Designation: B854 − 98 (Reapproved 2022)

Standard Guide for Measuring Electrical Contact Intermittences[1]

This standard is issued under the fixed designation B854; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 The techniques described in this guide apply to electrical circuits that include one or more electrical contacts in devices such as slip rings, separable connectors, electromechanical relays or closed switch contacts. The user should determine applicability for other devices.

1.2 The range of techniques described apply to circuit discontinuities (intermittences) of durations ranging from approximately 10 nanoseconds to several seconds and of sufficient magnitude to cause alteration of the circuit function. Extension of the guide to shorter duration events may be possible with suitable instrumentation. Events of longer duration may be monitored by techniques for dc measurements such as those described in Test Methods B539 or by adaptation of methods described in this guide.

1.3 The techniques described in this guide apply to electrical circuits carrying currents typical of signal circuits. Such currents are generally less than 100 ma. Extension of these techniques to circuits carrying larger currents may be possible, but the user should evaluate applicability first.

1.4 *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 become familiar with all hazards including those identified in the appropriate Safety Data Sheet (SDS) for this product/material as provided by the manufacturer, to establish appropriate safety, health, and environmental practices, and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B539 Test Methods for Measuring Resistance of Electrical Connections (Static Contacts)

B542 Terminology Relating to Electrical Contacts and Their Use

B615 Practice for Measuring Electrical Contact Noise in Sliding Electrical Contacts

B878 Test Method for Nanosecond Event Detection for Electrical Contacts and Connectors

2.2 *Other Documents:*

IEC Publication 512 Test 2e Contact Disturbance[3]

EIA-364-46 Continuity Test Procedure for Electrical Connectors[4]

3. Terminology

3.1 Terms relevant to this guide are defined in Terminology B542 except as noted in the following section.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *intermittence, n*—a transient increase in the voltage drop across a pair of electrical contacts.

4. Significance and Use

4.1 This guide suggests techniques to evaluate intermittences in a contact pair while it is subjected to simulated or actual environmental stress. Such measurements are a valuable tool in predicting circuit performance under these stress conditions and in diagnosing observed problems in circuit function under such conditions.

4.2 This document is intended to provide some general guidance on the best available practices for detecting, quantifying, characterizing and reporting short duration intermittences in circuits containing electrical contacts. Certain environmental stresses such as mechanical shock, vibration or

[1] This guide is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.05 on Precious Metals and Electrical Contact Materials and Test Methods.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from Electronic Industries Association, 2001 Pennsylvania Ave NW, Washington D.C. 20006.

temperature change may cause intermittences. These measurement procedures include methods applicable to contacts operating under various conditions in testing or in service.

4.3 Practice B615 defines methods for measuring electrical contact noise in sliding electrical contacts. In contrast Guide B854 provides guidance to the various methods for measuring similar phenomena in static contacts.

5. Apparatus

5.1 *General Comments*—The apparatus required varies depending upon the technique selected and the parameters (such as duration and magnitude) of the intermittence that the user wants to detect. In general, the cabling must be capable of carrying signals of the speed to be detected in the study, and must be isolated from sources of noise that may cause false indications.

5.2 *Special Precautions for Measurements Involving Events Less than 1 Microsecond in Duration*—Detection of events of duration less than 1 microsecond will require special attention to the wiring of the detection circuits and instrumentation. Such attention may include using coaxial cable, shielding the apparatus from interferences and minimizing cable lengths.

5.3 *Specific Apparatus*—The apparatus required will vary depending upon the measurement method selected and the environmental stresses imposed during the test.

6. Procedure

6.1 *General Comments*—The following sections describe, in general terms, several methods that have been used to detect or measure contact intermittences. The user should select an appropriate method and adapt it as required. Table 1 presents a comparison of the attributes of the various methods. The following list covers questions that the user should answer before selecting a test method.

6.1.1 What is the definition of an intermittence in the intended application? For example, what resistance change over what time interval constitutes an intermittence, or what error occurs if the contact resistance changes, or what other definition is appropriate for the intended purpose of the test results?

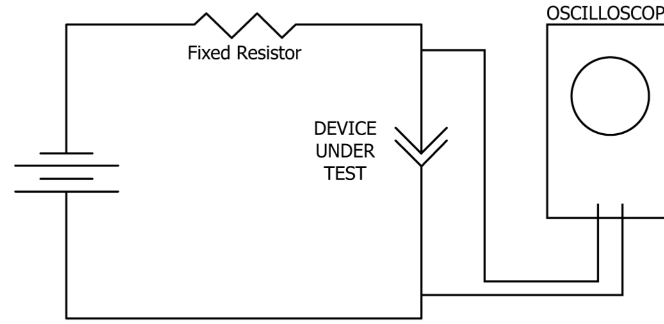

FIG. 1 Schematic Representation of Oscilloscope Method

6.1.2 Is it necessary to monitor more than one contact simultaneously? If so, is it acceptable to connect the contacts in series? If contacts cannot be connected in series, how many contacts must be measured simultaneously?

6.2 Test results should be reported in a format appropriate for the application and consistent with the format supplied by the test instrument.

6.3 *Oscilloscope*—In this method, an oscilloscope is wired to monitor the potential across the contact(s) of interest while a signal is passed through the contacts. Standards such as IEC Publication 512, Test 2e or EIA-364-46 are often implemented using this method. Practice B615 provides a specific circuit that uses this method. Examples of the use of this method are shown in the reference by Currence and Rhoades.[5]

6.3.1 Fig. 1 shows a schematic representation of an example of how this method may be implemented. In selecting an oscilloscope, choose a model with response time fast enough to observe events of the duration of interest in the study. The user may find it convenient to use an oscilloscope capable of storing and printing results.

[5] Currence, R. and Rhoades, W., "Predicting, Modeling and Measuring Transient Resistance Changes of Degraded Electrical Contacts," Electrical Contacts, Proceedings of the 29th Meeting of the Holm Conference on Electrical Contacts, Illinois Institute of Technology, p. 81, 1983.

TABLE 1 Comparison of Methods of Monitoring Electrical Contact Intermittences

Method	Typical Number of Channels	Typical Event Characterization	Possible Advantages
Oscilloscope	1, 2 or 4	ΔV vs time	Detailed characterization of each event
Custom Circuitry	1 per circuit	Presence or absence of one or more events during a preselected monitoring interval, such events defined as above a preselected threshold of ΔR and duration, the number of events during the interval may or may not be recorded.	Ability to closely model actual circuit conditions, allows use of various technologies in the transmitting and receiving devices
Event Detector	1 to 64	Presence or absence of one or more events during a preselected monitoring interval, such events defined as above a preselected threshold of ΔR and duration, but the number of events during the interval is not recorded.	Multichannel capability, selection of thresholds for events to be counted
Bit Error Rate	1	Ratio of errors to number of bits transmitted	The format of the results is readily applicable to ranking of interconnection devices with respect to transmission quality for a specific signal format

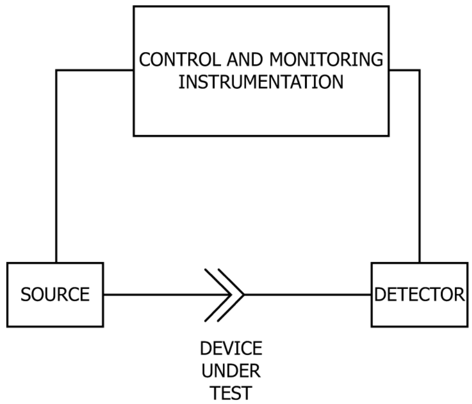

FIG. 2 Schematic Representation of Method Using Custom Circuitry

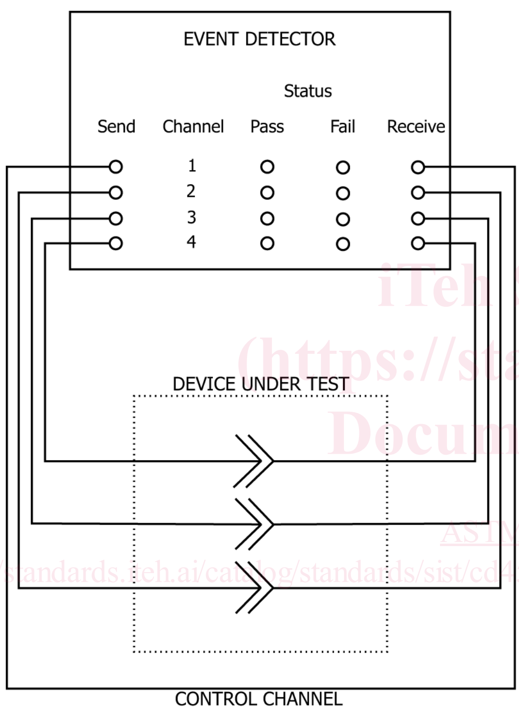

FIG. 3 Schematic Representation of Method Using Commercial Event Detector with Multiple Channel Capability

6.4 *Custom Circuitry*—In this method, the user assembles circuitry to measure the effects of the intermittences under the conditions of interest. For example, the circuitry may simulate the type of source and detector circuitry that the user plans to design into a system. Alternatively, the user may design circuitry based on specialized components to achieve capabilities different from those found in commercial instruments. An example of custom circuitry was described by Abbott and Schreiber.[6]

6.4.1 Fig. 2 shows a schematic representation of an example of how this method may be implemented. The source and detector incorporate the specific devices, technology, driver circuits, amplifiers, etc., that are of interest in the intended application of the connection or switch under test. The control and monitoring instrumentation monitors the performance of the connecting circuit by a suitable method such as comparing the signal received against a standard.

6.5 *Commercial Event Detector*—In this method, a commercial instrument that detects high resistance events is wired to monitor one or more electrical contacts under evaluation. Test Method B878 gives detailed instructions for implementing a specific version of this method. Certain instruments allow monitoring of several electrical contacts independently and simultaneously. Typically, the instrument has a pair of terminals for each channel to be monitored: a transmit terminal and a receive terminal. Each contact to be evaluated is wired into a cable that runs from the transmit terminal, through the test contact, to the receive terminal. Carefully follow all instructions and recommendations of the instrument manufacturer in making these connections.

6.5.1 The resistance change and the event duration required to trigger the event detector should be set according to the instructions of the instrument manufacturer. These levels should be selected based on the requirements of the system in which the contacts are intended to be used.

6.5.2 It is good practice to conduct a control experiment using similar wiring without the test contact in the circuit. In the case where the monitoring instruments have multiple channels available, wiring one or more of the channels as an experimental control is recommended. This control channel(s) should be wired with cables that are of the same types and lengths as those used for the test channels. The routing of the cable for the control channel(s) should follow the routing of the test channels as nearly as feasible.

6.5.3 If events are detected in a control channel, interference is suspected. Events in the control channel invalidate the associated test.

6.5.4 After the contact(s) under test are wired to the instrument, monitoring may begin. Typically, monitoring continues for a fixed time and the number of events is recorded. If the contacts are stressed, for example, through thermal cycles or mechanical disturbance, it is appropriate to conduct a control experiment where the same contacts are monitored for the same length of time under the same measurement conditions but without the imposed external stress.

6.5.5 Fig. 3 shows a schematic representation of an example of how this method may be implemented. In the instrument illustrated, each channel has a "send" and "receive" terminal. A connection or switch in the device under test is wired into a cable connecting the send and receive terminals for each channel. The instrument itself monitors the performance of each channel and indicates interruptions on a suitable display for each channel.

6.5.6 As mentioned in 6.1, test results should be reported in a format appropriate for the application and consistent with the format supplied by the test instrument. Typically, an event detector records if one or more events occurred during a fixed period of time, but may not tell how many events occurred or their magnitudes above the preset threshold. The report may list the total number of measurement periods and the number of

[6] Abbott, W. H. and Schreiber, K. L., "Dynamic Contact Resistance of Gold, Tin and Palladium Connector Interfaces During Low Amplitude Motion," Proceedings of Holm Conference, 1981, p. 211.