

EARTH FAULT PROTECTION PLUS SELECTION OF BOLTED OR SWITCHED NEUTRALS

This document details the requirements for including the various forms of Earth Fault Protection within switchboard systems.

The fundamental rules are shown in **bold type**, these **Must Always be Obeyed** to ensure that the system functions correctly.

1) RESTRICTED EARTH FAULT (R.E.F)

Protected Zone:	Transformer L.V. Winding and cabling/busbars upto L.V. Incomer.
Relay:	GEC MCAG14 Instantaneous operation.
C/T's:	4- Class X
Position of C/Ts:	Usually on Incoming copperwork
Position of Neutral/Earth Link:	Load side of Neutral C/T (NB: If Neutral is earthed at transformer Star point 5 - C/T's are required)
Incoming Device:	ACB, TPBN or TPSN
Relay to Trip:	MV/HV breaker, some specifications also require intertrip to LV breaker.

2) UNRESTRICTED EARTH FAULT (UREF) & EARTH FAULT (EF)

Protected Zone:	From Incoming Device out into the distribution system .
Incoming Device:	Terasaki, Tempower ACB.
Relay:	Terasaki, Temtrip PRQ2 , PRQ1. , AOR..GL, AOR..GS.
Relay to Trip:	Associated LV ACB.
CT,s ACB:	Integral on 4 pole devices Additional 'N' c/t on 3 pole devices.
Position of C/T's:	Normally on Line side of Incoming Device to give maximum protection including A.C.B.
Position of N/E link	Line side of Neutral C/T.

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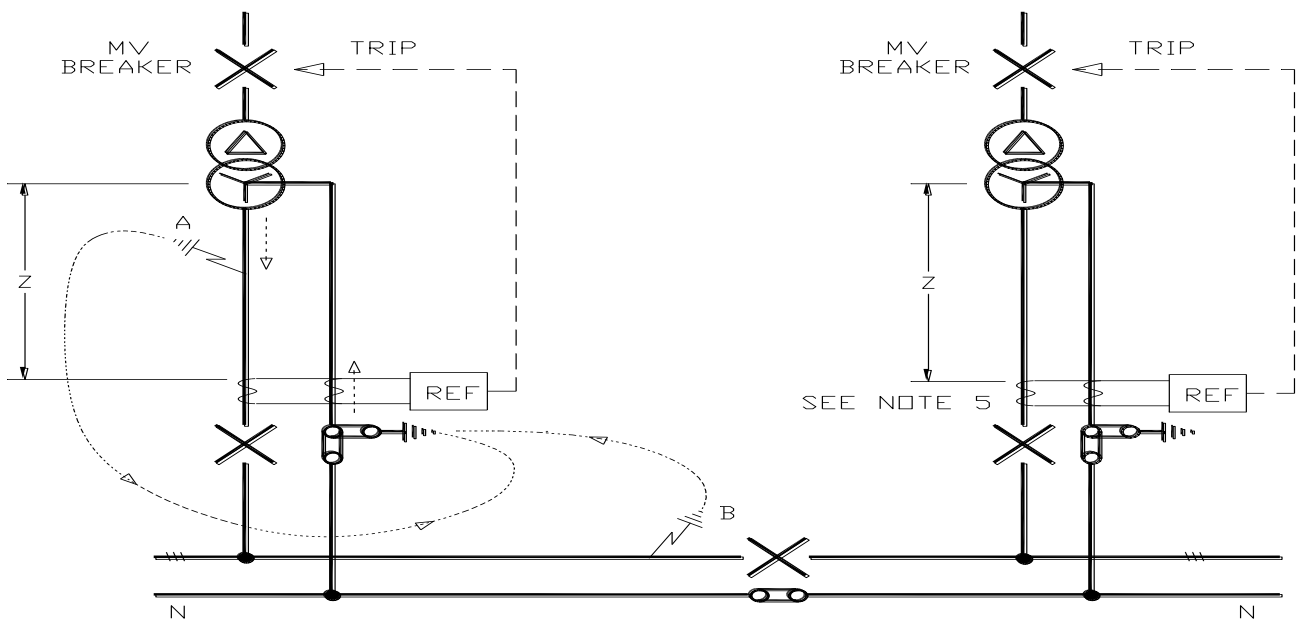
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IMPORTANT: If only 1 incomer TPBN or TPSN. If more than 1 incomer, all incomers, including Generator Incomers and bus section switches **MUST ALWAYS BE TPSN**. This is for correct operation of Earth Fault relay and to prevent circulating currents in neutral.

TYPICAL SCHEMES

Restricted Earth Fault



Notes

- 1) Z = Protected Zone

Earth fault at point 'A', current flow returns via Neutral, giving displacement of current through 'N' C/T, operating REF and tripping MV breaker, isolating the fault.

- 2) MV Breaker/Isolator must have a DC shunt trip and battery supply.
- 3) Intertrip to LV Breaker, is sometimes specified/necessary, the LV ACB will require a DC shunt trip and battery supply (either separate battery or use MV battery).
- 4) A fault at point 'B' would not cause a trip as earth fault current flows out through phase C/T's and returns via neutral C/T, cancelling out to "Zero Current". Use unrestricted Earth Fault relay for protection in this zone.
- 5) C/T's **must** be as close as possible to A.C.B. to ensure fullest protection zone.

UNRESTRICTED EARTH FAULT

Dotted lines/arrows indicates fault current flow.

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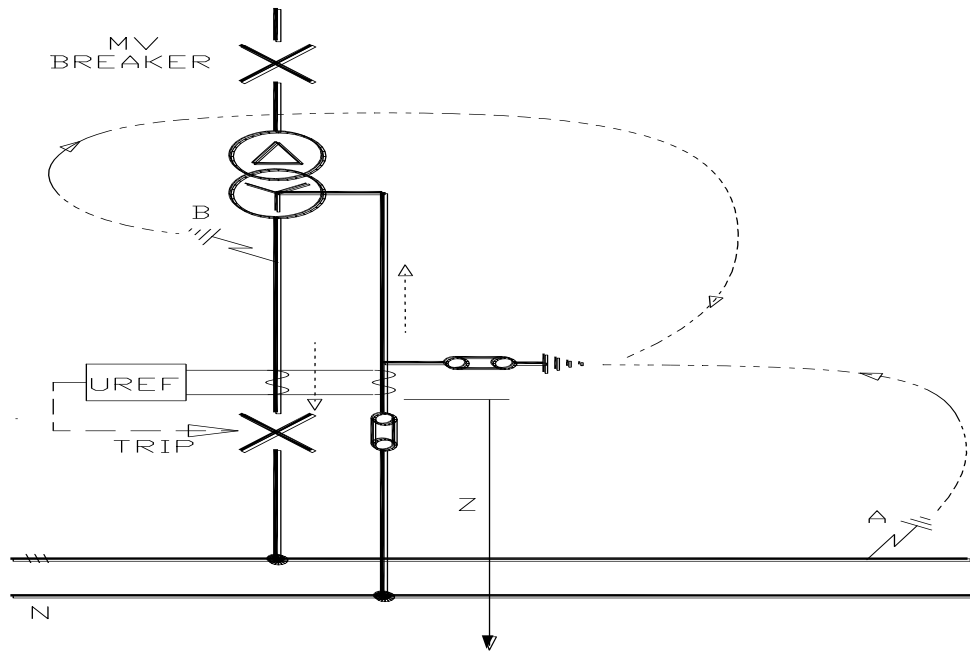
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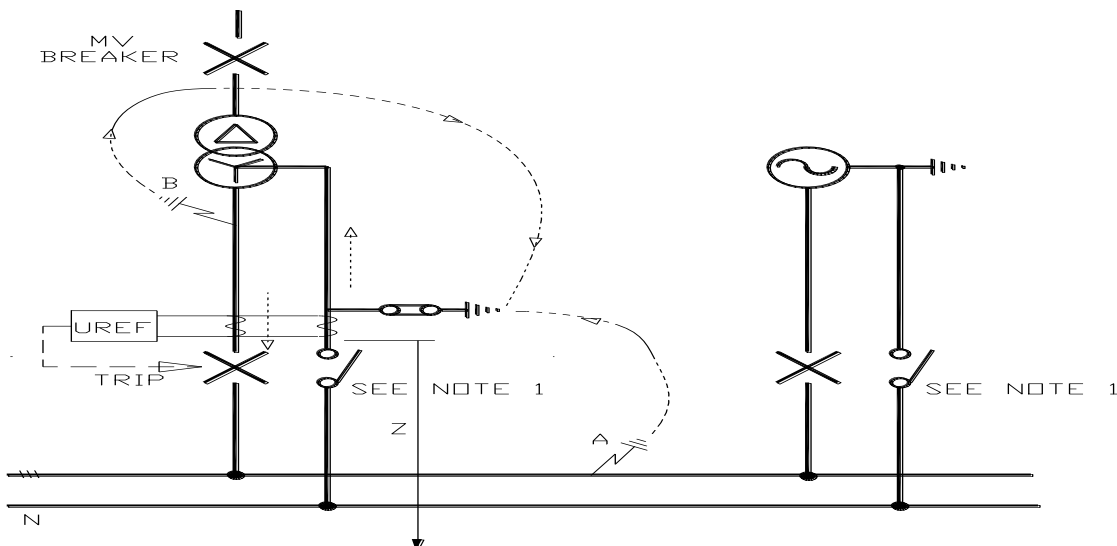
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SINGLE INCOMER



TWO INCOMERS
 (Mains & Generator)



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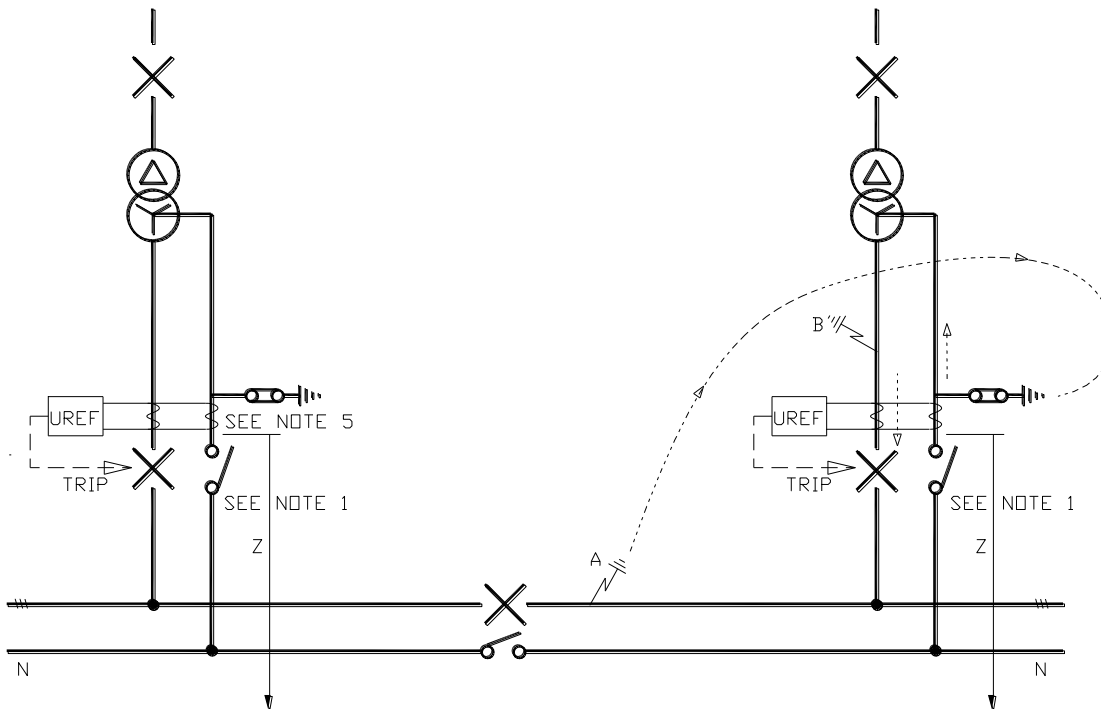
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UNRESTRICTED EARTH FAULT

2 or more supplies with Bus Coupler(s)



Notes

1) **Note Switched Neutrals necessary on incomers & buscouplers**

2) Z = Protected Zone

Earth Fault at point 'A', current flow returns to neutral/star point bypassing 'N' C/T, therefore giving a positive current which is not cancelled by return current through 'N' C/T, operating relay and tripping LV Breaker and Isolating the fault.

3) A fault at 'B', no displacement of current through C/T's, (for protection in this area REF relay would be necessary ~ MCAG14 or similar.)

4) C/T position to be on incoming copperwork to ensure fullest possible protection zone which includes the A.C.B.

Some specifications may indicate C/T's on load side of breaker, in this instance they should be mounted as close as possible to A.C.B. to ensure fullest protection zone.

N-E link must be upstream of C/T's.

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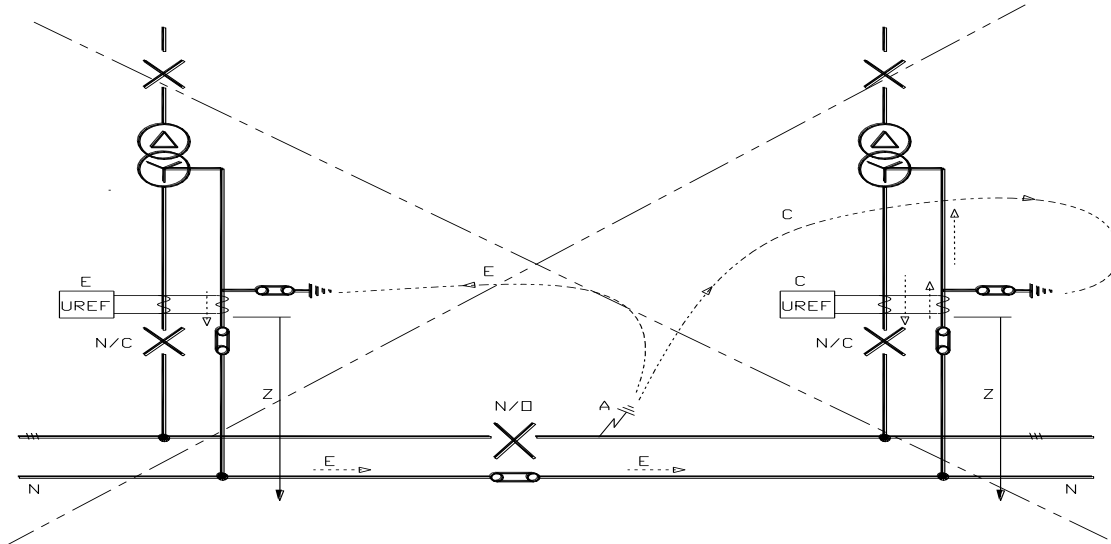
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UNRESTRICTED EARTH FAULT **INCORRECT APPLICATIONS**

Consider a 2 incomer system with buscoupler. All devices having bolted neutrals



- 1) Z = Protected Zone
- 2) Earth Fault at point 'A' would have 2 current return paths C & E. An unknown value of earth fault current (depending on circuit impedance's) would flow via path E, this has the effect of reducing the current detected by UREF (C) which would not trip because its 'set value' had not been reached and adding current to UREF (E) which may 'nuisance trip'.
- 3) A switched 'N' on the bus section switch would cut the return path 'E' and all earth fault current would flow via route 'C'.

Switched neutrals are required on both incomers to cut the incorrect return path when only 1 incomer is on with the buscoupler closed.

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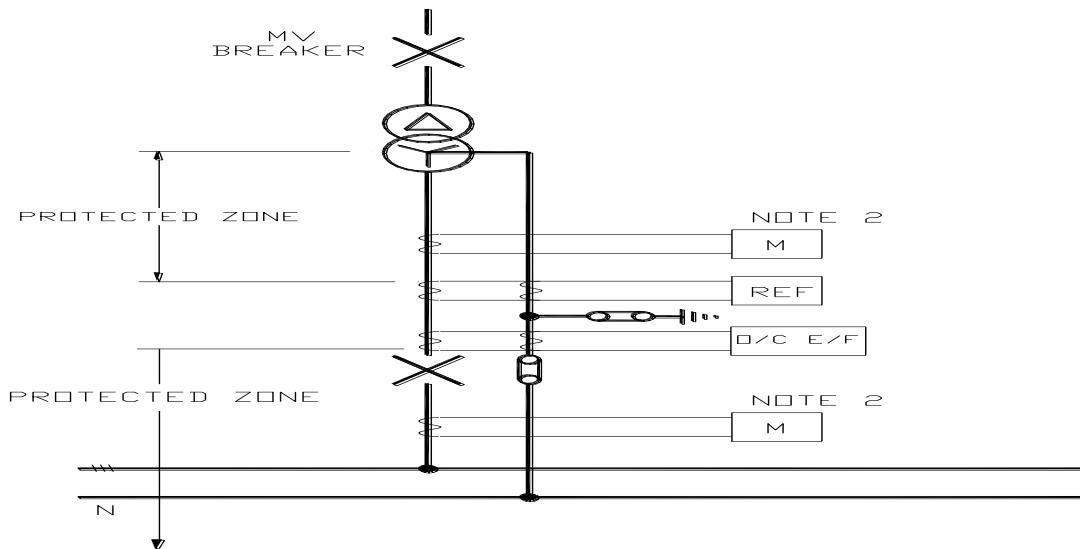
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3) Typical Arrangement of C/T's relating to A.C.B. affording Maximum protection



- 1) C/T's to be mounted as close as possible to A.C.B. to give maximum protection.
- 2) Metering / Instrument C/T's can be mounted on either side of A.C.B. as shown.
- 3) O/C = Overcurrent.
 E/F = Earth Fault or Unrestricted Earth Fault.
 REF = Restricted Earth Fault.

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