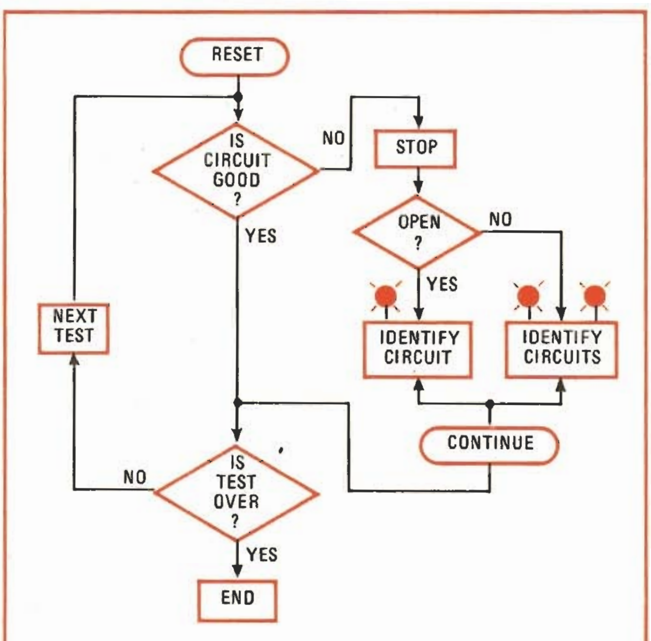
Programable cable tester spots opens and shorts

by D. Bruce Johnson
Tullahoma, Tenn.

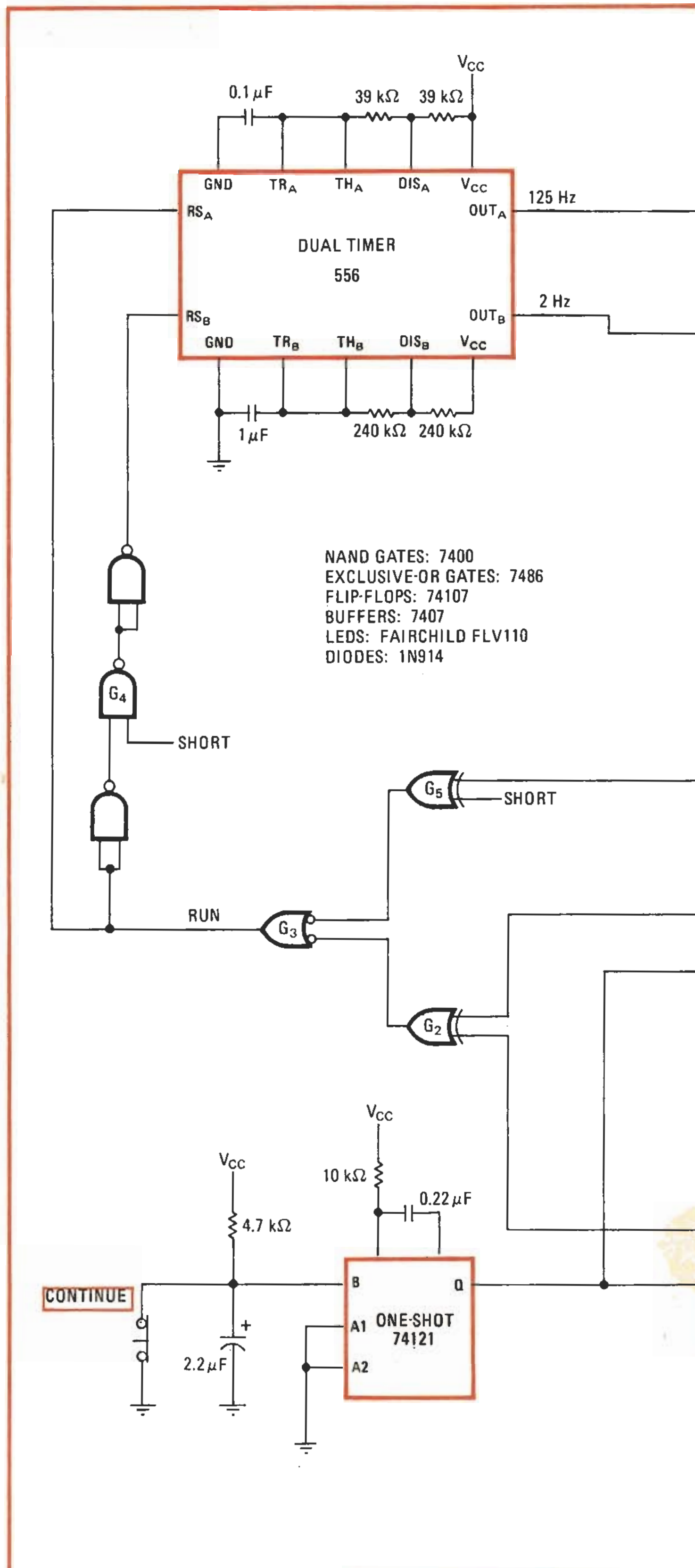
Testing large numbers of cables or cable harnesses can be very costly if 100% quality assurance is wanted. This is especially true in applications where several different cables must be tested simultaneously. Most existing cable testers are intended for checking a large number of circuits and, therefore, are too expensive for testing cables containing 16 or fewer circuits.

But here's a way to build a 16-circuit cable tester that is both fast and reliable, and yet inexpensive. The tester, which is programable, can also be used for checking out cables having less than 16 circuits. It tests for circuit continuity and clearly indicates whether the circuit is open or shorted. All possible circuit combinations are checked for unwanted shorts. The total test time for 16 good circuits is approximately 2½ seconds.

Programing is simple. Wire jumpers are added at the tester's terminals if the cable contains fewer than 16 circuits or if there are any known shorted circuits in the cable. This means that a correctly programed tester only looks for and identifies actual errors in the cable.

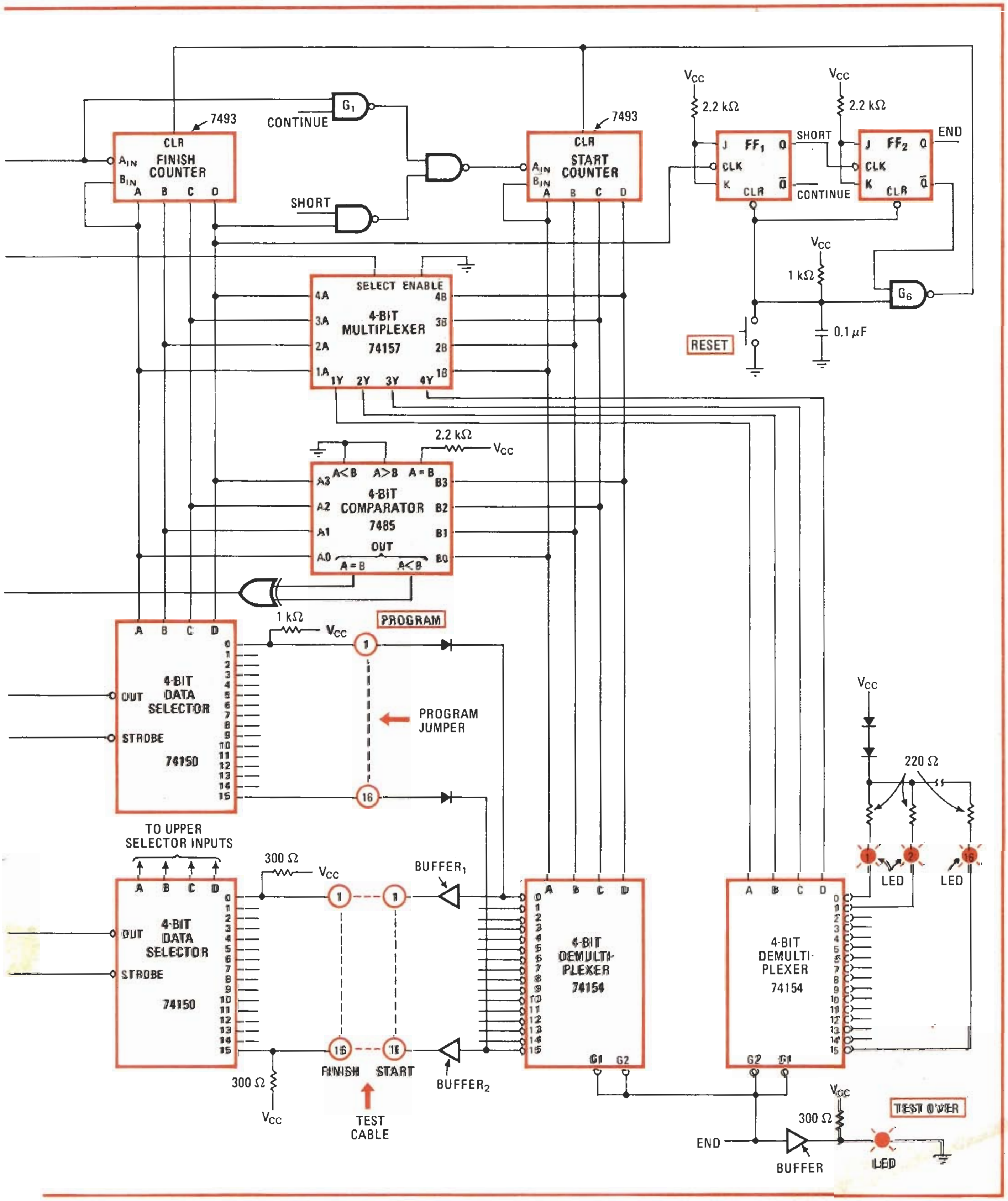


1. Finding cable faults. Flow chart summarizes the operation of a programable cable tester that can check out cables containing 16 or fewer circuits. Each circuit is tested for continuity, and all possible circuit combinations are checked for shorts. The tester is programed simply—by means of wire jumpers at the terminals.



The flow chart (Fig. 1) outlines the operation of the tester (Fig. 2). The left branch of the flow chart indicates that all circuits are tested for continuity, and all possible circuit combinations are checked for shorts. If the cable is faulty, the tester will stop and indicate an

2. The works. Cable tester indicates an open circuit by continuously lighting a single numbered LED. If a short is detected, two of the numbered LEDs are lighted, and testing is stopped. Testing can be resumed by pressing the CONTINUE push-button switch. A programed short is noted by two blinking numbered LEDs.



open circuit with a single numbered light-emitting diode, or a short circuit by lighting two numbered LEDs. The right branch of the flow chart shows this process.

Testing can be resumed by pushing the CONTINUE switch or by correcting the error that stopped the test. The RESET pushbutton switch clears flip-flops FF_1 and FF_2, as well as the START and FINISH binary counters. Both of these counters will log the same pulses because NAND gate G_1 is enabled by the CONTINUE signal ($\bar{Q}$ output) from flip-flop FF_1.

The input control signals (A, B, C, D) to the two data selectors and the two demultiplexers are identical for the continuity test. For a counter state of 0000, the 0 output pin of the left-hand demultiplexer is low, as is the output of $BUFFER_1$. If circuit 1 of the test cable is good, the 0 output pins of both data selectors are also low. A good circuit will enable exclusive-OR gate G_2, producing a high output at NOR gate G_3. This constitutes a RUN signal for the dual timer, allowing this device to be free-running at a frequency of 125 hertz.

As the START and FINISH counters advance, each cable is tested for continuity until all 16 checks are completed. If an open circuit is detected, the RUN signal goes low, disabling the timer and counters. The output of the right-hand demultiplexer that is associated with the faulty circuit will then go low, turning on its associated numbered LED to identify which circuit is open. Pressing the CONTINUE push-button overrides the tester's logic long enough to advance the counters by one bit, causing the testing to begin again.

When the tester completes all 16 continuity checks, it then goes on to look for all possible unwanted shorts. The 16th clock pulse from the timer returns both counters to their 0000 state and sets flip-flop FF_1. The START counter will now advance at 1/16th the rate of the FINISH counter. If a short is detected, the Q output of flip-flop FF_1 goes high, changing the test logic by enabling NAND gate G_4 and exclusive-OR gate G_5. Since the SHORT signal from FF_1 overrides the test logic only when the state of the START counter is greater than or equal to the state of the FINISH counter, there are no redundant error indications of cable shorts.

When a short is found, the lower half of the dual timer is enabled, which places a 2-Hz clock signal on the SELECT input of the multiplexer. The control lines of the right-hand demultiplexer are then alternated between the START counter and the FINISH counter so that two LEDs flash on and off to indicate which two circuits are shorted. At the end of the short test, flip-flop FF_2 is clocked to its set condition, and NAND gate G_o inhibits the counters. The END signal from FF_2 is buffered to turn on a LED that indicates that the test is over.

If the tester is programed for a planned cable short and that short is missing, the tester identifies one end of the missing short at a time with a single blinking LED. □

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