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IPC-TM-650
TEST METHODS MANUAL

Number	
2.5.19	
Subject	
Propagation Delay of Flat Cables Using Time Domain Reflectometer	
Date	Revision
7/84	**A**
Originating Task Group	

1 Scope This method describes the test procedures required to measure propagation delay in flat cables. Propagation delay is defined as the time required for a pulse to traverse a unit length of cable. Excessive propagation delay will result in the malfunction of critical circuits due to the late arrival of pulses. Propagation delay is directly proportional to the effective dielectric constant of the insulation.

2 Applicable Documents None

3 Test Specimen

3.1 One pre-production or production sample 1 m to 3 m long. The number of test samples should be determined by the manufacturer and/or user.

4 Apparatus

4.1 In this test, propagation delay is measured using time domain reflectometry (TDR). Commercial TDRs are readily available and consist of a pulse generator and sampling oscilloscopes. The TDR to be used should be a Hewlett-Packard 1415A, Hewlett-Packard 1815A, Tektronix 1 S2 or equal.

4.2 Two standard cable connection devices to terminate each end of the test cable, which should match Figure 1. It is made from a General Radio cable connector type 874-C62A.

4.3 A 509 load, type GR874 or equivalent, to terminate the output of the TDR

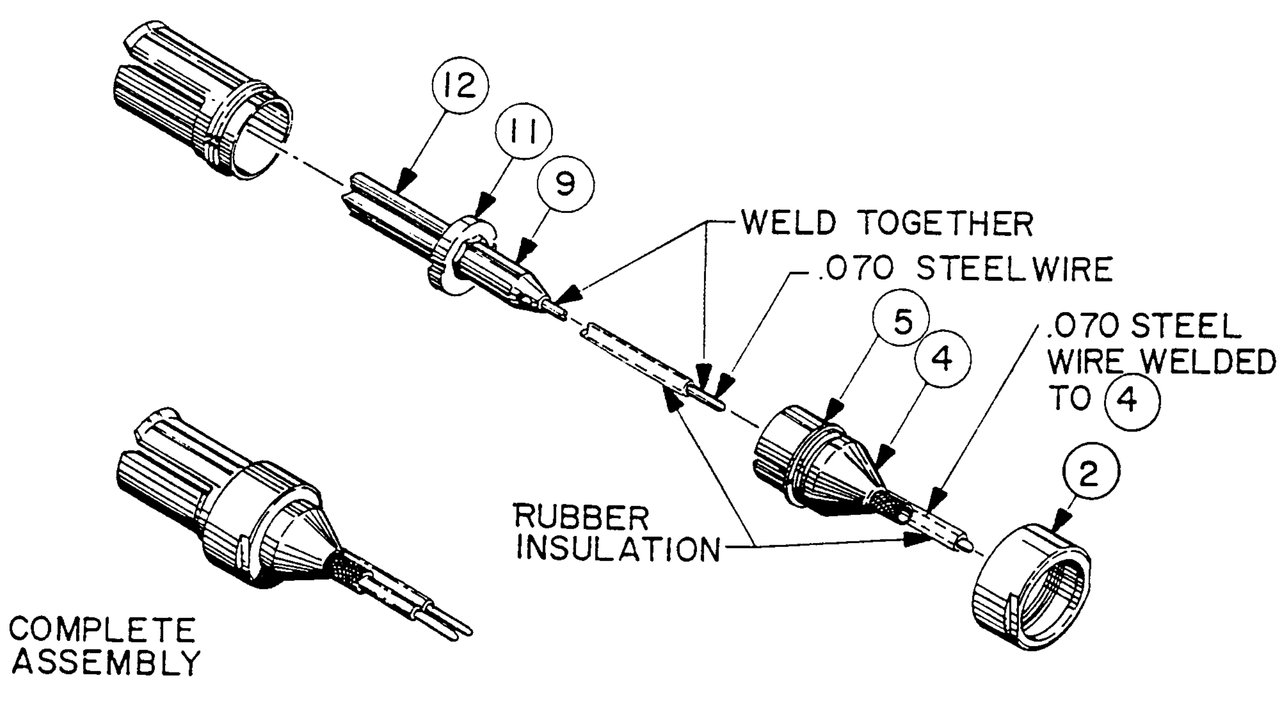

Figure 1 Cable Connection Device

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4.4 Fixture of plexiglass or other nonmetallic material. Cable hangers to suspend the cable in air (see Figure 2)

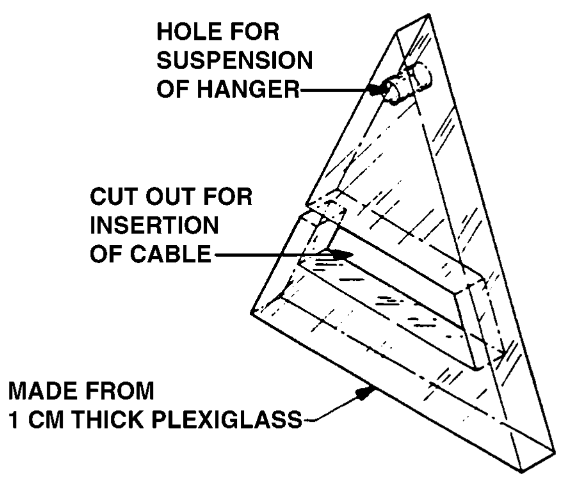

Figure 2 Sample Hanging Device

5 Procedure

5.1 Allow a minimum of one hour for TDR warmup and calibrate the instrument per manufacturer's instructions.

5.2 Prepare the test specimen by stripping approximately 13 mm of insulation from both ends of the cable. Separate the ground and signal conductors and solder a copper buss across the grounds of each end (see Figure 3). Solder a standard cable connection device to each end of the cable (see Figure 4).

5.3 Adjust the TDR settings as follows: Vertical-0.2 p/cm; Distanceltime-20 ns/cm; Magnifier-10X. (For equipment other than Hewlett-Packard, use settings as close as possible to these.)

5.4 Terminate TDR output using the 509 load.

5.5 Adjust the magnitude delay dial so the 50Ω termination is visible and positioned to the left on the screen. Adjust the vertical position so the pulse trace leading edge crosses the horizontal graticule center line at 10% of pulse height (see Figure 5). Mark the position of the leading edge of the pulse on the horizontal graticule (mentally or by camera). If a camera is used, don't advance the film; a second exposure will be made in 5.8.

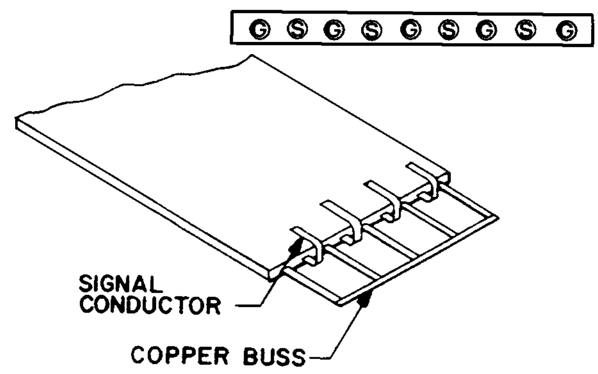

Figure 3 Cable Preparation

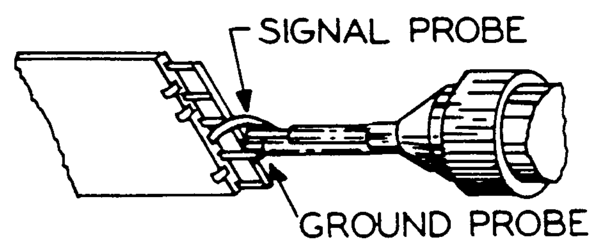

Figure 4 Cable Connection

5.6 Remove the U section of coaxial GR connectors connecting the step out and signal in. Position each L connector (made from the U connector) in the ''STEP OUT'' and ''SIGNAL IN'' connectors.

5.7 Connect the test specimen, one end to the ''Step Out'' and the other end to ''Signal In'' (see Figure 6).

5.8 The trace on the TDR screen will have moved to the right from its original position in 5.5. Mark the position of the leading edge of the pulse on the horizontal graticule (again at 10% of pulse height). At this time, a second exposure on the same film used in 5.5 can be made. This will result in both traces on one film. The distance between this mark and the mark in 5.5 is the measured propagation delay (TD). Multiply the measured T_D by 20 (distance/time set at 20 ns/cm), then

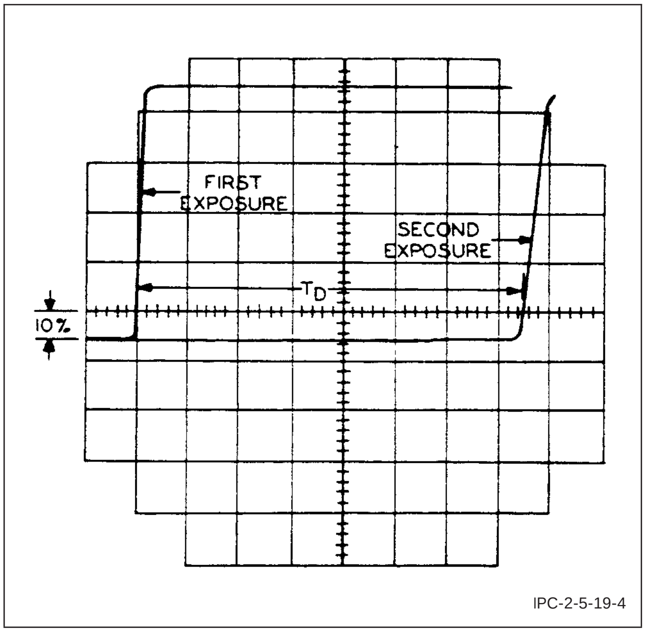

Figure 5 Dual Exposure Picture TDR Trace

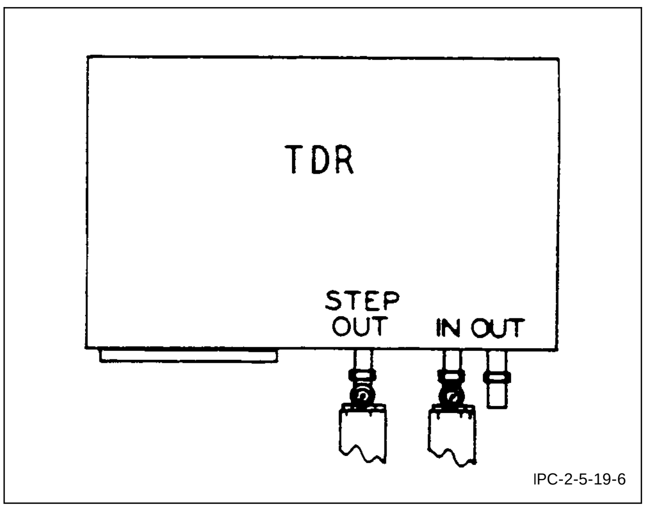

Figure 6 Test Cable Hookup

divide the result by 10 (distance/time magnifier set at 10) to get the total T_D of the test specimen. Subtract 0.20 ns x 2 = 0.40 ns delay caused by the connection device used at each end of the test cable and divide this result by the exact length of the test specimen to get the propagation delay in ns/0.3 m.