

Sixty-four-Channel Inline Cable Tester



Wire/Cable
Inspection and
Repair

Faults in wiring are a serious concern for the aerospace and aeronautics (commercial, military, and civil) industries. A number of accidents have occurred because faulty wiring created shorts or opens that resulted in the loss of control of the aircraft or because arcing led to fires and explosions. Some of these accidents have resulted in the massive loss of lives (such as in the TWA Flight 800 accident). Circuits on the Space Shuttle have also failed because of faulty insulation on wiring. STS-93 lost power when a primary power circuit in one engine failed and a second engine had a backup power circuit fault. Cables are usually tested on the ground after the crew reports a fault encountered during flight. Often such failures result from vibration and cannot be replicated while the aircraft is stationary. It is therefore important to monitor faults while the aircraft is in operation, when cables are more likely to fail.

Work is in progress to develop a cable fault tester capable of monitoring up to 64 individual wires simultaneously. Faults can be monitored either inline or offline. In the inline mode of operation, the monitoring is performed without disturbing the normal operation of the wires under test. That is, the operations are performed unintrusively and are essentially undetectable for the test signal levels are below the noise floor. A cable can be monitored several times per second in the offline mode and once a second in the inline mode. The 64-channel inline cable tester not only detects the occurrence of a fault, but also determines the type of fault (short/open) and the location of the fault. This will enable the detection of intermittent faults that can be repaired before they become serious problems.

The operation of the fault detector is based on time domain reflectometry (TDR). TDR techniques have been used to locate faults on cables since the advent of the telegraph. However, new technologies and signal processing techniques developed for the fault detector described here have significantly improved the operation and applicability of the TDR principle.

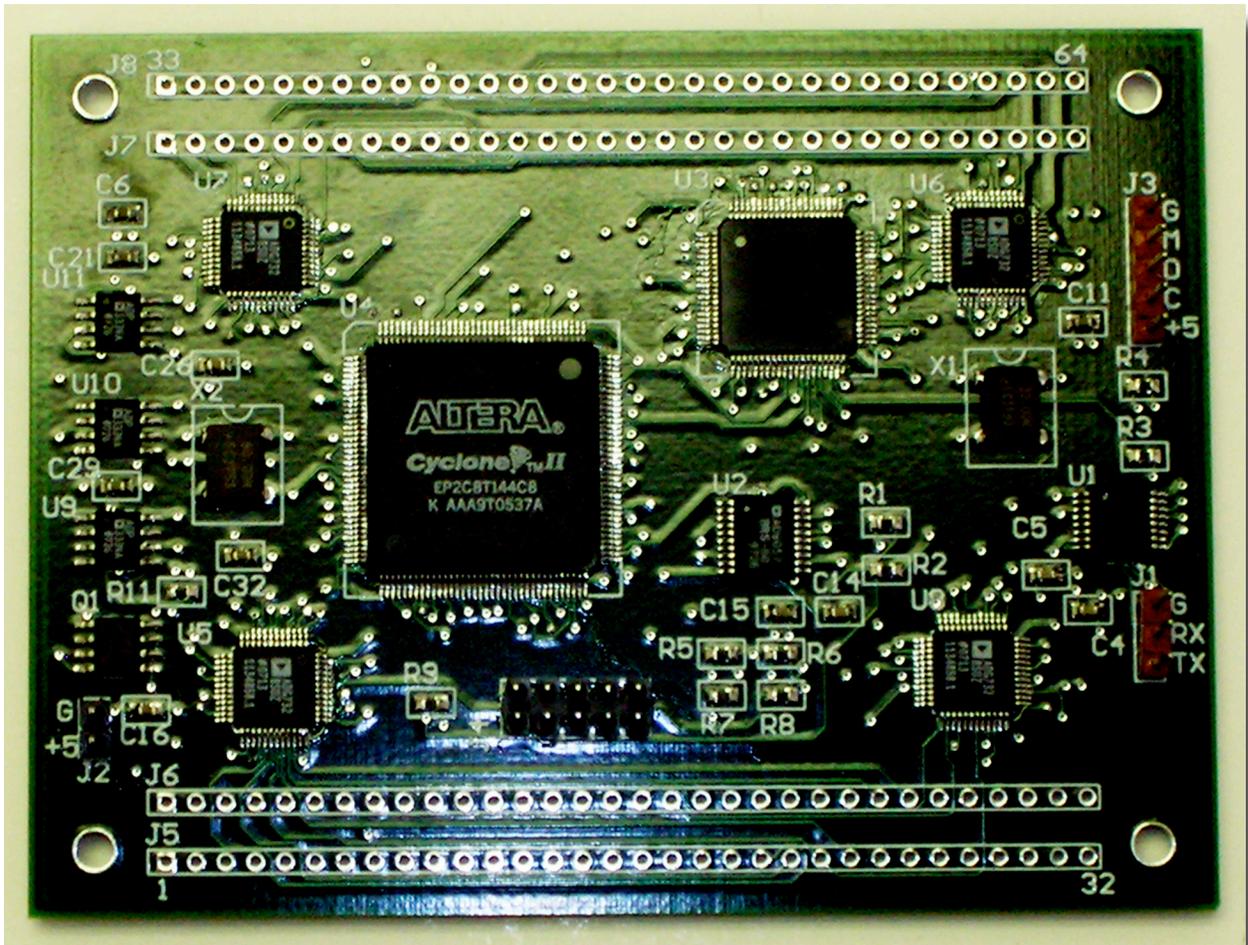
The 64-channel inline cable tester incorporates the following innovations:

- The amplitude of the fast-rising test pulse injected into the cable under test can be selected. The amplitude can be set to a few volts for testing wires offline and to a few millivolts when used in a live circuit.
- The reflections originating from any short- or open-cable condition can be detected, even when the amplitude of the test pulse is significantly smaller than the amplitude of other signals present in the cable. This is accomplished by synchronous detection of successive pulses, which removes the effect of any signals since they are uncorrelated with the test pulse.

The design incorporates over 8,000 logical gates and is based on a field-programmable gate array (FPGA). The FPGA allows for custom logic to be designed and embedded into a single chip and results in significant savings in printed circuit board space.

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Circuit board from 64-channel inline cable tester.