PROTECTA

Electronics Co. Ltd

Electronic, self-powered overcurrent protection

AZT 3/0

with IDMT characteristics and power storage for CB operation

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User's manual version information

Version	Datum	Modification	Compiled by
.00	June 1993	First Hungarian version	Póka
.01	March 2006	English version	Petri

CONTENTS

1 Application, main features

The self-powered AZT 3/0 electronic overcurrent protection has a special construction, the main characteristics of which are as follows:

- The device is self-powered; it does not need auxiliary power supply for the operation. The power source is the current transformer set.
- The device has power storage capacity; no auxiliary power is needed to operate the circuit breaker. The power is stored in internal capacitances, charged from the current transformers during the fault.
- The overcurrent protection has special inverse definite minimum type characteristics.
- The characteristics can be shifted parallel along the time axis.
- As an option the protection can be extended with special logic for discontinuity in one of the phase conductors.

The features above have main advantages in applications as a back-up protection. In case of failure of the auxiliary DC power supply of the substation this device provides back-up protection. It can be applied for selective protection in mashed networks too, due to the special IDMT characteristics.

The device is constructed for three phase connection, the electronic circuits select the phase with the largest current for processing and comparison with a special inverse minimum definite time characteristics. The internal capacitance can store sufficient power to operate all three phases of a circuit breaker set with individual drives.

The device with unchanged structure can be applied as a zero sequence back-up protection. In this case the internal circuits of the protection are unchanged, only the external connections are to be modified.

2 Construction, arrangement

The AZT 3/0 device is housed in a closed steel case, which can be mounted on a relay panel, the connections are located on the front side. The capacitors for power storage are mounted internally on the main panel. On the lower part of the casing six intermediate current transformers are mounted. The printed circuit board (marked as AZT-13) at the topside of the casing contains the overcurrent relays, the power supply unit delivering internal ±15V power supply voltages, and the trip and signalling relay contacts. The signalling LED-s and the counters are located here too. The optional printed circuit board of the logic for discontinuity in one of the phase conductors can be mounted in the middle of the casing (see chapter 7).

The K1 micro switchboard for setting the limit value of the I> overcurrent protection is located in the middle of the front panel. The K2 micro switchboard located on the right side of the front panel serves setting the time shift of the current dependent characteristics.

The 21 pieces of the Weindmüller external connectors of the device are located on the bottom part of the casing.

3 External connections

For application of the AZT 3/0 device as three-phase back-up overcurrent protection the connection is indicated in Fig. 1. The connection for zero sequence overcurrent protection is shown on Fig. 2.

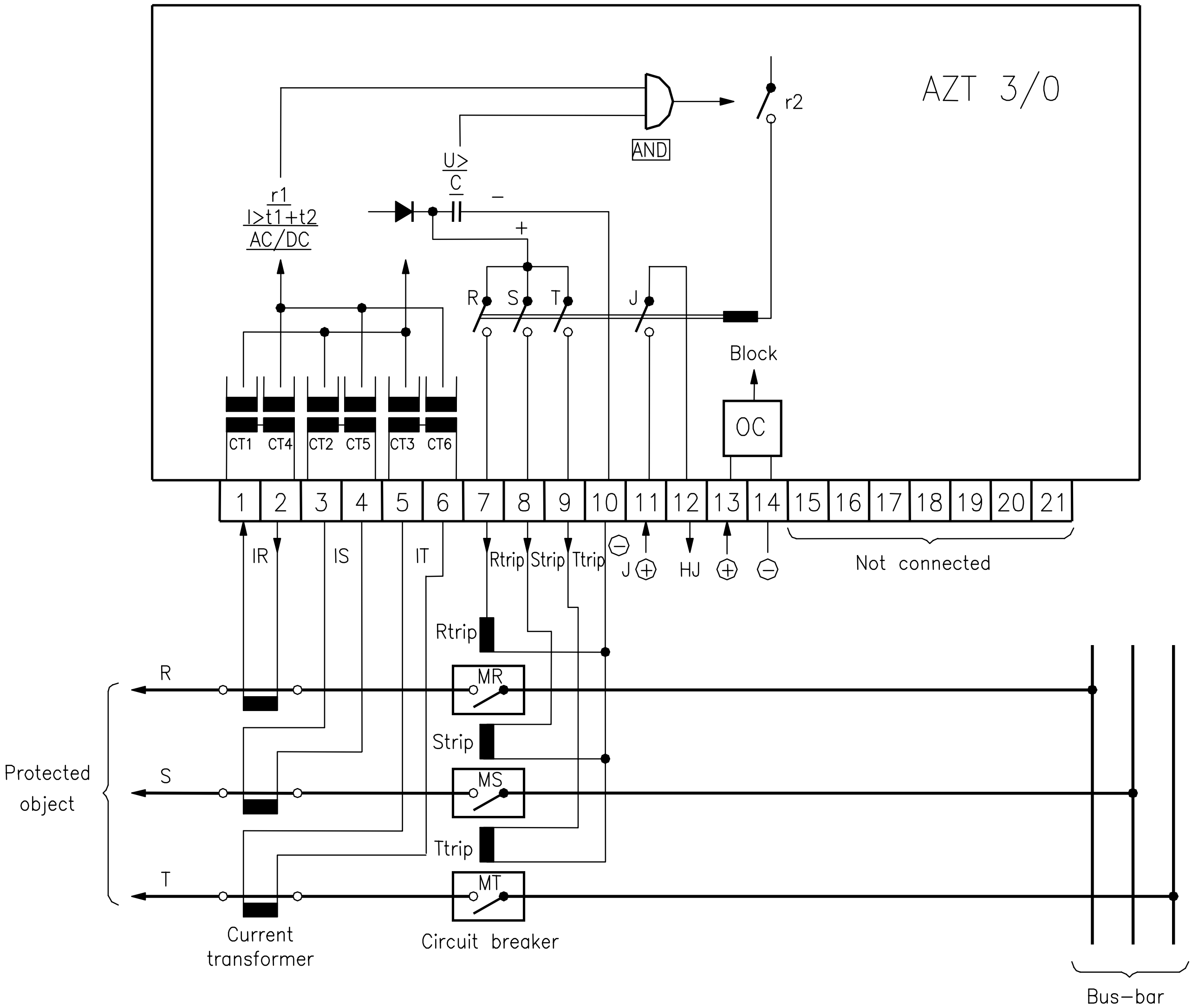
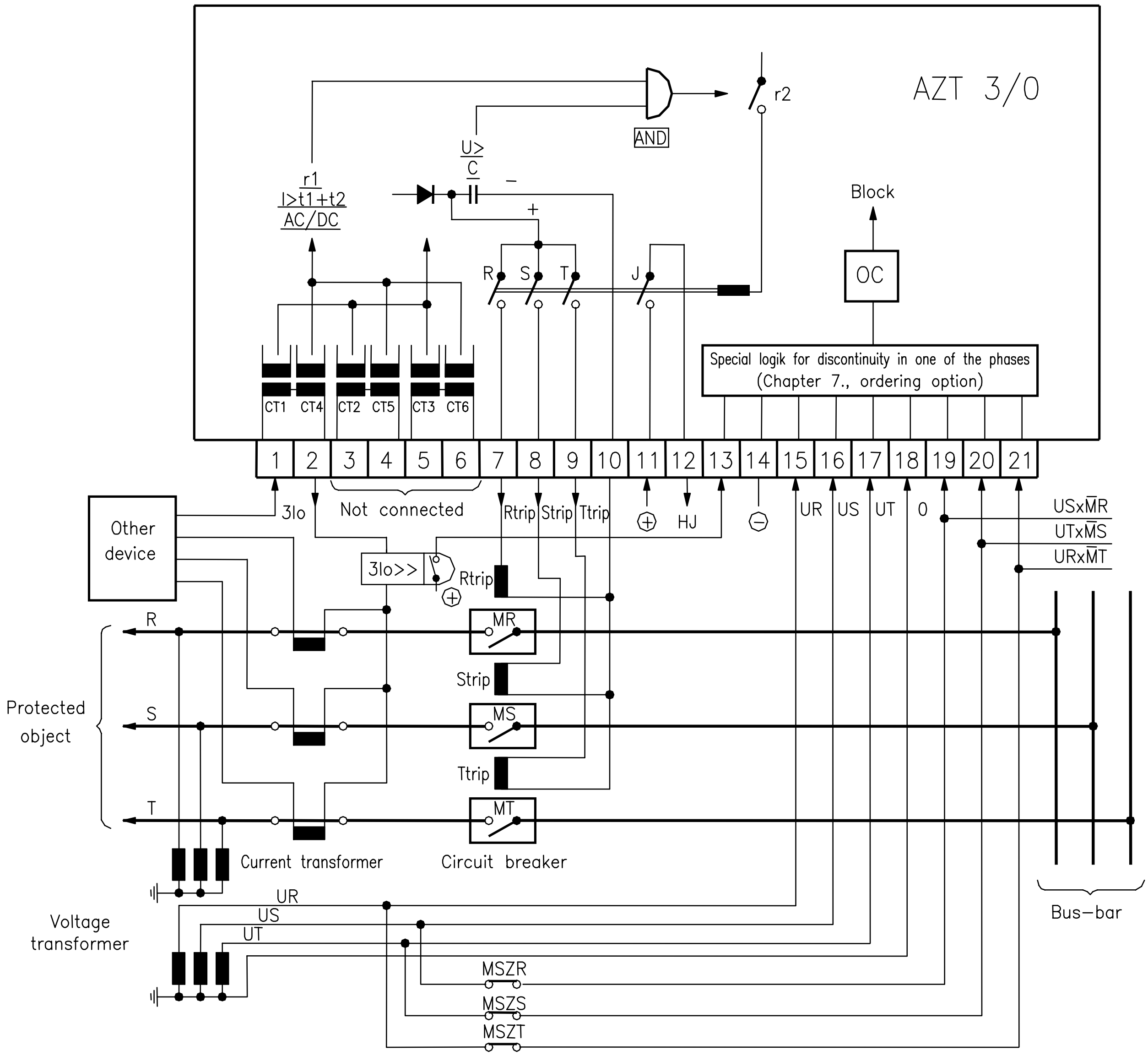


Fig.1. AZT 3/0 application as three-phase overcurrent back-up protection

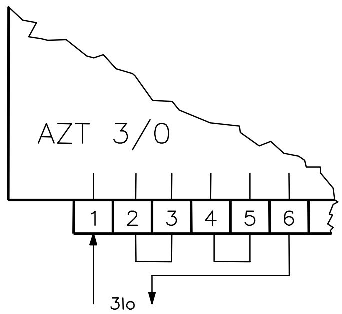
Remarks:

- When connecting 1 –6, a neutral point can be formed as well.
- To keep reliability the serial connection of other devices is not recommended.
- In the secondary wires connected to 7 – 9, no auxiliary contacts of the circuit breaker may be inserted



OC optical interface
MSZ Circiut breaker auxiliary contacts

Figure 2.a Setting ranges
1/M(1,5 … 3,48)
t2= 3 … 6 s



Remarks:

- To the connectors 1 – 2 other devices can be connected serially, but for the reliable operation it is not recommended.
- No auxiliary contacts of the circuit breakers may be inserted in the auxiliary circuit of connectors 7 – 9

Figure 2.b Setting ranges
1/M(1 … 3,48)
t2= 0 … 6 s

Remark: all other connections as in Fig 2.a

Fig. 2 Connections in zero sequence overcurrent applications

The current inputs are the connector pairs (1 and 2), (3 and 4), (5 and 6). To each connector pair two internal intermediate current transformers are connected. One group of them (including CT1, CT2 and CT3) serve charging the capacitors for power storage, the other group (including CT4, CT5 and CT6) supply the inverse definite minimum time overcurrent protection circuits. These connectors are interconnected with the secondary circuits of the main current transformers in phases R, S and T. If the device is applied as zero sequence overcurrent protection, only the pair of connectors 1 and 2 is applied according to Fig. 2 a. It must be emphasized that in case of three-phase connection and in case of connection according to Fig. 2 a the setting range of the overcurrent protection function is:

1/M (1,5 … 3,48)In [A]

and the t2 time shift is in the range:

3 … 8 [s]

(See details in chapter 5). If however the device is applied for zero sequence overcurrent protection, then it can be useful to increase the range by serial connection of the current inputs according to Fig. 2 b. In this case the setting range of the overcurrent protection function is extended to:

1/M (1 … 3,48)In [A]

and the t2 time shift is in the range:

0 … 8 [s]

The disadvantage of this extension is however that the power consumption of the device is three times of that as explained in Fig. 2 a. (See details in chapter 8: technical information).

The extension of the setting range is allowed by the fact that in case of charging the power storage by zero sequence current is quicker. The extended range could be applied in the other case as well, but for certain fault types the relay could operate quicker than the time needed for full power storage, and the enabling voltage relay of the power storage with the 300V factory setting permits tripping command after a longer delay only, as compared to the rated characteristics according to Fig. 7.

The tripping command is generated on the connections 7, 8 and 9 for the three tripping coils of the circuit breaker phases. This means that the three operating contacts "discharge" the stored capacitive power to the tripping coils of the circuit breaker. Accordingly for the closed circuit the common (-) pole of the coils must be connected to the connector 10.

The connections described above (current inputs and tripping command outputs) are sufficient for reliable back-up protection tripping. So it is advisable to design the secondary cabling as short and as safe as it is possible. The preferred solution is to locate this protective device in the cabinet for the circuit breaker drives (or in the cabinet of the current transformers), and the cabling can be direct instead of using the usual cable ducts. The additional advantage of this solution is that even in case of fire this device can be the safe protection.

Similarly for safety reasons the auxiliary contacts of the circuit breakers must be excluded from the tripping circuits, which are usually involved in these circuits. In case of battery-supplied tripping circuits it is necessary because the internal tripping relays of the protective devices cannot interrupt the current of the tripping coils. When applying AZT 3/0 this is not needed, because the capacitor delivering the tripping power is discharged in a short operation time, and practically no current interruption is needed. If the auxiliary contacts of the circuit breakers are excluded from the tripping circuits then the reliability of the system is increased.

The connectors 11-12 are connected to an independent internal relay contact (J), which is closed together with the tripping command. This contact serves status-signalling, data acquisition or supervisory functions. It can be applied for measurement of the protection operating time by stopping a timer. It can serve operation with 220 V DC as well.

When DC voltage is applied on connectors 13-14 with the indicated polarity, then this signal disables the operation of the AZT 3/0 device. The lack of the voltage enables the operation. If no voltage is connected to these connectors then the device is operable. These inputs serve external enabling or disabling, but the main application is disabling in case of discontinuity in one of the phase conductors.

The connectors 15 … 21 are applied only in the logic of discontinuity in one of the phase conductors (See details in chapter 7). Connectors 13-14 are used for this purpose too. Connector 13 inputs the positive pole of the station battery voltage via NC contact of the external 3Io>> zero sequence overcurrent protection. This voltage resets in case of operation of this protection. Connector 14 gets the negative pole of this battery voltage. The UR, US, UT and Uo secondary voltages of the voltage transformers are connected to connectors 15, 16, 17 and 18; they serve the disabling logic. The status signals of the circuit breaker poles are connected to connectors 19, 20 and 21. In order to be independent of the station battery voltage they connect the cyclically exchanged voltages of the voltage transformers of the same bay via NC auxiliary contacts of the circuit breakers. This method can assure that if the circuit breaker is closed in one of the phases and at the same time the voltage disappears, this information is available for the disabling logic in case of discontinuity in one of the phase conductors (See details in chapter 7).

If for any reasons the device must be opened then the connectors 1 … 8 towards the main current transformers must be closed, and the wires towards the device must be interrupted. The external voltages (connectors 11 … 21) must be disconnected too.

4 Status signalling, counters

The man-machine interface of the AZT 3/0 device consists of two red LED-s and two counters of five digits each. The LED-s and the counters are located in the middle of the front side, the can be seen in closed state of the housing too.

The LED on the left side (denoted as L1) is turned on, and the counter (denoted as Sz1) below the LED counts up if the internal I> overcurrent relay starts operation and the contact R1 closes. The LED turns off, if the voltage of the capacitor storage is above 300 V, or the overcurrent relay resets. In this case the contact R1 drops too. Using this indication the calibration of the setting value of the I> overcurrent relay is easy.

The LED on the right side (denoted as L2) is turned on, and the counter (denoted as Sz2) below the LED counts up if the both the t1 current dependent and the t2 definite timer expire, which indicates that the protection generated trip command. In this case the relay contact R2 is closed, the J signal relay operates too, and the R, S and T trip commands are generated.

5 Parameter setting

5.1 Setting the I> overcurrent stage

The setting value of the I> overcurrent relay is defined by the following formula:

$$I >= \frac{1}{M}(1+\Sigma a)I_n \qquad (5.1)$$

In this formula:

M multiplier defined by the turn's ration of the intermediate current transformers,

Σa is the sum of the values assigned to the set of switches denoted by K1,

In is the rated current of the protective device.

The set of K1 switches are located on the left side of the front cover (see Fig. 3). They have fives elements, the assigned vales are (if the switches are in the left position):

Identifier	Value in ON position
1	1,28
2	0,64
3	0,32
4	0,16
5	0,08

The total sum of the switches is 2,48, the default value is 1 so the setting range is:

1 … 3,48 with steps 0.08

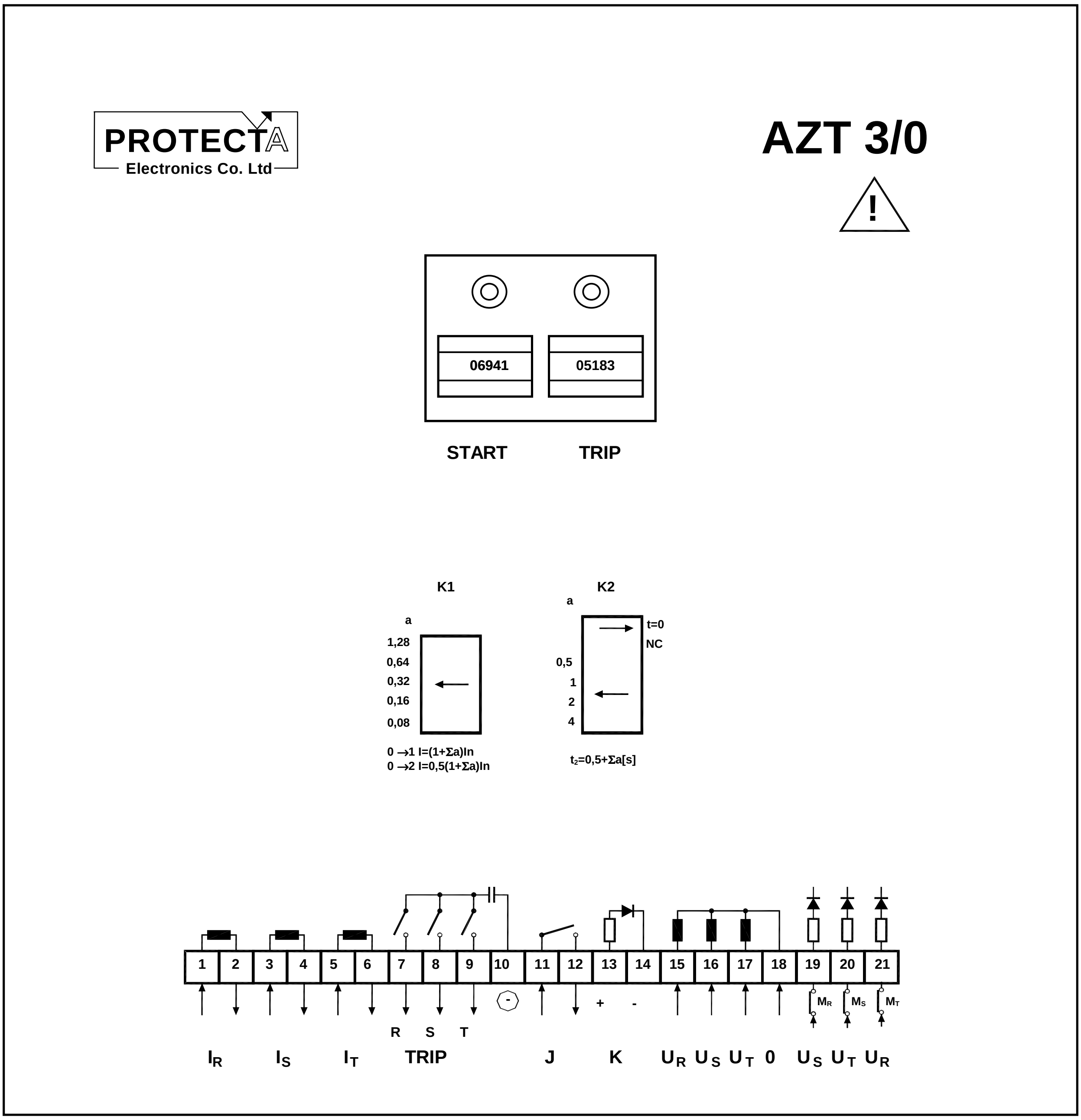


Fig. 3. AZT 3/0 front view

Remark:

Connection of intermediate current transformers 0 – 1 M=1

0 – 2 M=2

(See Fig. 4)

Warning:

Before opening the case read the manual carefully.

The “M” factor in the formula (5.1) depends on the turns ratio of the six internal intermediate current transformers. As Fig.4 indicates the three wires connecting the connectors 2, 4 and 6 of the device can be connected in two ways according to M=1 or M=2. The selection changes the turn’s ration as 1 : 2. Accordingly the value of M can be either 1 or 2, defined by the connections.

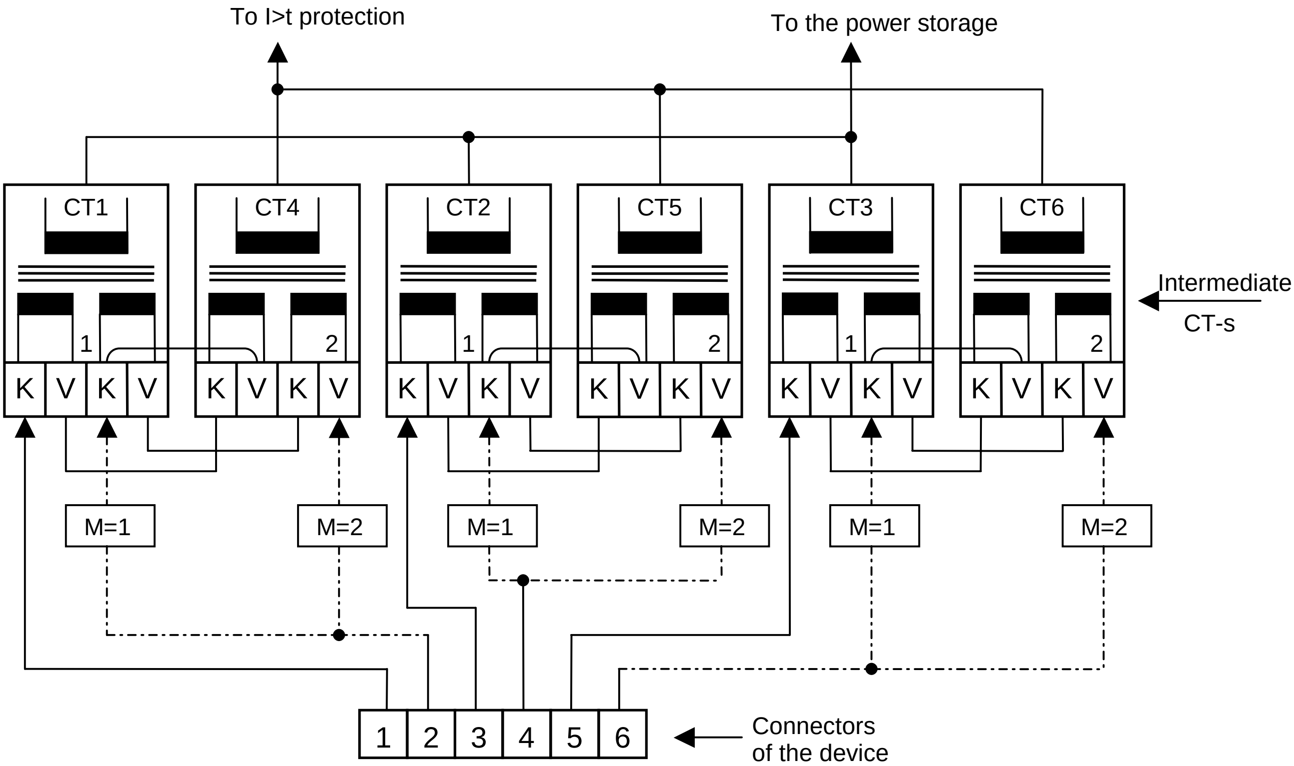


Fig. 4 Connections of the intermediate current transformers

The In rated current applied in the formula (5.1) can be defined at ordering. The possible selections are 1 A or 5 A, but based on preliminary consultation it can have other rated values as well.

The full setting range of the device based on the technical information in chapter 8 is:

$$I >= \frac{1}{M}(1{,}5...3{,}48)I_n \qquad (5.2)$$

with steps

$$\frac{1}{M}0{,}08I_n$$

In case of zero sequence overcurrent protection applications, if the connections are arranged according to Fig. 2 b, this setting range can be extended to:

$$I >= \frac{1}{M}(1...3{,}48)I_n \qquad (5.3)$$

with steps

$$\frac{1}{M}0{,}08I_n$$

The switches K1 serve this extended setting range too.

If the I> setting is to be performed according to the extended setting range of (5.3) in three-phase applications (see Fig. 1) or in zero sequence overcurrent applications using one current transformer (see Fig.2a), then the protection will operate correctly. As however the pre-condition of the operation is the full charged state above 300 V of the power storage capacitor, in case of some fault types the protection will not comply the characteristics defined by Fig. 7.

5.2 Setting the t2 time delay of the overcurrent stage

The set of K2 switches are located on the right side of the front cover (see Fig. 3). The values and the functions of these switches are as follows:

Identifier	Value in ON position /s/	Position	Function
1	0	Right (OFF)	Total off state
2	0,5	Left (ON)	Setting value
3	1,0	Left (ON)	Setting value
4	2,0	Left (ON)	Setting value
5	4,0	Left (ON)	Setting value

The switch on the top position can fully bypass the t2 time delay, so the time delay in case of right position is 0, independently of the position of the other switches. If this switch is on the left position, then the other switches define the t2 time delay.

The additional time delay of the characteristics can be set in the following setting range (See chapter 8):

$$t2 = 3 \ldots 8 \text{ s with steps } 0{,}5 \text{ s.} \qquad (5.4)$$

If in zero sequence overcurent protection applications the connection arrangement of Fig. 2 b is applied, the setting range is extended to:

$$t2 = 0 \ldots 8 \text{ s with steps } 0{,}5 \text{ s.} \qquad (5.5)$$

If applying connections according to Fig. 1 or Fig. 2.a and the setting is performed in the range of (5,5), then the operation of the protection will be correct, but in case of some fault types the protection will not comply the characteristics defined by Fig. 7. (The full charged state of the power storage capacitor must be waited for.)

5.3 Setting the voltage relay of the logic for discontinuity in one of the phase conductors

As an ordering option the AZT 3/0 protection can include a special logic for discontinuity in one of the phase conductors (see details in chapter 7). The setting value of the voltage relay of this logic can be selected from two values:

If the rated secondary voltage of the voltage transformer is 100 V or 110 V then:

$$U_{phase,\ setting} \leq 30\ V \qquad (5.6)$$

or

$$U_{phase,\ setting} \leq 40\ V \qquad (5.7)$$

If the rated secondary voltage of the voltage transformer is 200 V or 220 V then:

$$U_{phase,\ setting} \leq 60\ V \qquad (5.8)$$

or

$$U_{phase,\ setting} \leq 80\ V \qquad (5.9)$$

The rated secondary voltage of the voltage transformer must be defined at ordering, it neither can nor be changed in the ready-made device.

The printed circuit board identified as AZT-14 contains seven connectors at the bottom left corner. The connector identified as "0" connects the star point of the voltage transformer secondary, which is input on the connector No. 18 of the device (see Fig. 5) If the U_R voltage input on the connector No. 15 of the device is connected to second connector of the printed circuit board AZT-14, identified as U_R-1 then the setting value is the smaller one, according to formula (5.6) it is 30 V or according to formula (5.8) it is 60 V. If the third connector identified as U_R-2 is used, the value is the larger one: according to formula (5.7) it is 40 V or according to formula (5.9) it is 80 V. The other voltages must be connected similarly: The U_S voltage input on the connector No. 16 of the device can be connected to the fourth connector of the PCB, identified as U_S-1 or to the fifth, identified as U_S-2. The U_T voltage input on the connector No. 17 of the device can be connected to the sixth connector of the PCB, identified as U_T-1 or to the seventh, identified as U_T-2.

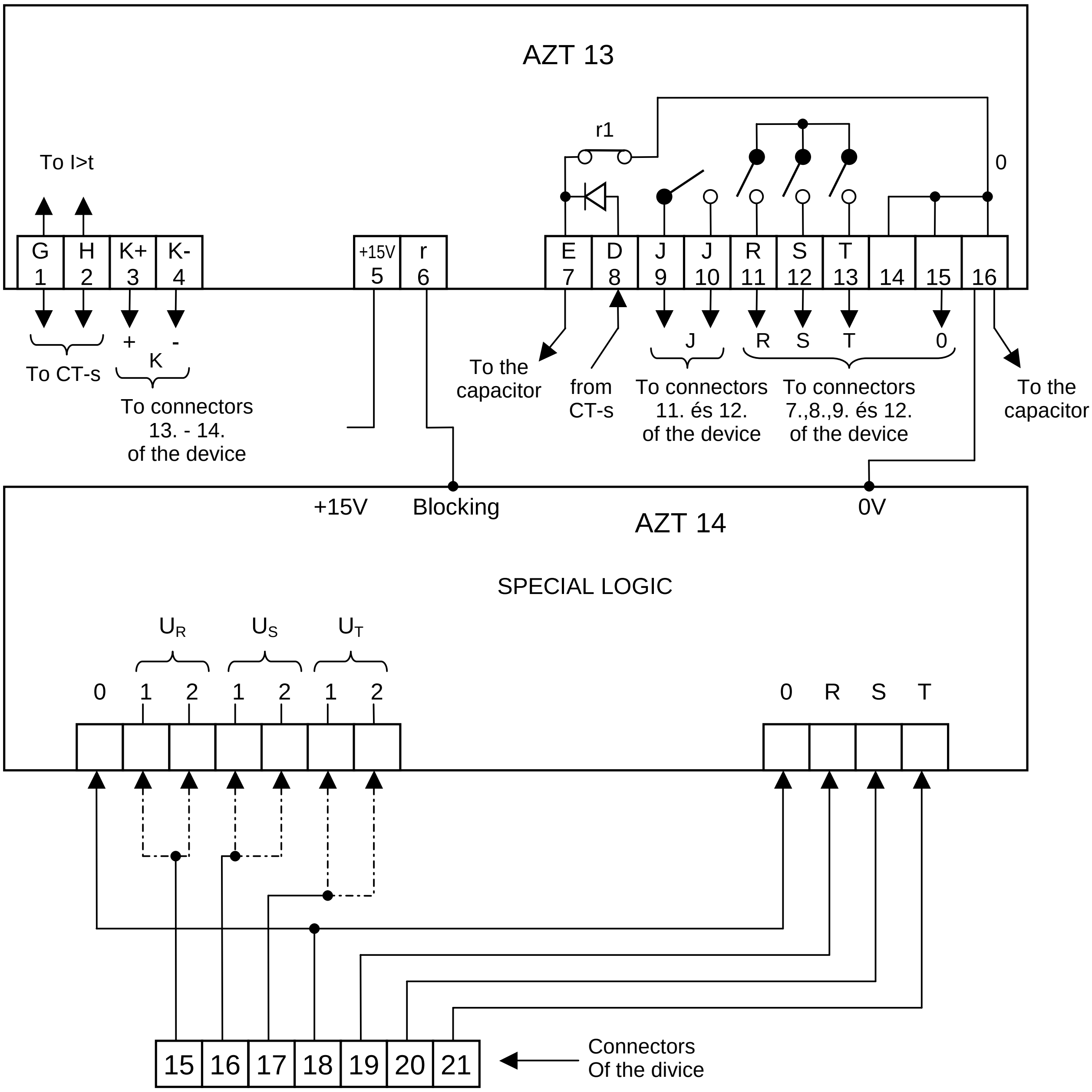


Fig. 5 Connecting the voltage relays

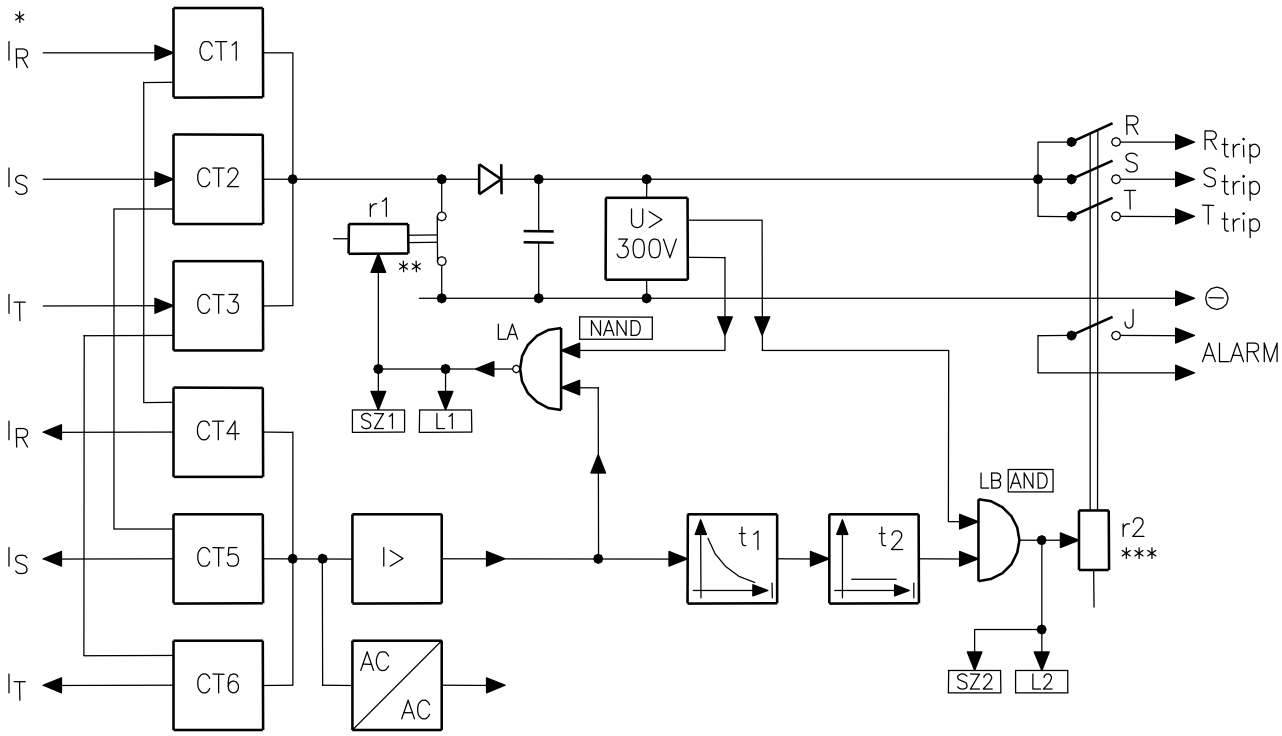


Fig.6 AZT 3/0 principal scheme

Remarks:

- The Currents IR, IS, IT can be replaced by 3Io, according to Fig.2
- r1 operates, if I> starts and U> does not start
- r2 operates, if I> t1+t2 and U> start

6 Operation of the protection

Based on the connecting diagrams on Figures 1 and 2, and on the principal scheme of Fig. 6 the mode of operation can be explained easily.

The role of the intermediate current transformers CT1, CT2 and CT3 of the device is to deliver the required amount of power to trip the circuit breaker by charging the capacitor. The charging process starts at the operation of the overcurrent relay, and it is stopped when the required voltage (U>) is reached.

The further intermediate current transformers CT4, CT5 and CT6 of the device supply the DC/DC power supply unit of the device. These are the current inputs for the electronic overcurrent relay (I>) and for the timers (t1 and t2).

The overcurrent element is of t here-phase structure, with maximum selection. If it operates, then the inverse type current timer t1 and the definite timer t2 are started as well. The compound characteristic of the overcurrent protection is defined in Fig. 7.

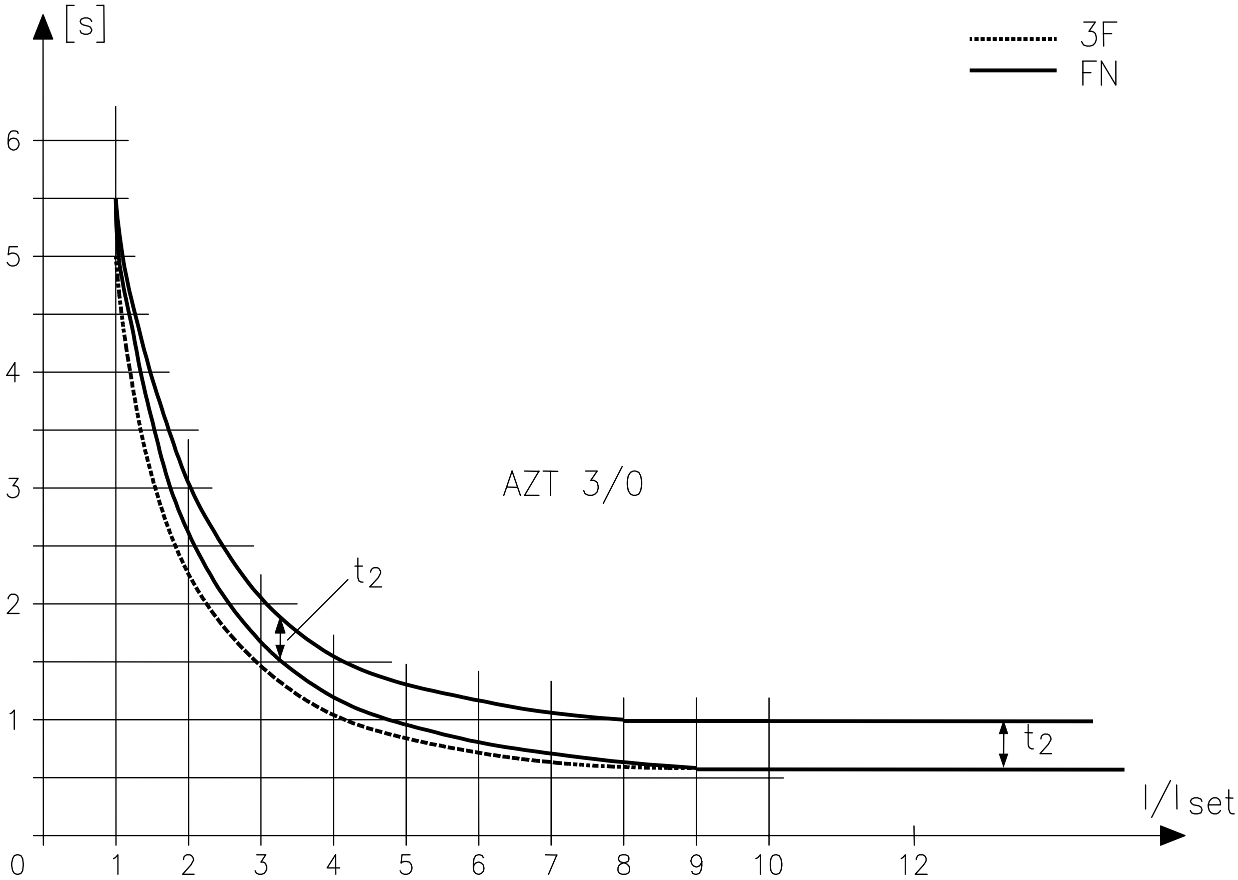


Fig.7. AZT 3/0 overcurrent characteristics

The lower inverse characteristics in Fig. 7 is valid if t2=0. The setting value t2 shifts the curve parallel upwards, as it is indicated in Fig. 7. The setting range of t2 is 3 … 8 s. In zero sequence overcurrent application if the serial arrangement according to Fig. 2.b is applied, the setting range is extended to t2 = 0 … 8 s.

As it was already mentioned in three-phase overcurrent applications (see Fig.1) or in zero sequence overcurrent application if the single current transformer arrangement according to Fig. 2.a is applied, then the setting is possible in the extended time delay range as well, but in this case the charging of the capacitor for certain fault types takes longer time, than the time delay as defined by the characteristics. So the relay will operate with longer time delay too. The operation however is reliable in this case as well. If the setting is within the range as defined by the technical specification (see Chapter 8), then the characteristics of Fig. 7 will be valid.

The starting of the I> protection generates a signal with the LED L1 through the LA logic gate (see Fig 6), if the voltage relay of the capacitor for power storage is in drop-off state. In this case the counter Sz1 counts up, and the relay R1 closes the contacts, enabling the charging of the capacitor. Before starting the I> protection, the relay R1 bypasses the CT1, CT2 and CT3 current transformers, so in normal state the power consumption of the device is small. During the charging process the power consumption increases, it reaches the highest consumption just before generating the trip command, when the capacitor is fully charged to 300 V. When 300 V is reached, then the U> voltage relay drops the relay R1, the charging process is stopped and the current transformer outputs for CT1, CT2 and CT3 are bypassed. So the power consumption of the device drops again to a small value. When the U> relay operates, the L1 LED switches off, and the LB logic gate gets permission signal. If the timers t1 and t2 of the I> overcurrent protection reach time-out, an other permission signal is generated to the LB logic gate. If both permission signals are available, then L2 switches on, the counter Sz2 counts up and the relay R2 operates. As a consequence the contact J generates a status signal, and the contacts R, S and T discharge the stored power of the capacitor to the operating coils R, S and T of the circuit breakers. So the circuit breakers interrupt the fault currents.

The power stored in the capacitor is sufficient to switch off the circuit breakers on all three phases. Considering the high voltage circuit breakers applied in the Hungarian power system, the OTKF drives have the highest power demand. To trip this circuit breaker with one coil, 200 V on 20 µF power is needed, which means:

$$E_m = \frac{1}{2} CU^2 = \frac{1}{2} 50 * 10^{-6} * 200^2 = 1 Joule$$

The device contains 9*50 µF = 450 µF capacitors, and the charged state is 300 V. So the full power for three phases is:

$$E_m = \frac{1}{2} 450 * 10^{-6} * 300^2 = 20{,}25 Joule$$

So the reserve is:

$$\frac{E}{3E_m}100 = \frac{20{,}25}{3*1}100 = 675\%$$

So 6.75 times of the needed power is available to trip the circuit breakers in three phases.

All circuit breakers applied in the Hungarian electric power system, and the known circuit breakers for EHV HV and MV electric power systems need much less power than this, so the tripping can take place with high security.

It is to be mentioned that the 300 V full charged voltage level, the comparison value of 300 V of the U> relay and the applied 450 µF capacitor is applied for 220 V DC auxiliary power source system. For systems with other voltage levels these values can be changed.

As the device is self-powered, the LED signals disappear after operation of the protection function. No latching is possible, and no acknowledgement is needed. The task of the LED-s is supporting the tests of the device. Based on the stored counter values however the counts for the starting and trip commands can be checked, and the correct operation can be supervised. The J signal contact is available for local alarm signalling, event recording or for the supervisory and control system of the substation.

The most important advantage of the device is the full autonomity, which mains that in case of failure of the auxiliary DC power system the device can generate a trip command to the circuit breakers. In lack of the DC power system the local alarm signalling, event recording or the signals for the supervisory and control system of the substation can fail too, but the internal counters give continuously available information about the events.

7 Logic for discontinuity in one of the phase conductors (option)

If the AZT 3/0 device is used for zero sequence back-up overcurrent protection for transmission lines of solidly grounded networks, then the connection is to be realised according to Fig.2. The connection plan of Figures 2.a and 2.b show both configurations for zero sequence current measurement. The overcurrent relay setting must be defined to be less than the minimal zero sequence current for single phase to earth faults at the far end of the protected line, but the setting must be above the zero sequence current which flows during the dead time period of a single phase reclosing cycle or that in case of discontinuity in one of the phase conductors. For single phase tripping the drop-off ratio is to be considered to, because the protection should drop off after opening the circuit breaker. The relation for the setting should be as follows:

$$(1-\varepsilon)3I_{0Ph-N\min} \geq 3I_{0SET} \geq \frac{1}{k_{drop}}(1+\varepsilon)3I_{0disc.\max} \qquad (7.1)$$

In this formula:

$3I_{0Ph\text{-}Nmin}$	fault current in case of earth fault at the far end of the protected line,
$3I_{0disc.max}$	highest zero sequence current in case of discontinuity in one of the phase conductors,
k_{drop}	drop of ratio of the AZT 3/0 overcurent protection,
ε	error factor of the protection and the current transformers.

The $3I_{0disc.max}$ highest zero sequence current in case of discontinuity in one of the phase conductors can be calculated using symmetrical component method for calculation discontinuity. For the setting it can be helpful if the following practical considerations are taken into account:
In radial lines, when the line supplies consumer substation, it is valid for both sides:

$$3I_{0disc} = (1{,}8 \ldots 2{,}2)\, I_{tn} \qquad (7.2)$$

In this formula:

I_{tn}	the sum of the rated currents in the transformers of the substation.

In lines within the meshed networks:

$$3I_{0disc} = (0{,}5 \ldots 1{,}5)\, I_{tmax} \qquad (7.3)$$

In this formula:

I_{tmax}	the thermal current limit of the protected line.

The multiplying factors in formulas (7.2) and (7.3) are to be considered according to the real network. If no other information is available, the highest values must be considered.

When calculating the setting values based on the formula (7.1), a contradiction can occur. This problem can be solved in two ways:

- No single phase definite trip command is applied, and the definite time setting of the back-up protection zone of the zero sequence overcurrent protection is set longer then the dead time of the single phase reclosing.
- Special logic for discontinuity in one of the phase conductors is applied.

The principle of this special logic for discontinuity in one of the phase conductors can be explained in Fig. 8.a. In normal operation the voltage relays are in closed position, the auxiliary contacts of the circuit breakers are open. The relay with “Te” drop-off time delay is closed due to the closed chain of the voltage relay contacts; its opened contact disables the trip command of the back-up protection.

In case of single phase to earth fault one of the voltage relays drops off, so the “Te” drop-off time relay starts operation. If the protection of the first zone trips the circuit breaker, and the auxiliary contact closes, and the “Te” timer pulls again. So the faulty operation due to the discontinuity in one of the phase conductors is prevented. If however the first zone protection fails to clear the fault, then the “Te” reaches time-out and the back-up protection is enabled.

The time delay for the “Te” timer is to be set longer then that of the first zone protection and shorter then that of the back-up protection. The voltage relay setting must be above the faulty voltage in case of earth fault at any location of the protected line. This setting is always possible at the end of any radial lines, but it can be difficult at the sending end of a radial line or in a line of a meshed network. In this case however the formula (7.1) will cause no problem in the setting.

In case of transmission lines, which operate always radially the “special logic for discontinuity in one of the phase conductors” can solve the problem of contradiction in the setting. For the lines however which operate sometimes radially, sometimes as a part of the mashed network, in case of setting contradiction for meshed operation a high set (3Io>>) backup protection must be provided, for radial operation however an other protection with lower setting (3Io>) with special logic must be applied. These two solutions are involved in the AZT 3/0 protection, if the optional special logic is ordered, and if needed an additional external 3Io>> relay is applied as well.

Fig. 8.b shows that the AZT 3/0 protection can operate alone with zero sequence current supply, if no blocking signal is received. A blocking signal can be applied, if the “special logic for discontinuity in one of the phase conductors” is ordered, and the blocking chain of contact is prepared, as it is shown on the Figure. The upper U> relay gets in logic “1” state if either the U_R voltage is available, or the circuit breaker trips in phase R, or both conditions are true. In this case it is sure that no fault is present in phase R, which is supplied from the side of the protection. The similar consideration is valid for phases S and T as well. The AZT 3/0 protection does not get in blocked state, if the voltage is down in at least on phase and the circuit breaker of the same phase is closed. If an auxiliary Io>> zero sequence overcurrent relay is applied to cover the mode of operation described above, then the operation of this relay, which means opening the NC contacts releases the blocking state as well. The AND NOT gate (denoted by “L”) issues blocking signal if all four inputs get active status signal. This blocking signal stops if at least one of the four inputs get signal announcing the faulty state.

It is to be noted that according to the Figure the status signal of the circuit breaker is composed in the AZT 3/0 by the signal of the subsequent phase. With this method this blocking chain gets independent of the auxiliary DC power supply of the substation. The auxiliary power supply is needed by the auxiliary 3Io>> relay only, but in this configuration the blocking is released if no auxiliary DC power is available, and so the back-up protection gets operable (perhaps not selectively).

If the AZT 3/0 protection gets a blocking status signal, neither of t1 nor t2 timer get in running state, so the time delay is started after releasing the blocking state only.

The AZT 3/0 protection can be blocked by a DC signal connected to the connectors 13 and 14 as well.

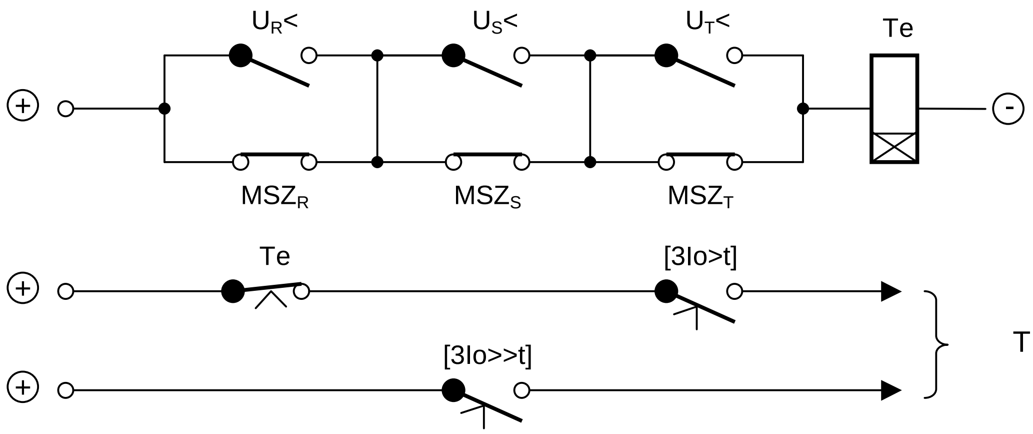


Fig.8. a Principle of the special logic for discontinuity in one of the phase conductors

Remarks:

U_R<, U_S<, U_T<	voltage relay connected to the voltage transformers of the line.
MSZ_R, MSZ_S, MSZ_T	auxiliary contact of the circuit breakers in the phases.
Te	timer with drop-off time delay.
3Io>t	zero sequence overcurrent protection.
3Io>>t	zero sequence overcurrent protection high current setting stage (if any).

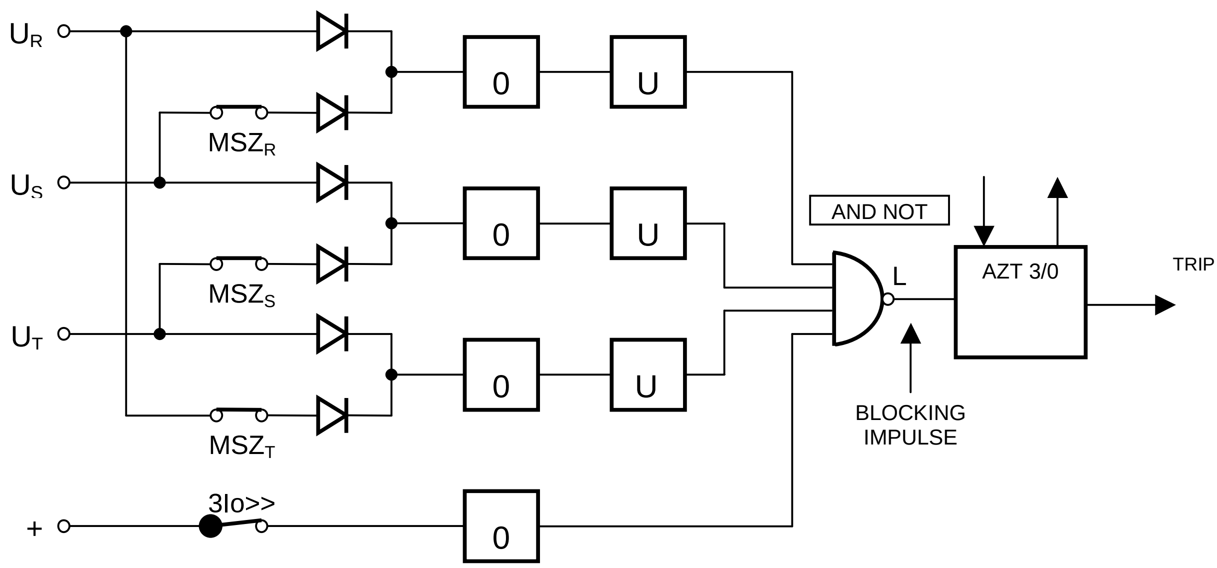


Fig.8. b Special logic for discontinuity in one of the phase conductors in AZT 3/0

Remarks:

U_A<, U_B<, U_C<	voltage relays connected to the voltage transformers of the line.
MSZ_R, MSZ_S, MSZ_T	auxiliary contact of the circuit breakers in the phases.
3Io>>t	externalzero sequence overcurrent protection with high current setting
U_R, U_S, U_T	phase voltages,
O	optical couplers,
AZT 3/0	zero sequence backup-up overcurrent protection with low current setting

Technical specification

Rated current, In	1 A or 5 A (or according to special request)
Rated voltage, Un	100 – 110 V or 200 – 220 V (or according to special request)
Rated frequency	50 or 60 Hz
Overload capacity Current circuits, thermal 1s Continuous Dynamic current limit	 50 In 1,2 In 100 In
Overload capacity Voltage circuits	 1,2 Un
Internal current transformers Selectable turn's ratio factor M	 1 or 2
Overcurrent relay (I>) setting range (preferred) (according to Fig.2.b)	 1/M (1,5 … 3.48) 1/M (1 … 3.48)
Overcurrent relay drop-off ratio	<0,85 (or according to special request)
Overcurrent relay accuracy	±5 %
Power consumption in current transformer circuits In normal or tripping state/before full charged state 1 A M = 1 1 A M = 2 5 A M = 1 5 A M = 2	 0,6 / 1,5 VA 1,2 / 3 VA 2 / 5 VA 4 / 10 VA
Power consumption in case of connection according to Fig. 2.b. In normal or tripping state/before full charged state 1 A M = 1 1 A M = 2 5 A M = 1 5 A M = 2	 1,8 / 4,5 VA 3,6 / 9 VA 6 / 15 VA 12 / 30 VA
Rated voltage of the circuit breaker operating coil	220 V DC (or according to special request)
Time delay	t1 + t2
t1 inverse type delay	According to Fig.7
Time delay accuracy	±5 %
t2 additional (definite minimum) time delay setting range (preferred) setting range (according to Fig. 2.b) time step accuracy	 3 … 8 s 0 … 8 s 0,5 s ±50 ms

Voltage setting for special logic for discontinuity in one of the phase conductors (fix values) For Un = 100 – 110 V For Un = 200 – 220 V	 30 V and 40 V 60 V and 80 V
Power consumption in voltage transformer circuits	< 1 W
External disabling or auxiliary zero sequence overcurrent relay (3Io>>) rated voltage	 220 V DC ±20% or 110 V DC ±20% or
Power consumption in DC circuits	< 1 W
Output relay contacts (J, R, S, T) Schrack print relays Rated making voltage Continuous load current Rated making current Breaking capacity, at 220 V DC At conductive load L/R= 40 ms load	 250 V 8 A 16 A 0.25 A 0,14 A
Rated operating temperature range	-20°C … +60°C
Insulation test (IEC 255)	2 kV, 50 Hz 5 kV 1,2/50 µs
Disturbance test (IEC255)	2,5 kV, 1 MHz

8 Dimensions, weight

The housing of the AZT 3/0 protection is a closed steel case, the sizes are:

Width: 323 mm
Height: 432 mm
Depth: 124 mm

Weight: 9 kg.

See Fig. 9.

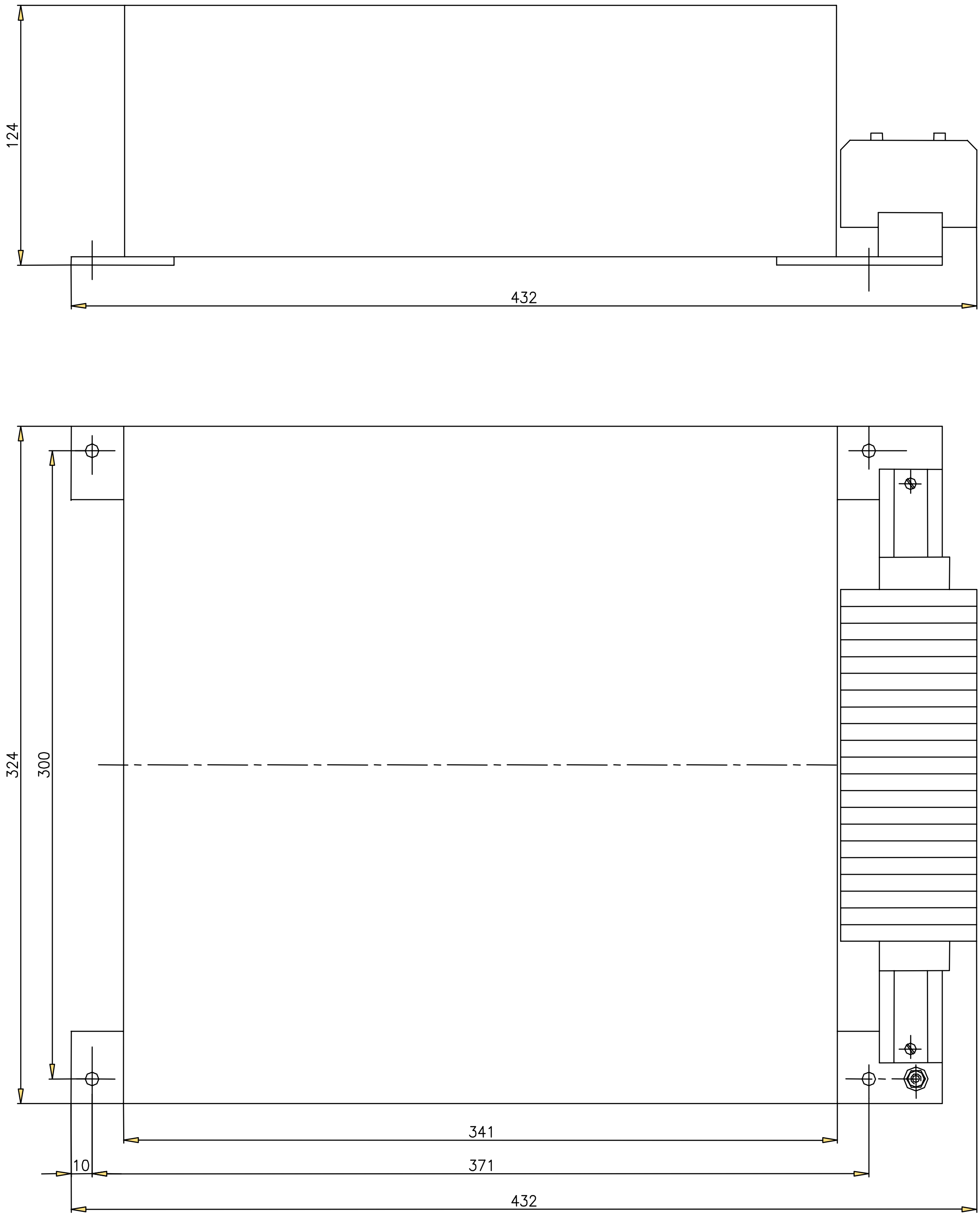


Fig.9. AZT 3/0 dimensions

9 Ordering information

At ordering the following information is needed:

- Device type: AZT 3/0
- Rated current 1 A, 5 A (or according to special request)
- Current relay drop-off ratio (if not 0,85)
- Rated DC voltage of the circuit breaker coil (if not 220 V DC)
- Rated input voltage for special logic (100 – 110 V or 200 – 220 V or according to special request)
- Rated input DC signal voltage (on connectors 13 and 14) 220 V or 110 V
- Options according to consultations.