



## **For Industrial, Commercial & Vocational Electrical Training**

TII Technical Education Systems' Kempf Troubleshooting Training Center (KTS100) is a complete program of hardware and instructional materials for learning how to troubleshoot modern industrial/commercial motor and relay control systems. Designed as a self-paced, individualized learning program requiring only nominal facilitations, the Training System presents in-depth explanations of how motor control circuits operate and provides practical hands-on experience of wiring, operating, and trouble-shooting these circuits. For testing comprehension, this system uses forty fault switches to provide important proficiency development exercises for high skill training.

The new advanced Troubleshooting Training Center provides hands-on applications for all industrial motor control circuits. The training systems uses a basic approach needed for novices, a more through approach for apprentices, and a refresher for more experienced electricians.

Troubleshooting concepts are developed quickly and advanced lessons are designed to challenge the skill of the most experienced electricians.

Every minute of production downtime is lost profit. To make a significant reduction in downtime, electricians must have a high degree of skill in locating control circuits-faults rapidly.

Stacking type patch cords are used to rapidly interconnect heavy duty panel components into a variety of motor control circuits. Trainees construct circuits by following a wiring list that supplies color of patchcord to be used and jack numbers to be connected.

Wiring, operation, and faults in these circuits are identical in every respect to circuits used in industrial plants.

Applications include industrial plants for troubleshooting production equipment; Commercial buildings for troubleshooting heating, air conditioning and water systems; and, Vocational and technical education using industry oriented programs which bring relevancy to training, improving employment opportunities.

# **SPECIFICATIONS**

## **GENERAL DESCRIPTION**

The TII Kempf Troubleshooting System has three front panels mounted at 15, 60, and 90 degrees for best viewing angles. The Rear Panel is recessed to protect fault switches. The Test Timer is spring wound, 0 to 30 minutes and is mounted on back panel for timing proficiency development exercises. The size of the unit is 20" wide, 19<sup>1</sup>/<sub>4</sub>" deep, and 14<sup>3</sup>/<sub>4</sub>" high. The Training Center weighs 40 pounds, and the accessory package weighs 8 pounds. A protective cover for the unit is also included.

## **CIRCUIT PROTECTION AND SAFETY**

A main breaker protects the 115-volt primary circuit of the control transformer and the 115 volt drive motor. A 24-volt circuit breaker with zero delay protects all of the wiring performed by the trainee on the front panel.

If an accidental short circuit or electrical overload occurs during wiring, a fast acting, zero delay control circuit breaker "trips" to interrupt the circuit.

## **OTHER COMPONENTS**

- Six heavy duty, industrial type, 24-volt pilot lights are connected across relay, timer, and motor starter coils to indicate when coils are energized.
- Three spare lamps are also furnished with each unit.
- Eight heavy duty, standard industrial type, oil-tight pushbuttons are provided on the front panel.
- Two selector switches, one three position and one two position, are also included in the trainer.
- Two 3PDT 10 amp, 24 volt coil control circuit relays are provided. Relays are enclosed in a plastic housing and mounted behind the panel. A Time Delay Relay adjustable from 1 to 10 seconds by means of a panel mounted 200k potentiometer is also provided. A window in the panel is provided for checking relay operation. Two Motor Starter Relays are mounted behind the panel and visible through a window to check relay operation. These relays control operation of the drive motor.
- A special 115-volt, 60 hertz, single phase, high slip 1200 rpm permanent split capacitor reversing motor is included. A patterned disc, visible through a front window, rotates at varying speeds to duplicate the operation of a conventional motor connected to the control circuit.

## **CIRCUIT CONNECTIONS**

Heavy duty, military specification tip jacks and stacking type patchcords are used to interconnect panel components into a wide variety of motor control circuits. These circuits can be constructed rapidly and are identical in every respect to circuits actually used in industrial plants. The panel consists of 82 tip jacks, and 32 stacking type patchcords.

## **FAULT SWITCHES**

Forty single pole, double throw, 3 position, flat handle toggle switches are mounted on the rear panel. The switches are used to set "short circuit" or "open circuit" faults into panel circuits. Trainees wire circuits to improve retention of material covered and practice sessions are provided to develop proficient troubleshooters. In these sessions, the trainee will be working with 77 faults or potentially hundreds of combinations.

The facilitator can set fault switches randomly to "bug" circuits wired on the front panel. Troubleshooting performance is based on the number of faults correctly identified in a given time period. Proficiency training develops a high degree of skill in troubleshooting actual control circuits. Practice sessions are repeated as often as necessary to bring troubleshooting skills up to acceptable levels.

## **CURRICULUM**

The Troubleshooting trainer comes with an instruction manual and an instructor's guide. The latter provides ideas and suggestions for getting maximum benefit from the program. To provide a common starting point, the program begins at an elementary level. Every trainee, regardless of previous experience can benefit from these early lessons. Troubleshooting concepts are developed rapidly and later lessons are designed to challenge the skill of the most experienced electricians. Learning is presented in a simple to complex building block approach. Knowledge learned in one lesson is immediately applied in the next lesson to develop working circuits. Twelve lessons are provided to cover all of the standard motor control circuits generally used in industrial plants. These are:

1. Basic Control Circuits
2. Overload Protection
3. Three-Wire Control, Start/Stop
4. Jogging Circuits
5. Sequence Start and Stop
6. Automatic Sequence Starting
7. Reversing Circuits
8. Troubleshooting Basic Control Circuits
9. Two-Wire Control, Hand/Off/Auto
10. Plug Stop and Anti-Plug Circuits
11. Two-Speed Motor Control
12. Reduced Voltage Starting Circuit

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