



Designation: B 878 – 97 (Reapproved 2003)

Standard Test Method for Nanosecond Event Detection for Electrical Contacts and Connectors¹

This standard is issued under the fixed designation B 878; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method describes equipment and techniques for detecting contact resistance transients yielding resistances greater than a specified value and lasting for at least a specified minimum duration.

1.2 The minimum durations specified in this standard are 1, 10, and 50 nanoseconds (ns).

1.3 The minimum sample resistance required for an event detection in this standard is 10 Ω .

1.4 An ASTM guide for measuring electrical contact transients of various durations is available as Guide B 854.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

B 542 Terminology Relating to Electrical Contacts and Their Use²

B 854 Guide for Measuring Electrical Contact Intermittences²

2.2 Other Standards:

IEC 801-2, ed 2:91³

EN 50 082-1:94³

3. Terminology

3.1 *Definitions:* Many terms used in this standard are defined in Terminology B 542.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *event*—a condition in which the sample resistance increases by more than 10 Ω for more than a specified time duration.

¹ This test method is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.11 on Electrical Contact Test Methods.

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² Annual Book of ASTM Standards, Vol 02.04.

³ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

4. Significance and Use

4.1 The tests in this test method are designed to assess the resistance stability of electrical contacts or connections.

4.2 The described procedures are for the detection of events that result from short duration, high-resistance fluctuations, or of voltage variations that may result in improper triggering of high speed digital circuits.

4.3 In those procedures, the test currents are 100 mA (± 20 mA) when the test sample has a resistance between 0 and 10 Ω . Since the minimum resistance change required to produce an event (defined in 3.2.1) is specified as 10 Ω (see 1.3), the voltage increase required to produce this event must be at least 1.0 V.

4.4 The detection of nanosecond-duration events is considered necessary when an application is susceptible to noise. However, these procedures are not capable of determining the actual duration of the event detected.

4.5 The integrity of nanosecond-duration signals can only be maintained with transmission lines; therefore, contacts in series are connected to a detector channel through coaxial cable. The detector will indicate when the resistance monitored exceeds the minimum event resistance for more than the specified duration.

4.6 The test condition designation corresponding to a specific minimum event duration of 1, 10, or 50 ns is listed in Table 1. These shall be specified in the referencing document.

5. Apparatus

5.1 *Detector*—The detector used shall be an AnaTech 64 EHD, 32 EHD, or equivalent. The detector shall meet the following requirements:

5.1.1 *Electromagnetic Interference (EMI)*—The detector shall pass the European Community (EC) electrostatic discharge (ESD) requirement for computers (EN50 082-1:94 based on IEC 801-2, ed. 2:91). The performance criteria is “1) normal performance within the specification limits;” that is, no channel is allowed to trip. Air discharge voltages shall include 2, 4, 8, and 15 kV. Contact discharge voltages shall include 2, 4, 6, and 8 kV. Detector inputs shall be protected with coaxial shorts.

TABLE 1 Test Condition Designations for Specific Minimum Event Durations

Test Condition	Event Duration, min
A	1 nanosecond
B	10 nanoseconds
C	50 nanoseconds

5.1.2 *dc Current*—Each channel shall supply 100 ± 20 mA when the sample being tested has a resistance between 0 and 10 Ω .

5.1.3 *Input Impedance:*

5.1.3.1 *Direct Current (dc)*—The detector source resistance (impedance) shall be 50 Ω when the sample resistance is between 0 and 10 Ω .

5.1.3.2 *RF Input Impedance*—A Time Domain Reflectometer (TDR) or Network Analyzer Time Domain Reflectometer (NATDR) shall be used to measure the reflection in percent of a (simulated) 0.5 ns risetime step when the sample direct current resistance is 10 Ω and the detector current is 100 mA. (The 10 Ω sample resistance is put on the bias port for NATDR.) An acceptable detector shall reflect less than 30 % amplitude.

5.1.4 *Amplitude Sensitivity*—Amplitude required to trip the detector with a 1 nanosecond duration pulse shall be no more than 120 % of the direct current trip amplitude. One nanosecond pulse duration shall be measured at 90 % of the pulse amplitude, and the rise and fall times shall be less than 0.5 ns. Pulse low level shall be 0 V. These shall be measured with a 1 GHz bandwidth oscilloscope and a pulse generator (see Fig. 1).

5.1.4.1 The same requirements shall be met for the 10 and 50 ns detector settings, but the pulse rise and fall times can now be less than 2 ns.

5.1.5 *Accuracy*—It shall be possible to adjust the detector to trip at $10 \pm 1 \Omega$ for all channels in use.

5.2 *Test Setup*—Recommended equipment is as shown in Fig. 2. A short flexible ground strap directs ground loop currents away from the sample (see Fig. 2, Note E). The RG-223 coaxial cable is well shielded whereas the short 50 Ω miniature coaxial cable is flexible. Each EMI loop is connected to a detector channel and is used as a control.

5.3 *Sample and EMI Loop Preparation*—The sample circuit shall have a resistance of less than 4 Ω .

5.3.1 *Sample Wiring:*

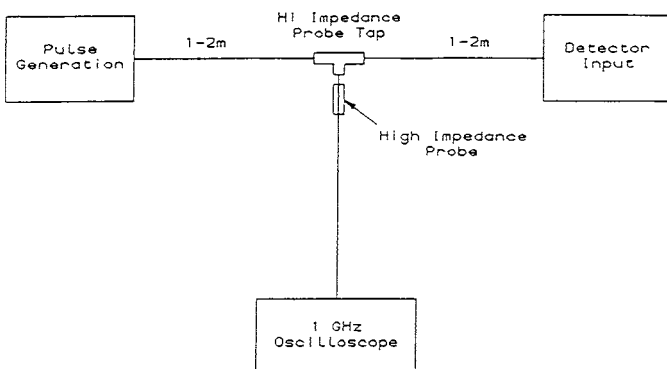
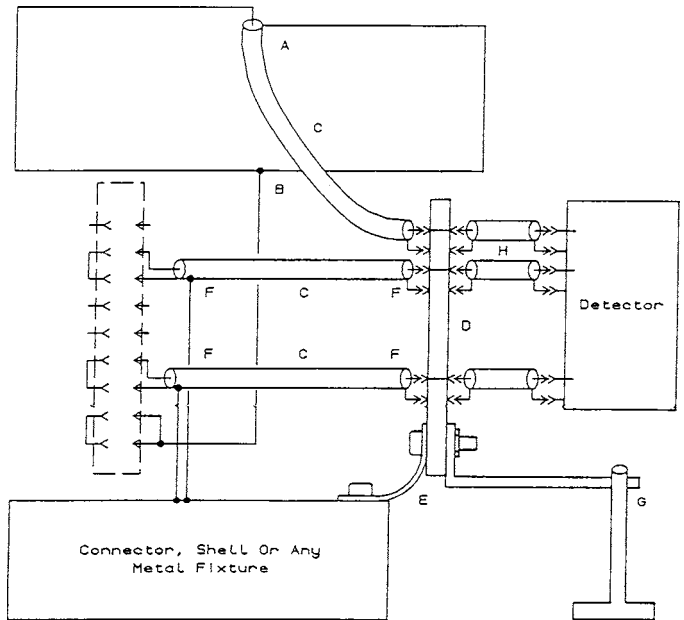


FIG. 1 Equipment Setup for Amplitude Sensitivity Measurement



NOTE 1—

- A One square meter EMI loop monitored at top center (see 6.1).
- B Connection to series wired sample circuit with the greatest capacitance

- shell or other metal fixturing (see 6.1).
- C Miniature coaxial cable (50 Ω) (see 5.3.1.1).
- D Patch panel, coaxial through-bulkhead RF connectors in metal panel.
- E Short flexible ground strap, 70 mm long and >25 mm wide (see 7.3).
- F Strain relief coaxial cable at these locations.
- G Physical support for patch panel.
- H RG-223 double braid coaxial cable.

FIG. 2 Ten and Fifty Nanosecond Fixturing

5.3.1.1 A contact or series-wired contacts (see Fig. 3, Note A) shall be wired from the center conductor to the braid of miniature 50- Ω coaxial cable (see Fig. 2, Note C).

5.3.1.2 The sample, as wired to the miniature coaxial cable for testing, shall be capable of passing short duration pulses. A time domain reflectometer (TDR) shall be used to measure the transition time of a fast risetime step (<60 ps) reflected from the sample under test. On the waveform, find the point representing the far end of the miniature 50- Ω coaxial cable (see Fig. 4, Point 1). Also find the last point on the waveform where the voltage amplitude is 20 % of Point 1 (see Fig. 4, Point 2). The time between these points shall be less than the minimum duration of the event identified in Table 1. Each series-wired sample circuit shall be measured.

5.3.2 *Electromagnetic Interference (EMI) Concerns of Sample Wiring*—At least three major paths for EMI can be identified in the sample fixturing.

5.3.2.1 EMI couples to the sample through the parasitic capacitance between the sample and any metal fixturing. To greatly reduce this coupling, the miniature coaxial cable shield shall be connected to the metal fixturing as close to the connector-under-test as possible. This connection shall be as short as possible and perpendicular to nearby sample conductors (see Fig. 3, Note D). This is done for the sample channels only, not the control channels.

NOTE 1—If there is no metal fixturing within 5 cm of the sample circuit,