

Over Voltage due to Broken Neutral and its protection

27th December 2012

Causes of Over/Under/Unbalance Voltage due to Broken Neutral

1. When a neutral conductor is broken in a 3 phase distribution system, over/under /Unbalance voltage might occur and causes consumer electronics to be damaged.
2. In a healthy power distribution system, the neutral line serves as a return path, dividing the voltage across the load connected at different phase. A rise in voltage at phase 1 would not affect the voltage level of phase 2 or phase 3 (see figure 1).

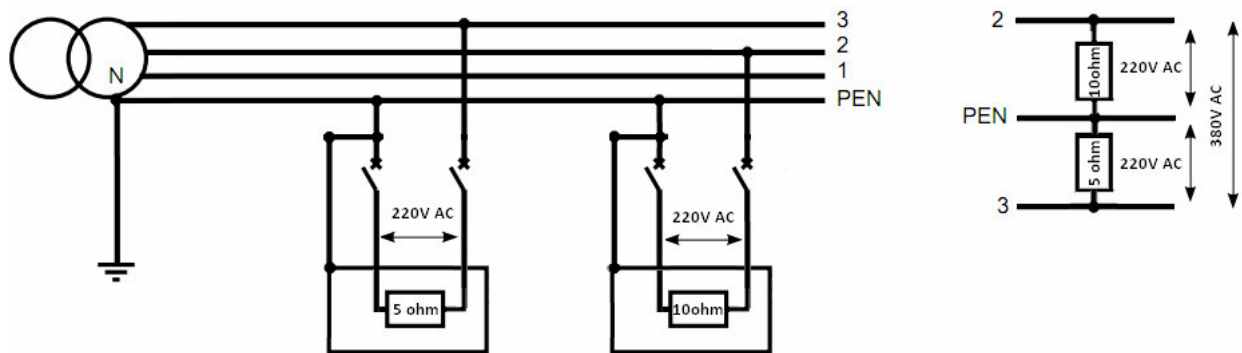


Figure 1: Three phase TN-C system

3. When the neutral line is broken, the line to line voltage will appear across loads connected at difference phase in series. The voltage across will be divided in accordance to the impedance of the load of different phases (see figure 2).

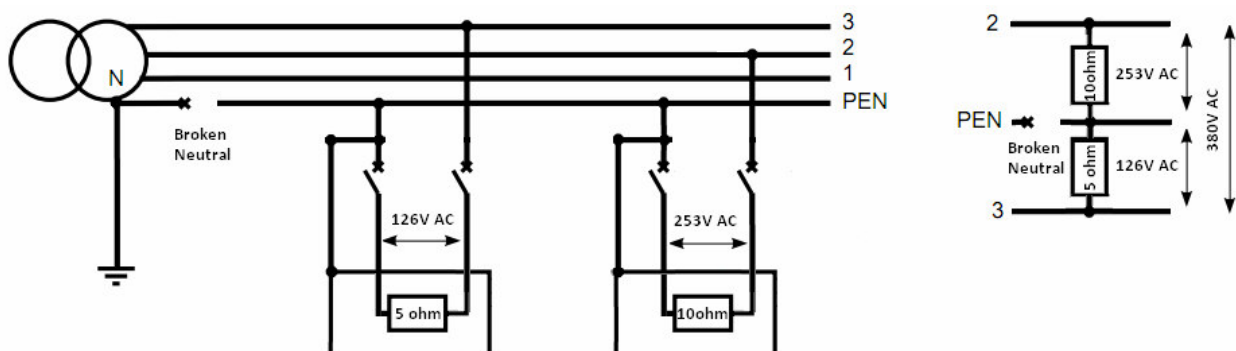


Figure 2: Effect of broken neutral on three phase TN-C system

- The load with higher impedance will experience an increase in voltage. The voltage increase is in accordance to the voltage divider principal. As in our example, the voltage across the 10 ohm load is increase to $10/15 \times 380 = 253 \text{ V AC}$.
- The bigger the differences in impedance, the bigger the voltage increase/drop.

Mikro's Voltage Relay Solution - Setting and wiring considerations

- To protect the appliances from damages due to over/under voltage, one can use Mikro's MU250 (or MU150 for single phase) type voltage relay.
- The MU250 detects the phase voltage level (V_{x-N}) between phases and phase unbalances to protect home appliances in the distribution system (See Figure 3) from under over and unbalance.

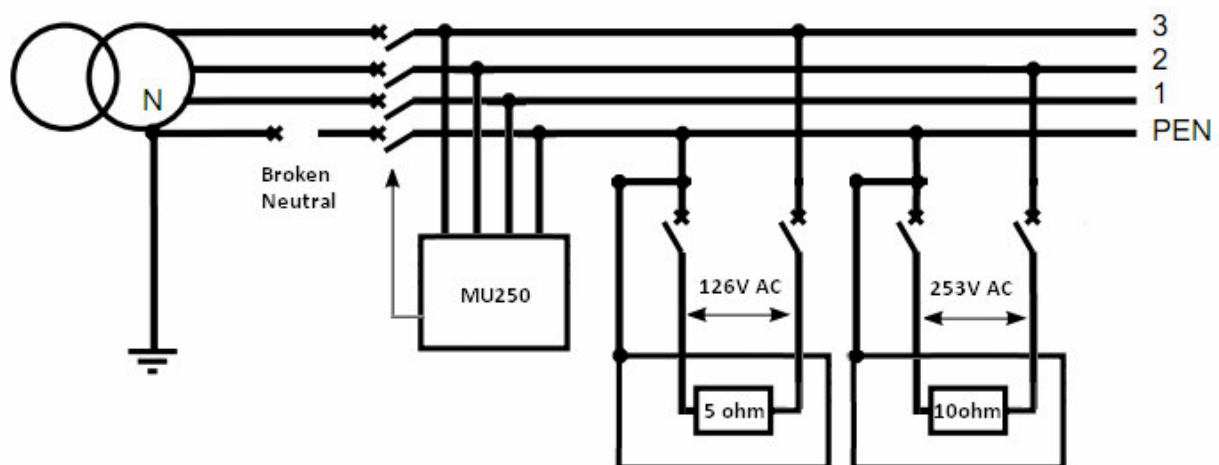


Figure 3: MU250 protection on three phase TN-C system

- The MU250/MU150 **MUST** be used in conjunction with **NEUTRAL CONNECTION** and **SET PHASE OVER VOLTAGE** protection for this protection scheme to work.
- The phase unbalance protection is only available for MU250 and three phase electrical distribution system.
- For single phase protection, MU150 detects the phase voltage level (V_{1-N}) to protect it from over voltage. In figure 4, device A at phase 3 is protected but not device B.

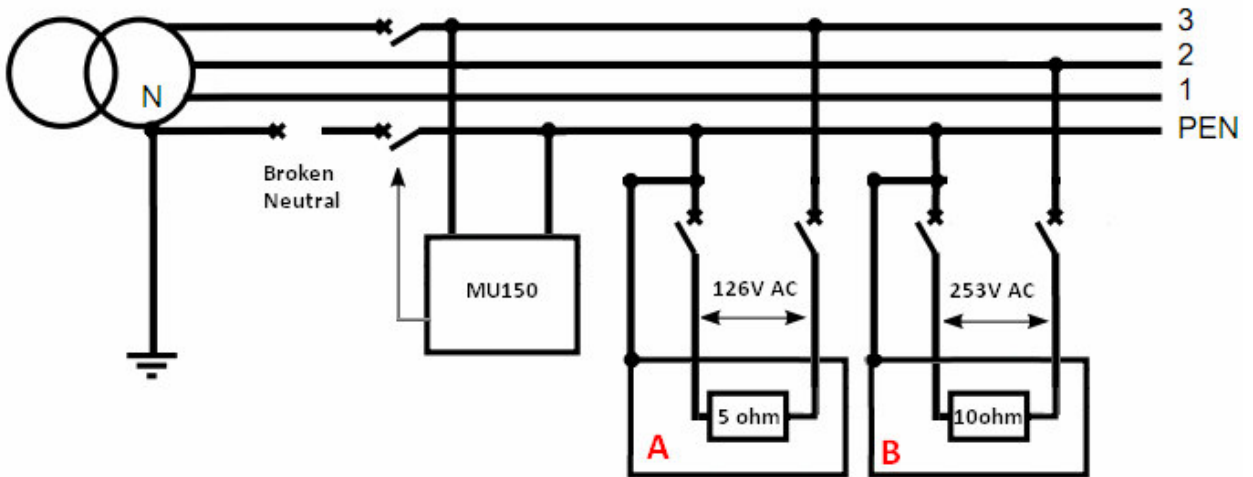


Figure 4: MU150 protection on single phase TN-C system

- The voltage relay can only protect downstream equipment from upstream broken neutral (See Figure 5). It is recommended that the voltage relay is installed near the load that it wishes to protect.

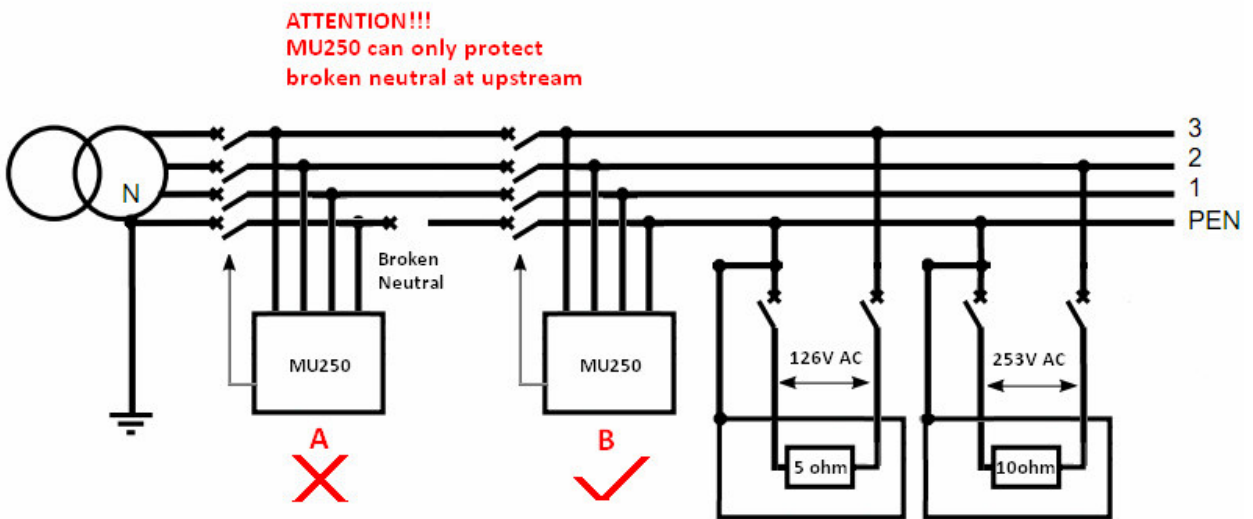


Figure 5: Voltage relay can only protect when broken neutral is at upstream