

BEPR- 554U
Generator Protection Device
Technical Manual
Operation Manual

Part 1

Technical Manual

1 Introduction to Device

BEPR- 554U generator protection device is designed specifically for small and medium sized generators, including generator differential protection and generator backup protection.

Function	BEPR-554
Differential protection	✓
Overvoltage protection	✓
Loss of excitation protection	✓
Comprehensive 3U ₀ stator ground protection	✓
Frequency protection	✓
One-point ground protection	✓
Rotator two-point ground protection	✓
Generator stator ground protection	✓
Reverse power protection	✓
Non-electric signal protection	✓
TA & TV breakage protection	✓

The device has the following features:

Main processor of the device is Motorola's 32-bit microprocessor with fast speed, high reliability, rich resources and big room to expandability;

The whole panel is a 240×128 big screen LCD which is operated and displayed in Chinese and has friendly human-machine interface;

Multiple kinds of communication interfaces. Reserved RS-232, RS-485/422, CAN and Ethernet can conveniently conduct high-speed communication with the local station or remote system;

A/D has high conversion accuracy and fast speed and the device does not need adjustable parts to automatically adjust sampling accuracy;

The device has well-improved software and hardware watchdog self-test function and automatically blocks the trip in case of failure of CPU;

The device uses back inserted structure to separate light current from heavy current so as to greatly enhance anti-jamming property of the device;

The device has overall, rich and simple debug functions.

2 Hardware Configuration of the Device

With an aim to executing the above functions in a set of hardware system and taking flexibility and adaptability of the device into consideration, modular design is conducted for the device. The device is composed of the following modules:

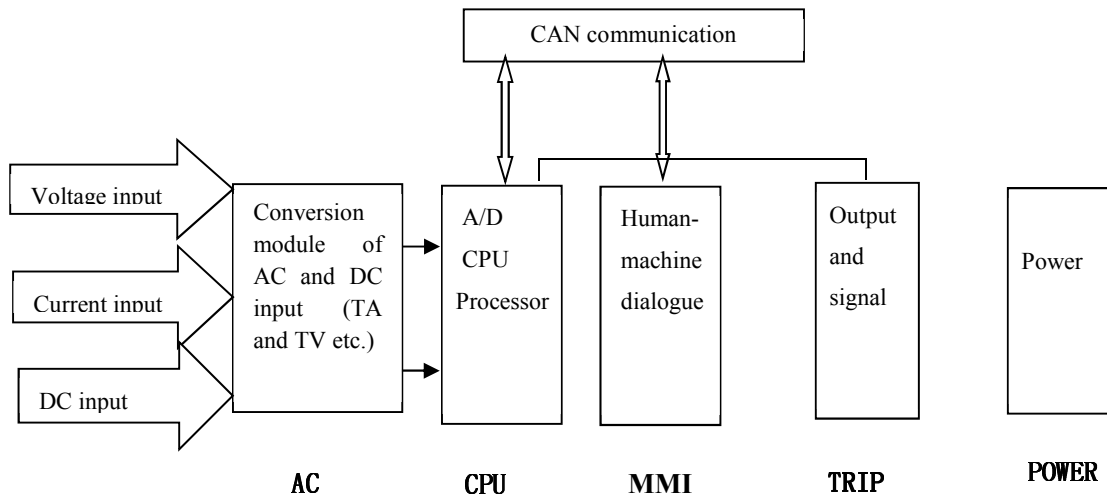


Figure 2-1: Hardware of NSC 554 generator protection device

2.1 AC and DC input module (AC/DC)

Three kinds of converting circuits are set according to different types of input signals.

AC voltage: set isolation conversion of intermediate transformer, such as extreme voltage of generator and high-tension side voltage of main transformer etc.

AC current: set isolation conversion of intermediat converter and obtain voltage at secondary side parallel resistance. 1A and 5A converters are selected and secondary resistance is changed to meet the requirement of measurement ranges of different currents, such as extreme current of generator and neutral point current etc.

DC voltage and current: set advanced isolated conversion of hall sensor, such as rotator voltage of generator and diverter voltage of rotator.

2.2 Host processing module (CPU)

All analogs resulting from conversion by AC and DC input modules can effectively filter out signals within pass band through active filter with lowpass filtering and bandpass filtering to meet filtering requirements of different frequency signals and achieve less than 1% of attenuation of fundamental wave, and concurrently attenuation ratio and phase shift of analogs of all channels can reach good consistency.

Central processing unit (CPU) is composed of A/D conversion, state quantity input, state quantity output (used for pulse output of trip and close, alarm signal output, opening of block relay and other signal outputs), microprocessor CPU, RAM, ROM, FLASH RAM and EEPROM. High performance microprocessor CPU (32-bit), large capacity ROM (256K bytes), RAM(256K bytes) and FLASH RAM (1M bytes) enable the CPU module to have strong data processing and recording capacity and achieve various complex fault handling schemes and record a lot of fault data. C language programming can enable the program to have strong reliability, portability and maintainability.

All parts relevant to CPU are concentrated in a plug-in unit and all input and output state quantities go through photoelectric coupling isolation. If the parts in this module are in abnormal conditions, then main processor drives block relay and cuts off OPS at photoelectric coupling output side of state quantity output. Auxiliary processor drives the above block relay when main processor is in abnormal conditions. Block relay will not be reset unless it is powered down. Mutual monitoring of dual processors ensures operation reliability of the device.

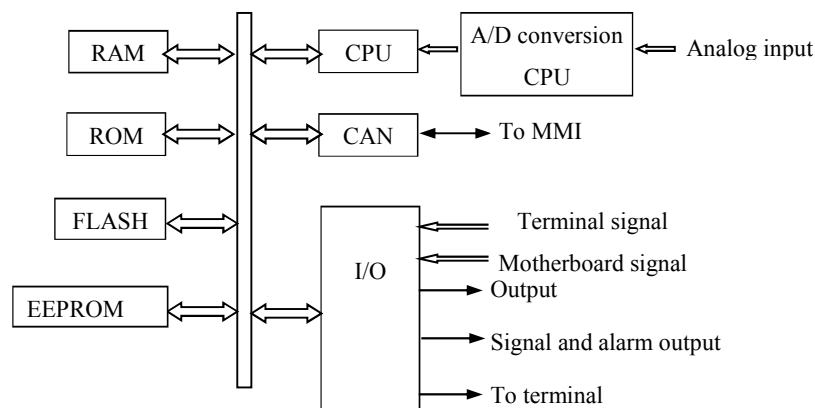


Figure 2-2 Schematic diagram of CPU module

The terminals of CPU module are used to connect in strap, dedicated input signal, output signal and position signal required by the CPU.

Analog/data conversion (A/D) uses 14-bit high accuracy, high stability, high speed and multi-channel concurrent conversion unit whose precision working current can reach 0.04In and precision working voltage can reach 0.2V to enhance measuring accuracy and speed. All analogs can effectively filter out, through lowpass filtering, higher harmonic wave and achieve less than 1% of attenuation of fundamental wave and attenuation ratio and phase shift of analogs of all channels can reach good consistency.

2.3 Human-machine module (MMI) module

Human-machine module (MMI) is installed in the rear of the whole panel of the device. The module includes microprocessor (32-bit), large capacity ROM (512K bytes), RAM (1M bytes), FLASH RAM (1M bytes), EEPROM, input and output state quantity, communication control unit, clock, LCD with big screen (240×128), full screen operating keyboard and signal indicating lamp etc.

The module is mainly used for human-machine interface management. Its main functions include keyboard operation, management of liquid crystal display, printing, signal lamp indication, communication with debug computer, monitoring system of transformer substation or remote safety automated device, GPS time calibration (minute/second pulse time) and information information with main CPU.

The communication with all CPUs uses CAN and the communication rate is 100Kbps, which breaks through the bottleneck of internal communication of the device and enhances internal information transmission rate of the device.

External communication has three ports, with one being set on the panel and two being set on the back panel of communication interface module (COM panel). RS232 serial port on the panel is used to be connected with PC. Two communication ports on the back panel of communication interface module can be set as different physical interfaces as required.

485 interface, Ethernet interface and optical fiber interface etc. are set up on the back panel to meet the needs of different automatic system when the device connects in the plant and station automatic systems. The port on the back panel can be set as RS232 interface (used to drive serial printer) or RS422/485 interface (it is used to communication with engineer station or for centralized printing).

Communication specification adopts IEC60870-5-103 specification.

Electronic schematic of Human-machine module (MMI) is shown in Figure 2-3:

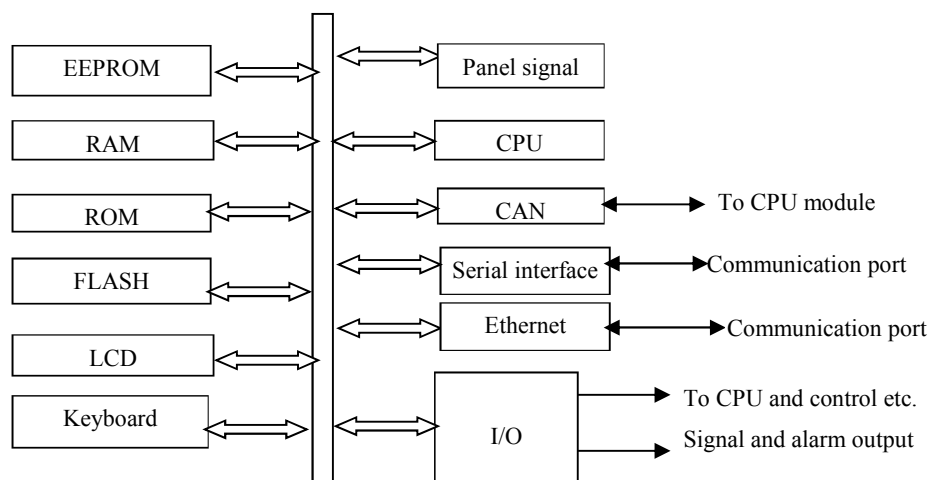


Figure 2-3 Electronic schematic of MMI module

2.4 Output and signal module (TRIP)

This module interfaces with the commands sent by CPU module and provides device actions and alarm signals which can be transmitted to either signal lamp on the panel or central signal device. Each unit is equipped with a set of three-phase operation circuit. Device can adaptive tripping current, without on-site adjustment.

3 Technical indicators

3.1 Operating environment

Working temperature: $-20^{\circ}\text{C} \sim 60^{\circ}\text{C}$, average temperature within 24 hours does not exceed 35°C .

Storage temperature: $-25^{\circ}\text{C} \sim 80^{\circ}\text{C}$, not apply excitation at limiting value; irreversible changes will not occur in the device. The device should normally work after temperature is recovered.

Relative humidity: not more than 95% (without dew).

Atmospheric pressure: $80 \sim 110\text{kPa}$ (below relative sea-level elevation of 2KM).

3.2 Nominal parameters

Rated DC voltage: $220\text{V}/110\text{V}$ (indicated in the order), around 10W , fluctuation range: $-20\% \sim +10\%$.

Rated AC data:

Phase voltage: $100/\sqrt{3}\text{V}$

Line voltage: 100V

AC: $5\text{A}/1\text{A}$ (indicated in the order)

Rate frequency: 50Hz

3.3 Technical parameters of device

Input circuit: $24\text{V D.C. } 2.4\text{mA}$ at each point

Output contact rating: 30W ($\tau = 5\text{ms}$), 220V D.C. or 0.5A D.C.

Trip time: $< 20\text{ms}$

Each phase of AC voltage circuit of the device at nominal parameter $\leq 0.2\text{VA}$

Each phase of AC current circuit of the device at nominal parameter $\leq 0.3\text{VA}$

Voltage, current and power: 0.5 grade

Phase angle measurement error $\leq 1^{\circ}$

Impedance measurement error $\leq 5\%$

4. Insulating Property

4.1 Insulation resistance

Megohmmeter with open circuit voltage 500V is used to measure insulation resistance of live part and dead part of the device and casings of the device and electrically unassociated circuits of the device and the insulation resistances of all circuits with different grades are not less than $100M\ \Omega$ in atmospheric conditions of normal test.

4.2 Dielectric strength

The device can withstand line frequency pressure test with 50Hz frequency and 2000V voltage and duration of 1 minute without breakdown and flashover and destroyed components in atmospheric conditions of normal test. The electric potentials of the remaining circuits are interconnected and grounded when voltage is applied on any circuit during test.

4.3 Impulse voltage

Short-time impulse voltage test with 1.2/50 μ s standard lightning wave is applicable for grounding of power input circuit, AC input circuit and output contact circuit of the device and between circuits in atmospheric conditions of normal test and voltage of open circuit test is 5kV.

4.4 Humid-heat resistance property

The device can withstand humid heat test stated in Chapter 21 of GB7261. The highest test temperature is +40°C and maximum humidity is 95% and test duration is 48 hours and each cycle lasts 24-hour alternating humid heat test. Insulation resistances of all conducting channels to exposed dead metal part, insulation resistance between casings and between all electrically unassociated circuits should be measured to be not less than $1.5M\ \Omega$ and medium VOLTAGE WITHSTAND STRENGTH should be measured to be not lower than 75% of voltage amplitude in dielectric strength test voltage amplitude stated in 2.3.2 according to 2.3.1 within two hours before the test is finished.

4.5 Electromagnetic interference resistance property

4.5.1 Impulsive interference

The device can withstand interference test stated in GB6162 and test power frequencies are 100kHz and 1MHz and test voltage is attenuating oscillatory wave of common mode 2500V and differential mode 1000V. Power is applied on the tested device in advance and interference test voltages are added according to critical conditions listed in No.3.3 of GB6162 and the device will not have maloperation and reject operation.

4.5.2 Fast transient disturbance

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The device can withstand fast transient interference test with IV level ($4\text{kV} \pm 10\%$) stated in IEC255—22—4 standard.

4.5.3 Electrostatic discharge

The device can withstand electrostatic discharge test with IV level (space discharge 15kV and contact discharge 8kV) stated in IEC255—22—2 standard.

4.6 Mechanical property

4.6.1 Vibration

The device can withstand vibration and endurance test with rigorous ranking level I stated in 16.3 of GB7261.

4.6.2 Impact

The device can withstand vibration and endurance test with rigorous ranking level I stated in 17.5 of GB7261.

4.6.3 Collision

The device can withstand vibration and endurance test with rigorous ranking level I stated in 18 of GB7261.

5 Protection Configuration

Multiple protection functions and non-electric signal interface can be provided according to requirements on protection of generator transformer in *Technical Regulations on Relay Protection and Safety Automatic Device* to meet the requirement on protection of generator transformer unit of small sized generating unit. The protection requirement on generator, main transformer, station transformer, high voltage reserved transformer, excitation transformer and large synchronous phase modifier can be met. Protection configuration is flexible and reasonably designed to meet counter measures requirement of power system and ensure operational reliability of the device.

5.1 Differential protection of generator

5.1.1 Protection Principle

The differential action of the generator can use single-phase differential action mode. Single-phase differential action mode: any phase differential protection action, namely tripping. This mode is equipped with TA line broken detection function. Differential protection is transiently blocked in case of TA line broken and the signal of TA line broken is delayed. When protection braking current is more than knee current, locking of TA line broken is released, namely, setting TA line broken and not blocking differential action.

The protection is equipped with threshold crossing alarm function of differential current. Differential protection can be braked through secondary harmonic wave (indicated in the order).

Percentage restraint is improved in digital protection compared to traditional protection principle. It is composed of no restraint part and percentage restraint part and has higher sensitivity and capacity of anti-TA saturation.

Its action equation is as follows:

$$\begin{cases} |\dot{I}_N + \dot{I}_T| \geq K_S (|\dot{I}_N - \dot{I}_T| / 2 - I_g) + I_q \\ |\dot{I}_N + \dot{I}_T| \geq I_q \end{cases}$$

Of which: I_g : - knee-point current of curve

I_q : -starting current of curve

K_s : - slope of curve

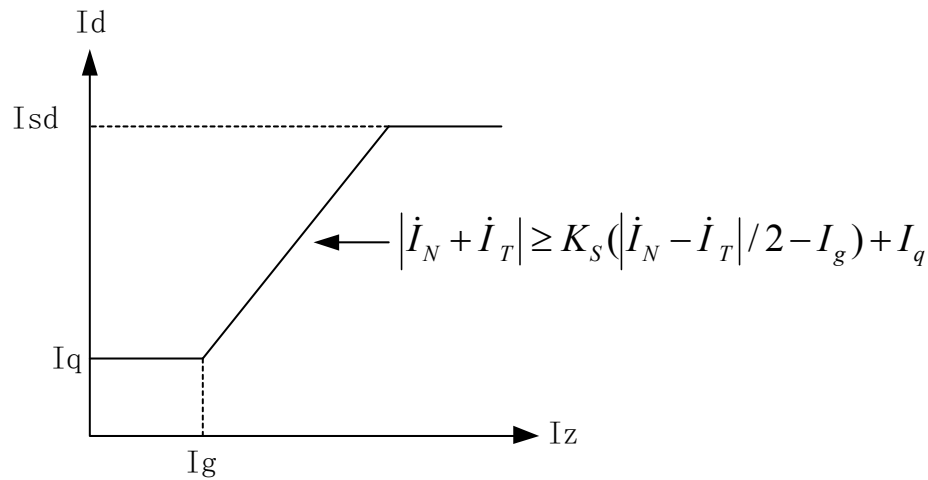


Figure 5-1 Characteristic curve of percentage restraint

Criterion for CT line broken:

Condition 1: abrupt change starts;

Condition 2: abrupt change must be negative abrupt change;

Condition 3: No abrupt change on the opposite side of abrupt change;

Condition 4: No change on other sides.

5.1.2 Input analog

Current at generator end: I_{AT} , I_{BT} , I_{CT} ;

Neutral point current of generator: I_{AN} , I_{BN} , I_{CN} ;

Protection calculation uses differential current method.

5.1.3 Logic chart of protection is as follows:

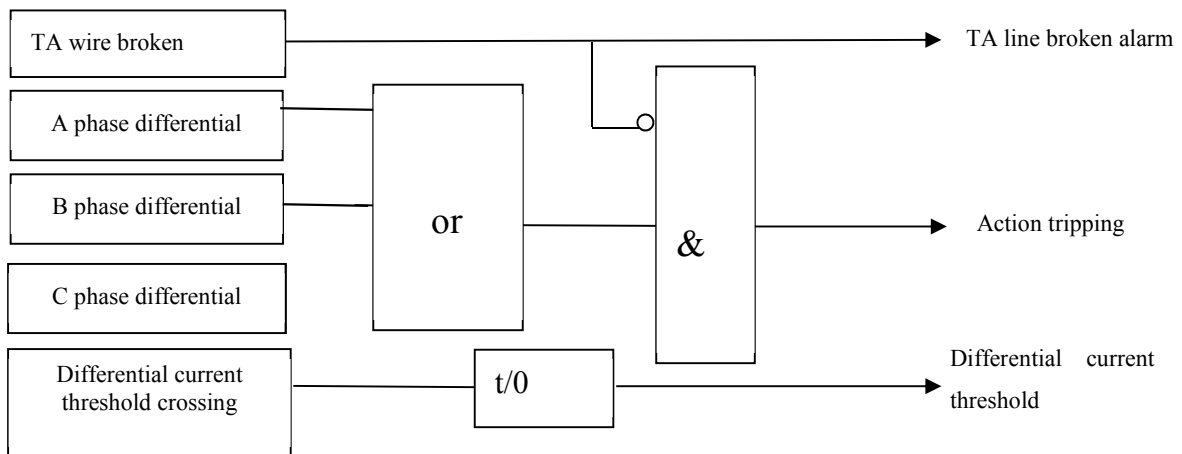


Figure 5-2 Differential output logic of generator: single-phase differential action mode

5.1.4 Setting contents and setting principles

1) Setting contents

Setting contents			
No	Setting name	Unit	Setting range and instructions
1	Quick-break setting	A	See setting principels and setting proposals
2	Differential setting	A	
3	Proportional differential inflection point setting	A	
4	Differential braking proportion coefficient		
5	Remove break line blocking Uf2	V	
6	Differential current out limited setting	A	
7	Differential current out limited delay setting	S	
Control characters			
No.	Setting 1	Setting 0	
1	Quick-break protection input	Quick-break protection quit	
2	CT break line check input	CT break line check quit	
3	CT break line not bloking differential	CT break line bloking differential	

2) Setting principles and setting proposals

(a) Proportional coefficient of the brake Kz (rate of curve)

Kz should accord escape outside three-phase short circuit when the maximum transient unbalanced differential current to setting, usually, the generator differential use $Kz = 0.3 \sim 0.5$, unit: no.

(b) Starting current Iq

Pickup current of setting differential protection: $Iq = 0.3 \sim 0.4I_e$, unit:A;

According to avoid the maximum unbalanced differential current under the condition of normal setting. Unbalanced differential current reasons: mainly is the variable ratio error of differential protection on both sides of the TA and the adjustment error of channel circuit protection device.

(c) Knee-piont current Ig

Knee-point current of setting differential protection: $Ig = 0.5 \sim 0.8I_e$, unit:A;

The size of the I_g , decided to start braking effect to protect the current size, avoid external fault is recommended after resection of the transient process of the maximum unbalanced differential current setting.

(d) Differential instantaneous I_s

Differential instantaneous I_{sd} : $I_s = 4 \sim 8 I_e$, unit: A

Differential action occurs when differential current of generator is more than the setting I_D despite the breaking.

It is based on rated current of the generator.

(e) Generator rated current I_e

Calculate based on

$$I_e = \frac{P_e}{\sqrt{3} U_e n_T \cos \varphi}$$

Inside: P_e : Generator power rating, K;

U_e : Generator voltage rating, KV;

n_T : ratio of differential TA; $\cos \varphi$: The rated power factor of generator

(f) Differential protection sensitivity calibration

According to relevant technical regulations, longitudinal differential protection, the sensitivity of generator must meet the machine end two-phase metallicity short-circuit, the sensitive coefficient of the differential protection K_{sen2} , K_{sen} sensitive coefficient is defined as a machine side two-phase metallicity short-circuit, when the short circuit current and the ratio of the differential protection operating current, the bigger the K_{sen} , protective action is sensitive, the higher reliability.

Digital protection sensitivity calibration required by regulations, because only K_{sen} meet the requirements, to ensure that when the internal fault, there is all kinds of aperiodic component in fault current, TA saturation effects, TA transient characteristics influence and so on, reliable protection action.

K_{sen} 、 K_z and differential protection setting values, I_q , I_g have relations, especially the K_z affected most. General advice according to this specification values, K_{sen} can meet the requirements.

5. 1. 5 The engineering application considerations

TA secondary circuit open circuit would cause the danger of high voltage, especially large generating units. For this purpose, the recommended TA break line not locking differential protection scheme.

5.2 Generator stator ground protection

5.2.1 The protection reflects zero sequence voltage size of generator

Fundamental wave type stator ground fault protection, protection for machine side to about 90% within the scope of the stator winding earth fault. As a small stator earthing protection of the unit. Also can use with the three times harmonic stator ground protection to protect fault protection of 100% of the large and medium-sized generator stator ground fault.

5.2.1.2 3U0 Protection principle

The protection reflects zero sequence voltage size of generator. The protection has third harmonic wave filtering function. Zero sequence voltage is obtained from opening Δ winding of generator terminal TV or neutral point TV secondary side (also from secondary square winding of arc suppressing coil).

Action equation $3U_0 > 3U_{0g}$, $3U_0$ is opening Δ winding of generator terminal TV or neutral point TV secondary side (also from secondary square winding of arc suppressing coil); $3U_{0g}$ is action voltage fixed value.

5.2.1.3 Logic chart of protection is as follows:

When the zero sequence voltage as the input voltage of stator ground fault protection from opening Δ winding of generator terminal TV, in order to ensure when the TV break line protection misoperation, needs to introduce a TV break line locking.

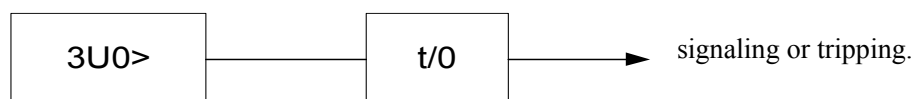


Figure 5-3 Tripping logic of 3U0 generator stator ground protection

5.2.1.4 Setting contents and setting principles

1) Setting contents

Setting contents			
No.	Setting name	Unit	Setting range and instructions
1	Stator ground 3Uo setting	V	See setting principals and setting proposals
2	Stator ground 3Uo delay	S	
Control characters			
No.	Setting 1	Setting 0	
1	TV break line lockIng 3Uo	TV break line not lockIng 3Uo	

2) Setting principles and setting proposals

(a) Action voltage $3U_{0g}$

In protection device, set up the good performance of the three times harmonic filtration device, therefore, 3 uog should based on escape during normal running opening Δ winding of generator terminal TV or neutral point TV secondary side may be the biggest wave of zero sequence voltage to setting.

When the stator lead wire is not enclosed bus bar, and pass the wear casing wall from outdoor, could be 10~13V.

When the stator lead wire is not enclosed bus bar, could be 5~10V.

(b) Action delay

Deferred operation time of setting protection, unit (s). $t=6s\sim 9s$.

5.2.2 The protection reflects zero sequence current size of generator

Zero sequence current of the stator ground fault protection, suitable for the machine end position three-phase outlet with zero sequence current transformer of small generators. The protection can be separately as a generator of the internal stator winding the stator ground fault protection.

5.2.2.1 3I0 Protection principle

Protect access 3 IO current, from the zero sequence current transformer secondary qualification , in the generator terminal three-phase outlet.

Action equation $3I_0 > 3I_{0g}$, $3I_0$ On machine side three-phase line zero sequence current transformer of the secondary current; $3I_{0g}$ is action current fixed value.

5.2.2.2 Logic chart of protection is as follows:

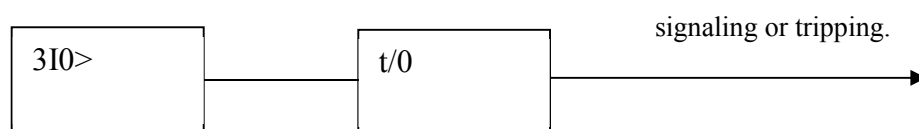


Figure 5-4 Tripping logic of 3I0 generator stator ground protection

5. 2. 2. 3 Setting contents and setting principles

1) Setting contents

Setting contents			
No.	Setting name	Unit	Setting range and instructions
1	Stator ground 3Io setting	A	See setting principels and setting proposals
2	Stator ground 3Io delay	S	
Control characters			

No.	Setting 1	Setting 0
1	3I0 stator ground input	3I0 stator ground quit

2) Setting principles and setting proposals

Of zero sequence current action value 3 I0g setting, quite tedious. The main reason is that zero sequence TA no strain ratio, a zero sequence current is by magnetic flux leakage to the secondary of TA.

For this purpose, the setting value should be issued by the generator primary side zero sequence current . Its value should refer to the security of the generator allows determining grounding current, such as 4 A or 3 A.

When the primary current action is determined, with a long wire through the zero sequence TA to check the single phase current. When is equal to a setting into the current when the current action, observation of the ma number as shown on the interface, the ma number as fixed values input device and curing.

Deferred operation time of setting protection, unit (s). $t=6s\sim 9s$.

5.3 Overvoltage protection of generator

5.3.1 Protection principle

The protection reflects voltage size of generator terminal.

Voltage is obtained from line voltages of generator terminal TV and three line voltages are and/or relation, such as U_{CA} voltage.

Tripping mode: signaling or tripping.

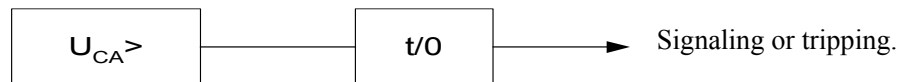


Figure 5-4 Overvoltage protection tripping logic of generator

5.3.2 Setting contents and setting principles

1) Setting contents

Setting contents			
No.	Setting name	Unit	Setting range and instructions
1	Overvoltage setting	V	See setting principles and setting proposals
2	Overvoltage delay setting	S	

2) Setting principles and setting proposals

Overvoltage protection voltage, shall, depending on the type of generator and excitation mode, allow the overvoltage of the ability and the condition of stator winding insulation to decide.

(a) Overvoltage setting

- For the steam turbine generator

$$U_g = (1.3 \sim 1.35) U_e$$

- For the hydro-generator

$$U_g = 1.5 U_e$$

- For the hydro-generator with silicon controlled excitation

$$U_g = (1.3 \sim 1.4) U_e$$

(b) Action delay t may be $(0.3 \sim 0.5) S$

5.4 Static stability excitation loss protection of generator

5.4.1 Protection principle

Loss of excitation protection is composed of measurement impedance criterion of generator terminal, low voltage criterion of rotator, low voltage criterion of transformer high tension side and stator overcurrent criterion. The setting boundary of impedance is generally boundary circle or other shapes of static stability. If impedance circle set according to static stability boundary cannot meet the requirement in case of under-excitation operation of generator, one of the following measures are generally taken to skive off under-excitation operation zone.

1: Move downward and set impedance circle according to stepout boundary.

2: Use two straight lines through origin point to skive off under-excitation operation zone. The depth of under-excitation can be set.

3: Use under-excitation operation zone (circular characteristics) to skive off leading phase zone.

Operational equation of rotator low voltage:

$$V_{fd} < V_{fl.zd} ; V_{fd} < V_{fl.zd} \quad (1)$$

$$V_{fd} < K_{zd} (P - P_t) ; V_{fd} > V_{fl.zd} \quad (2)$$

$$\text{Of which: } K_{fd.zd} = \frac{V_{fde}}{K_k \times S_n}$$

V_{fd} : rotator voltage

Vfl.zd: operating value of rotator low voltage

Vfde: rotator voltage (V) of generator in case of full load

Sn: rated power (MVA) of generator

Kk: reliable coefficient

Kfd.zd: scale coefficient of rotator low voltage

P: generator output

Pt: Reactive power of generator

Take static stability boundary criterion for example to describe the composition of loss of excitation protection principle:

Loss of excitation signal is sent and excitation switch command is output when rotator low voltage criterion is met. The criterion can predict whether generator loses stability due to loss of excitation so as to take timely measures (switch excitation etc.) before generator loses stability to prevent the accident from deteriorating.

High-tension side voltage of the system with insufficient reactive power reserve will probably reach system voltage breakdown before generator loses static stability after generator loss of excitation. Therefore, it indicates that loss of excitation of generator has threatened safe operation of power system when rotator low voltage criterion and high tension side low voltage criterion are met and generator is tripped after tripping command is sent by “and gate” logic.

Destabilization signal is sent through “and gate” circuit when rotator low voltage criterion and static stability boundary criterion are met. The signal indicates that generator loses static stability due to loss of excitation. Destabilization signal is generated by static stability boundary criterion when rotator low voltage criterion refuses operation in loss of excitation (if rotator voltage detects open circuit among rotator windings).

Steam turbine can be asynchronously operated for a period of time in loss of excitation and overcurrent criterion monitors active power of steam turbine. If stator current is more than 1.05 times of rated current, it indicates that average asynchronous power exceeds 0.5 times of rated power and command is sent to drive down generator output to enable steam turbine to continue stable asynchronous operation. Stable asynchronous operation generally allows 2~15 minutes and so the protection sends tripping command upon time delay. Operators can have enough time to shoot troubles and resume excitation during signaling to avoid tripping, which is of significance to economic operation. If output cannot be driven down within t_2 and overcurrent criterion is met, tripping command is sent to ensure the safety of generator.

Asynchronous operation is not allowed for hydraulic turbine and so t_1 can be set small value. Tripping command is sent after short time delay upon sending destabilization signal.

Functional block diagram of protection operation: the protection of small-sized unit uses basic logic chart 1 of generator loss of excitation protection and the protection of other units uses basic logic chart 2 of generator loss of excitation protection.



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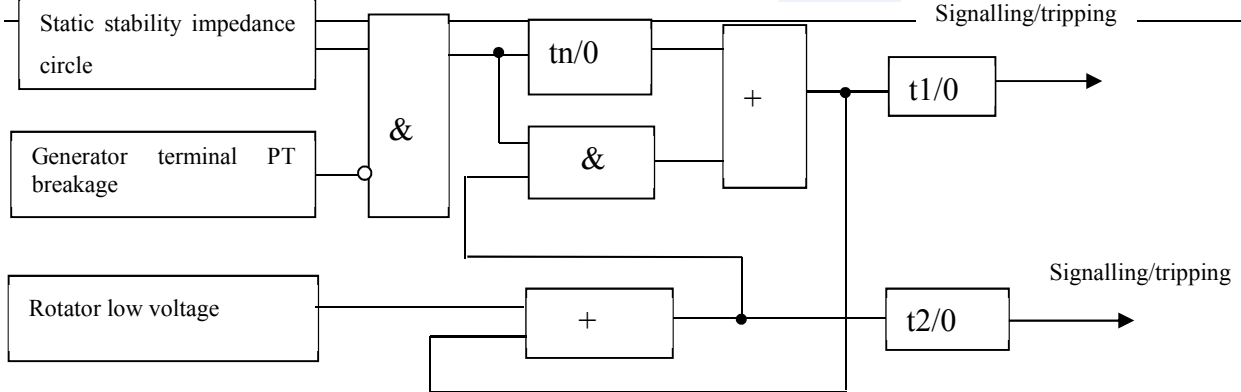


Figure 5-5 Basic logic chart 1 of excitation loss protection of generator

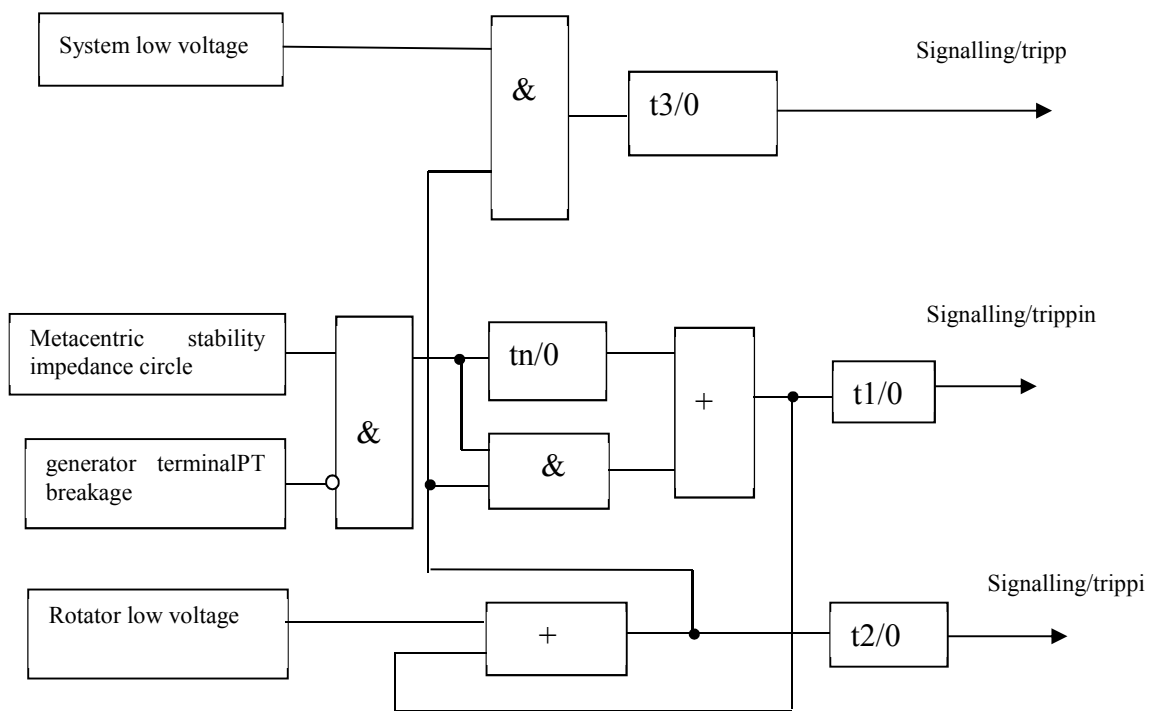


Figure 5-6 Basic logic chart 2 of excitation loss protection

t_n is internal delay of program and fixed t_n is 1.5s.

PT breakage criterion of generator terminal:

Three-phase line breakage: three-phase non-pressure; current available in any phase. Three-phase non-pressure ($U_a < 8V \& \& U_b < 8V \& \& U_c < 8V$)

Current available in any phase ($I_a > 0.25A \parallel I_a > 0.25A \parallel I_a > 0.25A$)

One phase or two phases line breakage: (negative sequence voltage $> 10V$) $\& \&$ (positive sequence

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voltage $> 0.8 \times$ negative sequence voltage) && (negative sequence current $< 0.25A$) && (positive sequence current $> 0.25A$).

Protection device reports generator terminal PT line breakage and indicates corresponding signal lamp however many phases have breakage.

System PT line breakage criterion:

Three-phase line breakage: three-phase non pressure ($U_a < 8V$ && $U_b < 8V$ && $U_c < 8V$).

One phase or two phases line breakage: (negative sequence voltage $> 10V$) && (positive sequence voltage $> 0.8 \times$ negative sequence voltage).

Protection device reports generator terminal PT breakage and lights corresponding signal lamp how many phases have breakage.

Protection uses the following algorithm:

It is known from protection block diagram that the following values (effective values of U_{fd} , P , R , X , U and I) need to be calculated so as to realize loss of excitation and voltage amplitude U protection algorithm of generator terminal is to calculate the above values according to sampling voltage and current to monitor the whole operation Q of generator. Protection algorithm is not affected by frequency.

Impedance boundary characteristics of excitation loss protection of generator and rotator low voltage characteristics (operation zone is below broken line):

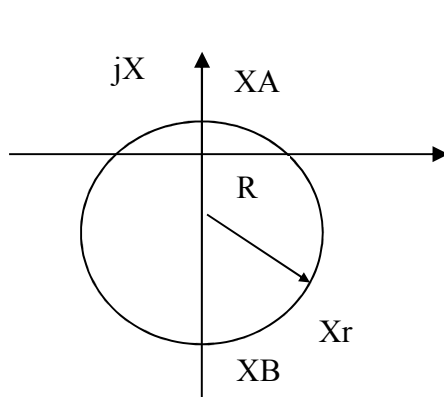


Figure 5-7 Impedance boundary of excitation loss protection

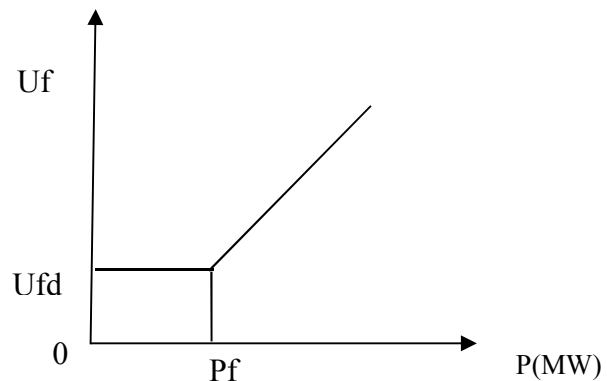


Figure 5-8 Rotator low voltage operation of excitation loss protection

5.4.2 Setting contents

5.4.2 Setting contents and setting principles

1) Setting contents

Setting contents

No.	Setting name	Unit	Setting range and instructions
1	Impedance starting current setting	A	See setting principles and setting proposals
2	Center of impedance circle -X _c	Ω	
3	Radius of impedance circle R _c	Ω	
4	Rotator low voltage V _{fd}	V	
5	Coefficient K _{fd} of rotator low voltage		
6	Reaction power P _f	MW	
7	Loss of excitation delay time t ₁ setting	S	
8	Loss of excitation delay time t ₂ setting	S	

2) Setting principles and setting proposals

(a) Low voltage $U_{hl} \cdot dz$ at system side

Depending on after the generator field loss does not endanger the stability of the system to setting. Usually

$$U_{hl} = (0.85 \sim 0.9)U_{he}$$

U_{he} : The system bus voltage rating (TV secondary value)

(b) Center of impedance circle -X_c

$$X_c = \frac{X_a + X_b}{2}$$

(c) Radius of impedance circle X_r

$$X_r = \frac{X_a - X_b}{2}$$

X_a , X_b : See the instructions in the impedance criterion

(d) Scale coefficient K_{zd} of rotator low voltage

$$K_{fd} = 0.7 \frac{V_{fde}}{S_n}$$

(e) Reaction power P_t

$$P_t = \frac{1}{2} \left(\frac{1}{X_{q\Sigma}} - \frac{1}{X_{d\Sigma}} \right) S_e$$

$$X_{d\Sigma} = X_d + X_s, \quad (\text{Table value}) ;$$

$$X_{q\Sigma} = X_q + X_s, \quad (\text{Table value}) ;$$

X_d, X_q Generator d axis and q axis reactance table values

1) Low voltage $U_{hl \cdot dz}$ at high tension side

Low voltage criterion operating voltage of main transformer at high-tension side, unit (V).

2) Center of impedance circle $-X_c$

Circle center of impedance criterion, the set input is positive (indicates that impedance circle center is negative). unit: ohm.

3) Radius of impedance circle X_r

Impedance criterion radius, unit: ohm.

4) Rotator low voltage $V_{fl \cdot dz}$

Ration of rotator low voltage, unit (V)

5) Scale coefficient K_{zd} of rotator low voltage

Low voltage coefficient of rotator is used to set slope of operation curve of rotator voltage and active power, unit (no)

6) Reactive power P_t

Salient pole effect is taken into consideration, unit (MW)

7) Operation time t_1

Deferred operation time of setting protection, unit(s)

8) Operation time t_2

Deferred operation time of setting protection, unit(s)

9) Operation time t_3

Deferred operation time of setting protection, unit(s)

5.4.3 Setting calculation of protection

1) Low voltage $U_{hl \cdot dz}$ at high tension side

It is set according to low voltage permitted by the system for long time.

2) Impedance circle center $-X_c$

It is set according to static stability circle or asynchronous circle.

3) Impedance circle radius X_r

It is set according to static stability circle or asynchronous circle.

4) Rotator low voltage $V_{fl \cdot dz}$

Rotator low voltage is set according to 0.2~0.5 times of excitation voltage of generator in case of zero load.

5) Scale coefficient K_{zd} of rotator low voltage

$$K_{zd} = \frac{V_{fde}}{Kk \times S_n}$$

V_{fde} : rotator voltage (V) of generator in case of full load

S_n : rated power (MVA) of generator

Kk : reliable coefficient (generally, 1~1.5)

6) Reactive power P_t

Salient pole effect is taken into consideration, unit (MW).

$$P_t = \frac{1}{2} \left(\frac{1}{X_{d\Sigma}} - \frac{1}{X_{q\Sigma}} \right) * S_N$$

of which: $X_{d\Sigma} = X_d + X_s$, $X_{q\Sigma} = X_q + X_s$

X_d and X_q are respectively reactance (per unit) of d axis and reactance of q axis of generator and S_N is secondary base power.

7) Operation time t_1

Deferred operation time of setting protection, unit (s)

8) Operation time t_2

Deferred operation time of setting protection, unit (s)

9) Operation time t_3

Deferred operation time of setting protection, unit (s)

5.5 Fixed time lag negative sequence overcurrent protection (overload protection of rotator surface

layer) of generator

5.5.1 Protection principle

The protection reflects the size of negative sequence current of generator stator and surface overheating of generator rotator is avoided.

Current is taken from generator neutral point (or generator terminal) TA.

Tripping mode: signaling or tripping.

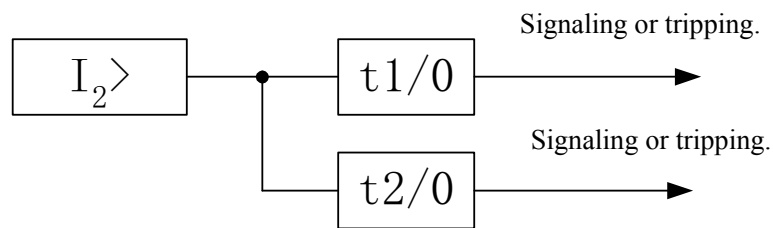


Figure 5-9 Tripping logic of negative sequence overcurrent protection of generator

5.5.2 Setting contents

1) Negative sequence current operation ration $I_{2.dz}$

Setting negative sequence current, unit (A).

2) Operation time t_1

Deferred operation time of setting protection, unit(s).

3) Operation time t_2

Deferred operation time of setting protection, unit(s).

5.5.3 Setting calculation of protection

1) Negative sequence current operation ration $I_{2.dz}$

Please see Rules and Regulations.

2) Operation time t_1 and t_2

Please see Rules and Regulations.

5.5.4 Sensitivity checking

Please see Rules and Regulations.

5.6 Overload protection of generator

5.6.1 Protection principle

The protection reflects the current size of generator stator. Current is taken from a certain phase (such as B phase) current of generator neutral point (or generator terminal).

Tripping mode: signaling or tripping (indicated in the order).

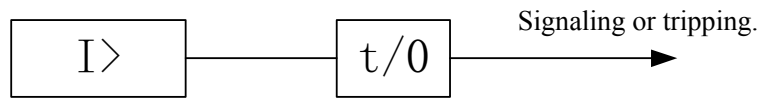


Figure 5-10 Tripping logic of overload protection of generator

5.6.2 Setting contents

1) Current setting ID $I_{g,dz}$

Setting current, unit (A).

2) Operation time t

Deferred operation time of setting protection, unit (s).

5.6.3 Setting calculation of protection

1) Current setting ID $I_{g,dz}$

It is set according to the current received by generator.

2) Operation time

It is set according to current $I_{g,dz}$ time received by generator.

Selectivity and sensibility of protection should be considered when the operation time conflicts with operation time of other protections.

5.6.4 Sensitivity checking

Please see *Rules and Regulations*.

5.7 One-point ground protection of overlying DC rotator of generator

5.7.1 Protection principle

New type of overlying DC method is used and overlying source voltage is 50V and internal resistance is more than $50k\Omega$. Microcomputer intelligent measurement is used to overcome the shortcoming of asymmetric positive and negative electrode sensitivity of winding in traditional protection and accurately calculate insulation resistance of rotator over the ground with up to $200k\Omega$. Rotator's distributed capacitance has no impact on measurement. The protection will remain valid when electrical motor is started and rotator has no voltage.

Protection introduces negative electrode and shaft earth connection of rotator and can signal or trip (indicated in the order).

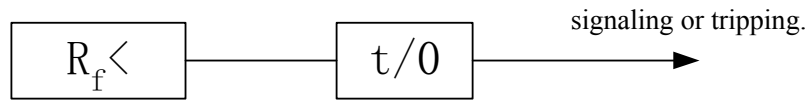


Figure 5-11 Tripping logic of generator rotator one-point ground protection

5.7.2 Setting contents and calculation method

1) R_g : unit: ($k\ \Omega$)

Earth fault signaling setting ID (setting range $1K\ \Omega \sim 100k\ \Omega$).

Please see Rules and Regulations.

2) t : unit:(s)

Protection operation delay (setting range $1s \sim 10s$).

Please see Rules and Regulations.

5.7.3 Description

Special descriptions should be made in case of tripping requirement or segmentation when protection operation relates to signaling.

5.8 Rotator two-point ground protection of Harmonic wave negative sequence voltage type of generator

5.8.1 Protection principle

“Negative sequence” component of secondary harmonic wave in stator voltage is reflected and it is resulting in stator winding from forward direction rotation of magnetic field with secondary harmonic wave at synchronous speed in case of short circuit of asymmetric loops of rotator winding. The protection is blocked by one-point ground protection and protection is automatically input in case of one-point ground.

Protection introduces three-phase voltage of generator terminal.

Protection operation logic chart:

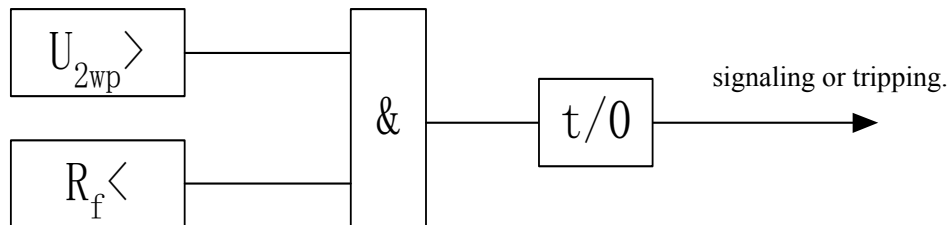


Figure 5-12 Tripping logic of generator rotator two-points ground protection

5.8.2 Setting contents

1) Operating value U_{ld} of secondary harmonic wave voltage.

2) Protection operation delay T_{ld} . unit: s.

5.8.3 Setting calculation method

1) Operating value U_{ld} of secondary harmonic wave voltage

Operating value of secondary harmonic wave voltage (setting range 0~10V).

$$U_{ld} = K_k \times U_{bpn}$$

U_{bpn} is measured value of secondary harmonic wave voltage at rated load; K_k is reliable coefficient and can take 2.5~3.

2) Protection operation delay T_{ld} , unit: s.

Protection operation delay (setting range 0.1s~2s) is set to increase reliability.

Please see Rules and Regulations.

5.8.4 Descriptions

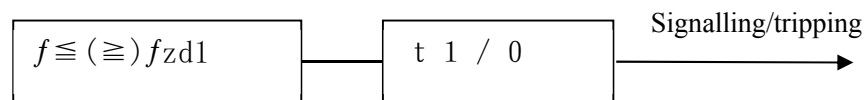
To avoid protection maloperation in transient process of external short circuit fault, special restraint criterion can be additionally added.

5.9 Frequency protection of generator

5.9.1 Protection principle

Low frequency or overfrequency of reaction generator, provided with section I 1st time limit;

Tripping logic chart is as follows:



5.9.2 Setting contents

Figure 5-13 Frequency protection logic

1) Low pressure blocking frequency setting ID U

Setting frequency, unit (Hz).

2) Low frequency (overfrequency) setting ID $f_{g,dz}$

Setting frequency, unit (Hz).

3) Low frequency slide difference blocking setting ID df/dt

Setting slide difference, unit (Hz/s).

4) Operation time t_1

Deferred operation time of setting protection, unit(s).

5.9.3 Setting calculation of protection

Please see *Rules and Regulations*.

5.9.4 Sensitivity checking

Please see *Rules and Regulations*.

5.10 Reverse power protection of generator

5.10.1 Protection principle

Reverse power protection is used to protect steam turbine. When emergency stop valve is switched off by accident or the unit protection operation closes emergency stop valve and exits breaker and does not trip, generator will be operated as electromotor to absorb active power from the system. Tail blade of steamer will probably overheat to cause destroy of steamer due to blast loss. Reverse power protection can have a good protection role. Two sets of independent reverse power protections are equipped on large generating unit.

Reverse power protection reaction generator absorbs active power from the system and reverse power is blocked by TV breakage.

Voltage is from generator terminal TV and current is from generator neutral point (or generator terminal) TA.

Tripping mode: signaling or tripping

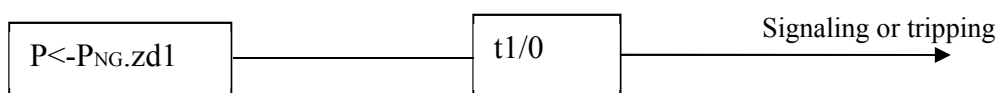


Figure 5-14 Reverse power protection logic

5.10.2 Setting contents

1) Power element setting ID - $P_{1.dz}$

Size of setting reverse power, setting input, reverse power, unit (W).

2) Operation time t_1

Deferred operation time of setting protection, unit(s)

5.10.3 Setting calculation of protection

1) Power element setting ID - $P_{1.dz}$

It is set to ensure steamer safety and possible accidents in maximum reactive power of generator in

case of 200MW and above. It is set according to operating power of steam turbine and no load loss of engine and it generally set $P_{g \cdot dz} = 0.5\% \sim 3\%P_e$, of which, P_e is rated power according to TA and TV secondary calculation.

2) Operation time t_1

Setting 0.5s ~ 1s time delay operation signaling.

3) Sensitivity checking

Please see Rules and Regulations.

5.11 Compound overcurrent (memory overcurrent) protection of generator

5.11.1 Number of generator current of protection reaction and generator terminal voltage

Short circuit current of self-excitation generating unit rapidly attenuates and protection uses memory overcurrent to protect reliable operation.

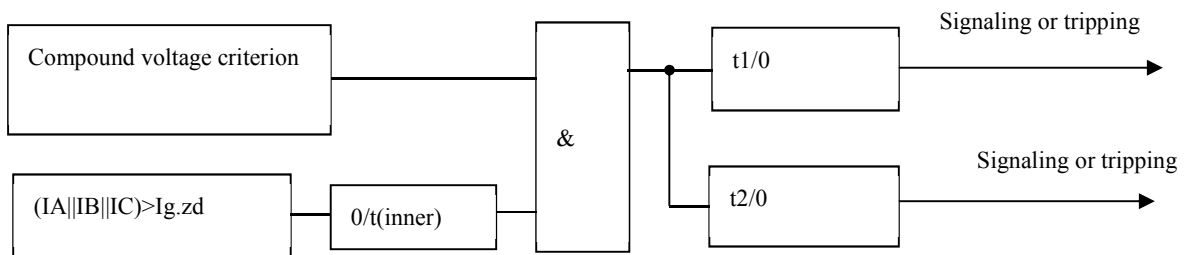


Figure 5-15 Logic chart of compound voltage (low voltage) over-current protection of generator

5.11.2 Setting contents

1) Current setting ID $I_{g \cdot dz}$

Setting current, unit (A).

2) Low voltage setting ID $U_{1 \cdot dz}$

Setting low voltage, unit (V).

3) Negative sequence voltage setting ID $U_{2 \cdot dz}$

Setting negative sequence voltage, unit (V).

4) Operation time t_1

Deferred operation time of setting protection, unit(s).

5) Operation time t_2

Deferred operation time of setting protection, unit(s).

5.11.3 Setting calculation of protection

Please see Rules and Regulations.

5.11.4 Sensitivity checking

Please see Rules and Regulations.

5.12 Non-electric signal protection (demagnetization tripping of generator, hot working (or water machine faults) protection etc.)

For non-electric signal protection of the device, direct tripping without through CPU and signaling through CPU at transient tripping.

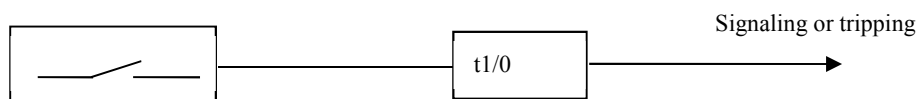


Figure 5-16 Non-electrical quantity protection quantity

6. Setting ID List

No	Setting ID name	Code	Unit	Description
1	Control word	KG	/	
2	Instantous differential setting Isd	Isd	A	
3	Differential setting Icd	Icd	A	
4	Inflection point current setting	IB	A	
5	Differential restraint factor	Kcd		
6	Differential current overlimit setting	Iyx	A	
7	Differential current overlimit deplay time setting	Tclyx	S	
8	Differential current overlimit trip mode			
9	Generator overvoltage protection setting	Ugy	V	Line voltage setting
10	Overvoltage protection time delay setting	Tgy	S	
11	Overvoltage protection trip mode			
12	Rotor one-point ground resistance ration	Rf	K Ω	
13	Leakage Current offset	KRf		Site setting
14	One-point ground time delay setting	Tyd	S	
15	2nd- harmonic wave negative sequence voltage setting	U2w	V	
16	Two-point ground delay setting	T	S	
17	Two-point ground trip mode	3Uo	V	
18	Stator ground 3Uo setting	T3Uo	S	
19	Stator ground 3Uo delay setting			
20	Stator ground 3Uo trip mode			
21	Start-up RX current Iqd	Iz	A	
22	Impedance circle center -Xc	Xc	Ω	
23	Impedance radius Xr	Xr	Ω	
24	Rotor-voltage low Ufd	Vfd	V	
25	Rotor-voltage correction factor Kxz	Kxz		
26	Rotor voltage proportional Kfd	Kfd		
27	Reaction power Pf	Pf	MW	
28	Loss-of-field delay t1	t1	S	
29	Loss-of-field delay t2	t2	S	
30	Loss-of-field delay t1 trip mode			
31	Loss-of-field delay t2 trip mode			
32	Low voltage Ulowf	ULow	V	Line voltage
33	Negative sequence voltage U2f	U2	V	
34	Overcurrent setting ID	Igl	A	
35	Compound voltage overcurrent delay t1	T1	S	
36	Compound voltage overcurrent delay t2	T2	S	
37	Compound voltage overcurrent t1 trip mode			
38	Compound voltage overcurrent t2 trip mode			

39	Reverse power protection setting P	P	MW	Primary value
40	Reverse power protection delay setting t	Tngl	S	
41	Reverse power protection trip mode			
42	Low voltage blocking frequency protection	UX	V	Line voltage
43	Frequency protection setting ID	f	Hz	
44	Frequency protection delay setting ID	Tf	S	
45	Frequency protection trip mode			
46	Generator overload setting ID	P	MW	Primary value
47	Generator overload delay setting ID	Tngl	S	
48	Not electric 1 protection delay			
49	Not electric 1 protection trip mode			
50	Not electric 2 protection delay			
51	Not electric 2 protection trip mode			
52	Not electric 3 protection delay			
53	Current factor Ki	Ki	/	
54	Voltage factor Ku	Ku	/	

KG1 control word description:

	1	0
KG1.0	CT rated current is 5A	CT rated current is 1A
KG1.1	TA wire breakage detection on	TA wire breakage detection off
KG1.2	TA wire breakage locking differential protection	TA wire breakage nonlocking differential protection
KG1.3	Ground protection of TV fuse breakage locking 3Uo stator	Ground protection of TV fuse breakage nonlocking 3Uo stator
KG1.4	Compound voltage criterion on	Compound voltage criterion off
KG1.5	Memory current input	Non-memory current value
KG1.6	TV breakage blocking inverse power protection	TV breakage non-blocking inverse power protection
KG1.7	Outlet 6-7 general contact	Outlet 6-7 remote control contact
KG1.8	TV breakage blocking loss of excitation protection	TV breakage nonblocking loss of excitation protection
KG1.9	TV breakage blocking compound voltage overcurrent protection	TV breakage nonblocking compound voltage overcurrent protection
KG1.10	Generator Overload protection on	generator Overload protection off
KG1.11	Positive orientation output of Generator power	Reversed orientation output of Genenator power
KG1.12	Not electric 1 protection on	Not electric 1 protection off
KG1.13	Not electric 2 protection on	Not electric 2 protection off
KG1.14	Not electric 2 protection on	Not electric 3 protection off
KG1.15	Generator terminal current symmetric detection on	Generator terminal current symmetric detection off

Part 2

Operation Manual

1 Operating Instruction

Keyboard operation and liquid crystal display interface of BEPR- 554U series digital protection use dialog box and menu operation mode.

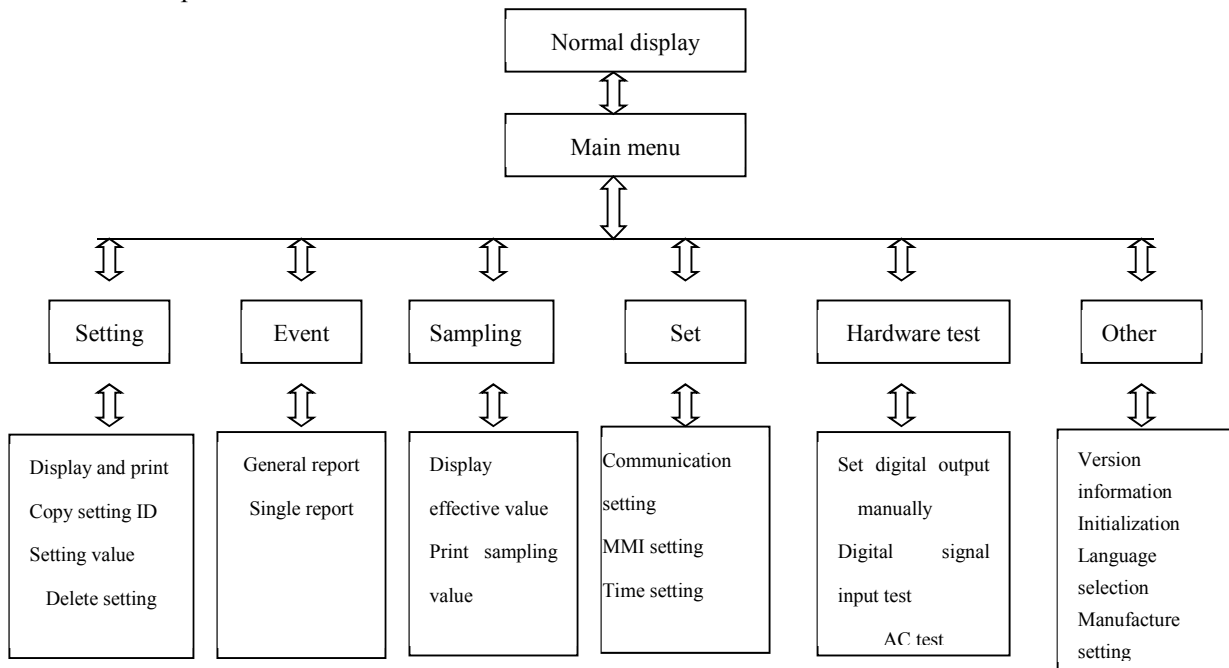


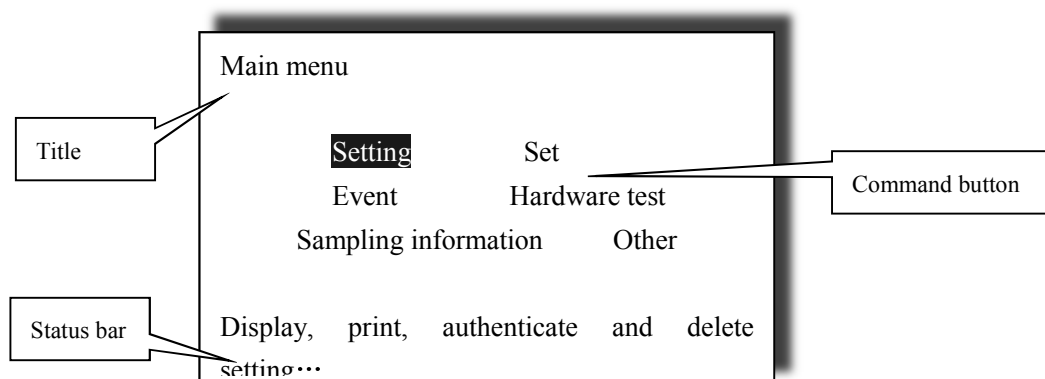
Figure 2-1 Overall architecture of display screen

The above figure gives various operations completed in different menus or display screens.

1.1 Basic operations

The operating interface of BEPR- 554 series digital protection uses “menu”, “dialog box”, “title panel”, “status bar”, “command button”, “list box”, “listing choice box”, “label control”, “scroll bar” and “edit box” etc.

1.1.1 Menu



Menu

As shown in the above figure, a typical menu used in BEPR- 554 series digital protection includes title

panel, status bar and several command buttons.

Title panel indicates functional type of the menu.

Status bar prompts main operations executed by the currently selected command button.

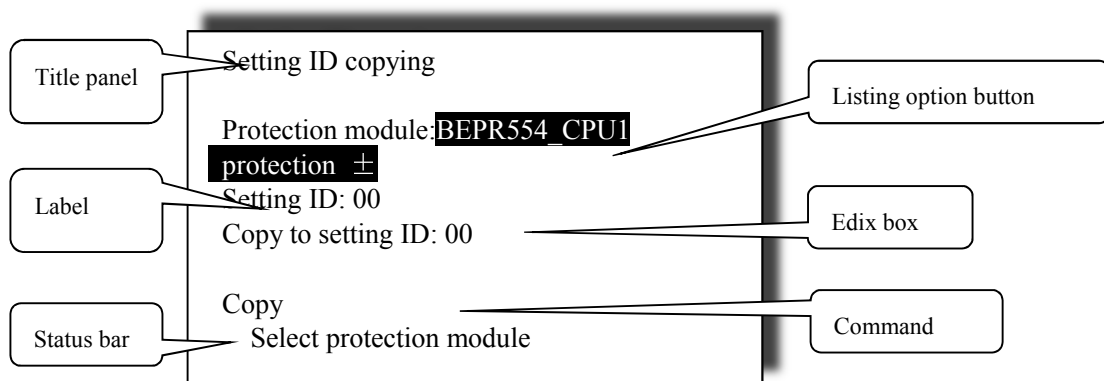
Command button group provides the interface executed through the menu and only one command button can be selected for one time and selected command button is expressed in the manner of being displayed in inverse background (white on black).

Operator can use “^”, “v”, “<” or “>” to select command button after entering the menu and press “←” to confirm and execute this command after selecting the required command button. The specific procedures are as follows:

- ◆ select designated command button;
- ◆ press “←” to execute or enter the next operation designated by command button.

“Q” key can be entered to exit the menu and return to the previous operation at any time during the above process.

1.1.2 Dialog box



“Setting ID copying” dialog box

As shown in the above figure, a typical dialog box used in BEPR- 554 series digital protection includes title panel, status bar, label, listing choice box, edit box and command button etc.

Title panel indicates functional type of the menu.

Status bar prompts the operation to be executed.

Label, also called static control, is generally put in front of edit box or listing button and indicates name or function of the edit box or listing button.

Listing choice box provides a set of values for selection and can use “+” key or “-” key for selection and only one value is valid at any time after obtaining input focus (displayed in inverse background). Listing

button prompts “±” behind listing button in addition to being displayed in inverse background after obtaining focus to prompt using “+” key or “-” key for selection.

Edit box is generally numerical value or ASCII character string and use “+” key or “-” key to modify (edit) it after obtaining input focus (displayed in inverse background) and use “<” key or “>” key to select the bit to be modified for multi-bit numerical value or ASCII character string.

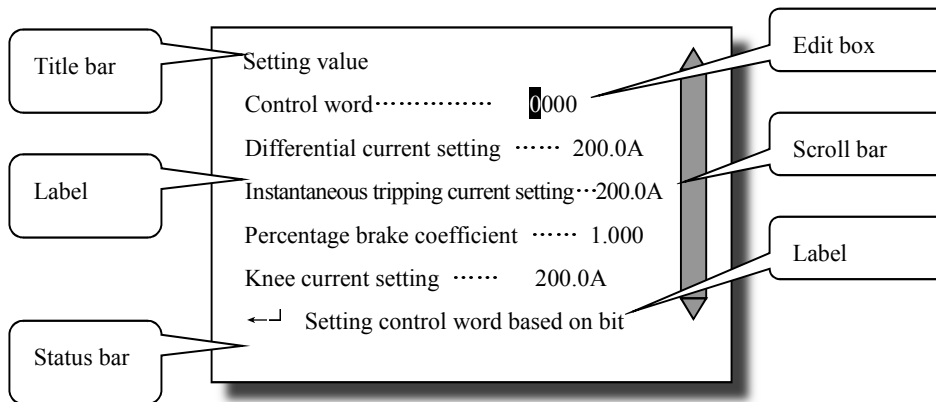
Command button (set) provides the operation interface and only one command of multiple command buttons can be executed for one time.

Operator generally selects listing button or modifies edit box after entering dialog box and then selects the required command button and press “←↵” key to confirm and execute the command. The specific procedures are as follows:

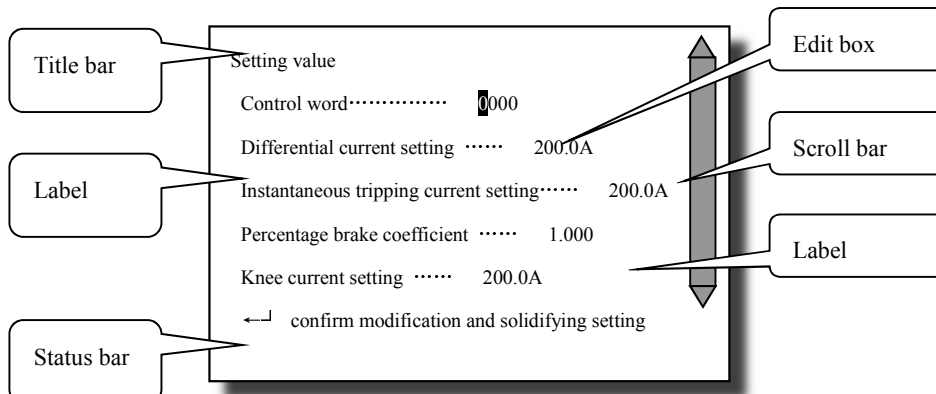
- ◆ Select listing button or modify edit box;
- ◆ Select command button;
- ◆ Press “←↵” key to execute or enter the next operation designated by command button.

Press “Q” key to exit dialog box and return to the previous operation at any time during the above process.

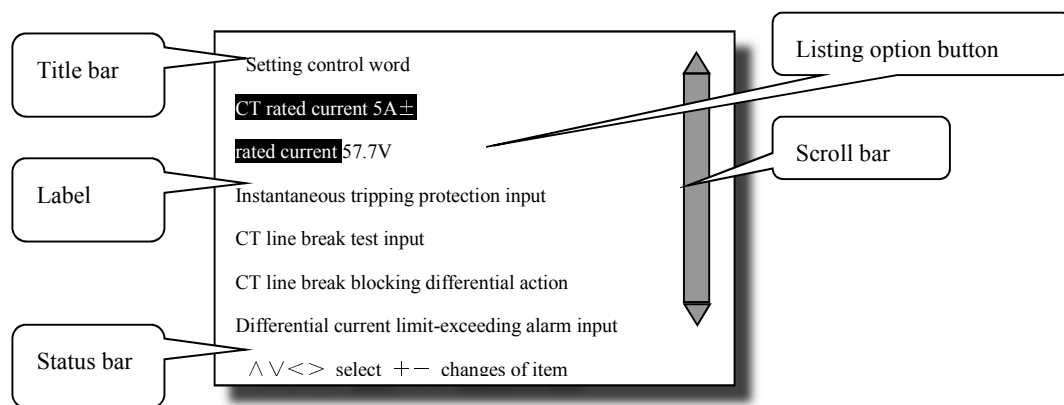
1.1.3 Setting value dialog box



Ration setting dialog box schematic layout 1



Setting value dialog box schematic layout 2



Setting value dialog box schematic layout 3

As shown in the above figure, three typical setting value dialog boxes used in BEPR- 554 series digital protection include title panel, status bar, label, edit box and command button etc.

Title panel indicates functional type of the menu.

Status bar prompts the operation to be executed.

Label, also called static control, is put in front of edit box or listing button and indicates name of edit box and behind edit box to indicate dimension.

Edit box is generally numerical value or ASCII character string and can use “+” key or “-” key to modify (edit) after obtaining input focus (displayed in inverse background) and can use “<” key or “>” key to select the bit to be modified for multi-bit numerical value or ASCII character string.

Edit box concurrently acts as command button in setting value dialog box. Press “←|” to execute the command of the control corresponding to the edit box (being displayed in inverse background) after any edit box obtains input focus. For example, press “←|” in Figure 1 to enter control word setting dialog box shown in Figure 3.

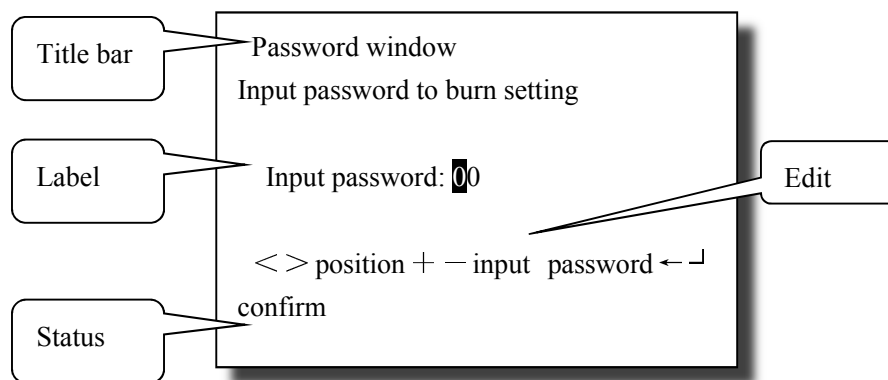
Operator generally needs to modify edit box according to the set contents and then press “←|” key in edit

box beyond control word to confirm modification and execute burn command (password may need to be provided) after entering dialog box. The specific procedures are as follows:

- ◆ Modify edit boxes by turns;
- ◆ Press “←↵” key in control word edit box to enter control word setting dialog box ;
- ◆ Select each listing choice box by turns in control word setting dialog box;
- ◆ Press “←↵” key to return to setting value dialog box.

Press “←↵” key to burn (prompt input password) after confirming the contents of edit boxes to conform to the setting requirement.

1.1.4 Dialog box of password input



Dialog box of password input

As shown in the above figure, a typical password input dialog box used in BEPR- 554 series digital protection includes title panel, status bar, label and edit box etc.

Title panel indicates functional type of the menu.

Status bar prompts the operation to be executed.

Label, also static button, is put in front of edit box or listing button to indicate the name of the edit box.

Edit box is generally numerical value or ASCII character string and can use “+” key or “-” key to modify (edit) after obtaining input focus (being displayed in inverse background) and can use “<” key or “>” key to modify the bit to be modified for multi-bit numerical value or ASCII character string. The content of edit box is input password and BEPR- 554 series digital protection uses the following two passwords:

99: = operation password (such as setting burn and digital output drive etc.)

3138: = modify internal setting

1.1.5 Normal display screen

554 data protection Setting ID 00

IAT 5.0A 0.000° IBT 5.05A -90.0°
ICT 4.9A -120.° IAN 5.05A 150.0°
IBN 5.0A 120.0° ICN 5.05A 30.01°

2005-07-10 14:26:17
Press any key to enter main menu

Normnal display screen 1

554 data protection Setting ID 00

Differential protection patch ● Transverse differential protection patch ●

Over-voltage protection patch ○ rotator one-point ground ○

Rotator two-point ground ● 3U0 stator ground ●

Excitation-loss protection patch ○ Composite voltage and over-current patch ○

← Main menu 2005-11-18 11:18:18
← Main menu 2005-11-18 11:18:18

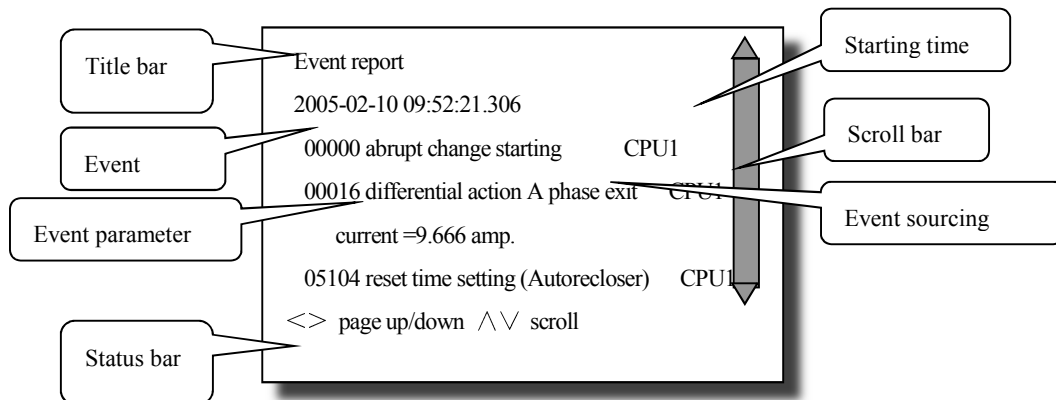
Normnal display screen 2

The above figure shows two typical normal display screens used in BEPR- 554 series digital protection and screen 1 shows effective value and angle of three-phase voltage and three-phase current and screen 2 shows state of protection strap ● = enabled, ○ = quit).

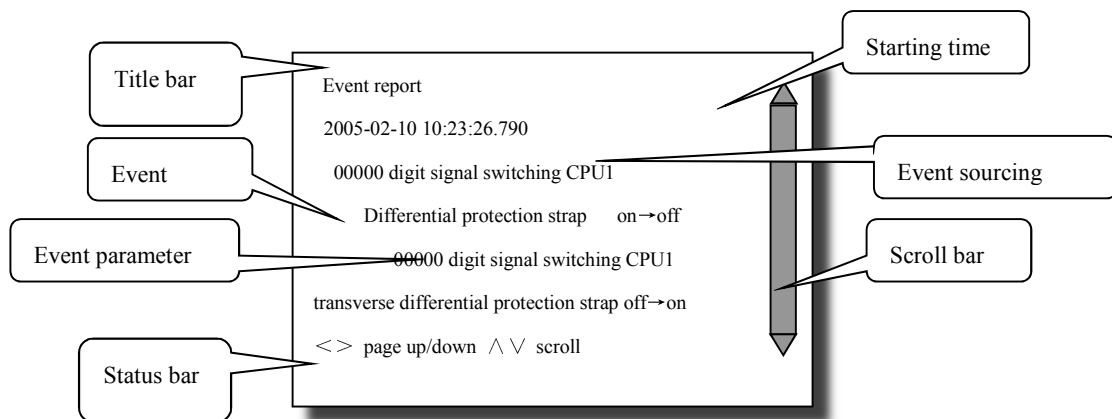
The device shows screen 1 and screen 2 by turns after the device is run upon power up, or is operated without keyboard for more than 5 minutes or is returned from the main menu to enter normal display screen. At that time, press “Q” key to stop the device from display automatic switchover and retain screen 1 or screen 2 (screen content itself continues to be refreshed) and then press “Q” key to switch screen 1 and screen 2.

Press “←” key to enter the main menu if the device needs to be operated.

1.1.6 Event display screen



Event display screen 1



Event display screen 2

As shown in the above figure, two event reporting display screens used in BEPR- 554 series digital protection include title panel, status bar, starting time of a set of events, event entry (corresponding event, event name and event sourcing) and possible event parameters. If operator does not operate keyboard, then several fault events are displayed in a list and are spaced with blank line and corresponding events. Use “<” key, “>” key to page down/up or “^” key, “v” key to scroll screen. Display list can retain 500 lines of information (including events and parameters) at its maximum and will automatically delete the first entries if 500 lines are exceeded. The deleted events can still be copied unless event record zone is refreshed.

1.2 Operating instruction of main functions

BEPR- 554 series protection operations can be divided into the following types:

Setting: including display, print, copy, modify (burn) and delete of the setting item;

Event reporting: including copy, display and print of general report and copy, display and print of single

reports of all protection modules;

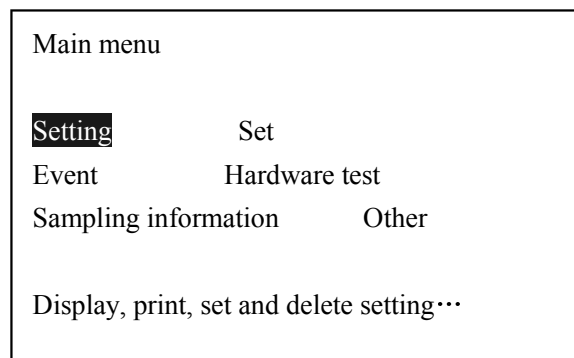
Sampling information: including display of effective values of sampling values of all AC analog channels and print waveform of two cycles;

Setting of human-machine: including communication setting, MMI module setting and time setting etc.

Hardware test: including digital output drive, digital input test (real-time status display of digital input), AC test (real-time display of amplitude, phase and DC offset of all AC analog channels);

Other operations: including version information prompt, forced MMI initialization, prompt language selection of MMI operation (such as English) or factory setting (select user-defined protection model, software/hardware and strap type etc.).

1.2.1 Main menu



Main menu

The above figure shows a typical main menu used in BEPR- 554 series digital protection. There are the following means to enter the main menu.

Press “←┐” key in normal display screen to enter the main menu;

Press “Q” key in event display screen to enter the main menu;

Press “Q” in other operation screens and return to the main menu according to prompt. A command indicates one type of operation in the main menu of BEPR- 554 series digital protection. The currently selected operation type is shown in the manner of displayed in inverse background (white on black) and prompt line at the bottommost prompts the operation of currently selected operation type in the main menu. Operator uses “^”, “v”, “>” or “<” to select and finally use “←┐” (“ENT” key) to confirm and enter the corresponding operation menu.

1.2.2 Setting

BEPR- 554 series digital protection provides a complete set of setting management interface and users can

conveniently input, modify, display, print, copy and delete setting item by means of these human-machine interface interfaces.

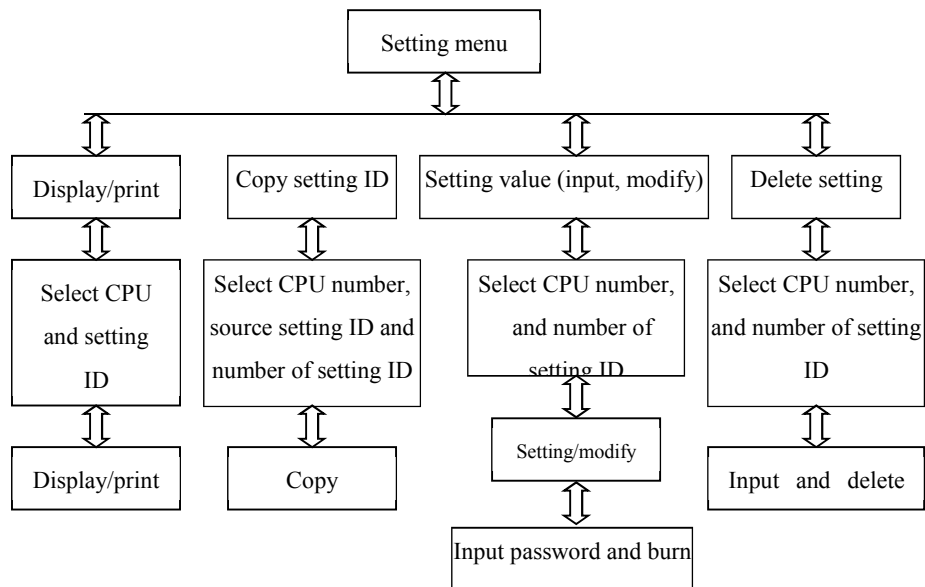


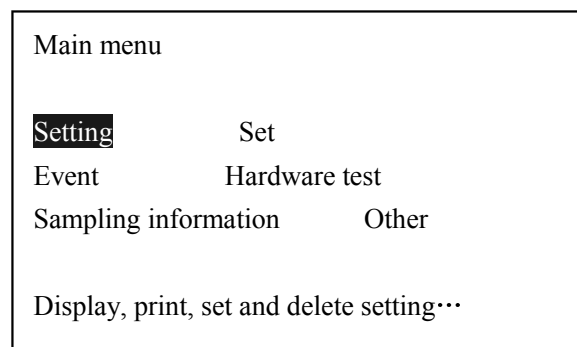
Figure 2-2 Setting operation process

The above figure shows operation flow chart of setting item in BEPR- 554 series digital protection and the common operations are as follows:

1) Display setting

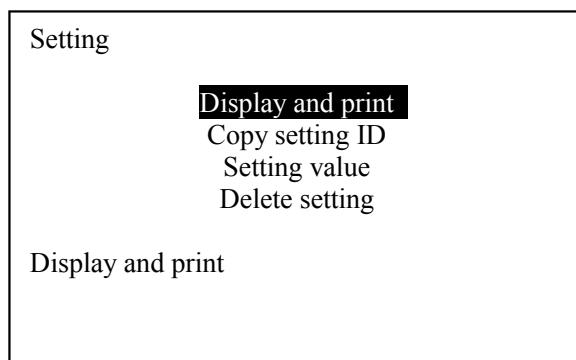
BEPR- 554 series digital protection can display setting item saved by protection modules in LCD and specific operational procedures are as follows:

- ◆ Enter the main menu;
- ◆ Select “setting” command button in main menu and then press “←┐” to enter setting operation dialog box;



Main menu

◆ Select “display and print” command button in setting operation dialog box and then press “←|” to enter “setting print/display” dialog box;



Setting

Display and print

Copy setting ID

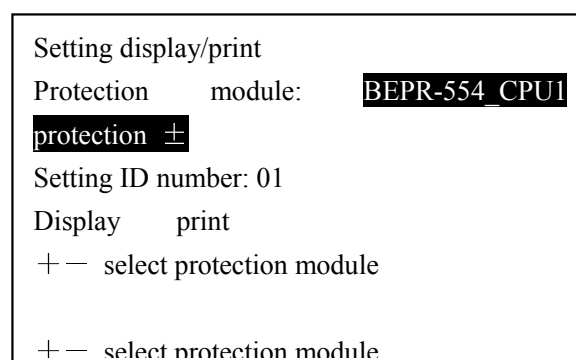
Setting value

Delete setting

Display and print

Setting operation dialog box

◆ Select protection modules in “setting display/print” dialog box (the device of single protection module does not need to be selected);



Setting display/print

Protection module: **BEPR-554 CPU1**

protection ±

Setting ID number: 01

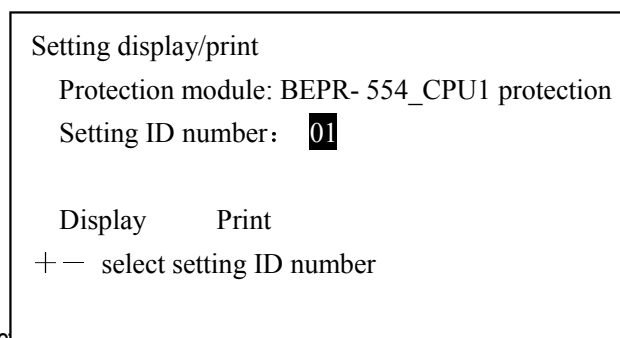
Display print

+ — select protection module

+ — select protection module

Setting display/print dialog box - select protection module

◆ Use “^” or “v” to transfer input focus to setting ID number edit box and use “+” or “-” to select setting ID number;



Setting display/print

Protection module: BEPR- 554_CPU1 protection

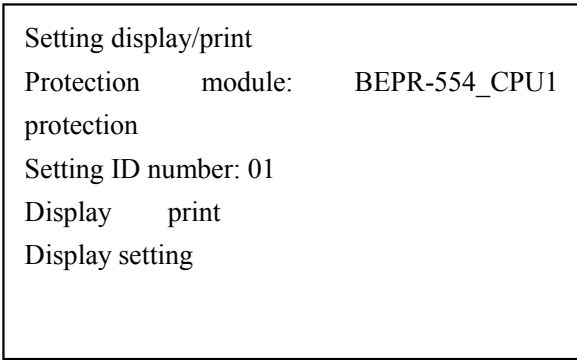
Setting ID number: **01**

Display Print

+ — select setting ID number

Setting display/print dialog box - select setting ID number

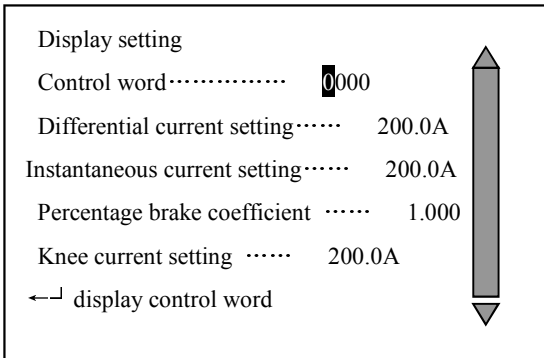
- ◆ Use “^” or “v” to transfer input focus to “display” command button;



Setting display/print
Protection module: BEPR-554_CPU1
protection
Setting ID number: 01
Display print
Display setting

Setting display/print dialog box – select “display” command button

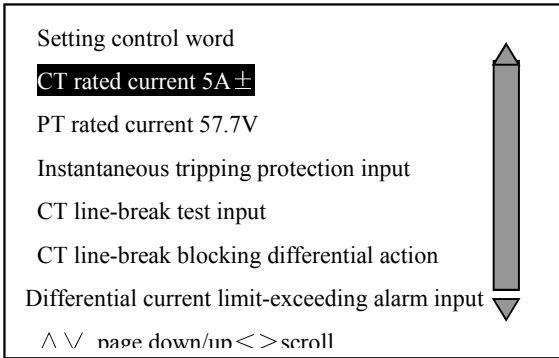
- ◆ Press “←↵” to display setting;



Display setting
Control word..... 0000
Differential current setting..... 200.0A
Instantaneous current setting..... 200.0A
Percentage brake coefficient 1.000
Knee current setting 200.0A
←↵ display control word

Setting display screen

- ◆ Press “←↵” to display control word;



Setting control word
CT rated current 5A ±
PT rated current 57.7V
Instantaneous tripping protection input
CT line-break test input
CT line-break blocking differential action
Differential current limit-exceeding alarm input
^ v page down/up < > scroll

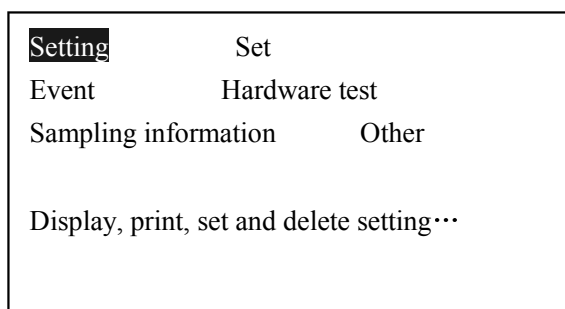
Control word display screen

- ◆ Press “←┘” to switch setting display screen and control word display screen;
- ◆ Press “Q” to return to the main menu step by step.

2) Print setting

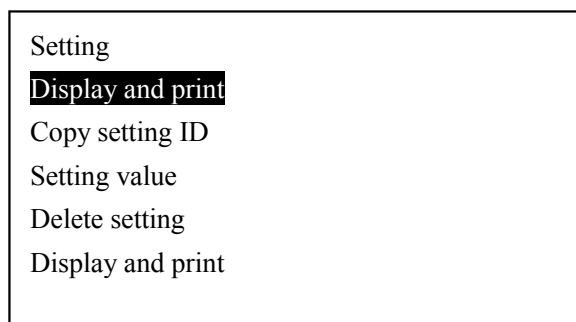
BEPR- 554 series digital protection can print the setting item saved by protection modules in the form and specific operational procedures are as follows:

- ◆ Enter the main menu;
- ◆ Select “setting” command button in the main menu and then press “←┘” to enter setting operation dialog box.



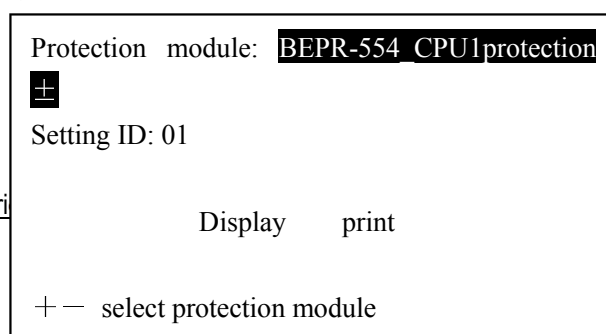
Main menu

- ◆ Select “display and print” command button in setting operation dialog box and press “←┘” to enter “setting print/display” dialog box;



Setting operation dialog box

- ◆ Select protection modules in “setting display/print” dialog box (the device of single protection module does not need to be selected);



Display/print operation dialog box – select protection module

◆ Use “^” or “v” to transfer input focus to setting ID number edit box and use “+” or “–” to select setting ID number;

Display/print setting
Protection module: BEPR-554_CPU1
protection
Setting ID number: 01
Display print
+ - select setting ID number

Display/print operation dialog box – select setting ID number

- ◆ Use “^” or “\” to transfer input focus to “print” command button;

Disp
lay/print setting
Protection module: zero sequence protection and
reclosing
Setting ID number: 01
Display print
Print setting

Display/print operation dialog box – select “print” command button

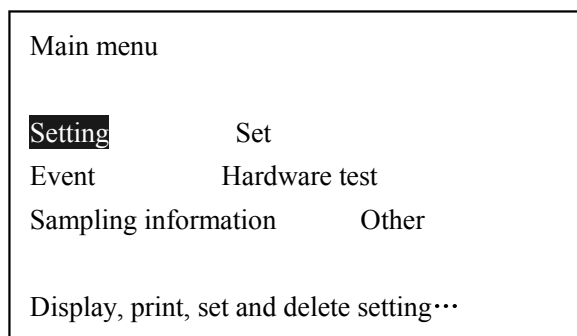
- ◆ Press “←” to print setting.

A message window will prompt “printer is busy or is failed” and printing fails if printer fails to be connected.

3) Copy setting

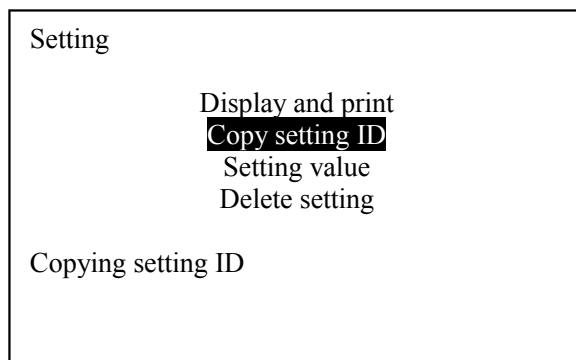
BEPR- 554 series digital protection can copy the setting of a certain setting ID saved in protection module to another setting ID. The input setting can be copied to another setting ID to be set before modification so as to conveniently input several sets of setting item suited to different modes of operation when the two sets of setting vary little. Setting copy has the following operational steps:

- ◆ Enter main menu;
- ◆ Select “setting” command button in the main menu and press “←” to enter setting operation dialog box;



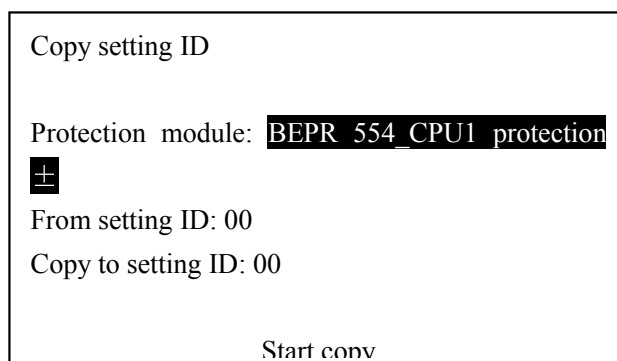
Main menu

◆ Select “copy setting ID” command button in setting operation dialog box and then press “←↵” to enter “setting ID copy” dialog box;



Setting operation dialog box

◆ Select protection module in “setting ID copy” dialog box (protection module needs not to be selected for the device of single protection module);



Setting ID copy operation dialog box – select protection module

Use “^” or “v” to transfer input focus to the copied setting ID edit box and use “+” or “-” to select the copied setting ID number (sourcing setting ID). The setting of sourcing setting ID must be valid. “+” and “-” will not function if there is only one valid setting ID.

Copy setting ID
Protection module: BEPR 554_CPU1 protection
From setting ID: 00
Copy to setting ID: 00
Start copy
+ – select source setting ID number

Setting ID copy operation dialog box – select copied setting ID (source setting ID)

◆ Use “^” or “v” to transfer input focus to the target setting ID edit box and use “+” or “–” to select the target setting ID number and “<” or “>” can be used to shift the input position of multi-bit numerical value.

Copy setting ID
Protection module: BEPR 554_CPU1 protection
Setting ID: 00
Copy to setting ID: 00
Start copy
< > shift + – change value

Setting ID copy operation dialog box – select destination setting ID number

◆ Use “^” or “v” to transfer input focus to “begin copying” command button and select the command button;

Copy setting ID
Protection module: BEPR 554_CPU1 protection
Setting ID: 00
Copy to setting ID: 00
Start copy
Start copy

Setting ID copy operation dialog box – select “start copy” command button

◆ Press “←” to copy setting and the device displays password input window.

Password window

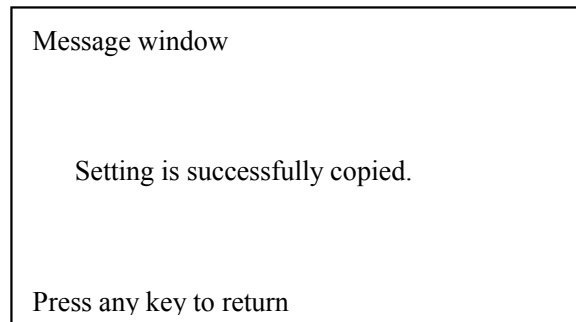
Input password to copy setting

Input password: 00

< > shift + — input password ← confirm

Setting ID copy operation dialog box – input password

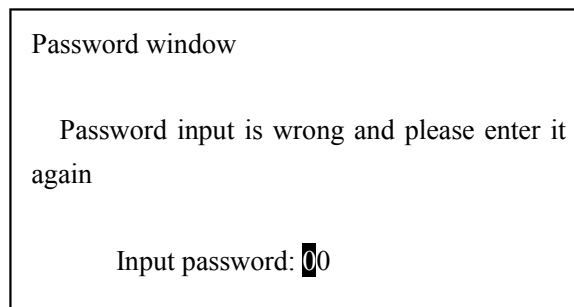
- ◆ Enter correct password in password window and “<” or “>” can be used to shift input position of multi-bit numerical value and use “+” or “-” to input password;
- ◆ Press “←” to confirm and copy setting and the device prompts message window “copy is successful”;



Setting ID copy operation dialog box – message window

- ◆ Press any key to return setting copy dialog box;
- ◆ Press “Q” to return to the main menu step by step.

Password input window will repeatedly prompt and password input error is prompted if password input is wrong, as shown in the following figure. At that time, password can be reentered.



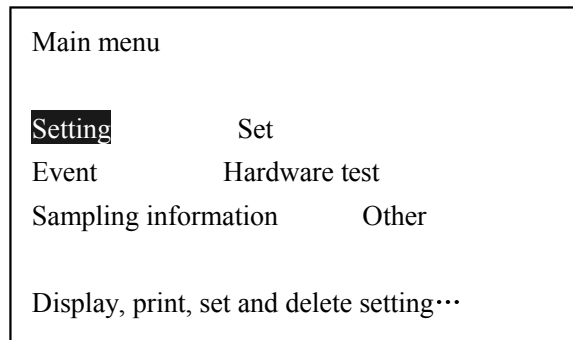
Setting ID copy operation dialog box – reinput password

4) Setting value

“Setting value” is to input setting and modify setting in BEPR- 554 series digital protection. BEPR- 554 series digital protection provides a full-screen edit dialog box and users can conveniently input setting and burn it to a certain setting ID of protection module by means of this dialog box or save it to a certain setting ID of protection module and reburn it after modification. Compared to previous digital protection (microcomputer protection), users can visually select each item of control word by means of list dialog box provided by BEPR- 554 series in addition to inputting control word in hexadecimal number. The specific operational steps are as

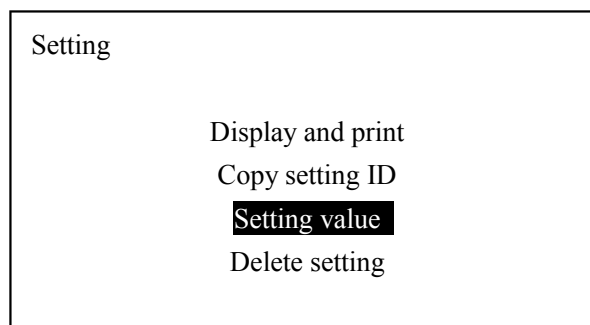
follows:

- ◆ Enter main menu;
- ◆ Select “setting” command button in main menu and press “←┐” to enter setting operation dialog box;



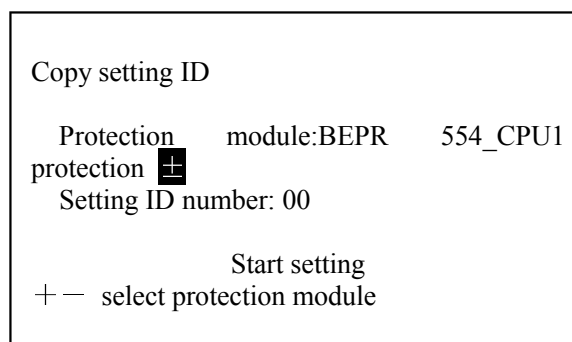
Main menu

- ◆ Select “setting value” command button and press “←┐” to enter “setting value” dialog box in setting operation dialog box;



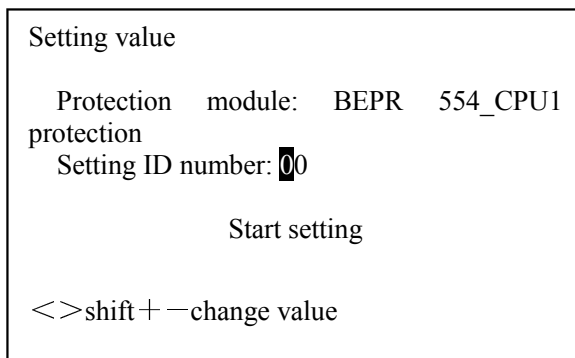
Setting operation dialog box

- ◆ Select protection module in “setting value” dialog box (protection module needs not to be selected for the device of single protection module);



Setting operation dialog box – select protection module

◆ Use “^” or “v” to transfer input focus to setting ID edit box and use “+” or “-” to select input or modified setting ID number and use “<” or “>” to shift input position of multi-bit numerical value;



Setting value

Protection module: BEPR 554_CPU1
protection

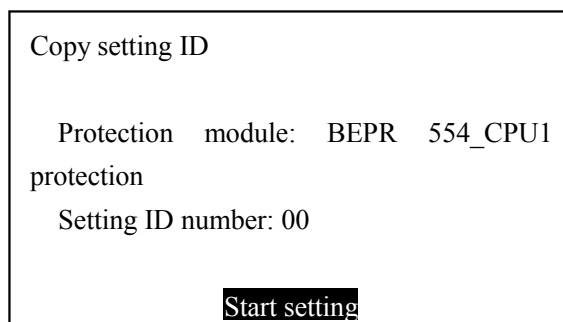
Setting ID number: 00

Start setting

<>shift + -change value

Setting operation dialog box – select setting ID number

◆ Use “^” or “v” to transfer input focus to “start setting” command button and select the command button or skip this step to setting value dialog box;



Copy setting ID

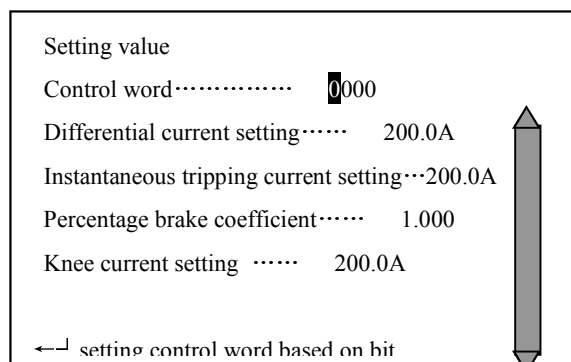
Protection module: BEPR 554_CPU1
protection

Setting ID number: 00

Start setting

Setting ID copy operation dialog box – select “start setting” command button

◆ Press “←” to enter setting input dialog box;



Setting value

Control word..... 0000

Differential current setting..... 200.0A

Instantaneous tripping current setting...200.0A

Percentage brake coefficient..... 1.000

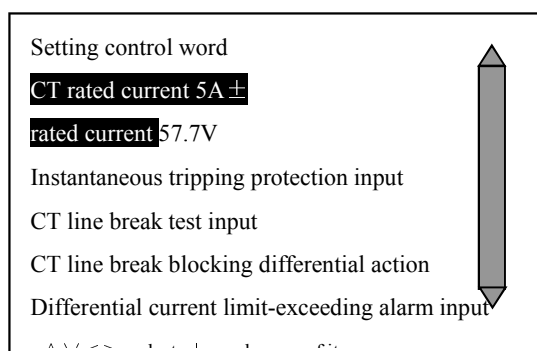
Knee current setting 200.0A

← setting control word based on bit

Setting value dialog box 1- setting input

◆ Edit and modify various setting items. Use “^” or “v” to select setting items to be modified or edited and use “<” or “>” to move cursor and use “+” or “-” to change the number of the bit where the cursor is located. Use “+” or “-” to move decimal place if the cursor is at decimal point;

◆ Status bar will prompt “←” to conduct bit-by-bit setting control word when the setting item which is being edited or modified is control word. Press “←” to enter bit-by-bit setting control word dialog box, as shown in the following figure:



Setting control word

CT rated current 5A ±

rated current 57.7V

Instantaneous tripping protection input

CT line break test input

CT line break blocking differential action

Differential current limit-exceeding alarm input

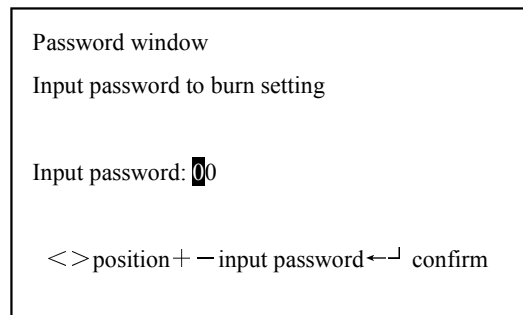
Setting value dialog box 2- control word

Use “^”, “v”, “<” or “>” to select a certain list (group) and use “+” or “-” to select and display the list of all significance bits of the setting item (control word) in control word setting dialog box. Press “←” to confirm control word input” and return to setting ID input dialog box after selecting all lists (group) and move cursor to the next non control word setting (“Q” for quitting modification to control word).

Control word and other setting items need to be burned before being written into protection module. Only contents of input buffer zone are modified here.

◆ Status bar will prompt “← confirm modifying burn setting”, indicating pressing “←” to execute setting burn when the setting which is being edited/modified is not control word, as shown in the following

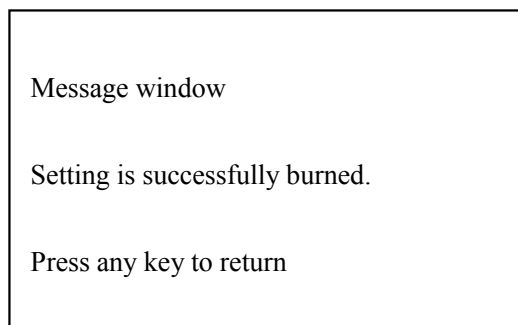
figure.



Setting value dialog box 2 - password window

◆ Press “←” to execute burn after entering correct password. Use “<” or “>” to shift edit and modifier bit of multi-bit numerical value and use “+” or “-” to change the number at digit bit of the current password in entering password.

A message window will prompt “setting burn is successful” upon setting burn, as shown in the following figure.



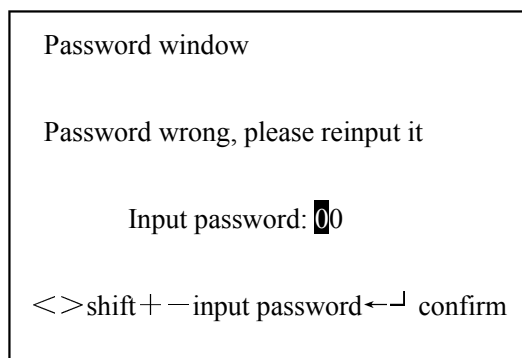
Setting value dialog box 3 - password

◆ Press any key to return to setting ID copy dialog box and then use “Q” to return to the main menu step by step.

Please pay attention to the following points during the above procedures:

If the input setting exceeds the range limited by the setting, status bar will prompt “setting cross limit” and the numerical area of the setting when using “^” or “v” to modify other setting item or press “←” to burn setting. At that time, users must reenter the setting according to the specified area before continuing to modify or burn other setting item.

The following window will prompt “password wrong” in LCD and password needs to be reentered before burning command if the input password is wrong in password input prompt window.



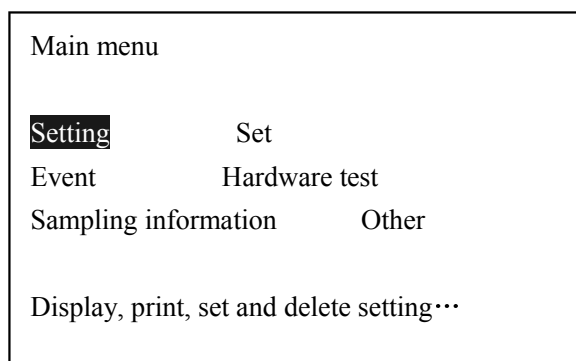
Setting value dialog box 3 - reinput password

The setting will not be burned to protection module before entering correct password and pressing “←” and press “Q” to return to the main menu step by step and quit the modifications. Likewise, stopping keyboard operation for 5 minutes to automatically quit modifications to the setting and return to normal display screen before entering correct password and pressing “←” and press “Q”.

5) Delete setting

BEPR- 554 series digital protection provides the operation of deleting setting to delete unnecessary integral setting of setting ID. As BEPR- 554 series setting ID switching operation can only switch to valid setting ID, deleting unnecessary setting of setting ID can prevent switching operation from being switched by accident to unexpected operating setting ID. The operational steps of deleting setting of setting ID are as follows:

- ◆ Enter main menu;
- ◆ Select “setting” command button in the main menu and press “←” to enter setting operation dialog box;



Main menu

- ◆ Select “delete setting” command button in setting operation dialog box and then press “←” to enter “delete setting” dialog box;

Setting

Display and print

Copy setting ID

Setting value

Delete setting

Delete setting in setting ID

Setting operation dialog box

◆ Select protection module in “delete setting” dialog box (the device of single protection module does not need to be selected);

Copy setting ID

Protection module: **BEPR 554_CPU1 protection**

±

Setting ID number: 00

Delete setting

+ — select protection module

Setting deletion operation dialog box – select protection module

◆ Use “^” or “v” to transfer input focus to setting ID edit box and use “+” or “—” to select the No. of setting ID to be input or modified. Deletion can not be executed if setting ID has no setting and so setting ID number may not be continuously changed;

Setting value

Protection module: BEPR554_CPU1 protection

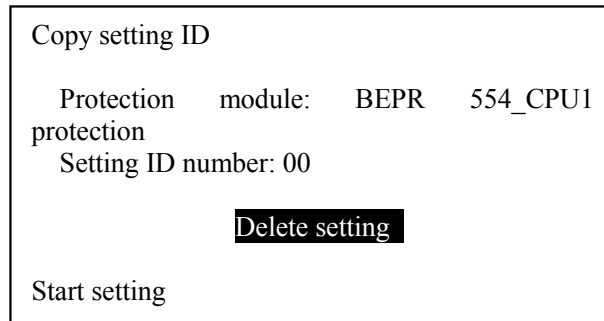
Setting ID number: **00 ±**

Delete setting

+ — select setting ID number

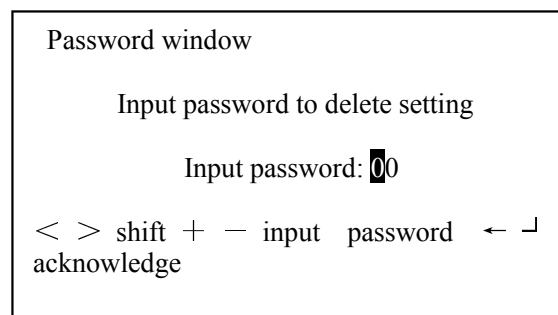
Setting deletion operation dialog box – select setting ID number

◆ Use “^” or “v” to transfer input focus to “delete setting” command button and select the command button or skip this step to password input window.



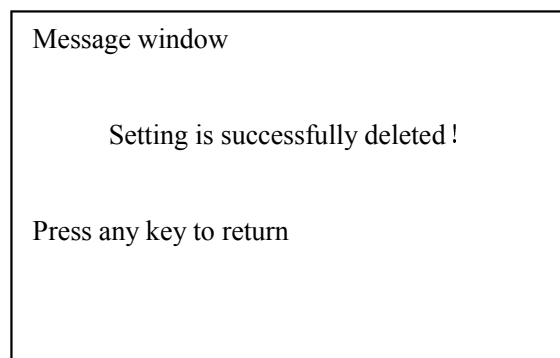
Setting deletion operation dialog box – select “delete setting” command button

◆ Press “←↵” to delete setting and password input prompt window will prompt as shown in the following figure:



Setting deletion dialog box – password window

◆ Enter correct password and then press “←↵” to delete. Use “<” or “>” to shift edit and modifier bit of multi-bit numerical value and use “+” or “-” to change the number at digit bit of the current password in entering password. A message window will prompt “setting deletion is successful” upon setting deletion, as shown in the follow figure:

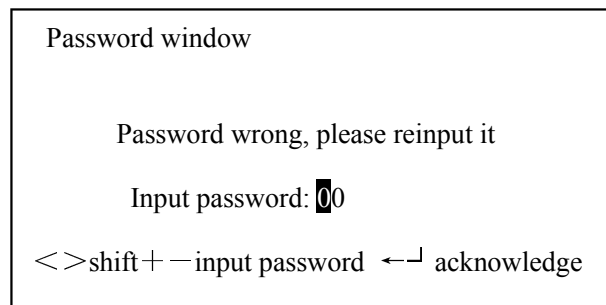


Setting value dialog box – message window

- ◆ Press any key to return and then use “Q” to return to the main menu step by step.

Please pay attention to the following points during the above procedures:

The following window will prompt “password wrong” in LCD and password needs to be reentered before burning command if the input password is wrong in password input prompt window.



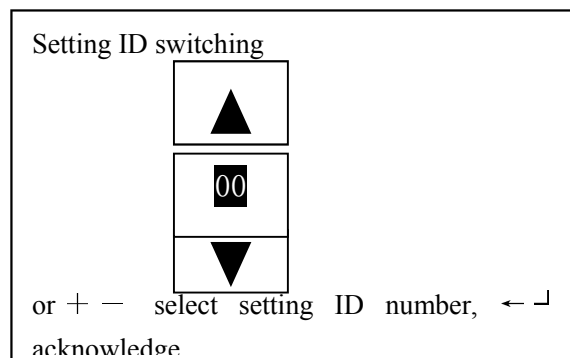
Setting value dialog box – reenter password

Setting will not be deleted to protection module before entering correct password and pressing “←” and press “Q” to return to the main menu step by step and quit deletion operation. Likewise, stopping keyboard operation for 5 minutes to automatically quit modifications to the setting and return to normal display screen before entering correct password and pressing “←” and press “Q”.

6) Switching setting ID

The panel of BEPR- 554 series digital protection is equipped with two setting switching keys which are used to switch the current operating setting ID. The operational steps are as follows:

- ◆ Press ▼ or ▲ at any time to prompt the following setting switching dialog box:



Setting ID switching dialog box – select setting ID number

- ◆ Press ▼ or ▲ , “+” or “-” to select the number of target setting ID to be switched;
- ◆ Press “←” to confirm switching operation to be executed and the device displays password window

which prompts “enter password”, of which, “XX” is number of selected target setting ID;

Password window

Setting will be switched to No.XX ID

Input password: 00

< > shift + - input password ← ↵
acknowledge

Setting ID switching dialog box – enter password

◆ Enter correct password and then press “←↵” to switch setting ID. Use “<” or “>” to shift edit and modifier bit of multi-bit numerical value and use “+” or “-” to change the number at digit bit of the current password in entering password. The device displays a message window which prompts “setting switching is successful” upon switching;

Message window

Setting has been successfully switched to No.
XX ID!

Press any key to return

Setting ID switching dialog box – message window

◆ Press any key to return to the state before switching.

Please pay attention to the following points during the above procedures:

Multiple protection modules (if any) of the device will simultaneously switch setting ID.

The following window will prompt “password wrong” in LCD and password needs to be reentered before burning command if the input password is wrong in password input prompt window.

Password window

Password wrong, please reinput it.

Input password: 00

< > shift + - input password ← ↵
acknowledge

Setting ID switching dialog box – reenter password

Setting ID will not be switched and press “Q” to return to the state before switching before entering correct password and pressing “←┐”. Likewise, stopping keyboard operation for 5 minutes will automatically quit setting ID switching operation and return to normal display screen before entering correct password and pressing “←┐” and press “Q”.

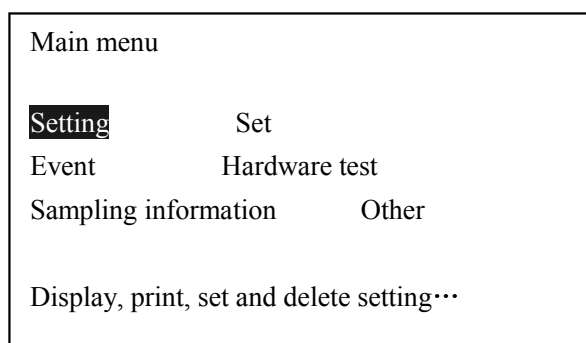
1.2.3 Event reporting operation

The event report of BEPR- 554 series digital protection can be divided into “general report” and “single report”. The “general report” is kept in event report recording of human-machine module and includes event report generated by protection start-up in case of failure of the system, operation report in the device operation and event report in abnormal conditions of the device etc. The “single report” is kept in event report of protection module. The operation of event report is to operate the two types of reports, including copy, display or print etc.

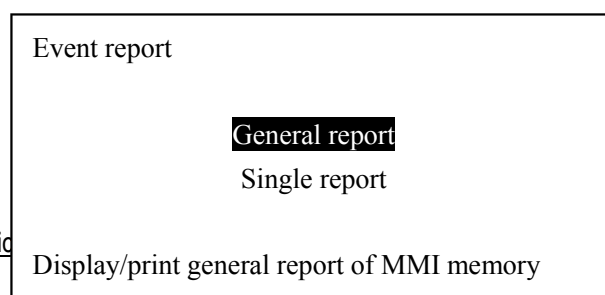
1) General report operation

BEPR- 554 series digital protection provides a simple listing option dialog box which can select display/print of a certain event report recording saved in human-machine module. The specific operation procedures are as follows:

- ◆ Select “event” command button in main menu after entering main menu;
- ◆ Press “←┐” to enter event report dialog box and select “general report” command button;

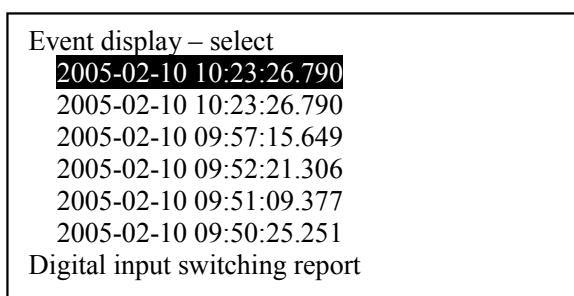


Main menu



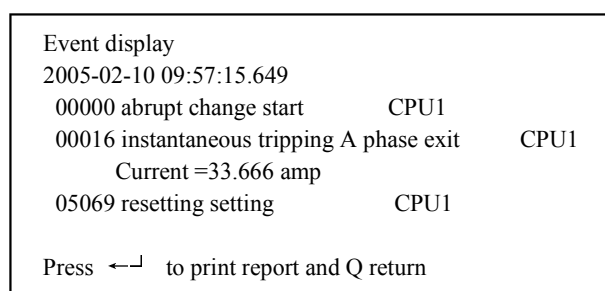
Event report dialog box – select “general report” command button

◆ Press “←┘” to enter event display - select dialog box and use “^” or “v” to select event recording of a certain fault and status bar will prompt corresponding report type (fault report, alarm report, switching report etc.). The event records in the list are ordered according to time sequence of the event to facilitate searching by users;



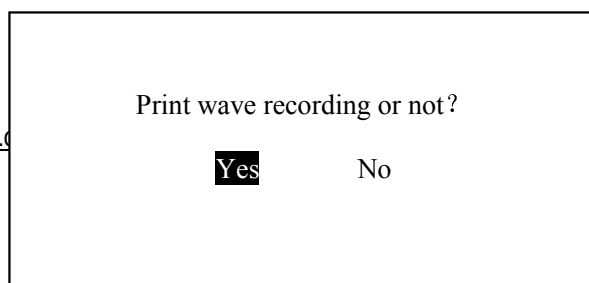
Event report dialog box – select event record

◆ Press “←┘” to enter event display dialog box. The relative time with millisecond as unit exists in front of each event recording entry in event display dialog box and the time in title panel is reference time of the relative time;



Event report dialog box – display event record

◆ Press “←┘” to print; otherwise, press “Q” to return to event display – select dialog box. Press “←┘” to print event and inquire whether wave recording dialog box is printed or not in case of fault event. Press “←┘” to print wave recording graph if selecting ‘yes’ and wave recording data is read from the set “wave recording protection”;



Dialog box of print wave recording or not

- ◆ Use “Q” to return to the main menu step by step.

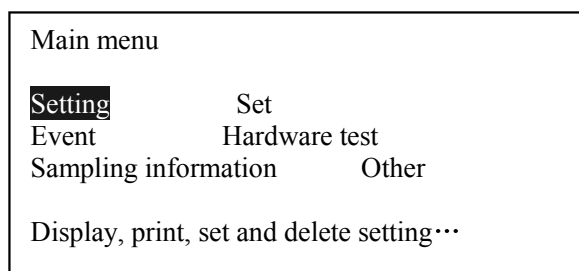
It is noted that the printer must be in on-line state before printing event report; otherwise, operate in Step No.5.

A message window prompts “print fails” after pressing “←| ”.

2) Single report operation

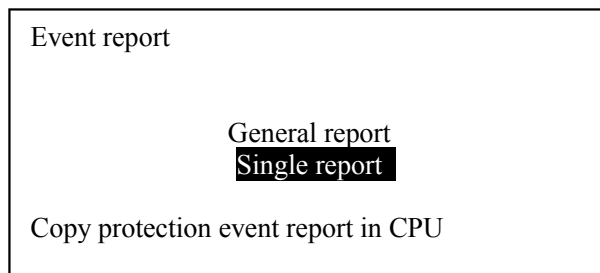
BEPR- 554 series digital protection provides a simple listing option dialog box which can copy, display or print event report recording saved in protection module. The specific operation procedures are as follows:

- ◆ Select “event” command button in the main menu;



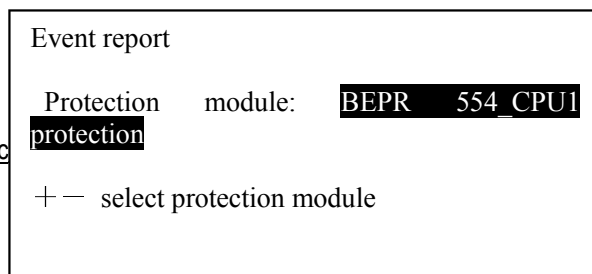
Main menu

- ◆ Press “←| ” to enter event report dialog box and select “single report” command button;



Event report dialog box – select “single report” command button

- ◆ Press “←| ” to enter protection module selection dialog box and use “+” or “—” to select protection module;



Event report dialog box – select protection module

◆ Press “←┘” to enter event display – select dialog box and use “^” or “v” to select event recording of a certain fault. The event records in the list are ordered according to time sequence of events to facilitate searching by users;

```
Event display – select
2005-02-10 09:57:15.640
2005-02-10 09:52:21.306
2005-02-10 09:51:09.377
2005-02-10 09:48:43.809
2005-02-10 09:47:04.209
2005-02-10 09:44:08.418
<> Page down/up ^ v select ←┘ to display contents
```

Event report dialog box – select event record

◆ press “←┘” to enter event display dialog box. The relative time with millisecond as unit exists in front of each event recording entry in event display dialog box and the time in title panel is reference time of the relative time;

```
Event display
2005-02-10 09:57:15.649
00000 abrupt change start      CPU1
00016 instantaneous tripping A phase exit
CPU1
      Current =33.666 amp
05069 resetting setting      CPU1
Press ←┘ to print report and Q to return
```

Event report dialog box – display event record

◆ Press “←┘” to print; otherwise, press “Q” to return to event display – select dialog box. Press “←┘” to print event and inquire whether wave recording dialog box is printed or not in case of fault event. Press “←┘” to print wave recording graph if selecting ‘yes’;

◆ Use “Q” to return to the main menu step by step.

It is noted that the printer must be in on-line state before printing event report; otherwise, a message

window will prompt “print fails” after print operation “←┘”.

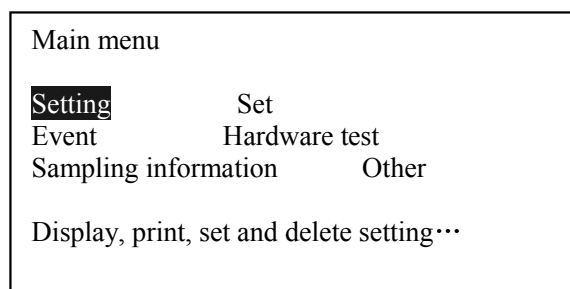
1.2.4 Sampling information

BEPR- 554 series digital protection provides a set of dialog boxes and users can display current state of all AC analog channels or print analog waveform by means of dialog box.

1) Effective value of display analog channel

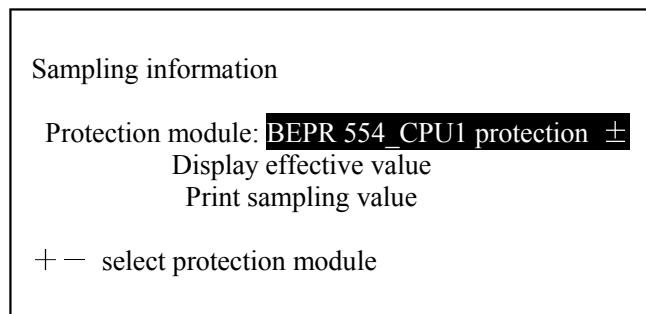
BEPR- 554 series digital protection can display amplitude, phase angle (take U_a as reference vector) and DC offset of all AC analog channels in a real-time manner and its operational steps are as follows:

- ◆ Select “sampling information” command button after entering the main menu;



Main menu

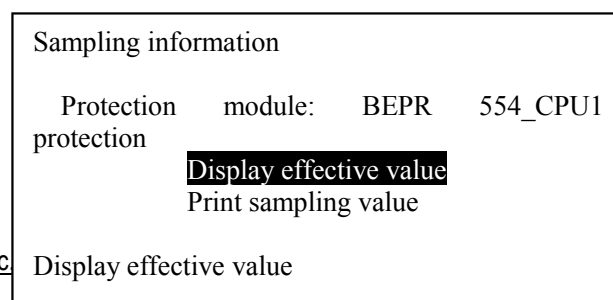
- ◆ Press “←┘” to enter sampling information operation dialog box and use “+” or “—” to select protection module;



Sampling information dialog box – select protection module

No “±” will prompt for the device of single protection module and “+” and “—” will not function.

Use “^” or “v” to select “display effective value” command button;



Sampling information dialog box – select “display effective value” command button

◆ Press “←┐” to confirm and execute the selected operations: Display the effective values of all analog channels. The following list display information will be shown:

Name	Amplitude	Phase	DC offset
IAT	0.001A	174.5°	-0.059
IBT	0.002A	-15.03°	-0.033
ICT	0.003A	35.85°	0.007
IAN	0.003A	178.1°	0.015
IBN	0.003A	0.000°	0.016
ICN	0.003A	-177.0°	0.001
^ \ scrolling, < > page down/up			

At that time, use “^” or “\” to one line) and use “<” or “>” to “page down/up”.o “scroll” (move down or up

◆ Press “Q” to return to the main menu step by step.

2) Print sampling value

BEPR- 554 series digital protection can print waveforms of two cycles. The operational steps are as follows:

◆ Enter the main menu and select “sampling information” command button;

Main menu	
Setting	Set
Event	Hardware test
Sampling information	Other
Display and print AC sampling ...	

Main menu

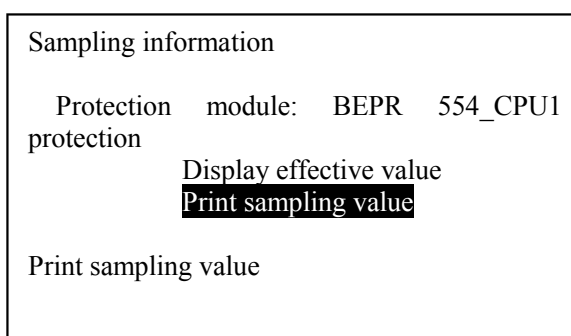
◆ Press “←┐” to enter sampling information operation dialog box. Use “+” or “-” to select protection modules;

Sampling information	
Protection module:	BEPR 554_CPU1
protection ±	
Display effective value	
Print sampling value	
+ - select protection module	

Sampling information dialog box – select protection module

No “±” will prompt for the device of single protection module and “+” and “—” will not function.

- ◆ Use “^” or “v” to select “print sampling value” command button;



Sampling information dialog box – select “print sampling value” command button

- ◆ Press “←↵” to print sampling value waveform.

It is noted that the printer must be in on-line state before printing event report; otherwise, a message window will prompt “print fails” after print operation “←↵”.

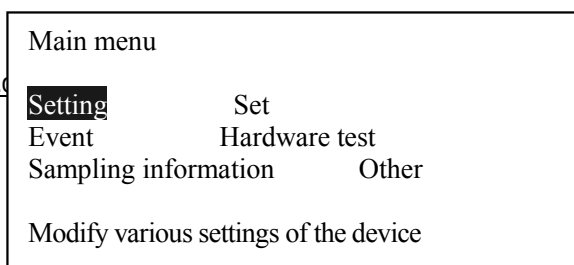
2.2.5 Setting

BEPR- 554 series digital protection provides a set of dialog boxes to enable users to set communication interface and clock of the device or select some operating parameters of human-machine module.

1) Communication setting

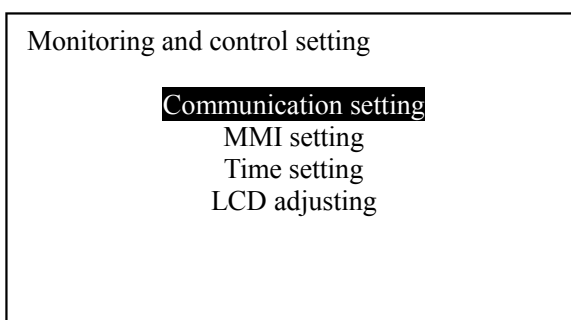
The back panel of BEPR- 554 series digital protection has one printer communication port and one multifunctional communication port. Printer port uses 19200 baud rate fixed setting. Users can set the communication mode, baud rate and communication address of the multi-functional port so as to use the port to communicate with background monitoring and control device or other equipment of the system. The specific operational steps are as follows:

- ◆ Enter the main menu and select “setting” command button;



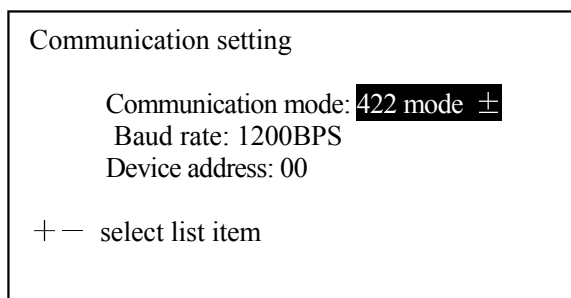
Main menu

◆ Press “←┘” to enter monitoring and control setting dialog box. Use “^” or “v” to select “communication setting” command button;



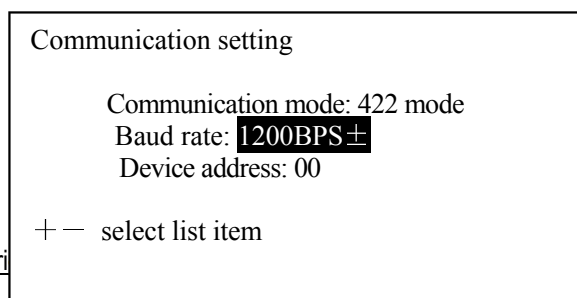
N Monitoring and control setting dialog box – select “communication setting” command button

◆ Press “←┘” to enter communication setting dialog box. Use “+” or “-” to select communication mode;



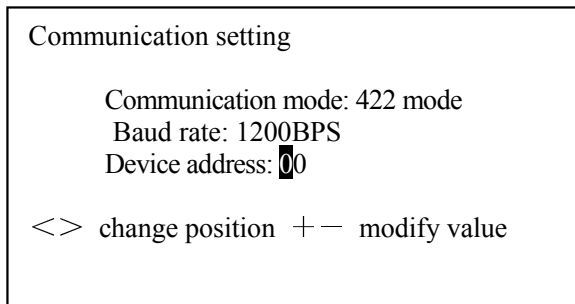
Communication setting dialog box - select communication mode

◆ Use “^” or “v” to select baud rate list and use “+” or “-” to select baud rate;



Communication setting dialog box - select baud rate

Use “^” or “v” to select device address edit box and use “+” or “-” to input device address and use “<” or “>” to select multi-bit numerical value;



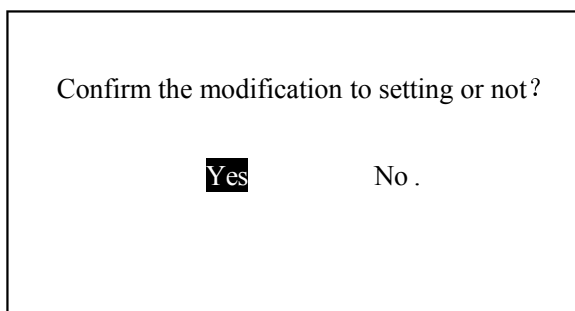
Communication setting

Communication mode: 422 mode
Baud rate: 1200BPS
Device address: 00

<> change position + - modify value

Communication setting dialog box – input device address

◆ Press “←” or “Q” to exit communication setting dialog box. If users modify communication setting, the device will display dialog box and prompt confirmation;



Confirm the modification to setting or not?

Yes No

Communication setting dialog box – modification confirmation

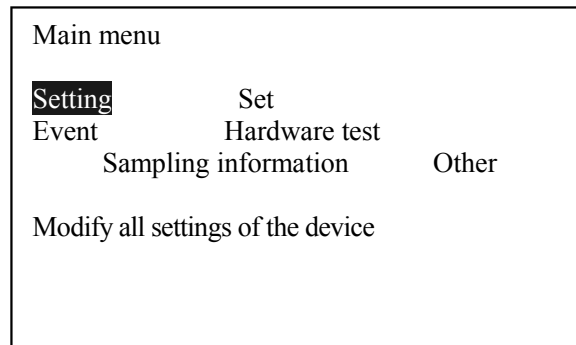
◆ Press “←” to confirm modification, and set human-machine module automatically once and initialize communication port according new communication setting. Press “Q” or use “<” or “>” to select “no” command button and then press “←” to quit modifications and then press “Q” to return to the main menu step by step.

2) Clock setting

The human-machine module of BEPR- 554 series digital protection is equipped with hardware calendar clock which is used to provide reference time for all protection modules. Hardware clock of human-machine module and software clock of protection modules can conduct GPS time calibration and the calendar clock needs to be calibrated prior to enabled operation or in case of periodic check of the device in operating place without

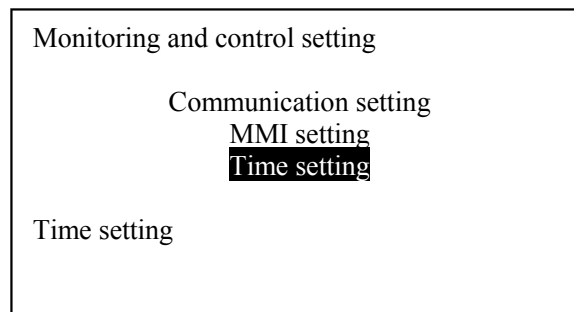
GPS device and only basic time needs to be set prior to the enabled operation in operating places with GPS device. The procedures of setting calendar clock by means of human-machine module are as follows:

- ◆ Enter main menu and select “setting” command button;



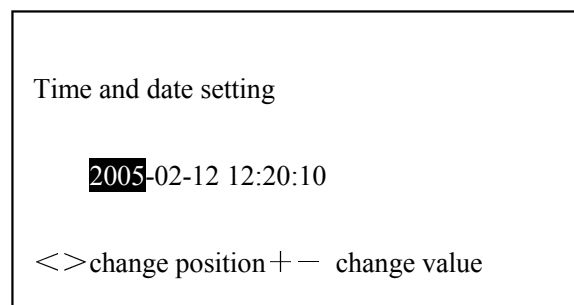
Main menu

- ◆ Press “←┐” to enter monitoring and control setting dialog box and use “^” or “v” to select “time setting” command button;



Monitoring and control setting dialog box – select “time setting” command button

- ◆ Press “←┐” to enter clock and date setting dialog box. Use “<” or “>” to select year, month, date, hour, minute, second edit box and use “+” or “-” to set new value;



Time and date setting dialog box – set new calendar clock value (year)

◆ Press “←┘” to confirm setting or press “Q” to quit modifications and return to monitoring and control setting dialog box;

◆ Press “Q” to return to the main menu step by step.

3) Setting operating parameters of human-machine module

Some operating parameters of BEPR- 554 series digital protection need to be set prior to the enabled operation of the device and these parameters include as follows:

Select sourcing of AC analog measured value in normal display screen for the device with multiple protection modules;

Select whether event is printed or not;

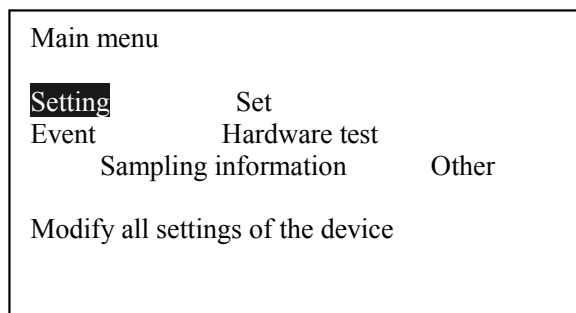
Select whether wave recording data is printed or not;

Select sourcing of wave recording data in fault report for the device with multiple protection modules;

Name (or code) of the protected equipment etc.

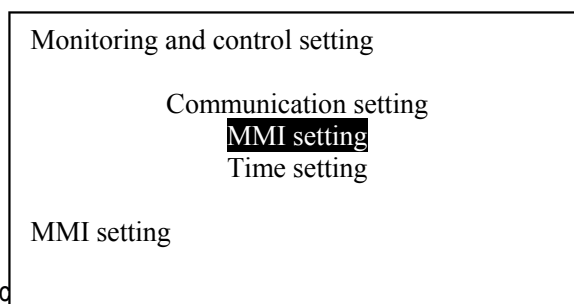
The operational steps of setting or modifying these parameters are as follows:

◆ Enter the main menu and then select “setting” command button;



Main menu

◆ Press “←┘” to enter monitoring and control setting dialog box. Use “^” or “v” to select “MMI setting” command button;



Monitoring and control setting dialog box – select “MMI setting” command button

◆ Press “←| ” to enter MMI setting dialog box. Use “+” or “–” to select measured value sourcing of normal display screen;

MMI setting

Measurement protection: BEPR 554_CPU1 protection ±

Wave recording protection: BEPR 554_CPU1 protection

Print mode: print event and wave recording

Device name:

+ - select protection module to display measurement value

Monitoring and control setting dialog box – select sourcing of measurement value

◆ Use “^” or “v” to select listing choice box of wave recording data. Use “+” or “-” to select wave recording data sourcing of accidental report;

MMI setting

Measurement protection: BEPR 554_CPU1 protection

Wave recording protection: BEPR 554_CPU1 protection ±

Print mode: print event and wave recording

Device name:

+ - select protection module to wave recording

Monitoring and control setting dialog box – select data sourcing of wave recording

◆ Use “^” or “v” to select listing choice box of auto print mode of accidental report. Use “+” or “-” to select accidental report print mode;

MMI setting

Measurement protection: BEPR 554_CPU1 protection

Wave recording protection: BEPR 554_CPU1 protection

Print mode: print event and wave recording ±

Device name:

+ - select print option of event and wave recording

Monitoring and control setting dialog box – select report printing mode

◆ Use “^” or “v” to select device name edit box. Use “+” or “-” to edit device name and use “<” or “>” to move edit position;

MMI setting

Measurement protection: BEPR 554_CPU1 protection

Wave recording protection: BEPR 554_CPU1 protection

Print mode: print event and wave recording

Device name: 1

Chinese ISN input: 31

Monitoring and control setting dialog box – edit device name

◆ Press “←|” or “Q” to exit communication setting dialog box. If users modify communication setting, then the device will display a dialog box to prompt confirmation;

Confirm modification to setting or not?

Yes No

MMI setting dialog box – modification confirmation

◆ Press “←|” to confirm modification and automatically set human-machine module and initialize communication port according to new communication setting. Press “Q” or use “<” or “>” to select “no” command button and then press “←|” to quit modification and then press “Q” to return to the main menu step by step.

Please pay attention to the following points:

Device name can be 8 Chinese characters or 16 English/numeric characters at its maximum and code and bit number of Chinese ISN must be separately edited.

The procedures of inputting device name are as follows, assuming that original device name is void and needs to be modified as “A” character:

◆ Input ID code C0, as shown in the following figure:

MMI setting

Measurement protection: BEPR 554_CPU1 protection

Wave recording protection: BEPR 554_CPU1 protection

Printing mode: print event and wave recording

Equipment name: @

Chinese ISN input: C0

Monitoring and control setting dialog box – edit ID code

- ◆ Press “>” to edit low bit of ID code and enable ID code=C4, as shown in the following figure:

MMI setting

Measurement protection: BEPR 554_CPU1 protection

Wave recording protection: BEPR 554_CPU1 protection

Printing mode: print event and wave recording

Equipment name:

Chinese ISN input:

Monitoring and control setting dialog box – edit ID code

- ◆ Press “>” to edit high bit of bit code and enable bit code=C0, as shown in the following figure:

MMI setting

Measurement protection: BEPR 554_CPU1 protection

Wave recording protection: BEPR 554_CPU1 protection

Printing mode: print event and wave recording

Equipment name:

Chinese ISN input:

Monitoring and control setting dialog box – edit bit code

- ◆ Press “>” to edit low bit of bit code and enable bit code=CF, as shown in the following figure:

MMI setting

Measurement protection: BEPR 554_CPU1 protection

Wave recording protection: BEPR 554_CPU1 protection

Printing mode: print event and wave recording

Equipment name:

Chinese ISN input:

Monitoring and control setting dialog box – edit bit code character is shown in the device name.

Note: multiple characters can be input by turns according to the above method;

If English/digit is shown in device name, input its ASCII code;

Bit code of Chinese character can be found in Table GB2312-80 and general Chinese character printer provides a bit code table.

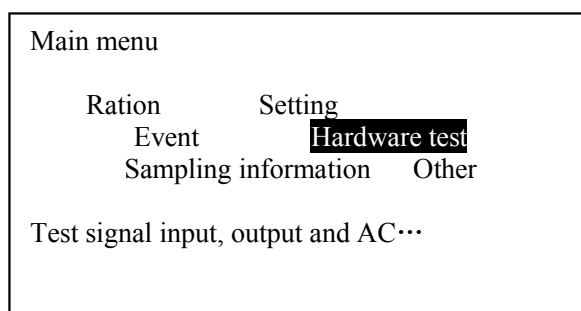
1.2.6 Hardware test operation

BEPR- 554 series digital protection provides a set of dialog boxes and users can drive digital output (relay), display digital output (manual inspection of switching input signal) in real time manner and display analog of AC input channel in real time manner by means of these dialog boxes. As the input or output operation of the device is generally used to test whether the device hardware is in good condition or not, it is called “hardware test” operation.

1) Digital output drive

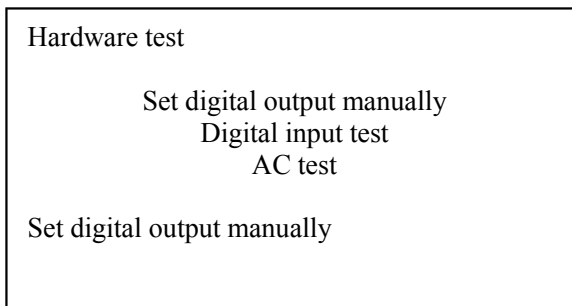
Each protection module of BEPR- 554 series digital protection is equipped with several switching output signals which are used to drive photoelectric coupler and relay etc. Users can manually drive/reset a certain switching output signal through menu (dialog box) operation to detect whether it is in good condition or not. The operational steps of driving/resetting a link of switching output signals are as follows:

- ◆ Confirm the protection modules to be operated to be in normal running state (no alarm signal);
- ◆ Enter the main menu and select “hardware test” command button;



Main menu

◆ Press “←↵” to enter hardware test operation dialog box and select “digital output drive” command button;



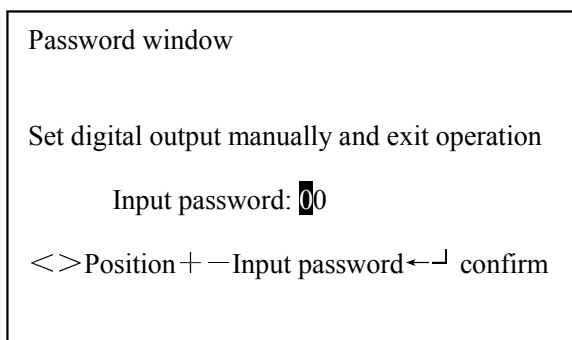
Hardware test

Set digital output manually
Digital input test
AC test

Set digital output manually

Hardware test dialog box – select “Set digital output manually” command button

◆ Press “←↵” to enter password input dialog box and press “Q” to return to the main menu;



Password window

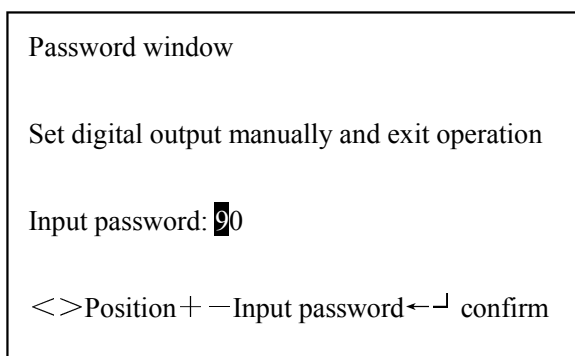
Set digital output manually and exit operation

Input password: 00

<>Position + – Input password ←↵ confirm

Dialog box of hardware test - enter password

◆ Edit password input box and enter correct password and use “<” or “>” to select editing bit and use “+” or “–” to edit the bit number;



Password window

Set digital output manually and exit operation

Input password: 00

<>Position + – Input password ←↵ confirm

Dialog box of hardware test - enter password

◆ Press “←↵” to enter digital output drive dialog box and use “+” or “–” to select protection module;

Set digital output manually and exit operation

Protection module: **BEPR 554_CPU1** protection **±**

Type: start

Set digital output manually and exit operation,
digital output returns
+ — select protection module

Digital output drive dialog box – select protection module

It is noted that the protection module has exited from the running state !

◆ Use “^” or “v” to select drive type listing choice box and use “+” or “—” to select the switch (name) to be operated;

Set digital output manually and exit operation

Protection module: BEPR 554_CPU1 protection

Type: **start** **±**

Digital output Digital output return

+ — select drive item

Digital output drive dialog box – select digital output (name)

◆ Use “^” or “v” to select operation mode. Select “digital output” command button to operate the switch; otherwise, select “digital output return” command button;

Set digital output manually and exit operation

Protection module: BEPR554_CPU1 protection

Type: start

Digital output Digital output return

+ — select drive item

Digital output drive dialog box – select “digital output” command button

◆ Press “←┘” to send drive command and select “digital output” command button to drive digital output signal; otherwise, reset digital output signal;

Inspect whether corresponding digital output signals are operated or reset if necessary according to drawings.

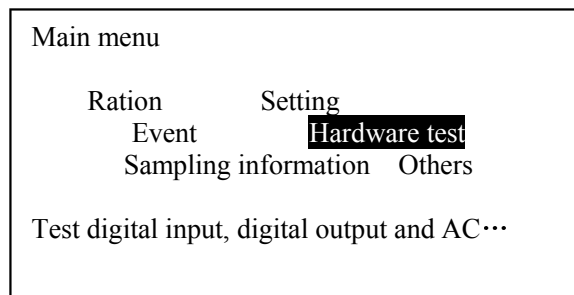
Other digital outputs of the protection module can be retested if necessary.

◆ Press “Q” to return.

2) Digital input test

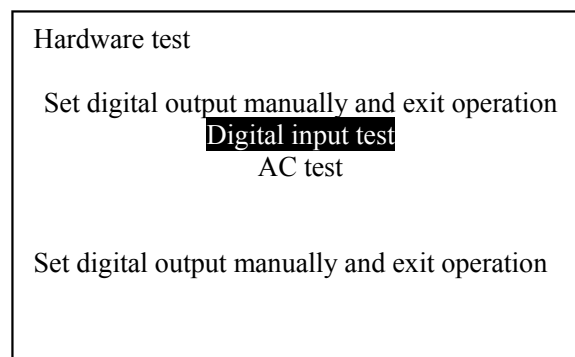
Each protection module of BEPR- 554 series digital protection is equipped with several switching input signals of which some digital input signals are led directly from phoenix terminal and others are led from 48-pin terminal template. Users can enable the device to display the state of digital input (closing or tripping) of the protection module through menu (dialog box) operation in a real-time manner. The operation steps of displaying state of digital input in a real-time manner are as follows:

- ◆ Confirm protection module to be operated to be in normal running state (no alarm signal);
- ◆ Enter the main menu and then select “hardware test” command button;



Main menu

- ◆ Press “←┘” to enter hardware test operation dialog box and select “digital input test” command button;



Hardware test dialog box – select “digital input test” command button

- ◆ Press “←┘” to enter password input dialog box and press “Q” to return to the main menu;

Password window

Enter digital output drive and exit operation

Input password: 00

<>Position + -input password ← ↵ confirm

Dialog box of hardware test - enter password

◆ Edit password input box and enter correct password and use “<” or “>” to select edit bit and use “+” or “-” to edit the bit number.

Password window

Enter digital output drive and exit operation

Input password: 90

<>Position + -input password ← ↵ confirm

Dialog box of hardware test - enter password

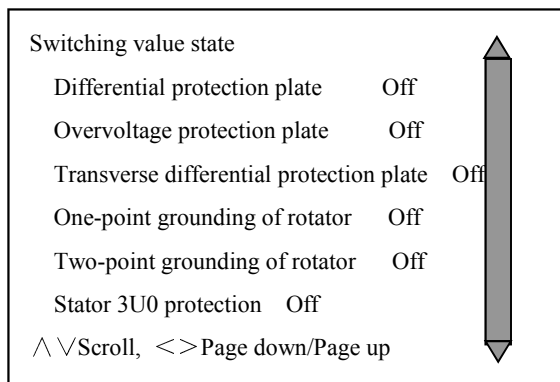
◆ Press “← ↵ ” to enter digital input operation dialog box and use “+” or “-” to select protection modules;

Digital input state

Protectio module: BEPR554_CPU1protection ±

+ - select protection module

◆ Press “← ↵ ” to enter real-time display dialog box of digital input;



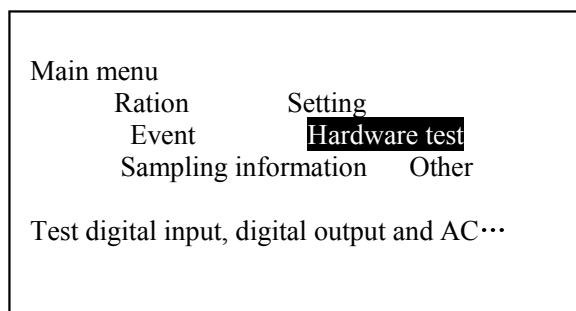
Use “^”, “\”, “<” or “>” to view the current states of all digital inputs.

◆ Press “Q” to return.

3) AC test

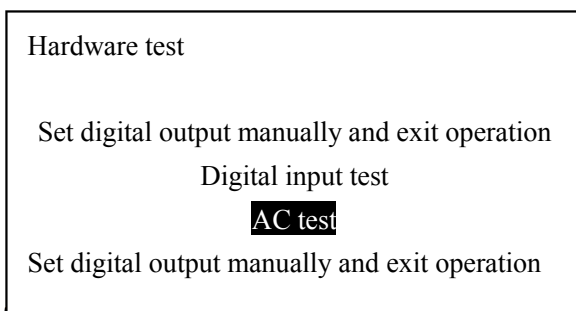
Users can enable BEPR- 554 series digital protection device to real-time display the current state of AC analog through menu (dialog box) operation, including amplitude, phase and DC offset. The operational steps are as follows:

- ◆ Confirm the protection module to be operated to be in normal running state (no alarm signal);
- ◆ Enter the main menu and select “hardware test” command button.



Main menu

- ◆ Press “←” to enter hardware test operation dialog box and select “AC test” command button;



Hardware test dialog box – select “AC test” command button

- ◆ Press “←↵” and then enter password input dialog box and press “Q” to return to the main menu;

Password window
Enter digital output drive and exit operation
Input password: 90
<>Position + –input password←↵ confirm

Dialog box of hardware test - enter password

- ◆ Edit password input box and then enter correct password and use “<” or “>” to select edit bit and use “+” or “–” to edit bit number;

Password window
Enter digital output drive and exit operation
Input password: 90
<>Position + –input password←↵ confirm

Dialog box of hardware test - enter password

- ◆ Press “←↵” to enter AC operation dialog box and use “+” or “–” to select protection module;

AC quantity state
Protection module: BEPR554_CPU1
protection ±
+ – select protection module

- ◆ Press “←↵” to enter AC real-time display dialog box;

Name	Amplitude	value	Phase	DC offset
IAT	0.001A	174.5°	-0.059	
IBT	0.002A	-15.03°	-0.033	
ICT	0.003A	35.85°	0.007	
IAN	0.003A	178.1°	0.015	
IBN	0.003A	0.000°	0.016	
ICN	0.003A	-177.0°	0.001	

^ \ / Scroll <>Page up/Page down

Use “^”, “v”, “<” or “>” to view the current states of all digital inputs.

- ◆ Press “Q” to return.

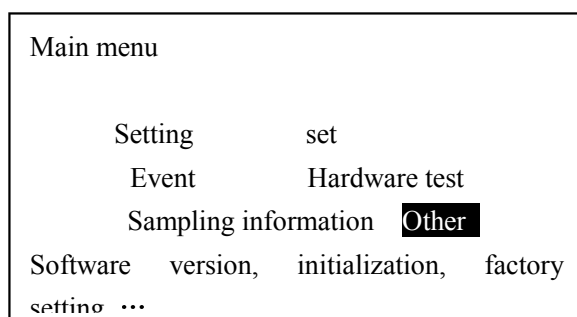
1.2.7 Other operations

BEPR- 554 series digital protection provides a set of operation menus (dialog boxes) to display version information, conduct factory setting, select language and forced initialization of human-machine module etc.

1) Display version information

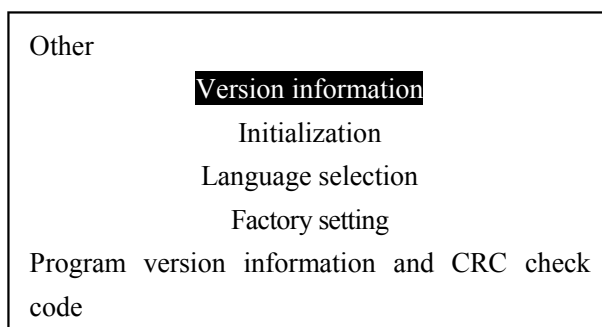
Users can view all protection modules of the current device, version number of human-machine module and CRC check code etc. The operational steps are as follows:

- ◆ Enter the main menu and select “other” command button;



Main menu

- ◆ Press “←┐” to enter other operations dialog box and select “version information” command button;



Dialog box of other operations – select “version information” command button

- ◆ Press “←┐” to display program version information and CRC check code;

Module name	version	CRC code
Human-machine dialog module	3.02	354E
BEPR-554_CPU1	2.00	93D1
BEPR- 554_CPU2	2.00	B445

Main menu

- ◆ Press “←” or “Q” to return;
- ◆ Press “Q” to return the main menu step by step.

2) Human-machine module initialization

Users can force initialization of human-machine module and read configuration information of protection module through keyboard operation and specific operational steps are as follows:

- ◆ Enter the main menu and select “other” command button;

Main menu			
Setting		set	
	Event	Hardware test	
	Sampling information	Other	
Software version,	initialization,	factory	
setting ...			

Main menu

- ◆ Press “←” to enter other operations dialog box and select “initialize” command button;

Other			
	Version information		
	Initialization		
	Language selection		
	Factory setting		
Read and protect	CPU	configuration	
information			

Dialog box of other operations – select “initialization” command button

◆ Press “←┘” to confirm operation and the device displays message window which prompts pressing any key to read configuration information again;

Message window

Press any key to protect configuration
information once again

Press any key to return

Dialog box of other operations – message window

◆ upon pressing any key, human-machine module is reset and read configuration information of protection module again and then enters normal display screen.

3) Select prompt language

Users can select prompt language (English or Chinese) of operating interface for BEPR- 554 series digital protection. Factory setting is in Chinese mode in case of no special requirement and users generally do not need to modify the setting. If the setting needs to be modified, please follow the following steps:

◆ Enter the main menu and then select “other” command button;

Main menu

Setting	set
Event	Hardware test
Sampling information	Other

Software version, initialization, factory
setting...

Main menu

◆ Press “←┘” to enter other operations dialog box and select “language selection” command button;

Other

Version information

Initialization

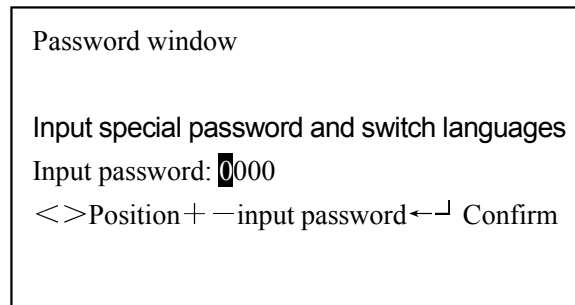
Language selection

Factory setting

Read and protect CPU configuration
information

Other operations dialog box – select “language selection” command button

- ◆ Press “←┘” to enter password input dialog box;



Other operations dialog box - password window

◆ Enter correct password and then press “←┘”, and the device displays message window which prompts that language has been switched. Upon pressing any key, human-machine module is reset and then enters normal display screen. The prompt language of the device has been switched at that time.

4) Factory setting

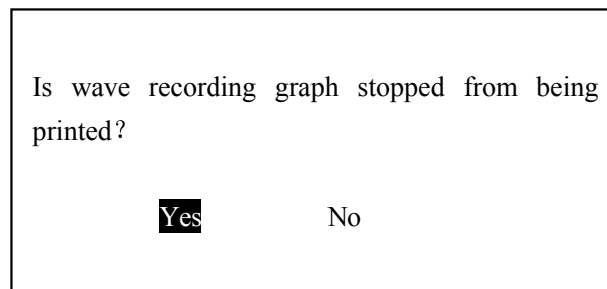
Users can select the type of protection device and select software/hardware strap mode through operation of factory setting dialog box. The setting is generally completed before the device leaves the factory and so users are recommended not to use the function.

Device type is specific model of the device in BEPR- 554 series, such as “BEPR- 552” and “BEPR- 410” etc.

Soft strap is burned in protection module and “strap” state can be modified through remote control command to “enable” or “exit” and soft strap is used together with integrated automation. Hard strap is generally installed on protection screen (cabinet).

1.2.8 Stop printing wave recording

Keep pressing signal reset button on the panel or screen for 1 second, and the device enters the following dialog box, and then press “←┘” after selecting “yes” to stop printing the current wave recording if print needs to be stopped due to reasons when the device is printing fault wave recording.



Stop print window of current wave recording