

# Overcurrent Relays

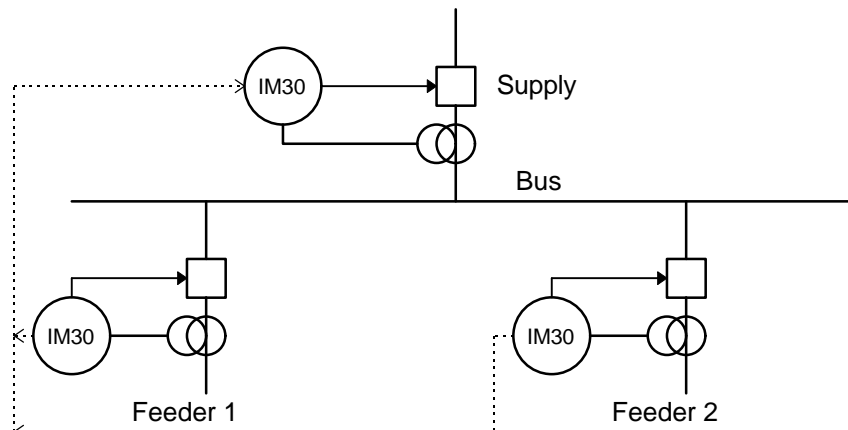
## R150-10-1

### Bus Fault Protection and Feeder Backup Using IM30AE or IM30BE Relays

The IM30AE and IM30BE relays both contain programmable blocking inputs which may be used to implement a very efficient bus fault and feeder backup mechanism without the need for a separate high impedance bus differential relaying system. The features used on these relays to implement this protection are:

- Programmable phase and ground blocking inputs, Bf, and Bo
- Phase and ground fault pick-up protective elements, I>, I>>, O>, and O>>
- Blocking request timers, TBf, and TBo
- Breaker Fail timer, tBO

Figure 1 indicates typical application. It is assumed that all relays are set for both phase and ground overcurrent protection. In addition, it is assumed that both low and high set protective elements for both are used. This document should be considered a guide as to the general methodology required to implement the described functions. It is incumbent upon the user to modify the described procedure as required for any given protective application.



**Figure 1**

The Supply line and both feeders are protected by any combination of IM30AE or IM30BE relays. The Feeder relays are set so that the phase pick-up elements, I> and I>> are programmed to operate output contact R3. The ground pick-up elements, O>, and O>> are all assigned to operate contact R4. These contacts will close immediately when the operating quantity exceeds the pick-up value. These are sometimes referred to as start-time elements.

The output of the Feeder's phase pick-up contact, R3, is then connected to the phase blocking input, Bf (terminals 1 and 2 on the relay) on the Supply relay. The phase blocking input variable Bf should be programmed to display "Bf I>> I>". This ensures that the Supply relay's low and high set phase elements will be prevented from operating as long as the phase block input is active. The ground overcurrent pick-up element contact R4 is similarly wired to the ground blocking input on terminals 1 and 3 of the Supply relay. The ground blocking input on the Supply relay is programmed to display "Bo O>> O>".

The blocking inputs on the Supply relay may be programmed to honor the blocking request for as long as the blocking input is active, or to ignore the blocking request after a certain period of time equal to twice the programming variable tBO (breaker fail timer). The blocking inputs should be set to honor the blocking request for only a fixed period time by setting the TBf and TBo variables to "2tBO". The variable tBO on each of the feeder relays should be set to a time delay equal to their breaker's expected operating time after receiving a trip signal.

The Supply relay should be set for very tight coordination with the Feeder relays ensure rapid bus fault clearing.

With these connections and settings, the following will occur:

1. If a fault occurs on one of the feeders, the feeder relay will pick-up. The pick-up contact will block the operation of the upstream Supply relay from operating, allowing the Feeder relay to clear the fault.

## BUS FAULT PROTECTION AND FEEDER RELAY BACKUP

---

2. If a bus fault occurs, neither of the Feeder relays will pick-up, therefore the Supply relay will not be blocked and the Supply relay will trip, implementing bus fault protection.
3. If the Feeder relay experiences a breaker fail condition – meaning the breaker has not cleared the fault after the time delay  $t_{BO}$ , then the pick-up element of the Feeder relay automatically drops out, removing the blocking signal from the Supply relay, allowing it to trip. This implements a breaker fail back-up function.

Note that the blocking input blocks the pick-up of the time delayed functions on the Supply relay. Therefore the time delay for the Supply can be set for very fast operation, assuming a bus fault, allowing only enough time delay ( $10\text{ms}^1$ ) for the pick-up element of the Feeder relay to block the operation of the Supply relay in case of a feeder fault.

4. If the breaker fail function does not operate in the Feeder relay, or if the blocking circuit connection is shorted, then after twice the breaker operating time  $t_{BO}$ , as set in the Supply relay, the blocking request will be ignored, allowing the Supply relay to trip. This provides an additional level of back-up.

In a similar fashion, the Supply relay may be interconnected with an upstream breaker, effectively implementing fault discrimination and back-up functions for itself.

---

<sup>1</sup> The output contact of the feeder relay will close in 10 msec after it picks up. This is the inherent time delay of the output contact.

---