



XA1 – Voltage balance relay

Manual XA1 (Revision A)

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1. Applications and features

Relay XA1 of the PROFESSIONAL LINE is a digital relay for voltage balance supervision of 3-phase systems and provides protection for electrical power generators and general equipment against voltage unbalance e.g. due to blown fuse or conductor break.

When compared to conventional protection equipment all relays of the PROFESSIONAL LINE reflect the superiority of digital protection technique with the following features:

- High measuring accuracy by digital processing
- Fault indication via LEDs
- Extremely wide operating ranges of the supply voltage by universal wide range power supply unit
- Wide setting ranges very accurately graded
- Data exchange with process management system by serial interface adapter XRS1 which can be retrofitted
- Extremely short reaction times
- Adjustment of rated data
- Negative sequence measuring of voltage unbalance
- Compact design by SMD-technology

In addition to this relay XA1 has the following special features:

- Different switching hysteresis adjustable
- Measurement phase-to-neutral or phase-to-phase voltage possible

2. Design

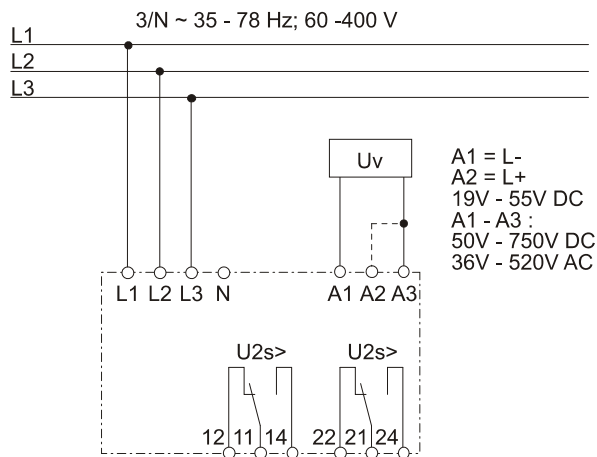


Figure 2.1: Connection three wire system; DIP-switch setting □

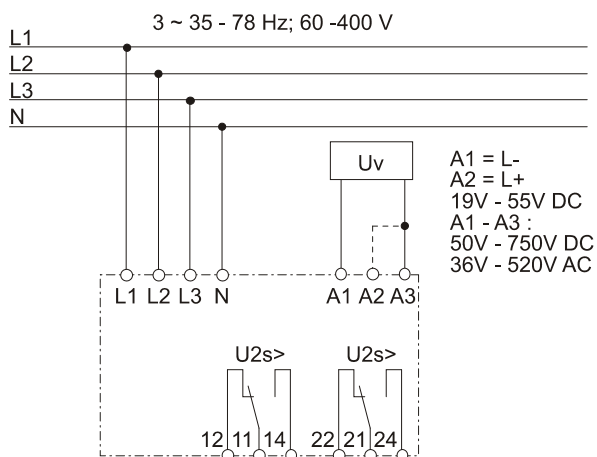


Figure 2.2: Connection four wire system; DIP-switch setting Y or Δ

Analog inputs

The analog voltage input signals are connected to the protection relay via terminals L1 - L3 and N.

Auxiliary voltage supply

The XA1 can be supplied directly from the measuring quantity itself or by a secured aux. supply. Therefore a DC or AC voltage must be used.

Unit XA1 has an integrated wide range power supply. Voltages in the range from 19 - 55 V DC can be applied at connection terminals A1(L-) and A2(L+). Terminals A1/A3 are to be used for voltages from 50 - 750 V DC or from 36 - 520 V AC.

Contact Positions

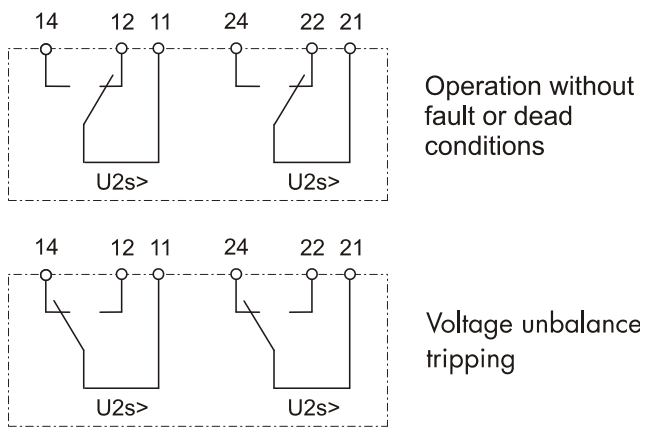


Figure 2.3: Contact positions of the output relays

3. Function

The XA1 detects unbalanced voltages in terms of value and phase position. Such unsymmetric conditions can occur due to break of a conductor, blown fuses or un-balanced loading of the three phases system.

These conditions always result in displacement of the star point. The negative sequence voltage is measured by the XA1 and so correct tripping after the adjusted time delay is ensured.

Measuring principle:

A rotating three-phase system can be split according to the method of „Symmetrical Components“ into a positive-sequence system, a negative-sequence system and a zero sequence system. The XA1 calculates the negative-sequence system by rotating the voltage vector U_2 by 240° and the voltage vector U_3 by 120° and following addition of the voltage-vectors.

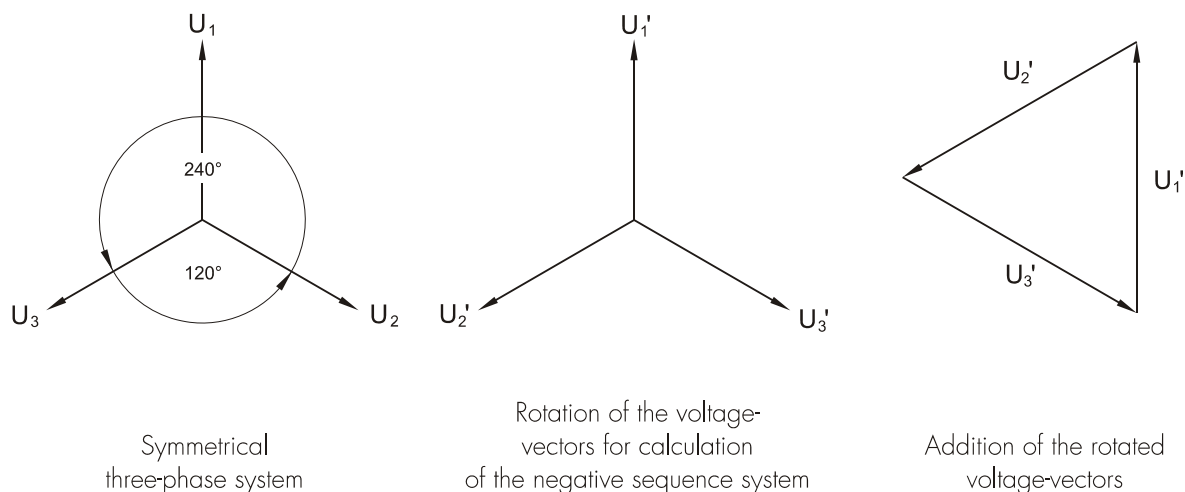


Figure 3.1: Symmetrical three-phase system

A rotating field is produced with opposite direction of rotating field. If the voltages of this negative-sequence system are added, the sum is zero in case of symmetrical voltages and angles.

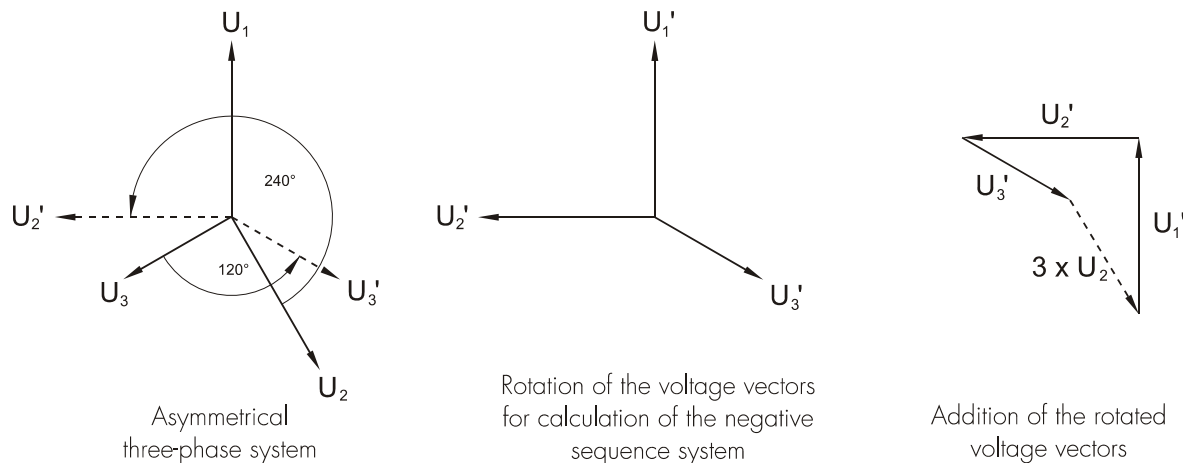


Figure 3.2: Asymmetrical three-phase system

In figure 3.2 voltages of an asymmetrical system are shown. The XA1 calculates the negative-sequence system by rotating and following addition of the voltage vectors. The adjusting pickup value related to the rated voltage U_n . At phase loss (and correct phase angle) the asymmetrical voltage amounts to 33 % U_n .

4. Operation and settings

All operating elements needed for setting parameters are located on the front plate unit XA1 as well as all display elements.

Because of this all adjustments of the unit can be made or changed without disconnecting the unit from the DIN-rail.

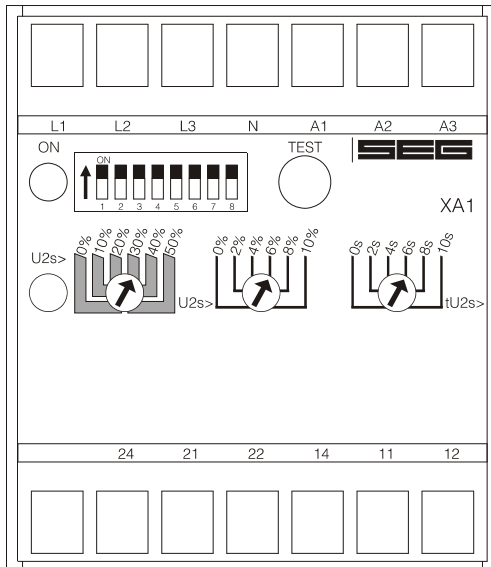


Figure 4.1: Front plate

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.

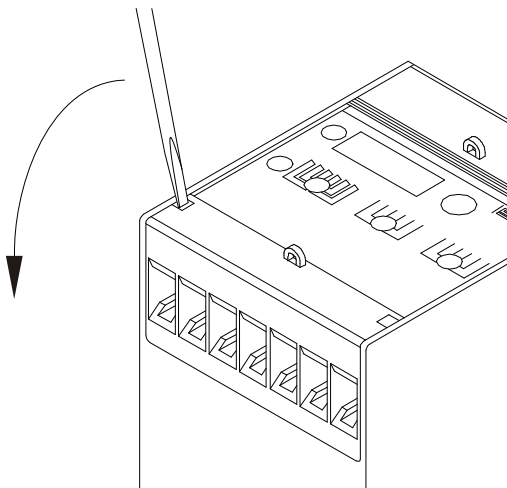


Figure 4.2: How to open the transparent cover

LEDs

LED "ON" is used for display of the readiness for operation (at applied auxiliary voltage U_v). LED U2s> indicates pickup by flashing, at trip of the voltage unbalance supervision the LED is lit permanently.

Test push button

This push button is used for test tripping of the unit and when pressed for 5 s a check-up of the hardware takes place. Both output relays are tripped and all tripping LEDs light up.

4.1 Setting of DIP-switches

The DIP-switch block on the front plate of unit XA1 is used for adjustment of the nominal values and setting of function parameters:

DIP-switch	OFF	ON	Functions
1*	Un = 60 V	Un = 110 V	Setting of rated voltage
2*	Un = 60 V	Un = 230 V	
3*	Un = 60 V	Un = 400 V	
4			
5	Y	Δ	Measurement phase-to-neutral/phase-to-phase voltage
6*	1 %	2 %	Switching hysteresis for U2s>
7*	1 %	5 %	
8*	1 %	10 %	

Table 4.1: Function at DIP-switches

* Only one of the DIP-switches 1 - 3 and 6 - 8 shall be in „ON“ position at the same time.

Rated voltage

The required rated voltage Un (phase-to-phase voltage) can be set with the aid of DIP-switch 1 - 3 to 60, 110, 230 or 400 V AC. It has to be ensured that only one of the three DIP-switches is switched on. The following DIP-switch configurations are permissible for adjustment of the rated voltage:

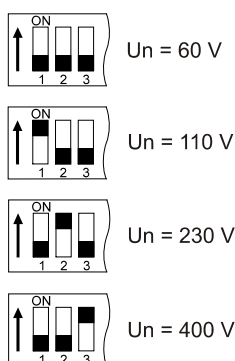


Figure 4.3: Adjustment of rated voltage

Rated voltage chosen too low, does not cause destruction of the unit but leads to wrong measuring results which may lead to false trippings.

Measurement of phase-to-neutral / phase-to-phase voltage

The phase-to-neutral (position "OFF") or phase-to-phase voltage (position "ON") can be adjusted by means of switching over the DIP-switch 5. (see fig. 2.1 and 2.2.)

Switching hysteresis

The switching hysteresis for U2s> can be adjusted with the aid of DIP-switches 6 - 8 to 1, 2, 5 or 10 % of the tripping value. As for the rated voltage, it has to be ensured that only one of the two DIP-switches is switched on.

4.2 Setting of the tripping values

The PROFESSIONAL LINE units have the unique possibility of high accuracy fine adjustments. For this, two potentiometers are used. The course setting potentiometer can be set in discrete steps of 10 %. A second fine adjustment potentiometer is then used for continuously variable setting of the final 0 - 10 %. Adding of the two values results in the precise tripping value.

Asymmetry trip element

The trip element can be set in the range of 0 - 60 % U_n with the aid of the potentiometer illustrated on the following drawing.

Example:

A pickup value U_{2s} for 36 % U_n is to be set. The set value of the right potentiometer is just added to the value of the coarse setting potentiometer. (The arrow of the coarse setting potentiometer must be in-side the marked bar, otherwise no defined setting value).

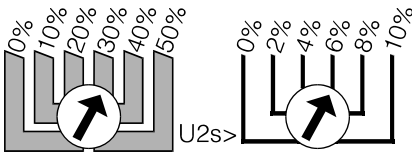


Figure 4.4: Adjustment example

Time delay

The time delay $t_{U_{2s}}$ can be adjusted continuously variable in the range from 0 - 10 s.

4.3 Communication via serial interface adapter XRS1

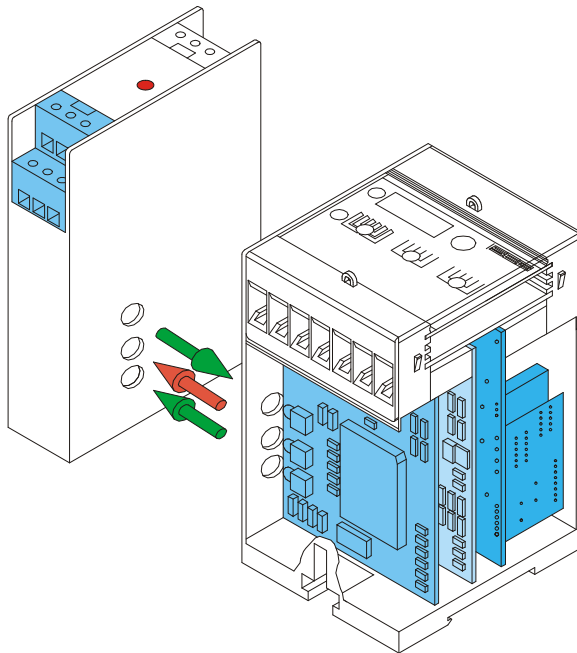


Figure 4.5: Communication principle

For communication of the units with a superior management system, the interface adapter XRS1 is available for data transmission, including operating software for our relays. This adapter can easily be retrofitted at the side of the relay. Screw terminals simplify its installation. Optical transmission of this adapter makes galvanic isolation of the relay possible. Aided by the software, actual measured values can be processed, relay parameters set and protection functions programmed at the output relays. In-formation about unit XRS1 in detail can be taken from the description of this unit.

5. Relay case and technical data

5.1 Relay case

Relay XA1 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).

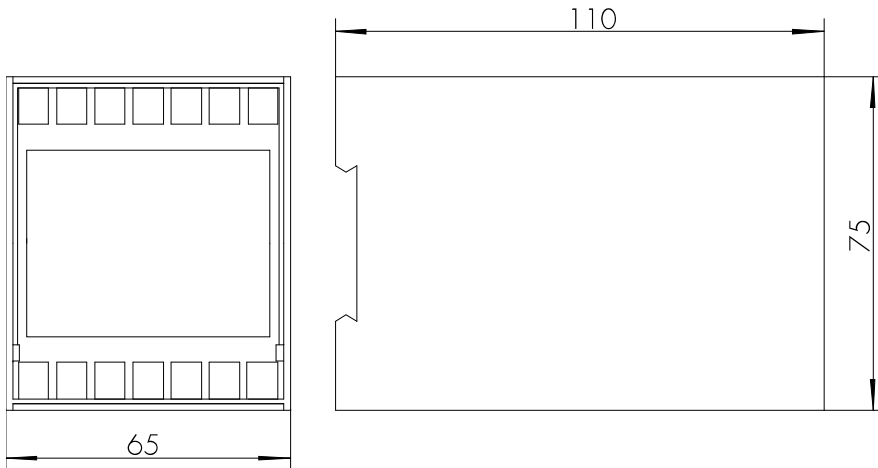


Figure 5.1: Dimensional drawing

Connection terminals

The connection of up to a maximum of 2 x 2.5 mm² cross-section conductors is possible. For this the transparent cover of the unit has to be removed (see para. 4).

5.2 Technical data

Measuring input circuits

Rated voltage U_n : 60, 110, 230, 400 V AC
 Rated frequency range: 35 - 78 Hz (35 - 66 Hz at communication via serial interface)

Power consumption in voltage circuit: 1 VA/per phase at U_n

Thermal capacity of the voltage circuit: continuously 520 V AC

Auxiliary voltage
 Rated auxiliary voltage U_v : 36 - 520 V AC (f = 35 - 78 Hz) or 50 - 750 V DC / 4 W (terminals A1-A3)

Power consumption: 19 - 55 V DC / 3 W (terminals A1(L-) and A2(L+))

Common data

Dropout to pickup ratio: depending on the adjusted hysteresis

Resetting time from pickup: <70 ms

Returning time from trip: 190 - 280 ms

Minimum initialization time after supply voltage has applied: <290 ms

Minimum response time when supply voltage is available: 70 - 130 ms

Output relay

Number of relays: 2
 Contacts: 1 changeover contact for each trip relay
 Maximum breaking capacity: ohmic 1250 VA/AC resp. 120 W/DC
 inductive 500 VA/AC resp. 75 W/DC
 Max. rated voltage: 250 V AC
 220 V DC ohmic load $I_{max.} = 0.2$ A
 24 V DC inductive load $I_{max.} = 0.1$ A at $L/R \leq 50$ ms
 inductive load $I_{max.} = 5$ A
 Minimum load: 1 W / 1 VA at $U_{min} \geq 10$ V
 Maximum rated current: 5 A
 Making current (16 ms): 20 A
 Contact life span: 10^5 operations at max. breaking capacity

System data

Design standard: VDE 0435 T303; IEC 0801 part 1-4, VDE 0160; IEC 255-4; BS 142; VDE 0871

Temperature range at storage and operation: - 25 °C to + 70 °C

Constant climate class F acc. to DIN 40040 and DIN IEC 68, part 2-3: more than 56 days at 40°C and 95 % relative humidity

High voltage test acc. to VDE 0435, part 303

Voltage test: 2.5 kV (eff) /50 Hz; 1 min

Surge voltage test: 5 kV; 1.2/50 μ s, 0.5 J

High frequency test: 2.5 kV / 1 MHz

Electrostatic discharge (ESD) acc. to IEC 0801, part 2: 8 kV

Radiated electromagnetic field test acc. to IEC 0801, part 3: 10 V/m

Electrical fast transient (burst) acc. to IEC 0801, part 4:	4 kV/2.5 kHz, 15 ms	
Radio interference suppression test acc. to DIN 57871 and VDE 0871:	limit value class A	
Repeat accuracy:	1 %	
Basic time delay accuracy:	0.5 % or ± 25 ms	
Accuracy of the specific rated values:	Un = 60 V	2 %
	Un = 110 V / 230 V / 400 V	1 %
Temperature effect:	0.02 % per K	
Frequency effect:	45 - 66 Hz no tolerance	
	35 - 45 Hz and 66 - 78 Hz 1 %	

Mechanical test

Shock:	class 1 acc. to DIN IEC 255-21-2
Vibration:	class 1 acc. to DIN IEC 255-21-1

Degree of protection

Front plate:	IP40 at closed front cover
Weight:	approx. 0.5 kg
Mounting position:	any
Relay case material:	self-extinguishing

Parameter	Setting range	Graduation
U2s>	0 - 60 % Un	continuously variable
tU2s	0 - 10 s	continuously variable
Hysteresis for U2s	1, 2, 5, 10 %	

Table 5.1: Setting ranges and graduation

Technical data subject to change without notice!

Setting-list XA1

Project: _____ Woodward job.-no.: _____

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

Relay functions: _____ Date: _____

Setting of parameters

Function		Unit	Default settings	Actual settings
U2s>	Voltage asymmetric	% Un	0	
tU2s>	Time delay for tU2s>	s	0	

DIP-switch	Function	Default settings	Actual settings
1*		60 V	
2*	Adjustment of rated voltage	60 V	
3*		60 V	
4			
5	Measuring phase-to-neutral / phase-to-phase voltage	Y	
6*		3 %	
7*	Hysteresis for U2s>	3 %	
8*		3 %	

*Only one of the DIP-switches 1 - 3 or 6 - 8 shall be in „ON“-position at the same time.

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