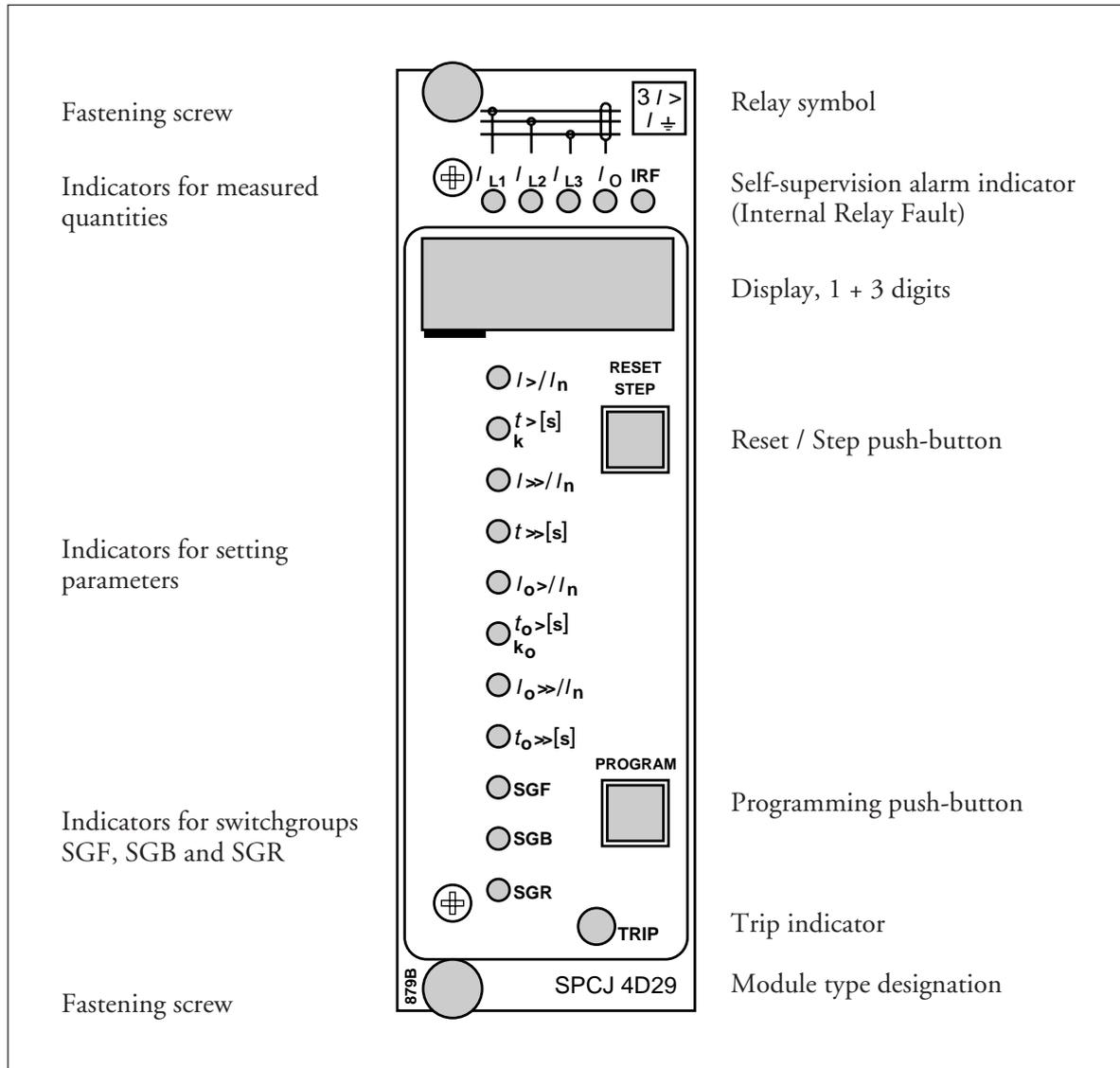


# General characteristics of D-type relay modules

## User's manual and Technical description



# General characteristics of D type relay modules

Data subject to change without notice

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## Contents

Front panel lay-out .....	1
Control push buttons .....	3
Display .....	3
Display main menu .....	3
Display submenus .....	3
Selector switchgroups SGF, SGB, SGR .....	4
Settings .....	4
Setting mode .....	4
Example 1: Setting of relay operation values .....	7
Example 2: Setting of relay switchgroups .....	9
Recorded information .....	11
Trip test function .....	12
Example 3: Forced activation of outputs .....	13
Operation indicators .....	15
Fault codes .....	15

<b>Control push-buttons</b>	<p>The front panel of the relay module contains two push buttons. The RESET / STEP push button is used for resetting operation indicators and for stepping forward or backward in the display main menu or submenus. The PROGRAM push button is used for moving from a</p>	<p>certain position in the main menu to the corresponding submenu, for entering the setting mode of a certain parameter and together with the STEP push button for storing the set values. The different operations are described in the subsequent paragraphs in this manual.</p>
<b>Display</b>	<p>The measured and set values and the recorded data are shown on the display of the protection relay module. The display consists of four digits. The three green digits to the right show the measured, set or recorded value and the leftmost red digit shows the code number of the register. The measured or set value displayed is indicated by the adjacent yellow LED indicator on the front panel. When a recorded fault value is being displayed the red digit shows the number of the corresponding register. When the display functions as an operation indicator the red digit alone is shown.</p>	<p>When the auxiliary voltage of a protection relay module is switched on the module initially tests the display by stepping through all the segments of the display for about 15 seconds. At first the corresponding segments of all digits are lit one by one clockwise, including the decimal points. Then the center segment of each digit is lit one by one. The complete sequence is carried out twice. When the test is finished the display turns dark. The testing can be interrupted by pressing the STEP push button. The protection functions of the relay module are alerted throughout the testing.</p>
<b>Display main menu</b>	<p>Any data required during normal operation are accessible in the main menu i.e. present measured values, present setting values and recorded parameter values.</p> <p>The data to be shown in the main menu are sequentially called up for display by means of the STEP push button. When the STEP push button is pressed for about one second, the display moves forward in the display sequence. When the push button is pressed for about 0.5 seconds, the display moves backward in the display sequence.</p>	<p>From a dark display only forward movement is possible. When the STEP push button is pushed constantly, the display continuously moves forward stopping for a while in the dark position.</p> <p>Unless the display is switched off by stepping to the dark point, it remains lit for about 5 minutes from the moment the STEP push button was last pushed. After the 5 minutes' time-out the display is switched off.</p>
<b>Display submenus</b>	<p>Less important values and values not very often set are displayed in the submenus. The number of submenus varies with different relay module types. The submenus are presented in the description of the concerned protection relay module.</p> <p>A submenu is entered from the main menu by pressing the PROGRAM push button for about one second. When the push button is released, the red digit of the display starts flashing, indicating that a submenu has been entered. Going from one submenu to another or back to the main menu follows the same principle as when moving from the main menu display to another;</p>	<p>the display moves forward when the STEP push button is pushed for one second and backward when it is pushed for 0.5 seconds. The main menu has been re-entered when the red display turns dark.</p> <p>When a submenu is entered from a main menu of a measured or set value indicated by a LED indicator, the indicator remains lit and the address window of the display starts flashing. A submenu position is indicated by a flashing red address number alone on the display without any lit set value LED indicator on the front panel.</p>

## Selector switch-groups SGF, SGB and SGR

Part of the settings and the selections of the operation characteristic of the relay modules in various applications are made with the selector switchgroups SG\_. The switchgroups are software based and thus not physically to be found in the hardware of the relay module. The indicator of the switchgroup is lit when the checksum of the switchgroup is shown on the display. Starting from the displayed checksum and by entering the setting mode, the switches can be set one by one as if they were real physical switches. At the end of the setting procedure, a checksum for the whole switchgroup is shown. The checksum can be used for verifying that the switches have been properly set. Fig. 2 shows an example of a manual checksum calculation.

When the checksum calculated according to the example equals the checksum indicated on the display of the relay module, the switches in the concerned switchgroup are properly set.

Switch No	Pos.		Weight	Value
1	1	x	1	= 1
2	0	x	2	= 0
3	1	x	4	= 4
4	1	x	8	= 8
5	1	x	16	= 16
6	0	x	32	= 0
7	1	x	64	= 64
8	0	x	128	= 0
Checksum			$\Sigma$	= 93

Fig. 2. Example of calculating the checksum of a selector switchgroup SG\_.

The functions of the selector switches of the different protection relay modules are described in detail in the manuals of the different relay modules.

## Settings

Most of the start values and operate times are set by means of the display and the push buttons on the front panel of the relay modules. Each setting has its related indicator which is lit when the concerned setting value is shown on the display.

In addition to the main stack of setting values most D type relay modules allow a second stack of settings. Switching between the main settings

and the second settings can be done in three different ways:

- 1) By command V150 over the serial communication bus
- 2) By an external control signal BS1, BS2 or RRES (BS3)
- 3) Via the push-buttons of the relay module, see submenu 4 of register A.

## Setting mode

Generally, when a large number of settings is to be altered, e.g. during commissioning of relay systems, it is recommended that the relay settings are entered with the keyboard of a personal computer provided with the necessary software. When no computer nor software is available or when only a few setting values need to be altered the procedure described below is used.

The registers of the main menu and the submenus contain all parameters that can be set. The settings are made in the so called setting mode, which is accessible from the main menu or a submenu by pressing the PROGRAM push button, until the whole display starts flashing. This position indicates the value of the parameter before it has been altered. By pressing the PROGRAM push button the programming sequence moves forward one step. First the rightmost digit starts flashing while the rest of the display is steady. The flashing digit is set by means of the STEP push button. The flashing

cursor is moved on from digit to digit by pressing the PROGRAM push button and in each stop the setting is performed with the STEP push button. After the parameter values have been set, the decimal point is put in place. At the end the position with the whole display flashing is reached again and the data is ready to be stored.

A set value is recorded in the memory by pressing the push buttons STEP and PROGRAM simultaneously. Until the new value has been recorded a return from the setting mode will have no effect on the setting and the former value will still be valid. Furthermore *any attempt to make a setting outside the permitted limits for a particular parameter will cause the new value to be disqualified and the former value will be maintained.* Return from the setting mode to the main menu or a submenu is possible by pressing the PROGRAM push button until the green digits on the display stop flashing.

NOTE! During any local man-machine communication over the push buttons and the display on the front panel a five minute time-out function is active. Thus, if no push button has been pressed during the last five minutes, the relay returns to its normal state automatically. This means that the display turns dark, the relay escapes from a display mode, a programming routine or any routine going on, when the relay is left untouched. This is a convenient way out of any situation when the user does not know what to do.

Before a relay module is inserted into the relay case, one must assure that the module has been given the correct settings. If there however is

any doubt about the settings of the module to be inserted, the setting values should be read using a spare relay unit or with the relay trip circuits disconnected. If this cannot be done the relay can be set into a non-tripping mode by pressing the PROGRAM push button and powering up the relay module simultaneously. The display will show three dashes "---" to indicate the non-tripping mode. The serial communication is operative and all main and submenus are accessible. In the non-tripping mode unnecessary trippings are avoided and the settings can be checked. *The normal protection relay mode is entered automatically after a timeout of five minutes or ten seconds after the dark display position of the main menu has been entered.*

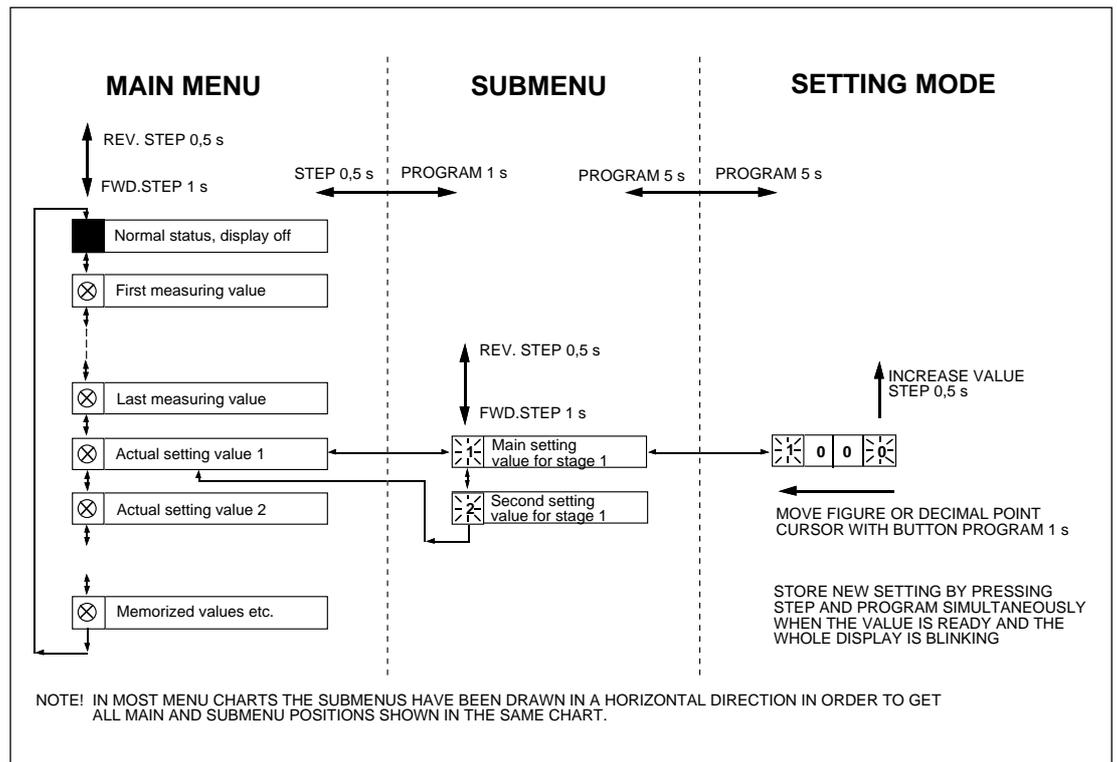


Fig.3. Basic principles of entering the main menus and submenus of a relay module.

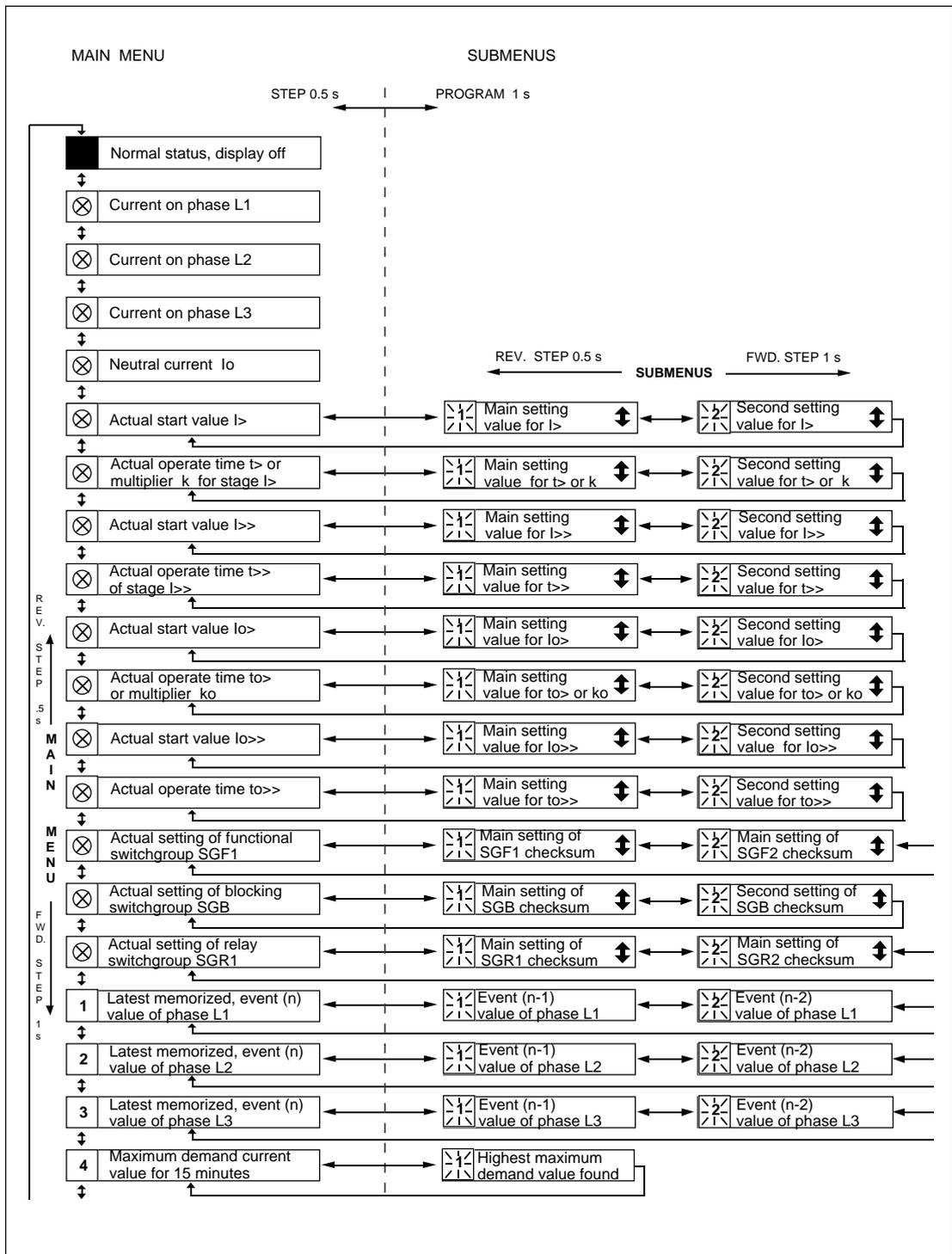


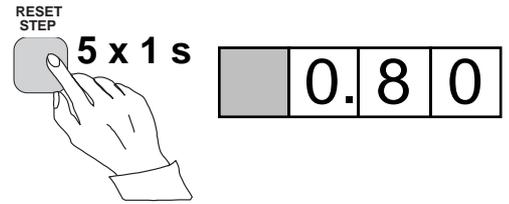
Fig. 4. Example of part of the main and submenus for the settings of the overcurrent and earth-fault relay module SPCJ 4D29. The settings currently in use are in the main menu and they are displayed by pressing the STEP push button. The main menu also includes the measured current values, the registers 1...9, 0 and A. The main and second setting values are located in the submenus and are called up on the display with the PROGRAM push button.

Example 1

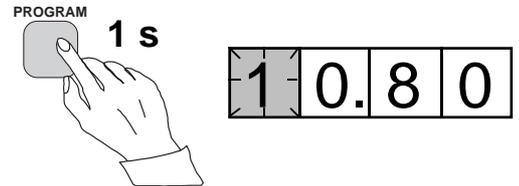
Operation in the setting mode. Manual setting of the main setting of the start current value  $I>$  of an overcurrent relay module. The initial value

for the main setting is  $0.80 \times I_n$  and for the second setting  $1.00 \times I_n$ . The desired main start value is  $1.05 \times I_n$ .

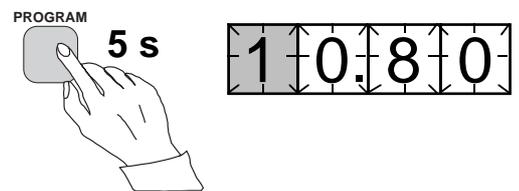
a) Press push button STEP repeatedly until the LED close to the  $I>$  symbol is lit and the current start value appears on the display.



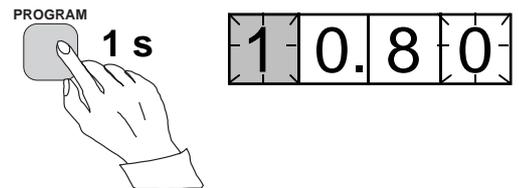
b) Enter the submenu to get the main setting value by pressing the PROGRAM push button more than one second and then releasing it. The red display digit now shows a flashing number 1, indicating the first submenu position and the green digits show the set value.



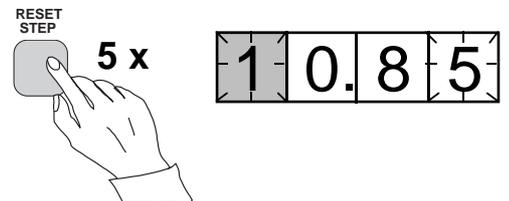
c) Enter the setting mode by pressing the PROGRAM push button for five seconds until the display starts flashing.



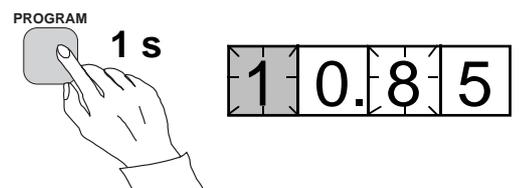
d) Press the PROGRAM push button once again for one second to get the rightmost digit flashing.



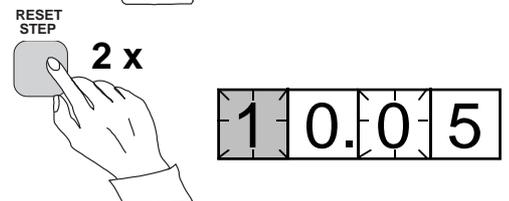
e) Now the flashing digit can be altered. Use the STEP push button to set the digit to the desired value.



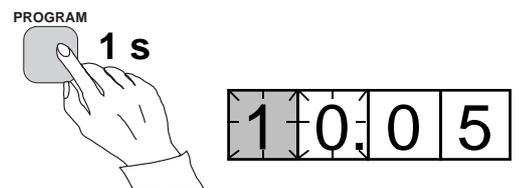
f) Press the PROGRAM push button to make the middle one of the green digits flash.



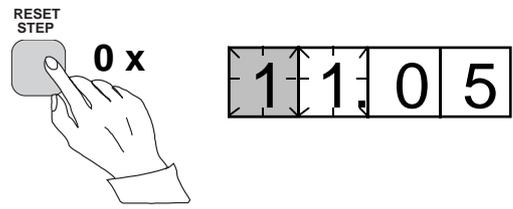
g) Set the middle digit with of the STEP push button.



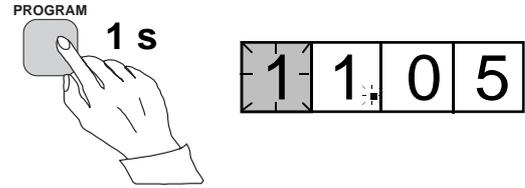
h) Press the PROGRAM push button to make the leftmost green digit flash.



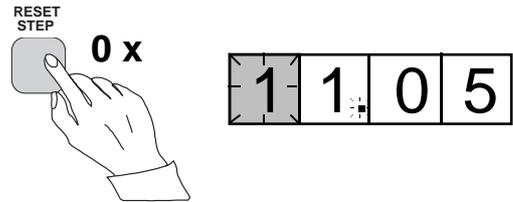
i) Set the digit with the STEP push button.



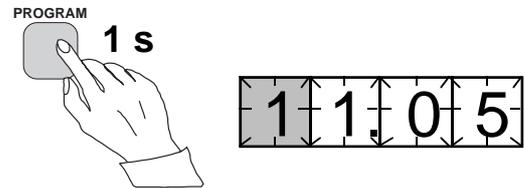
j) Press the PROGRAM push button to make the decimal point flash.



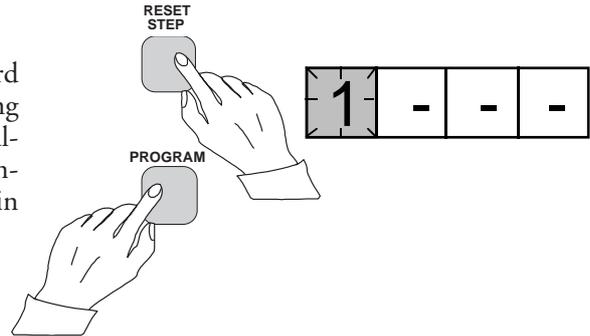
k) If needed, move the decimal point with the STEP push button.



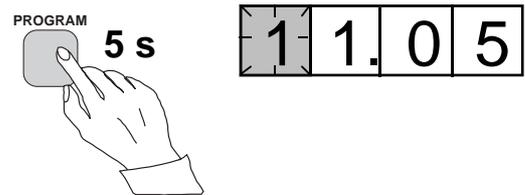
l) Press the PROGRAM push button to make the whole display flash. In this position, corresponding to position c) above, one can see the new value before it is recorded. If the value needs changing, use the PROGRAM push button to alter the value.



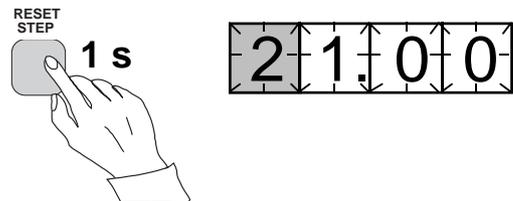
m) When the new value has been corrected, record it in the memory of the relay module by pressing the PROGRAM and STEP push buttons simultaneously. At the moment the information enters the memory, the green dashes flash once in the display, i.e. 1 - - -.



n) Recording of the new value automatically initiates a return from the setting mode to the normal submenu. Without recording one can leave the setting mode any time by pressing the PROGRAM push button for about five seconds, until the green display digits stop flashing.



o) If the second setting is to be altered, enter submenu position 2 of the setting I> by pressing the STEP push button for approx. one second. The flashing position indicator 1 will then be replaced by a flashing number 2 which indicates that the setting shown on the display is the second setting for I>.



Enter the setting mode as in step c) and proceed in the same way. After recording of the requested values return to the main menu is obtained by pressing the STEP push button

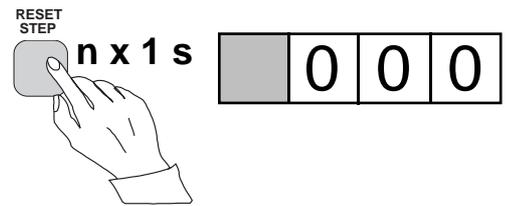
until the first digit is switched off. The LED still shows that one is in the I> position and the display shows the new setting value currently in use by the relay module.

Example 2

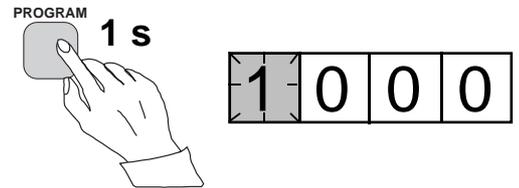
Operation in the setting mode. Manual setting of the main setting of the checksum for the switchgroup SGF1 of a relay module. The initial value for the checksum is 000 and the switches

SGF1/1and SGF1/3 are to be set in position 1. This means that a checksum of 005 should be the final result.

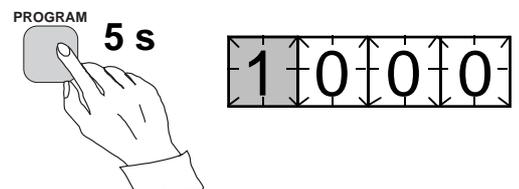
a) Press push button STEP until the LED close to the SGF symbol is lit and the checksum appears on the display.



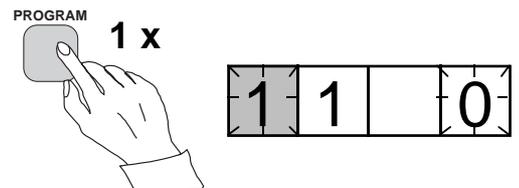
b) Enter the submenu to get the main checksum of SGF1 by pressing the PROGRAM push button for more than one second and then releasing it. The red display now shows a flashing number 1 indicating the first submenu position and the green digits show the checksum.



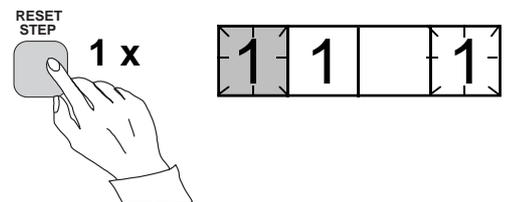
c) Enter the setting mode by pressing the PROGRAM push button for five seconds until the display starts flashing.



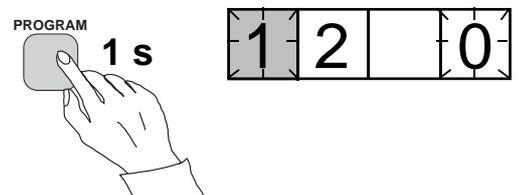
d) Press the PROGRAM push button once again to get the first switch position. The first digit of the display now shows the switch number. The position of the switch is shown by the rightmost digit.



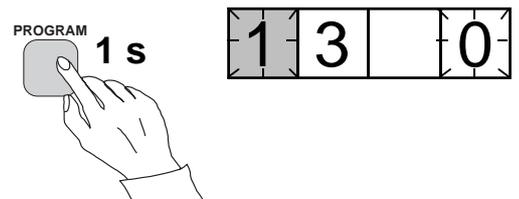
e) The switch position can now be toggled between 1 and 0 by means of the STEP push button and it is left in the requested position 1.



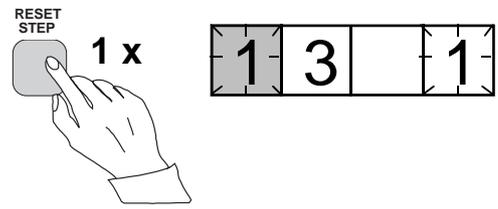
f) When switch number 1 is in the requested position, switch number 2 is called up by pressing the PROGRAM push button for one second. As in step e), the switch position can be altered by using the STEP push button. As the desired setting for SGF1/2 is 0 the switch is left in the 0 position.



g) Switch SGF1/3 is called up as in step f) by pressing the PROGRAM push button for about one second.



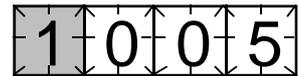
h)  
The switch position is altered to the desired position 1 by pressing the STEP push button once.



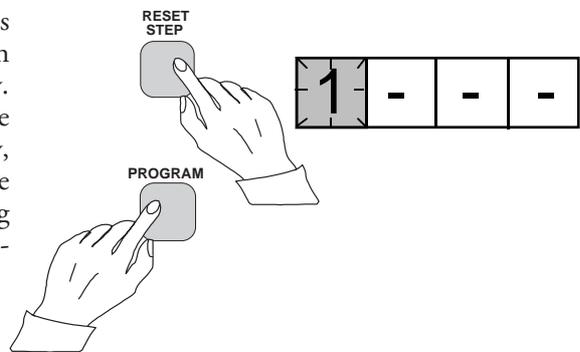
i)  
Using the same procedure the switches SGF 1/4...8 are called up and, according to the example, left in position 0.



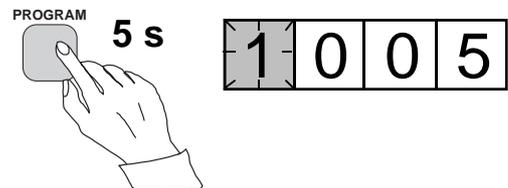
j)  
In the final setting mode position, corresponding to step c), the checksum based on the set switch positions is shown.



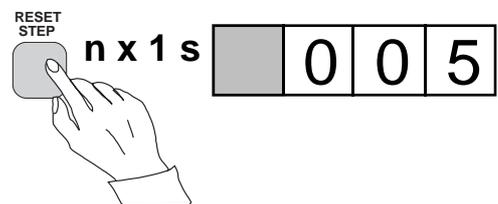
k)  
If the correct checksum has been obtained, it is recorded in the memory by pressing the push buttons PROGRAM and STEP simultaneously. At the moment the information enters the memory, the green dashes flash in the display, i.e. 1 - - -. If the checksum is incorrect, the setting of the separate switches is repeated using the PROGRAM and STEP push buttons starting from step d).



l)  
Recording the new value automatically initiates a return from the setting mode to the normal menu. Without recording one can leave the setting mode any time by pressing the PROGRAM push button for about five seconds, until the green display digits stop flashing.



m)  
After recording the desired values return to the main menu is obtained by pressing the STEP push button until the first digit is turned off. The LED indicator SGF still shows that one is in the SGF position and that the display shows the new checksum for SGF1 currently in use by the relay module.



## Recorded information

The parameter values measured at the moment when a fault occurs or at the trip instant are recorded in the registers. The recorded data, except for some parameters, are set to zero by pressing the push buttons STEP and PROGRAM simultaneously. The data in normal registers are erased if the auxiliary voltage supply to the relay is interrupted, only the set values and certain other essential parameters are maintained in non-volatile registers during a voltage failure.

The number of registers varies with different relay module types. The functions of the registers are illustrated in the descriptions of the different relay modules. Additionally, the system front panel of the relay contains a simplified list of the data recorded by the various relay modules of the protection relay.

All D type relay modules are provided with two general registers: register 0 and register A.

Register 0 contains, in coded form, the information about e.g. external blocking signals, status information and other signals. The codes are explained in the manuals of the different relay modules.

Register A contains the address code of the relay modul which is required by the serial communication system.

Submenu 1 of register A contains the data transfer rate value, expressed in kilobaud, of the serial communication.

Submenu 2 of register A contains a bus communication monitor for the SPAbus. If the protection relay, which contains the relay module, is linked to a system including a control data communicatoe, for instance SRIO 1000M and the data communication system is operating, the counter reading of the monitor will be zero. Otherwise the digits 1...255 are continuously scrolling in the monitor.

Submenu 3 contains the password required for changing the remote settings. The address code, the data transfer rate of the serial communication and the password can be set manually or via the serial communication bus. For manual setting see example 1.

The default value is 001 for the address code, 9.6 kilobaud for the data transfer rate and 001 for the password.

In order to secure the setting values, all settings are recorded in two separate memory banks within the non-volatile memory. Each bank is complete with its own checksum test to verify the condition of the memory contents. If, for some reason, the contents of one bank is disturbed, all settings are taken from the other bank and the contents from here is transferred to the faulty memory region, all while the relay is in full operation condition. If both memory banks are simultaneously damaged the relay will be set out of operation, and an alarm signal will be given over the serial port and the IRF output relay

## Trip test function

Register 0 also provides access to a trip test function, which allows the output signals of the relay module to be activated one by one. If the auxiliary relay module of the protection assembly is in place, the auxiliary relays then will operate one by one during the testing.

When pressing the PROGRAM push button for about five seconds, the green digits to the right start flashing indicating that the relay module is in the test position. The indicators of the settings indicate by flashing which output signal can be activated. The required output function is selected by pressing the PROGRAM push button for about one second.

The indicators of the setting quantities refer to the following output signals:

Setting I>	Starting of stage I>
Setting t>	Tripping of stage I>
Setting I>>	Starting of stage I>>
Setting t>>	Tripping of stage I>>
etc.	
No indication	Self-supervision IRF

The selected starting or tripping is activated by simultaneous pressing of the push buttons STEP and PROGRAM. The signal remains activated as long as the two push buttons are pressed. The effect on the output relays depends on the configuration of the output relay matrix switches.

The self-supervision output is activated by pressing the STEP push button 1 second when no setting indicator is flashing. The IRF output is activated in about 1 second after pressing of the STEP push button.

The signals are selected in the order illustrated in Fig. 4.

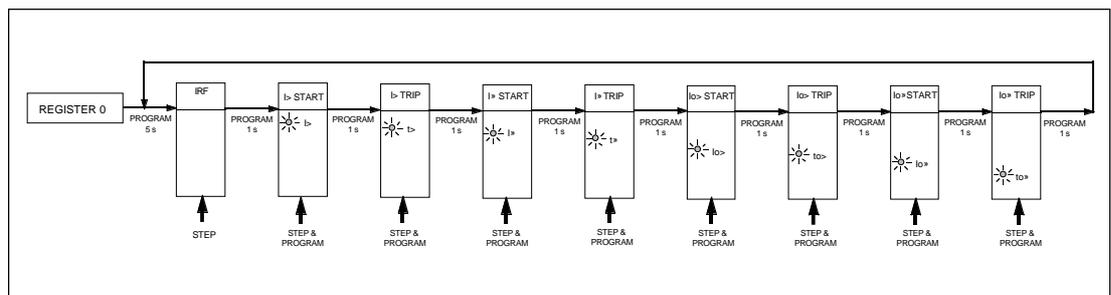


Fig. 5. Sequence order for the selection of output signals in the Trip test mode

If, for instance, the indicator of the setting t> is flashing, and the push buttons STEP and PROGRAM are being pressed, the trip signal from the low-set overcurrent stage is activated. Return to the main menu is possible at any stage of the trip test sequence scheme, by pressing the PROGRAM push button for about five seconds.

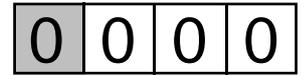
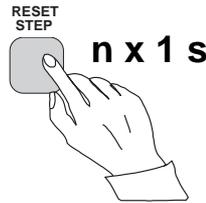
Note!

The effect on the output relays then depends on the configuration of the output relay matrix switchgroups SGR 1...3.

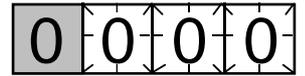
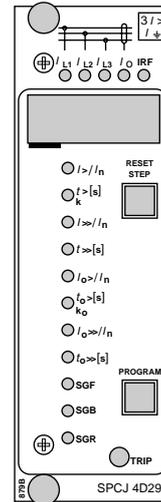
Example 3

Trip test function. Forced activation of the outputs.

- a)  
Step forward on the display to register 0.



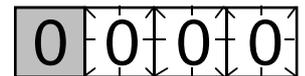
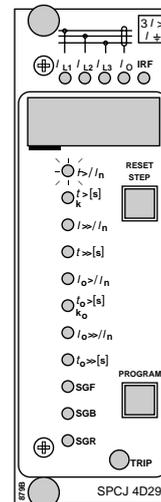
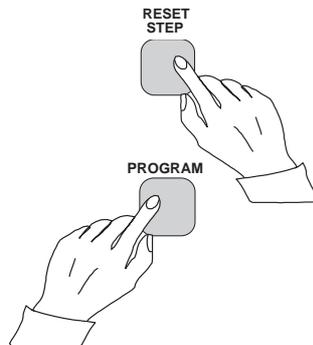
- b)  
Press the PROGRAM push button for about five seconds until the three green digits to the right.



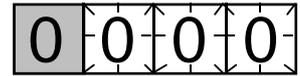
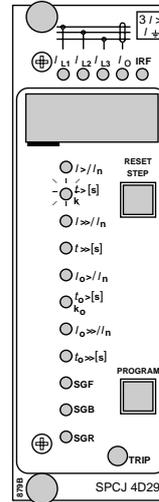
- c)  
Hold down the STEP push button. After one second the red IRF indicator is lit and the IRF output is activated. When the step push button is released the IRF indicator is switched off and the IRF output resets.

- d)  
Press the PROGRAM push button for one second and the indicator of the topmost setting start flashing.

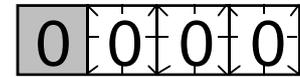
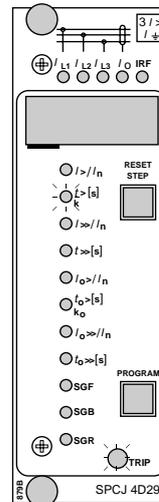
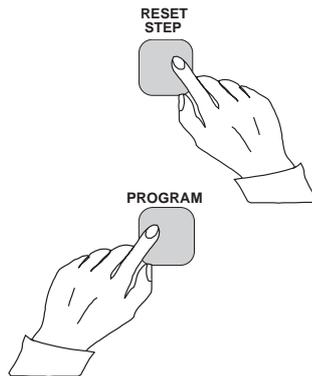
- e)  
If a start of the first stage is required, now press the push-buttons PROGRAM and STEP simultaneously. The stage output will be activated and the output relays will operate according to the actual programming of the relay output switchgroups SGR.



f)  
To proceed to the next position press the PROGRAM push button for about 1 second until the indicator of the second setting starts flashing.



g)  
Press the push buttons PROGRAM and STEP simultaneously to activate tripping of stage 1 (e.g. the I> stage of the overcurrent module SPCJ 4D29). The output relays will operate according to the actual programming of the relay switchgroups SGR. If the main trip relay is operated the trip indicator of the measuring module is lit.



h)  
The starting and tripping of the remaining stages are activated in the same way as the first stage above. The indicator of the corresponding setting starts flashing to indicate that the concerned stage can be activated by pressing the STEP and PROGRAM buttons simultaneously. For any forced stage operation, the output relays will respond according to the setting of the relay output switchgroups SGR. Any time a certain stage is selected that is not wanted to operate, pressing the PROGRAM button once more will pass by this position and move to the next one without carrying out any operation of the selected stage.

It is possible to leave the trip test mode at any step of the sequence scheme by pressing the PROGRAM push button for about five seconds until the three digits to the right stop flashing.

## Operation indication

A relay module is provided with a multiple of separate operation stages, each with its own operation indicator shown on the display and a common trip indicator on the lower part of the front plate of the relay module.

The starting of a relay stage is indicated with one number which changes to another number when the stage operates. The indicator remains glowing although the operation stage resets. The

indicator is reset by means of the RESET push button of the relay module. An unreset operation indicator does not affect the function of the protection relay module.

In certain cases the function of the operation indicators may deviate from the above principles. This is described in detail in the descriptions of the separate modules.

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## Fault codes

In addition to the protection functions the relay module is provided with a self-supervision system which continuously supervises the function of the microprocessor, its program execution and the electronics.

Shortly after the self-supervision system detects a permanent fault in the relay module, the red IRF indicator on the front panel is lit. At the same time the module puts forward a control signal to the output relay of the self-supervision system of the protection relay.

In most fault situations a fault code, indicating the nature of the fault, appears on the display of

the module. The fault code, which consists of a red figure "1" and a three digit green code number, cannot be removed from the display by resetting. When a fault occurs, the fault code should be recorded and stated when service is ordered. When in a fault mode, the normal relay menus are operative, i.e. all setting values and measured values can be accessed although the relay operation is inhibited. The serial communication is also operative making it possible to access the relay information also from a remote site. The internal relay fault code shown on the display remains active until the internal fault possibly disappears and can also be remotely read out as variable V 169.



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