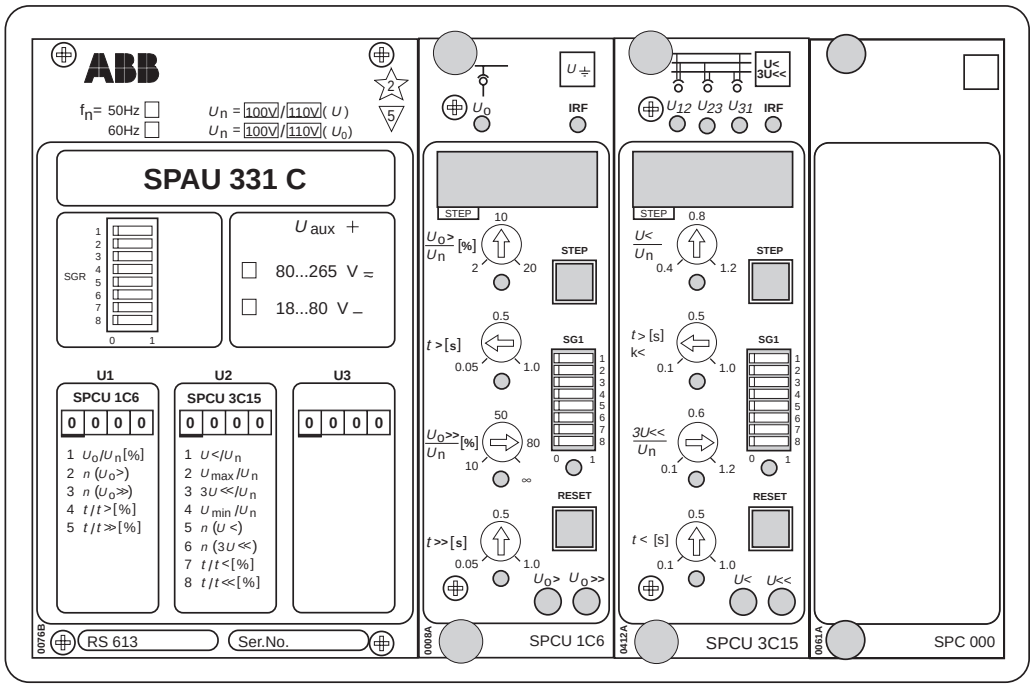
SPAU 331 C
Voltage relay

User´s manual and Technical description



1MRS 750123-MUM EN

Issued 1996-12-02
Modified 2002-04-26
Version B (replaces 34 SPAU 12 EN1)
Checked MK
Approved OL

SPAU 331 C
Voltage relay

Contents

The complete manual for the voltage relay SPAU 331 C includes the following submanuals:

Features

Two-stage residual overvoltage relay module containing a low-set residual overvoltage stage U_0> and a high-set residual overvoltage stage U_0>>

Both residual overvoltage stages feature definite time characteristic and wide setting ranges

Two-stage undervoltage relay module containing a higher under voltage stage U< and a lower undervoltage stage 3U<<

The three-phase undervoltage stage U< starts if one or more of the phase-to-phase voltages fall below the set start level

The three-phase under voltage stage 3U<< starts if all three phase-to-phase voltages fall below the set start level

The under voltage stage U< can be given definite time characteristic or inverse time characteristic while the under voltage stage 3U<< features definite time characteristic only

Numerical display of setting values, currently measured values, fault values, operate times, event messages etc.

Serial interface for connection of the relay to the serial bus and a substation level communication and reporting system and/or a remote control system

High system reliability and availability through integrated self-supervision system with auto-diagnostics capabilities in the relay modules

Application

The voltage relay SPAU 331 C is intended for the supervision of the bus bar voltages of distribution substations, both the residual voltage and the phase-to-phase voltages. The complete voltage relay contains two protection relay modules. The residual voltage is measured with a residual overvoltage relay module type SPAU 1C6 including two operation stages. The phase-to-phase voltage is measured with an undervoltage relay module type SPCU 3C15.

The voltage relay SPAU 331 C is a member of the SPACOM product family and as such it is provided with a serial communication port. Over the serial communication port and an optional bus connection module of the SPA-ZC_ series the relay can be connected to the optical fibre SPA bus and further to a substation level data communication and reporting system and/or a remote control system.

Description of operation

When the residual voltage of the monitored network exceeds the set start level of the low-set residual overvoltage stage U_0> the relay module SPCU 1C6 starts. If the fault persists the U_0> stage trips after the set operate time t> has elapsed. Correspondingly, the high-set residual overvoltage stage U_0>> starts when its set start level is exceeded and trips when its set operate time t>> has elapsed.

When one of the phase-to-phase voltages of the monitored network falls below the set start level of the undervoltage stage U<, the relay module SPCU 3C15 starts. If the undervoltage situation persists the U< stage trips after the set (at definite time mode) or calculated (at inverse time mode) operate time t< has elapsed. Correspondingly, the under voltage stage 3U<< starts when all three phase-to-phase voltages simultaneously fall below the set start level and trips when its set operate time t<< has elapsed.

The operation of the undervoltage stage U< can be given inverse time characteristic or definite time characteristic. At inverse time characteristic the operate time is a function of the measured voltage and the set time multplier k and the operate time is shorter the lower the measured voltage. The undervoltage stage 3U<< features definite time characteristic only.

By turning switch SG1/5 on the front panel of the undervoltage relay module SPCU 3C15 in position 1, the operation of the undervoltage stage U< can be blocked, when at least one of the measured phase-to-phase voltages falls below 0.2 x U_n. Further, the operation of the undervoltage stage U< can be blocked by the start signal of the undervoltage stage 3U<<, switch SG1/8 in position 1.

Tripping of both operation stages of the undervoltage relay module and the residual voltage relay module can be blocked by means of an external control signal applied to the control input 10-11 of the relay. The operation stages to be blocked are selected with switches 4 and 5 of switch group SGB in the relay modules respectively, see section "Signal flow diagram".

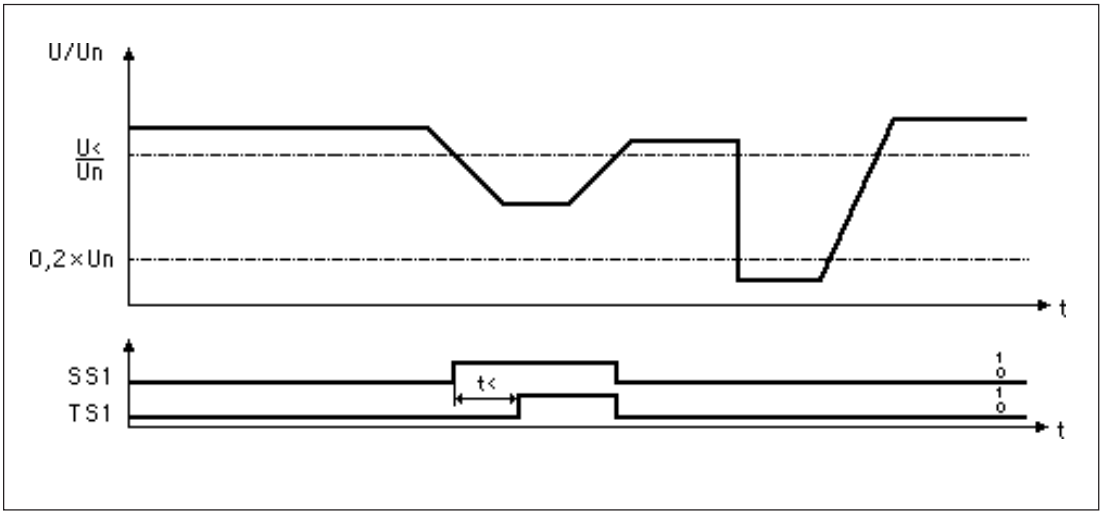


Fig. 1. Operation diagram for the undervoltage relay module SPCU 3C15 when selector switch SG1/5 = 1, i.e. starting of the undervoltage stage is blocked at voltage levels under 0.2 x U_n.

U</U_n	Set start level of the undervoltage stage U<
SS1	Start signal of the undervoltage stage U<
TS1	Trip signal of the undervoltage stage U<

Connections

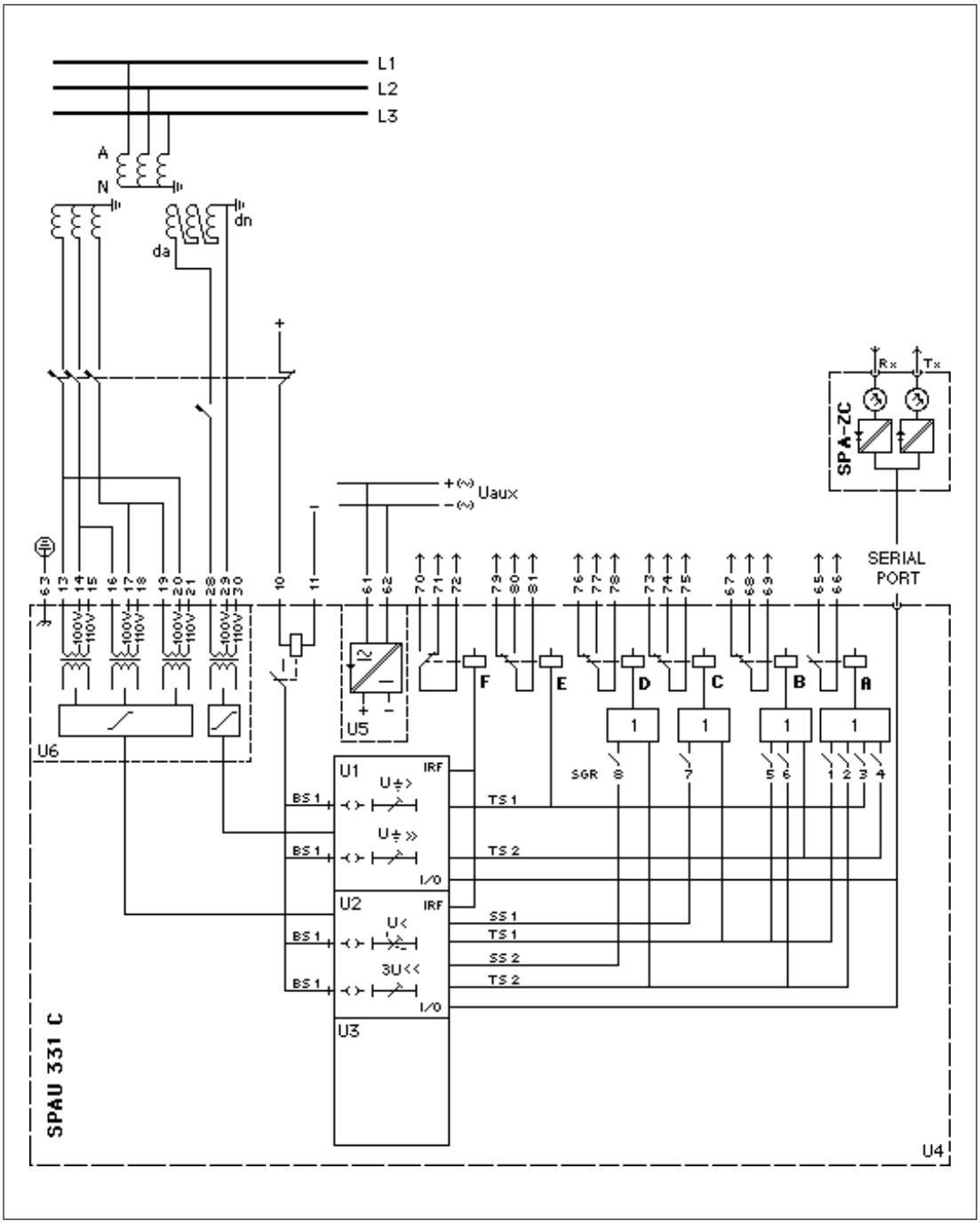


Fig. 2. Connection diagram for the voltage relay SPAU 331 C.

U_{aux}	Auxiliary supply voltage
A, B…F	Output relays
IRF	Self-supervision alarm
SGR	Switchgroup for programming of starting and tripping signals
U1	Residual overvoltage relay module SPCU 1 C6
U2	Undervoltage relay module SPCU 3C15
U3	Unoccupied module place
U4	Output relay module SPTR 6B3
U5	Power supply module SPGU 240A1 or SPGU 48B2
U6	Energizing input module SPTE 4B9
SPA-ZC_	Bus connection module
Rx/Tx	Optical fibre receiver (Rx) and transmitter (Tx) of the bus connection module

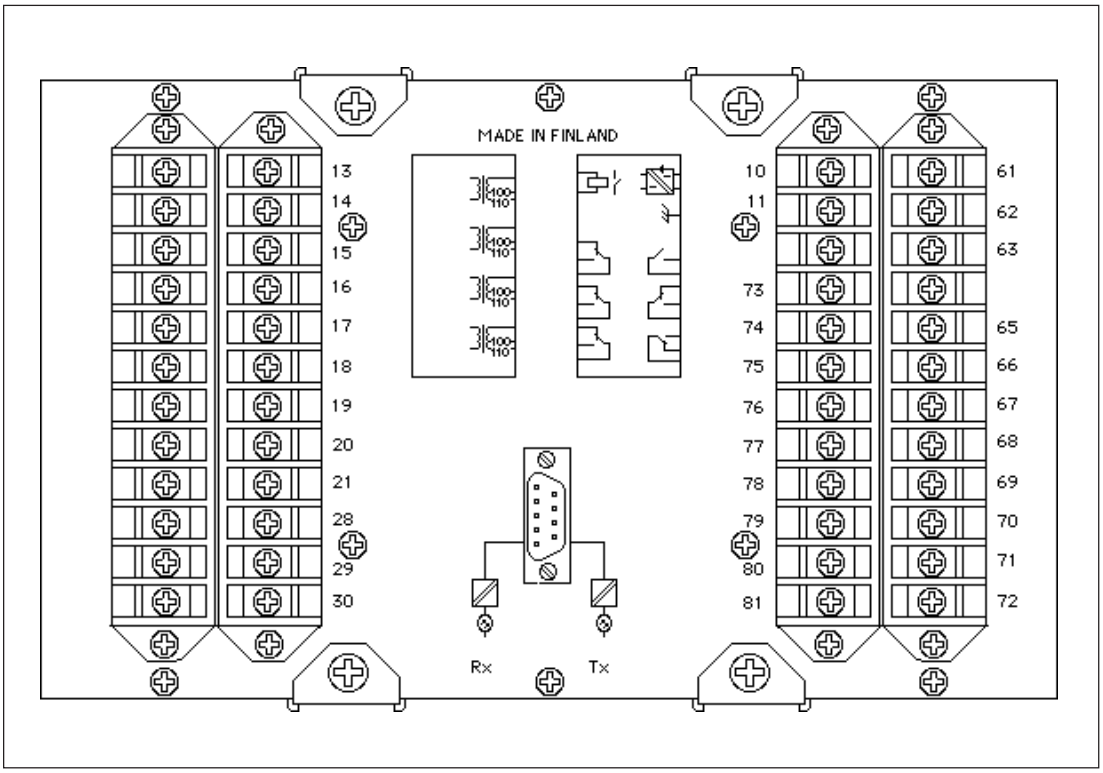


Fig. 3. Rear wiew of the voltage relay SPAU 331 C.

Specification of input and output terminals

Terminal number	Function
13-14	Phase-to-phase voltage U_{12} (100 V)
13-15	Phase-to-phase voltage U_{12} (110V)
16-17	Phase-to-phase voltage U_{23} (100 V)
16-18	Phase-to-phase voltage U_{23} (110 V)
19-20	Phase-to-phase voltage U_{31} (100 V)
19-21	Phase-to-phase voltage U_{31} (110 V)
28-29	Residual voltage U_0 (100 V)
28-30	Residual voltage U_0 (110V)
10-11	External blocking signal BS1
61-62	Auxiliary supply voltage. The positive pole (+) of the DC supply is connected to terminal 61. The auxiliary supply voltage range is marked on the system front plate of the relay.
63	Protection earth (PE)
65-66	Tripping output relay A (heavy-duty) for all stages, U_0>, U_0>>, U< and 3U<<
67-68-69	Alarm signal output relay B for stages stages U_0>>, U< and 3U<<
73-74-75	Alarm and start signal output relay C for stage U<
76-77-78	Alarm and start signal output relay D for stage 3U<<
79-80-81	Alarm signal output relay E for stage U_0>
70-71 -72	Self-supervision output relay F. In normal service conditions the contact gap 70-72 is closed. In a fault situation the contact gap 71-72 closes. NOTE! Detailed information about the programming of starting and tripping signals in switchgroups SGB and SGR is given in the section "Signal flow diagram and conficuration switches".

The voltage relay SPAU 331 C can be connected to the optical fibre SPA data bus by means of a 9-pole D type connector located on the rear panel of the voltage relay, and a matching bus connection module type SPA-ZC_. The opto-connectors of the optical fibres are blugged into the counter connectors Rx and Tx of the bus connection module and the optical fibres are linked from one protection relay to another and to the control data communicator.

Operation indicators and push-buttons

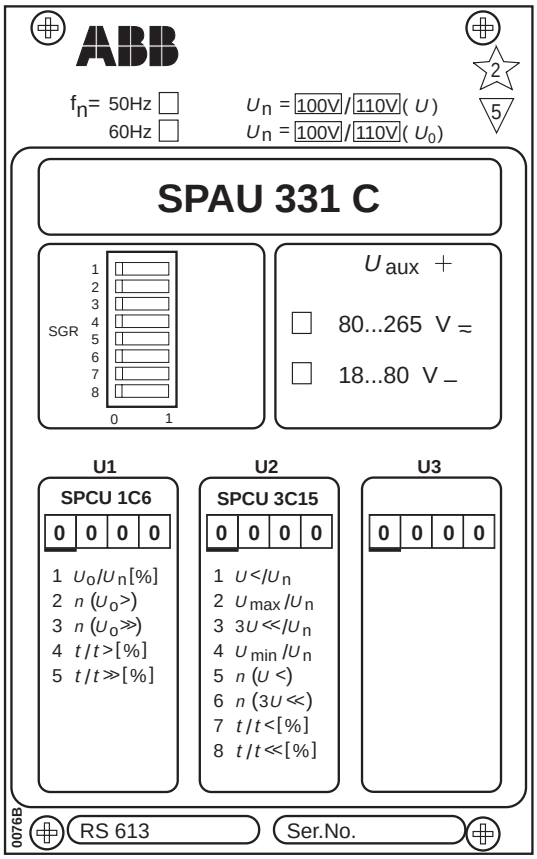


Fig. 4. System front panel of the voltage relay SPAU 331 C.

1. The green LED U_{aux} on the system panel is lit when the power supply of the relay is operating.

2. The relay modules are provided with two operating stages and each stage has its own yellow/red LED operation indicator. The operation indicator goes on with a yellow light when the operation stage starts and with a red light if the stage delivers a tripping signal as well. The LED indicators can be given self-reset or manual reset mode of operation. Normally, when the stage resets, the red operation indicator remains lit after being switched on to indicate by whitch stage the tripping was initiated.

3. The front panels of both relay modules are provided with a numerical display for indication of measured and set values, two push-buttons marked STEP and RESET, a programming switchgroup SG1 for selection of relay functions and four setting knobs for operation values. The STEP push-button can be used for scanning through the measured and set values of the module and for presentation of the values concerned on the display of the module. The RESET push-button is used for resetting locally the red operation indicators for tripping. An unreset operation indicator does not affect the operation of the relay module and thus, the module is constantely operative.

4. The front panels of the relay modules are provided with a red LED used as a self-supervision alarm indicator IRF which indicates that the self-supervision system has detected a permanent fault in the protection relay. Further, the relay modules are provided with separate LED indicators on the front panel for indication of the measured residual and phase-to-phase voltages.

5. The cover of the protection relay case is made of transparent, UV-stabilized polycarbonate polymer and provided with three push-buttons for scanning of the relay parameters by means of the separate displays of the modules and the STEP push-buttons inside the cover. To enable resetting of the modules by means of the RESET push-buttons, the cover of the relay case must be opened using the locking screws for the case.

Detailed operation instructions are given in the manuals describing the individual relay modules and in the document "General characteristics of C-type relay modules".

Signal flow diagram and configuration switches

In certain applications it may be necessary to alter the factory settings of the configuration switches of the relay SPAU 331 C. Fig. 5 illustrates schematically how the starting, tripping, control and blocking signals can be routed inside the relay to obtain the protection functions required by the intended application.

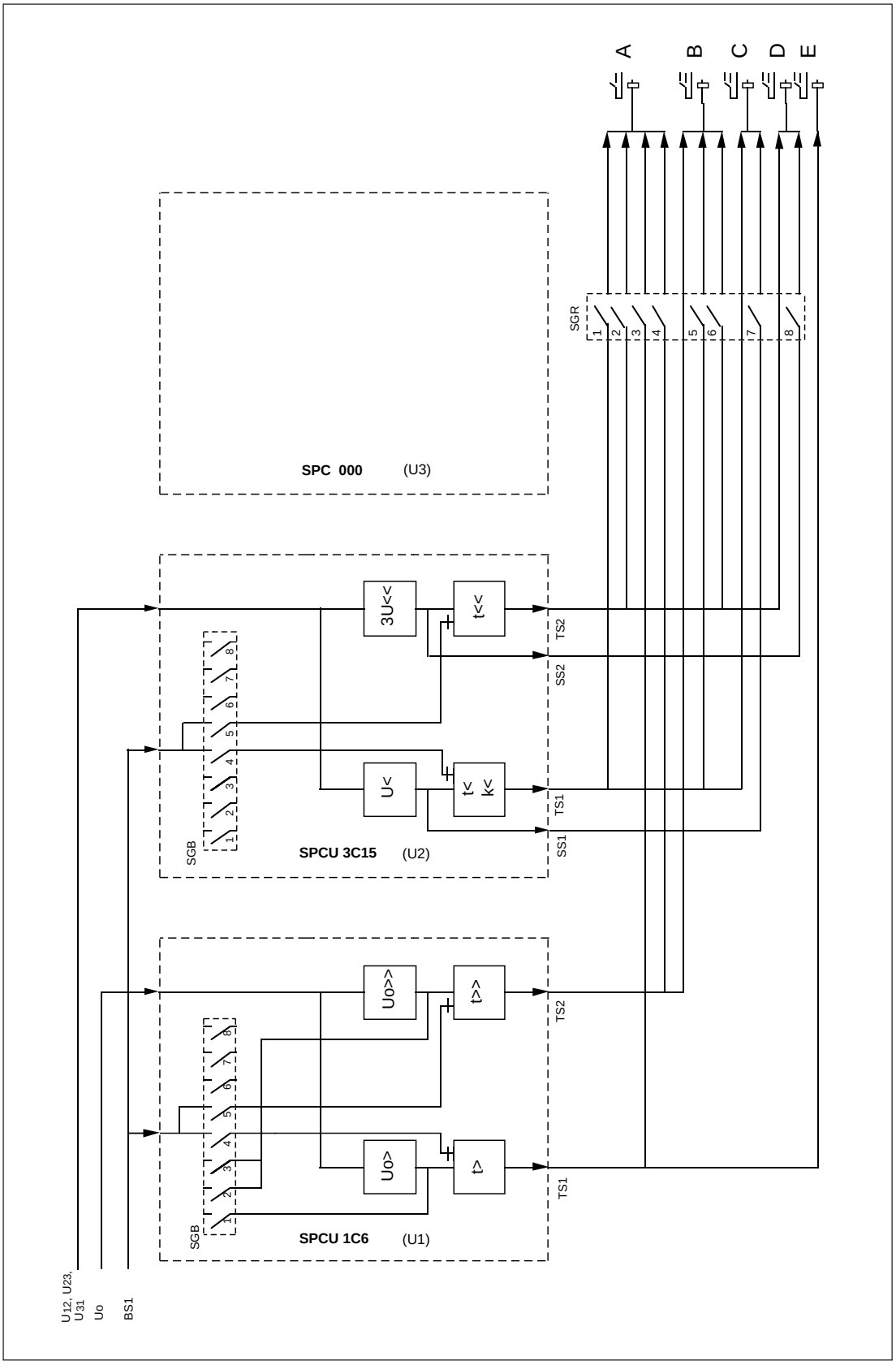


Fig. 5. Control signal routes between the relay modules of the voltage relay SPAU 331 C.

Configuration switches

Part of the starting and tripping signals from the relay modules are permanently connected to the output relays, whereas part of the output signals are routed through switchgroup SGR. The switchgroup is located at the front edge of the output relay module. The switches are set through the opening in the relay system front panel.

The switchgroups SGB on the PC-boards of the relay modules SPCU 1C6 and SPCU 3C15 are used for routing incoming external blocking signals to the protection stages to be blocked.

The functions of the switchgroups SGB and SGR are described in the tables as follows:

Switchgroup SGR on relay system panel

Switch	Function	Factory setting
SGR/1	Tripping signal from stage U< to output relay A	1
SGR/2	Tripping signal from stage 3U<< to output relay A	1
SGR/3	Tripping signal from stage U_0> to output relay A	1
SGR/4	Tripping signal from stage U_0>> to output relay A	1
SGR/5	Tripping signal from stage U< to output relay B	1
SGR/6	Tripping signal from stage 3U<< to output relay B	1
SGR/7	Starting signal from stage U< to output relay C	1
SGR/8	Starting signal from stage 3U<< to output relay D	1

Switchgroup SGB on PC-board in residual overvoltage relay module SPCU 1C6

Switch	Function	Factory setting
SGB/1	Not in use	0
SGB/2	Not in use	0
SGB/3	Not in use	0
SGB/4	Blocking signal BS1 for blocking of U_0>-tripping	0
SGB/5	Blocking signal BS1 for blocking of U_0>>-tripping	0
SGB/6	Not in use	0
SGB/7	Not in use	0
SGB/8	Not in use	0

Switchgroup SGB on PC-board in undervoltage relay module SPCU 3C15

Switch	Function	Factory setting
SGB/1	Not in use	0
SGB/2	Not in use	0
SGB/3	Not in use	0
SGB/4	Blocking signal BS1 for blocking of U<-tripping	0
SGB/5	Blocking signal BS1 for blocking of 3U<<-tripping	0
SGB/6	Not in use	0
SGB/7	Not in use	0
SGB/8	Not in use	0

Power supply module

The power supply module is located behind the system front panel of the relay together with the output relay module. The supply module is a separate relay module and can be withdrawn after removal of the system front panel. The power supply module produces the voltages required by the relay modules from the auxiliary supply voltage.

There are two types of power supply modules, differing only in input voltage:

SPGU 240 A1:
Nominal voltage U_n = 110/120/230/240 V ac
U_n = 110/125/220 V dc
Operative range U = 80...265 V ac/dc

SPGU 48 B2:
Nominal voltage U_n = 24/48/60 V dc
Operative range U = 18...80 V dc

The power supply type is marked on the system front panel.

The power supply module is a transformer connected, i.e. galvanically separated primary and secondary circuits, flyback type rectifier. The primary circuit is protected by a fuse F1, 1A (slow) in SPGU 240 A1 and 4A (fast) in SPGU 48 B2, which are located on the printed circuit board of the module.

When the power supply is on, a green LED indicator U_{aux} is lit on the system panel. The supervision of the supply voltages for the electronics is located on the regulating modules. The self-supervision alarm is given if any of the secondary voltages differ more than 25% from the nominal value. Also, if the power supply module is missing, or if there is no auxiliary supply to the voltage regulator at all, an alarm is given.

Output relay module

The output relay module SPTR 6B3 is located behind the system front panel of the relay together with the power supply module. The output relay module forms its own withdrawable relay module after removal of the system front plate. The module contains all output relays, A...F, the control circuits of the relays as well as the electronic circuitry of the external control inputs.

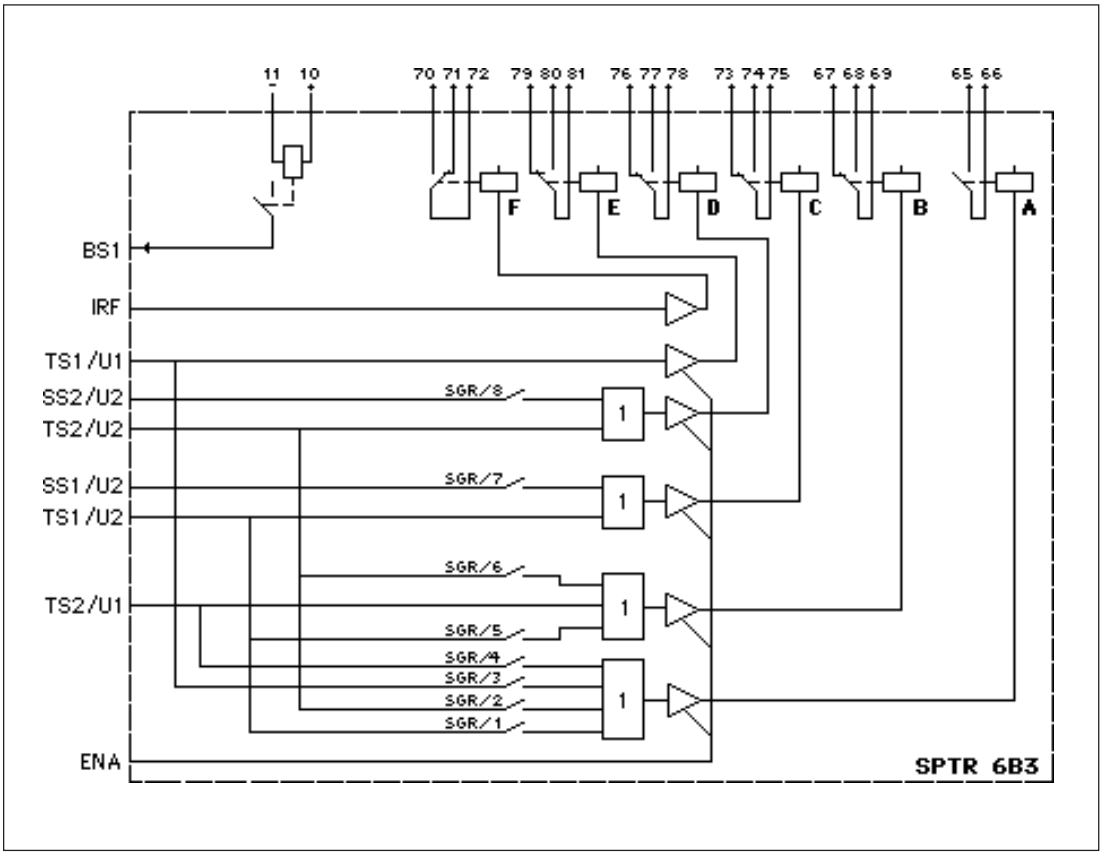


Fig. 6. Block diagram for the output relay module SPTR 6B3.

TS1/U1	Tripping signal of U_0>-stage
TS2/U1	Tripping signal of U_0>>-stage
SS1/U2	Starting signal of U>-stage
TS1/U2	Tripping signal of U>-stage
SS2/U2	Starting signal of U<-stage
TS2/U2	Tripping signal of U<-stage
BS1	External blocking input signal to U<-stage
A	Tripping output relay A (heavy-duty) for all stages, U_0>, U_0>>, U> and U<
B	Alarm signal output relay B for stages U_0>>, U> and U<
C	Alarm signal output relay C for stage U>
D	Alarm signal output relay D for stage U<
E	Alarm signal output relay E for stage U_0>
F	Self-supervision output relay F
IRF	Self-supervision input signal
SGR	Switchgroup for programming of starting and tripping signals
ENA	Enable output signal from control circuits

The input and output signals of the output relay module are related to the fixed positions of the relay modules which cannot be changed in the relay housing. The output signals from each relay module and PC-board location are wired individually to the output relay module. It must be pointed out that the relay modules have to be plugged into the relay case as illustrated in the figure on the front page in order to secure that the connection diagram drawn for the relay assembly also would correspond to the physical function of the protective device.

Technical data

(modified 2002-04)

Energizing inputs

Rated voltage U_n	100 V	110 V
Terminal numbers		
- phase-to-phase voltage U_{12}	13-14	13-15
- phase-to-phase voltage U_{23}	16-17	16-18
- phase-to-phase voltage U_{31}	19-20	19-21
- residual voltage U_0	28-29	28-30
Continuous voltage withstand	2 x U_n	
Burden at rated voltage U_n	<0.5 VA	
Rated frequency f_n, according to order	50 Hz or 60 Hz	

External control inputs

Terminal numbers	10-11
External control voltage	18...265 V dc or 80...265 V ac
Current drain, typically	2...15 mA

Contact outputs

Tripping outputs	
Terminal numbers	
- trip relay A	65-66
Rated voltage	250 V dc/ac
Continuous current carrying capacity	5 A
Make and carry for 0.5 s	30 A
Make and carry for 3 s	15 A
Breaking capacity for dc when the control circuit time constant L/R ≤40 ms at 48/110/220 V dc	5A /3A /1 A
Signalling outputs	
Terminal numbers	
- alarm relay B	67-68-69
- alarm relay C	73-74-75
- alarm relay D	76-77-78
- alarm relay E	79-80-81
- self-supervision relay F	70-71-72
Rated voltage	250 V dc/ac
Continuous current carrying capacity	5 A
Make and carry for 0.5 s	10 A
Make and carry for 3 s	8 A
Breaking capacity for dc when the control circuit time constant L/R ≤40 ms at 48/110/220 V dc	1A /0.25A /0.25A

Auxiliary power supply

Voltage range of power supply modules:	
SPGU 240 A1	
- Nominal voltage U_n	110/120/230/240 V ac 110/125/220 V dc
- Operative range	80...265 V ac/dc
SPGU 48 B2	
- Nominal voltage U_n	24/48/60 V dc
- Operative range	18...80 V dc
Power consumption under quiescent/ operation conditions	10 W / 15 W

Residual overvoltage relay module SPCU 1C6

See "Technical data" in the document 1MRS 750509-MUM EN for the relay module.

Two-stage undervoltage relay module SPCU 3C15

See "Technical data" in the document 1MRS 750588-MUM EN for the relay module.

Data communication

Transmission mode	Fibre-optic serial bus
Coding	ASCII
Data transfer rate, selectable	300, 1200, 2400, 4800 or 9600 Bd
Optical bus connection module powered from the host relay	
- for plastic-core cables	SPA-ZC 21 BB
- for glass-fibre cables	SPA-ZC 21 MM
Optical bus connection module powered from the host relay or from an external power source	
- for plastic-core cables	SPA-ZC 17 BB
- for glass-fibre cables	SPA-ZC 17 MM

Insulation Tests *)

Dielectric test IEC 60255-5	2 kV, 50 Hz, 1 min
Impulse voltage test IEC 60255-5	5 kV, 1.2/50 µs, 0.5 J
Insulation resistance measurement IEC 60255-5	>100 MΩ, 500 Vdc

Electromagnetic Compatibility Tests *)

High-frequency (1 MHz) burst disturbance test IEC 60255-22-1	
- common mode	2.5 kV
- differential mode	1.0 kV
Electrostatic discharge test IEC 60255-22-2 and IEC 61000-4-2	
- contact discharge	6 kV
- air discharge	8 kV
Fast transient disturbance test IEC 60255-22-4 and IEC 61000-4-4	
- power supply	4 kV
- I/O ports	2 kV

Emission tests

Radiated and conducted emission according to EN 55011	Class A

EMC tests

CE approved and tested according to
EN 50081-2 and EN 50082-2

Environmental conditions

Service temperature range	-10...+55°C
Temperature dependence	<0.2%/°C
Transport and storage temperature range according to IEC 60068-2-8	-40...+70°C
Damp heat test according to IEC 60068-2-30	≤95%, 55°C, 6 cycles
Degree of protection by enclosure of flush mounting relay case according to IEC 60529	IP54
Weight of fully equipped relay	5.5 kg

*) The tests do not apply to the serial port, which is used exclusively for the bus connection module.

Maintenance and repair

When the voltage relay SPAU 331 C is operating under the conditions specified in "Technical data", the relay requires practically no maintenance. The voltage relay includes no parts or components that are sensitive to physical or electrical wear under normal operating conditions.

Should the temperature and humidity at the operating site differ from the values specified, or the atmosphere contain chemically active gases or dust, the relay should be visually inspected in association with the secondary testing of the relay. This visual inspection should focus on:

- Signs of mechanical damage to relay case and terminals
- Collection of dust inside the relay case; remove with compressed air
- Signs of corrosion on terminals, case or inside the relay

If the relay malfunctions or the operating values differ from those specified, the relay should be overhauled. Minor measures can be taken by the customer but any major repair involving the electronics has to be carried out by the manufacturer. Please contact the manufacturer or his nearest representative for further information about checking, overhaul and recalibration of the relay.

The protection relay contains circuits sensitive to electrostatic discharge. If you have to withdraw a relay module, ensure that you are at the same potential as the module, for instance, by touching the case.

Note!
Protective relays are measuring instruments and should be handled with care and protected against moisture and mechanical stress, especially during transport.

Spare parts

Residual overvoltage relay module	SPCU 1C6
Two-stage undervoltage relay module	SPCU 3C15
Power supply modules	
- U_{aux} = 80...265 V ac/dc (operative range)	SPGU 240 A1
- U_{aux} = 18...80 V dc (operative range)	SPGU 48 B2
Output relay module	SPTR 6B3
Interface module	SPTE 4B9
Case (including connection module)	SPTK 4B9
Bus connection module	SPA-ZC 17_ or SPA-ZC 21_

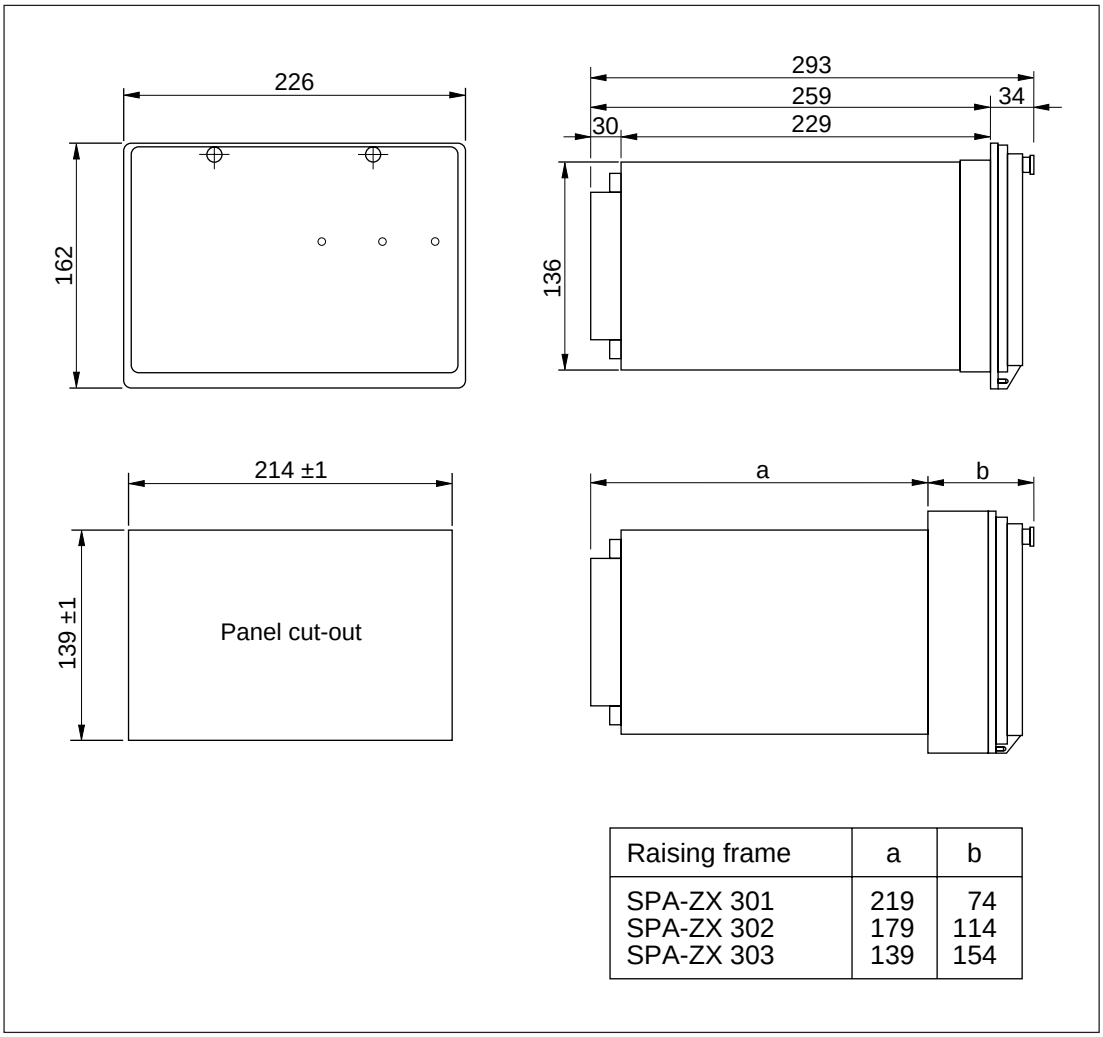
Delivery alternatives

Type	Equipment	SPCU 1C6	SPCU 3C15
SPAU 331 C1	Basic version, residual voltage and undervoltage module	x	x
SPAU 331 C3	Basic version, residual voltage module alone	x	
SPAU 331 C5	Basic version, undervoltage module alone		x

Delivery versions of the voltage relay SPAU 331 C.

Dimension drawings and mounting

The basic model of the protection relay case is designed for flush-mounting. When required, the mounting depth of the case can be reduced by using raising frames: type SPA-ZX 301 reduces the depth by 40 mm, type SPA-ZX 302 by 80 mm and type SPA-ZX 303 by 120 mm. When projecting mounting is preferred a relay case type SPA-ZX 306 is used. The relay case for projecting mounting is provided with front connectors.



Raising frame	a	b
SPA-ZX 301	219	74
SPA-ZX 302	179	114
SPA-ZX 303	139	154

Fig. 6. Dimension and mounting drawings for overvoltage, undervoltage and residual voltage relay SPAU 331 C.

The relay case is made of profile aluminium and finished in beige.

The rubber gasket fitted to the mounting collar provides an IP54 degree of protection by enclosure between the relay case and the mounting base.

The hinged cover of the case is made of transparent, UV-stabilized polycarbonate polymer and provided with two sealable locking screws. The rubber gasket of the cover provides an IP54 degree of protection between the case and the cover.

The required input and output connections are made to the multi-pole terminal blocks on the rear panel. Each screw terminal is dimensioned for one or two wires of maximum 2.5 mm^2. A connection diagram adjacent to the terminal blocks illustrates the connection of the terminals.

The 9-pole D-type connector is intended for serial communication of the relay. A 25-pole D-type connector is used for connecting the disturbance recorder module via the RS 232 C port on the front panel to an output device.

The bus connection modules (SPA-ZC 17_ or SPA-ZC 21_) and fibre-optic cables recommended by the manufacturer should always be used for the serial communication.

Order numbers and ordering information

Voltage relay

SPAU 331 C1	RS 613 031 - AA, CA, DA, FA
SPAU 331 C3	RS 613 033 - AA, CA, DA, FA
SPAU 331 C5	RS 613 035 - AA, CA, DA, FA

The letter combinations of the order number denote the rated frequency f_n and the operative range of the auxiliary supply voltage:

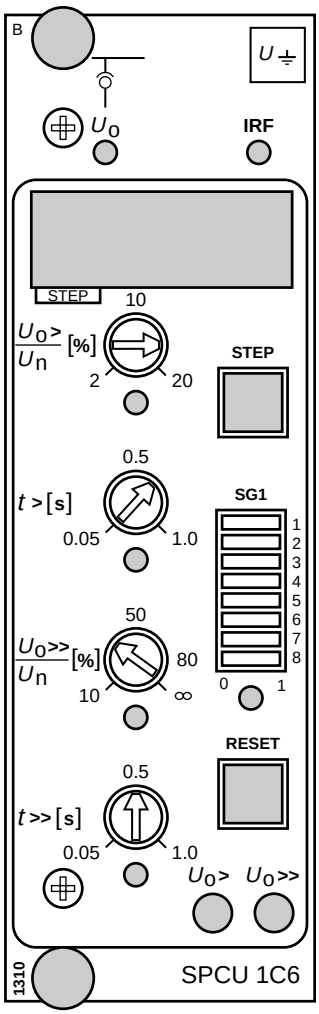
AA: f_n = 50 Hz, U_{aux} = 80...265 V ac/dc
CA: f_n = 50 Hz, U_{aux} = 18...80 V dc
DA: f_n = 60 Hz, U_{aux} = 80...265 V ac/dc
FA: f_n = 60 Hz, U_{aux} = 18...80 V dc

Ordering example:

1. Number and type designation	5 pcs SPAU 331 C1
2. Order number	RS 613 031 - AA
3. Rated frequency	f_n = 50 Hz
4. Auxiliary voltage	U_{aux} = 110 V dc
5. Accessories	5 raising frames SPA-ZX 301 5 bus connection modules SPA-ZC 17 MM2A
6. Special requirements	–

SPCU 1C6
Residual overvoltage relay module

User´s manual and Technical description



1MRS 750509-MUM EN

Issued 96-12-02
Version A (replaces 34 SPCU 2 EN1)
Checked L-W U
Approved TK

Data subject to change without notice

SPCU 1C6
Residual overvoltage relay module

Contents

Features

Low-set residual overvoltage stage U_0> with definite time operation characteristic, setting ranges 2...20% x U_n and 10...100% x U_n

High-set residual overvoltage stage U_0>> with definite time operation characteristic, setting ranges 10...80% x U_n or 2...16% x U_n

The operation of the high-set residual overvoltage stage can be set out of function by selecting the setting ∞, infinitive

Effective suppression of harmonics of the input energizing voltages

Local display of measured and set values as well as data recorded at the moment of a relay operation

Flexible selection of special operational features for particular applications

Continuous self-supervision of hardware and software. At a permanent fault the alarm output relay picks up and the other outputs are blocked.

Description of operation

The residual overvoltage relay module type SPCU 1C6 is used in a variety of different protection relay units where it constitutes a non-directional general earth-fault protection module which measures the residual voltage of the electrical power system.

The residual overvoltage module contains two overvoltage stages,that is a low-set stage U_0> and a high-set stage U_0>>.

The low-set or high-set voltage stage starts if the measured voltage exceeds the set start value of the stage concerned. When starting, the concerned stage delivers a starting signal SS1 or SS2 and simultaneously the operation indicator of the stage is lit with yellow colour. If the overvoltage situation lasts long enough to exceed the set operation delay, the stage that started also operates generating a trip signal, TS1 alt. TS2. The operation indicator of the stage that operated turns red. The start and operation indicators are provided with memory control, which means that they can be given the self-reset or the latching mode of operation. The latching indicators are reset with the RESET push-button on the front panel or by means of the command V101 or V102 via the serial port.

The tripping of the low-set overvoltage stage U_0> can be blocked by routing a blocking signal BTS1 to the low-set stage. Similarly, the tripping of the high-set stage U_0>> is blocked by a blocking signal BTS2. The blocking signals are routed by means of switchgroup SGB on the PC board of the relay module.

The setting range of the operation time t> of the low-set overvoltage stage U_0> is selected with switches SG1/1 and SG1/2. Three setting ranges are available.

Switches SG1/7 and SG1/8 are used for selecting the setting range for the operation time t>> of the high-set stage U_0>>. Three setting ranges are available.

The setting range of the start value of the low-set stage U_0> is selected with switch SG1/5. Two setting ranges are available, that is 2...20% x U_n and 10...100% x U_n.

The setting range of the start value of the high-set stage U_0>> is selected with switch SG1/6. Two setting ranges are available, that is 2...16% x U_n or 10...80% x U_n.

The operation of the two operating stages is provided with a so called latching facility, which means that the operation output is kept alerted, although the signal which caused the operation disappears. The latching function is selected with switch SG1/4. The latched output and the output relay can be reset in three different ways; (i) by pressing push buttons STEP and RESET simultaneously, (ii) via the serial inter-face using the command V101 or (iii) via the serial interface using the command V102. When alternative (ii) is used all recorded information is maintained but if the alternatives (i) or (iii) is used the recorded information is erased.

The residual voltage signal input is provided with an effective filter by means of which hamonics of the measured residual voltage is suppressed, see Fig. 1.

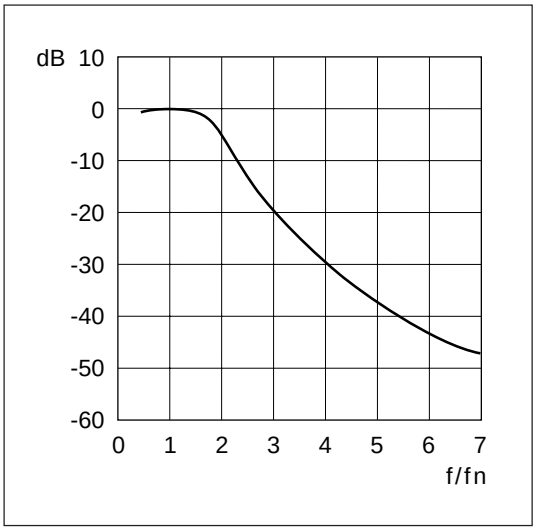


Fig. 1. Filter characteristics of the residual voltage input circuit.

Block diagram

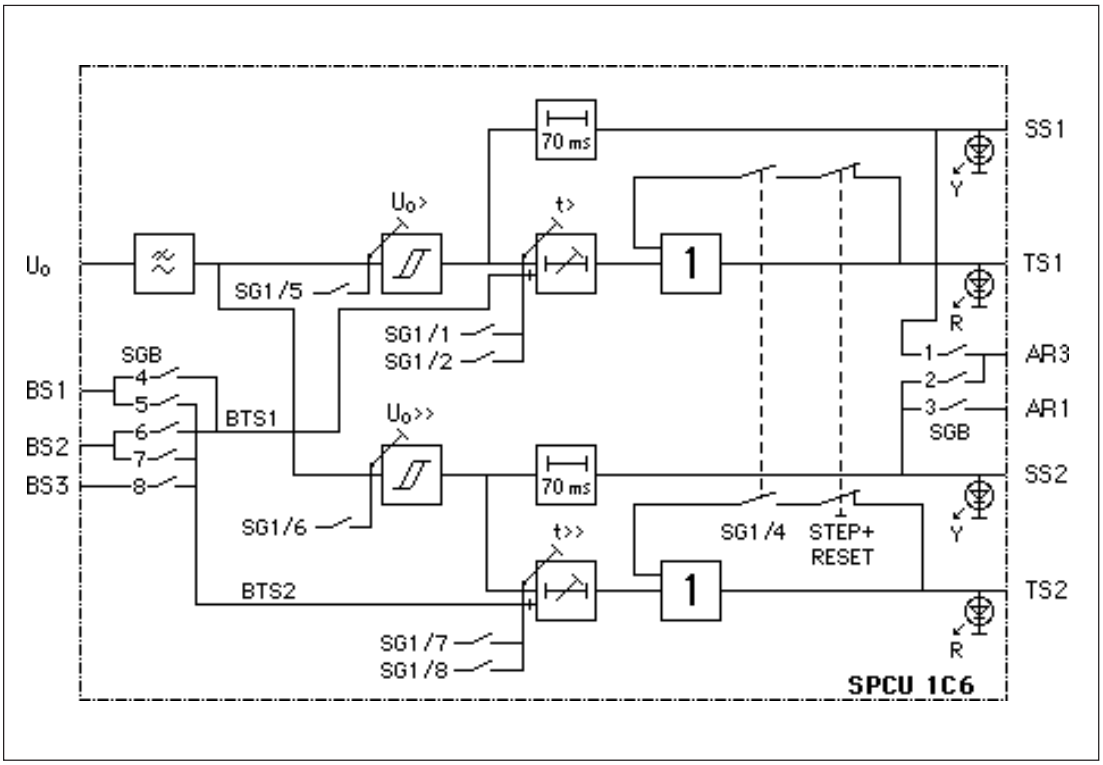


Fig. 2. Block schematic diagram of the residual overvoltage relay module SPCU 1C6.

U_0	Measured residual voltage
BS1, BS2, BS3	Incoming external blocking signals
BTS1	Blocking of tripping of stage U_0>
BTS2	Blocking of tripping of stage U_0>>
SG1	Selector switchgroup on the relay module front panel
SG2	Function selector switchgroup for the operation indicators
SGB	Selector switchgroup on the PC board for blocking signals
SS1	Start signal of stage U_0>
TS1	Trip signal of stage U_0>
SS2	Start signal of stage U_0>>
TS2	Trip signal of stage U_0>>
Y	Yellow indicator, starting
R	Red indicator, tripping

NOTE!
All input and output signals of the relay module are not necessarily wired to the terminals of every protection relay unit utilizing this module. The signals wired to the terminals are shown in the signal diagram in the manual of the concerned protection relay unit.

Front panel

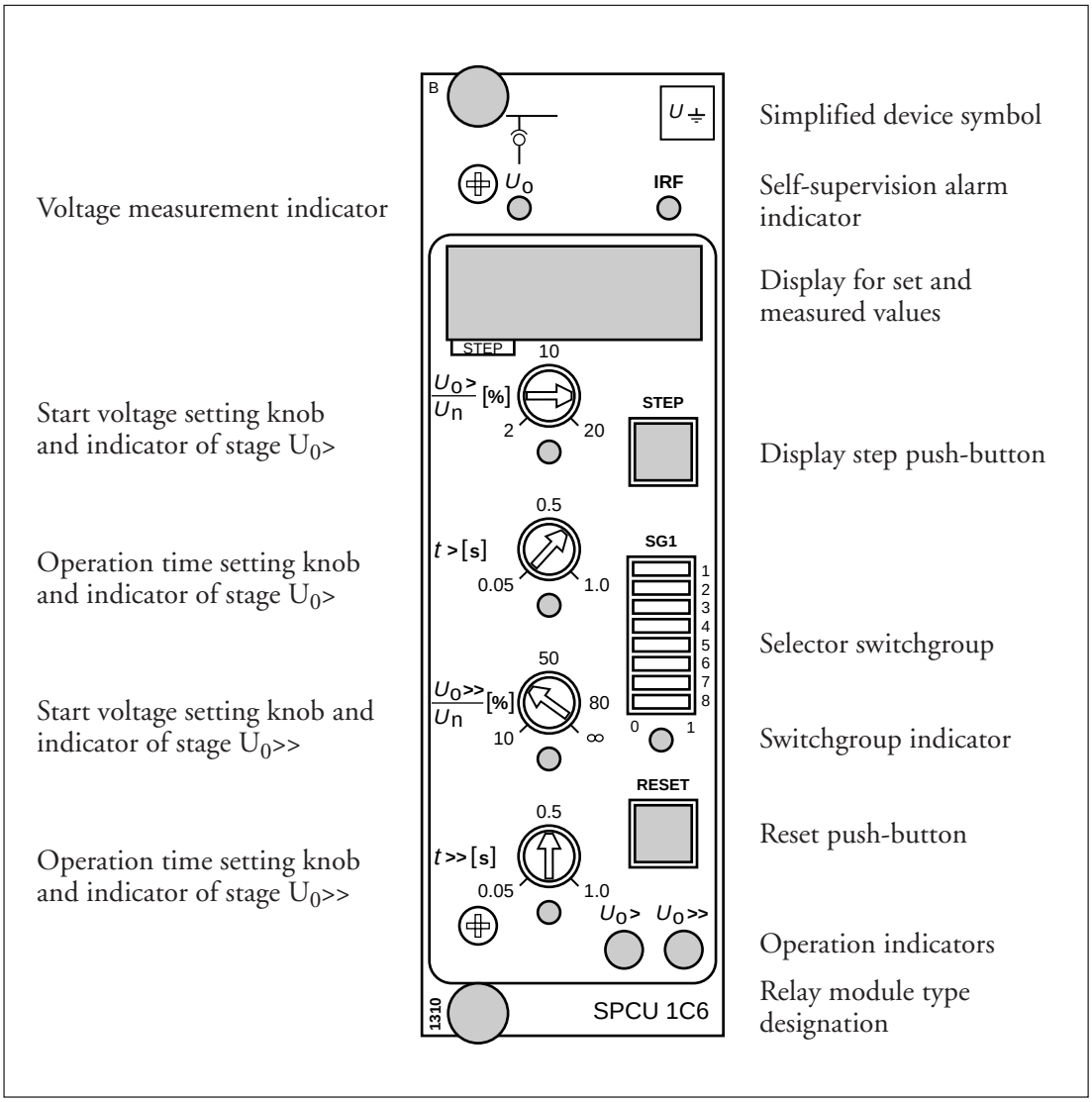


Fig. 3. Front panel of the residual overvoltage relay module SPCU 1C6.

Operation indicators

Both voltage stages have their own yellow/red LED indicators. Yellow light indicates starting of the concerned overvoltage stage and red light indicates that the overvoltage stage has operated.

The four LED indicators can, independently of one another, be given a non-latching or a latching mode of operation. The latching mode means that the indicator remains lit after being switched on, although the overvoltage stage, which controls the indicator, resets. If, for instance, the yellow start indicator is given the latching mode and the red indicator the non-latching mode, the yellow indicator is lit, when the stage starts, which then turns red if and when the stage operates. When the overvoltage stage resets only the yellow indicator remains lit. The indicators, which have been given the latching mode, are reset locally by pushing the RESET push-button or by remote control over the SPA bus using the command V102.

An unreset operation indicator does not affect the protective functions of the relay module.

The self-supervision alarm indicator IRF indicates that the self-supervision system has detected a permanent internal relay fault. The indicator is lit with red light shortly after the fault has been detected. At the same time the relay module puts forward a control signal to the self-supervision system output relay of the protection relay unit.

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 number one (1) and a green three-digit code number, indicates what type of internal fault that has been detected. When a fault message appears, the fault code should be noted down for later use when relay overhaul or repair is to be carried out.

Settings

The setting values are shown by the three rightmost digits of the display. A LED indicator below the setting knob shows, when lit, which setting value is presented on the display.

$U_0>/U_n$	Start voltage value of the $U_0>$ stage, expressed as a percentage of the rated voltage of the energizing input used. The setting range is 2...20% x U_n when SG1/5 = 0, and 10...100% x U_n when SG1/5 = 1.
t> [s]	Operate time of the $U_0>$ stage, expressed in seconds. The setting range is determined by the position of switches SG1/1 and SG1/2. Selectable operate time setting ranges 0.05...1.00 s, 0.5...10.0 s and 5...100 s.
$U_0>>/U_n$	Start voltage value of the $U_0>>$ stage, expressed as a percentage of the rated voltage of the energizing input used. The setting range is 10...80% x U_n when SG1/6 = 0, and 2...16% x U_n when SG1/6 = 1. The setting ∞, infinite, (displayed as - - -) sets the high-set stage $U_0>>$ out of operation.
t>> [s]	Operate time of the $U_0>>$ stage, expressed in seconds. The required setting range, 0.05...1.00 s, 0.5...10.0 s or 5.00...100 s, is selected with switches SG1/7 and SG1/8.

Further, the checksum of the selector switchgroup SG1 is shown on the display when the LED indicator below the switchgroup is lit. By means of the displayed checksum and the checksum manually calculated the proper operation of the switchgroup SG1 can be verified. An example of how the checksum is calculated is shown in the manual "General characteristics of C type relay modules".

Selector switches

Additional functions required by individual applications are selected by means of the function selector switches of switchgroup SG1 located on the front panel. The numbering of the switches, 1...8, as well as the switch positions 0 and 1 are marked on the relay module front panel.

<table>
<tr><th>Switch</th><th>Function</th></tr>
<tr><td>SG1/1
SG1/2</td><td>Selection of setting range for the operate time t> of low-set stage $U_0>$.
<table>
<tr><th>SG1/1</th><th>SG1/2</th><th>Operate time t></th></tr>
<tr><td>0
1
0
1</td><td>0
0
1
1</td><td>0.05...1.00 s
0.5...10.0 s
0.5...10.0 s
5...100 s</td></tr>
</table></td></tr>
<tr><td>SG1/3</td><td>Not in use. Has to be set in position 0.</td></tr>
<tr><td>SG1/4</td><td>Selection of latching function for the tripping signals TS1 and TS2.

When SG1/4 = 0, the trip signals reset to the initial state (= the output relay drops off), when the measuring signal causing the operation falls below the set start voltage level. When SG1/4 = 1, the trip signals remain activated (= the output relay remains picked up), although the measuring signal falls below the set start voltage level. Then the trip signals are reset by pressing the push-buttons STEP and RESET simultaneously or with the commands V101 or V102 via the serial port.</td></tr>
<tr><td>SG1/5</td><td>Selection of setting range for the start voltage value of the low-set stage $U_0>$.

When SG1/5 = 0, the setting range is 2...20% x U_n.
When SG1/5 = 1, the setting range is 10...100% x U_n.</td></tr>
</table>

<table>
<tr><th>Switch</th><th>Function</th></tr>
<tr><td>SG1/6</td><td>Selection of setting range for the start voltage value of the high-set stage U_0>>.

When SG1/6 = 0, the setting range is 10...80% x U_n and ∞, infinite.
When SG1/6 = 1, the setting range is 2...16% x U_n and ∞, infinite.</td></tr>
<tr><td>SG1/7
SG1/8</td><td>Selection of setting range for the operate time t>> of the high-set stage U_0>>.
<table>
<tr><th>SG1/7</th><th>SG1/8</th><th>Operate time t>></th></tr>
<tr><td>0</td><td>0</td><td>0.05...1.00 s</td></tr>
<tr><td>1</td><td>0</td><td>0.5...10.0 s</td></tr>
<tr><td>0</td><td>1</td><td>0.5...10.0 s</td></tr>
<tr><td>1</td><td>1</td><td>5...100 s</td></tr>
</table></td></tr>
</table>

Switchgroup SG2 is a so called software switchgroup, which is located in the third submenu of switchgroup SG1. The mode of operation, i.e. self-reset or manually reset, of the LED indicators U_0> and U_0>> is determined by the switches of switchgroup SG2. The mode of operation can be separately set for each indicator. The mode of operation is set by means of the checksum, which can be calculated from the following table. Normally the start indications are self-reset and the operation indications manually reset.

Indicator	Manually reset	Factory default
Start indicator U_0>	1	0
Operation indicator U_0>	2	2
Start indicator U_0>>	4	0
Operation indicator U_0>>	8	8
Checksum	15	10

The PC board of the relay module contains a switchgroup SGB including switches 1...8. The switches 1...3 are used for selecting the starting signals, whereas switches 4...8 are used for routing the blocking signals to the voltage module in various protection relay units. Instructions for setting of switchgroup SGB are given in the user's manual of the different protection relay units.

Measured data

The measured values are displayed by the three rightmost digits on the display. The measured data to be displayed are indicated by a lit LED indicator.

Indicator	Measured data
U_0	Residual voltage measured by the relay module, expressed as a percentage of the rated voltage of the energizing input used.

Recorded information

The leftmost red digit displays the address number of the register, the rightmost three green digits display the recorded data.

Register/ STEP	Recorded data
1	Maximum residual voltage measured by the module, as a percentage of the rated voltage U_n of the used energizing input. If the module operates, the voltage value at the moment of operation is stored in the memory. Any new operation erases the old value and updates the register with the new value. The same thing happens if the measured voltage exceeds a previously recorded maximum value.
2	Number of starts of the low-set overvoltage stage U_0>, n (U_0>) = 0...255.
3	Number of starts of the high-set overvoltage stage U_0>>, n (U_0>>) = 0...255.
4	Duration of the latest start situation of stage U_0> as a percentage of the set operate time t>. Any new start resets the counter, which then starts counting from zero. When the stage has operated, the counter reading is 100.
5	Duration of the latest start situation of stage U_0>> as a percentage of the set operate time t>>. Any new start resets the counter, which then starts recounting from zero. When the stage has operated, the counter reading is 100.
0	Display of blocking signals and other external control signals. The rightmost digit indicates the state of the blocking inputs of the relay module. The following states may be indicated: 0 = no blockings 1 = operation of the U_0> stage blocked 2 = operation of the U_0>> stage blocked 3 = operation of both stages blocked In this register the second digit from he right is constantly zero. The leftmost digit indicates the state of the remote reset control input, if applicable. The following states may be indicated: 0 = remote reset control input not energized 1 = remote reset control input energized From this register it is possible to move on to the TEST mode, where the start and operation signals of the module can be activated one by one. For further details see manual "General characteristics of C type relay modules".
A	The address code of the protection relay module in the serial communication system. The serial communication is broken if the relay module is given the address code 0 (zero). Register A is provided with the following subregisters: 1. Selection of data transfer rate for the serial communication. Selectable values 300, 1200, 2400, 4800 and 9600 Bd. Default value 9600 Bd. 2. Bus communication monitor. If the relay module is connected to a serial communication system and the serial communication system is in operation the counter of the bus communication monitor will show the value 0 (zero). If the communication is broken the numbers 0…255 are scrolling in the counter. 3. Password required when changing relay module settings via remote control

Registers 1...5 are set to zero by pressing the push buttons STEP and RESET simultaneously or by remote control using the command V102. The register values are also erased if the auxiliary power supply of the module is interrupted. The address code of the relay module, the set data transfer rate of the serial communication and the password are not erased by a supply voltage interruption. Instructions for setting the address code and the data transfer rate are given in the manual "General characteristics of C type relay modules".

Menu chart

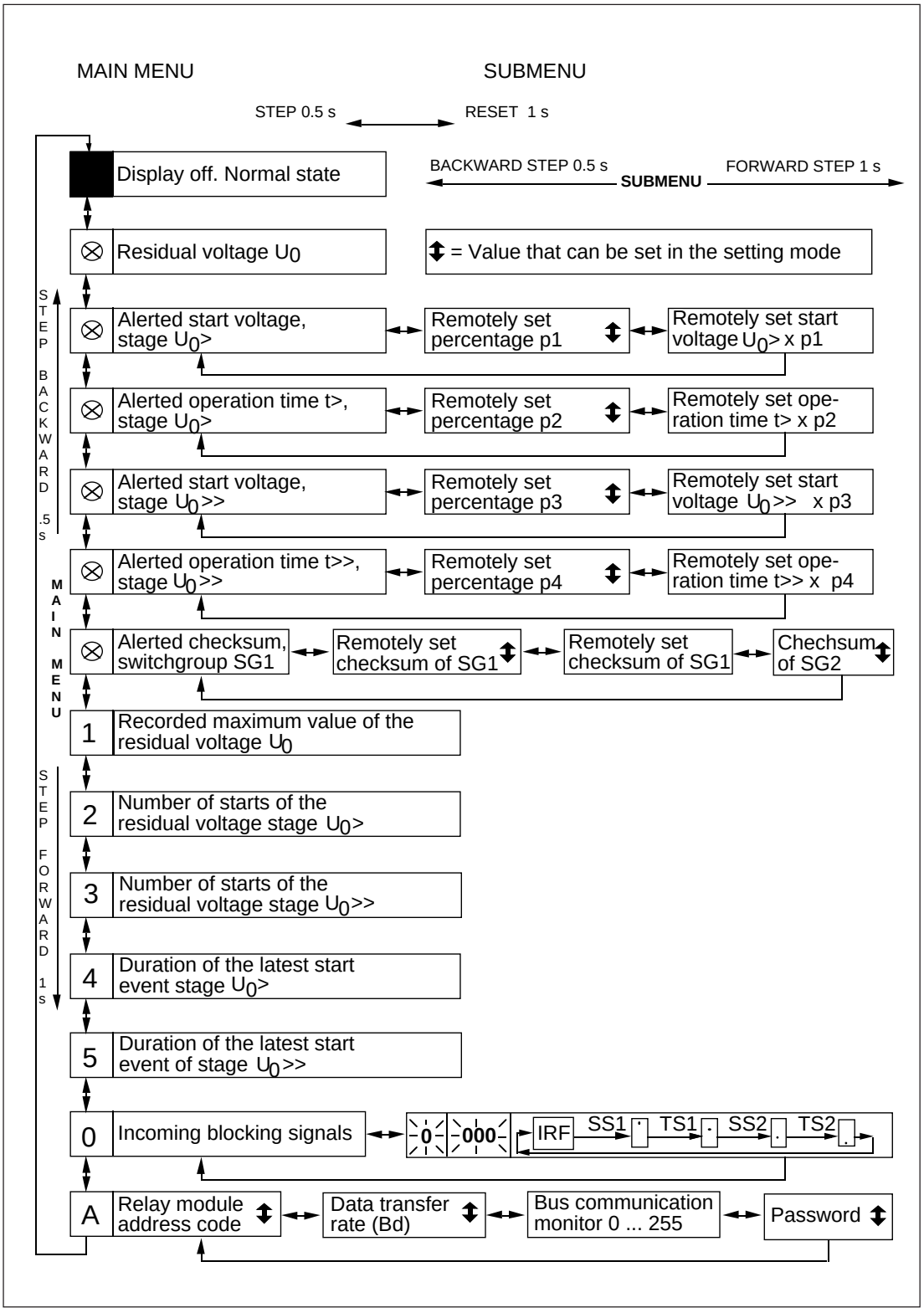


Fig. 4. Main menu and submenus of the residual overvoltage relay module SPCU 1C6.

The procedure for entering a submenu or a setting mode and configuring the module is described in detail in "General characteristics of C type relay modules".

Low-set overvoltage stage U_0>

Start voltage U_0>	2...20% x U_n or 10...100% x U_n
Start time, typically	70 ms
Operate time	0.05...1.00 s, 0.5...10.0 s or 5...100 s
Reset time	<100 ms
Drop-off/pick-up ratio, typically	0.96
Operate time accuracy	±2% of set value or ±40 ms
Operation accuracy	
- 10...100% x U_n	±3% of set value
- 2...20% x U_n	±5% of set value

High-set overvoltage stage U_0>>

Start voltage U_0>>	10...80% x U_n and ∞, infinite or 2...16% x U_n and ∞, infinite
Start time, typically	70 ms
Operate time	0.05...1.00 s, 0.5...10.0 s or 5...100 s
Reset time	<100 ms
Drop-off/pick-up ratio, typically	0.96
Operate time accuracy	±2% of set value or ±40 ms
Operation accuracy	
- 10...80% x U_n	±3% of set value
- 2...16% x U_n	±5% of set value

Serial communication parameters

Event codes

The substation level control data communicator is able to read, over the SPA serial bus, the event messages of the relay module, e.g. start and trip messages, from the residual overvoltage relay module SPCU 1C6. The events can be printed out in the format: time (ss.sss) and event code. The event codes of the relay module are E1...E8 , E50 and E51. Additional event codes relating to the data communication are generated by the data communication equipment.

The event codes E1...E8 and the events represented by these can be included in or excluded from the event reporting by writing, via the SPA bus, an event mask (V155) to the relay module. The event mask is a binary number coded to a decimal number. The event codes E1...E8 are represented by the numbers 1, 2, 4...128. The event mask is formed by multiplying the above numbers either with 0, event not included or 1, event included in reporting and by adding the products, see instructions for checksum calculation.

The event mask may take a value within the range 0...255. The default value of the residual overvoltage relay module SPCU 1C6 is 85, which means that any start or operation event is included in the reporting, but no resettings. The event codes E50...E54 and the events represented by these cannot be excluded from the reporting.

Event codes of residual voltage relay module SPCU 1C6:

Code	Event	Weighting coefficient	Default setting
E1	Starting of stage U_0>	1	1
E2	Starting of stage U_0> reset	2	0
E3	Tripping of stage U_0>	4	1
E4	Operation of stage U_0> reset	8	0
E5	Starting of stage U_0>>	16	1
E6	Starting of stage U_0>> reset	32	0
E7	Tripping of stage U_0>>	64	1
E8	Operation of stage U_0>> reset	128	0
	Default value of event mask V155		85

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

0 not included in the event reporting
1 included in the event reporting
* no code number, always included in event reporting
\- cannot be set

NOTE!
In the SPACOM system the event codes E52... E54 are generated by the station level control data communicator, e.g. type SRIO 1000M.

Data to be transferred over the serial bus

In addition to the event code data transfer, the input data (I data), output data (O data), setting values (S), memorized data (V data) and some other data can be read from the relay module over the serial communication bus. Further, part of the data can be changed over the SPA bus by separate commands. All data information is available in channel 0.

Data	Code	Data direct.	Values
Input data			
Energizing input voltage	I1	R	0...250% x U_n
Blocking of operation of stage U_0>	I2	R	0 = no blocking 1 = operation of stage U_0> blocked
Blocking of operation of stage U_0>>	I3	R	0 = no blocking 1 = operation of stage I_0>> blocked
Output data			
Starting of stage U_0>	O1	R	0 = stage U_0> not started 1 = stage U_0> started
Operation of stage U_0>	O2	R	0 = stage U_0> not tripped 1 = stage U_0> tripped
Starting of stage U_o>>	O3	R	0 = stage U_0>> not started 1 = stage U_0>> started
Operation of stage U_0>>	O4	R	0 = stage U_0>> not tripped 1 = stage U_0>> tripped
Setting values			
Alerted start value of stage U_0>	S1	R	2...100% x U_n
Alerted operate time of stage U_0>	S2	R	0.05...100 s
Alerted start value of stage U_0>>	S3	R	2...80% x U_n 999 = ∞, infinite
Alerted operate time of stage U_0>>	S4	R	0.05...100 s
Alerted checksum of switchgroup SG1	S5	R	0...255
Start value of stage U_0>, set with the setting knob	S11	R	2...100% x U_n
Operate time of stage U_0>, set with the setting knob	S12	R	0.05...100 s
Start value of stage U_0>>, set with the setting knob	S13	R	2...80% x U_n 999 = ∞, infinite
Operate time of stage U_0>>, set with the setting knob	S14	R	0.05...100 s
Checksum of switchgroup SG1, set with the switches	S15	R	0...255
Remotely setting percentage of the start value of stage U_0>	S21	R, W	0...999%
Remotely setting percentage of the operate time of stage U_0> or time multiplier	S22	R, W	0...999%
Remotely set percentage for the start value of stage U_0>>	S23	R, W	0...999%
Remotely setting percentage for the operate time of stage U_0>>	S24	R, W	0...999%
Remotely set checksum of switchgroup SG1	S25	R, W	0...255

Data	Code	Data direct.	Values
Remotely set start value of stage U_0>	S31	R	2...100% x U_n
Remotely set operate time of stage U_0>	S32	R	0.05...100 s
Remotely set start value of stage U_0>>	S33	R	2...80% x U_n 999 = ∞, infinite
Remotely set operate time of stage U_0>>	S34	R	0.05...100 s
Remotely set checksum of switchgroup SG1	S35	R	0...255
Max. measured voltage or voltage at operation	V1	R	0...250% x U_n
Number of starts of stage U_0>	V2	R	0...255
Number of starts of stage U_0>>	V3	R	0...255
Duration of the latest start situation of stage U_0>	V4	R	0...100%
Duration of the latest start situation of stage U_0>>	V5	R	0...100%
Resetting of output relays and operation indicators	V101	W	1 = output relays and operation indicators reset
Resetting of output relays and operation indicators and erasing of recorded data	V102	W	1 = output relays and operation indicators reset and registers (codes V1…V5) erased
Remote control of settings	V150	R, W	0 = setting with knobs S11...S15 activated 1 = remote settings S31...S35 activated
Event mask word	V155	R, W	0...255, see section "Event codes"
Manual reset or self-reset mode of operation of the LED indicators	V156	R, W	0…15, see section "Selector switches"
Opening of password for remote settings	V160	W	1...999
Changing or closing of password for remote settings	V161	W	0...999
Activation of self-supervision function	V165	W	1 = self-supervision output is activated and the IRF indicator turns on in about 5 seconds, whereafter the self-supervision system and the IRF indicator reset
Internal fault code	V169	R	0…255
Data communication address of the relay module	V200	R	1...254
Program version	V205	R	070_

Data	Code	Data direct.	Values
Type designation of the relay module	F	R	SPCU 1C6
Reading of event register	L	R	Time, channel number and event code
Re-reading of event register	B	R	Time, channel number and event code
Reading of module status data	C	R	0 = normal state 1 = module been subject to automatic reset 2 = overflow of event register 3 = events 1 and 2 together
Resetting of module status data	C	W	0 = resetting
Time reading or setting	T	R, W	00.000...59.999 s

R = data to be read from the module
W = data to be written to the module

The data transfer codes L, B, C and T have been reserved for the event data transfer between the relay module and the control data communicator.

The event register can be read by the L command only once. Should a fault occur, for example, in the data transfer, it is possible, by using the B command, to re-read the contents of the event register once already read by means of the L command. When required, the B command can be repeated.

The setting values S1...S5 are the alerted set values currently used by the protection relay module. These values are set either by remote control or by means of the setting knobs. The values S11...S15 are set with the setting knobs and the selector switches. Variables S21...S25 are set as percentage values via remote control.

The settings S21...S25 allow reading or writing. A condition for writing is that the password V160, for remote setting has been opened. The variables S31...S35 contain the remote setting values.

When the values of the variables S21...S24 are to be changed, the variables can be given a percentage factor within the range 0...999. It is possible to alter a setting value beyond the setting ranges specified in the technical data of the relay module. However, the validity of the setting values are guaranteed only within the setting ranges specified in the technical data.

Activation of the self-supervision function (V165) prevents the relay module from operating as long as the self-supervision output is activated and the IRF indicator is lit.

Fault codes

Once the self-supervision system has detected a permanent relay fault, the IRF LED on the front panel of the module is lit, and at the same time the normally operated signal relay of the self-supervision system drops off.

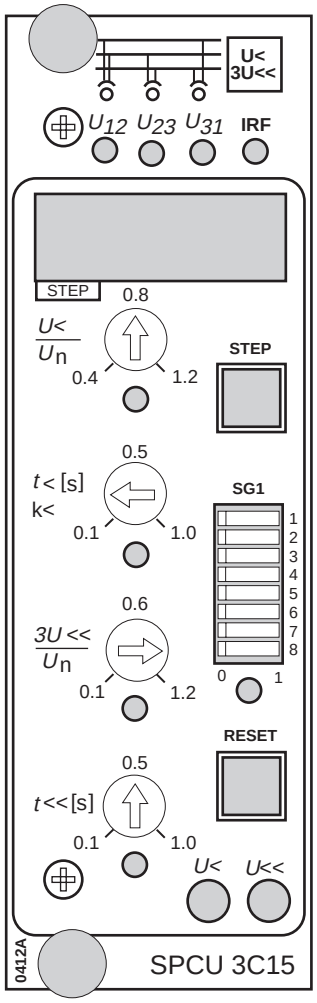
In most fault situations an auto-diagnostic fault code is shown on the relay display. The fault code cannot be reset. The fault code consists of a red digit one (1) and a green code number that indicates the fault type. The fault code should be recorded and stated when service is ordered.

The fault codes of the residual overvoltage relay module SPCU 1C6 are explained in the following table:

Fault code	Explanation
4	Faulty output relay path or missing output relay card
30	Faulty program memory (ROM)
50	Faulty working memory (RAM)
195	Too low a value in reference channel with multiplier 1
131	Too low a value in reference channel with multiplier 5
67	Too low a value in reference channel with multiplier 25
203	Too high a value in reference channel with multiplier 1
139	Too high a value in reference channel with multiplier 5
75	Too high a value in reference channel with multiplier 25
253	No interruptions from the A/D-converter

SPCU 3C15
Undervoltage relay module

User´s manual and Technical description



1MRS 750588-MUM EN

Issued 96-12-02
Version A (replaces 34 SPCU 4 EN1)
Checked LWU
Approved TL

SPCU 3C15
Undervoltage relay module

Data subject to change without notice

Contents

Features

Three-phase undervoltage stage U< which operates when one of the three energizing voltages falls below the set start value

Three-phase undervoltage stage 3U<< which operates when all three energizing voltages simultaneously fall below the set start value

The undervoltage stage U< can be given either definite time or inverse time operation characteristic

Starting of stage U< can be blocked by an external control signal

Operation of stages U< and 3U<< can be blocked by an external control signal

Starting and operation of stage U< can be automatically blocked on loss of energizing voltage

Digital display of measured and set values and data recorded at the moment of operation

Continuous self-supervision of hardware and software of the relay module including self-diagnostics

Description of operation

The undervoltage relay module SPCU 3C15 measures three voltages. The module includes two undervoltage stages. One of the stages operates if at least one of the three measured voltages falls below the set start value, while the other stage operates when all of the three voltages fall below the set start value.

If one of the three voltages measured by the module falls below the set start value of stage U<, the module delivers a start signal SS1 after the set start time has elapsed. The start time of stage U< is selected by means of the selector switches 1 and 2 of switchgroup SG1 and four alternative start time values are available.

After the preset operate time t<, the undervoltage stage U< delivers an operation signal TS1. The setting range of the operate time, 0.1…1.0 s or 1…10 s, is selected by means of switch SG1/4. If the operation of the U< stage is based on inverse time operation characteristic, the operate time depends on how much the voltage falls below the set start value. Switch SG1/3 is used for selecting the operation characteristic, definite time or inverse time. The inverse time operation of stage U< has one operation characteristic.

If all the three voltages measured by the module fall below the set start value of the 3U<< stage, the module delivers a start signal SS2 when the set start time has elapsed. The start time of the 3U<< stage is selected by means of switch SG1/6. Two alternative start time values are available.

After the preset operate time t<<, an operation signal TS2 is delivered by the undervoltage stage 3U<<, if all the three voltages remain below the set start value. One out of the two setting ranges available for the operate time is selected with switch SG1/7.

To avoid unwanted operations, for instance, during an auto-reclose sequence, starting and operation of the undervoltage stage U< can be blocked by means of switch SG1/5. The blocking function is activated if one of the three measured voltages falls to a value below 0.2 x U_n. This function is illustrated in fig. 1.

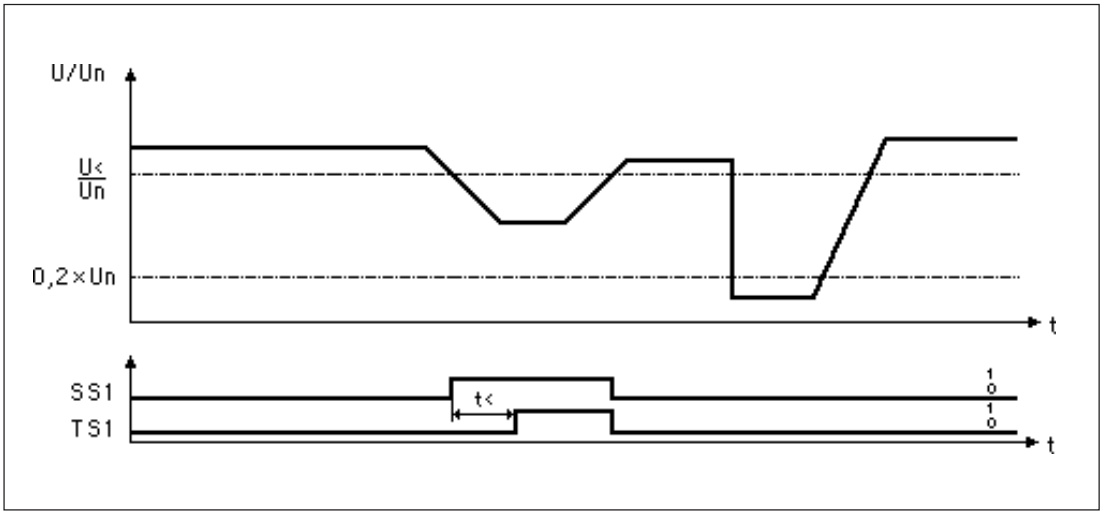


Fig. 1. Operation characteristic of stage U< of the undervoltage relay module, when the selector switch SG1/5 = 1.

The operation of stage U< can be blocked when stage 3U<< starts. The selection is made with switch SG1/8.

The operation of both stages can be blocked by means of external blocking signals. The blockings are selected separately for each relay unit, by means of switchgroup SGB on the relay module. Instructions for setting the switchgroup are given in the user's manual of the concerned protection relay unit and in the diagram illustrating the signals between the relay modules of the protection relay unit.

Block diagram

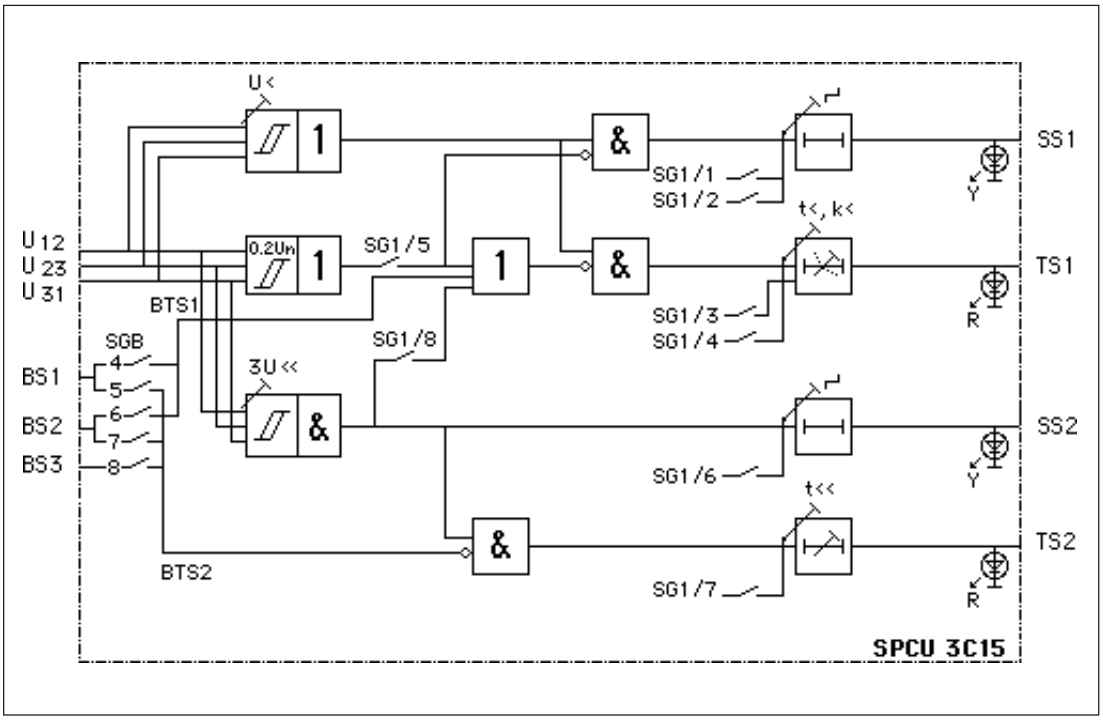


Fig. 2. Block diagram for undervoltage relay module SPCU 3C15.

U_{12}, U_{23}, U_{31}	Measured phase-to-phase voltages
BS1, BS2, BS3	External blocking signals for the operation of stage U<
BTS1	Blocking signal for the operation of stage U<
BTS2	Blocking signal for the operation of stage 3U<<
SG1	Front panel selector switchgroup
SGB	Selector switchgroup for blocking configuration (on the PC board)
SS1	Start signal of stage U<
TS1	Trip signal of stage U<
SS2	Start signal of stage 3U<<
TS2	Trip signal of stage 3U<<
Y	Yellow indicator
R	Red indicator

Note!
All input and output signals of the relay module are not necessarily wired to the terminals of every protection relay unit including this module. The signals wired to the terminals are shown in the signal diagram illustrating the concerned protection relay unit, see user's manual.

Front panel

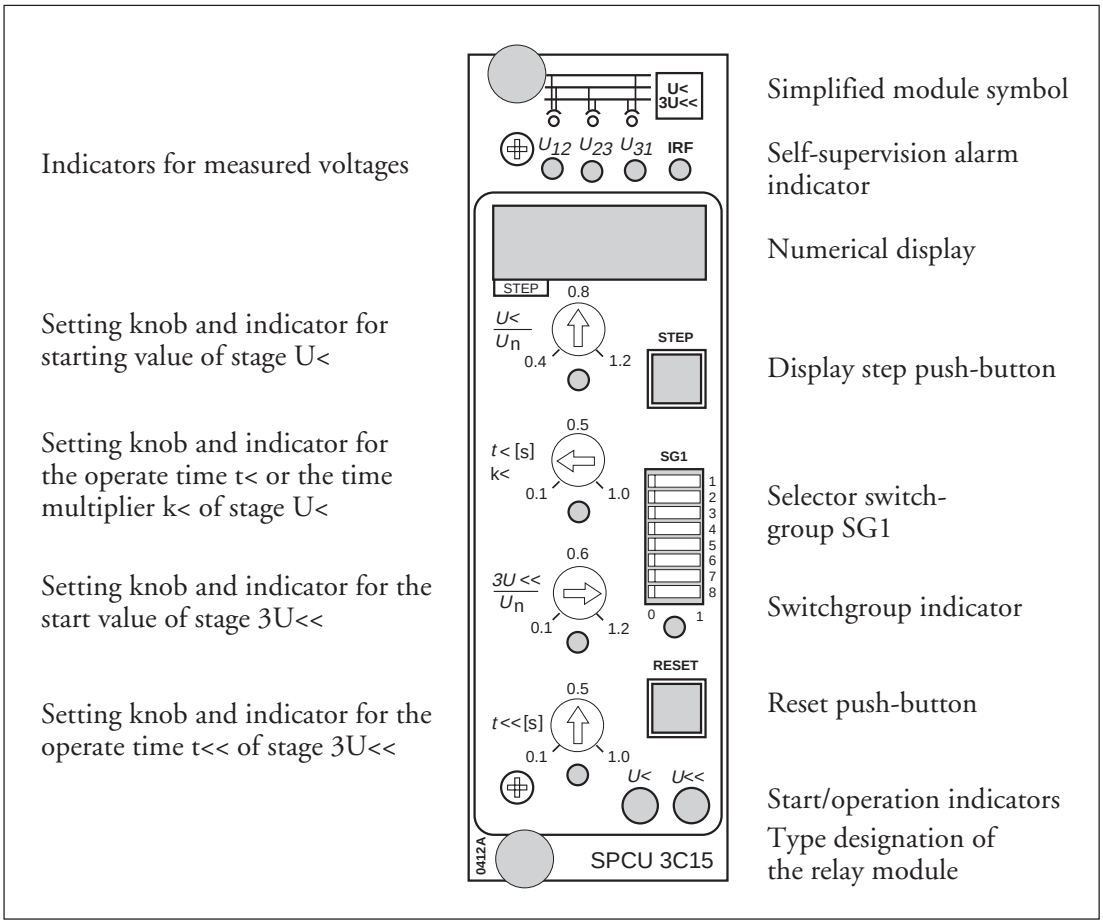


Fig. 3. Front panel of undervoltage relay module SPCU 3C15.

Start and operation indicators

Each stage has its own yellow/red operation indicator. Yellow light indicates starting of the operation stage and red light indicates that the stage has delivered a tripping signal.

The red indicator remains lit when the operation stage resets, thus indicating which protection stage operated. The operation indicator is reset by pressing the RESET push-button. The function of the relay module is not affected by an unreset operation indicator.

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 a permanent internal fault has been detected. At the same time the relay module delivers a control signal to the self-supervision output relay of the protection relay. Further, in most fault cases, a fault code indicating the type of fault appears on the display of the relay module. The fault code is to be recorded to serve the subsequent fault location and repair actions.

Settings

The setting values are shown by the three rightmost green digits of the display. The LED indicator below the setting knob shows, when lit, the setting value currently being shown on the display.

U</U_n	Start value of stage U< as a multiple of the rated voltage of the relay energizing input. Setting range 0.4…1.2 x U_n.
t< [s]	Operate time of stage U<, expressed in seconds, at definite time operation characteristic. The required setting range, 0.10…1.00 s or 1.00…10.0 s, is selected with switch SG1/4. At IDMT mode of operation the setting range 0.1…1.0 of the multiplier k> is 0.05…1.00.
3U<</U_n	Start value of stage 3U<< as a multiple of the rated voltage of the energizing input. Setting range 0.1…1.2 x U_n.
t<< [s]	Operate time of stage 3U<< expressed in seconds. The setting range is selected with switch SG1/7, alternatives 0.10…1.00 s and 1.00…10.0 s.

Further, the checksum of the selector switchgroup SG1 is indicated on the display when the indicator under the switchgroup is lit. In this way a check can be made to prove that the switches have been set and that they work properly. An example of calculating the checksum is given in the description "General characteristics of C-type relay modules".

Selector switches

Additional relay functions required in various applications are selected by means of the selector switches of switchgroup SG1 located on the front panel of the relay module. The numbering of the switches, 1…8, and the switch positions, 0 and 1, are marked on the front panel.

<table>
<tr><th>Switch</th><th>Function</th></tr>
<tr><td>SG1/1
SG1/2</td><td>Selection of start time for the undervoltage stage U<.
<table>
<tr><th>SG1/1</th><th>SG1/2</th><th>Start time</th></tr>
<tr><td>0</td><td>0</td><td>0.1 s</td></tr>
<tr><td>1</td><td>0</td><td>1 s</td></tr>
<tr><td>0</td><td>1</td><td>5 s</td></tr>
<tr><td>1</td><td>1</td><td>30 s</td></tr>
</table></td></tr>
<tr><td>SG1/3
SG1/4</td><td>Selection of definite time or IDMT mode of operation for the undervoltage stage U< and the setting range of the operate time at definite time mode of operation.
<table>
<tr><th>SG1/3</th><th>SG1/4</th><th>Mode of operation</th><th>Operate time t<</th></tr>
<tr><td>0</td><td>0</td><td>Definite time</td><td>0.1…1.0 s</td></tr>
<tr><td>0</td><td>1</td><td>Definite time</td><td>1…10 s</td></tr>
<tr><td>1</td><td>0</td><td>Inverse time</td><td>-</td></tr>
<tr><td>1</td><td>1</td><td>Inverse time</td><td>-</td></tr>
</table></td></tr>
</table>

Switch	Function
SG1/5	Selection of automatic blocking of starting and tripping of the undervoltage stage U<. When SG1/5 = 0, the undervoltage stage U< always operates when at least one of the measured voltages falls below the set start value. When SG1/5 = 1, the starting and tripping of the undervoltage stage U< is blocked if at least one of the three measured voltages falls to a value below 0.2 x U_n. This feature can be used for preventing unnecessary startings and tripping during auto-reclose sequences.
SG1/6	Selection of start time for undervoltage stage 3U<<. When SG1/6 = 0, the start time is 0.1 s. When SG1/6 = 1, the start time is 1 s.
SG1/7	Selection of setting range for the operate time t<< of the undervoltage stage 3U<<. When SG1/7 = 0, the setting range of the operate time is 0.1…1.0 s. When SG1/7 = 1, the setting range of the operate time is 1…10 s.
SG1/8	Operation of undervoltage stage U< blocked by start signal from stage 3U<<. When SG1/8 = 0, the stage U< always operates, irrespective of the operation of stage 3U<<. When SG1/8 = 1, the operation of stage U< is blocked on starting of stage 3U<<.

The PC board of the relay module contains a switchgroup SGB with eight switches. The switches 1…3 are used for configuring the start signals going from the module, whereas the switches 5, 7 and 8 are used for configuring the blocking signals applied on the undervoltage stage 3U<< in various protection relay units. Switches 4 and 6 are used for configuring blocking signals to stage U<. Instructions for setting the switchgroup SGB are given in the user's manual of the protection relay unit and in the signal diagram of the relay.

Measured data

Measured values are presented with the rightmost three green digits on the display. Data to be presented are indicated by LED indicators on the front panel.

Indicator	Measured data
U_{12}	The U_{12} voltage measured by the module as a multiple of the rated voltage of the relay energizing input.
U_{23}	The U_{23} voltage measured by the module as a multiple of the rated voltage of the relay energizing input.
U_{31}	The U_{31} voltage measured by the module as a multiple of the rated voltage of the relay energizing input.

Recorded information

The leftmost red digit on the display indicates the register address and the three rightmost digits the recorded information.

Register/ STEP	Recorded information
1	Minimum voltage measured by the module as a multiple of the rated voltage of the relay energizing input, the last time when one of the three measured voltages passed below the set start value of stage U<. Operation of the undervoltage stage stops the data recording sequence. Starting of the undervoltage stage erases a previously recorded value and starts a new recording sequence.
2	Maximum voltage measured by the module after the previous resetting of the registers, as a multiple of the rated voltage of the relay energizing input.
3	Lowest level of the highest voltage of the three voltages measured by the module the last time when stage 3U<< was activated, as a multiple of the rated voltage of the relay energizing input. A new start of the stage erases the previous value and starts a new data recording sequence. Operation of the stage stops the recording sequence.
4	Minimum voltage measured by the module after the previous resetting of the registers, as a multiple of the rated voltage of the relay.
5	Number of starts of the undervoltage stage U<, n (U<) = 0…255.
6	Number of starts of the undervoltage stage 3U<<, n (U<<) = 0…255.
7	Duration of the latest start event of the undervoltage stage U<, expressed as a percentage of the set operate time t<, or, at IDMT mode of operation of the calculated operate time. A new start resets the counter, which starts counting from zero again. If the stage has tripped, the counter reading is 100.
8	Duration of the latest start situation of the undervoltage stage 3U<<, expressed as a percentage of the set operate time t<<. A new start resets the counter, which starts recounting from zero. If the stage has tripped, the counter reading is 100.
0	Display of blocking signals and other external control signals. The rightmost green digit indicates the state of the blockings of the undervoltage stages. The following states are indicated: 0 = no blockings 1 = operation of the undervoltage stage U< blocked 2 = operation of the undervoltage stage 3U<< blocked 3 = operation of both stages blocked The middle digit of the register is always a zero. The leftmost green digit indicates the state of the remote reset input, if any. The following states are indicated: 0 = remote reset control input not energized 1 = remote reset control input energized From this register it is possible to move on to the TEST mode, where the starting and tripping signals of the module can be activated one by one. For further details see description "General characteristics of C-type relay modules".

Register/ STEP	Recorded information
A	The address code of the measuring relay module, required by the serial communication system. Submenu 1: Selection of the data transfer rate. Submenu 2: Bus traffic monitor. If the relay module is connected to a data communication system and the communication is operating, the counter reading of the bus traffic monitor will be 0. Otherwise the numbers 0...255 are continuously rolling in the counter. Submenu 3: Password required for remote setting. The password given in the setting mode of a submenu must always be entered via the serial communication before the settings can be altered remotely. If the module is connected to a control data communicator, for instance type SRIO 1000M and the data communication is operating, the counter of the monitor is zero. If the communication is interrupted the digits 0…255 are continuously scrolling in the counter.

When the display is dark, the register can be re-entered by pressing the STEP push-button.

The registers 1…8 are cleared by pressing the push buttons STEP and RESET simultaneously or via the SPA bus using the command V102. The registers are also cleared if the auxiliary power supply to the module is interrupted. The address code of the relay module, the data transfer rate of the serial communication system and the password are not erased by interruptions in the auxiliary supply. The instructions for setting the address and the data transfer rate are given in the manual "General characteristics of C-type relay modules".

At the initial state when none of the stages has started, the reading of register 1 is "000" and that of register 3 is "- - -".

Menu chart

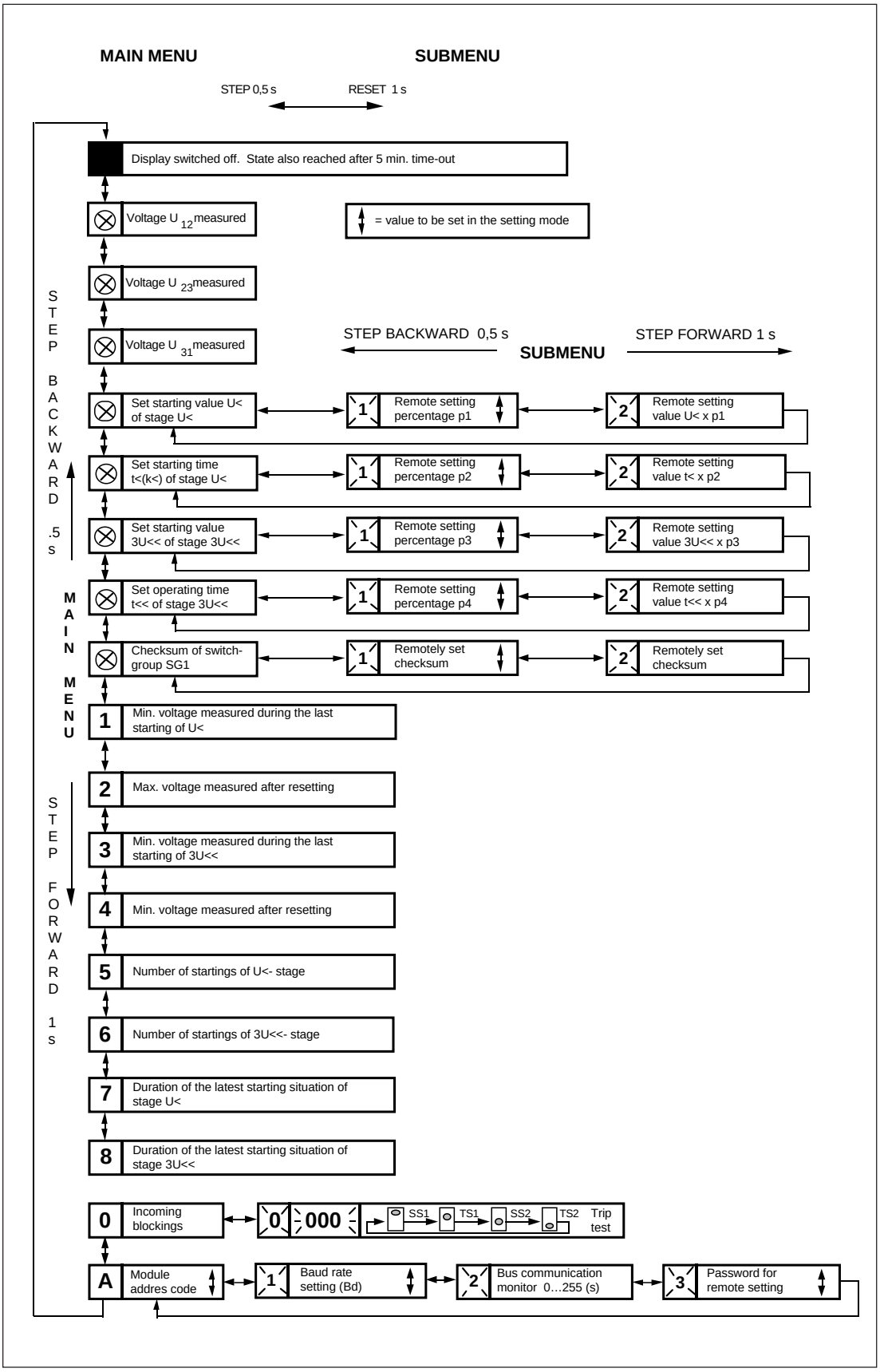


Fig. 4. Main menus and submenus of the undervoltage relay module SPCU 3C15.

The procedure for entering a submenu or a setting mode and configuring the module is described in detail in "General characteristics of C-type relay modules".

Inverse time characteristics

At IDMT operation characteristic the operate time of the undervoltage stage U< is shorter the lower the voltage in comparison with the set start voltage.

The operation of the U< stage is based on an IDMT operation characteristic, when the selector switch SG1/3 on the front panel is in the position 1. The relationship between time and voltage at an IDMT operation characteristic can be expressed as:

$$t = \frac{k< \text{ x } a}{\left(\frac{U< - U}{U<} \right) p} + d \text{ [s]}$$

where
t = operate time /s
k< = time multiplier
U = voltage value /V
U< = set start voltage /V
a = constant 480
b = constant 32
d = constant 0.055
p = constant 2

Recording of the operation time does not start until the voltage falls to a value of 6% below the set start value. The operate time accuracy stated in the technical data applies when the voltage falls to a level of 10% below the set start value. The undervoltage stage includes one operation characteristic with one degree of inversity.

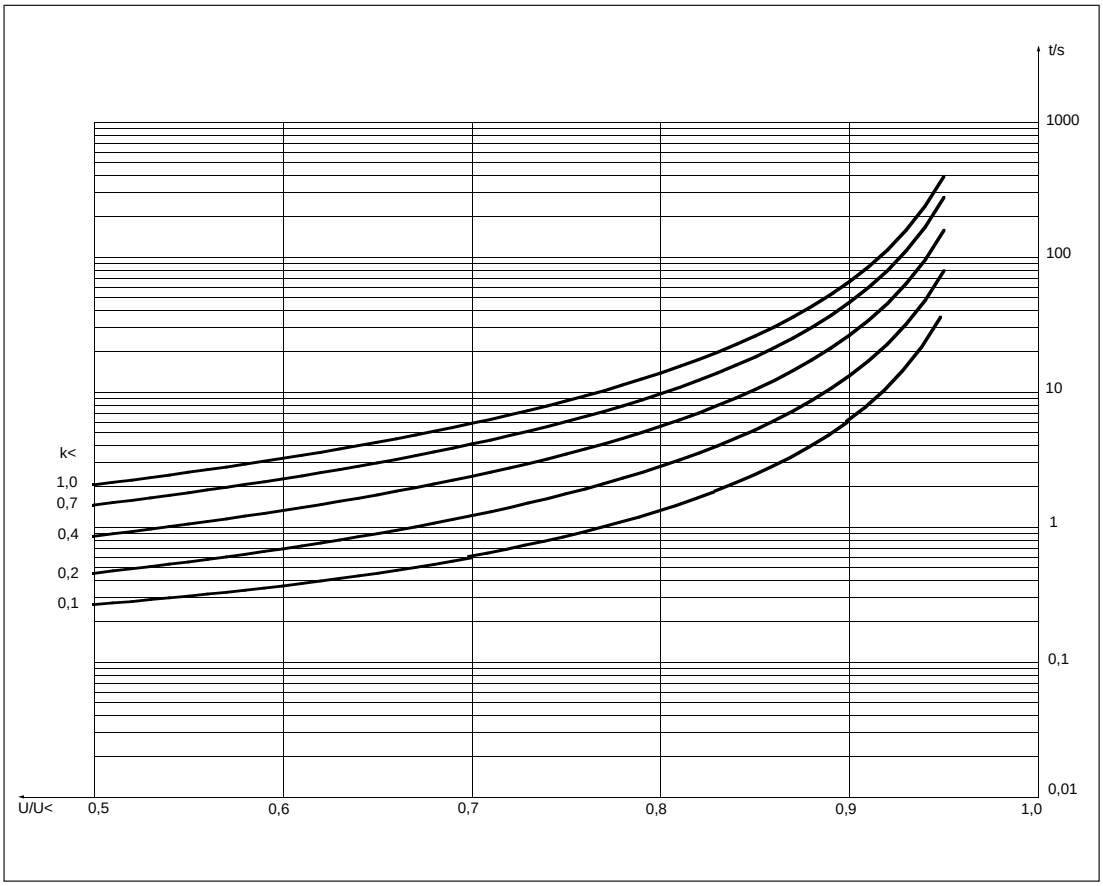


Fig. 5. Inverse time operation characteristic of the undervoltage stage U<.

Undervoltage stage U<

Start voltage U<	0.4…1.2 x U_n
Start time	0.1 s, 1 s, 5 s or 30 s
Operate time at definite time operation characteristic	1.1…1.00 s or 1…10 s
Time multiplier k< at IDMT operation characteristic	0.1…1.00
Reset time	≤80 ms
Drop-off/pick-up ratio	≥1.03
Operate time accuracy at definite time operation characteristic and start time accuracy	±2% of set value or ±25 ms
Operate time accuracy at IDMT operation characteristic	±25 ms or the inaccuracy appearing when the measured voltage varies ±3%
Operate accuracy	±3% of set value

Undervoltage stage 3U<<

Start voltage 3U<<	0.1…1.2 x U_n
Start time	0.1 s or 1.0 s
Operate time at definite time operation characteristic	0.1…1.0 s or 1…10 s
Reset time	≤80 ms
Drop-off/pick-up ratio	
- when the start value of the 3U<< stage >0.4	≤1.03
- when the start value of the 3U<< stage <0.4	approx. 1.1
Operate time accuracy and start time accuracy	±2% of set value or ±25 ms
Operate accuracy	±3% of set value

Serial communication parameters

Event codes

The substation level control data communicator is able to read, over the SPA serial bus, the event data of the module, e.g. starting and tripping, from the undervoltage relay module SPCU 3C15. Event information called for are printed out in the format: time (ss.sss) and event code. The event codes of the module are E1...E8, E50 and E51. Furthermore, the substation level control data communicator forms event codes relating to the data communication.

The codes E1...E8 and the events represented by these can be included in or excluded from the event reporting by writing, over the SPA bus, a so called event mask (V155) to the module. The event mask is a binary number coded to a decimal number. The event codes E1...E8 are represented by the numbers 1, 2, 4...128. The 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 calculation of checksum).

The event mask may have a value in the range 0...255. The default value of the undervoltage relay module SPCU 3C15 is 85, which means that all startings and trippings are included in the reporting, but not the resetting. The codes E50...E54 and the events represented by these cannot be excluded from the reporting.

Event codes for undervoltage relay module SPCU 3C15:

Code	Event	Weighting coefficient	Default setting
E1	Starting of undervoltage stage U<	1	1
E2	Starting of undervoltage stage U< reset	2	0
E3	Tripping of undervoltage stage U<	4	1
E4	Tripping of undervoltage stage U< reset	8	0
E5	Starting of stage 3U<<	16	1
E6	Starting of stage 3U<< reset	32	0
E7	Tripping of stage 3U<<	64	1
E8	Tripping of stage 3U<< reset	128	0
	Default value of event mask V155		85

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

0 not included in the event reporting
1 included in the event reporting
* no code number, always included in event reporting
- cannot be set

NOTE!
In the SPACOM system the event codes E52... E54 are generated by the station level control data communicator, e.g. type SRIO 1000M.

Data to be transferred over the serial bus

In addition to the event code data transfer, the input data (I data), output data (O data), setting values (S), memorized data (V data) and some other data can be read from the relay module over the serial communication bus. Further, part of the data can be changed over the SPA bus by separate commands. All data information is available in channel 0.

Data	Code	Data direct.	Values
Measured voltage U_{12}	I1	R	0…9.99 x U_n
Measured voltage U_{23}	I2	R	0…9.99 x U_n
Measured voltage U_{31}	I3	R	0…9.99 x U_n
Blocking of undervoltage stage U<	I4	R	0 = no blocking 1 = tripping of stage U< blocked
Blocking of undervoltage stage 3U<<	I5	R	0 = no blocking 1 = tripping of stage 3U<< blocked
Starting of undervoltage stage U<	O1	R	0 = U< stage not started 1 = U< stage started
Tripping of undervoltage stage U<	O2	R	0 = U< stage not tripped 1 = U< stage tripped
Starting of undervoltage stage 3U<<	O3	R	0 = 3U<< stage not started 1 = 3U<< stage started
Tripping of undervoltage stage 3U<<	O4	R	0 = 3U<< stage not tripped 1 = 3U<< stage tripped
Activated start value of stage U<	S1	R	0.4…1.2 x U_n
Activated operate time t< of stage U< or time multiplier k<	S2	R	0.1…10 s or 0.1…1.0
Activated start value of stage 3U<<	S3	R	0.1…1.2 x U_n
Activated operate time t<< of stage 3U<<	S4	R	0.1…10 s
Activated checksum of switchgroup SG1	S5	R	0…255
Start value of stage 3U<, set with the setting knob	S11	R	0.4…1.2 x U_n
Operate time or time multiplier of stage 3U< , set with the setting knob	S12	R	0.1…10 s or 0.1…1.0
Start value of stage 3U<<, set with the setting knob	S13	R	0.1…1.2 x U_n
Operate time of stage 3U<<, set with the setting knob	S14	R	0.1…10 s
Checksum of switchgroup SG1, (set with the switches)	S15	R	0…255
Remote setting percentage of the start value for stage U<	S21	R, W	0…999%
Remote setting percentage for the operate time or time multiplier of stage U<	S22	R, W	0…999%
Remote setting percentage for the start value of stage 3U<<	S23	R, W	0…999%
Remote setting percentage for the operate time of stage 3U<<	S24	R, W	0…999%
Remotely set checksum of switchgroup SG1	S25	R, W	0…255

Data	Code	Data direct.	Values
Remote setting of the start value of stage U<	S31	R	0.4…1.2 x U_n
Remote setting of the operate time or time multiplyer of stage U<	S32	R	0.1…10 s or 0.1…1.0
Remote setting of the start value of stage 3U<<	S33	R	0.1…1.2 x U_n
Remote setting of the operate time of stage 3U<<	S34	R	0.1…10 s
Remotely set checksum of switchgroup SG1	S35	R	0…255
Minimum voltage measured after starting of stage U<	V1	R	0…9.99 x U_n
Maximum voltage measured after resetting	V2	R	0…9.99 x U_n
Minimum voltage measured after starting of stage 3U<<	V3	R	0…9.99 x U_n
Minimum voltage measured after resetting	V4	R	0…9.99 x U_n
Number of starts of stage U<	V5	R	0…255
Number of starts of stage 3U<<	V6	R	0…255
Duration of the latest start event of stage U<	V7	R	0…100%
Duration of the latest start event of stage 3U<<	V8	R	0…100%
Resetting of recorded data	V102	W	1 = registers V1…V8 are reset
Remote control of settings	V150	R, W	0 = potentiometer settings S11…S15 activated 1 = remote settings S31…S35 activated
Event mask word	V155	R, W	0…255, see section "Event codes"
Opening of password for remote settings	V160	W	1…999
Changing or closing of password for remote settings	V161	W	0…999
Activation of self-supervision function	V165	W	1 = self-supervision output is activated and IRF indicator turns on in about 5 seconds, after which the self-supervision system and the IRF indicator reset
Data communication address of the relay module	V200	W	1…254
Program version	V205	R	018 _

Data	Code	Data direct.	Values
Type designation of the relay module	F	R	SPCU 3C15
Reading of event register	L	R	Time, channel number and event code
Re-reading of event register	B	R	Time, channel number and event code
Reading of module status data	C	R	0 = normal state 1 = module been subject to automatic reset 2 = overflow of event register 3 = events 1 and 2 together
Resetting of module status data	C	W	0 = resetting
Time reading or setting	T	R, W	00.000…59.999 s

R = data to be read from the relay module
W = data to be written to the relay module

The data transfer codes L, B, C and T have been reserved for the event data transfer between the relay module and the control data communicator.

The event register can be read by the L command only once. Should a fault occur, for example, in the data transfer, it is possible, by using the B command, to re-read the contents of the event register once already read by means of the L command. When required, the B command can be repeated.

The setting values S1...S5 are the alerted set values currently used by the protection relay module. These values are set either by remote control or by means of the setting knobs. The values S11...S15 are set with the setting knobs and the selector switches. Variables S21...S25 are set as percentage values via remote control.

The settings S21...S25 allow reading or writing. Acondition for writing is that password V160, for remote setting has been opened. The variables S31...S35 contain the remote setting values.

When the values of the variables S21...S24 are to be changed, the variables can be given a percentage factor within the range 0...999. It is possible to alter a setting value beyond the setting ranges specified in the technical data of the relay module. However, the validity of the setting values are guaranteed only within the setting ranges specified in the technical data.

Activation of the self-supervision funktion (V165) prevents the relay module from operating as long as the self-supervision output is activated and the IRF indicator is lit.

Fault codes

Once the self-supervision system has detected a permanent relay fault, the IRF LED on the front panel of the module is lit, and at the same time the normally operated signal relay of the self-supervision system drops off.

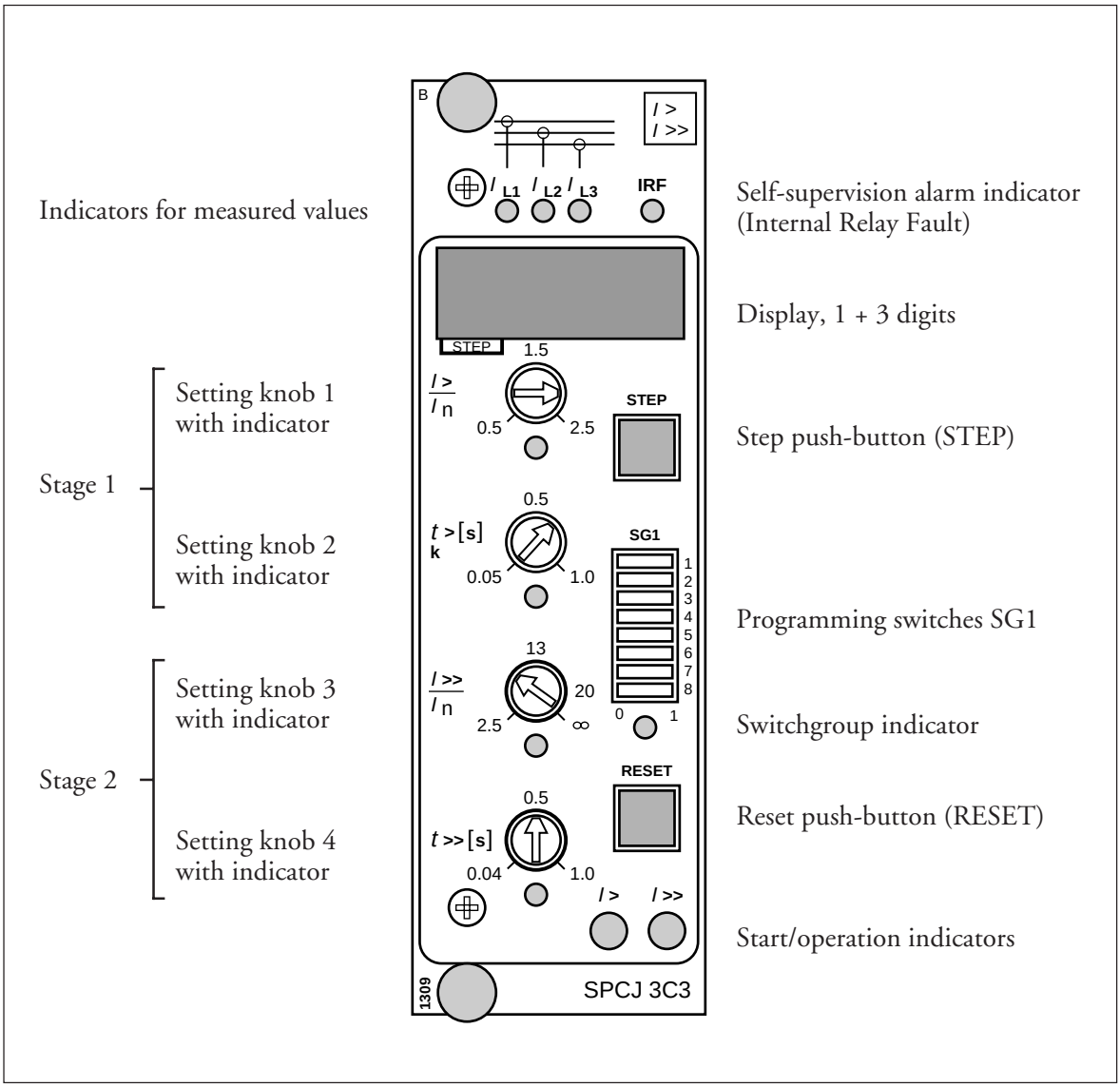
In most fault situations an auto-diagnostic fault code is shown on the relay display. The fault code cannot be reset. The fault code consists of a red digit one (1) and a green code number that indicates the fault type. The fault code should be recorded and stated when service is ordered.

The fault codes of the undervoltage relay module SPCU 3C15 are explained in the following table:

Fault code	Explanation
4	Faulty output relay path or missing output relay card
30	Faulty program memory (ROM)
50	Faulty working memory (RAM)
195	Too low a value in reference channel with multiplier 1
131	Too low a value in reference channel with multiplier 5
67	Too low a value in reference channel with multiplier 25
203	Too high a value in reference channel with multiplier 1
139	Too high a value in reference channel with multiplier 5
75	Too high a value in reference channel with multiplier 25
253	No interruptions from the A/D-converter

General characteristics of C-type relay modules

User´s manual and Technical description



1MRS 750328-MUM EN

Issued 96-02-19
Version A (replaces 34 SPC 2 EN1)
Checked L-W U
Approved TK

Data subject to change without notice

General characteristics of C-type relay modules

Contents

Push-buttons

The front panel of the relay module contains two push-buttons. The STEP button is used for stepping forward in the display and the RESET button for resetting the red indicators. Additionally, the push-buttons are used for certain settings, e.g. for setting the address of the relay module and the data transfer rate for the serial communication when the modules are used in relay packages provided with this quality. (See section Display).

Programming switches SG1

Part of the settings and the selections of the operating characteristics for the relay modules in various applications are made with the programming switches SG1 on the front panel. The indicator of the switchgroup glows when the checksum of the switchgroup is shown on the display. The checksum can be used for checking that the switches are properly set. Fig. 2 gives an example of calculating the checksum.

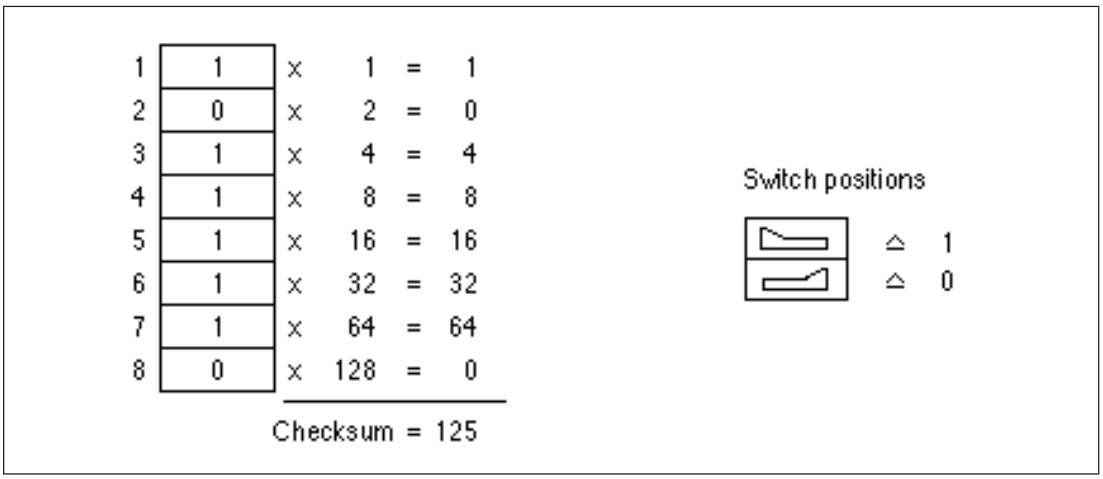


Fig. 2. Example of calculating the checksum of programming switchgroup SG1.

When the checksum calculated according to the example is equal to the checksum indicated on the display of the relay module, the switches are properly set.

The function of the programming switches of the individual measuring relay modules is specified in the description of the module concerned.

Setting knobs

Most of the operating values and operating times are set by means of the setting knobs on the front panel of the relay module. Each setting knob has its own (LED) indicator which glows when the concerned setting value is shown on the display.

If a setting knob is turned while the display is showing another measured or set value, the value being set automatically appears on the display. Simultaneously, the indicator for the concerned setting starts glowing.

In addition to the settings made with the setting knobs, most modules allow so called remote setting. This means that the settings made by means of the setting knobs of the module and the checksum of the programming switchgroup may be altered through an instruction over the serial communication bus. Remote setting is possible if the password in the register A is known, and the remote settings are not activated, i.e. parameter V150=0. The circumstance that the remote settings are activated is shown with a flashing light of the indicator of the setting knob, the value of which currently is being displayed.

Display

The measured and set values as well as the data recorded are shown on the display of the measuring relay module. The display consists of four digits. The three digits (green) to the right indicate the measured, set or stored value and the digit at the extreme left (red) the number of the register. The measured or set value displayed is indicated by a yellow LED indicator. The number of the register glows only when a stored value is displayed.

When the auxiliary voltage is connected to a measuring relay module, the module initially tests the display by stepping through the digits 1...9 for about 15 seconds. When the test is finished the display turns dark. The testing can be interrupted by pressing the STEP button. The protective functions of the module are operative throughout the testing.

Display main menu

All the data required during normal operating conditions are accessible from the main menu which presents the measured values in real-time, the normal setting knob settings as well as the most important memorized data.

The data to be shown in the main menu are selected to the display in a certain sequence by means of the STEP button. When pressing the STEP button for about one second, the display moves forward in the display sequence. When pressing it for about 0.5 seconds, the display moves backwards in the display sequence.

From a dark display only forward movement is possible. When keeping the STEP button depressed, the display is continuously moving in forward direction stopping for a while at the dark point.

Unless the display is switched off by stepping to the dark point, it remains activated for about 5 minutes from the last pressing of the STEP button and then goes out.

Display submenu

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 module.

A submenu is entered from the main menu by pressing the RESET button for about one second. When the button thereafter is released, the red digit (STEP) of the display starts flashing, indicating that one is in a submenu. 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; the display moves forward when pressing the STEP button for one second and backward when pressing it for 0.5 seconds. The return to the main menu has taken place when the red STEP display turns dark.

When entering a submenu from a measured or set value indicated by a LED indicator, the indicator remains glowing and the address window (STEP) of the display starts flashing. A flashing address window when no LED indicator is lit indicates that the submenu of a register has been entered.

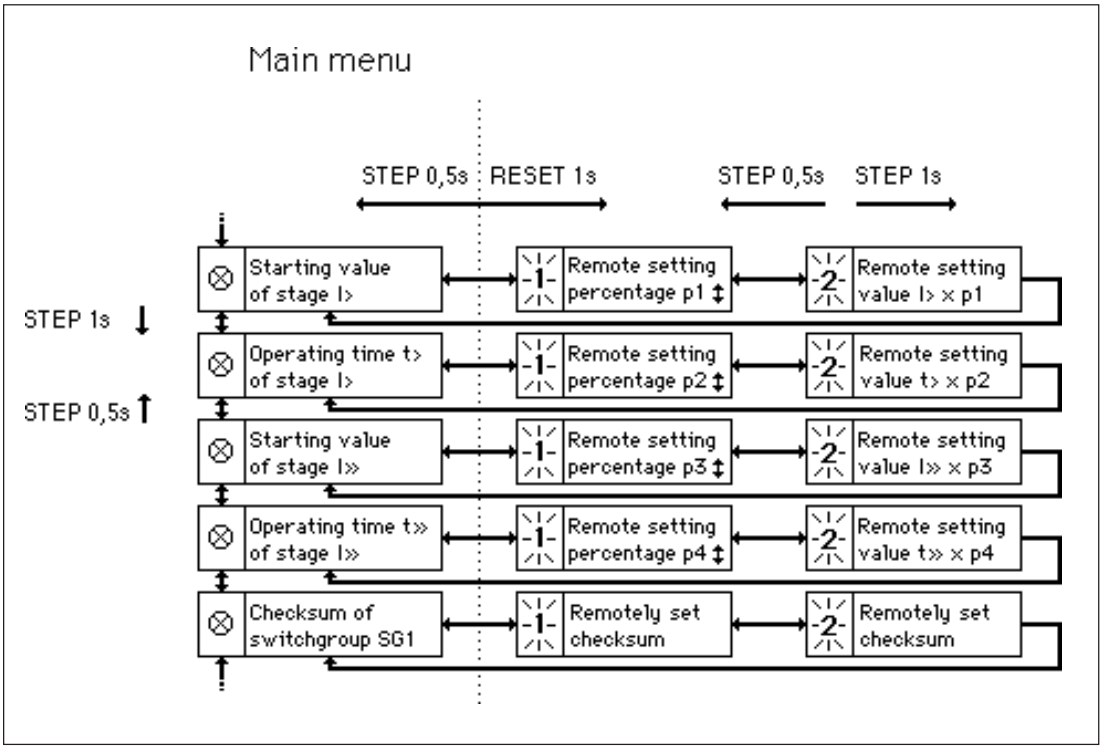


Fig. 3. Example of the main and submenus for the settings of the overcurrent relay module SPCJ 3C3. The settings made with the setting knobs are in the main menu and they are displayed by pressing the STEP button. In addition to the setting knob settings the main menu contains the measured current values as well as the registers 1…5, as well as 0 and A. The remote setting percentage and remote setting value are located in the submenus for the settings and are activated on the display by pressing the RESET button.

Setting mode

The registers of the main menu and the submenus also contain parameters to 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 RESET button, until the digit at the extreme right starts flashing (about 10 s). The flashing digit is set by means of the STEP button. The flashing is moved on from digit to digit by pressing the RESET button.

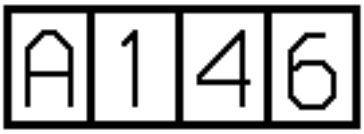
A set value is stored in the memory by pressing the push-buttons STEP and RESET simultaneously. In practice the RESET button must be pressed slightly in excess of the STEP button. Return from the setting mode to the main menu or submenu is possible by pressing (for about 10 s) the RESET button until the green digits on the display stop flashing. If the module is left in the setting mode, it will return automatically to the start condition after about 5 minutes.

The values to be set in the setting mode are for instance the address code of the relay module and the data transfer rate for the serial communication. Further the percentage values for the remote settings can be changed.

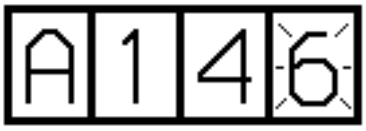
Example 1:

Function in the setting mode. Manual setting of the address code of a relay module and the data transfer rate for the serial communication. The initial value for the address code is 146.

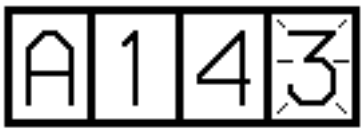
a)
Press push-button STEP until register address A appears on the display.



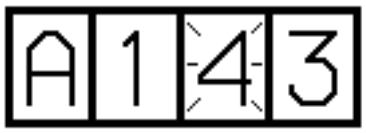
b)
Press the RESET button for about 10 s until the right most digit starts flashing.



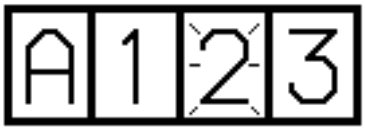
c)
Press the STEP button repeatedly to set the digit to the value desired.



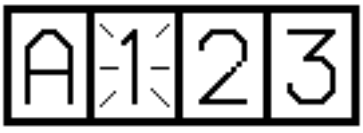
d)
Press the RESET button to make the middle of the green digits flash.



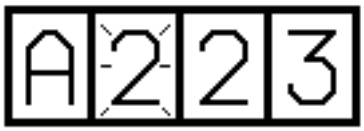
e)
Set the middle address digit by means of the STEP button.



f)
Press the RESET button to make the left most green digit flash.

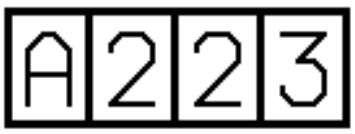


g)
Set the digit by means of the STEP button.



h)
Store the set address number in the memory of the relay module by pressing the RESET and STEP button simultaneously. At the moment the information enters the memory, the three green dashes flash in the display, i.e. A—.

i)
Leave the setting mode by pressing the RESET button for about 10 s, until the display stops flashing.



j)
Then enter submenu 1 of register A by pressing the RESET button for approx. one second. The register address A is then replaced by a flashing 1. This submenu is used for setting the data transfer rate of the serial communication.

k)
The data transfer rate for the serial communication is set and stored in the same way as the address, see sections b...i, except that the continuously glowing register address has been replaced by a flashing 1.

l)
After storing the data transfer rate for the serial communication you may return to the main menu of register A by pressing the STEP button for about 0.5 second.

Stored information

The parameter values measured at the moment when a fault occurs are recorded in the registers, in some modules also the setting values. The recorded data, except for some setting parameters, are set to zero by pressing the push-buttons STEP and RESET simul-taneously. The data in normal registers are erased if the auxiliary voltage supply to the relay is disrupted, only the set values and the number of autoreclosings are maintained in the registers at a voltage failure.

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

All C-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 and status information for the circuit breaker. The codes are explained in the descriptions of the relay modules.

Register A contains the address code of the relay module as required by the serial communication system. Example 1 on page 4 shows how the address code is altered. Submenu 1 of register A contains the data transfer rate value expressed in kilobaud for the serial communication.

Submenu 2 of register A contains a bus traffic monitor for the SPACOM system. If the protective relay, which contains the relay module, is linked to a system including the control data communicator and the data communication system is operating, the counter reading of the monitor will be zero. Otherwise the digits 1...255 are continuously rolling in the monitor.

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

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

Trip-test mode

Register 0 also allows access to the so called 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 will be included in the testing.

When pressing the RESET button for about 10 seconds, the three green digits to the right start flashing to indicate that the relay module is in test position. The indicators of the setting knobs indicate by flashing which output signal can be activated. The required output function is selected by pressing the RESET button for about 1 second, until the following LED indicator starts flashing.

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

Setting knob 1	SS1	Starting of stage 1
Setting knob 2	TS1	Tripping of stage 1
Setting knob 3	SS2	Starting of stage 2
Setting knob 4	TS2	Tripping of stage 2
No indication	IRF	Self-supervision

The selected starting or tripping is activated by simultaneous pressing of the push-buttons STEP and RESET. The signal remains activated as long as the two push-buttons are being pressed.

The self-supervision output is activated by pressing the STEP button once when no setting knob indicator is flashing. The IRF output is activated in about 5 seconds after pressing of the STEP button, and resets after that. Simultaneously, the display returns to the main menu and performs the initial testing indicated by rolling digits 0...9 in the display several times.

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

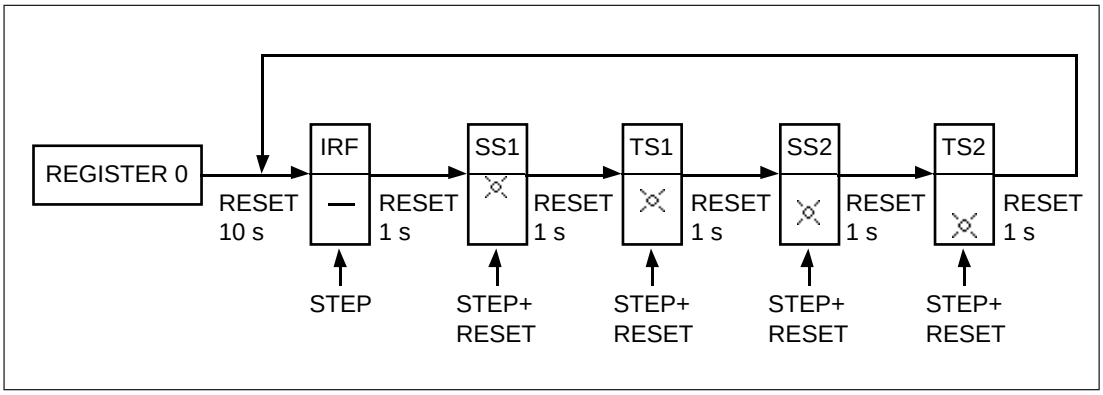


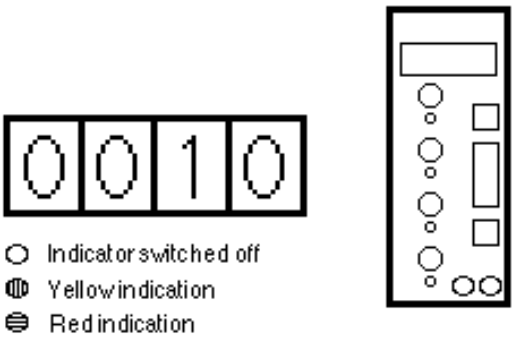
Fig. 4. Sequence order for selecting the output signals in the Trip-test mode.

If e.g. the indicator of the setting knob 2 (second from the top) is flashing, and the push-buttons STEP and RESET are being pressed, the signal TS1 (tripping of stage 1) is activated. Return to the main menu is possible at any stage of the Trip-test sequence scheme, by pressing the RESET button for about 10 seconds. If the module is left in the Trip-test mode, it will return automatically after approx. 5 minutes.

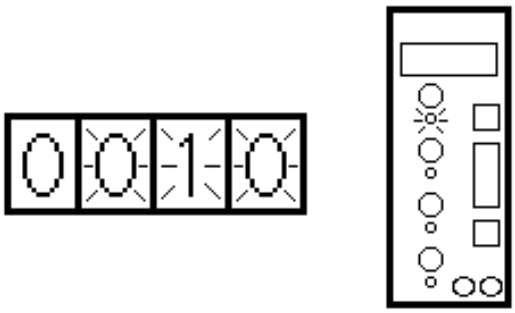
Example 2:

Trip-test function. Forced activation of the outputs is made as follows:

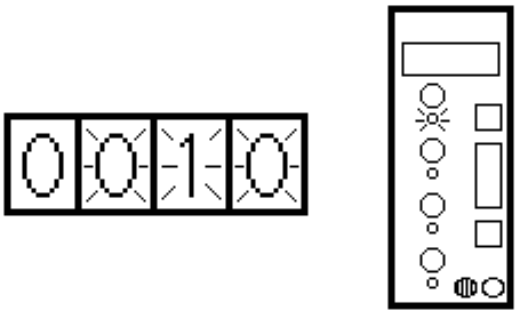
a)
Step forward on the display to register 0.



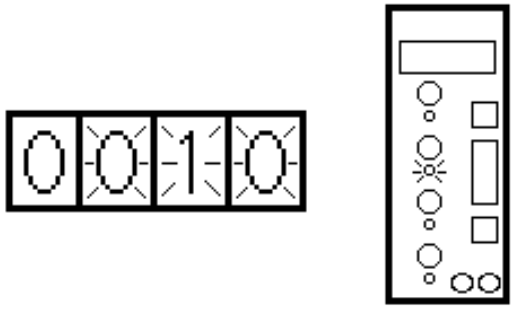
b)
Press the RESET button for about 10 seconds until the three green digits to the right and the LED indicator of the uppermost setting knob start flashing.



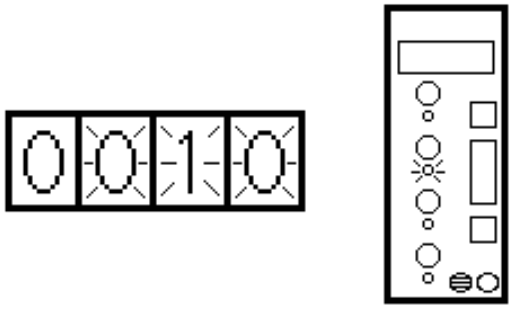
c)
Press the push-buttons RESET and STEP simultaneously. Then the starting of stage 1 (e.g. the I>-stage of the overcurrent module SPCJ 3C3) is activated and, simultaneously, the indicator of the stage starts glowing yellow.



d)
Press the RESET button for about 1 second until the indicator of the second setting knob starts flashing.



e)
Press the push-buttons RESET and STEP simultaneously to activate tripping of stage 1 (e.g. the I>-stage of the overcurrent module SPCJ 3C3). The indicator of the concerned stage starts glowing red.



f)
Starting and tripping of the second stage is activated in the same way as stage 1. The indicator of the third or fourth setting starts flashing to indicate that the concerned stage has been activated.

g)
To activate the self-supervision output step towards the test position, where no indicator is flashing. Press the STEP button once. In about 5 seconds the red IRF indicator starts glowing and the IRF output is activated. Shortly thereafter the indicator goes out and the output automatically resets. At the same time the module leaves the test position.

h)
It is possible to leave the trip test mode at any step of the sequence scheme by pressing the RESET button for about 10 seconds until the three digits to the right stop flashing.

Operation indicators

A measuring relay module is provided with two separate operating stages, each of which with its own yellow/red operation indicator on the lower part of the front plate of the relay module.

The operation indicator starts glowing yellow when the operating stage starts and red when a delayed tripping operates. The functions of the start and operation indicators are described in detail in the different protection relay module manuals.

Fault codes

In addition to the protective 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.

When the self-supervision system has detected a permanent fault in the relay module, the red IRF indicator on the panel starts glowing soon after the fault was discovered. At the same time the module puts forward a signal to the self-supervision contact of the relay assembly.

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 digit (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.

ABB Oy
Substation Automation
P.O.Box 699
FIN-65101 VAASA
Finland
Tel. +358 (0)10 22 11
Fax.+358 (0)10 22 41094
www.abb.com/substationautomation

1MRS 750123-MUM EN