



Technical Specification for Power Supply Test – TAC tests for Liquid Cooling Unit



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1. Power Supply Tests:

Power supply test to be carried out only for LCU, ECU and ACM Module. Power supply test of LCU will be carried out along with ECU. Tests to be carried out are described below.

Sl. No.	TEST & PROCEDURE	SEVERITY	DURATION	REMARKS	VENDOR ACCEPTANCE
1	TAC 102: Steady State Voltage test	As per MIL-HDBK-704 F	As per MIL-HDBK-704 F	The test will be carried out with unit in ON condition	
2	TAC 103: Voltage Phase Difference	As per MIL-HDBK-704 F	As per MIL-HDBK-704 F	The test will be carried out with unit in ON condition	
3	TAC 109 : Normal Voltage Transients	As per MIL-HDBK-704 F	As per MIL-HDBK-704 F	The test will be carried out with unit in ON condition	
4	TAC 110 Normal Frequency Transients	As per MIL-HDBK-704 F	As per MIL-HDBK-704 F	The test will be carried out with unit in ON condition	
5	TAC 301 : Abnormal Limits for Voltage and Frequency	As per MIL-HDBK-704 F	As per MIL-HDBK-704 F	The test will be carried out with unit in ON condition	
6	TAC 302 : Abnormal Voltage Transients	As per MIL-HDBK-704 F	As per MIL-HDBK-704 F	The test will be carried out with unit in ON condition	
7	TAC 303: Abnormal Frequency Transients	As per MIL-HDBK-704 F	As per MIL-HDBK-704 F	The test will be carried out with unit in ON condition	

Three phase, 400 Hz, 115 V utilization equipment compliance tests. Tests as per MIL STD 704F :

Details of each test are provided below,

1.1.1 TAC 102 – Steady State Voltage Test

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-704F.

Test Condition: The normal limits for steady state voltage, voltage unbalance, and frequency are provided below. Test conditions for steady state limits for voltage and frequency are also indicated below.

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 $\pm$ 20 Hz.

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	Nominal Frequency
	Vbn	NLSS Voltage+3.0V	
	Vcn	NLSS Voltage+3.0V	
K	Van	NHSS Voltage	Nominal Frequency
	Vbn	NHSS Voltage-3.0V	
	Vcn	NHSS Voltage-3.0V	

Test Setup: Make the test setup as given in figure below

Test Procedure:

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' to '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' to '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 400Hz. 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.

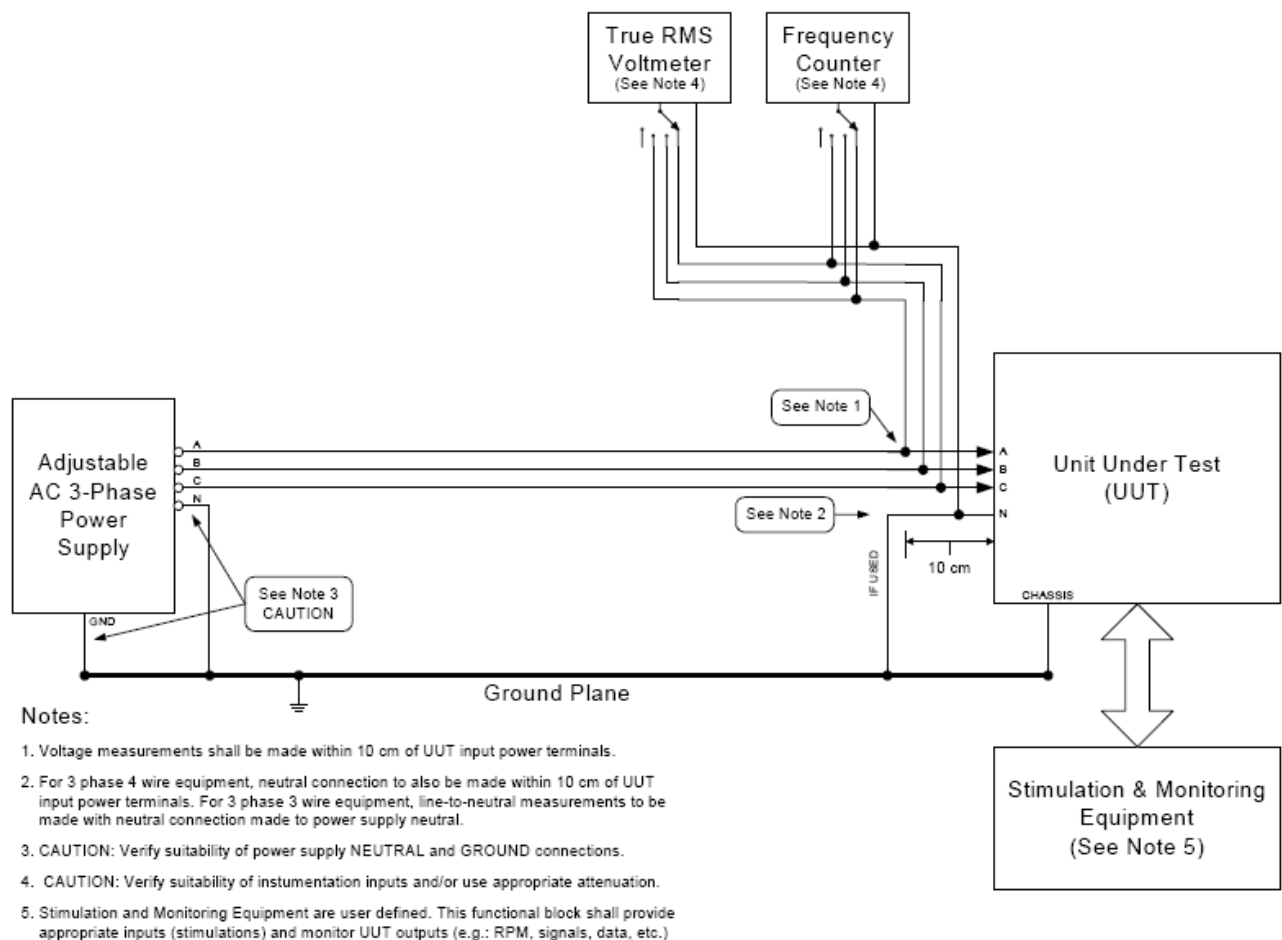


Figure TAC 102-1: Test Set up for TAC 102, Steady State Limits for Voltage (Including Unbalance) and Frequency

Pass Fail 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.

Test Results:

Record the Test results as per the sample data sheet provided below.

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}						
	A		V _{rms}		Hz		min		
	B		V _{rms}						
	C		V _{rms}						
	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}						

Table- Sample Data sheet for TAC-102 Steady State Limit for Voltage and Frequency

1.1.2 TAC 103 – Voltage Phase Difference

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 F

Test Condition: Test Conditions for the test are provided below,

TABLE TAC103-II. Test conditions for voltage phase difference.

Test Condition	Voltage Phase Angle V_{an}	Voltage Phase Angle V_{bn}	Voltage Phase Angle V_{cn}
A	0°	116°	240°
B	0°	124°	240°

Test Set Up: Test setup for the test are provided below,

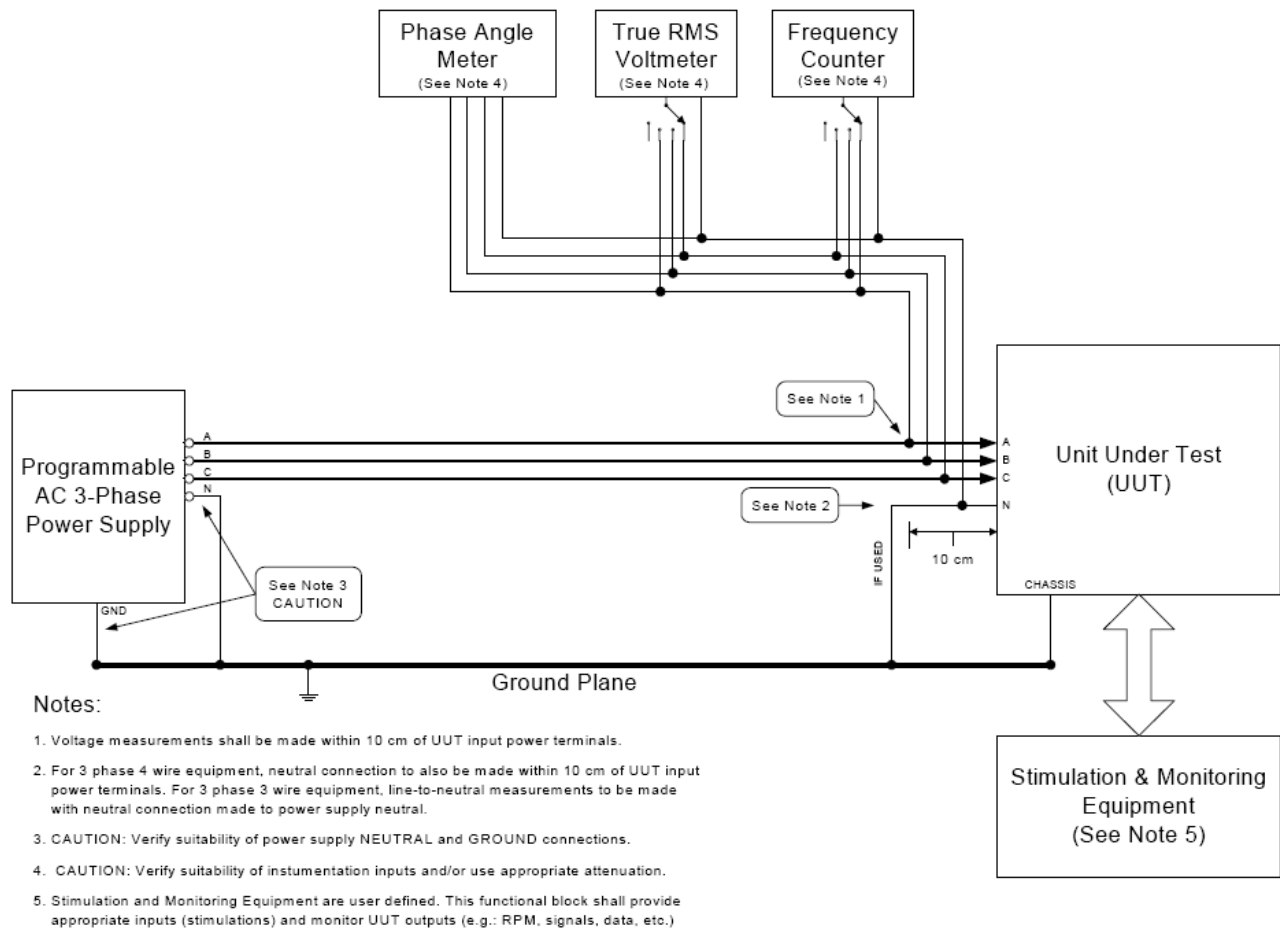


Figure TAC 103-1: Test Set up for TAC 103

Test Procedure: 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°, Vbn 120°, and Vcn 240°. 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.

Pass Fail 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

Test Record: Record the test results as per the sample data sheet provided below,

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		0	min	
	B		V _{rms}			Vbn		0		
	C		V _{rms}			Vcn		0		
B	A		V _{rms}		Hz	Van		0	min	
	B		V _{rms}			Vbn		0		
	C		V _{rms}			Vcn		0		

1.1.3 TAC 109- Normal Voltage Transients:

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 F.

Test Level: Test conditions for the test are provided below,

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

Test Set Up: Test set up is indicated in the figure below

Test Procedure:

- Procedure for Normal Voltage Transient:** 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 under voltage transients of 80 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition MM, an under voltage 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.

- b) Procedure for Repetitive Normal Voltage Transient:** 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.

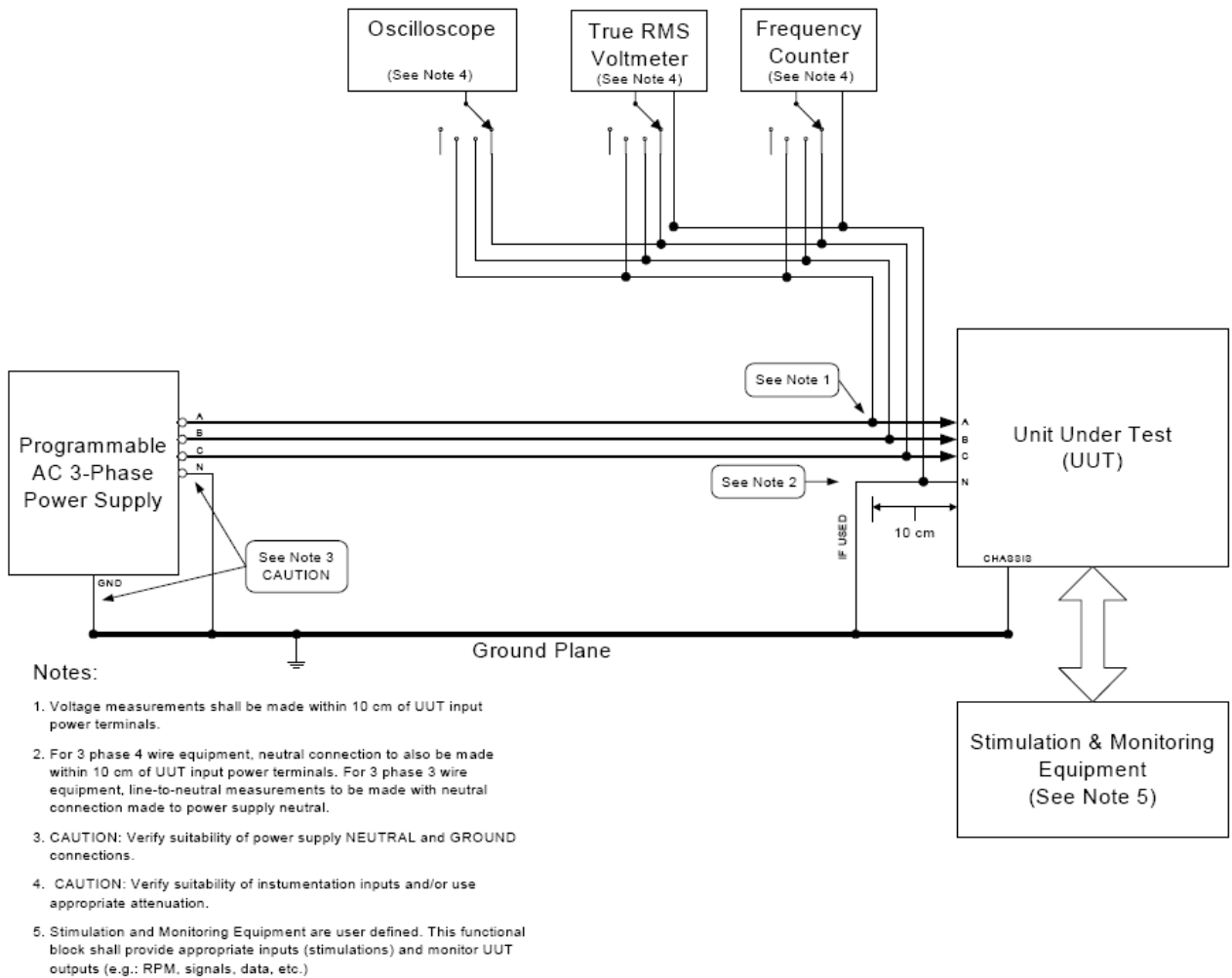
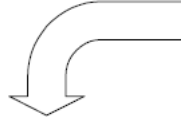
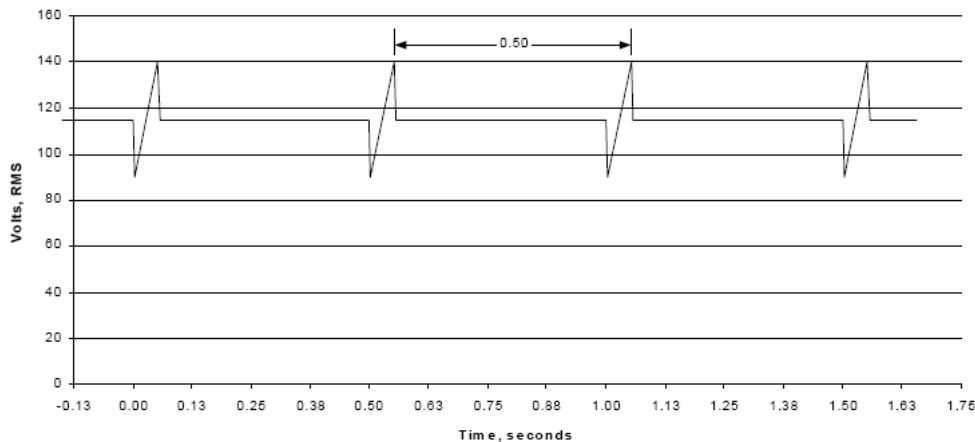
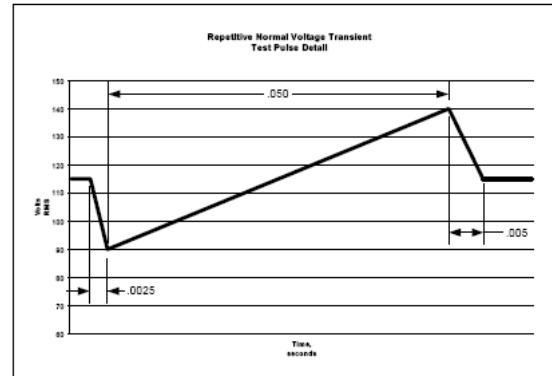


Figure 109-2: Test Set up for TAC 109

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



Repetitive Normal Voltage Transient



Pulse Detail

Figure 109 -3 : TAC 109 Repetitive Normal Voltage Transients

Pass / Fail Criteria: 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.

Test Record: Record the test results as per the specified format provided below-



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		

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}				V _{rms}		msec			
	B		V _{rms}				V _{rms}		msec			
	C		V _{rms}				V _{rms}		msec			



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	

1.1.4 TAC-110 Normal Frequency Transients:

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

Test Conditions: Test conditions for the test are specified below,

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	425 Hz	1 seconds	10 msec
	then 10 msec	420 Hz	4 seconds	20 msec
	then 20 msec	410 Hz	5 seconds	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	375 Hz	1 seconds	10 msec
	then 10 msec	380 Hz	4 seconds	20 msec
	then 20 msec	390 Hz	5 seconds	40 msec
Combined Transient				
II	100 msec	375 Hz	1 seconds	100 msec
	then 100 msec	425 Hz	1 seconds	100 msec



Test Set Up: Test set up is indicated in the figure below

Test Procedure: 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 under frequency transient of 375 Hz is immediately followed by an over frequency 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.

Pass/ Fail Criteria: 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.

Test Records: Record the test results as per the table provided below,

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

Test Condition	Parameters										Performance Pass/Fail	
	Phase	Voltage		Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		
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}									



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			

1.1.5 TAC-301: Abnormal Limits for Voltage and Frequency

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 F.

Test Levels: Test levels and test conditions are provided below,

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

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

Test Set Up: Test set up is indicated in the figure below

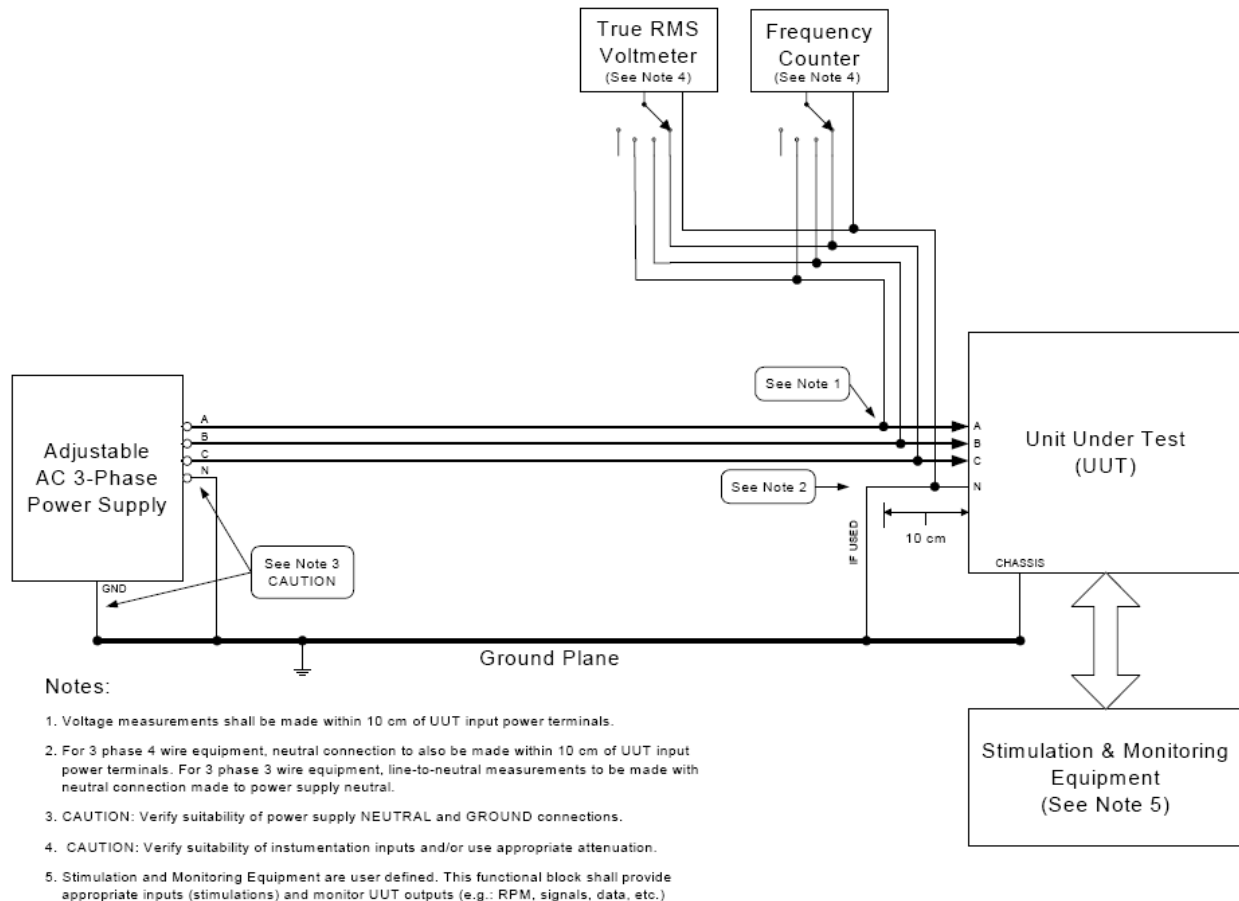


Figure 301.1: Test Set up for TAC 301

Test Procedure: 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.

Pass / Fail 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.

Test Record: Test Results should be recorded as per the table provided below,



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}					

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}					

1.1.6 TAC-302: Abnormal Voltage Transients

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.

Test Levels: Test levels for the test are provided below,

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

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		

Test Set Up: Test set up is indicated in the figure below

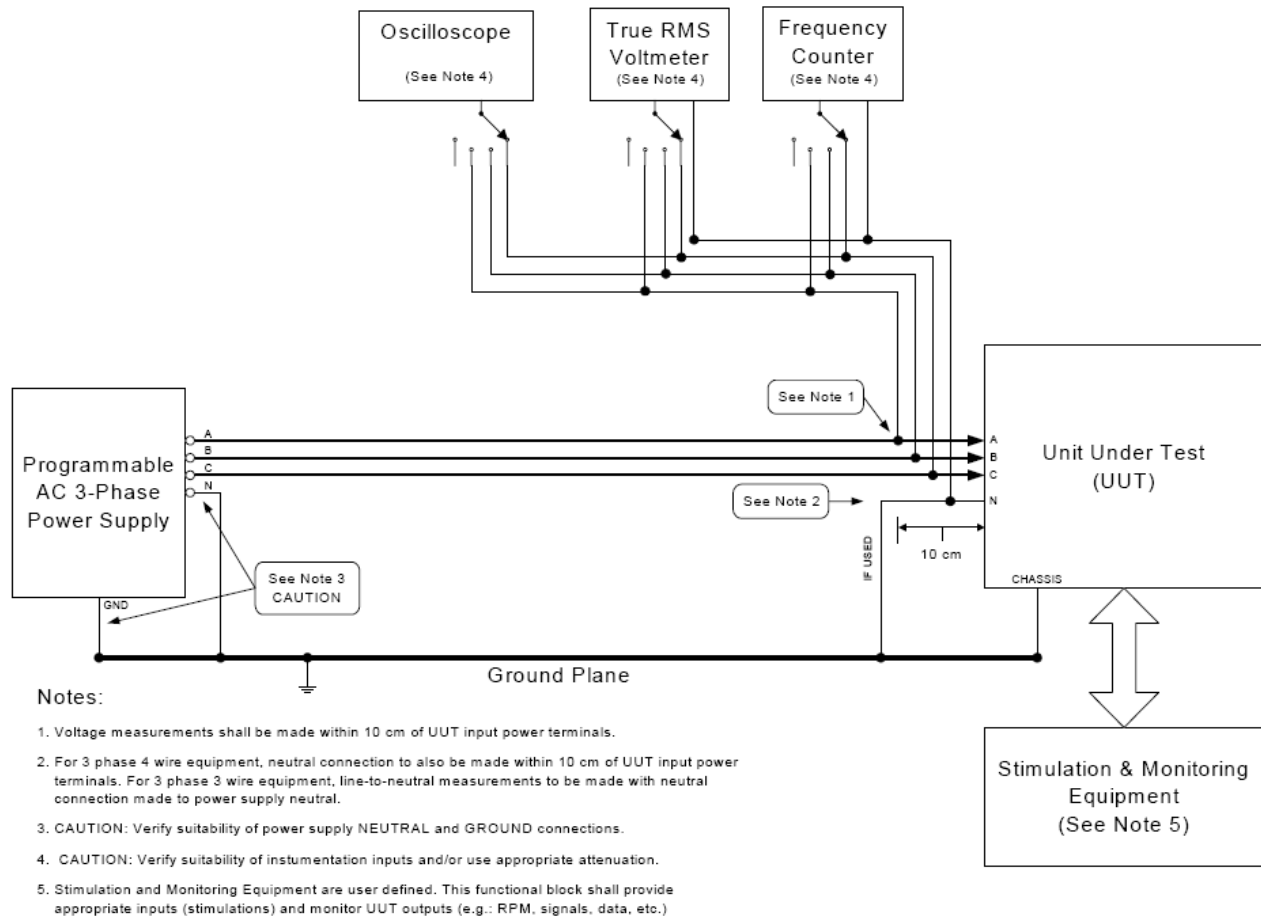


Figure 302.1: Test Set up for TAC 302

Test Procedure: 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 $\frac{1}{2}$ 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.

Pass/ Fail 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.

Test Records: Record the test results as per the format provided below,

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		Oscilloscope Trace	
AA	A		V _{rms}		Hz		V _{rms}	Attach Trace	V _{rms} vs. Time
	B		V _{rms}				V _{rms}		
	C		V _{rms}				V _{rms}		
BB	A		V _{rms}		Hz		V _{rms}	Attach Trace	V _{rms} vs. Time
	B		V _{rms}				V _{rms}		
	C		V _{rms}				V _{rms}		
CC	A		V _{rms}		Hz		V _{rms}	Attach Trace	V _{rms} vs. Time
	B		V _{rms}				V _{rms}		
	C		V _{rms}				V _{rms}		
DD	A		V _{rms}		Hz		V _{rms}	Attach Trace	V _{rms} vs. Time
	B		V _{rms}				V _{rms}		
	C		V _{rms}				V _{rms}		
EE	A		V _{rms}		Hz		V _{rms}	Attach Trace	V _{rms} vs. Time
	B		V _{rms}				V _{rms}		
	C		V _{rms}				V _{rms}		
FF	A		V _{rms}		Hz		V _{rms}	Attach Trace	V _{rms} vs. Time
	B		V _{rms}				V _{rms}		
	C		V _{rms}				V _{rms}		
GG	A		V _{rms}		Hz		V _{rms}	Attach Trace	V _{rms} vs. Time
	B		V _{rms}				V _{rms}		
	C		V _{rms}				V _{rms}		



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				

1.1.7 TAC 303 Abnormal Frequency Transients:

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

Test Level: Test conditions for the abnormal frequency transients are provided below,

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

Test set up: Test set up is indicated in Fig provided below,

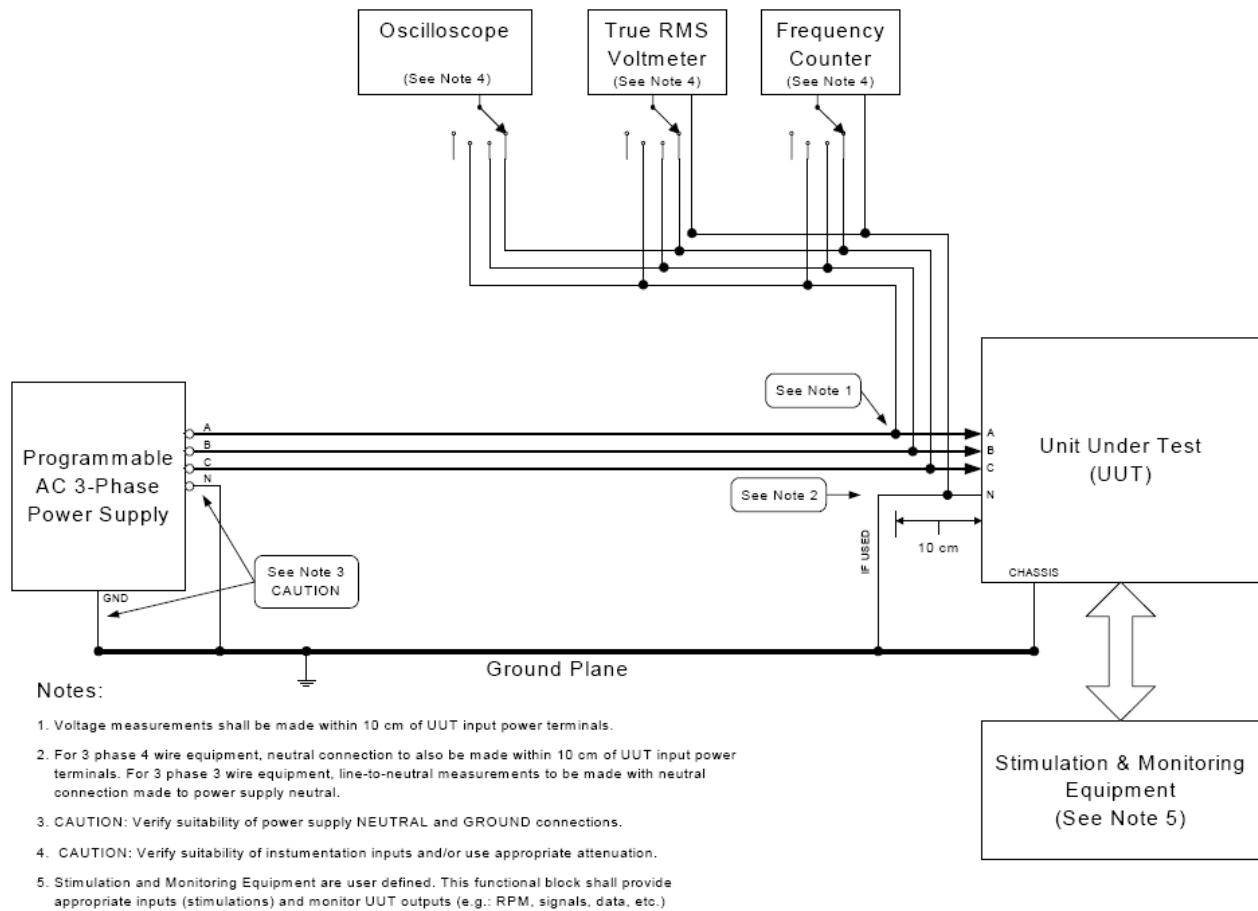


Figure 303.1: Test Set up for TAC 303

Test Procedure: The UUT must be subjected to the frequency transients for each test condition AA through EE noted in table TAC303-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 under frequency transient of 320 Hz is immediately followed by an over frequency 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.



2. RECORD OF REVISIONS

REV.NO.	DATE	REVISION DETAILS	REVISED	APPROVED
00	03-12-2021	New Specification	D Pavitran	G R Rao
01	31-03-2022	Details of tests included	A Sandeep	G R Rao

Reference Documents:

- MIL-STD-704 F – AIRCRAFT ELECTRIC POWER CHARACTERISTICS
- MIL Handbook 704 - GUIDANCE FOR TEST PROCEDURES FOR DEMONSTRATION OF UTILIZATION EQUIPMENT COMPLIANCE TO AIRCRAFT ELECTRICAL POWER CHARACTERISTICS