Cable Fault Locator using Murray Loop Principle

Final-Year Project Abstract · Electrical Engineering · Hardware

01 · Title

Cable Fault Locator using Murray Loop Principle — a working bridge-method rig for locating earth and short-circuit faults in underground power cables.

02 · Introduction / Background

Underground distribution cables fail from moisture ingress, mechanical damage and thermal ageing, and the costliest part of the repair is locating the fault before digging. The Murray loop is the classical bridge method taught in electrical measurement courses: the faulted core is looped with a sound core at the far end to form a Wheatstone bridge, and the balance reading gives the fault distance as a fraction of the loop length. This project turns that theory into a working demonstration rig with a decade resistance box, a center-zero galvanometer, and a two-core demo cable carrying fault taps at known distances.

03 · Problem Statement

Students learn the Murray loop as a circuit diagram but never balance a real bridge, compute a fault distance, or confront the method's conditions — the need for a sound core, the low-resistance-fault limit, and temperature effects. Commercial fault locators are sealed instruments that hide the measurement principle. There is a gap between the textbook formula and hands-on fault-location practice.

04 · Objectives

- Build a working Murray loop bridge with null-detector balance on a wooden test panel.
- Provide a demo cable with fault taps at known distances for earth and short-circuit faults.
- Enable the student to balance the bridge, compute fault distance from the ratio, and verify against the known tap.
- Document the method's conditions and error sources honestly in a buyer-run verification procedure.

05 · Proposed Methodology

The faulted core of the demo cable is joined to the sound core at the far end, forming the loop. At the test end the loop is wired into the bridge with fixed ratio arms and the decade box as the balance arm, energized by a 9 V DC supply. The operator adjusts the decade box until the galvanometer reads null, records the balance resistance, computes the fault distance from the standard Murray loop ratio, and checks it against the known tap position. The procedure is repeated across taps and fault types, building a computed-vs-actual table.

06 · System Architecture / Working

Test panel (decade box, galvanometer, knife switches, banana terminals) → bridge wiring → two-core demo cable with fault taps → far-end loop-back joint. The bridge is the measurement core; the demo cable is the device under test; the worksheet is the procedure layer. Balance is detected by the analog null meter; distance is computed arithmetically from the dial readings — no microcontroller is involved, which is faithful to the classical method.

07 · Hardware / Software Requirements

Component	Specification
Bridge supply	9 V DC battery (design)
Null detector	Center-zero galvanometer, typical ±50 µA
Balance arm	Decade resistance box, 1 Ω–10 kΩ
Demo cable	Two-core copper, approx. 20 m, 3 fault taps
Switching	Knife switches, banana sockets, hookup wire
Software	None — arithmetic worksheet

08 · Expected Outcomes

- A balanced bridge locating each demo fault with a computed-vs-actual distance table.
- Design-target location resolution of about 1 m on the 20 m demo cable for low-resistance faults.
- A documented verification procedure the student performs on their own rig.
- Clear understanding of why the method needs a sound core and fails on open circuits.

09 · Applications

- Electrical measurement and instrumentation laboratory demonstrations.
- Training aid for utility cable-fault crew induction.
- Viva and seminar demonstration of bridge methods.
- Foundation for studying modern TDR fault location comparatively.

10 · Future Scope

- Varley loop attachment for open-circuit faults.
- Motorized decade box with digital null readout.
- Temperature-correction procedure with a cable temperature probe.
- Comparative study rig adding a low-cost TDR module.