The Institute for Interconnecting and Packaging Electronic Circuits
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IPC-TM-650
TEST METHODS MANUAL

Number	
2.5.19.1	
Subject	
Propagation Delay of Flat Cables Using Dual Trace Oscilloscope	
Date	Revision
7/84	**A**
Originating Task Group	

1 Scope This test method describes the test procedures required to measure propagation delay in flat cables. This test method is an alternative to IPC-TM-650, Method 2.5.19. 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

IPC-TM-650 Test Methods Manual

2.5.19 Propagation Delay of Flat Cables Using Time Domain Reflectometer (TDR)

3 Test Specimen

3.1 One pre-production or production sample 0.9 m to 3 m long. The number of test samples should be determined by the manufacturer and/or user.

4 Equipment/Apparatus

4.1 Oscilloscope: Tektronix 7623 with a 7B53A dual time base, or equivalent.The oscilloscope is dual time based, triggered by the pulse generator, and capable of accuracy to 5 ns/div.

4.2 Pulse generator: Tektronix PG501, Hewlett-Packard 8013B, or equivalent. The pulse characteristics from the pulse generator should be determined by the manufacturer and/or user.

4.3 Oscilloscope test probes, preferably high speed, with matched propagation delay

4.4 Cable holder: Fixture of plexiglass or other nonmetallic material

4.5 Cable hangers to suspend the cable in air (see Figure 1)

4.6 A termination resistor equal to the characteristic impedance of the test specimen is required to terminate the output end of the cable. When oscilloscope probes are attached to the cable, the termination resistance (RT) has to be calculated:

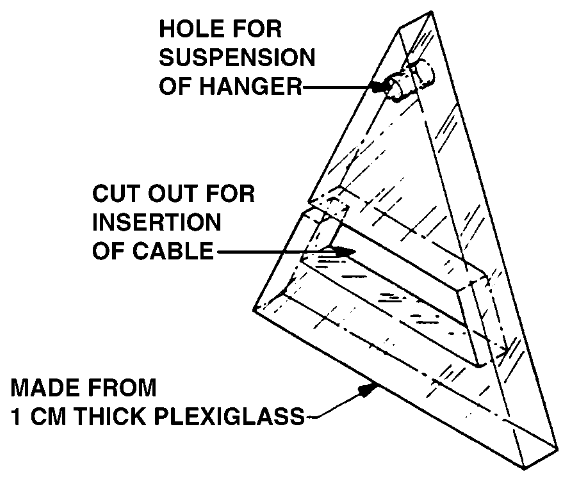

Figure 1 Sample Cable Hanger

$$R_T = \frac{R_{PROBE} + Z_{oCABLE}}{R_{PROBE} - Z_{oCABLE}}$$

4.7 An input resistor is required in series between the pulse generator and the test specimen (only) when the characteristic impedance of the cable is equal to or less than the output impedance of the pulse generator. In this case:

Input Resistance = $Z_{oGENERATOR} - Z_{oCABLE}$

4.8 Standard cable connection device matching Figure 2. It is made from a General Radio cable connector type 874-C62A (propagation delay 0.2 ns).

4.9 A 50Ω General Radio to BNC female adaptor is required to connect the pulse generator to the test specimen.

5 Procedure

5.1 Allow one hour for the test equipment to warm up. Connect the pulse generator Trig output to the oscilloscope main Trig in. Set the pulse generator output pulse characteristics as specified for the test. Hook up both test probes from each oscilloscope input to the single pulse generator output. Adjust the scope sweep rate to 5 ns/div and view both channels.

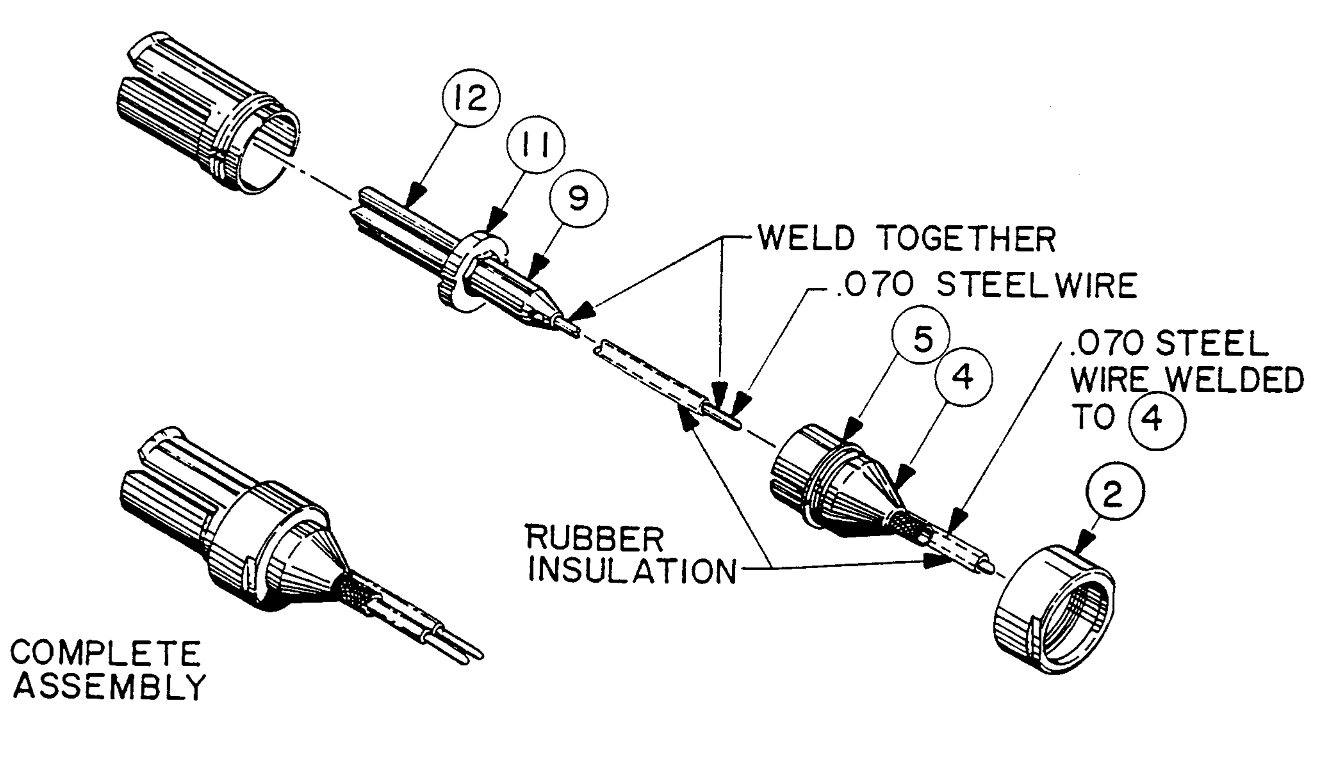

Figure 2 Cable Connection Device

There should be no time delay difference between the channels caused by the probes. If there is any delay, it should be noted and added to the final T_D calculation.

5.2 Prepare the test specimen by stripping approximately 13 mm of insulation from each end of the cable. Separate the ground and signal conductors and solder a copper buss across the grounds (see Figure 3). The exact length of the cable should be noted.

5.3 Solder the termination resistor from signal lead to ground buss at the output end of the cable.

5.4 Solder the input resistor in series with the signal lead on the input end of the cable (only if required).

5.5 Solder the standard cable connection device to the test specimen signal-to-signal lead and ground-to-ground buss.

5.6 Connect the pulse generator to the GR to BNC adapter via a short length of coaxial cable. Connect the input end of test specimen to the adapter.

5.7 Connect the oscilloscope input probes to the test specimen, one at the input and the other at the output termination (see Figure 4).

5.8 Set the oscilloscope sweep rate at 5ns/div and view both channels on the CRT. Measure the distance between the leading edge (at 10% pulse height) of each channel using the display graticule as a guide (see Figure 5). Divide the result by the cable length to get propagation delay in ns/0.3 m.

6 Notes

6.1 If using a small sample (0.9 m), the scope should be capable of accuracy to 1 ns/div.

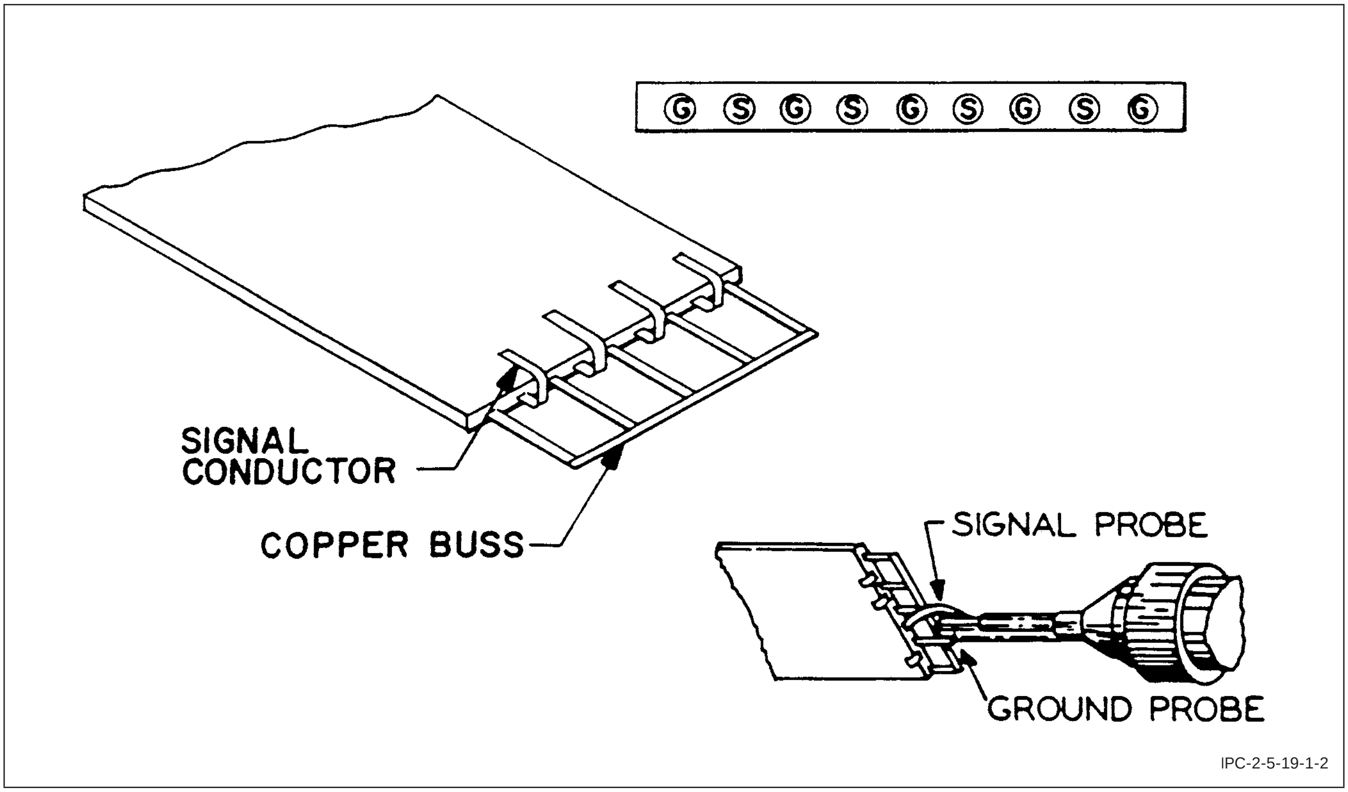

Figure 3 Cable Preparation and Cable Connection

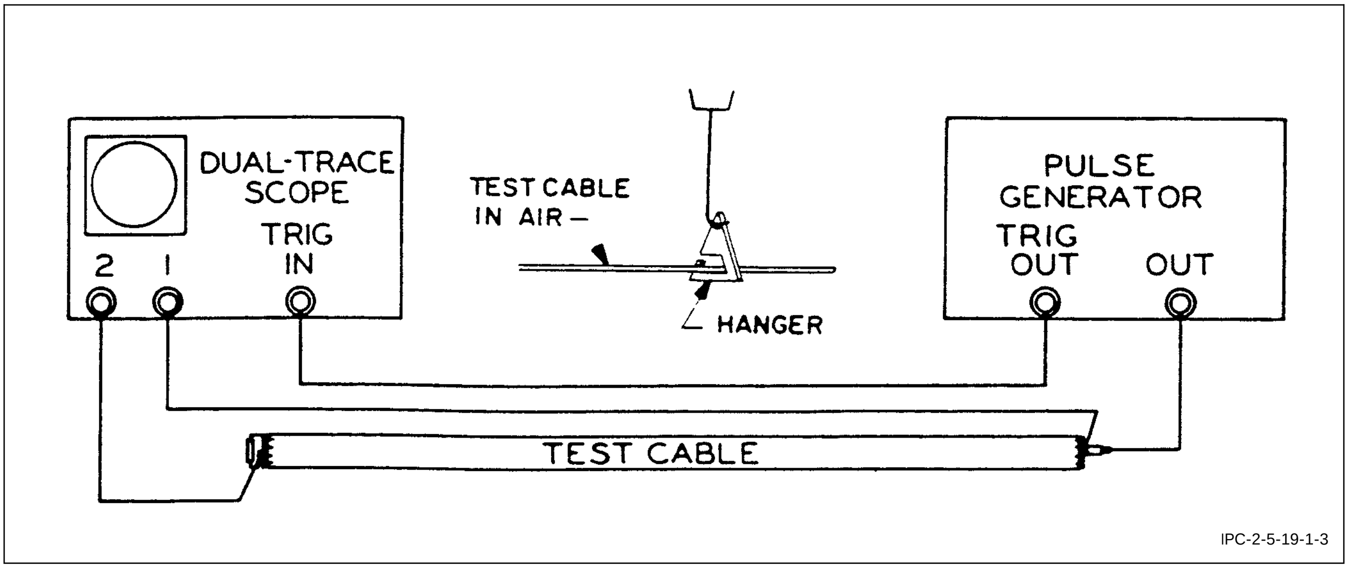

Figure 4 Test Cable Hookup

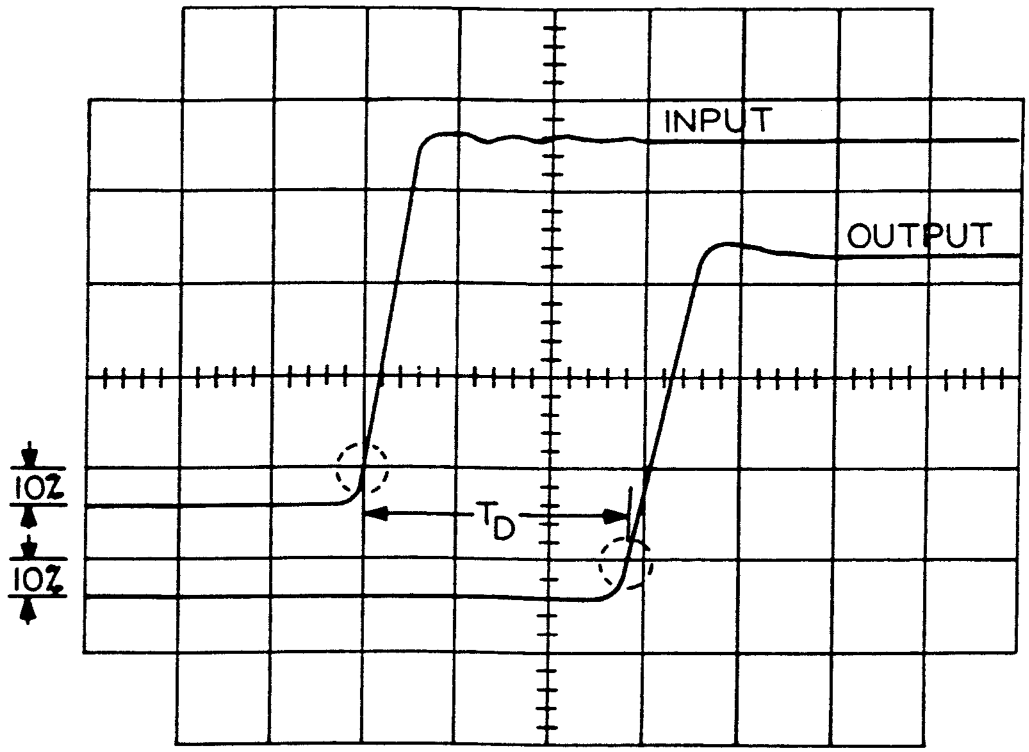

Figure 5 Dual Trace Oscilloscope Display