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**MIL-HDBK-704-7
9 April 2004**

**DEPARTMENT OF DEFENSE
HANDBOOK**

**GUIDANCE FOR
TEST PROCEDURES FOR DEMONSTRATION OF
UTILIZATION EQUIPMENT COMPLIANCE TO
AIRCRAFT ELECTRICAL POWER CHARACTERISTICS
270 VDC
(PART 7 OF 8 PARTS)**



**This Handbook is for guidance only.
Do not cite this document as a requirement.**

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FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.
2. This handbook provides guidance on test procedures for demonstration of 270 VDC utilization equipment to determine compliance with the applicable edition of MIL-STD-704.
3. MIL-HDBK-704-7 is Part 7 in a series of 8 Parts. Part 7 describes the test methods and procedures to demonstrate that 270 VDC utilization equipment is compatible with the electric power characteristics of MIL-STD-704. These series of handbooks and MIL-STD-704 are companion documents.
4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, Code 4.1.4, Highway 547, Lakehurst, NJ 08733-5100 or email to thomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil/.

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1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that 270 VDC utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704. This handbook is for guidance only and cannot be cited as a requirement.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-704

DoD Interface Standard for Aircraft Electric Power Characteristics

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch> or www.dodssp.daps.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

3. DEFINITIONS

3.1 Acronyms and definitions. The acronyms and definitions of MIL-STD-704 are applicable to this handbook.

4. TEST METHODS INFORMATION

4.1 Demonstration of compatibility. This section contains the test methods which will ensure that 270 VDC utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704, by testing the Unit Under Test (UUT) in accordance with the test procedures as described in test methods HDC101 through HDC602.

4.1.1 Recording performance. In table HDC-I, record the edition(s) of MIL-STD-704 that defined the aircraft electric power characteristics used for testing and the performance of the UUT for each of the test methods.

4.2 Calibration of test equipment. Test equipment and accessories required for measurement in accordance with this handbook should be calibrated in accordance with an approved calibration program traceable to the National Institute for Standards and Technology.

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The serial numbers, model, and calibration date of all test equipment should be included with the test data.

4.3 Test methods. The test methods listed in table HDC-I are provided in section 5 of this handbook.

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**TABLE HDC-I. Summary of 270 VDC utilization equipment
MIL-STD-704 compliance tests.**

UUT:			
Compliance to MIL-STD-704 Edition(s):			
Test Dates:			
Test Method	Description	Performance (Pass/Fail)	Comments
Normal, Aircraft Electrical Operation			
HDC101	Load Measurements		
HDC102	Steady State Limits for Voltage		
HDC103	Voltage Distortion Spectrum		
HDC104	Total Ripple		
HDC105	Normal Voltage Transients		
Transfer, Aircraft Electrical Operation			
HDC201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
HDC301	Abnormal Steady State Limits for Voltage		
HDC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
Emergency, Aircraft Electrical Operation			
HDC401	Emergency Limits for Voltage		
Starting, Aircraft Electrical Operation			
HDC501	Starting Voltage Transients		
Power Failure, Aircraft Electrical Operation			
HDC601	Power Failure		
HDC602	Polarity Reversal		

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5. TEST METHODS

METHOD HDC101
Load Measurements

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Load Measurements

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment meets the load limits, inrush limits, current distortion limits and current spectrum limits that may be required by the utilization equipment performance specification document.

2. Validation criteria. If required by the utilization equipment performance specification document, the utilization equipment is considered to have passed if the utilization equipment is within the load limits, inrush current limits, the current distortion limit, and the current spectrum limits specified in the utilization equipment performance specification document. As noted in table HDC101-I, the load limits, inrush current limits, the current distortion limit, and the current spectrum limits are not specified in MIL-STD-704 versions A through F. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: The utilization equipment performance specification document should include requirements that reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. Load, inrush currents, current distortion and current spectrum limits may be imposed to minimize undesirable effects to the electrical power characteristics. These limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

TABLE HDC101-I. MIL-STD-704 limits for load, inrush current, current distortion factor, and current spectrum for 270 volt DC utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Inrush Current	N/A ^{1/}					
Load (VA)	N/A ^{1/}					
Current Distortion Factor	N/A ^{1/}					
Current Spectrum	N/A ^{1/}					

1/. Limits for load, inrush current, current distortion factor, and current spectrum must be defined in the utilization equipment performance specification document and are unique to each equipment.

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3. Apparatus. The test equipment should be as follows:

- a. Adjustable DC power supply
- b. True RMS voltmeter
- c. Power meter
- d. Spectrum analyzer
- e. Distortion meter
- f. Current transformer
- g. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC101-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT. The current measurement must be taken from the 270 volt DC conductor.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC101-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. If the utilization equipment performance specification document:

- a. Imposes inrush current limits, close the circuit breaker, energizing the UUT. Record the inrush current in the data sheet shown in table HDC101-II and compare with the limits of utilization equipment performance specification document. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat for each mode of operation of the UUT.
- b. Imposes load limits, energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the load (Volt-Amps) and the voltage in the data sheet shown in table HDC101-II and compare with the limits of utilization equipment performance specification document. Repeat for each mode of operation of the UUT.
- c. Imposes current distortion limits, energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the current distortion factor in the data sheet shown in table HDC101-II and compare with the limits of utilization equipment performance specification document. Repeat for each mode of operation of the UUT.
- d. Imposes current spectrum limits, energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment

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performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the current spectrum (current amplitude vs. frequency) in the data sheet shown in table HDC101-II and compare with the limits of utilization equipment performance specification document. Repeat for each mode of operation of the UUT.

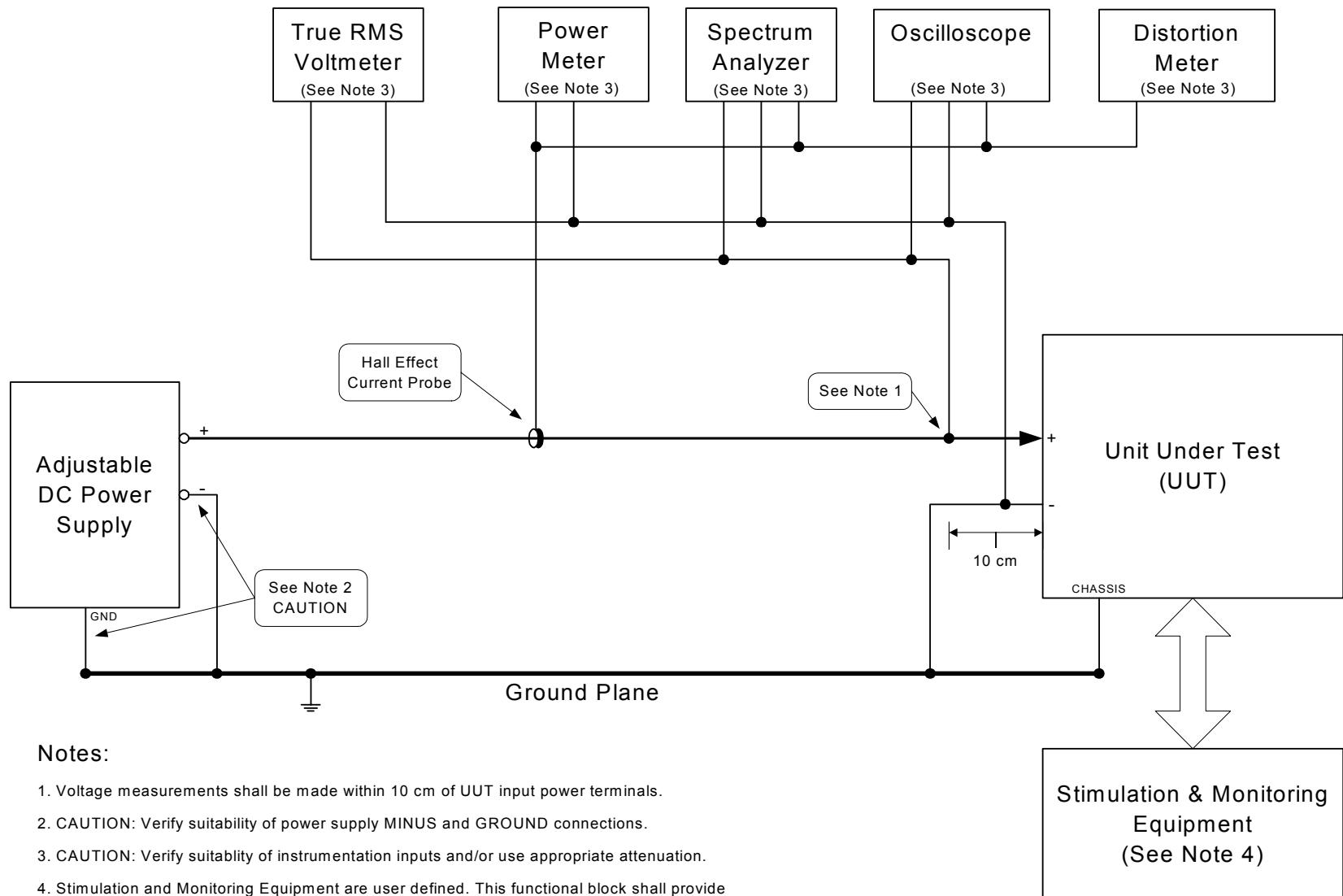
FIGURE HDC101-1. Normal operation - load and current distortion measurement.

TABLE HDC101-II. Sample data sheet for HDC101 load measurements.

Parameter	Measurement	Unit	Performance Pass/Fail
Inrush Current		Amps	
Voltage		VDC	N/A
Load (VA)		VA	
Total Current Distortion		% Current Distortion	
Current Spectrum	Attach Spectrum Plot	Amplitude vs. Frequency	

METHOD HDC102
Steady State Limits for Voltage

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Steady State Limits for Voltage

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: If the utilization has exactly the same full performance requirements for abnormal steady state limits and emergency steady state limits as required for the normal aircraft electrical conditions, then performance of test methods HDC301 and HDC401 will constitute performance of HDC102.

TABLE HDC102-I. MIL-STD-704 normal limits for steady state voltage.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	N/A	250 VDC				
Voltage NHSS	N/A	280 VDC				

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3. Apparatus. The test equipment should be as follows:

- a. Adjustable DC power supply
- b. True RMS voltmeter

4. Test setup. Configure the test setup as shown in figure HDC102-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through C noted in table HDC102-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table HDC102-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC102-II. Test conditions for steady state limits of DC voltage.

Test Condition	Voltage
A	Nominal Voltage
B	NLSS Voltage
C	NHSS Voltage

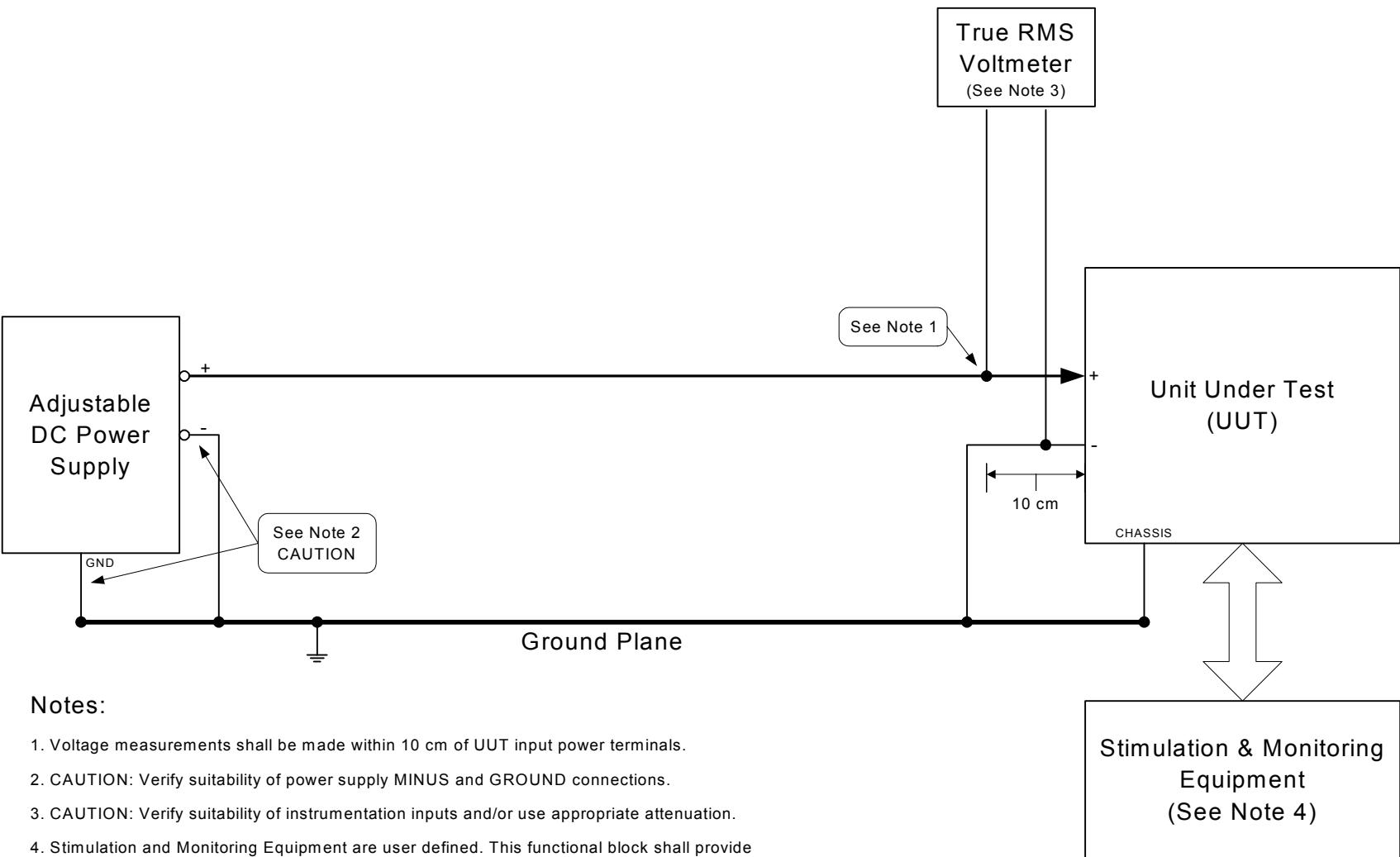
FIGURE HDC102-1. Normal operation - steady state limits for voltage.

TABLE HDC102-III. Sample data sheet for HDC102 steady state limits for voltage.

Test Condition	Parameters					Performance
	Voltage		Frequency		Time Duration at Condition	
A		V _{dc}		Hz		min
B		V _{dc}		Hz		min
C		V _{dc}		Hz		min

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METHOD HDC103
Voltage Distortion Spectrum

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Voltage Distortion Spectrum

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table HDC103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 50 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems equipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method HDC103 of this handbook does not relinquish the requirement to perform test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method HDC103 of this handbook.

TABLE HDC103-I. MIL-STD-704 limits for voltage distortion spectrum.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	N/A	figure 6 MIL-STD-704B	figure 9 MIL-STD-704C	figure 9 MIL-STD-704D	figure 13 MIL-STD-704E	figure 18 MIL-STD-704F

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3. Apparatus. The test equipment should be as follows:

- a. Programmable DC power supply
- b. Variable frequency power source
- c. Coupling transformer
- d. True RMS voltmeter
- e. Spectrum analyzer
- f. (2) Inductors, 50 μ H
- g. Capacitor, 10 μ F
- h. Resistor, calibrated load

4. Test setup (10 Hz and 25 Hz). Configure the test setup as shown in figure HDC103-1 voltage distortion spectrum setup for 10 Hz and 25 Hz. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test (10 Hz and 25 Hz). With the programmable DC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC103-1. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For test condition A noted in table HDC103-II, set the DC programmable power supply to vary the amplitude of the DC voltage at a 10 Hz rate at an average DC voltage of 270 VDC to create a voltage distortion (ripple) for test condition A of the appropriate edition of MIL-STD-704. Remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be, not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition, record voltage, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC103-III. Repeat for test condition B by setting the DC programmable power supply to vary the amplitude of the DC voltage at a 25 Hz rate at an average DC voltage of 270 Vdc to create a voltage distortion (ripple) specified for test condition B of the appropriate edition of MIL-STD-704. Repeat for each mode of operation of the UUT.

6. Test setup (50 Hz to 10 kHz). Configure the test setup as shown in figure HDC103-2. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

6.1 Calibration (50 Hz to 10 kHz). Install a calibrated resistive load in the test setup shown in figure HDC103-2 in place of the UUT. The calibrated resistive load must be sized to draw the same current as the UUT. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 270 VDC. Set the variable frequency power source to output a sine wave and adjust the frequency and amplitude so that the voltage distortion

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measured at the input to the calibrated resistive load conforms to each test condition C through K as noted in table HDC103-II of the applicable edition(s) of MIL-STD-704. Record the settings of the variable frequency power source for each test condition.

7. Compliance test (50 Hz to 10 kHz). With the programmable DC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC103-2. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

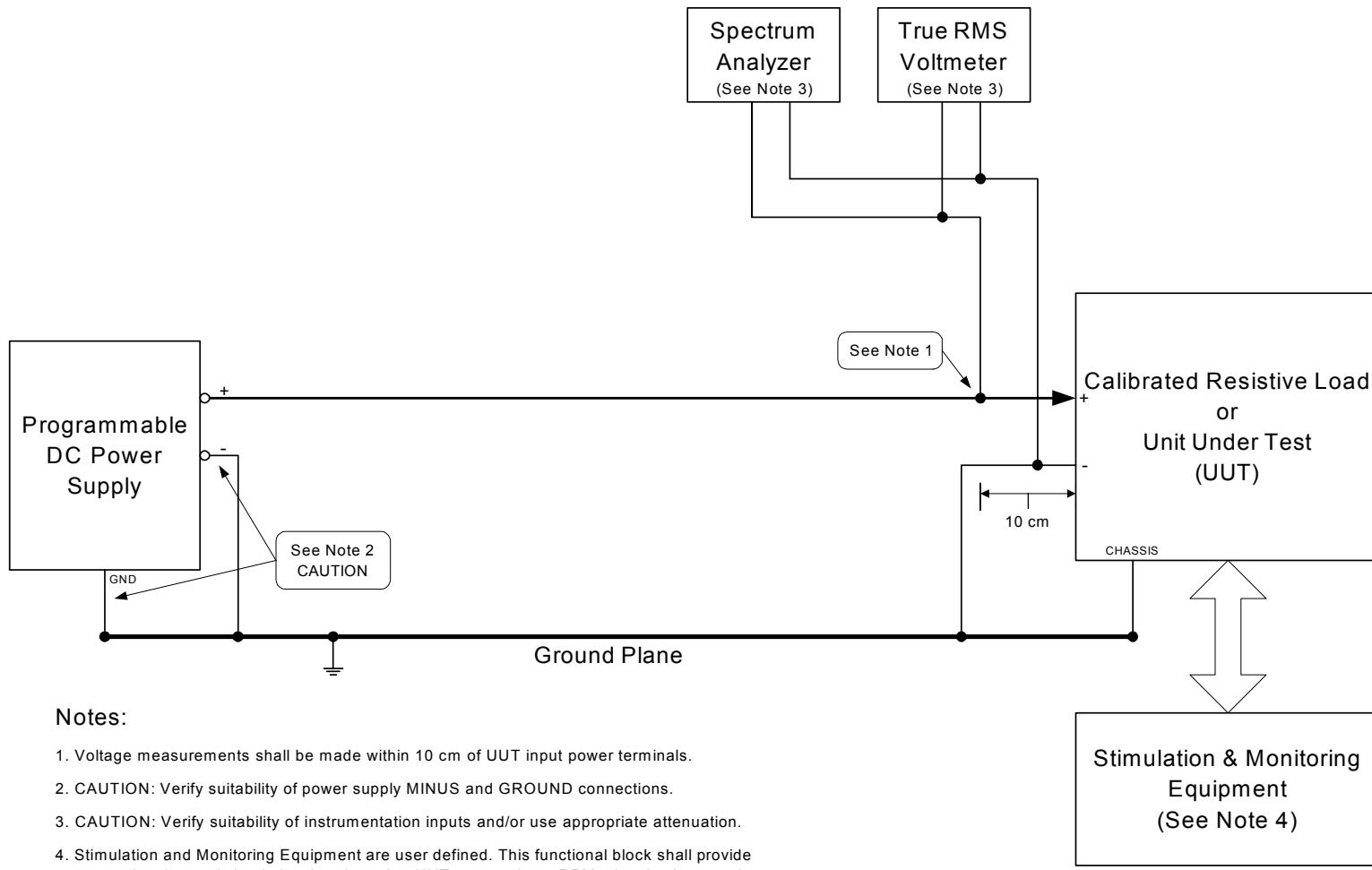
Set the variable frequency power source to the settings recorded for test condition C of the calibration procedure. For each test condition, remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be, not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. After each test condition, monitor the voltage distortion frequency and amplitude while slowly increasing the variable frequency power source frequency and adjusting the amplitude until the next test condition is reached. Do not exceed the voltage distortion spectrum limits. Repeat for each test condition C through K noted in table HDC103-II. For each test condition, record voltage, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC103-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, turn the programmable DC power supply off and remove the coupling transformer from the circuit. Turn on the programmable DC power supply. Adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

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TABLE HDC103-II. Test conditions for voltage distortion spectrum.

Test Condition	Frequency of Voltage Distortion	MIL-STD-704B, C, & D Amplitude of Voltage Distortion Voltage rms	MIL-STD-704E & F Amplitude of Voltage Distortion Voltage rms
A	10 Hz	0.600 Vrms	0.316 Vrms
B	25 Hz	0.893 Vrms	0.500 Vrms
C	50 Hz	1.197 Vrms	0.562 Vrms
D	60 Hz	1.307 Vrms	0.775 Vrms
E	250 Hz	2.430 Vrms	1.581 Vrms
F	1 kHz	4.439 Vrms	3.162 Vrms
G	1.7 kHz	5.591 Vrms	3.162 Vrms
H	2 kHz	6.000 Vrms	3.162 Vrms
I	5 kHz	1.844 Vrms	3.162 Vrms
J	6.5 kHz	1.315 Vrms	2.433 Vrms
K	10 kHz	0.755 Vrms	1.581 Vrms

FIGURE HDC103-1. Normal operation - voltage distortion spectrum (10 Hz and 25 Hz).

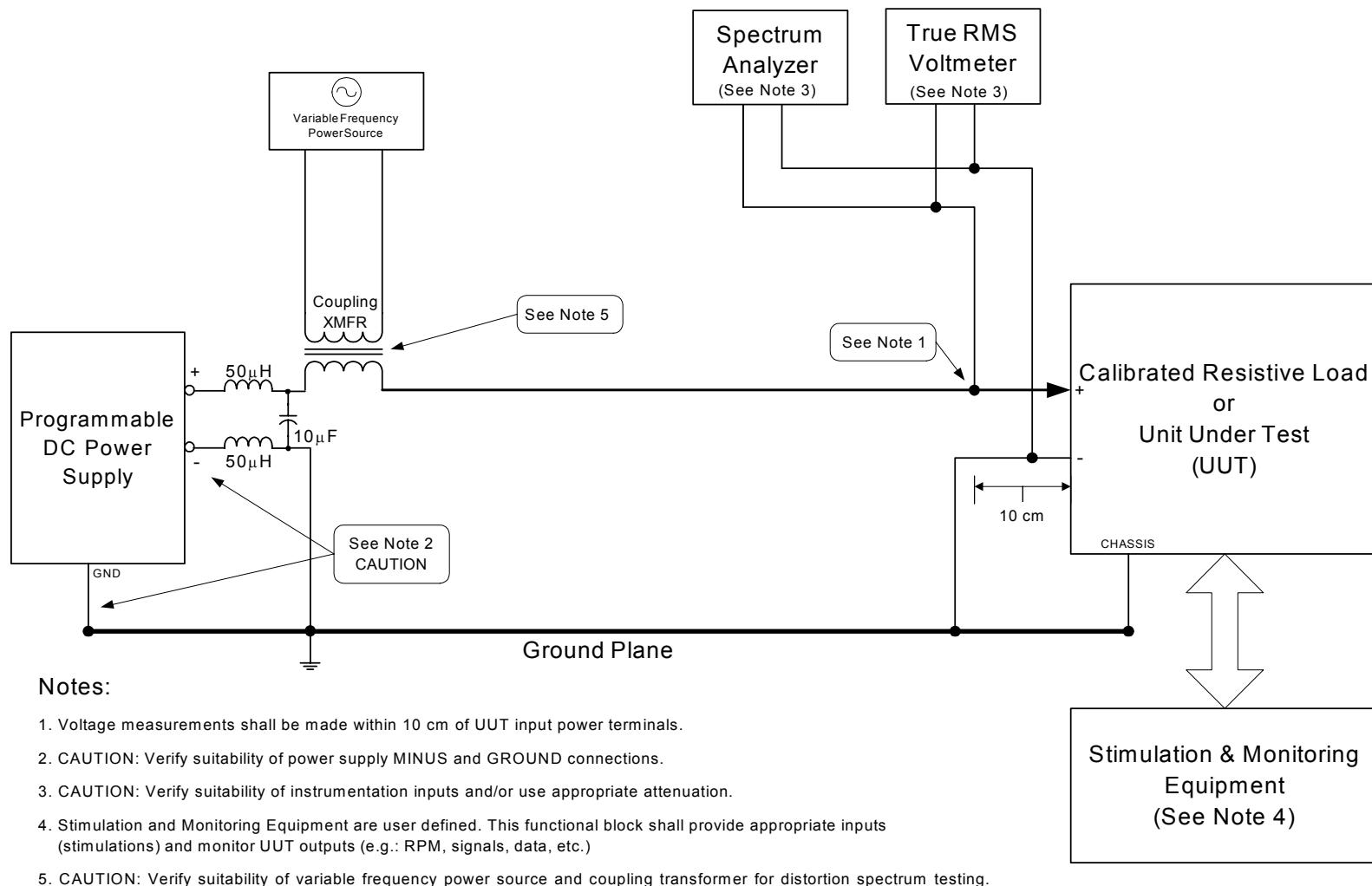
FIGURE HDC103-2. Normal operation - voltage distortion spectrum (50 Hz to 10 kHz).

TABLE HDC103-III. Sample data sheet for HDC103 voltage distortion spectrum.

Test Condition	Parameters					Performance
	Voltage	Frequency of Voltage Distortion	Amplitude of Voltage Distortion	Time Duration at Condition		
A	V _{DC}	Hz	V _{rms}		min	
B	V _{DC}	Hz	V _{rms}		min	
C	V _{DC}	Hz	V _{rms}		min	
D	V _{DC}	Hz	V _{rms}		min	
E	V _{DC}	Hz	V _{rms}		min	
F	V _{DC}	kHz	V _{rms}		min	
G	V _{DC}	kHz	V _{rms}		min	
H	V _{DC}	kHz	V _{rms}		min	
I	V _{DC}	kHz	V _{rms}		min	
J	V _{DC}	kHz	V _{rms}		min	
K	V _{DC}	kHz	V _{rms}		min	

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**METHOD HDC104
Total Ripple**

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Total Ripple

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to voltage having a ripple as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to ripple as specified by the applicable edition(s) of MIL-STD-704 and as noted in table HDC104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a distorted voltage waveform and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC104-I. MIL-STD-704 limits for ripple DC voltage distortion.

Limit	704A	704B	704C	704D	704E	704F
Voltage Ripple	N/A	6 Volts Peak to Average And figure 6 MIL-STD-704B	6 Volts Peak to Average And figure 9 MIL-STD-704C	6 Volts Peak to Average And figure 9 MIL-STD-704D	6 Volts Peak to Average And figure 13 MIL-STD-704E	6 Volts Peak to Average And figure 18 MIL-STD-704F

3. Apparatus. The test should be as follows.

- a. Programmable DC power supply
- b. True RMS voltmeter
- c. Spectrum analyzer
- d. Distortion meter

4. Test setup. Configure the test setup as shown in figure HDC104-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

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4.1 Calibration. Install a resistive load in the test setup shown in figure HDC104-1 in place of the UUT. The resistive load must be sized to draw the same current as the UUT. Set the programmable power supply to produce a DC voltage waveform having ripple as noted for test condition A in table HDC104-II for the applicable edition(s) of MIL-STD-704. The ripple should include all the frequencies components with amplitudes noted for test condition A. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Confirm that the programmable power supply is producing a voltage waveform having ripple content listed in table HDC104-II. Record the settings of the programmable power supply. Repeat the process for test condition B in table HDC104-II.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC104-1. Set the programmable power supply to the settings recorded during the calibration procedure for condition A. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Measure the ripple frequencies spectrum and record the DC ripple frequency components and amplitudes. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Remain for a length of time that confirms the utilization equipment can continuously operate with the ripple voltage, and should be not less than thirty (30) minutes. Repeat for test condition B noted in table HDC104-II. For each test condition, record the voltage, distortion factor, frequency spectrum of ripple, time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC104-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce a DC waveform without ripple. Adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

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TABLE HDC104-II. Ripple frequency and amplitude.

Test Condition	Ripple Frequency Components	MIL-STD-704B, C, D, E, & F Vrms
A	1200 Hz	3.16 Vrms
	2400 Hz	0.96 Vrms
	3600 Hz	1.56 Vrms
	4800 Hz	0.48 Vrms
	6000 Hz	0.78 Vrms
	7200 Hz	0.24 Vrms
	8400 Hz	0.36 Vrms
<hr/>		
B	2400 Hz	3.16 Vrms
	4800 Hz	0.96 Vrms
	7200 Hz	1.56 Vrms
	9600 Hz	0.48 Vrms
	12000 Hz	0.78 Vrms
	14400 Hz	0.24 Vrms
	16800 Hz	0.36 Vrms

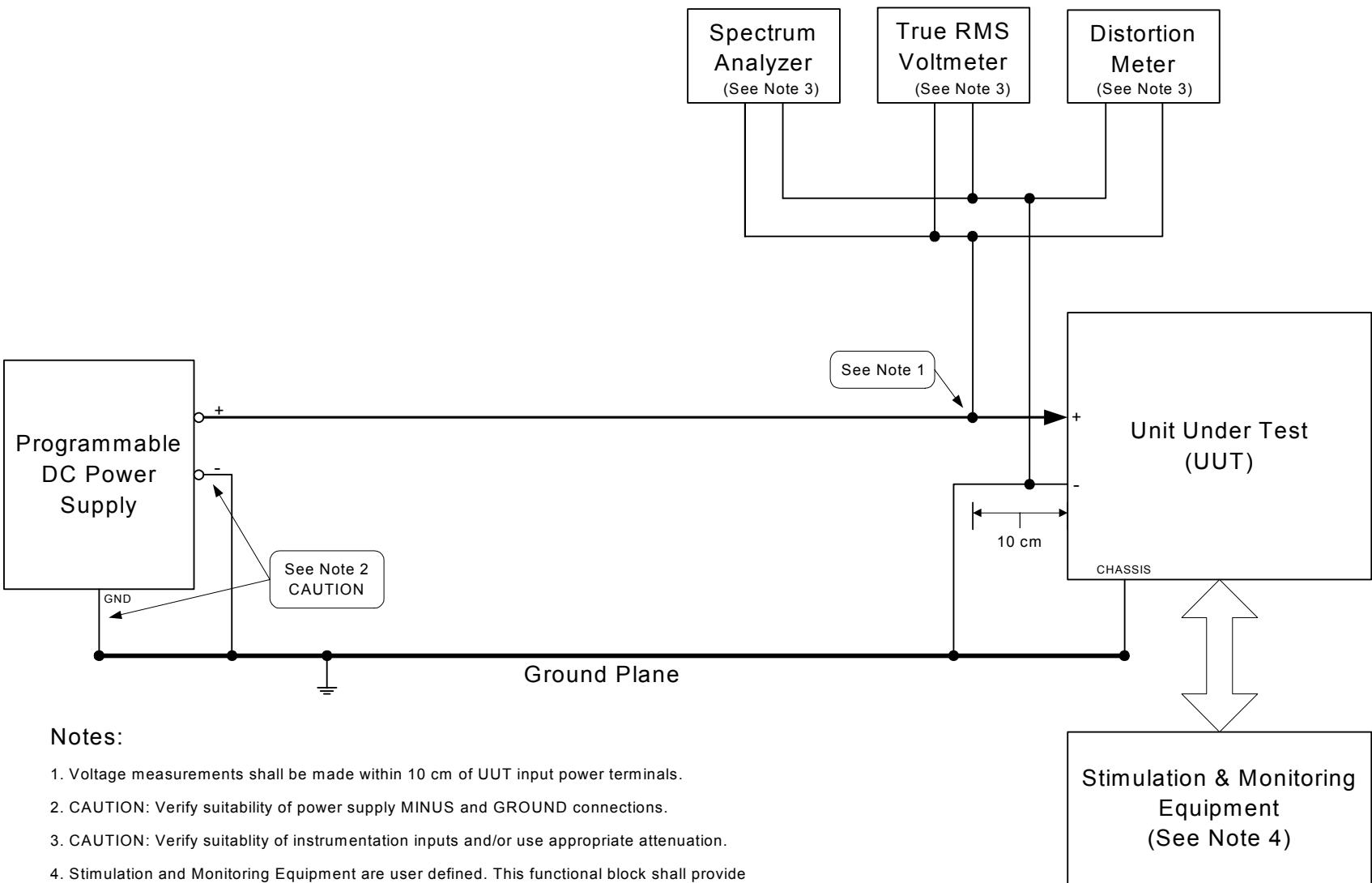
FIGURE HDC104-1. Normal operation - total ripple.

TABLE HDC104-III. Sample data sheet for HDC104 total ripple.

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METHOD HDC105
Normal Voltage Transients

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Normal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC105-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC105-I. MIL-STD-704 limits for normal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	N/A	figure 9 MIL-STD-704B	figure 11 MIL-STD-704C	figure 11 MIL-STD-704D	figure 10 MIL-STD-704E	figure 16 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

- a. Programmable DC power supply
- b. True RMS voltmeter
- c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC105-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC105-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

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5.1 Compliance test for MIL-STD-704B, C, and D. The UUT must be subjected to the voltage transients for each test condition A through V noted in table HDC105-II. The voltage must increase or decrease from steady state voltage as noted in table HDC105-II to the voltage transient level within 1 millisecond. The voltage must remain at the voltage transient level for the duration noted in table HDC105-II. The voltage must return to steady state over the time duration noted in table HDC105-II. For test condition E and J, three over-voltage transients of 475 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition O and T, three under-voltage transients of 125 Vdc for 10 millisecond are performed, separated by 0.5 second. For test condition U and V, an under-voltage transient of 125 Vdc for 10 milliseconds is immediately followed by an over-voltage transient of 475 Vdc for 10 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table HDC105-IV. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704B, C, and D test compliance perform the repetitive voltage transient test described in 5.3.

5.2 Compliance test for MIL-STD-704E & F. The UUT must be subjected to the voltage transients for each test condition AA through RR noted in table HDC105-III. The voltage must increase or decrease from steady state voltage as noted in table HDC105-III to the voltage transient level within 1 millisecond. The voltage must remain at the voltage transient level for the duration noted in table HDC105-III. The voltage must return to steady state over the time duration noted in table HDC105-III. For test condition EE and JJ, three over-voltage transients of 330 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition MM and PP, three under-voltage transients of 200 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition QQ and RR, an under-voltage transient of 200 Vdc for 10 milliseconds is immediately followed by an overvoltage transient of 330 Vdc for 20 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table HDC105-V. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704E, & F test compliance perform the repetitive voltage transient test described in 5.3.

5.3 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 270 Vdc to 215 Vdc in 2.5 msec, then

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increases to 315 Vdc over 30 msec, then decreases to 270 Vdc over 2.5 msec. The voltage transient is repeated every 0.5 second, see figure HDC105-2. The UUT must be subjected to the repetitive voltage transient for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, voltage transient (oscilloscope trace), time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC105-V. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

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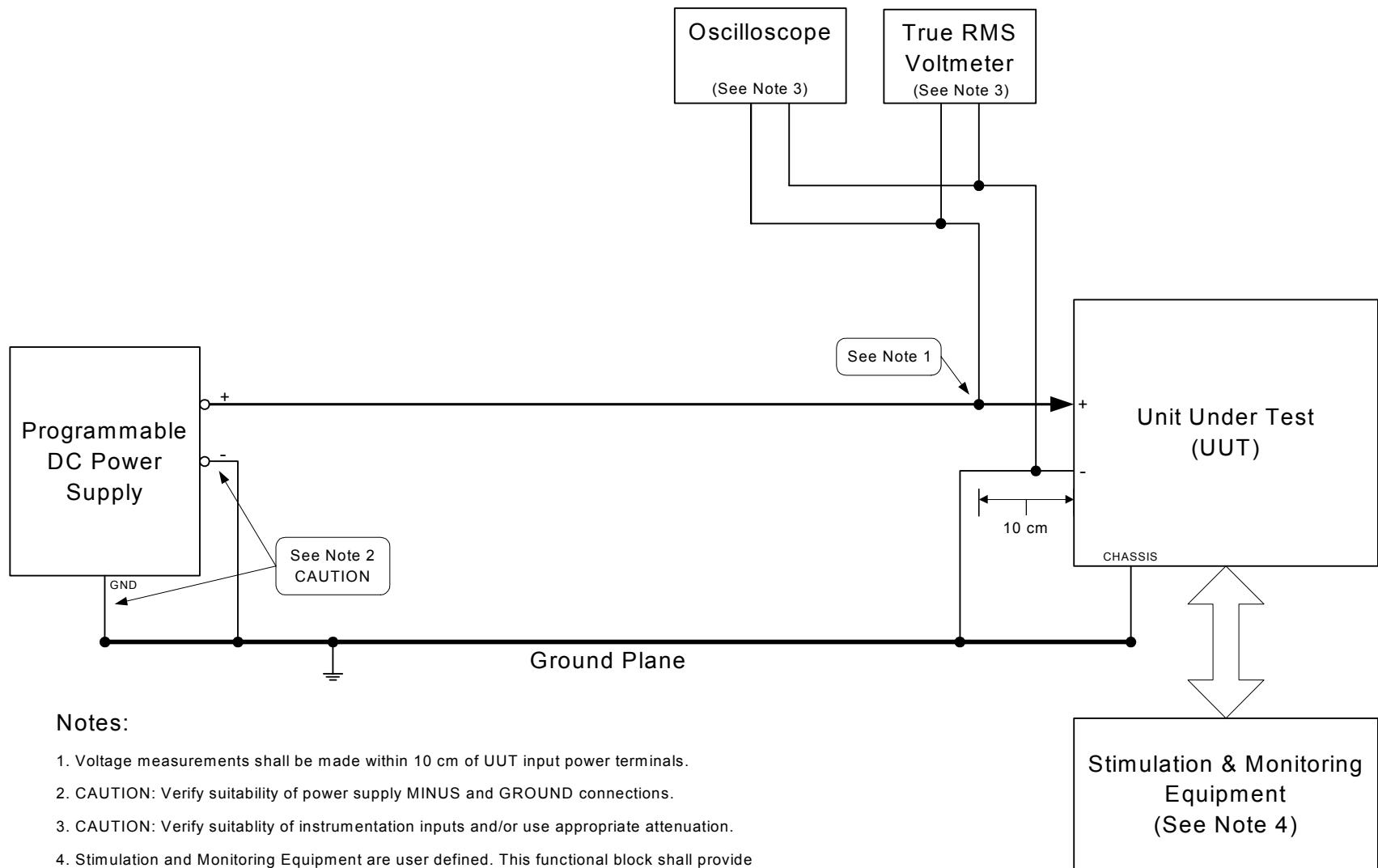
TABLE HDC105-II. Test conditions for MIL-STD-704B, C, and D normal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients					
A	280 Vdc	< 1 msec	475 Vdc	10 msec	< 1 msec
B	280 Vdc	< 1 msec	475 Vdc	10 msec	40 msec
C	280 Vdc	< 1 msec	375 Vdc	30 msec	< 1 msec
D	280 Vdc	< 1 msec	375 Vdc	30 msec	20 msec
E	280 Vdc	< 1 msec	475 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
F	250 Vdc	< 1 msec	475 Vdc	10 msec	< 1 msec
G	250 Vdc	< 1 msec	475 Vdc	10 msec	44 msec
H	250 Vdc	< 1 msec	375 Vdc	30 msec	< 1 msec
I	250 Vdc	< 1 msec	375 Vdc	30 msec	27 msec
J	250 Vdc	< 1 msec	475 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
Undervoltage Transients					
K	280 Vdc	< 1 msec	125 Vdc	50 msec	< 1 msec
L	280 Vdc	< 1 msec	125 Vdc	50 msec	63 msec
M	280 Vdc	< 1 msec	175 Vdc	70 msec	< 1 msec
N	280 Vdc	< 1 msec	175 Vdc	70 msec	43 msec
O	280 Vdc	< 1 msec	125 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
P	250 Vdc	< 1 msec	125 Vdc	50 msec	< 1 msec
Q	250 Vdc	< 1 msec	125 Vdc	50 msec	50 msec
R	250 Vdc	< 1 msec	175 Vdc	70 msec	< 1 msec
S	250 Vdc	< 1 msec	175 Vdc	70 msec	30 msec
T	250 Vdc	< 1 msec	125 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
Combined Transient					
U	280 Vdc then	< 1 msec < 1 msec	125 Vdc 475 Vdc	10 msec 10 msec	< 1 msec 40 msec
V	250 Vdc then	< 1 msec < 1 msec	125 Vdc 475 Vdc	10 msec 10 msec	< 1 msec 44 msec

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TABLE HDC105-III. Test conditions for MIL-STD-704E and F normal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients					
AA	280 Vdc	< 1 msec	330 Vdc	20 msec	< 1 msec
BB	280 Vdc	< 1 msec	330 Vdc	20 msec	20 msec
CC	280 Vdc	< 1 msec	305 Vdc	30 msec	< 1 msec
DD	280 Vdc	< 1 msec	305 Vdc	30 msec	37.5 msec
EE	280 Vdc	< 1 msec	330 Vdc (3 times)	10 msec Every 0.5 msec	< 1 msec
FF	250 Vdc	< 1 msec	330 Vdc	20 msec	< 1 msec
GG	250 Vdc	< 1 msec	330 Vdc	20 msec	33 msec
HH	250 Vdc	< 1 msec	305 Vdc	30 msec	< 1 msec
II	250 Vdc	< 1 msec	305 Vdc	30 msec	21 msec
JJ	250 Vdc	< 1 msec	330 Vdc (3 times)	10 msec Every 0.5 msec	< 1 msec
Undervoltage Transients					
KK	280 Vdc	< 1 msec	200 Vdc	10 msec	< 1 msec
LL	280 Vdc	< 1 msec	200 Vdc	10 msec	49 msec
MM	280 Vdc	< 1 msec	200 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
NN	250 Vdc	< 1 msec	200 Vdc	10 msec	< 1 msec
OO	250 Vdc	< 1 msec	200 Vdc	10 msec	30 msec
PP	250 Vdc	< 1 msec	200 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
Combined Transient					
QQ	280 Vdc then	< 1 msec < 1 msec	200 Vdc 330 Vdc	10 msec 20 msec	< 1 msec 20 msec
RR	250 Vdc then	< 1 msec < 1 msec	200 Vdc 330 Vdc	10 msec 20 msec	< 1 msec 33 msec

FIGURE HDC105-1. Normal operation - normal voltage transients.

Repetition Rate (f) for transient pulse is twice per second.

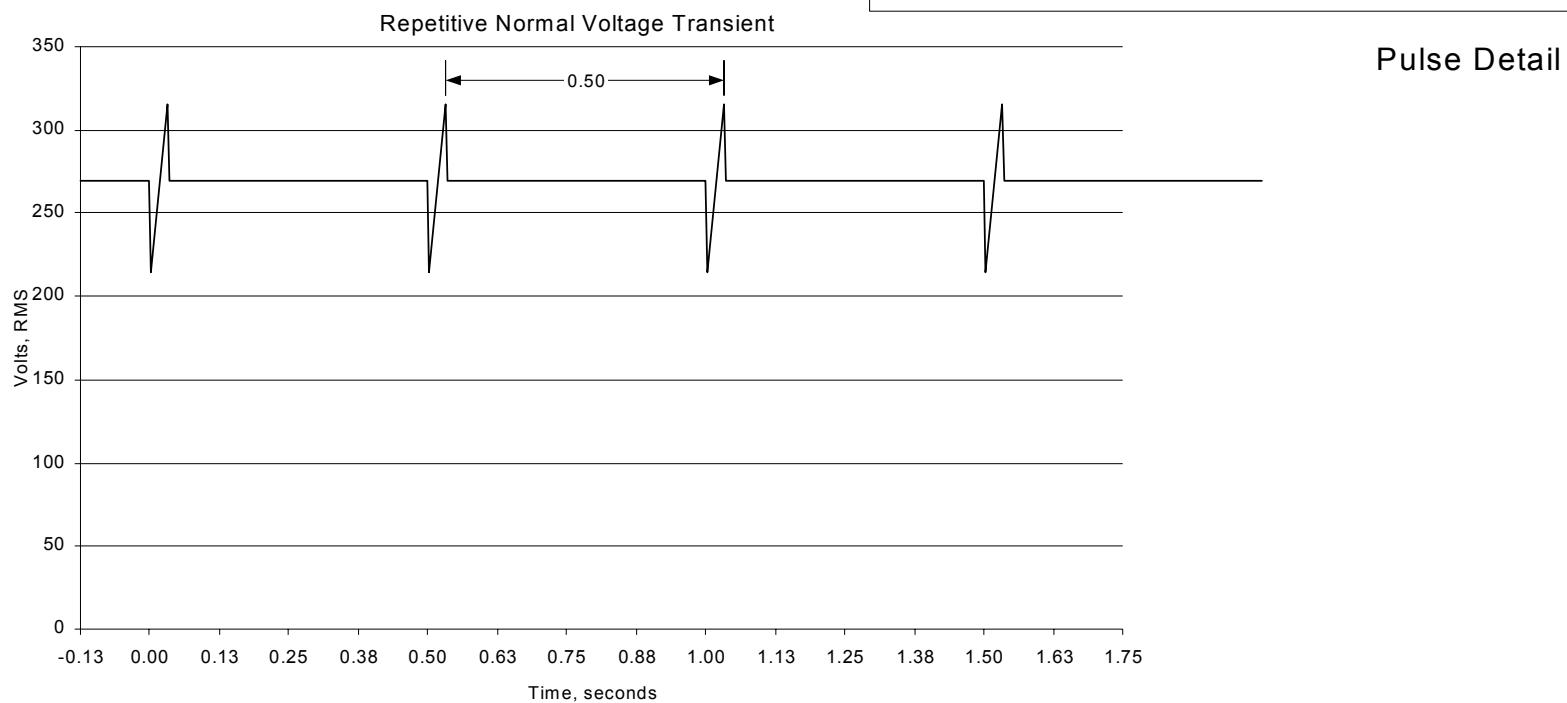
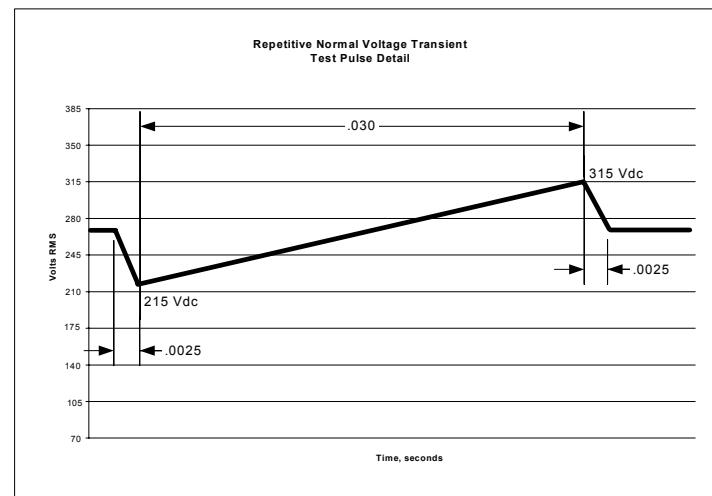
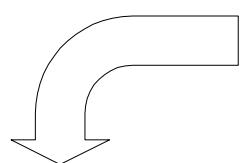


FIGURE HDC105-2. Repetitive normal voltage transient.

TABLE HDC105-IV. Sample data sheet for HDC105 normal voltage transients for MIL-STD-704A, B, C, & D.

Test Condition	Parameters						Performance	
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level	Oscilloscope Trace		
A		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
B		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
C		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
D		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
E		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
F		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
G		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
H		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
I		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
J		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
K		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
L		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
M		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
N		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
O		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
P		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
Q		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
R		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
S		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
T		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
U		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
				V _{DC}		msec		
V		V _{DC}		V _{DC}		msec	Attach Trace V _{DC} vs. Time	
				V _{DC}		msec		

TABLE HDC105-IV. Sample data sheet for HDC105 normal voltage transients for MIL-STD-704A, B, C, & D. - Continued

Test Condition	Parameters						Performance	
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level	Oscilloscope Trace		
Repetitive Transient		V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time
				V _{DC}		msec		
	Time Duration At Test Condition							
		min						

TABLE HDC105-V. Sample data sheet for HDC105 normal voltage transients for MIL-STD-704E, & F.

Test Condition	Parameters						Performance	
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level			
AA	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
BB	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
CC	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
DD	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
EE	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
FF	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
GG	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
HH	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
II	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
JJ	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
KK	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
LL	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
MM	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
NN	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
OO	V _{DC}		V _{DC}		msec			
PP	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
QQ	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
			V _{DC}		msec			
RR	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
			V _{DC}		msec			

TABLE HDC105-V. Sample data sheet for HDC105 normal voltage transients for MIL-STD-704E, & F. - Continued

Test Condition	Parameters						Performance	
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level			
Repetitive Transient		V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time
				V _{DC}		msec		
	Time Duration At Test Condition							
		min						

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METHOD HDC201
Power Interrupt

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Transfer Interrupt

PARAMETER: Power Interrupt

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table HDC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC201-I. MIL-STD-704 power transfer limits.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	N/A	50 msec				
Voltage NLSS	N/A	250 Vdc				
Voltage NHSS	N/A	280 Vdc				

3. Apparatus. The test equipment should be as follows:

- a. Programmable DC power supply
- b. True RMS voltmeter
- c. Oscilloscope
- d. Resistive dummy load

4. Test setup. Configure the test setup as shown in figure HDC201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the UUT up to a maximum 25 kW dummy load. Note: This is done to ensure that the UUT test

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does not lose stored energy to other aircraft loads during power interrupts. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 Vdc. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through K noted in table HDC201-II, adjust the voltage to the steady state voltage listed. Perform a power interrupt (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within 0.25 milliseconds, remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within 0.25 milliseconds. For test condition J, three 50 millisecond power interrupts are performed, separated by 0.5 seconds. For test condition K a normal overvoltage transient follows the power interrupt. The normal voltage transient is 330 Vdc for 20 milliseconds and returns to nominal voltage over the next 20 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 200 Vdc for 10 milliseconds and returns to nominal voltage over the next 30 milliseconds. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power transfer operation to verify that the UUT is providing specified performance for transfer aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, time duration of power interrupt, and the performance of the UUT for each test condition in the data sheet shown in table HDC201-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

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TABLE HDC201-II. Test conditions for transfer interrupt.

Test Condition	Steady State Voltage	Duration of Interrupt
A	Nominal Voltage	50 msec
B	NLSS Voltage	50 msec
C	NHSS Voltage	50 msec
D	Nominal Voltage	30 msec
E	NLSS Voltage	30 msec
F	NHSS Voltage	30 msec
G	Nominal Voltage	10 msec
H	NLSS Voltage	10 msec
I	NHSS Voltage	10 msec
J	Nominal Voltage	50 msec (repeated 3 times, separated by 0.5 sec)
K	Nominal Voltage	50 msec (followed by a normal voltage transient of 330 Vdc for 20 msec and return to steady state voltage in 20 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 200 Vdc for 10 msec and return to steady state voltage in 30 msec)

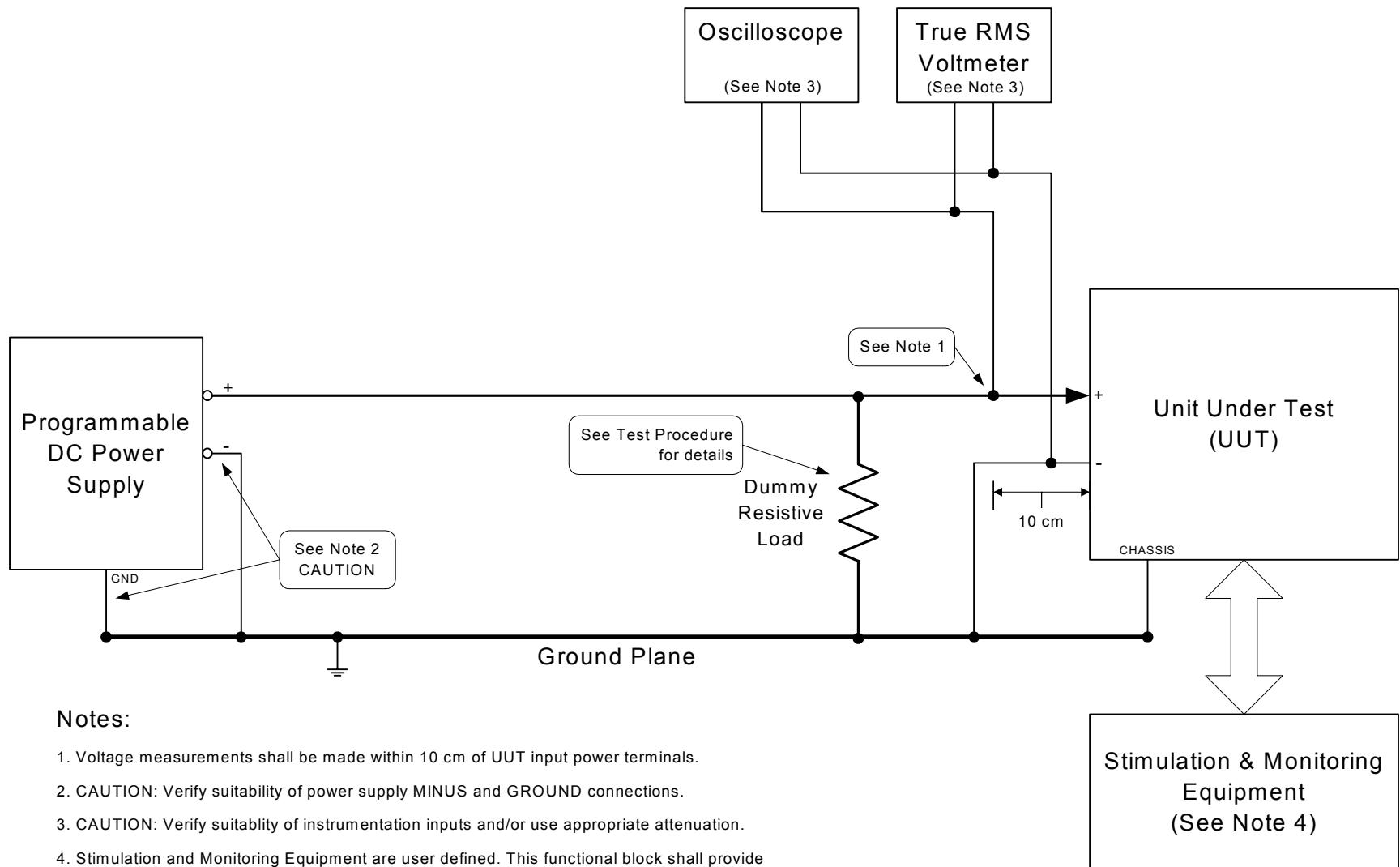
FIGURE HDC201-1. Transfer interrupt - power interrupt.

TABLE HDC201-III. Sample data sheet for HDC201 power interrupt.

Test Condition	Parameters			Performance
	Voltage	Time Duration of Power Interrupt		
A		V_{DC}		msec
B		V_{DC}		msec
C		V_{DC}		msec
D		V_{DC}		msec
E		V_{DC}		msec
F		V_{DC}		msec
G		V_{DC}		msec
H		V_{DC}		msec
I		V_{DC}		msec
J		V_{DC}		msec
K		V_{DC}		msec
	Overvoltage Transient			
	Voltage Transient		Time at Voltage Transient Level	
L		V_{DC}		msec
		V_{DC}		msec
	Overvoltage Transient			
	Voltage Transient		Time at Voltage Transient Level	
		V_{DC}		msec

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METHOD HDC301
Steady State Limits for Voltage

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Abnormal Operation

PARAMETER: Steady State Limits for Voltage

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC301-I. MIL-STD-704 abnormal limits for steady state voltage.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	N/A	245 Vdc	245 Vdc	245 Vdc	240 Vdc	240 Vdc
Voltage NHSS	N/A	285 Vdc	285 Vdc	285 Vdc	290 Vdc	290 Vdc

3. Apparatus. The test equipment should be as follows:

- a. Adjustable DC power supply
- b. True RMS voltmeter

4. Test setup. Configure the test setup as shown in figure HDC301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

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5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A and B noted in table HDC301-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the abnormal steady state voltage limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 270VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table HDC301-III. Repeat for each mode of operation of the UUT.

TABLE HDC301-II. Test conditions for abnormal steady state limits of DC voltage.

Test Condition	Voltage
A	ALSS Voltage
B	AHSS Voltage

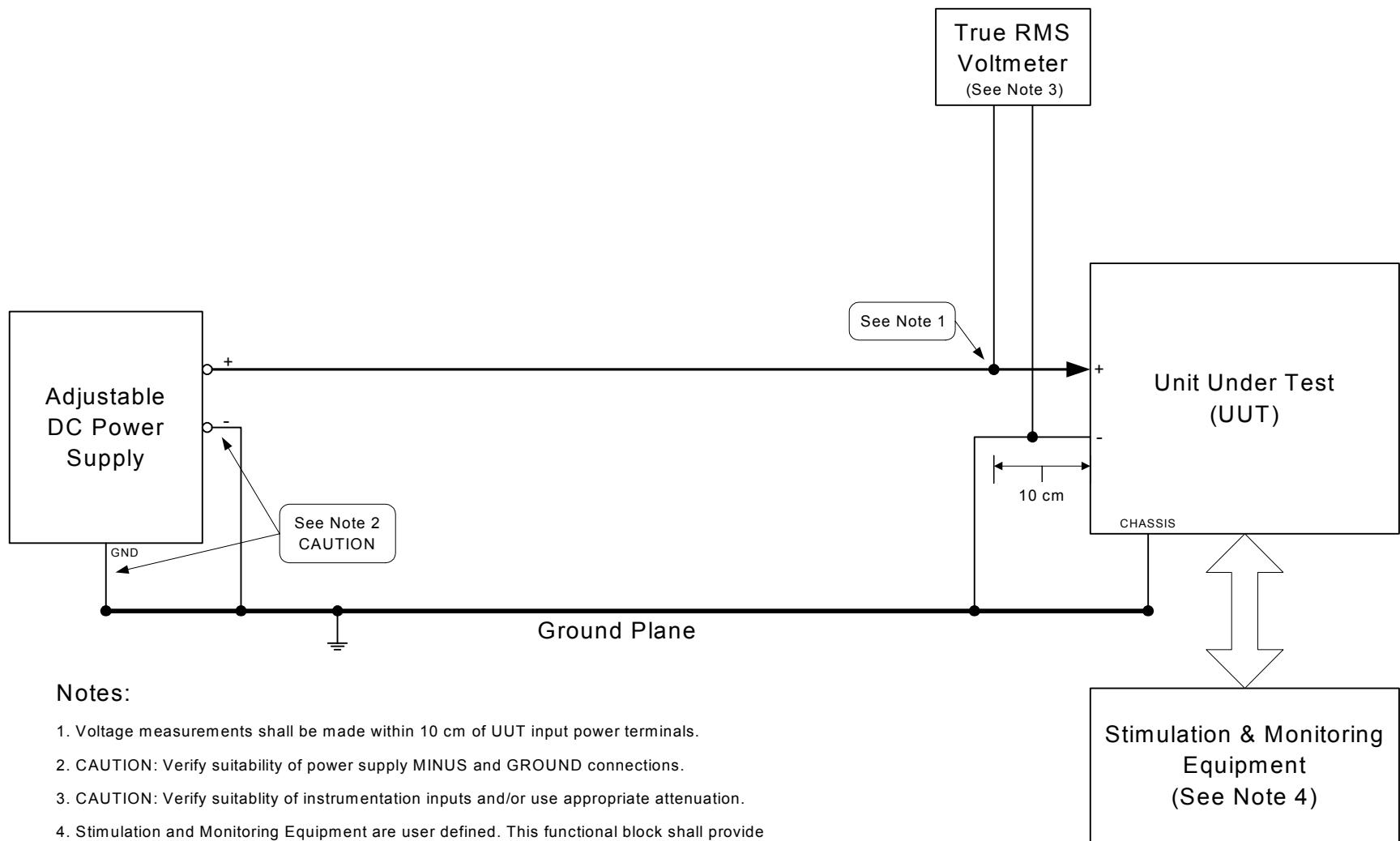
FIGURE HDC301-1. Abnormal operation - steady state limits for voltage.

TABLE HDC301-III. Sample data sheet for HDC301 abnormal steady state limits for voltage.

Test Condition	Parameters				Performance
	Voltage		Time Duration at Test Condition	Re-Start (Yes/No)	
A		V _{DC}		min	
B		V _{DC}		min	

METHOD HDC302
Abnormal Voltage Transients

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Abnormal Operation

PARAMETER: Abnormal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC302-I. MIL-STD-704 limits for abnormal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	N/A	figure 10 MIL-STD- 704B	figure 13 MIL-STD- 704C	figure 13 MIL-STD- 704D	figure 12 MIL-STD- 704E	figure 17 MIL-STD- 704F

3. Apparatus. The test equipment should be as follows:

- a. Programmable DC power supply
- b. True RMS voltmeter
- c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC302-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC302-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

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5.1 Compliance test for MIL-STD-704B, C, & D. The UUT must be subjected to the voltage transients for each test condition A through N noted in table HDC302-II. The voltage must increase or decrease from steady state voltage as noted in table HDC302-II to the voltage transient level within 1 millisecond. The voltage must remain at the voltage transient level for the duration noted in table HDC302-II. The voltage must return to steady state over the time duration noted in table HDC302-II. For test condition C and F, three over-voltage transients of 475 Vdc for 10 milliseconds are performed, separated by 0.5 seconds. For test condition I and L, three under-voltage transients of 65 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition M and N, an under-voltage transient of 65 Vdc for 10 milliseconds is immediately followed by an over-voltage transient of 475 Vdc for 27 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table HDC302-IV. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704E & F. The UUT must be subjected to the voltage transients for each test condition AA through NN noted in table HDC302-III. The voltage must increase or decrease from steady state voltage as noted in table HDC302-III to the voltage transient level within 1 millisecond. The voltage must remain at the voltage transient level for the duration noted in table HDC302-III. The voltage must return to steady state over the time duration noted in table HDC302-III. For test condition CC and FF, three over-voltage transients of 350 Vdc for 50 milliseconds are performed, separated by 0.5 second. For test condition II and LL, three under-voltage transients of 180 Vdc for 50 milliseconds are performed, separated by 0.5 second. For test condition MM and NN, an under-voltage transient of 180 Vdc for 10 milliseconds is immediately followed by an over-voltage transient of 350 Vdc for 50 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table HDC302-V. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment

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performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC302-II. Test conditions for MIL-STD-704B, C, and D abnormal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients					
A	280 Vdc	< 1 msec	475 Vdc	27 msec	< 1 msec
B	280 Vdc	< 1 msec	475 Vdc	27 msec	9 msec
		then	430 Vdc	decreasing	10 msec
		then	400 Vdc	decreasing	25 msec
		then	360 Vdc	decreasing	30 msec
		then	340 Vdc	decreasing	50 msec
		then	320 Vdc	decreasing	150 msec
		then	300 Vdc	decreasing	400 msec
		then	280 Vdc		
C	280 Vdc	< 1 msec	475 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
D	250 Vdc	< 1 msec	475 Vdc	27 msec	< 1 msec
E	250 Vdc	< 1 msec	475 Vdc	27 msec	9 msec
		then	430 Vdc	decreasing	10 msec
		then	400 Vdc	decreasing	25 msec
		then	360 Vdc	decreasing	30 msec
		then	340 Vdc	decreasing	50 msec
		then	320 Vdc	decreasing	150 msec
		then	300 Vdc	decreasing	2.7 sec
		then	250 Vdc		
F	250 Vdc	< 1 msec	475 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec

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TABLE HDC302-II. Test conditions for MIL-STD-704B, C, and D abnormal voltage transients.
 - Continued

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Undervoltage Transients					
G	280 Vdc	< 1 msec	65 Vdc	27 msec	< 1 msec
H	280 Vdc	< 1 msec	65 Vdc	27 msec	9 msec
		then	110 Vdc	increasing	10 msec
		then	140 Vdc	increasing	25 msec
		then	180 Vdc	increasing	30 msec
		then	200 Vdc	increasing	50 msec
		then	220 Vdc	increasing	150 msec
		then	240 Vdc	increasing	2.7 sec
		then	280 Vdc		
I	280 Vdc	< 1 msec	65 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
J	250 Vdc	< 1 msec	65 Vdc	27 msec	< 1 msec
K	250 Vdc	< 1 msec	65 Vdc	27 msec	9 msec
		then	110 Vdc	increasing	10 msec
		then	140 Vdc	increasing	25 msec
		then	180 Vdc	increasing	30 msec
		then	200 Vdc	increasing	50 msec
		then	220 Vdc	increasing	150 msec
		then	240 Vdc	increasing	400 msec
		then	250 Vdc		
L	250 Vdc	< 1 msec	65 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec

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TABLE HDC302-II. Test conditions for MIL-STD-704B, C, and D abnormal voltage transients.
 - Continued

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Combined Transient					
M	280 Vdc	< 1 msec	65 Vdc	10 msec	< 1 msec
		< 1 msec	475 Vdc	27 msec	9 msec
		then	430 Vdc	decreasing	10 msec
		then	400 Vdc	decreasing	25 msec
		then	360 Vdc	decreasing	30 msec
		then	340 Vdc	decreasing	50 msec
		then	320 Vdc	decreasing	150 msec
		then	300 Vdc	decreasing	400 msec
		then	280 Vdc		
N	250 Vdc	< 1 msec	65 Vdc	10 msec	< 1 msec
		< 1 msec	475 Vdc	27 msec	9 msec
		then	430 Vdc	decreasing	10 msec
		then	400 Vdc	decreasing	25 msec
		then	360 Vdc	decreasing	30 msec
		then	340 Vdc	decreasing	50 msec
		then	320 Vdc	decreasing	150 msec
		then	300 Vdc	decreasing	2.7 sec
		then	250 Vdc		

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TABLE HDC302-III. Test conditions for MIL-STD-704E and F abnormal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients					
AA	280 Vdc	< 1 msec	350 Vdc	50 msec	< 1 msec
BB	280 Vdc	< 1 msec	350 Vdc	50 msec	10 msec
		then	340 Vdc	decreasing	15 msec
		then	330 Vdc	decreasing	25 msec
		then	320 Vdc	decreasing	190 msec
		then	300 Vdc	decreasing	1.71 sec
			280 Vdc		
CC	280 Vdc	< 1 msec	350 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec
DD	250 Vdc	< 1 msec	350 Vdc	50 msec	< 1 msec
EE	250 Vdc	< 1 msec	350 Vdc	50 msec	10 msec
		then	340 Vdc	decreasing	15 msec
		then	330 Vdc	decreasing	25 msec
		then	320 Vdc	decreasing	190 msec
		then	300 Vdc	decreasing	6.7 sec
		then	250 Vdc		
FF	250 Vdc	< 1 msec	350 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec
Undervoltage Transients					
GG	280 Vdc	< 1 msec	180 Vdc	50 msec	< 1 msec
HH	280 Vdc	< 1 msec	180 Vdc	50 msec	10 msec
		then	190 Vdc	increasing	15 msec
		then	200 Vdc	increasing	25 msec
		then	210 Vdc	increasing	190 msec
		then	230 Vdc	increasing	6.7 sec
		then	280 Vdc		
II	280 Vdc	< 1 msec	180 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec
JJ	250 Vdc	< 1 msec	180 Vdc	50 msec	< 1 msec
KK	250 Vdc	< 1 msec	180 Vdc	50 msec	10 msec
		then	190 Vdc	increasing	15 msec
		then	200 Vdc	increasing	25 msec
		then	210 Vdc	increasing	190 msec
		then	230 Vdc	increasing	1.71 sec
		then	250 Vdc		
LL	250 Vdc	< 1 msec	180 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec

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TABLE HDC302-III. Test conditions for MIL-STD-704E and F abnormal voltage transients. -
Continued

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Combined Transient					
MM	280 Vdc	< 1 msec	180 Vdc	10 msec	< 1 msec
		< 1 msec	350 Vdc	50 msec	10 msec
		then	340 Vdc	decreasing	15 msec
		then	330 Vdc	decreasing	25 msec
		then	320 Vdc	decreasing	190 msec
		then	300 Vdc	decreasing	1.71 sec
			280 Vdc		
NN	250 Vdc	< 1 msec	180 Vdc	10 msec	< 1 msec
		< 1 msec	350 Vdc	50 msec	10 msec
		then	340 Vdc	decreasing	15 msec
		then	330 Vdc	decreasing	25 msec
		then	320 Vdc	decreasing	190 msec
		then	300 Vdc	decreasing	6.7 sec
		then	250 Vdc		

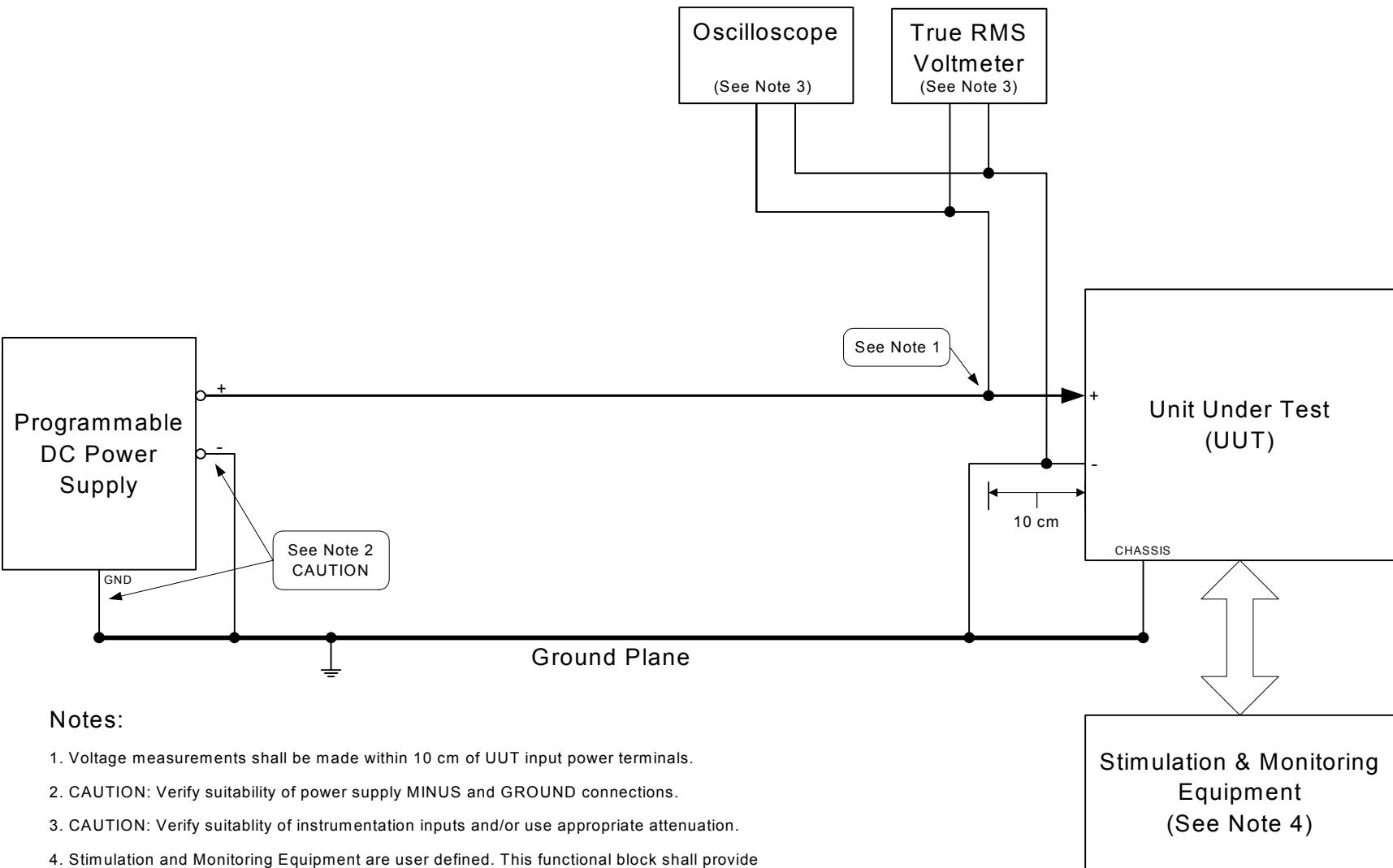
FIGURE HDC302-1. Abnormal operation - abnormal voltage transients.

TABLE HDC302-IV. Sample data sheet for HDC302 abnormal voltage transients for MIL-STD-704 B, C, & D.

Test Condition	Parameters						Performance	
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level			
A	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
B	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
C	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
D	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
E	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
F	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
G	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
H	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
I	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
J	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
K	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
L	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
M	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
N			V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
			V _{DC}					
			V _{DC}		msec			

TABLE HDC302-V. Sample data sheet for HDC302 abnormal voltage transients for MIL-STD-704E, & F.

Test Condition	Parameters						Performance	
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level	Oscilloscope Trace		
AA	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
BB	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
CC	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
DD	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
EE	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
FF	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
GG	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
HH	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
II	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
JJ	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
KK	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
LL	V _{DC}		V _{DC}		msec	Attach Trace	V _{DC} vs. Time	
MM		V _{DC}		V _{DC}	msec	Attach Trace	V _{DC} vs. Time	
				V _{DC}	msec			
NN		V _{DC}		V _{DC}	msec	Attach Trace	V _{DC} vs. Time	
				V _{DC}	msec			

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METHOD HDC401
Steady State Limits for Voltage

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Emergency Operation

PARAMETER: Steady State Limits for Voltage

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage at the specified emergency steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the emergency steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC401-I. MIL-STD-704 emergency limits for steady state voltage.

Emergency Limit	704A	704B	704C	704D	704E	704F
Voltage ELSS	N/A	240 Vdc	240 Vdc	240 Vdc	250 Vdc	250 Vdc
Voltage EHSS	N/A	290 Vdc	290 Vdc	290 Vdc	280 Vdc	280 Vdc

3. Apparatus. The test equipment should be as follows:

- a. Adjustable DC power supply
- b. True RMS voltmeter

4. Test setup. Configure the test setup as shown in figure HDC401-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

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5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC401-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A and B noted in table HDC401-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the emergency steady state voltage limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for emergency aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for emergency aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 270VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table HDC401-III. Repeat for each mode of operation of the UUT.

TABLE HDC401-II. Test conditions for emergency steady state limits of DC voltage.

Test Condition	Voltage
A	ELSS Voltage
B	EHSS Voltage

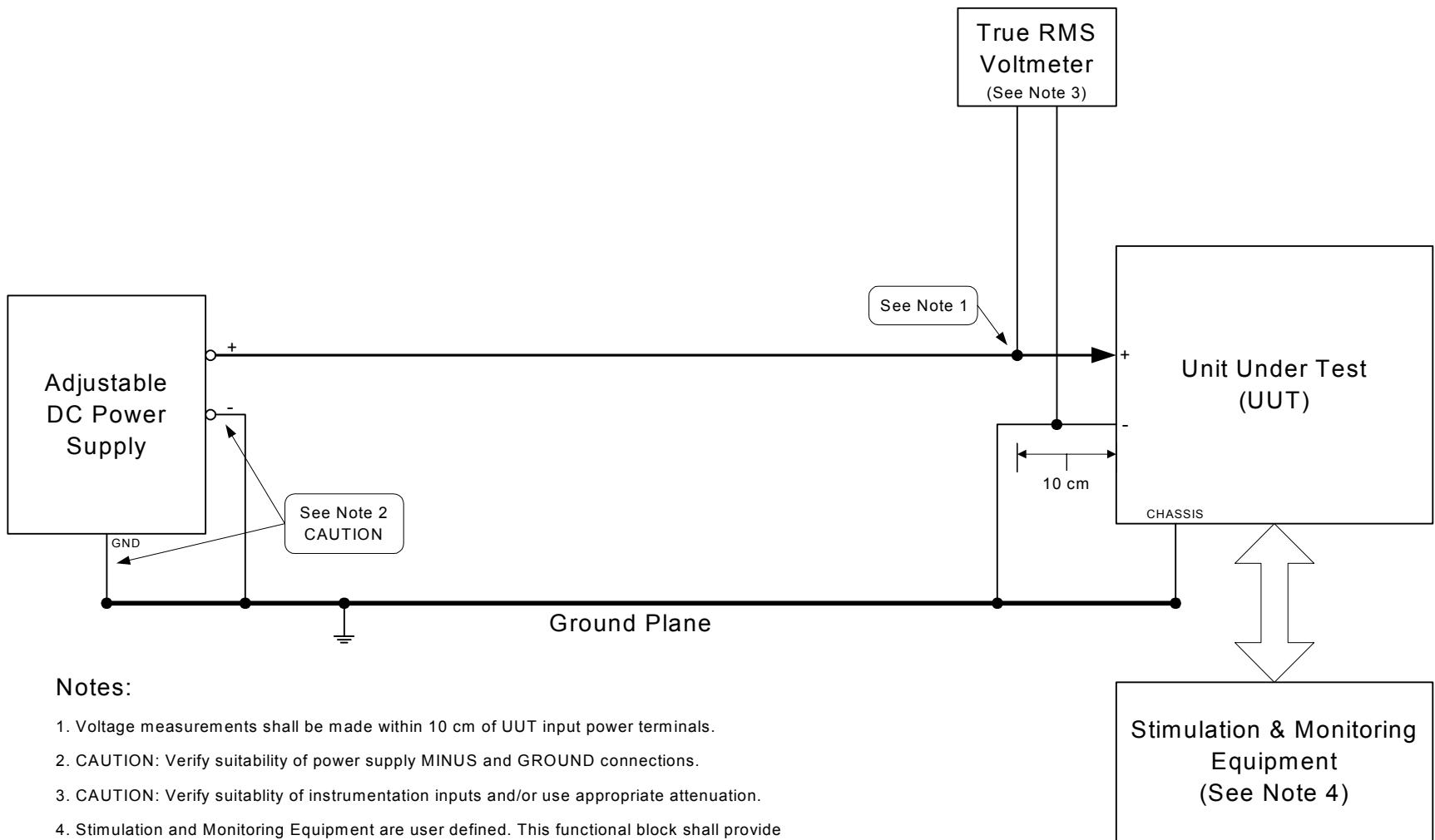
FIGURE HDC401-1. Emergency operation - steady state limits for voltage.

TABLE HDC401-III. Sample data sheet for HDC401 emergency steady state limits for voltage and frequency.

Test Condition	Parameters			Performance
	Voltage	Time Duration at Test Condition		
A		V _{DC}		min
B		V _{DC}		min

METHOD HDC501
Starting Voltage Transients

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Starting Operation

PARAMETER: Starting Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to starting voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for starting aircraft electrical conditions when subjected to starting voltage transients for the applicable edition(s) of MIL-STD-704 and as noted in table HDC501-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC501-I. MIL-STD-704 limits for starting voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Starting Voltage Transients	N/A	Use Limits of 704 C	155 Vdc to 280 Vdc	115 Vdc to 280 Vdc	115 Vdc to 280 Vdc	115 Vdc to 280 Vdc

3. Apparatus. The test equipment should be as follows:

- a. Programmable DC power supply
- b. True RMS voltmeter
- c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC501-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC501-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

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5.1 Compliance test for MIL-STD-704B and C. The UUT must be subjected to the starting voltage transients described in table HDC501-II (test condition A). The voltage must decrease from steady state voltage to 155 Vdc within 1 millisecond. The voltage must return to steady state at a constant rate over 30 seconds. Monitor the performance of the UUT during the starting voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for starting aircraft electrical conditions. Repeat the test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT in the data sheet shown in table HDC501-IV. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704D, E, and F. The UUT must be subjected to the starting voltage transients described in table HDC501-III (test condition AA). The voltage must decrease from steady state voltage to 115 Vdc within 1 millisecond. The voltage must return to steady state at a constant rate over 30 seconds. Monitor the performance of the UUT during the starting voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for starting aircraft electrical conditions. Repeat the test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT in the data sheet shown in table HDC501-IV. Repeat for each mode of operation of the UUT.

TABLE HDC501-II. Test conditions for MIL-STD-704B and C starting voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Time From Voltage Transient Level to Steady State Voltage
A	280 Vdc	< 1 msec	155 Vdc	30 sec

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TABLE HDC501-III. Test conditions for MIL-STD-704D, E, and F starting voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Time From Voltage Transient Level to Steady State Voltage
AA	280 Vdc	< 1 msec	115 Vdc	30 sec

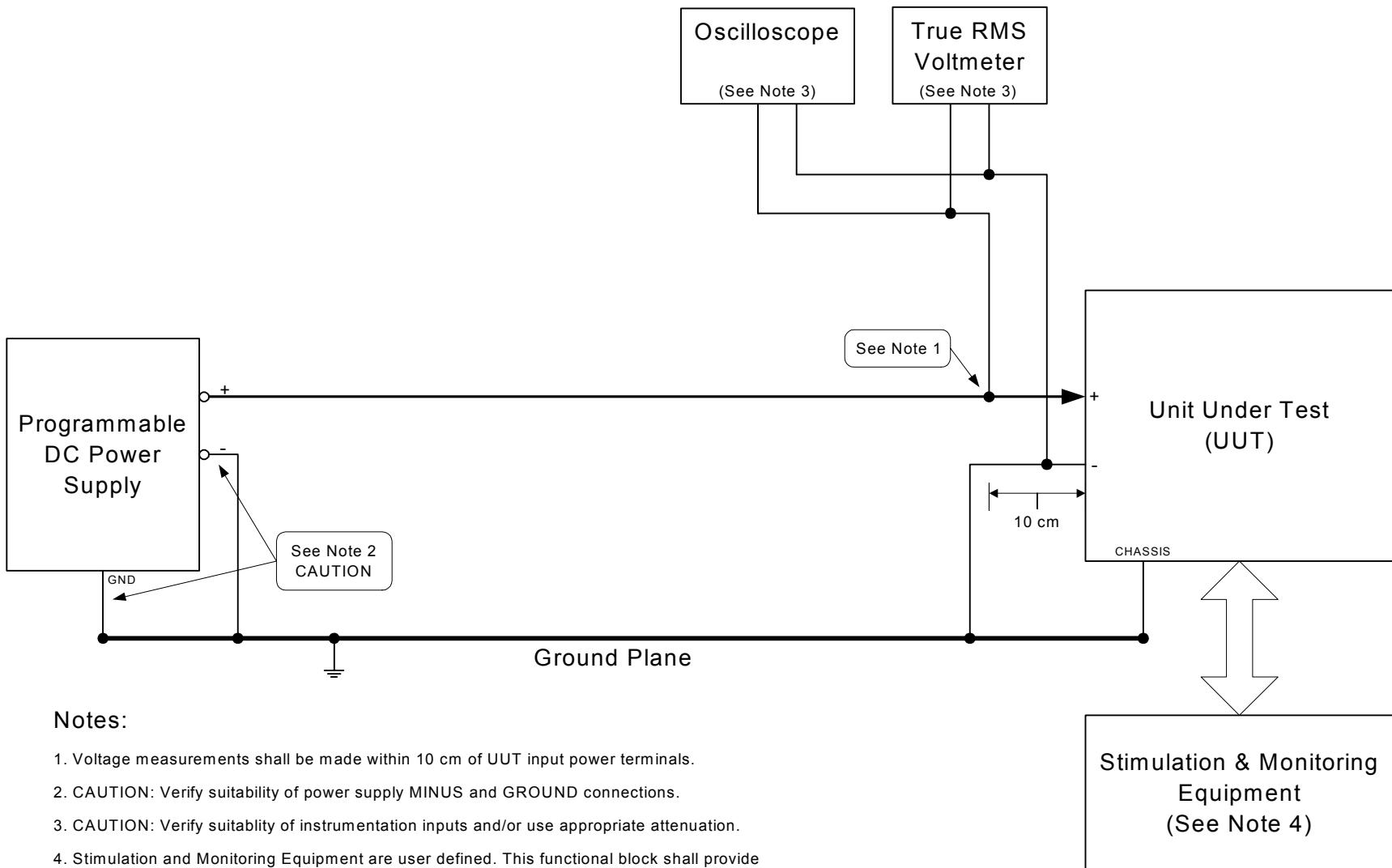
FIGURE HDC501-1. Starting operation - starting voltage.

TABLE HDC501-IV. Sample data sheet for HDC501 starting voltage transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters						Performance	
	Steady State Voltage	Voltage Transient	Time to Return to Steady State Voltage	Oscilloscope Trace		Pass/Fail		
	V_{DC}		V_{DC}		sec	Attach Trace	V_{DC} vs. Time	

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METHOD HDC601
Power Failure

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Power Failure

PARAMETER: Power Failure

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to Power Failures as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table HDC601-I. The utilization equipment must maintain the specified performance during power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC601-I. MIL-STD-704 Power failure limits.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	N/A	7 sec figure 10 MIL-STD-704B	7 sec figure 13 MIL-STD-704C	7 sec figure 13 MIL-STD-704D	7 sec figure 12 MIL-STD-704E	7 sec figure 17 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

- a. Programmable DC power supply
- b. True RMS voltmeter
- c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC601-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC601-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to

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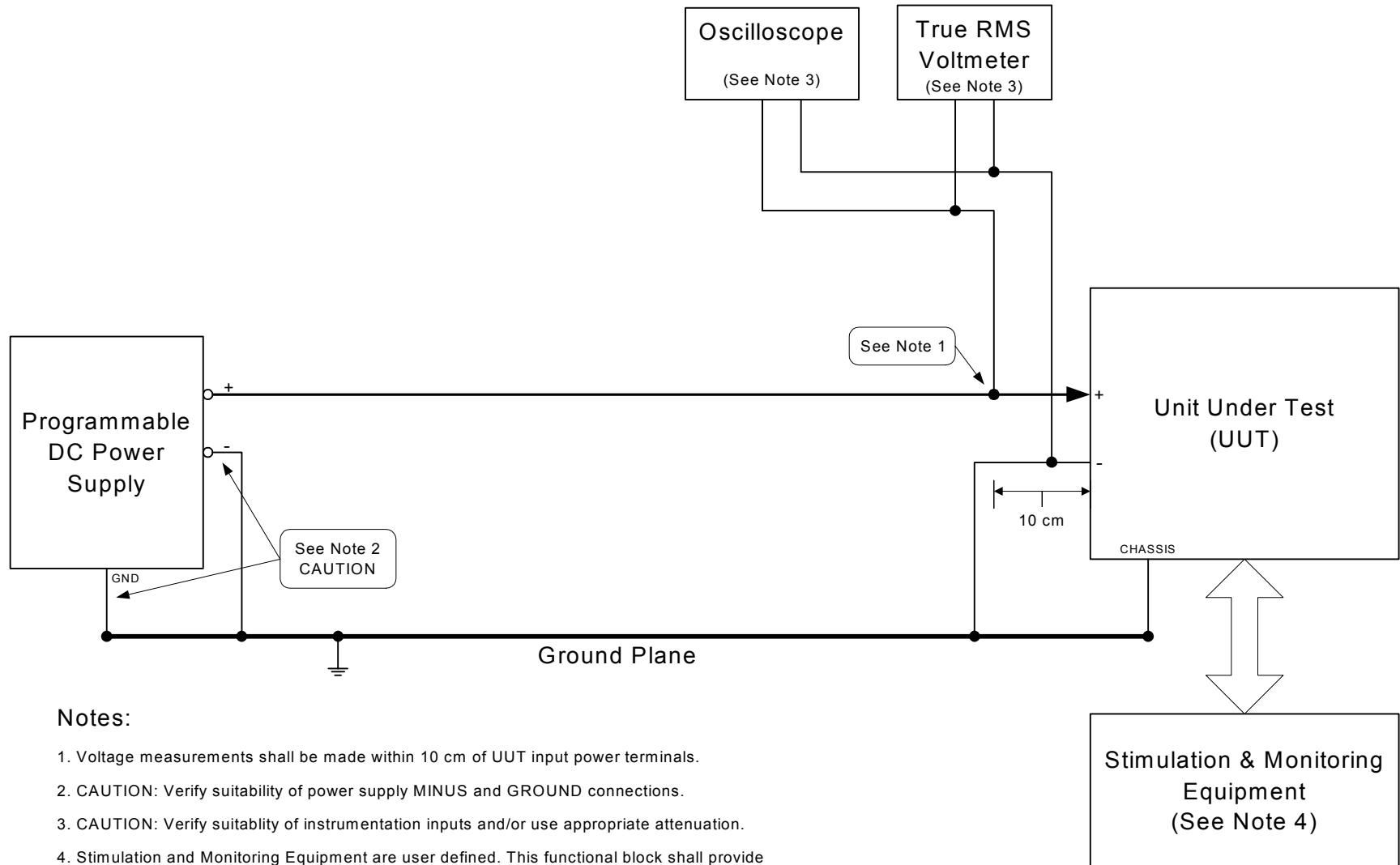
the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through D noted in table HDC601-II, perform a power failure (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 volts within 0.25 milliseconds, remain at 0 volts for the duration listed for the test condition, and return from 0 volts to the steady state voltage within 0.25 milliseconds. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table HDC601-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC601-II. Test conditions for power failures.

Test Condition	Duration of Power Failure
A	100 msec
B	500 msec
C	3 seconds
D	7 seconds

FIGURE HDC601-1. Power Failure.

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TABLE HDC601-III. Sample data sheet for HDC601 power failure.

Test Condition	Parameters			Performance
	Voltage	Time Duration of Power Failure		Pass/Fail
A		V_{DC}		msec
B		V_{DC}		msec
C		V_{DC}		sec
D		V_{DC}		sec

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METHOD HDC602
Phase Reversal

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment is not damaged and does not cause an unsafe condition when the positive and negative connection are reversed for the applicable edition(s) of MIL-STD-704 and as noted in table HDC602-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

TABLE HDC602-I. MIL-STD-704 phase reversal requirement.

Limit	704A	704B	704C	704D	704E	704F
Phase Reversal	N/A	N/A	N/A	N/A	N/A	Phase Reversal Does not Cause Damage

3. Apparatus. The test equipment should be as follows:

- a. Adjustable DC power supply
- b. True RMS voltmeter

4. Test setup. Configure the test setup as shown in figure HDC602-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

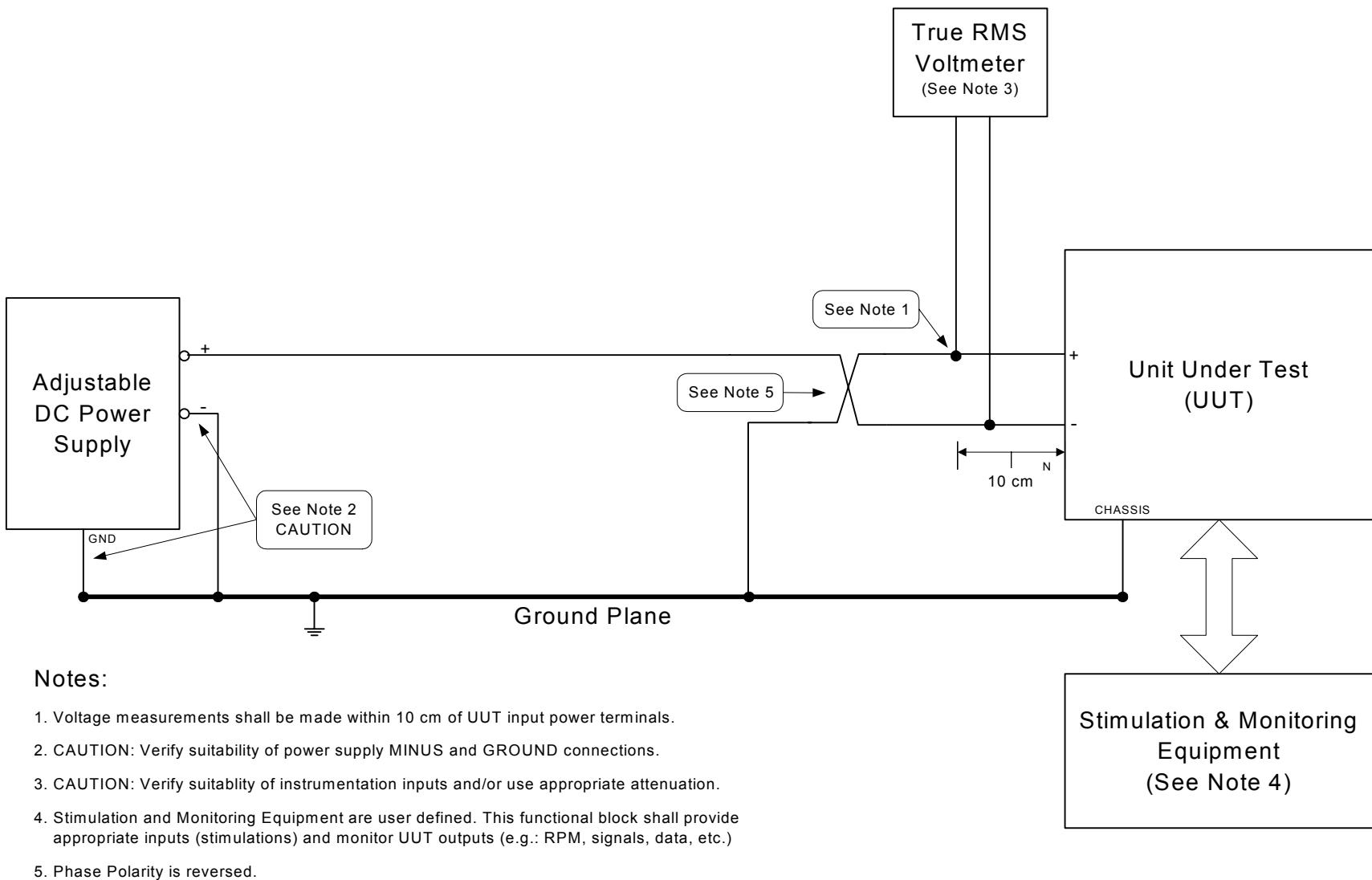
5. Compliance test. If a positive physical means is employed to prevent phase reversal, confirm that the positive and negative conductors cannot be reversed.

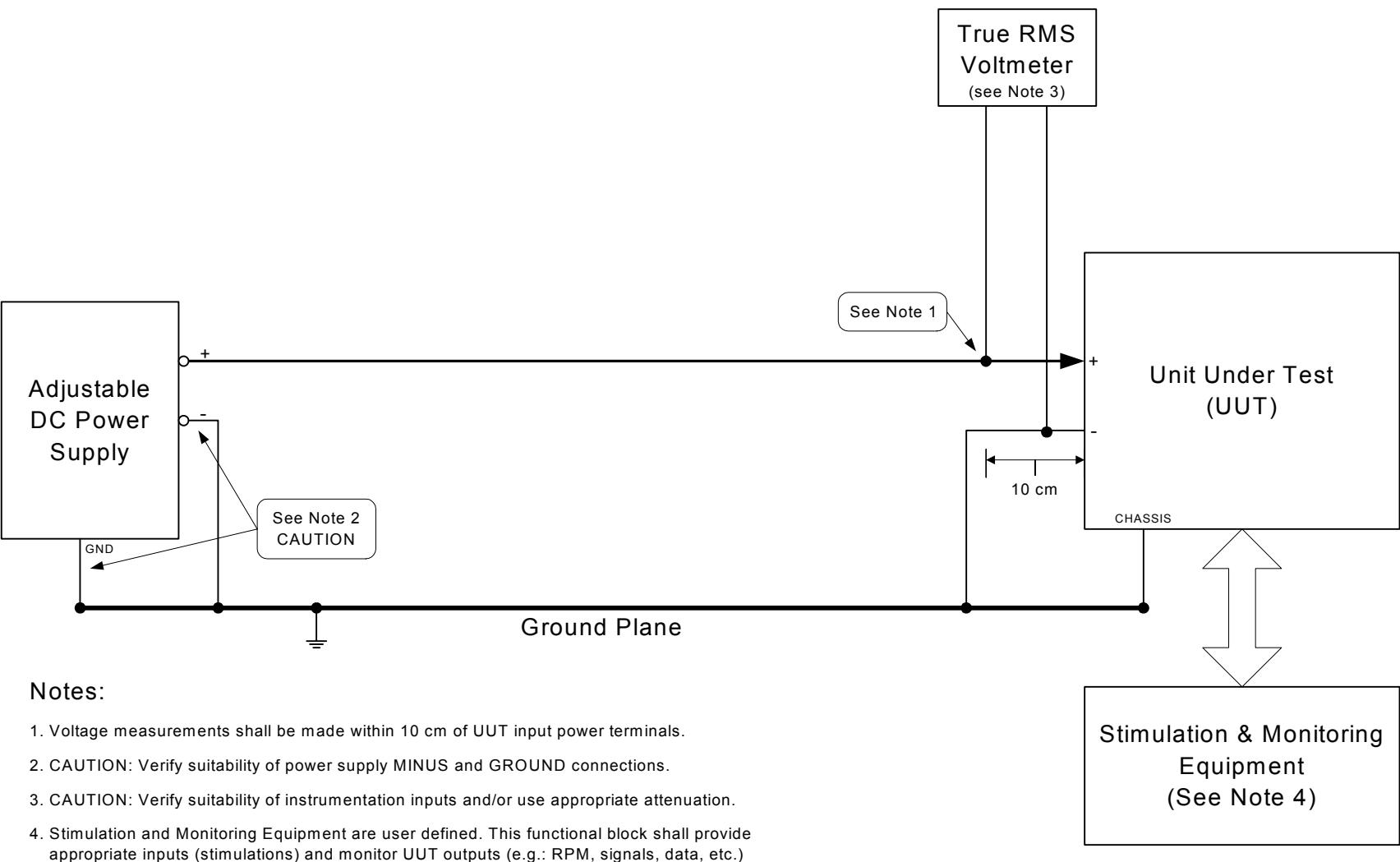
If the positive and negative conductors can be reversed, with the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC602-1 (positive and negative conductors reversed). Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment is not damaged and does not cause an

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unsafe condition due to phase reversal and should be not less than thirty (30) minutes. Record the steady state voltage, time duration at phase reversal test condition, and the performance of the UUT in the data sheet shown in table HDC602-II. Repeat for each mode of operation of the UUT.

With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC602-2 (positive and negative conductors connected properly). Turn on the power source and adjust the voltage to the nominal steady state voltage of 270VDC. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment was not damaged and does not cause an unsafe condition after the phase reversal and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has returned to the performance specified for normal aircraft electrical conditions and has not suffered damage. Record the steady state voltage, time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC602-II. Repeat for each mode of operation of the UUT.

FIGURE HDC602-1. Phase reversal.

FIGURE HDC602-2. Correct phase connection.

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TABLE HDC602-II. Sample data sheet for HDC602 phase reversal.

Test Condition	Parameters			Performance				
				Yes/No				
Phase Reversal Prevented by Positive Physical Means								
If No								
	Voltage		Time Duration at Condition		Pass/Fail			
Phase Reversal		V _{dc}		min				
Correct Phase Connection		V _{dc}		min				

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6. NOTES

6.1 Intended use. This handbook should be used as guidance when establishing test requirements, for inclusion in performance specifications developed for the procurement of utilization equipment, to ensure compliance with the aircraft electrical power characteristics as specified by MIL-STD-704.

6.2 Subject term (keyword) listing.

Aircraft, electrical power
Aircraft, electrical test
Electrical operating areas
Equipment, utilization
Power groups
Specification, utilization equipment

CONCLUDING MATERIAL

Custodians:

Army - AV
Navy - AS
Air Force - 11

Preparing Activity:

Navy - AS

(Project No. SESS-0053)

Review Activities:

Army - CR, MI, TE
Navy - EC, MC, SA, SH, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.