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Numerical Auto-Reclosure Relay

Single-Pole or Three-Pole, with Synchronism and Voltage Check Option

7VK512 V1.1

Instruction Manual Order No. C53000–G1176–C93–5

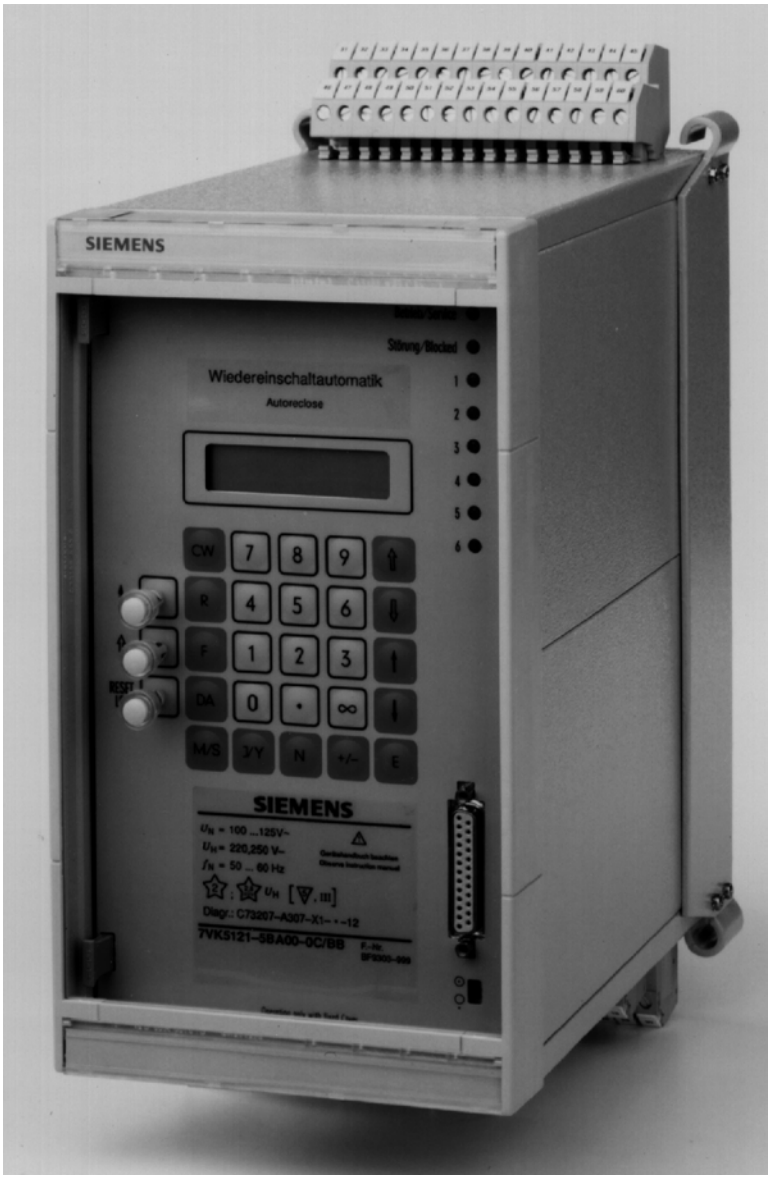

Figure 1 Illustration of the numerical auto–reclosure relay 7VK512 (in surface mounting case)

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Conformity

This product is in conformity with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Council Directive 89/336/EEC) and concerning electrical equipment for application within specified voltage limits (Low-voltage directive 73/23 EEC).

Conformity is proved by tests that had been performed according to article 10 of the Council Directive in accordance with the generic standards EN 50081–2 and EN 50082–2 (for EMC directive) and the standards EN 60255–6 (for low-voltage directive) by Siemens AG.

The device is designed and manufactured for application in industrial environment.

The device is designed in accordance with the international standards of IEC 60255 and the German standards DIN 57435 part 303 (corresponding to VDE 0435 part 303).

Contents

NOTE:

This instruction manual does not purport to cover all details in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the local Siemens sales office.

The contents of this instruction manual shall not become part nor modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligations of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties nor modify the existing warranty.

1 Introduction

1.1 Application

The numerical auto-reclosure relay 7VK512 is an universally applicable device for automatic reclosure as well as checking of the closing conditions of circuit breakers before automatic and/or manual switching in electrical power networks of all voltage ranges.

Single-pole, three-pole, or single- and three-pole rapid auto-reclosure is possible for overhead lines, as well as multiple auto-reclose sequences. The dead times during which the line is interrupted can be individually set for single-pole auto-reclosure, three-pole auto-reclosure (RAR = rapid auto-reclosure), and for consecutive auto-reclose cycles (DAR = delayed auto-reclosure).

The optional synchronism and voltage check function of 7VK512 can check the conditions for reclosing before the relay issues the close command. This function checks synchronism of the bus-bar and line voltage. Alternatively, it can be used to check that the line is dead before it is energized, or that the bus-bar is dead, or both. When desired, asynchronous switching is possible, too; in this case the device calculates the instant of the close command such that both voltages have equal phase at the moment when the breaker poles touch.

The circuit breaker must be suitable for auto-reclosure. When single-pole auto-reclosure is to be performed, the breaker poles must be switched individually. The readiness of the breaker to carry out a trip – close – cycle is taken into consideration as well as the position of the breaker, provided these informations are available from the circuit breaker. The recovery time of the breaker can be supervised. When single-pole auto-reclosure is used, the auxiliary contacts of the breaker poles can be connected in series (all three poles closed) or in parallel (either pole closed), or both connection can be fed to the device. Alternatively, the auxiliary contacts of the individual beaker poles can be considered by the device. But, generally, the device can operate without such informations from the circuit breaker.

7VK512 can operate in conjunction with conventional, static, or numerical protection devices. It requires starting and tripping signals from the feeder protection. When single-pole auto-reclosure is used, either different tripping signals must be available for single-pole trip and three-pole trip or tripping signals must be available for the individual breaker poles, in order to allow distinction to be made between initiation of single-pole and three-pole auto-reclosure.

Operation of the auto-reclose function of 7VK512 in conjunction with an external synchronism check relay is possible as well operation of the check synchronism function of 7VK512 in conjunction with an external auto-reclose device. Furthermore, two protection devices with one 7VK512 or two protection devices with two auto-reclose devices can be used.

Throughout a fault in the network the magnitudes of the instantaneous values are stored for a period of max. 3 seconds (0.66 seconds at 50 Hz for transmission to a central computer station) and are available for subsequent fault analysis.

Continuous monitoring of the internal measured value processing circuits and monitoring of the auxiliary voltages to ensure that they remain within tolerance are obviously inherent features.

Serial interfaces allow comprehensive communication with other digital control and storage devices. For data transmission a standardized protocol in accordance with DIN 19244 is used. The device can therefore be incorporated in Localized Substation Automation networks (LSA).

1.2 Features

– Processor system with powerful 16–bit–microprocessor;

– complete digital measured value processing and control from data acquisition and digitizing of the measured values up to the close decisions for the circuit breaker;

– complete galvanic and reliable separation of the internal processing circuits from the measurement, control and supply circuits of the system, with screened analog input transducers, binary input and output modules and DC converter;

– universal application for overhead lines of all voltage ranges;

– auto-reclosure and synchronism check are independent functions which can be used individually or with external supplementary units;

– calculation of operational measured values and indication on the front display;

– simple setting and operation using the integrated operation panel or a connected personal computer with menu-guided software;

– storage of fault data, storage of instantaneous values during a fault for fault recording;

– counters for the number of reclosing attempts;

– communication with central control and storage devices via serial interfaces is possible with optional connection of optical fibre;

– continuous monitoring of the hardware and software of the relay.

1.3 Implemented functions

Automatic reclose function

– single-pole, three-pole or single and three-pole;

– single- or multi-shot (e.g. RAR and three-pole DAR);

– with separately allocated action times and dead times for single-pole, three-pole RAR (rapid AR for first shot) and three-pole DAR (delayed AR for further shots).

Synchronism and voltage check (optional)

– synchronism check before auto-reclosure after three-pole trip;

– high-speed measurement of voltage magnitude difference ΔU, phase angle difference $\Delta\varphi$ and frequency difference Δf;

– settable alternatively for dead line check and/or dead bus check;

– asynchronous switching possible with pre-determination of the instant of synchronism;

– settable minimum voltage;

– synchro-check, dead-line check or dead-bus check also possible before manual close of the circuit breaker, with separately settable check programs;

– measured voltages can be connected either phase-to-phase or phase-to-earth.

2 Design

2.1 Arrangements

All functions including dc/dc converter are accommodated on one plug-in module of Double Europa Format. This module is installed in a housing 7XP20. Two different types of housings can be delivered:

– **7VK512⋆–⋆B⋆⋆⋆–** in housing 7XP2030–1 for **panel surface mounting**

  The housing has full sheet-metal covers, as well as a removable front cover with transparent plastic window.

  Guide rails are built in for the support of plug-in modules. On the top and bottom plates of the housing, contact areas which are electrically connected to the housing are installed to mate with the earthing springs of the module. Connection to earth is made before the plugs make contact. Earthing screws have been provided on the left hand side of the housing. Additionally, terminal 16 is connected to the case.

  All external signals are connected to 60 screwed terminals which are arranged over cut-outs on the top and bottom covers. The terminals are numbered consecutively from left to right at the bottom and top.

  For the optional interface to a central control and storage unit, an additional coupling facility has been provided. For the interface for optical fibre connection (model 7VK512⋆–⋆⋆⋆⋆⋆–⋆**C**), two F–SMA connectors have been provided.

  The degree of protection for the housing is IP51, for the terminals IP21. For dimensions please refer to Figure 2.2.

– **7VK512⋆–⋆C⋆⋆⋆–** in housing 7XP2030–2 for **panel flush mounting** or **7VK512⋆–⋆E⋆⋆⋆–** for **cubicle installation**

  The housing has full sheet-metal covers, as well as a removable front cover with transparent plastic window for panel mounting.

  Guide rails are built in for the support of plug-in modules. On the top and bottom plates of the housing, contact areas which are electrically connected to the housing are installed to mate with the earthing springs of the module. Connection to earth is made before the plugs make contact. Earthing screws have been provided on the rear wall of the housing.

  All external signals are connected to connector modules which are mounted on the rear cover over cut-outs. For each electrical connection, one screwed terminal and one parallel snap-in terminal are provided. For field wiring, the use of the screwed terminals is recommended; snap-in connection requires special tools.

  For the optional interface for optical fibre connection (7VK512⋆–⋆⋆⋆⋆⋆–⋆**C**), a module with 2 F–SMA connectors is provided.

  The plug modules are labelled according to their mounting position by means of a grid system (e.g. **1A**4). The individual connections within a module are numbered consecutively from left to right (when viewed from the rear), (e.g. 1A**4**); refer to Figure 2.1.

  Degree of protection for the housing is IP51 (for cubicle installation IP 30), for the terminals IP21. For dimensions please refer to Figure 2.3.

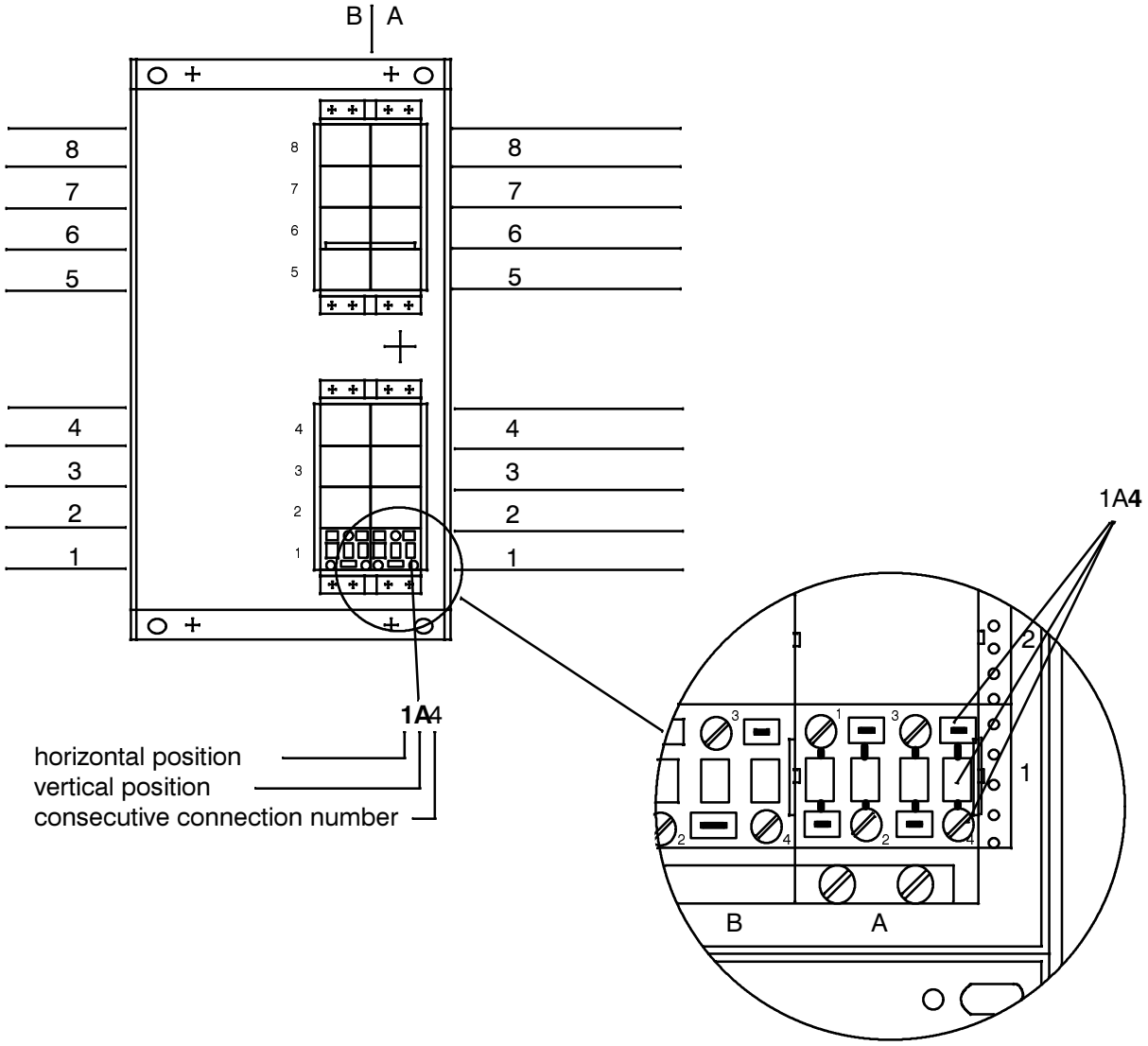


Figure 2.1 Connection plugs (rear view) – housing for flush mounting – example

2.2 Dimensions

Figures 2.2 and 2.3 show the dimensions of the various types of housings available.

7VK512 Housing for **panel surface mounting** 7XP2030 – 1

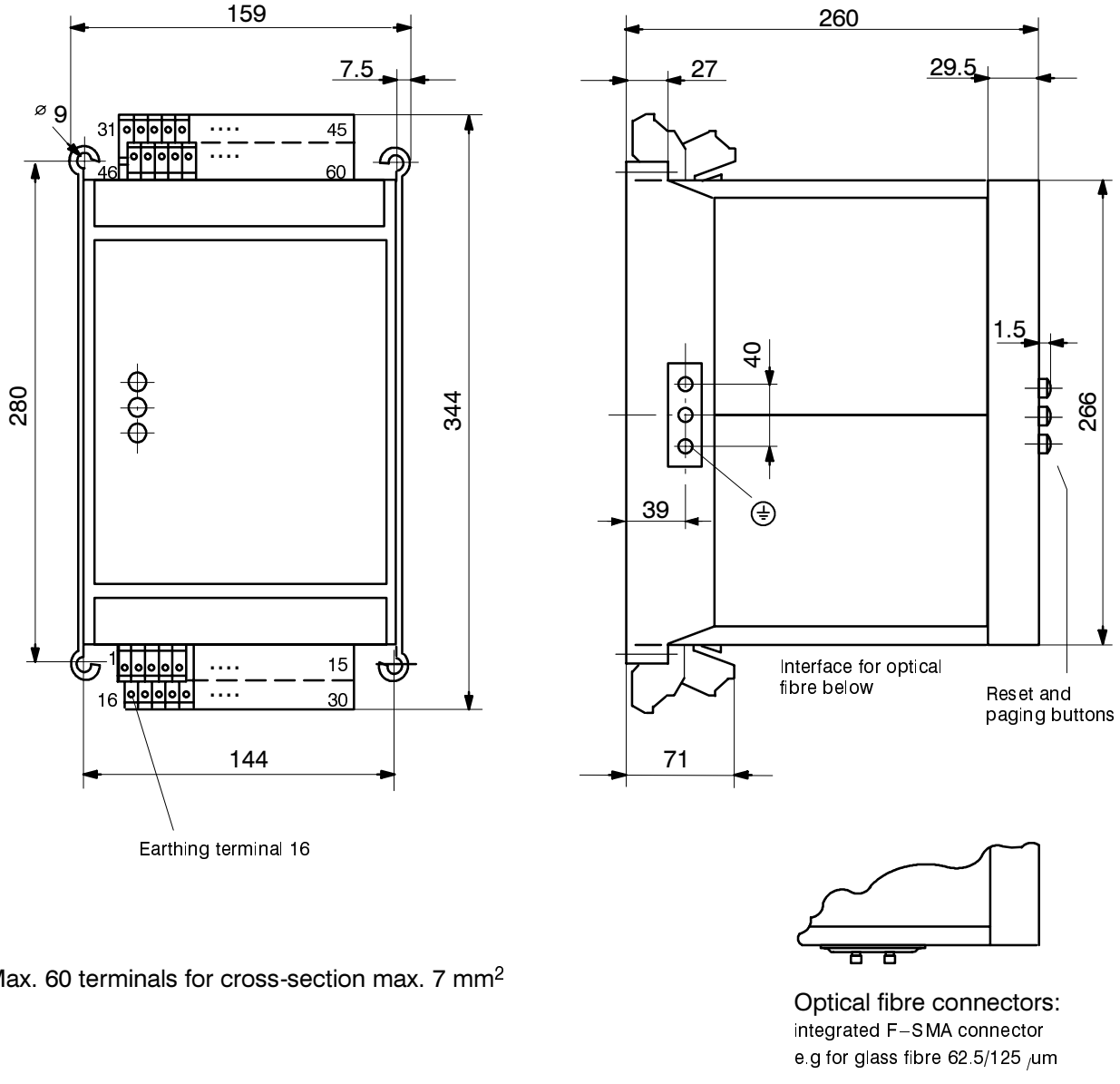


Figure 2.2 Dimensions for housing 7XP2030 – 1 for panel surface mounting

7VK512 Housing for **panel flush mounting** or **cubicle installation** 7XP2030 – 2

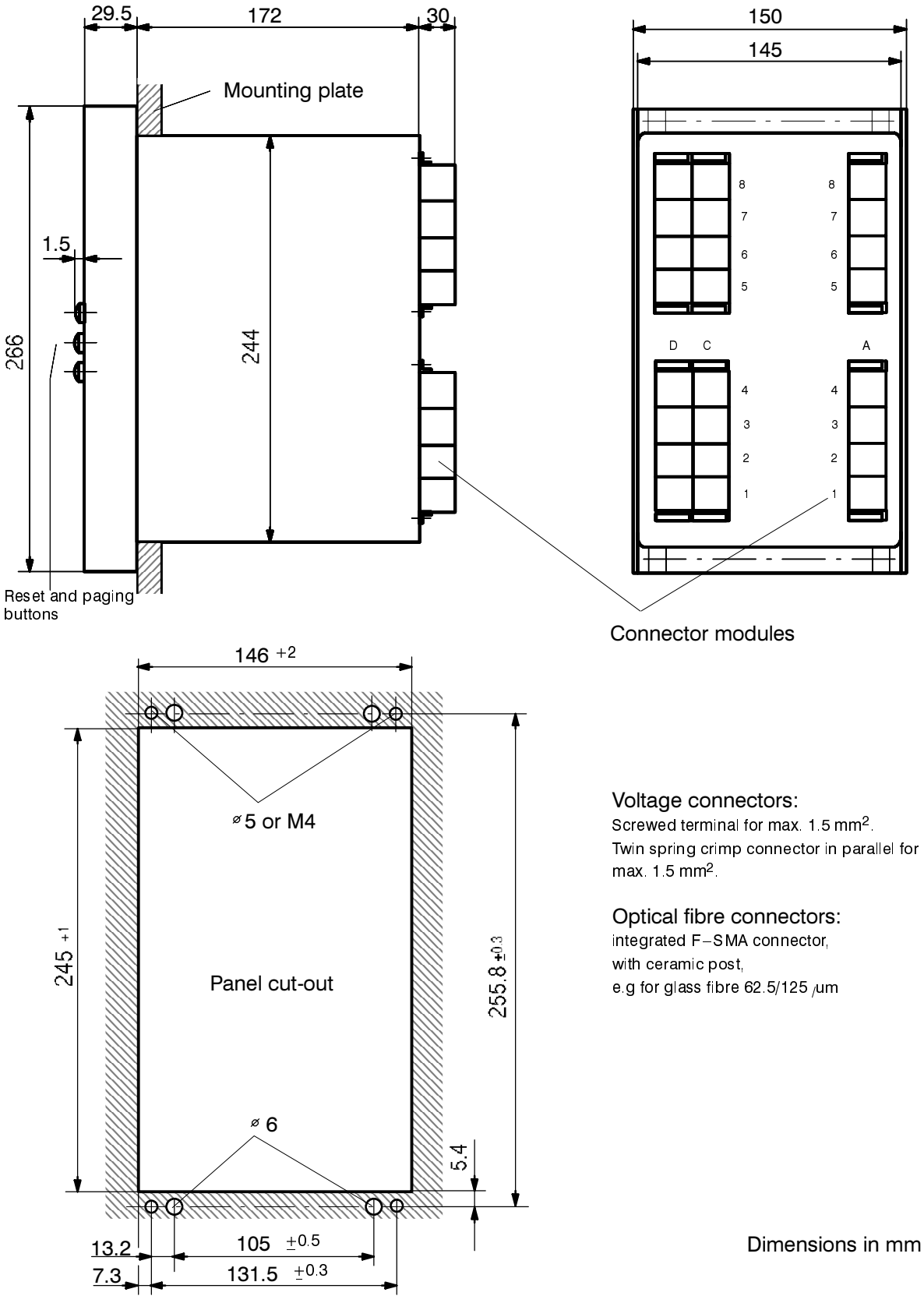


Figure 2.3 Dimensions for housing 7XP2030 – 2 for panel flush mounting or cubicle installation

2.3 Ordering data

Single- or Three-Pole Auto-Reclosure Relay, with Optional Synchronism and Voltage Check

7 V K 5 1 2

7.	8.	9.	10.	11.	12.		13.	14.	15.	16.
			A	0		–	0		A	0

Synchronism an voltage check

without 1

with 2

Auxiliary voltage

24/48 V dc 2

60/110/125 V dc 4

220/250 V dc 5

Construction

in housing 7XP2030 for panel surface mounting . . . . . B

in housing 7XP2030 for panel flush mounting C

in housing 7XP2030 for cubicle installation (without glass front) . . . E

Supplementary annunciation functions

without 0

with real time clock and non-volatile annunciation memories 1

Serial interface for coupling to a control centre

without serial interface . . . . . A

with serial interface for optical fibre connection C

3 Technical data

3.1 General data

3.1.1 Inputs/outputs

Measuring circuits

Rated voltage U_N		80 V to 125 V (settable)
Rated frequency f_N		50 Hz/60 Hz (settable)
Power consumption	voltage path at 100 V	approx 0.5 VA per phase
Overload capability – thermal (rms)	voltage path	200 V continuous

Auxiliary voltage

Power supply via integrated dc/dc converter

Rated auxiliary voltage U_H	24/48 Vdc	60/110/125 Vdc	220/250 Vdc
Permissible variations	19 to 56 Vdc	48 to 144 Vdc	176 to 288 Vdc

Superimposed ac voltage, peak-to-peak		$\leq$ 12 % at rated voltage $\leq$ 6 % at limits of admissible voltage
Power consumption	quiescent	approx 6 W
	energized	approx 12 W
Bridging time during failure/short-circuit of auxiliary voltage		$\geq$ 50 ms at $U_{dc} \geq$ 110 Vdc

Heavy duty (command) contacts

Command (trip) relays, number		2
Contacts per relays		2 NO
Switching capacity	MAKE	1000 W/VA
	BREAK	30 W/VA
Switching voltage		250 V
Permissible current		5 A continuous
		30 A for 0.5 s

Signal contacts

Signal/alarm relays		15
Contact per relays		1 CO or 1 NO
Switching capacity	MAKE/BREAK	20 W/VA
Switching voltage		250 V
Permissible current		1 A

Binary inputs

Number	15
Operating voltage	24 to 250 Vdc
Current consumption, energized	approx 2 mA, independent of operating voltage

Serial interfaces

Operator terminal interface	non-isolated
– Connection	at the front, 25-pole subminiature connector acc. ISO 2110 for connection of a personal computer or similar
– Transmission speed	as delivered 1200 Baud min 1200 Baud, max 19200 Baud
Floating interface for data transfer to a control centre (optional)	
– Standards	protocol according to DIN 19244
– Transmission speed	as delivered 9600 Baud min 4800 Baud, max 19200 Baud
– Transmission security	Hamming distance d = 4
– Connection optical fibre	integrated F–SMA connector for direct optical fibre connection, e.g. glass fibre 62.5/125 µm for flush mounted housing: at the rear for surface mounted housing: on the bottom cover
Optical wave length	820 nm
Permissible line attenuation	max 8 dB
Transmission distance	max 1.5 km
Normal signal position	reconnectable; factory setting: “light off”

3.1.2 Electrical tests

Insulation tests	
Standards:	IEC 60255−5
– High voltage test (routine test) except d.c. voltage supply input	2 kV (rms); 50 Hz
– High voltage test (routine test) only d.c. voltage supply input	2.8 kV dc
– Impulse voltage test (type test) all circuits, class III	5 kV (peak); 1.2/50 μs; 0.5 J; 3 positive and 3 negative shots at intervals of 5 s
EMC tests; immunity (type tests)	
Standards:	IEC 60255−6, IEC 60255−22 (product standards) EN 50082−2 (generic standard) VDE 0435 /part 303
– High frequency IEC 60255−22−1 class III	2.5 kV (peak); 1 MHz; τ =15 μs; 400 shots/s; duration 2 s
– Electrostatic discharge IEC 60255−22−2 class III and IEC 61000−4−2, class III	4 kV/6 kV contact discharge; 8 kV air discharge; both polarities; 150 pF; R_i = 330 Ω
– Radio-frequency electromagnetic field, non-modulated; IEC 60255−22−3 (report) class III	10 V/m; 27 MHz to 500 MHz
– Radio-frequency electromagnetic field, amplitude modulated; IEC 61000−4−3, class III	10 V/m; 80 MHz to 1000 MHz; 80 % AM; 1 kHz
– Radio-frequency electromagnetic field, pulse modulated; IEC 61000−4−3/ENV 50204, class III	10 V/m; 900 MHz; repetition frequency 200 Hz; duty cycle 50 %
– Fast transients IEC 60255−22−4 and IEC 61000−4−4, class III	2 kV; 5/50 ns; 5 kHz; burst length 15 ms; repetition rate 300 ms; both polarities; R_i = 50 Ω; duration 1 min
– Conducted disturbances induced by radio-frequency fields, amplitude modulated IEC 61000−4−6, class III	10 V; 150 kHz to 80 MHz; 80 % AM; 1 kHz
– Power frequency magnetic field IEC 61000−4−8, class IV IEC 60255−6	30 A/m continuous; 300 A/m for 3 s; 50 Hz 0.5 mT; 50 Hz
EMC tests; emission (type tests)	
Standard:	EN 50081−★ (generic standard)
– Conducted interference voltage, aux. voltage CISPR 22, EN 55022, class B	150 kHz to 30 MHz
– Interference field strength CISPR 11, EN 55011, class A	30 MHz to 1000 MHz

3.1.3 Mechanical stress tests

Vibration and shock during operation

Standards:	IEC 60255−21 and IEC 60068−2
− Vibration IEC 60255−21−1, class 1 IEC 60068−2−6	sinusoidal 10 Hz to 60 Hz: ± 0.035 mm amplitude; 60 Hz to 150 Hz: 0.5 g acceleration sweep rate 1 octave/min 20 cycles in 3 orthogonal axes
− Shock IEC 60255−21−2, class 1	half sine acceleration 5 g, duration 11 ms, 3 shocks in each direction of 3 orthogonal axes
− Seismic vibration IEC 60255−21−3, class 1 IEC 60068−3−3	sinusoidal 1 Hz to 8 Hz: ± 3.5 mm amplitude (hor. axis) 1 Hz to 8 Hz: ± 1.5 mm amplitude (vert. axis) 8 Hz to 35 Hz: 1 g acceleration (hor. axis) 8 Hz to 35 Hz: 0.5 g acceleration (vert. axis) sweep rate 1 octave/min 1 cycle in 3 orthogonal axes

Vibration and shock during transport

Standards:	IEC 60255−21 and IEC 60068−2
− Vibration IEC 60255−21−1, class 2 IEC 60068−2−6	sinusoidal 5 Hz to 8 Hz: ± 7.5 mm amplitude; 8 Hz to 150 Hz: 2 g acceleration sweep rate 1 octave/min 20 cycles in 3 orthogonal axes
− Shock IEC 60255−21−2, class 1 IEC 60068−2−27	half sine acceleration 15 g, duration 11 ms, 3 shocks in each direction of 3 orthogonal axes
− Continuous shock IEC 60255−21−2, class 1 IEC 60068−2−29	half sine acceleration 10 g, duration 16 ms, 1000 shocks each direction of 3 orthogonal axes

3.1.4 Climatic stress tests

− recommended temperature during service	−5 °C to +55 °C	(> 55 °C decreased
− permissible temperature during service	−20 °C to +70 °C	display contrast)
permissible temperature during storage	−25 °C to +55 °C	
permissible temperature during transport	−25 °C to +70 °C	

Storage and transport with standard works packaging!

– Permissible humidity	mean value per year $\leq$ 75 % relative humidity; on 30 days per year 95 % relative humidity; Condensation not permissible!

We recommend that all units are installed such that they are not subjected to direct sunlight, nor to large temperature fluctuations which may give rise to condensation.

3.1.5 Service conditions

The relay is designed for use in industrial environment, for installation in standard relay rooms and compartments so that with proper installation **electro-magnetic compatibility (EMC)** is ensured. The following should also be heeded:

– All contactors and relays which operate in the same cubicle or on the same relay panel as the digital protection equipment should, as a rule, be fitted with suitable spike quenching elements.

– All external connection leads in sub-stations from 100 kV upwards should be screened with a screen capable of carrying power currents and earthed at both sides. No special measures are normally necessary for sub-stations of lower voltages.

– It is not permissible to withdraw or insert individual modules under voltage. In the withdrawn condition, some components are electrostatically endangered; during handling the standards for electrostatically endangered components must be observed. The modules are not endangered when plugged in.

WARNING! The relay is not designed for use in residential, commercial or light-industrial environment as defined in EN 50081.

3.1.6 Design

Housing	7XP20; refer to Section 2.1
Dimensions	refer to Section 2.2
Weight (mass)	
– in housing for surface mounting	approx 11.0 kg
– in housing for flush mounting	approx 9.5 kg
Degree of protection acc. to DIN 40050	
– Housing	IP 51 *)
– Terminals	IP 21

*) IP30 for cubicle installation; the degree of protection required for the point of installation must be ensured by the cubicle.

3.2 Auto-reclosure

Max. number of possible shots	1 RAR (first shot) up to 9 DAR (further shots)
Auto-reclose modes	single-pole or three-pole or single/three-pole (1st shot RAR); further shots three-pole (DAR)
Possible programs for RAR	three-pole for all kinds of fault single-pole, no AR after three-pole trip single- and three-pole, depending on trip command

Single-pole trip from the feeder protection relay is a precondition for single-pole RAR.

Possible programs for DAR	DAR only after RAR DAR also without RAR no DAR
Action times	0.01 s to 320.00 s (steps 0.01 s); ∞
RAR dead time single-pole	0.01 s to 320.00 s (steps 0.01 s)
RAR dead time three-pole	0.01 s to 320.00 s (steps 0.01 s)
DAR dead times	0.01 s to 1800.00 s (steps 0.01 s)
Discrimination time for evolving faults	0.01 s to 320.00 s (steps 0.01 s)
Reclaim time	0.50 s to 320.00 s (steps 0.01 s)
Lock-out time	0.50 s to 320.00 s (steps 0.01 s); ∞
Reclaim time after manual close	0.50 s to 320.00 s (steps 0.01 s)
Duration of RECLOSE command	0.01 s to 320.00 s (steps 0.01 s)
Circuit breaker supervision time	0.01 s to 320.00 s (steps 0.01 s); ∞

3.3 Synchronism and voltage check (optional)

Operation modes

Check programs for auto-reclose	check synchronism dead-line live-bus check dead-bus live-line check dead-bus dead-line check override or combinations asynchronous switching is possible
Check programs for manual close	same as for auto-reclose, independent settings

Voltages

minimum operating voltage	1 V	
U< for dead-line or dead-bus check	1 V to 60 V	(steps 1 V)
U> for live-line or live-bus check	20 V to 125 V	(steps 1 V)
measuring tolerance	2 % of set value or 2 V	
reset ratio	approx. 0.9 %	

ΔU measurement		
setting range	1 V to 50 V	(steps 1 V)
measuring tolerance	2 V	
Δφ measurement		
setting range	1° to 60°	(steps 1°)
measuring tolerance	2°	
Δf measurement		
setting range for synchronous switching	0.03 Hz to 1.00 Hz	(steps 0.01 Hz)
setting range for asynchronous switching	0.03 Hz to 0.10 Hz	(steps 0.01 Hz)
measuring tolerance	15 mHz	
minimum operating voltage	20 V	

Times

minimum measuring time	approx. 80 ms; approx. 20 ms with standing measured values
active time	0.01 s to 320.00 s (steps 0.01 s)

3.4 Ancillary functions

Output of measured values

Operational values of voltages	U1, U2 in V secondary and kV primary
Operational value of frequency	f in Hz
Voltage difference	ΔU in V secondary
Frequency difference	Δf in Hz
Phase angle difference	$\Delta\varphi$ in degrees
Measuring tolerances	$\leq$ 2 % of respective rated value

Fault event data storage

Storage of annunciations of the three last fault events

Real time clock (optional)

Resolution for operational annunciations	1 min
Resolution for fault event annunciations	1 ms
Clock module (optional)	DALLAS Type DS 138 – 32k RAMifield TIMEKEEPER Self-discharge time >10 years
Max time deviation	0.01 %

Data storage for fault recording

Storage period (fault detection = 0 ms), max.	
– for operating interface	–100 ms to +2900 ms at 50 Hz – 83 ms to +2416 ms at 60 Hz
– for LSA interface	– 60 ms to + 600 ms at 50 Hz – 50 ms to + 500 ms at 60 Hz
Sampling rate	1 instantaneous value per ms at 50 Hz 1 instantaneous value per 0.83 ms at 60 Hz

4 Method of operation

4.1 Operation of complete unit

The numerical auto-reclosure relay 7VK512 is equipped with a powerful and proven 16-bit microprocessor. This provides fully digital processing of all functions from data acquisition of input values to the close signals for the circuit breaker.

Figure 4.1 shows the base structure of the unit.

The transducers of the measured value input section ME transform the voltages from the measurement transformers of the switch-gear (models with synchronism and voltage check) and match them to the internal processing level of the unit. Apart from the galvanic and low-capacitance isolation provided by the input transformers, filters are provided for the

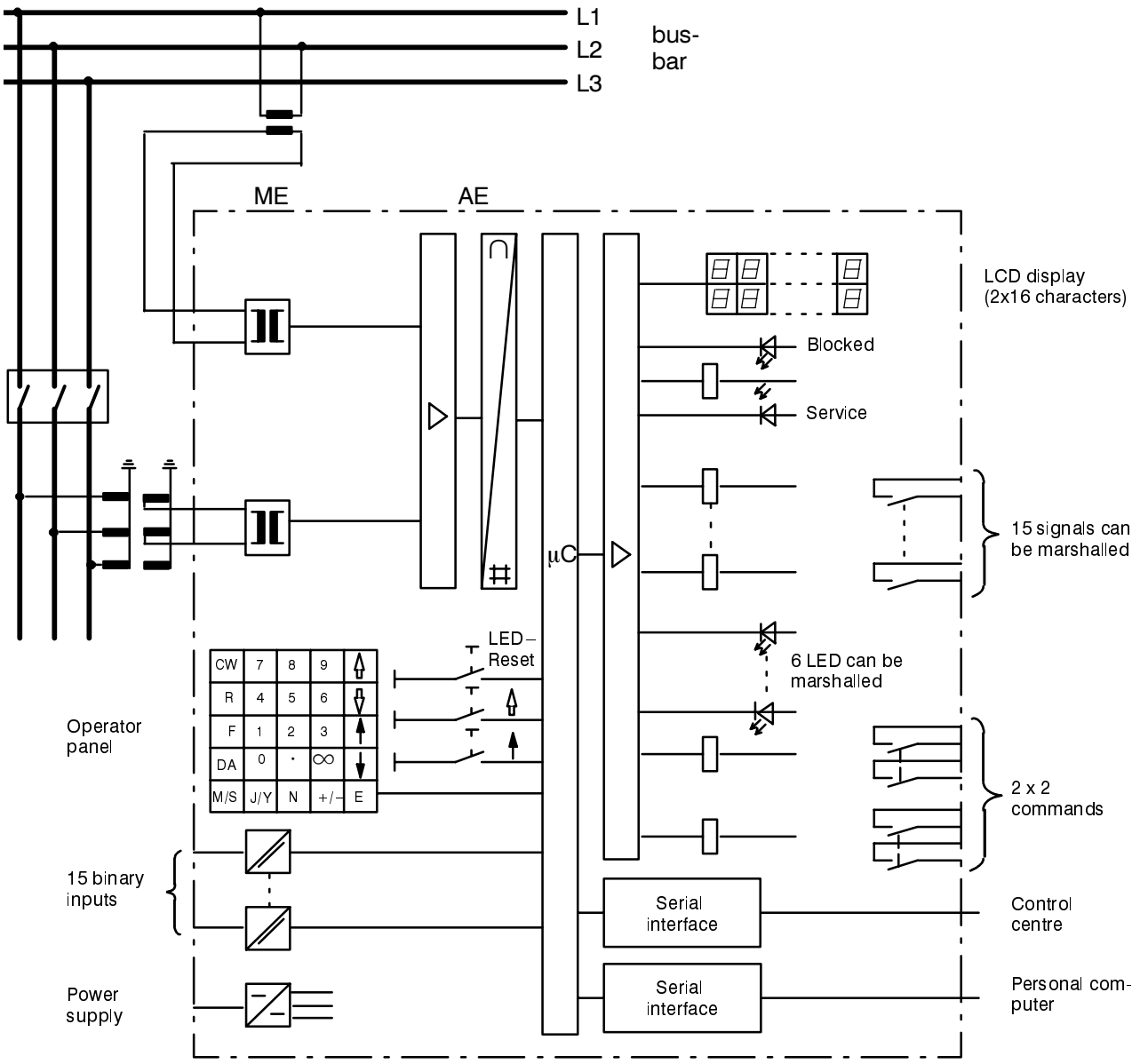


Figure 4.1 Hardware-structure of auto-reclosure relay 7VK512 (fully equipped)

suppression of interference. The filters have been optimized with regard to bandwidth and processing speed to suit the measured value processing. The matched analog values are then passed to the analog input section AE.

The analog input section AE contains input amplifiers, sample and hold elements for each input, analog-to-digital converters and memory circuits for the data transfer to the microprocessor.

Apart from control and supervision of the measured values, the microprocessor processes the actual automatic functions. These include in particular:

– filtering and formation of the input quantities,

– comparison of the voltages with the setting values relevant for circuit breaker closing ($|U1|$, $|U2|$, $|\Delta U|$, Δf, $\Delta\varphi$),

– scanning of limit values and time sequences,

– control of signals and sequences for manual closing, automatic reclosing and closing checks,

– decision about close commands,

– storage of measured quantities during a fault for analysis.

Binary inputs and outputs to and from the processor are channelled via the input/output elements. From these the processor receives information from the switch-gear (e.g. readiness signal from the circuit breaker) or from other equipment (e.g. initiation signal from feeder protection). Outputs include, in particular, close commands to the circuit breaker, signals for remote signalling of important events and conditions as well as visual indicators (LEDs), and an alphanumerical display on the front.

An integrated membrane keyboard in connection with a built-in alphanumerical LCD display enables communication with the unit. All operational data such as setting values, plant data, etc. are entered into the device from this panel (refer to Section 6.3). Using this panel the parameters can be recalled and the relevant data for the evaluation of a fault can be read out after a fault has occurred (refer to Section 6.4). The dialog with the relay can be carried out alternatively via the serial interface in the front plate by means of an operator panel or a personal computer.

Via a second serial interface (optional), fault data can be transmitted to a central evaluation unit. During healthy operation, measured values can also be transmitted, e.g. the measured voltages of bus-bar and feeder. This second interface is suitable for connection of optical fibre links.

A power supply unit provides the auxiliary supply on the various voltage levels to the described functional units. +18 V is used for the relay outputs. The analog input requires ±15 V whereas the processor and its immediate peripherals are supplied with +5 V. Transient failures in the supply voltage, up to 50 ms, which may occur during short-circuits in the dc supply system of the plant are bridged by a dc voltage storage element (rated auxiliary voltage $\geq$ 110 Vdc).

4.2 Automatic reclosure

4.2.1 General

Experience has shown that approximately 85 % of short circuits are caused by an arc, on overhead lines, and self-extinguish after interruption by the protective device. The line can therefore be re-energized. This is carried out by the automatic reclosure (AR) function. Figure 4.2 shows an example for the time sequence of a two-shot auto-reclosure with a RAR cycle followed by a DAR cycle.

If the circuit breaker poles can be tripped individually, then AR is often carried out single-pole for single-phase faults, and three-pole for multi-phase faults, in networks with earthed starpoint. If the short circuit is still present after the auto-reclosure (arc not quenched or metallic short circuit), then the protective relay finally disconnects the power. Multiple auto-reclosure attempts, often with a first rapid auto-reclosure (RAR) and subsequent delayed auto-reclose cycles (DAR) are possible in some networks.

7VK512 allows automatic three-pole, single-pole, single- and three-pole as well as single- and multi-shot reclosure. With multi-shot auto-reclosure, the first shot is designated with RAR (rapid auto-reclosure) and the subsequent shots are designated with DAR (delayed auto-reclosure) independent on the real setting of the dead times of the auto-reclose cycles.

In order to perform single-pole or single- and three-pole auto-reclosure it is necessary that the feeder protection is able to issue phase segregated trip commands.

Signal exchange between the feeder protection and the 7VK512 auto-reclose unit must be accomplished via the binary inputs and outputs of the unit.

Furthermore, it is also possible to allow the 7VK512 to be triggered from more than one protection relays (e.g. main protection and alternate protection) (see Section 4.2.10). In this case, 7VK512 can perform three-pole coupling for both feeder protection relays, if only one relay trips multi-pole or if the protection relays make attempt to trip single-pole in different phases.

The use of two 7VK512 relays with two feeder protection relays is also possible as well as the use of one 7VK512 with a feeder protection and a second auto-reclose relay with separate feeder protection (example see Section 4.2.11).

The possible programs of the AR-function for the first AR-cycle (designated in the following with RAR – rapid auto-reclosure) are:

– RAR PROG. = *THREE–POLE*, i.e. all types of faults result in three-pole AR.

– RAR PROG. = *SINGLE-POLE*, i.e. single-phase faults result in single-pole AR, multi-phase faults in three-pole final disconnection.

– RAR PROG. = *SINGLE/THREE–POL*e, i.e. single-phase faults result in single-pole AR, multi-phase faults in three-pole AR.

If more than one reclose attempt will be carried out, the second and any further auto-reclose cycle are designated in the following with DAR (delayed auto-reclosure) independent on the setting of the dead times of the cycles. It is possible to skip the RAR cycle so that only DAR cycles occur. DAR cycles are always three-pole. For the DAR-function, the following programs are selectable:

– DAR PROG. = *NO DAR*, i.e. no DAR occurs; unsuccessful RAR results in final trip.

– DAR PROG. = *DAR WITHOUT RAR*, i.e. DAR cycles can be carried out even without a preceding RAR cycle (e.g. RAR is by-passed because blocked).

– DAR PROG. = *DAR AFTER RAR*, i.e. the DAR cycles can only be initiated after an unsuccessful RAR.

Prerequisite for initiation of the AR-function is always that the circuit breaker is ready for operation when pick-up occurs. This information is transmitted to the device via a binary input.

Furthermore, reclosure is blocked if the tripping command occurs after the action time, which can be set individually for RAR and DAR.

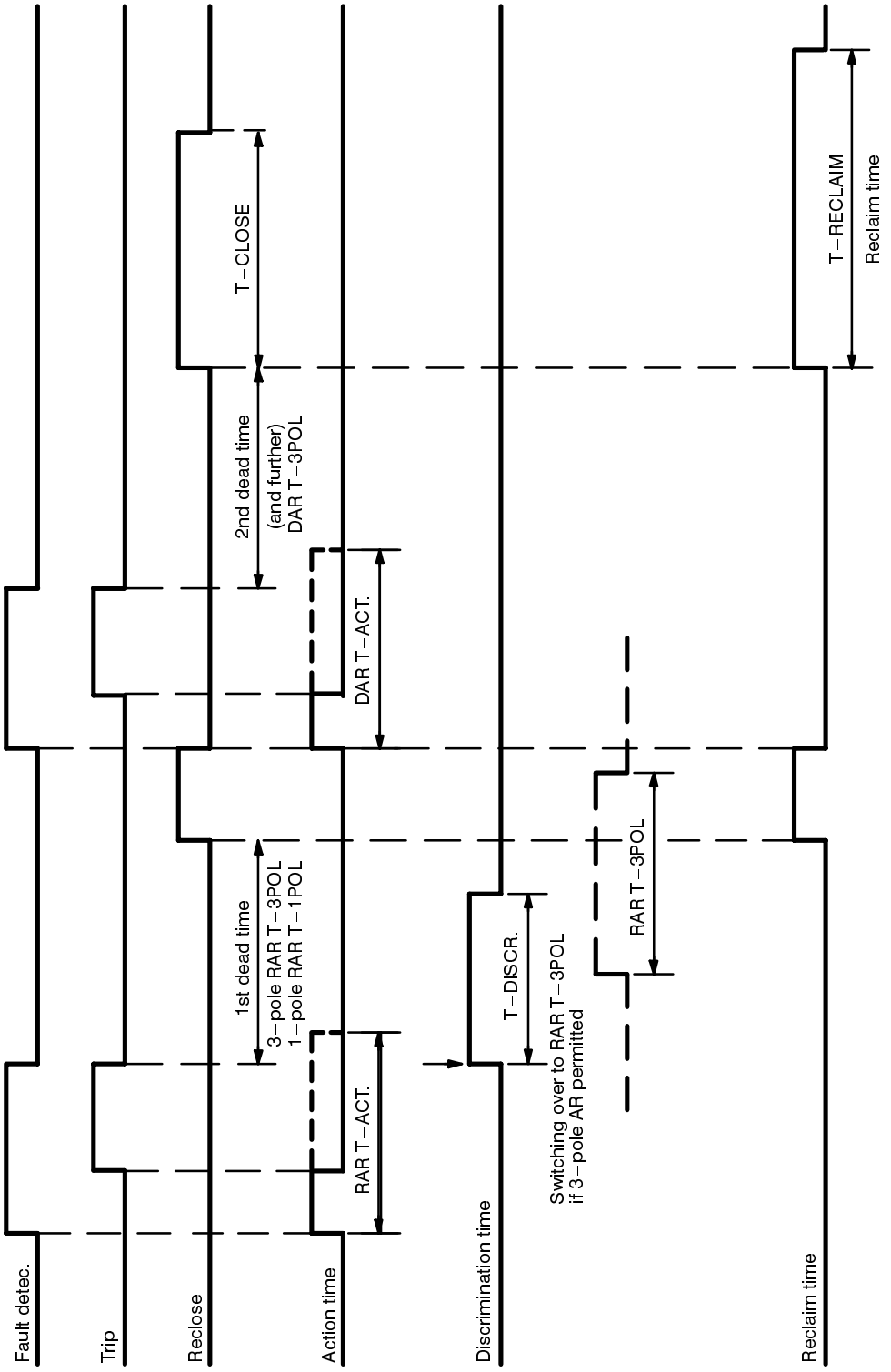


Figure 4.2 Diagram of an auto-reclosure sequence: RAR cycle followed by a DAR cycle

4.2.2 Selectivity during automatic reclosure

For the auto-reclosure sequence to be successful, faults on any part of the line must be cleared from both line ends within the same – shortest possible – time. Usually, therefore, an instantaneous stage of the short-circuit protection is set to operate before a reclosure by the AR-unit.

If the short-circuit protection is equipped with a so-called RAR stage then this stage can be activated by 7VK512; the output signal "RAR Zone Rel." is available as long as the RAR function is ready for reclose after disconnection of the line.

If the feeder protection incorporates the facility to activate its RAR stage only in case of single-phase faults but not in case of three-phase faults, the RAR function of 7VK512 can give the output signal "RAR 1p Prog" in addition to "RAR Zone Rel." which means that the RAR function will reclose only in case of single-pole trip but not after three-pole trip: that is the case when the RAR function is programmed to single-pole auto-reclosure.

If the feeder protection is equipped with an additional so-called DAR stage, this can be activated by 7VK512 through the output signal "RAR Zone Rel." which is present as long as the DAR function is ready to reclose after disconnection of the line.

If no reclosure is expected (e.g. circuit breaker not ready for a trip – close – cycle or action time expired) then the above mentioned release signals are not issued. The feeder protection then has to operate according to the time grading plan in order to achieve selectivity.

It is possible to block the AR functions (in common or separate for RAR or DAR) from external criteria (i.e. from the plant or from other protection devices). The release signals of 7VK512 are not issued in this case either.

The auto-reclose function provides an action time for each of RAR and DAR function which can separately set. The action times are started with any fault detection of a short-circuit protection which shall trigger the AR function. If the action time has elapsed before any trip signal is given, it is assumed that the fault is not on the protected line but on a different line; auto-reclosure is not initiated.

4.2.3 Action times and reclaim times

It is often appropriate to prevent readiness for reclosure, when the fault has persisted for a specified time; for example, when it can be assumed that the arc has burnt itself in to such an extent, that there is no chance of natural quenching during the dead time.

Tripping after faults which are cleared in a delayed time should, for reasons of selectivity (refer foregoing section) not result in an auto-reclosure either.

The AR-functions of 7VK512 are provided with settable action times, separate for RAR and DAR, which are started by the fault detection signal of the feeder protection. If, after expiry of the action time, no tripping signal has been given, reclosure is blocked.

The AR-functions of 7VK512 are provided with three settable reclaim times, which do not discriminate between RAR and DAR. Generally, the reclaim time is the time period during which no further reclosure attempt is permitted.

The reclaim time T – RECLAIM is started at every reclose command. If auto-reclosure has been successful, all functions reset to the quiescent condition after expiry of T – RECLAIM; any fault occurring after the expiry of the reclaim time is considered to be a new system fault. When a renewed trip command is given within this reclaim time, the next auto-reclose cycle is started if multi-shot AR is permitted; if no further AR cycle is permitted, a renewed trip command within the reclaim time is final: AR has been unsuccessful.

The lock-out time after dynamic blocking TBLOCK DYN is the time period during which any further close command by the 7VK512 relay is blocked after final disconnection. This applies for all closing attempts which are performed by the relay. If this time is set to ∞, closing is locked out until the AR function is reset by energization of the binary input ">AR Reset". After the reset signal all functions reset to the quiescent condition.

A special reclaim time TBLOCK M/C is provided for manual closing. During this time after manual close, reclosure is blocked; any trip command will be a final three-pole trip.

4.2.4 Interrogation for readiness of the circuit breaker

Pre-condition for a reclose attempt after short-circuit interruption is that the circuit breaker is ready for at least one TRIP – CLOSE – TRIP – cycle when the AR function is initiated (i.e. at the instant of trip command). The readiness information from the breaker has to be transmitted to the device via a binary input. In case that such readiness information is not available, interrogation can be suppressed since otherwise no auto-reclose would be possible at all.

When single-shot auto-reclosure is performed it is sufficient to interrogate the breaker readiness one single time before initiation of AR. As, for example, the air pressure for breaker operation will collapse during the trip execution, no further interrogation should be carried out.

When multi-shot auto-reclosure is used, it is advantageous to interrogate breaker readiness not only at the instant of the first trip command but also before every reclose attempt or before every other reclose attempt. If this facility is selected, reclosure is blocked as long as the circuit breaker is not ready for another TRIP – CLOSE sequence.

The recovery time of the circuit breaker can be supervised by the 7VK512 relay. This supervision time T – CB – SUPV will run as long as the circuit breaker does not inform about readiness. In this case, the dead time may be extended, when the breaker is not ready after expiry of the set dead time. But if the breaker is not yet ready after expiry of the supervision time then reclosure is blocked. This blocking is canceled only after the lock-out time TBLOCK DYN (refer Section 4.2.3) has elapsed. If TBLOCK DYN is set to ∞, closing is locked out until the AR function is reset by energization of the binary input "`>AR Reset`". After the reset signal all functions reset to the quiescent condition.

4.2.5 Three-pole auto-reclosure

The RAR function of 7VK512 informs the feeder protection about readiness for reclosure by its output signal "`RAR Zone Rel.`" in order to allow the feeder protection to trip in its RAR zone (if available). The action time (refer to Section 4.2.3) of the RAR function is started with the fault detection signal of the feeder protection via the binary input "`>Start AR`".

The feeder protection trips three-pole for all faults within the stage valid for RAR (e.g. the distance protection in overreaching zone). The AR-function of 7VK512 is informed via any of the binary inputs "`>Trip L* AR`". RAR function is initiated provided tripping occurs within the action time (refer to Section 4.2.3). With fault clearance, i.e. with disappearance of the trip signal, the (settable) dead time RAR T – 3POL commences for three-pole RAR; simultaneously, the signal "`RAR Zone Rel.`" disappears. On expiry of the dead time the circuit breaker receives a closing command, the duration of which is settable. and the (settable). The reclaim time T – RECLAIM (Section 4.2.3) is started.

If the fault is cleared (successful RAR), the reclaim time T – RECLAIM (Section 4.2.3) expires and all functions of 7VK512 reset to the quiescent condition. The network fault is cleared, the AR functions are ready for a new fault.

If the fault has not been cleared (unsuccessful AR) then the short-circuit protection carries out a final disconnection in the stage that is valid without RAR. Also, every fault during the reclaim time will result in final disconnection.

After unsuccessful AR (final disconnection) the lock-out time TBLOCK DYN (Section 4.2.3) is started. For this time any close command from 7VK512 is locked.

The above sequence comes into effect with single-shot RAR. With 7VK512, multiple AR-attempts (up to 9 DAR-shots, refer to Section 4.2.9) are also possible. Additionally, it is possible to skip the RAR cycle by a signal via a binary input of the device. In this case only DAR is effective (refer to Section 4.2.9).

4.2.6 Single-pole auto-reclosure

When only single-pole auto-reclosure is carried out, 7VK512 issues the continuous output signal "RAR 1p Prog", which indicates that reclosure will be carried out only in case of single-pole trip. The RAR function of 7VK512 informs the feeder protection about readiness for reclosure by its output signal "RAR Zone Rel." and issues output signal "1p Trip Perm." (i.e. single-pole trip permission, the logical inversion of three-pole coupling). The action time (refer to Section 4.2.3) of the RAR function is started with the fault detection signal of the feeder protection via the binary input ">Start AR".

The feeder protection trips single-pole if a single-phase fault is detected in the stage valid for RAR. The AR-function of 7VK512 is informed via the binary inputs ">Trip L1 AR" or ">Trip L2 AR" or ">Trip L3 AR". RAR function is initiated provided tripping occurs within the action time (refer to Section 4.2.3). With fault clearance, i.e. with disappearance of the trip signal, the (settable) dead time RAR T-1POL commences for single-pole RAR, the output signal "1p Trip Perm." disappears. After the dead time, the circuit breaker receives a closing command, the duration of which is settable. Simultaneously, the signal "RAR Zone Rel." disappears and the (settable) reclaim time T–RECLAIM (Section 4.2.3) is started.

If the fault is cleared (successful RAR), the reclaim time T–RECLAIM, Section 4.2.3) expires and all functions of 7VK512 reset to the quiescent condition. The network fault is cleared, the AR functions are ready for a new fault.

If the fault has not been cleared (unsuccessful AR) then feeder protection carries out a final disconnection in the stage that is valid without RAR. Also, every fault during the reclaim time will result in final disconnection.

After unsuccessful AR (final disconnection) the lock-out time TBLOCK DYN (Section 4.2.3) is started. For this time any close command from 7VK512 is locked.

After occurrences of multi-phase faults the short-circuit protection trips finally, three-pole. Every three-pole trip is a final trip. The lock-out time TBLOCK DYN (Section 4.2.3) is started. For this time any close command from 7VK512 is locked.

In this mode, only single-shot auto-reclosure is possible.

4.2.7 Single- and three-pole auto-reclosure

The RAR function of 7VK512 informs the feeder protection about readiness for reclosure by its output signal "RAR Zone Rel." in order to allow the feeder protection to trip in its RAR zone (if available), and issues output signal "1p Trip Perm." (i.e. single-pole trip permission, the logical inversion of three-pole coupling). The action time (refer to Section 4.2.3) of the RAR function is started with the fault detection signal of the feeder protection via the binary input ">Start AR".

The feeder protection trips single-pole for single-phase faults and three-pole for multi-phase faults. The AR-function of 7VK512 is informed via the binary inputs ">Trip L1 AR" or ">Trip L2 AR" or ">Trip L3 AR". RAR function is initiated provided tripping occurs within the action time (refer to Section 4.2.3). With fault clearance, i.e. with disappearance of the trip signal, the (settable) dead time RAR T–1POL commences for single-pole RAR, or the separately settable dead time RAR T–3POL for three-pole RAR; the output signal "1p Trip Perm." disappears. After the dead time, the circuit breaker receives a closing command, the duration of which is settable. The (settable) reclaim time T–RECLAIM (Section 4.2.3) is started.

If the fault is cleared (successful RAR), the reclaim time T–RECLAIM, Section 4.2.3) expires and all functions of 7VK512 reset to the quiescent condition. The network fault is cleared, the AR functions are ready for a new fault.

If the fault has not been cleared (unsuccessful AR) then the feeder protection carries out a final disconnection in the stage that is valid without RAR. Also, every fault during the reclaim time will result in final disconnection.

After unsuccessful AR (final disconnection) the lock-out time TBLOCK DYN (Section 4.2.3) is started. For this time any close command from 7VK512 is locked.

The above sequence comes into effect with single-shot RAR. With 7VK512, multiple AR-attempts (up to 9 DAR-shots, refer to Section 4.2.9) are also possible. Additionally, it is possible to skip the RAR cycle by a signal via a binary input of the device. In this case only DAR is effective (refer to Section 4.2.9).

4.2.8 Treatment of evolving faults for single-pole auto-reclosure

When single-pole or single- and three-pole auto-reclosures are carried out in the network, special attention has to be directed to evolving faults. Evolving faults are here defined as those which, after clearance of the first-detected fault, occur during the dead time of an AR cycle.

The evolving fault is detected by the feeder protection. It informs the AR function by outputting the fault detection and trip signals through binary inputs. The criterion for recognition of evolving faults can be selected in 7VK512 to be either *TRIP COMMAND* during the dead time or any further *FAULT DETEC*tion from the feeder protection.

The reaction of the AR-function to a recognized evolving fault can also be selected:

a) *NO* special reaction to evolving faults:

   As soon as an evolving fault has been detected, the unit switches to the three-pole auto-reclosure cycle. Every trip will be three-pole. If three-pole auto-reclosure is permitted, then the dead time for three-pole auto-reclosure begins simultaneously with the interruption of the evolving fault. When the dead time has expired, the circuit breaker receives the command to close. The further sequence is the same as for single- and three-pole auto-reclosure.

   The total dead time in this case consists of the dead time for the single-pole auto-reclosure, which has expired when the evolving fault is interrupted, plus the dead time for the three-pole auto-reclosure. This is useful because only the dead time for three-pole auto-reclosure is of importance for the stability of the network.

b) Blocking of reclosure, after evolving faults *ALWAYS*:

   As soon as an evolving fault has been detected, reclosure is blocked. Every trip will be three-pole regardless whether three-pole AR is permitted or not.

c) Blocking, after evolving faults, after an adjustable discrimination time, *>T–DISCR*:

   The discrimination time starts simultaneously with the single-pole dead time. It is used to discriminate from which point in time an evolving fault is identified as such. If the evolving fault occurs before the expiry of the discrimination time, the device is switched to a three-pole AR-cycle (if permitted), as under a). If however, the evolving fault occurs after the discrimination time has expired, reclosure is blocked, as under b).

4.2.9 Multi-shot auto-reclosure

The auto-reclose function of 7VK512 will also permit multi-shot reclosure, up to 9 consecutive DAR-cycles. The second and each further cycle are always three-pole. The DAR function of 7VK512 informs the feeder protection about readiness for reclosure by its output signal "`DAR Zone Rel.`". The (separately set) action time (refer to Section 4.2.3) of the DAR function is started with the fault detection signal of the feeder protection via the binary input "`>Start AR`".

Different numbers of DAR cycles can be set for single-phase faults and multi-phase fault; tripping command is, nevertheless, always three-pole. The set number of DAR cycles does not include the first RAR cycle.

Dead times can be individually set for the first three AR cycles; further cycles operate with the dead time of the third cycle. In this case, all AR cycles are decisive, i.e. also the RAR cycle. The RAR cycle operates with its dead time (RAR T–1POL for single- or RAR T–3POL for three-pole RAR), the first DAR is the second cycle with the dead time for the second cycle DAR T3POL2, etc.! If no RAR cycle has occurred (e.g. RAR blocked) then the first DAR cycle operates with the dead time for the first cycle DAR T3POL1, etc.

Each new pick-up restarts the action time DAR T–ACT. within which a tripping command must occur. After fault clearance within the action time the dead time begins. At the end of this, the circuit breaker is given a new closing command. Simultaneously, the reclaim time T–RECLAIM (Section 4.2.3) is started.

If one of the cycles is successful, that is, after reclose the fault is no longer present, the reclaim time T–RECLAIM (Section 4.2.3) runs out and all functions of 7VK512 return to the quiescent condition. The network fault is cleared, the AR functions are ready for a new fault.

As long as the permitted number of cycles has not been reached, the reclaim time is reset by each new trip command and recommences with the next closing command.

If none of the AR-cycles have been successful then the short-circuit protection carries out a final disconnection after the last permissible cycle. The lock-out time TBLOCK DYN (Section 4.2.3) is started. For this time any close command from 7VK512 is locked.

The subsequent cycles (DAR) can be blocked by a binary input independently of the function of the RAR cycle.

4.2.10 Control of the auto-reclose function by two protective relays

For lines with two protective relays (e.g. main protection and alternate protection), the auto-reclose function can be controlled by both feeder protection relays in parallel.

The following inputs and outputs of 7VK512 are suitable for communication with the protection relays.

The AR-function can be started via the binary inputs from both feeder protection relays, connected in parallel:

- `>Start AR` General start signal for AR (FNo 80),
- `>Trip L1 AR` Tripping command L1 for AR (FNo 81),
- `>Trip L2 AR` Tripping command L2 for AR (FNo 82),
- `>Trip L3 AR` Tripping command L3 for AR (FNo 83).

The general start signal is the criterion for the start of the action time. At the issue of the tripping command it is decided whether the dead time for single-pole AR or three-pole AR will be effective, or if reclosure is blocked for three-pole tripping (dependent upon the set AR program). The AR function of 7VK512 recognizes a multi-pole trip even in case each of the feeder protection relays detect a single-phase fault but in different phases.

If *only* three-pole AR is to be carried out, it is sufficient to use *any* convenient binary input for the tripping signal.

Alternatively, the following trip signals can be input to 7VK512 provided these are available from the feeder protection:

- `>Trip 1p AR` Tripping command single-pole for AR (FNo 96),
- `>Trip 3p AR` Tripping command three-pole for AR (FNo 97),

In this case the dead time is derived from these signals. But, with two protection relays, the AR function cannot recognize whether the two single-pole trip commands have been occurred in the same phase, so that external measures are necessary to block reclosure and to couple the three poles.

To couple the protection relays three-pole and to release their AR stages (if available), the following output functions are suitable:

- `1p Trip Perm.` AR ready for single-pole reclosure (logical inversion of three-pole coupling) (FNo 820),
- `RAR Zone Rel.` AR is ready for an RAR cycle, i.e. releases RAR zone for the external protection relay (FNo 823),
- `DAR Zone Rel.` AR is ready for a DAR cycle, i.e. releases DAR zone for the external protection relay (FNo 824),
- `RAR 1p Prog.` RAR programmed to single-pole reclosure only, i.e. recloses only after single-pole trip (FNo 821).

7VK512 issues no permission for single-pole trip (i.e. performs three-pole coupling) when trip signals occur in more than one phase, thus, in case each of the feeder protection relays trips a single-phase fault but in different phases, three-pole tripping will be effected.

Depending on the actual application and the used functions of the auto-reclose function, one or the other input or output can be omitted. E.g. for three-pole AR only the general start, general trip signals must be input, and "`RAR Zone Rel.`" is output from 7VK512.

4.2.11 Two protection relays with two auto-reclose devices

If a feeder is equipped with duplicated protection and each protection relay should control its own auto-reclose device, certain exchange of information is necessary between the two combinations. This is shown, as an example, in Figure 4.3. Three-pole coupling should be arranged with an external coupling unit which interacts directly with the circuit breaker trip circuits. This ensures three-pole tripping under all circumstances of multi-phase faults.

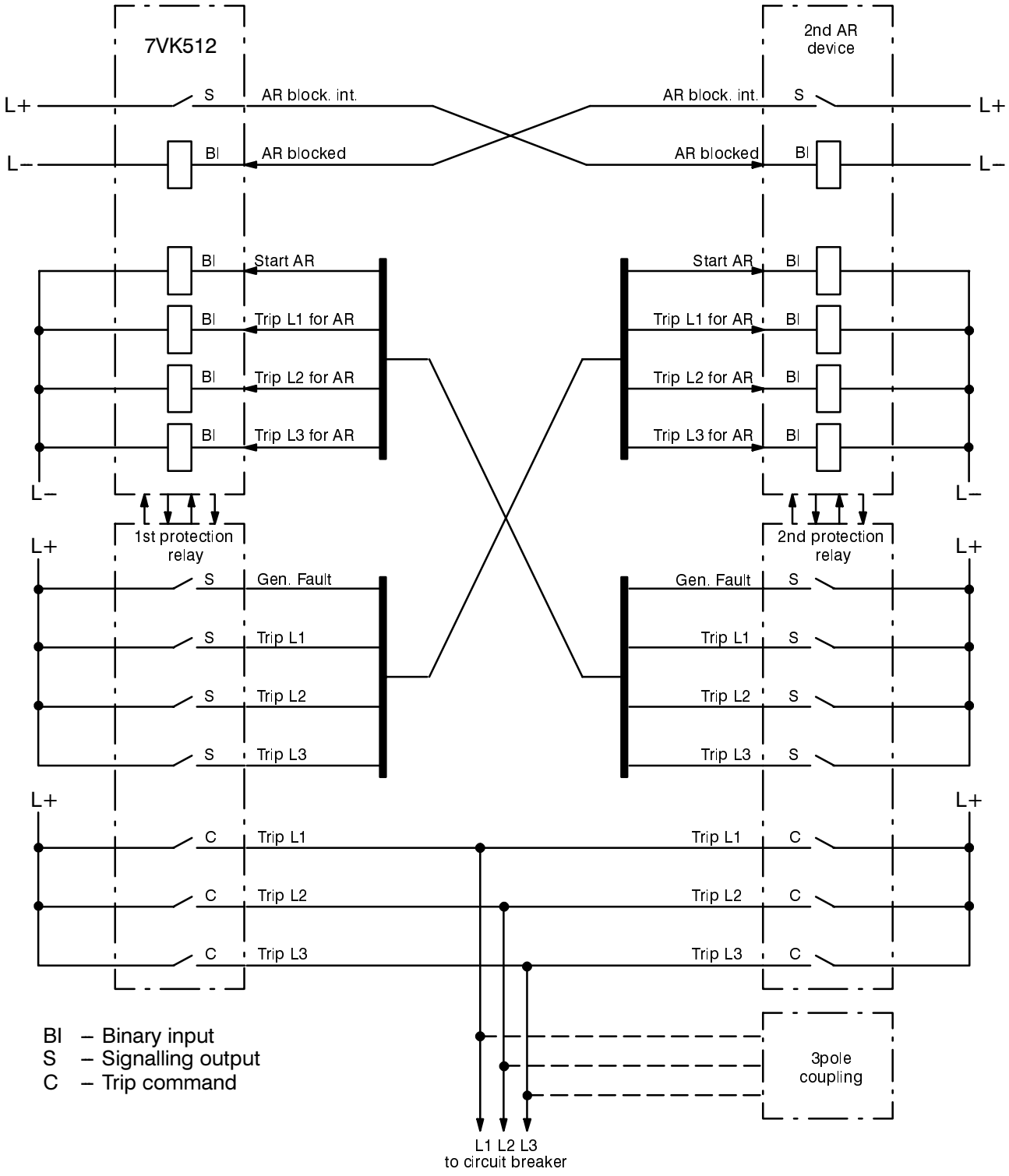


Figure 4.3 Connection example for 2 protection relays with 2 auto-reclosure devices

4.3 Synchronism and voltage check

4.3.1 General

The synchronism and voltage check function will ensure, when switching a line onto bus-bars, that the stability of the network will not be endangered. The function can be programmed to perform the synchronism and voltage check only for auto-reclose, only for manual close, or for both cases. Different permission criteria can also be programmed for automatic close and for manual close.

The synchronism and voltage check element uses the feeder voltage – designated with U1 – and the bus-bar voltage – designated with U2 – for comparison of the two voltages. These voltages can be any convenient phase-to-earth or phase-to-phase voltage but must be the same on the feeder side and on the bus-bar side.

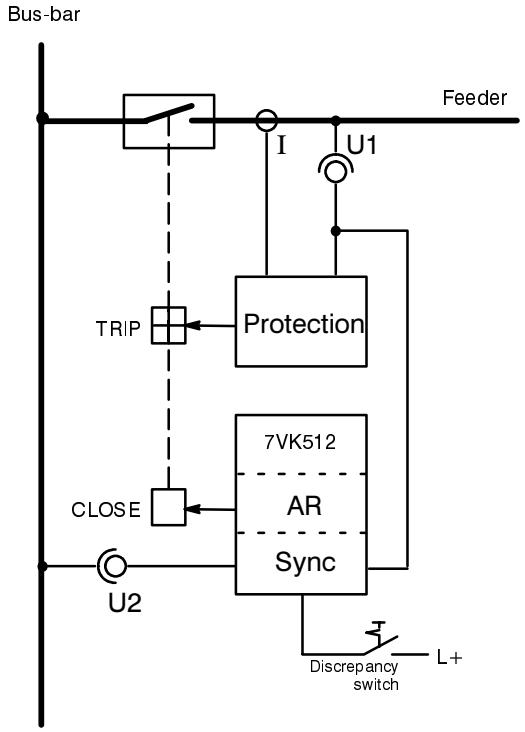


Figure 4.4 Synchro-check on closing

When a power transformer is situated between the feeder voltage transformer and the bus-bar voltage transformer (Figure 4.5), its vector group can be matched by the 7VK512 relay, so that no external matching transformers are necessary.

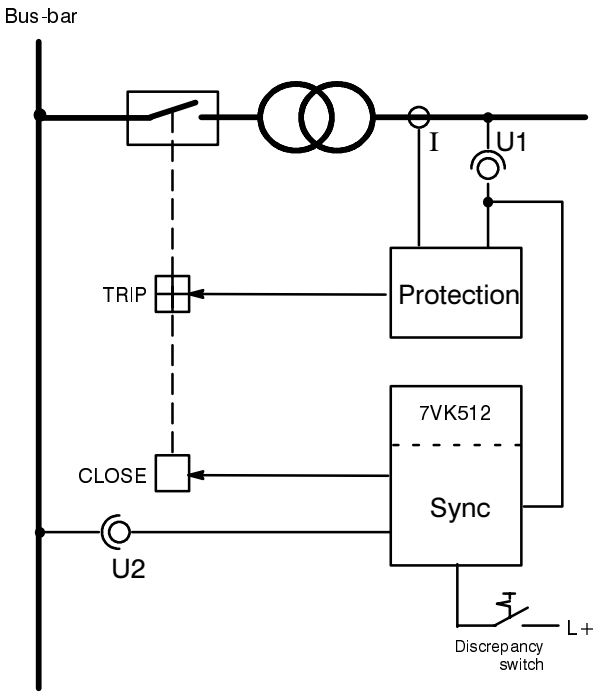


Figure 4.5 Synchro-check across transformer

The synchronism and voltage check function in 7VK512 normally operates in conjunction with the integrated auto-reclose and manual close functions. It is however possible to operate with an external auto-reclose relay. In this case, the signal exchange between the devices must be performed through binary inputs and outputs.

Furthermore, synchronous or asynchronous switching is possible. Synchronous switching means that the closing command is given as soon as the critical values (voltage magnitude difference ΔU, angle difference $\Delta\varphi$, and frequency difference Δf) lie within the set tolerances. For asynchronous switching, the device calculates the correct timing of the closing

command from the angle difference $\Delta\varphi$ and the frequency difference Δf such that the voltages at the bus-bar and the feeder circuit are exactly the same at the instant that the circuit breaker contacts touch. For that purpose the circuit breaker closing time must be programmed into the relay. For synchronous and asynchronous switching, different frequency difference limits can be programmed.

The synchronism and voltage check function operates only when it is requested to do so. This request can come from the internal auto-reclose function, from the manual closing command or from an external auto-reclose relay by binary input.

The synchro-check function gives permission for passage of the closing command.

Optionally, a closing command can be given by the synchro-check function. This can control the closing coil of the circuit breaker, or AR closing command and synchro-check closing command can be connected in series.

The permission time window is limited by an adjustable synchronous monitoring time. Within this period, the programmed conditions must have been met otherwise closing permission will not be given. A new synchro-check sequence requires a new request.

The relay indicates when the conditions for synchronism are not fulfilled, independent of a measuring request, i.e. when the voltage magnitude difference ΔU, the frequency difference Δf, or the angle difference $\Delta\varphi$ exceed the set limits. A precondition is that both voltages are of sufficient magnitude (>10 V).

4.3.2 Operating modes

The closing check procedure can be selected from the following functions:

– SYNCHR. = Release at synchronism. That is, when the critical values ΔU, $\Delta\varphi$ and Δf lie within the set limits.

– U1> U2< = Release for energized line (U1>) and de-energized bus-bar (U2<).

– U1< U2> = Release for de-energized line (U1<) and energized bus-bar (U2>).

– U1< U2< = Release for de-energized line (U1<) and de-energized bus-bar (U2<).

– OVERRIDE = Release without any check.

The release conditions can be set individually for automatic and for manual closing, e.g. one can permit manual closing at synchronism or dead line, whilst before an auto-reclose, at one line end only freedom from voltage and, at the other end, only synchronism will be checked.

Each of these conditions can be switched to be effective or not effective; combinations are also possible (e.g. release when U1> U2< or U1< U2> are satisfied). Combination of OVERRIDE with other parameters is, of course, not meaningful.

4.3.3 Dead-line switching

For release of the closing command to energize a volt-free line from the bus-bar, the following conditions are checked:

– Does the voltage U1 lie below the set value U<?

– Does the voltage U2 lie above the set value U>?

When the conditions are satisfied, the closing command is released. The duration of the command can be adjusted.

Corresponding conditions apply when switching a live line onto a dead bus-bar or a dead line onto a dead bus-bar.

4.3.4 Switching at synchronism

To release a closing command, the following conditions are checked:

– Does the voltage U1 lie above the set value U>?

– Does the voltage U2 lie above the set value U>?

– Is the voltage magnitude difference ||U1| – |U2|| within the permissible tolerance ΔU?

– Is the angle difference |φ1 – φ2| within the permissible tolerance $\Delta\varphi$?

– Is the frequency difference |f1 – f2| within the permissible tolerance Δf?

When the conditions are satisfied, the closing command is released. The duration of the command can be adjusted.

4.3.5 Asynchronous switching

For release of a closing command, the following conditions are checked:

– Does the voltage U1 lie above the set value U>?

– Does the voltage U2 lie above the set value U>?

– Is the voltage magnitude difference ||U1| – |U2|| within the permissible limit ΔU?

– Is the frequency difference |f1 – f2| within the permissible difference Δf, but larger than Δf_{sync}?

When the conditions are satisfied, the device calculates the time to the next instant of synchronism, from the rate of change of angle and frequency difference. The closing command is then released at the instant that the closing time of the breaker equals the difference between instant of command and the next instant of synchronism. The duration of the command is adjustable.

4.4 Ancillary functions

The ancillary functions of the numerical auto-reclosure relay 7VK512 include:

– Processing of annunciations,

– Storage of measured data for fault recording,

– Operational measurements and testing routines,

– Monitoring functions.

4.4.1 Processing of annunciations

After a fault in the protected object, information concerning the response of the device and knowledge of the measured values are of importance for an exact analysis of the history of the fault. For this purpose the device provides annunciation processing which is effective in three directions.

4.4.1.1 Indicators and binary outputs (signal relays)

Important events and conditions are indicated by optical indicators (LED) on the front plate. The module also contains signal relays for remote signalling. Most of the signals and indications can be marshalled, i.e. they can be allocated meanings other than the factory settings. In Section 5.5 the delivered condition and the marshalling facilities are described in detail.

The output signal relays are not latched and automatically reset as soon as the originating signal disappears. The LEDs can be arranged to latch or to be self-resetting.

The memories of the LEDs can be safe against supply voltage failure. They can be reset:

– locally, by operation of the reset button on the relay,

– remotely by energization of the remote reset input,

– automatically, on occurrence of a new general pick-up signal.

Some indicators and relays indicate conditions; it is not appropriate that these should be stored. Equally they cannot be reset until the originating criterion has been removed. This mainly concerns fault indications such as “auxiliary voltage fault”, etc.

A green LED indicates readiness for operation. This LED cannot be reset and remains illuminated when the microprocessor is working correctly and the unit is not faulty. The LED extinguishes when the self-checking function of the microprocessor detects a fault or when the auxiliary voltage is absent.

With the auxiliary voltage present but with an existing internal fault in the unit, a red LED illuminates (“Blocked”) and blocks the unit.

4.4.1.2 Information on the display panel or to a personal computer

Events and conditions can be read off in the display on the front plate of the device. Additionally, a personal computer, for example, can be connected via the operation interface, and all the informations can then be sent to it.

In the quiescent state, i.e. as long as no network faults are present, the display outputs selectable operating information (usually an operational measured value, models with synchronism and voltage check) in each of the two lines. In the event of a network fault, selectable information on the fault appears instead of the operating information, e.g. detected phase(s). The quiescent information is displayed again once these fault annunciations have been acknowledged. The acknowledgement is identical to resetting of the stored LED displays as in Section 4.4.1.1.

The device also has several event buffers, e.g. for operating messages, circuit breaker operation statistics etc. (refer to Section 6.4), which can be saved against supply voltage failure by a buffer battery. These messages, as well as all available operating values, can be transferred into the front display at any time using the keyboard or to the personal computer via the operating interface.

After a fault, for example, important information concerning its history, such as pick-up and tripping, can be called up on the display of the device. The fault inception is indicated with the absolute time of the operating system provided this feature is available. The sequence of the events is tagged with the relative time referred to the moment at which the fault detector has picked up. The resolution is 1 ms.

The events can also be read out with a personal computer by means of the appropriate program DIGSI®. This provides the comfort of a CRT screen and menu-guided operation. Additionally, the data can be documented on a printer or stored on a floppy disc for evaluation elsewhere.

The device stores the data of the last three network faults; if a fourth fault occurs the oldest fault is overwritten in the fault memory.

A network fault begins with recognition of the fault by pick-up of the feeder protection and ends with drop-off or expiry of the auto-reclose sequence so that non-successful auto-reclose attempts will also be stored as part of one network fault. Thus, one network fault can include different fault events (from pick-up until drop-off). This is particularly advantageous for allocation of time data.

4.4.1.3 **Information to a central unit** (optional)

In addition, all stored information can be transmitted via an optical fibre connector to a control centre, for example, the SIEMENS Localized Substation Automation System LSA 678. Transmission uses a standardized transmission protocol according to DIN 19244.

4.4.2 **Data storage and transmission for fault recording** (models with synchronism check)

The instantaneous values of the measured values

u1 and u2

are sampled at 1 ms intervals (for 50 Hz) and stored in a circulating shift register. In case of a fault, the data from 5 cycles before pick-up of the feeder protection up until 5 cycles after the trip command are stored, max. over 3 seconds. These data are then available for fault analysis. For each renewed network fault, the actual new fault data are stored without acknowledgement of the old data.

The data can be transferred to a connected personal computer via the operation interface at the front and evaluated by the protection data evaluation program DIGSI®. The voltages are referred to their maximum values, normalized to their rated values and prepared for graphic visualization. In addition, the signals “Pick-up”, “Trip” and “Drop-off” are marked on the fault record.

Alternatively, the fault record data can be transmitted to a control centre via the serial interface. In this case data are stored from 3 periods before to 30 periods after pick-up of the device. Evaluation of the data is made in the control centre, using appropriate software programs. The are referred to their maximum values, normalized to their rated values and prepared for graphic visualization. In addition, the signals “Pick-up”, “Trip” and “Drop-off” are marked on the fault record.

When the data are transferred to a central unit, readout can proceed automatically, optionally after each pick-up of the relay or after an instantaneous trip. The following then applies:

– The relay signals the availability of fault record data,

– The data remain available for recall until commencement of the next fault event.

– A transmission in progress can be aborted by the central unit.

4.4.3 **Operating measurements and conversion** (models with synchronism check)

For local recall or transmission of data, the true rms values of the voltages in primary and secondary values, the frequencies, the voltage magnitude difference ΔU, the frequency difference Δf and the phase angle difference $\Delta\varphi$ are always available, as long as the voltages are present.

The following is valid:

– U1 the feeder voltage in volts secondary,

– U2 the bus-bar voltage in volts secondary,

– $U1_{pri}$ the feeder voltage in kilovolts primary,

– $U2_{pri}$ the bus-bar voltage in kilovolts primary,

– f1 the frequency of the feeder voltage in Hertz,

– f2 the frequency of the bus-bar voltage in Hertz,

– ΔU the voltage magnitude difference

– Δf the frequency difference

– $\Delta \varphi$ the phase angle difference

4.4.4 Monitoring functions

The device incorporates comprehensive monitoring functions which cover both hardware and software.

4.4.4.1 Hardware monitoring

The complete hardware is monitored for faults and inadmissible functions, from the measured value inputs to the output relays. In detail this is accomplished by monitoring:

– Auxiliary and reference voltages

The processor monitors the offset and reference voltage of the ADC (analog/digital converter). The protection is blocked as soon as impermissible deviations occur. Permanent faults are annunciated.

Failure or switch-off of the auxiliary voltage automatically puts the system out of operation; this status is indicated by a fail-safe contact. Transient dips in supply voltage of less than 50 ms will not disturb the function of the relay.

– Command output channels:

The command relays for closing are controlled by two command and one additional release channels. As long as no pick-up condition exists, the central processor makes a cyclic check of these command output channel for availability, by exciting each channels one after the other and checking for change in the output signal level. Change of the feed-back signal to low level indicates a fault in one of the control channels or in the relay coil. Such a condition leads automatically to alarm and blocking of the command output.

– Memory modules:

The memory modules are periodically checked for fault by:

- Writing a data bit pattern for the working memory (RAM) and reading it,
- Formation of the modulus for the program memory (EPROM) and comparison of it with a reference program modulus stored there,
- Formation of the modulus of the values stored in the parameter store (EEPROM) then comparing it with the newly determined modulus after each parameter assignment process.

4.4.4.2 Software monitoring

For continuous monitoring of the program sequences, a watchdog timer is provided which will reset the processor in the event of processor failure or if a program falls out of step. Further, internal plausibility checks ensure that any fault in processing of the programs, caused by interference, will be recognized. Such faults lead to reset and restart of the processor.

If such a fault is not eliminated by restarting, further restarts are initiated. If the fault is still present after three restart attempts the protective system will switch itself out of service and indicate this condition by drop-off of the availability relay, thus indicating “equipment fault” and simultaneously the LED “Blocked” comes on.

5 Installation instructions

Warning

The successful and safe operation of this device is dependent on proper handling and installation by qualified personnel under observance of all warnings and hints contained in this manual.

In particular the general erection and safety regulations (e.g. IEC, DIN, VDE, or national standards) regarding the correct use of hoisting gear must be observed. Non-observance can result in death, personal injury or substantial property damage.

5.1 Unpacking and repacking

When dispatched from the factory, the equipment is packed in accordance with the guidelines laid down in IEC 60255–21, which specifies the impact resistance of packaging.

This packing shall be removed with care, without force and without the use of inappropriate tools. The equipment should be visually checked to ensure that there are no external traces of damage.

The transport packing can be re-used for further transport when applied in the same way. The storage packing of the individual relays is not suited to transport. If alternative packing is used, this must also provide the same degree of protection against mechanical shock, as laid down in IEC 60255–21–1 class 2 and IEC 60255–21–2 class 1.

Before initial energization with supply voltage, the relay shall be situated in the operating area for at least two hours in order to ensure temperature equalization and to avoid humidity influences and condensation.

5.2 Preparations

The operating conditions must accord with VDE 0100/5.73 and VDE 0105 part 1/7.83, or corresponding national standards for electrical power installations.

Caution!

The modules of digital relays contain CMOS circuits. These shall not be withdrawn or inserted under live conditions! The modules must be so handled that any possibility of damage due to static electrical charges is excluded. During any necessary handling of individual modules the recommendations relating to the handling of **e**lectrostatically **e**ndangered **c**omponents (EEC) must be observed.

In installed conditions, the modules are in no danger.

5.2.1 Mounting and connections

5.2.1.1 Model 7VK512⋆–⋆B⋆⋆⋆ for panel surface mounting

– Secure the unit with four screws to the panel. For the dimensions refer to Figure 2.2.

– Connect the earthing terminal (Terminal 16) of the unit to the protective earth of the panel.

– Make a solid low-ohmic and low-inductance operational earth connection between the earthing surface at the side of the unit using at least one standard screw M4, and the earthing continuity system of the panel; recommended grounding strap DIN 72333 form A, e.g. Order-No. 15284 of Messrs Druseidt, Remscheid, Germany.

– Make connections via screwed terminals.

5.2.1.2 Model 7VK512⋆–⋆C⋆⋆⋆ for panel flush mounting or ⋆E⋆⋆⋆ for cubicle installation

– Lift up both labelling strips on the lid of the unit and remove cover to gain access to the four holes for the fixing screws.

– Insert the unit into the panel cut-out and secure it with the fixing screws. For the dimensions refer to Figure 2.3.

– Connect the earthing screw on the rear of the unit to the protective earth of the panel or cubicle.

– Make a solid low-ohmic and low-inductance operational earth connection between the earthing surface at the rear of the unit using at least one standard screw M4, and the earthing continuity system of the panel or cubicle; recommended grounding strap DIN 72333 form A, e.g. Order-No. 15284 of Messrs Druseidt, Remscheid, Germany.

– Make connections via the screwed or snap-in terminals of the sockets of the housing. Observe labelling of the individual connector modules to ensure correct location; observe the max. permissible conductor cross-sections. The use of the screwed terminals is recommended; snap-in connection requires special tools and must not be used for field wiring unless proper strain relief and the permissible bending radius are observed.

5.2.2 Checking the rated data

The rated data of the unit must be checked against the plant data. This applies in particular to the rated d.c. voltage of the substation battery.

5.2.2.1 Control d.c. voltage of binary inputs

When delivered from the factory, the binary inputs are designed to operate in the total control voltage range from 19 V to 288 V. If the rated control voltage for the binary inputs is 110 V or higher, it is advisable to select a higher pick-up threshold to these inputs to increase stability against stray voltages in the d.c. circuits.

To select a higher pick-up threshold of approximately 70 V for a binary input a solder bridge must be removed. Figure 5.1 shows the allocation of these solder bridges for the inputs BI 1 to BI 6, and their location on the basic p.c.b. of the module EPS–2. Figure 5.2 shows the assignment of these solder bridges for the inputs BI 7 to BI 15 and their location on the additional p.c.b. (EAZ–2) of the module.

– Open housing cover.

– Loosen the basic module using the pulling aids provided at the top and bottom.

Caution!

Electrostatic discharges via the component connections, the PCB tracks or the connecting pins of the modules must be avoided under all circumstances by previously touching an earthed metal surface.

– Pull out module and place onto a conductive surface.

– Check the solder bridges according to Figure 5.1 and 5.2, remove bridges where necessary.

– Insert module into the housing; ensure that the releasing lever is pushed fully to the right before the module is pressed in.

– Firmly push in the module using the releasing lever.

– Close housing cover.

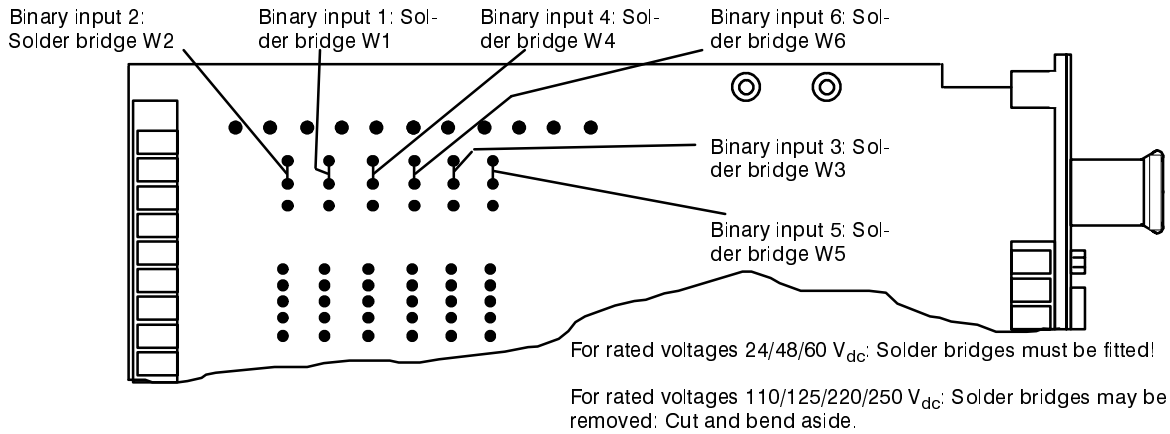


Figure 5.1 Checking of control voltages for binary inputs 1 to 6

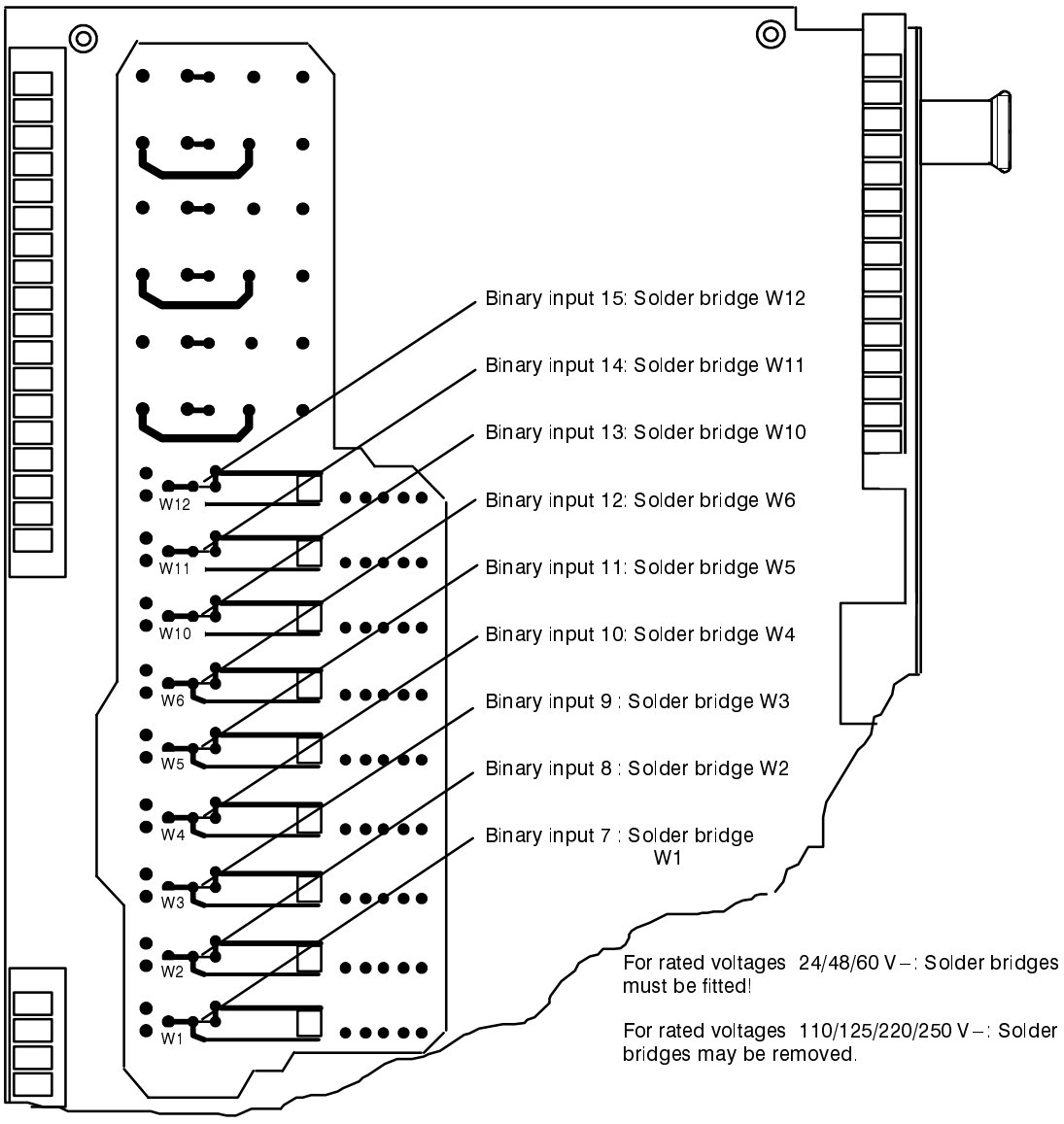


Figure 5.2 Checking of control voltages for binary inputs 7 to 15

5.2.3 Checking the LSA data transmission link

For models with an interface for a central data processing station (e.g. LSA) these connections must also be checked. It is important to visually check the allocation of the transmitter and receiver channels. Since each connection is used for one transmission direction, the transmit connection of the relay must be connected to the receive connection of the central unit and vice versa.

Transmission via optical fibre is particularly insensitive against disturbances and automatically provides galvanic isolation. Transmit and receive connectors are designated with the symbols ⟶● for transmit output and ●⟶ for receive input.

The normal signal position for the data transmission is factory preset as “light off”. This can be changed by means of a jumper plug X91 which is accessible when the plug-in module is removed from the case. The jumper is situated in the rear area of the CPU board (EPS–2) between the connector modules (Figure 5.3).

Jumper	Position	Normal signal position
X91	90 – 91	“Light off”
X91	91 – 92	“Light on”

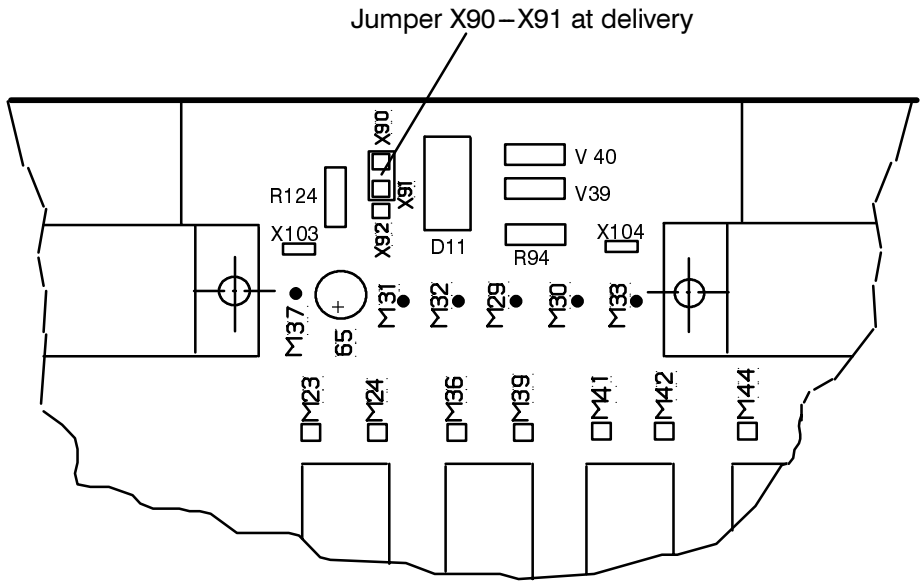


Figure 5.3 Position of the jumper X91 on the CPU board (EPS–2)

5.2.4 Connections

General and connection diagrams are shown in Appendix A and B. The marshalling possibilities of the binary inputs and outputs are described in Section 5.5.

5.2.5 Checking the connections

Warning

Some of the following test steps are carried out in the presence of hazardous voltages. They shall be performed by qualified personnel only which is thoroughly familiar with all safety regulations and precautionary measures and pay due attention to these.
Non-observance can result in severe personal injury.

Before initial energization with supply voltage, the relay shall be situated in the operating area for at least two hours in order to ensure temperature equalization and to avoid humidity influences and condensation.

– Switch off the circuit breakers for the d.c. supply and the voltage transformer circuits!

– Check the continuity of the voltage transformer circuits against the plant and connection diagrams:

  - Are the voltage transformers correctly earthed?
  - Are the polarities of the voltage transformer circuits correct?
  - Is the phase relationship of the voltage transformers correct?

– If test switches have been fitted in the secondary circuits, check their function.

– Fit a d.c. ammeter in the auxiliary power circuit; range approx. 1.5 A to 3 A.

– Close the battery supply circuit breaker; check polarity and magnitude of the voltage at the terminals of the unit or at the connector module.

– The measured current consumption should be correspond to approximately 6 W. Transient movement of the ammeter pointer only indicates the charging current of the storage capacitors.

– The unit starts up and, on completion of the run-up period, the green LED on the front comes on, the red LED gets off after at last 5 sec.

– Open the circuit breaker for the d.c. power supply.

– Remove d.c. ammeter; reconnect the auxiliary voltage leads.

– Close the voltage transformer m.c.b. (secondary circuit).

– Check the direction of the voltages at the relay terminals.

– Open the m.c.b.'s for voltage transformer secondary circuits and d.c. power supply.

– Check through the closing circuits to the circuit breaker.

– Check through the control wiring to and from other devices.

– Check the signal circuits.

– Close the protective m.c.b.'s.

5.3 Configuration of operational functions

5.3.1 Operational preconditions

For most operational functions, the input of a codeword is necessary. This applies for all entries via the membrane keyboard or front interface which concern the operation on the relay, for example

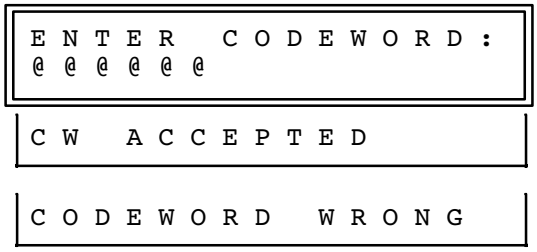
– configuration parameters for operation language, LSA configuration and device configuration,

– allocation or marshalling of annunciation signals, binary inputs, optical indications,

– setting of functional parameters (thresholds, functions).

The codeword is not required for the read-out of annunciations, operating data or fault data, or for the read-out of setting parameters.

To indicate authorized operator use, press key **CW**, enter the six figure code **0 0 0 0 0 0** and confirm with **E**. Codeword entry can also be made retrospectively after paging or direct addressing to any setting address.



The entered characters do not appear in the display, instead only a symbol @ appears. After confirmation of the correct input with **E** the display responds with **CW ACCEPTED**. Press the entry key **E** again.

If the codeword is not correct the display shows **CODEWORD WRONG**. Pressing the **CW** key allows another attempt at codeword entry.

5.3.2 Settings for operating parameters – address block 70

Operating parameters can be set in address block 70. This block allows the operator language to be changed. The transmission speed for transfer of data to a personal computer can be matched to the interface of the PC, messages on the front display can be selected here for the quiescent state of the unit or after a fault event. To change any of these parameters, codeword entry is necessary.

The simplest way of arriving at the beginning of this configuration block is to use key **DA**, followed by the address number **7 0 0 0** and ENTER, key **E**. The address 7000 appears (see below). Key ↑ will take the operator to address 7001.

The display shows the four-digit address number, i.e. block and sequence number. The title of the requested parameter appears behind the bar (see below). The second line of the display shows the text applicable to the parameter. The present text can be rejected by the "No"–key **N**. The next text choice then appears, as shown in the boxes below. The chosen alternative **must be confirmed with enter key E!**

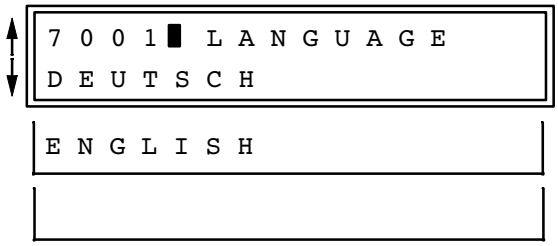
When the relay is delivered from the factory, the device is programmed to give function names and outputs in the German language. This can be changed under address 7001. The operator languages available at present are shown in the boxes below.

The setting procedure can be ended at any time by the key combination **F E**, i.e. depressing the function key **F** followed by the entry key **E**. The display shows the question "SAVE NEW SETTINGS?". Confirm with the "Yes"–key **Y** that the new settings shall become valid now. If you press the "No"–key **N** instead, codeword operation will be aborted, i.e. all alterations which have been changed since the last codeword entry are lost. Thus, erroneous alterations can be made ineffective.

If one tries to leave the setting range for the configuration blocks (i.e. address blocks 60 to 79) with keys ⇑ ⇓, the display shows the question "END OF CODEWORD OPERATION ?". Press the "No"–key **N** to continue configuration. If you press the "Yes"–key **J**/**Y** instead, another question appears: "SAVE NEW SETTINGS ?". Now you can confirm with **J**/**Y** or abort with **N**, as above.

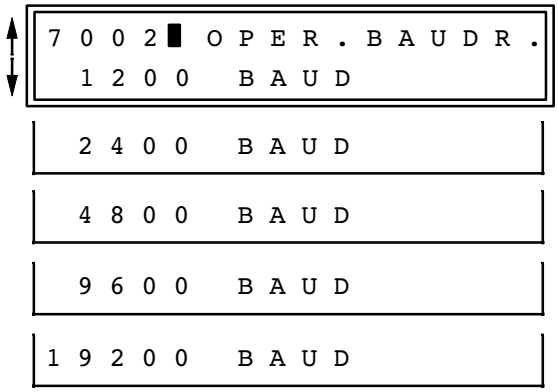
When one exits the setting program, the altered parameters, which until then have been stored in buffer stores, are permanently secured in EEPROMs and protected against power outage. If configuration parameters have been changed the processor system will reset and re-start. During re-start the device is not operational.

Beginning of the block "Operating parameters"



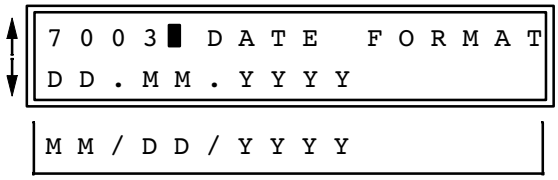
The available languages can be called up by repeatedly pressing the "No"–key **N**. Each language is spelled in the corresponding country's language. If you don't understand a language, you should find your own language.

The required language is chosen with the enter key **E**.



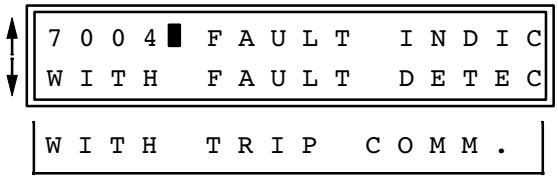
The transmission Baud-rate for communication via the operating interface at the front can be adapted to the operator's communication interface, e.g. personal computer, if necessary. The available possibilities can be displayed by repeatedly depression of the "No"–key **N**. Confirm the desired Baud-rate with the entry key **E**.

Note: For operator panel 7XR5, the operation Baud-rate must be *1200 BAUD*.

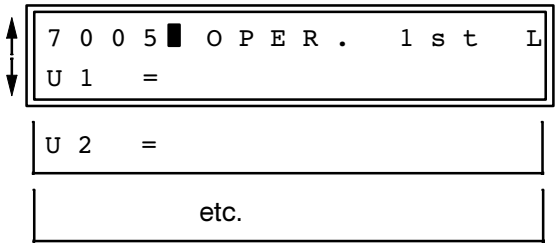


The date in the display is preset to the European format Day.Month.Year. Switch-over to the American format Month/Day/Year is achieved by depressing the "No"–key **N**; then confirm with the entry key **E**.

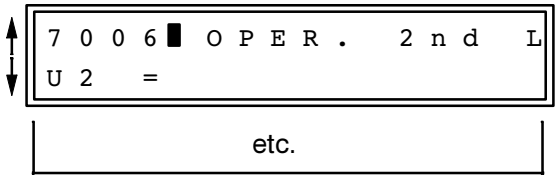
DD two figures for the day
MM two figures for the month
YYYY four figures for the year (incl. century)



Stored LED indications and the fault event messages in the display can be displayed either with each fault detection or only after trip command is given. This mode can be changed by depressing the "No"–key **N** and confirmed with the enter-key **E**.

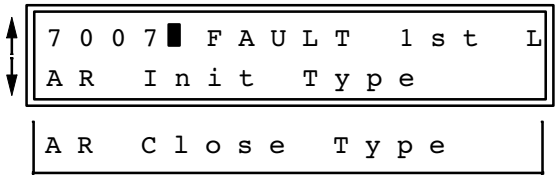


Message to be displayed in the **1st** display line during operation. Any of the operational measured values according to Section 6.4.5 can be selected as messages in the the quiescent state of the relay by repeatedly depressing the "No"–key **N**; The value selected by the entry key **E** under address 7005 will appear in the **first** line of the display.



Message to be displayed in the **2nd** display line during operation. The value selected by the entry key **E** under address 7006 will appear in the **second** line of the display.

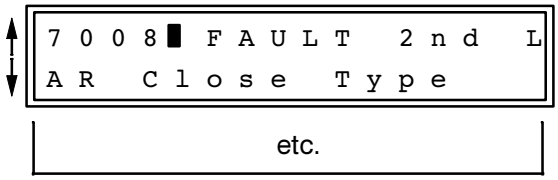
Fault event annunciations can be displayed after a fault on the front. These can be chosen under addresses 7007 and 7008. The possible messages can be selected by repeatedly pressing the "No"–key **N**. The desired message is confirmed with the enter key **E**. These spontaneous messages are acknowledged during operation with the RESET key or via the remote reset input of the device. After acknowledgement, the operational messages of the quiescent state will be displayed again as chosen under addresses 7005 and 7006.



After a fault event, the **first** line of the display shows:

type of AR initiation (faulty phases),

type of closing command (single- or three-pole),



After a fault event, the **second** line of the display shows:

the possibilities are the same as under address 7007.

Identification number of the relay within the substation; valid for both the interfaces (operating and LSA interface). The number can be chosen at liberty, but must be used only once within the plant system
Smallest permissible number: **0**
Largest permissible number: **255**

Number of the feeder within the substation; valid for both the interfaces (operating and LSA interface)
Smallest permissible number: **0**
Largest permissible number: **255**

5.4 Configuration of the device functions

5.4.1 Introduction

The **device** 7VK512 is capable of providing a series of **functions**. The scope of the hard- and firm-ware is matched to these functions. Furthermore, individual functions can be set (configured) to be effective or non-effective or the interaction of the functions can be modified by configuration parameters. Additionally, the relay can be adapted to the system frequency.

The configuration parameters are input through the integrated operation keyboard at the front of the device or by means of a personal computer, connected to this front-interface. The use of the integrated operating keyboard is described in detail in Section 6.2. Alteration of the programmed parameters requires the input of the codeword (see Section 5.3.1). Without codeword, the setting can be read out but not altered.

For the purpose of configuration, addresses 78★★ are provided. One can access the beginning of the configuration blocks either by direct dial

– press direct address key **DA**,
– type in address **7 8 0 0**,
– press execute key **E** ;

or by paging with the keys ⇑ (forwards) or ⇓ (backwards), until address 7800 appears.

Within the bock 78 one can page forward with ↑ or back with ↓. Each paging action leads to a further address for the input of a configuration parameter. In the following sections, each address is shown in a box and explained. In the upper line of the display, behind the number and the bar, stands the associated device function. In the second line is the associated text (e.g. "*EXIST*"). If this text is appropriate the arrow keys ↑ or ↓ can be used to page the next address. If the text should be altered press the "No"–key **N**; an alternative text then appears (e.g. "*NON–EXIST*"). There may be other alternatives which can then be displayed by repeated depression of the "No"–key **N**. The required alternative **must be confirmed with the key E!**

The configuration procedure can be ended at any time by the key combination **F E**, i.e. depressing the function key **F** followed by the entry key **E**. The display shows the question "SAVE NEW SETTINGS ?". Confirm with the "Yes"–key **J**/**Y** that the new settings shall become valid now. If you press the "No"–key **N** instead, codeword operation will be aborted, i.e. all alterations which have been changed since the last codeword entry are lost. Thus, erroneous alterations can be made ineffective.

If one tries to leave the setting range for the configuration blocks (i.e. address blocks 60 to 79) with keys ⇑ ⇓, the display shows the question "END OF CODEWORD OPERATION ?". Press the "No"–key **N** to continue configuration. If you press the "Yes"–key **J**/**Y** instead, another question appears: "SAVE NEW SETTINGS ?". Now you can confirm with **J**/**Y** or abort with **N**, as described above.

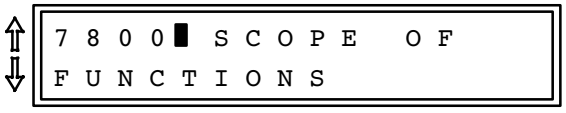
When one exits the setting program, the altered parameters, which until then have been stored in volatile memories, are then permanently secured in EEPROMs and protected against power outage. The processor system will reset and re-start. During restart the device is not operational.

5.4.2 Programming the scope of functions – address block 78

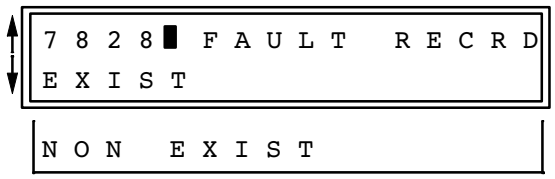
The available functions can be programmed as existing or not existing. For some functions it may also be possible to select between multiple alternatives.

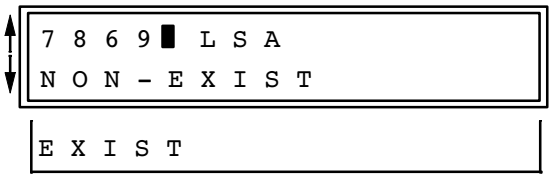
Functions which are **configured** as *NON EXIST* will not be processed in 7VK512: There will be no annunciations and the associated setting parameters (functions, limit values) will not be requested during setting (Section 6.3). In contrast, **switch-off** of a function means that the function will be processed, that indication will appear (e.g. "... switched off") but that the function will have no effect on the result of the protective process (e.g. no command).

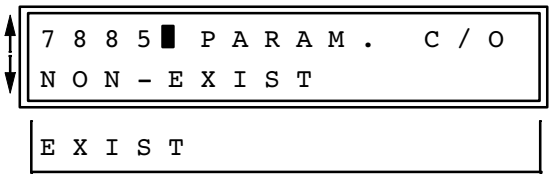
The following boxes show the possibilities for the maximum scope of the device. In an actual case, functions which are not available will not appear in the display.

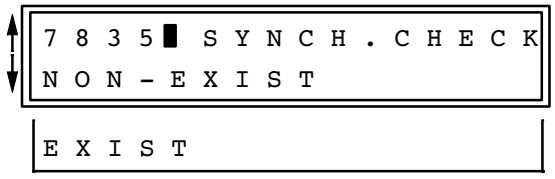


Beginning of the block "scope of functions"

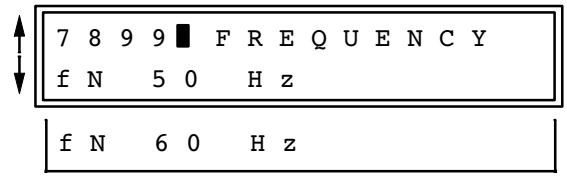








The rated system frequency must comply with the setting under address 7899. If the system frequency is not 50 Hz, address 7899 must be changed.



Rated system frequency *50 Hz* or *60 Hz*

5.5 Marshalling of binary inputs, binary outputs and LED indicators

5.5.1 Introduction

The functions of the binary inputs and outputs represented in the general diagrams (Appendix A) relate to the factory settings. The assignment of the inputs and outputs of the internal functions can be rearranged and thus adapted to the on-site conditions.

Marshalling of the inputs, outputs and LEDs is performed by means of the integrated operator panel or via the operating interface in the front. The operation of the operator panel is described in detail in Section 6.2. Marshalling begins at the parameter address 6000.

The input of the codeword is required for marshalling (refer to Section 5.3.1). Without codeword entry, parameters can be read out but not be changed. During codeword operation, i.e. from codeword entry until the termination of the configuration procedure, the solid bar in the display flashes.

When the firmware programs are running the specific logic functions will be allocated to the physical input and output modules or LEDs in accordance with the selection.

Example: Closing command is produced. This event is generated in the device as an "Annunciation" (logical function) and should be available at certain terminals of the unit as a N.O. contact. Since specific unit terminals are hard-wired to a specific (physical) output relay, e.g. to the trip relay 1, the processor must be advised that the logical signal "`AR Close Cmd`" should be transmitted to the trip relay 1. Thus, when marshalling is performed two statements of the operator are important: **Which** (logical) annunciation generated in the protection unit program should trigger **which** (physical) output relay? Up to 20 logical annunciations can trigger one (physical) output relay.

A similar situation applies to binary inputs. In this case external information (e.g. "Trip by feeder protection) is connected to the unit via a (physical) input module and should initiate a (logical) function, namely initiating. The corresponding question to the operator is then: **Which** signal from a (physical) input relay should initiate **which** reaction in the device? One physical input signal can initiate up to 10 logical functions.

The trip relays can also be assigned different functions. Each trip relay can be controlled by each command function or combination of command functions.

The logical annunciation functions can be used in multiple manner. E.g. one annunciation function can trigger several signal relays, several trip relays, additionally be indicated by LEDs, and be controlled by a binary input unit. The restriction is, that the total of all physical input/output units (binary inputs plus signal relays plus LEDs plus trip relays) which are to be associated with one logical function must not exceed a number of 10. If this number is tried to be exceeded, the display will show a corresponding message.

The marshalling procedure is set up such that for each (physical) binary input, each output relay, and for each marshallable LED, the operator will be asked which (logical) function should be allocated.

The offered logical functions are tabulated for the binary inputs, outputs and LEDs in the following sections.

The beginning of the marshalling parameter blocks is reached by directly selecting the address 6000, i.e.

– press direct address key **DA**,
– enter address **6 0 0 0**,
– press enter key **E**

or by paging with keys ⇑ (forwards) or ⇓ (backwards) until address 6000 has been reached. The beginning of the marshalling blocks then appears:

Beginning of marshalling blocks

One can proceed through the marshalling blocks with the key ⇑ or go back with the key ⇓. Within a block, one goes forwards with ↑ or backwards with ↓. Each forward or backward step leads to display of the next input, output or LED position. In the display, behind the address and the solid bar, the physical input/output unit forms the heading.

The key combination **F** ↑, i.e. depressing the function key **F** followed by the arrow key ↑, switches over to the selection level for the logical functions to be allocated. During this change-over (i.e. from pressing the **F** key until pressing the ↑ key) the bar behind the address number is replaced by an "F". The display shows, in the upper line, the physical input/output unit, this time with a three digit index number. The second display line shows the logical function which is presently allocated.

On this selection level the allocated function can be changed by pressing the "No" – key **N**. By repeated use of the key **N** all marshallable functions can be paged through the display. Back-paging is possible with the backspace key **R**. When the required function appears press the execute key **E**. After this, further functions can be allocated to the same physical input or output module (with further index numbers) by using the key ↑. **Each selection must be confirmed by pressing the key E!** If a selection place shall not be assigned to a function, selection is made with the function "`not allocated`".

You can leave the selection level by pressing the key combination **F** ↑ (i.e. depressing the function key **F** followed by the arrow key ↑). The display shows again the four digit address number of the physical input/output module. Now you can page with key ↑ to the next input/output module or with ↓ to the previous to repeat selection procedure, as above.

The logical functions are also provided with function numbers which are equally listed in the tables. If the function number is known, this can be input directly on the selection level. Paging through the possible functions is then superfluous. With direct input of the function number, leading zeros need not be entered. After input of the function number, use **the execute key E**. Immediately the associated identification of the function appears for checking purposes. This can be altered either by entering another function number or by paging through the possible functions, forwards with the "No" – key **N** or backwards with the backspace key **R**. If the function has been changed, another confirmation is necessary with **the execute key E**.

In the following paragraphs, allocation possibilities for binary inputs, binary outputs and LED indicators are given. The arrows or ↑↓ at the left hand side of the display box indicate paging from block to block, within the block or on the selection level. The character F before the arrow indicates that the function key **F** must be pressed before pushing the arrow key ↑.

The function numbers and designations are listed completely in Appendix C.

The marshalling procedure can be ended at any time by the key combination **F E**, i.e. depressing the function key **F** followed by the entry key **E**. The display shows the question "SAVE NEW SETTINGS?". Confirm with the "Yes" – key **J**/**Y** that the new allocations shall become valid now. If you press the "No" – key **N** instead, codeword operation will be aborted, i.e. all alterations which have been changed since the last codeword entry are lost. Thus, erroneous alterations can be made ineffective.

If one tries to leave the setting range for the configuration blocks (i.e. address blocks 60 to 79) with keys ⇑ ⇓, the display shows the question "END OF CODEWORD OPERATION ?". Press the "No" – key **N** to continue marshalling. If you press the "Yes" – key **J**/**Y** instead, another question appears: "SAVE NEW SETTINGS ?". Now you can confirm with **J**/**Y** or abort with **N**, as above.

When one exits the marshalling program, the altered parameters, which until then have been stored in volatile memory, are then permanently secured in EEPROMs and protected against power outage. The processor system will reset and re-start. During re-start the device is not operational.

5.5.2 Marshalling of the binary inputs – address block 61

The unit contains 15 binary inputs which are designated INPUT 1 to INPUT 15. They can be marshalled in address block 61. The address block is reached by paging in blocks ⇑ ⇓ or by direct addressing with **DA 6 1 0 0 E**. The selection procedure is carried out as described in Section 5.5.1.

A choice can be made for each individual input function as to whether the desired function should become operative in the "normally open" mode or in the "normally closed" mode, whereby:

NO – "normally open" mode: the input acts as a NO contact, i.e. the control voltage at the input terminals activates the function;

NC – "normally closed" mode: the input acts as a NC contact, i.e. control voltage present at the terminals turns off the function, control voltage absent activates the function.

When paging through the display, each input function is displayed with the index "NO" or "NC" when proceeding with the "No"–key **N**.

Table 5.1 shows a complete list of all the binary input functions with their associated function number **FNo**. Input functions naturally have no effect if the corresponding protection function is not fitted in the relay or has been programmed out ("de-configured", refer to Section 5.4.2).

With direct input of the function number, leading zeros need not be used. To indicate the contact mode the function number can be extended by a decimal point followed by **0** or **1**, whereby

.0 means "normally open" mode, corresponds to "NO" as above.

.1 means "normally closed" mode, corresponds to "NC" as above.

If the extension with .0 or .1 is omitted the display first indicates the function designation in "normally open" mode NO. By pressing the "No"–key **N** the mode is changed to NC. After direct input other functions can be selected by paging through the functions forwards with the "No"–key **N** or backwards with the backspace key **R**. The changed function then must be re-confirmed by the entry key **E**.

The assignment of the binary inputs as delivered from factory is shown in the general diagrams in Appendix A. The following boxes show, as an example, the allocation for binary input 1. Table 5.2 shows all binary inputs as preset from the factory.

6 1 0 0 MARSHALLING BINARY INPUTS	Beginning of block "Marshalling binary inputs"

The first binary input is reached with the key ↑:

F 6 1 0 1 BINARY INPUT 1	Allocations for binary input 1

Change over to the selection level with **F** ↑:

0 0 1 INPUT 1 > LED reset NO	Reset of stored LED indications, FNo 6; "normally open" operation: LEDs are reset when control voltage present
0 0 2 INPUT 1 not allocated	No further functions are initiated by binary input 1

Leave the selection level with key combination **F** ↑. You can go then to the next binary input with the arrow key ↑.

Marshalling binary input 1

FNo	Abbreviation	Description
1	not allocated	Binary input is not allocated to any input function
5	>Time Synchro	Synchronize internal real time clock
6	>LED-reset	Reset LED indicators
7	>Start FltRec	Start fault recording from external command via binary input
11	>Manual Close	Circuit breaker is manually closed (from discrepancy switch)
14	>U1 VT mcb	Feeder voltage transformer secondary m.c.b. has tripped
15	>U2 VT mcb	Bus-bar voltage transformer secondary m.c.b. has tripped
16	>CB Aux. L1	Circuit breaker auxiliary contact L1 (L1 is closed)
17	>CB Aux. L2	Circuit breaker auxiliary contact L2 (L2 is closed)
18	>CB Aux. L3	Circuit breaker auxiliary contact L3 (L3 is closed)
19	>CB Aux. 3p C	Circuit breaker auxiliary contact all poles closed (series connection)
20	>CB Aux. 1p C	Circuit breaker auxiliary contact any pole closed (parallel connection)
21	>Annunc. 1	User definable annunciation 1
22	>Annunc. 2	User definable annunciation 2
23	>Annunc. 3	User definable annunciation 3
24	>Annunc. 4	User definable annunciation 4
30	>Sync. Start	Initiate internal synchronism and voltage check function
31	>Sync. Block	Block internal synchronism and voltage check function
32	>Sync. synch	Synchro-check program: check synchronism
33	>Sync. U1>U2<	Synchro-check program: live-line dead-bus check
34	>Sync. U1<U2>	Synchro-check program: dead-line live-bus check
35	>Sync. U1<U2<	Synchro-check program: dead-line dead-bus check
36	>Sync. o/ride	Synchro-check program: override synchro-check
49	>Flt.Rec. on	Switch on fault recording function
50	>Flt.Rec. off	Switch off fault recording function
51	>SyncChck on	Switch on synchronism and voltage check function
52	>SyncChck off	Switch off synchronism and voltage check function
57	>AR on	Switch on auto-reclose function
58	>AR off	Switch off auto-reclose function
59	>ParamSelec.1	Parameter set selection 1 (in connection with FNo 060)
60	>ParamSelec.2	Parameter set selection 2 (in connection with FNo 059)
80	>Start AR	Start signal from external protection for AR
81	>Trip L1 AR	Trip signal L1 from external protection for AR
82	>Trip L2 AR	Trip signal L2 from external protection for AR
83	>Trip L3 AR	Trip signal L3 from external protection for AR
86	>1p RAR Block	Block single-pole RAR
88	>3p RAR Block	Block three-pole RAR
89	>RAR Block	Block RAR
90	>AR Block	Block complete AR function
91	>DAR Block	Block DAR
92	>CB Ready	Circuit breaker ready for AR cycle
93	>DAR aft. RAR	DAR cycle is allowed only after unsuccessful RAR cycle
94	>Sync.Release	Release reclose command (from external synchro-check relay)
95	>CloseCmd Blo	Block all closing commands from external
96	>Trip 1p AR	Single-pole trip for initiation of AR
97	>Trip 3p AR	Three-pole trip for initiation of AR
98	>AR Reset	Reset AR

Table 5.1 Marshalling possibilities for binary inputs

Addr	1st display line	2nd display line	FNo	Remarks
6100	MARSHALLING	BINARY INPUTS		Heading of the address block
6101	BINARY INPUT 1	INPUT 1 >LED reset NO	6	Acknowledge and reset of stored LED and display indications, LED-test
6102	BINARY INPUT 2	INPUT 2 >Start AR NO	80	Start signal from feeder protection
6103	BINARY INPUT 3	INPUT 3 >Trip L1 AR NO	81	Trip commands from feeder protection
6104	BINARY INPUT 4	INPUT 4 >Trip L2 AR NO	82	
6105	BINARY INPUT 5	INPUT 5 >Trip L3 AR NO	83	
6106	BINARY INPUT 6	INPUT 6 >CB ready NO	92	From circuit breaker
6107	BINARY INPUT 7	INPUT 7 >Manual Close NO	11	Manual close command from discrepancy switch
6108	BINARY INPUT 8	INPUT 8 >AR block. NO	90	Blocking of auto-reclose functions
6109	BINARY INPUT 9	INPUT 9 >CloseCmd Blo NO	95	
6110	BINARY INPUT 10	INPUT 10 >RAR Block NO	89	
6111	BINARY INPUT 11	INPUT 11 >DAR Block NO	91	
6112	BINARY INPUT 12	INPUT 12 [1] >AR on NO	57	Switching the internal auto-reclosure function
6113	BINARY INPUT 13	INPUT 13 [1] >AR off NO	58	
6114	BINARY INPUT 14	INPUT 14 [1] >1p RAR Block NO	86	Blocking of auto-reclosure functions
6115	BINARY INPUT 15	INPUT 15 [1] >3p RAR Block NO	88	
6112	BINARY INPUT 12	INPUT 12 [2] >U1 VT mcb NO	14	Voltage transformer secondary m.c.b. has tripped
6113	BINARY INPUT 13	INPUT 13 [2] >U2 VT mcb NO	15	
6114	BINARY INPUT 14	INPUT 14 [2] >Sync. Block NO	31	Blocking of synchronism and voltage check function (closing blocked)
6115	BINARY INPUT 15	INPUT 15 [2] >Sync. o/ride NO	36	Override synchro-check (closing released)

[1]) presettings for 7VK512**1** [2]) presettings for 7VK512**2**

Table 5.2 Preset binary inputs

5.5.3 Marshalling of the signal output relays – address block 62

The unit contains 15 signal outputs (alarm relays). The signal relays are designated SIGNAL RELAY 1 to SIGNAL RELAY 15 and can be marshalled in address block 62. The block is reached by paging in blocks with ⇑ ⇓ or by directly addressing **DA 6 2 0 0 E**. The selection procedure is carried out as described in Section 5.5.1. Multiple annunciations are possible, i.e. one logical annunciation function can be given to several physical signal relays (see also Section 5.5.1).

Table 5.3 gives a listing of all annunciation functions with the associated function numbers **FNo**. Annunciation functions are naturally not effective when the corresponding protection function is not fitted in the relay or has been programmed out ("de-configured" – refer to Section 5.4.2).

The assignment of the output signal relays as delivered from factory is shown in the general diagrams in Appendix A. The following boxes show an example for signal relay 10 with the group annunciation for several annunciation functions on one signal relay. Table 5.4 shows all signal relays as preset from the factory.

---

6 2 0 0 MARSHALLING SIGNAL RELAYS	Beginning of the block "Marshalling of the output signal relays"

E.g. signal relay 10 is reached with the key ↑:

6 2 1 0 SIGNAL RELAY 10	Allocations for signal relay 10, Meaning: "RAR dead time is running"

Change over to the selection level with **F** ↑:

0 0 1 RELAY 10 RAR T-1p run.	Signal relay 10 has been preset for: 1st: RAR single-pole dead time is running, FNo 809
0 0 2 RELAY 10 RAR T-3p run.	Signal relay 10 has been preset for: 2nd: RAR three-pole dead time is running, FNo 811
0 0 3 RELAY 10 not allocated	no further functions are preset for signal relay 10

After input of all annunciation functions for signal relay 10, change back to the marshalling level is carried out with **F** ↑:

6 2 1 0 SIGNAL RELAY 10	Allocations for signal relay 10, Meaning: "RAR dead time is running"

Note as to Table 5.3: Annunciations with the function numbers below 100 are identical with those for binary inputs. They represent the direct confirmation of the binary input and are available as long as the corresponding binary input is energized. These direct confirmation functions are indicated by a leading “>” sign.

Further information about annunciations see Section 6.4.

FNo	Abbreviation	Description
1	not allocated	Binary output is not allocated to any output function
5	>Time Synchro	Synchronize internal real time clock
6	>LED reset	Reset LED indicators
7	>Start FltRec	Start fault recording from external command via binary input
11	>Manual Close	Circuit breaker is manually closed (from discrepancy switch)
14	>U1 VT mcb	Feeder voltage transformer secondary m.c.b. has tripped
15	>U2 VT mcb	Bus-bar voltage transformer secondary m.c.b. has tripped
16	>CB Aux. L1	Circuit breaker auxiliary contact L1 (L1 is closed)
17	>CB Aux. L2	Circuit breaker auxiliary contact L2 (L2 is closed)
18	>CB Aux. L3	Circuit breaker auxiliary contact L3 (L3 is closed)
19	>CB Aux. 3p C	Circuit breaker auxiliary contact all poles closed (series connection)
20	>CB Aux. 1p C	Circuit breaker auxiliary contact any pole closed (parallel connection)
21	>Annunc. 1	User definable annunciation 1
22	>Annunc. 2	User definable annunciation 2
23	>Annunc. 3	User definable annunciation 3
24	>Annunc. 4	User definable annunciation 4
30	>Sync. Start	Initiate internal synchronism and voltage check function
31	>Sync. Block	Block internal synchro and voltage check function
32	>Sync. synch	Synchro-check program: check synchronism
33	>Sync. U1>U2<	Synchro-check program: live-line dead-bus check
34	>Sync. U1<U2>	Synchro-check program: dead-line live-bus check
34	>Sync. U1<U2<	Synchro-check program: dead-line dead-bus check
35	>Sync. o/ride	Synchro-check program: override synchro-check
49	>Flt.Rec. on	Switch on fault recording function
50	>Flt.Rec. off	Switch off fault recording function
51	>SyncChck on	Switch on synchronism and voltage check function
52	>SyncChck off	Switch off synchronism and voltage check function
57	>AR on	Switch on auto-reclose function
58	>AR off	Switch off auto-reclose function
59	>ParamSelec.1	Parameter set selection 1 (in connection with 060)
60	>ParamSelec.2	Parameter set selection 2 (in connection with 059)
80	>Start AR	Start signal from external protection for AR
81	>Trip L1 AR	Trip signal L1 from external protection for AR
82	>Trip L2 AR	Trip signal L2 from external protection for AR
83	>Trip L3 AR	Trip signal L3 from external protection for AR
86	>1p RAR Block	Block single-pole RAR
88	>3p RAR Block	Block three-pole RAR
89	>RAR Block	Block RAR
90	>AR Block	Block complete AR function
91	>DAR Block	Block DAR
92	>CB Ready	Circuit breaker ready for AR cycle
93	>DAR aft. RAR	DAR cycle is allowed only after unsuccessful RAR cycle
94	>Sync.Release	Release reclose command (from external synchro-check relay)
95	>CloseCmd.Blo	Block closing command
96	>Trip 1p AR	Single-pole trip for initiation of AR
97	>Trip 3p AR	Three-pole trip for initiation of AR
98	>AR Reset	Reset AR
101	Dev.Operative	Relay operative
106	LED reset	LED indicators reset
107	Flt.Rec.Activ	Fault record data are available or being transmitted
108	Flt.Rec. off	Fault recording switched off
110	Param.Running	Parameters are being set

Table 5.3 Marshalling possibilities for signal relays and LEDs (Continued next page)

FNo	Abbreviation	Description
111	Manual Close	Manual close indication of circuit breaker
112	Man.Close Cmd	Manual close command
116	Param. Set A	Parameter Set A is activated
117	Param. Set B	Parameter Set B is activated
118	Param. Set C	Parameter Set C is activated
119	Param. Set D	Parameter Set D is activated
121	Failure 18V	Failure in 18 V internal dc supply
122	Failure 15V	Failure in 15 V internal dc supply
123	Failure 5V	Failure in 5 V internal dc supply
124	Failure 0V	Failure in 0 V A/D converter
125	Failure RKA	Failure in input/output module
221	Device FltDet	General fault detection signal
251	Device Trip	General trip signal
801	AR off	Auto-reclose function switched off
802	AR Blocked	Auto-reclose function not operative
803	AR not ready	Auto-reclose function not ready for reclose
804	AR T-CB Exp.	Circuit breaker supervision time expired
805	CB not ready	Circuit breaker not ready for a trip/reclose cycle
806	AR Block.Dyn.	Auto-reclose function blocked from internal source
807	AR in prog.	Auto-reclose cycle is running
808	RAR T-Act.run	Auto-reclose function RAR action time is running
809	RAR T-1p run.	Auto-reclose function single-pole RAR dead time is running
810	AR T-Recl.run	Auto-reclose function reclaim time is running
811	RAR T-3p run.	Auto-reclose function three-pole RAR dead time is running
812	EV.Flt.Recog.	Auto-reclose function evolving fault recognized
813	AR Sucessful	Auto-reclosure was successful
814	Definit.Trip	Final (definitive) trip signal
815	CB Alarm Supp	Circuit breaker operation alarm suppressed
816	AR Close Cmd.	Reclose command from auto-reclose function
817	RAR 1p Close	Reclose command after 1-pole RAR
818	RAR 3p Close	Reclose command after 3-pole RAR
819	DAR 3p Close	Reclose command after 3-pole DAR
820	1p Trip Perm.	RAR function is ready to permit single-pole trip
821	RAR 1p Prog.	RAR function is programmed to reclose only 1pole
822	RAR 3p Prog.	RAR function is programmed to reclose only 3pole
823	RAR Zone Rel.	RAR function is ready to permit trip in an RAR stage
824	DAR Zone Rel.	DAR function is ready to permit trip in an DAR stage
825	Sync.Meas.St.	AR request for synchronism check
826	RAR Only	RAR cycle is only allowed, DAR blocked
827	DAR Only	DAR cycle is only allowed, RAR is overridden
828	DAR T-ACT.run	Auto-reclose function DAR action time is running
829	DAR T 3p1 run	Auto-reclose function DAR 1st dead time is running
830	DAR T 3p2 run	Auto-reclose function DAR 2nd dead time is running
831	DAR T 3p3 run	Auto-reclose function DAR 3rd dead time is running
832	AR 1p in prog	Auto-reclose function initiated by single-pole trip
833	AR 3p in prog	Auto-reclose function initiated by three-pole trip
840	Sync. off	Synchronism check is switched off
841	Sync. running	Synchronism check is running
842	Sync. faulty	Synchronism check is faulty
843	Sync.Tsup.Exp	Synchronism check supervision time expired
844	Sync.Override	Synchronism check is programmed to override
845	Sync. Synchro	Synchronism check synchronism is fulfilled
846	Sync. U1>U2<	Synchronism check to live-line dead-bus is fulfilled
847	Sync. U1<U2>	Synchronism check to dead-line live-bus is fulfilled
848	Sync. U1<U2<	Synchronism check to dead-line dead-bus is fulfilled
849	Sync. Blocked	Synchronism check is blocked
850	Sync. Release	Synchronism check release command
851	Sync.CloseCmd	Synchronism check close command
860	Sync.Del. U>	Synchronism check ΔU exceeded
861	Sync.Del. f>	Synchronism check Δf exceeded
862	Sync.Del.PHI>	Synchronism check $\Delta\varphi$ exceeded

Table 5.3 Marshalling possibilities for signal relays and LEDs

Addr	1st display line	2nd display line	FNo	Remarks
6200	MARSHALLING	SIGNAL RELAYS		Heading of the address block
6201	SIGNAL RELAY 1	RELAY 1 AR not ready	803	AR function is at the moment not ready for reclosing
6202	SIGNAL RELAY 2	RELAY 2 AR in prog.	807	AR-cycle in progress
6203	SIGNAL RELAY 3	RELAY 3 AR Block.Dyn.	806	AR function internally blocked
6204	SIGNAL RELAY 4	RELAY 4 RAR Zone Rel.	823	AR function is ready to release RAR zone of the feeder protection
6205	SIGNAL RELAY 5	RELAY 5 Dev.operative	101	Device operative; the NC contact of this relay indicates “Device fault”
6206	SIGNAL RELAY 6	RELAY 6 AR Sucessful	813	AR was successful
6207	SIGNAL RELAY 7	RELAY 7 Definit.Trip	814	AR was unsuccessful: final trip
6208	SIGNAL RELAY 8	RELAY 8 CB Alarm Supp	815	Circuit breaker operation alarm suppression
6209	SIGNAL RELAY 9	RELAY 9 AR T-Recl.run	810	AR reclaim time is running
6210	SIGNAL RELAY 10 RELAY 10	RELAY 10 RAR T-1p run. RAR T-3p run.	809 811	RAR dead time is running
6211	SIGNAL RELAY 11 RELAY 11 RELAY 11	RELAY 11 [1]) DAR T-3p1 run DAR T-3p2 run DAR T-3p3 run	829 830 831	DAR dead time is running
6212	SIGNAL RELAY 12	RELAY 12 [1]) DAR T 3p1 run	829	individual dead times of DAR
6213	SIGNAL RELAY 13	RELAY 13 [1]) DAR T 3p2 run	830	
6214	SIGNAL RELAY 14	RELAY 14 [1]) DAR T 3p3 run	831	
6215	SIGNAL RELAY 15	RELAY 15 [1]) EV.Flt.Recog.	812	Evolving fault recognition during single-pole RAR
6211	SIGNAL RELAY 11	RELAY 11 [2]) RAR T-3p run.	811	RAR 3-pole dead time is running
6212	SIGNAL RELAY 12	RELAY 12 [2]) Sync.Override	844	Synchro-check function is switched to “override”: closing release without check
6213	SIGNAL RELAY 13	RELAY 13 [2]) Sync.Tsup.Exp	843	Synchro-check supervision time expired: no more release
6214	SIGNAL RELAY 14	RELAY 14 [2]) Sync. Blocked	849	Synchro-check is blocked: no more release
6215	SIGNAL RELAY 15	RELAY 15 [2]) Sync. running	841	Synchro-check is running

[1]) presettings for 7VK512**1** [2]) presettings for 7VK512**2**

Table 5.4 Preset annunciations for signal relays

5.5.4 Marshalling of the LED indicators – address block 63

The unit contains 8 LEDs for optical indications, 6 of which can be marshalled. They are designated LED 1 to LED 6 and can be marshalled in address block 63. The block is reached by paging in blocks with ⇑ ⇓ or by directly addressing with **DA 6 2 0 0 E**. The selection procedure is carried out as described in Section 5.5.1. Multiple annunciations are possible, i.e. one logical annunciation function can be given to several LEDs (see also Section 5.5.1).

Apart from the logical function, each LED can be marshalled to operate either in the stored mode (m for "**m**emorized") or unstored mode (nm for "**n**ot **m**emorized"). Each annunciation function is displayed with the index m or nm when proceeding with the **N**–key.

The marshallable annunciation functions are the same as those listed in Table 5.3. Annunciation functions are, of course, not effective when the corresponding function has been programmed out (deconfigured).

With direct input of the function number it is not necessary to input the leading zeros. To indicate whether the stored or unstored mode shall be effective the function number can be extended by a decimal point followed by 0 or 1, whereby

.0 unstored indication (not memorized) corresponds to "nm" as above,
.1 stored indication (memorized) corresponds to "m" as above.

If the extension with .0 or .1 is omitted the display shows first the function designation in unstored mode with "nm". Press the "No"–key **N** to change to stored mode "m". After direct input other functions can be selected by paging through the functions forwards with the "No"–key **N** or backwards with the backspace key **R.** The changed function then must be re-confirmed by the enter-key **E**.

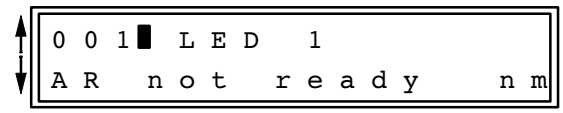
The assignment of the LEDs as preset by the factory is shown in the front of the unit (Figure 6.1). The following boxes show, as an example, the assignment for LED 1. Table 5.5 shows all LED indicators as they are preset from the factory.

Beginning of the block "Marshalling of the LED indicators"

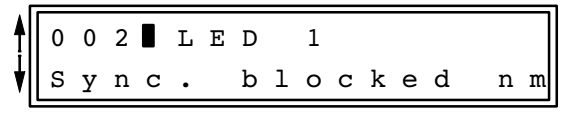
The first marshallable LED is reached with the key ↑:

Allocations for LED 1,
Meaning: "Device not ready for closing"

Change over to the selection level with **F** ↑:



LED 1 has been preset for:
1st: AR function not ready for reclosing, FNo 803



LED 1 has been preset for:
2nd: Synchronism and voltage check function is blocked, FNo 849

no further functions are preset for LED 1

After input of all annunciation functions for LED 1, change back to the marshalling level is carried out with **F** ↑:

Allocations for LED 1

The complete pre-settings for LED indicators are listed in Table 5.5.

Addr	1st display line	2nd display line	FNo	Remarks
6300	MARSHALLING	LEDs		Heading of the address block
6301	LED 1 LED 1 LED 1	AR not ready nm Sync. blocked nm[2)]	803 849	Closing not possible at the moment
6302	LED 2 LED 2	AR in prog. nm	807	AR cycle in progress
6303	LED 3 LED 3 LED 3	RAR T-1p run. nm RAR T-3p run. nm	809 811	RAR dead time running
6304	LED 4 LED 4 LED 4 LED 4	DAR T-3p1 run nm DAR T-3p2 run nm DAR T-3p3 run nm	829 830 831	DAR dead time running
6305	LED 5 LED 5	AR T-Recl.run nm	810	Reclaim time running
6306	LED 6 LED 6	Definit.Trip m	814	Final trip by the feeder protection

[2)] 7VK512**2** only

Table 5.5 Preset LED indicators

5.5.5 Marshalling of the command (trip) relays – address block 64

The unit contains 2 trip relays which are designated TRIP RELAY 1 and TRIP RELAY 2. The trip relays can be marshalled in the address block 64. The block is reached by paging in blocks with ⇑ ⇓ or by directly addressing with **DA**, input of the address number **6 4 0 0** and pressing the enter key **E**. The selection procedure is carried out as described in Section 5.5.1. Multiple commands are possible, i.e. one logical command function can be given to several trip relays (see also Section 5.5.1).

Principally, all annunciation functions in accordance with Table 5.3, can be marshalled to output command relays.

The assignment of the trip relays as delivered from factory is shown in the general diagrams in Appendix A. The following boxes show an example for marshalling of trip relay 1. Table 5.6 shows all trip relays as preset from the factory.

Beginning of the block “Marshalling of the trip relays”

The first trip relay is reached with the key ↑:

Allocations for trip relay 1

Change over to the selection level with **F** ↑:

Trip relay 1 has been preset for:
Close command from auto-reclose function, FNo 816

no further functions are preset for trip relay 1

Leave the selection level with key combination **F** ↑. You can go then to the next trip relay with the arrow key ↑.

Allocations for trip relay 1

Addr	1st display line	2nd display line	FNo	Remarks
6400	MARSHALLING	TRIP RELAYS		Heading of the address block
6401	TRIP TRIP REL. 1	RELAY 1 AR Close Cmd.	 816	Reclose command from auto-reclose function
6402	TRIP TRIP REL. 2	RELAY 2 1p Trip Perm.	 820	RAR function is ready to permit single-pole trip (no three-pole coupling)

Table 5.6 Preset command functions for trip relays

5.6 Configuration parameters for localized substation automation – address block 69

The unit must be informed as to whether it is used as a component in a localized substation automation system or not. If a central unit is not connected, no further information is required, since the unit is preset to "LSA = *NON–EXIST*".

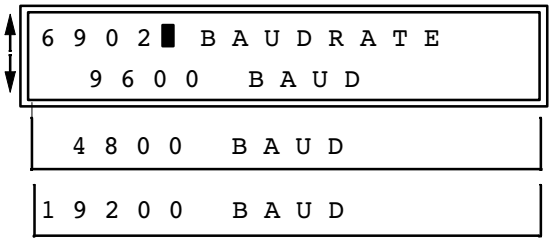
Otherwise block 69 contains several questions which must be answered. For this, the codeword must be entered (refer to Section 5.3.1). The entered data must be coordinated with the central unit. They refer to the Baud-rate of the serial data transfer. The identification address of the individual device and its measurement and fault data has been parameterized under addresses 7009 and 7010 (refer to Section 5.3.2).

They are valid also for identification of the device in the control centre.

Block 69 can be called-up by paging with keys ⇑ ⇓ or by directly addressing with **DA 6900 E**.

In addition, annunciations and messages which should be transmitted to the control centre must be coordinated with the central station. All annunciations which can be processed by the LSA are stored within the device in a separate table. For allocation of LSA-compatible annunciations, Table 5.7 is valid.

Beginning of the block "Localized substation automation (LSA coupling)"



Baudrate for serial interface.
Available settings: *9600 BAUD* or *4800 BAUD* or *19200 BAUD*

Note for LSA: The parameters DEVICE ADDress and FEEDER ADDress which had been entered to the device under this item are now set in the address block 70 when setting the operating parameters, refer to Section 5.3.2. They are valid for the operation interface for operation with a personal computer as well as for the LSA interface. If the device is connected to a central control station then these parameters should now be rechecked:

Address	7009	DEVICE ADD	0 to 255
Address	7010	FEEDER ADD	0 to 255

The following measured values are transmitted:

Measured voltage value U1
Measured voltage value U2
Measured frequency value f1
Measured frequency value f2
Measured voltage difference ΔU
Measured frequency difference Δf
Measured phase angle difference $\Delta\varphi$

FNo LSA	Annunciation	corresponding Annunc. FNo
004	Feeder voltage transformer secondary m.c.b. has tripped	14
005	Bus-bar voltage transformer secondary m.c.b. has tripped	15
011	User definable annunciation 1	21
012	User definable annunciation 2	22
013	User definable annunciation 3	23
014	User definable annunciation 4	24
020	Initiate internal synchronism and voltage check function	30
021	Block internal synchronism and voltage check function	31
022	Synchro-check program: check synchronism	32
023	Synchro-check program: live-line dead-bus check	33
024	Synchro-check program: dead-line live-bus check	34
025	Synchro-check program: dead-line dead-bus check	35
026	Synchro-check program: override synchro-check	36
030	Start signal from external protection for AR	80
031	Trip signal L1 from external protection for AR	81
032	Trip signal L2 from external protection for AR	82
033	Trip signal L3 from external protection for AR	83
036	Block single-pole RAR	86
038	Block three-pole RAR	88
039	Block RAR	89
040	Block complete AR function	90
041	Block DAR	91
042	Circuit breaker ready for AR cycle	92
043	DAR cycle is allowed only after unsuccessful RAR cycle	93
044	Release reclose command (from external synchro-check relay)	94
045	Block closing command	95
046	Single-pole trip for initiation of AR	96
047	Three-pole trip for initiation of AR	97
051	Relay operative	101
052	Re-start of the processor system	102
053	Fault in the network	103
056	LED indicators reset	106
059	Relative time response to LSA	109
060	Parameters are being set	110
061	Manual close indication of circuit breaker	111
062	Manual close command	112
066	Parameter Set A is activated	116
067	Parameter Set B is activated	117
068	Parameter Set C is activated	118
069	Parameter Set D is activated	119
071	Failure in 24 V internal dc supply	121
072	Failure in 15 V internal dc supply	122
073	Failure in 5 V internal dc supply	123
074	Failure in 0 V A/D converter	124
075	Failure in base input/output module	125
076	Annunciation for LSA lost	134

Table 5.7 Annunciations for localized substation automation with associated function numbers FNo
(continued next page)

FNo LSA	Annunciation	corresponding Annunc. FNo
091	Auto-reclose function switched off	801
093	Auto-reclose function not ready for reclose	803
094	Circuit breaker supervision time expired	804
095	Circuit breaker not ready for a trip/reclose cycle	805
096	Auto-reclose function blocked from internal source	806
138	Auto-reclose function RAR action time is running	808
139	Auto-reclose function single-pole RAR dead time is running	809
140	Auto-reclose function reclaim time is running	810
141	Auto-reclose function three-pole RAR dead time is running	811
142	Auto-reclose function evolving fault during dead time	812
143	Auto-reclosure was successful	813
144	Final trip signal	814
145	Circuit breaker operation alarm suppressed	815
146	Reclose command from auto-reclose function	816
100	RAR function is ready to permit single-pole trip	820
103	RAR function is ready to permit trip in an RAR stage	823
104	DAR function is ready to permit trip in an DAR stage	824
105	AR request for synchronism check	825
158	Auto-reclose function DAR action time is running	828
159	Auto-reclose function DAR 1st dead time is running	829
160	Auto-reclose function DAR 2nd dead time is running	830
161	Auto-reclose function DAR 3rd dead time is running	831
162	Auto-reclose function initiated by single-pole trip	832
163	Auto-reclose function initiated by three-pole trip	833
110	Synchronism check is switched off	840
111	Synchronism check is running	841
112	Synchronism check is faulty	842
113	Synchronism check supervision time expired	843
114	Synchronism check is programmed to override	844
115	Synchronism check synchronism is fulfilled	845
116	Synchronism check live-line dead-bus is fulfilled	846
117	Synchronism check dead-line live-bus is fulfilled	847
118	Synchronism check dead-line dead-bus is fulfilled	848
119	Synchronism check is blocked	849
120	Synchronism check release command	850
121	Synchronism check close command	851
122	Synchronism check ΔU exceeded	860
123	Synchronism check Δf exceeded	861
124	Synchronism check $\Delta \varphi$ exceeded	862
250	Drop-off of the device	900

Table 5.7 Annunciations for localized substation automation with associated function numbers FNo

6 Operating instructions

6.1 Safety precautions

Warning

All safety precautions which apply for work in electrical installations are to be observed during tests and commissioning.

Caution!

Connection of the device to a battery charger without connected battery may cause impermissibly high voltages which damage the device. See also Section 3.1.1 under Technical data for limits.

6.2 Dialog with the relay

Setting, operation and interrogation of digital protection and automation systems can be carried out via the integrated membrane keyboard and display panel located on the front plate. All the necessary operating parameters can be entered and all the information can be read out from here. Operation is, additionally, possible via the interface socket by means of a personal computer or similar.

6.2.1 Membrane keyboard and display panel

The membrane keyboard and display panel is externally arranged similar to a pocket calculator. Figure 6.1 illustrates the front view.

A two-line, each 16 character, liquid crystal display presents the information. Each character comprises a 5 x 8 dot matrix. Numbers, letters and a series of special symbols can be displayed.

During dialog, the upper line gives a four figure number, followed by a bar. This number presents the **setting address**. The first two digits indicate the address **block**, then follows the two-digit **sequence number**. In models with parameter change-over facility, the identifier of the parameter set is shown before the setting address.

The keyboard comprises 28 keys with numbers, Yes/No and control buttons. The significance of the keys is explained in detail in the following.

Numerical keys for the input of numerals:

0 … 9	Digits 0 to 9 for numerical input
•	Decimal point
∞	Infinity symbol
+/–	Change of sign (input of negative numbers)

Yes/No keys for text parameters:

J/Y	Yes key: operator affirms the displayed question
N	No key: operator denies the displayed question or rejects a suggestion and requests for alternative

Keys for paging through the display:

↑	Paging forwards: the next address is displayed
↓	Paging backwards: the previous address is displayed
⇑	Block paging forwards: the beginning of the next address block is displayed
⇓	Block paging backwards: the beginning of previous address block is displayed

Confirmation key:

E	Enter or confirmation key: each numerical input or change via the Yes/No keys must be confirmed by the enter key; only then does the device accept the change. The enter key can also be used to acknowledge and clear a fault prompt in this display; a new input and repeated use of the enter key is then necessary.

Control and special keys:

CW	Codeword: prevents unauthorized access to setting programs (not necessary for call-up of annunciations or messages)
R	Backspace erasure of incorrect entries
F	Function key; explained when used
DA	Direct addressing: if the address number is known, this key allows direct call-up of the address
M/S	Messages/Signals: interrogation of annunciations of fault and operating data (refer Section 6.4)

The three keys ↑; ⇑; RESET which are somewhat separated from the rest of the keys, can be accessed when the front cover is closed. The arrows have the same function as the keys with identical symbols in the main field and enable paging in forward direction. Thus all setting values and event data can be displayed with the front cover closed. Furthermore, stored LED indications on the front can be erased via the RESET key without opening the front cover. During reset operation all LEDs on the front will be illuminated thus performing a LED test. With this reset, additionally, the fault event indications in the display on the front panel of the device are acknowledged; the display shows then the operational values of the quiescent state. The display is switched over to operating mode as soon as one of the keys **DA**, **M**/**S**, **CW** or ⇑ is pressed.

6.2.2 Operation with a personal computer

A personal computer allows, just as the operator panel, all the appropriate settings and read-out of data, but with the added comfort of screen-based visualization and a menu-guided procedure.

All data can be read in from, or copied onto, magnetic data carrier (floppy disc) (e.g. for settings and configuration). Additionally, all the data can be documented on a connected printer. It is also possible, by connecting a plotter, to print out the fault history traces.

For operation of the personal computer, the instruction manuals of this device are to be observed. The PC program DIGSI® is available for setting and processing of all digital protection data. Note that the operating interface in the front of the relay is not galvanically isolated and that only adequate connection cables are applied (e.g. 7XV5100–2). Further information about facilities on request.

6.2.3 Operational preconditions

For most operational functions, the input of a codeword is necessary. This applies for all entries via the membrane keyboard or front interface which concern the operation on the relay, for example

– setting of functional parameters (thresholds, functions),

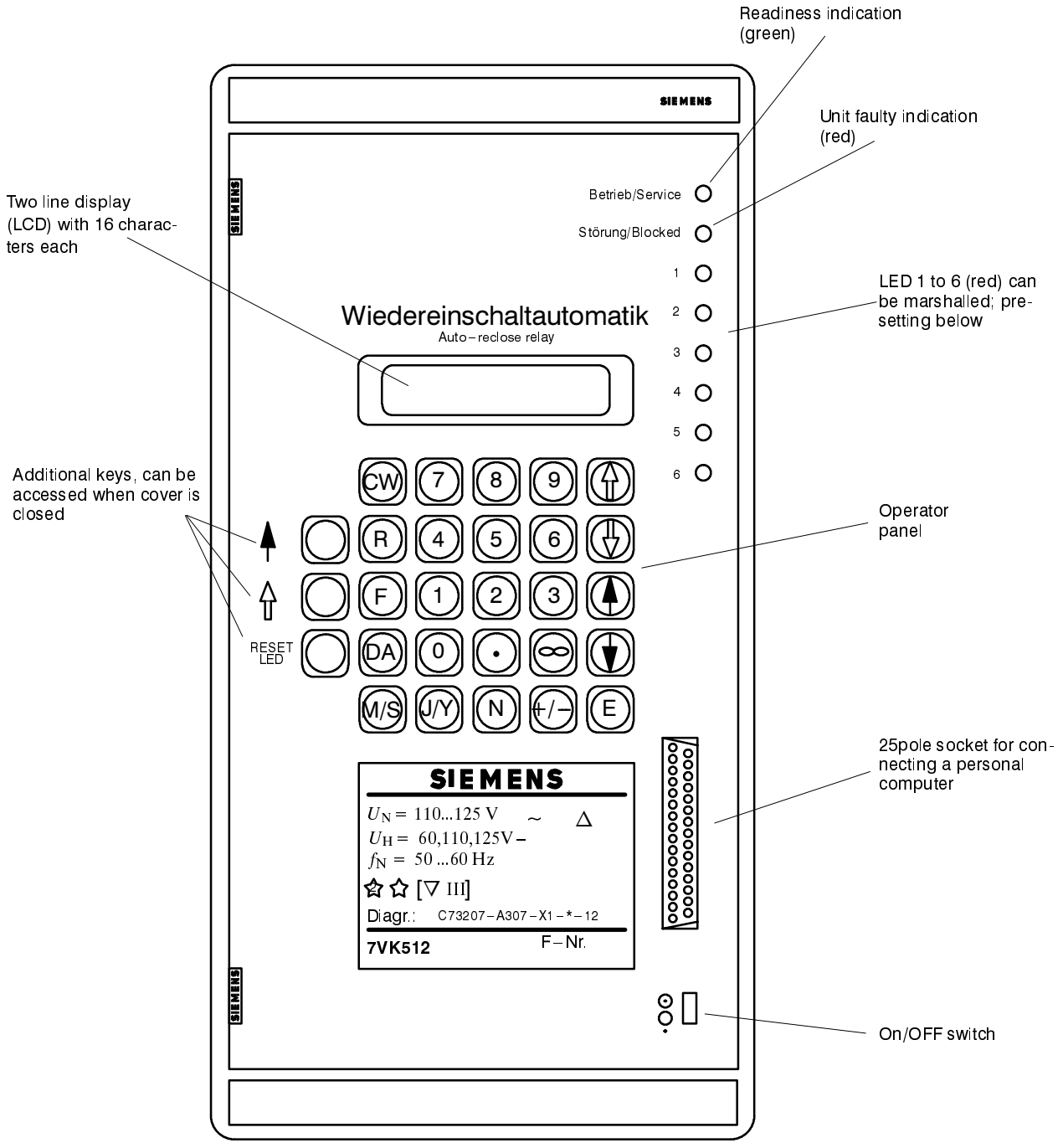
– allocation or marshalling of trip relays, signals, binary inputs, LED indicators,

– configuration parameters for operation language and device configuration.

The codeword is not required for the read-out of annunciations, operating data or fault data, or for the read-out of setting parameters.

The method of entry of the codeword is explained in detail in the installation instructions under Section 5.3.1.

6.2.4 Representation of the relay (front view)



Factory presetting LEDs:

1 Device not ready to close
2 Auto-reclose cycle in progress
3 DAR dead time is running
4 RAR dead time is running
5 Reclaim time is running
6 Final trip of feeder protection

Figure 6.1 Front view of operating key board and display panel

6.3 Setting the functional parameters

6.3.1. Introduction

6.3.1.1 Parameterizing procedure

For setting the functional parameters it is necessary to enter the codeword (see 5.3.1). Without codeword entry, parameters can be read out but not be changed.

If the codeword is accepted, parameterizing can begin. In the following sections each address is illustrated in a box and is explained. There are three forms of display:

– Addresses without request for operator input

  The address is identified by the block number followed by 00 as sequence number (e.g. **11**00 for block **11**). Displayed text forms the heading of this block. No input is expected. By using keys ⇑ or ⇓ the next or the previous block can be selected. By using the keys ↑ or ↓ the first or last address within the block can be selected and paged.

– Addresses which require numerical input

  The display shows the four-digit address, i.e. block and sequence number (e.g. **1104** for block **11**, sequence number **4**). Behind the bar appears the meaning of the required parameter, in the second display line, the value of the parameter. When the relay is delivered a value has been preset. In the following sections, this value is shown. If this value is to be retained, no other input is necessary. One can page forwards or backwards within the block or to the next (or previous) block. If the value needs to be altered, it can be overwritten using the numerical keys and, if required, the decimal point and/or change sign (+/**–**) or, where appropriate, infinity sign ∞. The permissible setting range is given in the following text, next to the associated box. Entered values beyond this range will be rejected. The setting steps correspond to the last decimal place as shown in the setting box. Inputs with more decimal places than permitted will be truncated down to the permissible number. **The value must be confirmed with the entry key E!** The display then confirms the accepted value. The changed parameters are only saved after termination of parameterizing (refer below).

– Addresses which require text input

  The display shows the four-digit address, i.e. block and sequence number (e.g. **2801** for block **28**, sequence number **1**). Behind the bar appears the meaning of the required parameter, in the second display line, the applicable text. When the relay is delivered, a text has been preset. In the following sections, this text is shown. If it is to be retained, no other input is necessary. One can page forwards or backwards within the block or to the next (or previous) block. If the text needs to be altered, press the “No” key **N**. The next alternative text, also printed in the display boxes illustrated in the following sections, then appears. If the alternative text is not desired, the **N** key is pressed again, etc. The alternative which is chosen, **is confirmed with the entry key E.** The changed parameters are only saved after termination of parameterizing (refer below).

For each of the addresses, the possible parameters and text are given in the following sections. If the meaning of a parameter is not clear, it is usually best to leave it at the factory setting. The arrows ⇑⇓ or ↑↓ at the left hand side of the illustrated display boxes indicate the method of moving from block to block or within the block. Unused addresses are automatically passed over.

If the parameter address is known, then direct addressing is possible. This is achieved by depressing key **DA** followed by the four-digit address and subsequently pressing the enter key **E**. After direct addressing, paging by means of keys ⇑ ⇓ and keys ↑ ↓ is possible.

The setting procedure can be ended at any time by the key combination **F E**, i.e. depressing the function key **F** followed by the entry key **E**. The display shows the question “SAVE NEW SETTINGS?”. Confirm with the “Yes”–key **Y** that the new settings shall become valid now. If you press the “No”–key **N** instead, codeword operation will be aborted, i.e. all alterations which have been changed since the last codeword entry are lost. Thus, erroneous alterations can be made ineffective.

If one tries to leave the setting range for the functional parameter blocks (i.e. address blocks 10 to 39) with keys ⇑ ⇓, the display shows the question “END OF CODEWORD OPERATION ?”. Press the “No”–key **N** to continue parameterizing. If you press the “Yes”–key **J**/**Y** instead, another question appears: “SAVE NEW SETTINGS ?”. Now you can confirm with **J**/**Y** or abort with **N**, as above.

After completion of the parameterizing process, the changed parameters which so far have only been stored in volatile memory, are then permanently stored in EEPROMs. The display confirms “NEW SETTINGS SAVED”. After pressing the key **M**/**S** followed by **RESET LED**, the indications of the quiescent state appear in the display.

6.3.1.2 Selectable parameter sets

Up to 4 different sets of parameters can be selected for the functional parameters, i.e. the addresses above 1000 and below 4000. These parameter sets can be switched over during operation, locally using the operator panel or via the operating interface using a personal computer, or also remotely using binary inputs.

If this facility is not used then it is sufficient to set the parameters for the preselected set. The rest of this section is of no importance. Otherwise, the parameter change-over facility must be configured as *EXIST* under address 7885 (refer to Section 5.4.2). The first parameter set is identified as set A, the other sets are B, C and D. Each of these sets is adjusted one after the other.

If the switch-over facility is to be used, first set all parameters for the normal status of parameter set A. Then switch over to parameter set B:

– Fist complete the parameterizing procedure for set A as described in Section 6.3.1.1.

– Press key combination **F 2**, i.e. first the function key **F** and then the number key **2**. All following inputs then refer to parameter set B.

All parameter sets can be accessed in a similar manner:

- Key combination **F 1**:
  access to parameter set **A**
- Key combination **F 2**:
  access to parameter set **B**
- Key combination **F 3**:
  access to parameter set **C**
- Key combination **F 4**:
  access to parameter set **D**

Input of the codeword is again necessary for the setting of a new selected parameter set. Without input of the codeword, the settings can only be read but not modified.

Since only a few parameters will be different in most applications, it is possible to copy previously stored parameter sets into another parameter set.

It is additionally possible to select the original settings, i.e. the settings preset on delivery, for a modified and stored parameter set. This is done by copying the “ORIG.SET” to the desired parameter set.

It is finally still possible to define the active parameter set, i.e. the parameter set which is valid for the functions and threshold values of the unit. See Section 6.5.4 for more details.

The parameter sets are processed in address block 85. The most simple manner to come to this block is using direct addressing:

– press direct address key **DA**,
– enter address, e.g. **8 5 0 0**,
– press enter key **E**.

The heading of the block for processing the parameter sets then appears.

It is possible to scroll through the individual addresses using the ↑ key. The copying facilities are summarized in Table 6.1.

⇑⇓ 8 5 0 0 P A R A M E T E R C H A N G E - O V E R	Beginning of the block “Parameter change-over”; processing of parameter sets

Addr.	Copy from	to
8510	ORIG.SET	SET A
8511	ORIG.SET	SET B
8512	ORIG.SET	SET C
8513	ORIG.SET	SET D
8514	SET A	SET B
8515	SET A	SET C
8516	SET A	SET D
8517	SET B	SET A
8518	SET B	SET C
8519	SET B	SET D
8520	SET C	SET A
8521	SET C	SET B
8522	SET C	SET D
8523	SET D	SET A
8524	SET D	SET B
8525	SET D	SET C

Table 6.1 Copying parameter sets

Following copying, only such parameters need be changed which are to be different from the source parameter set.

Parameterizing must be terminated for each parameter set as described in Section 6.3.1.1.

6.3.1.3 Setting of date and time

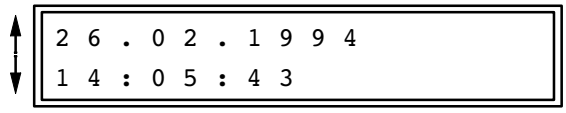
The date and time can be set if the unit is equipped with the real time clock. Setting is carried out in block 81 which is reached by direct addressing **DA 8 1 0 0 E** or by paging with ⇑ and ⇓. Input of the codeword is required to change the data.

Selection of the individual addresses is by further scrolling using ↑ ↓ as shown below. Each modification must be confirmed with the enter key **E**.

The date and time are entered with dots as separator signs since the keyboard does not have a colon or slash (for American date).

The clock is synchronized at the moment when the enter key **E** is pressed following input of the complete time. The difference time facility (address 8104) enables exact setting of the time since the difference can be calculated prior to the input, and the synchronization of the clock does not depend on the moment when the enter key **E** is pressed.

Beginning of the block “Setting the real time clock”
Continue with ↑.



At first, the actual date and time are displayed.
Continue with ↑.

Enter the new date: 2 digits for day, 2 digits for month and 4 digits for year (including century); use the order as configured under address 7003 (section 5.3.2), but always use a dot for separator:
DD.MM.YYYY or **MM.DD.YYYY**

Enter the new time: hours, minutes, seconds, each with 2 digits, separated by a dot:
HH.MM.SS

Using the difference time, the clock is set forwards by the entered time, or backwards using the +/– key. The format is the same as with the time setting above.

6.3.2 Initial displays – address blocks 00 and 10

When the relay is switched on or the operator terminal has been connected, firstly the address 0000 and the type identification of the relay appears. All Siemens relays have an MLFB (machine readable type number). When the device is operative and displays a quiescent message, any desired address can be reached e.g. by pressing the direct address key **DA** followed by the address number.

The relay introduces itself by giving its type number and the version of firmware with which it is equipped. The second display line shows the complete ordering designation.

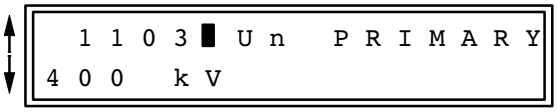
After address 1000, the functional parameters begin. Further address possibilities are listed under “Annunciations” and “Tests”.

Commencement of functional parameter blocks

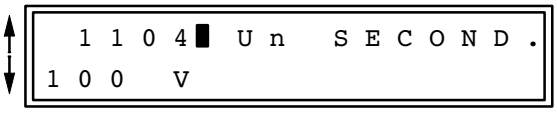
6.3.3 Power system data – address block 11

The relay requests basic data of the power system and the switchgear. The rated voltages (addresses 1103 and 1104) are of no concern for the actual protection functions of the device but are used for the calculation of the operational measured values (refer to Section 6.4). If rated values of the feeder voltage and the bus-bar voltage are different (e.g. because a power transformer is situated between bus-bar and feeder voltage transformers), then the rated value of the feeder voltage is set. The rated secondary voltages must be equal.

Beginning of the block “Power system data”



Voltage transformer primary voltage (line-to-line)
Smallest setting value: **1** kV
Largest setting value: **1200** kV



Voltage transformer secondary voltage (line-to-line)
Smallest setting value: **80** V
Largest setting value: **125** V

If the synchronism and voltage check function is used, note that the feeder voltage is designated with U1; it is the reference voltage for the device functions, which operate with measured voltages. The bus-bar voltage is designated U2.

If a power transformer is installed between the bus-bar and the location of the feeder voltage transformers then the phase displacement according to the power transformer connection group must be compensated. This can be done using the parameter address 1132.

The secondary rated voltages of the voltage transformers must be equal. Additionally, the primary rated voltages of the feeder voltage transformers on the one hand and the bus-bar voltage transformer(s) on the other hand must relate to the transformation ratio of the power transformer.

If no phase shifting element are installed between bus-bar an feeder voltages, leave address 1132 on the preset value 0°. Otherwise it must be noted that the phase displacement counts positive from the feeder circuit to the bus-bar circuit.

Example:

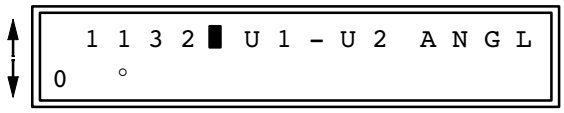
Bus-bar	400 kV primary 110 V secondary
Feeder	220 kV primary 110 V secondary

A power transformer should be installed between bus-bar voltage transformers and feeder voltage transformers:

Power transformer	400 kV/ 220 kV connection group Dy(n)5

The connection group of the power transformer is defined from the upper voltage side to the lower voltage side. The feeder voltage transformers, which are the reference voltages for the protection relay, are installed on the lower voltage side of the power transformer. Thus, the phase displacement according to the connection group numeral, i.e. 5 × 30°, must be entered as negative value.

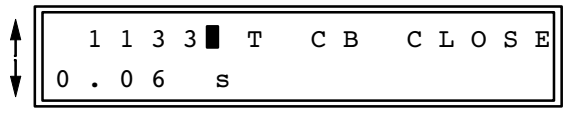
Setting will be address 1132
PHI U1–U2 = –150°



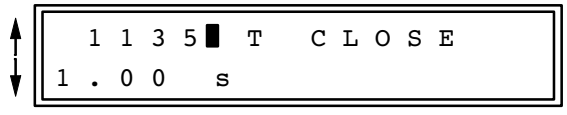
Phase displacement between U1 (feeder voltage) and U2 (bus-bar voltage), for synchronism check
Smallest setting value: **–179** °
Largest setting value: **+180** °

The closing time of the circuit breaker (address 1133 is necessary if the synchro-check function of the relay is used also for asynchronous switching. In this case, the relay calculates the ideal closing instant such that the two voltages (bus-bar and feeder) are in synchronism at the instant when the breaker poles contact each other.

Under address 1135, the minimum close command duration can be set. This time is then valid for all functions of the device which can close the circuit breaker. It must be long enough to ensure reliable closure of the circuit breaker. An excessively long time does not present any danger, since the closing command will be interrupted at once on occurrence of a renewed trip command.



Circuit breaker **closing** time (relevant only in case asynchronous switching is used in connection with synchro-check)
Smallest setting value: **0.01** s
Largest setting value: **0.50** s



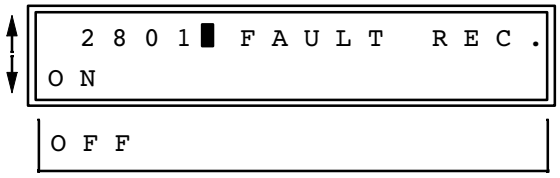
Maximum duration of **close** command
Smallest setting value: **0.01** s
Largest setting value: **32.00** s

6.3.4 Settings for fault recording – address block 28

The relay is equipped with a fault data store (see Section 4.4.2). This function can only be effective provided the configuration parameter (address 7828) of fault recording has been set to *EXIST* (Section 5.4.2).

The fault data store can be activated either by each fault detection of the feeder protection or only by instantaneous trip, i.e. within a settable time *T–REC.* (address 2802). Additionally, one can select whether the data of the fault data store will be output to the operator interface on the front *PC*/*PD* or to the LSA–interface *LSA*.

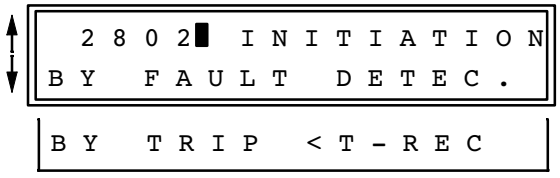
Beginning of block “Fault recordings”



Fault recording is

ON switched on

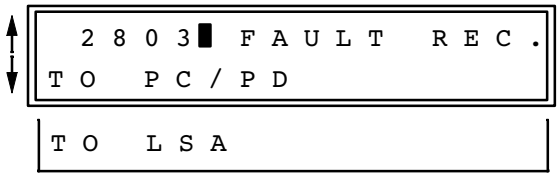
OFF switched off



Initiation of fault record storage

– *BY* each *FAULT DETEC*tion

– *BY TRIP* command < *T–REC,* i.e. instantaneous trip within a time *T–REC* (address 2804)



TO PC/*PD* – Fault records switched to the operating interface connector at the front (personal computer or programming device)

TO LSA – Fault records switched to the LSA interface connector

Time period within which trip command must have been issued for initiation of a fault record storage (address 2802)

Smallest setting value: **0.01** s

Largest setting value: **2.50** s

6.3.5 Settings for auto-reclosure – address block 34

Auto-reclose function is effective only if configured as *EXIST* under address 7834 (refer to Section 5.4.2).

With the AR function, generally distinction is made between the first AR-cycle, identified in the following with RAR (rapid auto-reclosure), and further AR-cycles with multi-shot auto-reclosure, identified in the following with DAR (delayed auto-reclosure). The above identifications are regardless whether the dead times are really "rapid" or "delayed". Setting addresses 3401 to 3419 are common for all types of auto-reclosure.

When switching manually on a dead fault, it is normally desired that the short-circuit protection trips instantaneously, and the AR function is blocked. Thus, address 3403 should remain in position MAN.CL.BL. = *YES*.

The reclaim time T–RECLAIM (address 3405) is the time period after which the network fault is supposed to be terminated after a successful auto-reclose cycle. A renewed trip of the feeder protection within this time increments the AR counter (when multi-shot AR is used) so that the next AR cycle starts; if no further AR is allowed the last AR is treated as unsuccessful.

The lock-out time TBLOCK DYN (address 3406) is the time period during which, after an unsuccessful auto-reclosure, further reclosures by 7VK512 are blocked. If the manual close command is led via the 7VK512 then this will be blocked also. This time must be longer than the renewed readiness for operation of the circuit breaker unless the CB is supervised in the relay (see below, address 3415). If this time is set to ∞, breaker close commands are locked. In this case switching can be unlocked only when the binary input ">AR Reset" (FNo 98) is energized. It must be ensured in this case, that this function is allocated to a binary input.

The set time for TBLOCK–M/C (address 3407) must cover the time for safe closing and opening of the circuit breaker (0.5 s to 1 s). If the feeder protection detects a fault within this time, three-pole final trip command is issued and reclosure is blocked provided MAN.CL.BL. (address 3403, see above) is switched *ON*.

The duration of the closing command has already been set when setting the general parameters (address 1135, Section 6.3.3).

A prerequisite for initiation of the AR function is that the circuit breaker is ready for at least one trip-close cycle when the feeder protection trips. This information has to be given to the relay via the binary input ">CB ready" (FNo 92). In case such information is not available from the CB circuit, interrogation of ">CB ready" can be suppressed by setting the parameter CB? 1 TRIP = *NO* (i.e. CB interrogation for 1st trip); otherwise reclosure would not be possible at all.

Additionally it is possible to interrogate readiness of the circuit breaker before each further reclose command or before every other reclose command. Setting is made in address 3413:

CB? CLOSE = CB? WITH EACH AR; interrogation is made before each reclose command,

CB? CLOSE = CB? NEVER; interrogation is not made or only at the moment of the first trip command as parameterized under address 3412,

CB? CLOSE = CB? WITH 2nd AR; interrogation is made before every other reclose command, i.e. before the 2nd, 4th, etc.; every trip-close cycle is valid regardless whether it is RAR or DAR.

In order to monitor the regeneration time of the circuit breaker a special circuit breaker supervision time T–CB–SUPV can be set under address 3415. This time should be set slightly higher than the regeneration time of the breaker after a trip–close cycle. If the circuit breaker is not yet ready after this time, reclosure is suppressed.

Finally, address 2419 determines for which reclose cycles synchronism or voltage shall be checked by the synchro-check function (if fitted and used). In the cases which are set there, reclosure is blocked as long as the conditions as set for the synchro-check function are not fulfilled.

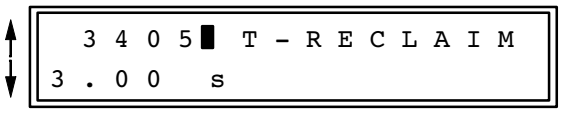
Beginning of block
"Auto-reclose functions"

Auto-reclose function is

ON switched on

OFF switched off

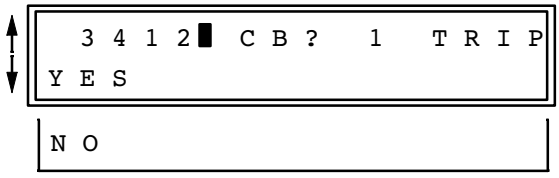
Blocking of reclosing after manual close of the circuit breaker
normal setting: *YES*



Reclaim time after successful AR cycle
Smallest setting value: **0.50** s
Largest setting value: **320.00** s

Lock-out time after unsuccessful AR; any close command is blocked
Smallest setting value: **0.50** s
Largest setting value: **320.00** s
and ∞ (locked until "`>AR Reset`" via binary input)

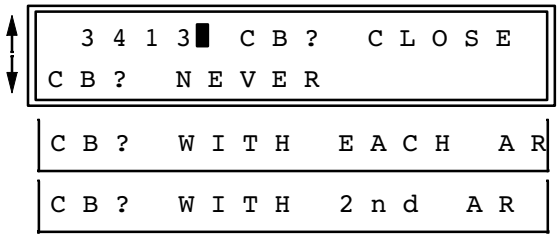
Reclaim time after manual closing of circuit breaker
Smallest setting value: **0.50** s
Largest setting value: **320.00** s



CB ready interrogation at the first trip command

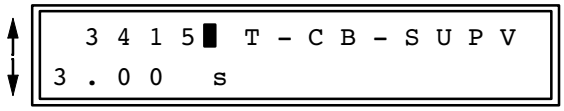
YES – normal setting

NO – only if there is no possibility to interrogate CB readiness

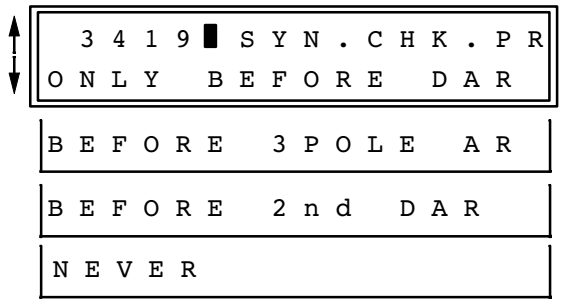


CB ready interrogation before reclosing

NEVER	no CB ready interrogation before reclosing
WITH EACH AR	CB ready interrogation before each reclosing
WITH EACH 2nd AR	CB ready interrogation before 2nd, 4th, 6th, etc. reclosing (RAR or DAR)



CB supervision time within which CB must be ready
Smallest setting value: **0.01** s
Largest setting value: **320.00** s



Request for synchro-check (internal or external) is made

– only before reclose during DAR
– before every reclose after three-pole tripping
– only before reclose during DAR from the 2nd DAR shot on
– no request for synchro-check

For RAR (first auto-reclose cycle), several programs are possible (address 3422).

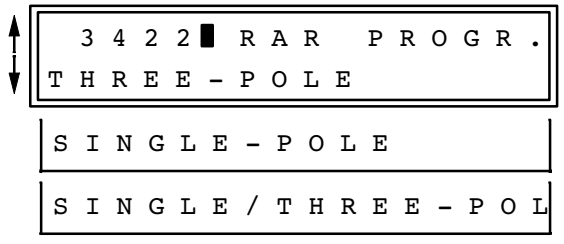
When setting the action time RAR T–ACT (address 3424), it must be ensured that this time is at least as long as the command time of the protective relay, including any possible signal transmission times, but smaller than the delayed back-up stage of the feeder protection (usually 0.2 s).

With single-pole auto-reclosure, the dead time RAR T–1POL (address 3426) must be long enough to ensure that the fault arc is extinguished and the air surrounding the arc is de-ionized, so that auto-reclosure can be successful. Because of the discharge and re-charge of the conductor capacitances, this time increases with the length of the line. Conventional values lie between 0.9 s and 1.5 s. The dead time starts always with the disappearance of the trip signal.

With three-pole auto-reclosure (address 3425), the stability of the network is the most important consideration. Since the disconnected line can no longer produce any synchronizing power, only a short dead time is permitted in most cases. Conventional values lie between 0.3 s and 0.6 s. If the synchro-check function is used, a longer time can often be tolerated. The dead time starts always with the disappearance of the trip signal.

The possibilities for the treatment of evolving faults have been described in detail in Section 4.2.8. The recognition of an evolving fault can be made dependent upon a tripping command or upon fault detection during the dead time (address 3428). The reaction to evolving faults is set in address 3429: blocking in the case of an evolving fault either occurs *ALWAYS* (i.e. with each evolving fault) or *NEVER* at all, or blocking occurs only after the fault is detected after the discrimination time *>TDISCR* which has to be set in address 3430. Blocking in these cases occurs even when three-pole auto-reclosure is permitted!

Also, for the treatment of evolving faults and for the discrimination time T–DISCR the stability of the network is of the utmost importance. In addition, the dynamic burden of the generators must be taken into account in the case of faults close to a large power station. For the discrimination time T–DISCR (address 3430) it is only meaningful to chose a value which is smaller than the dead time for single-pole AR, RAR T–1POL (address 3426).



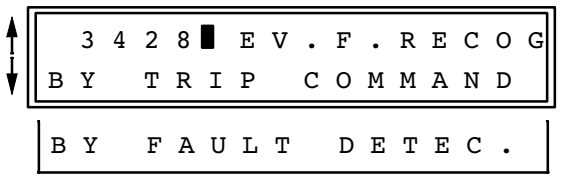
Auto-reclose program for the first AR cycle (RAR)

THREE–POLE – for each type of fault three-pole auto-reclosure
SINGLE–POLE – single-pole AR; for multi-phase faults no reclosure takes place (AR blocked)
*SINGLE/THREE–POL*e – for single-phase faults single-pole AR; for multi-phase faults three-pole AR

Action time for RAR (first AR-shot) (if trip signal is given after this time, AR is blocked)
Smallest setting value: **0.01** s
Largest setting value: **320.00** s
and ∞

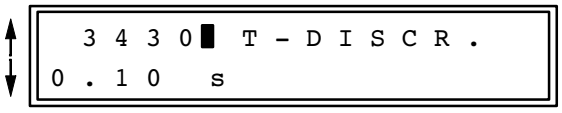
Dead time for first three-pole (RAR) cycle
Smallest setting value: **0.01** s
Largest setting value: **320.00** s

Dead time for first AR cycle (RAR) single-pole
Smallest setting value: **0.01** s
Largest setting value: **320.00** s



Recognition of evolving faults (only with single-pole AR)
BY TRIP COMMAND – faults during single-pole dead time are recognized as evolving faults only when the relay trips
*BY FAULT DETEC*tion – each fault detection during single-pole dead time is rec–ognized as an evolving fault

Treatment of evolving faults (only with 1pole AR)
– each evolving fault results in final three-pole trip; reclosure is blocked
– no blocking of reclosure in the case of evolving faults; a change from single-pole AR to three-pole AR occurs (when permitted)
– before expiry of T–DISCR, a change to three-pole AR (when permitted) occurs,
after expiry of T–DISCR, reclosure is blocked



Discrimination time for evolving faults (only with single-pole AR)
Smallest setting value: **0.01** s
Largest setting value: **320.00** s

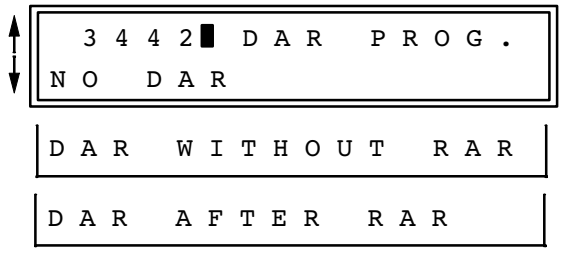
For DAR (further auto-reclose cycles), several programs are possible (address 3442). DAR can be excluded (DAR PROG = *NO DAR*). DAR can be permitted also if no RAR has been preceded (DAR PROG = *DAR WITHOUT RAR*). DAR can be permitted only after an unsuccessful RAR (DAR PROG = *DAR AFTER RAR*). DAR is always three-pole.

Multiple auto-reclosure with longer three-pole dead times are only permitted in networks in which no stability problems are to be expected (for example, due to a high degree of meshing), or in radial networks, or if synchro-check is used (refer to Section 6.3.6).

The number of DARs can be set differently for single-phase faults (address 3443) and for multi-phase faults (address 3444). Nevertheless, trip occurs always three-pole.

For DAR, a separate action time DAR T–ACT can be set (address 3445).

Different dead times can be set for the first, second and third trip–close cycle. The dead time for the first cycle (address 3446) is only valid if the DAR cycle is really the first cycle (i.e. RAR is suppressed). For the second (address 3447) and third (address 3448) cycle, a RAR counts only if it has occurred. Further cycles are treated as the third cycle. The dead time starts always with the disappearance of the trip signal.



Auto-reclose program for DAR cycles

NO DAR – no delayed AR

DAR WITHOUT RAR – DAR will be carried out also when no RAR has preceded

DAR AFTER RAR – DAR will be carried out only after an unsuccessful RAR cycle.

Number of permissible DAR cycles after single-phase faults; the RAR is not included in this number
Smallest setting value: **0**
Largest setting value: **9**

Number of permissible DAR cycles after multi-phase faults; the RAR is not included in this number
Smallest setting value: **0**
Largest setting value: **9**

Action time for DAR (further AR-shots) (if trip signal is given after this time, AR is blocked)
Smallest setting value: **0.01** s
Largest setting value: **320.00** s
and ∞

Dead time forthe first AR cycle if it is a DAR cycle
Smallest setting value: **0.01** s
Largest setting value: **1800.00** s

Dead time for the second AR cycle
Smallest setting value: **0.01** s
Largest setting value: **1800.00** s

Dead time for further AR cycles
Smallest setting value: **0.01** s
Largest setting value: **1800.00** s

6.3.6 Settings for synchronism and voltage check – address block 35

Synchronism an voltage check function is effective only if configured as *EXIST* under address 7835 (refer to Section 5.4.2).

Different interrogation conditions can be parameterized for automatic reclosure on one hand and for manual closure on the other hand.

The general limit values for closure are set under addresses 3501 to 3507. Additionally, addresses 3508 to 3519 are relevant for automatic reclosure, addresses 3521 to 3529 are relevant for manual closure.

The complete synchronism and voltage check function is switched *OFF* or *ON* under address 3501.

Warning

If synchronism check function is switched off (address 3501) each manual or automatic closure is carried out without synchronism check!

The voltage below which the line or bus-bar is regarded safely as dead, is set under address 3502 U< (for dead line or dead bus check). Setting is in volts secondary; dependent of the connection of the voltages (phase–phase or phase–earth), the phase–phase or phase–earth voltage is decisive.

The voltage above which the line or bus-bar is regarded safely as live, is set under address 3503 U> (for live line or live bus check). It must be set below the minimum operating voltage under normal conditions. Setting is in volts secondary; dependent of the connection of the voltages (phase–phase or phase–earth), the phase–phase or phase–earth voltage is decisive.

The permissible magnitude difference ΔU between the voltages is set under address 3505 DELTA U<. Setting is in volts secondary; dependent of the connection of the voltages (phase–phase or phase–earth), the phase–phase or phase–earth voltage is decisive.

The permissible frequency difference Δf between the voltages is set under address 3506 DELTA f<.

The permissible phase angle difference $\Delta\varphi$ between the voltages is set under address 3507 DELTA PHI<.

```
  3 5 0 0 C H E C K
S Y N C H R O N I S M
```

Beginning of the block “Synchronism and voltage check”

```
  3 5 0 1 S Y N C - C H E C K
O N
```

```
O F F
```

Synchronism and voltage check function (complete) is
ON switched on

Off switched off

```
  3 5 0 2 U <
5   V
```

Voltage magnitude below which the line or bus-bar can be regarded as dead (phase–phase or phase–earth) in V
Smallest setting value: **1** V
Largest setting value: **60** V

```
  3 5 0 3 U >
8 0   V
```

Voltage magnitude above which the line or bus-bar can be regarded as live (phase–phase or phase–earth) in V
Smallest setting value: **20** V
Largest setting value: **125** V

Limit value ΔU for the permissible voltage difference in magnitude (phase–phase or phase–earth) in V
Smallest setting value: **1** V
Largest setting value: **50** V

Limit value Δf for the permissible frequency difference in Hz
Smallest setting value: **0.03** Hz
Largest setting value: **1.00** Hz

Limit value Δφ for the permissible phase angle difference in °
Smallest setting value: **1** °
Largest setting value: **60** °

The synchronism and voltage check function in 7VK512 can also give closing command in asynchronous networks. In this case, closing command is given such that – under consideration of the circuit breaker closing time (address 1133) – the voltage phasors of the line and bus-bar voltages agree in phase at the instant when the breaker poles touch each other.

For automatic reclosure, address 3508 DEL.f<SYNC defines the limit within which the frequency difference must lie when the networks are regarded as synchronous. Above this frequency difference, asynchronous closing is carried out under consideration of the phase angle difference, frequency difference and the circuit breaker closing time. Below this frequency difference, the synchrocheck conditions as set under addresses 3505, 3506, and 3507 are only relevant. The setting value of address 3508 must lie below that of address 3506. If set to ∞, asynchronous switching is suppressed for automatic reclosure.

Limit value Δf< for synchronous auto-reclosure
Smallest setting value: **0.03** Hz
Largest setting value: **0.10** Hz
and ∞ (no asynchronous auto-reclosure)

The further release conditions for automatic reclosing are set under addresses 3515 to 3519:

3515 SYNCHR synchro-check: the conditions for synchronism ΔU, Δf, and Δφ are checked before reclosure;

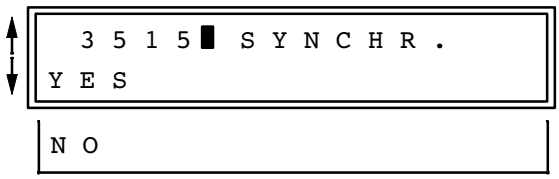
3516 U1>U2< dead-bus check: the feeder (U1) must be live (U>, refer address 3503), the bus-bar (U2) must be dead (U<, refer to address 3502);

3517 U1<U2> dead-line check: the feeder (U1) must be dead (U<, refer address 3502), the bus-bar (U2) must be live (U>, refer to address 3503);

3518 U1<U2< dead-line and dead-bus check: the feeder (U1) and the bus-bar (U2) must both be dead (U<, refer to address 3502);

3519 OVERRIDE automatic reclosure is released without any check;

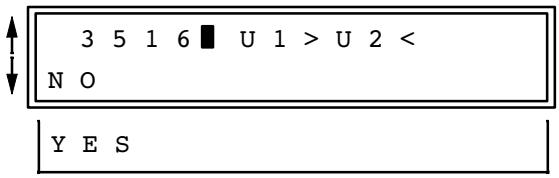
The five possible release conditions are independent from each other and can be combined.



Synchro-check before automatic reclosure

YES

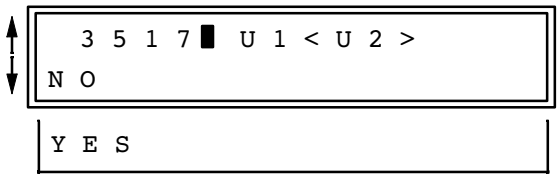
NO



Dead-bus check before automatic reclosure

NO

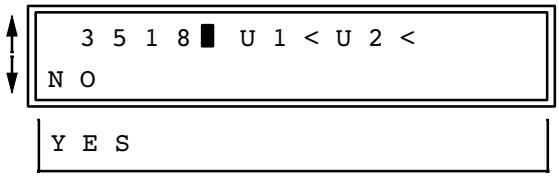
YES



Dead-line check before automatic reclosure

NO

YES



Dead-line and dead-bus check before automatic reclosure

NO

YES

Override of any check before automatic reclosure

NO

YES

The further release conditions for manual closing are set under addresses 3521 to 3529: The synchro-check function for manual closing can be individually switched off or on under address 3521. When SYN.MAN.CL is switched *OFF*, no checks are carried out for manual closing.

A separate frequency difference limit can be set for asynchronous switching after manual close command. Address 3522 M/C – Df<SYN defines the limit within which the frequency difference must lie when the networks are regarded as synchronous. Above this frequency difference, asynchronous closing is carried out under consideration of the phase angle difference, frequency difference and the circuit breaker closing time. Below this frequency difference, the synchro-check conditions as set under addresses 3505, 3506, and 3507 are only relevant. The setting value of address 3522 must lie below that of address 3506. If set to ∞, asynchronous switching is suppressed for manual closure.

The further release conditions for manual closing are set under addresses 3525 to 3529:

3525 M/C – SYNCHR synchro-check: the conditions for synchronism ΔU, Δf, and $\Delta\varphi$ are checked before reclosure;

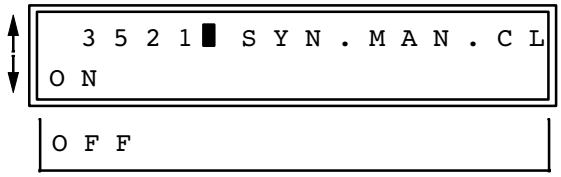
3526 M/C – U1>U2< dead-bus check: the feeder (U1) must be live (U>, refer to address 3503), the bus-bar (U2) must be dead (U<, refer to address 3502);

3527 M/C – U1<U2> dead-line check: the feeder (U1) must be dead (U<, refer address 3502), the bus-bar (U2) must be live (U>, refer to address 3503);

3528 M/C – U1<U2< dead-line and dead-bus check: the feeder (U1) and the bus-bar (U2) must both be dead (U<, refer to address 3502);

3529 M/C O/RIDE manual closing is released without any check;

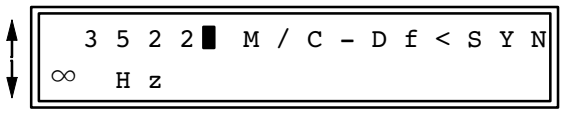
The five possible release conditions are independent from each other and can be combined.



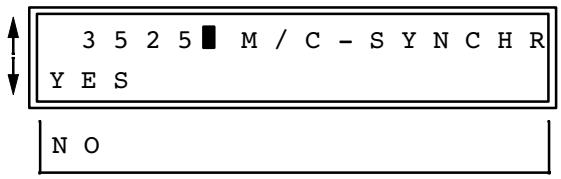
Synchronism and voltage check before manual close command is

ON switched on

OFF switched off



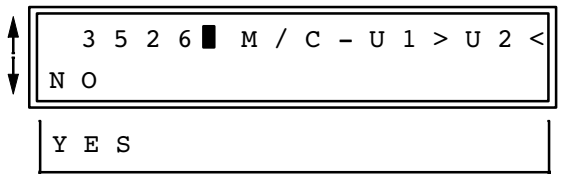
Limit value Δf< for synchronous manual closure
Smallest setting value: **0.03** Hz
Largest setting value: **0.10** Hz
and ∞ (no asynchronous manual switching)



Synchro-check before manual closure

YES

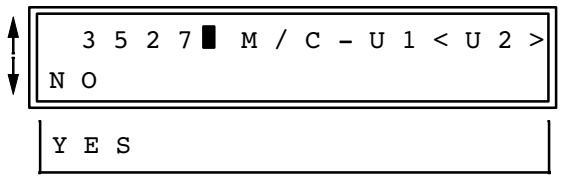
NO



Dead-bus check before manual closure

NO

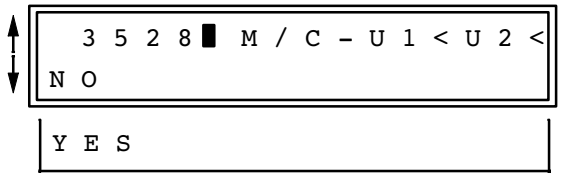
YES



Dead-line check before manual closure

NO

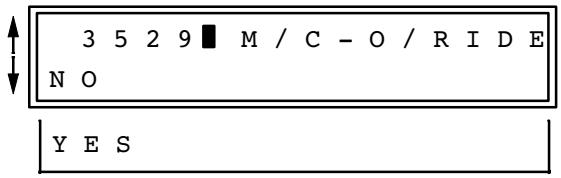
YES



Dead-line and dead-bus check before manual closure

NO

YES

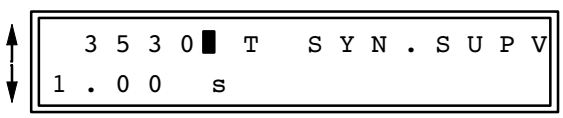


Override of any check before manual closure

NO

YES

Finally, address 3530 determines the time period, beginning from the measuring request, within which the check conditions as parameterized must be fulfilled. This time is valid for automatic reclosure as well as for manual closure. When the conditions are not fulfilled within this time, closing is blocked. Only after a renewed measuring request the time starts again and a new check is carried out.



Supervision time period within which the check conditions must be fulfilled
Smallest setting value: **0.01** s
Largest setting value: **320.00** s

6.4 Annunciations

6.4.1 Introduction

After a network fault, annunciations and messages provide a survey of important fault data and the function of the relay, and serve for checking sequences of functional steps during testing and commissioning. Further, they provide information about the condition of measured data and the relay itself during normal operation.

To read out recorded annunciations, no codeword input is necessary.

The annunciations generated in the relay are presented in various ways:

– LED indications in the front plate of the relay (Figure 6.1),

– Binary outputs (output relays) via the connections of the relay,

– Indications in the display on the front plate or on the screen of a personal computer, via the operating interface,

– Transmission via the serial interface to local or remote control facilities (optional).

Most of these annunciations can be relatively freely allocated to the LEDs and binary outputs (see Section 5.5). Also, within specific limitations, group and multiple indications can be formed.

To call up annunciations on the operator panel, the following possibilities exist:

– Block paging with the keys ⇑ forwards or ⇓ backwards up to address 5000,

– Direct selection with address code, using key **DA**, address **5 0 0 0** and execute with key **E**,

– Press key **M**/**S** (M stands for “messages”, S for “signals”); then the address 5000 appears automatically as the beginning of the annunciation blocks.

For configuration of the transfer of annunciations to a central processing device or localized substation automation system, the necessary data are entered in block 69 (see Section 5.6).

The annunciations are arranged as follows:

Block 51 Operational annunciations; these are messages which can appear during the operation of the relay: information about condition of relay functions, measurement data etc.

Block 52 Event annunciations for the last fault; pick-up, trip, reclosure, expired times, or similar. As defined, a network fault begins with pick-up of any fault detection of the feeder protection. If auto-reclose is carried out, the network fault ends after expiry of the last reclaim time; thus an AR-shot (or all shots) occupy only one fault data store. Within a network fault, several fault events can occur, from pick-up of any protection until drop-off.

Block 53 Event annunciations for the previous network fault, as block 52.

Block 54 Event annunciations for the last but two network fault, as block 52.

Block 56 Annunciations for CB operation statistics, that is counters for first AR (RAR), second or further AR (DAR).

Block 57 Indication of operational measured values (voltages, frequency).

Commencement of “annunciation blocks”

A comprehensive list of the possible annunciations and output functions with the associated function number FNo is given in Appendix C. It is also indicated to which device each annunciation can be routed.

6.4.2 Operational annunciations – address block 51

Operational and status annunciations contain information which the unit provides during operation and about the operation. They begin at address 5100. Important events and status changes are chronologically listed, starting with the most recent message. Time information is shown in hours and minutes. Up to 50 operational indications can be stored. If more occur, the oldest are erased in sequence.

Faults in the network are only indicated as "`System Flt`" together with the sequence number of the fault. Detailed information about the history of the fault is contained in blocks "Fault annunciations"; refer to Section 6.4.3.

The input of the codeword is not required.

After selection of the address 5100 (by direct selection with **DA 5 1 0 0 E** and/or paging with ⇑ or ⇓ and further scrolling ↑ or ↓) the operational annunciations appear. The boxes below show all available operational annunciations. In each specific case, of course, only the associated annunciations appear in the display.

Next to the boxes below, the abbreviated forms are explained. It is indicated whether an event is announced on occurrence (**C** = "**C**oming") or a status is announced "**C**oming" and "**G**oing" (**C**/**G**).

The first listed message is, as example, assigned with date and time in the first line; the second line shows an event with the character **C** to indicate that this condition occurred at the displayed time.

---

5 1 0 0 ▮ O P E R A T I O N A L A N N U N C I A T I O N S

Beginning of the block "Operational annunciations"

2 1 . 0 2 . 9 4 0 8 : 3 3 L E D r e s e t : C

1st line: Date and time of the event or status change

2nd line: Annunciation text, in the example **C**oming

If the real time clock is not available the date is replaced by ★★.★★.★★, the time is given as relative time from the last re-start of the processor system.

Direct response from binary inputs:

> M a n u a l C l o s e	Manual close signal from discrepancy switch (C/G)
> U 1 V T m c b	Voltage transformer secondary m.c.b. (feeder v.t.s) tripped (C/G)
> U 2 V T m c b	Voltage transformer secondary m.c.b. (bus-bar v.t.s) tripped (C/G)
> C B A u x . L 1	Circuit breaker auxiliary contact pole L1 closed (C/G)
> C B A u x . L 2	Circuit breaker auxiliary contact pole L2 closed (C/G)
> C B A u x . L 3	Circuit breaker auxiliary contact pole L3 closed (C/G)
> C B A u x . 3 p C	Circuit breaker auxiliary contact all poles closed (C/G)
> C B A u x . 1 p C	Circuit breaker auxiliary contact any pole closed (C/G)

> Annunc. 1	User defined annunciation No 1 received via binary input (C/G)
> Annunc. 2	User defined annunciation No 2 received via binary input (C/G)
> Annunc. 3	User defined annunciation No 3 received via binary input (C/G)
> Annunc. 4	User defined annunciation No 4 received via binary input (C/G)
> Sync. Start	Initiation of synchronism and voltage check function via binary input (C/G)
> Sync. Block	Synchronism and voltage check function blocked via binary input (C/G)
> Sync. synch	Synchronism check function programmed via binary input to check synchronism (C/G)
> Sync. U1>U2<	Synchronism check function programmed via binary input to check live line and dead bus (C/G)
> Sync. U1<U2>	Synchronism check function programmed via binary input to check dead line and live bus (C/G)
> Sync. U1<U2<	Synchronism check function programmed via binary input to check dead line and dead bus (C/G)
> Sync. o/ride	Synchronism check function programmed via binary input to override check (C/G)
> Start AR	Starting signal from feeder protection for AR (C/G)
> Trip L1 AR	Trip signal pole L1 from feeder protection for AR (C/G)
> Trip L2 AR	Trip signal pole L2 from feeder protection for AR (C/G)
> Trip L3 AR	Trip signal pole L3 from feeder protection for AR (C/G)
> Trip 1p AR	Trip signal single-pole from feeder protection for AR (C/G)
> Trip 3p AR	Trip signal three-pole from feeder protection for AR (C/G)
> AR Block	RAR blocked via binary input (C/G)
> RAR Block	RAR blocked via binary input (C/G)
> 1p RAR Block	Single-pole RAR blocked via binary input (C/G)
> 3p RAR Block	Three-pole RAR blocked via binary input (C/G)
> DAR block	DAR blocked via binary input (C/G)
> DAR aft. RAR	Control signal via binary input: DAR permitted only after unsuccessful RAR (C/G)
> CloseCmd.Blo	All close commands blocked via binary input (C/G)
> AR Reset	Auto-reclose function blocked via binary input (C/G)
> CB Ready	Circuit breaker ready information via binary input (C/G)

General operational annunciations of the device:

Re-start	Re-start annunciation of the processor system (C)
Syst.Flt	Network fault (C), detailed information in the fault annunciations
LED reset	Stored LED indications reset (C)
Flt.Rec. off	Fault recording switched off (C/G)
Param.Running	Parameters are being set (C/G)
Manual Close	Manual close command registered (impulse) (C)
Param. Set A	Parameter set A is active (C/G)
Param. Set B	Parameter set B is active (C/G)
Param. Set C	Parameter set C is active (C/G)
Param. Set D	Parameter set D is active (C/G)

Annunciations of monitoring functions:

Failure 18V	Failure in internal supply voltage 18 V (C/G)
Failure 15V	Failure in internal supply voltage 15 V (C/G)
Failure 5V	Failure in internal supply voltage 5 V (C/G)
Failure 0V	Failure in offset voltage 0 V (C/G)
Failure RKA	Failure on input/output module RKA (C/G)
Annunc. Lost	Annunciations lost (buffer overflow) (C)
Flt.Buff.Over	Buffer for fault annunciations overflow (C)
Oper.Ann.Inva	Operational annunciations invalid (C)
Flt.Ann.Inval	Fault annunciations invalid (C)
Stat.Buff.Inv	Buffer for operation statistics invalid (C/G)
LED Buff.Inva	Buffer for stored LEDs invalid (C/G)

Chs.Error	Check-sum error detected (C/G)
Chs.S1 Error	Check-sum error detected for parameter set A: no operation possible with this set (C/G)
Chs.S2 Error	Check-sum error detected for parameter Set B: no operation possible with this set (C/G)
Chs.S3 Error	Check-sum error detected for parameter set C: no operation possible with this set (C/G)
Chs.S4 Error	Check-sum error detected for parameter set D: no operation possible with this set (C/G)

Operational annunciations of the auto-reclose function:

AR off	Auto-reclose function is switched off (C/G)
AR inoperativ	Auto-reclose function inoperative, i.e, cannot be initiated (C/G)
CB not ready	Circuit breaker not ready for trip–close–cycle (C/G)
AR T-CB Exp.	Circuit breaker supervision time expired (C)
AR Block.Dyn.	AR is internally dynamically blocked (C/G)
1p Trip Perm.	AR permits single-pole trip of the main protection relay (C/G)
RAR Zone Rel.	AR releases RAR zone of the main protection relay (C/G)
DAR Zone Rel.	AR releases DAR zone of the main protection relay (C/G)

Operational annunciations of the synchronism and voltage check function:

Sync. off	Synchronism and voltage check function is switched off (C/G)
Sync. running	Synchronism and voltage check function is running (C)
Sync. faulty	Synchronism and voltage check function is faulty (C/G)
Sync.Tsup Exp	Time supervision of synchro-check function has elapsed: no more close release possible (C)
Sync.Override	Synchro-check function switched to program “Override”, i.e. close release without any check (C/G)
Sync. U1>U2<	Synchro-check condition “Live line – dead bus” is fulfilled (C/G)

Sync. U1<U2>	Synchro-check condition “Dead line – live bus” is fulfilled (C/G)
Sync. U1<U2<	Synchro-check condition “Dead line – dead bus” is fulfilled (C/G)
Sync. Synchro	Synchro-check condition “Synchronism” is fulfilled (C/G)
Sync. Blocked	Synchronism and voltage check function is blocked (C/G)
Sync. Release	Conditions fulfilled: Release to close (C)
Sync.CloseCmd	Close command of synchronism and voltage check function (C)
Sync.Del. U>	Synchro-check ΔU exceeded (C/G)
Sync.Del. f>	Synchro-check Δf exceeded (C/G)
Sync.Del.PHI>	Synchro-check Δφ exceeded (C/G)

Further messages:

Table overflow	If more messages have been received the last valid message is *Table overflow*.
End of table	If not all memory places are used the last message is *End of table*.

6.4.3 Fault annunciations – address blocks 52 to 54

The annunciations which occurred during the last three network faults can be read off on the front panel or via the operating interface. The indications are recorded in the sequence from the youngest to the oldest under addresses 5200, 5300 and 5400. When a further fault occurs, the data relating to the oldest are erased. Each fault data buffer can contain up to 80 annunciations.

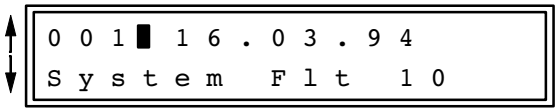
Input of the codeword is not required.

To call up the **last** fault data, one goes to address 5200 either by direct address **DA 5 2 0 0 E** or by paging with the keys ⇑ or ⇓ . With the keys ↑ or ↓ one can page the individual annunciations forwards or backwards. Each annunciation is assigned with a sequence item number.

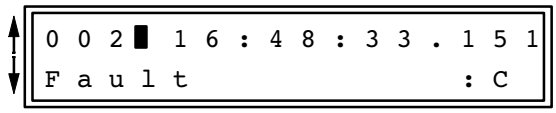
For these purposes, the term “system fault” means the period from short circuit inception up to final clearance. If auto-reclose occurs, then the “system fault” is finished on expiry of the last reclaim or lock-out time, that is, after successful or unsuccessful AR. Thus the total fault clearance procedure inclusive AR-cycles occupies only one fault annunciation store. Within one system fault, several fault events can have occurred, i.e. from pick-up of any feeder protection until drop-off of the last pick-up.

In the following clarification, all the available fault annunciations are indicated. In the case of a specific fault, of course, only the associated annunciations appear in the display. At first, an example is given for a system fault, and explained.

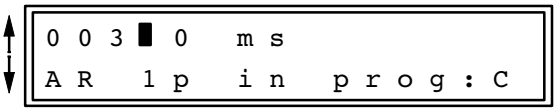
Beginning of the block “Fault annunciations of the last system fault”



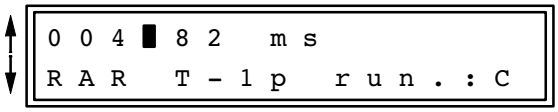
under item 1, the date of the system fault is indicated (provided the real time clock is available), in the second line the consecutive number of the system fault

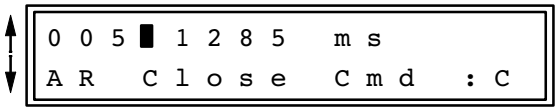


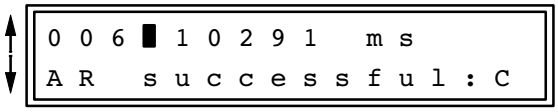
under item 2, the time of the beginning of the fault is given (provided the real time clock is available); time resolution is 1 ms



The following items indicate all fault annunciations which have occurred from fault detection of the feeder protection until drop-off, in chronological sequence. These annunciations are tagged with the relative time in milliseconds, starting with the fault detection.







etc.

General fault annunciations of the device:

Syst. Flt	System fault with consecutive number
Fault	Beginning of fault
Dev. Drop-off	Drop-off of the device, general

Annunciation of the auto-reclose function:

AR 1p in prog	Single-pole auto-reclosure is initiated
AR 3p in prog	Three-pole auto-reclosure is initiated
AR Block.Dyn.	AR is internally dynamically blocked
1p Trip Perm.	AR permits single-pole trip of the main protection relay
RAR Zone Rel.	AR releases RAR zone of the main protection relay
RAR T-Act.run	Action time for RAR cycle is running
RAR T-1p run.	Single-pole dead time for RAR cycle is running
RAR T-3p run.	Three-pole dead time for RAR cycle is running
DAR Zone Rel.	AR releases DAR zone of the main protection relay
DAR T-Act.run	Action time for DAR cycle is running
DAR T-3p1 run	First three-pole dead time for DAR cycle is running
DAR T-3p2 run	Second three-pole dead time for DAR cycle is running
DAR T-3p3 run	Third or further three-pole dead time for DAR cycle is running
AR T-Recl.run	Reclaim time for AR is running
AR T-CB Exp.	Circuit breaker supervision time expired
Ev.Flt.Recog.	Evolving fault is recognized
AR Successful	Auto-reclosure has been successful
Definit.Trip	Definitive (final) trip command

CB Alarm Supp	Suppression of circuit breaker operation alarm
Sync.Meas.St.	Start-to-measure signal to synchronism and voltage check function
AR Close Cmd.	Auto-reclosure command

Annunciations of the manual close function:

Manual Close	Manual close command

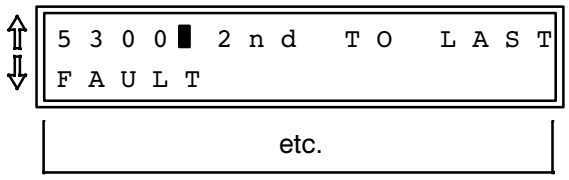
Annunciations of the synchronism and voltage check function:

Sync. running	Synchronism and voltage check function is running
Sync. faulty	Synchronism and voltage check function is faulty
Sync.Tsup Exp	Time supervision of synchro-check function has elapsed: no more close release possible
Sync.Override	Synchro-check function switched to program “Override”, i.e. close release without any check
Sync. U1>U2<	Synchro-check condition “Live line – dead bus” is fulfilled
Sync. U1<U2>	Synchro-check condition “Dead line – live bus” is fulfilled
Sync. U1<U2<	Synchro-check condition “Dead line – dead bus” is fulfilled
Sync. Synchro	Synchro-check condition “Synchronism” is fulfilled
Sync. Blocked	Synchronism and voltage check function is blocked
Sync. Release	Conditions fulfilled: Release to close
Sync.Del. U>	Synchro-check ΔU exceeded
Sync.Del. f>	Synchro-check Δf exceeded
Sync.Del.PHI>	Synchro-check $\Delta\varphi$ exceeded
Sync.CloseCmd	Close command of synchronism and voltage check function

Further messages:

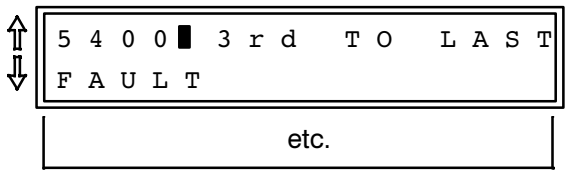
`Table empty`	means that no fault event has been recorded
`Table overflow`	means that other fault data have occurred, however, memory is full
`Table superceded`	a new fault event has occurred during read-out: page on with ↑ or ↓; the display shows the first annunciation in the actualized order
`End of table`	If not all memory places are used the last message is `End of table`.

The data of the **second to last** system fault can be found under address 5300. The available annunciations are the same as for the last fault.



Beginning of the block “Fault annunciations of the second to last system fault”

The data of the **third to last** system fault can be found under address 5400. The available annunciations are the same as for the last fault.

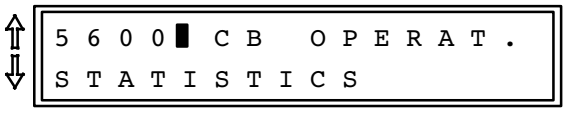


Beginning of the block “Fault annunciations of the third to last system fault”

6.4.4 Circuit breaker operation statistics – address block 56

The number of auto-reclose attempts is counted, separately for single-pole RAR, three-pole RAR (first shot) and three-pole DAR (further shots). Counter status are secured against auxiliary voltage failure and can be read off under address 5600. The address can be reached by direct addressing **DA 5 6 0 0 E** or by paging with the keys ⇑ or ⇓ until address 5600 is reached. The counters can be called up using the key ↑ for forwards paging or ↓ for backwards paging.

Entry of the codeword is not required for read-off of counter states.



Beginning of the block “Circuit breaker operation statistics”

Number of auto-reclose attempts after single-pole trip, e.g. 14

Page on with key ↑ to get further counter states:

Number of auto-reclose attempts after three-pole trip, 1st AR cycle (RAR)

Number of auto-reclose attempts after three-pole trip, further AR cycles (DAR)

The maximum values of the counters are:
– *RAR 1pole, RAR 3pole, DAR 3pole* 9 digits

The counters can be reset to 0 in block 82 (see Section 6.5.2).

6.4.5 Read-out of operational measured values – address block 57

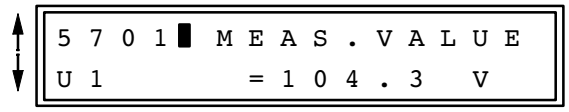
The steady state rms operating values can be read out at any time under the address 5700. The address can be called up directly using **DA 5 7 0 0 E** or by paging with ⇑ or ⇓. The individual measured values can be found by further paging with ↑ or ↓. Entry of the codeword is not necessary. The values will be updated in approximately 5 seconds intervals.

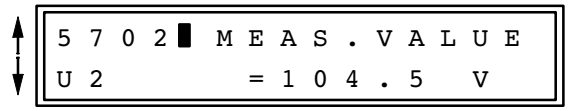
The data are displayed in primary and secondary values. To ensure correct primary values, the rated data must be entered to the device under address block 11 as described in Section 6.3.3.

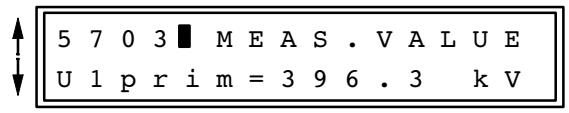
In the following example, some typical values have been inserted. In practice the actual values appear. Values outside the operation range of the relay are indicated with ⋆⋆⋆⋆.

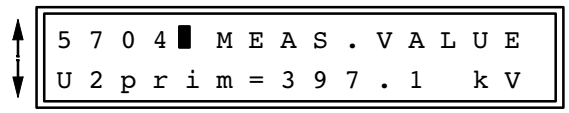
Beginning of the block “Operational measured values”

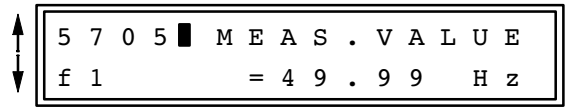
Use ↑ key to move to the next address with the next measured value.

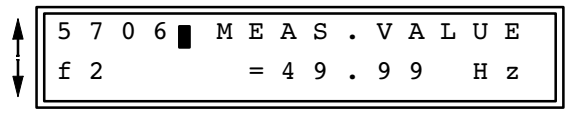


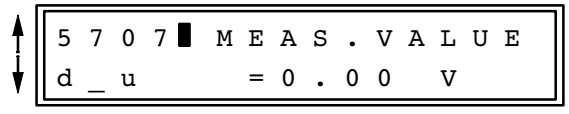


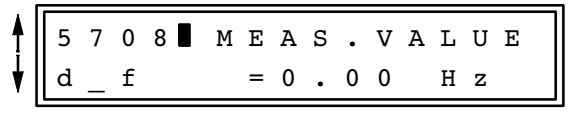


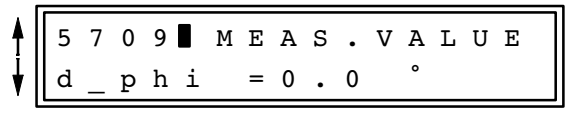












Page on with the ↑ key to read off the next address with the next measured value, or page back with ↓.

One address is available for each measured value. The values can be reached also by direct addressing using key **DA** followed by the address number and execute with **E**.

The primary values (addresses 5703 and 5704) are related to the primary rated values as parameterized under addresses 1103 (for U_N) (refer to Section 6.3.3).

The voltages and voltage difference are phase–phase or phase–earth, dependent of the connected voltage.

6.5 Operational control facilities

During operation of the protection relay it may be desired to intervene in functions or annunciations manually or from system criteria. 7VK512 comprises facilities, e.g. to re-adjust the real time clock, to erase stored informations and event counters, to switch on or off partial functions under specific conditions, or to change over preselected sets of function parameters.

The functions can be controlled from the operating panel on the front of the device, via the operating interface in the front as well as via binary inputs.

In order to control functions via binary inputs it is necessary that the binary inputs have been marshalled to the corresponding switching functions during installation of the device and that they have been connected (refer to Section 5.5.2 Marshalling of the binary inputs).

The control facilities begin with address block 8000. This address is reached

– by block paging with the keys ⇑ forwards or ⇓ backwards up to address 8000, or

– by direct selection with address code, using key **DA**, address **8 0 0 0** and execute with key **E.**

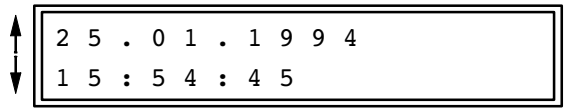
Beginning of the block “Device control”

6.5.1 Adjusting and synchronizing the real time clock – address block 81

The date and time can be adjusted at any time during operation as long as the real time clock is operative. Setting is carried out in block 81 which is reached by direct addressing **DA 8 1 0 0 E** or by paging with ⇑ and ⇓. Input of the codeword is required to change the data.

Selection of the individual addresses is by further scrolling using ↑ ↓ as shown below. Each modification must be confirmed with the enter key **E**.

Beginning of the block “Setting the real time clock”. Continue with ↑.



At first, the actual date and time are displayed. Continue with ↑.

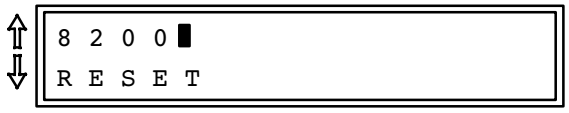
Enter the new date: 2 digits for day, 2 digits for month and 4 digits for year (including century); use the order as configured under address 7003 (Section 5.3.2), but always use a dot for separator:
DD.MM.YYYY or **MM.DD.YYYY**

Enter the new time: hours, minutes, seconds, each with 2 digits, separated by a dot:
HH.MM.SS

Using the difference time, the clock is set forwards by the entered time, or backwards using the +/– key. The format is the same as with the time setting above.

6.5.2 Erasing stored annunciations and counters – address block 82

The statistical indications (Section 6.4.4, address 5600) are stored in EEPROMs in the device. They are not therefore erased if the auxiliary power supply fails. Additionally, annunciations and the status of the LED memories are stored in NV–RAMs and thus saved provided the back-up battery is installed. These stores can be cleared in block 82. Block 82 is called up by paging with the keys ⇑ or ⇓ or directly by keying in the code **DA 8 2 0 0 E**. With the exception of resetting the LED indications (address 8201), codeword entry is necessary to erase the stored items. Reset is separate for the different groups of counters, memories and annunciations. One reaches the individual items by paging ↑ ↓. Erasure requires confirmation with the key **J/Y**. The display then confirms the erasure. If erasure is not required, press key **N** or simply page on.



Beginning of block “Reset”

Request whether the LED memories should be reset

Request whether the CB operation counters should be set to zero

Request whether the operational annunciation buffer store should be erased

Request whether the fault annunciation buffer store should be erased

During erasure of the stores the display shows TASK IN PROGRESS. After erasure the relay acknowledges erasure, e.g.

6.5.3 Off/On control of part functions of the device

During operation of the device it may be desired to control the relay manually or from system criteria, temporarily to switch off partial functions of the relay or to switch them on only under specific conditions. Examples may be the switching on or off of the auto-reclose system when a transfer bus is being used, dependent upon whether a transformer or line branch is switched to the transfer.

The relay allows partial functions to be switched on or off via binary inputs or manual operation via the integrated operator panel or via the operating interface at the front using a personal computer.

For switching via binary inputs it is, of course, necessary that the binary inputs have been marshalled to the corresponding switching functions. Furthermore, it must be noted that a binary input is required for each function, switching off and switching on. The switching command is stored in the relay and protected against auxiliary voltage failure (the function of a bi-stable store). The command can be annunciated via an annunciation relay or LED display.

For switching via the integrated operator panel or the front interface, a code word is necessary. The control functions are found at the beginning of the parameter block of each protection or supplementary function. The switch condition shown in the display can be changed over using the “No”–key **N**. The opposite switch condition then appears in the display. Each change of condition must be confirmed with the **E**–key. The change-over is first recorded in the relay when codeword operation has been terminated. This is done by the key combination **F E**, i.e. depressing the function key **F** followed by the entry key **E**. The display shows the question “SAVE NEW SETTINGS?”. Confirm with the “Yes”–key **J**/**Y** that the new settings shall become valid now. The switched conditions are then permanently stored in EEPROMs and protected against auxiliary voltage failure; the display confirms “NEW SETTINGS SAVED”. If you press the “No”–key **N** instead, codeword operation will be aborted, i.e. all alterations which have been changed since the last codeword entry are lost. Thus, erroneous alterations can be made ineffective.

A function is switched *ON* when the on–command has been given by both the binary input AND also from the operator panel or interface.

A function is switched *OFF* when the off–command is given by EITHER the binary input OR from the operator panel or the operating interface. Thus it is ensured that a partial function can only be switched on from that place where it was previously switched off.

Control inputs which are not marshalled to a binary input are regarded, from that location, as switched on, so that change of the condition is possible from the operator panel or the operating interface.

At the operator panel and the operating interface the factory setting is equally that all partial functions are switched on, so that switching via binary inputs is possible.

The completion of a switching command is, independent of its cause, output as an operational annunciation:

– “(function) `off`” **C**omes at the instant of switch-off,

– “(function) `off`” **G**oes at the instant that it is switched on.

These annunciations are listed in block 51 under OPERATIONAL ANNUNCIATIONS and can also be transmitted via the LSA interface to a central computer. Also they can be marshalled as binary outputs; the signal relay then indicates the switched-off condition.

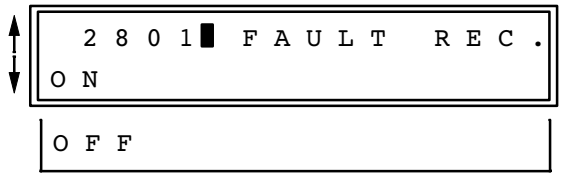
For annunciations one must differentiate:

– Direct confirmation of a binary input is available as long as the corresponding binary input is energized. It can be output via a signal relay or LED. In the summary of all annunciations (Appendix C) these annunciations are identified with a ’>’ symbol.

– The completion indication of the switched-off condition is signalized independently of the source of the command. It appears (“Comes”) at the instant of switch-off and disappears (“Goes”) at the instant of switching on.

The following survey shows the control functions and also indicates which confirmation indications are generated.

	Binary input confirmation	Completion indication ('comes' and 'goes')

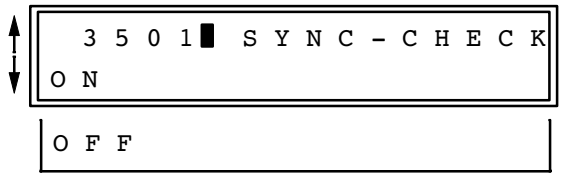


Fault recording function

49	>Flt.Rec. on		
50	>Flt.Rec. off	108	Flt.Rec. off

Auto-reclose function

57	>AR on		
58	>AR off	801	AR off



Synchronism and voltage check function

51	>SyncChck on		
52	>SyncChck off	840	Sync. off

Warning

If synchronism check function is switched off each manual or automatic closure is carried out without synchronism check!

6.5.4 Selection of parameter sets – address block 85

Up to 4 different sets of parameters can be selected for the functional parameters, i.e. the addresses above 1000 and below 4000. These parameter sets can be switched over during operation, locally using the operator panel or via the operating interface using a personal computer, or also remotely using binary inputs.

The first parameter set is identified as set A, the other sets are B, C and D. Each of these sets has been set during parameterizing (Section 6.3.1.2) provided the switch-over facility is used.

6.5.4.1 Read-out of settings of a parameter set

In order to **look up** the settings of a parameter set **in the display** it is sufficient to go to any address of the function parameters (i.e. addresses above 1000 and below 4000), either by direct addressing using key **DA**, entering the four-figure address code and terminating with enter key **E**, or by paging through the display with ⇑ or ⇓. You can switch over to look up a different parameter set, e.g.

– Press key combination **F 2**, i.e. first the function key **F** and then the number key **2**. All displayed parameters now refer to parameter set B.

The parameter set is indicated in the display by a leading character (A to D) before the address number indicating the parameter set identification.

The corresponding procedure is used for the other parameter sets:

- Key combination **F 1**:
  access to parameter set **A**
- Key combination **F 2**:
  access to parameter set **B**
- Key combination **F 3**:
  access to parameter set **C**
- Key combination **F 4**:
  access to parameter set **D**

The relay operates always with the active parameter set even during read-out of the parameters of any desired parameter set. The change-over procedure described here is, therefore, only valid for **read-out** of parameters **in the display**.

6.5.4.2 Change-over of the active parameter set from the operating panel

For **change over to a different parameter set**, i.e. if a different set shall be activated, the address block 85 is to be used. For this, codeword entry is required.

The block for processing parameter sets is reached by pressing the direct address key **DA** followed by the address **8 5 0 0** and enter key **E** or by paging through the display with ⇑ or ⇓. The heading of the block will appear:

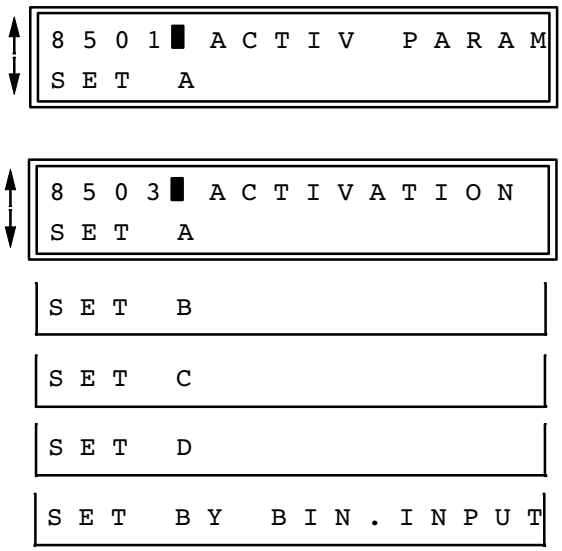
Beginning of the block “Parameter change-over”: processing of parameter sets

It is possible to scroll through the individual addresses using the ↑ key or to scroll backwards with ↓.

Address 8501 shows the actually active parameter set with which the relay operates.

In order to switch-over to a different parameter set scroll on with ↑ to address 8503. Using the “No”–key **N** you can change to any desired parameter set; alternatively, you can decide that the parameter sets are to be switched over from binary inputs. If the desired set or possibility appears in the display, press the enter key **E**.

As with every settings of the device for which codeword input is necessary, codeword operation must be terminated. This is done by using the key combination **F E**, i.e. depressing the function key **F** followed by the entry key **E**. The display shows the question “SAVE NEW SETTINGS?”. Confirm with the “Yes”–key **Y** that the new settings shall become valid now. If you press the “No”–key **N** instead, codeword operation will be aborted, i.e. all alterations which have been changed since the last codeword entry are lost. Thus, erroneous alterations can be made ineffective.



Address 8501 shows the actually active parameter set

Use the "No"–key **N** to page through the alternative possibilities. The desired possibility is selected by pressing the enter key **E**.

If you select *SET BY BIN.INPUT*, then the parameter set can be changed over via binary inputs (see Section 6.5.4.3).

6.5.4.3 Change-over of the active parameter set via binary inputs

If change-over of parameter sets is intended to be carried out via binary inputs, the following is to be heeded:

– Locally (i.e. from the operator panel or from PC via the operating interface), ACTIVATION must be switched to *SET BY BIN.INPUT* (refer to Section 6.5.4.2).

– 2 logical binary inputs are available for control of the 4 parameter sets. These binary inputs are designated "`Param.Selec.1`" and "`Param. Selec.2`".

– The logical binary inputs must be allocated to 2 physical input modules (refer to Section 5.5.2) in order to allow control. An input is treated as not energized when it is not assigned to any physical input.

– The control input signals must be continuously present as long as the selected parameter set shall be active.

The active parameter sets are assigned to the logical binary inputs as shown in Table 6.2.

A simplified connection example is shown in Figure 6.2. Of course, the binary inputs must be declared in normally open ("`NO`") mode.

Binary input		causes
ParamSelec.1	ParamSelec.2	active set
no	no	Set A
yes	no	Set B
no	yes	Set C
yes	yes	Set D

no = input not energized
yes = input energized

Table 6.2 Parameter selection via binary input

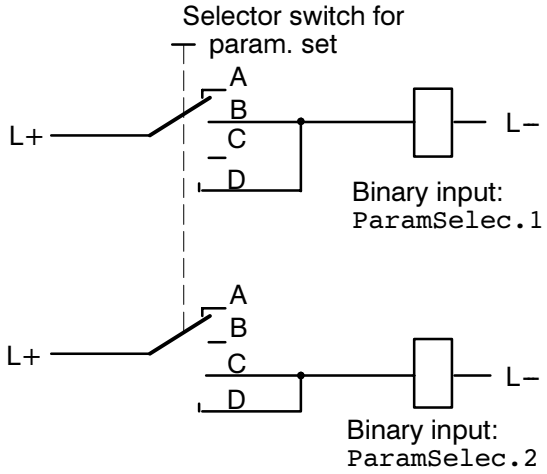


Figure 6.2 Connection scheme for parameter change-over via binary inputs

6.6 Testing and commissioning

6.6.1 General

Prerequisite for commissioning is the completion of the preparation procedures detailed in Chapter 5.

Warning

Hazardous voltages are present in this electrical equipment during operation. Non-observance of the safety rules can result in severe personal injury or property damage.

Only qualified personnel shall work on and around this equipment after becoming thoroughly familiar with all warnings and safety notices of this manual as well as with the applicable safety regulations.

Particular attention must be drawn to the following:

- The earthing screw of the device must be connected solidly to the protective earth conductor before any other connection is made.
- Hazardous voltages can be present on all circuits and components connected to the supply voltage or to the measuring and test quantities.
- Hazardous voltages can be present in the device even after disconnection of the supply voltage (storage capacitors!).
- The limit values given in the Technical data (Section 3.1) must not be exceeded at all, not even during testing and commissioning.

When testing the unit with a secondary injection test set, it must be ensured that no other measured values are connected and that the closing leads to the circuit breaker closing coils have been interrupted.

It is recommended that the actual settings for the relay be used for the testing procedure. If these values are not (yet) available, test the relay with the factory settings. In the following description of the test sequence the preset settings are assumed unless otherwise noted.

For the functional test a single-phase voltage source sufficient.

NOTE! The accuracy which can be achieved during testing depends on the accuracy of the testing equipment. The accuracy values specified in the Technical data can only be reproduced under the reference conditions set down in IEC 60255 resp. VDE 0435/part 303 and with the use of precision measuring instruments. The tests are therefore to be looked upon purely as functional tests.

During all the tests it is important to ensure that the correct command (trip) contacts close, that the proper indications appear at the LEDs and the output relays for remote signalling. If the relay is connected to a central memory device via the serial interface, correct communication between the relay and the master station must be checked.

After tests which cause LED indications to appear, these should be reset, at least once by each of the possible methods: the reset button on the front plate and via the remote reset relay (see connection diagrams, Appendix A). If the reset functions have been tested, resetting the stored indications is no more necessary as they are erased automatically with each new pick-up of the relay and replaced by the new annunciations.

6.6.2 Testing the auto-reclose function

The AR function can be programmed to single-pole, three-pole or single/three-pole AR (address 3422), provided it is configured as INTERNAL AR = *EXIST* (Address 7834, refer to Section 5.4.2) and switched to AR FUNCT = *ON* (Address 3401).

If the feeder protection provides an AR-stage, the proper control of this stage should be checked.

The binary input "circuit breaker ready" must be simulated unless an open circuit contact has been programmed for this purpose (FNo 92 "CB ready", refer also to Section 5.5.2).

Depending of the selected AR program (address 3422 RAR PROG), a single-phase and/or two-phase short circuit should be simulated within the instantaneous stage of the feeder protection and within the AR-stage – if available – but beyond the instantaneous stage, each time once with successful and once with unsuccessful AR. Check the proper reaction of the relay according to the set AR program.

Note that each new test can begin only after the reclaim time or lock-out time for the previous test has expired; otherwise an auto-reclosure cannot result: LED "AR not ready" (FNo 803, LED 1, as delivered) must not be illuminated.

If the circuit breaker is not ready a reclose attempt must not result. However, a normal AR cycle must occur when the signal "circuit breaker ready" first disappears after the inception of the fault.

If multi-shot auto-reclosure is used, test the function sequence in accordance to the set DAR program and the number of desired shots.

6.6.3 Testing the synchronism and voltage check function

The synchronism and voltage check function can – if fitted – operate with the integrated auto-reclose function or with an external auto-reclosure device. Additionally, synchronism or dead-line check can be performed before manual closing of the circuit breaker. A Pre-requisite is, that it is configured as SYNCH.CHECK = *EXIST* (Address 7835, refer to Section 5.4.2) and switched to SYN.CHECK = *ON* (Address 3501).

The start-to-measure signal can be given to the relay via the binary input ">Sync. Start" (FNo 30). The device checks for close permission according to the check program which is set under the addresses 3515 to 3519. If the check result is positive, close command is released (Annunciation "Sync.Release", FNo 850).

The programs available are:

SYNCHR = *YES* If measured voltages are in phase, close command is released, if in counter-phase no release occurs.

U1>U2< = *YES* If the feeder voltage (U1) is present but the bus-bar voltage (U2) switched off, close command is released.

U1<U2> = *YES* If the bus-bar voltage (U2) is present but the feeder voltage (U1) switched off, close command is released.

U1<U2< = *YES* If the bus-bar voltage (U2) and the feeder voltage (U1) are both switched off, close command is released.

OVERRIDE = *YES* Close command is released independent on whether voltages are present or not, nor what is the phase relationship.

6.7 Commissioning using primary tests

All secondary testing sets and equipment must be removed. Reconnect current and voltage transformers. For testing with primary values the line must be energized.

Warning

Primary tests shall be performed only by qualified personnel which is trained in commissioning of protection systems and familiar with the operation of the protected object as well as the rules and regulations (switching, earthing, etc.)

6.7.1 Measured voltage checks

Connections to the voltage transformers are checked with primary values. Open the line isolator and close the circuit breaker as to Figure 6.3. Thus, both voltage transformer sets receive the same voltage. Close the voltage transformer secondary m.c.b.s of bus-bar and feeder voltage.

The voltages can be read off on the display in the front or via the operating interface in block 57 and compared with the actual measured values. The secondary voltages (addresses 5701 and 5702) must be equal. The values for ΔU (address 5707), Δf (address 5708) and $\Delta\varphi$ (address 5709) must be almost zero. A deviation of the last indicated digit can be tolerated.

If higher deviations are recognized or even a large phase angle is indicated, check at first the setting of address 1132 and correct if necessary. Furthermore, an error can be present in the secondary wiring of the voltage transformer circuits. Check and correct the connections. Repeat measurement.

Read out the primary voltage values (addresses 5703 and 5704) and compare with the actual values. These values are relevant only for operational measurement. If deviations occur, addresses 1103 and 1104 should be checked (refer to Section 6.3.3).

6.7.2 Checking the voltage polarity for synchronism check

This check should verify the correct polarity of the voltage transformer connections for the synchronism and voltage check function. The protective m.c.b.s of both voltage transformer secondary circuits must be closed.

Open the circuit breaker.

At first, set the synchro-check function to the override program, i.e. address 3519 OVERRIDE = *YES*. Start synchronism check by energizing the binary start-to-measure input (FNo 94 “>Sync. Start”. The synchro-check function must issue the release command (annunciation “Sync.Release”, FNo 850). If not, check all relevant parameters: address 7835 (Section 5.4.2) and address 3501 (Section 6.3.6).

Next, open the line isolator and close the circuit breaker as to Figure 6.3. Thus, both voltage transformer sets receive the same voltage.

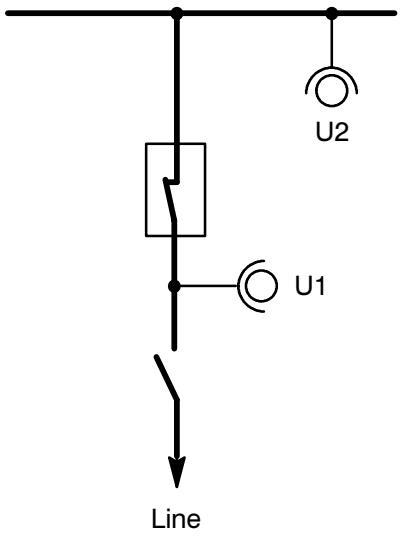


Figure 6.3 Measured voltages for synchronism check

Set the synchronism and voltage check function to the synchro-check program, i.e. address 3515 SYN-

CHR = *YES* and 3519 OVERRIDE = *NO*. Start synchronism check by energizing the binary start-to-measure input (FNo 94 ">Sync. Start". The synchro-check function must issue the release command (annunciation "Sync.Release", FNo 850). If not, check again the connections. If measurement is carried out over a transformer, check address 1132, too; this parameter matches the connection group of the transformer. If the parameters are correct, check and correct the polarity of the voltage transformer connections.

Set the synchronism check function to the dead-bus check program, i.e. address 3516 U1>U2< = *YES* and 3515 SYNCHR = *NO*. Switch voltage transformer m.c.b. of the bus-bar voltage to tripped position. Start by energizing the binary start-to-measure input (FNo 94 ">Sync. Start"). No release command occurs. Close voltage transformer m.c.b. of the bus-bar voltage.

Open circuit breaker. Set the synchronism check function to the dead-line check program, i.e. address 3517 U1<U2> = *YES* and 3516 U1>U2< = *NO*. Start by energizing the binary start-to-measure input (FNo 94 ">Sync. Start". The synchro-check function must issue the release command (annunciation "Sync.Release", FNo 850). If not, check again carefully all connections and parameters relating to the synchronism and voltage check function according to Section 6.3.3.

Switch voltage transformer m.c.b. of the feeder voltage to tripped position. Start by energizing the binary start-to-measure input (FNo 94 ">Sync. Start". No release command occurs. Close voltage transformer m.c.b. of the feeder voltage.

Re-check and re-adjust addresses 3515 to 3519 (in case they were altered for these tests).

6.7.3 Measuring the circuit breaker closing time

If asynchronous switching is to be allowed the circuit breaker closing time is measured and set correctly in address 1133 (see also Section 6.3.3). A suitable arrangement is shown in Figure 6.4.

The time meter is set to the 1 s range and to a resolution of 1 ms. Close the circuit breaker manually; the time meter is started at the same time. The voltage U1 appears when the poles of the circuit breakers are closed; the time meter is then stopped. The time indicated on the meter is the circuit breaker closing time.

The experiment must be repeated if the time meter does not stop because of an unfavourable closing instant.

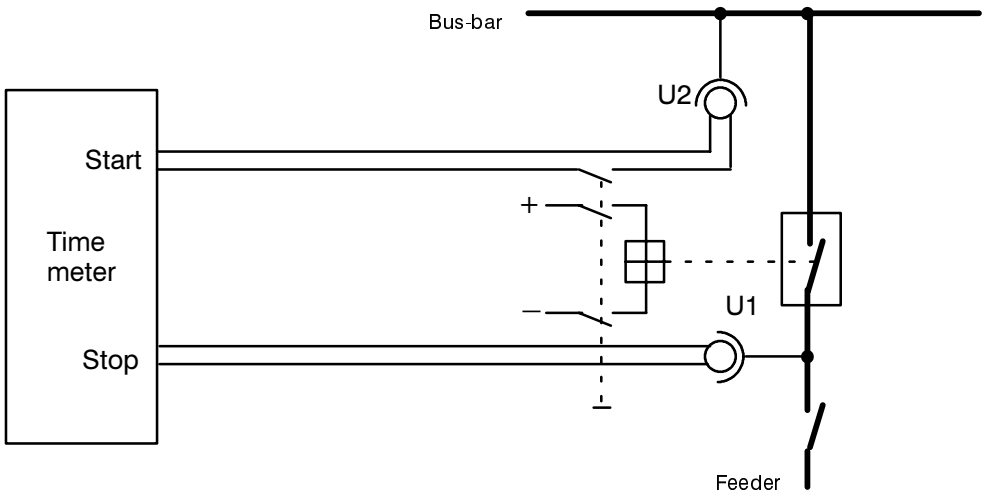


Figure 6.4 Measuring the circuit breaker closing time

6.8 Putting the relay into operation

All setting values should be checked again, in case they were altered during the tests. Particularly check that all desired functions have been programmed in the configuration parameters (address block 78, refer to Section 5.4) and all desired functions have been switched *ON*.

The counters for circuit breaker operation statistics should be erased (address block 82, refer to Section 6.5.2).

Push the key **M**/**S** on the front. The display shows the beginning of the annunciation blocks. Thus, it is possible that the measured values for the quiescent state of the relay can be displayed (see below). These values has been chosen during configuration (refer to Section 5.3.2) under the addresses 7005 and 7006.

Stored indications on the front plate should be reset by pressing the push-button “RESET LED” on the front so that from then on only real faults are indicated. From that moment the measured values of the quiescent state are displayed. During pushing the RESET button, the LEDs on the front will light up (except the “Blocked” – LED); thus, a LED test is performed at the same time.

Check that the module is properly inserted. The green LED must be on on the front; the red LED must not be on.

Close housing cover.

All terminal screws – even those not in use – must be tightened.

If a test switch is available, then this must be in the operating position.

The auto-reclose relay is now ready for operation.

7 Maintenance and fault tracing

Siemens digital protection and automation relays are designed to require no special maintenance. All measurement and signal processing circuits are fully solid state and therefore completely maintenance free. Input modules are even static, relays are hermetically sealed or provided with protective covers.

If the device is equipped with a back-up battery for saving of stored annunciations and the internal time clock, the battery should be replaced after at most 10 years of operation (refer to Section 7.2). This recommendation is valid independent on whether the battery has been discharged by occasional supply voltage failures or not.

As the device is almost completely self-monitored, hardware and software faults are automatically annunciated. This ensures the high availability of the relay and allows a more corrective rather than preventive maintenance strategy. Tests at short intervals become, therefore, superfluous.

With detected hardware faults the relay blocks itself; drop-off of the availability relay signals “equipment fault”.

Recognized software faults cause the processor to reset and restart. If such a fault is not eliminated by restarting, further restarts are initiated. If the fault is still present after three restart attempts the processor system will switch itself out of service and indicate this condition by the red LED “Blocked” on the front plate. Drop-off of the availability relay signals “equipment fault”.

The reaction to defects and indications given by the relay can be individually and in chronological sequence read off as operational annunciations under the address 5100, for defect diagnosis (refer to Section 6.4.2).

If the relay is connected to a local substation automation system (LSA), defect indications will also be transferred via the serial interface to the central control system.

Warning

Ensure that the connection modules are not damaged when removing or inserting the device modules!

7.1 Routine checks

Routine checks of internal functions or pick-up values are not necessary as they form part of the continuously supervised firmware programs. The planned maintenance intervals for checking and maintenance of the plant can be used to perform operational testing of the protection equipment. This maintenance serves mainly for checking the interfaces of the unit, i.e. the coupling with the plant. The following procedure is recommended:

– Read-out of operational values (address block 57) and comparison with the actual values for checking the analog interfaces.

Warning

Hazardous voltages can be present on all circuits and components connected with the supply voltage or with the measuring and test quantities!

– Circuit breaker close circuits can be tested during tests of the main protection equipment. Respective notes are given in the appropriate manuals of the main protection relays.

7.2 Replacing the clock module

If the device is equipped with the clock option (model 7VK512★–★★★★**1**–★★, refer to Section 2.3 Ordering data), the device annunciations are stored in NV–RAMs. The clock module contains also the back-up battery so that the annunciations are retained even with a longer failure of the d.c. supply voltage.

The clock module should be replaced at the latest after 10 years of operation.

Recommended clock module:

– DALLAS
  DS 1386 – 32 K
  RAMified TIMEKEEPER

The module is located on the basic p.c.b. (EPS–2). The complete draw-out module must be removed from the housing in order to replace the clock module.

The procedure when replacing the battery is described below.

– Prepare area of work: provide conductive surface for the basic module.

– Open housing cover.

– Read out device annunciations, i.e. all addresses which commence with 5 (5000 onwards). This is carried out most convenient using the front operating interface and a personal computer with the DIGSI® protection data processing program; the information is thus stored in the PC.

  Note: All configuration data and settings of the device are stored in EEPROMs protected against switching off of the power supply. They are stored independent of the clock module. They are, therefore, neither lost when the clock module is replaced nor when the device is operated without a clock module.

Warning

Hazardous voltages can be present in the device even after disconnection of the supply voltage or after removal of the modules from the housing (storage capacitors)!

– Loosen the draw-out module using the pulling aids provided at the top and bottom. (Figure 7.3).

Caution!

Electrostatic discharges via the component connections, the PCB tracks or the connecting pins of the modules must be avoided under all circumstances by previously touching an earthed metal surface.

– Pull out basic module and place onto the conductive surface.

– Get access to the basic p.c.b. (EPS–2).

– Pull out used clock module from the socket according to Figure 7.1; **do not place on the conductive surface!**

– Insert the prepared new clock module into the socket; observe correct mounting position.

– Remount PCB board to the draw-out module.

– Insert draw-out module into the housing; ensure that the releasing lever is pushed fully to the right before the module is pressed in.

– Firmly push in the module using the releasing lever (Figure 7.3).

Warning

The discharged battery contains Lithium. It must only be disposed off in line with the applicable regulations!

Do not reverse polarities! Do not recharge! Do not throw into fire! Danger of explosion!

– Provided the internal system clock is not automatically synchronized via the LSA interface, it can now be set or synchronized as described in Section 6.5.1

– Close housing cover.

The replacement of the clock module has thus been completed.

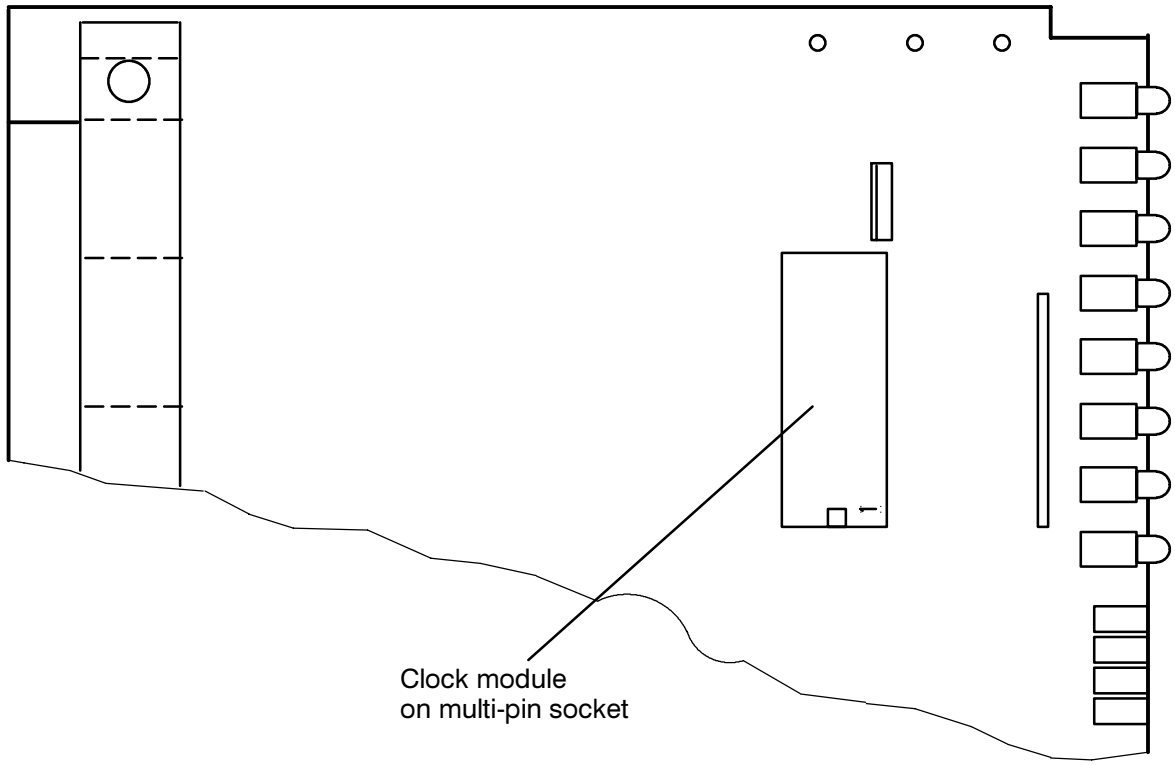


Figure 7.1 Position of the clock module

7.3 Fault tracing

If the device indicates a defect, the following procedure is suggested:

If none of the LEDs on the front plate of the module is on, then check:

– Has the module been properly pushed in and locked?

– Is the ON/OFF switch on the front plate in the ON position ⊙ ?

– Is the auxiliary voltage available with the correct polarity and of adequate magnitude, connected to the correct terminals (General diagrams in Appendix A)?

– Has the mini-fuse in the power supply section blown (see Figure 7.2)? If appropriate, replace the fuse according to Section 7.3.1.

If the red fault indicator “Blocked” on the front is on and the green ready LED remains dark, the device has recognized an internal fault. Re-initialization of the processor system could be tried by switching the processor system off and on again, by means of the switch in the front plate. This, however, results in loss of annunciations and messages if the relay is not equipped with the clock module, and, if a parameterizing process has not yet been completed, the last parameters are not stored.

7.3.1 Replacing the mini-fuse

– Select a replacement fuse 5 × 20 mm. Ensure that the rated value, time lag (medium slow) and code letters are correct. (Figure 7.2).

– Prepare area of work: provide conductive surface for the basic module.

– Open housing cover.

Warning

Hazardous voltages can be present in the device even after disconnection of the supply voltage or after removal of the modules from the housing (storage capacitors)!

– Loosen the basic module using the pulling aids provided at the top and bottom. (Figure 7.3).

Caution!

Electrostatic discharges via the component connections, the PCB tracks or the connecting pins of the modules must be avoided under all circumstances by previously touching an earthed metal surface.

– Pull out basic module and place onto the conductive surface.

– Remove blown fuse from the holder (Figure 7.2).

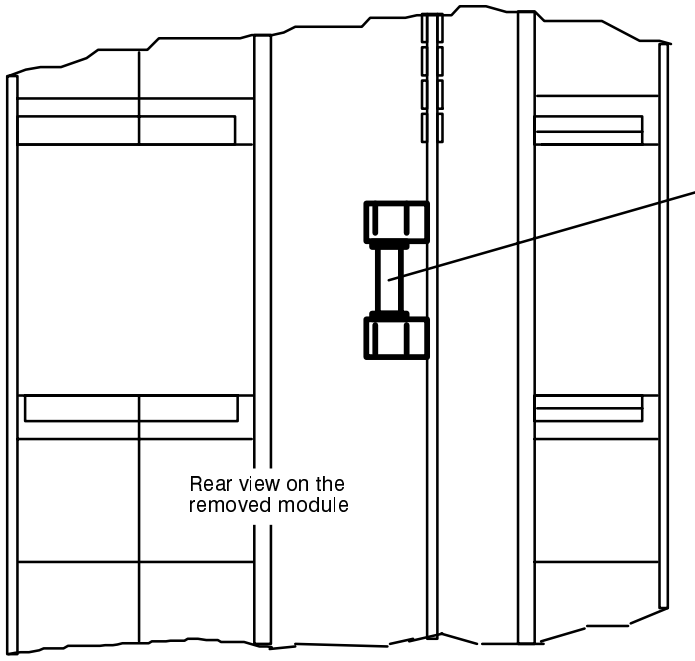
– Fit new fuse into the holder (Figure 7.2).

– Insert basic module into the housing; ensure that the releasing lever is pushed fully to the right before the module is pressed in (Figure 7.3).

– Firmly push in the module using the releasing lever. (Figure 7.3).

– Close housing cover.

Switch on the device again. If a power supply failure is still signalled, a fault or short-circuit is present in the internal power supply. The device should be returned to the factory (see Chapter 8).



Mini-fuse of the power supply;
medium slow (M)

at U_{HN}/V–	rated value
24/48	2 A/E
60/110/125	1,6 A/E
220/250	1 A/G

Figure 7.2 Mini-fuse of the power supply

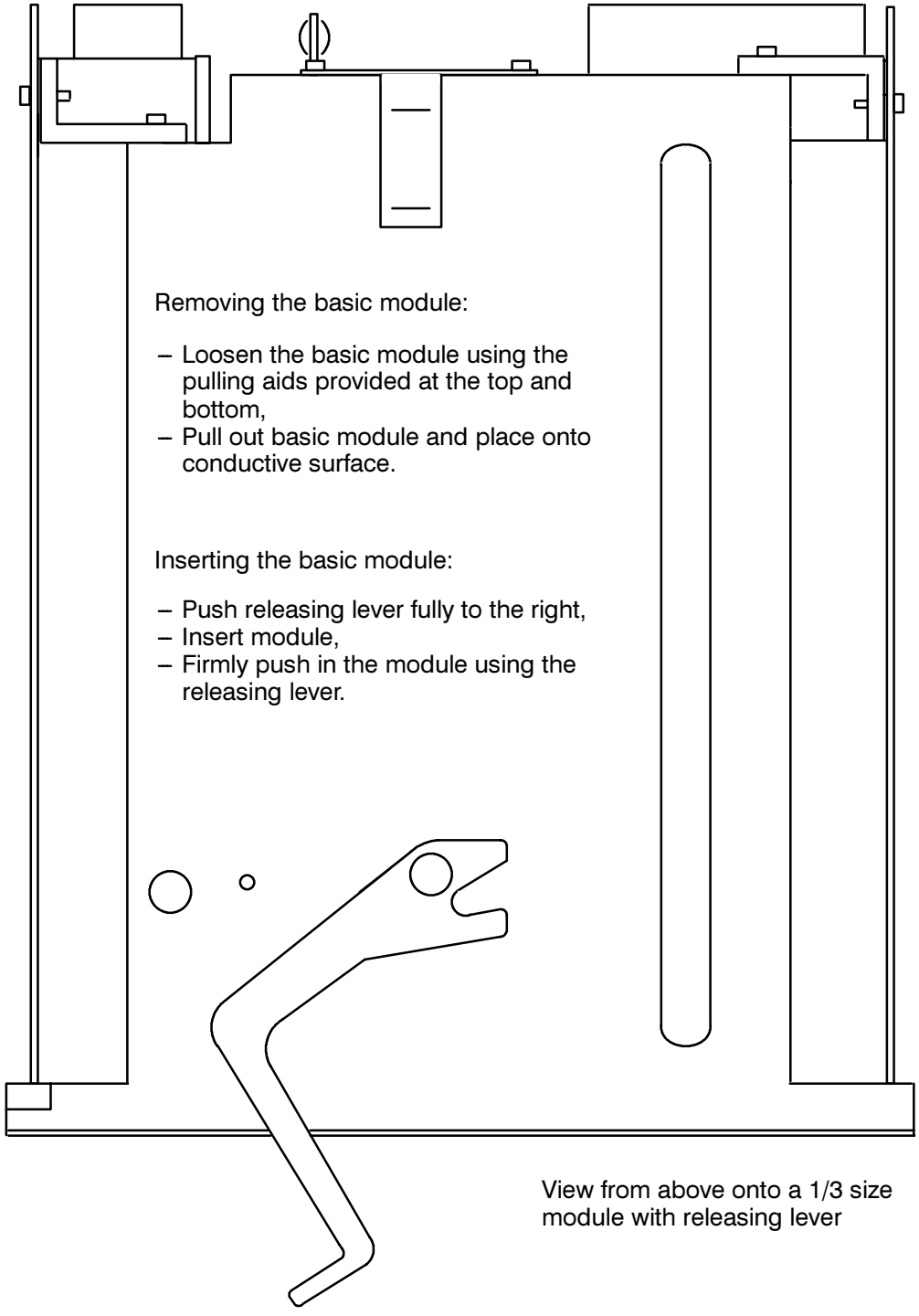


Figure 7.3 Aid for removing and inserting basic module

8 Repairs

Repair of defective modules is not recommended at all because specially selected electronic components are used which must be handled in accordance with the procedures required for **E**lectrostatically **E**ndangered **C**omponents (EEC). Furthermore, special manufacturing techniques are necessary for any work on the printed circuit boards in order to do not damage the bath-soldered multilayer boards, the sensitive components and the protective finish.

Therefore, if a defect cannot be corrected by operator procedures such as described in Chapter 7, it is recommended that the complete relay should be returned to the manufacturer. Use the original transport packaging for return. If alternative packing is used, this must provide the degree of protection against mechanical shock, as laid down in IEC 60255 – 21 – 1 class 2 and IEC 60255 – 21 – 2 class 1.

If it is unavoidable to replace individual modules, it is imperative that the standards related to the handling of **E**lectrostatically **E**ndangered **C**omponents are observed.

Warning

Hazardous voltages can be present in the device even after disconnection of the supply voltage or after removal of the module from the housing (storage capacitors)!

Caution!

Electrostatic discharges via the component connections, the PCB tracks or the connecting pins of the modules must be avoided under all circumstances by previously touching an earthed metal surface. This applies equally for the replacement of removable components, such as EPROM or EEPROM chips. For transport and returning of individual modules electrostatic protective packing material must be used.

Components and modules are not endangered as long as they are installed within the relay.

Should it become necessary to exchange any device or module, the complete parameter assignment should be repeated. Respective notes are contained in Chapter 5 and 6.

9 Storage

Solid state protective relays shall be stored in dry and clean rooms. The limit temperature range for storage of the relays or associated spare parts is –25 °C to +55 °C (refer to Section 3.1.4 under the Technical data), corresponding to –12 °F to 130 °F.

The relative humidity must be within limits such that neither condensation nor ice forms.

It is recommended to reduce the storage temperature to the range +10 °C to +35 °C (50 °F to 95 °F); this prevents from early ageing of the electrolytic capacitors which are contained in the power supply.

For very long storage periods, it is recommended that the relay should be connected to the auxiliary voltage source for one or two days every other year, in order to regenerate the electrolytic capacitors. The same is valid before the relay is finally installed. In extreme climatic conditions (tropics) pre-warming would thus be achieved and condensation avoided.

Before initial energization with supply voltage, the relay shall be situated in the operating area for at least two hours in order to ensure temperature equalization and to avoid humidity influences and condensation.

Appendix

A General diagrams

B Connection diagrams

C Tables

A General diagrams

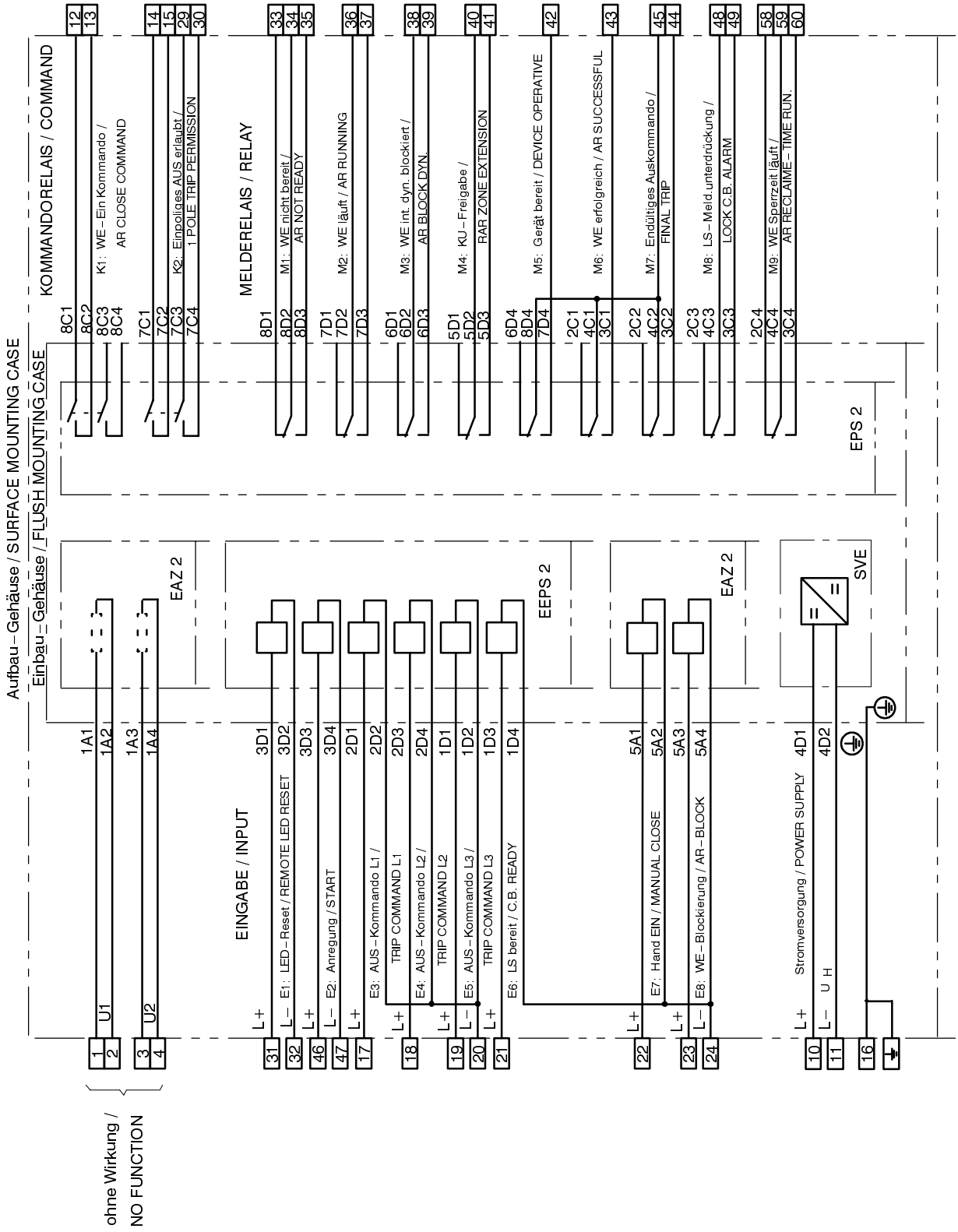


Figure A.1 General diagram 7VK5121 without synchronism check (sheet 1 of 3)

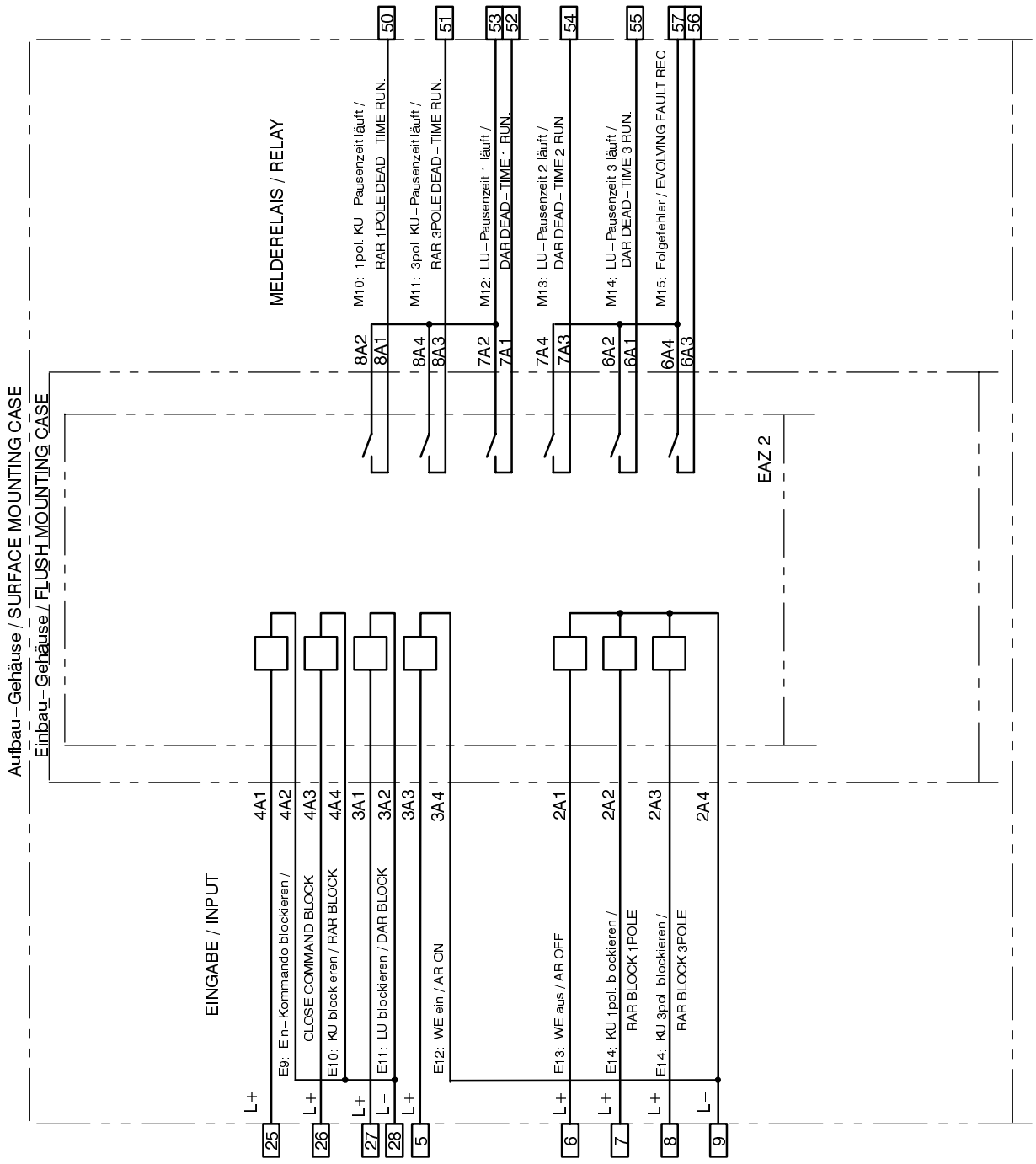


Figure A.2 General diagram 7VK5121 without synchronism check (sheet 2 of 3)

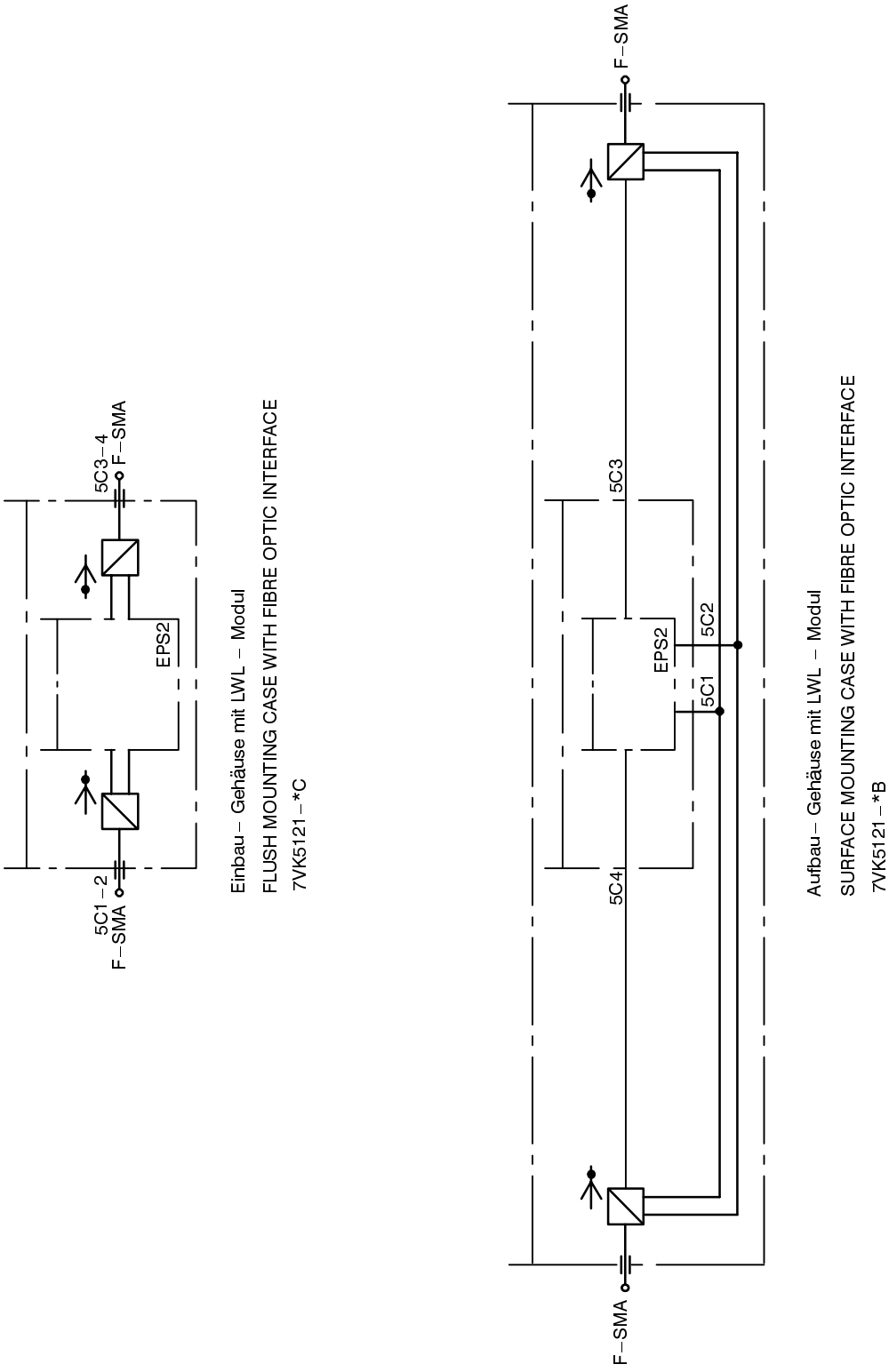


Figure A.3 General diagram 7VK5121 without synchronism check (sheet 3 of 3)

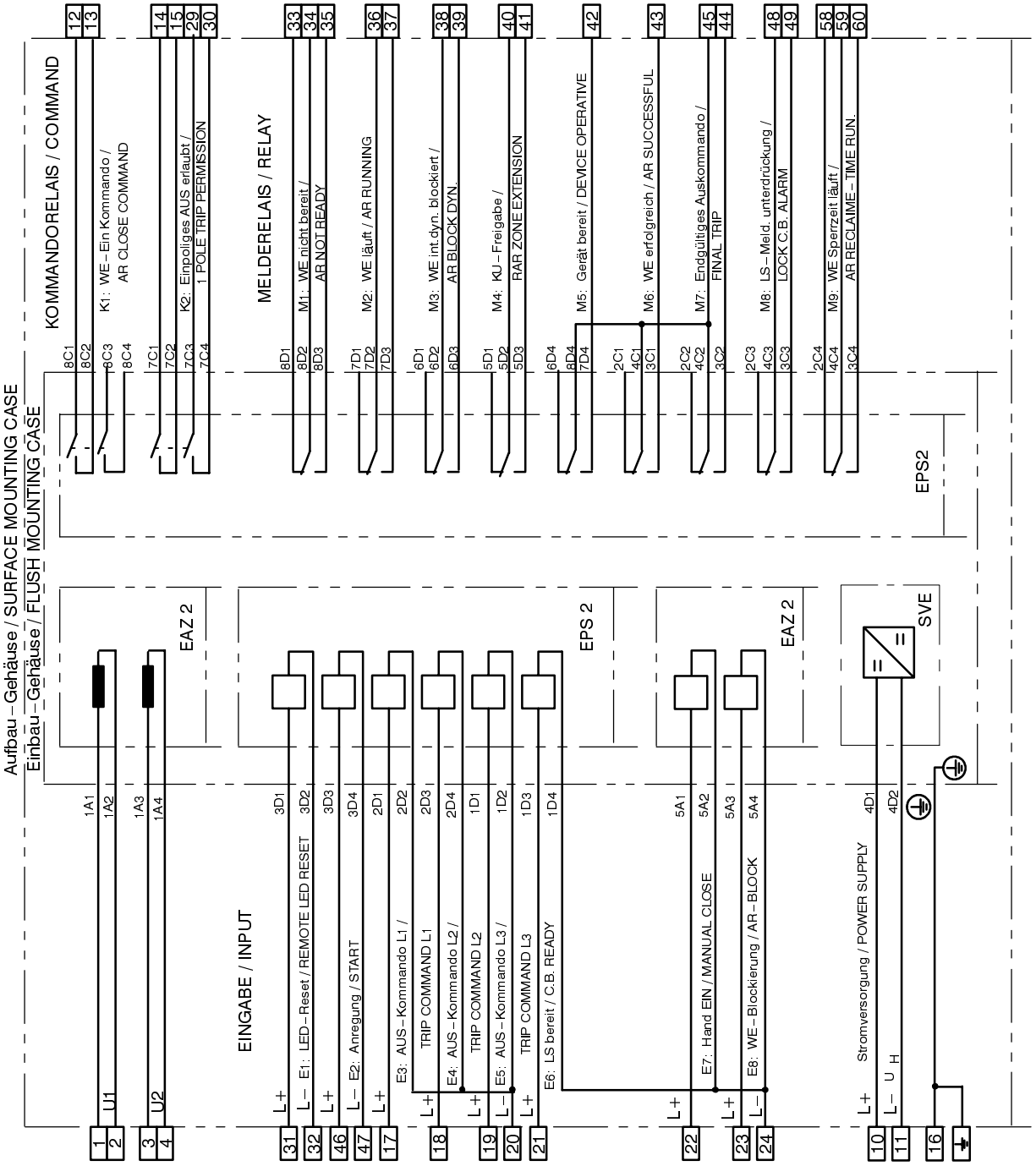


Figure A.4 General diagram 7VK5122 with synchronism check (sheet 1 of 3)

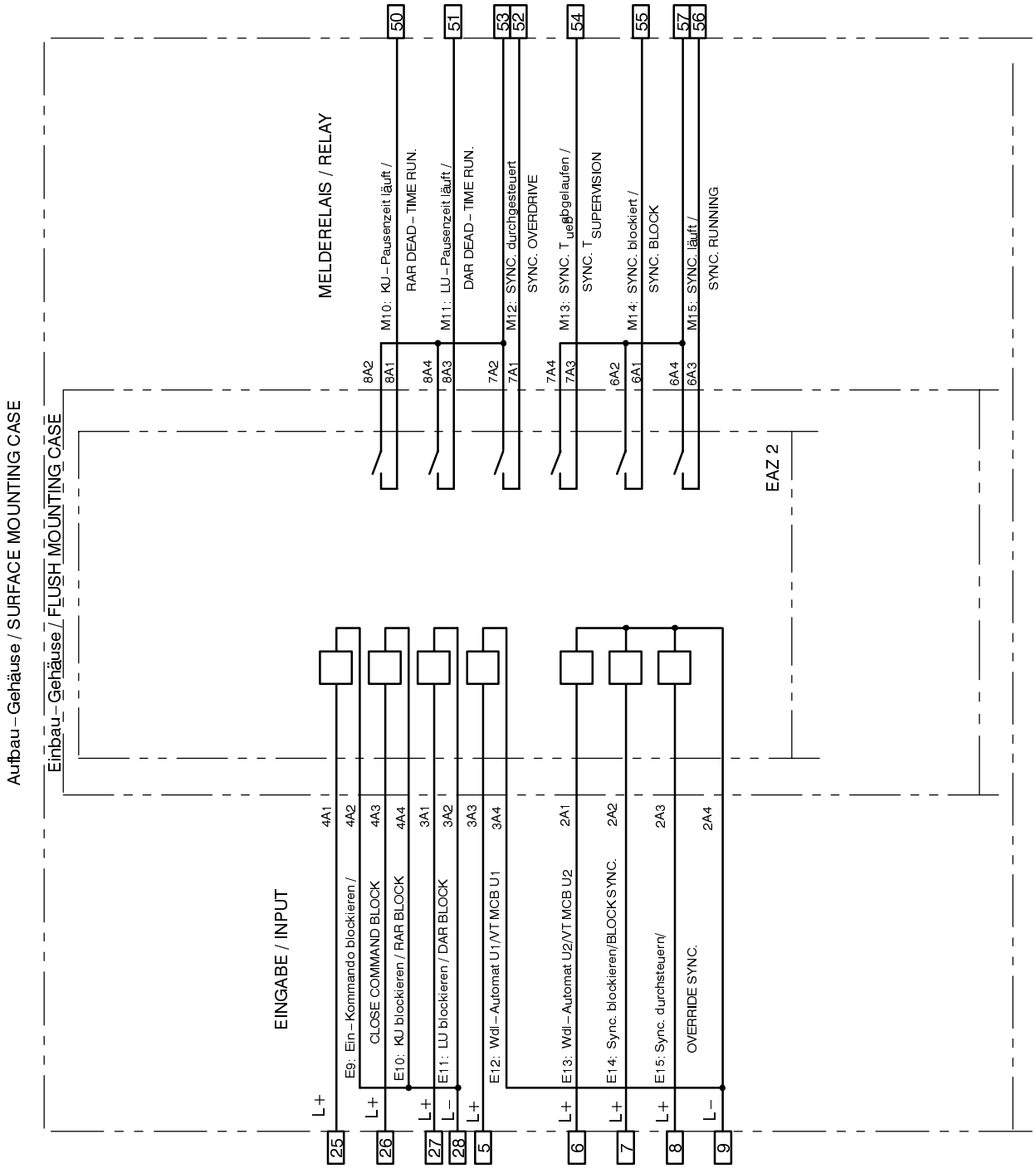


Figure A.5 General diagram 7VK5122 with synchronism check (sheet 2 of 3)

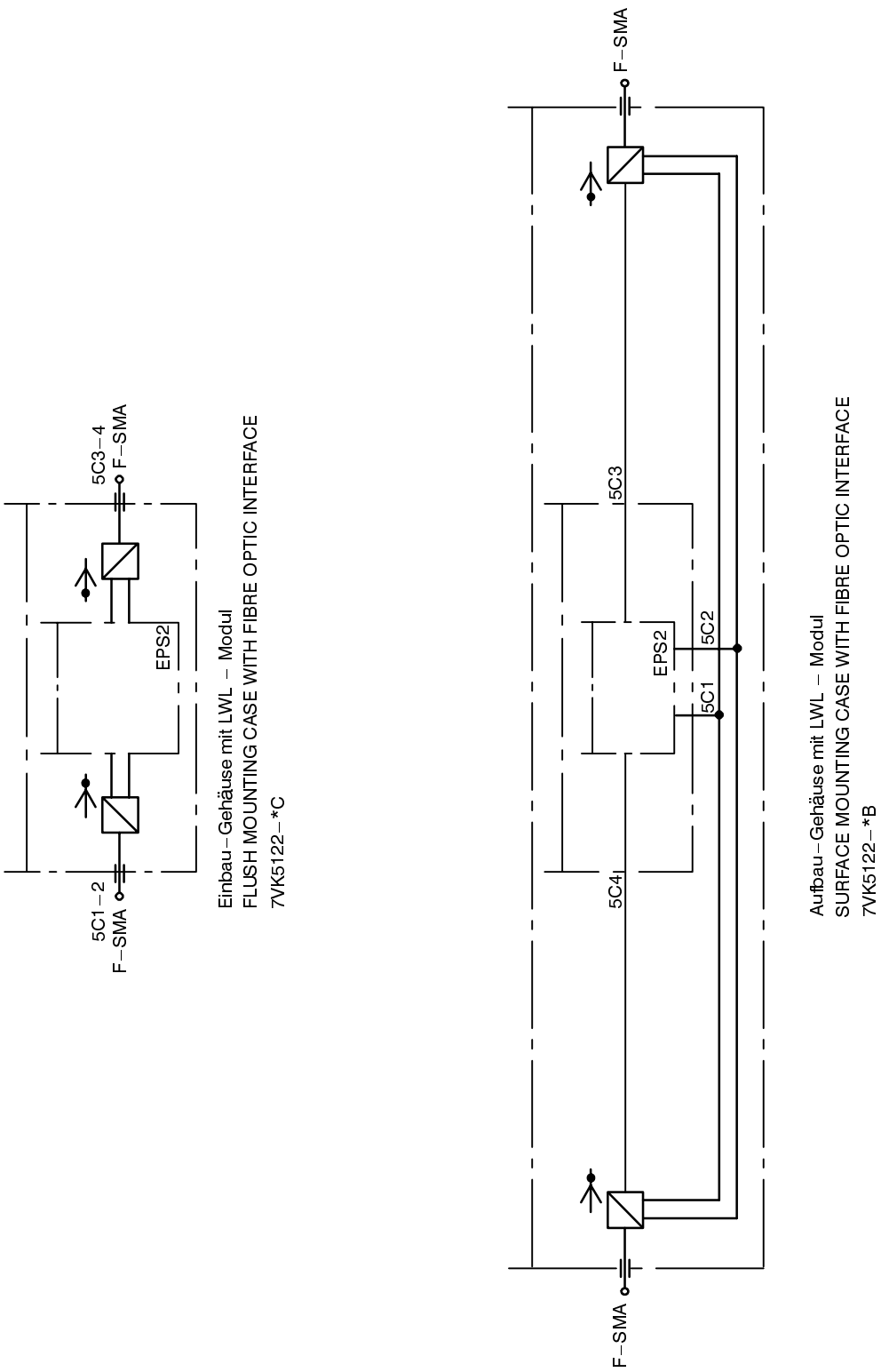


Figure A.6 General diagram 7VK5122 with synchronism check (sheet 3 of 3)

B Connection diagram

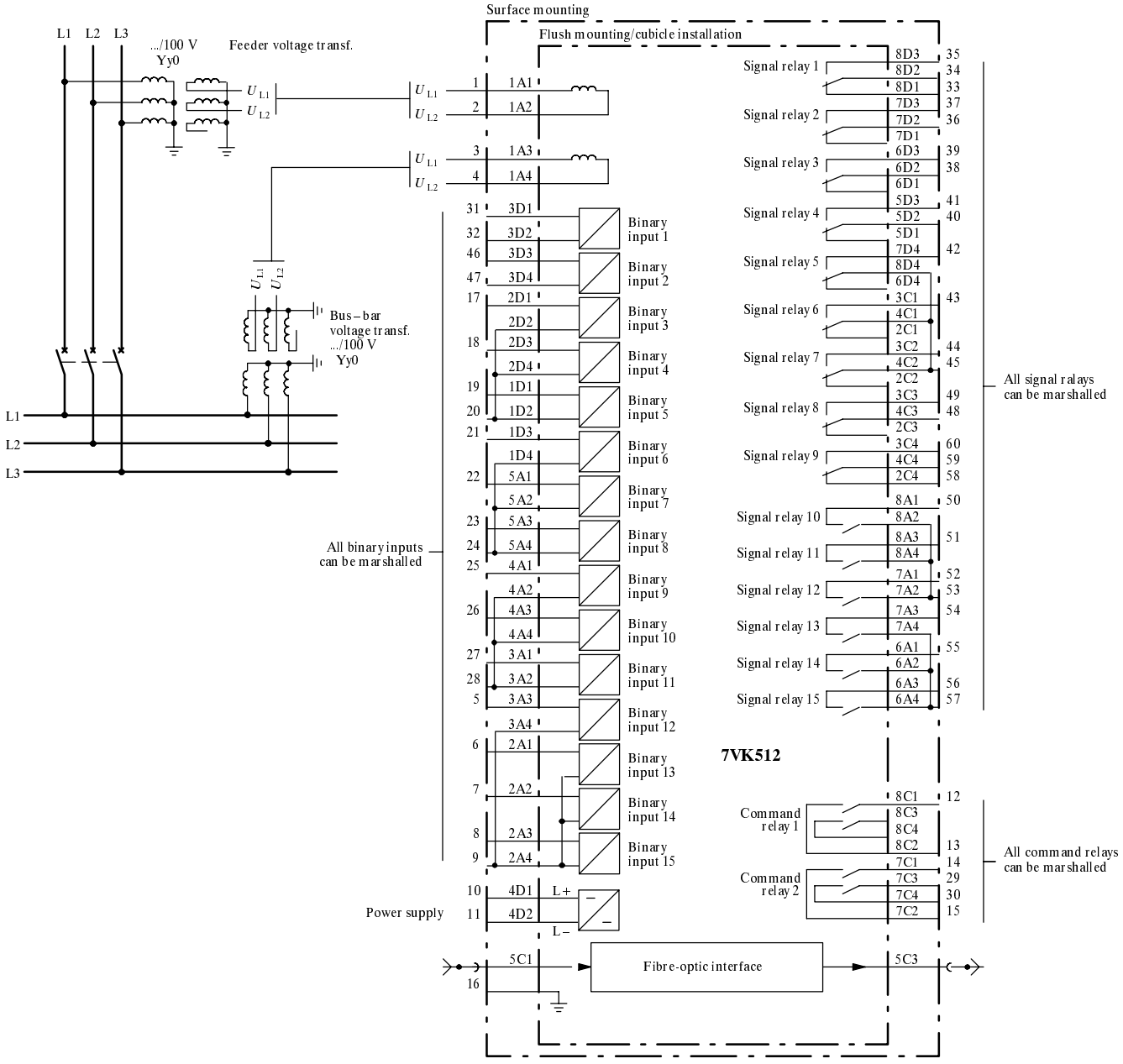


Figure B.1 Connection diagram (example) 7VK512

C Tables

NOTE: The following tables list all data which are available in the maximum complement of the device. Dependent on the ordered model, only those data may be present which are valid for the individual version.

NOTE: The actual tables are attached to the purchased relay.

Table of All Binary Inputs 7VK512

R - Function can be marshalled to binary input (BI)

FNo	Abbreviation	Meaning	BI
1	not allocated	no input fuction allocated	R
5	>Time Synchro	synchronize internal real time clock	R
6	>LED reset	reset LED indicators	R
7	>Start FltRec	start Fault Recording	R
11	>Manual Close	manual close of circuit breaker	R
14	>U1 VT MCB	VT m.c.b. line side tripped	R
15	>U2 VT MCB	VT m.c.b. bus-bar side tripped	R
16	>CB Aux. L1	circuit breaker aux. contact phase L1	R
17	>CB Aux. L2	circuit breaker aux. contact phase L2	R
18	>CB Aux. L3	circuit breaker aux. contact phase L3	R
19	>CB Aux. 3p C	CB aux. contact all poles closed	R
20	>CB Aux. 1p C	CB aux. contact any pole closed	R
21	>Annunc. 1	user defined annunciation 1	R
22	>Annunc. 2	user defined annunciation 2	R
23	>Annunc. 3	user defined annunciation 3	R
24	>Annunc. 4	user defined annunciation 4	R
30	>Sync. Start	unitate synchro-check from external	R
31	>Sync. Block	block Synchro-check from external	R
32	>Sync. synch	synchro-check prog: check synchronism	R
33	>Sync. U1>U2<	synchro-check prog: live line dead bus	R
34	>Sync. U1<U2>	synchro-check prog: dead bus live line	R
35	>Sync. U1<U2<	synchro-check prog: dead line dead bus	R
36	>Sync. o/ride	synchro-check prog: override (bypass)	R
49	>Flt.Rec. on	switch on fault Recording function	R
50	>Flt.Rec. off	switch off fault Recording function	R
51	>SyncChck on	switch on synchro-check function	R
52	>SyncChck off	switch off synchro-check function	R
57	>AR on	switch on auto-reclose function	R
58	>AR off	switch off auto-reclose function	R
59	>ParamSelec.1	parameter set selection 1 (with No.60)	R
60	>ParamSelec.2	parameter set selection 2 (with No.59)	R

FNo	Abbreviation	Meaning	BI
80	>Start AR	external start internal auto-reclose	R
81	>Trip L1 AR	trip L1 for auto-reclose initiate	R
82	>Trip L2 AR	trip L2 for auto-reclose initiate	R
83	>Trip L3 AR	trip L3 for auto-reclose initiate	R
86	>1p RAR Block	block 1pole rapid auto-reclose (RAR)	R
88	>3p RAR Block	block 3p rapid auto-reclose (RAR)	R
89	>RAR Block	block rapid auto-reclose (RAR)	R
90	>AR Block	block all auto-reclose from external	R
91	>DAR Block	block delayed auto-reclose (DAR)	R
92	>CB Ready	circuit breaker ready for reclosing	R
93	>DAR aft. RAR	delayed auto-reclose only after RAR	R
94	>Sync.Release	synchronism from ext. synchro-check	R
95	>CloseCmd.Blo	block all close commands from externa	R
96	>Trip 1p AR	1pole trip for auto-reclose initiate	R
97	>Trip 3p AR	3pole trip for auto-reclose initiate	R
98	>AR Reset	reset auto-reclose lockout	R

Table of All Binary Outputs 7VK512

Rel,LED - to output relay or LED
OP, PC - to operator panel or PC
LSA - to localized substation autom.

R - Annunc. marshallable
K - Annunciated "Coming"
K/G - "Coming" and "Going"

FNo	Abbreviation	Meaning	Rel LED	OP PC	LSA
1	not allocated	no annunciation function allocated	R		
5	>Time Synchro	synchronize internal real time clock	R		
6	>LED reset	reset stored LED indicators	R		
7	>Start FltRec	start fault recording	R		
11	>Manual Close	manual close of circuit breaker	R	K/G	
14	>U1 VT MCB	VT secondary m.c.b. line side tripped	R	K/G	K/G
15	>U2 VT MCB	VT second. m.c.b. bus-bar side tripped	R	K/G	K/G
16	>CB Aux. L1	circuit breaker aux. contact phase L1	R	K/G	
17	>CB Aux. L2	circuit breaker aux. contact phase L2	R	K/G	
18	>CB Aux. L3	circuit breaker aux. contact phase L3	R	K/G	
19	>CB Aux. 3p C	CB aux. contact: all poles closed	R	K/G	
20	>CB Aux. 1p C	CB aux. contact: any pole closed	R	K/G	
21	>Annunc. 1	user defined annunciation 1	R	K/G	K/G
22	>Annunc. 2	user defined annunciation 2	R	K/G	K/G
23	>Annunc. 3	user defined annunciation 3	R	K/G	K/G
24	>Annunc. 4	user defined annunciation 4	R	K/G	K/G
30	>Sync. Start	initate synchro-check from external	R	K/G	K
31	>Sync. Block	block Synchro-check from external	R	K/G	K/G
32	>Sync. synch	synchro-check prog: check synchronism	R	K/G	K/G
33	>Sync. U1>U2<	synchro-check prog: live line dead bus	R	K/G	K/G
34	>Sync. U1<U2>	synchro-check prog: dead line live bus	R	K/G	K/G
35	>Sync. U1<U2<	synchro-check prog: dead line dead bus	R	K/G	K/G
36	>Sync. o/ride	synchro-check prog: override (bypass)	R	K/G	K/G
49	>Flt.Rec. on	switch on fault recording function	R		
50	>Flt.Rec. off	switch off fault recording function	R		
51	>SyncChck on	switch on synchro-check function	R		
52	>SyncChck off	switch off synchro-check function	R		
57	>AR on	switch on auto-reclose function	R		
58	>AR off	switch off auto-reclose function	R		
59	>ParamSelec.1	parameter set selection 1 (with No.60)	R		
60	>ParamSelec.2	parameter set selection 2 (with No.59)	R		

FNo	Abbreviation	Meaning	Rel LED	OP PC	LSA
80	>Start AR	external start internal auto-reclose	R	K/G	K/G
81	>Trip L1 AR	trip L1 for auto-reclose initiate	R	K/G	K/G
82	>Trip L2 AR	trip L2 for auto-reclose initiate	R	K/G	K/G
83	>Trip L3 AR	trip L3 for auto-reclose initiate	R	K/G	K/G
86	>1p RAR Block	block 1pole rapid auto-reclose (RAR)	R	K/G	K/G
88	>3p RAR Block	block 3p rapid auto-reclose (RAR)	R	K/G	K/G
89	>RAR Block	block rapid auto-reclose (RAR)	R	K/G	K/G
90	>AR Block	block all auto-reclose from external	R	K/G	K/G
91	>DAR Block	block delayed auto-reclose (DAR)	R	K/G	K/G
92	>CB Ready	circuit breaker ready for reclosing	R	K/G	K/G
93	>DAR aft. RAR	delayed auto-reclose only after RAR	R	K/G	K/G
94	>Sync.Release	synchronism from ext. synchro-check	R		K/G
95	>CloseCmd.Blo	block all close commands from externa	R	K/G	K/G
96	>Trip 1p AR	1pole trip for auto-reclose initiate	R	K/G	K/G
97	>Trip 3p AR	3pole trip for auto-reclose initiate	R	K/G	K/G
98	>AR Reset	reset auto-reclose lockout	R	K/G	
101	Dev.Operative	device operative / healthy	R		K/G
102	Re-start	re-start of processor system		K	K
103	Syst.Flt	fault in the power system		K	K/G
104	Fault	fault event		K	
106	LED reset	LED's Reset	R	K	K
107	Flt.Rec.Activ	fault record available or transmiited	R		
108	Flt.Rec. off	fault recording function switched off	R	K/G	
109	Rel.TimeResp.	relative time response to LSA			K
110	Param.Running	parameters are being set	R	K/G	K/G
111	Manual Close	circuit breaker manually closed(pulse)	R	K	K
112	Man.Close Cmd	manual close command to CB	R	K/G	K
116	Param. Set A	parameter set A is active	R	K/G	K
117	Param. Set B	parameter set B is active	R	K/G	K
118	Param. Set C	parameter set C is active	R	K/G	K
119	Param. Set D	parameter set D is active	R	K/G	K
121	Failure 18V	failure of internal 18VDC power supply	R	K/G	K/G
122	Failure 15V	failure of internal 15VDC power supply	R	K/G	K/G
123	Failure 5V	failure of internal 5VDC power supply	R	K/G	K/G
124	Failure 0V	failure of internal 0VDC power supply	R	K/G	K/G
125	Failure RKA	command relay supervision alarm	R	K/G	K/G

FNo	Abbreviation	Meaning	Rel LED	OP PC	LSA
131	Annunc. Lost	annunciations lost (buffer overfow)		K	
132	Flt.Bff.Ovr	fault annunciation buffer overflow		K	
134	Annu.LSA Lost	annunciations for LSA lost		K	K
135					
136	Oper.Ann.Inva	operational annunciations invalid		K	
137	Flt.Ann.Inval	fault annunciations invalid		K	
139	Stat.Buff.Inv	statistic annunciation buffer invalid		K/G	
140	LED Buff.Inva	LED annunciation buffer invalid		K/G	
161	Chs Error	error in check sum		K/G	
162	Chs.1 Error	error in check sum for parameter set A		K/G	
163	Chs.2 Error	error in check sum for parameter set B		K/G	
164	Chs.3 Error	error in check sum for parameter set C		K/G	
165	Chs.4 Error	error in check sum for parameter set D		K/G	
221	Device FltDet	general fault detection	R		
251	Device Trip	general trip	R		
801	AR Off	auto-reclose is switched off	R	K/G	K/G
802	AR Blocked	auto-reclose is blocked/not operative	R	K/G	
803	AR not ready	auto-reclose is not ready	R	K/G	K/G
804	AR T-CB Exp.	AR :CB supervision time expired	R	K	K
805	CB not ready	AR :circuit breaker not ready	R	K/G	K/G
806	AR Block.Dyn.	auto-reclose is dynamically blocked	R	K	K
807	AR in prog.	auto-reclose in progress	R		
808	RAR T-Act.run	rapid auto-reclose (RAR) action runn'g	R	K	K
809	RAR T-1p run.	single-pole dead time is running	R	K	K
810	AR T-Recl.run	reclaim time is running	R	K	K
811	RAR T-3p run.	three-pole RAR dead time running	R	K	K
812	EV.Flt.Recog.	evolving fault recognized	R	K	K
813	AR Successful	auto-reclose cycle has been successful	R	K	K
814	Definit.Trip	definitive trip	R	K	K
815	CB Alarm Supp	circuit breaker alarm suppressed	R	K	K
816	AR Close Cmd.	close command from auto-reclose	R	K	K
817	RAR 1p Close	close comm. after 1-pole reclose cycle	R		
818	RAR 3p Close	close comm. after 3p RAR reclose cycle	R		
819	DAR 3p Close	close comm. after 3p DAR reclose cycle	R		
820	1p Trip Perm.	1-pole tripping allowed	R	K/G	K/G
821	RAR 1p Prog.	RAR programmed 1-pole only	R		
822	RAR 3p Prog.	RAR programmed 3-pole only	R		

FNo	Abbreviation	Meaning	Rel LED	OP PC	LSA
823	RAR Zone Rel.	zone extension for rapid reclosing	R	K/G	K/G
824	DAR Zone Rel.	zone extension for delayed reclosing	R	K/G	K/G
825	Sync.Meas.St.	start-to-measure signal for sync-check	R	K	K
826	RAR Only	only rapid auto-reclosing allowed	R		
827	DAR Only	only delayed auto-reclosing allowed	R		
828	DAR T-ACT.run	DAR action time is running	R	K	K
829	DAR T-3p1 run	DAR 3-pole dead time 1 is running	R	K	K
830	DAR T-3p2 run	DAR 3-pole dead time 2 is running	R	K	K
831	DAR T-3p3 run	DAR 3-pole dead time 3 is running	R	K	K
832	AR 1p in prog	1-pole auto-reclose initiate		K	K
833	AR 3p in prog	3-pole auto-reclose initiate		K	K
840	Sync. off	synchro-check function is switched off	R	K/G	K/G
841	Sync. running	synchro-check function is running	R	K	K
842	Sync. faulty	synchro-check function faulty	R	K	K
843	Sync.Tsup.Exp	synchro-check supervision time expired	R	K	K
844	Sync.Override	synchro-check programmed override	R	K/G	K/G
845	Sync. Synchro	synchro-check synchronism fulfilled	R	K/G	K/G
846	Sync. U1>U2<	syn-check live line dead bus fulfilled	R	K/G	K/G
847	Sync. U1<U2>	syn-check dead line live bus fulfilled	R	K/G	K/G
848	Sync. U1<U2<	syn-check dead line dead bus fulfilled	R	K/G	K/G
849	Sync. Blocked	synchro-check function is blocked	R	K/G	K/G
850	Sync. Release	synchronism release (to ext. recloser)	R	K	K
851	Sync.CloseCmd	close command from synchro-check funct	R	K	K
860	Sync.Del. U>	synchro-check delta U exceeded	R	K/G	K/G
861	Sync.Del. f>	synchro-check delta f exceeded	R	K/G	K/G
862	Sync.Del.PHI>	synchro-check delta PHI exceeded	R	K/G	K/G
900	Dev. Drop-off	general drop-off of the device (reset)		K	K

Reference Table for Configuration Parameters 7VK512

6000 MARSHALLING

6100 MARSHALLING BINARY INPUTS		6200 MARSHALLING SIGNAL RELAYS	
6101 INPUT 1	_____	6201 RELAY 1	_____
6102 INPUT 2	_____	6202 RELAY 2	_____
6103 INPUT 3	_____	6203 RELAY 3	_____
6104 INPUT 4	_____	6204 RELAY 4	_____
6105 INPUT 5	_____	6205 RELAY 5	_____
6106 INPUT 6	_____	6206 RELAY 6	_____
6107 INPUT 7	_____	6207 RELAY 7	_____
6108 INPUT 8	_____	6208 RELAY 8	_____
6109 INPUT 9	_____	6209 RELAY 9	_____
6110 INPUT 10	_____	6210 RELAY 10	_____
6111 INPUT 11	_____	6211 RELAY 11	_____
6112 INPUT 12	_____	6212 RELAY 12	_____
6113 INPUT 13	_____	6213 RELAY 13	_____
6114 INPUT 14	_____	6214 RELAY 14	_____
6115 INPUT 15	_____	6215 RELAY 15	_____

6300 MARSHALLING LED INDICATORS	
6301 LED 1	_____
6302 LED 2	_____
6303 LED 3	_____
6304 LED 4	_____
6305 LED 5	_____
6306 LED 6	_____

6400 MARSHALLING TRIP RELAYS

6401 TRIP REL. 1 _____

6402 TRIP REL. 2 _____

6900 LSA CONFIGURATION

6902 LSA BAUDR. _____

7000 OPERATING PARAMETERS

7001 LANGUAGE _____

7002 OPER.BAUDR. _____

7003 DATE FORMAT _____

7004 FAULT INDIC _____

7005 OPER. 1st L _____

7006 OPER. 2nd L _____

7007 FAULT 1st L _____

7008 FAULT 2nd L _____

7009 DEVIDE ADD. _____

7010 FEEDER ADD. _____

7800 SCOPE OF FUNCTIONS

7828 FAULT RECRD _____

7834 INTERNAL AR _____

7835 SYNCH.CHECK _____

7869 LSA _____

7885 PARAM.C/O _____

7899 FREQUENCY _____

Reference Table for Functional Parameters 7VK512

1000 PARAMETERS

1100 POWERSYSTEM DATA

1103 Un PRIMARY
min. 1 kV
max. 1200 ———

1104 Un SECOND.
min. 80 V
max. 125 ———

1132 U1-U2ANGLE
min. -179 °
max. 180 ———

1133 T CB CLOSE
min. 0.01 s
max. 0.50 ———

1135 T CLOSE
min. 0.01 s
max. 32.00 ———

2800 FAULT RECORDINGS

2801 FAULT REC.
ON [ ]
OFF [ ]

2802 INITIATION
BY FAULT DETEC. [ ]
BY TRIP <T-REC [ ]

2803 FAULT REC.
TO PC/PD [ ]
TO LSA [ ]

2804 T-REC
min. 0.01 s
max. 2.50 ———

3400 AUTO- RECLOSE FUNCTION

3401 AR FUNCT
ON [ ]
OFF [ ]

3403 MAN.CL.BL.
YES [ ]
NO [ ]

3405 T-RECLAIM
min. 0.50 s
max. 320.00 ———

3406 TBLOCK DYN
min. 0.50 s
max. 320.0/∞ ———

3407 TBLOCK M/C
min. 0.50 s
max. 320.00 ———

3412 CB? 1 TRIP
YES [ ]
NO [ ]

3413 CB? CLOSE
CB? NEVER [ ]
CB? WITH EACH AR [ ]
CB? WITH 2nd AR [ ]

3415 T-CB-SUPV
min. 0.01 s
max. 320.00 ———

3419 SYN.CHK.PR
ONLY ARTER DAR [ ]
AFTER 3POLE AR [ ]
AFTER 2nd DAR [ ]
NEVER [ ]

3422 RAR PROGR.
THREE-POLE [ ]
SINGLE-POLE [ ]
SINGLE/THREE-POL [ ]

3424 RAR T-ACT
min. 0.01 s
max. 320.0/∞ ———

```
3425 RAR T-3POL
     min. 0.01            s
     max. 320.00   _______

3426 RAR T-1POL
     min. 0.01            s
     max. 320.00   _______

3428 EV.F.RECOG
     BY TRIP COMMAND  [ ]
     BY FAULT DETEC.  [ ]

3429 EV.F.BLOCK
     ALWAYS           [ ]
     NEVER            [ ]
     >T-DISCR.        [ ]

3430 T-DISCR.
     min. 0.01            s
     max. 320.00   _______

3442 DAR PROGR.
     NO DAR           [ ]
     DAR WITHOUT RAR  [ ]
     DAR AFTER RAR    [ ]

3443 DAR No.1PH
     min. 0
     max. 9        _______

3444 DAR No.3PH
     min. 0
     max. 9        _______

3445 DAR T-ACT.
     min. 0.01            s
     max. 320.0/∞  _______

3446 DAR T3POL1
     min. 0.01            s
     max. 1800.00  _______

3447 DAR T3POL2
     min. 0.01            s
     max. 1800.00  _______

3448 DAR T3POL3
     min. 0.01            s
     max. 1800.00  _______
```

```
3500 CHECK SYNCHRONISM

3501 SYNC-CHECK
     ON               [ ]
     OFF              [ ]

3502 U<
     min. 1               V
     max. 60       _______

3503 U>
     min. 20              V
     max. 125      _______

3505 DELTA U<
     min. 1               V
     max. 50       _______

3506 DELTA f<
     min. 0.03            Hz
     max. 1.00     _______

3507 DELTA PHI<
     min. 1               °
     max. 60       _______

3508 DEL.f<SYNC
     min. 0.03            Hz
     max. 0.10/∞   _______

3515 SYNCHR.
     YES              [ ]
     NO               [ ]

3516 U1>U2<
     NO               [ ]
     YES              [ ]

3517 U1<U2>
     NO               [ ]
     YES              [ ]

3518 U1<U2<
     NO               [ ]
     YES              [ ]

3519 OVERRIDE
     NO               [ ]
     YES              [ ]

3521 SYN.MAN.CL
     ON               [ ]
     OFF              [ ]

3522 M/C-Df<SYN
     min. 0.03            Hz
     max. 0.10/∞   _______
```

```
3525 M/C-SYNCHR
     YES                [ ]
     NO                 [ ]

3526 M/C-U1>U2<
     NO                 [ ]
     YES                [ ]

3527 M/C-U1<U2>
     NO                 [ ]
     YES                [ ]

3528 M/C-U1<U2<
     NO                 [ ]
     YES                [ ]

3529 M/C-O/RIDE
     NO                 [ ]
     YES                [ ]

3530 T-SYN.SUPV
     min. 0.01                s
     max. 320.00   ──────
```

Operational Control Facilities 7VK512

```
8000 DEVICE CONTROL

8100 SETTING REAL TIME CLOCK
8101 DATE/TIME
8102 DATE
8103 TIME
8104 DIFF. TIME

8200 RESET
8201 RESET        LED ?
8202 RESET        COUNTERS ?
8203 RESET        TOTAL Isc ?
8204 RESET        OPERAT.ANNUNC. ?
8205 RESET        FAULT ANNUNC. ?

8500 PARAMETER CHANGE_OVER
8501 ACTIV PARAM
8503 ACTIVATION   SET A
                  SET B
                  SET C
                  SET D

8510 COPY ?       ORIG.SET->SET A
8511 COPY ?       ORIG.SET->SET B
8512 COPY ?       ORIG.SET->SET C
8513 COPY ?       ORIG.SET->SET D
8514 COPY ?       SET A ->  SET B
8515 COPY ?       SET A ->  SET C
8516 COPY ?       SET A ->  SET D
8517 COPY ?       SET B ->  SET A
8518 COPY ?       SET B ->  SET C
8519 COPY ?       SET B ->  SET D
8520 COPY ?       SET C ->  SET A
8521 COPY ?       SET C ->  SET B
8522 COPY ?       SET C ->  SET D
8523 COPY ?       SET D ->  SET A
8524 COPY ?       SET D ->  SET B
8525 COPY ?       SET D ->  SET C

     ON/OFF CONTROL

2801 FAULT REC.   ON
                  OFF

3401 AR FUNCT     ON
                  OFF

3501 SYNC-CHECK   ON
                  OFF
Attention! With SYNC-CHECK = OFF no closing checks!

3521 SYN.MAN.CL   ON
                  OFF
Note: When 3501 is switched off, 3521 is off, too!
```

To

SIEMENS AKTIENGESELLSCHAFT

Dept. EV S SUP 21

D – 13623 BERLIN

Germany

From

_____
Name

_____
Company/Dept.

_____
Address

_____
Telephone no.

_____

Dear reader,

printing errors can never be entirely eliminated: therefore, should you come across any when reading this manual, kindly enter them in this form together with any comments or suggestions for improvement that you may have.

Corrections/Suggestions

Subject to technical alteration

Siemens Aktiengesellschaft

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