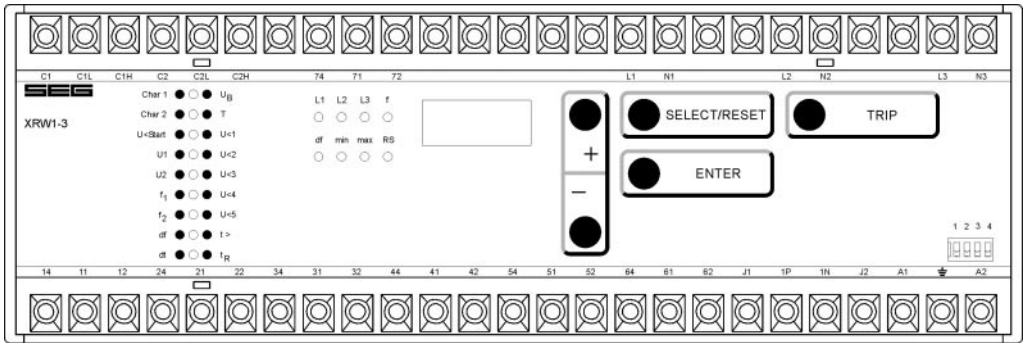
WOODWARD

XRW1-3 – Mains decoupling relay with two free programmable under voltage characteristics



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Inhalt

1 Overview and application

The mains decoupling relay *XRW1-3* has been designed for the use under special conditions, especially to be found at wind parks.
If power generating systems are due to comply with the GridCodes, i.e. if they shall not immediately disconnect from the grid in case of a mains failure, but support it, instead, the *XRW1-3* will be the optimal relay. Its' function is to supervise mains voltage and mains frequency in compliance with the GridCodes, the grid connection rules and the operator guidelines.

For this reason, the distinction between short-distance or long-distance errors is an elementary fact. As per the requirements of the e-on grid connection rules (version dd. 20.08.03) and the VDN guideline "EEG power generating plants at high and maximum voltage systems", in addition to the standard protection functions, the XRW provides the voltage time characteristics which are necessary to distinguish between short distance and long distance errors. Normal voltage collapse shapes at mains failures are taken into account by these characteristics, that allow selective disconnection of systems only there, where it is absolutely required for operation.

If, in the event of a failure, the systems are to be connected to the grid for a longer period, they will support the mains voltage and thus avoid large-area breakdowns that could no more be compensated by the interconnected network's primary control reserve.

Thanks to the presence of two independent characteristics, it is possible to distinguish between short-term or permanent interruption, each according to the type of error.

An integrated frequency gradient step (instantaneous disconnection) for the system's self-protection, finally completes the relay.

Within this error scenario, the *XRW1-3* - with its characteristics hat have been applied for the first time in protection technique - is of enormous use for the accurate identification and analysis of the grid state - as demanded by the rules.

2 Features and characteristics

- Microprocessor technology with watchdog.
- Effective analogue low pass filter for suppressing harmonics when measuring frequency.
- Digital filtering of the measured values by using discrete Fourier analysis to suppress higher harmonics and d.c. components induced by faults or system operations.
- Functions for the measuring of voltage, frequency and df/dt, integrated in one single device.
- Two free programmable under voltage limit curves with each 5 definition points.
- Voltage supervision with under or over voltage function that can be freely parameterised in two steps.
- Frequency supervision with two step under-/or over-frequency (user setting).
- Completely independent time settings for voltage and frequency supervision.
- Adjustable voltage threshold value for blocking frequency measuring.
- Display of all measuring values and setting parameters for normal operation as well as tripping via a alphanumerical display and LEDs
- Storage and indication of the tripping values.
- Storage of tripping values of five failure events (voltage fail-safe).
- Suppression of LED indication after pick up (LED-Flash).
- Protection functions can be freely assigned to the output relays
- For blocking the individual functions by the external blocking input, parameters can be set according to requirement.
- Direct connection 690 V (linked).
- Serial data exchange via RS485 interface possible; alternatively with SEG RS485 Pro-open Data Protocol or Modbus Protocol,
- In complience with VDE 0435, part 303 and IEC 255.

3 Design

3.1 Connections

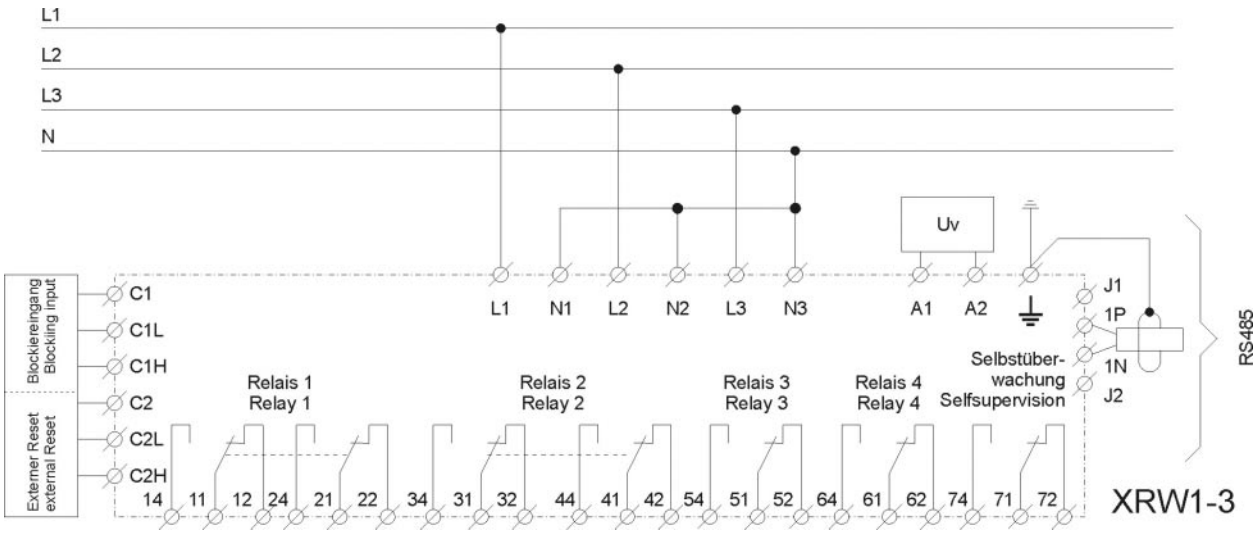

*Figure 3.1: Connection diagram **XRW1-3***

3.1.1 Analogue input circuits

The analogue input voltages are galvanically decoupled by the input transformers of the device, then filtered and finally fed to the analogue digital converter. The measuring circuits can be applied in star or delta connection (refer to chapter 4.3.1).

3.1.2 Blocking input

The blocking function can be set according to requirement. By applying the auxiliary voltage to C1/C1L or C1/C1H, the previously set relay functions are blocked (refer to 4.7).

3.1.3 Reset input

Please refer to chapter 6.6.1

3.1.4 Low/High range of functions blocking and reset

The *XRW1-3* relay has a wide-range power supply unit allowing to choose a suitable supply voltage. The operating threshold of the blocking and reset inputs, however, has to be defined by taking the supply voltage into account. The following two different operating thresholds can be adjusted:

- Low-range threshold U_{ON} >= 10 V; U_{OFF} <= 8 V
  Terminals C1/C1L for blocking input and C2/C2L for resetting input are assigned.
- High-range threshold U_{ON} >= 70 V; U_{OFF} = <60 V
  Terminals C1/C1H for blocking input and C2/C2H for resetting input are assigned.

3.1.5 Output relays

The *XRW1-3* is equipped with 5 output relays. Two relays with each two, and three relays with one changeover contact are used for signaling. Apart from the self-supervision relay, the protective functions can be freely assigned.

- Relay 1: 11, 12, 14 and 21, 22, 24
- Relay 2: 31, 32, 34 and 41, 42, 44
- Relay 3: 51, 52, 54
- Relay 4: 61, 62, 64
- Relay 5: Self supervision 71, 72, 74

All trip and alarm relays are normally-off relays, the relay for self supervision is a normally-on relay.

3.1.6 Data communication

For data communication with a central control system the *XRW1-3*- relay is provided with a serial interface RS485. Simplified and fast reading and changing of parameters and measuring values can be achieved by *HTL/PL-Soft4*.

The *XRW1-3* can be connected to other units of the *PROFESSIONAL LINE* or the *HIGH TECH LINE* via interface. If there are more than one relay in the system, the last relay of the chain has to be provided with a line termination resistor.

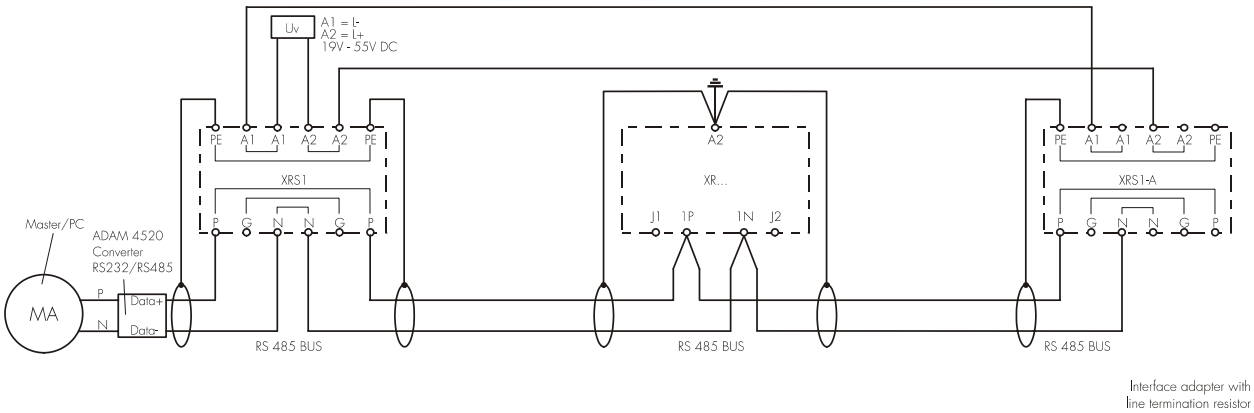

Figure 3.2: Connection example with 3 users, XR ... as linked device

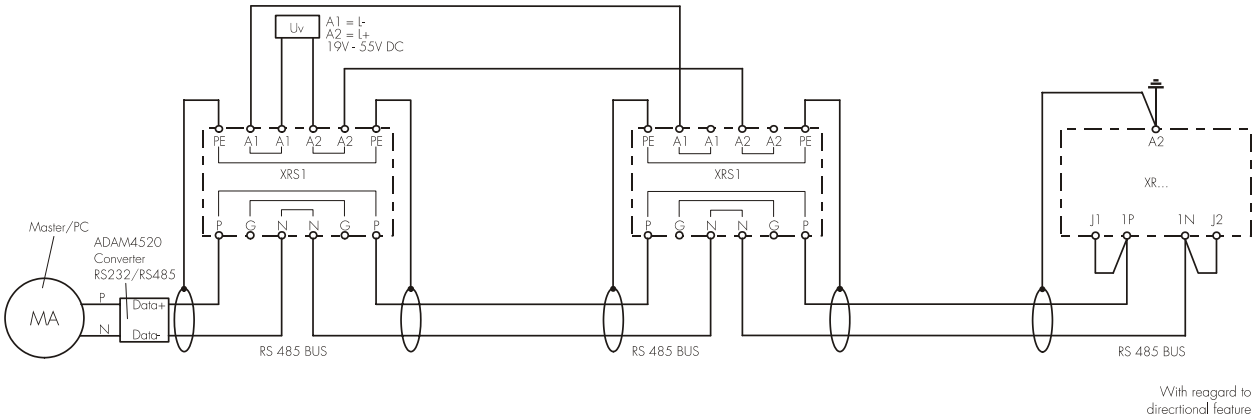

Figure 3.3: Connection example with 3 users, XR ... as last device

3.2 Front plate

3.2.1 Indication- and operation elements

The front plate of the *XRW1-3*-protection relay comprises the following operation and indication elements:

- Alphanumerical display (4 Digits)
- Push buttons for setting and other operations
- LEDs for measured value indication and setting

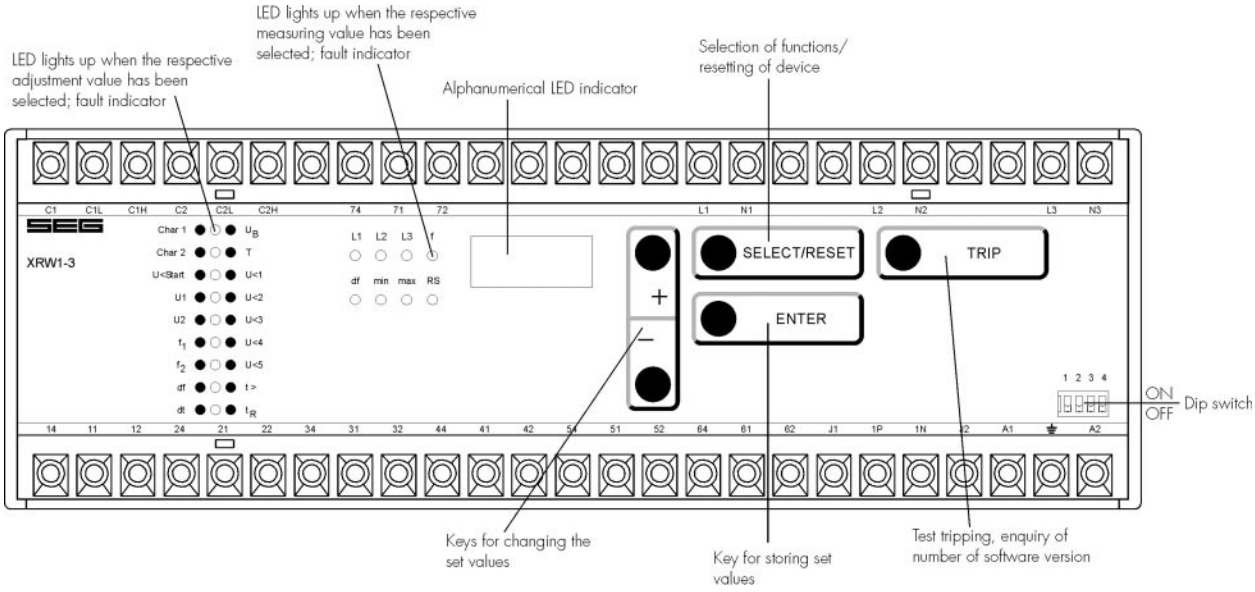

Figure 3.4: Front plate

3.2.2 Display

Function	Display shows	Pressed pushbutton	Corresponding LED
Normal operation	|SEG		
Measured operating values	Actual measured value Min. and max. values of voltage and frequency	<SELECT/RESET> one time for each value	L1, L2, L3, f, min, max df
Input transformer connection	DELT/Y	<SELECT/RESET><+><->	
Rated frequency	50Hz/60 Hz	<SELECT/RESET><+><->	
LED blinking after excitation	NOFL/FLSH	<SELECT/RESET><+><->	
Under voltage limit curve 1 Function	warn/trip	<SELECT/RESET><+><->	Char1
Starting point of the limit curve 1	Setting value in Volt	<SELECT/RESET><+> <-> one time for each value	Char1+U<Start
1. Char. point_value 1 (U<1) 1. Char. point_value_2	Setting value in Volt Setting value in seconds	<SELECT/RESET><+><-> set to 0s (fixed)	Char1+U<1
2. Char. point_value 1 (U<2) 2. Char. point_value_2 (tU<2)	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char1+U<2 Char1+U<2+t>
3. Char. point_value 1 (U<3) 3. Char. point_value_2 (tU<3)	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char1+U<3 Char1+U<3+t>
4. Char. point_value 1 (U<4) 4. Char. point_value_2 (tU<4)	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char1+U<4 Char1+U<4+t>
5. Char. point_value 1 (U<5) 5. Char. point_value_2 (tU<5)	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char1+U<5 Char1+U<5+t>
Permissible release time for undervoltage limit curve 1	Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char1+tR
Under voltage limit curve 2 Function	warn/trip	<SELECT/RESET><+><->	Char2
Starting point of the limit. curve 1	Setting value in Volt	<SELECT/RESET><+><-> one time for each value	Char2+U<Start
1. Char. point_value 1 (U<1) 1. Char. point_value_2	Setting value in Volt Setting value in seconds	<SELECT/RESET><+><-> set to 0s (fixed)	Char2+U<1
2. Char. point_value 1 (U<2) 2. Char. point_value_2 (tU<2)	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char2+U<2 Char2+U<2+t>
3. Char. point_value 1 (U<3) 3. Char. point_value_2 (tU<3)	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char2+U<3 Char2+U<3+t>
4. Char. point_value 1 (U<4) 4. Char. point_value_2 (tU<4)	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char2+U<4 Char2+U<4+t>
5. Char. point_value 1 (U<5) 5. Char. point_value_2 (tU<5)	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char2+U<5 Char2+U<5+t>
Permissible release time for undervoltage limit curve 1	Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	Char2+tR
Function of the 1st voltage element	U</U>	<SELECT/RESET><+><->	U1
Voltage threshold value U1 Tripping time delay tU1	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	U1 U1+t>
Function of the 2nd voltage element	U</U>	<SELECT/RESET><+><->	U2
Voltage threshold value U2 Tripping time delay tU2	Setting value in Volt Setting value in seconds	<SELECT/RESET><+> <-> one time for each value	U2 U2+t>
Rated frequency	setting value in Hz	<SELECT/RESET><+><->	f_N
Frequency measuring repitition T	setting value in periods	<SELECT/RESET><+><->	T
Frequency element f_1 Tripping delay of frequency element f_1	setting value in Hz setting value in seconds	<SELECT/RESET><+><-> one time for each value	f_1 f_1 + t>
Frequency element f_2 Tripping delay of frequency element f_2	setting value in Hz setting value in seconds	<SELECT/RESET><+><-> one time for each value	f_2 f_2 + t>
Setting value df/dt Measuring repitition df/dt	setting value in Hz/s setting value in periods	<SELECT/RESET><+><-> one time for each value	df dt
Blocking	EXIT	<+> until max. setting value <-> until min. setting value	LED of blocked parameter
Blocking of a protection step via digital input	BLOC/NO_B	<SELECT/RESET><+><->	LED of the blocking protection function
Voltage threshold value for frequency- and (df/dt-measuring)	Setting value in Volt	<SELECT/RESET><+><->	U_B

Funktion	Display shows	pressed pushbutton	Corresponding LED
Slave address of serial interface	1 - 32	<SELECT/RESET><+><->	RS
Baud-Rate of the serial interface*	1200/2400/4800/9600	<SELECT/RESET><+><->	RS
Parity check of transmitted data*	Even/odd/no	<SELECT/RESET><+><->	RS
Recorded fault data: star–connection: U1, U2, U3	tripping values in Volt	<SELECT/RESET><+><-> one time for each phase	L1, L2, L3,
delta-connection: U12, U23, U31	tripping values in Volt	<SELECT/RESET><+><-> one time for each phase	L1, L2, L3
frequency	tripping values in Hz	<SELECT/RESET><+><-> one time for each phase	f, f_{min}, f_{max}
rate of change of frequency	tripping value in Hz/s	<SELECT/RESET><+><->	df
Save parameter?	SAV?	<ENTER>	
Save parameter!	SAV!	<ENTER> for about 3 s	
Software version	First part (e.g. D02-) Sec. part (e.g. 6.01)	<TRIP> one time for each part	
Manual trip	TRI?	<TRIP> three times	
Inquire password	PSW?	<SELECT/RESET>/ <+>/<->/<ENTER>	
Relay tripped	TRIP	<TRIP> or fault tripping	
Secret password input	XXXX	<SELECT/RESET>/<+>/<-> /<ENTER>	
System reset	|SEG	<SELECT/RESET> for about 3 s	

*only at Modbus protocol

Table 3.1: possible indication messages on the display

3.2.3 LEDs

All LEDs (except LED RS, min and max) are two-coloured. The LEDs on the left side, next to the alpha-numerical display light up green during measuring and red after tripping.

The LEDs at the left on of the front are lit green during setting and inquiry procedure of the setting values which are printed on the left side next to the LEDs. The LEDs will light up red after activation of the setting values next to their right side.

The LED marked with letters RS lights up during setting of the slave address of the device for serial data communication.

3.2.4 Front plate *XRW1-3*

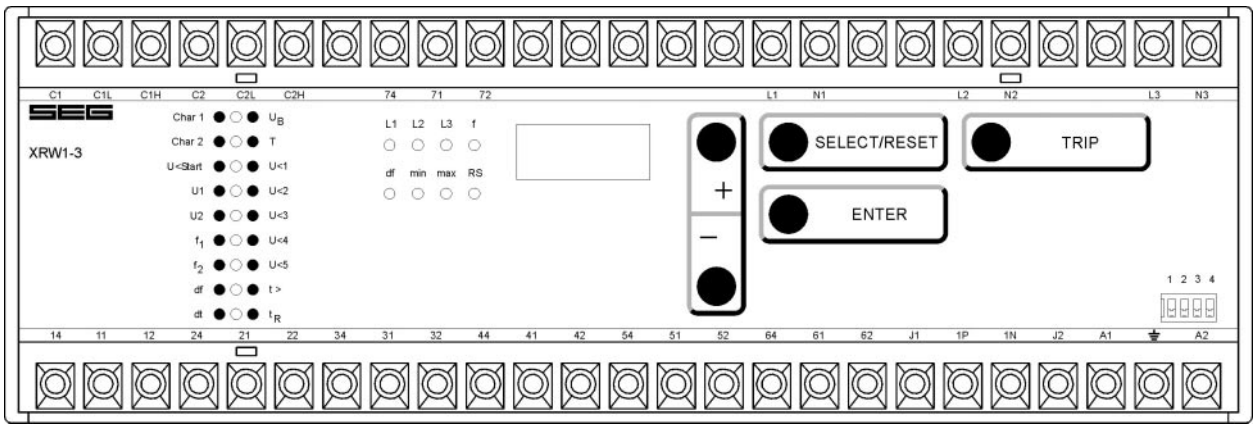

*Figure 3.5: Front plate **XRW1-3***

3.2.5 Parameter settings

Setting parameters		Unit	Range
Δ/Y	Input voltage correction depending on the input voltage transformer connection		Y = star DELT = Delta
	LED flashing after excitation	FLSH	FLSH/NOFL= flashing NOFL = no flashing
Char1	Under voltage limit curve 1		warn = Display shows no „TRIP" trip = Display shows „TRIP"
Char1+U<Start	Start point of the limit curve 1	V	1.–.200/4.–.800*
Char1+U<1	1. Char. point_value 1 (voltage value)	V	1* - <= U<Start 2* - <= U<Start
Char1+U<1+t>	1. Char. point_value 2 (not parameterisable)	s	0s fixed
Char1+U<2	2. Char. point_value 1 (voltage value)	V	>=U<1 – 200V*/ >=U<1 – 800V*
Char1+U<2+t>	2. Char. point_value 2 (time value)	s	> U<1+t> - 60s
Char1+U<3	3. Char. point_value 1 (voltage value)	V	>=U<2 – 200V*/ >=U<2 – 800V*
Char1+U<3+t>	3. Char. point_value 2 (time value)	s	> U<2+t> - 60s
Char1+U<4	4. Char. point_value 1 (voltage value)	V	>=U<3 – 200V*/ >=U<3 – 800V*
Char1+U<4+t>	4. Char. point_value 2 (time value)	s	> U<3+t> - 60s
Char1+U<5	5. Char. point_value 1 (voltage value)	V	>=U<4 – 200V* and >=U<Start – 200V*/ >=U<4 – 800V* and >= U<Start – 800V*
Char1+U<5+t>	5. Char. point_value 2 (time value)	s	> U<4+t> - 60s
Char1+tR	Release time after voltage recovery	s	0.06 – 1.00s
Char2	Under voltage limit curve 2		warn = Display shows no „TRIP" trip = Display shows „TRIP"
Char2+U<Start	Start point the limit curve 2	V	1.–.200/4.–.800*
Char2+U<1	1. Char. point_value 1 (voltage value)	V	1* - <= U<Start 2* - <= U<Start
Char2+U<1+t>	1. Char. point_value 2 (not parameterisable)	s	0s fixed
Char2+U<2	2. Char. point_value 1 (voltage value)	V	>= U<1 – 200V*/ >= U<1 – 800V*
Char2+U<2+t>	2. Char. point_value 2 (time value)	s	> U<1+t> - 60s
Char2+U<3	3. Char. point_value 1 (voltage value)	V	>= U<2 – 200V*/ >= U2 – 800V*
Char2+U<3+t>	3. Char. point_value 2 (time value)	s	> U<2+t> - 60s
Char2+U<4	4. Char. point_value 1 (voltage value)	V	>= U<3 – 200V*/ >=U3 – 800V
Char2+U<4+t>	4. Char. point_value 2 (time value)	s	> U<3+t> - 60s
Char2+U<5	5. Char. point_value 1 (voltage value)	V	>= U<4 – 200V* and >= U<Start – 200V*/ >=U<4 – 800V* and >= U<Start – 800V*
Char2+U<5+t>	5. Char. point_value 2 (time value)	s	> U<4+t> - 60s
Char2+tR	Release time after voltage recovery	s	0.06 – 1.00s

*according to the rated voltage U_N100V/U_N=400V/U_N=690V

Setting parameters		Unit	Range
U1	Function of the 1st voltage element		U< = undervoltage U> = overvoltage
U1	Pick-up value for the 1st voltage element	V	1.–.200/4.–.800*
tU1 (U1+t>)	Tripping time for the 1st voltage element	s	0,04 - 300
U2	Function der of the 2nd voltage element		U< = undervoltage U> = overvoltage
U2	Pick-up value of the 2nd voltage element	V	1.–.200/4.–.800*
tU2 (U2+t>)	Tripping time of the 2nd voltage element	s	0.04 - 300
T	Frequency measuring repetition in periods	periods	2 - 99
f_1	Pickup value for frequency element 1	Hz	30 – 70 or 40 - 80
t_{f1} (f_1+t>)	Tripping delay of the 1st frequency element	s	$t_{fmin.}$ -50
f_2	pickup value for frequency element 2	Hz	30 – 70 or 40 - 80
t_{f2} (f_2+t>)	Tripping delay of the 2nd frequency element	s	t_{fmin} -50
Df	pickup value for rate of frequency (dt/dt) in	Hz/s	0.2 - 10
Dt	measuring repetition for df/dt	periods	2 - 64
U_B	voltage threshold value for frequency and df/dt element	V	20 - 400
	LED blinking after excitation		NOFL/FLSH
RS	Slave address of the serial interface		1 - 32
RS	**Baud-Rate of the serial interface		1200 - 9600
RS	**Parity check*		even/odd/no

* According to the rated voltage U_N=100V/U_N=400V/U_N=690V
** Only at Modbus protocol

Table 3.2: Sequence of parameter setting

4 Working principle

4.1 Analogue circuits

The input voltages are galvanically insulated by the input transformers. The noise signals caused by inductive and capacitive coupling are suppressed by an analogue R-C filter circuit. The analogue voltage signals are fed to the A/D-converter of the microprocessor and transformed to digital signals through Sample- and Hold- circuits. The analogue signals are sampled with a sampling frequency of 16 x f_N, namely, a sampling rate of 1.25 ms for every measuring quantity, at 50 Hz or of 1.04 ms for every measuring quantity at 60 Hz.

4.2 Digital circuits

The essential part of the *XRW1-3* relay is a powerful microcontroller. All of the operations, from the analogue digital conversion to the relay trip decision, are carried out by the microcontroller digitally. The relay program is located in an EPROM (Electrically-Programmable-Read-Only-Memory). With this program the CPU of the microcontroller calculates the three phase voltage in order to detect a possible fault situation in the protected object.

For the calculation of the voltage value an efficient digital filter based on the Fourier Transformation (DFFT - Discrete Fast Fourier Transformation) is applied to suppress high frequency harmonics and d.c. components caused by fault-induced transients or other system disturbances. The microprocessor continuously compares the measured values with the preset thresholds stored in the parameter memory (EEPROM). If a fault occures an alarm is given and after the set tripping delay has elapsed, the corresponding trip relay is activated. A special feature of the *XRW1-3* is that the calculated fundamental harmonic is always adjusted to the currently measured frequency (frequency adjustment for the first harmonic).

The relay setting values for all parameters are stored in a parameter memory (EEPROM - Electrically Erasable Programmable Read Only Memory), so that the actual relay settings cannot be lost, even if the power supply is interrupted.

The microprocessor is supervised by a built-in "watchdog" timer. In case of a failure the watchdog gives an alarm signal via the output relay "self supervision".

4.3 Voltage supervision

The voltage element of *XRW1-3* has the application in protection of generators, consumers and other electrical equipment against over/and undervoltage.
The relay has two free programmable under voltage limit curves with each 5 setting points and two voltage supervision elements with under- or over voltage function than can be optionally parameterised with completely separate time and voltage settings. In delta connection the phase-to-phase voltages and in star connection the phase-to-neutral voltages are continuously compared with the preset thresholds.

For the overvoltage supervision the highest, for the undervoltage supervision of the lowest voltage of the three phases are decisive for energizing.

Basic for this elements is the RMS of the voltage fundamental.

4.3.1 Selection of star or delta connection

All connections of the input voltage transformers are led to screw terminals. The nominal voltage of the device is equal to the nominal voltage of the input transformers. Dependent on the application the input transformers can be connected in either delta or star. The connection for the phase-to-phase voltage is the delta connection. In star connection the measuring voltage is reduced by $1/\sqrt{3}$. During parameter setting the connection configuration either Y or Δ has to be adjusted.

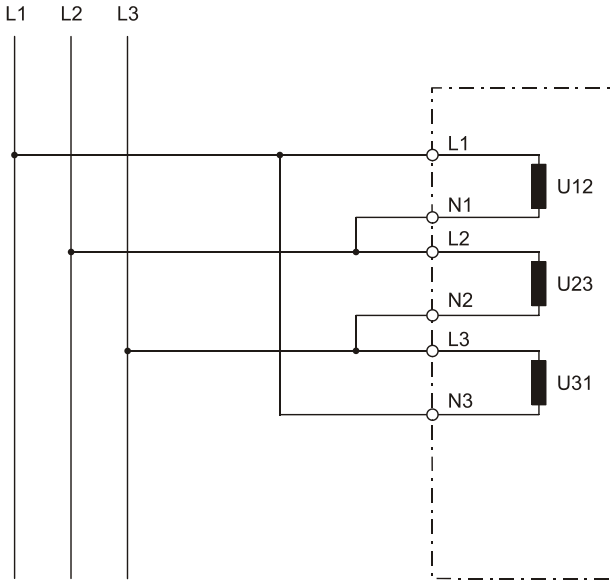

Figure 4.1: Input v.t.s in delta connection (Δ)

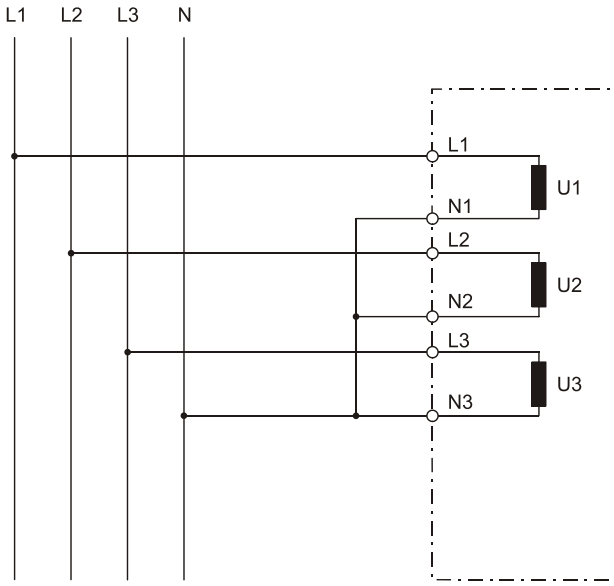

Figure 4.2: Input v.t.s in star connection (Y)

4.4 Principle of frequency supervision

The frequency element of *XRW1-3* protects electrical generators, consumers or electrical operating equipment in general against over- or underfrequency. The relay has independent three frequency elements f_1 - f_3 with a free choice of parameters, with separate adjustable pickup values and delay times.

The measuring principle of the frequency supervision is based in general on the time measurement of complete cycles, whereby a new measurement is started at each voltage zero passage. The influence of harmonics on the measuring result is thus minimized.

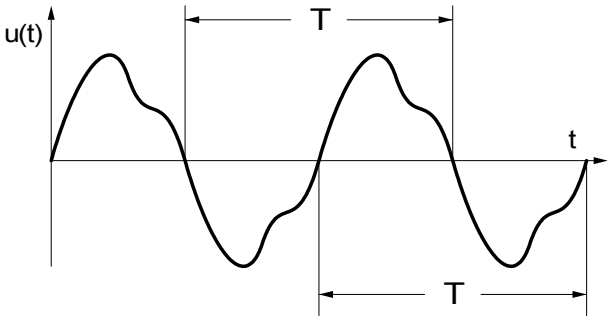

Figure 4.3: Determination of cycle duration by means of zero passages.

In order to avoid false tripping during occurence of interference voltages and phase shifts the relay works with an adjustable measuring repetition (see chapter 6.4.6).

Frequency tripping is sometimes not desired by low measured voltages which for instance occur during alternator acceleration. All frequency supervision functions can be blocked with the aid of an adjustable voltage threshold U_B in case the measured voltage value is below this value.

4.5 Measuring of frequency gradient

Electrical generators running in parallel with the mains, e.g. industrial internal power supply plants, should be separated from the mains when failure in the intrasystem occurs for the following reasons:

- It must be prevented that the electrical generators are damaged when mains voltage recovering asynchrone, e.g. after a short interruption.
- In order to prevent uncontrollable islands, users generating their own power must decouple from the remaining faulty grid.

In this case, either in order to protect his own system from damages or just to avoid network islanding, the operator can select the fast mains-decoupling with frequency gradient supervision function. Each depending on current grid connection rules, these two reasons can be given first priority for decoupling, namely as long as the system has the capability to basically stabilise the voltage.

A reliable criterion of detecting mains failure is the measurement of the rate of change of frequency df/dt. Precondition for this is a load flow via the mains coupling point. At mains failure the load flow changing then spontaneously leads to an increasing or decreasing frequency in the grid island. At active power deficit of the internal power station a linear drop of the frequency occurs and a linear increase occurs at power excess this assumption is valid within a time window of some 100 milliseconds, because regulator effects become here not marked out yet. Typical frequency gradients during application of "mains decoupling" are in the range of 0.5 Hz/s up to over 2 Hz/s. The *XRW1-4* detects the instantaneous frequency gradient df/dt of each mains voltage period in an interval of one half period each. Through multiple evaluation of the frequency gradient in sequence the continuity of the directional change (sign of the frequency gradient) is determined. Because of this special measuring procedure a high safety in tripping and thus a high stability against transient processes, e.g. switching procedure are reached. The total switching off time at mains failure is usually approx. 100 ms (T = 4) depending on the setting.

4.6 Voltage threshold value for frequency measuring

At low measuring voltages, e.g. during generator start-up, frequency and df/dt-measuring is perhaps not desired.

By means of the adjustable voltage threshold value $U_B<$, functions f_1 - f_3 and df/dt are blocked if one measured voltage falls below the set value.

4.7 Blocking function

Nr.	Dynamic behaviour	Char1, Char2	U1, U2	f_1, f_2, f_3	df/dt
1	voltage to external blocking input is applied	free programmable	free programmable	free programmable	free programmable
2	blocking input is released	released instantaneously	released instantaneously	released after 1 s	released after 5 s
3	supply voltage is switched on	blocked for 200 ms	blocked for 200 ms	blocked for 1 s	blocked for 1 s
4	3-phase measuring voltage is suddenly applied	released	released	blocked for 1 s	blocked for 5 s
5	one or several measuring voltages are switched off suddenly (phase failure)	released	released	blocked	blocked
6	measuring voltage smaller $U_B<$ (adjustable voltage threshold value)	released	released	blocked	blocked

*Table 4.1: Dynamic behaviour of **XRW1-3** functions*

Blocking function set in compliance with requirements:

The ***XRW1-3*** has an external blocking input. By applying the auxiliary voltage to input C1/C1L or C1/C1H, the requested protection functions of the relay are blocked.

5 Operation and setting

For adjustment of the unit the transparent cover has to be opened as illustrated. Do not use force! The transparent cover has two inserts for labels.

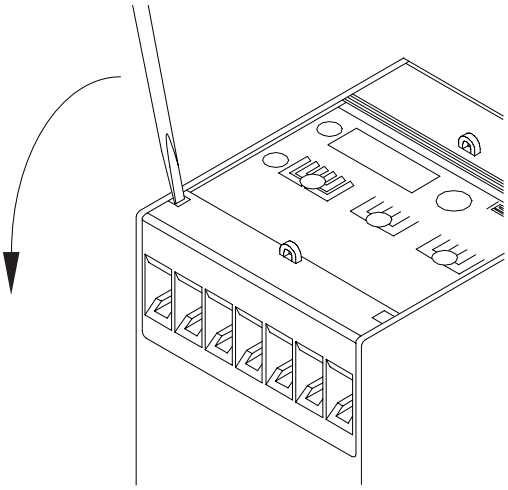

Figure 5.1: How to open the transparent cover

5.1 Push buttons

Push buttons are used for calling up the parameters to be processed, for selection of measuring parameters to be indicated and for changing and storing the parameters.

The individual setting and measuring values can be selected one after another by pressing push button <SELECT/RESET>. This push button is also used for resetting the display by pressing approx. 3s.

Push buttons <+> <-> are used for in-/decrementing of the parameter indicated on the display. They can be pressed step-by-step or continuously.

After the selected parameter is set by the <+> <-> push button it may be stored using the <ENTER> push button.

Through the push button <ENTER> the set value indicated on the display will be transferred to the internal parameter memory. An unintented or unauthorized change of the selected parameter is avoided by means of a password identification (see 5.4.2).

The <TRIP>-push button is used to test the output relay circuits both for tripping and signalling. During normal operation it is also interlocked by means of the password identification.

5.1.1 Indication of measuring values and fault data

Indication in faultless condition

In normal operation the display always shows |SEG. After pressing the push button <SELECT/RESET> the display switches cyclically to the next measuring value. After the measuring values had been indicated the setting parameters are displayed. Hereby the LEDs left to the display section signalize which measured value is indicated, the LEDs in the left end of the front section signalize which setting parameter is indicated on the display. Longer actuating the push button resets the relay and the display changes into normal operation (|SEG).

Indication after pickup/tripping

All of the faults detected by the relay are indicated on the front plate optically. Here not only the faults are indicated but also the faulty phase(s) and the protection function in operation. During pick-up LEDs are flashing, after tripping this changes to continuous light. In tripped condition "TRIP" appears on the display and the LEDs of the operating measuring data light up red together with the LEDs of the tripping parameter. All operating data, which were measured at the moment of tripping, can now be called one after another by pressing push button <SELECT/RESET>. If in this condition setting parameters are to be indicated, push button <ENTER> has to be pressed.

The graphic below shows again the difference between the different display modes.

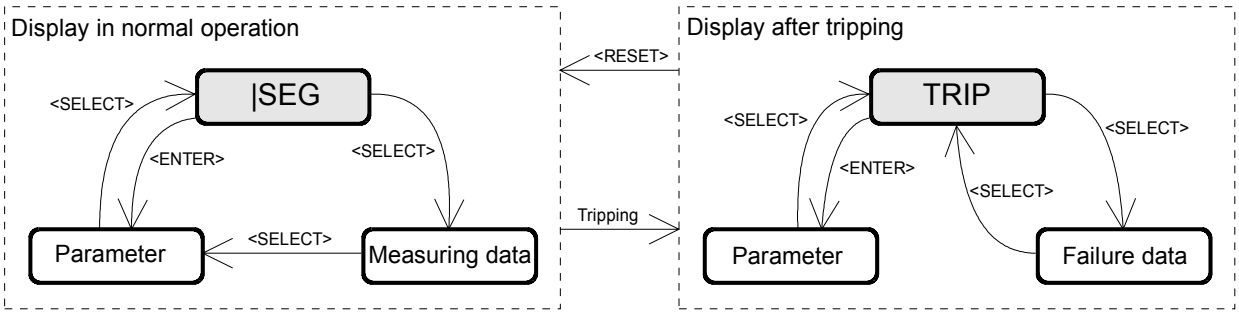

Figure 5.2: Switching over of the display in dependence of the operating mode.

5.2 DIP switches

On the front plate of the *XRW1-3*-relay there are DIP switches to preset the following functions:
- Password programming
- Output relay functions

5.2.1 Function of the output relays

The following functions of the output relays can be preset:
- Reset of the output relays manually or automatically

The alarm relays are activated according to the presetting:

Dip switch 2: No function

Dip switch 3 OFF:
All output relays will be reset automatically after the fault has been rectified, (e.g. when the fault current is interrupted).

Dip switch 3 ON:
All output relays remains activated and must be reset after fault clearence.
- Manually: By pressing push button <SELECT/RESET>
- External: By connecting aux. voltage to C2/C2L or C2/C2H
- Via RS 485 interface

Dip switch 4: No function

Note:
To let the parameter change take effect, the auxiliary voltage has to be switched off and on again after the dip switches are plugged or unplugged.

Dip switch	Function	Dip switch position	Operation mode
1	Password	OFF	Normal position
		ON	Password selection
2	No function		
3	Reset	OFF	Output relays will be reset automatically
		ON	Output relays will be reset manual/external/via software
4	No function		

Table 5.1: Summary of coding possibilities

5.3 Reset

Manual reset
By pressing push button <RESET/SELECT> for some time (about 3 s).

External reset-input C2/C2L or C2/C2H
The external reset input has the same function as the <SELECT/RESET> push button on the front plate. Connecting auxiliary voltage to this input, the unit can be reset, provided that the fault is removed.

Software reset via serial interface RS 485
Software reset has the same function as push button <SELECT/RESET>. Please refer to open data protocol of RS 485 interface named RS485-PRO.

5.4 Password

5.4.1 Password programming

The *XRW1-3*-relay is delivered with the preset password "++++", it can be programmed new with dip switch 1:

Set dip switch 1 to ON position. After power on and pressing any push button, the relay *XRW1-3* inquires for a new password. The text "PSW?" appears on the display. The new password is entered by any combination of the push buttons <SELECT> <-> <+> <ENTER>.

After the new password is given, the dip switch 1 has to be set off and aux. power must be switched off and on.

5.4.2 Using the password

Step by step, a new relay setting is made according to the following sequence:

- After the present setting value is changed with <+><-> push button, <ENTER>-push button should be pressed.
- A message "SAV?" appears on the display to inquire if the new setting value is really wanted to be stored.
- After pressing the <ENTER>-push button again, the password will be inquired by means of the message "PSW?" on the display.

After the password is given correctly, which is prompted by message "SAV!" on the display, the new setting value can be stored by pressing the<ENTER>-push button for about 3 seconds.

The new setting value for the selected parameter appears on the display again. A password consists of four push button operations. The pressed push buttons and their sequences define the password.

<SELECT/RESET> = S
<-> = -
<+> = +
<ENTER> = E

then a password "-E+S" means pressing push buttons according to the following sequence:
<-> <ENTER> <+> <SELECT>

After the password is given correctly, parameter setting is permitted for five minutes. This means: For a subsequent parameter setting, as long as it is made within five minutes after the password input, a renewed password input is not required. Moreover, the valid period for parameter setting is automatically extended to further 5 minutes after each new push button operation.
If no push button operation follows within the five minute period after password input, the validity for parameter setting will be suspended.

For entering further parameters the password is then called up again. During the validity for parameter setting a new set value, after having acknowledged "SAV" two times, is stored by just pressing push button <ENTER> for some time.
As to parameter setting via RS 485 interface: see open data protocol (SEG Profi-Pack). For comfortable operation please use HTL/PL-Soft4 Version 2.24 or higher.

5.5 Relay setting principle

By pressing push button <ENTER>, the parameter menu can be called up. By pressing push button <SELECT/RESET> the parameter to be set is reached. The corresponding LED lights up. The actual set value of the selected parameter is indicated on the display. The indicated set value can then be changed by pressing push buttons <+><-> (in-/decrementing). The selected set value is stored by pressing push button <ENTER> and by input of the authority code (password) which means the adjustment of the unit is only possible after the password had been put in. (see 5.2).

After a trip the push button <SELECT/RESET> is reserved for the indication of fault data. Now new parameter setting by means of push button <SELECT/RESET> is only possible by pressing <ENTER> first.

5.5.1 Setting of default parameters

Setting of the *XRW1-3* default parameters can be done as follows:

- switch off the auxiliary voltage supply
- press simultaneously push buttons <+><-> and <SELECT/RESET> and
- switch on the auxiliary voltage supply again.

5.5.2 Blocking the protection functions

The blocking function of the *XRW1-3*-relays can be set according to requirement. When pressing push buttons <ENTER> and <TRIP> at the same time the blocking menu is entered.

5.6 Display of software version and test-TRIP

By pressing push button <TRIP> the first part of the software version is displayed, the second part appears when this push button is pressed again. When push button <TRIP> is pressed repeatedly, the test trip routine starts.

By entering the password the display shows "TRI?". After pressing <TRIP> again all output relays will be energized one after the other with a time delay of 1 s.

All relays stay energized until manual reset.

5.7 Low/High range of the blockage and Reset function

All relays of the *PROFESSIONAL LINE* have a wide-range power supply unit allowing to choose a suitable supply voltage. The operating threshold of the blocking and reset inputs, however, has to be defined by taking the supply voltage into account. The following two different operating thresholds are available:

- Low-range threshold U_{AN} ≥10 V; U_{AB} ≤8 V
- High-range threshold U_{AN} ≥70 V; U_{AB} ≤60 V

Connection terminals

- Low-range blockage input terminal C1/C1L
- Low-range reset input terminal C2/C2L
- High-range blockage input terminal C1/C1H
- High-range reset input terminal C2/C2H

6 Parameter settings

6.1 Adjustable parameters

The following parameters can be set by the user himself:

Δ/Y	-	Input voltage correction depending on input voltage transformer connection
f_N	-	Mains rated frequency
LED Flash		LED flashing after excitation voltage limit curve 1
Char 1	-	Function of the Voltage limitcurve 1
U<Start 1	-	Starting point of the voltage limit curve 1
U<1		1. Char. point_value 1
U<1+t>	-	1. Char. point_value 2 (set to 0s (fixed))
U<2	-	2. Char. point_value 1
U<2+t>	-	2. Char. point_value 2
U<3	-	3. Char. point_value 1
U<3+t>	-	3. Char. point_value 2
U<4	-	4. Char. point_value 1
U<4+t>	-	4. Char. point_value 2
U<5	-	5. Char. point_value 1 (U-Voltage range)
U<5+t>	-	5. Char. point_value 2 (Endzeit)
Char1+tR	-	Permissible release time for voltage limit curve.
Char 2	-	Function of the voltage limit curve 2
U<Start	-	Starting point of the voltage limit curve 2
U<1	-	1. Char. point_value 1
U<1+t>	-	1. Char. point_value 2 (set to 0s (fixed))
U<2	-	2. Char. point_value 1
U<2+t>	-	2. Char. point_value 2
U<3	-	3. Char. point_value 1
U<3+t>	-	3. Char. point_value 2
U<4	-	4. Char. point_value 1
U<4+t>	-	4. Char. point_value 2
U<5	-	5. Char. point_value 1 (U-Voltage range)
U<5+t>	-	5. Char. point_value 2 (End time)
Char1+tR	-	Permissible release time for voltage limit curve.
U1	-	Function of the 1st voltage step
U1	-	Pick-up value for the 1st voltage step
U1+t>	-	Release time for the 1st voltage step
U2	-	Function of the 2nd voltage step
U2	-	Pick-up value for the 2nd voltage step
U2+t>	-	Release time for the 2nd voltage step
T	-	frequency measuring repetition in periods
f_1	-	threshold for frequency element 1
t_{f1}	-	tripping delay for frequency element 1
f_2	-	threshold for frequency element 2
t_{f2}	-	tripping delay for frequency element 2
U_B<	-	voltage threshold value for frequency and df/dt measuring LED blinking after excitation
df	-	threshold for rate of change of frequency (df/dt) in Hz/s
dt	-	measuring repetition for df/dt in periods
RS	-	Slave address of the serial interface
RS	-	*Baud-Rate of the serial interface
RS	-	*Parity check

*Only Modbus protocol

6.2 Setting procedure

In this paragraph the settings for all relay parameters are described in detail. For parameter saving a password has to be entered (please refer to 5.4).

6.3 System parameter

6.3.1 Δ/Y – Switch over

Depending on the mains voltage conditions, the input voltage transformers can be operated in delta or Y connection. Change-overs are effected via the <+> and the <-> keys and stored with <ENTER>. (see chapter 4.3.1).

6.3.2 Setting of nominal frequency

All frequency functions are determined by setting the nominal frequency, i.e. whether the set frequency thresholds are evaluated as over- or underfrequency (see chapter 6.4.5).

6.3.3 Display of the activation storage (FLSH/NOFL)

If after an activation the existing voltage drops again below the pickup value, e.g. U_1>, without a trip has been initiated, LED U_1> signals that an activation has occured by flashing brief. The LED keeps flashing until it is reset again (push button <RESET>). Flashing can be suppressed when the parameter is set to NOFL.

6.4 Protection parameter

6.4.1 Setting parameters for under voltage characteristics

For the under voltage detection, the *XRW1-3* has two under voltage characteristics (limit curves) that can be independently set and that each provide 5 characteristic definition points. All individual setting points are defined by two parameters: one voltage value (1) (in Volt) and a time-value (2) (in seconds).
Both characteristics can be optionally defined to either provide a warning or a tripping function. The difference lies in the varying display indication. In case of warning, the display retains unchanged, for tripping, the abbreviation « TRIP » will be indicated.
For characteristic setting point 1, only the value 1, i.e. the voltage will be adjusted since excitation of the step always starts as soon as the failure occurs. A fault incident is detected when the voltage is below the threshold value U<start and it will be stopped as soon as the voltage range U<5 had been exceeded.

At the moment when the voltage falls below the threshold value U<start, the *XRW1-3* will initiate the limit curves. The present voltageis compared with the adjusted characteristic after expiry of each one measuring cycle*. If the voltage at time x is below the appropriate characteristic value, the *XRW1-3* relay will trip. When the U<Start parameter is set to EXIT, the characteristic is out of service and all relevant setting values will be faded out.

6.4.2 Permissible release time for the under voltage characteristic curve

The end of the failure incident is detected on condition that the voltage had been above the voltage range for at least the period of setting value t_R. The characteristic value calculation is interrupted then and any new falling below the starting threshold will be defined as a new failure incident. The adjustable value is indicated in green by LEDs Char1 or Char2 and value t_R marked accordingly, in red.

* One measuring cycle is 6.6 ms at 50 Hz and it takes 5.5 ms at 60 Hz.

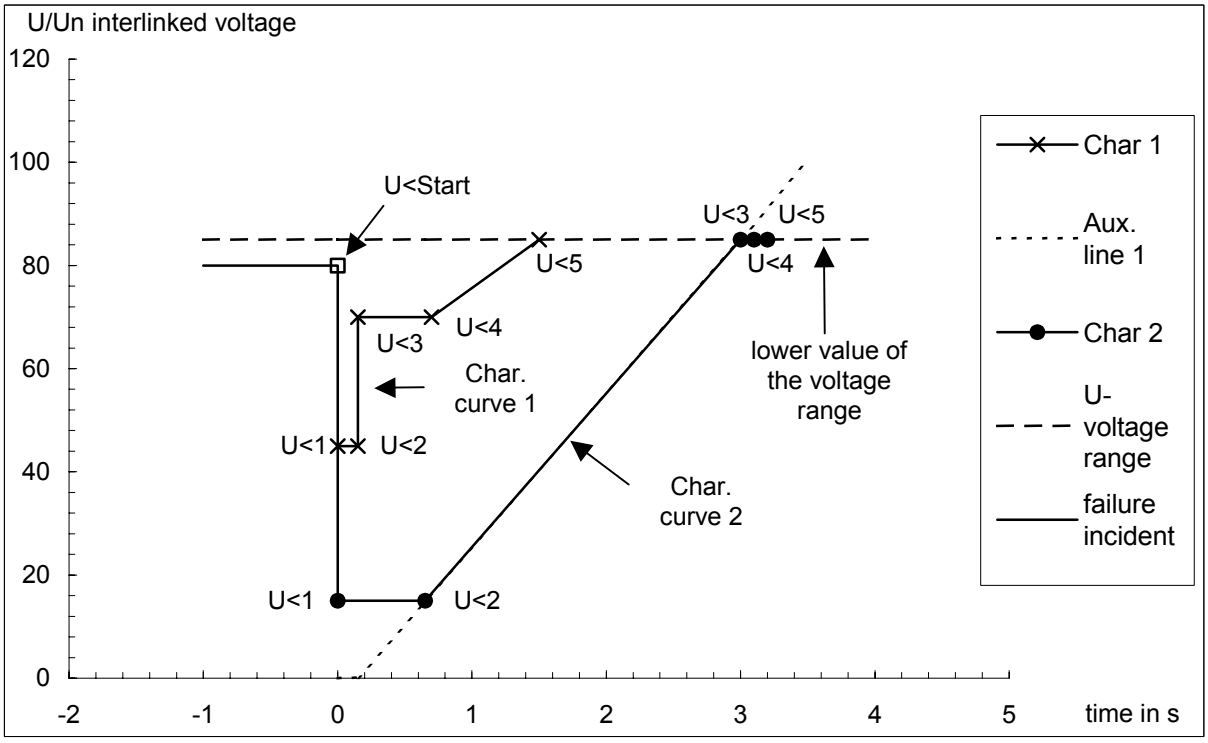

Figure 6.1: Trend of two characteristics

6.4.3 Plausibility check of the voltage characteristic

The setting points are not independent from each other. It is therefore recommended to parameterise them in ascending order, which, in fact, agrees with the unit's pre-adjusted parameter sequence. This, for example, means that follow-up times can only be higher than preceding ones. Voltage-related values, however, are depending on their function. If, for example, the factory set value of U<1 is higher than the value of U<Start that has to be adjusted, U<1 will automatically be set to the same value when U< is adjusted.
(See chapter 3.2.5: Order of parameter setting or chapter 8.3.2: Protection parameters.)

6.4.4 Parameter setting of the voltage functions

The function of the additional voltage elements is determined by means of a separately adjusted value, that either parameterizes the related function as overvoltage (U>) or as under voltage (U<). The adjustable parameters are indicated by LEDs flashing in two colors. When setting the voltage pick-up values U1 and U2, the LEDs U1 and U2 will flash in green, at setting of the related pick-up delay times t_{U1} an t_{U2}, the LED t> additionally flashes in red.

Pick-up values of the voltage supervision
When adjusting the pick-up values U1 and U2, the values on the display are indicated in Volt. By setting the pick-up values to "EXIT", each individual step can be deactivated.

Tripping delay of the voltage supervision
When adjusting the tripping delay time tU1 and tU2, the value on the display is indicated in seconds. The tripping delay time can be adjusted from 0.04s to 300s and the set values be stored via push-button <ENTER>.

When the tripping delay time was set to "EXIT", it is indefinite, i.e. there will be warning only, no tripping.

6.4.5 Setting of nominal frequency

First the nominal frequency (50 or 60 Hz) has to be correctly set before unit *XRW1-3* is put into operation. All frequency functions are determined by setting the nominal frequency, i.e. whether the set frequency thresholds are evaluated as over- or underfrequency (see also chapter 6.4.7). Also the cycle duration (20 ms at 50 Hz and 16.67 ms at 60 Hz) derives from this setting which determines the minimum tripping delay for frequency elements f_1 - f_3 with an adjustable multiplier (see also chapter 6.4.8).
During setting of the nominal frequency a value in Hz is shown on the display.

6.4.6 Number of measuring repetitions (T) for frequency functions

In order to avoid false tripping of the unit at short voltage drops of the system voltage or interference voltages, *XRW1-3* works with an adjustable measuring repetition. When the instantaneous frequency measuring value exceeds (at overfrequency) or falls below (at underfrequency) the set reference value, the counter is incremented, otherwise the counter is decremented down to the minimum value of 0. Only when the counter exceeds the value adjusted at T, alarm is given and after the tripping delay of the frequency element has elapsed the tripping command is given.
The setting range for T is between 2 - 99.

Recommendation for setting:
For short tripping times, e.g. for machine protection or for mains decoupling T should be set in the range from 2 - 5.
At precision measurements, e.g. exact measurement of the system frequency a setting of T in the range from 5 - 10 is recommended.

6.4.7 Threshold of frequency supervision

The frequency supervision of ***XRW1-3*** has two frequency elements independent from each other. Acc. to setting the pickup value above or below the nominal frequency, these elements can be used for over- or under frequency supervision.

Dependent on the preset nominal frequency f_N the pickup values from 30 Hz up to 70 Hz at f_N = 50 Hz and from 40 Hz to 80 Hz at f_N = 60 Hz can be set. During setting of the pickup values f_1 - f_3 the display shows the values in 1/100 Hz. A value of for instance 49,8 Hz is indicated with "4980".

The function of the individual frequency elements can be deactivated by setting the pickup values to "EXIT". The setting value "EXIT" corresponds to the rated frequency.

6.4.8 Tripping delays for the frequency elements

Tripping delays t_{f1} - t_{f3} of the four frequency elements can be set independently from t_{f1min} - 50 s. The minimum tripping delay t_{f1min} of the relay depends upon the number of set measuring repetitions T (periods) and amounts to:

T	$t_{f,min}$
2....49	(T+1)·20 ms
50....69	(T - 49)·50 ms + 1 s
70....99	(T - 69)·100 ms + 2 s

When setting the tripping delay to "EXIT" by pressing push button <+> up to the maximum setting value, the corresponding tripping relay is blocked. Pickup of the frequency element is however displayed on the front plate by the corresponding LED, an assigned alarm relay is also activated. This setting applies to 50 Hz and 60 Hz.

6.4.9 Parameter setting of frequency gradient

The pickup value of frequency gradient (parameter df) can be set between 0.2 to 10 Hz/s. The number of measuring repetitions (parameter dt) can be set between 2 - 64 cycles. This parameter defines the number of df/dt measurements, which have to exceed the set value, before tripping.

Setting information:
The power difference after mains failure causes a change in frequency, which can approximately be calculated as follows:

$$\frac{df}{dt} = -\frac{f_N}{T_A} \cdot \Delta P$$

with:
f_N = rated frequency in Hz
T_A = inertia time constant of the generators
ΔP = per unit power deficit with reference to the rated active power of the generators

If the inertia time constant is known and a power difference given, the frequency gradient can be estimated by the a.m. equation. At a supposed power difference of 20% and an inertia time constant of 10 s, the frequency gradient is 1 Hz/s.

To prevent false trippings at loading, deloading or failure signals, we would recommend a setting value for dt of minimum 4 cycles.

6.4.10 Voltage threshold value for frequency and df/dt measuring

Correct frequency measuring or vector surge measuring cannot be obtained if the system voltage is very low, for instance during generator start up or voltage failure. False tripping of the ***XRW1-3*** in such cases is prevented by an adjustable voltage threshold U_B. If the system voltage is below this threshold, these functions of the relay are blocked.
During adjustment of U_B< LEDs f and df light up in the right display part.

6.4.11 Adjustment of the slave address

The slave address can be set in the range of 1 - 32. During this adjustment the LED RS lights up.

6.4.12 Setting of the baud rate (applies for Modbus-Protocol only)

For the data exchange via modbus protocol, different data exchange rates (baud rates) can be adjusted.

6.4.13 Setting of the parity (applies for Modbus-Protocol only)

For parity check, three adjustments are possible:
- „even" means: even
- „odd" means: odd
- „no" means: no parity check

6.4.14 Setting procedure for blocking the protection functions and Assignment of the output relays

Blocking the protection functions

The blocking function of the *XRW1-3* can be set according to requirement. By applying the aux. voltage to C1/C1L or C1/C1H, the functions chosen by the user are blocked. Setting of the parameter should be done as follows:
- When pressing push buttons <ENTER> and <TRIP> at the same time, message "BLOC" is displayed (i.e. the respective function is blocked) or "NO_B" (i.e. the respective function is not blocked). The LEDs allocated to the first protection function Char 1 lights green.
- By pressing push buttons <+> <-> the value displayed can be changed.
- The changed value is stored by pressing <ENTER> and entering the password.
- By pressing the <SELECT/RESET> push button, any further protection function which can be blocked is displayed.
- Thereafter the menu is left by pressing <SELECT/RESET> again thus gaining access to the output relays' assign-mode.

Function	Description	Display	LED
Char1	Voltage limit curve 1	BLOC	green
Char2	Voltage limit curve 2	BLOC	green
U1	Voltage step 1	BLOC	green
U2	Voltage step 2	NO_B	green
f1	Frequency step 1	BLOC	red
f2	Frequency step 2	NO_B	red
df/dt	Rate of change of frequency step (df/dt)	NO_B	red

Table 6.1: Blocking function

Assignment of the output relays

Unit XRW1-3 has five output relays. The fifth output relay is provided as n.c. (normally closed) relay for self supervision is normally on. Output relays 1 - 4 are normally off and can be assigned as alarm or tripping relays to the protection functions which can either be done by using the push buttons on the front plate or via serial interface RS485. The assignment of the output relays is similar to the setting of parameters, however, only in the assignment mode. The assignment mode can be reached only via the blocking mode.

By pressing push button <SELECT/RESET> in blocking mode again, the assignment mode is selected.

The relays are assigned as follows::
The LEDs Char1, Char2, U1, U2, f1 and f2 are two-coloured and light up green when the output relays are assigned as alarm relays and LED t> red as tripping relays.

Definition:
Alarm relays are activated at pickup.
Tripping relays are only activated after elapse of the tripping delay.
After the assignment mode has been activated, first LED Char1 lights up green. Now the 1st voltage limit curve alarm function (fall short of U<start) can be assigned to one or more relays. At the same time the selected alarm are indicated on the display. Indication "1_ _ _" means that output relay 1 is assigned to this under voltage element. When the display shows "_ _ _ _", no alarm relay is assigned to this under voltage element. The assignment of output relays 1 - 4 to the current elements can be changed by pressing <+> and <-> push buttons.

The selected assignment can be stored by pressing push button <ENTER> and subsequent input of the password. By pressing push button <SELECT/RESET>, LEDs Char1 lights up green and t> red. The output relays can now be assigned to this element as tripping relays. Relays 1 - 4 are selected in the same way as described before. By repeatedly pressing of the <SELECT/RESET> push button and assignment of the relays all four elements can be assigned separately to the relays. The assignment mode can be terminated at any time by pressing the <SELECT/RESET> push button for some time (abt. 3 s).

Relay function		Output relays				Display-	Corresponding LED
		1	2	3	4		
Char1	Cycle running					_ _ _ _	Char1 green
Char1	Trip/Warning		X			_ 2 _ _	Char1 green t> red
Char2	Cycle running			X		_ _ 3 _	Char2 green
Char2	tripping/warning	X				1 _ _ _	Char2 green t> red
U1	alarm				X	_ _ _ 4	U1 green
tU1	tripping	X				1 _ _ _	U1 green t> red
U2	alarm				X	_ _ _ 4	U2 green
tU2	tripping	X				1 _ _ _	U2 green t> red
f1	alarm				X	_ _ _ 4	f1 green
tf1	tripping	X				1 _ _ _	f1 green t> red
t2	alarm				X	_ _ _ 4	f2 green
tf2	tripping	X				1 _ _ _	f2 green t> red
df/dt	tripping	X				1 _ _ _	df/dt green

Table 6.2: Assignment to the output relays (Default settings)

6.5 Indication of measuring values

In normal operation the following measuring values can be displayed:

Voltages (LED L1, L2, L3 green)
- In star connection all phase-to-neutral voltages
- In delta connection all phase-to-phase voltages

Frequency (LED f green)
Frequency gradient df/dt (LED df green)

Min. and max. values since the last reset:
- Frequency (LED f + min or f + max)
- Frequency gradient (LED df + min or df + max)

6.5.1 Min./Max. - values

The *XRW1-3* offers a minimum/maximum storage for the measuring values of the frequency gradient. These min./max. values are mainly used to appraise the system quality. Always the highest and lowest values of each cycle are measured and stored until the next reset.

Min./max. frequency measuring:
The *XRW1-3* ascertains the actual frequency from each cycle of the system voltage. These measuring values are entered into the min./max. storage. The latest entered min./max. values replace the previously stored values.

Dependent on the adjustment of dt and tripping delay, it is possible that the stored min./max. values are higher than the tripping threshold without causing a trip. The reason for this is storage of instantaneous values.

Min./Max. measuring of the frequency gradient:
The procedure described above applies also to storage of min./max. values of df/dt measurement. Since each instantaneous df/dt value is stored, high values can occur which, however, do not cause any tripping.

This can for instance happen during switching procedures where high positive and negative df/dt values occur, but they do not cause any tripping due to the special measuring method.

As to operation:
After each reset (ref. to 6.6) the min./max. storages are cleared. As from this instant there is no time limit for the min./max. storage until the next reset.

By repeatedly pressing the <SELECT/RESET> push button, the measuring values of the min./max. storage can be queried. The respective LEDs light up at the same time; e.g. during minimum frequency is displayed, LEDs "f" and "min" light up.

6.6 Fault memory

When the relay is energized or is energized or trips, all fault data and times are stored in a non-volatile memory manner. The ***XRW1-3*** is provided with a fault value recorder for max. five fault occurrences. In the event of additional trippings always the oldest data set is written over. The momentary values are stored in the moment the relay decides to trip.

For fault indication not only the trip values are recorded but also the status of LEDs. Fault values are indicated when push buttons <-> or <+> are pressed during normal measuring value indication.

- Normal measuring values are selected by pressing the <SELECT/RESET> button.
- When then the <-> button is pressed, the latest fault data set is shown. By repeated pressing the <-> button the last but one fault data set is shown etc. For indication of fault data sets abbreviations FLT1, FLT2, FLT3, ... are displayed (FLT1 means the latest fault data set recorded). At the same time the parameter set active at the occurence is shown.
- By pressing <SELECT/RESET> the fault measuring values can be scrolled.
- By pressing <+> it can be scrolled back to a more recent fault data set. At first FLT5, FLT4, ... are always displayed.
- When fault recording is indicated (FLT1 etc), the LEDs flash in compliance with the stored trip information, i.e. those LEDs which showed a continuous light when the fault occured are now blinking blinking to indicate that it is not a current fault. LEDs which were blinking blinking during trip conditions, (element had picked up) just briefly flash.
- If the relay is still in trip condition and not yet reset (TRIP is still displayed), no measuring values can be shown.
- To delete the trip store, the push button combination <SELECT/RESET> and <->, has to be pressed for about 3s. The display shows “wait”.

Recorded fault data:

Measuring	Displayed value	Corresponding LED
Voltage	L1; L2; L3 or L1/L2; L2/L3; L3/L1	L1; L2; L3
Frequency	f; f min; f max	f; min; max
Frequency rate of change	df	df

6.6.1 Reset

All relays have the following three possibilities to reset the display of the unit as well as the output relay at switch position 3=ON.

Manual Reset
- Pressing the push button <SELECT/RESET> for some time (about 3 s)

Electrical Reset
- Through applying auxiliary voltage to C2/C2L or C2/C2H

Software Reset
- The software reset has the same effect as the <SELECT/RESET> push button (see also communication protocol of RS485 interface)

The display can only be reset when the pickup is not present anymore (otherwise "TRIP" remains in display).

During resetting of the display the parameters are not affected.

6.6.2 Erasure of fault storage

To delete the trip store, the push button combination <SELECT/RESET> and <->, has to be pressed for about 3s. The display shows “wait” during the clearing process.

7 Relay testing and commissioning

The following test instructions should help to verify the protection relay performance before or during commissioning of the protection system. To avoid a relay damage and to ensure a correct relay operation, be sure that:

- the auxiliary power supply rating corresponds to the auxiliary voltage on site.
- the rated frequency and rated voltage of the relay correspond to the plant data on site.
- the voltage input circuits are connected to the relay correctly.
- all signal circuits and output relay circuits are connected correctly.

7.1 Power-On

NOTE!
Prior to switch on the auxiliary power supply, be sure that the auxiliary supply voltage corresponds to the rated data on the type plate.

Switch on the auxiliary power supply to the relay and check that the message "ISEG" appears on the display and the self supervision alarm relay (watchdog) is energized (terminals 71 and 74 closed).
It may happen that the relay is tripped because of under voltage condition after power-on. (The message "TRIP" on the display and LED L1, L2, L3 lights up red and the LED U1 light up green).
In this case:

- Press the push button <ENTER>, thus entering into the setting mode. Thereafter, the U<start parameters for the voltage limit curves and the pick-up value of the first voltage step U1 have to be set to "EXIT" in order to block the undervoltage functions. After that, press the <SELECT/RESET> for app. 3 s to reset the LEDs and "TRIP" message.
- The undervoltage tripping after power on can also be eliminated by applying three phase rated voltages after power-on and reset the LED and "TRIP" message.
- The voltage limit curves, as well as the parameterised voltage step U1 as under voltage step can be blocked by appropriate parameterisation to be set to "EXIT" in order to block the under voltage functions. (see chapter 6.4.14).
- Apply auxiliary voltage to the external blocking input (Terminals C1/C1L or C1/C1H) to inhibit the undervoltage functions (refer to 6.2.10) and press the <SELECT/RESET> for app. 3 s to reset the LEDs and "TRIP" message.

7.2 Testing the output relays

NOTE!
Prior to commencing this test, interrupt the trip circuit to the circuit breaker if tripping is not desired.

By pressing the push button <TRIP> once, the display shows the first part of the software version of the relay (e.g. „D08-"). By pressing the push button <TRIP> twice, the display shows the second part of the software version of the relay (e.g. „4.01". The software version should be quoted in all correspondence. Pressing the <TRIP> button once more, the display shows "PSW?". Please enter the correct password to proceed with the test. The message "TRI?" will follow. Confirm this message by pressing the push button <TRIP> again. All output relays should then be activated and the self supervision alarm relay (watchdog) be deenergized one after another with a time interval of 1 second. Thereafter, reset all output relays back to their normal positions by pressing the push button <SELECT/RESET>.

7.3 Checking the set values

By repeatedly pressing the push button <SELECT>, all relay set values may be checked. Set value modification can be done with the push button <+><-> and <ENTER>.

As relay input energizing quantities, three phase voltages should be applied to *XRW1-4* relay input circuits. Depending on the system conditions and the voltage transformer used, three voltages can be connected to the relay input circuits with either star or delta connection. In case of a star connection the phase-to-neutral voltage will be applied to the voltage input circuits, while the phase-to-phase voltages will be connected to the voltage input circuits in case of a delta connection. The voltage input connection must be set as a parameter, and should correspond with the actual voltage input connection:

Star connection:	Phase-to-neutral voltages will be measured and evaluated.
Delta connection:	Phase-to-phase voltages will be measured and evaluated.

7.4 Secondary injection test

7.4.1 Test equipment

- Voltmeter and frequency meter with class 1 or better
- Auxiliary power supply with the voltage corresponding to the rated data on the type plate
- Three-phase voltage supply unit with frequency regulation (Voltage: adjustable from 0 to ≥ 1.15 x U_N; Frequency: adjustable from 40 - 70 Hz)
- Timer to measure the operating time (Accuracy class ±10 ms)
- Switching device
- Test leads and tools

7.4.2 Example of test circuit

For testing of the *XRW1-3* relay, a three phase voltage source with adjustable voltage and frequency is required. Figure 7.1 shows an example of a three-phase test circuit energizing the *XRW1-3* relay during test. The three phase voltages are applied to the relay in Y-connection.

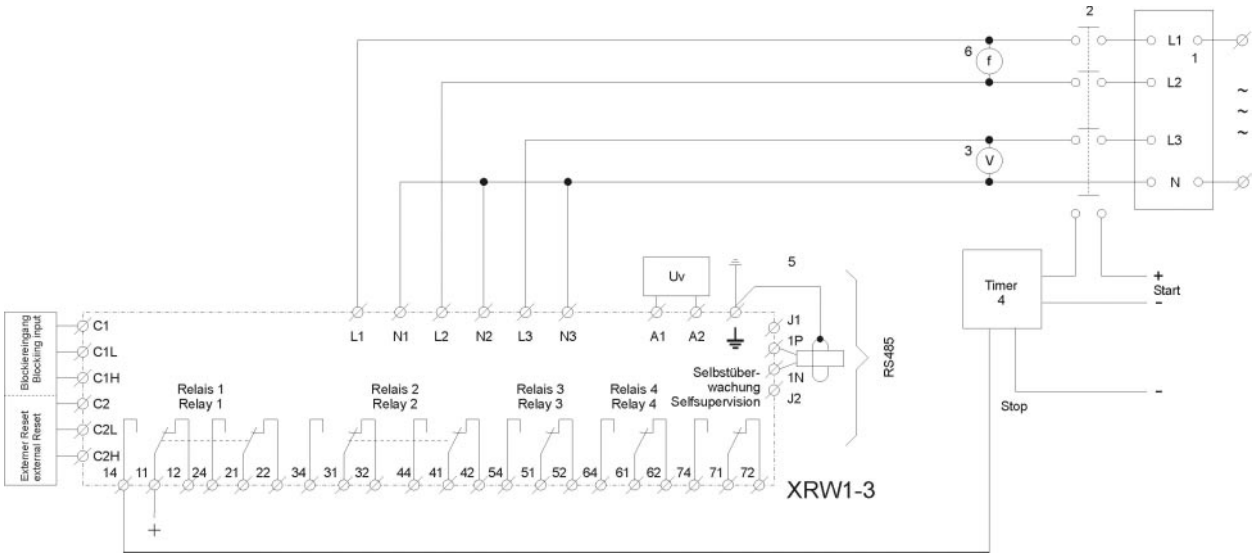

Figure 7.1: Three phase test circuit

For testing the df/dt function of the relay, a special test equipment is required, which produces a constant rate of change of frequency (linear of f-ramp).

7.4.3 Checking the input circuits and measuring functions

Apply three voltages of rated value to the voltage input circuits (terminals L1 and N1, L2 and N2, L3 and N3 of the relay. Check the measured voltages, frequency and the rate of change of frequency on the display by pressing the push button <SELECT/RESET> repeatedly. The voltages are indicated on the display in volts

At Y-connection:
- Phase-to-neutral voltages: LED L1, L2, L3

At Delta-connection:
- Phase-to-phase voltages: LED L1+L2, L2+L3, L3+L1

The frequency is indicated on the display in Hz: LED f (system frequency = 50.01Hz, Indication = 5001)
The rate of change of frequency (LED df) is indicated on the display in Hz/s.
Change the voltages around the rated value and check the measured voltages on the display.
Change the system frequency around the rated frequency and check the measured frequency on the display.
Compare the voltage and frequency on display with the signal on voltmeter and frequency meter. The deviation for the voltage must not exceed 1% and for frequency <0.05 Hz.

NOTE:
By using an RMS-metering instrument, a greater deviation may be observed if the test voltage contains harmonics. Because the *XRW1-3* relay measures only the fundamental component of the input signals, the harmonics will be rejected by the internal DFFT-digital filter. Whereas the RMS-metering instrument measures the RMS-value of the input signals.

7.4.4 Checking the operating and reset ting values of the over/under-voltage functions

NOTE!
When the measuring voltage is connected or disconnected, df/dt tripping can occur. In order to ensure a trouble-free test procedure, the df/dt function of the relay have to be blocked before tests are started.
Apply three voltages with the rated value and gradually increase (decrease) the voltages until the relay starts, i.e. at the moment when the LED U1 (Char1, Char 2 and/or U2) lights up or the voltage alarm output relay is activated. The switched and/or assigned alarm relay will simultaneously respond.

The deviation must not exceed 1% of the set operating value.
Furthermore, gradually decrease (increase) the voltages until the relay resets, i.e. the voltage alarm output relay is disengaged.
Check that the dropout to pickup ratio for voltage is greater than 0,99 (for overvoltage function) or smaller than 1,01 (for undervoltage).

7.4.5 Checking the relay operating time of the over/undervoltage functions

To check the relay's operating time, a timer must be connected to the assigned trip output relay contact. The timer should be started simultaneously with the voltage change from sound condition to a faulty condition and stopped by the trip relay contact. The operating time measured by timer should have a deviation about 3% of the set value or <30 ms.

7.4.6 Checking the operating and reset ting values of the over/under-frequency functions

NOTE!
Due to frequency changes df/dt tripping can occur during frequency tests. In order to ensure a trouble-free test procedure, the df/dt function of the relay has to be blocked before tests are started.
During frequency tests, each of the frequency elements should be tested separately. This makes it necessary that the other frequency elements of the relay have to be blocked by setting the frequency pickup values f_1 - f_2 to "EXIT". For testing the pickup and dropout to pickup values, the test frequency has to be increased (decreased) until the relay is engergized. This is indicated by lighting up of LEDs f_1 - f_2.
When comparing the values displayed with those of the frequency meter, the deviation must not exceed 0.05 Hz. The dropout to pickup values are ascertained by increasing (decreasing) the test frequency slowly until the output relay releases.
The dropout to pickup value for overfrequency must be >0.999, and for underfrequency <1.001.

7.4.7 Checking the relay operating time of the over/underfrequency functions

The operating time of the over/underfrequency functions can be tested in the similar manner as in chapter 7.4.5 for over/undervoltage functions.

7.4.8 Checking the tripping and reset values of the df/dt stages

The df/dt function can only be tested with a frequency generator which is capable of producing a defined linear frequency gradient. The step speed of the frequency generator must be < 10 ms. The tripping value of the frequency gradient can be tested with the following setting values.

Set all frequency stages to "EXIT"
df = 0.5 Hz/s, dt = 10, f_N = 50 Hz,
U_B = 40 % of Un

First of all a measuring voltage is applied the value of which must be higher than the voltage threshold for frequency measuring and the df/dt measuring. After 5 s the df/dt supervision is released (refer to chapter 4.7). The frequency generator should now run through a frequency ramp from 50 Hz to 48.6 Hz within 2.0 s which corresponds to a frequency-change speed of –0.7 Hz/s. If the frequency change during the set time dt = (T+1') x 20 ms is greater than the set trip value df, tripping will take place. In this case that means after 120 ms with a permissible tolerance of +/- 20 ms. Tripping will also take place if the frequency ramp from 50 Hz to 51.4 Hz within 2 s (+0.7 Hz/s). If the frequency ramp is set from 50 Hz to 49.4 Hz within 2 s (0.3 Hz/s), there must not be any tripping.

7.4.9 Checking the external blocking and reset functions

The external blocking input is free programmable by the user.

To test the blocking function apply auxiliary supply voltage to the external blocking input of the relay (terminals C1/C1L or C1/C1H). Inject a test voltage which could cause tripping for the tested functions. Observe that there is no trip and alarm for those functions.

Remove the auxiliary supply voltage from the blocking input. Return the test voltages to the same condition. The display should show "TRIP" now. Remove the test voltages and apply auxiliary supply voltage to the external reset input of the relay (terminals C2/C2L or C2/C2H). The display and LED indications should be reset immediately.

7.5 Primary injection test

Generally, a primary injection test could be carried out in the similar manner as the secondary injection test described above. With the difference that the protected power system should be, in this case, connected to the installed relays under test „on line", and the test voltages should be injected to the relay through the voltage transformers with the primary side energized. Since the cost and potential hazards are very high for such a test, primary injection tests are usually limited to very important protective relays in the power system.

Because of its powerful combined indicating and measuring functions, the *XRW1-3* relay may be tested in the manner of a primary injection test without extra expenditure and time consumption.

In actual service, for example, the measured voltage and frequency values on the *XRW1-3* relay display may be compared phase by phase with the concerned indications of the instruments of the switchboard to verify that the relay works and measures correctly.

7.6 Maintenance

Maintenance testing is generally done on site at regular intervals. These intervals vary among users depending on many factors: e.g. the type of protective relays employed; the importance of the primary equipment being protected; the user's past experience with the relay, etc.

For electromechanical or static relays, maintenance testing will be performed at least once a year according to the experiences. For digital relays like *XRW1-3*, this interval can be substantially longer. This is because:

- the *XRW1-3* relays are equipped with very wide self-supervision functions, so that many faults in the relay can be detected and signalised during service. Important: The self-supervision output relay must be connected to a central alarm panel!
- the combined measuring functions of the *XRW1-3* relay enable supervision the relay functions during service.
- the combined TRIP test function of the *XRW1-3* relay allows to test the relay output circuits.

A testing interval of two years for maintenance will, therefore, be recommended.
During a maintenance test, the relay functions including the operating values and relay tripping times should be tested.

8 Technical Data

8.1 Measuring input circuits

Rated data:	Nominal voltage	U_N 100 V / XRW1-31
		U_N 400 V / XRW1-34
		U_N 690 V / XRW1-37
	Frequency range	30 Hz – 80 Hz
	Nominal frequency	50/60 Hz
Power consumption in voltage circuit:	<1 VA per channel at rated	
Thermal rating:	continuously	2.00 x U_N at U_N= 100V
		2.00 x U_N ati U_N= 400V
		1.15 x U_N at U_N= 690V
Undervoltage lockout for frequency and df/dt measurement:	adjustable (5% - 100% U_N)	

8.2 Common data

Dropout to pickup ratio:	U>/U>>: >99% or –0.003U/U_N
	U</U<<: <101% oder +0.003U/U_N
	f>: >99.5% f<: <100.5%
Dropout time:	60 ms
Time lag error class index E:	±10 ms
Minimum operating time:	U = 40 ms
	f = 60 ms
	df/dt = 60 ms
Influences on voltage measuring:	
Aux. voltage:	in the range 0.8 < f/U_H/U_{HN} < 1,2 no additional influences to be measured
Frequency:	in the range 0.8 < f/f_N < 1.4 (for f_N = 50 Hz) <0.15%/Hz
Harmonics:	up tp 20% der 3rd harmonic <0.1%/per percent of the 3rd harmonic
	up to 20% der 5th harmonic <0.05%/per percent of the 5th harmonic
Influences on frequency measuring:	
Aux. voltage:	in the range 0.8 < U_H/U_{HN} < 1.2 no additional influences to be measured
Frequency:	no influences
Influences on delay time:	no additional influences to be measured

8.3 Setting ranges and steps

8.3.1 System parameter

Function	Parameter	Setting range	Steps	Tolerance
connection of voltage transformer		DELT/Y DELTA = delta connection Y = star connection		
Rated frequency	f_N	50 Hz/60 Hz		
LED pickup signalling		FLSH/NOFL		

8.3.2 Protection parameter

Function	Parameter	Setting range	Step	Tolerance
Function of the characteristic	Char 1/ Char 2	warn/trip		
Voltage characteristics Char 1/ Char 2	U<Start	Un = 100V (EXIT) 1…200V Un = 400V (EXIT) 4…800V Un = 690V (EXIT) 4…800V	1V 2V 2V	±1% from setting value or 0.3% of U_N
	U<1	Un = 100V 1…<= U<Start Un = 400V 2…<= U<Start Un = 690V 2…<= U<Start	1V 2V 2V	±1% from setting value or 0.3% of U_N
	U<2	Un = 100V >= U<1…200V Un = 400V >= U<1…800V Un = 690V >= U<1…800V	1V 2V 2V	±1% from setting value or 0.3% of U_N
	tU<2 (U<2+t>)	0,06…60s	0.02 (0,06…1.00) 0.05 (1.00…2.00) 0.1 (2.00…5.00) 0.2 (5.00…10.0) 0.5 (10.0…20.0) 1 (20.0…50.0) 2 (50.0…60)	±1% related to the measured value of voltage resp. ± 30ms see EN60255-3 + additional error
	U<3	Un = 100V >= U<2…200V Un = 400V >= U<2…800V Un = 690V >= U<2…800V	1V 2V 2V	±1% from setting value or 0.3% of U_N

* If parameter U>Start is set to « EXIT » all follow-up parameters of the characteristic will be faded out.

Function	Parameter	Setting range	Step	Tolerance
	tU<3 (U<3+t>)	> tU<2...60s	0.02 (0.06...1.00) 0.05 (1.00...2.00) 0.1 (2.00...5.00) 0.2 (5.00...10.0) 0.5 (10.0...20.0) 1 (20.0...50.0) 2 (50.0...60)	±1% related to the measured value of voltage resp. ± 30ms see EN60255-3 + additional error
	U<4	Un = 100V >= U<3...200V Un = 400V >= U<3...800V Un = 690V >= U<3...800V	1V 2V 2V	±1% from setting value or 0.3% of U_N
Voltage characteristic Char1/Char2	tU<4 (U<4+t>)	> tU<3...60s	0.02 (0.06...1.00) 0.05 (1.00...2.00) 0.1 (2.00...5.00) 0.2 (5.00...10.0) 0.5 (10.0...20.0) 1 (20.0...50.0) 2 (50.0...60)	±1% related to the measured value of voltage resp. ± 30ms see EN60255-3 + additional error
	U<5	Un = 100V >= U<1...200V >= U<4...200V Un = 400V >= U<1...800V >= U<4...800V Un = 690V >= U<1...800V >= U<4...800V	1V 2V 2V	±1% from setting value or 0.3% of U_N
	tU<5 (U<5+t>)	> tU<4...60s	0.02 (0.06...1.00) 0.05 (1.00...2.00) 0.1 (2.00...5.00) 0.2 (5.00...10.0) 0.5 (10.0...20.0) 1 (20.0...50.0) 2 (50.0...60)	±1% related to the measured value of voltage resp. ± 30ms see EN60255-3 + additional error
Release time of the undervoltage characteristic Char1/ Char2	tR	0.06...1.00s	0.02	±1% or 30ms

*Additional error :
Additional to the time error, related to EN60255-3, there is this error has to be taken into account.

Thoe minimal resolution of characteristic slope is 1V/32s. This equals to 0,03125V/s
The maximal resolution is 1V/0,005s (200V/s)

Range	Additional error of time setting
dU/dt > 10V/s	±1%
dU/dt > 1V/s <= 10V/s	±2%
dU/dt > 0,5V/s <= 1V/s	±4%
dU/dt > 0,25V/s <= 0,5V/s	±7%
dU/dt < 0,25V/s	±60%

Function	Parameter	Setting range	Step	Tolerance
Function of the voltage steps		U< (Under voltage function)/ U> (Over voltage function)		
Voltage stages U1 – U2	U1 U2	Un = 100V 1...200V (EXIT) Un = 400V 4...800V (EXIT) Un = 690V 4...800V (EXIT)	1V 2V 2V	±1% from setting value or 0.3% of U_N
	tU1 (U1+t>) tU2 (U2+t>)	0.04...300s (EXIT)	0.02 (0.04...1.00) 0.05 (1.00...2.00) 0.1 (2.00...5.00) 0.2 (5.00...10.0) 0.5 (10.0...20.0) 1 (20.0...50.0) 2 (50.0...100) 5 (100.....200) 10 (200.....300)	±1% or 30ms
Rated frequency	f_N	f = 50 Hz / f = 60 Hz		
Frequency measuring repetition	T	2...99 (Perioden)	1	
Frequency element 1 - 2	$f_1 - f_2$ t_{f1} - t_{f2} (f_1+t> - f_2+t>)	30...49.99; EXIT; 50.01...70 Hz[1] 40...59.99; EXIT; 60.01...80 Hz[2] $t_{f,min}$[3]...300 s; EXIT	0.01 (30.0...48.0) 0.1 (48.0...52.0) 0.01 (52.0...70.0) 0.01 (40.0...58.0) 0.1 (58.0...62.0) 0.01 (62.0...80.0) 0.02 (0.06 1.00) 0.05 (1.00...2.00) 0.1 (2.00...5.00) 0.2 (5.00...10.0) 0.5 (10.0...20.0) 1.0 (20.0...50.0) 2.0 (50.0...100) 5.0 (100....200) 10.0 (200....300)	0.05 Hz ±1% or ±40 ms
df/dt-Step df/dt-Measuring repetition	df dt	0,2...10 Hz/s (EXIT) 2 64 periods	0.1 (0.2...1.0) 0.2 (1.0...5.0) 0.5 (5.0...10.0) 1	0.1 Hz/s +/- 2 periods
Voltage threshold for frequency measuring	U_B<	U_N = 100 V: 5...100 V U_N = 400 V: 20...400 V U_N = 690 V: 20...400 V	1V 2V 2 V	±1% from setting value or 0.3% of U_N
Serial Interface	RS	1 - 32	1	

[1] At 50 Hz rated frequency
[2] At 60 Hz rated frequency
[3] $t_{f,min}$ min. time delay; see chapter 6.4.8

8.3.3 Interface parameter

Function	Parameter	Modbus-Protocol	RS485 Open Data Protocol
RS	Slave-Address	1 - 32	1 - 32
RS	Baud-Rate*	1200, 2400, 4800, 9600	9600 (fest)
RS	Parity*	even, odd, no	„even Parity" (fest)

* only Modbus protocol

8.4 Output relays

Contacts: 2 change-over contacts 1 and 2; 1 change-over contacts 3 - 4

The output relays have with the following characteristics:

maximum breaking capacity: 250 V AC/1500 VA/continuous current 6 A

for DC voltage:

	ohmic	L/R = 40 ms	L/R = 70 ms
300 V DC	0.3 A/90 W	0.2 A/63 W	0.18 A/54 W
250 V DC	0.4 A/100 W	0.3 A/70 W	0.15 A/40 W
110 V DC	0.5 A/55 W	0.4 A/40 W	0.2 A/22 W
60 V DC	0.7 A/42 W	0.5 A/30 W	0.3 A/17 W
24 V DC	6 A/144 W	4.2 A/100 W	2.5 A/60 W

Max. rated making current: 64 A (VDE 0435/0972 and IEC 65/VDE 0860/8.86)
Making current: max. 20 A (16 ms)
mechanical life span: 30×10^6 operating cycles
electrical life span: 2×10^5 operating cycles at 220 V AC/6 A
Contact material: Silber-Cadmium-Oxyd (AgCdO)

8.5 Power supply

Auxiliary voltage: 16 - 360 V DC/16 - 270 V AC

Power consumption: standby 3 Woperating ca. 5 W

Max. allowed interruption of the auxiliary supply without effecting the function of the device: 50 ms

Propper connection of the earthing terminal ⊥ is essential for the EMC withstand of the relay.
Use wires of min. 1.5 mm^2.

8.6 Inputs, blockage and reset

Low-range:
For rated voltages 24 V, 48 V, 60 V U_{AN} ≥10 V U_{AB} ≤8 V
Current consumption 1 mA DC bei 24 V

High-range:
For rated voltages 100 V, 110 V, 125 V, 220 V, 230 V U_{AN} ≥70 V U_{AB} ≤60 V
Current consumption 1.5 mA DC 270 V oder 11.0 mA AC

8.7 System data and test specifications

Design standards:	
Generic standard	EN 50082-2, EN 50081-1
Product standard	EN 60255-6, IEC 255-4, BS 142
Specified ambient service:	
recommended temperature for operation	
in storage:	- 40°C bis +85°C
in operation:	- 20°C bis +70°C

Moisture-carrying capacity class F as per DIN 40040 and per DIN IEC 68, part 2-3:	rel. humidity <95% at 40°C for 56 days

Insulation test voltage, inputs and outputs
EN 60255-6:
IEC 255-5: 2,5 kV (eff.)/50 Hz.; 1 min.
Impulse test voltage IEC 255-5: 5 kV; 1,2/50 µs, 0,5 J
High frequency interference test voltage IEC 255-22-1: 2,5 kV/1 MHz

Electrical discharge (ESD) test as per EN 61000-4-2, IEC 255-22-1:	8 kV air discharge, 6 kV contact discharge

Electrical fast transient (Burst) test as per EN 61000-4-8, IEC 255-22-1:	4 kV/2.5 kHz, 15 ms

Power frequency magnetic field immunity test:	100 A/m continuously 1000 A/m for 3 s

Radiated electromagnetic field disturbance
test as per ENV 50140, IEC 255-22-3: electric field strength: 10 V/m

Guided radiated electromagnetic field disturbance test as per ENV 50141:	electric field strength: 10 V/m

Surge immunity test as per EN 61000-4-5: EN 61000-4-5:	4 kV

Radio interference suppression test as per EN 55011:	limit value class B

Radio interference radiation test as per EN 55011:	limit value class B

Mechanical test:

Shock:	Class 1 as per DIN IEC 255 T 21-2
Vibration:	Class 1 as per DIN IEC 255 T 21-1
Degree of protection:	IP 40 at closed front cover
Back side:	IP 00
Overvoltage class:	III
Weight:	1.6 kg
Relay case material:	self-extinguishing

Technical data subject to change without notice!

8.8 Relay case

Relay ***XRW1-3*** is designed to be fastened onto a DIN-rail acc. to DIN EN 50022, the same as all units of the *PROFESSIONAL LINE*.

The front plate of the relay is protected with a sealable transparent cover (IP40).

Dimensional drawing

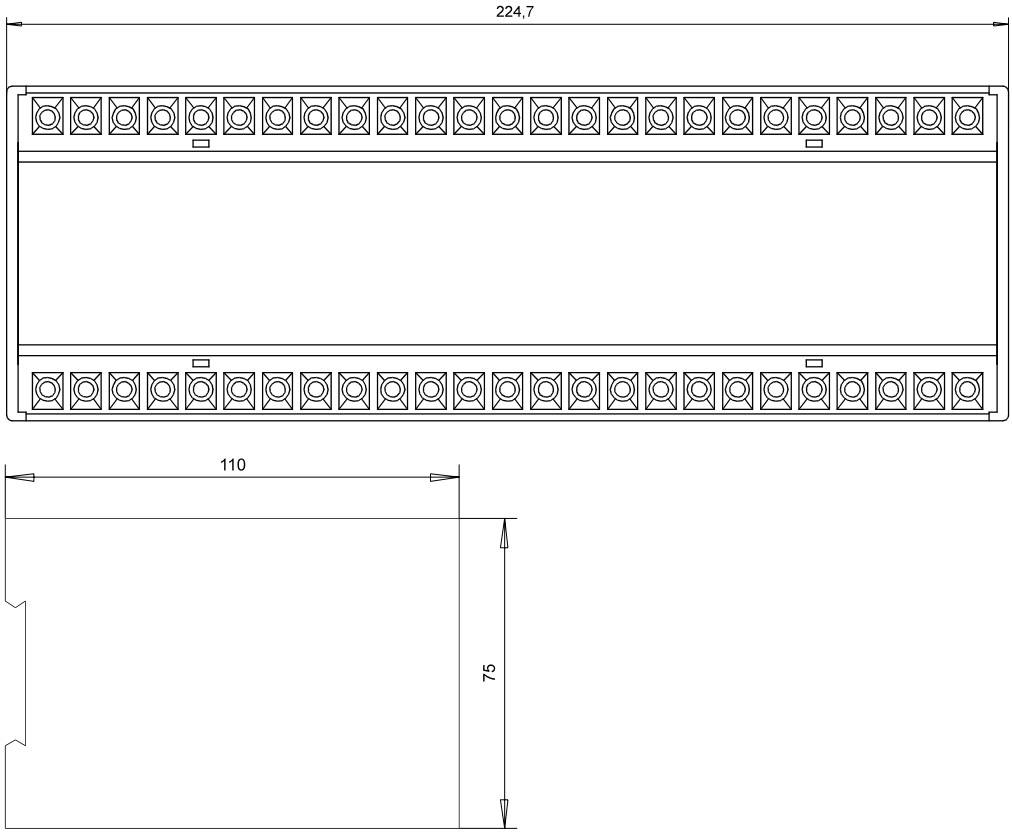

Figure 8.1: Dimensional drawing, dimensions in mm

Connection terminals

The connection of up to a maximum 2 x 2.5 mm^2 cross-section conductors is possible. For this the transparent cover of the unit has to be removed.

9 Order form

Mains decoupling relay		***XRW1-***	**3**	
Voltage, frequency and df/dt-supervision				
Rated voltage	100 V			**1**
	400 V			**4**
	690 V			**7**
Communication protocole RS485 Pro Open Data; Modbus RTU				**-M**

		Yes	**No**
Interface adapter	***RSC2-485-232-1***		
Interface adapter RS232 and RS485 (with galvanical decoupling)			

Important: For supplying the interface adapter needed:

		Yes	**No**
Plug-in power supply for interface transformer	***RSC2-NT1-230***		
230 V 50/60 Hz with german safety plug			

		Yes	**No**
Diagnosis- and parameterizing software	***HTL/PL-Soft4***		

Setting list *XRW1-3*

Project: _____ SEG-job.-no.: _____

Function group: = _____ Location: + _____ Relay code: - _____

Relay functions: _____ Password: _____

Date: _____

Setting of the parameter

Systemparameter

Function		Unit	Default settings	Actual settings
Δ/Y	input transformer connection		DELT	
f_N	Rated frequency	Hz	50	
	LED blinking after pick-up		FLSH	

Protection parameter

Function		Unit	Default settings	Actual settings
	Voltage limit curve 1			
Char 1	Function of the characteristic curve 1		warn	
U<Start	Start point of the characterstic curve 1	V	85/340/586*	
U<1	1. Char. point_value 1	V	45/180/310*	
	1. Char. point_value 2 (not changeable)	s	- / -	
U<2	2. Char. point_value 1	V	45/180/310*	
U<2+t>	2. Char. point_value 2	s	0.16	
U<3	3. Char. point_value 1	V	70/280/482*	
U<3+t>	3. Char. point_value 2	s	0.16	
U<4	4. Char. point_value 1	V	70/280/482*	
U<4+t>	4. Char. point_value 2	s	0.70	
U<5	5. Char. point_value 1 (U-voltage band)	V	85/340/586*	
U<5+t>	5. Char. point_value 2 (End time)	s	1.50	
tR	Permissible release time for characteristic 1	s	0.10	
	Voltage limit curve 2			
Char 2	Function of the characteristic curve 2		trip	
U<Start	Start point of the characteristic curve 2	V	85/340/586*	
U<1	1. Char. point_value 1	V	15/60/104*	
	1. Char. point_value 2 (not changeable)	s	- / -	
U<2	2. Char. point_value 1	V	15/60/104*	
U<2+t>	2. Char. point_value 2	s	0.66	
U<3	3. Char. point_value 1	V	85/340/586*	
U<3+t>	3. Char. point_value 2	s	3.00	
U<4	4. Char. point_value 1	V	85/340/586*	
U<4+t>	4. Char. point_value 2	s	3.00	
U<5	5. Char. point_value 1 (U-voltage band)	V	85/340/586*	
U<5+t>	5. Char. point_value 2 (End time)	s	3.00	
tR	Permissible release time for characteristic curve 2	s	0.10	

* Setting dependent on rated voltage 100V/400V or 690V

Protection parameter (continuation)

Function		Unit	Default settings	Actual setting
U1	Function of the 1st voltage step		U<	
U1	Pick-up value for the 1st voltage step	V	85/340/586*	
U1+t>	Tripping time for the 1st voltage step	s	5.00	
U2	Function of the 1st voltage step		U>	
U2	Pick-up value for the 1st voltage step	V	120/480/800*	
U2+t>	Tripping time for the 1st voltage step	s	1.00	
T	Measuring repetition for frequency measuring	Periods	4	
f_1	Pick-up value for the 1st frequency step	Hz	47.50	
t_{f1}	Tripping delay of the 1st frequency step	s	0.1	
f_2	Pick-up value for the 2nd frequency step	Hz	51.50	
t_{f2}	Tripping delay for 2nd frequency step	s	0.1	
df	Pick-up value für rate of change of df/dt	Hz/s	EXIT	
dt	measuring repetition fot df/dt	Periods	4	
U_B	Voltage threshold for frequency measuring	V	10/23/68*	

* Settings depending on the rated voltage 100V/400V or 690V

Parameter for serial interface

RS	Slave address of the serial interface		1	
RS	**Setting of the Baud-Rate		9600	
RS	**Parity check		even	

* Settings depending of the rated voltage 100V/400V or 690V
** only Modbus protocol

Assignment of the output relays

Function	Relay 1		Relay 2		Relay 3		Relay 4	
	Default settings	Actual settings	Default settings	Actual settings	Default settings	Actual settings	Default settings	Actual settings
Char. 1 cycle running								
Char. 1 trip/alarm			X					
Char. 2 cycle running					X			
Char 2 trip/alarm	X							
U1 alarm							X	
tU1 trip	X							
U2 alarm							X	
tU2 trip	X							
f1 alarm							X	
tf1 trip	X							
f2 alarm							X	
tf2 trip	X							
df/dt trip	X							

Blockage function

	Default setting		Actual setting	
	Blocked	Not blocked	Blocked	Not blocked
Char 1	X			
Char 2	X			
U1	X			
U2		X		
f1	X			
f2		X		
df/dt	X			

Setting of the dip switches

Dip switch	1 (PSW)		2		3		4	
	Default setting	Actual setting	Default setting	Actual setting	Default setting	Actual setting	Default setting	Actual setting
ON			No function				No function	
OFF	X		X		X		X	

This technical manual is valid for software version number:

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