

P&C Technologies Co., Ltd.

User's Guide

Over Current & Earth Fault Relay: PAC-E100



Table of Contents

1. Overview	5
1.1. Features	5
1.2. Functional Single line Diagram	6
2. Technical Data	7
2.1. General Specifications	7
2.1.1. Current Input	7
2.1.2. Rated Control Source	7
2.1.3. Rated Frequency	7
2.1.4. Contact Output	7
2.1.5. Contact Input	7
2.1.6. Case	7
2.2. Protection Elements	8
2.2.1. Over Current Protection	8
2.2.2. Ground Over Current Protection	8
2.2.3. Thermal Overload Protection	9
2.2.4. Under Current Protection	9
2.2.5. Negative Phase Sequence Over Current Protection ..	9
2.3. Environmental Tests	10
2.3.1. Insulation Tests	10
2.3.2. Electromagnetic Compatibility Tests	10
2.3.3. Mechanical Tests	12
2.3.4. Environmental Conditions	12
3. Functional Description	13
3.1. Protection Functions	13
3.1.1. Over Current	13
3.1.2. Ground Over Current	16
3.1.3. Thermal Overload	18
3.1.4. Under Current	20
3.1.5. Negative Phase Sequence Over Current	21
3.2. Additional Functions	22
3.2.1. Control	22
3.2.2. Measurement & Metering	23
3.2.3. Programmable Logic	23
3.2.4. Self Diagnosis	25
3.2.5. Communication	25

3.2.6. Setting & Configuration Software	25
4. Operational Description	26
4.1. Front Panel Construction	27
4.1.1. Front Panel Operation	27
4.1.2. LEDs	27
4.1.3. Keypad	28
4.2. Key Manipulation & Menu	29
4.2.1. Basic Principle of Key Manipulation	29
4.2.2. Menu Tree	30
4.3. Initial Display	32
4.4. Menu Tree Display	32
4.4.1. DISPLAY Menu	33
4.4.1.1. DISPLAY/STATUS	33
4.4.1.2. DISPLAY/STATUS/CONTACT INPUT	34
4.4.1.3. DISPLAY/STATUS/CONTACT OUTPUT	34
4.4.1.4. DISPLAY/STATUS/SELF DIAGNOSIS	34
4.4.1.5. DISPLAY/STATUS/PROTECTION	35
4.4.1.6. DISPLAY/MEASURE	36
4.4.1.7. DISPLAY/SYSTEM INFO.	37
4.4.2. SETTING Menu	38
4.4.2.1. SETTING/SYSTEM	38
4.4.2.2. SETTING/SYSTEM/POWER SYSTEM	39
4.4.2.3. SETTING/SYSTEM/CB CONTROL	40
4.4.2.4. SETTING/SYSTEM/COM	40
4.4.2.5. SETTING/SYSTEM/DNP3.0	41
4.4.2.6. SETTING/SYSTEM/CONTACT INPUT	42
4.4.2.7. SETTING/SYSTEM/CONTACT OUTPUT	43
4.4.2.8. SETTING/SYSTEM/LED	45
4.4.2.9. SETTING/SYSTEM/PASSWORD	46
4.4.2.10. SETTING/PROTECTION	47
4.4.2.11. SETTING/PROTECTION/IOC1 (50_1)	48
4.4.2.12. SETTING/PROTECTION/IOC2 (50_2)	49
4.4.2.13. SETTING/PROTECTION/TOC (51)	50
4.4.2.14. SETTING/PROTECTION/IOCG1 (50N_1)	51
4.4.2.15. SETTING/PROTECTION/IOCG2 (50N_2)	52
4.4.2.16. SETTING/PROTECTION/TOCG (51N)	53
4.4.2.17. SETTING/PROTECTION/THERMAL (49)	54
4.4.2.18. SETTING/PROTECTION/UC (37)	55
4.4.2.19. SETTING/PROTECTION/NSOC (46)	56
4.4.3. COMMAND Menu	57
4.4.3.1. COMMAND/CONT OUT TEST	57

4.4.3.2. COMMAND/PANEL TEST	58
5. Dimensions and External Connections	59
5.1. Dimensioned Drawing	59
5.2. Terminal Block Diagram	60
5.3. External Connections	61
5.3.1. Control Source	61
5.3.2. CT Connections	62
5.3.3. Input/Output Contacts Connection	64
5.3.4. RS232 Port Connection	65
5.3.5. RS485 Port Connection	65
5.3.6. Wiring Diagram	66
6. Setting & Configuration Software	67
6.1. Setting Software	67
6.1.1. Program Menu	67
6.1.2. Device Selecting	68
6.1.3. Communication Port Setting	68
6.1.4. System Configuration	69
6.1.5. Protection Setting	70
6.1.6. Contact In/Out Setting	71
6.1.7. LED Setting	72
6.1.8. Monitor	73
Appendix A. TC Characteristics Curves	74
Appendix B. Ordering Option	89

1. Overview

PAC-E100, Over Current & Earth Fault Relay is a microprocessor-based numerical protection relay designed for the management and protection of a distribution feeder. PAC-E100 has the protection elements of Over Current (OCR), Ground Over Current (OCGR), Thermal Overload, Under Current, and Negative Phase Sequence Over Current. It has 4 standard IEC TC curves (Normal Inverse, Very Inverse, Extremely Inverse, Long-time Inverse), 7 standard ANSI TC curves and 2 KEPCO's induction type TC curves (KEPCO Normal Inverse, KEPCO Very Inverse). Also it provides the measurements of 3 phase currents, Sequence Current, THD (Total Harmonic Distortion), and frequency, and control functions for a circuit breaker.

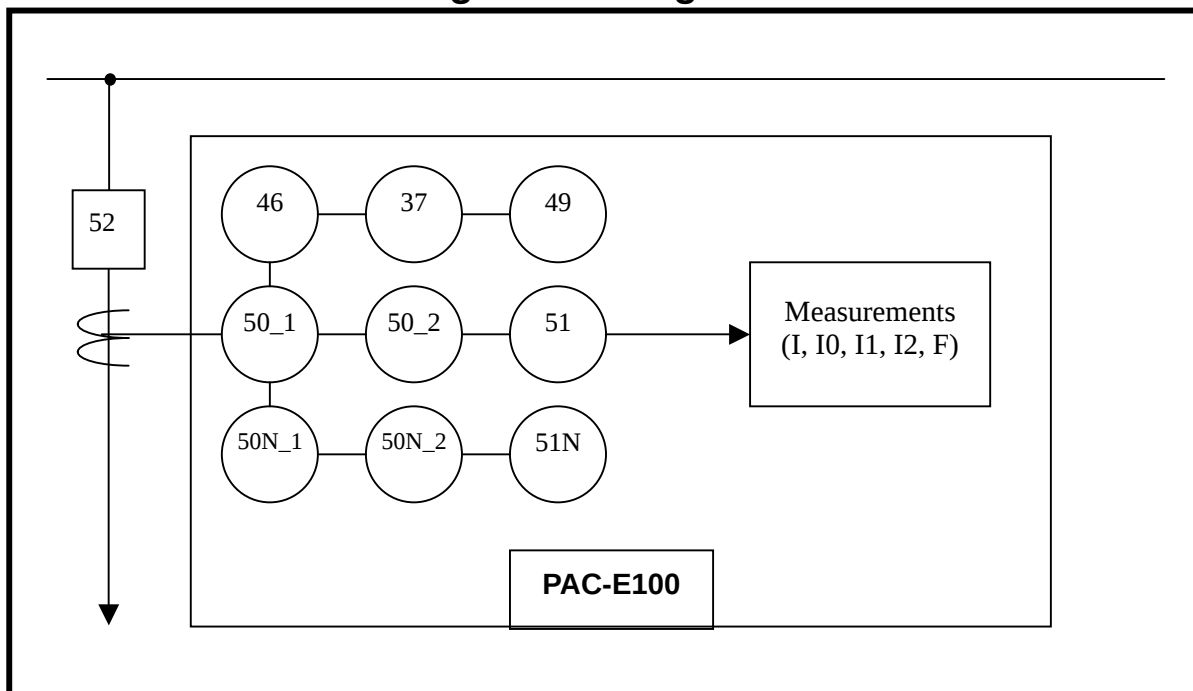
PAC-E100 can be used for protection of motor because it has the protection elements of Thermal Overload, Under Current, and Negative Phase Sequence Over Current for motor control.

Programmable Logic is designed for the replacement of external wiring for the sequence logic and it has 48 configurable logic components. The configurations of contact inputs/outputs are very easy with Programmable Logic. Programmable Logic is specially designed software for easy maintenance and operation of PAC-E100.

1.1. Features

- ☐ Numerical-type Over Current (OCR), Ground Over Current (OCGR), Thermal Overload, Under Current, and Negative Phase Sequence Over Current Protections
- ☐ Various TC Curves including 4 IEC Curves, 7 ANSI Curves, 2 KEPCO's Induction-type Compatible Curves
- ☐ Digital Indication of Setting and Metering on LCD (2 Lines × 16 Characters)
- ☐ Self-Diagnosis and Internal Status Monitoring
- ☐ Operation Blocking of Individual Relay Element by External Contact Inputs during the Relay Maintenance
- ☐ Configurable System Frequency (50 / 60Hz)
- ☐ Easy setting of 4 Contact Outputs and 4 Programmable LED to use Logic
Contact Output: Available Trip and Signaling Contact
- ☐ Direct Trip/Close Control of 1 CB from Front Panel Locally and SCADA remotely
- ☐ Useful PC Application (Setting Tool)
: System Configuration, Protection & Logic Setting, Monitoring & Measurement
- ☐ Self-Test Function of Contact Output by Manual Trip Emulation
- ☐ Access Security by Password for Setting Change and CB Control.
- ☐ Communication Interface
 - RS-232C (Front and Rear), RS485C (SCADA Communication)
 - Protocol: MODBUS, DNP3.0, IEC60870-5-103
- ☐ Measurement: 3-phase Currents, Sequence Currents, Thermal, Frequency
- ☐ EMI/EMC Performance Reinforced.

1.2. Functional Single Line Diagram



<Figure 1.2. PAC-E100 Functional Single Line Diagram>

Device Number	Function
50_1,2	Instantaneous/Definite Time Over Current Protection
51	Inverse Time-Delayed Over Current Protection
50N_1,2	Instantaneous/Definite Time Ground Over Current Protection
51N	Inverse Time-Delayed Ground Over Current Protection
46	Negative Phase Sequence Over Current Protection
37	Under Current Protection
49	Thermal Overload Protection
52	AC Circuit Breaker

2. Technical Data

2.1. General Specifications

2.1.1. Current Input

Rated Current	AC 1A/5A (50/60Hz)
Input range	0.01 ~ 50 * In
Thermal Withstand Capability	3 times of rated value: Continuous 20 times of rated value: 4 sec 40 times of rated value: 2 sec 100 times of rated value: 1 sec
Burden	< 0.5VA / phase

2.1.2. Rated Control Source

Voltage : 110 ~ 220 VAC $\pm$ 20%, 80 ~ 300 VDC, Power Consumption: < 30 VA
(Option: 24 ~ 48 VDC)

2.1.3. Rated Frequency

50Hz or 60Hz

2.1.4. Contact Output

For Trip: 4points (2A, 2C), Configurable	
Rated Load	10A / 0.3sec / AC 250V / Resistive Load
	30A / 0.3sec / DC 125V / Resistive Load
Switching capacity	1A / 0.1 (PF) / AC 250V
	1A / 25ms (L/R time constant) / DC 125V

2.1.5. Contact Input

4 Points Dry Contact, Configurable	
When no applied voltage	> 1000 Ω
When voltage supplied	DC 125V
Recognition time	< 10ms

2.1.6. Case

Construction	Draw-out type
IP Protection Level	IP51
Material	Steel with Hard-Combustion Plastic Cover

2.2. Protection Elements

2.2.1. Over Current Protection

Pickup	Instantaneous: 0.10 ~ 20.00 * In (0.01 * In step) Time-delayed: 0.10 ~ 20.00 * In (0.01 * In step)
TC Curve	IEC 255-3, BS142 -Normal Inverse (IEC_NI) -Very Inverse (IEC_VI) -Extremely Inverse (IEC_EI) -Long Inverse (IEC_LI) ANSI/IEEE -Inverse (ANSI_I) -Short Inverse (ANSI_SI) -Long Inverse (ANSI_LI) -Moderately Inverse (ANSI_MI) -Very Inverse (ANSI_VI) -Extremely Inverse (ANSI_EI) -Definite Inverse (ANSI_DI) KEPCO Normal Inverse (KNI) KEPCO Very Inverse (KVI)
Multiplier	0.01 ~ 10.0 (0.01 step)
DT operate time	0.00 ~ 60.00 sec (0.01 sec step)
Reset	>97 ~ 98 % of pickup value
Operation accuracy	< ± 2 % of set value
Timing accuracy	< ± 35 ms (Inst., op. time <700ms) ± 3 % (op. time >700ms)

2.2.2. Ground Over Current Protection

Pickup	Instantaneous: 0.10 ~ 20.00 * In (0.01 * In step) Time-delayed: 0.10 ~ 20.00 * In (0.01 * In step)
TC Curve	IEC 255-3, BS142 -Normal inverse (IEC_NI) -Very inverse (IEC_VI) -Extremely inverse (IEC_EI) -Long inverse (IEC_LI) ANSI/IEEE -Inverse (ANSI_I) -Short inverse (ANSI_SI) -Long inverse (ANSI_LI) -Moderately inverse (ANSI_MI) -Very inverse (ANSI_VI) -Extremely inverse (ANSI_EI) -Definite inverse (ANSI_DI)

	-KEPCO normal inverse (KNI) -KEPCO very inverse (KVI)
Multiplier	0.01 ~ 10.0 (0.01 step)
DT operate time	0.00 ~ 60.00 sec (0.01 sec step)
Reset	>97 ~ 98 % of pickup value
Operation accuracy	< ± 2 % of set value
Timing accuracy	< ± 35 ms (Inst., op. time <700ms) ± 3 % (op. time >700ms)

2.2.3. Thermal Overload Protection

K-Factor	0.10 ~ 4.00 (0.01 step)
Time Constant	1.0 ~ 999.9 min (0.1 min step)
Thermal Alarm	50 ~ 100 % (1 % step)
Reset	>97 ~ 98 % of Thermal trip
Operation accuracy	< ± 2 % of set value
Timing accuracy	< ± 2 s (op. time <1min) ± 10 % (op. time >1min)

2.2.4. Under Current Protection

Pickup	0.02 ~ 1.00 * In A (0.01 * In A step)
DT operate time	0.00 ~ 180.00 sec (0.01 sec step)
Reset	>102 ~ 103 % of pickup value
Operation accuracy	< ± 2 % of set value
Timing accuracy	< ± 35 ms (op. time <700ms) ± 3 % (op. time >700ms)

2.2.5. Negative Phase Sequence Over Current Protection

Pickup	0.10 ~ 20.00 * In A (0.01 * In A step)
DT operate time	0.00 ~ 180.00 sec (0.01 sec step)
Reset	>97 ~ 98 % of pickup value
Operation accuracy	< ± 2 % of set value
Timing accuracy	< ± 35 ms (Inst., op. time <700ms) ± 3 % (op. time >700ms)

2.3. Environmental Tests

2.3.1. Insulation Tests

Insulation resistance	To measure with 500 Vdc insulation resistance tester Overall Electric Circuit – Enclosure : 10M Ω Between Electric Circuits : 5 M Ω Between Contacts : 5 M Ω	IEC60255-5, ANSI/IEEE C37.90.0
Dielectric test voltage	Applied Time: 1 min (50/60 Hz) Overall Electric Circuit – Enclosure : 2kV Between Electric Circuits : 2 kV Between Contacts : 1 kV	IEC60255-5
Impulse test voltage	Applied Waveform: 1.2 $\times$ 50 μ s Applied Time: Each Positive/Negative 3 times Overall Electric Circuit – Enclosure : 5kV Between Transducer Circuits : 5 kV Transducer Circuit – Control Circuit : 5 kV Between Electric Circuits : 3 kV Between Contacts Terminals : 3 kV	IEC60255-5

2.3.2. Electromagnetic Compatibility Tests

1MHz burst disturbance	Vibrating Frequency : 1MHz Voltage Rising Time : 75nsec Repeating Frequency : 400Hz Output Impedance : 200 Ω Applying Method : Asynchronous Polarity : Positive, Negative Control Source Circuit Common Mode 2.5 kV Differential Mode 1.0 kV Transducer Circuit Common Mode 2.5 kV Differential Mode 1.0 kV Contact Circuit Common Mode 2.5 kV Differential Mode 1.0 kV	IEC60255-22-1 ANSI/IEEE C37.90.1
------------------------	--	--

Fast transients / burst	Voltage Rising Time : 5nsec 50% Peak Voltage Holding Time : 50nsec Repeating Frequency : 2.5kHz Burst Holding Time : 15msec Burst Period : 300msec Applying Method : Asynchronous, Common Mode Polarity : Positive, Negative Applied Time : 1min Halted Time : 1min Control Source Circuit : 4 kV Transducer Circuit : 4 kV I/O Contact Circuit : 4 kV Ground Circuit : 4 kV	IEC60255-22-4 class IV, ANSI/IEEE C37.90.1
Electrostatic discharge	Polarity : Positive, Negative Applied Count : 10 times Applied Interval : 1sec Applied Part – Enclosure Contact Mode : 6.0 kV Air Mode : 8.0 kV	IEC60255-22-2 class III
Compound Surge	Voltage Waveform : $1.2 \times 50\mu\text{sec}$ Current Waveform : $8 \times 20\mu\text{sec}$ Output Impedance : 2Ω Applying Method : Asynchronous Polarity : Positive, Negative Applied Count : 3 times Applied Interval : 30sec Control Source Circuit Common Mode 2.0 kV Differential Mode 1.0 kV Transducer Circuit Common Mode 2.0 kV Differential Mode 1.0 kV Contact Circuit Common Mode 2.0 kV Differential Mode 1.0 kV	IEC60255-22-5 class IV
Radiated Susceptibility	Applied Frequency : 25MHz ~ 1GHz Electric Field Strength : 10V/m 80% AM modulation Applying Method : Front Distance from Antenna: Cross and Horizontality Dwell Time : 1sec	IEC60255-22-3 class III ANSI/IEEE C37.90.2

2.3.3. Mechanical Tests

Vibration	Frequency: 16.7 Hz Wide: 0.4 mm Direction: front/back/left/right/top/bottom Time: 600 sec (10 min)	IEC60255-21-1 class II
Impulse	Volume: 30 g (g: Acceleration of gravity) Applying Method :front/back/left/right/top/bottom - twice per each, total six times	IEC60255-21-2 class II

2.3.4. Environmental Conditions

Temperature	-20 °C ~ +70 °C
Humidity	Daily average ~ 100 %
Altitude	<2000 m
No abnormal vibration, impact, inclination, or magnetic field effect	
No explosive/combustible dust, combustible/corrosive gas, or salinity	

3. Functional Description

3.1. Protection Functions

3.1.1. Over Current

Over Current element supports Instantaneous, Inverse Time Delayed, and Definite Time Delayed characteristics to apply to single, two and three phases over current and short circuit protections. PAC-E100 has 2 Instantaneous elements (IOC1 (50_1), IOC2 (50_2)) including Definite Time and 1 Inverse Time Delayed element (TOC (51)).

Instantaneous characteristic is to output TRIP signal as instantaneously within 30msec as the current higher than pick-up value is entered and Definite Time characteristic is to output TRIP signal after the pre-set time in case of the current higher than pick-up. Inverse Time Delayed characteristic is a function of time and current values which describes the relation of the operation time inversely proportional to the current value. 11 international standard INVERSE TC curves (4 IEC and 7 ANSI curves) and 2 KEPCO-specific Induction-type Relay Compatible INVERSE TC curves are implemented. Users can select one of 13 Inverse TC curves to apply.

These 13 TC curves' characteristics can be represented as the following functions.

$$T = \left(\frac{K}{\left(\frac{G}{G_s} \right)^L - 1} + C \right) \times TM (\text{sec})$$

Curve	K	L	C
IEC normal inverse (IEC_NI)	0.14	0.02	0.00
IEC very inverse (IEC_VI)	13.50	1.00	0.00
IEC extremely inverse (IEC_EI)	80.00	2.00	0.00
IEC long inverse (IEC_LI)	120.00	1.00	0.00
ANSI inverse (ANSI_I)	8.9341	2.0938	0.17966
ANSI short inverse (ANSI_SI)	0.2663	1.2969	0.03393
ANSI long inverse (ANSI_LI)	5.6143	1	2.18592
ANSI moderately inverse (ANSI_MI)	0.0103	0.02	0.0228
ANSI very inverse (ANSI_VI)	3.922	2	0.0982
ANSI extremely inverse (ANSI_EI)	5.64	2	0.02434
ANSI definite inverse (ANSI_DI)	0.4797	1.5625	0.21359
KEPCO normal inverse (KNI)	0.11	0.02	0.42
KEPCO very inverse (KVI)	39.85	1.95	1.08

T : Trip time in second

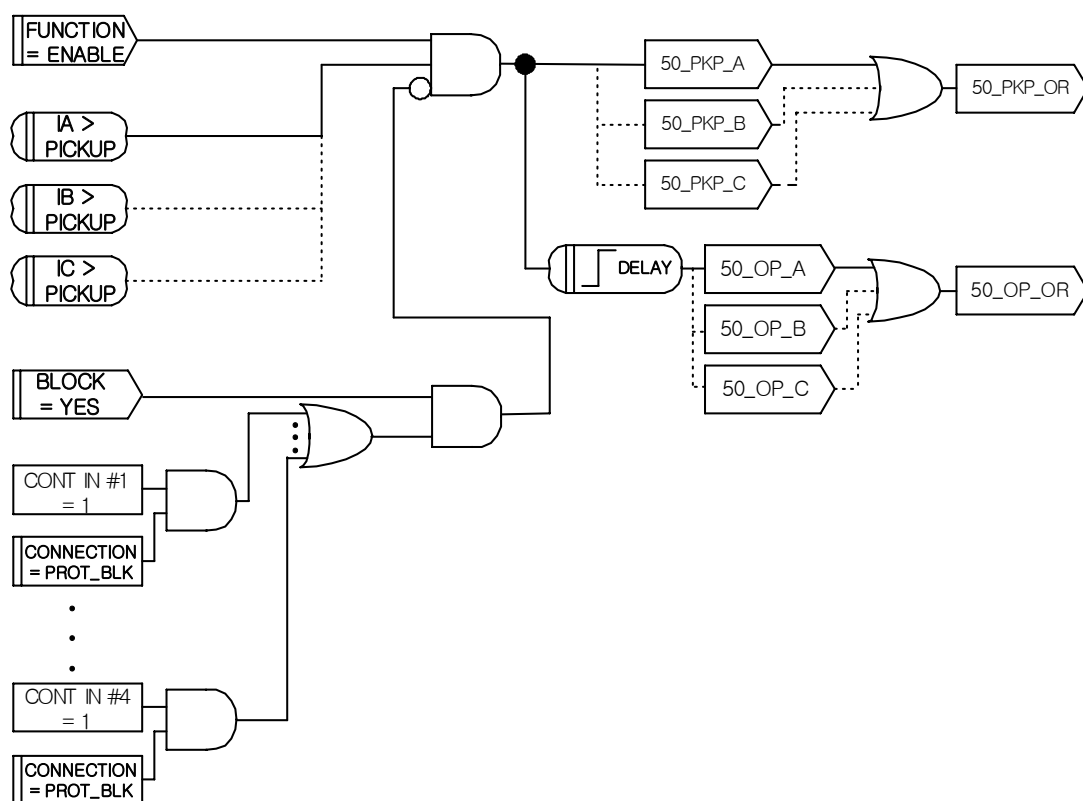
K,C,L : Constants

G : Current input

GS : Pickup current setting

TM : Time multiplier

Trip time for $G/G_s \geq 20$ are identical to those for $G/G_s = 20$.



IA/IB/IC: A/B/C phase Feeder Current

FUNCTION: Setting Function of Instantaneous Over Current

PICKUP: Setting Pickup of Instantaneous Over Current

DELAY: Setting Delay of Instantaneous Over Current

BLOCK: Setting Block Instantaneous Over Current

CONNECTION-PROT_BLK: Connection of Contact input is shown PROT_BLK

CONT IN #1~#4-1: Contact input is LOGIC "1"

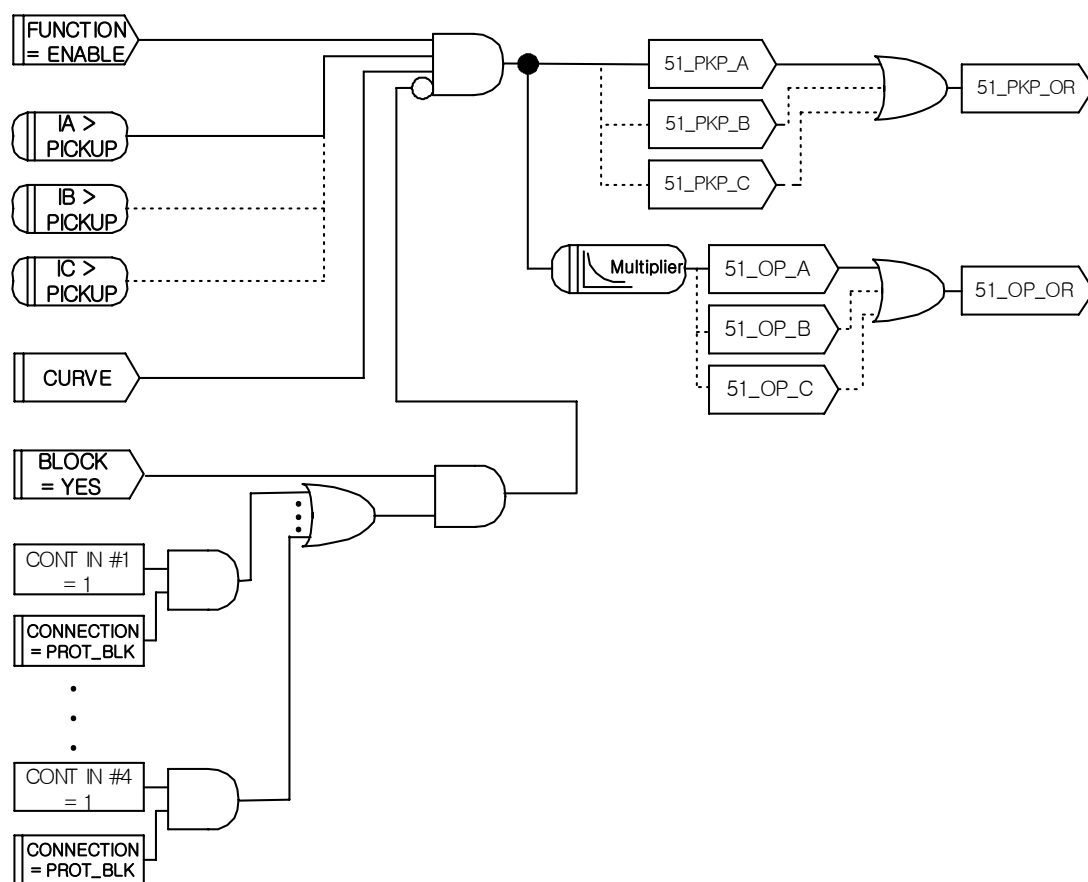
50_PKP_A/B/C: Each phase pickup for Instantaneous Over Current

50_PKP_OR: The least 1 phase for Instantaneous Over Current is pickup

50_OP_A/B/C: Each phase Operation for Instantaneous Over Current

50 OP OR: The least 1 phase for Instantaneous Over Current is Operation

<Figure 3.1.1.1. IOC1 (50_1), IOC2 (50_2) Logic Diagram>



IA/IB/IC: A/B/C phase Feeder Current

FUNCTION: Setting Function of Time-delayed Over Current

PICKUP: Setting Pickup of Time-delayed Over Current

CURVE: Setting Curve of Time-delayed Over Current

MULTIPLIER: Setting Multiplier of Time-delayed Over Current

BLOCK: Setting Block Time-delayed Over Current

CONNECTION-PROT_BLK: Connection of Contact input is shown PROT_BLK

CONT IN #1~#4-1: Contact input is LOGIC "1"

51_PKP_A/B/C: Each phase pickup for Time-delayed Over Current

51_PKP_OR: The least 1 phase for Time-delayed Over Current is pickup

51_OP_A/B/C: Each phase Operation for Time-delayed Over Current

51_OP_OR: The least 1 phase for Time-delayed Over Current is Operation

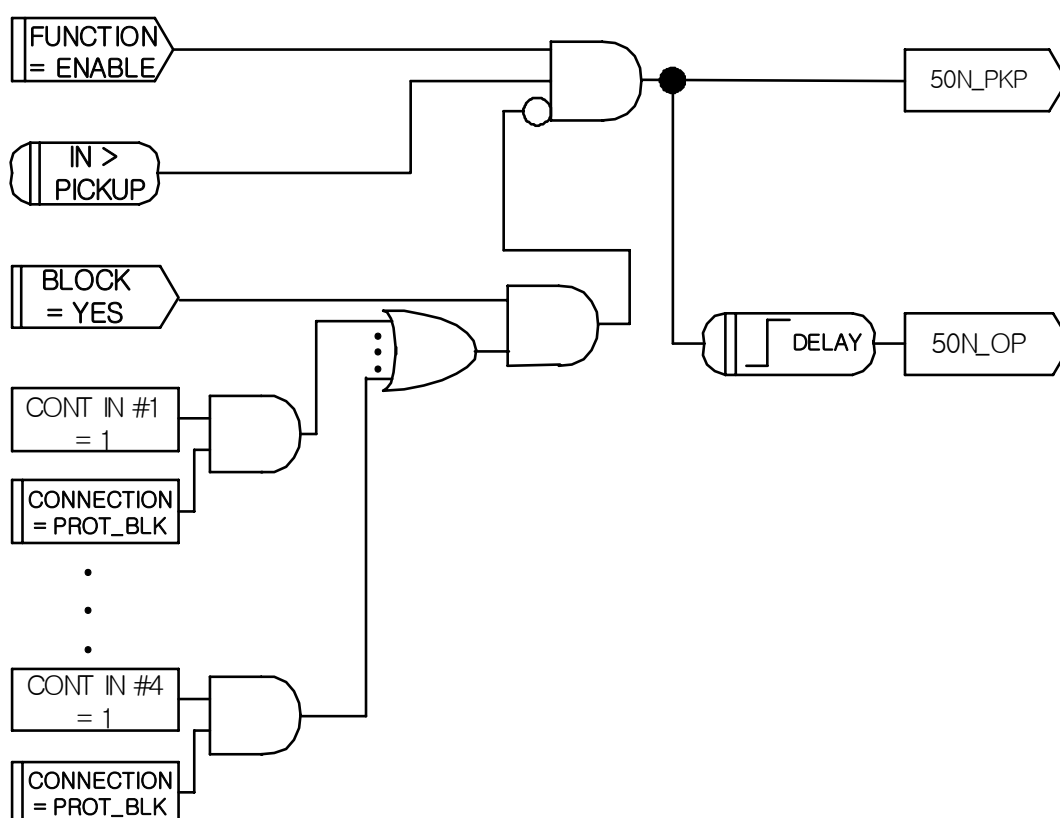
<Figure 3.1.1.2. TOC (51) Logic Diagram>

3.1.2. Ground Over Current

Ground Over Current (Earth Fault) protection has the same principle and characteristics with 3-phase Over Current protection, but the difference is to obtain input signal from ground current.

Ground Over Current element also supports Instantaneous and Time Delayed, and has 2 Instantaneous elements (IOCG1 (50N_1), IOCG2 (50N_2)) including Definite Time and 1 Inverse Time Delayed element (TOCG (51N)). TC curves of Inverse Time Delayed in Ground Over Current elements are of the same types with those of 3-phase Over Current elements.

Logic Diagram of Ground Over Current element operation is as follows.



IN: Feeder Ground Current

FUNCTION: Setting Function of Instantaneous Ground Over Current

PICKUP: Setting Pickup of Instantaneous Ground Over Current

DELAY: Setting Delay of Instantaneous Ground Over Current

BLOCK: Setting Block Instantaneous Ground Over Current

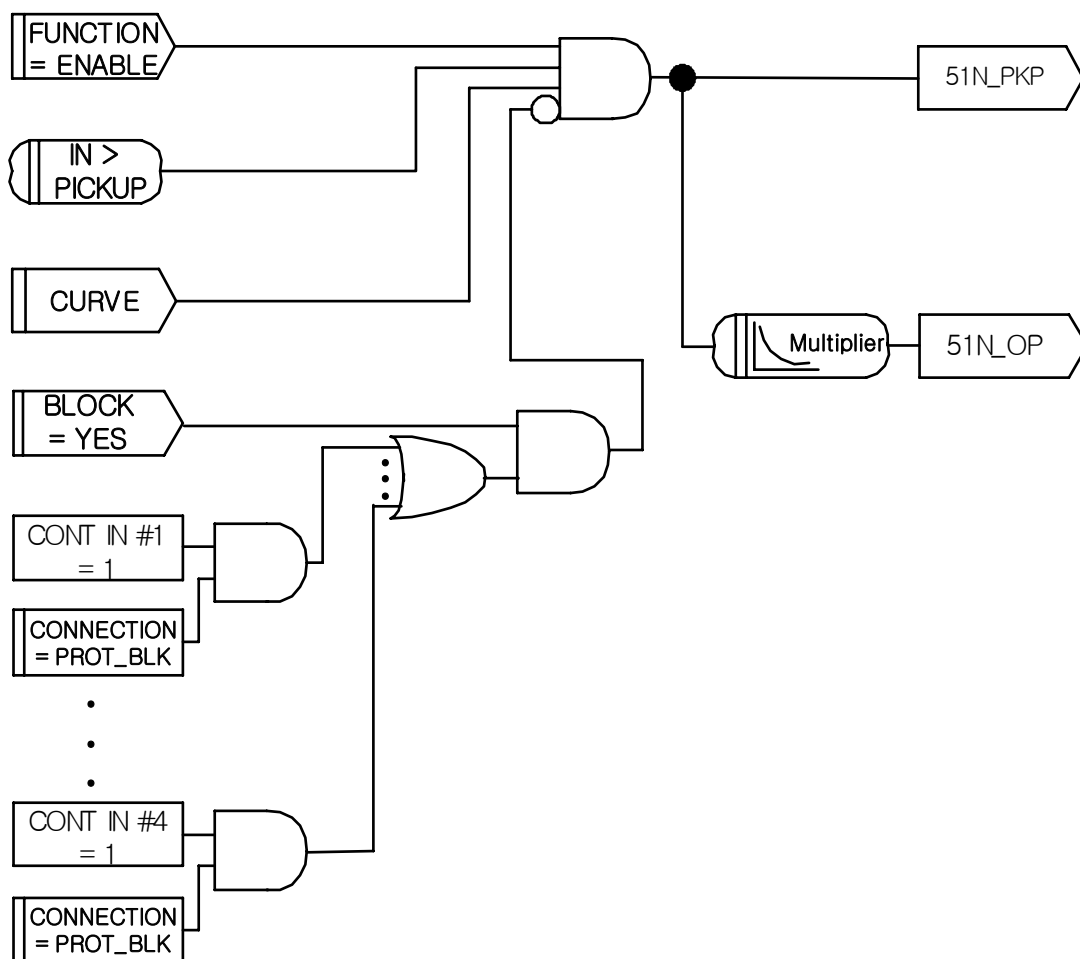
CONNECTION-PROT_BLK: Connection of Contact input is shown PROT_BLK

CONT IN #1~#4-1: Contact input is LOGIC "1"

50N_PKP: Each phase pickup for Instantaneous Ground Over Current

50N_OP: Each phase Operation for Instantaneous Ground Over Current

<Figure 3.1.2.1. IOCG1 (50N_1), IOCG2 (50N_2) Logic Diagram>



IN: Feeder Ground Current

FUNCTION: Setting Function of Time-delayed Ground Over Current

PICKUP: Setting Pickup of Time-delayed Ground Over Current

CURVE: Setting Curve of Time-delayed Ground Over Current

MULTIPLIER: Setting Multiplier of Time-delayed Ground Over Current

BLOCK: Setting Block Time-delayed Ground Over Current

CONNECTION-PROT_BLK: Connection of Contact input is shown PROT_BLK

CONT IN #1~#4-1: Contact input is LOGIC "1"

51N_PKP: Each phase pickup for Time-delayed Over Current

51N_OP: Each phase Operation for Time-delayed Over Current

<Figure 3.1.2.2. TOCG (51N) Logic Diagram>

3.1.3. Thermal Overload

Thermal Overload protection is operated by PAC-E100's CT ratings and K-factor. In case the largest current input value of phase currents is larger than the value of multiplication of nominal (rated) current and K-factor, Thermal value is getting higher. If this Thermal value is higher than the preset value, alarm is generated. And if this value is higher than 100%, then this protection element is operated. Operation time is decided by Current and Temperature Rise Time Constant. This element is used to prevent the overload of cable and motor.

Logic Diagram of Thermal Overload element operation is as follows.

[Trip TC Curve]

$$\begin{array}{cc}
 \text{- With pre-load} & \text{-Without pre-load} \\
 t = \tau \cdot \ln \left(\frac{\left(\frac{I}{k \cdot I_N} \right)^2 - \left(\frac{I_P}{k \cdot I_N} \right)^2}{\left(\frac{I}{k \cdot I_N} \right)^2 - 1} \right) [\text{min}] & t = \tau \cdot \ln \left(\frac{\left(\frac{I}{k \cdot I_N} \right)^2}{\left(\frac{I}{k \cdot I_N} \right)^2 - 1} \right) [\text{min}]
 \end{array}$$

t Trip time

τ Temperature rise time constant

I Load current

I_P Pre-load current

k Setting factor

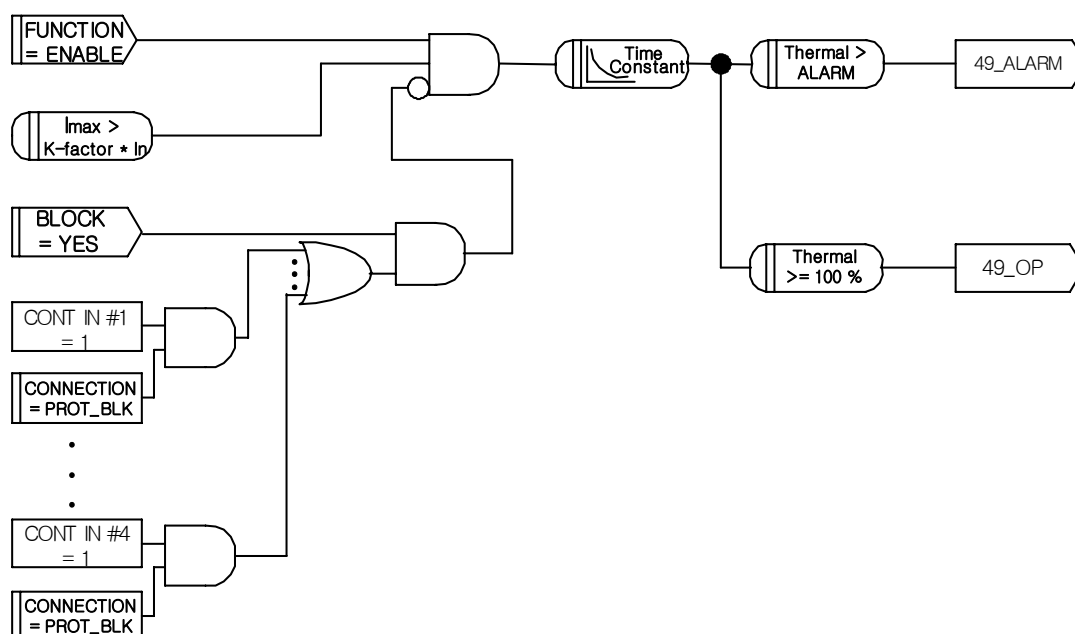
I_N Nominal current

[Thermal State Calculation]

$$\Theta_{m+1} = \left(\frac{I}{k \cdot I_N} \right)^2 \cdot [1 - \exp(-t/\tau)] + \Theta_m \cdot \exp(-t/\tau)$$

Θ being calculated every 100ms

I means True RMS



MAX: The biggest current of A/B/C phase
THERMAL: Generating Thermal because of Overload

FUNCTION: Setting Function of Thermal Overload
K-Factor: Setting K-factor of Thermal Overload
IN: Rate Current
Time Constant: Setting Time Constant of Thermal Overload
BLOCK: Setting Block Thermal Overload
CONNECTION-PROT_BLK: Connection of Contact input is shown PROT_BLK
CONT IN #1~#4-1: Contact input is LOGIC "1"

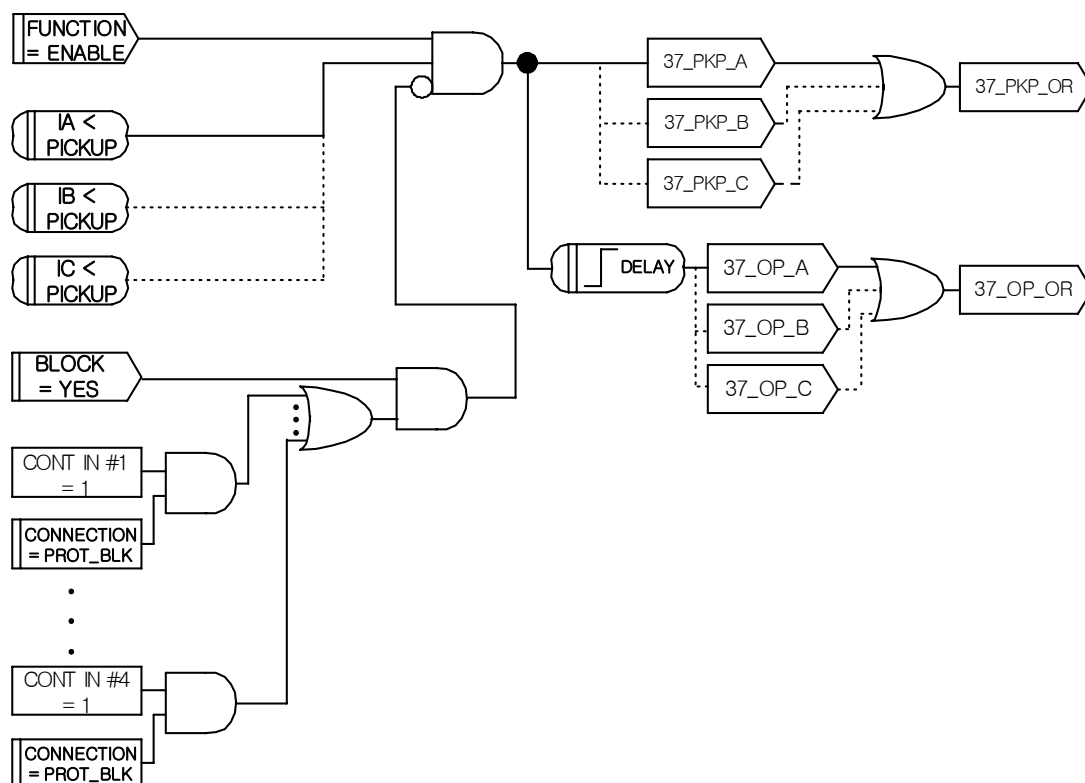
49_ALARM: Pickup for Thermal Overload
49 OP: Operation for Thermal Overload

<Figure 3.1.3. THERMAL (49) Logic Diagram>

3.1.4. Under Current

Under Current protection detects the fault using Phase Current values. This element is operated with Time Delay when Phase Currents below the preset value flow. This element is used, for example, to protect the situation of motor breakdown causing current decrease.

Logic Diagram of Under Current element operation is as follows.



IA/IB/IC: A/B/C phase Feeder Current

FUNCTION: Setting Function of Under Current

PICKUP: Setting Pickup of Under Current

DELAY: Setting Delay of Under Current

BLOCK: Setting Block Under Current

CONNECTION-PROT_BLK: Connection of Contact input is shown PROT_BLK

CONT IN #1~#4-1: Contact input is LOGIC "1"

37_PKP_A/B/C: Each phase pickup for Under Current

37_PKP_OR: The least 1 phase for Under Current

37_OP_A/B/C: Each phase Operation for Under Current

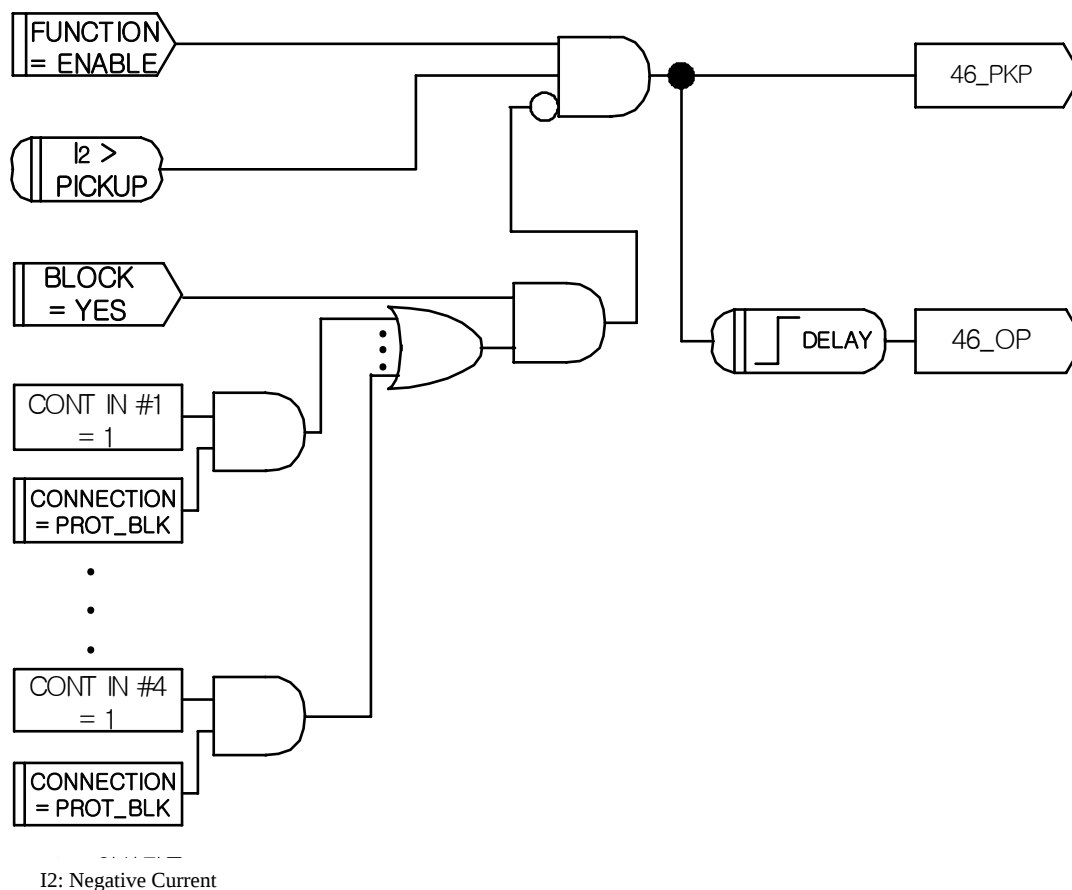
37 OP OR: The least 1 phase for Under Current is Operation

<Figure 3.1.4 UC (37) Logic Diagram>

3.1.5. Negative Phase Sequence Over Current

Negative Sequence Over Current protection detects the fault using Negative Sequence Current value during Fault occurrence or Load Unbalance situation. This element is operated with Time Delay when Negative Sequence Currents above the preset value flow.

Logic Diagram of Negative Sequence Over Current element operation is as follows.



FUNCTION: Setting Function of Negative Phase Sequence Over Current

PICKUP: Setting Pickup of Negative Phase Sequence Over Current

DELAY: Setting Delay of Negative Phase Sequence Over Current

MULTIPLIER: Setting Multiplier of Time-delayed Ground Over Current

BLOCK: Setting Block Negative Phase Sequence Over Current

CONNECTION-PROT_BLK: Connection of Contact input is shown PROT_BLK

CONT IN #1~#4-1: Contact input is LOGIC "1"

46_PKP: Each phase pickup for Negative Phase Sequence Over Current

46_OP: Each phase Operation for Negative Phase Sequence Over Current

<Figure 3.1.5. NSOC (46) Logic Diagram>

3.2. Additional Functions

3.2.1. Control

PAC-E100 supports direct CB Trip/Close control function (One CB).

Control functions of PAC-E100 also provide a local/remote selection for control location. As for remote control, PAC-E100 communicates with an upper master system (SCADA) through the rear RS485 port (Protocol: Modbus).

To control CB, a contact input should be allocated for CB STATUS input (CB_OPENED or CB_CLOSED). If there are many contact inputs allocated for CB status, "Contact Input #1" status is the first priority for CB control.

In case no contact input is allocated for CB status, CB control function is not available and all LEDs related to CB control (Local/Remote, Open/Close) are off.

Local / Remote (L/R) Control Position

To control the circuit breaker, the operator must get the appropriate right to control. The Local/Remote button renders CB control right to the local operators on site or to the remote operators in control center. Remote operator cannot control CB on the local mode, and vice versa. Security check by password inhibits the random mode change.

To change the control position mode (Local to Remote and Remote to Local), press L/R button and enter the password using arrow keys and ENT key. After correct password input, local and remote control positions can be toggled.

CB OPEN / CLOSE

This function performs trip (open)/close control actions of CB. CB Open or Close button on the front panel is activated only on the Local mode ("L" LED on). On the Remote mode, only control command from SCADA through communication is accepted.

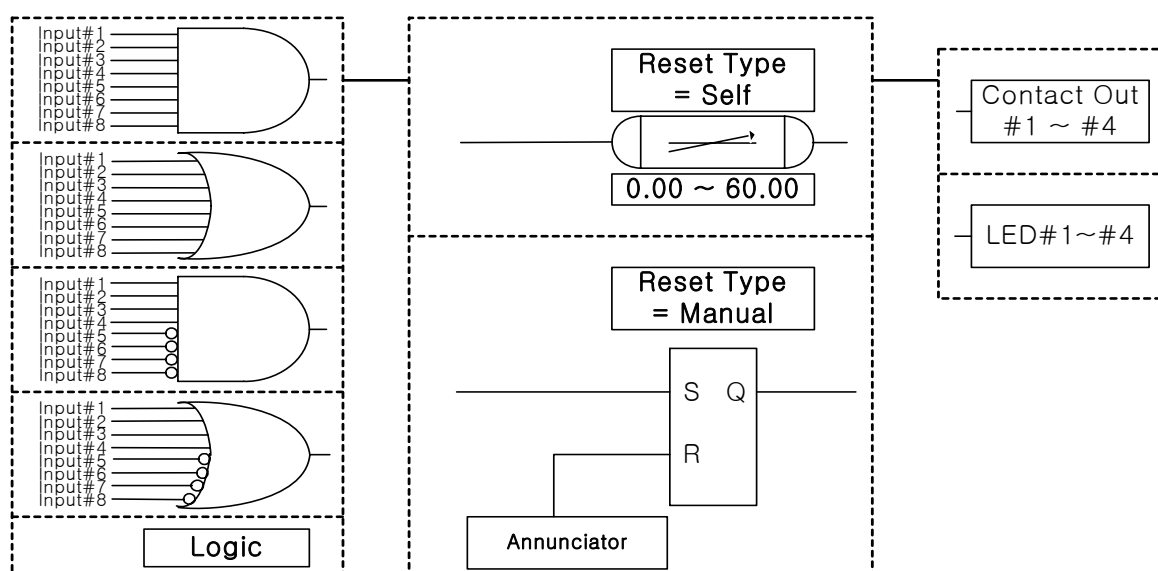
Before control command via front panel, SELECT button and Password enter are required first. SELECT button is the concept to prevent the mal-operation on the front panel and this concept is the same with SBO (Select Before Operate) concept in communication protocol, i.e. DNP3.0, where SCADA (master system) selects first the equipment to control remotely before setting out actual control command to keep other masters from selecting the same equipment so that control right is granted to that SCADA only. This dedicated concept is adopted equally to Local control and this is also used for mal-operation prevention of direct open/close command. After the correct password enter and SELECT button again, then a phrase that CB is selected is displayed on LCD and SELECT LED is blinking. After while, CB OPEN/CLOSE buttons are activated for 15 seconds.

3.2.2.Measurement & Metering

Current	RMS value of fundamental wave & phase angle per phase Range: 0.01 ~ 50 * In A RMS Measuring accuracy: $\pm 2\%$ (0.10 ~ 0.20 * In A) $\pm 0.5\%$ (0.20 ~ 1.20 * In A) $\pm 1.0\%$ (> 1.20 * In A)
Frequency	Measured based on A-phase current Metering range: 40 ~ 70 Hz Measuring Accuracy: ± 0.03 Hz
Sequence	Positive, Negative, Zero Sequence Values of Current
THERMAL	Residual Thermal Metering Metering range: 0.0 ~ 250.0%

3.2.3.Programmable Logic

Input	CB Open/Close control, Protection element is pickup, Self-diagnosis, Contact Input
Logic	OR8 (8 input OR) HALF-OR8 (Non inverting 4 input & inverting 4 input OR) AND8 (8 input AND) HALF-AND8 (Non inverting 4 input & inverting 4 input AND)
Reset Type	Self (latched until delay timer is expired) Manual (latched until annunciator reset is issued)
Reset Delay	0.00 ~ 60.00 sec (0.01 sec step)
Feature	Control contact output and LED using Logic



<Figure 3.2.3. Logic Design (Contact Output & LED)>

Input Group	Input	Description
Logic	L_OFF	Logic '0'
	L_ON	Logic '1'
CB Control	CB_OPEN_CTL	CB Open Control (Local or Remote)
	CB_CLOSE_CTL	CB Close Control (Local or Remote)
Contact Input	CONT_IN #1	Contact input#1 status
	...	...
	CONT_IN #4	Contact input#4 status
System	SYS_ERR	Self-diagnosis error is occurred
Protection elements	PROT_PKP_OR	Any protection element is picked up
	PROT_OP_OR	Any protection element is operated
	50_1_PKP_OR	At least 1 phase of 50_1 is picked up
	50_1_PKP_A	Phase A of 50_1 is picked up
	50_1_PKP_B	Phase B of 50_1 is picked up
	50_1_PKP_C	Phase C of 50_1 is picked up
	50_1_OP_OR	At least phase of 50_1 is operated
	50_1_OP_A	Phase A of 50_1 is operated
	50_1_OP_B	Phase B of 50_1 is operated
	50_1_OP_C	Phase C of 50_1 is operated
	50_2_PKP_OR	At least 1 phase of 50_2 is picked up
	50_2_PKP_A	Phase A of 50_2 is picked up
	50_2_PKP_B	Phase B of 50_2 is picked up
	50_2_PKP_C	Phase C of 50_2 is picked up
	50_2_OP_OR	At least phase of 50_2 is operated
	50_2_OP_A	Phase A of 50_2 is operated
	50_2_OP_B	Phase B of 50_2 is operated
	50_2_OP_C	Phase C of 50_2 is operated
	51_PKP_OR	At least 1 phase of 51 is picked up
	51_PKP_A	Phase A of 51 is picked up
	51_PKP_B	Phase B of 51 is picked up
	51_PKP_C	Phase C of 51 is picked up
	51_OP_OR	At least phase of 51 is operated
	51_OP_A	Phase A of 51 is operated
	51_OP_B	Phase B of 51 is operated
	51_OP_C	Phase C of 51 is operated
	50N_1_PKP	50N_1 is picked up
	50N_1_OP	50N_1 is operated
	50N_2_PKP	50N_2 is picked up
	50N_2_OP	50N_2 is operated
	51N_PKP	51N is picked up
	51N_OP	51N is operated
	37_PKP_OR	At least 1 phase of 37 is picked up
	37_PKP_A	Phase A of 37 is picked up

	37_PKP_B	Phase B of 37 is picked up
	37_PKP_C	Phase C of 37 is picked up
	37_OP_OR	At least phase of 37 is operated
	37_OP_A	Phase A of 37 is operated
	37_OP_B	Phase B of 37 is operated
	37_OP_C	Phase C of 37 is operated
	49_ALARM	49 is alarmed
	49_OP	49 is operated
	46_PKP	46 is picked up
	46_OP	46 is operated

<Table 3.2.3.1. Logic Input Table>

3.2.4. Self Diagnosis

As monitoring internal operating status, self-diagnosis function is provided to prevent the mal-operations of PAC-E100 internal systems. When any abnormality is detected for diagnosis items, ERROR LED on front panel is on and SYSTEM ERROR message is displayed on LCD. The diagnosis status for each item is listed on LCD in the menu of DISPLAY/STATUS/SELF DIAGNOSIS. After fixing the trouble and RESET button, this ERROR status is reset.

Main diagnosis items are as follows.

- ☐ Memory
- ☐ Setting
- ☐ A/D Converter
- ☐ Calibration

3.2.5. Communication

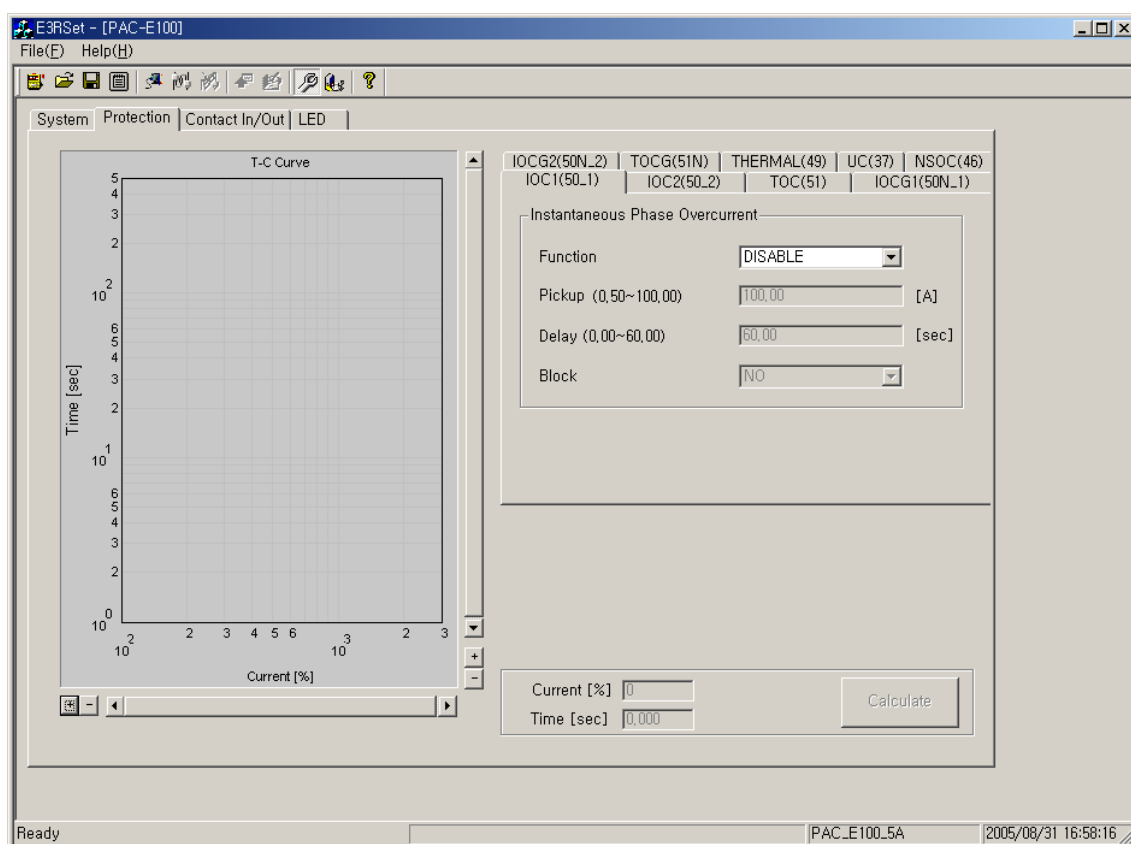
Front	1 RS232 Port (19200 BPS, ModBus Protocol) ➔ For maintenance and Setting software (Engineering Tool)
Rear	1 RS232 Port (19200 BPS, ModBus Protocol) ➔ For maintenance and Setting software (Engineering Tool) 1 RS485 Port (300 ~ 38400 BPS, DNP3.0/Modbus/ IEC870-5-103 Protocol) ➔ For SCADA communication

3.2.6. Setting & Configuration Software

PAC-E100 has the dedicated setting software. Through RS232 port on front or rear panel of PAC-E100 to notebook computer's RS232 port, maintenance and batch jobs are easily done. In the following, the functions of this tool are described briefly.

- ☐ System Configuration & Set Value Upload to PC and Batch Download to PAC-E100
- ☐ Set Value & Recorded Data Saving

The manipulation of setting software is explained in more detail on chapter 6 and the following figure shows protection page of setting program.



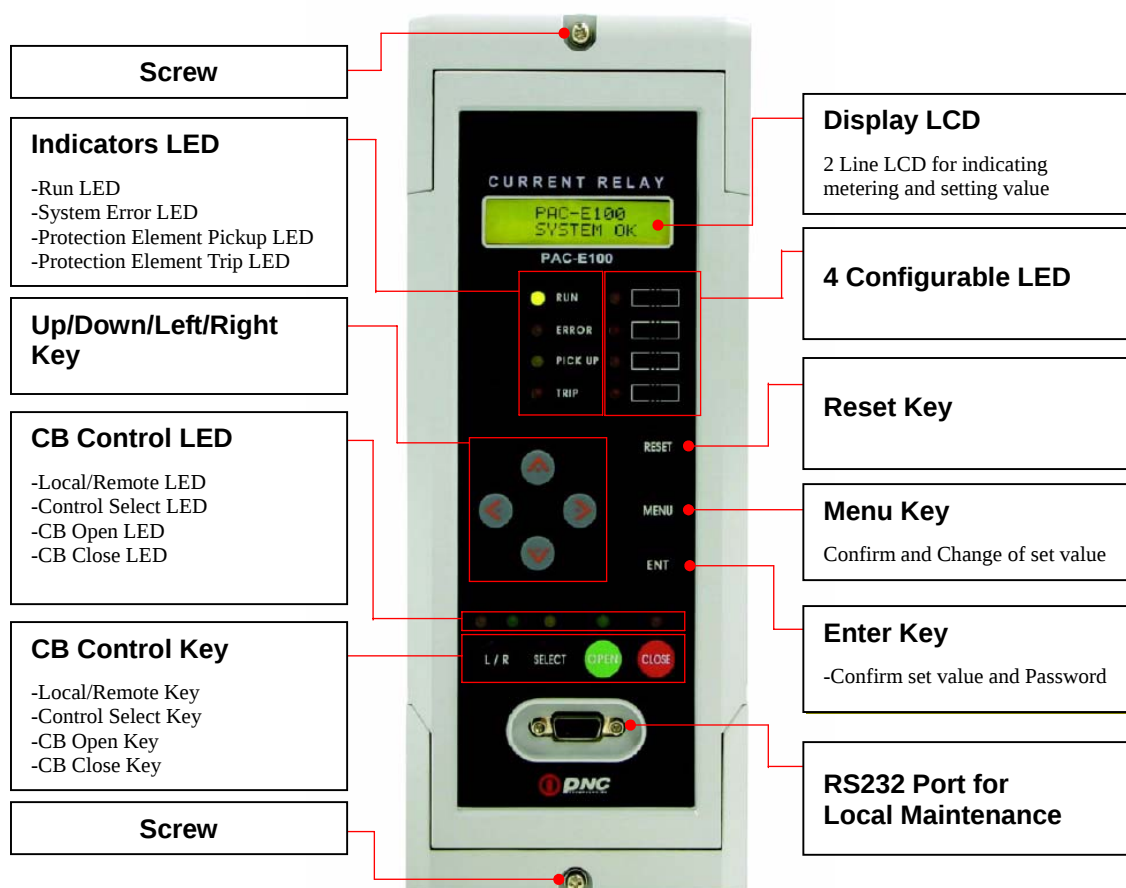
<Figure 3.2.6. Protection Page of Setting software >

4. Operational Description

4.1. Front Panel Construction

4.1.1. Front Panel Operation

The front-face display panel of PAC-E100 is composed of a graphic LCD 16 char × 2 lines, 13 LED's, 11 keypad buttons, and a RS232C communication port. Cover put on front panel play part that keep away invasion of dust and unnecessary button operation. Password protection prevents the unexpected mal-operation of keypad for control. The protection functions are executed in the background even during the manipulations of keypad. The alternative way to communicate with PAC-E100 for settings modification and fault/event data upload is to use the engineering tools through RS232C port in the front-face.



<Figure 4.1.1. Front Panel Operator Interface>

4.1.2.LEDs

RUN (Green)	RUN: Green is on when power is supplied. Test: Green is on and blinking when contact outputs are set out and during LCD/LED test on front panel.
ERROR (Red)	Red is on when self-diagnosis function detects device abnormalities. Relaying operation is inhibited. Details of abnormality are displayed on LCD, and even if the abnormal state returns to normal, LED is not reset to off but latched on. Manual RESET only returns to reset status.
PICK UP (Yellow)	Yellow is on when a protection element is picked up.
TRIP (Red)	Red is on when any trip signal is outputted. LED is latched on until manual RESET.
Programmable LED * 4 (Red)	Red is on when each logic status (contact outputs #1~#4) is 1 (ON). Reset depends on Reset Type (Self/Manual) and Reset Delay time (0.00~60.00sec).
L (Red)	Red is on in L/R LEDs when LOCAL control mode. (Any contact input should be allocated for CB status and password is required for control mode change.)
R (Green)	Green is on in L/R LEDs when REMOTE control mode. (Any contact input should be allocated for CB status and password is required for control mode change.)
SELECT (Yellow)	Yellow is blinking when CB control is SELECTed.
OPEN (Green)	Green is on when contact input CB status is OPEN. (Any contact input should be allocated for CB status.)
CLOSE (Red)	Red is on when contact input CB status is CLOSE. (Any contact input should be allocated for CB status.)

4.1.3.Keypad

ARROW	UP	Menu Move, Value Change
	DOWN	
	RIGHT	Menu Move, Menu Item Selection
	LEFT	Menu Move, Escape to Upper Menu / Cancel Item
RESET		Manual Reset of System Error and Trip LED
MENU		Enter into Menu Tree Display
ENT		Setting Value Enter and Confirm
CONTROL (Password)	L / R	Local / Remote Control Mode Change
	SELECT	CB Control Selection
	OPEN	CB Trip Control
	CLOSE	CB Close Control

4.2. Key Manipulation & Menu

4.2.1. Basic Principle of Key Manipulation

LCD display of PAC-E100 mainly consists of Initial Display and Menu Tree Display.

And Menu Tree Display is entered through MENU keypad button. Two display modes are alternated by MENU and Left keypad buttons. In the Menu Tree Display, 4 arrow keys determine the tree node and value change, and ENT key sets the determined values. All the menu items and set values take the rollover schemes using Up/Down keys.

[Setting Value Change]

- 1) All menus except PASSWORD display page numbers on the upper-right side of LCD. Press right arrow button on this page-numbered display.
- 2) If password is required, press ENTER button after inputting each digit of password. Right/Left keys are used to move cursor to each digit and Up/Down keys are used to input the password number/character of each digit.
- 3) After correct Password input and Right arrow key again, the set value is blinking to be ready for change.
- 4) After scrolling the required set value using Up/Down arrow keys, press ENT button. If Left arrow key is pressed before ENT button, the value is not changed and remains the previously saved value. This action confirms the input of a new set value.
- 5) Using Left arrow key a few times as exiting SETTING menu, the changed set values are saved in the memory to confirm the change save to YES.
- 6) Entering password into SETTING menu is required once for several value changes until exiting SETTING menu.

[Control Position Mode Change: Local / Remote]

- 1) Only if one or more contact inputs are allocated for CB Open/Closed status, CB control and related status are activated. In case all LEDs for control and related status are off, please check first the configuration of contact inputs and set contact input for CB status.
- 2) To change the CB control position between Local from control panel and Remote from SCADA (master system), press L/R button.
- 3) The password is required, and arrow keys and ENT button are used to input the password.
- 4) After correct password and L/R button again, control position is changed between Local (L) and Remote (R), and each LED (L: Red, R: Green) is toggled on and off.

[CB Control from Front Panel]

- 1) Only if one or more contact inputs are allocated for CB Open/Closed status, CB control and related status are activated. In case all LEDs for control and related status are off, please check first the configuration of contact inputs and set contact input for CB status.
- 2) In case the control position is Remote (R, Green LED is on.), it should be changed to Local (L, Red LED is on.) using the previous method of Control Position Mode Change.
- 3) Press SELECT button to confirm CB control intention.
- 4) The password is required for SELECT, and arrow keys and ENT button are used to input the password.
- 5) After correct password input, CB control is finally actuated using OPEN / CLOSE buttons. In case control command is the same with the current status of CB, the description of the same status (OPENED or CLOSED) is displayed on LCD and no control command goes out.
- 6) At all times, the password is required for CB control.

4.2.2.Menu Tree

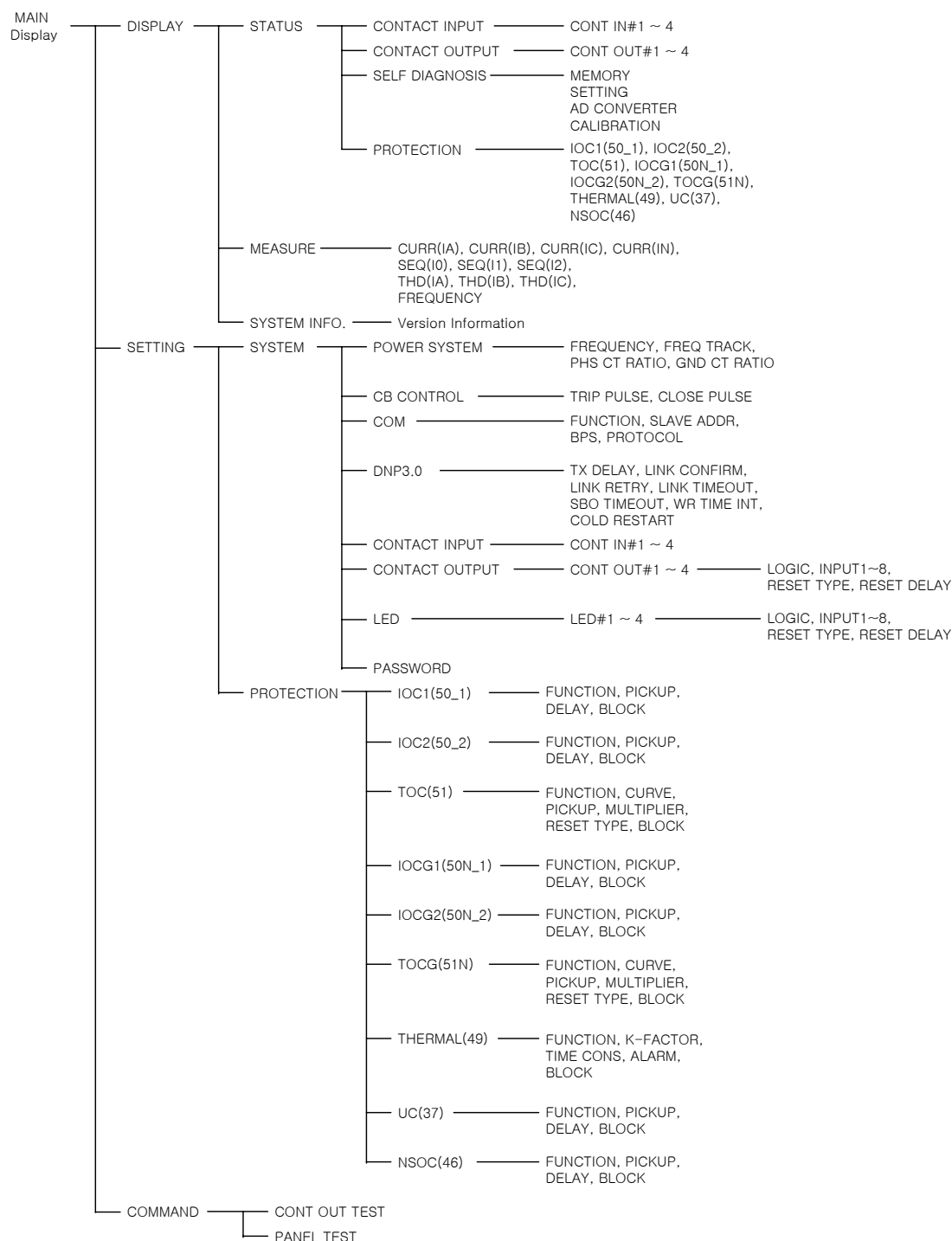
Menu of PAC-E100 mainly consists of DISPLAY, SETTING, and COMMAND.

DISPLAY menu is composed of STATUS, MEASURE, and SYS INFO sub menus. STATUS menu is used to monitor the statuses of input/output contacts, the results of self-diagnosis, and start/operated statuses of protection elements. MEASURE menu is used to display the measurement and metering of electric values, sequence current, and frequency. SYS INFO menu is used to display the system information of MPU and DSP S/W versions for maintenance.

SETTING menu is composed of SYSTEM and PROTECTION sub menus. This menu is used for settings modification. SYSTEM menu is composed of POWER SYSTEM, CB CONTROL, COM, DNP3.0, CONTACT INPUT, CONTACT OUTPUT, LED, and PASSWORD. POWER SYSTEM is used for setting of frequency, frequency tracking, phase CT ratio and ground CT. CB CONTROL is used for time setting TRIP and CLOSE PULSE. COM is used for communication setting. DNP3.0 is used for setting of DNP when communication method is DNP3.0. CONTACT INPUT / OUTPUT and LED are used for setting contact input/output and Programmable LED respectively. PASSWORD is used when change password.

PROTECTION menu is composed of protection elements, IOC1 (50_1), IOC2 (50_2), TOC (51), IOCG1 (50N_1), IOCG2 (50N_2), TOCG (51N), THERMAL (49), UC (37), and NSOC (46), and is used setting each of protection elements.

COMMAND menu is composed of CONT OUT TEST and PANEL TEST sub menus. This menu is used to test output contacts and LCD/LEDs of front-face display panel.



<Figure 4.2.2. PAC-E100 Overall Menu Tree>

4.3. Initial Display

Initial display divides normal and error display according to self-diagnosis.

User takes proper action when self-diagnosis status is “FAIL” one or more and must reset manual after make normally self-diagnosis.

LCD is indicated SYSTEM OK, when result of self-diagnosis is OK as following.

P A C - E 1 0 0									
S Y S T E M O K									

LCD is indicated SYSTEM ERROR, when result of self-diagnosis is FAIL as following.

		P A C - E 1 0 0		
		S Y S T E M E R R O R		

4.4. Menu Tree Display

To convert Initial Display into Menu Tree Display are operated through ENT and MENU buttons.

Menu Tree Display is entered through MENU keypad button. Two display modes are alternated by MENU and Left keypad buttons. In the Menu Tree Display, 4 arrow keys determine the tree node and value change, and ENT key sets the determined values. All the menu items and set values take the rollover schemes using Up/Down keys.

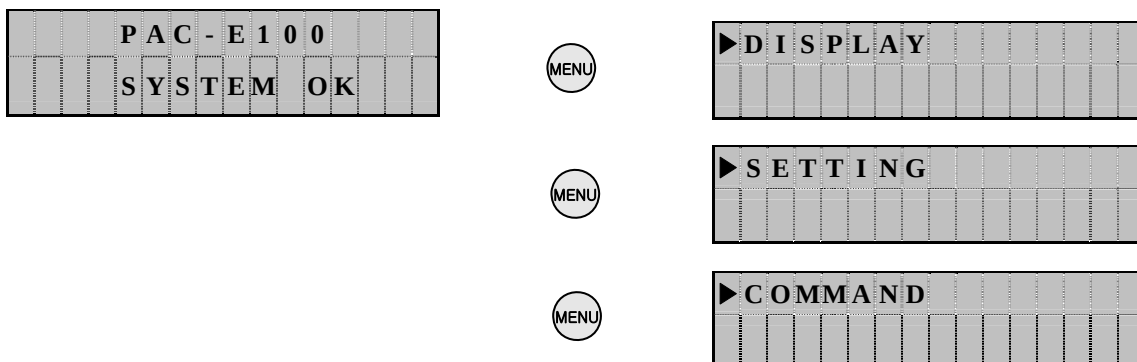
To convert Menu Tree Display into Initial Display are operated through Left arrow Escape keypad button and main menus first child nodes of the root consist of DISPLAY, SETTING, and COMMAND.

DISPLAY menu shows status of I/O contacts, self-diagnosis results, starting and operating status of protection elements, metering of electric values, and software version of DSP.

SETTING menu lets password for setting and control, analog circuit configuration, real-time system clock, CB setup, communication, input/output contacts and programmable LED setup, operation setup for protection elements, calibration data.

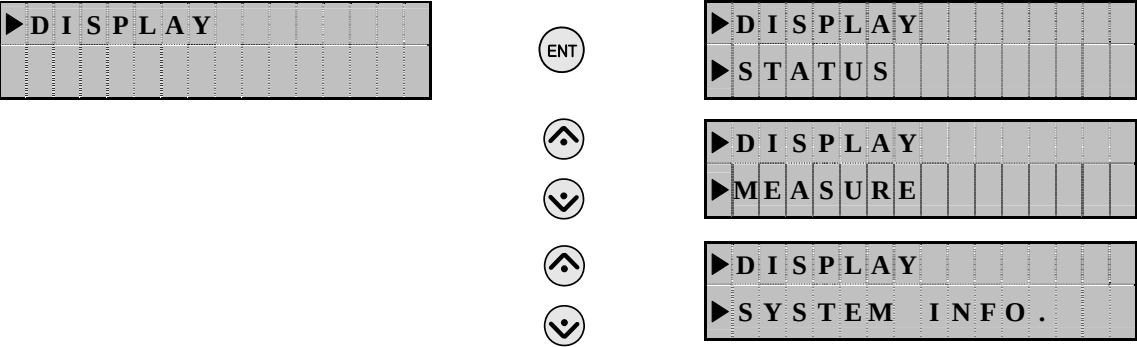
COMMAND menu is used to test output contacts and LCD/LEDs of front-face display panel.

In the following, each of the specific sub menus is explained.



4.4.1. DISPLAY Menu

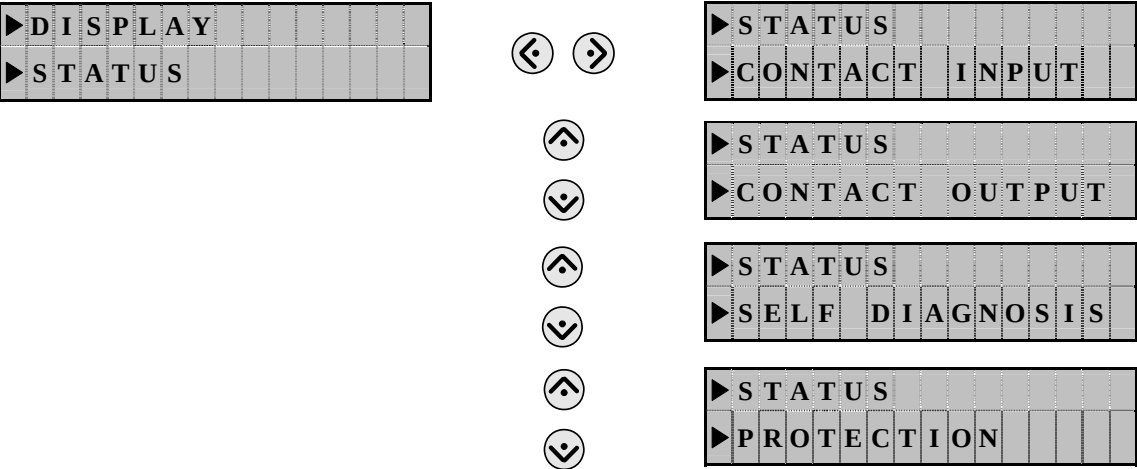
DISPLAY menu is composed of STATUS, MEASURE, and SYS INFO sub menus.



4.4.1.1. DISPLAY/STATUS

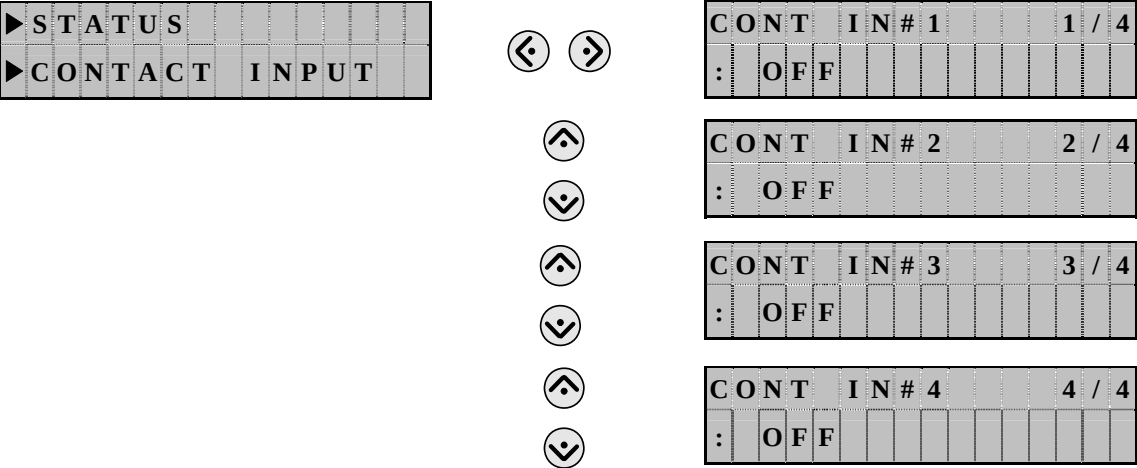
DISPLAY menu is composed of CONTACT INPUT, CONTACT OUTPUT, SELF DIAGNOSIS, and PROTECTION sub menu.

Each of sub menus shows contact input, contact output, self-diagnosis and operating status of protection elements.



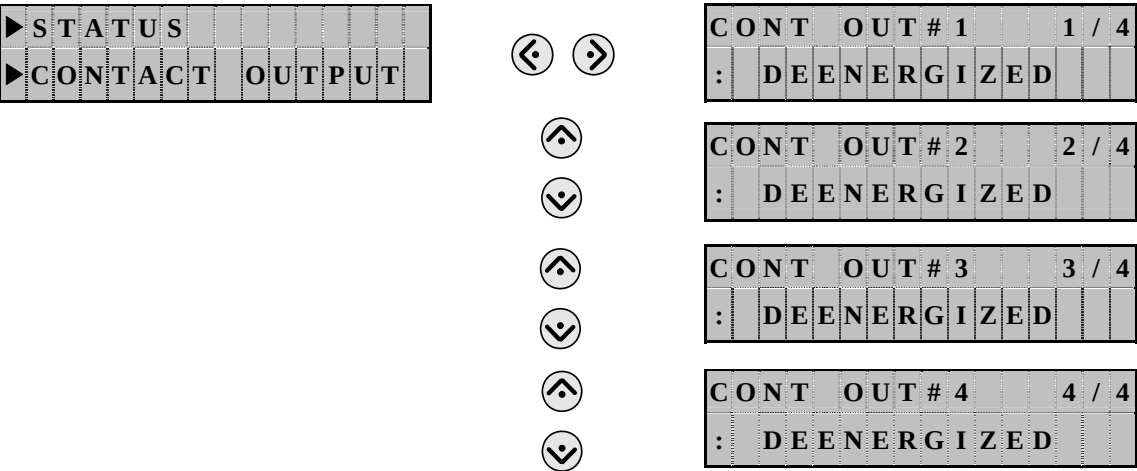
4.4.1.2. DISPLAY/STATUS/CONTACT INPUT

This menu displays On/Off status information of 4 contact inputs.



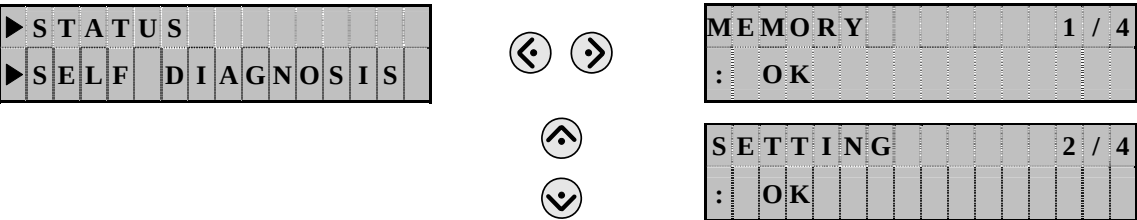
4.4.1.3. DISPLAY/STATUS/CONTACT OUTPUT

This menu displays On/Off status information of 4 contact outputs.



4.4.1.4. DISPLAY/STATUS/SELF DIAGNOSIS

This menu displays self-diagnosis results. System works normally if status of all self-diagnosis is OK.





A	D	C	O	N	V	E	R	T	E	R	3	/	4
:	O	K											



C	A	L	I	B	R	A	T	I	O	N	4	/	4
:	O	K											



4.4.1.5. DISPLAY/STATUS/PROTECTION

This menu displays picked-up started and operated status of 9 protection elements. Phase elements show started and operated phases A, B, and C, and ground elements show “PK” and “OP” symbols, when the fault current is picked up and the relaying element is signaled to operate.

▶	S	T	A	T	U	S							
▶	P	R	O	T	E	C	T	I	O	N			



I	O	C	1	(	5	0	_	1	)		1	/	9	
P	K	P	:	A	B	C	,		O	P	:	A	B	C



I	O	C	2	(	5	0	_	2	)		2	/	9	
P	K	P	:	A	B	C	,		O	P	:	A	B	C



T O C (5 1)										3 / 9			
P K P : A B C ,										O P : A B C			



I	O	C	G	1	(	5	0	N	_	1	)	4	/	9
P	K	P	:	P	K	P	,		O	P	:	O	P	



I	O	C	G	2	(	5	0	N	_	2	)	5	/	9
P	K	P	:	P	K	P	,		O	P	:	O	P	



T	O	C	G	(	5	1	N	)				6	/	9
P	K	P	:	P	K	P	,		O	P	:	O	P	



T	H	E	R	M	A	L	(	4	9	)		7	/	9
P	K	P	:	P	K	P	,		O	P	:	O	P	



U	C	(	3	7	)							8	/	9
P	K	P	:	A	B	C	,		O	P	:	A	B	C



N	S	O	C	(	4	6	)					9	/	9
P	K	P	:	P	K	P	,		O	P	:	O	P	



4.4.1.6.DISPLAY/MEASURE

This menu displays measurement and metering data of electric values. PAC-E100 has 4 current input. (Frequency is show according to input value of A-phase current.)

▶	D	I	S	P	L	A	Y												
▶	M	E	A	S	U	R	E												



C	U	R	R	(	I	A	)					1	/	1	2		
:					0	.	0	0	A	,	<				0	.	0

C	U	R	R	(	I	B	)					2	/	1	2
:		0	.	0	0	A	,	<				0	.	0	

C	U	R	R	(	I	C	)					3	/	1	2
:			0	.	0	0	A	,	<			0	.	0	

C	U	R	R	(	I	N	)					4	/	1	2
:		0	.	0	0		A	,	<			0	.	0	

S	E	Q	(	I	0	)							5	/	1	2	
:					0	.	0	0	A	,	<				0	.	0

S	E	Q	(	I	1	)								6	/	1	2
:				0	.	0	0	A	,	<				0	.	0	

S	E	Q	(	I	2	)							7	/	1	2
:		0	.	0	0		A	,	<				0	.	0	

T H D (I A)										8 / 1 2					
:	0 . 0		%												

T H D (I B)										9 / 1 2					
:					0 . 0	%									

T H D (I C)																	1 0 / 1 2																	
:	0 . 0																	%																

T H E R M A L										1 1 / 1 2							
:						0	.	0	%								

FREQUENCY										1 2 / 1 2		
:	0 . 0 0		H z									

This menu is used to display the system information of DSP S/W versions for maintenance.

P A C - E 1 0 0									
V e r	:	V 1 . 0 0							

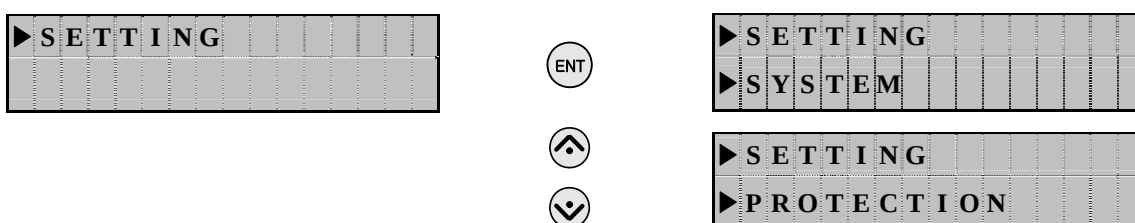
4.4.2. SETTING Menu

SETTING menu is composed of SYSTEM and PROTECTION sub menus. This menu is used for settings modification.

Basically, modifying settings and viewing are carried out in 2 ways: through LCD and keypad, and engineering tool batch download using Setting software.

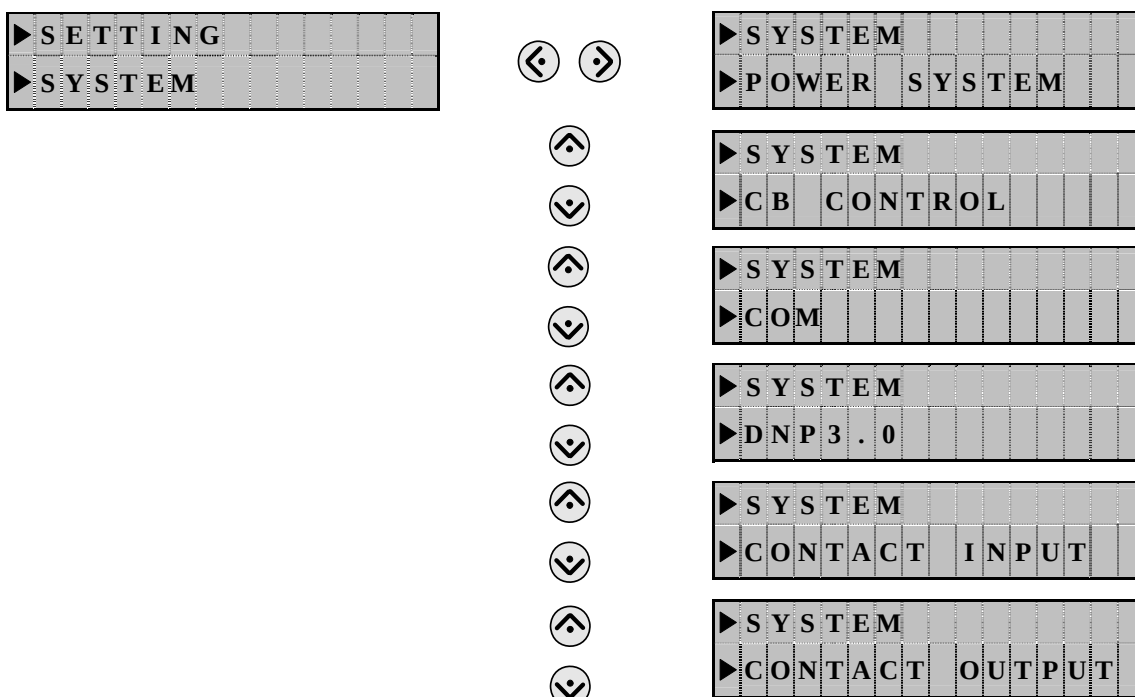
SETTING menu has 2 submenus; SYSTEM is for the general system setup and PROT COMP is for protection elements.

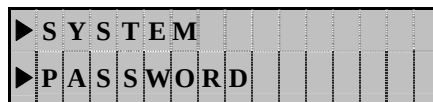
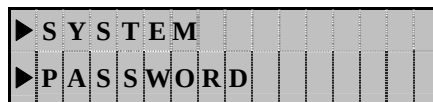
Password enter is always required when the setting values are to be changed, and the updated setting values are stored and reflected after yes/no confirmation escaping SETTING menu. And, once the password is entered using ENT key, it doesn't need to be entered again while in SETTING menu. New values are set and selected using arrow keys and ENT keypad button.



4.4.2.1. SETTING/SYSTEM

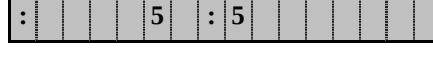
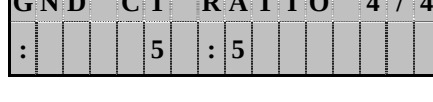
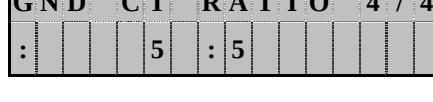
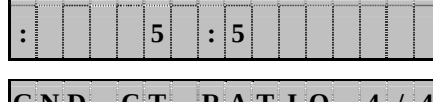
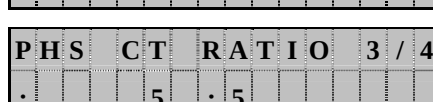
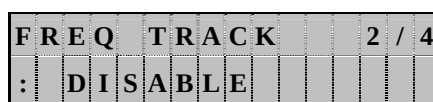
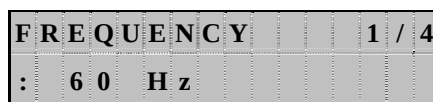
SYSTEM menu is composed of POWER SYSTEM, CB CONTROL, COM, DNP3.0, CONTACT INPUT, CONTACT OUTPUT, LED, and PASSWORD. POWER SYSTEM is used for setting of frequency, frequency tracking, phase CT ratio and ground CT. CB CONTROL is used for time setting TRIP and CLOSE PULSE. COM is used for communication setting. DNP3.0 is used for setting of DNP when communication method is DNP3.0. CONTACT INPUT / OUTPUT and LED are used for setting contact input/output and Programmable LED respectively. PASSWORD is used when change password.





POWER SYSTEM is used for setting of frequency, frequency tracking, phase CT ratio and ground CT ratio.

POWER SYSTEM is used for setting of frequency, frequency tracking, phase CT ratio and ground CT ratio.

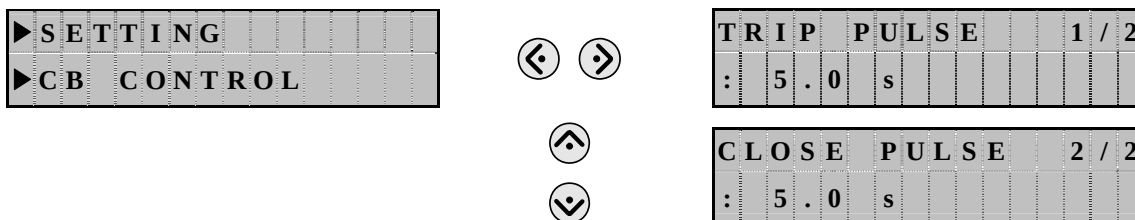


<Table 4.4.2.2. POWER SYSTEM Setting Item>

<Table 4.4.2.2. POWER SYSTEM Setting Item>

4.4.2.3. SETTING/SYSTEM/CB CONTROL

CB CONTROL is used for time setting TRIP and CLOSE PULSE.

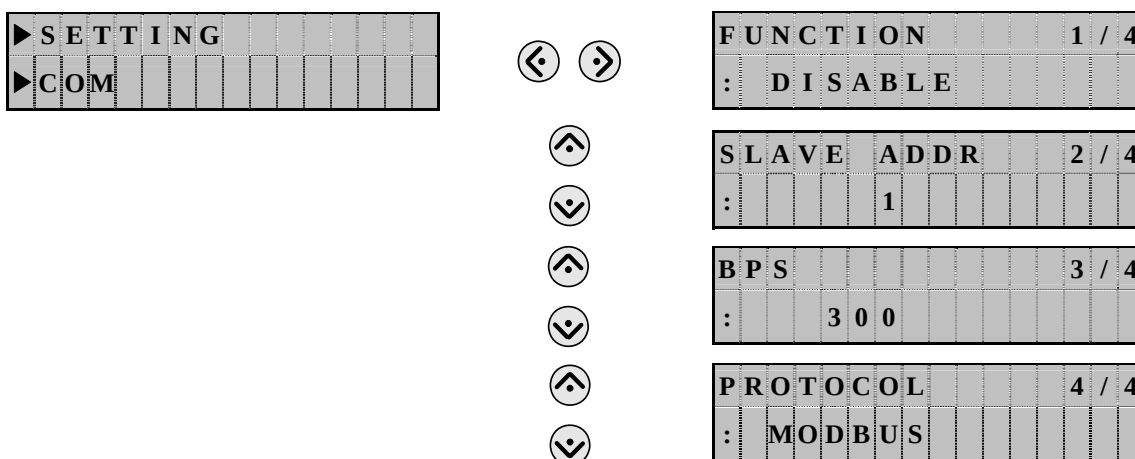


Item	Range	Setting unit	Basic value	Description
TRIP PULSE	0.1 ~ 5.0s	0.1s	5.0s	Time setting of CB Trip
CLOSE PULSE	0.1 ~ 5.0s	0.1s	5.0s	Time setting of CB Close

<Table 4.4.2.3. CB CONTROL Setting Item>

4.4.2.4. SETTING/SYSTEM/COM

COM menu is composed of FUNCTION, SLAVE ADDR, BPS, and PROTOCOL and each menu set up communication function, slave address, BPS and protocol.



Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Setting of use or not
SLAVE ADDR	1 ~ 65534	1	1	Slave address setting
BPS	300 ~ 38400		9600	Setting of communication speed
PROTOCOL	MODBUS/DNP3.0/IEC870		MODBUS	Protocol setting

<Table 4.4.2.4. COM Setting Item>

4.4.2.5. SETTING/SYSTEM/DNP3.0

DNP3.0 menu is composed of TX DELAY, LINK CONFIRM, LINK RETRY, LINK TIMEOUT, SBO TIMEOUT, WR TIME INT and COLD RESTART, and each menu set up Tx delay, Link confirm, Link retry, Link timeout, SBO timeout, Write time interval and Cold restart.

[illegible]

Item	Range	Setting unit	Basic value	Description
TX DELAY	0 ~ 65000msec	1msec	0msec	Tx delay setting
LINK CONFIRM	NEVER/ALWAYS /SOMETIMES		NEVER	Link confirm setting
LINK RETRY	0 ~ 5	1msec	0	Link retry setting
LINK TIMEOUT	1 ~ 65000msec	1msec	1msec	Link timeout setting
SBO TIMEOUT	1 ~ 65000msec	1msec	1msec	SBO timeout setting
WR TIME INT	0 ~ 65000min	1min	0min	Write time interval setting
COLD RESTART	ENABLE/DISABLE		DISABLE	Cold restart setting

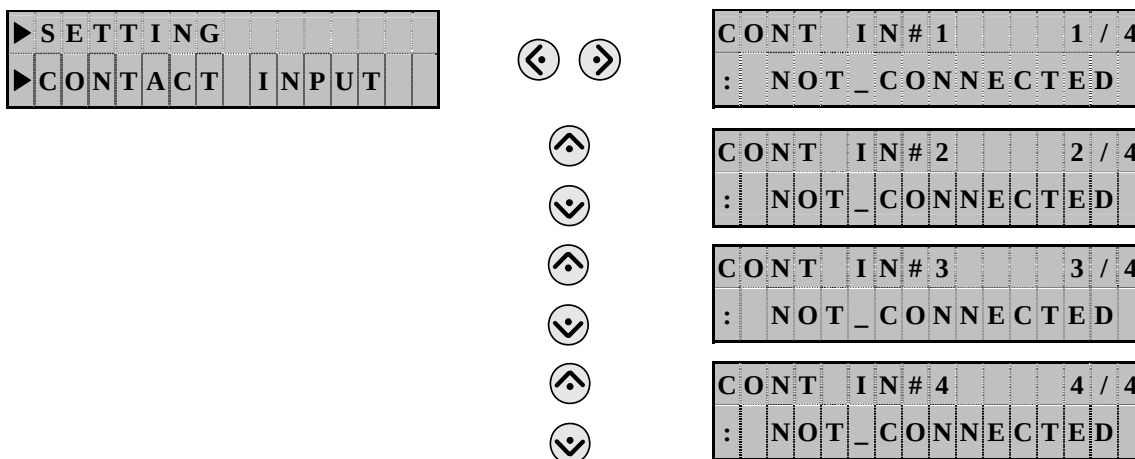
<Table 4.4.2.5. DNP3.0 Setting Item>

4.4.2.6. SETTING/SYSTEM/CONTACT INPUT

PAC-E100 has 4 Contact Input, it set each contact input "CONTACT INPUT".

There are NOT CONNECTED, CB OPENED, CB CLOSED, ANNUN RESET, PROT BLOCK and GENERAL INPUT in setting value of CONTACT INPUT.

That CB may control, only if one or more contact inputs are allocated for CB Open/Closed status. In that case, CB is controlled the fastest contact input.



Item	Range	Setting unit	Basic value	Description
CONT IN #1~#4	NOT_CONNECTED/ CB_OPENED/ CB_CLOSED/ ANNUN_RESET/ PROT_BLOCK/ GENERAL_INPUT		NOT_CONNECTED	Setting of contact input

<Table 4.4.2.6.1. CONTACT INPUT Setting Item>

Contact Input elements	Description
NOT_CONNECTED	No effect
CB_OPENED	Open CB, when input is logic "1".
CB_CLOSED	Close CB, when input is logic "1"
ANNUN_RESET	Operate Annunciator Reset, if there is status change of Input Logic.
PROT_BLOCK	Do action that protection element make BLOCK, when input is logic "1" and BLOCK of protection element is "Yes".
GENERAL_INPUT	Used general Contact Input

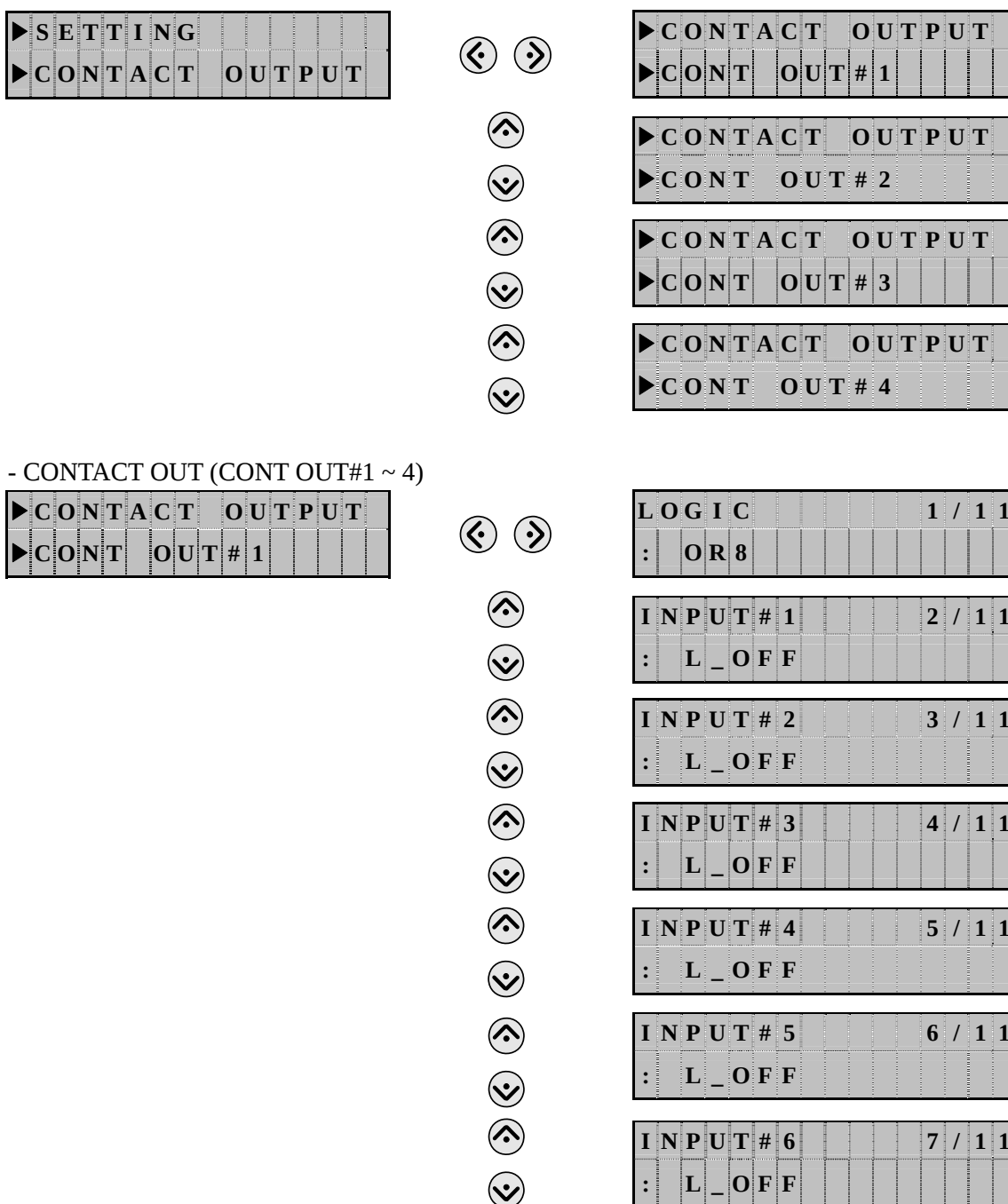
<Table 4.4.2.6.2. CONTACT INPUT Setting elements>

4.4.2.7. SETTING/SYSTEM/CONTACT OUTPUT

PAC-E100 has 4 Contact output and Contact output is set at "CONTACT OUTPUT". There are LOGIC, 8 INPUT, RESET TYPE and RESET DELAY in setting value of Contact Output가 있습니다.

Setting factor of LOGIC has OR8 and AND8 that are composed 8 Non Inverting Input, and HALF-OR8 and HALF-AND8 that are composed 4 Non Inverting Input and 4 Inverting Input.

Setting Factor of INPUT has System status, Contact Input/Output status and Operating status protection element, and RESET TYPE has two setting items; 1) SELF with RESET DELAY time and 2) MANUAL of LATCH type. RESET DELAY has Off Reset Delay time between 0.00sec ~ 60.00sec.



⬆	INPUT # 7	8 / 1 1
⬇	: L _ O F F	
⬆	INPUT # 8	9 / 1 1
⬇	: L _ O F F	
⬆	RESET TYPE	1 0 / 1 1
⬇	: S E L F	
⬆	RESET DELAY	1 1 / 1 1
⬇	: 6 0 . 0 0 s	

Item	Range	Setting unit	Basic value	Description
LOGIC	OR8/HALF-OR8/ AND8/HALF-AND8		OR8	Operator setting
INPUT #1~#8	Refer to Table 3.2.3.3.			Input setting of Operator
RESET TYPE	SELF/MANUAL			Form of Contact Output setting
RESET DELAY	0.00 ~ 60.00sec	0.01sec	0.00sec	Off delay setting (Activated when RESET TYPE is “SELF”)

<Table 4.4.2.7.1. CONTACT OUTPUT Setting Item>

PAC-E100 provides 4 Programmable LED for the convenience of user. The setting method is same with CONTACT OUTPUT.





R	E	S	E	T	T	Y	P	E	1	0	/	1	1
:	S	E	L	F									

R	E	S	E	T	D	E	L	A	Y	1	1	/	1	1
:	6	0	.	0	0	s								

Item	Range	Setting unit	Basic value	Description
LOGIC	OR8/HALF-OR8/ AND8/HALF-AND8		OR8	Operator setting
INPUT #1~#8	Table 3.2.3.3. 참조			Input setting of Operator
RESET TYPE	SELF/MANUAL			Form of Contact Output setting
RESET DELAY	0.00 ~ 60.00sec	0.01sec	0.00sec	Off delay setting (Activated when RESET TYPE is "SELF")

<Table 4.4.2.8.1. LED Setting Item>

4.4.2.9. SETTING/SYSTEM/PASSWORD

There are 2 types of passwords for PAC-E100: Settings modification password and Control action password. Both passwords are same and 4-digit decimal 0~9 numbers and have the initial values of "0000" on delivery of PAC-E100.

▶	S	Y	S	T	E	M								
▶	P	A	S	S	W	O	R	D						



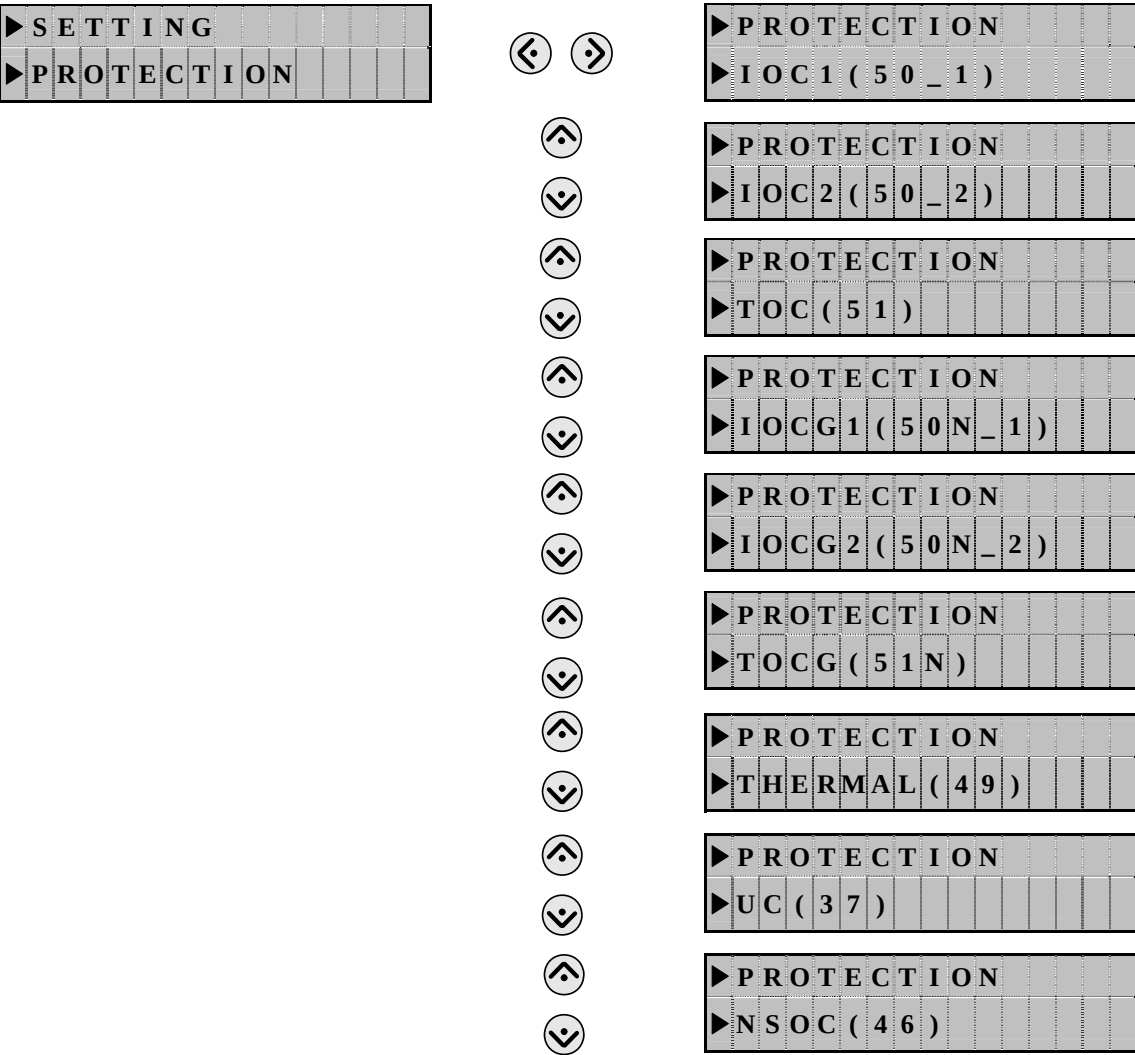
	N	E	W	P	A	S	S	W	O	R	D			
:	*	*	*	*										

[PASSWORDS setting steps]

- 1) Right arrow key from PASSWORDS menu in Menu Tree
- 2) Select which password to change using Up/Down keys and Right key
- 3) Enter original settings modification password if required
- 4) Change or select each of 4 digit values using arrow keys and ENT key
- 5) Save setting changes in escaping SETTING menu or Change other values

4.4.2.10. SETTING/PROTECTION

PROTECTION menu is composed of protection elements, IOC1 (50_1), IOC2 (50_2), TOC (51), IOCG1 (50N_1), IOCG2 (50N_2), TOCG (51N), THERMAL (49), UC (37), and NSOC (46), and is used setting each of protection elements.



4.4.2.11. SETTING/PROTECTION/IOC1 (50_1)

IOC1 (50_1) is Instantaneous Over Current protection including Definite Time-delayed. It is operated Definite Time-delayed, but when DELAY is “0.00s”, it is operated Instantaneous.

► PROTECTION

► IOC1 (5 0 _ 1)

◀ ▶

⬆ ⬇ ⬆ ⬇ ⬆ ⬇

FUNCTION 1 / 4

: DISABLE

PICKUP 2 / 4

: 2 0 . 0 0 A

DELAY 3 / 4

: 6 0 . 0 0 s

BLOCK 4 / 4

: NO

Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Protection Elements setting
PICKUP	0.10 ~ 20.00*In	0.01*In	20.00*In	Pickup setting
DELAY	0.00 ~ 60.00sec	0.01sec	0.00sec	Operation delay time setting
BLOCK	YES/NO		NO	Ban protection function It is set PROT_BLOCK of Contact Input, and banned protection function when Contact input status is Logic “1”.

<Table 4.4.2.11. IOC1 (50_1) Setting Item>

4.4.2.12. SETTING/PROTECTION/IOC2 (50_2)

IOC2 (50_2) is Instantaneous Over Current protection including Definite Time-delayed. It is operated Definite Time-delayed, but when DELAY is “0.00s”, it is operated Instantaneous.

► PROTECTION

► IOC2 (5 0 _ 2)

◀ ▶

⬆ ⬇ ⬆ ⬇ ⬆ ⬇

FUNCTION 1 / 4

: DISABLE

PICKUP 2 / 4

: 2 0 . 0 0 A

DELAY 3 / 4

: 6 0 . 0 0 s

BLOCK 4 / 4

: NO

Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Protection Elements setting
PICKUP	0.10 ~ 20.00*In	0.01*In	20.00*In	Pickup setting
DELAY	0.00 ~ 60.00sec	0.01sec	0.00sec	Operation delay time setting
BLOCK	YES/NO		NO	Ban protection function It is set PROT_BLOCK of Contact Input, and banned protection function when Contact input status is Logic “1”.

<Table 4.4.2.12. IOC2 (50_2) Setting Item>

4.4.2.13. SETTING/PROTECTION/TOC (51)

TOC (51) is Time-delayed Over Current protection except Definite Time-delayed. TC Curve is composed 11 international standard INVERSE TC curves (4 IEC and 7 ANSI curves) and 2 KEPCO-specific Induction-type Relay Compatible INVERSE TC curves (Inverse and Very Inverse).

► PROTECTION	◀ ▶	FUNCTION 1 / 6
► TOC (51)		: DISABLE
	⬆	CURVE 2 / 6
	⬇	: IEC_NI
	⬆	PICKUP 3 / 6
	⬇	: 20.00 A
	⬆	MULTIPLIER 4 / 6
	⬇	: 10.00
	⬆	RESET TYPE 5 / 6
	⬇	: INST
	⬆	BLOCK 6 / 6
	⬇	: NO

Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Protection Elements setting
CURVE	IEC_NI/IEC_VI/ IEC_EI/IEC_LI/ ANSI_I/ANSI_SI/ ANSI_LI/ANSI_MI/ ANSI_VI/ANSI_EI/ ANSI_DI/KNI/KVI		IEC_NI	TC Curve setting
PICKUP	0.10 ~ 20.00*In	0.01*In	20.00*In	Pickup setting
MULTIPLIER	0.01 ~ 10.00	0.01	10.00	Multiplier setting
RESET TYPE	INST/TIMED		INST	Reset type setting
BLOCK	YES/NO		NO	Ban protection function It is set PROT_BLOCK of Contact Input, and banned protection function when Contact input status is Logic “1”.

<Table 4.4.2.13. TOC (51) Setting Item>

4.4.2.14. SETTING/PROTECTION/IOCG1 (50N_1)

IOCG1 (51N_1) is Instantaneous Ground Over Current protection including Definite Time-delayed. It is operated Definite Time-delayed, but when DELAY is “0.00s”, it is operated Instantaneous.

► PROTECTION	◀ ▶	FUNCTION 1 / 4
► IOCG1 (50N_1)	⬆ ⬇ ⬆ ⬇ ⬆ ⬇	: DISABLE
		PICKUP 2 / 4
		: 20.00 A
		DELAY 3 / 4
		: 60.00 s
		BLOCK 4 / 4
		: NO

Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Protection Elements setting
PICKUP	0.10 ~ 20.00*In	0.01*In	20.00*In	Pickup setting
DELAY	0.00 ~ 60.00sec	0.01sec	0.00sec	Operation Delay Time setting
BLOCK	YES/NO		NO	Ban protection function It is set PROT_BLOCK of Contact Input, and banned protection function when Contact input status is Logic “1”.

<Table 4.4.2.14. IOCG1 (50N_1) Setting Item>

4.4.2.15. SETTING/PROTECTION/IOCG2 (50N_2)

IOCG2 (50N_2) is Instantaneous Ground Over Current protection including Definite Time-delayed. It is operated Definite Time-delayed, but when DELAY is “0.00s”, it is operated Instantaneous.

► PROTECTION	◀ ▶	FUNCTION 1 / 4
► IOCG2 (5 0 N _ 2)		: DISABLE
	⬆	PICKUP 2 / 4
	⬇	: 2 0 . 0 0 A
	⬆	DELAY 3 / 4
	⬇	: 6 0 . 0 0 s
	⬆	BLOCK 4 / 4
	⬇	: NO

Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Protection Elements setting
PICKUP	0.10 ~ 20.00*In	0.01*In	20.00*In	Pickup setting
DELAY	0.00 ~ 60.00sec	0.01sec	0.00sec	Operation Delay Time setting
BLOCK	YES/NO		NO	Ban protection function It is set PROT_BLOCK of Contact Input, and banned protection function when Contact input status is Logic “1”.

<Table 4.4.2.15. IOCG2 (50N_2) Setting Item>

4.4.2.16. SETTING/PROTECTION/TOCG (51N)

TOCG (51N) is Time-delayed Ground Over Current protection except Definite Time-delayed. TC Curve is composed 11 international standard INVERSE TC curves (4 IEC and 7 ANSI curves) and 2 KEPCO-specific Induction-type Relay Compatible INVERSE TC curves (Inverse and Very Inverse).

► PROTECTION	◀ ▶	FUNCTION 1 / 6
► T O C G (5 1 N)		: D I S A B L E
	⬆	CURVE 2 / 6
	⬇	: I E C _ N I
	⬆	PICKUP 3 / 6
	⬇	: 2 0 . 0 0 A
	⬆	MULTIPLIER 4 / 6
	⬇	: 1 0 . 0 0
	⬆	RESET TYPE 5 / 6
	⬇	: I N S T
	⬆	BLOCK 6 / 6
	⬇	: N O

Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Protection Elements setting
CURVE	IEC_NI/IEC_VI/ IEC_EI/IEC_LI/ ANSI_I/ANSI_SI/ ANSI_LI/ANSI_MI/ ANSI_VI/ANSI_EI/ ANSI_DI/KN1/KVI		IEC_NI	TC Curve setting
PICKUP	0.10 ~ 20.00*In	0.01*In	20.00*In	Pickup setting
MULTIPLIER	0.01 ~ 10.00	0.01	10.00	Multiplier setting
RESET TYPE	INST/TIMED		INST	Reset type setting
BLOCK	YES/NO		NO	Ban protection function It is set PROT_BLOCK of Contact Input, and banned protection function when Contact input status is Logic “1”.

<Table 4.4.2.16. TOCG (51N) Setting Item>

4.4.2.17. SETTING/PROTECTION/THERMAL (49)

THERMAL (49) is Thermal Overload protection. When the highest of phase current is higher than value that multiplies rate current by K-FACTOR, THERMAL is accumulated. And if THERMAL exceeds 100%, it is operated.

► PROTECTION	◀ ▶	FUNCTION 1 / 5
► THERMAL (4 9)		: DISABLE
	⬆	K - FACTOR 2 / 5
	⬇	: 4 . 0 0
	⬆	TIME CONST 3 / 5
	⬇	: 9 9 9 . 9 m i n
	⬆	ALARM 4 / 5
	⬇	: 1 0 0 %
	⬆	BLOCK 5 / 5
	⬇	: NO

Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Protection Elements setting
K-FACTOR	0.10 ~ 4.00	0.01	4.00	Trip Pickup setting
TIME CONST	1 ~ 999.9min	0.1min	999.9min	Multiplier setting
ALARM	50 ~ 100%	1%	100%	Alarm Pickup setting
BLOCK	YES/NO		NO	Ban protection function It is set PROT_BLOCK of Contact Input, and banned protection function when Contact input status is Logic "1".

<Table 4.4.2.17. THERMAL (49) Setting Item>

4.4.2.18. SETTING/PROTECTION/UC (37)

UC (37) is Under Current protection. It is operated Definite Time-delayed, but when DELAY is “0.00s”, it is operated Instantaneous.

► PROTECTION	◀ ▶	FUNCTION	1 / 4
► UC (3 7)	⬆ ⬇ ⬆ ⬇ ⬆ ⬇	: DISABLE	
		PICKUP	2 / 4
		: 1 . 0 0 A	
		DELAY	3 / 4
		: 1 8 0 . 0 0 s	
		BLOCK	4 / 4
		: NO	

Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Protection Elements setting
PICKUP	0.02 ~ 1.00*In	0.01*In	1.00*In	Pickup setting
DELAY	0.00 ~ 180.00sec	0.01sec	180.00sec	Operation Delay Time setting
BLOCK	YES/NO		NO	Ban protection function It is set PROT_BLOCK of Contact Input, and banned protection function when Contact input status is Logic “1”.

<Table 4.4.2.18. UC (37) Setting Item>

4.4.2.19. SETTING/PROTECTION/NSOC (46)

NSOC (46) is Negative Phase Sequence Over Current protection. It is operated Definite Time-delayed, but when DELAY is “0.00s”, it is operated Instantaneous.

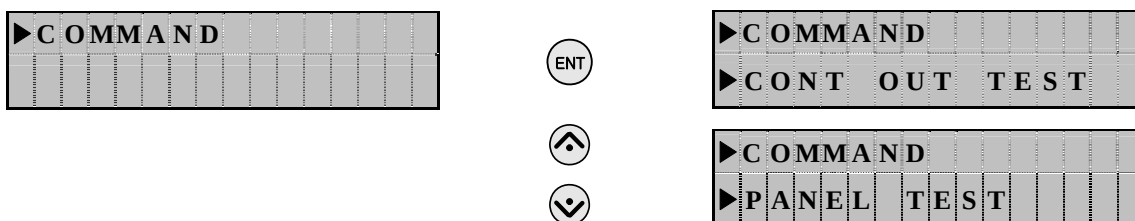
► PROTECTION	◀ ▶	FUNCTION 1 / 4
► NSOC (4 6)	⬆ ⬇ ⬆ ⬇ ⬆ ⬇	: DISABLE
		PICKUP 2 / 4
		: 2 0 . 0 0 A
		DELAY 3 / 4
		: 1 8 0 . 0 0 s
		BLOCK 4 / 4
		: NO

Item	Range	Setting unit	Basic value	Description
FUNCTION	ENABLE/DISABLE		DISABLE	Protection Elements setting
PICKUP	0.10 ~ 20.00*In	0.01*In	20.00*In	Pickup setting
DELAY	0.00 ~ 180.00sec	0.01sec	180.00sec	Operation Delay Time setting
BLOCK	YES/NO		NO	Ban protection function It is set PROT_BLOCK of Contact Input, and banned protection function when Contact input status is Logic “1”.

<Table 4.4.2.19. NSOC (46) Setting Item>

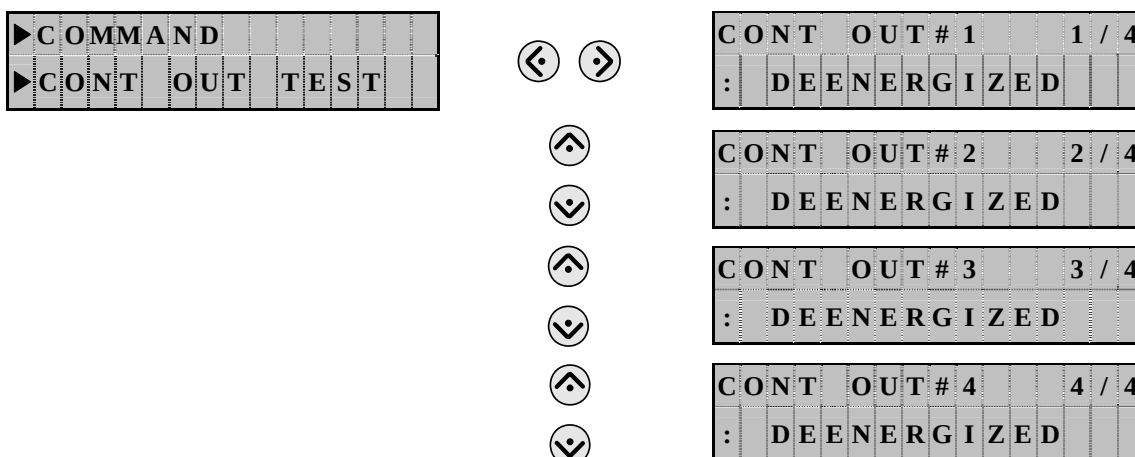
4.4.3. COMMAND Menu

COMMAND menu is composed of CONT OUT TEST and PANEL TEST sub menus. This menu is used to test output contacts and LCD/LEDs of front-face display panel. All the submenus are required to enter the password.



4.4.3.1. COMMAND/CONT OUT TEST

CONT OUT TEST command is used to test contact outputs individually.



[CONT OUT TEST command steps]

- 1) Right arrow key from CONT OUT TEST menu in Menu Tree
- 2) Select test item of 16 contact outputs using Up/Down key and Right key
- 3) Enter settings modification password if required
- 4) Execute Energized or DeEnergized test using Up/Down key
"Run/Test" LED blinking green or Error message
- 5) Left key to escape and Repeat steps 2~4 for other items

4.4.3.2. COMMAND/PANEL TEST

PANEL TEST command is used to test LCD and LEDs on front-face display panel.



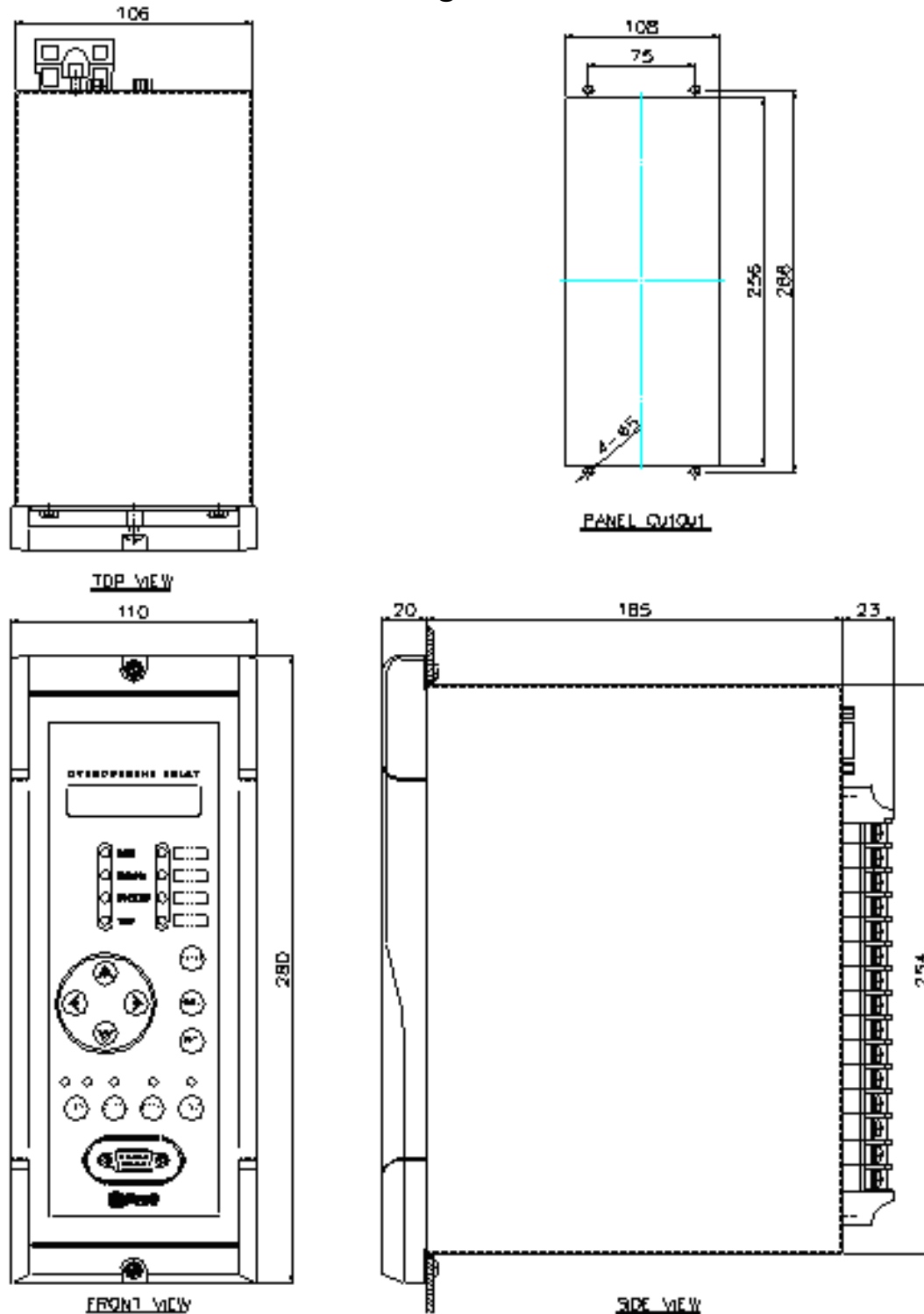
[PANEL TEST command steps]

- 1) Right arrow key from PANEL TEST menu in Menu Tree
- 2) Enter settings modification password and Right arrow key again
- 3) LCD and all LEDs blinking or Error message, and Return to Menu Tree

5. Dimensions and External Connections

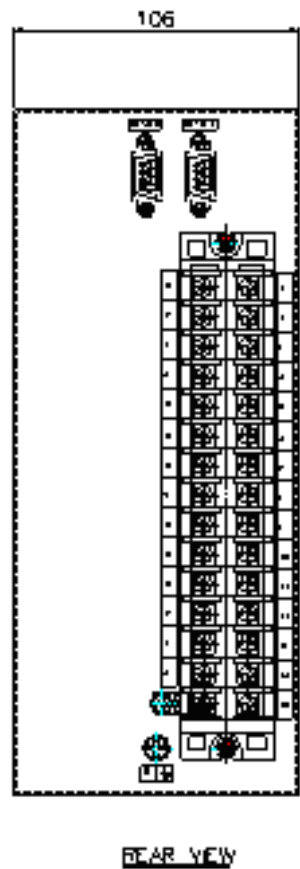
PAC-E100 is designed as draw-out type, and external connection, installation, and maintenance are easily managed.

5.1. Dimensioned Drawings



<Figure 5.1 Dimensioned Drawings of PAC-E100>

5.2. Terminal Block Diagram



<Figure 5.2 Terminal Block Diagram of PAC-E100>

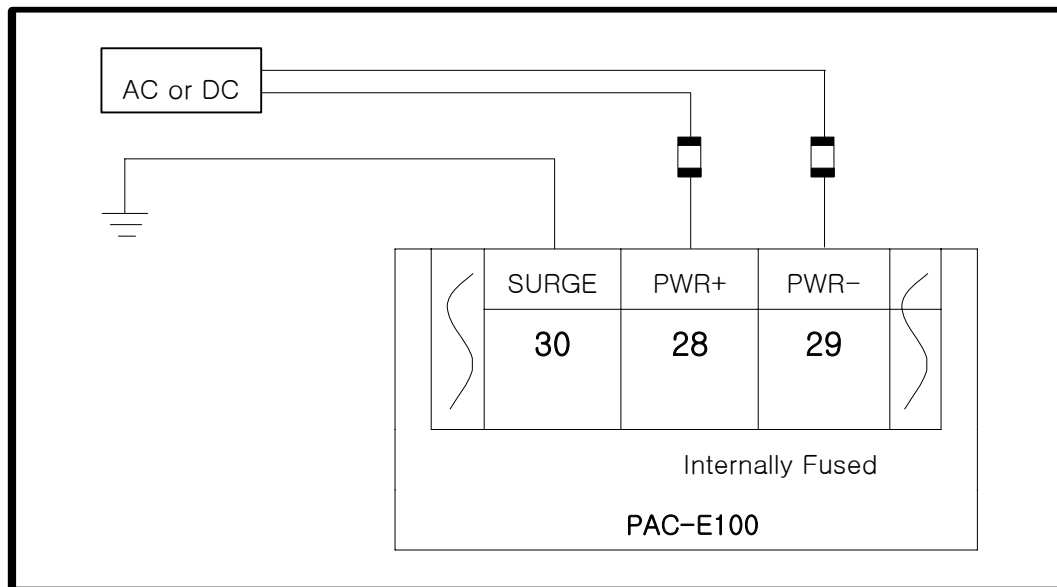
PAC-E100			
No	Description	No	Description
16	IA+	1	IA-
17	IB+	2	IB-
18	IC+	3	IC-
19	IN+	4	IN-
20		5	
21	TS1_COM	6	TS1_NO
22	TS2_COM	7	TS2_NO
23	TS3_COM	8	TS3_NO
24	TS4_COM	9	TS3_NC
25	TS4_NC	10	TS4_NO
26	DI1_COM	11	DI1_P
27	DI2_COM	12	DI2_P
28	PWR+	13	DI3_P
29	PWR-	14	DI4_P
30	FG	15	DI3_4_COM

<Table 5.2 Terminal Block Diagram Table>

5.3. External Connections

5.3.1. Control Source

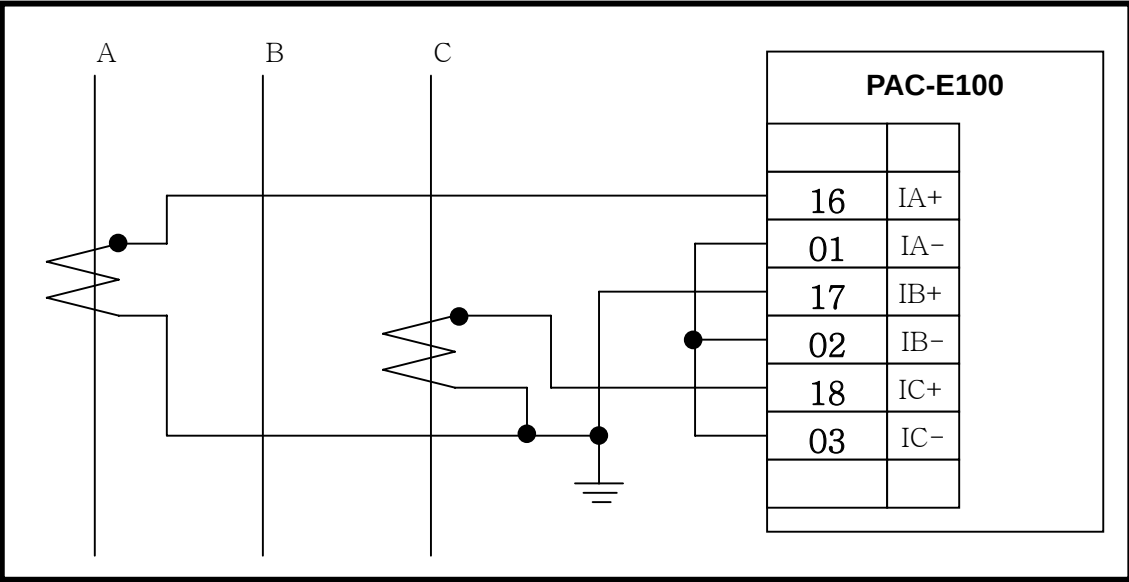
Control source or Energizing input to PAC-E100 necessitates validation between the permitted ranges. If the control source is connected to other than control source terminal, protection units and internal circuits are damaged.



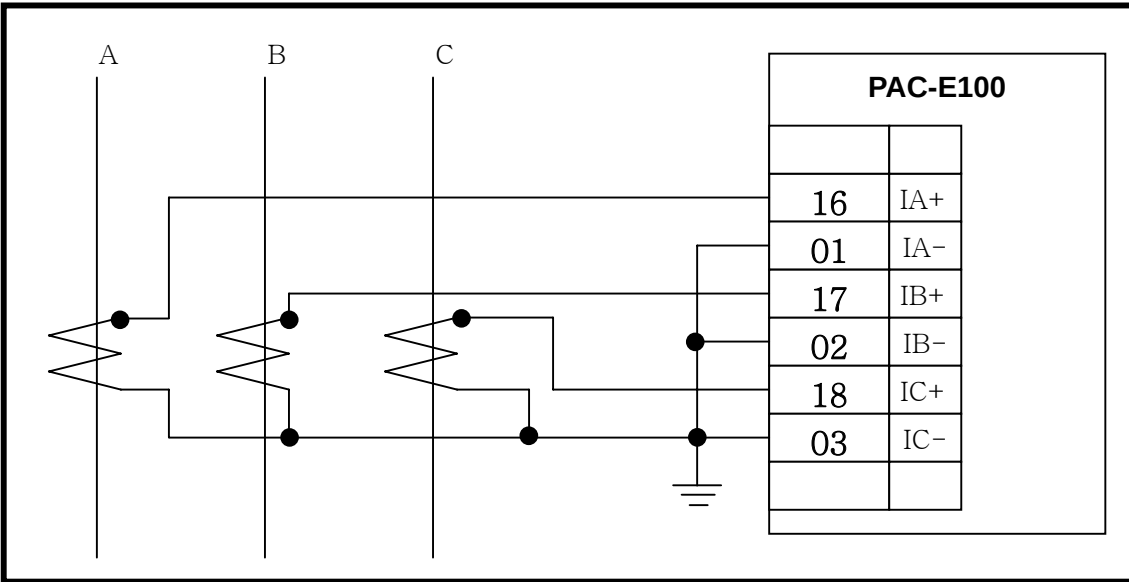
<Figure 5.3.1 Control Source Terminal Connection of PAC-E100 >

5.3.2. CT Connections

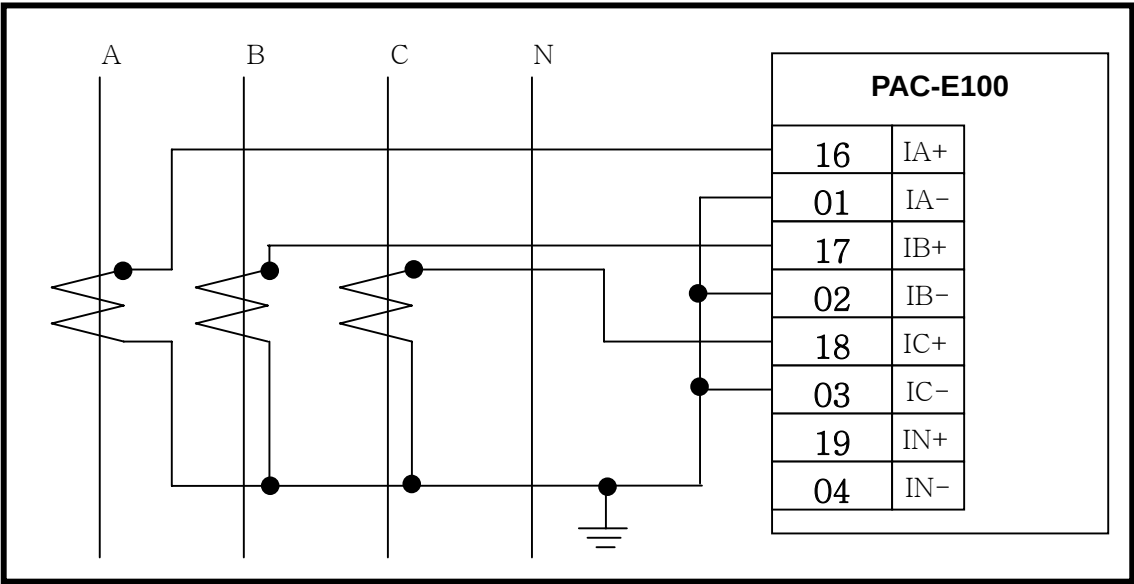
Refer to the Table 5.2. Terminal Block Diagram Table in the above



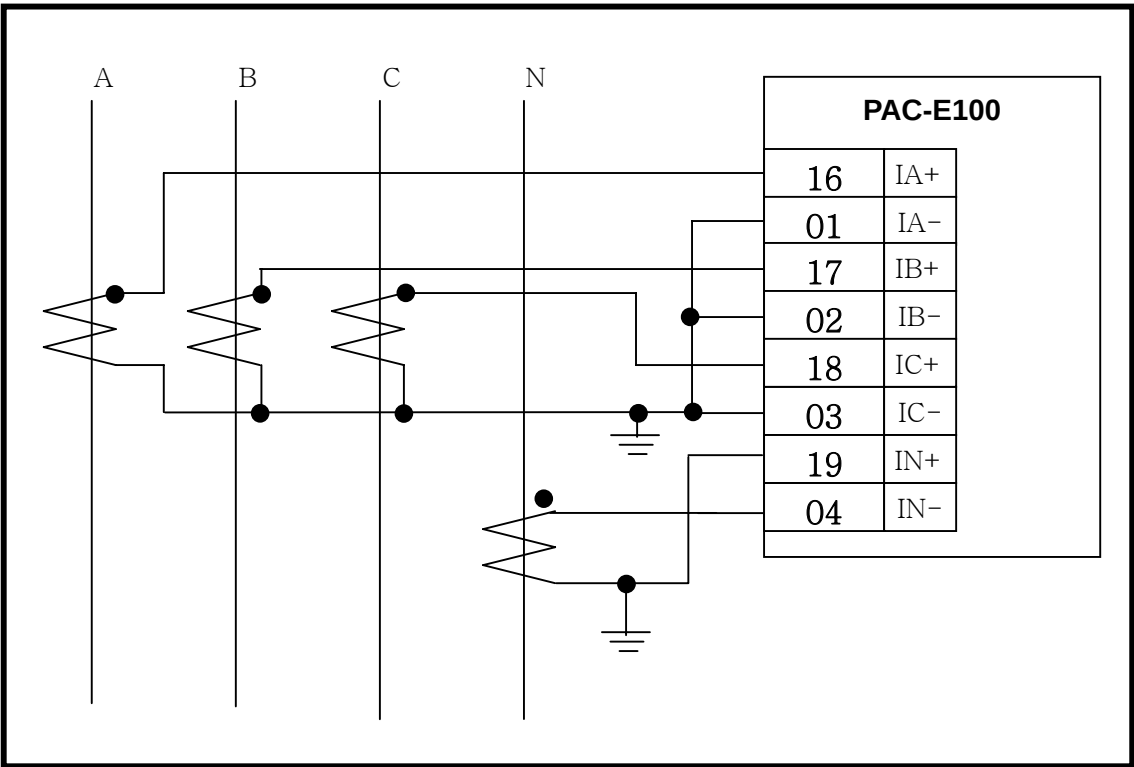
<Figure 5.3.2.1 3P3L 2CT Network CT Connection of PAC-E100>



<Figure 5.3.2.2 3P3L 3CT Network CT Connection OCGR non-use of PAC-E100>



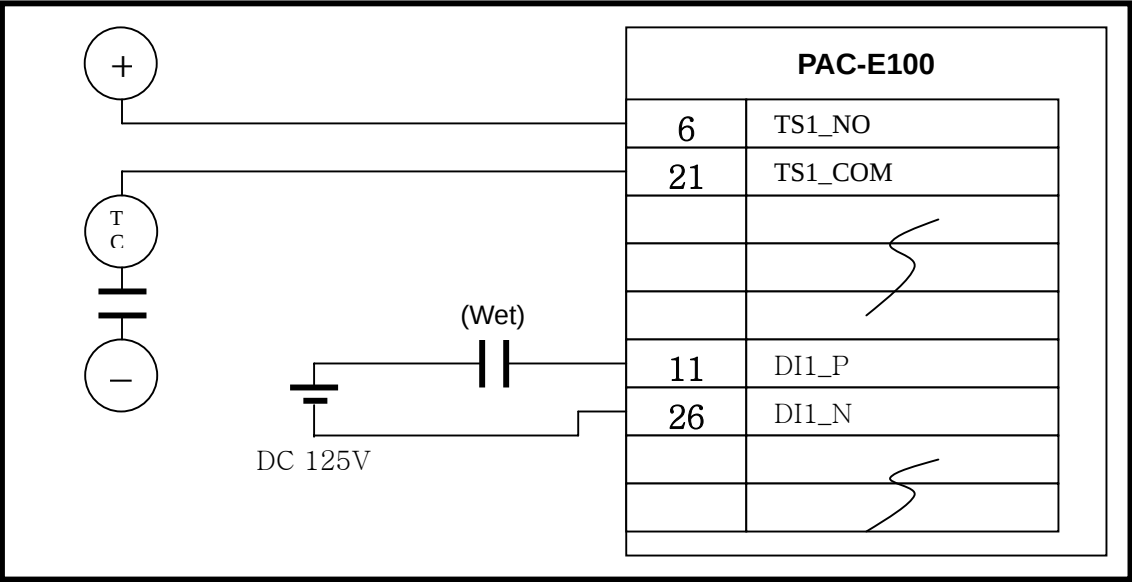
<Figure 5.3.2.3 3P3L 3CT Network CT Connection OCGR use of PAC-E100>



<Figure 5.3.2.4 3P4L Network CT Connection IN use of PAC-E100>

5.3.3. Input/Output Contacts Connection

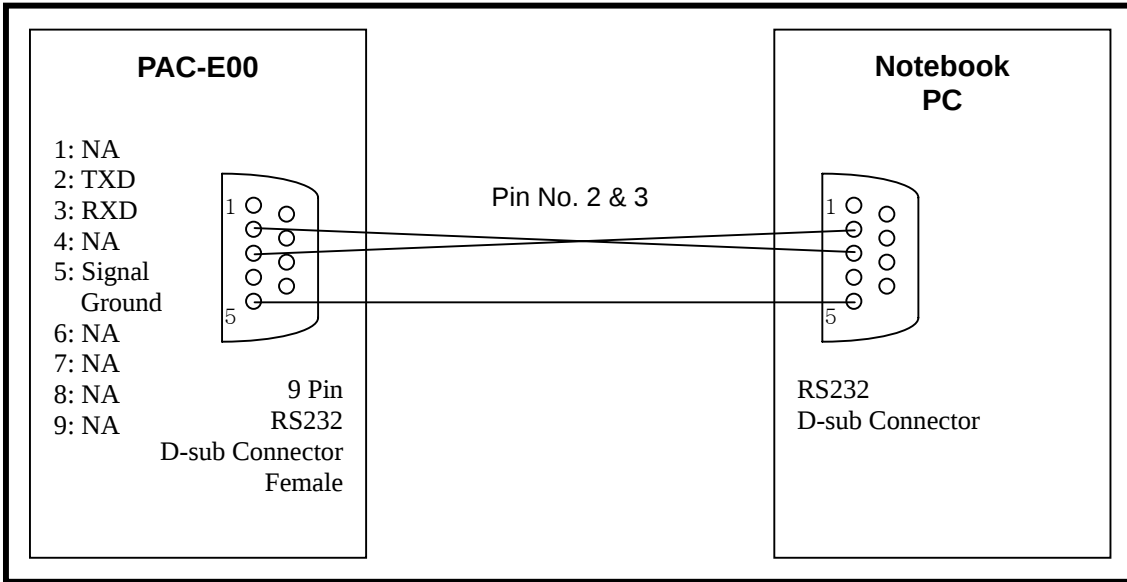
Refer to the Table 5.2. Terminal Block Diagram Table in the above.



<Figure 5.3.3 DI & DO Connection of PAC-E100>

5.3.4. RS232 Port Connection

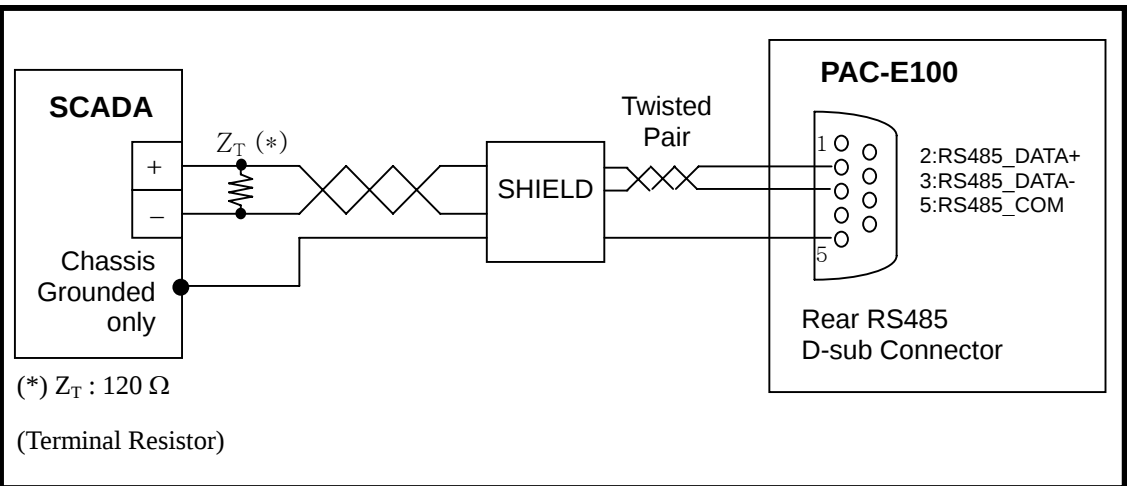
Refer to the Table 5.2. Terminal Block Diagram Table in the above.



<Figure 5.3.4 RS232 Port Connection of PAC-E100>

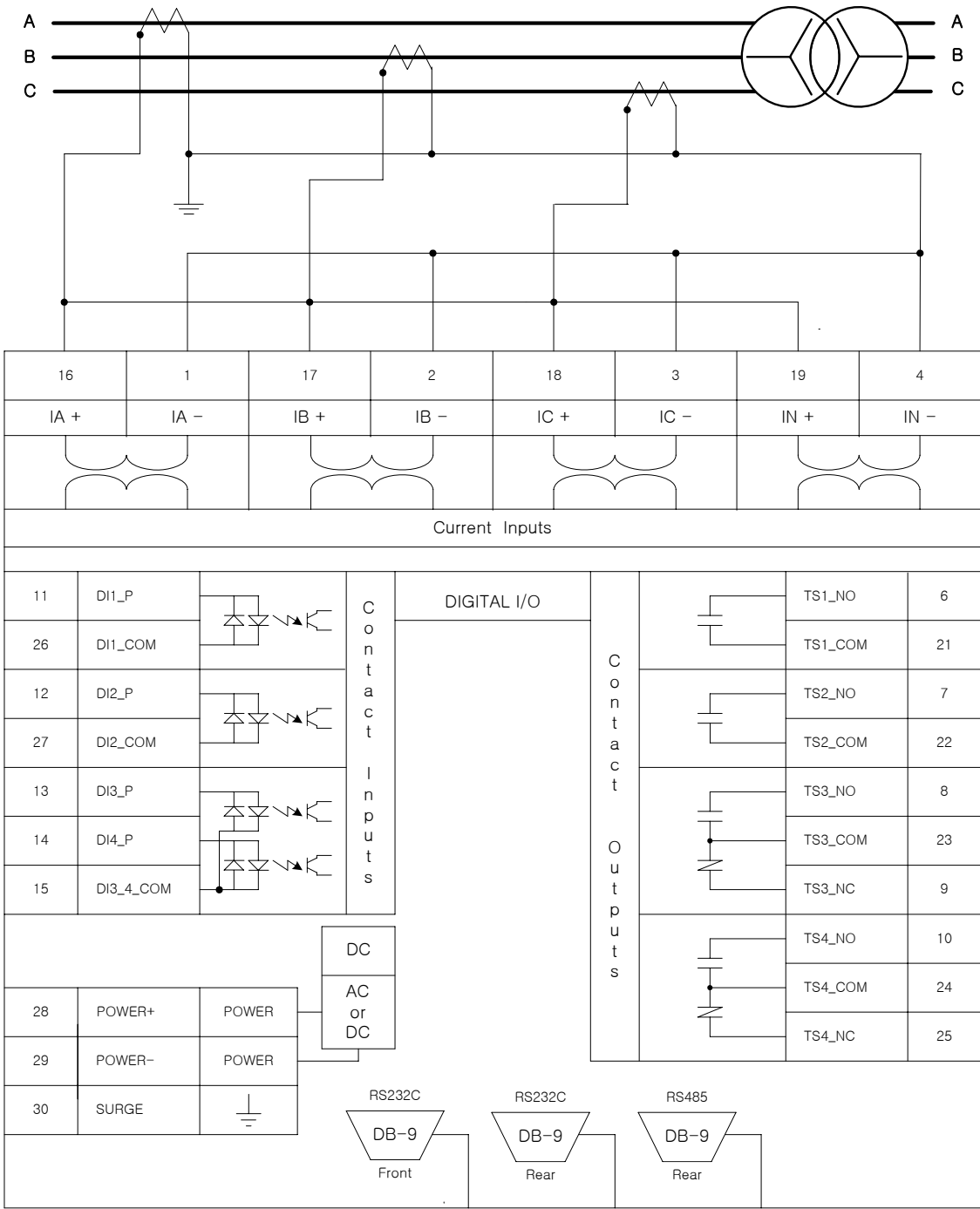
5.3.5. RS485 Port Connection

Refer to the Table 5.2. Terminal Block Diagram Table in the above.



<Figure 5.3.5 RS485 Port Connection of PAC-E100>

5.3.6. Wiring Diagram



<Figure 5.3.6 Wiring Diagram>

6. Setting & Configuration Software

Operate status, setting and metering information are shown and changed through Setting software of PAC-E100.

6.1. Setting Software

Modification of settings or/and system configuration is generally performed using keypad buttons in the LCD menu on front panel of PAC-E100. But this job is handled item by item at one time. So, this setting tool is used to facilitate a batch job. Refer to the figure of RS232 connection in the previous section, and the ModBus protocol is used. All the data can be saved in files as project concept and the specific setting values are downloaded to PAC-E100 just by opening the saved project data file. Other functions include event data uploading & listing, fault data uploading, and data printing.



Caution

: Certainly, COMport must be used 1 port of front or rear because RS232C port located front and rear panel of PAC-E100 is not communicate at the same time.

6.1.1. Program Menu

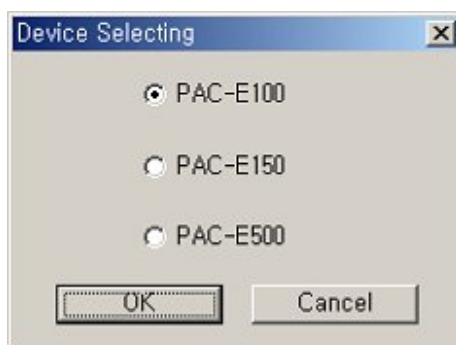
Setting software menu is composed of port setting, file input/output and setting of relay, and each menu is described below.

Program Menu	
Device Selecting	
Open	Saved Project File Loading
Save	Edited Data Saving to File
Report	Edited Data Saving to Text File and Printing
COM	Communication Port Selection on PC. (Addr: 1 fixed)
Connect	RS232 Port Communication Connection and Initialization
Disconnect	Communication Disconnection and Port Closing
Upload	Set Data on PAC-E100 Transfer from PAC-E100 to PC
Download	Edited Data on the program Transfer from PC to PAC-E100.
Setting	Open setting page of System, Protection, Contact In/Out, LED
Monitor	Open indicating page of Measuring value, status of self-diagnosis, Contact input/output and LED output.
About	Version Information of Setting Software
New	New Project Generation for Setting
Close	Finished Project Generation for Setting
Save As	Edited Data Saving to File as Different Name
Exit	Program Exit

<Table 6.1.1. Program Menu>

6.1.2. Device Selecting

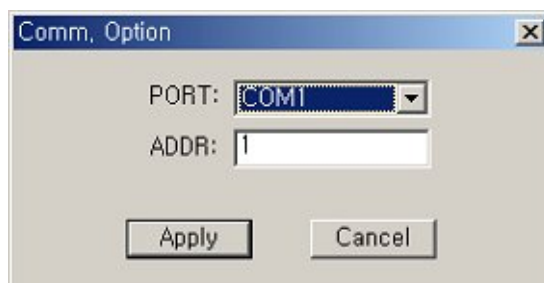
It must be selected to control relay model because setting software is program that control 3 types relay by 1 program. Press “Device Selecting” () button, show window as below figure and select to control relay model.



<Figure 6.1.2. Device Selecting>

6.1.3. Communication Port Setting

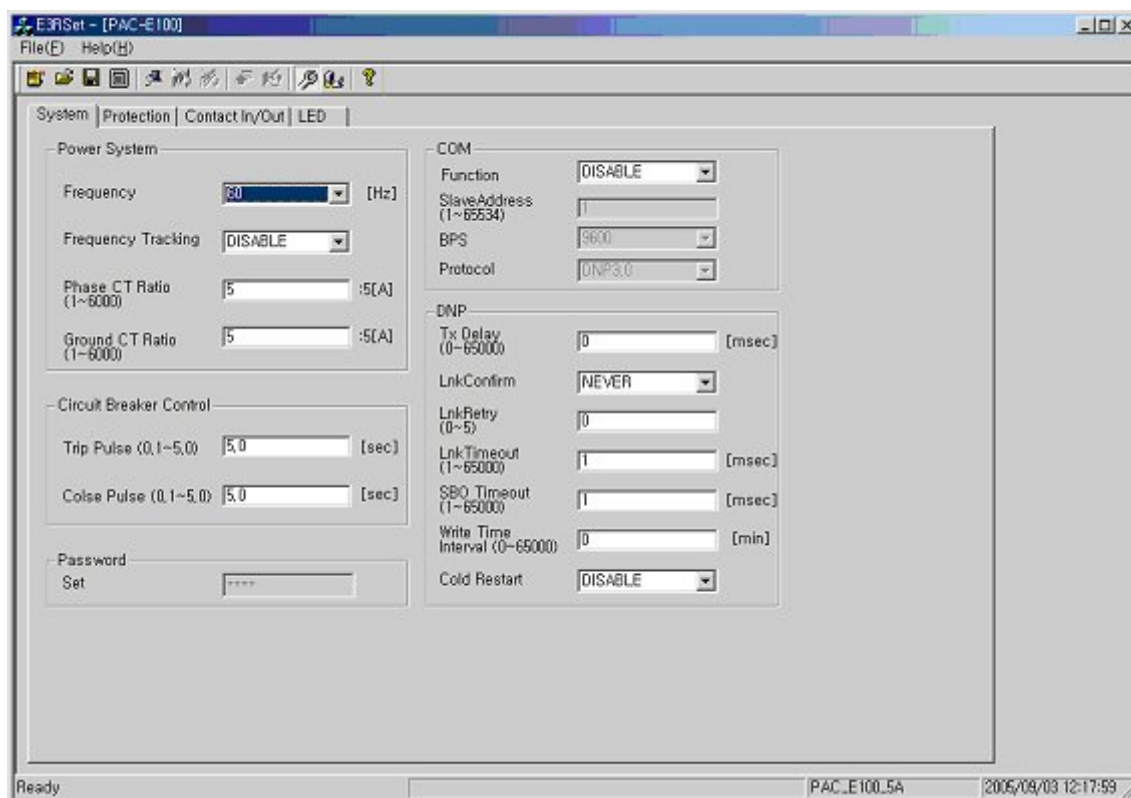
It can use to select 1 of 15 ports and another COMport when it can't use COMport due to other equipment. Address is fixed 1 when communicate through RS232C port. It must be set Address as COM Address of PAC-E100 when communicate through RS485 port.



<Figure 6.1.3. Port setting>

6.1.4. System Configuration

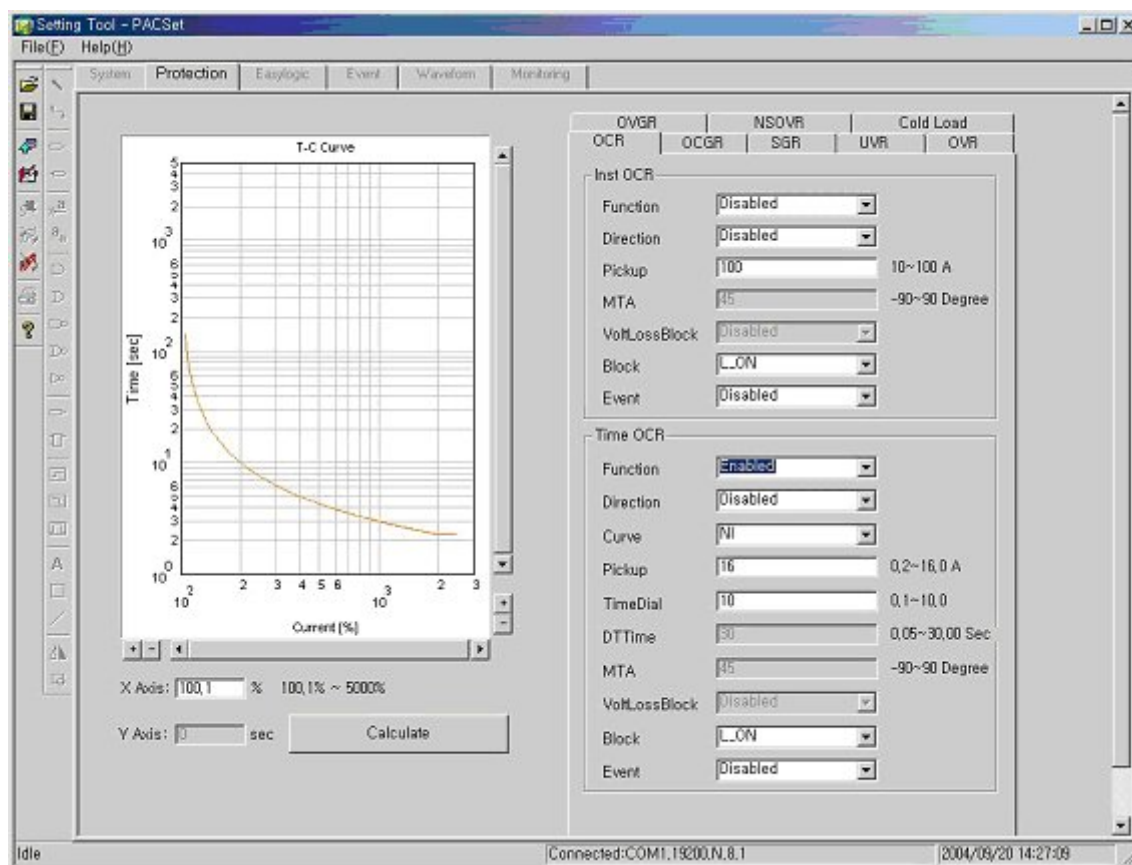
This configuration is related to general system setting of PAC-E100. Setting items are Power System, Circuit Breaker Control, Password, COM, and DNP communication. Each item's function is the same as that of LCD menu on front panel, and refer to chapter 4 Operational Description for more detailed explanation.



<Figure 6.1.4. Setting Tool-System Configuration>

6.1.5. Protection Setting

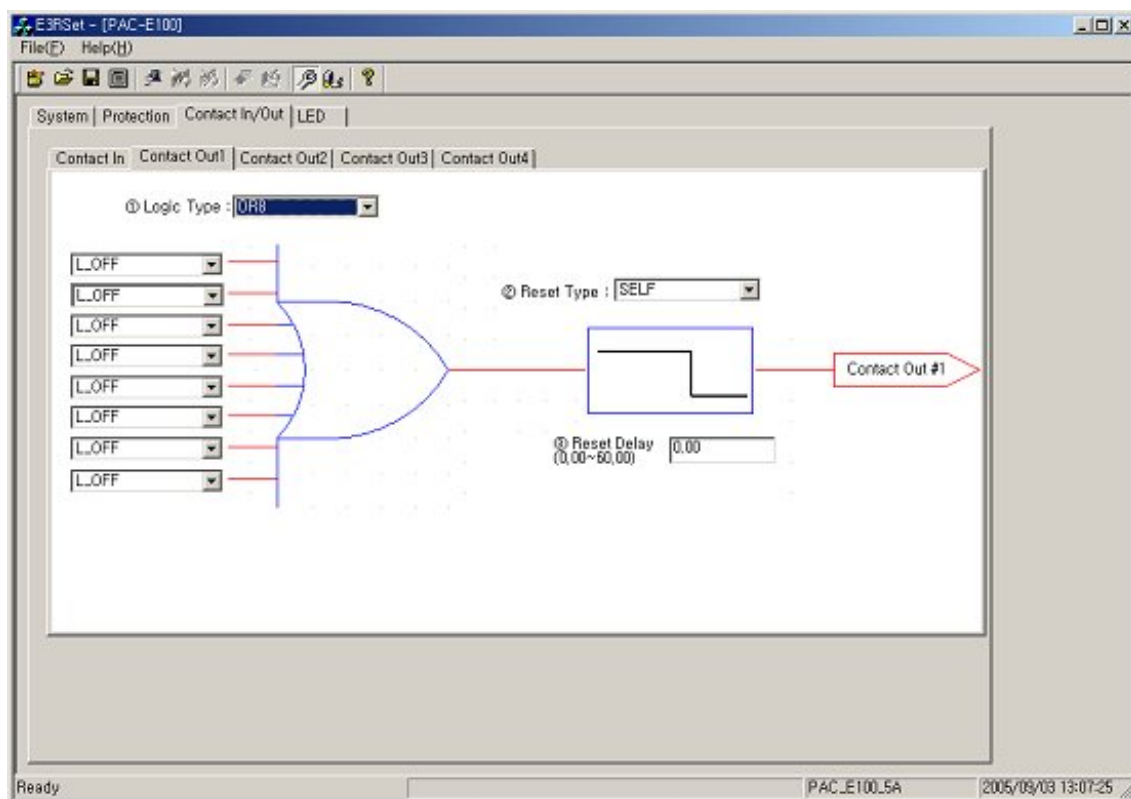
This setting is a main settings modification of PAC-E100 and is related to the setting items of protection elements. In the sub-frames, it is separated into OCR (IOC1, IOC2, TOC), OCGR (IOCG1, IOCG2, TOCG), THERMAL (49), UC (37) and NSOC (46). The selected TC curve represents each inverse time element and reflects the change of time dial multiplier. Refer to LCD setting menu on chapter 4 Operational Description for more detailed explanation.



<Figure 6.1.5. Setting Tool-Protection >

6.1.6. Contact In/Out Setting

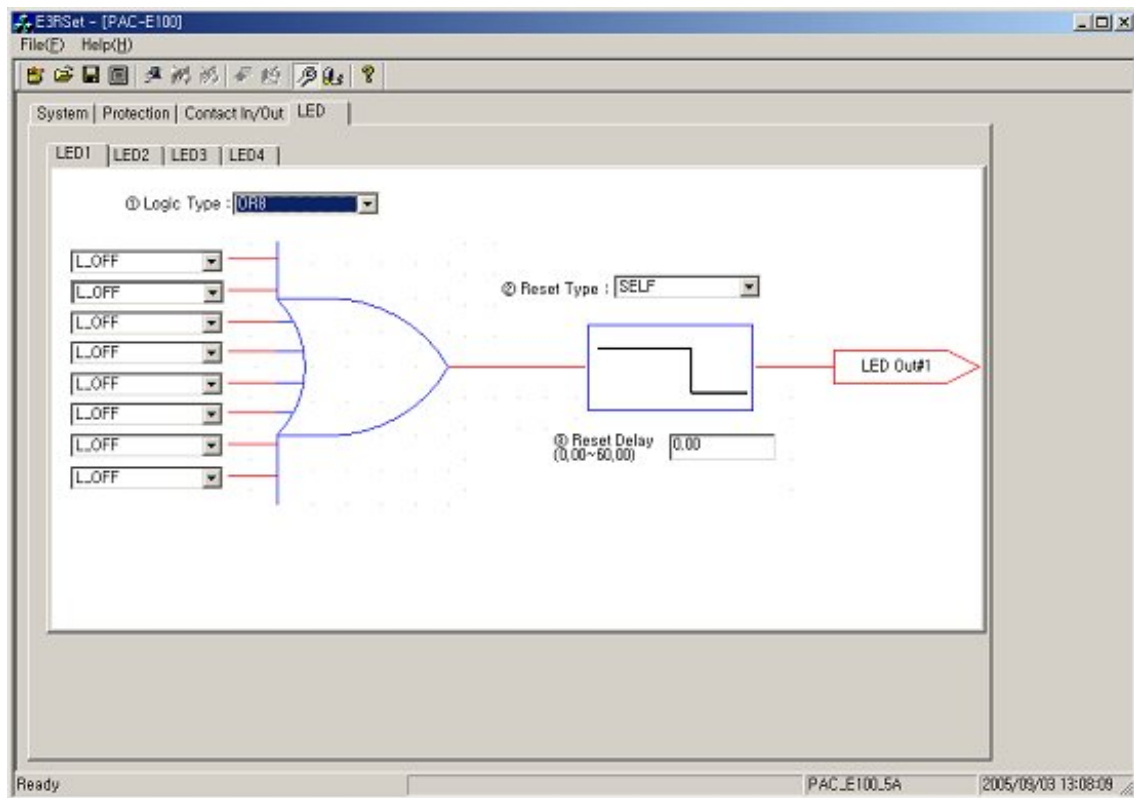
This setting is set up contact input/output of PAC-E100. Setting items are 4 Contact Input and 4 Contact Output. Refer to LCD setting menu on chapter 4 Operational Description for more detailed explanation.



<Figure 6.1.6. Setting Tool-Contact Input/Output>

6.1.7. LED Setting

This setting is each of Programmable LED respectively. Refer to LCD setting menu on chapter 4 Operational Description for more detailed explanation.

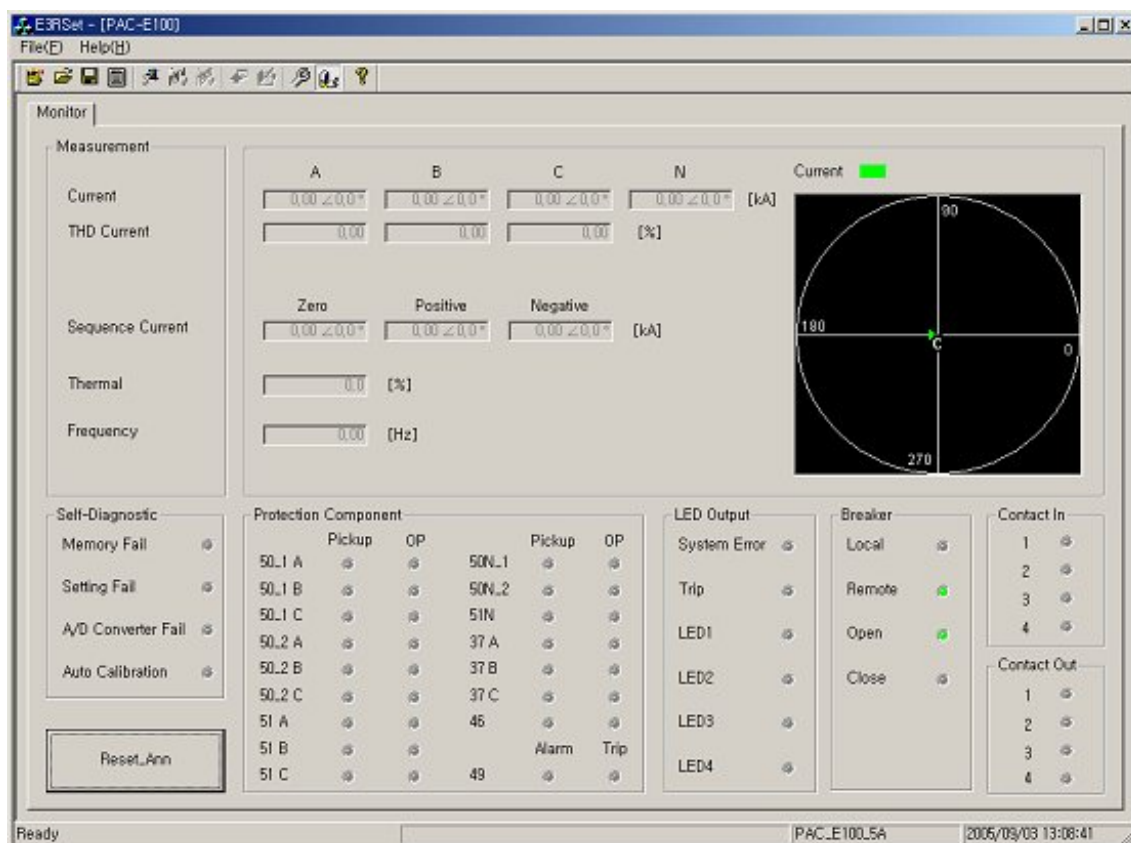


<Figure 6.1.7. Setting Tool-Programmable LED>

6.1.8. Monitor

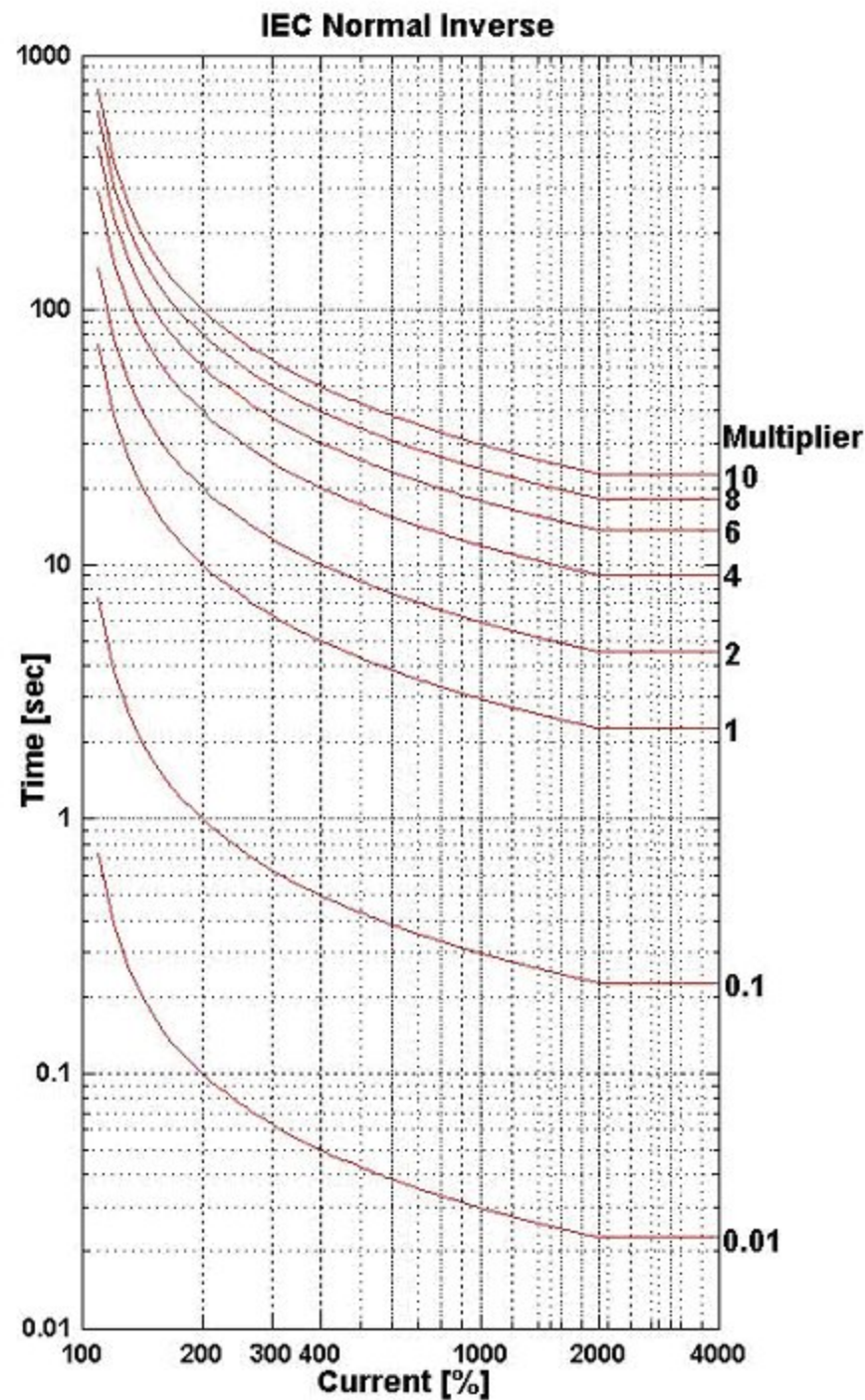
Monitor display shows status monitoring of PAC-E100. Elements or status monitoring is composed of Measurement, Self Diagnosis, Protection Component, LED Output, Breaker and Contact Input/ Output, and there is “Annun Reset” button on front panel’s left.

Refer to LCD setting menu on chapter 4 Operational Description for more detailed explanation.

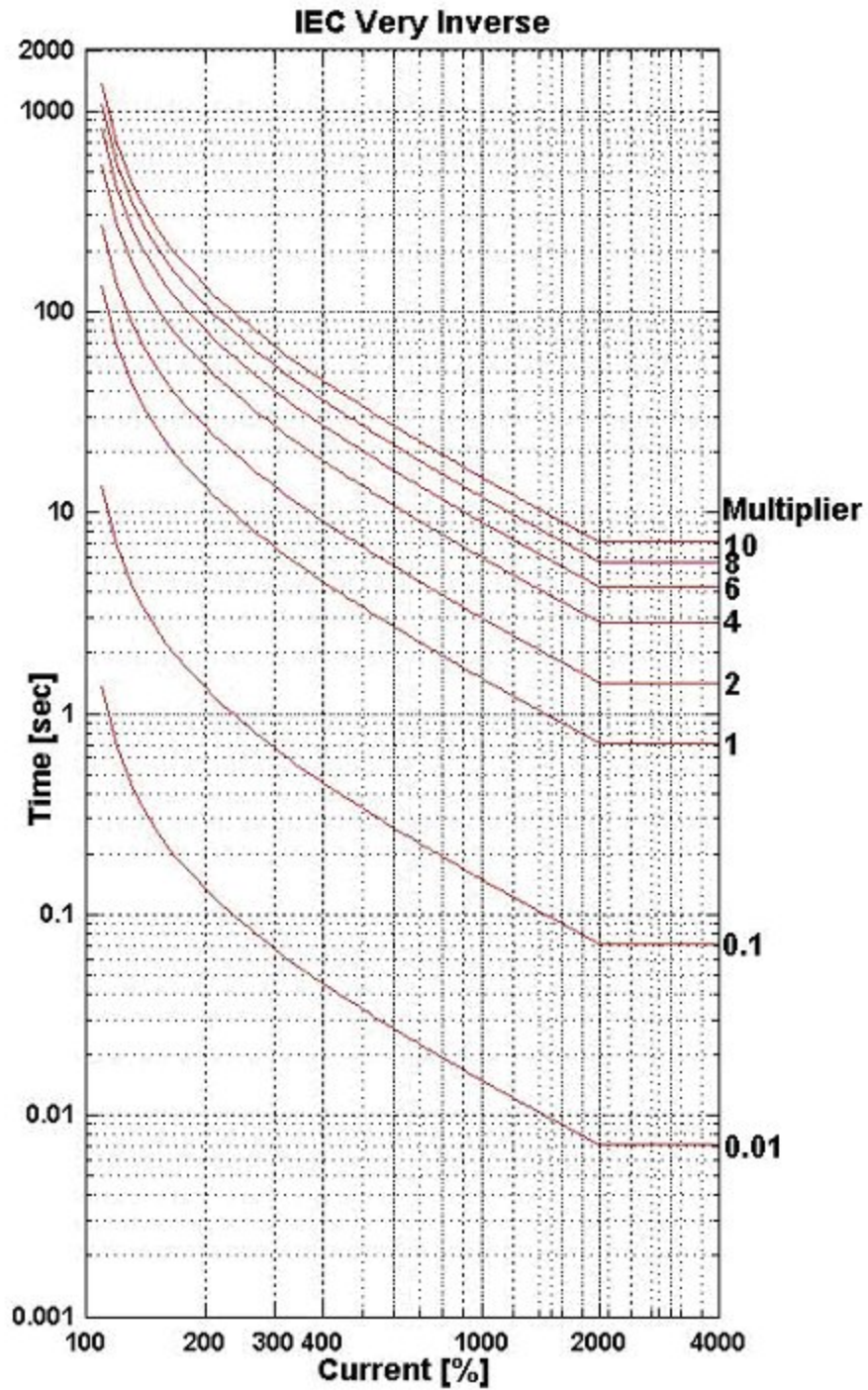


<Figure 6.1.8. Setting Tool-Monitoring>

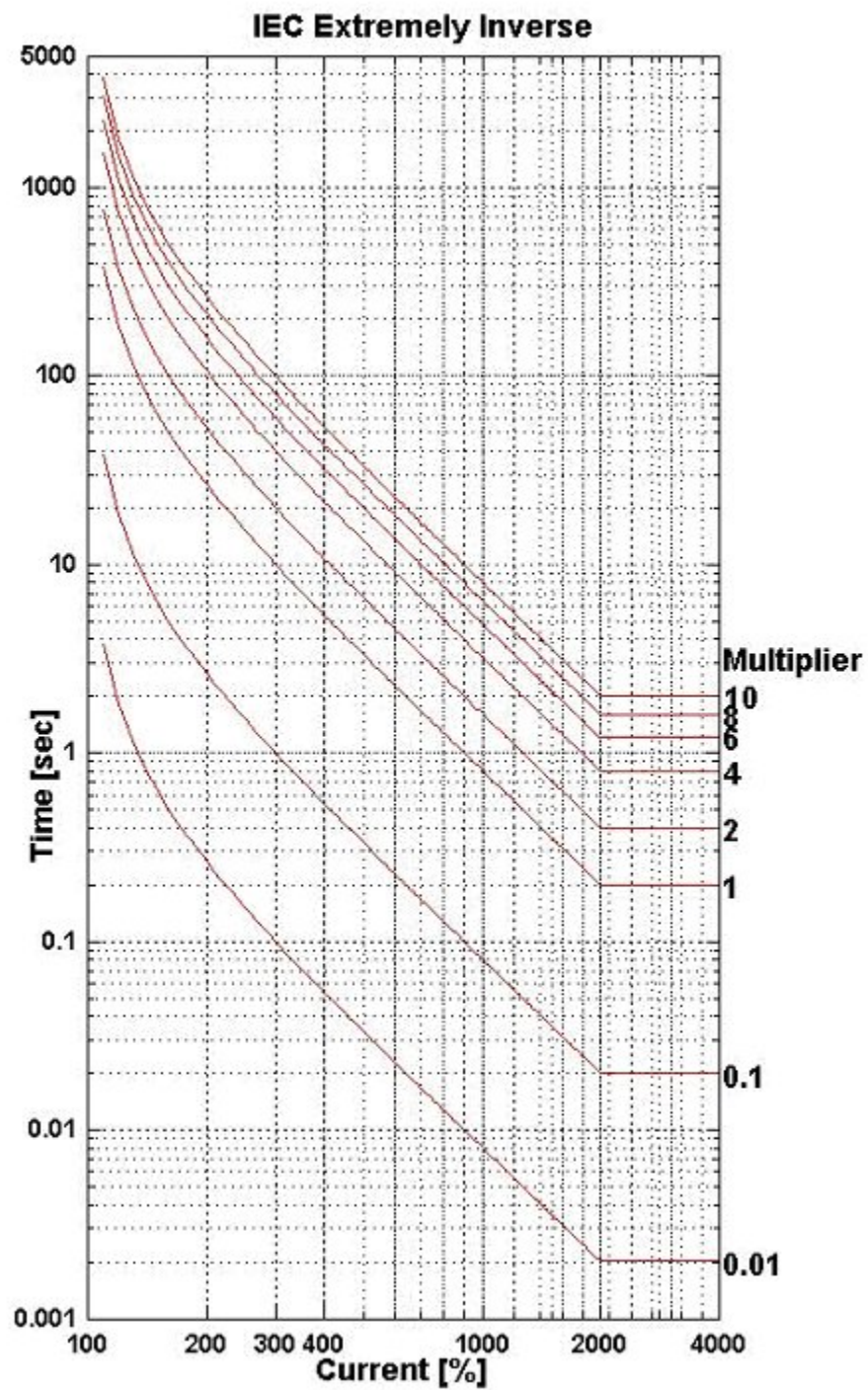
Appendix A. TC Characteristics Curves



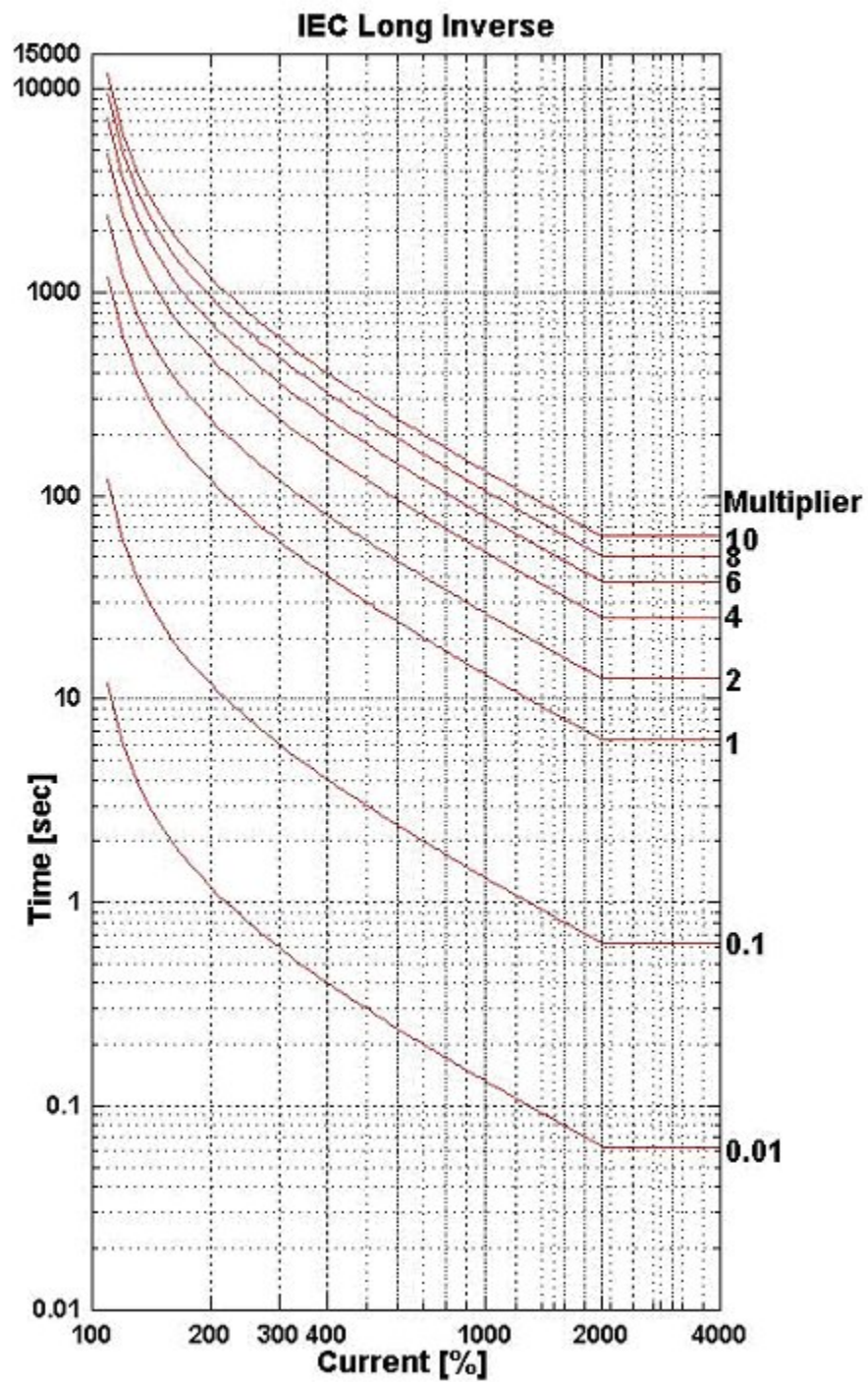
<Figure A.1 IEC NI TC Curve >



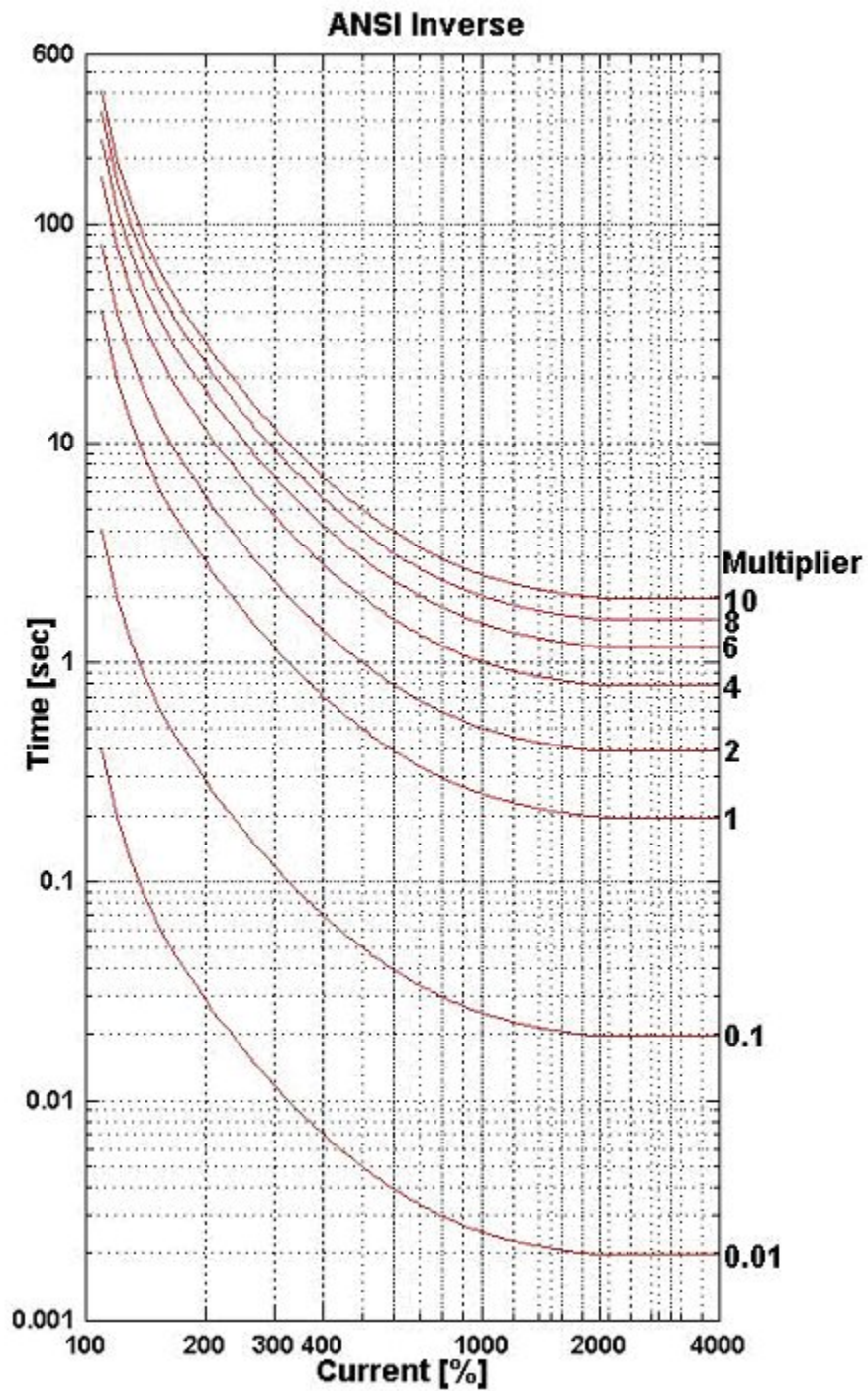
<Figure A.2 IEC VI TC Curve >



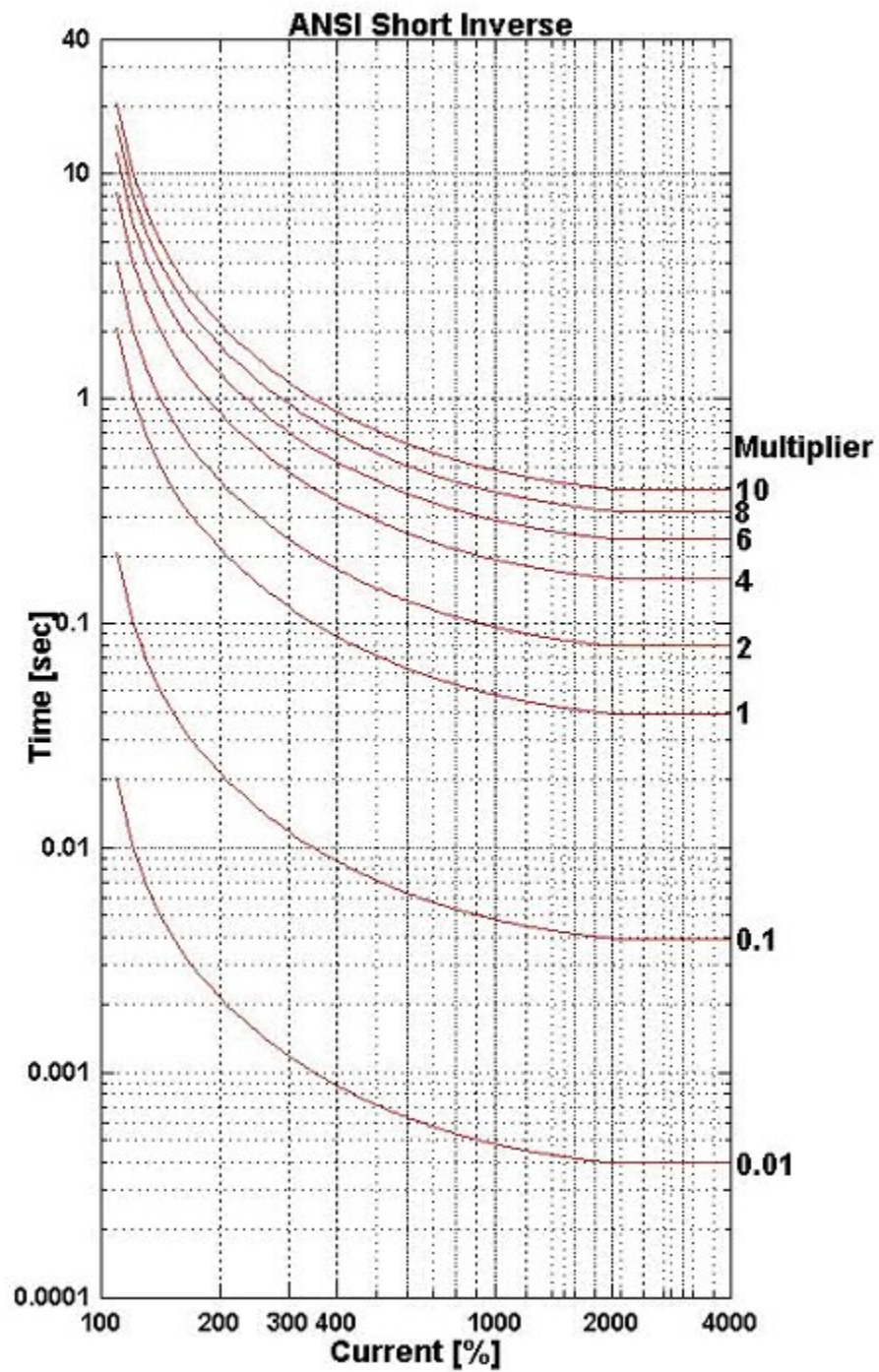
<Figure A.3 IEC EI TC Curve >



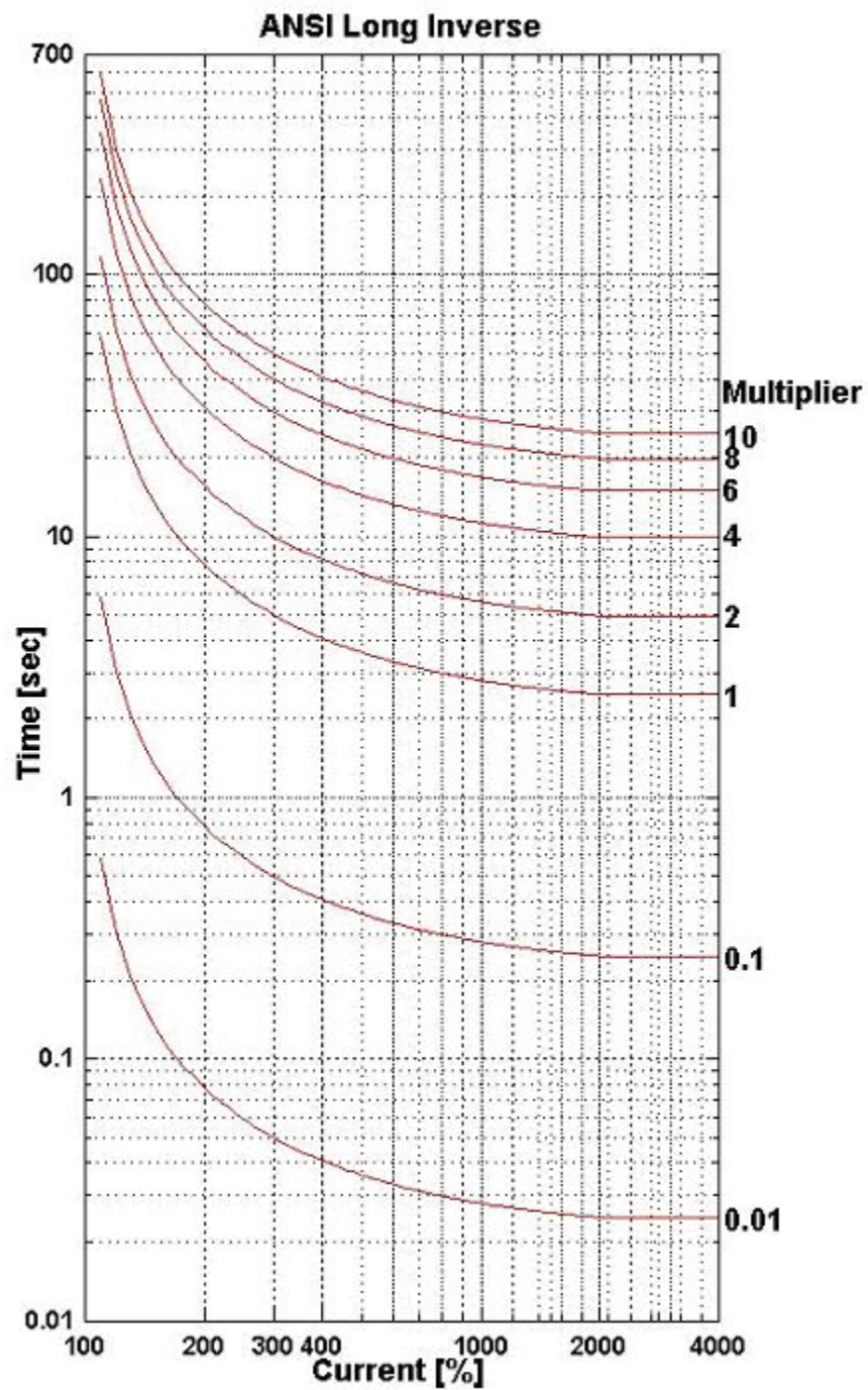
<Figure A.4 IEC LI TC Curve >



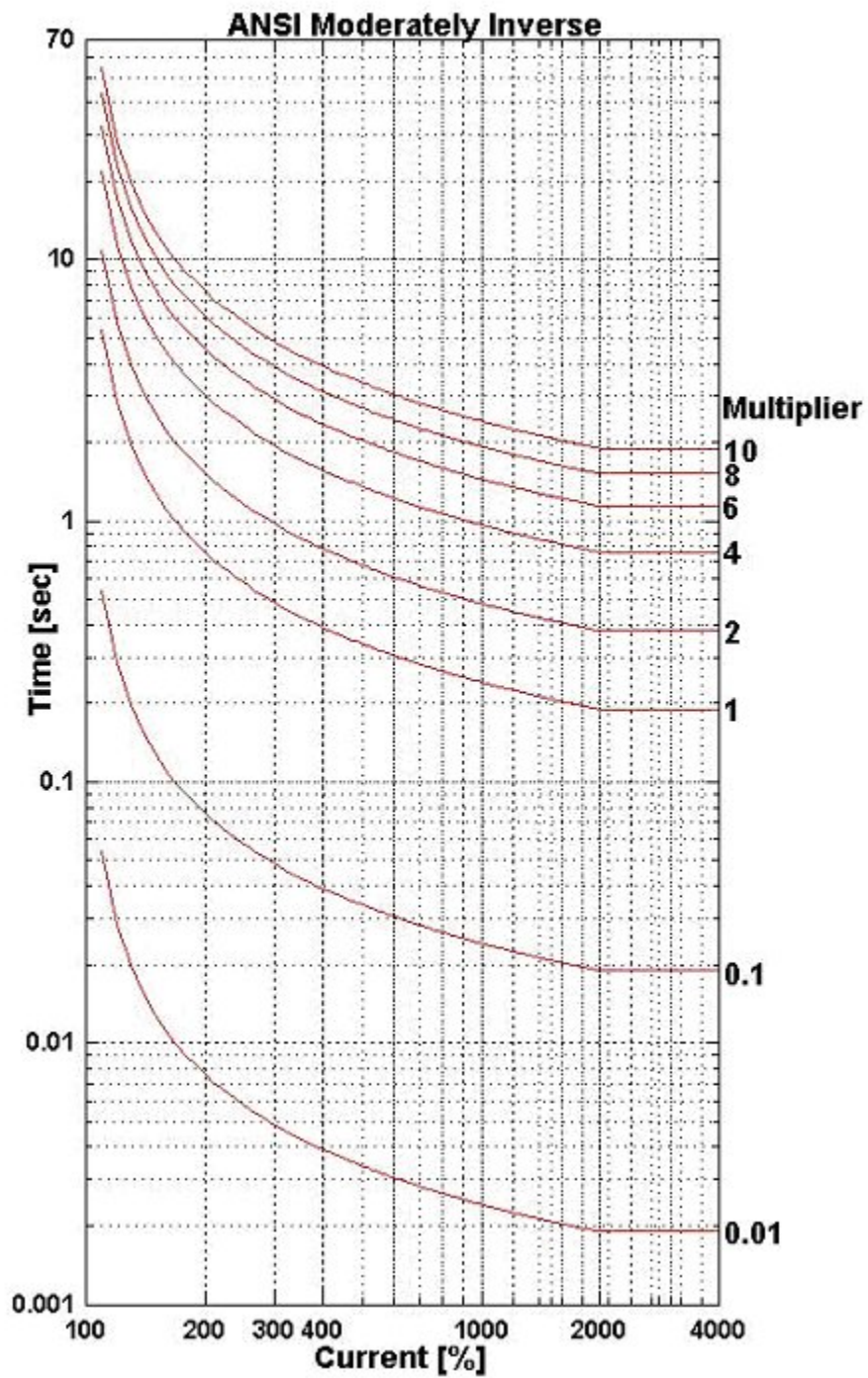
<Figure A.5 ANSI I TC Curve >



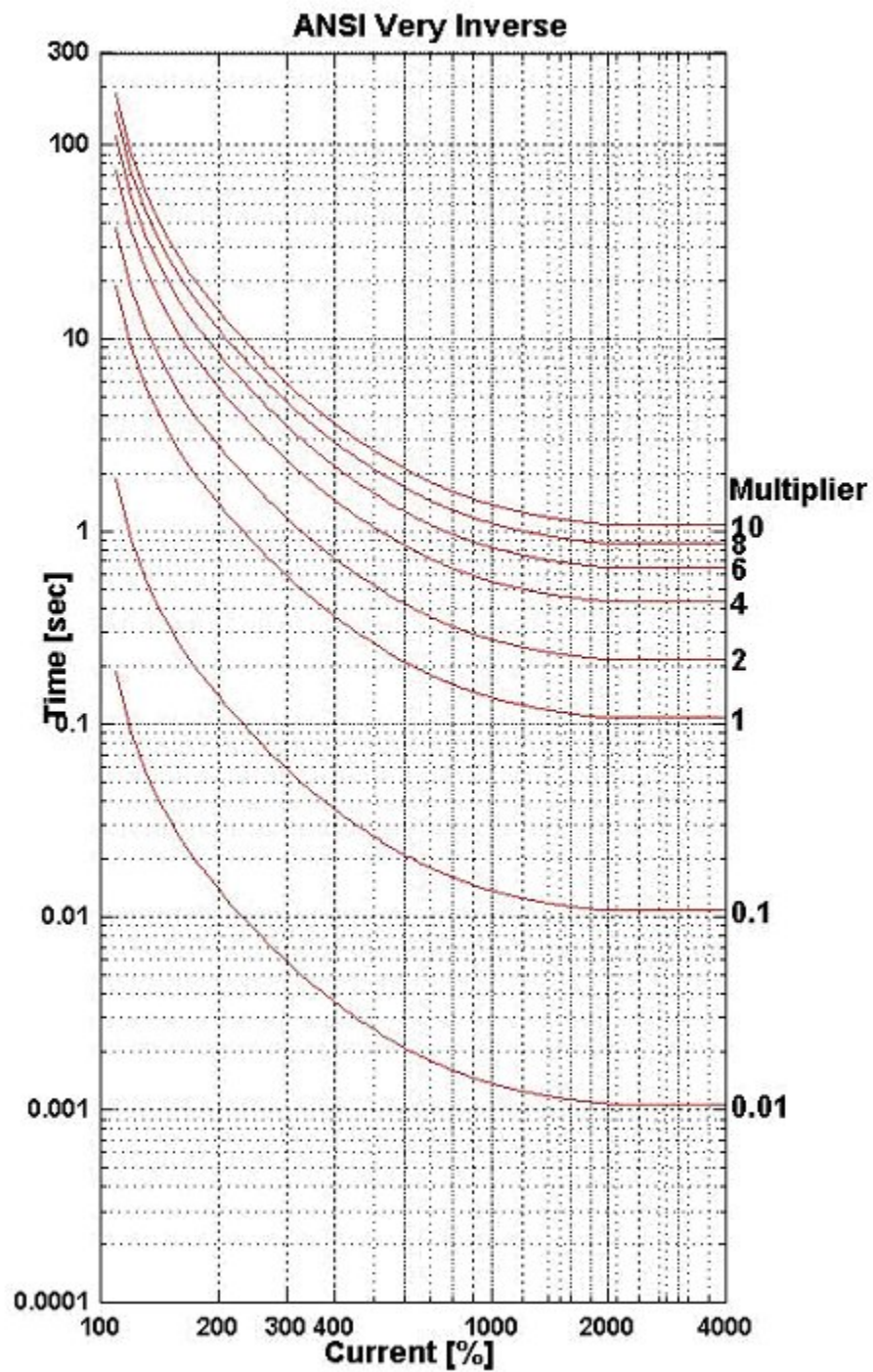
<Figure A.6 ANSI SI TC Curve >



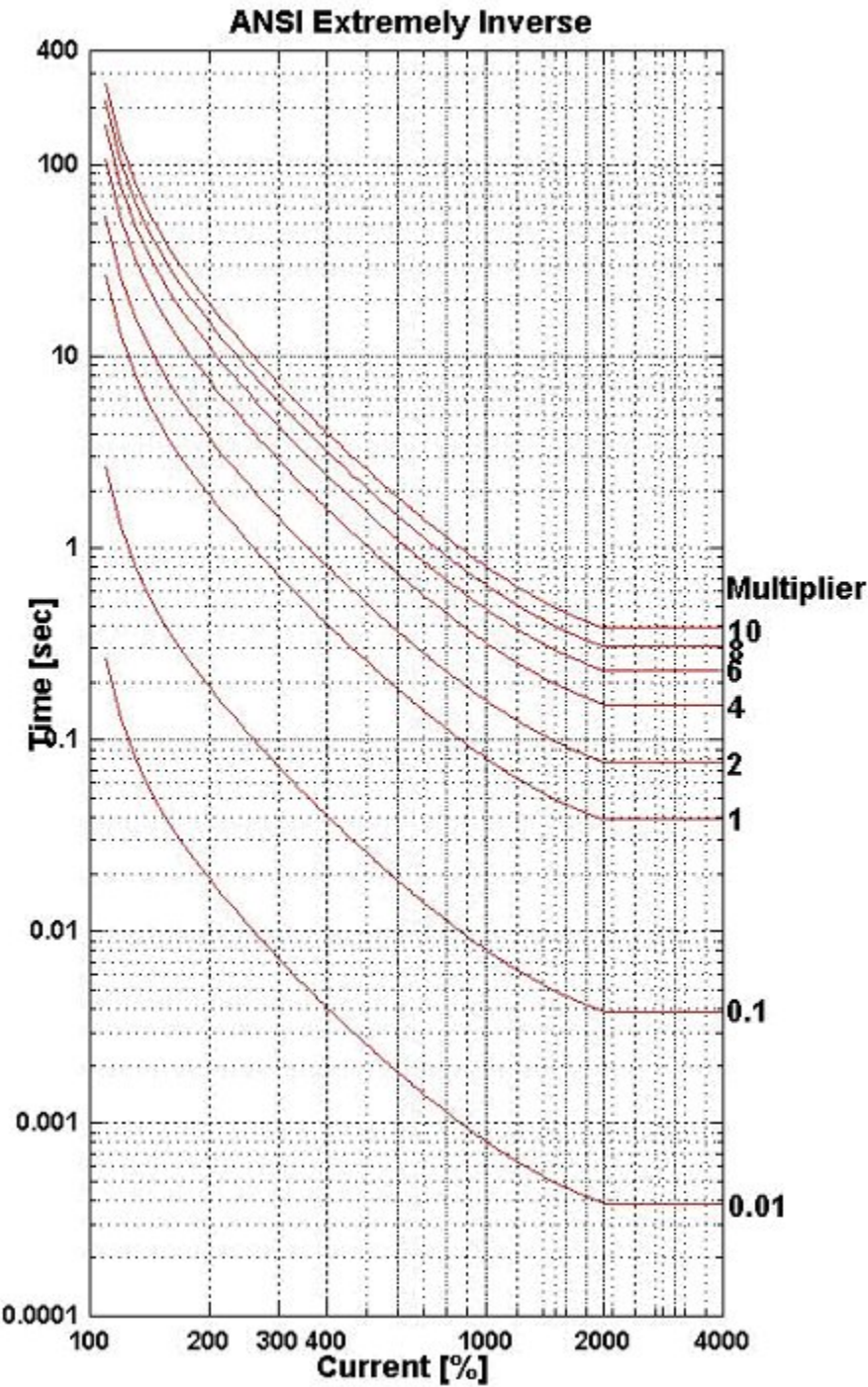
<Figure A.7 ANSI LI TC Curve >



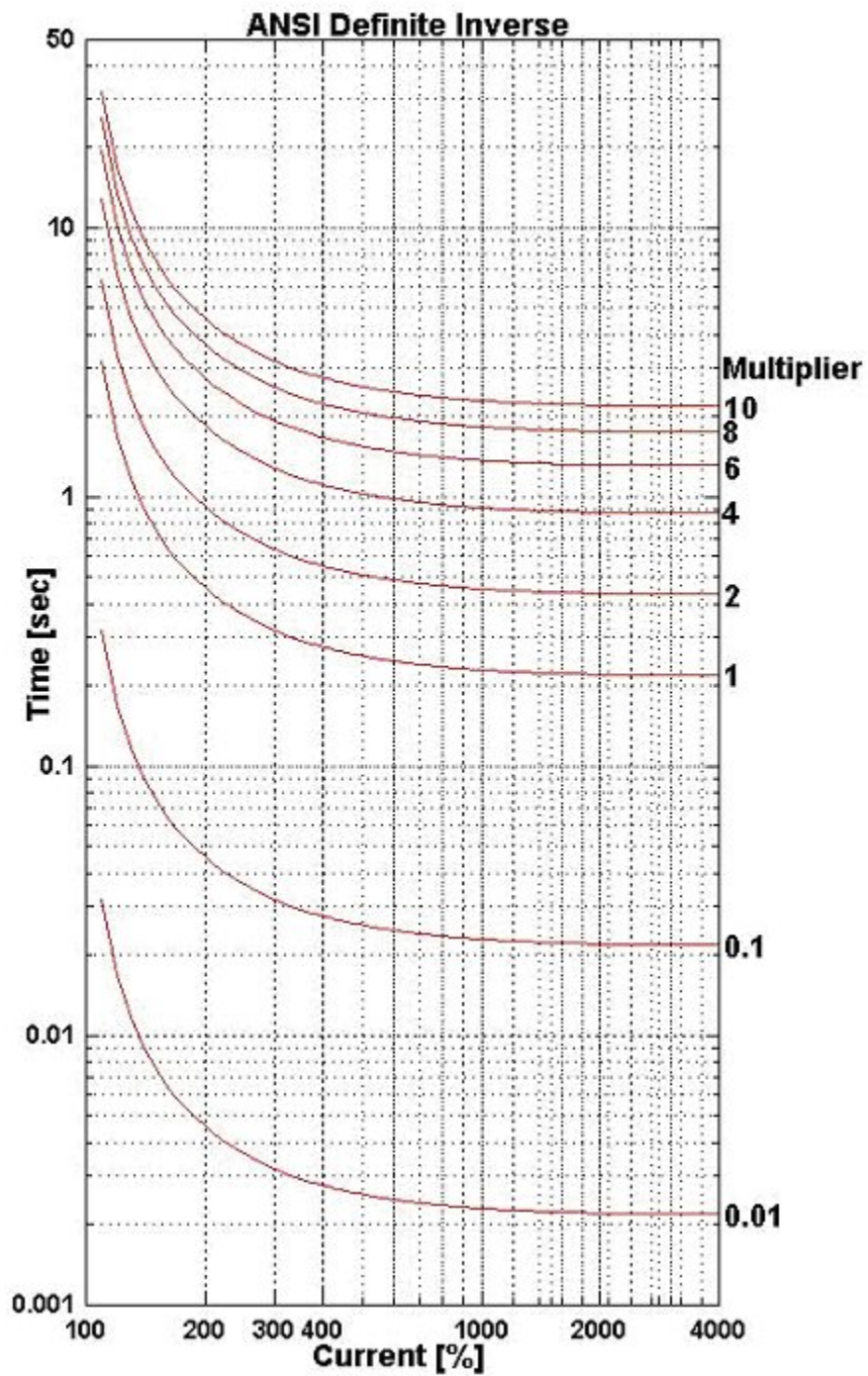
<Figure A.8 ANSI MI TC Curve >



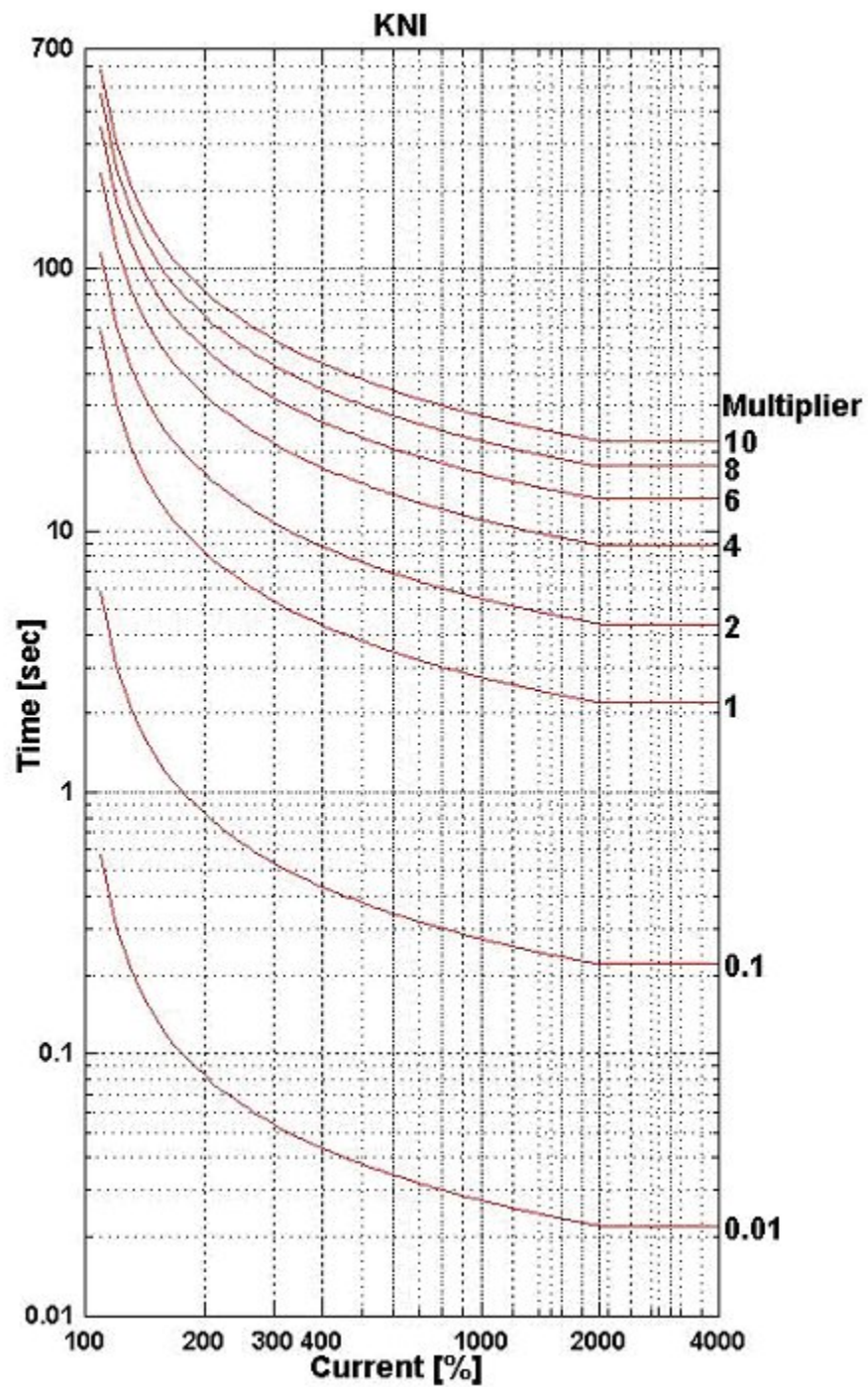
<Figure A.9 ANSI VI TC Curve >



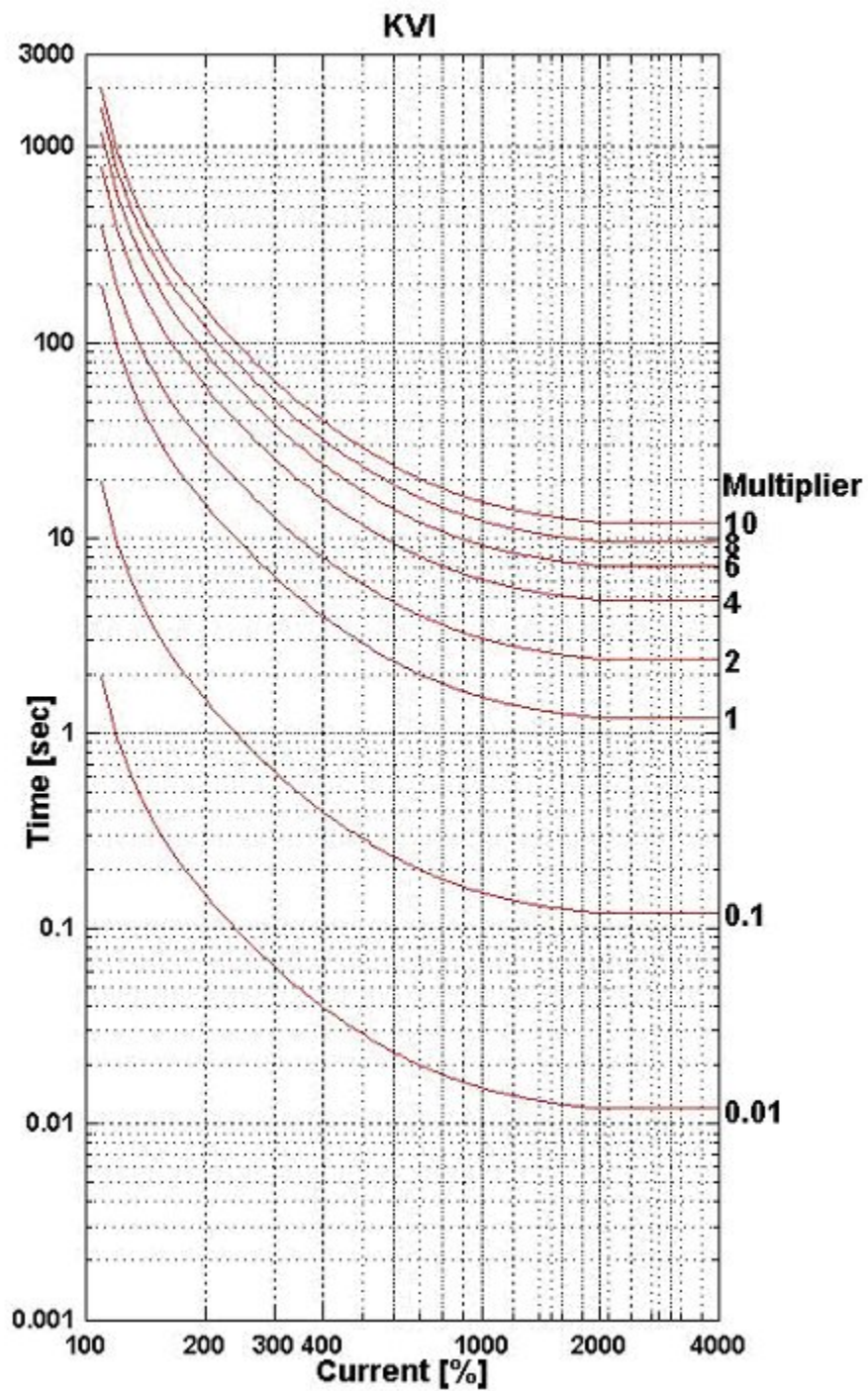
<Figure A.10 ANSI EI TC Curve >



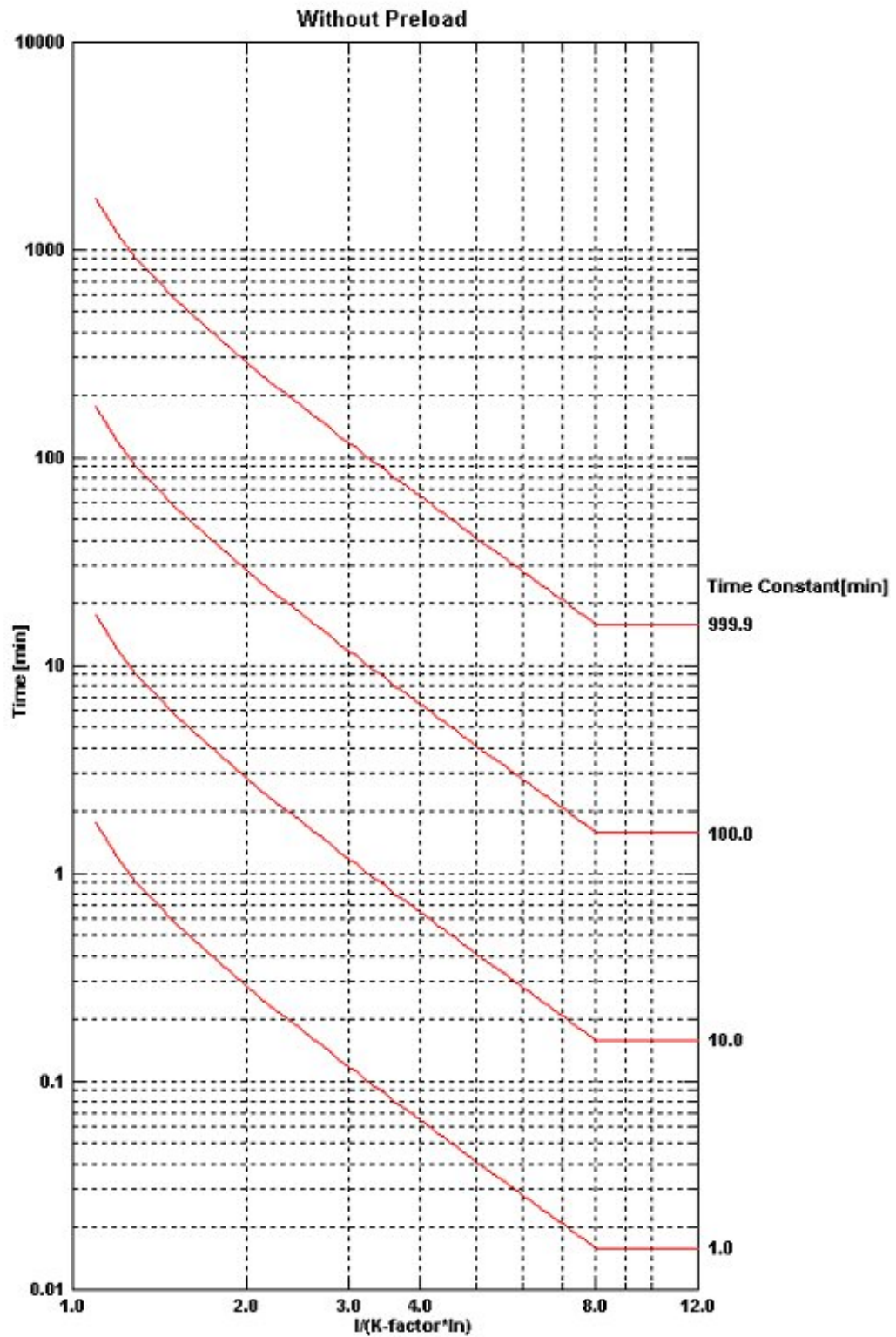
<Figure A.11 ANSI DI TC Curve >



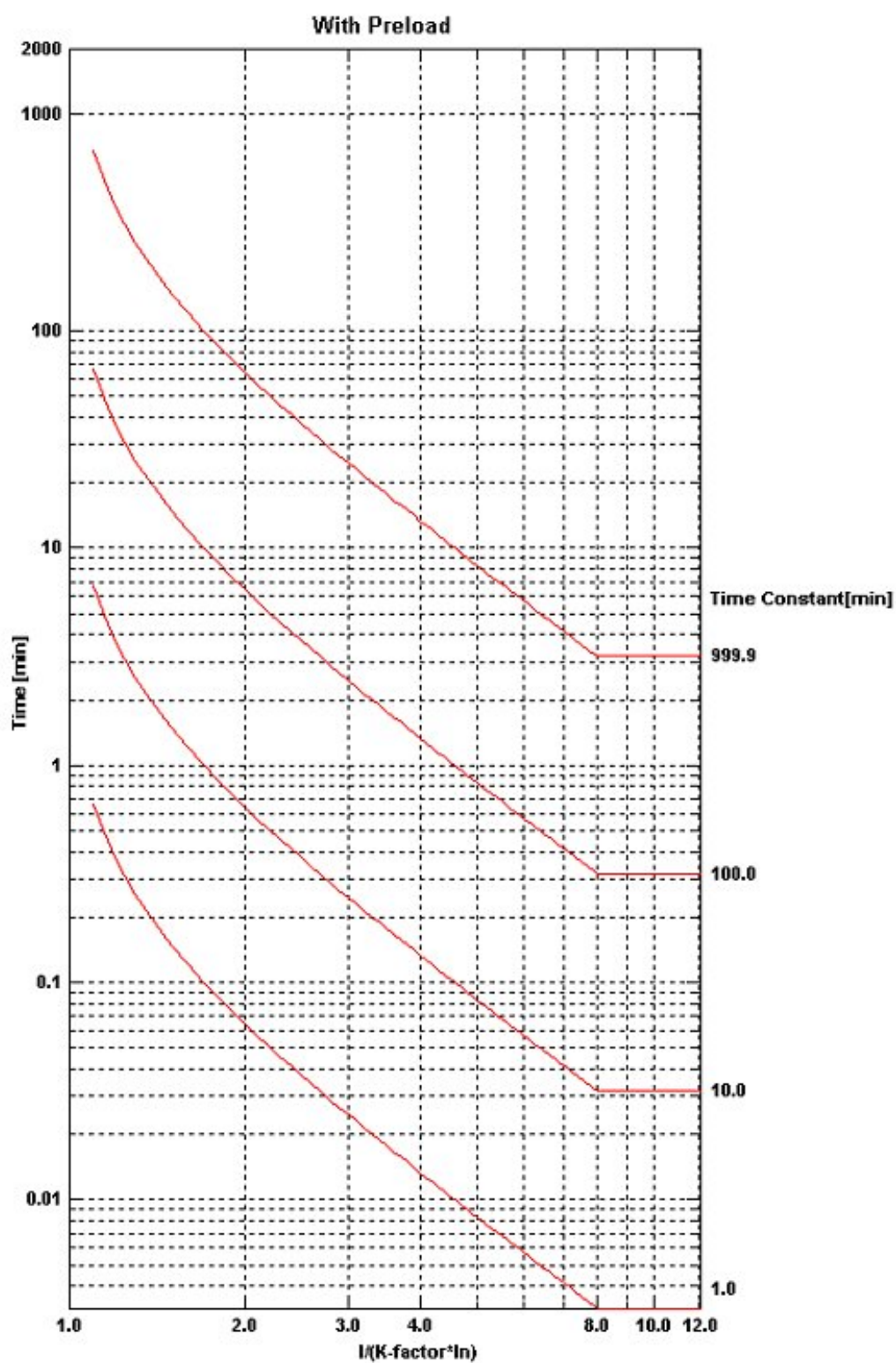
<Figure A.12 KNI (KEPCO Normal Inverse) TC Curve >



<Figure A.13 KVI (KEPCO Very Inverse) TC Curve >

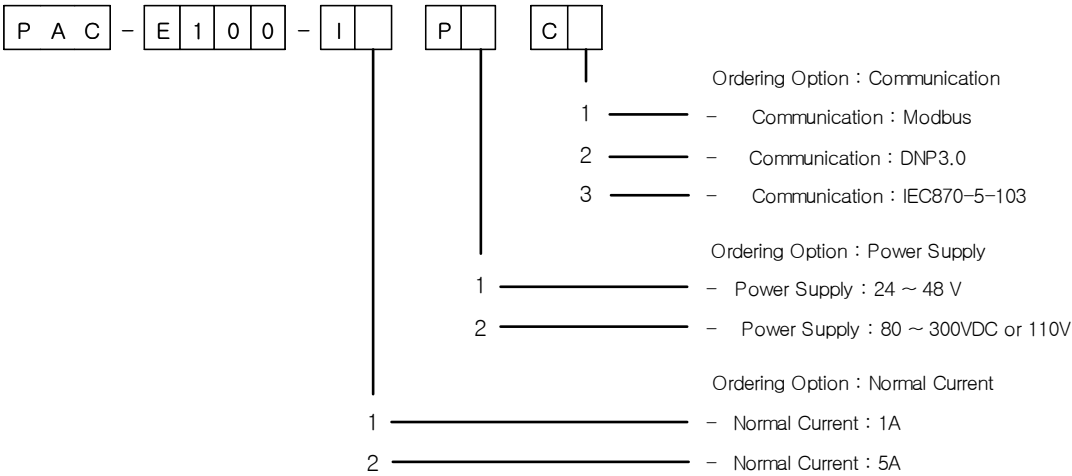


<Figure A.14 TC Curve for Thermal Overload Protection: In case of 0%>



< Figure A.15 TC Curve for Thermal Overload Protection: In case of 80%>

Appendix B. Ordering Option



P&C Technologies Co., Ltd.

Head of Office & Factory

Address #304, Anyang Megavalley, 799, Kwanyang-dong, Dongahn-ku,
Anyang-city, Kyongki-do, 431-080, Korea

Phone 82 31 4205791

Fax 82 31 4205793

Seoul Office

Address 6F, Kwangmyong B/D, 115-3, Bangi-dong, Songpa-gu,
Seoul, 138-050 Korea

Phone 82 2 22408106

Fax 82 2 22408195

Homepage <http://www.pnctech.co.kr/>

Contact Person Deuy Park (Oversea Sales & Marketing Manager)
ttegur@pnctech.co.kr