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REJ 513
Overcurrent Relay
User's Guide

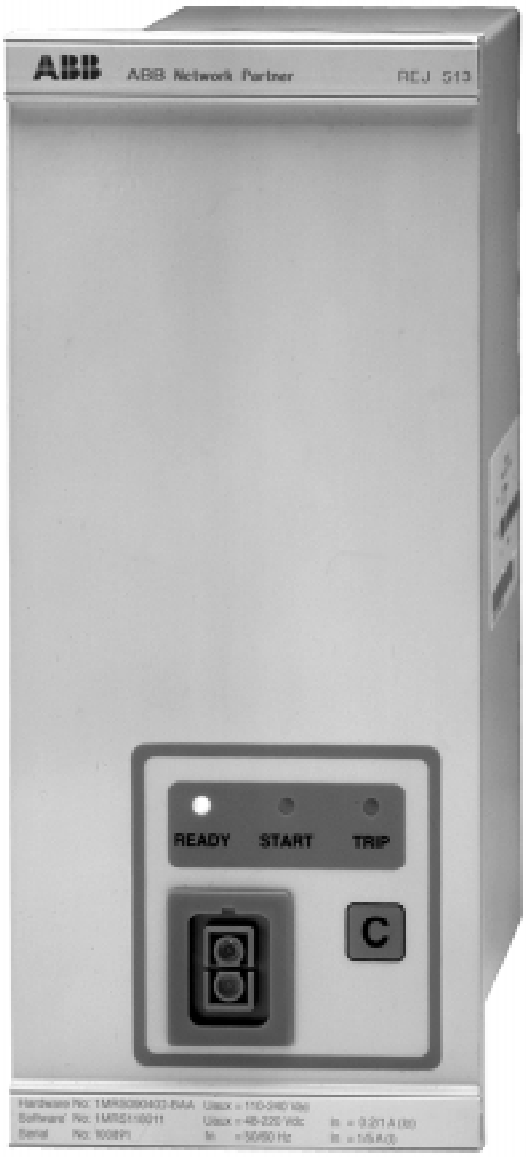

ABB Substation Automation Products and Systems

Contents

Introduction

About this manual

The purpose of this manual is to provide the user with thorough information on the relay REJ 513 and its applications. The manual consists of three parts, the first of which, part A, instructs the user in controlling the relay functions. Part B is a more detailed description of the features, operation and applications of the relay, whereas part C concentrates on service.

The use of the relay

The overcurrent relay REJ 513 is intended to be used for selective short-circuit protection in medium voltage distribution networks. The protection relay includes a phase overcurrent unit with flexible tripping and signalling facilities. The overcurrent relay can also be used in other applications requiring single-, two- or three-phase overcurrent protection.

Features

- Three-phase low-set overcurrent stage with definite-time or inverse definite minimum time (IDMT) characteristic.
- Three-phase high-set overcurrent stage with instantaneous or definite-time characteristic.
- Circuit-breaker failure protection unit.
- Disturbance recorder.
- Three accurate current inputs.
- Galvanically isolated binary input with a wide input voltage range.
- All settings are modified with a personal computer.
- Settings are stored into non-volatile memory and remain even in case of power supply failure.
- Two normally open power output contacts.
- Two change-over type signal output contacts.
- Output contact functions freely configurable for desired operation.
- Optical PC-connector for two-way data communication.
- Continuous self-supervision of hardware and software. At a permanent fault all stages and outputs are blocked.
- Rated frequency user-selectable 50/60 Hz.

Guarantee

Please inquire the guarantee of your nearest ABB representative.

Safety information

Dangerous voltages can occur on the connectors, even though the auxiliary voltage is disconnected.

National and local electrical safety regulations must always be followed.

The frame of the protection relay has to be carefully earthed.

Current transformers have to be short-circuited before disconnecting the relay from them.

Only a competent electrician is allowed to carry out the electrical installation.

A Operator's instructions

1 Operation indicators

The function of the relay can be monitored with the help of three indication LEDs on the relay front panel.

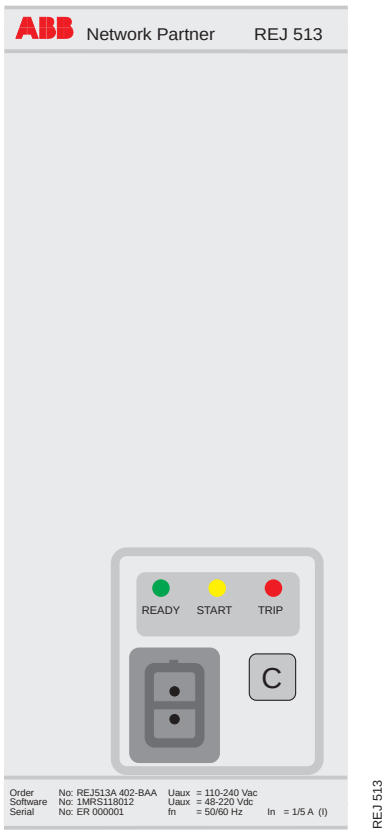

Figure 1-1 Operation indicators

Green READY indicator

- Indicator off:

  The auxiliary voltage supply to the relay has been disconnected.

- Lit indicator:

  The relay is in normal operation, i.e. the CPU operates, no internal faults have occurred, and auxiliary voltage is available to the relay.

- Blinking indicator:

  The internal self-supervision system has detected an internal relay fault (IRF). The output contact of the self-supervision system operates.

Yellow START indicator

- Indicator off:

  Normal operation mode. No protection function has started.

- Lit indicator:

  A protection function has started. The start indication can be selected to be latching or non-latching with switches SGF2/4...5. The latching/non-latching setting for the protection function last started or tripped determines whether the start indication will be latching or non-latching.

  A non-latching type of indication is automatically switched off when the fault disappears (the protection stage resets).

  Although the fault disappears, a latching type of indication remains lit until cleared by pressing the [C] button.

- Blinking indicator:

  Started protection functions are blocked by an external binary input. The blocking indication is non-latching, i.e. it disappears with the external binary input signal.

  The start LED goes on blinking as long as a protection function (or stage) of the relay is blocked. The blocking indication disappears when the binary input signal is removed or when the protection function in question is no longer started. Should the function still be started when the binary input signal is removed, the start indication will be activated.

  If a protection function is blocked when other protection functions are started but not blocked, the indicator will remain blinking (blocking has a higher priority than starting).

Red TRIP indicator

- Indicator off:

  Normal operation mode. No protection function has tripped.

- Lit indicator:

  A protection function has tripped. The trip indication is latching, i.e. the trip indication must be reset by pressing the [C] button (or via serial communication).

Further, the indicators may be reset via the external binary input X2.1/17-18 by applying control voltage to the input, provided that switches SGB1/1...3 are in position 1.

The basic protection relay functions do not depend on the state of the operation indicators, reset or non-reset. The relay is permanently operative.

2 Control push-button

The front panel of the relay contains one push-button for clearing operation indicators and unlatching relays. Operation indicators must be cleared and the [C] button released before the relays can be unlatched. The table below describes the use of the push-button.

Table 2-1 Control push-button

Push-button	Pressed 1 s	Pressed 5 s
C	Clear operation indicators	Unlatch relays

B Technical reference manual

1 Instructions

1.1 Application

The overcurrent relay REJ 513 is a secondary relay that is connected to the current transformers of an object to be protected. The three-phase overcurrent unit continuously measures the phase currents of the object. On detection of a fault the relay starts, trips the circuit breaker, provides alarms, records fault data etc. in accordance with the application and the configured relay functions.

The overcurrent unit includes two protection stages: a low-set stage I> and a high-set stage I>>. If the high-set stage is given a setting within the lower part of the setting range, the relay module will contain two nearly identical operation stages. In this case the relay can be used in two-stage load shedding applications.

The protection functions are independent of each other and have their own setting groups and data recording. The overcurrent protection function uses conventional current transformer measurement.

Output contact matrix allows any start or trip signal from the protection stages to be routed to the desired output contact.

1.2 Requirements

When the protection relay is operating under conditions specified below (see also "Technical data"), the relay is practically maintenance-free. The relay includes no parts or components subject to abnormal physical or electrical wear under normal operating conditions.

Environmental conditions

- Specified ambient service temperature range -10...+55 °C
- Temperature influence on the operating values of the relay within the specified ambient service temperature range 0.1% / °C
- Transport and storage temperature range -40...+70 °C

1.3 Configuration

Setting and connection examples

The appropriate configuration of the output contact matrix enables using the start signals of the overcurrent unit as contact functions. The start signals can be used for blocking co-operating protection relays, for signalling and for initiating autoreclosing.

Figures 1.3-1 and 1.3-2 represent the relay with default configuration: all trips are routed to operate the circuit breaker.

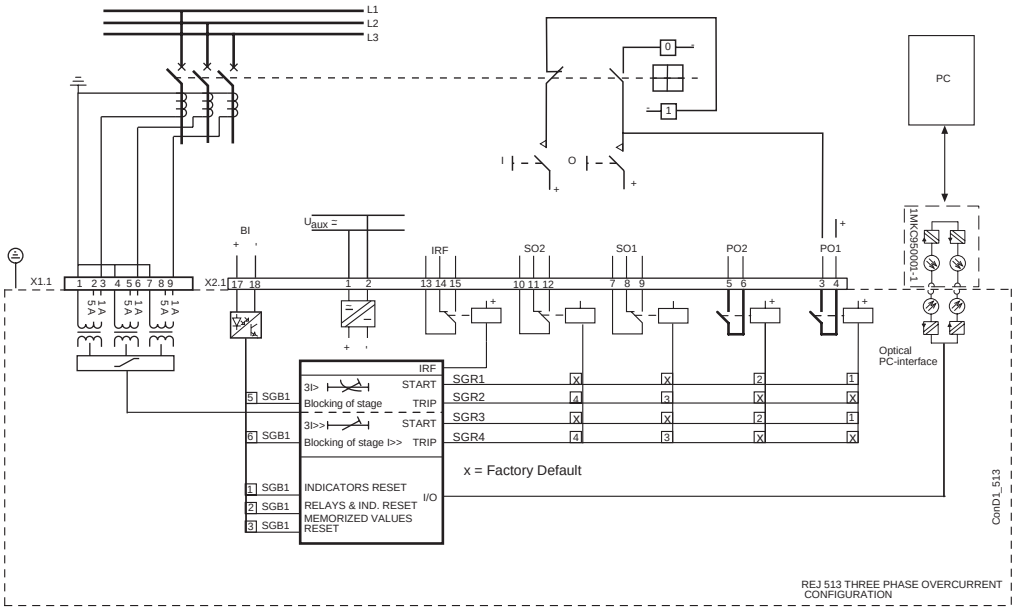

Figure 1.3-1 Connection diagram of the overcurrent relay

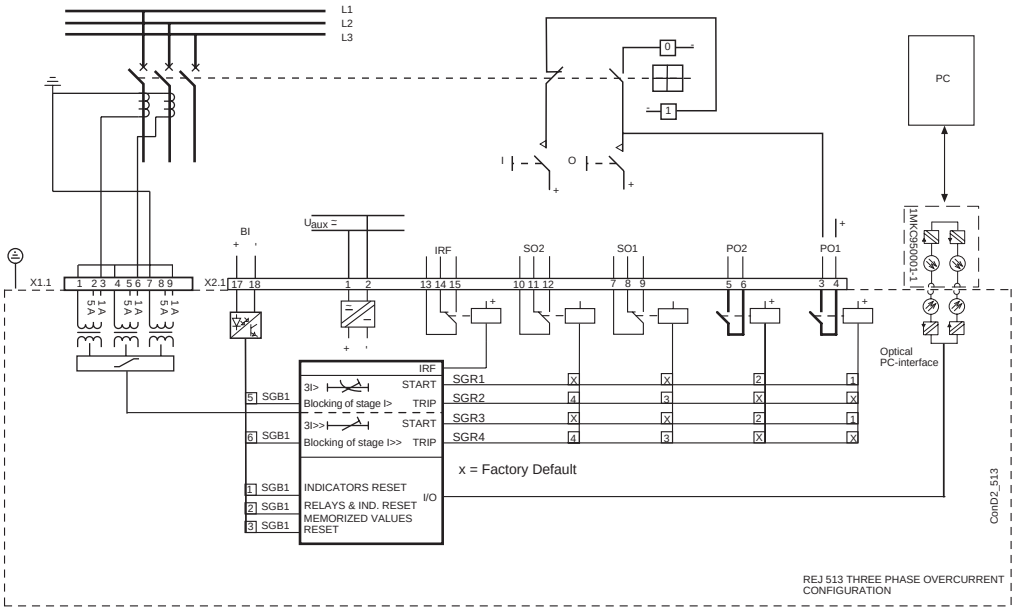

Figure 1.3-2 Connection diagram of the overcurrent relay

2 Technical description

2.1 Functional description

2.1.1 Product functions

2.1.1.1 Schema of product functions

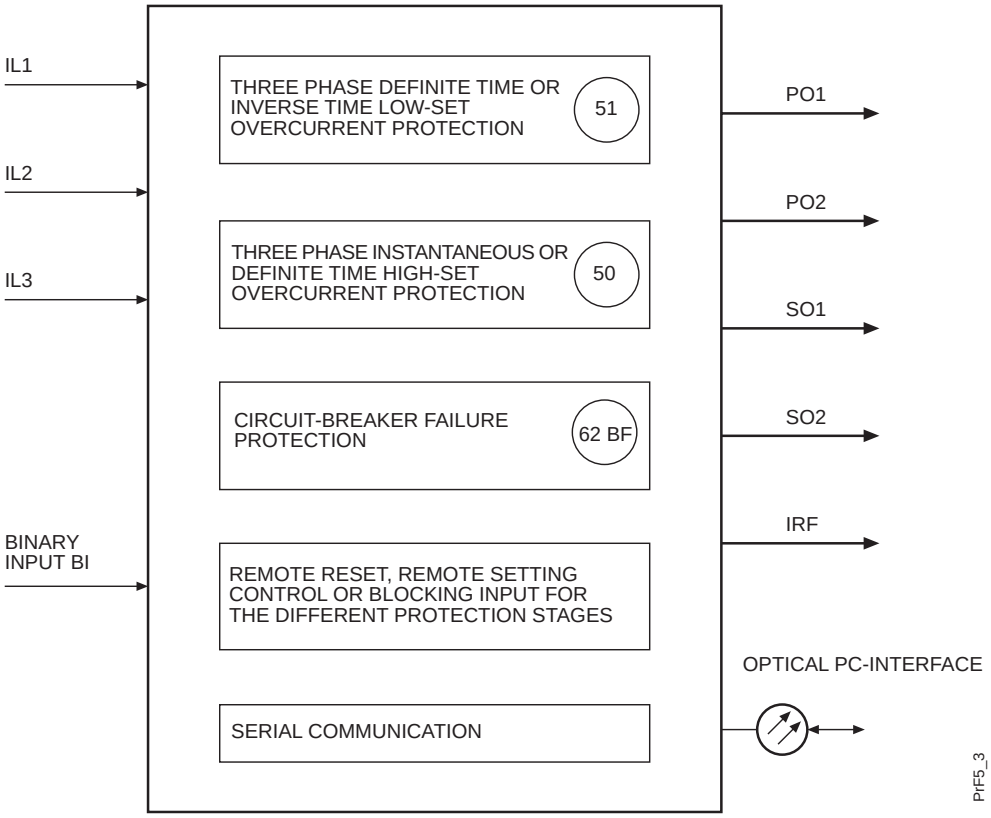

Figure 2.1.1.1-1 Product functions

2.1.1.2 Overcurrent

Refer to section 2.1.3.2 Overcurrent unit

2.1.1.3 Inputs

The relay includes three energizing inputs for phase currents and one external binary input controlled by an external voltage. The function of the binary input is determined with selector switches of the protection relay. For inputs, see also section 2.2.1 Input / output connections and tables 2.1.3.4-5, 2.2.1-1 and 2.2.1-5.

2.1.1.4 Outputs

The relay is provided with two power outputs (PO1 and PO2) and two signal outputs (SO1 and SO2). Switchgroups SGR1...4 are used for routing the start and trip signals of any protection stage to the desired signal or power output.

2.1.1.5 Circuit-breaker failure protection

The relay features a circuit-breaker failure protection (CBFP) unit. The CBFP unit generates a trip signal via output PO2 after the set operate time 0.1 s...1 s if the fault has not been cleared by that time.

Normally, the CBFP unit controls the upstream circuit breaker. It can also be used for tripping via redundant trip circuits of the same circuit breaker if the circuit breaker is provided with two trip coils. The circuit-breaker failure protection unit is activated with a switch of switchgroup SGF.

2.1.1.6 Disturbance recorder

The relay includes an internal disturbance recorder, which records momentary values, internal logic signals and external BI signal. The disturbance recorder can be set to be triggered on operation of stages or on an external BI signal, either on the falling or rising trigger edge.

2.1.1.7 Self-supervision

The relay is provided with an extensive self-supervision system that continuously supervises the software and the electronics of the relay. It handles run-time fault situations and informs the user about an existing fault.

When a fault is detected, the relay first tries to eliminate it by restarting. Only after the fault is found to be permanent, the green READY indicator starts to blink and the protection relay delivers a fault signal to the self-supervision output contact. The self-supervision output contact that is normally picked up drops off and a fault code can be read from the relay. All other output contacts are blocked during an internal fault.

The fault code is a number that identifies the fault type. The code shall be recorded, and stated when service is ordered. Fault codes are listed in the following table.

Table 2.1.1.7-1 Fault codes

Fault code	Type of fault
4	No response on output contact test, PO1
5	No response on output contact test, PO2
6	No response on output contact test, SO1
7	No response on output contact test, SO2
30	Faulty program memory
50, 59	Faulty work memory
51, 52, 53, 54, 56	Faulty parameter memory [1)]
55	Faulty parameter memory
56	Parameter memory (EEPROM) key faulty, formatting by writing V167:2
131, 139, 195, 203, 222, 223	Internal reference voltage error
253	Error in measuring unit

2.1.2 Configuration

The figure below illustrates how the start, trip and binary input signals can be configured so that the required protection functions are obtained.

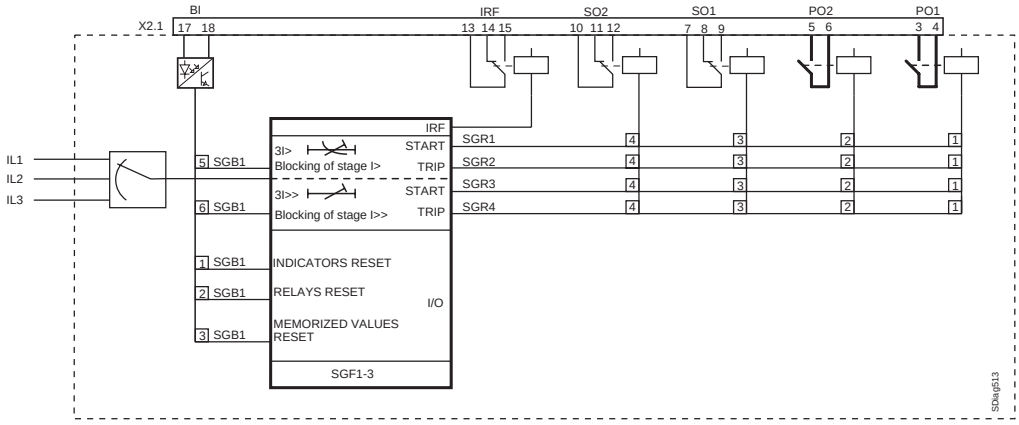

Figure 2.1.2-1 Signal diagram of the overcurrent relay

The functions of the blocking and start signals are selected with the switches of switchgroups SGF, SGB and SGR. The functions of these switches are explained in detail in the corresponding SG_ - tables.

2.1.3 Protection

2.1.3.1 Block diagram

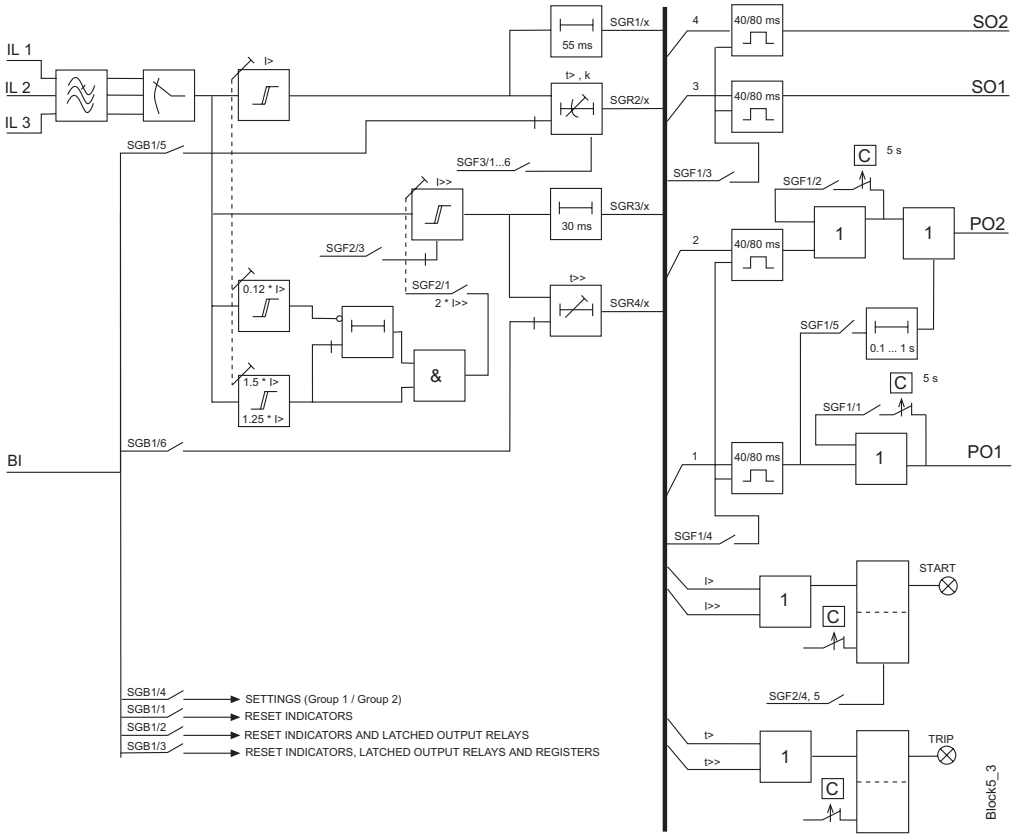

Figure 2.1.3.1-1 Block diagram of the overcurrent relay

2.1.3.2 Overcurrent unit

When the phase currents exceed the set start current of the low-set stage I>, the overcurrent unit starts delivering a start signal after a preset ~ 55 ms start time. When the set operate time at definite-time operation or the calculated operate time at inverse-time operation elapses, the overcurrent unit operates. In the same way, the high-set stage I>> of the overcurrent unit starts delivering a start signal after a preset ~ 30 ms start time when the set start current is exceeded. When the set operate time elapses, the overcurrent unit operates.

The low-set stage of the overcurrent unit may be given a definite-time or an inverse definite minimum time (IDMT) characteristic. When the IDMT characteristic is chosen, six time/current curve groups are available. Four of the groups comply with the standards BS 142 and IEC 60255, and are called “normal inverse “, “very inverse”, “extremely inverse” and “long-time inverse”. The two additional inverse-time curve groups are called “RI-” and “RD-curves”.

The inverse-time function of stage I> can be inhibited when stage I>> is started. In this case the operate time is determined by stage I>>.

If not needed, the stage I>> can be set out of operation completely. This state is indicated by “999” when the set start current value is read via serial communication.

The set start current value I>>/ I_n of stage I>> can be automatically doubled in a start situation, i.e. when the object to be protected is connected to a network. Thus a set start current value below the connection inrush current level may be selected for the overcurrent stage I>>. A start situation is defined as a situation where the phase current rises from a value below 0.12 x I> to a value above 1.5 x I> in less than 60 ms. The start situation ends when the current falls below 1.25 x I>.

2.1.3.3 Time/current characteristics

The overcurrent stage I> can be given a definite-time or an inverse definite minimum time operation characteristic. The settings of switches SGF3/1...6 determine the mode of operation. Refer to section "Settings". At the IDMT characteristic, the operate time of the stage is a function of the current: the higher the current, the shorter the operate time. Six time/current curve groups are available. Four of these comply with the standards BS 142 and IEC 60255, and two curve groups, RI and RD, are special type curve groups according to ABB praxis.

Characteristics according to IEC 60255 and BS 142

The relay module incorporates four internationally standardized time/current curve groups called "extremely inverse", "very inverse", "normal inverse" and "long-time inverse". The relationship between time and current is in accordance with the standards BS 142 and IEC 60255-4, and can be expressed as follows:

$$t[s] = \frac{k \times \beta}{\left(\frac{I}{I>}\right)^{\alpha} - 1}$$

where t = operate time

k = time multiplier

I = phase current value

I> = set current value.

Table 2.1.3.3-1 The values of constants α and β

Time/current curve group	α	β
Normal inverse	0.02	0.14
Very inverse	1.0	13.5
Extremely inverse	2.0	80.0
Long-time inverse	1.0	120

The standard BS 142.1966 defines the normal current range to be 2...20 times the setting value. In addition, the relay has to start at the latest when the current exceeds the setting value 1.3 times if the time/current characteristic is normal inverse, very inverse or extremely inverse. For the long-time inverse characteristic the normal current range is specified to be 2...7 times the setting, and the relay is to start when the current exceeds the setting value 1.1 times.

Table 2.1.3.3-2 The operate time tolerances specified by the standard

I/I>	Normal	Very	Extremely	Long time
2	2,22E	2,34E	2,44E	2,34E
5	1,13E	1,26E	1,48E	1,26E
7	-	-	-	1,00E
10	1,01E	1,01E	1,02E	-
20	1,00E	1,00E	1,00E	-

E = accuracy in per cent; - = not specified

In the normal current ranges, specified above, the inverse-time stage of the overcurrent relay fulfils the tolerance requirements of class 5 at all degrees of inversity.

The time/current characteristics according to the IEC and BS standards are illustrated in figures 2.1.3.3-1…2.1.3.3-4.

RI-type characteristic

The RI-type characteristic is a special characteristic that is principally used for obtaining time grading with mechanical relays. The characteristic can be expressed mathematically:

$$t\,[s] = \frac{k}{0.339 - 0.236 \times \frac{I>}{I}}$$

where t = operate time in seconds

k = time multiplier

I = phase current

I> = set start current.

The RI-type characteristic is illustrated in figure 2.1.3.3-5.

RD-type characteristic

The RD-type characteristic is a special characteristic that is principally used in earth-fault protection which requires a high degree of selectivity even at high resistance faults. In this case the protection can operate in a selective way even if it is not directional. Mathematically, the time/current characteristic can be expressed as follows:

$$t\,[s] = 5.8\text{-}1.35 \text{ x } \log_e\left(\frac{I}{k \times I>}\right)$$

where t = operate time in seconds

k = time multiplier

I = phase current

I> = set start current.

The RD-type characteristic is illustrated in figure 2.1.3.3-6.

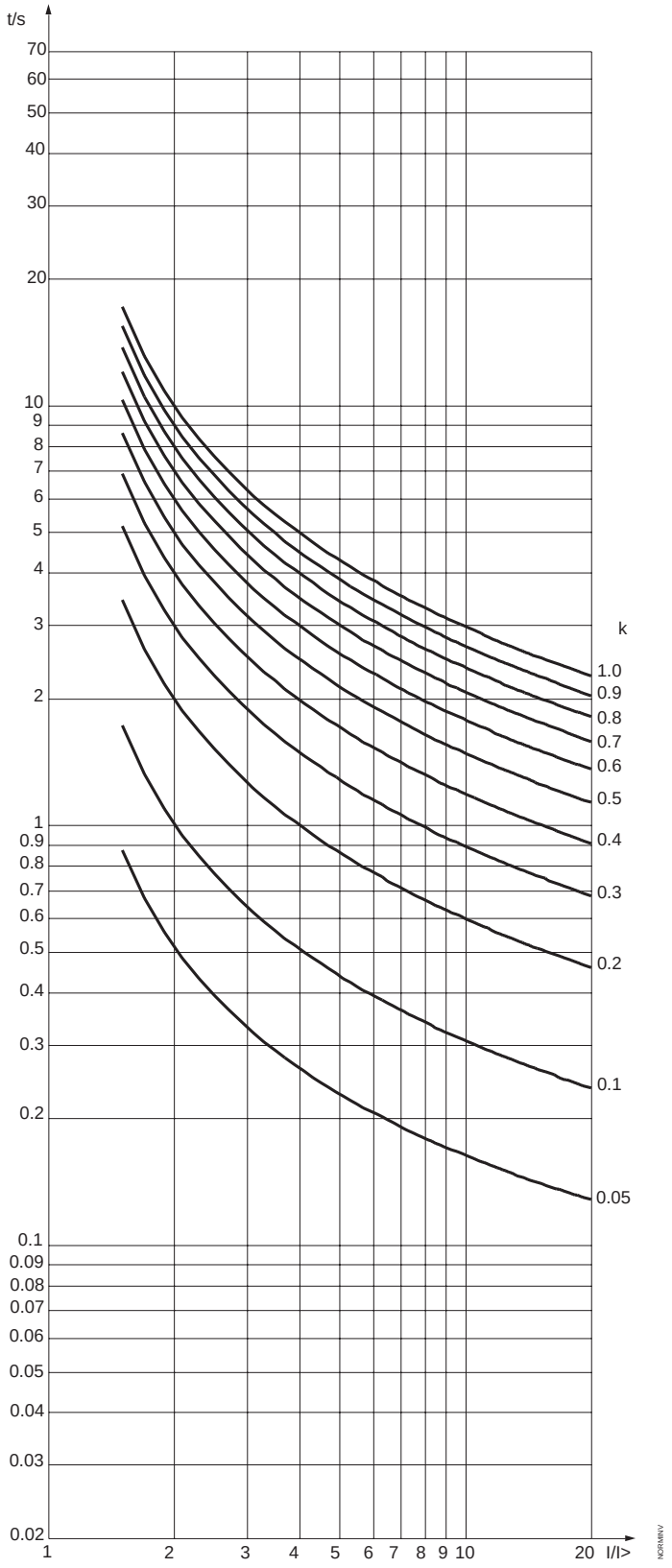

Figure 2.1.3.3-1 Normal inverse time characteristics

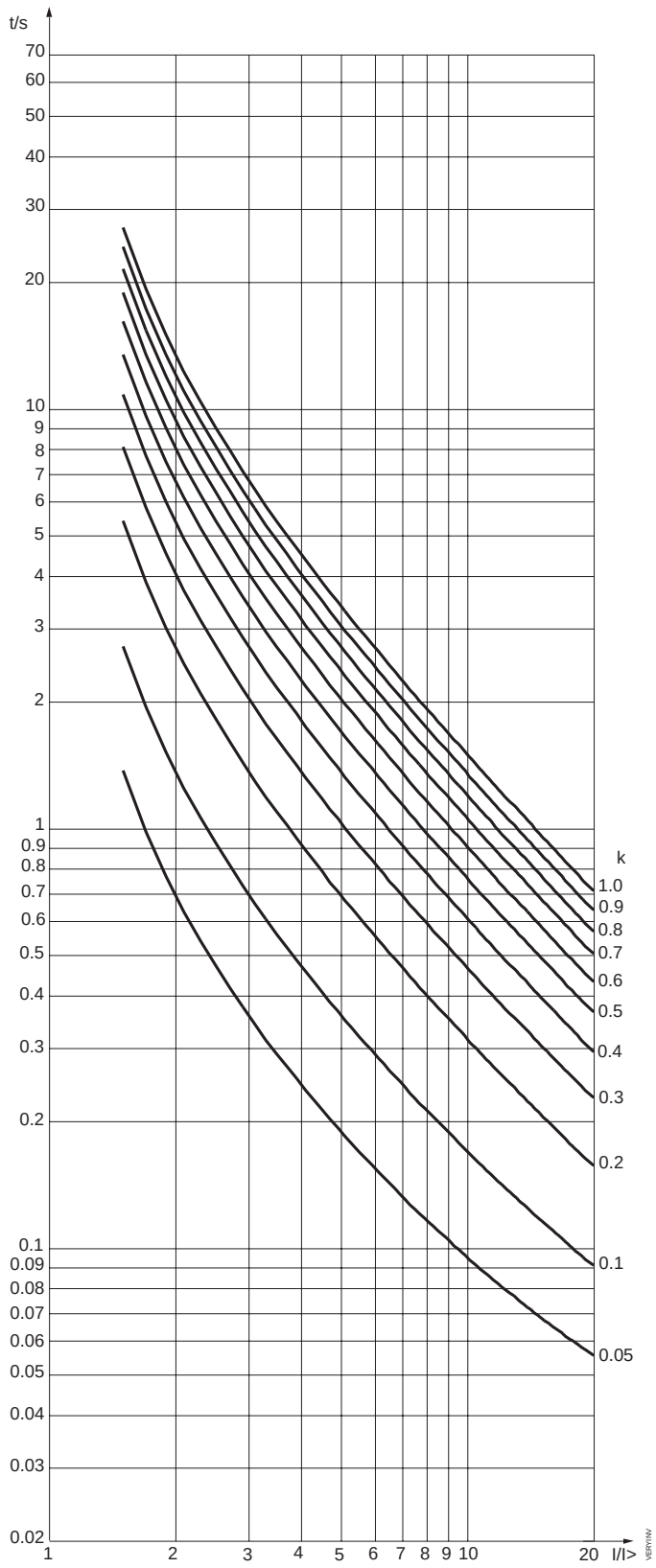

Figure 2.1.3.3-2 Very inverse time characteristics

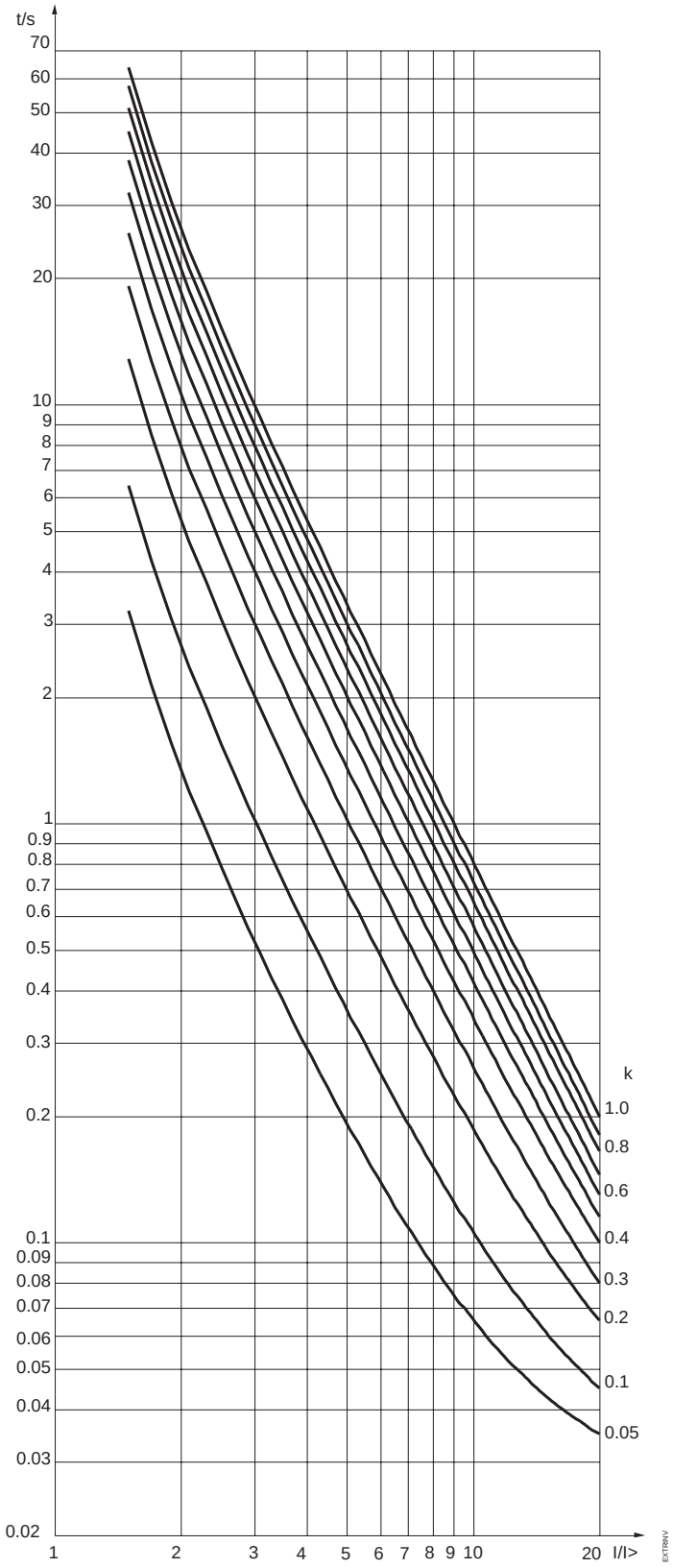

Figure 2.1.3.3-3 Extremely inverse time characteristics

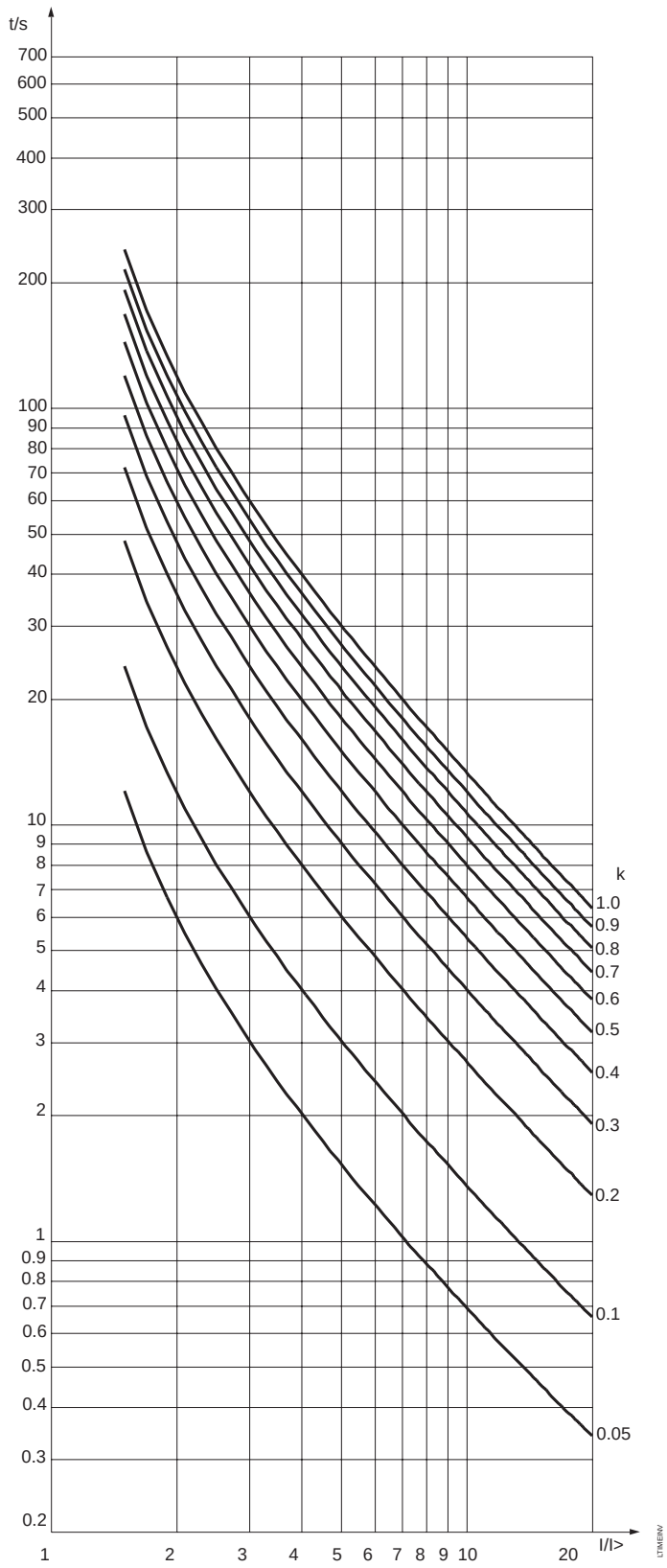

Figure 2.1.3.3-4 Long-time inverse characteristics

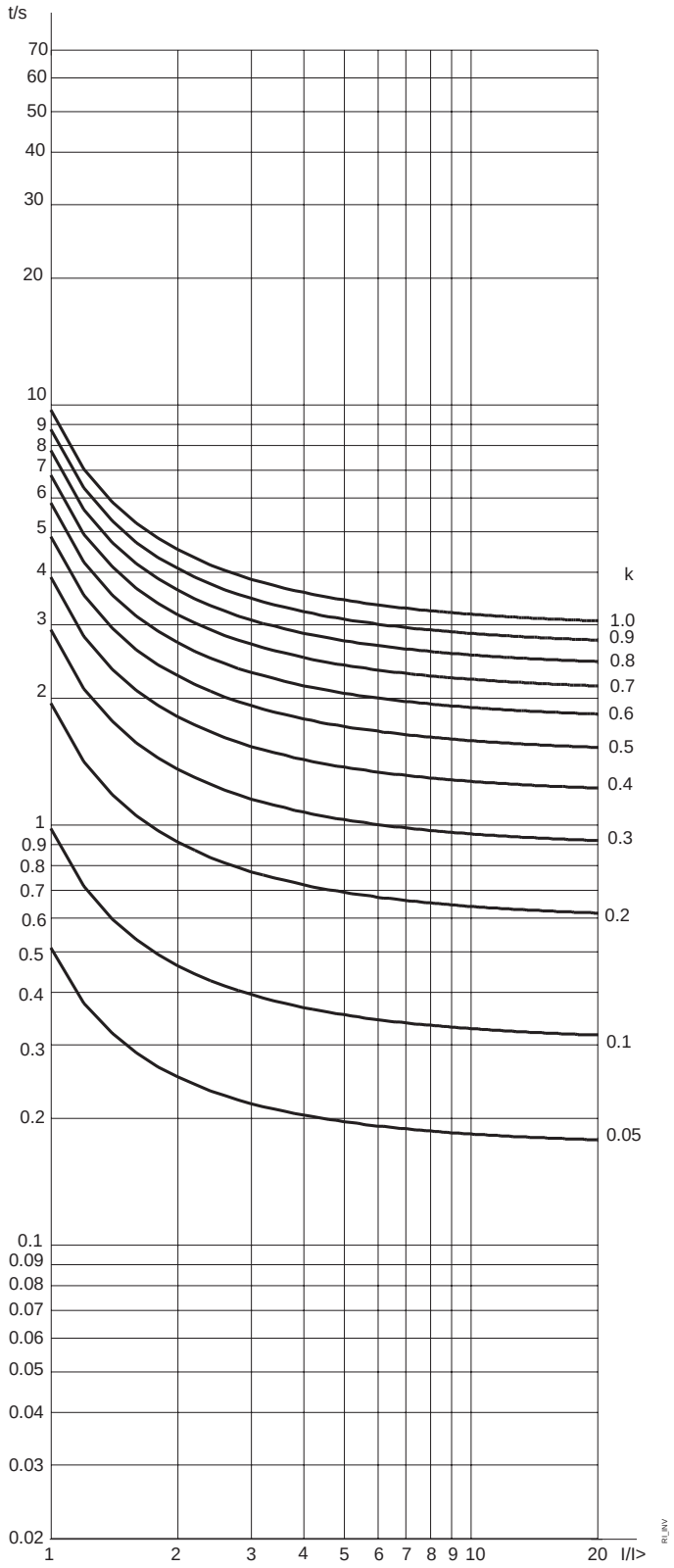

Figure 2.1.3.3-5 RI-type inverse-time characteristics

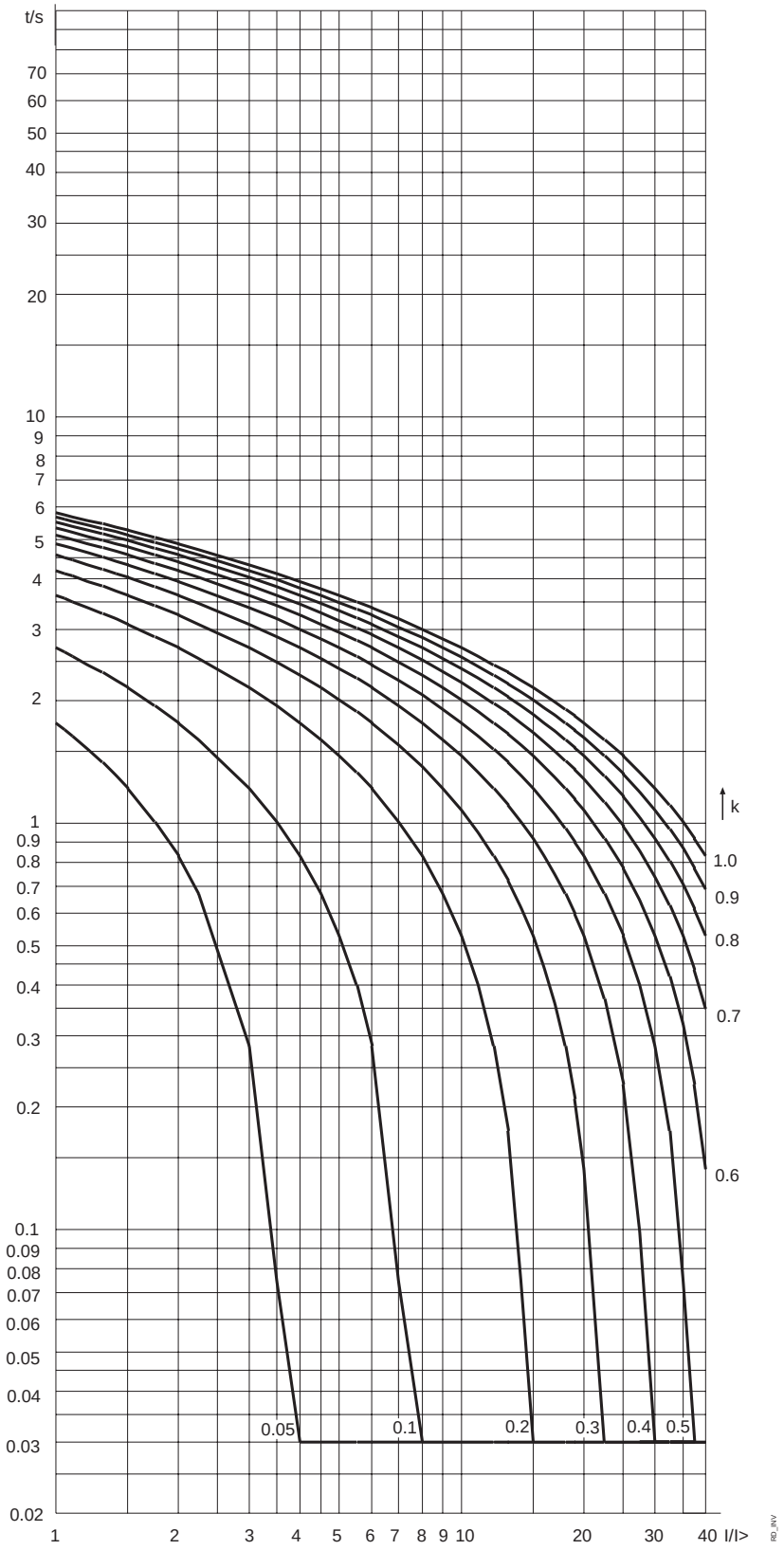

Figure 2.1.3.3-6 RD-type inverse-time characteristics

2.1.3.4 Settings

Two alternative setting groups, 1 and 2, are available for the relay. Either of these setting groups can be used as the actual settings, one group at a time. Both the groups have their related registers. Switching between the setting groups 1 and 2 enables changing a whole group of settings at the same time. This can be done in the following ways:

1. With command V150 via serial communication.

2. By means of an external binary input BI.

Values of the settings are altered with a personal computer provided with the Relay Setting Tool.

Before the relay is connected to a system, one must assure that the relay has been given correct settings. If there is any doubt about the settings, the setting values should be read with the relay trip circuits disconnected or tested with current injection. Refer to "Check lists".

Table 2.1.3.4-1 Setting values

Setting	Description	Setting range	Default setting
$I>/I_n$	Start current of stage I> as a multiple of the energizing input used.		
	- definite-time	0.30...5.00 x I_n	0.30 x I_n
	- inverse-time	0.30...2.50 x I_n [1)]	0.30 x I_n
t>	Operate time of stage I> in seconds at definite-time characteristic.	0.05...300 s	0.05 s
k	Time multiplier k of stage I> at inverse-time characteristic.	0.05...1.00	0.05
$I>>/I_n$	Start current of stage I>> as a multiple of the energizing input used.	0.30...35.0 x I_n and ∞ [2)]	0.30 x I_n
t>>	Operate time of stage I>> in seconds.	0.04...300 s	0.04 s
CBFP	Circuit-breaker failure protection	0.10...1.00 s	0.10 s

[1)] At inverse-time characteristic the relay allows settings above the set limit. However, applying settings above the limit might damage the relay.

[2)] The stage can be set out of operation with SGF switches. This state is indicated with the reading "999" when parameters are read over the SPA bus.

Note!

The continuous current carrying capacity of the energizing inputs is 4.0 x I_n.

Selector switchgroups SGF, SGB and SGR

Part of the settings and the selections of the operation characteristics of the relay in various applications is made with selector switchgroups SG_. The switchgroups are software-based and thus not physical switches to be found in the hardware of the relay. The switches can be set one by one.

A checksum is used for verifying that the switches have been properly set. The figure below shows an example of manual checksum calculation.

Switch No	Position		Weighting factor		Value
1	1	x	1	=	1
2	0	x	2	=	0
3	1	x	4	=	4
4	0	x	8	=	0
5	1	x	16	=	16
6	0	x	32	=	0
7	1	x	64	=	64
8	0	x	128	=	0
	Checksum		SG_ Σ	=	85

*Figure 2.1.3.4-1 An example of calculating the checksum of a selector switchgroup SG_*

When the checksum, calculated according to the example above, equals the checksum read from the relay, the switches in the concerned switchgroup are properly set.

The following tables indicate the factory default settings of the switches and the corresponding checksums.

SGF1...SGF3

Switchgroups SGF1...SGF3 are used for configuring the desired function as follows:

Table 2.1.3.4-2 SGF1

Switch	Function	Default setting
SGF1/1	Selection of the latching feature for output PO1.	0
SGF1/2	Selection of the latching feature for output PO2. When the switch is in position 0 and the measuring signal that caused an operation falls below the set start level, the output contact returns to its initial state. When the switch is in position 1, the output contact remains active although the measuring signal that caused an operation falls below the set start level. The latching feature selected, the output contact is reset with the push-button on the front panel, via the external binary input or the serial bus.	0
SGF1/3	Minimum pulse length for signal outputs SO1 and SO2. - 0 = 80 ms - 1 = 40 ms	0
SGF1/4	Minimum pulse length for power outputs PO1 and PO2. - 0 = 80 ms - 1 = 40 ms **Note!** The latching function of PO1 and PO2 will overrun this function.	0
SGF1/5	Circuit-breaker failure protection (CBFP). When the switch is in position 1, the signal on output PO1 starts a timer which will generate a delayed signal to the output PO2 if the fault is not cleared before the operate time elapses. When the switch is in position 0 the circuit-breaker failure protection is out of operation.	0
SGF1/6	Not in use.	0
SGF1/7	Not in use.	0
SGF1/8	Not in use.	0
Σ SGF1		0

Table 2.1.3.4-3 SGF2

Switch	Function	Default setting
SGF2/1	Automatic doubling of the start current of stage I>>. When the switch is in position 1, the set value for the stage is automatically doubled at start-up.	0
SGF2/2	Inverse-time operation of stage I> inhibited by the starting of stage I>>. When the switch is in position 1, the inverse-time operation is inhibited.	0
SGF2/3	Inhibition of the operation of stage I>>. When the switch is in position 1, the operation of stage I>> is inhibited.	0
SGF2/4	The operation mode of the start indicator of stage I>. When the switch is in position 0, the start indicator automatically resets once the fault disappears.	0
SGF2/5	The operation mode of the start indicator of stage I>>. When the switch is in position 0, the start indicator automatically resets once the fault disappears.	0
SGF2/6	Not in use.	0
SGF2/7	Not in use.	0
SGF2/8	Not in use.	0
Σ SGF2		0

Table 2.1.3.4-4 SGF3

SGF3/1	SGF3/2	SGF3/3	SGF3/4	SGF3/5	SGF3/6	SGF3/7	SGF3/8	Operation
0	0	0	0	0	0	-	-	Definite-time [1)]
1	0	0	0	0	0	-	-	Extremely inverse
0	1	0	0	0	0	-	-	Very inverse
0	0	1	0	0	0	-	-	Normal inverse
0	0	0	1	0	0	-	-	Long-time inverse
0	0	0	0	1	0	-	-	RI-type characteristic
0	0	0	0	0	1	-	-	RD-type characteristic

[1)] Default setting

Note!

Only one type of characteristic can be selected at a time! If more than one switch is set active, the characteristic with the lowest weighting factor of the selected switches will be activated.

SGB1

Table 2.1.3.4-5 SGB1 Resetting / blocking with BI

Switch	Function	Default setting
SGB1/1	SGB1/1 = 0: indicators are not reset by the binary input signal. SGB1/1 = 1: indicators are reset by the binary input signal.	0
SGB1/2	SGB1/2 = 0: indicators and output contacts are not reset by the binary input signal. SGB1/2 = 1: indicators and output contacts are reset by the binary input signal.	0
SGB1/3	SGB1/3 = 0: indicators, output contacts and memorized values are not reset by the binary input signal. SGB1/3 = 1: indicators, output contacts and memorized values are reset by the binary input signal.	0
SGB1/4	Switching between the setting groups 1 and 2, either via the serial bus with command V150, or using the external binary input. When SGB1/4=0, the setting group cannot be changed with an external binary input. When SGB1/4=1, the currently used setting group is determined exclusively by the state of the binary input. **Note**! When SGB1/4 is set to 1, it is important that the switch has the same setting in both the groups.	0
SGB1/5 SGB1/6	Blocking of stage I> by binary input. Blocking of stage I>> by binary input. When SGB1/5...6 = 1, tripping of the concerned stage is blocked by an external binary input signal.	0 0
SGB1/7	Not in use	0
SGB1/8	Not in use	0
Σ SGB1		0

SGR1...SGR4

The start and operate signals of the protection stages are connected to the output contacts with switches SGR1...SGR4.

The matrix below can be used for help in making the desired selections. The start and operate signals of the different protection stages are combined with the output contacts by encircling the desired intersection point. Each intersection point is marked with a switch number, and the corresponding weighting factor of the switch is shown on the bottom row of the matrix. The switchgroup checksum is obtained by adding horizontally the weighting factors of all the selected switches of the switchgroup.

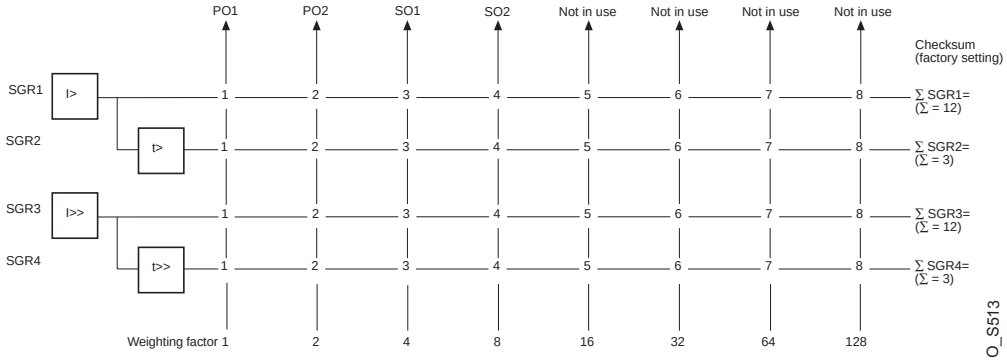

Figure 2.1.3.4-2 Output signal matrix of the overcurrent relay

2.1.3.5 Technical data of protection functions

Table 2.1.3.5-1 Technical data of protection functions

Feature	Stage I> [1]	Stage I>> [1]
Start current		
• at definite-time characteristic	0.30...5.00 x I_n	0.30...35.0 x I_n and ∞
• at inverse-time characteristic [2]	0.30...2.50 x I_n	
Start time, typical	55 ms	30 ms
Time/current characteristic		
• definite-time		
• operate time t>	0.05...300 s	0.04...300 s
• inverse definite minimum time (IDMT) characteristic as per IEC 60255-4 and BS 142	Extremely inverse Very inverse Normal inverse Long-time inverse	
• special type inverse characteristic	RI-type inverse RD-type inverse	
• time multiplier k	0.05...1.00	
Retardation time	30 ms	30 ms
Reset ratio, typical	0.96	0.96
Operate time accuracy at definite-time mode	±2 % of set value or ±25 ms	±2 % of set value or ±25 ms
Accuracy class index E at inverse-time mode	5	
Operation accuracy		
• 0.3...0.5 x I_n	±5 % of set value	±5 % of set value
• 0.5...5.0 x I_n	±3 % of set value	±3 % of set value
• 5.0...35.0 x I_n		±3 % of set value

[1] Note!

Operation of the low-set stage, based on the inverse-time characteristic, can be blocked by starting of the high-set stage if this function is selected in SGF. If set in SGF, the operate time is determined by the set operate time of the high-set stage at heavy fault currents. In order to obtain a trip signal, the high-set stage must be routed to a trip output contact.

[2] Note!

At inverse-time characteristics the relay allows settings above 2.5 x I_n for stage I>, but regards any setting > 2.5 x I_n as equal to 2.5 x I_n.

2.1.4 Monitoring

The operation of the relay can be monitored with the help of three indicators on the relay front panel: a green READY LED, a yellow START LED and a red TRIP LED. The basic protection functions of the relay are independent of the state of the indicators. For function of the LEDs, refer to part A, "Operator's instructions".

2.1.5 Disturbance recorder

The relay features an integrated disturbance recorder for recording monitored quantities. The recorder captures continuously the curve forms of the currents, as well as both the internal signals and the external binary input signal, and stores these to the volatile memory area.

When the recorder is triggered, the post-triggering recording starts. If the post-triggering recording length has been defined to be less than the total recording length of 38 cycles, a part of the history recording, preceding the triggering, also remains in the memory to fill the total recording length. When the post-triggering recording has finished, a complete recording has been created and stored in the memory.

As soon as the recorder has been triggered and the recording has finished, the recording can be unloaded and verified by means of a personal computer with a special program.

2.1.5.1 Recorder data

One recording contains the information of three analogue channels and five digital channels for a period of 38 cycles. The analogue channels are the currents measured by the relay, and the digital channels, referred to as digital signals, are the operating signals of the protection stages and the external binary input signal linked to the relay. The sampling frequency is 16 times the rated frequency, resulting in 800 Hz at 50 Hz rated frequency and in 960 Hz at 60 Hz rated frequency. At a power reset or reset of recorded values (WV102:1) the contents of the recorder memory are lost.

2.1.5.2 Control and indication of recorder status

It is possible to control and monitor the indicated status of the disturbance recorder by writing to and reading from parameter V246. Reading the parameter returns either the value 0 or 1, indicating whether the recorder is not triggered, or triggered and ready to be unloaded.

Writing the value 0 to the parameter clears the recorder memory, restarts storing of new data into the memory and enables triggering of the recorder. Writing the value 2 to the parameter restarts the unloading process in the recorder by setting the time stamp and first data ready to be read. Writing the value 4 to the parameter triggers the recorder.

2.1.5.3 Triggering

Triggering the disturbance recorder for start of a new recording sequence is only possible if the recorder is not already triggered (V246=0).

The recorder can be triggered either manually by writing the value 4 to parameter V246 or it can be triggered by the digital signals, either on the rising or falling edge of the signal(s). Triggering on the rising edge means that the recording sequence starts when the signal is activated. Correspondingly, triggering on the falling edge means that the recording sequence starts when the active signal resets.

Serial parameters V241...V244 define the triggering conditions and parameter V246 is for manual triggering. When the recorder has been triggered and a recording stored into the memory, the value of parameter V246 changes from 0 to 1.

2.1.5.4 Settings and unloading

Setting parameters for the disturbance recorder are V parameters V241...V246 and M parameters M18, M20 and M80...M82.

Parameter	Description
V241	Specifies the internal signal(s) to be used for triggering.
V242	Specifies whether the recorder is to be triggered on the falling or rising edge of the signal(s) specified by parameter V241.
V243	Defines the external binary input signal to be used for triggering.
V244	Defines whether the rising or falling edge of the binary input signal is to trigger the recorder.
V245	Length of recording after triggering. The total recording length is 38 cycles.
V246	Status of the recorder.
M18	Used for giving the disturbance recorder a unique identification number.

M20	Used for designating the disturbance recorder the name of the station where the relay is located. The maximum length of a name is 15 characters.
M80…82	Used for designating analogue channels the conversion factor and unit. The formats of the parameters are XXXXX, YY; where XXXXX is the conversion factor, and YY is the unit of the channel in question. The conversion factor is the ratio between the primary and secondary sides of the current transformer (CT) multiplied by the rated current of the relay, ranging between 0 and 65535. Unit is a one or two character text, indicating the unit of the analogue channel. The conversion factors and units are used for calculating the primary values in a special PC program used for unloading, displaying and storing the curve forms from the disturbance recorder.

2.1.5.5 Event code

It is possible to set the disturbance recorder to generate an event code into the event register when the recorder is triggered. To enable the event code to be generated, set the event mask in serial parameter V157. The event code generated is E31.

2.1.6 Recorded data

Table 2.1.6-1 Recorded data

REGISTER	Recorded data
EVENT1	Currents measured on L1, L2 and L3 as multiples of the rated current I_n. Duration of the latest start situation of stages t> and t>>, expressed as a percentage of the set operate time or, at IDMT mode of operation, of the calculated operate time. Time stamp for the event; date and time. The registers are updated when one of the overcurrent stages I> or I>> starts or operates. Then the previous recorded values are pushed forward one step in the event register stack while the oldest values are lost. The last five recorded events are memorized so that the most recent values are stored in register EVENT 1 and the other four recorded values in registers EVENT 2...EVENT 5. When the relay starts, but does not operate, the relay memorizes the maximum currents measured on L1, L2 and L3 during the start situation. When one of the stages operates, the values of the currents measured at the moment of operation are recorded, and the duration reading (t> or t>>) for the stage that has operated is 100%.
EVENT 2	The operation principle is the same as that of EVENT 1.
EVENT 3	The operation principle is the same as that of EVENT 1.
EVENT 4	The operation principle is the same as that of EVENT 1.
EVENT 5	The operation principle is the same as that of EVENT 1.

2.1.7 Serial communication

2.1.7.1 Communication port

The relay has an optical PC-connection on the front panel. Via this connector the relay is connected to a PC used for setting. The front interface uses SPA-bus protocol.

The optical PC-connector isolates the PC from the relay galvanically. The connection consists of a transmitter stage and a receiver stage. The front connector is standardized for ABB relay products and requires a specific opto-cable (ABB art. no 1MKC950001-1). The cable is connected to the serial RS-232C port of the PC. The optical stage of the cable is powered by RS-232C control signals. The cable works correctly with baud rates 4.8 and 9.6 kbps.

The following serial communication parameters shall be used for RS-232C:

- Number of data bits 7
- Number of stop bits 1
- Parity even
- Baud rate 9.6 kbps as default

Relay data, such as events, setting values, all input and recorded data, can be read via the optical PC-interface.

When setting values are altered via the optical PC-interface, the relay checks that the entered parameter values are within the permitted setting range. The relay refuses to accept too high or too low a setting value and keeps the former setting unchanged.

2.1.7.2 Event codes

Special codes have been determined to represent certain events, such as start and operation of protection stages and different states of output signals. The event codes can be read via serial communication.

Events E1...E51 are stored in the event register of the relay. Under normal conditions the register is empty. The maximum capacity of the register is 60 events.

The content of the register can be read with L command 5 events at a time. Using the L command erases the read events from the register. Should a fault occur, for example in data communication, these events can be re-read with B command. If needed, the B command can also be repeated.

Events to be included in event reporting are marked with a multiplier 1. The event mask is formed by the sum of the weighting factors of all those events that are to be included in event reporting.

Table 2.1.7.2-1 Event masks

Event mask	Code	Setting range	Default setting
V155	E1...E8	0...255	85
V156	E9...E16	0...255	3
V157	E31	0 or 1	1

Table 2.1.7.2-2 Event codes E1…E8

Code	Event	Weighting factor	Default value
E1	Starting of stage I>	1	1
E2	Starting of stage I> reset	2	0
E3	Tripping of stage I>	4	1
E4	Tripping of stage I> reset	8	0
E5	Starting of stage I>>	16	1
E6	Starting of stage I>> reset	32	0
E7	Tripping of stage I>>	64	1
E8	Tripping of stage I>> reset	128	0
	Default value of event mask V155		85

Table 2.1.7.2-3 Event codes E9…E16

Code	Event	Weighting factor	Default value
E9	PO1 activated	1	1
E10	PO1 reset	2	1
E11	PO2 activated	4	0
E12	PO2 reset	8	0
E13	SO1 activated	16	0
E14	SO1 reset	32	0
E15	SO2 activated	64	0
E16	SO2 reset	128	0
	Default value of event mask V156		3

Table 2.1.7.2-4 Event code E31

Code	Event	Weighting factor	Default value
E31	Disturbance recorder triggered and finished recording	1	1
	Default value of event mask V157		1

Table 2.1.7.2-5 Event codes E50 and E51

Code	Event
E50	Restart of relay
E51	Overflow of event register

Explanations for default values:

0 not included in event reporting

1 included in event reporting

2.1.7.3 Remote transfer data

In some cases, altering parameter values via serial communication requires the use of a password. The password is a number within the range 1...999. The default password is 1.

Password protection is removed by entering the password number in parameter V160 and reinstated by writing the same password to parameter V161. Loss of the auxiliary supply voltage also reinstates protection.

For example, to change a value of the setting group 1 to 0.5 x I_n, proceed as follows:

- Enter the password WV160:1
- Write a new value WS41:0.5
- Reinstate password protection WV161:1

The password can be changed via the serial bus by entering first the current password in parameter V160, and writing then a new password to parameter V161.

Abbreviations used in following tables:

- R = readable data
- W = writeable data
- P = password protected writeable data
- I = input data
- S = setting values
- V = recorded data / parameter
- M = Disturbance recorder parameter
- O = Output data

Settings

Table 2.1.7.3-1 Settings

Variable	Actual settings (R)	Group 1 (R, W, P)	Group 2 (R, W, P)	Setting range
Start current of stage I>	S1	S41	S81	0.30...5.00 x I_n
Operate time or time multiplier k of stage I>	S2	S42	S82	0.05...300 s / 0.05...1.00 [1]
Start current of stage I>>	S3 [2]	S43	S83	0.30...35.0 x I_n
Operate time of stage I>>	S4	S44	S84	0.04...300 s
Checksum, SGF 1	S5	S45	S85	0...255
Checksum, SGF 2	S6	S46	S86	0...255
Checksum, SGF 3	S7	S47	S87	0...255
Checksum, SGB 1	S8	S48	S88	0...255
Checksum, SGR 1	S9	S49	S89	0...255
Checksum, SGR 2	S10	S50	S90	0...255
Checksum, SGR 3	S11	S51	S91	0...255
Checksum, SGR 4	S12	S52	S92	0...255
Operate time of circuit-breaker failure protection	-	S121	S121	0.10...1.00 s

[1] Values above 1 equal 1.

[2] If the protection stage has been set out of function, "999" displaces the number indicating the currently used value in serial communication.

Recorded data

Parameters V1 and V2 indicate the number of starts of the protection stages, parameter V3 indicates the stage that has caused an operation and parameter V4 the operation.

Table 2.1.7.3-2 Parameters V1…V4

Recorded data	Parameter	R/W	Value
Number of starts of stage I>	V1	R	0...255
Number of starts of stage I>>	V2	R	0...255
Stage/phase that caused operation	V3	R	1=I_{L3}> 2=I_{L2}> 4=I_{L1}> 8=I_{L3}>> 16=I_{L2}>> 32=I_{L1}>>
Operation indication code	V4	R	0=no operation 1=starting of stage I> 2=tripping of stage I> 3=starting of stage I>> 4=tripping of stage I>> 5=tripping of CBFP unit

The last five recorded values can be read with parameters V11...V97. Event n denotes the latest recorded value, n-1 the next one, and so forth.

Table 2.1.7.3-3 Recorded data

Recorded data	Event (R)					Value
	n	n-1	n-2	n-3	n-4	
Phase current I_{L1}	V11	V31	V51	V71	V91	0...50 x I_n
Phase current I_{L2}	V12	V32	V52	V72	V92	0...50 x I_n
Phase current I_{L3}	V13	V33	V53	V73	V93	0...50 x I_n
Start duration, stage I>	V14	V34	V54	V74	V94	0...100 %
Start duration, stage I>>	V15	V35	V55	V75	V95	0...100 %
Time stamp of registered value, date	V16	V36	V56	V76	V96	YY-MM-DD
Time stamp of registered value, time	V17	V37	V57	V77	V97	HH.MM; SS.ms

Disturbance recorder

Table 2.1.7.3-4 M parameters for disturbance recorder

Description	Parameter	R/W	Value/Note
Analogue channels in use	M13	R	7 (=00000111B)
Digital channels in use	M14	R	31 (=00011111B)
Sampling rate	M15	R	800 or 960 Hz
Station identification/ unit number	M18	R/W	0…9999
Rated frequency	M19	R	50 or 60 Hz
Station name	M20	R/W	Max 15 characters
Digital channel texts	M40...44	R	
Analogue channel texts	M60...62	R	
Analogue channel conversion factor and unit, phases I_{L1}, I_{L2} and I_{L3}	M80…82	R/W	XXXXX, YY

Table 2.1.7.3-5 V parameters for disturbance recorder

Description	Para-meter	R/W	Value
Internal trigger signals' checksum	V241	R,W	0...15, see table 2.1.7.3-6
Internal trigger signal's edge	V242	R,W	0...15, 0=rising, 1=falling
External trigger signal (BI signal)	V243	R,W	0 / 1, see table 2.1.7.3-7
External trigger signal's edge	V244	R,W	0 / 1, 0=rising, 1=falling
Post-triggering recording time	V245	R,W	0...38, amount of periods
Triggering state, clearing and restart	V246	R,W	R: 0=recorder not triggered 1=recorder triggered and recording stored into the memory W: 0=clear recorder memory 2=download restart; sets first information and time stamp for triggering ready to be read. 4=manual triggering

Table 2.1.7.3-6 Disturbance recorder internal triggering

Event	Weighting factor	Default value of triggering mask, V241	Default value of triggering edge, V242
Starting of stage I>	1	0	0
Tripping of stage I>	2	0	0
Starting of stage I>>	4	0	0
Tripping of stage I>>	8	1	0
Not in use	-	0	0
Not in use	-	0	0
Not in use	-	0	0
Not in use	-	0	0
Checksum		8	0

Table 2.1.7.3-7 Disturbance recorder external triggering

Event	Weighting factor	Default value of triggering mask, V243	Default value of triggering edge, V244
External binary input BI	1	1	0
Not in use.	-	0	0
Not in use.	-	0	0
Not in use.	-	0	0
Not in use.	-	0	0
Not in use.	-	0	0
Not in use.	-	0	0
Not in use.	-	0	0
Checksum		1	0

Control parameters

Table 2.1.7.3-8 Control parameters

Description	Para-meter	R/W	Value
Resetting of output contacts with the latching feature	V101	W	1=reset
Resetting of registers and output contacts with the latching feature	V102	W	1=reset
Rated frequency	V133	R,W(P)	50=50 Hz 60=60 Hz
Remote control of settings	V150	R,W	0=setting group 1 1=setting group 2
Event mask for I> and I>>	V155	R,W	0...255, see Event codes
Event mask for output contacts' events	V156	R,W	0...255, see Event codes
Event mask for disturbance recorder	V157	R,W	0 / 1, see Event codes
Entering the password for settings	V160	W	1...999
Changing the password or reinstating password protection	V161	W(P)	1...999
Activating the self-supervision READY LED	V165	W	0=normal operation 1=self-supervision READY LED blinking
LED test for start and trip indicators	V166	W(P)	0=start and trip LEDs off 1=trip LED on, start LED off 2= start LED on, trip LED off 3=start and trip LEDs on
Default settings	V167	W(P)	2=Restore factory settings

Table continues on next page.

Description	Para-meter	R/W	Value
Internal fault code	V169	R	0...255
SPA address of the relay	V200	R, W	1...254
Data transfer rate, kbps	V201	R, W	4.8 or 9.6
Relay serial number	V230	R	ERxxxxxx
CPU serial number	V231	R	MRxxxxxx
Hardware number	V232	R	1MRS090402-BAA
Test date	V233	R	YYYYMMDD
Software number	V234	R	1MRS118012
Software revision	V235	R	A...Z
Date reading and setting (RED 500 format)	V250	R, W	YY-MM-DD
Time reading and setting (RED 500 format)	V251	R, W	HH.MM; SS.mss
Reading of event register	L	R	Time, channel number and event code
Re-reading of event register	B	R	Time, channel number and event code
Type designation of the module	F	R	REJ 513
Reading of module state data	C	R	0=normal state 1=module been subject to automatic reset 2=overflow of event register 3=both events 1 and 2
Resetting of module state data	C	W	0=resetting 1=reset only E50 2=reset only E51 4=reset all events including E51, but not E50
Time reading and setting	T	R, W	00.000... 59.999 s
Date and time reading and setting	D	R, W	YY-MM-DD HH.MM;SS.ms

Input and output signals

The measured currents and the status of the binary input signal can be read (R) with parameters I1...I4. When the value of parameter I4 is 1, the binary input is energized.

Table 2.1.7.3-9 Inputs

Information	Parameters (R)	Value
Current measured on phase L1	I1	0...50 x I_n
Current measured on phase L2	I2	0...50 x I_n
Current measured on phase L3	I3	0...50 x I_n
Binary input signal BI	I4	0 or 1

Each protection stage has its logical output signal. These signals can be read (R) with parameters O1...O4. The state of the output contacts can be read (R) or changed (W) with parameters O5...O8. Functions indicated by parameters O1…O8 are recorded and they can be read with parameters O21…O28.

Table 2.1.7.3-10 Output signals

Status of the protection stages	State of stage (R)	Recorded functions (R)	Value
Starting of stage I>	O1	O21	0 or 1
Tripping of stage I>	O2	O22	0 or 1
Starting of stage I>>	O3	O23	0 or 1
Tripping of stage I>>	O4	O24	0 or 1

Table 2.1.7.3-11 Outputs

Operation of output contacts	State of output (R,W,P)	Recorded functions (R)	Value
Output PO1	O5	O25	0 or 1
Output PO2	O6	O26	0 or 1
Output SO1	O7	O27	0 or 1
Output SO2	O8	O28	0 or 1
Enable of output contacts PO1, PO2, SO1 and SO2	O41	-	0 or 1

2.1.7.4 Relay parameterization

The Relay Setting Tool is used for parameterizing the relay units. The parameters can be set off-line in a PC and downloaded to the relay over a communication port.

2.2 Design description

2.2.1 Input / output connections

All external circuits are connected to the terminals on the rear panel of the relay. Terminals X1.1-_ are dimensioned for one 0.5...6.0 mm^2 wire or for two max 2.5 mm^2 wires and terminals X2.1-_ for one 0.08...2.5 mm^2 wire or for two max 1.5 mm^2 wires.

The energizing currents of the overcurrent unit are connected to terminals X1.1/1-2, X1.1/4-5 and X1.1/7-8 when the rated current of the CT secondary circuits is I_n = 5 A. When the rated current of the CT secondary circuits is I_n = 1 A, terminals X1.1/1-3, X1.1/4-6 and X1.1/7-9 are used. The relay can also be used in single-phase or two-phase applications by leaving one or two energizing inputs unoccupied.

The binary input X2.1/17-18 can be used in three different ways: 1) as the binary input for an external blocking signal, 2) as the binary input for unlatching the trip relay, or 3) as the binary input for the remote control of relay settings. The requested function is selected with the switches of switchgroup SGB. The binary input can also be used as a trigger signal for the disturbance recorder; this function is selected with SPA parameter V243.

The auxiliary supply voltage of the relay is connected to terminals X2.1/1-2. At dc supply the positive lead is connected to terminal X2.1/1. For further details, see the description of the auxiliary voltage. The permitted auxiliary voltage range of the relay is marked on the front panel of the relay.

Output contacts PO1 and PO2 are heavy-duty trip contacts, capable of controlling most circuit breakers. The operate signals of different protection stages are routed to the contacts with switches 1 and 2 of switchgroups SGR1...SGR4. On delivery from factory the trip signals of all the protection stages are routed to both the PO1 and PO2 contacts.

Output contacts SO1 and SO2 can be used for signalling on operation of the relay. The signals to be routed to the output contacts SO1 and SO2 are selected with switches 3 and 4 of switchgroups SGR1...SGR4. On delivery from factory the start signals of all the protection stages are routed to both the SO1 and SO2 contacts.

Output contact IRF functions as an output contact for the self-supervision system of the protection relay. The IRF contact is energized under normal operating conditions and contact gap X2.1/13-15 is closed. If a fault is detected by the self-supervision

system, or on loss of the auxiliary supply, the output contact drops off and contact X2.1/13-14 closes.

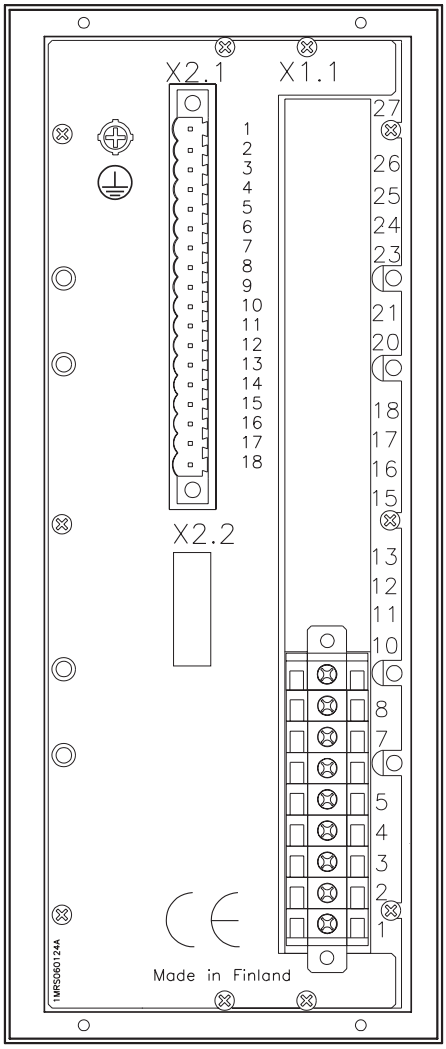

Figure 2.2.1-1 Rear view of the overcurrent relay

Table 2.2.1-1 Inputs for phase current

Terminal	Function
X1.1-1	IL1 Common
X1.1-2	IL1 5 A
X1.1-3	IL1 1 A
X1.1-4	IL2 Common
X1.1-5	IL2 5 A
X1.1-6	IL2 1 A
X1.1-7	IL3 Common
X1.1-8	IL3 5 A
X1.1-9	IL3 1 A

Table 2.2.1-2 Auxiliary supply voltage

Terminal	Function
X2.1-1	Input+
X2.1-2	Input-

Table 2.2.1-3 Output contacts

Terminal	Function
X2.1-3	PO1, closing contact
X2.1-4	
X2.1-5	PO2, closing contact
X2.1-6	
X2.1-7	SO1, common
X2.1-8	SO1, NC
X2.1-9	SO1, NO
X2.1-10	SO2, common
X2.1-11	SO2, NC
X2.1-12	SO2, NO

Table 2.2.1-4 Internal Relay Fault contact (IRF)

Terminal	Function
X2.1-13	Internal relay fault, common
X2.1-14	Closed; IRF, or U_{aux} disconnected
X2.1-15	Closed; no IRF, and U_{aux} connected

Table 2.2.1-5 Binary input BI

Terminal	Function
X2.1-17	Input+
X2.1-18	Input-

2.2.2 Technical data

Table 2.2.2-1 Dimensions

- Width 111.4 mm
- Height, frame 265.9 mm (6U), box 255.8 mm
- Depth 235 mm (245.1 mm with a protective rear cover, available as an option)
- Enclosure size ¼ (x 19")
- Weight of the relay ~3.1 kg

Table 2.2.2-2 Power supply

• Rated voltage	U_r =110/120/220/240 V ac U_r =48/60/110/125/220 V dc
• Operating range	80…265 V ac 38…265 V dc
• Relay power start-up time, typical	300 ms
• Burden of auxiliary supply under quiescent/operating condition	~ 5 W/~10 W
• Ripple in dc auxiliary voltage	Max 12% of the dc value
• Interruption time in auxiliary dc voltage without resetting	< 30 ms at 48 V dc < 100 ms at 110 V dc < 500 ms at 220 V dc

Table 2.2.2-3 Energizing inputs

Rated frequency	50/60 Hz ±5 Hz	
Rated current I_n	1 A	5 A
Thermal withstand capability		
• continuously	4 A	20 A
• for 1 s	100 A	500 A
Dynamic current withstand		
• half-wave value	250 A	1250 A
Input impedance	< 100 mΩ	< 20 mΩ

Table 2.2.2-4 Measuring range

Measured currents on phases L1, L2 and L3 as multiples of the rated currents of the energizing inputs	0…50 x I_n

Table 2.2.2-5 Binary input

• Operating range	18…265 V dc
• Rated voltage	24/48/60/110/220 V dc
• Current drain	~ 2…25 mA
• Power consumption	< 0.8 W

Table 2.2.2-6 Signal outputs (SO1, SO2) and self-supervision output (IRF)

• Rated voltage	250 V ac/dc
• Continuous carry	5 A
• Make and carry for 3.0 s	8 A
• Make and carry for 0.5 s	10 A
• Breaking capacity when the control circuit time-constant L/R < 40 ms, at 48/110/220 V dc	1 A / 0.25 A / 0.15 A
• Minimum contact load	100 mA at 24 V ac/dc

Table 2.2.2-7 Power outputs (PO1 and PO2)

• Rated voltage	250 V ac/dc
• Continuous carry	5 A
• Make and carry for 3.0 s	15 A
• Make and carry for 0.5 s	30 A
• Breaking capacity when the control circuit time-constant L/R < 40 ms, at 48/110/220 V dc	5 A / 3 A / 1 A
• Minimum contact load	100 mA at 24 V ac/dc

Table 2.2.2-8 Enclosure class

Front side	IP 54 (flush-mounted)
Rear side, connection terminals	IP20
Note! A rear protective cover (accessory part) can be used to protect and shield the rear of the case.	

Table 2.2.2-9 Environmental tests

• Specified service temperature range	-10...+55 °C
• Transport and storage temperature range	-40...+70 °C
• Dry heat test	according to IEC 60068-2-2
• Dry cold test	according to IEC 60068-2-1
• Damp heat test, cyclic	according to IEC 60068-2-30

Table 2.2.2-10 Electromagnetic compatibility tests

EMC immunity test level requirements consider the demands in the generic standard EN 50082-2	
1 MHz burst disturbance test, class III	According to IEC 60255-22-1
• Common mode	2.5 kV
• Differential mode	1.0 kV
Electrostatic discharge test, class III	According to IEC 61000-4-2
• For contact discharge	6 kV
• For air discharge	8 kV
Radio frequency interference tests	
• Conducted, common mode	According to IEC 61000-4-6 10 V (rms), f = 150 kHz…80 MHz
• Radiated, amplitude- modulated	According to IEC 61000-4-3 10 V/m (rms), f = 80…1000 MHz
• Radiated, pulse- modulated	According to ENV 50204 10 V/m, f = 900 MHz
• Radiated, test with a portable transmitter	According to IEC 60255-22-3, method C; f = 77.2 MHz, P = 6 W; f = 172.25 MHz, P = 5W
Fast transient disturbance tests	According to IEC 60255-22-4 and IEC 61000-4-4
• ac/dc ports	4 kV
• Binary input	2 kV
Surge immunity test	According to IEC 61000-4-5
• Power supply, ac/dc ports	4 kV, common mode 2 kV, differential mode
• I/O ports	2 kV, common mode 1 kV, differential mode
Electromagnetic immunity tests	According to IEC 61000-4-8
• Power frequency magnetic field	100 A/m
Voltage dips and short interruptions	According to IEC 61000-4-11 30% / 10 ms 60% / 100 ms > 95% / 5000 ms
Electromagnetic emission tests	According to EN 55011 and EN 50081-2
• Conducted, RF-emission (Mains terminal)	EN 55011, class A
• Radiated RF-emission	EN 55011, class A
CE approval: Complies with the EMC directive 89/336/EEC and the LV directive 73/23/EEC	

Table 2.2.2-11 Standard tests

Insulation tests	
Dielectric tests • Test voltage	According to IEC 60255-5 2 kV, 50 Hz, 1 min
Impulse voltage test • Test voltage	According to IEC 60255-5 5 kV, unipolar impulses, waveform 1.2/50 μs, source energy 0.5 J
Insulation resistance measurements • Isolation resistance	According to IEC 60255-5 > 100 MΩ, 500 V dc
Mechanical tests	
Vibration tests (sinusoidal)	According to IEC 60255-21-1 class I
Shock and bump test	According to IEC 60255-21-2 class I

Table 2.2.2-12 Data communication

Front panel
• Optical RS-232 connection for opto-cable
• SPA-bus protocol
• 4.8 or 9.6 kbps

Auxiliary voltage

For its operation the relay requires a secured auxiliary voltage supply. The internal power supply of the relay forms the voltages required by the relay electronics. The power supply is a galvanically isolated (flyback-type) DC/DC converter. A green READY LED on the front panel is lit when the power supply module is operating.

Input voltage ranges are:

- AC range 80...265 V ac, rated 110/120/220/240 V
- DC range 38...265 V dc, rated 48/60/110/125/220 V

The primary side of the power supply is protected with a fuse located on the PCB of the relay. The fuse size is 2.5 A (slow).

3 Check lists

Setting group 1

Variable	Group 1 (R, W, P)	Setting range	Default setting	Customer's setting
Start current of stage I>	S41	0.30...5.00 x I_n	0.30 x In	
Operate time or time multiplier k of stage I>	S42	0.05...300 s	0.05 s / 0.05	
Start current of stage I>>	S43	0.30...35.0 x I_n	0.30 x In	
Operate time of stage I>>	S44	0.04...300 s	0.04 s	
Checksum, SGF 1	S45	0...255	0	
Checksum, SGF 2	S46	0...255	0	
Checksum, SGF 3	S47	0...255	0	
Checksum, SGB 1	S48	0...255	0	
Checksum, SGR 1	S49	0...255	12	
Checksum, SGR 2	S50	0...255	3	
Checksum, SGR 3	S51	0...255	12	
Checksum, SGR 4	S52	0...255	3	

Setting group 2

Variable	Group 2 (R, W, P)	Setting range	Default setting	Customer's setting
Start current of stage I>	S81	0.30...5.00 x I_n	0.30 x I_n	
Operate time or time multiplier k of stage I>	S82	0.05...300 s	0.05 s / 0.05	
Start current of stage I>>	S83	0.30...35.0 x I_n	0.30 x I_n	
Operate time of stage I>>	S84	0.04...300 s	0.04 s	
Checksum, SGF 1	S85	0...255	0	
Checksum, SGF 2	S86	0...255	0	
Checksum, SGF 3	S87	0...255	0	
Checksum, SGB 1	S88	0...255	0	
Checksum, SGR 1	S89	0...255	12	
Checksum, SGR 2	S90	0...255	3	
Checksum, SGR 3	S91	0...255	12	
Checksum, SGR 4	S92	0...255	3	

Control parameters

Variable	Parameter	Setting range	Default setting	Customer's setting
Rated frequency	V133	50 / 60	50	
Remote control of settings	V150	0 / 1	0	
Event mask for I> and I>>	V155	0...255	85	
Event mask for output contacts' events	V156	0...255	3	
Event mask for disturbance recorder	V157	0 / 1	1	
SPA address of the relay	V200	1...254	1	
Data transfer rate	V201	4.8 or 9.6	9.6	
Operate time of circuit-breaker failure protection	S121	0.10...1.00 s	0.10 s	

Parameters for disturbance recorder

Information	Parameter	Setting range	Default setting	Customer's setting
Event mask for disturbance recorder	V157	0 / 1	1	
Internal trigger signals' checksum	V241	0...15	8	
Internal trigger signal's edge	V242	0...15	0	
External trigger signal (BI signal)	V243	0 / 1	1	
External trigger signal's edge	V244	0 / 1	0	
Post-triggering recording length	V245	0...38	1	
Station identification/ unit number	M18	0…9999	0000	
Station name	M20	Max 15 characters	- ABB -	
Analogue channel conversion factor and unit, phase currents	M80...82	Factor 0…65535, unit (A, kV)	00000, --	

C Service

1 General

When the protection relay is operating under conditions specified in section "Technical data", the relay is practically maintenance-free. The relay includes no parts or components subject to abnormal physical or electrical wear under normal operating conditions.

If the environmental conditions at the relay operating site differ from those specified, as to temperature, humidity, or if the atmosphere around the relay contains chemically active gases or dust, the relay ought to be visually inspected. At the visual inspection shall be noted:

- Signs of mechanical damage on relay, contacts and relay case.
- Rust spots or signs of corrosion on terminals or case.

If the relay fails in operation or if the operating values differ remarkably from those of the relay specifications, the relay is to be given a proper overhaul. All major measures involving overhaul of electronics are to be taken by the manufacturer. Please contact the manufacturer or his nearest representative for further information about checking, overhaul and recalibration of the relay.

When contacting ABB for ordering service, please state the possible fault code.

Note !

Static protection relays are measuring instruments that should be handled with care and protected against moisture and mechanical stress, especially during transport.

2 Secondary injection testing

When auxiliary voltage is connected to the protection relay, the relay performs a self-testing program, which does not include the measuring transformers and the output contacts. The operational condition of the relay is tested by means of ordinary relay test equipment and such a test also includes the measuring transformers, the output contacts and the accuracy of the operate values.

Testing, both primary and secondary, should always be performed in accordance with national regulations and instructions.

According to the manufacturer's recommendations the relay should be submitted to secondary testing at five years' intervals. The testing should include the entire protection chain from the measuring transformers to the relay outputs.

The secondary testing described in this manual is based on the relay's setting values during normal operation. (If necessary, the secondary testing can be extended by testing the protection stages throughout their setting ranges.)

All setting values that are altered during the test procedure have to be read and stored prior to the tests.

To enable secondary injection testing the relay has to be disconnected, either through disconnectable terminal blocks or a test plug fitted on the relay.

Danger!

Do not open the secondary circuit of a current transformer under any phases of the testing if the primary circuit is live. The high voltage generated by an open CT secondary circuit could be lethal and may damage instruments and insulation.

Equipment required for testing:

- adjustable voltage transformer 0...260 V, 1 A
- current transformer
- ammeter, accuracy ±0.5%
- stop watch or counter for time measurement
- ac/dc voltage source for the auxiliary supply
- switches and indicator lamps
- supply and pilot wires
- calibrated multimeter

The secondary current is to be selected on the basis of the rated current, 1 A or 5 A, of the relay energizing input to be tested.

Note!

The current carrying capacity of the wiring, terminals and measuring transformers of the relay is limited, see chapter "Technical data".

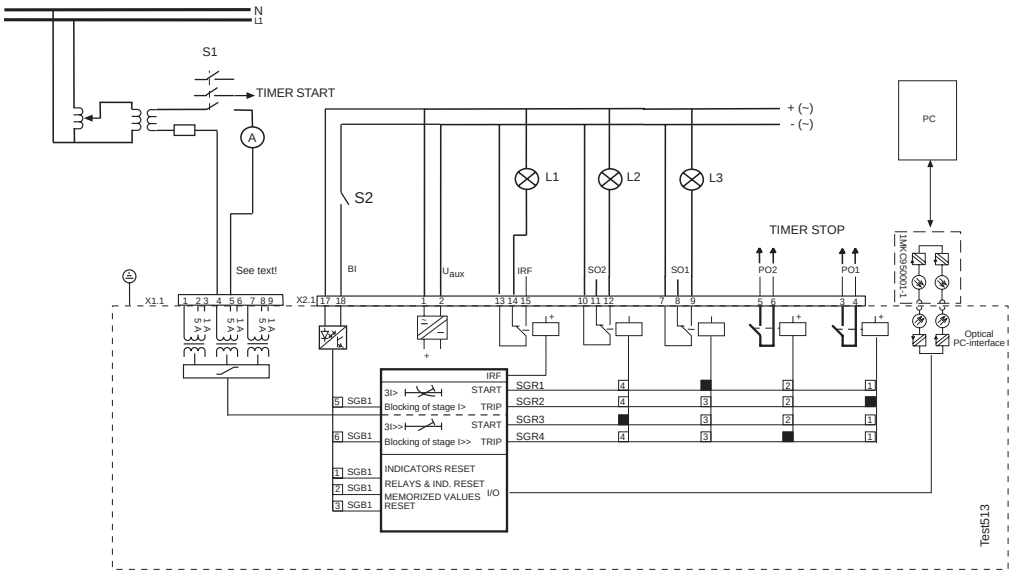

Figure 2-1 Secondary injection test circuitry for the overcurrent relay

When the test circuit has been completed and the switchgroups set, the auxiliary voltage may be connected to the relay. The operation of the test circuit can be verified with the aid of a multimeter.

2.1 Testing of the phase current measuring transformers

Test each used 1 A or 5 A current transformer input separately. Apply a pure sinusoidal voltage to the relay and compare the current value read from the relay via serial communication with that shown by the ammeter. The measurements can be made, for instance, at the rated current of the relay. Note that the relay shows the measured current as a multiple of the rated current I_n of the energizing input used.

2.2 Testing of the overcurrent stages

Before the test is started:

- Record the actual SGR settings for later restoring.
- Set the relay switchgroups as follows:

  SGR1 = 4 I> to SO1

  SGR2 = 1 t> to PO1

  SGR3 = 8 I>> to SO2

  SGR4 = 2 t>> to PO2

Setting values can be those actual used.

2.2.1 Low-set stage I>

Starting

The test is carried out as a single-phase test. Close switch S1 and slowly increase the test current until the relay starts and the indicator L3 is lit. Then read the start current value from the ammeter.

Operate time

Test according to selected characteristics.

Definite-time characteristic

Set the test current at 2 x the setting value of stage I>.

Switch off S1 and clear indicators and reset output relays. The clock is started by closing switch S1 and stopped by closing output contact PO1.

When the relay starts, the START indicator on the front panel is lit with yellow light. When the relay operates, the red indicator turns on

Inverse-time characteristic

At inverse-time characteristic, the operate time is measured at two different test current values (2 x I> and 10 x I>). The operate times thus obtained are compared with the operate times obtained from the current/time curves of the concerned inverse-time characteristic.

2.2.2 High-set stage I>>

Starting

Increase the test current until the relay starts and indicator L2 is lit. Then read the start current value from the ammeter.

Operate time

Set the test current at 2 x the set start value of stage I>>. The clock is started by closing switch S1 and stopped by closing output contact PO2.

2.3 Testing of the self-supervision system (IRF)

The self-supervision system and the function of the IRF LED and the IRF output can be tested in the Trip test mode.

2.4 Testing of the binary input

Read the state of the binary input via SPA parameter I4. Use switch S2 to change the state.

3 Spare parts

To achieve the best possible operation accuracy, all parts of REJ 513 have been calibrated together. Thus, each product forms a whole for which no separate spare parts can be supplied. In case of malfunction, please consult your relay supplier.

Ordering information

Order number	REJ513A 402-BAA (1MRS090402-BAA)
Protective cover for rear connectors	1MRS060132
Flush mounting kit	1MRS050209
Semi-flush mounting kit	1MRS050253
Wall mounting kit	1MRS050240
Side-by-side mounting kit	1MRS050241
19" Rack mounting kit	1MRS050257
Opto-cable	1MKC950001-1

References

Installation Manual 1MRS750526-MUM

Index/Glossary

Abbreviations

- BI — Binary input
- CBFP — Circuit-breaker failure protection
- CPU — Central processing unit
- CT — Current transformer
- IDMT — Inverse definite minimum time characteristic
- IRF — Internal relay fault
- LED — Light-emitting diode
- PCB — Printed Circuit Board
- PO1, PO2 — Power outputs
- SGB — Switchgroups for binary input
- SGF — Switchgroups for functions
- SGR — Switchgroups for output contacts
- SO1, SO2 — Signal outputs

Customer feedback

Date: _____ To fax: +358 10 224 1094

Category: _ Comment _ Query _ Complaint

In case of feedback related to a specific product, please state the name of the product.

Product: _____

Description: _____

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Initiator: _____

Issuer: _____

Company: _____

Country: _____

Telefax no/
e-mail address: _____

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