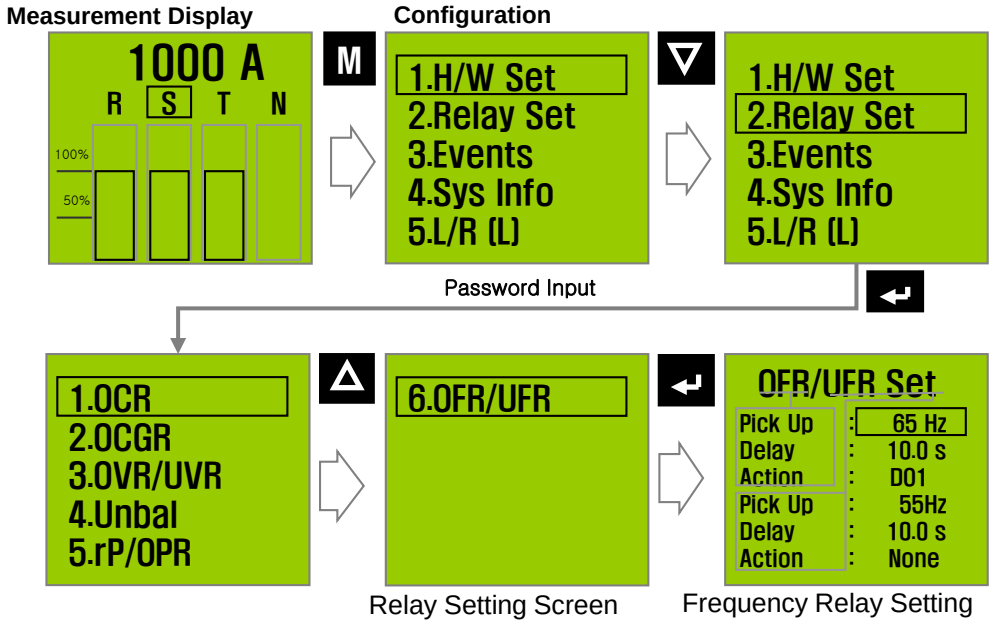


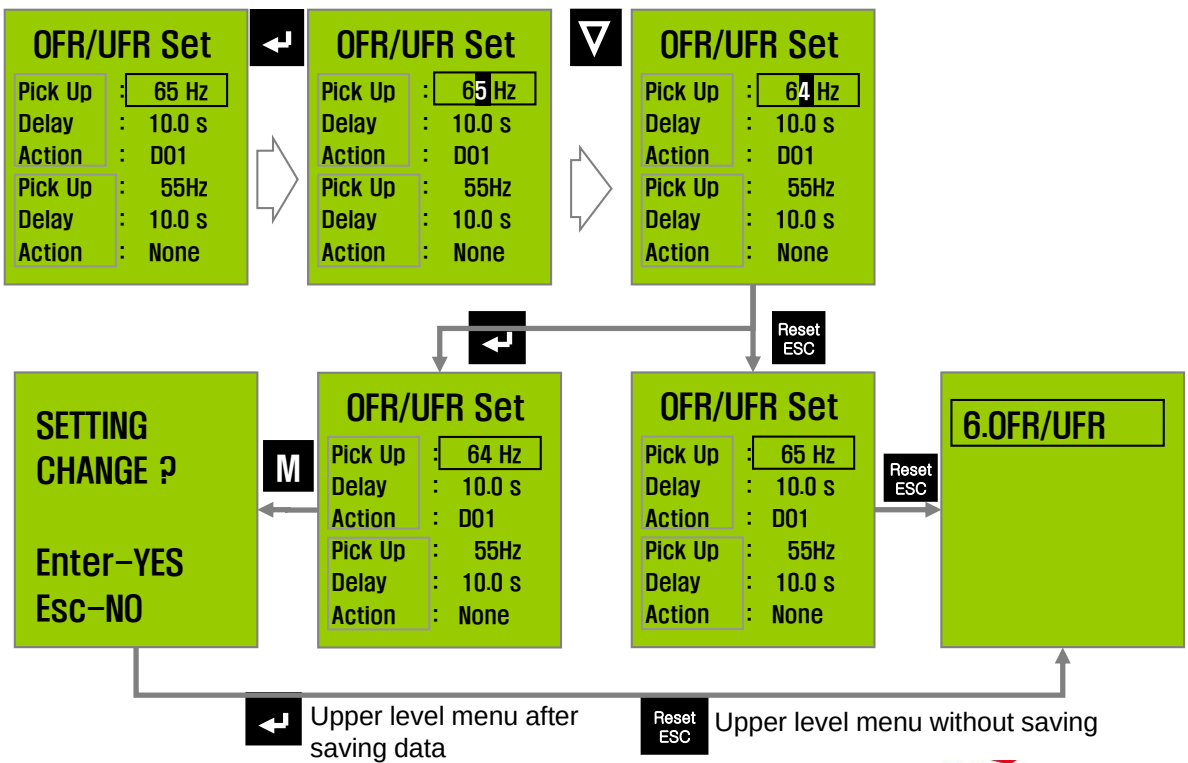
A. P/S Type Relay Setting

5. Over / Under Frequency Relay (OFR, UFR)

CAUTION

- When frequency on R phase voltage is greater than its setting value, Off/Alarm/DO function can be prearranged.
- Pickup Setting:
  - Over Frequency (60Hz) : Under Frequency Pickup Value ~ 65Hz (Step: 1Hz)
    (50Hz) : Under Frequency Pickup Value ~ 55Hz
  - Under Frequency (60Hz) : 55Hz ~ Over Frequency Pickup Value
    (50Hz) : 45Hz ~ Over Frequency Pickup Value
- Relay Voltage Range : R phase voltage above 80V ~ below 900V





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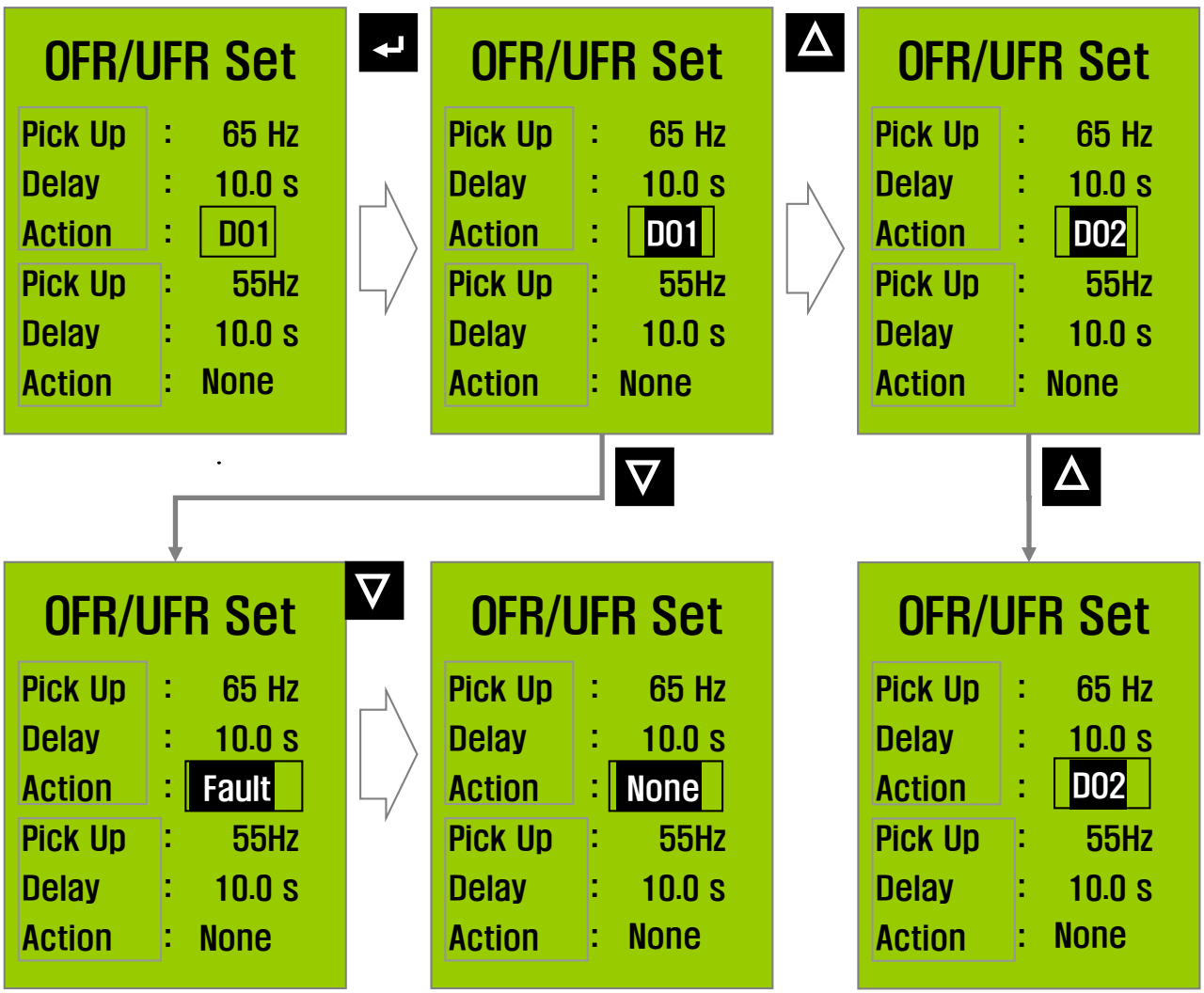
5. Over / Under Frequency Relay (OFR, UFR)

Relay Operation-Action Setting

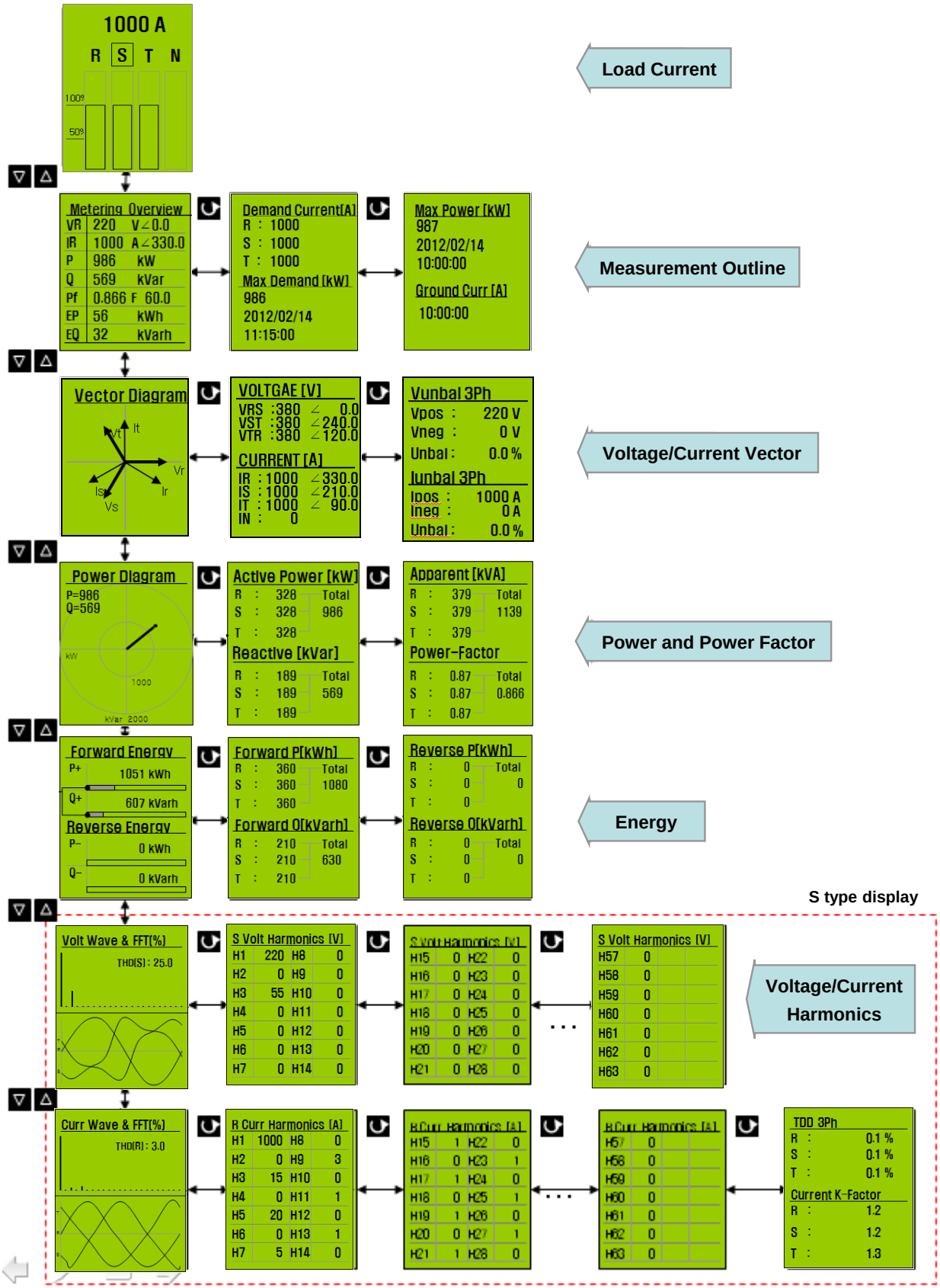
- There are 6 kinds of action in relay operation.

1. None: Relay function was not implemented.
2. Fault: Under OFR, UFR operation condition, it records fault events only.
3. DO1: Under OFR, UFR operation condition, it records fault events, and close D01 relay.
4. DO2: Under OFR, UFR operation condition, it records fault events, and close D02 relay.
5. DO3: Under OFR, UFR operation condition, it records fault events, and close D03 relay.
6. Trip: Under OFR, UFR operating condition, it records fault events, trip ACB, but does not close DO relay(s).



B. P/S Type Measurement Display

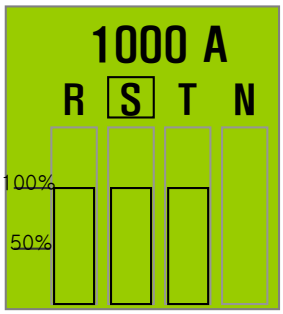
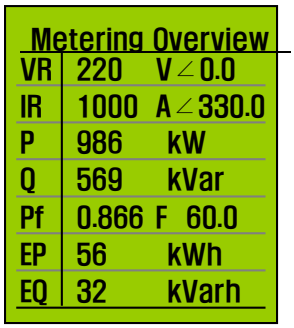
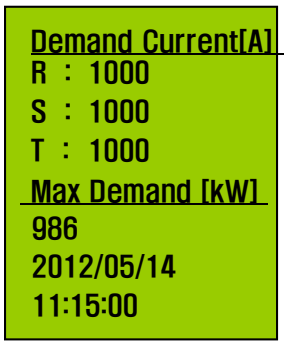
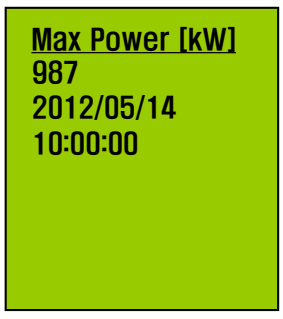
1. Measurement Display Arrangement



2. Initial Display and Measurement Outline

CAUTION

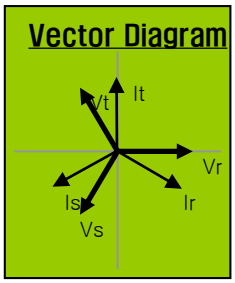
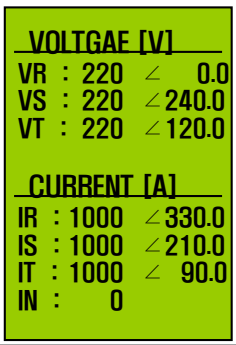
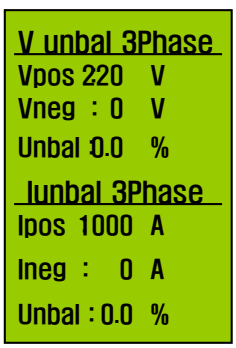
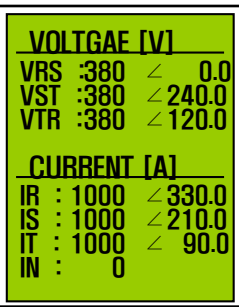
■ If there is no key input for 3 minutes at least on other measuring displays or setting display excluding the initial display, it will be moved to the initial display automatically.

Display	Button	Contents
	▽ △	The %load is indicated based on Ir current. Example) When Ir Knob is set on 0.4 at 2000AF, 100% Ir means 800A (0.4*2000).
	↻	1. P : 3 phase active power 2. Q : 3 phase reactive power 3. Pf : Synthesis power factor 4. EP : Forward Energy Display 5. EQ : Energy consumption Display
	↻	1. Demand Current[A] 2. Max Demand Value & Occurring time information
		1. Max power value & Occurring time information 2. Ground Current Occurring time information

3. Vector Diagram Display

CAUTION

- Displaying the voltage & current vector of 3 phases and symmetrical element value analyzed.
- Please refer to the algorism of measuring function.
- All values are updated once a second.
- The vector diagram can be drawn into phase voltage from 3P 4W mode, line voltage from 3P 3W mode.
- It displays the vector value through phase voltage and line voltage at 3s period alternately.

Display	Button	Contents
화면 설명 		1.Phase voltage vector display from 3P 4W mode 2. Line voltage vector display from 3P 3W mode
		1.It displays phase voltage and line voltage at 3s period alternately from 3P 4W mode. 2.It displays only line voltage from 3P 3W mode.
		
		

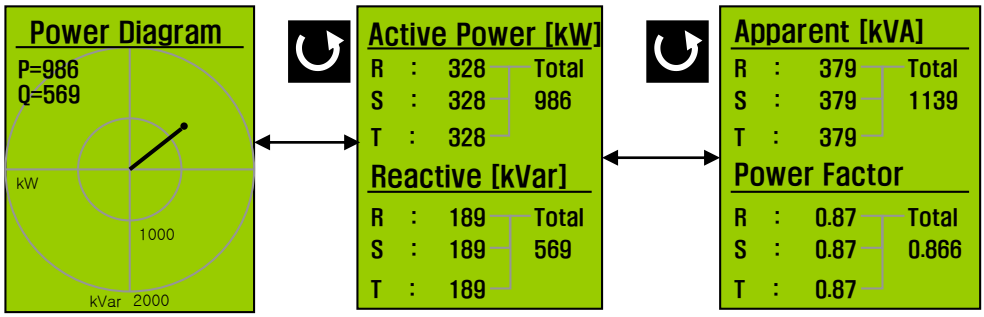
E. P/S Type Measurement Display

4. Power Diagram Display

CAUTION

- Displaying the 3 phases voltage/current vector & symmetrical element analyzed value
- Please refer to the algorism of measuring function.
- All values are updated once a second.
- As the decimal place is not calculated down, the sum of each phase could be slightly different from the total value.
- The scale control on display is automatic.

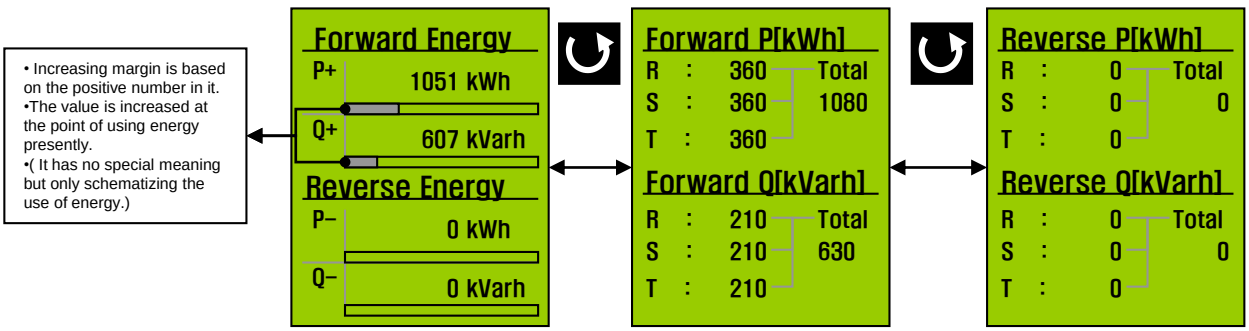
Energy Measurement Display

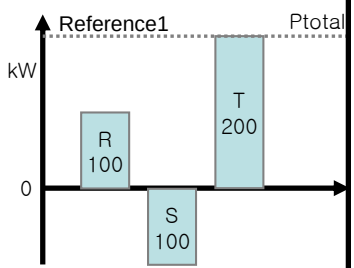


5. Energy Measurement Display

CAUTION

- Displaying each phase or synthetic energy measured
- Please refer to the algorism of measuring function
- All values are updated once a second.
- The energy accumulation of each phase could be different from synthetic energy. (Reference 1).





It is not common, but when the phase power is like the diagram, the synthetic power is 200.
In case of R phase, the forward energy is accumulated by 100.
In case of S phase, the reverse energy is accumulated by 200.
In case of T phase, the forward energy is accumulated by 200.
The synthetic power energy is 200 so the forward energy is accumulated by 200.
After 1 hour under the condition,
[Forward active energy is……]
R : 100 , S : 0 , T : 200 Total: 200
[Reverse active energy is……]
R : 0 , S : 100, T : 0 Total: 0
So, there will be difference among them.

6. Waveform and Harmonics Analysis Display

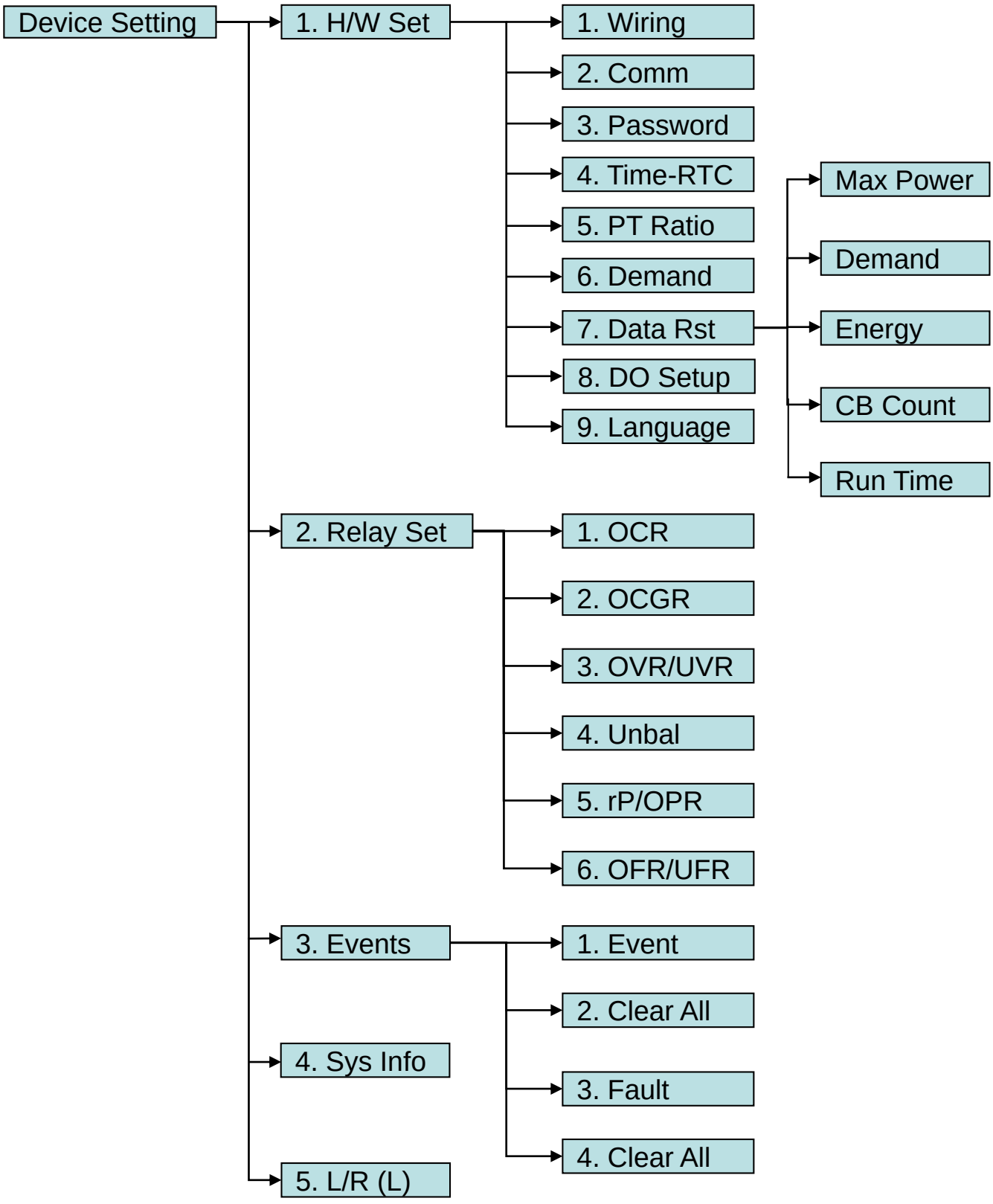
CAUTION

- Analyzes harmonics after obtaining the waveform of 3 phase voltage/current from 128 samples /cycle.
- Function of S type only.
- Refer to algorithm of the measurement function part.
- Displays TDD and K-factor value from current harmonics analysis.
- Executes once every 30 sec.
- Measures harmonics up to the 63rd.

Waveform and Harmonics Analysis

F. P/S Type Device Setting

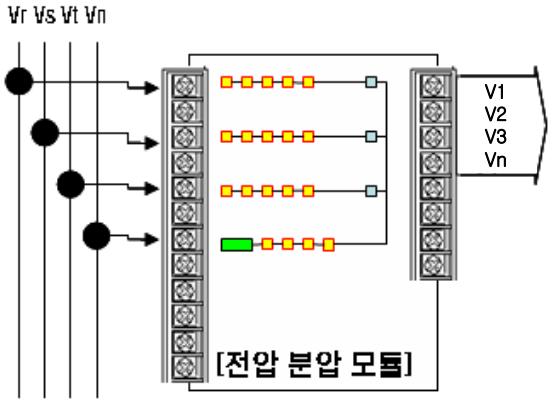
1. Menu Arrangement



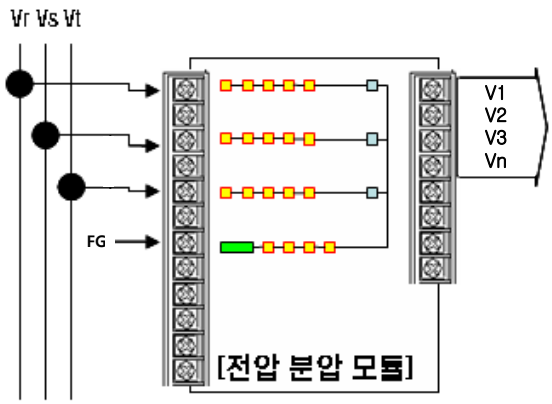
2. Device H/W Setting - Wiring Setting

CAUTION

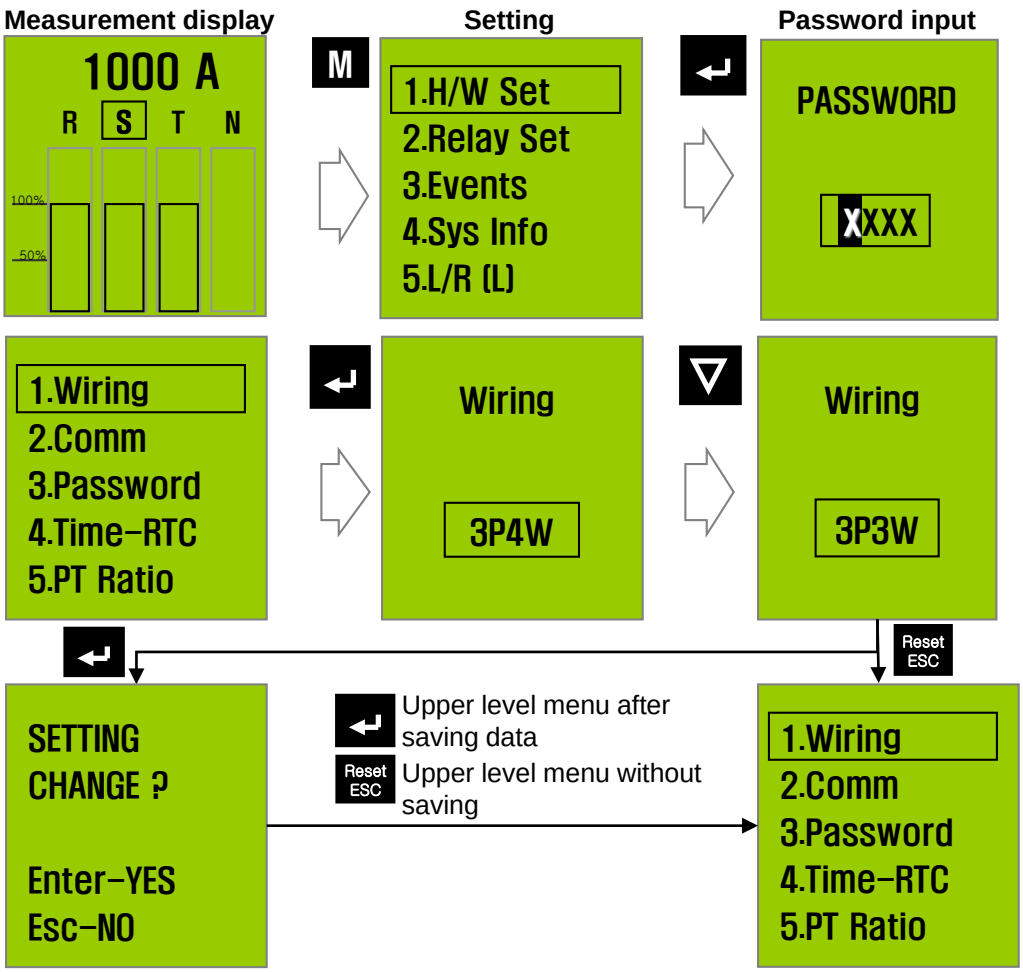
- P and S type support 3-phase 4-wire and 3-phase 3-wire type.
- According to wiring type, input the wiring method of voltage module correctly
- H/W Setting - set an accurate wiring method at the wiring setting.
- In case of 3-wire connection, connect N phase of VDM to FG



3P4W Voltage Wiring



3P3W Voltage Wiring

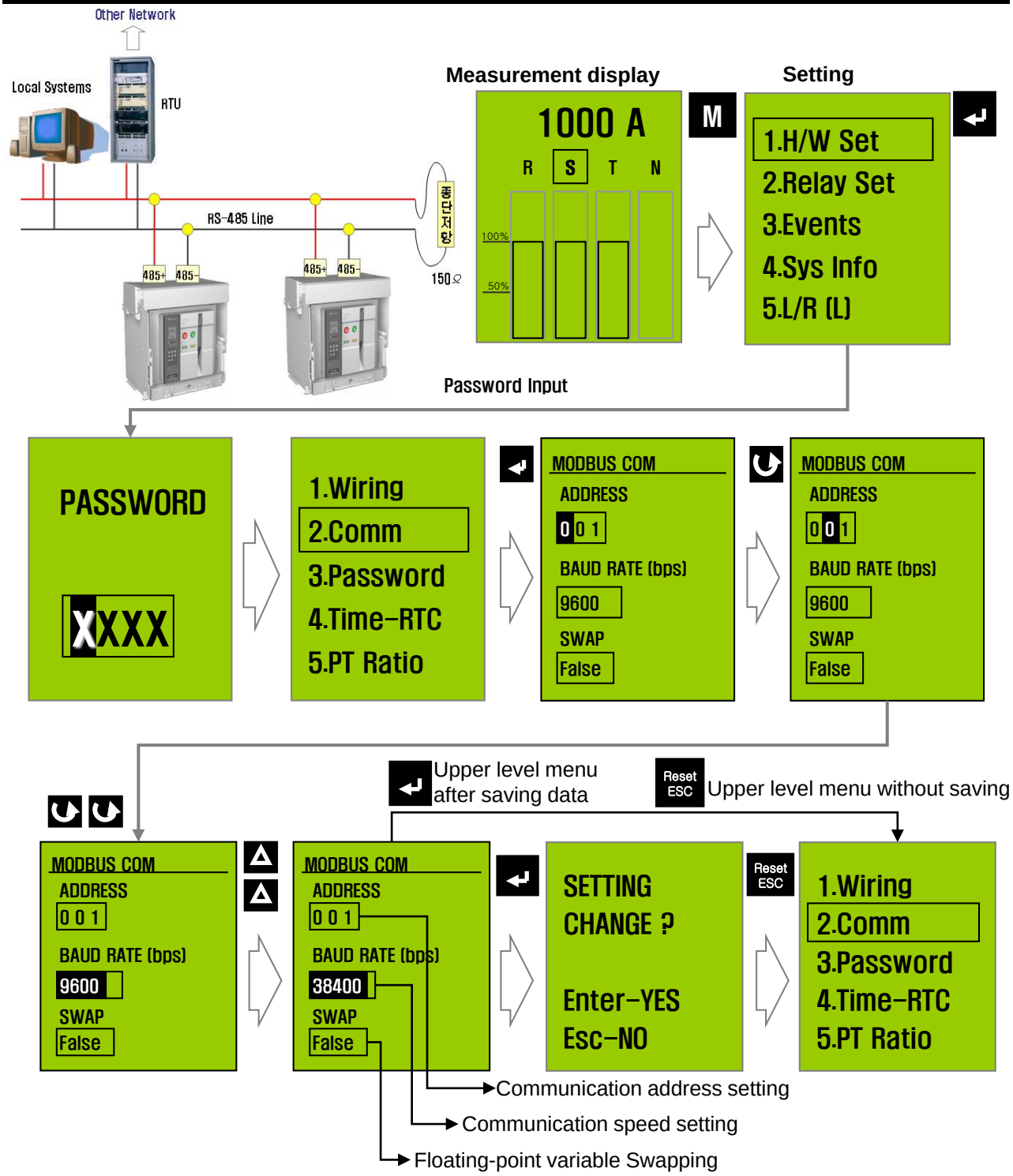


F. P/S Type Device Setting

3. Device H/W Setting - Communication Setting

CAUTION

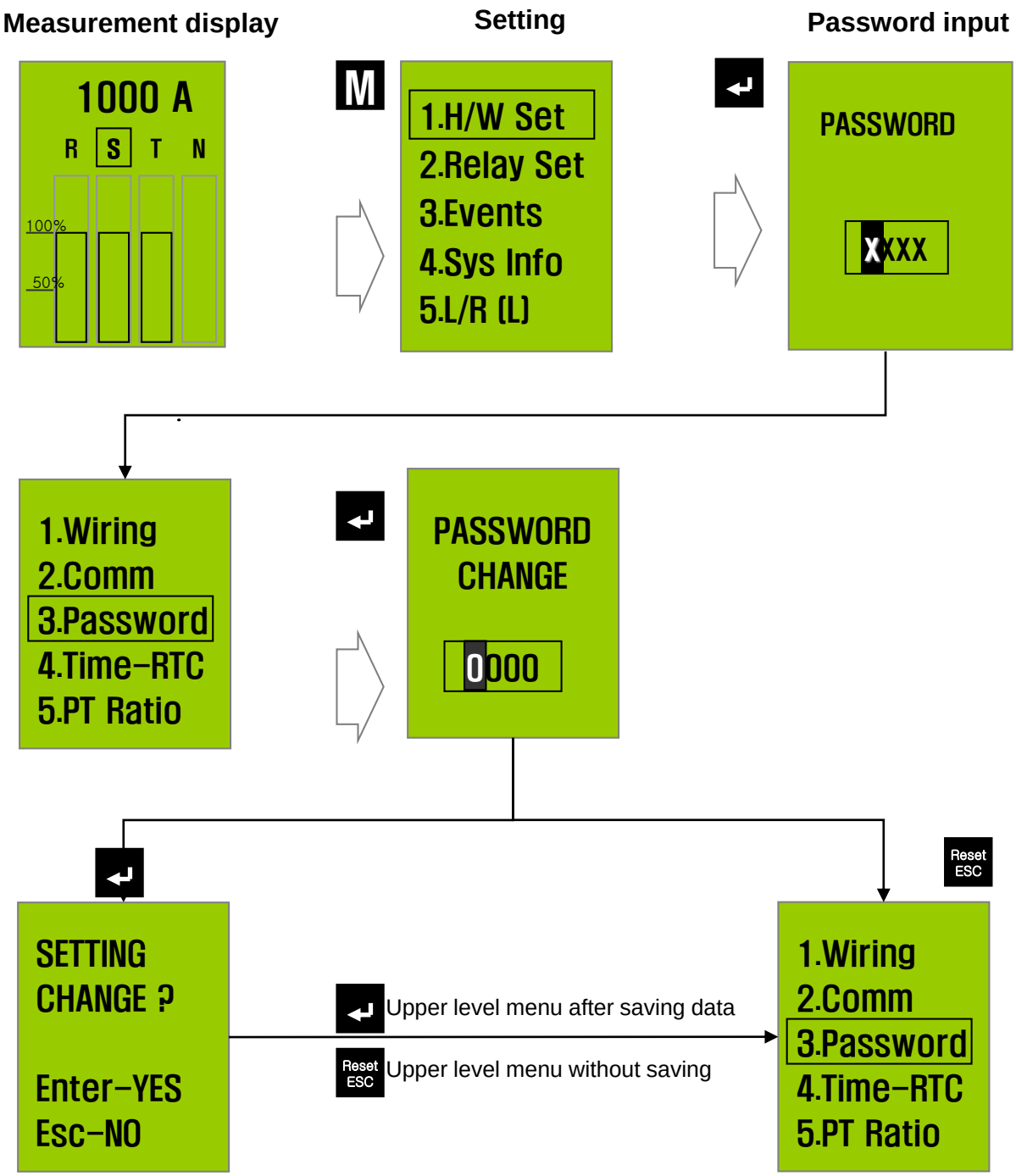
- P and S type support MODBUS RS-485 communication
- It forms Multi-Drop method on RS-485 line
- Put in 150ohm as terminating resistance.



4. Device H/W Setting - Password Setting

CAUTION

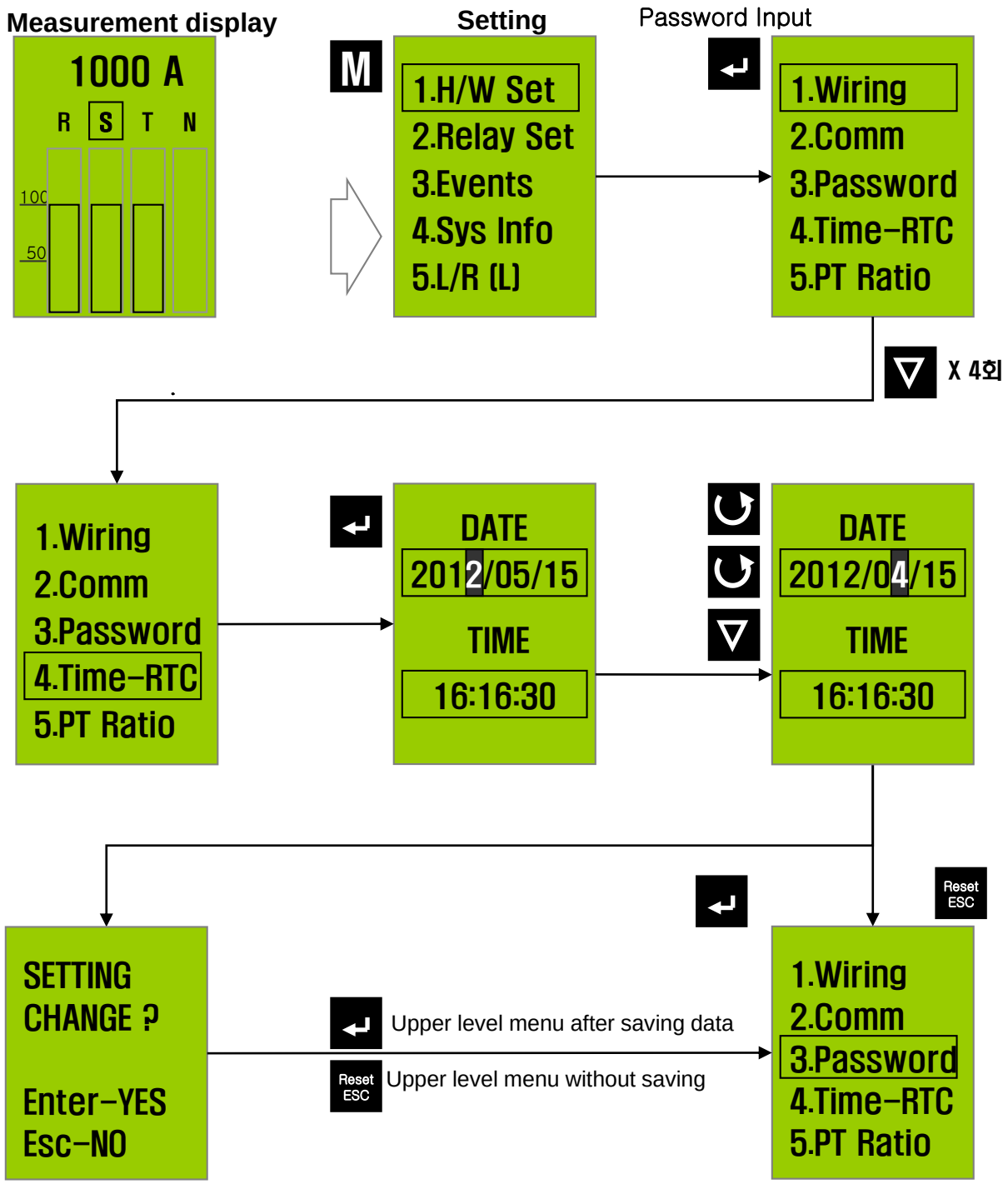
■ P and S type provide a password function to protect the device.
Default password is '0000'. Users can change the password through password setting.



5. Device H/W Setting - Time Setting

CAUTION

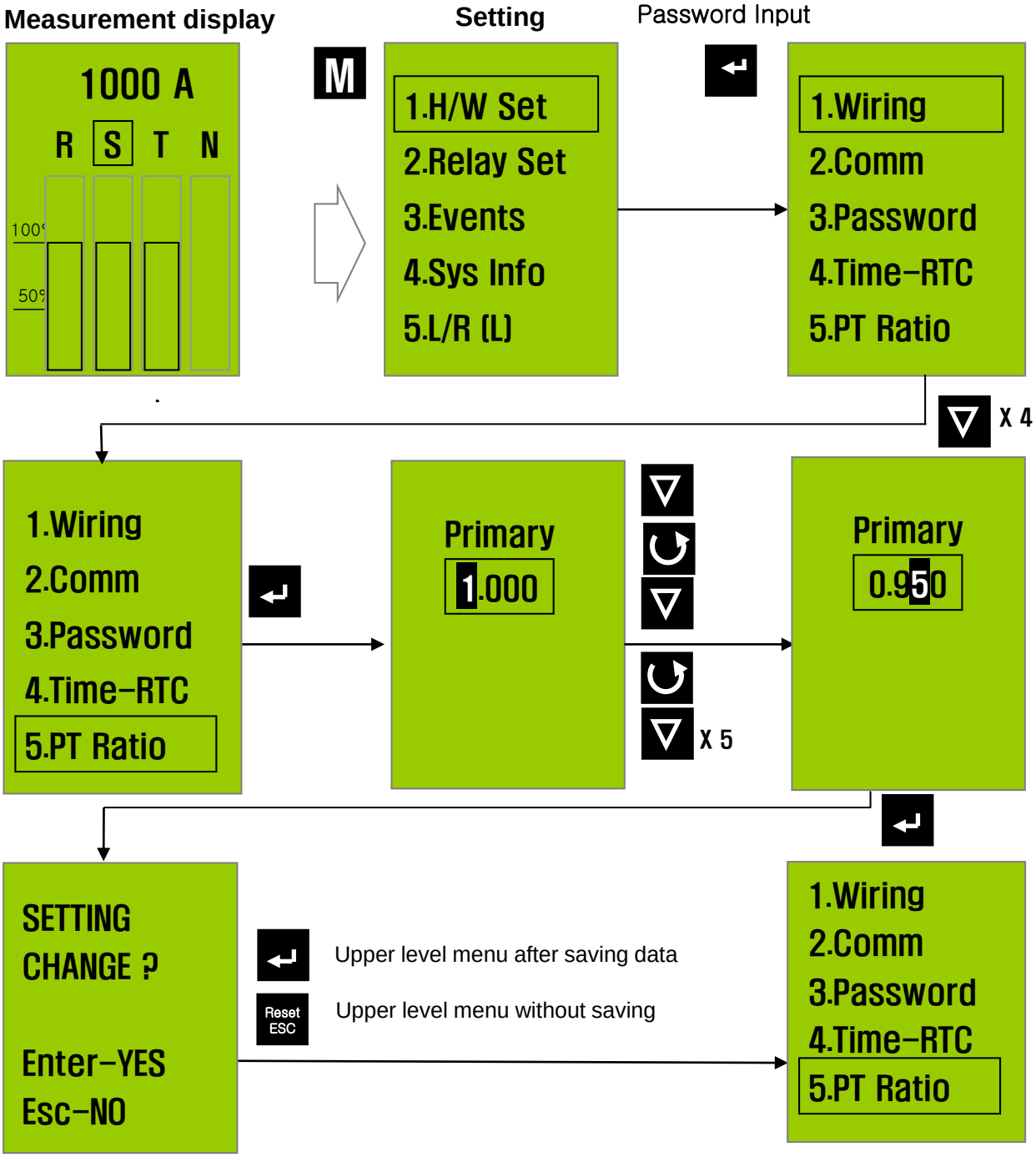
■ P and S type contain a precise timer (RTC) inside. User can adjust the time at a remote place or at the device.



6. Device H/W Setting – PT Ratio Setting

CAUTION

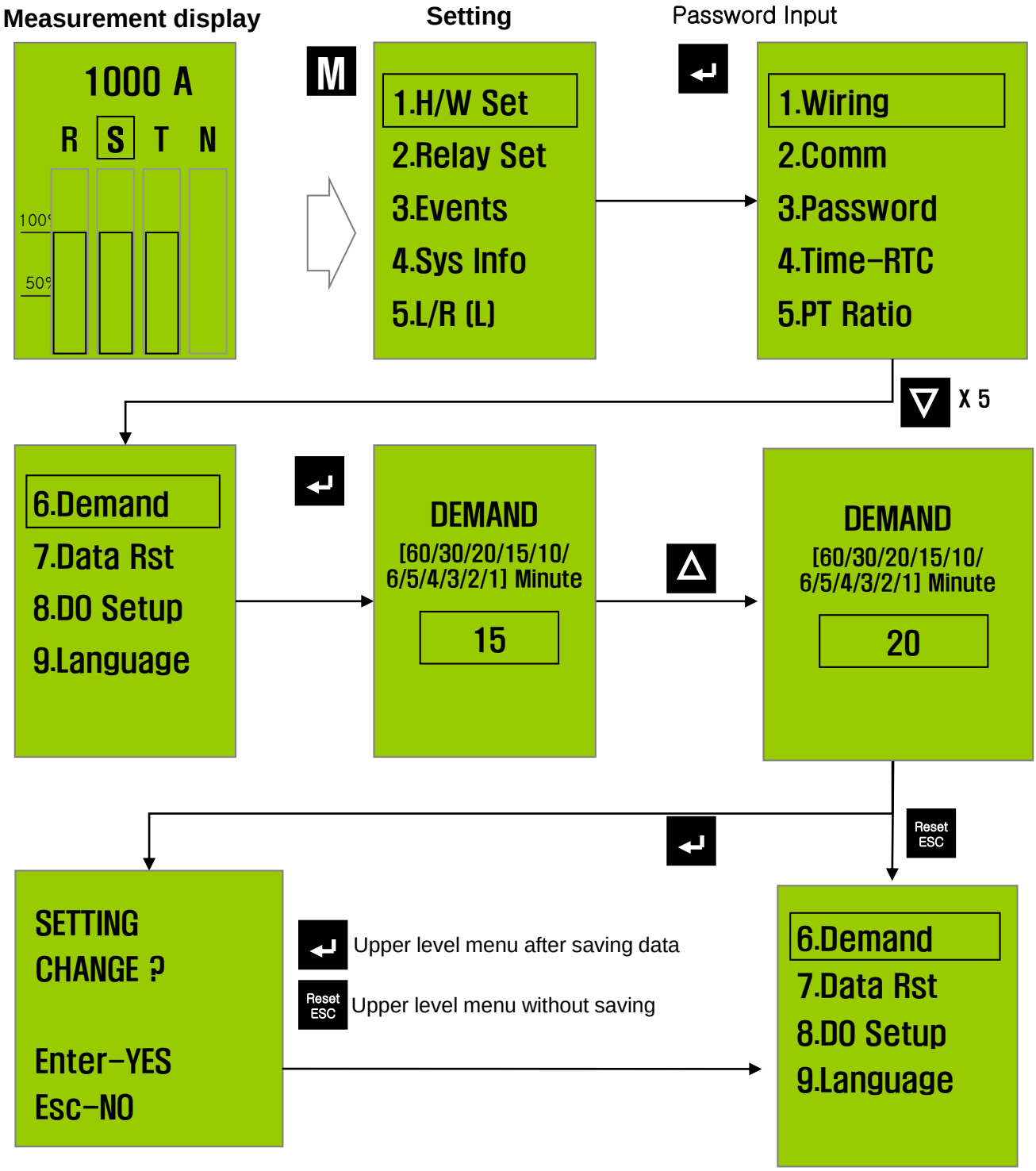
■ P and S Type provide a PT ratio function to display accurate PT voltages
In case of using VDM, users can setting PT ratio.



7. Device H/W Setting- Demand Setting

CAUTION

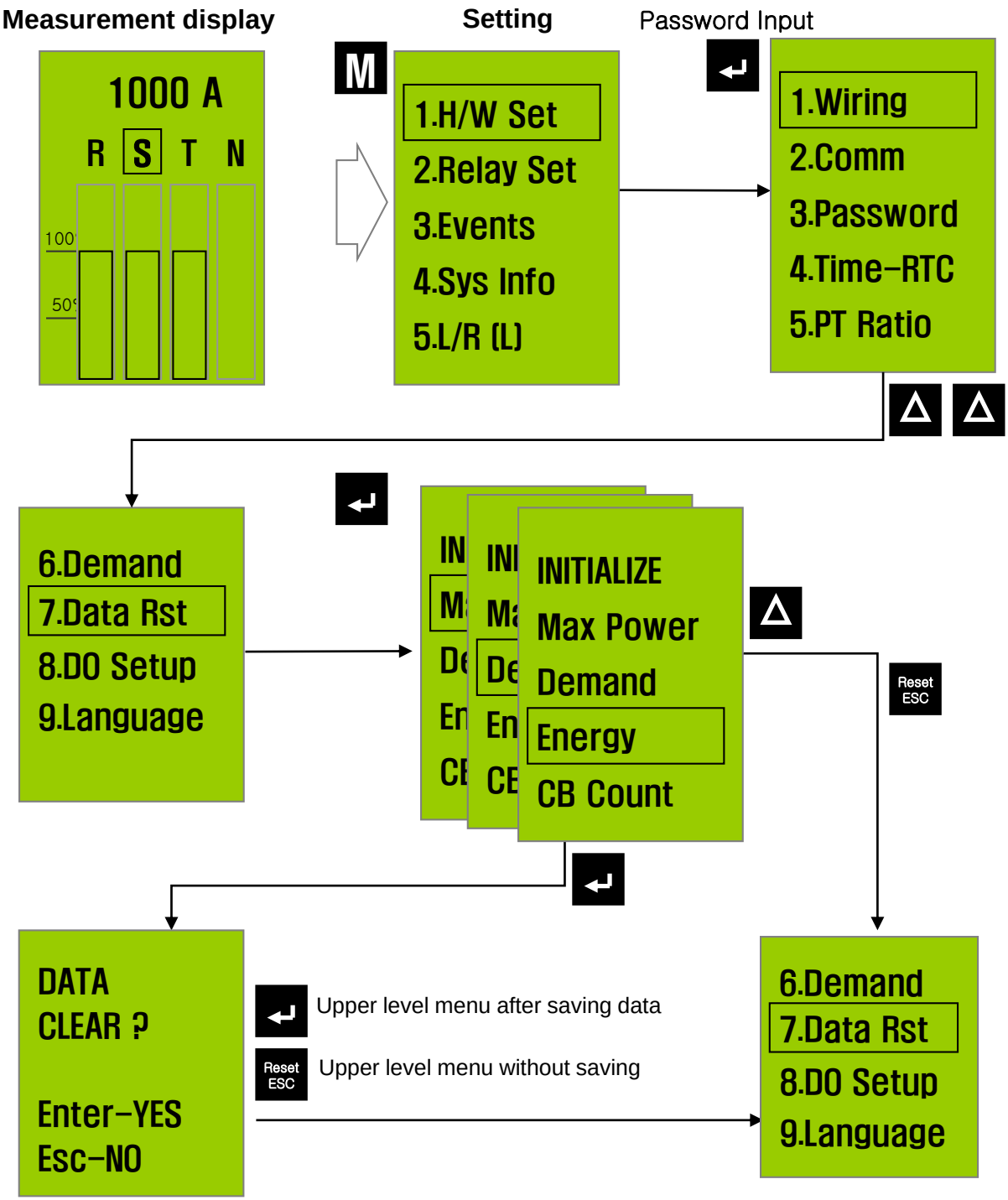
■ P and S type provide Demand measurement function. Demand cycle can be set by divisors of 60 minutes.



8. Device H/W Setting - Data Reset

CAUTION

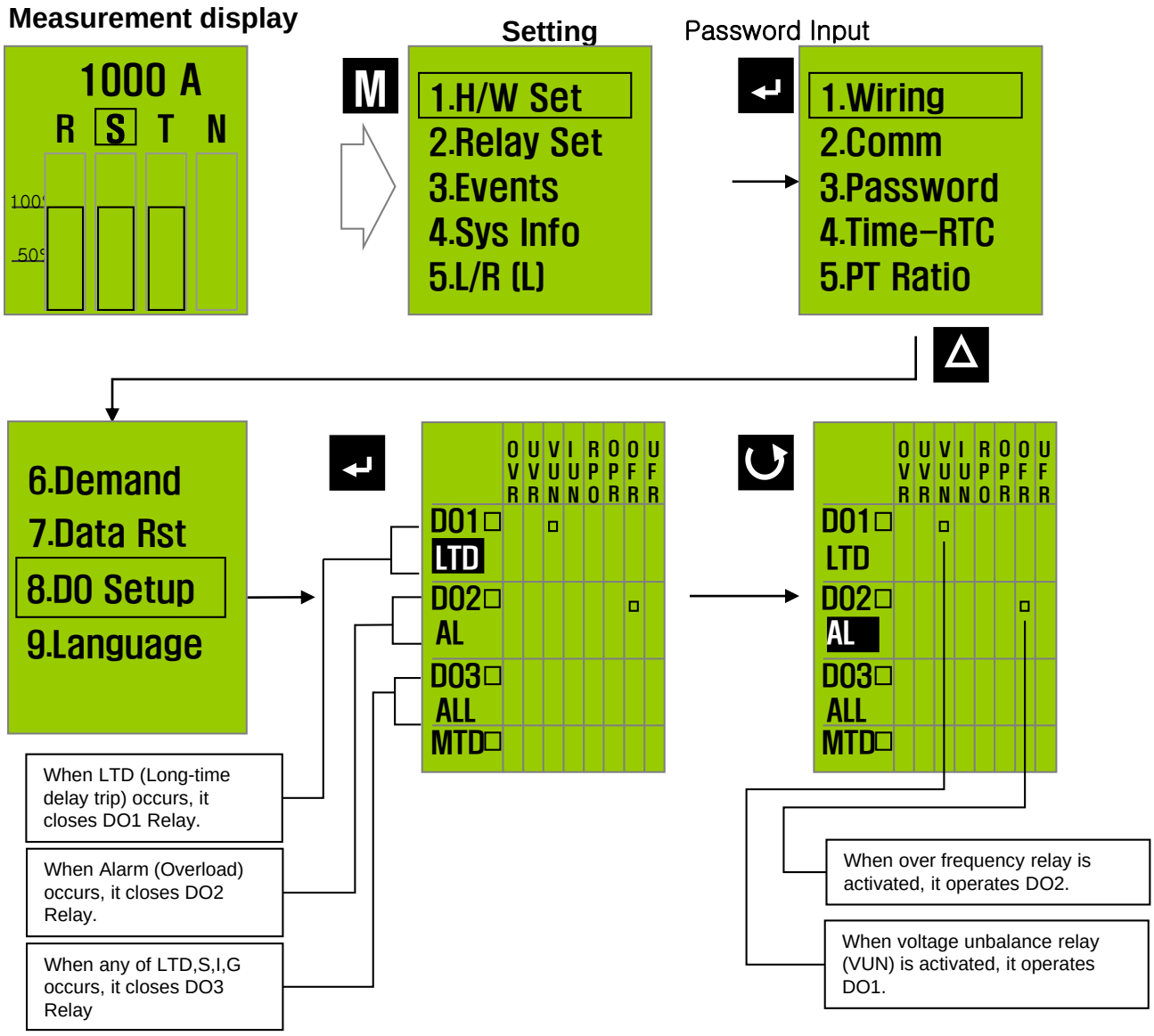
■ P and S type continuously save maximum power, maximum demand, energy, the breaking numbers of a circuit breaker, and operating time of a circuit breaker. User can set the data as default and restart it.



9. Device H/W Setting - DO Setting

CAUTION

■ P and S type have 3 Relay Outputs. User can set those upon their purposes such as relay operation, OCR/OCGR operating alarm, and overload alarm, etc.

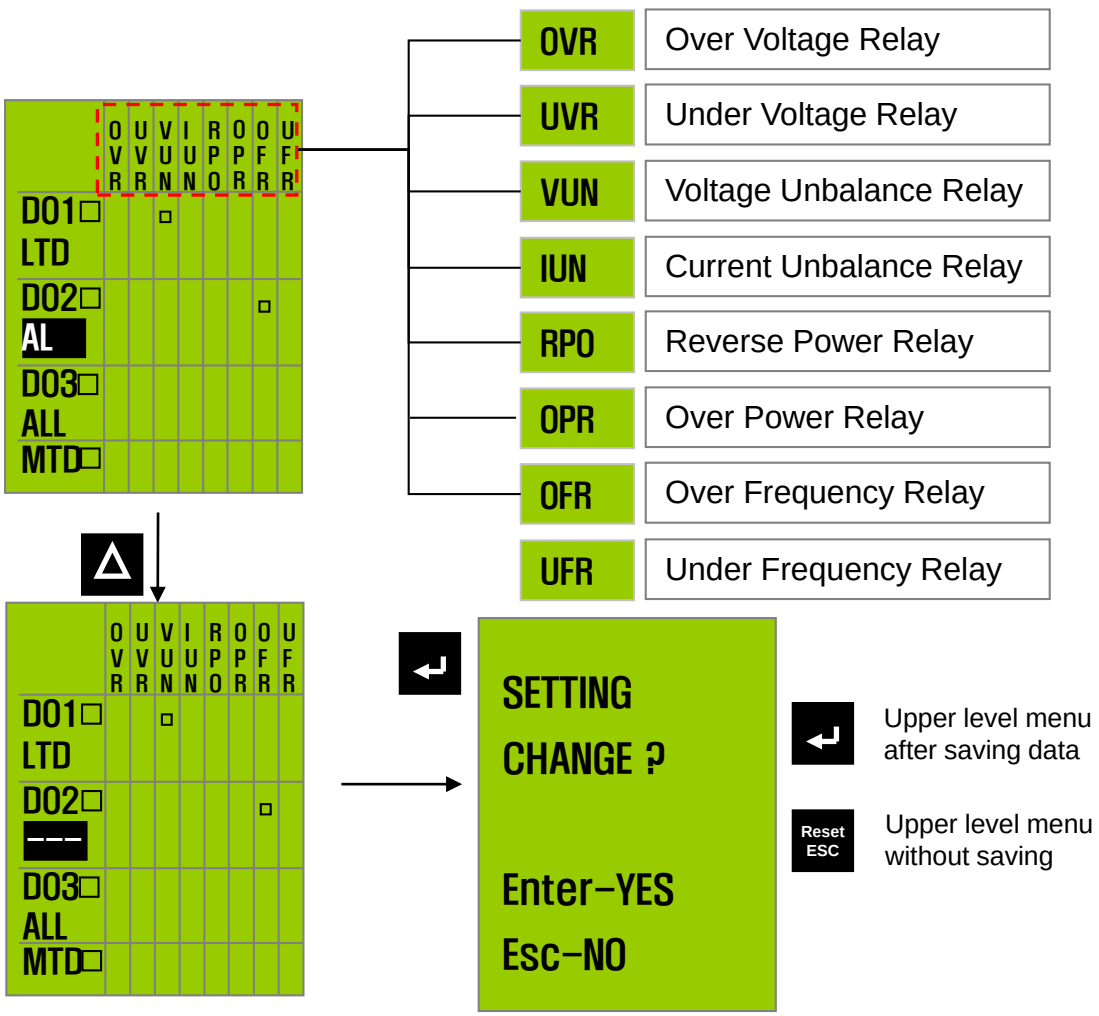


CAUTION

■ Settings for DO operation are as follows:
→ LTD → S,I → GND → PTA → AL → ALL

9. Device H/W Setting - DO Setting

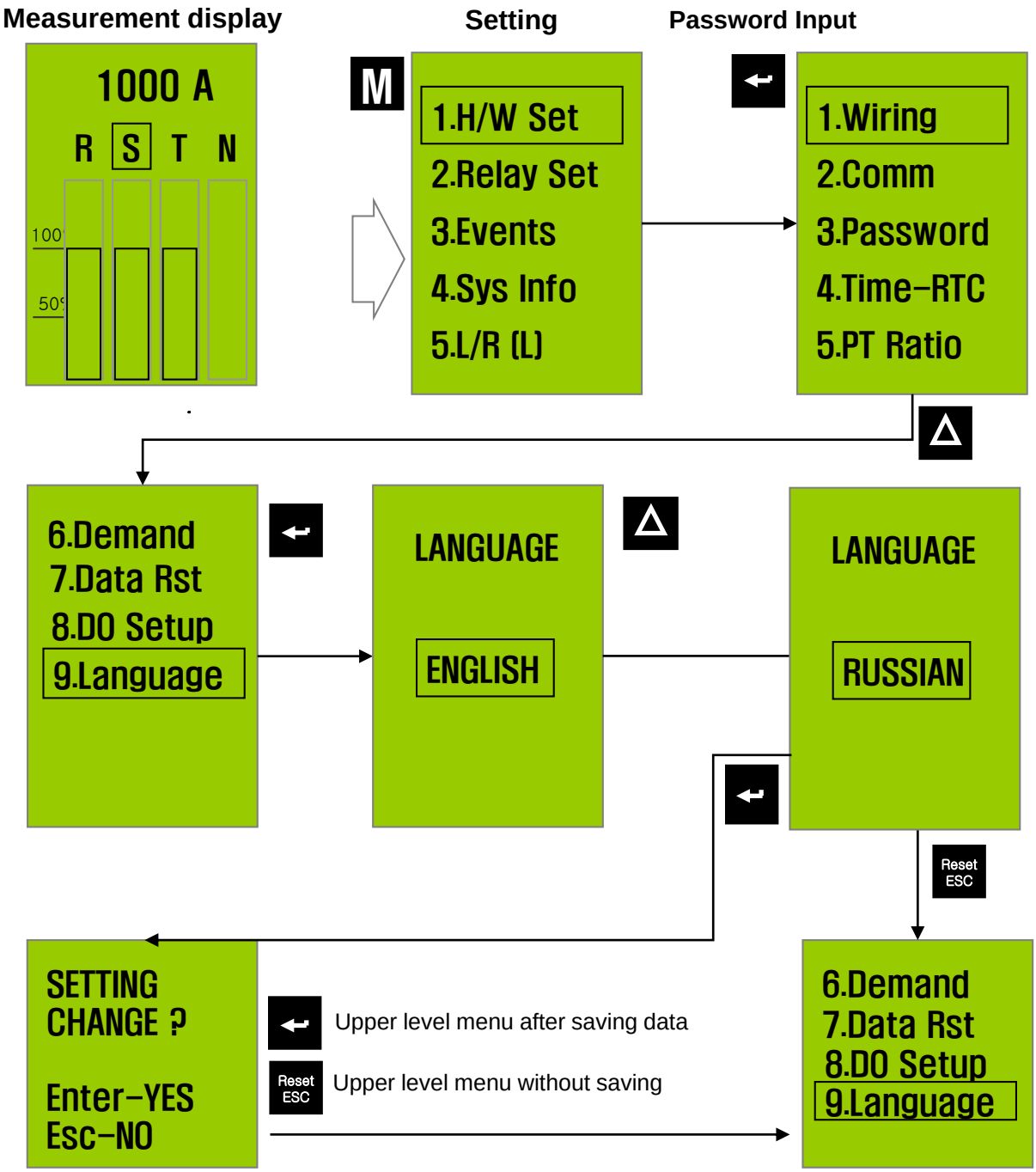
---	DO does not operate at all events.
LTD	When long-time delay trip occurs, it closes the corresponding DO (Relay).
S,I	When short-time, instantaneous trip occurs, it closes the corresponding DO (Relay).
GND	When ground gault trip occurs, it closes the corresponding DO (Relay).
PTA	When Pre-Trip Alram trip occurs, it closes the corresponding DO (Relay).
AL	When overload (above 95% of the rated current) occurs, it closes the corresponding DO (Relay).
ALL	When any of LTD,S,I,GND trip occurs, it closes the corresponding DO (Relay).



10. Device H/W Setting – Language Setting

CAUTION

■ P and S type can setting languages between English and Russian.



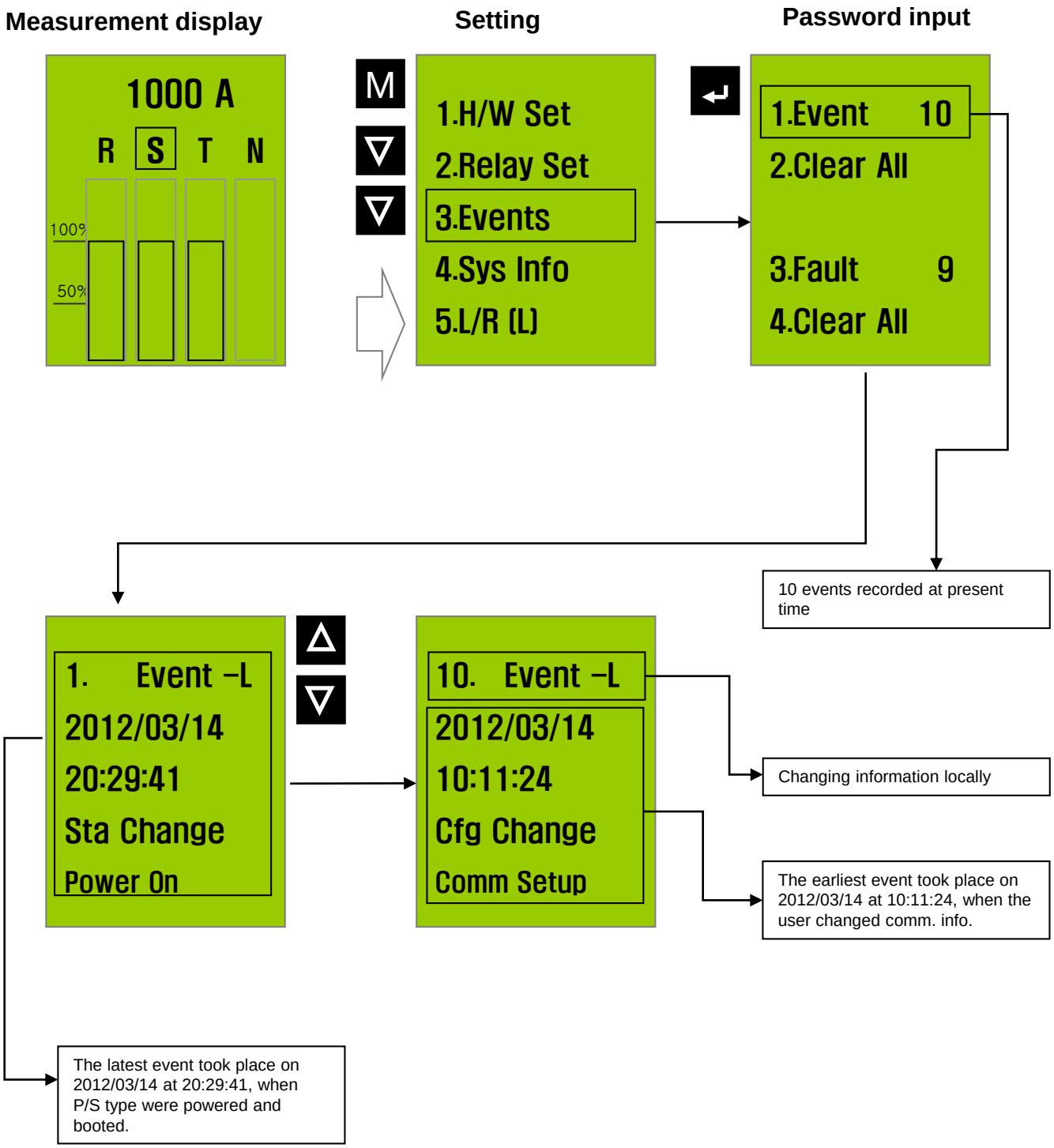
11. Event Information Display

Event information

- P and S type record up to 256 information of the events that took place in the device in accordance with time. In case where more than 256 events occurs, past events get deleted and new data gets recorded.
- Events that get recorded are as follows.

Change of device setting	Wiring method change	Records event when user changes wiring method
	Comm. config. Change	Records Comm. config. (Speed, Address, Swap) change
	Password change	Records info when password changes
	Time change	Records internal time info when it changes
	Demand setting change	Records when demand setting (demand cycle) changes
	DO setting change	Records when setting of DO1~DO3 changes
	OCR fine adjustment	Records when performing the fine adjustment for long-time delay, short-time delay, instantaneous relay setting of OCR
	OCGR fine adjustment	Records when performing fine adjustment of OCGR's relay current
	OVR/UVR change	Records when setting of OVR/UVR changes
	Unbalance relay setting change	Records when setting of voltage/current unbalance relay changes
	Reverse power relay setting change	Records when setting of reverse power changes
	Frequency relay setting change	Records when setting of Low/high frequency relay changes
	OCR knob change	Records when changing long, short-time, instantaneous knob on the front side of device
	OCGR knob change	Records when changing the knob relating ground fault on the front side of device
Device error	Internal comm. error	Records when comm. error occurs among internal CPUs
	MTD wiring fall out/cut off	Records when MTD (Magnetic Trip Device) wiring is wrongly connected
	Memory error	Records when internal memory error occurs
Device state change	Local / Remote change	Records when device mode changes Local→Remote, Remote→Local
	Power On	Records after initial booting when power of P/S type turns on
	Fault Reset	Records when fault occurs and reset is reset
	DO1 control (Close/Open)	Records when DO1's output changes OFF→ON, ON→OFF
	DO2 control (Close/Open)	Records when DO2's output changes OFF→ON, ON→OFF
	DO3 control (Close/Open)	Records when DO3's output changes OFF→ON, ON→OFF
Device info Change	Max. power reset	Records when max. power resets
	Max. demand reset	Records when max. demand resets
	Energy reset	Records when energy (electric) resets
	Event info reset	Records when deleting all event info
	Fault info reset	Records when deleting all Fault info

11. Event Information Display



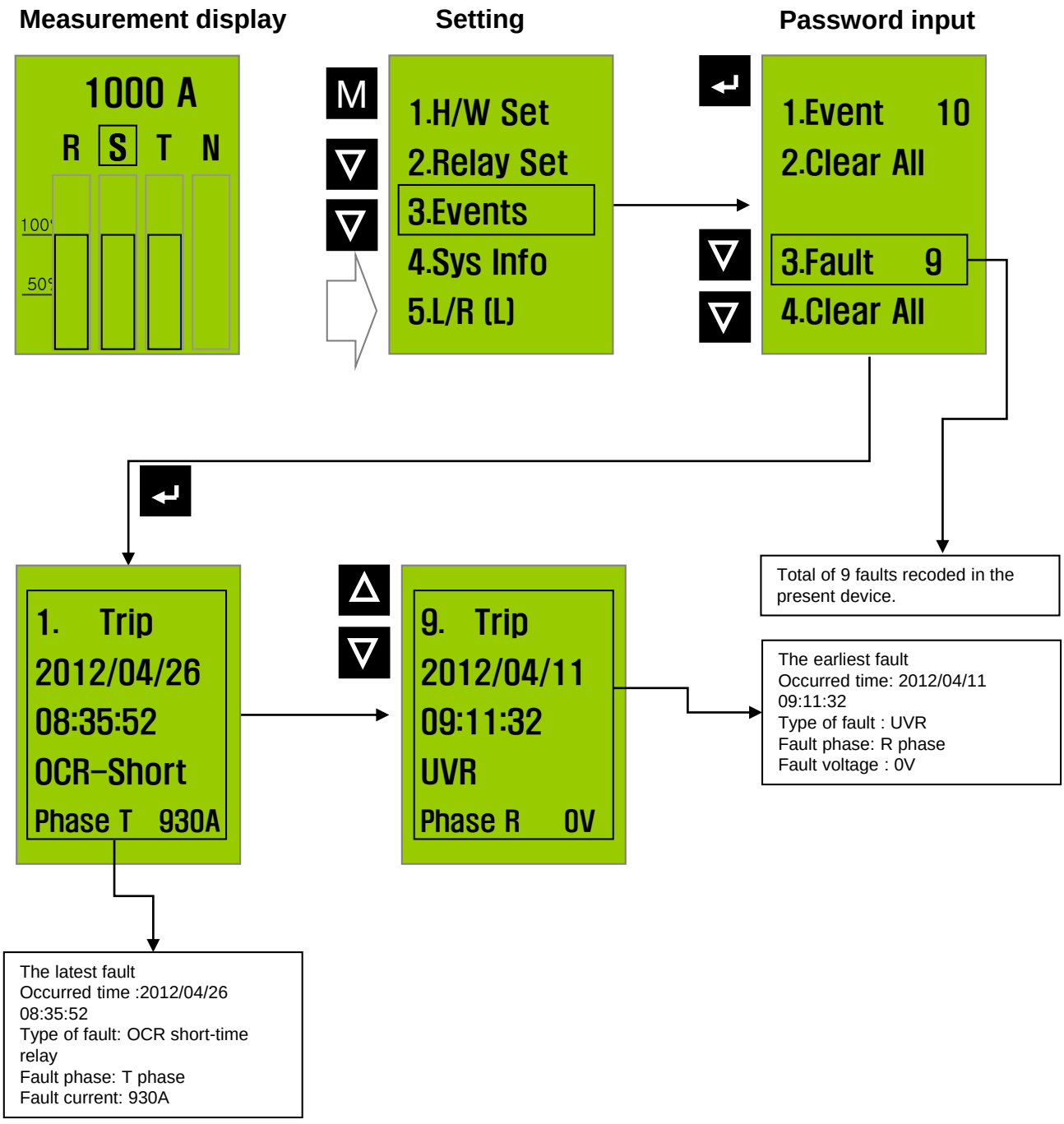
11. Event Information Display

Display		
Device configuration change → "Cfg Change"	Wiring method change	"Wiring"
	Comm. config. change	"Comm Setup"
	Password change	"Password"
	Time change	"Time Change"
	Demand setting change	"Demand"
	DO setting change	"OCR DO Config"
	OCR fine adjustment	"OCR Fine Set"
	OCGR fine adjustment	"OCGR Fine Set"
	OVR/UVR change	"OVR/UVR"
	Unbalance relay setting change	"Unbal RY"
	Reverse/Over power relay setting change	"rP/OPR RY"
	Frequency relay setting change	"OFR/UFR"
	OCR knob change	"OCR Knob"
	OCGR knob change	"OCGR Knob"
Device error → "Error"	Internal communication error	"Inter Comm"
	MTD wiring fall out/cut off	"MDT Wire"
	Memory error	"Memory"
Device state change → "Sta Change"	Local / Remote change	"Local 2 Remote" "Remote 2 Local"
	Power on	"Power On"
	Fault Reset	"Trip Reset"
	DO1 control (Close/Open)	"DO#1 CTRL"
	DO2 control (Close/Open)	"DO#2 CTRL"
	DO3 control (Close/Open)	"DO#3 CTRL"
Device info change → "Rst Data"	Max. power reset	"Reset MaxP"
	Max. demand reset	"Reset Demand"
	Energy reset	"Reset Energy"
	Event info clear	"Clear Sys Event"
	Fault info clear	"Clear Trip Event"

- P and S type record the faults occurred from device (Trip & selective relay operation) up to 256 to know operation info and factor when trip or relay operates.
- Past data gets deleted and new data gets recorded when records exceeds 256.
- The contents of record are as follows.

Fault Information		
OCR OCGR	Long-time	Records when Over Current Relay operates
	Short-time	Records when Short-time delay trip operates
	Instantaneous	Records when Instantaneous trip operates
	Ground fault	Records when Ground fault trip occurs
	Ground fault -ZCT	Records when Ground fault(external CT) trip occurs
	Leakage	Records when trip occurred due to Leakage current
Selective Relay	PTA (Pre Trip Alarm)	Records when Pre Trip Alarm Relay operates
	OVR	Records when OVR Relay operates
	UVR	Records when UVR Relay operates
	Voltage Unbalance	Records when Voltage Unbalance Relay operates
	Current Unbalance	Records when Current Unbalance Relay operates
	Over Power	Records when Current Unbalance Relay operates
	Reverse Power	Records when Over Power Relay operates
	OFR	Records when Over Frequency Relay operates
	UFR	Records when Under Frequency Relay operates

12. Fault Information Display



12. Fault Information Display

Display – Fault Information

OCR OCGR	Long-Time Delay	“OCR-Long”
	Short-Time Delay	“OCR-Short”
	Instantaneous	“OCR-Ins”
	Ground fault	“OCGR”
	Ground fault -CT(Externel-CT)	“OCGR-ZCT”
	Leakage	“Leakage”
Selective Relay	PTA (Pre Trip Alarm)	“PTA”
	OVR	“OVR”
	UVR	“UVR”
	Voltage Unbalance	“Vunbal”
	Current Unbalance	“Iunbal”
	Reverse Power	“rP”
	Over Power	“OPR”
	OFR	“OFR”
	UFR	“UFR”

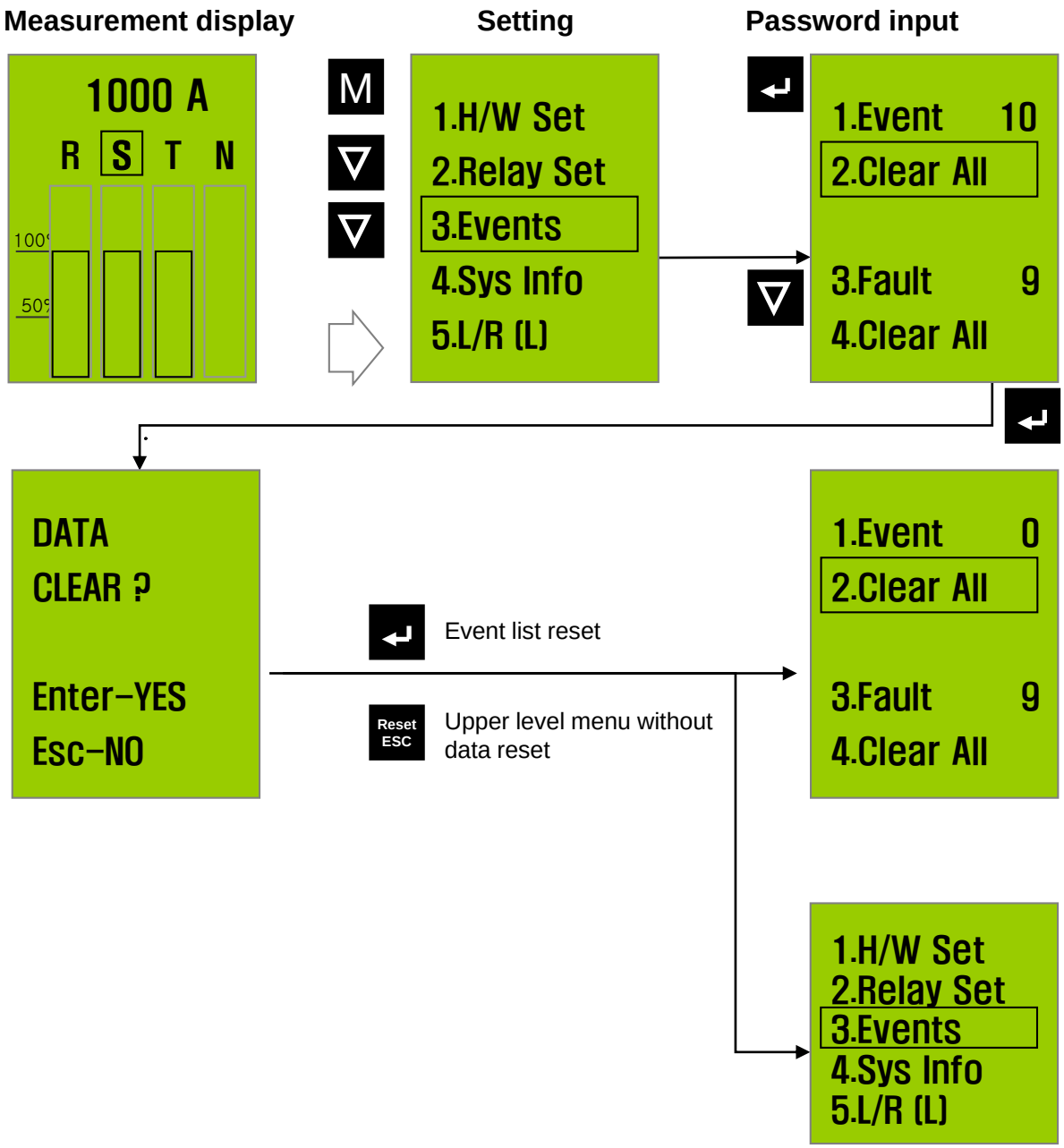
Display – Indication of fault phase and trip value

OCR OCGR	Long-Time Delay	“Phase-R xxx A” “Phase-S xxx A” “Phase-T xxx A” “Phase-N xxx A”
	Shot-Time Delay	
	Instantaneous	
	IDMTL	
	Ground fault	“xxx A”
	Leakage	“xxx A”
Selective Relay	PTA (Pre Trip Alarm)	“xxx A”
	OVR	“Phase-R xxx V” “Phase-S xxx V” “Phase-T xxx V”
	UVR	
	Voltage Unbalance	“xx %”
	Current Unbalance	“xx %”
	Reverse Power	“xxx kW”
	Over Power	“xxx kW”
	OFR	“xx Hz”
	UFR	“xx Hz”

13. Event Information / Fault Information Deletion

CAUTION

- P and S type can record up to 256 event info and 256 fault info.
- User can delete the corresponding event or fault list at the user's discretion .
- Deleted info remains in the event info



14. System Information Display

CAUTION

■ P and S type can indicate its own information including the information of the ACB

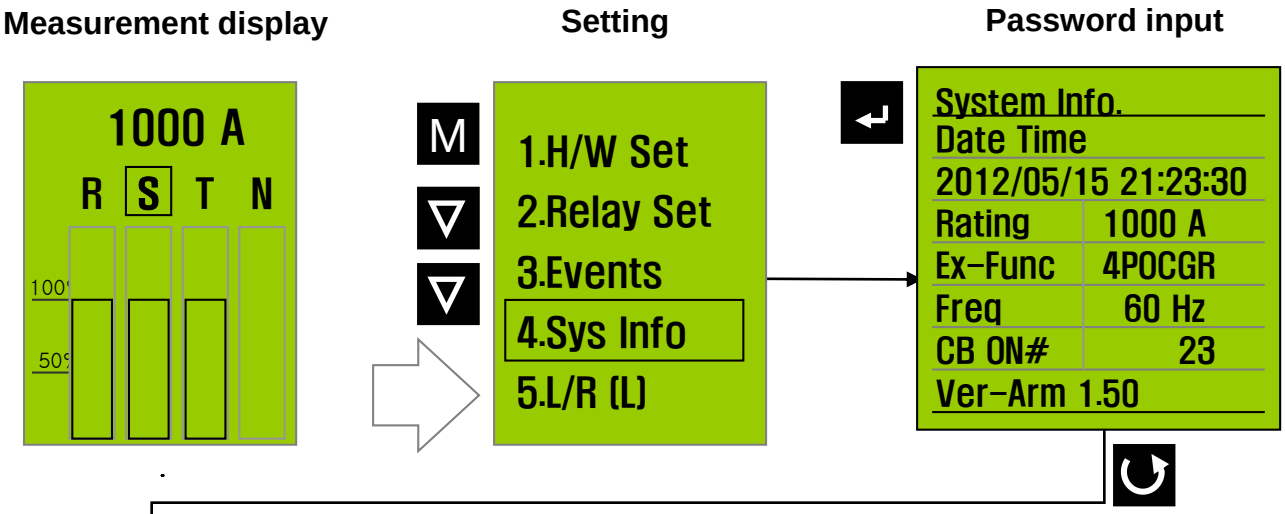
1) Present time 2) ACB current ratings 3) N-phase current ratings (50%, 100%)

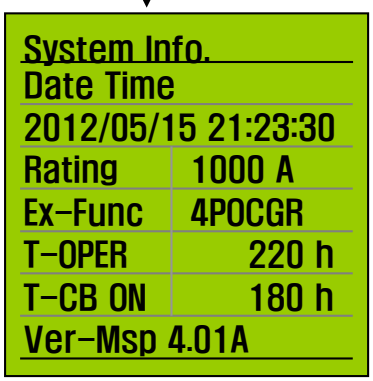
4) Frequency information (60Hz, 50Hz)

5) Breaking / Closing numbers of a circuit breaker (nr. of operating times)

6) OCR operating time 7) Conducting time of a circuit breaker 8) F/W version info

System Information



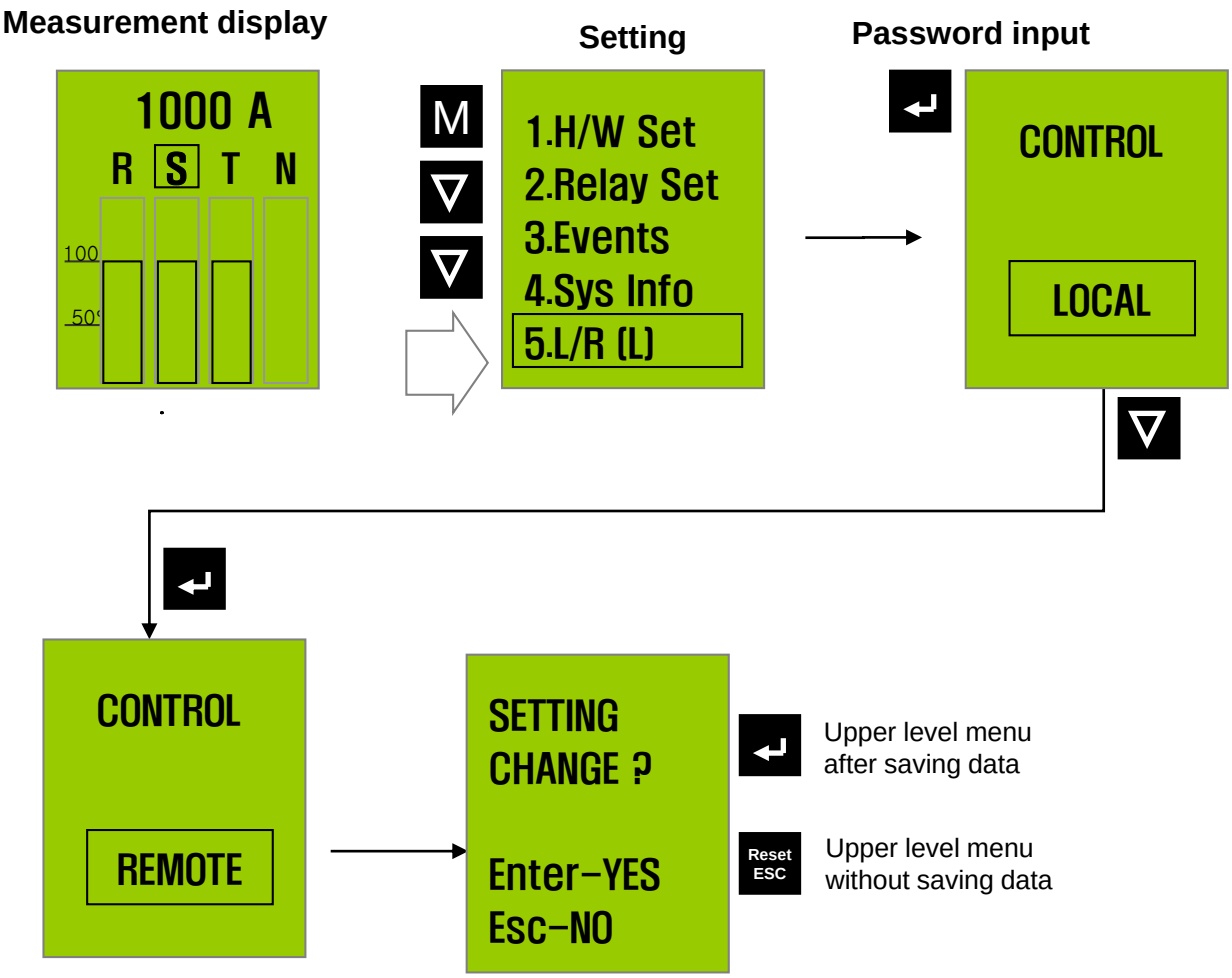


Rating	Rated current of ACB
N-Phase	Standard ratio of phase conductor for N phase conductor of ACB
Freq	Rated frequency
CB ON#	Breaking/Closing numbers of a circuit breaker
T-OPER	OCR(P/S type) operating time
T-CB ON	Operating time of ACB under closed condition
Version	Firmware version

15. Local / Remote Setting

CAUTION

- For P and S type, one can set whether to control locally or remotely. .
- When device is set to local, every operation is available through the Key of OCR..
- When device is set to Remote, it is locked not to be controlled from the local site.



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