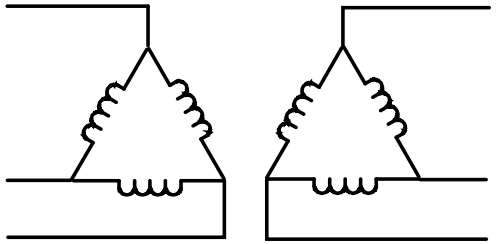
GARD

Unparalleled Protection

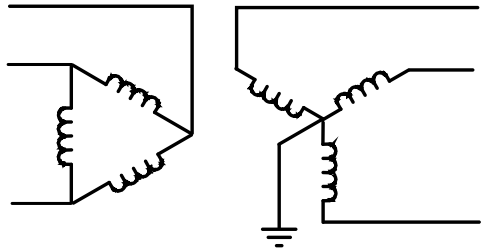
The Case for Advanced High Resistance Grounding

Power System Grounding Methods

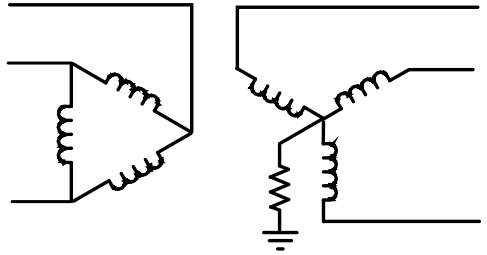
- Ungrounded



- Solidly Grounded
  - -Corner Delta Grounded System
  - -Mid Phase Grounded System



- Resistance Grounded



System Grounding Comparison

Reliability and Safety Impact	Ungrounded	Solidly Grounded	High Resistance Grounded
Process continuity under ground fault condition	✓	✗	✓
Control transient over-voltages	✗	✓	✓
Ability to locate ground fault	✗	✓	✓
Process continuity of critical process with second ground fault	✗	✗	✗
Arc Flash Mitigation for safety	✗	✗	✗

High Resistance Grounding

- ✓ Limit ground fault current to 10 A or less
- ✓ Provides service continuity on first ground fault
- ✓ Prevents arc flash incidents on first ground faults
- ✓ Allows faults to be located without de-energizing feeders (ground fault pulse locating)
- ✓ Used in 3 phase 3 wire circuits at 480. 600 and 4160 V specially in continuous process industries, hospitals, data centers and station service in gen stations where unscheduled downtime is costly or cannot be tolerated.

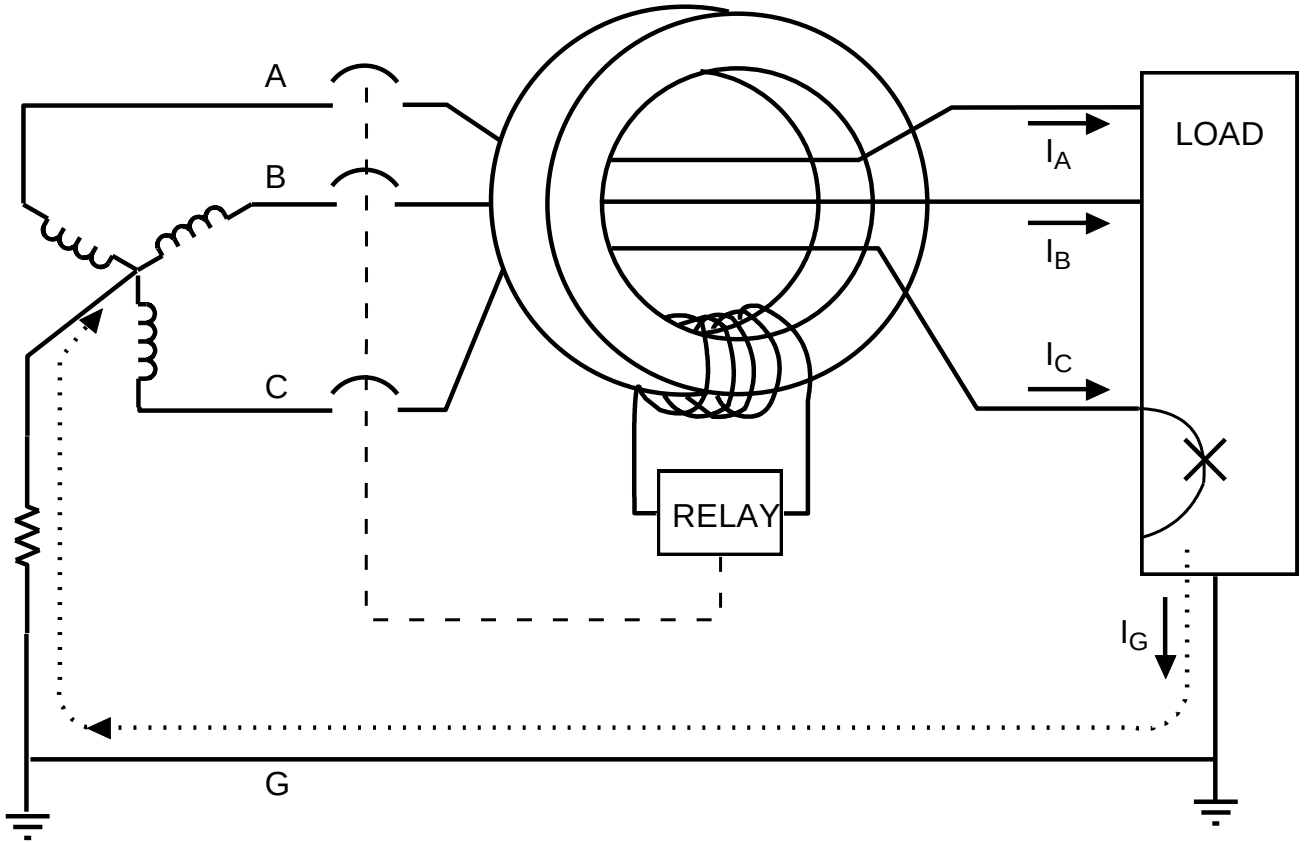
Alarming and Relaying

- ✓ Resistance grounding is not enough
- ✓ Must sense ground faults
- ✓ Take action
- ✓ Either alarm only, and locate the fault
- ✓ Or trip on fault

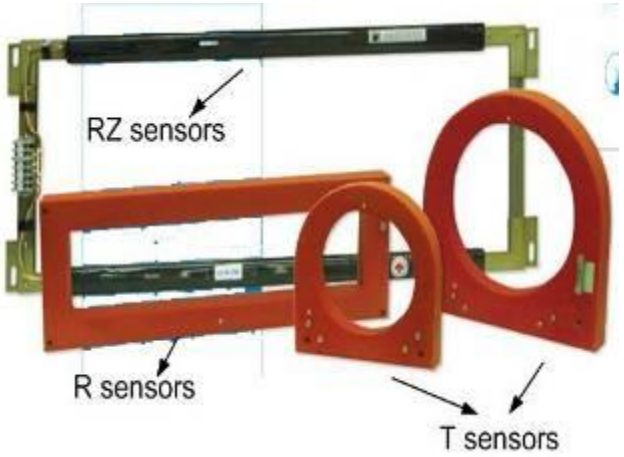
Approaches for Ground Detection

- ✓ Voltage Sensing GF Relay
- ✓ Current Sensing GF Relay
- ✓ Swbd Multi-Feeder GF Alarm Relay
- ✓ Swbd GF Relay with 2nd Fault Protection
- ✓ GF Relay for MCC’s
- ✓ Combination wall-mounted NGR and GF Relay for Retrofits

Sensing Ground Faults Using a Zero Sequence Sensor



Zero Sequence Sensors



Description:
The I-Gard zero sequence current sensors are used to detect ground leakage currents on medium or low voltage, grounded or ungrounded AC electrical systems.

The output from the sensors is used to operate I-Gard ground relays to provide equipment or life protection depending on the relay selected. The sensor should encircle the phase conductors and the neutral, if it exist s and is used, but not the grounding conductor or the shield of the cable.

Top 6 Excuses to Avoid HRG

1. What if I lose the resistor circuit?

2. It takes too long to locate the fault even with pulsing.

3. What if I don’t want the fault to stay on the system indefinitely?

4. What if the fault is intermittent?

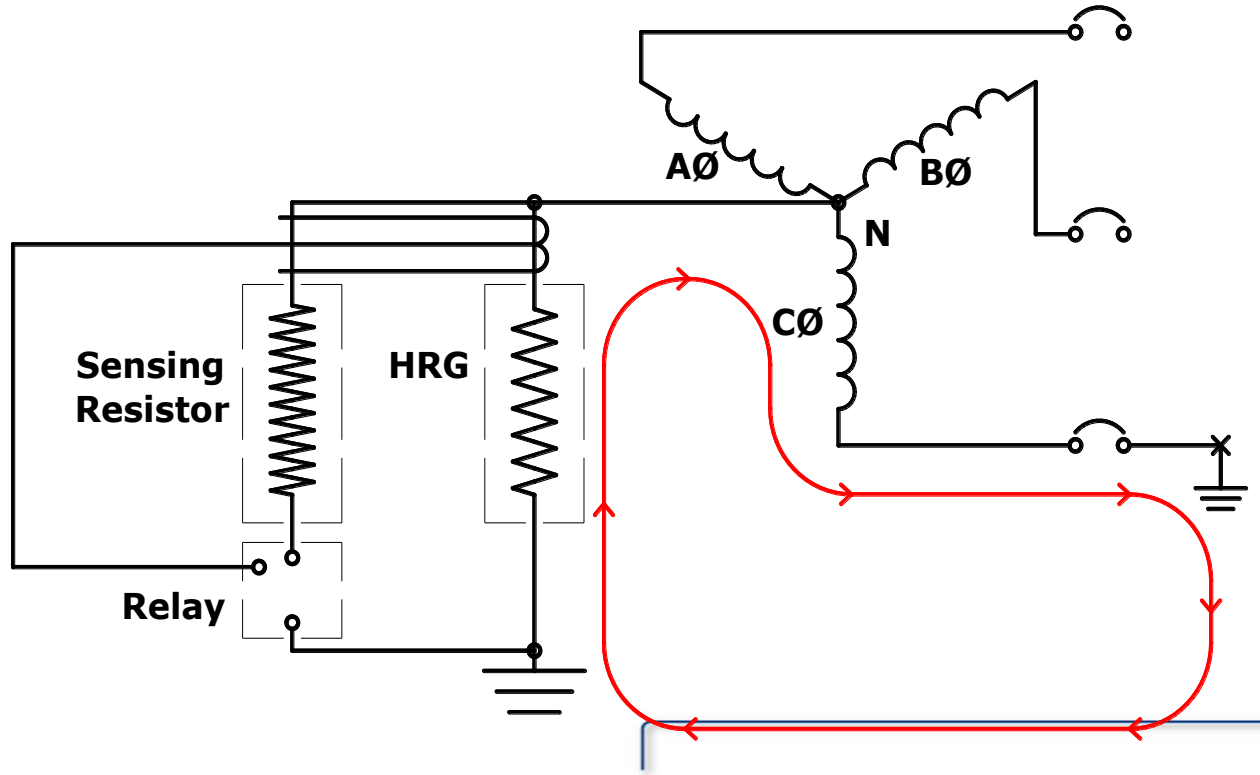
5. What if a second fault occurs?

6. HRG technology does not lower incident energy levels.

HRG: What if I lose the Resistor Circuit?

Ground Fault Relay & Sensing Resistor

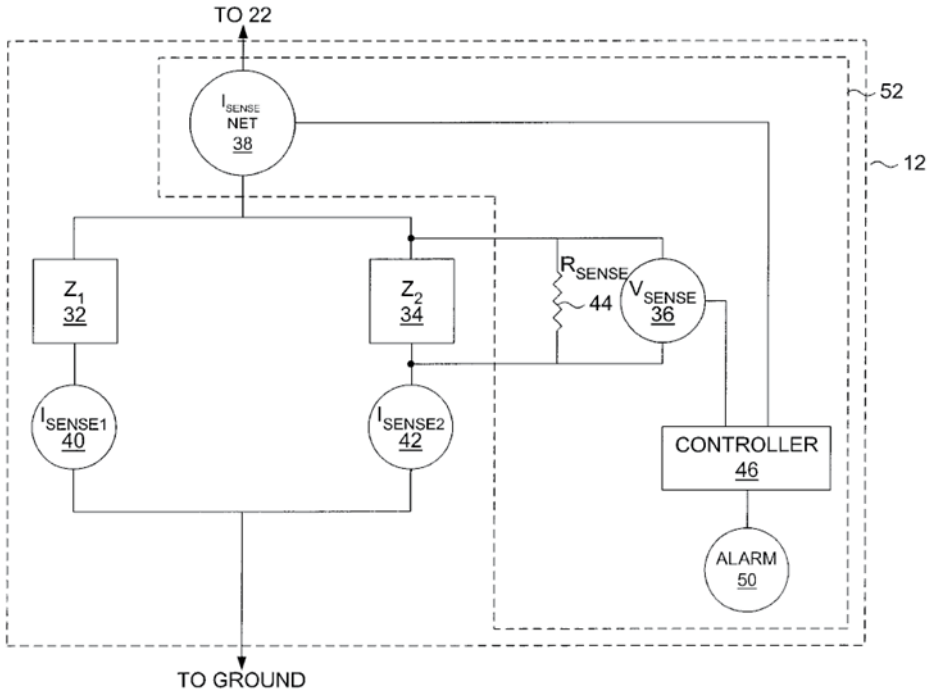
Detects Open / Short Circuits and annunciates failure of HRG even with circuit breaker open



HRG: What if I lose the Resistor Circuit?

In this monitored and fail-safe circuit, there is a parallel resistance circuit comprised of two identical resistor paths connected from the neutral to the ground.

The parallel resistance circuit is sized to limit any ground fault to predetermined levels. In the unlikely event that one resistor path fails,
the second resistor path continues to limit the ground fault to half of the predetermined levels and still provides full ground fault protection and an alarm indicating resistor failure.

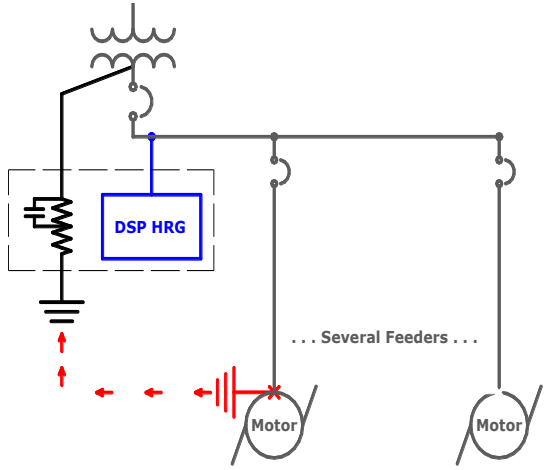


In conjunction with a sensing resistor and a series current transformer, a monitoring relay measures current through the neutral grounding resistor, transformer neutral to ground voltage and NGR resistance for continuity.

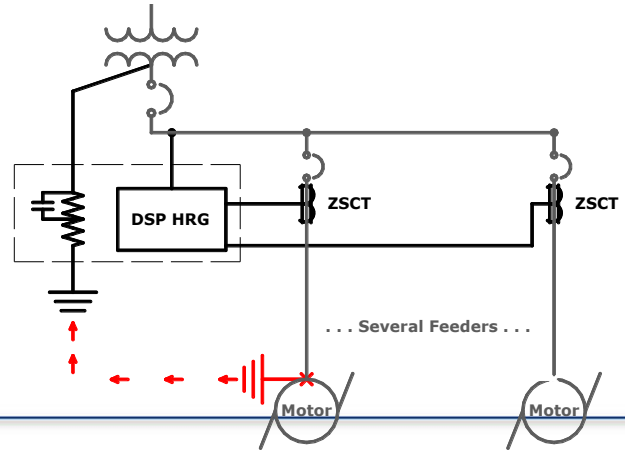
This relay has the capability to discriminate between ground faults, resistor failure and open and short circuits. The unit trips in 1.5 seconds when NGR failure is detected. NGR failure is determined when resistance varies to less than 66%or more than 150% of the selected value.

HRG: It takes too long to find the fault

Automatically indicates faulted phase

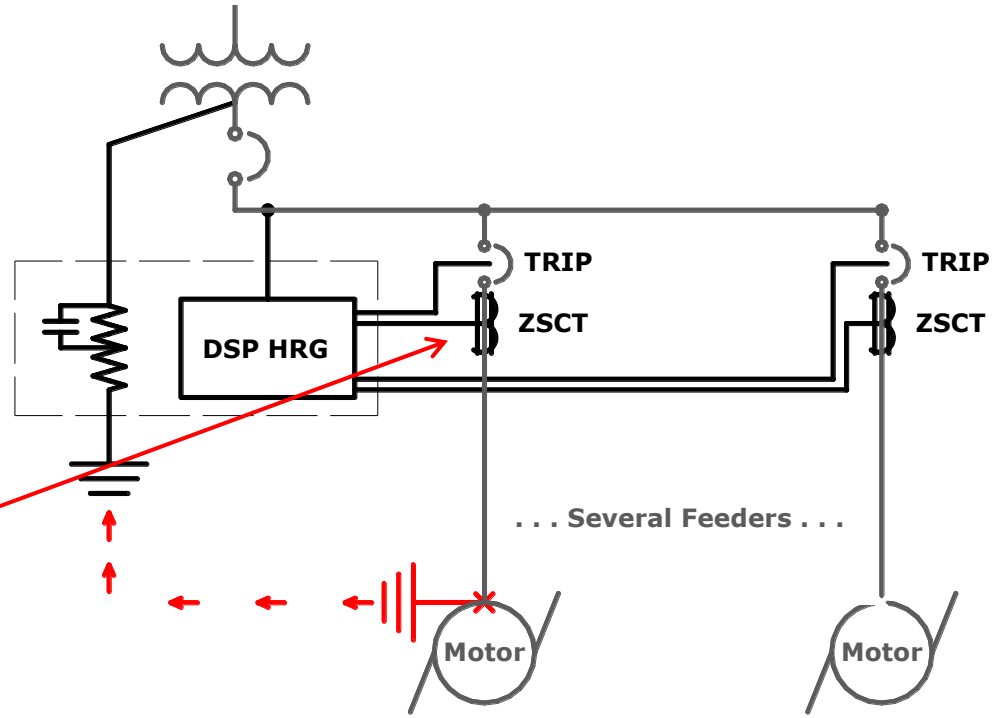


Automatically indicates faulted feeder



HRG: I don’t want the fault to stay on the system indefinitely

Feeder module



Options for Faulted Feeder:

1) Alarm Only (No Trip)

OR

2) Trip with Time Delay

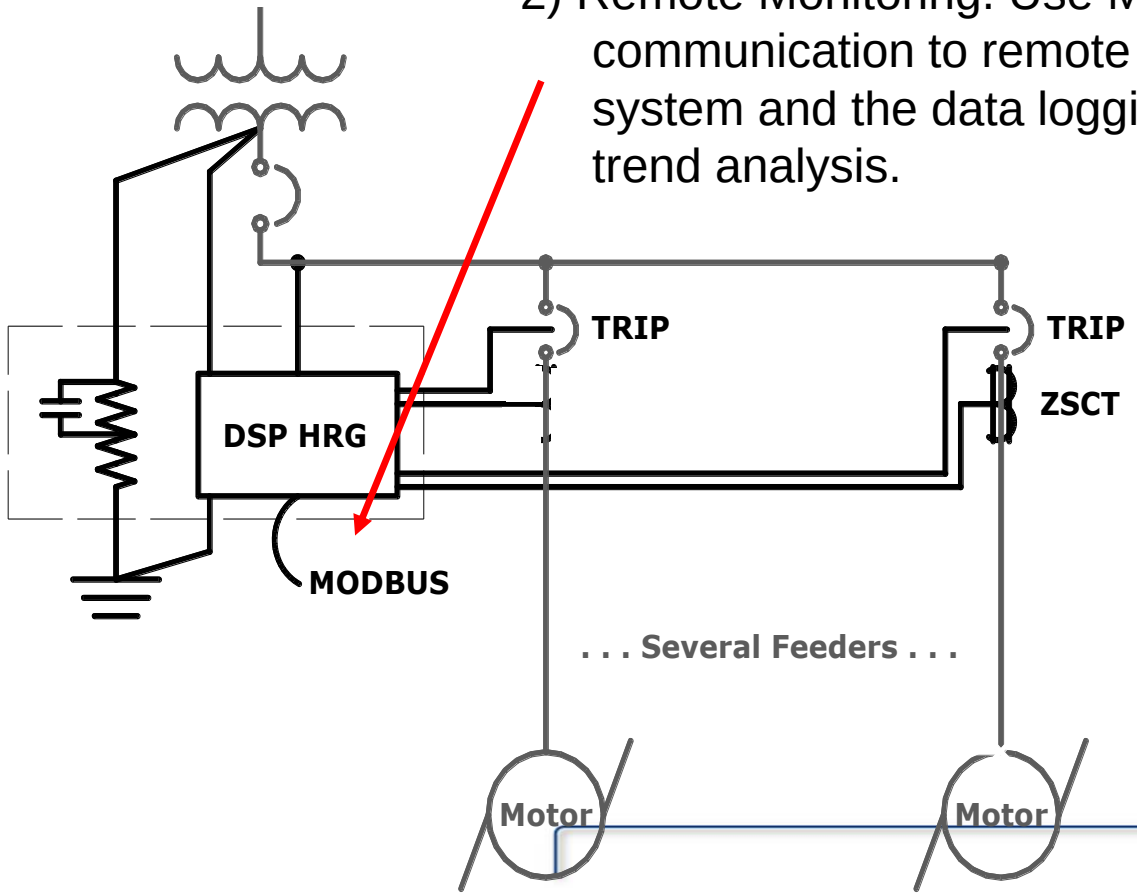
3) You set the Time Delay from 1 second to 99 hours

HRG: What if the fault is intermittent?

Data logging module

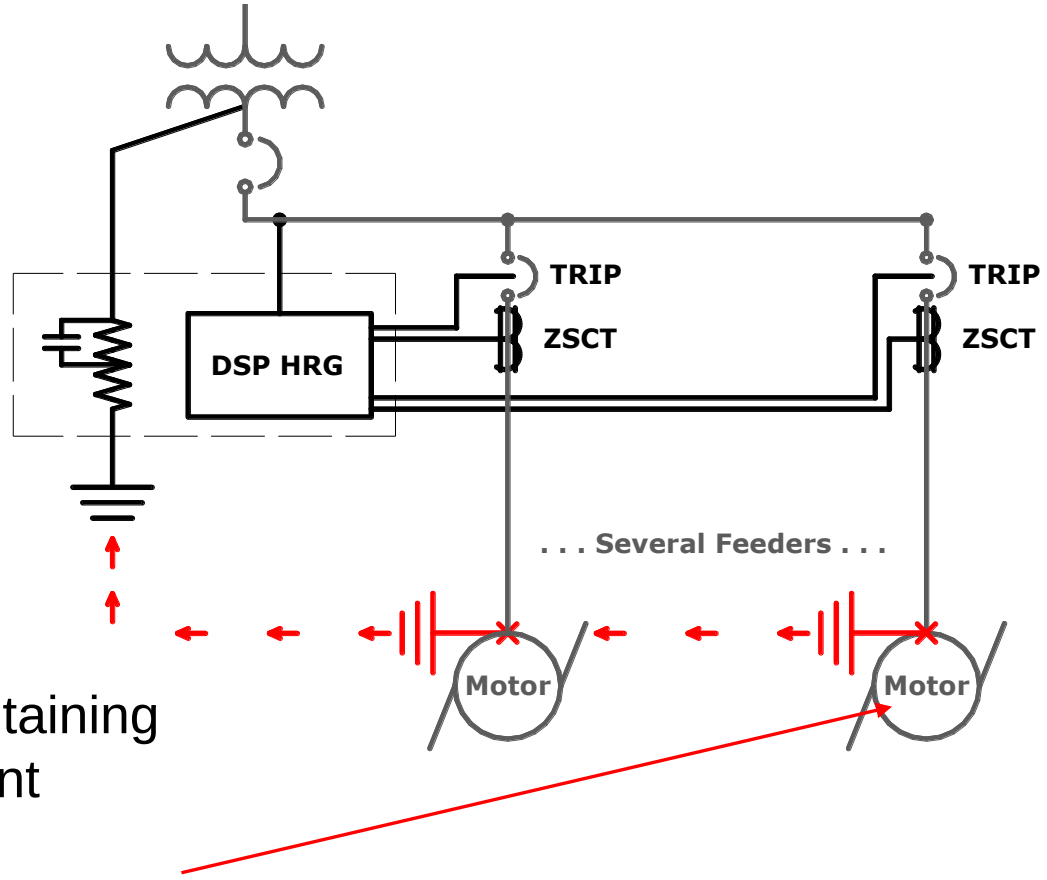
1) Feeder Module indicating light latches to indicate intermittent fault.

2) Remote Monitoring. Use Modbus communication to remote monitor the system and the data logging module for trend analysis.



HRG: What if a second ground fault occurs?

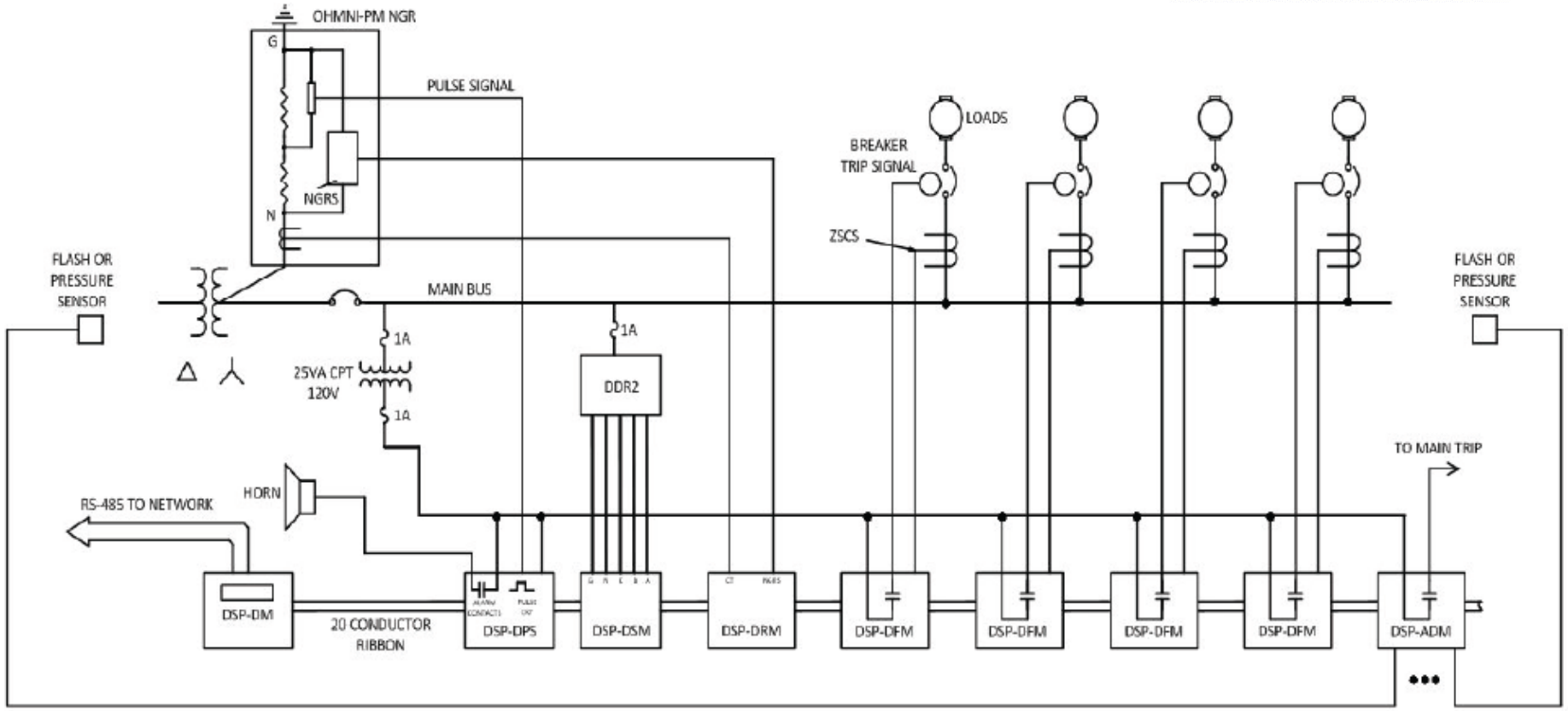
Feeder module



2nd Ground Fault:

- ✓ Prioritize Feeders
- ✓ Trips least important, maintaining operation on most important
- ✓ Up to 50 Feeders
- ✓ Reduces the risk of arc flash

Excuse #6: HRG technology does not lower incident energy levels



Installed Savings due to HRG System

Case Study - $60MM Plant

Electrical Cost ~$2MM (7 Substations)

Savings from No Neutral	+ $400,000
Cost of (7) HRG systems w/ Feeder Protection	- $ 97,500
Cost of (14) 1:1 transformers	- $ 21,500
TOTAL SAVINGS	**$281,000**

(NOT INCLUDING Safety & System Benefits)

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