Digital Motor Protection Relay User's Manual

TYPE : GDR-M02

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Version 1.00

Kyongbo Electric Co., Ltd.

Safety Precautions

This document is for the safety of the user, and to prevent property damage.

Be sure to read the user manual carefully, and use the product accordingly.

The user manual must be kept in a place where it can be easily seen by the product user.

⚠ WARNING

This symbol indicates the possibility of death or serious injury.

⚠ CAUTION

This symbol indicates the possibility of injury or damage to properties only.

SYMBOLS

🚫	**Be sure not to do.**
❗	**Be sure to follow the instruction.**

⚠ WARNING

- **Do not perform any wiring work while the power is on or the product is in operation.**

  It may cause an electric shock.

- **Must verify the status of the grounding connection before starting the operation.**

  Otherwise, it may cause an electric shock, damage, or a fire.

- **Do not operate the product with wet hands.**

  It may cause an electric shock.

- **Do not use if the clothing of the cable is damaged.**

  It may cause an electric shock.

- **Do not perform any wiring work when the main cable is live.**

  It may cause an electric shock, and a damage or a fire by the charged voltage

  of the converter.

- **Do not disassemble the product even if the power is not on, except for wiring or maintenance.**

  It may cause an electric shock by the charged current in the product.

- **Let the electrical technician to perform wiring, test run, and maintenance.**

  Otherwise, it may cause an electric shock or a fire by a wrongful operation.

- **Perform terminal work when cutting a cable.**

  Otherwise, it may cause an electric shock from the naked part of the cable.

- **Place the terminal cover on the terminal in the back after the wiring work.**

  Otherwise, it may cause an electric shock.

⚠ CAUTION

- **Apply the rated power to the power source terminal.**
  Otherwise, it may cause a damage to the product or a fire.

- **Follow the rated load on the input and output connections.**
  Otherwise, it may cause a damage to the product or a fire.

- **Prevent screws, metal parts, water, or oil from entering the product.**
  It may cause a damage to the product or a fire.

- **Do not let the product be exposed to a direct sunlight.**
  It may cause a damage to the product.

- **Extract and insert Case on a leveled surface.**
  Otherwise, it may cause a damage to the product.

- **Do not store the product in a humid or a dusty area.**
  It may cause a damage to the product.

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1. General Features

This Relay contains Relay elements of 50/51×3, 50/51N×1, 47×1, 46×1, 59×3, 27×3 at the same time, and is a Digital arithmetic relay designed and manufactured properly for the protection when fault occurred such as overcurrent, ground overcurrent, overvoltage, undervoltage, negative-sequence current, reverse phase etc. from directing grounding system or high load grounding system using 3phase motor. And it is not just easy to change the operation time and operation current, voltage but it can also record and store fault information thereby greatly enhancing the reliability of the cable line, and the main characteristics are as follows.

Features

- ▣ Total arithmetic type over-current & ground over-current, & over/under voltage & negative-sequence current Relay.
- ▣ Variety of time characteristic curve
    - OCR / OCGR : 10 time characteristic curve enclosed
    - OVR : Inverse time, Definite Time Characteristic curve enclosed
    - UVR : Reverse Inverse time, Definite time characteristic curve enclosed
    - NSOCR : Definite time characteristic curve enclosed
    - RPR : Definite time characteristic curve enclosed
- ▣ Duration of maintaining output contact is 0.00 ~ 60.00Sec (0.01Sec Step), and variable setting is possible.
- ▣ Set value and measured values are Displayed digitally through LCD Screen. (4 x 20 LCD Screen)
- ▣ Enhance reliability with surveillance function at all times.
- ▣ Free selection of frequency Settings according to the rated frequency of the line. (50 / 60Hz)
- ▣ Possible to set each of 4 Relay contact output (T/S Output) to 17 modes, and all of these can be used for Alarms.
    - contact for Trip(1a), contact for Signal(3a)
- ▣ Reliability is increased by the operation through output contacts when the Relay is in abnormal state.
- ▣ Convenient PC Applications
    - change setting values, verify the measurements, verify Fault information, display status, Remote Reset.
- ▣ Possible to self-test through manual Trip command(Contact Test)
- ▣ Maintains thorough security using password input when changing setting values

▣ Various communications supported
- Communication Methods : RS-232C, RS-485C (SCADA communications)
- Supported Protocol : MODBUS

▣ Enhanced EMC / EMI performance

▣ Applied Standard : Korea Electrical Manufacturers' Cooperative Standard (KEMC1120)

2. Technical Data

2.1 Voltage, Current Input

【Table 2.1】 Input Current

Rated Voltage		AC 110V
Rated Current		AC 5A
Overload Endurance	Voltage	1.15 times rated voltage / 3 hours
	Current	2 times rated current / 3 hours 20 times rated current / 2 seconds
Burden		0.5VA or less / Phase

2.2 Rated Control Power

【Table 2.2】 Rated Control Power

Rated Control Power	AC/DC 110 ~ 220V (free voltage)	
Overload Endurance	1.3 times rated voltage / 3 hours	
Burden	A l w a y s	30W or less
	operation	70W or less

2.3 Rated Frequency

50Hz or 60Hz (Sine Waveform)

2.4 Case

【Table 2.3】 Case

Case Structure	Flushed Drawer Type
Case Color	Munsell No. N1.5 (Black)
Case Material	Fe (steel)

2.5 Time OverCurrent Element

【Table 2.4】 Time Over Current Element

Operation Value	2.0 ~ 12.5A (0.1A Step)		
Operation Time Characteristics	Inverse Time	NI	0.1 ~ 10.0 (0.1 Step)
	Inverse Time (KEPCO Type)	KNI	
	Very Inverse Time	VI	
	Very Inverse Time (KEPCO Type)	KVI	
	Extreme Inverse Time	EI	
	Long Inverse Time	LI	
	Long Inverse Time (KEPCO Type)	KLNI	
	Long Very Inverse Time (KEPCO Type)	KLVI	
	Definite Time	DT	0.04 ~ 60.00Sec (0.01Sec Step)
Release Delay Time	0.00 ~ 60.00Sec (0.01Sec Step)		
Release Value	At least 95% of the Setting Value		
Operation Value Precision Ration	Within ±5% of the Setting Value		

2.6 Instantaneous OverCurrent Element

【Table 2.5】 Instantaneous Over Current Element

Operation Value	10 ~ 90A (1A Step)	
Operation Time Characteristics	Instantaneous Time	≤ 40ms
	Definite Time	0.04 ~ 60.00Sec (0.01Sec Step)
Release Delay Time	0.00 ~ 60.00Sec (0.01Sec Step)	
Release Value	At least 95% of the Setting Value	
Operation Value Precision Ratio	Within ±5% of the Setting Value	

2.7 Time Ground Overcurrent

【Table 2.6】 Time Ground Over Current Element

Operation Value	0.2 ~ 2.5A (0.1A Step)		
Operation Time Characteristics	Inverse Time	NI	0.1 ~ 10.0 (0.1 Step)
	Inverse Time (KEPCO Type)	KNI	
	Very Inverse Time	VI	
	Very Inverse Time (KEPCO Type)	KVI	
	Extreme Inverse Time	EI	
	Long Inverse Time	LI	
	Long Inverse Time (KEPCO Type)	KLNI	
	Long Very Inverse Time (KEPCO Type)	KLVI	
	Definite Time	DT	0.04 ~ 60.00Sec (0.01Sec Step)
Release Delay Time	0.00 ~ 60.00Sec (0.01Sec Step)		
Release Value	At least 95% of the Setting Value		
Operation Value Precision Ratio	Within ±5% of the Setting Value		

2.8 Instantaneous Ground Over Current Element

【Table 2.7】 Instantaneous Ground Overcurrent Element

Operation Value	2 ~ 50A (1A Step)	
Operation Time Characteristic	Instantaneous Time	≤ 40ms
	Definite Time	0.04 ~ 60.00Sec (0.01Sec Step)
Release Delay Time	0.00 ~ 60.00Sec (0.01Sec Step)	
Release Value	At least 95% of the Setting Value	
Operation Value Precision Ratio	Within ±5% of the Setting Value	

2.9 Over Voltage Element

【Table 2.8】 Over Votlage Element

Operation Value	65 ~ 170V (1V Step)	
Operation Time Characteristics	Inverse Time	0.1 ~ 10.0 (0.1 Step)
	Definite Time	0.04 ~ 60.00Sec (0.01Sec Step)
Release Delay Time	0.00 ~ 60.00Sec (0.01Sec Step)	
Release Value	At least 95% of the Setting Value	
Operation Value Precision Ratio	Within ±5% of the Setting Value	

2.10 Under Voltage Element

【Table 2.9】 Under Voltage Element

Operation Value	30 ~ 105V (1V Step)	
Operation Time Characteristics	Reverse Inverse Time	0.1 ~ 10.0 (0.1 Step)
	Definite Time	0.04 ~ 60.00Sec (0.01Sec Step)
Release Delay Time	0.00 ~ 60.00Sec (0.01Sec Step)	
Release Value	At least 95% of the Setting Value	
Operation Value Precision Ratio	Within ±5% of the Setting Value	

2.11 Reverse Phase Element

【Table 2.10】 Reverse Phase Element

Operation Value	When reverse phase from more than 40% of rated voltage	
Operation Time Characteristics	Definite Time	0.04 ~ 60.00Sec (0.01Sec Step)
Release Delay Time	0.00 ~ 60.00Sec (0.01Sec Step)	
Release Value	At least 95% of the Setting Value	
Operation Value Precision Ratio	Within ±5% of the Setting Value	

2.12 Negative-Sequence Current Element

【Table 2.11】 Negative-Sequence Current Element

Operation Value	Negative-Sequence 30 ~ 70% (1% step)	
Operation Time Characteristics	Definite Time	0.04 ~ 60.00Sec (0.01Sec Step)
Release Delay Time	0.00 ~ 60.00Sec (0.01Sec Step)	
Release Value	At least 95% of the Setting Value	
Operation Value Precision Ratio	Within ±5% of the Setting Value	

2.13 Output Contacts

【Table 2.12】 Output Contacts / Capacity

T / S1 Contacts (Trip contact) - 1a Contacts	
Rated Voltage	AC 250V, DC 125V
Continuous Flow Electricity Capacity	10A (AC 250V)
0.3 sec. Close Circuit Capacity	30A (DC 125V)
Closing Capacity	6250VA
Material	Silver alloy
T / S2 ~ T / S4 Contacts (Signal contacts) - 3a Contacts	
Rated Voltage	AC 250V, DC 125V
Continuous Flow Electricity Capacity	5A (AC 250V)
0.3 sec. Close Circuit Capacity	5A (DC 125V)
Closing Capacity	1250VA / 150W
Material	Gold-plate silver alloy
Healthy Alarm - 1b Contacts	
Rated Voltage	AC 250V, DC 125V
Continuous Flow Electricity Capacity	1A (AC 250V)
Open Circuit Capacity	DC 125V, 30W, Time constant(25ms), 1A
Closing Capacity	2500VA / 300W
Material	Silver alloy

2.14 Insulation Test

【Table 2.13】 Insulation

Insulation Resistance	DC 500V	Electric Circuit to Ground	10MΩ	IEC60255-5
		Between Electric Circuits	5MΩ	
		Between Electric Circuit Connections		
Commercial Frequency Withstand Voltage	50/60Hz, 1min	Electric Circuit Bundle to Ground	2kV	IEC60255-5
		Between Electric Circuits		
		Between Connection Circuit Contacts	1kV	
Impulse Withstand Voltage	1.2/50μs, 3 times each for positive/negative polarity	Electric Circuit Bundle to Ground	5kV	IEC60255-5
		Between Transformer Circuits		
		Between Transformer Control Circuits		
		Between Control Circuits	3kV	
		Between Tranformer Circuit Contacts		
		Between Control Power Circuit Contacts		

Caution) AUX POWER and 485 Communication Circuits enclose surge protection circuit inside the relay, so do not test insulation resistance test and withstand voltage test.

2.15 Mechanical Test

【Table 2.14】 Mechanical Test

Vibration	Vibration Response	10 ~ 150Hz, 0.5G, Front/Back, Left/Right, Up/Down 1 time
	Vibration Endurance	10 ~ 150Hz, 1G, Front/Back, Left/Right, Up/Down 20 times
Shock	Shock Response	5G, Front/Back, Left/Right, Up/Down 3 times
	Shock Withstand	15G, Front/Back, Left/Right, Up/Down 3 times
	Bump	10G, Front/Back, Left/Right, Up/Down 100 times
Earthquake	1 ~ 8㎐	x : 3.5mm, y : 1.5mm, Sweep : 1 time
	8 ~ 35㎐	x : 1G, y : 0.5G, Sweep : 1 time

2.16 Noise Test

【Table 2.15】 Noise Test

1MHz burst disturbance	1MHz, 75ns, 400Hz, 2Sec	Common mode	2.5kV	IEC60255-22-1
		Differential mode	1.0kV	
EFT Burst	Applied Voltage	4kV		IEC60255-22-4
	Repeated Frequency	2.5kHz		
Electrostatic Discharge	Air discharge	8kV		IEC60255-22-2
	Contact discharge	6kV		
Lighting Surge	1.2/50μs, 8/20μs, 30sec, 3 times	Common mode	2.0kV	IEC60255-22-5
		Differential mode	1.0kV	
Radio Frequency Radiation Endurance	80MHz ~ 1GHz, 10V/m, 1sec			IEC60255-22-3
Radio Frequency Conduction Endurance	150kHz ~ 80MHz, 10V/m, 1sec			IEC60255-22-6

2.17 Temperature, Humidity Test

【Table 2.16】 Temperature, Humidity Test

Temperature Range	Operation Assurance	-10℃ ~ +55℃
	Recovery Assurance	-20℃ ~ +60℃
Relative Humidity		Daily Average 30% ~ 90%

2.18 EMI : ElectroMagnetic Interference

【Table 2.17】 ElectriMagnetic Interference

Noise Terminal Voltage	Frequency (MHz)	Quasi-peak	Average
	0.15 ~ 0.5	79	66
	0.5 ~ 30	73	60
Noise Field Strength	Frequency (MHz)	Quasi-peak	Limit value (dBμV/m)
	30 ~ 230	50.5	
	230 ~ 1,000	57.5	

2.19 Other Operating Condition

【Table 2.18】 Other Operating Condition

Surface Height	1000m or less
Condition where there is no abnormal vibration, shock, slope or influence of the magnetic field	
Place where there is no explosive dust, flammable dust, or flammable / rusty gas, or salt	

3. Protection Characteristics

3.1 OverCurrent Function

This relay contains the Instantaneous Time characteristic and Time Characteristics of 9 to be used for overcurrent and short circuit protection. GDR-M02 marks the instantaneous element as INST.OCR(IOCR), and the time over current element as Time OCR(TOCR), time characteristics curve type is as follow 【Table 3.1】

The instantaneous time characteristic is a function to output Trip signal immediately when a current over the setting value is input, the Trip time is less than 40ms, and the time characteristic is a function between the current and the time, and the operation time is shorter as the current is bigger.   There are 4 international standard(IEC) inverse time characteristics and 4 KEPCO type inverse time characteristics equipped.

When applying the inverse time characteristics, select one from the 9 characteristics.
(Definite time included)

4 Inverse characteristics following the international standard(IEC255-4), and the time and current relationship function of 4 KEPCO type characteristics are as follows.

$$T = \left(\frac{K}{I^L - 1} + C \right) \times \frac{M}{10} (\sec)$$

T = Operation Time,   K and C = Relay characteristic value

I = Relay input current / Relay operation setting value

L = Characteristic curve index,   M = Operation time ratio

【Table 3.1】 Time Curve Characteristic

Time Characteristic	Feature Value			Reference
	K	L	C	
NI	0.14	0.02	0	-
KNI	0.11	0.02	0.42	KEPCO Type
VI	13.5	1	0	-
KVI	39.85	1.95	1.084	KEPCO Type
EI	80	2	0	-
LI	54	1	0	-
KLNI	3.8	0.11	2.8	KEPCO Type
KLVI	75	1.8	2	KEPCO Type
DT	-	-	-	-

When setting the relay, selecting the time characteristic curve will decide the K, L, C values in the above table.

Logic Diagram for overcurrent element operation is as follows.
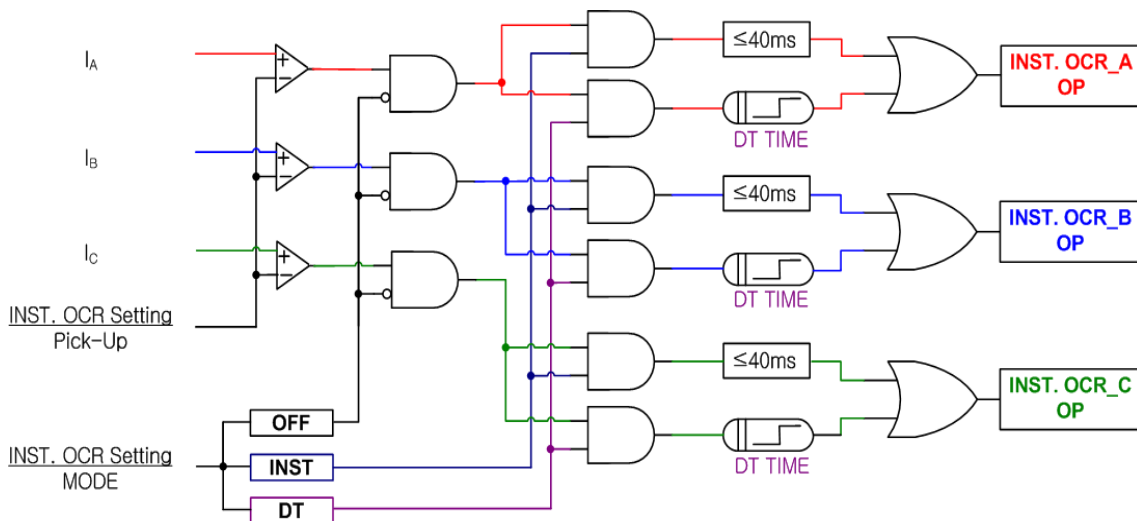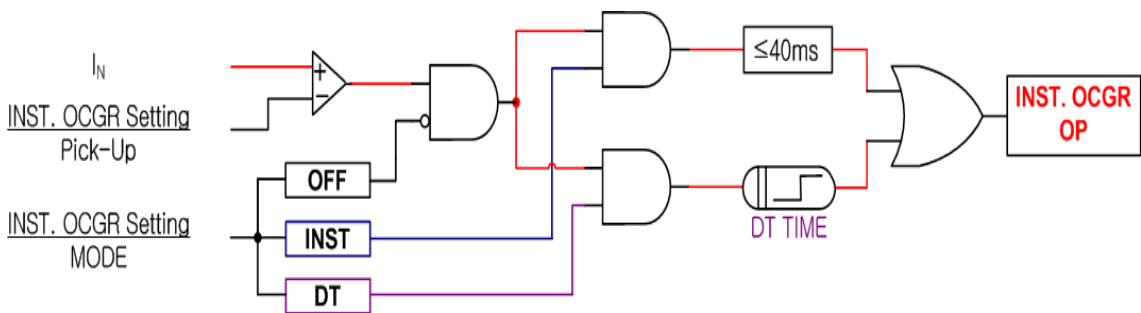

【Figure 3.1】 INST.OCR(IOCR) Logic Diagram
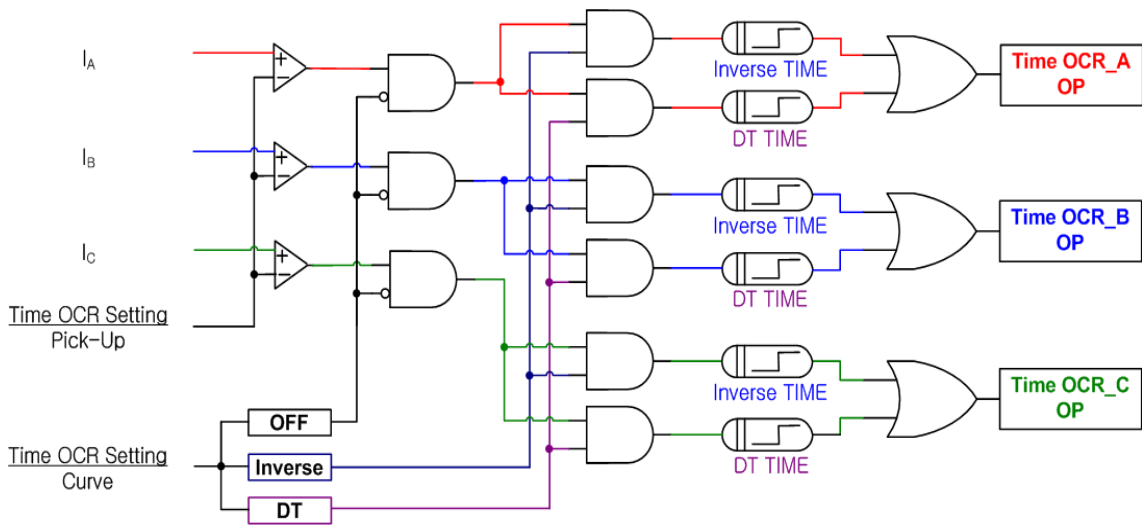
【Figure 3.2】　 Time OCR(TOCR) Logic Diagram

3.2 Ground Over Current Function

It has the same fundamental and characteristic with 3-Phase Over Current relay function, and the only differences are that it receives the ground current signal input and the setting range is smaller than 3-phase Over Current.

There are also instantaneous element and time element in the Ground Over Current relay function, instantaneous element is marked as INST. OCGR(IOCGR), and time element is marked as Time OCGR(TOCGR).

Logic Diagram for ground over current element operation is as follows.

【Figure 3.3】 INST.OCGR(IOCGR) Logic Diagram
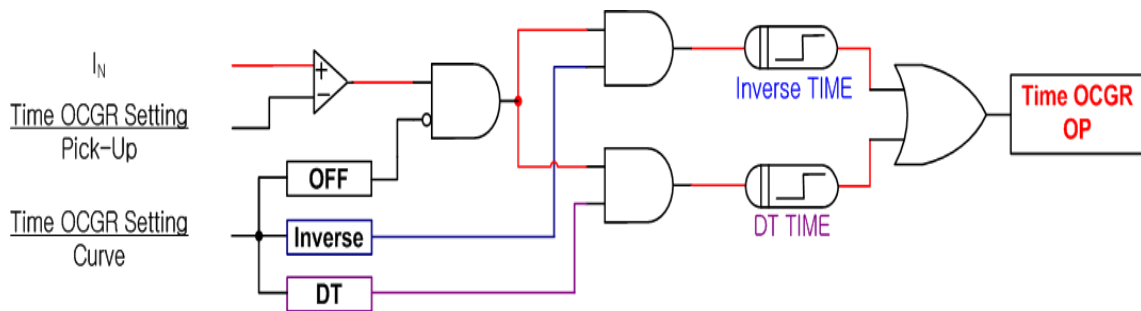
【Figure 3.4】 Time OCGR(TOCGR) Logic Diagram

3.3 Over Voltage Function

This relay has Inverse Time and Definite Time characteristic for Over Voltage element. NI characteristic relate voltage and time equation that if voltage magnitude is lager, operation time is short.

This element operation divide to 1 Phase and 3 Phases operating. When relay set 1 phase (OVR×3), relay operate independence V_{AB}, V_{BC}, V_{CA} and relay set 3 phase (3Φ OVR×1), relay operate all phase Pick-Up.

Equation of Time curve characteristic NI by voltage and time is follow

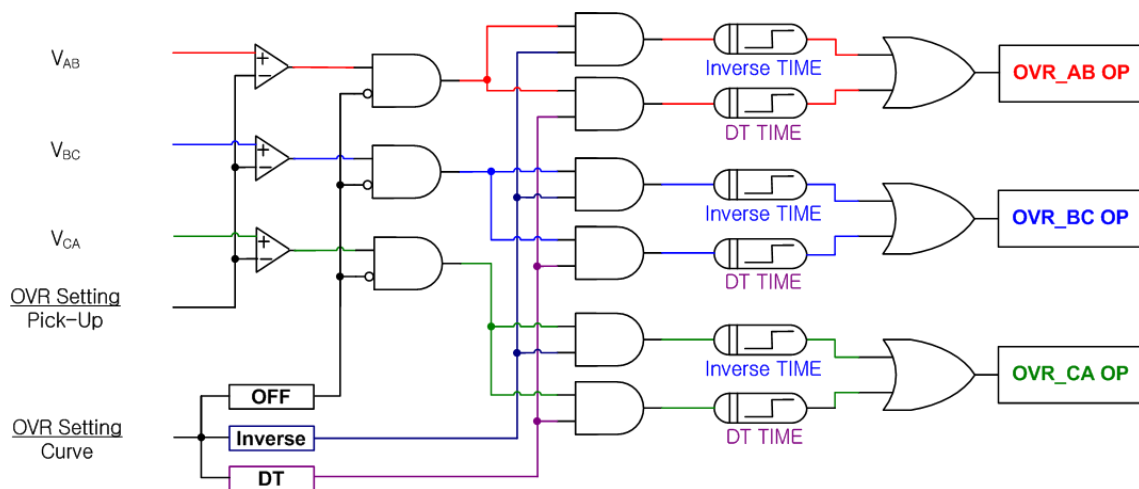$$T=\left(\frac{10.5}{V^{1.75}-1}\right)\times\frac{M}{10}(\sec)$$

T = Operation Time
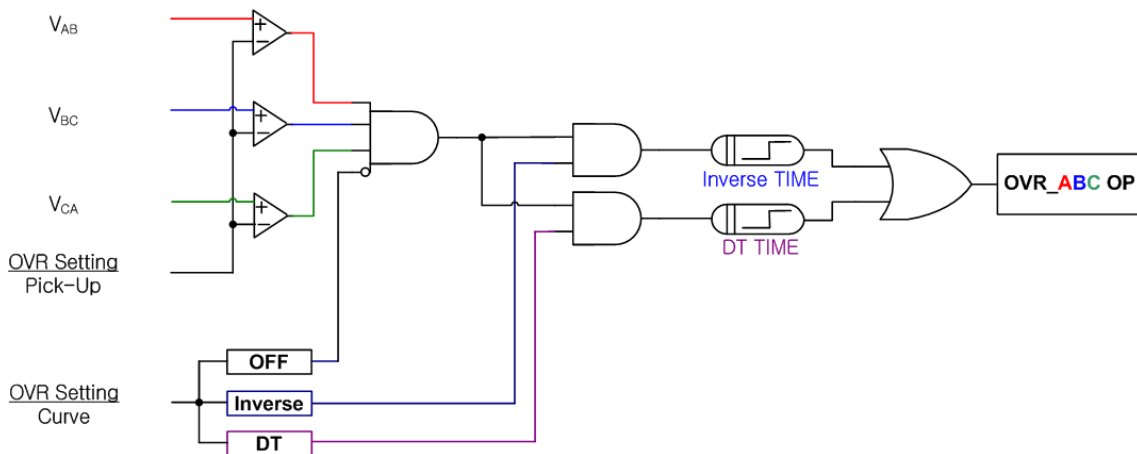V = Relay input voltage / Relay operation setting value
M = Operation time ratio

Logic Diagram for over voltage element operation is as follows.

【Figure 3.5】 OVR Logic Diagram (1 Phase)

【Figure 3.6】 OVR Logic Diagram (3 Phases)

3.4 Under Voltage Function

This relay has Inverse Time and Definite Time characteristic for Under Voltage element.

Operated Under Voltage element has many release mode, at first that voltage is higher than setting, second that user push reset key. NI characteristic relate voltage and time equation that if voltage magnitude is smaller, operation time is short.

This element operation divide to 1 Phase and 3 Phases operating. Voltage of operating for Under Voltage element is lower than setting, after higher than setting, so, relay don't operate at first apply power or after reset release. For example, when relay set 1 phase (UVR×3), operate after each phase voltage apply higher than setting and 3 phase (3Φ UVR×1), operate after all phase voltage apply higher than setting.

Operated Under Voltage element has many release mode, that voltage is higher than setting, that user push reset key, and that release after RST-Time when RST-Mode is ON.

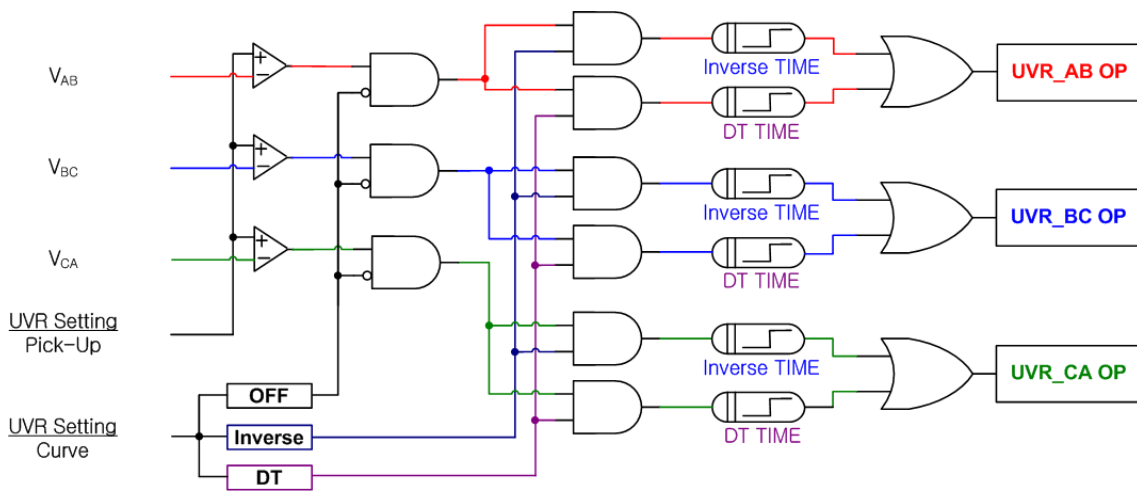Equation of Time curve characteristic by voltage and time is follow,

$$T = \left(\frac{8}{1 - V^{2.2}} \right) \times \frac{M}{10} (\sec)$$
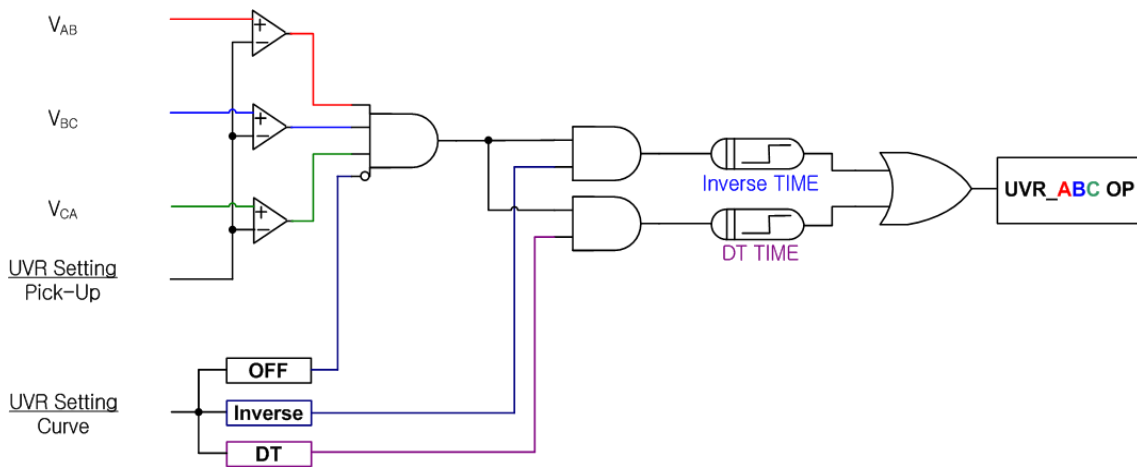
T = Operation Time

V = Relay input voltage / Relay operation setting value

M = Operation time ratio

Logic Diagram for under voltage element operation is as follows.

【Figure 3.7】 UVR Logic Diagram (1 Phase)

【Figure 3.8】 UVR Logic Diagram (3 Phases)

3.5 Negative-Sequence Current Function

This relay has Definition Time for Negative Sequence current element.

When motor come phase open according to inner problem or the other factor, motor stop rotate or continuous rotate. At this time, rotator of motor flow large current and motor has demage.

Negative-Sequence Current Element calculate 3 phase unbalanced current at this case and if unbalanced rate higher than setting(30 ~ 70%), operate DT (0.04 ~ 60.00 Sec).

Unbalanced current equation is as follow.

$$Unbalanced\ Current = \frac{Negative\ Sequence\ Current}{Positive\ Sequence\ Current} \times 100\,(\%)$$

Logic Diagram for negative sequence current element operation is as follows.
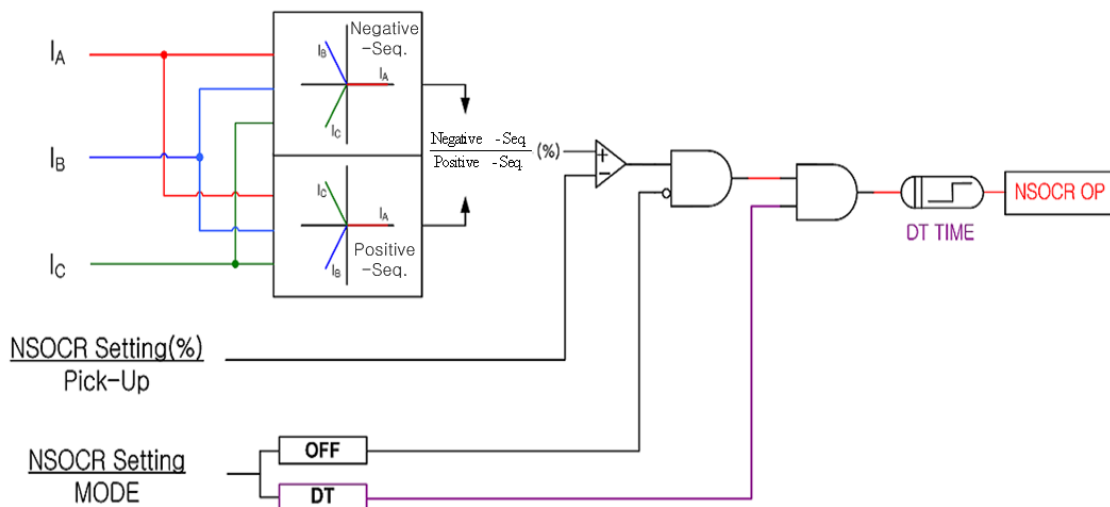
【Figure 3.9】 NSOCR Logic Diagram

3.6 Reverse Phase Function

This relay has Definite Time for Reverse Phase element.

This relay protective reverse phase input, that is element prevent backlashing. Relay compare 3phase angle dissimilarity, if relay detect angle exchange, operate DT (0.04 ~ 60.00 Sec). (However, when input voltage 40% of rated voltage, occur reverse phase) When use single phase motor, set "OFF".

Reverse Phase operate Logic Diagram is as follow.
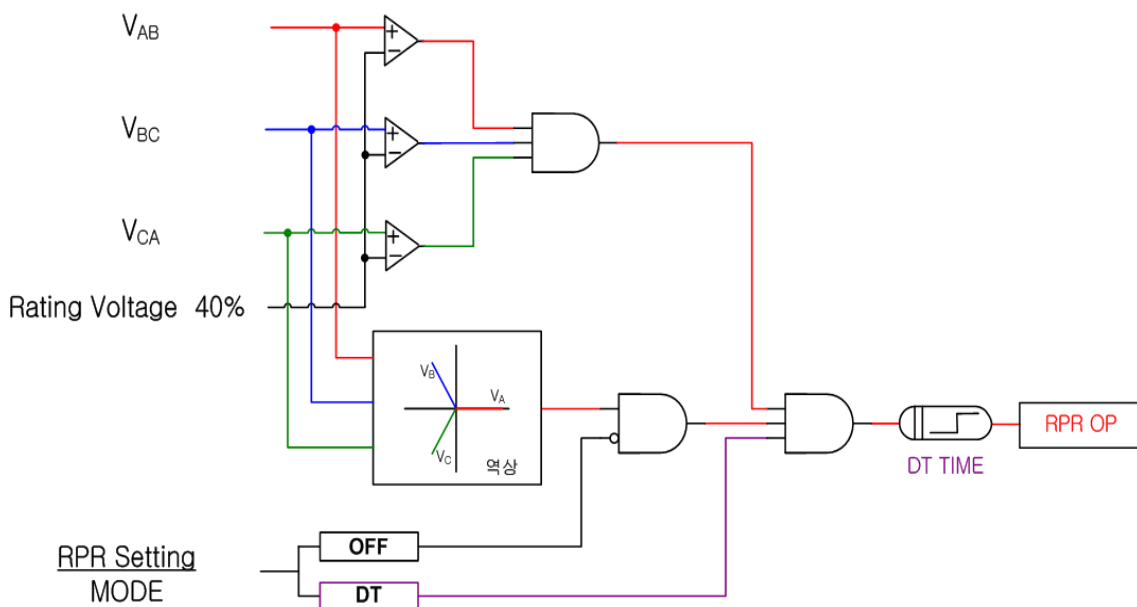
【Figure 3.10】 RPR Logic Diagram

4. Subsidiary Function

4.1 Metering

This relay measure voltage, current, angle, Unbalanced current.

【Table 4.1】 Measurement function

Section	Feature
Vab, Vbc, Vca	● Voltage RMS and angle metering. ● Primary line-to-line voltage that input voltage exchange PT ratio. ● Metering Range : 0 ~ 250V (When PT Ratio 1:1)
Ia, Ib, Ic	● Current RMS and angle metering. ● Primary currnet that input current exchange CT ratio. ● Metering Range : 0 ~ 200A (When CT Ratio 5:5)
In	● Current RMS metering. ● Primary currnet that input current exchange CT ratio. ● Metering Range : 0 ~ 100A (When CT Ratio 5:5)
Unbalanced Current	● Unbalanced Current is calculated by positive and negative sequence Current.
Angle	● Basis of angle is Vab.

However, indicate "FULL", when measuring data over metering range.

4.2 Communication

This relay provide communication method of common RS-232C / RS-485C and speed of maximum 19200 bps. Relay has 1 RS-232C port in front-side and RS-485C port in back-side. Front-side RS-232C port is used for setting change, confirm metering, confirm Fault information, LED indication, Remote Reset with PC tool and back-side RS-485C port is used for SCADA communication.

4.2.1 RS-232C Communication

RS-232C cable use cross-cable that crossed 2 and 3 pin like 【Figure 4.11】 . If you use direct-cable, you can't link communication.

When your PC don't have RS-232C, so you use USB port, must use cross-cable.
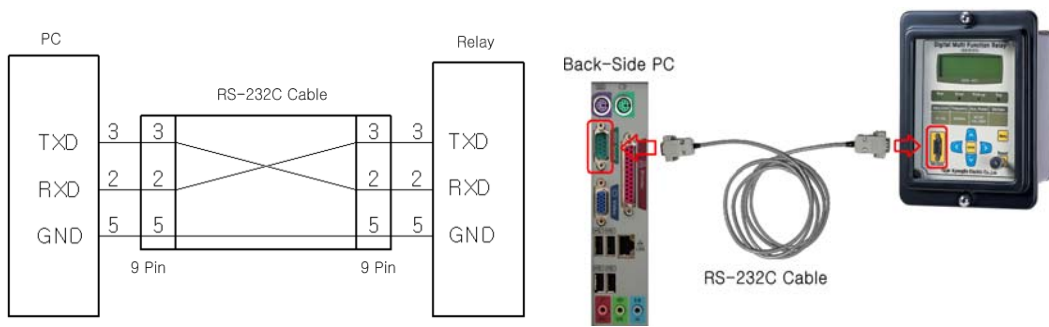
【Figure 4.1】 RS-232C Circuit   【Figure 4.2】 RS-232C Connect

【Table 4.2】 Communication Method

Communication Specification	Method	● RS-232 / RS-485
	Protocol	● MODBUS
Communication Standard (RS-485C)	Distance	● 1.2km
	Line	● Common RS-485C Two-Pair cable
	Speed	● 300 ~ 19,200 bps
	Method	● Half-Duplex
	Maximum input-output Voltage	● -7V ~ +12V
Communication Port	Front Display	● RS232 1port ● 300 ~ 19200 BPS, MODBUS Protocol
	Back - Side	● RS485 1port ● 300 ~ 19200 BPS, MODBUS Protocol ● Upper SCADA Communication ● Terminal number : 9(+), 11(-), 12(Com)

4.2.2 RS-485C Communicaton

This relay provide isolated RS-485C Half Duplex communication method for linking SCADA system. In this communication method can linked multi-drop and communication distance is maximum 1.2km. RS-485C line end resistance is parallel 120Ω like 【Figure 4.13】 RS-485C Connection Diagram.
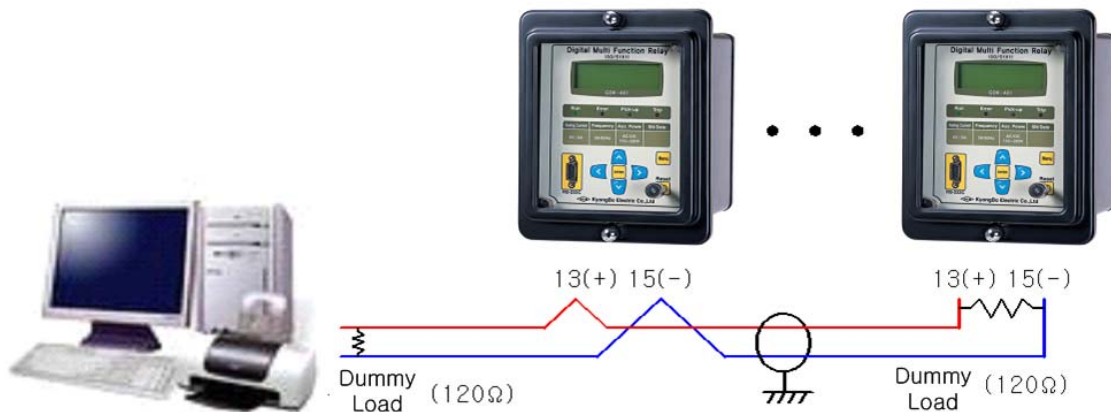
【Figure 4.3】 RS-485C Connect Diagram

4.3 Self Diagnosis Function

Self-diagnosis function keep back non-operation and mal-operation though observation at all time. If this function detect error, error LED turn on and self-diagnosis unit display FAIL. Also, when relay occur error, protection element stop operation and keep up the LCD and LED until error is removed.

Self-diagnosis unit is follow.

▣ Power Fail
▣ CPU Watchdog Fail
▣ Memory Fail
▣ Setting Fail

## 4.4 Fault Recording Function

Relay has to record and save that current and voltage magnitude / angle, unbalanced current, operation status of protection element, relay operating time, operating count for conventional fault analysis. Also, when new operation occur, old fault recording is deleted and new fault recording is saved. Even though, rated control power is disappeared, keep saved data.

5. Display Panel Construction

5.1 Front-side Display Panel Structure

Front-side and control panel have 20×4 LCD, 4 LED, 7 Keypad and RS-232C connector like 【Figure 5.14】.

When setting change, must input password, so other person don't change setting, and protective element run during relay control and setting change through LCD display.
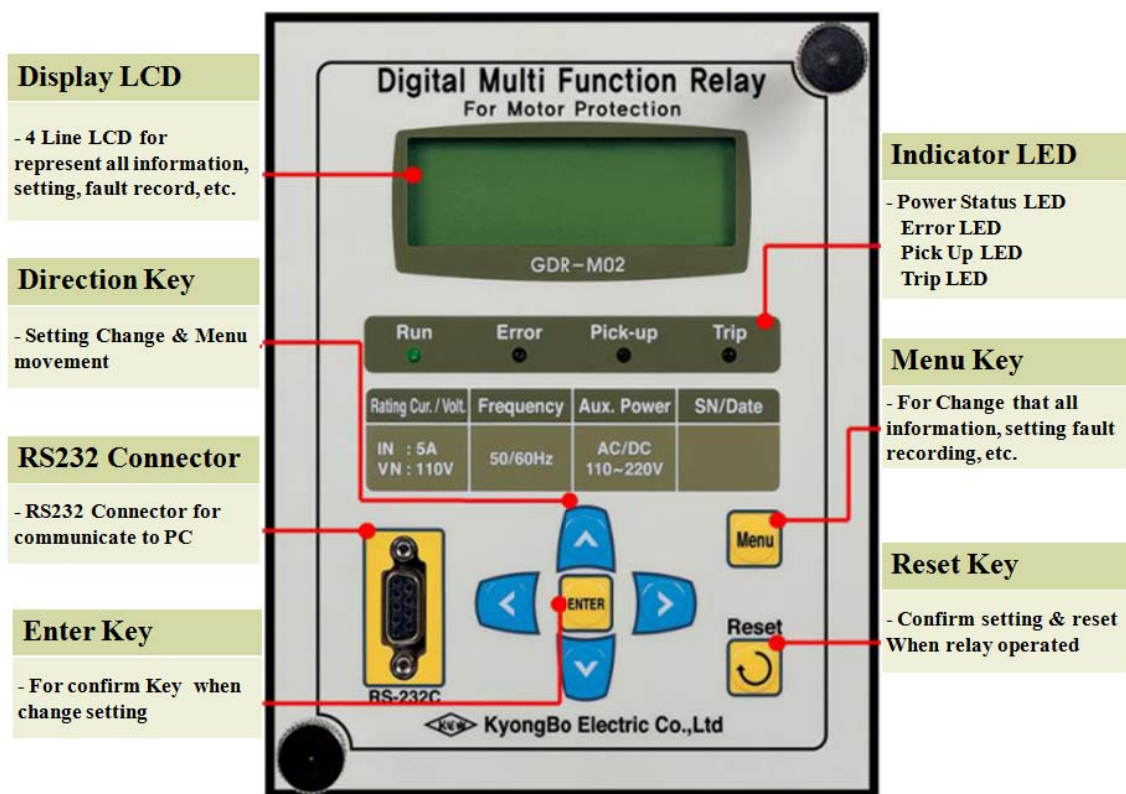
【Figure 5.1】 Front Panel Display

5.2 Key Pad & Communication Connector

【Table 5.1】 Key Pad & Communication Connector

Direction Key (◁ ▷ ∧ ∨)	Setting change and move to other menu use.
ENTER (ENTER) Key	Key use confirm, when menu or setting confirm.
Reset (↺) Key	Key use indicator reset, when relay operate.
Menu (Menu) Key	Key use for menu display.
RS-232C Connector	This is a RS-232C for Setting Tool PC application Program through communication.

5.3 LED (Operating Indicators)

【Table 5.2】 LED (Operating Indicators)

Run (Green)	This LED indicate normal operated CPU, when relay is supplied normal control power. If LED turn off during supplied normal control power, relay change or repair.
Error (Red)	This LED turn on red when relay detects error in device and protection element blocking. Detail relay error confirm relay menu through the LCD. If eliminate error, LED turn off.
Pick-up (Yellow)	When protection element become pick-up, Pick-Up LED turn on yellow. When protection element become release, Pick-Up LED turn off.
Trip (Red)	This LED is operation indicator of each protection element. When each protection element operate, the same time, each LED turn on red. This status LED keep up after release until push reset (↺) Key.

6. Display & Setting Modes

6.1 Key Control & LCD Construction

6.1.1 LCD Main Display, Backlight On/Off

LCD display main after supplied control power.

```
G D R - M 0 2    V 1 . 0
S y s t e m    O K !
```
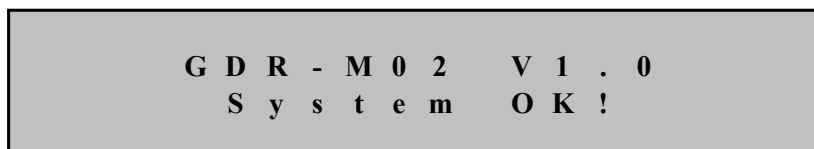
When relay has a error, LCD display "System Error!" in stead of "System OK!". Backlight of LCD turn off after 3minute without control and measuring rotate auto.

6.1.2 LCD Display & Key Control Principle

Relay menu is made up tree structure and select to use left(◀), right(▶), up(▲), down(▼) Key.

The place of (*) indicator is select unit and you want to move detail unit, push ▶ Key.

You want to escape the present menu, push ◀ Key.

6.1.3 One-button Display

If you do over again press Reset (↻) Key, can watch measure data, Setting values, self-diagnosis throw LCD display. This function can confirm relay data without opening cover.

Reset Key use to indicator reset, when protection element operated.

6.1.4 Menu-Tree

Menu Tree represent relay all manu structure follow 【Figure 6.1】 . Each menu setting method describe 6.2 Setting.
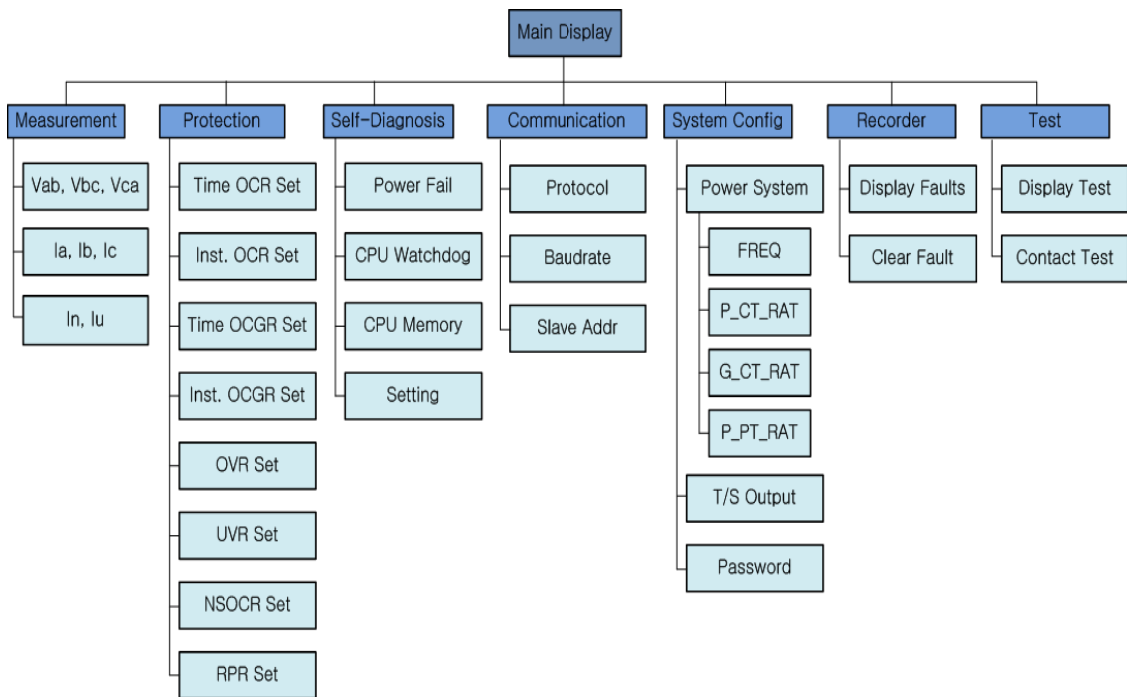
【Figure 6.1】 Menu Tree

6.1.5 Setting Modes

To right operate of this relay setting value match the power system. Setting and display elements of 7 are Measurement, Protection, Self-Diagnosis, RS-485 Comm., System Config, Recorder, Test.

At main display, if you push Menu (🟨) Key, display follow enter password next figure.
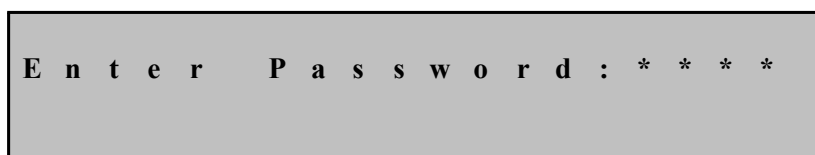
Enter   Password : * * * *

(1) 🔼🔽 Key : Number change.
(2) ◀▶ Key : Position change.
(3) ENTER (🟨) Key : Confirm password after enter password.

Password is composed of 4 position and each number made up from 0 to 9. First password value is "0000", so directly push enter key exchange setting mode.

Setting main display is follow.

```
-> S e t t i n g
1 . M e a s u r e m e n t                    *
2 . P r o t e c t i o n
3 . S e l f - D i a g n o s i s
4 . R S - 4 8 5   C o m m .
5 . S y s t e m   C o n f i g .
6 . R e c o r d e r
7 . T e s t
```
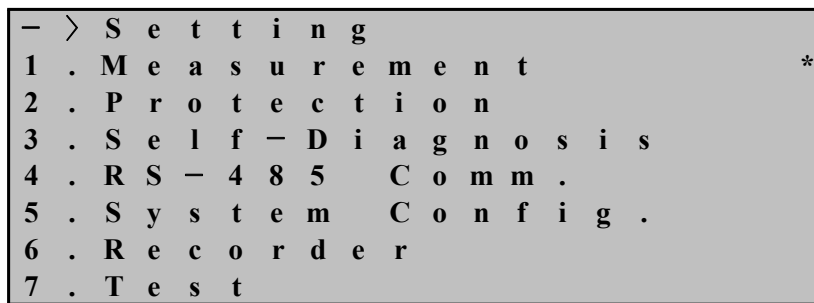
For example, if you want to change IOCG Pick-Up current, operate follow sequence.

(1) ☑ Key push : (*) indicator move to 2.Protection.
(2) ▸ Key push : Move to Protection display.
(3) ☑ Key push : (*) indicator move to 2.Inst. OCR.
(4) ▸ Key push : Move to Inst. OCR diplay.
(5) ☑ Key push : (*) indicator move to 2.PICK-UP.
(6) ▸ Key push : Present saving current value of 2.PICK-UP is flickering.
(7) ⌃☑ Key push : Change setting value.
(8) ENTER (⏎) Key push : Changing setting value temporary saving.
(9) ◂ Key push : Move to Protection display.
(10) ◂ Key push : Move to Setting display.
(11) ◂ Key push : Display follow. "No" is flickering.

```
       A r e   y o u   s u r e
  t o   s a v e   c h a n g e d
   S e t t i n g   V a l u e ?
              N o
```
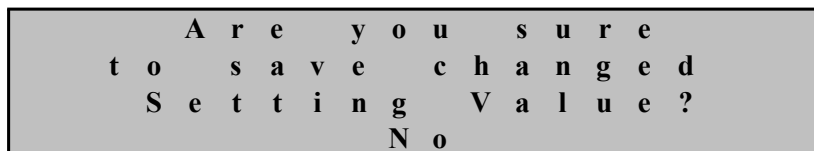
(12) ⌃☑ Key push : Select Yes.
(13) ENTER (⏎) Key push : Move to main display after saving change setting.
   If you push ENTER (⏎) Key after select No at (12), change setting delete and keep old setting values.
   Also, old setting values apply before press ENTER (⏎) Key at "Are you sure to save changed Setting Value? Yes".
   All contects setting do an upper example.

6.1.6　Measurement Display

Measurement display indicate measuring voltage and current.

Vab, Vbc, Vca mean line-to-line voltage, Ia, Ib, Ic mean phase current, In mean zero-sequence current, Iu mean unbalanced current ratio and indicate magnitude and angle.

That is, measuring data is primary values that are applied CT Ratio and PT Ration by secondary values.

```
—>   Measurements
Vab:110.1    V, <     0.0 °
Vbc:109.9    V, <239.8 °
Vca:110.3    V, <120.2 °
Ia:     5.03 A, <     0.0 °
Ib:     4.98 A, <240.1 °
Ic:     5.00 A, <119.8 °
In:     5.00 A, <     0.0 °
Iu:  0.00    %
```

If you want to escape Measurement Display, press ◀ Key. So, upper setting menu.

6.1.7　Protection Setting

Protection category has Time OCR, INST. OCR, Time OCGR, INST. OCGR, OVR, UVR, NSOCR and RPR.

In Setting, select 2. Protection, display follow.

```
—>   Protection
1. Time   OCR                *
2. INST   OCR
3. Time   OCGR
4. INST   OCGR
5. OVR
6. UVR
7. NSOCR
8. RPR
```

If you want to escape this menu, press ◀ Key. So, exchange main setting menu.

6.1.7.1　Protection ▶ Time OCR Setting

This is to set Time Over Current Element. In Protection, select (▶) 1. Time OCR, display follow.

```
−〉    T i m e    O C R
1 . C U R V E        :        L I        *
2 . P I C K − U P      :      5 . 0 A
3 . T − D I A L       :     1 0 . 0
```

If you want to escape Time OCR, press the ◄ Key.

Detail menu of Time OCR is follow,

【Table 6.1】 Time OCR Menu

Unit	Range	Step	Basis Value	Reference
CURVE	OFF, NI, VI, EI, LI, DT, KVI, KNI, KLVI, KLNI	-	KVI	Time Characteristic Setting
PickUp	2.0 ~ 12.5A	0.1A	5.0A	Time Pickup value
Time Dial	0.1 ~ 10.0	0.1	10.0	Time Ratio Setting
DT-Time	0.04 ~ 60.00Sec	0.01Sec	-	Definite Time Setting

6.1.7.2 Protection ▶ INST. OCR Setting

This is to set Instantaneous Over Current Element. In Protection, select (▷) 2. INST. OCR, display follow.

```
−〉    I N S T    O C R
1 . M O D E        :        D T        *
2 . P I C K − U P      :      5 0 A
3 . D T − T I M E     :    0 . 0 4 s
```

If you want to escape INST. OCR, press the ◄ Key.

Detail menu of INST. OCR is follow.

【Table 6.2】 INST. OCR Menu

Unit	Range	Step	Basis Value	Reference
MODE	OFF, INST, DT	-	DT	OFF, Inst, Definite time Setting
PickUp	10 ~ 90A	1A	50A	Inst. Pickup value
DT-Time	0.04 ~ 60.00Sec	0.01Sec	0.04Sec	Definite Time Setting

6.1.7.3 Protection ▶ Time OCGR Setting

This is to set Time ground over-current. In Protection, select (▶) 3. Time OCGR follow.

```
─〉  T i m e   O C G R
1 . C U R V E       :      L I       *
2 . P I C K － U P    :     0 . 5 A
3 . T － D I A L     :    1 0 . 0
```

If you want to escape Time OCGR, press the ◀ Key.
Detail menu of Time OCGR is follow.

【Table 6.3】 Time OCGR Menu

Unit	Range	Step	Basis Value	Reference
CURVE	OFF, NI, VI, EI, LI, DT, KVI, KNI, KLVI, KLNI	-	KVI	Time characteristic Setting
PickUp	0.2 ~ 2.5A	0.1A	0.5A	Time Pickup value
Time Dial	0.1 ~ 10.0	0.1	10.0	Time Ratio Setting
DT-Time	0.04 ~ 60.00Sec	0.01Sec	-	Definite Time Setting

6.1.7.4 Protection ▶ INST. OCGR Setting

This is to set Instantaneous ground over-current. In Protection, select (▶) 4. Inst OCGR, display follow.

```
-〉   I N S T   O C G R
1 . M O D E          :      D T      *
2 . P I C K - U P    :        5 A
3 . D T - T I M E    :    0 . 0 4 s
```

If you want to escape INST. OCGR, press the ◀ Key.

Detail menu of INST. OCGR is follow.

【Table 6.4】 INST. OCGR Menu

Unit	Range	Step	Basis value	Reference
MODE	OFF, INST, DT	-	DT	OFF, Inst, Definite Time Setting
PickUp	2 ~ 50A	1A	5A	Inst. Pickup Value
DT-Time	0.04 ~ 60.00Sec	0.01Sec	0.04Sec	Defnite Time Setting

6.1.7.5   Protection ▶ OVR Setting

This is to set Over Voltage Element. In Protection, select (▶) 5. OVR, display follow.

```
-〉   O V R   S e t
1 . C U R V E        :      D T      *
2 . P H A S E        : 1 P H A S E
3 . P I C K - U P    :    6 5 . 0 V
4 . T - D I A L      :      0 . 1
```

If you want to escape OVR, press the ◀ Key.

Detail menu of OVR is follow.

【Table 6.5】 OVR Menu

Unit	Range	Step	Basis Value	Reference
CURVE	OFF, NI, DT	-	NI	OFF, Inverse, Definite Time Setting
PHASE	1, 3 PHASE	-	1 PHASE	Single Phase / 3 Phase Setting
PICK-UP	65 ~ 170V	1V	130V	Time Pickup Value
T-DIAL	0.1 ~ 10.0	0.1	10.0	Time Ratio Setting
DT-TIME	0.04 ~ 60.00Sec	0.01Sec	-	Definite Time Setting

6.1.7.6　Protection ▶ UVR Set Setting

This is to set Under Voltage Element. In Protection, select (▷) 6. UVR, display follow.

```
─〉  U V R    S e t
1 . C U R V E          :      D T        *
2 . P H A S E          : 1 P H A S E
3 . P I C K − U P      : 1 0 5 . 0 V
4 . T − D I A L        :     1 0 . 0
5 . R S T - M O D E    :        O F F
```

If you want to escape UVR, press the ◁ Key.
Detail menu of UVR is follow.

【Table 6.6】 UVR Menu

Unit	Range	Step	Basis Value	Reference
CURVE	OFF, NI, DT	-	NI	OFF, Inverse, Definite Time Setting
PHASE	1, 3 PHASE	-	1 PHASE	Single Phase / 3 Phase Setting
PICK-UP	30 ~ 105V	1V	90V	Time Pickup Value
T-DIAL	0.1 ~ 10.0	0.1	10.0	Time Ratio Setting
DT-TIME	0.04 ~ 60.00Sec	0.01Sec	-	Definite Time Setting
RST Mode	ON, OFF	-	OFF	Release Mode Setting
RST Time	0.1 ~ 180.0Sec	0.1Sec	-	Release Time Setting

6.1.7.7 Protection ▶ NSOCR Setting

This is to set Negative-Sequence Over Current Element. In Protection, select (▶) 7. NSOCR, display follow.

```
-〉  N S O C R   S e t
1 . M O D E           :      D T      *
2 . P I C K - U P      :      3 0 %
3 . D T - T I M E      :   0 . 0 4 s
```

If you want to escape NSOCR, press the ◀ Key.
Detail menu of NSOCR is follow.

【Table 6.7】 NSOCR Menu

Unit	Range	Step	Basis Value	Reference
MODE	OFF, DT	-	DT	OFF, Definite Time Setting
PickUp	30 ~ 70%	1%	30 %	Pickup Value
DT-Time	0.04 ~ 60.00Sec	0.01Sec	0.04Sec	Definite Time Setting

6.1.7.8　Protection ▶ RPR Setting

This is to set Reverse Phase Element. In Protection, select (▷) 8. RPR, display follow.

```
─〉    R P R    S e t
1 . M O D E              :     D T        *
2 . D T － T I M E        :   0 . 0 4 s
```

If you want to escape RPR, press the ◁ Key.
Detail menu of RPR is follow.

【Table 6.8】　RPR Menu

Unit	Range	Step	Basis Value	Reference
MODE	OFF, DT	-	DT	OFF, Definite Time Setting
DT-Time	0.04 ~ 60.00Sec	0.01Sec	0.04Sec	Definite Time Setting

6.1.8　Self-Diagnosis Display

This menu display self-diagnosis of each unit.

Diagnosis unit are Power, CPU WatchDog Timer, Memory, Setting and if each unit has error, LCD indicate "FAIL", and LCD main display "System Error!" instead of "System OK!", and Error LED turn on red.

Self-Diagnosis display follow.

```
─〉    S e l f － D i a g n o s i s
1 . P o w e r              :    O K     *
2 . C P U   W a t c h d o g :    O K
3 . M e m o r y            :    O K
4 . S e t t i n g          :    O K
```

If you want to escape Self-diagnosis, press ◁ Key. So, exchange upper menu.

6.1.9 RS-485 Comm. Setting

For setting of communication unit set Baudrate, Slave Addr.

In setting, select 4. RS-485 Comm., Comm. setting display follow.

```
-〉  R S - 4 8 5   C o m m .
1 . P r o t o c o l      : M o d B u s *
2 . B a u d r a t e      : 1 9 2 0 0
3 . S l a v e   A d d r :        1
```

If you want to escape RS-485 Comm., press ◁ Key. Exchange main display.

【Table 6.9】 RS-485 Comm. Setting

Unit	Range	Basis Value	Reference
Protocol	MODBUS	MODBUS	Communication Protocol
Baudrate	300, 600, 1200, 2400, 4800, 9600, 19200 (bps)	19200	Communication Speed Setting
Slave Addr	1 ~ 254	1	Slave Addr Setting

6.1.10 System Config. Setting

System Config. has Power system, T/S Output, Password etc. of detail menu.

In setting, select 5. System Config., System Config. setting display follow.

```
-〉  S y s t e m   C o n f i g .
1 . P o w e r   S y s t e m          *
2 . T / S   O u t p u t
3 . P a s s w o r d
```

If you want to escape System Config., press ◁ Key. Exchange main display.

6.1.10.1 System Config. ▶ Power system Setting

Power system has FREQ(frequency), P_CT_RAT, G_CT_RAT, P_PT_RAT of detail menu.

In System Config., select 1. Power system, Power System setting display follow.

```
─ 〉   P o w e r    S y s t e m
1 . F R E Q            :          6  0  H z  *
2 . P _ C T _ R A T :              5  :  5
3 . G _ C T _ R A T :         1 . 0  :  1
4 . P _ P T _ R A T :         1 . 0  :  1
```

If you want to escape Power System., press ◁ Key. Exchange upper display.

• **System Config. ▶ Power system ▶ FREQ Setting**

To use for relay of official frequency setting menu.

50Hz and 60Hz two unit, if power system frequency is 60Hz, select 60Hz.

• **System Config. ▶ Power system ▶ P_CT_RAT Setting**

This manu set primary CT ratio of Phase. To set from 5 to 10000 with 5step. This relay is designed 5A to secondary rated current CT, so, you must selcect 5A to CT secondary rated current CT. For example, if you use 1000:5 CT, P_CT_RAT set 1000.

• **System Config. ▶ Power system ▶ G_CT_RAT Setting**

This manu set primary CT ratio of Ground side. To set from 5 to 10000 with 5step. This relay is designed 5A to secondary rated current CT, so, you must selcect 5A to CT secondary rated current CT. For example, if you use 1000:5 CT, G_CT_RAT set 1000.

• **System Config. ▶ Power system ▶ P_PT_RAT Setting**

This menu set primary PT ratio of Phase. To set from 0.1 to 3200.0 with 0.1step. For example, if you use 22900:110 PT, P_PT_RAT set 208.2.

6.1.10.2 System Config. ▶ T/S Output Setting

T/S Output menu set connecting type and delay time of 4 contact output.

In System Config, select 2. T/S Output, T/S Output setting display follow.

```
─ 〉   T / S    O u t p u t
1 . T / S 1                              *
2 . T / S 2
3 . T / S 3
4 . T / S 4
```

If you set T/S output you want, to use ⬆️⬇️ Key and move to (*) indicator at wish menu.

• **System Config. ▶ T/S Output ▶ T/S 1 Setting**

T/S number menu set connecting type, return method and delay time of 4 contact output.

In T/S Output, select 1. T/S 1, display follow.

```
− 〉   T / S   1
1 . C O N   :       P R O T _ O R   *
2 . R S T   :             S E L F
3 . D L Y   :           0 . 0 0 s
```

Upper display, T/S 1 means contact output #1.

If you want to escape T/S1, press ◀️ Key. Exchange upper display.

• **System Config. ▶ T/S Output ▶ T/S 1 ▶ 1. CON Setting**

This menu select operation status.

T/S output connection and mean follow.

【**Table 6.10**】　**T/S Connection Menus**

Connection	Reference
OFF	Don't use.
PROT_OR	Any other protection element operate, output.
OCR	Inst OCR or Time OCR element operate, output.
Inst OCR	Inst OCR element operate, output.
Time OCR	Time OCR element operate, output.
OCR_A	A phase OCR element operate, output.
OCR_B	B phase OCR element operate, output.
OCR_C	C phase OCR element operate, output.
OCR+OCGR	OCR element or OCGR element operate, output
OCGR	OCGR element operate, output.
Inst OCGR	Inst OCGR element operate, output.
Time OCGR	Time OCGR element operate, output.
OVR+UVR	OVR element or UVR element operate, output
OVR	OVR element operate, output.
UVR	UVR element operate, output.
NSOCR+RPR	NSOCR element or RPR element operate, output
NSOCR	NSOCR element operate, output.
RPR	RPR element operate, output.

• **System Config. ▶ T/S Output ▶ T/S 1 ▶ 2. RST Setting**

This menu set to return method of contact output.

This relay has two method of Self Mode and Manual Mode.

Self Mode is auto retuning method and, Manual Mode is manual retuning method.
In other word, user want to contact output retuning, must push Reset (🔄) Key.

• **System Config. ▶ T/S Output ▶ T/S 1 ▶ 3. DLY Setting**

At contact output retuning, you can set delay time throw this menu.

This menu is applicable to Self Mode and if Manual Mode isn't applicable to the menu.

If you DLY set 0.00, contact output return less than 40ms and if you want to return less than 100ms, set 0.06.

You can set from 0.00 to 60.00 with 0.01Sec step, if you set less than 100ms, error is ±35ms, if you set more than 100ms, error is ±5%.

6.1.10.3 System Config. ▶ Password Setting

This manu is to change password 4 position and each number set from 0 to 9.
In System Config., select 3.Password, password setting display follow.

```
─ 〉   P a s s w o r d
 N e w    P a s s w o r d   : * * * *


```

In this display, if you press ENTER (⬛) Key after enter new password, come out confirm new password display.

```
─ 〉   P a s s w o r d
  N e w    P a s s w o r d   : * * * *
C f m .    P a s s w o r d   : * * * *

```

In this display, enter new password agin and press ENTER (⬛) Key, come out under figure and exchange upper menu display.

```
─ 〉    P  a  s  s  w  o  r  d
   N  e  w    P  a  s  s  w  o  r  d    :  *  *  *  *
C  f  m  .    P  a  s  s  w  o  r  d    :  *  *  *  *
   P  a  s  s  w  o  r  d    C  o  n  f  i  r  m  e  d
```

If you don't want to change password, press ◄ Key, then escape this menu and exchange upper menu display.

6.1.11 Recorder

This menu indicate fault element and fault counter.

In Setting, select 6. Recorder, Recorder setting display follow.

```
─ 〉    F  a  u  l  t    R  e  p  o  r  t
1  .  D  i  s  p  l  a  y    F  a  u  l  t  s         *
2  .  C  l  e  a  r    F  a  u  l  t  s
               2      F  a  u  l  t  s  !
```

If you want to escape Recorder, press the ◄ Key, Exchange upper display.

6.1.11.1 Recorder ▶ 1.Display Fault Display

Display Fault displays latest fault recording. When new fault occur, delete oldest fault record and save new record.

In Recorder, select 1.Display Fault, Display Fault unit display follow.

```
─ 〉    D  i  s  p  l  a  y    F  a  u  l  t  s
1  .  C  o  u  n  t  e  r    :             1  9  6     *
2  .  E  l  e  m  e  n  t    :        I  O  C  R    A
3  .  T  i  m  e              :             4  0  m  s
4  .  V  a  b  :        0  .  0  V  ,       0  .  0  °
5  .  V  b  c  :  2  5  0  .  0  V  ,     4  4  .  4  °
6  .  V  c  a  :        0  .  0  V  ,     4  4  .  3  °
7  .  I  a  :     2  0  0  .  0  A  ,  2  9  9  .  9  °
8  .  I  b  :        0  .  0  0  A  ,  1  3  3  .  2  °
9  .  I  c  :        0  .  0  0  A  ,  3  2  6  .  6  °
0     I  n  :       5  0  .  0  A  ,  2  2  8  .  2  °
1     I  u  :  1  0  2  .  1  6  %
```

In upper display, if you want to confirm fault record, press ▲▼ Key and so, you can confirm cumulation counter, operation element and relay operation time.

If you want to escape Display Fault, press ◀ Key. Exchange upper display.

6.1.11.2 Recorder ▶ 2.Clear Fault Unit

This menu can delete saving fault recording.

In Recorder, select 2.Clear Fault, Clear Fault display follow.

```
─ 〉   C l e a r     F a u l t s
      C l e a r     A l l     F a u l t s ?
                    N o
```

In upper this display with flickering "No", if you want to escape Clear Fault, press ◀ Key, and, if you want to delete saving fault recording, press ENTER ([ENTER]) Key after exchange "No" for "Yes".

6.1.12 Test

Test menu can test display and contact.

In Setting, select 7. Test, test display follow.

```
─ 〉   T e s t
1 . D i s p l a y     T e s t                    *
2 . C o n t a c t     T e s t
```

If you want to escape Test, press ◀ Key. Exchange main menu display.

6.1.12.1 Test ▶ Display Test

This menu can be test of LCD and LED error existence and nonexistence.

In Test, select 1.Display Test, under display follow.

In Display Test, if you don't want to Display Test that press ◀ Key, escape this menu and exchange upper menu display.

```
─ 〉   D i s p l a y     T e s t
          A r e     y o u     s u r e
      t o     t e s t     D i s p l a y ?
                    N o
```

In upper display for Display Test, press ▲▼ Key so, exchange from "No" to "Yes" and press ENTER (ENTER) Key, if so, move to Test menu after TEST of LCD and all LED flicker 3time.

If you do Display Test, follow under display.

```
T E S T T E S T T E S T T E S T T E S T
T E S T T E S T T E S T T E S T T E S T
T E S T T E S T T E S T T E S T T E S T
T E S T T E S T T E S T T E S T T E S T
```

6.1.12.2 Test ▶ Contact Test

This menu can be error existence and nonexistence of contact output that exchange contact output.

In Test, select 2. Contact Test, under display follow.

```
─ 〉   C o n t a c t    T e s t
1 . T / S   1          :    O f f      *
2 . T / S   2          :    O f f
3 . T / S   3          :    O f f
4 . T / S   4          :    O f f
5 . H . A l a r m      :    O n
```

You want to test contact output select T/S1 ~ T/S4 and, to press ▲▼ Key, change On, press ENTER (ENTER) Key, contact output is energized and return off as sound click.

If you want to test Healthy Alarm, select contact output and later, to press ▲▼ Key, change On, press ENTER (ENTER) Key, contact output is energized and return on as sound click.

If you want to escape Contact Test, press ◀ Key. Exchange upper menu display.

【Table 6.11】 Setting Menus

| Setting (Menu)	1.Measurements			Vab∠θº, Vbc∠θº, Vca∠θº, Ia∠θº, Ib∠θº, Ic∠θº, In∠θº, Iu(%)
	2.Protection	1.Time OCR	1.Curve	OFF, NI, VI, EI, LI, DT, KVI, KNI,, KLVI, KLNI
			2.PickUp	2.0~12.5A (0.1A Step)
			3.Time Dial	0.1~10.0 (0.1Step)
			4.DT_Time	0.04~60.00Sec (0.01Sec Step)
		2.INST. OCR	1.Mode	OFF, INST, DT
			2.PickUp	10~90A (1A Step)
			3.DT_Time	0.04~60.00Sec (0.01Sec Step)
		3.Time OCGR	1.Curve	OFF, NI, VI, EI, LI, DT, KVI, KNI,, KLVI, KLNI
			2.PickUp	0.2~2.5A (0.1A Step)
			3.Time Dial	0.1~10.0 (0.1Step)
			4.DT_Time	0.04~60.00Sec (0.01Sec Step)
		4.INST. OCGR	1.Mode	OFF, INST, DT
			2.PickUp	2~50A (1A Step)
			3.DT_Time	0.04~60.00Sec (0.01Sec Step)
		5.OVR	1.Curve	OFF, NI, DT
			2.Phase	1Phase, 3Phase
			3.Pick-Up	65~170V (1V Step)
			4.Time Dial	0.1~10.0 (0.1 Step)
		6.UVR	1.Curve	OFF, NI, DT
			2.Phase	1Phase, 3Phase
			3.Pick-Up	30~105V (1V Step)
			4.Time Dial	0.1~10.0 (0.1 Step)
		7.NSOCR	1.Mode	OFF, DT
			2.PickUp	30~70% (1% Step)
			3.DT_Time	0.04~60.00Sec (0.01Sec Step)
		8.RPR	1.Mode	OFF, DT
			2.DT_Time	0.04~60.00Sec (0.01Sec Step)

Setting (Menu)	3.Self-Diagnosis			Power, CPU Watchdog, Memory, Setting
	4.RS-485 Comm.	1.Protocol		MODBUS
		2.Baudrate		300, 600, 1200, 2400, 4800, 9600, 19200 (bps)
		3.Slave Addr		1 ~ 254
	5.System Config.	1.Power System	1.FREQ	50Hz or 60Hz
			2.P_CT_RAT	5 ~ 10000 : 5 (5 Step)
			3.G_CT_RAT	5 ~ 10000 : 5 (5 Step)
			4.P_PT_RAT	0.1 ~ 3200.0 : 1 (0.1 Step)
		2.T/S Output	T/S 1~4 1.CON	OFF, PROT_OR, OCR, Inst OCR, Time OCR, OCR_A, OCR_B, OCR_C, OCR+OCGR, OCGR, Inst OCR, Time OCR, OVR+UVR, OVR, UVR, NSOCR+RPR, NSOCR, RPR
			2.RST	SELF or MANUAL
			3.DLY	0.00~60.00Sec (0.01Sec Step)
		3.Password		New Password : ****
	6.Recorder	1.Display Faults		Counter, Element, Time, Vab∠θº, Vbc∠θº, Vca∠θº, Ia∠θº, Ib∠θº, Ic∠θº, In∠θº, Iu(%)
		2.Clear Faults		Clear All Faults? Yes or No
	7.Test	1.Display Test		Are you sure to Display Test? Yes or No
		2.Contact Test		T/S 1~4, H.Alarm : On or Off

7. PC Software

GDR-M02 can use PC Tool like relay menu that every kind setting, fault information, status, data change and confirm. PC perform operation that connect RS-232C communication port of PC and relay print-side, and use MODBUS with communication protocol. Also, relay possible RS-485 communication to use back-side terminal. When relay change setting, repeat changing work, however, if you use GDR-M02, it work once, and save working data, so, if you do same working, it so open save file therefore so easy. Connected all working data is saved and again open. Under display is main display at operated GDR-M02.
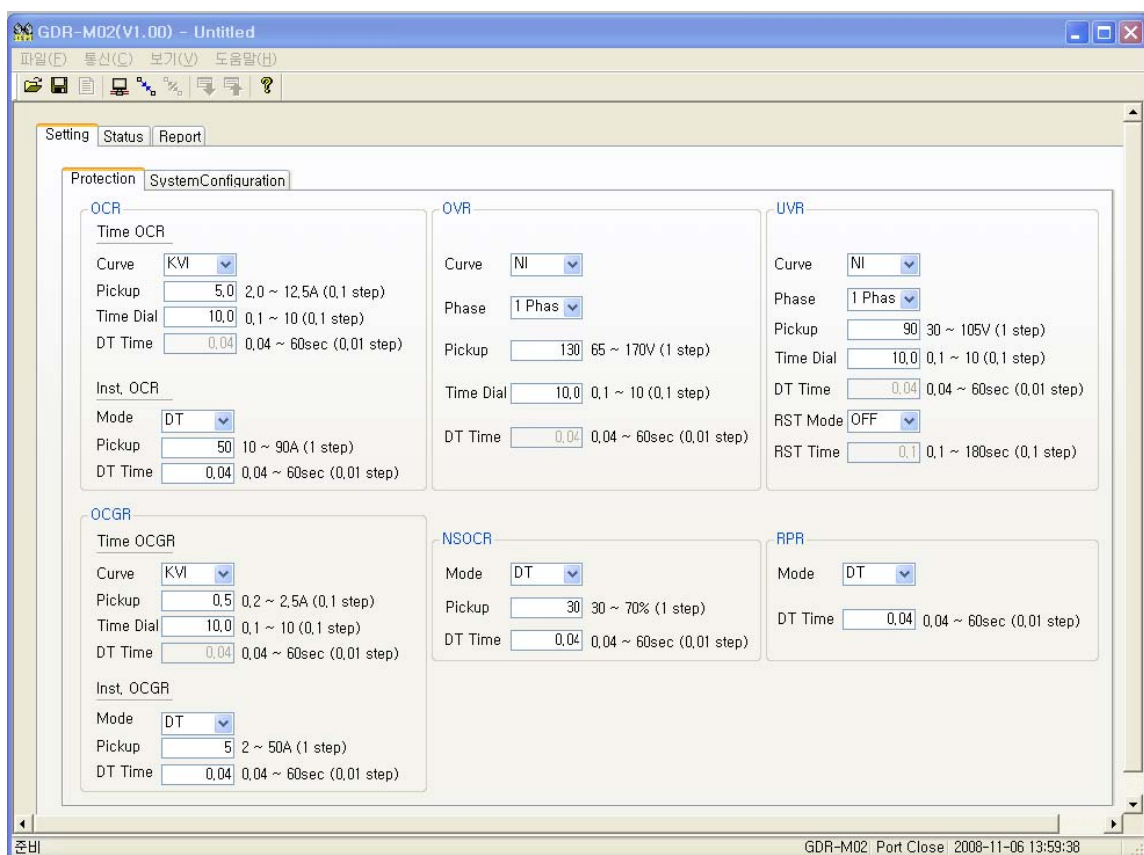
【Figure 7.1】 GDR-M02 Main Display

7.1 Program Menu

Basic menu of GDR-M02 is composed Communication Setting menu, File input and output menu, Relay relate Setting menu, and detail refer to 【Table 7.1】.

【Table 7.1】 GDR-M02 Program Menus

● Program Menu	
Comm	Select Com. port of PC (Refer to 7.2 Com. port setting)
Connect	Connect relay and PC communication and initialization.
Disconnect	Disconnect Communication.
Open	Open established Setting File.
Save	Save Setting(System, Protection).
Report	Save Setting(Relay Information, System, Protection, Fault) with text file.
PC → Relay	Sent to relay that changing System, Protection setting.
Relay → PC	Upload from relay of all GDR-M02 setting.
Exit(X)	Exit program.

7.2   Communication Port Configuration

This function use to select Com-port in 15port that don't used because of another equipment. Also, RS-232C communication protocol is MODBUS, so PC software use with RS-485.
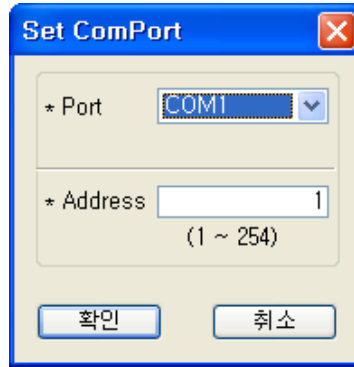
【Figure 7.2】   Communication Port Setting

【Table 7.2】   Communication Port Configuration

• Communication		
Port	COM1 ~ COM15	
	Communication Port	
ADDR	1~254	RS-485C use at communication
	Slave Address (MODBUS Protocol) for RS-485C	

7.3 Setting Change Display

When execute GDR-M02 Setting Tool, come out Setting, Status, Report contents display. In here, if click Relay → PC (⬆) button, confirm system composition and saving data of relay, and, in setting display, if click PC → Relay (⬇) button, send to relay PC setting. Also, if click Save(💾) button, contents of setting displays are saved (*.gdr) file, and, if click Open(📂) button, you can open saved file. If click Report(📋) button, you can save report with (*.txt) file.

7.3.1 Setting

In Setting display, you can set up Protection Element and System Configuration. Setting item is composed Time OCR(Time Over Current Element), INST. OCR(Instantaneous Over Current Element), Time OCGR(Time Ground Over Current Element), INST. OCGR(Instantaneous Ground Over Current Element), OVR(Over Voltage Element), UVR(Under Voltage Element), NSOCR(Negative-Sequence Over Current Element), RPR(Reverse Phase Element), Power System and T/S Output etc, description of each element equal to relay menu composition display, so refer to "6. Display and Setting Mode".
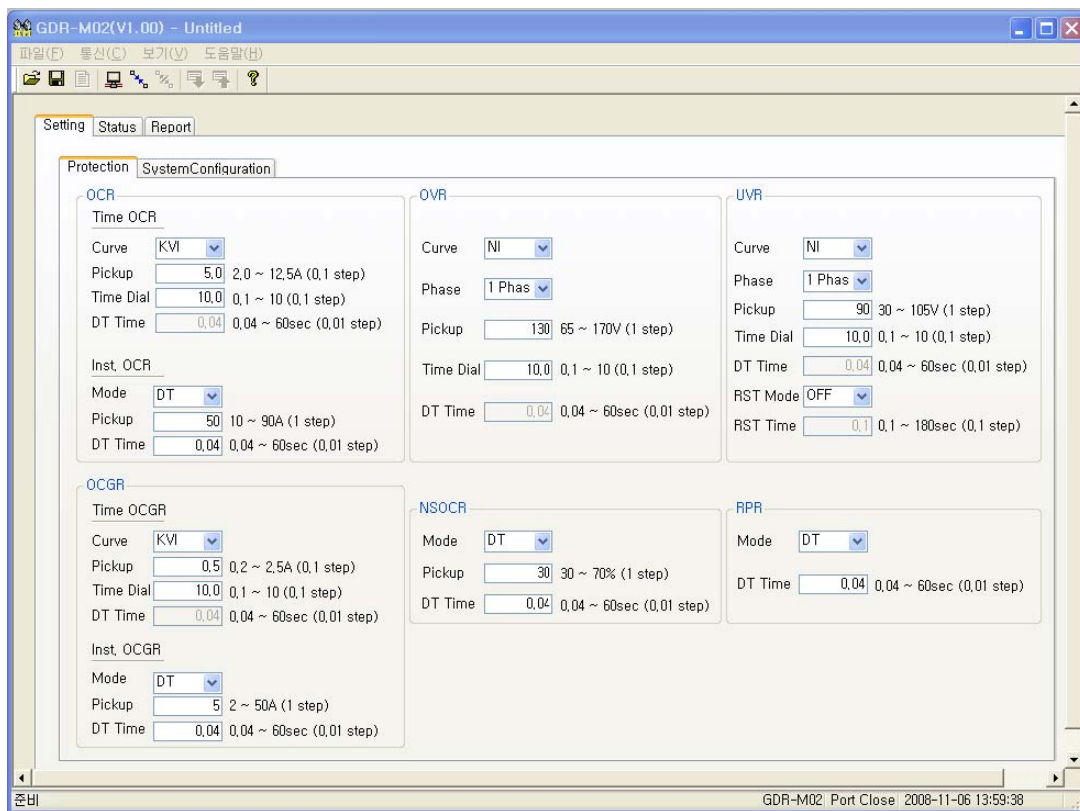
【Figure 7.3】 GDR-M02 Setting

7.3.2 Status

Status display represent one screen that is composed Measurement, Fault Record, State.

Description of this item equal to relay menu composition display, so refer to "6. Display and Setting Mode".
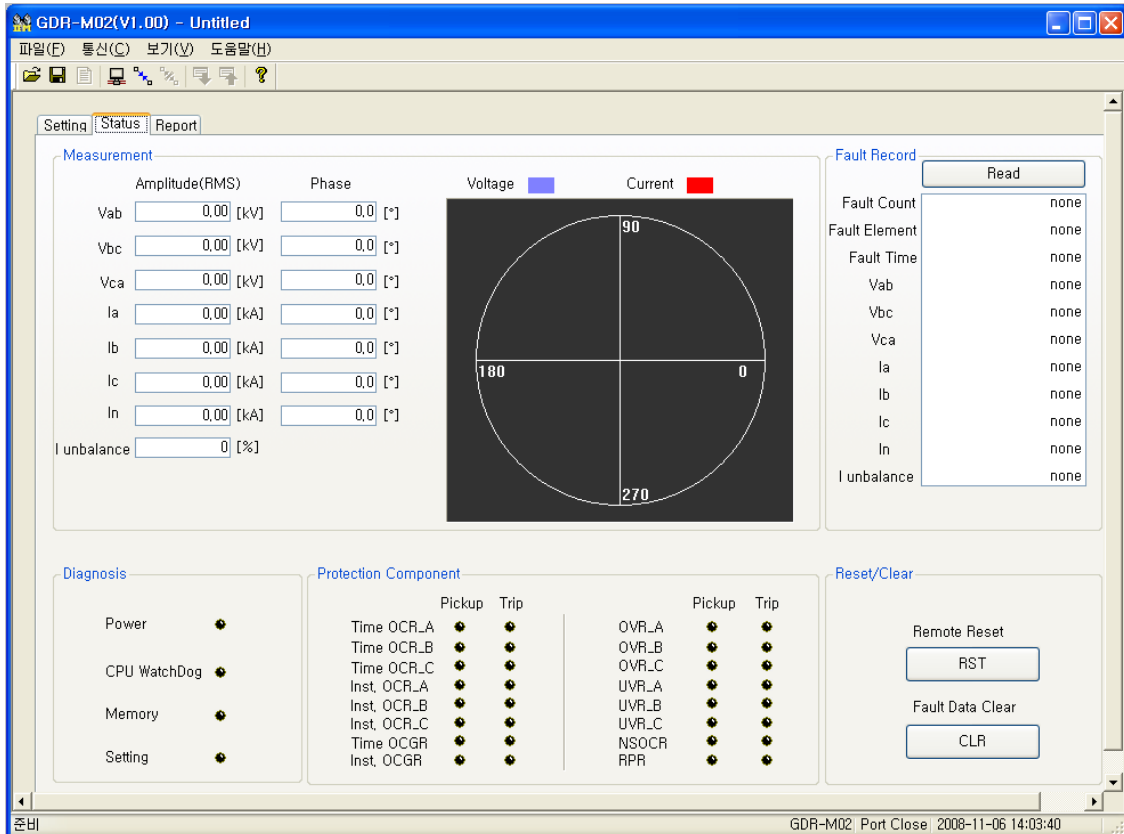
【Figure 7.4】 GDR-M02 Status

Measurement unit of GDR-M02 is kV, kA, mA, %.

Click Read button, relay shows last fault recording.

Click RST button, it operate remote Indicator Reset like relay Reset ( ) Key.

Click CLR button, it operate remote Clear Fault like Recorder ▶ 2.Clear Fault of relay menu.

7.3.3 Report

You can save relay information(Relay Information, Setting Data, System Configuration, Fault Record) txt file throw connected relay and PC.
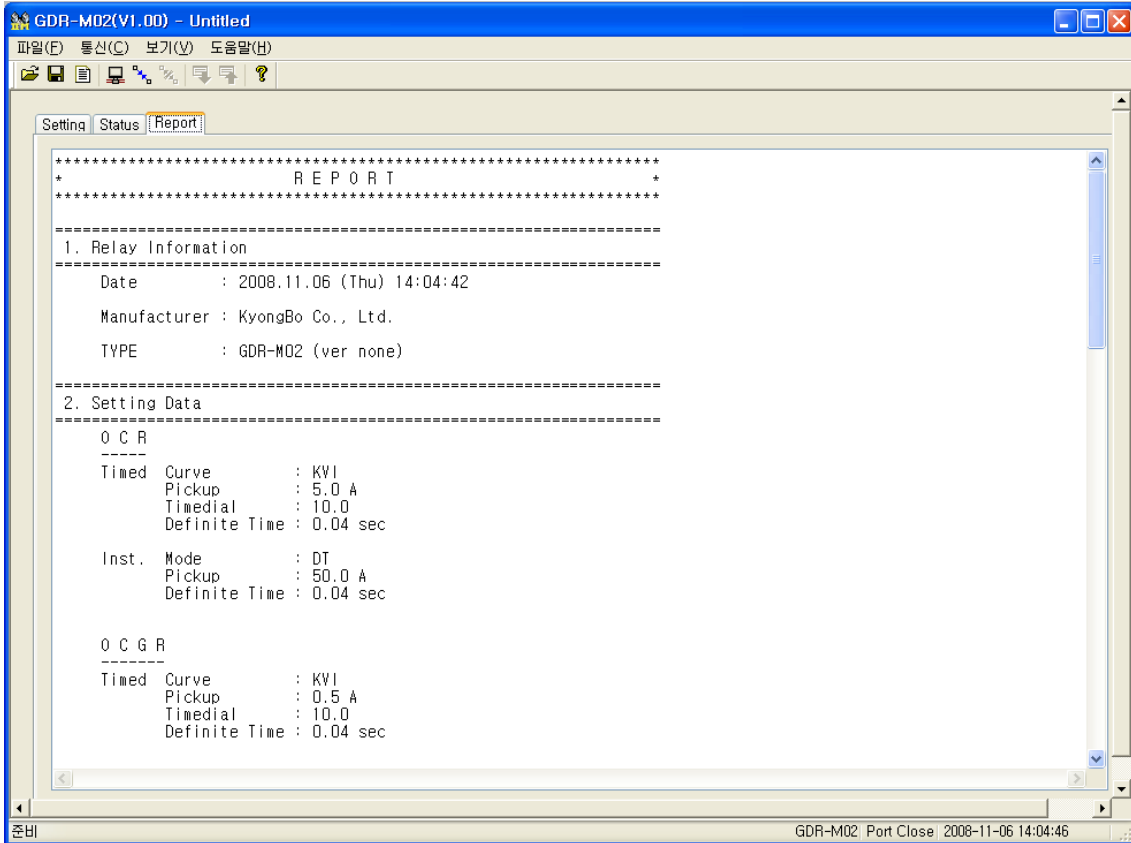
【Figure 7.5】 GDR-M02 Report

7.4 Help

This menu is known description of Setting Tool, A/S support, internet homepage, E-mail address, address, telephon number etc.

【Figure 7.6】 Help

Appendix 1. Setting Value at Product Shipping

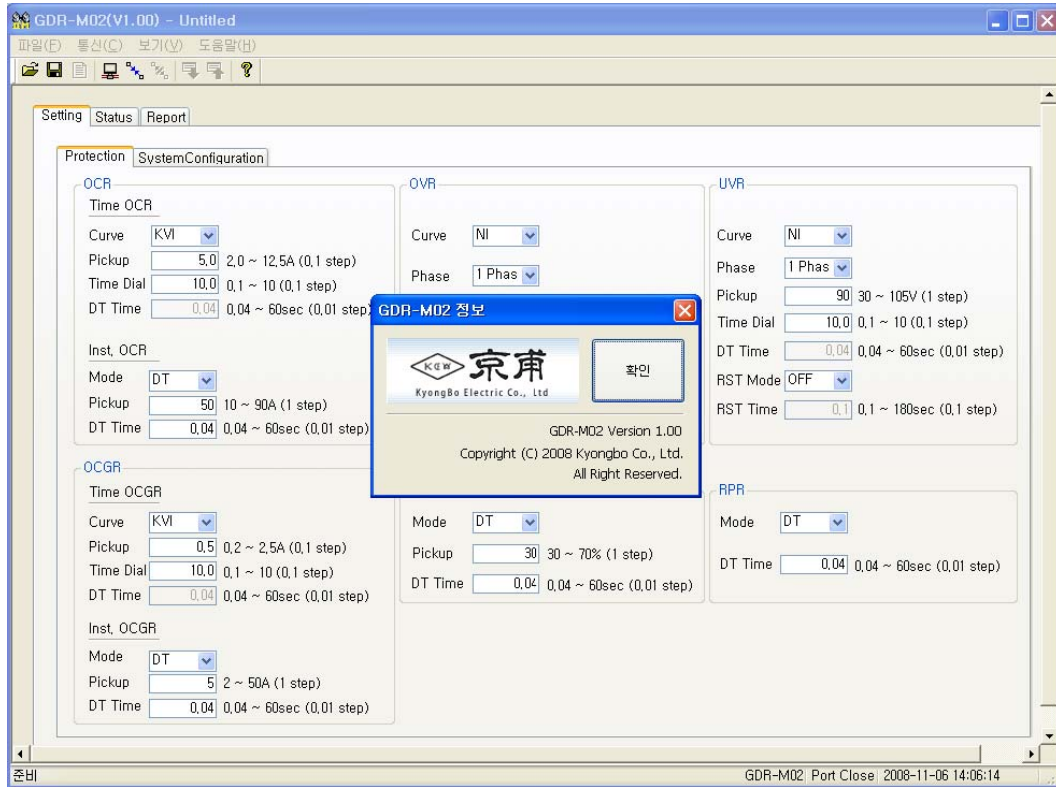| Setting (Menu)	2. Protection	1. Time OCR	1. Curve	KVI
			2. PickUp	5 A
			3. Time Dial	10
			4. DT_Time	-
		2. INST. OCR	1. Mode	DT
			2. PickUp	50 A
			3. DT_Time	0.04 Sec
		3. Time OCGR	1. Curve	KVI
			2. PickUp	0.5 A
			3. Time Dial	10
			4. DT_Time	-
		4. INST. OCGR	1. Mode	DT
			2. PickUp	5 A
			3. DT_Time	0.04 Sec
		5. OVR	1. Curve	NI
			2. Phase	1 Phase
			3. Pick-Up	130 V
			4. Time Dial	10
		6. UVR	1. Curve	NI
			2. Phase	1 Phase
			3. Pick-Up	90 V
			4. Time Dial	10
			5. RST Mode	OFF
			6. RST Time	-
		7. NSOCR	1. Mode	DT
			2. PickUp	30 %
			3. DT_Time	0.04 Sec
		8. RPR	1. Mode	DT
			2. DT_Time	0.04 Sec

|					
Setting (Menu)	4. RS-485 comm.	1. Baudrate			19200 bps
		2. Slave Addr			1
	5. System Config.	1. Power System	1. FREQ		60
			2. P_CT_RAT		5 : 5
			3. G_CT_RAT		5 : 5
			4. P_PT_RAT		1 : 1
		2. T/S Output	T/S1	1. CON	PROT-OR
				2. RST	Self
				3. DLY	0.00 Sec
			T/S2	1. CON	OCR + OCGR
				2. RST	Self
				3. DLY	0.00 Sec
			T/S3	1. CON	OVR + UVR
				2. RST	Self
				3. DLY	0.00 Sec
			T/S4	1. CON	NSOCR + RPR
				2. RST	Self
				3. DLY	0.00 Sec
		3. Password			0000

Appended 1. Dimensioned Drawings   Unit : mm
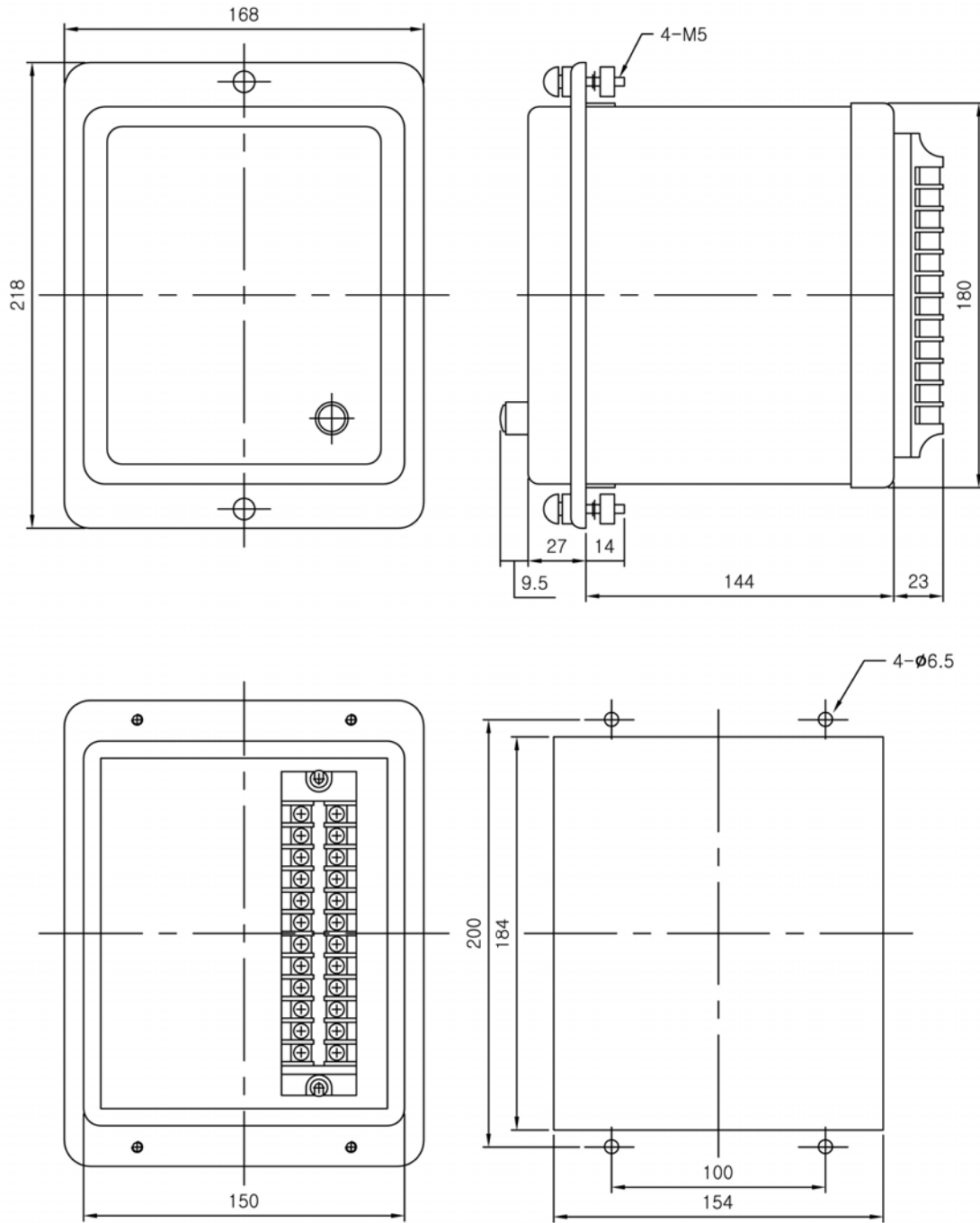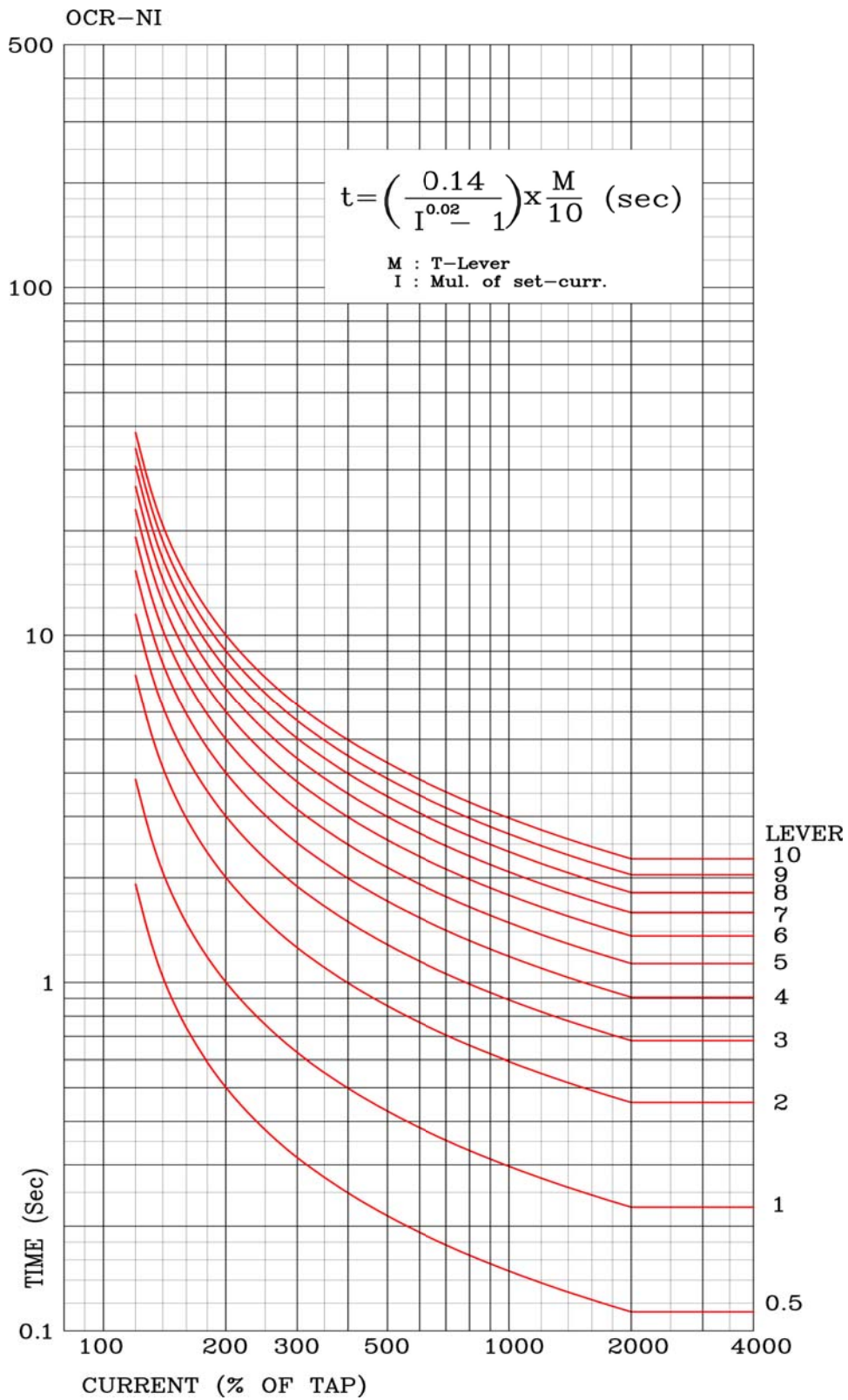
Appended 2. Internal Block Diagram
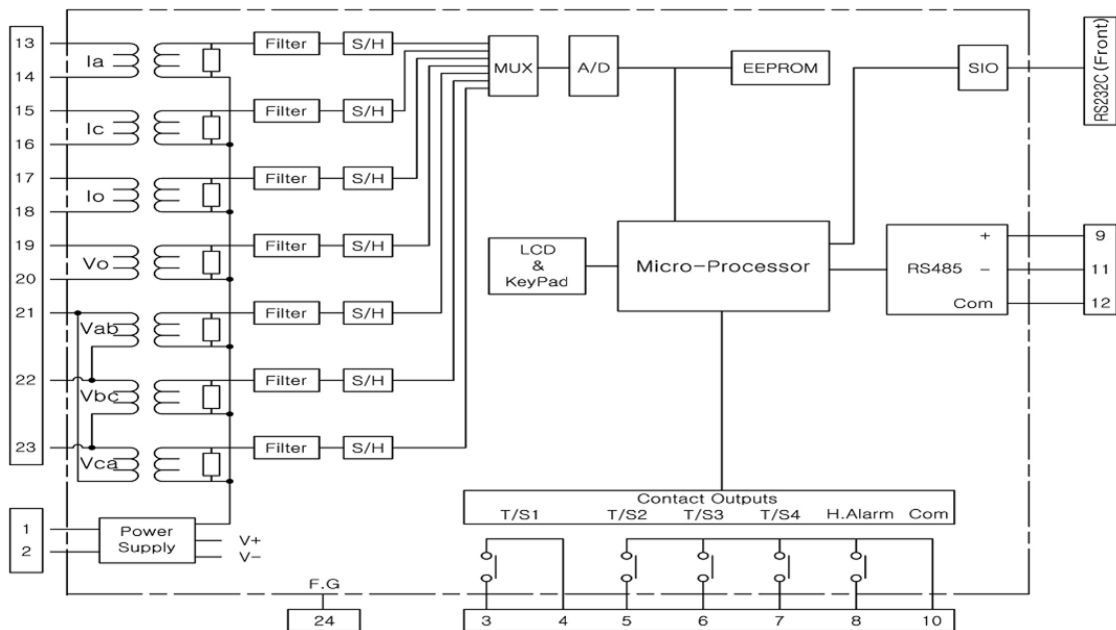
Appended 3. External Connection Diagram
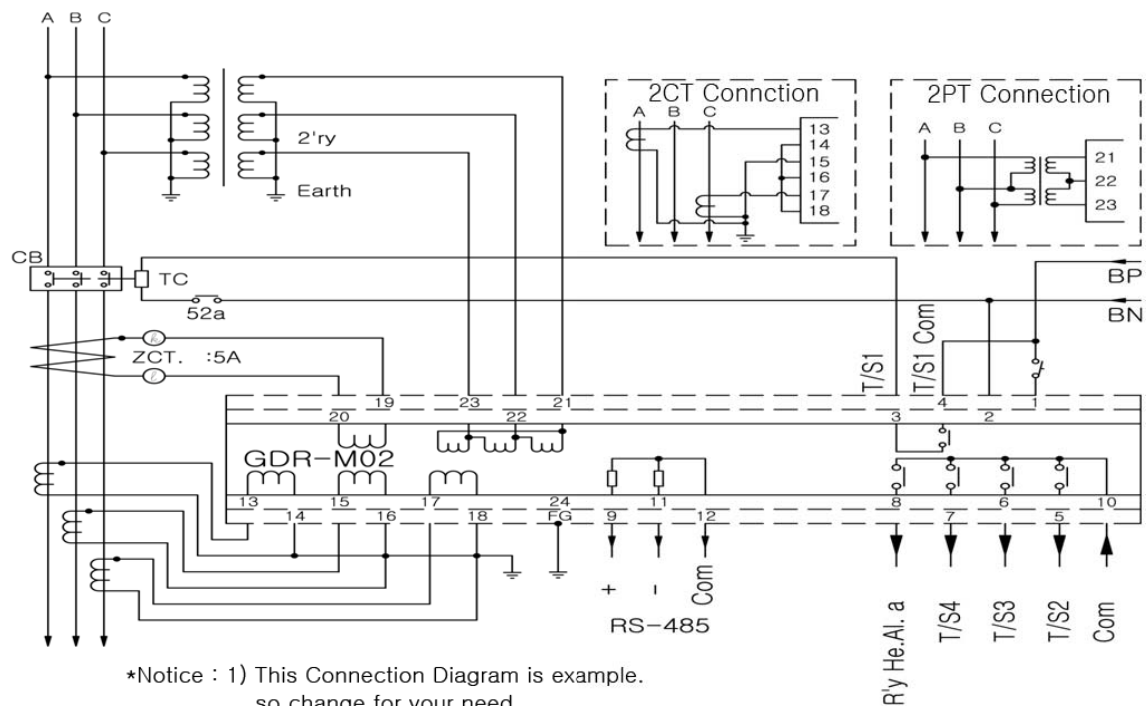
*Notice : 1) This Connection Diagram is example.
so change for your need.
2) R'y. He.Al contact output has no error status
when apply rated control source.
3) ZCT secondary rated current is 5A

Appended 4. Over Current, Ground Over Current Element NI Characteristic Curve

OCR—NI

$$t=\left(\frac{0.14}{I^{0.02}-1}\right)x\frac{M}{10}\ (sec)$$

M : T-Lever
I : Mul. of set-curr.

LEVER
10
9
8
7
6
5
4
3
2
1
0.5

TIME (Sec)

CURRENT (% OF TAP)

Appended 5. Over Current, Ground Over Current Element VI Characteristic Curve

OCR-VI

$$t=\left(\frac{13.5}{I-1}\right)x\frac{M}{10} \ (sec)$$

M : T-Lever
I : Mul. of set-curr.

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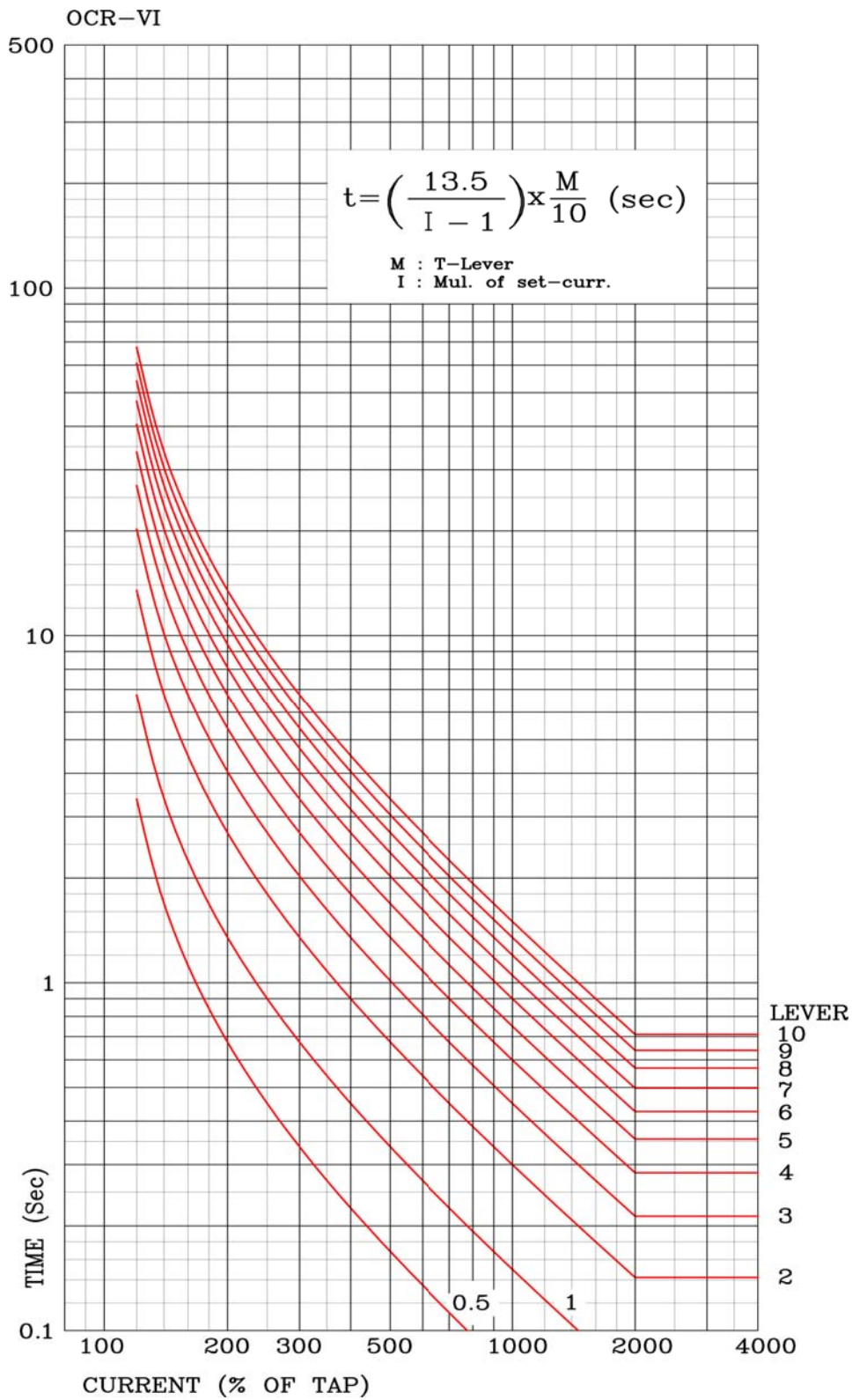
Appended 6. Over Current, Ground Over Current Element EI Characteristic Curve

OCR−EI

$$t=\left(\frac{80}{I^2-1}\right)\times\frac{M}{10}\ \ (sec)$$

M : T−Lever
I : Mul. of set−curr.
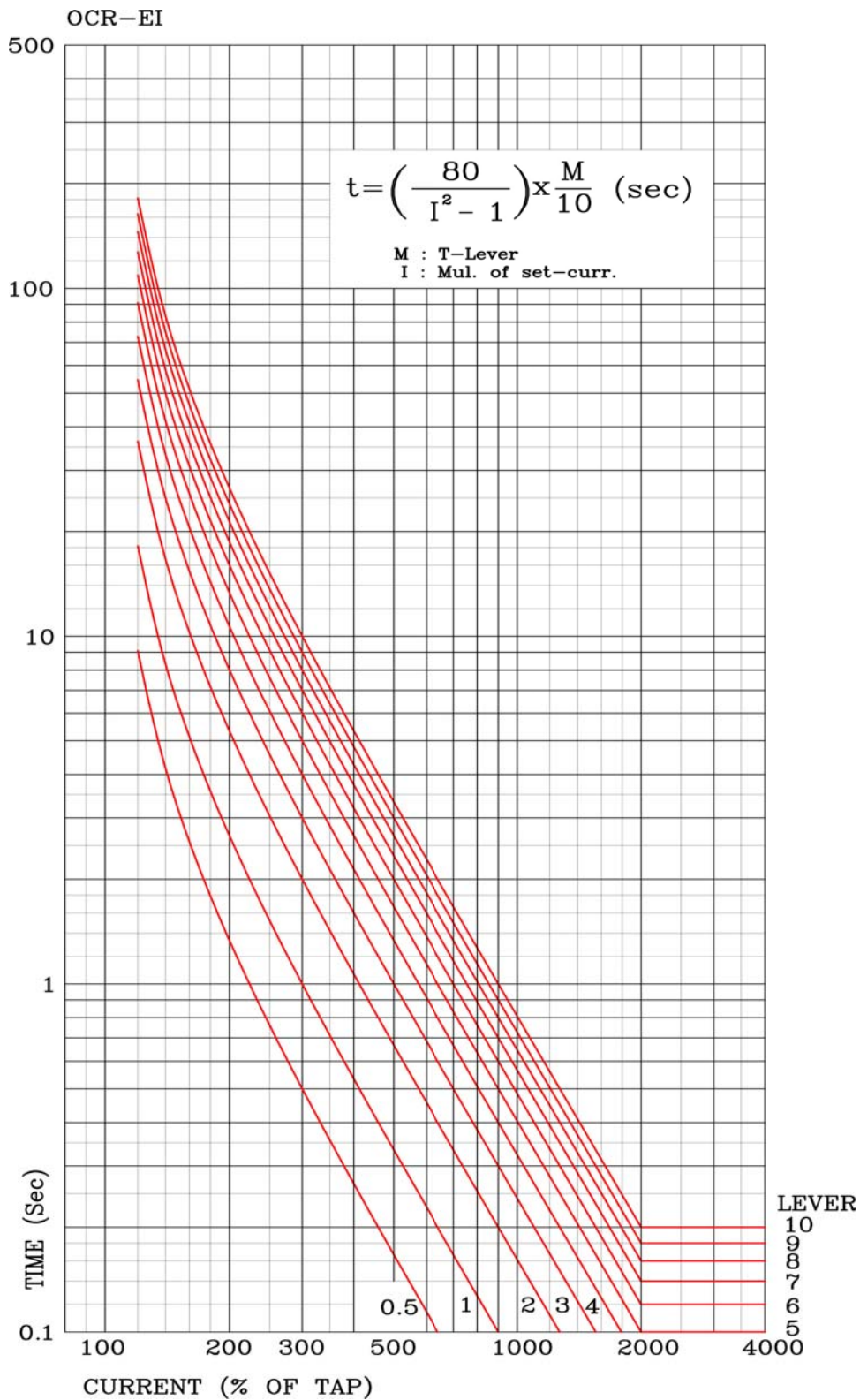
Appended 7. Over Current, Ground Over Current Element LI Characteristic Curve

OCR-LI

$$t=\left(\frac{54}{I-1}\right)\times\frac{M}{10} \ \ (sec)$$

M : T-Lever
I : Mul. of set-curr.

LEVER
10
9
8
7
6
5
4
3
2
1
0.5

TIME (Sec)

CURRENT (% OF TAP)
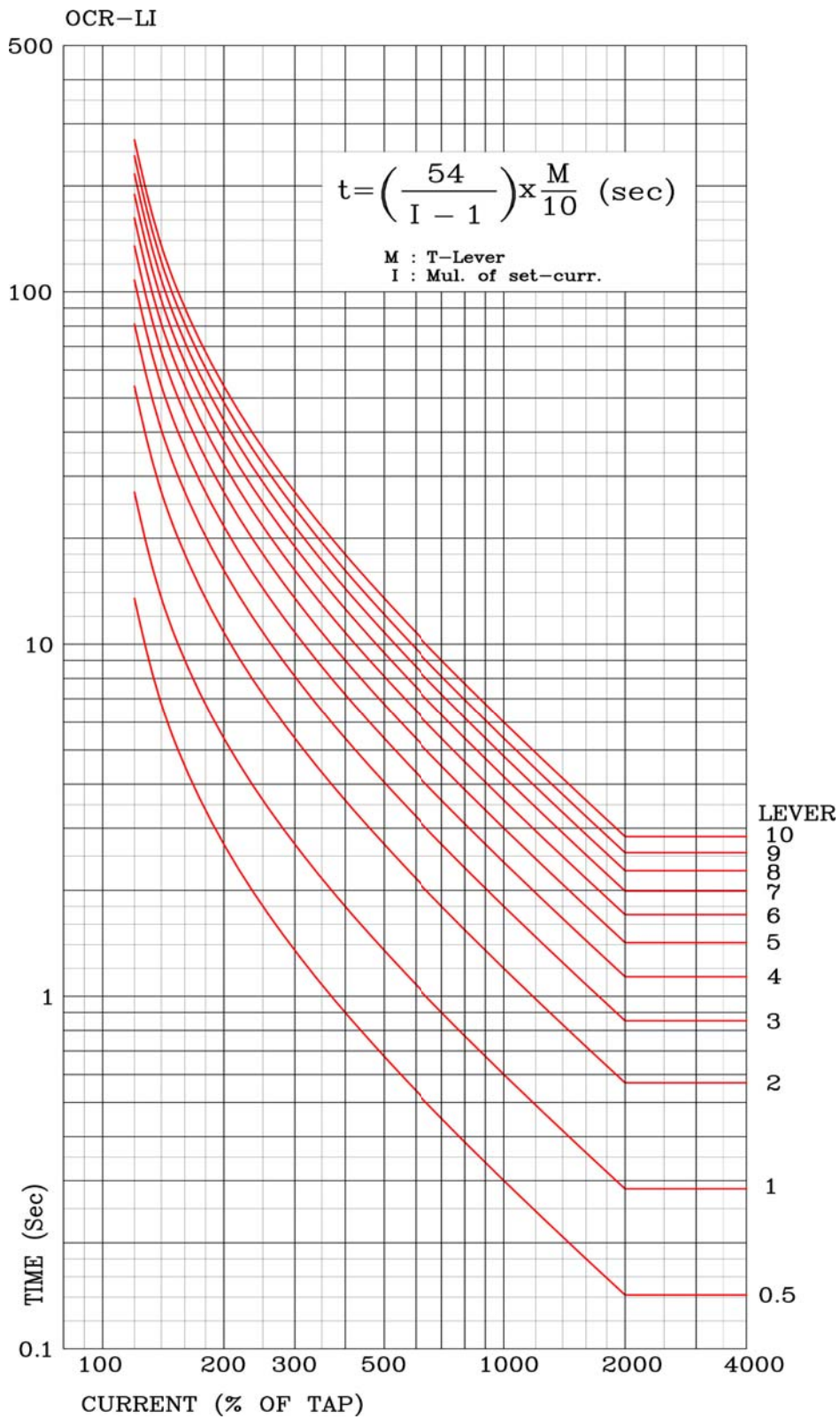
Appended 8. Over Current, Ground Over Current Element KNI(KEPCO Type) Characteristic Curve

OCR-KNI

$$t=\left(\frac{0.11}{I^{0.02}-1}+0.42\right)\times\frac{M}{10}\ \ (sec)$$

M : T-Lever
I : Mul. of set-curr.
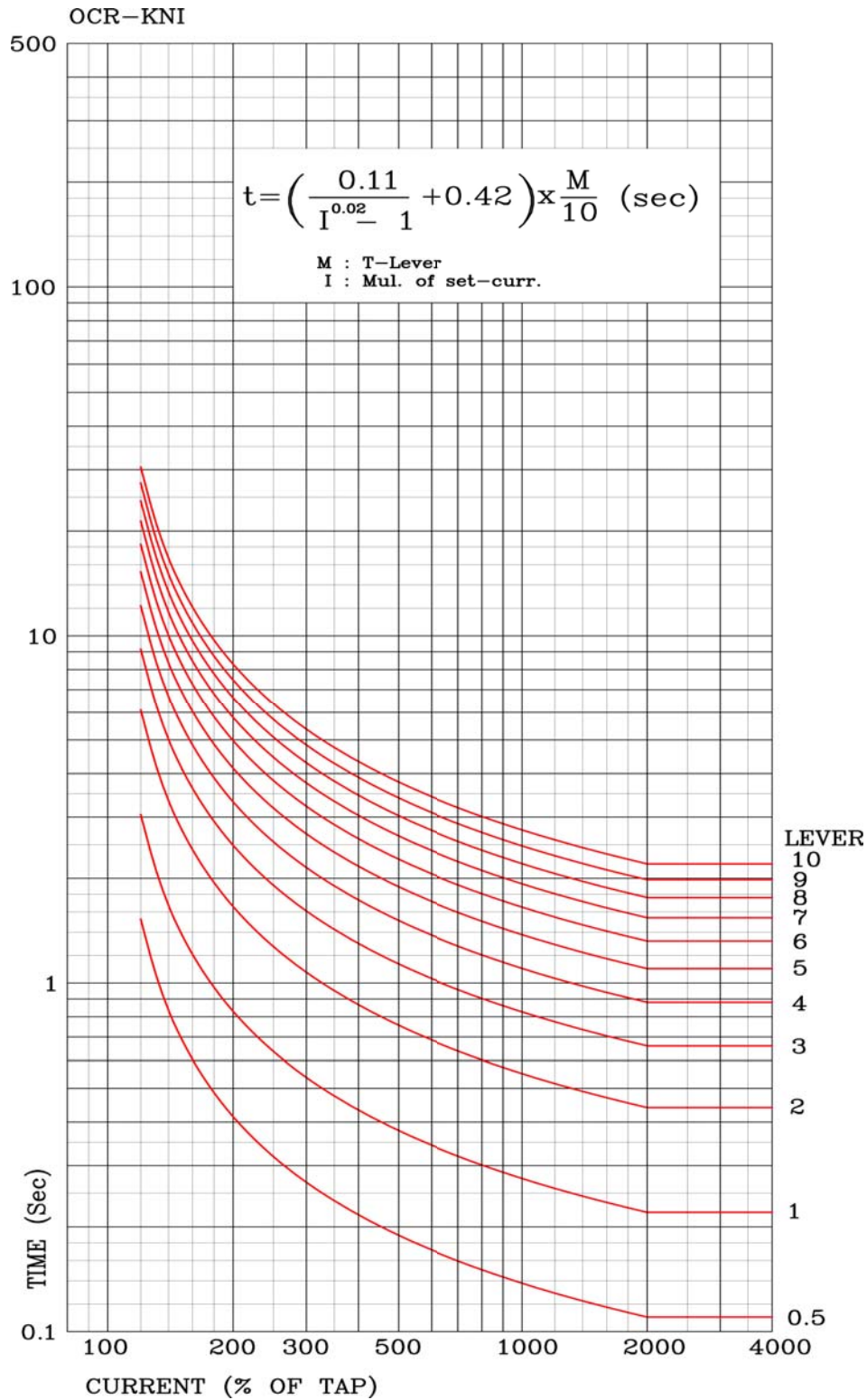
Appended 9. Over Current, Ground Over Current Element KVI(KEPCO Type) Characteristic Curve

OCR−KVI

$$t=\left(\frac{39.85}{I^{1.95}-1}+1.084\right)x\frac{M}{10}\ (sec)$$

M : T−Lever
I : Mul. of set−curr.

LEVER
10
9
8
7
6
5
4
3
2
1

TIME (Sec)

CURRENT (% OF TAP)
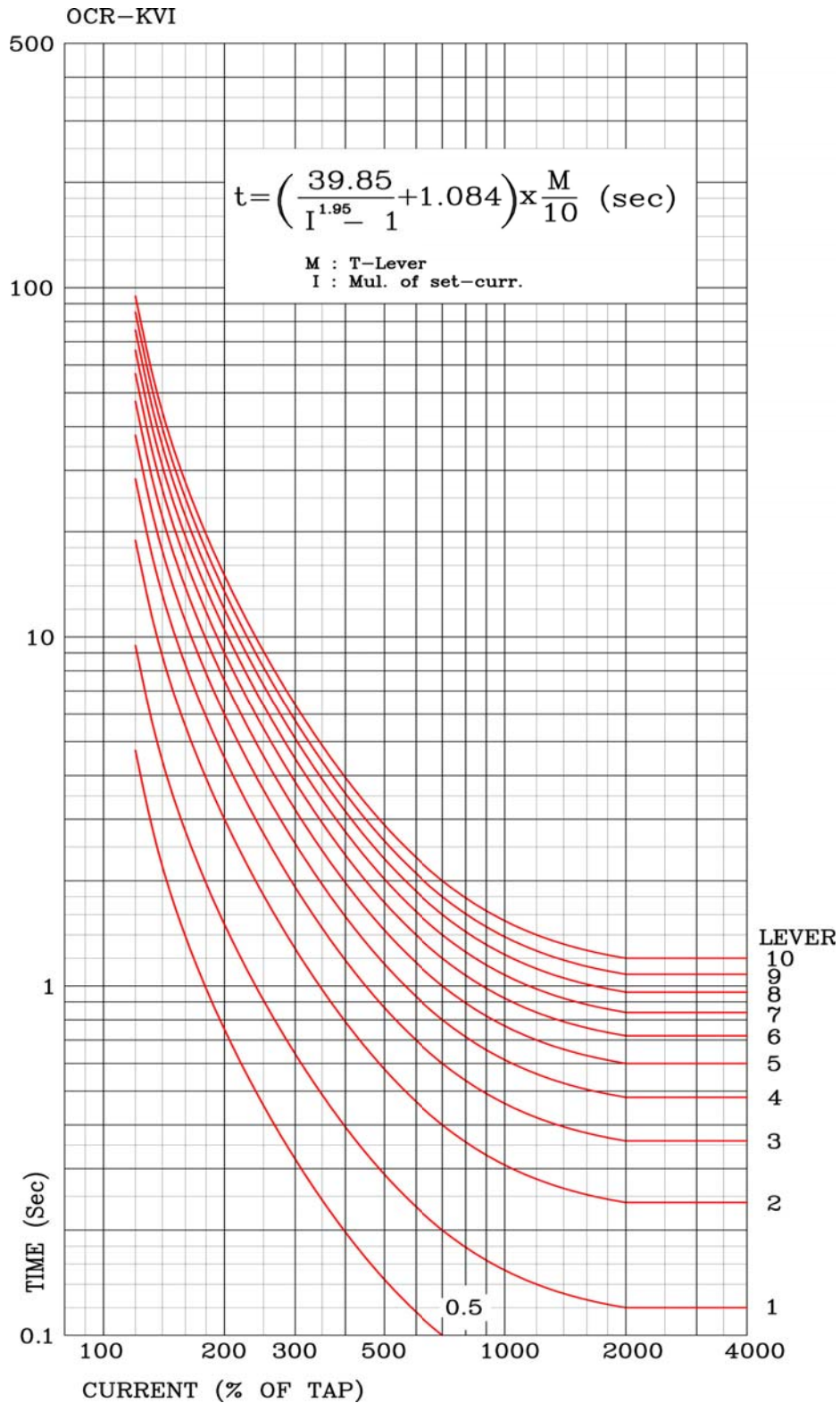
Appended 10. Over Current, Ground Over Current Element KLNI(KEPCO Type) Characteristic Curve

OCR－KLNI

$$t=\left(\frac{3.8}{I^{0.11}-1}+2.8\right)\times\frac{M}{10}\ \ (sec)$$

M : T-Lever
I : Mul. of set-current.

LEVER
10
9
8
7
6
5
4
3
2
1
0.5

TIME (Sec)

CURRENT (% OF TAP)
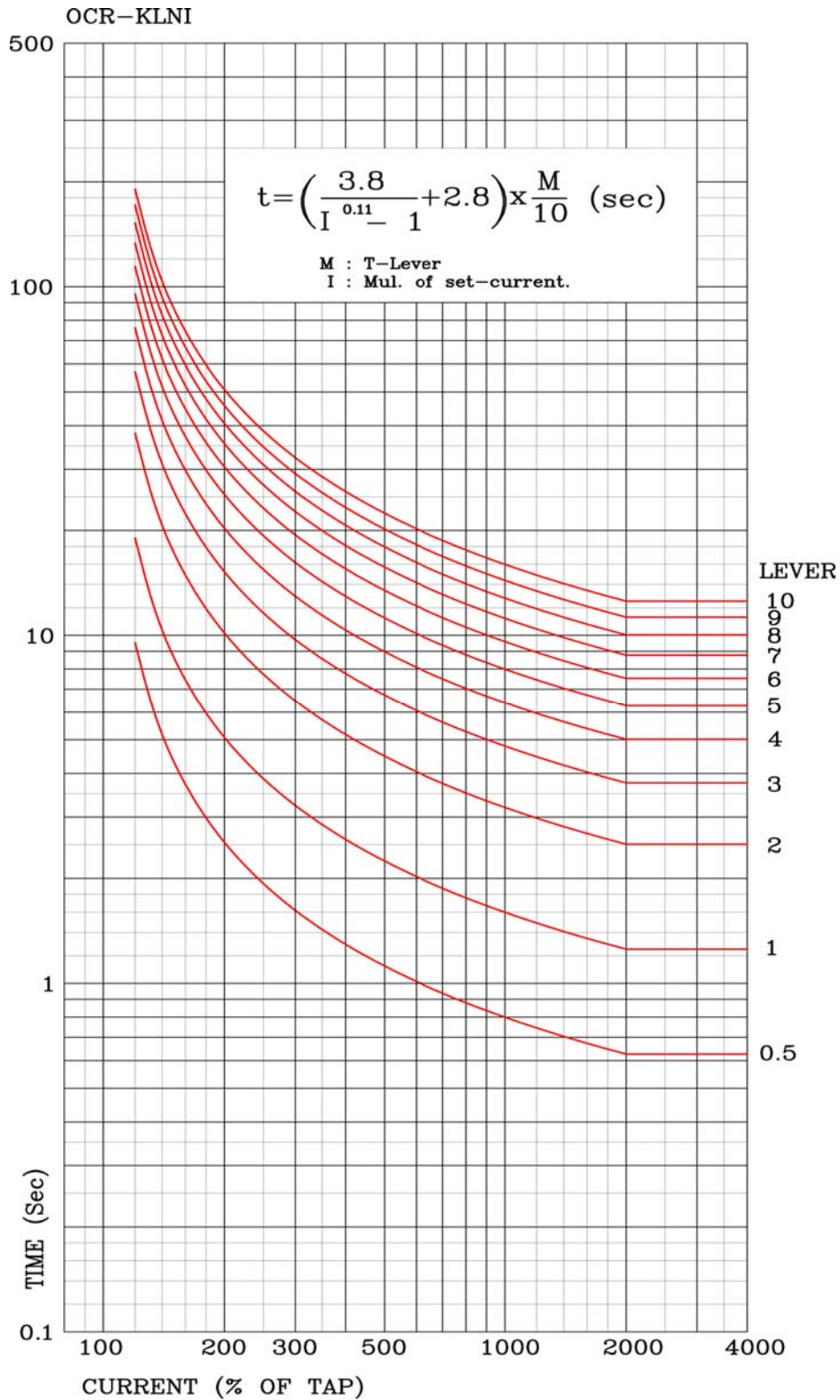
Appended 11. Over Current, Ground Over Current Element KLVI(KEPCO Type) Characteristic Curve

OCR−KLVI

$$t=\left(\frac{75}{I^{1.8}-1}+2\right)\times\frac{M}{10}\ \ (sec)$$

M : T−Lever
I : Mul. of set−current.

LEVER
10
9
8
7
6
5
4
3
2
1
0.5

TIME (Sec)

CURRENT (% OF TAP)
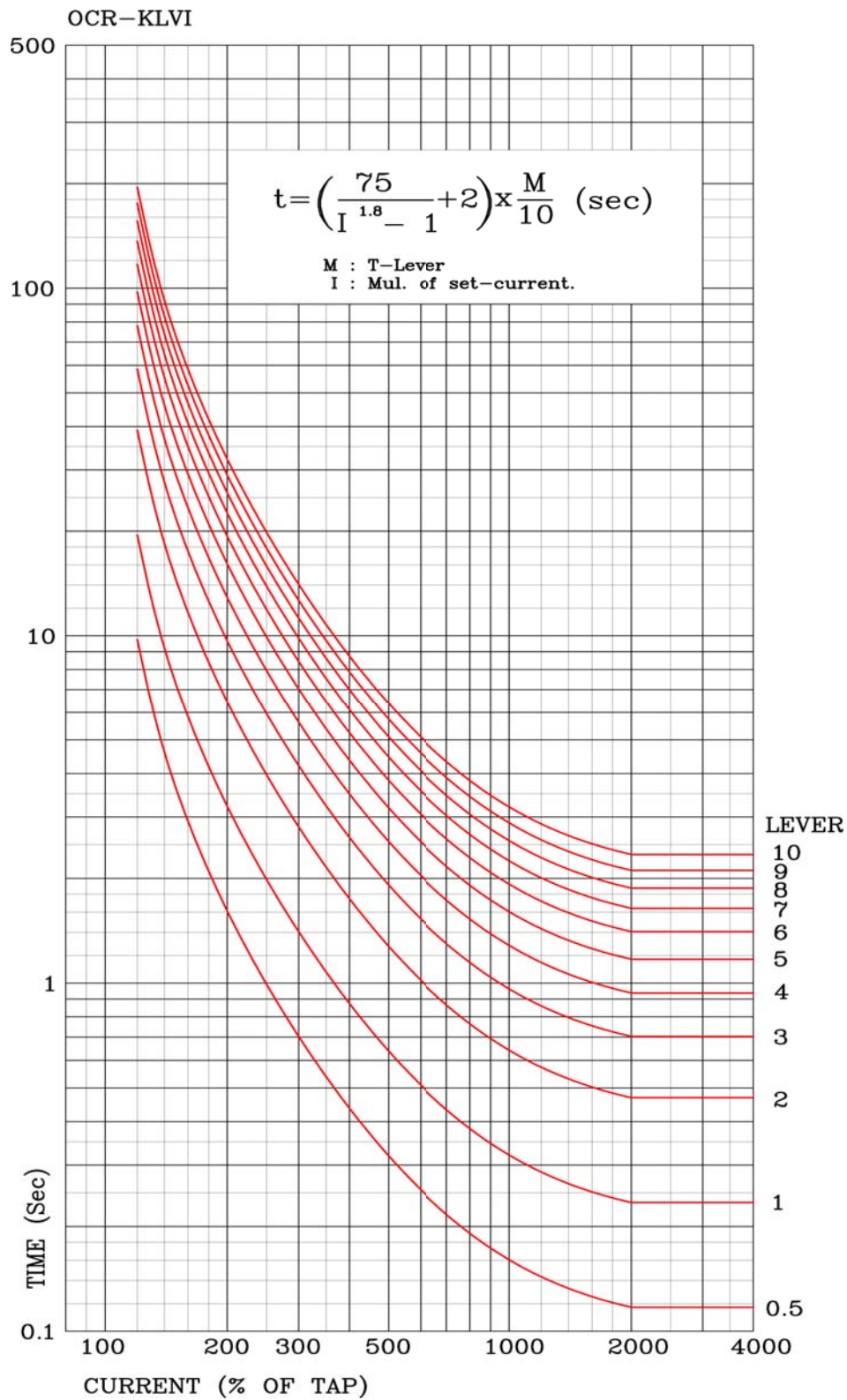
Appended 12. Over Current, Ground Over Current Element DT Characteristic Curve

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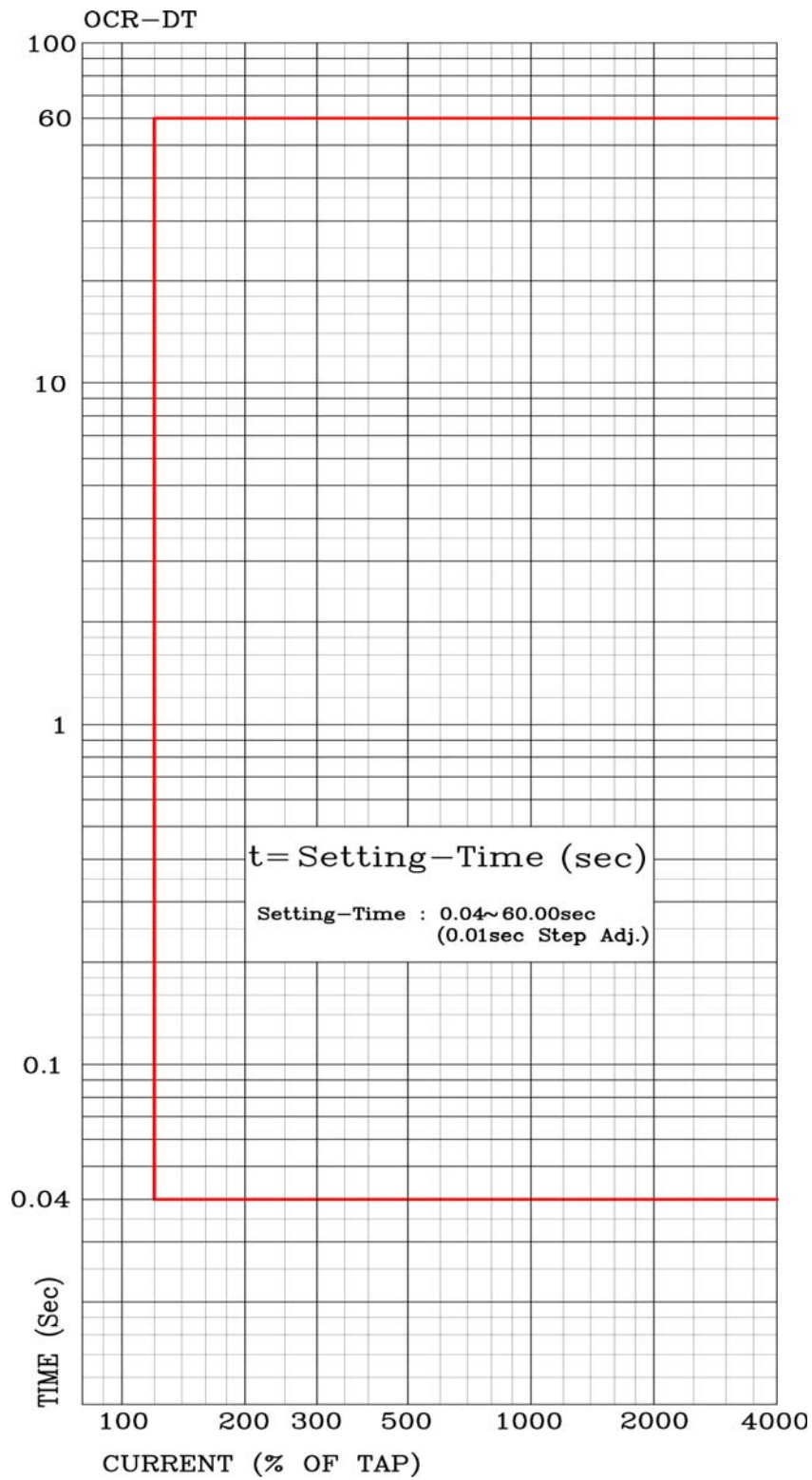
Appended 13. Over Voltage Element NI Characteristic Curve

OVR-NI

$$t = \left(\frac{10.5}{V^{1.75} - 1} \right) \times \frac{M}{10} \quad (sec)$$

M : T-Lever
V : Mul. of set-vol.

LEVER
10
9
8
7
6
5
4
3
2
1
0.5

TIME (Sec)

VOLTAGE (% OF TAP)
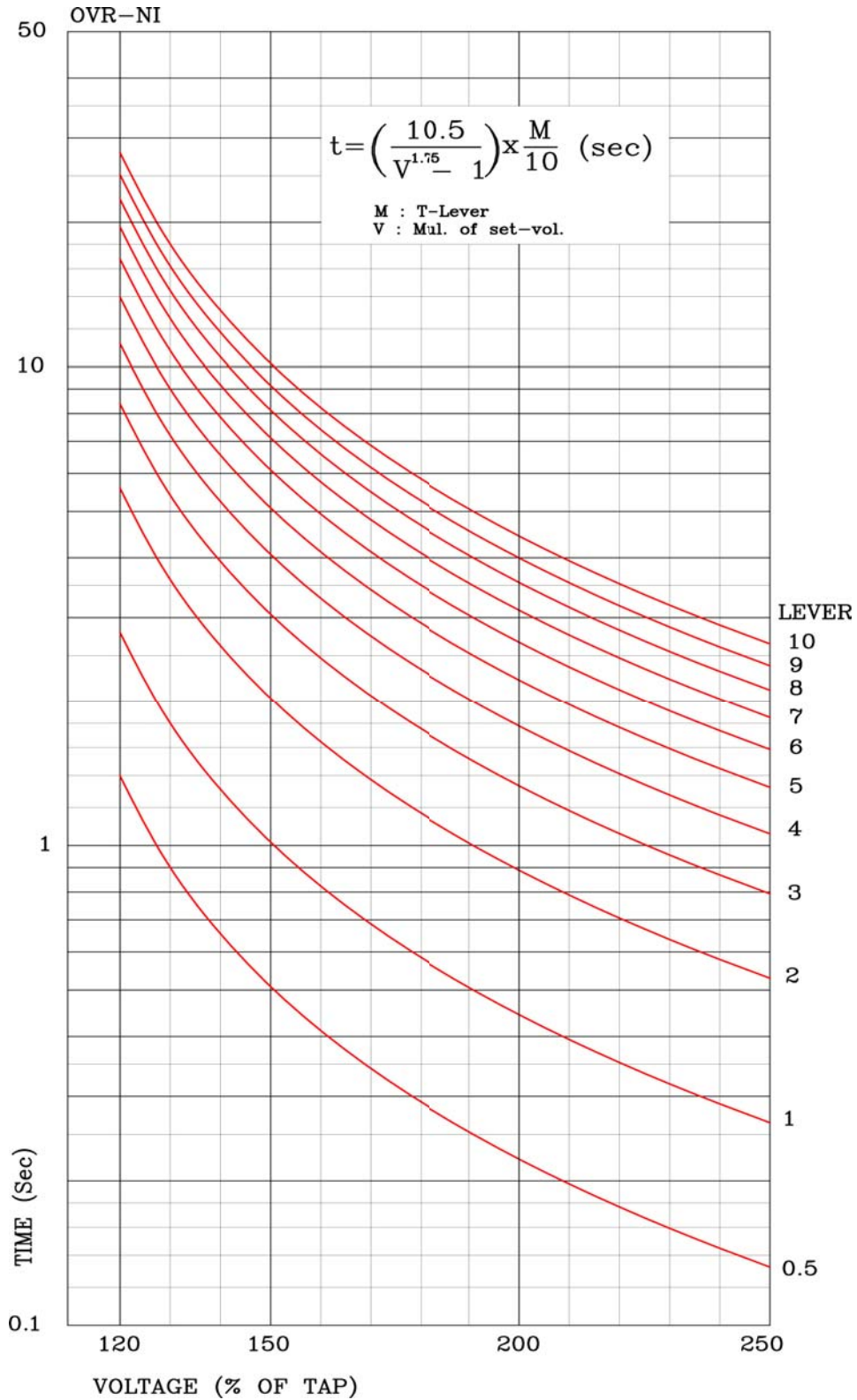
Appended 14. Over Voltage Element DT Characteristic Curve
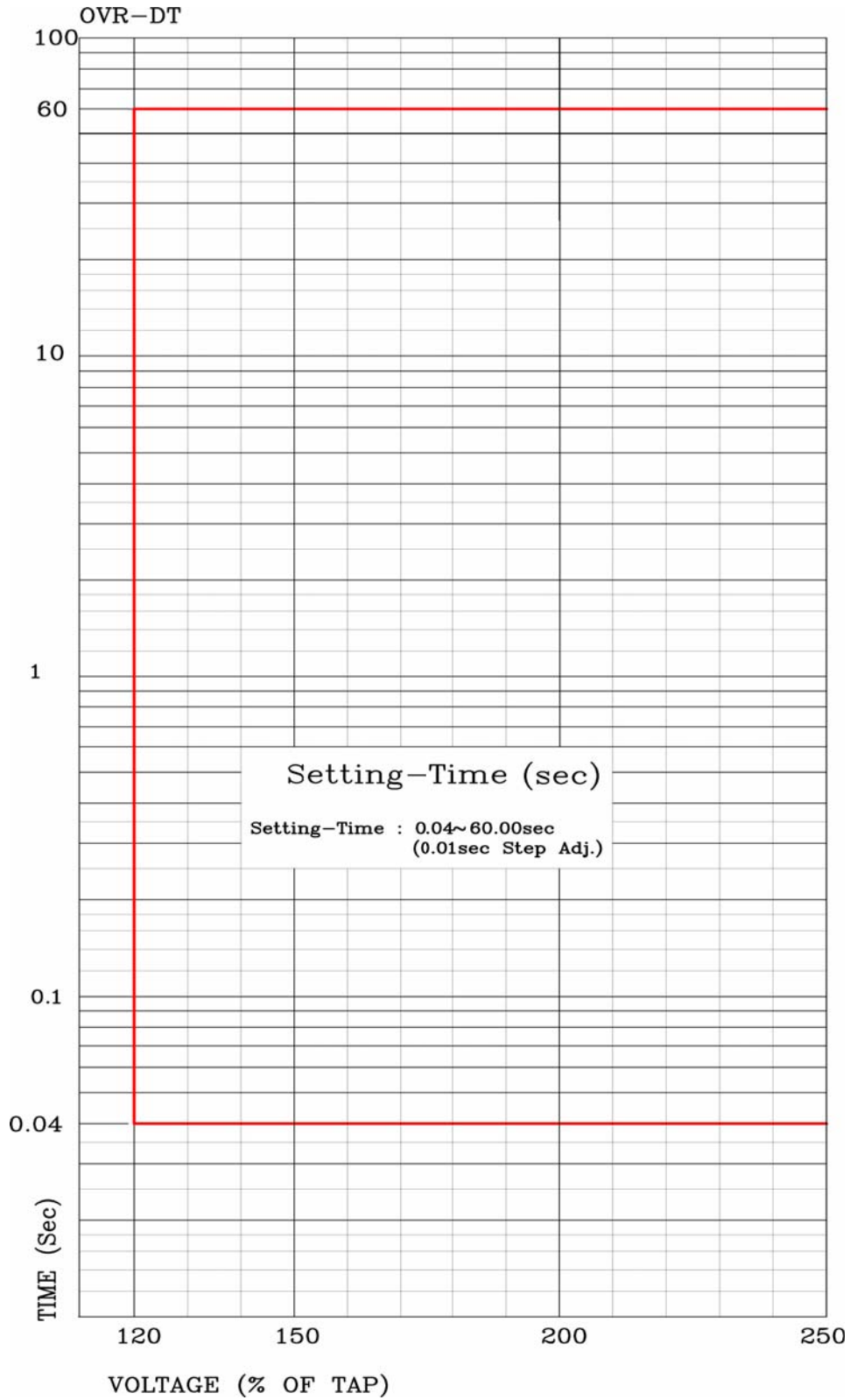
Appended 15. Under Voltage Element NI Characteristic Curve

UVR-NI

$$t=\left(\frac{8}{1-V^{2.2}}\right)x\frac{M}{10} \ (sec)$$

M : T-Lever
V : Mul. of set-vol.

LEVER

VOLTAGE (% OF TAP)

TIME (Sec)

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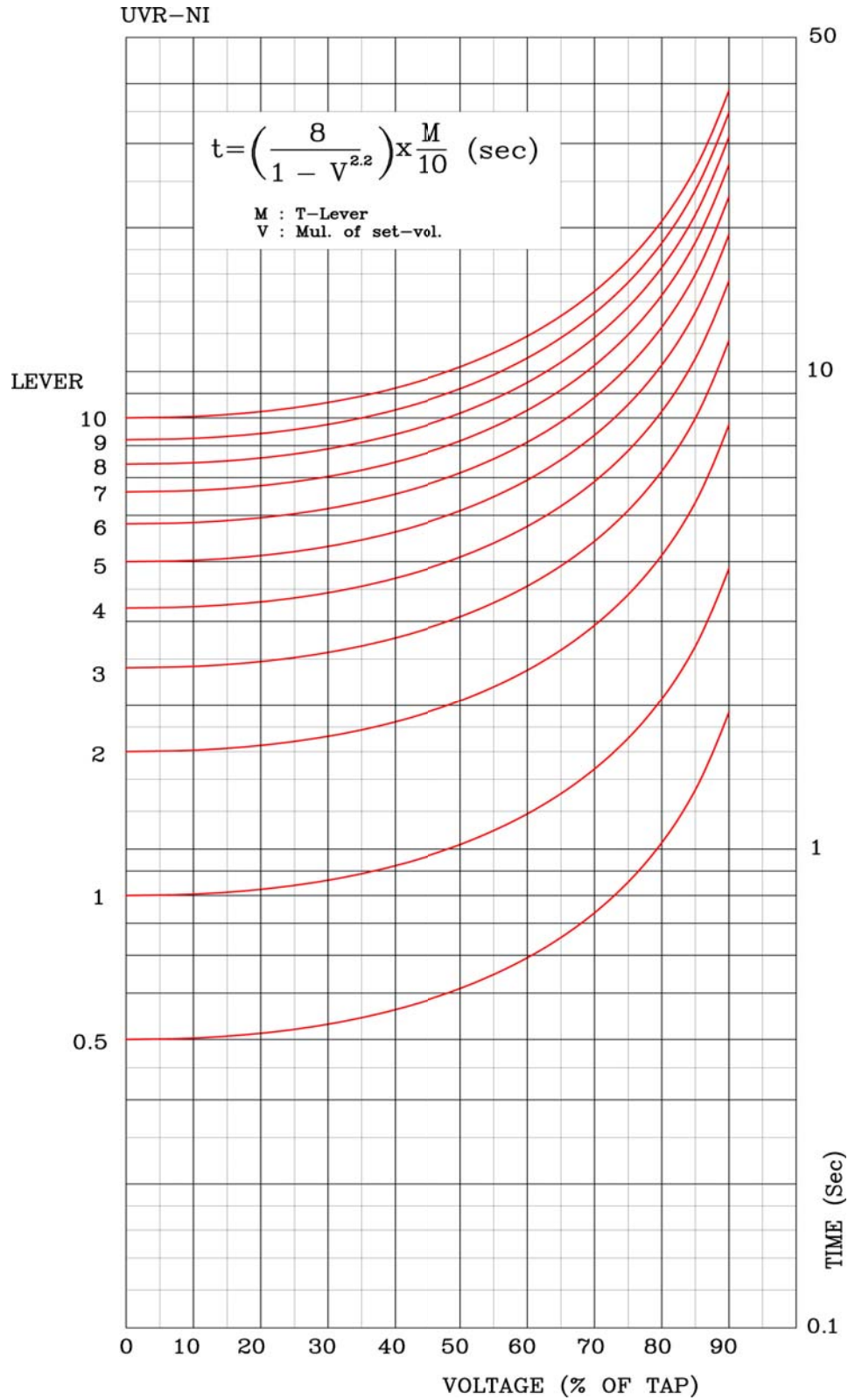
Appended 16. Under Voltage Element DT Characteristic Curve

UVR-DT

Setting-Time (sec)

Setting-Time : 0.04~60.00sec
(0.01sec Step Adj.)

TIME (Sec)

VOLTAGE (% OF TAP)