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BROWN BOVERI

Brown, Boveri & Company, Ltd.
Baden/Switzerland

Division E

Distance Relays
Types LZ 3, LZ 31, LZ 32

Application

Suitable for selective protection against short circuits
and earth faults on overhead lines or cables of networks
with insulated, compensated or solidly earthed neutrals,
irrespective of whether the fault current is higher or
lower than the rated current. Suitable for permissive
underreach or permissive overreach tripping schemes
(see description CH-ES 35-30.11).
Can be used, with additional apparatus, for 1-ph. only or
3-ph. only or 1 + 3-ph. autoreclosure, permissive
underreach transferred tripping, or permissive underreach
acceleration, or directional comparison schemes.
Temporary reversal of directional sensitivity.
Back-up protection schemes can easily be realized.

Main features

Suitable for protection of very long or heavily loaded
   overhead lines as well as cables.
Covers all kinds of faults selectively.
Underimpedance starting.
Earth-fault back-up protection (in LZ 32 type only).
Distance-time step characteristic with four indepen-
   dently adjustable time steps and distance zones.
One switched directional distance measuring element
   with offset mho tripping characteristic.
Fast tripping in the first step.
Low settable minimum measuring impedance.
Great adaptability due to large ranges of adjustments.
High degree of immunity to power swings.
Selector switch for four different autoreclosure
   programmes.
Selector switch for underreach or overreach operation
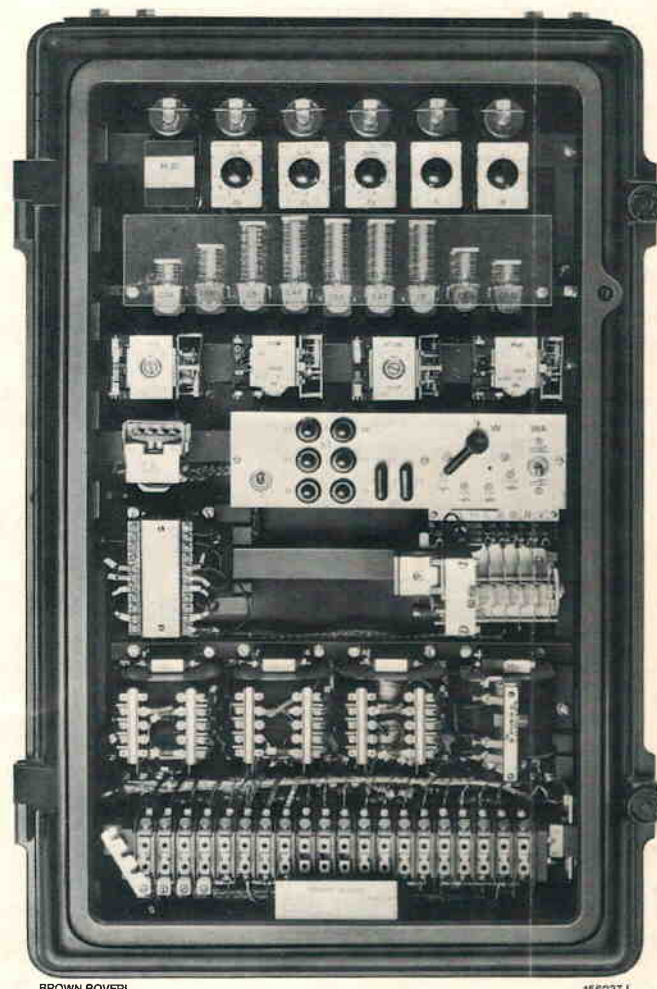   facilities.
Versatility of application (see Accessories).
Test terminals for easy connection with the test set
   type BB.
Contact for remote annunciation of kind of fault, step
   of operation and tripping.
Access to neutral point of current circuit (variant).
Possibility of temporary reversal of measurement
   direction of second or second and third zone.

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Front view of LZ 32 type for semi-flush mounting

Technical data

Input and auxiliary voltage

Relay type		LZ 3	LZ 31	LZ 32
Rated voltage	U_n	100/110 V or 200/220 V		
Rated current	I_n	1, 2 or 5 A		
Frequency	f_n	50 or 60 Hz		
Permissible continuous current		$2 \times I_n$		
Thermal short-time current		$30 \times I_n$ during 5 s $50 \times I_n$ during 1 s		

	LZ 3 ($\cos \beta \sim 1.0$)	LZ 31 and LZ 32 at $X_{comp.} = 5.2 \ \Omega$/ph. ($\cos \beta = 0.6 - 0.7$)
Burden of current circuit		
during normal operation	0.9 VA	6.0 VA
during two and three-phase short circuits	1.0 VA	6.5 VA
during single-phase and cross-country faults	4.2 VA	16.0 VA (at $k_0 = 1$)
Burden of voltage circuits when minimum impedance starting relays adjusted to lowest value:		
matching transformer taps at:	100 %	200 %
during normal operation	2.2 VA	2.2 VA
during short circuit	11.5 VA	23.0 VA
during earth faults	8.5 VA	9.0 VA

Auxiliary voltage	24, 36, 48, 60, 100, 110, 125, 200, 220 or 250 V d.c. (tolerance $\pm$ 10 %)
Consumption of d.c. auxiliary circuits	
during normal condition	0 W
during normal condition with overreach feature	2 W
during short circuits	max. 110 W

● to be specified with the order

Measurement

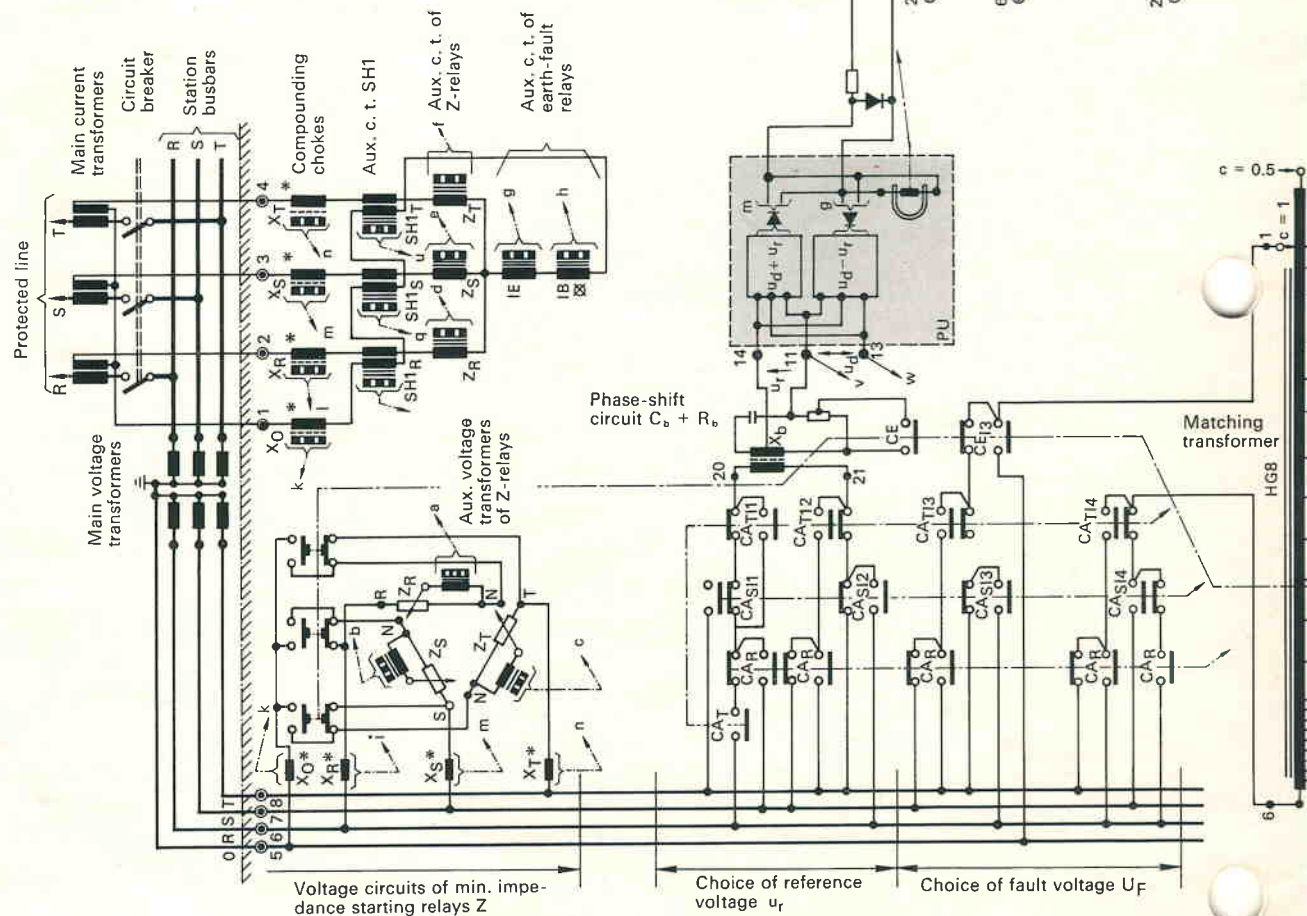| (The values indicated with $\oplus$ are based on a rated voltage of 110 V, a rated current of 5 A and a rated frequency of 50 Hz; the impedance values must be multiplied by 2 at rated voltage of 200 V, by 2,5 at rated current of 2 A and by 5 at rated current of 1 A.)	
a) Starting element: Pick-up impedance of underimpedance starters, adjustable between $\oplus$ Fall-back ratio Minimum operating current Compounding choke adjustment range (for relays type LZ 31 and LZ 32) $\oplus$	1 and 10 Ω/ph. 103 % $0.25 \times I_n$ 0 to 5.2 Ω/ph. (in steps of 0.4 Ω/ph.)
b) Earth-fault relay: Earth-fault starting relay adjustable between Fall-back ratio Back-up earth-fault starting relay (LZ 32) adjustable between Fall-back ratio	0.2 and $2 \times I_n$ 93 % 0.1 and $1 \times I_n$ 93 %
c) Timer: Number of directional time steps Number of non-directional time steps Adjustment range of each time step Accuracy of timer	3 1 0.5 to 5 s 0.1 s

d) Measuring element: Lowest setting of measuring impedance ⊕	0.075 Ω/ph.		
Directional sensitivity for three-phase short circuits for two-phase and earth faults	0.1 % of rated voltage unlimited		
Zero-sequence compensation: adjustment range (k_0) between	0 and 1.5 in steps		
Shortest tripping time	45 ms		

Output

One n.o. tripping contact (combined with phase-selection logic for one-phase reclosure) making current continuous current breaking current	20 A at voltages up to 250 V d.c. 6 A 0.4 A resistive ⎱ at 220 V d.c. 0.2 A inductive ⎰		
Signalling contacts (for arrangement see schematic) making current continuous current breaking current	10 A at voltages up to 250 V d.c. 0.5 A 0.2 A resistive ⎱ at 220 V d.c. 0.1 A inductive ⎰		
Temperature range	−5 °C to +40 °C		
Insulation test	2 kV at power frequency for 1 min		
Weights surface mounting flush type	LZ 3 40 kg 45 kg	LZ 31 42 kg 47 kg	LZ 32 43 kg 48 kg
Size	see dimension drawings		

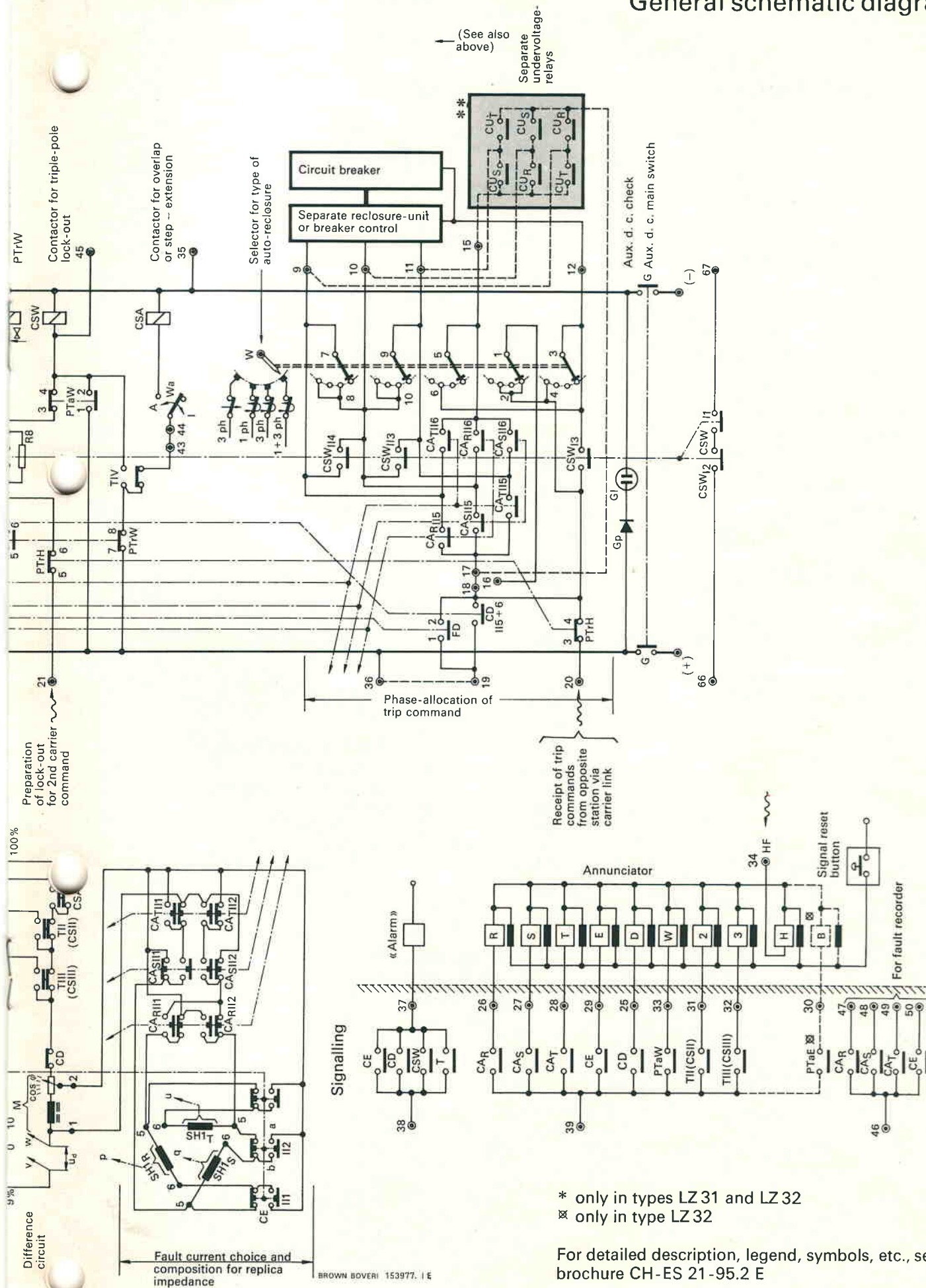DC-Control-Circuits

AC-Circuits

Starting minimum impedance relays Z

Aux. contactors for Z relays

Earth fault relays

Aux. contactors for earth fault relays

Time-step relay

Fast tripping contactor

Aux. contactor for FD

Trip command via carrier to opposite station

Starting signal for carrier link

Separate under-voltage-relays

(See also below)

Contactor for blocking carrier signal reception

Blocking – time contactor

59 58 60 22 69 68 70

CAR CAS CAT CE PTaE TIV FD CD PTrH PTaW

Z_T Z_S Z_R

IB IE

TI→TII→TIII→IV TIV
0→0.6s→1→2s3→5s 0.4s

51 52 CDI12 TII (CSII)

PU TV TI

42 41 PTaW

CDI4 CASII3 CARII3 CAT CAS II.4 II.4

CARII7 CARII3

CATII7 PTaW

CD I2 CE

R9 CSWIII1

CD I3 PTrW

23 68 24

Main current transformers

Circuit breaker

Station busbars

Protected line

R S T

Main voltage transformers

Compounding chokes

Aux. c. t. SH1

Aux. c. t. of Z-relays

Aux. c. t. of earth-fault relays

X_T X_S X_R X_O

SH1T SH1S SH1R

Z_T Z_S Z_R

IE IB

Aux. voltage transformers of Z-relays

Z_R N T Z_S Z_T

X_O* X_R* X_S* X_T*

Phase-shift circuit $C_b + R_b$

20 21

$u_d + u_r$ $u_d - u_r$

PU 14 11 13

CE

Matching transformer

HG8

CATI1 CATI2 CATI3 CATI4

CASI1 CASI2 CASI3 CASI4

CAR CAR CAR CAR

CAT

c = 0.5
c = 1

0 R S T
5 6 7 8

Voltage circuits of min. impedance starting relays Z

Choice of reference voltage u_r

Choice of fault voltage U_F

(See also above)

Separate undervoltage-relays

Circuit breaker

Separate reclosure-unit or breaker control

Selector for type of auto-reclosure

Contactor for overlap or step – extension

Contactor for triple-pole lock-out

PTrW

Aux. d. c. check

G Aux. d. c. main switch

Phase-allocation of trip command

Preparation of lock-out for 2nd carrier command

Receipt of trip commands from opposite station via carrier link

Signalling

Annunciator

Signal reset button

«Alarm»

For fault recorder

Difference circuit

Fault current choice and composition for replica impedance

* only in types LZ 31 and LZ 32
⊠ only in type LZ 32

For detailed description, legend, symbols, etc., see brochure CH-ES 21-95.2 E

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Principle of operation

This three-zone time-step distance relay has three compounded underimpedance starting elements (compounded in types LZ 31 and LZ 32) and one highly sensitive overcurrent relay (two in type LZ 32) in the neutral. They control a timer and switch the voltages and currents required to the switched directional distance measuring element.
Moreover, they automatically select the tripping phase-channels in accordance with the desired autoreclosure mode.
The compounding of the underimpedance starting elements allows the protection even of very long and heavily loaded lines. For the protection of extremely long lines additional compounded underimpedance relays may be applied.
The directional and the distance measurement are made in one highly sensitive moving coil element, which operates with rectified a.c. quantities. Accurate directional measurement is accomplished by detecting the phase relation between a difference voltage and a reference voltage. The difference voltage is the difference between the voltage drop across an adjustable replica impedance, derived from the fault current, and a selected portion of the fault potential at the relay location. The use of the replica impedance reduces strongly the influence of harmonics and transient d.c. components.
In the R/X plane, the tripping characteristic is an offset mho circle with unlimited directional sensitivity for all asymmetrical faults. For three-phase faults, the characteristic is a mho circle with directional sensitivity, ensured down to 0.1 % rated voltage.
Instantaneous tripping for three-phase close-in solid short circuits (complete voltage break-down) is provided for by a special trip assistance circuitry.
Contact pressure amplification by yet another special circuit ensures definite closing of the moving coil measuring element's contact once even the slightest touch has taken place.

Mechanical design

The complete distance relay which comprises all the components for covering interphase short-circuits and earth faults, is assembled in a single metal casing. The front of it consists of a framed glass panel, to allow observation of relay operation; it can be unhinged if required. The functional elements of the relay are mounted on a hinged frame which can be swung out to give access to the rear of these components and the internal wiring.
A row of test terminals is fitted across the lower part of the relay facilitating simple connection of the multi-terminal plug of the test set type BB.
Testing and checking of the adjustments can thus be accomplished without removing the distance relay from the panel or disconnecting its terminals.

Accessories

With the aid of the supplementary equipment mentioned below, the field of applications can be enlarged.

Autoreclosure apparatus

For carrying out single, three-phase or single and three-phase autoreclosure cycles automatically, as selected on the distance relay selector switch; additional apparatus available for slow or multiple reclosure.

Supplementary apparatuses

Pilot wire directional comparison schemes. Temporary reversal of the direction of the third zone alone. Busbar protection schemes by interconnecting all distance relays in one station, in conjunction with temporary reversal of the second directional time step.

Power line carrier

Permissive underreach transferred tripping schemes. Permissive overreach transferred tripping schemes. Directional comparison schemes. Permissive underreach transferred acceleration schemes. Blocking schemes, etc.

Annunciator

Indicates type of faults, zone in which the fault occurred, tripping, as well as operating of HF coupling.

Type designations

Distance relay LZ 3: the minimum impedance starting elements are without compounding.
Distance relay LZ 31: the minimum impedance starting elements have compounding.
Distance relay LZ 32: like LZ 31, with additional sensitive back-up earth-fault starting relay.
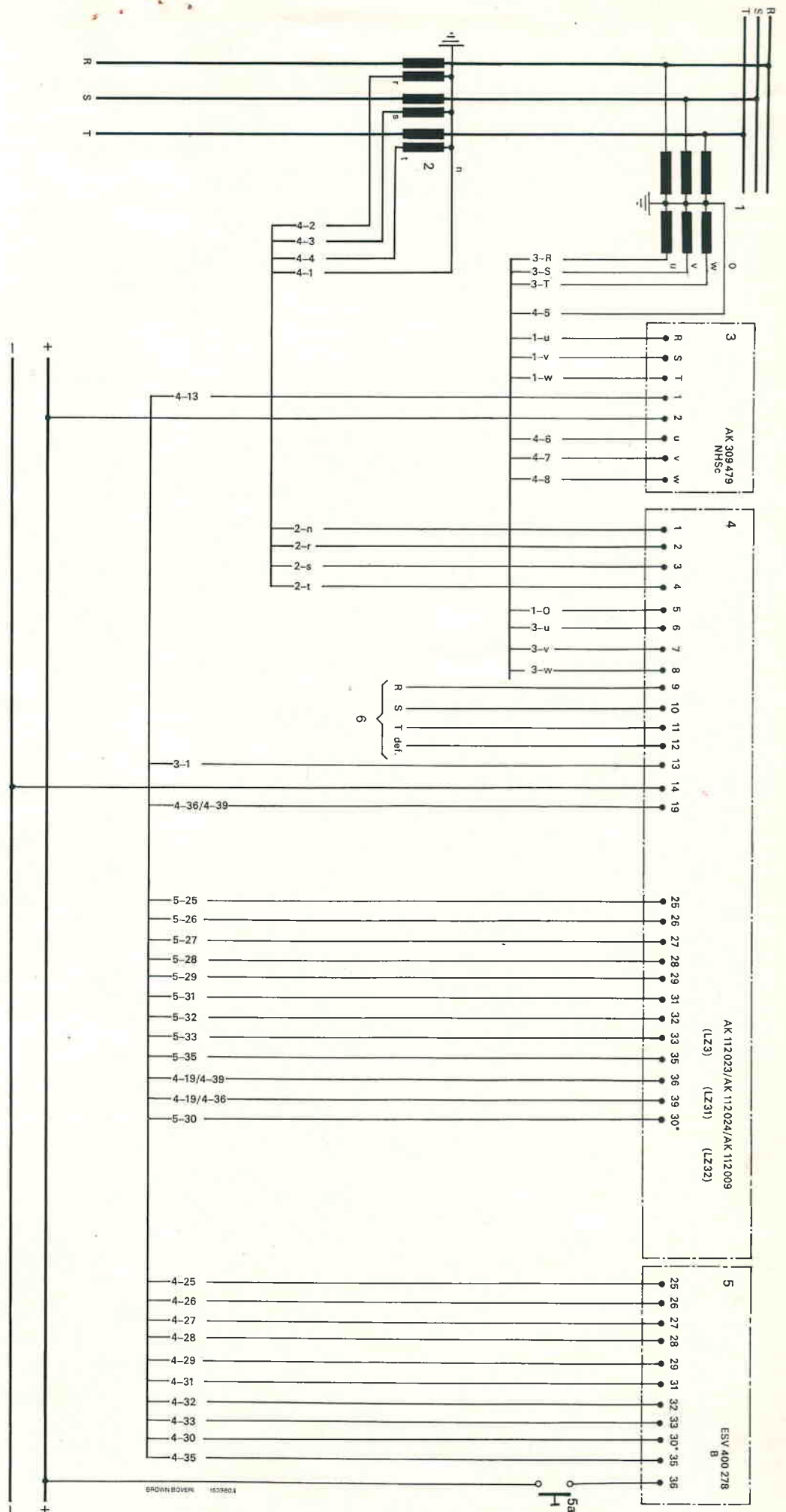All other data, facilities, designs features, etc., are identical.

Documentation

Description CH-ES 21-95.2 E

Example of a basic connection diagram
1 Voltage transformer
2 Current transformer
3 Protection switch NHSc for the voltage circuits
4 Distance relay type LZ3 or LZ31 or LZ32
5 Annunciator type B
* only for LZ32

AK 309 479
NHSc

AK 112 023/AK 112 024/AK 112 009
(LZ3)
(LZ31)
(LZ32)

ESV 400 278
B

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Dimensions

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153979J

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