Multiwire Branch Circuit (MWBC) and Shared Neutrals in Backup Systems - Application Note

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MWBC and Simultaneous Disconnect

A multiwire branch circuit (MWBC) is a branch circuit with a shared neutral, which means that there are two or more currents carrying circuit conductors with a voltage between them and a single neutral. The MWBC is split across different phases (A and B phase).

Using MWBCs is allowed by the National Electrical Code (NEC), and the relevant NEC Articles are listed below:

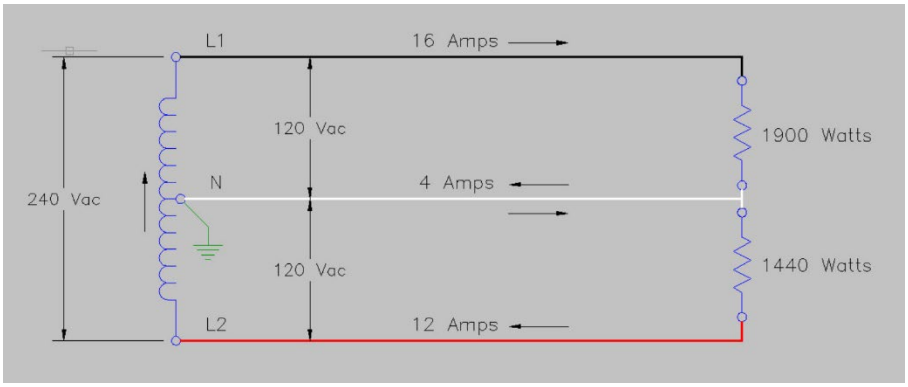
- 210.4 (A) General - "All conductors of a multiwire branch circuit shall originate from the same panel board or similar distribution equipment."
- 210.4 (B) Disconnecting Means - "Each multiwire branch circuit shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates."
- 210.4 (C) Line to Neutral Loads - "Multiwire branch circuits shall supply only line to neutral loads."
- 210.4 (D) Grouping -"The ungrounded and grounded circuit conductors of each multiwire branch circuit shall be grouped in accordance with 200.4 (B)."

The NEC mandates that all circuit conductors on the same MWBC must be simultaneously disconnected when work is performed on them. However, if the simultaneous disconnect is not performed according to protocol, there might be issues:

- Disconnecting the circuits on the MWBC, and the relevant devices connected to these circuits, might result in the disruption of power in unaffected areas that are supplied by associated branch circuits.
- MWBCs can be hazardous when ungrounded circuit conductors remain energized, and maintenance work is performed on equipment supplied from a multiwire circuit. Electricians run the risk of injury while working on the equipment supplied by a MWBC.

Proper use of simultaneous disconnects reduces the risk and takes the guess work out of ensuring safe conditions for maintenance.

See below for an example of how a MWBC can send current back on the shared neutral:



MWBCs and the Relevance to Backup Systems

From the NEC articles listed above, and the stated safety concerns, a MWBC needs to be evaluated carefully when selecting backed up loads. **The MWBC must never be split between a backed-up panel board, and a grid connected panel board**. If the multiwire circuit is split between a backed-up panel and a grid connected panel, the Energy Storage System (ESS) will not be able to island and provide backup power. Furthermore, when the ungrounded conductors are not connected to the opposite phase conductors, the current on the shared neutral could be doubled.

Therefore, when evaluating which loads to select for a partial home backup systems, either ALL of the circuits for a MWBC need to be backed up, or NONE of the circuits for a MWBC can be backed up. To identify a MWBC before the backup panel is installed, follow any of the following methods

1. Identify any single pole breakers that have been connected with a "trip tie". Usually there will be one red wire, and one black wire connected to the breakers to denote the different phases. This practice is done to meet the simultaneous disconnect requirements.
2. De-energize breaker for circuit that is suspected to be a MWBC. If the NEC was not followed, and the MWBC did not experience a simultaneous disconnect, then measure voltage at the suspected receptacle. If voltage is still present, then it could be a MWBC.
3. With power to the main panel off. Locate the first junction that the MWBC runs to. Use a circuit breaker finder and a continuity tester to identify each wire in the panel. The tracer will be used on the ungrounded conducts (hots) and the continuity tester will be used on the neutrals.

SolarEdge System Behavior

When the NEC is followed, and the MWBC meets the prevail code requirements, the SolarEdge ESS will work as intended. However, if the MWBC has been split between the backup panel and the grid connected panel, or the MWBC is on the same phase, the following conditions may occur when the system is transitioned to backup mode.

Look for these symptoms:

- Phase balance error
- Flickering lights
- Inoperable loads in the backup sub-panel
- Strange AC voltages in backup mode
- Hardware damage inside the inverter
- Damage to sensitive electronics in the home

Backup System Testing

After the installation of the backup system is complete, it is mandatory to perform a Shared Neutral test and a complete Backup Mode test.

Testing for a Shared Neutral Between the Backup Panel and the Grid Panel

This procedure tests if there is a shared neutral between the backup panel and the grid panel. When there is a MWBC shared between the grid connected panel and the backup panel, backup mode can fail. For this test, it is important to de-energize the entire home, to ensure proper transition for the ESS to enter backup mode.

1. Completely de-energize AC power at the Main Disconnect for the home.
2. Turn off ALL backup panel breakers.
3. Turn off the SolarEdge ESS.
4. Set meter to test continuity.
5. Put one meter probe on the Neutral terminal block of the Grid connected panel.
6. Un-land the Neutral feeder from the Backup panel terminal block. The wire should be in free-air.
7. Touch second probe to the Neutral wire in free-air.
8. If the continuity meter gives tone, the Neutral is shared. This means that the MWBC must be corrected. See MWBCs and the Relevance to Backup Systems.