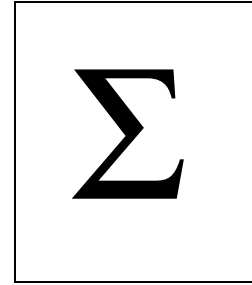


# DTD-SP

## COMPACT DIFFERENTIAL PROTECTION



### *Field of application*

The three phase differential protection is used as a selective and fast protection against short circuits of two-windings transformers (type *DTD-SP*), generators and generator-transformer units.

### *Main characteristics*

- No external additional auxiliary C.T.'s are needed, the C.T. ratios, and the vector rotation according to the transformer connection group are set by parameters.
- The differential characteristics have three sections.
- Its bias is based on the average of the two-side currents.
- Insensitive against transformer inrush current.
- The device provides overcurrent backup and overload protection.
- Sensitive earth fault protection function with independent time delaying.
- Breaker failure protection option on low side C.B.
- Programmable software matrix.
- Operating time is about 20 to 30 ms, and 15 to 20 ms if high current differential stage operates.

## *Differential protection working principle*

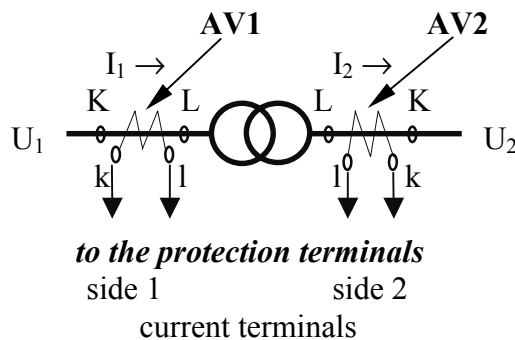
The currents are connected through input C.T.'s and analogue low pass filters to the multiplexer and A/D converter.

Setting the current balance of the differential protection is very easy. The main C.T. primary and secondary rated currents, the transformer rated current in percent of the C.T rated values need to be set. The current phase shift according to the transformer connection group (e.g.Yd11) is to be set by a parameter.

| Vector group parameter | Connection | Vectors                      | Angle $\alpha$   |
|------------------------|------------|------------------------------|------------------|
| 0                      | Dd0        | $U_1 \uparrow U_2$           | $0^0$            |
| 1                      | Yy0        | $U_1 \uparrow\uparrow U_2$   | $0^0$            |
| 2                      | Dy1        | $U_1 \uparrow\uparrow U_2$   | $30^0$           |
| 3                      | Yd1        | $U_1 \uparrow\uparrow U_2$   | $30^0$           |
| 4                      | Dy5        | $U_1 \uparrow\downarrow U_2$ | $150^0$          |
| 5                      | Yd5        | $U_1 \uparrow\downarrow U_2$ | $150^0$          |
| 6                      | Dd6        | $U_1 \downarrow U_2$         | $180^0$          |
| 7                      | Yy6        | $U_1 \downarrow U_2$         | $180^0$          |
| 8                      | Dy7        | $U_2 \uparrow U_1$           | $210^0 (-150^0)$ |
| 9                      | Yd7        | $U_2 \uparrow U_1$           | $210^0 (-150^0)$ |
| 10                     | Dy11       | $U_2 \uparrow\downarrow U_1$ | $330^0 (-30^0)$  |
| 11                     | Yd11       | $U_2 \uparrow\downarrow U_1$ | $330^0 (-30^0)$  |

Phase shift:  $U_2 = U_1 \cdot e^{j\alpha}$ .

*Table 1 Transformer connection and code values*



*Fig. 1 Polarity of the current transformers*

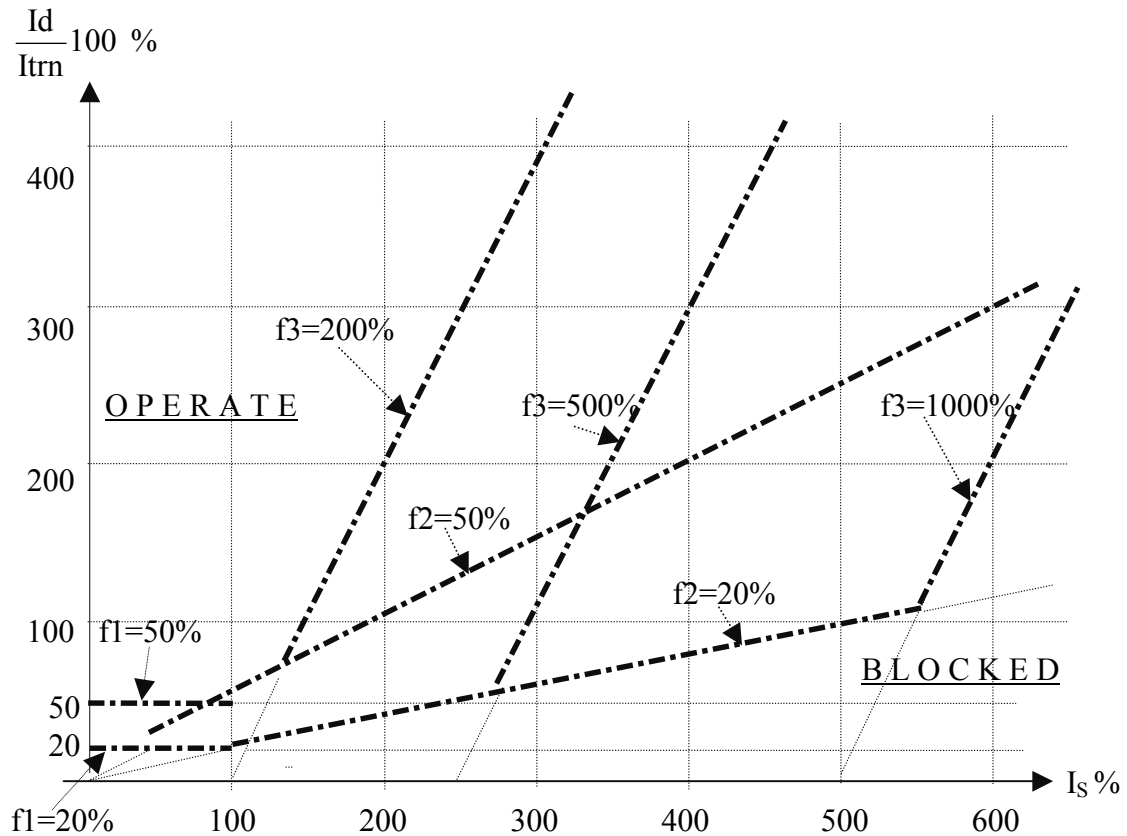


Fig. 2 The tripping characteristics

**f1%** Setting of the first horizontal section of the characteristic. It determines the basic sensitivity of protection in per cent of the transformer rating current.

**f2%** Setting of second section gradient of the characteristic. It is necessary for compensating the regulating transformer range. This section is a line originated from the origin.

**f3%** Setting of the third section. It is necessary for compensating the C.T. saturation, hence its gradient is always  $\text{tg}\alpha=2$ , and originating on the vertical axis at  $[-f3\%]$ .

**f2h** Setting of the second harmonic blocking. It is necessary against false trip on inrush current. It blocks if the second harmonic content of the differential current in per cent is more then the set value.

**Id>>** Setting of a high current value. If the differential current is higher than the set one the protection trip without bias. In the present case, the operation time is 15 to 20 ms.

The overcurrent relay has one stage only at side 1, and two stages at side 2.

As an option, sensitive earth fault relay can be integrated into the relay.

As an option, additional timer is used for breaker failure protection.

The protection has 8 output relays which can be programmed by software matrix.

### ***Technical data***

|  |
|--|
| General technical specification see in <b>SigmaProt system information sheet</b> |
| Type tests see in <b>SigmaProt system information sheet</b>                      |
| Design and sizes see in <b>SigmaProt system information sheet</b>                |

### ***Setting ranges:***

| <b><i>Setting ranges:</i></b>                |                           |
|--|---------------------------|
| Main C.T. on side 1, primer rated currents   | 50 to 1500 A, 25 A        |
| Main C.T. on side 2, primer rated currents   | 50 to 2500 A, 25 A        |
| Transformer rated currents                   | 20 to 270 %, step 2 %     |
| Diff.protection, trip without bias, Id>>     | 800 to 2500 %, step 50 %  |
| Characteristic, basic sensitivity, f1        | 20 to 50 %, step 2 %      |
| Characteristic, 2nd section gradient, f2     | 20 to 50 %, step 2 %      |
| Characteristic, 3rd section setting, f3      | 200 to 2000 %, step 10 %  |
| Inrush current second harmonic blocking, f2h | 10 to 30 %, step 2 %      |
| Overcurrent relays, setting value,           | 50 to 2500 %, step 5 %    |
| Timers                                       | 0 to 60000 ms, step 10 ms |

### ***Options***

- Interface to a SCADA system

### ***Information required with order***

- Type of protection [DTD-SP]
- Rated C.T. current [1 A, 5 A, independently chosen for both side]
- Auxiliary d.c. voltage [220 V, 110 V]