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MIL-HDBK-704-3
9 April 2004

DEPARTMENT OF DEFENSE HANDBOOK

GUIDANCE FOR TEST PROCEDURES FOR DEMONSTRATION OF UTILIZATION EQUIPMENT COMPLIANCE TO AIRCRAFT ELECTRICAL POWER CHARACTERISTICS THREE PHASE, 400 Hz, 115 VOLT (PART 3 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Do not cite this document as a requirement.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 three phase, 400 Hz, 115 volt utilization equipment to determine compliance with the applicable edition of MIL-STD-704.

3. MIL-HDBK-704-3 is Part 3 in a series of 8 Parts. Part 3 describes the test methods and procedures to demonstrate that three phase, 400 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, 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 http://www.dodssp.daps.mil/.

CONTENTS

PARAGRAPH PAGE

1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that three phase, 400 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 required.

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 http://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 three phase, 400 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 TA101 through TAC603.

4.1.1 Recording performance. In table TAC-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.

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

TABLE TAC-I. Summary of Three Phase, 400 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			
TAC101	Three Phase Load and Current Harmonic Measurements		
TAC102	Steady State Limits for Voltage (Including Unbalance) and Frequency		
TAC103	Voltage Phase Difference		
TAC104	Voltage Modulation		
TAC105	Frequency Modulation		
TAC106	Voltage Distortion Spectrum		
TAC107	Total Voltage Distortion		
TAC108	DC Voltage Component		
TAC109	Normal Voltage Transients		
TAC110	Normal Frequency Transients		
Transfer, Aircraft Electrical Operation			
TAC201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
TAC301	Abnormal Limits for Voltage and Frequency		
TAC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
TAC303	Abnormal Frequency Transients (Overfrequency/Underfrequency)		
Emergency, Aircraft Electrical Operation			
TAC401	Emergency Limits for Voltage and Frequency		
Starting, Aircraft Electrical Operation			
TAC501	See Note #1		
Power Failure, Aircraft Electrical Operation			
TAC601	Power Failure (Three Phase)		
TAC602	One Phase and Two Phase Power Failures		
TAC603	Phase Reversal		

Note 1: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for TAC501 unless specified by the equipment performance specification.

5. TEST METHODS

METHOD TAC101
Load Measurements

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Load Measurements

1. Scope.

1.1 Purpose. This test is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment utilizes only 115 Volt line-to-neutral power, current inrush is within limits, has balanced power, 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 utilize only 115 Volt line-to-neutral power, is within current inrush limits, is within the balanced load limits, 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 TAC101-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 TAC101-I. MIL-STD-704 limits for inrush current, balanced load, power factor, rectification restriction, current distortion, and current spectrum for three phase, 400 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Inrush Current	N/A	N/A	N/A	N/A	N/A	300 Percent for Loads >3 kVA
Percent Unbalanced Load	Figure 11 MIL-STD-704A	N/A 1/	Figure 1 MIL-STD-704C	Figure 1 MIL-STD-704D	Figure 1 MIL-STD-704E or 3.33% for Loads >30 kVA	Figure 1 MIL-STD-704F or 3.33% for Loads >30 kVA
Power Factor	Figure 12 MIL-STD-704A	N/A	N/A	N/A	N/A	0.85 Lagging to Unity for Loads >500 VA and No Leading Power Factor for > 100VA
Rectification Restriction	N/A 2/	N/A 2/	N/A 2/	N/A 2/	No Half-Wave Rectification	No Half-Wave Rectification
Current Distortion	See Note 3/	See Note 3/	See Note 3/	See Note 3/	See Note 3/	See Note 3/
Current Spectrum	See Note 3/	See Note 3/	See Note 3/	See Note 3/	See Note 3/	See Note 3/

1/ For utilization equipment being tested to MIL-STD-704 edition B use the unbalanced load limits of MIL-STD-704C.
2/ It is highly recommended that equipment built to MIL-STD-704 editions A, B, C, or D should not use half-wave rectification.
3/ Utilization equipment specification 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 the 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:

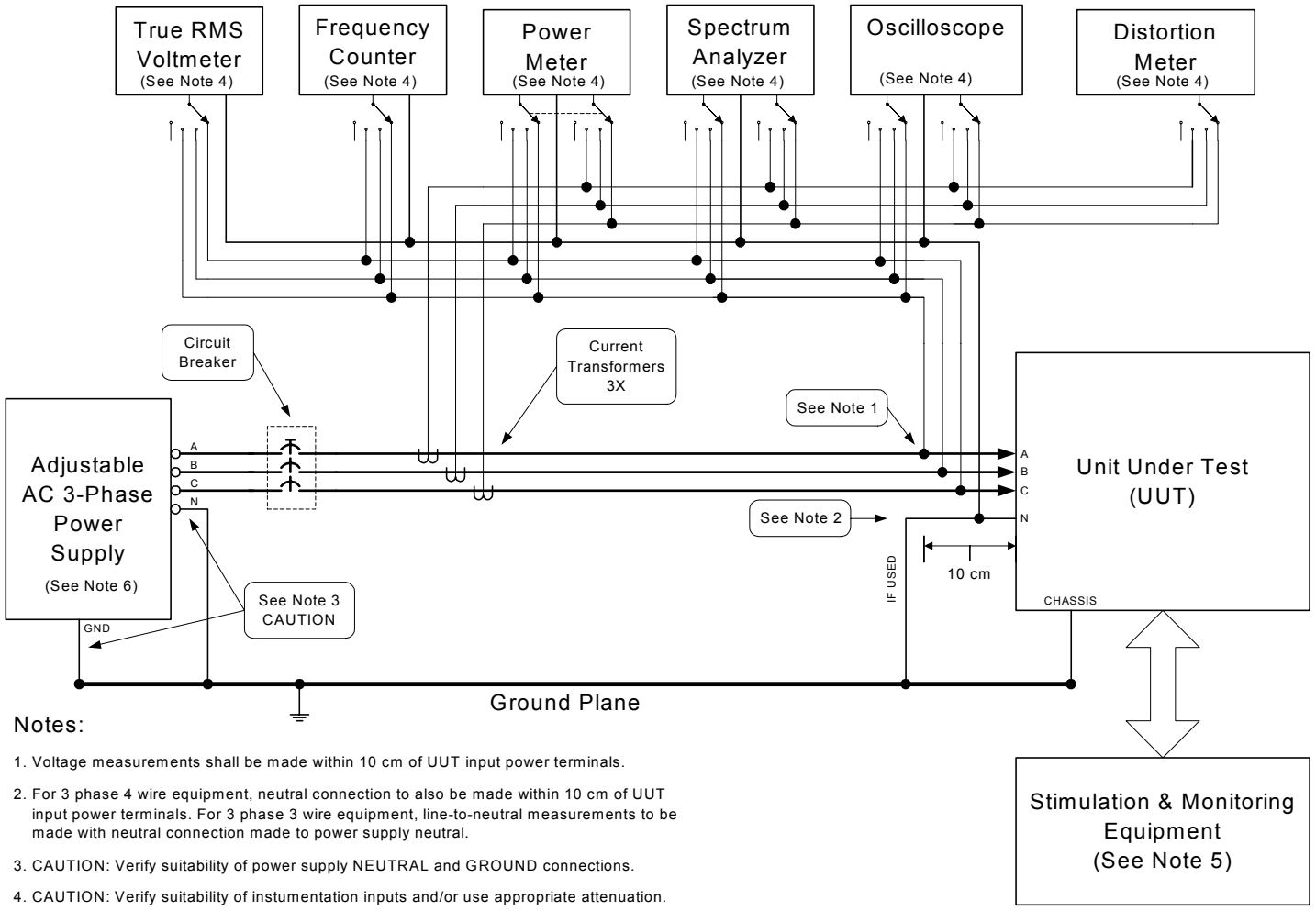
a. Adjustable AC power supply (rotating AC source for current waveform limits)
b. True RMS voltmeter
c. Frequency counter
d. Power meter
e. Spectrum analyzer
f. Distortion meter
g. Current transformer
h. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC101-1. 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 conductors. 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 TAC101-1. 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 400 Hz.

Close the circuit breaker, energizing the UUT. Record the inrush currents (oscilloscope traces) and record the maximum rms current of each phase in the data sheet shown in table TAC101-II. 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 frequency in table TAC101-II. For each phase, record the voltage, VA, and power factor in the data sheet shown in table TAC101-II. Compare the calculated percent inrush current, the load unbalance, and power factor with the limits of the applicable edition(s) of MIL-STD-704. Repeat for each mode of operation of the UUT.

Confirm the UUT does not use half-wave rectification and record in the data sheet shown in table TAC101-II. If the utilization equipment performance specification document imposes current waveform limits, for each phase record the total current distortion and current spectrum in the data sheet shown in table TAC101-II and compare to the limits defined in the utilization equipment performance specification document. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
6. If current waveform limits are imposed by the detail performance specification, the AC power source shall be a rotating machine.

FIGURE TAC101-1. Load measurement.

TABLE TAC101-II. Sample data sheet for TAC101 load measurement.

Parameters												
Inrush Current												
Phase	Inrush Current		Percent of Rated Current		Oscilloscope Trace						Pass/Fail	Comments
A		A_{rms}		%	Attach Trace		A_{rms} vs. Time					
B		A_{rms}		%	Attach Trace		A_{rms} vs. Time					
C		A_{rms}		%	Attach Trace		A_{rms} vs. Time					
Balanced Load and Power Factor												
Phase	Voltage		Frequency		Volt-Amp		Power Factor				Pass/Fail	Comments
A		V_{rms}		Hz		VA		pf				
B		V_{rms}				VA		pf				
C		V_{rms}				VA		pf				
Total VA						VA						
Maximum Unbalance (difference between highest and lowest phase load)						VA						
Rectification Type												
											Pass/Fail	Comments
Does not use half-wave rectification.												
Current Waveform Measurements												
Phase	Total Current Distortion				Current Spectrum						Pass/Fail	Comments
A			% Distortion		Attach Spectrum Plot		Amplitude Vs. Frequency					
B			% Distortion		Attach Spectrum Plot		Amplitude Vs. Frequency					
C			% Distortion		Attach Spectrum Plot		Amplitude Vs. Frequency					

METHOD TAC102
Steady State Limits for Voltage,
Including Unbalance, and Frequency

POWER GROUP:	Three Phase, 400 Hz, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Normal
PARAMETER:	Steady State Limits for Voltage, Including Unbalance, and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at 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 TAC102-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.

Note: If the utilization has exactly the same full performance requirements for abnormal steady state limits and emergency steady state limits as required for the normal aircraft electrical conditions, then performance of test methods TAC301 and TAC401 will constitute performance of test conditions A through I of TAC102.

TABLE TAC102-I. MIL-STD-704 normal limits for steady state voltage, voltage unbalance, and frequency.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	108 V	108 V	108 V	108 V	108 V	108 V
Voltage NHSS	118 V	118 V	118 V	118 V	118 V	118 V
Voltage Unbalance	3.0V	3.0V	3.0V	3.0V	3.0V	3.0V
Frequency NLSS	380 Hz	395 Hz (380 Hz)1/	393 Hz	393 Hz	393 Hz	393 Hz
Frequency NHSS	420 Hz	405 Hz (420 Hz)1/	407 Hz	407 Hz	407 Hz	407 Hz

1/ Normal steady state frequency limits for MIL-STD-704B for helicopters is 400 ±20 Hz.

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 TAC102-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

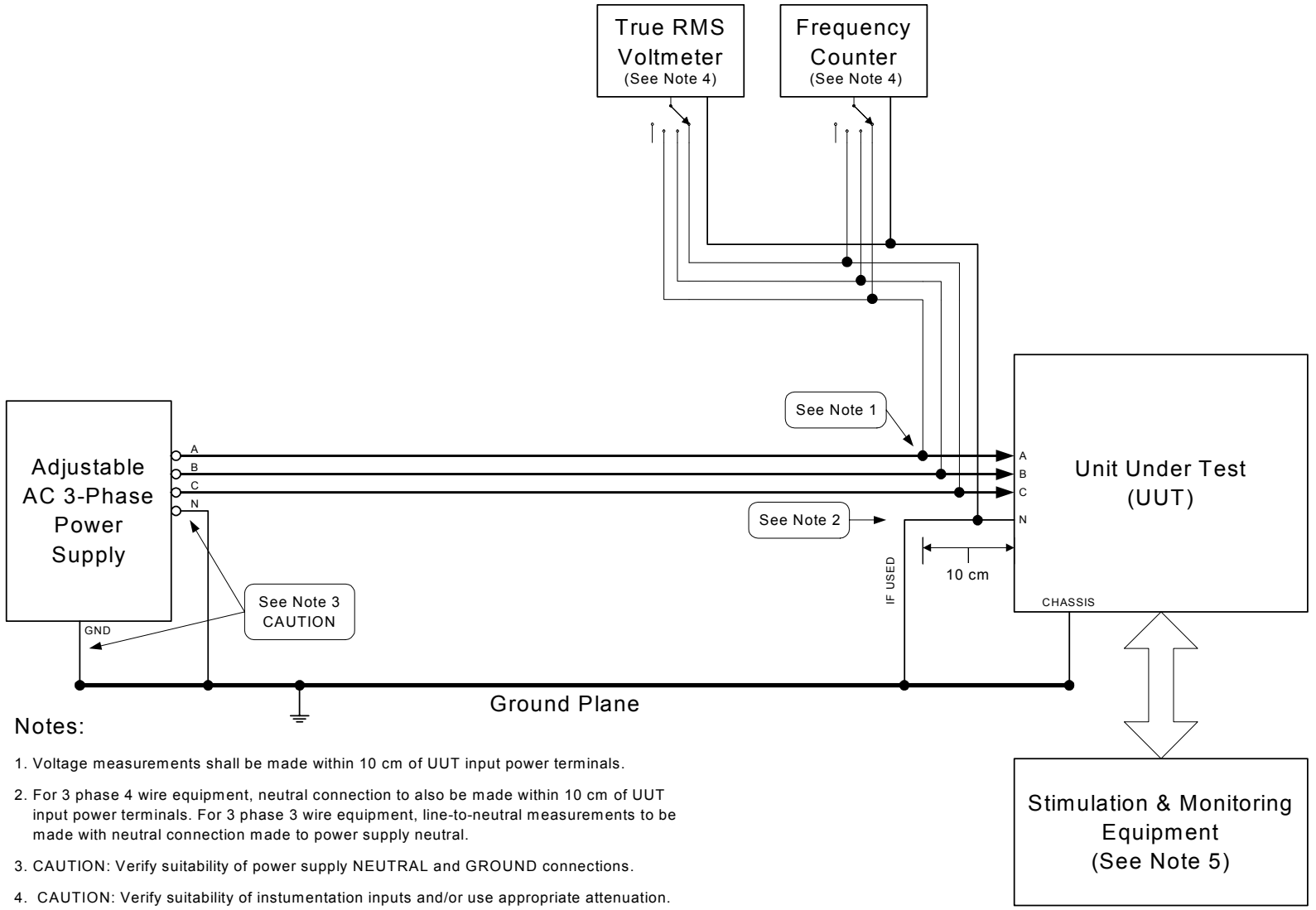
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 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 TAC102-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. Test conditions A through I are three phase balanced voltages. Test conditions J and K are unbalanced voltage conditions. 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 voltages, 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 TAC102-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 400 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 TAC102-II. Test conditions for steady state limits for voltage and frequency.

Test Condition	Voltage	Frequency
Balanced Voltages		
A	Nominal Voltage	Nominal Frequency
B	Nominal Voltage	NLSS Frequency
C	Nominal Voltage	NHSS Frequency
D	NLSS Voltage	Nominal Frequency
E	NLSS Voltage	NLSS Frequency
F	NLSS Voltage	NHSS Frequency
G	NHSS Voltage	Nominal Frequency
H	NHSS Voltage	NLSS Frequency
I	NHSS Voltage	NHSS Frequency
Unbalanced Voltages		
J	Van NLSS Voltage Vbn NLSS Voltage+3.0V Vcn NLSS Voltage+3.0V	Nominal Frequency
K	Van NHSS Voltage Vbn NHSS Voltage-3.0V Vcn NHSS Voltage-3.0V	Nominal Frequency



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC102-1. Steady state limits for voltage including unbalance.

TABLE TAC102-III. Sample data sheet for TAC102 steady state limits for voltage and frequency.

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
A	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
B	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
C	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
D	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
E	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
F	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
G	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

TABLE TAC102-III. Sample data sheet for TAC102 steady state limits for voltage and frequency. - Continued

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
H	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
I	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
J	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
K	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

METHOD TAC103
Voltage Phase Difference

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Phase Difference

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided voltages having phase angles within the limits 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 provided voltages having phase angles at the limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes for each of the test conditions. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC103-I. MIL-STD-704 limits for voltage phase difference.

Limit	704A	704B	704C	704D	704E	704F
Voltage Phase Difference	116° to 124°	116° to 124°	116° to 124°	116° to 124°	116° to 124°	116° to 124°

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

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Phase angle meter

4. Test setup. Configure the test setup as shown in figure TAC103-1. 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 TAC103-1. 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 400 Hz. Energize the UUT. Allow sufficient

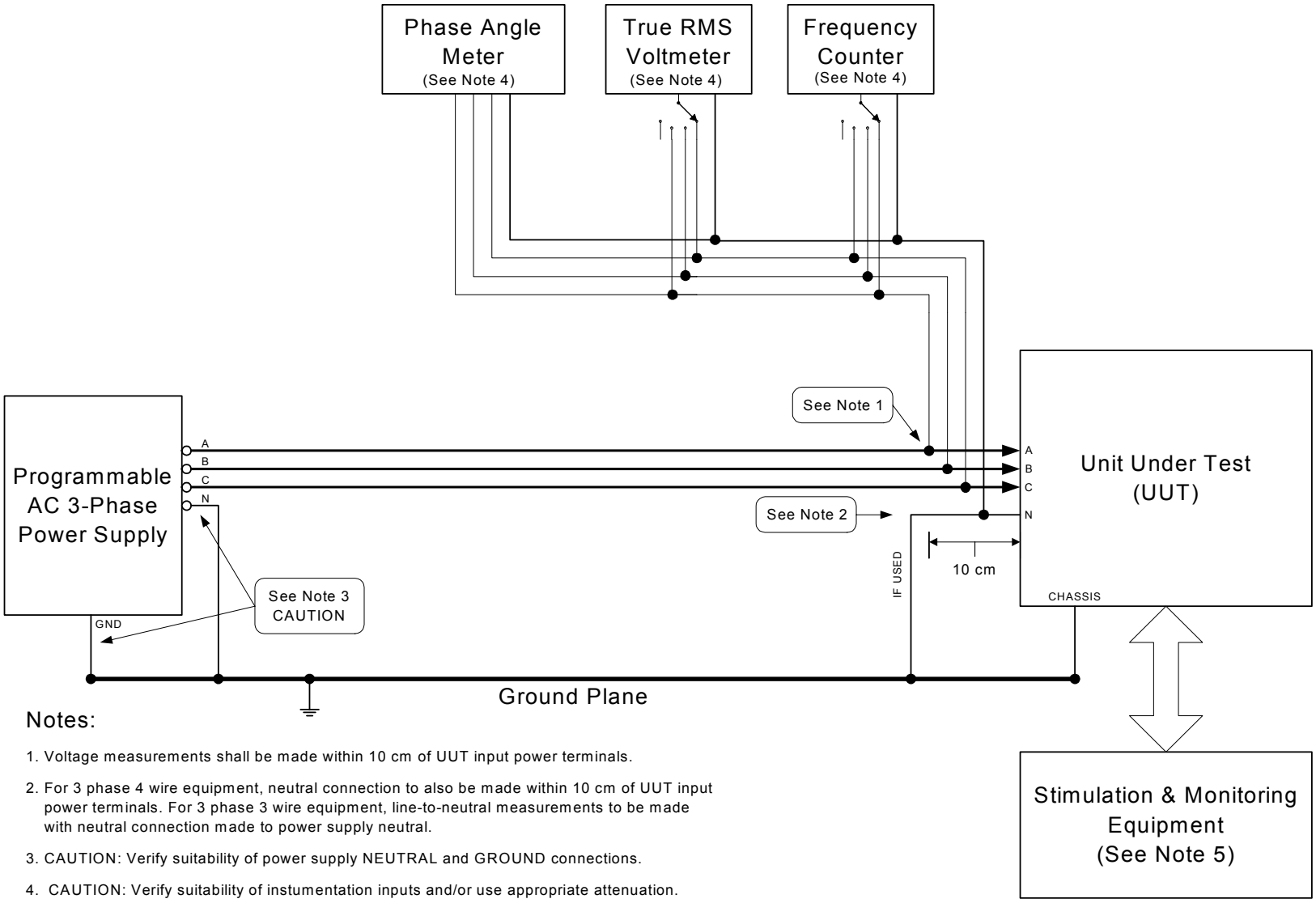
time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A and B noted in table TAC103-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate with voltage phase differences and should be, not less than thirty (30) minutes. The phase angles are referenced to Van. 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. Record the voltages, frequency, phase angles, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TAC103-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 400 Hz. Adjust the phase angles to Van 0^{o}, Vbn 120^{o}, and Vcn 240^{o}. 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 TAC103-II. Test conditions for voltage phase difference.

Test Condition	Voltage Phase Angle Van	Voltage Phase Angle Vbn	Voltage Phase Angle Vcn
A	0^{o}	116^{o}	240^{o}
B	0^{o}	124^{o}	240^{o}



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC103-1. Voltage phase difference.

TABLE TAC103-III. Sample data sheet for TAC103 voltage phase difference.

Test Condition	Parameters										Performance
	Phase	Voltage		Frequency		Phase Angle			Time Duration at Test Condition		Pass/Fail
A	A		V_{rms}		Hz	Van		^{o}		min	
	B		V_{rms}			Vbn		^{o}			
	C		V_{rms}			Vcn		^{o}			
B	A		V_{rms}		Hz	Van		^{o}		min	
	B		V_{rms}			Vbn		^{o}			
	C		V_{rms}			Vcn		^{o}			

METHOD TAC104
Voltage Modulation

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 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 TAC104-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 TAC104-I. MIL-STD-704 limits for voltage modulation.

Limit	704A	704B 1/	704C 1/	704D 1/	704E	704F
Voltage Modulation	3.5 V Peak-to-Valley Figure 1 MIL-STD-704A	sideband 0.62 Vrms over the range 400 ± 60 Hz	N/A	N/A	2.5 Vrms max	2.5 Vrms max

1/ For utilization equipment being tested to MIL-STD-704 edition B, C, and D, use MIL-STD-704E limits.

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 TAC104-1. 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 TAC104-1. 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 400 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

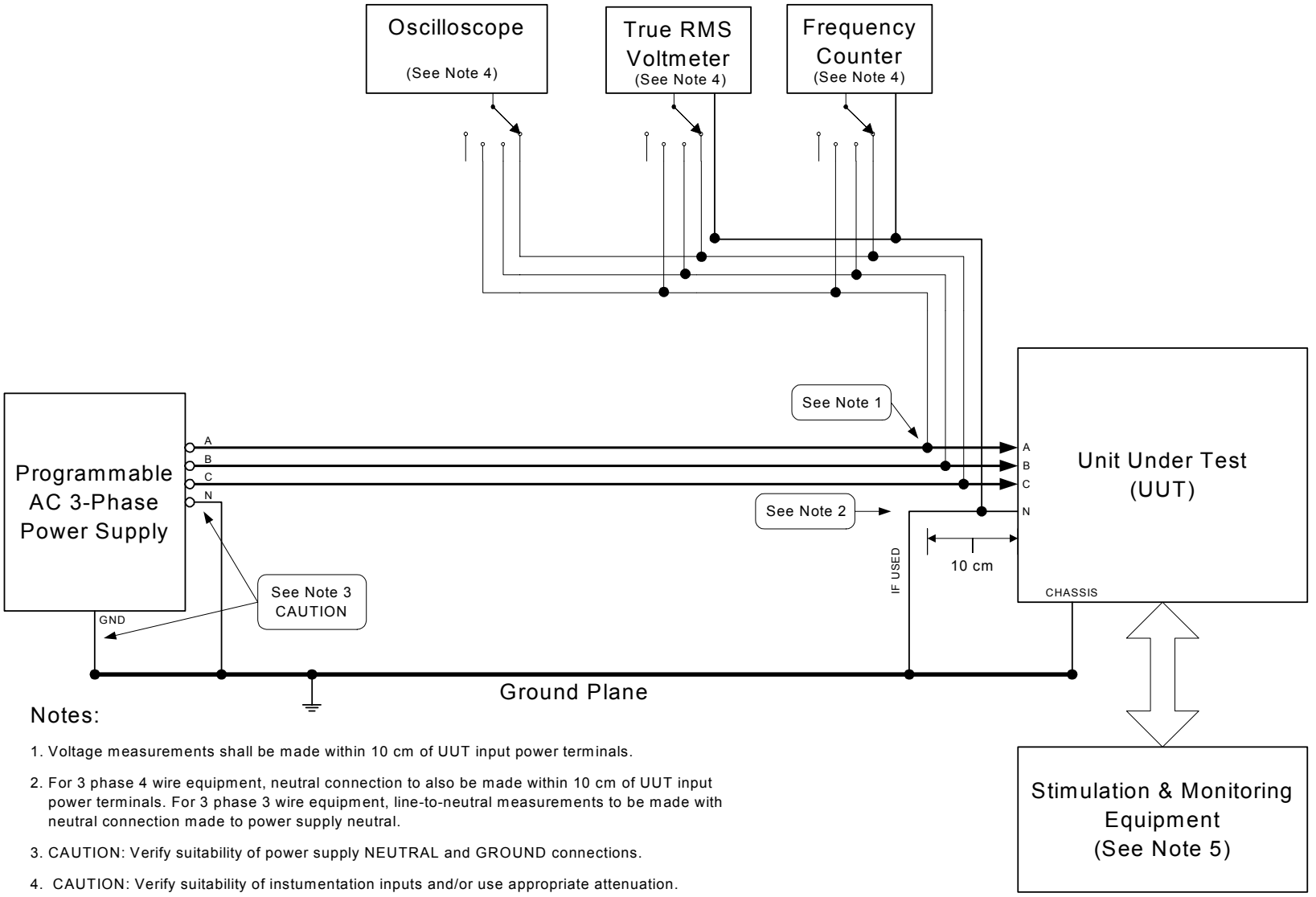
For each test condition A through G noted in table TAC104-II, set the voltage modulation amplitude and frequency of voltage modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state voltage of 115 Vrms, at least ten (10) minutes at an average steady state voltage of 109.25 Vrms, and at least ten (10) minutes at an average steady state voltage of 116.75 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 TAC104-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 400 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 TAC104-II. Test conditions for voltage modulation.

Test Condition	Frequency of Voltage Modulation	MIL-STD-704A Amplitude of Voltage Modulation Voltage Peak-to-Valley	MIL-STD-704E & F[1/] Amplitude of Voltage Modulation Vrms
A	1.0 Hz	0.5 Vp-v	0.375 Vrms
B	1.7 Hz	0.5 Vp-v	0.375 Vrms
C	10 Hz	3.5 Vp-v	2.5 Vrms
D	25 Hz	3.5 Vp-v	2.5 Vrms
E	70 Hz	0.5 Vp-v	0.375 Vrms
F	100 Hz	0.5 Vp-v	0.375 Vrms
G	200 Hz	0.5 Vp-v	0.375 Vrms

1/ For utilization equipment being tested to MIL-STD-704 edition B, C, and D, use MIL-STD-704E limits.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC104-1. Voltage modulation.

TABLE TAC104-III. Sample data sheet for TAC104 voltage modulation.

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
A-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
A-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
A-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
C-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TAC104-III. Sample data sheet for TAC104 voltage modulation. - Continued

Test Condition	Parameters												Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition			Pass/Fail
C-2	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
C-3	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
D-1	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
D-2	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
D-3	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
E-1	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
E-2	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				

TABLE TAC104-III. Sample data sheet for TAC104 voltage modulation. - Continued

Test Condition	Parameters												Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition			Pass/Fail
E-3	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
F-1	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
F-2	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
F-3	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
G-1	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
G-2	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				
G-3	A		V_{rms}		Hz		V_{rms}		Hz		min		
	B		V_{rms}				V_{rms}		Hz				
	C		V_{rms}				V_{rms}		Hz				

METHOD TAC105
Frequency Modulation

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Frequency Modulation

1. Scope.

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 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 TAC105-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 TAC105-I. MIL-STD-704 limits for frequency modulation.

Limit	704A	704B	704C	704D	704E	704F
Frequency Modulation	± 4 Hz	± 5 Hz Figure 3 MIL-STD-704B	± 5 Hz Figure 4 MIL-STD-704C	± 5 Hz Figure 4 MIL-STD-704D	4 Hz	4 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 TAC105-1. 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 TAC105-1. 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 400 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.

5.1 Compliance test for MIL-STD-704A. For each test condition A through D noted in table TAC105-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 400 Hz, at least ten (10) minutes at an average steady state frequency of 384 Hz, and at least ten (10) minutes at an average steady state frequency of 416 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 TAC105-III. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704B, C, & D. For each test condition A through E noted in table TAC105-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. For test condition A, 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 an average steady state frequency of 400 Hz for at least thirty (30) minutes. For test condition B through E, 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 400 Hz, at least ten (10) minutes at an average steady state frequency of 395 Hz, and at least ten (10) minutes at an average steady state frequency of 405 Hz. 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. Record voltages, 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 TAC105-III. Repeat for each mode of operation of the UUT.

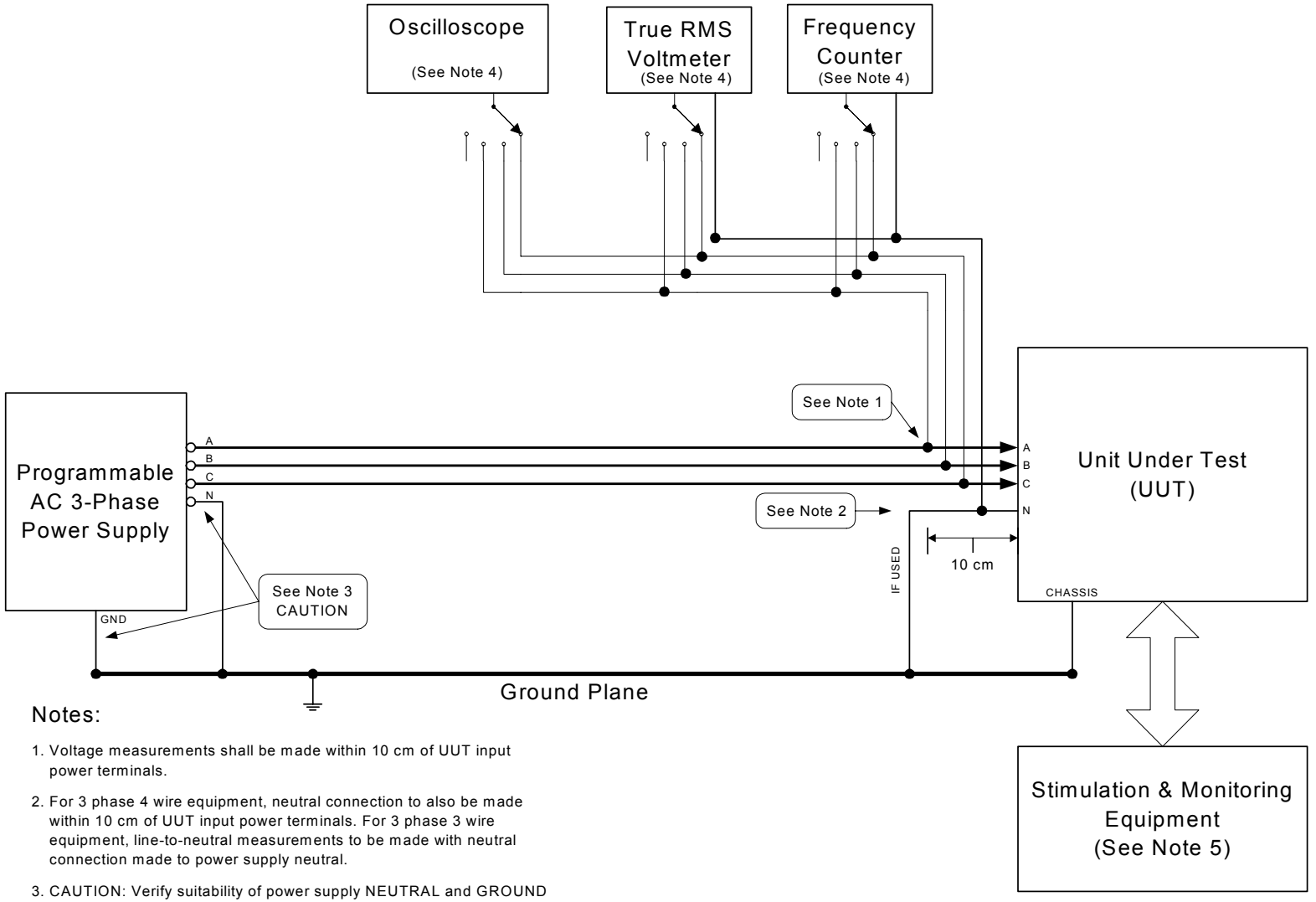
5.3 Compliance test for MIL-STD-704E & F. For each test condition A through E noted in table TAC105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state frequency of 400 Hz, at least ten (10) minutes at an average steady state frequency of 395 Hz, and at least ten (10) minutes at an average steady state frequency of 405 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 voltages, 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 TAC105-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 400 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 TAC105-II. Test conditions for frequency modulation.

Test Condition	Rate of change for frequency modulation	MIL-STD-704 A Amplitude of Frequency Modulation	MIL-STD-704 B, C, & D Amplitude of Frequency Modulation	MIL-STD-704 E &F Amplitude of Frequency Modulation
A	1 Hz/sec	± 4 Hz	± 5.00 Hz	4 Hz (± 2 Hz)
B	5 Hz/sec	± 4 Hz	± 1.75 Hz	4 Hz (± 2 Hz)
C	10 Hz/sec	± 4 Hz	± 1.20 Hz	4 Hz (± 2 Hz)
D	25 Hz/sec	± 4 Hz	± 0.85 Hz	4 Hz (± 2 Hz)
E	100 Hz/sec	N/A	± 0.58 Hz	4 Hz (± 2 Hz)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC105-1. Frequency modulation.

TABLE TAC105-III. Sample data sheet for TAC105 frequency modulation.

Test Condition	Parameters											Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition		Pass/Fail
A-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
A-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
A-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

TABLE TAC105-III. Sample data sheet for TAC105 frequency modulation. - Continued

Test Condition	Parameters											Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition		Pass/Fail
C-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
C-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
C-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

TABLE TAC105-III. Sample data sheet for TAC105 frequency modulation. - Continued

Test Condition	Parameters											Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition		Pass/Fail
E-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
E-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
E-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

METHOD TAC106
Voltage Distortion Spectrum

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 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 TAC106-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 TAC106 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 TAC106 of this handbook.

TABLE TAC106-I. MIL-STD-704 limits for voltage distortion spectrum.

Limit	704A[1/]	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	Individual Harmonic < 5%	Figure 2 MIL-STD-704B	Figure 3 MIL-STD-704C	Figure 3 MIL-STD-704D	Figure 3 MIL-STD-704E	Figure 7 MIL-STD-704F

1/ For utilization equipment being tested to MIL-STD-704 edition A, use MIL-STD-704B limits.

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. (3) Inductors, 50 μH
h. (3) Capacitors, 10 μF
i. Resistor, calibrated load

4. Test setup. Configure the test setup as shown in figure TAC106-1. 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 TAC106-1 in place of the UUT. The calibrated resistive load should 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 400 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 H in table TAC106-II. 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 TAC106-1. Figure TAC106-1 shows the coupling transformer installed in phase A. The test will be repeated with the coupling transformer installed in Phase B and Phase C. 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 400 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 H noted in table TAC106-II. For each test condition, record the phase tested, 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 TAC106-III. Repeat for each mode of operation of the UUT. Turn the adjustable AC power supply off, install the coupling transformer in phase B, 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 400 Hz and repeat the testing for phase B. Turn the adjustable AC power supply off, install the coupling transformer in phase C, 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 400 Hz and repeat the testing for Phase C.

After all test conditions are complete for Phase A, Phase B, and Phase C, 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 400 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 TAC106-II. Test conditions for voltage distortion spectrum.

Test Condition	Frequency of Voltage Distortion	MIL-STD-704B C, D, E & F[1/] Amplitude of Voltage Distortion Voltage rms
A	50 Hz	0.316 Vrms
B	100 Hz	0.316 Vrms
C	500 Hz	1.580 Vrms
D	1 kHz	3.160 Vrms
E	2 kHz	3.160 Vrms
F	3 kHz	3.160 Vrms
G	5 kHz	1.900 Vrms
H	10 kHz	0.950 Vrms

1/ For utilization equipment being tested to MIL-STD-704 edition A, use MIL-STD-704B limits.

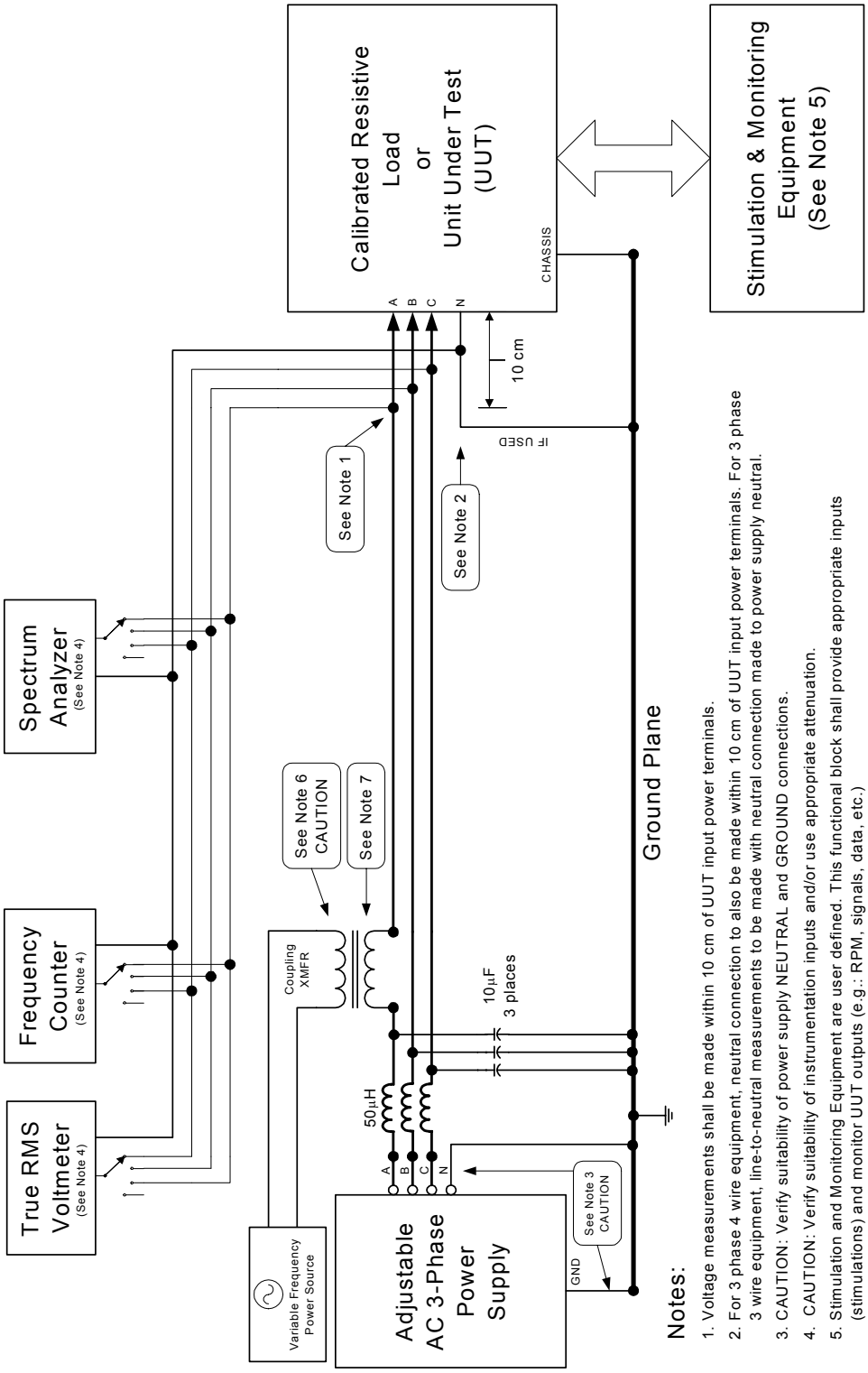


FIGURE TAC106-1. Normal operation - voltage distortion spectrum (50 Hz to 10 kHz).

TABLE TAC106-III. Sample data sheet for TAC106 voltage distortion spectrum.

Test Condition	Parameter										Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition	Pass/Fail
	A										
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	
H			V_{rms}		Hz		kHz		V_{rms}	min	
	B										
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	
H			V_{rms}		Hz		kHz		V_{rms}	min	

TABLE TAC106-III. Sample data sheet for TAC106 voltage distortion spectrum. - Continued

Test Condition	Parameter											Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
	C											
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	
H			V_{rms}		Hz		kHz		V_{rms}		min	

METHOD TAC107
Total Voltage Distortion

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage waveforms 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 voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to distorted voltage waveforms and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC107-I. MIL-STD-704 limits for total voltage distortion.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Factor	0.08	0.05	0.05	0.05	0.05	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 TAC107-1. 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 TAC107-1 in place of the UUT. The resistive load should be sized to draw the same current as the UUT. Set

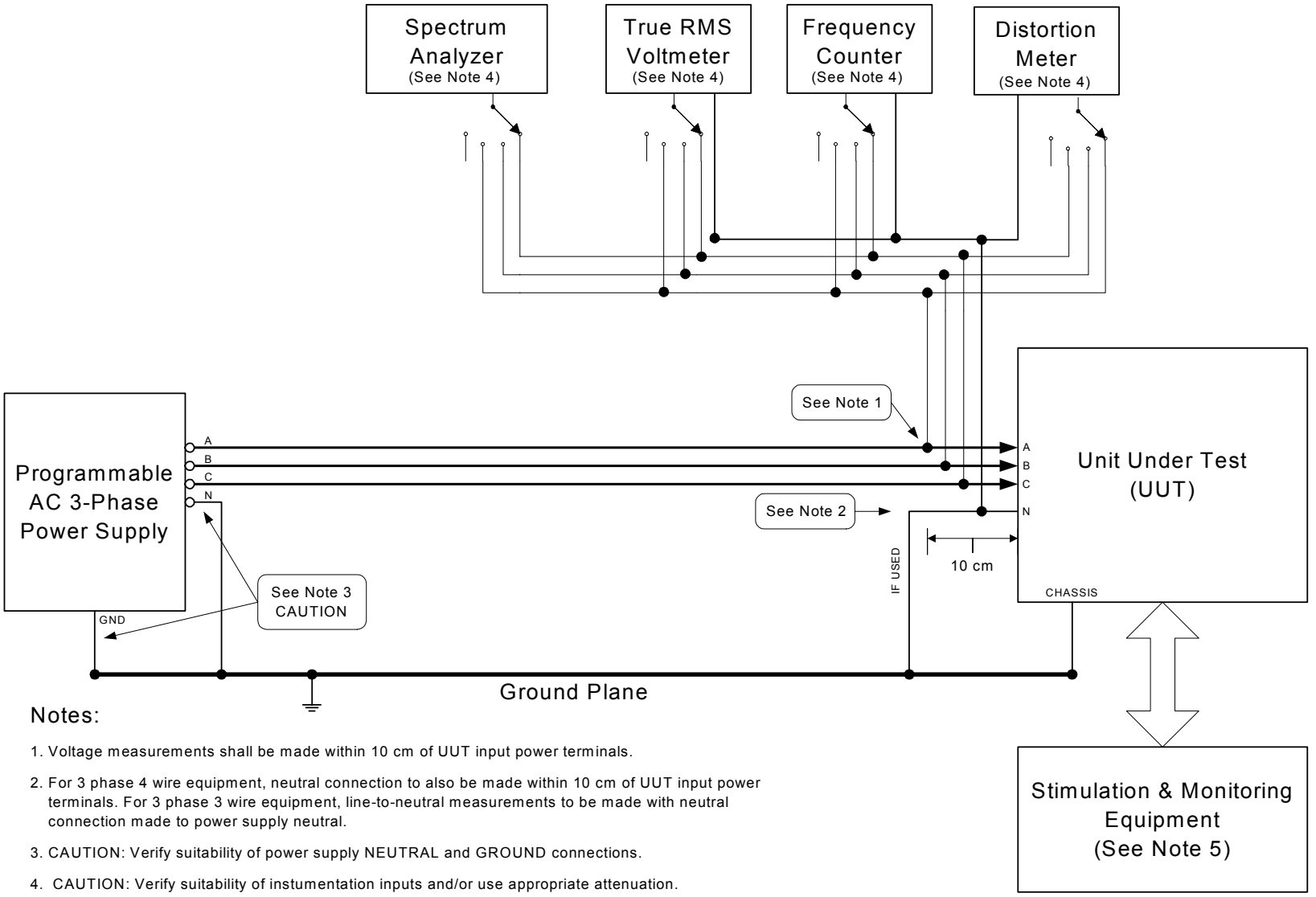
the programmable power supply to produce a voltage waveform having harmonic contents listed in table TAC107-I. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Confirm that the programmable power supply is producing a voltage waveform having harmonic content listed in table TAC107-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 TAC107-1. 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 400 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 TAC107-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce sine waves for each of the three phases. 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 400 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 TAC107-II. Voltage harmonics as percent of fundamental for total voltage distortion test.

Harmonic	MIL-STD-704A Percent of Fundamental	MIL-STD-704B, C, D, E, & F Percent of Fundamental
Fundamental	100%	100%
2nd	0%	0%
3rd	5.00%	2.75%
4th	0%	0%
5th	4.12%	2.75%
6th	0%	0%
7th	2.94%	1.97%
8th	0%	0%
9th	2.29%	1.53%
10th	0%	0%
11th	1.87%	1.25%
12th	0%	0%
13th	1.58%	1.06%
14th	0%	0%
15th	1.37%	0.92%



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC107-1. Total voltage distortion.

TABLE TAC107-III. Sample data sheet for TAC107 total voltage distortion.

Parameters									Performance
Phase	Voltage		Frequency		Voltage Distortion Factor		Time Duration at Test Condition		Pass/Fail
A		V_{rms}		Hz		No units		min	
B		V_{rms}				No units			
C		V_{rms}				No units			

Voltage Harmonics Phase A			Voltage Harmonics Phase B			Voltage Harmonics Phase C		
Fund		%	Fund		%	Fund		%
2^{nd}		%	2^{nd}		%	2^{nd}		%
3^{rd}		%	3^{rd}		%	3^{rd}		%
4^{th}		%	4^{th}		%	4^{th}		%
5^{th}		%	5^{th}		%	5^{th}		%
6^{th}		%	6^{th}		%	6^{th}		%
7^{th}		%	7^{th}		%	7^{th}		%
8^{th}		%	8^{th}		%	8^{th}		%
9^{th}		%	9^{th}		%	9^{th}		%
10^{th}		%	10^{th}		%	10^{th}		%
11^{th}		%	11^{th}		%	11^{th}		%
12^{th}		%	12^{th}		%	12^{th}		%
13^{th}		%	13^{th}		%	13^{th}		%
14^{th}		%	14^{th}		%	14^{th}		%
15^{th}		%	15^{th}		%	15^{th}		%

METHOD TAC108
DC Voltage Component

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 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 TAC108-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 TAC108-I. MIL-STD-704 limits for direct current component of AC voltage.

Limit	704A	704B	704C	704D	704E	704F
DC Voltage Component of the AC Voltage	± 0.10 V	± 0.10 V	± 0.10 V	± 0.10 V	± 0.10 V	± 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 TAC108-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

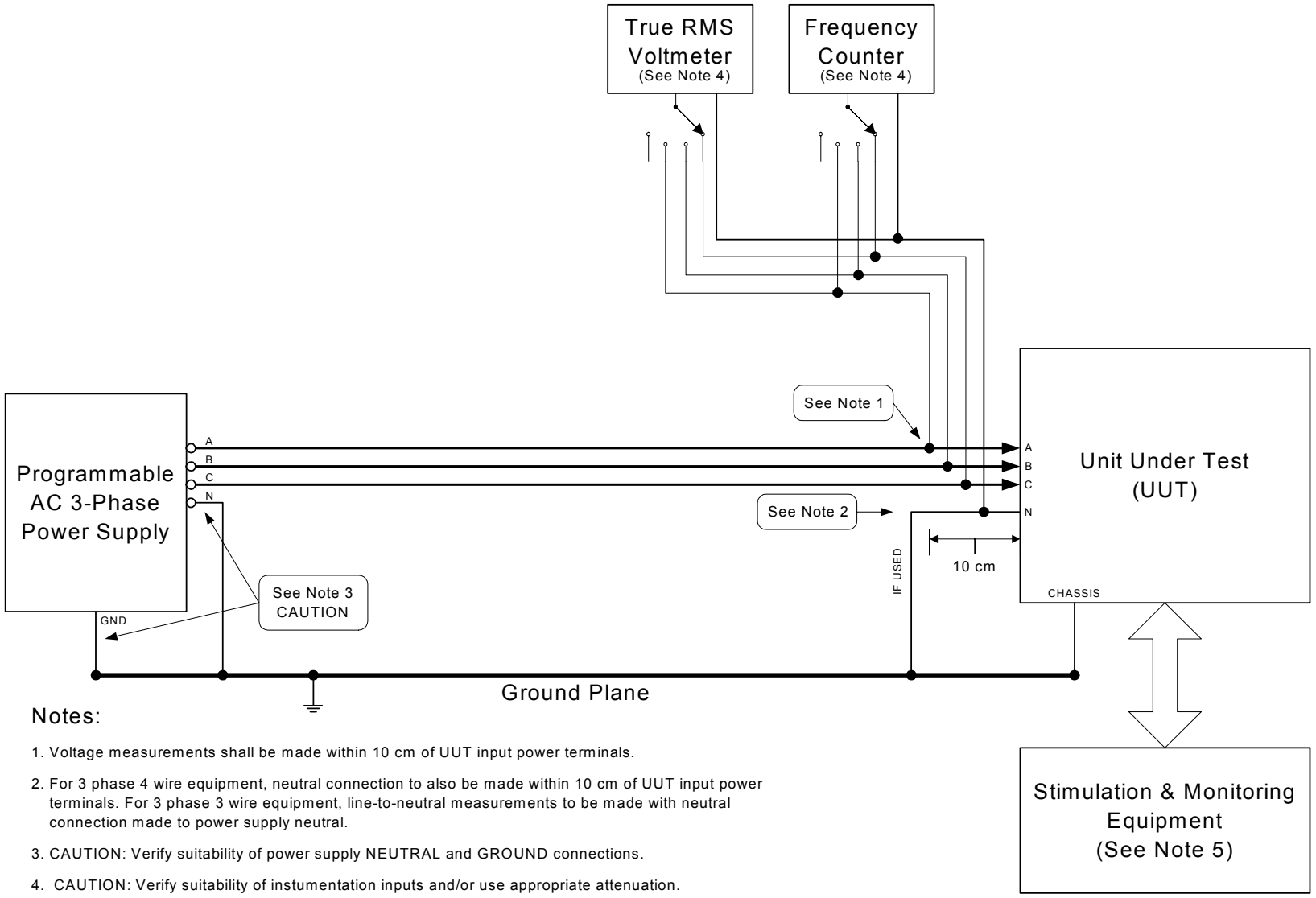
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC108-1. Set the programmable power supply to produce voltage waveforms having a DC component on each of the three phases for

test condition A as noted in table TAC108-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 400 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 TAC108-II. Record the voltages, 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 TAC108-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce voltage sine waves 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 400 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 TAC108-II. Test conditions for direct current component of AC voltage.

Test Condition	MIL-STD-704A, B C, D, E & F Direct Current Component of AC Voltage
A	+ 0.10V
B	– 0.10 V



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC108-1. DC voltage component.

TABLE TAC108-III. Sample data sheet for TAC108 DC voltage component.

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

METHOD TAC109
Normal Voltage Transients

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 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 TAC109-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 TAC109-I. MIL-STD-704 limits for normal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	Figure 3 MIL-STD-704A Locus of Equivalent Step Function Curves 2 and 3	Figure 4 MIL-STD-704B	Figure 5 MIL-STD-704C	Figure 5 MIL-STD-704D	Figure 4 MIL-STD-704E	Figure 3 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 TAC109-1. 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 TAC109-1. 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 400 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.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the voltage transients for each test condition A through O noted in table TAC109-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table TAC109-II. The voltage must return to steady state over the time duration noted in table TAC109-II. For test condition G, three over-voltage transients of 160 Vrms for 25 milliseconds are performed, separated by 0.5 seconds. For test condition N, three under-voltage transients of 58 Vrms for 25 milliseconds are performed, separated by 0.5 seconds. For test condition O, an under-voltage transient of 58 Vrms for 25 milliseconds is immediately followed by an overvoltage transient of 160 Vrms for 25 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 voltages, 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 TAC109-IV. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704A test compliance perform the repetitive normal voltage transient test described later.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the voltage transients for each test condition AA through MM noted in table TAC109-III. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table TAC109-III. The voltage must return to steady state over the time duration noted in table TAC109-III. For test condition GG, three overvoltage transients of 180 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition LL, three undervoltage transients of 80 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition MM, an undervoltage transient of 80 Vrms for 10 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 10 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft

electrical conditions. Record the steady state voltages, 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 TAC109-V. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704B, C, D, E, & F test compliance perform the repetitive normal voltage transient test as described in 5.3.

5.3 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 115 Vrms to 90 Vrms in 2.5 msec, then increases to 140 Vrms over 50 msec, then decreases to 115 Vrms over 5.0 msec. The voltage transient is repeated every 0.5 seconds, see figure TAC109-2. 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 voltages, 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 TAC109-IV or table TAC109-V. Repeat for each mode of operation of the UUT.

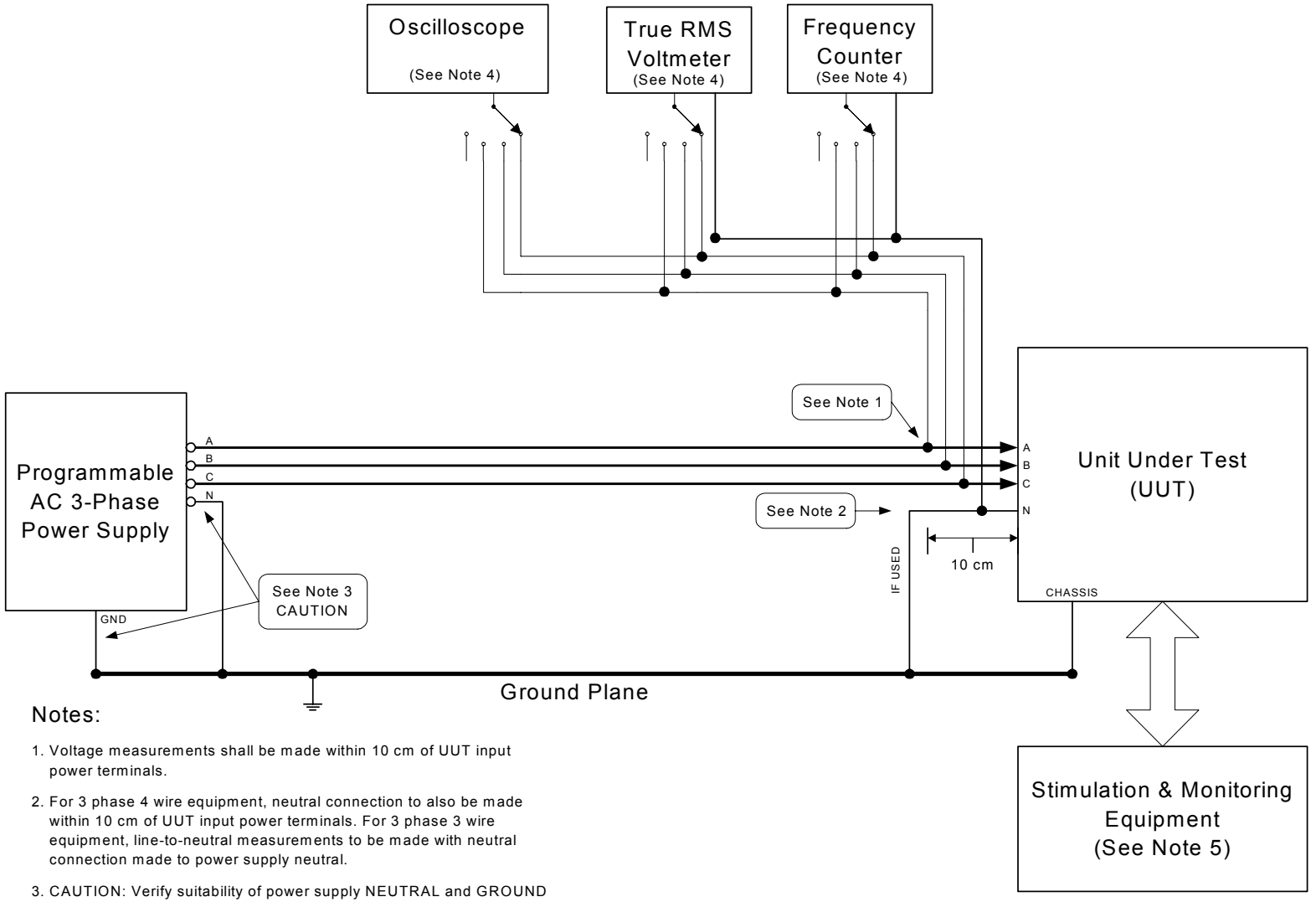
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC109-II. Test conditions for MIL-STD-704A normal voltage transients.

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	< 1.25 msec	135 Vrms	210 msec	< 1.25 msec
B	< 1.25 msec	135 Vrms	145 msec	130 msec
C	< 1.25 msec	145 Vrms	130 msec	< 1.25 msec
D	< 1.25 msec	145 Vrms	90 msec	80 msec
E	< 1.25 msec	160 Vrms	48 msec	< 1.25 msec
F	< 1.25 msec	160 Vrms	30 msec	40 msec
G	< 1.25 msec	160 Vrms (3 times)	25 msec every 0.5 sec	< 1.25 msec
Undervoltage Transients				
H	< 1.25 msec	90 Vrms	300 msec	< 1.25 msec
I	< 1.25 msec	90 Vrms	210 msec	180 msec
J	< 1.25 msec	70 Vrms	140 msec	< 1.25 msec
K	< 1.25 msec	70 Vrms	95 msec	85 msec
L	< 1.25 msec	58 Vrms	48 msec	< 1.25 msec
M	< 1.25 msec	58 Vrms	30 msec	40 msec
N	< 1.25 msec	58 Vrms (3 times)	25 msec every 0.5 sec	< 1.25 msec
Combined Transient				
O	< 1.25 msec then < 1.25 msec	58 Vrms 160 Vrms	25 msec 25 msec	< 1.25 msec 50 msec

TABLE TAC109-III. Test conditions for MIL-STD-704B, C, D, E, and F normal voltage transients.

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				
AA	< 1.25 msec	140 Vrms	60 msec	< 1.25 msec
BB	< 1.25 msec	140 Vrms	60 msec	25 msec
CC	< 1.25 msec	160 Vrms	34 msec	< 1.25 msec
DD	< 1.25 msec	160 Vrms	34 msec	52 msec
EE	< 1.25 msec	180 Vrms	10 msec	< 1.25 msec
FF	< 1.25 msec	180 Vrms	10 msec	77 msec
GG	< 1.25 msec	180 Vrms (3 times)	10 msec every 0.5 sec	< 1.25 msec
Undervoltage Transients				
HH	< 1.25 msec	90 Vrms	35 msec	< 1.25 msec
II	< 1.25 msec	90 Vrms	35 msec	45 msec
JJ	< 1.25 msec	80 Vrms	10 msec	< 1.25 msec
KK	< 1.25 msec	80 Vrms	10 msec	70 msec
LL	< 1.25 msec	80 Vrms (3 times)	10 msec every 0.5 sec	< 1.25 msec
Combined Transient				
MM	< 1.25 msec then < 1.25 msec	80 Vrms 180 Vrms	10 msec 10 msec	< 1.25 msec 77 msec

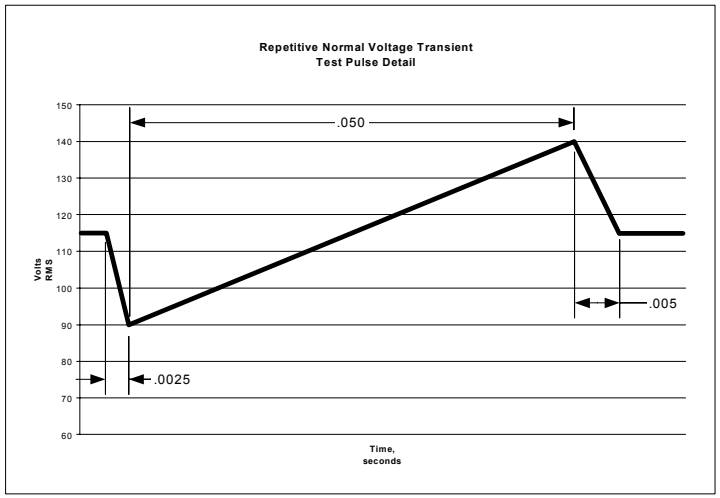


Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC109-1. Normal voltage transients.

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



Pulse Detail

Repetitive Normal Voltage Transient

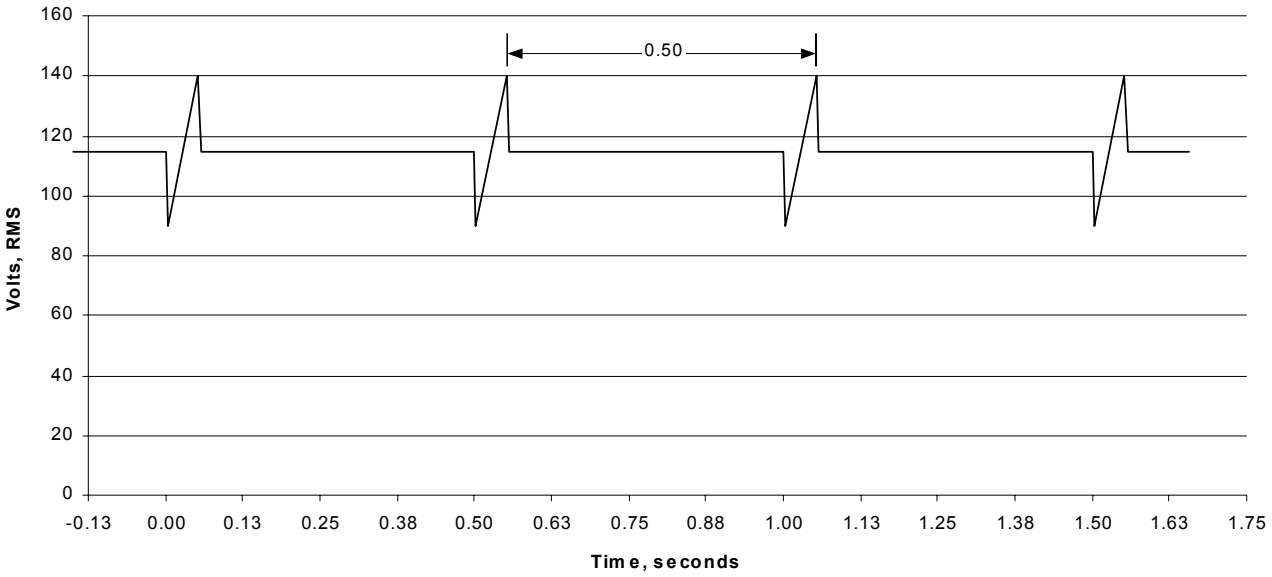


FIGURE TAC109-2. Repetitive normal voltage transients.

TABLE TAC109-IV. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704A.

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

TABLE TAC109-IV. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704A. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
N	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC109-IV. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704A. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
O	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
Repetitive Transient	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
	Time duration at test condition										min	

TABLE TAC109-V. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace	Pass/Fail
AA	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
BB	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
CC	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
DD	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
EE	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
FF	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
GG	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		

TABLE TAC109-V. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace	Pass/Fail
HH	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
II	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
JJ	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
KK	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
LL	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
MM	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
	A						V_{rms}		msec		
	B						V_{rms}		msec		
	C						V_{rms}		msec		

TABLE TAC109-V. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace	Pass/Fail
Repetitive Transient	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
	A						V_{rms}		msec		
	B						V_{rms}		msec		
	C						V_{rms}		msec		
	Time duration at test condition									min	

METHOD TAC110
Normal Frequency Transients

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 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 TAC110-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 TAC110-I. MIL-STD-704 limits for normal frequency transients.

Limit	704A	704B	704C	704D	704E	704F
Normal Frequency Transients	Figure 5 MIL-STD-704A Locus of Equivalent Step Function Curves 2 and 3	¶ 5.1.3 MIL-STD-704B	Figure 6 MIL-STD-704C	Figure 6 MIL-STD-704D	Figure 5 MIL-STD-704E	Figure 5 MIL-STD-704F
Normal Maximum Rate of Change of Frequency	250 Hz/sec	N/A	N/A	N/A	N/A	N/A

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 TAC110-1. 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 TAC110-1. 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 400 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.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the frequency transients for each test condition A through I noted in table TAC110-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 I, an underfrequency transient of 350 Hz is immediately followed by an overfrequency transient of 450 Hz. For each test condition, monitoring 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 voltages, 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 TAC110-IV. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the frequency transients for each test condition AA through II noted in table TAC110-III. 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 II, an underfrequency transient of 375 Hz is immediately followed by an overfrequency transient of 425 Hz. For each test condition, monitoring 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 voltages, 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 TAC110-V. Repeat for each mode of operation of the UUT.

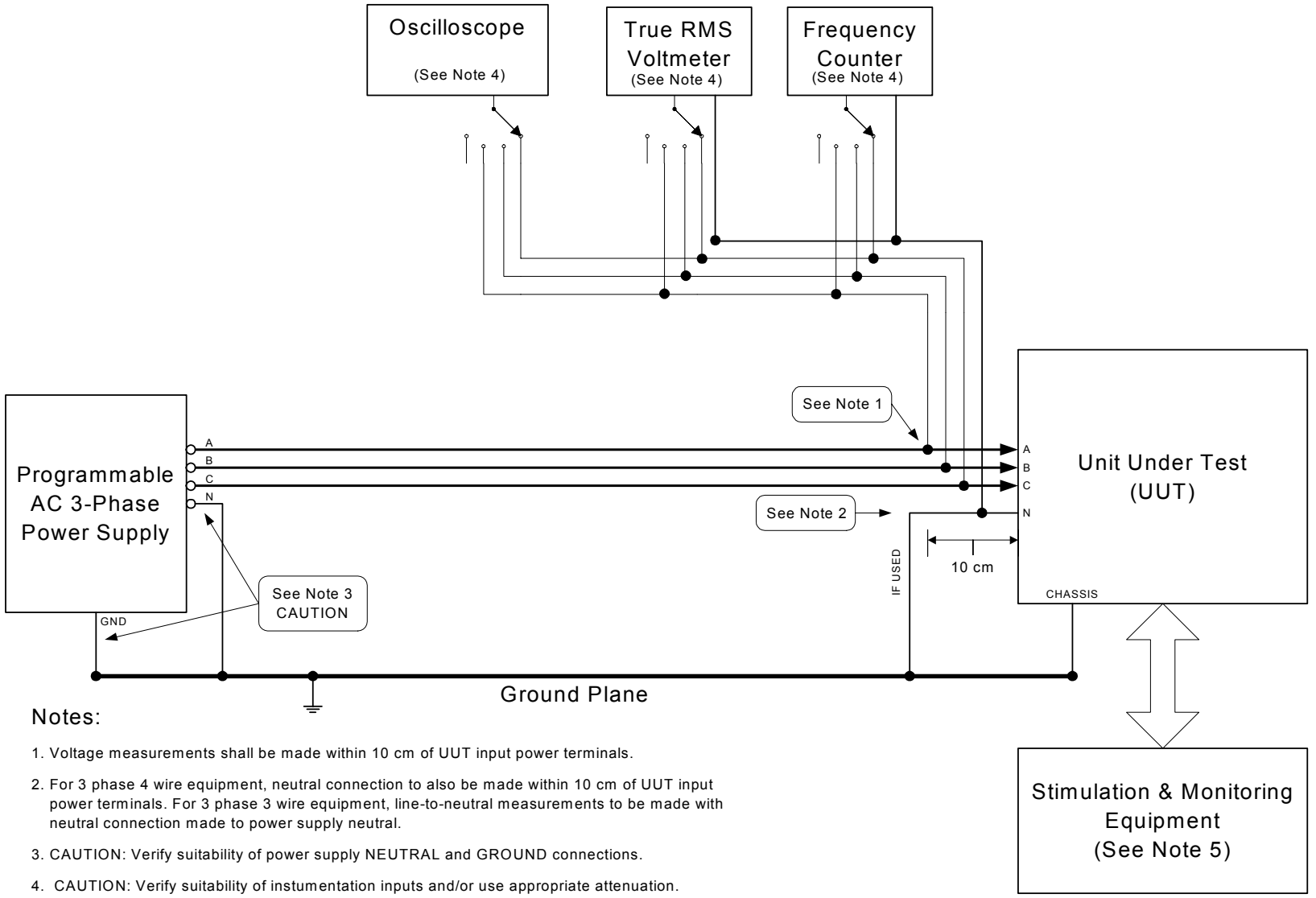
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC110-II. Test conditions for MIL-STD-704A normal frequency transients.

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	120 msec	430 Hz	½ cycle	120 msec
B	300 msec	430 Hz	½ cycle	1.2 seconds
C	200 msec	450 Hz	½ cycle	200 msec
D	250 msec	450 Hz	½ cycle	3 seconds
Underfrequency Transients				
E	120 msec	370 Hz	½ cycle	120 msec
F	300 msec	370 Hz	½ cycle	1.2 seconds
G	200 msec	350 Hz	½ cycle	200 msec
H	250 msec	350 Hz	½ cycle	3 seconds
Combined Transient				
I	200 msec then 200 msec	350 Hz 450 Hz	½ cycle ½ cycle	200 msec 200 msec

TABLE TAC110-III. Test conditions for MIL-STD-704B, C, D, E, and F normal frequency transients.

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				
AA	40 msec	410 Hz	10 seconds	40 msec
BB	80 msec	420 Hz	5 seconds	80 msec
CC	100 msec	425 Hz	1 seconds	100 msec
DD	100 msec then 10 msec then 20 msec	425 Hz 420 Hz 410 Hz	1 seconds 4 seconds 5 seconds	10 msec 20 msec 40 msec
Underfrequency Transients				
EE	40 msec	390 Hz	10 seconds	40 msec
FF	80 msec	380 Hz	5 seconds	80 msec
GG	100 msec	375 Hz	1 seconds	100 msec
HH	100 msec then 10 msec then 20 msec	375 Hz 380 Hz 390 Hz	1 seconds 4 seconds 5 seconds	10 msec 20 msec 40 msec
Combined Transient				
II	100 msec then 100 msec	375 Hz 425 Hz	1 seconds 1 seconds	100 msec 100 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC110-1. Normal frequency transients.

TABLE TAC110-IV. Sample data sheet for TAC110 normal frequency transients for MIL-STD-704A.

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

TABLE TAC110-IV. Sample data sheet for TAC110 normal frequency transients for MIL-STD-704A. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
H	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
I	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
							Hz		msec			

TABLE TAC110-V. Sample data sheet for TAC110 normal frequency transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters										Performance
	Phase	Voltage		Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace	Pass/Fail
AA	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
BB	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
CC	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
DD	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
EE	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
FF	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
GG	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									

TABLE TAC110-V. Sample data sheet for TAC110 normal frequency transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters											Performance
	Phase	Voltage		Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
HH	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
II	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
							Hz		sec			

METHOD TAC201
Power Interrupt

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 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 TAC201-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 TAC201-I. MIL-STD-704 power transfer limits.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	50 msec	50 msec	50 msec	50 msec	50 msec	50 msec
Voltage NLSS	108 V	108 V	108 V	108 V	108 V	108 V
Voltage NHSS	118 V	118 V	118 V	118 V	118 V	118 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 TAC201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the UUT up to a maximum of 25 kW dummy load. 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.

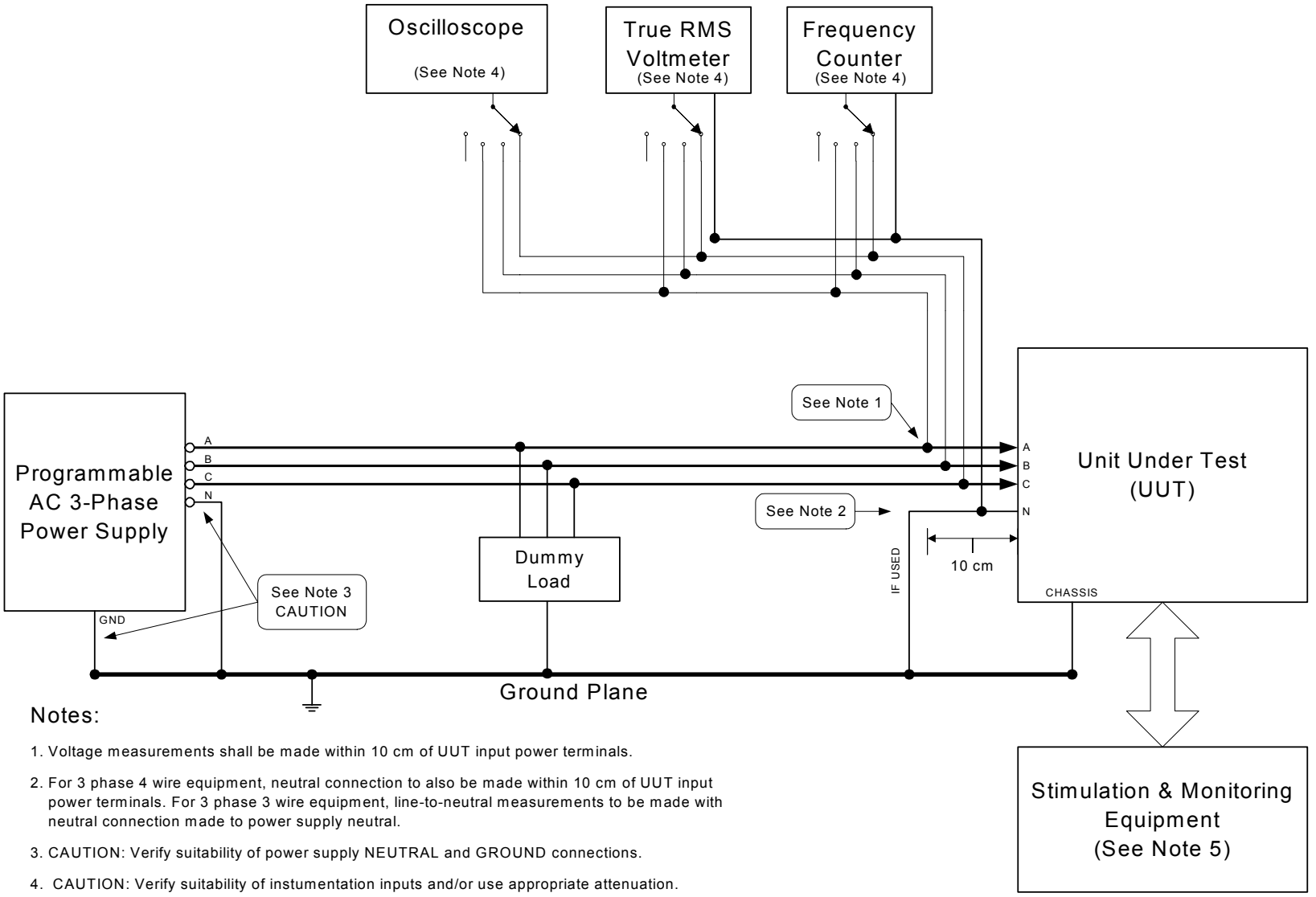
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 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 TAC201-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 ½ cycle (1.25 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within ½ cycle (1.25 milliseconds). For test condition J, three 50 millisecond power interrupts are performed, separated by 0.5 seconds. For test condition K a normal overvoltage transient follows the power interrupt. The normal voltage transient is 160 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 70 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power transfer operation to verify that the UUT is providing specified performance for transfer aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing 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 voltages, 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 TAC201-II. 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 400 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 TAC201-II. Test conditions for transfer interrupt.

Test Condition	Steady State Voltage	Duration of Interrupt
A	Nominal Voltage	50 msec
B	NLSS Voltage	50 msec
C	NHSS Voltage	50 msec
D	Nominal Voltage	30 msec
E	NLSS Voltage	30 msec
F	NHSS Voltage	30 msec
G	Nominal Voltage	10 msec
H	NLSS Voltage	10 msec
I	NHSS Voltage	10 msec
J	Nominal Voltage	50 msec (repeated 3 times, separated by 0.5 sec)
K	Nominal Voltage	50 msec (followed by a normal voltage transient of 160 Vrms for 30 msec and return to steady state voltage in 40 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 70 Vrms for 30 msec and return to steady state voltage in 40 msec)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC201-1. Power interrupt.

TABLE TAC201-III. Sample data sheet for TAC201 power interrupt.

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
A	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
B	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
C	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
D	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
E	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
F	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
G	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TAC201-III. Sample data sheet for TAC201 power interrupt. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
H	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
I	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
J	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
K	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
	Voltage Transient Level					Time at Voltage Transient Level		
	A		V_{rms}				msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TAC201-III. Sample data sheet for TAC201 power interrupt. – Continued

Test	Parameter							Performance
Condition	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
L	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
	Voltage Transient Level					Time at Voltage Transient Level		
	A		V_{rms}				msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

METHOD TAC301
Abnormal Steady State Limits for Voltage and Frequency

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 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 TAC301-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 TAC301-I. MIL-STD-704 abnormal limits for steady state voltage and frequency.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage ALSS	102 V	100 V	100 V	100 V	100 V	100 V
Voltage AHSS	124 V	125 V	125 V	125 V	125 V	125 V
Frequency ALSS	370 Hz	375 Hz	380 Hz	375 Hz	380 Hz	380 Hz
Frequency AHSS	430 Hz	425 Hz	420 Hz	425 Hz	420 Hz	420 Hz

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 TAC301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

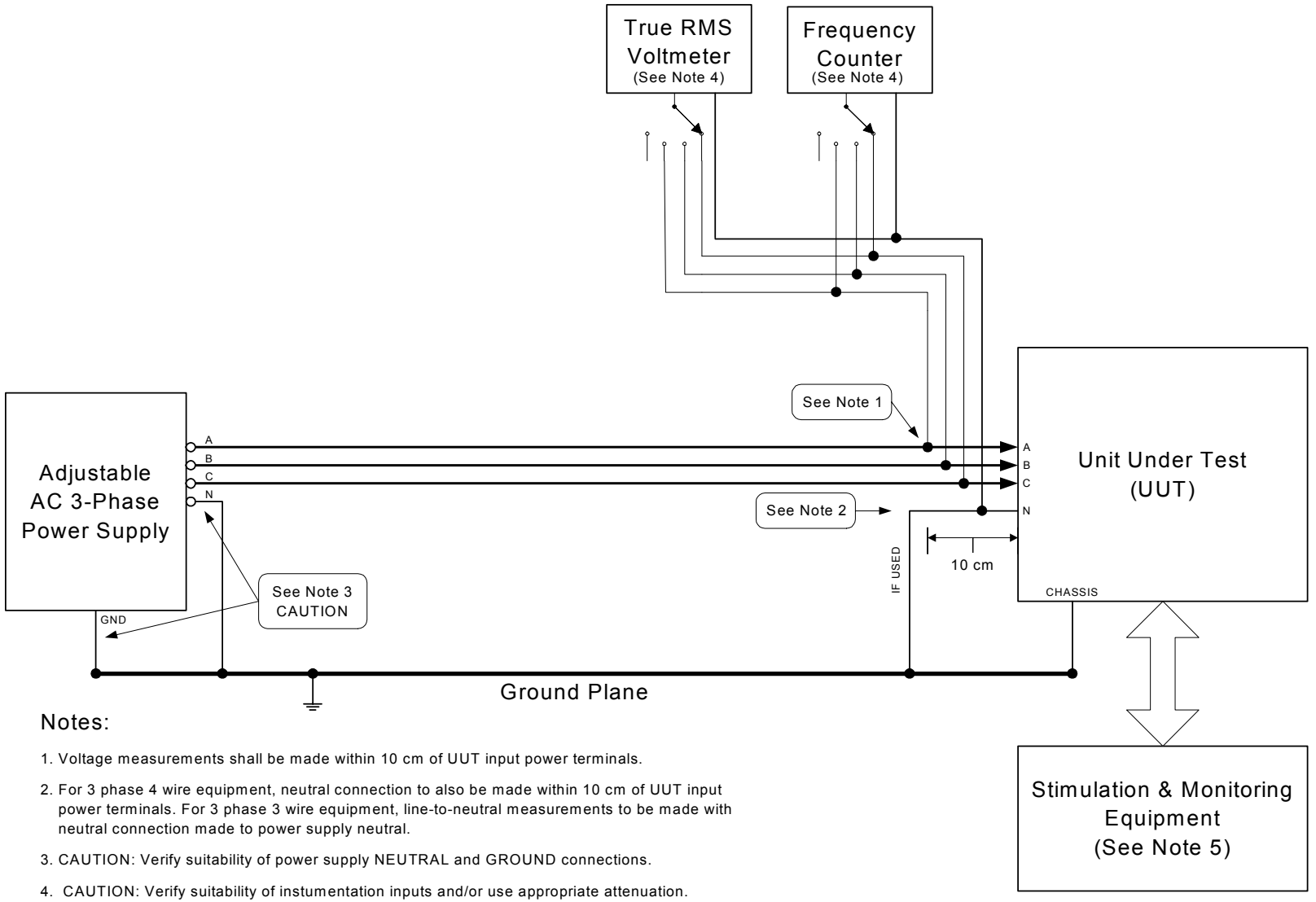
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 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 TAC301-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 400 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 voltages, 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 TAC301-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 400 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 TAC301-II. Test conditions for abnormal steady state limits for voltage and frequency.

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



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC301-1. Abnormal steady state limits for voltage and frequency.

TABLE TAC301-III. Sample data sheet for TAC301 abnormal steady state limits for voltage and frequency.

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
A	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
B	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
C	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
D	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
E	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
F	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					

TABLE TAC301-III. Sample data sheet for TAC301 abnormal steady state limits for voltage and frequency. - Continued

Test Condition	Parameter								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition			Pass/Fail
G	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
H	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

METHOD TAC302
Abnormal Voltage Transients

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 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 TAC302-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 TAC302-I. MIL-STD-704 limits for abnormal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	Figure 3 MIL-STD-704A Locus of Equivalent Step Function Curves 1 and 4	Figure 5 MIL-STD-704B	Figure 7 MIL-STD-704C	Figure 7 MIL-STD-704D	Figure 6 MIL-STD-704E	Figure 4 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 TAC302-1. 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 TAC302-1. 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 400 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.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the voltage transients for each test condition A through O noted in table TAC302-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table TAC302-II. The voltage must return to steady state over the time duration noted in table TAC302-II. For test condition G, three over-voltage transients of 180 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition N, three under-voltage transients of 45 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition O, an under-voltage transient of 45 Vrms for 20 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 75 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits, and has not suffered damage. Record the steady state voltages, 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 TAC302-IV. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the voltage transients for each test condition AA through OO noted in table TAC302-III. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table TAC302-III. The voltage must return to steady state over the time duration noted in table TAC303-III. For test condition GG, three over-voltage transients of 180 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition NN, three under-voltage transients of 45 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition OO, an under-voltage transient of 45 Vrms for 20 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 50 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test

procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits, and has not suffered damage. Record the steady state voltages, 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 TAC302-V. Repeat for each mode of operation of the UUT.

TABLE TAC302-II. Test conditions for MIL-STD-704A abnormal voltage transients.

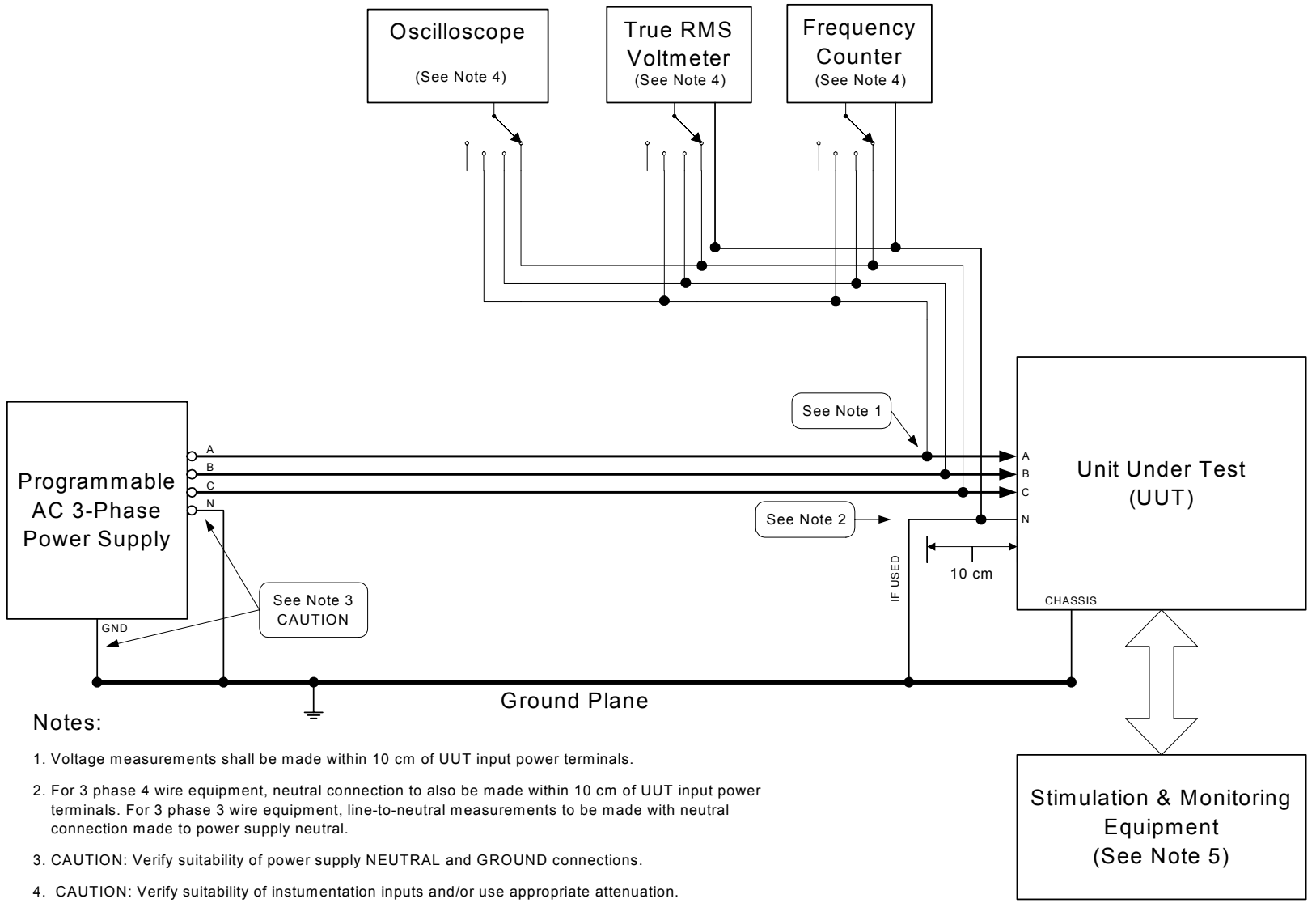
Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
A	< 1.25 msec	140 Vrms	1450 msec	< 1.25 msec
B	< 1.25 msec	140 Vrms	1025 msec	850 msec
C	< 1.25 msec	160 Vrms	520 msec	< 1.25 msec
D	< 1.25 msec	160 Vrms	390 msec	250 msec
E	< 1.25 msec	180 Vrms	98 msec	< 1.25 msec
F	< 1.25 msec	180 Vrms	75 msec	50 msec
G	< 1.25 msec	180 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec
Undervoltage Transients				
H	< 1.25 msec	85 Vrms	1450 msec	< 1.25 msec
I	< 1.25 msec	85 Vrms	1025 msec	850 msec
J	< 1.25 msec	75 Vrms	520 msec	< 1.25 msec
K	< 1.25 msec	75 Vrms	390 msec	250 msec
L	< 1.25 msec	45 Vrms	98 msec	< 1.25 msec
M	< 1.25 msec	45 Vrms	75 msec	50 msec
N	< 1.25 msec	45 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec
Combined Transient				
O	< 1.25 msec then < 1.25 msec	45 Vrms 180 Vrms	20 msec 75 msec	< 1.25 msec 50 msec

TABLE TAC302-III. Test conditions for MIL-STD-704B, C, D, E, and F abnormal voltage transients.

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				
AA	< 1.25 msec	140 Vrms	180 msec	< 1.25 msec
BB	< 1.25 msec	140 Vrms	180 msec	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		
CC	< 1.25 msec	160 Vrms	78 msec	< 1.25 msec
DD	< 1.25 msec	160 Vrms	78 msec	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		
EE	< 1.25 msec	180 Vrms	50 msec	< 1.25 msec
FF	< 1.25 msec	180 Vrms	50 msec	11 msec
	then	170 Vrms	decreasing	17 msec
	then	160 Vrms	decreasing	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		
GG	< 1.25 msec	180 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec

TABLE TAC302-III. Test conditions for MIL-STD-704B, C, D, E, and F abnormal voltage transients. - Continued

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
Undervoltage Transients				
HH	< 1.25 msec	85 Vrms	180 msec	< 1.25 msec
II	< 1.25 msec	85 Vrms	180 msec	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	>10 sec
		115 Vrms		
JJ	< 1.25 msec	66 Vrms	78 msec	< 1.25 msec
KK	< 1.25 msec	65 Vrms	78 msec	31 msec
	then	75 Vrms	increasing	71 msec
	then	85 Vrms	increasing	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	>10 sec
		115 Vrms		
LL	< 1.25 msec	45 Vrms	50 msec	< 1.25 msec
MM	< 1.25 msec	45 Vrms	50 msec	11 msec
	then	55 Vrms	increasing	17 msec
	then	65 Vrms	increasing	31 msec
	then	75 Vrms	increasing	71 msec
	then	85 Vrms	increasing	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	>10 sec
		115 Vrms		
NN	< 1.25 msec	45 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec
Combined Transient				
OO	< 1.25 msec	45 Vrms then	20 msec	< 1.25 msec
	< 1.25 msec	180 Vrms	50 msec	11 msec
	then	170 Vrms	decreasing	17 msec
	then	160 Vrms	decreasing	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC302-1. Abnormal voltage transients.

TABLE TAC302-IV. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704A.

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

TABLE TAC302-IV. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704A. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC302-IV. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704A. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
N	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
O	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

TABLE TAC302-V. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace	Pass/Fail
AA	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
BB	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
CC	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
DD	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
EE	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
FF	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
GG	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		

TABLE TAC302-V. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
HH	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
II	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
JJ	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
KK	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
LL	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
MM	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC302-V. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
NN	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
OO	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

METHOD TAC303
Abnormal Frequency Transients

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 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 TAC303-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 TAC303-I. MIL-STD-704 limits for abnormal frequency transients.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Frequency Transients	Figure 5 MIL-STD-704A Locus of Equivalent Step Function Curves 1 and 4	¶ 5.1.5 MIL-STD-704B	Figure 8 MIL-STD-704C	Figure 8 MIL-STD-704D	Figure 7 MIL-STD-704E	Figure 6 MIL-STD-704F
Abnormal Maximum Rate of Change of Frequency	500 Hz/sec	500 Hz/sec	500 Hz/sec	N/A	N/A	N/A

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 TAC303-1. 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 TAC303-1. 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 400 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.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the frequency transients for each test condition A through E noted in table TAC303-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 voltages, 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 TAC302-IV. Repeat for each mode of operation of the UUT.

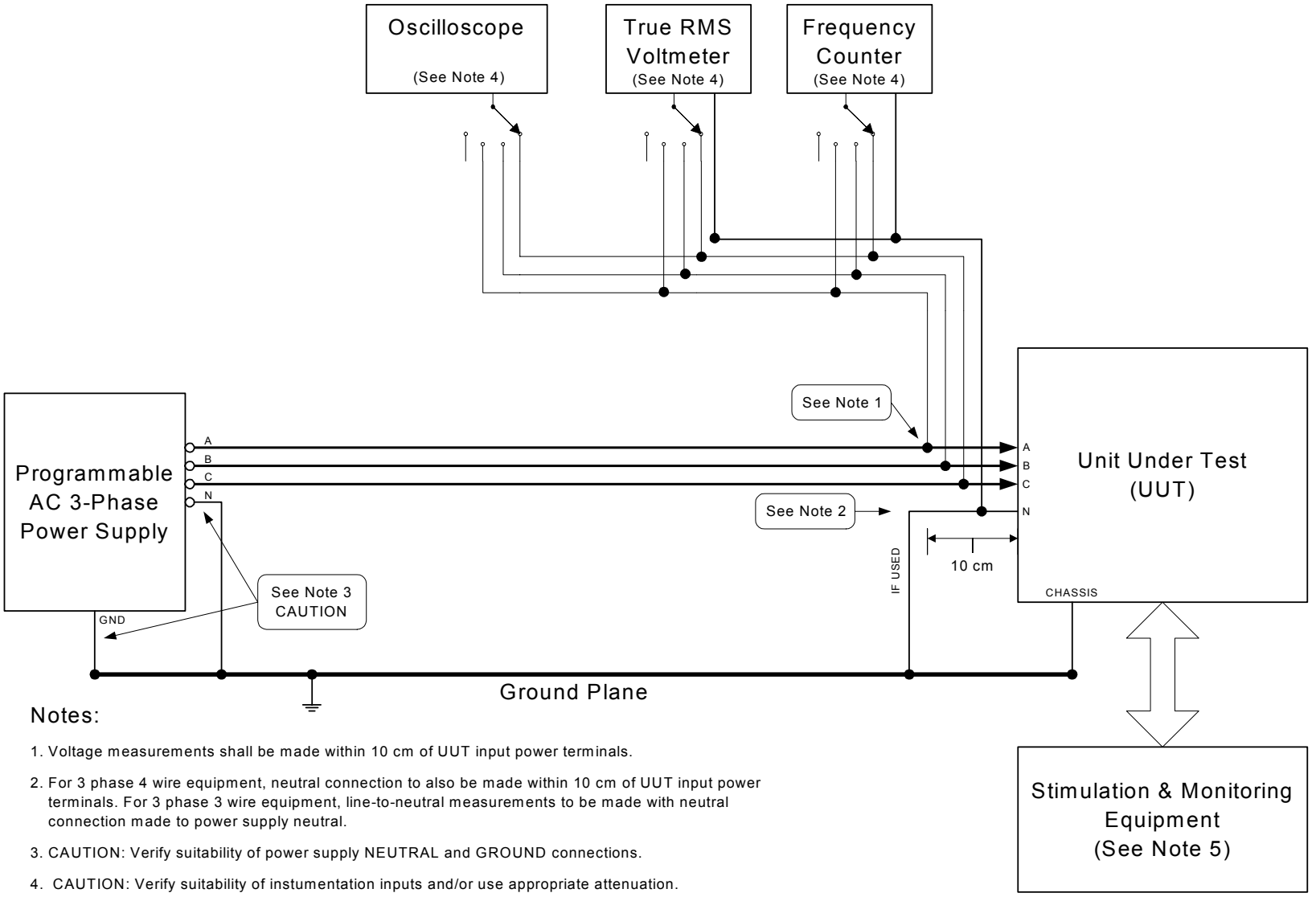
5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the frequency transients for each test condition AA through EE noted in table TAC302-III. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the 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 EE, 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 voltages, 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 TAC303-V. Repeat for each mode of operation of the UUT.

TABLE TAC303-II. Test conditions for MIL-STD-704A abnormal frequency transients.

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	333 msec	480 Hz	½ cycle	60 msec
B	333 msec	480 Hz	6.69 seconds	60 msec
Underfrequency Transients				
C	333 msec	320 Hz	½ cycle	60 msec
D	333 msec	320 Hz	6.69 seconds	60 msec
Combined Transient				
E	333 msec 333 msec	320 Hz then 480 Hz	½ cycle ½ cycle	333 msec 333 msec

TABLE TAC303-III. Test conditions for MIL-STD-704B, C, D, E and F abnormal frequency transients.

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				
AA	160 msec	480 Hz	½ cycle	160 msec
BB	160 msec	480 Hz	4.78 seconds	160 msec
Underfrequency Transients				
CC	160 msec	320 Hz	½ cycle	160 msec
DD	160 msec	320 Hz	4.78 seconds	160 msec
Combined Transient				
EE	160 msec 160 msec	320 Hz then 480 Hz	½ cycle ½ cycle	160 msec 160 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC303-1. Abnormal frequency transients.

TABLE TAC303-IV. Sample data sheet for TAC303 abnormal frequency transients for MIL-STD-704A.

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

TABLE TAC303-V. Sample data sheet for TAC303 abnormal frequency transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace	Pass/Fail
AA	A		V_{rms}		Hz		Hz		msec	Attach Trace Hz vs. Time	
	B		V_{rms}								
	C		V_{rms}								
BB	A		V_{rms}		Hz		Hz		sec	Attach Trace Hz vs. Time	
	B		V_{rms}								
	C		V_{rms}								
CC	A		V_{rms}		Hz		Hz		msec	Attach Trace Hz vs. Time	
	B		V_{rms}								
	C		V_{rms}								
DD	A		V_{rms}		Hz		Hz		sec	Attach Trace Hz vs. Time	
	B		V_{rms}								
	C		V_{rms}								
EE	A		V_{rms}		Hz		Hz		msec	Attach Trace Hz vs. Time	
	B		V_{rms}								
	C		V_{rms}								
							Hz		msec		

METHOD TAC401
Emergency Steady State Limits for Voltage and Frequency

POWER GROUP: Three Phase, 400 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 three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage and frequency at the specified emergency steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the emergency 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 emergency steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC401-I. MIL-STD-704 emergency limits for steady state voltage and frequency.

Emergency Limit	704A	704B	704C	704D	704E 1/	704F 1/
Voltage ELSS	104 V	102 V	104 V	104 V	108 V	108 V
Voltage EHSS	122 V	124 V	122 V	122 V	118 V	118 V
Frequency ELSS	360 Hz	360 Hz	360 Hz	360 Hz	393 Hz	393 Hz
Frequency EHSS	440 Hz	440 Hz	440 Hz	440 Hz	407 Hz	407 Hz

1/ For MIL-STD-704E and F, performance of test method TAC102 will constitute performance of test method TAC401.

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

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

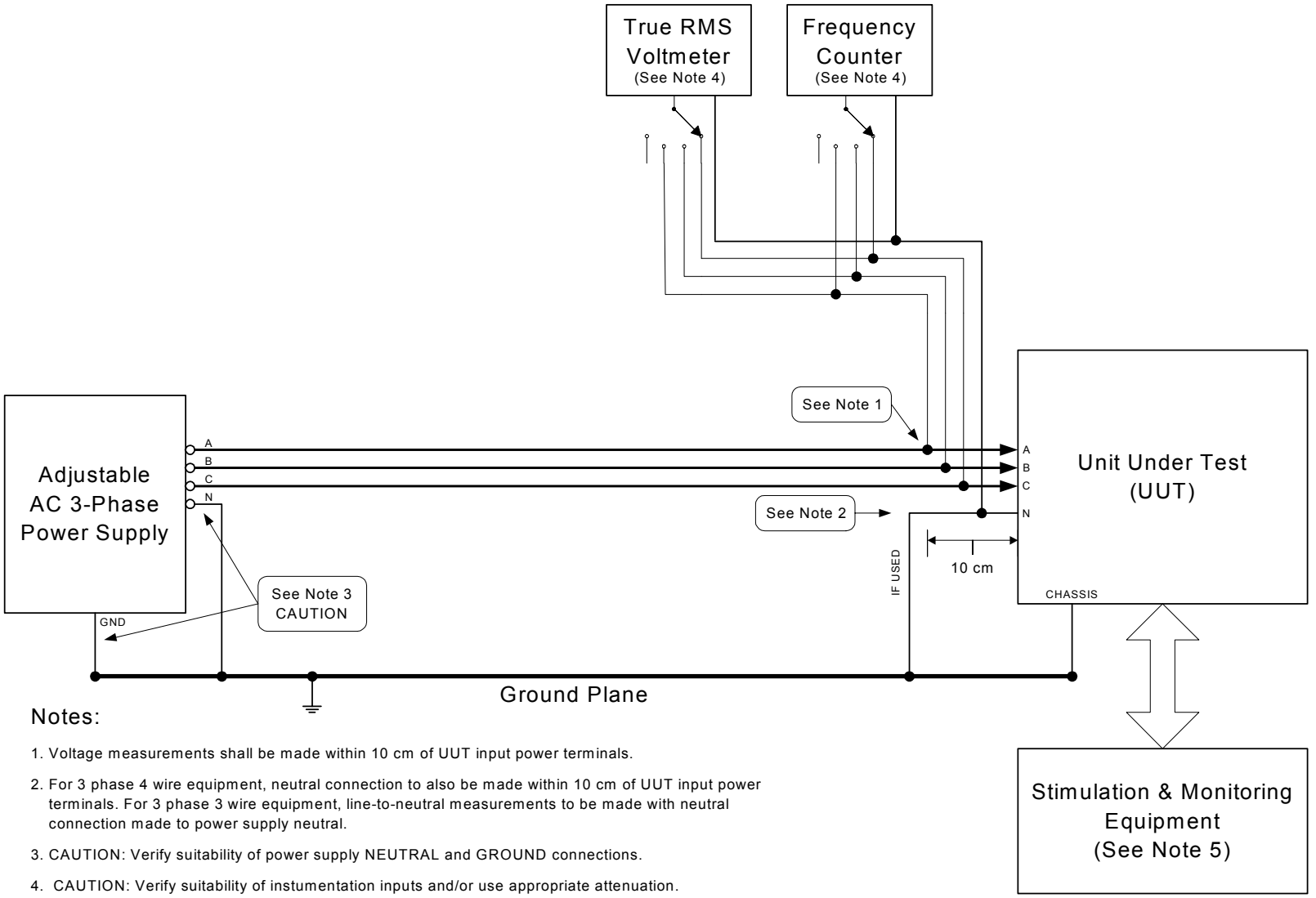
4. Test setup. Configure the test setup as shown in figure TAC401-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure1. 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 400 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 TAC401-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the emergency steady state voltage 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 emergency 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 400 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 voltages, frequency, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TAC401-III. Repeat for each mode of operation of the UUT.

TABLE TAC401-II. Test conditions for emergency steady state limits for voltage and frequency.

Test Condition	Voltage	Frequency
A	Nominal Voltage	ELSS Frequency
B	Nominal Voltage	EHSS Frequency
C	ELSS Voltage	Nominal Frequency
D	ELSS Voltage	ELSS Frequency
E	ELSS Voltage	EHSS Frequency
F	EHSS Voltage	Nominal Frequency
G	EHSS Voltage	ELSS Frequency
H	EHSS Voltage	EHSS Frequency



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC401-1. Emergency steady state limits for voltage and frequency.

TABLE TAC401-III. Sample data sheet for TAC401 emergency steady state limits for voltage and frequency.

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
A	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
B	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
C	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
D	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
E	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
F	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					

TABLE TAC401-III. Sample data sheet for TAC401 emergency steady state limits for voltage and frequency. - Continued

Test Condition	Parameter								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition			Pass/Fail
G	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
H	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

METHOD TAC501
(No Test Required)

POWER GROUP:	Three Phase, 400 Hz, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Starting
PARAMETER:	No Tests

Starting operations are usually not applicable to AC utilization equipment.

METHOD TAC601
Power Failure (Three Phase)

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Power Failure (Three Phase)

1. Scope

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to three phase 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 three phase power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC601-I. The utilization equipment must maintain the specified performance during the three phase 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 TAC601-I. MIL-STD-704 power failure limits.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	7 sec Figure 3 Curve 4 MIL-STD-704A	7 sec Figure 5 MIL-STD-704B	7 sec Figure 7 MIL-STD-704C	7 sec Figure 7 MIL-STD-704D	7 sec Figure 6 MIL-STD-704E	7 sec Figure 4 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 TAC601-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

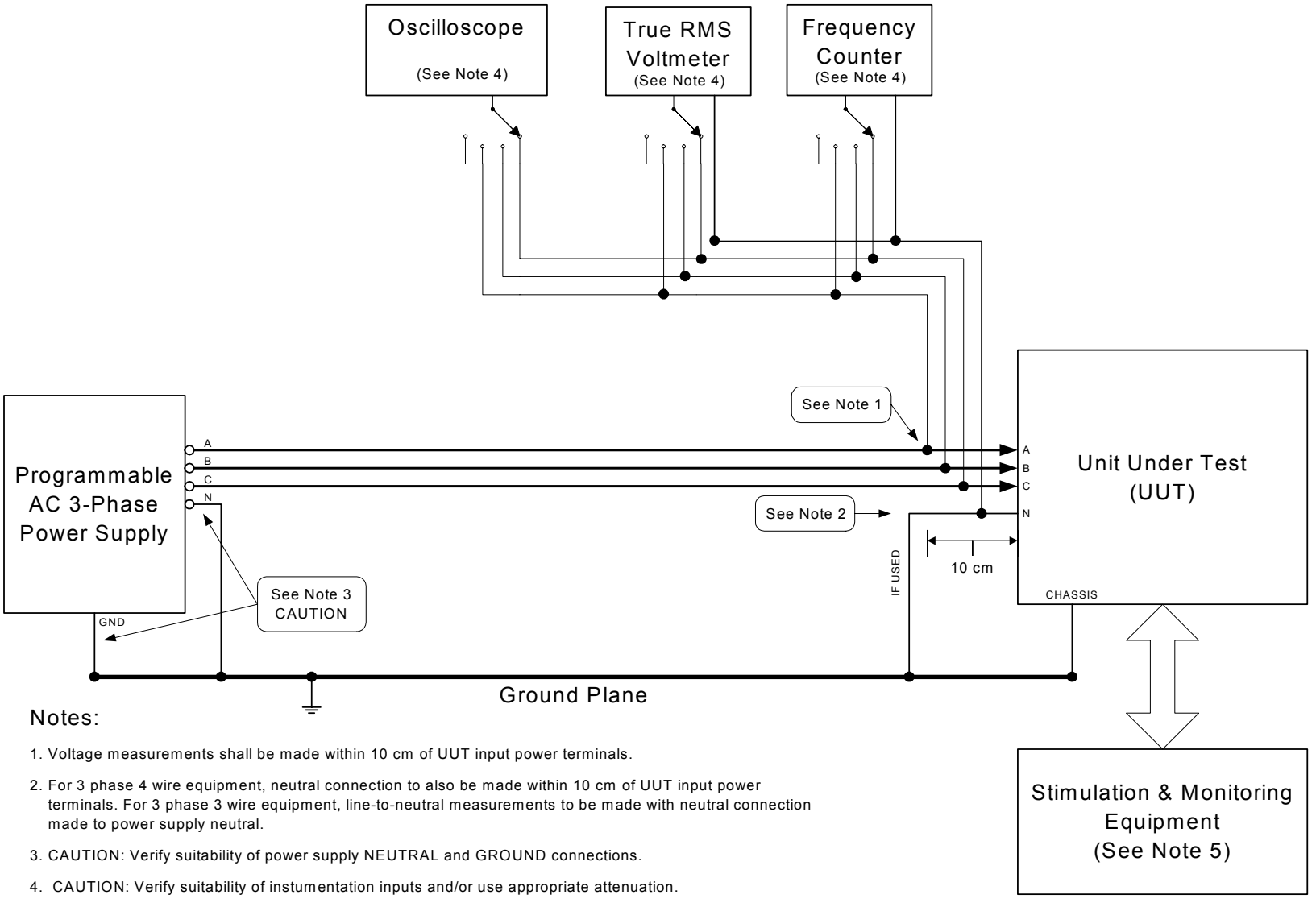
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC601-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 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 D noted in table TAC601-II, perform a three phase power failure (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle (1.25 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within ½ cycle (1.25 milliseconds). For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltages, 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 TAC601-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 400 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 TAC601-II. Test conditions for three phase power failures.

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



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC601-1. Power failure (three phase).

TABLE TAC601-III. Sample data sheet for TAC601 power failure (three phase).

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
A	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
B	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

METHOD TAC602
One and Two Phase Power Failures

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: One and Two Phase Power Failures

1. Scope.

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to one and two phase power failures (7 seconds and indefinitely) 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 TAC602-I. The utilization equipment must maintain the specified performance during one and two phase power failures. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate with one and two phase power failures 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 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 TAC602-I. MIL-STD-704 power failure limits.

Limit	704A	704B	704C	704D	704E	704F
Single Phase and Two Phase Power Failure	7 sec and indefinitely Figure 3 Curve 4 MIL-STD-704B	7 sec and indefinitely Figure 5 MIL-STD-704B	7 sec and indefinitely Figure 7 MIL-STD-704C	7 sec and indefinitely Figure 7 MIL-STD-704D	7 sec and indefinitely Figure 6 MIL-STD-704E	7 sec and indefinitely Figure 4 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 TAC602-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

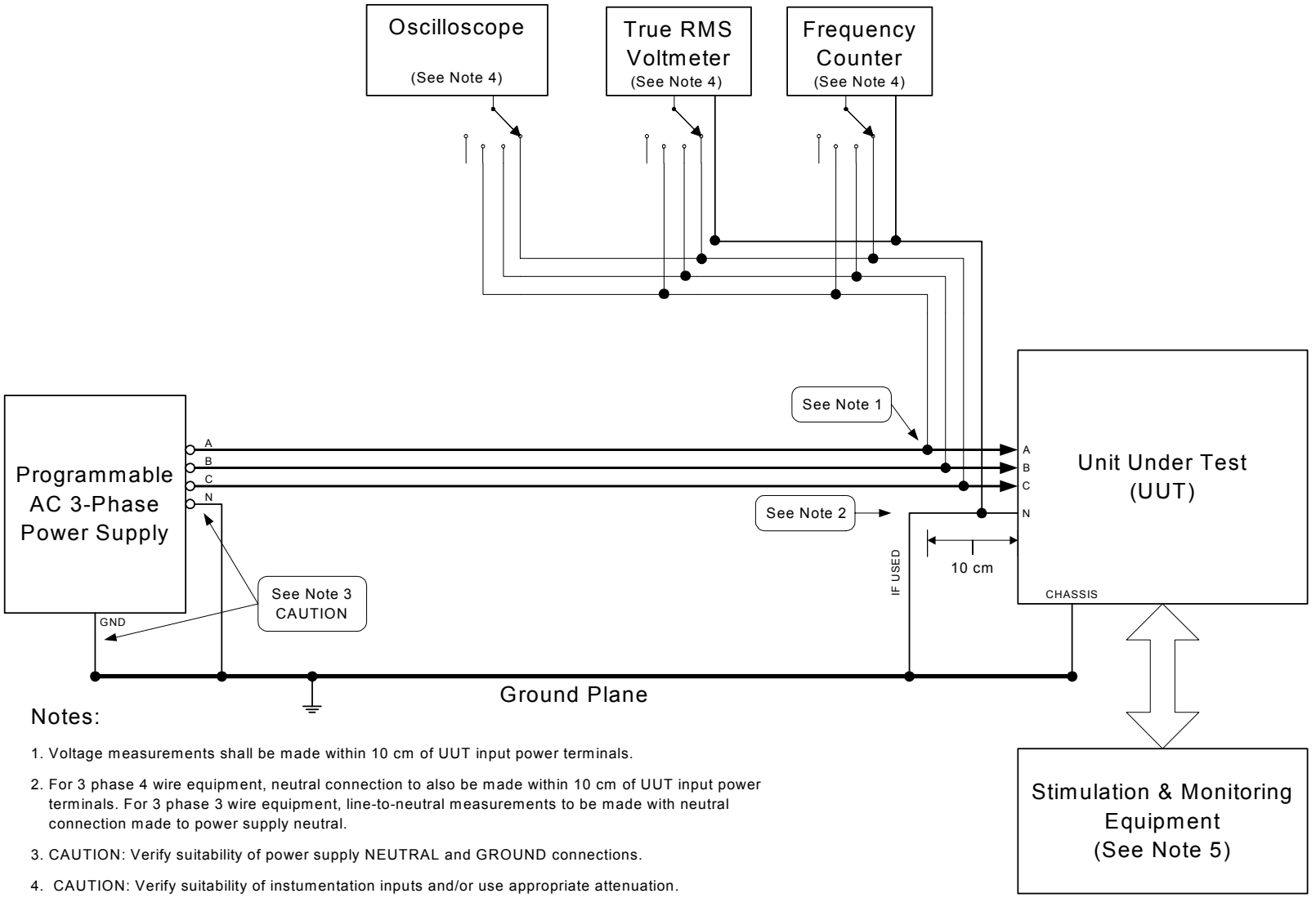
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC602-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 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 J noted in table TAC062-II, perform a power failure (0 V) on the phase(s) noted and of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle (1.25 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within ½ cycle (1.25 milliseconds). For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. For the indefinite time duration, 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. 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 voltages, 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 TAC602-III. Repeat test conditions A, B, C, G, and H 5 times. Test conditions D, E, F, I, and J are required to be performed once each. 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 400 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 TAC602-II. Test conditions for one and two phase power failures.

Test Condition	Phases	Duration of Power Failure
One Phase Power Failure		
A	Phase A	7 seconds
B	Phase B	7 seconds
C	Phase C	7 seconds
D	Phase A	Indefinitely
E	Phase B	Indefinitely
F	Phase C	Indefinitely
Two Phase Power Failures		
G	Phase A & B	7 seconds
H	Phase B & C	7 seconds
I	Phase A & B	Indefinitely
J	Phase B & C	Indefinitely



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC602-1. One and two phase power failures.

TABLE TAC602-III. Sample data sheet for TAC602 one and two phase power failures.

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
A	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
B	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
E	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
F	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
G	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
H	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
I	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
J	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

METHOD TAC603
Phase Reversal (Three Phase)

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal (Three Phase)

1. Scope.

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 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 input phase sequence is reversed for the applicable edition(s) of MIL-STD-704 and as noted in table TAC603-I. A positive physical means to prevent phase sequence reversal may be used to fulfill this requirement.

TABLE TAC603-I. MIL-STD-704 phase sequence reversal requirement.

Limit	704A	704B	704C	704D	704E	704F
Phase Reversal	N/A	N/A	N/A	N/A	N/A	Phase Sequence 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

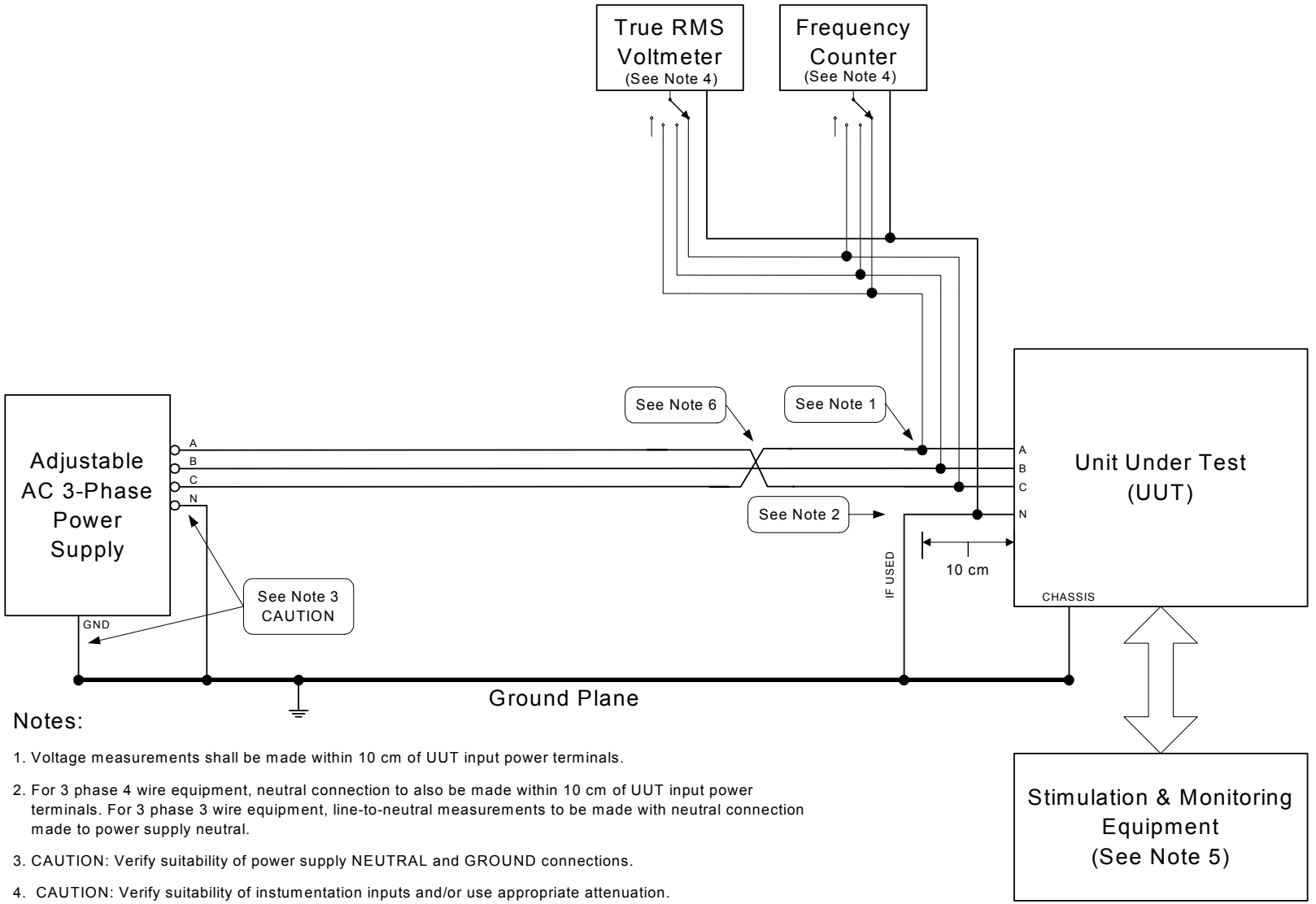
4. Test setup. Configure the test setup as shown in figure TAC603-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

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

If the phase sequence can be reversed, with the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC603-1 (reversed phase sequence of C-B-A). 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 400 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 sequence reversal and should be not less than thirty (30) minutes. Record the steady state voltages, steady state frequency, time duration at phase sequence reversal test condition, and the performance of the UUT in the data sheet shown in table TAC603-II.

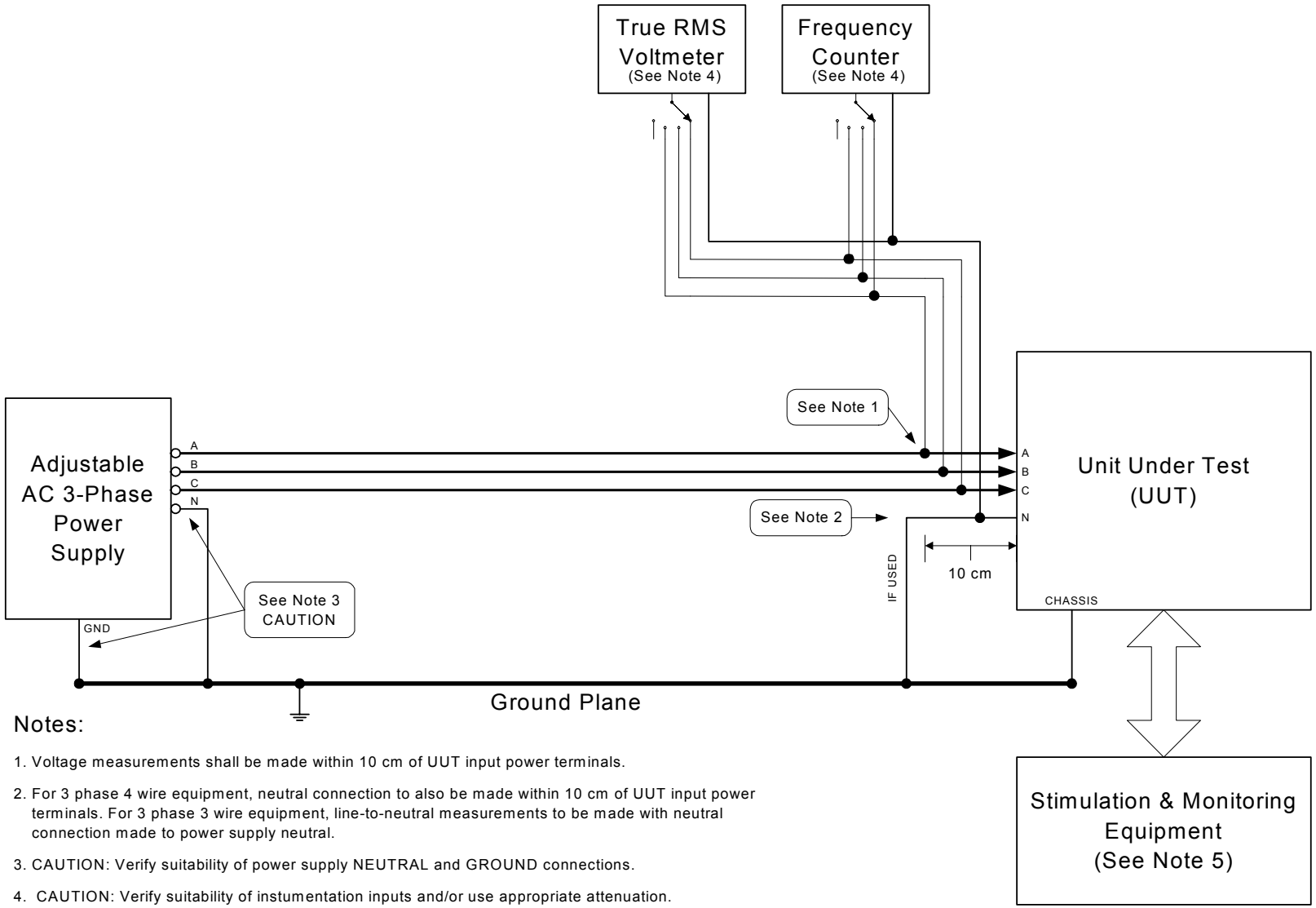
With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC603-2 (correct phase sequence of A-B-C). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 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 sequence 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 voltages, steady state frequency, time duration at test condition, and the performance of the UUT in the data sheet shown in table TAC603-II. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
6. Phase Rotation is reversed.

FIGURE TAC603-1. Phase reversal.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
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3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC603-2. Correct phase connection.

TABLE TAC603-II. Sample data sheet for TAC603 phase sequence reversal.

Test Condition	Parameters								Performance
									Yes/No
Phase Sequence Reversal Prevented by Positive Physical Means									
If No									
	Phase	Voltage		Frequency		Time Duration at Test Condition			Pass/Fail
Phase Sequence Reversed (C-B-A)	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
Correct Phase Sequence (A-B-C)	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

6. NOTES

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

6.2 Subject term (keyword) listing.

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

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 11

Preparing Activity:
Navy - AS

(Project No. SESS-0049)

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.