Society of Cable Telecommunications Engineers

ENGINEERING COMMITTEE
Interface Practices Subcommittee

AMERICAN NATIONAL STANDARD

ANSI/SCTE 49 2011

Test Method for Velocity of Propagation

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1.0 SCOPE

The method described in this procedure provides a means to measure the velocity of propagation (Vp), in coaxial cables. This method is for use with cables having low-loss dielectrics as noted in ANSI/SCTE 15 and ANSI/SCTE 74 that have relative permittivity nearly constant with frequency.

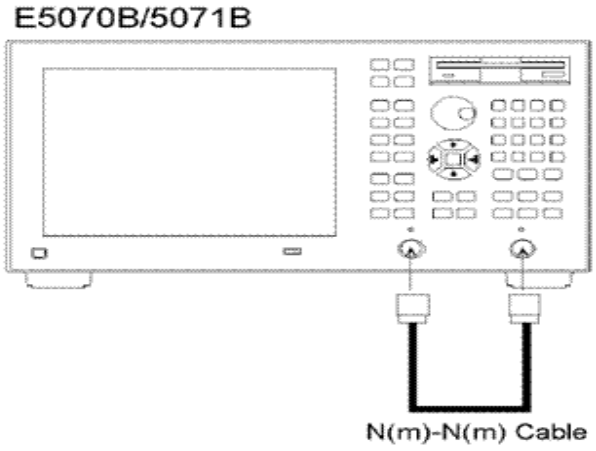
2.0 NOTES

2.1 Errors associated with this test are based on two factors, the frequency measurement and the sample length. The published accuracy of the Network Analyzer is specified as less than 0.05%. Physical measurements are to be made to within 0.1% accuracy or less. This is approximately equal to 1/4 inch in twenty feet. The resultant Vp accuracy will be approximately 2%.

2.2 This procedure uses the network analyzer RF output to measure the electrical length of the sample. This is accomplished by connecting the cable between the output and detector ports of the analyzer using appropriate size test connectors. (See Diagram 1)

2.3 Accurately cutting the sample length is essential for the accuracy of the test.

Diagram 1



Network Analyzer and DUT

3.0 METHOD

3.1 Equipment

3.1.1 Agilent E5071B ENA Series Network Analyzer or equivalent

3.1.2 Agilent 11852B 50 Ohm to 75 Ohm Low Loss Pad or equivalent

3.1.3 Applicable precision test connectors

3.1.4 Tape Measure

4.0 SAMPLE PREPARATION

4.1 Obtain a sample of cable 25 ± 1 feet in length; prepare one end of the cable to be tested for connector acceptance. At each cable end, stretch the sample straight and lay on floor maintaining tension. Beginning from the dielectric of the prepared end, measure 20 feet and cut the cable creating an open circuit. *(Depending on the connector type the dielectric length shall be cut to maintain the 20 foot ± 0.25 in.).* The physical measurement of the sample is critical for the accuracy of this procedure. Use the remaining cable to measure and prepare a 12 ± 0.125 inch or 1 foot sample (see 2.1 Notes).

4.2 Attach proper precision test connectors to the test leads of the analyzer.

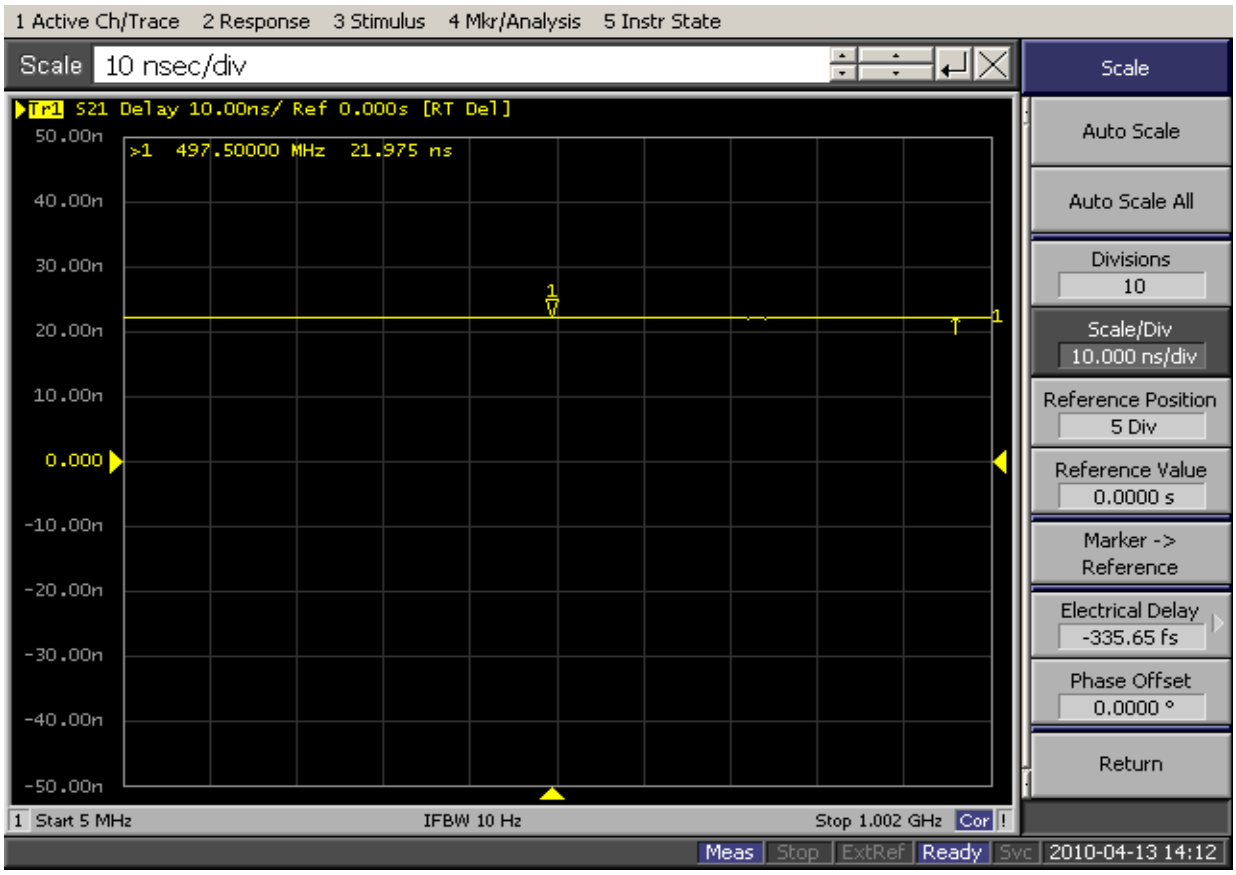
5.0 TEST PROCEDURE

5.1 Set up the ENA E5071B (or equivalent) analyzer for a Log Magnitude (Log Mag) measurement with linear frequency sweep type. The bandwidth should be set from 5 to 1002 MHz and the Sweep Setup Number of Points set at 201 for the measurement.

5.2 Use the 1-foot sample to perform a “Thru” response calibration measurement between the test leads and connectors. This method includes the test connectors as part of the calibration.

5.3 Place the 20 foot sample between connectors of the test leads. With a marker at the middle of the trace, set the display to Delay to view the electrical length. (See Diagram 2)

Diagram 2



S21 Delay Measurement

5.4 Determine the velocity of propagation (Vp) of the sample by using the following formula.

$$Vp = (19/PD_{(s)})/ (9.84*10^{8})$$

$$Vp\ \% = Vp*100$$

Where: 19 = 20ft. CUT – 1ft. Calibration sample

PD = S21 Propagation Delay at 497.5 MHz

$9.84* 10^{8}$ = Speed of light in a vacuum in ft/sec

6.0 REPORT

Report the following:

6.1 Date

6.2 Specimen Identification (Type, Lot No., reel no., etc.)

6.3 PD time measurement of the sample in seconds

6.4 Vp (%Velocity of Propagation)