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**MIL-HDBK-704-6
9 April 2004**

**DEPARTMENT OF DEFENSE
HANDBOOK**

**GUIDANCE FOR
TEST PROCEDURES FOR DEMONSTRATION OF
UTILIZATION EQUIPMENT COMPLIANCE TO
AIRCRAFT ELECTRICAL POWER CHARACTERISTICS
SINGLE PHASE, 60 Hz, 115 VOLT
(PART 6 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Do not cite this document as a requirement.**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 single phase, 60 Hz, 115 volt utilization equipment to determine compliance with the applicable edition of MIL-STD-704.

3. MIL-HDBK-704-6 is Part 6 in a series of 8 Parts. Part 6 describes the test methods and procedures to demonstrate that single phase, 60 Hz, 115 volt 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.

MIL-HDBK-704-6

CONTENTS

<u>PARAGARPH</u>	<u>PAGE</u>
FOREWORD	ii
1. SCOPE	1
1.1 Scope.....	1
2. APPLICABLE DOCUMENTS	1
2.1 General.....	1
2.2 Government documents	1
2.2.1 Specifications, standards and handbooks.....	1
3 DEFINITIONS.....	1
3.1 Acronyms and definitions	1
4. TEST METHODS INFORMATION.....	1
4.1 Demonstration of compatibility	1
4.1.1 Recording performance.....	1
4.2 Calibration of test equipment.....	1
4.3 Test methods	2
5. TEST METHODS.....	4
METHOD SXF101 Load Measurements.....	5
METHOD SXF102 Steady State Limits for Voltage and Frequency.....	9
METHOD SXF103 No Test Required.....	13
METHOD SXF104 Voltage Modulation.....	14
METHOD SXF105 Frequency Modulation.....	18
METHOD SXF106 Voltage Distortion Spectrum.....	22
METHOD SXF107 Total Voltage Distortion.....	27
METHOD SXF108 DC Voltage Component	32
METHOD SXF109 Normal Voltage Transients.....	36
METHOD SXF110 Normal Frequency Transients	42
METHOD SXF201 Power Interrupt.....	47
METHOD SXF301 Abnormal Steady State Limits for Voltage	
and Frequency	52
METHOD SXF302 Abnormal Voltage Transients.....	57
METHOD SXF303 Abnormal Frequency Transients	62
METHOD SXF401 Emergency Steady State Limits for Voltage	
and Frequency	66
METHOD SXF501 No Tests.....	67
METHOD SXF601 Power Failure (Single Phase)	68
METHOD SXF602 No Test Required.....	72
METHOD SXF603 Phase Reversal (Single Phase).....	73

MIL-HDBK-704-6

<u>PARAGARPH</u>	<u>PAGE</u>
6. NOTES	78
6.1 Intended use	78
6.2 Single phase test numbers	78
6.3 Subject term (keyword) listing.....	78
TABLE	
SXF-I. Summary of single phase, 400 Hz, 115 volt utilization equipment	
MIL-STD-704 compliance test.....	3
CONCLUDING MATERIAL	78

MIL-HDBK-704-6

1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that single phase, 60 Hz, 115 volt 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 single phase, 60 Hz, 115 volt 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 SXF101 through SXF603.

4.1.1 Recording performance. In table SXF-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.

MIL-HDBK-704-6

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 SXF-I are provided in section 5 of this handbook.

MIL-HDBK-704-6

TABLE SXF-I. Summary of single phase, 60 Hz, 115 volt 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			
SXF101	Load and Current Harmonic Measurements		
SXF102	Steady State Limits for Voltage and Frequency		
SXF103	No Test, See Note #1	N/A	N/A
SXF104	Voltage Modulation		
SXF105	Frequency Modulation		
SXF106	Voltage Distortion Spectrum		
SXF107	Total Voltage Distortion		
SXF108	DC Voltage Component		
SXF109	Normal Voltage Transients		
SXF110	Normal Frequency Transients		
Transfer, Aircraft Electrical Operation			
SXF201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
SXF301	Abnormal Limits for Voltage and Frequency		
SXF302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
SXF303	Abnormal Frequency Transients (Overfrequency/Underfrequency)		
Emergency, Aircraft Electrical Operation			
SXF401	Emergency Limits for Voltage and Frequency		
Starting, Aircraft Electrical Operation			
SXF501	See Note#2	N/A	N/A
Power Failure, Aircraft Electrical Operation			
SXF601	Power Failure (Single Phase)		
SXF602	No Test, See Note #1	N/A	N/A
SXF603	Phase Reversal		

Note 1: There are no tests required for SXF103 and SXF602. The numbering has been arranged so that the single phase test numbers coincide with the three phase test numbers.

Note 2: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for SXF501 unless specified by the equipment performance specification.

MIL-HDBK-704-6

5. TEST METHODS

MIL-HDBK-704-6

METHOD SXF101

Load Measurements

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Load Measurements

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment utilizes only 115 volt line-to-neutral power, does not require more power than allowed, the power factor is within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and current spectrum (current distortion vs. frequency) limits defined in the utilization equipment performance specification document.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment requires less than or equal to the power limit for single phase equipment, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704 and as noted in table SXF101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF101-I. MIL-STD-704 limits for single phase power, power factor, rectification restriction, current distortion, and current spectrum for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Single Phase kVA	N/A	N/A	N/A	N/A	N/A	0.5 kVA
Power Factor	N/A	N/A	N/A	N/A	N/A	No Leading Power Factor for >100 VA
Rectification Restriction	N/A	N/A	N/A	N/A	N/A	No Half-Wave Rectification
Current Distortion	N/A	N/A	N/A	N/A	N/A	See Note 1/
Current Spectrum	N/A	N/A	N/A	N/A	N/A	See Note 1/

MIL-HDBK-704-6

1/. 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. 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.

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

- a. Adjustable AC power supply (rotating AC source for current waveform limits)
- b. True RMS voltmeter
- c. Frequency counter
- d. Power meter
- e. Spectrum analyzer
- f. Distortion meter
- g. Current transformer
- h. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF101-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT. Current measurements must be taken from the 115 Volt conductor. If the utilization equipment performance specification document imposes current waveform limits, the AC power source must be a rotating machine.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF101-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz.

Close the circuit breaker, energizing 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 voltage, frequency, kVA, and power factor in table SXF101-II. Confirm that the utilization equipment does not use half-wave rectification and record in table SXF101-II. Compare the kVA, power factor, and rectification with the required limits/restriction of the applicable edition(s) of MIL-STD-704. If the utilization equipment performance specification document imposes current waveform limits, record the total current distortion and current spectrum in the data sheet shown in table SXF101-II and compare to the limits defined in the utilization equipment performance specification document. Repeat for each mode of operation of the UUT.

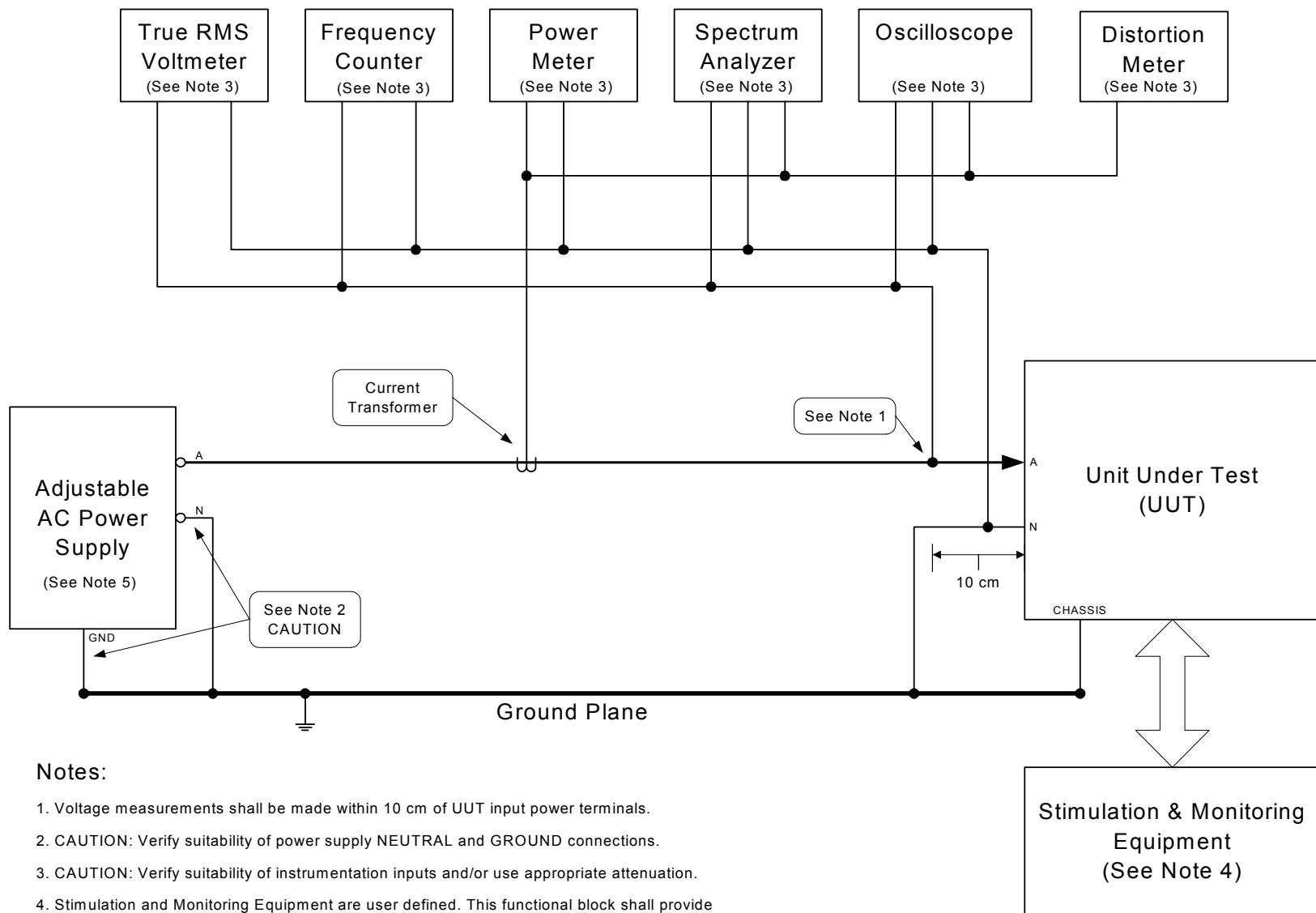
FIGURE SXF101-1. Load and current distortion measurement.

TABLE SXF101-II. Sample data sheet for SXF101 load measurements for single phase, 60 Hz utilization equipment.

Parameter	Measurement	Unit	Performance Pass/Fail
Voltage		V _{rms}	N/A
Frequency		Hz	N/A
kVA		kVA	
Power Factor		pf	
No Half-Wave Rectification		N/A	
Total Current Distortion		% Current Distortion	
Current Spectrum	Attach Spectrum Plot	Amplitude vs. Frequency	

MIL-HDBK-704-6

METHOD SXF102
Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
 OPERATING CONDITION: Normal

PARAMETER: Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 60 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency 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 and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF102-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 and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF102-I. MIL-STD-704 normal limits for steady state voltage and frequency for single phase, 60 Hz utilization equipment.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	N/A	N/A	N/A	N/A	N/A	105 V
Voltage NHSS	N/A	N/A	N/A	N/A	N/A	125 V
Frequency NLSS	N/A	N/A	N/A	N/A	N/A	59.5 Hz
Frequency NHSS	N/A	N/A	N/A	N/A	N/A	60.5 Hz

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

- a. Adjustable AC power supply
- b. True RMS voltmeter
- c. Frequency counter

MIL-HDBK-704-6

4. Test setup. Configure the test setup as shown in figure SXF102-1. 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 SXF102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 I noted in table SXF102-II, the UUT must remain 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. 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 SXF102-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 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 SXF102-II. Test conditions for steady state limits for voltage and frequency for single phase, 60 Hz utilization equipment.

Test Condition	Voltage	Frequency
A	115 V	60 Hz
B	115 V	59.5 Hz
C	115 V	60.5 Hz
D	105 V	60 Hz
E	105 V	59.5 Hz
F	105 V	60.5 Hz
G	125 V	60 Hz
H	125 V	59.5 Hz
I	125 V	60.5 Hz

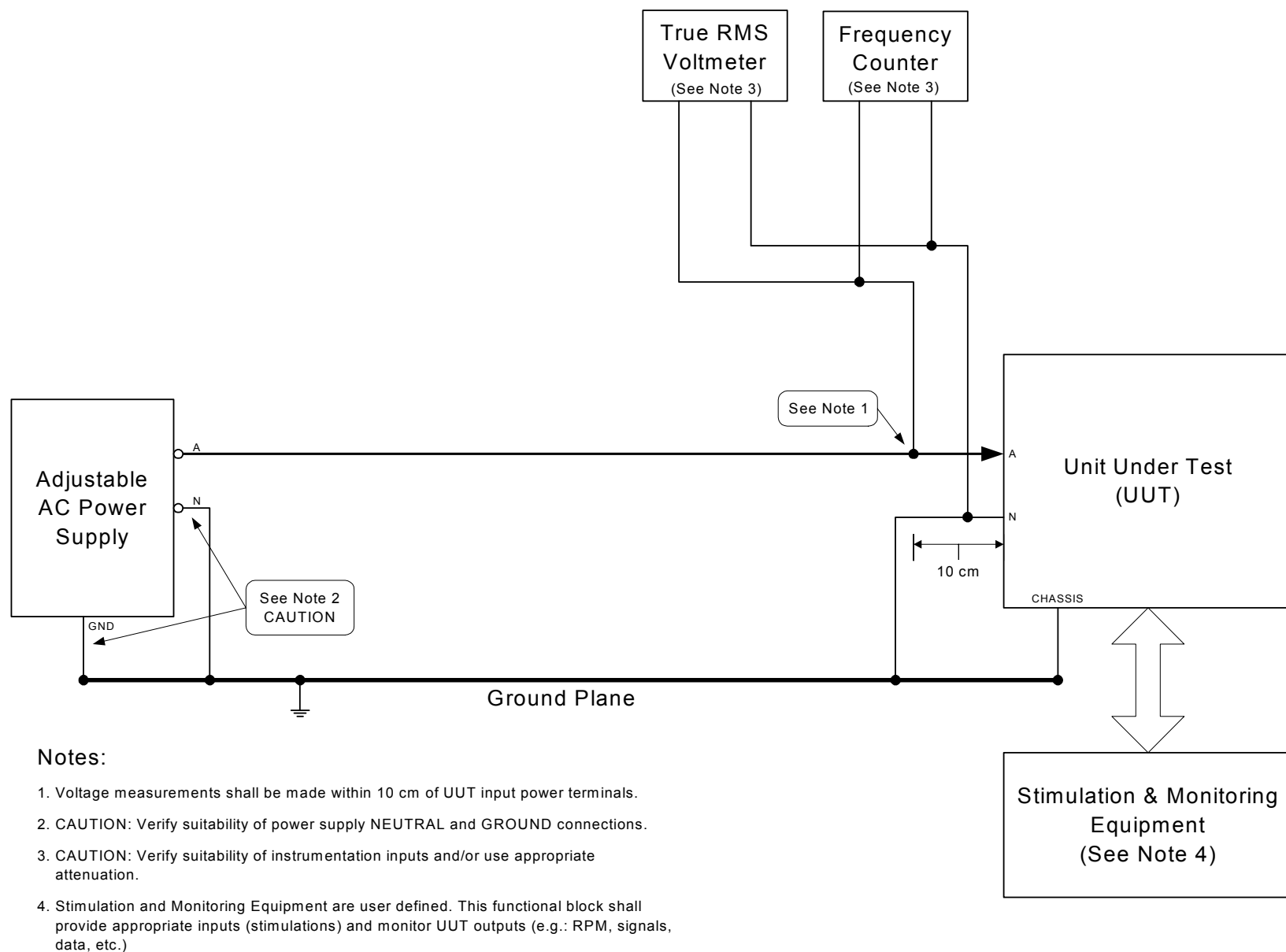
FIGURE SXF102-1. Steady state limits for voltage and frequency.

TABLE SXF102-III. Sample data sheet for SXF102 steady state limits for voltage and frequency for 60 Hz utilization equipment.

Test Condition	Parameters						Performance
	Voltage		Frequency		Time Duration at Condition		Pass/Fail
A		V _{rms}		Hz		min	
B		V _{rms}		Hz		min	
C		V _{rms}		Hz		min	
D		V _{rms}		Hz		min	
E		V _{rms}		Hz		min	
F		V _{rms}		Hz		min	
G		V _{rms}		Hz		min	
H		V _{rms}		Hz		min	
I		V _{rms}		Hz		min	

MIL-HDBK-704-6

METHOD SXF103

No Test Required

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: No Test Required.
Test number SXF103 is not used so that the Single Phase,
60 Hz, 115 V(SXF) test numbers coincide with the Three
Phase, 115 V (TAC and TVF) test sequence numbers.

MIL-HDBK-704-6

METHOD SXF104

Voltage Modulation

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Voltage Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to voltage modulation 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 having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SXF104-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 modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF104-I. MIL-STD-704 limits for voltage modulation for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Modulation	N/A	N/A	N/A	N/A	N/A	2.5 Vrms max

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

- Programmable AC power supply
- True RMS voltmeter
- Frequency counter
- Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF104-1. 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 SXF104-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the

MIL-HDBK-704-6

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 F noted in table SXF104-II, set the voltage modulation amplitude and frequency of voltage modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state voltage of 115 Vrms, at least ten (10) minutes at an average steady state voltage of 109 Vrms, and at least ten (10) minutes at an average steady state voltage of 117 Vrms. During the 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. Record average voltage, frequency, amplitude of voltage modulation, frequency of voltage modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SXF104-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 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 SXF104-II. Test conditions for voltage modulation for single phase, 60 Hz utilization equipment.

Test Condition	Frequency of Voltage Modulation	MIL-STD-704F Amplitude of Voltage Modulation Vrms
A	1.0 Hz	0.375 Vrms
B	1.5 Hz	2.5 Vrms
C	4 Hz	2.5 Vrms
D	10 Hz	0.375 Vrms
E	15 Hz	0.375 Vrms
F	30 Hz	0.375 Vrms

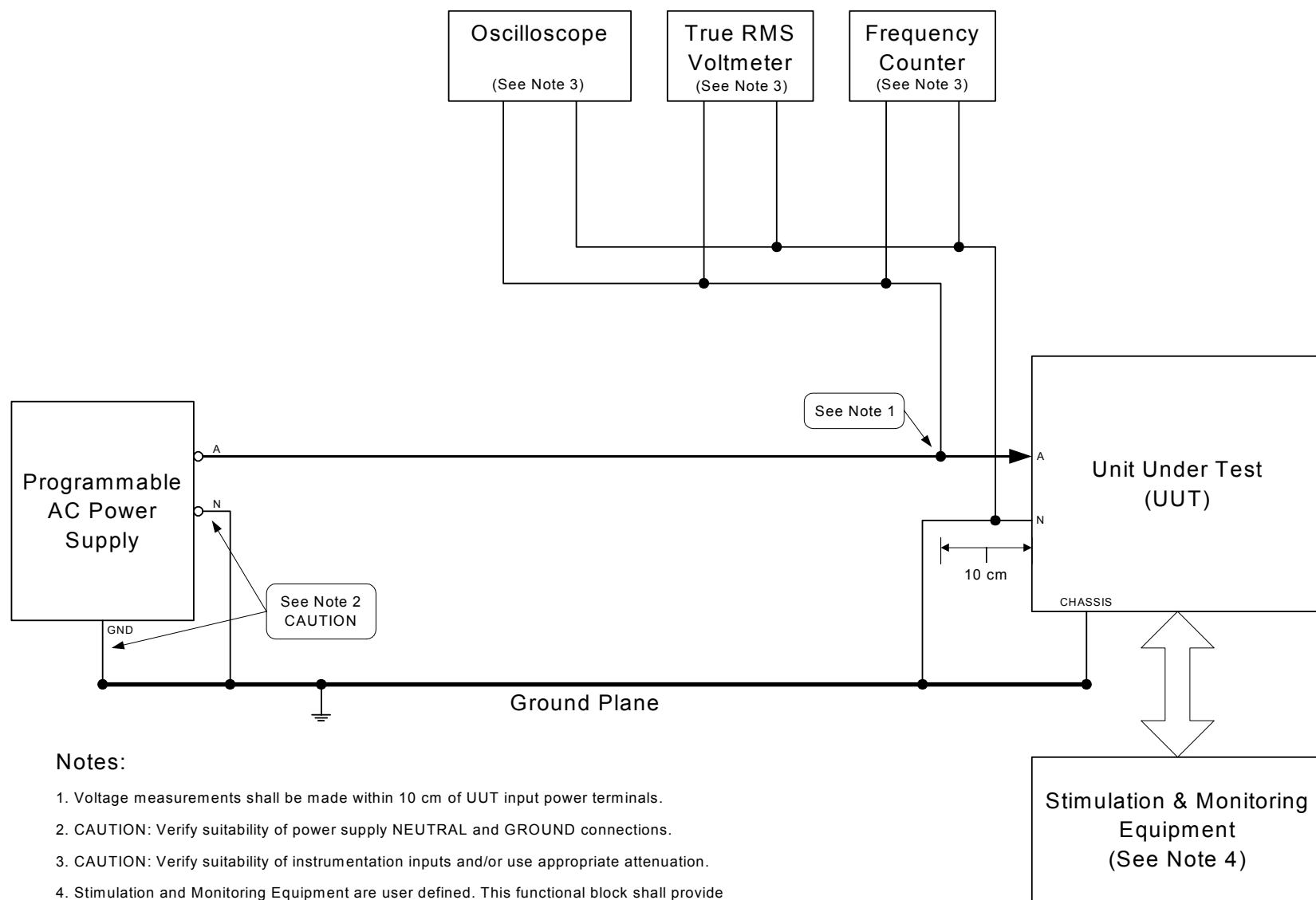
FIGURE SXF104-1. Voltage modulation.

TABLE SXF104-III. Sample data sheet for SXF104 voltage modulation for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Condition		Pass/Fail
A		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
B		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
C		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
D		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
E		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
F		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	
		V _{rms}		Hz		V _{rms}		Hz		min	

MIL-HDBK-704-6

METHOD SXF105
Frequency Modulation

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
 OPERATING CONDITION: Normal

PARAMETER: Frequency Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to frequency modulation 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 having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SXF105-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 frequency modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF105-I. MIL-STD-704 limits for frequency modulation for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Frequency Modulation	N/A	N/A	N/A	N/A	N/A	0.5 Hz

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

- a. Programmable AC power supply
- b. True RMS voltmeter
- c. Frequency counter
- d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF105-1. 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 SXF105-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient

MIL-HDBK-704-6

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 E noted in table SXF105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state frequency of 60 Hz, at least ten (10) minutes at an average steady state frequency of 59.75 Hz, and at least ten (10) minutes at an average steady state frequency of 60.75 Hz. During the 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. Record voltage, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SXF105-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 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 SXF105-II. Test conditions for frequency modulation for single phase, 60 Hz utilization equipment.

Test Condition	Rate of change for frequency modulation	MIL-STD-704F Amplitude of Frequency Modulation
A	0.1 Hz/sec	0.5 Hz (± 0.25 Hz)
B	0.5 Hz/sec	0.5 Hz (± 0.25 Hz)
C	4 Hz/sec	0.5 Hz (± 0.25 Hz)
D	25 Hz/sec	0.5 Hz (± 0.25 Hz)
E	15 Hz/sec	0.5 Hz (± 0.25 Hz)

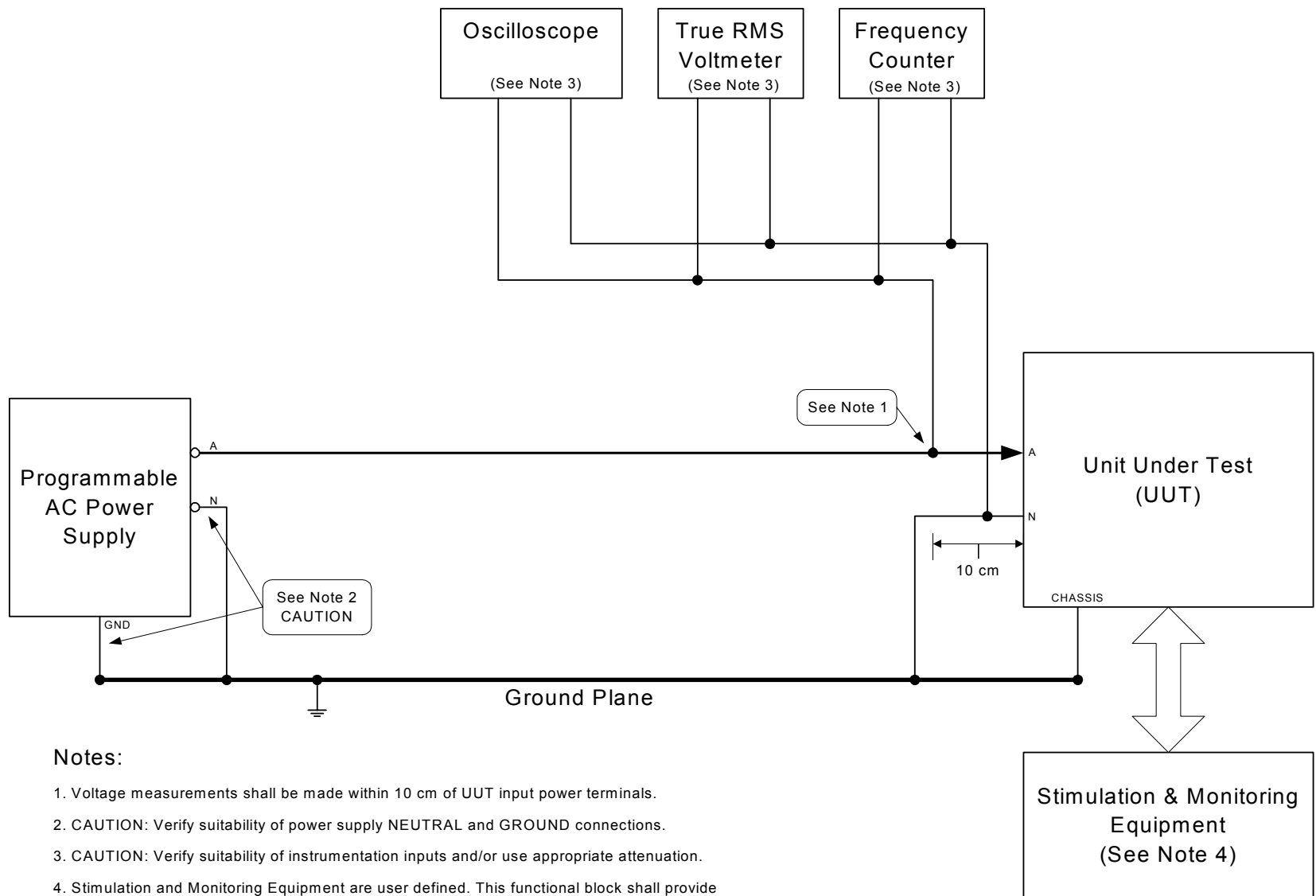
FIGURE SXF105-1. Frequency modulation.

TABLE SXF105-III. Sample data sheet for SXF105 frequency modulation for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Condition		Pass/Fail
A		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	
B		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	
C		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	
D		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	
E		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	
		V _{rms}		Hz		± Hz		Hz/sec		min	

MIL-HDBK-704-6

METHOD SXF106

Voltage Distortion Spectrum

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Voltage Distortion Spectrum

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz 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 SXF106-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 SXF106 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 SXF106 of this handbook.

TABLE SXF106-I. MIL-STD-704 limits for voltage distortion spectrum for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	N/A	N/A	N/A	N/A	N/A	figure 12 MIL-STD-704F

MIL-HDBK-704-6

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

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

4. Test setup. Configure the test setup as shown in figure SXF106-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

4.1 Calibration (50 Hz to 10 kHz). Install a calibrated resistive load in the test setup shown in figure SXF106-1 in place of the UUT. The calibrated resistive load must be sized to draw the same current as the UUT. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Set the variable frequency power source to output a sine wave and adjust the frequency and amplitude so that the voltage distortion measured at the input to the calibrated resistive load conforms to each test condition A through G in table SXF106-II of the applicable edition(s) of MIL-STD-704. Record the settings of the variable frequency power source for each test condition.

5. Compliance test. With the adjustable AC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF106-1. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 A 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 A through G noted in table SXF106-II. For each test condition, record voltage, frequency, 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 SXF106-III. Repeat for each mode of operation of the UUT.

MIL-HDBK-704-6

After all test conditions are complete, turn the adjustable AC power supply off and remove the coupling transformer from the circuit. Turn on the adjustable AC power supply. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to the nominal steady state frequency of 60 Hz. 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 confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF106-II. Test conditions for voltage distortion spectrum for single phase, 60 Hz utilization equipment.

Test Condition	Frequency of Voltage Distortion	MIL-STD-704F Amplitude of Voltage Distortion Voltage rms
A	50 Hz	1.000 Vrms
B	150 Hz	3.162 Vrms
C	450 Hz	3.162 Vrms
D	1 kHz	1.333 Vrms
E	3 kHz	0.473 Vrms
F	5 kHz	0.282 Vrms
G	10 kHz	0.150 Vrms

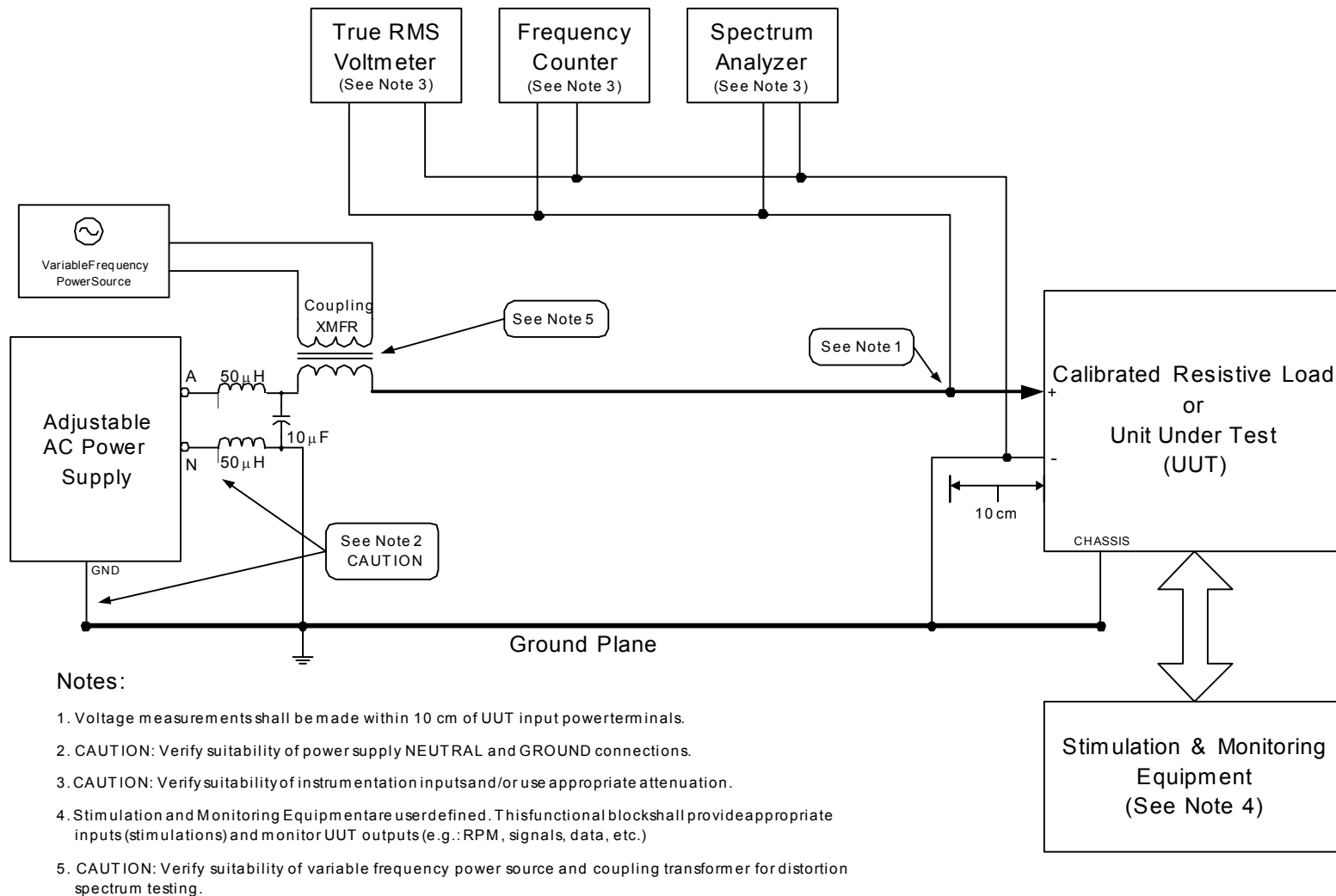
FIGURE SXF106-1. Normal operation - voltage distortion spectrum (50 Hz to 10 kHz).

TABLE SXF106-III. Sample data sheet for SXF106 voltage distortion spectrum for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Condition		Pass/Fail
A		V _{rms}		Hz		Hz		V _{rms}		min	
B		V _{rms}		Hz		Hz		V _{rms}		min	
C		V _{rms}		Hz		Hz		V _{rms}		min	
D		V _{rms}		Hz		kHz		V _{rms}		min	
E		V _{rms}		Hz		kHz		V _{rms}		min	
F		V _{rms}		Hz		kHz		V _{rms}		min	
G		V _{rms}		Hz		kHz		V _{rms}		min	

MIL-HDBK-704-6

METHOD SXF107
Total Voltage Distortion

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
 OPERATING CONDITION: Normal

PARAMETER: Total Voltage Distortion

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to a voltage waveform having a distortion factor 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 a voltage waveform having a distortion factor as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SXF107-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 SXF107-I. MIL-STD-704 limits for total voltage distortion for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Factor	N/A	N/A	N/A	N/A	N/A	0.05

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

- a. Programmable AC power supply
- b. True RMS voltmeter
- c. Frequency counter
- d. Spectrum analyzer
- e. Distortion meter

4. Test setup. Configure the test setup as shown in figure SXF107-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

4.1 Calibration. Install a resistive load in the test setup shown in figure SXF107-1 in place of the UUT. The resistive load must be sized to draw the same current as the UUT. Set

MIL-HDBK-704-6

the programmable power supply to produce a voltage waveform having harmonic contents listed in table SXF107-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60Hz. Confirm that the programmable power supply is producing a voltage waveform having harmonic content listed in table SXF107-II. Record the settings of the programmable power supply.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF107-1. Set the programmable power supply to the settings recorded during the calibration procedure. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the total voltage distortion 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, frequency, voltage distortion factor, voltage harmonics, time duration at test condition, and the performance of the UUT in the data sheet shown in table SXF107-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce a sine wave. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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.

MIL-HDBK-704-6

TABLE SXF107-II. Voltage harmonics as percent of fundamental for total voltage distortion test for single phase, 60 Hz utilization equipment.

Harmonic	MIL-STD-704F Percent of Fundamental
Fundamental	100%
2nd	0%
3rd	2.75%
4th	0%
5th	2.75%
6th	0%
7th	1.97%
8th	0%
9th	1.53%
10th	0%
11th	1.25%
12th	0%
13th	1.06%
14th	0%
15th	0.92%

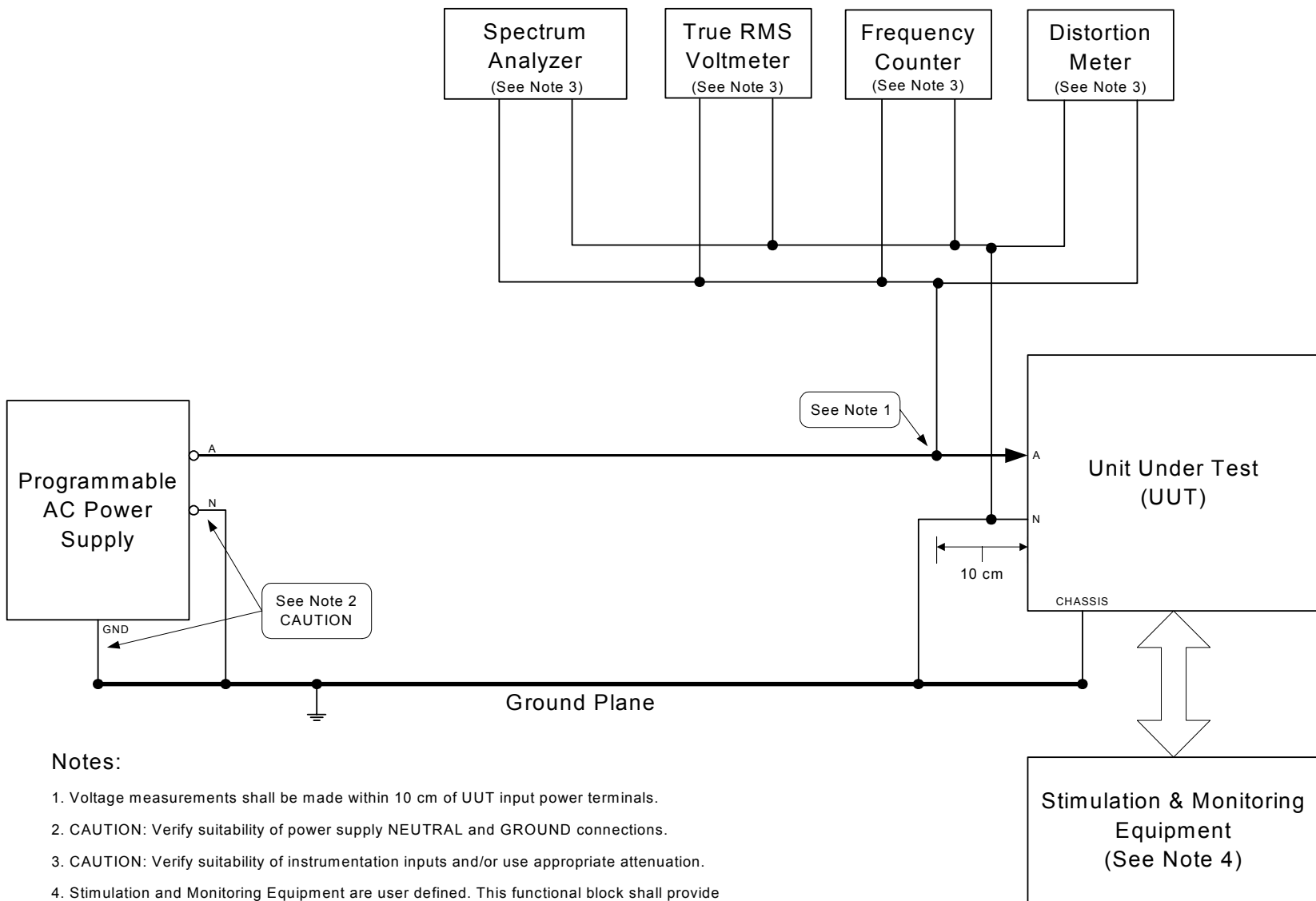
FIGURE SXF107-1. Total distortion.

TABLE SXF107-III. Sample data sheet for SXF107 total voltage distortion for single phase, 60 Hz utilization equipment.

Parameters								Performance
Voltage		Frequency		Voltage Distortion Factor		Time Duration at Condition		Pass/Fail
	V _{rms}		Hz		No Units		min	
Voltage Harmonics								
Fund								%
2 nd								%
3 rd								%
4 th								%
5 th								%
6 th								%
7 th								%
8 th								%
9 th								%
10 th								%
11 th								%
12 th								%
13 th								%
14 th								%
15 th								%

MIL-HDBK-704-6

METHOD SXF108
DC Voltage Component

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
 OPERATING CONDITION: Normal

PARAMETER: DC Voltage Component

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage 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 a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SXF108-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 direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF108-I. MIL-STD-704 limits for direct current component of AC voltage for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
DC Voltage Component of the AC Voltage	N/A	N/A	N/A	N/A	N/A	± 0.10 V

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

- a. Programmable AC power supply
- b. True RMS voltmeter (with capability to measure DC component of AC waveform)
- c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SXF108-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

MIL-HDBK-704-6

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF108-1. Set the programmable power supply to produce a voltage waveform having a DC component for test condition A as noted in table SXF108-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the direct current component of the AC voltage and should be not less than thirty (30) minutes. Repeat the test for test condition B as noted in table SXF108-II. Record the voltage, frequency, DC voltage component, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SXF108-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce a voltage sine wave without a DC component. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 SXF108-II. Test conditions for direct current component of AC voltage for single phase, 60 Hz utilization equipment.

Test Condition	MIL-STD-704F Direct Current Component of AC Voltage
A	+ 0.10V
B	– 0.10 V

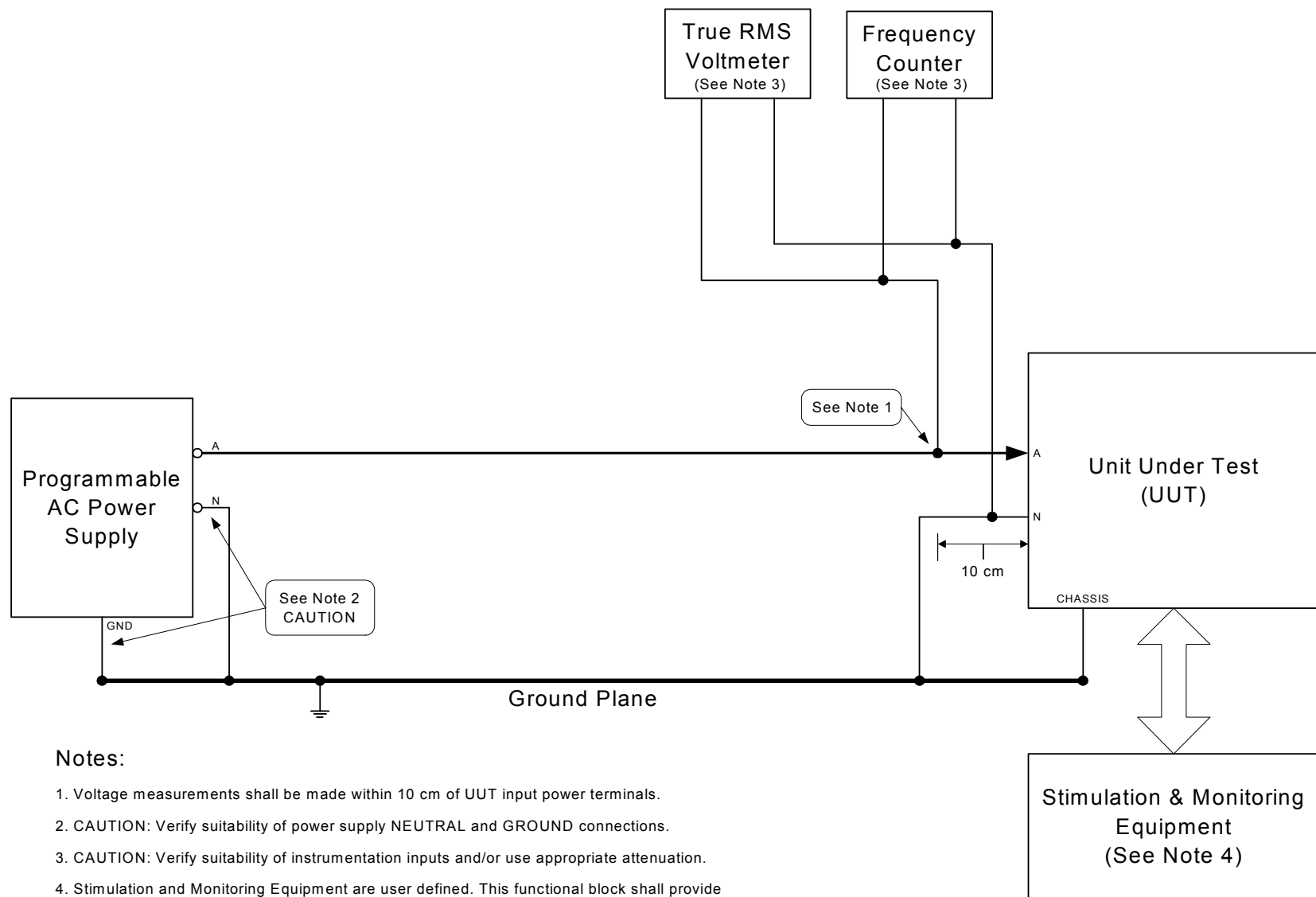
FIGURE SXF108-1. DC voltage component.

TABLE SXF108-III. Sample data sheet for SXF108 DC voltage component for single phase, 60 Hz utilization equipment.

Test Condition	Parameters								Performance
	Voltage		Frequency		DC Voltage Component		Time Duration at Condition		Pass/Fail
A		V _{rms}		Hz		V _{dc}		min	
B		V _{rms}		Hz		V _{dc}		min	

MIL-HDBK-704-6

METHOD SXF109

Normal Voltage Transients

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Normal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz 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 SXF109-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 SXF109-I. MIL-STD-704 limits for normal voltage transients for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	N/A	N/A	N/A	N/A	N/A	figure 8 MIL-STD-704F

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

- a. Programmable AC power supply
- b. True RMS voltmeter
- c. Frequency counter
- d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF109-1. 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 SXF109-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the

MIL-HDBK-704-6

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

The UUT must be subjected to the voltage transients for each test condition A through I noted in table SXF109-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within $\frac{1}{2}$ cycle (8.33 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table SXF109-II. The voltage must return to steady state over the time duration noted in table SXF109-II. For test condition D, three over-voltage transients of 130 Vrms for 16.67 milliseconds are performed, separated by 0.5 seconds. For test condition H, three under-voltage transients of 70 Vrms for 16.67 milliseconds are performed, separated by 0.5 seconds. For test condition I, an under-voltage transient of 70 Vrms for 16.67 milliseconds is immediately followed by an overvoltage transient of 130 Vrms for 16.67 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, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SXF109-III. Repeat for each mode of operation of the UUT. In addition, perform the repetitive normal voltage transient test described below.

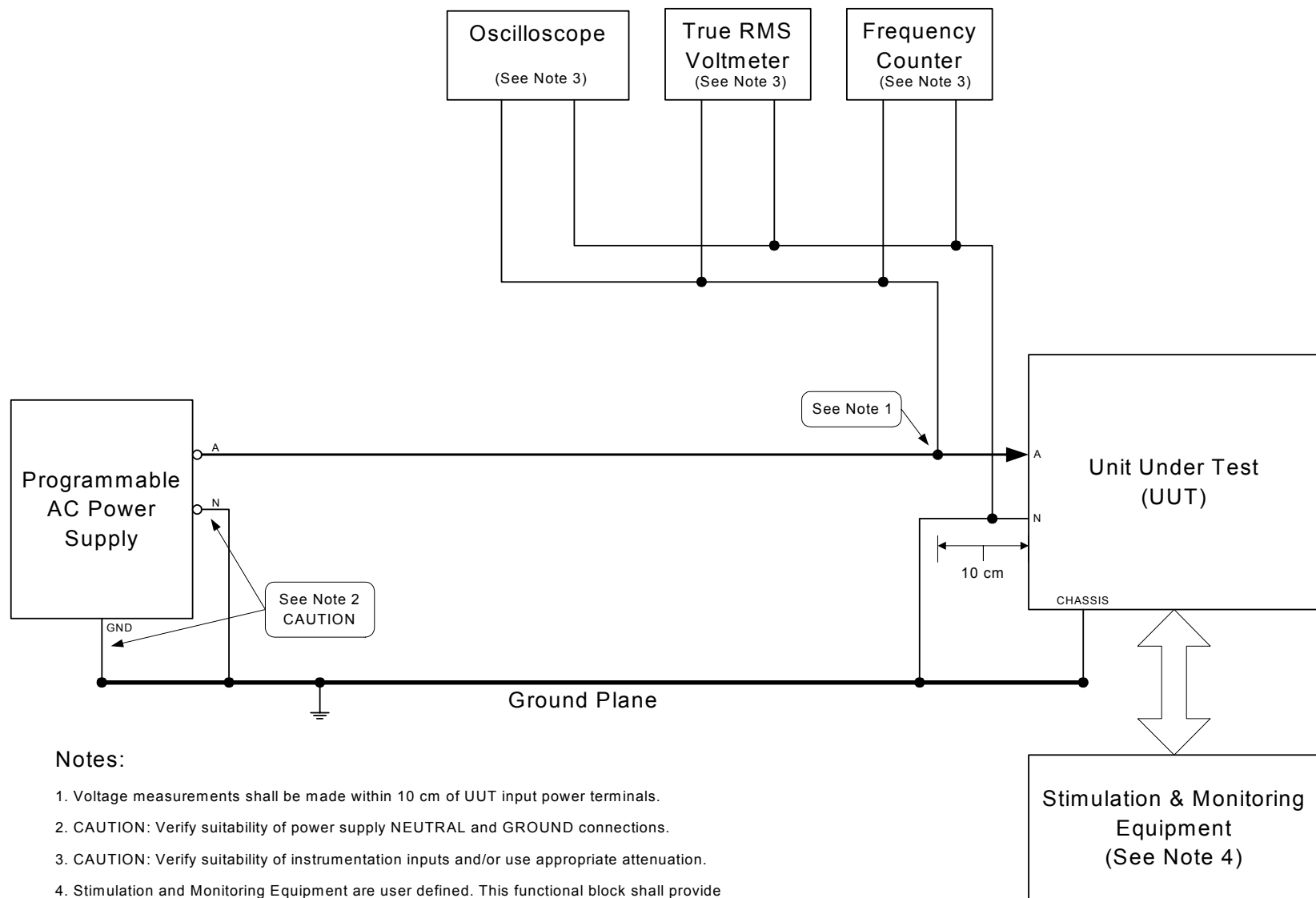
5.1 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 115 Vrms to 100 Vrms in 8.33 msec, then increases to 128 Vrms over 50 msec, then decreases to 115 Vrms over 8.33 msec. The voltage transient is repeated every 0.5 seconds, see figure SXF109-2. 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 steady state voltage, steady state frequency, high voltage transient level, low voltage transient level, oscilloscope trace, time duration at test condition, and the performance of the UUT in the data sheet shown in table SXF109-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 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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.

MIL-HDBK-704-6

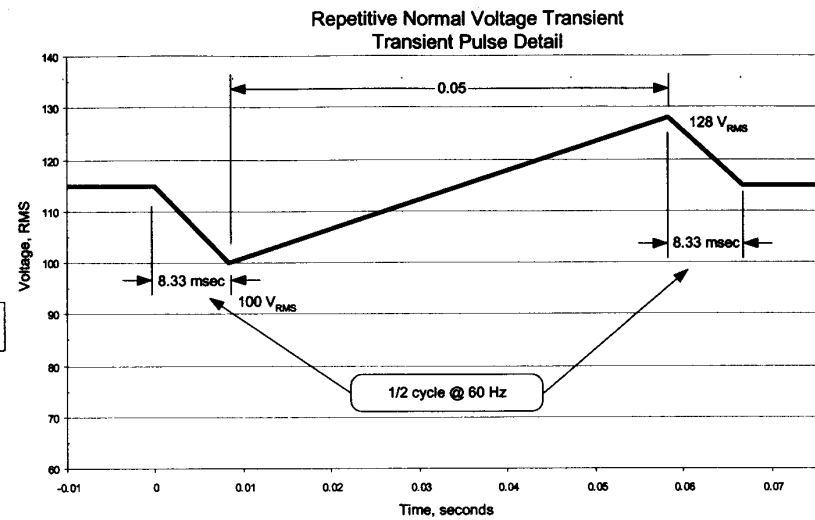
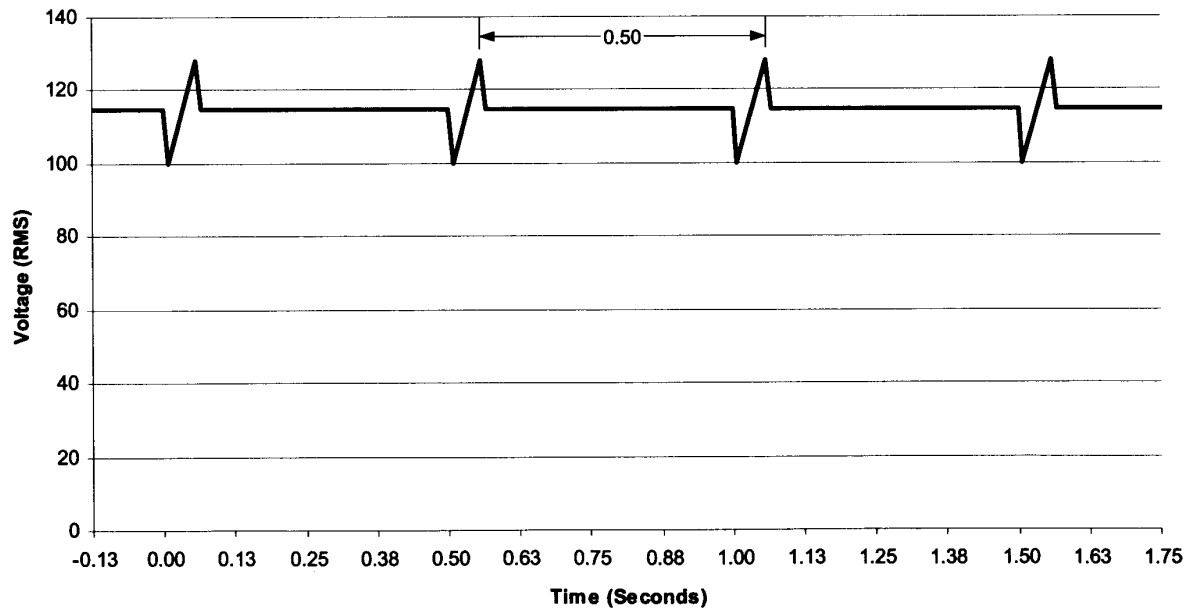
TABLE SXF109-II. Test conditions for normal voltage transients for single phase, 60 Hz utilization equipment.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
A	N/A	152 Vrms	1/2 cycle	N/A
B	< 8.333 msec	130 Vrms	1 cycle	< 8.333 msec
C	< 8.333 msec	130 Vrms	1 cycle	250 msec
D	< 8.333 msec	130 Vrms (3 times)	1 cycle every 0.5 sec	< 8.333 msec
Undervoltage Transients				
E	N/A	31 Vrms	1/2 cycle	N/A
F	< 8.333 msec	70 Vrms	1 cycle	< 8.333 msec
G	< 8.333 msec	70 Vrms	1 cycle	107 msec
H	< 8.333 msec	70 Vrms (3 times)	1 cycle every 0.5 sec	< 8.333 msec
Combined Transient				
I	< 8.333 msec	70 Vrms	1 cycle	< 8.333 msec
	then < 8.333 msec	130 Vrms	1 cycle	250 msec

FIGURE SXF109-1. Normal voltage transients.

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

Repetitive Normal Voltage Transient



Pulse Detail

FIGURE SXF109-2. Repetitive normal voltage transient.

TABLE SXF109-III. Sample data sheet for SXF109 normal voltage transients for MIL-STD-704 for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance	
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail	
A		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time		
B		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time		
C		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time		
D		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time		
E		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time		
F		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time		
G		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time		
H		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time		
I		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time		
						V _{rms}		msec				
Repetitive Normal Voltage Transient												
Repetitive Transient	Steady State Voltage		Steady State Frequency		High Voltage Transient		Low Voltage Transient		Oscilloscope Trace			
		V _{rms}		Hz		V _{rms}		V _{rms}	Attach Trace	V _{rms} vs. Time		
	Time Duration at Test Condition											
		minutes										

MIL-HDBK-704-6

METHOD SXF110

Normal Frequency Transients

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Normal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to normal frequency 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 frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF110-I. MIL-STD-704 limits for normal frequency transients for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Normal Frequency Transients	N/A	N/A	N/A	N/A	N/A	figure 10 MIL-STD-704F
Normal Maximum Rate of Change of Frequency	N/A	N/A	N/A	N/A	N/A	100 Hz/sec

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

- a. Programmable AC power supply
- b. True RMS voltmeter
- c. Frequency counter
- d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF110-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

MIL-HDBK-704-6

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF110-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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.

The UUT must be subjected to the frequency transients for each test condition A through E noted in table SXF110-II. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition E, an underfrequency transient of 59 Hz is immediately followed by an overfrequency transient of 61 Hz. For each test condition, monitor the performance of the UUT during the frequency 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, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table SXF110-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 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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.

MIL-HDBK-704-6

TABLE SXF110-II. Test conditions for normal frequency transients for single phase, 60 Hz utilization equipment.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency
Overfrequency Transients				
A	10 msec	61 Hz	½ cycle	10 msec
B	10 msec	61 Hz	5 sec	10 msec
Underfrequency Transients				
C	10 msec	59 Hz	½ cycle	10 msec
D	10 msec	59 Hz	5 sec	10 msec
Combined Transient				
E	10 msec then 10 msec	59 Hz 61 Hz	½ cycle ½ cycle	10 msec 10 msec

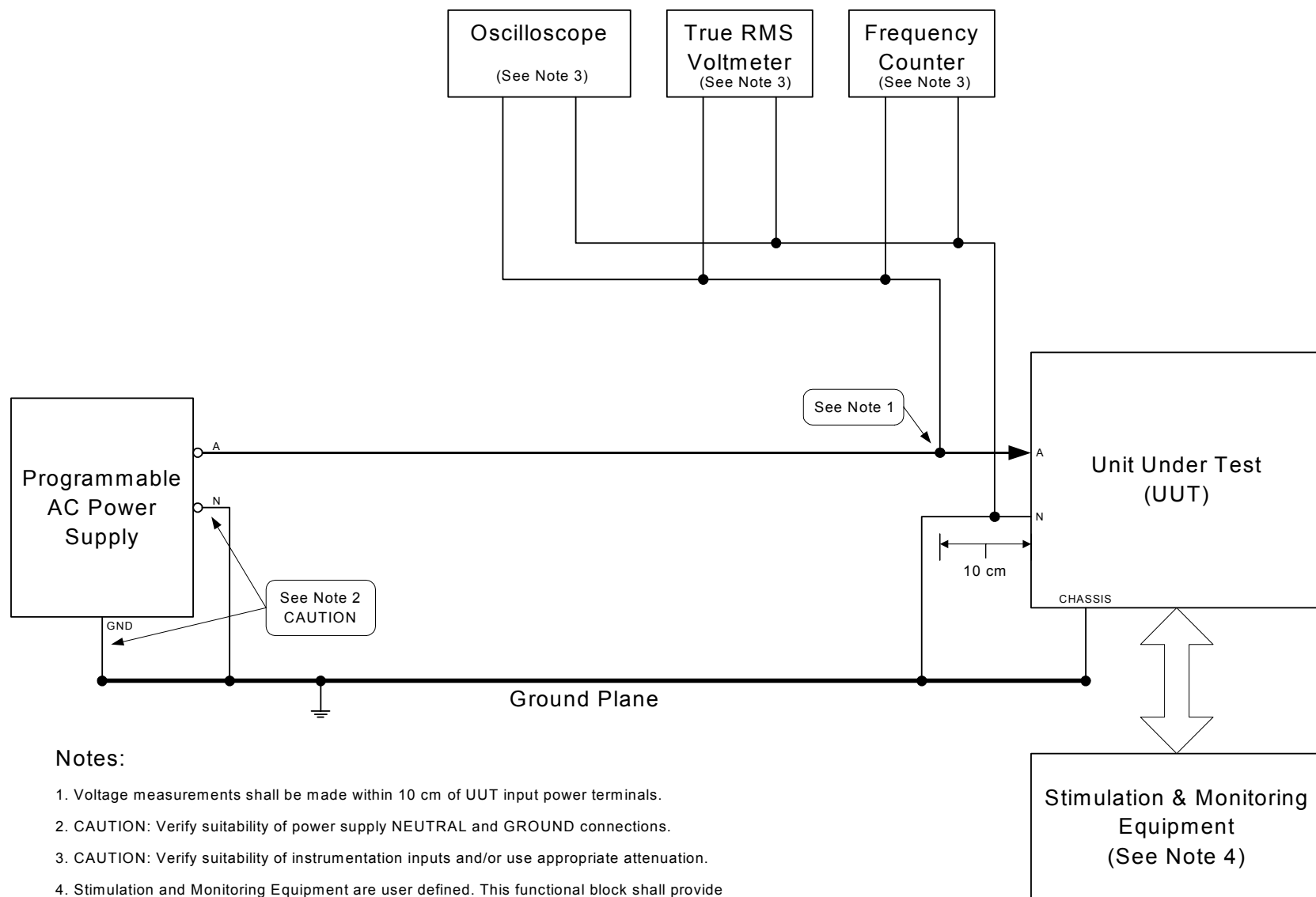
FIGURE SXF110-1. Normal frequency transients.

TABLE SXF110-III. Sample data sheet for SXF110 normal frequency transients for MIL-STD-704 for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
A		V _{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
B		V _{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
C		V _{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
D		V _{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
E		V _{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
						Hz		msec			

MIL-HDBK-704-6

METHOD SXF201
Power Interrupt

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Transfer Interrupt

PARAMETER: Power Interrupt

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz 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 SXF201-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 SXF201-I. MIL-STD-704 power transfer limits for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	N/A	N/A	N/A	N/A	N/A	50 msec
Voltage NLSS	N/A	N/A	N/A	N/A	N/A	105 V
Voltage NHSS	N/A	N/A	N/A	N/A	N/A	125 V

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

- a. Programmable AC power supply
- b. True RMS voltmeter
- c. Frequency counter
- d. Oscilloscope
- e. Resistive dummy load

4. Test setup. Configure the test setup as shown in figure SXF201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the

MIL-HDBK-704-6

UUT. Note: This is done to ensure that the UUT test 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 SXF201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 SXF201-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 $\frac{1}{2}$ cycle (8.33 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within $\frac{1}{2}$ cycle (8.33 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 130 Vrms for 1 cycle and returns to nominal voltage over the next 250 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 70 Vrms for 1 cycle and returns to nominal voltage over the next 107 milliseconds. For each test condition, monitoring 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 the performance specified for normal aircraft electrical conditions (if the UUT is allowed degraded performance during power interrupts, verify the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage). Record the steady state voltage, steady state frequency, time duration of power interrupts, and the performance of the UUT for each test condition in the data sheet shown in table SXF201-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 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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.

MIL-HDBK-704-6

TABLE SXF201-II. Test conditions for transfer interrupt for single phase, 60 Hz utilization equipment.

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 130 Vrms for 1 cycle and return to steady state voltage in 250 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 70 Vrms for 1 cycle and return to steady state voltage in 107 msec)

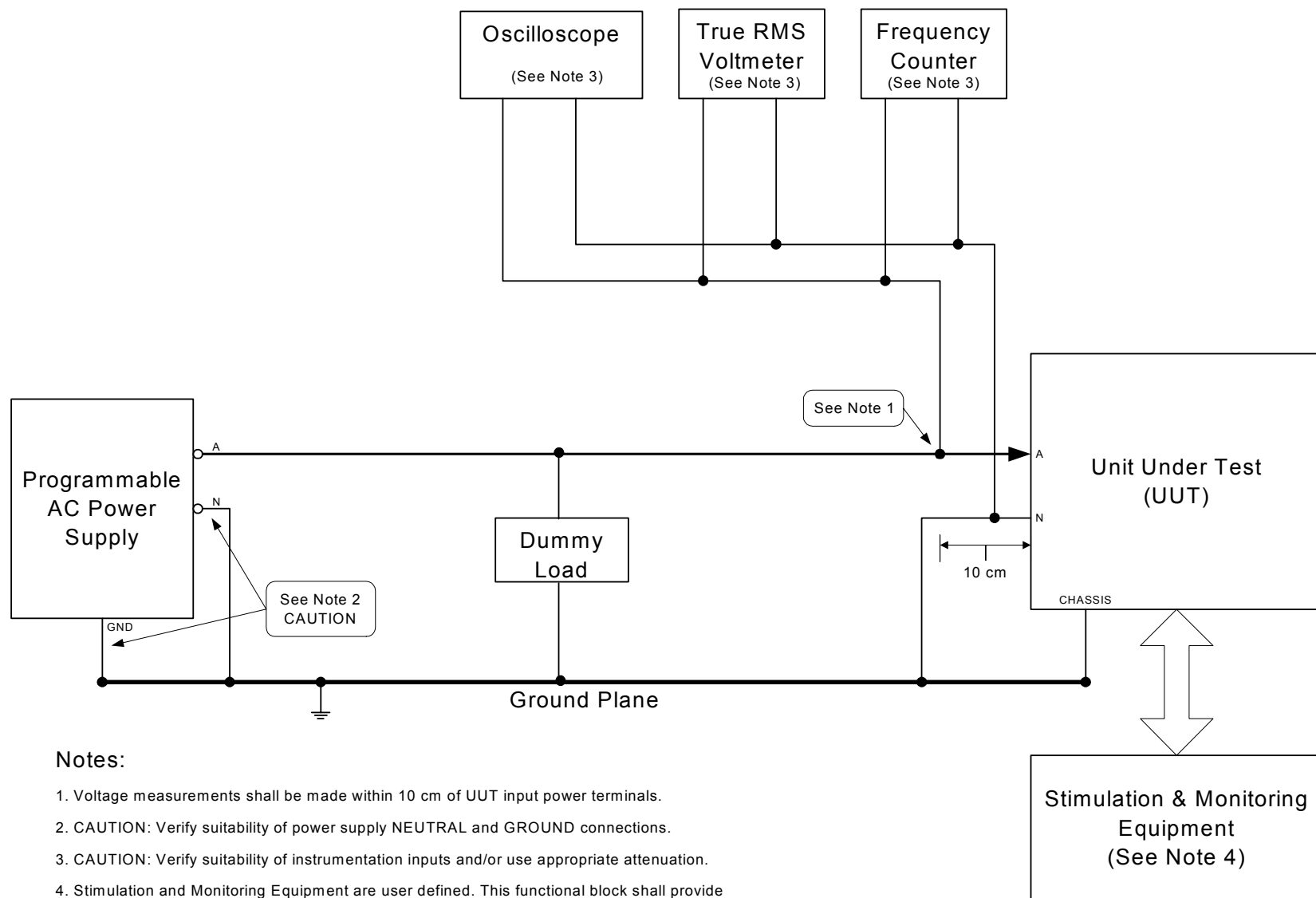
FIGURE SXF201-1. Power interrupt.

TABLE SXF201-III. Sample data sheet for SXF201 power interrupt for single phase, 60 Hz utilization equipment.

Test Condition	Parameters						Performance
	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
A		V _{rms}		Hz		msec	
B		V _{rms}		Hz		msec	
C		V _{rms}		Hz		msec	
D		V _{rms}		Hz		msec	
E		V _{rms}		Hz		msec	
F		V _{rms}		Hz		msec	
G		V _{rms}		Hz		msec	
H		V _{rms}		Hz		msec	
I		V _{rms}		Hz		msec	
J		V _{rms}		Hz		msec	
K		V _{rms}		Hz		msec	
	Overvoltage Transient						
	Voltage Transient			Time at Voltage Transient Level			
		V _{rms}		msec			
L		V _{rms}		Hz		msec	
	Overvoltage Transient						
	Voltage Transient			Time at Voltage Transient Level			
		V _{rms}		msec			

MIL-HDBK-704-6

METHOD SXF301
Abnormal Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
 OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at 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 and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits 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 and frequency limits. 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 SXF301-I. MIL-STD-704 abnormal limits for steady state voltage and frequency for single phase, 60 Hz utilization equipment.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage ALSS	N/A	N/A	N/A	N/A	N/A	100 V
Voltage AHSS	N/A	N/A	N/A	N/A	N/A	128 V
Frequency ALSS	N/A	N/A	N/A	N/A	N/A	59.5 Hz
Frequency AHSS	N/A	N/A	N/A	N/A	N/A	60.5 Hz

MIL-HDBK-704-6

3. Apparatus. The test equipment should be as follows:
 - a. Adjustable AC power supply
 - b. True RMS voltmeter
 - c. Frequency counter
4. Test setup. Configure the test setup as shown in figure SXF301-1. 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 SXF301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 H noted in table SXF301-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 and frequency 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 shut down 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 115 Vrms and adjust the frequency to the nominal steady state frequency of 60 Hz. 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, 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 SXF301-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 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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.

MIL-HDBK-704-6

TABLE SXF301-II. Test conditions for abnormal steady state limits for voltage and frequency for single phase, 60 Hz utilization equipment.

Test Condition	Voltage	Frequency
A	Nominal Voltage	ALSS Frequency
B	Nominal Voltage	AHSS Frequency
C	ALSS Voltage	Nominal Frequency
D	ALSS Voltage	ALSS Frequency
E	ALSS Voltage	AHSS Frequency
F	AHSS Voltage	Nominal Frequency
G	AHSS Voltage	ALSS Frequency
H	AHSS Voltage	AHSS Frequency

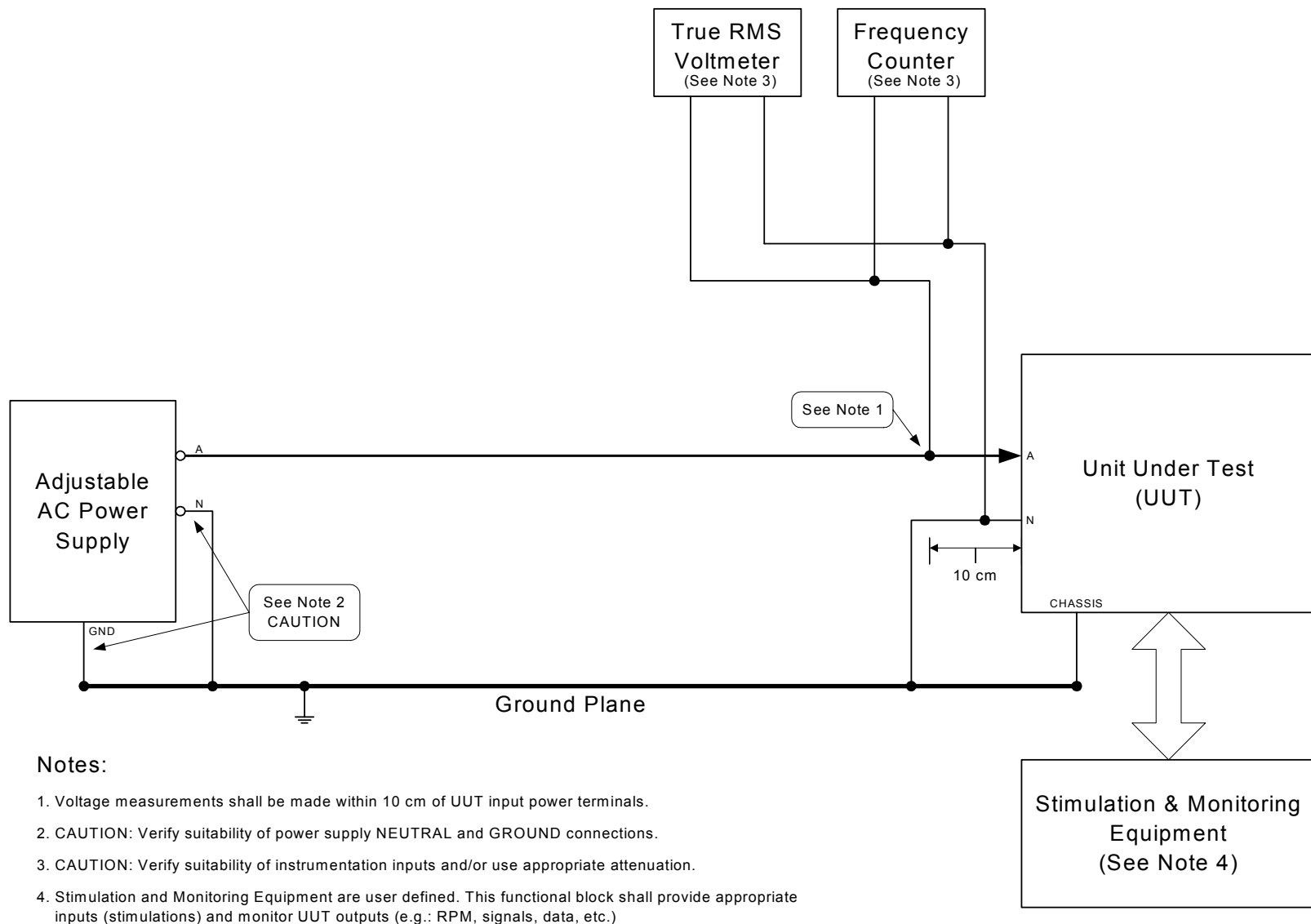
FIGURE SXF301-1. Abnormal steady state limits for voltage and frequency.

TABLE SXF301-III. Sample data sheet for SXF301 abnormal steady state limits for voltage and frequency for single phase, 60 Hz utilization equipment.

Test Condition	Parameters						Performance
	Voltage		Frequency		Time Duration at Condition		Pass/Fail
A		V _{rms}		Hz		min	
B		V _{rms}		Hz		min	
C		V _{rms}		Hz		min	
D		V _{rms}		Hz		min	
E		V _{rms}		Hz		min	
F		V _{rms}		Hz		min	
G		V _{rms}		Hz		min	
H		V _{rms}		Hz		min	

MIL-HDBK-704-6

METHOD SXF302
Abnormal Voltage Transients

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
 OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz 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 SXF302-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 SXF302-I. MIL-STD-704 limits for abnormal voltage transients for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	N/A	N/A	N/A	N/A	N/A	figure 9 MIL-STD-704F

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

- a. Programmable AC power supply
- b. True RMS voltmeter
- c. Frequency counter
- d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF302-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

MIL-HDBK-704-6

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF302-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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.

The UUT must be subjected to the voltage transients for each test condition A through K noted in table SXF302-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within $\frac{1}{2}$ cycle (8.33 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table SXF302-II. The voltage must return to steady state over the time duration noted in table SXF302-II. For test condition E, three over-voltage transients of 180 Vrms for $\frac{1}{2}$ cycle are performed, separated by 0.5 second. For test condition J, three under-voltage transients of 50 Vrms for $\frac{1}{2}$ cycle are performed, separated by 0.5 seconds. For test condition K, an under-voltage transient of 50 Vrms for $\frac{1}{2}$ cycle is immediately followed by an overvoltage transient of 180 Vrms for $\frac{1}{2}$ cycle 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, and has not suffered damage. Record the steady state voltage, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SXF302-III. Repeat for each mode of operation of the UUT.

MIL-HDBK-704-6

TABLE SXF302-II. Test conditions for abnormal voltage transients for single phase, 60 Hz utilization equipment.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients				
A	< 8.333 msec	180 Vrms	1/2 cycle	< 8.333 msec
B	< 8.333 msec	180 Vrms	1/2 cycle	16.67 msec
	then	147 Vrms	Decreasing	16.67 msec
	then	140 Vrms	Decreasing	2.0 sec
		115 Vrms		
C	< 8.333 msec	160 Vrms	1 cycle	< 8.333 msec
D	< 8.333 msec	160 Vrms	1 cycle	16.67 msec
	then	140 Vrms	Decreasing	2.0 sec
		115 Vrms		
E	< 8.333 msec	180 Vrms (3 times)	1/2 cycle every 0.5 sec	< 8.333 msec
Undervoltage Transients				
F	< 8.333 msec	50 Vrms	1/2 cycle	< 8.333 msec
G	< 8.333 msec	50 Vrms	1/2 cycle	16.67 msec
	then	83 Vrms	Increasing	16.67 msec
	then	90 Vrms	Increasing	2.0 sec
		115 Vrms		
H	< 8.333 msec	70 Vrms	1 cycle	< 8.333 msec
I	< 8.333 msec	70 Vrms	1 cycle	16.67 msec
	then	90 Vrms	Increasing	2.0 sec
		115 Vrms		
J	< 8.333 msec	50 Vrms (3 times)	1/2 cycle every 0.5 sec	< 8.333 msec
Combined Transient				
K	< 8.333 msec	50 Vrms	1/2 cycle	< 8.333 msec
	< 8.333 msec	180 Vrms	1/2 cycle	16.67 msec
	then	147 Vrms	Decreasing	16.67 msec
	then	140 Vrms	Decreasing	2.0 sec
		115 Vrms		

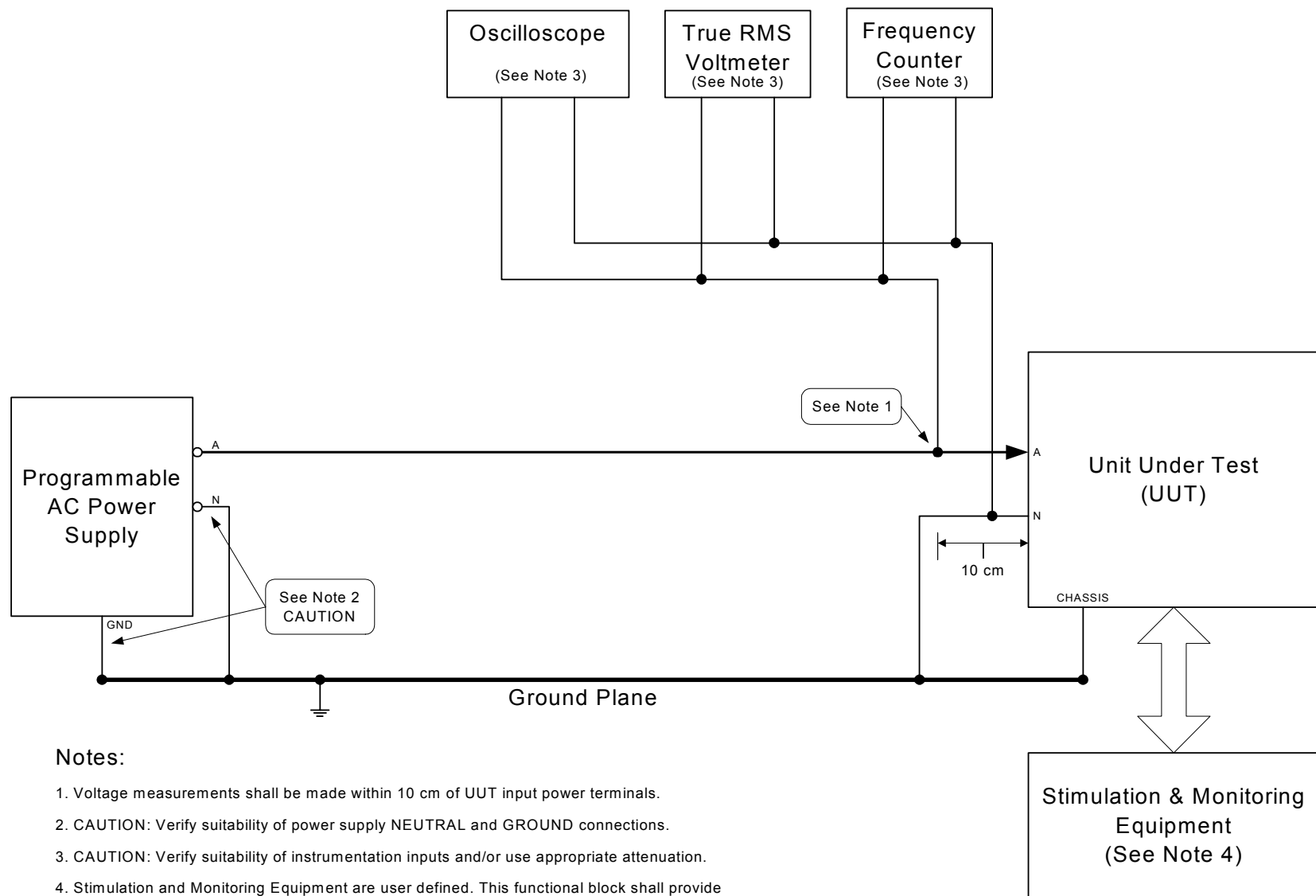
FIGURE SXF302-1. Abnormal voltage transients.

TABLE SXF302-III. Sample data sheet for SXF302 abnormal voltage transients for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
B		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
C		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
D		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
E		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
F		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
G		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
H		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
I		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
J		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
K		V _{rms}		Hz		V _{rms}		msec	Attach Trace	V _{rms} vs. Time	
						V _{rms}		msec			

MIL-HDBK-704-6

METHOD SXF303

Abnormal Frequency Transients

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal frequency 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 frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF303-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 SXF303-I. MIL-STD-704 limits for abnormal frequency transients for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Frequency Transients	N/A	N/A	N/A	N/A	N/A	figure 11 MIL-STD-704F
Abnormal Maximum Rate of Change of Frequency	N/A	N/A	N/A	N/A	N/A	150 Hz/sec

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

- a. Programmable AC power supply
- b. True RMS voltmeter
- c. Frequency counter
- d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF303-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

MIL-HDBK-704-6

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF303-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 abnormal aircraft electrical conditions.

The UUT must be subjected to the frequency transients for each test condition A through E noted in table SXF303-II. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition E, an underfrequency transient of 320 Hz is immediately followed by an overfrequency transient of 480 Hz. For each test condition, monitor the performance of the UUT during the frequency 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 is providing specified performance for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table SXF303-III. Repeat for each mode of operation of the UUT.

TABLE SXF303-II. Test conditions for MIL-STD-704 abnormal frequency transients for single phase, 60 Hz utilization equipment.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency milliseconds
Overfrequency Transients				
A	½ cycle	61 Hz	½ cycle	½ cycle
B	½ cycle	61 Hz	6.968 seconds	½ cycle
Underfrequency Transients				
C	½ cycle	50 Hz	½ cycle	½ cycle
D	½ cycle	50 Hz	6.968 seconds	½ cycle
Combined Transient				
E	½ cycle ½ cycle	50 Hz then 61 Hz	½ cycle ½ cycle	½ cycle ½ cycle

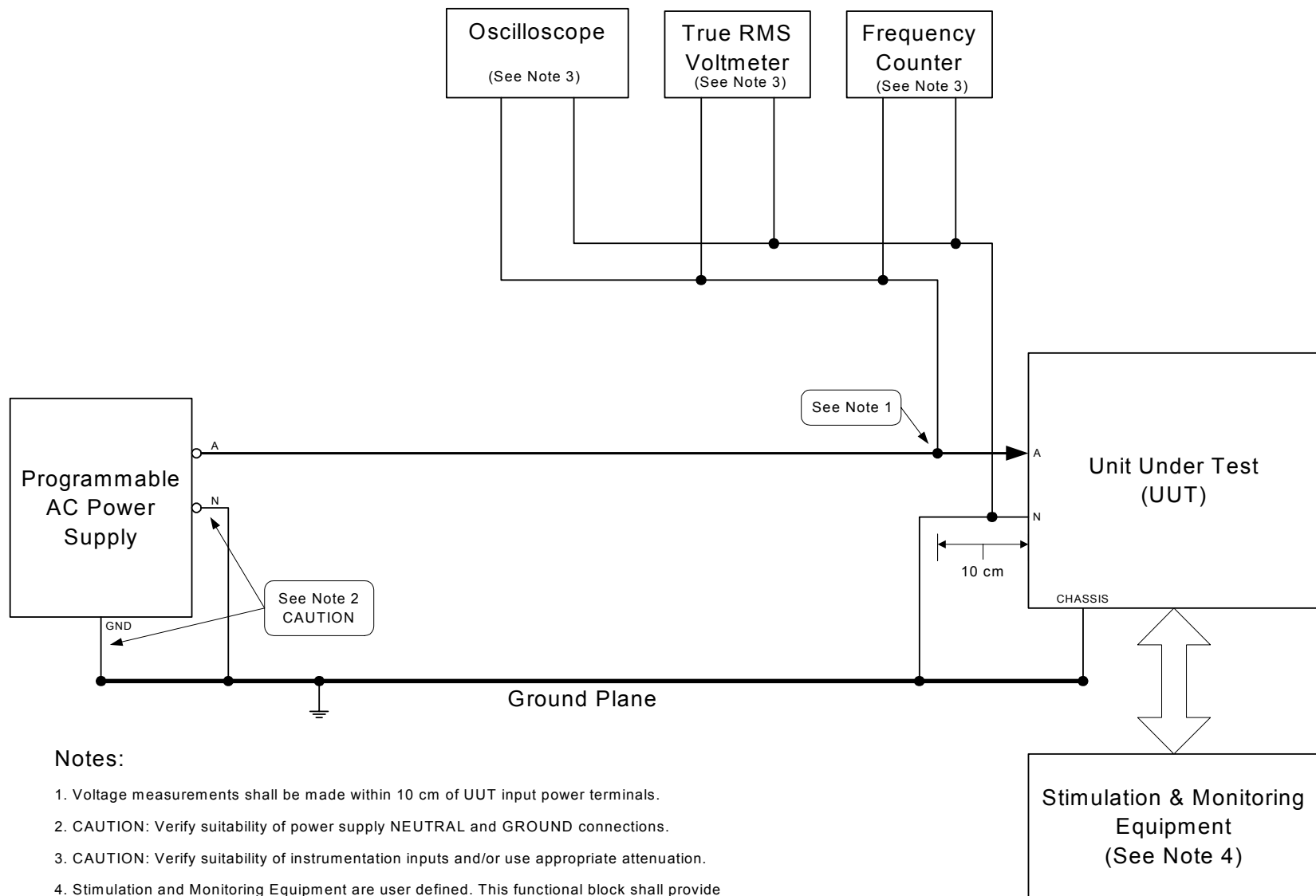
FIGURE SXF303-1. Abnormal frequency transients.

TABLE SXF303-III. Sample data sheet for SXF303 abnormal frequency transients for MIL-STD-704A for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
A		V _{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
B		V _{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
C		V _{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
D		V _{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
E		V _{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
						Hz		msec			

MIL-HDBK-704-6

METHOD SXF401
Emergency Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
 OPERATING CONDITION: Emergency

PARAMETER: Emergency Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at 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. For MIL-STD-704F, the single phase, 115 volt, 60 Hz power utilization equipment normal steady state limits are the same as the emergency steady state limits. The emergency steady state limits for single phase, 115 Volt, 60 Hz equipment are noted in table SXF401-I. Performance of test method SXF102 will constitute performance of test method SXF401.

TABLE SXF401-I. MIL-STD-704 emergency limits for steady state voltage and frequency for single phase, 60 Hz utilization equipment.

Emergency Limit	704A	704B	704C	704D	704E	704F
Voltage ELSS	N/A	N/A	N/A	N/A	N/A	105 V
Voltage EHSS	N/A	N/A	N/A	N/A	N/A	125 V
Frequency ELSS	N/A	N/A	N/A	N/A	N/A	59.5 Hz
Frequency EHSS	N/A	N/A	N/A	N/A	N/A	60.5 Hz

MIL-HDBK-704-6

METHOD SXF501

No Tests

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Starting

PARAMETER: No Tests

Starting operations are usually not applicable to AC utilization equipment.

MIL-HDBK-704-6

METHOD SXF601
Power Failure (Single Phase)

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
 OPERATING CONDITION: Power Failure

PARAMETER: Power Failure (Single Phase)

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 60 Hz 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 SXF601-I. The utilization equipment must maintain the specified performance during the 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 SXF601-I. MIL-STD-704 power failure limits for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	N/A	N/A	N/A	N/A	N/A	2 sec figure 9 MIL-STD- 704F

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

- a. Programmable AC power supply
- b. True RMS voltmeter
- c. Frequency counter
- d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF601-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

MIL-HDBK-704-6

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF601-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 SXF601-II, perform a power failure (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within $\frac{1}{2}$ cycle (8.33 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within $\frac{1}{2}$ cycle (8.33 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, steady state frequency, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table SXF601-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 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 SXF601-II. Test conditions for single phase power failures for single phase, 60 Hz utilization equipment.

Test Condition	Duration of Power Failure
A	100 msec
B	500 msec
C	2 seconds

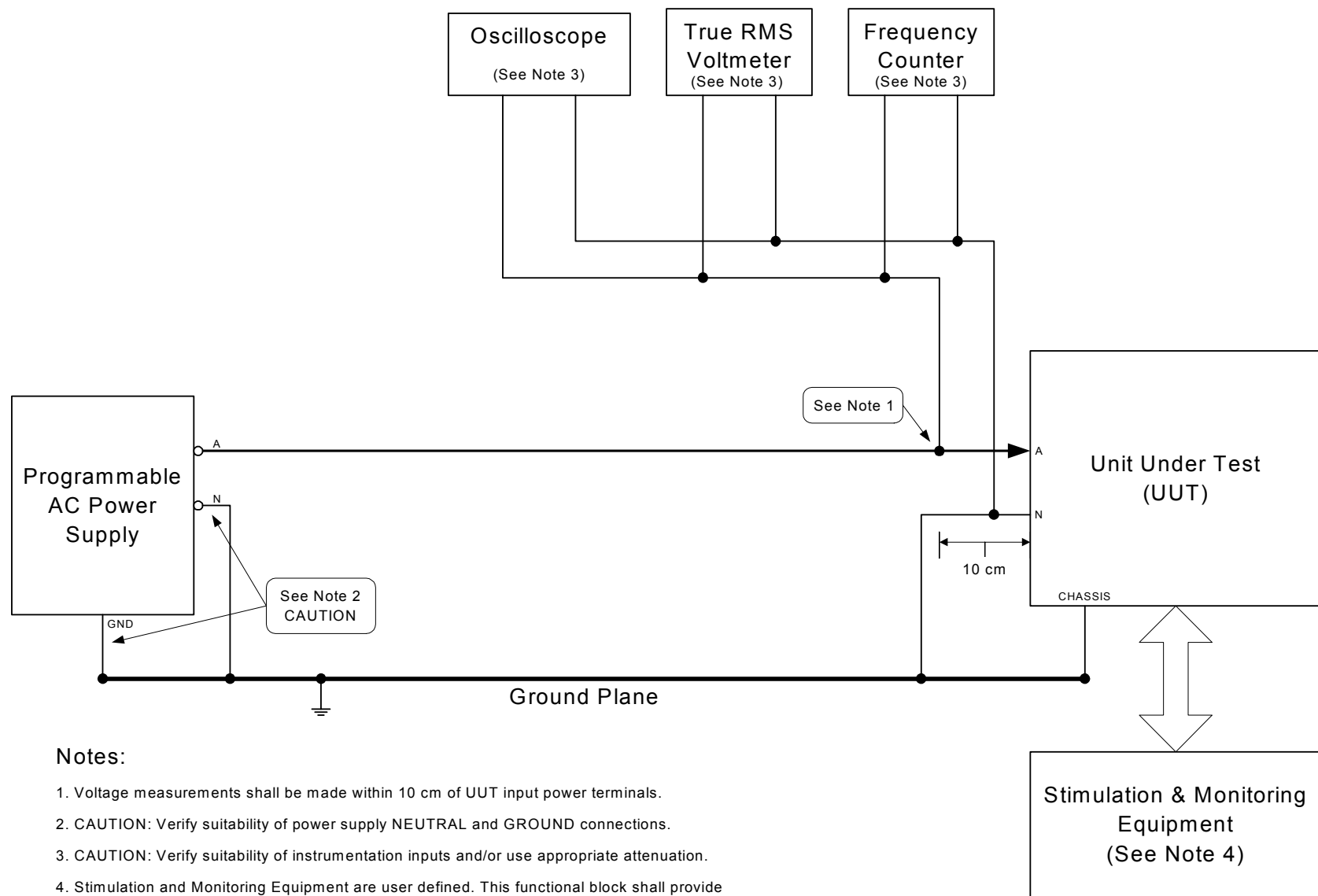
FIGURE SXF601-1. Power failure.

TABLE SXF601-III. Sample data sheet for SXF601 power failure (single phase) for single phase, 60 Hz utilization equipment.

Test Condition	Parameters						Performance
	Voltage		Frequency		Time Duration of Power Failure		Pass/Fail
A		V _{rms}		Hz		msec	
B		V _{rms}		Hz		msec	
C		V _{rms}		Hz		sec	

MIL-HDBK-704-6

TEST METHOD SXF602

No Test Required

POWER GROUP:

Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION:

Power Failure

PARAMETER:

No Test Required.

Test number SXF602 is not used so that the Single Phase, 60 Hz, 115 V (SXF) test numbers coincide with the Three Phase, 115 V (TAC and TVF) test sequence numbers.

MIL-HDBK-704-6

METHOD SXF603
Phase Reversal (Single Phase)

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
 OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal (Single Phase)

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz 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 line and neutral connection are reversed for the applicable edition(s) of MIL-STD-704 and as noted in table SXF603-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

TABLE SXF603-I. MIL-STD-704 phase reversal requirement for single phase, 60 Hz utilization equipment.

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 AC power supply
- b. True RMS voltmeter
- c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SXF603-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

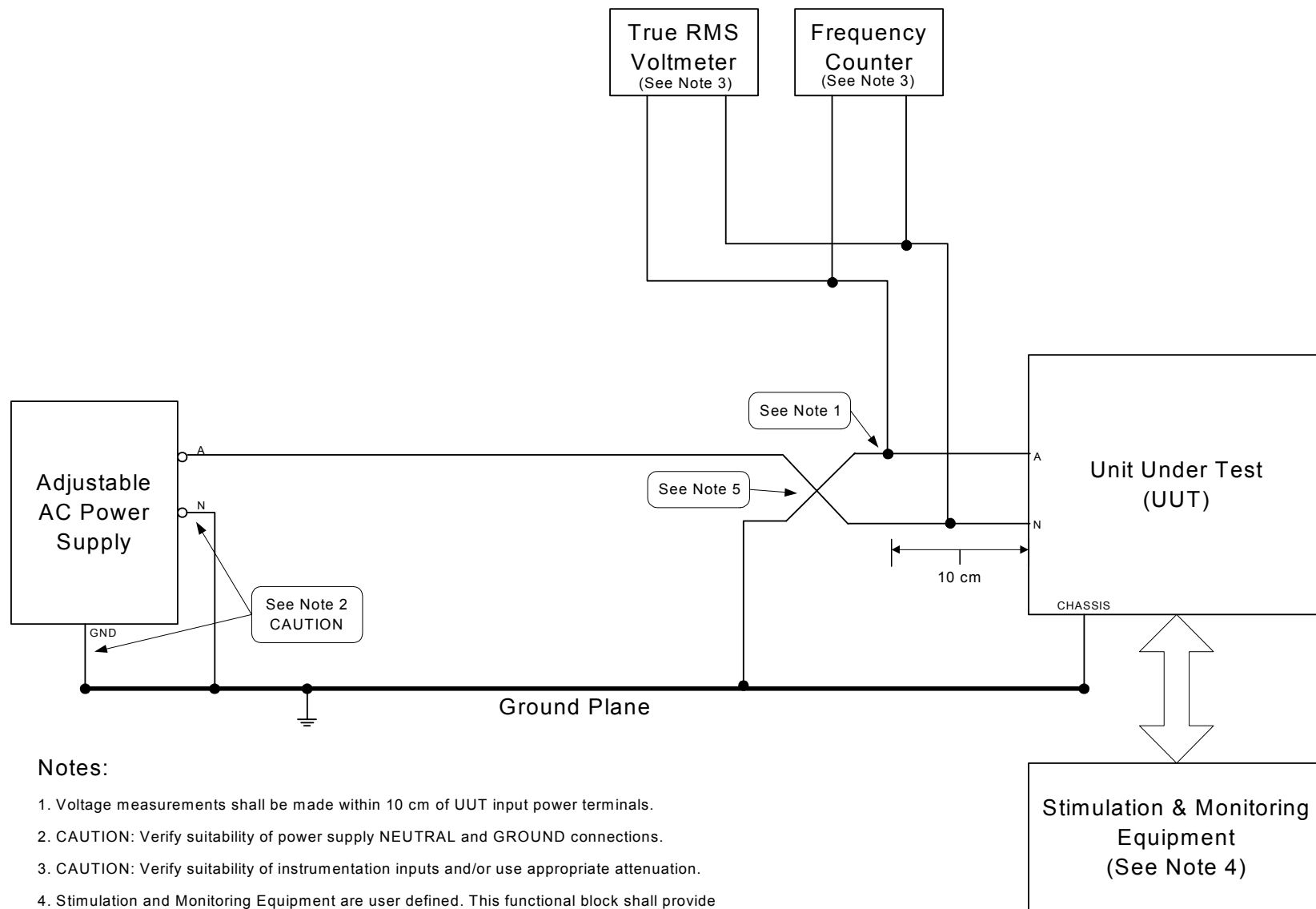
5. Compliance test. If a positive physical means is employed to prevent phase reversal, confirm that the line and neutral conductor cannot be reversed.

If the line and neutral conductor can be reversed, with the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF603-1 (line and neutral conductors reversed). Turn on the power source and adjust the voltage to the nominal

MIL-HDBK-704-6

steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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 unsafe condition due to phase reversal and should be not less than thirty (30) minutes. Record the steady state voltage, steady state frequency, time duration at phase reversal test condition, and the performance of the UUT in the data sheet shown in table SXF603-II.

With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF603-2 (line and neutral conductors connected properly). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. 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, steady state frequency, time duration at test condition, and the performance of the UUT in the data sheet shown in table SXF603-II. Repeat for each mode of operation of the UUT.

FIGURE SXF603-1. Phase reversal.

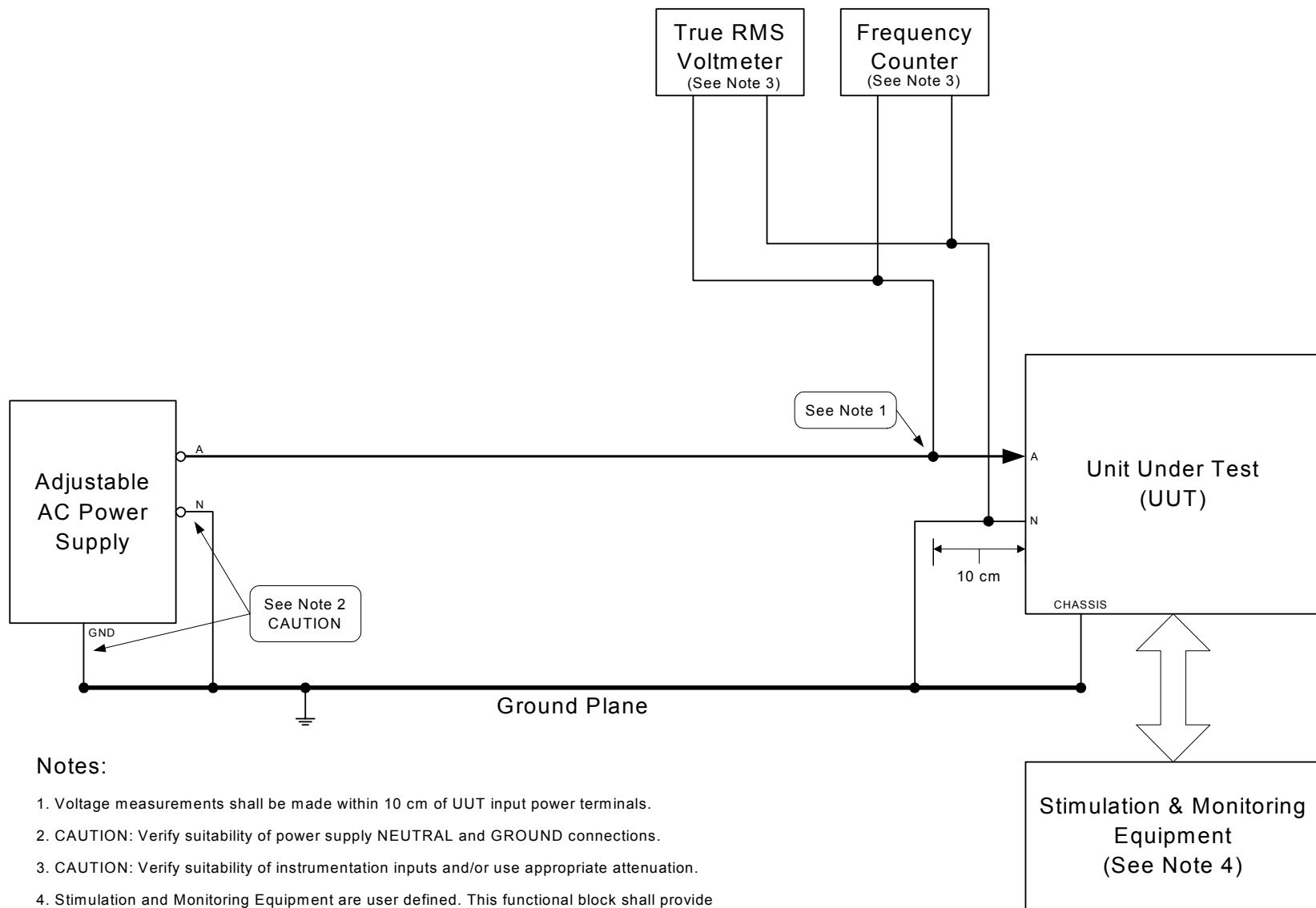
FIGURE SXF603-2. Correct phase connection.

TABLE SXF603-II. Sample data sheet for SXF603 phase reversal for single phase, 60 Hz utilization equipment.

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

MIL-HDBK-704-6

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 Single phase test numbers. There are no tests required for SXF103 and SXF602. This is done so that the single phase test numbers coincide with the three phase test numbers.

6.3 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-0052)

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.