SIEMENS

Numerical Voltage, Frequency, and Overflux Protection

SIPROTEC 7RW600 V3.0

Instruction Manual   Order No: C53000−G1176−C117−4

Figure 1   Illustration of the numerical voltage, frequency, and overflux protection relay 7RW600 (in flush mounting case)

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Conformity

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

Conformity is proved by tests that had been performed according to article 10 of the Council Directive in accordance with the generic standards EN 50081 and EN 50082 (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 C37.90.0 and 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.
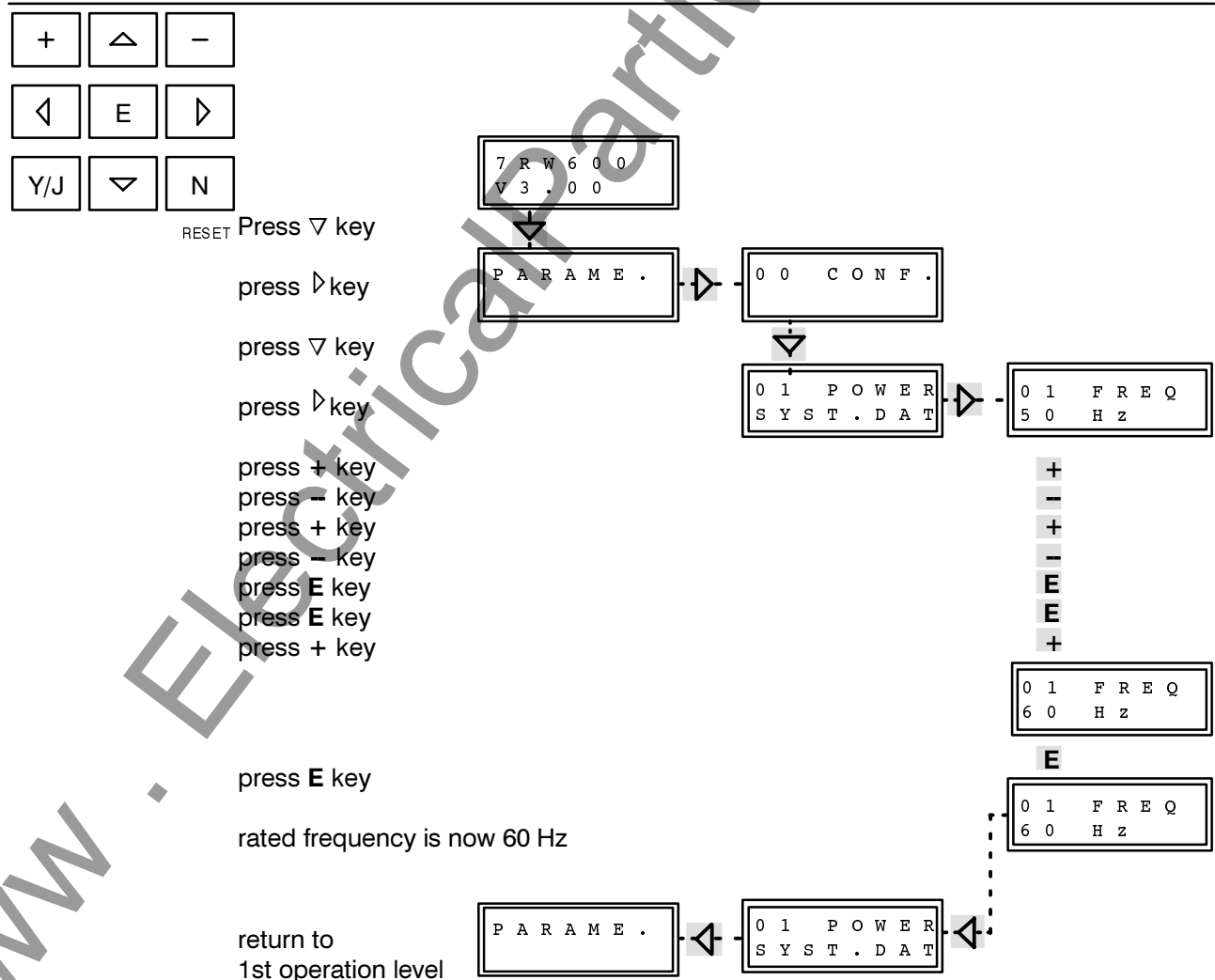
After the relay has been switched on, the green LED ("Service") illuminates and the red LED ("Blocked") lights up until the processor system has started up. The display shows the type identification of the relay

("7RW600") and the version of the implemented firmware ("V1.**").

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 functions contained in the relay SIPROTEC 7RW600 can be used for various protection and supervision tasks.

Typical application is the use as a network disconnecting relay, which maintains the in-plant generation after a network fault. Furthermore, it can be used as load shedding relay, when impermissible voltage or frequency fluctuations may give rise to network black-out. In conjunction with the overcurrent time protection relay SIPROTEC 7SJ600, protection for electrical machines can be established.

As machine protection relay, the voltage, frequency, and overflux protection guard generators and transformers against faulty operation of the voltage and/or speed regulator, after full load rejection, or in island operation of power stations.

This phase sequence sensitive, three–phase under voltage relay is intended principally for the detection of excessive reduction of the network voltage in motor supply systems. For this purpose, 7RW600 monitors the positive phase sequence voltage value. This is the factor which determines the torque output of electrical machines. The settings allow the inverse–time characteristic of the relay to be matched to a machine's stability characteristic, for which the permissible voltage reduction is a function of time.

Throughout a fault in the network or power station the magnitudes of the instantaneous measured and calculated values are stored for a period of max. 5 seconds and are available for subsequent fault analysis. Alternatively, the r.m.s. values can be stored over max. 50 s. In order to transmit these data, 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.

Continuous monitoring of the hardware and software of the relay permits rapid annunciation of internal faults. This ensures the high reliability and availability of the device.

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 breaker;

– 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 d.c./d.c. converter;

– insensitive against current transformer errors, transient phenomena and interferences;

– different combinations of the protective and supervision functions can be ordered;

– the two measured input voltages may be connected phase-to-phase (V-connection) or single-phase to different voltage transformers;

– circuit breaker operation test facility by test trip of the breaker;

– trip circuit supervision for the tripping coil including the circuitry possible;

– 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 or r.m.s. values during a fault for fault recording.

1.3   Implemented functions

The available protective and supervisory functions of the numerical voltage, frequency, and overflux relay SIPROTEC 7RW600 depend on the ordered version, refer also to Section 2.3 Ordering data. They can be switched effective or ineffective. The total possible scope of functions is the following:

Undervoltage protection

– single-stage undervoltage detection:

– two different voltages can be processed with single-phase voltage connection,

– the positive sequence voltage is processed with two-phase voltage connection (V-connection),

– processing of the positive sequence voltage is possible with different voltage-dependent time characteristics.

Overvoltage protection

– two-stage overvoltage detection with separately adjustable setting values,

– two voltages can be processed with single-phase voltage connection, two-stage each,

– both the phase-to-phase voltages are processed with two-phase voltage connection (V-connection), two-stage.

Frequency protection

– four individually adjustable frequency stages can be set as overfrequency protection $f>$ or underfrequency protection $f<$,

– high-accuracy measurement procedure,

– insensitive against harmonics and phase shifts,

– adjustable minimum operating voltage threshold,

– each stage with individually settable time delay.

Rate-of-frequency-change protection

– four individually adjustable rate-of-change stages can be set as drop-of-frequency protection $|-df/dt|>$,

– adjustable minimum operating voltage threshold,

– each stage with individually settable time delay,

– negative rate of change is registered as long as $f < f_N$; positive rate of change is registered as long as $f > f_N$,

– all stages can be combined with the corresponding underfrequency stage.

Overflux protection

– calculation of the ratio U/f (proportional to induction B),

– calculation of the thermal stress,

– standard characteristic or either optional characteristic selectable,

– adjustable warning and tripping stage.

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

Three different types of housings can be delivered:

– **7RW600★–★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 sol-
id bare wires (even with different diameter) can be connected directly. Use copper conductors only! Use copper conductors only!

For dimensions please refer to Figure 2.1.

– **7RW600★–★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.

– **7RW600★–★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.

7RW600★−★B★★★ Housing for **panel surface mounting** 7XP20 with terminals at both sides

Dimensions in mm

Heavy current connectors (terminals 1 to 6, not used in 7RW600):

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 31 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

7RW600★−★D★★★ in housing for **panel surface mounting** 7XP20 with terminals top and bottom
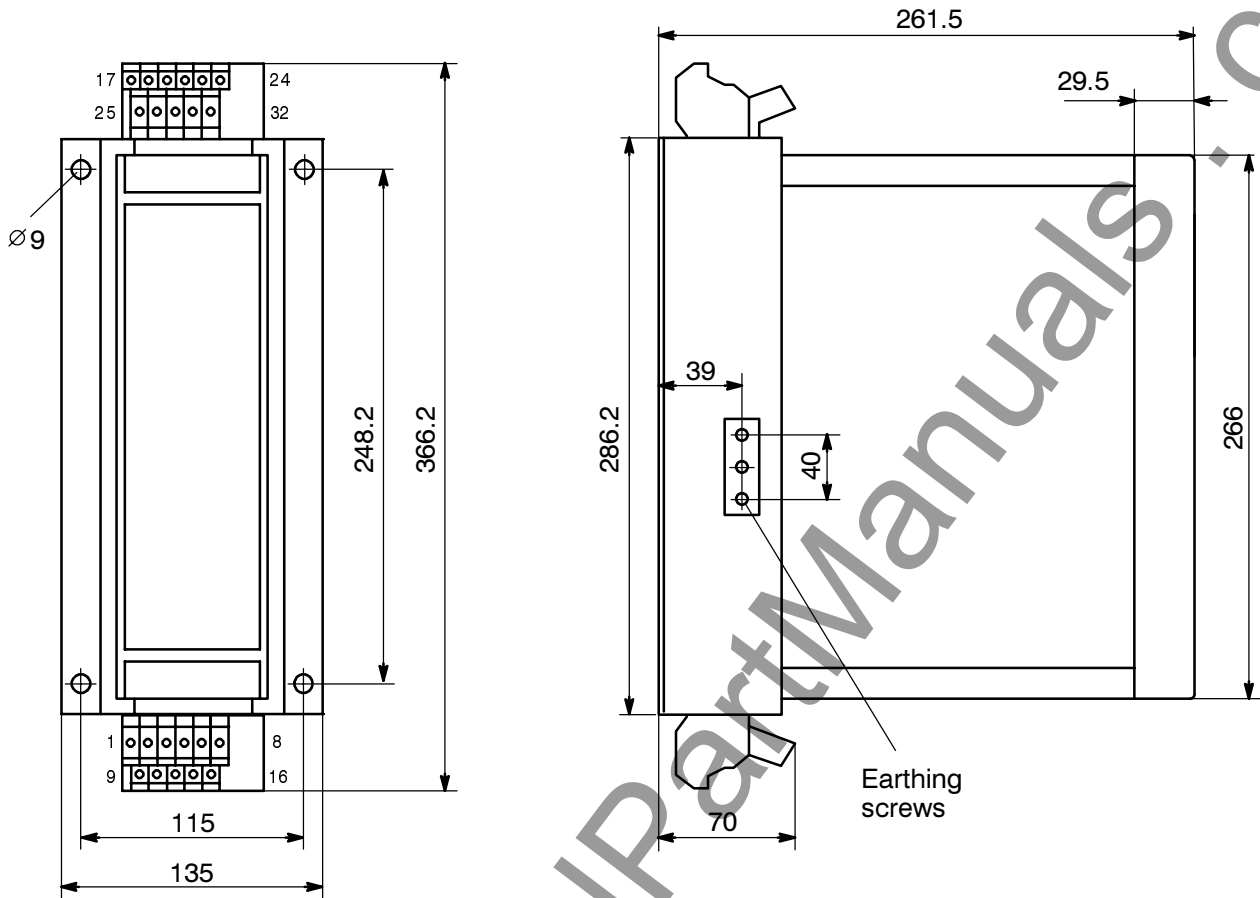
Max. 32 terminals for cross-section max. 5 mm^2 or AWG 10

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

7RW600★−★E★★★ Housing for **panel flush mounting** or **cubicle installation** 7XP20

29.5   172   37

Mounting plate

266

244

75

70

31
30 29
28 27

12 11
10 9
8   7
5   6
3   4
1   2

Connector terminals
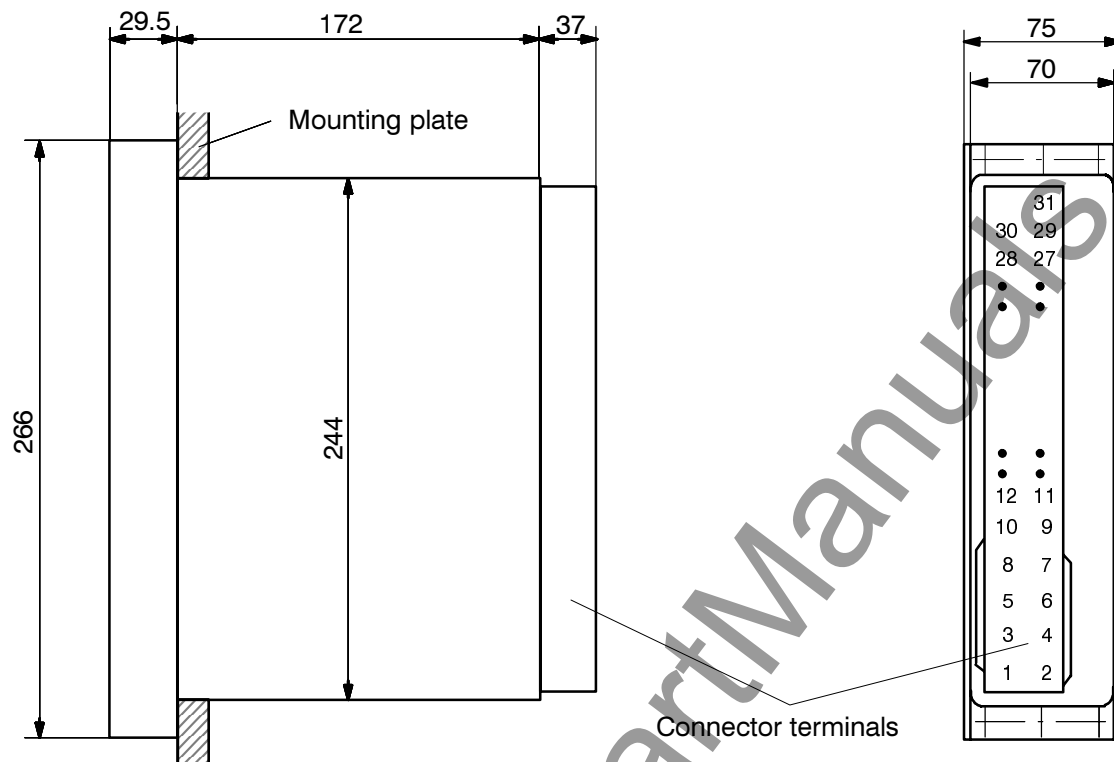
Heavy current connectors (terminals 1 to 6, not used in 7RW600):

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 31 in-lbs

Voltage connectors (terminals 7 to 31):

Screwed terminal (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

71 $^{+2}$

Ø 5 or M4

245 $^{+1}$

255.8 $\pm$0,3

Ø 6

5.4

7.3   56.5 $\pm$0.3

Panel cut-out
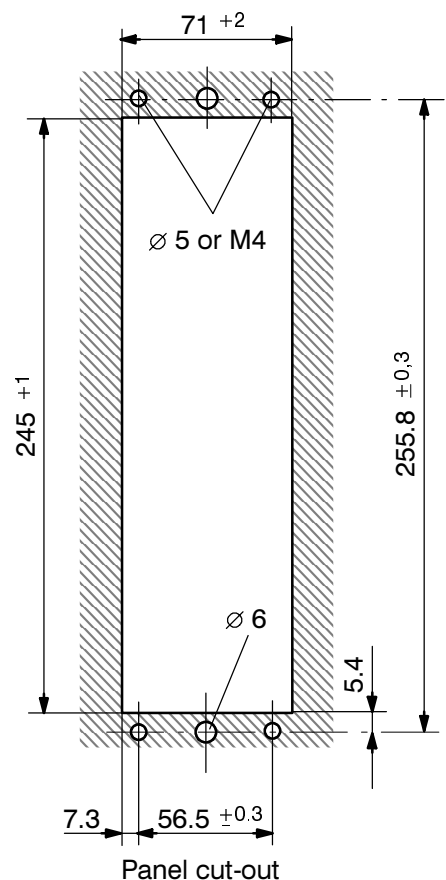
Figure 2.3   Dimensions for housing 7XP20 for panel flush mounting or cubicle installation

2.3   Ordering data

Numerical Frequency, Voltage, and Overflux Protection	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
7 R W 6 0 0	0	–			A	0	–		D	A	0

Auxiliary voltage

24/48 V dc 2

60/110/125 V dc 4

220/250 V dc / 115 V ac, 50/60 Hz 5

Construction

in housing for panel surface mounting
with terminals at both sides . . . . B

in housing for panel surface mounting
with terminals top and bottom . . . . D

in housing for panel flush mounting/cubicle installation . . . . E

Preset operating language

English 0

German 1

Spanish 2

French 3

Scope of functions

Voltage and frequency protection 0

Voltage, frequency, rate-of-frequency-change protection 1

Voltage and overflux protection 2

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 V.24 − RS485 . . . . **7XV5100−2**
between PC (25pin socket) and converter V.24 − RS485 . . . . **7XV5100−0**

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

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

Operating software DIGSI
DIGSI−LIGHT V3 (expansion level 1)
parameterization and operating software (English) . . . . **7XS5120−1AA00**
DIGSI V3 extended version
parameterization and operating software (English) . . . . **7XS5020−1AA00**
requirement: MS−WINDOWS V3.1 or higher

Graphic evaluation program DIGRA[1])
for visualization of fault recordings, together with DIGSI V3 (English) . . . . **7XS5130−1AA00**
requirement: MS−WINDOWS V3.1 or higher and DIGSI

[1]) is included in the extended version of operating software program DIGSI V3

3 Technical data

3.1 General data

3.1.1 Inputs/outputs

Measuring circuits

Rated voltage U_N	100 V to 125 V (selectable)
Rated frequency f_N	50 Hz/60 Hz (selectable)
Power consumption voltage path at 100 V	$\leq$ 0.2 VA per input
Linearity range voltage path	170 Vac
Overload capability voltage path – thermal (r.m.s.)	200 V continuous 230 V for $\leq$ 10 s

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 a.c. voltage, peak–peak	$\leq$ 12 %
Power consumption quiescent energized	approx. 2 W approx. 4 W
Bridging time during failure/short-circuit of auxiliary voltage	$\geq$ 50 ms at U_{rated}

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

Output contacts

Output relays, number, total		6 (can be marshalled)
two-channel controlled and monitored command relays (K1 and K2)		2 (can be marshalled)
Contacts per relay	K1 to K5	1 NO
	K6	1 NC or 1 NO (reconnectable)
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

Binary inputs, number		3 (can be marshalled)
Rated operating voltages		24 to 250 Vdc
Current consumption		approx. 2.5 mA, independent of operating voltage
Pick-up threshold		reconnectable by jumpers
– 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	$U_{pick-up}$	$\geq$ 75 Vdc
	$U_{drop-off}$	< 45 Vdc
– pick-up/drop-off time		approx. 7 ms

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 converter RS485/fibre-optic; core pairs with individual and common screening, screen must be earthed at both sides; characteristic impedance 120 Ω (>100 kHz) capacitance per unit length <60 nF/km loop resistance per unit length <160 Ω/km major diameter > 0.53 mm
– Transmission speed	as delivered 9600 Baud min. 1200 Baud; max. 19200 Baud
– Protocol	according to IEC 60870−5−103

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 (r.m.s.), 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	1.5 kV dc
– Impulse voltage test (type test) all circuits, class III	5 kV (peak); 1.2/50 μs; 0.5 J; 3 positive and 3 negative shots at intervals of 5 s

EMC tests; immunity (type tests)

Standards:	IEC 60255−6, IEC 60255−22 (product standards) EN 50082−2 (generic standard) VDE 0435 part 303
– High frequency IEC 60255−22−1, class III	2.5 kV (peak); 1 MHz; $\tau = 15\ \mu s$; 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; $R_i = 330\ \Omega$
– 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; $R_i = 50\ \Omega$; 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	2.5 kV to 3 kV (peak); 1 MHz to 1.5 MHz, decaying oscillation; 50 shots per s; duration 2 s; $R_i = 150\ \Omega$ to 200 Ω
– Fast transient surge withstand capability ANSI/IEEE C37.90.1	4 kV to 5 kV; 10/150 ns; 50 shots per s; both polarities; duration 2 s; $R_i = 80\ \Omega$
– 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; $R_i = 50\ \Omega$

EMC tests; emission (type tests)

Standard:	EN 50081−★ (generic standard)
– Conducted interference voltage, aux. voltage CISPR 22, EN 55022, class B	150 kHz to 30 MHz
– Interference field strength CISPR 11, EN 55011, class A	30 MHz to 1000 MHz

3.1.3   Mechanical stress tests

Vibration and shock during operation

Standards: IEC 60255−21
                                                        and IEC 60068−2

− Vibration   sinusoidal
  IEC 60255−21−1, class 2   10 Hz to 60 Hz: ± 0.075 mm amplitude;
  IEC 60068−2−6   60 Hz to 150 Hz: 1.0 g acceleration
                                                        sweep rate 1 octave/min
                                                        20 cycles in 3 orthogonal axes

− Shock   half sine
  IEC 60255−21−2, class 1   acceleration 5 g, duration 11 ms, 3 shocks in
  IEC 60068−2−27   each direction of 3 orthogonal axes

− Seismic vibration   sinusoidal
  IEC 60255−21−3, class 1   1 Hz to 8 Hz: ± 4 mm amplitude (hor. axis)
  IEC 60068−2−59   1 Hz to 8 Hz: ± 2 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   sinusoidal
  IEC 60255−21−1, class 2   5 Hz to 8 Hz: ± 7.5 mm amplitude;
  IEC 60068−2−6   8 Hz to 150 Hz: 2 g acceleration
                                                        sweep rate 1 octave/min
                                                        20 cycles in 3 orthogonal axes

− Shock   half sine
  IEC 60255−21−2, class 1   acceleration 15 g, duration 11 ms, 3 shocks in
  IEC 60068−2−27   each direction of 3 orthogonal axes

− Continuous shock   half sine
  IEC 60255−21−2, class 1   acceleration 10 g, duration 16 ms, 1000 shocks
  IEC 60068−2−29   each direction of 3 orthogonal axes

3.1.4   Climatic stress tests

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

Storage and transport with standard works packaging!

– Permissible humidity	mean value per year ≤ 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   Undervoltage protection U< (U$_x$<, U$_1$<[1], Up<[1])

Setting ranges/steps

Undervoltage	U< (U$_x$<, U$_1$<[1], Up<[1])	20 V to 120 V	(steps 1 V)
Time delay for definite time characteristic and additional time delay	T(U<, U$_x$<, U$_1$<[1]), T Up<	0.00 s to 60.00 s or ∞	(steps 0.01 s)
Time multiplier for inverse time characteristic	TM	0.10 s to 5.00 s	(steps 0.01 s)

Operating times

– pick-up time   approx. 50 ms
– drop-off time   approx. 50 ms

Reset ratio
  undervoltage U< (U$_x$<, U$_1$<[1], Up<[1])   approx. 1.05

Trip time characteristic
 (refer to Figure 3.1)

$$t = \frac{1}{1 - \dfrac{U}{U_p}} \cdot T_M + T_{Up<}$$

t	tripping time
U	voltage
U$_p$	setting value (address 1902), valid for t $\rightarrow \infty$
T$_M$	time multiplier (Parameter 1903)
T$_{Up<}$	additional time delay (Param. 1904)

Tolerances

– voltage limit values U< (U$_x$<, U$_1$<[1], Up<[1])   3 % of set value or 1 V

– Inverse time characteristic   3 % referred to U

– delay times   T, T Up<   1 % of set value or 10 ms

Influence variables

– Auxiliary d.c. voltage
  in range $0.8 \leq U_H/U_{HN} \leq 1.15$ $\leq 1\%$
– Temperature
  in range $-5\ °C \leq \vartheta_{amb} \leq +40\ °C$ $\leq 0.5\ \%/10\ K$
– Frequency
  in range 0.95 f$_N$ to 1.05 f$_N$ $\leq 1\ \%$ referred to U

[1] positive sequence voltage U$_1$ only with two-phase connection
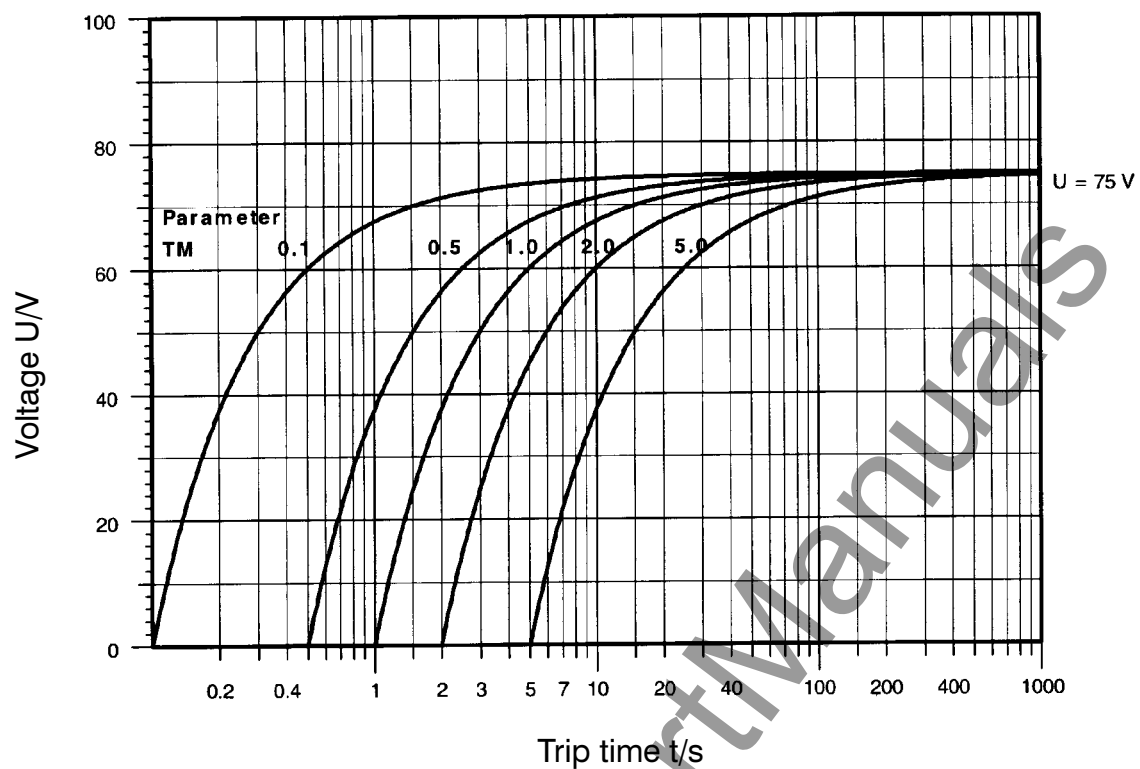
Figure 3.1   Trip characteristic of the undervoltage protection
for setting value Up< = 75 V, without additional delay time (T Up< = 0)

3.3   Overvoltage protection U>, U>> (U_x>, U_x>>[1])

Setting ranges/steps

Overvoltage	U>, U>>	20 V to 170 V	(steps 1 V)
	U_x>, U_x>>[1])	10 V to 170 V	(steps 1 V)
Time delays	T(U>, U>>, U_x>, U_x>>[1])	0.00 s to 60.00 s or ∞	(steps 0.01 s)
Reset ratios U>, U>> (U_x>, U_x>>[1])		0.90 to 0.99	(steps 0.01)

Operating times

pick-up times
– overvoltage U>, U>> (U_x>, U_x>>[1])   approx. 50 ms

drop-off times
– overvoltage U>, U>> (U_x>, U_x>>[1])   approx. 50 ms

Tolerances

– voltage limit values U>, U>> (U_x>, U_x>>[1])   3 % of set value or 1 V

– time delays T   1 % of set value or 10 ms

Influence variables

– Auxiliary d.c. voltage
  in range $0.8 \leq U_H/U_{HN} \leq 1.15$ $\leq 1\%$
– Temperature
  in range $-5\ °C \leq \vartheta_{amb} \leq +40\ °C$ $\leq 0.5\ \%/10\ K$
– Frequency
  in range $0.95\ f_N$ to $1.05\ f_N$ $\leq 1\ \%$ referred to U

[1]) separate voltage U_x only with connection of two single-phase voltages

3.4   Rate-of-frequency-change protection df/dt>

Setting ranges/steps

Number of rate-of-change stages	4
Rate-of-change values df/dt	0.4 Hz/s to 10.0 Hz/s (steps 0.1 Hz/s) or ∞ (ineffective)
Time delays T	0.00 s to 60.00 s (steps 0.01 s) or ∞ (ineffective)
Undervoltage blocking U<	20 V to 100 V (steps 1 V) or ∞ (ineffective)

Operating times   dependent on frequency

– pick-up times df/dt>   approx. 200 ms

reset ratios

– pick–up value df/dt   approx. 0.6

– undervoltage blocking   approx. 1.05

Tolerances

– rate-of-change df/dt
  in range 45 Hz to 50 Hz
  in range 54 Hz to 60 Hz
	100 mH/s at f_N = 50 Hz and U = U_N
	150 mH/s at f_N = 60 Hz and U = U_N

– time delays T	1 % of set value or 10 ms
– undervoltage blocking U<	3 % of set value or 1 V

Influence variables rate-of-change

– Auxiliary d.c. voltage in range $0.8 \leq U_H/U_{HN} \leq 1.15$	$\leq$ 0.1 %
– Temperature in range $-5\ °C \leq \vartheta_{amb} \leq +40\ °C$	$\leq$ 0.1 %/10 K
– Frequency in range 40 Hz to 65 Hz	$\leq$ 0.05 %

3.5   Frequency protection f><

Setting ranges/steps

Number of frequency stages	4; adjustable f> or f<
Pick-up value f> or f<	40.00 Hz to 68.00 Hz (steps 0.01 Hz)
Delay times T(f>, f<)	0.00 s to 60.00 s (steps 0.01 s) or ∞ (ineffective)
Undervoltage blocking U< for f>, f<	20 V to 100 V (steps 1 V) or ∞ (ineffective)

Operating times

– pick-up times f>, f<	approx. 100 ms
– drop-off times f>, f<	approx. 100 ms
Reset hysteresis Δf	approx. 20 mHz
Reset ratio undervoltage blocking U<	approx. 1.05

Tolerances

– frequency f>, f<	10 mHz at f = f_N typical 5 mHz at f = f_N and U = U_N
– undervoltage blocking U<	3 % of set value or 1 V
– time delays T(f>, f<)	1 % of set value or 10 ms

Influence variables

– Auxiliary d.c. voltage in range $0.8 \leq U_H/U_{HN} \leq 1.15$	$\leq 0.1\%$
– Temperature in range $-5\,°C \leq \vartheta_{amb} \leq +40\,°C$	$\leq 0.1\,\%/10\,K$
– Frequency in range 40 Hz to 65 Hz	$\leq 0.05\,\%$

3.6   Overflux protection U/f>

Setting ranges/steps

Overflux warning stage (ratio $\frac{U/U_N}{f/f_N} >$) = limit for preload processing	1.00 to 1.20	(steps 0.01)
Time delay T_{warn} (warning stage)	0.00 s to 60.00 s or ∞ (ineffective)	(steps 0.01 s)
Overflux tripping stage (ratio $\frac{U/U_N}{f/f_N} >>$)	1.00 to 1.40	(steps 0.01)
Time delay T(U/f>>) (stepped characteristic)	0.00 s to 60.00 s or ∞ (ineffective)	(steps 0.01 s)
Characteristic values U/f associated time delays T (for thermal stage)	1.10 / 1.15 / 1.20 / 1.25 / 1.30 / 1.35 / 1.40 0 s to 20000 s	(steps 1 s)
Cooling-down time	0 s to 20000 s	(steps 1 s)
Voltage transformer matching factor	0.50 to 2.00	(steps 0.01)

Operating times (stepped characteristic)

– pick-up time at 1.1 times setting value	$\leq$ 50 ms
– drop-off time	approx 60 ms

Reset ratio   pick-up on U/f   approx 0.95

Tripping time characteristics
thermal replica according presettings   refer to Figure 3.2

Tolerances

– pick-up on U/f	3 % of set value
– time delays T (stepped charact., warning stage)	1 % but min. 10 ms
– thermal stage	5 % referred to U/f $\pm$ 0.5 s

Influence variables

– Auxiliary d.c. voltage in range $0.8 \leq U_H/U_{HN} \leq 1.15$	$\leq$ 1%
– Temperature in range $-5\ °C \leq \vartheta_{amb} \leq +40\ °C$	$\leq$ 0.5 %/10 K
– Frequency in range $0.9\ f_N$ to $1.1\ f_N$	$\leq$ 1 %
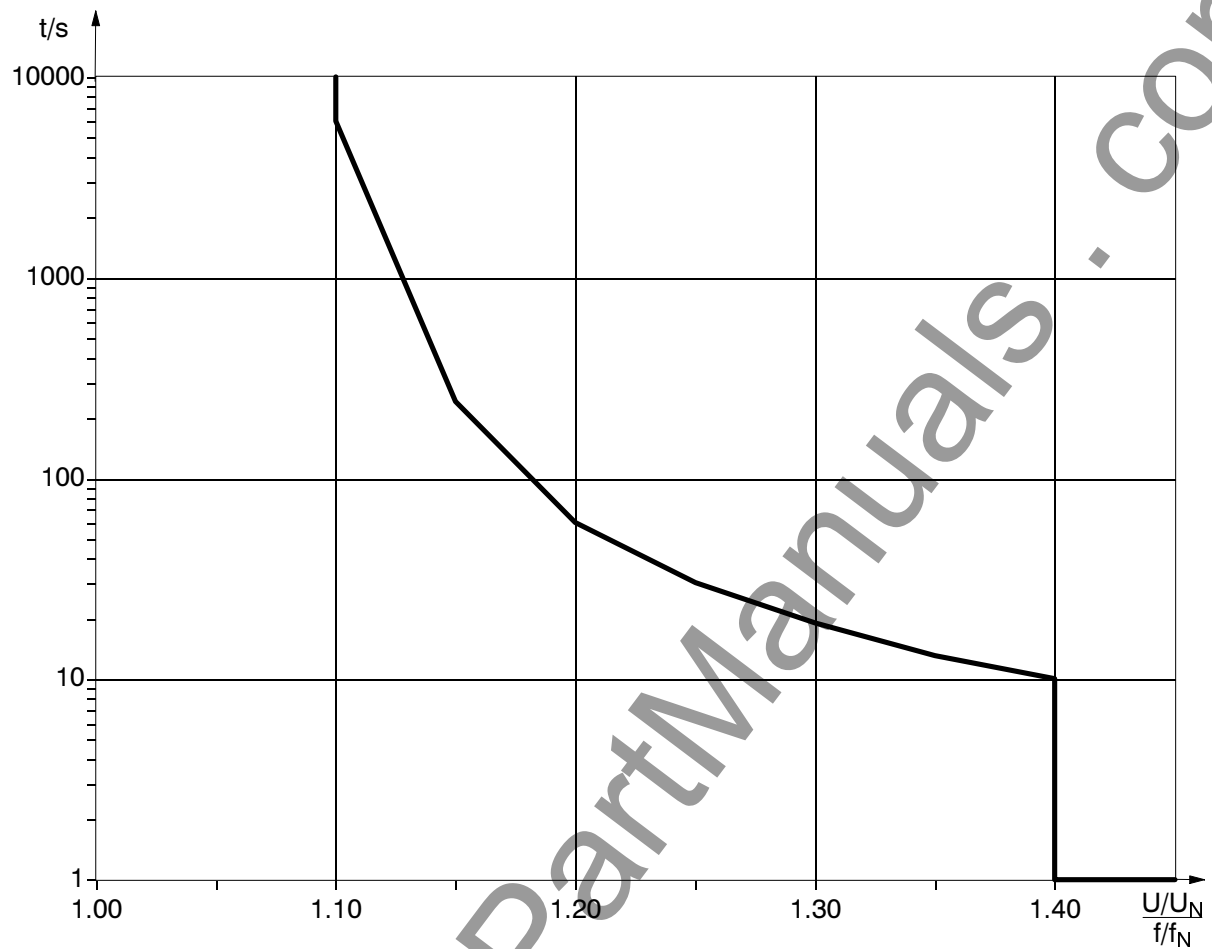
Figure 3.2   Trip characteristic resulting from the thermal stage and the stepped stage of the overflux protection (presettings)

3.7   Ancillary functions

Operational value measurements

– operational voltage values	$U; U_x$ [1]) in V secondary
measurement range	0 V to 170 V
tolerance	3 % or 2 V
– operational meas. value positive sequence voltage	U_1 [2]) in V secondary
measurement range	0 V to 170 V
tolerance	3 % or 2 V
– Frequency	f
Measurement range	25 Hz to 70 Hz
Tolerance	$\leq$ 0.05 Hz
– Overflux	U/f referred to rated flux U_N/f_N
Measurement range	0 to 2.4
Tolerance	$\leq$ 5 %

[1]) separate voltage U_x only with connection of two single-phase voltages
[2]) positive sequence voltage U_1 only with two-phase connection

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Fault event data storage

storage of annunciations of the last eight faults

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
	alternatively instantaneous or r.m.s. values

Instantaneous values:

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

r.m.s. values

total storage time (fault detection or trip command = 0 ms)

max. 50 s, selectable pre-trigger and post-fault time

max. storage period per fault event	T_{max}	0.30 to 50.00 s (steps 0.01 s)
pre-trigger time	T_{pre}	0.05 to 5.00 s (steps 0.01 s)
post-fault time	T_{post}	0.05 to 5.00 s (steps 0.01 s)

sampling rate   1 r.m.s. value per 10 ms at 50 Hz
                                                      1 r.m.s. value per 8.33 ms at 60 Hz

Trip circuit supervision   with one or two binary inputs

Circuit breaker trip test   with live trip

3.8   Performance outside of the operation ranges

Operating ranges   U >10 V; 25 < f/Hz < 70

Function	U < 10 V	f < 25 Hz or f > 70 Hz
Undervoltage protection U<, U_x< U_1<, U_p<	**no blocking** pick-up and trip will occur when the voltage has been in the operating range before	**no blocking** measured values seem smaller; thus, over-function is possible
Overvoltage protection U>, U_x>	**no blocking** no pick-up since the measured value lies below the setting value; no trip	**no blocking** measured values seem smaller; thus, no overfunction
Rate-of-frequency-change protection df/dt>	**blocking**[*]) undervoltage blocking of this protection is effective	**blocking** no pick-up; protection resets when already picked up
Frequency protection f><	**blocking**[*]) undervoltage blocking of this protection is effective	**blocking** no pick-up; protection resets when already picked up
Overflux protection U/f>	**blocking** no pick-up; protection resets when already picked up	**blocking** no pick-up; protection resets when already picked up

[*]) unless undervoltage blocking is set ineffective (∞)

Table 3.1 Performance of the functions outside of the operating ranges

4   Method of operation

4.1   Operation of complete unit

The numerical voltage, frequency, and overflux protection relay SIPROTEC 7RW600 is equipped with a powerful and proven 16-bit microcontroller. This provides fully digital processing of all functions from data acquisition of measured values to the trip signals to the circuit breaker.

Figure 4.1 shows the base structure of the unit.

The transducers of the measured value input section ME transform the voltages from the measurement transformers of the switch-gear and match them to the internal processing level of the unit.

Apart from the galvanic and low-capacitive 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.

The voltage inputs are independent from each other. They can be connected either to two different voltage sources (as illustrated) or to two voltages of a voltage transformer set, e.g. phase-to-phase in V−connection.
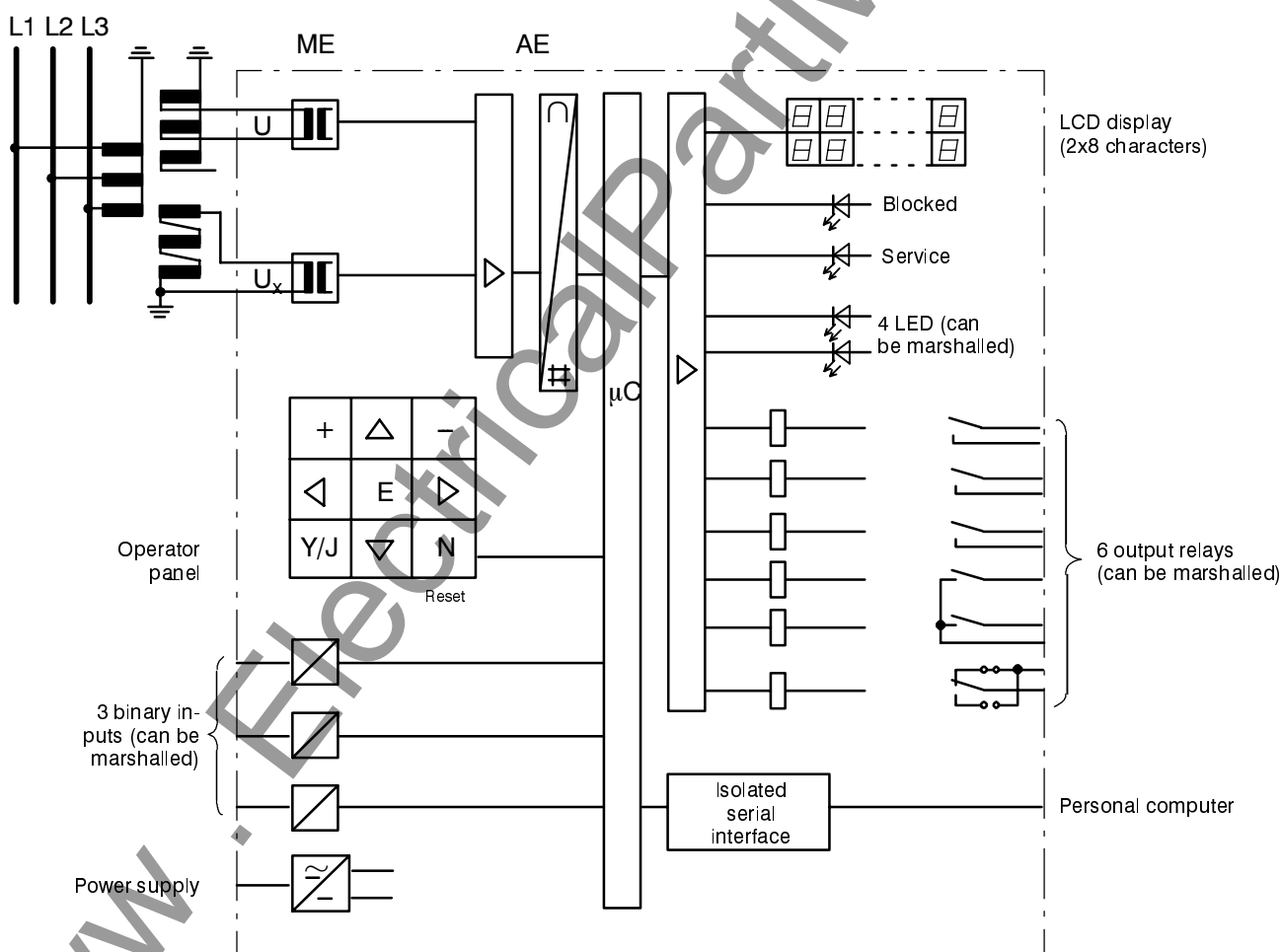
Figure 4.1   Hardware structure of the numerical frequency, voltage, and overflux protection relay 7RW600 – example for connection to two independent single-phase voltages U and U_x

The analog input section AE contains input amplifiers 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,

– scanning of limit values and time sequences,

– calculation of the frequency and the rate-of-change in frequency,

– calculation of the positive sequence voltage in case of two-phase voltage connection (V–connection),

– calculation of the ratio U/f which is proportional to the flux or induction,

– calculation of the tripping time in accordance with the selected characteristics and delay times,

– decision about trip commands,

– storage of measured quantities during a fault for analysis.

Binary inputs and outputs to and from the microcontroller 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, the 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. can be 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, up to 50 ms, which may occur during short-circuits in the d.c. supply system of the plant are bridged by a d.c. voltage storage element.

The following clarification explain all possible protection functions of the relay. In the actual case, only the functions in accordance with the ordering code are available (see Section 2.3 Ordering data).

4.2   Undervoltage protection U< ($U_x<$, $U_1<$, $U_p<$)

The undervoltage protection mainly protects consumers (induction machines) from the consequences of dangerous voltage drops in island networks and prevents impermissible operating conditions and possible loss of stability. It can also be used as a criterion for load shedding in interconnected networks.

The relay provides two measured voltage inputs U and U_x. Thus, it is possible either to process two independent voltages and monitor them for undervoltage or to process the positive sequence voltage U_1 of a three-phase system. In the latter case, two phase-to-phase voltages must be connected to the relay in V−connection.

The positive sequence component is not influenced by asymmetrical occurrences in the system. It is decisive for the torque of an induction machine and has an advantage in particular when evaluating stability problems. In the event of two-phase short-circuits or earth faults, asymmetrical voltage drops will occur. In contrast to single-phase measuring systems, the measurement of the positive sequence system is not influenced by these events.

An adjustable time delay is provided to bridge out permissible short-term voltage drops.

The voltage-dependent characteristic allows to adapt the protection exactly to the stability characteristic of the machine. If a machine falls into the unstable area below the stability curve, it will stall or run at substantially reduced speed, even if full voltage is restored after a short time. Only squirrel cage machines for which the torque characteristic of the driven machine lies below the motor characteristic at all speeds, will regain their rated speed. All other machines will be thermally and perhaps mechanically overstressed during an attempt to return to full speed after return of voltage.

The undervoltage protection is of single-stage design. In order to avoid malfunction of the protection in the event of secondary voltage failure, it can be blocked via a binary input, e.g. by the auxiliary contact of a voltage transformer miniature circuit breaker or from the position of the main circuit breaker when the machine is at stand-still.

The measured voltages are filtered by numerical filter algorithms; the fundamental wave is paramount. The frequency error of the filters is compensated internally within the operating range. When the frequency goes beyond the operating range of the protection, i.e. below 20 Hz or above 70 Hz, the undervoltage protection remains operative. But, since frequency compensation is no more possible, increased measurement error is expected so that the protection will become more sensitive and tends to overfunction. Therefore, when used as machine protection, the undervoltage protection must be blocked via a binary input during run-up and shutdown of the machine.

When the relay is switched on and no measured voltage is present, the undervoltage protection does not operate. First, when a measured voltage is connected within the operation range, i.e. above 10 V and within 25 Hz to 70 Hz, the protection is activated; the frequency is measured at the voltage input U. This prevents from pick-up and tripping immediately after the relay has been connected to its supply voltage. Once the protection has been activated, it can be deactivated only by triggering the blocking input. This feature can be suppressed: in case the setting parameter 0V BLK is switchen *OFF*, every undervoltage leads to pick-up of the undervoltage protection even in case undervoltage is present before switching on of this protection function.

The measured voltage inputs U and Ux may be used for different applications but the frequency of both voltages must be the same.

Figure 4.2 shows the logic diagram of the undervoltage protection with two independent voltages, Figure 4.3 with two phase-to-phase voltages in V−connection with definite time characteristic and Figure 4.4 with inverse time characteristic.
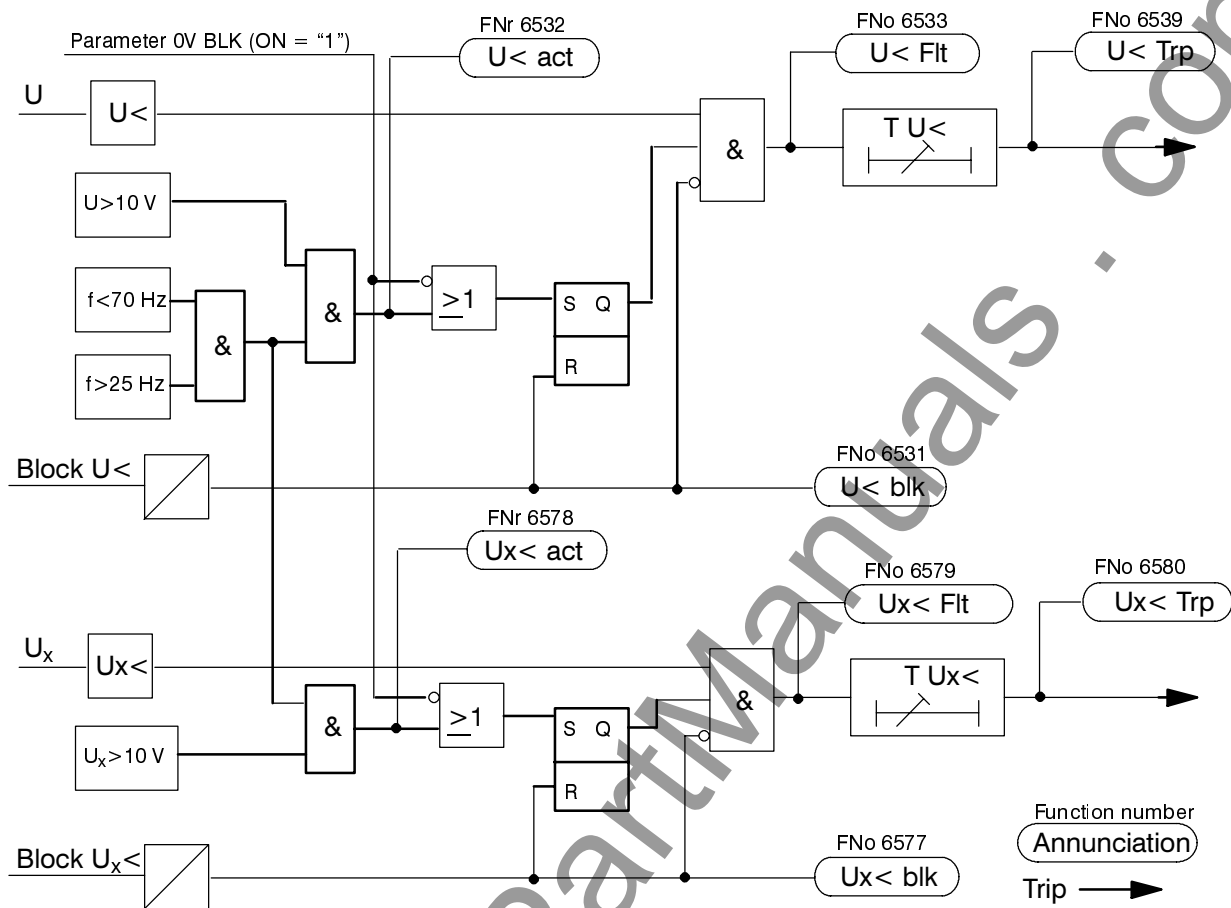
Figure 4.2   Logic diagram of the undervoltage protection with two independent single-phase voltages
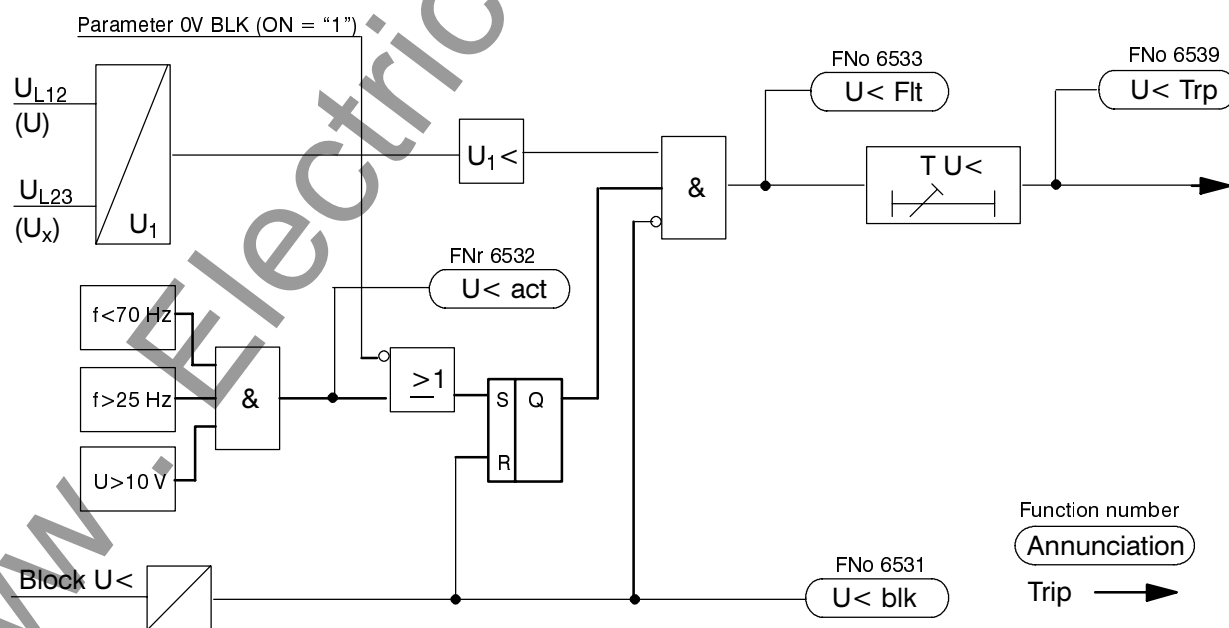
Figure 4.3   Logic diagram of the undervoltage protection with two-phase connection (V−connection) and processing of the positive sequence voltage component U_1
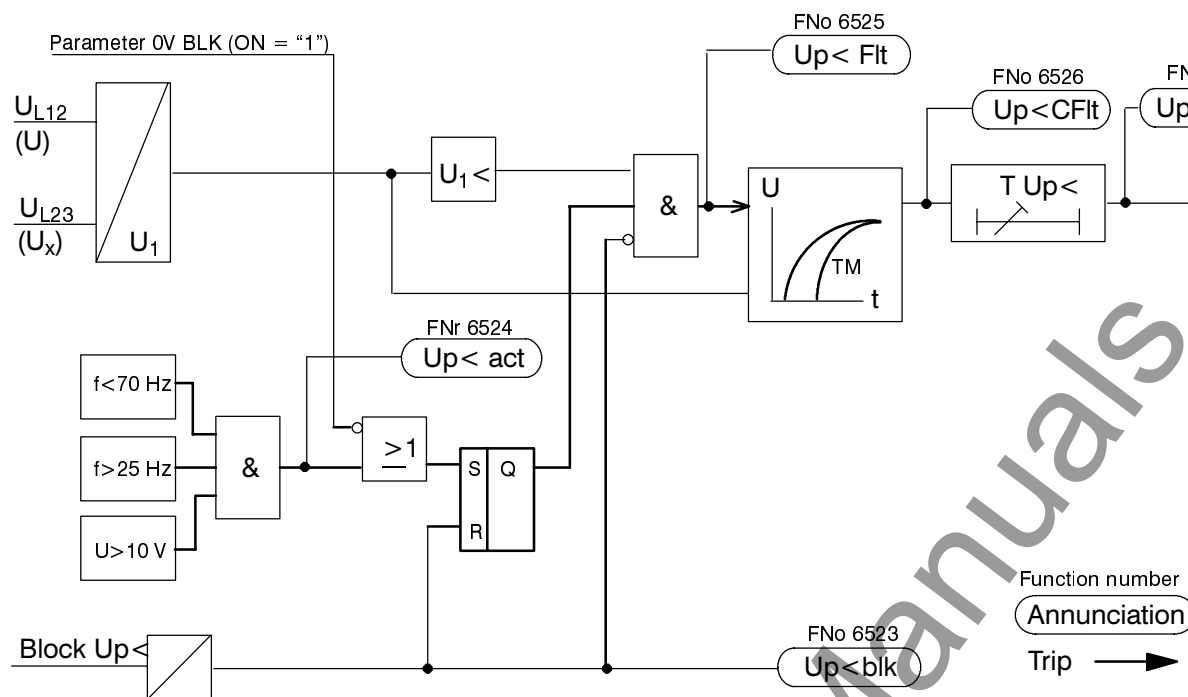
Figure 4.4   Logic diagram of the undervoltage protection with two-phase connection (V−connection) and processing of the positive sequence voltage component U_1 and with inverse time tripping characteristic

4.3   Overvoltage protection U>, U>> (U_x>, U_x>>)

Overvoltage protection has the task of protecting electrical machines, and the associated electrical plant connected to it, from the effects of impermissible voltage increases. Overvoltages can be caused by incorrect manual operation of the excitation system, faulty operation of the automatic voltage regulator, (full) load shedding of a generator, separation of the generator from the system or during island operation.

The relay provides two measured voltage inputs U and U_x. Thus, it is possible either to process two independent voltages and monitor them for overvoltage or to process the voltages of a three-phase system. In the first case, separate threshold values U> and Ux> can be set. In the latter case, two phase-to-phase voltages must be connected to the relay in V−connection; the setting values U> and T U> are then valid for both voltages, and the setting values Ux> and T Ux> are irrelevant, but annunciations are

generated for each voltage which has exceeded the threshold.

The overvoltage protection is of two-stage design. Numerical filters ensure that only the fundamental waves are processed and harmonics are suppressed. Time stages are provided to bridge out short voltage rises. A large overvoltage initiates a fast trip by the assigned U>> stage; a small overvoltage initiates a long-time trip by the assigned U> stage. Voltage limit values, drop out ratio and time delays can be set individually for each stage.

Tripping of the overvoltage protection can be blocked by an external criterion via binary inputs.

Figure 4.5 shows the logic diagram of the overvoltage protection with two independent voltages, Figure 4.6 with two phase-to-phase voltages in V−connection.
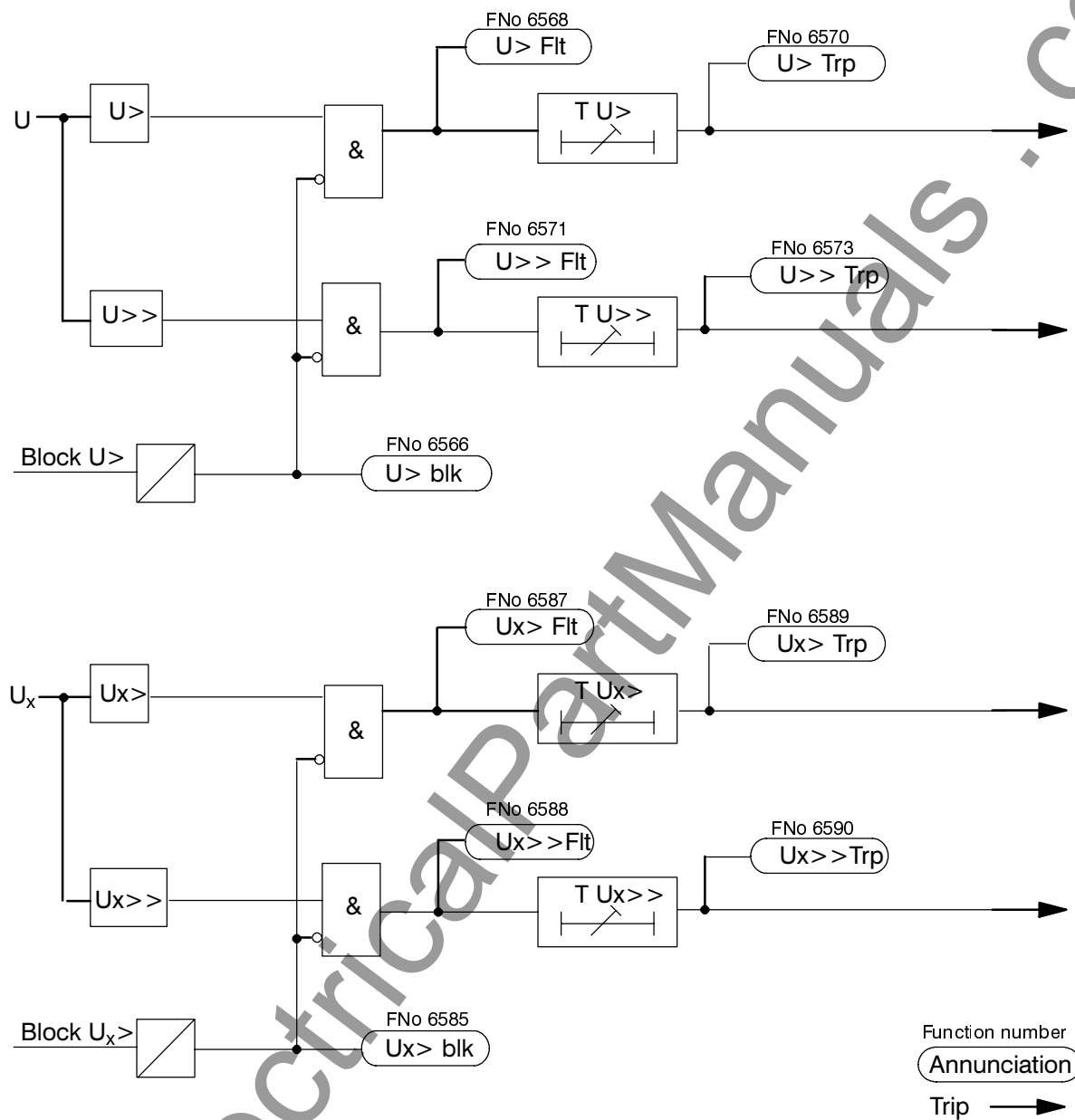
Figure 4.5   Logic diagram of the two-stage overvoltage protection with two independent **single-phase** voltages: separate setting values and separate blocking facilities for the two measured voltages U and U_x
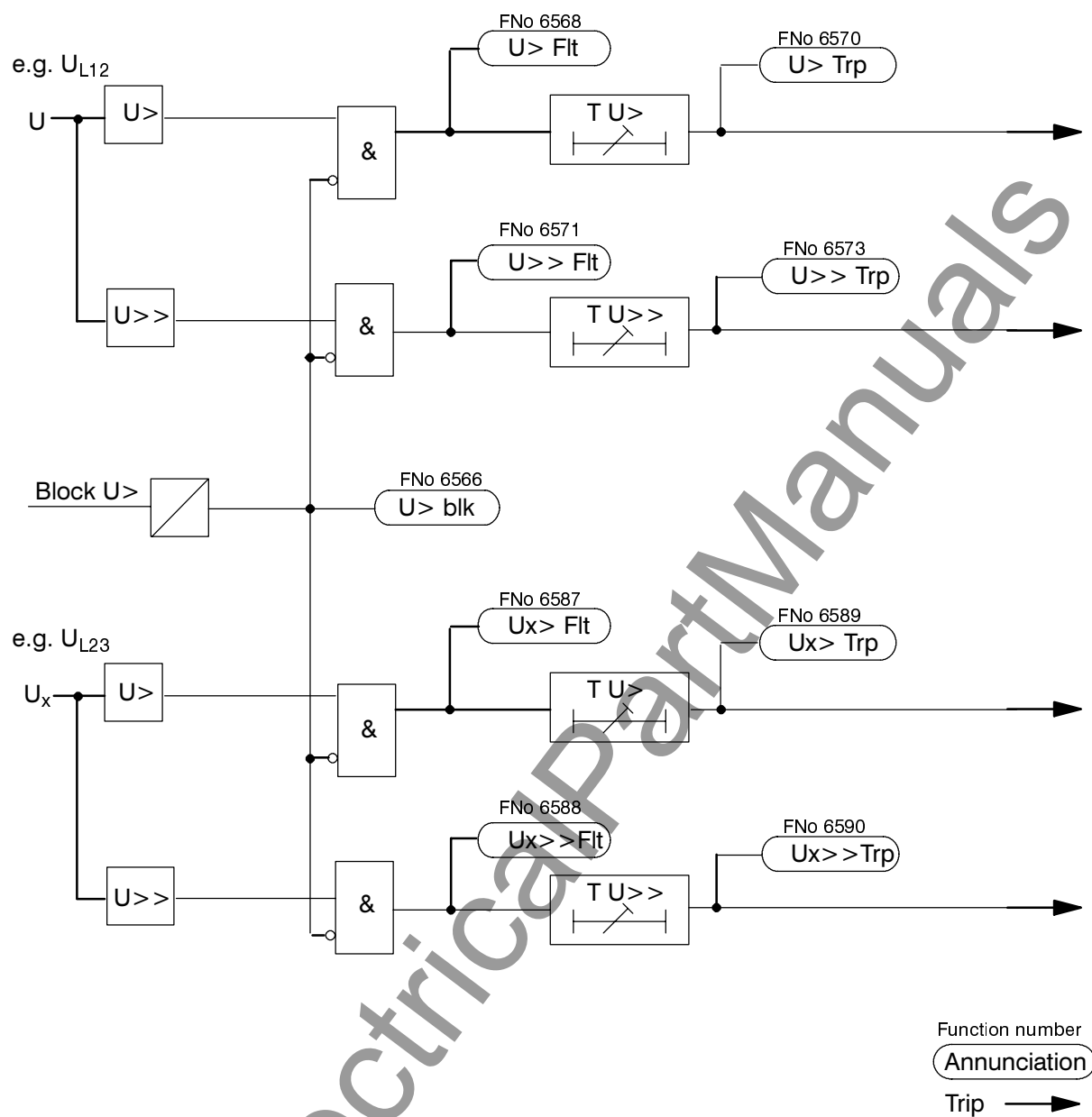
Figure 4.6   Logic diagram of the two-stage overvoltage protection with **two-phase** connection (V–con-
            nection) and processing of the maximum voltage: common setting values and common
            blocking facility for the two measured voltages, but separate annunciations and outputs

4.4   Rate-of-frequency-change protection df/dt>

When the power equilibrium between the power generation and the power demand is distorted, e.g. by failure of an important power station, disconnecting or load shedding measures must be taken immediately in order to prevent black-out of the entire power system. These measures are the more effective the earlier they are taken after the disturbance is detected.

The rate-of-frequency-change protection detects changes in the frequency fast and reliably. Load shedding measures can thus be initiated before the permissible frequency limit (which can be detected by the frequency protection, see Section 4.5) is reached.

The rate-of-frequency-change protection of 7RW600 is of four-stage design. The stages can be set with individual and independent operating direction (frequency acceleration or frequency reduction), pick-up value, and delay time. They can initiate different control functions. Thus, variable matching to the system conditions is possible.

If a stage is to operate on frequency reduction (negative rate-of-change) it operates below the rated frequency. If a stage is to operate on frequency acceleration (positive rate-of-change) it operates above the rated frequency.

The frequency is derived from the voltage input U, which is normally supplied by a phase-to-phase voltage (e.g. U_{L1-L2}). The voltage input U_x is irrelevant for frequency measurement. The fundamental wave is filtered out. The rate-of-change is evaluated from the calculated frequency in 100 ms intervals. The result is stabilized by a sufficient number of repeated measurement.

The frequency, and thus its rate-of-change, can be processed as long as the input voltage U is of sufficient magnitude and the frequency lies within the operating range of the protection. When the voltage is too small for evaluation, the rate-of-change protection is blocked as is the frequency protection.

The trip commands can be delayed by timer stages. Additionally, each rate-of-change stage can be logically AND-combined with the corresponding frequency stage. Each rate-of-change stage can be blocked via binary inputs from external sources, and the rate-of-change protection can be blocked in total.

The logic diagram of the rate-of-frequency-change protection is illustrated in Figure 4.7. In this example all four stages are set to operate on frequency reduction (df/dt<), which corresponds to the factory setting of the relay.
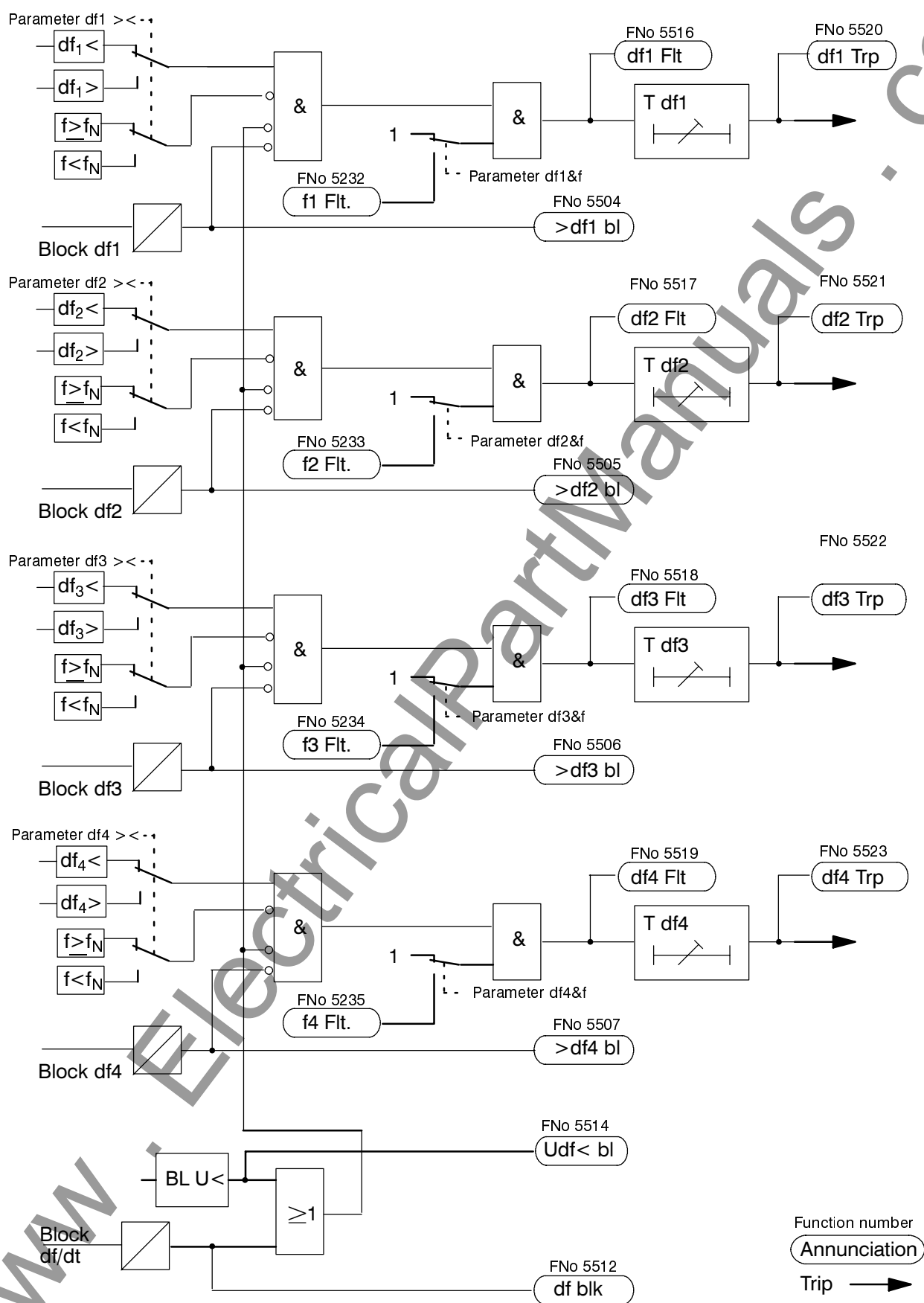
Figure 4.7   Logic diagram of the rate-of-frequency-change protection

4.5   **Frequency protection f> <**

Frequency protection is used to detect overfrequency or underfrequency in electrical networks or power stations. When the frequency increases above or decreases below the permissible limits, control commands are output, e.g. to divide the network, to shed consumers, or to disconnect the power station.

The cause of **under**frequency is either an excessive demand of active power from the network, or faulty operation of the governor or of the frequency regulator. Underfrequency protection is also applied on generators which operate (temporarily) in an island network. In island operation the reverse power protection cannot operate should the prime mover fail. The underfrequency protection can be used to separate the generator from the network.

Overfrequency is caused, for example, by load shedding (island operation) or by faulty operation of the frequency regulator. The danger in this case is that machines connected to long unloaded lines may commence to self-excite.

The frequency protection includes four frequency stages. Each stage can be set individually as an underfrequency or overfrequency stage and is independent from the other stages and can initiate different control functions. Thus, variable matching to the

system conditions is possible. The set frequency threshold determines whether a stage operates as an overfrequency protection (when set above the rated frequency) or as an underfrequency protection (when set below the rated frequency).

Numerical filters are provided to exclude influences by harmonics and phase shifts. Ripple control frequencies are irrelevant (attenuation >65 dB at twice rated frequency). The result is stabilized by a sufficient number of repeated measurement.

The frequency is derived from the voltage input U, which is normally supplied by a phase-to-phase voltage (e.g. U_{L1-L2}). The voltage input U_x is irrelevant for frequency measurement.

The frequency can be processed as long as the input voltage U is of sufficient magnitude and the frequency lies within the operating range of the protection. When the voltage is too small for evaluation, the frequency protection is blocked.

The trip commands can be delayed by timer stages. Additionally, each frequency stage can be blocked via binary inputs from external sources, and the frequency protection can be blocked in total.

The logic diagram of the frequency protection is illustrated in Figure 4.8.
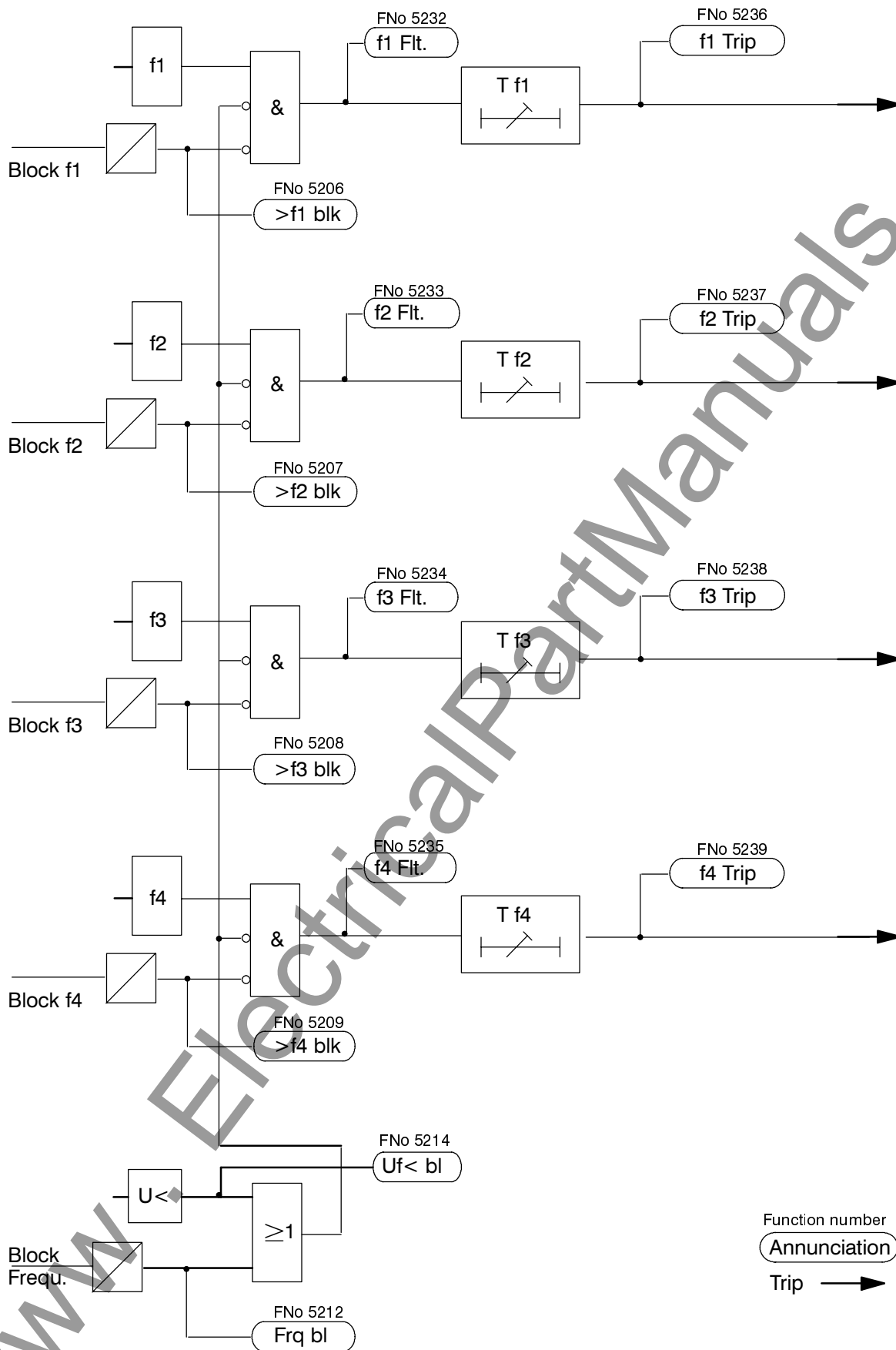
Figure 4.8   Logic diagram of the frequency protection

4.6 Overflux protection U/f>

The overflux protection is used to detect impermissible overflux conditions in electrical equipment which can endanger e.g. generators or transformers. Such conditions are caused by an increase in voltage and/or reduction in frequency.

The induction which is proportional to the flux is

$$B = \frac{\Phi}{A} = \frac{1}{4.44 \cdot N \cdot A} \cdot \frac{U}{f}$$

where

  B = induction
  Φ = flux
  N = number of turns
  A = iron cross-section
  U = induced voltage
  f = frequency

An increase in induction above the rated values leads very quickly to saturation of the iron core and to large eddy current losses. Power station unit transformers which are separated from the system and connected only to the generator are particularly endangered.

The overflux protection measures the ratio voltage/ frequency which is proportional to the induction B.

The measured voltage for overflux protection depends on the connection mode (single-phase or two-phase). With single-phase connection, the voltage U is taken for overflux detection, the voltage U_x is then irrelevant. With two-phase connection the maximum of the two voltages U and U_x is decisive for overflux detection. The frequency is assumed to be the same, it is always measured from the voltage U.

The overflux protection is fitted with a definite time stage U/f>> and a thermal stage which approximates the heating-up of the iron caused by the overflux, according to a thermal single-body model.

A counter is released when a settable pick-up value U/f> is exceeded. This counter is incremented according to the excess in U/f. When the trip limit is reached trip command is issued.

When the measured quantity falls below the pick-up value, trip command is cancelled and the counter is decremented according to the set cooling-down time. The counter is set to zero when the reset input is energized or when the overflux protection is blocked.

The thermal characteristic is defined by 7 pairs of values U/f (referred to rated values) and T (see Figure 4.9). The preset values are adequate in most cases; it corresponds to a standard power transformer.

The preset values can be changed if necessary by entering different time values during setting. The protection calculates then a user defined tripping time characteristic. The intermediate values are interpolated.

The preset values suppose that the pick-up value U/ f> and the first setting value of the thermal stage are identical (1.1 times rated flux, see Figure 3.2). If these values differ from each other, the relay will react as shown in Figure 4.9.

An adjustable correction factor allows matching of the voltage magnitude in case the rated voltage of the voltage transformers differs from the rated voltage of the protected object.

The logic diagram of the overflux protection is illustrated in Figure 4.10.

a) Pick-up threshold U/f> is smaller than 1st setting value of thermal stage

b) Pick-up threshold U/f> is greater than 1st setting value of thermal stage
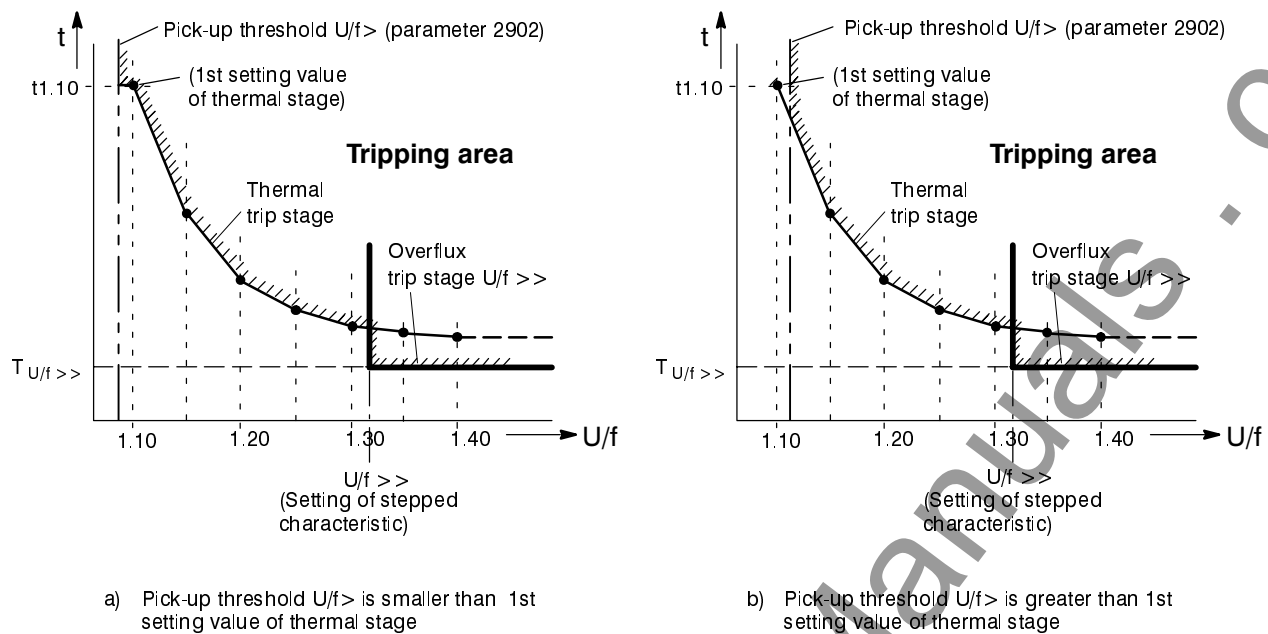
Figure 4.9   Tripping time characteristics of the overflux protection
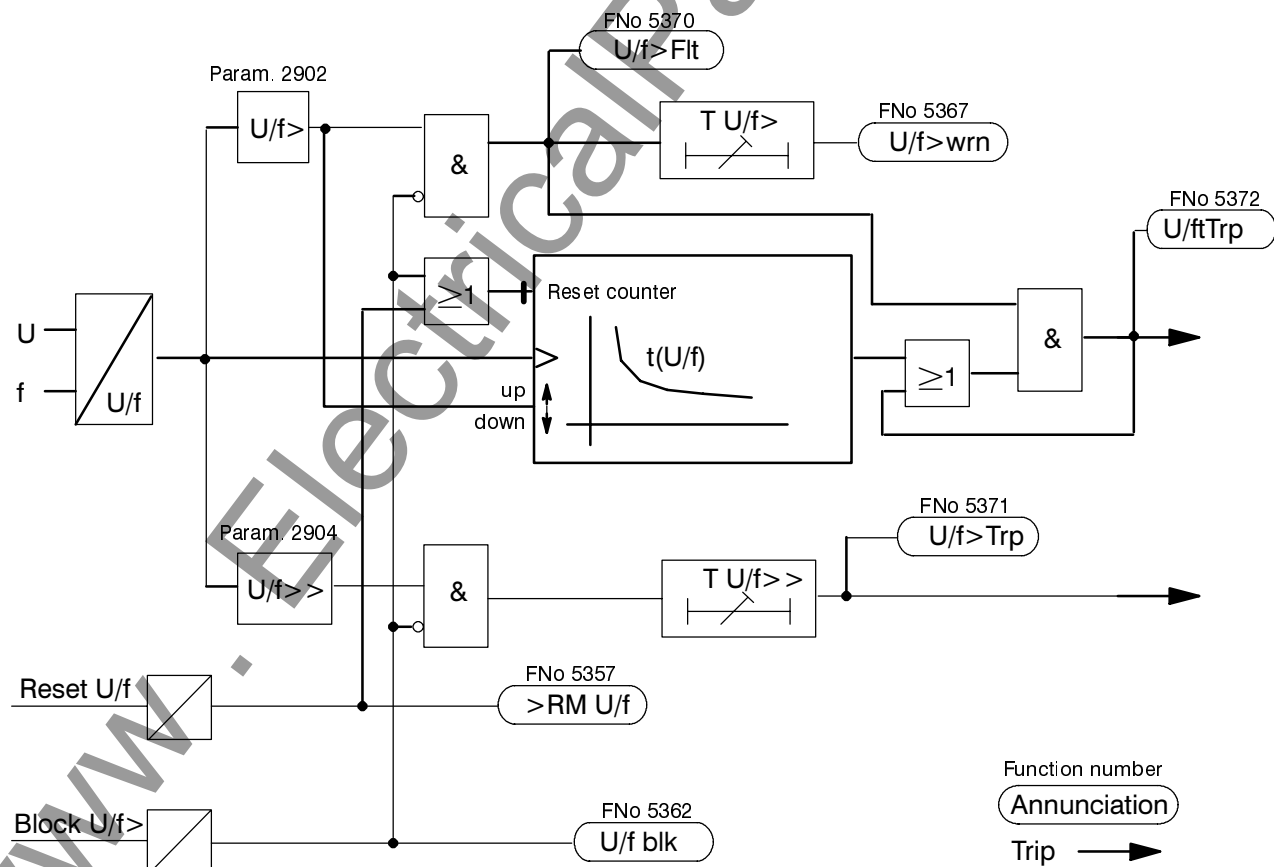
Figure 4.10 Logic diagram of the overflux protection

4.7　Trip circuit supervision

The device includes a trip circuit supervision for one trip circuit. Dependent on the number of binary inputs which are available for this purpose, supervision can be effected with one or two binary inputs. When two binary inputs are used, disturbances in the trip circuit can be detected for every switching condition; when one binary input is used, those disturbances which occur during closed trip contacts cannot be detected.

Figure 4.13 shows the logic diagram of the annunciations generated by the trip circuit supervision.

4.7.1　Supervision using two binary inputs

When two binary inputs are used, they are connected according to Figure 4.11: one input in parallel to the trip relay the circuit of which is to be supervised, the other in parallel to the circuit breaker auxiliary contact.

Note: In 7RW600, the two binary inputs BI2 and BI3 have a common negative pole. This combination is, therefore, not suitable for trip circuit supervision. Use the binary inputs BI1 and BI2 instead.

The binary inputs are energized (logical "H") or short-circuited (logical "L") depending on the status of the trip relay and the circuit breaker (see Figure 4.11).

During normal operation it is not possible that both the binary inputs are de-energized (logical "L") at the same time unless for the short time where the trip relay has already closed but the breaker is not yet open.

If both the binary inputs are de-energized continuously, this indicates that either the trip circuit is interrupted, or the trip circuit is short-circuited, or the control voltage for tripping is absent, or the breaker has not properly operated. Thus, this status indicates a fault in the trip circuit.

The status of the two binary inputs is checked approximately in 200 ms intervals. An intentional time delay for alarm is produced by three repeated status checks before an alarm is given. This prevents from faulty alarms due to short transient occurrences.

4.7.2　Supervision using one binary input

When one binary input is used, this is connected according to Figure 4.12: in parallel to the trip relay the circuit of which is to be supervised.

The binary input is energized (logical "H") as long as the trip relay is not energized and the trip circuit is healthy.

When the binary input is not energized (logical "L"), this indicates that either the trip contact is closed or the trip circuit is interrupted, or the trip circuit is short-circuited, or the control voltage for tripping is absent. As the trip contacts may be closed during healthy trip circuit condition, the status of the binary input is checked in relatively long periods (30 s). Furthermore, an intentional time delay for alarm is produced by three repeated status checks before an alarm is given. This prevents from faulty alarms during closed trip contacts.

Since the second binary input is not available in this mode, it must be replaced by a resistor R which is connected to the breaker auxiliary contact Aux2 (refer to Figure 4.12, compare with Figure 4.11). This allows to detect disturbance in the trip circuit even when the breaker auxiliary contact Aux1 is open and the trip contact is reset. The resistance of R is dimensioned such that the trip coil TC must not be energized when the circuit breaker is open (auxiliary contact Aux1 open, Aux 2 closed); on the other hand the binary input must be safely energized when the trip contact is open.

Information on how to dimension the resistor are contained in Section 5.2.3.2.
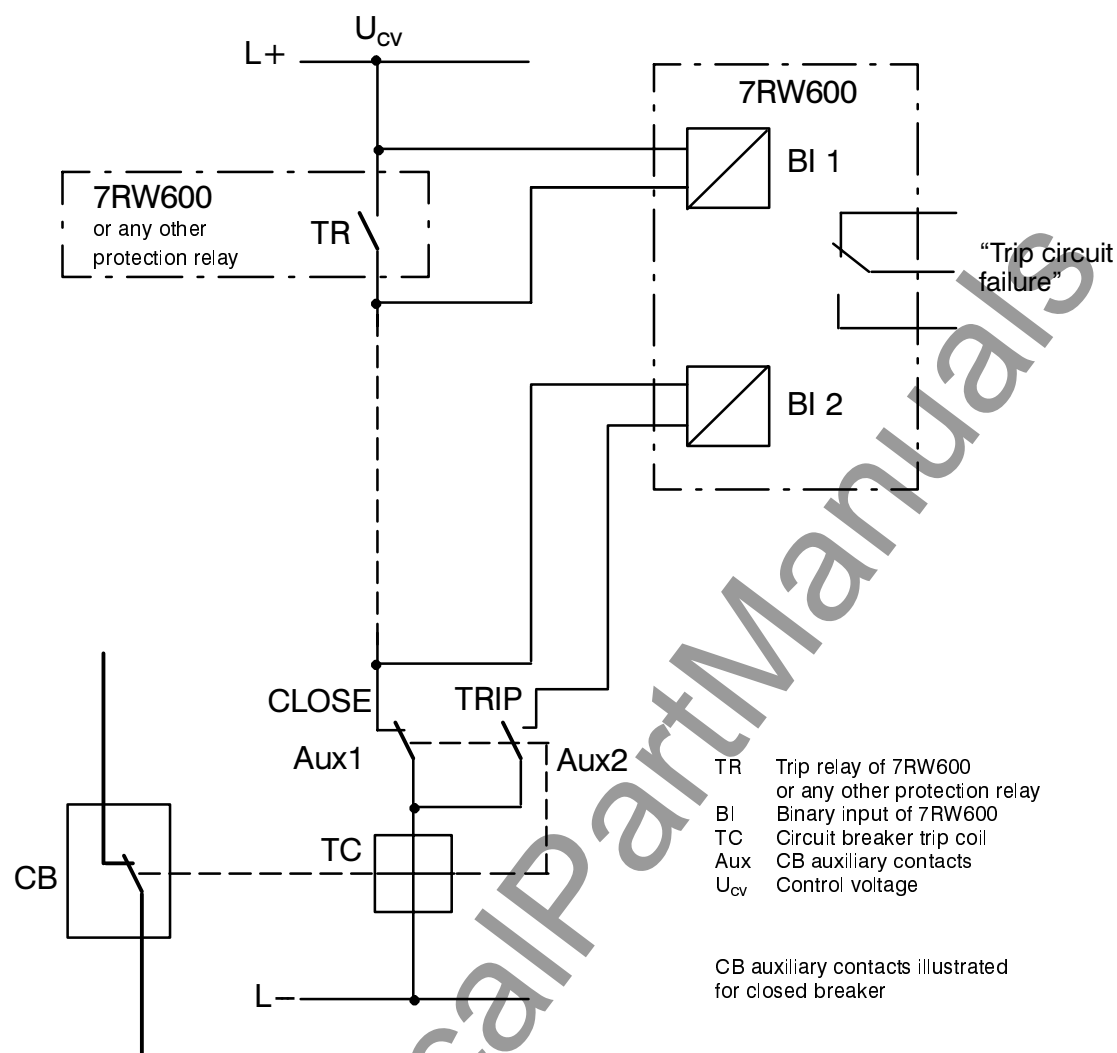
No	Trip relay	CB position	BI 1	BI 2
1	open	CLOSED	H	L
2	open	OPEN	H	H
3	closed	CLOSED	L	L
4	closed	OPEN	L	H

TR   Trip relay of 7RW600 or any other protection relay
BI   Binary input of 7RW600
TC   Circuit breaker trip coil
Aux CB auxiliary contacts
U_{cv} Control voltage

CB auxiliary contacts illustrated for closed breaker

BI 1 (L)
BI 2 (L) ≥ 1 (H)   n   (H)   "Failure Trip circuit"

n   number of repeated status checks = 3
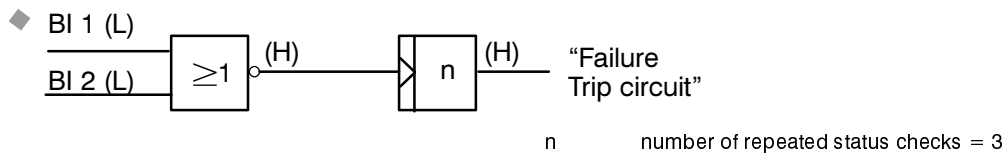
Figure 4.11   Principle of trip circuit supervision with two binary inputs

U_{cv}

L+

7RW600

BI 1

"Trip circuit failure"

7RW600
or any other
protection relay

TR

R

CLOSE   TRIP
Aux1   Aux2

CB

TC

L−

TR   Trip relay of 7RW600
     or any other protection relay
BI   Binary input of 7RW600
TC   Circuit breaker trip coil
Aux CB auxiliary contacts
U_{cv} Control voltage

CB auxiliary contacts illustrated
for closed breaker

BI 1 (L)   ≥1   (H)   n   (H)   "Failure
                                          Trip circuit"

n   number of repeated status checks = 3

Figure 4.12   Principle of trip circuit supervision with one binary input
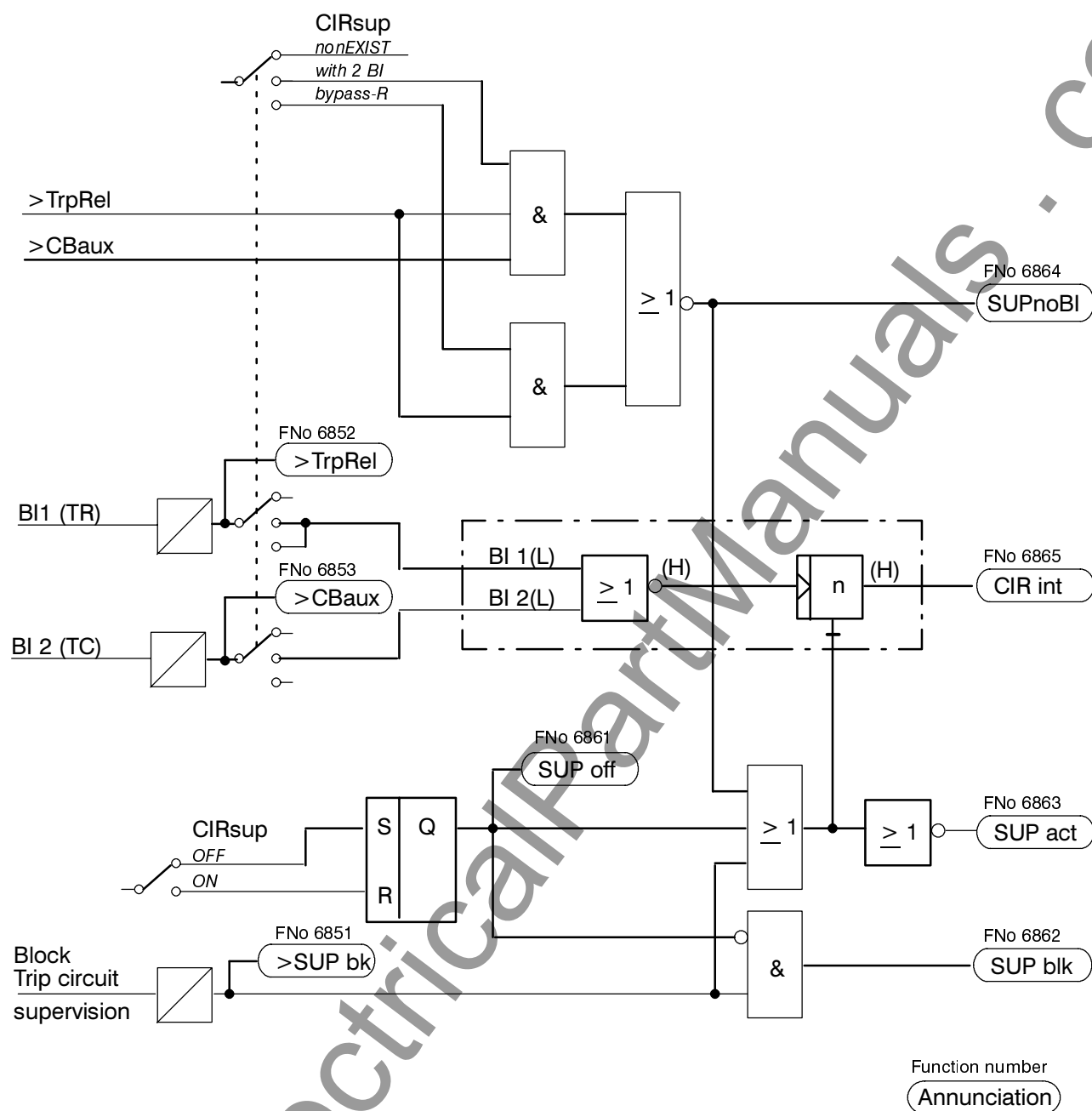
Figure 4.13 Logic diagram of trip circuit supervision

4.8   Ancillary functions

The ancillary functions of the numerical voltage, frequency, and overflux protection 7RW600 include:

– processing of annunciations,

– storage of fault data for fault recording,

– operational measurements,

– test routines,

– monitoring functions.

4.8.1   Processing of annunciations

After a fault in the protected object, 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.

4.8.1.1   Indicators and binary outputs (output relays)

Important events and conditions are indicated by optical indicators (LED) on the front plate. The relay also contains output relays for remote signalling and trip commands. All of the signals 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 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 ("**N**") on the relay,

– remotely by energization of the remote reset input,

– via the operating interface,

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

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

A green LED indicates readiness for operation ("Service"). This LED cannot be reset and remains illuminated when the microcontroller is working correctly and the unit is not faulty. The LED extinguishes when the self-checking function of the microcontroller 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.

4.8.1.2   Information on the display panel or to a personal computer

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

In the quiescent state, i.e. as long as no system faults are present, the display outputs the operational measured values of the frequency and voltage at voltage input U. In the event of a network fault, information on the fault appears instead of the operating information. The first line of the display indicates fault detection messages; the second line displays the trip annunciation of the 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 4.8.1.1.

The device also contains several event buffers, e.g. for operating messages or fault annunciations (refer to Section 6.4). These messages, as well as the available operating values, can be transferred into the front display at any time using the keyboard or to the personal computer via the operating interface.

After a fault, for example, important information concerning its history, such as pick-up and tripping, can be called up on the display of the device. The fault inception is indicated with the absolute time of the operating system. 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 of any fault detector and ends with the latest fault detector reset.

4.8.2   Data storage and transmission for fault recording

The <u>instantaneous</u> values of the measured values

u and u_x

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 <u>r.m.s.</u> values of the measured values

U, U_x, and f − f_N

can alternatively be sampled at intervals of one half a.c. period and stored in a circulating shift register. In case of a fault, the data are stored over a selectable time period, but max. over 50 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 operation interface and evaluated by the protection data evaluation program DIGSI®. The voltages are referred to their maximum values, normalized to their rated values and prepared for graphic visualization. In addition, signals are marked as binary traces, e.g. "Pick-up" and "Trip".

4.8.3   Operating measurements and conversion

For local recall or transmission of data, the true r.m.s. values of the voltages U and U_x (if connected) as well as the frequency f are available as long as the relay is not dealing with a fault. When the overflux protection is available (model 7RW600★−★★★★★−**2**★★★), the calculated quotient U/f can be read out.

The following is valid:

− U and U_x [1]   voltages in V secondary,

− U_1 [2]   positive sequence voltage in V secondary (if available),

− f   frequency in Hz,

− U/f   flux proportional to U/f, referred to rated conditions U_N/f_N (if available).

[1] separate voltage U_x only with connection of two single-phase voltages

[2] positive sequence voltage U_1 only with two-phase connection

4.8.4   Test facilities

7RW600 allows simple checking of the tripping circuit and the circuit breaker as well as interrogation of the state of the binary inputs. Initiation of the test can be given from the operator keyboard or via the operator interface (refer to Section 6.6.3 and 6.6.4).

4.8.4.1   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.

4.8.4.2   Interrogation of binary states

The momentary condition of the binary inputs can be displayed on request by the operator as well as the LED indicators.

4.8.5   Monitoring functions

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

4.8.5.1   Hardware monitoring

The hardware is monitored for faults and inadmissible functions. In detail this is accomplished by monitoring:

– Auxiliary and reference voltages

   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 provided it is accordingly allocated. Transient dips in supply voltage of less than 50 ms will not disturb the function of the relay.

– Command output channels:

   Two of the six output relays are controlled by two command channels (K1 and K2); they are, therefore, particularly suited for tripping. As long as no pick-up condition exists, the central controller 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 a data bit pattern and reading it.

   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.

4.8.5.2   Software monitoring

For continuous monitoring of the program sequences, watchdog timers are provided which will reset the controller in the event of controller 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 controller.

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

5   Installation instructions

⚠ **Warning**

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

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

5.1   Unpacking and repacking

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

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

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

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

5.2   Preparations

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

⚠ **Caution!**

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

In installed conditions, the modules are in no danger.

5.2.1   Mounting and connections

5.2.1.1   Model 7RW600★−−★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.

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

5.2.1.2   Model 7RW600★−−★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. 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.

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

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 of the unit.

5.2.2.1   Auxiliary voltage

Four different ranges of auxiliary voltage can be delivered (cf. Section 2.3 and 3.1.1). 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. 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 jumpers need be altered.

5.2.2.2   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 19 V to 300 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 75 V to a binary input a jumper must be removed. Figure 5.2 shows the assignment of these jumpers and their location on the p.c.b.

Note: If binary inputs are used for trip circuit supervision, it must be considered that two binary inputs (or one input and a replacement resistor) are connected in series. Therefore, the pick-up threshold must be clearly smaller than half the control voltage.

5.2.2.3   Relay K6: NO or NC operation

The output relay K6 is equipped with a change-over contact but only one contact circuit can be connected to the terminals. A jumper on the p.c.b. determines whether the normally open contact or the normally closed contact is effective. When delivered the NC contact is effective and signals "equipment fault". The allocation of this jumper is illustrated in Figure 5.1.

For all alteration of jumpers, proceed as follows:

– 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 electro-statically 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 jumpers according to Figures 5.1 and 5.2.

– Insert module into the housing;

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

– Re-insert covers.
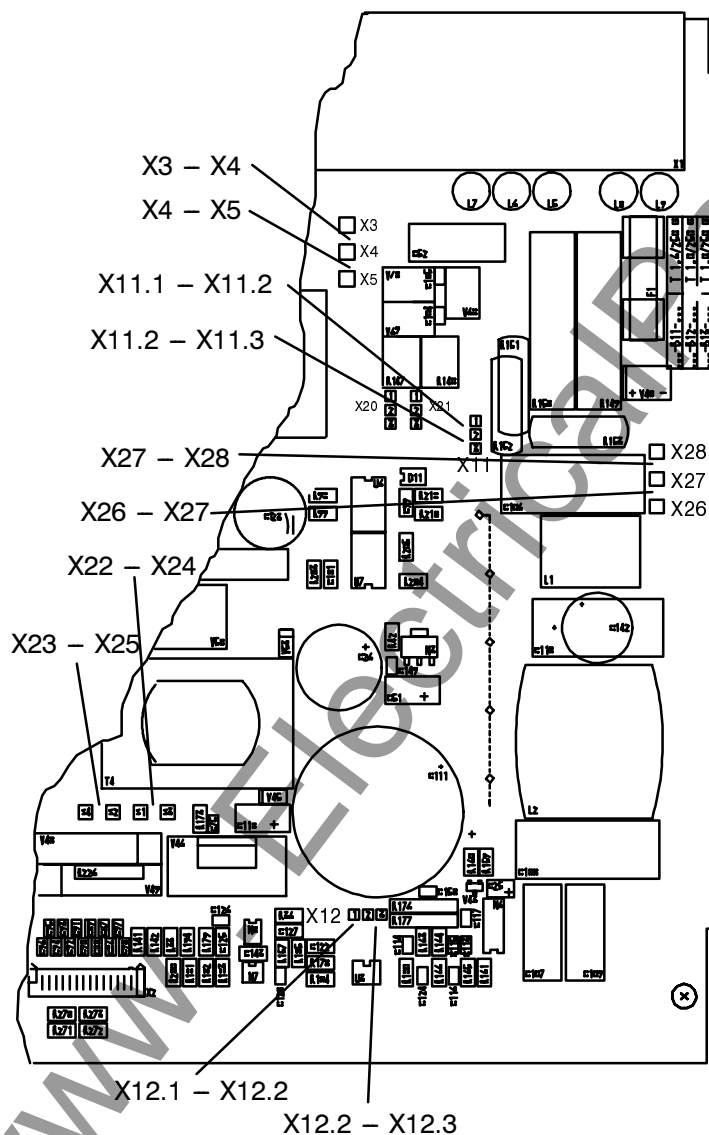
Jumper	Output relay K6
X3 – X4	NO contact
X4 – X5	**NC contact** (as delivered)

Jumpers	Rated auxiliary voltage		
	24 Vdc 48 Vdc	60 Vdc 110 Vdc 125 Vdc	220 Vdc 250 Vdc 115 Vac
X11.1–X11.2		X	
X11.2–X11.3			X
X12.1–X12.2			X
X12.2–X12.3	X	X	
X22 – X24		X	
X22 – X23			X
X23 – X25		X	
X26 – X27			X
X27 – X28		X	

Figure 5.1 Checking for auxiliary voltage of the integrated dc-dc-converter and contact mode K6

Binary input 1
Binary input 2
Binary input 3
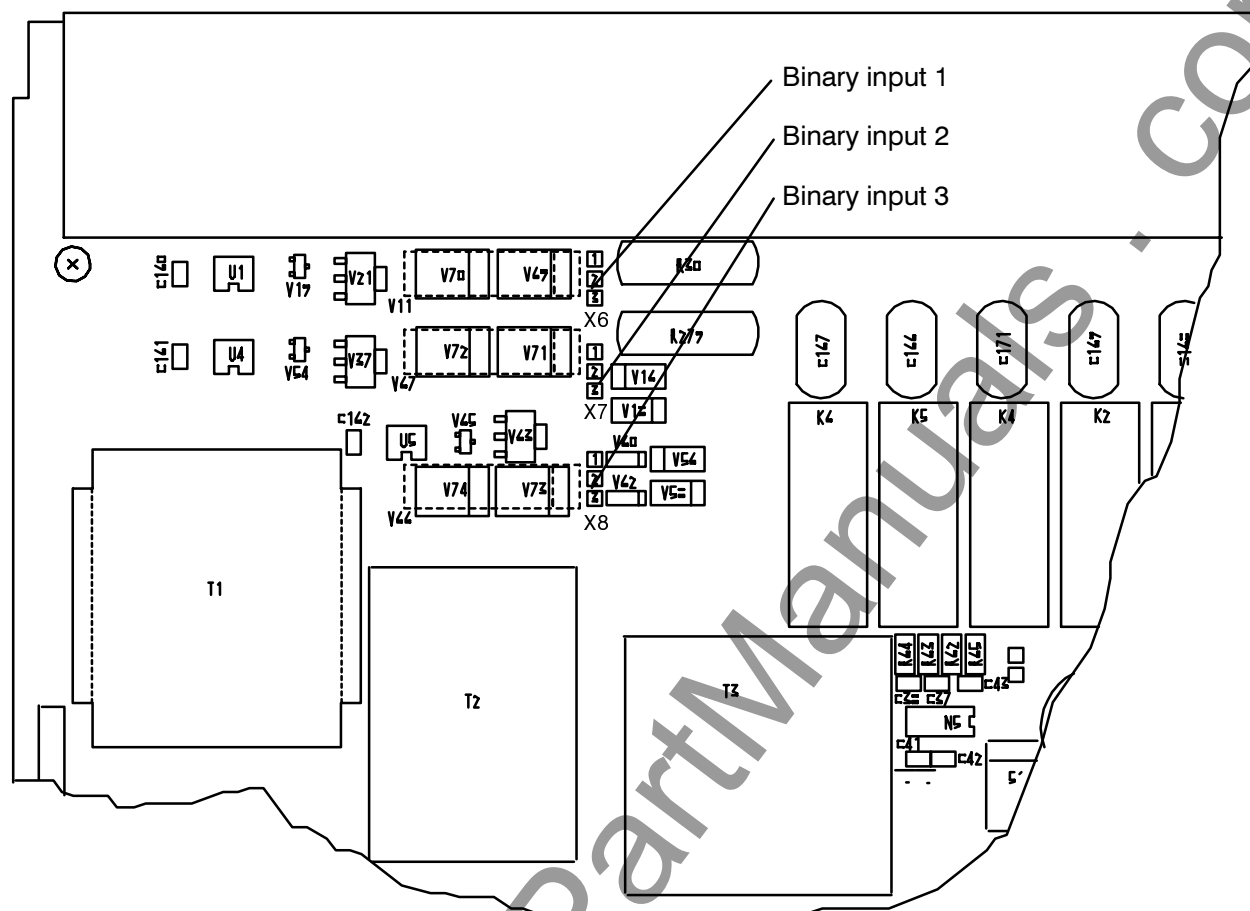
For rated voltages 24/48/60 V −: Jumpers X*.2 − X*.3 must be inserted! (pick-up threshold approx. 17 Vdc)

For rated voltages 110/125/220/250 V −: Jumpers X*.1 − X*.2 may be inserted. (pick-up threshold approx. 75 Vdc)

where * = 6, 7 and 8

Figure 5.2   Checking for control voltages for binary inputs

5.2.3 Checking the communication link (if used)

If the relay is intended to communicate with a central data evaluation device or with a personal computer, the data link must be checked. It is important to visually check the allocation of the transmission wires to the terminals. Depending on the used converter 7XV56 or 7XV57, the following assignment must be obtained:

Converter RS485/ V.24 7XV57	Desig- optic fibre nation 7XV56		7RW6000 – ★B★★★ – ★E★★★ –	★D★★★ –
GND	Term. 1/4	GND	Term. 27	Term. 10
A	Terminal 2	A	Term. 29	Term. 12
B	Terminal 3	B	Term. 28	Term. 11

Check that the necessary auxiliary voltage for supply of the converter is connected correctly. The cable shield is grounded at **both** ends of the cable.

The standard cable has only two conductors. The two inner conductors are connected to A and B. GND is not usually connected.

If the cable used provides a third inner conductor it is connected to GND. Where communication is subject to heavy interference or a potential difference of more than 7 V exists between the units connected to one cable, the GND connection may be connected to the shielding, and both grounded to the shield connection of the housing.

To ensure reliable data transmission the RS485 bus must be terminated at the last unit on the bus (connect terminating resistor). The unit 7RW600 is not already terminated. To activate the termination, open the unit (see Section 5.2.2) and set jumpers X20 and X21 to position 2 – 3 (see Figure 5.3). If the bus is extended, the termination must be deactivated on the units that are connected in the middle of the bus. To do this, set jumpers X20 and X21 to position 1 – 2.
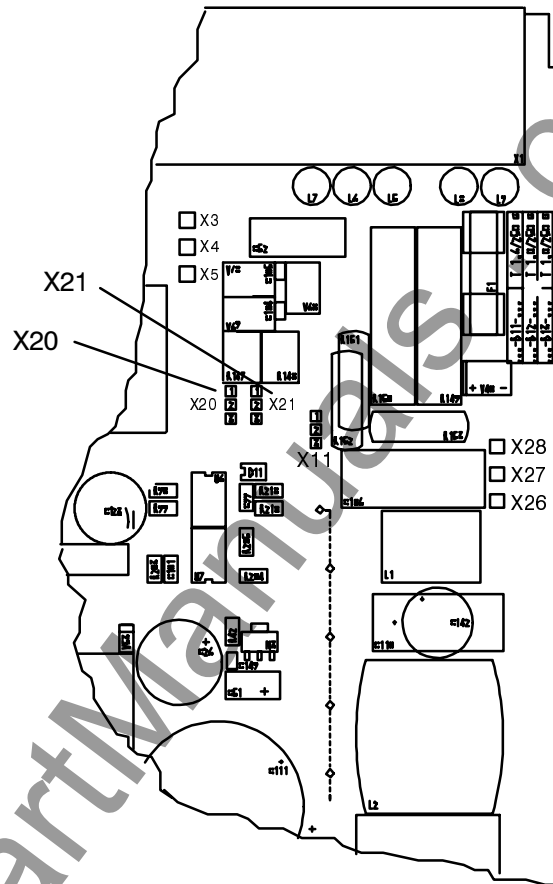
Terminating resistor	jumper X20	jumper X21
effective	2 – 3	2 – 3
not effective (as delivered)	**1 – 2**	**1 – 2**

Figure 5.3   Terminating resistor

The optical interface of the 7XV56 converter works with positive logic. The normal character position for the fiber-optic connection is therefore "Light off". If the normal character position has to be changed you can do this with a switch that is accessible when you open the housing of the 7XV56.

5.2.4   Connections

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

5.2.4.1   Measured voltage inputs

The relay contains two measured voltage inputs, designated with U and U_x. Frequency, rate-of-frequency-change, and overflux determination are derived from the main input U (terminals 7 and 8).

The second voltage input U_x (terminals 9 and 10 for versions 7RW6000−★B★★★ and −★E★★★ resp. terminals 13 and 14 for version 7RW6000−★D★★★) can

be used for a separate and independent measured voltage (see Figure 5.4). Alternatively, the two inputs can be connected phase-to-phase to a three-phase system in V−connection (see Figure 5.5).

In the first case, two different voltages U and U_x can be processed and individually monitored for overvoltage and/or undervoltage by the voltage protection functions.

In the latter case, two phase-to-phase voltages of the three-phase system are connected in V−connection. The overvoltage protection processes then both of these two voltages, the undervoltage protection processes the positive sequence component of the voltages.
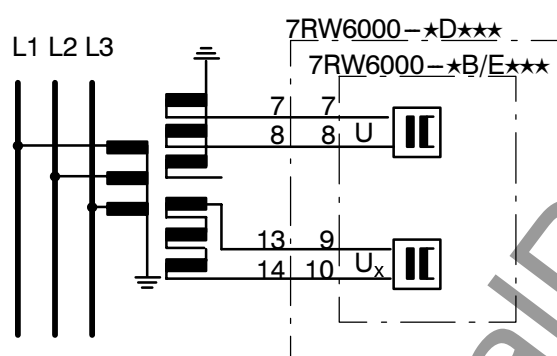
Figure 5.4   Connection example for two independent single-phase voltages
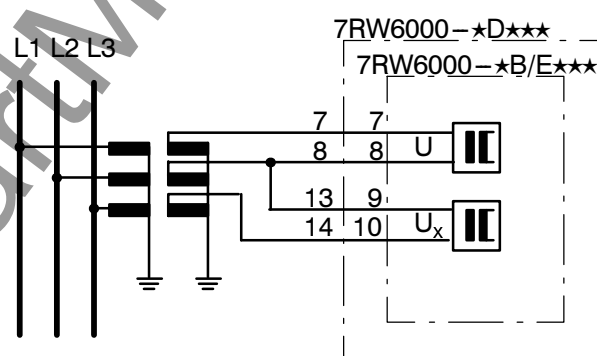
Figure 5.5   Connection example for two phase-to-phase voltages in V−connection

5.2.4.2   Trip circuit supervision

If the trip circuit supervision is used, decision must be made whether two binary inputs or only one is available for this purpose. The function is explained in detail in Section 4.7, where also the principle connections are given.

Note: It must be considered that two binary inputs (or one input and a replacement resistor) are connected in series. Therefore, the pick-up threshold of the binary input(s) (Section 5.2.2.2) must be clearly smaller than half the control voltage.

Note: In 7RW600, the two binary inputs BI2 and BI3 have a common negative pole. This combination is,

therefore, not suitable for trip circuit supervision. Use the binary inputs BI1 and BI2 instead.

If one single binary input is available (Figure 5.6), an external resistor R must be connected in the circuit of the breaker auxiliary contact (Aux2), which replaces the missing second binary input (refer also to Section 4.7.2). Thus, a fault is also detected when the NO auxiliary contact is open and the trip relay contact has reset. This resistor must be dimensioned such that the trip coil (TC) of the breaker cannot operate when the breaker is open (Aux1 open and Aux2 closed), but that the binary input (BI1) can operate when the trip contact of the device has opened, at the same time (Figure 5.6).

This results in an upper limit R_{max} and a lower limit R_{min} of the resistance, from which the arithmetical mean value is taken:

$$R = \frac{R_{max} + R_{min}}{2}$$

The maximum resistance R_{max} is derived from the minimum control voltage of the binary input:

$$R_{max} = \left(\frac{U_{CV} - U_{BI\,min}}{I_{BI\,(High)}} \right) - R_{TC}$$

The minimum resistance R_{min} is derived from the maximum control voltage which does not operate the circuit breaker trip coil:

$$R_{min} = R_{TC} \cdot \left(\frac{U_{CV} - U_{TC\,(LOW)}}{U_{TC\,(LOW)}} \right)$$

$I_{BI\,(High)}$	constant current which operates the binary input (approx. 2 mA)
$U_{BI\,min}$	minimum control voltage for the binary input (approx. 17 V at delivery, approx. 75 V with increased pick-up)
U_{CV}	Control voltage of the trip circuit
R_{TC}	ohmic resistance of the trip coil
$U_{TC(LOW)}$	maximum voltage which does not operate the trip coil

If this calculation results in R_{max} being smaller than R_{min}, it must be repeated with a lower control voltage $U_{BI\,min}$. The jumpers of the binary input must be set according Section 5.2.2.2 corresponding to this smaller voltage.

The power demand of the resistor is

$$P_R = I^2 \cdot R = \left(\frac{U_{CV}}{R + R_{TC}} \right)^2 \cdot R$$
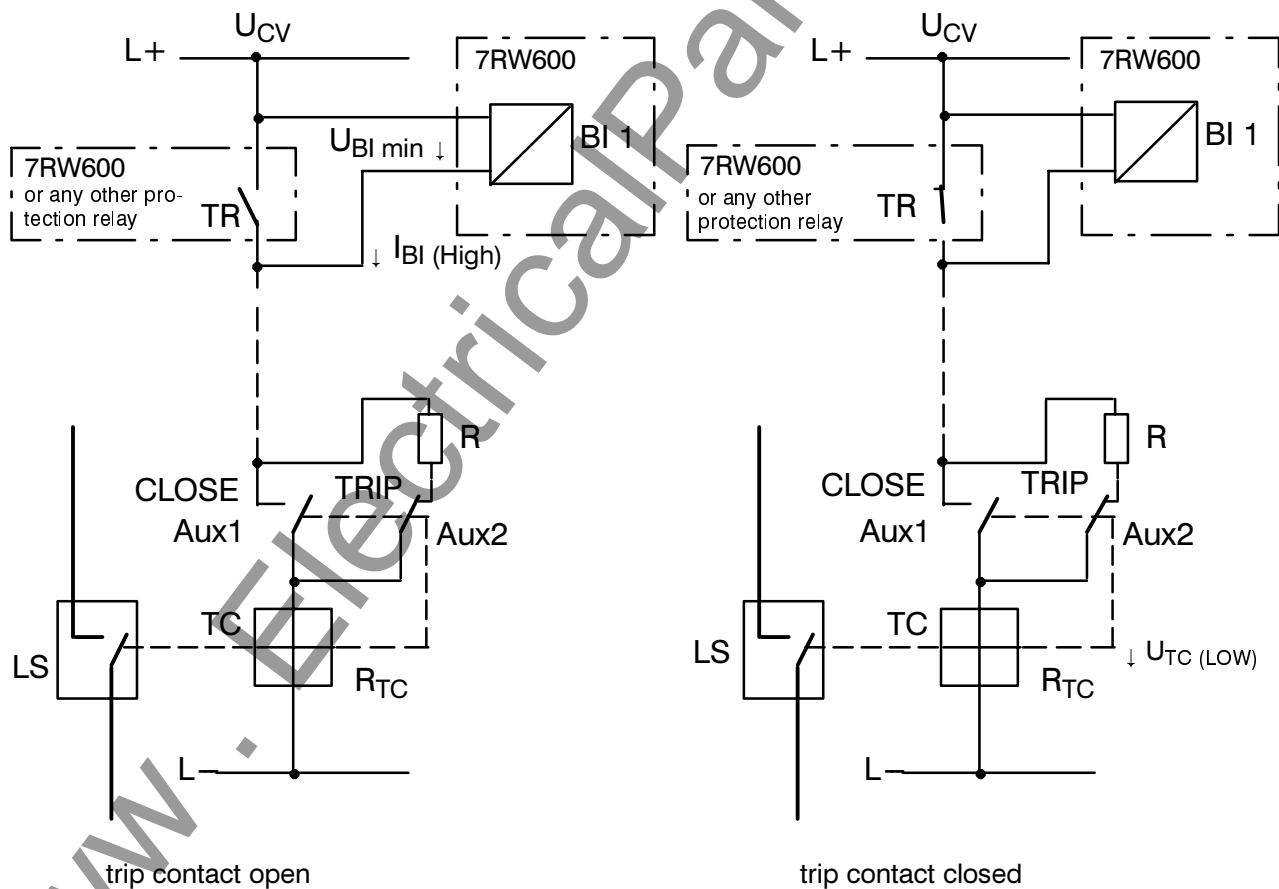
Figure 5.6   Dimensioning the external resistor R when one single binary input is used

Example:

$I_{BI\ (High)}$	2 mA (protection relay data)
$U_{BI\ min}$	17 V (protection relay data)
U_{CV}	110 V (switchgear control voltage)
R_{TC}	500 Ω (circuit breaker data)
$U_{TC\ (LOW)}$	2 V (circuit breaker data)

$$R_{max} = \left(\frac{110\ V - 17\ V}{2\ mA} \right) - 500\ \Omega$$

$$R_{max} = 46\ k\Omega$$

$$R_{min} = 500\ \Omega \cdot \left(\frac{110\ V - 2\ V}{2\ V} \right)$$

$$R_{min} = 27\ k\Omega$$

$$R = \frac{R_{max} + R_{min}}{2} = 36.5\ k\Omega$$

The nearest standard value is selected: 33 kΩ.

The power consumption of the resistor is

$$P_R = \left(\frac{110\ V}{(33 + 0.5)\ k\Omega} \right)^2 \cdot 33\ k\Omega$$

$$P_R = 0.36\ W$$

A safety factor of at least 2 should be observed:

$$P_R = 0.75\ W$$

5.2.5   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 d.c. supply!

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

- Are the voltage transformers correctly earthed?

- Is the phase relationship of the voltage transformers correct? The relay may be connected corresponding to Figure 5.4 (single-phase, whereby input U_x may be left open) or to Figure 5.5 (V–connection, whereby the main v.t.s may be installed in three-phase or V–connection). This must be in accordance with parameter "MEAS" (address 7901, refer to Section 5.4.2).

- Are the polarities of the voltage transformer connections consistent (if applicable)?

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

– Close the power 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.

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

– 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.

– 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 code-word 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.

```
C W :
@ @ @
```

```
C W    O K _
```

```
C W    W R O N G
```

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.

```
┌──────────┐
│ 7 R W 6 0 0 │
│ V 3 . 0 0 │
└──────────┘

┌──────────┐      ┌──────────┐      ┌──────────┐
│ P A R A M E . │──│ 0 0   C O N F . │──│ 0 0   U < │
└──────────┘      └──────────┘      │ E X I S T │
     │                   │          └──────────┘
     │                   ↓                ⋮
   ( 1 )          ┌──────────┐      ┌──────────┐
                  │ 0 1   P O W E R │──│ 0 1   F R E Q │
                  │ S Y S T . D A T │  │ 5 0   H z │
                  └──────────┘      └──────────┘
                         │                ⋮
                         ↓          ┌──────────┐
                  ┌──────────┐      │ 1 5   U x < │
                  │ 1 5   U x < │──│ O F F │
                  │ P R O T . │    └──────────┘
                  └──────────┘          ⋮
                       ⋮
                  ┌──────────┐      ┌──────────┐
                  │ 3 9 C I R s u p │──│ 3 9 C I R s u p │
                  │ │              │  │ O F F │
                  └──────────┘      └──────────┘
```

```
┌──────────┐   ┌──────────┐   ┌──────────┐   ┌──────────┐
│ 6 0   M A R S H │─│ 6 1   M A R S H │─│ 6 1   M A R S H │─│ 6 1   B I 1  1 │
└──────────┘   │ B I │          │ B I   1 │      │ > L E D   r . │
               └──────────┘   └──────────┘   └──────────┘
                    │              ⋮              ⋮
               ┌──────────┐   ┌──────────┐   ┌──────────┐
               │ 6 2 M A R S H │─│ 6 2   M A R S H │─│ 6 2 R E L 3  1 │
               │ R E L A Y │    │ R E L   3 │     │ f 2   T r i p │
               └──────────┘   └──────────┘   └──────────┘
                    │              ⋮              ⋮
               ┌──────────┐   ┌──────────┐   ┌──────────┐
               │ 6 3   M A R S H │─│ 6 3   M A R S H │─│ 6 3 L E D 1  1 │
               │ L E D   I N D │  │ L E D   1 │     │ f 1   T r i p │
               └──────────┘   └──────────┘   └──────────┘
                    │              ⋮              ⋮
               ┌──────────┐   ┌──────────┐   ┌──────────┐
               │ 6 4   M A R S H │─│ 6 4   M A R S H │─│ 6 4 C M D 1  1 │
               │ C M D . R E L │  │ C M D . R E  1 │  │ U <   T r p │
               └──────────┘   └──────────┘   └──────────┘
                                    ⋮              ⋮
```

```
┌──────────┐      ┌──────────┐
│ 7 1 I N T . O P │──│ 7 1 L A N G U A │
└──────────┘      │ E N G L I S H │
                  └──────────┘

┌──────────┐      ┌──────────┐
│ 7 2   I N T E R │──│ 7 2 D E V I C E │
│ F A C E │        │ 1 │
└──────────┘      └──────────┘
                       ⋮
┌──────────┐      ┌──────────┐
│ 7 4   F A U L T │──│ 7 4 R E C i n i │
│ R E C O R D E R │  └──────────┘
└──────────┘           ⋮
```

| 1st operation level | 2nd operation level | 3rd operation level | 4th operation level | 5th operation level |
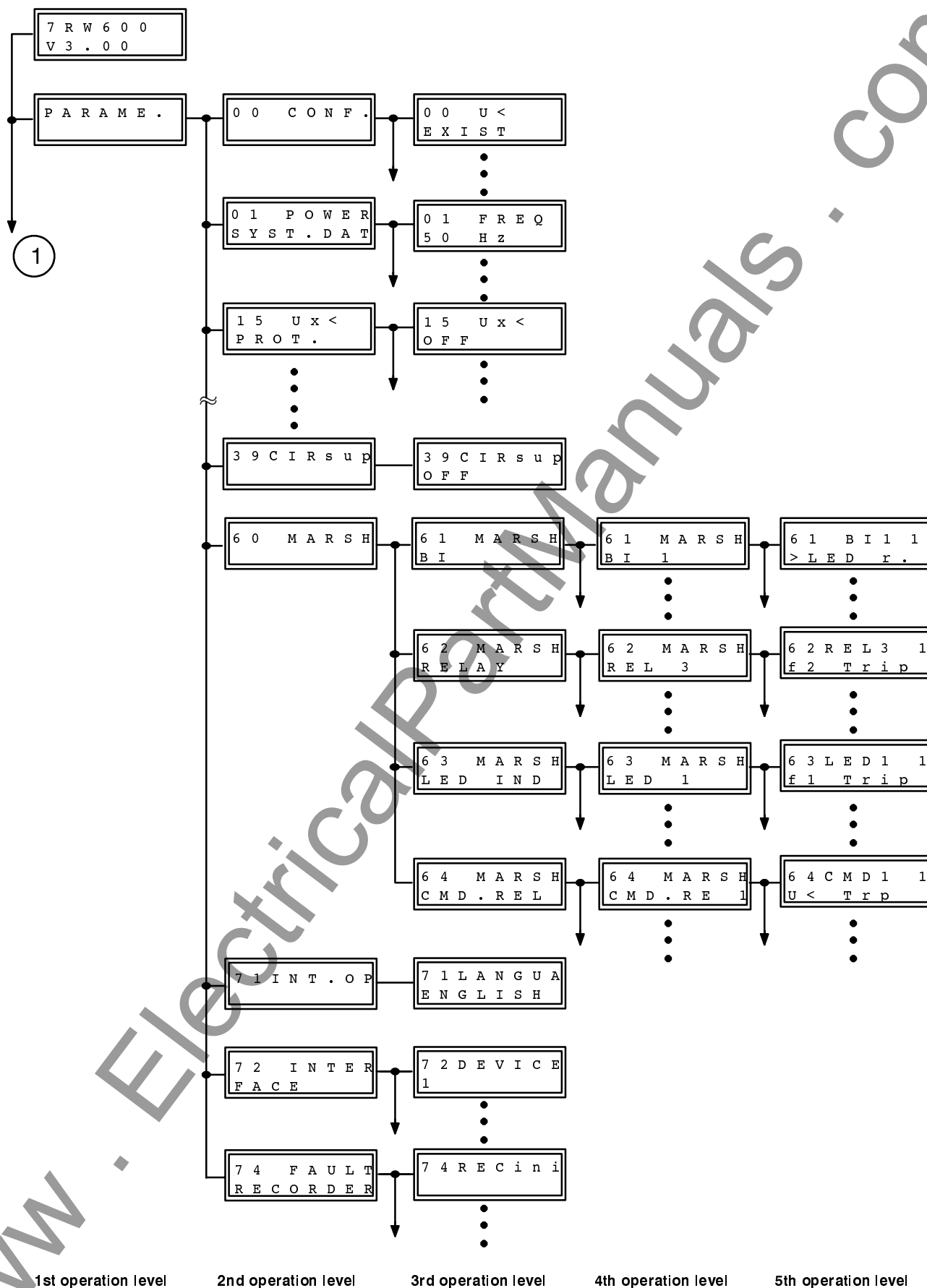
Figure 5.7   Menu tree (sheet 1): Selection and settings of protection functions (continued next page)

①

```
┌──────────────┐     ┌──────────────┐     ┌──────────────┐
│ A N N U N C. │─────│ 8 1  O P E R.│─────│ annunciation │
│              │     │ A N N U N C. │     │ list         │
└──────────────┘     └──────────────┘     └──────────────┘
                                                  ↕
                     ┌──────────────┐     ┌──────────────┐
                     │ 8 2  F A U L T│────│ 8 2  L A S T │─────│ annunciation │
                     │ A N N U N C. │     │ F A U L T    │     │ list         │
                     └──────────────┘     └──────────────┘     └──────────────┘
                                                  ●                    ↕
                                                  ●
                                                  ●
                                         ┌──────────────┐     ┌──────────────┐
                                         │ 8 2  8 t h   │─────│ annunciation │
                                         │ F A U L T    │     │ list         │
                                         └──────────────┘     └──────────────┘
                                                                     ↕
                     ┌──────────────┐     ┌──────────────┐
                     │ 8 4  M E A S.│─────│ f =          │
                     │ V A L U E S  │     │ 5 0 . 0 1  H z│
                     └──────────────┘     └──────────────┘
                                                  ●
                                                  ●
                                                  ●

┌──────────────┐     ┌──────────────┐     ┌──────────────┐
│ A D D I T I O N│───│ T I M E      │─────│ D A T E  and │
│ F U N C T I O N│   │ S E T T I N G│     │ T I M E      │
└──────────────┘     └──────────────┘     └──────────────┘
                                                  ●
                                                  ●
                                                  ●
                     ┌──────────────┐     ┌──────────────┐     ┌──────────────┐
                     │ T E S T      │─────│ P R F  E / A │─────│ B I - S T A T│
                     │ A I D S      │     │              │     │              │
                     └──────────────┘     └──────────────┘     └──────────────┘

                                                             ┌──────────────┐
                                                             │ L E D        │
                                                             │ S T A T U S  │
                                                             └──────────────┘

                     ┌──────────────┐     ┌──────────────┐
                     │ C B - T E S T│─────│ C B - T E S T│
                     │ T R I P      │     │ T R I P    ? │
                     └──────────────┘     └──────────────┘
                                                  ●
                                                  ●
                                                  ●
                                         ┌──────────────┐
                                         │ C B - T E S T│
                                         │ T R I P    ? │
                                         └──────────────┘
```

1st operation level   **2nd operation level**   **3rd operation level**   **4th operation level**   **5th operation level**
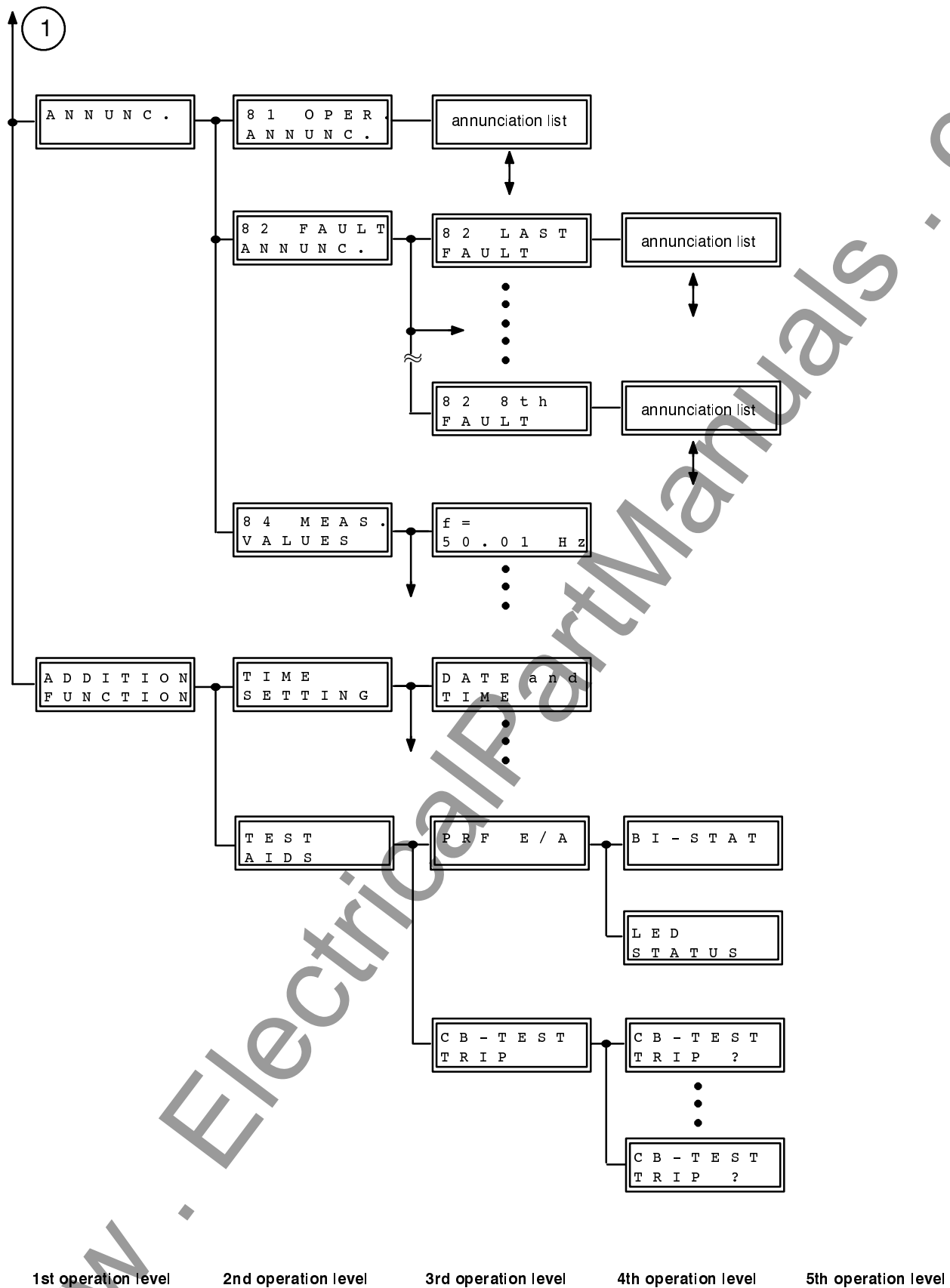
Figure 5.7   Menu tree (sheet 2): Annunciations and ancillary functions

The menu tree 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 5.8 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 ◁ .

```
△      ┌─────────────────┐      ▷
       │  7 1 I N T . O P │
▽      └─────────────────┘
```

[7100]
Beginning of the block "Integrated operation"
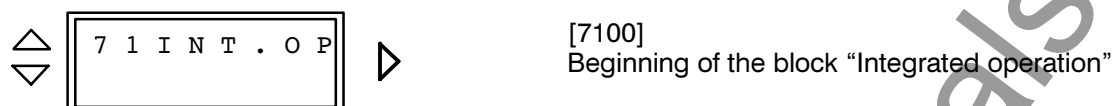
Address blocks 71 to 74 are provided for configuration of the software operating system. These settings concern the operation of the relay, communi-

cation with external operating and processing devices via the serial interface, and the interaction of the device functions.
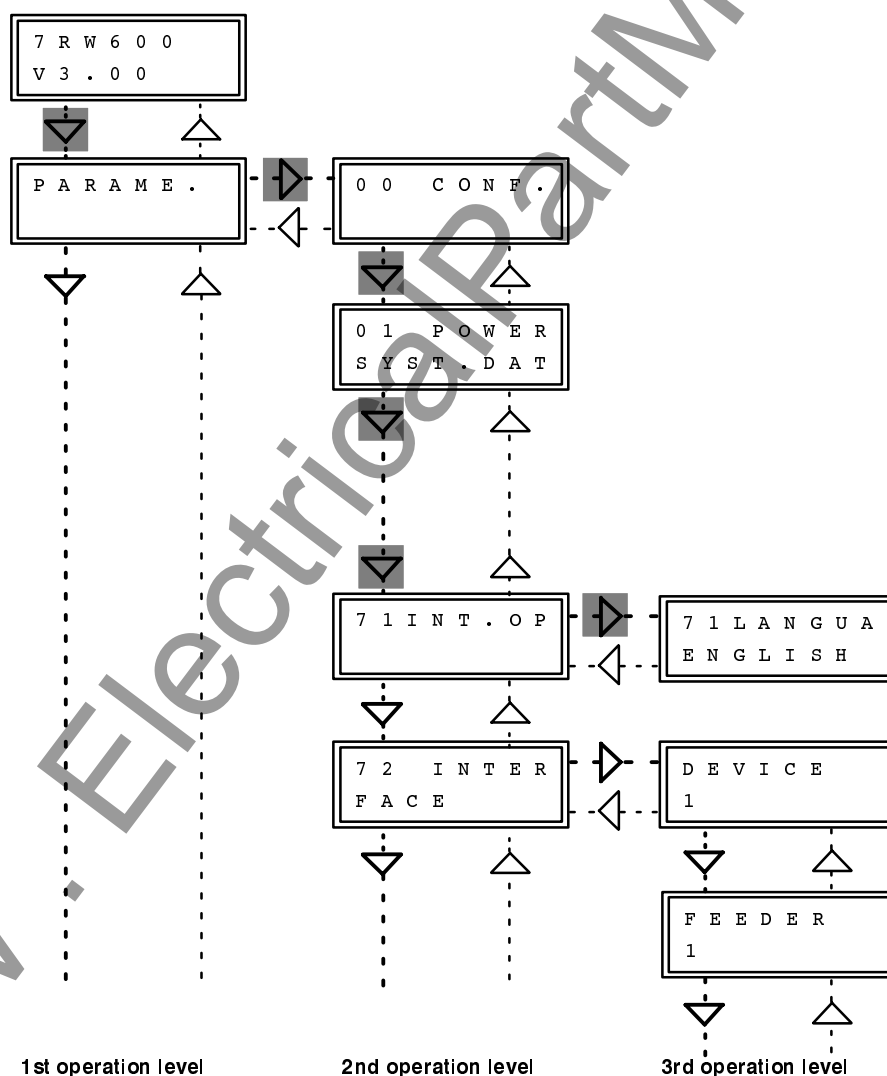
Figure 5.8   Extract from the operation structure and illustration of selection of the configuration blocks

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 5.8. 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 5.8). 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.

```
    ┌─────────────────┐
◁   │ 7 1 L A N G U A │
    │ E N G L I S H   │
    └─────────────────┘
    ┌─────────────────┐
+   │ D E U T S C H   │
    └─────────────────┘
    ┌─────────────────┐
    │ F R A N C A I S │
    └─────────────────┘
    ┌─────────────────┐
    │ E S P A N O L   │
    └─────────────────┘
```

[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:

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

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.

```
72  INTER
FACE
```

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

```
DEVICE
1
```

[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**

```
FEEDER
1
```

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

```
SUBSTA.
1
```

[7203]
Identification number of the substation, in case more than one substation will be processed
Smallest permissible number: **1**
Largest permissible number: **254**

```
FUN.TYPE
78
```
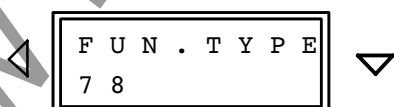
[7208]
Function type in accordance with VDEW/ZVEI and IEC 60870–5–103; for voltage and frequency protection no. 78.
This address is mainly for information, it should not be changed.

```
┌─────────────────┐
│ P C  –  I N T   │
│ D I G S I   V 3 │
└─────────────────┘
    ┌─────────────────┐
  + │ A S C I I       │
    └─────────────────┘
    ┌─────────────────┐
    │ V D E W   e x t │
    └─────────────────┘
```

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

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

ASCII format

format acc. *VDEW*/ZVEI and IEC 60870 – 5 – 103, extended by Siemens specified data

```
┌─────────────────┐
│ 7 2   G A P S   │
│ 1 . 0   s       │
└─────────────────┘
```

[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

```
┌─────────────────┐
│ P C   B A U D   │
│ 9 6 0 0 B A U D │
└─────────────────┘
    ┌─────────────────┐
  + │ 1 9 2 0 0   B D │
    └─────────────────┘
    ┌─────────────────┐
    │ 1 2 0 0 B A U D │
    └─────────────────┘
    ┌─────────────────┐
    │ 2 4 0 0 B A U D │
    └─────────────────┘
    ┌─────────────────┐
    │ 4 8 0 0 B A U D │
    └─────────────────┘
```

[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**.

```
┌─────────────────┐
│ P A R I T Y     │
│ D I G S I   V 3 │
└─────────────────┘
    ┌─────────────────┐
  + │ 8 0 1           │
    └─────────────────┘
    ┌─────────────────┐
    │ 8 N 2           │
    └─────────────────┘
    ┌─────────────────┐
    │ 8 N 1           │
    └─────────────────┘
```

[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 protection relay is equipped with a fault data store (see Section 4.8.2). 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 refer-

ence instant (*SRT witTP*), in this case, the trip command is the storage criterion, too.

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

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 of instantaneous values, 50 s for recording of r.m.s. values. In this time range up to 8 fault records can be stored.

Note: The pre-settings illustrated in the following boxes relate to storage of instantaneous values. If r.m.s. values are to be stored, set an adequately longer period (e.g. 10 times).

Note: The setting ranges include both instantaneous and r.m.s. value ranges. If excessively long times are set for instantaneous values, the relay will limit them to the highest permissible value.

```
7 4    F A U L T
R E C O R D E R
```

[7400]
Beginning of block "Fault recordings"

```
7 4 R E C i n i
R E C b y F T
+ R E C b y T P
S R T w i t T P
```

[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

```
7 4    T − M A X
1 . 0 0    s
```
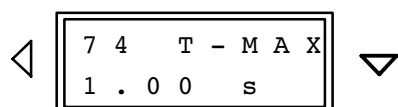
[7410]
Maximum time period of one fault record
Smallest setting value: **0.30** s
Largest setting value (instant. values):   **5.00** s
Largest setting value (r.m.s. values):   **50.00** s

```
7 4    T − P R E
0 . 1 0    s
```
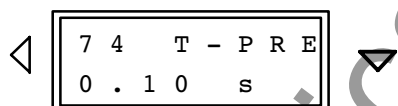
[7411]
Pre-trigger time before the reference instant
Smallest setting value: **0.05** s
Largest setting value (instant. values):   **0.50** s
Largest setting value (r.m.s. values):   **5.00** s

```
7 4    T − P O S
0 . 1 0    s
```
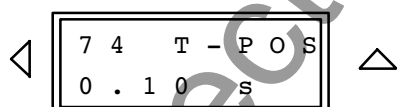
[7412]
Post-fault time after the storage criterion disappears
Smallest setting value: **0.05** s
Largest setting value (instant. values):   **0.50** s
Largest setting value (r.m.s. values):   **5.00** s

```
7 4    V A L U E
I N S T .
+ R . M . S .
```
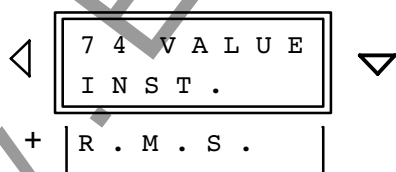
[7420]
Data storage of
– instantaneous values (20 samples per a.c. period)

– r.m.s. values (2 samples per a.c. period)

C53000−G1176−C117   65

5.4   Configuration of the protective functions

5.4.1   Introduction

The device 7RW600 provides a series of protection and additional functions. The scope of the hard- and firmware is matched to these functions, dependent on the ordered version (refer to Section 2.3 Ordering data). Furthermore, individual functions can be set (configured) to be effective or non-effective by configuration parameters.

The configuration parameters are input through the integrated operation keyboard at the front of the device or by means of a personal computer, connected to the operation interface. The use of the integrated

operating keyboard is described in detail in Section 6.2. Alteration of the programmed parameters requires the input of the codeword (see Section 5.3.1). Without codeword, the setting can be read out but not altered.

For the purpose of configuration, 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 5.9).

1st operation level   **2nd operation level**   **3rd operation level**
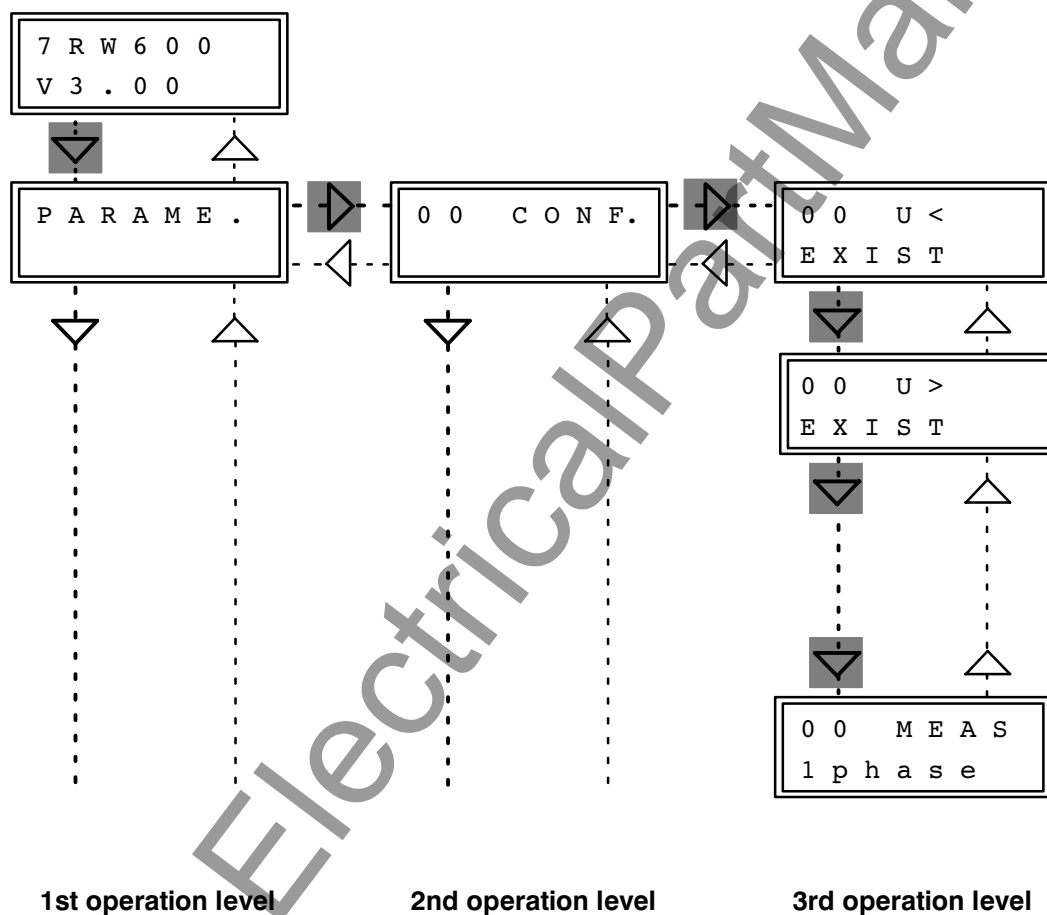
Figure 5.9   Extract from the operation structure and illustration of selection of the configuration block

Within the block 00 one can page with key ▷ to the third operation level and scroll with key ▽ or scroll back with key △. Each paging action leads to a further operation object for the input of a configuration parameter. In the following sections, each operating

object is shown in a box and explained. In the upper line of the display, behind the block number, stands the associated device function. In the second line is the associated text (e.g. "*EXIST*"). If this text is appropriate the arrow keys ▽ or △ can be used to page the

next or previous operating item. If the text should be altered, press the keys ⊞ or ⊟, after having input the codeword; an alternative text then appears (e.g. "*nonEXIST*"). There may be other alternatives which can then be displayed by repeated depression of the keys ⊞ or ⊟. 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 ⊟. 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®, 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 operating item or operating level by pressing one of the arrow keys without hav-

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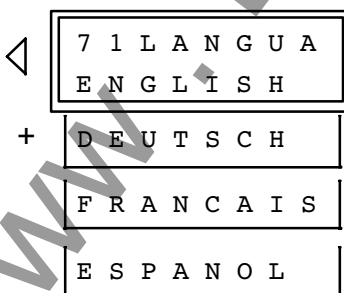
When the configuration or setting process is terminated by pressing the enter key **E**, the altered parameters are permanently secured in EEPROMs and protected against power outage.

With the arrow key ◁ (one level back), 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.

5.4.2 Programming the scope of functions and the connection mode − address block 00

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

Functions which are **configured** as *nonEXIST* will not be processed in 7RW600: There will be no annunciations and the associated setting parameters (functions, limit values) will not be requested during setting (Section 6.3). In contrast, **switch-off** of a

function means that the function will be processed, that indication will appear (e.g. "... switched off") but that the function will have no effect on the result of the protective process (e.g. no tripping command).

The following boxes show the possibilities for the maximum scope of the device. In an actual case, functions which are not available will not appear in the display.
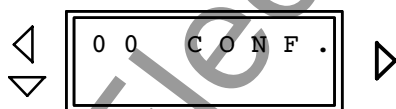
[7800]
Beginning of block "Configuration of the scope of functions"

[7816] Undervoltage protection:
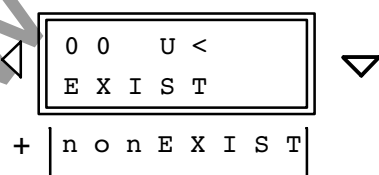
[7817] Overvoltage protection:
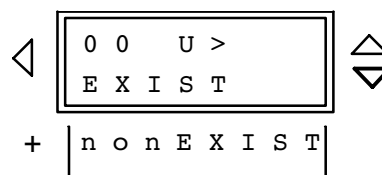
[7820]   Rate-of-frequency-change protection:

◁ | 0 1   d f / d t |
  | E X I S T | ▽
+ | n o n E X I S T |
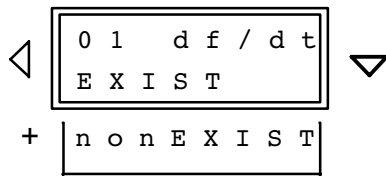
[7829]   Overflux protection:

◁ | 0 1   U / f |
  | E X I S T | ▽
+ | n o n E X I S T |
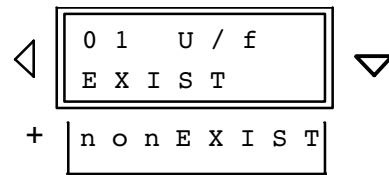
[7821]   Frequency protection:

◁ | 0 0   f > < |
  | E X I S T | ▽
+ | n o n E X I S T |

[7839]   Trip circuit supervision:

◁ | 0 1 C I R s u p |
  | n o n E X I S T | △
+ | w i t h   2 B I |
  | b y p a s s - R |
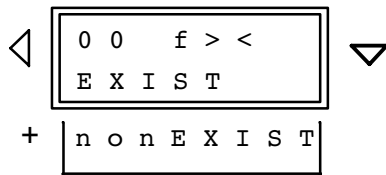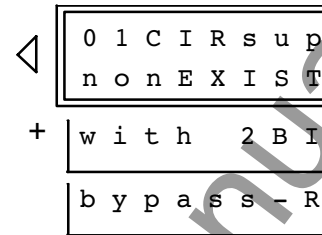
The relay must be informed how the voltage inputs are connected. The inputs U and U_x can be connected to two independent voltages, e.g. according to Figure 5.10, or to two phase-to-phase voltages of a three-phase system in V–connection, according to Figure 5.11. Refer also to Section 5.2.4.1.

The first possibility is also valid if only one single measured voltage is connected to the relay.
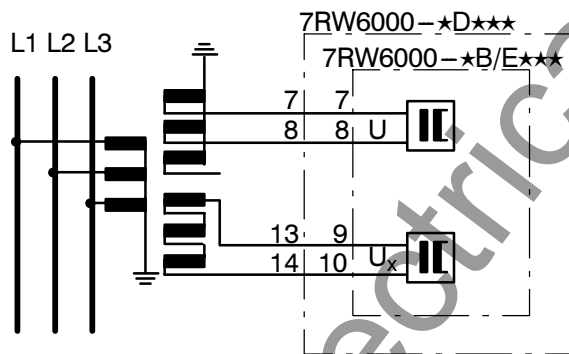
Figure 5.10   Connection of two independent
single-phase voltages
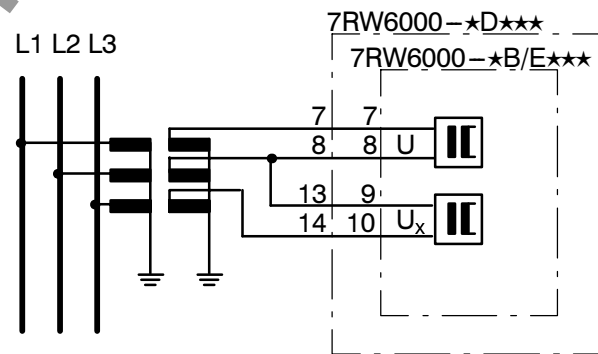
Figure 5.11   Connection of two phase-to-phase
voltages in V–connection

◁ | 0 0   M E A S |
  | 1 p h a s e | ▽
+ | 2 p h a s e |
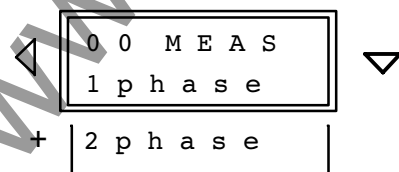
[7901]
Connection of the voltage inputs to two independent voltages, according to figure 5.10.

Connection of the voltage inputs to two phase-to-phase voltages in V–connection, according to figure 5.11.

The following address determines whether the undervoltage protection functions are blocked when the relay is connected to its auxiliary voltage in absence of a measured voltage. If set to *ON*, the undervoltage protection functions are only active once the voltage has been above the setting values.

◁ ┌──────────────┐ ◬
  │ 0 0   0 V   B L │ ◭
  │ O N   │
  └──────────────┘
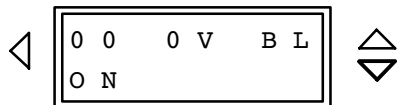
[7902]
Blocking *ON*, i.e. the measured voltage must have been at least once above the pick-up value before the undervoltage protection function can operate

  ┌──────────────┐
  │ O F F   │
  └──────────────┘

Blocking *OFF*, i.e. undervoltage protection functions operate as soon as the auxiliary voltage is switched on; pick-up occurs immediately if no measured voltage is present

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: A fault is registered from any of the integrated protection functions. This event is generated in the device as an "annunciation" (logical function) and should be available at certain terminals of the unit as a N.O. contact. Since specific unit terminals are hard-wired to a specific (physical) output relay, e.g. to the output relay 2, the processor must be advised that the logical signal "FT det" (fault detected) should be transmitted to the output relay 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.

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

The logical annunciation functions can be used in multiple manner. E.g. one annunciation function can trigger several output 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 5.12):

– key ▽ (forwards),

– key ▷ (second operation level),

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

```
6 0    M A R S H
```

[6000]
Beginning of marshalling blocks
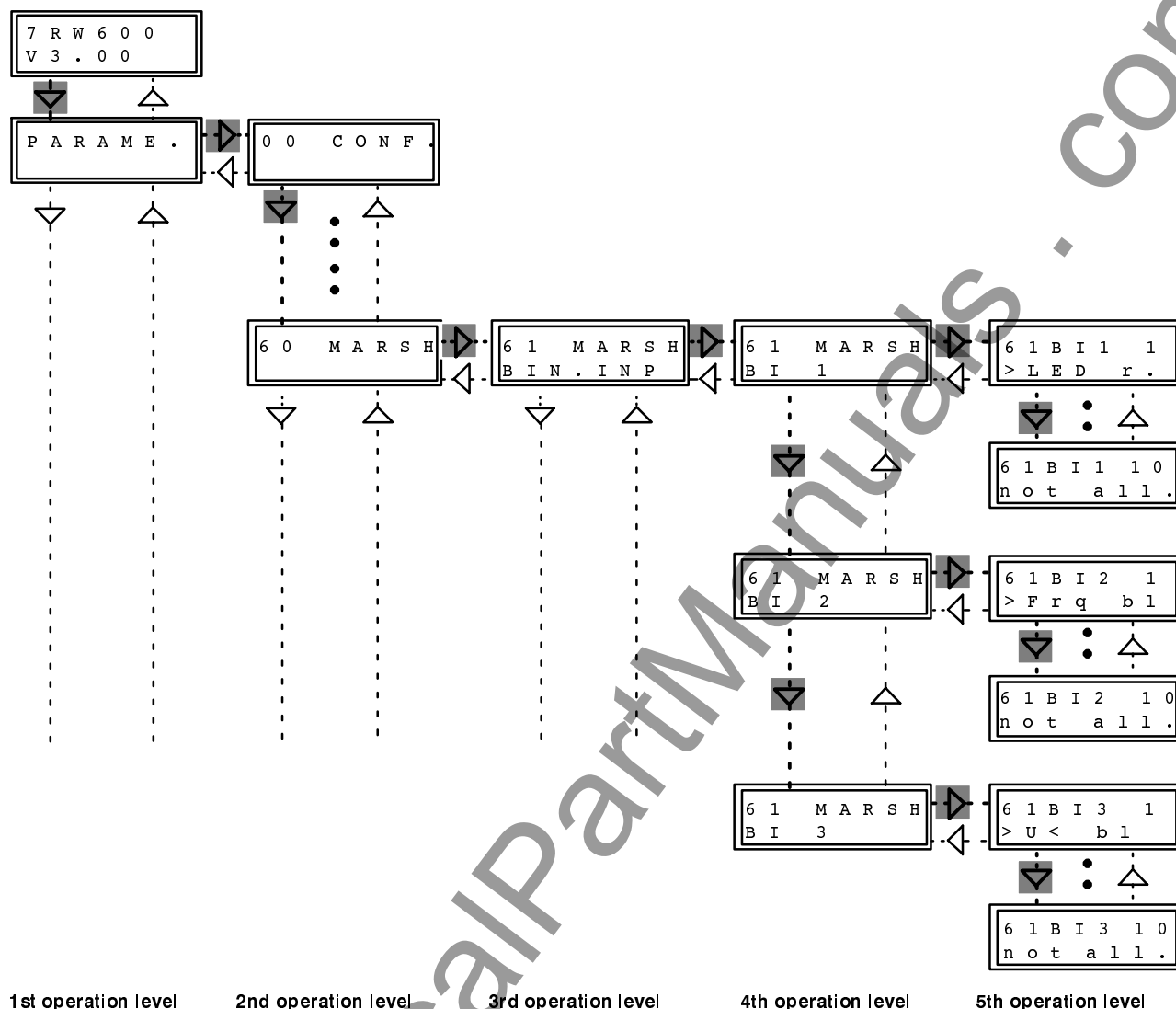
Figure 5.12   Extract from the operation structure and illustration of selection of the marshalling blocks

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 5.12. 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. Back-paging 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 $\nabla \triangle$ or $\triangleright \triangleleft$ 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 $\triangleright$ 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 $\triangleright$ leads to operation level 3 with address block "61 MARSH BIN. INP" (marshalling of binary inputs) (refer also to Figure 5.12).

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**. Input functions naturally have no effect if the corresponding protection function has been programmed out ("de-configured", refer to Section 5.4.2).

The assignment of the binary inputs as delivered from factory is shown in the general diagrams in Appendix A. The following boxes show, as an example, the allocation for binary input 1. Table 5.2 shows all binary inputs as preset from the factory for versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★, table 5.3 for version 7RW600★−★★★★★−**2**★★★.
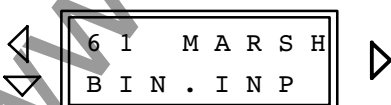
◁ | 6 1   M A R S H | ▷   [6100]
▽ | B I N . I N P | Beginning of block "Marshalling binary inputs"

The first binary input is reached with the key ▷ :
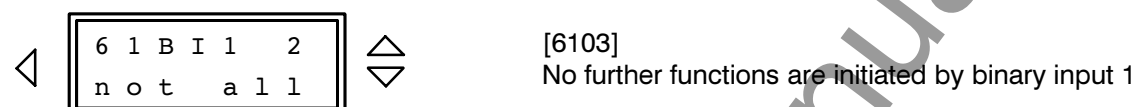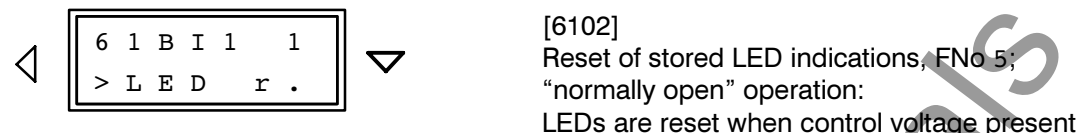
```
 ◁  ┌──────────────┐   ▷      [6101]
    │ 6 1   M A R S│          Allocations for binary input 1
 ▽  │ H   B I   1  │
    └──────────────┘
```

Change over to the selection level with ▷ :

```
 ◁  ┌──────────────┐   ▽      [6102]
    │ 6 1 B I 1   1│          Reset of stored LED indications, FNo 5;
    │ > L E D   r .│          "normally open" operation:
    └──────────────┘          LEDs are reset when control voltage present
```

```
 ◁  ┌──────────────┐   △      [6103]
    │ 6 1 B I 1   2│   ▽      No further functions are initiated by binary input 1
    │ n o t   a l l│
    └──────────────┘
 .
```

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
3	>Ti.syn	Time synchronization of internal time clock
5	>LED r.	Reset LED indicators
1157	>CBclo	Circuit breaker is manually closed (from discrepancy switch)
5203	>Frq bl	Block frequency protection
5206	>f1 blk	Block frequency protection f1 stage
5207	>f2 blk	Block frequency protection f2 stage
5208	>f3 blk	Block frequency protection f3 stage
5209	>f4 blk	Block frequency protection f4 stage
5353	>U/f bl	Block overexcitation protection
5357	>RM U/f	Reset memory of thermal replica U/f
5503	>df blk	Block rate-of-frequency-change protection
5504	>df1 bl	Block rate-of-change stage df1/dt
5505	>df2 bl	Block rate-of-change stage df2/dt
5506	>df3 bl	Block rate-of-change stage df3/dt
5507	>df4 bl	Block rate-of-change stage df4/dt
6506	>U< bl	Block undervoltage protection U< stage
6513	>U> bl	Block overvoltage protection U> stage
6518	>Ux< bl	Block undervoltage protection $U_x<$ stage
6519	>Ux> bl	Block overvoltage protection $U_x>$ stage
6520	>Up<blk	Block undervoltage protection Up< stage
6851	>SUP bk	Blocking trip circuit supervision
6852	>TrpRel	Trip circuit supervision: Trip relay
6853	>CBaux	Trip circuit supervision: CB auxiliary

Table 5.1   Marshalling possibilities for binary inputs

The complete pre-settings are listed in Tables 5.2 and 5.3.

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	BINARY INPUTS		Heading of the address block
6 1 M A R S H B I 1	6 1 B I 1 1 > L E D r .	 5	Acknowledge and reset of stored LED and displayed fault indications, LED−test
6 1 M A R S H B I 2	6 1 B I 2 1 > F q r b l	 5203	Block frequency protection
6 1 M A R S H B I 3 B I 3 B I 3	6 1 B I 3 1 > U < b l > U x < b l > U p < b l k	 6506 6518 6520	Block undervoltage protection

Table 5.2   Preset binary inputs for versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★
              (voltage, frequency, rate-of-frequency-change protection)

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	BINARY INPUTS		Heading of the address block
6 1 M A R S H B I 1	6 1 B E 1 1 > L E D Q .	 5	Acknowledge and reset of stored LED and displayed fault indications, LED−test
6 1 M A R S H B I 2	6 1 B E 2 1 > U / f b l	 5353	Block overexcitation protection
6 1 M A R S H B I 3 B I 3	6 1 B E 3 1 > U > b l > U x > b l	 6513 6519	Block overvoltage protection

Table 5.3   Preset binary inputs for version 7RW600★−★★★★★−**2**★★★
              (voltage and overflux protection)

5.5.3   Marshalling of the output relays − address block 62

The unit contains 6 output relays (K1 to K6). These are of equal type and, thus, of equal switching capacity and capable to trip circuit breaker coils. Nevertheless, the output relays K1 and K2 are dual channel controlled, i.e. they are energized via two different control channels and continuously supervised. Therefore, they are particularly suited for trip relays. They are marshalled according to Section 5.5.5.

The remaining output relays K3 to K6 can be marshalled in address block 62. The output relays K4 and K5 have a common plus connection. Output relay K6 can optionally operate with its make or

break contact. Refer to Section 5.2.2.3 for selection of this contact mode. The break contact is suitable for internal fault alarm.

The block 62 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 RELAY" (marshalling relays) (refer also to Figure 5.12).

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 output relays (see also Section 5.5.1).

Table 5.4 gives a listing of all annunciation functions with the associated function numbers FNo. Annunciation functions are naturally not effective when the corresponding protection function is not available or has been programmed out ("de-configured" – refer to Section 5.4.2).

Note: Besides the annunciation functions listed in Table 5.4, further functions may appear in the display which are not meaningful for marshalling (e.g. annunciations of measured values). Therefore, **it is**

strongly advised to use only the annunciations listed in Table 5.4 for marshalling of output functions.

The assignment of the output relays as delivered from factory is shown in the general diagrams in Appendix A. The following boxes show an example for marshalling of the output relay 3. Table 5.5 shows all relays as preset from the factory for versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★, Table 5.6 for version 7RW600★−★★★★★−**2**★★★.

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.

◁ ▽
```
6 2    M A R S
H  R E L A Y
```
▷

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

The first output relay is reached with the key ▷ :

◁ ▽
```
6 2    M A R S
H R E L    3
```
▷
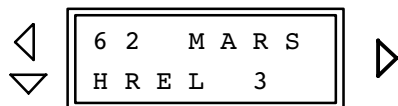
[6201]
Allocations for relay 3

Change over to the selection level with ▷ :

◁
```
6 2 R E L 3    1
f 2    T r i p
```
▽

[6202]
Relay 3 has been preset for:
Frequency protection: Trip stage f_2, FNo 5237;

◁
```
6 2 R E L 3    2
n o t    a l l .
```
△ ▽

[6203]
no further functions are preset for output relay 3

Following codeword input, all marshallable functions can be paged through the display by repeated use of the key ⊞ . At first, all direct confirmation annunciations of binary inputs will appear, then the further annunciations. 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 output 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 output relay with the arrow key ▽.

FNo	Abbreviation	Description
1	not all.	No annunciation allocated
3	>Ti.syn	Time synchronization of the internal real time clock
5	>LED r.	Reset LED indicators
52	operat.	At least one protection function is operative
60	LED res	Stored annunciations are reset
110	ANNlost	Annunciations lost (buffer overflow)
111	PCannLT	Annunciations for personal computer interface lost
113	TAGlost	Fault tag lost
115	ANNovfl	Fault annunciation buffer overflow
203	REC del	Fault recording data deleted
501	FT det	General fault detection of the device
511	DEV.Trp	General trip command of the device
1157	>CBclo	Circuit breaker is closed (from discrepancy switch)
1174	CBtest	Circuit breaker test in progress
1185	CBtpTST	Circuit breaker test: Trip 3pole
5203	>Frq bl	Block frequency protection complete
5206	>f1 blk	Block frequency protection f1 stage
5207	>f2 blk	Block frequency protection f2 stage
5208	>f3 blk	Block frequency protection f3 stage
5209	>f4 blk	Block frequency protection f4 stage
5211	Frq off	Frequency protection is switched off
5212	Frq bl	Frequency protection is blocked
5213	Frq act	Frequency protection is active
5214	Uf< bl	Frequency protection is blocked by undervoltage
5232	f1 Flt.	Frequency protection: f1 stage fault detection
5233	f2 Flt.	Frequency protection: f2 stage fault detection
5234	f3 Flt.	Frequency protection: f3 stage fault detection
5235	f4 Flt.	Frequency protection: f4 stage fault detection
5236	f1 Trip	Frequency protection: Trip by f1 stage
5237	f2 Trip	Frequency protection: Trip by f2 stage
5238	f3 Trip	Frequency protection: Trip by f3 stage
5239	f4 Trip	Frequency protection: Trip by f4 stage
5353	>U/f bl	Block overflux protection
5357	>RM U/f	Reset memory of thermal replica U/f
5361	U/f off	Overflux protection is switched off
5362	U/f blk	Overflux protection is blocked
5363	U/f act	Overflux protection is active
5367	U/f>wrn	Overflux protection: U/f warning stage
5370	U/f>Flt	Overflux protection: Fault detection U/f>
5371	U/f>Trp	Overflux protection: Trip of U/f> stage
5372	U/ftTrp	Overflux protection: Trip of the thermal stage
5503	>df blk	Block rate-of-frequency-change protection
5504	>df1 bl	Block rate-of-change stage df1/dt
5505	>df2 bl	Block rate-of-change stage df2/dt
5506	>df3 bl	Block rate-of-change stage df3/dt
5507	>df4 bl	Block rate-of-change stage df4/dt
5511	df off	Rate-of-frequency-change protection is switched off
5512	df blk	Rate-of-frequency-change protection is blocked
5513	df act	Rate-of-frequency-change protection is active
5514	Udf< bl	df/dt protection is blocked by undervoltage
5516	df1 Flt	df1/dt stage: Fault detection
5517	df2 Flt	df2/dt stage: Fault detection
5518	df3 Flt	df3/dt stage: Fault detection
5519	df4 Flt	df4/dt stage: Fault detection

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

FNo	Abbreviation	Description
5520	df1 Trp	df1/dt stage trip
5521	df2 Trp	df2/dt stage trip
5522	df3 Trp	df3/dt stage trip
5523	df4 Trp	df4/dt stage trip
6506	>U< bl	Block undervoltage protection U<
6513	>U> bl	Block overvoltage protection U>
6518	>Ux< bl	Block undervoltage protection U_x<
6519	>Ux> bl	Block overvoltage protection U_x>
6520	>Up<blk	Block undervoltage protection with voltage−time characteristic U_p<
6522	Up< off	Undervoltage protection Up< is switched off
6523	Up< blk	Undervoltage protection Up< is blocked
6524	Up< act	Undervoltage protection Up< is active
6525	Up< Flt	Undervoltage fault detection Up<
6526	Up<CFlt	Undervoltage fault after inverse time characteristic
6527	Up< Trp	Undervoltage protection, Up< trip
6530	U< off	Undervoltage protection U< is switched off
6531	U< blk	Undervoltage protection U< is blocked
6532	U< act	Undervoltage protection U< is active
6533	U< Flt	Undervoltage fault detection U<
6539	U< Trp	Undervoltage protection, U< trip
6565	U> off	Overvoltage protection U> is switched off
6566	U> blk	Overvoltage protection U< is blocked
6567	U> act	Overvoltage protection U> is active
6568	U> Flt	Overvoltage fault detection U>
6570	U> Trp	Overvoltage protection, U> trip
6571	U>> Flt	Overvoltage fault detection U>>
6573	U>> Trp	Overvoltage protection U>> trip
6576	Ux< off	Undervoltage protection U_x< is switched off
6577	Ux< blk	Undervoltage protection U_x< is blocked
6578	Ux< act	Undervoltage protection U_x< is active
6579	Ux< Flt	Undervoltage fault detection U_x<
6580	Ux< Trp	Undervoltage protection, U_x< trip
6584	Ux> off	Overvoltage protection U_x> is switched off
6585	Ux> blk	Overvoltage protection U_x< is blocked
6586	Ux> act	Overvoltage protection U_x> is active
6587	Ux> Flt	Overvoltage fault detection U_x>
6588	Ux>>Flt	Overvoltage protection, U_x> trip
6589	Ux> Trp	Overvoltage fault detection U_x>>
6590	Ux>>Trp	Overvoltage protection U_x>> trip
6851	>SUP bk	Blocking trip circuit supervision
6852	>TrpRel	Trip circuit supervision: Trip relay
6853	>CB aux.	Trip circuit supervision: Circuit breaker auxiliary
6861	SUP off	Trip circuit supervision is switched off
6862	SUP blk	Trip circuit supervision is blocked
6863	SUP act	Trip circuit supervision is active
6864	SUPnoBI	Trip circuit supervision is blocked: Binary input not marshalled
6865	CIR int	Trip circuit interrupted

Table 5.4　◆Marshalling possibilities for output relays and LEDs

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	SIGNAL RELAYS		Heading of the address block
6 2 M A R S H R E L 3	6 2 R E L 3 1 f 2 T r i p	5237	Frequency protection: Trip by stage f_2
6 2 M A R S H R E L 4	6 2 R E L 4 1 f 3 T r i p	5238	Frequency protection: Trip by stage f_3
6 2 M A R S H R E L 5 R E L 5 R E L 5 R E L 5 R E L 5 R E L 5	6 2 R E L 5 1 f 1 F l t . f 2 F l t . f 3 F l t . U < F l t U x < F l t U p < F l t	5232 5233 5234 6533 6579 6525	Frequency protection: fault detec. stage f_1 Frequency protection: fault detec. stage f_2 Frequency protection: fault detec. stage f_3 Undervoltage fault detection $U<$ Undervoltage fault detection $U_x<$ Undervoltage fault detection $U_p<$
6 2 M A R S H R E L 6	6 2 R E L 6 1 o p e r a t .	52	At least one protection function is active; device operative; NC contact indicates "device fault"

Table 5.5   Marshalling possibilities for output relays and LEDs for versions
7RW600★−★★★★★−**0**★★★ and −**1**★★★ (voltage, frequency, rate-of-frequency-change protection)

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	SIGNAL RELAYS		Heading of the address block
6 2 M A R S H R E L 3 R E L 3	6 2 R E L 3 1 U > > T r p U x > > T r p	6573 6590	Overvoltage protection U>> trip Overvoltage protection U_x>> trip
6 2 M A R S H R E L 4	6 2 R E L 4 1 U / f > w r n	5367	Overflux protection: U/f> warning stage
6 2 M A R S H R E L 5 R E L 5 R E L 5 R E L 5	6 2 R E L 5 1 U > F l t U > > F l t U x > F l t U x > > F l t	6568 6571 6587 6588	Overvoltage fault detection U> Overvoltage fault detection U>> Overvoltage fault detection U_x> Overvoltage fault detection U_x>>
6 2 M A R S H R E L 6	6 2 R E L 6 1 o p e r a t .	52	At least one protection function is active; device operative; NC contact indicates "device fault"

Table 5.6   Marshalling possibilities for output relays and LEDs for version 7RW600★−★★★★★−**2**★★★
7RW600★−★★★★★−**2**★★★ (voltage and overflux protection)

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 "PA-RAME." (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 5.12).

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. Annunciation functions are, of course, not effective when the corresponding protection function has been programmed out (de-configured).

The changed function must be re-confirmed by the enter–key **E**.

The assignment of the LEDs as preset by the factory for both versions is shown in the front of the unit (Fig 6.1). The following boxes show, as an example, the assignment for LED 2. Table 5.7 shows all LED indicators as they are preset from the factory for versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★, Table 5.8 for version 7RW600★−★★★★★−**2**★★★.

```
  ◁  ┌─────────────────┐  ▷
     │ 6 3   M A R S H │
  ▽  │ L E D   I N D   │  ▽
     └─────────────────┘
```

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

The first marshallable LED is reached with the key ▷ , the second with ▽:

```
  ◁  ┌─────────────────┐  ▷
     │ 6 3   M A R S H │
  ▽  │ L E D   2       │
     └─────────────────┘
```
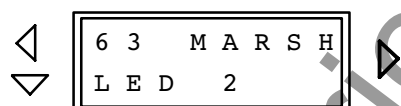
[6322]
Allocations for LED 2

Change over to the selection level with ▷ :

```
  ◁  ┌─────────────────┐
     │ 6 3 L E D 2   1 │  ▽
     │ f 2   T r i p M │
     └─────────────────┘
```

[6323]
LED 2 has been preset for:
1st: Frequency protection: Trip stage f_2, memorized, FNo 5237

```
  ◁  ┌─────────────────┐  △
     │ 6 3 L E D 2   2 │
     │ n o t   a l l . │  ▽
     └─────────────────┘
```

[6324]
No further functions are preset for LED 2

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 ▽; key △ is used to scroll backwards.

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	LEDs		Heading of the address block ◆
6 3 M A R S H L E D 1	6 3 L E D 1 1 f 1 T r i p M	 5236	Frequency protection: Trip stage f_1; memorized
6 3 M A R S H L E D 2	6 3 L E D 2 1 f 2 T r i p M	 5237	Frequency protection: Trip stage f_2; memorized
6 3 M A R S H L E D 3	6 3 L E D 3 1 f 3 T r i p M	 5238	Frequency protection: Trip stage f_3; memorized
6 3 M A R S H L E D 4 L E D 4 L E D 4	6 3 L E D 4 1 U < T r p M U x < T r p M U p < T r p M	 6539 6580 6527	Trip by undervoltage protection (U<, U_x<); memorized

Table 5.7   Preset LED indicators for versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★ (voltage, frequency, rate-of-frequency-change protection)

4th selection level	5th selection level	FNo	Remarks
MARSHALLING	LEDs		Heading of the address block
6 3 M A R S H L E D 1	6 3 L E D 1 1 U / f > w r n M	 5367	Overflux protection: U/f warning stage; memorized
6 3 M A R S H L E D 2 L E D 2	6 3 L E D 2 1 U / f t T r p M U / f > T r p M	 5372 5371	Trip by overflux protection; memorized
6 3 M A R S H L E D 3 L E D 3	6 3 L E D 3 1 U > T r p M U x > T r p M	 6570 6589	Trip by overvoltage protection (U>, U_x>); memorized
6 3 M A R S H L E D 4 L E D 4	6 3 L E D 4 1 U > > T r p M U x > > T r p M	 6573 6590	Trip by overvoltage protection (U>>, U_x>>); memorized

Table 5.8   Preset LED indicators for version 7RW600★−★★★★★−**2**★★★ (voltage and overflux protection)

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

The unit contains 6 output relays (K1 to K6). These are of equal type and, thus, of equal switching capacity and capable to trip circuit breaker coils. Nevertheless, the output relays K1 and K2 are dual channel controlled, i.e. they are energized via two different control channels and continuously supervised. Therefore, they are particularly suited for trip relays. These trip relays can be marshalled in the address block 64.

Address block 64 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).

All of the annunciation functions in accordance with Table 5.4, can be marshalled to output command relays. But those listed in Table 5.9 are particularly suitable for trip relay output. Regard the table as a recommended pre-selection. Command functions are naturally not effective when the corresponding protection function is not available in the relay or has been programmed out (de-configured).

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 5.10 shows all trip relays as preset from the factory for versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★, Table 5.11 for version 7RW600★−★★★★★−**2**★★★.

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

◁ ▽ | 6 4   M A R S H | ▷
      | C M D . R E L |

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

The first trip relay is reached with the key ▷ :
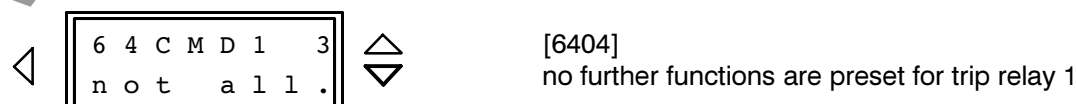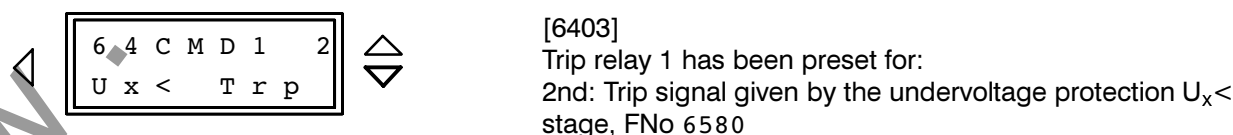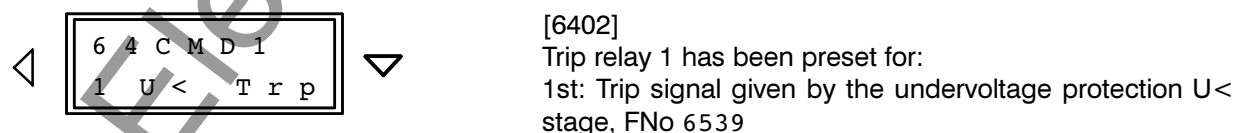
◁ ▽ | 6 4   M A R S H | ▷
      | C M D . R E 1 |

[6401]
Allocations for trip relay 1

Change over to the selection level with ▷ :

◁ | 6 4 C M D 1 | ▽
    | 1 U <   T r p |

[6402]
Trip relay 1 has been preset for:
1st: Trip signal given by the undervoltage protection U< stage, FNo 6539

◁ | 6 4 C M D 1   2 | △▽
    | U x <   T r p |

[6403]
Trip relay 1 has been preset for:
2nd: Trip signal given by the undervoltage protection $U_x<$ stage, FNo 6580

◁ | 6 4 C M D 1   3 | △▽
    | n o t   a l l . |

[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
5236	f1 Trip	Frequency protection: trip by f_1 stage
5237	f2 Trip	Frequency protection: trip by f_2 stage
5238	f3 Trip	Frequency protection: trip by f_3 stage
5239	f4 Trip	Frequency protection: trip by f_4 stage
5371	U/f>Trp	Overflux protection: trip by U/f stage
5372	U/ftTrp	Overflux protection: trip by thermal stage
5520	df1 Trp	Rate-of-frequency-change protection: trip by df1/dt stage
5521	df2 Trp	Rate-of-frequency-change protection: trip by df2/dt stage
5522	df3 Trp	Rate-of-frequency-change protection: trip by df3/dt stage
5523	df4 Trp	Rate-of-frequency-change protection: trip by df4/dt stage
6527	Up< Trp	Undervoltage protection: trip by Up< stage
6539	U< Trp	Undervoltage protection: trip by U< stage
6570	U> Trp	Overvoltage protection: trip by U> stage
6573	U>> Trp	Overvoltage protection: trip by U>> stage
6580	Ux< Trp	Undervoltage protection: trip by U_x< stage
6589	Ux> Trp	Overvoltage protection: trip by U_x> stage
6590	Ux>>Trp	Overvoltage protection: trip by U_x>> stage

Table 5.9   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	6 4 C M D 1 1		
C M D . R E 1	U < T r p	6539	Trip by U< stage of undervoltage protection
C M D . R E 1	U x < T r p	6580	Trip by U_x< stage of undervoltage protection
C M D . R E 1	U p < T r p	6527	
6 4 M A R S H	6 4 C M D 2 1		Trip by f_1 stage of frequency protection
C M D . R E 2	f 1 T r i p	5236	

Table 5.10   Preset command functions for trip relays for versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★
(voltage, frequency, rate-of-frequency-change protection)

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 C M D . R E 1	6 4 C M D 1 1 U / f t T r p U / f > T r p	5372 5371	Trip by overflux protection
6 4 M A R S H C M D . R E 2 C M D . R E 2	6 4 C M D 2 1 U > T r p U x > > T r p	6570 6589	Trip by overvoltage protection

Table 5.11   Preset command functions for trip relays for version 7RW600★−★★★★★−**2**★★★ (voltage and overflux protection)

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 2.4.

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 inputs, 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)

Readiness indication
(green)

Unit faulty indication
(red)

Two line display
(LCD) with 8 charac-
ters each

LED 1 to 4 (red) can
be marshalled; pre-
setting below

SIEMENS

Service/
Betrieb   1

Blocked/
Störung   2

                 3

                 4

Operator panel with control
and function keys

+   △   −

◁   E   ▷

Y/J   ▽   N

RESET

SIEMENS

U−, f−Protection
U−, f−Schutz

U_N = 100...125 V AC   [∇ III]
f_N = 50, 60 Hz
U_H = 60,110,125V DC   CE △
Diagr.: C53207−A320−X1−1*−12

Operation only with fixed cover
Betrieb nur mit angeschraubter Kappe

7RW6000−4EA00−*DA0/BB
F−Nr.

Factory presetting LEDs:

for versions 7RW600★−★★★★★−0★★★ and −1★★★		for version 7RW600★−★★★★★−2★★★	
1	Trip by frequency protection: f1 stage	1	Overflux protection: U/f warning stage
2	Trip by frequency protection: f2 stage	2	Trip by overflux protection
3	Trip by frequency protection: f3 stage	3	Trip by overvoltage protection: U>, U_x>
4	Trip by undervoltage protection: U<, U_x<, Up<	4	Trip by overvoltage protection: U>>, U_x>>

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. Figure 6.2 show the principle, 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 △, for those functions which are available in the relay and configured as *EXIST*ing.

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.

1st operation level   **2nd operation level**   **3rd operation level**
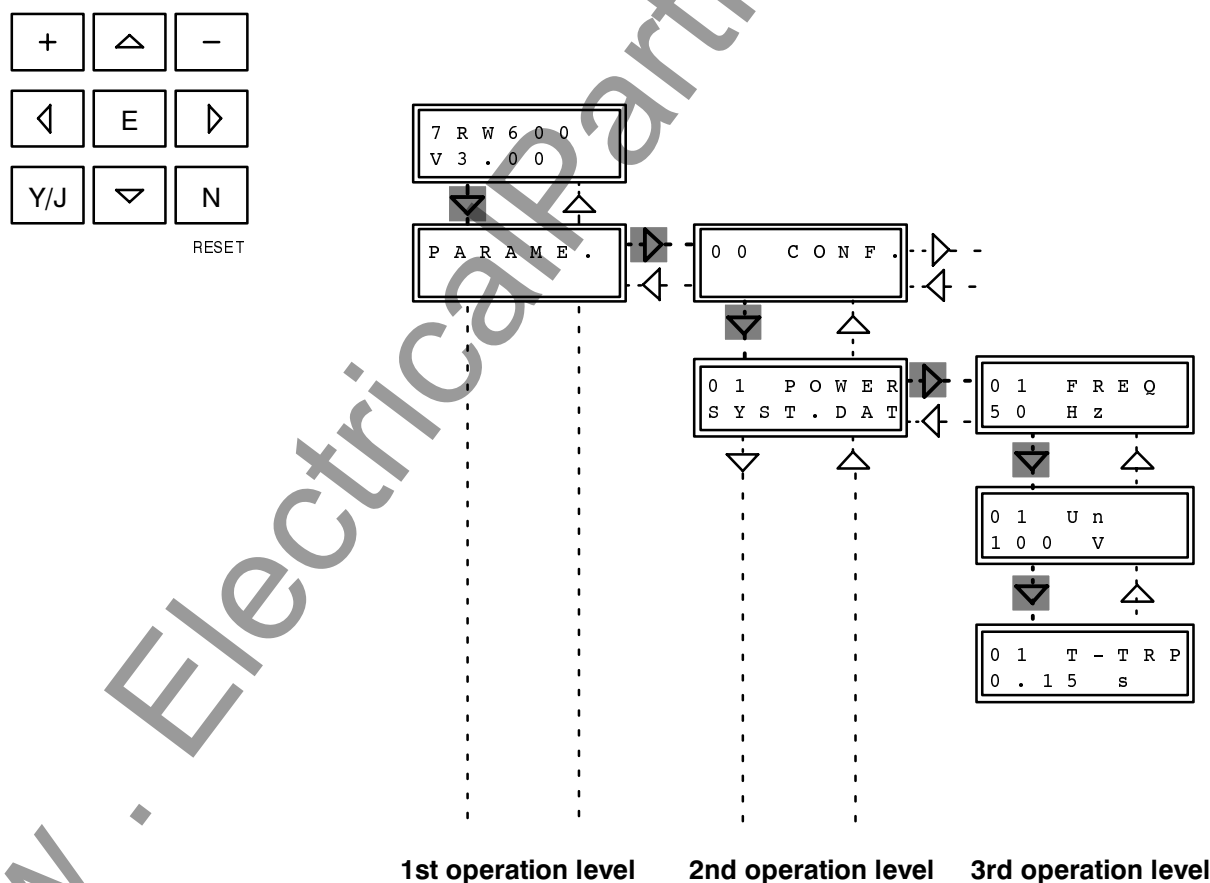
Figure 6.2   Selection of the power system data

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 $\triangle$ the next or the previous block can be selected. By using the key $\triangleright$ 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 $\nabla \triangle$ or $\triangleright \triangleleft$ 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.

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. After the relay has been switched on, first the date "01.07.97" appears and the time since the start-up of the processor system.

[9000]
Beginning of the block "Additional functions"

[8100]
Beginning of the block "Setting the real time clock"
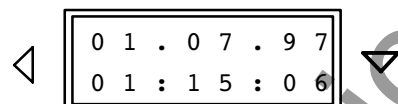
[8101]
At first, the "actual" date (**DD.MM.YY**) and the "actual" time (**HH.MM.SS**) are displayed.
Continue with ▽.
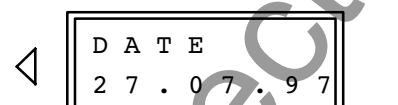
[8102]
Enter the new date: 2 digits for day, 2 digits for month and 2 digits for year: **DD   MM ▷ YY   ▷**

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**.

```
┌─────────────────┐
│ T I M E         │
│ 1 3 : 4 4 : 2 7 │
└─────────────────┘
```
◁
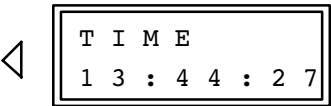
[8103]
Key ▽ is used to come to the time setting. Enter the new time: 2 digits for hour, 2 digits for minute: **HH** ▷ **MM**

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 (frequency and voltage U). When the keys ▽ and subsequently △ is pressed, the initial display is shown again.

```
┌─────────────────┐
│ 7 R W 6 0 0     │
│ V 3 . 0 *       │
└─────────────────┘
```
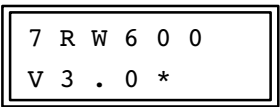
The relay introduces itself by giving its type number. The second display line shows the version of firmware with which it is equipped.

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.

```
┌─────────────────┐
│ 0 1     P O W E R │
│ S Y S T . D A T │
└─────────────────┘
```
◁   ▷

[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.

```
┌─────────────────┐
│ 0 1     F R E Q │
│ 5 0     H z     │
└─────────────────┘
```
◁   ▽

```
┌─────────────────┐
│ 6 0     H z     │
└─────────────────┘
```
+
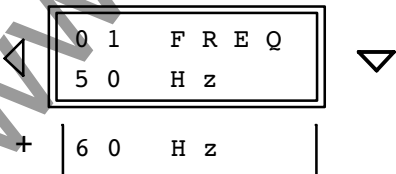
[1101]
Rated system frequency *50 Hz* or *60 Hz*

Next, the secondary rated voltage is entered; it should comply with the voltage transformers' rated secondary voltage:

```
┌──────────────┐
│ 0 1   U n    │
│ 1 0 0   V    │
└──────────────┘
```
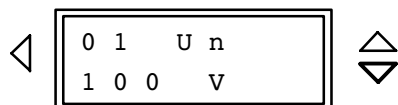
[1102]
Rated secondary voltage of voltage transformers (phase-to-phase)
Smallest setting value :   **100** V
Largest setting value: **125** V

The minimum trip command duration T−TRP can be set. This is then valid for all protection functions of the device which can issue a trip signal.

```
┌──────────────┐
│ 0 1   T − T R P │
│ 0 . 1 5   s    │
└──────────────┘
```
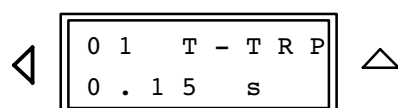
[1134]
Minimum duration of the **trip** command
Smallest setting value: **0.01** s
Largest setting value: **60.00** s

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 15. The individual parameters are listed in the next operation level.

6.3.4   Settings for undervoltage protection $U_x <$ − address block 15

The parameters for U_x are only effective and available when the relay is connected to two single-phase voltages and when it is informed about (address 7901, MEAS = *1 phase*). These parameters of address block 15 are decisive for the voltage U_x when it is fed to the terminals 9 and 10 (for model

7RW6000−★B★★★ and −★E★★★) or to the terminals 13 and 14 (for models 7RW6000−★D★★★).

This function can, furthermore, operate only when it is configured as *EXIST* in block address 00 (refer to Section 5.4.2).

```
┌──────────────┐
│ 1 5   U x <  │
│ P R O T .    │
└──────────────┘
```
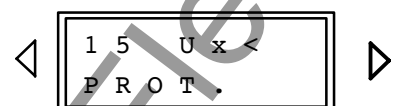
[1500]
Beginning of the block "Undervoltage protection $U_x <$"

```
┌──────────────┐
│ 1 5   U x <  │
│ O F F        │
└──────────────┘
```
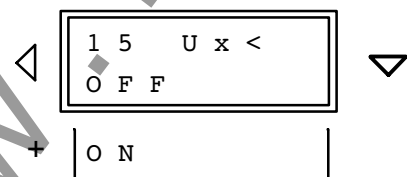
[1501]
Switching *OFF* of the undervoltage protection $U_x <$

```
┌──────────────┐
│ O N          │
└──────────────┘
```

Switching *ON* of the undervoltage protection $U_x <$

For the settings no generally applicable values can be stated. Taking into account that the protection

shall in the first place protect consumers from the consequences of voltage drops and prevent stability

problems, the setting values will be between 60% and 75% of the rated voltage. The time delays have to be set such that voltage drops, which endanger the stability, are tripped. The time delays should, however, be long enough to avoid tripping for permissible short-time voltage drops.

All setting times are additional delay times, which do not include the normal operating times (measuring time, reset time) of the protection function itself.
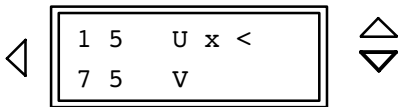
```
◁  ┌─────────────────┐   △      [1502]
   │ 1 5    U x <    │   ▽      Pick-up value of $U_x<$ stage of undervoltage protection
   │ 7 5    V        │          Setting range:          20 V to 120 V
   └─────────────────┘
```
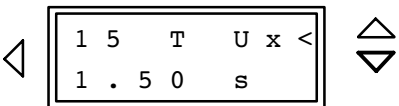
```
◁  ┌─────────────────┐   △      [1503]
   │ 1 5   T   U x <  │   ▽      Trip delay of undervoltage protection $U_x<$
   │ 1 . 5 0    s    │          Setting range:          0.00 s to 60.00 s
   └─────────────────┘                                  and $\infty$
```

6.3.5 Settings for undervoltage protection U< – address block 16

Address block 16 determines the parameters of the undervoltage protection U<. When two single-phase voltages are connected and the relay is informed about (address 7901, MEAS = *1 phase*) the voltage at the terminals 7 to 8 is decisive. With two-phase connection (V–connection) (address 7901, MESS = *2 phase*), the positive sequence voltage of the three-phase system is decisive. This function can operate only when it is configured as *EXIST* in block address 00 (refer Section 5.4.2).

```
◁  ┌─────────────────┐   ▷      [1600]
   │ 1 6    U <      │          Beginning of the block "Undervoltage protection U<"
   │ P R O T .       │
   └─────────────────┘
```
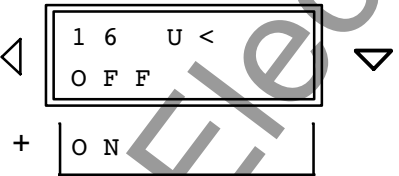
```
◁  ┌─────────────────┐   ▽      [1601]
   │ 1 6    U <      │          Switching *OFF* of the undervoltage protection U<
   │ O F F           │
   └─────────────────┘
+  ┌─────────────────┐          Switching *ON* of the undervoltage protection U<
   │ O N             │
   └─────────────────┘
```

For the settings, similar considerations apply as for address block 15, Section 6.3.4.

```
┌─────────────────┐
│ 1 6    U <      │
│ 7 5    V        │
└─────────────────┘
```
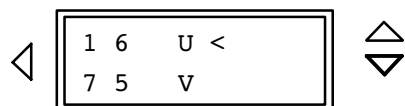
[1602]
Pick-up value of U< stage of undervoltage protection
Setting range: **20** V to **120** V

```
┌─────────────────┐
│ 1 6    T   U <  │
│ 1 . 5 0    s    │
└─────────────────┘
```
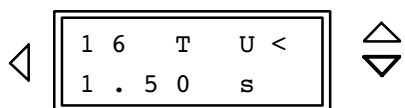
[1603]
Trip delay of undervoltage protection U<
Setting range: **0.00** s to **60.00** s
                            and ∞

6.3.6   Settings for inverse dependent undervoltage protection Up< – address block 19

The voltage dependent (inverse time) undervoltage stage operates only with two-phase voltage connection (address 7901, MEAS = *2 phase*) using the positive sequence component of the voltages. Furthermore, the undervoltage protection must be configured as *EXIST* in block 00 (refer to Section 5.4.2).

```
┌─────────────────┐
│ 1 9    U p <    │
│ P R O T .       │
└─────────────────┘
```
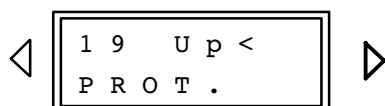
[1900]
Beginning of the block "Inverse time undervoltage protection Up<"

```
┌─────────────────┐
│ 1 9    U p <    │
│ O F F           │
└─────────────────┘
```
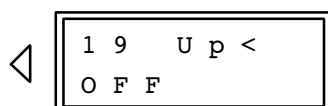
[1901]
Switching *OFF* of the inversely time undervoltage protection Up<

```
+  ┌─────────────────┐
   │ O N             │
   └─────────────────┘
```

Switching *ON* of the inversely time undervoltage protection Up<

For the setting values, the same considerations apply as given in Section 6.3.4. Remember that synchronous motors are particularly susceptable to even small voltage dips since they may cause a machine to fall out of step. Therefore the voltage/time and torque/speed characteristics must be used to determine the correct setting. Normally, the undervoltage detection relay will be set at 80 % of the rated voltage. In exceptional cases when, for example, the voltage drop during run-up is large, it may be necessary to set the relay at a lower value.

```
┌─────────────────┐
│ 1 9    U p <    │
│ 7 5    V        │
└─────────────────┘
```
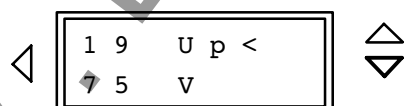
[1902]
Pick-up value of Up< stage of undervoltage protection
Setting range: **20** V to **120** V

```
┌─────────────────┐
│ 1 9    T – M    │
│ 1 . 0 0    s    │
└─────────────────┘
```
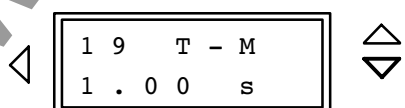
[1903]
Time multiplier of undervoltage protection Up<
Setting range: **0.10** s to **5.00** s

An additional definite time delay T Up< can be set which is normally 0.

```
1 9   T U p <
0 . 0 0   s
```
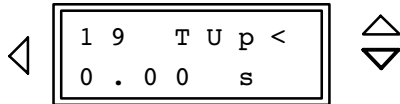
[1904]
Additional time delay of the inversely dependent under-
voltage protection Up<
Setting range: **0.00** s to **60.00** s
                        and ∞

6.3.7   Settings for overvoltage protection U> – address block 17

Address block 17 determines the parameters of the overvoltage protection U>. When two single-phase voltages are connected and the relay is informed about (address 7901, MEAS = *1 phase*) the voltage at the terminals 7 to 8 is decisive. With two-phase

connection (V–connection) (address 7901, MESS = *2 phase*), the parameter U> is valid for both voltages U and U_x. This function can operate only when it is configured as *EXIST* in block address 00 (refer Section 5.4.2).

```
1 7   U >
P R O T .
```
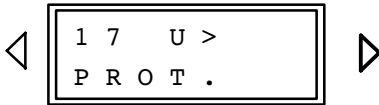
[1700]
Beginning of the block "Overvoltage protection U>"

```
1 7   U <
O F F
```
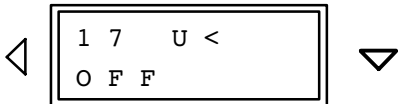
[1701]
Switching *OFF* of the Overvoltage protection U>

```
+  | O N
```

Switching *ON* of the Overvoltage protection U>

For the settings no generally applicable rules can be given. Taking into account that the protection shall in the first place prevent from excessive voltage stress of parts of the power system or station, setting values between 110 % and 115 % of the rated voltage are normal.

When the relay is used as generator protection, the setting of the overvoltage protection depends on the speed with which the voltage regulator can regulate voltage changes. The protection must not interfere in the operation of a correctly operating voltage regulator. The two-stage characteristic, therefore, must always lie above the voltage/time characteristic of the regulator.

The U> stage (long-time stage) should intervene in the event of steady-state overvoltages. It is set to approximately 110 % U_N and, depending on the regulating speed, to 1.5 s to 2 s.

If the generator sheds full load, the voltage initially increase depending on the transient voltage and is then reduced back to the rated value by the voltage regulator. The U>> stage as a short-time stage is usually set such that the transients after full-load rejection do not initiate tripping. A common setting is, e.g. 130 % U_N with a delay of 0.1 s.

All setting times are additional delay times, which do not include the normal operating times (measuring time, reset time) of the protection function itself.

```
┌─────────────────┐          [1702]
│ 1 7    U >      │   △      Pick-up value of U> stage of overvoltage protection
│ 1 1 0    V      │   ▽      Setting range:          20 V to 170 V
└─────────────────┘
```
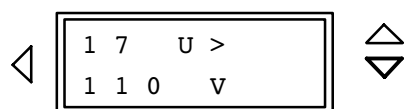
```
┌─────────────────┐          [1703]
│ 1 7    T   U >  │   △      Trip delay of overvoltage protection U>
│ 1 . 5 0    s    │   ▽      Setting range:          0.00 s to 60.00 s
└─────────────────┘                                  and ∞
```
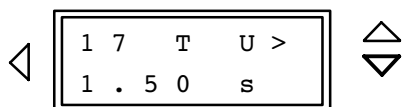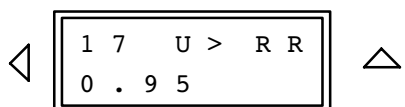
```
┌─────────────────┐          [1704]
│ 1 7    U >  R R │   △      Drop out ratio of overvoltage protection U>
│ 0 . 9 5         │          Setting range:          0.90 to 0.99
└─────────────────┘
```
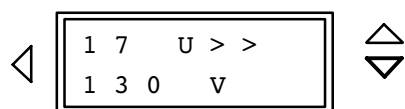
```
┌─────────────────┐          [1705]
│ 1 7    U > >    │   △      Pick-up value of U>> stage of overvoltage protection
│ 1 3 0    V      │   ▽      Setting range:          20 V to 170 V
└─────────────────┘
```
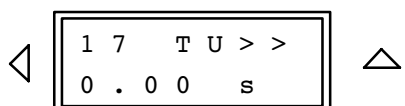
```
┌─────────────────┐          [1706]
│ 1 7    T U > >  │   △      Trip delay of overvoltage protection U>>
│ 0 . 0 0    s    │          Setting range:          0.00 s to 60.00 s
└─────────────────┘                                  and ∞
```
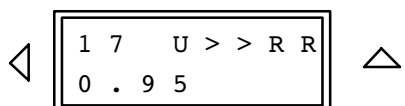
```
┌─────────────────┐          [1707]
│ 1 7    U > > R R│   △      Drop out ratio of overvoltage protection U>>
│ 0 . 9 5         │          Setting range:          0.90 to 0.99
└─────────────────┘
```

6.3.8 Settings for overvoltage protection $U_x>$ – address block 18

The parameters for U_x are only effective and available when the relay is connected to two single-phase voltages and when it is informed about it (address 7901, MEAS = *1 phase*). These parameters of address block 18 are decisive for the voltage U_x when it is fed to the terminals 9 and 10 (for model 7RW6000−⋆B⋆⋆⋆ and −⋆E⋆⋆⋆) or to the terminals 13 and 14 (for models 7RW6000−⋆D⋆⋆⋆).

This function can, furthermore, operate only when it is configured as *EXIST* in block address 00 (refer to Section 5.4.2).

```
┌─────────────────┐          [8700]
│ 1 8    U x >    │   ▷      Beginning of the block "Overvoltage protection $U_x>$"
│ P R O T .       │
└─────────────────┘
```

```
  ◁  | 1 8   U x <  |  ▽
     | O F F        |

  +  | O N          |
```
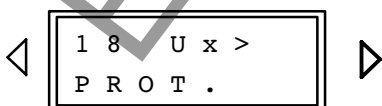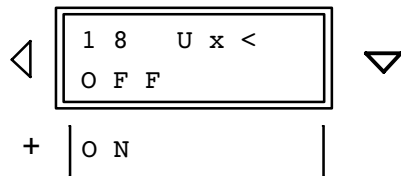
[1801]
Switching *OFF* of the Overvoltage protection $U_x>$

Switching *ON* of the Overvoltage protection $U_x>$

For the settings, similar considerations apply as for address block 17, Section 6.3.6. An alternative application of the $U_x>$ protection function is as stator earth fault protection. For this case, smaller voltage thresholds are possible (smallest setting value 10 V).

```
  ◁  | 1 8   U x >  |  △
     | 1 1 0   V    |  ▽
```
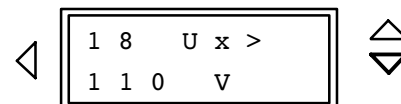
[1802]
Pick-up value of $U_x>$ stage of overvoltage protection
Setting range: **10** V to **170** V

```
  ◁  | 1 8   T   U x > |  △
     | 1 . 5 0   s     |  ▽
```
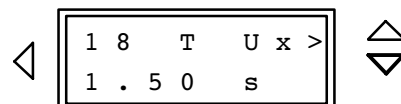
[1803]
Trip delay of overvoltage protection $U_x>$
Setting range: **0.00** s to **60.00** s
                              and ∞

```
  ◁  | 1 8   U x > R R |  △
     | 0 . 9 5         |
```
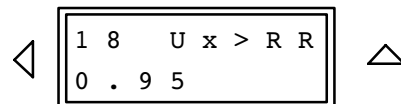
[1804]
Drop-off ratio of overvoltage protection $U_x>$
Setting range: **0.90** to **0.99**

```
  ◁  | 1 8   U x > >  |  △
     | 1 3 0   V      |  ▽
```
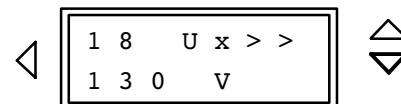
[1805]
Pick-up value of $U_x>>$ stage of overvoltage protection
Setting range: **10** V to **170** V

```
  ◁  | 1 8   T U x > > |  △
     | 0 . 0 0   s     |
```
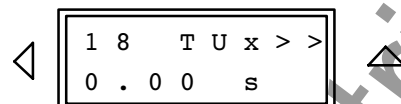
[1806]
Trip delay of overvoltage protection $U_x>>$
Setting range: **0.00** s to **60.00** s
                              and ∞

```
  ◁  | 1 8 U x > > R R |  △
     | 0 . 9 5         |
```
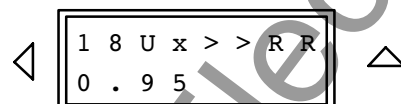
[1807]
Drop-off ratio of overvoltage protection $U_x>>$
Setting range: **0.90** to **0.99**

6.3.9 Settings for rate-of-frequency-change protection − address block 20

This section is valid only for model 7RW6000−★★★★★−**1**★★★. This model includes a rate-of-requency-change protection (refer also to Section 4.4). This can operate only when it is configured as *EXIST* in address block 00 (refer to Section 5.4.2).

```
◁  ┌──────────────┐  ▷
   │ 2 0   d f / d t │
   │ P R O T .      │
   └──────────────┘
```

[2000]
Beginning of the block "Rate-of-frequency-change protection"

```
◁  ┌──────────────┐  ▽
   │ 2 0   d f / d t │
   │ O F F          │
   └──────────────┘
+  ┌──────────────┐
   │ O N            │
   └──────────────┘
```

[2001]
Switching *OFF* of the rate-of-frequency-change protection

Switching *ON* of the rate-of-frequency-change protection
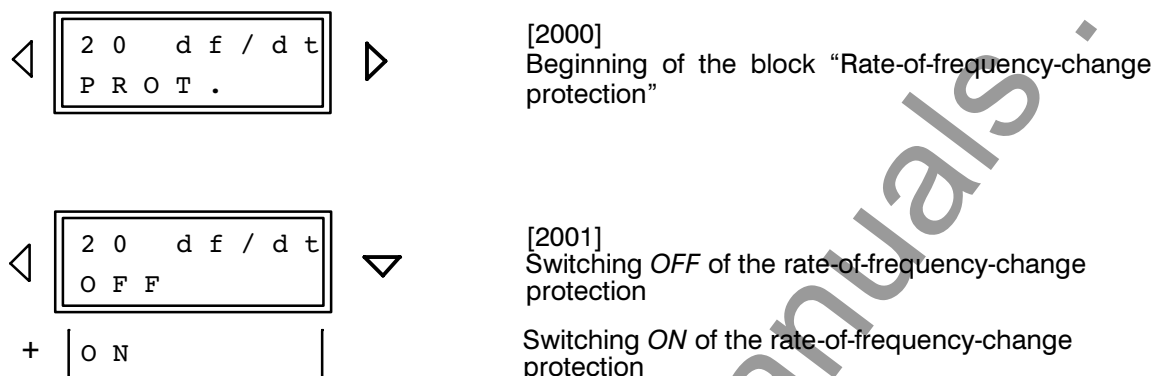
Parameter df1>< determines whether the first stage shall operate on negative rate-of-change (−df/dt<) or on positive rate-of-change (+df/dt>).

```
◁  ┌──────────────┐  ▽
   │ 2 0   d f 1 > < │
   │ − d f / d t <    │
   └──────────────┘
+  ┌──────────────┐
   │ + d f / d t >    │
   └──────────────┘
```

[2002]
Measurement direction of the 1st stage:

frequency reduction (negative rate-of-change)

frequency acceleration (positive rate-of-change)
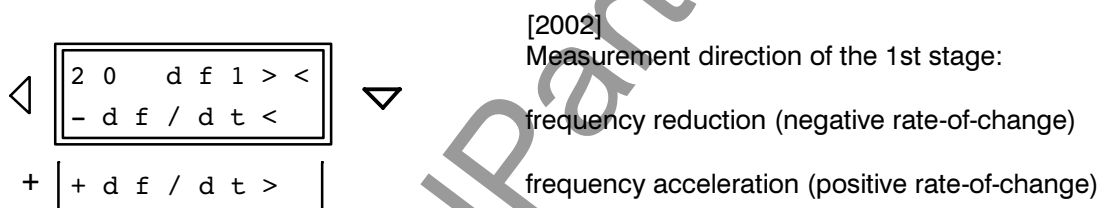
When a certain underfrequency threshold f_{static} is decisive for the stability limit of a power system, a frequency relay would have to be set to a higher value in order to ensure that stability is not endangered under all circumstances. Such a setting would be too sensitive under conditions of steady-state underfrequency.

The rate-of-frequency-change protection can detect frequency drops already during their development. Thus, it can disconnect networks before the steady-state underfrequency limit is reached and prevent the system from loss of stability, without excessive sensitivity of the steady-state underfrequency limit. Frequency protection and rate-of-frequency-change protection may complement each other such that the relay will trip on higher frequency reduction (at the steady-state limit) but on smaller frequency reduction with more severe rate-of-change in frequency. In this way, the network can be disconnected at smaller frequency reduction when, at the same time, the rate-of-change exceeds a certain amount.

Similar applies for frequency acceleration.

The following considerations may apply: When the power system is split and part of the network works in island operation, the power equilibrium is distorted. This causes a frequency change. When the power demand is higher than the power generation, the difference must be produced by the kinetic energy of the remaining rotating machines. The following applies for the first second:

$$\frac{df}{dt} = -\frac{f_N}{2 \cdot H} \cdot \frac{\Delta P}{S_N}$$

where
f_N rated system frequency
ΔP step change in active power
H inertia constant
S_N rated apparent power of the machines

Typical value of the inertia constant H are: 2 s to 10 s for cylindrical-rotor sets, and 1.5 s to 6 s for salient-pole machines.

The rate-of-change in frequency of an island net-work can be approximated with these data, as long as the frequency regulator has not yet interfered.

The rate-of-frequency-change protection of the relay 7RW600 generally operates only when the system frequency is below the rated frequency and the rate-of-change is negative, or, when the system frequency is above the rated frequency and the rate-of-change is positive.

It is, furthermore, possible to combine a rate-of-change stage with the associated frequency stage by an AND–condition (parameter df*&f* = *ON*, where * is replaced by the index of the stage). The rate-of-change protection will then issue a trip com-mand only when, for example, the frequency has fallen below the setting value f* < *AND* the negative rate-of-change exceeds the setting value of the as-sociated rate-of-change stage (i.e. the stages with equal index). Note that for application –df/dt< (neg-ative rate-of-change) the associated frequency stage must be set below the rated system frequency an vice versa.

Similar applies if the associated stages are set to the opposite direction (overfrequency and positive rate-of-change).

The rate-of-frequency-change protection is blocked when the measured voltage U has fallen below the release threshold BL U<.

◁ `20   df1` `2.0   Hz/s` ⬍	[2003] Pick-up value for the first df/dt stage Setting range: **0.4** Hz/s to **10.0** Hz/s and ∞ (no pick-up by rate-of-frequency-change stage df1/dt)
◁ `20   T   df1` `0.50   s` ⬍	[2004] Time delay for the first df/dt stage Setting range: **0.00** s to **20.00** s and ∞ (no trip by rate-of-frequen-cy-change stage df1/dt)
◁ `20   df1&f` `OFF` ⬍ + `ON`	[2005] *AND*–combination between rate-of-frequency-change stage df1/dt and frequency protection stage f1 *OFF* or *ON*
◁ `20   df2><` `–df/dt<` ⬇ + `+df/dt>`	[2006] Measurement direction of 2nd stage: frequency reduction (negative rate-of-change) frequency acceleration (positive rate-of-change)
◁ `20   df2` `4.0   Hz/s` ⬍	[2007] Pick-up value for the second df/dt stage Setting range: **0.4** Hz/s to **10.0** Hz/s and ∞ (no pick-up by rate-of-frequency-change stage df2/dt)
◁ `20   T   df2` `0.25   s` ⬍	[2008] Time delay for the second df/dt stage Setting range: **0.00** s to **20.00** s and ∞ (no trip by rate-of-frequen-cy-change stage df2/dt)
◁ `20   df2&f` `OFF` ⬍ + `ON`	[2009] *AND*–combination between rate-of-frequency-change stage df2/dt and frequency protection stage f2 *OFF* or *ON*

◁ | `2 0   d f 3 > <` | ▽
   | `- d f / d t <` |
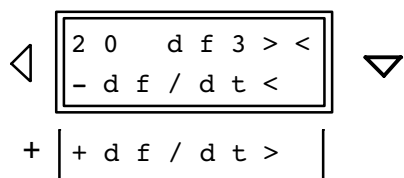
+ | `+ d f / d t >` |

[2010]
Measurement direction of 3rd stage:
frequency reduction (negative rate-of-change)

frequency acceleration (positive rate-of-change)

◁ | `2 0   d f 3` | ⬘⬙
   | `6 . 0   H z / s` |
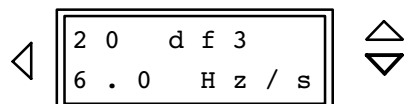
[2011]
Pick-up value for the third df/dt stage
Setting range: **0.4** Hz/s to **10.0** Hz/s
                        and ∞ (no pick-up by rate-of-
                        frequency-change stage df3/dt)

◁ | `2 0   T   d f 3` | ⬘⬙
   | `0 . 1 0   s` |
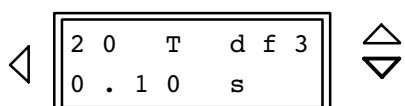
[2012]
Time delay for the third df/dt stage
Setting range: **0.00** s to **20.00** s
                        and ∞ (no trip by rate-of-frequen-
                        cy-change stage df3/dt)

◁ | `2 0   d f 3 & f` | ⬘⬙
   | `O F F` |

+ | `O N` |
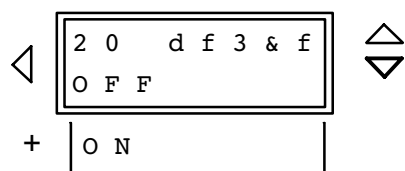
[2013]
AND – combination between rate-of-frequency-change
stage df3/dt and frequency protection stage f3
OFF or
ON

◁ | `2 0   d f 4 > <` | ▽
   | `- d f / d t <` |
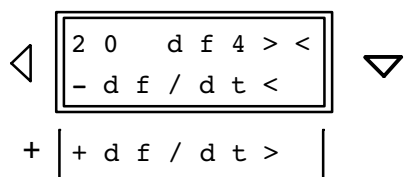
+ | `+ d f / d t >` |

[2014]
Measurement direction of 4th stage:

frequency reduction (negative rate-of-change)

frequency acceleration (positive rate-of-change)

◁ | `2 0   d f 4` | ⬘⬙
   | `∞   H z / s` |
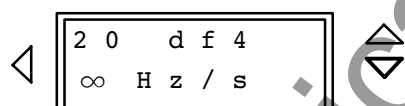
[2015]
Pick-up value for the fourth df/dt stage
Setting range: **0.4** Hz/s to **10.0** Hz/s
                        and ∞ (no pick-up by rate-of-
                        frequency-change stage df4/dt)

◁ | `2 0   T   d f 4` | ⬘⬙
   | `∞   s` |
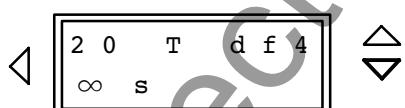
[2016]
Time delay for the fourth df/dt stage
Setting range: **0.00** s to **20.00** s
                        and ∞ (no trip by rate-of-frequen-
                        cy-change stage df4/dt)

◁ | `2 0   d f 4 & f` | ⬘⬙
   | `O F F` |

+ | `O N` |
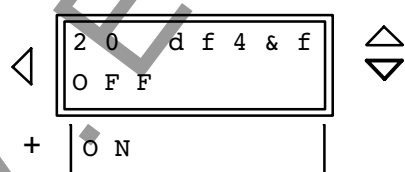
[2017]
AND – combination between rate-of-frequency-change
stage df4/dt and frequency protection stage f4
OFF or
ON

◁ | `2 0   B L   U <` | △
   | `6 5   V` |
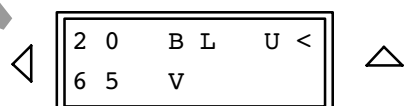
[2018]
Minimum operating voltage, below which rate-of-frequen-
cy-change measurement df/dt is blocked
Setting range: **20** V to **100** V
                        and ∞ (blocking is ineffective)

6.3.10 Settings for frequency protection – address block 21

Four frequency stages are available in models 7RW6000−★★★★★−**0**★★★ and −**1**★★★. These functions can operate only when they are configured as *EXIST* in block address 00 (refer Section 5.4.2). Each stage can be set as overfrequency stage or underfrequency stage. This is determined by the rated frequency as configured under address 1101 (refer to Section 6.3.3) and the set limit value. When the limit value is set smaller than the rated frequency, the stage operates as underfrequency stage; when the limit value is set higher than the rated frequency, the stage operates as overfrequency stage. **When the limit value is set equal to the rated frequency, the concerned stage is ineffective**.

Frequency protection is used for network disconnection or load shedding. The setting values depend on the actual network conditions; general recommendations are, therefore, not possible.

Further application is in power stations. As a matter of principle, the setting values for frequency and delay times depend on the values supplied by the power station operator, in this case.

In power stations, the **underfrequency** protection usually has the task of maintaining the power station auxiliary supply by promptly disconnecting it from the network. The turbine regulator then regulates the generator set to rated speed so that the power station auxiliary supply can be maintained with rated frequency.

In general, turbine−generator sets can be continuously operated at down to 95 % of rated frequency provided that the apparent power is reduced by the same amount. For the inductive consumers, however, the reduction in frequency does not only result in increased current intake but also endangers the operational stability. Therefore, only a short-time frequency reduction down to 48 Hz (at $f_N = 50$ Hz) or 58 Hz ($f_N = 60$ Hz) is usually permitted.

Overfrequency can occur, for example, during load shedding or faulty operation of the speed regulator (e.g. in island operation). Thus the overfrequency stage can be used e.g. as overspeed protection.

All setting times are additional delay times, which do not include the normal operating times (measuring time, reset time) of the protection function itself.

◁ | `21  f><`
`PROT.` | ▷
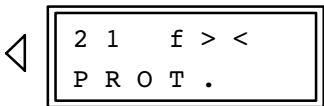
[2100]
Beginning of the block "Overfrequency and underfrequency protection"

◁ | `21  f><`
`OFF` | ▽
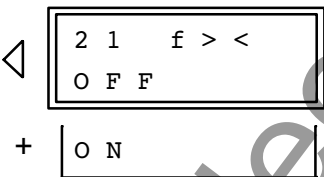
[2101]
Switch *OFF* of the frequency protection

+ | `ON`

Switch *ON* of the frequency protection

◁ | `21  f1`
`47.50  Hz` | △▽
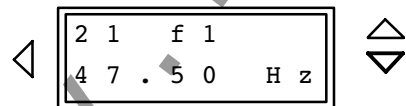
[2102]
Pick-up value of the frequency stage f_1
Setting range: **40.00** Hz to **68.00** Hz
The preset value results in an <u>under</u>frequency stage

```
┌─────────────────┐        △
│ 2 1    T    f 1 │       ▽▽
│ 0 . 0 0    s    │
└─────────────────┘
```

[2103]
Trip time delay of the frequency stage f_1
Setting range: **0.00** s to **60.00** s
                         and ∞ (no trip by frequency stage f_1)

```
┌─────────────────┐        △
│ 2 1    f 2      │       ▽▽
│ 4 9 . 0 0    H z│
└─────────────────┘
```

[2104]
Pick-up value of the frequency stage f_2
Setting range: **40.00** Hz to **68.00** Hz
The preset value results in an underfrequency stage

```
┌─────────────────┐        △
│ 2 1    T    f 2 │       ▽▽
│ 3 . 0 0    s    │
└─────────────────┘
```

[2105]
Trip time delay of the frequency stage f_2
Setting range: **0.00** s to **60.00** s
                         and ∞ (no trip by frequency stage f_2)

```
┌─────────────────┐        △
│ 2 1    f 3      │       ▽▽
│ 4 9 . 5 0    H z│
└─────────────────┘
```

[2106]
Pick-up value of the frequency stage f_3
Setting range: **40.00** Hz to **68.00** Hz
The preset value results in an underfrequency stage

```
┌─────────────────┐        △
│ 2 1    T    f 3 │       ▽▽
│ 1 0 . 0 0    s  │
└─────────────────┘
```

[2107]
Trip time delay of the frequency stage f_3
Setting range: **0.00** s to **60.00** s
                         and ∞ (no trip by frequency stage f_3)

```
┌─────────────────┐        △
│ 2 1    f 4      │       ▽▽
│ 5 1 . 0 0    H z│
└─────────────────┘
```

[2108]
Pick-up value of the frequency stage f_4
Setting range: **40.00** Hz to **68.00** Hz
The preset value results in an overfrequency stage when
$f_N = 50$ Hz

```
┌─────────────────┐        △
│ 2 1    T    f 4 │       ▽▽
│ 3 . 0 0    s    │
└─────────────────┘
```

[2109]
Trip time delay of the frequency stage f_4
Setting range: **0.00** s to **60.00** s
                         and ∞ (no trip by frequency stage f_4)

```
┌─────────────────┐        △
│ 2 1    B L    U <│
│ 6 5    V        │
└─────────────────┘
```

[2110]
Minimum operating voltage, below which frequency
measurement f>< is blocked
Setting range: **20** V to **100** V
                         and ∞ (blocking is ineffective)

6.3.11 Settings for overflux protection – address block 29

Depending on the model ordered (refer to Section 2.3 Ordering data), SIPROTEC 7RW600 contains an overflux protection. This function is valid only for model 7RW6000−★★★★★−**2**★★★. It can operate only when it is configured as *EXIST* in block address 00 (refer to Section 5.4.2).
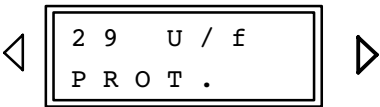
◁ | 2 9   U / f
P R O T . | ▷ | [2900]
Beginning of the block "Overflux protection U/f"
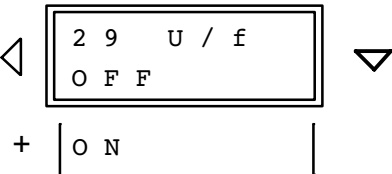
◁ | 2 9   U / f
O F F | ▽ | [2901]
Switch *OFF* of overflux protection U/f

+ | O N | | Switch *ON* of overflux protection U/f

The overflux protection measures the ratio voltage/ frequency which is proportional to the induction B and the flux Φ. The overflux protection must pick up when the induction admissible for the protected object (e.g. power station unit transformer) is exceeded. The transformer is endangered, for example, when a power station block is disconnected from the system from full-load, and the voltage regulator either does not operate or does not operate sufficiently fast to control the associated voltage rise.

Similarly, decrease in frequency (speed), e.g. in island systems, can endanger the transformer because of increased Induction.

Thus, the overflux protection supervises correct operation of the voltage regulator as well as the speed governor for all operational conditions.

The continuously permissible induction value as stated by the manufacturer determines the setting. This related value (B/B_N) is the base value and is to be set under address 2902

If the value U/f (referred to U_N/f_N, and thus proportional to the induction B/B_N), as set under address 2902, is exceeded, pick-up occurs. After expiry of the time delay address 2903, warning signal is given.
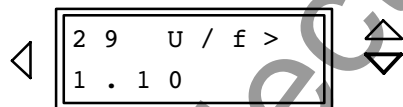
◁ | 2 9   U / f >
1 . 1 0 | △▽ | [2902]
Pick-up value of the warning stage and base value of thermal overflux
Setting range: **1.00** to **1.20**

◁ | 2 9   T U / f >
1 0 . 0   s | △▽ | [2903]
Delay time for warning stage
Setting range: **0.00** s to **60.00** s
and ∞

A stepped characteristic (U/f>>, TUf>>) is provided in order to clear high overflux conditions rapidly.

The setting time is an additional delay time, which does not include the normal operating time (measuring time, reset time) of the protection function.

A thermal characteristic is superimposed on the definite time stage as described before. For this purpose, the temperature rise caused by the overflux or overinduction is simulated in a thermal approximation. When the pick-up (address 2902, see above) is exceeded, alarm is output, and a counter is released

which accumulates the overflux and causes a trip command as soon as the time according to the setting has elapsed. The U/f base value is the lowest limit below which no temperature rise is calculated. That means, that values below this setting are not processed.

The preset values of the thermal characteristic correspond to a Siemens standard transformer. The values can be matched to the actual protected object with the aid of seven time delays which are assigned to seven overflux values, so that a characteristic of six straight lines results. If the data of the protected object are stated by the manufacturer, the seven time values should be entered for the overflux conditions U/f = 1.10, 1.15, 1.20, 1.25, 1.30, 1.35, and 1.40. If no data are available, the preset characteristic is adequate in most cases. Values between the parameterized points are interpolated by the protection function.

The trip command, once given, is reset as soon as the overflux has fallen below the pick-up value. But the counter is decremented with the time which is set for T RES under address 2913. This parameter determines the the counter time for counting from 100 % to 0 %.

The U/f–values can be matched to the rated v.t. voltage by means of the adaptation factor k ad under address 2914.

$$k_{ad} = \frac{U_{N\ prim\ v.t.}}{U_{N\ protected\ object}}$$

where

$U_{N\ protected\ object}$ — rated voltage of the protected object

$U_{N\ prim\ v.t.}$ — primary rated voltage of voltage transformers

Display		Description
29 U / f > > 1 . 4 0	◁ △▽	[2904] Pick-up value of the definite time stage Setting range: **1.00** to **1.40**
29 T U f > > 1 . 0 0 s	◁ △▽	[2905] Delay time for definite time stage Setting range: **0.00** s to **60.00** s and ∞
29 t 1 . 1 0 6 0 0 0 s	◁ △▽	[2906] Time delay of 1st characteristic value U/f = 1.10 Setting range: **0** s to **20000** s
29 t 1 . 1 5 2 4 0 s	◁ △▽	[2907] Time delay of 2nd characteristic value U/f = 1.15 Setting range: **0** s to **20000** s
29 t 1 . 2 0 6 0 s	◁ △▽	[2908] Time delay of 3rd characteristic value U/f = 1.20 Setting range: **0** s to **20000** s
29 t 1 . 2 5 3 0 s	◁ △▽	[2909] Time delay of 4th characteristic value U/f = 1.25 Setting range: **0** s to **20000** s
29 t 1 . 3 0 1 9 s	◁ △▽	[2910] Time delay of 5th characteristic U/f = 1.30 Setting range: **0** s to **20000** s
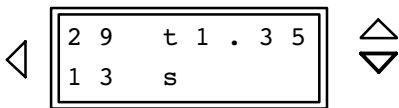
```
┌──────────────┐          
│ 2 9    t 1 . 3 5 │     △
│ 1 3    s         │     ▽
└──────────────┘          
```
[2911]
Time delay of 6th characteristic U/f = 1.35
Setting range: **0** s to **20000** s
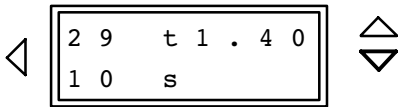
```
┌──────────────┐          
│ 2 9    t 1 . 4 0 │     △
│ 1 0    s         │     ▽
└──────────────┘          
```
[2912]
Time delay of 7th characteristic U/f = 1.40
Setting range: **0** s to **20000** s

```
┌──────────────┐          
│ 2 9    T   R E S │     △
│ 3 6 0 0    s     │     ▽
└──────────────┘          
```
[2913]
Time for cool down
Setting range: **0** s to **20000** s
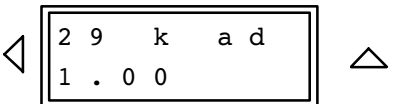
```
┌──────────────┐          
│ 2 9    k   a d   │     △
│ 1 . 0 0          │      
└──────────────┘          
```
[2914]
Adaptation factor
Setting range: **0.50** to **2.00**

6.3.12 Settings for trip circuit supervision – address block 39

The relay includes a trip circuit supervision function (refer to Section 4.7), which requires one or two binary inputs. This can operate only when it is configured (refer to Section 5.4.2) using one ("*bypass – R*") or two ("*with 2 BI*") binary inputs. Furthermore, the adequate number of binary inputs must be allocated to this function and the external wiring must be correct.

If one binary input is used, trip circuit faults like interruption or control voltage failure can be detected but

not trip circuit fault which occur during closed trip relay of the device. But if the trip command lasts more than 60 s to 90 s, then the trip circuit supervision will give alarm even without any other fault.

Details about the function of this supervision are given in Section 4.7. Section 5.2.3.2 contains information about connection and dimensioning hints as to the resistor in case of supervision with one single binary input.

```
┌──────────────┐          
│ 3 9 C I R s u p  │     ▷
│                  │      
└──────────────┘          
```
[3900]
Beginning of the block "Trip circuit supervision"
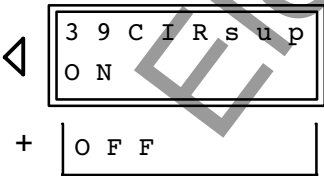
```
┌──────────────┐          
│ 3 9 C I R s u p  │      
│ O N              │      
└──────────────┘          

   ┌──────────────┐
+  │ O F F            │
   └──────────────┘
```
[3901]
Switch *ON* the trip circuit supervision

Switch *OFF* the trip circuit supervision

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 6.3. 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. Within a network fault, several fault events can occur, from pick-up of any fault detection until drop-off of the latest protection function.

Block 84   Indication of operational measured values (voltage magnitudes, frequency).

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 6.4.

▽
▽ | A N N U N C . | ▷   [5000]
                                              Commencement of "annunciation blocks"
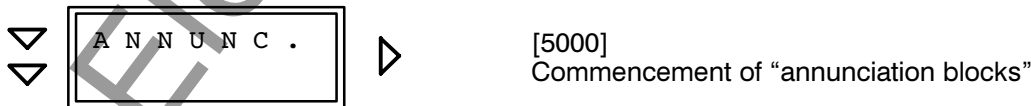
A comprehensive list of the possible annunciations and output functions with the associated function number FNo is given in Appendix C. It is also indicated to which device each annunciation can be routed.
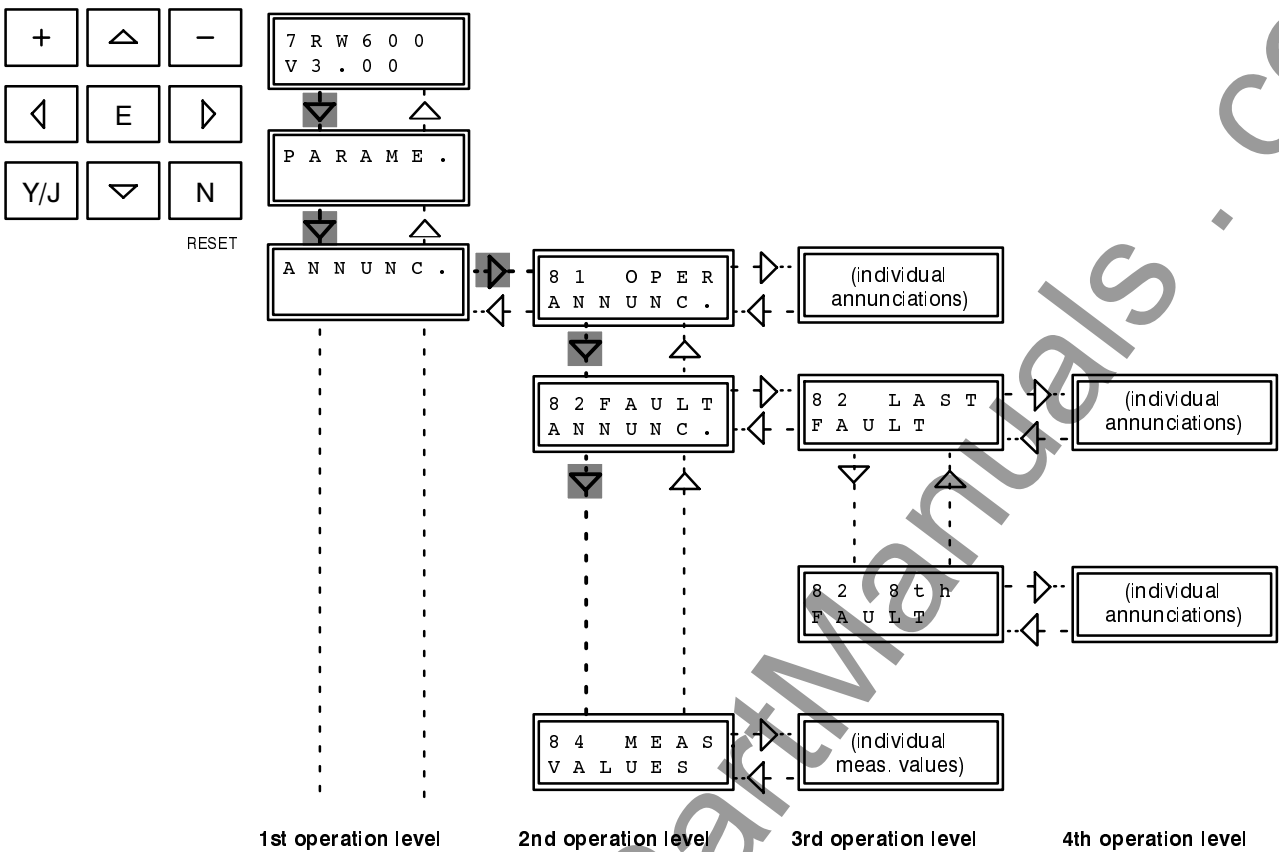
Figure 6.3   Selection of annunciation blocks
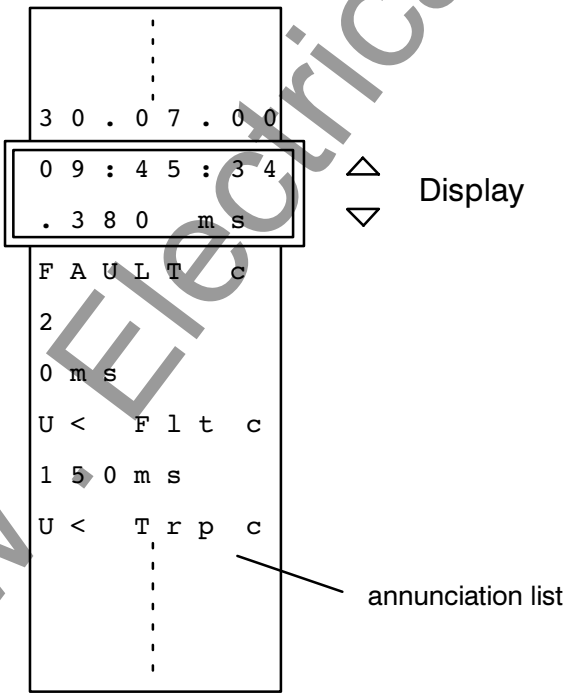
Figure 6.4   Display of an annunciation list – example

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 "FAULT" 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.

```
| 8 1   O P E R . |
| A N N U N C .   |
```

[5100]
Beginning of the block "Operational annunciations"

```
| 1 4 . 0 7 . 0 0 |
| 0 9 : 4 5 : 3 4 |
```

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.

```
| 0 9 : 4 5 : 3 4 |
| L E D   r e s c |
```

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 6.3.1.2), the date is shown as 01.07.97, the time is given as relative time from the last re-start of the processor system.

Direct response from binary inputs:

```
| > C B   c l o   |
```
Circuit breaker closed (from CB auxiliary contact) (c/g)

```
| > f 1   b l k   |
```
Block frequency protection f1 stage (c/g)

```
| > f 2   b l k   |
```
Block frequency protection f2 stage (c/g)

```
| > f 3   b l k   |
```
Block frequency protection f3 stage (c/g)

```
| > f 4   b l k   |
```
Block frequency protection f4 stage (c/g)

```
| > R M   U / f   |
```
Reset memory of thermal replica U/f (c/g)

`> d f 1   b l`	Block rate-of-frequency-change protection df1/dt stage (c/g)
`> d f 2   b l`	Block rate-of-frequency-change protection df2/dt stage (c/g)
`> d f 3   b l`	Block rate-of-frequency-change protection df3/dt stage (c/g)
`> d f 4   b l`	Block rate-of-frequency-change protection df4/dt stage (c/g)
`> T r p R e l`	Trip circuit supervision: binary input in parallel to trip contact (c/g)
`> C B a u x`	Trip circuit supervision: binary input in parallel to CB auxiliary contact (c/g)

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), detailed information in the fault annunciations
`F A U L T`	Fault with associated sequence number (c)

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 the undervoltage protection:

`U <    o f f`	Undervoltage protection U< is switched off (c/g)
`U <    b l k`	Undervoltage protection U< is blocked (c/g)
`U <    a c t`	Undervoltage protection U< is active (c/g)

| U x <   o f f | Undervoltage protection $U_x<$ is switched off (c/g) |

| U x <   b l k | Undervoltage protection $U_x<$ is blocked (c/g) |

| U x <   a c t | Undervoltage protection $U_x<$ is active (c/g) |

| U p <   o f f | Inversely dependent undervoltage protection Up< is switched off (c/g) |

| U p <   b l k | Inversely dependent undervoltage protection Up< is blocked (c/g) |

| U p <   a c t | Inversely dependent undervoltage protection Up< is active (c/g) |

Operational annunciations of the overvoltage protection:

| U >   o f f | Overvoltage protection U> is switched off (c/g) |

| U >   b l k | Overvoltage protection U> is blocked (c/g) |

| U >   a c t | Overvoltage protection U> is active (c/g) |

| U x >   o f f | Overvoltage protection $U_x>$ is switched off (c/g) |

| U x >   b l k | Overvoltage protection $U_x>$ is blocked (c/g) |

| U x >   a c t | Overvoltage protection $U_x>$ is active (c/g) |

Operational annunciations of the rate-of-frequency-change protection:

| d f   o f f | Rate-of-frequency-change protection is switched off (c/g) |

| d f   b l k | Rate-of-frequency-change protection is blocked (c/g) |

| d f   a c t | Rate-of-frequency-change protection is active (c/g) |

| U d f <   b l | Rate-of-frequency-change protection is blocked by undervoltage (c/g) |

Operational annunciations of the frequency protection:

| F r q   o f f | Frequency protection is switched off (c/g) |

| F r q   b l | Frequency protection is blocked (c/g) |

| F r q   a c t | Frequency protection is active (c/g) |

| U f <   b l | Frequency protection is blocked by undervoltage (c/g) |

Operational annunciations of the overflux protection:

| U / f   o f f | Overflux protection is switched off (c/g) |

| U / f   b l k | Overflux protection is blocked (c/g) |

| U / f   a c t | Overflux protection is active (c/g) |

| U / f > w r n | Overflux protection: U/f warning stage (c/g) |

| U / f > F l t | Overflux protection: Fault detection U/f> (c/g) |

Operational annunciations of the trip circuit supervision:

| S U P   o f f | Trip circuit supervision is switched off (c/g) |

| S U P   b l k | Trip circuit supervision is blocked (c/g) |

| S U P   a c t | Trip circuit supervision is active (c/g) |

| S U P n o B I | Trip circuit supervision is blocked, because binary input is not marshalled (c/g) |

| C I R   i n t | Trip circuit is interrupted (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 operating 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 6.3. Use the keys ▽ and △ to scroll through the annunciation list (Figure 6.4).

For these purposes, the term "system fault" means the period from fault inception up to final clearance. Within a network fault, several fault events can occur, from pick-up of any fault detection until drop-off of the latest protection function.

When date and time have not yet been set (refer also to Section 6.3.1.2), the date is shown as 01.07.97, 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.

◁ ▽ `8 2   F A U L T` ▷ [5200]
      `A N N U N C .`   Beginning of the block "Fault annunciations"

      `8 2   L A S T`   ▷ [5210]
      `F A U L T`   Beginning of the block "Fault annunciations of the last system fault"

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

▽▽ `0 3 . 0 1 . 0 1`   [5211]
      `2 2 : 0 9 : 4 6`   1st line: Date of the last system fault
                            2nd line: Time of the last system fault
                                       (hours, minutes, seconds ...

△△ `. 8 1 0   m s`   ... and ms)
▽▽ `F A U L T     c`   System fault, **c**oming

△△ `2`   1st line: Consecutive number of the system fault
▽   `0  m s`   2nd line: Beginning of the relative time; time resolution is 1 ms

△   `0   m s`   1st line: Beginning of the relative time
▽   `F D   L 1 E     c`   2nd line: Event that has started the relative time

                    etc.

General fault annunciations of the device:

`S y s . F l t`	Network system fault
`F A U L T`	Beginning of fault
`A N N o v f l`	Fault annunciations lost (buffer overflow)
`F T   d e t`	General fault detection of device
`D E V . T r p`	General trip of device
`f =      H z`	Last frequency during fault in Hz
`U =       V`	Last voltage U during fault in Volt
`U x =      V`	Last voltage U_x during fault in Volt (if applicable)

Fault annunciations of the undervoltage protection functions :

`U <   F l t`	Fault detection of undervoltage protection U<
`U <    T r p`	Trip by undervoltage protection U<
`U x <   F l t`	Fault detection of undervoltage protection U_x<
`U x <   T r p`	Trip by undervoltage protection U_x<
`U p <   F l t`	Fault detection of inverse time undervoltage protection Up<
`U p < C F l t`	Undervoltage fault after inverse time characteristic
`U p <   T r p`	Trip by inverse time undervoltage protection U_p<

Fault annunciations of the overvoltage protection functions :

`U >   F l t`	Fault detection of overvoltage protection U>
`U >    T r p`	Trip by overvoltage protection U>
`U > >   F l t`	Fault detection of overvoltage protection U>>
`U > >   T r p`	Trip by overvoltage protection U>>
`U x >   F l t`	Fault detection of overvoltage protection U_x>

`U x >   T r p`	Trip by overvoltage protection $U_x>$
`U x > > F l t`	Fault detection of overvoltage protection $U_x>>$
`U x > > T r p`	Trip by overvoltage protection $U_x>>$

Fault annunciations of rate-of-frequency-change protection:

`d f 1   F l t`	Fault detection of rate-of-frequency-change protection: df1/dt stage
`d f 2   F l t`	Fault detection of rate-of-frequency-change protection: df2/dt stage
`d f 3   F l t`	Fault detection of rate-of-frequency-change protection: df3/dt stage
`d f 4   F l t`	Fault detection of rate-of-frequency-change protection: df4/dt stage
`d f 1   T r p`	Trip by rate-of-frequency-change protection: df1/dt stage
`d f 2   T r p`	Trip by rate-of-frequency-change protection: df2/dt stage
`d f 3   T r p`	Trip by rate-of-frequency-change protection: df3/dt stage
`d f 4   T r p`	Trip by rate-of-frequency-change protection: df4/dt stage

Fault annunciations of frequency protection:

`f 1   F l t .`	Fault detection of frequency protection: f1 stage
`f 2   F l t .`	Fault detection of frequency protection: f2 stage
`f 3   F l t .`	Fault detection of frequency protection: f3 stage
`f 4   F l t .`	Fault detection of frequency protection: f4 stage
`f 1   T r p`	Trip by frequency protection: f1 stage
`f 2   T r p`	Trip by frequency protection: f2 stage
`f 3   T r p`	Trip by frequency protection: f3 stage
`f 4   T r p`	Trip by frequency protection: f4 stage

Fault annunciation of overflux protection:

| U / f > F l t |

Fault detection of overflux protection

| U / f t T r p |

Trip by thermal stage of overflux protection

| U / f > T r p |

Trip by overflux protection (U/f> stage)

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 | ▷
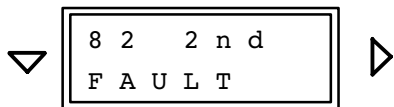
[5220]
Beginning of the "Fault annunciations of the second to last system fault"

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

▽ | 8 2   3 r d
    | F A U L T | ▷

[5230]
Beginning of the "Fault annunciations of the third to last system fault"

▽ | 8 2   8 t h
    | F A U L T | ▷

[5280]
Beginning of the "Fault annunciations of the eighth to last system fault"

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 $\triangledown$ to reach the item "ANNUNC." Key $\triangleright$ is used to change over to the second operation level, where one can go with the key $\triangledown$ 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 $\triangleright$), see Figure 6.3. Use the keys $\triangledown$ and $\triangle$ to scroll through the individual measured values (Figure 6.4).

Entry of the codeword is not necessary.

During read-out, the values are not actualized, but after scrolling through the list with the keys $\triangledown$ and $\triangle$, the actual values will be displayed.

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

```
8 4    M E A S .
V A L U E S
```
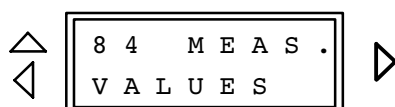
[5700]
Beginning of the block "Operational measured values"

Use $\triangledown$ key to move to the next address with the next measured value.
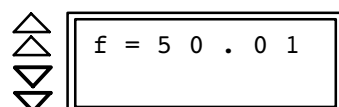
Page on with the $\triangledown$ key to read off the next measured value, or page back with $\triangle$

```
f = 5 0 . 0 1
```

[5701]
Frequency in Hz

```
U / f = 0 . 9 7
```
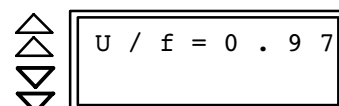
[5702]
Overflux, referred to rated flux U_N/f_N

The secondary voltages are referred to the voltages applied to the relay terminals. These values are not influenced by address 1102. The voltages U and Ux are displayed even outside of the operating range of the relay but with additional errors (because of missing frequency correction the displayed values are too small)

```
U = 9 8   V
```
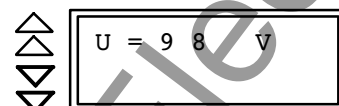
[5703]
Voltage U (applied to the relay terminals 7, 8)

```
U x = 0    V
```
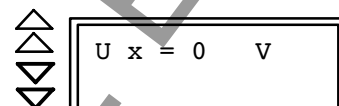
[5704]
Voltage U_x (applied to the relay terminals 9 and 10, resp. 13 and 14)

```
U 1 = 9 8    V
```
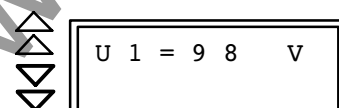
[5705]
With two-phase connection (V–connection) and correct configuration of address 7901 (MEAS = *2 phase*), the positive sequence voltage is displayed

---

6.5   Testing and commissioning

6.5.1   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.

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.

First, read out the operational measured values in order to verify that the test equipment is correctly connected.

When the relay is intended to operate with two two-phase voltages of a three-phase system in V−connection, a three-phase symmetrical voltage source with individually adjustable voltages should be available. When the relay is intended to operate with one or two single-phase voltages, a single-phase voltage source is sufficient.

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

During all the tests it is important to ensure that the correct command (trip) contacts close, that the proper indications appear at the LEDs and the output relays for remote signalling.

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, see connection diagrams, Appendix A). If the reset functions have been tested, resetting the stored indications is no more necessary as they are erased automatically with each new pick-up of the relay and replaced by the new annunciations.

NOTE: Three versions with different scope of function can be delivered. The 13th figure of the ordering code is decisive. The presettings of LEDs and binary inputs and outputs differ dependent on this scope of functions. In the following clarifications, the versions are considered where necessary:

− statements valid for versions 7RW600★−★★★★★− **0**★★★ and −**1**★★★ are specified in brackets [],

− statements valid for versions 7RW600★−★★★★★− **2**★★★ are specified in braces {},

− statements valid for all versions are specified in parentheses ().

6.5.2   Testing the undervoltage protection U<, U_x<

The functions of undervoltage protection can only be tested if these functions have been configured as *EXIST* and parameterized as operative (Ux< = *ON* and/or U< = *ON*).

The relay contains two measured voltage inputs, designated with U (at terminals 7 and 8) and U_x (at terminals 9 and 10 on models 7RW6000−★B★★★ and −★E★★★, or terminals 13 and 14 on model 7RW6000−★D★★★). Possibility exists to connect either two different single-phase voltages to the inputs, or to connect two phase-to-phase voltages of a three-phase system in V−connection. The relay had been informed about this during configuration (refer to Section 5.4.2, address 7901). In the first case each voltage is monitored independently by the associated stage. In the latter case the positive sequence component of the voltages is used for the internal formation of the measured value. Measurement on the undervoltage protection should then be performed with three-phase symmetrical measurement values with clockwise phase rotation. If asymmetrical values are used, deviations must be expected. The set voltages are always referred to phase-to-phase voltages! Therefore when checking the pick-up values, the phase-to-phase voltage must be measured.

The time delay of the definite time characteristic is checked by switching the voltage to 0 V. It must be noted that the set times are pure delay times; operating times of the measurement functions are not included.

The inverse time trip stage of the voltage dependent undervoltage protection is tested by sudden reduction of the applied voltage to the value reqired. It is sufficient to check one point of the trip time characteristic. Check the trip time in accordance with Figure 3.1.

Set voltage(s) to approximately rated voltage. Reduce voltage until it has fallen below the threshold value U<, address 1602 or Up<, address 1902.

- Annunciation "U< Flt" or "Up<CFlt" (not marshalled when delivered from factory).

Readjust the voltage to approx. nominal value. Then disrupt the voltage suddenly.

- After T U< (1.5 s; address 1603) annunciation "U< Trp" [LED 4 and relay 1] {not marshalled when delivered from factory}.

For testing the inverse time stage, readjust the voltages. to approx. nominal value. Then disrupt the voltage of one phase.

- With the preset values (Up< = 75 V, TM = 1 s and T Up< = 0 s) trip occurs after 4.4 s: annunciation "Up< Trp" [LED 4 and relay 1], {not marshalled when delivered from factory}.

Set voltage(s) to approximately rated voltage. Activate binary inputs ">U< bl" and ">Up< bl" [binary input 3] {not marshalled when delivered from factory}. Disconnect voltage(s)

- Annunciations "U< blk" and "Up< blk" (not marshalled when delivered from factory).
- No further alarms regarding undervoltage protection.

De-activate binary input.

For single-phase measurement with two different voltages (address 7901 = *1phase*), repeat the test for the definite time characteristic for the voltage input U_x with the parameters for U_x< (addresses 1502 and 1503). When the relay is delivered, the same LEDs, binary inputs and outputs are valid as during test of voltage U<.

Attention! If setting values have been changed for testing, reset to correct values (addresses 1602, 1603, 1902, 1903 and addresses 1502, 1503)!

Further checks are performed with primary values during commissioning (Section 6.6.2).

6.5.3   Testing the overvoltage protection U>, U>>, U$_x$>, U$_x$>>

The functions of overvoltage protection can only be tested if these functions have ben configured as *EXIST* and parameterized as operative (in address 1701 U> = *ON* and/or in address 1801 U$_x$> = *ON*).

The relay contains two measured voltage inputs, designated with U (at terminals 7 and 8) and U$_x$ (at terminals 9 and 10 on models 7RW6000−★**B**★★★ and −★**E**★★★, or terminals 13 and 14 on model 7RW6000−★**D**★★★). Possibility exists to connect either two different single-phase voltages to the inputs, or to connect two phase-to-phase voltages of a three-phase system in V−connection. The relay had been informed about this during configuration (refer to Section 5.4.2, address 7901). In the first case each voltage is monitored independently by the associated stage. In the latter case both voltages are monitored by the U> and U>> stages. Parameters U$_x$> and U$_x$>> are then ineffective and not available. Measurement on the overvoltage protection function can therefore be performed with single-phase test values. The stages can be tested individually one after another. The pick-up values relate to the connected phase-to-phase voltages.

⚠ **Caution!**

Test voltages larger than 200 V may overload and damage the relay if applied continuously (refer to Section 3.1.1 for overload capability).

The time delays for overvoltages are checked with approximately 1.2 x pick-up value. It must be noted that the set times are pure delay times; operating times of the measurement functions are not included.

Connect voltage of 1.2 x pick-up value U> (address 1702) at terminals 7, 8.

- Annunciation "U> Flt" [in versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★ not marshalled when delivered from factory] {in version 7RW600★−★★★★★−**2**★★★ relay 5}.
- After T−U> (1.5 s; address 1703), annunciation "U> Trp" [not marshalled when delivered from factory] (LED 3 and relay 2).

Disconnect voltage. Activate binary input ">U> bl" [not marshalled when delivered from factory] {binary input 3}. Connect voltage of 1.2 x pick-up value U> (address 1702) at terminals 7, 8.
- Annunciation "U> blk" (not marshalled when delivered from factory).
- No further alarms regarding overvoltage protection.

Disconnect voltage. De-activate binary input.

Connect voltage of 1.2 x pick-up value U>> (address 1704).
- Annunciation "U>> Flt" [not marshalled when delivered from factory] {relay 5}.
- After T−U>> (0 s; address 1705), annunciation "U>> Trp" [not marshalled when delivered from factory] (LED 4 and relay 3).
Disconnect voltage.

Repeat the tests accordingly for the voltage input Ux at the terminals 9 and 10 for model 7RW6000−★B★★★ and −★E★★★ or at the terminals 13 and 14 for model 7RW6000−★D★★★. When the relay is delivered, the same LEDs, binary inputs and outputs are valid as during test of voltage U>, U>>.

Attention! If setting values have been changed for testing, reset to correct values(addresses1702 to 1705 and 1802 to 1805, if applicable)!

Further checks are performed with primary values during commissioning (Section 6.6.2).

6.5.4   Testing the frequency protection functions

◆   **Frequency protection f<, f>**

The functions of the frequency protection in versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★   can only be tested if this protection is configured as *EXIST* in address 7821 (as delivered, refer to Section 5.4.2) and has been parameterized as operative − contrary to the condition as delivered from factory (address 2101 f>< = *ON*).

The frequency is always measured from the voltage input U, i.e. at terminals 7 and 8. So it is sufficient to apply the test voltage only to these input terminals.

The simplest function check is a read-out of the frequency as measured by the unit. This value is found in the operational measured values under address 5701 (address block 84).

If a voltage source with adjustable frequency is available, then the limits of the overfrequency f> and of the underfrequency f< stages can be checked without difficulties.

When measuring times, it must be noted that the set times are pure delay times; operating times of the measurement functions are not included.

Connect rated voltage, increase frequency until overfrequency protection (f_4) picks up.
• Annunciation "f4 Flt." [not marshalled when delivered from factory].
• After T f4 (3 s; address 2109), annunciation "f4 Trip" [not marshalled when delivered from factory].

Activate binary input ">f4 blk" [FNo 5209, not marshalled when delivered from factory].
• The blocking annunciations ">f4 blk" appear (not marshalled when delivered from factory).
• Annunciations "f4 Flt." and "f4 Trip" disappear.

Reduce frequency to rated frequency; de-activate binary input.

Reduce frequency until the first underfrequency protection stage (f_3) picks up.
• Annunciation "f3 Flt." [relay 5].
• After T f3 (10 s; address 2107), annunciation "f1 Trip" [LED 3 and relay 4].

Further reduce frequency until the second underfrequency stage f_2 picks up.
• Annunciation "f2 Flt." [relay 5].
• After T f2 (3 s; address 2105), annunciation "f2 Trip" [LED 2 and relay 3].

Further reduce frequency until the third underfrequency stage f_1 picks up.
• Annunciation "f1 Flt." [relay 5].
• After T f1 (0 s; address 2103), annunciation "f1 Trip" [LED 1 and relay 2].

Activate binary input (">Frq blk") [FNo 5203, binary input 2 when delivered from factory].
• The blocking annunciations "Frq bl" appear [not marshalled when delivered from factory].
• Annunciations "f1 Flt.", "f2 Flt.", "f3 Flt." and "f1 Trip", "f2 Trip" and "f3 Trip" disappear.

Bring frequency back to rated frequency. De-activate binary input. Switch off test quantity.

Further checks are performed with primary values during commissioning (Section 6.6.2).

◆   **Rate-of-requency-change protection df/dt**

The function of the rate-of-frequency-change protection in model 7RW600★−★★★★★−**1**★★★ can only be tested if this protection is configured as *EXIST* in address 7820 (as delivered, refer to Section 5.4.2) and has been parameterized as operative − contrary to the condition as delivered from factory (address 2001, df/dt = *ON*).

The frequency, and thus the rate-of-change in frequency, is always measured from the voltage input U, i.e. at terminals 7 and 8. So it is sufficient to apply the test voltage only to these input terminals.

An exact check of the rate-of-frequency-change protection requires a voltage source with adjustable frequency and definable rate-of-change df/dt. The frequency change must be continuous, not in steps.

When measuring times, it must be noted that the set times are pure delay times; operating times of the measurement functions are not included.

Connect rated voltage, set frequency to rated value. Increase the negative rate-of-change |−df/dt| until the first rate-of-change stage (df$_1$/dt) picks up. Note that a rate-of-change stage will operate only when the frequency lies below the rated frequency.
- Annunciation "df1 Flt" [not marshalled when delivered from factory].
- After T df1 (0.5 s; address 2004), annunciation "df1 Trp" [not marshalled when delivered from factory].

Continue increasing |−df/dt| until the second stage (df$_2$/dt) picks up.
- Annunciation "df2 Flt" [not marshalled when delivered from factory].
- After T df2 (0.25 s; address 2008), annunciation "df2 Trp" [not marshalled when delivered from factory].

Continue increasing |−df/dt| until the third stage (df$_3$/dt) picks up.

- Annunciation "df3 Flt" [not marshalled when delivered from factory].
- After T df3 (0.1 s; address 2012), annunciation "df3 Trp" [not marshalled when delivered from factory].

Activate binary input (">df blk") [FNo 5503, not marshalled when delivered from factory].
- The blocking annunciations "df blk" appear [not marshalled when delivered from factory].
- Annunciations "df1 Flt", "df2 Flt", "df3 Flt" and "df1 Trp", "df2 Trp" and "df3 Trp" disappear, or cannot be provoked by higher frequency change.

Bring frequency back to rated frequency. De-activate binary input. Switch off test quantity.

Further checks are performed with primary values during commissioning (Section 6.6.2).

6.5.5   Testing the overflux protection U/f>

The function of the overflux protection in version 7RW600★−★★★★★−2★★★ can only be tested if this protection is configured as *EXIST* in address 7829 (as delivered, refer to Section 5.4.2) and has been parameterized as operative − contrary to the condition as delivered from factory (address 2901, U/f = *ON*).

The overflux protection comprises a definite time stage and a thermal stage as a tripping stage. In addition, a delayed alarm is output when the continuously permissible limit value U/f> (address 2902) is exceeded.

The relay contains two measured voltage inputs, designated with U (at terminals 7 and 8) and U$_x$ (at terminals 9 and 10 on models 7RW6000−★B★★★ and −★E★★★, or terminals 13 and 14 on model 7RW6000−★D★★★). Possibility exists to connect either two different single-phase voltages to the inputs, or to connect two phase-to-phase voltages of a three-phase system in V−connection. The relay had been informed about this during configuration (refer to Section 5.4.2, address 7901). In the first case, only the voltage U is decisive for flux evaluation. In the latter case, the higher of the voltages are decisive. In both cases, the frequency is always derived

from the input U. Therefore, tests are performed with the voltage input U (terminals 7 and 8).

The simplest function check is a read-out of the frequency, overflux and maximum voltage U and U$_x$ as measured and calculated by the unit. These values are found in the operational measured values under addresses 5701, 5702, 5703, 5704 and 5705 (block address 84).

If a voltage source with adjustable frequency is available, then the limit of the overflux <u>definite time</u> stage U/f> (address 2904) can be checked by slowly decreasing the frequency with constant voltage.

If the voltage source has only constant (system) frequency, the voltage can be increased until the protection picks up.

⚠ **Caution!**

Test voltages larger than 200 V may overload and damage the relay if applied continuously (refer to Section 3.1.1 for overload capability).

Increase the test voltage until the definite U/f stage (address 2904) picks up.

- Annunciation "U/f>Flt" {not marshalled when delivered from factory}.

Switch off test voltage.

The delay times are checked with approximately 1.1 times the pick-up value. It must be noted that the set times are pure delay times; operating times of the measurement functions are not included.

Connect voltage of 1.1 x pick-up value U/f> (address 2902).
- Annunciation "U/f>Flt" {not marshalled when delivered from factory}.
- After TU/f> (10 s, address 2903, annunciation "U/f>wrn" {LED 1 and relay 4 with factory pre-settings}.

Switch off test voltage.

The thermal stages can be tested at different points of the characteristic by applying different U/f quantities.

The basis value of the thermal characteristic is the set value U/f> (address2902). Smaller overflux does not produce a simulated temperature rise, i.e. do not affect pre-load processing.

The shape of the thermal characteristic is determined by the addresses 2906 to 2912.

With the preset value (U/f> = 1.10, address 2902) and an applied overflux of

$$\frac{U/U_N}{f/f_N} = 1{,}05$$

no warning, no tripping must occur.

The operational measured values under address block 84 should show the calculated overflux U/f which should amount to approx. 1.05 in this case.

Note: Before measuring the thermal trip time for different applied overflux, it must be ensured that the thermal memory is reset to 0. This is performed via the binary input ">RM U/f" (reset memory of thermal replica) or by energizing briefly the blocking input ">U/f bl", {allocated to binary input 2 when delivered}. It is either possible to de-activate and re-activate the overflux protection function (address 2901).

Switch voltage corresponding to U/f = 1.25.
- After delay time of the warning stage (10 s, address 2903) Annunciation "U/f>wrn" {LED 1 and relay 4}.
- On reaching the thermal trip stage after a time according to the trip time characteristic (t = 30 s) annunciation "U/ftTrp" {LED 2 and relay 1}.

Note: Depending on the set values for U/f>> and TUf>> (addresses2904 and 2905), the definite time stage "U/f>Trp" may pick up and trip before the thermal stage.

If testing with pre-load is performed (i.e. the flux has exceeded the base value of address 2902 before starting of the test), it must be ensured, that the trip time may be reduced when the counter has already reached a value greater than 0.

When the drop-off time is measured, it must be considered that the thermal stage is generally limited to 150 % of the tripping value.

6.5.6   Testing the trip circuit supervision

The trip circuit supervision function can only be
tested if it has been configured in address block 00
(contrary to the state of delivery) *with 2 BI* (with 2
binary inputs) or *bypass−R* (with one binary input,
the second is by-passed by a resistor). Furthermore,
it must be switched *ON* in address block 39 (CIRsup
= *ON*), and the associated binary input(s) must be
marshalled for this purpose (refer to Section 5.5.2).

6.5.6.1   Trip circuit supervision using two binary inputs

In accordance with the task of this operation mode
of the trip circuit supervision, the trip circuit is as-
sumed to be disturbed when none of the two binary
inputs is energized. (refer also to Section 4.7.1). This
condition cannot occur steadily, i.e. over a certain
time, as long as the trip circuit is operating correctly.
It can only occur for a short time during the operation
of the circuit breaker. Therefore, alarm is given, if this
condition lasts for a time which corresponds to three
measurement repetitions.

Note: In 7RW600, the two binary inputs BI2 and BI3
have a common negative pole. This combination is,
therefore, not suitable for trip circuit supervision.
Use the binary inputs BI1 and BI2 instead.

Energize the binary inputs one after the other: the
fault indication disappears as long as one binary in-

put is energized and reappears a short time after
both inputs are de-energized.

When both control voltages are switched off, the an-
nunciation "CIR int" (i.e. trip circuit interrupted,
not allocated at delivery) appears after 400 ms to
700 ms.

6.5.6.2   Trip circuit supervision using one binary input

In accordance with the task of this operation mode
of the trip circuit supervision, the trip circuit is as-
sumed to be disturbed when the binary input is not
energized. (refer also to Section 4.7.2). This condi-
tion cannot occur steadily, i.e. over a certain time, as
long as the trip circuit is operating correctly. It can
only occur for a short time during which the trip relay
of the protection device is closed. Therefore, alarm
is given, if this condition lasts for a time which should
be longer than the duration of a trip command of the
device.

Energize the binary input: the fault indication disap-
pears.

When the control voltage is switched off, the annun-
ciation "CIR int" (not allocated at delivery) ap-
pears after 60 s to 90 s.

6.6   Commissioning using primary tests

6.6.1   General advices

All secondary testing sets and equipment must be removed. Connect measurement values. All installation preparations according to Section 5.2 must have been completed. 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.)

All protection functions should be initially switched *OFF* so that they do not influence one another. During primary testing the functions are progressively switched to being operative. If a particular protection function is not required at all, it should be "de-configured" (refer to Section 5.4.2). It is then treated as non existing. If configuration parameters must be changed during commissioning, the measured quantities should have been switched off before.

Proper functioning of the trip circuits including the circuit breakers (or other control devices connected to the trip relays) should be checked at least once for each protection function by a live trip. Furthermore, live trip may be produced from the operating panel or via the operating interface according to Section 6.6.4.

6.6.2   Checking the voltage circuits

Switch on the voltage protection functions which shall be used and which are configured as *EXIST* (Section 5.4.2). If the undervoltage protection is used, then blocking of this function on tripping of the voltage transformer secondary m.c.b. should also be checked during voltage testing. It is assumed that the auxiliary contact of the m.c.b. is marshalled to the binary input ">U< blk" (in versions 7RW600★−★★★★★−**0**★★★ and −**1**★★★ binary input 3 when delivered from factory).

Before energizing the protected object, ensure that no short-circuit bridges or earthing isolators are present.

With the voltage transformer m.c.b. closed, switch on the protected object.
– Read out voltage(s) under address block 75 (block 84). They can be compared with the actual voltage(s).

Switch voltage transformer m.c.b. to tripped position.
– Check that the message "U< bl" and ">Ux< bl" (if applicable) are indicated in the operational annunciations (address block 51, block 81) with the **C**oming index (both messages are not marshalled when delivered from factory).
– Check that the voltage(s) in address block 57 function block81) is (are) almost zero.
– Switch on voltage transformer m.c.b.
– check that the message ">U< bl" and ">Ux< bl" (if applicable) are indicated in the operational annunciations, but this time with the **G**oing index.

Should the message not be given then check the connection of the voltage transformer secondary circuits, and check correct marshalling of the binary input from the auxiliary contact of the m.c.b. (refer to Section 5.5.2).

If the indices "**C**" for "Coming" and "**G**" for "Going" are interchanged, check and correct the contact mode of the binary input ("NO" or "NC" contact) in accordance with Section 5.5.2.

If the relay contains the overflux protection {model 7RW600★−★★★★★−**2**★★★} and this shall be used, switch it on under address 2901, U/f = *ON*.

At rated frequency and rated voltage, the value U/f should be near 1.00 (address 5702, block 84). If deviation occurs, check the adaptation factor k_{ad} in address 2914 (see Section 6.3.10) and correct if necessary.

In power station applications, switch machine speed regulation to "manual " operation.

Reduce machine speed, so that the overflux warning stage U/f> (address 2902) picks up:
– Annunciation "U/f>Flt" {not marshalled when delivered from factory},
– After TU/f (address 2903, 10 s when delivered) annunciation "U/f>wrn" {LED1 and relay 4}.

If a binary input is used for blocking the overflux protection {input 2 when delivered from factory}, activate the block: Annunciations of the overflux protection disappear. De-activate binary input. Adjust machine to rated speed.

If the relay contains the frequency protection {model 7RW600★−★★★★★−**0**★★★ and −**1**★★★**2**★★★} and this shall be used, switch it on under address 2101, f><
= *ON*.

Increase machine speed, so that overfrequency protection just picks up (at delivery frequency stage f4, address 2108):
• Annunciation "f4> Flt." (not marshalled when delivered from factory).
• After Tf4 annunciation "f4 Trip" (not marshalled when delivered from factory).

Reduce machine speed, so that all underfrequency protection stages (at delivery frequency stages f1, f2, and f3) pick up (addresses 2102, 2104, and 2106):
• Annunciations "f*< Fault" [relay 5].
• After Tf* annunciation "f1 Trip" [LED 1 and relay 2 when delivered from factory] and annunciation "f2 Trip" [LED 2 and relay 3 when delivered from factory] and "f3 Trip" [LED 3 and relay 4 when delivered from factory].

If a binary input is used for blocking the frequency stages [input 2 when delivered from factory], activate the block: Annunciations of the frequency protection disappear. De-activate binary input.

Adjust machine to rated speed and slowly de-excite the generator. When the generator voltage drops below the value set for U< (address 1602) and/or U_p (address 1902) and/or U_x (address 1502): pick-up annunciation "U< Flt" resp. "Up< Flt" resp. "Ux< Flt" appears (all are not marshalled when delivered from factory) and trip command "U< Trp" resp. "Up< Trp" resp. "Ux< Trp" after delay according to the set characteristic [LED 4 and relays 1, when delivered from factory].

The annunciations remain after the machine has been completely de-excited. They can be reset by energizing the accordingly allocated binary input ">U< bl" (FNo 6506) resp. ">Up< bl" (FNo 6520) resp. ">Ux< bl" (FNo 6518).

The voltage tests are completed after the generator has been shut down. The required voltage and frequency protection functions are switched to be operative:

(address 1501: Ux< = *ON* or *OFF),*
(address 1601: Ux< = *ON* or *OFF),*
(address 1701: U> = *ON* or *OFF*),
(address 1801: Ux> = *ON* or *OFF*),
(address 1901: Up< = *ON* or *OFF*),
(address 2001: df/dt = *ON* or *OFF),*
(address 2101: f>< = *ON* or *OFF),*
(address 2901: U/f = *ON* or *OFF).*

Partial functions can be switched to be inoperative by appropriate limit value settings (e.g. f* set to rated frequency).

6.6.3   Testing the switching conditions of binary inputs and LED indicators

The relay contains a test routine which interrogates the positions of the binary inputs and LEDs 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.

```
  △   | T E S T       |   ▷
      | A I D S       |
```

[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.

```
  ◁   | I / O   S T A T |   ▷
```
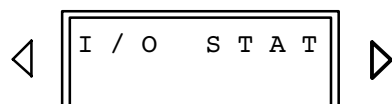
[4100]
Beginning of the block "Input/output status"

```
  ◁   | B I - S T A T  |   E
```
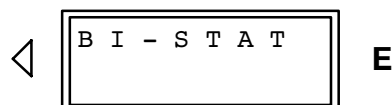
[4101]
Block "Status of the binary inputs"

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.
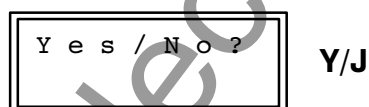
```
      | Y e s / N o ? |   Y/J
```

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)

```
      | B I   S T A T |   ▽
      | 1   2   −     |
```

Indication for BI1, BI2, BI3

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 LEDs:

```
△  ┌─────────────────┐
   │  L E D          │    E
   │  S T A T U S    │
   └─────────────────┘
```

```
   ┌─────────────────┐
   │  Y e s / N o ?  │    Y/J
   │                 │
   └─────────────────┘
```
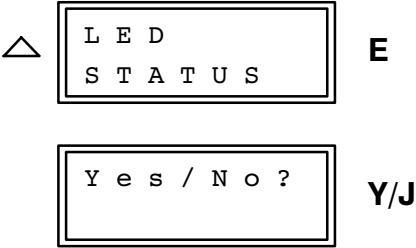
[4103]
Block "Status of LED indicators"

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

```
   ┌─────────────────┐
   │  L E D          │    △
   │  –   2   –   4  │
   └─────────────────┘
        │   │   │   │
Indication for
   LED1,  LED2,  LED3,  LED4
```
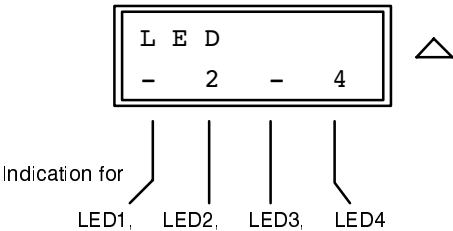
The illustrated example shows that the LED 1 is energized, LED 2 is not energized, LED 3 is not energized, LED 4 is energized.

6.6.4 Tripping test including circuit breaker

SIPROTEC 7RW600 allows simple checking of the tripping circuit and the circuit breaker.

Tests can be performed in address block 40. This block is reached by pressing the key ▽ three times so that the block "ADDITION FUNCTIONS" (additional functions) is displayed. Change to the next operation level by the key ▷; "I/O STAT" 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 individual test item is reached with the key ▷ in the next operation level.

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

A prerequisite for starting the test is that no protection function of the relay be picked up. Codeword input is necessary. The circuit breaker test feature must have been allocated to the trip relay during marshalling.

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

△ | 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

R U N N I N G
– a circuit breaker test is already running

F A U L T
– a system fault is in progress

C B   O P E N !
– the breaker signals via a binary input that it is open

If none of the above mentioned 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

6.7   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 to Section 5.4) and all desired protection functions have been switched *ON*. Ensure that the trip times are not set to ∞ for those functions or stages which should trip.

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 LEDs on the front will light up (except the "Blocked"–LED); thus, a LED test is performed at the same time.

Check that the module is properly inserted 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 protection relay is now ready for operation.

7   Maintenance and fault tracing

Siemens digital protection 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".

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 (addresses 5701 to 5705, block 84) and comparison with the actual values for checking the analog interfaces.

⚠ Warning

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

– Circuit breaker trip circuits are tested by actual live tripping. Respective notes are given in Section 6.6.4.

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 6.3.1.2).

7.2.1   Replacing the mini-fuse

– Select a replacement fuse 5 $\times$ 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.

Switch on the device again. If a power supply failure is still signalled, a fault or short-circuit is present in the internal power supply. The device should be returned to the factory (see Chapter 8).

Mini-fuse of the power supply;
slow (T)

at U_{HN}/V	rated value
24/48 Vdc	1,6 / 250 G
60/110/125 Vdc	1,0 / 250 G
220/250 Vdc/115 Vac	1,0 / 250 G

front side with fixing screw

View upon the p.c.b. after removal of the module from the housing;
top of the left corner
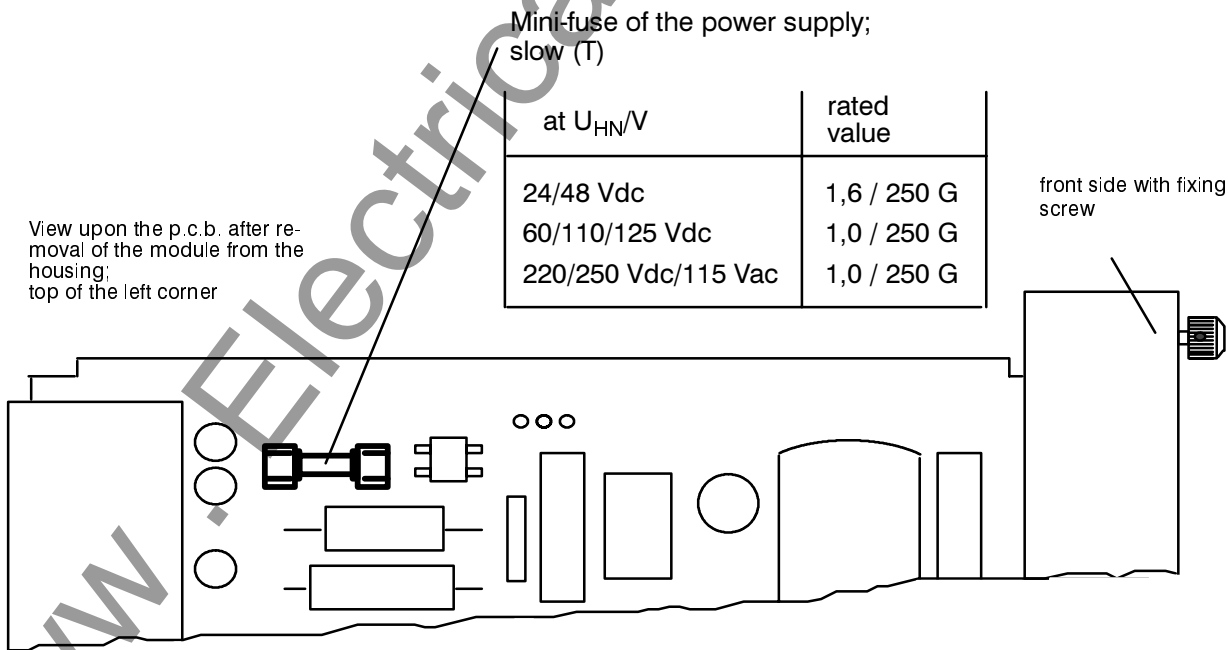
Figure 7.1   Mini-fuse of the power supply

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 60255−21−1 class 2 and IEC 60255−21−2 class 1.

If it is unavoidable to replace individual modules, it is imperative that the standards related to the handling of **E**lectrostatically **E**ndangered **C**omponents are observed.

⚠ **Warning**

Hazardous voltages can be present in the device even after disconnection of the supply voltage or after removal of the module from the housing (storage capacitors)!

⚠ **Caution!**

Electrostatic discharges via the component connections, the PCB tracks or the connecting pins of the modules must be avoided under all circumstances by previously touching an earthed metal surface. This applies equally for the replacement of removable components, such as EPROM or EEPROM chips. For transport and returning of individual modules electrostatic protective packing material must be used.

Components and modules are not endangered as long as they are installed within the relay.

Should it become necessary to exchange any device or module, the complete parameter assignment should be repeated. Respective notes are contained in Chapter 5 and 6.

9   Storage

Solid state protective relays shall be stored in dry and clean rooms. The limit temperature range for storage of the relays or associated spare parts is −25 °C to +55 °C (refer Section 3.1.4 under the Technical data), corresponding to −12 °F to 130 °F.

The relative humidity must be within limits such that neither condensation nor ice forms.

It is recommended to reduce the storage temperature to the range +10 °C to +35 °C (50 °F to 95 °F); this prevents from early ageing of the electrolytic capacitors which are contained in the power supply.

For very long storage periods, it is recommended that the relay should be connected to the auxiliary voltage source for one or two days every other year, in order to regenerate the electrolytic capacitors. The same is valid before the relay is finally installed. In extreme climatic conditions (tropics) pre-warming would thus be achieved and condensation avoided.

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

Appendix

A   General diagrams

B   Voltage transformer circuits – Connection examples

C   Operation structure, Tables

A   General diagrams

Figure A.1   General diagram of voltage and frequency protection 7RW600★−★B/E★★★−0★★★ and −1★★★

Aufbau–Gehäuse / SURFACE MOUNTING CASE 7RW600*–*B***

Einbau–Gehäuse / FLUSH MOUNTING CASE 7RW600*–*E***

KOMMANDORELAIS / COMMAND

K1: Übererregungsschutz AUS / OVEREXCITATION TRIP

K2: Überspannungssch. U> AUS / OVERVOLTAGE U> TRIP

K3: Überspannungssch. U>> AUS / OVERVOLT. U>> TRIP

K4: Warnstufe Übererregung / WARN. STAGE OVEREXC.

K5: Anregung Überspannung / FAULT DET. OVERVOLT.

MELDERELAIS / RELAY

K6: Selbstüberwachung / MONITOR

Störschutzkondensatoren an den Relaisausgängen Keramik, 4,7 nF, >250 V

Interference suppression capacitors at relay outputs, ceramic, 4,7 nF, >250 V

EINGABE / INPUT

E1: LED–Anzeigen zurückstellen / LED–RESET

E2: Übererregungsschutz blockieren / BLOCK OVEREXCITATION PROTECTION

E3: Überspannungsschutz blockieren / BLOCK OVERVOLTAGE PROTECTION

Stromversorgung / POWER SUPPLY

RS485

Figure A.2   General diagram of voltage and overflux protection 7RW600★–★**B**/**E**★★★–**2**★★★

KOMMANDORELAIS / COMMAND

K1: Unterspannungsschutz AUS ? UNI*ERVOLTAGE TRIP
K2: Frequenzschutz f1 < AUS / UNDERFREQU. f1 < TRIP
K3: Frequenzschutz f2 < AUS / UNDERFREQU. f2 < TRIP
K4: Frequenzschutz f3 < AUS / UNDERFREQU. f3 < TRIP
K5: Schutz Anregung / FAULT DETECTION

MELDERELAIS / RELAY

K6: Selbstüberwachung / MONITOR

Störschutzkondensatoren
an den Relaisausgängen
Keramik, 4,7 nF, >250 V

Interference suppression capacitors at relay outputs, ceramic,
4.7 nF, >250 V

Aufbau–Gehäuse / SURFACE MOUNTING CASE 7RW600*–*D***–
Einbau–Gehäuse / FLUSH MOUNTING CASE 7RW600*–*E***–

EINGABE / INPUT

E1: LED–Anzeigen zurückstellen / LED–RESET
E2: Frequenzschutz blockieren / BLOCK FREQUENCY PROTECTION
E3: Unterspannungsschutz blockieren / BLOCK UNDERVOLTAGE PROTECTION

Stromversorgung / POWER SUPPLY

RS485

U1 U1' Ux Ux' L+ L+ L+ L+ UH L– A B GND

Figure A.3   General diagram of voltage and frequency protection 7RW600*–*D***–0*** and –1***

Aufbau-Gehäuse / SURFACE MOUNTING CASE 7RW600*-*D***

Einbau-Gehäuse / FLUSH MOUNTING CASE 7RW600*-*E***

KOMMANDORELAIS / COMMAND

K1: Übererregungsschutz AUS / OVEREXCITATION TRIP

K2: Überspannungssch. U> AUS / OVERVOLTAGE U> TRIP

K3: Überspannungssch. U>> AUS / OVERVOLT. U>> TRIP

K4: Warnstufe Übererregung / WARN. STAGE OVEREXC.

K5: Anregung Überspannung / FAULT DET. OVERVOLT.

MELDERELAIS / RELAY

K6: Selbstüberwachung / MONITOR

Störschutzkondensatoren an den Relaisausgängen Keramik, 4,7 nF, >250 V

Interference suppression capacitors at relay outputs, ceramic, 4,7 nF, >250 V

EINGABE / INPUT

E1: LED-Anzeigen zurückstellen / LED-RESET

E2: BLOCK OVEREXCITATION PROTECTION
L+ Übererregungsschutz blockieren

E3: Überspannungsschutz blockieren / BLOCK OVERVOLTAGE PROTECTION

Stromversorgung / POWER SUPPLY

RS485

Figure A.4   General diagram of voltage and overflux protection 7RW600★−★D★★★−2★★★

B   Voltage transformer circuits – Connection examples

Figure B.1   Connection of one phase-to-phase voltage U and a displacement voltage Ux –
             "1phase" under address 7901
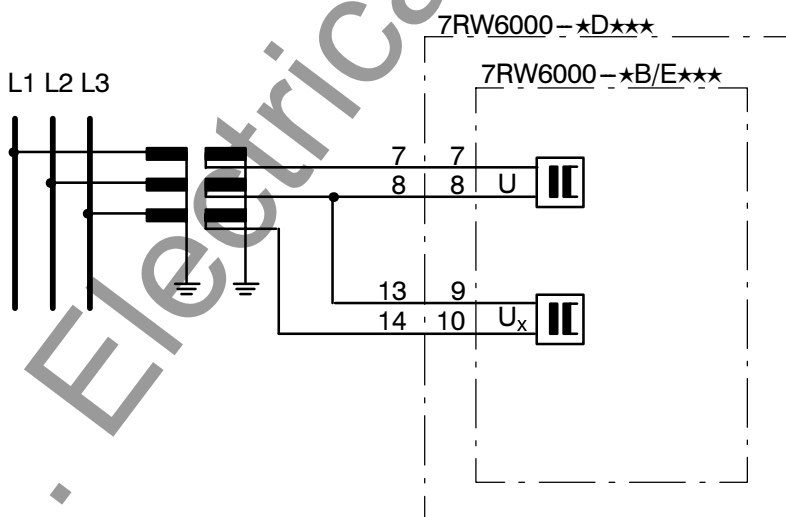
Figure B.2   Connection of two phase-to-phase voltages of one three-phase voltage transformer set
             (V–connection at the relay) – "2phase" under address 7901
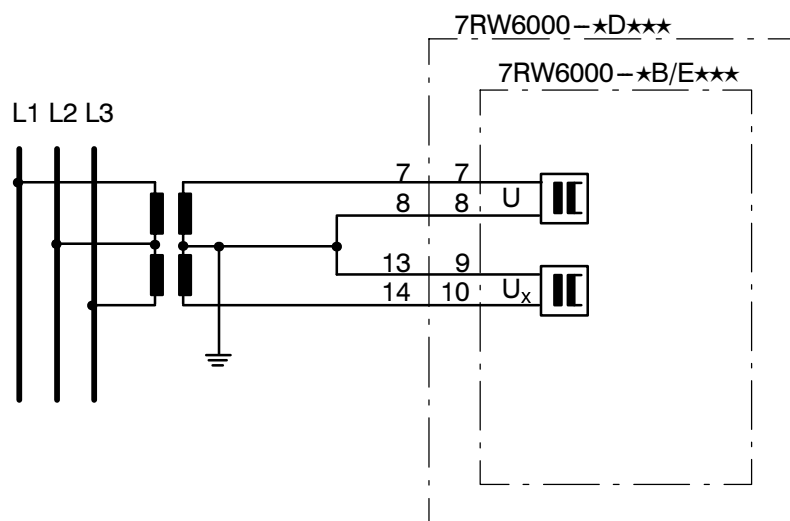
Figure B.3   Connection to two phase-to-phase voltages of a voltage transformer set in V – connection – "2phase" under address 7901

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 7RW600

```
┌──────────┐   ┌──────────┐   ┌──────────┐
│ 7RW600   ├───┤ 7RW600   ├───┤          │
│ V3.00    │   │          │   │          │
└──────────┘   └──────────┘   └──────────┘

┌──────────┐   ┌──────────┐   ┌──────────┐
│ PARAME.  ├───┤ 00 CONF. ├───┤ 00 U<    │
└──────────┘   └──────────┘   └──────────┘
                                ┌──────────┐
                              ──┤ 00 U>    │
                                └──────────┘
                                ┌──────────┐
                              ──┤ df/dt    │
                                └──────────┘
                                ┌──────────┐
                              ──┤ 00 f><   │
                                └──────────┘
                                ┌──────────┐
                              ──┤ 00 U/f   │
                                └──────────┘
                                ┌──────────┐
                              ──┤ 00CIRsup │
                                └──────────┘
                                ┌──────────┐
                              ──┤ 00 MEAS  │
                                └──────────┘
                                ┌──────────┐
                              ──┤ 00 0V BL │
                                └──────────┘
               ┌──────────┐   ┌──────────┐
             ──┤ 01 POWER ├───┤ 01 FREQ  │
               │ SYST.DAT │   └──────────┘
               └──────────┘   ┌──────────┐
                            ──┤ 01 Un    │
                              └──────────┘
                              ┌──────────┐
                            ──┤ 01 T-TRP │
                              └──────────┘
               ┌──────────┐   ┌──────────┐
             ──┤ Ux<      ├───┤ 15 Ux<   │
               │ PROT.    │   └──────────┘
               └──────────┘   ┌──────────┐
                            ──┤ 15 Ux<   │
                              └──────────┘
                              ┌──────────┐
                            ──┤ 15 T Ux< │
                              └──────────┘
               ┌──────────┐   ┌──────────┐
             ──┤ U<       ├───┤ 16 U<    │
               │ PROT.    │   └──────────┘
               └──────────┘   ┌──────────┐
                            ──┤ 16 U<    │
                              └──────────┘
                              ┌──────────┐
                            ──┤ 16 T U<  │
                              └──────────┘
               ┌──────────┐   ┌──────────┐
             ──┤ U>       ├───┤ 17 U>    │
               │ PROT.    │   └──────────┘
               └──────────┘
```

```
                                    ┌─────────────┐
                                    │ 17 U>       │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 17 T U>     │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 17 U> RR    │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 17 U>>      │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 17 T U>>    │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 17 U>>RR    │
                                    └─────────────┘
                 ┌─────────────┐    ┌─────────────┐
                 │ Ux>         │    │ 18 Ux>      │
                 │ PROT.       │    └─────────────┘
                 └─────────────┘    ┌─────────────┐
                                    │ 18 Ux>      │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 18 T Ux>    │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 18 Ux>RR    │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 18 Ux>>     │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 18 TUx>>    │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 18Ux>>RR    │
                                    └─────────────┘
                 ┌─────────────┐    ┌─────────────┐
                 │ 19 Up<      │    │ 19 Up<      │
                 │ PROT.       │    └─────────────┘
                 └─────────────┘    ┌─────────────┐
                                    │ 19 Up<      │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 19 T-M      │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 19 T Up<    │
                                    └─────────────┘
                 ┌─────────────┐    ┌─────────────┐
                 │ df/dt       │    │ 20 df/dt    │
                 │ PROT.       │    └─────────────┘
                 └─────────────┘    ┌─────────────┐
                                    │ 20 df1><    │
                                    └─────────────┘
                                    ┌─────────────┐
                                    │ 20 df1      │
                                    └─────────────┘
```

```
                                    ┌──────────┐
                                 ───│ 20 T df1 │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df1&f │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df2>< │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df2   │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 T df2 │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df2&f │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df3>< │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df3   │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 T df3 │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df3&f │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df4>< │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df4   │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 T df4 │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 df4&f │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 20 BL U< │
                                    └──────────┘
         ┌────────┐                 ┌──────────┐
       ──│ f><    │───────────────  │ 21 f><   │
         │ PROT.  │                 └──────────┘
         └────────┘                 ┌──────────┐
                                 ───│ 21 f1    │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 21 T f1  │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 21 f2    │
                                    └──────────┘
                                    ┌──────────┐
                                 ───│ 21 T f2  │
                                    └──────────┘
```

```
                              ┌──────────┐
                              │ 21 f3    │
                              └──────────┘
                              ┌──────────┐
                              │ 21 T f3  │
                              └──────────┘
                              ┌──────────┐
                              │ 21 f4    │
                              └──────────┘
                              ┌──────────┐
                              │ 21 T f4  │
                              └──────────┘
                              ┌──────────┐
                              │ 21 BL U< │
                              └──────────┘
           ╔══════════╗       ┌──────────┐
           ║ U/f      ║───────│ 29 U/f   │
           ║ PROT.    ║       └──────────┘
           ╚══════════╝       ┌──────────┐
                              │ 29 U/f>  │
                              └──────────┘
                              ┌──────────┐
                              │ 29 TU/f> │
                              └──────────┘
                              ┌──────────┐
                              │ 29 U/f>> │
                              └──────────┘
                              ┌──────────┐
                              │ 29 TUf>> │
                              └──────────┘
                              ┌──────────┐
                              │ 29 t1.10 │
                              └──────────┘
                              ┌──────────┐
                              │ 29 t1.15 │
                              └──────────┘
                              ┌──────────┐
                              │ 29 t1.20 │
                              └──────────┘
                              ┌──────────┐
                              │ 29 t1.25 │
                              └──────────┘
                              ┌──────────┐
                              │ 29 t1.30 │
                              └──────────┘
                              ┌──────────┐
                              │ 29 t1.35 │
                              └──────────┘
                              ┌──────────┐
                              │ 29 t1.40 │
                              └──────────┘
                              ┌──────────┐
                              │ 29 T RES │
                              └──────────┘
                              ┌──────────┐     ┌──────────┐
                              │ 29 k ad  │─────│ 27 O/L   │
                              └──────────┘     └──────────┘
           ╔══════════╗       ┌──────────┐
           ║ 39CIRsup ║───────│ 39CIRsup │
           ╚══════════╝       └──────────┘
```

```
                    ┌──────────┐   ┌──────────┐   ┌──────────┐   ┌──────────┐
                    │ 60 MARSH │───│ 61 MARSH │───│ 61 MARSH │───│ 61BI1 1  │
                    └──────────┘   │ BIN.INP  │   │ BI 1     │   └──────────┘
                                   └──────────┘   └──────────┘        :
                                                                 ┌──────────┐
                                                                 │ 61BI1 10 │
                                                                 └──────────┘

                                                  ┌──────────┐   ┌──────────┐
                                                  │ 61 MARSH │───│ 61BI2 1  │
                                                  │ BI 2     │   └──────────┘
                                                  └──────────┘        :
                                                                 ┌──────────┐
                                                                 │ 61BI2 10 │
                                                                 └──────────┘

                                                  ┌──────────┐   ┌──────────┐
                                                  │ 61 MARSH │───│ 61BI3 1  │
                                                  │ BI 3     │   └──────────┘
                                                  └──────────┘        :
                                                                 ┌──────────┐
                                                                 │ 61BI3 10 │
                                                                 └──────────┘

                                   ┌──────────┐   ┌──────────┐   ┌──────────┐
                                   │ MARSH    │───│ 62 MARSH │───│ 62REL3 1 │
                                   │ RELAY    │   │ REL 3    │   └──────────┘
                                   └──────────┘   └──────────┘        :
                                                                 ┌──────────┐
                                                                 │ 62REL320 │
                                                                 └──────────┘

                                                  ┌──────────┐   ┌──────────┐
                                                  │ 62 MARSH │───│ 62REL4 1 │
                                                  │ REL 4    │   └──────────┘
                                                  └──────────┘        :
                                                                 ┌──────────┐
                                                                 │ 62REL420 │
                                                                 └──────────┘

                                                  ┌──────────┐   ┌──────────┐
                                                  │ 62 MARSH │───│ 62REL5 1 │
                                                  │ REL 5    │   └──────────┘
                                                  └──────────┘        :
                                                                 ┌──────────┐
                                                                 │ 62REL520 │
                                                                 └──────────┘

                                                  ┌──────────┐   ┌──────────┐
                                                  │ 62 MARSH │───│ 62REL6 1 │
                                                  │ REL 6    │   └──────────┘
                                                  └──────────┘        :
                                                                 ┌──────────┐
                                                                 │ 62REL620 │
                                                                 └──────────┘

                                   ┌──────────┐   ┌──────────┐   ┌──────────┐
                                   │ 63 MARSH │───│ 63 MARSH │───│ 63LED1 1 │
                                   │ LED IND  │   │ LED 1    │   └──────────┘
                                   └──────────┘   └──────────┘        :
                                                                 ┌──────────┐
                                                                 │ 63LED120 │
                                                                 └──────────┘
```

```
                                        ┌──────────┐      ┌──────────┐
                                        │ 63 MARSH │──────│ 63LED2 1 │
                                        │ LED 2    │      └──────────┘
                                        └──────────┘           :
                                                          ┌──────────┐
                                                          │ 63LED220 │
                                                          └──────────┘

                                        ┌──────────┐      ┌──────────┐
                                        │ 63 MARSH │──────│ 63LED3 1 │
                                        │ LED 3    │      └──────────┘
                                        └──────────┘           :
                                                          ┌──────────┐
                                                          │ 63LED320 │
                                                          └──────────┘

                                        ┌──────────┐      ┌──────────┐
                                        │ 63 MARSH │──────│ 63LED4 1 │
                                        │ LED 4    │      └──────────┘
                                        └──────────┘           :
                                                          ┌──────────┐
                                                          │ 63LED420 │
                                                          └──────────┘

            ┌──────────┐     ┌──────────┐      ┌──────────┐
            │ 64 MARSH │─────│ 64 MARSH │──────│ 64CMD1 1 │
            │ CMD.REL  │     │ CMD.RE 1 │      └──────────┘
            └──────────┘     └──────────┘           :
                                                ┌──────────┐
                                                │ 64CMD120 │
                                                └──────────┘

                             ┌──────────┐      ┌──────────┐
                             │ 64 MARSH │──────│ 64CMD2 1 │
                             │ CMD.RE 2 │      └──────────┘
                             └──────────┘           :
                                                ┌──────────┐
                                                │ 64CMD220 │
                                                └──────────┘

    ┌──────────┐     ┌──────────┐
    │ 71INT.OP │─────│ 71LANGUA │
    └──────────┘     └──────────┘

    ┌──────────┐     ┌──────────┐
    │ 72 INTER │─────│ 72DEVICE │
    │ FACE     │     └──────────┘
    └──────────┘
                     ┌──────────┐
                     │ 72FEEDER │
                     └──────────┘

                     ┌──────────┐
                     │ 72SUBSTA │
                     └──────────┘

                     ┌──────────┐
                     │ 72F-TYPE │
                     └──────────┘

                     ┌──────────┐
                     │ 72PC-INT │
                     └──────────┘

                     ┌──────────┐
                     │ 72 GAPS  │
                     └──────────┘

                     ┌──────────┐
                     │ 72PCBAUD │
                     └──────────┘

                     ┌──────────┐
                     │ 72PARITY │
                     └──────────┘
```

```
┌──────────┐   ┌──────────┐
│74 FAULT  │───│74RECini  │
│RECORDER  │   └──────────┘
└──────────┘   ┌──────────┐
               │74 T-MAX  │
               └──────────┘
               ┌──────────┐
               │74 T-PRE  │
               └──────────┘
               ┌──────────┐
               │74 T-POS  │
               └──────────┘
               ┌──────────┐
               │74 VALUE  │
               └──────────┘

┌──────────┐   ┌──────────┐
│95 SYST   │───│95 TEST   │
│SETTING   │   └──────────┘
└──────────┘   ┌──────────┐
               │95 MODUL  │
               └──────────┘

┌──────────┐   ┌──────────┐
│ANNUNC.   │───│81 OPER.  │
└──────────┘   │ANNUNC.   │
               └──────────┘
               ┌──────────┐   ┌──────────┐
               │82 FAULT  │───│82 LAST   │
               │ANNUNC.   │   │FAULT     │
               └──────────┘   └──────────┘
                              ┌──────────┐
                              │82 2nd    │
                              │FAULT     │
                              └──────────┘
                              ┌──────────┐
                              │82 3rd    │
                              │FAULT     │
                              └──────────┘
                              ┌──────────┐
                              │82 4th    │
                              │FAULT     │
                              └──────────┘
                              ┌──────────┐
                              │82 5th    │
                              │FAULT     │
                              └──────────┘
                              ┌──────────┐
                              │82 6th    │
                              │FAULT     │
                              └──────────┘
                              ┌──────────┐
                              │82 7th    │
                              │FAULT     │
                              └──────────┘
                              ┌──────────┐
                              │82 8th    │
                              │FAULT     │
                              └──────────┘
               ┌──────────┐   ┌──────────┐
               │84 MEAS.  │───│f=        │
               │VALUES    │   └──────────┘
               └──────────┘
```

```
                                            ┌──────────┐
                                            │ U/f=     │
                                            └──────────┘
                                            ┌──────────┐
                                            │ U=       │
                                            └──────────┘
                                            ┌──────────┐
                                            │ Ux=      │
                                            └──────────┘
                                            ┌──────────┐
                                            │ Up=      │
                                            └──────────┘
    ┌──────────┐   ┌──────────┐   ┌──────────┐
    │ ADDITION │   │ TIME     │   │ DATE and │
    │ FUNCTION │   │ SETTING  │   │ TIME     │
    └──────────┘   └──────────┘   └──────────┘
                                   ┌──────────┐
                                   │ DATE     │
                                   └──────────┘
                                   ┌──────────┐
                                   │ TIME     │
                                   └──────────┘
                   ┌──────────┐   ┌──────────┐   ┌──────────┐
                   │ TEST     │   │ I/O STAT │   │ BI-STAT  │
                   │ AIDS     │   └──────────┘   └──────────┘
                   └──────────┘                  ┌──────────┐
                                                 │ RE-STAT  │
                                                 └──────────┘
                                                 ┌──────────┐
                                                 │ LED      │
                                                 │ STATUS   │
                                                 └──────────┘
                                   ┌──────────┐   ┌──────────┐
                                   │ CB-TEST  │   │ CB-TEST  │
                                   │ TRIP     │   │ TRIP ?   │
                                   └──────────┘   └──────────┘
                   ┌──────────┐
                   │ MONITOR  │
                   └──────────┘
```

Annunciations 7RW600 for LSA (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",
          Default = 78)
Inf   - Information number

FNo.	Meaning	Ann. Op	Ft	CA	GI	BT	Typ	Inf
501	General fault detection of the device	CG		CA		BT	p	84
511	General trip of the device	C		CA		BT	p	68
937	Frequency [Hz] =		M				p	138
968	Voltage at input U [%] =		M				p	138
969	Voltage at input Ux [%] =		M				p	138

Annunciations 7RW600 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
3	>Ti.syn	>Time synchronization			I	O
5	>LED r.	>Reset LED indicators			I	O
52	operat.	Any protection operative	CG			O
60	LED res	LED Reset	C			O
83	SigTest	For internal use only				O
110	ANNlost	Annunciations lost (buffer overflow)	C			O
111	PCannLT	Annunciations for PC lost	C			O
113	TAGlost	Fault tag lost				O
115	ANNovfl	Fault annunciation buffer overflow		C		O
203	REC del	Fault recording data deleted	C			O
301	Sys.Flt	Fault in the power system	C	C		O
302	FAULT	Flt. event w. consecutive no.	C	C		O
501	FT det	General fault detection of device		CG		O
511	DEV.Trp	General trip of device		C		O
527	f=	Interrupted frequency f=		C		O
528	U=	Interrupted voltage U=		C		O
529	Ux=	Interrupted voltage Ux=		C		O
694	f=	Frequency f [Hz] =	M			O
765	U/f=	Overflux (U/Un) / (f/fn)	M			O
907	Up=	Positive sequence voltage	M			O
937	-	Frequency f [Hz] = (only LSA)	M			O
968	U=	Voltage U	M			O
969	Ux=	Voltage Ux	M			O
1157	>CBclo	>Circuit breaker closed	CG		I	O
1174	CBtest	Circuit breaker test in progress	CG			O
1185	CBtpTST	Circuit breaker test: Trip 3pole	CG			O
5203	>Frq bl	>Block frequency protection			I	O
5206	>f1 blk	>Block frequency prot. f1 stage	CG		I	O
5207	>f2 blk	>Block frequency prot. f2 stage	CG		I	O
5208	>f3 blk	>Block frequency prot. f3 stage	CG		I	O
5209	>f4 blk	>Block frequency prot. f4 stage	CG		I	O
5211	Frq off	Frequency protection is switched off	CG			O
5212	Frq bl	Frequency protection is blocked	CG			O
5213	Frq act	Frequency protection is active	CG			O
5214	Uf< bl	Frequency protection blocked by U<	CG			O
5232	f1 Flt.	Frequency protection: Fault stage f1		CG		O
5233	f2 Flt.	Frequency protection: Fault stage f2		CG		O
5234	f3 Flt.	Frequency protection: Fault stage f3		CG		O
5235	f4 Flt.	Frequency protection: Fault stage f4		CG		O
5236	f1 Trip	Frequency protection: Trip stage f1		C		O
5237	f2 Trip	Frequency protection: Trip stage f2		C		O
5238	f3 Trip	Frequency protection: Trip stage f3		C		O
5239	f4 Trip	Frequency protection: Trip stage f4		C		O
5353	>U/f bl	>Block overexcitation protection			I	O
5357	>RM U/f	>Reset memory of thermal replica U/f	CG		I	O
5361	U/f off	Overexcitation prot. is swiched off	CG			O
5362	U/f blk	Overexcitation prot. is blocked	CG			O

FNo.	Text	Meaning	Op	Ft	I	O
5363	U/f act	Overexcitation prot. is active	CG			O
5367	U/f>wrn	Overexc. prot.: U/f warning stage	CG			O
5370	U/f>Flt	Overexc. prot.: Fault detec. U/f>		CG		O
5371	U/f>Trp	Overexc. prot.: Trip of U/f> stage		C		O
5372	U/ftTrp	Overexc. prot.: Trip of th. stage		C		O
5503	>df blk	>Block rate-of-frequency-change prot.			I	O
5504	>df1 bl	>Block rate-of-change stage df1/dt	CG		I	O
5505	>df2 bl	>Block rate-of-change stage df2/dt	CG		I	O
5506	>df3 bl	>Block rate-of-change stage df3/dt	CG		I	O
5507	>df4 bl	>Block rate-of-change stage df4/dt	CG		I	O
5511	df off	Rate-of-freq.-change prot. is sw. off	CG			O
5512	df blk	Rate-of-freq.-change prot. is blocked	CG			O
5513	df act	Rate-of-freq.-change prot. is active	CG			O
5514	Udf< bl	df/dt prot. blocked by undervoltage	CG			O
5516	df1 Flt	df1/dt stage: Fault detection		CG		O
5517	df2 Flt	df2/dt stage: Fault detection		CG		O
5518	df3 Flt	df3/dt stage: Fault detection		CG		O
5519	df4 Flt	df4/dt stage: Fault detection		CG		O
5520	df1 Trp	df1/dt stage trip		C		O
5521	df2 Trp	df2/dt stage trip		C		O
5522	df3 Trp	df3/dt stage trip		C		O
5523	df4 Trp	df4/dt stage trip		C		O
6506	>U< bl	>Block undervoltage protection U< stage			I	O
6513	>U> bl	>Block overvoltage protection			I	O
6518	>Ux< bl	>Block undervoltage protection Ux<			I	O
6519	>Ux> bl	>Block overvoltage protection Ux>			I	O
6520	>Up<blk	>Block inverse undervoltage prot. Up<			I	O
6522	Up< off	Inv. undervoltage prot. is switched off	CG			O
6523	Up< blk	Inv. undervoltage protection is blocked	CG			O
6524	Up< act	Inv. undervoltage protection is active	CG			O
6525	Up< Flt	Inverse undervoltage Up< picked up		CG		O
6526	Up<CFlt	Inv. undervoltage Up<-char. picked up		CG		O
6527	Up< Trp	Inverse undervoltage Up< trip		C		O
6530	U< off	Undervoltage protection is switched off	CG			O
6531	U< blk	Undervoltage protection is blocked	CG			O
6532	U< act	Undervoltage protection is active	CG			O
6533	U< Flt	Undervoltage fault detection U<		CG		O
6539	U< Trp	Undervoltage protection, U< trip		C		O
6565	U> off	Overvoltage protection is switched off	CG			O
6566	U> blk	Overvoltage protection is blocked	CG			O
6567	U> act	Overvoltage protection is active	CG			O
6568	U> Flt	Overvoltage fault detection U>		CG		O
6570	U> Trp	Overvoltage protection U> trip		C		O
6571	U>> Flt	Overvoltage prot. fault detec. U>>		CG		O
6573	U>> Trp	Overvoltage protection U>> trip		C		O
6576	Ux< off	Undervoltage prot. Ux is switched off	CG			O
6577	Ux< blk	Undervoltage protection Ux is blocked	CG			O
6578	Ux< act	Undervoltage protection Ux is active	CG			O
6579	Ux< Flt	Undervoltage fault detection Ux		CG		O
6580	Ux< Trp	Undervoltage protection Ux< trip		C		O
6584	Ux> off	Overvoltage prot. Ux is switched off	CG			O
6585	Ux> blk	Overvoltage protection Ux is blocked	CG			O
6586	Ux> act	Overvoltage protection Ux is active	CG			O
6587	Ux> Flt	Overvoltage fault detection Ux>		CG		O
6588	Ux>>Flt	Overvoltage fault detection Ux>>		CG		O
6589	Ux> Trp	Overvoltage protection Ux> trip		C		O
6590	Ux>>Trp	Overvoltage protection Ux>> trip		C		O
6851	>SUP bk	>Blocking trip circuit supervision			I	O

FNo.	Text	Meaning	Op	Ft	I	O
6852	>TrpRel	>Trip circuit supervision: Trip relay	CG		I	O
6853	>CBaux	>Trip circuit supervision: CB aux.	CG		I	O
6861	SUP off	Trip circuit supervision off	CG			O
6862	SUP blk	Trip circuit supervision blocked	CG			O
6863	SUP act	Trip circuit supervision active	CG			O
6864	SUPnoBI	TC superv. blocked: BI not marshalled	CG			O
6865	CIR int	Trip circuit interrupted	CG			O

```
Reference Table for Functional Parameters 7RW600
================================================

PARAME. - PARAMETER SETTINGS

   00 CONF. - SCOPE OF FUNCTIONS

      00 U<                  Undervoltage protection
         EXIST         [ ] Existent
         nonEXIST      [ ] Non-existent

      00 U>                  Overvoltage protection
         EXIST         [ ] Existent
         nonEXIST      [ ] Non-existent

      df/dt                  Rate-of-frequency-change protection
         EXIST         [ ] Existent
         nonEXIST      [ ] Non-existent

      00 f><                 Frequency protection
         EXIST         [ ] Existent
         nonEXIST      [ ] Non-existent

      00 U/f                 Overflux protection
         EXIST         [ ] Existent
         nonEXIST      [ ] Non-existent

      00CIRsup               Trip circuit supervision
         nonEXIST      [ ] Non-existent
         with 2BI      [ ] No resist., 2 BI
         bypass-R      [ ] bypass resistor,1 BI

      00 MEAS                Measurement mode
         1phase        [ ] single-phase
         2phase        [ ] two-phase

      00 0V BL               Block. undervoltage prot. after startup
         ON            [ ] on
         OFF           [ ] off
_____


   01 POWER SYST.DAT - POWER SYSTEM DATA

      01 FREQ               Rated system frequency
         50 Hz         [ ] fN 50 Hz
         60 Hz         [ ] fN 60 Hz

      01 Un                 Secondary rated voltage
         min. 100            V
         max. 125      ____

      01 T-TRP              Minimum trip command duration
         min. 0.01           s
         max. 60.00    ____
_____
```

```
         Ux< PROT. - UNDERVOLTAGE PROTECTION Ux<

            15 Ux<                State of the undervoltage protection Ux<
               OFF         [ ] off
               ON          [ ] on

            15 Ux<                Pick-up value of the Ux< stage
               min. 20            V
               max. 120     ——

            15 T Ux<              Time delay for trip Ux<
               min. 0.00          s
               max. 60.00/∞ ——
```

```
         U< PROT. - UNDERVOLTAGE PROTECTION

            16 U<                 State of the undervoltage protection
               OFF         [ ] off
               ON          [ ] on

            16 U<                 Pick-up value of the U<-protection
               min. 20            V
               max. 120     ——

            16 T U<               Time delay for trip U<
               min. 0.00          s
               max. 60.00/∞ ——
```

```
         U> PROT. - OVERVOLTAGE PROTECTION

            17 U>                 State of the overvoltage protection
               OFF         [ ] off
               ON          [ ] on

            17 U>                 Pick-up value of the U> stage
               min. 20            V
               max. 170     ——

            17 T U>               Time delay for trip U>
               min. 0.00          s
               max. 60.00/∞ ——

            17 U> RR              Overvoltage reset ratio: U> reset /U>
               min. 0.90
               max. 0.99    ——

            17 U>>                Pick-up value of the U>> stage
               min. 20            V
               max. 170     ——

            17 T U>>              Time delay for trip U>>
               min. 0.00          s
               max. 60.00/∞ ——

            17 U>>RR              Highset overvoltage reset: U>> reset/U>>
               min. 0.90
               max. 0.99    ——
```

PROT. - OVERVOLTAGE PROTECTION Ux>

```
    18 Ux>                  State of the overvoltage protection Ux>
       OFF          [ ] off
       ON           [ ] on

    18 Ux>                  Pick-up value of the Ux> stage
       min. 10              V
       max. 170      ————

    18 T Ux>                Time delay for trip Ux>
       min. 0.00            s
       max. 60.00/∞   ————

    18 Ux>RR                Overvoltage reset ratio: Ux> reset/Ux>
       min. 0.90
       max. 0.99     ————

    18 Ux>>                 Pick-up value of the Ux>> stage
       min. 10              V
       max. 170      ————

    18 TUx>>                Time delay for trip Ux>>
       min. 0.00            s
       max. 60.00/∞   ————

    18Ux>>RR                Highset overvoltage reset: Ux>> reset/Ux>>
       min. 0.90
       max. 0.99     ————
```

_____

```
   19 Up< PROT. - UNDERVOLTAGE PROTECTION Up<

    19 Up<                  State of undervoltage protection Up<
       OFF          [ ] off
       ON           [ ] on

    19 Up<                  Pick-up value of Up<
       min. 20              V
       max. 120      ————

    19 T-M                  Time-multiplier Up<
       min. 0.10            s
       max. 5.00     ————

    19 T Up<                Time delay for trip Up<
       min. 0.00            s
       max. 60.00/∞   ————
```

_____

```
   df/dt PROT. - RATE-OF-FREQUENCY-CHANGE PROTECTION

    20 df/dt                State of the rate-of-frequency-change prot.
       OFF          [ ] off
       ON           [ ] on

    20 df1><                Direction of frequency-change stage df1
       -dt/dt<      [ ] -dt/dt<
       +df/dt>      [ ] +dt/dt>
```

_____

```
20 df1                  Pick-up value of the df1/dt stage
   min. 0.4             Hz/s
   max. 10.0/∞   ────

20 T df1                Time delay for trip df1/dt
   min. 0.00            s
   max. 20.00/∞  ────

20 df1&f                State of AND-combination with fault f1
   OFF          [ ] off
   ON           [ ] on

20 df2><                Direction of frequency-change stage df2
   -dt/dt<      [ ] -dt/dt<
   +df/dt>      [ ] +dt/dt>

20 df2                  Pick-up value of the df2/dt stage
   min. 0.4             Hz/s
   max. 10.0/∞   ────

20 T df2                Time delay for trip df2/dt
   min. 0.00            s
   max. 20.00/∞  ────

20 df2&f                State of AND-combination with fault f2
   OFF          [ ] off
   ON           [ ] on

20 df3><                Direction of frequency-change stage df3
   -dt/dt<      [ ] -dt/dt<
   +df/dt>      [ ] +dt/dt>

20 df3                  Pick-up value of the df3/dt stage
   min. 0.4             Hz/s
   max. 10.0/∞   ────

20 T df3                Time delay for trip df3/dt
   min. 0.00            s
   max. 20.00/∞  ────

20 df3&f                State of AND-combination with fault f3
   OFF          [ ] off
   ON           [ ] on

20 df4><                Direction of frequency-change stage df4
   -dt/dt<      [ ] -dt/dt<
   +df/dt>      [ ] +dt/dt>

20 df4                  Pick-up value of the df4/dt stage
   min. 0.4             Hz/s
   max. 10.0/∞   ────

20 T df4                Time delay for trip df4/dt
   min. 0.00            s
   max. 20.00/∞  ────

20 df4&f                State of AND-combination with fault f4
   OFF          [ ] off
   ON           [ ] on
```

```
    20 BL U<              Min. volatge for rate-of-freq.-change prot.
       min. 20            V
       max. 100/∞    ────
```
_____

    f>< PROT. - OVER/UNDER-FREQUENCY PROTECTION

```
    21 f><               State of the frequency protection
       OFF          [ ] off
       ON           [ ] on

    21 f1                Pick-up value for stage f1
       min. 40.00        Hz
       max. 68.00    ────

    21 T f1              Time delay for trip f1 stage
       min. 0.00         s
       max. 60.00/∞  ────

    21 f2                Pick-up value for stage f2
       min. 40.00        Hz
       max. 68.00    ────

    21 T f2              Time delay for trip f2 stage
       min. 0.00         s
       max. 60.00/∞  ────

    21 f3                Pick-up value for stage f3
       min. 40.00        Hz
       max. 68.00    ────

    21 T f3              Time delay for trip f3 stage
       min. 0.00         s
       max. 60.00/∞  ────

    21 f4                Pick-up value for stage f4
       min. 40.00        Hz
       max. 68.00    ────

    21 T f4              Time delay for trip f4 stage
       min. 0.00         s
       max. 60.00/∞  ────

    21 BL U<             Minimum operating voltage for frequency prot.
       min. 20           V
       max. 100/∞    ────
```
_____

    U/f PROT. - OVERFLUX PROTECTION U/f>

```
    29 U/f               State of the overflux protection
       OFF          [ ] off
       ON           [ ] on

    29 U/f>              Pick-up value warning stage U/f>
       min. 1.00
       max. 1.20     ────
```

```
29 TU/f>                  Time delay for warning stage
   min. 0.00        s
   max. 60.00/∞   ────

29 U/f>>                  Pick-up value for trip U/f>>
   min. 1.00
   max. 1.40      ────

29 TUf>>                  Time delay for trip U/f>>
   min. 0.00        s
   max. 60.00/∞   ────

29 t1.10                  Time delay for trip at (U/Un)/(f/fn)=1.10
   min. 0           s
   max. 20000     ────

29 t1.15                  Time delay for trip at (U/Un)/(f/fn)=1.15
   min. 0           s
   max. 20000     ────

29 t1.20                  Time delay for trip at (U/Un)/(f/fn)=1.20
   min. 0           s
   max. 20000     ────

29 t1.25                  Time delay for trip at (U/Un)/(f/fn)=1.25
   min. 0           s
   max. 20000     ────

29 t1.30                  Time delay for trip at (U/Un)/(f/fn)=1.30
   min. 0           s
   max. 20000     ────

29 t1.35                  Time delay for trip at (U/Un)/(f/fn)=1.35
   min. 0           s
   max. 20000     ────

29 t1.40                  Time delay for trip at (U/Un)/(f/fn)=1.40
   min. 0           s
   max. 20000     ────

29 T RES                  Time for cool down
   min. 0           s
   max. 20000     ────

29 k ad                   Adaption factor
   min. 0.50
   max. 2.00      ────

27 O/L                    State of thermal overload protection
   ON             [ ] on
   OFF            [ ] off
```

───

```
39CIRsup - TRIP CIRCUIT SUPERVISION

39CIRsup                  Trip circuit supervision
   ON             [ ] on
   OFF            [ ] off
```

```
Reference Table for Configuration Parameters 7RW600
===================================================

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
_____	_____

_____

MARSH RELAY - MARSHALLING OF OUTPUT RELAYS

   62 MARSH REL 3 - MARSHALLING OF OUTPUT RELAY 3

62REL3 1	RELAY 3 1st CONDITION
_____	_____
62REL3 2	RELAY 3 2nd CONDITION
_____	_____
62REL3 3	RELAY 3 3rd CONDITION
_____	_____
62REL3 4	RELAY 3 4th CONDITION
_____	_____
62REL3 5	RELAY 3 5th CONDITION
_____	_____
62REL3 6	RELAY 3 6th CONDITION
_____	_____
62REL3 7	RELAY 3 7th CONDITION
_____	_____
62REL3 8	RELAY 3 8th CONDITION
_____	_____
62REL3 9	RELAY 3 9th CONDITION
_____	_____
62REL310	RELAY 3 10th CONDITION
_____	_____

62REL311   RELAY 3 11th CONDITION

————————————   ————————————————————————

62REL312   RELAY 3 12th CONDITION

————————————   ————————————————————————

62REL313   RELAY 3 13th CONDITION

————————————   ————————————————————————

62REL314   RELAY 3 14th CONDITION

————————————   ————————————————————————

62REL315   RELAY 3 15th CONDITION

————————————   ————————————————————————

62REL316   RELAY 3 16th CONDITION

————————————   ————————————————————————

62REL317   RELAY 3 17th CONDITION

————————————   ————————————————————————

62REL318   RELAY 3 18th CONDITION

————————————   ————————————————————————

62REL319   RELAY 3 19th CONDITION

————————————   ————————————————————————

62REL320   RELAY 3 20th CONDITION

————————————   ————————————————————————

62 MARSH REL 4 - MARSHALLING OF OUTPUT RELAY 4

62REL4 1   RELAY 4 1st CONDITION

————————————   ————————————————————————

62REL4 2   RELAY 4 2nd CONDITION

————————————   ————————————————————————

62REL4 3   RELAY 4 3rd CONDITION

————————————   ————————————————————————

62REL4 4   RELAY 4 4th CONDITION

————————————   ————————————————————————

62REL4 5	RELAY 4 5th CONDITION
_____	_____
62REL4 6	RELAY 4 6th CONDITION
_____	_____
62REL4 7	RELAY 4 7th CONDITION
_____	_____
62REL4 8	RELAY 4 8th CONDITION
_____	_____
62REL4 9	RELAY 4 9th CONDITION
_____	_____
62REL410	RELAY 4 10th CONDITION
_____	_____
62REL411	RELAY 4 11th CONDITION
_____	_____
62REL412	RELAY 4 12th CONDITION
_____	_____
62REL413	RELAY 4 13th CONDITION
_____	_____
62REL414	RELAY 4 14th CONDITION
_____	_____
62REL415	RELAY 4 15th CONDITION
_____	_____
62REL416	RELAY 4 16th CONDITION
_____	_____
62REL417	RELAY 4 17th CONDITION
_____	_____
62REL418	RELAY 4 18th CONDITION
_____	_____
62REL419	RELAY 4 19th CONDITION
_____	_____

62REL420	RELAY 4 20th CONDITION
_____	_____

---

62 MARSH REL 5 - MARSHALLING OF OUTPUT RELAY 5

62REL5 1	RELAY 5 1st CONDITION
_____	_____
62REL5 2	RELAY 5 2nd CONDITION
_____	_____
62REL5 3	RELAY 5 3rd CONDITION
_____	_____
62REL5 4	RELAY 5 4th CONDITION
_____	_____
62REL5 5	RELAY 5 5th CONDITION
_____	_____
62REL5 6	RELAY 5 6th CONDITION
_____	_____
62REL5 7	RELAY 5 7th CONDITION
_____	_____
62REL5 8	RELAY 5 8th CONDITION
_____	_____
62REL5 9	RELAY 5 9th CONDITION
_____	_____
62REL510	RELAY 5 10th CONDITION
_____	_____
62REL511	RELAY 5 11th CONDITION
_____	_____
62REL512	RELAY 5 12th CONDITION
_____	_____
62REL513	RELAY 5 13th CONDITION
_____	_____

```
62REL514              RELAY 5 14th CONDITION
     _____       _____

62REL515              RELAY 5 15th CONDITION
     _____       _____

62REL516              RELAY 5 16th CONDITION
     _____       _____

62REL517              RELAY 5 17th CONDITION
     _____       _____

62REL518              RELAY 5 18th CONDITION
     _____       _____

62REL519              RELAY 5 19th CONDITION
     _____       _____

62REL520              RELAY 5 20th CONDITION
     _____       _____
```

_____

```
62 MARSH REL 6 - MARSHALLING OF OUTPUT RELAY 6

62REL6 1              RELAY 6 1st CONDITION
     _____       _____

62REL6 2              RELAY 6 2nd CONDITION
     _____       _____

62REL6 3              RELAY 6 3rd CONDITION
     _____       _____

62REL6 4              RELAY 6 4th CONDITION
     _____       _____

62REL6 5              RELAY 6 5th CONDITION
     _____       _____

62REL6 6              RELAY 6 6th CONDITION
     _____       _____

62REL6 7              RELAY 6 7th CONDITION
     _____       _____
```

62REL6 8	RELAY 6 8th CONDITION
_____	_____
62REL6 9	RELAY 6 9th CONDITION
_____	_____
62REL610	RELAY 6 10th CONDITION
_____	_____
62REL611	RELAY 6 11th CONDITION
_____	_____
62REL612	RELAY 6 12th CONDITION
_____	_____
62REL613	RELAY 6 13th CONDITION
_____	_____
62REL614	RELAY 6 14th CONDITION
_____	_____
62REL615	RELAY 6 15th CONDITION
_____	_____
62REL616	RELAY 6 16th CONDITION
_____	_____
62REL617	RELAY 6 17th CONDITION
_____	_____
62REL618	RELAY 6 18th CONDITION
_____	_____
62REL619	RELAY 6 19th CONDITION
_____	_____
62REL620	RELAY 6 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 accordance with VDEW/ZVEI
       min. 1
       max. 254     ____

    72PC-INT              Data format for PC-interface
       DIGSI V3       [ ] DIGSI V3
       ASCII          [ ] ASCII
       VDEW ext       [ ] VDEW 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. 50.00      ——

        74 T-PRE                 Pre-trigger time for fault recording
           min. 0.05         s
           max. 5.00       ——

        74 T-POS                 Post-fault time for fault recording
           min. 0.05         s
           max. 5.00       ——

        74 VALUE                 Fault values
           INST.           [ ] Instantaneous values
           R.M.S.          [ ] R.M.S. values
   _____

     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. PTD PA D PSN

D−13623 BERLIN

Germany

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 sug-
gestions for improvement that you may have.

From

_____
Name

_____
Company/Dept.

_____
Address

_____
Telephone no.

_____

Corrections/Suggestions

Substantial alterations against previous issue:

Complete revision with regard of firmware V3.0

Subject to technical alteration