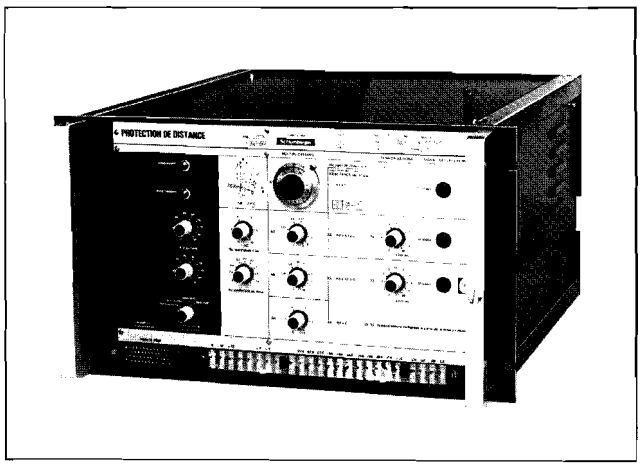
K 1.6987 B

SOLID-STATE DISTANCE PROTECTIONS
FOR HV AND UHV POWER LINES
PDS 2000 A and B

The Compteurs-Schlumberger PDS 2000 series of solid-state distance protections are designed of HV and UHV power transmission lines forming part of networks in which the neutral is directly connected to earth. These devices provide protection against all types of faults, whether between phases or between a phase and earth, irrespective of network configuration.



FEATURES

The operating characteristics of series PDS 2000 protection devices can be adjusted to suit all line lengths irrespective of loading.

The main features of these devices are:

- Parallelogram starting characteristic, ensures the detection of both short circuits and resistive faults, irrespective of their location along the line.
- Minimum impedance starting and simultaneous switching of distance measuring element.
- Minimal operating time when the protection device is powered via current transformers, provided these are not subject to saturation by the fault current.
- Distance measurement, for both phase-to-phase and phase-to-earth faults, by measurement of the true reactance of the fault loop.
- Operating time is short, constant, and independent of both fault location and fault current amplitude.
- Direct pole-by-pole tripping of circuit-breakers for single phase faults; simultaneous control of all three circuit-breakers in the event phase-to-phase faults.
- Instantaneous blocking of tripping sequence in the event of:
  — break in circuit of secondary of a voltage step-down transformer (e.g. blowing of fuse);
  — synchronization fault in network.
- Device start-up and correct distance measurement for an S.I.R. (system impedance ratio) between 0 and 30.
- Possibility of correct measurement of fault distance even when current transformers are saturated.
- Instantaneous three-phase tripping following switching in on a faulty line.
- Adaptable for use with lines operating in parallel.
- Built-in d-c/d-c power supply converter; when a PDS 2000 protection device is powered by a station battery, the distance measuring circuits are automatically protected against overvoltages that might otherwise be induced in the auxiliary supply network.
- Low-consumption current and voltage measuring circuits.

VARIANTS

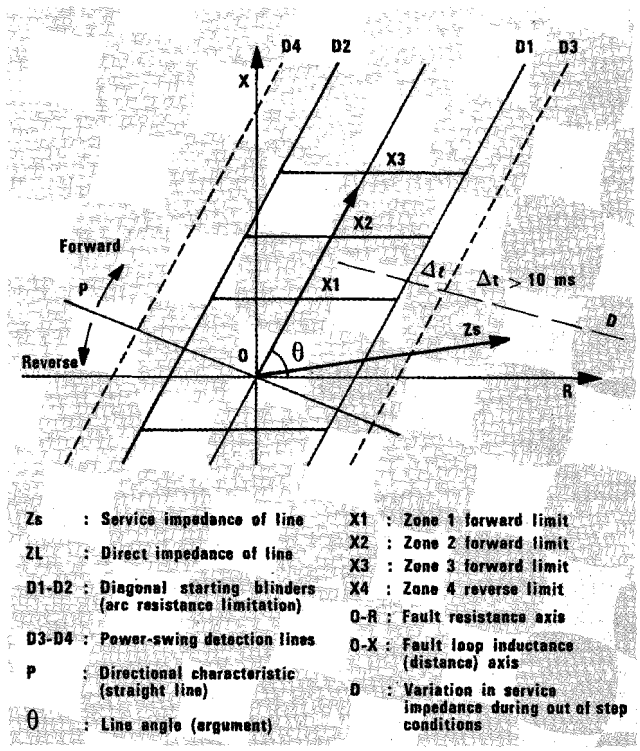
Two basic versions of the PDS 2000 are available: the PDS 2000 A and the PDS 2000 B. Also, various optional items can be added to each version, without modifying overall dimensions, to yield a range of variants.

- **PDS 2000 A**
  — Single phase tripping for phase-to-earth faults in the first zone.
  — Three-phase tripping for multiphase faults.
  — Control panel indicator lamps locate fault zone.
  — Manual reset pushbutton for clearing of all indicator lamps.
  — Blocking by surge guard device.

Options

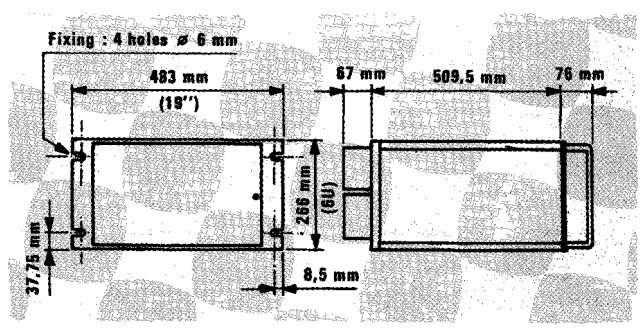
— Current transformer saturation detector.
— Permissive over-reaching feature.

OPERATING CHARACTERISTICS



Zs	: Service impedance of line	X1	: Zone 1 forward limit
ZL	: Direct impedance of line	X2	: Zone 2 forward limit
D1-D2	: Diagonal starting blinders (arc resistance limitation)	X3	: Zone 3 forward limit
		X4	: Zone 4 reverse limit
		O-R	: Fault resistance axis
D3-D4	: Power-swing detection lines	O-X	: Fault loop inductance (distance) axis
P	: Directional characteristic (straight line)	D	: Variation in service impedance during out of step conditions
θ	: Line angle (argument)		

DIMENSION DIAGRAM



• PDS 2000 B

— Three-phase tripping irrespective of fault type or location.
— Can be used as a second main protection.

Options

— Control panel indicator lamps to locate fault zone.
— Power-swing blocking device.
— Current transformer saturation detector.
— Permissive over-reaching feature.

Model	Function / Variant	Tripping: Single phase	Tripping: Three phase	Second-main protection	Indicator lamps	Current transformer saturation detector	Surge guard	Permissive over-reaching
PDS 2000 A	Basic	•	•		•		•	
	Options					•		•
PDS 2000 B	Basic		•	•				
	Options				•	•	•	•

OPERATION

When a PDS 2000 protection device is in the "waiting" state, three static under-impedance relays monitor the three phase-to-phase loops.

The device starts up when the impedance seen by it falls within the parallelogram characteristic defined by zones Z3 (forward side impedance) and Z4 (reverse side impedance) and by the two diagonal blinders that limit the arcing resistance value. Since these different adjustments are independent of one another, series PDS 2000 devices can be readily adapted for use with all lines, irrespective of their length or argument.

For earth-to-phase faults, the impedance relays are switched to the different earth-to-phase loops by a biased zero-phase-sequence over-current relay.

The characteristic diagram for PDS 2000 devices includes three forward side monitoring zones (Z1, Z2 and Z3) and an reverse side monitoring zone (Z4). All four zones are supervised by a single reactance relay for all types of phase-to-phase and phase-to-earth faults, and by a memorised directional relay.

Tripping takes place at a predetermined time for each zone (i.e. step in the tripping sequence).

PDS 2000 protection devices can be used in association with single- or three-phase reclosing devices presenting parallel characteristics. In this way it is possible to obtain instantaneous three-phase tripping during re-closing following a permanent fault.

PHYSICAL CONSTRUCTION

PDS 2000 protection devices are housed in standard 19" rack units that occupy 6 rack mounting spaces. The various logic functions are performed by high reliability integrated circuits mounted on plug-in printed-circuit boards.

The control panel supports all necessary controls and indicator lamps. A set of test terminals facilitates the checking of various voltages and overall function testing. In addition, a test point patchboard is provided for checking various signals with the aid of an oscilloscope. The control panel is protected by a detachable plastic cover.

The terminal board, which features **screw and spade** type terminals, is located on the device's rear panel along with the solidstate converter of the auxiliary power supply.

PDS 2000 protection devices can be installed in "Europe" type standard cabinets or in standard 19" racks.

ORDERING INFORMATION

- Model designation.
- Options: see variants.
- Frequency: 50 or 60 Hz.
- Ratios of voltage transformers (3 VTs).
- Ratios of current transformers (3 CTs).
- Voltage of auxiliary power supply (d-c).
- Language for engravings (French, English or Spanish).
- Voltage of auxiliary power supply for remote control.

SPECIFICATIONS

DISTANCE MEASURING CIRCUIT	
• Nominal voltage (Un) (3 VTs)	$100/\sqrt{3}$ and $120/\sqrt{3}$ V
- Burden (max.)	3.5 VA per phase
- Permanent overload (max.)	1.2 Un
• Nominal frequency	50 or 60 Hz
• Nominal current (In)	1 A or 5 A
- Operating value (current)	0.25 In
- Permanent overload (max.)	2 In
- Adiabatic overload (max.)	3 In for 3 s
- Burden at In	0.3 VA (1 A) or 2.2 VA (5 A)
SETTING	
• Number of zones	3 forward zones: Z1 - Z2 - Z3 1 reverse zone : Z4
• Forward reactance	
- Zone 1	0.1 to 10 Ω (5 A), 0.5 to 50 Ω (1 A)
- Zone 2	1 to 5 times value selected for zone 1
- Zone 3	1 to 10 times value selected for zone 1
• Reverse reactance	
- Zone 4	0.5 to 5 Ω (5 A), 2.5 to 25 Ω (1 A)
• Number of steps (in tripping sequence)	3
• Operating times	
- 1st step (following fault condition)	40 ± 10 ms
- 2nd step	0.1 to 1 s
- 3rd step	0.25 to 5 s
• Resetting time	20 ms
• Characteristic angle of line (θ argument)	45° to 85°
• Residual coefficient $Ko = \frac{Xo - Xd}{3\,Xd}$	0.4 to 1.2 (by increments of 0.1)
• Mutual inductance compensation coefficient $KoM = \frac{XoM}{Xd}$	0.1 to 0.8 (by increments of 0.1)
• Width of characteristic parallelogram (RG)	0 to 10 Ω (arc resistance) (5 A) 0 to 50 Ω (arc resistance) (1 A)
• Width of diagonal surge guard blinder	R = 2 Ω (5 A) R = 10 Ω (1 A)
AUXILIARY POWER SUPPLY (d-c/d-c converter)	
• Nominal voltage	48, 100, 125, 220, 250 Vd-c
• Operating range	— 20 % to + 10 %
• Power consumption	
- "waiting" state	50 W
- "fault" state	65 W
ENVIRONMENT	
• Temperature	
- nominal operating temperature range	— 10 to + 40 °C
- extremal operating temperature range	— 10 to + 55 °C
- storage temperature range	— 10 to + 55 °C
• Relative humidity	
- over nominal operating temperature range	≤ 85 %
- over extremal operating temperature range	≤ 60 %
- over storage temperature range	≤ 85 %
WITHSTAND TESTS	
• Breakdown voltages	
- According to standard BS 142	
- between current and voltage terminals and earth	2 kV - 50 Hz - 1 min
- between contact terminals and earth	2 kV - 50 Hz - 1 min
- According to recommendation BEAMA 219	
- between current and voltage terminals and earth	5 kV - 1/50 µs - 0.5 J
- between any terminal and earth	5 kV - 1/50 µs - 0.5 J
- between auxiliary power supply terminals and earth	2.5 kV - 1/50 µs - 0.5 J
• Tripping contacts Breaking capacity	20 A - 250 Vd-c - 0.5 s
• Connection diagram	S 1.6987/01
• Dimensions (19" rack unit, 6 rack mounting spaces)	see drawing D 1.6180/02
• Weight	35 kg (approx.)

Compteurs Schlumberger is bound by the foregoing specifications, dimensions and diagrams only after confirmation.

R.C. PARIS B 337180475

DECEMBER 1976

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