



Features

- ❑ Multifunction numerical relay
- ❑ Phase overcurrent & earth fault protection
- ❑ Two sets of low-set & high-set setting
- ❑ Four IDMT curves
- ❑ Definite time setting
- ❑ Instantaneous trip time setting
- ❑ Phase & earth fault currents metering
- ❑ Nine tripping records
- ❑ Flexible programmable outputs
- ❑ Multifunction external digital input
- ❑ Isolated RS485 Modbus communication

Table of Contents	Page
1. Introduction	2
2. Description of Operation	3
3. Characteristic Curves	16
4. Soft Switches	21
5. Connection Diagram & Terminal Connection	38
6. Case Dimensions	42
7. Technical Data	43
8. Tests and Standards	46
9. Appendix A	47
10. Appendix B	48

For continuous product development, we reserve the right to supply equipment which may vary from that described in this manual.

1. Introduction

The MK2200 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.

MK2200 can be connected to a network system through its RS485 Modbus-RTU communication channel.

2. Description of Operation

The MK2200 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 feeders to be protected. The current inputs can be configured for operation with either 1A or 5A current transformers by connecting the current transformers to the appropriate terminals of the MK2200 relay.

2.1 Phase Overcurrent Protection

Phase overcurrent protection consists of low-set stage and high-set stage for each phase overcurrent element of I_{L1} , I_{L2} , & I_{L3} . All the three phases share the same low-set & high-set settings.

When the phase current exceeded the low-set stage $I_{>}$ setting, the low-set overcurrent element starts by delivering a start signal to the display panel and a group of user pre-assigned contact outputs. If the phase current continue to exceed the low-set stage $I_{>}$ setting for a period of time, the low-set element trips by delivering a trip signal to the display panel and a group of user pre-assigned contact outputs. This time delay is determined by the low-set time delay setting ($t_{>}$) or the time-current characteristic of the selected inverse definite minimum time (IDMT) curve.

Similarly, the high-set stage $I_{>>}$ of the overcurrent element starts once the set $I_{>>}$ current is exceeded. After a preset delay time of $t_{>>}$, the overcurrent element operates and trips the relay by delivering a trip signal to the display panel and a group of user pre-assigned contact outputs.

There are two groups of phase overcurrent settings, namely, Group A and Group B. Each group has one high-set and one low-set and both the high-set stage and low-set stage function independently. Group selection is done by the external digital input with the appropriate setting of soft switch 9.

2.2 Earth-Fault Protection

Earth-fault protection element consists of independent low-set and high-set stages.

When the earth fault current exceeded the low-set stage $I_{o>}$ setting, the low-set earth fault element starts by delivering a start signal to the display panel and a group of user pre-assigned contact outputs. If the earth fault current continue to exceed the low-set stage $I_{o>}$ setting for a period of time, the low-set element trips by delivering a trip signal to the display panel and a group of user pre-assigned contact outputs. This time delay is determined by the low-set time delay setting ($t_{o>}$) or the time-current characteristic of the selected inverse definite minimum time (IDMT) curve.

Similarly, the high-set stage $I_{o>>}$ of the overcurrent element starts once the set $I_{o>>}$ current is exceeded. After a preset delay time of $t_{o>>}$, the overcurrent element operates and trips the relay by delivering a trip signal to the display panel and a group of user pre-assigned contact outputs.

There are two groups of earth fault settings, namely, Group A and Group B. Each group has one high-set and both the high-set stage and low-set stage function independently. Group selection is done by the external digital input with the appropriate setting of soft switch 9.

2.3 Measuring Elements

All the three overcurrent elements and one earth-fault element are provided with user selectable 1A or 5A current transformer inputs. The MK2200 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, extremely inverse curve and definite time. 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 input are

- o Blocking the operation of one or more protection stages.
- o Resetting a latched output relay in the manual reset mode.
- o Selection of protection setting group - Group A or Group B.
- o Trip input to operate contact R1.

The input source can be either ac or dc.

2.5 Output Contacts

MK2200 has six relay outputs of which 4 are user configurable. Contact R1 is the dedicated trip contact and cannot be programmed. Either earth fault or overcurrent will activate this contact. Contacts R2, R3, R4 and R5 are user configurable outputs. The sixth output contact IRF is also not user programmable. It is used to signal an internal failure of MK2200.

2.5.1 User programmable outputs

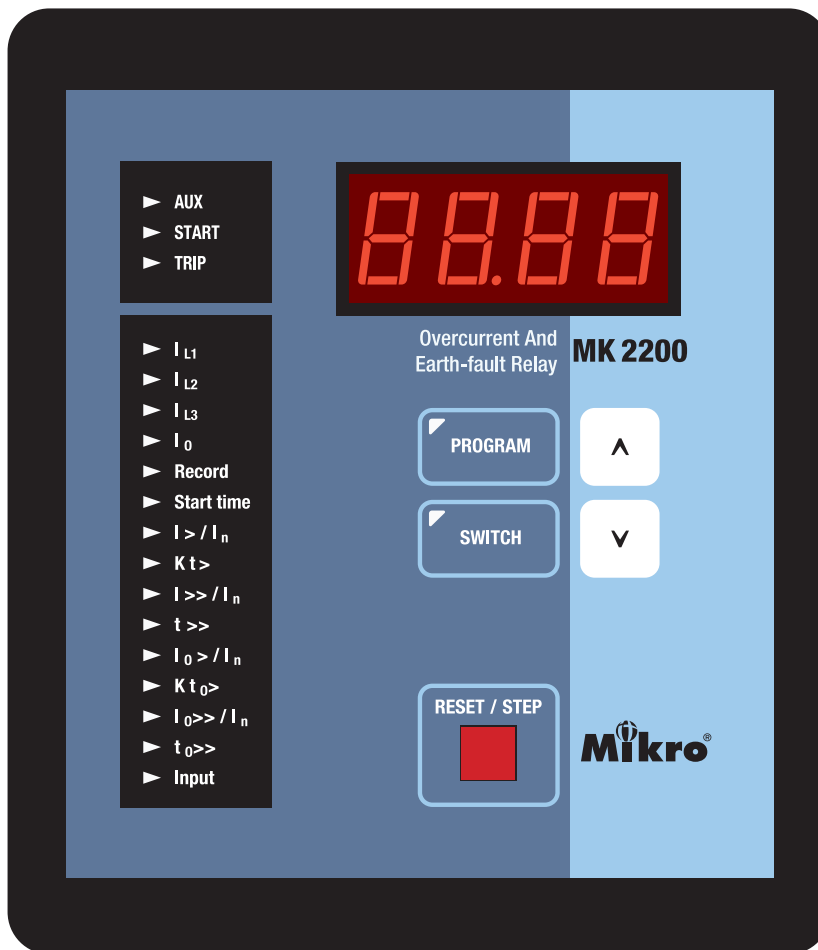
Output contacts R2, R3, R4 and R5 can be programmed as follows:

- o Linked to overcurrent low-set starting
- o Linked to overcurrent low-set tripping
- o Linked to overcurrent high-set starting
- o Linked to overcurrent high-set tripping
- o Linked to earth fault low-set starting
- o Linked to earth fault low-set tripping
- o Linked to earth fault high-set starting
- o Linked to earth fault high-set tripping
- o Manual reset or auto reset for contact outputs R1,R2,R3,R4&R5

2.5.2 Internal Relay Failure (IRF) output

When the auxiliary power of MK2200 is switched on, the relay starts operation. If the MK2200 is functioning normally, the IRF output is energized hence the NC contact of the output will open and the NO contact will close.

2.6 Display



a) **AUX**

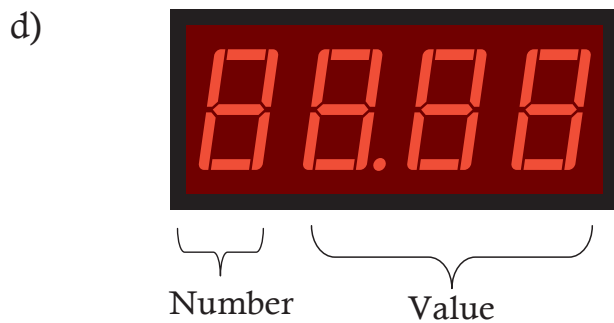
This indicator indicates the presence of auxiliary power supply to MK2200.

b) **START**

When any of the 3 phases or the earth fault protection elements is started (pick-up), this indicator lights up.

c) **TRIP**

When any of the 3 phases or the earth fault protection elements is first started and then subsequently tripped, this indicator lights up to signal a tripped condition



The 4-digit display is for displaying the value of the selected item and its corresponding number. The left-most digit represents the number or group selection and the right-most 3 digits represent the value.

e) ▶ I_{L1}

Phase L1 current is selected. When selected, the 4-digit display indicates the measured phase L1 current.

f) ▶ I_{L2}

Phase L2 current is selected. When selected, the 4-digit display indicates the measured phase L2 current.

g) ▶ I_{L3}

Phase L3 current is selected. When selected, the 4-digit display indicates the measured phase L3 current.

h) ▶ I_0

Earth fault current is selected. When selected, the 4-digit display indicates the measured earth fault current.

i) ▶ **Record**

This indicator lights up simultaneously with either indicators I_{L1} , I_{L2} , I_{L3} or indicator I_{LO} . When selected, the digit display shows the latest tripping fault current of the corresponding phases I_{L1} , I_{L2} , I_{L3} or I_{LO} .

There are nine sets of trip records. To view other records, press the UP or DOWN key. Record 1 is the latest record.

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

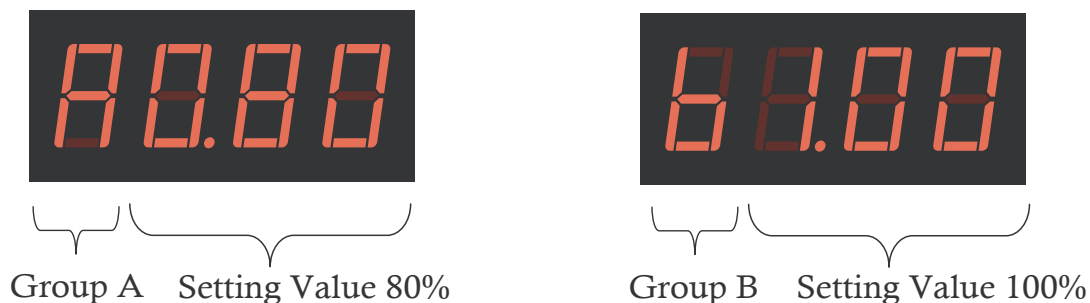
j) ▶ **Start time**

When selected, the 4-digit display shows the latest relay start time. This is the time from relay pick-up until the fault current is removed. The minimum time is 0.1 second.

k) ▶ **I>/I_n**

When selected, the 4-digit display shows the overcurrent low-set current setting. The left-most digit on the 4-digit display indicates either Group A or Group B selection. The setting value is expressed as ratio of I_{setting}/I_{rated}.

Examples:



l) ▶ **Kt>**

When selected, depending on the setting of soft switch 8 and 9, the digit display shows the overcurrent time multiplier setting or the low-set time delay setting. Refer to page 21 for the soft switch selection.

The left-most digit on the 4-digit display indicates either Group A or Group B setting selection. When time delay is selected, the unit is second.

m) ▶ $I_{>>} / I_n$

When selected, the 4-digit display shows the overcurrent high-set setting.

The left-most digit on the 4-digit display indicates either Group A or Group B setting selection.

n) ▶ $t_{>>}$

When selected, the digit display shows the overcurrent high-set time delay setting.

The left-most digit on the 4-digit display indicates either Group A or Group B setting selection.

o) ▶ $I_{0>} / I_n$

When selected, the digit display shows the earth fault low-set setting.

The left-most digit on the 4-digit display indicates either Group A or Group B setting selection.

p) ▶ $K t_{0>}$

When selected, depending on the setting of soft switch 8 and 9, the digit display shows the earth fault time multiplier setting or the low-set time delay setting. Refer to page 21 for the soft switch selection.

The left-most digit on the 4-digit display indicates either Group A or Group B setting selection.

q) ▶ $I_0 \gg / I_n$

When selected, the 4-digit display shows the earth fault high-set setting.

The left-most digit on the 4-digit display indicates either Group A or Group B setting selection.

r) ▶ $t_0 \gg$

When selected, the 4-digit display shows the earth fault high-set time delay setting.

The left-most digit on the 4-digit display indicates either Group A or Group B setting selection.

s) ▶ **Input**

This indicator reflect the status of the external digital input regardless of the soft-switch A selection.

t) Normal Status Display

Under normal operating condition, all the indicators are off except the following:

i) The Aux indicator shows the presence of auxiliary power supply.

▶ **AUX**

ii)



↑
Blinking

The decimal point on the left-most digit blinks to indicate that the relay is functioning.

u) Start Status Display

i) START indicator lights up to indicate relay pick-up.

▶ **START**

ii) One or more of the following indicator(s) blinks to indicate the source(s) of the pick-up.

▶ **I_{L1}**

▶ **I_{L2}**

▶ **I_{L3}**

▶ **I₀**

v) Trip Status Display

i) TRIP indicator lights up to indicate the relay is in a tripped condition.

▶ **TRIP**

ii) One of the indicators below blink to indicate the source of tripping.

▶ **I_{L1}**

▶ **I_{L2}**

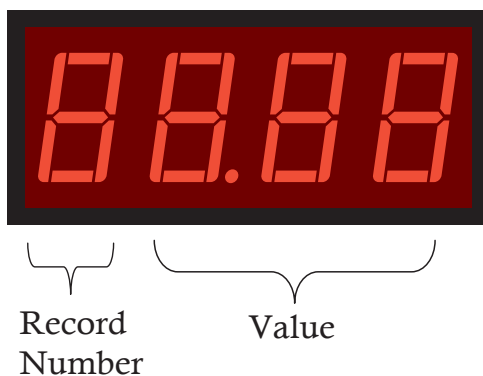
▶ **I_{L3}**

▶ **I₀**

iii) One of the indicators below blink to indicate the tripping element.

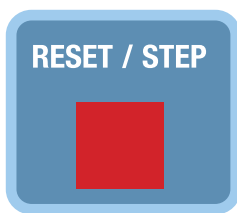
- ▶ $I > / I_n$
- ▶ $I >> / I_n$
- ▶ $I_0 > / I_n$
- ▶ $I_0 >> / I_n$

iv) The digit display indicates the value of the tripping current. The left-most blinking digit indicates the record number



2.7 Key Button Input

a) RESET / STEP key



This key has two functions

- i) To reset the relay when the relay is tripped.
- ii) To select the displayed item on the digit display under normal condition.

c) The UP and DOWN keys



These keys are for changing the value of the selected item while in programming mode or for changing the record number while in the recorded data retrieving mode.

d) The SWITCH key



Press this key to step through all the soft switches.

2.8 Programming Key Operations

a) To program the setting for $I_{>}/In$, $K_{t>}$, $I_{>>}/In$, $t_{>>}$, $I_{o>}/In$, $K_{t_{o>}}$, $I_{o>>}/In$, 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 light up.



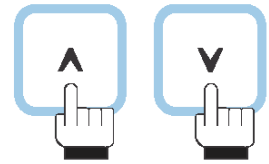
Step 2

Press the PROGRAM key once. The indicator for the selected item will blink and the PROGRAM key lights up to indicate that the system is now in programming mode.



Step 3

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



Step 4

To save the modified value, press the PROGRAM key again. The light on the PROGRAM key turned off and the blinking indicator for the selected item stopped.

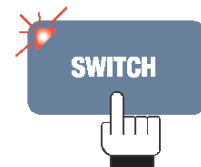


To abort without saving the modified setting, press the RESET/STEP key.

b) To program the soft switches

Step 1

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



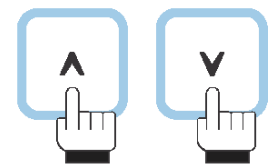
Step 2

Press the PROGRAM key to enter into programming mode. The switch number on the left-most digit display blinks to indicate that the system is now in soft switch programming mode. The PROGRAM and SWITCH keys also light up.



Step 3

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



Step 4

To save the changed setting, press the PROGRAM key again. The switch number stop blinking and the PROGRAM key's light is off.



To abort without saving 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 IEC255-3 and may generally be expressed as:

$$t = \frac{K\beta}{(I/I>)^{\alpha} - 1}$$

Where, t = operating time in seconds

K = time multiplier

I = measured current

I> = set current

α = constant

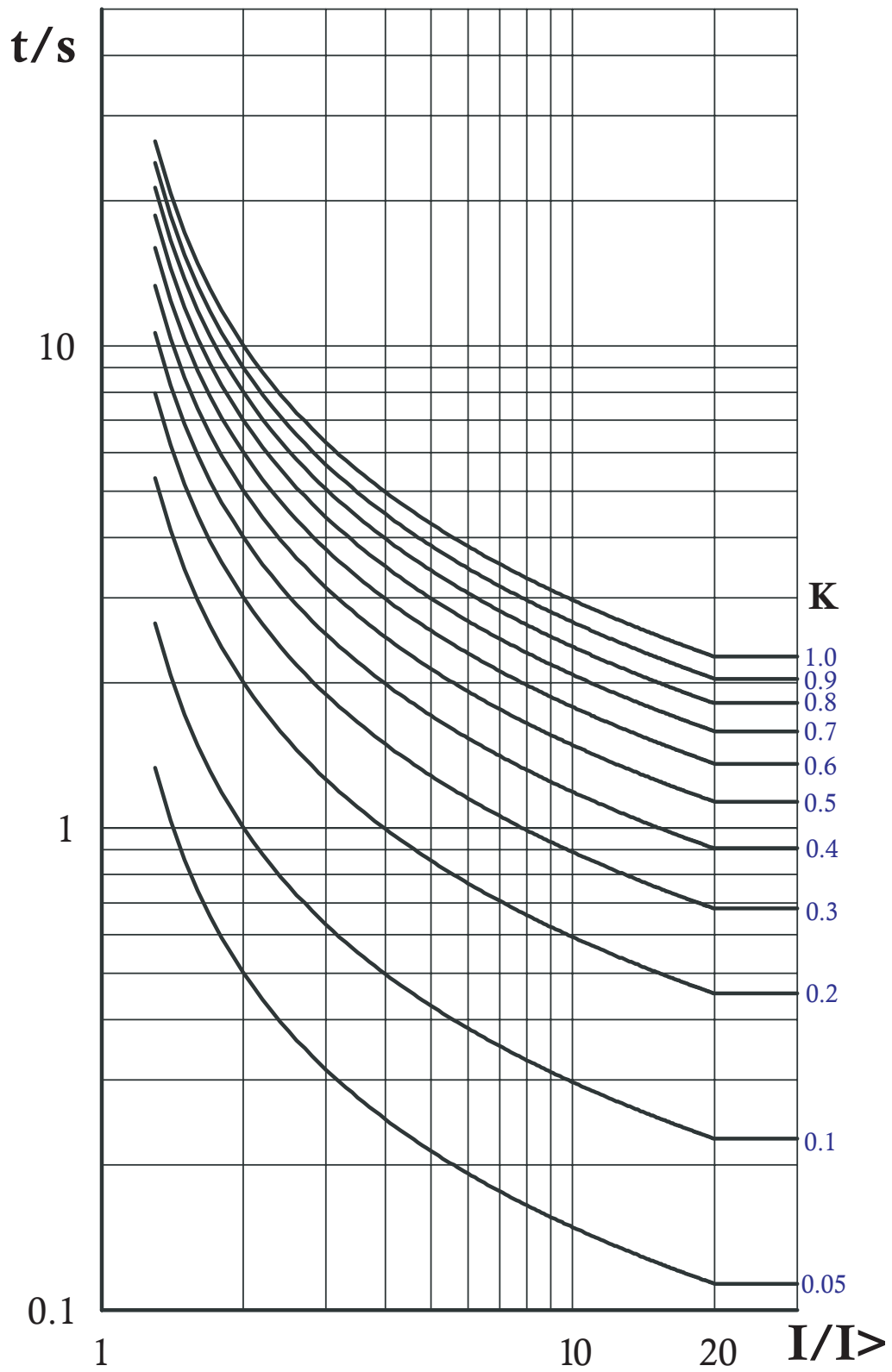
β = constant

Characteristic curve	α	β
Normal Inverse	0.02	0.14
Very Inverse	1.00	13.50
Extremely Inverse	2.00	80.00
Long-time Inverse	1.00	120.00

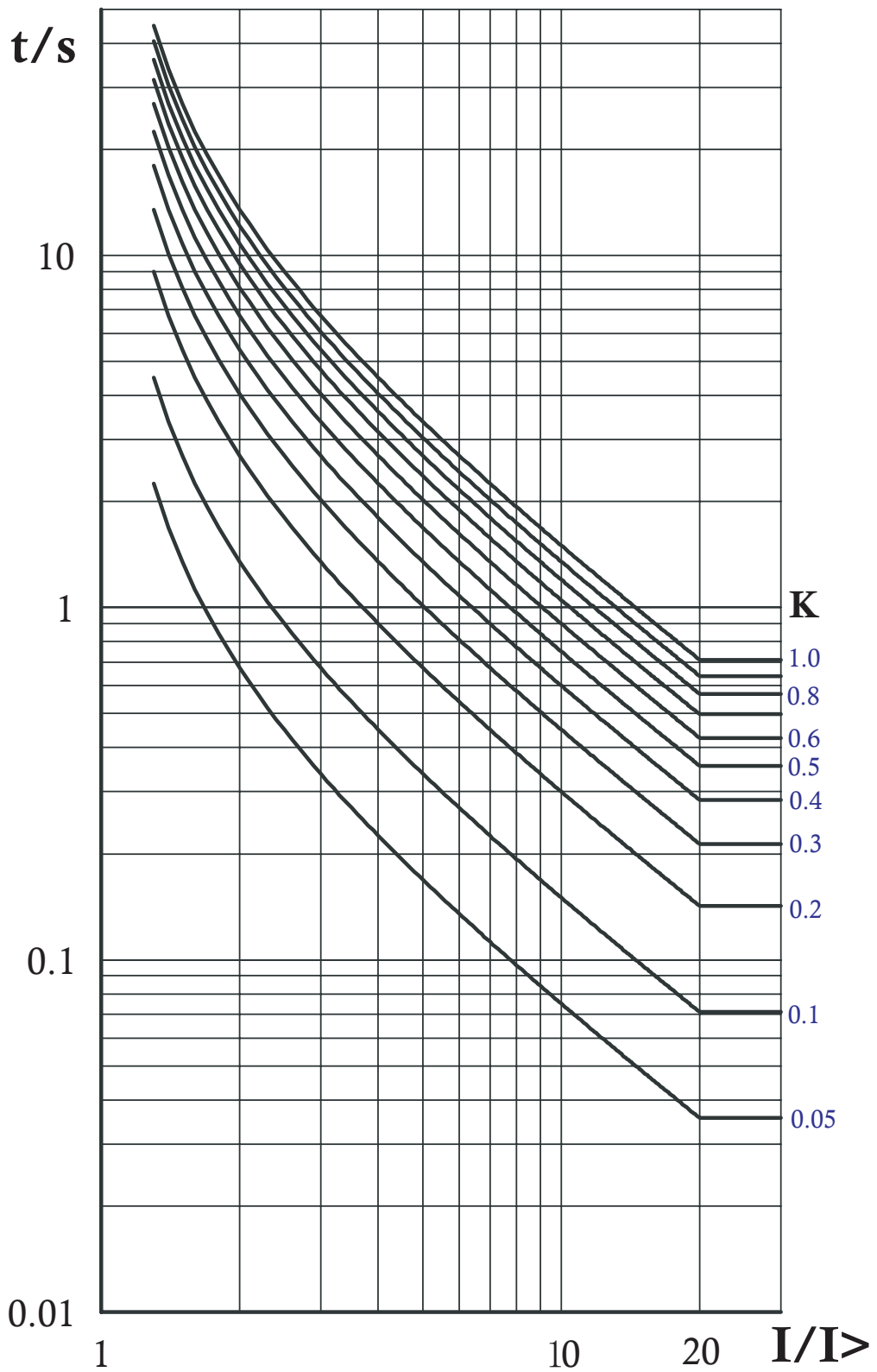
The overcurrent low-set and earth fault low-set elements can also be independently configured for definite time delay instead of the above inverse time delay.

The overcurrent high-set and earth fault high-set elements are independently configured with definite time delay only. The time delay can be from 0 sec (instantaneous) to 300 sec. The high-set feature can also be disabled by the user.

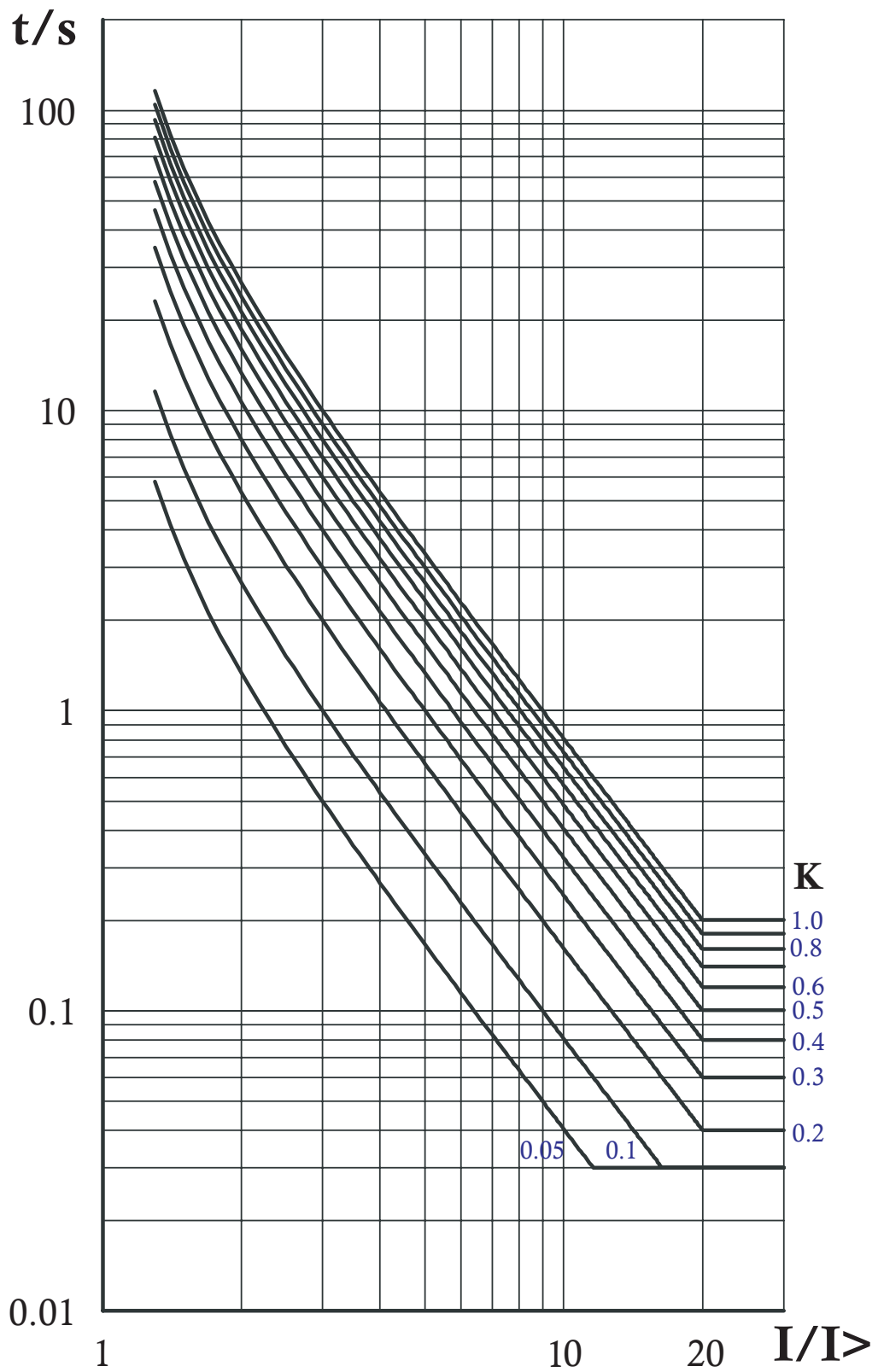
NORMAL INVERSE



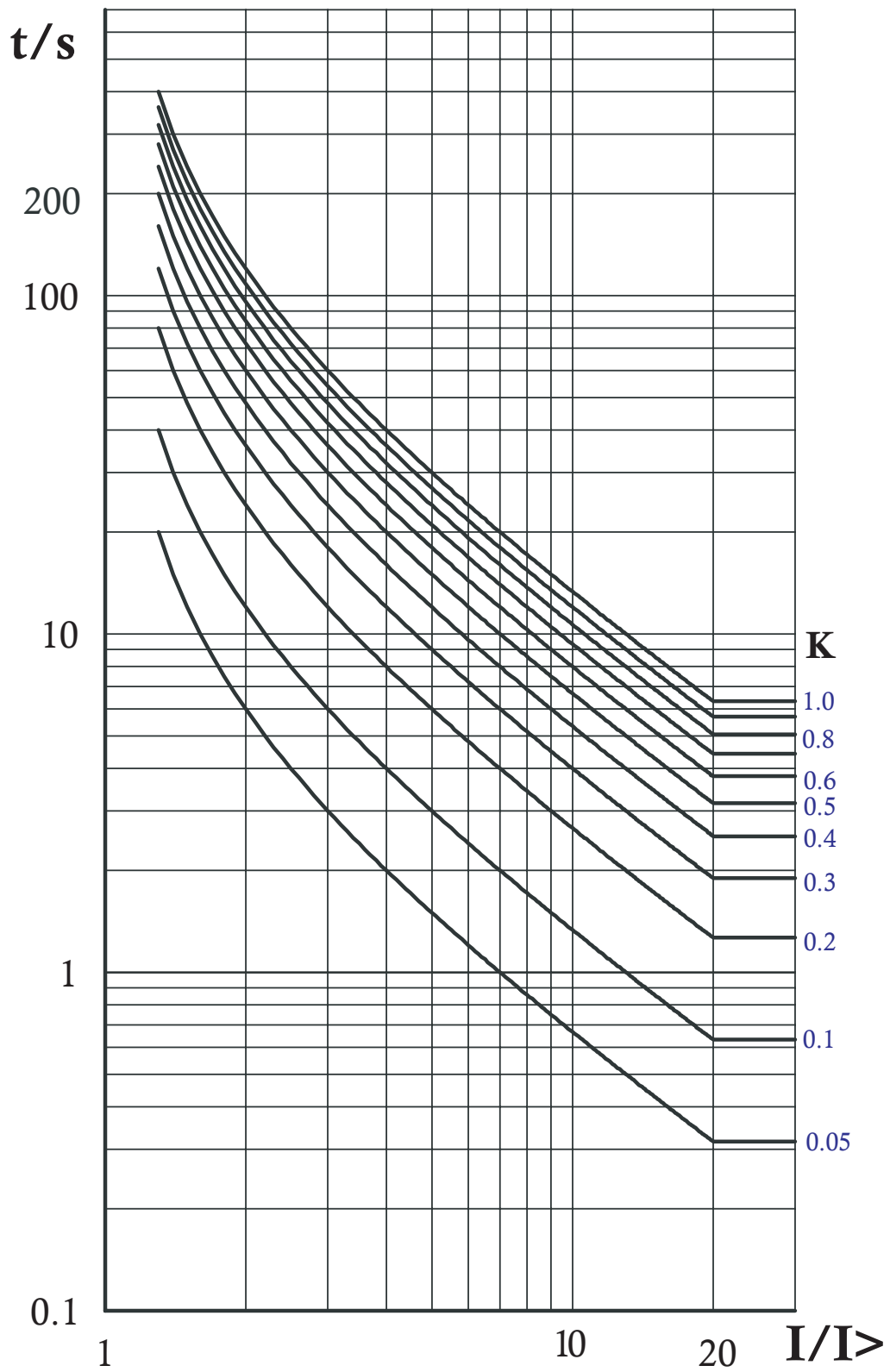
VERY INVERSE



EXTREMELY INVERSE

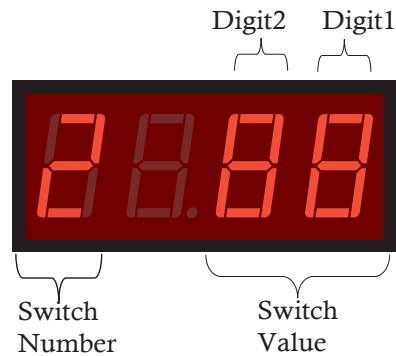


LONG-TIME INVERSE



4. Soft Switches

Soft switches are used to configure the features of the relay and the functional characteristic of the relay outputs.



Soft Switch 1

This soft switch is for enabling or disabling the high-set elements of overcurrent and earth fault for Group A and Group B protection settings.

Soft Switch 1

	S1.7	S1.6	S1.5	S1.4	S1.3	S1.2	S1.1	S1.0
Default setting	0	0	1	1	0	0	1	1
Default setting - hexadecimal Value	3 (Digit 2)				3 (Digit 1)			
User's setting	0	0			0	0		
User's setting -hexadecimal value								

S1.0

This switch is for selection of overcurrent high-set for Group A

1 = overcurrent high-set enabled.

0 = overcurrent high-set disabled.

S1.1

This switch is for selection of overcurrent high-set for Group B

1 = overcurrent high-set enabled.

0 = overcurrent high-set disabled.

S1.2

Reserved - not used

S1.3

Reserved - not used

S1.4

This switch is for selection of earth fault high-set for Group A

1 = earth fault high-set enabled.

0 = earth fault high-set disabled.

S1.5

This switch is for selection of earth fault high-set for Group B

1 = earth fault high-set enabled.

0 = earth fault high-set disabled.

S1.6

Reserved - not used

S1.7

Reserved - not used

Soft Switches 2 to 5

Soft Switches 2 to 5 are used to configure the functional characteristic of the contact outputs R2 to R5 respectively. Through these soft switches, an output can be configured to response to one or more events as shown below:

Soft Switch 2

	S2.7	S2.6	S2.5	S2.4	S2.3	S2.2	S2.1	S2.0
Default setting	0	0	0	0	0	0	0	0
Default setting - hexadecimal Value	0 (Digit 2)				0 (Digit 1)			
User's setting								
User's setting -hexadecimal value								

S2.0

This switch relates the relay output R2 to *overcurrent low-set start signal*
 1 = R2 is connected to overcurrent low-set start signal.
 0 = R2 is disconnected from overcurrent low-set start signal.

S2.1

This switch relates the relay output R2 to *overcurrent low-set trip signal*
 1 = R2 is connected to overcurrent low-set trip signal.
 0 = R2 is disconnected from overcurrent low-set trip signal.

S2.2

This switch relates the relay output R2 to *overcurrent high-set start signal*
 1 = R2 is connected to overcurrent high-set start signal.
 0 = R2 is disconnected from overcurrent high-set start signal.

S2.3

This switch relates the relay output R2 to *overcurrent high-set trip signal*
 1 = R2 is connected to overcurrent high-set trip signal.
 0 = R2 is disconnected from overcurrent high-set trip signal.

S2.4

This switch relates the relay output R2 to *earth fault low-set start signal*
 1 = R2 is connected to earth fault low-set start signal.
 0 = R2 is disconnected from earth fault low-set start signal.

S2.5

This switch relates the relay output R2 to *earth fault low-set trip* signal

1 = R2 is connected to earth fault low-set trip signal.

0 = R2 is disconnected from earth fault low-set trip signal.

S2.6

This switch relates the relay output R2 to *earth fault high-set start* signal

1 = R2 is connected to earth fault high-set start signal.

0 = R2 is disconnected from earth fault high-set start signal.

S2.7

This switch relates the relay output R2 to *earth fault high-set trip* signal

1 = R2 is connected to earth fault high-set trip signal.

0 = R2 is disconnected from earth fault high-set trip signal.

Soft Switch 3

	S3.7	S3.6	S3.5	S3.4	S3.3	S3.2	S3.1	S3.0
Default setting	0	0	0	0	0	0	0	1
Default setting - hexadecimal value	0 (Digit 2)				1 (Digit 1)			
User's setting								
User's setting -hexadecimal value								

S3.0

This switch relates the relay output R3 to *overcurrent low-set start* signal

1 = R3 is connected to overcurrent low-set start signal.

0 = R3 is disconnected from overcurrent low-set start signal.

S3.1

This switch relates the relay output R3 to *overcurrent low-set trip* signal

1 = R3 is connected to overcurrent low-set trip signal.

0 = R3 is disconnected from overcurrent low-set trip signal.

S3.2

This switch relates the relay output R3 to *overcurrent high-set start* signal

1 = R3 is connected to overcurrent high-set start signal.

0 = R3 is disconnected from overcurrent high-set start signal.

S3.3

This switch relates the relay output R3 to *overcurrent high-set trip* signal

1 = R3 is connected to overcurrent high-set trip signal.

0 = R3 is disconnected from overcurrent high-set trip signal.

S3.4

This switch relates the relay output R3 to *earth fault low-set start* signal

1 = R3 is connected to earth fault low-set start signal.

0 = R3 is disconnected from earth fault low-set start signal.

S3.5

This switch relates the relay output R3 to *earth fault low-set trip* signal

1 = R3 is connected to earth fault low-set trip signal.

0 = R3 is disconnected from earth fault low-set trip signal.

S3.6

This switch relates the relay output R3 to *earth fault high-set start* signal

1 = R3 is connected to earth fault high-set start signal.

0 = R3 is disconnected from earth fault high-set start signal.

S3.7

This switch relates the relay output R3 to *earth fault high-set trip* signal

1 = R3 is connected to earth fault high-set trip signal.

0 = R3 is disconnected from earth fault high-set trip signal.

Soft Switch 4

	S4.7	S4.6	S4.5	S4.4	S4.3	S4.2	S4.1	S4.0
Default setting	0	0	0	0	1	0	1	0
Default setting - hexadecimal value	0 (Digit 2)				A (Digit 1)			
User's setting								
User's setting -hexadecimal value								

S4.0

This switch relates the relay output R4 to *overcurrent low-set start* signal

1 = R4 is connected to overcurrent low-set start signal.

0 = R4 is disconnected from overcurrent low-set start signal.

S4.1

This switch relates the relay output R4 to *overcurrent low-set trip* signal

1 = R4 is connected to overcurrent low-set trip signal.

0 = R4 is disconnected from overcurrent low-set trip signal.

S4.2

This switch relates the relay output R4 to *overcurrent high-set start* signal

1 = R4 is connected to overcurrent high-set start signal.

0 = R4 is disconnected from overcurrent high-set start signal.

S4.3

This switch relates the relay output R4 to *overcurrent high-set trip* signal

1 = R4 is connected to overcurrent high-set trip signal.

0 = R4 is disconnected from overcurrent high-set trip signal.

S4.4

This switch relates the relay output R4 to *earth fault low-set start* signal

1 = R4 is connected to earth fault low-set start signal.

0 = R4 is disconnected from earth fault low-set start signal.

S4.5

This switch relates the relay output R4 to *earth fault low-set trip* signal

1 = R4 is connected to earth fault low-set trip signal.

0 = R4 is disconnected from earth fault low-set trip signal.

S4.6

This switch relates the relay output R4 to *earth fault high-set start* signal

1 = R4 is connected to earth fault high-set start signal.

0 = R4 is disconnected from earth fault high-set start signal.

S4.7

This switch relates the relay output R4 to *earth fault high-set trip* signal

1 = R4 is connected to earth fault high-set trip signal.

0 = R4 is disconnected from earth fault high-set trip signal.

Soft Switch 5

	S5.7	S5.6	S5.5	S5.4	S5.3	S5.2	S5.1	S5.0
Default setting	1	0	1	0	0	0	0	0
Default setting - hexadecimal value	A (Digit 2)				0 (Digit 1)			
User's setting								
User's setting -hexadecimal value								

S5.0

This switch relates the relay output R5 to *overcurrent low-set start* signal

1 = R5 is connected to overcurrent low-set start signal.

0 = R5 is disconnected from overcurrent low-set start signal.

S5.1

This switch relates the relay output R5 to *overcurrent low-set trip* signal

1 = R5 is connected to overcurrent low-set trip signal.

0 = R5 is disconnected from overcurrent low-set trip signal.

S5.2

This switch relates the relay output R5 to *overcurrent high-set start* signal

1 = R5 is connected to overcurrent high-set start signal.

0 = R5 is disconnected from overcurrent high-set start signal.

S5.3

This switch relates the relay output R5 to *overcurrent high-set trip* signal

1 = R5 is connected to overcurrent high-set trip signal.

0 = R5 is disconnected from overcurrent high-set trip signal.

S5.4

This switch relates the relay output R5 to *earth fault low-set start* signal

1 = R5 is connected to earth fault low-set start signal.

0 = R5 is disconnected from earth fault low-set start signal.

S5.5

This switch relates the relay output R5 to *earth fault low-set trip* signal

1 = R5 is connected to earth fault low-set trip signal.

0 = R5 is disconnected from earth fault low-set trip signal.

S5.6

This switch relates the relay output R5 to *earth fault high-set start* signal

1 = R5 is connected to earth fault high-set start signal.

0 = R5 is disconnected from earth fault high-set start signal.

S5.7

This switch relates the relay output R5 to *earth fault high-set trip* signal

1 = R5 is connected to earth fault high-set trip signal.

0 = R5 is disconnected from earth fault high-set trip signal.

Soft Switch 6

Soft Switch 6 is for configuring the contact outputs to be latching or non-latching type in response to a start signal.

Soft Switch 6

	S6.7	S6.6	S6.5	S6.4	S6.3	S6.2	S6.1	S6.0
Default setting	0	0	0	0	0	0	0	0
Default setting - hexadecimal value	0 (Digit 2)				0 (Digit 1)			
User's setting	0	0	0					
User's setting -hexadecimal value								

S6.0

This switch set the relationship between *R1 and the relay start signal*.

1 = Manual reset of R1 if it is configured to response to start signal.

0 = Auto reset of R1 if it is configured to response to start signal.

S6.1

This switch set the relationship between *R2 and the relay start signal*.

1 = Manual reset of R2 if it is configured to response to start signal.

0 = Auto reset of R2 if it is configured to response to start signal.

S6.2

This switch set the relationship between *R3 and the relay start signal*.

1 = Manual reset of R3 if it is configured to response to start signal.

0 = Auto reset of R3 if it is configured to response to start signal.

S6.3

This switch set the relationship between *R4 and the relay start signal*.

1 = Manual reset of R4 if it is configured to response to start signal.

0 = Auto reset of R4 if it is configured to response to start signal.

S6.4

This switch set the relationship between *R5 and the relay start signal*.

1 = Manual reset of R5 if it is configured to response to start signal.

0 = Auto reset of R5 if it is configured to response to start signal.

S6.5

Reserved – not used

S6.6

Reserved – not used

S6.7

Reserved – not used

Soft Switch 7

Soft Switch 7 is for configuring the contact outputs to be latching or non-latching type in response to a trip signal.

Soft Switch 7

	S7.7	S7.6	S7.5	S7.4	S7.3	S7.2	S7.1	S7.0
Default setting	0	0	0	1	1	0	0	0
Default setting - hexadecimal value	1 (Digit 2)				8 (Digit 1)			
User's setting	0	0	0					
User's setting -hexadecimal value								

S7.0

This switch set the relationship between *R1 and the relay trip signal*.

1 = Manual reset of R1 if it is configured to response to trip signal.

0 = Auto reset of R1 if it is configured to response to trip signal.

S7.1

This switch set the relationship between *R2 and the relay trip signal*.

1 = Manual reset of R2 if it is configured to response to trip signal.

0 = Auto reset of R2 if it is configured to response to trip signal.

S7.2

This switch set the relationship between *R3 and the relay trip signal*.

1 = Manual reset of R3 if it is configured to response to trip signal.

0 = Auto reset of R3 if it is configured to response to trip signal.

S7.3

This switch set the relationship between *R4 and the relay trip signal*.

1 = Manual reset of R4 if it is configured to response to trip signal.

0 = Auto reset of R4 if it is configured to response to trip signal.

S7.4

This switch set the relationship between *R5 and the relay trip signal*.

1 = Manual reset of R5 if it is configured to response to trip signal.

0 = Auto reset of R5 if it is configured to response to trip signal.

S7.5

Reserved – not used

S7.6

Reserved – not used

S7.7

Reserved – not used

Soft Switch 8

This switch is for selecting the low-set elements for overcurrent and earth fault for Group A setting.

	Digit 2	Digit 1
Default setting	1	1
User's setting		

Digit 1 is for selecting the earth fault low-set element's IDMT curve and time characteristic.

Low-set characteristic for earth fault	Display Value
Normal inverse	1
Very inverse	2
Extremely inverse	3
Long-time inverse	4
Definite time	5

Digit 2 is for selecting the overcurrent low-set element's IDMT curve and time characteristic.

Low-set characteristic for overcurrent	Display Value
Normal inverse	1
Very inverse	2
Extremely inverse	3
Long-time inverse	4
Definite time	5

Soft Switch 9

This switch is for selecting the low-set elements for overcurrent and earth fault for GroupB setting.

	Digit 2	Digit 1
Default setting	1	1
User's setting		

Digit 1 is for selecting the earth fault low-set element's IDMT curve and time characteristic.

Low-set characteristic for earth fault	Display Value
Normal inverse	1
Very inverse	2
Extremely inverse	3
Long-time inverse	4
Definite time	5

Digit 2 is for selecting the overcurrent low-set element's IDMT curve and time characteristic.

Low-set characteristic for overcurrent	Display Value
Normal inverse	1
Very inverse	2
Extremely inverse	3
Long-time inverse	4
Definite time	5

Soft Switch A

This soft switch is for configuring the external digital input with the exception of switch SA.7. The external digital input can be configured for *one* of the following functions.

- ❑ Change of protection settings by switching between Group A and Group B settings.
- ❑ Used as a remote trip reset.
- ❑ Input for tripping the MK2200 by an external device.
- ❑ Input for blocking any of the overcurrent and/or earth fault protection elements for Group A setting only.

Soft Switch A

	SA.7	SA.6	SA.5	SA.4	SA.3	SA.2	SA.1	SA.0
Default setting	0	0	0	0	0	0	0	0
Default setting - hexadecimal value	0 (Digit 2)				0 (Digit 1)			
User's setting								
User's setting - hexadecimal value								

SA.0

When enabled, this switch blocks the *earth fault low-set element* by closing the two input terminals of the external digital input.

- 1 – Enable the blocking function.
- 0 – Disable the blocking function.

SA.1

When enabled, this switch blocks the *earth fault high-set element* by closing the two input terminals of the external digital input.

- 1 – Enable the blocking function.
- 0 – Disable the blocking function.

SA.2

When enabled, this switch blocks the *overcurrent low-set element* by closing the two input terminals of the external digital input.

- 1 – Enable the blocking function.
- 0 – Disable the blocking function.

SA.3

When enabled, this switch blocks the *overcurrent high-set element* by closing the two input terminals of the external digital input.

- 1 – Enable the blocking function.
- 0 – Disable the blocking function.

SA.4

When enabled, the external digital input switches the protection setting between Group A and Group B. When the two input terminals are connected, Group B settings are selected. Otherwise, Group A is selected.

- 1 – Enable the group switching function.
- 0 – Disable the group switching function.

SA.5

When enabled, the external digital input can be used to perform remote reset of the MK2200 when tripped. A closed input reset the MK2200.

- 1 – Enable remote reset function.
- 0 – Disable remote reset function.

SA.6

When enabled, a tripping of the MK2200 can be initiated by an external device or source. Closing the two input terminals of the external digital input activate the output contact R1 of MK2200. R1 contact cannot be programmed and it is the dedicated tripping contact for MK2200.

- 1 – Enable external tripping.
- 0 – Disable external tripping.

SA.7

When enabled, the high-set setting for the phase overcurrent element automatically doubled during a cold load pickup.

A cold load pick up condition is started when the phase current increases from below 0.12 times of the overcurrent low-set setting to 3 times of the overcurrent low-set setting in less than 60ms. This condition ends when the phase current fall below 2 times the overcurrent low-set setting.

- 1 – Enable the cold load pickup feature.
- 0 – Disable the cold load pickup feature.

Soft Switch B

This soft switch selects the baud rate and data format of the serial Modbus communication between the host computer (client) and the relay MK2200 (server).

	Digit 2	Digit 1
Default setting	4	7
User's setting		

Digit 1 is for selecting the communication baud rate.

Baud rate	Value of Digit 1
300	1
600	2
1200	3
2400	4
4800	5
9600	6
19200	7

Digit 2 is for selecting the data format.

Data format	Value of Digit 2
1 start bit, 8 data bits, no parity bit, 1 stop bit	1
1 start bit, 8 data bits, no parity bit, 2 stop bits	2
1 start bit, 8 data bits, odd parity bit, 1 stop bit	3
1 start bit, 8 data bits, even parity bit, 1 stop bit	4

Soft Switch C

This soft switch is for setting the device unit number of the relay MK2200 in a Modbus communication network. The setting range for the device unit is from 1 to 127 and it is displayed and set in hexadecimal format. Example: If the selected unit number is 42, then the equivalent hexadecimal number is 2A. For conversation between hexadecimal number and decimal number, please refer to Appendix B.

The default unit number is 1.

Soft Switch D

This soft switch allows the user to either allow or disallow remote programming or changing of the setting values of the MK2200 relay. Once enabled, the remote host computer (client) is able to read all the settings and parameters of the relay through the serial Modbus communication channel. In addition, it can also modify all the settings on the relay. If disabled, only reading of the setting values and relay parameters is possible.

- 1 – Remote programming is enabled.
- 0 – Remote programming is disabled.

The default setting for MK2200 is remote programming disabled (0).

Soft Switch E

This switch allows the output contacts of MK2200 to be manually switched on individually. This is very useful during testing and commissioning of the relay.

Description	Display Value
Off all contacts	00
On contact R1 only	01
On contact R2 only	02
On contact R3 only	03
On contact R4 only	04
On contact R5 only	05

Steps to turn on a contact:

1. Select soft switch E by pressing the SWITCH key.
2. Press PROGRAM key.
3. Press UP or DOWN key to select the desired contact.
4. Press SWITCH or PROGRAM key to exit.

Note that all contacts will be switched OFF after the above test regardless of the previous status of the contacts before the test.

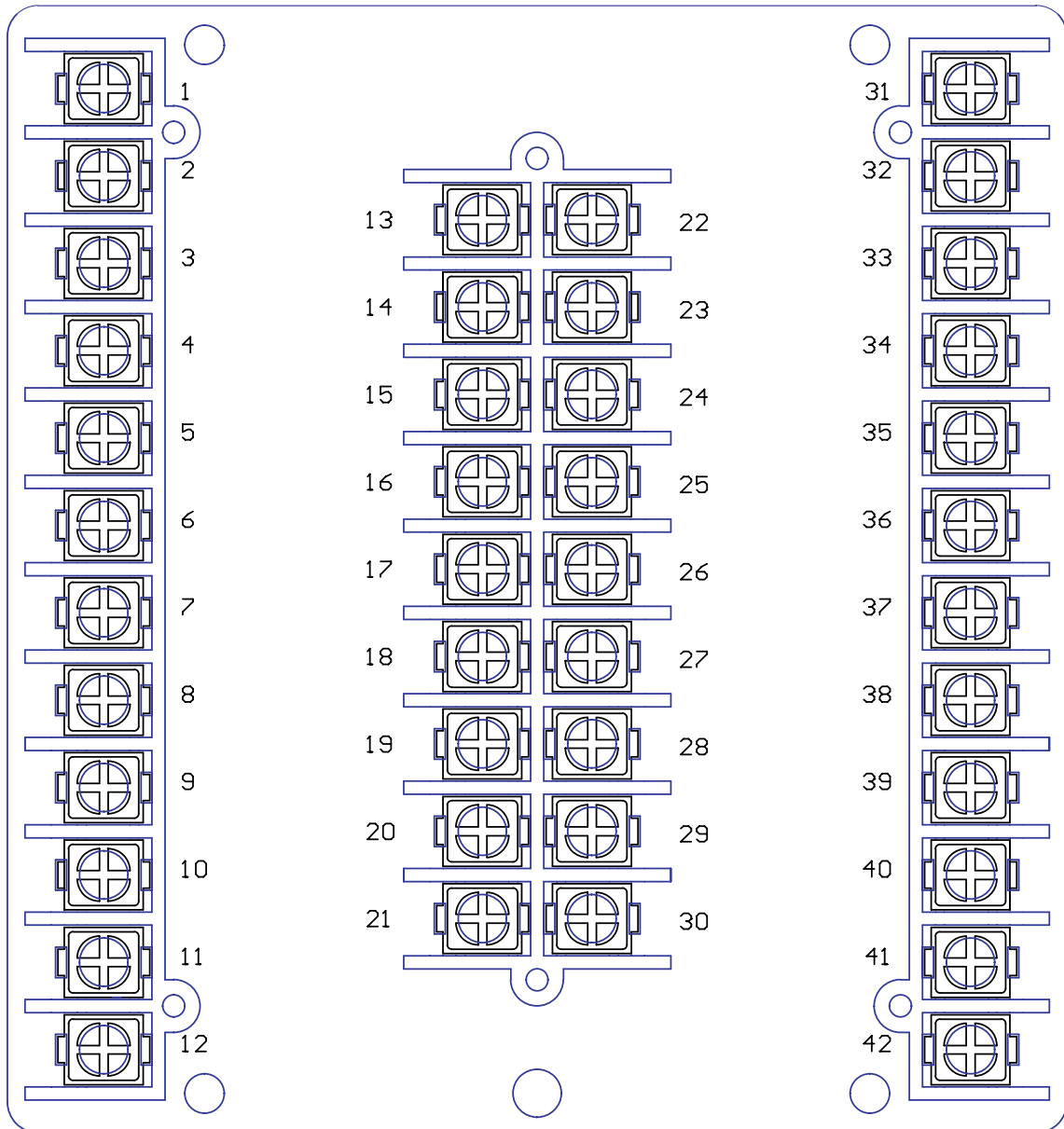
Soft Switch F

This switch is for selecting the operation frequency of the electrical system to be protected. It is crucial that the correct frequency of operation be selected and failure to do so will give rise to wrong current measurements.

- 0 – 50Hz system frequency
- 1 – 60Hz system frequency

5. Connection Diagram & Terminal Connection

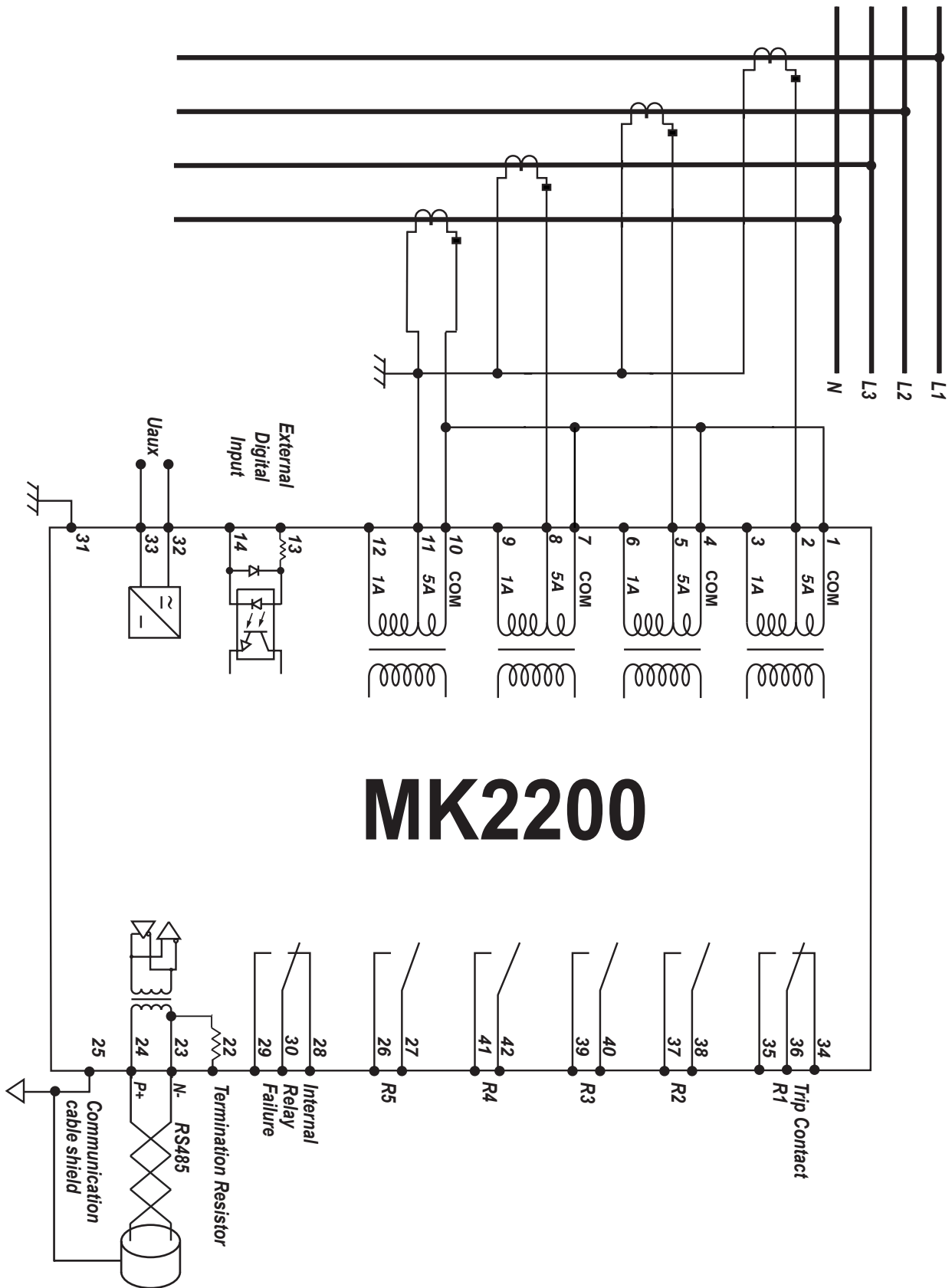
5.1 Terminal Connection



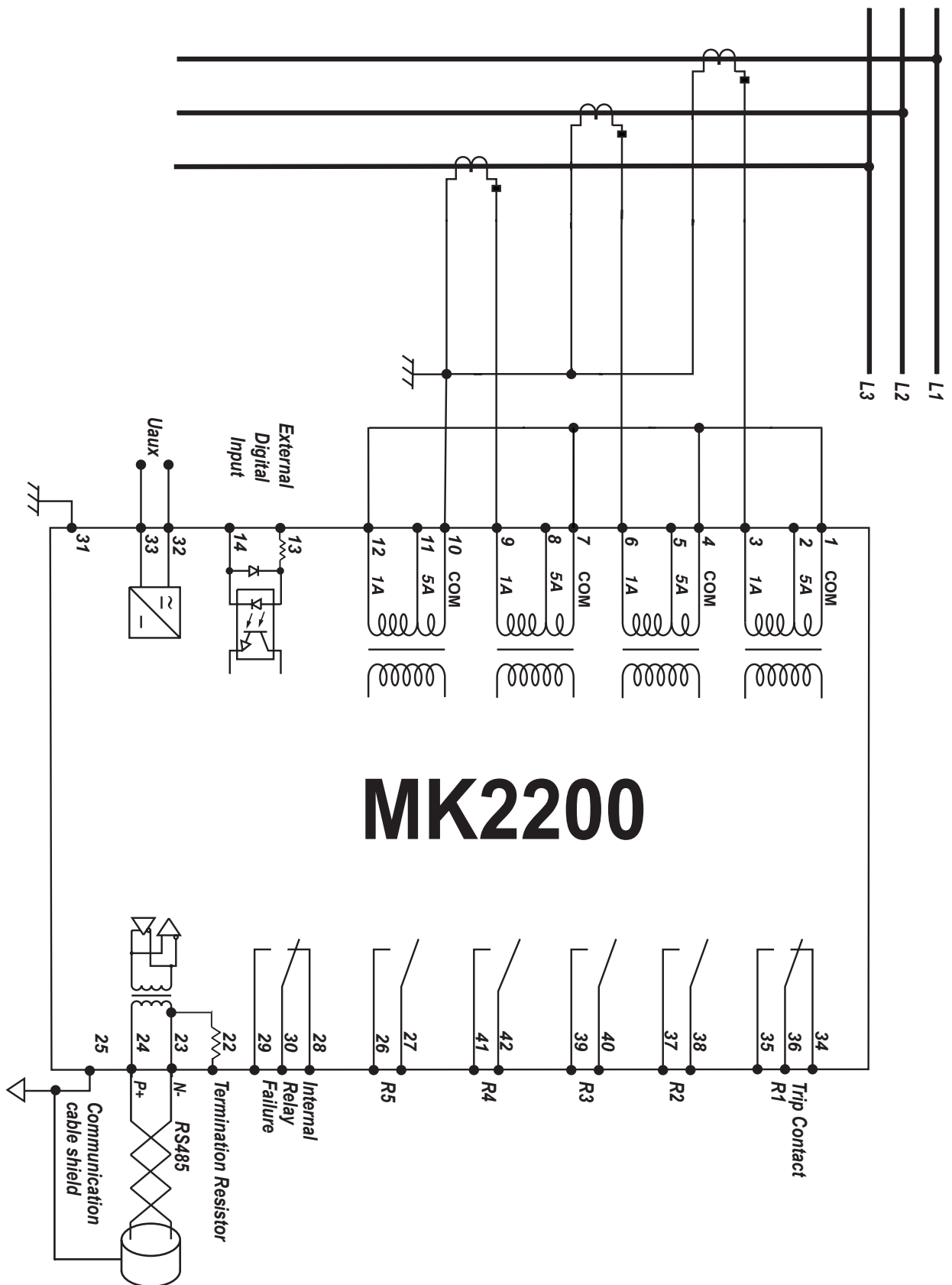
Rear view of MK2200

Connection terminal	Function description
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 / 1 A 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_0
11	5A CT input for I_0
12	1A CT input for I_0
13	External digital input
14	External digital input
15 to 21	Not used
22	Termination resistor (for RS485)
23	RS485 negative terminal
24	RS485 positive terminal
25	Communication cable shield
26,27	Output contact R5
28	N.C. contact for IRF
29	N.O. contact for IRF
30	COMMON contact for IRF
31	Casing earth terminal
32	Auxiliary supply input (No polarity)
33	Auxiliary supply input (No polarity)
34	N.C. contact for tripping contact R1
35	N.O. contact for tripping contact R1
36	COMMON contact for contact R1
37,38	Output contact R2
39,40	Output contact R3
41,42	Output contact R4

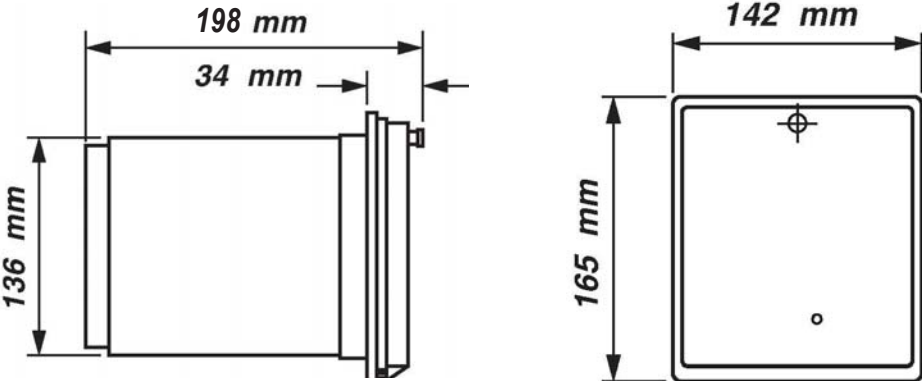
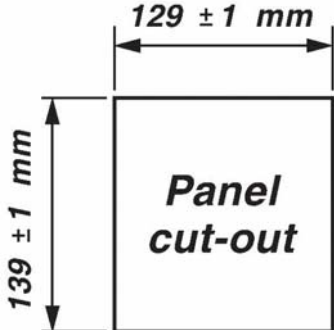
Example 1: Typical connection diagram



Example 2: Typical connection diagram



6. Case Dimensions



7. Technical Data

Input

i)	Measuring inputs	
	Rated current I_n	1A or 5A
	Frequency	50Hz or 60Hz
	Thermal withstand capability	4 x I_n continuous 25 x I_n for less than 10 sec 100 x I_n for less than 1 sec
	Burden	< 0.3 VA at I_n
ii)	Rated auxiliary supply voltage	
	Model MK 2200-150D	24 ~ 150V DC
	Model MK 2200-240A D	85 ~ 265V AC 110 ~ 340V DC
iii)	Power consumption	5 ~ 9W typical
iv)	External digital input	18 ~ 265V DC 85 ~ 265V AC

Output

i)	All contacts	
	Rated voltage	250V AC
	Continuous carry	5A AC or DC
	Make and carry for 0.2 sec	30A AC or DC
	Expected electrical life (min operation)	100,000 at max load
	Expected mechanical life (min operation)	5,000,000
	Operating time	Max. 15ms

Overcurrent element

i)	Low-set	
	Low-set setting $I >$	$0.10 \sim 2.50 \times I_n$ step 0.01
	Time multiplier	$0.02 \sim 1.0$ step 0.01
	Definite time setting	0 ~ 10.0 s step 0.01 10.0 ~ 100 s step 0.1 100 ~ 300 s step 1
	Reset ratio	95% typical
	IDMT curve and accuracy class (IEC255-3)	Normal inverse (E5)
		Very inverse (E5)
		Extremely inverse (E7.5)
		Long-time inverse (E5)
ii)	High-set	
	High-set setting $I \gg$	0.1 to 10 step 0.05 10 to 40 step 0.1
	Definite time setting	0 ~ 10.0 s step 0.01 10.0 ~ 100 s step 0.1 100 ~ 300 s step 1

Earth fault element

i)	Low-set	
	Low-set setting $I_o >$	$0.05 \sim 1.0 \times I_n$ step 0.01
	Time multiplier	$0.02 \sim 1.0$ step 0.01
	Definite time setting	0 ~ 10.0 s step 0.01 10.0 ~ 100 s step 0.1 100 ~ 300 s step 1
	Reset ratio	95% typical
	IDMT curve and accuracy class (IEC255-3)	Normal inverse (E5)
		Very inverse (E5)
		Extremely inverse (E7.5)
		Long-time inverse (E5)
ii)	High-set	
	High-set setting $I \gg$	$0.05 \sim 10.0 \times I_n$ step 0.05
	Definite time setting	0 ~ 10.0 s step 0.01 10.0 ~ 100 s step 0.1 100 ~ 300 s step 1

Communication

i)	<i>Hardware interface</i>	Isolated RS485
ii)	<i>Protocol</i>	Modbus-RTU
iii)	<i>Baud rate</i>	300, 600, 1200, 2400, 4800, 9600, 19200

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 μ 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

Binary to hexadecimal conversion table: -

Hexadecimal	Binary	Decimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
B	1011	11
C	1100	12
D	1101	13
E	1110	14
F	1111	15

10. Appendix B

Decimal to Hexadecimal Conversation

Decimal	Hexadecimal	Decimal	Hexadecimal	Decimal	Hexadecimal
1	1	44	2C	87	57
2	2	45	2D	88	58
3	3	46	2E	89	59
4	4	47	2F	90	5A
5	5	48	30	91	5B
6	6	49	31	92	5C
7	7	50	32	93	5D
8	8	51	33	94	5E
9	9	52	34	95	5F
10	A	53	35	96	60
11	B	54	36	97	61
12	C	55	37	98	62
13	D	56	38	99	63
14	E	57	39	100	64
15	F	58	3A	101	65
16	10	59	3B	102	66
17	11	60	3C	103	67
18	12	61	3D	104	68
19	13	62	3E	105	69
20	14	63	3F	106	6A
21	15	64	40	107	6B
22	16	65	41	108	6C
23	17	66	42	109	6D
24	18	67	43	110	6E
25	19	68	44	111	6F
26	1A	69	45	112	70
27	1B	70	46	113	71
28	1C	71	47	114	72
29	1D	72	48	115	73
30	1E	73	49	116	74
31	1F	74	4A	117	75
32	20	75	4B	118	76
33	21	76	4C	119	77
34	22	77	4D	120	78
35	23	78	4E	121	79
36	24	79	4F	122	7A
37	25	80	50	123	7B
38	26	81	51	124	7C
39	27	82	52	125	7D
40	28	83	53	126	7E
41	29	84	54	127	7F
42	2A	85	55		
43	2B	86	56		