SIEMENS

Communications Equipments for the Power Industry

Coupling Unit AKE 100

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For carrier-frequency communication over power lines or over communication circuits subject to interference from power lines, the high-frequency currents from and to the PLC terminals must be fed into or tapped from the lines at the chosen points without the operating personnel or the PLC terminals being exposed to a high-voltage hazard.

The PLC terminals are connected to the power line via coupling capacitors or via capacitive voltage transformers and the coupling unit. In order to prevent the PLC currents from flowing to the power switchgear or in other undesired directions (e.g. spur lines), traps (coils) are used, which are rated for the operating and short-circuit currents of the power installation and which involve no significant loss for the power distribution system.

The coupling unit AKE described here, together with a high-voltage coupling capacitor, forms a high-pass filter for the required carrier frequencies, whose lower cut-off frequency f_u is determined by the rating of the coupling capacitor and the chosen matching ratio (see Fig. 4).

The coupling unit is supplied in four versions, and is used for:

- phase-to-ground coupling to overhead power lines.
- phase-to-phase coupling to overhead power lines
- phase-to-ground coupling to power cables
- phase-to-phase coupling to power cables
- inter-system coupling with two phase-to-ground coupling units.

The coupling units for phase-to-phase coupling are adaptable for use as phase-to-ground coupling units. The versions for phase-to-ground coupling can be retrofitted for phase-to-phase coupling.

All the components of the coupling unit are mounted in and on a saltwater-proof, die-cast aluminium case with weatherresistant paint finish RAL 7031. The case is divided internally into a high- and a low-voltage section. The high-voltage section is covered by an insulated cover on which is printed the circuit diagram of the respective connecting unit. The case is fitted with a water-tight, screw-on lid. The PLC cable is led in via a conduit with weatherproof screw connection.

The AKE is always supplied with two conduits, in order to permit field installation of an HF hybrid.

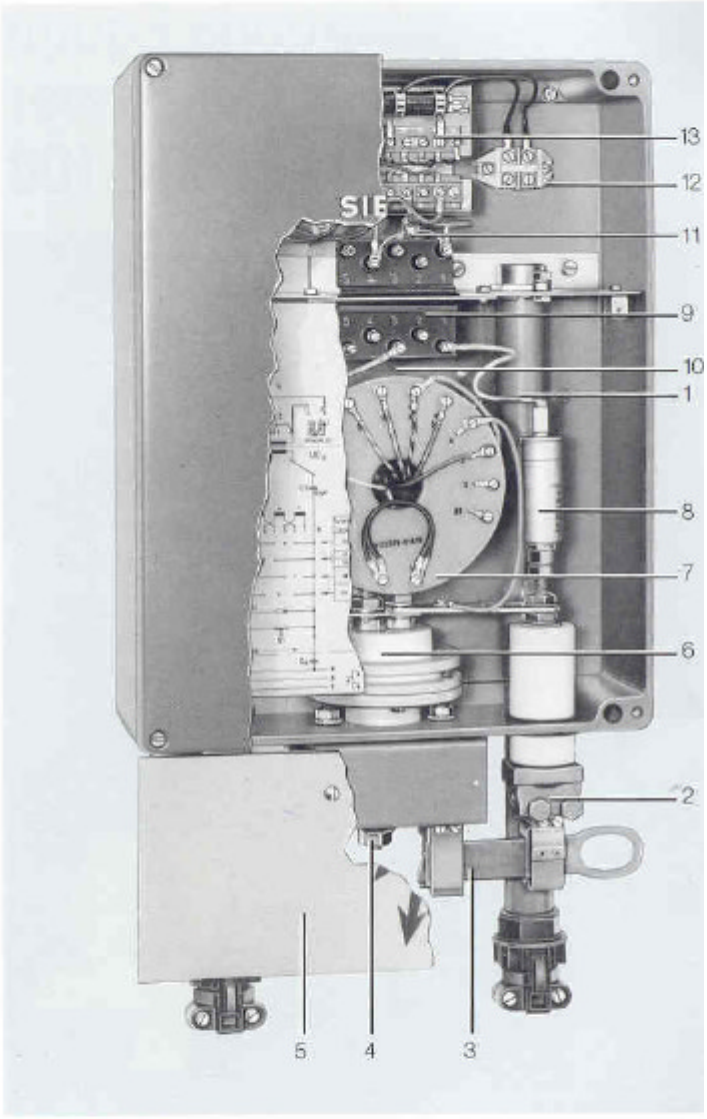


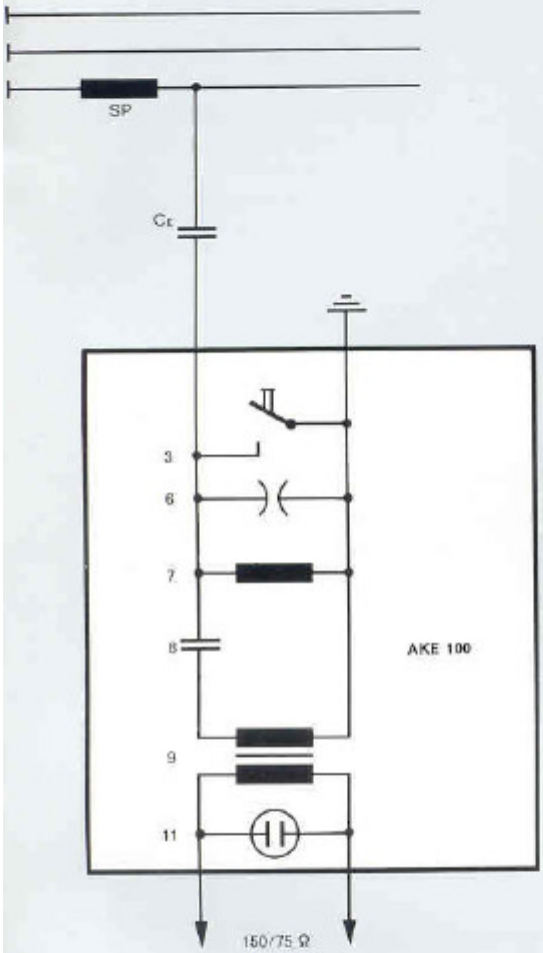
Fig. 1
Coupling unit AKE 100 with built-in HF hybrid transformer

Coarse voltage arrester

The built-in coarse voltage arrester protects the equipment of a PLC link against overvoltages (e.g. due to switchgear operations or lightning) that may penetrate the coupling capacitor and reach the coupling unit.

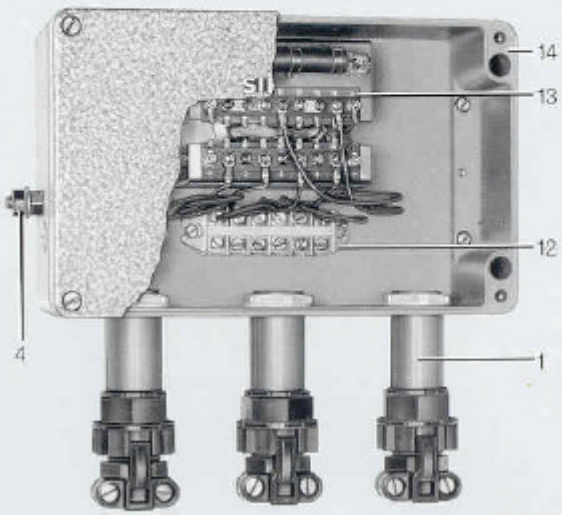
Drain and tuning coil

It is the task of the built-in drain and tuning coil to drain off the capacitive, wattless current flowing through the coupling capacitor and, by suitable inpedance matching, to form an optimum pass-band together with the various capacitances. In order to prevent the reactive current generating excessive magnetic flux in the



SP HF wave trap
C_K coupling capacitor

Fig. 2
Circuit of the AKE 100 for phase-to-ground coupling



1 Conduit with weather-resistant PLC cable screw connection
2 Terminal for coupling capacitor
3 Grounding switch with switch-rod eye
4 Main ground connection
5 External shock hazard protection
6 1- or 2-pole coarse voltage arrester
7 Drain and tuning coil
8 Isolating capacitor
9 Isolating transformer
10 Resistor for phase-to-phase coupling (balancing resistor)
11 Gas-type surge arrester (optional extra)
12 PLC cable terminals
13 HF hybrid transformer
14 Case for separate mounting of hybrid transformer

Fig. 3
HF hybrid transformer in separate case

isolating transformer, an isolating capacitor is necessary.

Isolating transformer

The isolating transformer provides dc-decoupling between the high-voltage and the communication section of the coupling unit and impedance matching to the PLC terminal via balanced 150 Ω cables or non-balanced 75 Ω cables. The required mechanical separation of primary from secondary side is obtained with the aid of a special potting technique and copper shielding foil inside the winding. On special order, a gas-type surge arrester can be installed for voltage limitation on the secondary side of the isolating transformer, both to combat steep voltage peaks on the coupling side and induced voltages in the PLC cable.

HF hybrid transformer

For inter-system coupling with two phase-to-ground coupling units, an HF hybrid transformer is installed in one of the two coupling units. If the cable link between the two coupling units is longer than 30 m, the hybrid transformer must be installed in a separate case. It is advisable to make sure that the cables between the hybrid transformer and the two coupling units are equally long.

Either a balanced 150 Ω cable or a non-balanced 75 Ω cable can be connected. In the event of short-circuit or failure of one system, the communication link remains operational over the other leg.

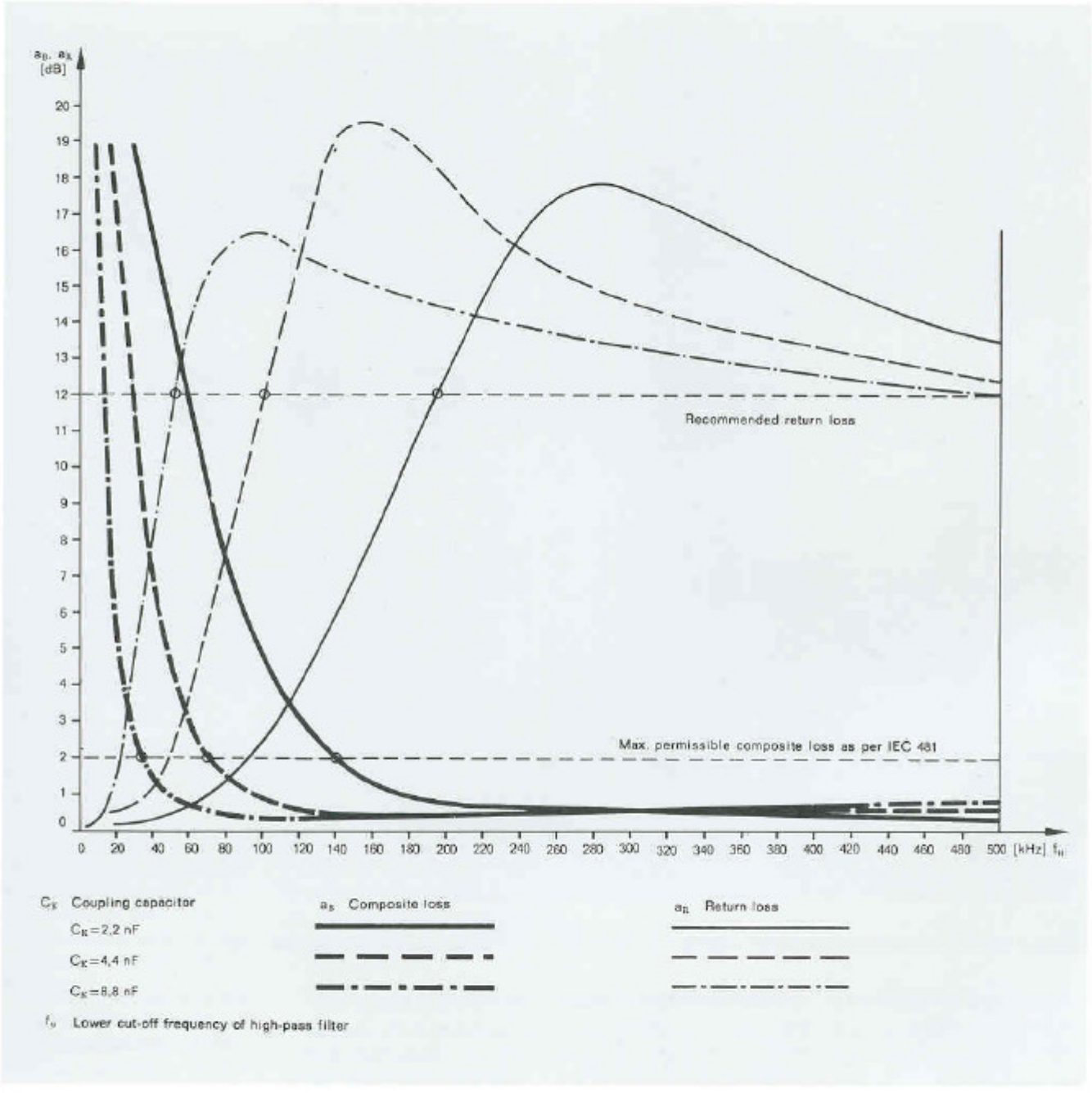


Fig. 4
Composite and return loss of the AKE 100 for phase-to-phase coupling with various coupling capacitors for Z_L = 600 Ω

Ordering designations and characteristic data:

Version for	**Overhead power line,** 0 to 60 Hz						**Power cable,** 0 to 60 Hz				
Type of coupling	Phase-to-phase			Phase-to-ground, intersystem			Phase-to-phase			Phase-to-ground, intersystem	
Ordering designations of the AKE 100	**L22663-K5-A2**			**L22663-K5-A3** **L22663-K5-A4 ***			**L22663-K5-A5**			**L22663-K5-A6** **L22663-K5-A7 ***	
Impedance Z_L of power line [Ω]	600			360			70			35	
Coupling capacitor C_K [nF]	2.2	4.4	8.8	2.2	4.4	8.8	4.4	10	20	40	120
Matching ratio I $a_B \leq 1$ dB f_u [kHz]	180	94	50	140	84	42		295	177	90	35
Matching ratio I $a_B \leq 2$ dB f_u [kHz]	140	72	34	110	64	29		225	138	67	
Matching ratio I $a_B \leq 3$ dB f_u [kHz]	122	60	28	95	54	25		192	120	58	
Matching ratio II $a_B \leq 2$ dB f_u [kHz]	103	57		84	46		340	165	85	46	
Matching ratio II $a_B \leq 3$ dB f_u [kHz]	80	42		66	35		295	136	70	36	

* AKE 100 with built-in HF hybrid transformer
f_u Lower cut-off frequency of high-pass filter, ± 3 %, frequency range as per IEC: 35 to 500 kHz
a_B Composite loss of coupling unit

Ordering designation	
HF hybrid transformer in separate case	**L22663-K5-A1**
Gas-type surge arrester	**L22663-K5-A11**
Set of parts for equipping the phase-to-ground AKE with an HF hybrid	**L22663-K5-B3**

Set of parts for converting the phase-to-ground AKE into a phase-to-phase AKE	
for overhead power lines	**L22663-K5-B4**
for power cables	**L22663-K5-B5**

Technical data

PLC cable lead-in	With screw connection Without screw connection Sealing of PLC cable	12 to 19 mm cable diameter up to 24 mm cable diameter according to cable manufacturer's specifications
Line connection for coupling capacitor	Twin terminal clamps for round wire with protective safety cover	for copper wire, up to 70 mm^2 or 10 mm diameter
	Grounding	ground switch for 250 A with switch-rod eye; single or double-pole; the switch is easily removed if local regulations prohibit built-in ground switches
Main equipment ground	Screw terminal	M 12 M 8 on the HF hybrid in its separate case -A1
Coarse voltage arrester	Electrode gap to ground Ac sparkover voltage Max. discharge capacity Impulse discharge current	0.6 mm about 2 kV rms 8 kA/0.2 s 5 kA; 8/20 µs
Drain and tuning coil		Overhead line / Power cable
	Max. coil inductance	8 mH / 1 mH
	Max. winding resistance	3 Ω / 0.5 Ω
	Max. 50 Hz impedance	< 4 Ω / < 1 Ω
	Dielectric strenght winding to ground	10 kV; 1.2/50 µs
	Current-carrying capacity	50 A/0.2 s; 20 A/1 s 1.5 A continuous load
Isolating transformer	Dielectric strenght	10 kV~/1 min, breakdown at about 16 kV
	Impulse strength	10 kV~, 1.2/50 µs
	Transmissible power	multi-tone transmission: > 600 W, calculated
	Rated impedance of equipment side	150 Ω balanced 75 Ω non-balanced } adaptable
Gas-type surge arrester	Sparkover voltage	350 V
Hybrid transformer	Transhybrid loss	< 0.4 dB
	Transmissible power	Multi-tone transmission: > 600 W
Coupling unit	Weight	13.75 kg max.
	Type of protection	IP 10/54
	Temperature range	–25 °C to + 50 °C
	Test voltage	10 kV~, 1 min rms
HF hybrid transformer in separate case	Weight	3.5 kg
	Type of protection	IP 54
	Temperature range	–25 °C to + 50 °C
Recommendations and rules complied with:	VDE 0850-62, IEC 481 SEV (Switzerland)	

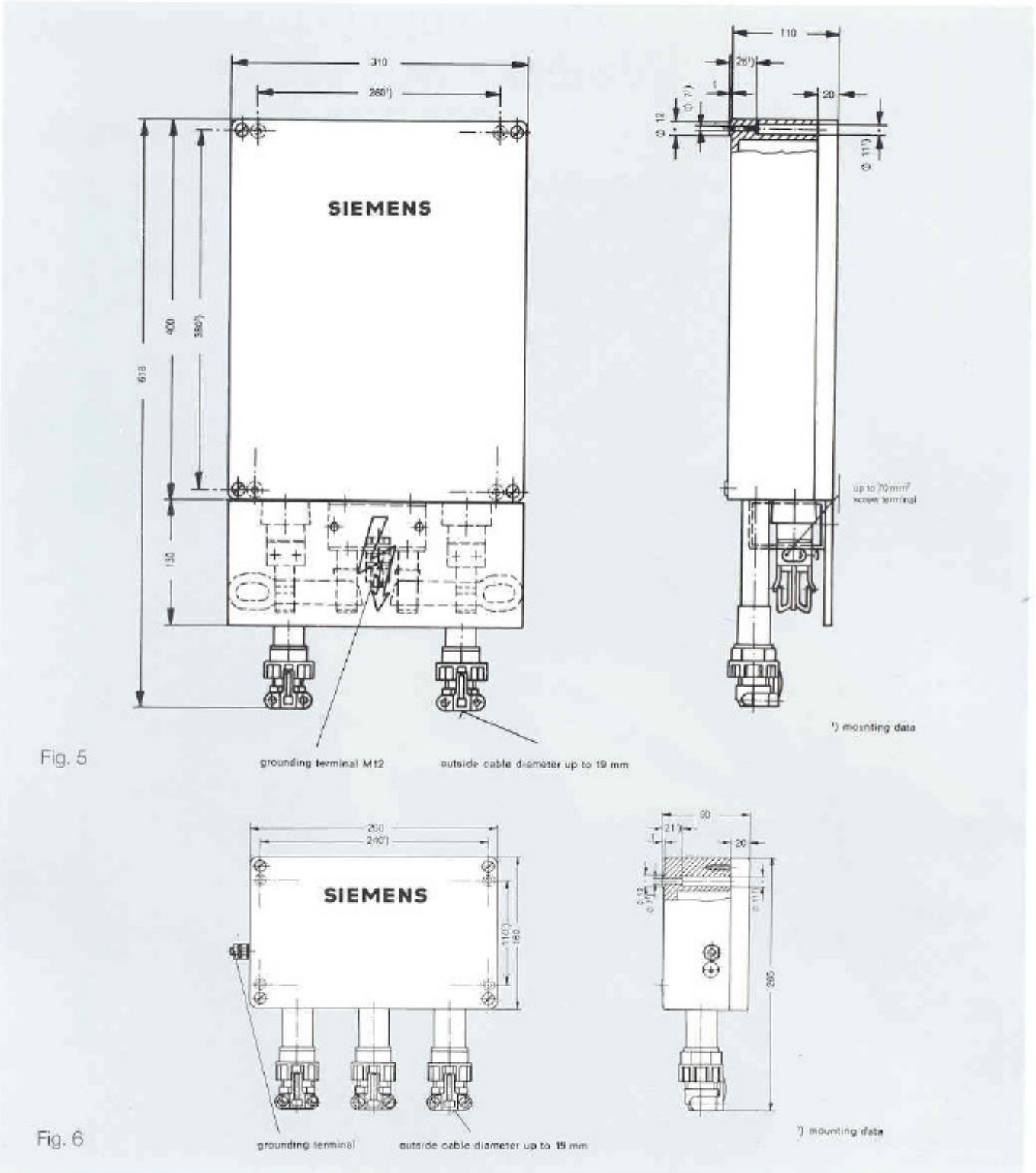


Fig. 5
Dimensions and installation details (in mm) of the AKE 100

Fig. 6
Dimensions and installation details (in mm) of the HF hybrid transformer in separate case

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