

AUTOMATIC TRANSFER SWITCH

SENSITIVE GROUND FAULT SENSING FOR SOLIDLY GROUNDED 3 PHASE/4 WIRE TRANSFER SYSTEMS

ENGINEERING BRIEF

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On a three phase electrical system with a distributed neutral (ie. 3 phase, 4 wire) the neutral conductor will be grounded at the source, as required to provide a fault current return path in the event of a ground fault. This fault current is not limited, and is therefore usually relatively large, and of sufficient magnitude to trip the feeder circuit breaker of the connected source due to phase overcurrent. This simple protection is typically afforded by a thermal-magnetic molded case circuit breaker.

If a superior level of ground fault protection is desired, whereby the feeder breaker is required to trip on a low level ground fault, then a more sensitive ground fault sensing device must be employed. This may typically be a molded case circuit breaker with an integral solid-state ground fault sensor, operating on the "zero sequence" principal. Alternately, an external sensor may be used, in conjunction with a zero sequence C.T.

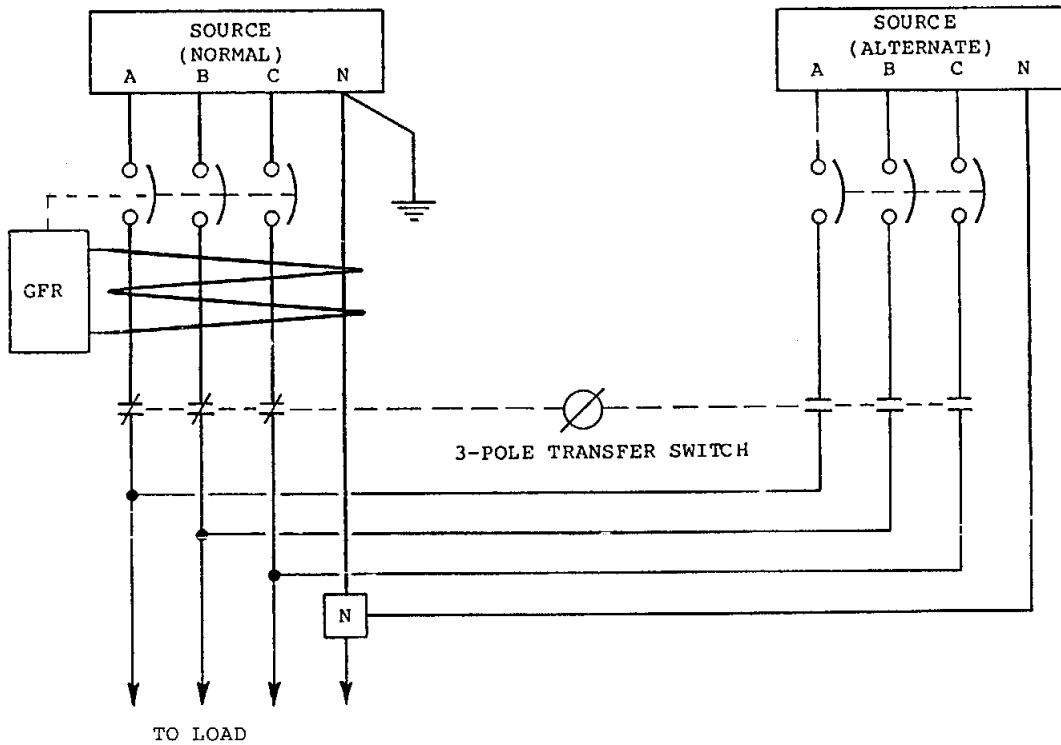
Note: - A zero sequence sensor will only detect a ground fault if the neutral is grounded on the source side of the C.T., while the fault occurs on the load side of the C.T. (ie the fault current return path, through the grounded circuit passes outside the C.T.).

A Zero sequence C.T. may be 4 separate C.T.'s connected in Zero-sequence configuration, as in a molded case circuit breaker with internal solid-state trip.

CASE #1

On a transfer system with sensitive ground fault sensing on only one source (usually the normal source), the neutral should be grounded as shown in fig. 1. Note that the neutral system cannot be grounded in more than one place, as it would then be a parallel conductor to the ground conductor, and part of the neutral current would flow in the ground conductor.

Fig. 1

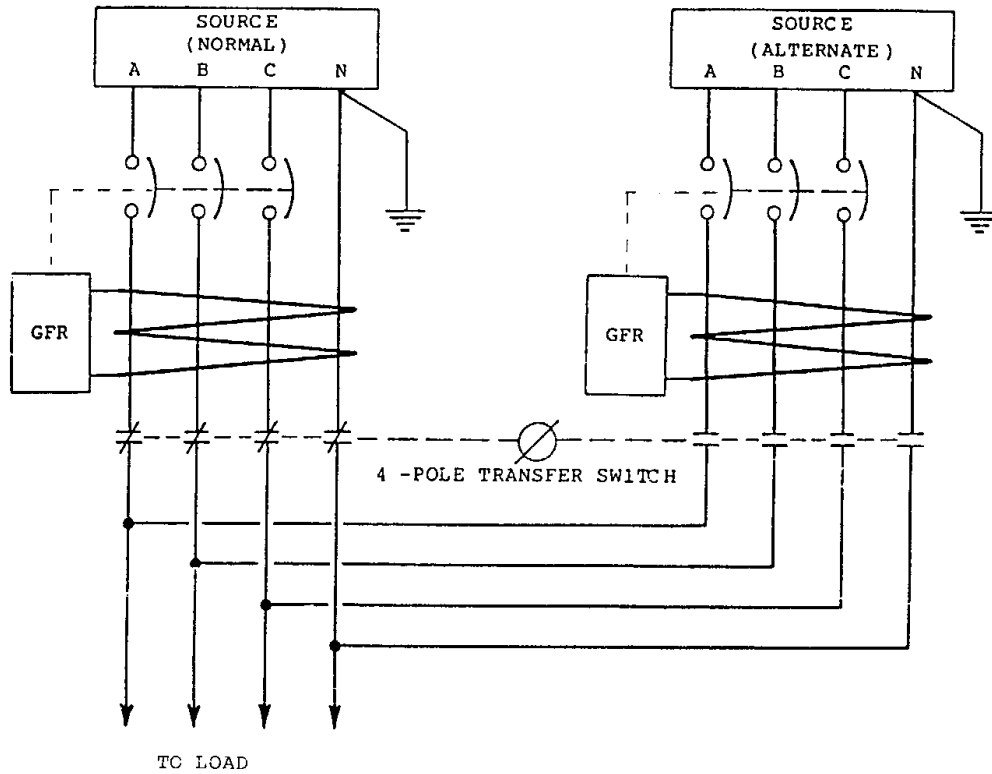


CASE #2

On a transfer system with sensitive ground fault sensing on both source feeder breakers, it is possible to employ a four-pole transfer switch as shown in fig. 2, to prevent simultaneously grounding the neutral in more than one place.

This method is relatively expensive, and has questionable merit, since a ground fault will trip the normal source breaker thus starting the generator (which sees the tripping as a power failure). When the faulted load is transferred to the generator, the generator breaker will then likely trip also. There is no benefit to a 4 pole transfer switch other than neutral isolation for ground fault sensing purposes.

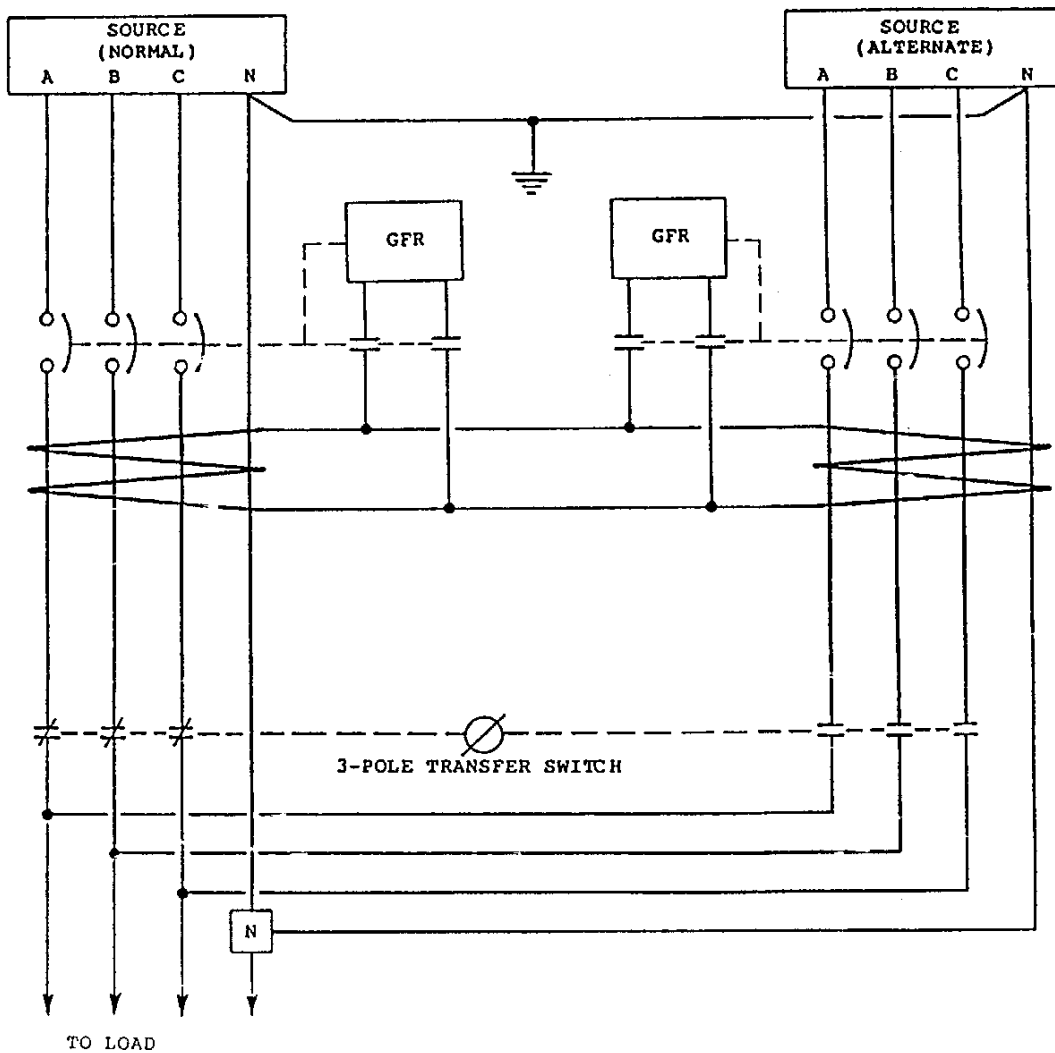
Fig. 2



CASE #3

The method of providing ground fault protection on both sources as shown in fig. 3 is very effective and requires only a 3 pole transfer switch. The disadvantage of this system is that the ground fault relays of both sources must be coordinated and installed in reasonable proximity due to the C.T. circuits.

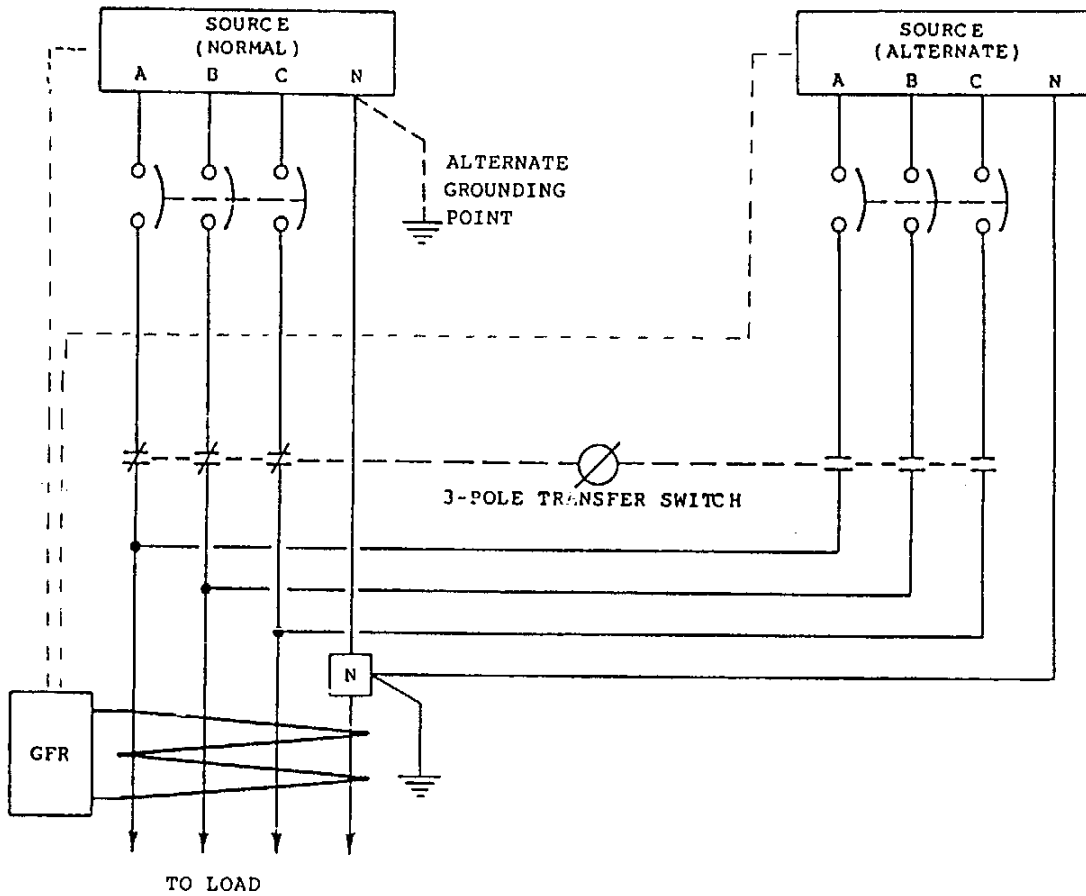
Fig. 3



CASE #4

An alternate method of providing for sensitive ground fault sensing on both sources, while avoiding the disadvantages of the four-pole transfer switch method, is shown in fig. 4. this is the method used by Thomson Technology to provide option "GFP" ground fault protection on T.T.I. transfer switches.

Fig. 4



Features of Option "GFP" ground fault protection:

- 1) On detection of a ground fault:
 - the closed transfer breaker is tripped, immediately de-energizing the load
 - the generator start contact circuit is interrupted & locked out, preventing the generator from starting automatically
 - the transfer motor circuit is locked out
 - a visual lockout indicator (manually resetting this lockout returns the controls the normal, and the transfer breaker is reset by transferring to the opposite source either manually or electrically).
- 2) The ground fault detector provides adjustable trip current and adjustable tripping delay (to allow coordination with downstream breakers).
- 3) All "GFP" wiring is internal - no installer connections are required.

Benefits of Option "GFP" ground fault protection:

- 1) Eliminates need for 4-pole transfer switch.
- 2) Prevents (unless ordered otherwise) the transfer of a faulted load to the alternate source.
- 3) Employs only one ground fault sensor instead of two.
- 4) Reduced cost in most cases.
- 5) Offers good operator interface and reduces operator confusion in the event of ground fault tripping during emergency situations.
- 6) Consolidates ground fault equipment into a single location.

Using a 3-pole transfer switch with option "GFP" can substantially reduce system cost and complexity, while maintaining system performance. It should be considered for application where this type of protection is desirable.