BEPR- 842U
Digital Capacitor Protection Device
Technical Manual

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Part 1

Technical Manual

1 Introduction

BEPR- 842U Digital Capacitor Protection Device is a packaged capacitor protection Device that takes the current and voltage protection Device and the unbalance protection Device as its basic configuration and applicable for the capacitor banks of the voltage levels of 66kV or less.

The basic configuration of this protection Device would be two CPU modules, protection and reclosing unit composed of 32-bit microprocessor, which is configured with the bulk RAM and Flash Memory, with strong ability of data processing, logic computation and information storage. Another CPU is the man-machine interface unit composed of single chip computer, whose bus is not out of the chip. The two CPUs modules are mutually independent, with no interrelation.Each protection function and automation function would be realized by software. The logic relation of the protection Device conforms to the standard design principles of the Device.

1) Features:

- All English character LCD display, and clear and easy man-machine interface.
- The precision of the selected measuring modules (including KWH metering) can reach to the class 0.5.
- To provide access to the accumulated pulse-degree side.
- High speed Ethernet interface is provided to integrated the IEC 870-5-103 standard communication protocol.
- High precision clock chips are used. The GPS time checking circuit is provided to realize the clock synchronism of the whole system.
- High speed Ethernet interface is provided to integrated the IEC 870-5-103 standard communication protocol.
- The core of CPU, the protection functional module is the powerful 32-bit micro- processors with large capacity RAM and Flash Memory. They are powerful to process data, perform logic calculation and store information. 8 to 50 recorded reports and 1000 events can be recorded. These information will not be lost even in power interruption.

2）Complete functional configuration

Table 1 Types and functional configuration of this series products

Function	BEPR- 842U
2-zone inter-phase current	√
2-zone zero-sequence current	√
Current inverse time-limit	√

Function		BEPR- 842U
Zero-sequence inverse time-limit		√
Under-voltage protection		√
Over-voltage protection		√
Single-phase （3-phase） unbalance voltage		√
Single-phase （3-phase） unbalance current		
Automatic throw-over / switch-off protection		√
Telemeter	Measurement level TA	alternative use
	Protection level TA	alternative use
Telesignal		alternative use
Telecontrol		alternative use
GPS time synchronization		√
KWh	Pulse metering	√
False-blocking prevention		√
Remote management		√

3) Monitoring

Telemeter: Ia，Ib，Ic，Ua，Ub，Uc， P，Q and other analog telemetry

- Telecontrol:Division and the normal remote control circuit breaker
- Telesignal:16way telesignalling open into the volume of the collection, installation of remote signal deformation, events, letters and other remote
- Remote pulse: 2-way electric-degree pulse input
- Out: Device has a 13 way out, of which 10 road trip because of the export-driven relay, 3-way signal drive for the notice of police.
- GPS time-checking

2 Technical Parameters

2.1 Rated parameters

2.1.1 Rated DC voltage**:** 220V or 110V (please specify in the order)

2.1.2 Rated AC data:

a) Phase voltage 100 / 3 V

b) Line extract voltage 100 V or 100 / 3 V

c) AC current 5A or1A（Please specify in the order）

c) Rated frequency 50Hz

2.1.3 Power consumption

a) DC power circuit Under normal work: no more than 25W

During operation: no more than 40W

b) AC voltage circuit No more than 0.5VA for each phase

c) AC current circuit

when the rated current is 5A: no more than 1VA for each phase.

when the rated current is 1A: no more than 0.5VA for each phase.

2.1.4 State vector level

The input state variable level of CPU and communication interface module

24V（18 V～30V）

GPS time synchronization impulse input level

24V（18 V～30V）

CPU output state variable (photo-coupling output)

Permissive level 24V（18 V～30V）

Driving capability 150mA

2.2 Main technical performance

2.2.1 Sampling circuit precise working range (10% error)

Voltage：0.4 V～120V

Current：0.08In～20In

2.2.2 Contact capacity

Signal circuit contact load: 400VA

Signal circuit contact arc break: 60VA

Operating circuit contact load: 1100VA （without arc break）

2.2.3 Tripping current and closing current

CIRCUIT BREAKER tripping current 0.5A～4A（please specify in the order）

CIRCUIT BREAKER closing current 0.5A～4A（please specify in the order）

2.2.4 Precision of various components

Current component： ≤±5%

Voltage component ： ≤±5%

Time component： ≤±40ms

2.2.5 Complete set operating time (include relay inherent time)

Inherent operation time of transient zone：

≤40ms, measurement is made for 1.2 times of setting

2.2.6 Precision of the analog variable measurement circuit

Monitoring device with the special measurement submodule：

Current, voltage: class 0.2

Power, kWh: class 0.5

2.3 Insulation capability

2.3.1 Insulation resistance

The insulation resistance values between the charged parts and in charged parts, racks as well as irrelevant electrical circuits are measured by 500V megger and under normal test atmospheric conditions, the resistance values of the various circuit at all levels are not lower than 50MΩ.

2.3.2 Media intensity

Under normal test atmospheric conditions, the Device can tolerate the frequency 50Hz, signal input terminal to ground voltage, 500V, other circuit to ground voltage 2000V, 1min power-frequency withstand voltage test, without breakdowns, flashovers and element damages. During the test, when the voltage is applied at any tested circuit,all the other circuits are interconnected and grounded equipotentially.

2.3.3 Impulse voltage

Under normal experiment atmospheric conditions, the power input circuit, AC input circuit, output contact point circuit to ground, and all the circuits are able to endure short-time standard lightning impulse voltage test of 1.2/50μs, with open-circuit test voltage of 5kV.

2.3.4 Humidity and heat resistance performance

This Device can endure the constant humidity and heat test regulated in GB/T 7261-2000, chapter 20, with highest test temperature +40℃, hightest humidity 95％，and test time of 48h. Within two hours after the completion of test, according to the requirements in 2.3.1, among the outside uncharged parts of each conductive circuit, the casing and irrelevant electrical circuits, the insulation resistance is measured, and it is no less than 1.5MΩ. The medium voltage withstand intensity is not below the 75 ％ of voltage amplitude in medium intensity test, as regulated in 2.3.2.

2.3.4 Humidity and heat resistance performance

2.4 Electromagnetic compatibility (EMC) capability

2.4.1 Electrostatic discharge immunity test

This Device can endure the electrostatic discharge immunity test Class IV stipulated in GB/T 17626.2－1998.

2.4.2 Radiated Radio-frequency electromagnetic field immunity test

This Device can endure the radiated, radio-frequency, electromagnetic field immunity test Class III stipulated in GB/T 17626.3－1998.

2.4.3 Electrical fast transient/burst immunity

This Device can endure the electrical fast transient/burst immunity test Class IV stipulated in GB/T 17626.4－1998.

2.4.4 Surge immunity test

This Device can endure the surge immunity test Class III stipulated in GB/T 17626.5－1999.

2.4.5 Immunity to conducted disturbances, induced by radio-frequency fields

This Device can endure the immunity to conducted disturbances, induced by radio-frequency fields test Class III stipulated in GB/T 17626.6－1998.

2.4.6 Power frequency magnetic field immunity test

This Device can endure the power frequency magnetic field immunity test Class V stipulated in GB/T 17626.8－1998.

2.4.7 Pulse magnetic field immunity test

This Device can endure the pulse magnetic field immunity test regulated Class V stipulated in GB/T 17626.9－1998.

2.4.8 Damped oscillatory magnetic field immunity test

This Device can endure the damped oscillatory magnetic field immunity test Class V stipulated in GB/T 17626.10－1998.

2.4.9 Oscillatory waves immunity test

This Device can endure the oscillatory waves immunity test Class IV stipulated in GB/T 17626.12－1998.

2.4.10 Radiated emission limited value test

This Device has passed the radiated emission limited value test A stipulated in GB 9254－1998

2.5 Mechanical performance

2.5.1 Vibration

This Device can endure the grimness vibration duration test of severity Class I stipulated in 16.3 of GB 7261-2000.

2.5.2 Impact

This Device can endure the impact duration test of severity Class I stipulated in 17.5 of GB 7261-2000.

2.5.3 Collision

This Device can endure the collision test of severity Class I stipulated in Chapter 18 of GB 7261-2000.

2.6 Environmental conditions

a) Ambient temperature:

Work: -5℃～+40℃， -20℃～+55℃（as required in the contract）

Storage: −25℃～+70℃， no energized variables are applied at the limit

value and no irreversible changes occur. The Device can normally operate when the temperature recovers.

b) Relative humidity: 5%～95%（no dew or ice inside the product.)

c) Atmospheric pressure: 66kPa～110kPa（lower than 35m at the altitude above sea level）.

d) Surrounding environment

No explosive danger, no caustic gas or conductive dust, no serious mildew, and no severe vibration sources exist in the operation location of the Device. The possible electromagnetic field that would exceed the normal operation range of power plant or substation could not be permitted. The measures to prevent rain, snow, wind, sand, dust and static changes would be considered. The field security should accord with regulations of Type B in GB/T 9361-1988. And ground resistance should accord with requirements in 4.4 of GB/T 2887-2000.

The earthquake intensity of the operation location of the Device should not be more than 8-degree.

3 Hardware

The demand of reliability is fully considered for overall design and design of each module. In the fields of program execution, signal indication, and communication, elaborate consideration has been taken out. there is no need to install additional AC, DC input anti-interference module.

3.1 Enclosure structure

This Device adopts full-panel form, including English LCD, signal indicating light, operating keyboard, etc.

3.2 AC modules

The AC modules include two parts of voltage input and current input, and the numbers of the voltage and current input elements vary with the different types of the Device.

The voltage input element is composed of voltage converter. When its input is AC 100V, its output is about AC 3V. The linear range is from 0.4V to 120V. The current input element is composed of current converter and shunt resistors. There are three specifications.

1） In=5A current: when input is 20In, output is 5/ 2 V, and the linear range is form 0.04In to 20In.

2） In=5A current: when input is 1.1In, output is 5/ 2 V, and the linear range is form 0.005In to 1.1In.

3） In=1A current: when input is 20A, output is 5/ 2 V, and the linear range is from 100mA to 20A.

3.3 CPU module

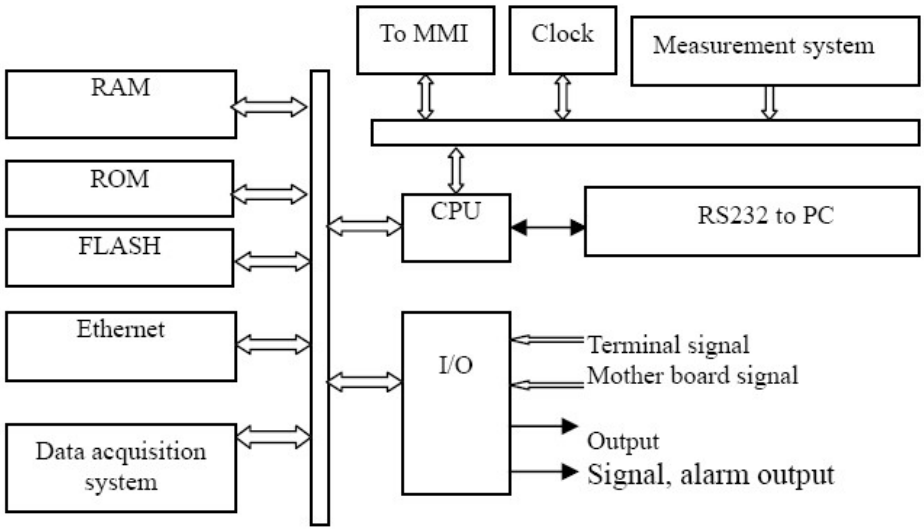

Figure 3-1 Schematic diagram of CPU module principle

1）CPU system

CPU system is structured by microprocessor CPU, RAM, ROM, Flash Memory, tc.

The microprocessor CPU (32-bit) with high capability, large capacity ROM（512K byte）, RAM（1M byte）and Flash Memory（1M byte）make this CPU module strong data processing and recording capability, which could realize various complicated fault processing schemes and could record large amount of fault data. In Flash Memory, the recorded reports could be 8 to 50, and the recorded events could be no less than 40 times. Some

operation configuration information, such as protection settings, is also stored in this memory, and the information would not be loses when Device power is failed. The protection program complied in C language would make the program strong reliability, excellent plant ability and maintainability

2) Data acquisition system

The protection system is composed of 14-bit precision A/D converter with high reliability, multiplexer and filtering circuit. Inside A/D conversion chip with the latest technology, there are sampling maintenance and synchronous circuit, which have the advantages of rapid conversion speed, little sampling error, very little power consumption and excellent stability. Therefore, there is no adjustable component for sampling circuit, and there is no need to make the adjustment in fieldwork, and the Device has excellent reliability.

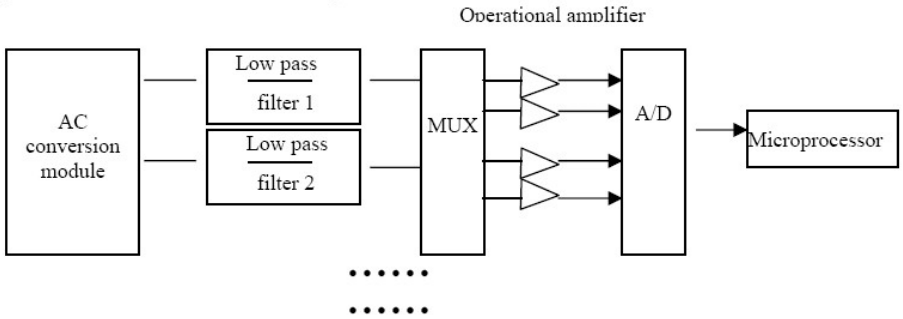

Figure 3-2 Schematic diagram of A/D system

The measurement system adopts the latest sampling technology measurement chip, with measurement precision up to 24-bit. The problem of measurement error increase caused by frequency error is solved without the application of any software technology. The measurement system has the function of automatic memory after single adjustment of measurement precision, and there is no need to readjust in the field.

3) Communication part

Inside this module, there is Ethernet chip with high-speed communication and universal interface, using Ethernet as main communication interface to connect with system. Usually, the Device provides RJ45 communication interface, using STP5 as communication medium. Under special condition, fiber-optic interface communication module could be added to provide the, fiber-optic interface.

4) Clock circuit

The hardware clock circuit is configured inside the module. Besides, CPU module adopts multi-layer printed board and SMT, with small and deft appearance and compact structure, which greatly improve the reliability and EMI resistant ability.

3.4 Power supply module

This module is DC inverted power supply module. Through anti-interference filtering circuit, DC 220V or 110V voltage would output necessary three groups of DC voltage, 5V, 24V(1) and 24V(2), utilizing inversion principle. The three groups of

voltage are not common-grounded, and apply floating mode, with sheath unconnected.

a) +5V is the working power supply for CPU

b) 24V(1) is power supply for driving relays

c) 24V(2) is power supply for exterior inputs

To strengthen anti-interference ability of power supply module, the 24V power supply of DC input and outgoing-out terminal is configured with filters. For power supply module principle, please refer to the appended figure.

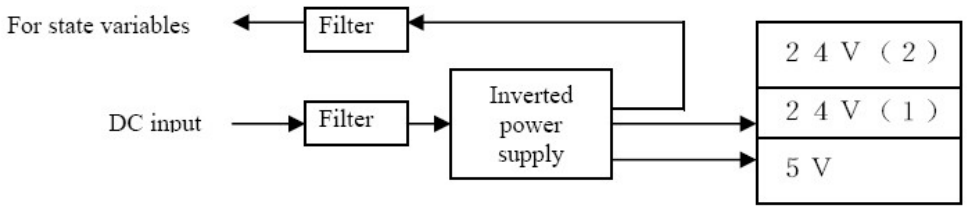

Figure 3-3 Power supply module principle schematic diagram

3.5 Man-machine interaction module

The core of man-machine interaction (MMI) is the single chip computer, whose bus is not out of chip. Its main function is to display protection CPU output information, scan the keyboard status on panel, and real-time transmit it to protection CPU. Therefore, for protection CPU, man-machine interaction module is equivalent to its peripheral Device. The communication between CPU and MMI is carried out through SPI interface, at a speed as high as 2Mb/S, which has high reliability. Using this configuration mode, large amount of bus import for protection CPU is avoided, and protection Device's reliability is improved. Moreover, almost, it would not add product cost, and would promote cost-effectiveness.

The display window of this module adopts four lines, with LCD of 12 English characters in each line. The man-machine interface is clear and easy to understand, configured with universal keyboard operation more convenient and simple. Meanwhile, considering the features of low voltage protection operation, plenty light indicating information is configured in this module, making operation information more visible.

The configuration of man-machine interaction and simple panel easy operation circuit would greatly enrich the choices of field operation modes.

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4 Principle of Protection

Since the 32-bit microprocessors are adopted, the operational speed is greatly increased. In this Device, no special starting element is provided and all the computations for the elements are made in real-time, which has relatively simplified the protection logic and makes the protection more reliable.

4.1 Over-current element

The real-time computation and the over-current discrimination for two zones can be done by the protection. As the any phase current is higher than 1.2 times of the setting for zone I, the output tripping of the instantaneous zone will occur within 40 ms.

The logic for the over-current discrimination for two zones is consistent with each other and their operation conditions are:

1) IΦ > Idn: Idn is the current setting for zone n,

IΦ is the phase current

2) T > T dn: Tdn is the time delay settings for zone n

4.2 Zero-sequence over-current element

The realization mode of the zero-sequence over-current element is basically same as the over-current element.

The output tripping will occur as the following conditions are satisfied.

1) 3I0>I0n，I0n is the setting for the ground zone N;

2) T>T0n，T0n is the setting for the time-delay of the ground zone N.

For the instantaneous zone of the this element, as the zero-sequence current 3I0 is larger than the 1.2 times of the setting for zone I, the output tripping time of the Device will not be longer than 40ms

4.3 Inverse-time element

The inverse-time protection element is the protection element that resulted from the natural coordination between the operation time-limit and the current magnitudes in the protected line. The coordination in the full line can be easily realized by shifting horizontally the operating curves. The common analysis equations for the inverse-time performance can be classified into three sorts: Standard inverse-time, very inverse-time and extreme inverse-time. The inverse-time performance in this Device is set by the inverse-time exponent in the settings.

T he equations for the inverse-time performance are presented as follows:

a)Normal inverse-time $t = \dfrac{0.14tp}{(\frac{I}{Ip})^{2} - 1}$

b)Very inverse-time $t = \dfrac{80tp}{(\frac{I}{Ip})^{2} - 1}$

c)Extreme inverse-time

$$t = \frac{13.5tp}{(\frac{I}{Ip}) - 1}$$

Where,

Tp is time constant and its range is 0.05 ~ 1

Ip is the reference value of current

I is fault current

T is tripping time

The partial inverse-time time in the setting is the product of the numerators in the above expression, its unit is second and the range is 0.007~127. The long-time inverse-time performance can be also realized. The expression for the long-time inverse-time is presented as follows:

$$t = \frac{120tp}{(\frac{I}{Ip}) - 1}$$

Both the interphase current relay and the zero-sequence current relay of this Device can implement the definite-and-inverse-time functions. The definite-time or the inverse-time mode can be selected by setting up the related bits of the control characters. As the inverse-time mode is selected, the definite-time zone II over-current and zone III zero-sequence current elements will be automatically switched off, then the interphase current zone II and the zero-sequence current zone II function linking pieces will become the interphae current inverse-time functions switching-on/off linking pieces respectively.

4.4 Under-voltage protection element

The operation conditions of the under-voltage element:

1) All the 3 line voltages are lower than the under-voltage setting;

2) All the 3-phase current are lower than current setting, generally, 0.25A can be taken.

3) The line voltage becomes under-voltage from voltage;

4) The circuit breaker is in the close state;

5) The time-delay is up.

4.5 Under-voltage element

As the following conditions are met, the under-voltage element will operate.

1) Any one voltage of the 3 line voltage is higher than the overvoltage setting;

2) The circuit breaker is in the close state;

3) The time-delay is up.

4.6 Unbalance element

The unbalance element is mainly used to protect the internal faults in capacitor and its operation conditions are presented as follows:

1) The single-phase unbalance input(single-phase) or any one of the 3-phase unbalance inputs(3-phase) is larger than the unbalance setting;

2) The circuit breaker is in the close state;

3) The time-delay is up.

4.7 Automatic throw-over / switch-off function

As the voltage Var regulator in the integrated automation system (e.g., VQC) is not used, User can select this function on the basis of the conditions.

4.7.1 Automatic switching-off conditions:

1) Any one of the 3 line voltages is higher than the automatic throw-over / switch-off overvoltage setting;

2) No protection operation blocking signals;

3) The circuit breaker is in the close state;

4) The time-delay is up;

5) The automatic throw-over / switch-off linking piece(reserve 3) and related control characters are switched on.

4.7.2 Automatic throw-over conditions:

1) All the 3 line voltages are longer than the automatic throw-over / switch-off under-voltage setting and higher than 64V;

2) No protection operation blocking signals;

3) The circuit breaker is in the close state;

4) The time-delay is up;

5) TWJ has been held for longer than 5 minutes (V1.30 or more)

6) The automatic throw-over / switch-off linking piece(reserve 3) is switched-on.

Attention:

1) The automatic throw-over / switch-off operation time is recommended to be longer than 2s;

2) To prevent the false automatic throw-over of the capacitor for a fault, for manual trip and remote trip or as the relay operates to block the throw-over / switch-off binary inputs, this protection Device will automatically switch off the soft pressure plates of the automatic throw-over / switch-off (reserve 3). At time, the reserve operation signal contacts (X5:15, X5:16) should be connected in feedback to block the switching-on/off binary input terminal(X3:9)

4.8 TV line break detection

When one of the following conditions is satisfied, the alarm lamp will be lit and the information “TV line break” will be shown:

1) All the three phase voltages are lower than 8V, one of the phase current (phase a or c) is higher than 0.25A, it is the three phase voltage loss.

2) When the sum of the vectors of the three-phase voltages is larger than 8V, and the minimum line voltage is lower than 16V, the condition is a two-phase TV line break. 3) When the sum of the vector of the three-phase voltage is larger than 8V, and the difference between the maximum and the minimum line voltage is greater than 16V, the condition is a single-phase TV line break.

The switching-on/off of the function of TV line break detection can be performed by the control character

"Self-detection of analog variables summation".

4.9 Data recording

This protection can perform the fault wave-recording function. The analog variables that can be recorded are: Ia, Ib, Ic, 3I0, Ua, Ub, Uc, BPA, BPB, BPC, and the status variable circuit breaker position, tripping commands of the protection.

To avoid storing too much unnecessary data during the frequent starting caused by system disturbances, the necessary recorded data will only be recorded in the Flash RAM (hold for power loss) after the protection operates, otherwise, these data will be stored in the RAM(no hold for power loss) and can be read by PC.

8 to 50 reports can be recorded, and no less than 40 events can be recorded. These data will be stored in FLASH RAM.

5 Settings and Setting Specifications

5.1 Setting list and specifications of BEPR- 842U Series Digital Capacitor Protection Device

Nos.	Setting name	Range	Unit	Remarks
1	Control character 1	0000～FFFF	None	Refer to Control character 1 (KG1) definitions
2	Current zone I	0.2～100.0	A	
3	Current zone II	0.2～100.0	A	
4	Current zone I time	0.0～20.00	s	
5	Current zone II time	0.1～20.00	s	
6	Zero-sequence zone I current	0.1～20.0	A	
7	Zero-sequence zone II current	0.1～20.0	A	
8	Zero-sequence zone I time	0.0～20.00	s	
9	Zero-sequence zone II time	0.1～20.00	s	
10	Current inverse-time reference current	0.2～100.0	A	
11	Current inverse-time time	0.005～127	s	
12	Zero-sequence current inverse- time reference current	0.1～20.0	A	
13	Zero-sequence current inverse- time time	0.005～127	s	
14	Inverse-time index	0.01～10.0	None	Only value 0.02 or 1 or 2 can be selected
15	Overvoltage setting	30～120.0	V	
16	Overvoltage operating time	0.0～1200.0	s	
17	Lowvoltage setting	10～100.0	V	
18	Lowvoltage operating time	0.0～100.0	s	
19	Lowvoltage current	0.2～100.0	A	
*20	Unbalance setting	0.5～100.0	V	
21	Unbalance operating time	0.0～20.0	s	
22	Automatic throw-over / switch-off overvoltage setting	30～120.0	V	
23	Automatic throw-over / switch-off	30～120.0	V	

Nos.	Setting name	Range	Unit	Remarks
	undervoltage setting			
24	Automatic throw-over operating time	0.0～60.0	s	
25	Automatic switch-off operating time	0.0～60.0	s	
26	TA ratio（kA/A）	0.01～10.0	None	Primary current/ (second current *1000）
27	TV ratio（kV/V）	0.01～10.0	None	Primary voltage/ (second voltage *1000）

Control character 1（KG1）definition:

Bit	Meanings for 1	Meanings for 0
15	Analog quantity summation self-check on	Analog quantity summation self-check off
14	TA rated current: 1A	TA rated current: 5A
13	Inverse-time mode is selected for protection Device	Definite-time mode is selected for protection Device
12	Automatic throw-over / switch-off function is switched on	Automatic throw-over / switch-off function is switched off
11	Reserve	Reserve
10	Reserve	Reserve
9	Reserve	Reserve
8	Reserve	Reserve
7	Reserve	Reserve
6	Reserve	Reserve
5	Reserve	Reserve
4	Reserve	Reserve
3	Reserve	Reserve
2	Reserve	Reserve
1	Reserve	Reserve
0	Gap voltage is selected for overvoltage	Reserve

Specification:

1) "Measuring TA ratio" is used for measurement of TA ratio. If primary side TA ratio is 600/5 ＝120, it is set as 120/1000 = 0.12;

2) If "TV ratio" is 10000/100＝100, it is set as 100/1000=0.10.

5.2 Soft pressure plates list and specifications of BEPR- 842U Series Digital Capacitor Protection Device

Linking piece name	Corresponding function
Current zone Ⅰ	Current zone Ⅰ protection function on/off
Current zone Ⅱ	Current zone II protection function on/off
Zero-sequence zone Ⅰ	Zero-sequence zone I protection function on/off
Zero-sequence zone II	Zero-sequence zone II protection function on/off
Unbalance	Unbalance protection function on/off
Overvoltage	Overvoltage protection function on/off
Lowvoltage	Lowvoltage protection function on/off
Reserve1	
Reserve2	
Automatic throw-over / switch-off	Automatic throw-over / switch-off function on/off

Note:

1) Those functions that are not used in the Protection can be totally got out of service by the selection of the related soft pressure plates or the control characters and no settings for the related functions are required to be set up specially.

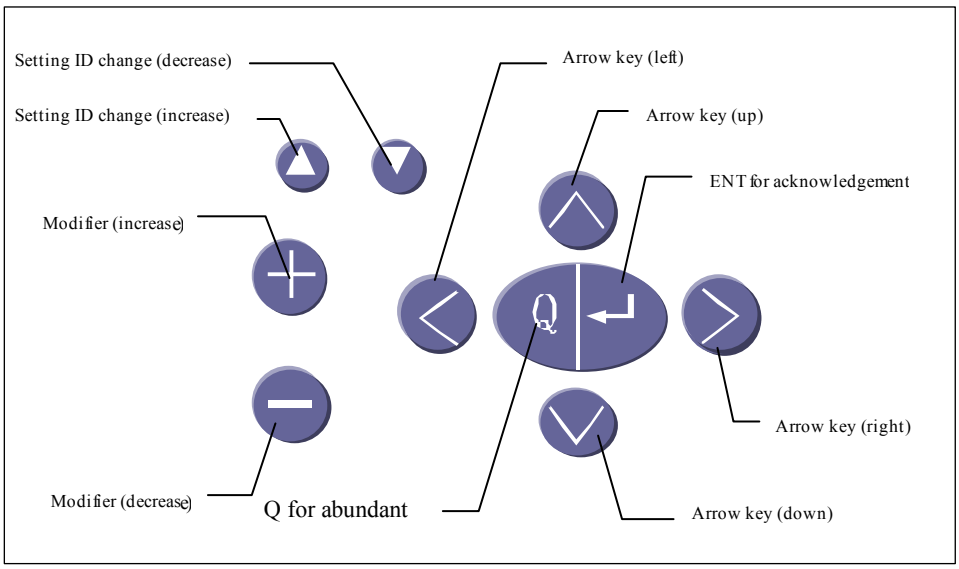
2) The above list represents the setup in the standard configuration. The contents in the list may be not conformed to the conditions actually displayed in the project application. In this case, what are actually displayed by the protection is taken as the reference.

Part 2

Operation Manual

1 Introduction

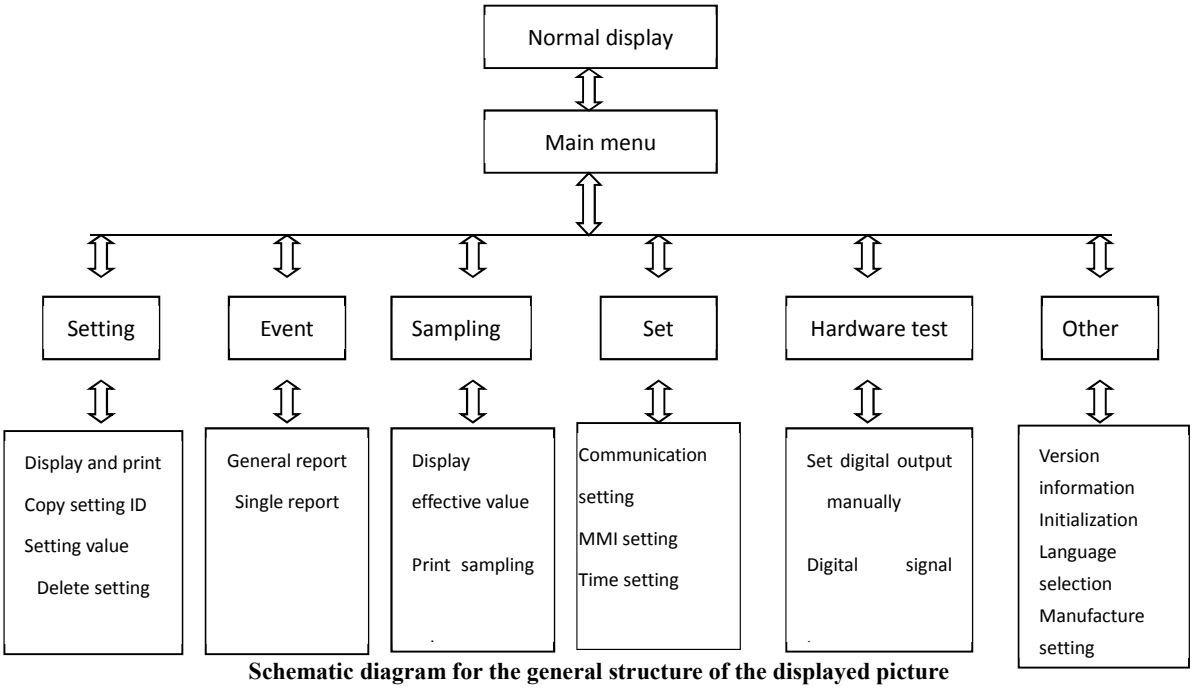
1.1 Keyboard



Schematic Diagram for the keyboard of the BEPR- 800 Series Protection

2 Menu operation

The keyboard for the BEPR- 800 Series Digital Protection and LCD interface are operated in the way of the interaction block in combination with the menus.



Schematic diagram for the general structure of the displayed picture

2.1 Functions

2.1.1 Sampling

RMS value : shows in real-time the RMS values and phase angles for all the analog channels;

Measured value : shows in real-time the magnitudes of the measured-variables;

Electric quantity value : shows in real-time KWHs.

2.1.2 Event

Display, check or printing of the fault reports.

2.1.3 Rated value

Rated value display : shows the rated values in all the setting zones ;

Rated value switching : switch from one setting zone to another one ;

Rated value amendment : amend the rated values in the selected setting zone ;

Rated value printing : print the rated value list for the selected setting zone.

2.1.4 System setup

Pressure plate setup :in-service and out-of-service of the functional soft pressure plates ;

Time adjustment : adjust the time of the protection ;

Energy –measuring setup :

- ✓ Offset check : check the zero-shift ;

- ✓ Gain check : check its linearity;
- ✓ Save setup : save corrected settings ;
- ✓ Energy-clearance : KWH clearance :

2.1.5 System test

Switch-out drive : manual control output or return of the output switching variables ;

Switch-in check : real-time display of the switch-in variables ;

AC test : real-time display of values and phase angles for all the analog channels ;

Integrated automation function : integrated use of the information from the background monitoring and telecontrol station .

- ✓ Protection upstream transmission : transmit protection SOE reports one by one;
- ✓ Alarm upstream transmission : transmit alarm reports one by one ;
- ✓ Telesignal upstream transmission : transmit the telesignalling position-varying information one by one ;
- ✓ Telemeter upstream transmission : transmit the telemetering variables one by one . the fixed quantity for transmission is the half of the full scaled value ;
- ✓ Code list printing : print all the internal communication code lists, including protection SOE list, alarm information list, soft pressure plate formation list, telesignaling list, telemetering list, telecontrol list.

2.1.6 Others

Display the program version information, logic information and identifications.

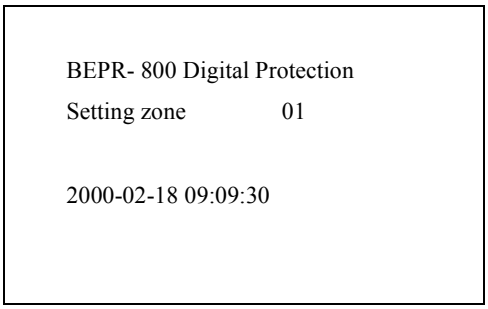
2.1.7 Operation set up

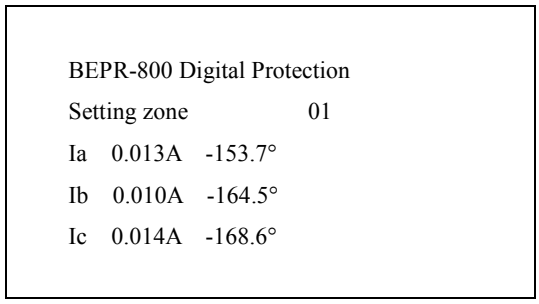
Setup of the protection soft pressure plates, setting zone switching rated value amendment and time adjustment

2.2 Operation instructions

2.2.1 Normal display

When the protection is energized and the mode switch is pointed at “Local” or “Remote”, the MMI turns to normal display :





In normal operation, the display will alternatively shows the number of the current setting zone, date and

time information, RMS values of current, voltage and phase angle etc.

2.2.2 Primary menu

When【←┘】key is pressed, the primary menu will show :

Primary menu	
Sampling	System setup
Event	Hardware test
Setting	Others

Then press "∧" or "˅", "<" or ">" keys to select menu and press【←┘】key to select the sub menu. press【Q】to return to previous display.

2.2.3 Sampling

2.2.3.1 RMS

After entering this menu, MMI will renew RMS values and phase angles of all the analog channels every 3 seconds.

RMS		
Ia	0.013 A	-153.7º
Ib	0.010 A	-164.5º
Ic	0.014 A	-168.6º

Press "∧" or "˅" key to turn the lines and press "+" or "—" key to turn pages.

2.2.3.2 Measured value

After entering this menu, MMI will renew measured values every 3 seconds.

Measured value		
Measure	Ia	0.013A
Measure	Ib	0.010A
Measure	Ic	0.014A

Press "∧" or "∨" key to turn the lines. Press "+" or "—" key to turn pages.

2.2.3.3 Electric quantity

After entering this menu, the menu MMI will renew the KWHs every 3 seconds.

KWH	
Pulse P	0
Pulse Q	0

+ KWh	0.0 KWh

Press "∧" or "∨" key to turn lines. Press "+" or "—" key to turn the pages.

2.2.4 Event

2.2.4.1 Report display

In case of no fault report, MMI will display a news block indicating that there is no fault report. It resumes automatically after 2 seconds if key Q is not pressed under the news block.

Report display
No event report

In case there are events reports in the system, a browsing window for fault report will be display. Press "+" or "—" key to search the previous one or the next one, press "∧" or "∨" key to look for a previous record or next one.

03 2000-02-18 10:30:00:000
0 ms protection start
20ms overcurrent relay zone I operation
2059ms reclosing operation

Form at for report display

This time press【←┘】key asking if the fault report should be printed

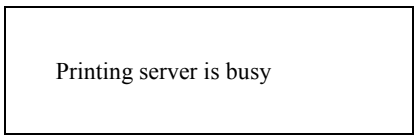
Report printing
Will the report be printed?

Within 3 seconds, press 【←┘】 key to print this report, otherwise the display will exit. If the printing is finished, it will show

Report printing
Printing is finished

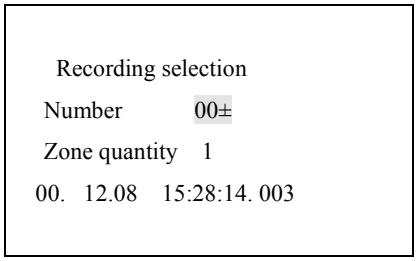
If the printer or communication are in failure, then the display shows

Report printing



2.2.4.2 Recording printing

In case there is a recording report in the system, a browsing window for the recorded report will show, press "+" or "—" key to search the report. Press【←┘】key to print

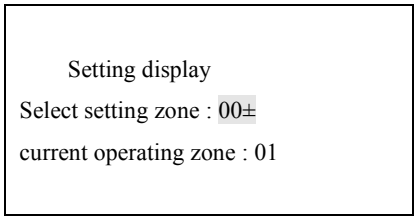


Recording report select

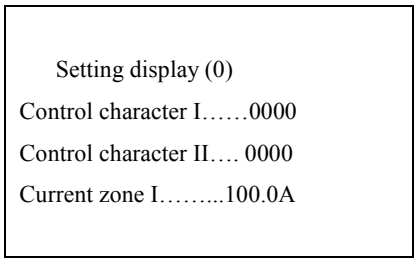
2.2.5 Setting

2.2.5.1 Setting display

After entering the menu, MMI begins to indicate which setting zone you want to select. Press "+" or "—" key to select zone number. Press 【←┘】key to perform the setting display.



Setting zone selection



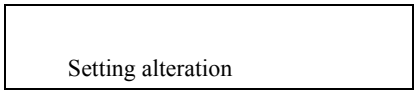
Setting display

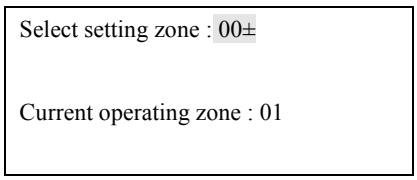
Note : The system defaulted setting will be displayed for the invalid setting zones.

Press "∧" or "∨" key for turn the lines. Press "+" or "—" key to turn the pages.

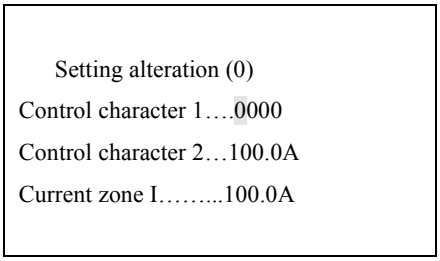
2.2.5.2 Setting alteration

Select the submenu "setting alteration" under menu "system setup". The system will indicate which area you want to alter setting zone :



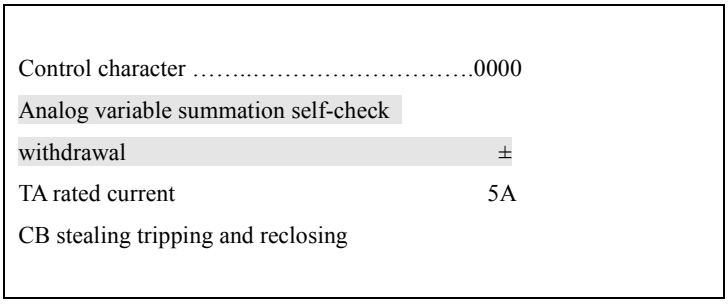


After the setting zone is selected, press【←┘】key to enter the setting alteration window :



Note : The system defaulted setting will be displayed for the invalid setting zones.

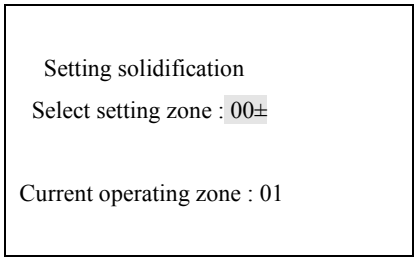
After entering the setting alteration window, press "∧" or "∨" key, "<" or ">" key to select the alteration position press "+" or "—" key to make alteration For the contents in the effective bit of the control Character press ">" key and hold it for 3 second, the selective sub-menu containing the contents in the effective bit of the control character are displayed. In the sub-menu, the effective bit of the control character can be easily put in-service or out of service.



After alteration, press【←┘】key to confirm. In case of giving up the alteration, press "Q" key. The system will give up the alteration and return to the previous menu.

After all the alteration are confirmed to be completed, press【←┘】 key to solidify. In case of giving up the alteration, press "Q" key, the system will give up the alteration and return to the previous menu.

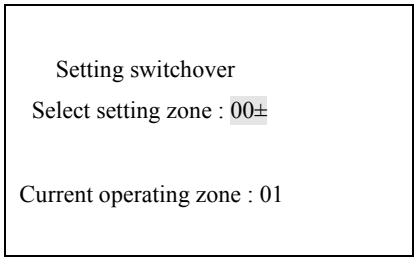
Before solidification, the system wants you to identify the target for solidification. By doing so, the alteration zone and duplication of a setting zone can be completed.



When the target solidification zone is selected, press【←┘】key to solidify. The system asks you entering the secret codes, the process will not be repeated here.

2.2.5.3 Setting switchover

Select the submenu “setting switchover” under the menu “operation setup” or press the “setting switchover” key, a setting change window will be seen directly.

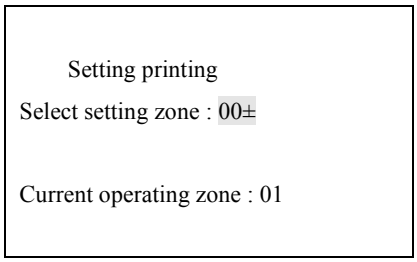


Use “+” or “—” key to select setting area you want to change (also it can be done by the setting switchover keys). If you want to give up the switchover, just press “Q” key. press【←┘】key to start the switchover. The system asks you entering the secret code. The process is the same as the pressure plate switchover and will not be repeated here.

Several setting zone are provided for storage. Before operating a setting switchover, care must be taken that the zone you want to switch over must have its settings otherwise you cannot make any switch. By using the command “setting alteration” you can write several sets of setting into the zone and then make switchover..

2.2.5.4 Setting printing

In the setting print menu, MMI will first ask you to select setting zone. Press “+” and “—” keys to select the number of the setting zone to be printed. Press【←┘】key to make the setting printing.



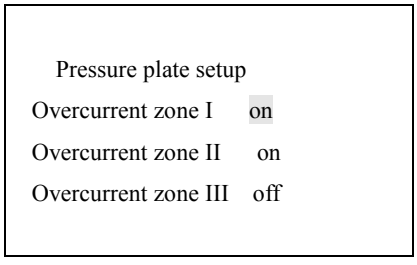
Setting zone selection

Use “∧” or “∨” key to turn the lines, “+” or “—” key to turn the pages .

2.2.6 System setup

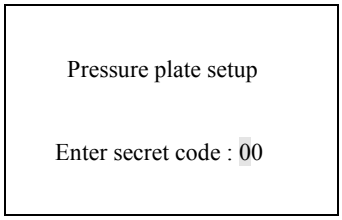
2.2.6.1 Pressure plate setup

Select submenu “pressure plate setup” under menu “system setup”, the window will show :

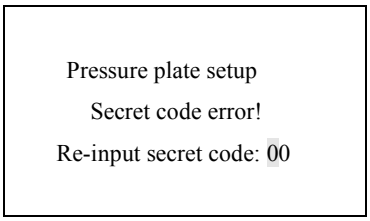


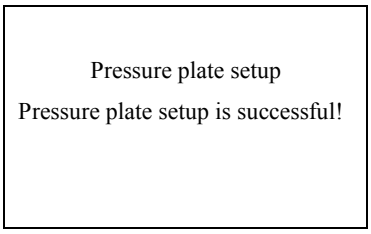
Use “∧” or “∨” key to select the different plates, use “+” or “—” key to select in-service or out of service. If

the setup is required to given up. Press “Q” key. Press【←┘】key starts to setup pressure plate. System asks for the secret codes.



In case secret codes are in error, an news window for error will be seen. Otherwise, the news window for the result of the pressure plate setup will be seen.

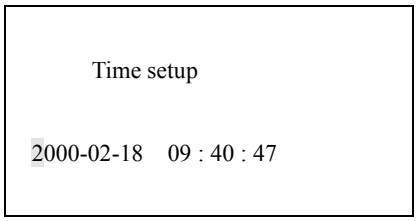




In any case, when “Q” key is pressed, display will go back to the previous menu.

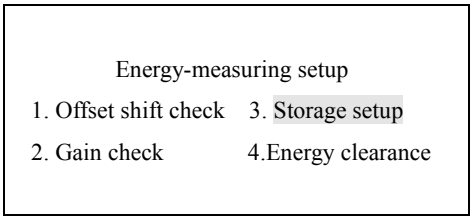
2.2.6.2 Time adjustment

Select the “time adjustment”, use “∧” or “∨” key to turn the lines “+” or “—” key to switch for the in service or out of service of the function.



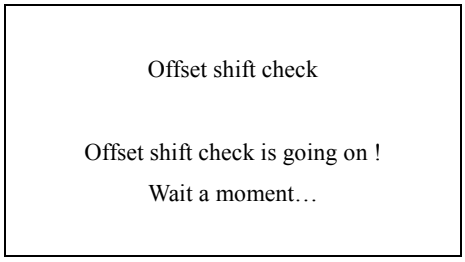
2.2.6.3 Energy-measuring setup

Select the menu “energy-measuring setup”, use “∧” or “∨” key to select .

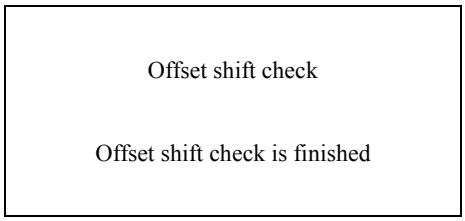


2.2.6.3.1 Offset shift check

Select the menu “shift check” enter security secret codes, a waiting notice is shown:

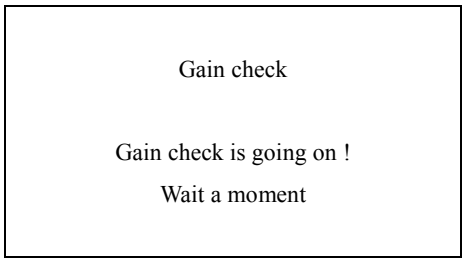


After finishing check it returns to “energy-measuring setup

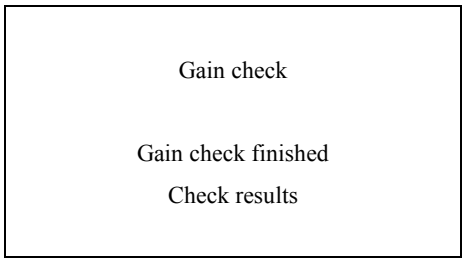


2.2.6.3.2 Gain check setup

select the “ gain check” menu, after entering the secret codes, a waiting notice is shown .



After finishing the check a display for the completion is seen and it returns to the menu “energy-measuring setup”



2.2.6.3.3 Energy-measuring setup

Select the menu “save setup”, enter the secret codes and finish the zero clearance

2.2.6.3.4 Energy zero clearance

Select the menu “energy zero clearance”, enter the secret codes and finish zero clearance.

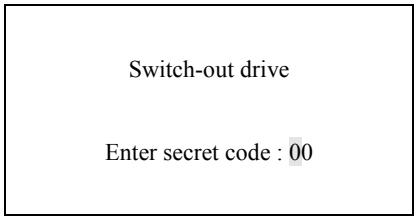
2.2.7 System test

A set of the interaction block is provided in the BEPR- 800 Series Digital Protection. By operating this set of the interaction block. Users can perform the tests on the switch out (relay) drive, switch-in real-time display

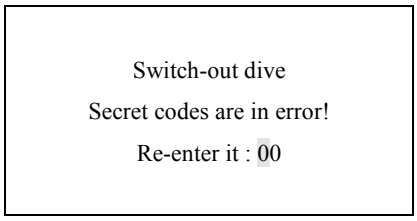
(manual detection of the switch-in signals), real-time display of the analog variables in the AC input channels and the related functions for the integrated automation. Since this set of operations is generally used to test the perfect state of the definitions for the protection, monitoring and telecontrol back ground data bases, it is called the "system test" operations. For the "switch-out drive", "AC test" operations, the position of the switch must be put at "local" position, and for the integrated automation "function" at the "remote" position. But for the "switch-in chock" operation, both the "local" and "remote" modes will do.

2.2.7.Switch-out drive

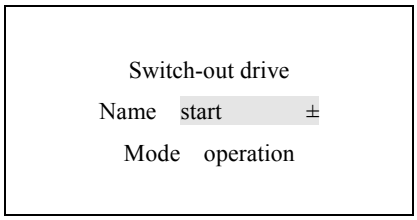
Select the sub menu "Switch-out drive" under the menu "System test", the system asks for the secret code :



Use "<" or ">" key to select the enter position, use "+" or "—" key to enter the secret codes. Press 【←┘】 key to enter. In case the secret codes are in error, a news block indicating the error secret codes can be seen :



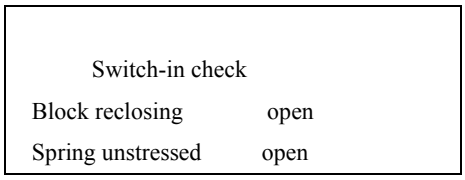
When the correct secret codes are entered, the system indicates that the menu "switch-out drive" has been entered :



Use "∧" or "∨" key to select the different input items, use "+" or "—" key to select name and mode of the switch-out, Press 【←┘】 key to start operation.

2.2.7.2 Switch-in check

Select the sub-menu "switch-in check" under the menu "system test". The system will enter directly the menu "switch-in check". The MMI will renew the switch-in status every 2 seconds.



Stand by 1	open

Use "∧" or "∨" key to turn the lines and, use "+" or "—" key to turn the pages .

2.2.7.3 AC test

<u>During AC test, protection is put out of service, so as to do the channel precision tests in heavy current.</u>

Select the sub-menu "AC test" under the menu "system test", systems asks for the secret cods.

AC test Input secret code: 00

Secret codes check window

AC test Secret code error! Re-input secret code: 00

News block for the error secret codes

When the secret codes are correctly entered, the system indicates that the menu "AC test" has been entered. The MMI renews the channel RMS values and phase angles every 3 seconds .

AC test		
Ia	0.013 A	-153.7º
Ib	0.010 A	-164.5º
Ic	0.014 A	-168.6º

Use "∧" or "∨" key to turn the lines "+" or "—" key to turn the pages.

2.2.7.4 Integrated automation function

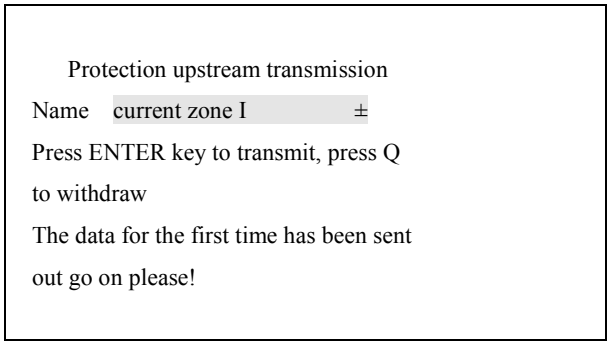
Integrated automation function	
Protection upstream transmission	Telemetering upstream transmission
Alarm upstream transmission	Code list printing
Telesignalling upstream transmission	

2.2.7.4.1 Protection upstream transmission

Enter "protection upstream transmission" and enter the secret codes, a picture is shown.

Protection upstream transmission Name current zone I ±
Press ENTER key to transmit , press Q to withdraw
Wait for transmission

Press【←┘】key, the operating information of protection zone I is sent to the monitoring and telecontrol background

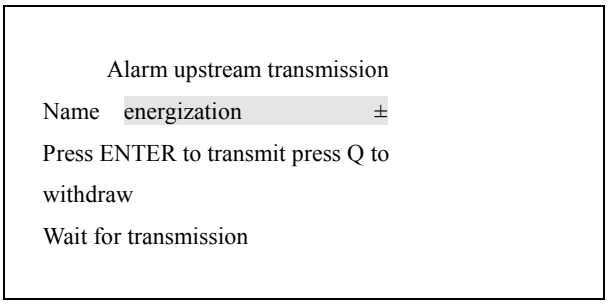


Use "+" or "-" key to switch over onto the different entities, press ENTER to transmit the in formation of the related entities..

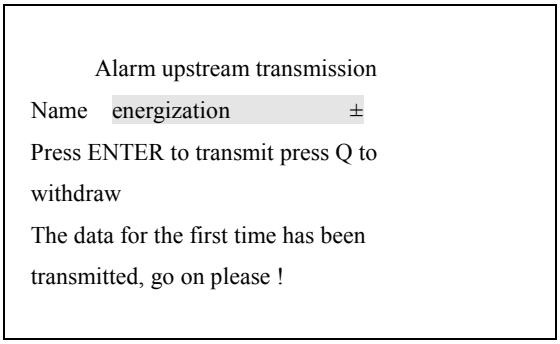
Press "Q" to exit from the "protection upstream transmission" and return to the menu integrated automation

2.2.7.4.2 Alarm upstream transmission

After entering the " Alarm upstream transmission", enter secret coded, a picture is shown：



Press【←┘】key, the alarm information of energization will be transmitted to the monitoring and telecontrol background

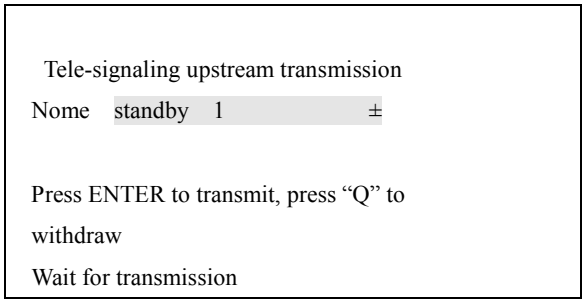


Use "+" or "—" key to switch over on to different entities, press ENTER to send corresponding information.

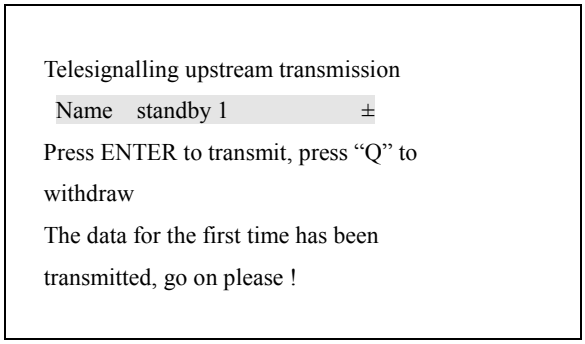
Press "Q" to exit from the "alarm upstream transmission" and return to the menu "Integrated automation"

2.2.7.4.3 Telesignalling upstream transmission

After entering the “telesignalling upstream transmission” enter the secret code.



Press【←┘】key and send stand-by 1 tele-signaling displacement information to the monitoring and telecontrol background

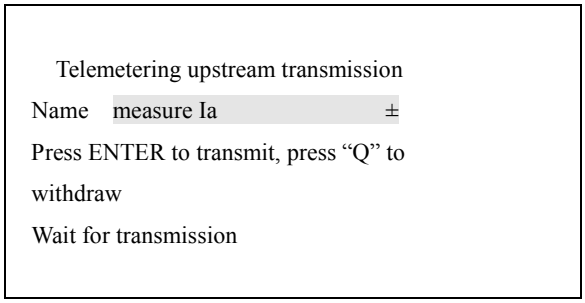


Use “+” or “—” key to switch over on to different entities, press ENTER to send the corresponding information.

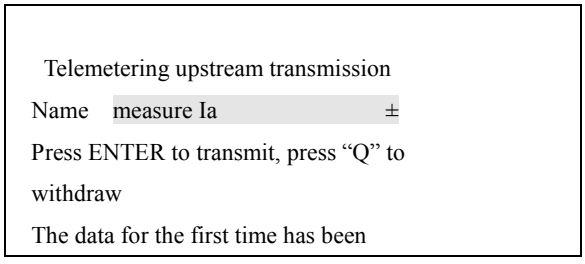
Press “Q” to exit from the “telesignalling upstream transmission” and return to menu “Integrated automation”

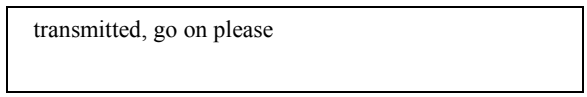
2.2.7.4.4 Telemetering upstream transmission

After entering the “telemetering upstream transmission”, enter secret codes a picture is shown :



Press【←┘】key to send the Ia information to the monitoring and telecontrol background. The transmitted value is the half of full scaled value.



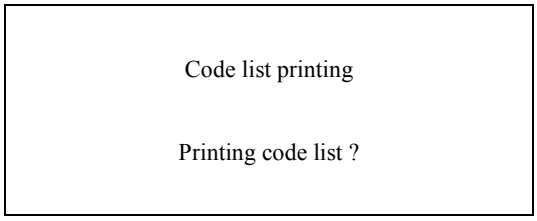


Use "+" or "—" key to switchover onto the different entities, press ENTER to transmit the related intormation.

Press "Q" to exit from this function and return to "Integrated automation"

2.2.7.4.5 Code list printing

Entering the "code list printing", a picture is shown:

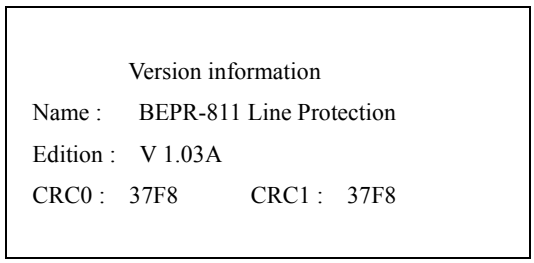


Press【←┘】key to print, press "Q" to exit from this function

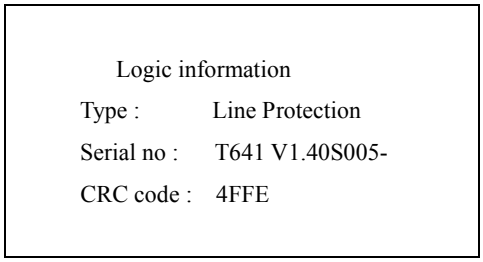
2.2.8 Others

A set of the operating menus (interaction block) is provided in the BEPR- 800 Digital Protection including the version information, logic information, IP address setup, etc..

2.2.8.1 Version information

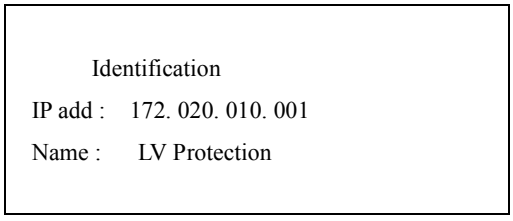


2.2.8.2 Logic information



2.2.8.3 Identification

Select the sub-menu "identification" under the menu "Others"



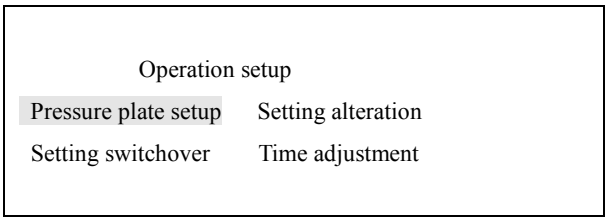
IP address is composed with four bytes divided by dots. Each byte is the decimal integral number from 0 to 255. It is used for identification in network communication within sub-stations. The same IP address is not allowed in one sub-station. The first and second bytes were decided by the network. The third and fourth (00.XX), (01. XX), 255.XX), (XX. 00), (XX. 255) are to be saved and can not be used.

As the protection is connected into the signal network configured system, the network no. of the IP address is recognized as "172.20". As protection is connected into the dual-network configured system, for the network no. of the IP address, refer to the description about the "network interface module COMM" in the "Manual for the BEPR- 861 Integrated Monitoring Device". It is dependent upon the setting of the module in the system.

Use "<" or ">" to select the position to enter. Use "+" or "—" key to enter the address. press【←┘】key to setup, then the system indicates that the secret codes can be entered, if it is correctly entered system will indicate that the address is correctly setup and exit from the submenu.

2.2.9 Operation setup

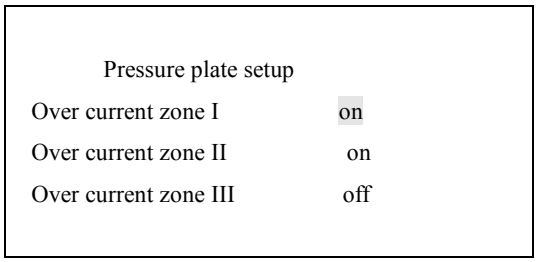
Under the normal operating conditions, as the mode switch on the panel is put at the "operation setup", the system automatically enters the menu "operation setup" :



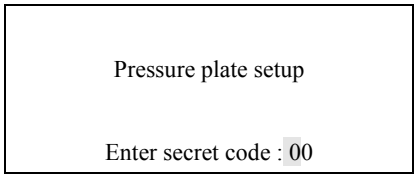
In this menu. Use "∧" or "∨" key and "<" or ">" key to select menu items, then press【←┘】key to enter the sub-menus or do the corresponding operations. Press "Q" to return to the previous picture.

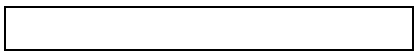
2.2.9.1 Pressure plate setup

Select the sub menu "Pressure plate setup" under the menu "operation setup" and enter pressure plate setup window :



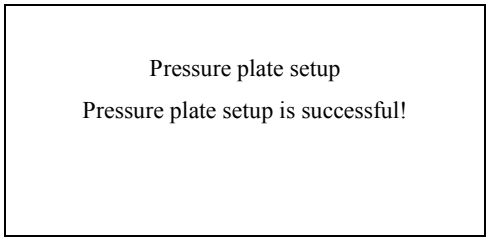
Use "∧" or "∨" key to select the different pressure plate, use "+" or "—" key to select on or off. Press "Q" to give up. Press【←┘】key to start setup. System asks for secret codes :

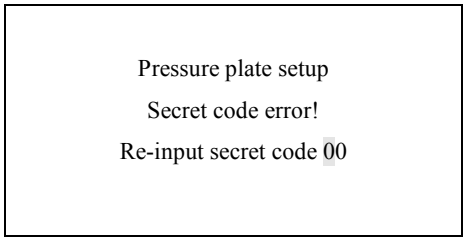




If the secret codes are in error, a news block for the error secret codes is displayed.

If the secret code' are correct, news block for the correct secret codes is displayed.

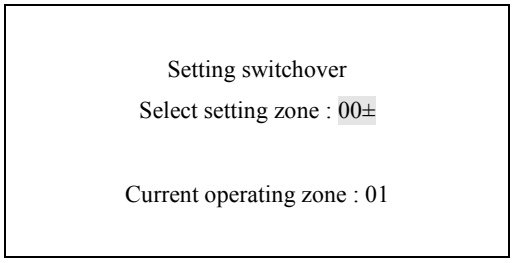




Under any conditions, when “Q” key is pressed, system will return back to the previous menu.

2.2.9.2 Setting switchover

Select sub-menu “setting switchover” under the menu “operation setup” or press the setting switchover key directly, a setting switchover window will be seen :

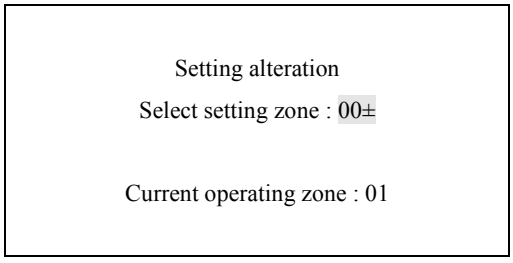


Use “+” or “—” key to select the setting zone you want to switchover (also it can be done by the setting switchover keys). If you want to give up the switchover, just press Q key. Press【←┘】key to start the switchover. The system asks you enter the secret codes. The process is the same as the pressure plate switchover and will not be repeated.

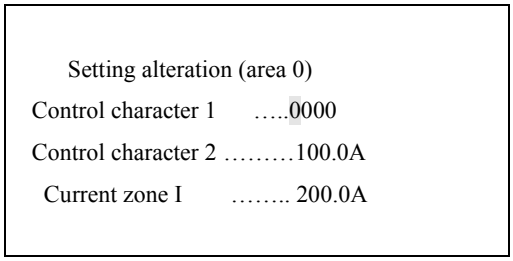
Several setting zone are provided for storage. Before operating a setting switchover, care must be taken that the zone you want to switchover must already have its settings, otherwise, you cannot make any change. By using command “setting switchover”, you can write several sets of settings in the zone and then make changes.

2.2.9.3 Setting alteration

Select the sub-menu “setting alteration” under the menu “operation setup”. The system will ask you which area you want to alter :

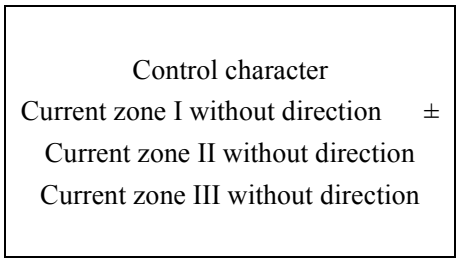


After the setting zone is selected . Press【←┘】key to get the setting alteration window :



Note : The system defaulted setting will be displayed for the invalid setting zone.

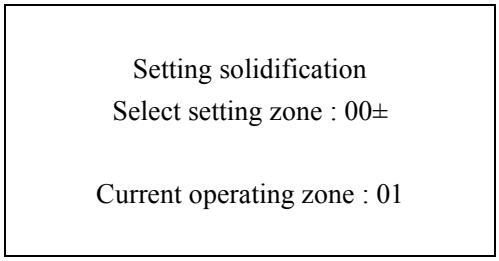
After entering setting alteration window, press"∧" or "∨" key and "<" or ">" key to select the position for alteration. Press "+" or "－" key to make alteration. For the contents in the effective bit of the control character, press ">" key and hold it for 3 seconds, the selective submenu containing the contents in the effective bit of the control character are displayed. In the submenu, effective bit or the control character can be easily put in-service or out of service. But the combined control bit must be entered through the manual calculation.



After alteration, press【←┘】key to confirm. In case of giving up the alteration, press "Q" key. The system will return to the main menu.

After all the alterations are completed, press【←┘】key to solidify. In case of giving up the alteration, press "Q" key, the system will return to the previous menu.

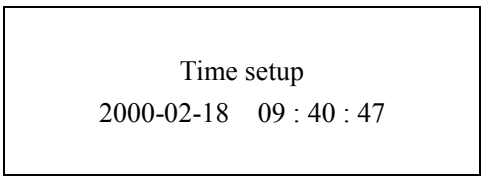
Before solidification, the system wants you to identify the target zone to perform the alteration. By doing so, the alteration or duplication of a setting zone can be realized.



When the target solidification zone is selected, press【←┘】 key to solidify. The system asks you enter the secret . The process is the same as the setting switchover and will not to be repeated here.

2.2.9.4 Time adjustment

After entering the window, use "+" or "－" key to adjust the time to the precise time, press【←┘】 key to start setup, when it is done, MMI returns to the previous menu automatically.



2.2.10 Note

Reset key is pressed to reset all lamp signals and switching-outs.

Press “Q” key for more than 1 second, the display will directly return to the main picture.

3 Debugging Outlines for Users.

This protection and its panel-assembled cabinet have been strictly debugged in the factory and as they are delivered, they are in the perfect conditions and correctly connected. The user’s debugging on the protection is to check whether any damages have occurred in the transportation and installation and whether the outgoing connections are correct. Since the perfect self-detection functions of the software and hardware are provided in the protection, the failed parts can be precisely located at the modules or ever chips. No adjustable components are mounted in the AC sampling circuit, which is excellent in its vibration-proof capability and temperature property, so the precision of the protection can be ensured by the delivery test. The test emphasis can be thus placed on the parts of the status variable inputs(opto-coupler) ,

AC inputs, tripping and closing output circuits and signal circuits (relay contacts). Although the following debugging procedures are directed at the protection as whole the debugging operations had better to be made on the panels and cabinets, that is, the internal panel connections should be included in the detection.

3.1 Check before energization

The advanced manufacturing technology is adopted and no adjustable components are used and. A large quantity of the LSI circuits is employed in the protection. For the sake of its reliability, in the normal test state, don’t pullout any, even in the insulation check.

Before energization check whether the surface is perfect without any damages and loosen parts for terminals and whether the parameters are consistent with the specifications. The special tests should be made on the power supply voltage. TA rated current, tripping rated current and closing rated current, etc.

3.2 Insulation check

The modules and terminals are connected in parallel (insulation test may be done on the communication terminals). The insulation to the ground for modules is tested by the 500V megaohmmeter and the tested insulation resistance should be larger than 100 MΩ. As the filters are located at the 24V, 200V output and input inlets of the power supply module and the capacitance to ground is present, the power supply socket can be pulled out in the insulation test.

3.3 Energization check

a. The groups at the settings are input into the related setting zones per the setting list and the setting zones are switched into the operating setting zones.

b. The protection pressure plates are put in service and the lamp signals on the panel will indicate the in-service conditions of the protection.

3.4 Sampling precision check

No adjustments are required for the sampling precision of the protection and the sampling error should not larger than 2%. Generally, the check can be specifically done by the microprocessor-based protection testing instrument. To meet the more strict requirements, the phase current input terminals of the protection can be connected in-series to the current of 5A, the TVs for the various phases are connected in parallel to the voltage of 50V. Now the accurate values are displayed and consistent for the various phases. In the meantime, the check should be done to see whether the phases for the analog channels are correct.

3.5Contact output check

The contact output check, including the signal contact output check, can be done in combination with the setting check. The contact output for each channel is once checked, in the other tests, only the signal indications and LCD display are required to be observed.

The contact output check can also be done via the menu “Switch-out drive” of the protection. The functions of this menu can be driven separately for each output. The operating methods can be seen in the “Operating Guidelines” of the Operation Manual.

The tripping drive and closing drive test with the circuit breakers should be done for onetime to confirm the correct operation of the circuit breakers.

3.6 Setting check

The dynamic simulation tests or other tests on the protection functions and operational logic hare been done for several times. The field debugging can only be done to check the settings.

3.7 Tripping and closing current hold test

Put the tripping and closing pressure plates in service and simulate the faults to make the protection operate and confirm the perfect conditions of the tripping and closing currents. The manual tripping and closing operations can also be done to inspect the perfect state of the circuit. The protection should not be reclosed after the manual tripping of the circuit breakers.

3.8 Phase sequence check

As the line is energized, observe whether the currents, voltages for phases and their phase angles are consistent with the actual conditions.

3.9 Calibration of the cleck

Check whether the clock is accurate in time. If it is not accurate, the calibration can be made. The operating methods are shown in the “Operating Guidelines”.

It is convinced from the above chocks that the protection and panels as well as cabinets are correctly connected and they can function normally and can be put in operation.