Recommended Guidelines for Battery Check Circuits
Revised 2025 (6 Pages)

A. Purpose

This Manual Part identifies hazards posed by reversal of polarity on dc energy buses feeding polarized circuits, and provides guidelines for application of battery check circuits.

B. General

1. These guidelines apply to both relay and solid-state systems employing polarized dc circuits where improper reversal of polarity at the energy source could result in a more permissive indication than intended.

2. Polarized circuits communicate one of three states using a single pair of wires: energized normal, energized reverse, and de-energized. Polarized circuits are commonly used for signal control, traffic control/locking and switch indication. Polar or mag-stick devices respond only to change in applied polarity, not loss of energization.

3. These guidelines present methods for checking that the correct dc polarity is applied to energy buses feeding polar and polarized circuits. Specific circuit designs will vary depending on practices of the individual railroad.

4. The objective of battery checking is to ensure the polarity of dc energy feeding polarized circuits cannot be improperly reversed due to open connections or loss of power to energy buses.

5. Use of polarized copper line circuits for signal control and traffic locking purposes has been superseded in new design work by radio, fiber and thru-the-rails communication pathways. However, existing polarized circuits will continue to exist and designers must be aware of potential hazards including polarity reversal.

6. Use of split battery dc power sources has been superseded due to difficulty in maintaining proper charging where voltages and loads are not equally balanced.

C. Design Criteria

1. Whenever polarized circuits are employed, the circuit design shall ensure dc polarity applied to the circuit cannot be improperly reversed by any combination of open circuits and back-feeds.

2. Where back-feeding is possible, battery check circuits should be provided to ensure that polarized circuits cannot be improperly fed by reverse polarity.

3. Diodes shall not be employed to sense polarity, prevent back-feeding, or to ensure correct polarity of energy feeding polarity-sensing circuits.

   a. Diodes may fail in an open or shorted condition.

   b. Diodes tend to rectify stray ac energy superimposed on line circuits, falsely producing dc energy.

4. Battery check relays should be applied where other techniques are ineffective or non-applicable.

   a. Provide independent power sources for individual polarized circuits.

   b. Avoid use of power loops for feeding polarized circuits.

   c. Avoid use of common return wires servicing two or more independent power sources.

   d. Provide correspondence checking, i.e., switch call vs. switch indication.

5. Battery checking does not provide an effective means of mitigating hazards arising from backwards connection of wires in a polarized circuit.

6. Polar and polarized circuits contribute little to enhancing system reliability. They no longer provide a significant savings in wiring or components. Driving polarized circuits using bi-polar solid-state outputs requires additional components as compared to ordinary uni-polar outputs. Specialized components such as polarized relays and retained-neutral polarized relays have not been manufactured in many years. Searchlight mechanisms, a polarized device, are now being rapidly eliminated. Polarized circuits should be avoided in new design work.

D. **<u>Typical Circuits - Figure 1647-1</u>**

1. An example of battery checking is provided as shown in Figure 1647-1. This diagram shows a pair of 2-wire reversible signal line circuits using a Battery Check Relay (BCR).

2. Circuit operation and hazard condition:

   a. Detail not essential to understanding the cause and prevention of polarity reversal is omitted. Disregard the BCR and contacts until step (3) below.

   b. Under certain conditions, ‘East’ and ‘West’ B/N energy buses may be unintentionally interconnected via one or both line circuits.

c. The polarity of connections between buses is determined by the state of pole changer contacts PC2W. Series resistors are provided to prevent short circuiting when opposing polarities are interconnected.

d. To illustrate a polarity reversal hazard scenario, the dc power source feeding the ‘West’ bus is disconnected. B energy from the ‘East’ bus now improperly feeds the N side of the ‘West’ bus.

e. The polarity of DC energy supplied to polarized circuits fed from the ‘West’ bus is now improperly reversed. Relay 1ED will be falsely picked-up while pole changer PC1W is down.

3. Addition of the BCR continuously proves that energy appearing on the bus is of the intended polarity. The polarity discriminating characteristic of this biased neutral relay is not subject to degradation or failure.

4. Under certain circumstances, back-fed energy from an external source could sustain the BCR, however, this condition will cease and cannot resume once the interconnection between buses is broken.

5. In some instances battery checking is performed using other biased relays in the circuit. The designer must be aware that relays not specifically identified as a BCR may perform polarity checking in conjunction with their other functions.

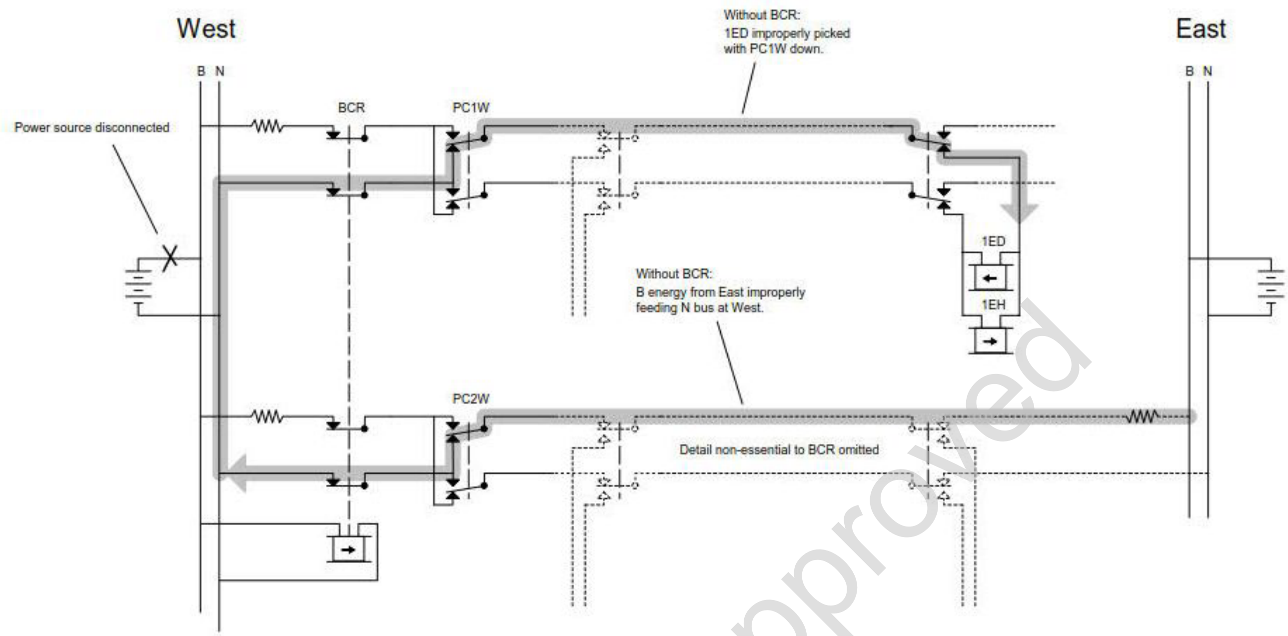

Figure 1647-1: Example of Battery Checking

E. Typical Circuits - Figure 1647-2

1. Another example of battery checking is provided in Figure 1647-2. This circuit shows a split battery arrangement where a polarized circuit is fed by one-half of the battery (V1).

2. Circuit operation and hazard condition:

   a. Disregard the presence of the BCR and contacts until step (3) below.

   b. If power source V1 becomes disconnected or otherwise ineffective, the polarized circuit fed by V1 will be improperly back-fed through other loads from battery V2.

   c. The resultant polarity across the open V1 connections is now opposite to the intended polarity, i.e., C is positive with respect to B12.

3. The BCR prevents false energizing of the wrong switch repeater relay (NWP/RWP) if the polarity of V1 is reversed.

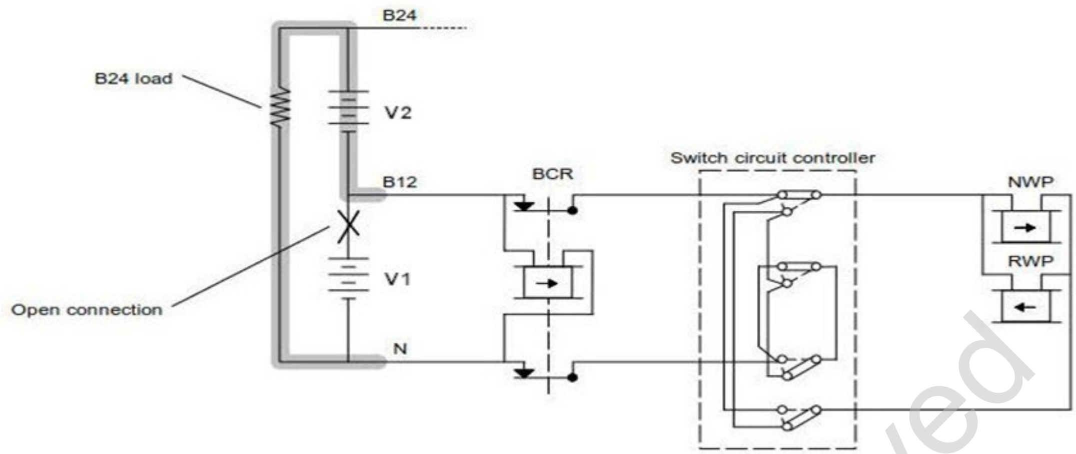

Figure 1647-2: Another Example of Battery Checking

F. **Typical Circuits - Figure 1647-3**

1. Figure 1647-3 illustrates a back-feed [run-around] created by power loop connections. In the example scenario, current from other loads is improperly diverted through a device connected to the N12 power loop.

2. Circuit operation and hazard condition:

   a. Mag-stick relay WR is normally energized by NWSR up, and RWSR down (or vice versa).

   b. Opening of the N12 loop at the first break is undetectable in normal operation.

   c. A second, subsequent break in the N12 loop will cause the NWSR to immediately drop. With both WSR relays down (an abnormal condition) the WR coil is now connected to the N12 loop across the first break. Connecting both sides of the WR to the N12 loop may have been intended to suppress foreign current to the WR, but in this instance the N-side connections create an unintended bypath through the WR.

   d. Other loads serviced by the same N12 loop back-feed current through WR, causing this relay to improperly change position.

3. This hazard can be mitigated by eliminating other current sources in B/N wiring to the WR. The corrected circuit shows that no combination or open or high resistance connections can improperly divert current through the WR coil with both WSR relays up or down.

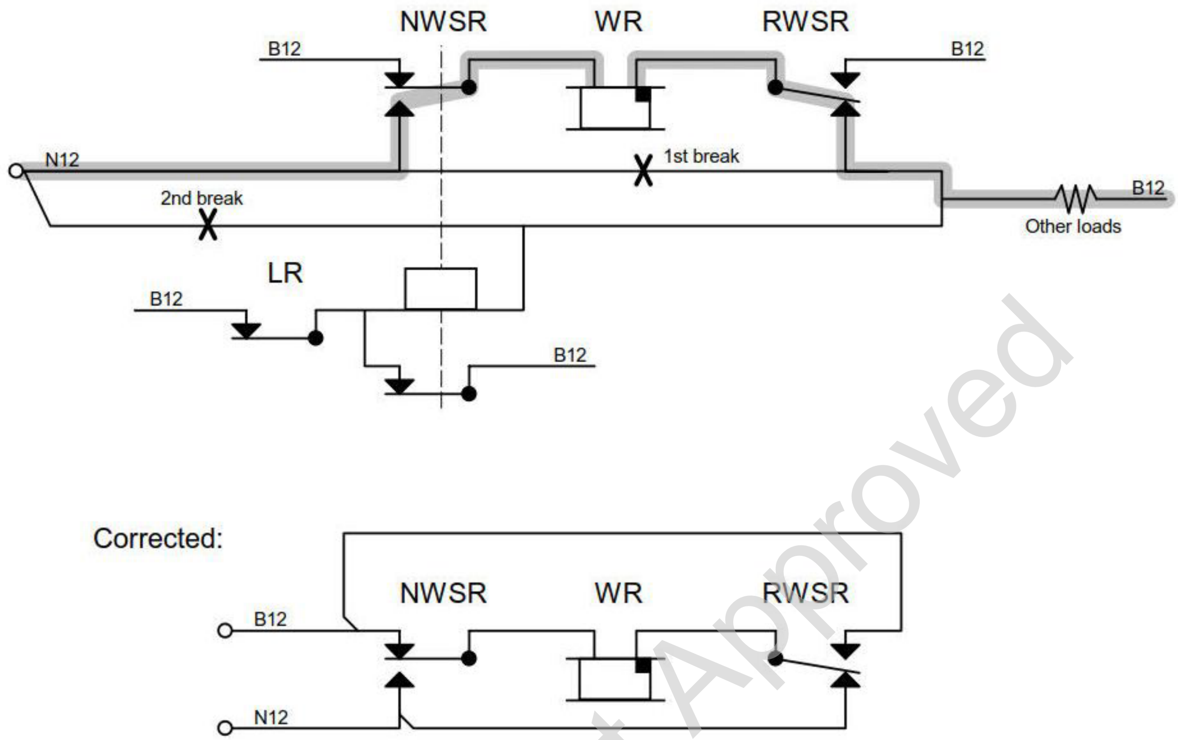

Figure 1647-3: Example of a Back-feed