



Detailed Description

Integrated Autonomous Tester is a real-time scanning system that conducts efficient and effective test routines on electrical harnesses. Cable failures are automatically detected and highlighted, allowing prompt corrective action to take place removing the unnecessary overhead of rework procedure. The project is sponsored by one of the world leading manufacturers of electrical harness testing systems (MK Test Systems Ltd) with the intention to upgrade the company's second-generation measuring technology. The self-contained unit consists of an Auto-Measuring Module, Switching-Matrix Module and Information-Display Module.

The Measuring Module composes of a high efficiency DC-DC step-up regulator which boosts the input voltage to feed a precision current regulator circuit that injects a steady test current. As current flows through the shunt resistor and unit under test, voltage drop. The voltage signals are continuously monitored with instrumental amplifiers that have a high common-mode rejection ratio, which eliminates residual noise that is common on both input pins and improves the signal to noise ratio. The analogue signals are then filtered by a 3rd order active Butterworth filter that minimises aliasing and band limit the input signal, which is sampled by a 12-bit low power successive approximation ADC.

The system is automated using an ARM Cortex-M4 microcontroller that runs a multithread operating system using the Round-Robin Architecture. The NUCLEO board has been programmed to oversample and average the input analogue signals to reduce the ADC noise floor and spread the quantisation noise over a wider bandwidth. Besides, remaining active throughout the application lifetime to interact with the user via PUTTY and locally log the test results to an SD Card. Concurrently, the system's status is displayed on a 16x2 LCD, and the results are transferred to the Inf-Display Module via a secure and standardised low energy (2dBm) Bluetooth serial protocol.

The Switching-Matrix Module is designed using electromechanical relays that generate internal test routes to connect or isolate different sections of the electrical harness to the electronics measuring circuits. The relays are managed by a control circuit that adjusts the sequence and duration at which the mechanical switches operate. The injected test current flow through the internal test routes to the unit under test and back.

The Inf-Display Module is a handheld unit that provides greater flexibility to the user. The ARM Cortex-M4 microcontroller is used to initialise a Bluetooth module and a high-resolution 2.8-inch TFT LCD that runs simultaneously using a sperate thread. AT Commands were implemented to modify the default settings of the master/client Bluetooth modules and enable them to autonomously pair. As soon as the modules pair, the master creates a data pipe to continuously transmit signals using frequency hopping spread spectrum, allowing the user to live stream the test results.