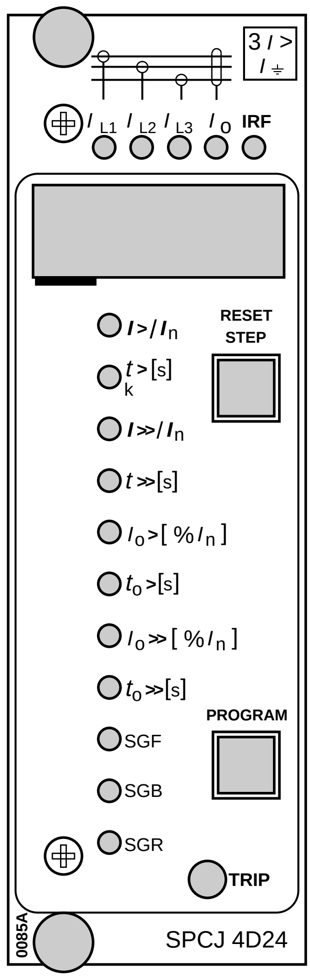
SPCJ 4D24
Combined overcurrent and earth-fault relay module

User´s manual and Technical description



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Combined overcurrent and earth-fault relay module

Contents

Features

A low-set overcurrent stage I> with a definite time and six inverse time modes of operation

A high-set overcurrent stage I>> with a setting range of 0.5...40 x I_n. The operation of the high-set overcurrent stage can be set out of function

A low-set neutral overcurrent stage I_0> with a setting range of 1.0...25.0 % I_n and definite time mode of operation

A high-set neutral overcurrent stage I_0>> with a setting range of 2.0...200 % I_n. The operation of the high-set neutral over current stage can be set out of function

Digital display of measured and set values and sets of data recorded at the moment when faults occur

All settings may be keyed in using the push-buttons of the front panel or they may be set using a personal computer

Continuous self-supervision including both hardware and software. At a permanent fault the alarm output relay operates and the other outputs are blocked.

Description of function

Overcurrent unit

The overcurrent unit of the combined overcurrent and earth-fault module SPCJ 4D24 is designed for single-phase, two-phase or three-phase operation. It contains two overcurrent stages, i.e. a low-set overcurrent stage I> and a high-set overcurrent stage I>>.

The low-set or high-set current stage starts if the current on one of the phases exceeds the setting value of the stage concerned. When starting, the concerned stage provides a starting signal SS1 or TS1 and simultaneously the digital display on the front panel indicates starting. If the overcurrent situation lasts long enough to exceed the set operating time, the stage that started calls for a C.B. tripping by providing a tripping signal TS2. At the same time the operation indicator goes on with red light. The red operation indicator remains on although the stage resets. The indicator is reset with the RESET push-button. By proper configuration of the output relay switchgroups an additional auxiliary trip signal TS1 can be generated.

The maximum continuous current carrying capacity of the energizing inputs is 4 x I_n, which must be observed when relay settings are calculated.

The operation of the low-set overcurrent stage I> or the high-set overcurrent stage I>> can be blocked by bringing a blocking signal BS to the unit. The blocking configuration is set by means of switchgroup SGB.

The operation of the low-set overcurrent stage can be based on a definite time or an inverse time characteristic. The mode of operation is programmed with SGF1/1…3. At definite time mode of operation the operating time t> is directly set in seconds within the setting range, 0.05...300 s. When using inverse time mode of operation (I.D.M.T.) four internationally standardized and two special type time/current characteristics are available. The programming switches SGF1/1...3 are also used for selecting the desired operation characteristic.

The operating time t>> of the high-set overcurrent stage is set separately within the range 0.04...300 s.

The operation of the two overcurrent stages is provided with a latching facility (switch SGB/6) keeping the tripping output energized, although the signal which caused the operation disappears. The stages are reset by simultaneous pressing of the push-buttons RESET and PROGRAM, see section "Programming switches".

The setting value I>>/I_n of the high-set overcurrent stage may be subject to automatic doubling when connecting the protected object to the network, i.e. in a starting situation. Thus the setting value of the high-set overcurrent stage may be lower than the connection inrush current. The automatic doubling function is selected with switch SGF1/5. The starting situation is defined as a situation where the phase currents rise from a value below 0.12 x I> to a value exceeding 1.5 x I> in less than 60 ms. The starting situation comes to an end when the currents fall below 1.25 x I>.

The setting range of the high-set overcurrent stage is 0.5...40 x I_n. When selecting a setting in the lower end of the range, the module will contain two almost identical operation stages. In this case the overcurrent unit of the SPCJ 4D24 module may be used for e.g. two-stage load shedding purposes.

The operation of the high-set overcurrent stage may be set out of operation by means of switch SGF2/5. When the high-set unit is set out of operation the display shows a "- - -" readout, indicating that the operating value is infinite.

Note!
At inverse time characteristic the effective setting range of the low-set overcurrent stage is 0.5…2.5 x I_n, although start current settings within the range 2.5…5.0 x I_n can be set on the relay. At inverse time characteristic any start current setting above 2.5 x I_n of the low-set stage will be regarded as being equal to 2.5 x I_n.

Note!
The operation of the low-set stage based on inverse time characteristic will be blocked by starting of the high-set stage. Then the operate time of the overcurrent unit is determined by the set operate time of the high-set stage at heavy fault currents.

Earth-fault unit

The non-directional earth-fault unit of the module SPCJ 4D24 is a single-pole neutral current or residual current overcurrent unit. It contains two neutral overcurrent stages, i.e. a low-set overcurrent stage $I_0>$ and a high-set overcurrent stage $I_0>>$.

The low-set or high-set overcurrent stage starts if the current to be measured exceeds the setting value of the stage concerned. When starting, the stage provides a starting signal SS1 or TS1 and simultaneously the operation indicator on the front panel indicates starting. If the earth-fault situation lasts long enough to exceed the set operating time, the stage that started calls for a C.B. tripping by providing a tripping signal TS2. At the same time the red operation indicator of the tripping stage goes on. The operation indicator remains on although the stage resets. The indicator is reset with the RESET push-button.

The neutral current measured by the earth-fault unit is filtered in a low-pass filter which effectively reduces the amount of harmonics in the measured signal. For example the third harmonics is reduced to about ten percent of its original value by the filter. Higher order harmonics are reduced even more.

The operation of the low-set overcurrent stage $I_0>$ or the high-set stage $I_0>>$ can be blocked by applying a blocking signal BS onto the stage. The blockings are programmed by means of switchgroup SGB on the front of the plug-in module.

The operation of the low-set neutral current stage $I_0>$ is based on a definite time characteristic. The operating time $t_0>$ can be set within the setting range 0.05...300 s.

The operating time $t_0>>$ of the high-set current stage is set separately within the range 0.05… 300 s.

The operation of the two neutral overcurrent stages is provided with a latching facility (switch SGB/7) keeping the tripping output energized, although the signal which caused the operation disappears. The stages are reset by simultaneous pressing of the push-buttons RESET and PROGRAM, see section "Programming switches".

The operation of the high-set earth-fault stage may be inhibited when connecting the protected object to the network, i.e. when the low-set stage of the overcurrent unit is started. Thus it is possible to avoid malfunction due to virtual earth-fault currents caused by current transformer anomalies in connection with the connection inrush current. The automatic inhibiting function is selected with switch SGF1/6.

The operation of the high-set earth-fault stage $I_0>>$ may be totally blocked by means of switch SGF2/6. When the high-set stage is set out of operation, the display shows a "- - -" readout, indicating that the setting value is infinite.

Circuit breaker failure protection

The unit is also provided with a circuit breaker failure protection (CBFP), which gives a trip signal via TS1 within a set time 0.1…1 s after the normal trip signal TS2, if the fault has not been cleared within that time. The output contact of the circuit breaker failure protection is normally used for tripping an upstream circuit breaker. The CBFP can also be used to establish a redundant trip system by using dual trip coils on the circuit breaker and wiring one of them to TS2 and the other one to TS1. The circuit breaker failure protection is selected by means of switch SGF1/4. The setting of the time delay can be made using submenu position five in register A.

Remote settings

All the main setting values may be provided with alternative setting values that can be called up by remote control. The switching between main and remote settings is normally made by utilizing the serial communication link. If the serial communication is not used, the control input signal BS can be programmed to perform the switching too. Finally manual switching between setting banks can be made using submenu position four in register A.

Block diagram

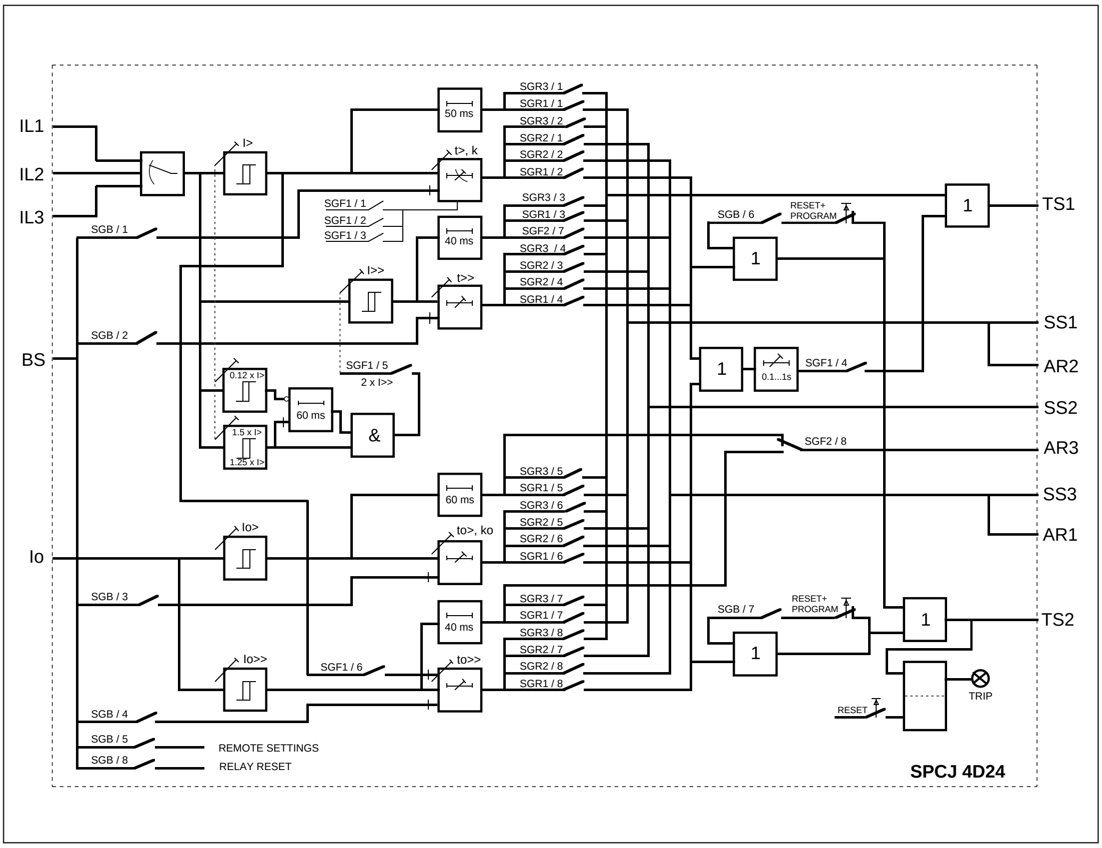


Fig. 1. Block diagram for overcurrent and earth-fault module SPCJ 4D24

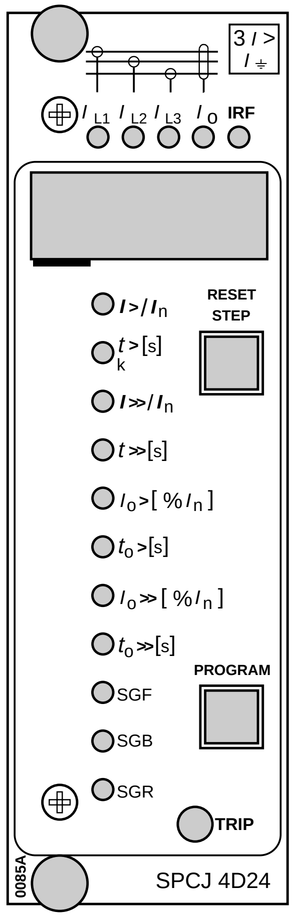
I_{L1}, I_{L2}, I_{L3}	Measured phase currents
I_0	Measured neutral current
BS1	External blocking or resetting signal
SGF	Programming switchgroup SGF on the front panel
SGB	Programming switchgroup SGB on the front panel
SGR1...3	Programming switchgroups SGR on the front panel
TS1	Starting signal1 or auxiliary tripping signal depending on programming of switchgroup SGR3
SS1	Start signal for stages selected with switchgroup SGR1
SS2	Trip signal 1 for stages selected with switchgroup SGR2
SS3	Trip signal 2 for stages selected with switchgroup SGR2
TS2	Tripping signal from stages selected with switchgroup SGR1
AR1, AR2, AR3	Starting signals to autoreclose unit
TRIP	Red indicator for tripping

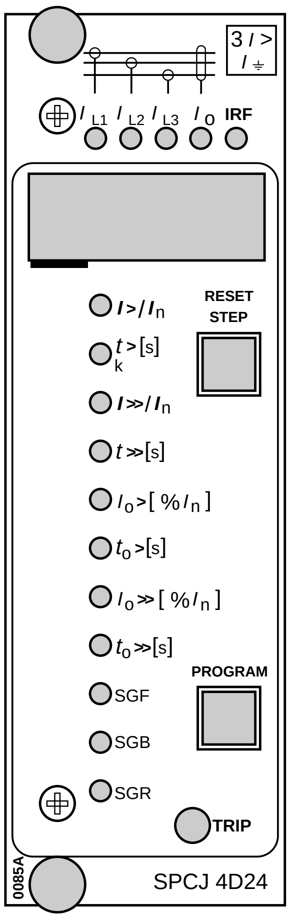
Note!
All input and output signals of the module are not necessarily wired to the terminals of every relay assembly using this module. The signals wired to the terminals are shown in the diagram illustrating the flow of signals between the plug-in modules of the relay assembly.

Front panel

Current measurement indicators
for phases L1, L2, L3 and I_0

Indicator for starting value setting of stage I>
Indicator for setting ofoperating time t> or
time multiplier k of stage I>
Indicator for starting value setting of stage I>>
Indicator for operating time setting of stage I>>
Indicator for starting value setting of stage I_0>
Indicator for setting of operating time t_0>
Indicator for starting value setting of stage I_0>>
Indicator for operating time setting of stage I_0>>
Indicator for switchgroup SGF1..2 checksum
Indicator for switchgroup SGB checksum
Indicator for switchgroup SGR1...3 checksum





Simplified device symbol

Self-supervision alarm indicator

Display

Reset and display step push-button

Programming push-button

Trip indicator

Type designation of plug-in module

Fig. 2. Front panel of the combined overcurrent and earth-fault module SPCJ 4D24

Operation indications

Each overcurrent stage has its own starting indicator and operation indicator shown as a figure in the digital display. Further all stages share a common red LED indicator named "TRIP", which indicates that the module has delivered a tripping signal.

The operation indicator in the display remains illuminated when the current stage resets, thus indicating which protection stage was operating. The operation indicator is reset with the RESET push-button. The function of the plug-in module is not affected by an activated operation indicator. If a starting of a stage is short enough not to cause a trip, the starting indication is normally self-reset when the stage is reset. By means of switches SGF2/1…4 if needed, the starting indicators can be programmed for manual resetting. The following table shows the starting and tripping indicators and their meanings.

Indication	Explanation	
1	I> START	= The low-set stage I> of the overcurrent unit has started
2	I> TRIP	= The low-set stage I> of the overcurrent unit has tripped
3	I>> START	= The high-set stage I>> of the overcurrent unit has started
4	I>> TRIP	= The high-set stage I>> of the overcurrent unit has tripped
5	I_0> START	= The low-set stage I_0> of the earth-fault unit has started
6	I_0> TRIP	= The low-set stage I_0> of the earth-fault unit has tripped
7	I_0>> START	= The high-set stage I_0>> of the earth-fault unit has started
8	I_0>> TRIP	= The high-set stage I_0>> of the earth-fault unit has started
9	CBFP	= The circuit breaker failure protection has operated

When one of the protection stages of the module performs a tripping, the indicators for the measured values of the module indicate the faulty phase, i.e. in which phase(s) the current has exceeded the setting value of the stage (so called phase fault indication). If for instance, the operation indicator of the I> stage is switched goes on and the indicators I_{L1} and I_{L2} are illuminated, the operation was caused by overcurrent in phases L1 and L2. When pressing the push-button RESET, the phase fault indication disappears.

The self-supervision alarm indicator IRF indicates that the self-supervision system has detected a permanent fault. The indicator is lit with red light shortly after the fault has been detected. At the same time the plug-in module delivers a signal to the self-supervision system output relay of the protection assembly. Additionally, in most fault cases, a fault code showing the nature of the fault appears on the display of the module. The fault code, consisting of a red figure one and a green code number, persists until the STEP/RESET button is pressed. When a fault occurs, the fault code should be recorded and stated when ordering service.

Settings

The setting values are shown by the right-most three digits of the display. An indicator close to the setting value symbol shows when illuminated which setting value is indicated on the display.

$I>/I_n$	The operating current of the I> stage as a multiple of the rated current of the protection. Setting range 0.5...5.0 x I_n at definite time characteristic and 0.5…2.5 x I_n at inverse time characteristic.
t> k	The operating time of the I> stage, expressed in seconds, when in the definite time mode of operation (SGF1/1-2-3 = 0-0-0). The setting range is 0.05...300 s. At inverse definite minimum time mode of operation the time multiplier k setting range is 0.05...1.00.
$I>>/I_n$	The starting current of the I>> stage as a multiple of the rated current of the protection. Setting range 0.5...40.0 x I_n. Additionally, the setting "infinite" (displayed as n - - -) can be selected, with switch SGF2/5, which makes the stage I>> inoperative.
t>>	The operating time of the I>> stage, expressed in seconds. The setting range is 0.04...300 s
$I_0>/I_n$	The starting current of the I_0> stage as a per cent of the rated current of the protection. Setting range 1.0...25.0 % I_n.
$t_0>$	The operating time of the I_0> stage, expressed in seconds. The setting range is 0.05...300 s
$I_0>>/I_n$	The starting current of the I_0>> stage as a percent of the rated current of the protection. Setting range 2.0...200% I_n. Additionally, the setting "infinite" set by switch SGF2/6 (displayed as n - - -) can be selected with switch SGF2/6 which makes the stage I_0>> inoperative.
$t_0>>$	The operating time of the I_0>> stage, expressed in seconds. The setting range is 0.05...300 s

Further, the checksums of the programming switchgroups SGF1,SGB and SGR1 are indicated on the display when the indicators adjacent to the switchgroup symbols on the front panel are illuminated. The checksums for groups SGF2, SGR2 and SGR3 are found in the submenus of the corresponding first switchgroup. See further clause "Main menus and submenus of settings and registers". An example of calculating the checksum is given in the general description of the D-type SPC relay modules.

Programming switches

Additional functions required by individual applications are selected by means of the switchgroups SGF, SGB and SGR indicated on the front panel. The numbering of the switches, 1...8, and the switch positions 0 and 1 are indicated when setting the switchgroups. In normal service only the checksums are shown. The switchgroups SGF2, SGR2 and SGR3 are found in the submenus of the switchgroups SGF and SGR.

Functional switchgroup SGF1

Switch	Function
SGF1/1 SGF1/2 SGF1/3	Switches SGF1/1...3 are used for selecting the operation characteristic of the low-set overcurrent stage I>, i.e. definite time mode of operation or inverse definite minimum time (I.D.M.T.) mode of operation. At inverse definite minimum time mode of operation the switches are, further, used for selecting the current/time characteristic of the module.
SGF1/4	Selection of the circuit breaker failure protection. When SGF1/4 =1 the trip signal TS2 will start a timer which will produce a 0.1…1 s delayed trip signal via TS1, if the fault has not been cleared before. With switch SGF1/4 = 0 only the normal trip signal TS2 is activated.
SGF1/5	Selection of automatic doubling of the setting value of the high-set overcurrent stage when the protected object is energized. When SGF1/5 = 0, no doubling of the setting value I>> is obtained. When SGF1/5 = 1, the setting value of the I>> stage doubles automatically. This makes it possible to give the high-set current stage a setting value below the connection inrush current level.
SGF1/6	High-set stage of the earth-fault protection inhibited by starting of the low-set stage of the overcurrent unit When SGF1/6 = 0, the operation of the high-set earth-fault protection is operating under all phase current conditions When SGF1/6 =1, the earth-fault protection is inhibited if the low-set stage of the overcurrent unit has started
SGF1/7	Reserved for future use
SGF1/8	Reserved for future use

Characteristic selection (SGF1/1...3):

SGF1/1	SGF1/2	SGF1/3	Mode of operation	Characteristics
0	0	0	Definite time	0.05...300 s
1	0	0	I.D.M.T	Extremely inverse
0	1	0	"	Very inverse
1	1	0	"	Normal inverse
0	0	1	"	Long-time inverse
1	0	1	"	RI-characteristic
0	1	1	"	RXIDG-characteristic
1	1	1	"	Not in use (long-time inverse)

Functional switch-group SGF2

Switch	Function
SGF2/1 SGF2/2 SGF2/3 SGF2/4	Switches SGF2/1...4 are used for selecting the mode of operation of the starting indicators of the different stages. When the switches are in position 0 the starting signals are all automatically reset when the fault is cleared. In order to get a hand reset starting indication for a stage, the corresponding switch is brought into position 1: SGF2/1 = 1 equals manual resetting of the starting indication of stage I> SGF2/2 = 1 equals manual resetting of the starting indication of stage I>> SGF2/3 = 1 equals manual resetting of the starting indication of stage I_0> SGF2/4 = 1 equals manual resetting of the starting indication of stage I_0>>
SGF2/5	The high-set instantaneous operation of the stage I>> can be set out of operation by means of this switch. When SGF2/5 = 0 the high-set stage I>> is operative When SGF2/5 = 1 the high-set stage I>> is blocked and the display shows "- - -"
SGF2/6	The high-set instantaneous operation of the stage I_0>> can be completely set out of operation by means of this switch. When SGF2/6 = 0 the high-set stage I_0>> is operative When SGF2/6 = 1 the high-set stage I_0>> is blocked and the display shows "- - -"
SGF2/7	The starting signal of the high-set overcurrent stage I>> brought to the auto-reclose signal output AR1 When SGF2/7 = 1, the starting signal of I>> is controlling AR1. Note! The output is equal to SS3, which means that in this case an other signal must not be connected to same output! When SGF2/7 =0, the starting output of I>> is not affecting the output AR1 or SS3. Thus the signal output SS3 is available for other purposes.
SGF2/8	The starting signal from stage I_0>- or stage I_0>>- brought to auto-reclose signal output AR3 When SGF2/8 = 0 the starting signal from stage I_0> is controlling AR3 When SGF2/8 = 1 the starting signal from stage I_0>> is controlling AR3

Blocking or control input switchgroup SGB

Switch	Function
SGB/1...4	Switches SGB/1...4 are used when the external control signal BS is to be used for blocking one or more of the current stages of the module. When all the switches are in position 0 no stage is blocked. When SGB/1 = 1, the stage I> is blocked by the input signal BS When SGB/2 = 1, the stage I>> is blocked by the input signal BS When SGB/3 = 1, the stage I_0> is blocked by the input signal BS When SGB/4 = 1, the stage I_0>> is blocked by the input signal BS
SGB/5	This switch enables switching over from the main settings to the second settings and vice versa even without serial communication, using the external control input signal BS. When SGB/5 = 0, the settings are not to be remotely controlled or they are controlled via the serial communication only When SGB/5 = 1, the settings are remotely controlled or via the external input. Main values of the settings are used when there is no control voltage on the input and the second settings are enforced when a control voltage is connected to the control input. Note! Whenever main and second settings are used, care should be taken that the switch SGB/5 has the same position both in the main and second setting bank. Otherwise a conflict situation might occur when switching setting banks by contact or via serial communication.
SGB/6	Selection of a latching feature for the tripping signal TS2 for overcurrent faults. When SGB/6 = 0, the tripping signal returns to its initial state (= the output relay drops off), when the measuring signal causing the operation falls below the starting level. When SGB/6 = 1, the tripping signal remains on (= the output relay operated), although the measuring signal falls below the starting level. Then the starting signals have to be reset by pressing the push-buttons RESET and PROGRAM simultaneously. [1)]
SGB/7	Selection of a latching feature for the trip signal TS2 for earth faults. When SGB/7 = 0, the tripping signal returns to its initial state (= the output relay drops off), when the measuring signal causing the operation falls below the starting level. When SGB/7 = 1, the tripping signal remains on (= the output relay operated), although the measuring signal falls below the starting level. Then the starting signals have to be reset by pressing the push-buttons RESET and PROGRAM simultaneously. [1)]
SGB/8	Remote resetting of a latched output relay. When the output relay with SGB/6 or SGB/7 has been selected to be latching, a remote relay reset can be performed using the control input signal BS when SGB/8 =1. When delivered from factor all switches SGB are set at zero, i.e. the checksum SGB is 0.

[1)] From the program version 042D and later versions an additional feature has been incorporated into the relay module SPCJ 4D24. When the latching function is used the latched output can be reset by pushing the PROGRAM button alone, in which case the stored information of the module is not erased.

Output relay matrix switchgroups SGR1, SGR2 and SGR3

SGR1	The switches of switchgroup SGR1 are used to select the protective stages to be brought to the starting signal output SS1 and the tripping signal output TS2.
SGR2	The switches of switchgroup SGR2 are used for configuring the tripping signals of the different protective stages. There are two outputs, SS2 and SS3, to which the signals can be linked.
SGR3	The switches of switchgroup SGR3 are used for configurating the starting and tripping signals to the starting or auxiliary tripping output TS1. Note! If the circuit breaker failure protection has been selected in with switch SGF1/4, it will also utilize the TS1 output.

Switch	Function	Factory setting	Checksum value
SGR1/1	When SGR1/1 = 1, the starting signal of stage I> is linked to SS1	1	1
SGR1/2	When SGR1/2 = 1, the tripping signal of stage I> is linked to TS2	1	2
SGR1/3	When SGR1/3 = 1, the starting signal of stage I>> is linked to SS1	0	4
SGR1/4	When SGR1/4 = 1, the tripping signal of stage I>> is linked to TS2	1	8
SGR1/5	When SGR1/5 = 1, the starting signal of stage I_0> is linked to SS1	0	16
SGR1/6	When SGR1/6 = 1, the tripping signal of stage I_0> is linked to TS2	1	32
SGR1/7	When SGR1/7 = 1, the staring signal of stage I_0>> is linked to SS1	0	64
SGR1/8	When SGR1/8 = 1, the tripping signal of stage I_0>> is linked to TS2	1	128
	Checksum for factory setting of SGR1		171

SGR2/1	When SGR2/1 = 1, the tripping signal from stage I> is linked to SS2	1	1
SGR2/2	When SGR2/2 = 1, the tripping signal from stage I> is linked to SS3	0	2
SGR2/3	When SGR2/3 = 1, the tripping signal from stage I>> is linked to SS2	1	4
SGR2/4	When SGR2/4 = 1, the tripping signal from stage I>> is linked to SS3	0	8
SGR2/5	When SGR2/5 = 1, the tripping signal from stage I_0> is linked to SS2	0	16
SGR2/6	When SGR2/6 = 1, the tripping signal from stage I_0> is linked to SS3	1	32
SGR2/7	When SGR2/7 = 1, the tripping signal from stage I_0>> is linked to SS2	0	64
SGR2/8	When SGR2/8 = 1, the tripping signal from stage I_0>> is linked to SS3	1	128
	Checksum for factory setting of SGR2		165

Switch	Function	Factory setting	Checksum value
SGR3/1	When SGR3/1 = 1, the starting signal of stage I> is linked to TS1	0	1
SGR3/2	When SGR3/2 = 1, the tripping signal of stage I> is linked to TS1	0	2
SGR3/3	When SGR3/3 = 1, the starting signal of stage I>> is linked to TS1	0	4
SGR3/4	When SGR3/4 = 1, the tripping signal of stage I>> is linked to TS1	0	8
SGR3/5	When SGR3/5 = 1, the starting signal of stage I_0> is linked to TS1	0	16
SGR3/6	When SGR3/6 = 1, the tripping signal of stage I_0> is linked to TS1	0	32
SGR3/7	When SGR3/7 = 1, the starting signal of stage I_0>> is linked to TS1	0	64
SGR3/8	When SGR3/8 = 1, the tripping signal of stage I_0>> is linked to TS1	0	128
	Checksum for factory setting of SGR3		0

Measured data

The measured values are displayed by the three right-most digits of the display. The currently measured data are indicated by an illuminated LED indicator on the front panel.

Indicator	Measured data
I_{L1}	Line current on phase L1 as a multiple of the rated current I_n (0…63 x I_n)
I_{L2}	Line current on phase L2 as a multiple of the rated current I_n (0…63 x I_n)
I_{L3}	Line current on phase L3 as a multiple of the rated current I_n (0…63 x I_n)
I_0	Neutral current as a per cent of the rated current I_n (0…210% I_n)

Recorded information

The left-most red digit displays the register address and the other three digits the recorded information.

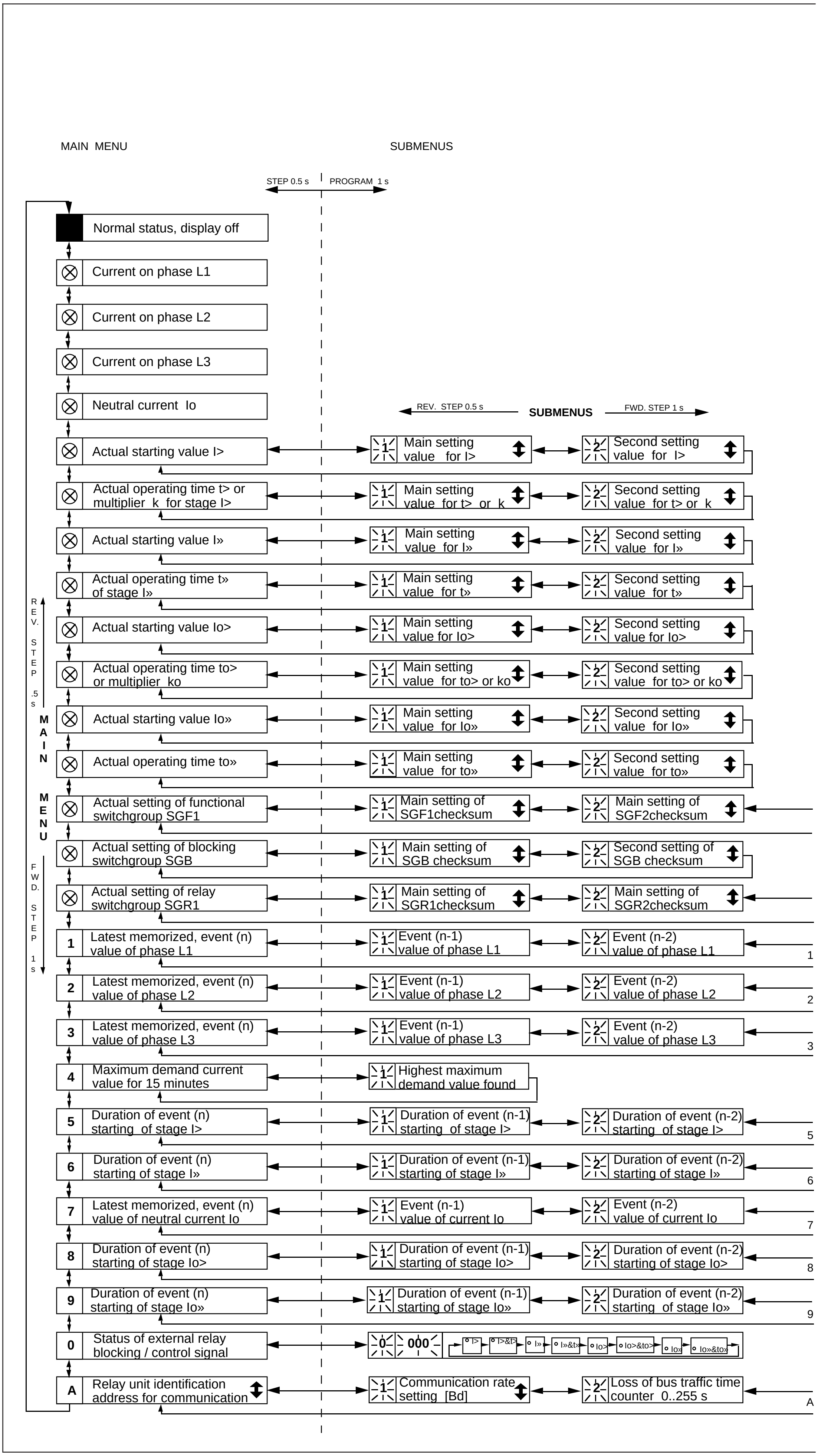
A symbol "//" in the text indicates that the following item is found in a submenu.

Register/ STEP	Recorded information
1	Phase current I_{L1} measured as a multiple of the rated current of the overcurrent protection. If the overcurrent stage starts or performs a tripping, the current value at the moment of tripping is stored in a memory stack. A new tripping moves the old value up one place in the stack and adds a new value to the stack. At a maximum five values are memorized - if a sixth starting occurs, the oldest value will be lost.
2	Phase current I_{L2} measured as a multiple of the rated current of the overcurrent protection. If the overcurrent stage starts or performs a tripping, the current value at the moment of tripping is stored in a memory stack. A new tripping moves the old value up one place in the stack and adds a new value to the stack. At a maximum five values are memorized - if a sixth starting occurs, the oldest value will be lost.
3	Phase current I_{L3} measured as a multiple of the rated current of the overcurrent protection. If the overcurrent stage starts or performs a tripping, the current value at the moment of tripping is stored in a memory stack. A new tripping moves the old value up one place in the stack and adds a new value to the stack. At a maximum five values are memorized - if a sixth starting occurs, the oldest value will be lost.
4	Maximum demand current value for a period of 15 minutes expressed in multiples of the relay rated current In and based on the highest phase current. // Highest maximum demand value found since latest full relay reset.
5	Duration of the latest starting situation of stage I> as a percentage of the set operating time t> or at I.D.M.T. mode of operation the calculated operation time. A new starting resets the counter, which then starts counting from zero and moves the old value up in the memory stack. At a maximum five values are memorized - if a sixth starting occurs the oldest value will be lost. When the concerned stage has tripped, the counter reading is 100. // Number of startings of the low-set overcurrent stage I>, n (I>) = 0...255.
6	Duration of the latest starting situation of stage I>> as a percentage of the set operating time t>>. A new starting resets the counter, which then starts counting from zero and moves the old value up in the memory stack. At a maximum five values are memorized - if a sixth starting occurs, the oldest value will be lost. When the concerned stage has tripped, the counter reading is 100. // Number of startings of the high-set overcurrent stage I>>, n (I>>) = 0...255.
7	Neutral overcurrent I_0 measured as a per cent of the rated current of the earth-fault protection. If the earth-fault stage starts or performs a tripping, the current value at the moment of tripping is stored in a memory stack. A new tripping moves the old value up one place in the stack and adds a new value to the stack. At a maximum five values are memorized - if a sixth starting occurs, the oldest value will be lost.

Register/ STEP	Recorded information
8	Duration of the latest starting situation of stage I_0> as a percentage of the set operating time t_0>. A new starting resets the counter, which then starts counting from zero and moves the old value up in the memory stack. At a maximum five values are memorized - if a sixth starting occurs the oldest value will be lost. When the concerned stage has tripped, the counter reading is 100. // Number of startings of the low-set neutral overcurrent stage I_0>, n (I_0>) = 0...255.
9	Duration of the latest starting situation of stage I_0>> as a percentage of the set operating time t_0>>. A new starting resets the counter, which then starts counting from zero and moves the old value up in the memory stack. At a maximum five values are memorized - if a sixth starting occurs, the oldest value will be lost. When the concerned stage has tripped, the counter reading is 100. // Number of startings of the high-set neutral overcurrent stage I_0>>, n (I_0>>) = 0...255.
0	Display of blocking signals and other external control signals. The right-most digit indicates the state of the blocking input of the unit. The following states may be indicated: 0 = no blocking signal 1 = the blocking or control signal BS is active. The effect of the signal on the unit is determined by the setting of switchgroup SGB From this register "0" it is possible to move on to the TEST mode, where the starting and tripping signals of the module are activated one by one. For further details see the description "General characteristics of D-type SPC relay units".
A	The address code of the measuring relay module, required by the serial communication system. The address code is set at zero unless the serial communication system is used. The submenus of this register comprise the selection of the data transfer rate of the serial communication, a bus traffic monitor indicating the operating state of the serial communication system, a password required for the remote control of the settings and a status information for the main/second setting bank, and finally the setting of time delay for the circuit breaker failure protection. If the module is connected to a system including a control data communicator and if the communication system is operating, the counter reading of the bus traffic monitor will be zero. Otherwise the numbers 0...255 are continuously rolling in the counter. The password given in the setting mode of the next submenu step must always be entered via the serial communication before settings can be remotely altered. With the setting selector status in the fourth submenu either the main setting bank or the second setting bank can be made active.
-	Display dark. By pressing the STEP push-button the beginning of the display sequence is re-entered.

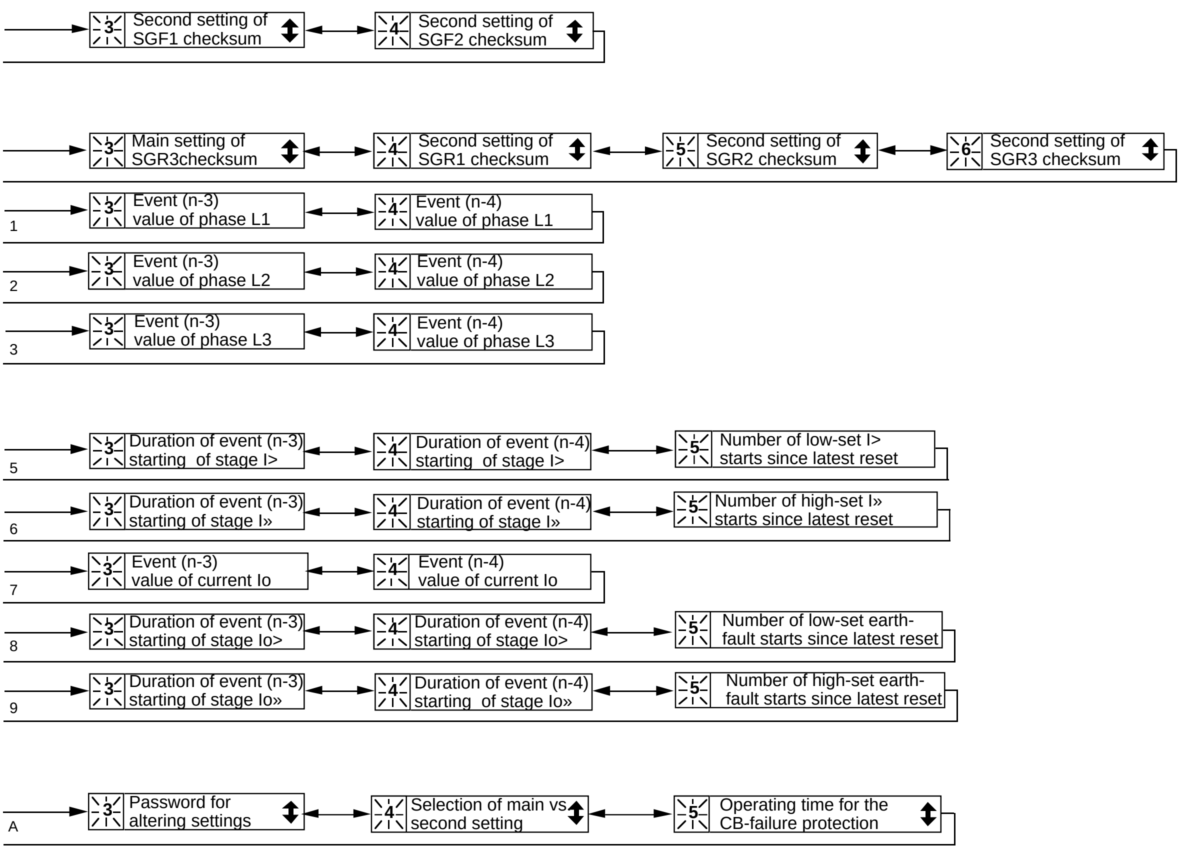
The registers 1...9 are set to zero by pressing the push-buttons RESET and PROGRAM simultaneously. The registers are also cleared if the auxiliary power supply of the module is interrupted. The address code of the plug-in module, the data transfer rate of the serial communication, the password and the status of the main/second setting bank switch are not erased by a voltage failure. The instructions for setting the address and the data transfer rate are described in the "General characteristics of D-type SPC relay units".

Main menus and submenus of settings and registers



The measures required for entering a submenu or a setting mode and how to perform the setting and use the TEST mode are described in detail in the manual "General characteristics of the D-type relay modules". A short form guide to the operations is shown below.

Desired step or programming operation	Push-button	Action
Forward step in main or submenu	STEP	Press for more than 0.5 s
Rapid scan forward in main menu	STEP	Keep depressed
Reverse step in main or submenu	STEP	Press less than about 0.5 s
Entering to submenu from main menu	PROGRAM	Press for 1 s (Active on release)
Entering or leaving setting mode	PROGRAM	Press for 5 s
Increasing a value in setting mode	STEP	
Moving the cursor in setting mode	PROGRAM	Press for about 1 s
Storing a value in setting mode	STEP&PROGRAM	Press simultaneously
Resetting of memorized values and latched output relays	STEP&PROGRAM	
Resetting of latched output relays	PROGRAM	Note! Display must be off
Note! All parameters which can be set in a setting mode are indicated with the symbol ↕.		



Time/current characteristics

(modified 2002-05)

The operation of the low-set overcurrent stage I> of the module is based on either definite time or inverse time characteristics. The mode of operation is selected with switches 1...3 of switchgroup SGF1 (see page 9).

When selecting an IDMT mode of operation, the operating time of the stage will be a function of the current; the higher the current, the shorter the operating time.The unit comprises of six different time/current characteristics - four according to the BS 142 standard and two special types called the RI and RXIDG characteristic..

BS-type characteristics

There are four standard curves, extremely, very, normal and long- time inverse. The relationship between current and time complies with the standards BS 142.1966 and IEC 60255-3 and may generally be expressed as:

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

where
- t = operating time in seconds
- k = time multiplier
- I = current value
- I> = set current value

The unit includes four BS 142-specified characteristics with different degrees of inversity.

The degree of inversity is determined by the values of the constants α and β

Degree of inversity of the characteristic	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	120.0

According to the standard BS 142.1966 the normal current range is defined as 2...20 times the setting current. Additionally the relay must start at the latest when the current exceeds a value of 1.3 times the setting, when the time/current characteristic is normal inverse, very inverse or extremely inverse. When the characteristic is long-time inverse, the normal range in accordance with the standard is 2...7 times the setting and the relay is to start when the current exceeds 1.1 times the setting.

The following requirements with regard to operating time tolerances are specified in the standard (E denotes accuracy in per cent, - = not specified):

I/I>	Normal inv.	Very inv.	Extremely inv.	Long-time inv.
2	2.22 E	2.34 E	2.44 E	2.34 E
5	1.13 E	1.26 E	1.48 E	1.26 E
7	-	-	-	1.00 E
10	1.01 E	1.01 E	1.02 E	-
20	1.00 E	1.00 E	1.00 E	-

In the defined normal current ranges, the inverse-time stage of the overcurrent and earth-fault unit SPCJ 4D24 complies with the tolerances of class 5 at all degrees of inversity.

The time/current characteristics specified in the BS-standards are illustrated in Fig. 3, 4, 5 and 6.

Note.
The actual operate time of the relay, presented in the graphs in Fig. 3…6, includes an additional filter and detection time plus the operate time of the trip output relay. When the operate time of the relay is calculated using the mathematical expression above, these additional times of about 30 ms in total have to be added to the time received.

RI-type characteristic

The RI-type characteristic is a special characteristic used mainly for time grading with existing mechanical relays. The characteristic is based on the following mathematical expression:

t [s] = k / (0.339 - 0.236 x I> / I)

where t = operating time in seconds
k = time multiplier
I = phase current
I> = set starting current

The graph of the characteristic is shown in Fig.7.

RXIDG-type characteristic

The RXIDG-type characteristic is a special characteristic used mainly for earth-fault protection where a high degree of selectivity is needed also for high-resistance faults. With this characteristic, the protection need not to be directional and the scheme can operate without a pilot communication.

The time / current characteristic can be expressed as:

t [s] = 5.8 - 1.35 x loge (I / (k x I>))

where t = operating in seconds
k = time multiplier
I = phase current
I> = set starting current

The graph of the characteristic is shown in Fig.8.

Note!
If the setting is higher than 2.5 x I_n, the maximum continuous carry (3 x I_n) and the levelling out of the IDMT-curves at high current levels must be noted.

Note!
The high-current end of any inverse time characteristic is determined by the high-set stage which, when started, inhibits the low-set stage operation. The trip time is thus equal to the set t>> for any current higher than I>>. In order to get a trip signal, the stage I>> must of course be linked to a trip output relay.

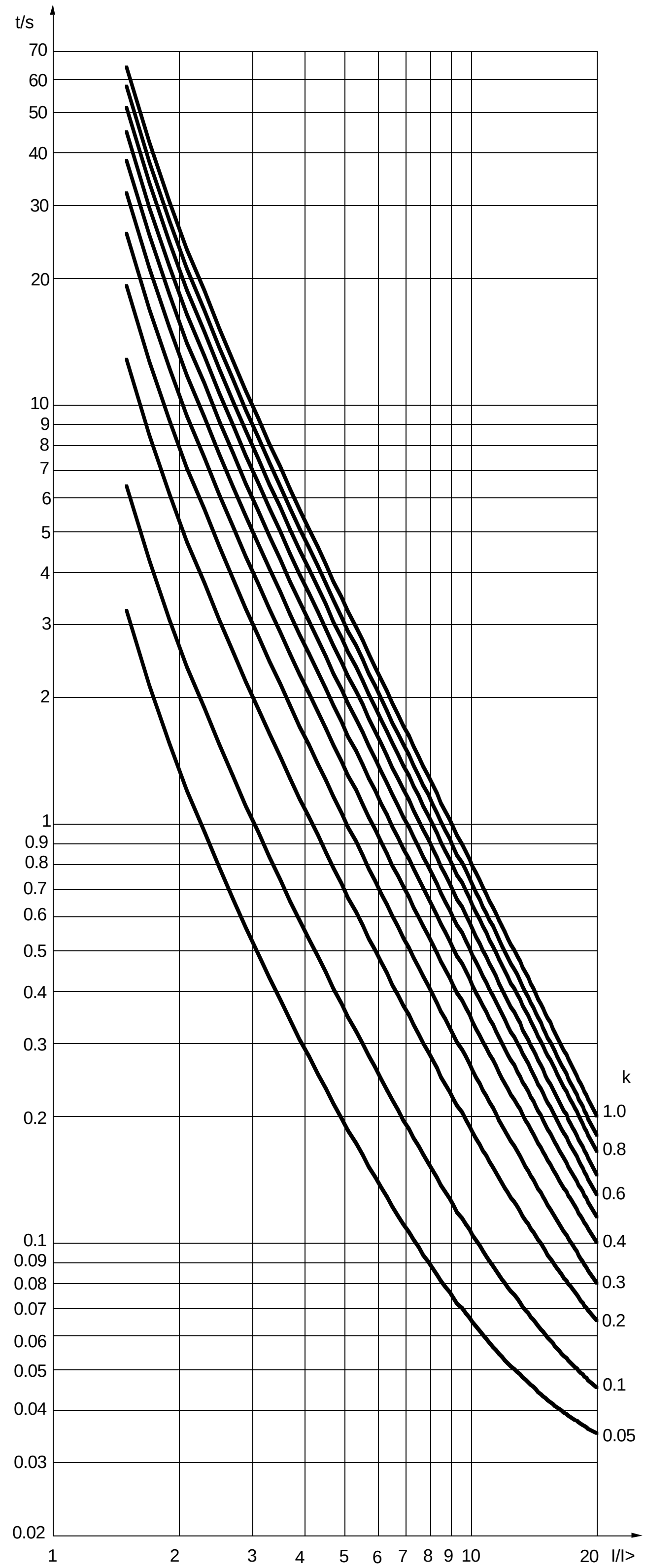


Fig. 3. Extremely inverse-time characteristics of the low-set overcurrent unit in relay module SPCJ 4D24

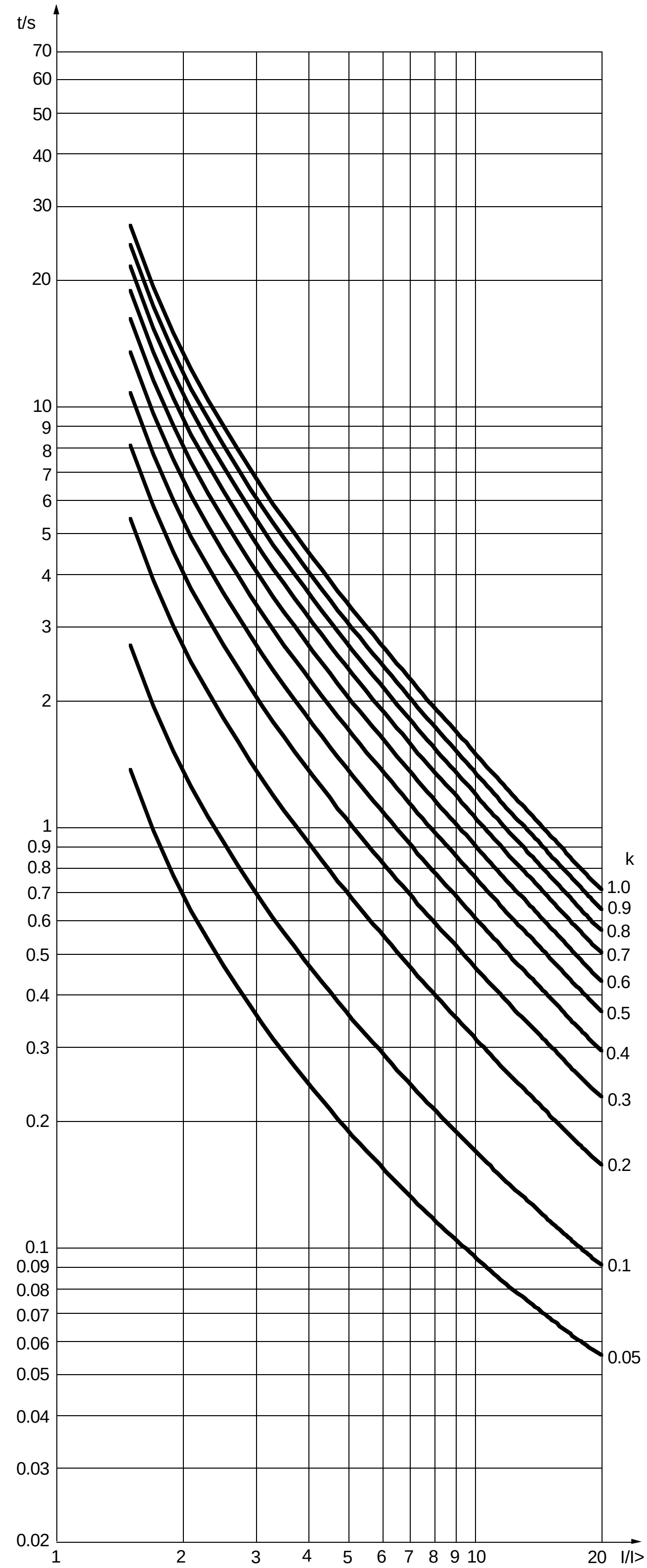


Fig. 4. Very inverse-time characteristics of the low-set overcurrent unit in relay module SPCJ 4D24

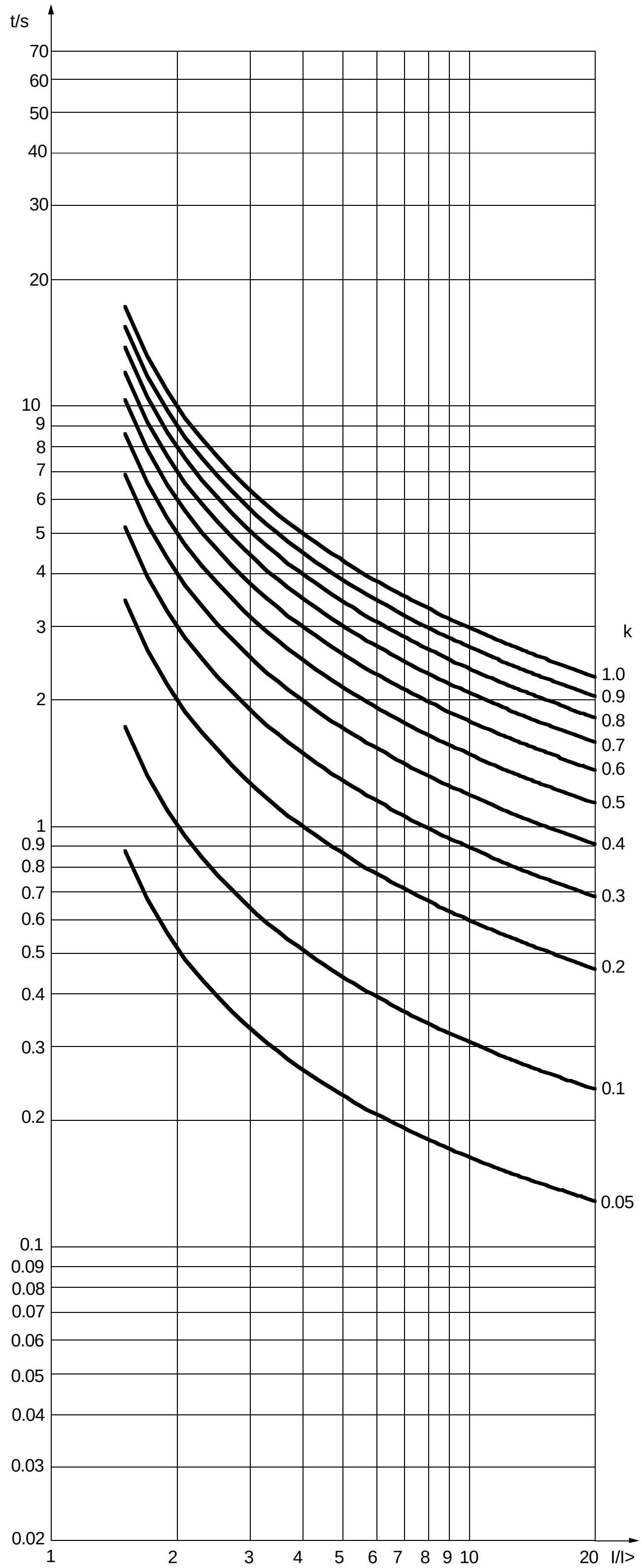


Fig. 5. Normal inverse-time characteristics of the low-set overcurrent unit in relay module SPCJ 4D24

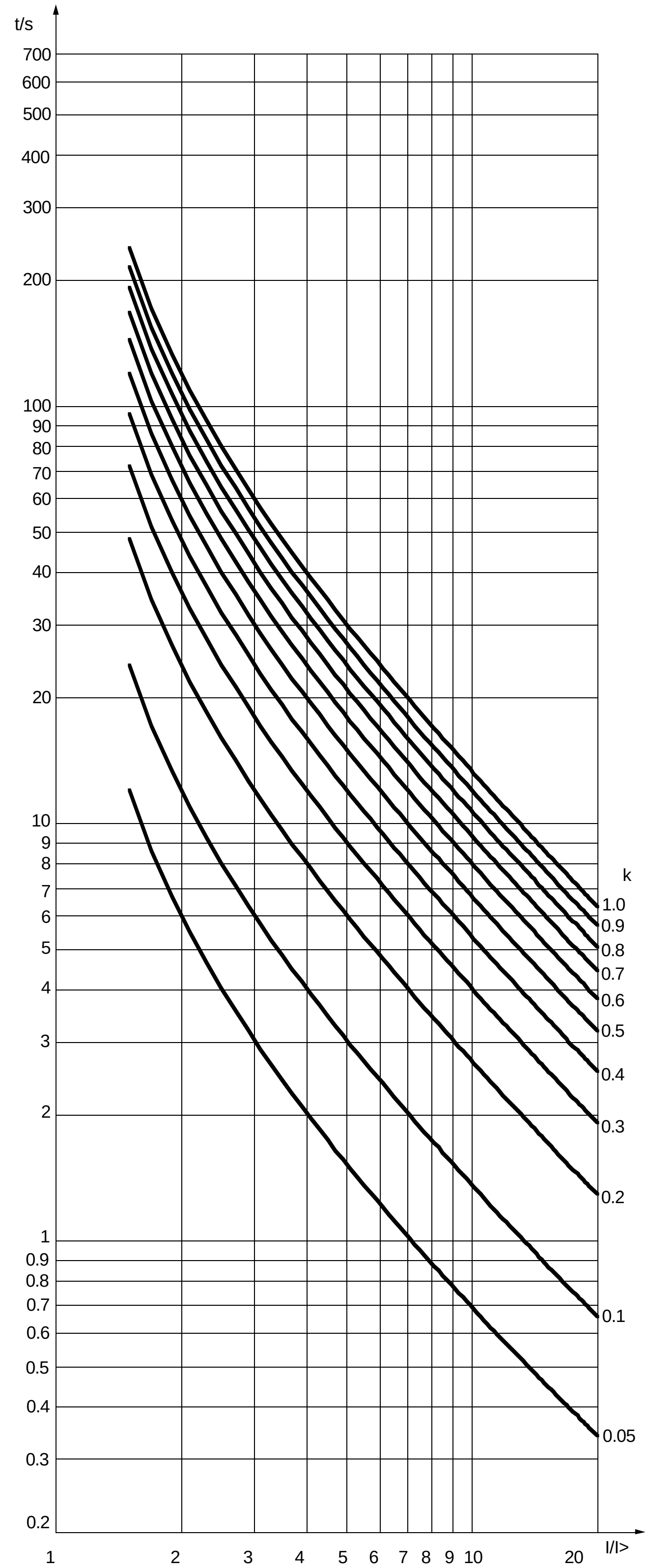


Fig. 6. Long-time inverse-time characteristics of the low-set overcurrent unit in relay module SPCJ 4D24

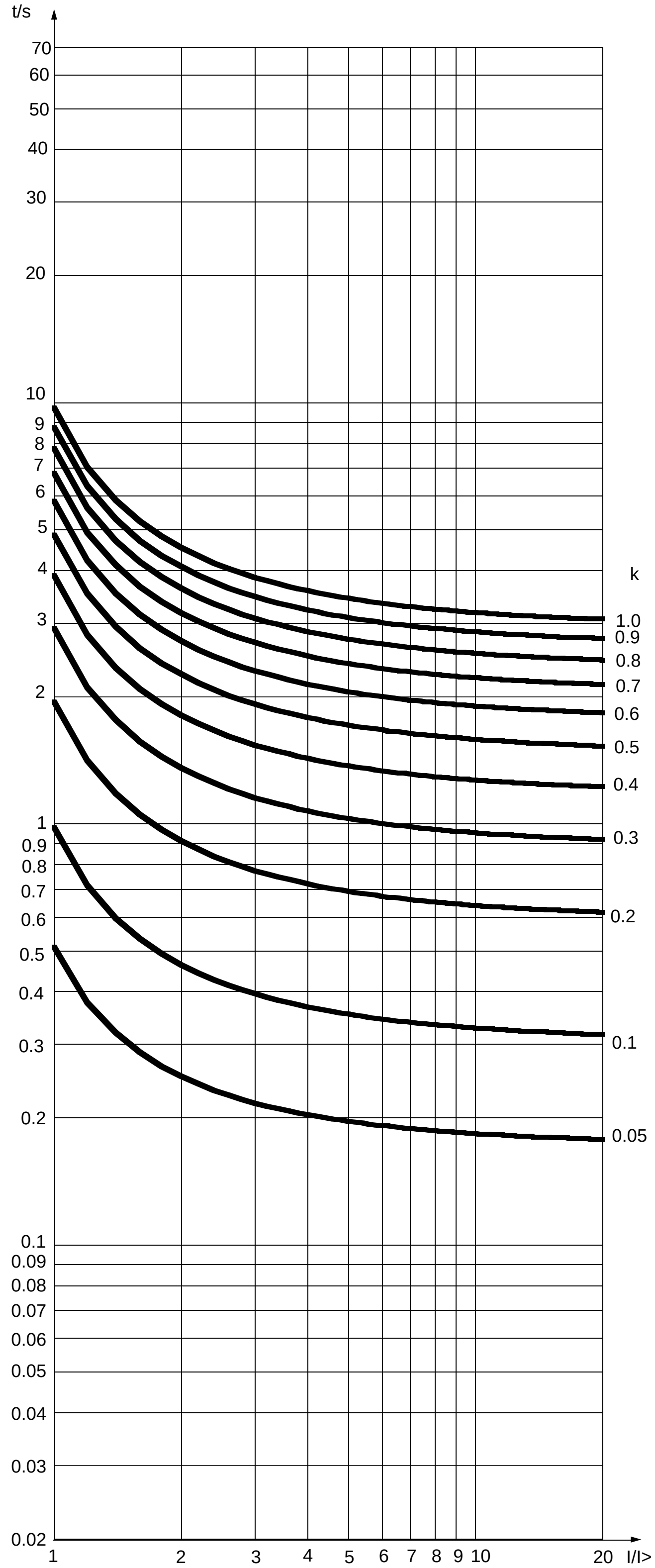


Fig. 7. RI-type inverse-time characteristics of the low-set overcurrent unit in relay module SPCJ 4D24

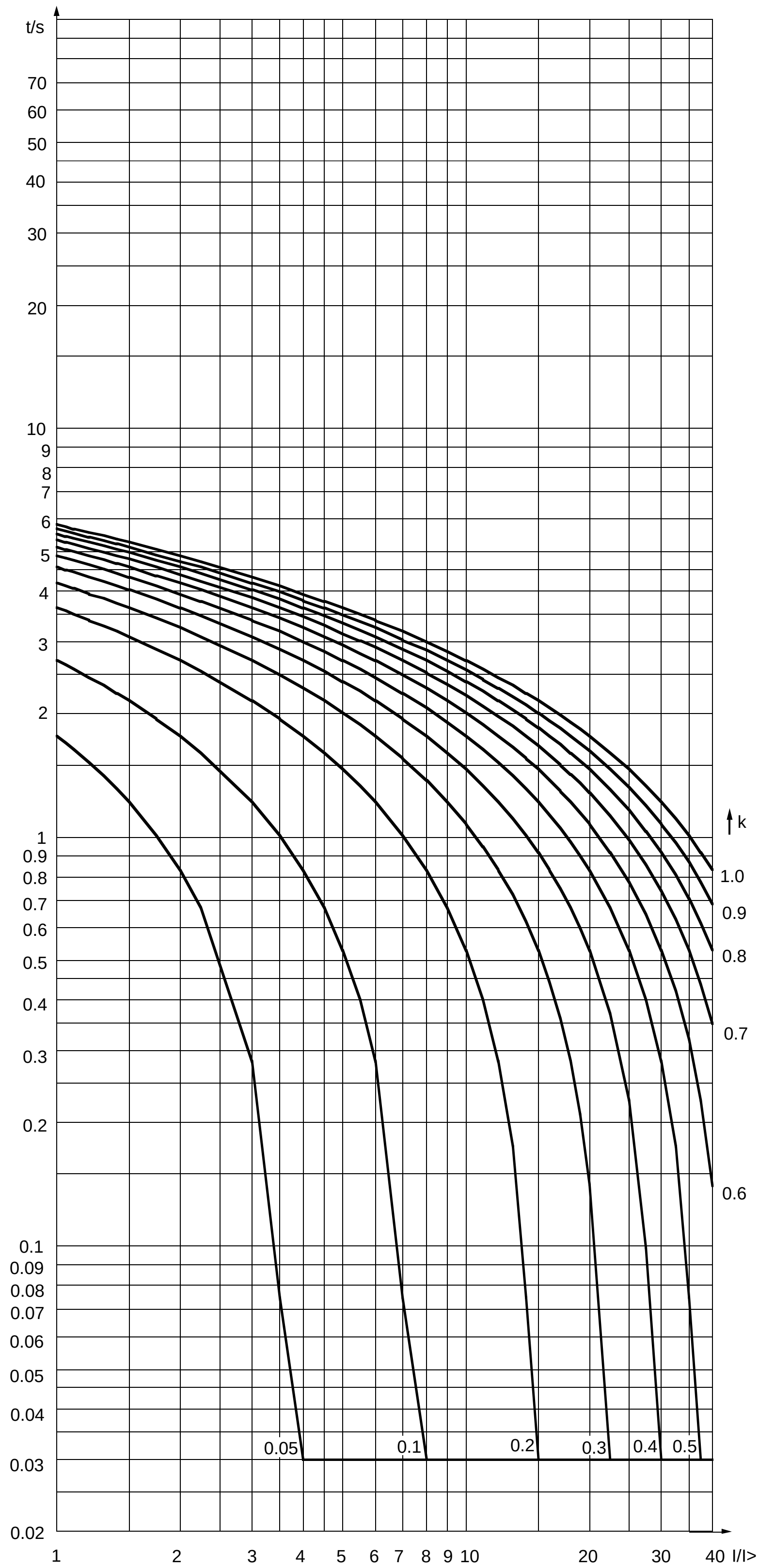


Fig. 8. RXIDG-type inverse-time characteristics of the low-set overcurrent unit in module SPCJ 4D24

Technical data

Low-set overcurrent stage I>

Setting range	
- at definite time	0.5…5.0 x I_n
- at inverse time	0.5…2.5 x I_n
Starting time	< 70 ms
Operating time at definite time mode of operation	0.05...300 s
Operating characteristics at IDMT mode of operation	Extremely inverse Very inverse Normal inverse Long-time inverse RI-type inverse RXIDG-type inverse
Time multiplier k	0.05...1.00
Resetting time	< 80 ms
Retardation time	30 ms
Drop-off/pick-up ratio, typically	0.96
Operation time accuracy at definite time mode of operation	± 2 % of set value or ± 25 ms
Operation time accuracy class E at inverse time mode of operation	5
Operation accuracy	± 3 % of set value

High-set overcurrent stage I>>

Setting range	0.5...40.0 x I_n or ∞, infinite
Starting time, typically	40 ms
Operating time	0.04...300 s
Resetting time	< 80 ms
Retardation time	30 ms
Drop-off/pick-up ratio, typically	0.96
Operation time accuracy	± 2 % of set value or ± 25 ms
Operation accuracy	± 3 % of set value

Low-set neutral overcurrent stage I_0>

Setting range	1.0...25.0 % I_n
Starting time	< 70 ms
Operation time	0.05...300 s
Resetting time	< 80 ms
Drop-off/pick-up ratio, typically	0.96
Operation time accuracy	± 2 % of set value or ± 25 ms
Operation accuracy	± 4 % of set value

High-set neutral overcurrent stage I_0>>

Setting range	2.0...200 % I_n or ∞, infinite
Starting time, typically	50 ms
Operation time	0.05...300 s
Resetting time	< 80 ms
Drop-off/pick-up ratio, typically	0.96
Operation time accuracy	± 2 % of set value or ± 25 ms
Operation accuracy	± 4 % of set value

Serial communication parameters

Event codes

When the overcurrent and earth-fault relay module SPCJ 4D24 is linked to the control data communicator SACO 148 D4 over a SPA bus, the module will provide spontaneous event markings e.g. to a printer. The events are printed out in the format: time, text which the user may have programmed into SACO 148 D4 and event code.

The codes E1...E16 and the events represented by these can be included in or excluded from the event reporting by writing an event mask V155 for the overcurrent events and V156 for earth-fault events to the module over the SPA bus. The event masks are binary numbers coded to decimal numbers. The event codes E1...E8 are represented by the numbers 1, 2, 4...128. An event mask is formed by multiplying the above numbers either by 0, event not included in reporting, or 1, event included in reporting and adding up the numbers received, compare the procedure used in calculation of a checksum.

The event masks V155 and V156 may have a value within range 0...255. The default value of the overcurrent and earth-fault relay module SPCJ 4D24 is 85 both for overcurrent and earth-fault events, which means that all startings and trippings are included in the reporting, but not the resetting.

The output signals are monitored by codes E17...E26 and the events represented by these can be included in or excluded from the event reporting by writing an event mask V157 to the module. The event mask is a binary number coded to a decimal number. The event codes E17...E26 are represented by the numbers 1, 2, 4...512. An event mask is formed by multiplying the above numbers either by 0, event not included in reporting or 1, event included in reporting and adding up the numbers received, compare the procedure used in calculation of a checksum.

The event mask V157 may have a value within the range 0...1024. The default value of the overcurrent and earth-fault relay module SPCJ 4D24 is 768 which means that only the operations of the trip relay are included in the reporting.

The codes E50...E54 and the events represented by these cannot be excluded from the reporting.

An event buffer is capable of memorizing up to eight events. If more than eight events occure before the content of the buffer is sent to the communicator an overflow event "E51" is generated. This event has to be reset by writing a command "0" to parameter C over the SPA-bus.

More information about the serial communication over the SPA-bus can be found in the manual "SPA-BUS COMMUNICATION PROTOCOL", 34 SPACOM 2 EN1.

Event codes of the combined overcurrent and earth-fault relay module SPCJ 4D24:

Code	Event	Weight factor	Default value of the factor
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 I>> stage	16	1
E6	Starting of I>> stage reset	32	0
E7	Tripping of stage I>>	64	1
E8	Tripping of stage I>> reset	128	0
	Default checksum for mask V155		85

Code	Event	Weight factor	Default value of the factor
E9	Starting of stage I_0>	1	1
E10	Starting of stage I_0> reset	2	0
E11	Tripping of stage I_0>	4	1
E12	Tripping of stage I_0> reset	8	0
E13	Starting of I_0>> stage	16	1
E14	Starting of I_0>>stage reset	32	0
E15	Tripping of stage I_0>>	64	1
E16	Tripping of stage I_0>> reset	128	0
	Default checksum for mask V156		85

E17	Output signal TS1 activated	1	0
E18	Output signal TS1 reset	2	0
E19	Output signal SS1 activated	4	0
E20	Output signal SS1 reset	8	0
E21	Output signal SS2 activated	16	0
E22	Output signal SS2 reset	32	0
E23	Output signal SS3 activated	64	0
E24	Output signal SS3 reset	128	0
E25	Output signal TS2 activated	256	1
E26	Output signal TS2 reset	512	1
	Default checksum for mask V157		768

E50	Restarting	*	-
E51	Overflow of event register	*	-
E52	Temporary interruption in data communication	*	-
E53	No response from the module over the data communication	*	-
E54	The module responds again over the data communication	*	-

0 not included in the event reporting
1 included in the event reporting
* no code number
- cannot be programmed

Note !
The event codes E52...E54 are only generated by the data communicator unit (SACO 100M, SRIO 1000M, etc.)

Data to be transferred over the serial bus

In addition to the spontaneous data transfer the SPA bus allows reading of all input data (I-data) of the module, setting values (S-values), information recorded in the memory (V-data), and some other data. Further, part of the data can be altered by commands given over the SPA bus.

All the data are available in channel 0.

R = data to be read from the unit
W = data to be written to the unit
(P) = writing enabled by a password

Data	Code	Data direction	Values
INPUTS			
Measured current on phase L1	I1	R	0...63 x I_n
Measured current on phase L2	I2	R	0...63 x I_n
Measured current on phase L3	I3	R	0...63 x I_n
Measured neutral current	I4	R	0...210 % I_n
Blocking or control signal	I5	R	0 = no blocking 1 = external blocking or control signal active
OUTPUTS			
Starting of stage I>	O1	R	0 = I> stage not started 1 = I> stage started
Tripping of stage I>	O2	R	0 = I> stage not tripped 1 = I> stage tripped
Starting of stage I>>	O3	R	0 = I>> stage not started 1 = I>> stage started
Tripping of stage I>>	O4	R	0 = I>> stage not tripped 1 = I>> stage tripped
Starting of stage I_0>	O5	R	0 = I_0> stage not started 1 = I_0> stage started
Tripping of stage I_0>	O6	R	0 = I_0> stage not tripped 1 = I_0> stage tripped
Starting of stage I_0>> started	O7	R	0 = I_0>> stage not 1 = I_0>> stage started
Tripping of stage I_0>> tripped	O8	R	0 = I_0>> stage not 1 = I_0>> stage tripped
Signal START1 TS1	O9	R, W (P)	0 = signal not active 1 = signal active
Signal START2 SS1	O10	R, W (P)	0 = signal not active 1 = signal active
Signal ALARM1 SS2	O11	R, W (P)	0 = signal not active 1 = signal active
Signal ALARM2 SS3	O12	R, W (P)	0 = signal not active 1 = signal active
Signal TRIP TS2	O13	R, W (P)	0 = signal not active 1 = signal active
Operate output relays	O41	R, W (P)	0 = not operated 1 = operated

Data	Code	Data direction	Values
Memorized I> start	O21	R	0 = signal not active 1 = signal active
Memorized I> trip	O22	R	0 = signal not active 1 = signal active
Memorized I>> start	O23	R	0 = signal not active 1 = signal active
Memorized I>> trip	O24	R	0 = signal not active 1 = signal active
Memorized I_0> start	O25	R	0 = signal not active 1 = signal active
Memorized I_0> trip	O26	R	0 = signal not active 1 = signal active
Memorized I_0>> start	O27	R	0 = signal not active 1 = signal active
Memorized I_0>> trip	O28	R	0 = signal not active 1 = signal active
Memorized output signal TS1	O29	R	0 = signal not active 1 = signal active
Memorized output signal SS1	O30	R	0 = signal not active 1 = signal active
Memorized output signal SS2	O31	R	0 = signal not active 1 = signal active
Memorized output signal SS3	O32	R	0 = signal not active 1 = signal active
Memorized output signal TS2	O33	R	0 = signal not active 1 = signal active

PRESENT SETTING VALUES

Present starting value for stage I>	S1	R	0.5...5.0 x I_n
Present operating time for stage I>	S2	R	0.05...300 s
Present starting value for stage I>>	S3	R	0.5...40 x I_n 999 = not in use (∞)
Present operating time for stage I>>	S4	R	0.04...300 s
Present starting value for stage I_0>	S5	R	1.0...25.0 % I_n
Present operating time for stage I_0>	S6	R	0.05...300 s
Present starting value for stage I_0>>	S7	R	2...200 % I_n 999 = not in use (∞)
Present operating time for stage I_0>>	S8	R	0.05...300 s
Present checksum of switchgroup SGF1	S9	R	0...255
Present checksum of switchgroup SGF2	S10	R	0...255
Present checksum of switchgroup SGB	S11	R	0...255
Present checksum of switchgroup SGR1	S12	R	0...255
Present checksum of switchgroup SGR2	S13	R	0...255
Present checksum of switchgroup SGR3	S14	R	0...255

Data	Code	Data direction	Values
MAIN SETTING VALUES			
Starting value for I> stage, main setting	S21	R, W (P)	0.5...5.0 x I_n
Operating time for I> stage, main setting	S22	R, W (P)	0.05...300 s
Starting value for I>> stage, main setting	S23	R, W (P)	0.5...40.0 x I_n
Operating time for I>> stage, main setting	S24	R, W (P)	0.04...300 s
Starting value for I_0> stage, main setting	S25	R, W (P)	1.0...25.0 % I_n
Operating time for I_0> stage, main setting	S26	R, W (P)	0.05...300 s
Starting value for I_0>> stage, main setting	S27	R, W (P)	2...200 % I_n
Operating time for I_0>> stage, main setting	S28	R, W (P)	0.05...300 s
Checksum of group SGF1, main setting	S29	R, W (P)	0...255
Checksum of group SGF2, main setting	S30	R, W (P)	0...255
Checksum of group SGB, main setting	S31	R, W (P)	0...255
Checksum of group SGR1, main setting	S32	R, W (P)	0...255
Checksum of group SGR2, main setting	S33	R, W (P)	0...255
Checksum of group SGR3, main setting	S34	R, W (P)	0...255
SECOND SETTING VALUES			
Starting value for I> stage, second setting	S41	R, W (P)	0.5...5.0 x I_n
Operating time for I> stage, second setting	S42	R, W (P)	0.05...300 s
Starting value for I>> stage, second setting	S43	R, W (P)	0.5...40.0 x I_n
Operating time for I>> stage, second setting	S44	R, W (P)	0.04...300 s
Starting value for I_0> stage, second setting	S45	R, W (P)	1.0...25.0 % I_n
Operating time for I_0> stage, second setting	S46	R, W (P)	0.05...300 s
Starting value for I_0>> stage, second setting	S47	R, W (P)	2...200 % I_n
Operating time for I_0>> stage, second setting	S48	R, W (P)	0.05...300 s
Checksum of group SGF1, second setting	S49	R, W (P)	0...255
Checksum of group SGF2, second setting	S50	R, W (P)	0...255
Checksum of group SGB, second setting	S51	R, W (P)	0...255
Checksum of group SGR1, second setting	S52	R, W (P)	0...255
Checksum of group SGR2, second setting	S53	R, W (P)	0...255
Checksum of group SGR3, second setting	S54	R, W (P)	0...255
Operation time for circuit breaker failure prot.	S61	R, W (P)	0.1...1.0 s

Data	Code	Data direction	Values
RECORDED AND MEMORIZED PARAMETERS			
Current in phase L1 at starting or tripping	V11...V51	R	0...63 x I_n
Current in phase L2 at starting or tripping	V12...V52	R	0...63 x I_n
Current in phase L3 at starting or tripping	V13...V53	R	0...63 x I_n
Netral current Io at starting or tripping	V14...V54	R	0...210 % I_n
Duration of the latest starting situation of stage I>	V15...V55	R	0...100%
Duration of the latest starting situation of stage I>>	V16...V56	R	0...100%
Duration of the latest starting situation of stage I_0>	V17...V57	R	0...100%
Duration of the latest starting situation of stage I_0>>	V18...V58	R	0...100%
Maximum demand current for 15 min.	V1	R	0...2.5 x I_n
Number of startings of stage I>	V2	R	0...255
Number of startings of stage I>>	V3	R	0...255
Number of startings of stage I_0>	V4	R	0...255
Number of startings of stage I_0>>	V5	R	0...255
Phase conditions during trip	V6	R	1 = I_{L3}>, 2 = I_{L2}>, 4 = I_{L1}>, 8 = I_0> 16 = I_{L3}>>, 32 = I_{L2}>> 64 = I_{L1}>>,128 = I_0>>
Operation indicator	V7	R	0...9
Highest maximum demand current 15 minute value	V8	R	0…2.55 x I_n
CONTROL PARAMETERS			
Resetting of output relays at self-holding	V101	W	1 = output relays and all information from the display are reset
Resetting of output relays and recorded data	V102	W	1 = output relays and registers are reset
Remote control of settings	V150	R, W	0 = main settings activated 1 = second settings activated, see section "Description of function"
Event mask word for overcurrent events	V155	R, W	0...255, see section "Event codes"
Event mask word for earth-fault events	V156	R, W	0...255, see section "Event codes"
Event mask word for output signal events	V157	R, W	0...1023, see section "Event codes"
Opening of password for remote settings	V160	W	1...999
Changing or closing of password for remote settings	V161	W (P)	0...999

Data	Code	Data direction	Values
Activating of self-supervision output	V165	W	1 = self-supervision output is activated and IRF LED turned on 0 = normal mode
EEPROM formatting	V167	W (P)	2 = formatted with a power reset for a fault code [53]
Internal error code	V 169	R	0...255
Data comm. address of the module	V200	R, W	1...254
Data transfer rate	V201	R, W	4,8 or 9,6 kBd (W) 4800 or 9600 Bd (R)
Programme version symbol	V205	R	042 _
Event register reading	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	SPCJ 4D24
Reading of module status data	C	R	0 = normal state 1 = module been subject to automatic reset 2 = overflow of event regist. 3 = events 1 and 2 together
Resetting of module state data	C	W	0 = resetting
Time reading and setting	T	R, W	00.000...59.999 s

The event register can be read by L-command only once. Should a fault occur e.g. in the data transfer, the contents of the event register may be re-read using the B-command. When required, the B-command can be repeated. Generally, the control data communicator SACO 100M reads the event data and forwards them to the output device continuously. Under normal conditions the event register of the module is empty. In the same way the data communicator resets abnormal status data, so this data is normally a zero.

The setting values S1...S14 are the setting values used by the protection functions. These values are set either as the main settings and switchgroup checksums S21...S34 or as the corresponding second settings S41...S54. All the settings can be read or written. A condition for writing is that remote set password has been opened.

When changing settings, the relay unit will check that the variable values are within the ranges specified in the technical data of the module. If a value beyond the limits is given to the unit, either manually or by remote setting, the unit will not perform the store operation but will keep the previous setting.

Fault codes

A short time after the internal self-supervision system has detected a permanent relay fault the red IRF indicator is lit and the output relay of the self-supervision system operates. Further, in most fault situations, an auto-diagnostic fault code is shown on the display. This fault code consists of a red figure 1 and a green code number which indicates the fault type. When a fault code appears on the display, the code number should be recorded and given to the authorized repair shop when overhaul is ordered. In the table below some fault codes that might appear on the display of the SPCJ 4D24 module are listed:

Fault code	Type of error in module
4	Faulty trip relay path or missing output relay card
30	Faulty program memory (ROM)
50	Faulty work memory (RAM)
51	Parameter memory (EEPROM) block 1 faulty
52	Parameter memory (EEPROM) block 2 faulty
53	Parameter memory (EEPROM) block 1 and block 2 faulty
54	Parameter memory (EEPROM) block 1 and block 2 faulty with different checksums
56	Parameter memory (EEPROM) key faulty. Format by writing a "2" to variable V167
195	Too low value in reference channel with multiplier 1
131	Too low value in reference channel with multiplier 5
67	Too low value in reference channel with multiplier 25
203	Too high value in reference channel with multiplier 1
139	Too high value in reference channel with multiplier 5
75	Too high value in reference channel with multiplier 25
252	Faulty filter on Io channel
253	No interruptions from the A/D-converter

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