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EIA STANDARD

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Rise Time Degradation Test Procedure for Electrical Connectors, Sockets, Cable Assemblies or Interconnection Systems

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ELECTRONIC INDUSTRIES ALLIANCE

Electronic Components, Assemblies, Equipment & Supplies Association

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(From Standards Proposal No. 4154, formulated under the cognizance of the CE-2.0 National Connector Standards Committee.)

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TEST PROCEDURE No. 102

RISE TIME DEGRADATION TEST PROCEDURE FOR ELECTRICAL CONNECTORS, SOCKETS, CABLE ASSEMBLIES OR INTERCONNECTION SYSTEMS

(From EIA Standards Proposal No. 4154, formulated under the cognizance EIA CE-2.0 Committee on National Connector Standards)

1 Introduction

1.1 Scope

This standard is applicable to electrical connectors, sockets, cable assemblies, or interconnection systems.

1.2 Object

This standard describes a method for measuring the effect a specimen has on the rise time of a signal passing through it.

1.3 Definitions

1.3.1 Rise time degradation

The increase in rise time to a theoretically perfect (zero rise time) voltage step when the specimen is inserted in the transmission path; see figure 1. The formula used to calculate rise time degradation for gaussian signals from 10% to 90% is as follows:

Rise time degradation = square root [(measured rise time)^2 - (measurement system rise time)^2]

1.3.2 Measurement system rise time

Rise time measured with fixture in place, without the specimen, and with filtering (or normalization). Rise time is typically measured from 10% to 90% levels; see figure 1.

1.3.3 Specimen environment impedance

The impedance presented to the signal conductors by the fixture. This impedance is a result of transmission lines, termination resistors, attached receivers and signal sources, and fixture parasitics.

1.3.4 Rise time

The time required for a voltage step to occur, measured between its initial value and final value, typically from 10% to 90% levels.

1.3.5 Termination (electronics usage)

An impedance connected to the end of a transmission line, typically to minimize reflected energy on the line.

2 Test resources

2.1 Equipment

Pulse generator and oscilloscope, time domain reflectometer (TDR) or other suitable equipment with a measurement system rise time less than or equal to 70% of the measured rise time.

2.2 Material

When the fixture is a printed circuit board, the reference trace and the test trace should be made on the same printed circuit board to reduce any difference in PCB fabrication processes, dielectric material variations, etc.

2.3. Fixture

Unless otherwise specified in the referencing document the specimen environment impedance shall match the impedance of the test equipment. Typically this will be 50 ohms for single-ended measurements and 100 ohms for differential.

2.3.1 Method A, single-ended

The fixture shall allow one signal line to be driven at a time. The driven line shall be terminated according to one of the methods of figure A.2 with the specimen environment impedance. Unless otherwise specified a 1:1 signal to ground ratio shall be used with each end having all grounds commoned. Each line adjacent to the driven line shall also be terminated in its specimen environment impedance at both near and far ends.

2.3.1.1 Insertion technique

The fixture shall be designed to allow measurement of rise time with and without the specimen; see figure A.1.a.

2.3.1.2 Reference fixture technique

Two fixtures shall be designed to have the same fixture electrical length and characteristics of environment transmission line. The “specimen fixture” includes the specimen. The “reference fixture” does not include the specimen. The fixture electrical length does not include the specimen length; see figure A.1.b.

2.3.2 Method B, differentially driven

The fixture shall allow one signal pair to be driven at a time. The driven line shall be terminated according to one of the methods of figure A.3 with the specimen environment impedance. Unless otherwise specified a 2:1 signal to ground ratio shall be used. Each line adjacent to the driven line shall also be terminated in the specimen environment impedance at both near and far ends.

2.3.2.1 Insertion technique

The fixture shall be designed to allow measurement of rise time with and without the specimen; see figure A.1.a.

2.3.2.2 Reference fixture technique

Two fixtures shall be designed to have the same fixture electrical length and characteristics of environment transmission line. The “specimen fixture” includes the specimen. The “reference fixture” does not include the specimen. The fixture electrical length does not include the specimen length; see figure A.1.b.

3 Test Specimen

3.1 Description

For this test procedure the test specimen shall be as follows:

3.1.1 Separable connectors

A mated connector pair.

3.1.2 Cable assembly

Assembled connectors and cables, and mating connectors.

3.1.3 Sockets

A socket and test device or a socket and pluggable header adapter.

4 Test procedure

Unless otherwise specified the measurement system rise time shall be less than or equal to 70% of the measured rise time with the specimen; see figure 1. It is recommended to use the fastest output signal of which the equipment is capable. Each of the two techniques below apply to both single-ended and differential measurements. For differential measurements, it is necessary to determine whether any phase and/or amplitude errors exist between the channels, and to provide necessary compensation for these errors. Place the specimen a minimum of 5 cm from any object that would affect measured results.

NOTE — The test professional should be aware of limitations of any math operation(s) performed by an instrument, (e.g. normalization or software filtering).

4.1 Insertion technique

4.1.1 Measure the rise time and plot the waveform of the output signal that is transmitted through the fixture without the specimen and with filtering or normalization. This is the measurement system rise time.

4.1.2 Measure the rise time and plot the waveform of the output signal that is transmitted through the fixture with the specimen and with filtering or normalization. This is the measured rise time.

4.2 Reference fixture technique

4.2.1 Measure the rise time and plot the waveform of the output signal that is transmitted through the reference fixture without the specimen and with filtering or normalization. This is the measurement system rise time.

4.2.2 Measure the rise time and plot the waveform of the output signal that is transmitted through the reference fixture with the specimen and with filtering or normalization. This is the measured rise time.

4.3 Rise time degradation calculation

4.3.1 If the signal is gaussian in nature and the rise time was measured from 10% to 90% levels, see note; then calculate the rise time degradation as follows:

Rise time degradation = square root[(measured rise time)^2 - (measurement system rise time)^2].

NOTE — The input and output step amplitudes may not be equal due to attenuation in the device under test. When this occurs, the output step 10% and 90% levels are to be referenced from the maximum output voltage, regardless of what voltage was put in.

4.3.2 The equation, see 4.3.1, may not be used if the signal was not gaussian in nature or the signal rise time was not measured from 10% to 90% levels. In this case report the measured rise times and waveform plots.

5 Details to be specified

The following details shall be specified in the referencing document:

5.1 Measurement system rise time (if available)

5.2 Specimen environment impedance if other than 50 ohms for single-ended or 100 ohms for differential.

5.3 Signal/ground pattern, including the number and location of signal and grounds to be wired for this test.

5.4 Fixture requirements, if any

5.5 Rise time levels if other than 10% to 90%

5.6 Method A (single-ended), method B (differentially driven), or both

6 Test documentation

Documentation shall contain the details specified in clause 5, with any exceptions, and the following:

6.1 Title of test

6.2 Test equipment used, and date of last and next calibration

6.3 Test procedure and method

6.4 Fixture description

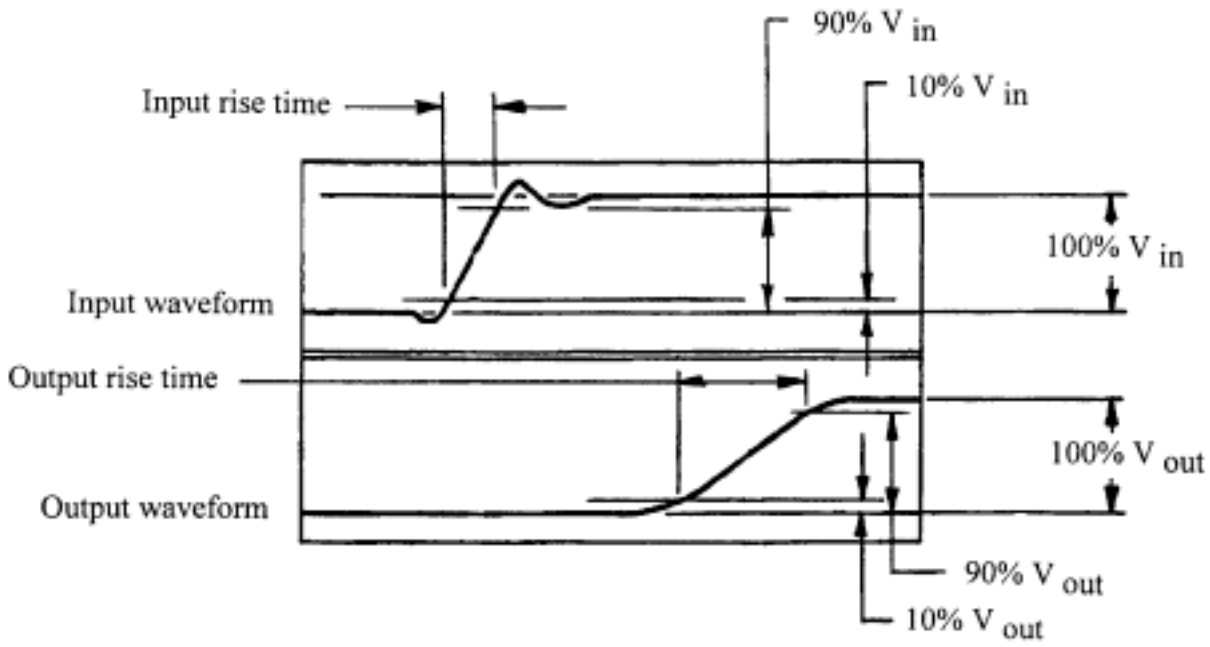
6.5 Measurement system rise time as applicable (see clause 4)

6.6 Measured rise times with specimen.

6.7 Wave form plots, (required if the signals are not gaussian in nature or the rise time was not measured from 10% to 90% levels).

6.8 Values and observations

6.9 Name of operator and date of test



NOTE — Ignore overshoot and undershoot when calculating 0% and 100% levels.

Figure 1 - Waveform

Annex

A Normative

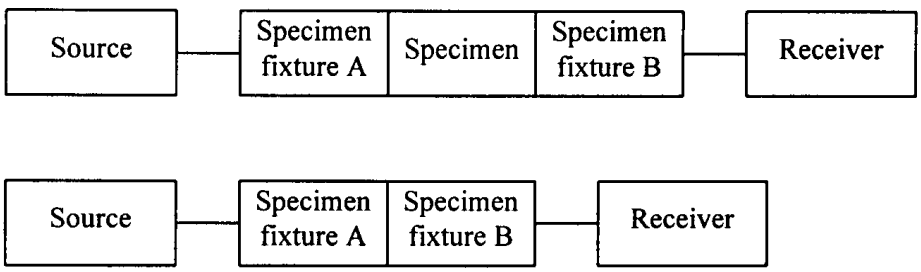


Figure A.1.a - Insertion technique

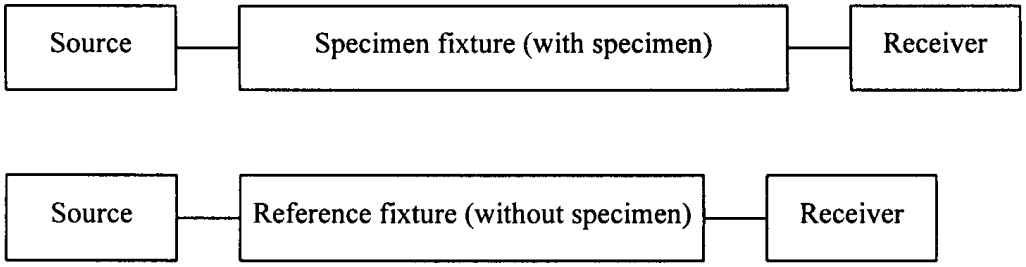
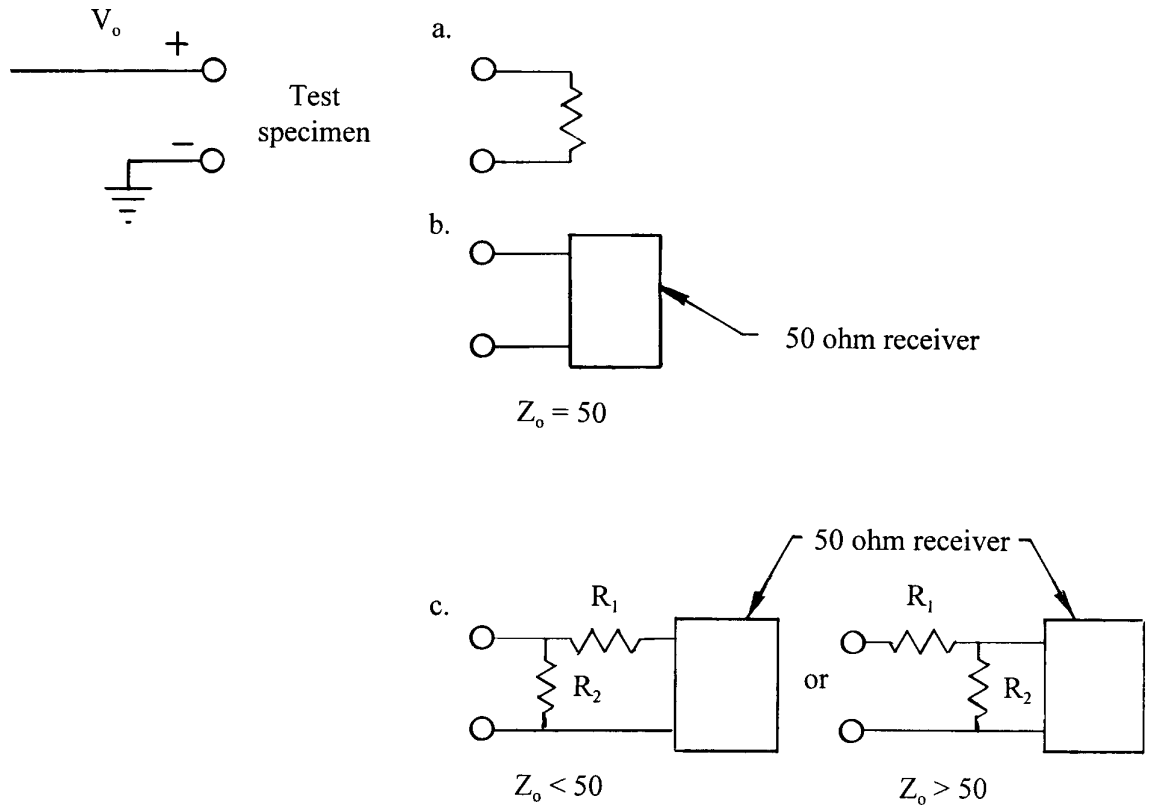


Figure A.1.b - Reference fixture technique

Figure A.1 - Technique diagrams

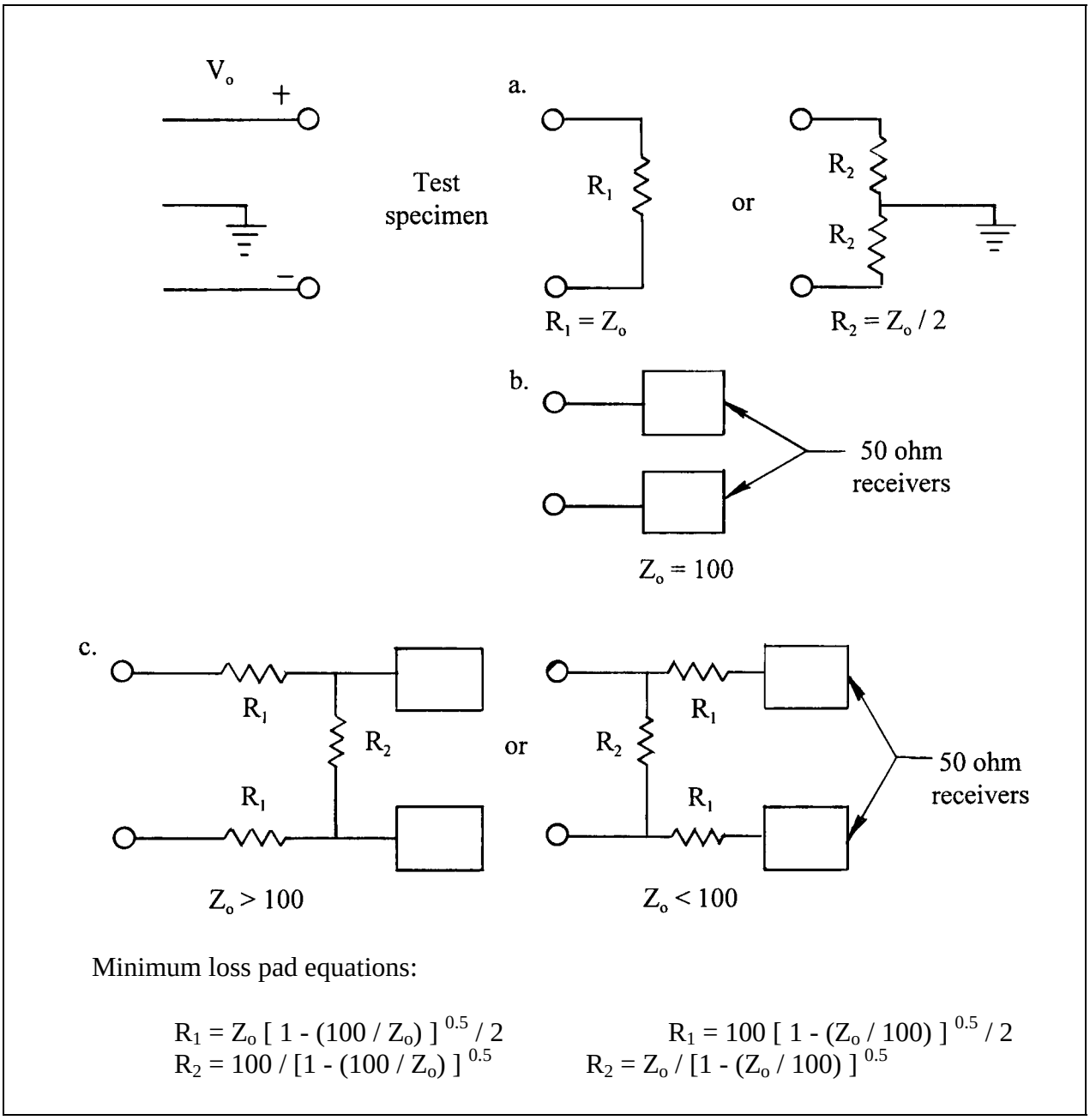


Minimum loss pad equations:

$R_1 = 50 [1 - (Z_o / 50)]^{0.5}$ $\quad R_1 = Z_o [1 - (50 / Z_o)]^{0.5}$

$R_2 = Z_o / [1 - (Z_o / 50)]^{0.5}$ $\quad R_2 = 50 / [1 - (50 / Z_o)]^{0.5}$

Figure A.2 - Single-ended terminations



Minimum loss pad equations:

$R_1 = Z_o [1 - (100 / Z_o)]^{0.5} / 2$
$R_2 = 100 / [1 - (100 / Z_o)]^{0.5}$

$R_1 = 100 [1 - (Z_o / 100)]^{0.5} / 2$
$R_2 = Z_o / [1 - (Z_o / 100)]^{0.5}$

Figure A.3 - Differential (balanced) terminations

B Informative

B.1 Practical guidance

Near perfect resistive terminations of the signal lines may not be possible at high frequencies due to parasitic reactances in both signal and ground conductors. These reactances will have an impact on measured results. In this case it is desirable that the test fixture duplicate the exact geometry (parasitics) of the actual application. This may involve the use of transmission lines in addition to the components of figures A.1 and A.2. Most instruments used for these measurements are internally terminated in 50 ohms at both source and detector ports.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