

Abstract

- Complete phase and ground protection
- Static measuring circuits with active filters for optimum utilization of harmonics in the current circuits
- Up to three kilometer of high voltage cable can be included in the differential zone
- Harmonic restrained operating time 30 ms at 3 times pick-up current
- Unrestrained operating time 10-20 ms at 2 times pick-up current with minimum impulse time of 3 ms
- Variable percentage restraint for external fault security and on-load tap-changer transformer protection
- Second harmonic restraint from all three phases for inrush security
- Fifth harmonic restraint from all three phases for overexcitation security
- Sensitivity can be set to 20, 25, 35 or 50 per cent of rated current 1 A or 5 A
- Unrestrained operation does not respond to dc offset and can be set 8, 13 or 20 times relay rated current
- Provided with separate auxiliary CTs for ratio and phase angle matching and containment of zero sequence current
- No restrictions on the type of main CT connections
- Long CT secondary leads are feasible with 1 A relay
- Built-in trip relay, indicator and test switch

Application

The RADSB is a protective relay intended for all types of auto-transformers and multiple winding transformers. By including additional input restraint modules, up to 6 transformer windings can be connected. The relay is also well suited for generator and step-up transformer overall protection, often including the auxiliary transformer in the protected zone.

The non-linear percentage restraint characteristic provides the required restraint for external faults. This makes the relay suitable for use with multi-winding transformers, auto-transformers or in a system where one transformer winding is directly connected to two or more breakers. The characteristics are designed to provide excellent internal fault sensitivity; RADSB is virtually unaffected by load restraint.

The RADSB relay also has an unrestrained instantaneous module which responds to the total differential current (less any dc component). This module will provide redundant operation for severe internal faults.

The second and fifth harmonic restraint voltages for each phase are paralleled and the sum used for harmonic restraint for each phase. The polyphase harmonic restraint circuitry prevents the relay from operating on inrush currents yet has a minimum effect on relay sensitivity if an internal fault occurs during energization. The fifth harmonic is used to prevent operation of the relay due to possible overexcitation of the transformer. Overexcitation protection should be provided by a V/Hz relay (preferably type RATUB which has an inverse-time operating characteristic).

Auxiliary CTs are used to balance the main CT ratios. In addition auxiliary CTs may be used to reduce the effective lead burden of long secondary leads. The differential zone of the relay can include up to three kilometre of high voltage cable since adequate filtering provides security against high current oscillations.

Type RADSB

Transformer differential relay

1MDB04301-YN

Page 2

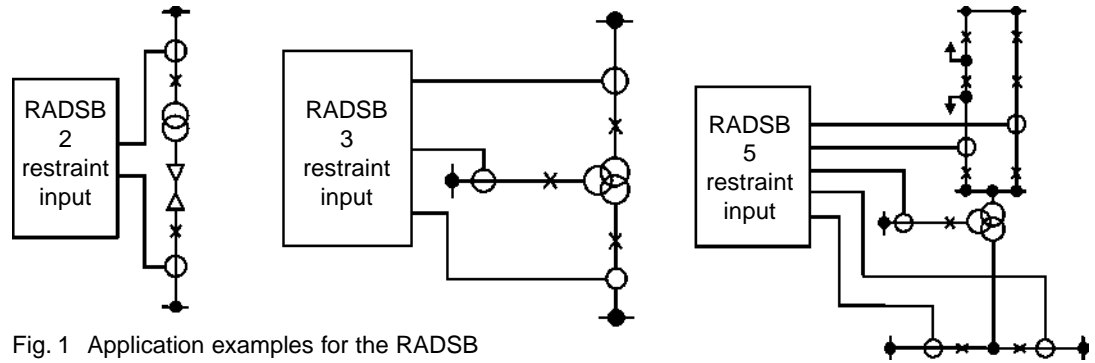


Fig. 1 Application examples for the RADSB transformer differential relay.

Application

The RADSB relay is available with two, three, five or six through-fault restraint inputs and can be used for dual-winding or multi-winding transformers which have one or more circuit-breakers for each winding.

The relay comprises the following modules:

- With or without test switch (Screw type termination)
- DC-DC converter type RXTUG 22H
- Transformer unit type RTQTB 060 and 061
- Measuring unit type RXDSB 4
- Tripping relay type RXMS 1
- Indicator type RXSGA 1

In RXSGA 1, LEDs indicate unrestrained operation and restrained operation and also the phase which caused the latter operation.

The RADSB relay can be connected directly to the main current transformers; however, when this is not practical, auxiliary CTs are used for ratio and phase-angle matching purposes. Auxiliary CTs also provide an additional point of insulation so that the main CTs can be grounded independent of the

ground at the relay location in addition to main CT secondary grounding. In the case of long CT leads, auxiliary current transformers can be used to reduce the secondary CT lead burden to the relay or the 1 A relay can be used.

When internal faults such as short circuits between phases, groundfaults or inter-turn short circuits occur, the differential relay rapidly disconnects the supply to the transformer. On the other hand, the RADSB restrains for differential currents which are caused by external faults, inrush currents or overvoltages. The operating values for restrained and unrestrained operations are set with switches on the measuring unit. The operating times of the relay are shown in fig. 2.

RADSB has static measuring circuits with active filters to enable optimum utilization of the harmonics in the differential current when restraining to inrush currents and overvoltages. The restraint limits in the case of external faults are shown in fig. 3.

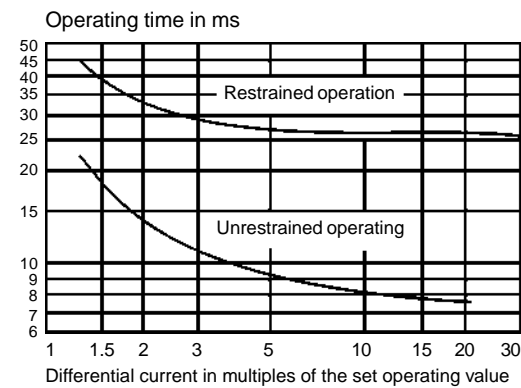


Fig. 2 Operating times for restrained and unrestrained operation, with RXMS 1 as the tripping relay.

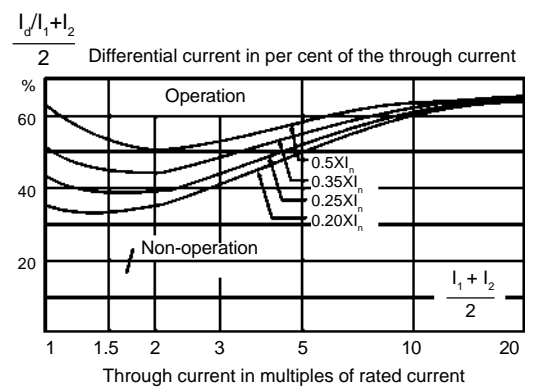


Fig. 3 The restraint of the relay for external faults is variable and is adapted to the magnitude of the through current

where I_x and I_y are the highest incoming and outgoing currents, respectively, of the transformer.

$$\frac{I_x + I_y}{2}$$

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Page 3

Technical data	Rated current I_n	1 or 5A	Power consumption total at rated current (approximately)
Rated frequency	50 or 60 Hz		$I_n = 1\text{ A}$ 0.02 VA/phase $I_n = 5\text{ A}$ 0.14 VA/phase
Restrained operating value I_{sr}	Settable 20, 25, 35, or 50% of I_n		In diff. circuit $0.25 \times I_n$ $I_n = 1\text{ A}$ 0.003 VA/phase $I_n = 5\text{ A}$ 0.02 VA/phase
Unrestrained instantaneous operating value I_{su}	Reconnectible : 8, 13 and 20 times I_n		In auxiliary voltage circuit before operation 10 W at operation 14 W
Operating time: at $I_d = 3 \times I_{sr}$ at $I_d = 2 \times I_{su}$	RXMS 1 30 ms RXME 18 50 ms 10-20 ms 40 ms		Dielectric tests current circuits 50 Hz, 2.5 kV, 1 min remaining circuits 50 Hz, 2.0 kV, 1 min Impulse voltage test 1.2/50 μ s, 5.0 kV, 0.5 J
Overload capacity: withstands 1 A version	10 A continuously 100 A for 1 s		Power frequency test 50 Hz, 0.5 kV, 2 min Fast transient test 4–8 kV, 2s 1 MHz burst test 2.5 kV, 2s
5 A version	20 A continuously 250 A for 1 s		Auxiliary CTs type SLCE 12, taps from 0.75 – 0.95 and 4 – 4.8 in one per cent steps
Permitted ambient temperature	–25 to 55°C		
Auxiliary voltage U_n (EL)	dc 24 – 36 V, 48 – 60 V or 110 – 250 V + 10% – 20%		

To order

- Specify :
- Type RADSB
 - Quantity
 - **Ordering no. from table 1 for COMBIFLEX version & refer page 7 for screw type version.**

Table 1, RADSB Selection:

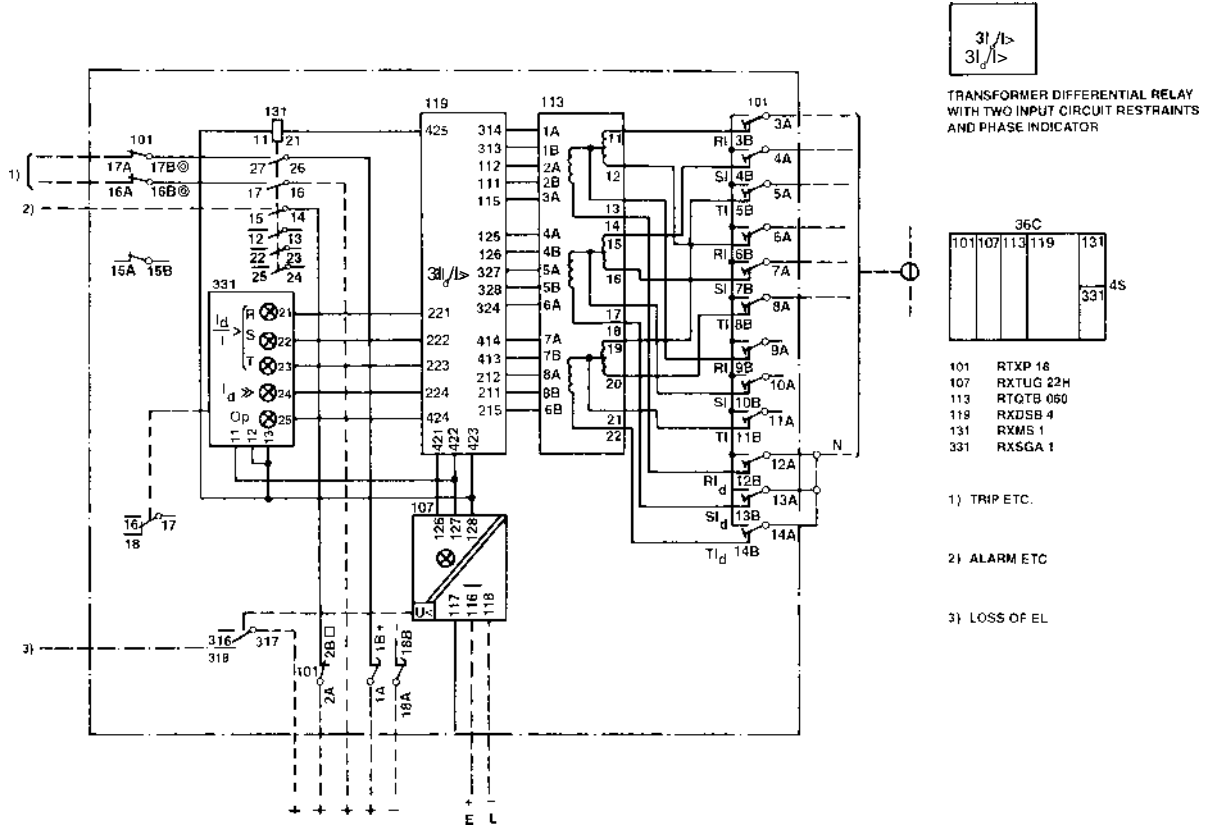
No. of restraint input	Rated current	Freq.	Aux. Voltage	Modular size	Ordering No.	Circuit diagram
2	1A	50 Hz	110 VDC / 220 VDC	4 S, 36 C	IN 330-021-CA	IN 7454-3344-CE
3	1A	50 Hz	110 VDC / 220 VDC	4 S, 42 C	IN 330-041-CA	7454-356-CC
5	1A	50 Hz	110 VDC / 220 VDC	4 S, 60 C	IN 330-051-CA	7454-359-CC
2	5A	50 Hz	110 VDC / 220 VDC	4 S, 36 C	IN 330-021-CB	IN 7454-3344-CE
3	5A	50 Hz	110 VDC / 220 VDC	4 S, 42 C	IN 330-041-CB	7454-356-CC
5	5A	50 Hz	110 VDC / 220 VDC	4 S, 60 C	IN 330-051-CB	7454-359-CC

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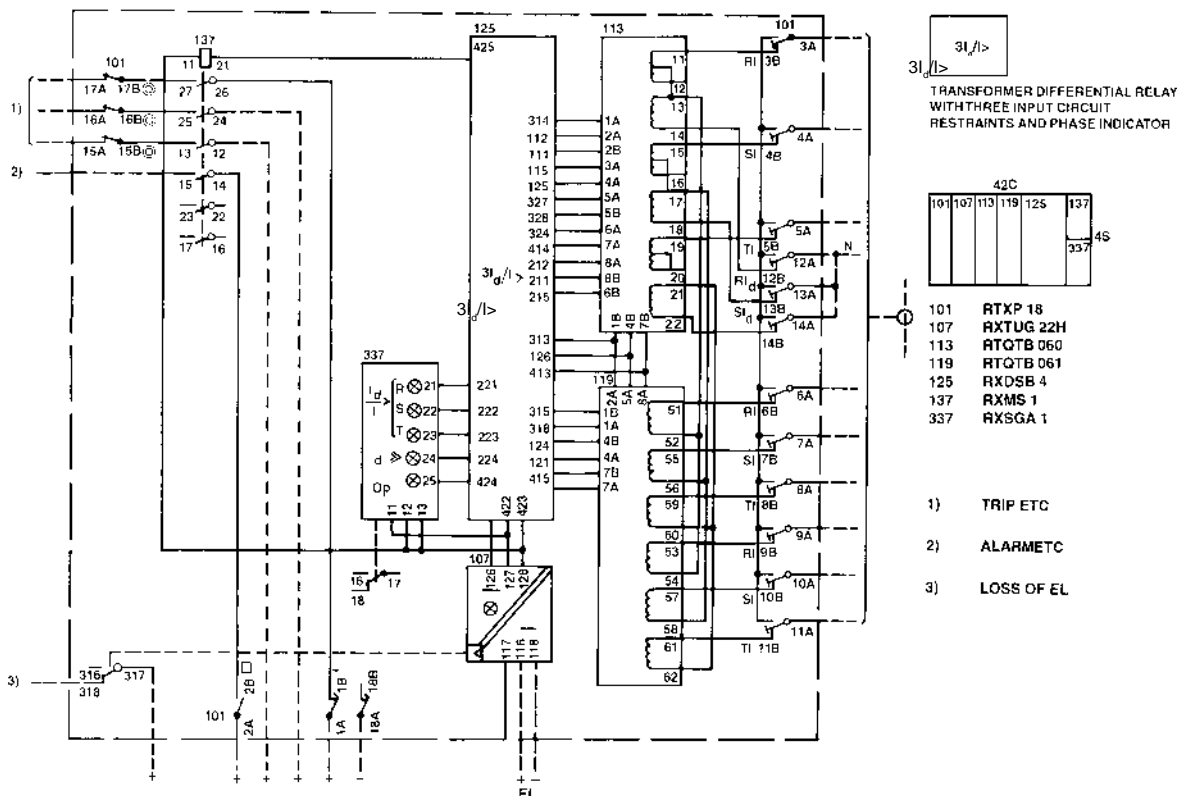
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1MDB04301-YN

Page 4



IN7454-3344-CE – Circuit diagram for RADSB with 2 restraint inputs



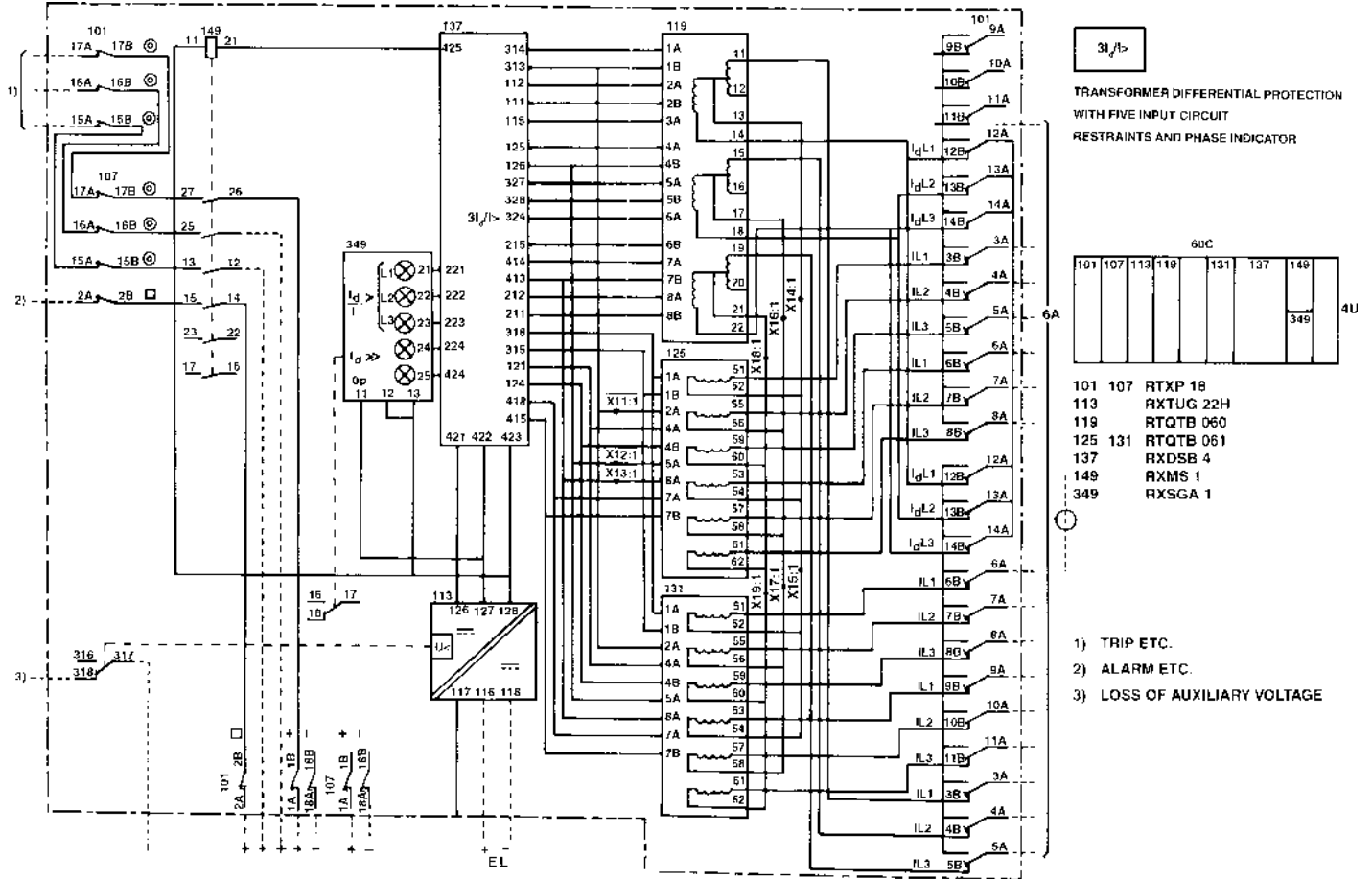
7454-356-CC – Circuit diagram for RADSB with 3 restraint inputs

Type RADSB

Transformer differential relay

1MDB04301-YN

Page 5



7454-359-CC – Circuit diagram for RADSB with 5 restraint inputs

