

UTILITY RELAY COMPANY – Technical Bulletin #1A
AC-PRO Family Trip Units – September 2018
Retrofitting Ground Fault Trip Units on 4-wire Double-Ended Substation Main & Tie Breakers

● **Issue**

- Providing proper Ground Fault Protection on 4-Wire Double-Ended Substation Main & Tie breakers can be confusing.
- If the neutral bus is grounded at multiple locations, multiple paths for Ground Fault current exist. This can cause incorrect Ground Fault current sensing at Main & Tie breakers, which can result in undesirable tripping or lack of tripping. See Figure 1 below for an example of improper application of Ground Fault Protection on a 4-wire Double-ended Substation.

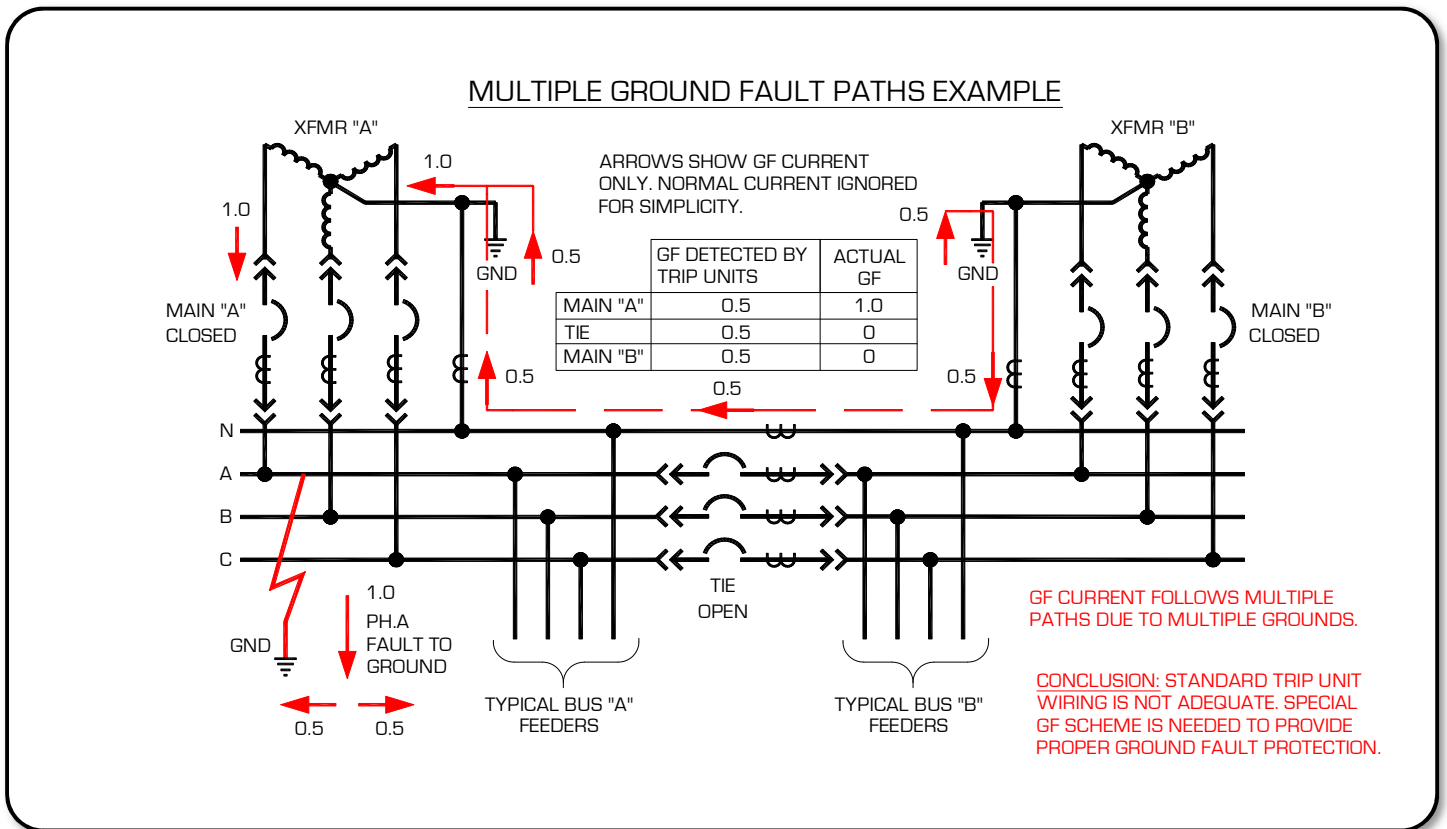


Figure 1: Multiple Ground Fault Paths Example with Improper Ground Fault Protection

- In a properly applied Ground Fault scheme (see examples in next section), the correct breaker(s) are tripped if a Ground Fault occurs. This accomplishes the following:
 - Provides protection in compliance with the National Electrical Code (NEC).
 - Tripping only the correct breaker(s) (Selective Coordination) ensures loads fed from unfaulted buses can remain energized.

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- **Available Solutions**

- A couple of common existing schemes that provide proper Ground Fault Protection:

- **Figure 2: Single Point Ground**, with Ground Return Scheme
- **Figure 3: Modified Differential** with Multiple Grounds

NOTE: These schemes are examples, demonstrating the concept of two of the most common schemes. Many variations exist, and URC recommends review of each specific application.

- Utility Relay Company Solutions for 4-wire Double-Ended Substation Mains & Ties:
 - Retrofit trip units available with two GFP methods / types:
 - Ground Return (GF Current is measured). See **Figure 2**.
 - Residual GF (GF Current is calculated). This is the standard GF method in URC trip units unless determined otherwise. See **Figure 3**, showing Residual GF trip units implemented in a Modified Differential GF Scheme.
 - AC-PRO-II
 - “GF Type” is a setting (Residual or Ground Return)
 - CT Secondary Rating (i.e. 1A, 0.5A, 0.4A, 0.25A, 0.2A) is a setting
 - AC-PRO
 - “GF Type” (Residual or Ground Return) is determined at time of order
 - CT Secondary Rating is determined at time of order
 - Custom solutions
 - Example: If the existing equipment is a 4-Wire Double-ended substation without Ground Fault Protection, additional wiring is required beyond standard breaker retrofit wiring to achieve proper Ground Fault Protection
- See page 5 for “**What to do**” section.

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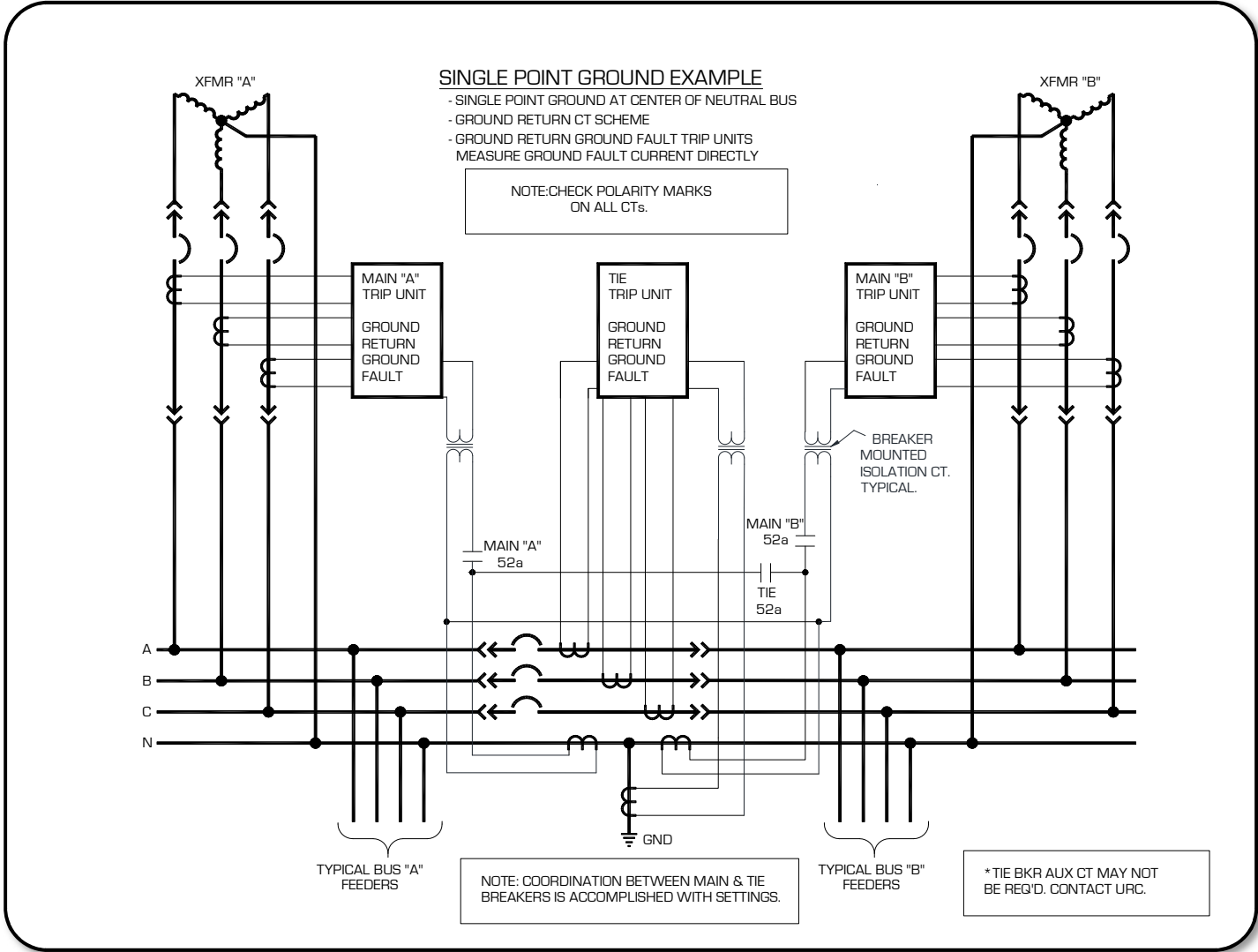


Figure 2: Single Point Ground Example

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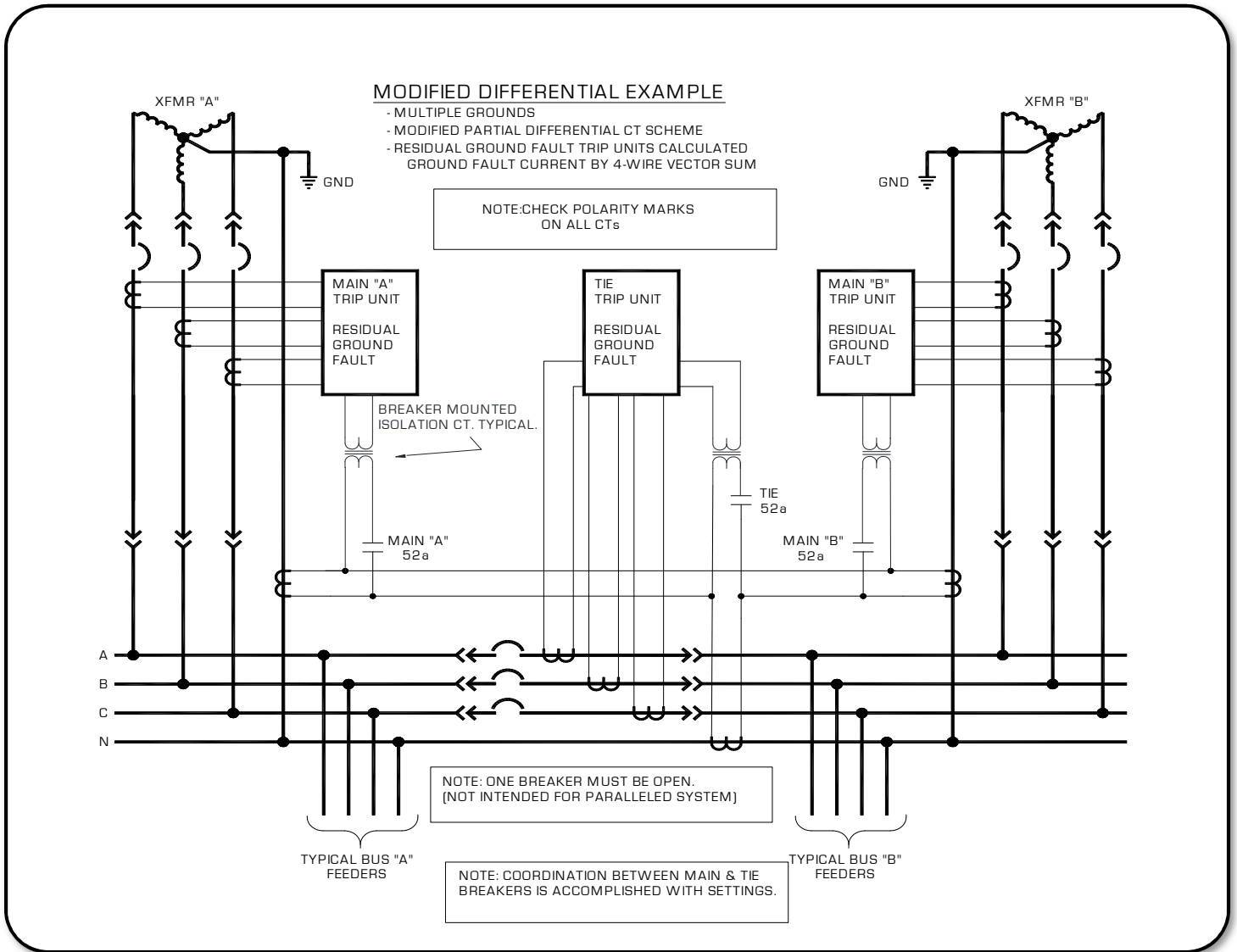


Figure 3: Modified Differential Example

See "What to do" section on Page 5.

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- **What to do**

- Before investigating further, confirm ALL of the following apply to your breaker,
 1. Double-Ended substation
 2. Main or Tie breaker
 3. 4-wire system (solidly grounded with neutral distributed to loads)
 4. Ground Fault Protection is required.

If all of the above items do not apply, a standard AC-PRO or AC-PRO-II (Residual Ground Fault) trip unit can be used. If Ground Fault is not required, it can be turned OFF.

- How to determine your existing Ground Fault scheme and which retrofit trip unit you need for your main or tie breaker:
 1. Review existing manufacturer 1-line diagram showing neutral bus, how the neutral bus is grounded, neutral CT locations, and neutral CT wiring. If the 1-line is not available, field verify this information if possible.
 2. Determine if existing neutral CT's can be reused. Many existing neutral CT's can be reused. The standard CT Secondary for URC AC-PRO Family trip units is 1A, unless determined otherwise. Coordinate with Utility Relay Company.
 3. Note location of isolation CT's – contact URC for proper ratios and if they're required.
 4. Review and compare existing conditions to diagrams in this document
 - Applications with **Single Point Ground** that match **Figure 2** require **Ground Return (GR)** Ground Fault trip units for Mains & Ties.
 - Applications with **Multiple Grounds** that match **Figure 3** require **Residual** Ground Fault trip units for Mains & Ties.

OR

Utility Relay Company can help determine which scheme you have and which trip unit fits your application.