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14. ABSTRACT
This document has been developed to address electrical stress tests for use in the evaluation of weapon system fuzes and fuze components. The primary purpose of the test guideline is to standardize various credible stressing electrical stimuli to determine a level of electrical ruggedness of the safety system.

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Electrical Stress Test ESADS Complex Logic Device

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DEPARTMENT OF DEFENSE

JOINT ORDNANCE TEST PROCEDURE (JOTP)-053

ELECTRICAL STRESS TEST

DoD Fuze Engineering Standardization Working Group (FESWG)

Joint Ordnance Test Procedure (JOTP)-053
Electrical Stress Test (EST)

DOCUMENT COMPLETION DATE:

11 March 2015

TITLE AND SUBTITLE:

Joint Ordnance Test Procedure (JOTP)-053
Electrical Stress Test (EST)

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COORDINATION DRAFT REVIEWED BY:
This document was coordinated with the following Standardization Offices: AR, AS, EA, MC, MI, MR, OS, TE, AF-2, AF-70, and AF-99. In addition, the document was also coordinated with the Joint Weapon Safety Working Group and select Subject Matter Experts (SMEs).

ASSIST COORDINATION DATE: 20 November 2014

IMPLEMENTATION PLAN:

This Joint Ordnance Test Procedure (JOTP) shall serve as the U.S. Joint Services Electrical Stress Test for use in weapon system fuzes and fuze components.

This JOTP will be referenced in MIL-STD-331, DEPARTMENT OF DEFENSE TEST METHOD STANDARD, FUZE AND FUZE COMPONENTS, ENVIRONMENTAL AND PERFORMANCE TESTS FOR

APPROVING AUTHORITY:

JOSE GONZALEZ   3/11/15
Date

Director, Land Warfare & Munitions
Office of the Under Secretary of Defense for
Acquisition, Technology and Logistics

DEPARTMENT OF DEFENSE
JOINT ORDNANCE TEST PROCEDURE

*Joint Ordnance Test Procedure (JOTP)-053 11 March 2015
DTIC AD No.

ELECTRICAL STRESS TEST (EST)

Approved for public release; distribution unlimited.

1. SCOPE.

This is a laboratory test which sets forth a set of electrical stress tests for use in the evaluation of fuzes, electronic safe-arm devices (ESAD), ignition safety devices (ISD), arm fire devices (AFD), hand-emplaced ordnance (HEO) and their components. The goal of performing these tests is to highlight any unexpected reaction of the electronics used in safety related devices when exposed to various credible stressing electrical stimuli and to determine a level of electrical ruggedness of the safety system.

2. RELATED/REFERENCE DOCUMENTS.

a. MIL-STD-1316, Department of Defense Design Criteria Standard, Fuze Design, Safety Criteria for.

b. MIL-STD-1901, Department of Defense Design Criteria Standard, Munition Rocket and Missile Motor Ignition System Design, Safety Criteria for.

c. MIL-STD-1911, Department of Defense Design Criteria Standard, Hand-Emplaced Ordnance Design, Safety Criteria for.

d. MIL-STD-331, Department of Defense Test Method Standard, Fuze and Fuze Components, Environmental and Performance Tests for.

e. JOTP-052, Guidelines for the Qualification of Fuzes, Safe and Arm (S&A) Devices, and Ignition Safety Devices (ISD).

f. MIL-STD-882, Department of Defense Standard Practice, System Safety.

3. DESCRIPTION.

3.1 General.

a. This test evaluates the effect of various stressing electrical stimuli on applicable electronics. In an operating environment applicable devices may be subjected to irregular power sources and component failures that result in voltage spikes, varying rise times, and other faults that could degrade the safety system.

b. The test plan (see paragraph 3.5.1) will specify the test, levels and pass/fail criteria. Tests described herein whose intent is satisfied by system requirements and design validation testing may be met provided sufficient documentation is submitted to show that the intent of the requirement has been satisfied. Detailed test requirements may vary by system, and therefore submission of the test plan to the relevant System Safety Authority (SSA) is required to obtain concurrence. Table 1 provides the electrical stress test matrix.

TABLE 1. ELECTRICAL STRESS TEST MATRIX

TEST	FUZE OR TOP ASSEMBLY	REGULATOR	SAFETY CRITICAL COMPLEX LOGIC DEVICE
Under-Voltage/Over-Voltage	5.1.1	5.2.1	
Power Cycling	5.1.2		
Voltage Rise/Fall Time	5.1.3		
Power Dropout	5.1.4	5.2.2	
Brownout/Surge	5.1.5		
Floating I/O	5.1.6		5.3.1
Transient Loss of Ground	5.1.7	5.2.3	5.3.2
Shorting of I/O	5.1.8		5.3.3

3.2 Selection of Test Points.

Selection of test points shall be based on engineering judgment and system architecture. As a minimum, safety critical points shall be monitored. For example for ESADs, safety switches, the drive circuitry to the safety switches, and the voltage on the high voltage capacitor shall be monitored. In addition, where appropriate, the monitoring of all inputs and outputs of complex logic devices should be monitored, as well as the output of any voltage regulators. Where practical, the drive current through the high voltage convertor should be monitored.

3.3 Configuration of Test Item.

The test item shall be production representative hardware. Any energetic components or materials may be replaced with simulants that maintain the electrical configuration of the item. Any modifications or deviations shall be clearly documented and require prior SSA approval.

3.4 Number of Test Items.

A minimum of 3 units shall be tested. The test plan specifies how many items are to be tested.

3.5 Test Documentation.

Test plans, performance records, equipment, conditions, results, and analyses shall be documented in accordance with Section 4.8 of the General Requirements of MIL-STD-331. The following unique requirements also apply.

3.5.1 Test Plan.

The test plan shall include:

a. Identification of the Unit Under Test (UUT) as a part of an end item (e.g., system, munition, fuze, subsystem, assembly, circuit, individual component, etc.), including:

(1) The test points and supporting rationale for choices.

(2) The method of operation and monitoring of any unique equipment for operating the UUT.

(3) The controls to protect personnel and equipment.

b. A detailed description of the test including:

(1) Description of anything unique to the UUT.

(2) A statement of the specific test levels and test sequences and minimum acceptable performance for each test.

(3) List and description of test equipment to be used.

(4) A detailed timeline of the safety critical events and/or states of the UUT's nominal mission must be included to illustrate when transient electrical stress conditions will be applied.

3.5.2 Test Report.

The test report shall contain the test plan and all the data and the conclusions resulting from the tests delineated in the test plan. Any deviations or waivers on the original test plan or the procedures from this guideline shall be documented, along with the technical reasons for the changes.

4. CRITERIA FOR TEST EVALUATION.

4.1 UUT Condition.

No safety system failures shall have occurred during conduct of the test. Evidence of any other faults or anomalies shall be presented to the relevant SSA for assessment. At the completion of this test, the UUT shall be safe for transportation, storage, handling and use in accordance with paragraph 4.6.2.1.a of the general requirements to MIL-STD-331. No explosive component or its replacement simulants shall have inadvertently actuated. The UUT does not have to be operable unless required by the procuring activity.

4.2 Decision Basis.

Breakdown, inspection, other appropriate tests, and engineering judgment will form the basis for the decision that UUTs have passed or failed the test.

5. PROCEDURES.

The procedures listed herein are designed to electrically stress the safety features of the UUT. Where applicable, it is required to conduct a functional test of the UUT under nominal conditions to ensure that correct operation is validated before applying electrically stressing conditions.

5.1 ESAD, ISD, HEO, and FUZES Top Assembly Tests.

5.1.1 Test Procedure - Under Voltage/Over Voltage.

a. The units will be operated with the input voltage varied in 10% increments between the range of 50% below the lower specified voltage limit and 50% above the upper specified voltage limit. The voltage level and rationale for selection of the under and over voltage levels for each voltage source should be specified in the test plan.

(1) Monitor voltages in addition to the test points detailed in the test plan.

(2) For each source supply, the UUT shall be run through a normal operational cycle with the supply voltage set to 50% less than the minimum specified voltage of that supply.

(3) Repeat steps 1 and 2 incrementing the voltage by no more than 10% of the nominal supply voltage for each step. The under/over voltage shall, at a minimum, encompass -50% of the lower specified supply voltage to +50% of the upper specified supply voltage.

(4) For overvoltage, it is acceptable to conduct the maximum upper voltage limit test first, and eliminate the remaining overvoltage tests if that results in a pass.

(5) Repeat above steps for each unit.

b. Test Rationale. The objective of the test is to determine the effect of variations of source supply voltage on the operation of the safety critical electronics. Instruments shall be used to monitor the voltages in addition to the test points detailed in the test plan to verify that no safety system failures, faults, or anomalies occur during the conduct of this test.

5.1.2 Test Procedure - Power Cycling.

a. Perform the steps below:

(1) Monitor voltages and the test points detailed in the test plan.

(2) Allow the UUT to begin its functional mission.

(3) Remove one of the power sources for a period of 5 seconds. This removal of power shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(4) Repeat steps 2 and 3 with the power source off for periods of 10 and 50 seconds. For devices that are required to continue without power for longer periods of time, these time values shall be extended to exceed that time by 25%.

(5) Allow the UUT to begin its functional mission.

(6) Remove one of the power sources for a period of 5 seconds. This removal of power shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(7) Repeat steps 5 and 6 with the power source off for periods of 10 and 50 seconds. For devices that are required to continue without power for longer periods of time, these time values shall be extended to exceed that time by 25%.

(8) Repeat steps 1 through 7 for each source supply.

(9) For systems with more than 2 sources, including power on communication bus lines or test points, additional testing may be required.

(10) Repeat steps 1 through 9 for each unit.

b. Test Rationale. This test shall be conducted to determine the ability of the safety critical electronics to remain safe after power is cycled. The objective of this test is to verify that no safety system failures, faults, or anomalies occur due to cycling of power supplies.

5.1.3 Test Procedure - Voltage Rise/Fall Time.

a. Perform the steps below:

(1) Monitor the test points detailed in the test plan.

(2) Apply all power supplies with a ramp rate of one order of magnitude slower than nominal.

(3) Apply normal power to the UUT from all supplies.

(4) Allow all supplies to decay from nominal supply voltage to zero voltage over periods of 1 second and 100 seconds.

(5) For UUTs that have a system requirement for a commanded disarm function, apply normal power to the UUT from all supplies.

(6) Allow the UUT to arm normally.

(7) Allow all supplies to decay from nominal supply voltage to zero voltage over periods of 1 second and 100 seconds.

(8) Repeat steps 1 through 7 for each unit.

b. Test Rationale. This test shall be conducted to evaluate the electronics' behavior when exposed to varying rise and fall times of the power source. The objective of the rise time test is to highlight susceptibilities of the unit safety logic to the rise time of the power source. The objective of the fall time is to verify that the unit remains safe as supply voltages slowly bleed out of the system and various circuit components begin to shut down. Steps 5 through 7 are to ensure systems that may lose power while in an armed state do not inadvertently function. Monitor voltages in addition to the test points detailed in the test plan to verify that no safety system failures, faults, or anomalies occur during the conduct of this test.

5.1.4 Test Procedure - Power Drop-Out.

a. Perform the steps below:

(1) Monitor the test points detailed in the test plan.

(2) Allow the UUT to begin its functional mission.

(3) Apply 3 consecutive cycles of a 50 ms drop-out condition at 50% duty cycle to one of the power sources. If the program has a specified requirement for susceptibility to a voltage drop-out, that time shall be used in lieu of 50 ms. This drop-out of power shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(4) Allow the UUT to begin its functional mission.

(5) Apply 3 consecutive cycles of a 50 ms drop-out condition at 50% duty cycle to one of the power sources. If the program has a specified requirement for susceptibility to a voltage drop-out, that time shall be used in lieu of 50 ms. This drop-out of power shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(6) Repeat steps 2 through 5 for each voltage source.

(7) Repeat steps 1 through 6 for the remaining UUTs.

b. Test Rationale. This test shall be conducted to determine the ability of the safety critical electronics to remain safe or continue normal operation during a transient power loss. The units will be subjected to a 3-cycle drop-out of the each power source at the times specified in the test plan. Monitor the test points detailed in the test plan to verify that no safety system failures, faults, or anomalies occur during the conduct of this test.

5.1.5 Test Procedure - Brownout/Surge.

a. Perform the steps below:

(1) Monitor voltages and the test points detailed in the test plan.

(2) Allow the UUT to begin its functional mission. Apply a 50 ms brownout condition of 20% less than the minimum specified supply voltage on one of the source supplies. This brownout condition shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(3) Allow the UUT to begin its functional mission.

(4) Apply a 50 ms brownout condition of 20% less than the minimum specified supply voltage on one of the source supplies. This brownout condition shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(5) Repeat steps 2 through 4 for the remaining source supplies.

(6) Allow the UUT to begin its functional mission.

(7) Apply a 50 ms surge condition of 20% greater than the maximum specified supply voltage on one of the source supplies. This surge condition shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(8) Allow the UUT to begin its functional mission.

(9) Apply a 50 ms surge condition of 20% greater than the maximum specified supply voltage on one of the source supplies. This surge condition shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(10) Repeat steps 6 through 9 for the remaining source supplies.

(11) Repeat steps 1 through 10 for each of the remaining UUTs.

b. Test Rationale. This test shall be conducted on electronics to evaluate their safety during and after exposure to various intermittent stresses. The objective of this test is to determine the effect of intermittent stresses on the safety features of the unit. The units will be subjected to a 50 ms brownout/surge of all power sources at the times specified in the test plan. It is important to monitor the voltages in addition to the test points detailed in the test plan to verify that no safety system failures, faults, or anomalies occur during the conduct of this test.

5.1.6 Test Procedure - Floating Input / Output (I/O).

a. Perform the steps below:

(1) Monitor the test points detailed in the test plan.

(2) Remove one of the UUT's electrical I/O connections allowing it to float prior to applying power.

(3) Power up and allow the UUT to perform its functional mission.

(4) Repeat steps 2 through 3 for each remaining I/O with the exception of power.

(5) Allow the UUT to begin its functional mission.

(6) Remove one of the UUT's electrical I/O connections allowing it to float. This floating condition shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(7) Repeat steps 5 through 6 for each remaining I/O with the exception of power (removing the ground I/O should be tested).

(8) Allow the UUT to begin its functional mission.

(9) Remove one of the UUT's electrical I/O connections allowing it to float. This floating condition shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(10) Repeat steps 8 through 9 for each remaining I/O with the exception of power.

(11) Repeat steps 1 through 10 for the remaining UUTs.

b. Test Rationale. The objective of this test is to verify that the electronics will not respond in an unsafe manner if the I/O pins are floating including grounds. A floating pin analysis shall be conducted for each pin in the connectors of the device under test. This analysis shall address floating pins occurring both, prior to, and after, application of power(s), and at various stages in the arming cycle. Testing shall be conducted for any case which cannot be determined via analysis to verify that no safety system failures, faults, or anomalies occur.

5.1.7 Test Procedure - Transient Loss of Ground.

a. Perform the steps below:

(1) Monitor the test points detailed in the test plan.

(2) Allow the UUT to begin its functional mission.

(3) Apply 3 consecutive cycles of a 50 ms loss of ground condition at 50% duty cycle to one of the ground sources. If the program has a specified requirement for susceptibility to a ground drop-out, that time shall be used in lieu of 50 ms. This drop-out of ground shall occur

before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(4) Allow the UUT to begin its functional mission.

(5) Apply 3 consecutive cycles of a 50 ms loss of ground condition at 50% duty cycle to one of the ground sources. If the program has a specified requirement for susceptibility to a ground drop-out, that time shall be used in lieu of 50 ms. This drop-out of ground shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(6) Repeat steps 2 through 5 for each ground source.

(7) Repeat steps 1 through 6 for the remaining UUTs.

b. Test Rationale. The objective of the loss of ground test is to determine if any safety system failures, faults, or anomalies occur as a result of the ground connections being removed from the unit prior to arming.

5.1.8 Test Procedure - Shorting of I/O.

a. An analysis with the equivalent rigor of a “bent pin” analysis shall be conducted giving consideration to the pins in the input connector. This analysis shall address shorts occurring both prior to, and after application of power, and after the enabling of the first safety feature. Testing shall be conducted for any case which cannot be determined via analysis.

(1) Monitor the test points detailed in the test plan.

(2) Short two adjacent pins within the UUT’s electrical I/O connector prior to applying power.

(3) Power up and allow the UUT to perform its functional mission.

(4) Repeat steps 2 through 3 for each adjacent I/O combination.

(5) Allow the UUT to begin its functional mission.

(6) Short two adjacent pins within the UUT’s electrical I/O connector after applying power. This shorted condition shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(7) Repeat steps 5 through 6 for each adjacent I/O combination.

(8) Allow the UUT to begin its functional mission.

(9) Short two adjacent pins within the UUT’s electrical I/O connector after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(10) Repeat steps 8 through 9 for each adjacent I/O combination.

(11) Repeat steps 1 through 10 for the remaining UUTs.

b. Test Rationale. The objective of this test is to verify that no safety system failures, faults, or anomalies occur as of a result of I/O pins being shorted at various points during the mission. This is intended to primarily be proven through analysis with testing to be conducted on any case that cannot be analyzed.

5.2 Voltage Regulator Tests.

5.2.1 Test Procedure - Under Voltage/Over Voltage (Regulator).

a. The units will be operated with the regulator output voltage varied in 10% increments between the range of 50% below the lower specified voltage limit and 50% above the upper specified voltage limit. The voltage level and rationale for selection of the under and over voltage levels for each voltage source should be specified in the test plan.

(1) Monitor voltages in addition to the test points detailed in the test plan.

(2) For each voltage regulator, the UUT shall be run through a normal operational cycle with the voltage set to 50% less than the minimum specified voltage of that regulator.

(3) Repeat steps 1 and 2 incrementing the voltage by no more than 10% of the nominal regulator voltage for each step. The under/over voltage shall, at a minimum, encompass -50% of the lower specified voltage to +50% of the upper specified voltage.

(4) For overvoltage, it is acceptable to conduct the maximum upper voltage limit test first, and eliminate the remaining overvoltage tests if that results in a pass.

(5) Repeat above steps for each unit.

b. Test Rationale. The objective of the test is to determine the effect of variations of voltage at the output of each regulator (due to regulator malfunction or failure) on the operation of the safety critical electronics. Instruments shall be used to monitor the voltages in addition to the test points detailed in the test plan to verify that no safety system failures, faults, or anomalies occur during the conduct of this test.

5.2.2 Test Procedure - Power Drop-Out (Regulator).

a. Perform the steps below:

(1) Monitor the test points detailed in the test plan.

(2) Allow the UUT to begin its functional mission.

(3) Apply 3 consecutive cycles of a 50 ms drop-out condition at 50% duty cycle to the output of the regulator. If the program has a specified requirement for susceptibility to a voltage drop-out, that time shall be used in lieu of 50 ms. This drop-out of power shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(4) Allow the UUT to begin its functional mission.

(5) Apply 3 consecutive cycles of a 50 ms drop-out condition at 50% duty cycle to the output of the regulator. If the program has a specified requirement for susceptibility to a voltage drop-out, that time shall be used in lieu of 50 ms. This drop-out of power shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(6) Repeat steps 2 through 5 for each voltage regulator.

(7) Repeat steps 1 through 6 for the remaining UUTs.

b. Test Rationale. This test shall be conducted to determine the ability of the safety critical electronics to remain safe or continue normal operation during a transient power loss at the output of each regulator. The units will be subjected to a 3-cycle drop-out of each voltage regulator at the times specified in the test plan. Monitor the test points detailed in the test plan to verify that no safety system failures, faults, or anomalies occur during the conduct of this test.

5.2.3 Test Procedure - Transient Loss of Ground (Regulator).

a. Perform the steps below:

(1) Monitor the test points detailed in the test plan.

(2) Allow the UUT to begin its functional mission.

(3) Apply 3 consecutive cycles of a 50 ms loss of ground condition at 50% duty cycle to one of the regulator ground sources. If the program has a specified requirement for susceptibility to a ground drop-out, that time shall be used in lieu of 50 ms. This drop-out of ground shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(4) Allow the UUT to begin its functional mission.

(5) Apply 3 consecutive cycles of a 50 ms loss of ground condition at 50% duty cycle to one of the regulator ground sources. If the program has a specified requirement for susceptibility to a ground drop-out, that time shall be used in lieu of 50ms. This drop-out of ground shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(6) Repeat steps 2 through 5 for each regulator’s ground source.

(7) Repeat steps 1 through 6 for the remaining UUTs.

b. Test Rationale. The objective of the loss of ground test is to determine if any safety system failures, faults, or anomalies occur as a result of the ground connections being removed from the individual voltage regulators prior to arming. This test is only intended for systems with cascaded regulators that have separate ground references.

5.3 Safety Critical Complex Logic Device Tests.

5.3.1 Test Procedure - Floating I/O (Logic Device).

a. Perform the steps below:

(1) Monitor the test points detailed in the test plan.

(2) Remove one of the complex logic device's electrical I/O connections allowing it to float prior to applying power.

(3) Power up and allow the UUT to perform its functional mission.

(4) Repeat steps 2 through 3 for each remaining I/O with the exception of power.

(5) Allow the UUT to begin its functional mission.

(6) Remove one of the complex logic device's electrical I/O connections allowing it to float. This floating condition shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(7) Repeat steps 5 through 6 for each remaining I/O with the exception of power (removing the ground I/O should be tested).

(8) Allow the UUT to begin its functional mission.

(9) Remove one of the complex logic device's electrical I/O connections allowing it to float. This floating condition shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(10) Repeat steps 8 through 9 for each remaining I/O with the exception of power.

(11) Repeat steps 1 through 10 for each remaining complex logic device.

(12) Repeat steps 1 through 11 for the remaining UUTs.

b. Test Rationale. The objective of this test is to verify that the complex logic device will not respond in an unsafe manner if the I/O pins are floating, including grounds. A floating pin analysis shall be conducted for each pin of the complex logic device under test. This analysis shall address floating pins occurring both, prior to, and after, application of power(s), and at various stages in the arming cycle. Testing shall be conducted for any case which cannot be determined via analysis to verify that no safety system failures, faults, or anomalies occur.

5.3.2 Test Procedure - Transient Loss of Ground (Logic Device).

a. Perform the steps below:

(1) Monitor the test points detailed in the test plan.

(2) Allow the UUT to begin its functional mission.

(3) Apply 3 consecutive cycles of a 50 ms loss of ground condition at 50% duty cycle to all of the ground pins of the complex logic device. If the program has a specified requirement for susceptibility to a ground drop-out, that time shall be used in lieu of 50 ms. This drop-out of ground shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(4) Allow the UUT to begin its functional mission.

(5) Apply 3 consecutive cycles of a 50 ms loss of ground condition at 50% duty cycle to all of the ground pins of the complex logic device. If the program has a specified requirement for susceptibility to a ground drop-out, that time shall be used in lieu of 50 ms. This drop-out of ground shall occur after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(6) Repeat steps 2 through 5 for each complex logic device.

(7) Repeat steps 1 through 6 for the remaining UUTs.

b. Test Rationale. The objective of the loss of ground test is to determine if any safety system failures, faults, or anomalies occur as a result of the ground connections being intermittently removed from the complex logic device prior to arming.

5.3.3 Test Procedure - Shorting of I/O (Logic Device).

a. An analysis with the equivalent rigor of a “bent pin” analysis shall be conducted giving consideration to the adjacent pins of the complex logic device. This analysis shall address shorts occurring both prior to, and after application of power, and after the enabling of the first safety feature. Testing shall be conducted for any case which cannot be determined via analysis.

(1) Monitor the test points detailed in the test plan.

(2) Short two adjacent I/O pins of the complex logic device prior to applying power.

(3) Power up and allow the UUT to perform its functional mission.

(4) Repeat steps 2 through 3 for each adjacent I/O combination.

(5) Allow the UUT to begin its functional mission.

(6) Short two adjacent I/O pins of the complex logic device after applying power. This shorted condition shall occur before the enabling of any safety features (as shown on the UUT event timeline within the test plan).

(7) Repeat steps 5 through 6 for each adjacent I/O combination.

(8) Allow the UUT to begin its functional mission.

(9) Short two adjacent I/O pins of the complex logic device after the enabling of the first safety feature (as shown on the UUT event timeline within the test plan).

(10) Repeat steps 8 through 9 for each adjacent I/O combination.

(11) Repeat steps 1 through 10 for each complex logic device.

(12) Repeat steps 1 through 11 for the remaining UUTs.

b. Test Rationale. The objective of this test is to verify that no safety system failures, faults, or anomalies occur as of a result of I/O pins on the complex logic devices being shorted at various points during the mission. This is intended to primarily be proven through analysis with testing to be conducted on any case that cannot be analyzed.

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