SIEMENS

Numerical Circuit Breaker Failure Protection

SIPROTEC 7SV600 V3.0

Instruction Manual Order No: C53000–G1176–C123–1

Figure 1 Illustration of the numerical circuit breaker failure protection relay 7SV600 (in flush mounting case)

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CE

Indication of 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).

Further applicable standards: ANSI/IEEE C37.90, C37.90.1.

Matching the rated frequency

When the relay is delivered from factory, it is preset to operate with a rated frequency of 50 Hz. If the rated system frequency is 60 Hz, this must be matched accordingly. Switch-over to 60 Hz is explained in detail in the operation instructions in Section 6.3.3, first item. In the following, switch-over to 60 Hz is described in an abbreviated form.

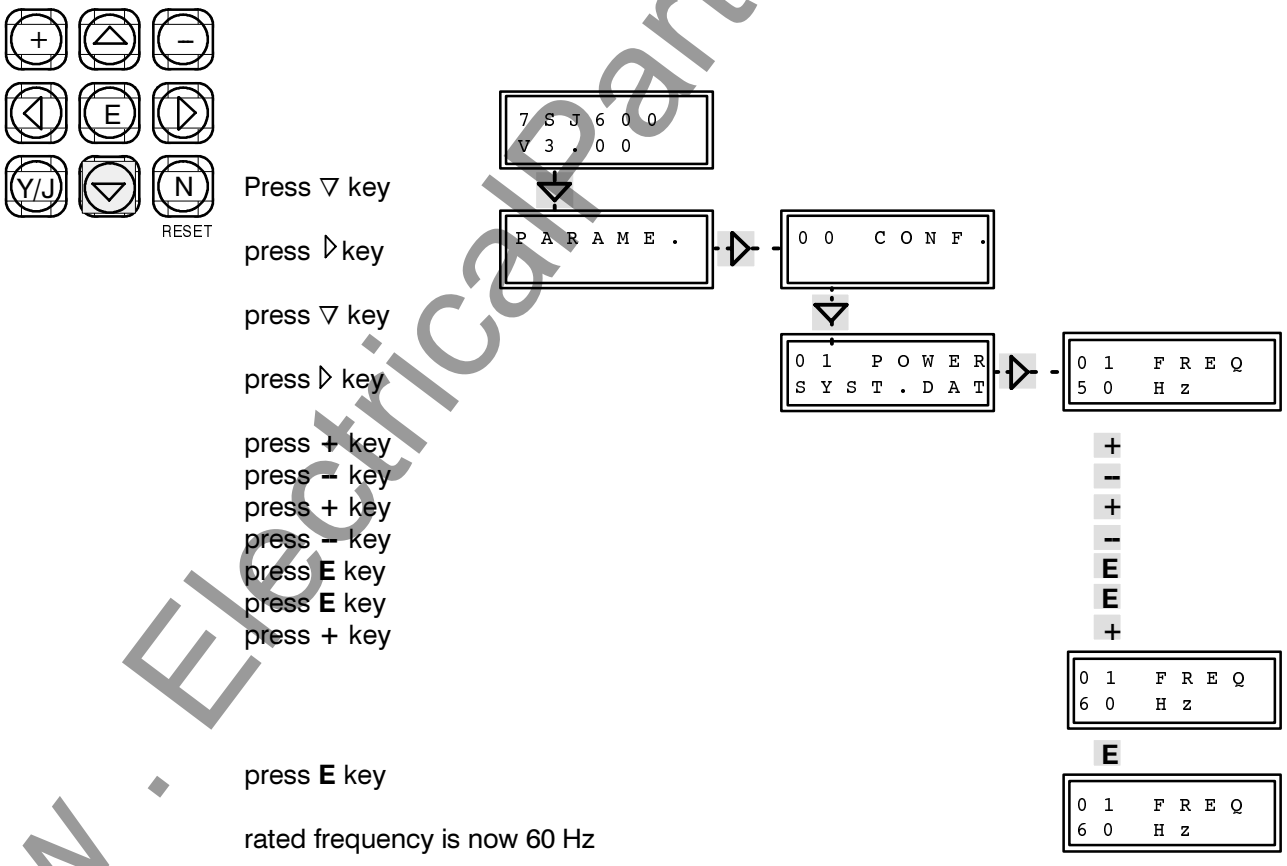
The operating interface is built up by a hierarchically structured menu tree, which can be passed through by means of the scrolling keys ◁ , ▷ , △ , and ▽. Thus, each operation object can be reached as illustrated in the example below for change-over of the rated frequency.

After the relay has been switched on, the green LED ("Service") illuminates and the red LED ("Blocked") lights up until the processor system has started up. The display shows the type identification of the relay ("7SV600") and the version of the implemented firmware.

Pressing the key ▽ leads to the main menu item "PARAME." (parameters). Switch over to the second operation level with key ▷ . The first address block is "00 CONF." (configuration). Key ▽ leads to the second address block "01 POWER SYST.DAT" (power system data). On the third operation level, which is obtained with ▷ , the first item is "01 FREQ" (frequency).

Press the following keys in sequence: ⊞ ⊟ ⊞ ⊟ **E E** ⊞ . The display shows the new rated frequency 60 Hz. Confirm again with **E**.

Press twice the key ◁ to return to the first operation level.



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 circuit breaker failure protection relay 7SV600 provides rapid back-up fault clearance instruction to the associated circuit breakers in case the circuit breaker nearest to the fault fails to respond.

It is suitable for power systems of all voltage ranges. The initiation signal can be derived from any protection or supervision equipment or, in case of manual opening, from the discrepancy control switch of the breaker. Information from the circuit breaker auxiliary contact is required for the breaker failure protection to function during faults which produce little or no current flow (possible only for common-phase initiation).

The breaker failure protection can operate single-stage or two-stage. When used as single-stage protection, the bus trip command is given to the adjacent circuit breakers if the protected feeder breaker fails. When used as two-stage protection, the first stage can be used to repeat the trip command to the relevant breaker, normally on a different trip coil, if the initial trip command from the feeder protection is not executed. The second stage will result in a bus trip to the adjacent breakers, if the command of the first stage is not successful.

The bus trip command from the breaker failure protection can be routed to all circuit breakers linked to the same bus-bar (section) as the breaker that failed. It can also be transmitted to the remote end by means of a suitable communication link (e.g. PLC, radio wave, or optical fibre). The distribution logic which is necessary in case of multiple bus-bar sections is not part of 7SV600 relay.

The current level is monitored in each of the three phases against a set threshold. In addition, the zero sequence component or the negative sequence component of the phase currents is monitored, derived by symmetrical component analysis. This ensures high security against malfunction by use of a 2-out-of-4 check of the current detectors.

The version with phase segregated current monitoring enables reliable breaker failure detection even during single-pole auto-reclose cycles provided the phase segregated trip signals of the feeder protection are connected to 7SV600.

If the protected circuit breaker is not operative (e.g. air pressure failure or spring not charged), instantaneous bus trip of the adjacent circuit breakers can be achieved following a feeder protection trip provided the relay is informed by an external breaker monitor (possible only for common-phase initiation).

An end fault protection function is integrated in the 7SV600 relay. An end fault is a short-circuit located between the circuit breaker and the current transformer set of the feeder. For this fault current flow is detected although the auxiliary contact of the breaker indicate open breaker poles. A command signal is generated which can be transmitted to the remote end breaker (possible only for common-phase initiation).

Special measures are taken to prevent malfunction of the relay. Besides the mentioned 2-out-of-4 check of the current detection elements the trip signals of the feeder protection can be connected in redundant manner, dependent on the ordered model, so that they can be checked for plausibility (possible only for common-phase initiation). Continuous monitoring of the measured values permits rapid annunciation of any fault in the measuring transformer circuits. Continuous plausibility 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.

Throughout a fault in the network the magnitudes of the instantaneous values are stored for a period of max. 5 seconds and are available for subsequent fault analysis. In order to achieve this, the relay is equipped with a serial RS485 interface. Thus, comfortable and clear evaluation of the fault history including fault recording is possible as well as comfortable operation of the relay, by means of a personal computer with appropriate programs. This interface is suited to communication via a modem link.

1.2 Features

– Processor system with powerful 16-bit-microcontroller;

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

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

– highly sensitive current detection;

– independent current detectors for monitoring of current flow through each individual circuit breaker pole;

– 2-out-of-4 check of the current detectors;

– short reset time, negligible overshoot time;

– single-stage or two-stage delay;

– can be controlled from circuit breaker auxiliary contacts, dependent an the ordered version;

– can be initiated by pole-segregated or common-phase trip commands, dependent an the ordered version;

– instantaneous trip possible in case of defective circuit breaker, dependent an the ordered version;

– transmission of trip command to the remote end possible;

– integrated end fault protection for intertrip, dependent an the ordered version;

– 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;

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

2 Design

2.1 Arrangements

All protection functions including dc/dc converter are accommodated on a printed circuit board of Double Europa Format. This p.c.b. forms, complemented by a guide plate, a multi-pin connector module and a front unit, a plug-in module which is installed in a housing 7XP20.

The guide plate cams in conjunction with distance pieces on the p.c.b. and the shaping of the connector modules ensure proper mounting and fixing of the module. The inner part of the housing is free from enamel and thus functions as a large contact plane and shield with solid electrical conductivity and mates with the earthing blades of the module. Connection to earth is made before the plugs make contact. An earthing area has been provided at the housing to which grounding strips can be connected in order to ensure solid low-impedance earthing.

The heavy duty current plug connectors provide automatic shorting of the c.t. circuits whenever the module is withdrawn. This does not release from the care to be taken when c.t. secondary circuits are concerned.

The degree of protection for the housing is IP51, for the terminals IP21.

Three different types of housings can be delivered:

– **7SV600⋆–⋆B⋆⋆⋆–** in housing 7XP20 with terminals at both sides for **panel surface mounting**

  The housing is built of a metal tube and carries a terminal block with four holes for fixing the relay to the panel.

  All external signals are connected to the terminal block which is mounted without screws at the rear of the housing. For each electrical connection, one screwed terminal for the use of up to two ring cable lugs is provided. Alternatively, up to two solid bare wires (even with different diameter) can be connected directly. Use copper conductors only!

  For dimensions please refer to Figure 2.1.

– **7SV600⋆–⋆D⋆⋆⋆–** in housing 7XP20 with terminal top and bottom for **panel surface mounting**

  The housing is built of a metal tube and carries fixing angles for mounting on the panel.

  All external signals are connected to 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. Use copper conductors only!

  For dimensions please refer to Figure 2.2.

– **7SV600⋆–⋆E⋆⋆⋆–** in housing 7XP20 for **panel flush mounting** or **cubicle installation**

  The housing is built of a metal tube and carries fixing angles for mounting into the panel cut-out or into the cubicle rack.

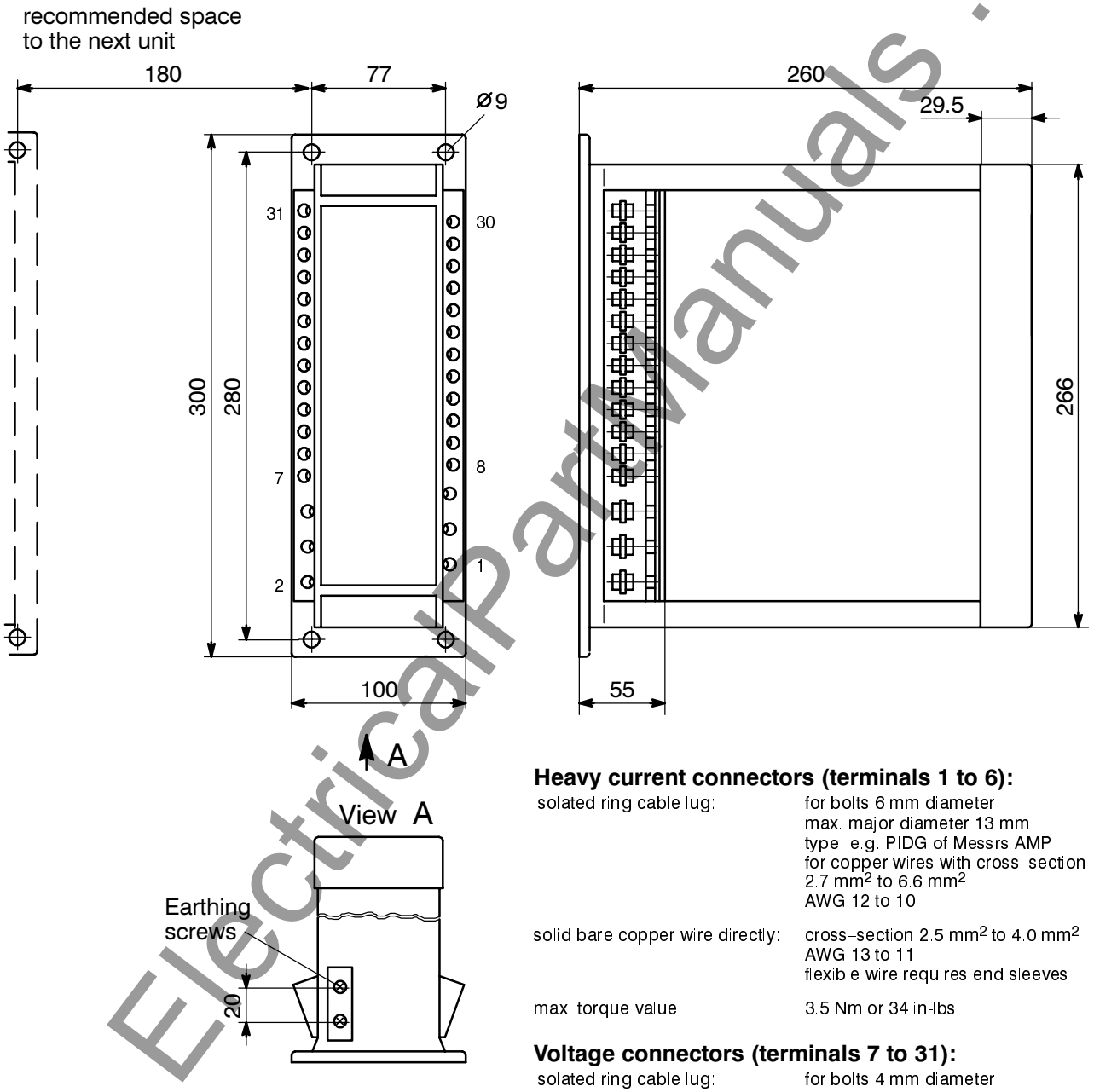
  All external signals are connected to a connector block which is mounted without screws at the rear of the housing. For each electrical connection, one screwed terminal for the use of up to two ring cable lugs and one parallel snap-in terminal are provided. For field wiring, the use of the screwed terminals is recommended; snap-in connection requires special tools. Use copper conductors only!

  For dimensions please refer to Figure 2.3.

2.2 Dimensions

Figures 2.1 to 2.3 show the dimensions of the various types of housings available.

7SV600⋆–⋆B⋆⋆⋆ Housing for **panel surface mounting** 7XP20 with terminals at both sides



Heavy current connectors (terminals 1 to 6):

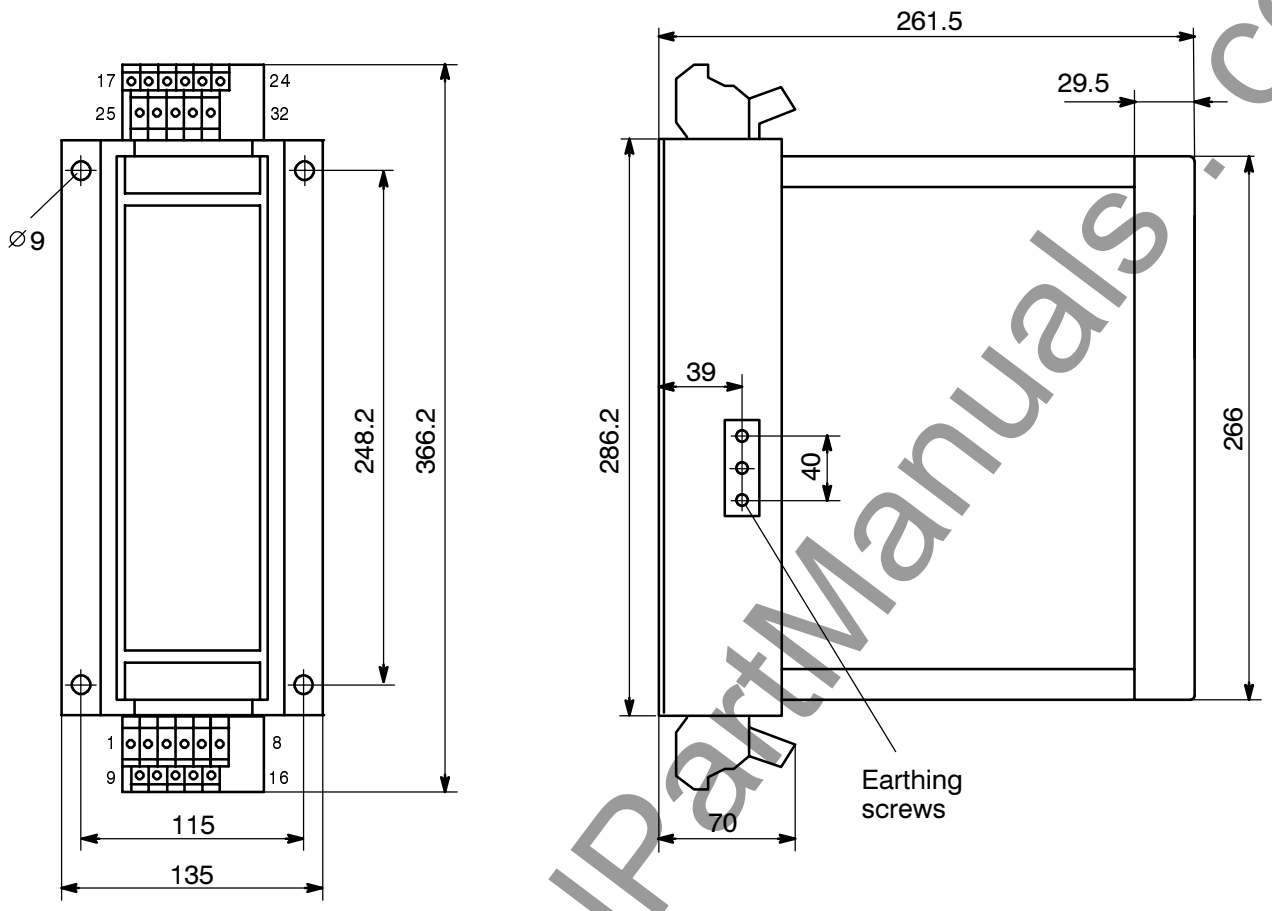
isolated ring cable lug:	for bolts 6 mm diameter max. major diameter 13 mm type: e.g. PIDG of Messrs AMP for copper wires with cross–section 2.7 mm² to 6.6 mm² AWG 12 to 10
solid bare copper wire directly:	cross–section 2.5 mm² to 4.0 mm² AWG 13 to 11 flexible wire requires end sleeves
max. torque value	3.5 Nm or 34 in-lbs

Voltage connectors (terminals 7 to 31):

isolated ring cable lug:	for bolts 4 mm diameter max. major diameter 9 mm type: e.g. PIDG of Messrs AMP for copper wires with cross–section 1.0 mm² to 2.6 mm² AWG 17 to 13
solid bare copper wire directly:	cross–section 0.5 mm² to 2.6 mm² AWG 20 to 13 flexible wire requires end sleeves
max. torque value	1.8 Nm or 16 in-lbs

Figure 2.1 Dimensions for housing 7XP20 for panel surface mounting with terminals at both sides

7SV600⋆–⋆D⋆⋆⋆ in housing for **panel surface mounting** 7XP20 with terminals top and bottom



Max. 32 terminals for copper wires with cross-section max. 5 mm^2 AWG 10

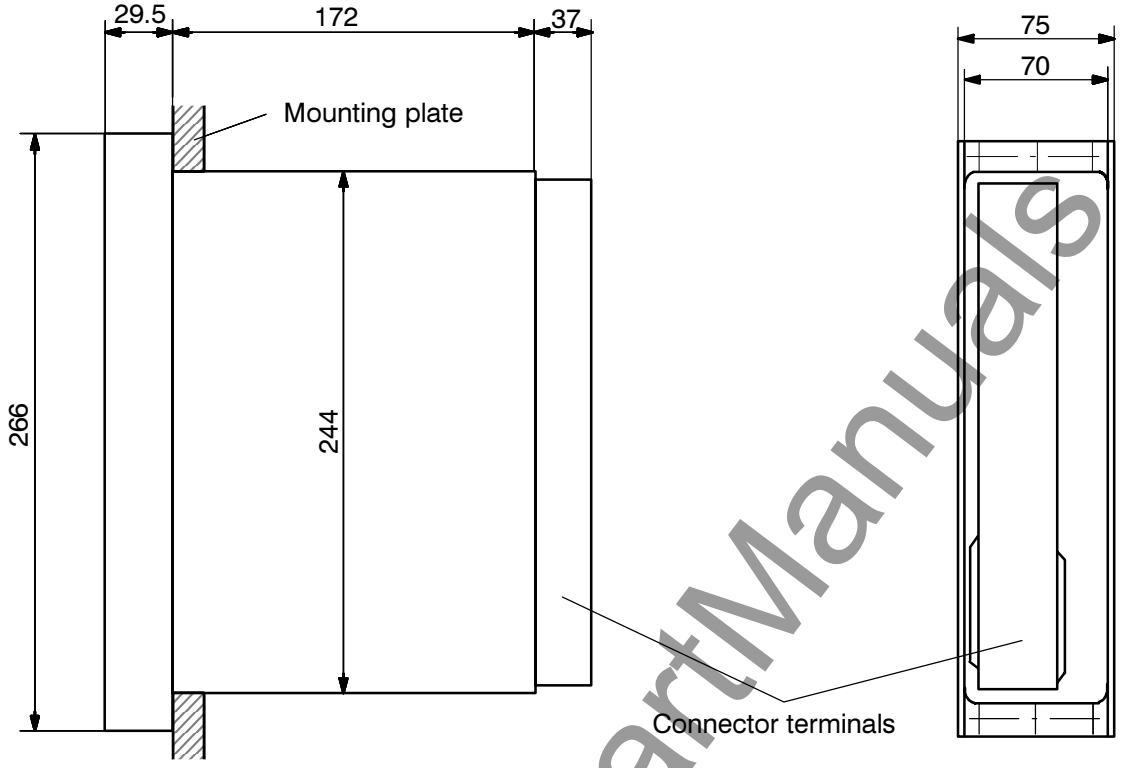
Max. torque value 1.7 Nm or 15 in-lbs

Installation on the panel shall be carried out with studs or screws size M6.
If the relay is to be mounted on (e.g. existing) bolts size M8, then slot nuts acc. DIN 546 shall be used.

Dimensions in mm

Figure 2.2 Dimensions for housing 7XP20 for panel surface mounting with terminals top and bottom

7SV600⋆–⋆E⋆⋆⋆ Housing for **panel flush mounting** or **cubicle installation** 7XP20



Heavy current connectors (terminals 1 to 6):

Screwed terminal (ring cable lug):	for bolts 6 mm diameter max. major diameter 13 mm type: e.g. PIDG of Messrs AMP for copper wires with cross–section 2.7 mm² to 6.6 mm² AWG 12 to 10
Snap-in terminal:	for copper wires with cross–section 2.5 mm² to 4.0 mm² AWG 13 to 11
max. torque value	3.5 Nm or 34 in-lbs

Voltage connectors (terminals 7 to 31):

isolated ring cable lug:	for bolts 4 mm diameter max. major diameter 9 mm type: e.g. PIDG of Messrs AMP for copper wires with cross–section 1.0 mm² to 2.6 mm² AWG 17 to 13
Snap-in terminal:	for copper wires with cross–section 0.5 mm² to 2.5 mm² AWG 20 to 13
max. torque value	1.8 Nm or 16 in-lbs

Dimensions in mm

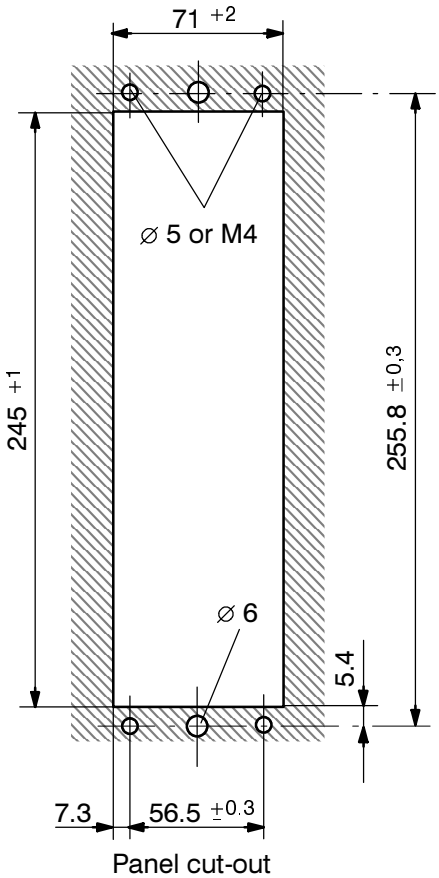
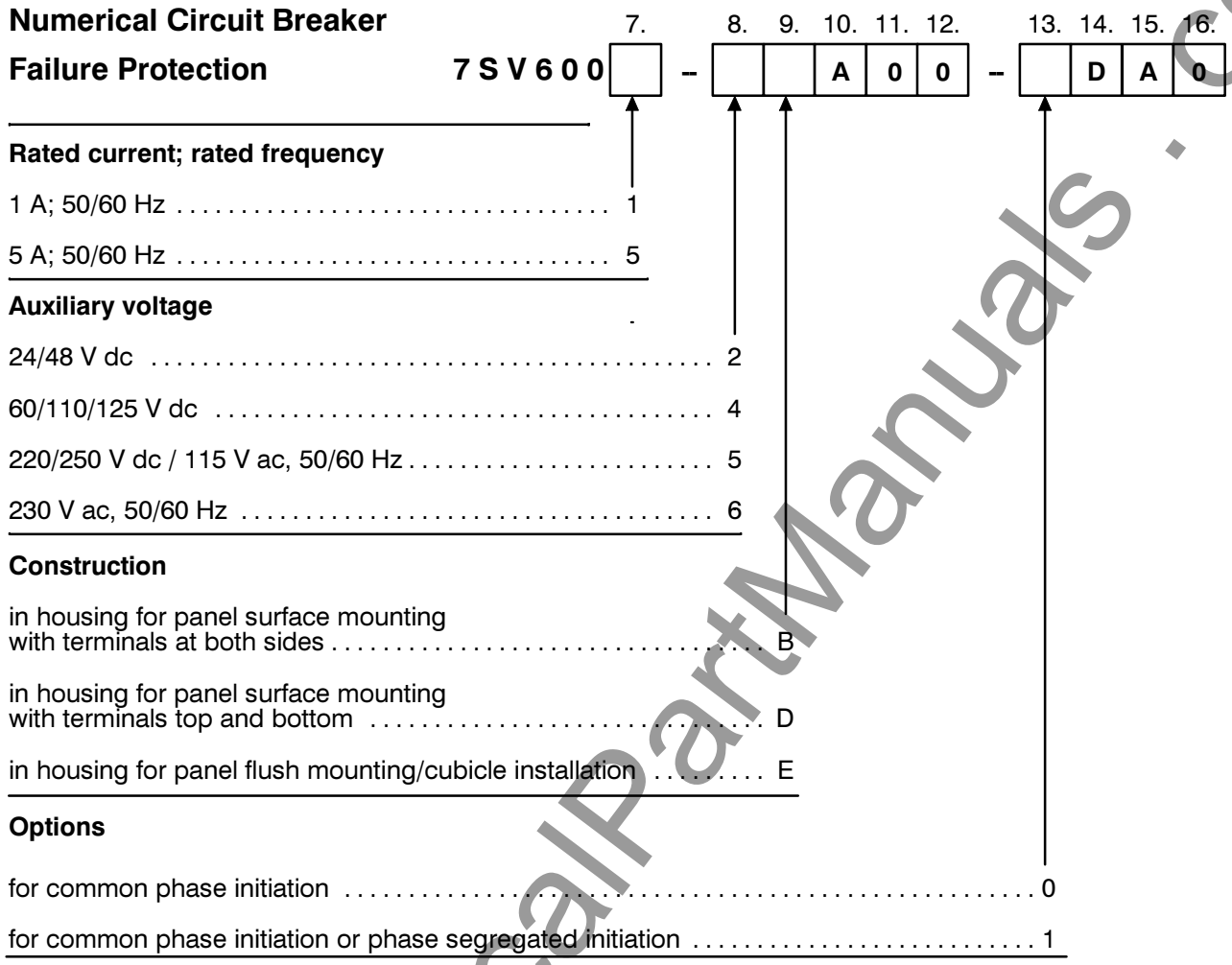


Figure 2.3 Dimensions for housing 7XP20 for panel flush mounting or cubicle installation

2.3 Ordering data



2.4 Accessories

A connecting cable of 1 m length is attached to the converter V.24–to–RS485. This is used to connect the terminals of the relay with the 25-pole socket at the converter which is designated with ”RS422”.

The copper connecting cable 7XV5100 is to connect the 25-pole connector at the converter which is designated with ”RS232”, with the personal computer or laptop.

A copper connecting cable, a converter V.24–to–RS485, and an operating program DIGSI are necessary for communication between the protection relay and a personal computer or laptop.

A fibre-optic converter is necessary when the relay is to be connected via an optical fibre cable to a central station.

Copper connecting cable
between PC (9pin socket) and converter/protective device **7XV5100–2**

Converter V.24 – RS485
with connecting cable 1 m, PC adapter with connector
for power supply 230 Vac, 50 Hz **7XV5700–0AA00**
for power supply 110 Vac, 60 Hz **7XV5700–1AA00**

Converter full-duplex fibre-optic cable – RS485
with connecting cable 1 m, with aux. supply 24–250 Vdc and 110/230 Vac **7XV5600–0AA00**

Operating software DIGSI Expansion level 1
Parameterization and operating software (English);
requirement: MS–WINDOWS V3.1 or higher **7XS5120–1AA0**

Graphic evaluation program DIGRA
for visualization of fault recordings, together with DIGSI (English);
requirement: MS–WINDOWS V3.1 or higher and DIGSI **7XS5130–1AA0**

3 Technical data

3.1 General data

3.1.1 Inputs/outputs

Measuring circuits

Rated current I_N		1 A or 5 A
Rated frequency f_N		50 Hz/60 Hz (selectable)
Power consumption	current path at I_N = 1 A	<0.1 VA
	current path at I_N = 5 A	<0.2 VA
Overload capability	current path	
– thermal (rms)		100 $\times I_N$ for $\leq$1 s 30 $\times I_N$ for $\leq$10 s 4 $\times I_N$ continuous
– dynamic (pulse current)		250 $\times I_N$ one half cycle

Auxiliary voltage

Power supply via integrated dc/dc converter

Rated auxiliary voltage U_H dc	24/48 Vdc	60/110/125 Vdc	220/250 Vdc
Permissible variations	19 to 58 Vdc	48 to 150 Vdc	176 to 300 Vdc

Superimposed ac voltage, peak-to-peak		$\leq$ 12 % at rated voltage $\leq$ 6 % at limits of admissible voltage
Power consumption	quiescent	approx. 2 W
	energized	approx. 4 W
Bridging time during failure/short-circuit of auxiliary voltage		$\geq$ 50 ms at $U_{rated} \geq$ 110 Vdc $\geq$ 20 ms at $U_{rated} \geq$ 24 Vdc

Rated auxiliary voltage U_H ac	115 Vac, 50/60 Hz	230 Vac, 50/60 Hz
Permissible variations	92 to 133 Vac	184 to 265 Vac

Heavy duty (command) contacts

Command (trip) relays, number		2 (can be marshalled)
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		2 (can be marshalled)
Contact per relays		1 CO
Switching capacity	MAKE	1000 W/VA
	BREAK	30 W/VA
Switching voltage		250 V
Permissible current		5 A
Binary inputs, number		3 (can be marshalled)
Rated operating voltage		24 to 250 Vdc
Current consumption		approx. 2.5 mA, independent of operating voltage
Pick-up threshold		reconnectable by solder bridges
– rated aux. voltage 24/48/60 Vdc	$U_{pick-up}$	$\geq$17 Vdc
	$U_{drop-off}$	< 8 Vdc
– rated aux. voltage 110/125/220/250 Vdc	$U_{pick-up}$	$\geq$ 74 Vdc
	$U_{drop-off}$	< 45 Vdc
Serial interface		isolated
– Standard		RS485
– Test voltage		2.8 kV d.c.
– Connection		data cable at housing terminals, two data wires, one frame reference, for connection of a personal computer or similar; core pairs with screening, screen must be earthed; communication possible via modem
– Transmission speed		as delivered 9600 Baud min. 1200 Baud; max. 19200 Baud

3.1.2 Electrical tests

Insulation tests	
Standards:	IEC 60255–5; ANSI/IEEE C37.90.0
– High voltage test (routine test) except d.c. voltage supply input and RS485	2 kV (rms); 50 Hz
– High voltage test (routine test) only d.c. voltage supply input and RS485	2.8 kV dc
– High voltage test (type test)	
between open contacts of trip relays	1.5 kV (rms), 50 Hz
between open contacts of alarm relays	1 kV (rms), 50 Hz
– 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

Further EMC tests; immunity (type tests)

− Oscillatory surge withstand capability ANSI/IEEE C37.90.1 (common mode)	2.5 kV to 3 kV (peak); 1 MHz to 1.5 MHz, decaying oscillation; 50 shots per s; duration 2 s; R_i = 150 Ω to 200 Ω
− Fast transient surge withstand capability ANSI/IEEE C37.90.1 (common mode)	4 kV to 5 kV; 10/150 ns; 50 shots per s; both polarities; duration 2 s; R_i = 80 Ω
− Radiated electromagnetic interference ANSI/IEEE C37.90.2	10 V/m to 20 V/m; 25 MHz to 1000 MHz; amplitude and pulse modulated
− High frequency test document 17C (SEC) 102	2.5 kV (peak, alternating polarity); 100 kHz, 1 MHz, 10 MHz and 50 MHz, decaying oscillation; R_i = 50 Ω

EMC tests; emission (type tests)

Standard:	EN 50081−$\star$ (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

− permissible temperature during service	−20 °C to +70 °C	(> 55 °C decreased display contrast)
− recommended temperature during service	−5 °C to +55 °C	
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.
- The screen of the RS485 cable must be earthed.
- 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	
– in housing for surface mounting	approx. 4.5 kg
– in housing for flush mounting	approx. 4.0 kg
Degree of protection acc. to EN 60529	
– Housing	IP 51
– Terminals	IP 21

3.2 Circuit breaker failure protection

Breaker supervision

Current detection setting range	0.05 I_N to 4.00 I_N (steps 0.01 I_N)
drop-off ratio	approx. 0.9
tolerance	0.01 · I_N or 5 % of set value

Initiation conditions

dependent on ordered version	phase segregated initiation (single-pole trip from feeder protection) or common-phase initiation (three-pole trip from feeder protection and common-phase initiation (three-pole trip from non-short-circuit protection)

Times

pick-up time	approx. 15 ms with measured quantities present approx. 25 ms after switch-on of meas. quantities
drop-off time with sinusoidal measured quantities	$\leq$ 10 ms
drop-off time maximum	$\leq$ 25 ms
delay times for all time stages	0.00 s to 32.00 s (steps 0.01 ms) or ∞
delay time tolerance	1 % of set value or 10 ms

The set times are pure delay times.

3.3 Ancillary functions

Operational value measurements

– operational current values	I_{L1}; I_{L2}; I_{L3}
measurement range	0 % to 240 % I_N
tolerance	3 % of rated value or of measured value

Steady-state measured value supervision

Current unbalance	I_{max}/I_{min} > symmetry factor as long as I > I_{limit}

Fault event data storage

storage of annunciations of the last eight faults with max. 30 messages each

Time assignment

resolution for operational annunciations	1 s
resolution for fault event annunciations	1 ms
max time deviation	0.01 %

Data storage for fault recording max. 8 fault events

total storage time (fault detection or trip command = 0 ms)
max. 5 s, selectable pre-trigger and post-fault time

max. storage period per fault event	T_{max}	0.30 to 5.00 s (steps 0.01 s)
pre-trigger time	T_{pre}	0.05 to 0.50 s (steps 0.01 s)
post-fault time	T_{post}	0.05 to 0.50 s (steps 0.01 s)

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 circuit breaker failure protection 7SV600 is equipped with a powerful and proven 16-bit microcontroller. This provides fully digital processing of all functions from data acquisition of the measured values to trip signal output to the circuit breakers.

Figure 4.1 shows the basic structure of the unit.

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

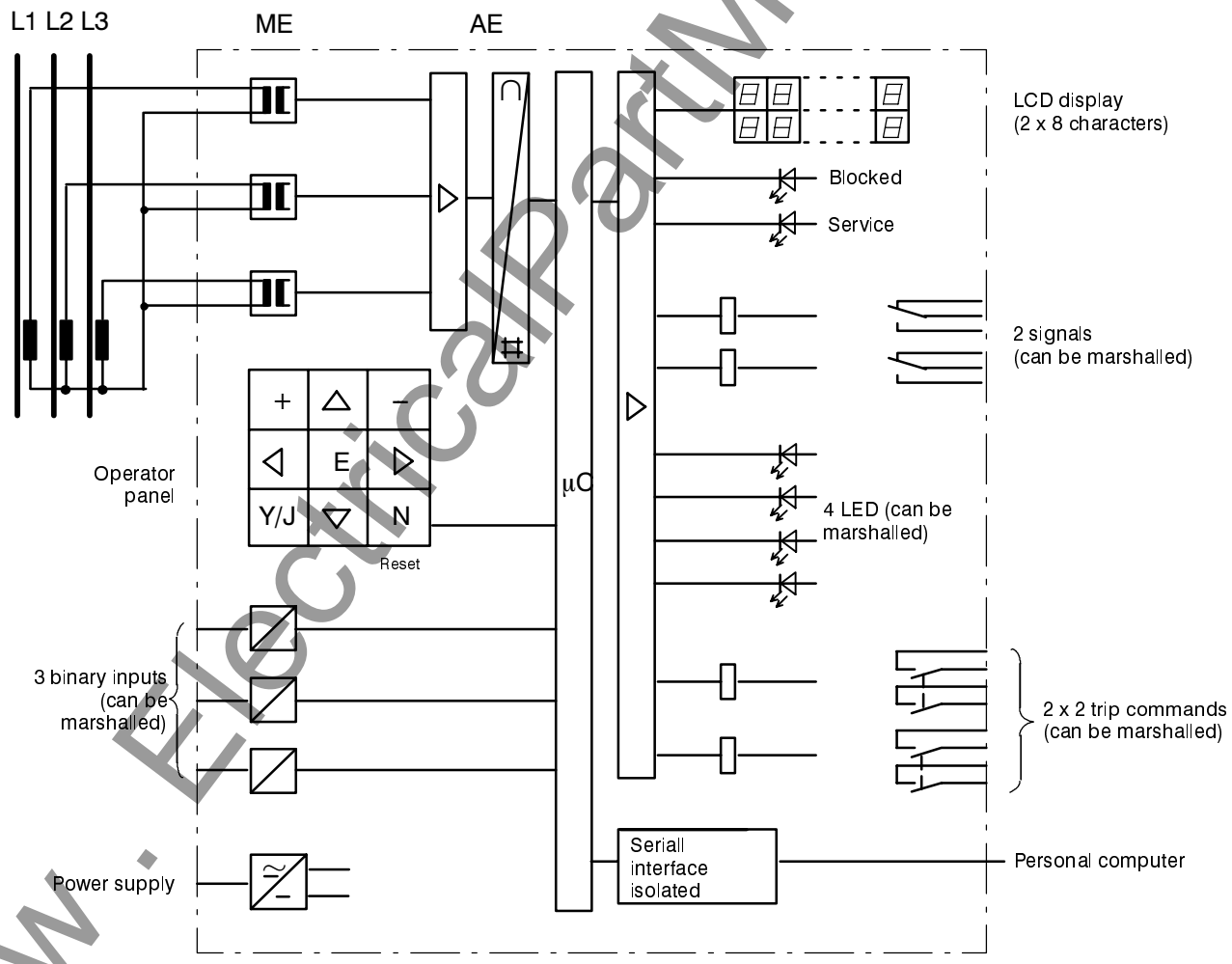


Figure 4.1 Hardware structure of the numerical circuit breaker failure protection relay 7SV600

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 microcontroller.

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

– filtering and formation of the measured quantities,

– continuous interrogation of the binary input which are used for initiation,

– continuous calculation of the currents,

– plausibility checks on the measured currents and the starting conditions,

– scanning of limit values and time sequences,

– decision on trip commands,

– Storage of instantaneous current and voltage values during a fault for analysis.

Binary inputs and outputs to and from the controller are channelled via the input/output elements. From these the controller receives information from the switch-gear (e.g. remote resetting) or from other equipment (e.g. blocking signals). Outputs include, in particular, trip commands to the circuit breakers, 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 protection 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 by means of personal computer.

A power supply unit provides the auxiliary supply to the described functional units with +5 V. Transient failures in the supply voltage which may occur during short-circuits in the dc supply system of the plant are bridged by a dc voltage storage element (refer to Technical data, Section 3.1.1).

4.2 Circuit breaker failure protection

4.2.1 General

The circuit breaker failure protection provides rapid back-up clearance of fault, in the event that the circuit breaker nearest to the fault fails to respond to a trip command from the feeder protection.

Whenever e.g. a short-circuit protection relay of a feeder issues a trip command to the breaker, this is repeated to the circuit breaker failure protection. A timer T–BF in the breaker failure protection is started. The timer runs as long as a tripping command is present and current continues to flow through the breaker poles (Figure 4.2).

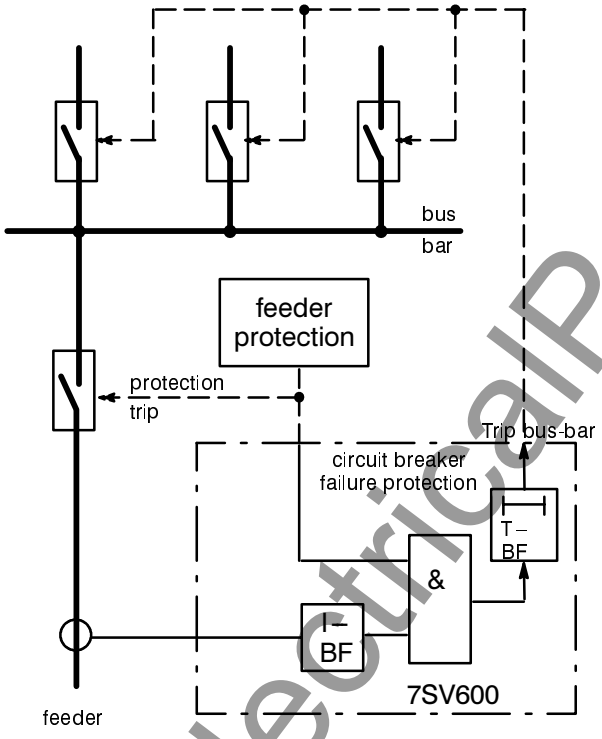


Figure 4.2 Simplified function diagram of circuit breaker failure protection

Normally, the breaker will open and interrupt the fault current. The current monitoring stage quickly resets (typical 10 ms) and stops the timer.

If the tripping command is not carried out (breaker failure case), current continues to flow and the timer runs to its set value. The breaker failure protection then issues a command to trip the back-up breakers and interrupt the fault current.

The reset time of the feeder protection is of no importance because the breaker failure protection itself recognizes the interruption of the current.

For protection relays for which the tripping criteria are not dependant on current (e.g. Buchholz protection), current flow is not a reliable criterion for proper operation of the breaker.

In the such cases, the circuit breaker position can be read from the auxiliary contacts of the breaker. Therefore, instead of monitoring the current, the condition of the auxiliary contacts is monitored. For that purpose, the outputs from the auxiliary contacts must be fed to binary inputs on the relay (refer also Section 4.2.3).

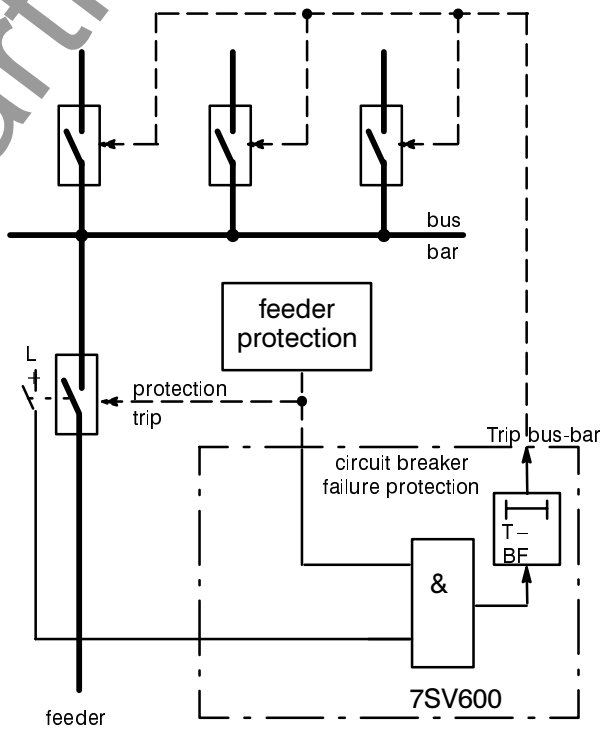


Figure 4.3 Simplified function diagram of circuit breaker failure protection controlled by circuit breaker auxiliary contact

In addition to this basic operation sequence, 7SV600 contains further possibilities which are described in detail in the following sections.

4.2.2 Current flow monitoring

Each of the phase currents are filtered by two-stage numerical filter algorithms so that only the fundamental frequency is used for further evaluation. The filters are designed such that the occurrence and the disappearance of a sinusoidal current is detected within less than a half a.c. cycle.

Particular features apply for recognition of the instant of interruption. With sinusoidal currents, current interruption is detected after approx. 5 to 10 ms. With aperiodic d.c. current components in the fault current and after interruption (e.g. with linear current transformers) or if the current transformers are saturated by the d.c. component in the fault current, it can take up to one a.c. cycle, with extreme conditions, before the disappearance of the primary current is reliably detected.

Besides the three phase currents, a fourth current threshold is provided in order to detect a plausibility current. This is either three times the zero sequence current $3I_0$ which is calculated from the sum of the three phase currents, or three times the calculated negative sequence current $3I_2$. The higher of these two current is used for plausibility current. The currents are calculated according to their definition equations:

$$3 \cdot \underline{I}_0 = \underline{I}_{L1} + \underline{I}_{L2} + \underline{I}_{L3} \quad \text{and}$$

$$3 \cdot \underline{I}_2 = \underline{I}_{L1} + \underline{a}^2 \cdot \underline{I}_{L2} + \underline{a} \cdot \underline{I}_{L3}$$

where

$$\underline{a} = e^{j120^\circ}$$

The plausibility current does not have any direct influence on the basic function of the breaker failure protection but it allows a 2-out-of-4 comparison to be made (refer Figure 4.4). This means that the current detection signal L⋆> associated with a phase current $I_{L\star}$ can only be generated when current is present in at least one of the other phases, or a plausibility current is detected.

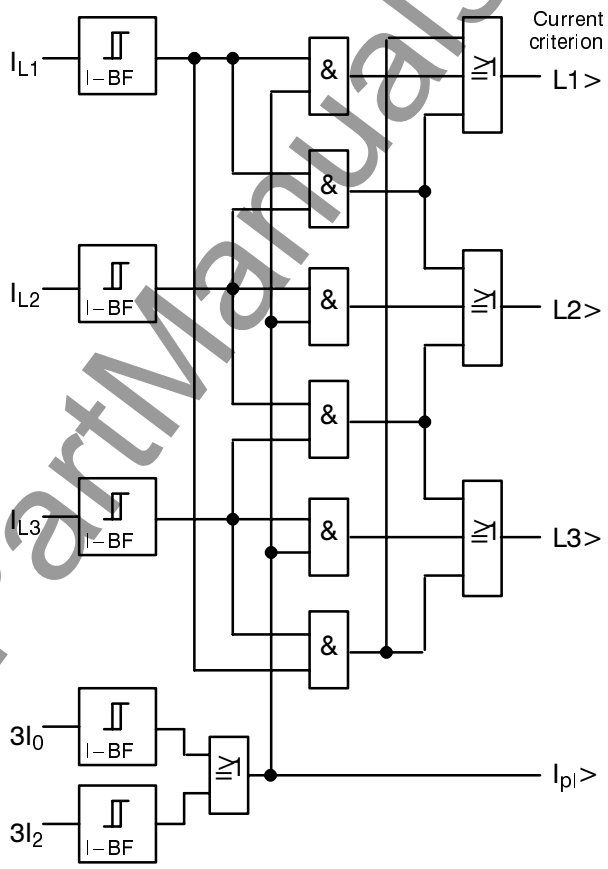


Figure 4.4 Current flow monitoring with 2-out-of-4 check

4.2.3 Processing of the circuit breaker auxiliary contacts

Current flow is not a reliable criterion for proper operation of the circuit breaker for faults which do not cause detectable current flow (e.g. Buchholz protection). Information about the position of the circuit breaker auxiliary contacts is required in these cases to check correct response of the circuit breaker.

Evaluation of the breaker auxiliary contacts is carried out in the breaker failure protection function only as long as the current flow monitoring has not picked up. Once the current flow criterion has been detected during trip signal of the protection, the circuit breaker is assumed to be open as soon as the current has disappeared, even when the associated auxiliary contact does not (yet) indicate that the circuit breaker has opened (Figure 4.5). This gives preference to the more reliable current criterion and avoids overfunctioning due to a defect e.g. in the auxiliary contact mechanism or circuit.

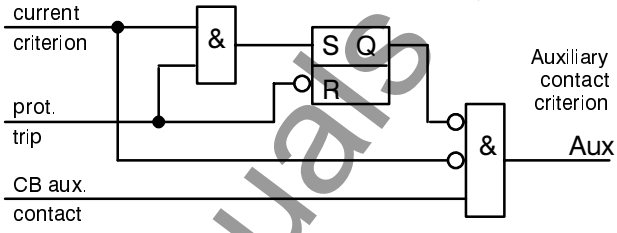


Figure 4.5 Interlock of the auxiliary contact criterion

4.2.4 Initiation conditions and delay times

4.2.4.1 Common phase initiation

Common phase initiation is used, for example, for lines without automatic reclosure (e.g. cables), for lines with only three-pole auto-reclosure (e.g. in overhead line systems without earthed neutral), for transformer feeders, or if the bus-bar protection trips.

For safety reasons, initiation can only be valid when at least two binary inputs are energized. To achieve this, the feeder protection must deliver at least the three-pole trip command at the input "`>Strt3p`" and an additional release signal (e.g. pick-up signal of the feeder protection) at the input "`>Releas`". If no release signal is available, the trip signal of the feeder protection should be repeated to this binary input. If a release signal is neither connected nor allocated to a binary input, it will not be processed in the protection; that means, initiation depends only on the input "`>Strt3p`".

The function scheme is shown in Figure 4.6. When the initiation conditions are fulfilled and at least one current flow criterion (according Figure 4.4) is present, the delay time T1 – 3P is started. After expiry of this time, the trip command "`Trip T1`" is issued.

If none of the current criteria is fulfilled, the breaker auxiliary contact can be interrogated according to Figure 4.5.

Initiation can be blocked via the binary input "`>BF blo`" (e.g. during test of the feeder protection relay). Additionally, an internal blocking possibility is provided (refer also Section 4.7.5.4).

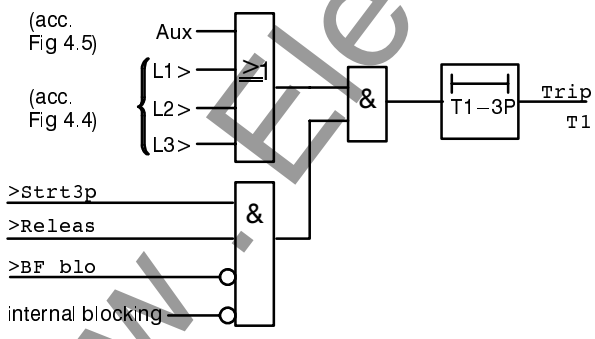


Figure 4.6 Single-stage breaker failure protection with common phase initiation

4.2.4.2 Two-stage breaker failure protection with common phase initiation

Two-stage protection means that two timers with different delay times are started. After expiry of the first stage T1, the trip command of the feeder protection is normally repeated on the feeder circuit breaker, often on a second trip coil (local trip or cross trip), if the breaker has not responded to the original trip command. A second time stage T2 monitors the response to this repeated trip command and trips the breakers of the relevant bus-bar section, if the fault is not yet cleared after this time. The two timers are started at the same time with initiation.

The functional scheme is shown in Figure 4.7. The operation sequence of the first stage is, in principle, the same as that of the single-stage example shown in Figure 4.6 (refer Section 4.2.4.1). After expiry of the time T1 – 3P, the trip command "`TripT1`" is generated which normally repeats the command for the feeder circuit breaker (local trip or cross trip). After expiry of the second time stage T2, the bus-bar (section) is disconnected by the command "`TripT2`".

Initiation can be blocked via the binary input "`>BF blo`" (e.g. during test of the feeder protection relay). Additionally, an internal blocking possibility is provided (refer also Section 4.7.5.4).

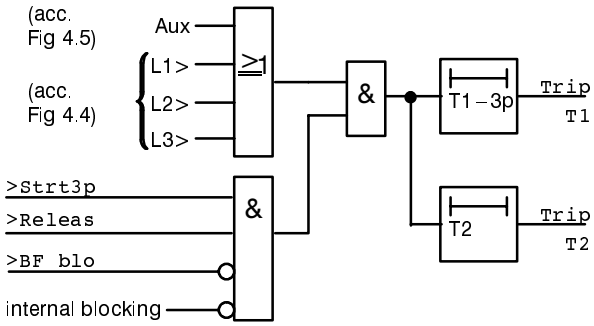


Figure 4.7 Two-stage breaker failure protection with common phase initiation

4.2.4.3 Phase segregated initiation

Phase segregated initiation is necessary if the circuit breaker poles can be switched individually, e.g. if single-pole auto-reclosure is used. It requires the model 7SV600★–★★★★★–**1**.

Initiation is only valid when either exactly one of the binary inputs "`>StrtL1`", "`>StrtL2`", or "`>StrtL3`" (single-pole trip of the feeder protection), or all three inputs (three-pole trip of the feeder protection) are energized (refer to Figure 4.8).

Besides this, for single-pole trip, current flow must be detected in at least the faulty phase. For three-pole trip, current flow must be detected in at least two phases, or the plausibility current (Section 4.2.2) must be recognized. Other initiation conditions are regarded as implausible.

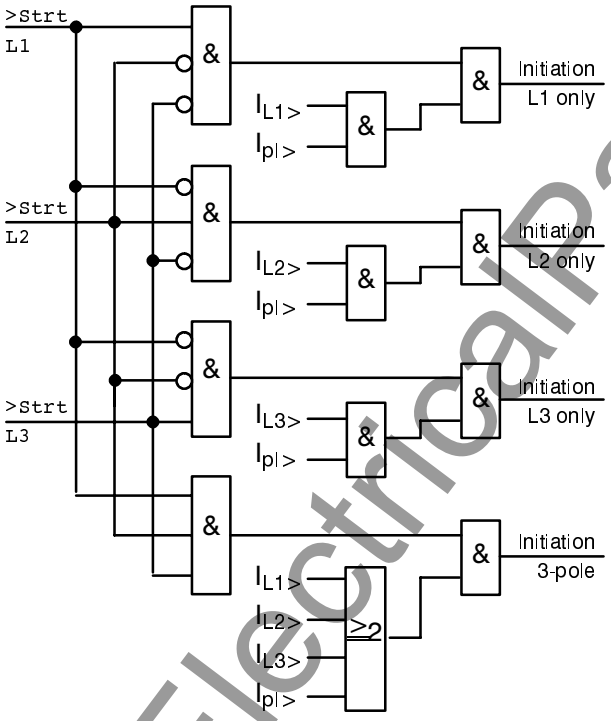


Figure 4.8 Initiation conditions for phase-segregated initiation

The initiation conditions start the delay timers which are built-up separately for each phase, for three-phase, and a further set for the second stage (Figure 4.9). Thus, current flow and initiation conditions are processed for each phase. In case of single-pole interruption during an auto-reclose cycle, current disappearance is reliably monitored only for the tripped breaker pole.

For the first breaker failure protection stage, different delay time can be set for single-pole trip by the feeder protection and for three-pole trip.

For the second stage, the timers T2 are valid.

The outputs of the timers form the trip signals "`TripT1`" for the first stage and "`TripT2`" for the second stage.

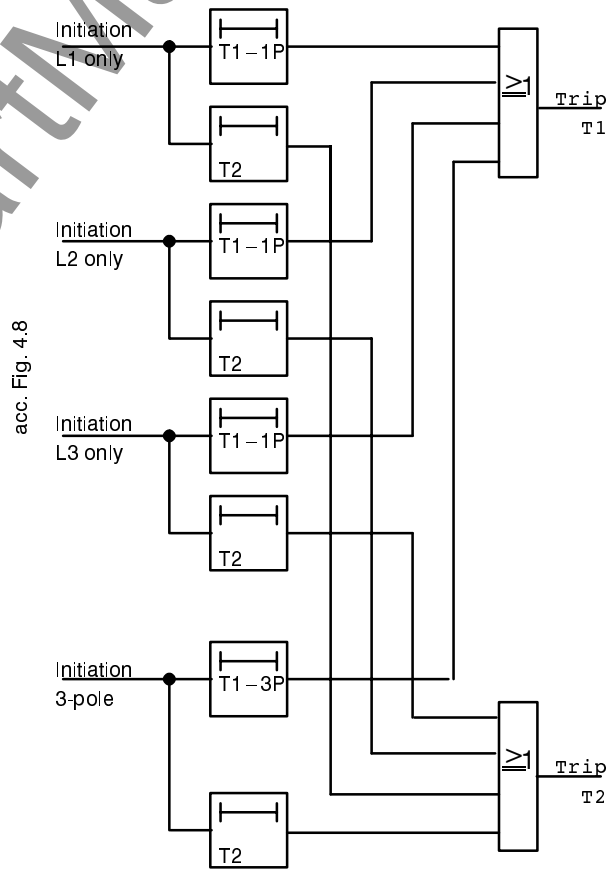


Figure 4.9 Two-stage breaker failure protection with phase-segregated initiation

4.2.5 Circuit breaker not operational

There may be cases when it is already clear that the circuit breaker associated with a feeder protection relay cannot clear a fault, e.g. when the tripping voltage or the tripping energy is not available.

In such a case it is not necessary to wait for reaction of the feeder circuit breaker. If provision has been made for such a condition to be indicated (e.g. control voltage monitor, or air pressure or spring-charge monitor), the monitor alarm signal can be fed to the binary input "`>CBdef.`" of the 7SV600. On occurrence of this alarm and trip command of the feeder protection, a separate timer T–BrkD is started (Figure 4.10), which is normally set to 0. Thus, the neighbouring circuit breakers (bus-bar) are tripped immediately in case the feeder circuit breaker is not operational. The annunciation "`TripCBd`" appears. A choice can be made whether this trip signal is forwarded to the command output "`TripT1`", or "`TripT2`", or to both outputs.

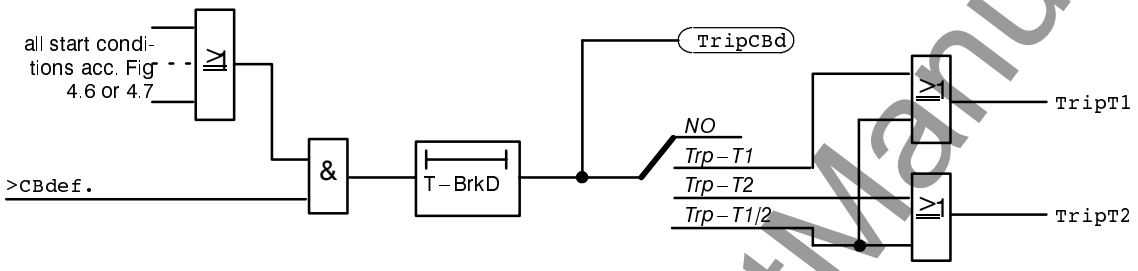


Figure 4.10 Circuit breaker defective

4.3 Current asymmetry supervision

In healthy operation it can be expected that the currents will be approximately symmetrical. Asymmetrical condition in the power system may occur during short-circuits or interruptions in the primary or secondary system or during single-pole auto-reclosure. Asymmetries are normally indicated (refer also to Section 4.7.5.3)

If the circuit breaker poles can be tripped individually, the current asymmetry supervision can be used as pole discrepancy supervision. Under steady-state conditions, either all three poles of the breaker must be closed, or all three poles must be open. Discrepancy is permitted only for a short time interval during a single-pole auto-reclose cycle.

When current asymmetry is detected, a trip command can be issued after a time delay that must be clearly longer than a single-pole auto-reclosure cycle. This command operates always in parallel to the trip command of the first breaker failure protection stage, i.e. "`TripT1`". Thus, for two-stage breaker failure protection, it trips the associated feeder circuit breaker. Of course, this function can be set inoperative.

Current symmetry is supervised in the relay by calculation of the amplitudes of the three phase currents. The following applies:

$$|I_{min}| / |I_{max}| < \text{SymFa}$$

as long as

$$I_{max} / I_N > \text{Sym}-I / I_N$$

I_{max} is always the largest of the three phase currents and I_{min} always the smallest. The symmetry factor SymFa represents the magnitude of asymmetry of the phase currents, and the threshold Sym–I is the lower limit of the processing area of this monitoring function (see Figure 4.14). Both parameters can be set (see Section 6.3.9).

4.4 Trip circuit seal-in

7SV600 provides a trip circuit seal-in feature that may be used for lock-out reclosing after the relay has tripped the breaker. When activated, the trip commands are sealed until they are reset manually on the relay or via the serial interface. This prevents from closing the breaker because, normally, closing is impossible as long as a trip command is hanging-on.

Trip circuit seal-in operates on the trip signals "TripT1", or "TripT2", or on both (see Figure 4.11, parameter L–Out).

After seal-in, these signals can only be reset manually, either by pressing the RESET–key (**N**–key) on the front or via the serial interface with the general reset information.

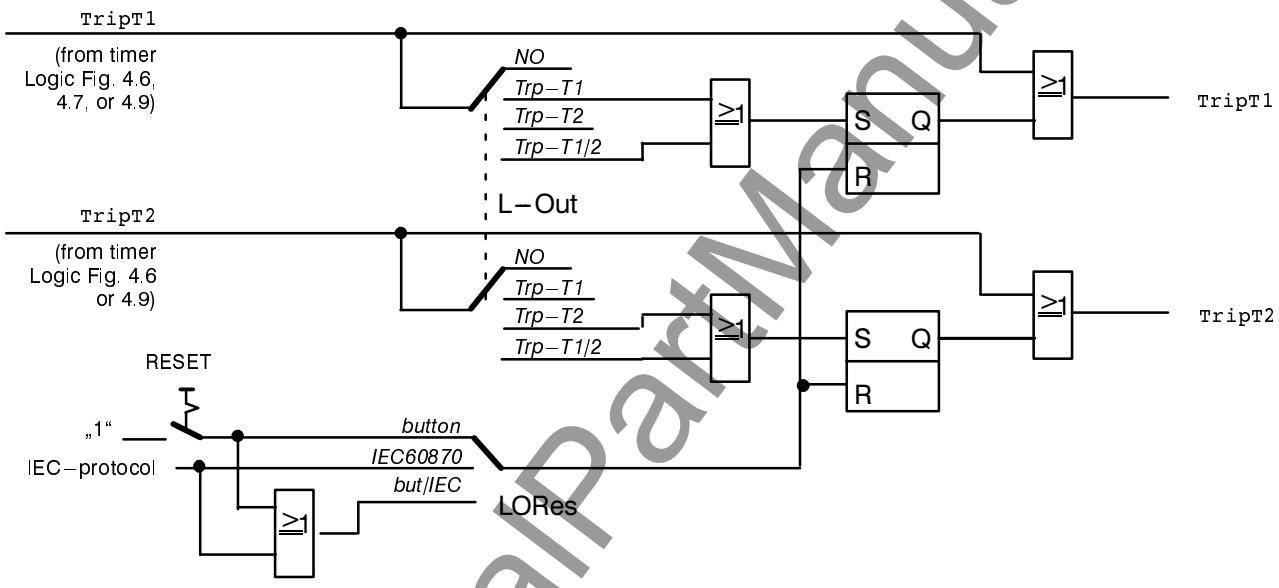


Figure 4.11 Trip circuit seal-in (reclose lock-out)

4.5 Transfer trip to the remote end circuit breaker

7SV600 provides facility to give an additional inter-trip signal to the circuit breaker of the remote line end in case the local feeder circuit breaker fails. For this, a suitable protection signal transmission link is required (e.g. via communication cable, power line carrier, radio wave, or optical fibre).

The output commands "TripT1" or "TripT2", which can be allocated to an output relay of the device, are suitable to control the transmitter. The corresponding command must be assigned to an output relay which then controls the transmitter for remote trip.

4.6 End fault protection

An end fault is defined here as a short-circuit which has occurred at the end of a line or protected object, between the circuit breaker and the current transformer set. It can be detected in operation mode with common phase initiation.

This situation is shown in Figure 4.12. The fault is located – as seen from the current transformers (= measurement location) – at the bus-bar side, thus, it will not be regarded by the feeder protection relay as a feeder fault. It can only be detected by either a reverse stage of the feeder protection or by a bus-bar protection. Nevertheless, a trip command given to the feeder circuit breaker cannot clear the fault since it is continued to be fed from the opposite end. Thus, the fault current does not stop flowing even though the feeder circuit breaker has properly responded to the trip command.

The end fault protection has the task to recognize this situation and to transmit a trip signal to the remote line end to stop this situation. For this, a transmission channel is required (e.g. power line carrier, radio wave, or optical fibre).

The end fault is detected by the end fault protection using the following logic: The end fault is recognized when the current continues flowing although the circuit breaker auxiliary contact indicates that the breaker is open. The function scheme is shown in Figure 4.13. If the feeder protection has tripped and current flow is recognized (current criteria “L*>” according Section 4.2.2, see Figure 4.4), but the circuit breaker is not closed (auxiliary contact criterion “Aux”, then a timer T – EndF is started, after which an intertrip signal “TrpEndF” is issued.

The end fault protection requires the breaker position indicated by the breaker auxiliary contact via a binary input.

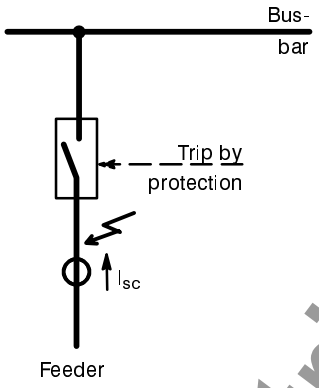


Figure 4.12 End fault between circuit breaker and current transformers

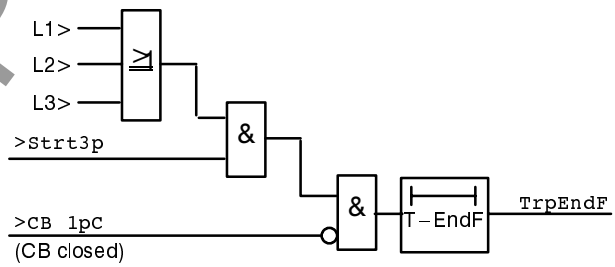


Figure 4.13 Function scheme of end fault protection

4.7 Ancillary functions

The ancillary functions of the circuit breaker failure protection 7SV600 include:

– Processing of annunciations,

– Storage of short circuit data for fault recording,

– Operational measurements,

– Test functions,

– Monitoring functions.

4.7.1 Processing of annunciations

After a fault in the network system, information concerning the response of the protective 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.

4.7.1.1 Indicators and binary outputs (signal relays)

Important events and conditions are indicated by optical indicators (LED) on the front plate. The device 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 reset:

– locally, by operation of the reset button (key **N**) on the relay front,

– remotely via the serial interface using the IEC–protocol or a personal computer,

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

Some indicators 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.

4.7.1.2 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 serial 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 operational measured values: the currents I_{L1} and I_{L2}. In the event of a network fault, information on the fault appears instead of the operating information: the faulty phase(s) and trip information of the breaker failure protection. 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 4.7.1.1.

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 serial 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. The sequence of the events is

tagged with the relative time referred to the moment at which the fault detector has picked up. Thus, the elapsed time until tripping is initiated and until the trip signal is reset can be read out. 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 protection device stores the data of the last eight network faults; if a ninth fault occurs the oldest fault is overwritten in the fault memory.

A network fault begins with recognition of the fault by pick-up and ends with fault detector reset.

4.7.2 Data storage for fault recording

The instantaneous values of the measured values

i_{L1}, i_{L2}, i_{L3}

are sampled at 1 ms intervals (for 50 Hz) or 0.83 ms intervals (for 60 Hz) and stored in a circulating shift register. In case of a fault, the data are stored over a selectable time period, but max. over 5 seconds. The maximum number of fault records within this time period is 8. These data are then available for fault analysis. For each renewed fault event, 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 serial interface and evaluated by the protection data evaluation program DIGSI®. The currents are referred to their maximum values, normalized to their rated values and prepared for graphic visualization. In addition, the logical state of the binary inputs are marked as binary traces.

4.7.3 Operating measurements

For local recall or transmission of data, the true rms values of the measured currents are always available.

4.7.4 Test facilities

7SV600 allows simple checking of the tripping circuit and the circuit breaker as well as interrogation of the state of all binary inputs and outputs. Initiation of the test can be given from the operator keyboard or via the serial interface (refer to Section 6.7.6 and 6.7.7).

4.7.4.1 Circuit breaker trip test

Prerequisite for the start of a circuit breaker trip test is that no protective function has picked up.

The relay issues a trip command. Before start of the procedure and during the test procedure, the relay indicates the test sequence in the display. Trip test applies always to the local feeder circuit breaker.

4.7.4.2 Retrieval of binary states

The momentary condition of all binary inputs and binary outputs (signal relays, trip relays, LED indicators) can be displayed on request by the operator.

4.7.5 Monitoring functions

The device incorporates comprehensive monitoring functions which cover both hardware and software; furthermore, the measured values are continuously checked for plausibility so that the current transformer circuits are also included in the monitoring system.

4.7.5.1 Hardware monitoring

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

– 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 reported.

Failure or switch-off of the auxiliary voltage automatically puts the system out of operation; this status is indicated by the breaking contact of an availability relay. Transient dips in supply voltage will not disturb the function of the relay (refer also to the Technical data, Section 3.1.1).

– Command output channels:

The command relays for tripping 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 channels 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:

After the relay has been connected to the auxiliary supply voltage, the working memory (RAM) is checked by writing and reading a data bit pattern.

The further memory modules are periodically checked for fault by

- 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.

4.7.5.2 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 system.

If such a fault is not eliminated by restarting, further restarts are initiated. If the fault is still present after three restart attempts within 30 s 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.

4.7.5.3 Monitoring of external measuring transformer circuits

To detect interruptions or short circuits in the external measuring transformer circuits or faults in the connections (an important commissioning aid) the measured values are checked at cyclic intervals, as long as no pick-up condition exists:

– Current symmetry

In healthy operation it can be expected that the currents will be approximately symmetrical. The following applies:

$$|I_{min}| / |I_{max}| < \text{SymFa}$$
if
$$I_{max} / I_N > \text{Sym}-I / I_N$$

I_{max} is always the largest of the three phase currents and I_{min} always the smallest. The symmetry factor SymFa represents the magnitude of asymmetry of the phase currents, and the threshold Sym–I is the lower limit of the processing area of this monitoring function (see Figure 4.14). Both parameters can be set (see Section 6.3.9).

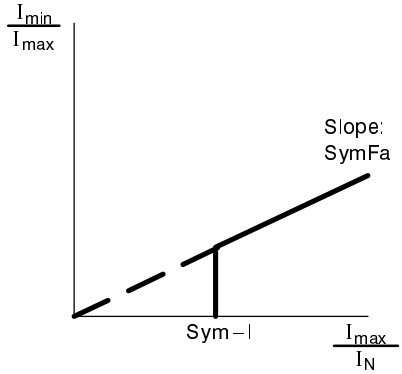


Figure 4.14 Current symmetry monitoring

4.7.5.4 Supervision of the initiation signals

The initiation signals to the breaker failure protection can be supervised. If the signals are implausible, the protection can be blocked.

If the relay operates in the *common phase* initiation mode, an additional release signal can be routed to the relay, besides the feeder protection trip signal. For initiation without current flow (e.g. Buchholz protection), the additional release input may be connected, too.

This two-channel initiation requires two binary inputs to be energized before the protection starts: the trip signal with or without current flow and the release signal. If only one of these inputs is energized, this state is considered implausible.

If the release channel is not connected and not allocated to a binary input, it cannot be processed; initiation of the breaker failure protection is then single-channel.

If the relay operates with *phase segregated* initiation, it is assumed that either *one single* pole shall be tripped (with single-phase fault) or *all three* poles are tripped (with multi-phase faults). Correspondingly, it is considered implausible when trip occurs in exactly two poles.

If the relay operates with *phase segregated* initiation, it is, furthermore, possible to check that the pole which is tripped has carried current. If not, this is considered implausible.

You may decide by setting parameters which implausibility checks are effective and whether or not they shall block the breaker failure protection (refer also to Section 6.3.8).

All supervision features which are set to be effective trigger the general alarm annunciation. If the breaker failure protection is blocked, the annunciation "`BF bloc`" is generated. Additionally, each blocking of the protection is annunciated by the block alarm.

Table 4.1 shows the conditions which lead to the general alarm annunciation.

Plausibility check	Alarm delay	Causes
1. Binary inputs implausible for two-channel, *common phase* initiation Precondition: Addr. 1603 Sup.2c = *YES*	approx. 1 s	only „`>Strt3p`“ (FNo 7703) or only „`>Releas`“ (FNo 7702) only „`>St.woI`“ (FNo 7704) or only „`>Releas`“ (FNo 7702)
2. Binary inputs implausible for single-channel, *phase segregated* initiation Precondition: Addr. 1603 Sup.2c = *YES*	approx. 1 s	Initiation neither single-pole nor three-pole; i.e. exactly in two of the three phases: „`>StrtL1`“ (FNo 7705) „`>StrtL2`“ (FNo 7706) „`>StrtL3`“ (FNo 7707)
3. Current flow must be detected in the tripped phase, for single-channel, *phase segregated* initiation Precondition: Addr. 1604 Sup.1c = *YES*	approx. 1 s	Initiation in a phase that does not carry current
4. Current asymmetry	adjustable: Sym–T (Addr. 1705)	Current asymmetry, e.g. caused by phase failure or CB pole discrepancy $\lvert I_{min}\rvert$ / $\lvert I_{max}\rvert$ < SymFa and I_{max} / I_N > Sym–I / I_N

Table 4.1 Composition of the common alarm annunciation

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 7SV600⋆–⋆B⋆⋆⋆ or –⋆D⋆⋆⋆ for panel surface mounting

– Secure the unit with four screws to the panel. Verify sufficient space to adjacent relays in case of model –⋆B⋆⋆⋆. For dimensions refer to Figure 2.1 or 2.2.

– Make a solid low-ohmic and low-inductive operational earth connection between the earthing surface at the bottom 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; observe labelling of the individual terminals; observe the maximum permissible cross sections and torque (see Section 2.2). Use copper conductors only!

– If the RS485 interface is used, the cable screen must be earthed.

5.2.1.2 Model 7SV600⋆–⋆E⋆⋆⋆ for panel flush mounting or cubicle installation

– Slip away the covers at top and bottom of the housing in order to gain access to the four holes in the fixing angle.

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

– Make a solid low-ohmic and low-inductive 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 connectors of the housing. Observe labelling of the individual connector modules to ensure correct location; observe the max. permissible conductor cross-sections and torque (see Section 2.2). Use copper conductors only! 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.

– Earth the screen of the serial RS485 interface when it is used.

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 auxiliary voltage and the rated current of the current transformers.

5.2.2.1 Auxiliary voltage

Four different ranges of auxiliary voltage can be delivered (cf. Section 2.3 and 3.1). If, for exceptional reason, the rated voltage of the supply input is to be changed, it must be taken into account that the models for rated auxiliary voltage 60/110/125 Vdc and 220/250 Vdc differ from each other by different plug jumpers. The assignment of these jumpers and their location on the p.c.b. are shown in Figure 5.1. The model for 220/250 Vdc is suitable for 115 Vac, too. A different model is suited for 230 Vac. When the relay is delivered, all theses plugs are correctly located and matched to the specification given on the name plate of the relay, so that, normally, none of the bridges need to be altered.

5.2.2.2 Rated currents

The current inputs of the relay are matched to the rated current as given on the name plate of the relay according to the order designation. The rated current is considered by correct location of plug jumpers on the p.c.b. The assignment of these jumpers and their location on the p.c.b. are shown in Figure 5.2. When the relay is delivered, all theses plugs are correctly located and matched to the specification given on the name plate of the relay, so that, normally, none of the bridges need to be altered.

5.2.2.3 Control d.c. voltage of binary inputs

When delivered from factory, the binary inputs are designed to operate in the total control voltage range from 17 V to 288 V d.c. If the rated control voltage for binary inputs is 110 V or higher, it is advisable to fit a higher pick-up threshold to these inputs in order to increase stability against stray voltages in the d.c. circuits.

To fit a higher pick-up threshold of approximately 74 V to a binary input a solder bridge must be removed. Figure 5.3 shows the assignment of these solder bridges and their location on the p.c.b.

– Slip away the covers at top and bottom of the housing in order to gain access to the two fixing screws of the module. Unscrew these screws.

– Pull out the module by taking it at the front cover and place it on a surface which is suited to electrostatically endangered components (EEC);

Caution!

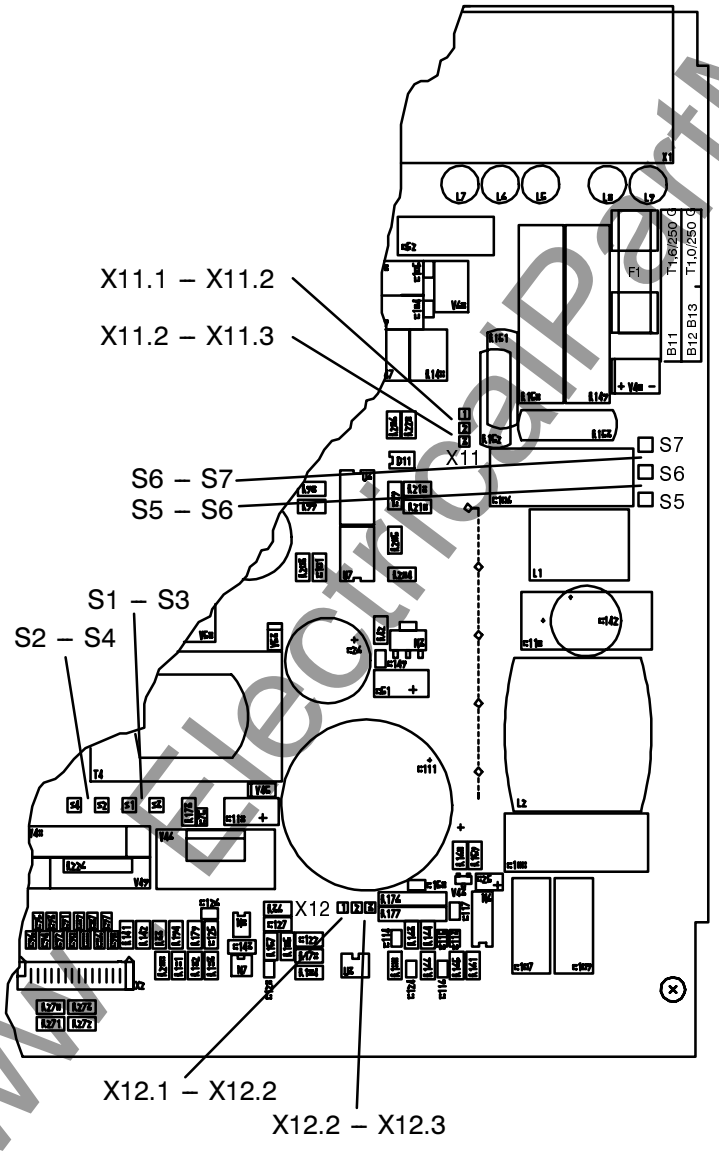
Electrostatic discharges via the component connections, the PCB tracks or the connecting pins of the modules must be avoided under all circumstances by previously touching an earthed metal surface.

– Check the solder bridges according to Figure 5.1 to 5.3.

– Insert module into the housing;

– Fix the module into the housing by tightening the two fixing screws.

– Re-insert covers.



Bridges	Rated auxiliary voltage	
	60 V_{dc} 110 V_{dc} 125 V_{dc}	220 V_{dc} 250 V_{dc} 115 V_{ac}
X11.1 – X11.2	X	
X11.2 – X11.3		X
X12.1 – X12.2		X
X12.2 – X12.3	X	
S1 – S3	X	
S1 – S2		X
S2 – S4	X	
S5 – S6		X
S6 – S7	X	

Figure 5.1 Checking for auxiliary voltage of the integrated dc–dc–converter

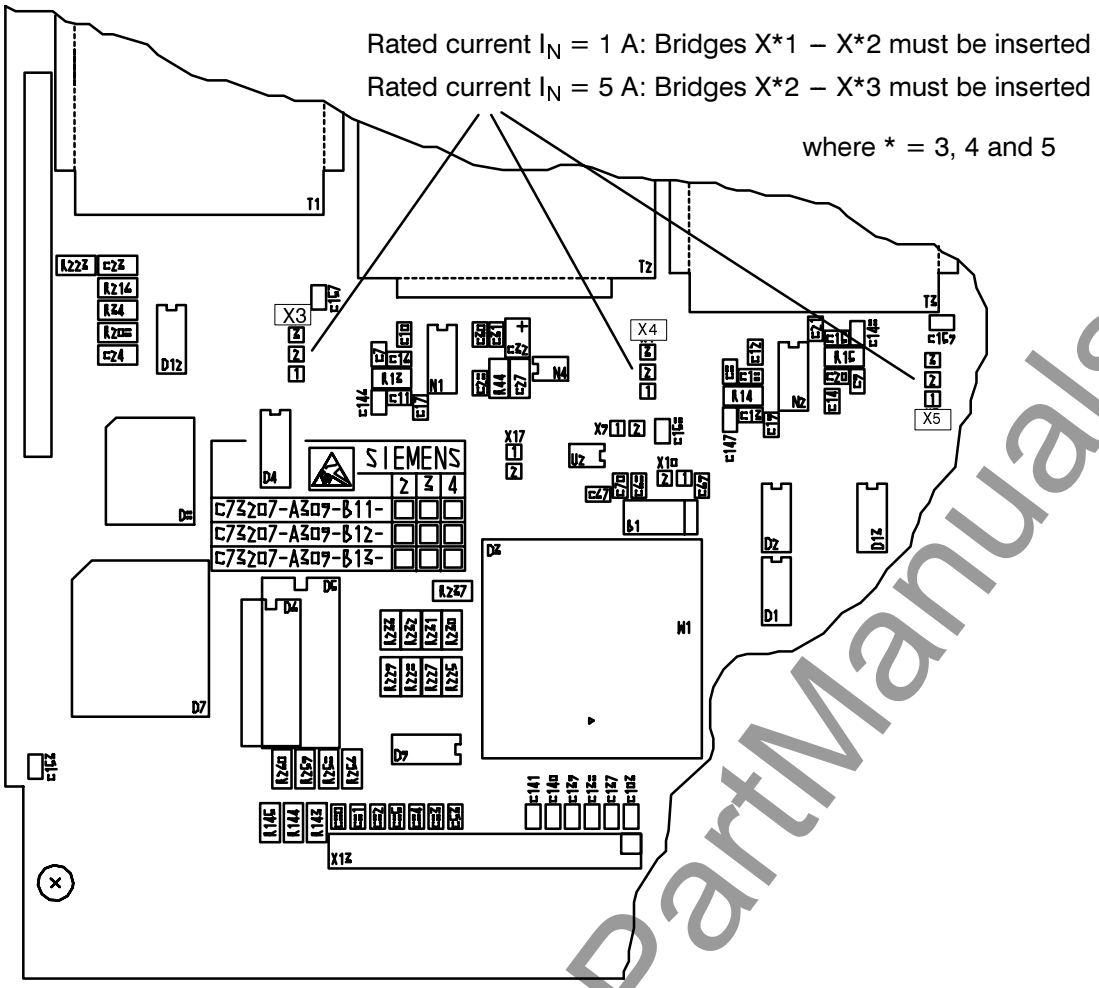
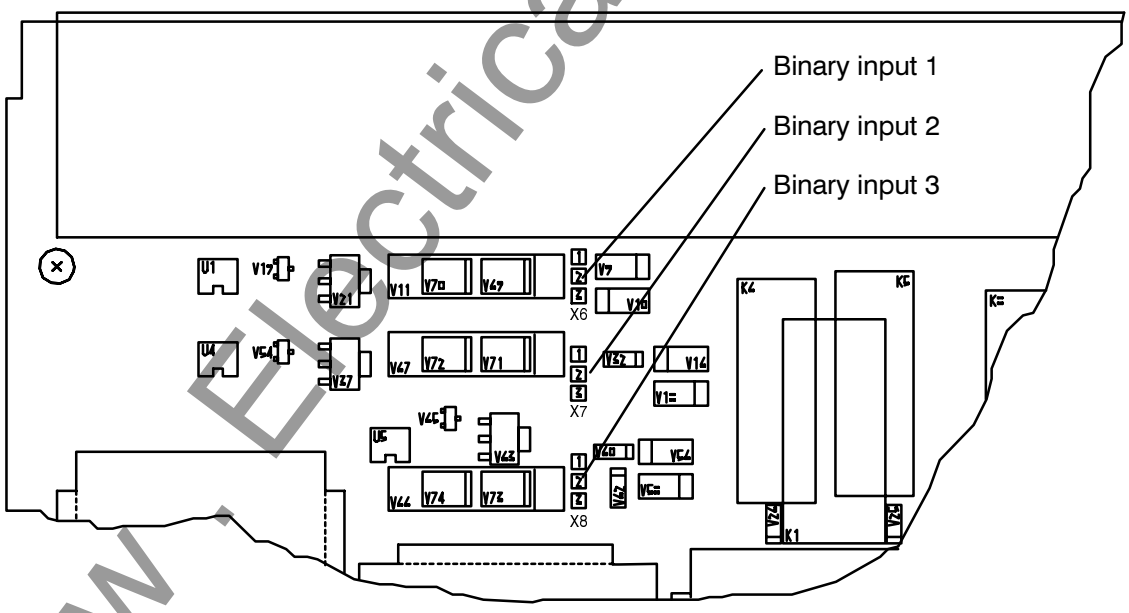


Figure 5.2 Checking for the rated current 1 A/5 A



For rated voltages 24/48/60 Vdc: Bridges X*2 – X*3 must be inserted! (pick-up threshold approx. 17 Vdc)
For rated voltages 110/125/220/250 Vdc: Bridges X*1 – X*2 may be inserted. (pick-up threshold approx. 74 Vdc)

where * = 6, 7 and 8

Figure 5.3 Checking for control voltages for binary inputs

5.2.3 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.

It must be considered that the possible control connections to the binary inputs depend on the ordered model an the operation mode: common-phase initiation or phase-segregated initiation (only 7SV600*–*****–**1**).

Figure 5.4 shows a connection example for common phase initiation by a line protection. Initiation is of two-channel design: Trip of the line protection and fault detection (pick-up) signal. If no fault detection signal is available, the trip command can be connected twice. The breaker failure protection is only initiated when both binary inputs "`>Strt3p`" and "`>Releas`" are energized. If, on the other hand, the release signal is not connected and not allocated to a binary input, it will be ignored, i.e. initiation is effected single-channel. The third binary input can be controlled from the breaker auxiliary contact.

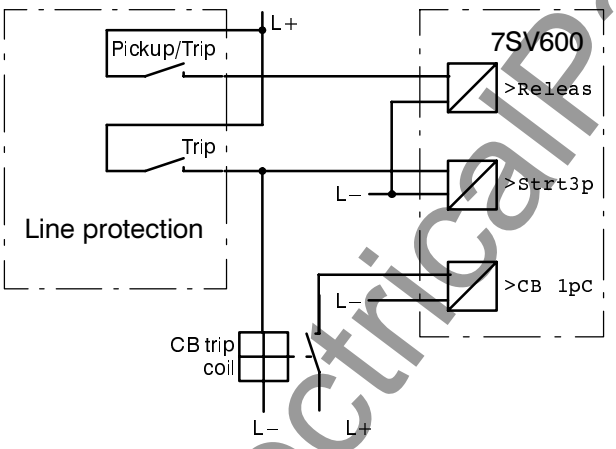


Figure 5.4 Common-phase initiation, two-channel, with circuit breaker auxiliary contact

Figure 5.5 shows a connection example for common phase initiation with a transformer feeder. The short-circuit protection initiates the breaker failure protection by its trip command via the binary input "`>Strt3p`", the Buchholz protection energizes the input "`>St.woI`", i.e. initiation without current flow. The breaker auxiliary contact must be connected in this case because trip by the Buchholz protection is not necessarily associated with a remarkable current flow.

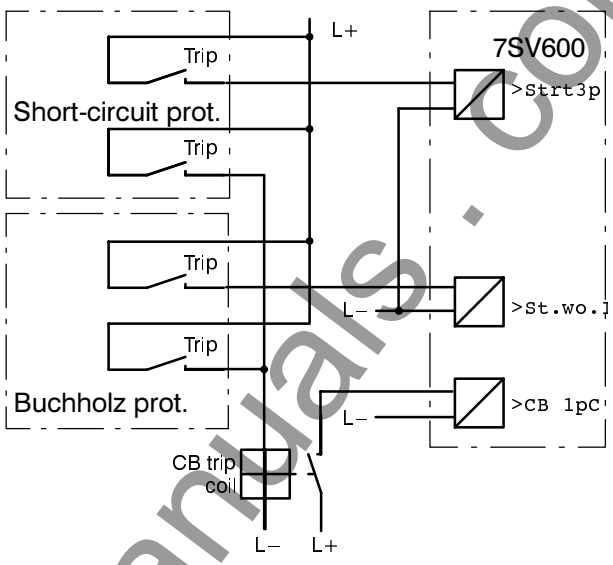


Figure 5.5 Common-phase initiation, from short-circuit protection and Buchholz protection, CB auxiliary contact must be connected

Figure 5.6 shows a connection example for phase segregated initiation by a line protection. This requires, that the line protection is able to trip single-pole. It is only possible with the model with phase segregated initiation facility 7SV600*–*****–**1**.

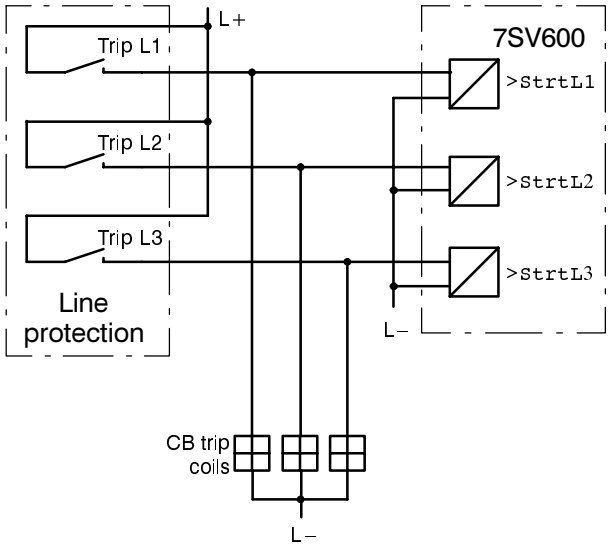


Figure 5.6 Phase segregated initiation, only with version 7SV600*–*****–**1**

5.2.4 Checking the connections

Warning

Some of the following test steps are carried out in 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 them. 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 auxiliary power supply!

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

  - Are the current transformers correctly earthed?
  - Is the phase relationship of the current transformers correct?
  - Are the polarities of the current transformer connections consistent?

  If test switches have been fitted in the secondary circuits, check their function, particularly that in the ”test” position the current transformer secondary circuits are automatically short-circuited.

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

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

– The measured current consumption should correspond to the quiescent power consumption of approximately 2 W/VA. Transient movement of the ammeter pointer only indicates the charging current of the storage capacitors.

– Open the circuit breaker for the power supply.

– Remove the ammeter; reconnect the auxiliary voltage leads.

– Close the power supply circuit breaker. 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 most 7 sec.

– Open the circuit breaker for the power supply.

– Check through the tripping circuits to the circuit breaker.

– If multiple bus-bar is used, ensure that the distribution of the bus-bar trip command depending on the bus-bar disconnector position of all feeders is correct.

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

– Check the signal circuits.

5.3 Configuration of operation and memory functions

5.3.1 Operational preconditions and general

For most operational functions, the input of a codeword is necessary. The “codeword” is a predefined key sequence which must be entered via the membrane keyboard or operating interface which concern the operation on the relay, for example

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

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

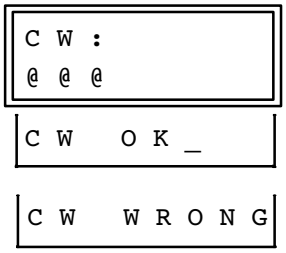
– setting of functional parameters (thresholds, functions).

– starting of test procedures.

In order to indicate authorized operation and to prevent from unintended alteration, the codeword must be entered before any alteration can be performed.

When an operation object is selected which requires codeword input, press one of the keys ⊞ or ⊟ in order to inform the relay about the intended alteration. The display then shows the line “CW :” which indicates that the codeword is required. The ‘codeword’ itself consists of the key sequence ⊟ ⊞ ⊟. Press these keys in the indicated sequence and confirm with the enter key **E**. If the codeword is correct the display shows “CW OK_”. By pressing the enter key **E** one more time the operation item is displayed again. Use the keys ⊞ or ⊟ in order to change the presented text or numerical value. A flashing cursor indicates that the relay operates now in alteration mode, starting with the first alteration and ending after confirmation of the altered item with the enter key **E**. The alteration mode is equally ended when the setting menu is left or after an internal waiting time.

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 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 OK_**. Press the entry key **E** again.

If the codeword is not correct the display shows **CW WRONG**. Pressing the keys ⊞ or ⊟ allows another attempt at codeword entry.

The operating interface is built up by a hierarchically structured menu tree, which can be passed through by means of the scrolling keys ◁, ▷, △, and ▽. Thus, each operation object can be reached. A complete overview is listed in Appendix C. Figure 5.7 illustrates the way to get to the configuration items.

After the relay has been switched on, the display shows the type designation and the version of the implemented firmware. Pressing the key ▽ leads to the first main menu item ”PARAME.” (parameters) in the first operation level of the menu tree. Press key ▷ to reach the second operation menu level, which starts with the first parameter block ”00 CONF.” (configuration). Press the key ▽ repeatedly until address block 71 appears. You may scroll back with the key △ or page to the previous operation menu level with ◁.

Next to the address block number (71), the heading of the address block appears in abbreviated form: ”INT. OP” (integrated operation).

[7100]
Beginning of the block ”Integrated operation”

Address blocks 71 to 74 are provided for configuration of the software operating system. These settings concern the operation of the relay, communication with external operating and processing devices via the serial interface, fault recordings, and the interaction of the device functions.

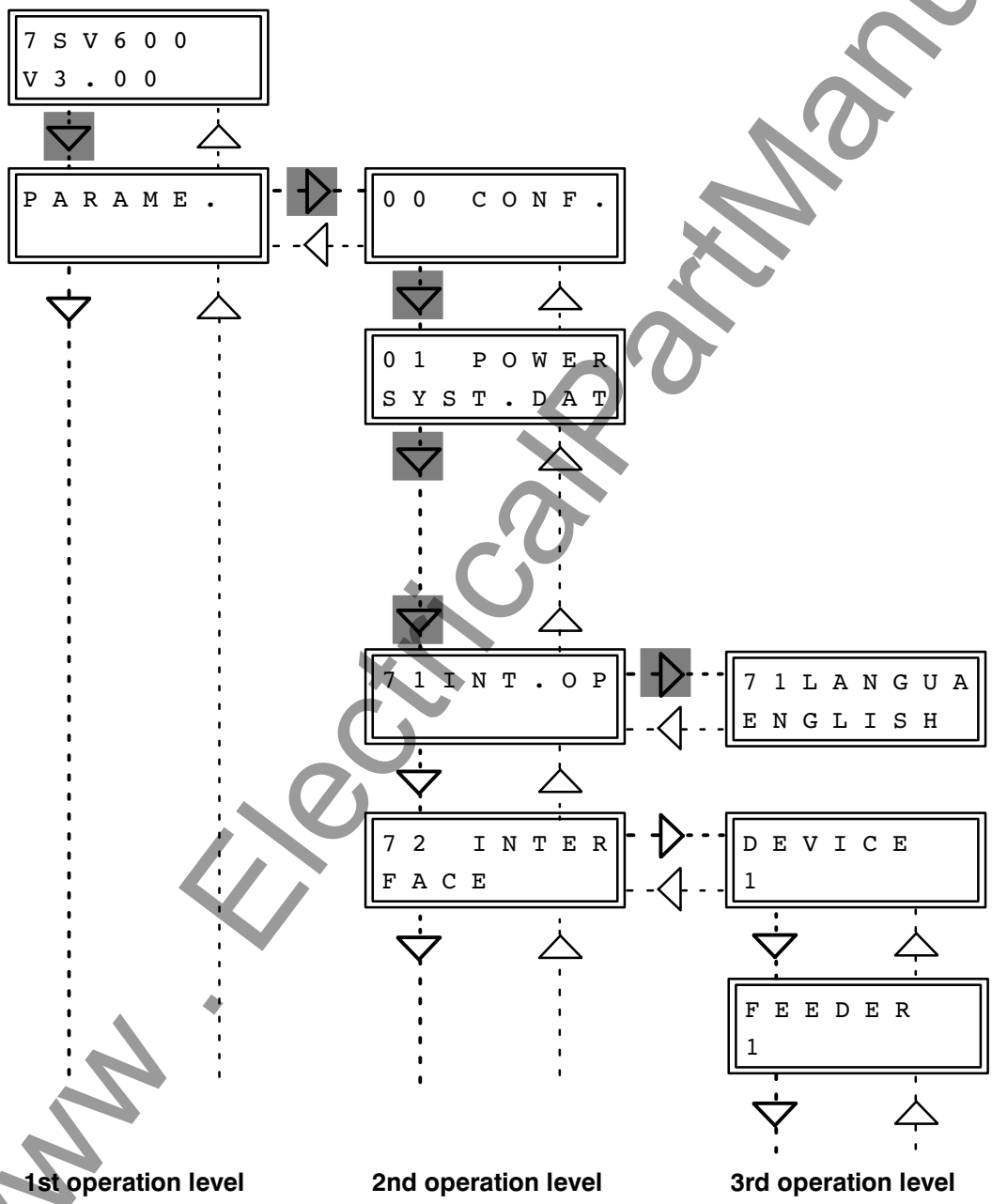


Figure 5.7 Extract from the operation structure and illustration of selection of the configuration blocks

You may, for example, change with the key ▷ to the third operation menu level, then with key ◁ back to the second operation menu level, as shown in Figure 5.7. Press the key ▽ to change to address block 72, etc.

The display shows the two-figure address block number and the meaning of the requested parameter (Figure 5.7). In the second display line follows the text or number which is presently applicable. The preset text or number can be altered by pressing the keys ⊞ or ⊟.

When the relay is operated from a personal computer by means of the protection data processing program DIGSI®, each configuration parameter is identified by a four-digit address number. In the following clarifications, this number is indicated at the beginning of the explanations in brackets.

For text parameters, an alternative text appears which is illustrated in the explanations below. Multiple alternatives may be possible. The alternative which is chosen, **is confirmed with the enter key E.** When the last possible alternative is reached, no further changing with the key ⊞ is possible. The same is valid when one tries to change the first alternative with the key ⊟.

If a numerical value of the parameter is required, the preset number can equally be changed with the keys ⊞ or ⊟ in order to get a higher or lower number. The desired value **must be confirmed with the enter key E!**

When one of the keys, ⊞ or ⊟, is pressed continuously, the numbers will change with an accelerating sequence. Thus, a fast and fine adjustment is possible within a wide setting range.

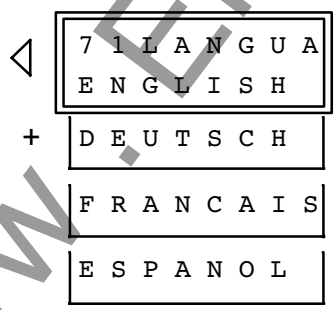
If one tries to leave an operating item or operating level by pressing one of the arrow keys without having confirmed an alteration with the enter key **E**, the display will show the question "SAVE NEW SETTING?". Confirm with the "Yes" – key **Y**/**J** that the new settings shall become valid now. If you press the "No" – key **N** instead, codeword operation will be aborted, and the alteration which has been changed since the last entry is lost. Thus, erroneous alterations can be made ineffective. Press the arrow key once again in order to change really the operating item or level.

When the configuration or setting process is terminated by pressing the enter key **E**, the altered parameters are permanently secured in EEPROMs and protected against power outage.

5.3.2 Settings for the integrated operation – address block 71

Operating parameters can be set in address block 71. This block allows the operating language to be selected.

When the relay is delivered from the factory, the device is programmed to give function names and outputs in the English language. This can be changed under address block 71. This item is reached from the second operation level, address block 71 (as described above) by changing with the key ▷ to the third operation level where the operation language may be changed. The operator languages available at present are shown in the boxes below.



[7101]
The available languages can be called up by repeatedly pressing the key ⊞ or ⊟ Each language is spelled in the corresponding national language. If you don't understand a language, you should find your own language, nevertheless.

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

5.3.3 Configuration of the serial interface – address block 72

The device provides one serial interface (operating or PC interface). Communication via this interface requires some data prearrangements: identification of the relay, transmission format, transmission speed.

These data are entered to the relay in address block 72. Codeword input is necessary (refer to Section 5.3.1). The data must be coordinated with the connected devices.

The setting of the GAPS is relevant only when the relay is intended to communicate via a modem. The setting is the maximum time period which is tolerated by the relay when gaps occur during transmission of a telegram. Gaps may occur, when modems are used, by compression of data, error correction, and differences of the Baud-rate. With good transmission quality, 1.0 s is adequate. The value should be increased when transmission quality is not so good. It must be noted that GAPS must be smaller than the setting of ”reaction time protection relay” in the protection software DIGSI® V3. Recommended value:

$$\text{GAPS} \approx \frac{\text{”reaction time protection relay”}}{2}$$

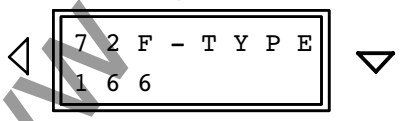
Higher values for ”reaction time protection relay” reduce the transmission speed in case of transmission errors. If the relay interface is connected directly to a personal computer, then GAPS may be set to 0.0 s.

[7200]
Beginning of the block ”Interface for personal computer”

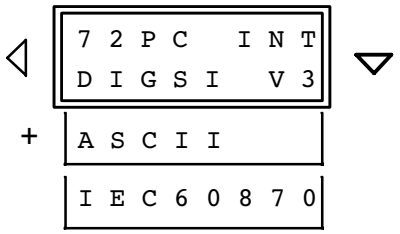
[7201]
Identification number of the relay within the substation; The number can be chosen at liberty, but must be used only once within the plant system
Smallest permissible number: **1**
Largest permissible number: **254**

[7202]
Number of the feeder within the substation;
Smallest permissible number: **1**
Largest permissible number: **254**

[7203]
Identification number of the substation, in case more than one substation can be connected to a central device
Smallest permissible number: **1**
Largest permissible number: **254**



[7208]
Function type in accordance with IEC 60870–5–103; for breaker failure protection no. 166.
This address is mainly for information, it should not be changed.



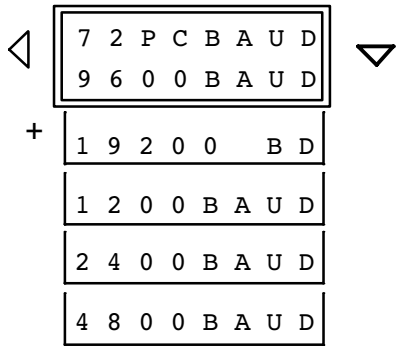
[7211]
Data format for the PC (operating) interface:

format for Siemens protection data processing program *DIGSI*® Version *V3*

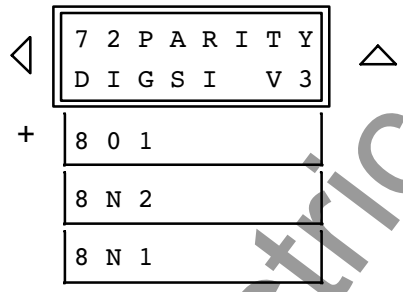
ASCII format

format according to IEC 60870–5–103)

[7214]
Maximum time period of data gaps which may occur during data transmission via modem
Smallest setting value: **0.0** s
Largest setting value: **5.0** s



[7215]
The transmission Baud-rate for communication via the PC (operating) interface 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 key **+** or **–**. Confirm the desired Baud-rate with the entry key **E**.



[7216]
Parity and stop-bits for the PC (operating) interface:

format for Siemens protection data processing program *DIGSI*® Version *V3* with even parity and 1 stop-bit

transmission with *O*dd parity and *1* stop-bit

transmission with *N*o parity and *2* stop-bits

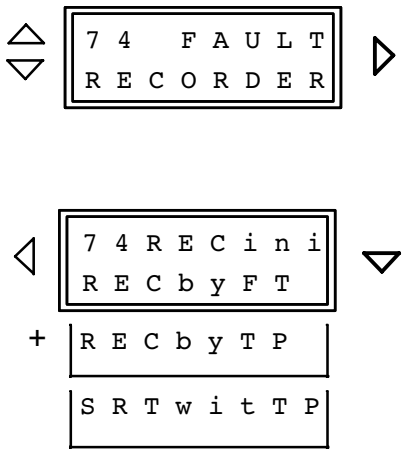
transmission with *N*o parity and *1* stop-bit

5.3.4 Settings for fault recording – address block 74

The circuit breaker failure protection relay is equipped with a fault data store (see Section 4.7.2). Distinction must be made between the reference instant and the storage criterion. Normally, the general fault detection signal of the protection is the reference instant. The storage criterion can be the general fault detection, too (*RECbyFT*), or the trip command (*RECbyTP*). Alternatively, the trip command can be selected as reference instant (*SRT witTP*), in this case, the trip command is the storage criterion, too.

A fault event begins with the fault detection of the protection function and ends with drop-off of the latest fault detection. This is the scope of a fault record.

The actual recording time starts with the pre-trigger time T–PRE before the reference instant and ends with the post-fault time T–POS after the recording criterion has disappeared. The permissible recording time for each record is set as T–MAX. Altogether 5 s are available for fault recording. In this time range up to 8 fault records can be stored.



[7400]
Beginning of block "Fault recordings"

[7402]
Data storage is initiated:

– fault detection is reference instant
  fault detection is storage criterion
– fault detection is reference instant
  trip command is storage criterion
– trip command is reference instant
  trip command is storage criterion

[7410]
Maximum time period of one fault record
Smallest setting value: **0.30** s
Largest setting value: **5.00** s

[7411]
Pre-trigger time before the reference instant
Smallest setting value: **0.05** s
Largest setting value: **0.50** s

[7412]
Post-fault time after the storage criterion disappears
Smallest setting value: **0.05** s
Largest setting value: **0.50** s

5.4 Configuration of the protective functions

5.4.1 Programming the scope of functions – address block 00

The version 7SV600*–*****–**1** offers two alternatives to be selected by the user: common phase initiation (3–POLE) or phase segregated initiation (1/3–POLE). The version 7SV600*–*****–**0** allows only common phase initiation. Therefore, this selection is not possible, and the configuration block as described in this section is not available.

Alteration of this configuration parameter is carried out through the integrated operation keyboard at the front of the device or by means of a personal computer, connected to the serial interface. The use of the integrated operating keyboard is described in detail in Section 6.2. Alteration 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, address block 00 is provided. This block is reached from the initial display in operation level 1 with the key ▽ (“PARAME.”) and changing with key ▷ to the second operation level. Address block 00 CONFiguration appears (Figure 5.8).

Within the block 00 one can page with key ▷ to the third operation level. In the upper line of the display, behind the block number, stands the associated device function: BF P. for Breaker Failure Protection (Figure 5.8). In the second line is the associated text: *1/3–POLE* for single- and three-pole, i.e. with phase-segregated initiation. If this text should be altered, press the keys ⊞ or ⊟, after having input the codeword; the alternative text then appears: *3–POLE* for three-pole, i.e. common phase initiation. The required alternative **must be confirmed with the key E!**

When the relay is operated from a personal computer by means of the protection data processing program DIGSI®, this configuration parameter is identified by the address number **7816**.

If one tries to leave an operating item or operating level by pressing one of the arrow keys without having confirmed an alteration with the enter key **E**, the display will show the question “SAVE NEW SETTING?”. Confirm with the “Yes”–key **Y**/**J** that the new settings shall become valid now. If you press the “No”–key **N** instead, codeword operation will be aborted, and the alteration which has been changed since the last entry is lost. Thus, erroneous alterations can be made ineffective. Press the arrow key once again in order to change really the operating item or level.

When the configuration or setting process is terminated by pressing the enter key **E**, the altered parameters are permanently secured in EEPROMs and protected against power outage.

With the arrow key ◁, the second operation level can be reached where you may scroll with key ▽ to the next address block. If you press the arrow key ◁ once again, the first operation level is reached.

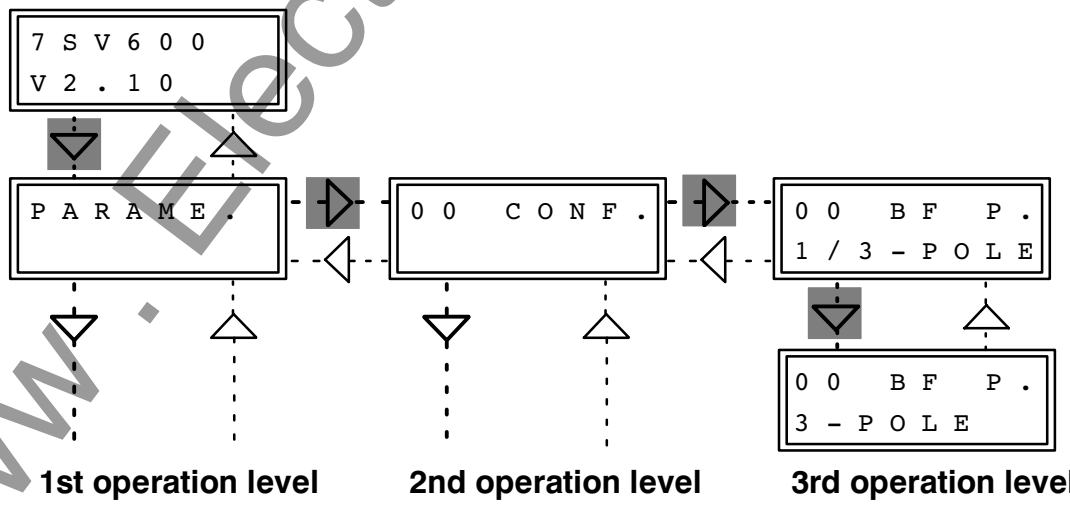


Figure 5.8 Extract from the operation structure and illustration of selection of the configuration block (valid only for 7SV600*–*****–**1**)

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 most 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. The operation of the operator panel is described in detail in Section 6.2. Marshalling begins at the address block 60.

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. A flashing cursor indicates that the relay operates now in alteration mode, starting with the first alteration and ending after confirmation of the altered item with the enter key **E**. The alteration mode is equally ended when the setting menu is left or after an internal waiting time.

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: The trip time T1 – 3p has elapsed because of a breaker failure. 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, the processor system must be advised that the logical signal "T1–3p" should be transmitted to the trip 2. 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.

The device incorporates two command (trip) relays with two normally open contacts each (observe switching capability), and two further output relays with one change-over contact each for signalling purposes.

A similar situation applies to binary inputs. In this case external information (e.g. trip signal from the feeder protection) is connected to the unit via a (physical) input unit and should initiate a (logical) function, e.g. initiation of the breaker failure protection.. The corresponding question to the operator is then: **Which** signal from a (physical) input unit should initiate **which** reaction in the device? One physical input signal can initiate up to 10 logical 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 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) functions should be allocated.

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

The marshalling block is reached with the keys ▽ (scrolling forwards) or △ (scrolling backwards), ▷ (next operation level) or ◁ (previous operation level), i.e. from the initial display (Figure 5.9):

– key ▽ (forwards),

– key ▷ (second operation level),

– key ▽ (forwards) until address block 60 appears in the display.

[6000]
Beginning of marshalling blocks

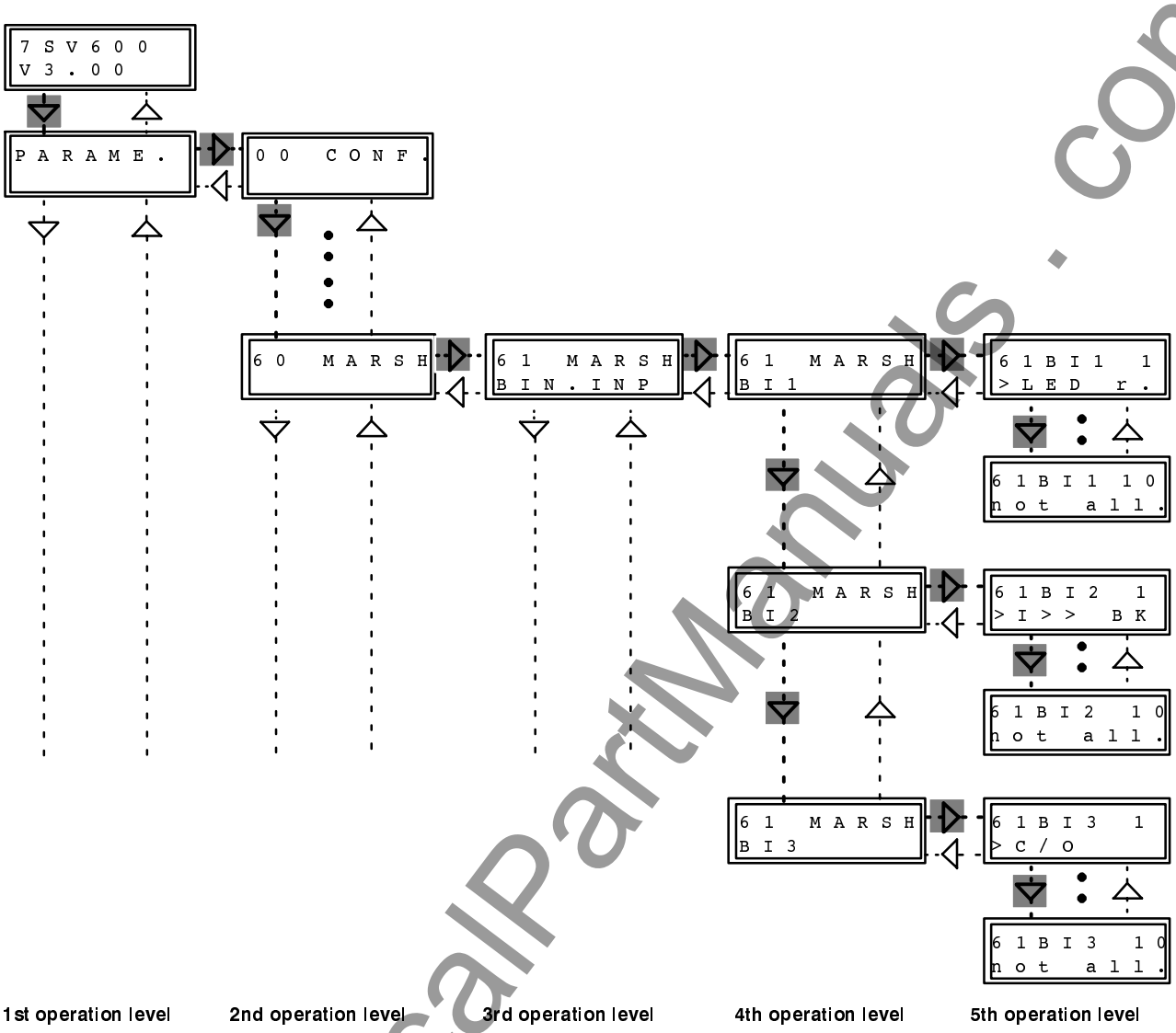


Figure 5.9 Extract from the operation structure and illustration of selection of the marshalling blocks

You may, for example, change with the key ▷ to the next operation menu level, then with key ◁ back to the previous operation menu level, as shown in Figure 5.9. Within a menu level, key ▽ is used to scroll forwards or △ to scroll backwards. Each forward or backward step in the fourth operation level leads to display of the next input, output or LED position. In the display the physical input/output unit forms the heading.

Key ▷ leads to the selection level of an individual input/output module. The display shows, in the upper line, the physical input/output unit, this time with a one to two 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 after codeword input by pressing the key ⊞. By repeated use of the key ⊞ all marshallable functions can be paged through the display. Backpaging is possible with the key ⊟. When the required function appears press the execute key **E**. After this, further functions can be assigned 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 all.`" (not allocated).

You can leave the selection level by pressing the key ◁. The display shows again the previous selection level. Now you can page with key ▽ to the next input/output module or with △ to the previous to repeat selection procedure, as above.

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 operation level to another operation level, within the operation level or selection level. Those arrows which lead to the next operating step in a logical sequence are indicated in bold figures.

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

When the relay is operated from a personal computer by means of the protection data processing program DIGSI®, each configuration parameter is identified by a four-digit address number. In the following clarifications, this number is indicated at the beginning of the explanations in brackets.

If one tries to leave an item or operating level by pressing one of the arrow keys without having confirmed the allocation with the enter key **E**, the display will show the question "SAVE NEW SETTING?". Confirm with the "Yes"–key **Y**/**J** that the new settings shall become valid now. The new text is displayed now. If you press the "No"–key **N** instead, all alterations which has been changed since the last entry of the key **E** are lost and the old text is displayed. Thus, erroneous alterations can be made ineffective. Press the arrow key once again in order to change really the operating item or level.

When the marshalling process is terminated by pressing the enter key **E**, the allocations are permanently secured in EEPROMs and protected against power outage.

5.5.2 Marshalling of the binary inputs – address block 61

The unit contains 3 binary inputs which are designated INPUT 1 to INPUT 3. They can be marshalled in address block 61. The block is reached from the initial display by pressing the key ▽ to the first main menu item "PARAME." (parameters) in the first operation level of the menu tree. Press key ▷ to reach the second operation menu level, which starts with the first parameter block "00 CONF." (configuration). Press the key ▽ repeatedly until address block "60 MARSH" (marshalling) appears. Key ▷ leads to operation level 3 with address block "61 MARSH BIN INP" (marshalling of binary inputs) (refer also to Figure 5.9).

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

n – "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 with ⊞ or ⊟, each input function is displayed without any index which indicates the "normally open" mode and with the index "n" which indicates the "normally closed" mode, as above. The changed function then must be re-confirmed by the entry key **E**.

Table 5.1 shows a complete list of all the binary input functions with their associated function number **FNo**.

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. Tables 5.2 and 5.3 show all binary inputs as preset from the factory.

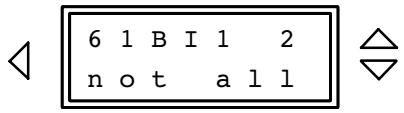
[6100]
Beginning of block "Marshalling binary inputs"

The first binary input is reached with the key ▷:

[6101]
Allocations for binary input 1

Change over to the selection level with ▷:

[6102]
Trip signal from the feeder protection = Start of the breaker failure protection, FNo 7703;
"normally open" operation:
Start when control voltage present



[6103]
No further functions are initiated by binary input 1

Following codeword input, all marshallable functions can be paged through the display by repeated use of the key ⊞. Back-paging is possible with the key ⊟. 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 1 to 10) 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 all." (not allocated).

Leave the selection level with key ◁. You can go then to the next binary input with the arrow key ▽.

FNo	Abbreviation	Description
1	not all.	Binary input is not allocated to any input function
5	>LED r.	Reset LED indicators
355	>CB 1pC	Circuit breaker closed (from CB auxiliary contact)
1403	>BF blo[2])	Block circuit breaker failure protection [2])
1421	>CBdef.[2])	Circuit breaker defective [2])
7701	>LO Res	Lock-out reset (trip circuit seal-in)
7702	>Releas[2])	Release initiation signal (2nd channel) [2])
7703	>Strt3p[2])	Start breaker failure protection three-pole (common phase initiation) [2])
7704	>St.woI[2])	Start breaker failure protection three-pole without current [2])
7705	>StrtL1[1])	Start breaker failure protection L1 (phase segregated initiation) [1])
7706	>StrtL2[1])	Start breaker failure protection L2 (phase segregated initiation) [1])
7707	>StrtL3[1])	Start breaker failure protection L3 (phase segregated initiation) [1])

[1]) only with 7SV600*–*****–**1** [2]) only with common phase initiation

Table 5.1 Marshalling possibilities for binary inputs

The complete pre-settings are listed in Table 5.2 for version 7SV600*–*****–0 (common phase initiation), in Table 5.3 for version 7SV600*–*****–1 (phase segregated initiation).

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	BINARY INPUTS		Heading of the address block
6 1 MARSH BI 1	6 1 BI 1 1 > Strt 3p	7703	Start breaker failure protection three-pole (common phase initiation)
6 1 MARSH BI 2	6 1 BI 2 1 > Releas	7702	Release initiation signal (2nd channel)
6 1 MARSH BI 3	6 1 BI 3 1 > CB 1pC	355	Circuit breaker closed (from CB auxiliary contact)

Table 5.2 Preset binary inputs for version 7SV600*–*****–0 (common phase initiation)

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	BINARY INPUTS		Heading of the address block
6 1 MARSH BI 1	6 1 BI 1 1 > Strt L1	7705	Start breaker failure protection L1 (phase segregated initiation)
6 1 MARSH BI 2	6 1 BI 2 1 > Strt L2	7706	Start breaker failure protection L2 (phase segregated initiation)
6 1 MARSH BI 3	6 1 BI 3 1 > Strt L3	7707	Start breaker failure protection L3 (phase segregated initiation)

Table 5.3 Preset binary inputs for version 7SV600*–*****–1 (phase segregated initiation)

5.5.3 Marshalling of the signal output relays – address block 62

The unit contains 2 signal outputs (alarm relays). These signal relays are designated SIG.RE 1 and SIG.RE 2 and can be marshalled in address block 62. The block is reached from the initial display by pressing the key ▽ to the first main menu item ”PARAME.” (parameters) in the first operation level of the menu tree. Press key ▷ to reach the second operation menu level, which starts with the first parameter block ”00 CONF.” (configuration). Press the key ▽ repeatedly until address block ”60 MARSH” (marshalling) appears. Key ▷ leads to operation level 3 with address block ”61 MARSH BIN INP” (marshalling of binary inputs); key ▽ leads to address block ”62 MARSH SIG REL” (marshalling signal relays) (refer also to Figure 5.9).

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 routed to several physical signal relays (see also Section 5.5.1).

Table 5.4 gives a listing of all annunciation functions with the associated function numbers FNo.

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 marshalling for signal relay 1. Table 5.5 shows all signal relays as preset from the factory.

Note as to Table 5.4: Annunciations which are indicated by a leading ">" sign, represent the direct confirmation of the binary inputs and are available as long as the corresponding binary input is energized.

Further information about annunciations see Section 6.4.

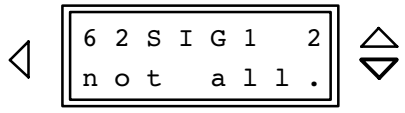
[6200]
Beginning of the block "Marshalling of the output signal relays"

The first signal relay is reached with the key ▷:

[6201]
Allocations for signal relay 1

Change over to the selection level with ▷:

[6202]
Signal relay 1 has been preset for:
At least one protection function is operative, FNo 52;



[6203]
no further functions are preset for signal relay 1

Following codeword input, all marshallable functions can be paged through the display by repeated use of the key ⊞. Back-paging is possible with the key ⊟. When the required function appears press the execute key **E**. After this, further functions can be allocated to the same signal relay (with further index numbers 1 to 20) 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 all.`" (not allocated).

Leave the selection level with key ◁. You can go then to the next signal relay with the arrow key ▽.

FNo	Abbreviation	Description
1	not all.	No annunciation allocated
5	>LED r.	Reset LED indicators
51	Dev.OK	Device operative
52	operat.	At least one protection function is operative
355	>CB 1pC[2])	Circuit breaker closed (from CB auxiliary contact)
501	FT det	General fault detection of device
511	DEV.Trp	General trip of device
1174	CBtest	Circuit breaker test in progress
1185	CBtpTST	Circuit breaker test: Trip 3pole
1403	>BF blo[2])	Block circuit breaker failure protection [2])
1421	>CBdef.[2])	Circuit breaker defective [2])

[1]) only with 7SV600*–*****–**1** [2]) only with common phase initiation

Table 5.4 Marshalling possibilities for signal relays and LEDs (continued next page)

FNo	Abbreviation	Description
1451	BF off	Breaker failure protection is switched off
1452	BF bloc	Breaker failure protection is blocked
1455	BF flt	Breaker failure fault detection (initiated)
7701	>LO Res	Lock-out reset (trip circuit seal-in)
7702	>Releas[2])	Release initiation signal (2nd channel) [2])
7703	>Strt3p[2])	Start breaker failure protection three-pole (common phase initiation) [2])
7704	>St.woI[2])	Start breaker failure protection three-pole without current [2])
7705	>StrtL1[1])	Start breaker failure protection L1 (phase segregated initiation) [1])
7706	>StrtL2[1])	Start breaker failure protection L2 (phase segregated initiation) [1])
7707	>StrtL3[1])	Start breaker failure protection L3 (phase segregated initiation) [1])
7710	TripT1	Breaker failure protection: Trip with T1 (1st stage)
7711	TripT2	Breaker failure protection: Trip with T2 (2nd stage)
7712	TripCBd[2])	Breaker failure protection: Trip with defective circuit breaker [2])
7713	TrpEndF[2])	End fault protection: Trip [2])
7714	TripSym	Current symmetry supervision: Trip on asymmetry (pole discrepancy)
7715	Supv.2c[2])	Supervision of two-channel initiation [2])
7716	Supv.2p[1])	Supervision of wrong two-phase initiation
7717	Supv.L1[1])	Supervision of initiation L1; initiation without current [1])
7718	Supv.L2[1])	Supervision of initiation L2; initiation without current [1])
7719	Supv.L3[1])	Supervision of initiation L3; initiation without current [1])
7720	SupvSym	Supervision of current symmetry
7721	LockOut	Lock-out state
7726	BF Warn	Breaker failure protection: Warning (common alarm)
7727	BF Fail	Breaker failure protection: Failure (common failure message)
7728	BF act.	Breaker failure protection active (operational)

[1]) only with 7SV600*–*****–**1** [2]) only with common phase initiation

Table 5.4 Marshalling possibilities for signal relays and LEDs

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	SIGNAL RELAYS		Heading of the address block
6 2 MARSH SIG. RE 1	6 2 SIG1 1 operat.	52	At least one protection function is operative
6 2 MARSH SIG. RE 2	6 2 SIG2 1 FT det	501	General fault detection of device

Table 5.5 Preset annunciations for signal relays

5.5.4 Marshalling of the LED indicators – address block 63

The unit contains 6 LEDs for optical indications, 4 of which can be marshalled. They are designated LED 1 to LED 4 and can be marshalled in address block 63. The block is reached from the initial display by pressing the key ▽ to the first main menu item ”PARAME.” (parameters) in the first operation level of the menu tree. Press key ▷ to reach the second operation menu level, which starts with the first parameter block ”00 CONF.” (configuration). Press the key ▽ repeatedly until address block ”60 MARSH” (marshalling) appears. Key ▷ leads to operation level 3 with address block ”61 MARSH BIN INP” (marshalling of binary inputs); key ▽ (twice) leads to address block ”63 MARSH LED IND” (marshalling LED indicators) (refer also to Figure 5.9).

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 routed 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 or unstored mode. Each annunciation function is displayed with the index `m` (for **m**emorized) or without index (for not memorized) when proceeding with the key ⊞.

The marshallable annunciation functions are the same as those listed in Table 5.4.

The changed function 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 (Fig 6.1). The following boxes show, as an example, the assignment for LED 1. Table 5.6 shows all LED indicators as they are preset from the factory.

[6300]
Beginning of the block ”Marshalling of the LED indicators”

The first marshallable LED is reached with the key ▷:

[6301]
Allocations for LED 1”

Change over to the selection level with ▷:

[6302]
LED 1 has been preset for:
1st: Breaker failure protection is blocked, not memorized, FNo `1452`

[6303]
No further functions are preset for LED 1

Following codeword input, all marshallable functions can be paged through the display by repeated use of the key ⊞. Back-paging is possible with the key ⊟. When the required function appears press the execute key **E**. After this, further functions can be allocated to the same LED indicator (with further index numbers 1 to 20) 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 all.`” (not allocated).

Leave the selection level with key ◁. You can go then to the next LED indicator with the arrow key ▽.

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	LEDs		Heading of the address block
6 3 MARSH LED 1	6 3 LED 1 1 BF blo	1452	Breaker failure protection blocked; not memorized
6 3 MARSH LED 2	6 3 LED 2 1 BF Warn	7726	Breaker failure protection: Warning (common alarm); not memorized
6 3 MARSH LED 3	6 3 LED 3 1 FD det	501	General fault detection of the device; not memorized
6 3 MARSH LED 4	6 3 LED 4 1 DEV.TrpM	511	General trip of device; memorized

Table 5.6 Preset LED indicators

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

The unit contains 2 trip relays which are designated CMD.RE 1 and CMD.RE 2. Each trip relay can be controlled by up to 20 logical commands. The trip relays can be marshalled in the address block 64. The block is reached from the initial display by pressing the key ▽ to the first main menu item ”PARAME.” (parameters) in the first operation level of the menu tree. Press key ▷ to reach the second operation menu level, which starts with the first parameter block ”00 CONF.” (configuration). Press the key ▽ repeatedly until address block ”60 MARSH” (marshalling) appears. Key ▷ leads to operation level 3 with address block ”61 MARSH BIN.INP” (marshalling of binary inputs); repeated pressing of the key ▽ leads to address block ”64 MARSH CMD.REL” (marshalling command relays).

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 routed to several trip relays (see also Section 5.5.1).

Most of the annunciation functions in accordance with Table 5.4, can be marshalled to output command relays. But those listed in Table 5.7 are particularly suitable for trip relay output. Regard the table as a recommended pre-selection.

The assignment of the trip relays as delivered from factory is shown in the general diagrams in Appendix A. The following boxes show examples for marshalling of trip relays 1.Table 5.8 shows all trip relays as preset from the factory.

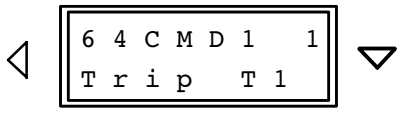
If further protection functions shall trip the same breaker, the assigned trip relay must be triggered by the corresponding command functions.

[6400]
Beginning of the block ”Marshalling of the trip relays”

The first trip relay is reached with the key ▷:

[6401]
Allocations for trip relay 1

Change over to the selection level with ▷:



[6402]
Trip relay 1 has been preset for:
1st: Trip signal after T1 (1st stage), FNo 7710

[6404]
no further functions are preset for trip relay 1

Following codeword input, all marshallable functions can be paged through the display by repeated use of the key ⊞. Back-paging is possible with the key ⊟. When the required function appears press the execute key **E**. After this, further functions can be allocated to the same trip relay (with further index numbers 1 to 20) 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 all." (not allocated).

Leave the selection level with key ◁. You can go then to the next command relay with the arrow key ▽.

FNo	Abbreviation	Logical command function
1	not all.	No function allocated
501	FT det	General fault detection of the device
511	DEV.Trp	General trip command of the device
1185	CBtpTST	Circuit breaker test: live trip [1])
7710	TripT1	Breaker failure protection: Trip with T1 (1st stage)
7711	TripT2	Breaker failure protection: Trip with T2 (2nd stage)
7712	TripCBd[2])	Breaker failure protection: Trip with defective circuit breaker [2])
7713	TrpEndF[2])	End fault protection: Trip [2])
7714	TripSym	Current symmetry supervision: Trip on asymmetry (pole discrepancy)

[2]) only with common phase initiation

Table 5.7 Command functions

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	TRIP RELAYS		Heading of the address block
6 4 M A R S H C M D . R E 1	6 4 C M D 1 1 T r i p T 1	7710	Trip by breaker failure protection after T1 (1st stage)
6 4 M A R S H C M D . R E 2	6 4 C M D 2 1 T r i p T 2	7711	Trip by breaker failure protection after T2 (2nd stage)

Table 5.8 Preset command functions for trip relays

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

Figure 6.1 illustrates the front view.

A two-line, each 8 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 two figure number. This number presents the **setting address block**.

The keyboard comprises 9 keys with paging, Yes/No and control buttons. The significance of the keys is explained in detail in the following:

Keys for alteration of numerical values and alternative texts:

+	increasing a value or text item
-	decreasing a value or text item

Yes/No keys:

Y/J	Yes key: operator affirms the displayed question
N	No key: operator denies the displayed question; this key serves either as reset key for stored LED indicators and fault annunciations

Keys for scrolling and paging:

▽	Scrolling forwards: the next display line or menu item is displayed
△	Scrolling backwards: the previous display line or menu item is displayed
▷	Paging to the next operation level: the operation object of the next operating level is displayed
◁	Paging to the previous operation level: the operation object of the previous operating level is displayed

Confirmation key:

E	Enter or confirmation key: each change via the "Yes"/"No"–keys or the ⊞ or ⊟ 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.

Stored LED indications on the front and the fault annunciation buffer can be erased via the "No"–key" **N**. During reset operation the assigned 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.

6.2.2 Operation with a personal computer

A personal computer (with operating system MS WINDOWS) allows, just as the operator panel, all the appropriate settings, initiation of test routines and read-out of data, but with the added comfort of screen-based visualization and a menu-guided procedure. The PC program DIGSI® is available for setting and processing of all digital protection data.

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.

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. A survey of the suitable operating programs and further accessories is shown in Section 2.3 Ordering data.

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 interface which concern the operation on the relay, for example

– setting of functional parameters (thresholds, functions),

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

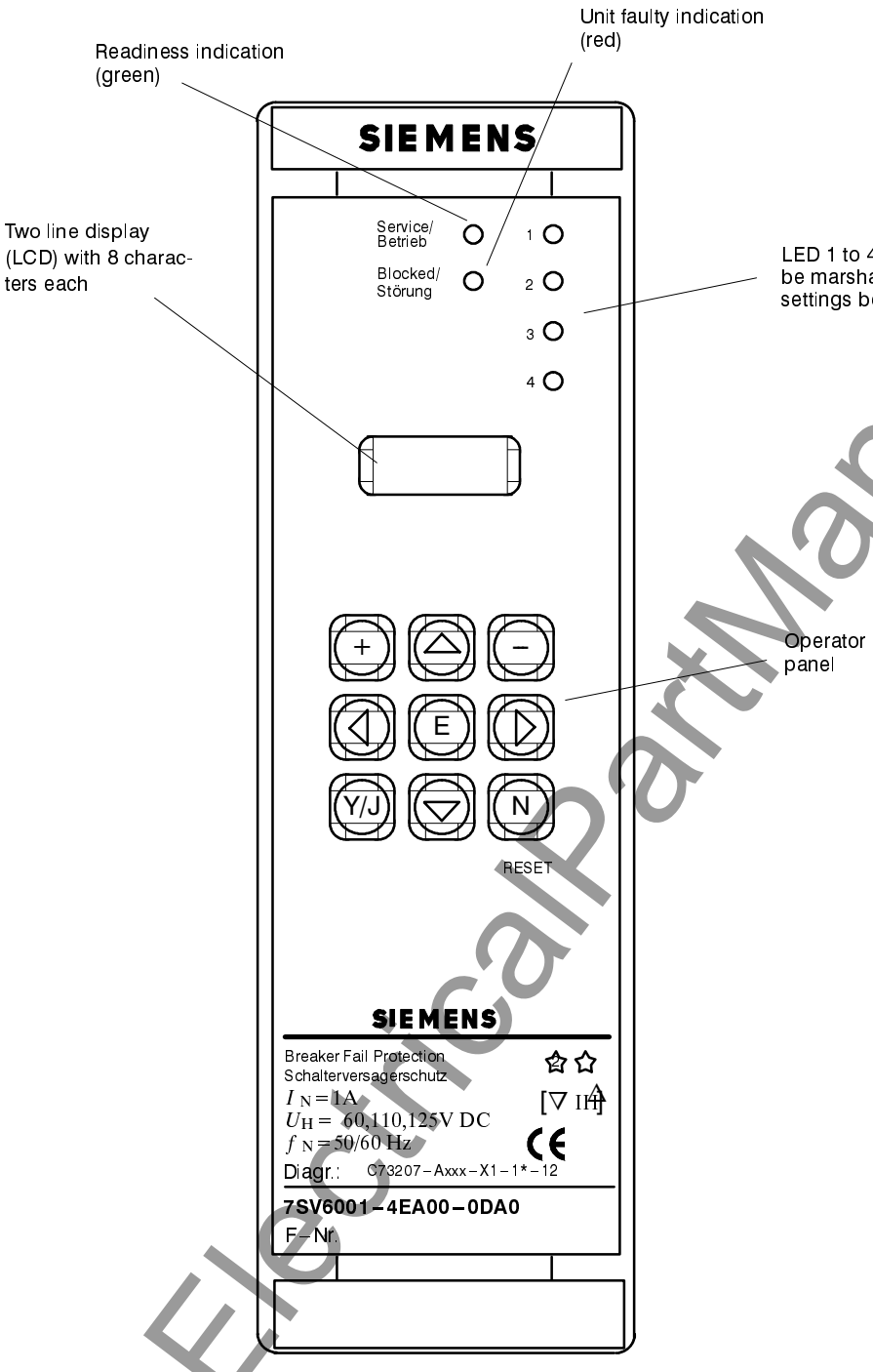
– configuration parameters for operation language, interface and device configuration,

– initiation of test procedures.

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 Circuit breaker failure protection blocked
2 Circuit breaker failure protection: Common alarm
3 Device: General fault detection
4 Device: General trip

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

The operating surface is built up by a hierarchically structured menu tree, which can be passed through by means of the scrolling keys ▷ , ◁ , ▽, and △. Thus, each operation object can be reached. A complete overview is listed in Appendix C.

From the initial display, the key ▽ is used to switch to the first operation item "PARAME." (parameters) which contains all setting and configuration blocks of the device (see Figure 6.2). Key ▷ is pressed to change to the next operation level. The display shows the first item "CONF." (configuration), which is described in Section 5.3 and 5.4.

Pressing the key ▽ leads to the first parameter block "01 POWER SYST.DAT" (power system data). Further parameter blocks can be called up with the scrolling keys ▽ or △.

The key ▷ changes to the third operation level where the individual functions and values are set; refer to Figure 6.2. They are explained in detail in the following sections.

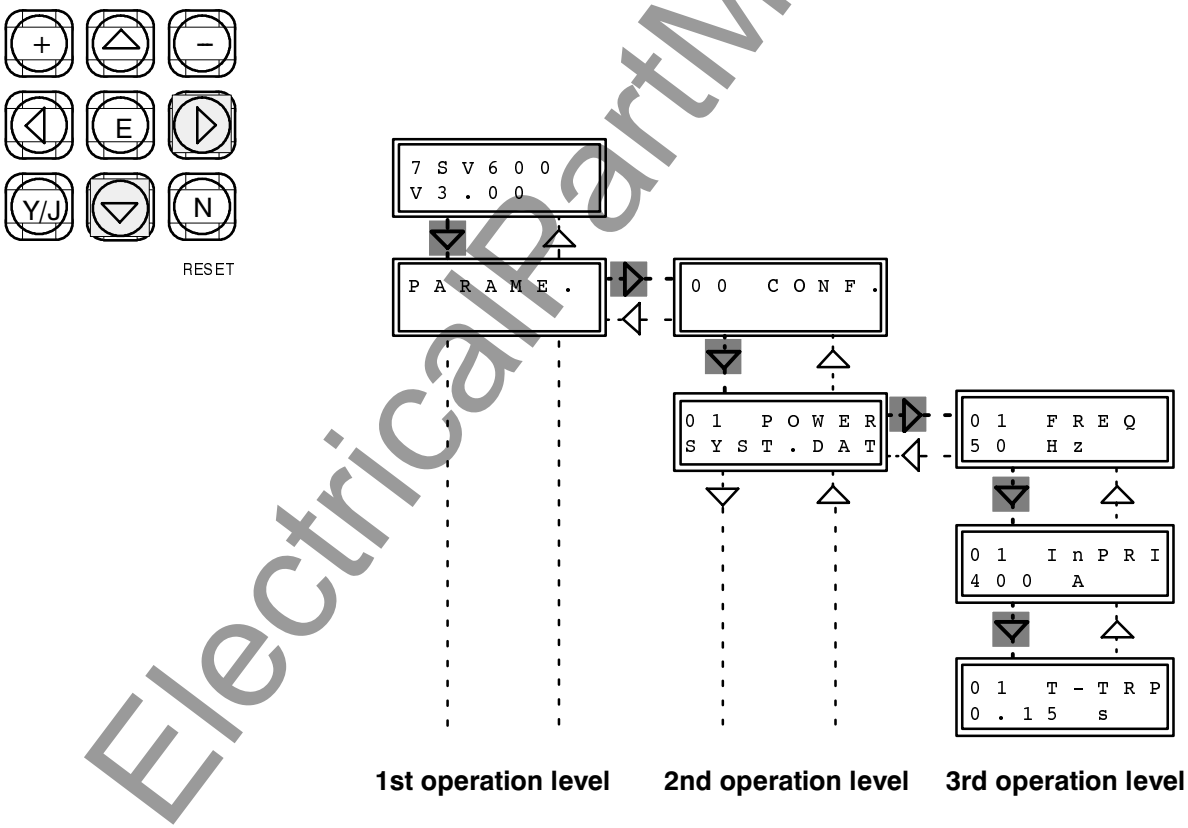


Figure 6.2 Selection of the power system data

For setting the functional parameters it is necessary to enter the codeword (see Section 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

  Displayed text forms the heading of this address block. The address block is identified by the block number (two digit number). No input is expected. By using keys ▽ or △ the next or the previous block can be selected. By using the key ▷ the next operation level can be reached.

– Addresses which require numerical input

  The display shows the two-digit block number in the first line. Behind the block number appears the meaning of the required parameter in abbreviated form, 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) operation level. If the value needs to be altered, it can – after codeword input – be increased with the keys ⊞ or decreased with the key ⊟. When one of the keys, ⊞ or ⊟, is pressed continuously, the numbers will change with an accelerating sequence. Thus, a fast and fine adjustment is possible within a wide setting range. The permissible setting range is given in the following text, next to the associated box. When the highest possible value is reached, no further changing with the key ⊞ is possible. The same is valid when one tries to change the lowest value with the key ⊟. **The selected value must be confirmed with the entry key E!** The display then confirms the accepted value. The changed parameter is effective after this confirmation.

– Addresses which require text input

  The display shows the two-digit block number and the meaning of the required parameter and 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) operation level. If the text needs to be altered, press – after codeword input – the key ⊞ (or ⊟). The next (or previous) alternative text, also printed in the display boxes illustrated in the following sections, then appears. If the alternative text is not desired, then the key ⊞ (or ⊟) is pressed again, etc. The alternative which is chosen, **is confirmed with the entry key E.** When the last possible alternative is reached, no further changing with the key ⊞ is possible. The same is valid when one tries to change the first alternative with the key ⊟.

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 ▷ ◁ besides the illustrated display boxes indicate the method of moving from block to block or within the block. Unused addresses are automatically passed over.

When the relay is operated from a personal computer by means of the protection data processing program DIGSI®, each functional parameter is identified by a four-digit address number. In the following clarifications, this number is indicated at the beginning of the explanations in brackets.

If one tries to leave an operating item or operating level by pressing one of the arrow keys without having confirmed an alteration with the enter key **E**, the display will show the question “SAVE NEW SETTING?”. Confirm with the “Yes”–key **Y**/**J** that the new settings shall become valid now. If you press the “No”–key **N** instead, codeword operation will be aborted, and the alteration which has been changed since the last entry is lost. Thus, erroneous alterations can be made ineffective. Press the arrow key once again in order to change really the operating item or level.

When the setting process is terminated by pressing the enter key **E**, the altered parameters are permanently secured in EEPROMs and protected against power outage.

6.3.1.2 Setting of date and time

The date and time should be set when the relay is finally installed and connected to the supply voltage.

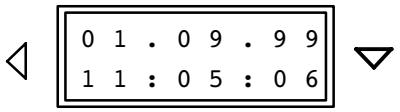
From the initial display, the key ▽ is pressed (three times) until the menu item “ADDITION FUNCTION” (“additional functions”) is displayed. Key ▷ is pressed to change to the next operation level. The display shows the first item “TIME SETTING”. Change to the third operation level with key ▷. The actual date and time is displayed now. Scroll on with key ▽ to find the setting items for date and time, as illustrated below.

After the relay has been switched on, first the date “01.01.95” appears and the time since the start-up of the processor system.

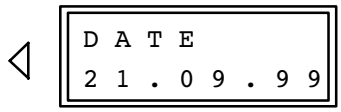
The next two addresses allow to set date and time. Codeword entry is not required. Day, month, and year can be altered using the keys ⊞ and ⊟. Each time a value is changed, the enter key **E** must be pressed, before the next number can be changed. Proceed in analog manner to change the time.

Note: When the day is changed, the display firstly allows 31 days. Only when the month and year is changed, the relay can check plausibility of the complete date. After confirmation with the enter key **E**, the day may be reduced to an existing number.

[8100]
Beginning of the block ”Setting the real time clock”

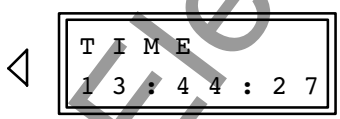


[8101]
At first, the ”actual” date (**DD.MM.YY**) and the ”actual” time (**HH.MM.SS**) are displayed.
Continue with ▽.



[8102]
Enter the new date: 2 digits for day, 2 digits for month and 2 digits for year: **DD▷ MM ▷ YY**

Use key ⊞ to increase the day or ⊟ to decrease;
use key ▷ to change over to the month;
use key ⊞ to increase the month or ⊟ to decrease;
use key ▷ to change over to the year;
use key ⊞ to increase the year or ⊟ to decrease;
confirm with enter key **E**.



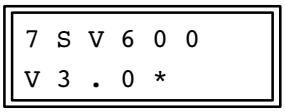
[8103]
Key ▽ is used to come to the time setting. Enter the new time: 2 digits for hour, 2 digits for minute: **HH ▷ MM**

Use key ⊞ to increase the hour or ⊟ to decrease;
use key ▷ to change over to the minute;
use key ⊞ to increase the minute or ⊟ to decrease;

the seconds are not changed. They are automatically set to ”00” when the enter key **E** is pressed.

6.3.2 Initial display

When the relay is switched on, firstly the type identification of the relay and the version of the implemented firmware appears. All Siemens relays have an MLFB (machine readable order number). Approximately 30 s after the relay has been switched on, the display shows the quiescent messages, i.e. the measured values of the currents I_{L1} and I_{L2}. When the keys ▽ and subsequently △ is pressed, the initial display is shown again.

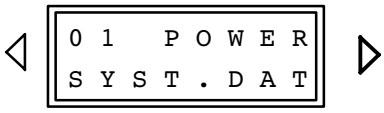


The relay introduces itself by giving its type number. The second display line shows the version of firmware with which it is equipped.

The setting parameters start at address block 01. This block is reached by pressing the key ▽ (refer also to Figure 6.2), with ▷ to the second operation level (”00 CONFIG.”), with ▽ to block ”01 POWER SYST.DAT” (power system data). Further address possibilities are listed under ”Annunciations” and ”Tests”.

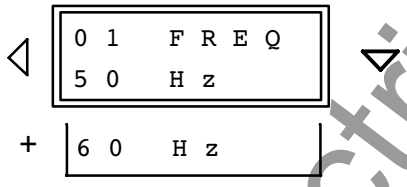
6.3.3 Power system data – address block 01

The relay requests basic data of the power system and the switchgear.



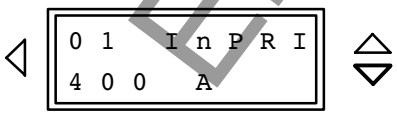
[1100]
Beginning of the block ”Power system data”

Firstly, the rated system frequency can be changed. It must comply with the setting. If the system frequency is not 50 Hz, the address must be changed.

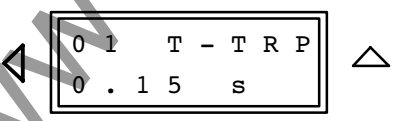


[1101]
Rated system frequency *50 Hz* or *60 Hz*

The rated primary current does not affect the protection functions but is used for scaling of the fault recording data. Next, the minimum trip command duration T–TRP can be set.



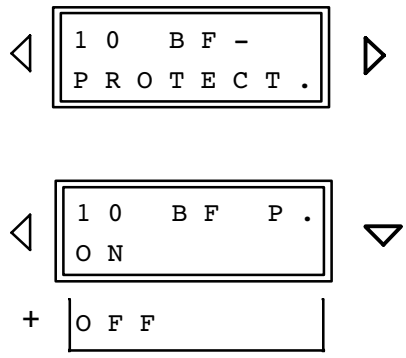
[1105]
Current transformer primary rated current
Smallest setting value: **10** A
Largest setting value: **50000** A



[1134]
Minimum duration of the trip command
Smallest setting value: **0.01** s
Largest setting value: **32.00** s

In order to come to the next address block, key ◁ is pressed to return to the previous operation level, and subsequently ▽ is pressed which will lead to the next address block 10.

6.3.4 Settings for circuit breaker failure protection – address block 10



[1200]
Beginning of the block ”Breaker failure protection”

[1201]

Switching *ON* of the breaker failure protection

Switching *OFF* of the breaker failure protection

Depending on the ordered version of the device, different possibilities exist for the initiation of the breaker failure protection:

– Initiation by the common trip command of the feeder protection (all versions). The trip command is three-pole, but current flow through each of the breaker poles is monitored individually. The current threshold I–BF (address 1202) shall be selected such that the protection will operate at the smallest expected short-circuit current. To be sure of this, the value should be 10 % less than the minimum anticipated fault current. On the other hand, the value should not be set lower than necessary.

– Initiation by the phase segregated trip commands of the feeder protection (only with 7SV600*–*****–**1**). The trip commands may be single-pole or three-pole. In each case, current flow through each of the breaker poles is monitored individually. The current threshold I–BF (address 1202) shall be selected such that the protection will operate at the smallest expected short-circuit current. To be sure of this, the value should be 10 % less than the minimum anticipated fault current. On the other hand, the value should not be set lower than necessary.

– Initiation by the trip command of a protection or supervision device which does not necessarily react to short-circuit current (e.g. Buchholz protection). The circuit breaker auxiliary contact is the criterion for the breaker reaction in this case. This is possible with all version but only in the common phase initiation mode; trip is always three-pole.

The breaker failure protection 7SV600 can be operate single-stage or two-stage:

– With single-stage operation, the adjacent circuit breakers (i.e. the breakers of the bus-bar zone and – if transmission of the signal is possible – the breaker at the remote end) are tripped after a delay time following initiation. Normally, this delay time is T1. The delay time T2 is set ineffective in this case. An example of the time sequence is illustrated in Figure 6.3.

– With two-stage operation, the trip command is repeated after a time delay T1 to the local feeder breaker, normally to a different tripping coil of this breaker. After a further delay time T2 (address 1205), the adjacent circuit breakers (i.e. the breakers of the bus-bar zone and – if signal transmission is possible – the breaker at the remote end) are tripped provided the fault has not yet been cleared. An example of the time sequence is illustrated in Figure 6.4.

– When phase segregated initiation is used (only with 7SV600*–*****–**1**), the time delay T1 of the first stage can be different after single-pole trip (T1–1P, address 1203) and after three-pole trip (T1–3P, address1204) of the feeder breaker. This allows, with two-stage operation, to wait for the breaker reaction in case of single-pole trip of the feeder protection but to repeat the local trip command (first stage) immediately in case of three-pole trip (T1–3P = 0).

The delay times are determined from the maximum operating time of the feeder circuit breaker, the reset time of the current detectors of the breaker failure protection, plus a safety margin which allows for any tolerance of the delay timers. The time sequence is illustrated in Figure 6.3 for single-stage breaker failure protection, and in Figure 6.4 for two-stage breaker failure protection.

For sinusoidal currents one can assume that the reset time of the current detectors is less than 10 ms but if current transformer saturation is expected then 20 ms should be calculated.

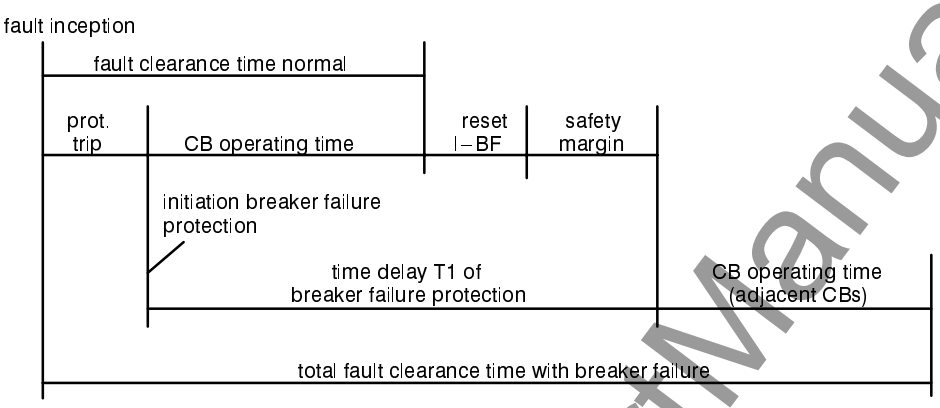


Figure 6.3 Time sequence example for normal clearance of a fault, and with circuit breaker failure, using single-stage breaker failure protection

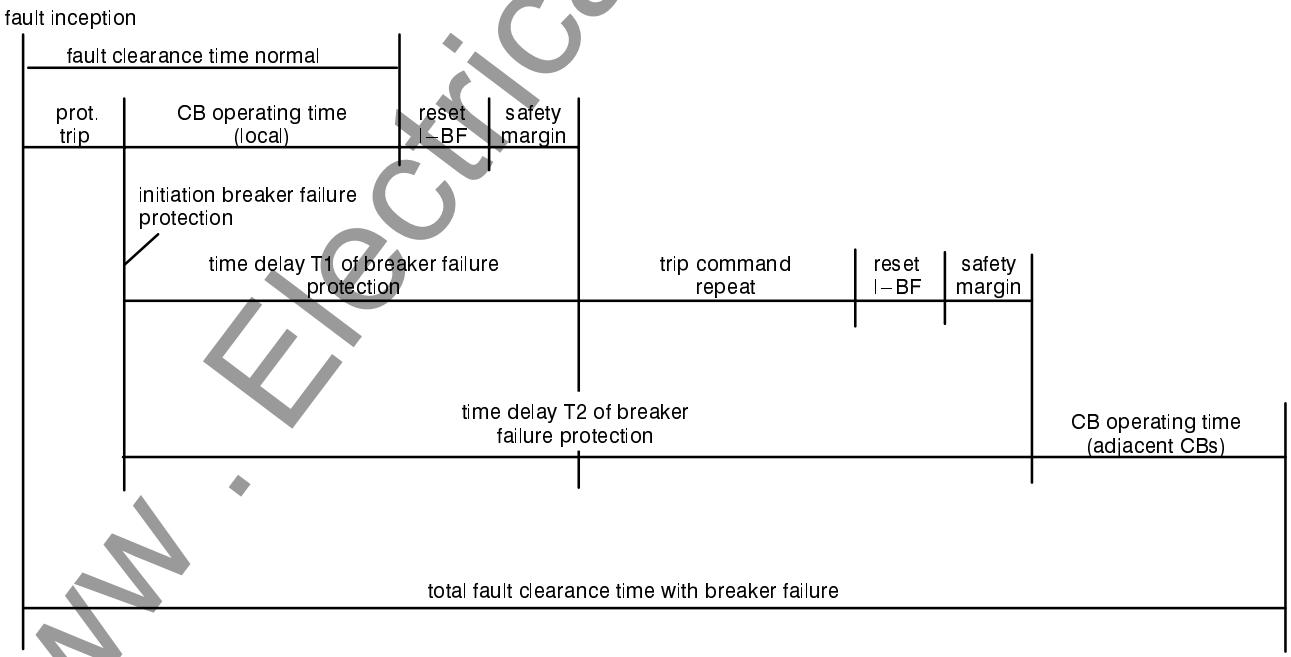
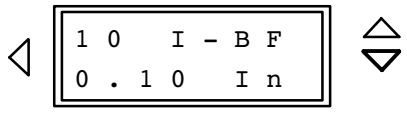
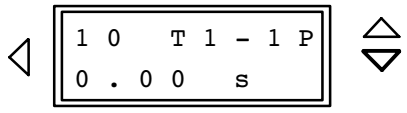


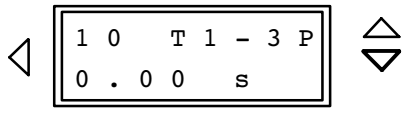
Figure 6.4 Time sequence example for normal clearance of a fault, and with circuit breaker failure, using two-stage breaker failure protection



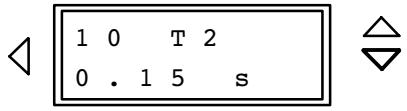
[1202]
Pick-up value of the current detector of the breaker failure protection
Setting range: **0.05** I_N to **4.00** I_N



[1203] **Only for 7SV600*–*****–1 in phase-segregated initiation mode** (1/3–POLE)
Delay time for trip signal repetition to the local feeder breaker (1st stage) after single-pole trip command of the feeder protection
Setting range: **0.00** s to **32.00** s
and ∞ (no trip with 1st stage after single-pole trip)



[1204]
Delay time for trip signal repetition to the local feeder breaker (1st stage) after three-pole trip command of the feeder protection
Setting range: **0.00** s to **32.00** s
and ∞ (no trip with 1st stage after three-pole trip)



[1205]
Delay time of the trip signal to the adjacent breakers (bus-bar) (2nd stage)
Setting range: **0.00** s to **32.00** s
and ∞ (no trip with 2nd stage)

When the breaker failure protection can be initiated by a feeder protection function or supervisory device whose trip command is not necessarily combined with a considerable current flow (e.g. Buchholz protection of a transformer feeder), address 1206 must be set to *YES*. The trip command of this feeder protection must be led to the binary input function "`St.woI`" (Start without current). This binary input is available only in operation mode "Common phase initiation".

[1206] **Only for common phase initiation**
Drop-off criteria are: the disappearance of current AND open breaker indication from the CB auxiliary contact
NO or
YES

6.3.5 Settings for end protection – address block 11

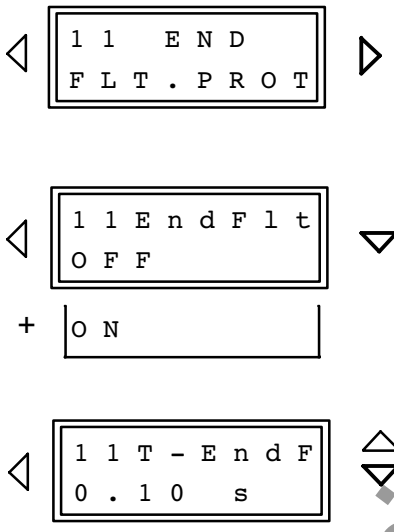
This address block is only available in operation mode with common phase initiation of the breaker failure protection.

The delay time of the end fault protection is set under address 1302. An end fault is a short-circuit between the circuit breaker and the current transformer set of the feeder.

If, during an end fault, the circuit breaker is tripped by a reverse fault stage of the feeder protection or by the bus-bar protection (the fault is a bus-bar fault as determined from the location of the current transformers), the fault current will continue, because it is fed from the remote end of the feeder circuit.

The time T–EndF (address 1302) is started when, during start conditions of the breaker failure protection, the circuit breaker auxiliary contacts indicate open poles and, at the same time, current flow is detected (address 1202). The trip command of the end fault protection is intended for the transmission of an intertrip signal to the remote end circuit breaker.

Thus, the delay time is set such that it can bridge out short transient end fault conditions which seem to occur during switching of the breaker.



[1300] **Only for common phase initiation**
Beginning of the block “End fault protection”

[1301]

Switching *OFF* of the end fault protection

Switching *ON* of the end fault protection

[1302]
Trip time delay of the end fault protection
Setting range: **0.00** s to **32.00** s
and ∞ (no trip by end fault protection)

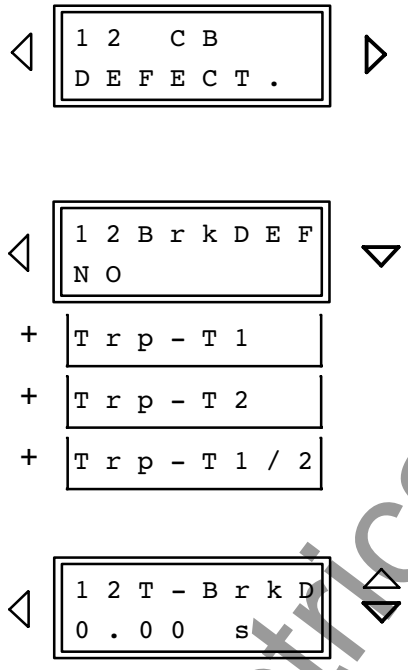
6.3.6 Settings for the breaker being not operational – address block 12

This address block is only available in operation mode with common phase initiation of the breaker failure protection.

When the circuit breaker of the feeder is not operational (e.g. when the tripping voltage or the tripping energy is not available), it is clear that the feeder breaker cannot clear the fault. If the device is informed about this disturbance (via the binary input "`>CB def.`", the adjacent circuit breakers (bus-bar and remote end if applicable) can be tripped immediately (or after a brief delay T–BrkD).

Address 1401 BrkDEF determines to which command output this trip signal is forwarded: either to the output of the first stage *Trp–T1*, or to the output of the second stage *Trp–T2*, or to both *Trp–T1/2*. With setting *NO* no special reaction occurs in case of circuit breaker disturbance. Select that output which trips the adjacent (bus-bar) breakers: normally *T1* for single-stage, and *T2* for two-stage protection.

The delay time T–BrkD is normally set to 0 since the feeder fault should be cleared by the adjacent breakers as soon as possible.



[1400] **Only for common phase initiation**
Beginning of the block "Reaction in case the feeder circuit breaker is defective"

[1401]
Selection to which trip output the trip command is forwarded when the feeder breaker is defective:
to *NO*ne or
to the output of *Trip–T1* (first stage)
to the output of *Trip–T2* (second stage)
to the output of *Trip–T1/2* (both stages)

[1402]
Time delay for trip with defective breaker
Setting range : **0.00** s to **32.00** s
and ∞ (no trip with defectve breaker)

6.3.7 Settings for trip circuit seal-in (reclose lock-out) – address block 13

When the trip circuit seal-in feature is activated, the trip command(s) are sealed until they are reset manually at the device front, via a binary input (if allocated), or the serial interface. This locks reclosing of the breaker because, normally, closing is impossible as long as a trip command is hanging-on.

This lock-out can be switched off (address 1501 L–Out = *NO*). Alternatively the trip output(s) can be selected that should be sealed: Trip output *Trp–T1* (first stage), *Trp–T2* (second stage) or *Trp–T1/2* (both stages).

Address 1502 LORes (Lock-Out Reset) determines the source from which the seal-in can be cancelled: via the local push-*button* on the front of the device, or via the serial interface using the protocol *IEC60870*, or via both: *but*/*IEC*.

◁ | 1 3 T R I P L O C K O U T | ▷

[1500]
Beginning of block “Trip lock-out”

◁ | 1 3 L - O u t N O | ▽

[1501]
Selection to which trip output should cause lock-out:

*NO*ne or

\+ | T r p - T 1 |

output of *Trip–T1* (first stage)

\+ | T r p - T 2 |

output of *Trip–T2* (second stage)

\+ | T r p - T 1 / 2 |

output of *Trip–T1/2* (both stages)

◁ | 1 3 L O R e s b u t t o n | ▽

[1502]
Lock-out can be reset via

the local reset *button* (**N**–key) or

\+ | I E C 6 0 8 7 0 |

the serial interface using the *IEC60870*–5–103–protocol or

\+ | b u t /I E C |

all of the above sources

6.3.8 Settings for blocking of the breaker failure protection – address block 14

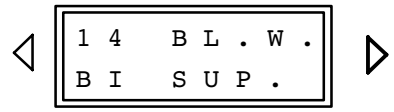
The reaction of the plausibility supervision of the initiation circuits can be selected in address block 14. When an implausibility is detected, this can be annunciated. Additionally, the breaker failure protection can be blocked completely.

Address 1601 determines generally whether the protection should be blocked on detection of an implausibility. In address 1602, the time delay for this blocking is set; recommended: some seconds.

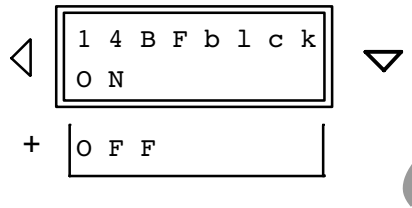
If the blocking facility is used, the causes can be selected in addresses 1603 and 1604.

If address 1603 Sup.2c is set to *YES*, the breaker failure protection is blocked on implausibility of the binary inputs which can initiate the protection. The common phase, two-channel initiation is implausible when only one of the two binary inputs is energized. The phase segregated initiation is implausible when exactly two of the three phase-dedicated inputs are energized. The latter is possible only with version 7SV600*–*****–**1** in the phase-segregated initiation mode.

In phase segregation initiation mode (only 7SV600*–*****–**1**), address 1604 can be set to *YES*. in order to block the protection on occurrence of implausibility. Implausibility is detected when any initiation signal occurs without current flow above the pick-up value of the current detector of the breaker failure protection (address 1202) .



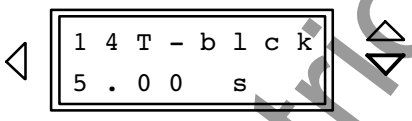
[1600]
Beginning of the block “Blocking of the breaker failure protection on an implausibility detected by the binary input supervision”



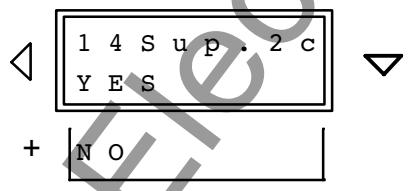
[1601] Blocking is completely

switched *ON* or

switched *OFF*



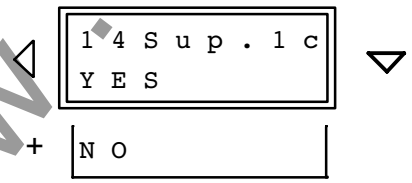
[1602]
Delay of blocking after detection of an implausibility
Setting range: **0.00** s to **32.00** s



[1603]
Blocking of the breaker failure protection on detection of incoincidence of two-channel initiation or 2-phase initiation with phase-segregated mode

YES or

NO



[1604] **Only with phase segregated initiation**
Blocking of the breaker failure protection on detection of initiation without current flow

YES or

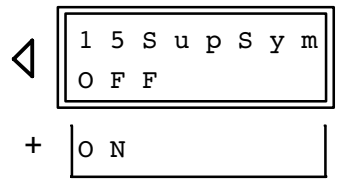
NO

6.3.9 Settings for measured value monitoring – address block 15

The sensitivity of the measured value monitoring can be changed in block 15. The factory settings are suitable in most cases. If particularly high operational asymmetries of the currents are expected, or if, during operation, one or more monitoring functions reacts sporadically, then sensitivity should be reduced.

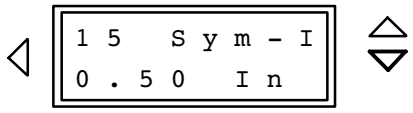
The current symmetry monitoring can be used as circuit breaker pole discrepancy supervision if the breaker poles can be tripped individually. In this case it must not be set too sensitive, and a delay Sym–T (address 1704) is necessary which is remarkable longer than the maximum opening time of a single breaker pole (during single-pole auto-reclosure). Under address1705 you can decide that the breaker should be tripped in case of longer asymmetry. This trip controls the output of the first stage T1. Note that this pole discrepancy trip must control only the local feeder breaker; therefore, it should be used only with two-stage breaker failure protection where the first stage trips only the feeder breaker.

[1700]
Beginning of the block “Current symmetry supervision”

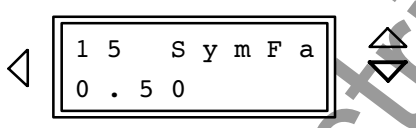


[1701]
Switch *ON* the current symmetry supervision

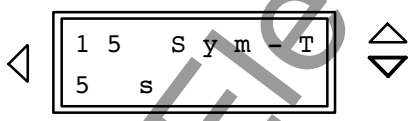
Switch *OFF* the current symmetry supervision



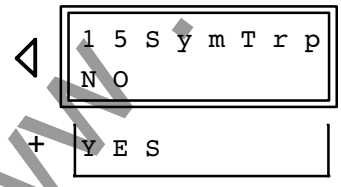
[1702]
Current threshold above which the symmetry monitoring is effective (see Figure 4.14)
Setting range: **0.10** I_N to **1.00** I_N



[1703]
Symmetry factor for the current symmetry = slope of the symmetry characteristic (see Figure 4.14)
Setting range: **0.10** to **0.95**



[1704]
Annunciation (and trip) delay of the current symmetry monitor
Setting range: **1** s to **32** s
and ∞ (no annunciation or trip with current asymmetry)



[1705]
Trip command shall be issued on occurrence of current asymmetry
NO or
YES

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,

Most of these annunciations can be 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 scroll with the key ▽ to the item ”ANNUNC.” (annunciations), refer to Figure 6.5. The key ▷ changes over to the second operation level, where you can reach the different groups of annunciations with the scrolling keys ▽ and △.

When the relay is operated from a personal computer by means of the protection data processing program DIGSI®, the annunciation groups are identified by a four-digit address number. In the following clarifications, this number is indicated at the beginning of the explanations in brackets.

The annunciations are arranged as follows:

Block 81 Operational annunciations; these are messages which may appear during the operation of the relay: information about condition of relay functions, measurement data etc.

Block 82 Event annunciations for the last eight network faults: pick-up, trip, expired times, or similar. As defined, a network fault begins with pick-up of any fault detector and ends after drop-off of the last protection function,

Block 84 Indication of operational measured values,

Block 85 Annunciations for operation statistics, that is counters for initiation occurrences and tripping commands.

The annunciations and measured values are arranged in lists. After paging to a certain annunciation block, an extract (two lines) of a list is shown in the display; the list can be scrolled by the keys ▽ and △, as illustrated in Figure 6.6.

[5000]
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.

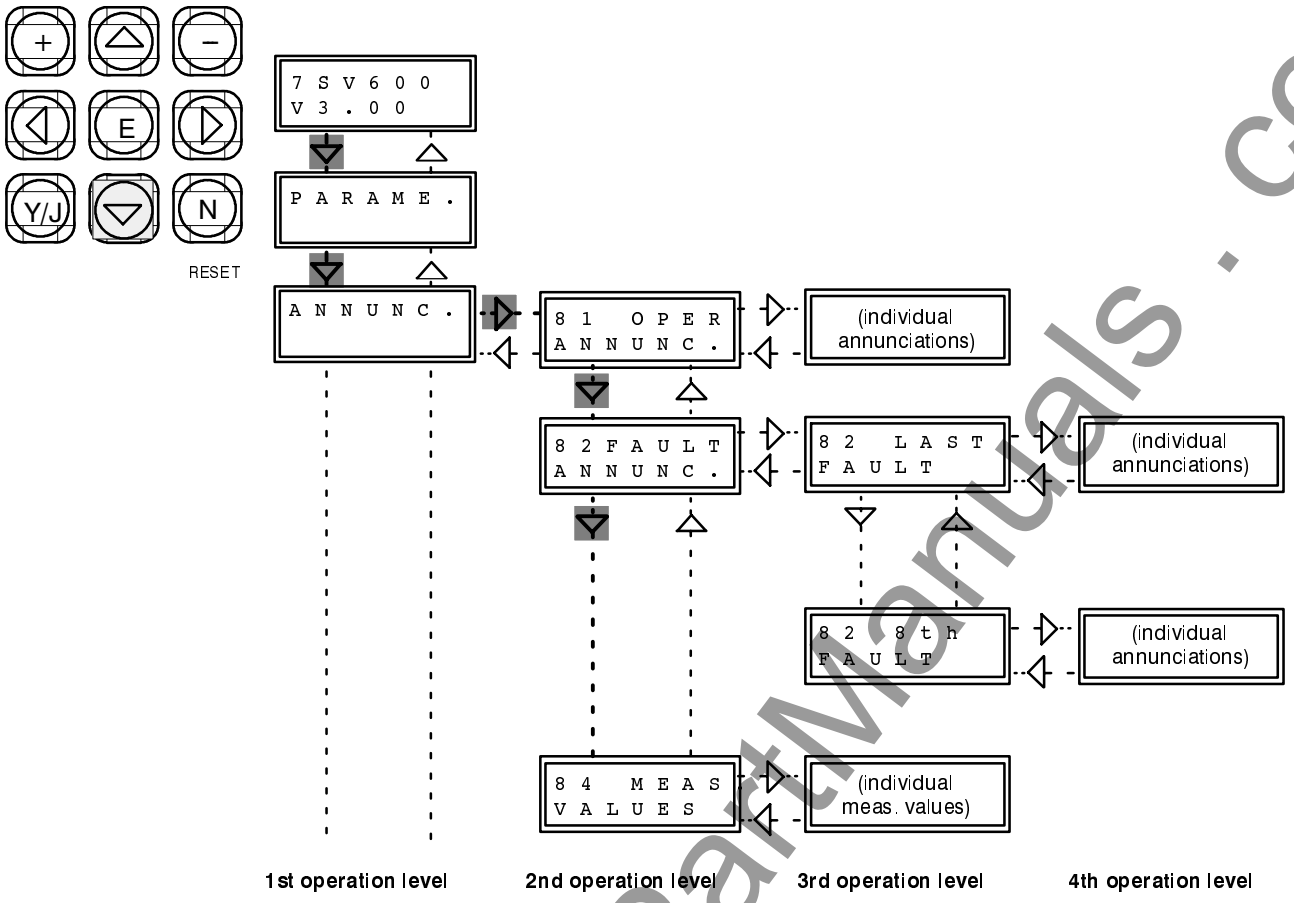


Figure 6.5 Selection of annunciation blocks

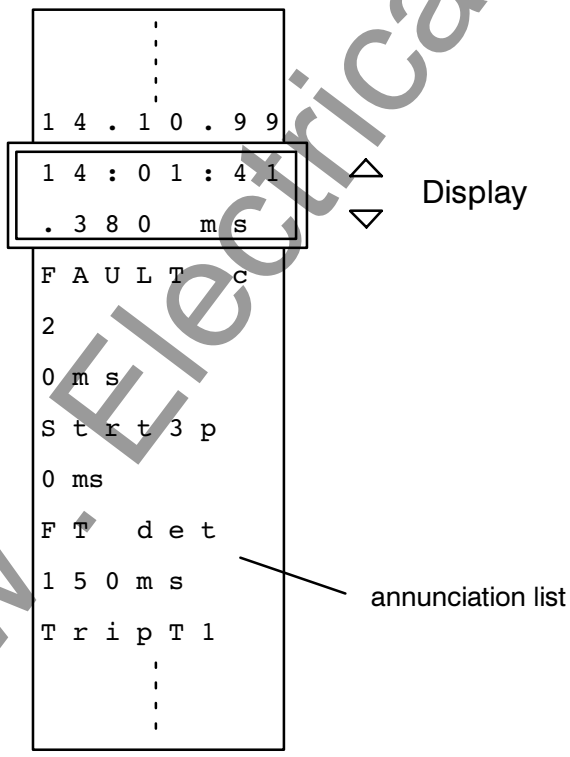


Figure 6.6 Display of an annunciation list – example

6.4.2 Operational annunciations – address block 81

Operational and status annunciations contain information which the unit provides during operation and about the operation. They begin at address block 81. Important events and status changes are chronologically listed, starting with the most recent message. Time information is shown in hours, minutes and seconds. Up to 30 operational indications can be stored. If more occur, the oldest are erased in sequence.

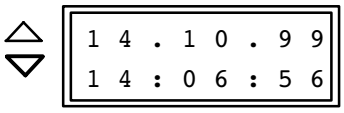
Faults in the network are only indicated as "Sys.Flt" together with the sequence number of the fault. Detailed information about the history of the fault is contained in the block "Fault annunciations"; refer to Section 6.4.3.

The input of the codeword is not required. 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**).

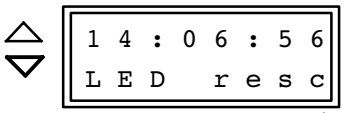
The first listed message is, as example, assigned with date and time in the first two lines; the third line shows the beginning of a condition with the character **c** to indicate that this condition occurred at the displayed time.

[5100]
Beginning of the block "Operational annunciations"



1st line: Date of the event or status change
2nd line: Time of the event or status change

Use the arrow keys to scroll through the displayed annunciation list.



1st line: Time of the event or status change
2nd line: Annunciation text, in the example **c**oming

When date and time have not yet been set (refer also to Section 6.5.1), the date is shown as 01.01.95, the time is given as relative time from the last re-start of the processor system.

Direct response from binary inputs:

> C B 1 p C	Circuit breaker closed (from CB auxiliary contact) (c/g)
> B F b l o	Block breaker failure protection (c/g)
> C B d e f .	Circuit breaker defective (c/g)
> R e l e a s	Release signal for breaker failure initiation (2nd channel, only for phase-common initiation mode with two-channel initiation (c/g)
> S t r t 3 p	Common-phase initiation (three-pole trip of feeder protection); only in common-phase initiation mode (c/g)
> S t . w o I	Common-phase initiation without current flow; only in common-phase initiation mode with breaker auxiliary contact (c/g)

> S t r t L 1	Phase segregated initiation L1 (trip of feeder protection); only 7SV600*–*****–1 in phase-segregated initiation mode (c/g)
> S t r t L 2	Phase segregated initiation L2 (trip of feeder protection); only 7SV600*–*****–1 in phase-segregated initiation mode (c/g)
> S t r t L 3	Phase segregated initiation L3 (trip of feeder protection); only 7SV600*–*****–1 in phase-segregated initiation mode (c/g)
> L O R e s	Reset of lock-out (trip seal-in) (c)

General operational annunciations of the protection device:

o p e r a t .	At least one protection function operative (c/g)
L E D r e s	Stored LED indications reset (c)
R E C d e l	Fault recording data deleted (c)
S y s . F l t	Network system fault (c/g), detailed information in the fault annunciations
> C B 1 p C	Circuit breaker is closed (c/g)

Annunciations of monitoring functions:

A N N l o s t	Annunciations lost (buffer overflow) (c)
P C a n n L T	Annunciations for operating (PC) interface lost (c)

Operational annunciations of breaker failure protection:

> B F b l o	Block breaker failure protection (c/g)
B F o f f	Breaker failure protection is switched off (c/g)
B F b l o c	Breaker failure protection is blocked (c/g)
B F a c t .	Breaker failure protection is operative (c/g)
> R e l e a s	Release signal for breaker failure initiation (2nd channel, only for phase-common initiation mode with two-channel initiation (c/g)
> S t r t 3 p	Common-phase initiation (three-pole trip of feeder protection); only in common-phase initiation mode (c/g)

> S t . w o I	Common-phase initiation without current flow; only in common-phase initiation mode with breaker auxiliary contact (c/g)
> S t r t L 1	Phase segregated initiation L1 (trip of feeder protection); only 7SV600*–*****–1 in phase-segregated initiation mode (c/g)
> S t r t L 2	Phase segregated initiation L2 (trip of feeder protection); only 7SV600*–*****–1 in phase-segregated initiation mode (c/g)
> S t r t L 3	Phase segregated initiation L3 (trip of feeder protection); only 7SV600*–*****–1 in phase-segregated initiation mode (c/g)
> L O R e s	Reset of lock-out (trip seal-in) (c)
L o c k O u t	Lock-out state (trip seal-in) (c/g)
B F W a r n	Breaker failure protection common warning annunciation (c/g)
B F F a i l	Breaker failure protection failure (c/g)

Operational annunciations of supervision functions of breaker failure protection:

S u p v . 2 c	Two-channel supervision; no coincidence of initiation signals; only in common-phase initiation mode (c/g)
S u p v . 2 p	Supervision of phase segregated initiation: two-pole trip implausible (c/g)
S u p v . L 1	Supervision of phase segregated initiation: L1 implausible (no current flow in L1) (c/g)
S u p v . L 2	Supervision of phase segregated initiation: L2 implausible (no current flow in L2) (c/g)
S u p v . L 3	Supervision of phase segregated initiation: L3 implausible (no current flow in L3) (c/g)
S u p v . S y m	Current asymmetry (c/g)
B F W a r n	Breaker failure protection common alarm (c/g)
B F F a i l	Breaker failure protection failure (c/g)

Operational annunciations of the circuit breaker test function:

C B t e s t	Circuit breaker test in progress (c/g)
C B t p T s t	Trip by internal circuit breaker test function (c/g)

6.4.3 Fault annunciations – address block 82

The annunciations which occurred during the last eight network faults can be read off on the front panel or via the serial interface. The indications are recorded in the sequence from the youngest to the oldest. When a ninth fault occurs, the data relating to the oldest are erased. Each of the eight fault data buffer can contain up to 30 annunciations. When more occur, the last message signals "buffer overflow".

Input of the codeword is not required.

When the relay is operative and the initial display or the quiescent messages are displayed, press the key ▽ to reach the item "ANNUNC." Key ▷ is used to change over to the second operation level, where one can go with the key ▽ to the address block 82 which forms the heading of the fault annunciations. The third operation level, with key ▷ contains the eight system faults. The individual annunciations can be found in the fourth operation level (key ▷), see Figure 6.5. Use the keys ▽ and △ to scroll through the annunciation list (Figure 6.6).

For these purposes, the term "system fault" means the period from fault inception up to final clearance.

When date and time have not yet been set (refer also to Section 6.5.1), the date is shown as 01.01.95, the time is given as relative time from the last re-start of the processor system. Thereafter, the fault annunciations are listed in chronological sequence with the relative time referred to the first fault detection.

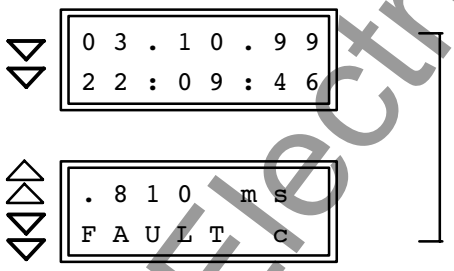
In the following clarification, all the available fault annunciations are indicated. In the case of a specific fault, of course, only the associated annunciations appear in the display.

At first, an example is given for a system fault, and explained.

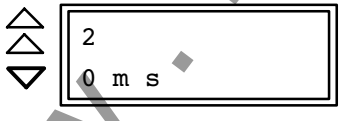
[5200]
Beginning of the block "Fault annunciations"

[5210]
Beginning of the block "Fault annunciations of the last system fault"

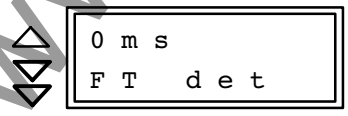
Use the arrow keys to scroll through the displayed annunciation list.



[5211]
1st line: Date of the last system fault
2nd line: Time of the last system fault (hours, minutes, seconds and ms)
System fault, **c**oming



1st line: Consecutive number of the system fault
2nd line: Beginning of the relative time; time resolution is 1 ms



1st line: Beginning of the relative time
2nd line: Event that has started the relative time

etc.

General fault annunciations of the device:

Sys.Flt	Network system fault
FAULT	Beginning of fault with consecutive number
ANNovfl	Fault annunciations lost (buffer overflow)
FT det	General fault detection of device
DEV.Trp	General trip of device
IL1	Interrupted fault current of phase L1 (I_{L1}/I_N)
IL2	Interrupted fault current of phase L2 (I_{L2}/I_N)
IL3	Interrupted fault current of phase L3 (I_{L3}/I_N)

Fault annunciations of the breaker failure protection:

>Releas	Release signal for breaker failure initiation (2nd channel, only for phase-common initiation mode with two-channel initiation
>Strt3p	Common-phase initiation (three-pole trip of feeder protection); only in common-phase initiation mode
>St.woI	Common-phase initiation without current flow; only in common-phase initiation mode with breaker auxiliary contact
>StrtL1	Phase segregated initiation L1 (trip of feeder protection); only 7SV600*–*****–1 in phase-segregated initiation mode
>StrtL2	Phase segregated initiation L2 (trip of feeder protection); only 7SV600*–*****–1 in phase-segregated initiation mode
>StrtL3	Phase segregated initiation L3 (trip of feeder protection); only 7SV600*–*****–1 in phase-segregated initiation mode
>CB 1pC	Circuit breaker closed (from CB auxiliary contact)
BF flt	Fault detection breaker failure protection
TripT1	Breaker failure protection trip first stage (T1)
TripT2	Breaker failure protection trip second stage (T2)
TripCBd	Breaker failure protection trip on defective circuit breaker

Fault annunciations of the end fault protection:

T r p E n d F	End fault protection trip

Fault annunciations of the current symmetry monitor (if programmed to trip):

T r i p S y m	Current symmetry monitor trip (pole discrepancy)

Further messages:

T A B e m p t y	means that no fault event has been recorded
T A B o v r f l	means that other fault data have occurred, however, memory is full
T A B . E N D	If not all memory places are used the last message is TAB.END

Use key ◁ to go back to the third operation level. You can reach the **second to last** system fault by pressing the key ▽. The individual fault annunciations can be found with the key ▷ in the fourth operation level and scrolled through with the keys ▽ and △. The available annunciations are the same as for the last fault.

▽ 8 2 2 n d F A U L T ▷ [5220] Beginning of the ”Fault annunciations of the second to last system fault”

In corresponding way the annunciations of the third to last up to the eighth to last fault can be achieved.

6.4.4 Read-out of operational measured values – address block 84

Operating measured values can be read out at any time under the address block 84. When the relay is operative and the initial display or the quiescent messages are displayed, press the key ▽ to reach the item "ANNUNC." Key ▷ is used to change over to the second operation level, where one can go with the key ▽ to the address block 84 which forms the heading of the operational measured values. The individual annunciations can be found in the third operation level (key ▷), see Figure 6.5. Use the keys ▽ and △ to scroll through the individual measured values (Figure 6.6).

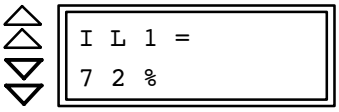
Entry of the codeword is not necessary.

The data are displayed in percent of the rated device values. During read-out, the values are not actualized, but after scrolling through the list with the keys ▽ and △, the actual values will be displayed.

In the following boxes, some example values have been inserted. In practice the actual values appear.

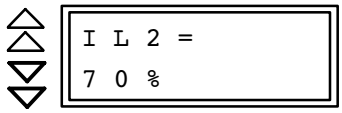
[5200]
Beginning of the block "Operational measured values"

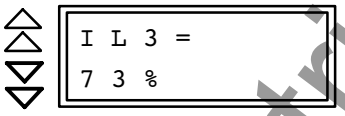
Use ▽ key to move to the next address with the next measured value.



Page on with the ▽ key to read off the next measured value, or page back with △

The percentage is referred to rated relay current





6.4.5 Circuit breaker operation statistics – address block 85

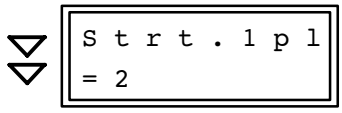
The number of initiation signals are counted separately for of common-phase and phase-segregated initiation (if applicable). Additionally, the number trip commands initiated by 7SV600 are counted, separately for the first and the second stage (if applicable). Counter status are secured against auxiliary voltage failure and can be read off in address block 85.

Entry of the codeword is not required.

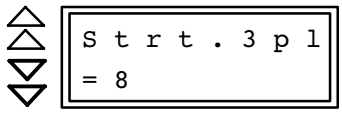
When the relay is operative and the initial display or the quiescent messages are displayed, press the key ▽ to reach the item "ANNUNC." Key ▷ is used to change over to the second operation level, where one can go with the key ▽ to the address block 85.

[5600]
Beginning of the block "Circuit breaker operation statistics"

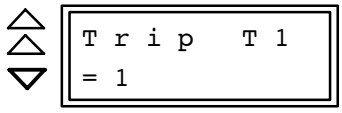
You may scroll with the keys ▽ and △ through the messages.



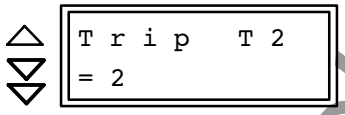
Number of phase-segregated initiation occurrences, e.g. 2



Number of common-phase initiation occurrences, e.g. 8



Number of trip commands after T1 (first stage), e.g. 1



Number of trip commands after T2 (second stage), e.g. 2

The maximum values of the counters are:

– *for initiation occurrences*	5 digits
– *for trip occurrences*	5 digits

The counters can be reset to 0 in block 83 (see Section 6.5.2).

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. 7SV600 comprises facilities, e.g. to re-adjust the real time clock, to erase stored information and event counters, or to switch on or off partial functions under specific conditions.

Switching on and off of part functions from the device front is described at the beginning of each subsection in Section 6.3.

Further control facilities via the key pad or serial interface are found under the item "ADDITION FUNCTION" (additional functions). When the relay is operative and the initial display or quiescent messages are displayed, press the key ▽ to reach the item "ADDITION FUNCTION". Key ▷ is used to change over to the second operation level, where one can go with the key ▽ to the required control addresses.

When the relay is operated from a personal computer by means of the protection data processing program DIGSI®, the control items are identified by a four-digit address number. In the following clarifications, this number is indicated at the beginning of the explanations in brackets.

[9000]
Beginning of the block "Additional functions"

6.5.1 Adjusting and synchronizing the real time clock

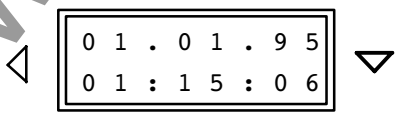
Key ▷ is pressed to change to the second operation level. The display shows the first item "TIME SETTING". Change to the third operation level with key ▷. The actual date and time are displayed now. Scroll on with key ▽ to find the setting items for date and time, as illustrated below.

When date and time have not yet been set, the date "01.01.95" appears and the time since the start-up of the processor system.

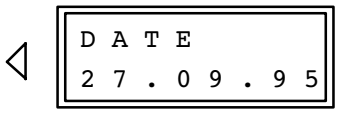
Codeword entry is not required. Day, month, and year can be altered using the keys ⊞ and ⊟. Key ▷ is used to switch from day to month etc. Confirm with the enter key **E** when the date is completed. Proceed in analog manner to adjust the time.

Note: When the day is changed, the display firstly allows 31 days. Only when the month and year is changed, the relay can check plausibility of the complete date. After confirmation with the enter key **E**, the day may be reduced to an existing number.

[8100]
Beginning of the block "Setting the real time clock".



[8101]
At first, the "actual" date (**DD.MM.YY**) and the "actual" time (**HH:MM:SS**) are displayed.
Continue with ▽.



[8102]
Enter the new date: 2 digits for day, 2 digits for month and 2 digits for year: **DD** ▷ **MM** ▷ **YY**

Use key ⊞ to increase the day or ⊟ to decrease;
use key ▷ to change-over to the month;
use key ⊞ to increase the month or ⊟ to decrease;
use key ▷ to change-over to the year;
use key ⊞ to increase the year or ⊟ to decrease;
confirm with enter key **E**.

[8103]
Key ▽ is used to come to the time setting. Enter the new time: 2 digits for hour, 2 digits for minute: **HH** ▷ **MM**

Use key ⊞ to increase the hour or ⊟ to decrease;
use key ▷ to change-over to the minute;
use key ⊞ to increase the minute or ⊟ to decrease;

the seconds are not changed. They are automatically set to ”00” when the enter key **E** is pressed.

6.5.2 Erasing stored annunciations and counters – address block 83

The statistical indications (Section 6.4.5, address block 85) are stored in EEPROMs in the device. They are therefore not erased if the auxiliary power supply fails. These memories can be cleared in block 83.

Codeword entry is necessary to erase the stored items. Erasure requires confirmation with the key **Y**/**J**. The display then confirms the erasure. If erasure is not required, press key **N** or simply page on.

[8300]
Beginning of the block “Erasure of statistics counters”

Request whether the counters for initiation and trip should be set to zero

After erasure the relay acknowledges erasure:

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 tripping leads to the circuit breaker trip-coils have been interrupted.

DANGER!

Secondary connections of the current transformers must be short-circuited before the current leads to the relay are interrupted!
If a test switch is installed which automatically short-circuits the current transformer secondary leads, it is sufficient to set this switch to the ”Test” position. The short-circuit switch must be checked beforehand (refer Section 5.2.4).

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.

For the functional test of the breaker failure protection, a single-phase current source is sufficient; but the current symmetry monitor can only tested with a three-phase symmetrical current source with individually adjustable currents.

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.

After tests which cause LED indications to appear, these should be reset, at least once by each of the possible methods: the reset button **N** on the front plate and via the remote reset relay (if marshalled). 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 circuit breaker failure protection

In order to test the circuit breaker failure protection, this function must be switched on, i.e. address 1201 BF P. = *ON*. The end fault protection is made ineffective by setting address 1301 EndFlt = OFF.

Before a test current is injected, the initiation conditions must be fulfilled:

– Devices with common-phase, two-channel initiation, i.e. version 7SV600*–*****–0 or version 7SV600*–*****–1 in common-phase initiation mode: Energize the binary inputs "`>Strt3p`" (FNo 7703) and "`>Releas`" (FNo 7702).

– Devices with common-phase, single-channel initiation, i.e. version 7SV600*–*****–0 or version 7SV600*–*****–1 in common-phase initiation mode: Energize the binary input "`>Strt3p`" (FNo 7703).

– Devices with phase-segregated initiation, i.e. version 7SV600*–*****–1 in phase-segregated initiation mode: Energize the binary input "`>StrtL1`" (FNo 7705). The following tests are carried out for each of the phases, in this case.

Testing can be performed with single-phase, two-phase or three-phase test current. When testing single-phase, the test current is injected via the phase under test.

Caution!

Test currents larger than 4 times I_N may overload and damage the relay if applied continuously (refer to Section 3.1.1 for overload capability). Observe a cooling down period!

For current above $4 \cdot I_N$, therefore, measurement shall be performed dynamically. It should be stated that the relay picks up at 1.1 times setting value and does not pick up at 0.9 times setting value. Current below $4 \cdot I_N$ can be slowly increased.

When the set value for I–BF (address 1202, factory setting $0.1 \times I_N$) is exceeded the indication "`BF flt`" (FNo 1455, on LED 3 when delivered) appears. The further reaction of the breaker failure protection depends on the parameterized functions:

– With two-stage breaker failure protection appears after expiry of the time delay T1 – 3p or T1 – 1p (address 1204 or 1203, 0.00 s when delivered) the annunciation "`TripT1`" (FNo 7710, LED 4 when delivered). Check that the assigned trip relay contacts close (trip relays 1 when delivered).

  After expiry of the time T2 (address 1205, factory setting 0.15 s) the annunciation "`TripT2`" appears (FNo 7711, LED 4 when delivered). Check that the assigned trip relay contacts close (trip relays 2 when delivered).

– With single-stage breaker failure protection, only one trip command occurs, dependent on the marshalling.

It must generally be noted that the set times are pure delay times; operating times of the measurement functions are not included.

De-energize all binary inputs.

The tests carried out until now have used the current flow as breaker failure criterion. If, in version 7SV600*–*****–0, the position of the breaker auxiliary contact is used, the following test with the breaker auxiliary contact criterion is carried out without test current. The binary inputs "`>St.woI`" (FNo 7704, input 4 when delivered) is energized, if applicable, additionally input "`>Releas`" (FNo 7702).

In addition, the binary input for the breaker auxiliary contact is energized (FNo 355, input 3 when delivered). The test can be carried out single-stage or two-stage, as it was done with the current tests, dependent on the settings.

When the reset time of the protection is measured it must be considered that the values given in the Technical data are valid only when the test current is interrupted at the moment of its zero crossing.

Finally, de-energize all binary inputs.

6.7 Commissioning using primary tests

All secondary testing sets and equipment must be removed. Reconnect current transformers. For testing with primary values the protected object 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.)

Because of the variety of application possibilities and possible switch-gear configuration, a detailed description of the applicable tests is not possible. The most important thing is that the local circumstances and the switch-gear and protection diagrams are observed.

It is recommended that the local circuit breaker of the feeder under test is isolated at both sides, i.e. the bus-bar disconnector(s) and the line disconnector must be opened. Thus, switching of the circuit breaker is possible without danger.

Caution!

The protection relay will issue bus-bar trip command even during tests on the local feeder breaker. The trip signal to the adjacent circuit breakers of the bus-bar should be made ineffective, e.g. by switching off of the corresponding control voltages.

The trip command of the feeder protection to the local feeder circuit breaker is also interrupted until final completion of the tests in order to ensure that only the breaker failure protection can trip this breaker.

The following lists do not claim to cover all possibilities. On the other hand, they may contain items that can be bypassed in the actual application.

6.7.1 Checking the initiation conditions

All possible initiation conditions must be checked. The trip command(s) of the 7SV600 should first be interrupted. The circuit breaker – isolated by its adjacent disconnectors, as mentioned above – is now switched on.

For models with phase-segregated initiation (7SV600*–***–1 in operation mode BF P. = *1/3–POLE*)**:

a) Initiation by single-pole trip command L1 of the feeder protection:
Binary input functions "`>StrtL1`" (FNo 7705) is triggered (check in operational and fault annunciations). Local trip after T1–1P.

b) Initiation by single-pole trip command L2 of the feeder protection:
Binary input functions "`>StrtL2`" (FNo 7706) is triggered (check in operational and fault annunciations). Local trip after T1–1P.

c) Initiation by single-pole trip command L3 of the feeder protection:
Binary input functions "`>StrtL3`" (FNo 7707) is triggered (check in operational and fault annunciations). Local trip after T1–1P.

d) Initiation by three-pole trip command of the feeder protection:
Binary input functions "`>StrtL1`" (FNo 7705), "`>StrtL2`" (FNo 7706), and "`>StrtL3`" (FNo 7707) are triggered (check in operational and fault annunciations). Local trip after T1–3P.

e) Initiation by two-pole trip command of the feeder protection:
Binary input functions e.g "`>StrtL1`" (FNo 7705) and "`>StrtL2`" (FNo 7706) are triggered (check in operational and fault annunciations), additionally annunciation "Supv.2p" in the operational annunciations.

For models with common-phase initiation (7SV600*– ***–0 or 7SV600*–*****–1 in operation mode BF P. = *3–POLE*)**:

a) Initiation by three-pole trip command of the feeder protection (single-channel):
Binary input function "`>Strt3p`" (FNo 7703) is triggered (check in operational and fault annunciations). No trip if two-channel initiation is set.

a) Initiation by three-pole trip command of the feeder protection **and** release signal:
Binary input functions "`>Strt3p`" (FNo 7703) and "Releas" (7702) are triggered (check in operational and fault annunciations). Local trip after T1–3P.

De-energize all binary inputs.

6.7.2 Checking the local trip with breaker failure criterion from the auxiliary contacts

The following tests apply only for 7SV600*–*****–**0** and only if initiation without current flow is required (e.g. Buchholz protection).

The local feeder circuit breaker is open.

Only for models with common-phase initiation (7SV600*– ***–0)**:

a) Initiation by trip command of protection relay without current (single-channel):
Binary input function "`>St.woI`" (FNo 7704) is triggered (check in operational and fault annunciations). No trip by the breaker failure protection.

Close the local feeder circuit breaker (isolated by its adjacent disconnectors).

b) Initiation by trip command of protection relay without current (single-channel):
Binary input function "`>St.woI`" (FNo 7704) is triggered (check in operational and fault annunciations). No trip if two-channel initiation is set.

c) Initiation by three-pole trip command of the feeder protection **and** release signal:
Binary input functions "`>St.woI`" (FNo 7704) and "`Releas`" (7702) are triggered (check in operational and fault annunciations). Local trip after T1–3P.

If the protection is two-stage:

d) Trip after T2 at the trip relay for the adjacent breakers (bus-bar). Check the Fault annunciations: "`TripT2`".

De-energize all binary inputs.

6.7.3 Checking the local trip and the current circuits

The current transformer connections are checked with real primary current. Before the protected object is energized, it must be ensured, that a back-up protection is effective in case a real fault should occur during the tests.

The circuit breaker is now – after closing of the adjacent disconnectors – switched on.

For current test, a load current of 10 % of the rated current but at least 1.2 times the pick-up value I–BF (address 1202) is necessary.

If the measuring circuit connections are correct, none of the measured value monitoring systems in the relay will operate. If a fault indication appears, the possible causes can be found in the operational annunciations.

Currents can be read off on the display in the front or via the serial interface in block 84 and compared with the actual measured values (refer also to Section 6.4.4). If substantial deviations occur, then the current transformer connections are incorrect. Short-circuit the current transformers and make corrections.

DANGER!

Secondary connections of the current transformers must be short-circuited before the current leads to the relay are interrupted!

The circuit breaker is closed again for the following trip tests. It is presumed that the correct allocation of the individual circuit breaker poles is already verified during the tests according to Section 6.7.1.

For single-stage breaker failure protection:

a) Initiation by trip command of the feeder protection:
Trip command is issued by the breaker failure protection after T1 – 1P (address 1203) or T1 – 3P (address 1204), depending on the relay version and the simulated fault type, to the local feeder circuit breaker.
At least the following annunciations appear:
"`>Strt ... c`" (... dependent on the simulated fault type, operational and fault annunciations).
"`FT det c`" (operational and fault annunciations).
"`TripT1 c`" (fault annunciations).
Additionally LED 3 and 4 (as delivered)

Note: Dependent on the marshalling and settings, also the trip annunciation "`TripT2`" may appear if this time is used for single-stage breaker failure protection.

For two-stage breaker failure protection:

a) Initiation by trip command of the feeder protection:
Trip command is issued by the breaker failure protection after T1 – 1P (address 1203) or T1 – 3P (address 1204), depending on the relay version and the simulated fault type, to the local feeder circuit breaker.
At least the following annunciations appear:
"`>Strt... c`" (... dependent on the simulated fault type, operational and fault annunciations).
"`FT det c`" (operational and fault annunciations).
"`TripT1 c`" (fault annunciations).
Additionally LED 3 and 4 (as delivered)

Trip command is issued by the breaker failure protection after T2 to trip relay for the adjacent breakers (bus-bar).
additional annunciation: "`TripT2 c`" (fault annunciations).

Finally, de-energize all binary inputs. Open the circuit breaker.

6.7.4 Checking the transfer trip to the opposite feeder end

If an intertrip signal to the opposite line end is to be transmitted, all devices which are necessary for transmission must be commissioned in accordance with the associated commissioning instructions. The transmission link must be checked.

The trip commands to the bus-bar circuit breakers remain ineffective during the test. The disconnectors at both sides of the feeder circuit breaker must be open. The circuit breaker is closed.

The trip command to the local feeder breaker is made ineffective (e.g. by switching off the control voltage).

At the remote end of the feeder, the circuit breaker must be isolated from the feeder and the bus-bar, too. The circuit breaker is closed there.

If the auxiliary contact criterion is used, anyone of the tests as described in Section 6.7.3 is repeated. The initiation conditions remain effective after the local feeder breaker has tripped.

According to the marshalling of the output relays, the signal is transmitted to the remote end and trips the breaker. Possibly, trip of the remote end breaker is made dependent on further conditions: this must be considered.

If the intertrip check is to be carried out with current flow as breaker failure criterion (e.g. because the auxiliary contact criterion is not used), then either the feeder must be energized at both ends in order to produce a current above the pick-up value I – BF (address 1202), or a corresponding secondary current must be injected into the relay under test. In the first case, it must be ensured that a back-up protection for the feeder is effective in case a real fault would occur during the test.

6.7.5 Checking the bus-bar trip

The distribution of the trip commands to the adjacent circuit breakers of the bus-bar depends widely on the bus-bar arrangement.

Checking the bus-bar trip should be carried out after completion of the tests on all individual feeder circuit breakers.

The trip circuits of the circuit breakers under test shall be made effective, the control voltage switched on. Again, ensure that the switching operations on the tested breakers are allowed without danger in the actual state of the switch-gear.

In most cases a trip bus is installed for the trip commands of the bus-bar breakers, if applicable, dependent of the position of the bus-bar disconnector(s) of the feeders under test.

The important thing is that the bus-bar trip command arrives at all circuit breakers associated with that bus-bar section, to which the feeder of the originating protection relay is connected, including any bus tie, and that the bus-bar trip command does not arrive at any of the other circuit breakers. The bus-bar trip checks must be performed such, that finally all switching combinations have been covered.

After completion of the tests, it must be carefully checked that the required operational status of the trip bus(ses) is re-arranged (e.g. in case that certain circuits have been interrupted for certain tests) and that all control voltages are switched on (in case certain control voltages have been switched off for certain tests). This is also valid for all the tripping commands of feeder protection relays which have been interrupted in order to simulate a breaker failure condition.

6.7.6 Testing the switching conditions of binary inputs and outputs

The relay contains a test routine which interrogates the positions of the binary inputs and outputs and indicates them on the display.

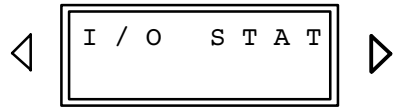
Tests can be performed in address block 40. This block is reached by pressing the key ▽ three times so that the block "ADDITION FUNCTION" (additional functions) is displayed. Change to the second operation level by the key ▷; "DATE/TIME" is displayed.

Key ▽ is pressed to scroll to the test blocks.

When the relay is operated from a personal computer by means of the protection data processing program DIGSI®, the test items are identified by a four-digit address number. In the following clarifications, this number is indicated at the beginning of the explanations in brackets.

[4000]
Beginning of the block "Tests and commissioning aids"

Change over with key ▷ to the next operation level which shows the heading of the input/output conditions. Page to the next operation level by the key ▷ to gain access to the individual tests.



[4100]
Beginning of the block "Input/output status"

E

[4101]
Block "Status of the binary inputs"

Pressing the enter key **E** causes the relay to display the the question whether the states of the binary inputs shall be checked. Press the "Yes" – key **Y**/**J** to confirm, or the "No" – key **N** to abort. With the key ▽ the next test item can be selected.

Y/J

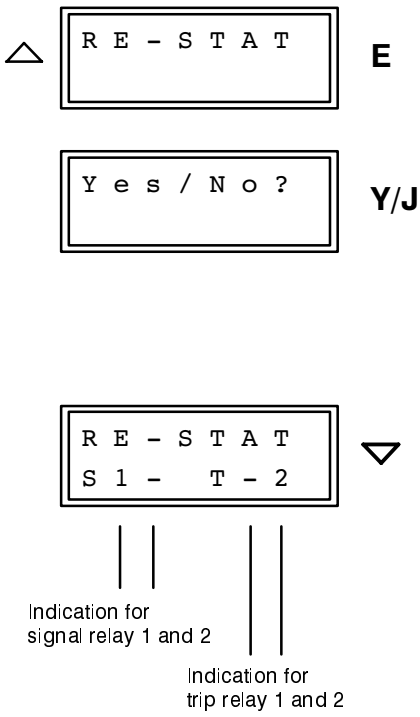
Indication for BI1, BI2, BI3

Pressing the "Yes" – key **Y**/**J** makes the relay display the states of the binary inputs (BI). Each energized input is marked by its number, inputs which are not energized are marked with a –:

1: BI 1 is energized (control voltage present)
2: BI 2 is energized (control voltage present)
3: BI 3 is energized (control voltage present)
–: BI is **not** energized (control voltage absent)

The illustrated example shows that the binary inputs BI 1 and BI 2 are energized, and binary input BI 3 is not energized.

Press the key ▽ to change to the conditions of the signal relays and trip relays:



[4102]
Block “Status of the output relays”

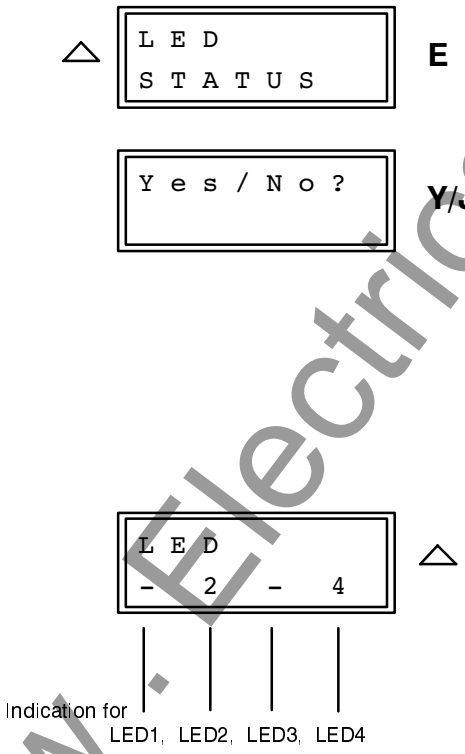
Pressing the enter key **E** causes the relay to display the the question whether the states of the binary outputs (relays) shall be checked. Press the “Yes”–key **Y/J** to confirm, or the “No”–key **N** to abort.

Pressing the “Yes”–key **Y/J** makes the relay display the states of the output relays (RE). The letter “S” indicates “Signal relay”, “T” indicates “Trip relay”. Each energized output is marked by its number, outputs which are not energized are marked with a –:

1: signal (S) or trip (T) relay 1 is energized
2: signal (S) or trip (T) relay 2 is energized
–: signal (S) or trip (T) relay is not energized

The illustrated example shows that the signal relay 1 is energized, signal relay 2 is not energized, trip relay 1 is not energized, trip relay 2 is energized.

Press the key ▽ to change to the conditions of the LED indicators:



[4103]
Block “Status of LED indicators”

Pressing the enter key **E** causes the relay to display the the question whether the states of the LED indicators (LED) shall be checked. Press the “Yes”–key **Y/J** to confirm, or the “No”–key **N** to abort.

Pressing the “Yes”–key **Y/J** makes the relay display the states of the LEDs. Each energized LED is marked by its number, LEDs which are not energized are marked with a –:

1: LED 1 is energized
2: LED 2 is energized
3: LED 3 is energized
4: LED 4 is energized
–: LED is **not** energized

The illustrated example shows that the LED 1 is energized, LED 2 is not energized, LED 3 is not energized, LED 4 is energized.

6.7.4 Tripping test including the local circuit breaker

The breaker failure protection 7SV600 allows simple checking of the tripping circuit and the circuit breaker. For this, the circuit breaker can be tripped by initiation from the operator keyboard or via the operator interface. A precondition is that the trip test output "CBtpTST" (FNo 1185) is allocated to the trip relay for the local breaker during marshalling.

Tests can be performed in address block 40. This block is reached by pressing the key ▽ three times so that the block "ADDITION FUNCTION" (additional functions) is displayed. Change to the second operation level by the key ▷; "DATE/TIME" is displayed. Key ▽ is pressed until the display shows the test block "CB – TEST".

When the relay is operated from a personal computer by means of the protection data processing program DIGSI®, the test items are identified by a four-digit address number. In the following clarifications, this number is indicated at the beginning of the explanations in brackets.

The relay displays the test sequence in the second display line.

If the circuit breaker auxiliary contacts advise the relay, through a binary input, of the circuit breaker position, the test cycle can only be started when the circuit breaker is closed.

Prerequisites for the start of test are that no protective function fault detector has picked up. Codeword input is necessary. The circuit breaker test feature must have been allocated to the trip relay "CBtpTST" during marshalling.

Warning

It must be ensured that the trip test affects only the local circuit breaker unless the whole bus-bar should be really tripped. Consider that the trip test may be carried out during operational test or revision of the switch-gear. Ensure also that the bus-bar will not be isolated in this case, too.

The individual test item is reached with the key ▷ in the next operation level.

△ | C B - T E S T
T R I P | ▷

[4400]
Block "Test of circuit breaker – Trip test"

△ | C B - T E S T
T R I P ? | **E**

[4404]
After confirmation with the enter key **E** the relay requests for codeword input. After correct codeword input, repeat confirmation with the enter key **E**. The relay checks whether breaker test is permitted or one of the above mentioned obstacles is detected

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If none of the reasons to refuse is present, the test is started. The following messages may occur during the test:

A B O R T E D	– circuit breaker test is aborted
U N S U C C .	– circuit breaker test has been unsuccessful; breaker has not opened
E X E C U T E D	– circuit breaker test executed

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 protection and ancillary functions have been programmed in the configuration parameters (address blocks 00 and 01, refer Section 5.4) and all desired protection functions have been switched *ON*.

Check again that all control voltages for tripping are switched on , in case they had been interrupted during tests.

Stored indications on the front plate should be reset by pressing the key "**N**" on the front so that from then on only real faults are indicated. During pushing the reset button, the marshallable LEDs on the front will light up; thus, a LED test is performed at the same time.

Check that the module is properly inserted and fixed. The green LED must be on on the front; the red LED must not be on.

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 breaker failure protection 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.

As the protection 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" (when marshalled).

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 protective 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 block 81, for defect diagnosis (refer to Section 6.4.2).

7.1 Routine checks

Routine checks of characteristics 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 84) and comparison with the actual values for checking the analog interfaces.

– Simulation of an internal short-circuit with $4 \times I_N$ for checking the analog input at high currents.

Warning

Hazardous voltages can be present on all circuits and components connected with the supply voltage or with the measuring and test quantities!

Caution!

Test currents larger than 4 times I_N may overload and damage the relay if applied continuously (refer to Section 3.1.1 for overload capability). Observe a cooling down period!

– Circuit breaker trip circuits are tested by actual live tripping. Respective notes are given in Section 6.7.7. Ensure that the trip test refers only to those circuit breakers which are allowed to be operated in the actual switch-gear state.

7.2 Fault tracing

If the protective 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 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 7.1)? If appropriate, replace the fuse according to Section 7.2.1.

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 protection system could be tried by switching the d.c. auxiliary voltage off and on again. This, however, results in loss of fault data and messages and, if a parameterizing process has not yet been completed, the last parameters are not stored. Additionally, date and time must be set again (refer to Section 6.5.1).

7.2.1 Replacing the mini-fuse

– Select a replacement fuse 5 × 20 mm. Ensure that the rated value, time lag (slow) and code letters are correct. (Figure 7.1).

– Prepare area of work: provide conductive surface for the module.

– Slip away the covers at top and bottom of the housing in order to gain access to the two fixing screws of the module. Unscrew these screws.

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)!

– Pull out the module by taking it at the front cover and place it on a surface which is suited to electrostatically endangered components (EEC);

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.

– Remove blown fuse from the holder (Figure 7.1).

– Fit new fuse into the holder (Figure 7.1).

– Insert draw-out module into the housing;

– Fix the module into the housing by tightening the two fixing screws. Re-establish the covers.

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).

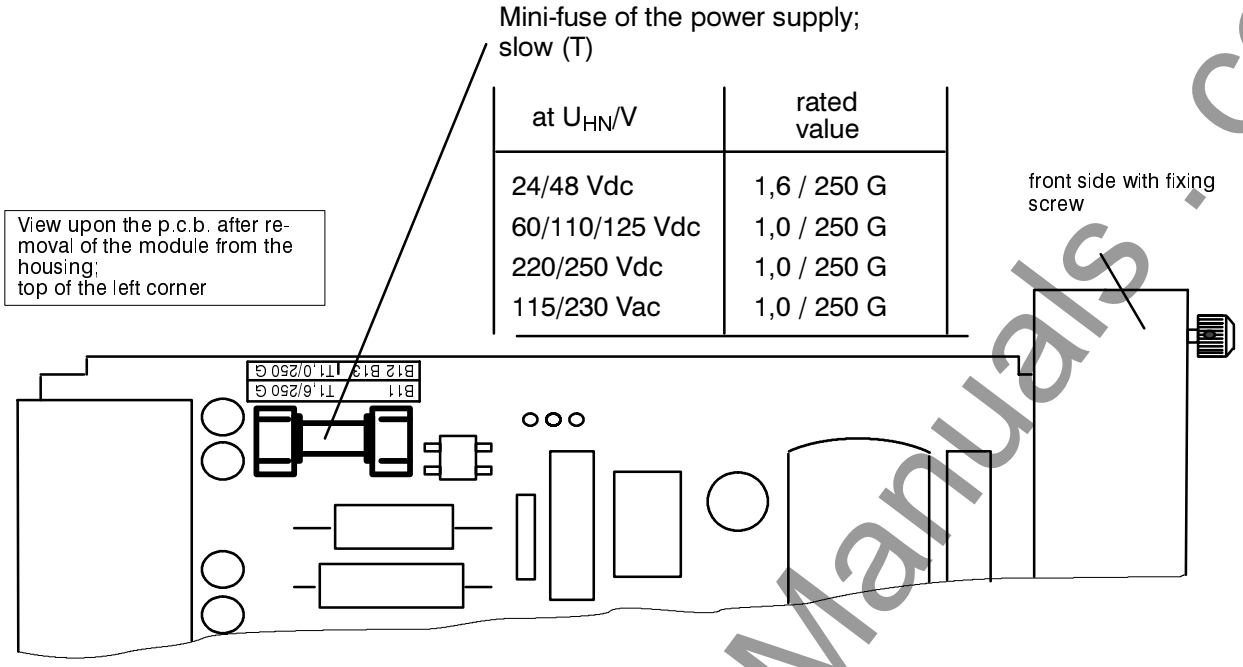


Figure 7.1 Mini-fuse of the power supply

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 packaging for return. If alternative packing is used, this must provide the degree of protection against mechanical shock, as laid down in IEC 255–21–1 class 2 and IEC 255–21–2 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 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

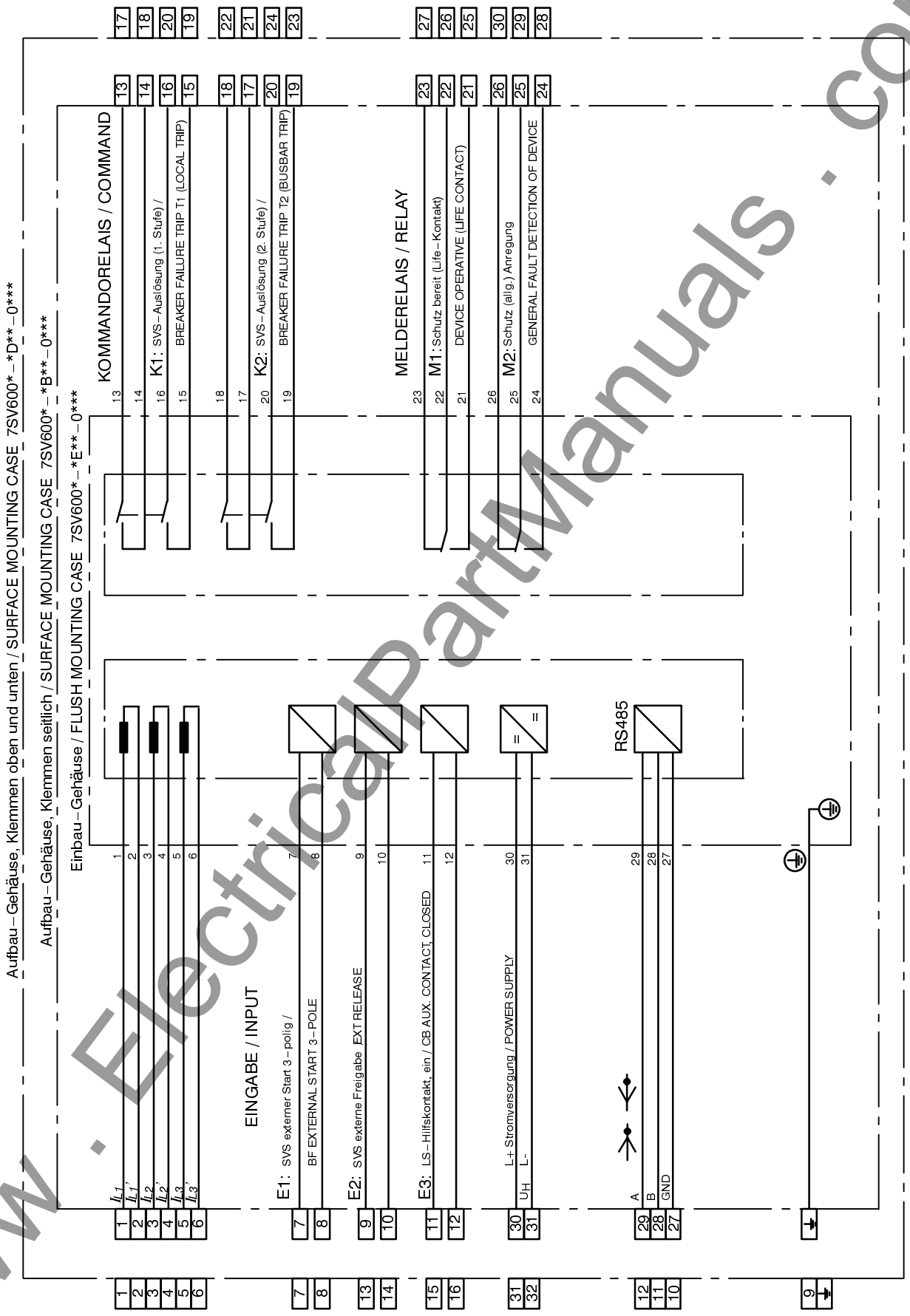


Figure A.1 General diagram of breaker failure relay 7SV600* – ***** – 0 (common phase initiation)

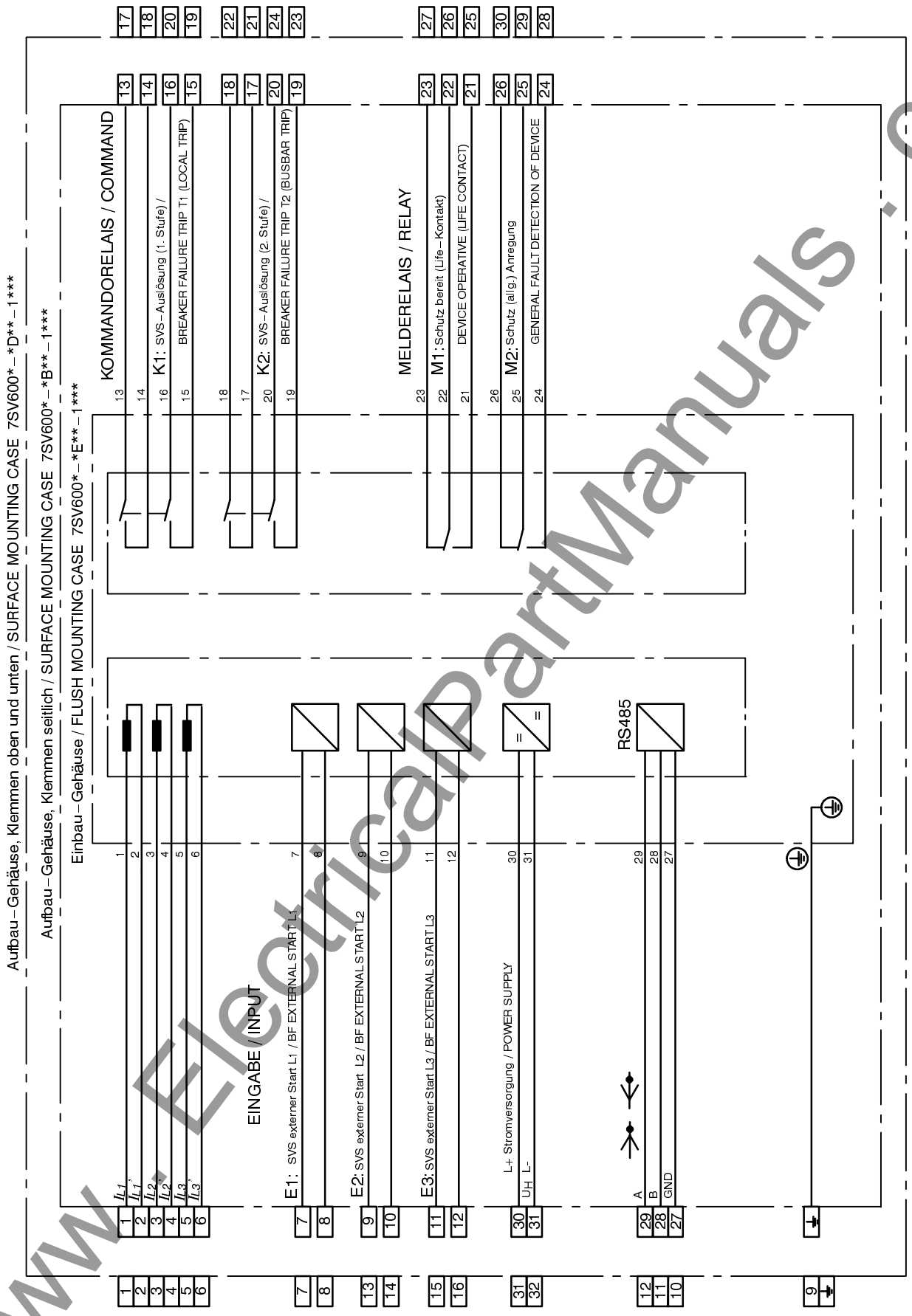


Figure A.2 General diagram of breaker failure relay 7SV600*–*****–1 (presettings shown fo phase segregated initiation)

B Connection examples

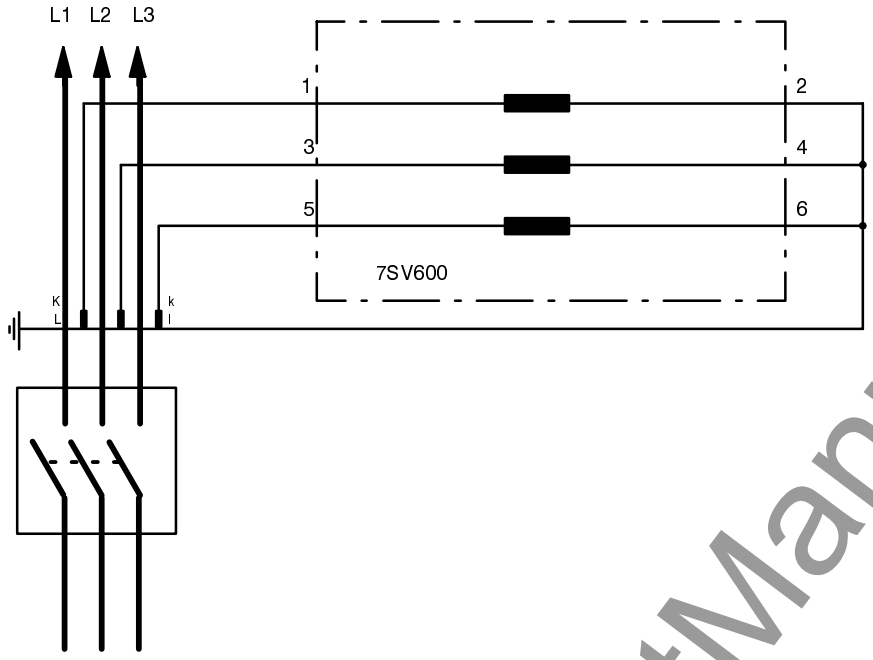


Figure B.1 **Three-c.t. connection** (normal connection for all systems)

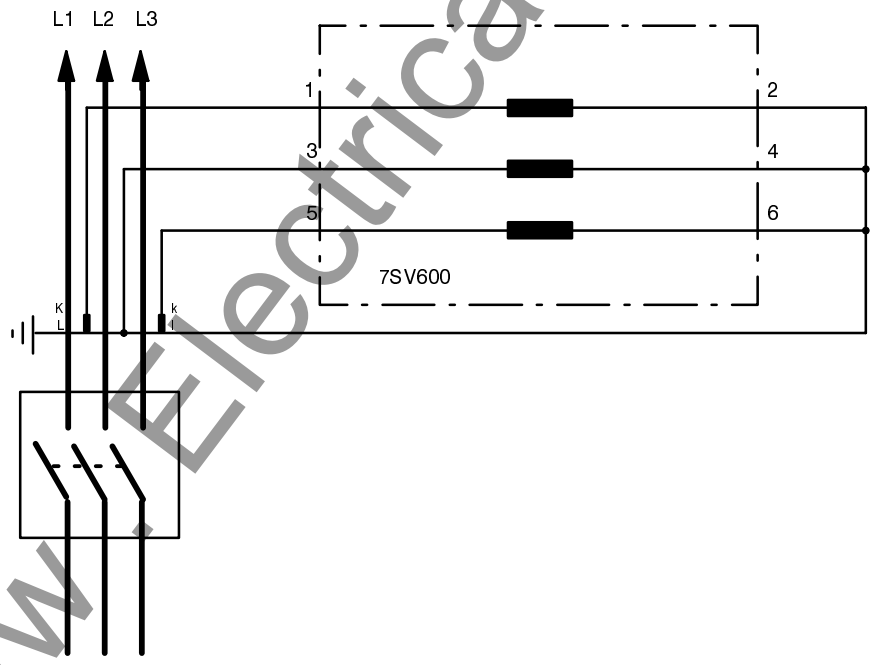


Figure B.2 **Two-C.T. connection:** only for isolated or compensated systems

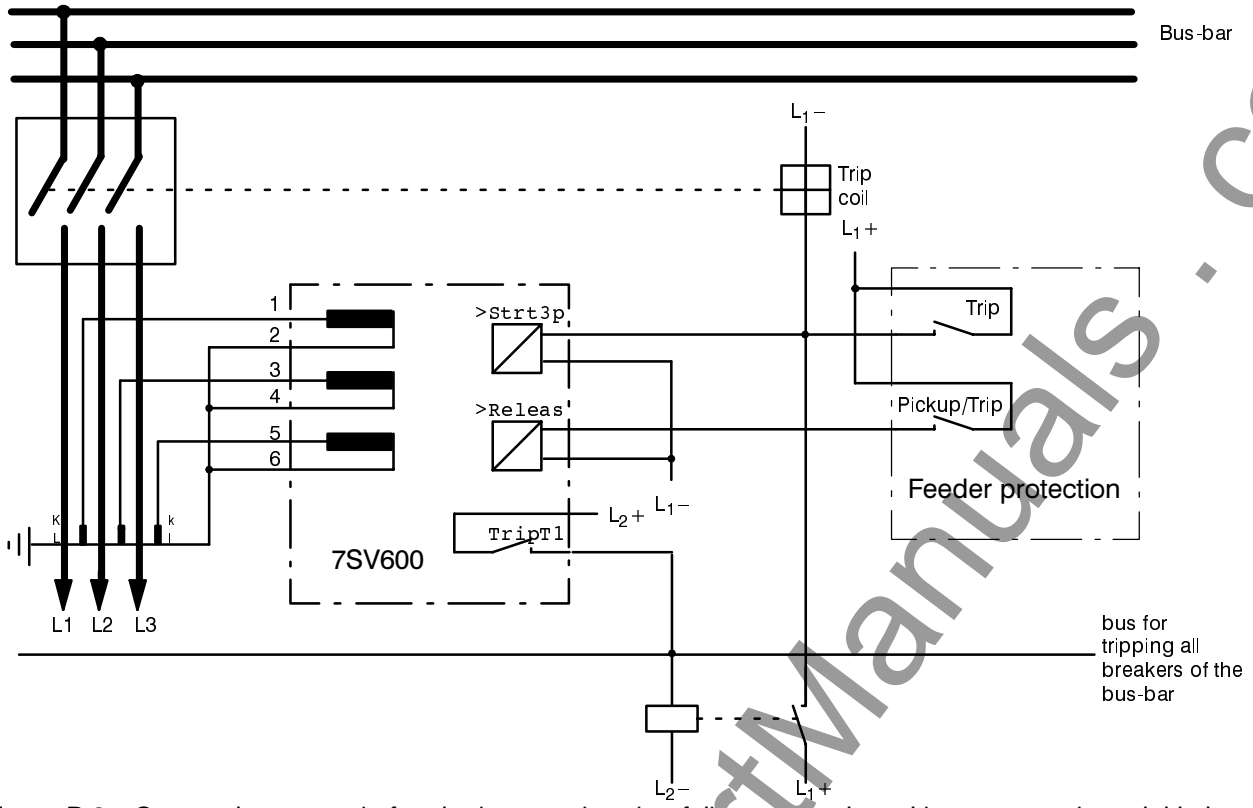


Figure B.3 Connection example for single-stage breaker failure protection with common phase initiation

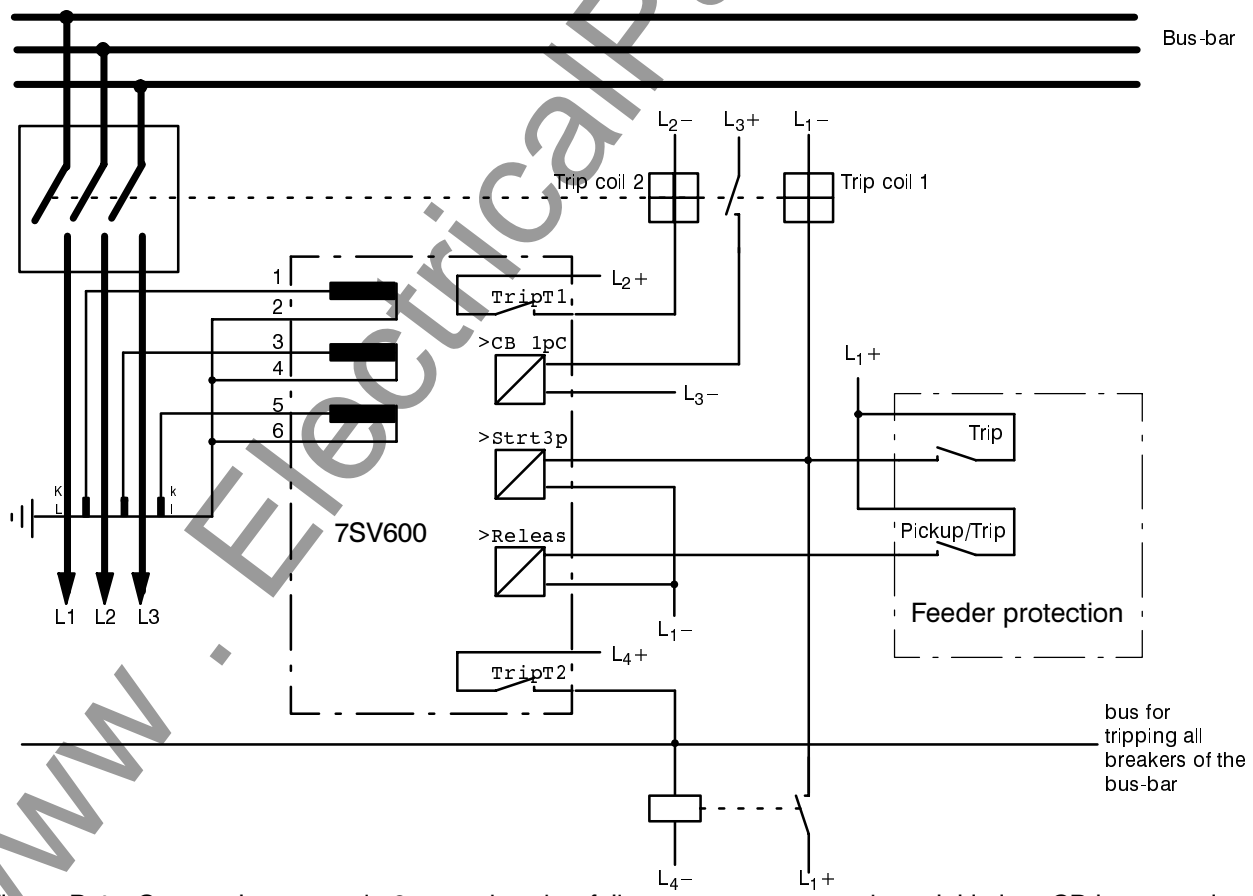


Figure B.4 Connection example 2-stage breaker failure prot., common phase initiation, CB interrogation

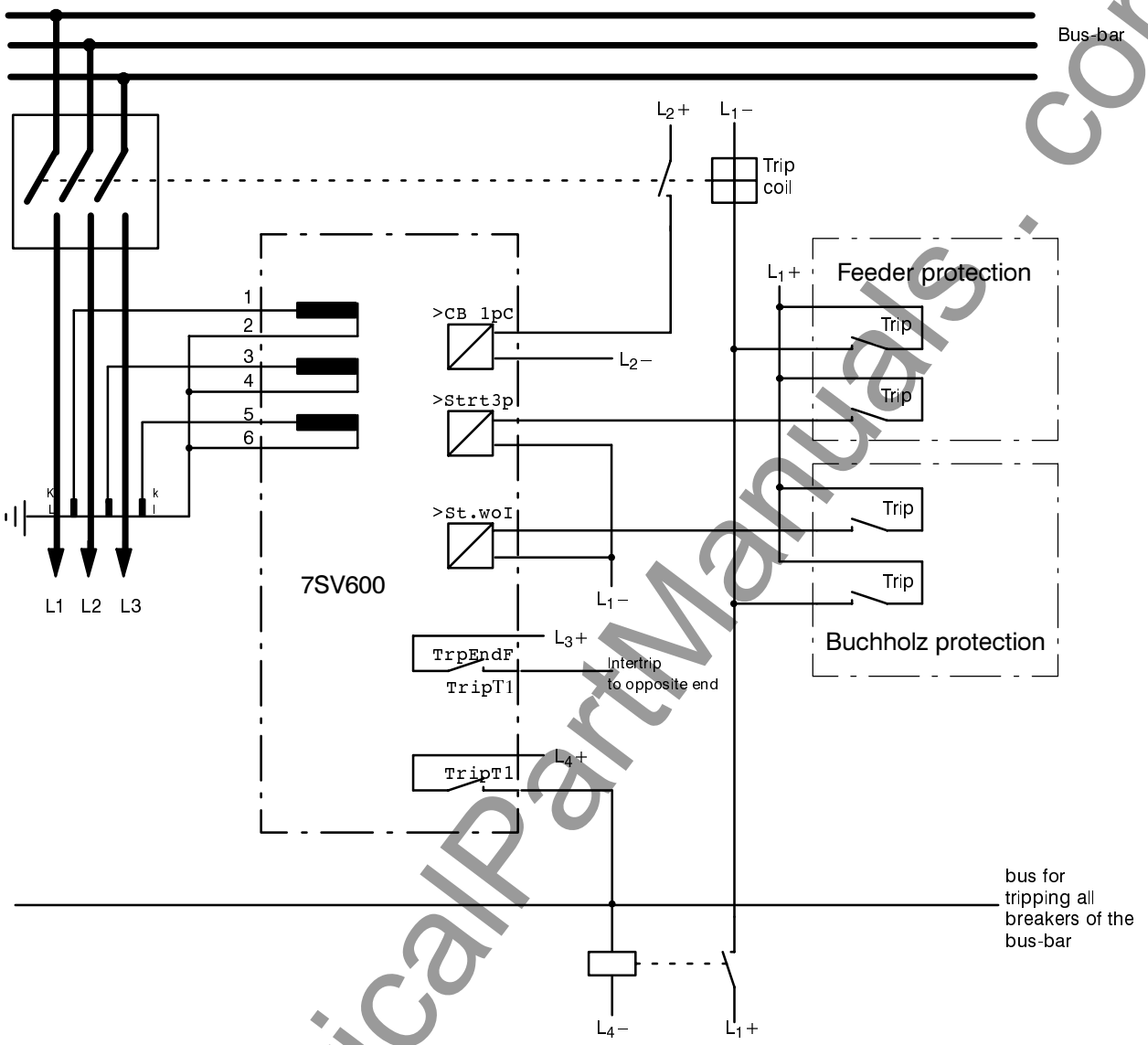


Figure B.5 Connection example for single-stage breaker failure protection with common phase initiation and Buchholz protection, CB interrogation is imperative; additional intertrip signal to the opposite line end in case of breaker failure or end fault

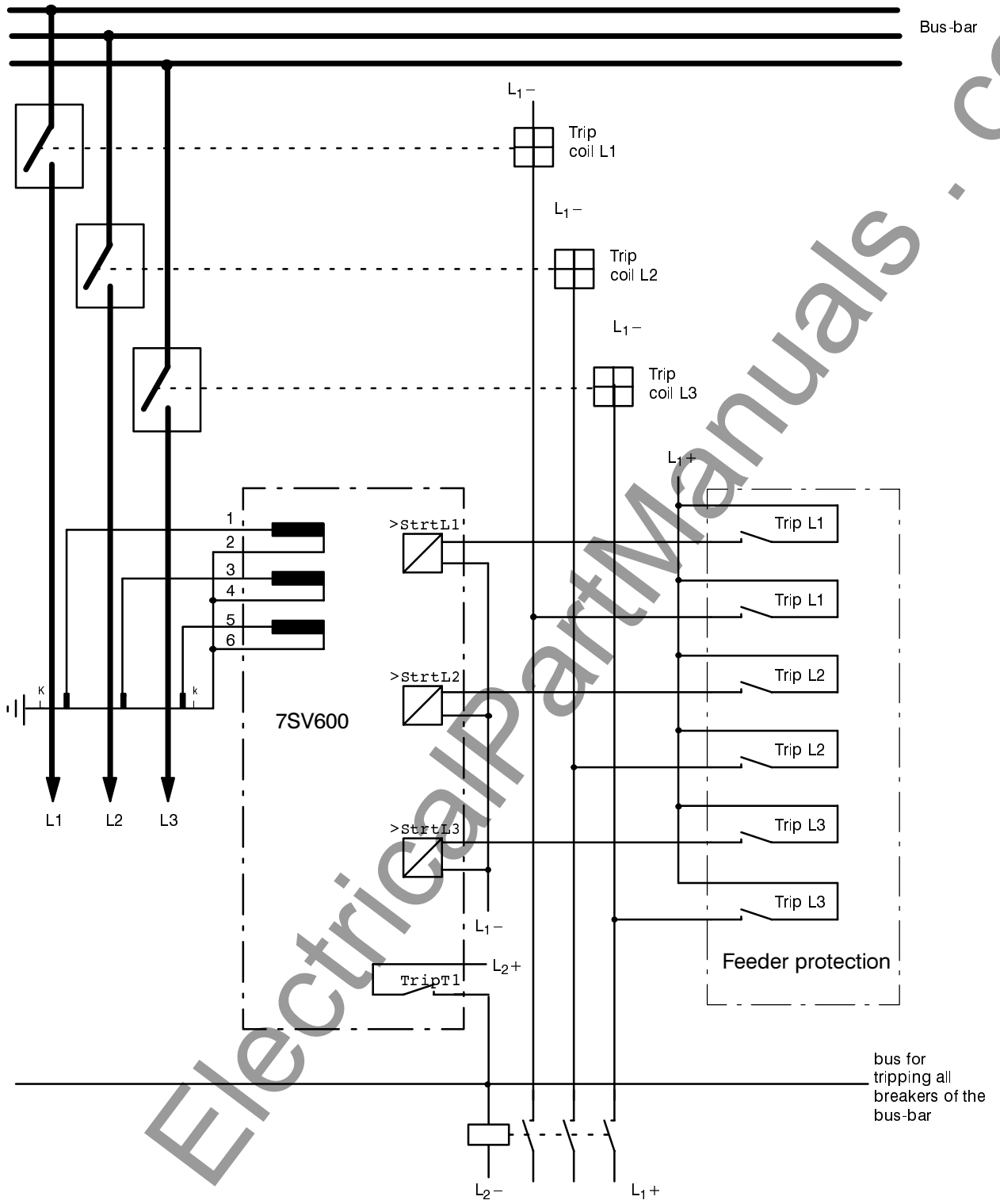


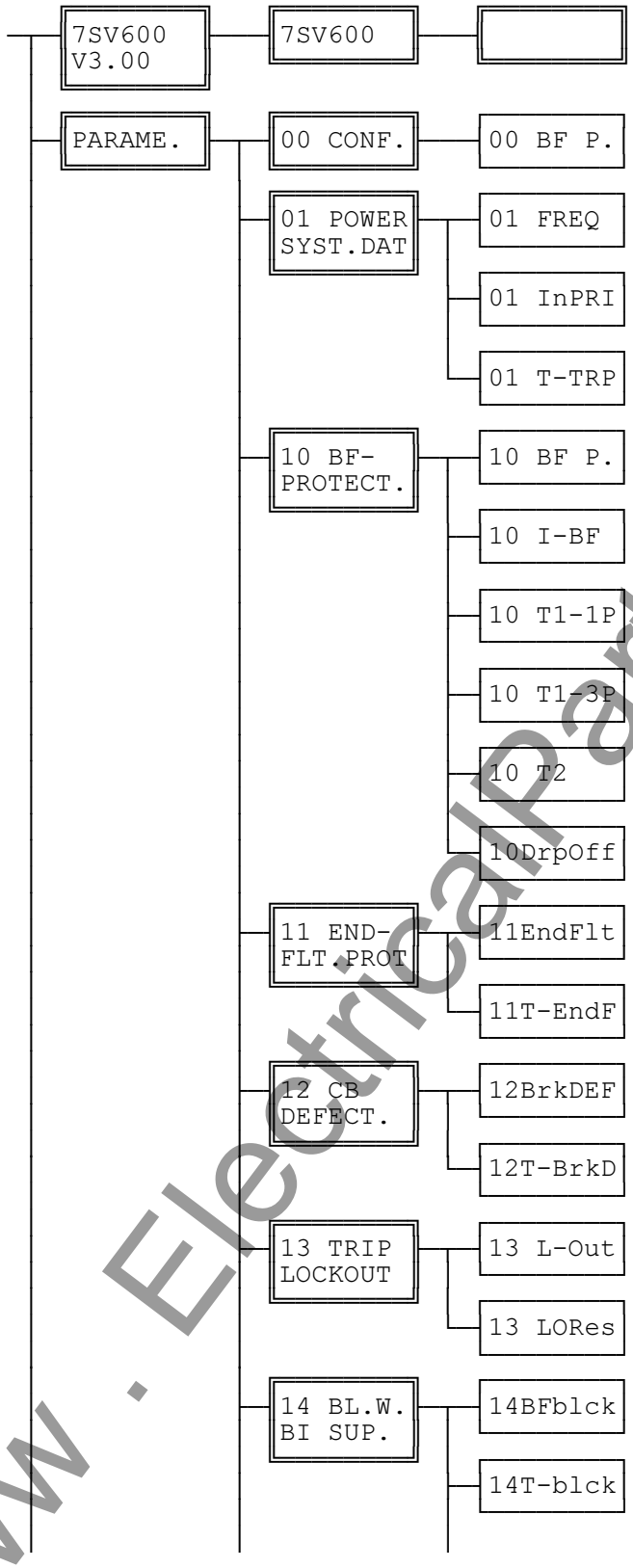
Figure B.6 Connection example for single-stage breaker failure protection with phase-segregated initiation

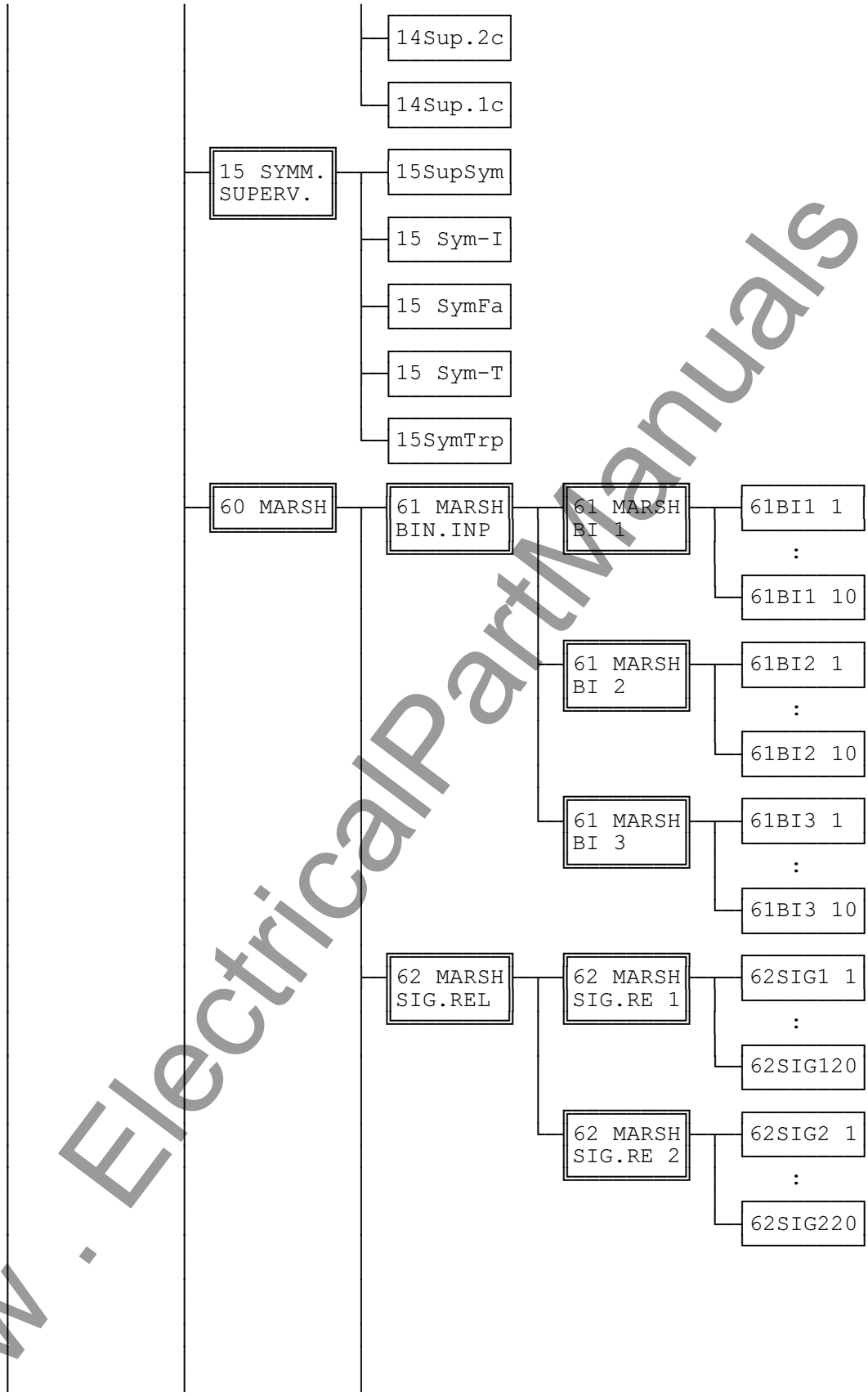
C Operation structure, Tables

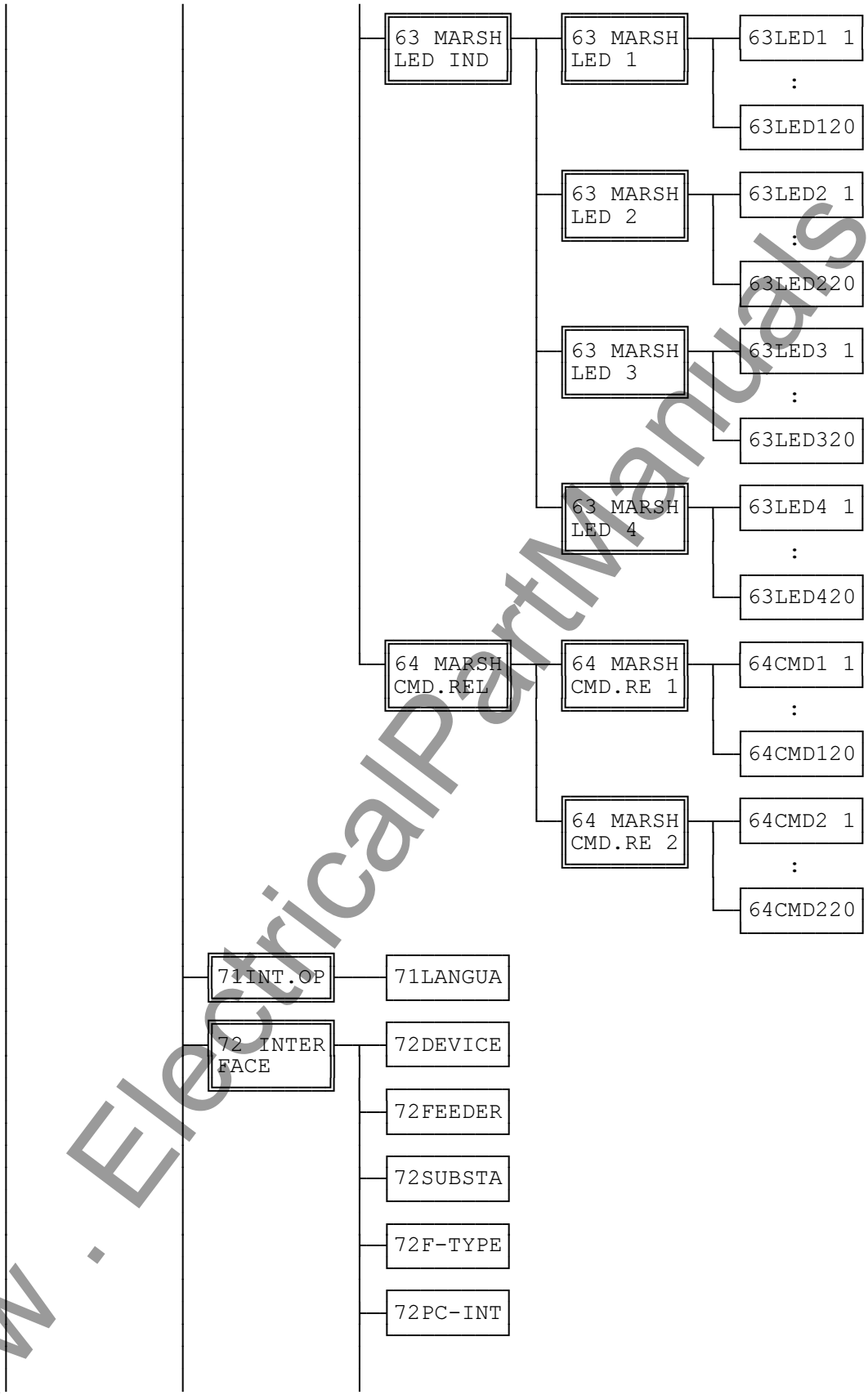
NOTE: The following tables list all data which are available in the maximum complement of the device. Dependent on the ordered model, only those data may be present which are valid for the individual version.

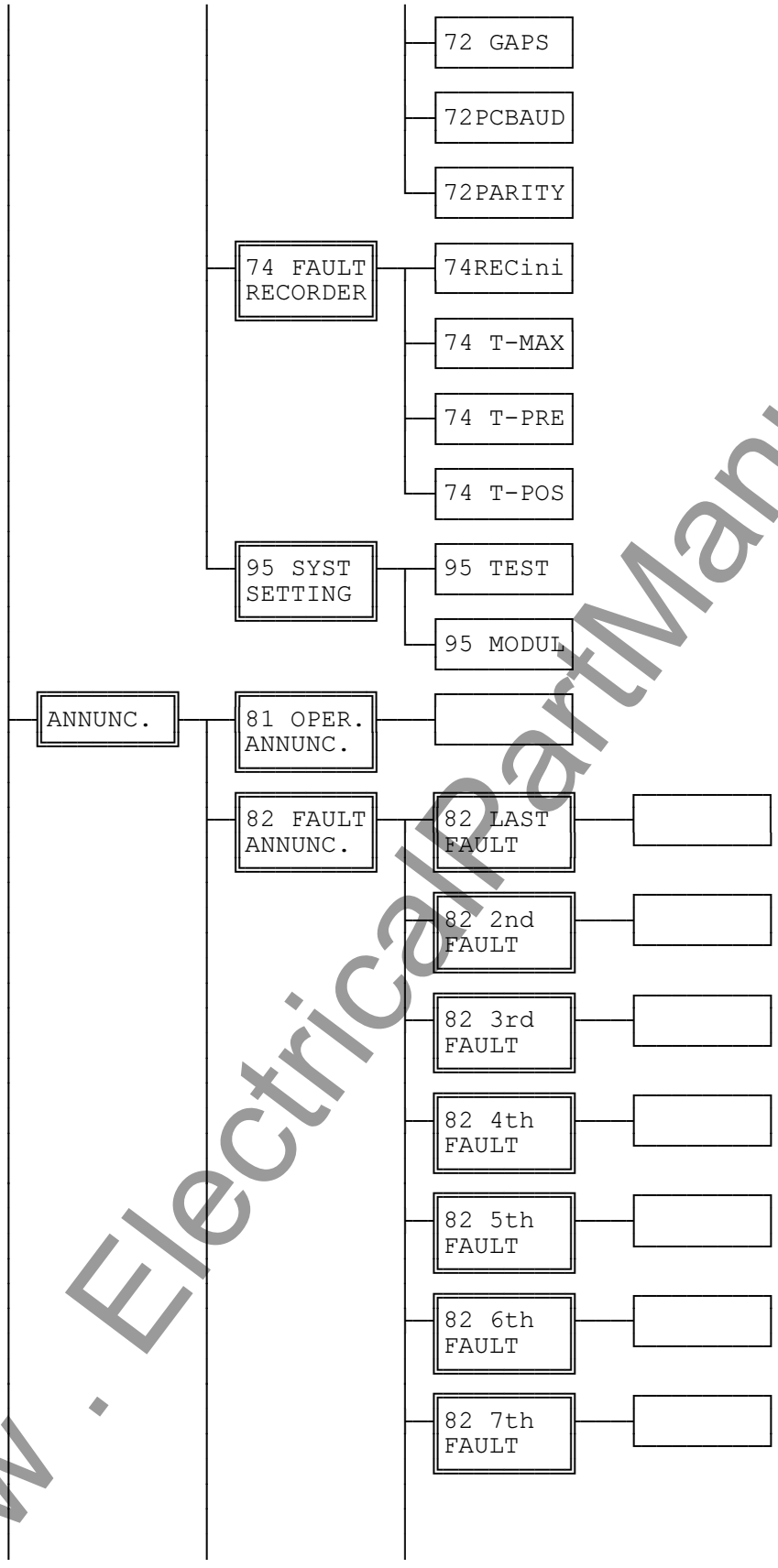
NOTE: The actual tables are attached to the purchased relay.

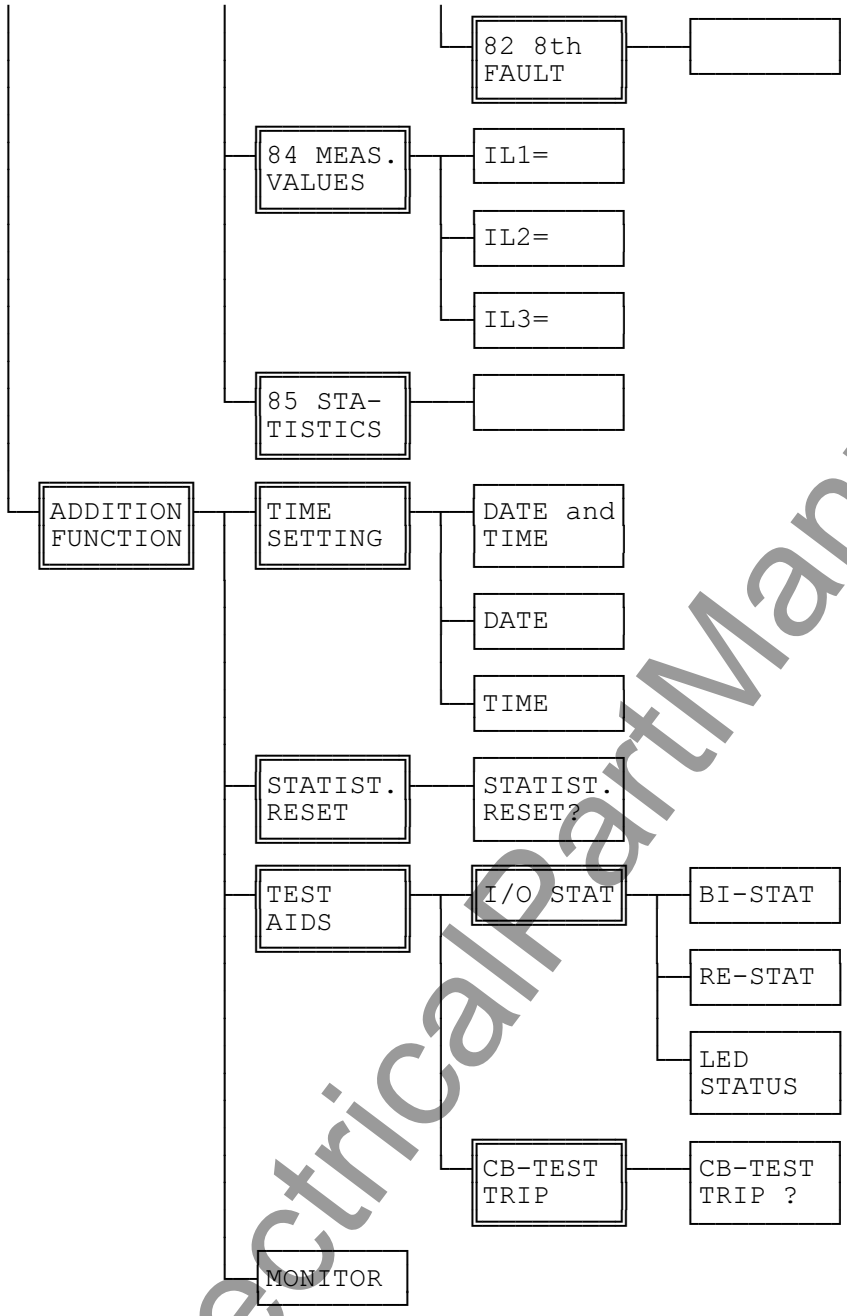
Menu Structure of 7SV600











Annunciations 7SV600 for LSA (according to IEC 60870-5-103)

FNo. - Function number of annunciation
Op/Ft - Operation/Fault annunciation
C/CG: Coming/Coming and Going annunciation
V : Annunciation with Value
M : Measurand

according to IEC 60870-5-103:
CA - Compatible Annunciation
GI - Annunciation for General Interrogation
BT - Binary Trace for fault recordings
Typ - Function type (p: according to the configured "Function type")
Inf - Information number

FNo.	Meaning	Ann. Op	Ann. Ft		IEC 60870-5-103 CA	GI	BT	Typ	Inf
501	General fault detection of the device		CG		CA		BT	165	84
511	General trip of the device		C		CA		BT	165	68
602	Current in phase L2 [%] =	M			CA			165	144
7710	Breaker failure Trip T1 (local Trip)		CG				BT	165	1
7711	Breaker failure Trip T2 (Busbar Trip)		CG				BT	165	2
7712	Circuit breaker defective: Trip		CG					165	3
7713	Trip by End-Fault protection		CG					165	4
7714	Trip by monitoring current symmetry		CG					165	5
7728	Breaker failure protection is active	CG						165	6

Control Commands from LSA to 7SV600 (according to IEC 60870-5-103)

FNo. - Function number of annunciation

according to IEC 60870-5-103:
CA - Compatible Annunciation
GI - Annunciation for General Interrogation
BT - Binary Trace for fault recordings
Typ - Function type (p: according to the configured "Function type")
Inf - Information number

FNo.	Meaning			IEC 60870-5-103 CA	GI	BT	Typ	Inf
5	>Reset LED indicators						165	19

Annunciations 7SV600 for PC, LC-Display and Binary Inputs/Outputs

FNo. - Function number of annunciation
Op/Ft - Operation/Fault annunciation
C/CG: Coming/Coming and Going annunciation
M : Measurand
I - can be marshalled to binary input
O - can be marshalled to binary output (LED, signal/trip relay)

FNo.	Text	Meaning	Op	Ft	I	O
1	not all.	Not allocated			I	O
5	>LED r.	>Reset LED indicators			I	O
51	Dev.OK	Device operative / healthy	CG			O
52	operat.	Any protection operative	CG			O
60	LED res	LED Reset	C			
83	SigTest	For internal use only				
110	ANNlost	Annunciations lost (buffer overflow)	C			
111	PCannLT	Annunciations for PC lost	C			
113	TAGlost	Fault tag lost				
115	ANNovfl	Fault annunciation buffer overflow		C		
203	REC del	Fault recording data deleted	C			
301	Sys.Flt	Fault in the power system	C	CG		
302	FAULT	Flt. event w. consecutive no.	C	C		
355	>CB 1pC	>CB aux. contact:1pole closed(parallel)	CG	CG	I	O
501	FT det	General fault detection of device		CG		O
511	DEV.Trp	General trip of device		C		O
521	IL1	Interrupted current: Phase L1(I/In)		C		
522	IL2	Interrupted current: Phase L2(I/In)		C		
523	IL3	Interrupted current: Phase L3(I/In)		C		
601	IL1=	Current in phase IL1 [%] =	M			
602	IL2=	Current in phase IL2 [%] =	M			
603	IL3=	Current in phase IL3 [%] =	M			
1174	CBtest	Circuit breaker test in progress	CG			O
1185	CBtpTST	Circuit breaker test: Trip 3pole	CG			O
1403	>BF blo	>Block breaker fail protection	CG		I	O
1421	>CBdef.	>Circuit breaker defective	CG		I	O
1451	BF off	Breaker fail protection is switched off	CG			O
1452	BF bloc	Breaker failure protection is blocked	CG			O
1455	BF flt	Breaker failure : fault detection		CG		O
7701	>LO Res	>Lock Out reset	C		I	O
7702	>Releas	>Ext. release (only for 3-pole start)	CG	CG	I	O
7703	>Strt3p	>BF external start 3-pole	CG	CG	I	O
7704	>St.woI	>BF external start 3-p. without current	CG	CG	I	O
7705	>StrtL1	>BF external start L1	CG	CG	I	O
7706	>StrtL2	>BF external start L2	CG	CG	I	O
7707	>StrtL3	>BF external start L3	CG	CG	I	O
7710	TripT1	Breaker failure Trip T1 (local Trip)		CG		O
7711	TripT2	Breaker failure Trip T2 (Busbar Trip)		CG		O
7712	TripCBd	Circuit breaker defective: Trip		CG		O
7713	TrpEndF	Trip by End-Fault protection		CG		O
7714	TripSym	Trip by monitoring current symmetry		CG		O
7715	Supv.2c	Supervision: No two-channel start	CG			O
7716	Supv.2p	Supervision: Wrong 2-phase initiation	CG			O
7717	Supv.L1	Supervision: Start L1 not plausible	CG			O
7718	Supv.L2	Supervision: Start L2 not plausible	CG			O
7719	Supv.L3	Supervision: Start L3 not plausible	CG			O
7720	SupvSym	Supervision: Current symmetry	CG			O
7721	LockOut	Lock Out state	CG			O

FNo.	Text	Meaning	Op	Ft	I	O
7722	Strt 1p=	Number of BF starts, 1-pole				
7723	Strt 3p=	Number of BF starts, 3-pole				
7724	TripNoT1	Number of Trips with T1				
7725	TripNoT2	Number of Trips with T2				
7726	BF Warn	Common alarm (Warning)	CG			O
7727	BF Fail	General failure of device (Defect)	CG			O
7728	BF act.	Breaker failure protection is active	CG			O

Reference Table for Functional Parameters 7SV600

PARAME. - PARAMETER SETTINGS

00 CONF. - SCOPE OF FUNCTIONS

00 BF P.		Breaker Failure Protection
3-POLE	[ ]	Three-pole
1/3-POLE	[ ]	Single/three-pole

---

01 POWER SYST.DAT - POWER SYSTEM DATA

01 FREQ		Rated system frequency
50 Hz	[ ]	fN 50 Hz
60 Hz	[ ]	fN 60 Hz
01 InPRI		Primary rated current
min. 10		A
max. 50000	____	
01 T-TRP		Minimum trip command duration
min. 0.01		s
max. 32.00	____	

---

10 BFPROTECT. - BREAKER FAILURE PROTECTION

10 BF P.		Breaker Failure Protection ON/OFF
ON	[ ]	on
OFF	[ ]	off
10 I-BF		Current pick-up for Breaker Fail
min. 0.05		I/In
max. 4.00	____	
10 T1-1P		Local trip time delay (T1): 1pole
min. 0.00		s
max. 32.00/∞	____	
10 T1-3P		Local trip time delay (T1): 3pole
min. 0.00		s
max. 32.00/∞	____	
10 T2		Busbar trip delay (T2)
min. 0.00		s
max. 32.00/∞	____	
10DrpOff		Extended criterion for Drop Off
NO	[ ]	no
YES	[ ]	yes

---

11 ENDFLT.PROT - END-FAULT PROTECTION

11EndFlt		End-Fault Protection
OFF	[ ]	off
ON	[ ]	on

```
   11T-EndF                Time delay for trip by End-Fault Protection
      min. 0.00            s
      max. 32.00/∞  ———
```

```
   12 CB DEFECT. - CIRCUIT BREAKER DEFECTIVE

   12BrkDEF                Handling of Binary Input 'CB defective'
      NO               [ ] no
      Trp-T1           [ ] Trip T1
      Trp-T2           [ ] Trip T2
      Trp-T1/2         [ ] Trip T1 and T2

   12T-BrkD                Time delay for trip by BI 'CB defective'
      min. 0.00            s
      max. 32.00/∞  ———
```

```
   13 TRIP LOCKOUT - TRIP LOCKOUT

   13 L-Out                Operating mode of Lockout function
      NO               [ ] no
      Trp-T1           [ ] Trip T1
      Trp-T2           [ ] Trip T2
      Trp-T1/2         [ ] Trip T1 and T2

   13 LORes                Reset of Lockout
      button           [ ] via LED-quit button
      IEC/Digs         [ ] by IEC 60870/Digsi
      but/IEC          [ ] by button/IEC/Digsi
```

```
   14 BL.W. BI SUP. - BLOCK WITH BINARY INPUT SUPERVISION

   14BFblck                Block BF-protection via supervision
      ON               [ ] on
      OFF              [ ] off

   14T-blck                Time delay for BF blocking by supervision
      min. 0.00            s
      max. 32.00    ———

   14Sup.2c                Supervision of two-channel BF start
      YES              [ ] yes
      NO               [ ] no

   14Sup.1c                Supervision of BF start without current
      YES              [ ] yes
      NO               [ ] no
```

```
   15 SYMM. SUPERV. - SYMMETRY SUPERVISION

   15SupSym                Operating mode of current symmetry supervision
      OFF              [ ] off
      ON               [ ] on
```

15 Sym-I		Symmetry threshold for current monitoring
min. 0.10		I/In
max. 1.00	———	
15 SymFa		Symmetry factor for current monitoring
min. 0.10		
max. 0.95	———	
15 Sym-T		Time delay for current symmetry supervision
min. 1		s
max. 32/∞	———	
15SymTrp		Local Trip by current symmetry supervision
NO	[ ]	no
YES	[ ]	yes

Reference Table for Configuration Parameters 7SV600

60 MARSH - MARSHALLING

61 MARSH BIN.INP - MARSHALLING BINARY INPUTS

61 MARSH BI 1 - MARSHALLING OF BINARY INPUT 1

61BI1 1	BINARY INPUT 1 1st FUNCTION
61BI1 2	BINARY INPUT 1 2nd FUNCTION
61BI1 3	BINARY INPUT 1 3rd FUNCTION
61BI1 4	BINARY INPUT 1 4th FUNCTION
61BI1 5	BINARY INPUT 1 5th FUNCTION
61BI1 6	BINARY INPUT 1 6th FUNCTION
61BI1 7	BINARY INPUT 1 7th FUNCTION
61BI1 8	BINARY INPUT 1 8th FUNCTION
61BI1 9	BINARY INPUT 1 9th FUNCTION
61BI1 10	BINARY INPUT 1 10th FUNCTION

61 MARSH BI 2 - MARSHALLING OF BINARY INPUT 2

61BI2 1	BINARY INPUT 2 1st FUNCTION
61BI2 2	BINARY INPUT 2 2nd FUNCTION

61BI2 3		BINARY INPUT 2 3rd FUNCTION
61BI2 4		BINARY INPUT 2 4th FUNCTION
61BI2 5		BINARY INPUT 2 5th FUNCTION
61BI2 6		BINARY INPUT 2 6th FUNCTION
61BI2 7		BINARY INPUT 2 7th FUNCTION
61BI2 8		BINARY INPUT 2 8th FUNCTION
61BI2 9		BINARY INPUT 2 9th FUNCTION
61BI2 10		BINARY INPUT 2 10th FUNCTION

61 MARSH BI 3 - MARSHALLING OF BINARY INPUT 3

61BI3 1		BINARY INPUT 3 1st FUNCTION
61BI3 2		BINARY INPUT 3 2nd FUNCTION
61BI3 3		BINARY INPUT 3 3rd FUNCTION
61BI3 4		BINARY INPUT 3 4th FUNCTION
61BI3 5		BINARY INPUT 3 5th FUNCTION
61BI3 6		BINARY INPUT 3 6th FUNCTION

61BI3 7	BINARY INPUT 3 7th FUNCTION	
61BI3 8	BINARY INPUT 3 8th FUNCTION	
61BI3 9	BINARY INPUT 3 9th FUNCTION	
61BI3 10	BINARY INPUT 3 10th FUNCTION	

62 MARSH SIG.REL - MARSHALLING SIGNAL RELAYS

62 MARSH SIG.RE 1 - MARSHALLING OF SIGNAL RELAY 1

62SIG1 1	Signal RELAY 1 1st CONDITION	
62SIG1 2	Signal RELAY 1 2nd CONDITION	
62SIG1 3	Signal RELAY 1 3rd CONDITION	
62SIG1 4	Signal RELAY 1 4th CONDITION	
62SIG1 5	Signal RELAY 1 5th CONDITION	
62SIG1 6	Signal RELAY 1 6th CONDITION	
62SIG1 7	Signal RELAY 1 7th CONDITION	
62SIG1 8	Signal RELAY 1 8th CONDITION	
62SIG1 9	Signal RELAY 1 9th CONDITION	
62SIG110	Signal RELAY 1 10th CONDITION	

62SIG111	Signal RELAY 1 11th CONDITION
62SIG112	Signal RELAY 1 12th CONDITION
62SIG113	Signal RELAY 1 13th CONDITION
62SIG114	Signal RELAY 1 14th CONDITION
62SIG115	Signal RELAY 1 15th CONDITION
62SIG116	Signal RELAY 1 16th CONDITION
62SIG117	Signal RELAY 1 17th CONDITION
62SIG118	Signal RELAY 1 18th CONDITION
62SIG119	Signal RELAY 1 19th CONDITION
62SIG120	Signal RELAY 1 20th CONDITION

62 MARSH SIG.RE 2 - MARSHALLING OF SIGNAL RELAY 2

62SIG2 1	Signal RELAY 2 1st CONDITION
62SIG2 2	Signal RELAY 2 2nd CONDITION
62SIG2 3	Signal RELAY 2 3rd CONDITION
62SIG2 4	Signal RELAY 2 4th CONDITION

62SIG2 5	Signal RELAY 2 5th CONDITION
62SIG2 6	Signal RELAY 2 6th CONDITION
62SIG2 7	Signal RELAY 2 7th CONDITION
62SIG2 8	Signal RELAY 2 8th CONDITION
62SIG2 9	Signal RELAY 2 9th CONDITION
62SIG210	Signal RELAY 2 10th CONDITION
62SIG211	Signal RELAY 2 11th CONDITION
62SIG212	Signal RELAY 2 12th CONDITION
62SIG213	Signal RELAY 2 13th CONDITION
62SIG214	Signal RELAY 2 14th CONDITION
62SIG215	Signal RELAY 2 15th CONDITION
62SIG216	Signal RELAY 2 16th CONDITION
62SIG217	Signal RELAY 2 17th CONDITION
62SIG218	Signal RELAY 2 18th CONDITION
62SIG219	Signal RELAY 2 19th CONDITION

62SIG220	Signal RELAY 2 20th CONDITION

63 MARSH LED IND - MARSHALLING LED INDICATORS

63 MARSH LED 1 - MARSHALLING OF LED INDICATOR 1

63LED1 1	LED 1 1st CONDITION
63LED1 2	LED 1 2nd CONDITION
63LED1 3	LED 1 3rd CONDITION
63LED1 4	LED 1 4th CONDITION
63LED1 5	LED 1 5th CONDITION
63LED1 6	LED 1 6th CONDITION
63LED1 7	LED 1 7th CONDITION
63LED1 8	LED 1 8th CONDITION
63LED1 9	LED 1 9th CONDITION
63LED110	LED 1 10th CONDITION
63LED111	LED 1 11th CONDITION
63LED112	LED 1 12th CONDITION
63LED113	LED 1 13th CONDITION

63LED114	LED 1 14th CONDITION
63LED115	LED 1 15th CONDITION
63LED116	LED 1 16th CONDITION
63LED117	LED 1 17th CONDITION
63LED118	LED 1 18th CONDITION
63LED119	LED 1 19th CONDITION
63LED120	LED 1 20th CONDITION

63 MARSH LED 2 - MARSHALLING OF LED INDICATOR 2

63LED2 1	LED 2 1st CONDITION
63LED2 2	LED 2 2nd CONDITION
63LED2 3	LED 2 3rd CONDITION
63LED2 4	LED 2 4th CONDITION
63LED2 5	LED 2 5th CONDITION
63LED2 6	LED 2 6th CONDITION
63LED2 7	LED 2 7th CONDITION

63LED2 8	LED 2 8th CONDITION
63LED2 9	LED 2 9th CONDITION
63LED210	LED 2 10th CONDITION
63LED211	LED 2 11th CONDITION
63LED212	LED 2 12th CONDITION
63LED213	LED 2 13th CONDITION
63LED214	LED 2 14th CONDITION
63LED215	LED 2 15th CONDITION
63LED216	LED 2 16th CONDITION
63LED217	LED 2 17th CONDITION
63LED218	LED 2 18th CONDITION
63LED219	LED 2 19th CONDITION
63LED220	LED 2 20th CONDITION

63 MARSH LED 3 - MARSHALLING OF LED INDICATOR 3

63LED3 1	LED 3 1st CONDITION

63LED3 2	LED 3 2nd CONDITION
63LED3 3	LED 3 3rd CONDITION
63LED3 4	LED 3 4th CONDITION
63LED3 5	LED 3 5th CONDITION
63LED3 6	LED 3 6th CONDITION
63LED3 7	LED 3 7th CONDITION
63LED3 8	LED 3 8th CONDITION
63LED3 9	LED 3 9th CONDITION
63LED310	LED 3 10th CONDITION
63LED311	LED 3 11th CONDITION
63LED312	LED 3 12th CONDITION
63LED313	LED 3 13th CONDITION
63LED314	LED 3 14th CONDITION
63LED315	LED 3 15th CONDITION
63LED316	LED 3 16th CONDITION

63LED317	LED 3 17th CONDITION
63LED318	LED 3 18th CONDITION
63LED319	LED 3 19th CONDITION
63LED320	LED 3 20th CONDITION

63 MARSH LED 4 - MARSHALLING OF LED INDICATOR 4

63LED4 1	LED 4 1st CONDITION
63LED4 2	LED 4 2nd CONDITION
63LED4 3	LED 4 3rd CONDITION
63LED4 4	LED 4 4th CONDITION
63LED4 5	LED 4 5th CONDITION
63LED4 6	LED 4 6th CONDITION
63LED4 7	LED 4 7th CONDITION
63LED4 8	LED 4 8th CONDITION
63LED4 9	LED 4 9th CONDITION
63LED410	LED 4 10th CONDITION

63LED411	LED 4 11th CONDITION
63LED412	LED 4 12th CONDITION
63LED413	LED 4 13th CONDITION
63LED414	LED 4 14th CONDITION
63LED415	LED 4 15th CONDITION
63LED416	LED 4 16th CONDITION
63LED417	LED 4 17th CONDITION
63LED418	LED 4 18th CONDITION
63LED419	LED 4 19th CONDITION
63LED420	LED 4 20th CONDITION

64 MARSH CMD.REL - MARSHALLING TRIP RELAYS

64 MARSH CMD.RE 1 - MARSHALLING OF COMMAND RELAY 1

64CMD1 1	COMMAND RELAY 1 1st CONDITION
64CMD1 2	COMMAND RELAY 1 2nd CONDITION
64CMD1 3	COMMAND RELAY 1 3rd CONDITION
64CMD1 4	COMMAND RELAY 1 4th CONDITION

64CMD1 5	COMMAND RELAY 1 5th CONDITION
64CMD1 6	COMMAND RELAY 1 6th CONDITION
64CMD1 7	COMMAND RELAY 1 7th CONDITION
64CMD1 8	COMMAND RELAY 1 8th CONDITION
64CMD1 9	COMMAND RELAY 1 9th CONDITION
64CMD110	COMMAND RELAY 1 10th CONDITION
64CMD111	COMMAND RELAY 1 11th CONDITION
64CMD112	COMMAND RELAY 1 12th CONDITION
64CMD113	COMMAND RELAY 1 13th CONDITION
64CMD114	COMMAND RELAY 1 14th CONDITION
64CMD115	COMMAND RELAY 1 15th CONDITION
64CMD116	COMMAND RELAY 1 16th CONDITION
64CMD117	COMMAND RELAY 1 17th CONDITION
64CMD118	COMMAND RELAY 1 18th CONDITION
64CMD119	COMMAND RELAY 1 19th CONDITION

64CMD120	COMMAND RELAY 1 20th CONDITION

64 MARSH CMD.RE 2 - MARSHALLING OF COMMAND RELAY 2

64CMD2 1	COMMAND RELAY 2 1st CONDITION
64CMD2 2	COMMAND RELAY 2 2nd CONDITION
64CMD2 3	COMMAND RELAY 2 3rd CONDITION
64CMD2 4	COMMAND RELAY 2 4th CONDITION
64CMD2 5	COMMAND RELAY 2 5th CONDITION
64CMD2 6	COMMAND RELAY 2 6th CONDITION
64CMD2 7	COMMAND RELAY 2 7th CONDITION
64CMD2 8	COMMAND RELAY 2 8th CONDITION
64CMD2 9	COMMAND RELAY 2 9th CONDITION
64CMD210	COMMAND RELAY 2 10th CONDITION
64CMD211	COMMAND RELAY 2 11th CONDITION
64CMD212	COMMAND RELAY 2 12th CONDITION
64CMD213	COMMAND RELAY 2 13th CONDITION

64CMD214		COMMAND RELAY 2 14th CONDITION
64CMD215		COMMAND RELAY 2 15th CONDITION
64CMD216		COMMAND RELAY 2 16th CONDITION
64CMD217		COMMAND RELAY 2 17th CONDITION
64CMD218		COMMAND RELAY 2 18th CONDITION
64CMD219		COMMAND RELAY 2 19th CONDITION
64CMD220		COMMAND RELAY 2 20th CONDITION

71INT.OP - INTEGRATED OPERATION

71LANGUA		Language
ENGLISH	[ ]	English
DEUTSCH	[ ]	German
FRANCAIS	[ ]	French
ESPANOL	[ ]	Spanish

---

72 INTER FACE - PC AND SYSTEM INTERFACES

72DEVICE		Device address
min. 1		
max. 254	___	
72FEEDER		Feeder address
min. 1		
max. 254	___	
72SUBSTA		Substation address
min. 1		
max. 254	___	
72F-TYPE		Function type in accord. with IEC60780-5-103
min. 1		
max. 254	___	
72PC-INT		Data format for PC-interface
DIGSI V3	[ ]	DIGSI V3
ASCII	[ ]	ASCII
IEC ext.	[ ]	IEC 60870 extended

```
   72 GAPS                 Transmission gaps for PC-interface
      min. 0.0             s
      max. 5.0       ____

   72PCBAUD                Transmission baud rate for PC-interface
      9600BAUD        [ ] 9600 Baud
      19200 BD        [ ] 19200 Baud
      1200BAUD        [ ] 1200 Baud
      2400BAUD        [ ] 2400 Baud
      4800BAUD        [ ] 4800 Baud

   72PARITY                Parity and stop-bits for PC-interface
      DIGSI V3        [ ] DIGSI V3
      8O1             [ ] Odd parity,1 stopbit
      8N2             [ ] No parity,2 stopbits
      8N1             [ ] No parity,1 stopbit
```

```
74 FAULT RECORDER - FAULT RECORDINGS

   74RECini                Initiation of data storage
      RECbyFT         [ ] Storage by fault det
      RECbyTP         [ ] Storage by trip
      SRTwitTP        [ ] Start with trip

   74 T-MAX                Maximum time period of a fault recording
      min. 0.30            s
      max. 5.00       ____

   74 T-PRE                Pre-trigger time for fault recording
      min. 0.05            s
      max. 0.50       ____

   74 T-POS                Post-fault time for fault recording
      min. 0.05            s
      max. 0.50       ____
```

```
95 SYST SETTING - OPERATING SYSTEM SETTINGS

   95 TEST                 Activating internal test
      NONE            [ ] none
      withREPO        [ ] With report
      BUF-OVFL        [ ] Err.buf.owerfl=moni

   95 MODUL                Number of tested module
      min. 0
      max. 100        ____
```

To

SIEMENS AKTIENGESELLSCHAFT

Dept. EV S SUP 2

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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