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Tech Note *04/26/00*

MULTIWIRE BRANCH CIRCUIT WIRING PRECAUTIONS WHEN USING STAND-ALONE 120 VAC INVERTERS OR GENERATORS

WARNING: A POSSIBLE FIRE HAZARD CAN EXIST IF 120 VAC ONLY SOURCES (SUCH AS INVERTERS AND GENERATORS) ARE WIRED INCORRECTLY INTO 120/240 VAC PANELS CONTAINING MULTIWIRE BRANCH CIRCUITS. THIS DOCUMENT DESCRIBES HOW TO CHECK FOR MULTIWIRE BRANCH CIRCUITS IN THE LOAD CENTER AND PRESENTS SOME POSSIBLE SOLUTIONS TO THIS WIRING METHOD.

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Multiwire Branch Circuits

A potential safety problem exists when installing stand-alone 120 VAC inverters into existing 120/240 VAC wired panels where multiwire branch circuit wiring methods were used.

Multiwire branch circuits are wired differently from “home run” type wiring (Figure 1) in that only one neutral wire is used to provide the neutral-return path for each circuit connected to both phases of the ac grid. This method has been employed by electricians in recent years to keep construction costs down by saving copper and labor costs involved in running separate “romex” for each circuit.

Under normal conditions, this technique is quite safe and meets code requirements. When used as originally installed, the current for each circuit is 180° out-of-phase with each other, so the neutral wire never receives more current than it was designed to handle as the current from each circuit subtracts (or cancels out–leaving only the difference current between the two circuits). Refer to Figure 2.

A safety problem occurs when a stand-alone 120 VAC inverter is installed to power these circuits, causing the one neutral wire to now carry the in-phase currents for both circuits. Since the current is in-phase, the two circuits add instead of subtract, potentially doubling the current flow in the neutral return wire! Refer to Figure 3. The branch circuit breakers do not protect the neutral wire from overload under this condition. This excess current will overheat the neutral wire, potentially creating a fire hazard.

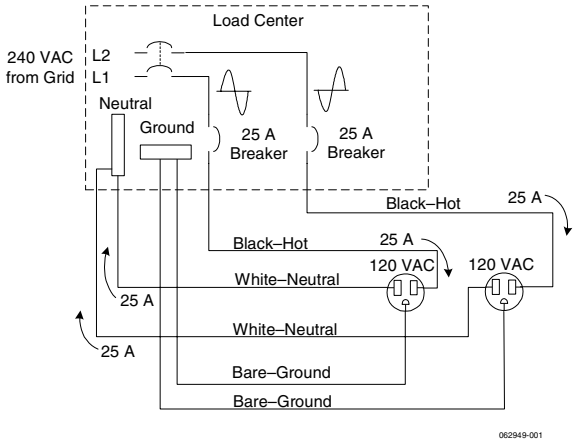

Figure 1
Conventional “Home-run” Type Wiring

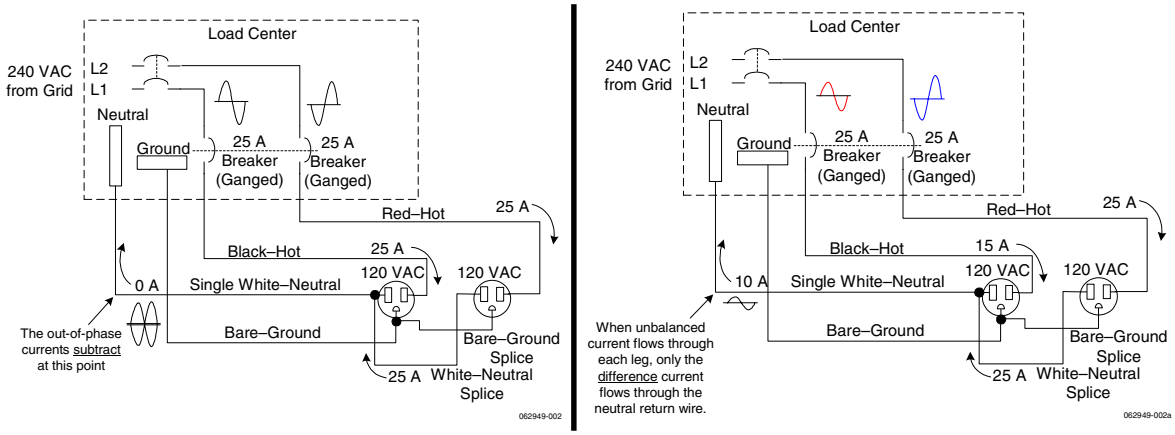

Figure 2
Multiwire Branch Circuit Wiring and Current Flow

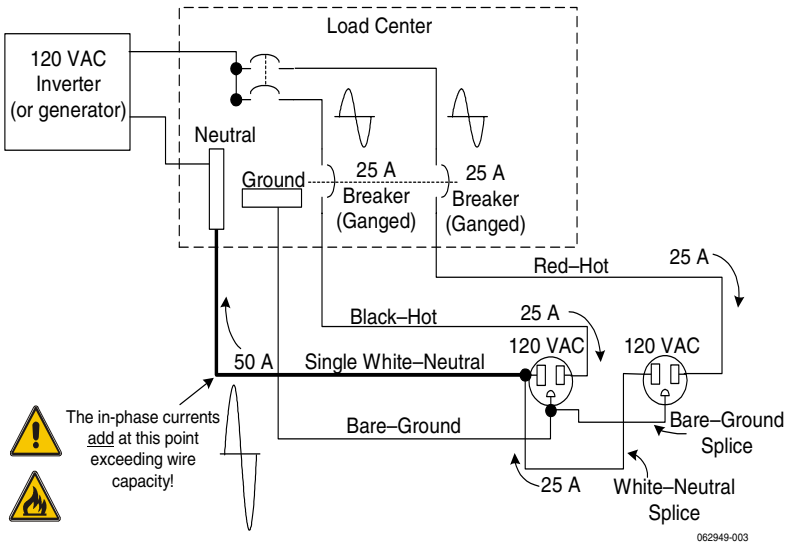

Figure 3
120 VAC Inverter Incorrectly Wired in a Multiwire Branch Circuit

Identifying Multiwire Branch Circuits

WARNING: THE NEXT STEP INVOLVES OPENING THE LOAD CENTER EXPOSING LIVE CIRCUITS. THIS PROCEDURE SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONS OR ELECTRICIANS.

Multiwire branch circuits can be identified by removing the cover on the load center and inspecting the wiring. Conventional 120 VAC circuits are identified by a 2-wire-plus-ground (black, white and copper) “romex” for each circuit. Multiwire branch circuits use a 3-wire-plus-ground arrangement (black, red, white and copper) for each circuit run.

If this arrangement exists in the panel and it is being powered by a stand-alone 120 VAC inverter, a potential fire hazard exists! For safety, these circuits must be rewired to meet code.

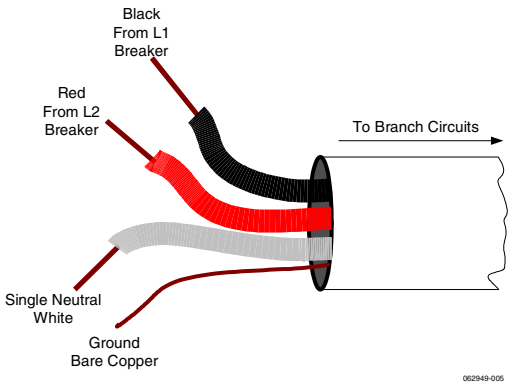

Figure 4
Multiwire Branch Circuit Wiring

Correcting Multiwire Branch Circuit Wiring

Correcting multiwire branch circuit wiring is not an easy task. There are several approaches that can be taken, each with its advantages and disadvantages.

- Rewire existing multiwire branch circuits to conventional “home run” wiring. This requires a qualified electrician (knowledgeable of multiwire branch circuit wiring) and is expensive. There may be multiple multiwire branch circuits located throughout the structure, requiring complete rewiring.

- Add a second inverter in a “series stacked” arrangement. This is an expensive solution, but would restore the original 240 VAC split-phase configuration. This solution may actually be less expensive than having an electrician re-wire the multiwire branch circuits, plus it provides increased power backup protection and can power 240 VAC loads.

- Add a T240 Autotransformer to the output of the inverter to restore the split-phase configuration. This is the least expensive and easiest method to correct for multiwire branch circuit wiring. Refer to Figure 5. Using this method, half of the current is supplied to one leg of the circuit and half to the other in a split-phase arrangement (180° out-of-phase). This will restore the original functionality and safety to the multiwire branch circuit.

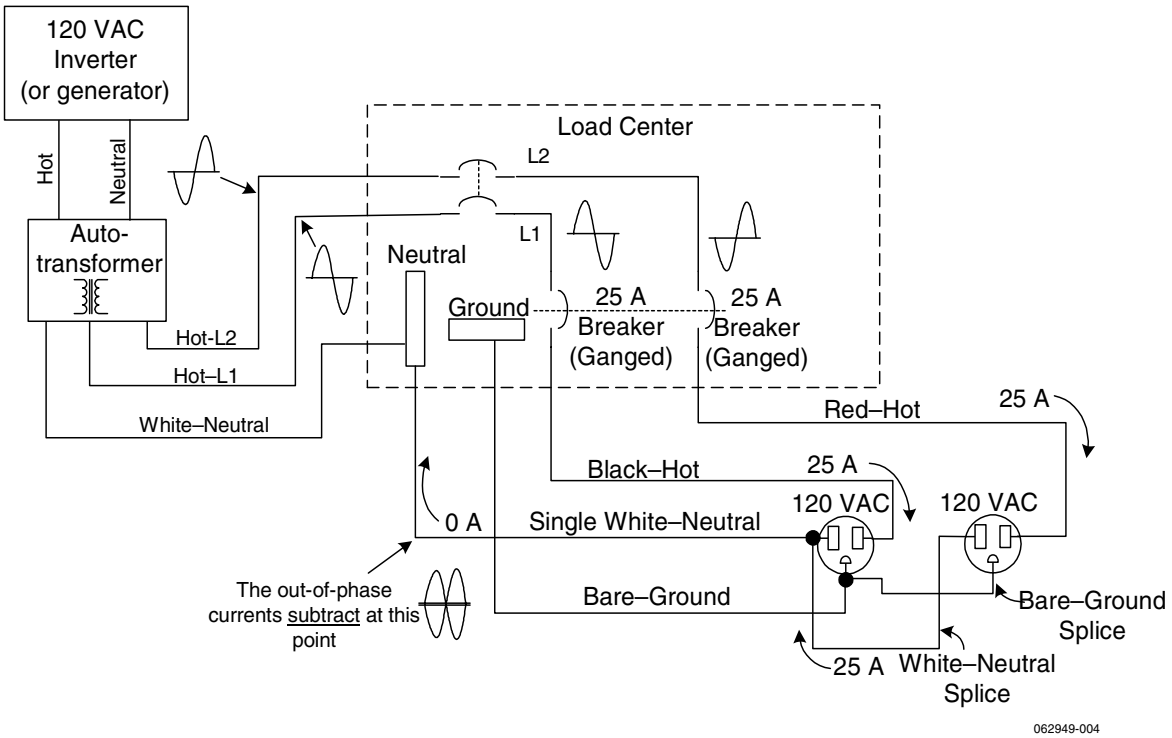

Figure 5
Using A T240 Autotransformer in Multiwire Branch Circuit Wiring

WARNING: UNTIL ONE OF THE SOLUTIONS ABOVE IS IMPLEMENTED, A STAND-ALONE 120 VAC INVERTER (OR GENERATOR) MUST NOT BE INSTALLED WHERE MULTIWIRE BRANCH CIRCUITS EXIST.