



# MK2000

## User's Manual

### ***Combined Overcurrent and Earth-Fault Relay***



## Features

## Multifunction numerical relay

### Programmable control outputs

## Metering

### Fault value recording

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# *1. Introduction*

The MK2000 combined overcurrent and earth-fault relay is a digital microprocessor based relay. This relay employs extensive advanced numerical techniques which are implemented in real time, for the computation of measured input quantity. Other advanced features include programmable control output, metering and fault data storage.

A fully digital user interface with bright seven-segment display provides a very user-friendly access to all the relay settings, meters and fault data.

## 2. Description of Operation

The MK2000 relay provides three independent phase overcurrent elements and one non-directional earth-fault element. All these elements are connected to the current transformers of the feeder to be protected.

### 2.1 Phase Overcurrent Protection

When the phase current exceeds the low-set  $I_{>}$  setting value, the overcurrent low-set element starts and delivers a start signal to the display panel and a group of pre-assigned relay outputs. After a delay time, determined by the inverse time current characteristic curve selected and measured current, this overcurrent element operates and delivers a trip signal to the display panel and a group of relay outputs that are configured to link to the low-set phase overcurrent tripping.

When the phase current exceeds the high-set  $I_{>>}$  setting value, the overcurrent high-set element starts and delivers a start signal to the display panel and a group of pre-assigned relay outputs. After a pre-set time, determined by  $t_{>>}$ , this overcurrent element operates and delivers a trip signal to the display panel and a group of relay outputs that are configured to link to high-set phase overcurrent tripping.

### 2.2 Earth-Fault Protection

When the earth-fault current exceeds the low-set  $I_{0>}$  setting value, the earth-fault low-set element starts and delivers a start signal to the display panel and a group of pre-assigned relay outputs. After a delay time, determined by the inverse time current characteristic curve selected and measured current, this earth-fault element operates and delivers a trip signal to the display panel and a group of relay outputs that are configured to link to the low-set earth-fault tripping.

When the earth-fault current exceeds the high-set  $I_{0>>}$  setting value, the earth-fault high-set element starts and delivers a start signal display panel and a group of pre-assigned relay outputs. After a pre-set time, determined by  $t_{0>>}$ , this earth-fault element operates and delivers a trip signal to the display panel and a group of relay outputs that are configured to link to high-set earth-fault tripping.

## 2.3 Measuring Elements

All the three overcurrent elements and one earth-fault element are provided with user configurable 1A or 5A current transformer inputs. The MK2000 settings are normalized to 1A. If 5A current transformers are used, the user is required to connect the current transformers to the 5A block terminal inputs and normalize all required setting values to 1A before entering it into the relay.

For each measuring elements, there is one independent high-set and one independent low-set. The elements' overcurrent or earth-fault low-set tripping time current characteristics are selectable between inverse definite minimum time (IDMT) normal inverse curve, long time inverse curve, very inverse curve and extremely inverse curve. The overcurrent elements and earth-fault element tripping time current characteristic curves are individually selectable.

The high-set tripping characteristic for both overcurrent element and earth-fault element are of the definite time type. Instantaneous tripping is made possible by setting the time to minimum.

## 2.4 Digital Inputs

The functions of this external binary inputs are

- Blocking the operation of one or more protection stages.
- Resetting a latched output relay in the manual reset mode.

The input can be both ac or dc source. For dc input, the positive (+) terminal is 34 and the negative (-) terminal is 35.

## 2.5 Output Contacts

The MK2000 has six relay outputs, namely, TRIP(TS2), START1(TS1), START2(SS1), SIGNAL1(SS2), SIGNAL2(SS3) and IRF. The functions of the relay outputs are user programmable as follow:

Output	Selectable Function
TS1 START1	<ul style="list-style-type: none"> <li>• Linked to low-set overcurrent and/or earth-fault trip signal.</li> <li>• Linked to low-set overcurrent and/or earth-fault start signal.</li> <li>• Linked to high-set overcurrent and/or earth-fault trip signal.</li> <li>• Linked to high-set overcurrent and/or earth-fault start signal.</li> <li>• Backup for circuit breaker failure protection.</li> </ul>
TS2 TRIP	<ul style="list-style-type: none"> <li>• Linked to low-set overcurrent and/or earth-fault trip signal.</li> <li>• Linked to high-set overcurrent and/or earth-fault trip signal.</li> </ul> <p>This is the default trip signal output for both overcurrent and earth-fault.</p>
SS1 START2	<ul style="list-style-type: none"> <li>• Linked to low-set overcurrent and/or earth-fault start signal.</li> <li>• Linked to high-set overcurrent and/or earth-fault start signal.</li> </ul>
SS2 SIGNAL1	<ul style="list-style-type: none"> <li>• Linked to low-set overcurrent and/or earth-fault trip signal.</li> <li>• Linked to high-set overcurrent and/or earth-fault trip signal.</li> </ul>
SS3 SIGNAL2	<ul style="list-style-type: none"> <li>• Linked to low-set overcurrent and/or earth-fault trip signal.</li> <li>• Linked to high-set overcurrent and/or earth-fault trip signal.</li> </ul>

IRF relay is not user programmable. The function of this relay is for signaling an internal relay failure. When the auxiliary power of the relay is switched on and the MK2000 is functioning normally, the IRF relay output will be energized hence the NC contact will open and the NO contact will close.

## 2.6 Display



i)



This light indicates the presence of auxiliary power supply.

ii)



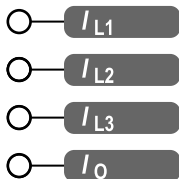
This light indicates the relay is in start or trip condition. [Refer to section xv. (page 9) on trip status display].

iii)



The 3-digit display indicates the value of the item selected.

iv)



If any of the above light is on, the relay is in metering mode. The 3-digit display indicates the corresponding phase current or earth-fault current.

v)



When this indicator is lighted, the 3-digit display simultaneously indicates the overcurrent low-set current setting.

vi)



When this indicator is lighted, the 3-digit display simultaneously indicates the overcurrent time multiplier setting.

vii)




When this indicator is lighted, the 3-digit display simultaneously indicates the overcurrent high-set current setting.

viii)




When this indicator is lighted, the 3-digit display simultaneously indicates the overcurrent high-set delay time setting.




ix)   **$I_0 > I_n$**


When this indicator is lighted, the 3-digit display simultaneously indicates the earth-fault low-set current setting.

x)   **$K t_0 >$**


When this indicator is lighted, the 3-digit display simultaneously indicates the earth-fault time multiplier setting.

xi)   **$I_0 >> I_n$**

When this indicator is lighted, the 3-digit display simultaneously indicates the earth-fault high-set current setting.


xii)   **$t_0 >>$**

When this indicator is lighted, the 3-digit display simultaneously indicates the earth-fault high-set delay time setting.

xiii)  **SWITCH**

When this light is on, the relay is in software switch setting mode. The 3-digit display indicates the soft switch number and the switch setting.



xiv)  **Data**

When this light is on, one of the indicators  $I_{L1}$ ,  $I_{L2}$ ,  $I_{L3}$  or  $I_0$  will switch on simultaneously. The 3-digit display then indicates the stored value of the corresponding phase or earth-fault current during the previous tripping of the relay.

Note that the fault values recorded are at the moment of tripping.

## xv) Start and trip status display

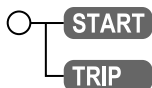
## a) Normal condition

Under normal operating condition, all the light indicators are switched off except the AUX indicator. If the RESET/STEP key is pressed, the corresponding indicator and the 3-digit display will light up. After 6 minutes, the indicator and the 3-digit display will automatically switch off if no further key is pressed.

## b) Relay start condition

When the overcurrent elements or the earth-fault element measure an input current higher than the set value, the relay starts and the START indicator light up. If the measured current subsequently drops below the set value before reaching trip condition, the START indicator will switch off.

## c) Relay trip condition



Under relay trip condition, the START/TRIP indicator lights up until the relay is reset.



One of these indicators blinks to indicate the source of tripping.



One of these indicators blinks to indicate high-set or low-set tripping element.



The 3-digit display indicates the tripping value

## 2.7 Key Button Input

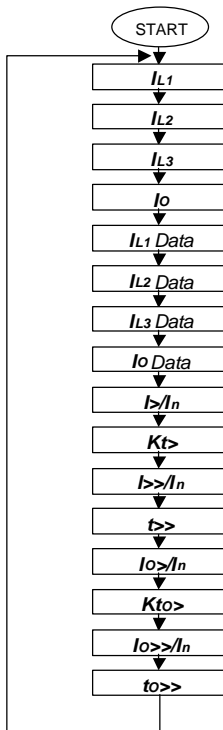
i). RESET/STEP key



There are two functions associated with this key.

- Reset the system when in trip mode.
- Scroll the display to view the measured current, recorded fault current and the relay current setting and time setting.

The scrolling sequence is as follow:



## ii) The PROGRAM key



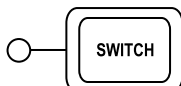
Pressing this key once to enter into programming mode for the selected items (e.g. I/In). The light indicator for the selected item blinks to indicate that the relay is in programming mode. By pressing this PROGRAM key again while in the programming mode, the new value of the selected item is saved, the relay then exits from programming mode and the light indicator for the selected item stop blinking.

## iii) The UP and DOWN keys



These keys are for changing the value of the selected item while in programming mode.

## iv) The SWITCH key



Press this key to scroll through all the software switches.

## 2.8 Key Operation of Setting

- i) To program the settings for  $I>/In$ ,  $kt>$ ,  $I>>/In$ ,  $t>>$ ,  $I_o>/In$ ,  $kt_o>$ ,  $I_o>>/In$  and  $t_o>>$ .

### Step 1

Select the required item by stepping through all the items using the RESET/STEP key. The corresponding light of the selected item will be lighted.

### Step 2

Press the PROGRAM key once, the indicator light of the selected item will blink to indicate that the system is now in programming mode.

### Step 3

Use the UP or DOWN key to select the desired value. Holding down the key until the desired value appears.

### Step 4

To save the selected value, press the PROGRAM key once. The indicator light stop blinking and the setting is saved.

To abort without saving the selected setting, press the RESET/STEP key.

- ii) To program the software switch setting

### Step 1

Press the SWITCH key until the desired switch number appears on the display.

### Step 2

Press the PROGRAM key to enter into programming mode. The SWITCH light will blink to indicate that the system is in switch programming mode.

### Step 3

Use the UP or DOWN key for changing the soft switch setting.

### Step 4

To save the change, press the PROGRAM key again until SWITCH light stop blinking .

To abort the change, press the SWITCH key or RESET/STEP key.

### 3. Characteristic Curves

Both the low-set overcurrent and earth-fault elements can be independently configured to have following IDMT characteristic curves :-

- Normal inverse
- Very inverse
- Extremely inverse
- Long-time inverse

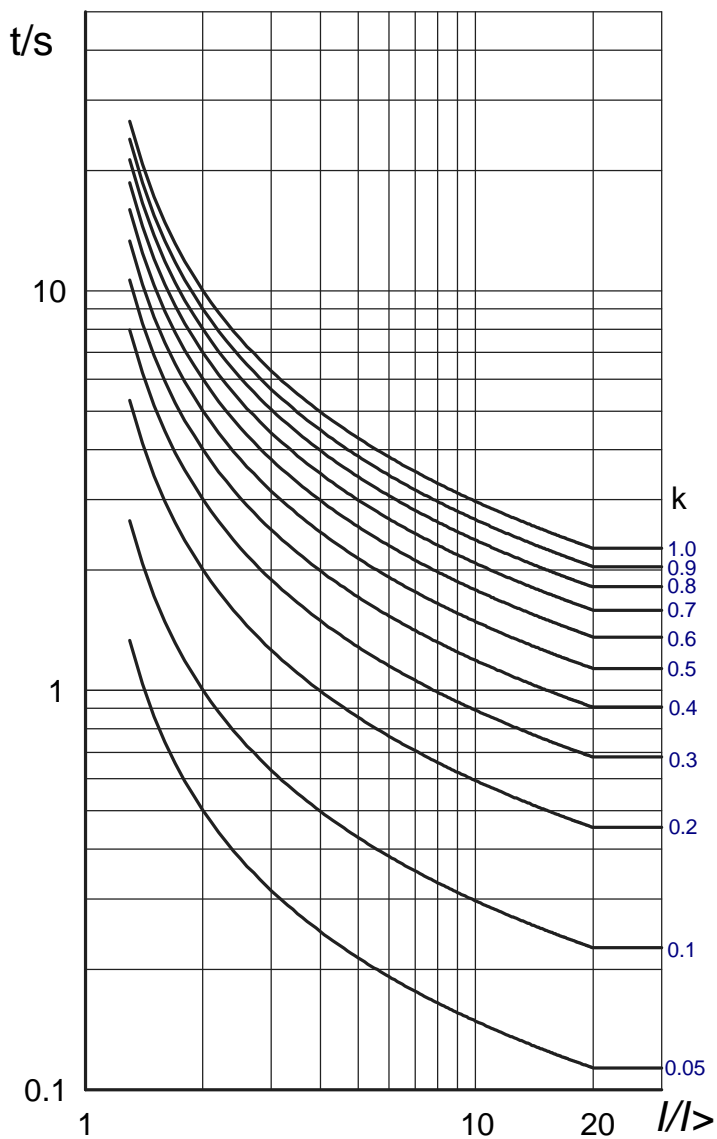
The relationship between current and time for the above curves comply with the standard IEC255-4 and may generally be expressed as :

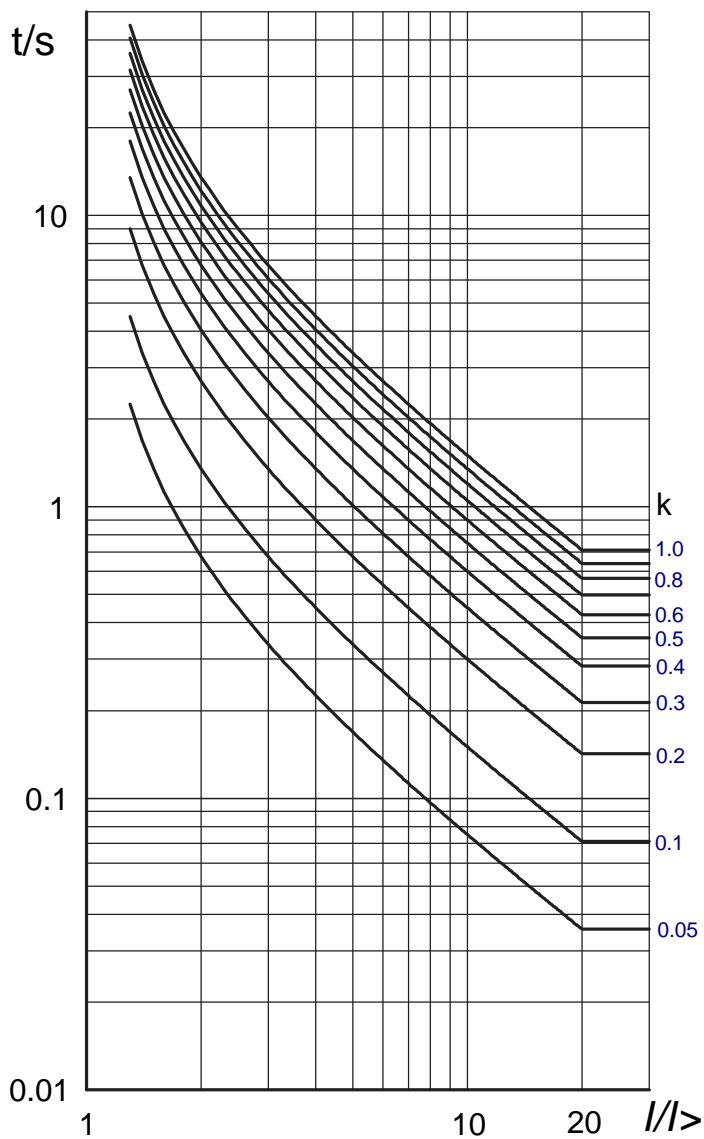
$$t = \frac{k}{(I/I_{set})^n - 1}$$

Where     $t$  = operating time in seconds  
              $k$  = time multiplier  
              $I$  = measured current  
              $I_{set}$  = set current  
              $n$  = constant  
              $n$  = constant

Characteristic curve		
Normal Inverse	0.02	0.14
Very Inverse	1.0	13.5
Extremely Inverse	2.0	80.0
Long-time Inverse	1.0	120.0

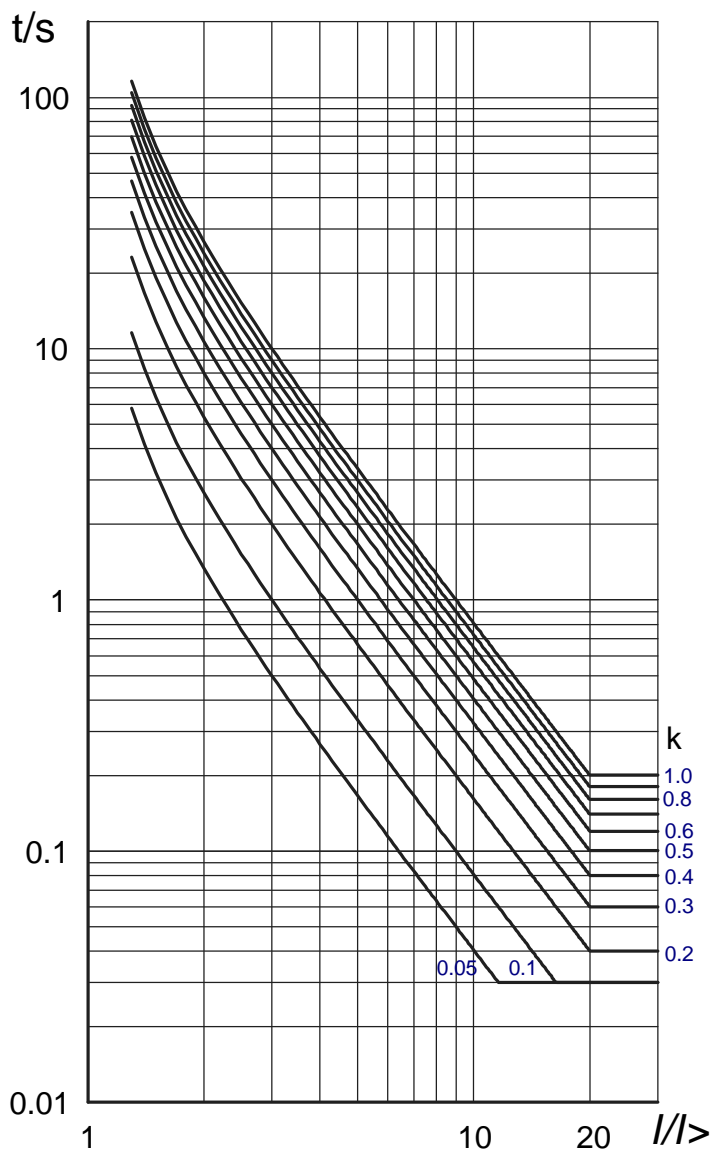
Both the high-set overcurrent and high-set earth-fault elements are independently configured with definite time delay only. The time delay can be from 0.05 sec (instantaneous) to 300 sec. The high-set feature can also be disabled by the user.

**NORMAL INVERSE**

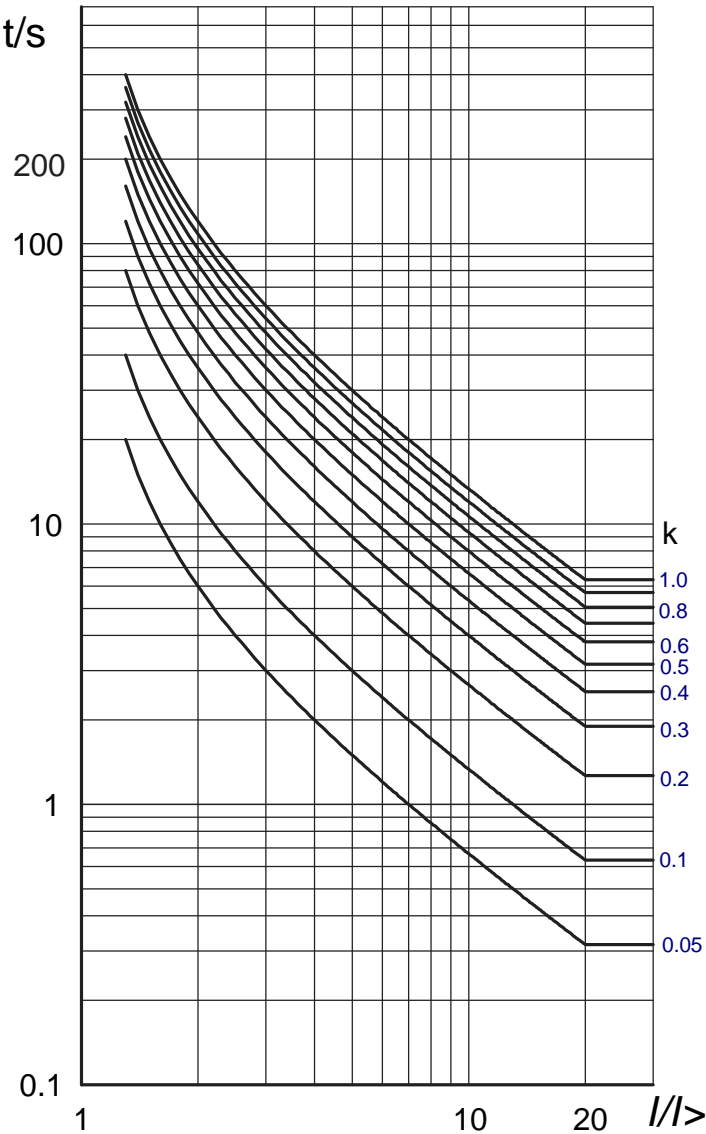
**VERY INVERSE**



## EXTREMELY INVERSE



LONG-TIME INVERSE



## 4. *Soft Switches*

These soft switches are for configuring and testing of the MK2000 relay. The functions for all these switches are listed below. Please note that the switch settings are in hexadecimal format.

### 4.1 Switch Group 1

This switch allows the user to activate the relay output one-by-one. Once entered into the switch programming mode, the output can be switched on by using the UP and DOWN key.

Switch Value	Function
00	All relays de-activated
01	Only TS1 activated (START1)
02	Only TS2 activated (TRIP)
03	Only SS1 activated (START2)
04	Only SS2 activated (SIGNAL1)
05	Only SS3 activated (SIGNAL2)

## 4.2 Switch Group 2

This switch configures the blocking signal and high-set elements selection.

	RSV	RSV	HEES	HOES	BLEH	BLEL	BLOH	BLOL
Default value	0	0	0	0	0	0	0	0
Default hexadecimal value	0				0			
User setting	0	0						
User hexadecimal value*								

\* Refer to Appendix A for the corresponding hexadecimal value.

### **BLOL** - Block Low-set Overcurrent

This switch enables or disables the low-set overcurrent blocking function by the digital input signal.

- 1 = I> stage blocking enabled.
- 0 = I> stage blocking disabled.

### **BLOH** - Block High-set Overcurrent

This switch enables or disables the high-set overcurrent blocking function by the digital input signal.

- 1 = I>> stage blocking enabled
- 0 = I>> stage blocking disabled.

### **BLEL** - Block Low-set Earth-Fault

This switch enables or disables the low-set earth-fault blocking function by the digital input signal.

- 1 = I<sub>0</sub>> stage blocking enabled.
- 0 = I<sub>0</sub>> stage blocking disabled.

### **BLEH** - Block High-set Earth-Fault

This switch enables or disables the high-set earth-fault blocking function by the digital input signal.

- 1 = I<sub>0</sub>>> stage blocking enabled.
- 0 = I<sub>0</sub>>> stage blocking disabled.

**HOES** - High-set Overcurrent Element Select

This switch activates or de-activates the high-set overcurrent function. The I>> will not operate once de-activated.

- 1 = High-set overcurrent (I>>) function de-activated
- 0 = High-set overcurrent (I>>) function activated.

**HEES** - High-set Earth-fault Element Select

This switch activates or de-activates the high-set earth-fault function. The Io>> will not operate once de-activated.

- 1 = High-set earth-fault (Io>>) function de-activated.
- 0 = High-set earth-fault (Io>>) function activated.

**RSV** - Reserve

These switches are always set to '0'. They are reserved for future use.

### 4.3 Switch Group 3

This switch group configures the operation characteristic of relay output "START1, (TS1)".

	ST1EH	ST1EL	ST10H	ST10L	T1EH	T1EL	T10H	T10L
Default value	0	0	0	0	0	0	0	0
Default hexadecimal value	0				0			
User setting								
User hexadecimal value*								

\* Refer to Appendix A for the corresponding hexadecimal value.

#### **T10L** - TS1 Low-set Overcurrent Trip

This switch selects or de-selects the linkage between the low-set overcurrent trip signal and the relay output START1 (TS1).

- 1 = I> trip signal linked to TS1.
- 0 = I> trip signal not linked to TS1.

#### **T10H** - TS1 High-set Overcurrent Trip

This switch selects or de-selects the linkage between the high-set overcurrent trip signal and the relay output START1 (TS1).

- 1 = I>> trip signal linked to TS1.
- 0 = I>> trip signal not linked to TS1.

#### **T1EL** - TS1 Low-set Earth-Fault Trip

This switch selects or de-selects the linkage between the low-set earth-fault trip signal and the relay output START1 (TS1).

- 1 = I<sub>0</sub>> trip signal linked to TS1.
- 0 = I<sub>0</sub>> trip signal not linked to TS1.

**T1EH** - TS1 High-set Earth-Fault Trip

This switch selects or de-selects the linkage between the high-set earth-fault trip signal and the relay output START1 (TS1).

- 1 =  $I_0 >>$  trip signal linked to TS1.
- 0 =  $I_0 >>$  trip signal not linked to TS1.

**ST10L** - TS1 Low-set Overcurrent Start

This switch selects or de-selects the linkage between the low-set overcurrent start signal and the relay output START1 (TS1).

- 1 =  $I >$  start signal linked to TS1.
- 0 =  $I >$  start signal not linked to TS1.

**ST10H** - TS1 High-set Overcurrent Start

This switch selects or de-selects the linkage between the high-set overcurrent start signal and the relay output START1 (TS1).

- 1 =  $I >>$  start signal linked to TS1.
- 0 =  $I >>$  start signal not linked to TS1.

**ST1EL** - TS1 Low-set Earth-Fault Start

This switch selects or de-selects the linkage between the low-set earth-fault start signal and the relay output START1 (TS1).

- 1 =  $I_0 >$  start signal linked to TS1.
- 0 =  $I_0 >$  start signal not linked to TS1.

**ST1EH** - TS1 High-set Earth-Fault Start

This switch selects or de-selects the linkage between the high-set earth-fault start signal and the relay output START1 (TS1).

- 1 =  $I_0 >>$  start signal linked to TS1.
- 0 =  $I_0 >>$  start signal not linked to TS1.

## 4.4 Switch Group 4

This switch group configures the operation characteristic of relay output "TRIP, (TS2)".

	REMOTE	ELATCH	ILATCH	CBFP	T2EH	T2EL	T20H	T20L
Default value	0	0	0	0	1	1	1	1
Default hexadecimal value	0				F			
User setting					1	1	1	1
User hexadecimal value*					F			

\* Refer to Appendix A for the corresponding hexadecimal value.

### **T20L** - TS2 Low-set Overcurrent Trip

This switch is permanently set to '1' and not user selectable. The low-set overcurrent trip signal is always linked to the relay output TRIP.

### **T20H** - TS2 High-set Overcurrent Trip

This switch is permanently set to '1' and not user selectable. The high-set overcurrent trip signal is always linked to the relay output TRIP.

### **T2EL** - TS2 Low-set Earth-Fault Trip

This switch is permanently set to '1' and not user selectable. The low-set earth-fault trip signal is always linked to the relay output TRIP.

### **T2EH** - TS2 High-set Earth-Fault Trip

This switch is permanently set to '1' and not user selectable. The high-set earth-fault trip signal is always linked to the relay output TRIP.



**CBFP** - Circuit Breaker Failure Protection

This switch enables or disables the circuit breaker failure protection feature. During a fault condition, TS2 output is activated in an attempt to clear the fault. If after a prefixed delay time has lapsed, the fault remains despite the activation of TS2 and this CBFP switch option is enabled, TS1 will be activated. Please note that if this feature is enabled, the settings in Switch Group 3 will be overridden.

- 1 = Circuit breaker failure protection feature enabled
- 0 = Circuit breaker failure protection feature disabled

**ILATCH** - Overcurrent Latching Output

If this switch is set, an overcurrent trip will latch the relay output TS2. Otherwise, the relay output TS2 will reset once the fault is cleared. Please note that only the relay output is reset, the display remains in tripped condition.

- 1 = Overcurrent trip will latch TS2 output.
- 0 = No latching of TS2 relay output.

**ELATCH** - Earth-Fault Latching Output

If this switch is set, an earth-fault trip will latch the relay output TS2. Otherwise, the relay output TS2 will reset once the fault is cleared. Please note that only the relay output is reset, the display remains in tripped condition.

- 1 = Earth-fault trip will latch TS2 output.
- 0 = No latching of TS2 relay output.

**REMOTE** - Remote Reset

If either or both ILATCH and ELATCH are set to 1, trip reset can be done by a remote signal from the digital input

- 1 = Remote reset feature enabled.
- 0 = No remote reset.

## 4.5 Switch Group 5

This switch group configures the operation characteristic of relay output "START2, (SS1)".

	S1EH	S1EL	S10H	S10L	MRSEH	MRSEL	MRSOH	MRSOL
Default value	0	0	0	1	0	0	0	0
Default hexadecimal value	1				0			
User setting								
User hexadecimal value*								

\* Refer to Appendix A for the corresponding hexadecimal value.

### **MRSOL** - Manual Reset for Low-set Overcurrent

This switch selects or de-selects the manual resetting feature of the relay output SS1 when activated by the low-set overcurrent start signal.

- 1 = Manual reset of SS1 when activated by low-set overcurrent start signal.
- 0 = Auto reset of SS1 when fault is cleared.

### **MRSOH** - Manual Reset for High-set Overcurrent

This switch selects or de-selects the manual resetting feature of the relay output SS1 when activated by the high-set overcurrent start signal.

- 1 = Manual reset of SS1 when activated by high-set overcurrent start signal.
- 0 = Auto reset of SS1 when fault is cleared.

### **MRSEL** - Manual Reset for Low-set Earth-Fault

This switch selects or de-selects the manual resetting feature of the relay output SS1 when activated by the low-set earth-fault start signal.

- 1 = Manual reset of SS1 when activated by low-set earth-fault start signal.
- 0 = Auto reset of SS1 when fault is cleared.

**MRSEH** - Manual Reset for High-set Earth-Fault

This switch selects or de-selects the manual resetting feature of the relay output SS1 when activated by the high-set earth-fault start signal.

- 1 = Manual reset of SS1 when activated by high-set earth-fault start signal.
- 0 = Auto reset of SS1 when fault is cleared.

**S10L** - SS1 link to Low-set Overcurrent

This switch enables or disables the link between the SS1 output and the low-set overcurrent start signal.

- 1 = The low-set phase overcurrent start signal is linked to relay output SS1.
- 0 = The low-set phase overcurrent start signal is not linked to relay output SS1.

**S10H** - SS1 link to High-set Overcurrent

This switch enables or disables the link between the SS1 output and the high-set overcurrent start signal.

- 1 = The high-set phase overcurrent start signal is linked to relay output SS1.
- 0 = The high-set phase overcurrent start signal is not linked to relay output SS1.

**S1EL** - SS1 link to Low-set Earth-Fault

This switch enables or disables the link between the SS1 output and the low-set earth-fault start signal.

- 1 = The low-set earth-fault start signal is linked to relay output SS1.
- 0 = The low-set earth-fault start signal is not linked to relay output SS1.

**S1EH** - SS1 link to High-set Earth-Fault

This switch enables or disables the link between the SS1 output and the high-set earth-fault start signal.

- 1 = The high-set earth-fault start signal is linked to relay output SS1.
- 0 = The high-set earth-fault start signal is not linked to relay output SS1.

## 4.6 Switch Group 6

This switch group configures the operation characteristic of relay outputs SIGNAL1(SS2) and SIGNAL2(SS3).

	S3EH	S3EL	S30H	S30L	S2EH	S2EL	S20H	S20L
Default value	1	1	0	0	0	0	1	1
Default hexadecimal value	C				3			
User setting								
User hexadecimal value*								

\* Refer to appendix A for the corresponding hexadecimal value.

### **S20L** - SS2 link to Low-set Overcurrent

This switch enables or disables the link between the SS2 output and the low-set overcurrent trip signal.

- 1 = The low-set phase overcurrent trip signal is linked to relay output SS2.
- 0 = The low-set phase overcurrent trip signal is not linked to relay output SS2.

### **S20H** - SS2 link to High-set Overcurrent

This switch enables or disables the link between the SS2 output and the high-set overcurrent trip signal.

- 1 = The high-set phase overcurrent trip signal is linked to relay output SS2.
- 0 = The high-set phase overcurrent trip signal is not linked to relay output SS2.

### **S2EL** - SS2 link to Low-set Earth-Fault

This switch enables or disables the link between the SS2 output and the low-set earth-fault trip signal.

- 1 = The low-set earth-fault trip signal is linked to relay output SS2.
- 0 = The low-set earth-fault trip signal is not linked to relay output SS2.

**S2EH** - SS2 link to High-set Earth-Fault

This switch enables or disables the link between the SS2 output and the high-set earth-fault trip signal.

- 1 = The high-set earth-fault trip signal is linked to relay output SS2.
- 0 = The high-set earth-fault trip signal is not linked to relay output SS2.

**S30L** - SS3 link to Low-set Overcurrent

This switch enables or disables the link between the SS3 output and the low-set overcurrent trip signal.

- 1 = The low-set phase overcurrent trip signal is linked to relay output SS3.
- 0 = The low-set phase overcurrent trip signal is not linked to relay output SS3.

**S30H** - SS3 link to High-set Overcurrent

This switch enables or disables the link between the SS3 output and the high-set overcurrent trip signal.

- 1 = The high-set phase overcurrent trip signal is linked to relay output SS3.
- 0 = The high-set phase overcurrent trip signal is not linked to relay output SS3.

**S3EL** - SS3 link to Low-set Earth-Fault

This switch enables or disables the link between the SS3 output and the low-set earth-fault trip signal.

- 1 = The low-set earth-fault trip signal is linked to relay output SS3.
- 0 = The low-set earth-fault trip signal is not linked to relay output SS3.

**S3EH** - SS3 link to High-set Earth-Fault

This switch enables or disables the link between the SS2 output and the high-set earth-fault trip signal.

- 1 = The high-set earth-fault trip signal is linked to relay output SS3.
- 0 = The high-set earth-fault trip signal is not linked to relay output SS3.

## 4.7 Switch Group 7

This switch group configures the characteristic of IDMT curve.

	IE3	IE2	IE1	IE0	IO3	IO2	IO1	IO0
Default value	0	0	0	0	0	0	0	0
Default hexadecimal value	0				0			
User setting								
User hexadecimal value*								

\* Refer to Appendix A for the corresponding hexadecimal value.

IE3/IO3	IE2/IO2	IE1/IO1	IE0/IO0	CURVE SELECTED
0	0	0	0	Normal Inverse
0	0	0	1	Long-time Inverse
0	0	1	0	Very Inverse
0	0	1	1	Extremely Inverse
1	1	X	X	Reserve

X denotes 1 or 0

### IE3 - IE0

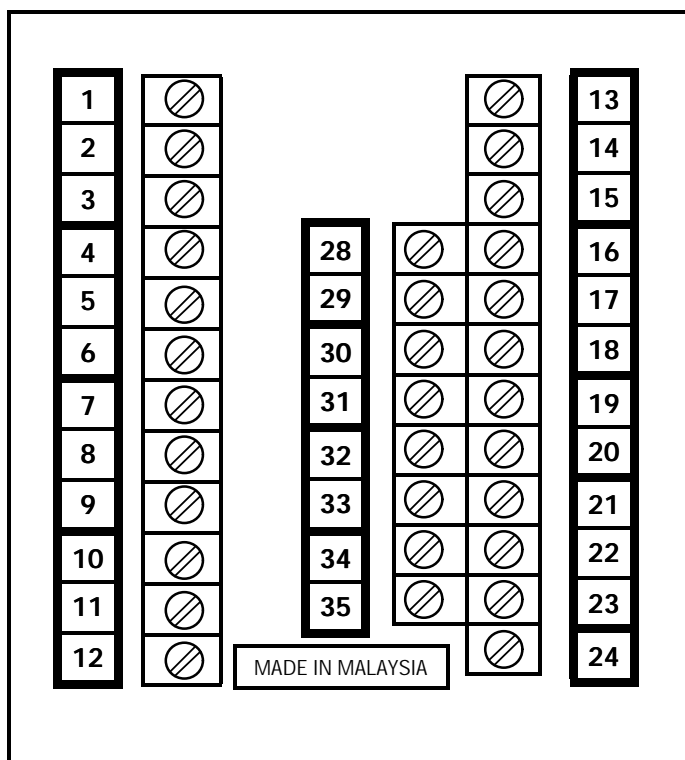
These switches are for selecting the low-set earth-fault inverse curve.

### IO3 - IO0

These switches are for selecting the low-set overcurrent inverse curve.

## 5. Connection Diagram & Terminal Connection

### 5.1 Terminal Connection

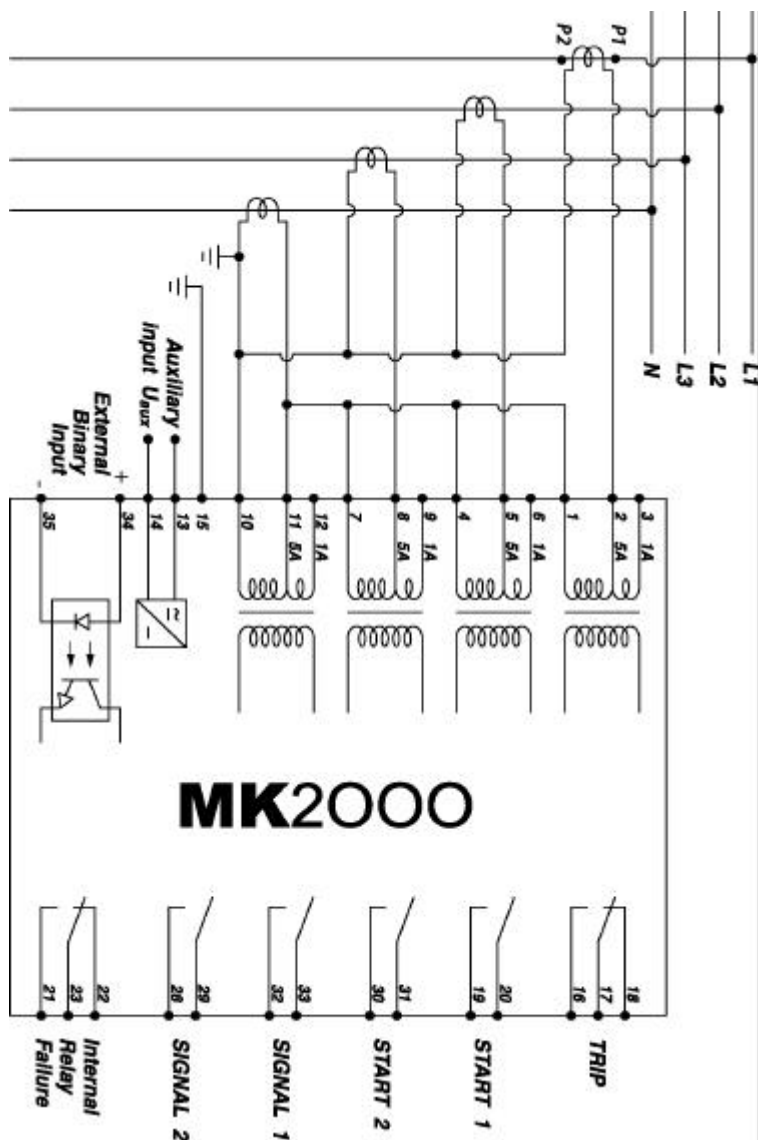


Rear view of MK2000

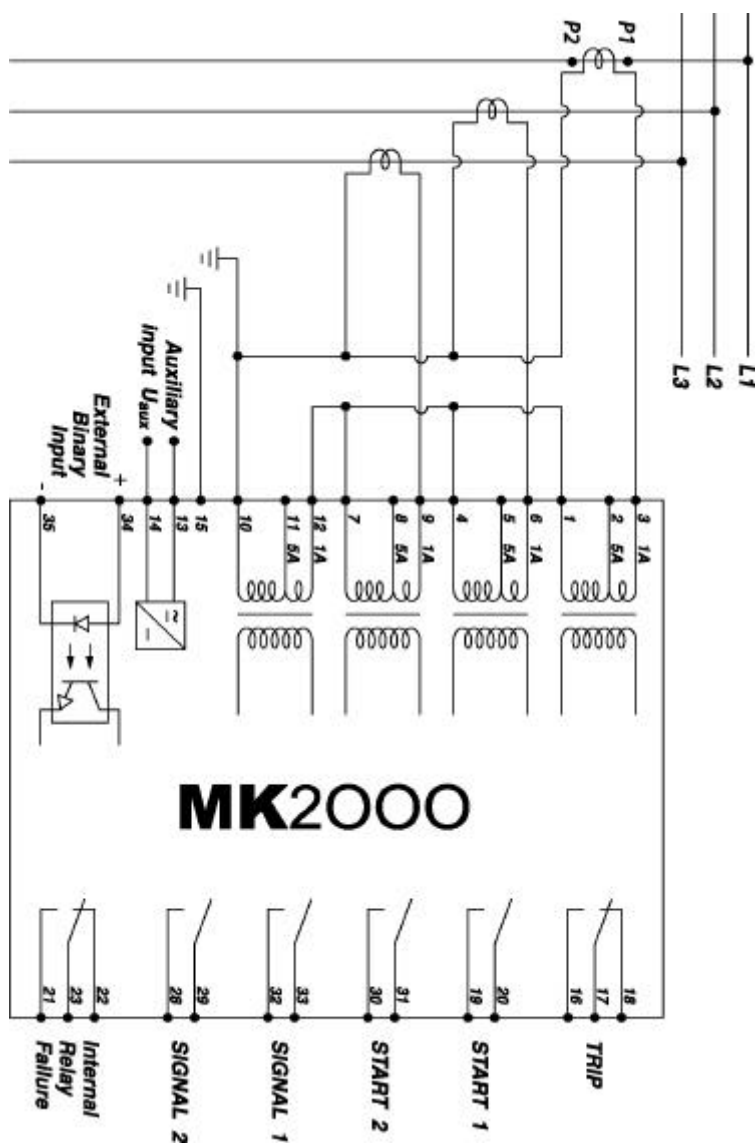
Terminal	Function
1	5A/1A common CT input for $I_{L1}$
2	5A CT input for $I_{L1}$
3	1A CT input for $I_{L1}$
4	5A/1A common CT input for $I_{L2}$
5	5A CT input for $I_{L2}$
6	1A CT input for $I_{L2}$
7	5A/1A common CT input for $I_{L3}$
8	5A CT input for $I_{L3}$
9	1A CT input for $I_{L3}$
10	5A/1A common CT input for $I_o$
11	5A CT input for $I_o$
12	1A CT input for $I_o$
13, 14	Auxiliary supply input
15	Casing earth
16	NO contact output for TRIP (TS2)
17	COM contact for TRIP (TS2)
18	NC contact output for TRIP (TS2)
19, 20	START1 (TS1) output contact
21	NO Contact output for Internal Relay Failure (IRF)
22	NC Contact output for Internal Relay Failure (IRF)
23	COM Contact output for Internal Relay Failure (IRF)
24	No connection
28, 29	SIGNAL2 (SS3) output contact
30, 31	START2 (SS1) output contact
32, 33	SIGNAL1 (SS2) output contact
34	External digital input (+)
35	External digital input (-)



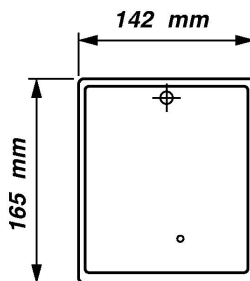
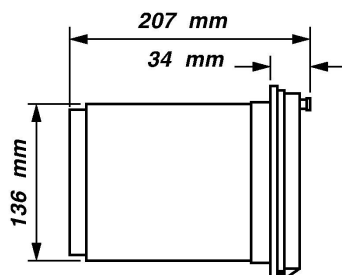
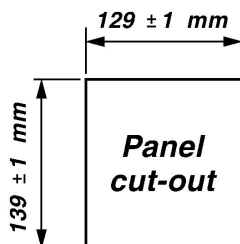
Example 1: Typical connection diagram



Example 2: Typical connection diagram



## 6. Case Dimensions



## 7. Technical Data

### 7.1 Inputs

- a) Measuring inputs
- |                                   |                         |
|-----------------------------------|-------------------------|
| Rated current $I_n$ .....         | 1A or 5A                |
| Frequency.....                    | 50 Hz                   |
| Thermal withstand capability..... | 4 x $I_n$ continuous    |
|                                   | 25 x $I_n$ for - 10 sec |
|                                   | 100 x $I_n$ for - 1 sec |
| Burden.....                       | <0.3 VA at $I_n$        |
- b) Rated auxiliary voltage
- |                         |  |
|-------------------------|--|
| Model MK2000-240A.....  | 190 V <sub>ac</sub> to 265 V <sub>ac</sub> |
| Model MK2000-240AD..... | 85 V <sub>ac</sub> to 265 V <sub>ac</sub>  |
|                         | 110 V <sub>dc</sub> to 340 V <sub>dc</sub> |
| Model MK2000-24D.....   | 18 V <sub>dc</sub> to 36 V <sub>dc</sub>   |
| Model MK2000-24D.....   | 36 V <sub>dc</sub> to 72 V <sub>dc</sub>   |
- c) Power consumption
- |                           |                 |
|---------------------------|-----------------|
| AC auxiliary voltage..... | 6-10 VA typical |
| DC auxiliary voltage..... | 5-9 W typical   |
- d) Digital Input
- |                            |                           |
|----------------------------|---------------------------|
| External binary input..... | 80-250 V <sub>ac/dc</sub> |
|----------------------------|---------------------------|

### 7.2 Outputs

- a) Tripping contacts
- |  |                     |
|--|---------------------|
| Rated voltage.....                                   | 250 V <sub>ac</sub> |
| Continuous carry .....                               | 5A ac or dc         |
| Make and carry for 0.2 sec.....                      | 30A ac or dc        |
| Minimum number of operations<br>at maximum load..... | 10,000 operation    |

b) Signaling contacts	
Rated voltage.....	250 V <sub>ac</sub>
Continuous carry	
NO contact.....	5A ac or dc
NC contact.....	2A ac or dc
Make and carry for 0.2 sec.....	10A ac or dc
Minimum number of operations	
at maximum load.....	10,000 operation

### 7.3 Overcurrent element

Low-set setting $I_{>}$ .....	0.5-5 x $I_n$
High-set setting $I_{>>}$ .....	0.5 - 40 x $I_n$
Time multiplier $kt_{>}$ .....	0.05-1.0
High-set definite time $t_{>>}$ .....	0.05-300 sec

### 7.4 Earth-fault element

Low-set setting $I_{o>}$ .....	0.1-1.0 x $I_n$
High-set setting $I_{o>>}$ .....	0.1 x 10.0 $I_n$
Time multiplier $kt_{o>}$ .....	0.05-1.0
High-set definite time $t_{o>>}$ .....	0.05-300 sec

## 8. Test and Standards

High voltage dielectric withstand test IEC60255-5.....2.0KV rms, 1 min

High voltage impulse test. IEC60255-5.....5KV, 1.2/50 $\mu$ s

Electrical fast transient. IEC61000-4-4,  
Level 4, power supply inputs.....4KV, 5/50ns

Electrical fast transient. IEC61000-4-4,  
Level 4, other inputs.....2KV, 5/50ns

Electrostatic discharge. IEC61000-4-2  
Class III, air discharge.....8KV

Electrostatic discharge. IEC61000-4-2  
Class III, contact discharge.....6KV

Enclosure protection when panel mounted.....IP54

## 9. Appendix A

Hexadecimal - Binary conversion table:-

Hexadecimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111



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