

7UT613_63x: Differential Protection for an Autotransformer Bank

7UT6 – Application

Autotransformer bank with CTs located inside the delta winding

In this application the zero sequence currents of all 3 sides of a autotransformer bank are measured, including the circulating current in the balance (delta) winding (side 3) !

For a configuration like Figure 1 (not described in the current manual), some **special settings** have to be considered for correct operation and to guarantee full phase selectivity.

This application is valid for the SIPROTEC relays 7UT613/633/635.

Settings:

With setting 0313, 0323, 0333 Starpoint of side X = **“Isolated”** there will be **no** I_0 -Elimination

For internal single pole faults the sensitivity increases from 66.7% to 100% !

The indication of an internal fault is phase segregate.

Algorithm for an individual side X in case of vector group = 0 and starpoint of side X = Isolated is:

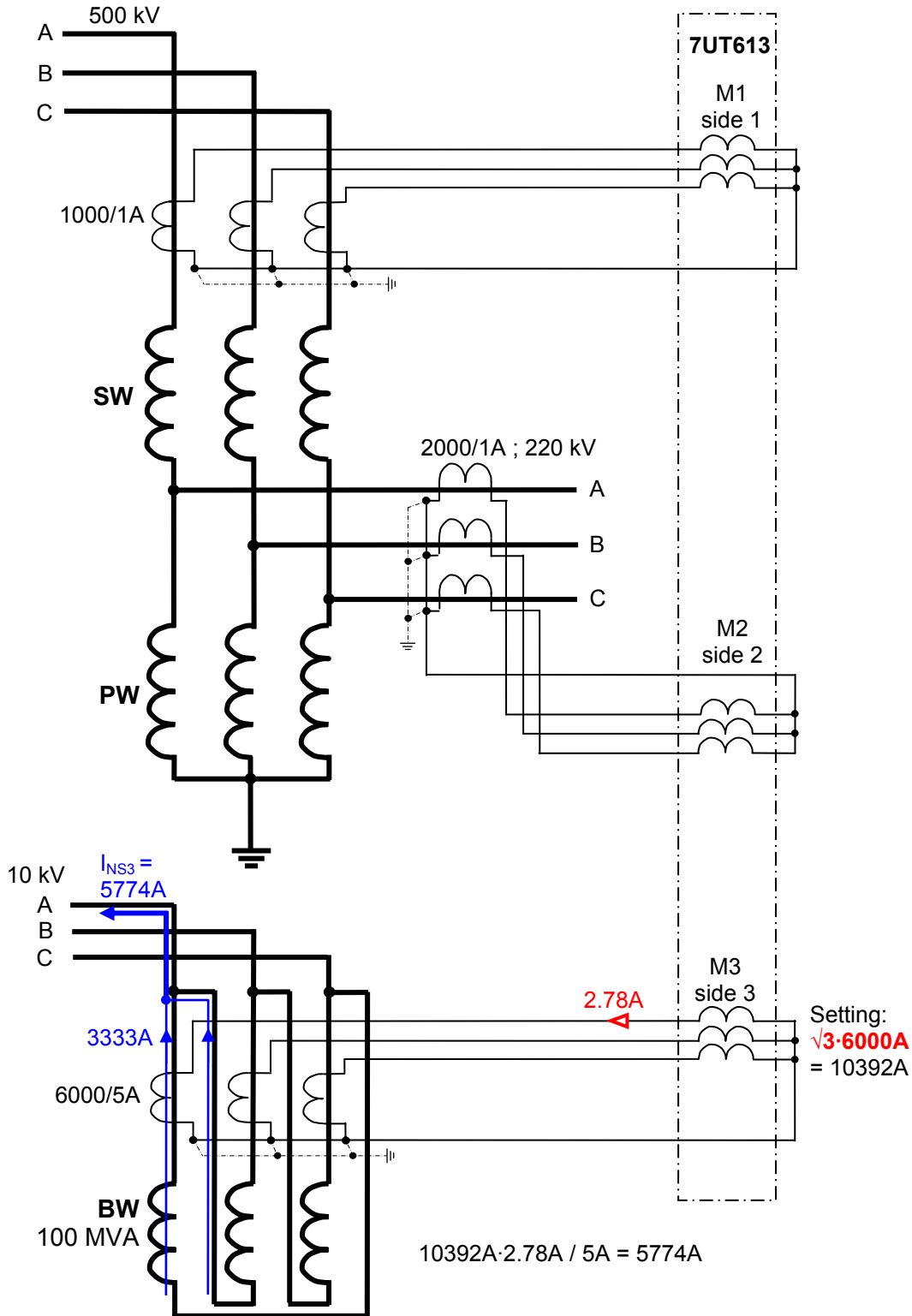
$$\begin{pmatrix} I_{AX}^* \\ I_{BX}^* \\ I_{CX}^* \end{pmatrix} = 1 \cdot \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} I_{AX} \\ I_{BX} \\ I_{CX} \end{pmatrix}$$

For through flowing currents (**load** or also external faults) the relay must be stabile! Therefore the 7UT6 needs the **real out flowing currents**.

But to get the real out flowing currents, the setting for the primary CT current of side 3 has to be multiplied by $\sqrt{3}$. (refer to Figure 1 ,example with nominal load on side 3) With the voltage setting for side 3 (10.0 kV) and the measured current side 3 it calculates a value referred to the nominal power (501 MVA) and compares this value with the values from side 1 and 2.

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Figure 1: 501 MVA Autotransformer Bank
CT's for Balance winding are located inside Delta connection



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No.	Function	Scope
0105	Protection Object	3 phase Transformer
0112	Differential protection	Enabled

Power System Data 1

No.	Settings	Value
CT-Numbers		
0211	No. of connected Meas. Loc.	3
0212	No. of assigned Meas. Loc.	3
0213	No. of sides	3
CT-Assign		
0220	Assignment at 3 assig. Meas.Loc./3 sides	S1:M1, S2:M2, S3:M3
0251	Auxiliary CT IX1 is used as	not connected
0252	Auxiliary CT IX2 is used as	not connected
0253	Auxiliary CT IX3 is used as	not connected
0255	Type of auxiliary CT IX3	1A/5A current input
Transf.		
0311	Rated Primary Voltage Side 1	500.0 kV
0312	Rated Apparent Power of Transf. Side 1	501.00 MVA
0313	Starpoint of Side 1 is	Isolated
0314	Transf. Winding Connection Side 1	Y (Wye)
0321	Rated Primary Voltage Side 2	220.0 kV
0322	Rated Apparent Power of Transf. Side 2	401.00 MVA
0323	Starpoint of Side 2 is	Isolated
0324	Transf. Winding Connection Side 2	Y (Wye)
0325	Vector Group Numeral of Side 2	0
0331	Rated Primary Voltage Side 3	10.0 kV
0332	Rated Apparent Power of Transf. Side 3	100.00 MVA
0333	Starpoint of Side 3 is	Isolated
0334	Transf. Winding Connection Side 3	Y (Wye)
0335	Vector Group Numeral of Side 3	0
CT's		
0511	CT-Strpnt. Meas.Loc.1 in Dir. of Object	YES
0512	CT Rated Primary Current Meas. Loc. 1	1000 A
0513	CT Rated Secondary Current Meas. Loc. 1	1 A
0521	CT-Strpnt. Meas.Loc.2 in Dir. of Object	YES
0522	CT Rated Primary Current Meas. Loc. 2	2000 A
0523	CT Rated Secondary Current Meas. Loc. 2	1 A
0531	CT-Strpnt. Meas.Loc.3 in Dir. of Object	YES
0532	CT Rated Primary Current Meas. Loc. 3	10392 A
0533	CT Rated Secondary Current Meas. Loc. 3	5 A