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Avionics Software Manual

California Instruments, an AMETEK Company.

Supplement to:

- RS Series User Manual – M440036-01
- MX Series User Manual – 7003-960
- MX15 Series User Manual – 7005-960
- CSW Series User Manual – M162084-01
- i/iX Series User Manual – 7000-970
- i/iX Series II User Manual – 4994-970
- Lx/Ls Series User Manual – 7004-960
- Lx/Ls Series II User Manual – 7004-980
- 751i/751iX and 1501i/1501iX Series User Manual – 6005-960
- 2253i/2253iX Series User Manual – 6005-962
- Asterion User-Manual\_M330000-01\_rv C

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# 1 Introduction

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This manual contains information on the function and use of the various avionics software packages available for multiple California Instruments power sources.

## 1.1 General Description

---

California Instruments offers many different software packages to aid in the testing of EUTs to comply with certain military and commercial specifications. The software has been designed to be intuitive, user friendly, and completely customizable to provide maximum flexibility in testing options. The software test parameters are data file driven, so the user can modify any of the tests performed to better suit their needs. This means that if there is a revision change to a specification, the user can make the necessary changes without waiting for an updated version of software to be released.

Each software package has a report generation feature that creates Microsoft Word format reports including test parameters, various pass/fail criteria, current harmonics tables, current harmonics bar graphs, and output waveforms.

This manual is intended to accompany the user manual of the power source being used. Please refer to the appropriate user manual for information on general use and operation of the power source.

## 1.2 Manual organization and format

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All user documentation for California Instruments power sources is provided on CDROM in electronic format. (Adobe Portable Document Format) The required Adobe PDF viewer is supplied on the same CDROM. This manual may be printed for personal use if a hardcopy is desired. To request a hardcopy from California Instruments, contact customer service at [ci.ppd@ametek.com](mailto:ci.ppd@ametek.com). There will be an additional charge for printed manuals.

All of the avionics test packages are based on the same general software layout and operation. This manual contains sections on how to use the basic functions of all of the avionics options, followed by sections detailing the specific differences for each option. No matter which option was purchased, please read Section 2 first, and then read the subsequent section(s) that pertain to your specific option(s).

**Note:** Some avionics options are firmware based. For information on these options, please refer to the user manual for your power source.

### **1.3 Availability of tests**

---

Front Panel support of aerospace specifications may not be supported directly in the future release of the firmware starting January 1, 2015. Please utilize GUI based testing for these applications.

**Error! Reference source not found.** below shows a comprehensive list of available avionics test options, their availability on various California Instruments power sources, and the GUI needed to run the option.

**Note:** *For all the tests virtual panel GUI will be used. If F/W is specified, the option is implemented in firmware. NS means NOT SUPPORTED, In AST device F/W mode is not supported. please refer to the user manual for the power source being used.*

		Rev.	iX Series	Compact iX	CSW Series	MX/RS Series	Lx/Ls Series	AST Series
Defense Avionics								
MIL-STD704	AC Mode	A	-704	-704	-704	-704	-704F	-704
		B	-704	-704	-704	-704	-704F	-704
		C	-704	-704	-704	-704	-704F	-704
		D	-704(F/W)	-704(F/W)	-704	-704	-704 or -704F	-704
		E	-704(F/W)	-704(F/W)	-704	-704	-704 or -704F	-704
		F	-704	-704	-704	-704	-704F	-704
	DC Mode	A	-704	-704	-704	-704(F/W)		-704
		B	-704	-704	-704	-704		-704
		C	-704	-704	-704	-704		-704
		D	-704(F/W)	-704(F/W)	-704	-704		-704
		E	-704(F/W)	-704(F/W)	-704	-704		-704
		F	-704	-704	-704	-704		-704
Commercial Avionics								
RTCA-DO160	AC Mode	C	-	-	-	-	-160(F/W)	-
		D	-160(F/W)	-160(F/W)	-160(F/W)	-160(F/W)	-160(F/W)	-160(NS)
		Euro/14	-	-	-	-	-	-
		D	-160(F/W)	-160(F/W)	-160(F/W)	-160(F/W)	-160(F/W)	-160(NS)
		Chng 2	-	-	-	-	-160(F/W)	-
		E	-160	-160	-160	-160	-160	-160
		F	-160	-160	-160	-160	-	-160
	G	-160	-160	-160	-160	-	-160	
	DC Mode	C	-	-	-	-	-	-
		D	-160(F/W)	-160(F/W)	-160(F/W)	-160(F/W)	-	-160(NS)
Euro/14		-	-	-	-	-	-	
D	-160(F/W)	-160(F/W)	-160(F/W)	-160(F/W)	-	-160(NS)		
Chng 2	-	-	-	-	-	-		

		Rev.	iX Series	Compact iX	CSW Series	MX/RS Series	Lx/Ls Series	AST Series
		E	-160	-160	-160	-160		-160
		F	-160	-160	-160	-160		-160
		G	-160	-160	-160	-160		-160
<b>Boeing</b>								
787B3-0147	AC Mode	A	-B787	-B787	-B787	-B787	-B787	-B787
		B	-B787	-B787	-B787	-B787	-B787	-B787
		C	-B787	-B787	-B787	-B787	-B787	-B787
	DC Mode	A	-B787	-B787	-B787	-B787		-B787
		B	-B787	-B787	-B787	-B787		-B787
		C	-B787	-B787	-B787	-B787		-B787
<b>Airbus</b>								
AMD-24	AC Mode	C	-AMD	-AMD	-AMD	-AMD	-AMD	-AMD
	DC Mode	C	-AMD	-AMD	-AMD	-AMD		-AMD
ABD0100.1.8	AC Mode	D	-ABD	-ABD	-ABD	-ABD	-ABD	-ABD
		E	-ABD	-ABD	-ABD	-ABD	-ABD	-ABD
	DC Mode	D	-ABD	-ABD	-ABD	-ABD		-ABD
		E	-ABD	-ABD	-ABD	-ABD		-ABD
A350 / ABD0100.1.8.1	AC Mode	B	-A350	-A350	-A350	-A350	-A350	-A350
	DC Mode	B	-A350	-A350	-A350	-A350		-A350

Table 3- 1: -Avionics Option Test Coverage

## 2 Basic Operation

---

This section explains how to use features of the avionics software packages that are common to all of the options. These options can only be used in conjunction with the provided Gui Windows application software due to the amount of selections and data presentation involved. As such, these tests require the use of a PC running Windows 7 to 10 and cannot be operated from the front panel. PC system requirements are the same that are called out to run the gui program, however a 3GHz or higher processor and 512 MB of RAM or more is recommended if generating reports due to the high processing power required. Use of Windows Vista is possible but not recommended.

The avionics software options are completely data file driven to allow a large degree of customization by the end-user if needed so many changes can be supported without the need for software updates.

If purchasing an option after purchasing a unit, the Gui may need to be updated to run the optional software. If the option and the power source are purchased at the same time, no update will be needed to run the software. The Gui program is supplied with all systems free of charge on CD ROM CIC496. It can also be downloaded or updated from the California Instruments web site ([www.programmablepower.com/support/support.htm](http://www.programmablepower.com/support/support.htm)).

### 2.1 General Test Procedure

---

Generally, the following steps are needed to perform an avionics test on an EUT.

1. Connect the EUT to the power source.
2. Select the correct mode of operation for the EUT, AC or DC mode, single or three-phase mode (if applicable).
3. Program the relevant nominal voltage and frequency using the Gui main screen.
4. Apply power by closing the output relay. This can be done at a later stage or will be done automatically after prompting the operator when a test is started.
5. Open the avionics option control screen from the Applications menu or click on the appropriate toolbar icon.
6. Select the correct test revision or use the default.
7. Select the correct Power Group Test Category.
8. Select a test from the test table displayed in the middle of this screen. You can select a test by clicking on a row. The selected row will be highlighted.
9. Verify that the test sequence and description shown in the table on the Test Control screen is indeed the desired test.
10. Click the Start button to initiate the test.
11. Observe the test progress monitor at the top of the window and observe the EUT.
12. Wait for test completion. You can Abort a test in progress by clicking the Abort button.
13. Select the **EUT Performance Measurements** tab (left tab along top of the screen).
14. Click the **Update Meas.** Button located in the top center of the screen. This will initiate a measurement cycle. Measurements in three-phase mode may take some time to complete.
15. Use the tabs located along the top of the measurement tab (**Parameters, Waveforms, Curr Graph and Curr Spectrum**) to review the EUT data. Any anomalies can be noted

in the observations tab located on the **Parameters** screen. This information will be included in the test report.

16. Click on the **Test Report** button, Print to print a test report for this test.<sup>1</sup>
17. Return to step 8 as needed.

The following sections provide details on the various screens, menus, displays and controls available to the operator to manage the test process.

---

<sup>1</sup> For test report generation, use of a 3GHz+ Intel or equivalent Windows PC with minimum 512Mb RAM is recommended. Otherwise reports may take a long time to generate.

## 2.2 Test Control Window

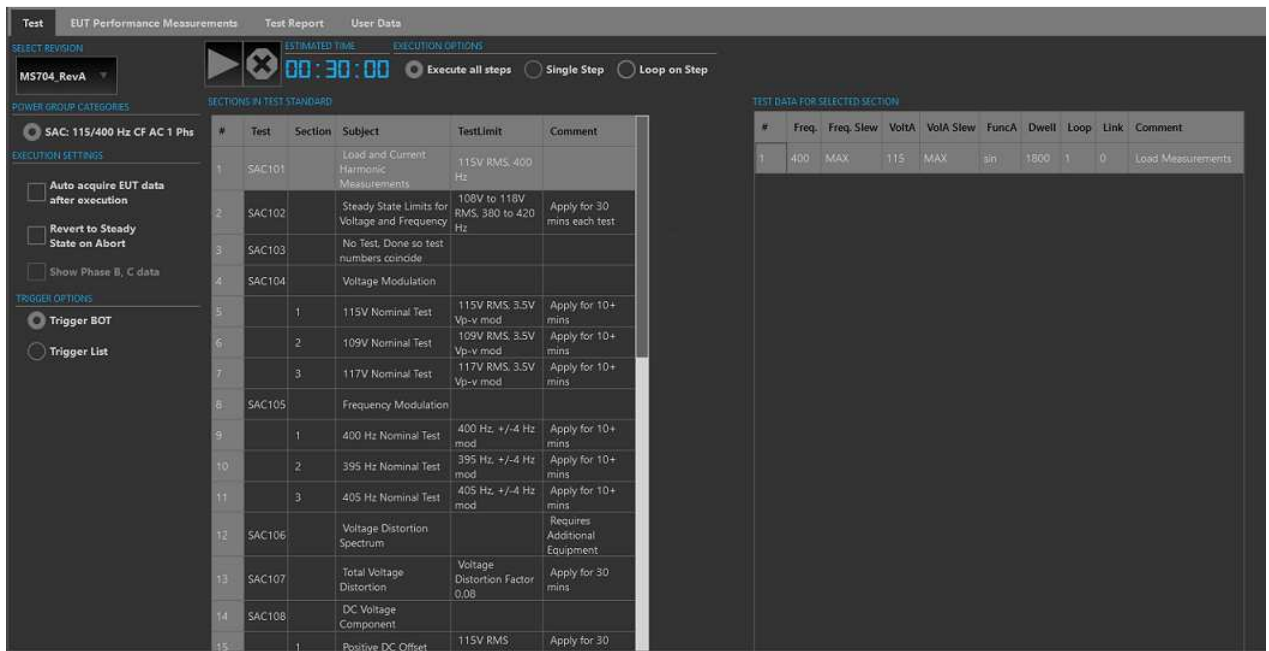


Figure 2- 1: 160 Option Test Selection Screen.

To access an avionics option, click on the orange color square box on the top left corner of the screen. Navigate to avionics test standards. The Tables Control window will open selecting the last power group that was selected in a previous instance. It may still be necessary to select the desired power group first however. Also verify that the selected power group on the screen is the correct one for the EUT being tested.

The avionics tests can be operated from the test control screen. This screen contains three main tabs located along the top edge of the window. The following tabs are available. Click on the tab name for additional help on how to use each tab.

Tab	Description
Sections in test standard	This tab allows the operator to select the library of test files to use (Select Test) and the relevant Power group. Available power group selections are shown below the test selection field on the right hand side next to bus monitor. The table shown at the bottom of this tab shows the available test sections that can be selected.
Test data for selected section	This tab provides information on the test sequence that is presently selected and also contains the execution controls. It shows the progress of any test that is executing.
EUT Performance Measurements	This tab may be used to display EUT performance data as measured by the power source’s advanced data acquisition system. If the source used does not support advanced measurement function such as waveform capture and FFT, some of the information in this tab may not be displayed.

In addition to the three tab controls, the left pane of the test control window contains Test report and user data. On the top right corner of the screen you can find the output relay on/off slider. The on/off slider may be used to open or close the output relay of the power source at any time. If the output relay is opened during a test run, the test is automatically aborted when the operator clicks on the Off button. The ON button will be shown in red while the output relay is closed. The

Off button is shown in green if the output relay is open. The report print function can be invoked by either clicking on the test report button, Clicking the test report icon will launch a screen, clicking the play icon will generate a test report that can be saved in PDF format as well as excel format.

If the GUI program is used in demo mode, the “SIMULATION MODE” will be displayed on the top left of the screen . In Demo mode, all test runs and all measurements are simulated. This mode may be used to develop new test sequences off-line but any run-time errors will not be detected until executed with an actual power source.

### 2.2.1 Menus

The top of the test control window contains a standard Windows menu bar. Available menus are:

Menu	Sub Menu	Description
File	New	The selected clears all data from the Test Control data grid. This operation is not normally recommended unless a complete new test sequence is to be entered manually.
	Open	Opens a specific test sequence file. This menu may be used to directly select a test file without using the Test Selection table tab.
	Save	Saves the contents of the test sequence data grid to the selected test file.
	Save As...	Saves the contents of the test sequence data grid to a user defined file name. A file dialog box will appear enabling selection of the directory and file name under which to store the contents of the test sequence data grid.
	Print	Prints a test report using MS Word format. Only data for the presently selected test sequence is printed. The test reports also include EUT performance measurement data. Note: To print reports, the MS Word report format selection must be made from the Main GUI, Options menu → Report Format menu before opening the test control screen. If not, an error prompt will indicate that no supported report format is selected.
	Exit	Closes the test control window.
Edit	Cut	Cuts the selected row from either the Test selection data grid or the Test sequence data grid. The data in the row cut is available for a Paste operation.
	Copy	Copies the selected row from either the Test selection data grid or the Test sequence data grid. Copied rows can be pasted to the same grid at a different location.
	Paste	Pastes a copied row from to either the Test selection data grid or the Test sequence data grid.
	Insert Row	Inserts a new blank row at the selected data grid location.
	Delete Row	Deletes the selected row from either the Test selection data grid or the Test sequence data grid. The row contents are permanently discarded.
Run	All	Run selected test
	Stop	Abort test in progress
Help		Opens the on-line help file.



## 2.3 Test Selection

The Test Selections tab in the test control window contains the following controls and displays.



Control / Display	Description	
Select Revision.	This drop down control allows the operator to select from one or more libraries of test sequences grouped by revision. The GUI program is supplied with predefined revisions of test sequences.	
Power Group categories	A library can contain a number of power group test tables. These table names correspond to the Power Groups identified in the specific standard, and are listed in their section of this manual. The operator cannot select a group that is not supported by the present mode of operation of the power source. Thus, if the power source is in AC mode, an error message will be displayed when trying to select a DC group. Operating modes such as AC or DC must be changed from the main GUI screen. The test control screen can remain open while switching back to the main screen. Upon return to the test control screen, the relevant power groups can be selected.	
	The operator needs to determine what the relevant power group selection is for the unit under test. (EUT). When switching power groups, the table data shown at the bottom of this tab will be updated to reflect the new selection. The first test section of the table will automatically be selected when switching power groups.	
Table Header	The table header is shown against a blue background and contains the table reference designator and a description of the selected power group.	
Test Table Display	The data grid at the right side of the screen displays the selected power group test table. It is also used to select the specific test section and number to be executed. Thus, every test starts by selecting the desired test step from this table. Clicking on the desired ROW does this. The selected row will be highlighted and the associated file shown in the File Ref. Field will be loaded in the Test Control tab. For better readability, the user can adjust the column widths by dragging the dividers between columns. If the window is too small to display all rows and columns, scroll bars will appear at the bottom and/or right of the data grid. The following fields are displayed in the test data tables.	
	Test	Number of the test from the avionics standard. For sub sections of a test number, this field will be blank.
	Section	Test section. Some tests may only have one section in which case this field is blank.
	Subject	Description of the type of test.
	Test Limits	A summary of the test limits that will be applied by this test.
	Comment	Comments concerning this test or its parameters.
	File Reference	The test sequence file that is used to implement this test section on the power source.
User Data	This tab may be used to enter general information regarding the unit under test, the test location and operator and environmental conditions in effect during the test. This information will be incorporated in the test reports generated by the GUI.	

## 2.4 Test Control

TEST DATA FOR SELECTED SECTION									
#	Freq.	Freq. Slew	VoltA	VoltA Slew	FuncA	Dwell	Loop	Link	Comment
1	400	MAX	115	MAX	sin	1800	1	0	Nominal Voltage Nominal Frequency
2	395	MAX	115	MAX	sin	1800	1	0	Nominal Voltage NLSS Frequency
3	405	MAX	115	MAX	sin	1800	1	0	Nominal Voltage NHSS Frequency
4	400	MAX	108	MAX	sin	1800	1	0	NLSS Voltage Nominal Frequency
5	395	MAX	108	MAX	sin	1800	1	0	NLSS Voltage NLSS Frequency
6	405	MAX	108	MAX	sin	1800	1	0	NLSS Voltage NHSS Frequency
7	400	MAX	118	MAX	sin	1800	1	0	NHSS Voltage Nominal Frequency
8	395	MAX	118	MAX	sin	1800	1	0	NHSS Voltage NLSS Frequency
9	405	MAX	118	MAX	sin	1800	1	0	NHSS Voltage NHSS Frequency
10	400	MAX	115	MAX	sin	0.01	1	0	Return to nominal settings

Figure 2- 2: 160 Option Test Control Screen.

The Test Control tab in the test control window is used to display and execute a selected test. This tab contains the following controls and displays.

Control / Display	Description		
Execution Controls	  <p>The Start and Abort buttons are used to start and stop the selected test step. The execution mode that will be used is determined by the Execution Options setting. The same can be accomplished using the Run menu entries. When operating in Single Step or Loop mode, make sure the desired test step is selected in the test sequence table at the bottom of this tab as this will be the one used by the program.</p>		
Execution Options	<p>The execution options determine the mode of operation when the Start button is clicked. Available execution modes and settings are:</p> <table border="1"> <tr> <td>Execute all steps</td> <td>In this mode, all steps in the test sequence will be executed sequentially until the end of the table is reached.</td> </tr> </table>	Execute all steps	In this mode, all steps in the test sequence will be executed sequentially until the end of the table is reached.
Execute all steps	In this mode, all steps in the test sequence will be executed sequentially until the end of the table is reached.		

Control / Display	Description	
	Single Step	Runs only the selected test step. When operating in Single Step mode, make sure the desired test step is selected in the test sequence table at the bottom of this tab before clicking on the Start button.
	Loop on Step	In this mode, the same step will be executed repeatedly until the operator clicks on the Abort button. In this mode, the Complete test progress status bar may run past its maximum and will no longer update as the total test time is determined by the operator now and not the program.
	Revert to Steady State on Abort	When selected, the output of the power source will be set back to the steady state settings in effect before the start of the test when the operator aborts a test. Normally, the output of the source at the end of a test run is determined by the settings in the test sequence file loaded.
Options	This section contains additional options that can be set by the operator as needed. The following options are available:	
	Auto Acquire EUT Data after execution	When set, this option causes the GUI program to initiate an EUT performance data measurement sequence automatically at the end of a test (normal mode) or test step (single step mode).
	Show Phase B, C data	For three-phase EUTs, data for phases B and C can be displayed as well. In most cases, the settings for all three phases are the same and there is no need to display them all as it takes up screen space. However, this is not the case for voltage imbalance tests. This is a display feature only and has no effect on the actual test. Note however that if the power source is in single-phase mode, settings for phase B and C will be ignored. The phase mode of the power source can only be changed from the main GUI screen.
	External Trigger Output	An external trigger signal is provided through the trigger out connection during test execution. There are two modes of operation that can be selected: <b>BOT</b> mode: Beginning of transient. In this mode, a trigger pulse is generated at the first step of each sub list. A sub list may consist of one or more rows as indicated by the value of the link field. Note that most test scripts consist of multiple short sub lists to support single step mode. <b>List</b> Mode: This mode adds a Trig column to the test sequence table. A trigger will be generated for each entry in the trigger column that is set to 1. Any other value including empty will not generate a trigger out. In this mode, the user has to set one or more triggers. Setting a trigger can be done by double clicking on the trigger column with the left mouse button and entering 1.
Test Status	This area of the Test Control tab displays test execution status for each individual test step as well as the complete test. The top section shows the complete test time and	

Control / Display	Description																														
	what part has been completed so far. The bottom section shows the same information for the present test step.																														
Test Description	The area at the top of the Test Control tab is used to display additional information about the selected test tab. It is for information purposes only and has no effect on the actual test execution.																														
Table Header	The table header is shown against a yellow background and shows the table from which this test sequence was selected.																														
Test Sequence Data Grid	<p>The test sequence data grid displays the specific parameters used to program the power source. This data implements the required tests. The parameters are loaded for the referenced ini file in the test table on the Test Selection tab. It is possible to edit this information if needed which allows variations on any of these tests to be made. Any changes can be saved to a new file. The standard provided test files are write protected however and should not be overwritten.</p> <p>The following columns/data fields are available in this table for each test step (row).</p> <table border="1"> <tbody> <tr> <td>Step number</td> <td>Sequential number from 1 through end of sequence.</td> </tr> <tr> <td>Freq</td> <td>Test frequency in Hz</td> </tr> <tr> <td>FSlew</td> <td>Frequency slew rate in Hz/sec</td> </tr> <tr> <td>Volt A</td> <td>Test voltage for phase/output A in Vrms or Vdc depending on mode.</td> </tr> <tr> <td>VSlew A</td> <td>Voltage slew rate in V/sec</td> </tr> <tr> <td>Func A</td> <td>Waveform function. Default is SINE for AC mode and DC for DC mode. Arbitrary waveform can be used in AC mode if this capability is supported by the power source.</td> </tr> <tr> <td>Volt B</td> <td>Test voltage for phase/output B in Vrms or Vdc depending on mode.</td> </tr> <tr> <td>VSlew B</td> <td>Voltage slew rate in V/sec</td> </tr> <tr> <td>Func B</td> <td>Waveform function. Default is SINE for AC mode and DC for DC mode. Arbitrary waveform can be used in AC mode if this capability is supported by the power source.</td> </tr> <tr> <td>Volt C</td> <td>Test voltage for phase/output C in Vrms or Vdc depending on mode.</td> </tr> <tr> <td>VSlew C</td> <td>Voltage slew rate in V/sec</td> </tr> <tr> <td>Func C</td> <td>Waveform function. Default is SINE for AC mode and DC for DC mode. Arbitrary waveform can be used in AC mode if this capability is supported by the power source.</td> </tr> <tr> <td>Dwell</td> <td>Dwell time in seconds.</td> </tr> <tr> <td>Loop</td> <td>Repeat count for each step. Default is 1.</td> </tr> <tr> <td>Link</td> <td>Number of subsequent rows that are linked to this step. This function is required to implement complex transients that require multiple steps with zero time skew. When set to a value other than blank or "0", subsequent rows are considered part of the same test step for</td> </tr> </tbody> </table>	Step number	Sequential number from 1 through end of sequence.	Freq	Test frequency in Hz	FSlew	Frequency slew rate in Hz/sec	Volt A	Test voltage for phase/output A in Vrms or Vdc depending on mode.	VSlew A	Voltage slew rate in V/sec	Func A	Waveform function. Default is SINE for AC mode and DC for DC mode. Arbitrary waveform can be used in AC mode if this capability is supported by the power source.	Volt B	Test voltage for phase/output B in Vrms or Vdc depending on mode.	VSlew B	Voltage slew rate in V/sec	Func B	Waveform function. Default is SINE for AC mode and DC for DC mode. Arbitrary waveform can be used in AC mode if this capability is supported by the power source.	Volt C	Test voltage for phase/output C in Vrms or Vdc depending on mode.	VSlew C	Voltage slew rate in V/sec	Func C	Waveform function. Default is SINE for AC mode and DC for DC mode. Arbitrary waveform can be used in AC mode if this capability is supported by the power source.	Dwell	Dwell time in seconds.	Loop	Repeat count for each step. Default is 1.	Link	Number of subsequent rows that are linked to this step. This function is required to implement complex transients that require multiple steps with zero time skew. When set to a value other than blank or "0", subsequent rows are considered part of the same test step for
Step number	Sequential number from 1 through end of sequence.																														
Freq	Test frequency in Hz																														
FSlew	Frequency slew rate in Hz/sec																														
Volt A	Test voltage for phase/output A in Vrms or Vdc depending on mode.																														
VSlew A	Voltage slew rate in V/sec																														
Func A	Waveform function. Default is SINE for AC mode and DC for DC mode. Arbitrary waveform can be used in AC mode if this capability is supported by the power source.																														
Volt B	Test voltage for phase/output B in Vrms or Vdc depending on mode.																														
VSlew B	Voltage slew rate in V/sec																														
Func B	Waveform function. Default is SINE for AC mode and DC for DC mode. Arbitrary waveform can be used in AC mode if this capability is supported by the power source.																														
Volt C	Test voltage for phase/output C in Vrms or Vdc depending on mode.																														
VSlew C	Voltage slew rate in V/sec																														
Func C	Waveform function. Default is SINE for AC mode and DC for DC mode. Arbitrary waveform can be used in AC mode if this capability is supported by the power source.																														
Dwell	Dwell time in seconds.																														
Loop	Repeat count for each step. Default is 1.																														
Link	Number of subsequent rows that are linked to this step. This function is required to implement complex transients that require multiple steps with zero time skew. When set to a value other than blank or "0", subsequent rows are considered part of the same test step for																														

Control / Display	Description	
		single step or loop on step execution modes. Rows that are linked will not become highlighted when executed.
	PhsB	Phase angle of phase B, only visible if phase angle is changed.
	PhsC	Phase angle of phase C, only visible if phase angle is changed.
	Comment	A comment about the specific test step.

## 2.5 EUT Performance Measurements

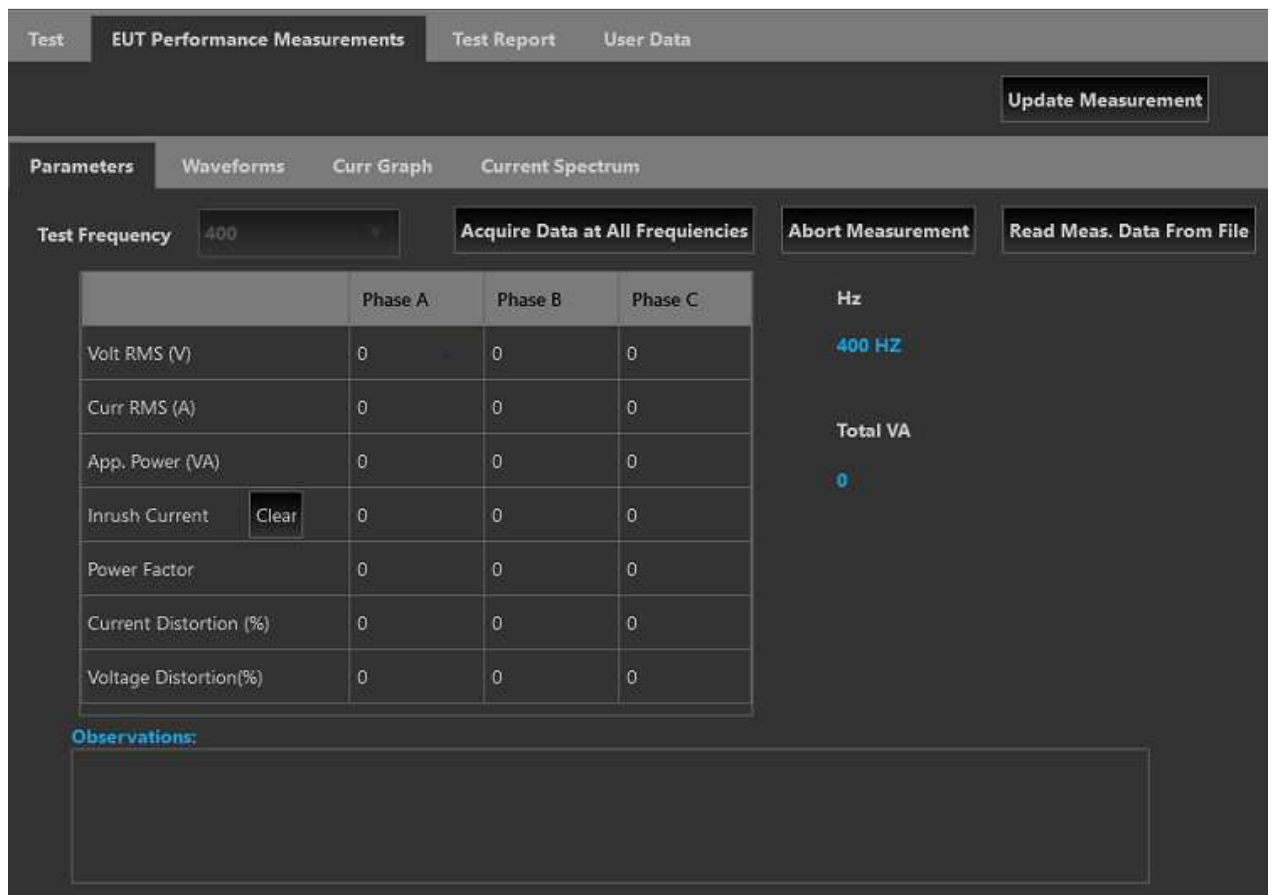


Figure 2- 3: 160 Option EUT Measurement Data Screen.

The EUT Performance Measurements tab in the test control window provides measurement data taken by the power source's data acquisition system. This tab contains four sub-tabs that each present different aspects of the EUT measurement data. Additional user controls for measurement updates and graph scaling are provided right next to the four sub tabs. The following sub tabs are available for selection.

Sub-Tab	Description				
Parameters	This tab displays the parametric measurement data in tabular form. This includes voltage, current, power, power factor, distortion etc. For three-phase EUT's data is shown for all three phases. For single phase EUT, data is shown for phase A only as long as the power source is in single-phase mode.				
	The top half of the Parameters tab displays all parametric measurement data. The following data is available:				
	<table border="1"> <tr> <td>Volt RMS (V)</td> <td>Displays source voltage per phase in Volt RMS or DC depending on power source mode of operation.</td> </tr> <tr> <td>Curr RMS (A)</td> <td>Displays EUT current per phase in amps RMS or DC depending on power source mode of operation.</td> </tr> </table>	Volt RMS (V)	Displays source voltage per phase in Volt RMS or DC depending on power source mode of operation.	Curr RMS (A)	Displays EUT current per phase in amps RMS or DC depending on power source mode of operation.
	Volt RMS (V)	Displays source voltage per phase in Volt RMS or DC depending on power source mode of operation.			
Curr RMS (A)	Displays EUT current per phase in amps RMS or DC depending on power source mode of operation.				

Sub-Tab	Description	
	App. Power (VA)	Displays the apparent power for each phase as well as the total power for all three phases. For three-phase EUT's, any imbalance in power between the three phases is calculated by the GUI. The amount of imbalance is displayed in % of total VA to the right of the power readings.
	Inrush Current (A)	Displays peak current detected per phase in Amps since last measurement was taken.
	Power Factor	Displays power factor for each phase. If one or more phases is outside the allowable limits, a Fail indication is displayed.
	Current Distortion (%)	Displays Total Current Distortion for each phase in percent of fundamental current. Limits are applied when the specification calls them out, otherwise the user can set the limits by modifying the limits text file.
The bottom half of the Parameters tab contains user controls and a text entry field for entering observations regarding the EUT operation.		
	Test Frequency Dropdown control	The frequency selection drop down control is active only for Variable Frequency tables and can be used to set the frequency at which data from the EUT is to be acquired. For all other modes, it is fixed to either 400 Hz or DC.
	Acquire Data at all frequencies	This button causes data to be acquired at all frequencies available in the Test Frequency Dropdown control. For all constant frequency, this button functions like the Update Meas. Button located above the sub tabs.
	Abort Meas.	This button aborts measurements in progress. In case of Variable Frequency Tables, acquiring data at all 12 frequency settings can take a long time. This button allows this process to be aborted.
	Read Meas. Data from File	This button reads measurement data from disk. Each time measurement data is acquired by the GUI, it is saved to an ASCII text file. A separate file is used for each frequency or DC setting. To recall data taken at a specific frequency setting, select the desired frequency using the Test Frequency Dropdown control before clicking on this button. Note that all measurement data files are saved in the Reports subdirectory of the GUI application directory using file name convention "MeasData_option_nnn_Hz.txt" where 'option' is the avionics option and 'nnn' is the frequency setting or DC.
Waveforms	This tab displays the voltage and current waveform (time domain) for each phase. The sample rate is automatically set to display about 20 msec of time.	
Cur Graph	This tab displays the Current harmonics in a bar graph format. Up to 50 harmonics are displayed.	
Cur Spectrum	This tab displays the same current harmonics as the Current Graph tab except in a tabular format. Data is shown in both absolute and relative from (percent of fundamental current). A limit table is applied and a pass or fail indication is shown in the last column. Values that exceed the allowable limits are shown with a red background in the Pass/Fail column.	

Sub-Tab	Description
	<p><b>Note:</b> Usually, the power source measurement bandwidth is less than required to make full compliance current harmonics measurements. This feature is provided for pre-compliance assessment purposes only. A high bandwidth power analyzer with a 100 KHz sampling rate or better is generally required. Harmonics that are outside of the range of the measurement system are indicated with a <b>"BWL"</b> (bandwidth limited) label instead of a readout.</p>
No.	Harmonic number, 1 through 40
Freq (Hz)	Frequency of harmonic in Hz.
Curr (A)	Absolute current (rms) in Amps.
% Fund.	Relative current in percent of the fundamental current (I1).
Limit	Allowable current harmonic limits per individual EUT specifications. These limits are located in the file named "option_Distortion_Limits.ini" where 'option' is the avionics option, located in the Gui application directory. They are set to correspond with the limits called out in the applicable standard. If there are no limits called out in the standard, these are set to 0 and no limits will be implemented. All limits are subject to change by the user.
P/F	Pass or Fail indication.
A phase selection is available to the left of the graphs and table, which allows each phase to be displayed, one at a time.	

Additional user controls located on the EUT Performance Measurements Tab:

Control / Display	Description
Update Meas.	Triggers a new acquisition cycle and updates measurement data for all tabs. For Variable Frequency tables, data will be acquired at the frequency set by the Test Frequency Dropdown control. This button is always available regardless of what sub tab is selected.
Settings	Brings up a dialog box that allows scaling and color changes for the Waveform or Current harmonics graphs. Note that setting changes will apply to graphs for all phases. For current harmonics graphs, only the absolute bar settings apply. The measurement screen does not display relative current harmonic bar charts but relative data is available in tabular format on the Cur Spectrum tab. This button is available only if either the Waveforms or Cur Graph sub tab is selected



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## 2.6 Test Description Files – Creating Custom Tests

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The avionics options use a set of configuration files that contain the relevant test descriptions. These files are contained in the test revision folder in the Gui application directory. For example, the DO160 test folder is titled 'DO160\_RevE'.

The contents of these tables are defined by the "option\_Structure\_Tbl\_X.ini" configuration files located in the test revision directory. "X" references the relevant table and "option" is the avionics option (example: DO160\_Structure\_Tbl\_ACF115.ini).

The test description files used to perform a specific test are listed in the last column labeled "Test File". These files must be present in the directory.

The structure files cannot be renamed, since they relate to one of the available power groups. The structure files can be completely edited to include as many or as little subsequent tests as desired. The individual test file names can be renamed as needed as long as they are correctly referenced in the structure configuration files. From there, the individual test files can be modified to perform the new test.

Tests can be customized as needed by editing these table configuration and test sequence files. To access these new tests, create a new subdirectory under the application directory. To access any new sub directory from within the test control window, the directory name must be added to the UserTestLibraries text file located in the Gui application directory. This is a simple text file listing all test description directories available.

Example: "DO160UserTestLibraries.txt" file content:

MyNew\_DBase

Dummy\_Dir\_Entry

These two directories listed will now be available for selection from the Test Revision selection in the 160 Test Setup screen.

To facilitate creating new test directories, it is easiest to create a copy of the existing directory first and rename it as required.

## 2.7 Avionics Option Related Error Messages

The GUI program will monitor the power source on a regular basis for any run time errors. If an error is reported by the power source, any test step execution will be aborted. Possible errors and error sources are:

No	Description	Potential cause
2	Current Limit Fault	EUT may require more current than the programmed current limit setting. This is possible on constant power loads during reduced voltage (low line) type test steps. If the power source is set to Constant Voltage (CV) mode, the output will trip off when the current limit is exceeded and a Current Limit fault is generated. In Constant Current (CC) mode, the output voltage will be reduced to reduce the current to the set limit. In this case, no error message will be generated.
- 113	Undefined Header	Generally caused by a communication problem between the PC and the power source.  If the RS232 interface is used and these problems persist, try using the GPIB interface instead. (Requires National Instruments GPIB controller).
15	Slew exceeds dwell	The power source transient system was programmed to slew to a voltage and/or frequency value that would take longer to accomplish than the slew time set. This error can result in single step mode if the steps are executed out of order or one or more steps are skipped. The voltage/frequency values may no longer line up. Try running the test from the first step.
16	Illegal during transient	A transient step is still in progress. Try using the Abort button to abort any test in progress. If other Gui screens other than the Main GUI screen are open, they may have initiated a transient, which conflicts with the option. Try closing all other Gui windows.

Great efforts have been made to check all test sequence files provided as part of the avionics options. However, due to the breadth and complexity of the test databases, an occasional error may occur while using these files. If an error cannot be resolved, turn on the Gui bus monitor window and rerun the test that yields the error and save the bus trace to a text file using the File, Save All menu in the bus monitor window. This file can be emailed to [ci.ppd@ametek.com](mailto:ci.ppd@ametek.com) along with a description of the error.

Furthermore, test files were developed making reasonable assumptions concerning the intent of the avionics test directives. The user is free to modify, edit, revise or otherwise update any of these tests to match his/her own requirements. In this case, we recommend you copy the supplied test revision subdirectory and use this copy to make modifications to. This will preserve the original data provided.

## **2.8 Frequency Control(-FC) Option Limitations**

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Sources equipped with the FC option may not meet frequency accuracy requirements for some avionics tests. Example is DO160F section 16.5.1.3, Figure 16-2 where the AC source is expected to modulate frequency at 100Hz repetition rate and deviation of +/- 0.2Hz from fundamental frequencies at 400Hz, 360Hz, 650Hz and 800Hz.

Frequency accuracy of sources with the -FC option is 0.15% so at 400Hz the accuracy is 0.6Hz. Some sections of the test require 0.2Hz at 800Hz fundamental so the source does not have the accuracy to provide the 0.2Hz.

Note that standard sources without the -FC option fully comply with frequency accuracy requirements. If full compliance to DO160F is required use the standard AC source or add the -LF option.

### 3 Option –160: RTCA/DO-160 Rev E, F, G Tests

The -160 option supports RTCA/DO-160 rev E, F, and G, Section 16, voltage and frequency immunity tests in either of the AC or DC modes (if available).

The –160 option is based on the RTCA/DO-160 Environmental Conditions and Test Procedures for Airborne Equipment: Section 16 – Power Input dated December 9 2004.

Future revisions of the RTCA/DO-160 directive may be issued over time and updates may be made available to cover any changes in test levels, durations, procedures etc. Furthermore, the –160 option is completely data file driven to allow a large degree of customization by the end-user if needed so many changes can be supported without the need for software updates.

This section of the manual explains the limitations of this test option, the use of special features unique to this option, and gives a complete layout of all tests performed by this option.

This manual is **not** intended to elaborate on the intent or purpose of the immunity tests and the expected behavior of the EUT as described in the RTCA/DO-160 documents. It is assumed that the end-user is familiar with the content of the RTCA/DO-160 test standard.

#### 3.1 Test Coverage

The comprehensiveness of the tests that can be performed with the –160 option is determined primarily by the capabilities of the power source used. Tests that are outside the hardware capabilities of the power source used will not be enabled and cannot be selected. For these tests, additional equipment may be required as indicated.

##### 3.1.1 MX/RS Series –DO160 Option Limitations

The extent of coverage of the –160 option as implemented on the MX/RS Series platform is shown in the table below. Tests marked with an 'x' generally require additional hardware to be used. Tests marked 'N/A' are not applicable to the corresponding table. Tests marked with a '√' are covered by the –160 option. Tests marked with a 'P' require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. An –HV indication means the –HV 400Vrms range option is required. **Note:** *The MX15 Series power sources are single phase output only and therefore all three phase tests are not available on the MX15.*

##### Revision E

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	N/A	√	√

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√					
16.5.2.2	Momentary Under Voltage Operation	√	√	√					
16.5.2.3.1	Abnormal Surge Voltage	√	√	√					
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A					

Table 3- 2: -160 Option MX/RS Test Coverage, 115VAC and 28VDC, Rev E

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√
16.5.1.5.1	Normal Surge Voltage (see note)	-HV	-HV	-HV	16.6.1.5	Engine Starting Under Voltage	N/A	√	√
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√					
16.5.2.2	Momentary Under Voltage Operation	√	√	√					
16.5.2.3.1	Abnormal Surge Voltage (see note)	-HV	-HV	-HV					

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A					

*Table 3- 3: -160 Option MX/RS Test Coverage, 230VAC and 14VDC, Rev E*

**Note** that some AC tests requiring more than 300Vrms output will require the –HV (400 Vrms) optional output range.

**Revision F**

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	X
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						
16.5.2.2	Momentary Under Voltage Operation	√	√	√						
16.5.2.3.1	Abnormal Surge Voltage	√	√	√						
16.5.2.3.2	Abnormal Frequency Transient	√	√	√						
16.5.2.3.3	Abnormal Frequency Variations	√	√	√						
16.5.2.4	Loss of Phase Input	√	√	√						

Table 3- 4: -160 Option MX/RS Test Coverage, 115VAC, 28VDC and 270VDC, Rev F

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.5.1	Normal Surge Voltage (see note)	-HV	-HV	-HV	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						
16.5.2.2	Momentary Under Voltage Operation	√	√	√						
16.5.2.3.1	Abnormal Surge Voltage (see note)	-HV	-HV	-HV						
16.5.2.3.2	Abnormal Frequency Transient	√	√	√						
16.5.2.3.3	Abnormal Frequency Variations	√	√	√						
16.5.2.4	Loss of Phase Input	√	√	√						

Table 3- 5: -160 Option MX/RS Test Coverage, 230VAC, 14VDC and 135VDC, Rev F

**Note** that some AC tests requiring more than 300Vrms output will require the –HV (400 Vrms) optional output range.

### Revision G

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	X
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A



No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						
16.5.2.2	Momentary Under Voltage Operation	√	√	√						
16.5.2.3.1	Abnormal Surge Voltage	√	√	√						
16.5.2.3.2	Abnormal Frequency Transient	√	√	√						
16.5.2.3.3	Abnormal Frequency Variations	√	√	√						
16.5.2.4	Loss of Phase Input	√	√	√						

Table 3- 6: -160 Option MX/RS Test Coverage, 115VAC, 28VDC and 270VDC, Rev G

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√
16.5.1.5.1	Normal Surge Voltage (see note)	-HV	-HV	-HV	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						
16.5.2.2	Momentary Under Voltage Operation	√	√	√						

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.2.3.1	Abnormal Surge Voltage (see note)	-HV	-HV	-HV						
16.5.2.3.2	Abnormal Frequency Transient	√	√	√						
16.5.2.3.3	Abnormal Frequency Variations	√	√	√						
16.5.2.4	Loss of Phase Input	√	√	√						

Table 3- 7: -160 Option MX/RS Test Coverage, 230VAC, 14VDC and 135VDC, Rev G

**Note** that some AC tests requiring more than 300Vrms output will require the –HV (400 Vrms) optional output range.

### 3.1.1.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the RTCA/DO-160 tests, some limitations apply, largely due to hardware limitations of the MX/RS power source such as available programming resolution or rounding. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Vnom	Test	Std requirement	Actual setting	Reason
115VAC	A(CF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(NF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(CF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(NF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- .36 Vrms	230 +/- .4 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- 2.48 Vrms	230 +/- 2.5 Vrms	Resolution
115VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	650Hz mod by .75Hz	650Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	800Hz mod by .75Hz	800Hz mod by .8Hz	Resolution
230VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
14VDC	ADC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
14VDC	BDC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
14VDC	ZDC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
270VDC	ADC:16.6.1.2	ripple voltage	Not included	Requires additional equipment
28VDC	ADC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
28VDC	BDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
28VDC	ZDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ADC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	BDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ZDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ADC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	BDC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	ZDC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	ADC:16.6.2.4	23.15V in transient	23.2V in transient	Resolution

### 3.1.2 AST –DO160 Option Limitations

The extent of coverage of the –160 option as implemented on the AST Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –160 option. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. An –HV indication means the –HV 400Vrms range option is required. **Note:** *The AST Series power sources model number ending with “1” (eg: AST 751,1501) are single phase output only and therefore all three phase tests are not available on these series.*

#### Revision E

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	N/A	√	√
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√					
16.5.2.2	Momentary Under Voltage Operation	√	√	√					
16.5.2.3.1	Abnormal Surge Voltage	√	√	√					
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A					

Table 3- 8: -160 Option AST Test Coverage, 115VAC and 28VDC, Rev E

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√
16.5.1.5.1	Normal Surge Voltage (see note)	-HV	-HV	-HV	16.6.1.5	Engine Starting Under Voltage	N/A	√	√
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√					
16.5.2.2	Momentary Under Voltage Operation	√	√	√					
16.5.2.3.1	Abnormal Surge Voltage (see note)	-HV	-HV	-HV					
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A					

Table 3- 9: -160 Option AST Test Coverage, 230VAC and 14VDC, Rev E

**Note** that some AC tests requiring more than 300Vrms output will require the high voltage range to be selected.

**Revision F**

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	X
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						
16.5.2.2	Momentary Under Voltage Operation	√	√	√						
16.5.2.3.1	Abnormal Surge Voltage	√	√	√						
16.5.2.3.2	Abnormal Frequency Transient	√	√	√						
16.5.2.3.3	Abnormal Frequency Variations	√	√	√						
16.5.2.4	Loss of Phase Input	√	√	√						

Table 3- 10: -160 Option AST Test Coverage, 115VAC, 28VDC and 270VDC, Rev F

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.5.1	Normal Surge Voltage (see note)	-HV	-HV	-HV	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						
16.5.2.2	Momentary Under Voltage Operation	√	√	√						
16.5.2.3.1	Abnormal Surge Voltage (see note)	-HV	-HV	-HV						
16.5.2.3.2	Abnormal Frequency Transient	√	√	√						
16.5.2.3.3	Abnormal Frequency Variations	√	√	√						
16.5.2.4	Loss of Phase Input	√	√	√						

Table 3- 11: -160 Option AST Test Coverage, 230VAC, 14VDC and 135VDC, Rev F

**Note** that some AC tests requiring more than 300Vrms output will require high voltage range to be selected.

### Revision G

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	X
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						
16.5.2.2	Momentary Under Voltage Operation	√	√	√						
16.5.2.3.1	Abnormal Surge Voltage	√	√	√						
16.5.2.3.2	Abnormal Frequency Transient	√	√	√						
16.5.2.3.3	Abnormal Frequency Variations	√	√	√						
16.5.2.4	Loss of Phase Input	√	√	√						

Table 3- 12: -160 Option AST Test Coverage, 115VAC, 28VDC and 270VDC, Rev G

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√
16.5.1.5.1	Normal Surge Voltage (see note)	-HV	-HV	-HV	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						



No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.2.2	Momentary Under Voltage Operation	√	√	√						
16.5.2.3.1	Abnormal Surge Voltage (see note)	-HV	-HV	-HV						
16.5.2.3.2	Abnormal Frequency Transient	√	√	√						
16.5.2.3.3	Abnormal Frequency Variations	√	√	√						
16.5.2.4	Loss of Phase Input	√	√	√						

Table 3- 13: -160 Option AST Test Coverage, 230VAC, 14VDC and 135VDC, Rev G

**Note** that some AC tests requiring more than 300Vrms output will require the High voltage range to be selected.

### 3.1.2.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the RTCA/DO-160 tests, some limitations apply, largely due to hardware limitations of the AST power source such as available programming resolution or rounding. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Vnom	Test	Std requirement	Actual setting	Reason
115VAC	A(CF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(NF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(CF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(NF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- .36 Vrms	230 +/- .4 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- 2.48 Vrms	230 +/- 2.5 Vrms	Resolution
115VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	650Hz mod by .75Hz	650Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	800Hz mod by .75Hz	800Hz mod by .8Hz	Resolution
230VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
14VDC	ADC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
14VDC	BDC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
14VDC	ZDC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
270VDC	ADC:16.6.1.2	ripple voltage	Not included	Requires additional equipment
28VDC	ADC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
28VDC	BDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
28VDC	ZDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ADC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	BDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ZDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ADC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	BDC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	ZDC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	ADC:16.6.2.4	23.15V in transient	23.2V in transient	Resolution

### 3.1.3 Error! Bookmark not defined. CSW Series –DO160 Option Limitations Error! Bookmark not defined.

The extent of coverage of the –160 option as implemented on the CSW Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –160 option. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. An –HV indication means the –HV 400Vrms range option is required.

#### Revision E

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	N/A	√	√
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√					
16.5.2.2	Momentary Under Voltage Operation	√	√	√					
16.5.2.3.1	Abnormal Surge Voltage	√	√	√					
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A					

Table 3- 14:-160 Option CSW Test Coverage, 115VAC and 28VDC, Rev E

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√
16.5.1.5.1	Normal Surge Voltage (see note)	-HV	-HV	-HV	16.6.1.5	Engine Starting Under Voltage	N/A	√	√
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√					
16.5.2.2	Momentary Under Voltage Operation	√	√	√					
16.5.2.3.1	Abnormal Surge Voltage (see note)	-HV	-HV	-HV					
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A					

Table 3- 15: -160 Option CSW Test Coverage, 230VAC and 14VDC, Rev E

**Note** that some AC tests requiring more than 300Vrms output will require the –HV (400 Vrms) optional output range.

**Revision F**

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	X
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						
16.5.2.2	Momentary Under Voltage Operation	√	√	√						
16.5.2.3.1	Abnormal Surge Voltage	√	√	√						
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A						

Table 3- 16: -160 Option CSW Test Coverage, 115VAC, 28VDC and 270VDC, Rev F

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	P	P	P	P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√	√
16.5.1.5.1	Normal Surge Voltage (see note)	-HV	-HV	-HV	16.6.1.5	Engine Starting Under Voltage	N/A	√	√	N/A

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC	Table DDC
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A	N/A
16.5.1.7	Voltage DC Content	P	P	P	16.6.2.3	Momentary Under Voltage Operation	√	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√						
16.5.2.2	Momentary Under Voltage Operation	√	√	√						
16.5.2.3.1	Abnormal Surge Voltage (see note)	-HV	-HV	-HV						
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A						

Table 3- 17: -160 Option CSW Test Coverage, 230VAC, 14VDC and 135VDC, Rev F

**Note** that some AC tests requiring more than 300Vrms output will require the –HV (400 Vrms) optional output range.

### 3.1.3.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the RTCA/DO-160 tests, some limitations apply, largely due to hardware limitations of the CSW power source such as available programming resolution or rounding. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Vnom	Test	Std requirement	Actual setting	Reason
115VAC	A(CF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(NF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(CF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(NF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- .36 Vrms	230 +/- .4 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- 2.48 Vrms	230 +/- 2.5 Vrms	Resolution
115VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	650Hz mod by .75Hz	650Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	800Hz mod by .75Hz	800Hz mod by .8Hz	Resolution
230VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
14VDC	ADC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
14VDC	BDC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
14VDC	ZDC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
270VDC	ADC:16.6.1.2	ripple voltage	Not included	Requires additional equipment
28VDC	ADC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
28VDC	BDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
28VDC	ZDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ADC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	BDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ZDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ADC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	BDC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	ZDC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution

Vnom	Test	Std requirement	Actual setting	Reason
14VDC	ADC:16.6.2.4	23.15V in transient	23.2V in transient	Resolution

### 3.1.4 i/iX Series –DO160 Option Limitations

The extent of coverage of the –160 option as implemented on the iX Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –160 option. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on iX models only. Tests marked with an ‘I’ are available on the i/iX products only. Tests marked with a ‘C’ are available on the Compact iX products only.

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	√	√	√
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	I, P	I, P	I, P
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	√	√	√
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	√	√	√
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	N/A	√	√
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	N/A	√	N/A
16.5.1.7	Voltage DC Content	P or C,x	P or C,x	P or C,x	16.6.2.3	Momentary Under Voltage Operation	√	√	√
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	√	√					
16.5.2.2	Momentary Under Voltage Operation	√	√	√					
16.5.2.3.1	Abnormal Surge Voltage	√	√	√					
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A					

Table 3- 18: -160 Option i/iX Test Coverage, 115VAC and 28VDC



No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	C	C	16.6.1.1	Voltage	√	√	√
16.5.1.2	Voltage Modulation	√	C	C	16.6.1.2	Ripple Voltage	I, P	I, P	I, P
16.5.1.3	Frequency Modulation	√	C	C	16.6.1.3	Momentary Power Interruptions	√	√	√
16.5.1.4	Momentary Power Interruptions	√	C	C	16.6.1.4	Normal Surge Voltage	√	√	√
16.5.1.5.1	Normal Surge Voltage	X	X	X	16.6.1.5	Engine Starting Under Voltage	N/A	√	√
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	√	√	√
16.5.1.6	Normal Frequency Variations	N/A	C	C	16.6.2.2	Low Voltage Conditions	N/A	√	N/A
16.5.1.7	Voltage DC Content	P or C,x	C, x	C, x	16.6.2.3	Momentary Under Voltage Operation	√	√	√
16.5.1.8	Voltage Distortion	P	C, P	C, P	16.6.2.4	Abnormal Voltage Surge	√	√	√
16.5.2.1	Abnormal Voltage and Frequency	√	C	C					
16.5.2.2	Momentary Under Voltage Operation	√	C	C					
16.5.2.3.1	Abnormal Surge Voltage	X	X	X					
16.5.2.3.2	Abnormal Frequency Transient	√	C	C					

Table 3- 19: -160 Option i/iX Test Coverage, 230VAC and 14VDC

**Note** that the iX Series does not support 800 Hz testing at more than 150Vrms. Consequently, all 230V nominal tests for A(NF) and A(WF) categories are not supported. Some A(CF) tests requiring more than 300V output are also unavailable due to hardware limitations of the iX Series power source.

### 3.1.4.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the RTCA/DO-160 tests, some limitations apply, largely due to hardware limitations of the iX power source such as available programming resolution or rounding. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Vnom	Test	Std requirement	Actual setting	Reason
230VAC	A(NF)		No Tests Performed	Max. output voltage limitation
230VAC	A(WF)		No Tests Performed	Max. output voltage limitation
115VAC	A(CF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution

Vnom	Test	Std requirement	Actual setting	Reason
115VAC	A(NF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(CF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(NF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- .36 Vrms	230 +/- .4 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- 2.48 Vrms	230 +/- 2.5 Vrms	Resolution
115VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	650Hz mod by .75Hz	650Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	800Hz mod by .75Hz	800Hz mod by .8Hz	Resolution
230VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
230VAC	A(CF):16.5.1.5.1	320V Transient	Test skipped	Requires additional equipment
230VAC	A(CF):16.5.2.3.1	360V Transient	Test skipped	Requires additional equipment
14VDC	ADC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
14VDC	BDC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
14VDC	ZDC:16.6.1.1	15.15 V nom	15.2 V nom	Resolution
28VDC	ADC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
28VDC	BDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
28VDC	ZDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ADC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	BDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ZDC:16.6.1.2	> 5 kHz ripple voltage	Test skipped	Requires additional equipment
14VDC	ADC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	BDC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	ZDC:16.6.2.1	10.25 V nom	10.3 V nom	Resolution
14VDC	ADC:16.6.2.4	23.15V in transient	23.2V in transient	Resolution

### 3.1.5 Lx/Ls Series –DO160 Option Limitations

The extent of coverage of the –160 option as implemented on the Lx/Ls Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –160 option. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Lx models and Ls models with the –ADV option only. Note that some voltage surge tests may require optional output voltage ranges on the Lx/Ls and may not be supported on the standard voltage range.

***DC tests are NOT supported by the Lx/Ls Series***

No.	115V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	28 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	X	X	X
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	X	X	X
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	X	X	X
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	X	X	X
16.5.1.5.1	Normal Surge Voltage	√	√	√	16.6.1.5	Engine Starting Under Voltage	X	X	X
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	X	X	X
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	X	X	X
16.5.1.7	Voltage DC Content	X	X	X	16.6.2.3	Momentary Under Voltage Operation	X	X	X
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	X	X	X
16.5.2.1	Abnormal Voltage and Frequency	√	√	√					
16.5.2.2	Momentary Under Voltage Operation	√	√	√					
16.5.2.3.1	Abnormal Surge Voltage	√	√	√					
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A					

Table 3- 20: -160 Option Ls/Lx Test Coverage, 115VAC and 28VDC

No.	230V Tests Description	Table A(CF)	Table A(NF)	Table A(WF)	No.	14 VDC Tests Description	Table ADC	Table BDC	Table ZDC
16.5.1.1	Voltage and Frequency	√	√	√	16.6.1.1	Voltage	X	X	X
16.5.1.2	Voltage Modulation	√	√	√	16.6.1.2	Ripple Voltage	X	X	X
16.5.1.3	Frequency Modulation	√	√	√	16.6.1.3	Momentary Power Interruptions	X	X	X
16.5.1.4	Momentary Power Interruptions	√	√	√	16.6.1.4	Normal Surge Voltage	X	X	X
16.5.1.5.1	Normal Surge Voltage <sup>2</sup>	√	√	√	16.6.1.5	Engine Starting Under Voltage	X	X	X
16.5.1.5.2	Normal Frequency Transients	√	N/A	N/A	16.6.2.1	Abnormal Voltage	X	X	X
16.5.1.6	Normal Frequency Variations	N/A	√	√	16.6.2.2	Low Voltage Conditions	X	X	X
16.5.1.7	Voltage DC Content	X	X	X	16.6.2.3	Momentary Under Voltage Operation	X	X	X
16.5.1.8	Voltage Distortion	P	P	P	16.6.2.4	Abnormal Voltage Surge	X	X	X
16.5.2.1	Abnormal Voltage and Frequency	√	√	√					
16.5.2.2	Momentary Under Voltage Operation	√	√	√					
16.5.2.3.1	Abnormal Surge Voltage <sup>3</sup>	√	√	√					
16.5.2.3.2	Abnormal Frequency Transient	√	N/A	N/A					

Table 3- 21: -160 Option Ls/Lx Test Coverage, 230VAC and 14VDC

<sup>2</sup> Requires –HV voltage range option.

<sup>3</sup> Requires –HV voltage range option.

### 3.1.5.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the RTCA/DO-160 tests, some limitations apply, largely due to hardware limitations of the Lx power source such as available programming resolution or rounding. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

#### ***DC tests are NOT supported by the Lx/Ls Series***

Vnom	Test	Std requirement	Actual setting	Reason
115VAC	A(CF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(NF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
115VAC	A(CF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(NF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
115VAC	A(WF):16.5.1.2	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- .36 Vrms	230 +/- .4 Vrms	Resolution
230VAC	A(CF):16.5.1.2	230 +/- 2.48 Vrms	230 +/- 2.5 Vrms	Resolution
115VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(NF):16.5.1.3	650Hz mod by .75Hz	650Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	360Hz mod by .75Hz	360Hz mod by .8Hz	Resolution
115VAC	A(WF):16.5.1.3	800Hz mod by .75Hz	800Hz mod by .8Hz	Resolution
230VAC	A(CF):16.5.1.3	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
230VAC	A(CF):16.5.1.5.1	320V Transient	No deviation but –HV option required to run.	Max voltage 320Vrms requires 400V range.
230VAC	A(CF):16.5.2.3.1	360V Transient	No deviation but –HV option required to run.	Max voltage 360Vrms requires 400V range.

## 3.2 –160 Power Groups

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The following twelve power groups are covered in the RTCA/DO-160 directive:

Category reference:

- For ac equipment: A(CF), A(NF), and A(WF)
- For dc equipment: A, B, Z
- AC tests can be performed at 115V nominal or 230V nominal, except A(NF) and A(CF), which can only be done at 115V nominal. All AC line voltages shown are L-N.
- DC tests can be performed at 28V nominal or 14V nominal

Definitions:

**A(CF):** designates ac equipment intended for use on aircraft electrical systems where the primary power is from constant frequency (400 Hz) ac system.

**A(NF):** designates ac equipment intended for use on aircraft electrical systems where the primary power is from narrow variable frequency (360 to 650 Hz) ac system.

**A(WF):** designates ac equipment intended for use on aircraft electrical systems where the primary power is from wide variable frequency (360 to 800 Hz) ac system.

**A:** designates dc equipment intended for use on aircraft electrical systems where the dc is generated from primary power supplied from either a constant or variable frequency ac system.

**B:** designates dc equipment intended for use on aircraft electrical systems supplied by engine-driven alternator/rectifiers, or dc generators where a battery of significant capacity is floating on the dc bus at all times.

**Z:** designates dc equipment that may be used on all other types of aircraft electrical systems applicable to these standards. Category Z shall be acceptable for use in lieu of Category A or Category B.

**D:** designates dc equipment that may be used on all other types of aircraft electrical systems applicable to these standards. Category Z shall be acceptable for use in lieu of Category A or Category B.

The required steady state output settings for each power group must be selected based on the type of EUT to be tested. These settings can be made from the front panel of the power source or from the main Gui control screen.

### 3.3 –160 Option Special Features

DC ripple tests for 28VDC or 14VDC EUT's are provided through a separate control screen. This is required to extend the range of the ripple frequency to 5000 Hz. The actual requirement for DO160 Rev E is testing up to 150 KHz ripple. This is out of the available range of the power source. To test to the full 150 KHz range, an external audio generator and coupling transformer as outlined in RTCA/DO160, Section 18, Figure 18-1 is required.

The DO160 DC Ripple test screen is available from the main screen, **Applications, RTCA/DO160, DC Ripple Test** menu. Once selected, the DC ripple test control screen is modal and must be closed before any other tests can be run. Opening this screen requires several seconds as the power source is being set up to perform the DC ripple tests. This screen also places the power source in AC+DC mode.

Available test settings are 14VDC or 28VDC nominal, category A, Z or category B and phase/output selection. For single-phase systems, only phase A can be selected. The test pattern is fixed per section 18.3.1 with a ripple frequency range from 16 Hz to 5000 Hz per Figure 18-2 (Cat A,Z) or 18-3 (Cat B). The frequency slew rate is 30 minutes for each decade covered or one hour and 15 minutes total. Tests can be aborted sooner if needed.

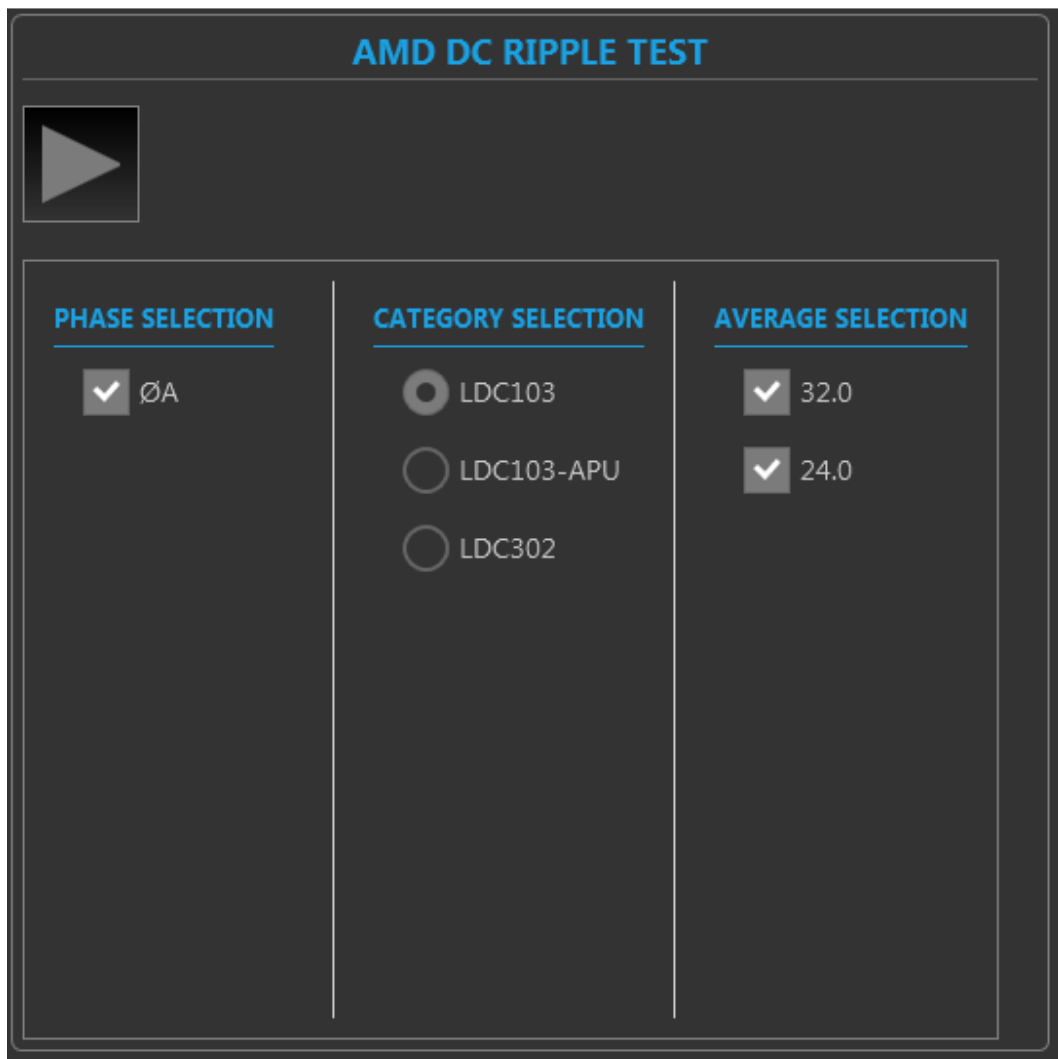


Figure 3- 1: DO160E DC Ripple Test Window.

### **3.4 Test Tables**

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The tables shown on the next few pages list the test sections covered by the –160 option. Where relevant, the numbering used matches that of the RTCA/DO-160 document. Test tables are listed by power group



**3.4.1 DO160 Section 16, Rev E:**

**3.4.1.1 Table A(CF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.1b(1)	1 Phs Voltage and Frequency (ac)	100V to 122V, 390Hz to 410Hz	Apply for 30 mins each test	EACF115_VFNORM1P
	16.5.1.1c(1)	3 Phs Voltage and Frequency (ac)	100V to 122V, 390Hz to 410Hz	Apply for 30 mins each test	EACF115_VFNORM3P
16.5.1		Emergency Operating Conditions (ac)			
	16.5.1.1b(2)	1 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 440Hz	Apply for 30 mins each test	EACF115_VFEMER1P
	16.5.1.1c(2)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 440Hz	Apply for 30 mins each test	EACF115_VFEMER3P
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.2	Voltage Modulation (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	EACF115_VMOD
	16.5.1.3	Frequency Modulation (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	EACF115_FMOD
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1	Equipment with Digital Circuits	EACF115_PINTB
	16.5.1.4c	Momentary Power Interruptions (ac)		Other Equipment	EACF115_PINTC
	16.5.1.5	Normal Transients (ac)			
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 400 Hz		EACF115_NV SUR
		16.5.1.5.2 - Normal Frequency Surge (ac)	115V, 350Hz to 400Hz		EACF115_NFSUR
	16.5.1.7	Voltage DC Content (ac)			
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC	Apply for 30 mins each test	EACF115_DCOFS1P
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC	Apply for 30 mins each test	EACF115_DCOFS3P
	16.5.1.8	Voltage Distortion (ac)	8% +2%/-0% VTHD - Clipped Sine, 400Hz	Apply for 30 mins each test	EACF115_VTHD
16.5.2		Abnormal Operating Conditions (ac)			
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 400Hz	Apply for 5 mins each test	EACF115_VABN1P
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 400Hz	Apply for 5 mins each test	EACF115_VABN3P

	16.5.2.1d	1 Phs Voltage and Frequency (ac)	100V to 122V, 370Hz to 430Hz	Apply for 5 mins each test	EACF115_VFABN1P
	16.5.2.1e	3 Phs Voltage and Frequency (ac)	100V to 122V, 370Hz to 430Hz	Apply for 5 mins each test	EACF115_VFABN3P
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 400Hz	Apply for 7 seconds each test	EACF115_VUND
	16.5.2.3	Abnormal Transients (ac)			
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 400Hz	Figure 16.5 - apply at 10 sec intervals	EACF115_AVSUR
		16.5.2.3.1 - Abnormal Frequency transients	0V to 115V, 320Hz to 480Hz	Figure 16.5 - apply at 10 sec intervals	EACF115_AFSUR

**3.4.1.2 Table A(NF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.1b(1)	1 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 650Hz	Apply for 30 mins each test	EANF115_VFNORM1P
	16.5.1.1c(1)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 650Hz	Apply for 30 mins each test	EANF115_VFNORM3P
16.5.1		Emergency Operating Conditions (ac)			
	16.5.1.1c(2)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 650Hz	Apply for 30 mins each test	EANF115_VFEMER3P
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.2	Voltage Modulation 360Hz (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	EANF115_VMOD360
	16.5.1.2	Voltage Modulation 650Hz (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	EANF115_VMOD650
	16.5.1.3	Frequency Modulation 360Hz (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	EANF115_FMOD360
	16.5.1.3	Frequency Modulation 650Hz (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	EANF115_FMOD650
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1 360Hz nom	Equipment with Digital Circuits	EANF115_PINTB360
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1 650Hz nom	Equipment with Digital Circuits	EANF115_PINTB650
	16.5.1.4c	Momentary Power Interruptions (ac)	360Hz nom	Other Equipment	EANF115_PINTC360

	16.5.1.4c	Momentary Power Interruptions (ac)	650Hz nom	Other Equipment	EANF115_PINTC650
	16.5.1.4d	Momentary Power Interruptions (ac)	Table 16-2	Additional Requirement (Var Freq)	EANF115_PINTD
	16.5.1.5	Normal Transients (ac)			
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 360 Hz		EANF115_NV SUR360
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 650 Hz		EANF115_NV SUR650
	16.5.1.6	Normal Frequency Surge (ac)	115V, 360Hz to 650Hz		EANF115_NFSUR
	16.5.1.7	Voltage DC Content (ac)			
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC (360Hz nom)	Apply for 30 mins each test	EANF115_DCOFS1P360
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC (650Hz nom)	Apply for 30 mins each test	EANF115_DCOFS1P650
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC (360Hz nom)	Apply for 30 mins each test	EANF115_DCOFS3P360
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC (650Hz nom)	Apply for 30 mins each test	EANF115_DCOFS3P650
	16.5.1.8	Voltage Distortion (ac)	8% +2%/-0% VTHD - Clipped Sine, 360Hz	Apply for 30 mins each test	EANF115_VTHD360
	16.5.1.8	Voltage Distortion (ac)	8% +2%/-0% VTHD - Clipped Sine, 650Hz	Apply for 30 mins each test	EANF115_VTHD650
16.5.2		Abnormal Operating Conditions (ac)			
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 360Hz	Apply for 5 mins each test	EANF115_VABN1P360
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 650Hz	Apply for 5 mins each test	EANF115_VABN1P650
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 360Hz	Apply for 5 mins each test	EANF115_VABN3P360
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 650Hz	Apply for 5 mins each test	EANF115_VABN3P650
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 360Hz	Apply for 7 seconds each test	EANF115_VUND360
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 650Hz	Apply for 7 seconds each test	EANF115_VUND650
	16.5.2.3	Abnormal Transients (ac)			
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 360Hz	Figure 16.5 - apply at 10 sec intervals	EANF115_AVSUR360
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 650Hz	Figure 16.5 - apply at 10 sec intervals	EANF115_AVSUR650

**3.4.1.3 Table A(WF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.1b(1)	1 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 800Hz	Apply for 30 mins each test	EAWF115_VFNORM1P
	16.5.1.1c.2(1)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 800Hz	Apply for 30 mins each test	EAWF115_VFNORM3P
16.5.1		Emergency Operating Conditions (ac)			
	16.5.1.1c.2(2)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 800Hz	Apply for 30 mins each test	EAWF115_VFEMER3P
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.2	Voltage Modulation 360Hz (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	EAWF115_VMOD360
	16.5.1.2	Voltage Modulation 800Hz (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	EAWF115_VMOD800
	16.5.1.3	Frequency Modulation 360Hz (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	EAWF115_FMOD360
	16.5.1.3	Frequency Modulation 800Hz (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	EAWF115_FMOD800
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1 360Hz nom	Equipment with Digital Circuits	EAWF115_PINTB360
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1 800Hz nom	Equipment with Digital Circuits	EAWF115_PINTB800
	16.5.1.4c	Momentary Power Interruptions (ac)	360Hz nom	Other Equipment	EAWF115_PINTC360
	16.5.1.4c	Momentary Power Interruptions (ac)	800Hz nom	Other Equipment	EAWF115_PINTC800
	16.5.1.4d	Momentary Power Interruptions (ac)	Table 16-2	Additional Requirement (Var Freq)	EAWF115_PINTD
	16.5.1.5	Normal Transients (ac)			
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 360 Hz		EAWF115_NV SUR360
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 800 Hz		EAWF115_NV SUR800
	16.5.1.6	Normal Frequency Surge (ac)	115V, 360Hz to 800Hz		EAWF115_NFSUR
	16.5.1.7	Voltage DC Content (ac)			
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC (360Hz nom)	Apply for 30 mins each test	EAWF115_DCOFS1P360
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC (800Hz nom)	Apply for 30 mins each test	EAWF115_DCOFS1P800

		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC (360Hz nom)	Apply for 30 mins each test	EAWF115_DCOFS3P360
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC (800Hz nom)	Apply for 30 mins each test	EAWF115_DCOFS3P800
	16.5.1.8	Voltage Distortion (ac)	10% +2%/-0% VTHD - Clipped Sine, 360Hz	Apply for 30 mins each test	EAWF115_VTHD360
	16.5.1.8	Voltage Distortion (ac)	10% +2%/-0% VTHD - Clipped Sine, 800Hz	Apply for 30 mins each test	EAWF115_VTHD800
16.5.2		Abnormal Operating Conditions (ac)			
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 360Hz	Apply for 5 mins each test	EAWF115_VABN1P360
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 800Hz	Apply for 5 mins each test	EAWF115_VABN1P800
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 360Hz	Apply for 5 mins each test	EAWF115_VABN3P360
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 800Hz	Apply for 5 mins each test	EAWF115_VABN3P800
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 360Hz	Apply for 7 seconds each test	EAWF115_VUND360
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 800Hz	Apply for 7 seconds each test	EAWF115_VUND800
	16.5.2.3	Abnormal Transients (ac)			
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 360Hz	Figure 16.5 - apply at 10 sec intervals	EAWF115_AVSUR360
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 800Hz	Figure 16.5 - apply at 10 sec intervals	EAWF115_AVSUR800

**3.4.1.4 Table ADC28:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	22.0V to 30.3V	Apply for 30 mins each test	EADC28_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	18.0V	Apply for 30 mins each test	EADC28_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>4</sup>	Ripple Voltage (dc)	Vp-p = 0.6V to 1.6V, Freq = 10Hz to 200Hz	Figure 18-2	EADC28_VRIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	EADC28_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	EADC28_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	47V to 17V		EADC28_NV SUR
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	20.5V to 32.2V	Apply for 5 mins each test	EADC28_VABN
	16.6.2.3	Momentary Undervoltage (dc)	12V	Apply for 7 seconds each test	EADC28_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4c - Abnormal Voltage Surge	46.3V	Figure 16-4 - apply at 10 sec intervals	EADC28_AVSUR

<sup>4</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

**3.4.1.5 Table BDC28:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	22.0V to 30.3V	Apply for 30 mins each test	EBDC28_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	18.0V	Apply for 30 mins each test	EBDC28_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>5</sup>	Ripple Voltage (dc)	Vp-p = 1.6V, Freq = 200Hz	Figure 18-2	EBDC28_VVIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	EBDC28_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	EBDC28_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	47V to 17V		EBDC28_NVISUR
	16.6.1.5	Engine Starting Under Voltage Operation (dc)	10V min	Slew for 35 sec	EBDC28_VENG
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	20.5V to 32.2V	Apply for 5 mins each test	EBDC28_VABN
	16.6.2.2	Low Voltage Conditions (dc)	0V over 10 minutes		EBDC28_LVABN
	16.6.2.3	Momentary Undervoltage (dc)	12V	Apply for 7 seconds each test	EBDC28_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4d - Abnormal Voltage Surge	60VDC	Figure 16-4 - apply at 10 sec intervals	EBDC28_AVISUR

<sup>5</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

**3.4.1.6 Table ZDC28:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	22.0V to 30.3V	Apply for 30 mins each test	EZDC28_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	18.0V	Apply for 30 mins each test	EZDC28_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>6</sup>	Ripple Voltage (dc)	Vp-p = 0.6V to 1.6V, Freq = 10Hz to 200Hz	Figure 18-2	EZDC28_VRIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	EZDC28_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	EZDC28_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	50V to 12V		EZDC28_NV SUR
	16.6.1.5	Engine Starting Under Voltage Operation (dc)	10V min	Slew for 35 sec	EZDC28_VENG
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	20.5V to 32.2V	Apply for 5 mins each test	EZDC28_VABN
	16.6.2.3	Momentary Undervoltage (dc)	12V	Apply for 7 seconds each test	EZDC28_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4b - Abnormal Voltage Surge	80VDC	Figure 16-4 - apply at 10 sec intervals	EZDC28_AV SUR

<sup>6</sup> For more comprehensive DC Ripple tests, refer to section 3.3.



**3.4.1.7 Table A(CF)230:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.1b(1)	1 Phs Voltage and Frequency (ac)	200V to 244V, 390Hz to 410Hz	Apply for 30 mins each test	EACF230_VFNORM1P
	16.5.1.1c(1)	3 Phs Voltage and Frequency (ac)	200V to 244V, 390Hz to 410Hz	Apply for 30 mins each test	EACF230_VFNORM3P
16.5.1		Emergency Operating Conditions (ac)			
	16.5.1.1b(2)	1 Phs Voltage and Frequency (ac)	200V to 244V, 360Hz to 440Hz	Apply for 30 mins each test	EACF230_VFEMER1P
	16.5.1.1c(2)	3 Phs Voltage and Frequency (ac)	200V to 244V, 360Hz to 440Hz	Apply for 30 mins each test	EACF230_VFEMER3P
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.2	Voltage Modulation (ac)	Vamp = 0.36V to 2.48V, Mrate = 1Hz to 200Hz	Figure 16-1	EACF230_VMOD
	16.5.1.3	Frequency Modulation (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	EACF230_FMOD
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1	Equipment with Digital Circuits	EACF230_PINTB
	16.5.1.4c	Momentary Power Interruptions (ac)		Other Equipment	EACF230_PINTC
	16.5.1.5	Normal Transients (ac)			
		16.5.1.5.1 - Normal Voltage Surge (ac)	320V to 140V, 400 Hz		EACF230_NV SUR
		16.5.1.5.2 - Normal Frequency Surge (ac)	230V, 350Hz to 400Hz		EACF230_NFSUR
	16.5.1.7	Voltage DC Content (ac)			
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.2VDC	Apply for 30 mins each test	EACF230_DCOFS1P
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.2VDC	Apply for 30 mins each test	EACF230_DCOFS3P
	16.5.1.8	Voltage Distortion (ac)	8% +2%/-0% VTHD - Clipped Sine, 400Hz	Apply for 30 mins each test	EACF230_VTHD
16.5.2		Abnormal Operating Conditions (ac)			
	16.5.2.1b	1 Phs Voltage (ac)	194V to 268V, 400Hz	Apply for 5 mins each test	EACF230_VABN1P
	16.5.2.1c	3 Phs Voltage (ac)	194V to 268V, 400Hz	Apply for 5 mins each test	EACF230_VABN3P
	16.5.2.1d	1 Phs Voltage and Frequency (ac)	200V to 244V, 370Hz to 430Hz	Apply for 5 mins each test	EACF230_VFABN1P

	16.5.2.1e	3 Phs Voltage and Frequency (ac)	200V to 244V, 370Hz to 430Hz	Apply for 5 mins each test	EACF230_VFABN3P
	16.5.2.2	Momentary Undervoltage (ac)	20V and 120V, 400Hz	Apply for 7 seconds each test	EACF230_VUND
	16.5.2.3	Abnormal Transients (ac)			
		16.5.2.3.1 - Abnormal Voltage surge	296V to 360V, 400Hz	Figure 16.5 - apply at 10 sec intervals	EACF230_AVSUR
		16.5.2.3.1 - Abnormal Frequency transients	0V to 230V, 320Hz to 480Hz	Figure 16.5 - apply at 10 sec intervals	EACF230_AFSUR

**3.4.1.8 Table ADC14:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	11.0V to 15.2V	Apply for 30 mins each test	EADC14_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	9.0V	Apply for 30 mins each test	EADC14_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>7</sup>	Ripple Voltage (dc)	Vp-p = 0.3V to .8V, Freq = 10Hz to 200Hz	Figure 18-2	EADC14_VRIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	EADC14_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	EADC14_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	23.5V to 8.5V		EADC14_NVVSUR
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	10.3V to 16.1V	Apply for 5 mins each test	EADC14_VABN
	16.6.2.3	Momentary Undervoltage (dc)	6V	Apply for 7 seconds each test	EADC14_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4c - Abnormal Voltage Surge	23.2V	Figure 16-4 - apply at 10 sec intervals	EADC14_AVSUR

<sup>7</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

**3.4.1.9 Table BDC14:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	11.0V to 15.2V	Apply for 30 mins each test	EBDC14_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	9.0V	Apply for 30 mins each test	EBDC14_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>8</sup>	Ripple Voltage (dc)	Vp-p = .8V, Freq = 200Hz	Figure 18-2	EBDC14_VRIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	EBDC14_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	EBDC14_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	23.5V to 8.5V		EBDC14_NVVSUR
	16.6.1.5	Engine Starting Under Voltage Operation (dc)	5V min	Slew for 35 sec	EBDC14_VENG
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	10.3V to 16.1V	Apply for 5 mins each test	EBDC14_VABN
	16.6.2.2	Low Voltage Conditions (dc)	0V over 10 minutes		EBDC14_LVABN
	16.6.2.3	Momentary Undervoltage (dc)	6V	Apply for 7 seconds each test	EBDC14_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4d - Abnormal Voltage Surge	30VDC	Figure 16-4 - apply at 10 sec intervals	EBDC14_AVSUR

<sup>8</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

**3.4.1.10 Table ZDC14:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	11.0V to 15.2V	Apply for 30 mins each test	EZDC14_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	9.0V	Apply for 30 mins each test	EZDC14_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>9</sup>	Ripple Voltage (dc)	Vp-p = 0.3V to .8V, Freq = 10Hz to 200Hz	Figure 18-2	EZDC14_VRIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	EZDC14_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	EZDC14_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	25V to 6V		EZDC14_NV SUR
	16.6.1.5	Engine Starting Under Voltage Operation (dc)	5V min	Slew for 35 sec	EZDC14_VENG
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	10.3V to 16.1V	Apply for 5 mins each test	EZDC14_VABN
	16.6.2.3	Momentary Undervoltage (dc)	6V	Apply for 7 seconds each test	EZDC14_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4b - Abnormal Voltage Surge	40VDC	Figure 16-4 - apply at 10 sec intervals	EZDC14_AVSUR

<sup>9</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

**3.4.2 DO160 Section 16, Rev F:**

**3.4.2.1 Table A(CF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.1b(1)	1 Phs Voltage and Frequency (ac)	100V to 122V, 390Hz to 410Hz	Apply for 30 mins each test	FACF115_VFNORM1P
	16.5.1.1c(1)	3 Phs Voltage and Frequency (ac)	100V to 122V, 390Hz to 410Hz	Apply for 30 mins each test	FACF115_VFNORM3P
16.5.1		Emergency Operating Conditions (ac)			
	16.5.1.1b(2)	1 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 440Hz	Apply for 30 mins each test	FACF115_VFEMER1P
	16.5.1.1c(2)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 440Hz	Apply for 30 mins each test	FACF115_VFEMER3P
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.2	Voltage Modulation (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	FACF115_VMOD
	16.5.1.3	Frequency Modulation (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	FACF115_FMOD
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1	Equipment with Digital Circuits	FACF115_PINTB
	16.5.1.4c	Momentary Power Interruptions (ac)		Other Equipment	FACF115_PINTC
	16.5.1.5	Normal Transients (ac)			
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 400 Hz		FACF115_NV SUR
		16.5.1.5.2 - Normal Frequency Surge (ac)	115V, 350Hz to 400Hz		FACF115_NFSUR
	16.5.1.7	Voltage DC Content (ac)			
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC	Apply for 30 mins each test	FACF115_DCOFS1P
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC	Apply for 30 mins each test	FACF115_DCOFS3P
	16.5.1.8	Voltage Distortion (ac)	8% +2%/-0% VTHD - Clipped Sine, 400Hz	Apply for 30 mins each test	FACF115_VTHD
16.5.2		Abnormal Operating Conditions (ac)			
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 400Hz	Apply for 5 mins each test	FACF115_VABN1P
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 400Hz	Apply for 5 mins each test	FACF115_VABN3P

	16.5.2.1d	1 Phs Voltage and Frequency (ac)	100V to 122V, 370Hz to 430Hz	Apply for 5 mins each test	FACF115_VFABN1P
	16.5.2.1e	3 Phs Voltage and Frequency (ac)	100V to 122V, 370Hz to 430Hz	Apply for 5 mins each test	FACF115_VFABN3P
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 400Hz	Apply for 7 seconds each test	FACF115_VUND
	16.5.2.3	Abnormal Transients (ac)			
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 400Hz	Figure 16.5 - apply at 10 sec intervals	FACF115_AVSUR
		16.5.2.3.1 - Abnormal Frequency transients	0V to 115V, 320Hz to 480Hz	Figure 16.5 - apply at 10 sec intervals	FACF115_AFSUR

**3.4.2.2 Table A(CF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.1b(1)	1 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 650Hz	Apply for 30 mins each test	FANF115_VFNORM1P
	16.5.1.1c(1)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 650Hz	Apply for 30 mins each test	FANF115_VFNORM3P
16.5.1		Emergency Operating Conditions (ac)			
	16.5.1.1c(2)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 650Hz	Apply for 30 mins each test	FANF115_VFEMER3P
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.2	Voltage Modulation 360Hz (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	FANF115_VMOD360
	16.5.1.2	Voltage Modulation 650Hz (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	FANF115_VMOD650
	16.5.1.3	Frequency Modulation 360Hz (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	FANF115_FMOD360
	16.5.1.3	Frequency Modulation 650Hz (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	FANF115_FMOD650
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1 360Hz nom	Equipment with Digital Circuits	FANF115_PINTB360
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1 650Hz nom	Equipment with Digital Circuits	FANF115_PINTB650
	16.5.1.4c	Momentary Power Interruptions (ac)	360Hz nom	Other Equipment	FANF115_PINTC360
	16.5.1.4c	Momentary Power Interruptions (ac)	650Hz nom	Other Equipment	FANF115_PINTC650

	16.5.1.4d	Momentary Power Interruptions (ac)	Table 16-2	Additional Requirement (Var Freq)	FANF115_PINTD
	16.5.1.5	Normal Transients (ac)			
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 360 Hz		FANF115_NV SUR360
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 650 Hz		FANF115_NV SUR650
	16.5.1.6	Normal Frequency Surge (ac)	115V, 360Hz to 650Hz		FANF115_NFSUR
	16.5.1.7	Voltage DC Content (ac)			
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC (360Hz nom)	Apply for 30 mins each test	FANF115_DCOFS1P360
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC (650Hz nom)	Apply for 30 mins each test	FANF115_DCOFS1P650
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC (360Hz nom)	Apply for 30 mins each test	FANF115_DCOFS3P360
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC (650Hz nom)	Apply for 30 mins each test	FANF115_DCOFS3P650
	16.5.1.8	Voltage Distortion (ac)	8% +2%/-0% VTHD - Clipped Sine, 360Hz	Apply for 30 mins each test	FANF115_VTHD360
	16.5.1.8	Voltage Distortion (ac)	8% +2%/-0% VTHD - Clipped Sine, 650Hz	Apply for 30 mins each test	FANF115_VTHD650
16.5.2		Abnormal Operating Conditions (ac)			
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 360Hz	Apply for 5 mins each test	FANF115_VABN1P360
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 650Hz	Apply for 5 mins each test	FANF115_VABN1P650
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 360Hz	Apply for 5 mins each test	FANF115_VABN3P360
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 650Hz	Apply for 5 mins each test	FANF115_VABN3P650
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 360Hz	Apply for 7 seconds each test	FANF115_VUND360
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 650Hz	Apply for 7 seconds each test	FANF115_VUND650
	16.5.2.3	Abnormal Transients (ac)			
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 360Hz	Figure 16.5 - apply at 10 sec intervals	FANF115_AVSUR360
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 650Hz	Figure 16.5 - apply at 10 sec intervals	FANF115_AVSUR650



**3.4.2.3 Table A(CF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.1b(1)	1 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 800Hz	Apply for 30 mins each test	FAWF115_VFNORM1P
	16.5.1.1c.2(1)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 800Hz	Apply for 30 mins each test	FAWF115_VFNORM3P
16.5.1		Emergency Operating Conditions (ac)			
	16.5.1.1c.2(2)	3 Phs Voltage and Frequency (ac)	100V to 122V, 360Hz to 800Hz	Apply for 30 mins each test	FAWF115_VFEMER3P
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.2	Voltage Modulation 360Hz (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	FAWF115_VMOD360
	16.5.1.2	Voltage Modulation 800Hz (ac)	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	Figure 16-1	FAWF115_VMOD800
	16.5.1.3	Frequency Modulation 360Hz (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	FAWF115_FMOD360
	16.5.1.3	Frequency Modulation 800Hz (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	FAWF115_FMOD800
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1 360Hz nom	Equipment with Digital Circuits	FAWF115_PINTB360
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1 800Hz nom	Equipment with Digital Circuits	FAWF115_PINTB800
	16.5.1.4c	Momentary Power Interruptions (ac)	360Hz nom	Other Equipment	FAWF115_PINTC360
	16.5.1.4c	Momentary Power Interruptions (ac)	800Hz nom	Other Equipment	FAWF115_PINTC800
	16.5.1.4d	Momentary Power Interruptions (ac)	Table 16-2	Additional Requirement (Var Freq)	FAWF115_PINTD
	16.5.1.5	Normal Transients (ac)			
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 360 Hz		FAWF115_NV SUR360
		16.5.1.5.1 - Normal Voltage Surge (ac)	160V to 70V, 800 Hz		FAWF115_NV SUR800
	16.5.1.6	Normal Frequency Surge (ac)	115V, 360Hz to 800Hz		FAWF115_NFSUR
	16.5.1.7	Voltage DC Content (ac)			
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC (360Hz nom)	Apply for 30 mins each test	FAWF115_DCOFS1P360
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.1VDC (800Hz nom)	Apply for 30 mins each test	FAWF115_DCOFS1P800

		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC (360Hz nom)	Apply for 30 mins each test	FAWF115_DCOFS3P360
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.1VDC (800Hz nom)	Apply for 30 mins each test	FAWF115_DCOFS3P800
	16.5.1.8	Voltage Distortion (ac)	10% +2%/-0% VTHD - Clipped Sine, 360Hz	Apply for 30 mins each test	FAWF115_VTHD360
	16.5.1.8	Voltage Distortion (ac)	10% +2%/-0% VTHD - Clipped Sine, 800Hz	Apply for 30 mins each test	FAWF115_VTHD800
16.5.2		Abnormal Operating Conditions (ac)			
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 360Hz	Apply for 5 mins each test	FAWF115_VABN1P360
	16.5.2.1b	1 Phs Voltage (ac)	97V to 134V, 800Hz	Apply for 5 mins each test	FAWF115_VABN1P800
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 360Hz	Apply for 5 mins each test	FAWF115_VABN3P360
	16.5.2.1c	3 Phs Voltage (ac)	97V to 134V, 800Hz	Apply for 5 mins each test	FAWF115_VABN3P800
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 360Hz	Apply for 7 seconds each test	FAWF115_VUND360
	16.5.2.2	Momentary Undervoltage (ac)	10V and 60V, 800Hz	Apply for 7 seconds each test	FAWF115_VUND800
	16.5.2.3	Abnormal Transients (ac)			
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 360Hz	Figure 16.5 - apply at 10 sec intervals	FAWF115_AVSUR360
		16.5.2.3.1 - Abnormal Voltage surge	148V to 180V, 800Hz	Figure 16.5 - apply at 10 sec intervals	FAWF115_AVSUR800

**3.4.2.4 Table A(CF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	22.0V to 30.3V	Apply for 30 mins each test	FADC28_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	18.0V	Apply for 30 mins each test	FADC28_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			

	16.6.1.2 <sup>10</sup>	Ripple Voltage (dc)	Vp-p = 0.6V to 1.6V, Freq = 10Hz to 200Hz	Figure 18-2	FADC28_V RIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	FADC28_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	FADC28_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	47V to 17V		FADC28_NV SUR
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	20.5V to 32.2V	Apply for 5 mins each test	FADC28_VABN
	16.6.2.3	Momentary Undervoltage (dc)	12V	Apply for 7 seconds each test	FADC28_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4c - Abnormal Voltage Surge	46.3V	Figure 16-4 - apply at 10 sec intervals	FADC28_AV SUR

### 3.4.2.5 Table A(CF)115:

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	22.0V to 30.3V	Apply for 30 mins each test	FBDC28_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	18.0V	Apply for 30 mins each test	FBDC28_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>11</sup>	Ripple Voltage (dc)	Vp-p = 1.6V, Freq = 200Hz	Figure 18-2	FBDC28_V RIP

<sup>10</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

<sup>11</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	FBDC28_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	FBDC28_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	47V to 17V		FBDC28_NV SUR
	16.6.1.5	Engine Starting Under Voltage Operation (dc)	10V min	Slew for 35 sec	FBDC28_VENG
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	20.5V to 32.2V	Apply for 5 mins each test	FBDC28_VABN
	16.6.2.2	Low Voltage Conditions (dc)	0V over 10 minutes		FBDC28_LVABN
	16.6.2.3	Momentary Undervoltage (dc)	12V	Apply for 7 seconds each test	FBDC28_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4d - Abnormal Voltage Surge	60VDC	Figure 16-4 - apply at 10 sec intervals	FBDC28_AV SUR

**3.4.2.6 Table A(CF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	22.0V to 30.3V	Apply for 30 mins each test	FZDC28_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	18.0V	Apply for 30 mins each test	FZDC28_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>12</sup>	Ripple Voltage (dc)	Vp-p = 0.6V to 1.6V, Freq = 10Hz to 200Hz	Figure 18-2	FZDC28_VRIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	FZDC28_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	FZDC28_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	50V to 12V		FZDC28_NV SUR
	16.6.1.5	Engine Starting Under Voltage Operation (dc)	10V min	Slew for 35 sec	FZDC28_VENG
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	20.5V to 32.2V	Apply for 5 mins each test	FZDC28_VABN
	16.6.2.3	Momentary Undervoltage (dc)	12V	Apply for 7 seconds each test	FZDC28_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4b - Abnormal Voltage Surge	80VDC	Figure 16-4 - apply at 10 sec intervals	FZDC28_AV SUR

<sup>12</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

**3.4.2.7 Table A(CF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.1b(1)	1 Phs Voltage and Frequency (ac)	200V to 244V, 390Hz to 410Hz	Apply for 30 mins each test	FACF230_VFNORM1P
	16.5.1.1c(1)	3 Phs Voltage and Frequency (ac)	200V to 244V, 390Hz to 410Hz	Apply for 30 mins each test	FACF230_VFNORM3P
16.5.1		Emergency Operating Conditions (ac)			
	16.5.1.1b(2)	1 Phs Voltage and Frequency (ac)	200V to 244V, 360Hz to 440Hz	Apply for 30 mins each test	FACF230_VFEMER1P
	16.5.1.1c(2)	3 Phs Voltage and Frequency (ac)	200V to 244V, 360Hz to 440Hz	Apply for 30 mins each test	FACF230_VFEMER3P
16.5.1		Normal Operating Conditions (ac)			
	16.5.1.2	Voltage Modulation (ac)	Vamp = 0.36V to 2.48V, Mrate = 1Hz to 200Hz	Figure 16-1	FACF230_VMOD
	16.5.1.3	Frequency Modulation (ac)	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	Figure 16-2	FACF230_FMOD
	16.5.1.4b	Momentary Power Interruptions (ac)	Table 16-1	Equipment with Digital Circuits	FACF230_PINTB
	16.5.1.4c	Momentary Power Interruptions (ac)		Other Equipment	FACF230_PINTC
	16.5.1.5	Normal Transients (ac)			
		16.5.1.5.1 - Normal Voltage Surge (ac)	320V to 140V, 400 Hz		FACF230_NV SUR
		16.5.1.5.2 - Normal Frequency Surge (ac)	230V, 350Hz to 400Hz		FACF230_NFSUR
	16.5.1.7	Voltage DC Content (ac)			
		16.5.1.7 - 1 Phs Voltage DC Content (ac)	± 0.2VDC	Apply for 30 mins each test	FACF230_DCOFS1P
		16.5.1.7 - 3 Phs Voltage DC Content (ac)	± 0.2VDC	Apply for 30 mins each test	FACF230_DCOFS3P
	16.5.1.8	Voltage Distortion (ac)	8% +2%/-0% VTHD - Clipped Sine, 400Hz	Apply for 30 mins each test	FACF230_VTHD
16.5.2		Abnormal Operating Conditions (ac)			
	16.5.2.1b	1 Phs Voltage (ac)	194V to 268V, 400Hz	Apply for 5 mins each test	FACF230_VABN1P
	16.5.2.1c	3 Phs Voltage (ac)	194V to 268V, 400Hz	Apply for 5 mins each test	FACF230_VABN3P
	16.5.2.1d	1 Phs Voltage and Frequency (ac)	200V to 244V, 370Hz to 430Hz	Apply for 5 mins each test	FACF230_VFABN1P

	16.5.2.1e	3 Phs Voltage and Frequency (ac)	200V to 244V, 370Hz to 430Hz	Apply for 5 mins each test	FACF230_VFABN3P
	16.5.2.2	Momentary Undervoltage (ac)	20V and 120V, 400Hz	Apply for 7 seconds each test	FACF230_VUND
	16.5.2.3	Abnormal Transients (ac)			
		16.5.2.3.1 - Abnormal Voltage surge	296V to 360V, 400Hz	Figure 16.5 - apply at 10 sec intervals	FACF230_AVSUR
		16.5.2.3.1 - Abnormal Frequency transients	0V to 230V, 320Hz to 480Hz	Figure 16.5 - apply at 10 sec intervals	FACF230_AFSUR

### 3.4.2.8 Table A(CF)115:

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	11.0V to 15.2V	Apply for 30 mins each test	FADC14_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	9.0V	Apply for 30 mins each test	FADC14_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>13</sup>	Ripple Voltage (dc)	Vp-p = 0.3V to .8V, Freq = 10Hz to 200Hz	Figure 18-2	FADC14_VRIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	FADC14_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	FADC14_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	23.5V to 8.5V		FADC14_NV SUR
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	10.3V to 16.1V	Apply for 5 mins each test	FADC14_VABN
	16.6.2.3	Momentary Undervoltage (dc)	6V	Apply for 7 seconds each test	FADC14_VUND
	16.6.2.4	Abnormal Transients (ac)			

<sup>13</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

		16.6.2.4c - Abnormal Voltage Surge	23.2V	Figure 16-4 - apply at 10 sec intervals	FADC14_AVSUR
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### 3.4.2.9 Table A(CF)115:

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	11.0V to 15.2V	Apply for 30 mins each test	FBDC14_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	9.0V	Apply for 30 mins each test	FBDC14_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>14</sup>	Ripple Voltage (dc)	Vp-p = .8V, Freq = 200Hz	Figure 18-2	FBDC14_VRIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	FBDC14_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	FBDC14_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	23.5V to 8.5V		FBDC14_NV SUR
	16.6.1.5	Engine Starting Under Voltage Operation (dc)	5V min	Slew for 35 sec	FBDC14_VENG
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	10.3V to 16.1V	Apply for 5 mins each test	FBDC14_VABN
	16.6.2.2	Low Voltage Conditions (dc)	0V over 10 minutes		FBDC14_LVABN
	16.6.2.3	Momentary Undervoltage (dc)	6V	Apply for 7 seconds each test	FBDC14_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4d - Abnormal Voltage Surge	30VDC	Figure 16-4 - apply at 10 sec intervals	FBDC14_AVSUR

<sup>14</sup> For more comprehensive DC Ripple tests, refer to section 3.3.



**3.4.2.10 Table A(CF)115:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.1b	Voltage (Average Value dc)	11.0V to 15.2V	Apply for 30 mins each test	FZDC14_VAVG
16.6.1		Emergency Operating Conditions (dc)			
	16.6.1.1b(3)	Voltage (Average Value dc)	9.0V	Apply for 30 mins each test	FZDC14_VAVGEMER
16.6.1		Normal Operating Conditions (dc)			
	16.6.1.2 <sup>15</sup>	Ripple Voltage (dc)	Vp-p = 0.3V to .8V, Freq = 10Hz to 200Hz	Figure 18-2	FZDC14_V RIP
	16.6.1.3b	Momentary Power Interruptions (dc)	Table 16-3	Equipment with Digital Circuits	FZDC14_PINTB
	16.6.1.3c	Momentary Power Interruptions (dc)		Other Equipment	FZDC14_PINTC
	16.6.1.4	Normal Transients (dc)			
		16.6.1.4b - Normal Voltage Surge (dc)	25V to 6V		FZDC14_NV SUR
	16.6.1.5	Engine Starting Under Voltage Operation (dc)	5V min	Slew for 35 sec	FZDC14_VENG
16.6.2		Abnormal Operating Conditions (dc)			
	16.6.2.1	Voltage Steady State (dc)	10.3V to 16.1V	Apply for 5 mins each test	FZDC14_VABN
	16.6.2.3	Momentary Undervoltage (dc)	6V	Apply for 7 seconds each test	FZDC14_VUND
	16.6.2.4	Abnormal Transients (ac)			
		16.6.2.4b - Abnormal Voltage Surge	40VDC	Figure 16-4 - apply at 10 sec intervals	FZDC14_AV SUR

<sup>15</sup> For more comprehensive DC Ripple tests, refer to section 3.3.

## 4 Option –B787: Boeing 787B3-0147 Rev A, B, and C Tests

The -B787 option supports Boeing 787B3-0147 revs A, B, and C, Section 3.3, voltage and frequency immunity tests in either of the AC or DC modes (if available).

The –B787 option rev C (currently the most recent revision) is based on the Boeing 787 Electrical Power Quality and Design Requirements Document: Section 3.3 – Electrical Power Characteristics dated October 6 2006.

Future revisions of the Boeing 787B3-0147 directive may be issued over time and updates may be made available to cover any changes in test levels, durations, procedures etc. Furthermore, the –787 option is completely data file driven to allow a large degree of customization by the end-user if needed so many changes can be supported without the need for software updates.

This section of the manual explains the limitations of this test option, the use of special features unique to this option, and gives a complete layout of all tests performed by this option.

This manual is **not** intended to elaborate on the intent or purpose of the immunity tests and the expected behavior of the EUT as described in the Boeing 787B3-0147 documents. It is assumed that the end-user is familiar with the content of the Boeing 787B3-0147 test standard.

### 4.1 Test Coverage

The comprehensiveness of the tests that can be performed with the –787 option is determined primarily by the capabilities of the power source used. Tests that are outside the hardware capabilities of the power source used will not be enabled and cannot be selected. For these tests, additional equipment may be required as indicated.

#### 4.1.1 MX/RS Series –B787 Option Limitations

The extent of coverage of the –787 option as implemented on the MX/RS Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –787 option. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. **Note:** *The MX15 Series power sources are single phase output only and therefore all three phase tests are not available on the MX15.*

No.	Description	115 VAC	235 VAC	No.	28 VDC Tests Description	Type I DC	Type II DC	Type III DC	Type IV DC	Type V DC	Type VI DC
1.1	Individual Phase Voltage	√	√	5.1-4	DC Voltage	√	√	√	√		
1.2	Average of Three Phase Voltages	√	√	5.5.2	Voltage Ripple	P	P	P	P		
1.3	Phase Displacement	√	√	6.1	Voltage Transients	√	√	√	√		
1.4	Phase Voltage Unbalance	√	√	6.2	Voltage Spikes	X	X	X	X		
1.5	Voltage Modulation	√	√	6.3	Multiple Stroke Power Interruptions	√	√	√	√		
1.6.1	Total Harmonic Content	P	P	7.1-4	Abnormal DC Voltage	√	√	√	√		

No.	Description	115 VAC	235 VAC	No.	28 VDC Tests Description	Type I DC	Type II DC	Type III DC	Type IV DC	Type V DC	Type VI DC
1.6.2	Individual Harmonic Content	X	X	8.1	Abnormal Voltage Transients	√	√	√	√		
1.6.3	DC Content	P	P	Supp	Supplementary Transient Tests	√	√	√	√		
1.8	Frequency Modulation	√	√	9.1.1 13.1	Steady State Voltage					√	√
2.1	Voltage Transients	√	√	9.1.2	Steady State Voltage					√	N/A
2.2	Voltage Spikes	X	X	9.2.1	Differential Mode Voltage Ripple					TBD	N/A
2.3.1	Maximum Ramp Rate	√	√	9.2.2 13.3	Differential Mode Ripple Components					X	X
2.3.2	Frequency Transients	√	√	9.3.1 13.2	Common Mode Voltage					TBD	√
2.4	Multiple Stroke Power Interruptions	√	√	9.3.2	Common Mode Frequency					X	N/A
3.1	Abnormal Individual Phase Voltage	√	√	10.1 14.1	Voltage Transients					√	√
3.2	Abnormal Average of Three Phase Voltages	√	√	11.1 15.1	Abnormal Steady State Voltage					√	√
4.1	Abnormal Voltage Transients	√	√	11.2.1	Abnormal Differential Mode Ripple					X	N/A
4.2.1	Abnormal Maximum Ramp Rate	√	√	12.1 16.1	Abnormal Voltage Transients					√	√
4.2.2	Abnormal Frequency Transients	√	√								
4.3	Abnormal DC Content	P	P								
Supp	Supplementary Transient Tests	√	√								

Table 4- 1: -B787 Option MX/RS Test Coverage

**Note** that some AC tests requiring more than 300Vrms output will require the –HV (400 Vrms) optional output range.

#### 4.1.1.1 *Specific Test Limitations and Discrepancies*

While every effort has been made to provide comprehensive coverage of the Boeing 787B3-0147 tests, some limitations apply, largely due to hardware limitations of the AST power source such as available programming resolution or rounding. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Vnom	Test	Std requirement	Actual setting	Reason
115VAC	1.5.1	115 +/- .26 V mod	115 +/- .3 V mod	Resolution
115VAC	1.5.1	115 +/- 1.77 V mod	115 +/- 1.8 V mod	Resolution
115VAC	1.6.2	Audio Frequencies	Test Skipped	Requires Audio Generator
115VAC	2.2	Voltage Spike	Test Skipped	Requires additional equipment
115VAC	2.4	450us dropouts	1ms dropouts	Resolution
115VAC	4.2.2	885 Hz	885Hz	Requires HF option
235VAC	1.5.1	230 +/- .52 V mod	230 +/- .6 V mod	Resolution
235VAC	1.5.1	230 +/- 3.54 V mod	230 +/- 3.6 V mod	Resolution
235VAC	1.6.2	Audio Frequencies	Test Skipped	Requires Audio Generator
235VAC	2.2	Voltage Spike	Test Skipped	Requires additional equipment
235VAC	2.4	450us dropouts	1ms dropouts	Resolution
235VAC	4.1	315 V	315 V	Requires HV option
235VAC	4.2.2	885 Hz	885Hz	Requires HF option
28VDC	5.5.2	Voltage Ripple	Tests up to 5kHz only	Hardware Limit
28VDC	6.1	350us dropout	1ms dropout	Resolution
28VDC	6.2	Voltage Spikes	Test Skipped	Requires additional equipment
28VDC	6.3	450us dropouts	1ms dropout	Resolution

#### 4.1.2 AST Series –B787 Option Limitations

The extent of coverage of the –787 option as implemented on the AST Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –787 option. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. **Note:** *The AST Series power sources model number ending with “1” (eg: AST 751,1501) are single phase output only and therefore all three phase tests are not available on these series.*

No.	Description	115 VAC	235 VAC	No.	28 VDC Tests Description	Type I DC	Type II DC	Type III DC	Type IV DC	Type V DC	Type VI DC
1.1	Individual Phase Voltage	√	√	5.1-4	DC Voltage	√	√	√	√		
1.2	Average of Three Phase Voltages	√	√	5.5.2	Voltage Ripple	P	P	P	P		
1.3	Phase Displacement	√	√	6.1	Voltage Transients	√	√	√	√		
1.4	Phase Voltage Unbalance	√	√	6.2	Voltage Spikes	X	X	X	X		
1.5	Voltage Modulation	√	√	6.3	Multiple Stroke Power Interruptions	√	√	√	√		
1.6.1	Total Harmonic Content	P	P	7.1-4	Abnormal DC Voltage	√	√	√	√		
1.6.2	Individual Harmonic Content	X	X	8.1	Abnormal Voltage Transients	√	√	√	√		
1.6.3	DC Content	P	P	Supp	Supplementary Transient Tests	√	√	√	√		
1.8	Frequency Modulation	√	√	9.1.1 13.1	Steady State Voltage					√	√
2.1	Voltage Transients	√	√	9.1.2	Steady State Voltage					√	N/A
2.2	Voltage Spikes	X	X	9.2.1	Differential Mode Voltage Ripple					TBD	N/A
2.3.1	Maximum Ramp Rate	√	√	9.2.2 13.3	Differential Mode Ripple Components					X	X
2.3.2	Frequency Transients	√	√	9.3.1 13.2	Common Mode Voltage					TBD	√
2.4	Multiple Stroke Power Interruptions	√	√	9.3.2	Common Mode Frequency					X	N/A
3.1	Abnormal Individual Phase Voltage	√	√	10.1 14.1	Voltage Transients					√	√
3.2	Abnormal Average of Three Phase Voltages	√	√	11.1 15.1	Abnormal Steady State Voltage					√	√
4.1	Abnormal Voltage Transients	√	√	11.2.1	Abnormal Differential Mode Ripple					X	N/A
4.2.1	Abnormal Maximum Ramp Rate	√	√	12.1 16.1	Abnormal Voltage Transients					√	√

No.	Description	115 VAC	235 VAC	No.	28 VDC Tests Description	Type I DC	Type II DC	Type III DC	Type IV DC	Type V DC	Type VI DC
4.2.2	Abnormal Frequency Transients	√	√								
4.3	Abnormal DC Content	P	P								
Supp	Supplementary Transient Tests	√	√								

Table 4- 2: -B787 Option AST Test Coverage

**Note** that some AC tests requiring more than 300Vrms output will require the high voltage range to be selected.

#### 4.1.3 i/iX Series –B787 Option Limitations

The extent of coverage of the –787 option as implemented on the iX Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –787 option. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on iX models only. Tests marked with a ‘C’ are available on the Compact iX products only. Tests marked with an “I” are available on the i/iX products only.

No.	Description	115 VAC	235 VAC	No.	28 VDC Tests Description	Type I DC	Type II DC	Type III DC	Type IV DC	Type V DC	Type VI DC
1.1	Individual Phase Voltage	√	C	5.1-4	DC Voltage	√	√	√	√		
1.2	Average of Three Phase Voltages	√	C	5.5.2	Voltage Ripple	I, P	I, P	I, P	I, P		
1.3	Phase Displacement	√	C	6.1	Voltage Transients	√	√	√	√		
1.4	Phase Voltage Unbalance	√	C	6.2	Voltage Spikes	X	X	X	X		
1.5	Voltage Modulation	√	C	6.3	Multiple Stroke Power Interruptions	√	√	√	√		
1.6.1	Total Harmonic Content	P	C, P	7.1-4	Abnormal DC Voltage	√	√	√	√		
1.6.2	Individual Harmonic Content	X	X	8.1	Abnormal Voltage Transients	√	√	√	√		
1.6.3	DC Content	P	C, P	Supp	Supplementary Transient Tests	√	√	√	√		
1.8	Frequency Modulation	√	C	9.1.1 13.1	Steady State Voltage					√	√
2.1	Voltage Transients	√	C	9.1.2	Steady State Voltage					√	N/A
2.2	Voltage Spikes	X	X	9.2.1	Differential Mode Voltage Ripple					TBD	N/A
2.3.1	Maximum Ramp Rate	√	C	9.2.2 13.3	Differential Mode Ripple Components					X	X
2.3.2	Frequency Transients	√	C	9.3.1 13.2	Common Mode Voltage					TBD	√

No.	Description	115 VAC	235 VAC	No.	28 VDC Tests Description	Type I DC	Type II DC	Type III DC	Type IV DC	Type V DC	Type VI DC
2.4	Multiple Stroke Power Interruptions	√	C	9.3.2	Common Mode Frequency					X	N/A
3.1	Abnormal Individual Phase Voltage	√	C	10.1 14.1	Voltage Transients					√	√
3.2	Abnormal Average of Three Phase Voltages	√	C	11.1 15.1	Abnormal Steady State Voltage					√	√
4.1	Abnormal Voltage Transients	√	C	11.2.1	Abnormal Differential Mode Ripple					X	N/A
4.2.1	Abnormal Maximum Ramp Rate	√	C	12.1 16.1	Abnormal Voltage Transients					√	√
4.2.2	Abnormal Frequency Transients	C	C								
4.3	Abnormal DC Content	P	C, P								
Supp	Supplementary Transient Tests	√	C								

Table 4- 3: -B787 Option i/iX Test Coverage

**Note** that the iX Series does not support 800 Hz testing at more than 150Vrms. Consequently, all 230V nominal tests for A(NF) and A(WF) categories are not supported. Some A(CF) tests requiring more than 300V output are also unavailable due to hardware limitations of the iX Series power source.

#### 4.1.3.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Boeing 787B3-0147 tests, some limitations apply, largely due to hardware limitations of the iX power source such as available programming resolution or rounding. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Vnom	Test	Std requirement	Actual setting	Reason
115VAC	1.5.1	115 +/- .26 V mod	115 +/- .3 V mod	Resolution
115VAC	1.5.1	115 +/- 1.77 V mod	115 +/- 1.8 V mod	Resolution
115VAC	1.6.2	Audio Frequencies	Test Skipped	Requires Audio Generator
115VAC	2.2	Voltage Spike	Test Skipped	Requires additional equipment
115VAC	2.4	450us dropouts	1ms dropouts	Resolution
235VAC	1.5.1	230 +/- .52 V mod	230 +/- .6 V mod	Resolution
235VAC	1.5.1	230 +/- 3.54 V mod	230 +/- 3.6 V mod	Resolution
235VAC	1.6.2	Audio Frequencies	Test Skipped	Requires Audio Generator
235VAC	2.2	Voltage Spike	Test Skipped	Requires additional equipment
235VAC	2.4	450us dropouts	1ms dropouts	Resolution
235VAC	4.1	315 V	300 V	Voltage limit
28VDC	5.5.2	Voltage Ripple	Test Skipped	Requires additional equipment
28VDC	6.1	350us dropout	1ms dropout	Resolution
28VDC	6.2	Voltage Spikes	Test Skipped	Requires additional equipment
28VDC	6.3	450us dropout	1ms dropout	Resolution
+/- 270VDC	All	Requires +/-300VDC+	+/- 300VDC+	Requires Series II controller (iX only)



#### 4.1.4 Lx/Ls –B787 Option Series Limitations

The extent of coverage of the –787 option as implemented on the Lx/Ls Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –787 option. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Lx models or Ls models with the –ADV option only. Note that some voltage surge tests may require optional output voltage ranges on the Lx/Ls and may not be supported on the standard voltage range.

***DC tests are NOT supported by the Lx/Ls Series***

No.	Description	115 VAC	235 VAC	No.	Description	115 VAC	235 VAC
1.1	Individual Phase Voltage	√	√	2.2	Voltage Spikes	X	X
1.2	Average of Three Phase Voltages	√	√	2.3.1	Frequency Transients	√	√
1.3	Phase Displacement	√	√	2.4	Multiple Stroke Power Interruptions	√	√
1.4	Phase Voltage Unbalance	√	√	3.1	Abnormal Individual Phase Voltage	√	√
1.5.1	Voltage Modulation	√	√	3.2	Abnormal Average of Three Phase Voltages	√	√
1.6.1	Total Harmonic Content	P	P	4.1	Abnormal Voltage Transients	√	√
1.6.2	Individual Harmonic Content	X	X	4.2.1	Abnormal Frequency Transients	√	√
1.6.3	DC Content	X	X	4.2.2	Abnormal Frequency Transients	√	√
1.8	Frequency Modulation	√	√	4.3	DC Content	X	X
2.1	Voltage Transients	√	√	Supp	Supplementary Transient Tests	√	√

Table 4- 4: -B787 Option Ls/Lx Test Coverage

#### 4.1.4.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Boeing 787B3-0147 tests, some limitations apply, largely due to hardware limitations of the Lx power source such as available programming resolution or rounding. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

#### ***DC tests are NOT supported by the Lx/Ls Series***

Vnom	Test	Std requirement	Actual setting	Reason
115VAC	1.5.1	115 +/- .26 V mod	115 +/- .3 V mod	Resolution
115VAC	1.5.1	115 +/- 1.77 V mod	115 +/- 1.8 V mod	Resolution
115VAC	1.6.2	Audio Frequencies	Test Skipped	Requires Audio Generator
115VAC	2.2	Voltage Spike	Test Skipped	Requires additional equipment
115VAC	2.4	450us dropouts	1ms dropouts	Resolution
235VAC	1.5.1	230 +/- .52 V mod	230 +/- .6 V mod	Resolution
235VAC	1.5.1	230 +/- 3.54 V mod	230 +/- 3.6 V mod	Resolution
235VAC	1.6.2	Audio Frequencies	Test Skipped	Requires Audio Generator
235VAC	2.2	Voltage Spike	Test Skipped	Requires additional equipment
235VAC	2.4	450us dropouts	1ms dropouts	Resolution
235VAC	4.1	315 V	315 V	Requires EHV option

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## 4.2 –B787 Power Groups

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The following twelve power groups are covered in the Boeing 787B3-0147 directive:

Category reference:

- For ac equipment: 115V L-N, 235V L-N
- For dc equipment: Type 1 through Type 5, and Type 6 for Rev B and C

Definitions:

**AC Power Sources:** Variable frequency primary AC power will be supplied by either a 230V L-N (400V L-L) or 115V L-N (200V L-L) nominal, 360-800 Hz nominal, three-phase, four wire, Y (wye) connected system. The neutral of the system is connected to the current return network and the current return network is considered to be the fourth wire. Phase rotation is in the order A, B, C. The current return network is also referred to as the airplane electrical power return and grounding protection path.

Variable frequency single-phase AC power is obtained by connection to any one line and the current return network.

This system includes multiple, engine driven power-generation channels. The output characteristics of these individual electric power channels will remain within the limits specified herein, but will not necessarily be identical.

**Ground Handling Equipment:** Ground Handling Equipment has a constant frequency and these tests are kept separate from the variable frequency AC tests.

**Type I DC Power:** Type I DC power will be supplied by a 28 volt (nominal), two-wire, Transformer Rectifier Unit (TRU) powered by the primary AC system, without battery backup. The negative terminal of the TRU is connected to the current return network and the current return network is considered to be the second wire.

**Type II DC Power:** Type II DC power normally will be supplied by the Type I DC power sources. A 24 volt (nominal) storage battery system will be an alternative backup source of Type II DC power.

**Type III DC Power:** Type III DC power will be supplied by a 24 volt (nominal) storage battery system with backup by a battery charger.

**Type IV DC Power:** Type IV DC power will normally be supplied by a 28 volt (nominal) converter regulator (Power Supply Assembly) powered by dedicated Permanent Magnet Generators (PMGs) on one or more engines. Backup sources of power for the converter regulator include: Type I DC power, the standby system main battery and the RAM air turbine generator.

Type IV DC power is provided exclusively for the Fly-By-Wire flight control system and dependent equipment.

**Type V High Voltage DC Power:** Type V High Voltage DC (HVDC) power will be a +/-270 volt (nominal) system supplied by a two-wire, Auto-Transformer Rectifier Unit (ATRU) system powered by a variable frequency 230V L-N (400V L-L) nominal primary AC system.

The voltage of the two output terminals of this system with respect to ground will be +270 and -270 volts respectively. All +/-270 volt equipment shall be connected between the +270 and -270 volt terminals.

Note: The Type V HVDC system nominal voltage has been initially defined at +/-270V. The nominal voltage may change by as much as +/-20V.

**Type VI High Voltage DC Power:** Type VI DC power will be a +/-130 volt (nominal) system supplied by a two-wire, Electric Brake Power Supply Unit (EBPSU) system powered by either the Type I DC or Type III DC power system.

The voltage of the two output terminals of this system with respect to the current return network will be +130 and -130 respectively. All +/-130 volt equipment shall be connected between the +130 and -130 volt terminals.

Type VI DC power is provided exclusively for the landing gear electric braking system.

### 4.3 –B787 Option Special Features

DC ripple tests for 28VDC EUT's are provided through a separate control screen. This is required to extend the range of the ripple frequency to 5000 Hz. The actual requirement for 787 Rev C is testing up to 150 KHz ripple. This is out of the available range of the power source. To test to the full 150 KHz range, an external audio generator and coupling transformer as outlined in 787B3-0147, Figure 18 is required.

The B787 DC Ripple test screen is available from the main screen, **Applications, Boeing, DC Ripple Test** menu. Once selected, the DC ripple test control screen is modal and must be closed before any other tests can be run. Opening this screen requires several seconds as the power source is being set up to perform the DC ripple tests. This screen also places the power source in AC+DC mode. **Note:** *This feature is not available on the Compact iX or Ls/Lx Series power sources.*

Available test settings are phase/output selection. For single-phase systems, only phase A can be selected. The test pattern is fixed per section B.5.5.2 with a ripple frequency range from 16 Hz to 5000 Hz per Figure 7. The frequency slew rate is 30 minutes for each decade covered or one hour and 15 minutes total. Tests can be aborted sooner if needed.

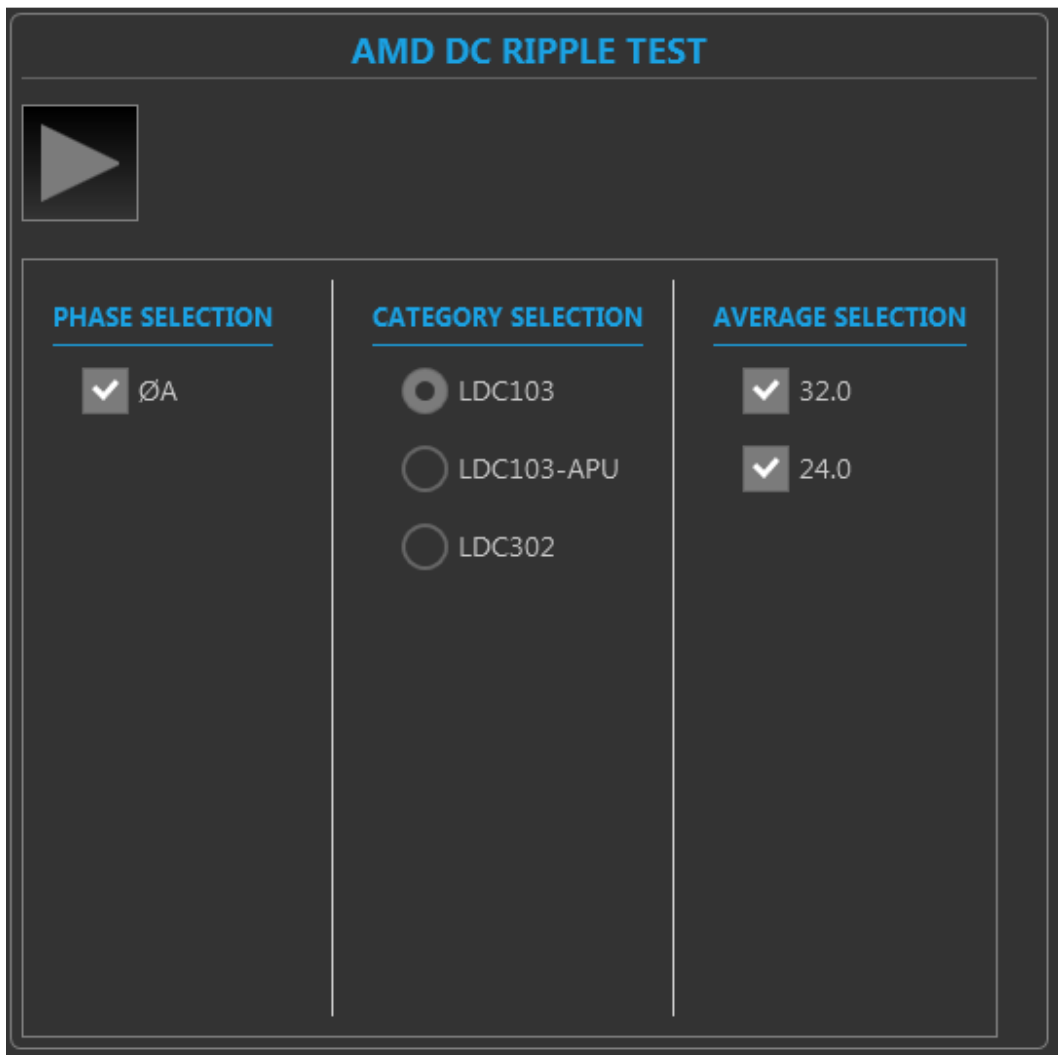


Figure 4- 1: B787 DC Ripple Test Window.

#### 4.3.1.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Boeing 787B3-0147 tests, some limitations apply, largely due to hardware limitations of the Lx power source such as available programming resolution or rounding. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

#### ***DC tests are NOT supported by the Lx/Ls Series***

Vnom	Test	Std requirement	Actual setting	Reason
115VAC	1.5.1	115 +/- .26 V mod	115 +/- .3 V mod	Resolution
115VAC	1.5.1	115 +/- 1.77 V mod	115 +/- 1.8 V mod	Resolution
115VAC	1.6.2	Audio Frequencies	Test Skipped	Requires Audio Generator
115VAC	2.2	Voltage Spike	Test Skipped	Requires additional equipment
115VAC	2.4	450us dropouts	1ms dropouts	Resolution
235VAC	1.5.1	230 +/- .52 V mod	230 +/- .6 V mod	Resolution
235VAC	1.5.1	230 +/- 3.54 V mod	230 +/- 3.6 V mod	Resolution
235VAC	1.6.2	Audio Frequencies	Test Skipped	Requires Audio Generator
235VAC	2.2	Voltage Spike	Test Skipped	Requires additional equipment
235VAC	2.4	450us dropouts	1ms dropouts	Resolution
235VAC	4.1	315 V	315 V	Requires EHV option

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## 4.4 –B787 Power Groups

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The following twelve power groups are covered in the Boeing 787B3-0147 directive:

Category reference:

- For ac equipment: 115V L-N, 235V L-N
- For dc equipment: Type 1 through Type 5, and Type 6 for Rev B and C

Definitions:

**AC Power Sources:** Variable frequency primary AC power will be supplied by either a 230V L-N (400V L-L) or 115V L-N (200V L-L) nominal, 360-800 Hz nominal, three-phase, four wire, Y (wye) connected system. The neutral of the system is connected to the current return network and the current return network is considered to be the fourth wire. Phase rotation is in the order A, B, C. The current return network is also referred to as the airplane electrical power return and grounding protection path.

Variable frequency single-phase AC power is obtained by connection to any one line and the current return network.

This system includes multiple, engine driven power-generation channels. The output characteristics of these individual electric power channels will remain within the limits specified herein, but will not necessarily be identical.

**Ground Handling Equipment:** Ground Handling Equipment has a constant frequency and these tests are kept separate from the variable frequency AC tests.

**Type I DC Power:** Type I DC power will be supplied by a 28 volt (nominal), two-wire, Transformer Rectifier Unit (TRU) powered by the primary AC system, without battery backup. The negative terminal of the TRU is connected to the current return network and the current return network is considered to be the second wire.

**Type II DC Power:** Type II DC power normally will be supplied by the Type I DC power sources. A 24 volt (nominal) storage battery system will be an alternative backup source of Type II DC power.

**Type III DC Power:** Type III DC power will be supplied by a 24 volt (nominal) storage battery system with backup by a battery charger.

**Type IV DC Power:** Type IV DC power will normally be supplied by a 28 volt (nominal) converter regulator (Power Supply Assembly) powered by dedicated Permanent Magnet Generators (PMGs) on one or more engines. Backup sources of power for the converter regulator include: Type I DC power, the standby system main battery and the RAM air turbine generator.

Type IV DC power is provided exclusively for the Fly-By-Wire flight control system and dependent equipment.

**Type V High Voltage DC Power:** Type V High Voltage DC (HVDC) power will be a +/-270 volt (nominal) system supplied by a two-wire, Auto-Transformer Rectifier Unit (ATRU) system powered by a variable frequency 230V L-N (400V L-L) nominal primary AC system.

The voltage of the two output terminals of this system with respect to ground will be +270 and -270 volts respectively. All +/-270 volt equipment shall be connected between the +270 and -270 volt terminals.

Note: The Type V HVDC system nominal voltage has been initially defined at +/-270V. The nominal voltage may change by as much as +/-20V.

**Type VI High Voltage DC Power:** Type VI DC power will be a +/-130 volt (nominal) system supplied by a two-wire, Electric Brake Power Supply Unit (EBPSU) system powered by either the Type I DC or Type III DC power system.

The voltage of the two output terminals of this system with respect to the current return network will be +130 and -130 respectively. All +/-130 volt equipment shall be connected between the +130 and -130 volt terminals.

Type VI DC power is provided exclusively for the landing gear electric braking system.



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## 4.5 –B787 Option Special Features

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DC ripple tests for 28VDC EUT's are provided through a separate control screen. This is required to extend the range of the ripple frequency to 5000 Hz. The actual requirement for 787 Rev C is testing up to 150 KHz ripple. This is out of the available range of the power source. To test to the full 150 KHz range, an external audio generator and coupling transformer as outlined in 787B3-0147, Figure 18 is required.

The B787 DC Ripple test screen is available from the main screen, **Applications, Boeing, DC Ripple Test** menu. Once selected, the DC ripple test control screen is modal and must be closed before any other tests can be run. Opening this screen requires several seconds as the power source is being set up to perform the DC ripple tests. This screen also places the power source in AC+DC mode. **Note:** *This feature is not available on the Compact iX or Ls/Lx Series power sources.*

Available test settings are phase/output selection. For single-phase systems, only phase A can be selected. The test pattern is fixed per section B.5.5.2 with a ripple frequency range from 16 Hz to 5000 Hz per Figure 7. The frequency slew rate is 30 minutes for each decade covered or one hour and 15 minutes total. Tests can be aborted sooner if needed.

**Note:** DC Ripple Test not yet implemented in Virtual Panel GUI.

*Figure 4-1: B787 DC Ripple Test Window.*

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## 4.6 Test Tables

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The tables shown on the next few pages list the test sections covered by the –787 option. Where relevant, the numbering used matches that of the Boeing 787B3-0147 document. Test tables are listed by power group

**4.6.1 Rev C:****4.6.1.1 115VAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	100.0 to 122.0 Volts RMS	30 mins, 800Hz and 360Hz	LVAC-11
	1.2	Average of Three-Phase Voltages	101.5 to 120.5 Volts RMS	30 mins, 800Hz and 360Hz	LVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	No specified test	
	1.4	Phase Voltage Unbalance	Max. 6.0 Volts RMS	Apply each test 30 mins	LVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	5.0 Volts Peak-to-Valley	Follows specification Figure 1	LVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	LVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.20 Volts (after first cycle)	30 mins each test	LVAC-16-3
	1.6.4	Crest Factor	1.41 +/- 0.15	No specified test	
	1.7	Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation		Applies to Ground Handling Equip only	
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	800Hz and 360Hz	LVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 800Hz and 360Hz	LVAC-21-2
	2.1	Voltage Transients	Per Table 3.3.2-6	2 times each	LVAC-21-3
	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3.1	Frequency Variations - Max Ramp Rate	100Hz/s up, 200Hz/s down	3 times each, 360Hz nominal	LVAC-23

	2.3.2	Frequency Variations - Frequency Transients		Applies to Ground Handling Equip only	
	2.4	Multiple Stroke Power Interruptions	450us interrupts (actual 1ms)		LVAC-24
3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	90.0 to 134.0 Volts RMS	Single Phase Unit Test	LVAC-31
	3.2	Average of Three-Phase Voltages	91.5 to 132.5 Volts RMS	5 mins each test	LVAC-32-1
	3.2	Average of Three-Phase Voltages	90.0 to 134.0 Volts RMS	Three Phase Unit Test	LVAC-32-2
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	LVAC-41
	4.2	Frequency Variations			
	4.2.1	Maximum Ramp Rate	120Hz/s up, 400Hz/s down	3 times each, 360Hz nominal	LVAC-42-1
	4.2.2	Frequency Transients	350 to 885 Hz	3 times each, 400Hz nominal	LVAC-42-2
	4.3	DC Content	+/- 55VDC offset	800Hz and 360Hz	LVAC-43
SUPP		Supplementary Transient Test Requirements	Tests 1-7, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 8-14, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 15-20, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 21-27, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 28-34, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 35-40, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 41-47, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 48-53, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 54-62, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-9
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-10
SUPP		Supplementary Transient Test Requirements	Tests 1-6 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	LSUPP-11

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SUPP		Supplementary Transient Test Requirements	Tests 7-12 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	LSUPP-12
SUPP		Supplementary Transient Test Requirements	Tests 13-18 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	LSUPP-13
SUPP		Supplementary Transient Test Requirements	Test 19 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	LSUPP-14

**4.6.1.2 115VAC for Ground Handling Equipment:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	100.0 to 122.0 Volts RMS	30 mins, 441Hz and 360Hz	GHLVAC-11
	1.2	Average of Three-Phase Voltages	101.5 to 120.5 Volts RMS	30 mins, 441Hz and 360Hz	GHLVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	No specified test	
	1.4	Phase Voltage Unbalance	Max. 6.0 Volts RMS	Apply each test 30 mins	GHLVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	5.0 Volts Peak-to-Valley	Follows specification Figure 1	GHLVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	GHLVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.20 Volts (after first cycle)	30 mins each test	GHLVAC-16-3
	1.6.4	Crest Factor	1.41 +/- 0.15	No specified test	
	1.7	Steady State Frequency (see Designer Notes)	360 to 441 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation		Applies to Ground Handling Equip only	GHLVAC-18
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	441Hz and 360Hz	GHLVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 441Hz and 360Hz	GHLVAC-21-2
	2.1	Voltage Transients	Per Table 3.3.2-6	2 times each	GHLVAC-21-3
	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3.1	Frequency Variations - Max Ramp Rate	100Hz/s up, 200Hz/s down	N/A for GHE	
	2.3.2	Frequency Variations - Frequency Transients		Applies to Ground Handling Equip only	GHLVAC-23

	2.4	Multiple Stroke Power Interruptions	450us interrupts (actual 1ms)		GHLVAC-24
3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	90.0 to 134.0 Volts RMS	Single Phase Unit Test	GHLVAC-31
	3.2	Average of Three-Phase Voltages	91.5 to 132.5 Volts RMS	5 mins each test	GHLVAC-32-1
	3.2	Average of Three-Phase Voltages	90.0 to 134.0 Volts RMS	Three Phase Unit Test	GHLVAC-32-2
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 441 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	GHLVAC-41
	4.2	Frequency Transients			
	4.2.1	Maximum Ramp Rate	120Hz/s up, 400Hz/s down	N/A for GHE	
	4.2.2	Frequency Transients	350 to 480 Hz	3 times each, 400Hz nominal	GHLVAC-42-2
	4.3	DC Content	+/- 55VDC offset	441Hz and 360Hz	GHLVAC-43
SUPP		Supplementary Transient Test Requirements	Tests 1-10, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 11-20, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 21-30, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 31-40, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 41-50, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 51-62, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 1-11 Table 3.3.2-3B	Tests performed at 360 and 441 Hz	GHLSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 12-19 Table 3.3.2-3B	Tests performed at 360 and 441 Hz	GHLSUPP-9

**4.6.1.3 235VAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	190.0 to 244.0 Volts RMS	30 mins, 800Hz and 360Hz	HVAC-11
	1.2	Average of Three-Phase Voltages	193.0 to 241.0 Volts RMS	30 mins, 800Hz and 360Hz	HVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	No specified test	
	1.4	Phase Voltage Unbalance	Max. 12.0 Volts RMS	Apply each test 30 mins	HVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	10.0 Volts Peak-to-Valley	Follows specification Figure 1	HVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	HVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.20 Volts (after first cycle)	30 mins each test	HVAC-16-2
	1.6.4	Crest Factor	1.41 +/- 0.15	No specified test	
	1.7	Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation		Applies to Ground Handling Equip only	
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	800Hz and 360Hz	HVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 800Hz and 360Hz	HVAC-21-2
	2.1	Voltage Transients	Per Table 3.3.2-6	2 times each	HVAC-21-3
	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3.1	Frequency Variations - Max Ramp Rate	100Hz/s up, 200Hz/s down	3 times each, 360Hz nominal	HVAC-23
	2.3.2	Frequency Variations - Frequency Transients		Applies to Ground Handling Equip only	

3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	190.0 to 268.0 Volts RMS	Single Phase Unit Test	HVAC-31-1
	3.1	Average of Three-Phase Voltages	193.0 to 265.0 Volts RMS	5 mins each test	HVAC-31-2
	3.2	Average of Three-Phase Voltages	190.0 to 268.0 Volts RMS	Three Phase Unit Test	HVAC-32
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	HVAC-41
	4.2	Frequency Variations			
	4.2.1	Maximum Ramp Rate	120Hz/s up, 400Hz/s down	3 times each, 360Hz nominal	HVAC-42-1
	4.2.2	Frequency Transients	350 to 885 Hz	3 times each, 400Hz nominal	HVAC-42-2
	4.3	DC Content	+/- 15VDC offset	800Hz and 360Hz	HVAC-43
SUPP		Supplementary Transient Test Requirements	Tests 1-7, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 8-14, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 15-20, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 21-27, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 28-34, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 35-40, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 41-47, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 48-53, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 54-62, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-9
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-10
SUPP		Supplementary Transient Test Requirements	Tests 1-6 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	HSUPP-11
SUPP		Supplementary Transient Test Requirements	Tests 7-12 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	HSUPP-12
SUPP		Supplementary Transient Test Requirements	Tests 13-18 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	HSUPP-13



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SUPP		Supplementary Transient Test Requirements	Test 19 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	HSUPP-14
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**4.6.1.4 235VAC for Ground Handling Equipment:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	190.0 to 244.0 Volts RMS	30 mins, 441Hz and 360Hz	GHHVAC-11
	1.2	Average of Three-Phase Voltages	193.0 to 241.0 Volts RMS	30 mins, 441Hz and 360Hz	GHHVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	No specified test	
	1.4	Phase Voltage Unbalance	Max. 12.0 Volts RMS	Apply each test 30 mins	GHHVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	10.0 Volts Peak-to-Valley	Follows specification Figure 1	GHHVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	GHHVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.20 Volts (after first cycle)	30 mins each test	GHHVAC-16-3
	1.6.4	Crest Factor	1.41 +/- 0.15	No specified test	
	1.7	Steady State Frequency (see Designer Notes)	360 to 441 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation		Applies to Ground Handling Equip only	
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	441Hz and 360Hz	GHHVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 441Hz and 360Hz	GHHVAC-21-2
	2.1	Voltage Transients	Per Table 3.3.2-6	2 times each	GHHVAC-21-3
	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3.1	Frequency Variations - Max Ramp Rate	100Hz/s up, 200Hz/s down	N/A for GHE	
	2.3.2	Frequency Variations - Frequency Transients		Applies to Ground Handling Equip only	GHHVAC-23

3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	190.0 to 268.0 Volts RMS	Single Phase Unit Test	GHHVAC-31
	3.2	Average of Three-Phase Voltages	193.0 to 265.0 Volts RMS	5 mins each test	GHHVAC-32-1
	3.2	Average of Three-Phase Voltages	190.0 to 268.0 Volts RMS	Three Phase Unit Test	GHHVAC-32-2
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 441 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	GHHVAC-41
	4.2	Frequency Transients			
	4.2.1	Maximum Ramp Rate	120Hz/s up, 400Hz/s down	N/A for GHE	
	4.2.2	Transients Outside of Steady State Range	350 to 480 Hz	3 times each, 400Hz nominal	GHHVAC-42-2
	4.3	DC Content	+/- 30VDC offset	441Hz and 360Hz	GHHVAC-43
SUPP		Supplementary Transient Test Requirements	Tests 1-10, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 11-20, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 21-30, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 31-40, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 41-50, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 51-62, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 1-11 Table 3.3.2-3B	Tests performed at 360 and 441 Hz	GHHSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 12-19 Table 3.3.2-3B	Tests performed at 360 and 441 Hz	GHHSUPP-9

**4.6.1.5 Type I DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.1	Type 1 DC Voltage	22.0 to 32.8 Volts		TYPE1-51
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Requirement fulfilled in 5.5.2	
	5.5.2	Ripple Components	Per Figure 7	Use B787 DC ripple window to perform	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE1-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
	6.3	Multiple Stroke Power Interrupts	450us dropouts (actual 1ms)		TYPE1-63
7.0		Abnormal DC Steady State			
	7.1	Type 1 DC Voltage	20.5 to 35.5 Volts		TYPE1-71
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE1-81
SUPP		Supplementary Transient Test Requirements	Tests 1-23, Table 3.3.3-3A		DC1SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 24-46, Table 3.3.3-3A		DC1SUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 47-67, Table 3.3.3-3A		DC1SUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 1-19, Table 3.3.3-3B		DC1SUPP-4

**4.6.1.6 Type II DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.2	Type 2 DC Voltage	22.0 to 32.8 Volts		TYPE2-52
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Requirement fulfilled in 5.5.2	
	5.5.2	Ripple Components	Per Figure 7	Use B787 DC ripple window to perform	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE2-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
	6.3	Multiple Stroke Power Interrupts	450us dropouts (actual 1ms)		TYPE2-63
7.0		Abnormal DC Steady State			
	7.2	Type 2 DC Voltage	18.0 to 35.5 Volts		TYPE2-72
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE2-81
SUPP		Supplementary Transient Test Requirements	Tests 1-23, Table 3.3.3-3A		DC2SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 24-46, Table 3.3.3-3A		DC2SUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 47-66, Table 3.3.3-3A		DC2SUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 1-19, Table 3.3.3-3B		DC2SUPP-4

**4.6.1.7 Type III DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.3	Type 3 DC Voltage	22.0 to 32.8 Volts		TYPE3-53
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Requirement fulfilled in 5.5.2	
	5.5.2	Ripple Components	Per Figure 7	Use B787 DC ripple window to perform	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE3-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
	6.3	Multiple Stroke Power Interrupts	450us dropouts (actual 1ms)		TYPE3-63
7.0		Abnormal DC Steady State			
	7.3	Type 3 DC Voltage	18.0 to 32.8 Volts		TYPE3-73
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE3-81
SUPP		Supplementary Transient Test Requirements	Tests 1-65, Table 3.3.3-3A		DC3SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 1-19, Table 3.3.3-3B		DC3SUPP-2

**4.6.1.8 Type IV DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.4	Type 4 DC Voltage	18.0 to 32.8 Volts		TYPE4-54
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Requirement fulfilled in 5.5.2	
	5.5.2	Ripple Components	Per Figure 7	Use B787 DC ripple window to perform	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE4-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
	6.3	Multiple Stroke Power Interrupts	450us dropouts (actual 1ms)		TYPE4-63
7.0		Abnormal DC Steady State			
	7.4	Type 4 DC Voltage	18.0 to 35.5 Volts		TYPE4-74
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE4-81
SUPP		Supplementary Transient Test Requirements	Tests 1-79, Table 3.3.3-3A		DC4SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 1-19, Table 3.3.3-3B		DC4SUPP-2

**4.6.1.9 Type V DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
9.0		Normal DC Steady State			
	9.1	Normal Steady-State Voltage			
		Engine Start with Forward EP Source	+/-230.0 Volts	Apply for 15 min	TYPE5-91-1
		All Other Operating Modes	+/-250.0 to +/-320.0 Volts	Apply for 30 min each	TYPE5-91-2
	9.2	Voltage Ripple			
	9.2.1	Differential Mode Ripple Maximum Amplitude	32.0 Volts Peak to Peak	Ripple Frequency Not Specified	
	9.2.2	Differential Mode Ripple Components	Per Figure 13	Requires Additional Equipment	
	9.3	Common Mode Voltage			
	9.3.1	Common Mode Maximum Amplitude	62.0 Volts Peak to Peak	Ripple Frequency Not Specified	
	9.3.2	Common Mode Frequency Components	Per Figure 14	Requires Additional Equipment	
10.0		Normal DC Transients			
	10.1	Voltage Transients	Per Figures 15A and 15B		TYPE5-101
11.0		Abnormal DC Steady State	Per Figures 9A through 9D		
	11.1	Steady State Voltage	+/-240.0 to +/-356.0 VDC		TYPE5-111
	11.2	Voltage Ripple			
	11.2.1	Maximum Amplitude	120 Volts Peak to Peak	Ripple Frequency Not Specified	
12.0		Abnormal DC Transients			
	12.1	Voltage Transients	Per Figure 16		TYPE5-121



**4.6.1.10 Type VI DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
13.0		Normal DC Steady State			
	13.1	Normal Steady-State Voltage	+/-120.0 to +/-140.0 Volts	Apply for 30 min each	TYPE6-131
	13.2	Common Mode Voltage	1.25 Volts	Apply for 30 min	TYPE6-132
	13.3	Differential Mode Voltage - Max Amplitude	2.0 Volts Peak to Peak	Requires Additional Equipment	
	13.4	Differential Mode Voltage - Max Ripple Components	40kHz - 120kHz	Requires Additional Equipment	
14.0		Normal DC Transients			
	14.1	Voltage Transients	Per Figure 30		TYPE6-141
15.0		Abnormal DC Steady-State			
	15.1	Steady State Voltage	+/-120.0 to +/-140.0 Volts	Requirement fulfilled in 13.1	
16.0		Abnormal DC Transients			
	16.1	Voltage Transients	Per Figure 31		TYPE6-161

**4.6.2 Rev B:****4.6.2.1 115VAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	100.0 to 122.0 Volts RMS	30 mins, 800Hz and 360Hz	LVAC-11
	1.2	Average of Three-Phase Voltages	101.5 to 120.5 Volts RMS	30 mins, 800Hz and 360Hz	LVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	No specified test	
	1.4	Phase Voltage Unbalance	Max. 6.0 Volts RMS	Apply each test 30 mins	LVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	5.0 Volts Peak-to-Valley	Follows specification Figure 1	LVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	LVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.10 Volts (after first cycle)	30 mins each test	LVAC-16-3
	1.6.4	Crest Factor	1.41 +/- 0.15	No specified test	
	1.7	Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation		Applies to Ground Handling Equip only	
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	800Hz and 360Hz	LVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 800Hz and 360Hz	LVAC-21-2
	2.1	Voltage Transients	Per Table B.2.1.1.1	2 times each	LVAC-21-3
	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3.1	Frequency Variations - Max Ramp Rate	100Hz/s up, 200Hz/s down	3 times each, 360Hz nominal	LVAC-23

	2.3.2	Frequency Variations - Frequency Transients		Applies to Ground Handling Equip only	
3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	90.0 to 134.0 Volts RMS	Single Phase Unit Test	LVAC-31
	3.2	Average of Three-Phase Voltages	91.5 to 132.5 Volts RMS	5 mins each test	LVAC-32-1
	3.2	Average of Three-Phase Voltages	90.0 to 134.0 Volts RMS	Three Phase Unit Test	LVAC-32-2
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	LVAC-41
	4.2	Frequency Transients			
	4.2.1	Maximum Ramp Rate	120Hz/s up, 400Hz/s down	3 times each, 360Hz nominal	LVAC-42-1
	4.2.2	Frequency Transients	350 to 885 Hz	3 times each, 400Hz nominal	LVAC-42-2
	4.3	DC Content	+/- 15VDC offset	800Hz and 360Hz	LVAC-43
SUPP		Supplementary Transient Test Requirements	Tests 1-7, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 8-14, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 15-20, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 21-27, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 28-34, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 35-40, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 41-47, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 48-53, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 54-62, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-9
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	LSUPP-10
SUPP		Supplementary Transient Test Requirements	Tests 1-6 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	LSUPP-11
SUPP		Supplementary Transient Test Requirements	Tests 7-12 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	LSUPP-12

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SUPP		Supplementary Transient Test Requirements	Tests 13-18 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	LSUPP-13
SUPP		Supplementary Transient Test Requirements	Test 19 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	LSUPP-14

**4.6.2.2 115VAC for Ground Handling Equipment:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	100.0 to 122.0 Volts RMS	30 mins, 441Hz and 360Hz	GHLVAC-11
	1.2	Average of Three-Phase Voltages	101.5 to 120.5 Volts RMS	30 mins, 441Hz and 360Hz	GHLVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	No specified test	
	1.4	Phase Voltage Unbalance	Max. 6.0 Volts RMS	Apply each test 30 mins	GHLVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	5.0 Volts Peak-to-Valley	Follows specification Figure 1	GHLVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	GHLVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.10 Volts (after first cycle)	30 mins each test	GHLVAC-16-3
	1.6.4	Crest Factor	1.41 +/- 0.15	No specified test	
	1.7	Steady State Frequency (see Designer Notes)	360 to 441 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation		Applies to Ground Handling Equip only	GHLVAC-18
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	441Hz and 360Hz	GHLVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 441Hz and 360Hz	GHLVAC-21-2
	2.1	Voltage Transients	Per Table B.2.1.1.1	2 times each	GHLVAC-21-3
	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3.1	Frequency Variations - Max Ramp Rate	100Hz/s up, 200Hz/s down	N/A for GHE	
	2.3.2	Frequency Variations - Frequency Transients		Applies to Ground Handling Equip only	GHLVAC-23

3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	90.0 to 134.0 Volts RMS	Single Phase Unit Test	GHLVAC-31
	3.2	Average of Three-Phase Voltages	91.5 to 132.5 Volts RMS	5 mins each test	GHLVAC-32-1
	3.2	Average of Three-Phase Voltages	90.0 to 134.0 Volts RMS	Three Phase Unit Test	GHLVAC-32-2
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 441 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	GHLVAC-41
	4.2	Frequency Transients			
	4.2.1	Maximum Ramp Rate	120Hz/s up, 400Hz/s down	N/A for GHE	
	4.2.2	Frequency Transients	350 to 480 Hz	3 times each, 400Hz nominal	GHLVAC-42-2
	4.3	DC Content	+/- 15VDC offset	441Hz and 360Hz	GHLVAC-43
SUPP		Supplementary Transient Test Requirements	Tests 1-10, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 11-20, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 21-30, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 31-40, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 41-50, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 51-62, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHLSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 1-11 Table 3.3.2-3B	Tests performed at 360 and 441 Hz	GHLSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 12-19 Table 3.3.2-3B	Tests performed at 360 and 441 Hz	GHLSUPP-9

**4.6.2.3 235VAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	190.0 to 244.0 Volts RMS	30 mins, 800Hz and 360Hz	HVAC-11
	1.2	Average of Three-Phase Voltages	193.0 to 241.0 Volts RMS	30 mins, 800Hz and 360Hz	HVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	No specified test	
	1.4	Phase Voltage Unbalance	Max. 12.0 Volts RMS	Apply each test 30 mins	HVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	10.0 Volts Peak-to-Valley	Follows specification Figure 1	HVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	HVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.20 Volts (after first cycle)	30 mins each test	HVAC-16-2
	1.6.4	Crest Factor	1.41 +/- 0.15	No specified test	
	1.7	Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation		Applies to Ground Handling Equip only	
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	800Hz and 360Hz	HVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 800Hz and 360Hz	HVAC-21-2
	2.1	Voltage Transients	Per Table B.2.1.1.1	2 times each	HVAC-21-3
	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3.1	Frequency Variations - Max Ramp Rate	100Hz/s up, 200Hz/s down	3 times each, 360Hz nominal	HVAC-23
	2.3.2	Frequency Variations - Frequency Transients		Applies to Ground Handling Equip only	

3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	190.0 to 268.0 Volts RMS	Single Phase Unit Test	HVAC-31-1
	3.1	Average of Three-Phase Voltages	193.0 to 265.0 Volts RMS	5 mins each test	HVAC-31-2
	3.2	Average of Three-Phase Voltages	190.0 to 268.0 Volts RMS	Three Phase Unit Test	HVAC-32
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	HVAC-41
	4.2	Frequency Transients			
	4.2.1	Maximum Ramp Rate	120Hz/s up, 400Hz/s down	3 times each, 360Hz nominal	HVAC-42-1
	4.2.2	Transients Outside of Steady State Range	350 to 885 Hz	3 times each, 400Hz nominal	HVAC-42-2
	4.3	DC Content	+/- 15VDC offset	800Hz and 360Hz	HVAC-43
SUPP		Supplementary Transient Test Requirements	Tests 1-7, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 8-14, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 15-20, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 21-27, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 28-34, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 35-40, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 41-47, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 48-53, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 54-62, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-9
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360, 680, and 800 Hz	HSUPP-10
SUPP		Supplementary Transient Test Requirements	Tests 1-6 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	HSUPP-11
SUPP		Supplementary Transient Test Requirements	Tests 7-12 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	HSUPP-12
SUPP		Supplementary Transient Test Requirements	Tests 13-18 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	HSUPP-13



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SUPP		Supplementary Transient Test Requirements	Test 19 Table 3.3.2-3B	Tests performed at 360, 680, and 800 Hz	HSUPP-14
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**4.6.2.4 235VAC for Ground Handling Equipment:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	190.0 to 244.0 Volts RMS	30 mins, 441Hz and 360Hz	GHHVAC-11
	1.2	Average of Three-Phase Voltages	193.0 to 241.0 Volts RMS	30 mins, 441Hz and 360Hz	GHHVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	No specified test	
	1.4	Phase Voltage Unbalance	Max. 12.0 Volts RMS	Apply each test 30 mins	GHHVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	10.0 Volts Peak-to-Valley	Follows specification Figure 1	GHHVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	GHHVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.20 Volts (after first cycle)	30 mins each test	GHHVAC-16-3
	1.6.4	Crest Factor	1.41 +/- 0.15	No specified test	
	1.7	Steady State Frequency (see Designer Notes)	360 to 441 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation		Applies to Ground Handling Equip only	
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	441Hz and 360Hz	GHHVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 441Hz and 360Hz	GHHVAC-21-2
	2.1	Voltage Transients	Per Table B.2.1.1.1	2 times each	GHHVAC-21-3
	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3.1	Frequency Variations - Max Ramp Rate	100Hz/s up, 200Hz/s down	N/A for GHE	
	2.3.2	Frequency Variations - Frequency Transients		Applies to Ground Handling Equip only	GHHVAC-23

3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	190.0 to 268.0 Volts RMS	Single Phase Unit Test	GHHVAC-31
	3.2	Average of Three-Phase Voltages	193.0 to 265.0 Volts RMS	5 mins each test	GHHVAC-32-1
	3.2	Average of Three-Phase Voltages	190.0 to 268.0 Volts RMS	Three Phase Unit Test	GHHVAC-32-2
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 441 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	GHHVAC-41
	4.2	Frequency Transients			
	4.2.1	Maximum Ramp Rate	120Hz/s up, 400Hz/s down	N/A for GHE	
	4.2.2	Transients Outside of Steady State Range	350 to 480 Hz	3 times each, 400Hz nominal	GHHVAC-42-2
	4.3	DC Content	+/- 30VDC offset	441Hz and 360Hz	GHHVAC-43
SUPP		Supplementary Transient Test Requirements	Tests 1-10, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 11-20, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 21-30, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 31-40, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 41-50, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 51-62, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360 and 441 Hz	GHHSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 1-11 Table 3.3.2-3B	Tests performed at 360 and 441 Hz	GHHSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 12-19 Table 3.3.2-3B	Tests performed at 360 and 441 Hz	GHHSUPP-9

**4.6.2.5 Type I DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.1	Type 1 DC Voltage	22.0 to 32.8 Volts		TYPE1-51
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Requirement fulfilled in 5.5.2	
	5.5.2	Ripple Components	Per Figure 7	Use B787 DC ripple window to perform	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE1-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
7.0		Abnormal DC Steady State			
	7.1	Type 1 DC Voltage	20.5 to 35.5 Volts		TYPE1-71
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE1-81
SUPP		Supplementary Transient Test Requirements	Tests 1-23, Table 3.3.3-3A		DC1SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 24-46, Table 3.3.3-3A		DC1SUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 47-67, Table 3.3.3-3A		DC1SUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 1-19, Table 3.3.3-3B		DC1SUPP-4

**4.6.2.6 Type II DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.2	Type 2 DC Voltage	22.0 to 32.8 Volts		TYPE2-52
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Requirement fulfilled in 5.5.2	
	5.5.2	Ripple Components	Per Figure 7	Use B787 DC ripple window to perform	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE2-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
7.0		Abnormal DC Steady State			
	7.2	Type 2 DC Voltage	18.0 to 35.5 Volts		TYPE2-72
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE2-81
SUPP		Supplementary Transient Test Requirements	Tests 1-23, Table 3.3.3-3A		DC2SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 24-46, Table 3.3.3-3A		DC2SUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 47-66, Table 3.3.3-3A		DC2SUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 1-19, Table 3.3.3-3B		DC2SUPP-4

**4.6.2.7 Type III DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.3	Type 3 DC Voltage	22.0 to 32.8 Volts		TYPE3-53
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Requirement fulfilled in 5.5.2	
	5.5.2	Ripple Components	Per Figure 7	Use B787 DC ripple window to perform	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE3-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
7.0		Abnormal DC Steady State			
	7.3	Type 3 DC Voltage	18.0 to 32.8 Volts		TYPE3-73
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE3-81
SUPP		Supplementary Transient Test Requirements	Tests 1-65, Table 3.3.3-3A		DC3SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 1-19, Table 3.3.3-3B		DC3SUPP-2

**4.6.2.8 Type IV DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.4	Type 4 DC Voltage	18.0 to 32.8 Volts		TYPE4-54
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Requirement fulfilled in 5.5.2	
	5.5.2	Ripple Components	Per Figure 7	Use B787 DC ripple window to perform	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE4-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
7.0		Abnormal DC Steady State			
	7.4	Type 4 DC Voltage	18.0 to 35.5 Volts		TYPE4-74
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE4-81
SUPP		Supplementary Transient Test Requirements	Tests 1-79, Table 3.3.3-3A		DC4SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 1-19, Table 3.3.3-3B		DC4SUPP-2

**4.6.2.9 Type V DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
9.0		Normal DC Steady State			
	9.1	Normal Steady-State Voltage			
		Engine Start with Forward EP Source	+/-230.0 Volts	Apply for 15 min	TYPE5-91-1
		All Other Operating Modes	+/-250.0 to +/-320.0 Volts	Apply for 30 min each	TYPE5-91-2
	9.2	Voltage Ripple			
	9.2.1	Differential Mode Ripple Maximum Amplitude	32.0 Volts Peak to Peak	Ripple Frequency Not Specified	
	9.2.2	Differential Mode Ripple Components	Per Figure 13	Requires Additional Equipment	
	9.3	Common Mode Voltage			
	9.3.1	Common Mode Maximum Amplitude	62.0 Volts Peak to Peak	Ripple Frequency Not Specified	
	9.3.2	Common Mode Frequency Components	Per Figure 14	Requires Additional Equipment	
10.0		Normal DC Transients			
	10.1	Voltage Transients	Per Figures 15A and 15B		TYPE5-101
11.0		Abnormal DC Steady State	Per Figures 9A through 9D		
	11.1	Steady State Voltage	+/-240.0 to +/-356.0 VDC		TYPE5-111
	11.2	Voltage Ripple			
	11.2.1	Maximum Amplitude	120 Volts Peak to Peak	Ripple Frequency Not Specified	
12.0		Abnormal DC Transients			
	12.1	Voltage Transients	Per Figure 16		TYPE5-121



**4.6.2.10 Type VI DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
13.0		Normal DC Steady State			
	13.1	Normal Steady-State Voltage	+/-120.0 to +/-140.0 Volts	Apply for 30 min each	TYPE6-131
	13.2	Common Mode Voltage	1.25 Volts	Apply for 30 min	TYPE6-132
	13.3	Differential Mode Voltage - Max Amplitude	2.0 Volts Peak to Peak	Requires Additional Equipment	
	13.4	Differential Mode Voltage - Max Ripple Components	40kHz - 120kHz	Requires Additional Equipment	
14.0		Normal DC Transients			
	14.1	Voltage Transients	Per Figure 30		TYPE6-141
15.0		Abnormal DC Steady-State			
	15.1	Steady State Voltage	+/-120.0 to +/-140.0 Volts	Requirement fulfilled in 13.1	
16.0		Abnormal DC Transients			
	16.1	Voltage Transients	Per Figure 31		TYPE6-161

**4.6.3 Rev A:****4.6.3.1 115VAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	100.0 to 122.0 Volts RMS	30 mins, 800Hz and 360Hz	LVAC-11
	1.2	Average of Three-Phase Voltages	101.5 to 120.5 Volts RMS	30 mins, 800Hz and 360Hz	LVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	Apply from main gui screen manually	
	1.4	Phase Voltage Unbalance	Max. 6.0 Volts RMS	Apply each test 30 mins	LVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	5.0 Volts Peak-to-Valley	Follows specification Figure 1	LVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	LVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.10 Volts (after first cycle)	30 mins each test	LVAC-16-2
	1.6.4	Crest Factor	1.41 +/- 0.15		
	1.7	Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation	Per Figure 2	2 mins each test (400 Hz nominal)	LVAC-18
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	800Hz and 360Hz	LVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 800Hz and 360Hz	LVAC-21-2
	2.1	Voltage Transients	Per Table B.2.1.1.1	2 times each	LVAC-21-3
	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3	Frequency Transients			

	2.3.1	Maximum Ramp Rate	100Hz/s up, 200Hz/s down	3 times each, 360Hz nominal	LVAC-23
3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	90.0 to 134.0 Volts RMS	Single Phase Unit Test	LVAC-31-1
	3.1	Individual Phase Voltage	90.0 to 134.0 Volts RMS	Three Phase Unit Test	LVAC-31-2
	3.2	Average of Three-Phase Voltages	91.5 to 132.5 Volts RMS	5 mins each test	LVAC-32
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	LVAC-41
	4.2	Frequency Transients			
	4.2.1	Maximum Ramp Rate	100Hz/s up, 200Hz/s down	Test procedure TBD	
	4.2.2	Transients Outside of Steady State Range	Per Figure 6	Test procedure TBD	
	4.3	DC Content	Per Figure 11	Test procedure TBD	
SUPP		Supplementary Transient Test Requirements	Tests 1-7, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 8-14, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 15-20, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 21-27, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 28-34, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 35-40, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 41-47, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 48-53, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 54-62, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-9
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	LSUPP-10
SUPP		Supplementary Transient Test Requirements	Tests 1-6 Table 3.3.2-3B	Tests performed at 360, 530, and 800 Hz	LSUPP-11
SUPP		Supplementary Transient Test Requirements	Tests 7-12 Table 3.3.2-3B	Tests performed at 360, 530, and 800 Hz	LSUPP-12

SUPP	Supplementary Transient Test Requirements	Tests 13-15 Table 3.3.2-3B	Tests performed at 360, 530, and 800 Hz	LSUPP-13
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**4.6.3.2 230VAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
1.0		Normal AC Steady State			
	1.1	Individual Phase Voltage	190.0 to 244.0 Volts RMS	30 mins, 800Hz and 360Hz	HVAC-11
	1.2	Average of Three-Phase Voltages	193.0 to 241.0 Volts RMS	30 mins, 800Hz and 360Hz	HVAC-12
	1.3	Phase Displacement	120.0 +/- 4.0°	Apply from main gui screen manually	
	1.4	Phase Voltage Unbalance	Max. 12.0 Volts RMS	Apply each test 30 mins	HVAC-14
	1.5	AC Voltage Modulation			
	1.5.1	Maximum Amplitude	10.0 Volts Peak-to-Valley	Follows specification Figure 1	HVAC-15
	1.5.2	Frequency Components	Per Figure 1	Figure only, not a test. (Refer to spec)	
	1.6	Voltage Waveform			
	1.6.1	Total Harmonic Content	Max. 10% of Fundamental	30 mins each test	HVAC-16-1
	1.6.2	Individual Harmonic Content	Max. 8% of Fundamental	Requires audio generator	
	1.6.3	DC Content	+/-0.20 Volts (after first cycle)	30 mins each test	HVAC-16-2
	1.6.4	Crest Factor	1.41 +/- 0.15		
	1.7	Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.1 and 1.2	
	1.8	Frequency Modulation	Per Figure 2	2 mins each test (360, 800Hz nominal)	HVAC-18
2.0		Normal AC Transients			
	2.1	Voltage Transients	50ms Dropouts	800Hz and 360Hz	HVAC-21-1
	2.1	Voltage Transients	Voltage Surge/Sag	3 times each, 800Hz and 360Hz	HVAC-21-2
	2.1	Voltage Transients	Per Table B.2.1.1.1	2 times each	HVAC-21-3

	2.2	Voltage Spikes	Per Figure 10	Requires additional equipment	
	2.3	Frequency Transients			
	2.3.1	Maximum Ramp Rate	100Hz/s up, 200Hz/s down	3 times each, 360Hz nominal	HVAC-23
3.0		Abnormal AC Steady State			
	3.1	Individual Phase Voltage	190.0 to 268.0 Volts RMS	Single Phase Unit Test	HVAC-31-1
	3.1	Individual Phase Voltage	190.0 to 268.0 Volts RMS	Three Phase Unit Test	HVAC-31-2
	3.2	Average of Three-Phase Voltages	193.0 to 265.0 Volts RMS	5 mins each test	HVAC-32
	3.3	Abnormal Steady State Frequency (see Designer Notes)	360 to 800 Hz	Requirement fulfilled in 1.7	
4.0		Abnormal AC Transients			
	4.1	Voltage Transients	Per Figure 5A	Apply each transient 3x with 10s interval	HVAC-41
	4.2	Frequency Transients			
	4.2.1	Maximum Ramp Rate	100Hz/s up, 200Hz/s down	Test procedure TBD	
	4.2.2	Transients Outside of Steady State Range	Per Figure 6	Test procedure TBD	
	4.3	DC Content	Per Figure 11	Test procedure TBD	
SUPP		Supplementary Transient Test Requirements	Tests 1-7, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 8-14, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 15-20, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 21-27, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-4
SUPP		Supplementary Transient Test Requirements	Tests 28-34, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-5
SUPP		Supplementary Transient Test Requirements	Tests 35-40, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-6
SUPP		Supplementary Transient Test Requirements	Tests 41-47, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-7
SUPP		Supplementary Transient Test Requirements	Tests 48-53, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-8
SUPP		Supplementary Transient Test Requirements	Tests 54-62, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-9
SUPP		Supplementary Transient Test Requirements	Tests 63-74, Table 3.3.2-3A	Tests performed at 360, 530, and 800 Hz	HSUPP-10

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SUPP		Supplementary Transient Test Requirements	Tests 1-6 Table 3.3.2-3B	Tests performed at 360, 530, and 800 Hz	HSUPP-11
SUPP		Supplementary Transient Test Requirements	Tests 7-12 Table 3.3.2-3B	Tests performed at 360, 530, and 800 Hz	HSUPP-12
SUPP		Supplementary Transient Test Requirements	Tests 13-15 Table 3.3.2-3B	Tests performed at 360, 530, and 800 Hz	HSUPP-13

**4.6.3.3 Type I DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.1	Type 1 DC Voltage	22.0 to 29.5 Volts		TYPE1-51
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Procedure TBD	
	5.5.2	Ripple Components	Per Figure 7	Requires Additional Equipment	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE1-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
7.0		Abnormal DC Steady State			
	7.1	Type 1 DC Voltage	20.5 to 32.2 Volts		TYPE1-71
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE1-81
SUPP		Supplementary Transient Test Requirements	Tests 1-27, Table 3.3.3-3A		DC1SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 28-51, Table 3.3.3-3A		DC1SUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 52-79, Table 3.3.3-3A		DC1SUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 1-15, Table 3.3.3-3B		DC1SUPP-4

**4.6.3.4 Type II DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.2	Type 2 DC Voltage	18.0 to 29.5 Volts		TYPE2-52
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Procedure TBD	
	5.5.2	Ripple Components	Per Figure 7	Requires Additional Equipment	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE2-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
7.0		Abnormal DC Steady State			
	7.2	Type 2 DC Voltage	18.0 to 32.2 Volts		TYPE2-72
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE2-81
SUPP		Supplementary Transient Test Requirements	Tests 1-27, Table 3.3.3-3A		DC2SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 28-51, Table 3.3.3-3A		DC2SUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 52-80, Table 3.3.3-3A		DC2SUPP-3
SUPP		Supplementary Transient Test Requirements	Tests 1-15, Table 3.3.3-3B		DC2SUPP-4



**4.6.3.5 Type III DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.3	Type 3 DC Voltage	18.0 to 32.2 Volts		TYPE3-53
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Procedure TBD	
	5.5.2	Ripple Components	Per Figure 7	Requires Additional Equipment	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E	N/A for Type 3	
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
7.0		Abnormal DC Steady State			
	7.3	Type 3 DC Voltage	18.0 to 32.2 Volts		TYPE3-73
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D	N/A for Type 3	
SUPP		Supplementary Transient Test Requirements	Tests 1-80, Table 3.3.3-3A		DC3SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 1-15, Table 3.3.3-3B		DC3SUPP-2

**4.6.3.6 Type IV DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
5.0		Normal DC Steady State			
	5.4	Type 4 DC Voltage	18.0 to 29.5 Volts		TYPE4-54
	5.5	Voltage Ripple			
	5.5.1	Maximum Amplitude	4.0 Volts Peak to Peak	Procedure TBD	
	5.5.2	Ripple Components	Per Figure 7	Requires Additional Equipment	
6.0		Normal DC Transients			
	6.1	Voltage Transients	Per Figures 8A through 8E		TYPE4-61
	6.2	Voltage Spikes	Per Figure 10	Requires Additional Equipment	
7.0		Abnormal DC Steady State			
	7.4	Type 4 DC Voltage	18.0 to 32.2 Volts		TYPE4-74
8.0		Abnormal DC Transients			
	8.1	Voltage Transients	Per Figures 9A through 9D		TYPE4-81
SUPP		Supplementary Transient Test Requirements	Tests 1-79, Table 3.3.3-3A		DC4SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 1-15, Table 3.3.3-3B		DC4SUPP-2

**4.6.3.7 Type V DC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
9.0		Normal DC Steady State			
	9.1	Steady State Voltage	+/-250.0 to +/-320.0 Volts		TYPE5-91
	9.2	Voltage Ripple			
	9.2.1	Differential Mode Ripple Maximum Amplitude	32.0 Volts Peak to Peak	Procedure TBD	
	9.2.2	Differential Mode Ripple Components	Per Figure 13	Requires Additional Equipment	
	9.3	Common Mode Voltage			
	9.3.1	Common Mode Maximum Amplitude	62.0 Volts Peak to Peak	Procedure TBD	
	9.3.2	Common Mode Frequency Components	Per Figure 14	Procedure TBD	
10.0		Normal DC Transients			
	10.1	Voltage Transients	Per Figures 15A and 15B		TYPE5-101
	10.2	Voltage Spikes	Figure TBD	Requires Additional Equipment	
11.0		Abnormal DC Steady State	Per Figures 9A through 9D		
	11.1	Steady State Voltage	+/-240.0 to +/-356.0 VDC		TYPE5-111
	11.2	Voltage Ripple			
	11.2.1	Differential Mode Ripple Maximum Amplitude	120 Volts Peak to Peak	Procedure TBD	
	11.3	Common Mode Voltage			
	11.3.1	Common Mode Maximum Amplitude	TBD		
12.0		Abnormal DC Transients			
	12.1	Voltage Transients	Per Figure 16		TYPE5-121
SUPP		Supplementary Transient Test Requirements	Tests 1-24, Table 3.3.3-8A		DC5SUPP-1
SUPP		Supplementary Transient Test Requirements	Tests 25-46, Table 3.3.3-8A		DC5SUPP-2
SUPP		Supplementary Transient Test Requirements	Tests 47-69, Table 3.3.3-8A		DC5SUPP-3

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SUPP	Supplementary Transient Test Requirements	Tests 1-15, Table 3.3.3-8B	DC5SUPP-4
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## 5 Option –704: MIL-STD-704 rev A, B, C, E, & F Tests

The –704 option supports MIL-STD-704 revs A, B, C, E, and F voltage and frequency immunity tests in either of the AC or DC mode (if available).

The –704 option is based on MIL-STD-704 Department of Defense Interface Standard: Aircraft Electric Power Characteristics Appendix A dated March 2004.

Future revisions of the MIL-STD-704 directive may be issued over time and updates may be made available to cover any changes in test levels, durations, procedures etc. Furthermore, the –704 option is completely data file driven to allow a large degree of customization by the end-user if needed so many changes can be supported without the need for software updates.

This section of the manual explains the limitations of this test option, the use of special features unique to this option, and gives a complete layout of all tests performed by this option.

This manual is **not** intended to elaborate on the intent or purpose of the immunity tests and the expected behavior of the EUT as described in the MIL-STD-704 documents. It is assumed that the end-user is familiar with the content of the MIL-STD-704 test standard.

**Note:** All three phase California Instruments power sources have a phase rotation of A C B where phase C is +120° from phase A and phase B is +240° from phase A. Some interpretations of this specification call for phase B to be +120° from phase A. The easiest way to accomplish a ABC phase rotation is to simply switch phase B and phase C wires at the EUT input. Alternatively, the programmed phase angles for B and C can be changed but this will require editing of the test scripts and is not recommended.

### 5.1 Test Coverage

The comprehensiveness of the test that can be performed with the –704 option is determined primarily by the capabilities of the power source used. Tests that are outside the hardware capabilities of the power source used will not be enabled and cannot be selected. For these tests, additional equipment may be required as indicated.

#### 5.1.1 MX/RS Series -704 Option Limitations

The extent of coverage of the –704 option as implemented on the MX/RS Series platform is shown in the table below. Tests marked with an 'x' generally require additional hardware to be used. Tests marked 'N/A' are not applicable to the corresponding table. Tests marked with a '√' are covered by at least one rev of the MIL-STD-704. Additional implementation issues may apply as well as indicated in section 5.1.1.1. Tests marked with a 'P' require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. **Note:** *The MX15 Series power sources are single phase output only and therefore all three phase tests are not available on the MX15.*

No.	Description	Table SAC	Table TAC	Table SVF	Table TVF	Table SXF	No.	Description	Table LDC	Table HDC
101	Load and Current Harmonic Measurements	√	√	√	√	√	101	Load Measurements	√	√
102	Steady State Limits for Voltage and Freq.	√	√	√	√	√	102	Steady State Limits for Voltage	√	√
103	Voltage Phase Difference	N/A	√	N/A	√	N/A	103	Voltage Distortion Spectrum	X	X

No.	Description	Table SAC	Table TAC	Table SVF	Table TVF	Table SXF	No.	Description	Table LDC	Table HDC
104	Voltage Modulation	√	√	√	√	√	104	Total Ripple	X	X
105	Frequency Modulation	√	√	√	√	√	105	Normal Voltage Transients	√	√
106	Voltage Distortion Spectrum	X	X	X	X	X	201	Power Interrupt	√	√
107	Total Voltage Distortion	P, X	P, X	P, X	P, X	P, X	301	Abnormal Steady State Limits for Voltage	√	√
108	DC Voltage Component	P	P	P	P	P	302	Abnormal Voltage Transients	√	√
109	Normal Voltage Transients	√	√	√	√	√	401	Emergency Limits for Voltage	√	√
110	Normal Frequency Transients	√	√	√	√	√	501	Starting Voltage Transients	√	√
201	Power Interrupt	√	√	√	√	√	601	Power Failure	√	√
301	Abnormal Steady State Limits for Voltage and Frequency	√	√	√	√	√	602	Polarity Reversal	√	√
302	Abnormal Voltage Transients	√	√	√	√	√				
303	Abnormal Frequency Transients	√	√	√	√	√				
401	Emergency Steady State Limits for Voltage and Frequency	√	√	√	√	√				
501	Starting Voltage Transients	N/A	N/A	N/A	N/A	N/A				
601	Power Failure	√	√	√	√	√				
602	One and Two Phase Power Failure	N/A	√	N/A	√	N/A				
603	Phase Reversal	√	√	√	√	√				

Table 5- 1: -704 Option MX/RS Test Coverage

### 5.1.1.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Mil-Std 704 tests, some limitations apply, largely due to hardware limitations of the MX/RS power source. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Rev	Test	Standard requirement	Actual setting	Reason
A	SAC104	5Vp-v modulation (.3536V RMS)	.4V RMS modulation	Resolution
A	SAC104	3.5Vp-v modulation (2.475V RMS)	2.4V RMS modulation	Resolution
A	TAC104	5Vp-v modulation (.3536V RMS)	.4V RMS modulation	Resolution
A	TAC104	3.5Vp-v modulation (2.475V RMS)	2.4V RMS modulation	Resolution
A-F	SAC106	50kHz	Test skipped	Requires additional equipment
A-F	TAC106	50kHz	Test skipped	Requires additional equipment
A-F	LDC103	50kHz	Test skipped	Requires additional equipment
A-F	LDC104	16.8kHz	Test skipped	Requires additional equipment
B-F	SAC104	.375V RMS modulation	.4V RMS modulation	Resolution
B-F	SAC104	2.5V RMS modulation	2.4V RMS modulation	Resolution
B-F	TAC104	.375V RMS modulation	.4V RMS modulation	Resolution
B-F	TAC104	2.5V RMS modulation	2.4V RMS modulation	Resolution
B-F	HDC103	50kHz	Test skipped	Requires additional equipment
B-F	HDC104	16.8kHz	Test skipped	Requires additional equipment
F	SVF104	.375V RMS modulation	.4V RMS modulation	Resolution
F	SVF104	2.5V RMS modulation	2.4V RMS modulation	Resolution
F	SVF106	50kHz	Test skipped	Requires additional equipment
F	TVF104	.375V RMS modulation	.4V RMS modulation	Resolution
F	TVF104	2.5V RMS modulation	2.4V RMS modulation	Resolution
F	TVF106	50kHz	Test skipped	Requires additional equipment
F	SXF104	.375V RMS modulation	.4V RMS modulation	Resolution
F	SXF104	2.5V RMS modulation	2.4V RMS modulation	Resolution
F	SXF106	50kHz	Test skipped	Requires additional equipment
F	SXF109	Dwell time = 1 cycle (16.666667 msec)	Dwell time = 17msec	Resolution
F	SXF201	Dwell time = 1 cycle (16.666667 msec)	Dwell time = 17msec	Resolution
F	SXF302	Dwell time = 1 cycle (16.666667 msec)	Dwell time = 17msec	Resolution
B, C	HDC105	475VDC	400VDC limit (test written but will not run)	Hardware limit DC range MX/RS

Rev	Test	Standard requirement	Actual setting	Reason
B, C	HDC302	475VDC	400VDC limit (test written but will not run)	Hardware limit DC range MX/RS
B, C	SAC105	+/-1.75Hz modulation	+/-2Hz modulation	Resolution
B, C	SAC105	+/-0.85Hz modulation	+/-0.9Hz modulation	Resolution
B, C	SAC105	+/-0.58Hz modulation	+/-0.6Hz modulation	Resolution
B, C	TAC105	+/-1.75Hz modulation	+/-2Hz modulation	Resolution
B, C	TAC105	+/-0.85Hz modulation	+/-0.9Hz modulation	Resolution
B, C	TAC105	+/-0.58Hz modulation	+/-0.6Hz modulation	Resolution



### 5.1.2 AST Series -704 Option Limitations

The extent of coverage of the –704 option as implemented on the AST Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by at least one rev of the MIL-STD-704. Additional implementation issues may apply as well as indicated in section 5.1.1.1. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. **Note:** *The AST Series power sources model number ending with “1” (eg: AST 751,1501) are single phase output only and therefore all three phase tests are not available on these series.*

No.	Description	Table SAC	Table TAC	Table SVF	Table TVF	Table SXF	No.	Description	Table LDC	Table HDC
101	Load and Current Harmonic Measurements	√	√	√	√	√	101	Load Measurements	√	√
102	Steady State Limits for Voltage and Freq.	√	√	√	√	√	102	Steady State Limits for Voltage	√	√
103	Voltage Phase Difference	N/A	√	N/A	√	N/A	103	Voltage Distortion Spectrum	X	X
104	Voltage Modulation	√	√	√	√	√	104	Total Ripple	X	X
105	Frequency Modulation	√	√	√	√	√	105	Normal Voltage Transients	√	√
106	Voltage Distortion Spectrum	X	X	X	X	X	201	Power Interrupt	√	√
107	Total Voltage Distortion	P, X	P, X	P, X	P, X	P, X	301	Abnormal Steady State Limits for Voltage	√	√
108	DC Voltage Component	P	P	P	P	P	302	Abnormal Voltage Transients	√	√
109	Normal Voltage Transients	√	√	√	√	√	401	Emergency Limits for Voltage	√	√
110	Normal Frequency Transients	√	√	√	√	√	501	Starting Voltage Transients	√	√
201	Power Interrupt	√	√	√	√	√	601	Power Failure	√	√
301	Abnormal Steady State Limits for Voltage and Frequency	√	√	√	√	√	602	Polarity Reversal	√	√
302	Abnormal Voltage Transients	√	√	√	√	√				
303	Abnormal Frequency Transients	√	√	√	√	√				
401	Emergency Steady State Limits for Voltage and Frequency	√	√	√	√	√				
501	Starting Voltage Transients	N/A	N/A	N/A	N/A	N/A				

No.	Description	Table SAC	Table TAC	Table SVF	Table TVF	Table SXF	No.	Description	Table LDC	Table HDC
601	Power Failure	√	√	√	√	√				
602	One and Two Phase Power Failure	N/A	√	N/A	√	N/A				
603	Phase Reversal	√	√	√	√	√				

Table 5- 2: -704 Option AST Test Coverage

### 5.1.2.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Mil-Std 704 tests, some limitations apply, largely due to hardware limitations of the AST power source. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Rev	Test	Standard requirement	Actual setting	Reason
A	SAC104	5Vp-v modulation (.3536V RMS)	.4V RMS modulation	Resolution
A	SAC104	3.5Vp-v modulation (2.475V RMS)	2.4V RMS modulation	Resolution
A	TAC104	5Vp-v modulation (.3536V RMS)	.4V RMS modulation	Resolution
A	TAC104	3.5Vp-v modulation (2.475V RMS)	2.4V RMS modulation	Resolution
A-F	SAC106	50kHz	Test skipped	Requires additional equipment
A-F	TAC106	50kHz	Test skipped	Requires additional equipment
A-F	LDC103	50kHz	Test skipped	Requires additional equipment
A-F	LDC104	16.8kHz	Test skipped	Requires additional equipment
B-F	SAC104	.375V RMS modulation	.4V RMS modulation	Resolution
B-F	SAC104	2.5V RMS modulation	2.4V RMS modulation	Resolution
B-F	TAC104	.375V RMS modulation	.4V RMS modulation	Resolution
B-F	TAC104	2.5V RMS modulation	2.4V RMS modulation	Resolution
B-F	HDC103	50kHz	Test skipped	Requires additional equipment
B-F	HDC104	16.8kHz	Test skipped	Requires additional equipment
F	SVF104	.375V RMS modulation	.4V RMS modulation	Resolution
F	SVF104	2.5V RMS modulation	2.4V RMS modulation	Resolution
F	SVF106	50kHz	Test skipped	Requires additional equipment
F	TVF104	.375V RMS modulation	.4V RMS modulation	Resolution
F	TVF104	2.5V RMS modulation	2.4V RMS modulation	Resolution
F	TVF106	50kHz	Test skipped	Requires additional equipment
F	SXF104	.375V RMS modulation	.4V RMS modulation	Resolution
F	SXF104	2.5V RMS modulation	2.4V RMS modulation	Resolution
F	SXF106	50kHz	Test skipped	Requires additional equipment
F	SXF109	Dwell time = 1 cycle (16.666667 msec)	Dwell time = 17msec	Resolution
F	SXF201	Dwell time = 1 cycle (16.666667 msec)	Dwell time = 17msec	Resolution
F	SXF302	Dwell time = 1 cycle (16.666667 msec)	Dwell time = 17msec	Resolution
B, C	HDC105	475VDC	400VDC limit (test written but will not run)	Hardware limit DC range AST

Rev	Test	Standard requirement	Actual setting	Reason
B, C	HDC302	475VDC	400VDC limit (test written but will not run)	Hardware limit DC range AST
B, C	SAC105	+/-1.75Hz modulation	+/-2Hz modulation	Resolution
B, C	SAC105	+/-0.85Hz modulation	+/-0.9Hz modulation	Resolution
B, C	SAC105	+/-0.58Hz modulation	+/-0.6Hz modulation	Resolution
B, C	TAC105	+/-1.75Hz modulation	+/-2Hz modulation	Resolution
B, C	TAC105	+/-0.85Hz modulation	+/-0.9Hz modulation	Resolution
B, C	TAC105	+/-0.58Hz modulation	+/-0.6Hz modulation	Resolution

### 5.1.3 i/iX Series -704 Option Limitations

The extent of coverage of the –704 option as implemented on the IX Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by at least one rev of the MIL-STD-704. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on iX models only.

No.	Description	Table SAC	Table TAC	Table SVF	Table TVF	Table SXF	No.	Description	Table LDC	Table HDC
101	Load and Current Harmonic Measurements	√	√	√	√	√	101	Load Measurements	√	√
102	Steady State Limits for Voltage and Frequency	√	√	√	√	√	102	Steady State Limits for Voltage	√	√
103	Voltage Phase Difference	N/A	√	N/A	√	N/A	103	Voltage Distortion Spectrum	X	X
104	Voltage Modulation	√	√	√	√	√	104	Total Ripple	X	X
105	Frequency Modulation	√	√	√	√	√	105	Normal Voltage Transients	√	√ <sup>16</sup>
106	Voltage Distortion Spectrum	X	X	X	X	X	201	Power Interrupt	√	√
107	Total Voltage Distortion	P, X	P, X	P, X	P, X	P, X	301	Abnormal Steady State Limits for Voltage	√	√
108	DC Voltage Component	P	P	P	P	P	302	Abnormal Voltage Transients	√	√ <sup>17</sup>
109	Normal Voltage Transients	√	√	√	√	√	401	Emergency Limits for Voltage	√	√
110	Normal Frequency Transients	√	√	√	√	√	501	Starting Voltage Transients	√	√
201	Power Interrupt	√	√	√	√	√	601	Power Failure	√	√
301	Abnormal Steady State Limits for Voltage and Freq.	√	√	√	√	√	602	Polarity Reversal	√	√
302	Abnormal Voltage Transients	√	√	√	√	√				
303	Abnormal Frequency Transients	√	√	√	√	√				
401	Emergency Steady State Limits for Voltage and Freq.	√	√	√	√	√				
501	Starting Voltage Transients	N/A	N/A	N/A	N/A	N/A				
601	Power Failure	√	√	√	√	√				

<sup>16</sup> Note: Some restrictions apply due to voltage range limitations. See section 5.1.4 for details.

<sup>17</sup> Note: Some restrictions apply due to voltage range limitations. See section 5.1.4 for details.

No.	Description	Table SAC	Table TAC	Table SVF	Table TVF	Table SXF	No.	Description	Table LDC	Table HDC
602	One and Two Phase Power Failure	N/A	√	N/A	√	N/A				
603	Phase Reversal	√	√	√	√	√				

Table 5- 3: -704 Option i/iX Test Coverage

#### 5.1.4 CSW Series -704 Option Limitations

The extent of coverage of the –704 option as implemented on the CSW Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by at least one rev of the MIL-STD-704. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on CSW models only.

No.	Description	Table SAC	Table TAC	Table SVF	Table TVF	Table SXF	No.	Description	Table LDC	Table HDC
101	Load and Current Harmonic Measurements	√	√	√	√	√	101	Load Measurements	√	√
102	Steady State Limits for Voltage and Frequency	√	√	√	√	√	102	Steady State Limits for Voltage	√	√
103	Voltage Phase Difference	N/A	√	N/A	√	N/A	103	Voltage Distortion Spectrum	X	X
104	Voltage Modulation	√	√	√	√	√	104	Total Ripple	X	X
105	Frequency Modulation	√	√	√	√	√	105	Normal Voltage Transients	√	√ <sup>18</sup>
106	Voltage Distortion Spectrum	X	X	X	X	X	201	Power Interrupt	√	√
107	Total Voltage Distortion	P, X	P, X	P, X	P, X	P, X	301	Abnormal Steady State Limits for Voltage	√	√
108	DC Voltage Component	P	P	P	P	P	302	Abnormal Voltage Transients	√	√ <sup>19</sup>
109	Normal Voltage Transients	√	√	√	√	√	401	Emergency Limits for Voltage	√	√
110	Normal Frequency Transients	√	√	√	√	√	501	Starting Voltage Transients	√	√
201	Power Interrupt	√	√	√	√	√	601	Power Failure	√	√
301	Abnormal Steady State Limits for Voltage and Freq.	√	√	√	√	√	602	Polarity Reversal	√	√
302	Abnormal Voltage Transients	√	√	√	√	√				
303	Abnormal Frequency Transients	√	√	√	√	√				

<sup>18</sup> Note: Some restrictions apply due to voltage range limitations. See section 5.1.4 for details.

<sup>19</sup> Note: Some restrictions apply due to voltage range limitations. See section 5.1.4 for details.

No.	Description	Table SAC	Table TAC	Table SVF	Table TVF	Table SXF	No.	Description	Table LDC	Table HDC
401	Emergency Steady State Limits for Voltage and Freq.	√	√	√	√	√				
501	Starting Voltage Transients	N/A	N/A	N/A	N/A	N/A				
601	Power Failure	√	√	√	√	√				
602	One and Two Phase Power Failure	N/A	√	N/A	√	N/A				
603	Phase Reversal	√	√	√	√	√				

Table 5- 4: -704 Option CSW Test Coverage

### 5.1.4.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Mil-Std 704 tests, some limitations apply, largely due to hardware limitations of the iX power source. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Rev	Test	Std requirement	Actual setting	Reason
A	SAC104	.5Vp-v modulation (.3536V RMS)	.4V RMS modulation	Resolution
A	SAC104	3.5Vp-v modulation (2.475V RMS)	2.4V RMS modulation	Resolution
A	TAC104	.5Vp-v modulation (.3536V RMS)	.4V RMS modulation	Resolution
A	TAC104	3.5Vp-v modulation (2.475V RMS)	2.4V RMS modulation	Resolution
A-F	SAC106	50kHz	Test skipped	Requires additional equipment
A-F	TAC106	50kHz	Test skipped	Requires additional equipment
A-F	LDC103	50kHz	Test skipped	Requires additional equipment
A-F	LDC104	16.8kHz	Test skipped	Requires additional equipment
B-F	SAC104	.375V RMS modulation	.4V RMS modulation	Resolution
B-F	SAC104	2.5V RMS modulation	2.4V RMS modulation	Resolution
B-F	TAC104	.375V RMS modulation	.4V RMS modulation	Resolution
B-F	TAC104	2.5V RMS modulation	2.4V RMS modulation	Resolution
B-F	HDC103	50kHz	Test skipped	Requires additional equipment
B-F	HDC104	16.8kHz	Test skipped	Requires additional equipment
F	SVF104	.375V RMS modulation	.4V RMS modulation	Resolution
F	SVF104	2.5V RMS modulation	2.4V RMS modulation	Resolution
F	SVF106	50kHz	Test skipped	Requires additional equipment
F	TVF104	.375V RMS modulation	.4V RMS modulation	Resolution
F	TVF104	2.5V RMS modulation	2.4V RMS modulation	Resolution
F	TVF106	50kHz	Test skipped	Requires additional equipment
F	SXF104	.375V RMS modulation	.4V RMS modulation	Resolution
F	SXF104	2.5V RMS modulation	2.4V RMS modulation	Resolution
F	SXF106	50kHz	Test skipped	Requires additional equipment
F	SXF109	Dwell time = 1 cycle (16.666667 msec)	Dwell time = 17msec	Resolution
F	SXF201	Dwell time = 1 cycle (16.666667 msec)	Dwell time = 17msec	Resolution
F	SXF302	Dwell time = 1 cycle (16.666667 msec)	Dwell time = 17msec	Resolution



Rev	Test	Std requirement	Actual setting	Reason
F	HDC105 <sup>20</sup>	330VDC	300VDC limit (test written but will not run)	Hardware limit DC range i/iX
F	HDC302 <sup>3</sup>	350VDC	300VDC limit (test written but will not run)	Hardware limit DC range i/iX
B, C	HDC105	475VDC	300VDC limit (test written but will not run)	Hardware limit DC range i/iX
B, C	HDC302	475VDC	300VDC limit (test written but will not run)	Hardware limit DC range i/iX
B, C	SAC105	+/-1.75Hz modulation	+/-2Hz modulation	Resolution
B, C	SAC105	+/-0.85Hz modulation	+/-0.9Hz modulation	Resolution
B, C	SAC105	+/-0.58Hz modulation	+/-0.6Hz modulation	Resolution
B, C	TAC105	+/-1.75Hz modulation	+/-2Hz modulation	Resolution
B, C	TAC105	+/-0.85Hz modulation	+/-0.9Hz modulation	Resolution
B, C	TAC105	+/-0.58Hz modulation	+/-0.6Hz modulation	Resolution

<sup>20</sup> **Note:** To perform MIL-STD-704F tests HDC105-1, -3 and HDC302-1, -3, it is advised to use the firmware revision E tests TRANSIENT and ABNORMAL respectively. The –704 firmware implementation overrides the DC voltage range hardware limit making it possible for these tests to be performed. If the i/iX system is a Series II system, the DC limit is 400V so this limitation does not apply. The same does not apply to the equivalent rev B or rev C tests, which require 475VDC. The 475 VDC level is not supported on any of the i/iX Series.

### 5.1.5 Lx/Ls Series -704 Option Limitations

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MIL-STD-704 rev A through F tests are all implemented via firmware for Lx/Ls Series power sources. Please see Lx/Ls Series user manual for operation instructions and limitations (P/N 7004-980).

## 5.2 –704 Power Groups

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The –704 option supports both AC and DC modes of operation. The correct mode is a function of the EUT to be tested and the operator must select the corresponding operating mode first. This can be done from the front panel if needed or using the Gui program. Use of the Gui program for all settings will be assumed for the remainder of this chapter.

Seven power groups are covered in the MIL-STD-704 directive:

Group	Description
SAC	Single Phase 115VAC / 400 Hz (CF)
TAC	Three Phase 115VAC / 400 Hz (CF)
SVF	Single Phase 115VAC / Variable Frequency (VF), 360 – 800 Hz.
TVF	Three Phase 115VAC / Variable Frequency (VF), 360 – 800Hz.
SXF	Single Phase 115VAC / 60 Hz (CF)
LDC	28VDC
HDC	270VDC

The required steady state output settings for each power group must be selected based on the type of EUT to be tested. These settings can be made from the front panel of the power source or from the main Gui control screen.

## 5.3 Test Tables

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The tables shown on the next few pages list the test sections covered by the –704 option. Where relevant, the numbering used matches that of the MIL-STD-704 document. The notes in the right hand column indicate tests that are either not directly supported or require additional external test equipment. Test tables are listed by rev and then by power group. The list starts with the most current rev to date, rev F.

**5.3.1 Rev F:****5.3.1.1 Table SAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SAC101		Load and Current Harmonic Measurements	115V RMS, 400 Hz		FSAC101
SAC102		Steady State Limits for Voltage and Frequency	108V to 118V RMS, 393 to 407 Hz	Apply for 30 mins each test	FSAC102
SAC103		No Test, Done so test numbers coincide			
SAC104		Voltage Modulation			
	1	115V Nominal Test	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FSAC104-1
	2	109V Nominal Test	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FSAC104-2
	3	117V Nominal Test	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FSAC104-3
SAC105		Frequency Modulation			
	1	400 Hz Nominal Test	400 Hz, 4 Hz mod	Apply for 10+ mins	FSAC105-1
	2	395 Hz Nominal Test	395 Hz, 4 Hz mod	Apply for 10+ mins	FSAC105-2
	3	405 Hz Nominal Test	405 Hz, 4 Hz mod	Apply for 10+ mins	FSAC105-3
SAC106		Voltage Distortion Spectrum		Requires Additional Equipment	
SAC107		Total Voltage Distortion	Voltage Distortion Factor 0.05	Apply for 30 mins	FSAC107
SAC108		DC Voltage Component			
	1	Positive DC Offset	115V RMS + .10V DC	Apply for 30 mins	FSAC108-1
	2	Negative DC Offset	115V RMS - .10V DC	Apply for 30 mins	FSAC108-2
SAC109		Normal Voltage Transients	180V RMS to 80V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table SAC109-3 AA-GG	FSAC109-1
	2	Undervoltage Transients	Low voltage 80V RMS	Table SAC109-3 HH-LL	FSAC109-2
	3	Combined Transient	180V RMS to 80V RMS	Table SAC109-3 MM	FSAC109-3
	4	Repetitive Normal Voltage Transient Test	90V RMS to 140V RMS	Run transient for 30 mins	FSAC109-4

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SAC110		Normal Frequency Transients	375 Hz to 425 Hz		
	1	Overfrequency Transients	High Frequency 425 Hz	Table SAC110-3 AA-DD	FSAC110-1
	2	Underfrequency Transients	Low Frequency 375 Hz	Table SAC110-3 EE-HH	FSAC110-2
	3	Combined Transient	375 Hz to 425 Hz	Table SAC110-3 II	FSAC110-3
SAC201		Power Interrupt	0V for 50 msec	Table SAC201-2 A-L	FSAC201
SAC301		Abnormal Steady State Limits for Voltage and Frequency	100V RMS to 125V RMS, 380 Hz to 420 Hz	Apply for 30 mins	FSAC301
SAC302		Abnormal Voltage Transients	45V RMS to 180V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table SAC302-3 AA-GG	FSAC302-1
	2	Undervoltage Transients	Low voltage 45V RMS	Table SAC302-3 HH-NN	FSAC302-2
	3	Combined Transient	45V RMS to 180V RMS	Table SAC302-3 OO	FSAC302-3
SAC303		Abnormal Frequency Transients	320 Hz to 480 Hz	Table SAC303-3 AA-EE	FSAC303
SAC401		Emergency Steady State Limits for Voltage and Frequency	Perform Test SAC102		
SAC501		No Tests		N/A to AC Utilization Equipment	
SAC601		Power Failure (Single Phase)	0V for 7 seconds	Table SAC601-2 A-D	FSAC601
SAC602		Power Failure	No test, done so numbers coincide		
SAC603		Phase Reversal		Phase reversal done physically	FSAC603

### 5.3.1.2 Table TAC:

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TAC101		Three Phase Load and Current Harmonic Measurements	115V RMS, 400 Hz		FTAC101
TAC102		Steady State Limits for Voltage (Including Unbalance) and Frequency			
	1	Balanced Phases	108V to 118V RMS, 393 to 407 Hz	Apply for 30 mins each test	FTAC102-1

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	2	Unbalanced Phases	108V to 118V RMS, +/- 3V Unbalance	Apply for 30 mins each test	FTAC102-2
TAC103		Voltage Phase Difference	Phase B 116 to 124 degrees	Apply for 30 mins each test	FTAC103
TAC104		Voltage Modulation			
	1	115V Nominal Test	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FTAC104-1
	2	109V Nominal Test	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FTAC104-2
	3	117V Nominal Test	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FTAC104-3
TAC105		Frequency Modulation			
	1	400 Hz Nominal Test	400 Hz, 4 Hz mod	Apply for 10+ mins	FTAC105-1
	2	395 Hz Nominal Test	395 Hz, 4 Hz mod	Apply for 10+ mins	FTAC105-2
	3	405 Hz Nominal Test	405 Hz, 4 Hz mod	Apply for 10+ mins	FTAC105-3
TAC106		Voltage Distortion Spectrum		Requires Additional Equipment	
TAC107		Total Voltage Distortion	Voltage Distortion Factor 0.05	Apply for 30 mins	FTAC107
TAC108		DC Voltage Component			
	1	Positive DC Offset	115V RMS + .10V DC	Apply for 30 mins	FTAC108-1
	2	Negative DC Offset	115V RMS - .10V DC	Apply for 30 mins	FTAC108-2
TAC109		Normal Voltage Transients	180V RMS to 80V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table TAC109-3 AA-GG	FTAC109-1
	2	Undervoltage Transients	Low voltage 80V RMS	Table TAC109-3 HH-LL	FTAC109-2
	3	Combined Transient	180V RMS to 80V RMS	Table TAC109-3 MM	FTAC109-3
	4	Repetitive Normal Voltage Transient Test	90V RMS to 140V RMS	Run transient for 30 mins	FTAC109-4
TAC110		Normal Frequency Transients	375 Hz to 425 Hz		
	1	Overfrequency Transients	High Frequency 425 Hz	Table TAC110-3 AA-DD	FTAC110-1
	2	Underfrequency Transients	Low Frequency 375 Hz	Table TAC110-3 EE-HH	FTAC110-2

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	3	Combined Transient	375 Hz to 425 Hz	Table TAC110-3 II	FTAC110-3
TAC201		Power Interrupt	0V for 50 msec	Table TAC201-2 A-L	FTAC201
TAC301		Abnormal Steady State Limits for Voltage and Frequency	100V RMS to 125V RMS, 380 Hz to 420 Hz	Apply for 30 mins	FTAC301
TAC302		Abnormal Voltage Transients	45V RMS to 180V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table TAC302-3 AA-GG	FTAC302-1
	2	Undervoltage Transients	Low voltage 45V RMS	Table TAC302-3 HH-NN	FTAC302-2
	3	Combined Transient	45V RMS to 180V RMS	Table TAC302-3 OO	FTAC302-3
TAC303		Abnormal Frequency Transients	320 Hz to 480 Hz	Table TAC303-3 AA-EE	FTAC303
TAC401		Emergency Steady State Limits for Voltage and Frequency	Perform Test TAC102		
TAC501		No Tests		N/A to AC Utilization Equipment	
TAC601		Power Failure (Three Phase)	0V for 7 seconds	Table TAC601-2 A-D	FTAC601
TAC602		One Phase and Two Phase Power Failures			
	1	One Phase Power Failures	0V for 7 seconds	Table TAC602-2 A-F	FTAC602-1
	2	Two Phase Power Failures	0V for 30 mins	Table TAC602-2 G-J	FTAC602-2
TAC603		Phase Reversal		Phase reversal done physically	FTAC603

**5.3.1.3 Table SVF:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SVF101		Load and Current Harmonic Measurements	115V RMS, 360-800 Hz		FSVF101
SVF102		Steady State Limits for Voltage and Frequency	108-118V RMS, 360-800 Hz	Apply for 30 mins each test	FSVF102
SVF103		No Test, Done so numbers coincide			
SVF104		Voltage Modulation			
	400-1	115V RMS, 400 Hz nominal settings	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-400-1

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	400-2	109V RMS, 400 Hz nominal settings	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-400-2
	400-3	117V RMS, 400 Hz nominal settings	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-400-3
	360-1	115V RMS, 360 Hz nominal settings	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-360-1
	360-2	109V RMS, 360 Hz nominal settings	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-360-2
	360-3	117V RMS, 360 Hz nominal settings	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-360-3
	600-1	115V RMS, 600 Hz nominal settings	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-600-1
	600-2	109V RMS, 600 Hz nominal settings	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-600-2
	600-3	117V RMS, 600 Hz nominal settings	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-600-3
	800-1	115V RMS, 800 Hz nominal settings	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-800-1
	800-2	109V RMS, 800 Hz nominal settings	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-800-2
	800-3	117V RMS, 800 Hz nominal settings	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FSVF104-800-3
SVF105		Frequency Modulation			
	400-1	115V RMS, 400 Hz nominal settings	400 Hz, 4 Hz mod	Apply for 30+ mins	FSVF105-400-1
	360-1	115V RMS, 360 Hz nominal settings	360 Hz, 4 Hz mod	Apply for 30+ mins	FSVF105-360-1
	600-1	115V RMS, 600 Hz nominal settings	600 Hz, 4 Hz mod	Apply for 30+ mins	FSVF105-600-1
	800-1	115V RMS, 800 Hz nominal settings	800 Hz, 4 Hz mod	Apply for 30+ mins	FSVF105-800-1
SVF106		Voltage Distortion Spectrum		Requires Additional Equipment	
SVF107		Total Voltage Distortion			
	400-1	115V RMS, 400 Hz nominal settings	Voltage Distortion Factor 0.05	Apply for 30 mins	FSVF107-400-1
	360-1	115V RMS, 360 Hz nominal settings	Voltage Distortion Factor 0.05	Apply for 30 mins	FSVF107-360-1
	600-1	115V RMS, 600 Hz nominal settings	Voltage Distortion Factor 0.05	Apply for 30 mins	FSVF107-600-1
	800-1	115V RMS, 800 Hz nominal settings	Voltage Distortion Factor 0.05	Apply for 30 mins	FSVF107-800-1
SVF108		DC Voltage Component			

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	400-1	400 Hz, Positive DC Offset	115V RMS + .10 DC offset	Apply for 30 mins	FSVF108-400-1
	400-2	400 Hz, Negative DC Offset	115V RMS - .10 DC offset	Apply for 30 mins	FSVF108-400-2
	360-1	360 Hz, Positive DC Offset	115V RMS + .10 DC offset	Apply for 30 mins	FSVF108-360-1
	360-2	360 Hz, Negative DC Offset	115V RMS - .10 DC offset	Apply for 30 mins	FSVF108-360-2
	600-1	600 Hz, Positive DC Offset	115V RMS + .10 DC offset	Apply for 30 mins	FSVF108-600-1
	600-2	600 Hz, Negative DC Offset	115V RMS - .10 DC offset	Apply for 30 mins	FSVF108-600-2
	800-1	800 Hz, Positive DC Offset	115V RMS + .10 DC offset	Apply for 30 mins	FSVF108-800-1
	800-2	800 Hz, Negative DC Offset	115V RMS - .10 DC offset	Apply for 30 mins	FSVF108-800-2
SVF109		Normal Voltage Transients			
	400-1	400 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table SVF109-2	FSVF109-400-1
	400-2	400 Hz, Undervoltage Transients	Low Voltage 80V RMS	Table SVF109-2	FSVF109-400-2
	400-3	400 Hz, Combined Transient	180V to 80V RMS	Table SVF109-2	FSVF109-400-3
	400-4	400 Hz, Repetitive Normal Voltage Transient Test	90V to 140V RMS	Figure SVF109-2	FSVF109-400-4
	360-1	360 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table SVF109-2	FSVF109-360-1
	360-2	360 Hz, Undervoltage Transients	Low Voltage 80V RMS	Table SVF109-2	FSVF109-360-2
	360-3	360 Hz, Combined Transient	180V to 80V RMS	Table SVF109-2	FSVF109-360-3
	360-4	360 Hz, Repetitive Normal Voltage Transient Test	90V to 140V RMS	Figure SVF109-2	FSVF109-360-4
	600-1	600 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table SVF109-2	FSVF109-600-1
	600-2	600 Hz, Undervoltage Transients	Low Voltage 80V RMS	Table SVF109-2	FSVF109-600-2
	600-3	600 Hz, Combined Transient	180V to 80V RMS	Table SVF109-2	FSVF109-600-3
	600-4	600 Hz, Repetitive Normal Voltage Transient Test	90V to 140V RMS	Figure SVF109-2	FSVF109-600-4
	800-1	800 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table SVF109-2	FSVF109-800-1
	800-2	800 Hz, Undervoltage Transients	Low Voltage 80V RMS	Table SVF109-2	FSVF109-800-2



Test No.	Section	Subject	Test Limits	Comment	File Ref.
	800-3	800 Hz, Combined Transient	180V to 80V RMS	Table SVF109-2	FSVF109-800-3
	800-4	800 Hz, Repetitive Normal Voltage Transient Test	90V to 140V RMS	Figure SVF109-2	FSVF109-800-4
SVF110		Normal Frequency Transients			
	1	Overfrequency Transients	High Frequency 800 Hz	Table SVF110-2	FSVF110-1
	2	Underfrequency Transients	Low Frequency 360 Hz	Table SVF110-2	FSVF110-2
	3	Combined Transient	360 Hz to 800 Hz	Table SVF110-2	FSVF110-3
SVF201		Power Interrupt			
	400-1	115V RMS, 400 Hz nominal settings	0V for 50 msec	Table SVF201-2	FSVF201-400-1
	360-1	115V RMS, 360 Hz nominal settings	0V for 50 msec	Table SVF201-2	FSVF201-360-1
	600-1	115V RMS, 600 Hz nominal settings	0V for 50 msec	Table SVF201-2	FSVF201-600-1
	800-1	115V RMS, 800 Hz nominal settings	0V for 50 msec	Table SVF201-2	FSVF201-800-1
SVF301		Abnormal Steady State Limits for Voltage and Frequency	100V to 125V RMS, 360Hz to 800 Hz	Apply for 30 mins	FSVF301
SVF302		Abnormal Voltage Transients			
	400-1	400 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table SVF302-2 A-G	FSVF302-400-1
	400-2	400 Hz, Undervoltage Transients	Low Voltage 45V RMS	Table SVF302-2 H-N	FSVF302-400-2
	400-3	400 Hz, Combined Transient	45V RMS to 180V RMS	Table SVF302-2 O	FSVF302-400-3
	360-1	360 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table SVF302-2 A-G	FSVF302-360-1
	360-2	360 Hz, Undervoltage Transients	Low Voltage 45V RMS	Table SVF302-2 H-N	FSVF302-360-2
	360-3	360 Hz, Combined Transient	45V RMS to 180V RMS	Table SVF302-2 O	FSVF302-360-3
	600-1	600 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table SVF302-2 A-G	FSVF302-600-1
	600-2	600 Hz, Undervoltage Transients	Low Voltage 45V RMS	Table SVF302-2 H-N	FSVF302-600-2
	600-3	600 Hz, Combined Transient	45V RMS to 180V RMS	Table SVF302-2 O	FSVF302-600-3
	800-1	800 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table SVF302-2 A-G	FSVF302-800-1

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	800-2	800 Hz, Undervoltage Transients	Low Voltage 45V RMS	Table SVF302-2 H-N	FSVF302-800-2
	800-3	800 Hz, Combined Transient	45V RMS to 180V RMS	Table SVF302-2 O	FSVF302-800-3
SVF303		Abnormal Frequency Transients			
	1	Overfrequency Transients	High Frequency 800 Hz	Table SVF303-2 A-D	FSVF303-1
	2	Underfrequency Transients	Low Frequency 360 Hz	Table SVF303-2 E-H	FSVF303-2
	3	Combined Transient	360 Hz to 800 Hz	Table SVF303-2 I	FSVF303-3
SVF401		Emergency Limits for Voltage and Frequency	Perform Test SVF102		
SVF501		No Tests		N/A to AC Utilization Equipment	
SVF601		Power Failure (Single Phase)			
	400-1	115V RMS, 400 Hz nominal settings	0V for 7 seconds	Table SVF601-2	FSVF601-400-1
	360-1	115V RMS, 360 Hz nominal settings	0V for 7 seconds	Table SVF601-2	FSVF601-360-1
	600-1	115V RMS, 600 Hz nominal settings	0V for 7 seconds	Table SVF601-2	FSVF601-600-1
	800-1	115V RMS, 800 Hz nominal settings	0V for 7 seconds	Table SVF601-2	FSVF601-800-1
SVF602		No Test, Done so numbers coincide			
SVF603		Phase Reversal		Phase reversal done physically	FSVF603

**5.3.1.4 Table TVF:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TVF101		Load and Current Harmonic Measurements	115V RMS, 360-800 Hz		FTVF101
TVF102		Steady State Limits for Voltage (Including Unbalance) and Frequency			
	1	Balanced Phases	108V to 118V RMS, 360 to 800 Hz	Apply for 30 mins each test	FTVF102-1
	2	Unbalanced Phases	108V to 118V RMS, +/- 3V Unbalance	Apply for 30 mins each test	FTVF102-2
TVF103		Voltage Phase Difference			

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	400-1	115V RMS, 400 Hz nominal settings	Phase B 116 to 124 degrees	Apply for 30 mins each test	FTVF103-400-1
	360-1	115V RMS, 360 Hz nominal settings	Phase B 116 to 124 degrees	Apply for 30 mins each test	FTVF103-360-1
	600-1	115V RMS, 600 Hz nominal settings	Phase B 116 to 124 degrees	Apply for 30 mins each test	FTVF103-600-1
	800-1	115V RMS, 800 Hz nominal settings	Phase B 116 to 124 degrees	Apply for 30 mins each test	FTVF103-800-1
TVF104		Voltage Modulation			
	400-1	115V RMS, 400 Hz nominal settings	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-400-1
	400-2	109V RMS, 400 Hz nominal settings	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-400-2
	400-3	117V RMS, 400 Hz nominal settings	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-400-3
	360-1	115V RMS, 360 Hz nominal settings	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-360-1
	360-2	109V RMS, 360 Hz nominal settings	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-360-2
	360-3	117V RMS, 360 Hz nominal settings	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-360-3
	600-1	115V RMS, 600 Hz nominal settings	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-600-1
	600-2	109V RMS, 600 Hz nominal settings	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-600-2
	600-3	117V RMS, 600 Hz nominal settings	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-600-3
	800-1	115V RMS, 800 Hz nominal settings	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-800-1
	800-2	109V RMS, 800 Hz nominal settings	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-800-2
	800-3	117V RMS, 800 Hz nominal settings	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FTVF104-800-3
TVF105		Frequency Modulation			
	400-1	115V RMS, 400 Hz nominal settings	400 Hz, 4 Hz mod	Apply for 30+ mins	FTVF105-400-1
	360-1	115V RMS, 360 Hz nominal settings	360 Hz, 4 Hz mod	Apply for 30+ mins	FTVF105-360-1
	600-1	115V RMS, 600 Hz nominal settings	600 Hz, 4 Hz mod	Apply for 30+ mins	FTVF105-600-1
	800-1	115V RMS, 800 Hz nominal settings	800 Hz, 4 Hz mod	Apply for 30+ mins	FTVF105-800-1
TVF106		Voltage Distortion Spectrum		Requires Additional Equipment	

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TVF107		Total Voltage Distortion			
	400-1	115V RMS, 400 Hz nominal settings	Voltage Distortion Factor 0.05	Apply for 30 mins	FTVF107-400-1
	360-1	115V RMS, 360 Hz nominal settings	Voltage Distortion Factor 0.05	Apply for 30 mins	FTVF107-360-1
	600-1	115V RMS, 600 Hz nominal settings	Voltage Distortion Factor 0.05	Apply for 30 mins	FTVF107-600-1
	800-1	115V RMS, 800 Hz nominal settings	Voltage Distortion Factor 0.05	Apply for 30 mins	FTVF107-800-1
TVF108		DC Voltage Component			
	400-1	400 Hz, Positive DC Offset	115V RMS + .10 DC offset	Apply for 30 mins	FTVF108-400-1
	400-2	400 Hz, Negative DC Offset	115V RMS - .10 DC offset	Apply for 30 mins	FTVF108-400-2
	360-1	360 Hz, Positive DC Offset	115V RMS + .10 DC offset	Apply for 30 mins	FTVF108-360-1
	360-2	360 Hz, Negative DC Offset	115V RMS - .10 DC offset	Apply for 30 mins	FTVF108-360-2
	600-1	600 Hz, Positive DC Offset	115V RMS + .10 DC offset	Apply for 30 mins	FTVF108-600-1
	600-2	600 Hz, Negative DC Offset	115V RMS - .10 DC offset	Apply for 30 mins	FTVF108-600-2
	800-1	800 Hz, Positive DC Offset	115V RMS + .10 DC offset	Apply for 30 mins	FTVF108-800-1
	800-2	800 Hz, Negative DC Offset	115V RMS - .10 DC offset	Apply for 30 mins	FTVF108-800-2
TVF109		Normal Voltage Transients			
	400-1	400 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table TVF109-2	FTVF109-400-1
	400-2	400 Hz, Undervoltage Transients	Low Voltage 80V RMS	Table TVF109-2	FTVF109-400-2
	400-3	400 Hz, Combined Transient	180V to 80V RMS	Table TVF109-2	FTVF109-400-3
	400-4	400 Hz, Repetitive Normal Voltage Transient Test	90V to 140V RMS	Figure TVF109-2	FTVF109-400-4
	360-1	360 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table TVF109-2	FTVF109-360-1
	360-2	360 Hz, Undervoltage Transients	Low Voltage 80V RMS	Table TVF109-2	FTVF109-360-2
	360-3	360 Hz, Combined Transient	180V to 80V RMS	Table TVF109-2	FTVF109-360-3
	360-4	360 Hz, Repetitive Normal Voltage Transient Test	90V to 140V RMS	Figure TVF109-2	FTVF109-360-4

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	600-1	600 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table TVF109-2	FTVF109-600-1
	600-2	600 Hz, Undervoltage Transients	Low Voltage 80V RMS	Table TVF109-2	FTVF109-600-2
	600-3	600 Hz, Combined Transient	180V to 80V RMS	Table TVF109-2	FTVF109-600-3
	600-4	600 Hz, Repetitive Normal Voltage Transient Test	90V to 140V RMS	Figure TVF109-2	FTVF109-600-4
	800-1	800 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table TVF109-2	FTVF109-800-1
	800-2	800 Hz, Undervoltage Transients	Low Voltage 80V RMS	Table TVF109-2	FTVF109-800-2
	800-3	800 Hz, Combined Transient	180V to 80V RMS	Table TVF109-2	FTVF109-800-3
	800-4	800 Hz, Repetitive Normal Voltage Transient Test	90V to 140V RMS	Figure TVF109-2	FTVF109-800-4
TVF110		Normal Frequency Transients			
	1	Overfrequency Transients	High Frequency 800 Hz	Table TVF110-2	FTVF110-1
	2	Underfrequency Transients	Low Frequency 360 Hz	Table TVF110-2	FTVF110-2
	3	Combined Transient	360 Hz to 800 Hz	Table TVF110-2	FTVF110-3
TVF201		Power Interrupt			
	400-1	115V RMS, 400 Hz nominal settings	0V for 50 msec	Table TVF201-2	FTVF201-400-1
	360-1	115V RMS, 360 Hz nominal settings	0V for 50 msec	Table TVF201-2	FTVF201-360-1
	600-1	115V RMS, 600 Hz nominal settings	0V for 50 msec	Table TVF201-2	FTVF201-600-1
	800-1	115V RMS, 800 Hz nominal settings	0V for 50 msec	Table TVF201-2	FTVF201-800-1
TVF301		Abnormal Steady State Limits for Voltage and Frequency	100V to 125V RMS, 360Hz to 800 Hz	Apply for 30 mins	FTVF301
TVF302		Abnormal Voltage Transients			
	400-1	400 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table TVF302-2 A-G	FTVF302-400-1
	400-2	400 Hz, Undervoltage Transients	Low Voltage 45V RMS	Table TVF302-2 H-N	FTVF302-400-2
	400-3	400 Hz, Combined Transient	45V RMS to 180V RMS	Table TVF302-2 O	FTVF302-400-3
	360-1	360 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table TVF302-2 A-G	FTVF302-360-1

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	360-2	360 Hz, Undervoltage Transients	Low Voltage 45V RMS	Table TVF302-2 H-N	FTVF302-360-2
	360-3	360 Hz, Combined Transient	45V RMS to 180V RMS	Table TVF302-2 O	FTVF302-360-3
	600-1	600 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table TVF302-2 A-G	FTVF302-600-1
	600-2	600 Hz, Undervoltage Transients	Low Voltage 45V RMS	Table TVF302-2 H-N	FTVF302-600-2
	600-3	600 Hz, Combined Transient	45V RMS to 180V RMS	Table TVF302-2 O	FTVF302-600-3
	800-1	800 Hz, Overvoltage Transients	Peak Voltage 180V RMS	Table TVF302-2 A-G	FTVF302-800-1
	800-2	800 Hz, Undervoltage Transients	Low Voltage 45V RMS	Table TVF302-2 H-N	FTVF302-800-2
	800-3	800 Hz, Combined Transient	45V RMS to 180V RMS	Table TVF302-2 O	FTVF302-800-3
TVF303		Abnormal Frequency Transients			
	1	Overfrequency Transients	High Frequency 800 Hz	Table TVF303-2 A-D	FTVF303-1
	2	Underfrequency Transients	Low Frequency 360 Hz	Table TVF303-2 E-H	FTVF303-2
	3	Combined Transient	360 Hz to 800 Hz	Table TVF303-2 I	FTVF303-3
TVF401		Emergency Limits for Voltage and Frequency	Perform Test TVF102		
TVF501		No Tests		N/A to AC Utilization Equipment	
TVF601		Power Failure (Single Phase)			
	400-1	115V RMS, 400 Hz nominal settings	0V for 7 seconds	Table TVF601-2	FTVF601-400-1
	360-1	115V RMS, 360 Hz nominal settings	0V for 7 seconds	Table TVF601-2	FTVF601-360-1
	600-1	115V RMS, 600 Hz nominal settings	0V for 7 seconds	Table TVF601-2	FTVF601-600-1
	800-1	115V RMS, 800 Hz nominal settings	0V for 7 seconds	Table TVF601-2	FTVF601-800-1
TVF602		One Phase and Two Phase Power Failures			
	400-1	One Phase Power Failures	0V for 7 seconds	Table TVF602-2 A-F	FTVF602-400-1
	400-2	Two Phase Power Failures	0V for 30 mins	Table TVF602-2 G-J	FTVF602-400-2
	360-1	One Phase Power Failures	0V for 7 seconds	Table TVF602-2 A-F	FTVF602-360-1

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	360-2	Two Phase Power Failures	0V for 30 mins	Table TVF602-2 G-J	FTVF602-360-2
	600-1	One Phase Power Failures	0V for 7 seconds	Table TVF602-2 A-F	FTVF602-600-1
	600-2	Two Phase Power Failures	0V for 30 mins	Table TVF602-2 G-J	FTVF602-600-2
	800-1	One Phase Power Failures	0V for 7 seconds	Table TVF602-2 A-F	FTVF602-800-1
	800-2	Two Phase Power Failures	0V for 30 mins	Table TVF602-2 G-J	FTVF602-800-2
TVF603		Phase Reversal		Phase reversal done physically	FTVF603

**5.3.1.5 Table SXF:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SXF101		Load and Current Harmonic Measurements	115V RMS, 60 Hz		FSXF101
SXF102		Steady State Limits for Voltage and Frequency	105V to 125V RMS, 59.75 to 60.25 Hz	Apply for 30 mins each test	FSXF102
SXF103		No Test, Done so test numbers coincide			
SXF104		Voltage Modulation			
	1	115V Nominal Test	115V RMS, 2.5V RMS mod	Apply for 10+ mins	FSXF104-1
	2	109V Nominal Test	109V RMS, 2.5V RMS mod	Apply for 10+ mins	FSXF104-2
	3	117V Nominal Test	117V RMS, 2.5V RMS mod	Apply for 10+ mins	FSXF104-3
SXF105		Frequency Modulation			
	1	60 Hz Nominal Test	60 Hz, .5 Hz mod	Apply for 10+ mins	FSXF105-1
	2	59.75 Hz Nominal Test	59.75 Hz, .5 Hz mod	Apply for 10+ mins	FSXF105-2
	3	60.75 Hz Nominal Test	60.75 Hz, .5 Hz mod	Apply for 10+ mins	FSXF105-3
SXF106		Voltage Distortion Spectrum		Requires Additional Equipment	
SXF107		Total Voltage Distortion	Voltage Distortion Factor 0.05	Apply for 30 mins	FSXF107
SXF108		DC Voltage Component			

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	1	Positive DC Offset	115V RMS + .10V DC	Apply for 30 mins	FSXF108-1
	2	Negative DC Offset	115V RMS - .10V DC	Apply for 30 mins	FSXF108-2
SXF109		Normal Voltage Transients	152V RMS to 31V RMS		
	1	Overvoltage Transients	Peak voltage 152V RMS	Table SXF109-3 A-D	FSXF109-1
	2	Undervoltage Transients	Low voltage 31V RMS	Table SXF109-3 E-H	FSXF109-2
	3	Combined Transient	130V RMS to 70V RMS	Table SXF109-3 I	FSXF109-3
	4	Repetitive Normal Voltage Transient Test	100V RMS to 128V RMS	Run transient for 30 mins	FSXF109-4
SXF110		Normal Frequency Transients	59 Hz to 61 Hz		
	1	Overfrequency Transients	High Frequency 61 Hz	Table SXF110-3 A-B	FSXF110-1
	2	Underfrequency Transients	Low Frequency 59 Hz	Table SXF110-3 C-D	FSXF110-2
	3	Combined Transient	59 Hz to 61 Hz	Table SXF110-3 E	FSXF110-3
SXF201		Power Interrupt	0V for 50 msec	Table SXF201-2 A-L	FSXF201
SXF301		Abnormal Steady State Limits for Voltage and Frequency	100V RMS to 128V RMS, 59.5 Hz to 60.5 Hz	Apply for 30 mins	FSXF301
SXF302		Abnormal Voltage Transients	50V RMS to 180V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table SXF302-3 A-E	FSXF302-1
	2	Undervoltage Transients	Low voltage 50V RMS	Table SXF302-3 F-J	FSXF302-2
	3	Combined Transient	50V RMS to 180V RMS	Table SXF302-3 K	FSXF302-3
SXF303		Abnormal Frequency Transients	50 Hz to 61 Hz	Table SXF303-3 A-E	FSXF303
SXF401		Emergency Steady State Limits for Voltage and Frequency	Perform Test SXF102		
SXF501		No Tests		N/A to AC Utilization Equipment	
SXF601		Power Failure (Single Phase)	0V for 2 seconds	Table SXF601-2 A-C	FSXF601
SXF602		Power Failure	No test, done so numbers coincide		
SXF603		Phase Reversal		Phase reversal done physically	FSXF603



**5.3.1.6 Table LDC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
LDC101		Load Measurements	28V DC		FLDC101
LDC102		Steady State Limits for Voltage	22V to 29V DC	Apply for 30 mins	FLDC102
LDC103		Voltage Distortion Spectrum		Requires Additional Equipment	
LDC104		Total Ripple		Requires Additional Equipment	
LDC105		Normal Voltage Transients	18V to 50V DC		
	1	Overvoltage Transients	Peak Voltage 50V DC	Table LDC105-3 AA-JJ	FLDC105-1
	2	Undervoltage Transients	Low Voltage 18V DC	Table LDC105-3 KK-PP	FLDC105-2
	3	Combined Transients	18V to 50V DC	Table LDC105-3 QQ-RR	FLDC105-3
	4	Repetitive Normal Voltage Transient Test	18V to 45V DC	Repeat transient for 30 mins	FLDC105-4
LDC201		Power Interrupt	0V for 50 msec	Table LDC201-2 A-L	FLDC201
LDC301		Abnormal Steady State Limits for Voltage	20V to 31.5V DC	Apply each test for 30 mins	FLDC301
LDC302		Abnormal Voltage Transients	7V to 50V DC		
	1	Overvoltage Transients	Peak Voltage 50V DC	Table LDC302-4 AAA-FFF	FLDC302-1
	2	Undervoltage Transients	Low Voltage 7V DC	Table LDC302-4 GGG-LLL	FLDC302-2
	3	Combined Transients	7V to 50V DC	Table LDC302-4 MMM-NNN	FLDC302-3
LDC401		Emergency Limits for Voltage	18V to 29V DC	Apply each test for 30 mins	FLDC401
LDC501		Starting Voltage Transients	12V to 29V DC	Table LDC501-3 AA	FLDC501
LDC601		Power Failure	0V for 7 seconds	Table LDC601-2 A-D	FLDC601
LDC602		Polarity Reversal		Polarity reversal done physically	FLDC602

**5.3.1.7 Table HDC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
HDC101		Load Measurements	270V DC		FHDC101
HDC102		Steady State Limits for Voltage	250V to 280V DC	Apply for 30 mins	FHDC102
HDC103		Voltage Distortion Spectrum		Requires Additional Equipment	
HDC104		Total Ripple		Requires Additional Equipment	
HDC105		Normal Voltage Transients	200V to 330V DC		
	1	Overvoltage Transients	Peak Voltage 330V DC	Table HDC105-2 AA-JJ	FHDC105-1
	2	Undervoltage Transients	Low Voltage 200V DC	Table HDC105-2 KK-PP	FHDC105-2
	3	Combined Transients	200V to 330V DC	Table HDC105-2 QQ-RR	FHDC105-3
	4	Repetitive Normal Voltage Transient Test	215V to 315V DC	Repeat transient for 30 mins	FHDC105-4
HDC201		Power Interrupt	0V for 50 msec	Table HDC201-2 A-L	FHDC201
HDC301		Abnormal Steady State Limits for Voltage	240V to 290V DC	Apply each test for 30 mins	FHDC301
HDC302		Abnormal Voltage Transients	180V to 350V DC		
	1	Overvoltage Transients	Peak Voltage 350V DC	Table HDC302-4 AAA-FFF	FHDC302-1
	2	Undervoltage Transients	Low Voltage 180V DC	Table HDC302-4 GGG-LLL	FHDC302-2
	3	Combined Transients	180V to 350V DC	Table HDC302-4 MMM-NNN	FHDC302-3
HDC401		Emergency Limits for Voltage	250V to 280V DC	Apply each test for 30 mins	FHDC401
HDC501		Starting Voltage Transients	115V to 280V DC	Table HDC501-3 AA	FHDC501
HDC601		Power Failure	0V for 7 seconds	Table HDC601-2 A-D	FHDC601
HDC602		Polarity Reversal		Polarity reversal done physically	FHDC602

**5.3.2 Rev E**

This test should be performed using the firmware version of the –704 option.

**5.3.3 Rev D**

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This test should be performed using the firmware version of the –704 option.

**5.3.4 Rev C:****5.3.4.1 Table SAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SAC101		Load and Current Harmonic Measurements	115V RMS, 400 Hz		CSAC101
SAC102		Steady State Limits for Voltage and Frequency	108V to 118V RMS, 393 to 407 Hz	Apply for 30 mins each test	CSAC102
SAC103		No Test, Done so test numbers coincide			
SAC104		Voltage Modulation			
	1	115V Nominal Test	115V RMS, 2.5V RMS mod	Apply for 10+ mins	CSAC104-1
	2	109V Nominal Test	109V RMS, 2.5V RMS mod	Apply for 10+ mins	CSAC104-2
	3	117V Nominal Test	117V RMS, 2.5V RMS mod	Apply for 10+ mins	CSAC104-3
SAC105		Frequency Modulation			
	1	400 Hz Nominal Test	400 Hz, +/-5 Hz mod	Apply for 10+ mins	CSAC105-1
	2	395 Hz Nominal Test	395 Hz, +/-5 Hz mod	Apply for 10+ mins	CSAC105-2
	3	405 Hz Nominal Test	405 Hz, +/-5 Hz mod	Apply for 10+ mins	CSAC105-3
SAC106		Voltage Distortion Spectrum		Requires Additional Equipment	
SAC107		Total Voltage Distortion	Voltage Distortion Factor 0.05	Apply for 30 mins	CSAC107
SAC108		DC Voltage Component			
	1	Positive DC Offset	115V RMS + .10V DC	Apply for 30 mins	CSAC108-1
	2	Negative DC Offset	115V RMS - .10V DC	Apply for 30 mins	CSAC108-2
SAC109		Normal Voltage Transients	180V RMS to 80V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table SAC109-3 AA-GG	CSAC109-1
	2	Undervoltage Transients	Low voltage 80V RMS	Table SAC109-3 HH-LL	CSAC109-2
	3	Combined Transient	180V RMS to 80V RMS	Table SAC109-3 MM	CSAC109-3
	4	Repetitive Normal Voltage Transient Test	90V RMS to 140V RMS	Run transient for 30 mins	CSAC109-4

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SAC110		Normal Frequency Transients	375 Hz to 425 Hz		
	1	Overfrequency Transients	High Frequency 425 Hz	Table SAC110-3 AA-DD	CSAC110-1
	2	Underfrequency Transients	Low Frequency 375 Hz	Table SAC110-3 EE-HH	CSAC110-2
	3	Combined Transient	375 Hz to 425 Hz	Table SAC110-3 II	CSAC110-3
SAC201		Power Interrupt	0V for 50 msec	Table SAC201-2 A-L	CSAC201
SAC301		Abnormal Steady State Limits for Voltage and Frequency	100V RMS to 125V RMS, 380 Hz to 420 Hz	Apply for 30 mins	CSAC301
SAC302		Abnormal Voltage Transients	45V RMS to 180V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table SAC302-3 AA-GG	CSAC302-1
	2	Undervoltage Transients	Low voltage 45V RMS	Table SAC302-3 HH-NN	CSAC302-2
	3	Combined Transient	45V RMS to 180V RMS	Table SAC302-3 OO	CSAC302-3
SAC303		Abnormal Frequency Transients	320 Hz to 480 Hz	Table SAC303-3 AA-EE	CSAC303
SAC401		Emergency Steady State Limits for Voltage and Frequency	104V to 122V RMS, 360 to 440 Hz	Apply for 30 mins each test	CSAC401
SAC501		No Tests		N/A to AC Utilization Equipment	
SAC601		Power Failure (Single Phase)	0V for 7 seconds	Table SAC601-2 A-D	CSAC601
SAC602		Power Failure	No test, done so numbers coincide		
SAC603		Phase Reversal	N/A to Rev C		

#### 5.3.4.2 Table TAC:

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TAC101		Three Phase Load and Current Harmonic Measurements	115V RMS, 400 Hz		CTAC101
TAC102		Steady State Limits for Voltage (Including Unbalance) and Frequency			
	1	Balanced Phases	108V to 118V RMS, 393 to 407 Hz	Apply for 30 mins each test	CTAC102-1
	2	Unbalanced Phases	108V to 118V RMS, +/- 3V Unbalance	Apply for 30 mins each test	CTAC102-2

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TAC103		Voltage Phase Difference	Phase B 116 to 124 degrees	Apply for 30 mins each test	CTAC103
TAC104		Voltage Modulation			
	1	115V Nominal Test	115V RMS, 2.5V RMS mod	Apply for 10+ mins	CTAC104-1
	2	109V Nominal Test	109V RMS, 2.5V RMS mod	Apply for 10+ mins	CTAC104-2
	3	117V Nominal Test	117V RMS, 2.5V RMS mod	Apply for 10+ mins	CTAC104-3
TAC105		Frequency Modulation			
	1	400 Hz Nominal Test	400 Hz, +/-5 Hz mod	Apply for 10+ mins	CTAC105-1
	2	395 Hz Nominal Test	395 Hz, +/-5 Hz mod	Apply for 10+ mins	CTAC105-2
	3	405 Hz Nominal Test	405 Hz, +/-5 Hz mod	Apply for 10+ mins	CTAC105-3
TAC106		Voltage Distortion Spectrum		Requires Additional Equipment	
TAC107		Total Voltage Distortion	Voltage Distortion Factor 0.05	Apply for 30 mins	CTAC107
TAC108		DC Voltage Component			
	1	Positive DC Offset	115V RMS + .10V DC	Apply for 30 mins	CTAC108-1
	2	Negative DC Offset	115V RMS - .10V DC	Apply for 30 mins	CTAC108-2
TAC109		Normal Voltage Transients	180V RMS to 80V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table TAC109-3 AA-GG	CTAC109-1
	2	Undervoltage Transients	Low voltage 80V RMS	Table TAC109-3 HH-LL	CTAC109-2
	3	Combined Transient	180V RMS to 80V RMS	Table TAC109-3 MM	CTAC109-3
	4	Repetitive Normal Voltage Transient Test	90V RMS to 140V RMS	Run transient for 30 mins	CTAC109-4
TAC110		Normal Frequency Transients	375 Hz to 425 Hz		
	1	Overfrequency Transients	High Frequency 425 Hz	Table TAC110-3 AA-DD	CTAC110-1
	2	Underfrequency Transients	Low Frequency 375 Hz	Table TAC110-3 EE-HH	CTAC110-2
	3	Combined Transient	375 Hz to 425 Hz	Table TAC110-3 II	CTAC110-3

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TAC201		Power Interrupt	0V for 50 msec	Table TAC201-2 A-L	CTAC201
TAC301		Abnormal Steady State Limits for Voltage and Frequency	100V RMS to 125V RMS, 380 Hz to 420 Hz	Apply for 30 mins	CTAC301
TAC302		Abnormal Voltage Transients	45V RMS to 180V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table TAC302-3 AA-GG	CTAC302-1
	2	Undervoltage Transients	Low voltage 45V RMS	Table TAC302-3 HH-NN	CTAC302-2
	3	Combined Transient	45V RMS to 180V RMS	Table TAC302-3 OO	CTAC302-3
TAC303		Abnormal Frequency Transients	320 Hz to 480 Hz	Table TAC303-3 AA-EE	CTAC303
TAC401		Emergency Steady State Limits for Voltage and Frequency	104V to 122V RMS, 360 to 440 Hz	Apply for 30 mins each test	CTAC401
TAC501		No Tests		N/A to AC Utilization Equipment	
TAC601		Power Failure (Three Phase)	0V for 7 seconds	Table TAC601-2 A-D	CTAC601
TAC602		One Phase and Two Phase Power Failures			
	1	One Phase Power Failures	0V for 7 seconds	Table TAC602-2 A-F	CTAC602-1
	2	Two Phase Power Failures	0V for 30 mins	Table TAC602-2 G-J	CTAC602-2
TAC603		Phase Reversal	N/A to Rev C		

#### 5.3.4.3 Table LDC:

Test No.	Section	Subject	Test Limits	Comment	File Ref.
LDC101		Load Measurements	28V DC		CLDC101
LDC102		Steady State Limits for Voltage	22V to 29V DC	Apply for 30 mins	CLDC102
LDC103		Voltage Distortion Spectrum		Requires Additional Equipment	
LDC104		Total Ripple		Requires Additional Equipment	
LDC105		Normal Voltage Transients	18V to 50V DC		
	1	Overvoltage Transients	Peak Voltage 50V DC	Table LDC105-3 AA-JJ	CLDC105-1

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	2	Undervoltage Transients	Low Voltage 18V DC	Table LDC105-3 KK-PP	CLDC105-2
	3	Combined Transients	18V to 50V DC	Table LDC105-3 QQ-RR	CLDC105-3
	4	Repetitive Normal Voltage Transient Test	18V to 45V DC	Repeat transient for 30 mins	CLDC105-4
LDC201		Power Interrupt	0V for 50 msec	Table LDC201-2 A-L	CLDC201
LDC301		Abnormal Steady State Limits for Voltage	20V to 31.5V DC	Apply each test for 30 mins	CLDC301
LDC302		Abnormal Voltage Transients	7V to 50V DC		
	1	Overvoltage Transients	Peak Voltage 50V DC	Table LDC302-3 AA-FF	CLDC302-1
	2	Undervoltage Transients	Low Voltage 7V DC	Table LDC302-3 GG-LL	CLDC302-2
	3	Combined Transients	7V to 50V DC	Table LDC302-3 MM-NN	CLDC302-3
LDC401		Emergency Limits for Voltage	16V to 30V DC	Apply each test for 30 mins	CLDC401
LDC501		Starting Voltage Transients	16V to 30V DC	Table LDC501-2 A	CLDC501
LDC601		Power Failure	0V for 7 seconds	Table LDC601-2 A-D	CLDC601
LDC602		Polarity Reversal	N/A to Rev B		

#### 5.3.4.4 Table HDC:

Test No.	Section	Subject	Test Limits	Comment	File Ref.
HDC101		Load Measurements	270V DC		CHDC101
HDC102		Steady State Limits for Voltage	250V to 280V DC	Apply for 30 mins	CHDC102
HDC103		Voltage Distortion Spectrum		Requires Additional Equipment	
HDC104		Total Ripple		Requires Additional Equipment	
HDC105		Normal Voltage Transients	125V to 475V DC		
	1	Overvoltage Transients	Peak Voltage 475V DC	Table HDC105-1 A-J	CHDC105-1
	2	Undervoltage Transients	Low Voltage 125V DC	Table HDC105-1 K-P	CHDC105-2



Test No.	Section	Subject	Test Limits	Comment	File Ref.
	3	Combined Transients	125V to 475V DC	Table HDC105-1 Q-R	CHDC105-3
	4	Repetitive Normal Voltage Transient Test	215V to 315V DC	Repeat transient for 30 mins	CHDC105-4
HDC201		Power Interrupt	0V for 50 msec	Table HDC201-2 A-L	CHDC201
HDC301		Abnormal Steady State Limits for Voltage	245V to 285V DC	Apply each test for 30 mins	CHDC301
HDC302		Abnormal Voltage Transients	65V to 475V DC		
	1	Overvoltage Transients	Peak Voltage 475V DC	Table HDC302-2 A-F	CHDC302-1
	2	Undervoltage Transients	Low Voltage 65V DC	Table HDC302-2 G-L	CHDC302-2
	3	Combined Transients	65V to 475V DC	Table HDC302-2 M-N	CHDC302-3
HDC401		Emergency Limits for Voltage	240V to 290V DC	Apply each test for 30 mins	CHDC401
HDC501		Starting Voltage Transients	155V to 280V DC	Table HDC501-2 A	CHDC501
HDC601		Power Failure	0V for 7 seconds	Table HDC601-2 A-D	CHDC601
HDC602		Polarity Reversal	N/A to Rev B		

**5.3.5 Rev B:****5.3.5.1 Table SAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SAC101		Load and Current Harmonic Measurements	115V RMS, 400 Hz		BSAC101
SAC102		Steady State Limits for Voltage and Frequency			
	1	Regular Test	108V to 118V RMS, 395 to 405 Hz	Apply for 30 mins each test	BSAC102-1
	2	Helicopter Test	108V to 118V RMS, 380 to 420 Hz	Apply for 30 mins each test	BSAC102-2
SAC103		No Test, Done so test numbers coincide			
SAC104		Voltage Modulation			
	1	115V Nominal Test	115V RMS, 2.5V RMS mod	Apply for 10+ mins	BSAC104-1
	2	109V Nominal Test	109V RMS, 2.5V RMS mod	Apply for 10+ mins	BSAC104-2
	3	117V Nominal Test	117V RMS, 2.5V RMS mod	Apply for 10+ mins	BSAC104-3
SAC105		Frequency Modulation			
	1	400 Hz Nominal Test	400 Hz, +/-5 Hz mod	Apply for 10+ mins	BSAC105-1
	2	395 Hz Nominal Test	395 Hz, +/-5 Hz mod	Apply for 10+ mins	BSAC105-2
	3	405 Hz Nominal Test	405 Hz, +/-5 Hz mod	Apply for 10+ mins	BSAC105-3
SAC106		Voltage Distortion Spectrum		Requires Additional Equipment	
SAC107		Total Voltage Distortion	Voltage Distortion Factor 0.05	Apply for 30 mins	BSAC107
SAC108		DC Voltage Component			
	1	Positive DC Offset	115V RMS + .10V DC	Apply for 30 mins	BSAC108-1
	2	Negative DC Offset	115V RMS - .10V DC	Apply for 30 mins	BSAC108-2
SAC109		Normal Voltage Transients	180V RMS to 80V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table SAC109-3 AA-GG	BSAC109-1
	2	Undervoltage Transients	Low voltage 80V RMS	Table SAC109-3 HH-LL	BSAC109-2

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	3	Combined Transient	180V RMS to 80V RMS	Table SAC109-3 MM	BSAC109-3
	4	Repetitive Normal Voltage Transient Test	90V RMS to 140V RMS	Run transient for 30 mins	BSAC109-4
SAC110		Normal Frequency Transients	375 Hz to 425 Hz		
	1	Overfrequency Transients	High Frequency 425 Hz	Table SAC110-3 AA-DD	BSAC110-1
	2	Underfrequency Transients	Low Frequency 375 Hz	Table SAC110-3 EE-HH	BSAC110-2
	3	Combined Transient	375 Hz to 425 Hz	Table SAC110-3 II	BSAC110-3
SAC201		Power Interrupt	0V for 50 msec	Table SAC201-2 A-L	BSAC201
SAC301		Abnormal Steady State Limits for Voltage and Frequency	100V RMS to 125V RMS, 375 Hz to 425 Hz	Apply for 30 mins	BSAC301
SAC302		Abnormal Voltage Transients	45V RMS to 180V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table SAC302-3 AA-GG	BSAC302-1
	2	Undervoltage Transients	Low voltage 45V RMS	Table SAC302-3 HH-NN	BSAC302-2
	3	Combined Transient	45V RMS to 180V RMS	Table SAC302-3 OO	BSAC302-3
SAC303		Abnormal Frequency Transients	320 Hz to 480 Hz	Table SAC303-3 AA-EE	BSAC303
SAC401		Emergency Steady State Limits for Voltage and Frequency	102V to 124V RMS, 360 to 440 Hz	Apply for 30 mins each test	BSAC401
SAC501		No Tests		N/A to AC Utilization Equipment	
SAC601		Power Failure (Single Phase)	0V for 7 seconds	Table SAC601-2 A-D	BSAC601
SAC602		Power Failure	No test, done so numbers coincide		
SAC603		Phase Reversal	N/A to Rev B		

### 5.3.5.2 Table TAC:

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TAC101		Three Phase Load and Current Harmonic Measurements	115V RMS, 400 Hz		BTAC101
TAC102		Steady State Limits for Voltage (Including Unbalance) and Frequency			

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	1	Balanced Phases	108V to 118V RMS, 395 to 405 Hz	Apply for 30 mins each test	BTAC102-1
	2	Helicopter Test	108V to 118V RMS, 380 to 420 Hz	Apply for 30 mins each test	BTAC102-2
	3	Unbalanced Phases	108V to 118V RMS, +/- 3V Unbalance	Apply for 30 mins each test	BTAC102-3
TAC103		Voltage Phase Difference	Phase B 116 to 124 degrees	Apply for 30 mins each test	BTAC103
TAC104		Voltage Modulation			
	1	115V Nominal Test	115V RMS, 2.5V RMS mod	Apply for 10+ mins	BTAC104-1
	2	109V Nominal Test	109V RMS, 2.5V RMS mod	Apply for 10+ mins	BTAC104-2
	3	117V Nominal Test	117V RMS, 2.5V RMS mod	Apply for 10+ mins	BTAC104-3
TAC105		Frequency Modulation			
	1	400 Hz Nominal Test	400 Hz, +/-5 Hz mod	Apply for 10+ mins	BTAC105-1
	2	395 Hz Nominal Test	395 Hz, +/-5 Hz mod	Apply for 10+ mins	BTAC105-2
	3	405 Hz Nominal Test	405 Hz, +/-5 Hz mod	Apply for 10+ mins	BTAC105-3
TAC106		Voltage Distortion Spectrum		Requires Additional Equipment	
TAC107		Total Voltage Distortion	Voltage Distortion Factor 0.05	Apply for 30 mins	BTAC107
TAC108		DC Voltage Component			
	1	Positive DC Offset	115V RMS + .10V DC	Apply for 30 mins	BTAC108-1
	2	Negative DC Offset	115V RMS - .10V DC	Apply for 30 mins	BTAC108-2
TAC109		Normal Voltage Transients	180V RMS to 80V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table TAC109-3 AA-GG	BTAC109-1
	2	Undervoltage Transients	Low voltage 80V RMS	Table TAC109-3 HH-LL	BTAC109-2
	3	Combined Transient	180V RMS to 80V RMS	Table TAC109-3 MM	BTAC109-3
	4	Repetitive Normal Voltage Transient Test	90V RMS to 140V RMS	Run transient for 30 mins	BTAC109-4
TAC110		Normal Frequency Transients	375 Hz to 425 Hz		

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	1	Overfrequency Transients	High Frequency 425 Hz	Table TAC110-3 AA-DD	BTAC110-1
	2	Underfrequency Transients	Low Frequency 375 Hz	Table TAC110-3 EE-HH	BTAC110-2
	3	Combined Transient	375 Hz to 425 Hz	Table TAC110-3 II	BTAC110-3
TAC201		Power Interrupt	0V for 50 msec	Table TAC201-2 A-L	BTAC201
TAC301		Abnormal Steady State Limits for Voltage and Frequency	100V RMS to 125V RMS, 375 Hz to 425 Hz	Apply for 30 mins	BTAC301
TAC302		Abnormal Voltage Transients	45V RMS to 180V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table TAC302-3 AA-GG	BTAC302-1
	2	Undervoltage Transients	Low voltage 45V RMS	Table TAC302-3 HH-NN	BTAC302-2
	3	Combined Transient	45V RMS to 180V RMS	Table TAC302-3 OO	BTAC302-3
TAC303		Abnormal Frequency Transients	320 Hz to 480 Hz	Table TAC303-3 AA-EE	BTAC303
TAC401		Emergency Steady State Limits for Voltage and Frequency	102V to 124V RMS, 360 to 440 Hz	Apply for 30 mins each test	BTAC401
TAC501		No Tests		N/A to AC Utilization Equipment	
TAC601		Power Failure (Three Phase)	0V for 7 seconds	Table TAC601-2 A-D	BTAC601
TAC602		One Phase and Two Phase Power Failures			
	1	One Phase Power Failures	0V for 7 seconds	Table TAC602-2 A-F	BTAC602-1
	2	Two Phase Power Failures	0V for 30 mins	Table TAC602-2 G-J	BTAC602-2
TAC603		Phase Reversal	N/A to Rev B		

**5.3.5.3 Table LDC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
LDC101		Load Measurements	28V DC		BLDC101
LDC102		Steady State Limits for Voltage	22V to 29V DC	Apply for 30 mins	BLDC102
LDC103		Voltage Distortion Spectrum		Requires Additional Equipment	

Test No.	Section	Subject	Test Limits	Comment	File Ref.
LDC104		Total Ripple		Requires Additional Equipment	
LDC105		Normal Voltage Transients	18V to 50V DC		
	1	Overvoltage Transients	Peak Voltage 50V DC	Table LDC105-3 AA-JJ	BLDC105-1
	2	Undervoltage Transients	Low Voltage 18V DC	Table LDC105-3 KK-PP	BLDC105-2
	3	Combined Transients	18V to 50V DC	Table LDC105-3 QQ-RR	BLDC105-3
	4	Repetitive Normal Voltage Transient Test	18V to 45V DC	Repeat transient for 30 mins	BLDC105-4
LDC201		Power Interrupt	0V for 50 msec	Table LDC201-2 A-L	BLDC201
LDC301		Abnormal Steady State Limits for Voltage	20V to 31.5V DC	Apply each test for 30 mins	BLDC301
LDC302		Abnormal Voltage Transients	7V to 50V DC		
	1	Overvoltage Transients	Peak Voltage 50V DC	Table LDC302-3 AA-FF	BLDC302-1
	2	Undervoltage Transients	Low Voltage 7V DC	Table LDC302-3 GG-LL	BLDC302-2
	3	Combined Transients	7V to 50V DC	Table LDC302-3 MM-NN	BLDC302-3
LDC401		Emergency Limits for Voltage	18V to 29V DC	Apply each test for 30 mins	BLDC401
LDC501		Starting Voltage Transients	16V to 30V DC	Table LDC501-2 A	BLDC501
LDC601		Power Failure	0V for 7 seconds	Table LDC601-2 A-D	BLDC601
LDC602		Polarity Reversal	N/A to Rev B		

**5.3.5.4 Table HDC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
HDC101		Load Measurements	270V DC		BHDC101
HDC102		Steady State Limits for Voltage	250V to 280V DC	Apply for 30 mins	BHDC102
HDC103		Voltage Distortion Spectrum		Requires Additional Equipment	
HDC104		Total Ripple		Requires Additional Equipment	

Test No.	Section	Subject	Test Limits	Comment	File Ref.
HDC105		Normal Voltage Transients	125V to 475V DC		
	1	Overvoltage Transients	Peak Voltage 475V DC	Table HDC105-1 A-J	BHDC105-1
	2	Undervoltage Transients	Low Voltage 125V DC	Table HDC105-1 K-P	BHDC105-2
	3	Combined Transients	125V to 475V DC	Table HDC105-1 Q-R	BHDC105-3
	4	Repetitive Normal Voltage Transient Test	215V to 315V DC	Repeat transient for 30 mins	BHDC105-4
HDC201		Power Interrupt	0V for 50 msec	Table HDC201-2 A-L	BHDC201
HDC301		Abnormal Steady State Limits for Voltage	245V to 285V DC	Apply each test for 30 mins	BHDC301
HDC302		Abnormal Voltage Transients	65V to 475V DC		
	1	Overvoltage Transients	Peak Voltage 475V DC	Table HDC302-2 A-F	BHDC302-1
	2	Undervoltage Transients	Low Voltage 65V DC	Table HDC302-2 G-L	BHDC302-2
	3	Combined Transients	65V to 475V DC	Table HDC302-2 M-N	BHDC302-3
HDC401		Emergency Limits for Voltage	240V to 290V DC	Apply each test for 30 mins	BHDC401
HDC501		Starting Voltage Transients	155V to 280V DC	Table HDC501-2 A	BHDC501
HDC601		Power Failure	0V for 7 seconds	Table HDC601-2 A-D	BHDC601
HDC602		Polarity Reversal	N/A to Rev B		

**5.3.6 Rev A:****5.3.6.1 Table SAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SAC101		Load and Current Harmonic Measurements	115V RMS, 400 Hz		ASAC101
SAC102		Steady State Limits for Voltage and Frequency	108V to 118V RMS, 380 to 420 Hz	Apply for 30 mins each test	ASAC102
SAC103		No Test, Done so test numbers coincide			
SAC104		Voltage Modulation			
	1	115V Nominal Test	115V RMS, 3.5V Vp-v mod	Apply for 10+ mins	ASAC104-1
	2	109V Nominal Test	109V RMS, 3.5V Vp-v mod	Apply for 10+ mins	ASAC104-2
	3	117V Nominal Test	117V RMS, 3.5V Vp-v mod	Apply for 10+ mins	ASAC104-3
SAC105		Frequency Modulation			
	1	400 Hz Nominal Test	400 Hz, +/-4 Hz mod	Apply for 10+ mins	ASAC105-1
	2	395 Hz Nominal Test	395 Hz, +/-4 Hz mod	Apply for 10+ mins	ASAC105-2
	3	405 Hz Nominal Test	405 Hz, +/-4 Hz mod	Apply for 10+ mins	ASAC105-3
SAC106		Voltage Distortion Spectrum		Requires Additional Equipment	
SAC107		Total Voltage Distortion	Voltage Distortion Factor 0.08	Apply for 30 mins	ASAC107
SAC108		DC Voltage Component			
	1	Positive DC Offset	115V RMS + .10V DC	Apply for 30 mins	ASAC108-1
	2	Negative DC Offset	115V RMS - .10V DC	Apply for 30 mins	ASAC108-2
SAC109		Normal Voltage Transients	160V RMS to 58V RMS		
	1	Overvoltage Transients	Peak voltage 160V RMS	Table SAC109-2 A-G	ASAC109-1
	2	Undervoltage Transients	Low voltage 58V RMS	Table SAC109-2 H-N	ASAC109-2
	3	Combined Transient	160V RMS to 58V RMS	Table SAC109-2 O	ASAC109-3
	4	Repetitive Normal Voltage Transient Test	90V RMS to 140V RMS	Run transient for 30 mins	ASAC109-4



Test No.	Section	Subject	Test Limits	Comment	File Ref.
SAC110		Normal Frequency Transients	350 Hz to 450 Hz		
	1	Overfrequency Transients	High Frequency 425 Hz	Table SAC110-2 A-D	ASAC110-1
	2	Underfrequency Transients	Low Frequency 350 Hz	Table SAC110-2 E-H	ASAC110-2
	3	Combined Transient	350 Hz to 450 Hz	Table SAC110-2 I	ASAC110-3
SAC201		Power Interrupt	0V for 50 msec	Table SAC201-2 A-L	ASAC201
SAC301		Abnormal Steady State Limits for Voltage and Frequency	102V RMS to 124V RMS, 370 Hz to 430 Hz	Apply for 30 mins	ASAC301
SAC302		Abnormal Voltage Transients	45V RMS to 180V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table SAC302-2 A-G	ASAC302-1
	2	Undervoltage Transients	Low voltage 45V RMS	Table SAC302-2 H-N	ASAC302-2
	3	Combined Transient	45V RMS to 180V RMS	Table SAC302-2 O	ASAC302-3
SAC303		Abnormal Frequency Transients	320 Hz to 480 Hz	Table SAC303-2 A-E	ASAC303
SAC401		Emergency Steady State Limits for Voltage and Frequency	104V to 122V RMS, 360 Hz to 440 Hz	Apply for 30 mins	ASAC401
SAC501		No Tests		N/A to AC Utilization Equipment	
SAC601		Power Failure (Single Phase)	0V for 7 seconds	Table SAC601-2 A-D	ASAC601
SAC602		Power Failure	No test, done so numbers coincide		
SAC603		Phase Reversal	N/A to rev A		

**5.3.6.2 Table TAC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TAC101		Three Phase Load and Current Harmonic Measurements	115V RMS, 400 Hz		ATAC101
TAC102		Steady State Limits for Voltage (Including Unbalance) and Frequency			
	1	Balanced Phases	108V to 118V RMS, 380 to 420 Hz	Apply for 30 mins each test	ATAC102-1
	2	Unbalanced Phases	108V to 118V RMS, +/- 3V Unbalance	Apply for 30 mins each test	ATAC102-2

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TAC103		Voltage Phase Difference	Phase B 116 to 124 degrees	Apply for 30 mins each test	ATAC103
TAC104		Voltage Modulation			
	1	115V Nominal Test	115V RMS, 3.5V Vp-v mod	Apply for 10+ mins	ATAC104-1
	2	109V Nominal Test	109V RMS, 3.5V Vp-v mod	Apply for 10+ mins	ATAC104-2
	3	117V Nominal Test	117V RMS, 3.5V Vp-v mod	Apply for 10+ mins	ATAC104-3
TAC105		Frequency Modulation			
	1	400 Hz Nominal Test	400 Hz, +/- 4 Hz mod	Apply for 10+ mins	ATAC105-1
	2	395 Hz Nominal Test	395 Hz, +/- 4 Hz mod	Apply for 10+ mins	ATAC105-2
	3	405 Hz Nominal Test	405 Hz, +/- 4 Hz mod	Apply for 10+ mins	ATAC105-3
TAC106		Voltage Distortion Spectrum		Requires Additional Equipment	
TAC107		Total Voltage Distortion	Voltage Distortion Factor 0.08	Apply for 30 mins	ATAC107
TAC108		DC Voltage Component			
	1	Positive DC Offset	115V RMS + .10V DC	Apply for 30 mins	ATAC108-1
	2	Negative DC Offset	115V RMS - .10V DC	Apply for 30 mins	ATAC108-2
TAC109		Normal Voltage Transients	160V RMS to 58V RMS		
	1	Overvoltage Transients	Peak voltage 160V RMS	Table TAC109-2 A-G	ATAC109-1
	2	Undervoltage Transients	Low voltage 58V RMS	Table TAC109-2 H-N	ATAC109-2
	3	Combined Transient	160V RMS to 58V RMS	Table TAC109-2 O	ATAC109-3
	4	Repetitive Normal Voltage Transient Test	90V RMS to 140V RMS	Run transient for 30 mins	ATAC109-4
TAC110		Normal Frequency Transients	350 Hz to 450 Hz		
	1	Overfrequency Transients	High Frequency 450 Hz	Table TAC110-2 A-D	ATAC110-1
	2	Underfrequency Transients	Low Frequency 350 Hz	Table TAC110-2 E-H	ATAC110-2
	3	Combined Transient	350 Hz to 450 Hz	Table TAC110-2 I	ATAC110-3

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TAC201		Power Interrupt	0V for 50 msec	Table TAC201-2 A-L	ATAC201
TAC301		Abnormal Steady State Limits for Voltage and Frequency	102V RMS to 124V RMS, 370 Hz to 430 Hz	Apply for 30 mins	ATAC301
TAC302		Abnormal Voltage Transients	45V RMS to 180V RMS		
	1	Overvoltage Transients	Peak voltage 180V RMS	Table TAC302-2 A-G	ATAC302-1
	2	Undervoltage Transients	Low voltage 45V RMS	Table TAC302-2 H-N	ATAC302-2
	3	Combined Transient	45V RMS to 180V RMS	Table TAC302-2 O	ATAC302-3
TAC303		Abnormal Frequency Transients	320 Hz to 480 Hz	Table TAC303-2 A-E	ATAC303
TAC401		Emergency Steady State Limits for Voltage and Frequency	104V to 122 V, 360 to 440 Hz	Apply for 30 mins	ATAC401
TAC501		No Tests		N/A to AC Utilization Equipment	
TAC601		Power Failure (Three Phase)	0V for 7 seconds	Table TAC601-2 A-D	ATAC601
TAC602		One Phase and Two Phase Power Failures			
	1	One Phase Power Failures	0V for 7 seconds	Table TAC602-2 A-F	ATAC602-1
	2	Two Phase Power Failures	0V for 30 mins	Table TAC602-2 G-J	ATAC602-2
TAC603		Phase Reversal	N/A to rev A		

### 5.3.6.3 Table LDC:

Test No.	Section	Subject	Test Limits	Comment	File Ref.
LDC101		Load Measurements	28V DC		ALDC101
LDC102		Steady State Limits for Voltage	24V to 28.5V DC	Apply for 30 mins	ALDC102
LDC103		Voltage Distortion Spectrum		Requires Additional Equipment	
LDC104		Total Ripple		Requires Additional Equipment	
LDC105		Normal Voltage Transients	8V to 70V DC		
	1	Overvoltage Transients	Peak Voltage 70V DC	Table LDC105-2 A-J	ALDC105-1

Test No.	Section	Subject	Test Limits	Comment	File Ref.
	2	Undervoltage Transients	Low Voltage 8V DC	Table LDC105-2 K-T	ALDC105-2
	3	Combined Transients	8V to 70V DC	Table LDC105-2 U-V	ALDC105-3
	4	Repetitive Normal Voltage Transient Test	18V to 45V DC	Repeat transient for 30 mins	ALDC105-4
LDC201		Power Interrupt	0V for 50 msec	Table LDC201-2 A-L	ALDC201
LDC301		Abnormal Steady State Limits for Voltage	22.5V to 30V DC	Apply each test for 30 mins	ALDC301
LDC302		Abnormal Voltage Transients	6V to 80V DC		
	1	Overvoltage Transients	Peak Voltage 80V DC	Table LDC302-2 A-J	ALDC302-1
	2	Undervoltage Transients	Low Voltage 6V DC	Table LDC302-2 K-T	ALDC302-2
	3	Combined Transients	6V to 80V DC	Table LDC302-2 U-V	ALDC302-3
LDC401		Emergency Limits for Voltage	16V to 24V DC	Apply each test for 30 mins	ALDC401
LDC501		Starting Voltage Transients	16V to 28.5V DC	Table LDC501-2 A	ALDC501
LDC601		Power Failure	0V for 7 seconds	Table LDC601-2 A-D	ALDC601
LDC602		Polarity Reversal	N/A to rev A		

## 6 Option –A350: Airbus A350 (ABD0100.1.8.1) Test, Rev B

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The –A350 option supports several of the Airbus ABD0100.1.8.1 voltage and frequency immunity tests in either of the AC or DC mode (if available).

The –A350 option is based on Airbus Directive 0100, Part 1, Chapter 8, Electric Install (ABD0100.1.8.1) dated September 2007 (Rev B) for the Airbus A350. Section 1 refers to wiring, installation and connectors and is outside the scope of the –A350 option.

Future revisions of the ABD0100.1.8.1 directive may be issued over time and updates may be made available to cover any changes in test levels, durations, procedures etc. Furthermore, the –A350 option is completely data file driven to allow a large degree of customization by the end-user if needed so many changes can be supported without the need for software updates.

This section of the manual explains the limitations of this test option, the use of special features unique to this option, and gives a complete layout of all tests performed by this option.

This manual is **not** intended to elaborate on the intent or purpose of the immunity tests and the expected behavior of the EUT as described in the ABD0100.1.8 documents. It is assumed that the end-user is familiar with the content of the relevant Airbus test standards.

### 6.1 Test Coverage

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The comprehensiveness of the tests that can be performed with the –ABD option is determined primarily by the capabilities of the power source used. Tests that are outside the hardware capabilities of the power source used will not be enabled and cannot be selected. For these tests, additional equipment may be required as indicated

#### 6.1.1 MX/RS Series –A350 Option Limitations

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The extent of coverage of the –A350 option as implemented on the MX/RS Series platform is shown in the table below. Tests marked with an 'X' generally require additional hardware to be used. Tests marked with a 'P' require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only.

Section 6.2.1.4 and Appendix D current harmonics measurements will require the use of an external power analyzer per Figure B.14 of ABD0100.1.8.1 since the MX/RS Series measurement system does not support the required measurement bandwidth for this test. Furthermore, the MX/RS Series does not meet the required 1.25% maximum  $V_{thd}$  over the 360 to 900Hz frequency range required for the distortion tests.

**Note:** *The MX15 Series power sources are single-phase output only and therefore all three-phase tests are not available on the MX15*

Note that in order to support the required 900Hz for variable EUT testing, the –HF extended frequency range option is required on the MX/RS. Without this option, most of these tests cannot be run. For constant frequency EUT test or DC test, the –HF option is not required.

Note also that for EUT's with a nominal voltage of 230Vrms, the optional 400Vac output range, option –HV is required to perform some of the voltage transient tests that require an output voltage higher than 300Vrms AC. (Test 102 and 202 for 230V power groups) The available current on the –HV range is 25% lower compared to the 300V range so the MX/RS power level should be sized accordingly to support the EUT's to be tested.

**Variable Frequency A350 Power Groups – MX/RS Series (Requires –HF option)**

AC Power Groups					
No.	Description	SVF	TVF	SVFH	TVFH
<b>Normal Operation</b>					
101	Steady-state voltage and frequency	YES	YES	YES	YES
102	Voltage transients	YES	YES	YES (2)	YES (2)
103	Voltage modulation	YES	YES	YES	YES
104	Voltage spikes	X	X	X	X
105	Current distortion	YES	YES	YES	YES
106	Voltage distortion 1	P	P	P	P
107	Voltage distortion 2	X	X	X	X
108	Voltage distortion transients	P	P	P	P
109	Inrush current	YES	YES	YES	YES
110	Frequency variations	YES	YES	YES	YES
111	Frequency modulation	YES	YES	YES	YES
112	Voltage DC content	P	P	P	P
113	Voltage modulation due to equipment	YES	YES	YES	YES
114	Voltage spike due to equipment load switching	YES	YES	YES	YES
115	Voltage unbalance transient	N/A	YES	N/A	YES
<b>Abnormal Operation</b>					
201	Steady-state voltage and frequency	YES	YES	YES	YES
202	Voltage transients	YES	YES	YES (2)	YES (2)
203	Voltage modulation	YES	YES	YES	YES
<b>Emergency Operation</b>					
301	Steady-state voltage and frequency	YES	YES	YES	YES
302	Voltage distortion 1	YES	YES	YES	YES
303	Voltage distortion 2	YES	YES	YES	YES
304	Voltage distortion transients	YES	YES	YES	YES
305	Inrush current	YES	YES	YES	YES
306	Frequency variations	YES	YES	YES	YES
307	Voltage modulation due to equipment	YES	YES	YES	YES
<b>Switching Transients</b>					
401	Transparency time	YES	YES	YES	YES
402	Voltage switching transients 1	(1)	(1)	(1)	(1)

AC Power Groups					
No.	Description	SVF	TVF	SVFH	TVFH
403	Voltage switching transients 2	(1)	(1)	(1)	(1)
404	Voltage switching transients with frequency change	YES	YES	YES	YES
<b>Power Supply Removal</b>					
501	Power line disconnection	YES	YES	YES	YES

Table 6- 1 A350 MX/RS Test coverage

Note (1): Clicking on the test will open up switching transient windows.

Note (2): Requires –HV option.

### Constant Frequency A350 Power Groups – MX/RS Series.

AC Power Groups					
No.	Description	SCF	TCF	SCFH	TCFH
<b>Normal Operation</b>					
101	Steady-state voltage and frequency	YES	YES	YES	YES
102	Voltage transients	YES	YES	YES (2)	YES (2)
103	Voltage modulation	YES	YES	YES	YES
104	Voltage spikes	X	X	X	X
105	Current distortion	YES	YES	YES	YES
106	Voltage distortion 1	P	P	P	P
107	Voltage distortion 2	X	X	X	X
108	Voltage distortion transients	P	P	P	P
109	Inrush current	YES	YES	YES	YES
110	Frequency modulation	YES	YES	YES	YES
111	Voltage DC content	P	P	P	P
112	Voltage modulation due to equipment	YES	YES	YES	YES
113	Voltage spike due to equipment load switching	YES	YES	YES	YES
114	Voltage unbalance transient	N/A	YES	N/A	YES
<b>Abnormal Operation</b>					
201	Steady-state voltage and frequency	YES	YES	YES	YES
202	Voltage transients	YES	YES	YES (2)	YES (2)
203	Voltage modulation	YES	YES	YES	YES
204	Frequency transients	YES	YES	YES	YES
<b>Switching Transients</b>					
401	Transparency time	YES	YES	YES	YES

AC Power Groups					
No.	Description	SCF	TCF	SCFH	TCFH
402	Voltage switching transients 1	(1)	(1)	(1)	(1)
403	Voltage switching transients 2	(1)	(1)	(1)	(1)
<b>Power Supply Removal</b>					
501	Power line disconnection	YES	YES	YES	YES

Note (1): Clicking on the test will open up switching transient windows.

Note (2): Requires –HV option.



**DC A350 Power Groups – MX/RS Series.**

<b>DC Power Groups</b>		
<b>No.</b>	<b>Description</b>	<b>LDC</b>
	<b>Normal Operation</b>	YES
101	Steady-state voltage	YES
102	Voltage transients	YES
103	Voltage ripple	X
104	Voltage spikes	X
105	Inrush current	YES
106	Voltage variation APU start	YES
107	Equipment current ripple	X
108	Voltage spike due to load	YES
109	EPDC voltage clamping	YES
	<b>Abnormal Operation</b>	
201	Steady-state voltage	YES
202	Voltage transients	YES
203	Voltage ripple	X
	<b>Emergency Operation</b>	
301	Steady state voltage	YES
302	Voltage ripple	X
303	Inrush current	YES
304	Equipment Ripple	X
	<b>Switching Transients</b>	
401	Transparency time	YES
402	Voltage switching transients 1	(1)
403	Voltage switching transients 2	(1)
	<b>Power Supply Removal</b>	
501	Power line disconnection	YES

Note (1): Clicking on the test will open up switching transient windows.

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### 6.1.2 AST Series –A350 Option Limitations

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The extent of coverage of the –A350 option as implemented on the AST Series platform is shown in the table below. Tests marked with an ‘X’ generally require additional hardware to be used. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only.

Section 6.2.1.4 and Appendix D current harmonics measurements will require the use of an external power analyzer per Figure B.14 of ABD0100.1.8.1 since the AST Series measurement system does not support the required measurement bandwidth for this test. Furthermore, the AST Series does not meet the required 1.25% maximum  $V_{thd}$  over the 360 to 900Hz frequency range required for the distortion tests.

**Note:** The AST Series power sources model number ending with “1” (eg: AST 751,1501) are single phase output only and therefore all three phase tests are not available on these series.

Note that in order to support the required 900Hz for variable EUT testing, the –HF extended frequency range option is required on the AST. Without this option, most of these tests cannot be run. For constant frequency EUT test or DC test, the –HF option is not required.

Note also that for EUT’s with a nominal voltage of 230Vrms, the optional 400Vac output range, option –HV is required to perform some of the voltage transient tests that require an output voltage higher than 300Vrms AC. (Test 102 and 202 for 230V power groups) The available current on the –HV range is 25% lower compared to the 300V range so the AST power level should be sized accordingly to support the EUT’s to be tested.

**Variable Frequency A350 Power Groups – AST Series (Requires –HF option).**

AC Power Groups					
No.	Description	SVF	TVF	SVFH	TVFH
<b>Normal Operation</b>					
101	Steady-state voltage and frequency	YES	YES	YES	YES
102	Voltage transients	YES	YES	YES (2)	YES (2)
103	Voltage modulation	YES	YES	YES	YES
104	Voltage spikes	X	X	X	X
105	Current distortion	YES	YES	YES	YES
106	Voltage distortion 1	P	P	P	P
107	Voltage distortion 2	X	X	X	X
108	Voltage distortion transients	P	P	P	P
109	Inrush current	YES	YES	YES	YES
110	Frequency variations	YES	YES	YES	YES
111	Frequency modulation	YES	YES	YES	YES
112	Voltage DC content	P	P	P	P
113	Voltage modulation due to equipment	YES	YES	YES	YES
114	Voltage spike due to equipment load switching	YES	YES	YES	YES
115	Voltage unbalance transient	N/A	YES	N/A	YES
<b>Abnormal Operation</b>					
201	Steady-state voltage and frequency	YES	YES	YES	YES
202	Voltage transients	YES	YES	YES (2)	YES (2)
203	Voltage modulation	YES	YES	YES	YES
<b>Emergency Operation</b>					
301	Steady-state voltage and frequency	YES	YES	YES	YES
302	Voltage distortion 1	YES	YES	YES	YES
303	Voltage distortion 2	YES	YES	YES	YES
304	Voltage distortion transients	YES	YES	YES	YES
305	Inrush current	YES	YES	YES	YES
306	Frequency variations	YES	YES	YES	YES
307	Voltage modulation due to equipment	YES	YES	YES	YES
<b>Switching Transients</b>					
401	Transparency time	YES	YES	YES	YES
402	Voltage switching transients 1	(1)	(1)	(1)	(1)

AC Power Groups					
No.	Description	SVF	TVF	SVFH	TVFH
403	Voltage switching transients 2	(1)	(1)	(1)	(1)
404	Voltage switching transients with frequency change	YES	YES	YES	YES
Power Supply Removal					
501	Power line disconnection	YES	YES	YES	YES

Table6- 2 A350 AST Test coverage

Note (1): Clicking on the test will open up switching transient windows.

Note (2): Requires –HV range to be selected.

### Constant Frequency A350 Power Groups – AST Series.

AC Power Groups					
No.	Description	SCF	TCF	SCFH	TCFH
Normal Operation					
101	Steady-state voltage and frequency	YES	YES	YES	YES
102	Voltage transients	YES	YES	YES (2)	YES (2)
103	Voltage modulation	YES	YES	YES	YES
104	Voltage spikes	X	X	X	X
105	Current distortion	YES	YES	YES	YES
106	Voltage distortion 1	P	P	P	P
107	Voltage distortion 2	X	X	X	X
108	Voltage distortion transients	P	P	P	P
109	Inrush current	YES	YES	YES	YES
110	Frequency modulation	YES	YES	YES	YES
111	Voltage DC content	P	P	P	P
112	Voltage modulation due to equipment	YES	YES	YES	YES
113	Voltage spike due to equipment load switching	YES	YES	YES	YES
114	Voltage unbalance transient	N/A	YES	N/A	YES
Abnormal Operation					
201	Steady-state voltage and frequency	YES	YES	YES	YES
202	Voltage transients	YES	YES	YES (2)	YES (2)
203	Voltage modulation	YES	YES	YES	YES
204	Frequency transients	YES	YES	YES	YES
Switching Transients					
401	Transparency time	YES	YES	YES	YES
402	Voltage switching transients 1	(1)	(1)	(1)	(1)

	AC Power Groups				
No.	Description	SCF	TCF	SCFH	TCFH
403	Voltage switching transients 2	(1)	(1)	(1)	(1)
	<b>Power Supply Removal</b>				
501	Power line disconnection	YES	YES	YES	YES

Note (1): Clicking on the test will open up switching transient windows.

Note (2): Requires –HV range to be selected.

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**6.1.3 i/iX Series –A350 Option Limitations**

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The extent of coverage of the –A350 option as implemented on the i/iX Series and Compact i/iX Series platforms is shown in the table below. Tests marked with an 'X' generally require additional hardware to be used. Tests marked with a 'P' require arbitrary waveform capability, which is available on iX models only.

Section 6.2.1.4 and Appendix D current harmonics measurements will require the use of an external power analyzer per Figure B.14 of ABD0100.1.8.1 since the iX Series measurement system does not support the required measurement bandwidth for this test.

The following variable frequency power groups are not supported on the 3001/5001i/iX series due to voltage/frequency output restrictions: SVFH, TVFH. They are supported on the compact i/iX Series however.

The following tests from the SVFH, TVFH, SCFH and TCFH power groups are not supported, as they require more than 300Vrms output voltage: 102, 202.

The Compact i/iX Series does not support CF112 and VF112 DC offset test due to offset programming accuracy restrictions. An external DC offset supply is required to perform these tests per Figure B.16 and B.17 of the test standard.

**Variable Frequency A350 Power Groups – 3001/5001iX Series.**

<b>AC Power Groups</b>					
No.	Description	SVF	TVF	SVFH	TVFH
<b>Normal Operation</b>		<b>9003/15003</b>			
101	Steady-state voltage and frequency	YES	YES	X	X
102	Voltage transients	YES	YES	X	X
103	Voltage modulation	YES	YES	X	X
104	Voltage spikes	X	X	X	X
105	Current distortion	YES	YES	X	X
106	Voltage distortion 1	P	P	X	X
107	Voltage distortion 2	X	X	X	X
108	Voltage distortion transients	P	P	X	X
109	Inrush current	YES	YES	X	X
110	Frequency variations	YES	YES	X	X
111	Frequency modulation	YES	YES	X	X
112	Voltage DC content	P	P	X	X
113	Voltage modulation due to equipment	YES	YES	X	X
114	Voltage spike due to equipment load switching	YES	YES	X	X
115	Voltage unbalance transient	N/A	YES	X	X
<b>Abnormal Operation</b>		<b>9003/15003</b>			
201	Steady-state voltage and frequency	YES	YES	X	X
202	Voltage transients	YES	YES	X	X
203	Voltage modulation	YES	YES	X	X
<b>Emergency Operation</b>		<b>9003/15003</b>			
301	Steady-state voltage and frequency	YES	YES	X	X
302	Voltage distortion 1	YES	YES	X	X
303	Voltage distortion 2	YES	YES	X	X
304	Voltage distortion transients	YES	YES	X	X
305	Inrush current	YES	YES	X	X
306	Frequency variations	YES	YES	X	X
307	Voltage modulation due to equipment	YES	YES	X	X
<b>Switching Transients</b>		<b>9003/15003</b>			

	AC Power Groups				
No.	Description	SVF	TVF	SVFH	TVFH
401	Transparency time	YES	YES	X	X
402	Voltage switching transients 1	(1)	(1)	X	X
403	Voltage switching transients 2	(1)	(1)	X	X
404	Voltage switching transients with frequency change	YES	YES	X	X
	<b>Power Supply Removal</b>	<b>9003/15003</b>			
501	Power line disconnection	YES	YES	X	X

*Table6- 3 A350 iX test coverage*

Note (1): Provided through ABD Switching Transients test menu.



**Variable Frequency A350 Power Groups – Compact iX Series (751/1501/2253).**

<b>AC Power Groups</b>					
<b>No.</b>	<b>Description</b>	<b>SVF</b>	<b>TVF</b>	<b>SVFH</b>	<b>TVFH</b>
	<b>Normal Operation</b>	<b>2253iX only</b>		<b>2253iX only</b>	
101	Steady-state voltage and frequency	YES	YES	YES	YES
102	Voltage transients	YES	YES	Max 300V	Max 300V
103	Voltage modulation	YES	YES	YES	YES
104	Voltage spikes	X	X	X	X
105	Current distortion	YES	YES	YES	YES
106	Voltage distortion 1	P	P	P	P
107	Voltage distortion 2	X	X	X	X
108	Voltage distortion transients	P	P	P	P
109	Inrush current	YES	YES	YES	YES
110	Frequency variations	YES	YES	YES	YES
111	Frequency modulation	YES	YES	YES	YES
112	Voltage DC content	X	X	X	X
113	Voltage modulation due to equipment	YES	YES	YES	YES
114	Voltage spike due to equipment load switching	YES	YES	YES	YES
115	Voltage unbalance transient	N/A	YES	N/A	YES
	<b>Abnormal Operation</b>	<b>2253iX only</b>		<b>2253iX only</b>	
201	Steady-state voltage and frequency	YES	YES	YES	YES
202	Voltage transients	YES	YES	X	X
203	Voltage modulation	YES	YES	YES	YES
	<b>Emergency Operation</b>	<b>2253iX only</b>		<b>2253iX only</b>	
301	Steady-state voltage and frequency	YES	YES	YES	YES
302	Voltage distortion 1	YES	YES	YES	YES
303	Voltage distortion 2	YES	YES	YES	YES
304	Voltage distortion transients	YES	YES	YES	YES
305	Inrush current	YES	YES	YES	YES
306	Frequency variations	YES	YES	YES	YES
307	Voltage modulation due to equipment	YES	YES	YES	YES
	<b>Switching Transients</b>	<b>2253iX only</b>		<b>2253iX only</b>	

AC Power Groups					
No.	Description	SVF	TVF	SVFH	TVFH
401	Transparency time	YES	YES	YES	YES
402	Voltage switching transients 1	(1)	(1)	(1)	(1)
403	Voltage switching transients 2	(1)	(1)	(1)	(1)
404	Voltage switching transients with frequency change	YES	YES	YES	YES
	<b>Power Supply Removal</b>	<b>2253iX only</b>		<b>2253iX only</b>	
501	Power line disconnection	YES	YES	YES	YES

Note (1): Provided through ABD Switching Transients test menu.

**Constant Frequency A350 Power Groups – iX Series & Compact iX Series.**

<b>AC Power Groups</b>					
<b>No.</b>	<b>Description</b>	<b>SCF</b>	<b>TCF</b>	<b>SCFH</b>	<b>TCFH</b>
<b>Normal Operation</b>					
101	Steady-state voltage and frequency	YES	YES	YES	YES
102	Voltage transients	YES	YES	X	X
103	Voltage modulation	YES	YES	YES	YES
104	Voltage spikes	X	X	X	X
105	Current distortion	YES	YES	YES	YES
106	Voltage distortion 1	P	P	P	P
107	Voltage distortion 2	X	X	X	X
108	Voltage distortion transients	P	P	P	P
109	Inrush current	YES	YES	YES	YES
110	Frequency modulation	YES	YES	YES	YES
111	Voltage DC content	P (2)	P (2)	P (2)	P (2)
112	Voltage modulation due to equipment	YES	YES	YES	YES
113	Voltage spike due to equipment load switching	YES	YES	YES	YES
114	Voltage unbalance transient	N/A	YES	N/A	YES
<b>Abnormal Operation</b>					
201	Steady-state voltage and frequency	YES	YES	YES	YES
202	Voltage transients	YES	YES	X	X
203	Voltage modulation	YES	YES	YES	YES
204	Frequency transients	YES	YES	YES	YES
<b>Switching Transients</b>					
401	Transparency time	YES	YES	YES	YES
402	Voltage switching transients 1	(1)	(1)	(1)	(1)
403	Voltage switching transients 2	(1)	(1)	(1)	(1)
<b>Power Supply Removal</b>					
501	Power line disconnection	YES	YES	YES	YES

Note (1): Provided through ABD Switching Transients test menu.

Note (2): Available on 3001/5001/9003/15003iX only, not Compact iX.

**DC A350 Power Groups – iX Series & Compact iX Series.**

DC Power Groups		
No.	Description	LDC
	<b>Normal Operation</b>	YES
101	Steady-state voltage	YES
102	Voltage transients	YES
103	Voltage ripple	X
104	Voltage spikes	X
105	Inrush current	YES
106	Voltage variation APU start	YES
107	Equipment current ripple	X
108	Voltage spike due to load	YES
109	EPDC voltage clamping	YES
	<b>Abnormal Operation</b>	
201	Steady-state voltage	YES
202	Voltage transients	YES
203	Voltage ripple	X
	<b>Emergency Operation</b>	
301	Steady state voltage	YES
302	Voltage ripple	X
303	Inrush current	YES
304	Equipment Ripple	X
	<b>Switching Transients</b>	
401	Transparency time	YES
402	Voltage switching transients 1	(1)
403	Voltage switching transients 2	(1)
	<b>Power Supply Removal</b>	
501	Power line disconnection	YES

Note (1): Provided through ABD Switching Transients test menu.

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#### 6.1.4 Lx/Ls Series –A350 Option Limitations

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The extent of coverage of the –A350 option as implemented on the Lx/Ls Series platform is shown in the table below. Tests marked with an ‘X’ generally require additional hardware to be used. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Lx models or Ls models with the –ADV option only.

Note that the Lx/Ls Series only provides AC output so **none** of the DC tests (LDC Power Group and DC Offset tests in AC power groups) are supported on the Lx/Ls Series. External DC supplies per Figure B.16 and Figure B.17 are required to perform these tests.

Section 6.2.1.4 and Appendix D current harmonics measurements will require the use of an external power analyzer per Figure B.14 of ABD0100.1.8.1 since the iX Series measurement system does not support the required measurement bandwidth for this test.

Note also that for EUT's with a nominal voltage of 230Vrms, the optional 200/400 output voltage range, option –EHV is required to perform some of the voltage transient tests that require an output voltage higher than 300Vrms AC. (Test 102 and 202 for 230V power groups) The available current on the –EHV range is lower compared to the standard 300V (Lx) or 270V (Ls) range so the Lx/Ls power level should be sized accordingly to support the EUT's to be tested.

**Variable Frequency A350 Power Groups – Lx/Ls Series.**

<b>AC Power Groups</b>					
<b>No.</b>	<b>Description</b>	<b>SVF</b>	<b>TVF</b>	<b>SVFH</b>	<b>TVFH</b>
<b>Normal Operation</b>					
101	Steady-state voltage and frequency	YES	YES	YES	YES
102	Voltage transients	YES	YES	YES (2)	YES (2)
103	Voltage modulation	YES	YES	YES	YES
104	Voltage spikes	X	X	X	X
105	Current distortion	YES	YES	YES	YES
106	Voltage distortion 1	P	P	P	P
107	Voltage distortion 2	X	X	X	X
108	Voltage distortion transients	P	P	P	P
109	Inrush current	YES	YES	YES	YES
110	Frequency variations	YES	YES	YES	YES
111	Frequency modulation	YES	YES	YES	YES
112	Voltage DC content	X	X	X	X
113	Voltage modulation due to equipment	YES	YES	YES	YES
114	Voltage spike due to equipment load switching	YES	YES	YES	YES
115	Voltage unbalance transient	N/A	YES	N/A	YES
<b>Abnormal Operation</b>					
201	Steady-state voltage and frequency	YES	YES	YES	YES
202	Voltage transients	YES	YES	YES (2)	YES (2)
203	Voltage modulation	YES	YES	YES	YES
<b>Emergency Operation</b>					
301	Steady-state voltage and frequency	YES	YES	YES	YES
302	Voltage distortion 1	YES	YES	YES	YES
303	Voltage distortion 2	YES	YES	YES	YES
304	Voltage distortion transients	YES	YES	YES	YES
305	Inrush current	YES	YES	YES	YES
306	Frequency variations	YES	YES	YES	YES
307	Voltage modulation due to equipment	YES	YES	YES	YES
<b>Switching Transients</b>					
401	Transparency time	YES	YES	YES	YES

AC Power Groups					
No.	Description	SVF	TVF	SVFH	TVFH
402	Voltage switching transients 1	(1)	(1)	(1)	(1)
403	Voltage switching transients 2	(1)	(1)	(1)	(1)
404	Voltage switching transients with frequency change	YES	YES	YES	YES
<b>Power Supply Removal</b>					
501	Power line disconnection	YES	YES	YES	YES

Table6- 4 A350 Ls/Lx test coverage

Note (1): Provided through ABD Switching Transients test menu.

Note (2): Requires –EHV option.

**Constant Frequency A350 Power Groups – Lx/Ls Series.**

AC Power Groups					
No.	Description	SCF	TCF	SCFH	TCFH
<b>Normal Operation</b>					
101	Steady-state voltage and frequency	YES	YES	YES	YES
102	Voltage transients	YES	YES	YES (2)	YES (2)
103	Voltage modulation	YES	YES	YES	YES
104	Voltage spikes	X	X	X	X
105	Current distortion	YES	YES	YES	YES
106	Voltage distortion 1	P	P	P	P
107	Voltage distortion 2	X	X	X	X
108	Voltage distortion transients	P	P	P	P
109	Inrush current	YES	YES	YES	YES
110	Frequency modulation	YES	YES	YES	YES
111	Voltage DC content	X	X	X	X
112	Voltage modulation due to equipment	YES	YES	YES	YES
113	Voltage spike due to equipment load switching	YES	YES	YES	YES
114	Voltage unbalance transient	N/A	YES	N/A	YES
<b>Abnormal Operation</b>					
201	Steady-state voltage and frequency	YES	YES	YES	YES
202	Voltage transients	YES	YES	YES (2)	YES (2)
203	Voltage modulation	YES	YES	YES	YES
204	Frequency transients	YES	YES	YES	YES
<b>Switching Transients</b>					

<b>AC Power Groups</b>					
<b>No.</b>	<b>Description</b>	<b>SCF</b>	<b>TCF</b>	<b>SCFH</b>	<b>TCFH</b>
401	Transparency time	YES	YES	YES	YES
402	Voltage switching transients 1	(1)	(1)	(1)	(1)
403	Voltage switching transients 2	(1)	(1)	(1)	(1)
<b>Power Supply Removal</b>					
501	Power line disconnection	YES	YES	YES	YES

Note (1): Provided through ABD Switching Transients test menu.

Note (2): Requires –EHV option.



### 6.1.5 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the A350 tests, some limitations apply, largely due to hardware limitations of the various power source models. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column. Unless indicates otherwise, these discrepancies apply to all models covered by this manual.

Rev	Test	Standard requirement	Actual setting	Reason
B	103	0.18 Vrms modulation	0.2 Vrms modulation	Programming resolution
B	103	1.24 Vrms modulation	1.2 Vrms modulation	Programming resolution
B	103H	0.36 Vrms modulation	0.4 Vrms modulation	Programming resolution
B	103H	2.48 Vrms modulation	2.5 Vrms modulation	Programming resolution
B	104	Voltage Spike	Not supported	Requires additional equipment
B	107	Voltage distortion 2 700Hz to 150KHz	Not supported	Requires additional equipment
B	CF 110	+/-0.75Hz modulation	+0.7/-0.8 Hz modulation	Programming resolution
B	VF 111	+/-0.75Hz modulation	+0.7/-0.8 Hz modulation	Programming resolution
B	203	0.18 Vrms modulation	0.2 Vrms modulation	Programming resolution
B	203	1.24 Vrms modulation	1.2 Vrms modulation	Programming resolution
B	203H	0.36 Vrms modulation	0.4 Vrms modulation	Programming resolution
B	203H	2.48 Vrms modulation	2.5 Vrms modulation	Programming resolution

## 6.2 –A350 Power Groups

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The –A350 option supports both AC and DC modes of operation. The correct mode is a function of the EUT to be tested and the operator must select the corresponding operating mode first. This can be done from the front panel if needed or using the Gui program. Use of the Gui program for all settings will be assumed for the remainder of this chapter.

Nine power groups are covered in the ABD0100.1.8.1 A350 directive:

Group	Description
SVF	AC, Single phase, 115VAC, Variable frequency.
SVFH	AC, Single phase, 230VAC, Variable frequency.
SCF	AC, Single phase, 115VAC, Constant frequency.
SCFH	AC, Single phase, 230VAC, Constant frequency.
TVF	AC, Three phase, 115VAC, Variable frequency.
TVFH	AC, Three phase, 230VAC, Variable frequency.
TCF	AC, Three phase, 115VAC, Constant frequency.
TCFH	AC, Three phase, 230VAC, Constant frequency.
LDC	DC 28VDC

The required steady state output settings for each power group must be selected based on the type of EUT to be tested. These settings can be made from the front panel of the power source or from the main Gui control screen.

## 6.3 Test Tables

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The tables shown on the next few pages list the test sections covered by the –A350 option. Where relevant, the numbering used matches that of the ABD0100.1.8.1 document. The notes in the right hand column indicate tests that are either not directly supported or require additional external test equipment. Test tables are listed by rev and then by power group. The list starts with the most current rev to date, rev B.

Data shown is for MX/RS Series. Other models may have slight variations from the data shown here.

**6.3.1 A350 ABD0100.1.8.1 Rev B:****6.3.1.1 SCF:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1			Normal Operation				
2	SCF101		Steady State Voltage and frequency	100.0V to 122.0V RMS	16.5.1.1.c.1 (1)	Apply at 390Hz and 410Hz	SCF101
3	SCF102		Voltage Transients	67V to 160V RMS	16.5.1.5.b	Appendix A, Table C.4	SCF102
4	SCF103	1	Voltage Modulation	100.0V RMS, 400 Hz	16.5.1.5.b	Appendix B, Figure B.2	SCF103-1
5	SCF103	2	Voltage Modulation	122.0V RMS, 400 Hz	16.5.1.5.b	Appendix B, Figure B.2	SCF103-2
6	SCF104		Voltage Spikes	184V to 1000V	17.4, Figure 17.4	Not supported, additional equipment required.	
7	SCF105		Current Distortion	Requires external HF power analyzer		App A, Tables A.7, A.8, App B, Fig B.14	SCF105
8	SCF106	1	Voltage Distortion 1	Distortion limits		Appendix D	SCF106-1
9	SCF106	2	VTHD 1 - No motor	Endurance		Appendix D	SCF106-2
10	SCF106	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	SCF106-2M
11	SCF107		Voltage Distortion 2	700Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
12	SCF108		Voltage Distortion Transients	Distortion limits		Appendix D	SCF108
13	SCF109		Inrush current	104V to 130V RMS		App B, Figure B.18,B19	SCF109
14	SCF110		Frequency Modulation	400Hz		Appendix B, Figure B.10	SCF110
15	SCF111		Voltage DC Content	-0.3Vdc and +0.3Vdc		Appendix B, Figure B.17	SCF111
16	SCF112		VMod due to equipment.	104V to 130V, 370Hz and 430Hz		App A, Table A.3, App B, Fig B.2	SCF112

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
17	SCF113		Vspike due to equipment.	115V, 400Hz		App B, Fig 4. Requires external contactors	SCF113
18			Abnormal Operation				
19	SCF201		Steady State Voltage and Frequency	96V to 130V, 370Hz and 430Hz	16.5.2.1.c	Appendix A, Table A.3	SCF201
20	SCF202		Voltage Transients	0V to 180V, 400Hz	16.5.2.3.1.b & 16.5.2.2.b	Appendix A, Table A.4	SCF202
21	SCF203	1	Voltage Modulation	96V , 400Hz		Appendix A, Table A.3	SCF203-1
22	SCF203	2	Voltage Modulation	130V, 400Hz		Appendix A, Table A.3	SCF203-2
23	SCF204		Frequency Transients	122V to 115V, 320Hz to 480Hz		Appendix A, Table A.3	SCF204
24			Switching Transients				
25	SCF401	1	Transparency Time.	100V, 400Hz, 10ms		Fig TCF401-1, Table TCF401-1	SCF401
26	SCF402		Voltage switching transients 1	100V, 400Hz, 2ms to 200ms		Use ABD0100.8.1 Switching transients screen Fig A	
27	SCF403		Voltage switching transients 2	100V, 400Hz, 0ms to 5000ms		Use ABD0100.8.1 Switching transients screen Fig B, Table 1.1	
28			Power Supply Removal				
29	SCF501		Power line disconnection	115V 400Hz			SCF501

**6.3.1.2 TCF:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1			Normal Operation				
2	TCF101		Steady State Voltage and frequency	101.5V to 122V RMS	16.5.1.1.c.1 (1)	Apply at 390Hz and 410Hz	TCF101
3	TCF102		Voltage Transients	67V to 160V RMS	16.5.1.5.b	Appendix A, Table C.4	TCF102
4	TCF103	1	Voltage Modulation	101.5V RMS, 400 Hz	16.5.1.5.b	Appendix B, Figure B.2	TCF103-1
5	TCF103	2	Voltage Modulation	120.5V RMS, 400 Hz	16.5.1.5.b	Appendix B, Figure B.2	TCF103-2
6	TCF104		Voltage Spikes	184V to 1000V	17.4, Figure 17.4	Not supported, additional equipment required.	
7	TCF105		Current Distortion	Requires external HF power analyzer		App A, Tables A.7, A.8, App B, Fig B.14	TCF105
8	TCF106	1	Voltage Distortion 1	Distortion limits		Appendix D	TCF106-1
9	TCF106	2	VTHD 1 - No motor	Endurance		Appendix D	TCF106-2
10	TCF106	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	TCF106-2M
11	TCF107		Voltage Distortion 2	700Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
12	TCF108		Voltage Distortion Transients	Distortion limits		Appendix D	TCF108
13	TCF109		Inrush current	104V to 130V RMS		App B, Figure B.18, B19	TCF109
14	TCF110		Frequency Modulation	400Hz		Appendix B, Figure B.10	TCF110
15	TCF111		Voltage DC Content	-0.3Vdc and +0.3Vdc		Appendix B, Figure B.17	TCF111
16	TCF112		VMod due to equipment.	104V to 130V, 370Hz and 430Hz		App A, Table A.3, App B, Fig B.2	TCF112
17	TCF113		VSpikes due to equipment.	115V, 400Hz		App B, Fig 4. Requires external contactors	TCF113
18	TCF114		Voltage unbalance transient	100V to 122V, 400Hz		App A, Table A.4	TCF114
19			Abnormal Operation				

20	TCF201		Steady State Voltage and Frequency	96V to 130V, 370Hz and 430Hz	16.5.2.1.c	Appendix A, Table A.3	TCF201
21	TCF202		Voltage Transients	0V to 180V, 400Hz	16.5.2.3.1.b & 16.5.2.2.b	Appendix A, Table A.4	TCF202
22	TCF203	1	Voltage Modulation	96V , 400Hz		Appendix A, Table A.3	TCF203-1
23	TCF203	2	Voltage Modulation	130V, 400Hz		Appendix A, Table A.3	TCF203-2
24	TCF204		Frequency Transients	120.5V to 115V, 320Hz to 480Hz		Appendix A, Table A.3	TCF204
25			Switching Transients				
26	TCF401	1	Transparency Time.	100V, 400Hz, 10ms		Fig TCF401-1, Table TCF401-1	TCF401
27	TCF402		Voltage switching transients 1	100V, 400Hz, 2ms to 200ms		Use ABD0100.8.1 Switching transients screen Fig A	
28	TCF403		Voltage switching transients 2	100V, 400Hz, 0ms to 5000ms		Use ABD0100.8.1 Switching transients screen Fig B, Table 1.1	
29			Power Supply Removal				
30	TCF501		Power line disconnection	115V 400Hz			TCF501

**6.3.1.3 SVF:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1			Normal Operation				
2	SVF101		Steady State Voltage and frequency	100V to 122V RMS	16.5.1.1.c.1 (1)	Apply at 360Hz and 900Hz	SVF101
3	SVF102		Voltage Transients	67V to 160V RMS	16.5.1.5.b	Appendix A, Table C.4	SVF102
4	SVF103	1	Voltage Modulation	100V RMS, 360 Hz	16.5.1.5.b	Appendix B, Figure B.2	SVF103-1
5	SVF103	2	Voltage Modulation	122V RMS, 360 Hz	16.5.1.5.b	Appendix B, Figure B.2	SVF103-2
6	SVF103	3	Voltage Modulation	100V RMS, 900 Hz	16.5.1.5.b	Appendix B, Figure B.2	SVF103-3
7	SVF103	4	Voltage Modulation	122V RMS, 900 Hz	16.5.1.5.b	Appendix B, Figure B.2	SVF103-4
8	SVF104		Voltage Spikes	184V to 1000V	17.4, Figure 17.4	Not supported, additional equipment required.	
9	SVF105		Current Distortion	Requires external HF power analyzer		App A, Tables A.7, A.8, App B, Fig B.14	SVF105
10	SVF106	1	Voltage Distortion 1	Distortion limits		Appendix D	SVF106-1
11	SVF106	2	VTHD 1 - No motor	Endurance		Appendix D	SVF106-2
12	SVF106	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	SVF106-2M
13	SVF107		Voltage Distortion 2	700Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
14	SVF108		Voltage Distortion Transients	Distortion limits		Appendix D	SVF108
15	SVF109		Inrush current	104V to 130V RMS		App B, Figure B.18,B19	SVF109
16	SVF110		Frequency Variations	360Hz to 900Hz, 100Hz/s		Appendix A, Table A.4	SVF110
17	SVF111		Frequency Modulation	360Hz and 900Hz		Appendix B, Figure B.10	SVF111
18	SVF112		Voltage DC Content	-0.3Vdc and +0.3Vdc		Appendix B, Figure B.17	SVF112

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
19	SVF113		VMod due to equipment.	104V to 130V, 360Hz and 900Hz		App A, Table A.3, App B, Fig B.2	SVF113
20	SVF114		VSpikes due to equipment.	115V, 360Hz and 900Hz		App B, Fig 4. Requires external contactors	SVF114
21			Abnormal Operation				
22	SVF201		Steady State Voltage and Frequency	96V to 130V, 360Hz and 900Hz	16.5.2.1.c	Appendix A, Table A.3	SVF201
23	SVF202		Voltage Transients	0V to 180V, 360Hz and 900Hz	16.5.2.2.b & 16.5.2.2.b	Appendix A, Table A.4	SVF202
24	SVF203	1	Voltage Modulation	96V , 360Hz		Appendix A, Table A.3	SVF203-1
25	SVF203	2	Voltage Modulation	130V, 360Hz		Appendix A, Table A.3	SVF203-2
26	SVF203	3	Voltage Modulation	96V, 900Hz		Appendix A, Table A.3	SVF203-3
27	SVF203	4	Voltage Modulation	130V, 900Hz		Appendix A, Table A.3	SVF203-4
28			Emergency Operation				
29	SVF301		Steady State Voltage and Frequency	100V to 122V, 360Hz and 900Hz	16.5.1.1.c.1	Same as TVF101	SVF101
30	SVF302	1	Voltage Distortion 1	Distortion limits		Appendix D	SVF302-1
31	SVF302	2	VTHD 1 - No motor	Endurance		Appendix D	SVF302-2
32	SVF302	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	SVF302-2M
33	SVF303		Voltage Distortion 2	1400Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
34	SVF304		Voltage Distortion Transients	Distortion limits		Appendix B, Figure B.15	SVF304
35	SVF305		Inrush current	108V to 122V RMS		App B, Figure B.18,B19	SVF305
36	SVF306		Frequency Variations	360Hz to 900Hz, 1000Hz/s		Appendix A, Table A.4	SVF306
37	SVF307		VMod due to equipment.	108V to 122V, 360Hz and 900Hz		App A, Table A.3, App B, Fig B.2	SVF307



#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
38			Switching Transients				
39	SVF401	1	Transparency Time.	100V, 360Hz, 10ms		Fig TVF401-1, Table TVF401-1	SVF401-1
40	SVF401	2	Transparency Time.	100V, 900Hz, 10ms		Fig TVF401-1, Table TVF401-1	SVF401-2
41	SVF402		Voltage switching transients 1	100V, 360Hz and 900Hz, 2ms to 200ms		Use ABD0100.8.1 Switching transients screen Fig A	
42	SVF403		Voltage switching transients 2	100V, 360Hz and 900Hz, 0ms to 5000ms		Use ABD0100.8.1 Switching transients screen Fig B, Table 1.1	
43	SVF404		Volt switch trans with freq change	100V, 360Hz and 900Hz, 50ms to 200ms		Appendix A, Table A.4	SVF404
44			Power Supply Removal				
45	SVF501		Power line disconnection	115V 360Hz and 900Hz			SVF501

**6.3.1.4 TVF:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1			Normal Operation				
2	TVF101		Steady State Voltage and frequency	101.5V to 122V RMS	16.5.1.1.c.1 (1)	Apply at 360Hz and 900Hz	TVF101
3	TVF102		Voltage Transients	67V to 160V RMS	16.5.1.5.b	Appendix A, Table C.4	TVF102
4	TVF103	1	Voltage Modulation	101.5V RMS, 360 Hz	16.5.1.5.b	Appendix B, Figure B.2	TVF103-1
5	TVF103	2	Voltage Modulation	120.5V RMS, 360 Hz	16.5.1.5.b	Appendix B, Figure B.2	TVF103-2
6	TVF103	3	Voltage Modulation	101.5V RMS, 900 Hz	16.5.1.5.b	Appendix B, Figure B.2	TVF103-3
7	TVF103	4	Voltage Modulation	120.5V RMS, 900 Hz	16.5.1.5.b	Appendix B, Figure B.2	TVF103-4
8	TVF104		Voltage Spikes	184V to 1000V	17.4, Figure 17.4	Not supported, additional equipment required.	
9	TVF105		Current Distortion	Requires external HF power analyzer		App A, Tables A.7, A.8, App B, Fig B.14	TVF105
10	TVF106	1	Voltage Distortion 1	Distortion limits		Appendix D	TVF106-1
11	TVF106	2	VTHD 1 - No motor	Endurance		Appendix D	TVF106-2
12	TVF106	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	TVF106-2M
13	TVF107		Voltage Distortion 2	700Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
14	TVF108		Voltage Distortion Transients	Distortion limits		Appendix D	TVF108
15	TVF109		Inrush current	104V to 130V RMS		App B, Figure B.18,B19	TVF109
16	TVF110		Frequency Variations	360Hz to 900Hz, 100Hz/s		Appendix A, Table A.4	TVF110
17	TVF111		Frequency Modulation	360Hz and 900Hz		Appendix B, Figure B.10	TVF111
18	TVF112		Voltage DC Content	-0.3Vdc and +0.3Vdc		Appendix B, Figure B.17	TVF112

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
19	TVF113		VMod due to equipment.	104V to 130V, 360Hz and 900Hz		App A, Table A.3, App B, Fig B.2	TVF113
20	TVF114		VSpikes due to equipment.	115V, 360Hz and 900Hz		App B, Fig 4. Requires external contactors	TVF114
21	TVF115		Voltage unbalance transient	100V to 122V, 360Hz and 900Hz		App A, Table A.4	TVF115
22			Abnormal Operation				
23	TVF201		Steady State Voltage and Frequency	96V to 130V, 360Hz and 900Hz	16.5.2.1.c	Appendix A, Table A.3	TVF201
24	TVF202		Voltage Transients	0V to 180V, 360Hz and 900Hz	16.5.2.2.b & 16.5.2.2.b	Appendix A, Table A.4	TVF202
25	TVF203	1	Voltage Modulation	96V, 360Hz		Appendix A, Table A.3	TVF203-1
26	TVF203	2	Voltage Modulation	130V, 360Hz		Appendix A, Table A.3	TVF203-2
27	TVF203	3	Voltage Modulation	96V, 900Hz		Appendix A, Table A.3	TVF203-3
28	TVF203	4	Voltage Modulation	130V, 900Hz		Appendix A, Table A.3	TVF203-4
29			Emergency Operation				
30	TVF301		Steady State Voltage and Frequency	100V to 120.5V, 360Hz and 900Hz	16.5.1.1.c.1	Same as TVF101	TVF101
31	TVF302	1	Voltage Distortion 1	Distortion limits		Appendix D	TVF302-1
32	TVF302	2	VTHD 1 - No motor	Endurance		Appendix D	TVF302-2
33	TVF302	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	TVF302-2M
34	TVF303		Voltage Distortion 2	1400Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
35	TVF304		Voltage Distortion Transients	Distortion limits		Appendix B, Figure B.15	TVF304
36	TVF305		Inrush current	109.5V to 120.5V RMS		App B, Figure B.18,B19	TVF305
37	TVF306		Frequency Variations	360Hz to 900Hz, 1000Hz/s		Appendix A, Table A.4	TVF306

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
38	TVF307		VMod due to equipment.	109.5V to 120.5V, 360Hz and 900Hz		App A, Table A.3, App B, Fig B.2	TVF307
39			Switching Transients				
40	TVF401	1	Transparency Time.	100V, 360Hz, 10ms		Fig TVF401-1, Table TVF401-1	TVF401-1
41	TVF401	2	Transparency Time.	100V, 900Hz, 10ms		Fig TVF401-1, Table TVF401-1	TVF401-2
42	TVF402		Voltage switching transients 1	100V, 360Hz and 900Hz, 2ms to 200ms		Use ABD0100.8.1 Switching transients screen Fig A	
43	TVF403		Voltage switching transients 2	100V, 360Hz and 900Hz, 0ms to 5000ms		Use ABD0100.8.1 Switching transients screen Fig B, Table 1.1	
44	TVF404		Volt switch trans with freq change	100V, 360Hz and 900Hz, 50ms to 200ms		Appendix A, Table A.4	TVF404
45			Power Supply Removal				
46	TVF501		Power line disconnection	115V 360Hz and 900Hz			TVF501

**6.3.1.5 SCFH:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1			Normal Operation				
2	SCFH101		Steady State Voltage and frequency	202V to 248V RMS	16.5.1.1.c.1 (1)	Apply at 390Hz and 410Hz	SCFH101
3	SCFH102		Voltage Transients	136V to 324V RMS	16.5.1.5.b	Appendix A, Table C.4	SCFH102
4	SCFH103	1	Voltage Modulation	202V RMS, 400 Hz	16.5.1.5.b	Appendix B, Figure B.2	SCFH103-1
5	SCFH103	2	Voltage Modulation	248V RMS, 400 Hz	16.5.1.5.b	Appendix B, Figure B.2	SCFH103-2
6	SCFH104		Voltage Spikes	184V to 1000V	17.4, Figure 17.4	Not supported, additional equipment required.	
7	SCFH105		Current Distortion	Requires external HF power analyzer		App A, Tables A.7, A.8, App B, Fig B.14	SCFH105
8	SCFH106	1	Voltage Distortion 1	Distortion limits		Appendix D	SCFH106-1
9	SCFH106	2	VTHD 1 - No motor	Endurance		Appendix D	SCFH106-2
10	SCFH106	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	SCFH106-2M
11	SCFH107		Voltage Distortion 2	700Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
12	SCFH108		Voltage Distortion Transients	Distortion limits		Appendix D	SCFH108
13	SCFH109		Inrush current	200V to 260V RMS		App B, Figure B.18,B19	SCFH109
14	SCFH110		Frequency Modulation	400Hz		Appendix B, Figure B.10	SCFH110
15	SCFH111		Voltage DC Content	-0.6Vdc and +0.6Vdc		Appendix B, Figure B.17	SCFH111
16	SCFH112		VMod due to equipment.	200V to 260V, 370Hz and 430Hz		App A, Table A.3, App B, Fig B.2	SCFH112
17	SCFH113		VSpoke due to equipment.	230V, 400Hz		App B, Fig 4. Requires external contactors	SCFH113
18			Abnormal Operation				

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
19	SCFH201		Steady State Voltage and Frequency	192V to 248V, 370Hz and 430Hz	16.5.2.1.c	Appendix A, Table A.3	SCFH201
20	SCFH202		Voltage Transients	0V to 360V, 400Hz	16.5.2.3.1.b & 16.5.2.2.b	Appendix A, Table A.4	SCFH202
21	SCFH203	1	Voltage Modulation	192V , 400Hz		Appendix A, Table A.3	SCFH203-1
22	SCFH203	2	Voltage Modulation	260V, 400Hz		Appendix A, Table A.3	SCFH203-2
23	SCFH204		Frequency Transients	248V to 230V, 320Hz to 480Hz		Appendix A, Table A.3	SCFH204
24			Switching Transients				
25	SCFH401	1	Transparency Time.	202V, 400Hz, 10ms		Fig TCF401-1, Table TCF401-1	SCFH401
26	SCFH402		Voltage switching transients 1	202V, 400Hz, 2ms to 200ms		Use ABD0100.8.1 Switching transients screen Fig A	
27	SCFH403		Voltage switching transients 2	202V, 400Hz, 0ms to 5000ms		Use ABD0100.8.1 Switching transients screen Fig B, Table 1.1	
28			Power Supply Removal				
29	SCFH501		Power line disconnection	230V 400Hz			SCFH501

**6.3.1.6 TCFH:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1			Normal Operation				
2	TCFH101		Steady State Voltage and frequency	202V to 248V RMS	16.5.1.1.c.1 (1)	Apply at 390Hz and 410Hz	TCFH101
3	TCFH102		Voltage Transients	136V to 324V RMS	16.5.1.5.b	Appendix A, Table C.4	TCFH102
4	TCFH103	1	Voltage Modulation	206V RMS, 400 Hz	16.5.1.5.b	Appendix B, Figure B.2	TCFH103-1
5	TCFH103	2	Voltage Modulation	243V RMS, 400 Hz	16.5.1.5.b	Appendix B, Figure B.2	TCFH103-2
6	TCFH104		Voltage Spikes	184V to 1000V	17.4, Figure 17.4	Not supported, additional equipment required.	
7	TCFH105		Current Distortion	Requires external HF power analyzer		App A, Tables A.7, A.8, App B, Fig B.14	TCFH105
8	TCFH106	1	Voltage Distortion 1	Distortion limits		Appendix D	TCFH106-1
9	TCFH106	2	VTHD 1 - No motor	Endurance		Appendix D	TCFH106-2
10	TCFH106	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	TCFH106-2M
11	TCFH107		Voltage Distortion 2	700Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
12	TCFH108		Voltage Distortion Transients	Distortion limits		Appendix D	TCFH108
13	TCFH109		Inrush current	200V to 260V RMS		App B, Figure B.18,B19	TCFH109
14	TCFH110		Frequency Modulation	400Hz		Appendix B, Figure B.10	TCFH110
15	TCFH111		Voltage DC Content	-0.6Vdc and +0.6Vdc		Appendix B, Figure B.17	TCFH111
16	TCFH112		VMod due to equipment.	200V to 260V, 370Hz and 430Hz		App A, Table A.3, App B, Fig B.2	TCFH112
17	TCFH113		VSpoke due to equipment.	230V, 400Hz		App B, Fig 4. Requires external contactors	TCFH113
18	TCFH114		Voltage unbalance transient	192V to 248V, 400Hz		App A, Table A.4	TCFH114
19			Abnormal Operation				

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
20	TCFH201		Steady State Voltage and Frequency	192V to 248V, 370Hz and 430Hz	16.5.2.1.c	Appendix A, Table A.3	TCFH201
21	TCFH202		Voltage Transients	0V to 360V, 400Hz	16.5.2.3.1.b & 16.5.2.2.b	Appendix A, Table A.4	TCFH202
22	TCFH203	1	Voltage Modulation	192V , 400Hz		Appendix A, Table A.3	TCFH203-1
23	TCFH203	2	Voltage Modulation	260V, 400Hz		Appendix A, Table A.3	TCFH203-2
24	TCFH204		Frequency Transients	243V to 230V, 320Hz to 480Hz		Appendix A, Table A.3	TCFH204
25			Switching Transients				
26	TCFH401	1	Transparency Time.	202V, 400Hz, 10ms		Fig TCF401-1, Table TCF401-1	TCFH401
27	TCFH402		Voltage switching transients 1	202V, 400Hz, 2ms to 200ms		Use ABD0100.8.1 Switching transients screen Fig A	
28	TCFH403		Voltage switching transients 2	202V, 400Hz, 0ms to 5000ms		Use ABD0100.8.1 Switching transients screen Fig B, Table 1.1	
29			Power Supply Removal				
30	TCFH501		Power line disconnection	230V 400Hz			TCFH501



**6.3.1.7 SVFH:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1			Normal Operation				
2	SVFH101		Steady State Voltage and frequency	202.0V to 248.0V RMS	16.5.1.1.c.1 (1)	Apply at 360Hz and 900Hz	SVFH101
3	SVFH102		Voltage Transients	136V to 324V RMS	16.5.1.5.b	Appendix A, Table C.4	SVFH102
4	SVFH103	1	Voltage Modulation	202.0V RMS, 360 Hz	16.5.1.5.b	Appendix B, Figure B.2	SVFH103-1
5	SVFH103	2	Voltage Modulation	248.0V RMS, 360 Hz	16.5.1.5.b	Appendix B, Figure B.2	SVFH103-2
6	SVFH103	3	Voltage Modulation	202.0V RMS, 900 Hz	16.5.1.5.b	Appendix B, Figure B.2	SVFH103-3
7	SVFH103	4	Voltage Modulation	248.0V RMS, 900 Hz	16.5.1.5.b	Appendix B, Figure B.2	SVFH103-4
8	SVFH104		Voltage Spikes	184V to 1000V	17.4, Figure 17.4	Not supported, additional equipment required.	
9	SVFH105		Current Distortion	Requires external HF power analyzer		App A, Tables A.7, A.8, App B, Fig B.14	SVFH105
10	SVFH106	1	Voltage Distortion 1	Distortion limits		Appendix D	SVFH106-1
11	SVFH106	2	VTHD 1 - No motor	Endurance		Appendix D	SVFH106-2
12	SVFH106	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	SVFH106-2M
13	SVFH107		Voltage Distortion 2	700Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
14	SVFH108		Voltage Distortion Transients	Distortion limits		Appendix D	SVFH108
15	SVFH109		Inrush current	200V to 260V RMS		App B, Figure B.18,B19	SVFH109
16	SVFH110		Frequency Variations	360Hz to 900Hz, 100Hz/s		Appendix A, Table A.4	SVFH110
17	SVFH111		Frequency Modulation	360Hz and 900Hz		Appendix B, Figure B.10	SVFH111
18	SVFH112		Voltage DC Content	-0.6Vdc and +0.6Vdc		Appendix B, Figure B.17	SVFH112

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
19	SVFH113		VMod due to equipment.	200V to 260V, 360Hz and 900Hz		App A, Table A.3, App B, Fig B.2	SVFH113
20	SVFH114		VSpoke due to equipment.	230V, 360Hz and 900Hz		App B, Fig 4. Requires external contactors	SVFH114
21			Abnormal Operation				
22	SVFH201		Steady State Voltage and Frequency	192V to 260V, 360Hz and 900Hz	16.5.2.1.c	Appendix A, Table A.3	SVFH201
23	SVFH202		Voltage Transients	0V to 360V, 360Hz and 900Hz	16.5.2.2.b & 16.5.2.2.b	Appendix A, Table A.4	SVFH202
24	SVFH203	1	Voltage Modulation	192V , 360Hz		Appendix A, Table A.3	SVFH203-1
25	SVFH203	2	Voltage Modulation	260V, 360Hz		Appendix A, Table A.3	SVFH203-2
26	SVFH203	3	Voltage Modulation	192V, 900Hz		Appendix A, Table A.3	SVFH203-3
27	SVFH203	4	Voltage Modulation	260V, 900Hz		Appendix A, Table A.3	SVFH203-4
28			Emergency Operation				
29	SVFH301		Steady State Voltage and Frequency	202V to 248V, 360Hz and 900Hz	16.5.1.1.c.1	Same as TVF101	SVFH101
30	SVFH302	1	Voltage Distortion 1	Distortion limits		Appendix D	SVFH302-1
31	SVFH302	2	VTHD 1 - No motor	Endurance		Appendix D	SVFH302-2
32	SVFH302	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	SVFH302-2M
33	SVFH303		Voltage Distortion 2	1400Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
34	SVFH304		Voltage Distortion Transients	Distortion limits		Appendix B, Figure B.15	SVFH304
35	SVFH305		Inrush current	210V to 248V RMS		App B, Figure B.18,B19	SVFH305
36	SVFH306		Frequency Variations	360Hz to 900Hz, 1000Hz/s		Appendix A, Table A.4	SVFH306
37	SVFH307		VMod due to equipment.	210V to 248V, 360Hz and 900Hz		App A, Table A.3, App B, Fig B.2	SVFH307

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
38			Switching Transients				
39	SVFH401	1	Transparency Time.	202V, 360Hz, 10ms		Fig TVF401-1, Table TVF401-1	SVFH401-1
40	SVFH401	2	Transparency Time.	202V, 900Hz, 10ms		Fig TVF401-1, Table TVF401-1	SVFH401-2
41	SVFH402		Voltage switching transients 1	202V, 360Hz and 900Hz, 2ms to 200ms		Use ABD0100.8.1 Switching transients screen Fig A	
42	SVFH403		Voltage switching transients 2	202V, 360Hz and 900Hz, 0ms to 5000ms		Use ABD0100.8.1 Switching transients screen Fig B, Table 1.1	
43	SVFH404		Volt switch trans with freq change	202V, 360Hz and 900Hz, 50ms to 200ms		Appendix A, Table A.4	SVFH404
44			Power Supply Removal				
45	SVFH501		Power line disconnection	230V 360Hz and 900Hz			SVFH501

**6.3.1.8 TVFH:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1			Normal Operation				
2	TVFH101		Steady State Voltage and frequency	202.0V to 243V RMS	16.5.1.1.c.1 (1)	Apply at 360Hz and 900Hz	TVFH101
3	TVFH102		Voltage Transients	136V to 324V RMS	16.5.1.5.b	Appendix A, Table C.4	TVFH102
4	TVFH103	1	Voltage Modulation	206.0V RMS, 360 Hz	16.5.1.5.b	Appendix B, Figure B.2	TVFH103-1
5	TVFH103	2	Voltage Modulation	243.0V RMS, 360 Hz	16.5.1.5.b	Appendix B, Figure B.2	TVFH103-2
6	TVFH103	3	Voltage Modulation	206.0V RMS, 900 Hz	16.5.1.5.b	Appendix B, Figure B.2	TVFH103-3
7	TVFH103	4	Voltage Modulation	243.0V RMS, 900 Hz	16.5.1.5.b	Appendix B, Figure B.2	TVFH103-4
8	TVFH104		Voltage Spikes	184V to 1000V	17.4, Figure 17.4	Not supported, additional equipment required.	
9	TVFH105		Current Distortion	Requires external HF power analyzer		App A, Tables A.7, A.8, App B, Fig B.14	TVFH105
10	TVFH106	1	Voltage Distortion 1	Distortion limits		Appendix D	TVFH106-1
11	TVFH106	2	VTHD 1 - No motor	Endurance		Appendix D	TVFH106-2
12	TVFH106	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	TVFH106-2M
13	TVFH107		Voltage Distortion 2	700Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
14	TVFH108		Voltage Distortion Transients	Distortion limits		Appendix D	TVFH108
15	TVFH109		Inrush current	200V to 260V RMS		App B, Figure B.18,B19	TVFH109
16	TVFH110		Frequency Variations	360Hz to 900Hz, 100Hz/s		Appendix A, Table A.4	TVFH110
17	TVFH111		Frequency Modulation	360Hz and 900Hz		Appendix B, Figure B.10	TVFH111
18	TVFH112		Voltage DC Content	-0.3Vdc and +0.3Vdc		Appendix B, Figure B.17	TVFH112
19	TVFH113		VMod due to equipment.	200V to 260V, 360Hz and 900Hz		App A, Table A.3, App B, Fig B.2	TVFH113

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
20	TVFH114		VSpoke due to equipment.	230V, 360Hz and 900Hz		App B, Fig 4. Requires external contactors	TVFH114
21	TVFH115		Voltage unbalance transient	202V to 248V, 360Hz and 900Hz		App A, Table A.4	TVFH115
22			Abnormal Operation				
23	TVFH201		Steady State Voltage and Frequency	192V to 260V, 360Hz and 900Hz	16.5.2.1.c	Appendix A, Table A.3	TVFH201
24	TVFH202		Voltage Transients	0V to 360V, 360Hz and 900Hz	16.5.2.2.b & 16.5.2.2.b	Appendix A, Table A.4	TVFH202
25	TVFH203	1	Voltage Modulation	192V , 360Hz		Appendix A, Table A.3	TVFH203-1
26	TVFH203	2	Voltage Modulation	260V, 360Hz		Appendix A, Table A.3	TVFH203-2
27	TVFH203	3	Voltage Modulation	192V, 900Hz		Appendix A, Table A.3	TVFH203-3
28	TVFH203	4	Voltage Modulation	260V, 900Hz		Appendix A, Table A.3	TVFH203-4
29			Emergency Operation				
30	TVFH301		Steady State Voltage and Frequency	202V to 248V, 360Hz and 900Hz	16.5.1.1.c.1	Same as TVF101	TVFH101
31	TVFH302	1	Voltage Distortion 1	Distortion limits		Appendix D	TVFH302-1
32	TVFH302	2	VTHD 1 - No motor	Endurance		Appendix D	TVFH302-2
33	TVFH302	2M	VTHD 1 - EUT incl. motor	Endurance		Appendix D	TVFH302-2M
34	TVFH303		Voltage Distortion 2	1400Hz to 150KHz	Section 18, Figure 18-1	Not supported, additional equipment required.	
35	TVFH304		Voltage Distortion Transients	Distortion limits		Appendix B, Figure B.15	TVFH304
36	TVFH305		Inrush current	109.5V to 120.5V RMS		App B, Figure B.18,B19	TVFH305
37	TVFH306		Frequency Variations	360Hz to 900Hz, 1000Hz/s		Appendix A, Table A.4	TVFH306
38	TVFH307		VMod due to equipment.	214V to 243V, 360Hz and 900Hz		App A, Table A.3, App B, Fig B.2	TVFH307
39			Switching Transients				

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
40	TVFH401	1	Transparency Time.	202V, 360Hz, 10ms		Fig TVF401-1, Table TVF401-1	TVFH401-1
41	TVFH401	2	Transparency Time.	202V, 900Hz, 10ms		Fig TVF401-1, Table TVF401-1	TVFH401-2
42	TVFH402		Voltage switching transients 1	202V, 360Hz and 900Hz, 2ms to 200ms		Use ABD0100.8.1 Switching transients screen Fig A	
43	TVFH403		Voltage switching transients 2	202V, 360Hz and 900Hz, 0ms to 5000ms		Use ABD0100.8.1 Switching transients screen Fig B, Table 1.1	
44	TVFH404		Volt switch trans with freq change	202V, 360Hz and 900Hz, 50ms to 200ms		Appendix A, Table A.4	TVFH404
45			Power Supply Removal				
46	TVFH501		Power line disconnection	230V 360Hz and 900Hz			TVFH501

**6.3.1.9 LDC:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1			Normal Operation				
2	LDC101		Steady State Voltage	24.5V to 31.7Vdc	16.6.1.1.b		LDC101
3	LDC102		Voltage Transients	16V to 41.4V RMS	16.6.1.2	Table LDC 102-1	LDC102
4	LDC103		Voltage Ripple	0.01 to 150 KHz	16.6.1.2, Figure B.8	Not supported, additional equipment required.	
5	LDC104		Voltage Spikes	80V to 600V	17.4, Figure 17.4	Not supported, additional equipment required.	
6	LDC105		Inrush current	24Vdc to 32.5Vdc		App B, Figure B.18,B19	LDC105
7	LDC106		Voltage variation due to APU starting	17Vdc to 24Vdc		Appendix B, Figure B.13	LDC106
8	LDC107		Equipment current ripple	24Vdc and 32.5Vdc		Not supported, additional equipment required.	
9	LDC108		Voltage spike due to equipment load switching	0Vdc to 600Vdc		App B, Fig B.7, Fig B.22	LDC108
10	LDC109		Compatibility with EPDC voltage clamping devices	28Vdc		App B, Fig B.22	LDC109
11			Abnormal Operation				
12	LDC201		Steady State Voltage	21Vdc to 32.5Vdc	16.6.2.1.b	Appendix A, Table A.5	LDC201
13	LDC202		Voltage Transients	0V to 46Vdc	16.6.2.4.c & 16.6.2.3.b	Appendix A, Table A.5	LDC202
14	LDC203		Voltage ripple	31.5Vdc to 32.5Vdc	16.6.1.2	Not supported, additional equipment required.	
15			Emergency Operation				
16	LDC301		Steady-state voltage	18.5Vdc to 32.5Vdc	16.6.1.1.b	Appendix A, Table A.5	LDC301

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
17	LDC302		Voltage Ripple	18.5Vdc to 32.5Vdc	16.6.1.2	Not supported, additional equipment required.	
18	LDC303		Inrush current	21Vdc to 32.5Vdc		Appendix B, Fig B.12	LDC303
19	LDC304		Equipment current ripple	18.5Vdc to 32.5Vdc		Not supported, additional equipment required.	
20			Switching Transients				
21	LDC401		Transparency Time.	24.5Vdc, 10ms		Fig LDC401-1, Table LDC401-1	LDC401
22	LDC402		Voltage switching transients 1	24.5Vdc, 2ms to 200ms		Use ABD0100.8.1 Switching transients screen Fig A	
23	LDC403		Voltage switching transients 2	24.5Vdc, 0ms to 5000ms		Use ABD0100.8.1 Switching transients screen Fig B, Table 1.1	
24			Power Supply Removal				
25	LDC501		Power line disconnection	28Vdc			LDC501



## 7 Option –ABD: Airbus ABD0100.1.8 Test, Rev D, E

The –ABD option supports several of the Airbus ABD0100.1.8 voltage and frequency immunity tests in either of the AC or DC mode (if available).

The –ABD option is based on Airbus Directive 0100, Part 1, Chapter 8, Section 2 (ABD0100.1.8) dated August 2002 (Rev D) or 2005 (Rev E). Section 1 refers to wiring, installation and connectors and is outside the scope of the –ABD option.

Future revisions of the ABD0100.1.8 directive may be issued over time and updates may be made available to cover any changes in test levels, durations, procedures etc. Furthermore, the –ABD option is completely data file driven to allow a large degree of customization by the end-user if needed so many changes can be supported without the need for software updates.

This section of the manual explains the limitations of this test option, the use of special features unique to this option, and gives a complete layout of all tests performed by this option.

This manual is **not** intended to elaborate on the intent or purpose of the immunity tests and the expected behavior of the EUT as described in the ABD0100.1.8 documents. It is assumed that the end-user is familiar with the content of the ABD test standard.

### 7.1 Test Coverage

The comprehensiveness of the tests that can be performed with the –ABD option is determined primarily by the capabilities of the power source used. Tests that are outside the hardware capabilities of the power source used will not be enabled and cannot be selected. For these tests, additional equipment may be required as indicated

#### 7.1.1 MX/RS Series –ABD Option Limitations

The extent of coverage of the –ABD option as implemented on the MX/RS Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Also, section 2.4.2.6 Current harmonics will require the use of an external power analyzer per Figure 11 of ABD0100.1.8 since the MX/RS Series measurement system does not support the required measurement bandwidth for this test. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. Furthermore, the MX/RS Series does not meet the required 1.25% maximum V<sub>thd</sub> over the 360 to 800Hz frequency range required for the distorted voltage test No. 10.

**Note:** The MX15 Series power sources are single phase output only and therefore all three phase tests are not available on the MX15.

No.	Description	Table A	Table B	Table C	No.	Description	Table D	No.	Description	Table E
1	Steady State Voltage	√	√	√	1	Steady State Voltage	√	1	Steady State Voltage	√
2	Abnormal Steady State Voltage	√	√	√	2	Abnormal Steady State Voltage	√	2	Voltage Surge - Normal	√
3	Voltage Surge - Normal	√	√	√	3	Voltage Surge - Normal	√	3	Voltage Surge - Abnormal	√
4	Voltage Surge - Abnormal	√	√	√	4	Voltage Surge - Abnormal	√	4	Voltage Spikes	X
5	Voltage Spikes	X	X	X	5	Voltage Spikes	X	5	Switching Transients – Appendix 1	√

No.	Description	Table A	Table B	Table C	No.	Description	Table D	No.	Description	Table E
6	Switching Transients – Appendix 1	√	√	√	6	Switching Transients – Appendix 1	√	6	Ripple Voltage	X
7	Voltage Modulation	√	√	√	7	Square Wave	√	7	Starting Current	√
8	Normal Frequency Variations	√	√	√	8	Ripple Voltage	X			
9	Frequency Modulation	√	√	√						
10	Distorted Voltage	P		P						
11	Voltage DC Content	√	√	√						

*Table 7- 1: -ABD Option MX/RS Test Coverage*

### 7.1.2 AST Series –ABD Option Limitations

The extent of coverage of the –ABD option as implemented on the AST Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Also, section 2.4.2.6 Current harmonics will require the use of an external power analyzer per Figure 11 of ABD0100.1.8 since the AST Series measurement system does not support the required measurement bandwidth for this test. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. Furthermore, the AST Series does not meet the required 1.25% maximum Vthd over the 360 to 800Hz frequency range required for the distorted voltage test No. 10.

**Note:** The AST Series power sources model number ending with “1” (eg: AST 751,1501) are single phase output only and therefore all three phase tests are not available on these series.

No.	Description	Table A	Table B	Table C	No.	Description	Table D	No.	Description	Table E
1	Steady State Voltage	√	√	√	1	Steady State Voltage	√	1	Steady State Voltage	√
2	Abnormal Steady State Voltage	√	√	√	2	Abnormal Steady State Voltage	√	2	Voltage Surge - Normal	√
3	Voltage Surge - Normal	√	√	√	3	Voltage Surge - Normal	√	3	Voltage Surge - Abnormal	√
4	Voltage Surge - Abnormal	√	√	√	4	Voltage Surge - Abnormal	√	4	Voltage Spikes	X
5	Voltage Spikes	X	X	X	5	Voltage Spikes	X	5	Switching Transients – Appendix 1	√
6	Switching Transients – Appendix 1	√	√	√	6	Switching Transients – Appendix 1	√	6	Ripple Voltage	X
7	Voltage Modulation	√	√	√	7	Square Wave	√	7	Starting Current	√
8	Normal Frequency Variations	√	√	√	8	Ripple Voltage	X			
9	Frequency Modulation	√	√	√						
10	Distorted Voltage	P		P						
11	Voltage DC Content	√	√	√						

Table 7- 2: -ABD Option AST Test Coverage

### 7.1.3 i/iX Series –ABD Option Limitations

The extent of coverage of the –ABD option as implemented on the i/iX Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on iX models only.

No.	Description	Table A	Table B	Table C	No.	Description	Table D	No.	Description	Table E
1	Steady State Voltage	√	√	√	1	Steady State Voltage	√	1	Steady State Voltage	√
2	Abnormal Steady State Voltage	√	√	√	2	Abnormal Steady State Voltage	√	2	Voltage Surge - Normal	√
3	Voltage Surge - Normal	√	√	√	3	Voltage Surge - Normal	√	3	Voltage Surge - Abnormal	√
4	Voltage Surge - Abnormal	√	√	√	4	Voltage Surge - Abnormal	√	4	Voltage Spikes	X
5	Voltage Spikes	X	X	X	5	Voltage Spikes	X	5	Switching Transients – Appendix 1	√
6	Switching Transients – Appendix 1	√	√	√	6	Switching Transients – Appendix 1	√	6	Ripple Voltage	X
7	Voltage Modulation	√	√	√	7	Square Wave	√	7	Starting Current	√
8	Normal Frequency Variations	√	√	√	8	Ripple Voltage	X			
9	Frequency Modulation	√	√	√						
10	Distorted Voltage	P		P						
11	Voltage DC Content	√	√	√						

Table 7- 3: -ABD Option i/iX Test Coverage

### 7.1.4 Lx/Ls Series –ABD Option Limitations

The extent of coverage of the –ABD option as implemented on the Lx/Ls Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Lx models or Ls models with the –ADV option only.

Note that the Lx/Ls Series only provides AC output so none of the DC tests (Table D and E) are supported on the Lx/Ls Series.

#### Harmonic Measurement Restrictions

The maximum bandwidth for current harmonic measurements of the Lx/Ls Series is limited to 48KHz in single-phase mode and 16 KHz in three-phase range. Harmonic components that fall outside this bandwidth are not reported (value of 0.00 is returned). The same applies to voltage harmonics.

The requirement for ABD is 150 KHz so for EUT’s with high harmonic order currents, a higher bandwidth external power analyzer should be used in addition to the AC source.

No.	Description	Table A	Table B	Table C	No.	Description	Table D	No.	Description	Table E
1	Steady State Voltage	√	√	√	1	Steady State Voltage	X	1	Steady State Voltage	X
2	Abnormal Steady State Voltage	√	√	√	2	Abnormal Steady State Voltage	X	2	Voltage Surge - Normal	X
3	Voltage Surge - Normal	√	√	√	3	Voltage Surge - Normal	X	3	Voltage Surge - Abnormal	X
4	Voltage Surge - Abnormal	√	√	√	4	Voltage Surge - Abnormal	X	4	Voltage Spikes	X
5	Voltage Spikes	X	X	X	5	Voltage Spikes	X	5	Switching Transients – Appendix 1	X
6	Switching Transients – Appendix 1	√	√	√	6	Switching Transients – Appendix 1	X	6	Ripple Voltage	X
7	Voltage Modulation	√	√	√	7	Square Wave	X	7	Starting Current	X
8	Normal Frequency Variations	√	√	√	8	Ripple Voltage	X			
9	Frequency Modulation	√	√	√						
10	Distorted Voltage	P		P						
11	Voltage DC Content	X	X	X						

Table 7- 4: -ABD Option Ls/Lx Test Coverage

## 7.2 –ABD Power Groups

The –ABD option supports both AC and DC modes of operation. The correct mode is a function of the EUT to be tested and the operator must select the corresponding operating mode first. This can be done from the front panel if needed or using the Gui program. Use of the Gui program for all settings will be assumed for the remainder of this chapter.

Five power groups are covered in the ABD0100.1.8 directive:

Group	Description
A	115VAC / 400 Hz (CF)
B	26 VAC / 400 Hz
C	115VAC / Variable Frequency (VF), 360 – 800 Hz.
D	28VDC, Conventional DC network.
E	28VDC, No Break Power Transfer (NBPT) DC network.

The required steady state output settings for each power group must be selected based on the type of EUT to be tested. These settings can be made from the front panel of the power source or from the main Gui control screen

## 7.3 –ABD Special Features

### 7.3.1 Appendix 1: ABD Switching Transients Test Window

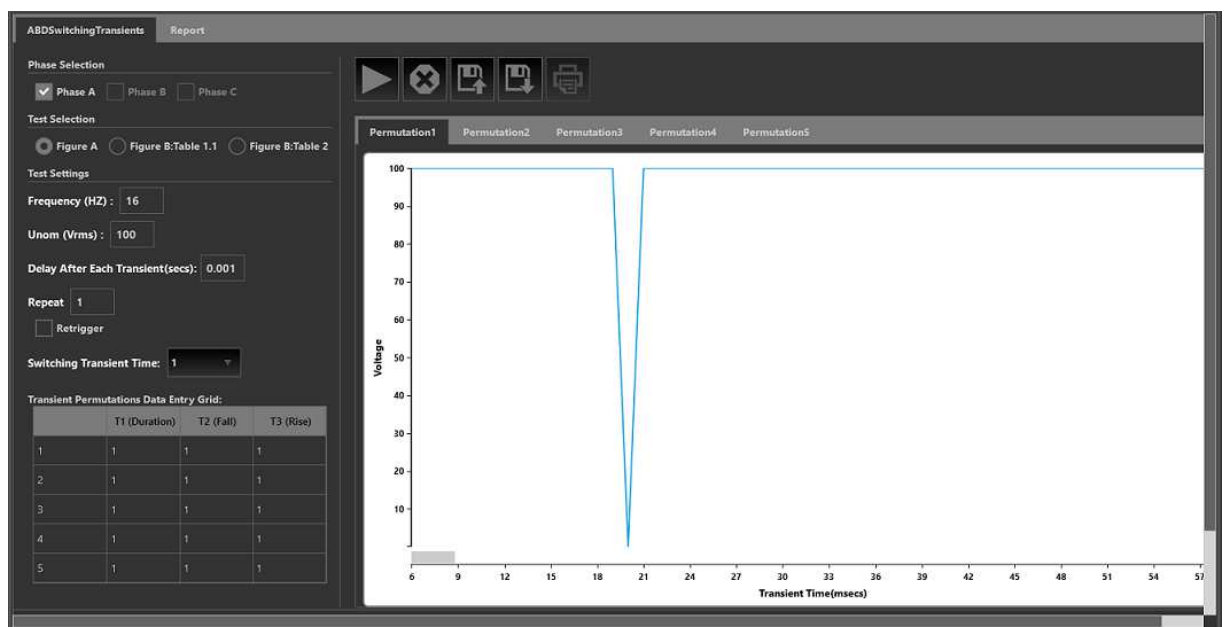


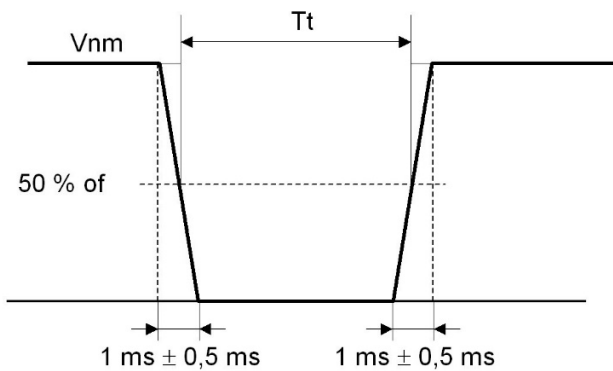
Figure 7-1: ABD0100.1.8 Switching Transient Control Window

The ABD0100.1.8 Switching Transients screen provides a high level of control for performing AC or DC transient tests according to appendix 1 of the ABD0100.1.8. The switching transient tests

are also incorporated in the ABD Table test screen but the parameters for these tests are pre-set by the test sequence files provided. Using the ABD0100.1.8 Switching Transient control window, transient parameters can be set interactively and resulting transient timing is displayed graphically.

Both Figure A (Rev D) or Figure 1.1 (Rev E) (Transparency Tests) and Figure B (Rev D) or Figure 1.2 (Rev E) types transients (Transient Tests) can be selected (see figures below) and timing parameter permutations for Figure B / Figure 1.2 tests are automatically generated and displayed in the transient permutations table above the time domain display.

Switching Transients conform Figure A (Rev D) or Figure 1.1 (Rev E) (Transparency).  $T_t$  is shown in the T1 column of the table. This transient is repeated 5 times with a delay of 1 second (default) between transients.



Switching Transients conform Figure B (Rev D) or Figure 1.2 (Rev E). The T1, T2 and T3 values are shown on screen in the table above the graph. Each permutation shown is repeated one time with a 1 second delay (default) between transients

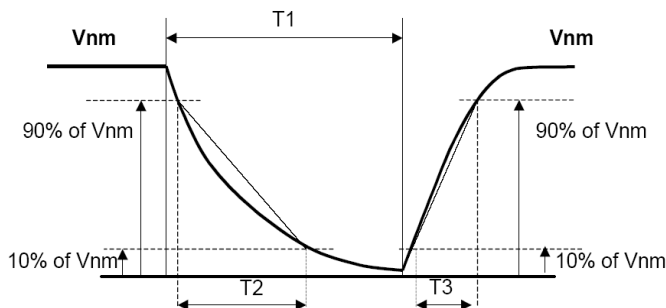
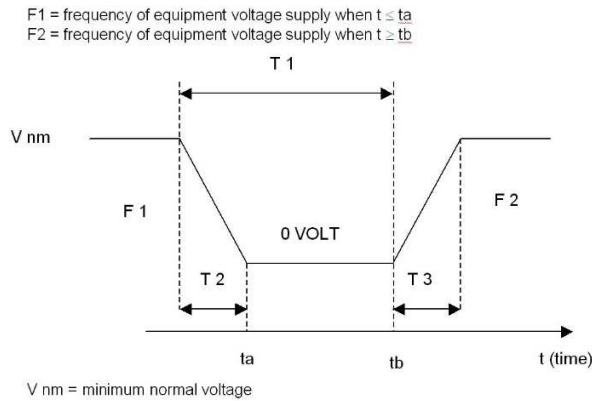


Table 2 (Rev D) or Table 1.3 (Rev E) transients with roman numerals I through VI are supported as well by selecting Figure B, Table 2. F1 and F2 represent the test frequencies before and after the transient.



Controls

The following controls and displays are available in this window:

Control / Display	Description
Start button	Start selected transient test. This button will be disabled while a test is running and re-enabled at the end of a test.
Abort button	Aborts a test in progress. This button will be disabled unless a test is running and enabled as soon as a test is started.
Phase Checkbox	The Phase selections may be used to include one or more or all phases in a test run. Only phases with a check mark will be included in a test. Phases that are not checked remain unchanged during the test.
Graph Preview indicator.	This text field displays the currently selected Row from the Transient permutations grid that is shown in the graph display in the lower half of the window. Normally, this is the row that is highlighted in the grid and/or the row that is presently executing.
Output On/Off	Indicates the status of the output relay of the power source. Normally, the output relay should remain closed during and between tests. To toggle the state of the output relay, the main GUI screen must be used.
Test Selection	This section contains the settings and control to determine the type and duration of the transient tests to be run.
Figure / Table no.	This selection sets the type of transient to be run as either conform Figure A or Figure B (Rev D) or Figure 1.2 or Figure 1.1 (Rev E) of Appendix 1. In case Figure B / Figure 1.2 is selected, the parameter table to be used can be selected as well. Some choices may not be available depending on the capabilities of the power source. For example, Table 1.2 applies only to DC transients and will always be grayed out since the Lx/Ls Series supports AC output only. Note that the size of the Transient permutations table will vary depending on the Figure and Table selection made in this control.
Type No.	<b>For Figure A / Figure 1.1 Transparency Transients:</b> This drop down list control contains drop times in msec. Select the desired drop time from this list. Rise and fall times will be set to <1 msec. Each transient will be run 5 times with a 1 second delay



Control / Display	Description											
		<p>between transients per ABD0100.1.8 Appendix 1.</p> <p><b><u>For Figure B / Figure 1.2 Switching Transients:</u></b>                      This drop down list contains the numbers from the selected table 1.1, 1.2 or 2. Select the number for the transient you want to run. The GUI will automatically load all available permutations for the selected table entry. For tables 1.1 and 1.2, these numbers are Arabic. For table 2, they are Roman numerals.</p>										
	Unom	<p>Sets the nominal voltage at which these transients are to be run. Recommended nominal voltages to use per Appendix 1 are shown here.</p> <table border="1"> <tr> <td>Network Type</td> <td>Voltage applied at equipment terminals (Unom)</td> </tr> <tr> <td>115 VAC</td> <td>104 Vrms</td> </tr> <tr> <td>26 VAC</td> <td>23 Vrms</td> </tr> <tr> <td>Conventional DC</td> <td>25.5 Vdc</td> </tr> <tr> <td>NBPT DC</td> <td>24 Vdc</td> </tr> </table>	Network Type	Voltage applied at equipment terminals (Unom)	115 VAC	104 Vrms	26 VAC	23 Vrms	Conventional DC	25.5 Vdc	NBPT DC	24 Vdc
	Network Type	Voltage applied at equipment terminals (Unom)										
	115 VAC	104 Vrms										
	26 VAC	23 Vrms										
	Conventional DC	25.5 Vdc										
	NBPT DC	24 Vdc										
	Delay after each transient	<p>This field sets the time delay between transients in seconds. Default value is 1 second. Note that there is a small amount of overhead from the GUI program as it reprograms the power source between transients. This time is small compared to the 1-second delay itself however.</p>										
	Repeat	<p>Sets the number of times each transient is run. Default value is 1. For most situations, this value should be set to 1.</p>										
	Retrig.	<p>If repeat count greater than 1 is used and external trigger source is selected, setting this check box will require only a single trigger input. Subsequent repeats will trigger automatically.</p>										
Freq F1 < ta	<p>Sets the frequency before the transient (ta) for Table 2 type transients. Normally this value is set automatically per Appendix A, but the operator can change it in this field.</p>											
Freq F2 > tb	<p>Sets the frequency after the transient (tb) for Table 2 type transients. Normally this value is set automatically per Appendix A, but the operator can change it in this field.</p>											
Transient permutations data entry grid. (Table)	<p>This data grid displays the T1, T2 and T3 values used for each permutation of the table values from Appendix A. These values are normally loaded automatically when selecting a table number using the Type No. drop down list. It is possible however to edit these values and save them to disk. User defined transients can be recalled using the File, Open menu. See Menu help below.</p>											
Graph	<p>The graph shows each transient type on a time scale from –20 msec to 350 msec. Note that for AC mode, only the envelope of the AC waveform is shown for clarity. Thus, the type of display is the same for AC and DC modes. The graph can be zoomed using the left mouse button. Double click on the graph to unzoom.</p>											

Control / Display	Description
User Data	The area at the bottom of this tab may be used to enter general information regarding the unit under test, the test location and operator and environmental conditions in effect during the test. This information will be incorporated in the test reports generated by the GUI.

## Menus

The top of the ABD Transients window contains a standard Windows menu bar. Available menus are:

Menu	Sub Menu	Description
File	New	The selected resets all data from the Transient permutations data entry grid to the selected Type No entry. This operation may be used to undo any edits made by the user.
	Open	Opens a specific transient test file with ABD0100_1_8 extension. This menu may be used to directly select a test file without using the Type No. drop down list.
	Save	Saves the contents of the Transient permutations data entry grid to the selected test file. The ABD0100_1_8 file extension is automatically appended.
	Save As...	Saves the contents of the Transient permutations data entry grid to a user defined file name. A file dialog box will appear enabling selection of the directory and file name under which to store the contents of the test sequence data grid. The ABD0100_1_8 file extension is automatically appended.
	Print	Prints a test report using MS Word format. Only data for the presently selected test sequence is printed. Note: To print reports, the MS Word report format selection must be made from the Main GUI, Options menu → Report Format menu before opening the ABD0100.1.8 test screen. If not, an error prompt will indicate that no supported report format is selected.
	Exit	Closes the ABD Transients test window.
Edit	Cut	Cuts the selected row from the Transient permutations data entry grid. The data in the row cut is available for a Paste operation.
	Copy	Copies the selected row from the Transient permutations data entry grid. Copied rows can be pasted to the same grid at a different location.
	Paste	Pastes a copied row from to the Transient permutations data entry grid.
Run	All	Run selected test
	Stop	Abort test in progress
Help		Opens this help file.

## **7.4 Test Tables**

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The tables shown on the next few pages list the test sections covered by the –ABD option. Where relevant, the numbering used matches that of the ABD0100.1.8 document. The notes in the right hand column indicate tests that are either not directly supported or require additional external test equipment. Test tables are listed by power groups A through E.

**7.4.1 Revision E****7.4.1.1 Table A:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1							
2		1.1	Voltage each phase	104V to 122V RMS	16.5.1.1.b test 1,2,3	Apply at 430Hz and 370Hz	A1P1_NSSVF
3		1.2		105.5V to 120.5V RMS	16.5.1.1.c.1 test 1 to 5	Apply at 430Hz and 370Hz	A1P3_NSSVF
4	2a		Abnormal Steady State Voltage				
5		2.1	Voltage single phase	96V to 130V RMS	16.5.2.1.b	Apply for 30 mins iso 5 mins	A2P1_ABN_SSV
6		2.2	Average voltage 3 phases	96V to 130V RMS	16.5.2.1.c	Apply for 30 mins iso 5 mins	A2P3_ABN_SSV
7	2b		Abnormal Steady State Frequency				
8		2.3	Voltage single phase	104V to 122V RMS	16.5.2.1.d	Apply for 30 mins iso 5 mins	A2P1_ABN_SSF
9		2.4	Average voltage 3 phases	105.5V to 120.5V RMS	16.5.2.1.e	Apply for 30 mins iso 5 mins	A2P3_ABN_SSF
10	3		Voltage Surge - Fig 1				
11		3.1	Normal Transients	160V for 30ms,71V for 15ms	16.5.1.5.1.b	Use specified limit iso DO160	A3P0_NORMVSURGE1
12		3.2	Normal Transients	156V for 50ms,80V for 30ms	16.5.1.5.1.b	Use specified limit iso DO160	A3P0_NORMVSURGE2
13		3.3	Normal Transients	148V for 100ms,86V for 50ms	16.5.1.5.1.b	Use specified limit iso DO160	A3P0_NORMVSURGE3
14		3.4	Normal Transients	140V for 200ms	16.5.1.5.1.b	No undervoltage test required	A3P0_NORMVSURGE4

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
15	4		Voltage Surge - Fig 1				
16		4.1	Abnormal Transients	180V for 100ms, 148V for 1 sec	16.5.2.3.1.b		A4P0_ABNVSURGE1
17		4.2	Abnormal Transients	0V for 5 secs	16.5.2.2.b	No undervoltage test required	A4P0_ABNVSURGE2
18		4.3	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests	A4P3_APPENDIX3
19	5		Voltage Spike - Fig 3-A	Peak voltage 1000V	17.4	Requires add'l equipment	
20	6		Switching Transients		n/a	Appendix 1 DC Switching Transients	
21		6.1		Table 1.1 - T1 1 to 50 msec			A6P0_APP1A_AC400_61
22		6.2	Appendix 1: Figure 1.1	Table 1.1 - T1 51 to 100 msec			A6P0_APP1A_AC400_62
23		6.3	Appendix 1: Figure 1.1	Table 1.1 - T1 100 to 200 msec			A6P0_APP1A_AC400_63
24		6.2.1	Appendix 1: Figure 1.2	Table 1.1 - N = 1			A6P0_APP1TransientsB_N1
25		6.2.2	Appendix 1: Figure 1.2	Table 1.1 - N = 2			A6P0_APP1TransientsB_N2
26		6.2.3	Appendix 1: Figure 1.2	Table 1.1 - N = 3			A6P0_APP1TransientsB_N3
27		6.2.4	Appendix 1: Figure 1.2	Table 1.1 - N = 4			A6P0_APP1TransientsB_N4
28		6.2.5	Appendix 1: Figure 1.2	Table 1.1 - N = 5			A6P0_APP1TransientsB_N5
29		6.2.6		Table 1.1 - N = 6			A6P0_APP1TransientsB_N6
30		6.2.7	Appendix 1: Figure 1.2	Table 1.1 - N = 7			A6P0_APP1TransientsB_N7
31		6.2.8	Appendix 1: Figure 1.2	Table 1.1 - N = 8			A6P0_APP1TransientsB_N8
32		6.2.9	Appendix 1: Figure 1.2	Table 1.1 - N = 9			A6P0_APP1TransientsB_N9
33		6.2.10	Appendix 1: Figure 1.2	Table 1.1 - N = 10			A6P0_APP1TransientsB_N10
34		6.2.11	Appendix 1: Figure 1.2	Table 1.1 - N = 11			A6P0_APP1TransientsB_N11
35	7		Voltage Modulation			Replace DO160 Fig 16.1 with Fig 4-A	

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
36		A.1	Normal & Emergency		16.5.1.2	122 Vrms each phase	A7P0_VMOD_A1
37		A.2	Normal & Emergency	Fig 4-A	16.5.1.2	104 Vrms each phase	A7P0_VMOD_A2
38		B.1	Abnormal	Fig 4-A	16.5.1.2	130 Vrms each phase	A7P0_VMOD_B1
39		B.2	Abnormal	Fig 4-A	16.5.1.2	96 Vrms each phase	A7P0_VMOD_B2
40	8		Frequency excursions abnormal	Fig 5, limits 1 and 4	n/a	Appendix 2 tests	A8P0_ABNFEXCURS
41	9		Frequency modulation	Fig 6	16.5.1.3		A9P0_FMOD
42	10		Distorted Voltage	Par 2.4.2.6.1	n/a	Test conditions 1 & 2	A10P0_VDIST
43	11		Voltage DC Content	Appendix 4	n/a	DC Offset	A11P0_DCOffs_APP4

**7.4.1.2 Table B:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1					16.5.1.1.b.1 test 1,2,3	Apply at 430Hz and 370Hz, Replace 100V & 122V with 23V & 28V	B1P0_NSSVF
2	2		Abnormal Steady State Voltage	21V to 30V RMS	16.5.2.1.b	Apply for 30 mins iso 5 mins	B2P0_ABN_SSV
3	2			21V to 30V RMS	16.5.2.1.d	Apply for 30 mins iso 5 mins	B2P0_ABN_SSF
4	3		Voltage Surge				
5		3.1	Normal Transients	36.5V for 30ms,16.1V for 15ms	16.5.1.5.1.b	Use specified limit iso DO160	B3P0_NORMVSURGE1
6		3.2	Normal Transients	35.6V for 50ms,18.2V for 30ms	16.5.1.5.1.b	Use specified limit iso DO160	B3P0_NORMVSURGE2
7		3.3	Normal Transients	33.8V for 19.5ms,86V for 50ms	16.5.1.5.1.b	Use specified limit iso DO160	B3P0_NORMVSURGE3
8		3.4	Normal Transients	32V for 200ms	16.5.1.5.1.b	No undervoltage has to be applied	B3P0_NORMVSURGE4
9	4		Voltage Surge - Fig 1				
10		4.1	Abnormal Transients	41.1V for 100ms, 33.8V for 1 sec	16.5.2.3.1.b		B4P0_ABNVSURGE1
11		4.2	Abnormal Transients	0V for 5 secs	16.5.2.2.b		B4P0_ABNVSURGE2

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
12		4.3	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests	B4P3_APPENDIX3
13	5		Voltage Spike - Fig 3-B	Peak voltage 250V	17.4	Requires add'l equipment	
14	6		Switching Transients		17.4		
15		6.1	Appendix 1: Figure 1.1	Table 1.1 - T1 1 to 50 msec			B6P0_APP1A_AC400_61
16		6.2	Appendix 1: Figure 1.1	Table 1.1 - T1 51 to 100 msec			B6P0_APP1A_AC400_62
17		6.3	Appendix 1: Figure 1.1	Table 1.1 - T1 100 to 200 msec			B6P0_APP1A_AC400_63
18		6.2.1	Appendix 1: Figure 1.2	Table 1.1 - N = 1			B6P0_APP1TransientsB_N1
19		6.2.2	Appendix 1: Figure 1.2	Table 1.1 - N = 2			B6P0_APP1TransientsB_N2
20		6.2.3	Appendix 1: Figure 1.2	Table 1.1 - N = 3			B6P0_APP1TransientsB_N3
21		6.2.4		Table 1.1 - N = 4			B6P0_APP1TransientsB_N4
22		6.2.5	Appendix 1: Figure 1.2	Table 1.1 - N = 5			B6P0_APP1TransientsB_N5
23		6.2.6	Appendix 1: Figure 1.2	Table 1.1 - N = 6			B6P0_APP1TransientsB_N6
24		6.2.7	Appendix 1: Figure 1.2	Table 1.1 - N = 7			B6P0_APP1TransientsB_N7
25		6.2.8	Appendix 1: Figure 1.2	Table 1.1 - N = 8			B6P0_APP1TransientsB_N8
26		6.2.9	Appendix 1: Figure 1.2	Table 1.1 - N = 9			B6P0_APP1TransientsB_N9
27		6.2.10	Appendix 1: Figure 1.2	Table 1.1 - N = 10			B6P0_APP1TransientsB_N10
28		6.2.11	Appendix 1: Figure 1.2	Table 1.1 - N = 11			B6P0_APP1TransientsB_N11
29	7					Replace DO160 Fig 16.1 with Fig 4-A	
30		A.1	Normal & Emergency	Fig 4-A	16.5.1.2	28 Vrms each phase	B7P0_VMOD_A1
31		A.2	Normal & Emergency	Fig 4-A	16.5.1.2	23 Vrms each phase	B7P0_VMOD_A2
32		B.1	Abnormal	Fig 4-A	16.5.1.2	30 Vrms each phase	B7P0_VMOD_B1
33		B.2	Abnormal	Fig 4-A	16.5.1.2	21 Vrms each phase	B7P0_VMOD_B2
34	8		Frequency excursions abnormal	Fig 5, limits 1 and 4	n/a	Refer to Appendix 2 for test description	B8P0_ABNFEXCURS
35	9		Frequency modulation	Fig 6	16.5.1.3		B9P0_FMOD
36	10		Distorted Voltage		n/a	Test condition 2	B10P0_VDIST
37	11		Voltage DC Content	Appendix 4	n/a	DC Offset	B11P0_DCOFFS_APP4

**7.4.1.3 Table C:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1	1		Normal Steady State Voltage and frequency				
2		1.1	Voltage each phase	104V to 122V RMS	16.5.1.1.b test 1 and 2	Apply at 800Hz and 360Hz	C1P1_NSSVF
3		1.2	Average voltage 3 phases	105.5V to 120.5V RMS	16.5.1.1.c.2 test 1 to 4	Apply at 800Hz and 360Hz	C1P3_NSSVF
4	2		Abnormal Steady State Voltage				
5		2.1	Voltage each phase	96V to 130V RMS	16.5.2.1.b	Apply for 30 mins iso 5 mins	C2P1_ABN_SSV
6		2.2	Average voltage 3 phases	96V to 130V RMS	16.5.2.1.c	Apply for 30 mins iso 5 mins	C2P3_ABN_SSV
7	3		Voltage Surge - Fig 1				
8		3.1	Normal Transients	160V for 30ms,71V for 15ms	16.5.1.5.1.b	Use specified limit iso DO160	C3P0_NORMVSURGE1
9		3.2	Normal Transients	156V for 50ms,80V for 30ms	16.5.1.5.1.b	Use specified limit iso DO160	C3P0_NORMVSURGE2
10		3.3	Normal Transients	148V for 100ms,86V for 50ms	16.5.1.5.1.b	Use specified limit iso DO160	C3P0_NORMVSURGE3
11		3.4	Normal Transients	140V for 200ms	16.5.1.5.1.b	No undervoltage test required	C3P0_NORMVSURGE4
12	4		Voltage Surge - Fig 1				
13		4.1	Abnormal Transients	180V for 100ms, 148V for 1 sec	16.5.2.3.1.b		C4P0_ABNSURGE1
14		4.2	Abnormal Transients	0V for 5 secs	16.5.2.2.b	No undervoltage test required	C4P0_ABNSURGE2
15		4.3	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests	C4P3_APPENDIX3
16	5		Voltage Spike - Fig 3-A	Peak voltage 1000V	17.4	Requires add'l equipment	
17	6		Switching Transients		n/a		
18		6.1.1	Appendix 1: Figure 1.1	Table 1.1 - T1 = 1 to 50 msec		At 360Hz	C6P0_APP1A_AC360_61
19		6.1.2	Appendix 1: Figure 1.1	Table 1.1 - T1 = 51 to 100 msec		At 360Hz	C6P0_APP1A_AC360_62
20		6.1.3	Appendix 1: Figure 1.1	Table 1.1 - T1 = 100 to 200 msec		At 360Hz	C6P0_APP1A_AC360_63



#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
21		6.1.4	Appendix 1: Figure 1.1	Table 1.1 - T1 = 1 to 50 msec		At 800Hz	C6P0_APP1A_AC800_64
22		6.1.5	Appendix 1: Figure 1.1	Table 1.1 - T1 = 51 to 100 msec		At 800Hz	C6P0_APP1A_AC800_65
23		6.1.6	Appendix 1: Figure 1.1	Table 1.1 - T1 = 100 to 200 msec		At 800Hz	C6P0_APP1A_AC800_66
24		6.2.1	Appendix 1: Figure 1.2	Table 1.1 - N = 1		Run transient at 360Hz.	C6P0_APP1TransientsB_N1_360
25		6.2.2	Appendix 1: Figure 1.2	Table 1.1 - N = 2		Run transient at 360Hz.	C6P0_APP1TransientsB_N2_360
26		6.2.3	Appendix 1: Figure 1.2	Table 1.1 - N = 3		Run transient at 360Hz.	C6P0_APP1TransientsB_N3_360
27		6.2.4	Appendix 1: Figure 1.2	Table 1.1 - N = 4		Run transient at 360Hz.	C6P0_APP1TransientsB_N4_360
28		6.2.5	Appendix 1: Figure 1.2	Table 1.1 - N = 5		Run transient at 360Hz.	C6P0_APP1TransientsB_N5_360
29		6.2.6	Appendix 1: Figure 1.2	Table 1.1 - N = 6		Run transient at 360Hz.	C6P0_APP1TransientsB_N6_360
30		6.2.7	Appendix 1: Figure 1.2	Table 1.1 - N = 7		Run transient at 360Hz.	C6P0_APP1TransientsB_N7_360
31		6.2.8	Appendix 1: Figure 1.2	Table 1.1 - N = 8		Run transient at 360Hz.	C6P0_APP1TransientsB_N8_360
32		6.2.9	Appendix 1: Figure 1.2	Table 1.1 - N = 9		Run transient at 360Hz.	C6P0_APP1TransientsB_N9_360
33		6.2.10	Appendix 1: Figure 1.2	Table 1.1 - N = 10		Run transient at 360Hz.	C6P0_APP1TransientsB_N10_360
34		6.2.11	Appendix 1: Figure 1.2	Table 1.1 - N = 11		Run transient at 360Hz.	C6P0_APP1TransientsB_N11_360
35		6.2.1	Appendix 1: Figure 1.2	Table 1.1 - N = 1		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N1_800
36		6.2.2	Appendix 1: Figure 1.2	Table 1.1 - N = 2		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N2_800
37		6.2.3	Appendix 1: Figure 1.2	Table 1.1 - N = 3		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N3_800
38		6.2.4	Appendix 1: Figure 1.2	Table 1.1 - N = 4		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N4_800
39		6.2.5	Appendix 1: Figure 1.2	Table 1.1 - N = 5		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N5_800
40		6.2.6	Appendix 1: Figure 1.2	Table 1.1 - N = 6		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N6_800
41		6.2.7	Appendix 1: Figure 1.2	Table 1.1 - N = 7		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N7_800
42		6.2.8	Appendix 1: Figure 1.2	Table 1.1 - N = 8		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N8_800
43		6.2.9	Appendix 1: Figure 1.2	Table 1.1 - N = 9		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N9_800
44		6.2.10	Appendix 1: Figure 1.2	Table 1.1 - N = 10		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N10_800
45		6.2.11	Appendix 1: Figure 1.2	Table 1.1 - N = 11		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N11_800
46		6.3.1	Appendix 1: Table 2	Table 2 - N = I		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_I
47		6.3.1	Appendix 1: Table 2	Table 2 - N = II		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_II
48		6.3.1	Appendix 1: Table 2	Table 2 - N = III		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_III
49		6.3.1	Appendix 1: Table 2	Table 2 - N = IV		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_IV

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
50		6.3.1	Appendix 1: Table 2	Table 2 - N = V		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_V
51		6.3.1	Appendix 1: Table 2	Table 2 - N = VI		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_VI
52	7		Voltage Modulation				
53		A.1	Normal & Emergency	Fig 4-A	16.5.1.2	122 Vrms 360 Hz each phase	C7P0_VMOD_A1_360
54		A.1	Normal & Emergency	Fig 4-A	16.5.1.2	122 Vrms 800 Hz each phase	C7P0_VMOD_A1_800
55		A.2	Normal & Emergency	Fig 4-A	16.5.1.2	104 Vrms 360 Hz each phase	C7P0_VMOD_A2_360
56		A.2	Normal & Emergency	Fig 4-A	16.5.1.2	104 Vrms 800 Hz each phase	C7P0_VMOD_A2_800
57		B.1	Abnormal	Fig 4-A	16.5.1.2	130 Vrms 360 Hz each phase	C7P0_VMOD_B1_360
58		B.1	Abnormal	Fig 4-A	16.5.1.2	130 Vrms 800 Hz each phase	C7P0_VMOD_B1_800
59		B.2	Abnormal	Fig 4-A	16.5.1.2	96 Vrms 360 Hz each phase	C7P0_VMOD_B2_360
60		B.2	Abnormal	Fig 4-A	16.5.1.2	96 Vrms 800 Hz each phase	C7P0_VMOD_B2_800
61	8		Frequency variations				
62		8.1	Normal Frequency variations	Fig 5, limits 1 and 4	16.5.1.6	Slew at 100Hz/sec	C8P0_NORMFREQVARS
63		8.2	Emergency Frequency variations	Fig 5, limits 1 and 4	16.5.1.6	Slew at 500Hz/sec	C8P0_EMERFREQVARS
64	9		Frequency modulation	Fig 6	16.5.1.3		C9P0_FMOD
65	10		Distorted Voltage				
66		10.1	Distorted Voltage 10% - Normal	Par 2.4.2.6.2	n/a	Test condition 2 Normal	C10P0_VDIST10
67		10.2	Distorted Voltage 15% - Emergency	Par 2.4.2.6.2	n/a	Test condition 2 Emergency	C10P0_VDIST15
68		10.3	Distorted Voltage 25% - Emergency	Par 2.4.2.6.2	n/a	Test condition 3 Emergency	C10P0_VDIST25
69	11		Voltage DC Content	Appendix 4	n/a	DC Offset	C11P0_DCOffs_APP4

**7.4.1.4 Table D:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1	1		Steady State Voltage				
2		1.1	Maximum Voltage - Norm and Emer	30.3V DC	16.6.1.1.b (1)		D1P0_NORM_MAXV
3		1.2	Minimum voltage - Normal operation	25.5V DC	16.6.1.1.b (2)		D1P0_NORM_MINV
4		1.3	Minimum voltage - Emergency operation	17V DC	16.6.1.1.b (3)		D1P0_EMER_MINV
5	2		Abnormal Steady State Voltage				
6		2.1	Maximum	32.5V DC	16.6.2.1.b (1)	Apply for 30 mins iso 5 mins	D2P0_ABN_MAXV
7		2.2	Minimum	23.5V DC	16.6.2.1.b (2)	Apply for 30 mins iso 5 mins	D2P0_ABN_MINV
8	3		Voltage Surge - Fig 2				
9		3.1	Normal Transients	40V for 30ms,17V for 15ms	16.6.1.4.b	Replace DO160 28V with 28.8V	D3P0_NORMVSURGE1
10		3.2	Normal Transients	39V for 50ms,19.5V for 30ms	16.6.1.4.b	Replace DO160 28V with 28.8V	D3P0_NORMVSURGE2
11		3.3	Normal Transients	37V for 100ms,21V for 50ms	16.6.1.4.b	Replace DO160 28V with 28.8V	D3P0_NORMVSURGE3
12		3.4	Normal Transients	35V for 200ms,23,5V 100ms	16.6.1.4.b	Replace DO160 28V with 28.8V	D3P0_NORMVSURGE4
13	4		Voltage Surge - Fig 2				
14		4.1	Abnormal Transients	46V for 100ms, 38V for 1 sec	16.6.2.4.c	Apply also Appendix 3 test	D4P0_ABNVSURGE1
15		4.2	Abnormal Transients	0V for 5 secs	16.6.2.3.b	Apply also Appendix 3 test	D4P0_ABNVSURGE2
16		4.3	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests for multiple power input equipment.	D4P3_APPENDIX3
17	5		Voltage Spike - Fig 3-C	Peak voltage 600V	17.4	Requires additional equipment	
18	6		Switching Transients	Appendix 1	n./a	Appendix 1 DC Switching Transients	
19		6.1	Cf Figure 1.1	Table 1.1 - T1 1 to 50 msec	n./a		D6P0_APP1A_DC61
20		6.2	Cf Figure 1.1	Table 1.1 - T1 51 to 100 msec	n./a		D6P0_APP1A_DC62

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
21		6.3	Cf Figure 1.1	Table 1.1 - T1 100 to 200 msec	n./a		D6P0_APP1A_DC63
22		6.2.1	Cf Figure 1.2	Table 1.1 - N=1	n./a		D6P0_APP1TransientsB_N1
23		6.2.2	Cf Figure 1.2	Table 1.1 - N=2	n./a		D6P0_APP1TransientsB_N2
24		6.2.3	Cf Figure 1.2	Table 1.1 - N=3	n./a		D6P0_APP1TransientsB_N3
25		6.2.4	Cf Figure 1.2	Table 1.1 - N=4	n./a		D6P0_APP1TransientsB_N4
26		6.2.5	Cf Figure 1.2	Table 1.1 - N=5	n./a		D6P0_APP1TransientsB_N5
27		6.2.6	Cf Figure 1.2	Table 1.1 - N=6	n./a		D6P0_APP1TransientsB_N6
28		6.2.7	Cf Figure 1.2	Table 1.1 - N=7	n./a		D6P0_APP1TransientsB_N7
29		6.2.8	Cf Figure 1.2	Table 1.1 - N=8	n./a		D6P0_APP1TransientsB_N8
30		6.2.9	Cf Figure 1.2	Table 1.1 - N=9	n./a		D6P0_APP1TransientsB_N9
31		6.2.10	Cf Figure 1.2	Table 1.1 - N=10	n./a		D6P0_APP1TransientsB_N10
32		6.2.11	Cf Figure 1.2	Table 1.1 - N=11	n./a		D6P0_APP1TransientsB_N11
33		6	Cf Figure 1.1 - N = 1 to 22	Table 1.4	n./a		D6P0_APP1TransT14_N1
34	7		Square wave DC load variations	Fig 7-A and 7-B	n/a	Apply Fig 7-A or 7-B depending on distribution bus bar	
35		7.1	Square wave DC load variations	Figure 7-A	n/a	A380 Version	D7P0_DCFIG7A_A380
36		7.1	Square wave DC load variations	Figure 7-A	n/a	Other Airbus	D7P0_DCFIG7A_AIRB
37		7.2	Square wave DC load variations	Figure 7-B	n/a	A380 Version	D7P0_DCFIG7B_A380
38		7.2	Square wave DC load variations	Figure 7-B	n/a	Other Airbus	D7P0_DCFIG7B_AIRB
39	8		Ripple Voltage	Fig 8	16.6.1.2	Requires additional equipment	

**7.4.1.5 Table E:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1	1		Steady State Voltage				
2		1.1	Maximum Voltage - Norm and Emer	32V DC	16.6.1.1.b (1)		E1P0_NORM_MAXV
3		1.2	Minimum voltage - Normal operation	24V DC	16.6.1.1.b (2)		E1P0_NORM_MINV
4		1.3	Minimum voltage - Emergency operation	18.5V DC	16.6.1.1.b (3)		E1P0_EMER_MINV
5	2		Voltage Surge - Figure 13				
6		2.1	Normal Transients	36V for 100ms	16.6.1.4.b	Use specified limit iso DO160	E2P0_NORMVSURGE1
7		2.2	Normal Transients	35V for 200ms	16.6.1.4.b	Use specified limit iso DO160	E2P0_NORMVSURGE2
8		2.3	Normal Transients	34V for 300ms	16.6.1.4.b	Use specified limit iso DO160	E2P0_NORMVSURGE3
9		2.4	Normal Transients	18.5V for 5 secs	16.6.1.4.b	Use specified limit iso DO160	E2P0_NORMVSURGE4
10	3		Voltage Surge - Figure 13				
11		3.1	Abnormal Transients	36V for 1 sec	16.6.2.4.c	Apply also Appendix 3 test	E3P0_ABNVSURGE1
12		3.2	Abnormal Transients	33V for 3 sec	16.6.2.4.c	Apply also Appendix 3 test	E3P0_ABNVSURGE2
13		3.3	Abnormal Transients	0V for 5 secs	16.6.2.3.b	Apply also Appendix 3 test	E3P0_ABNVSURGE3
14		3.4	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests for multiple power input equipment.	E3P3_APPENDIX3
15	4		Voltage Spikes - Fig 3-C	Peak voltage 600V	17.4	Requires additional equipment	
16	5		Switching Transients	Appendix 1	n/a	Appendix 1 DC Switching Transients	
17		5.1	Cf Figure A	Table 1.2 - T1 >= 3 msec	n/a		E5P0_APP1TransientsA
18		5.2.1	Cf Figure B	Table 1.2 - N=1	n/a		E5P0_APP1TransientsB_N1
19		5.2.2	Cf Figure B	Table 1.2 - N=2	n/a		E5P0_APP1TransientsB_N2
20		5.2.3	Cf Figure B	Table 1.2 - N=3	n/a		E5P0_APP1TransientsB_N3
21		5.2.4	Cf Figure B	Table 1.2 - N=4	n/a		E5P0_APP1TransientsB_N4
22		5.2.5	Cf Figure B	Table 1.2 - N=5	n/a		E5P0_APP1TransientsB_N5
23	6		Ripple Voltage	Figure 8	16.6.1.2 and Figure 18.2	Requires additional equipment	
24	7		Starting inrush current	Figure 14	n/a	Refer to ABD0100.1.8 par 2.4.2.3.2.2	E7P0_DCINRUSH

**7.4.2 Revision D****7.4.2.1 Table A:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1							
2		1.1	Voltage each phase	104V to 122V RMS	16.5.1.1.b.1 test 1,2,3	Apply at 430Hz and 370Hz	A1P1_NSSVF
3		1.2		105.5V to 120.5V RMS	16.5.1.1.b.2 test 1 to 5	Apply at 430Hz and 370Hz	A1P3_NSSVF
4	2		Abnormal Steady State Voltage				
5		2.1	Voltage each phase	96V to 130V RMS	16.5.3.1.b	Apply for 30 mins iso 5 mins	A2P1_ABN_SSV
6		2.2	Average voltage 3 phases	96V to 130V RMS	16.5.3.1.c	Apply for 30 mins iso 5 mins	A2P3_ABN_SSV
7	3		Voltage Surge - Fig 1				
8		3.1	Normal Transients	160V for 30ms, 71V for 15ms	16.5.1.5.1.b	Use specified limit iso DO160	A3P0_NORMVSURGE1
9		3.2	Normal Transients	156V for 50ms, 80V for 30ms	16.5.1.5.1.b	Use specified limit iso DO160	A3P0_NORMVSURGE2
10		3.3	Normal Transients	148V for 100ms, 86V for 50ms	16.5.1.5.1.b	Use specified limit iso DO160	A3P0_NORMVSURGE3
11		3.4	Normal Transients	140V for 200ms	16.5.1.5.1.b	No undervoltage test required	A3P0_NORMVSURGE4
12	4		Voltage Surge - Fig 1				
13		4.1	Abnormal Transients	180V for 100ms, 148V for 1 sec	16.5.3.3.1.b		A4P0_ABNVSURGE1
14		4.2	Abnormal Transients	0V for 5 secs	16.5.3.2.b	No undervoltage test required	A4P0_ABNVSURGE2
15		4.3	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests	A4P3_APPENDIX3
16	5		Voltage Spike - Fig 3-A	Peak voltage 1000V	17.4	Requires add'l equipment	

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
17	6		Switching Transients		n/a	Appendix 1 DC Switching Transients	
18		6.1	Appendix 1: Figure A	Table 1.1 - T1 >= 10 msec			A6P0_APP1TransientsA
19		6.2.1	Appendix 1: Figure 1.B	Table 1.1 - N = 1			A6P0_APP1TransientsB_N1
20		6.2.2	Appendix 1: Figure 1.B	Table 1.1 - N = 2			A6P0_APP1TransientsB_N2
21		6.2.3		Table 1.1 - N = 3			A6P0_APP1TransientsB_N3
22		6.2.4	Appendix 1: Figure 1.B	Table 1.1 - N = 4			A6P0_APP1TransientsB_N4
23		6.2.5	Appendix 1: Figure 1.B	Table 1.1 - N = 5			A6P0_APP1TransientsB_N5
24		6.2.6	Appendix 1: Figure 1.B	Table 1.1 - N = 6			A6P0_APP1TransientsB_N6
25		6.2.7	Appendix 1: Figure 1.B	Table 1.1 - N = 7			A6P0_APP1TransientsB_N7
26		6.2.8	Appendix 1: Figure 1.B	Table 1.1 - N = 8			A6P0_APP1TransientsB_N8
27		6.2.9	Appendix 1: Figure 1.B	Table 1.1 - N = 9			A6P0_APP1TransientsB_N9
28		6.2.10	Appendix 1: Figure 1.B	Table 1.1 - N = 10			A6P0_APP1TransientsB_N10
29		6.2.11		Table 1.1 - N = 11			A6P0_APP1TransientsB_N11
30	7		Voltage Modulation	Fig 4-A	16.5.1.2	Replace DO160 Fig 16.1 with Fig 4-A	A7P0_VMOD
31	8		Frequency excursions abnormal	Fig 5, limits 1 and 4	n/a	Appendix 2 tests	A8P0_ABNFEXCURS
32	9		Frequency modulation	Fig 6	16.5.3.1		A9P0_FMOD
33	10		Distorted Voltage	Par 2.4.2.6.1	n/a	Test conditions 1 & 2	A10P0_VDIST

**7.4.2.2 Table B:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1					16.5.1.1.b.1 test 1,2,3	Apply at 430Hz and 370Hz, Replace 100V & 122V with 23V & 28V	B1P0_NSSVF
2	2		Abnormal Steady State Voltage	21V to 30V RMS	16.5.3.1.b	Apply for 30 mins iso 5 mins	B2P0_ABN_SSV
3	3						
4		3.1	Normal Transients	36.5V for 30ms, 16.1V for 15ms	16.5.1.5.b	Use specified limit iso DO160	B3P0_NORMVSURGE1
5		3.2	Normal Transients	35.6V for 50ms, 18.2V for 30ms	16.5.1.5.b	Use specified limit iso DO160	B3P0_NORMVSURGE2
6		3.3	Normal Transients	33.8V for 19.5ms, 86V for 50ms	16.5.1.5.b	Use specified limit iso DO160	B3P0_NORMVSURGE3
7		3.4	Normal Transients	32V for 200ms	16.5.1.5.b	No undervoltage has to be applied	B3P0_NORMVSURGE4
8	4		Voltage Surge - Fig 1				
9		4.1	Abnormal Transients	41.1V for 100ms, 33.8V for 1 sec	16.5.3.3.1.b		B4P0_ABNVSURGE1
10		4.2	Abnormal Transients	0V for 5 secs	16.5.3.2.b		B4P0_ABNVSURGE2
11		4.3	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests	B4P3_APPENDIX3
12	5		Voltage Spike - Fig 3-B	Peak voltage 250V	17.4	Requires add'l equipment	
13	6		Switching Transients		17.4		
14		6.1	Appendix 1: Figure A	Table 1.1 - T1 = 10 msec			B6P0_APP1TransientsA
15		6.2.1	Appendix 1: Figure 1.B	Table 1.1 - N = 1			B6P0_APP1TransientsB_N1
16		6.2.2	Appendix 1: Figure 1.B	Table 1.1 - N = 2			B6P0_APP1TransientsB_N2



#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
17		6.2.3	Appendix 1: Figure 1.B	Table 1.1 - N = 3			B6P0_APP1TransientsB_N3
18		6.2.4	Appendix 1: Figure 1.B	Table 1.1 - N = 4			B6P0_APP1TransientsB_N4
19		6.2.5	Appendix 1: Figure 1.B	Table 1.1 - N = 5			B6P0_APP1TransientsB_N5
20		6.2.6	Appendix 1: Figure 1.B	Table 1.1 - N = 6			B6P0_APP1TransientsB_N6
21		6.2.7		Table 1.1 - N = 7			B6P0_APP1TransientsB_N7
22		6.2.8	Appendix 1: Figure 1.B	Table 1.1 - N = 8			B6P0_APP1TransientsB_N8
23		6.2.9	Appendix 1: Figure 1.B	Table 1.1 - N = 9			B6P0_APP1TransientsB_N9
24		6.2.10	Appendix 1: Figure 1.B	Table 1.1 - N = 10			B6P0_APP1TransientsB_N10
25		6.2.11	Appendix 1: Figure 1.B	Table 1.1 - N = 11			B6P0_APP1TransientsB_N11
26	7		Voltage Modulation	Fig 4-B	16.5.1.2	Replace DO160 Fig 16.1 with Fig 4-B	B7P0_VMOD
27	8		Frequency excursions abnormal	Fig 5, limits 1 and 4	n/a	Refer to Appendix 2 for test description	B8P0_ABNFEXCURS
28	9		Frequency modulation	Fig 6	16.5.3.1		B9P0_FMOD

**7.4.2.3 Table C:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1							
2		1.1	Voltage each phase	104V to 122V RMS	16.5.1.1.d.1 test 1 and 2	Apply at 800Hz and 360Hz	C1P1_NSSVF
3		1.2		105.5V to 120.5V RMS	16.5.1.1.d.2 test 1 to 4	Apply at 800Hz and 360Hz	C1P3_NSSVF
4	2		Abnormal Steady State Voltage				
5		2.1	Voltage each phase	96V to 130V RMS	16.5.3.1.b	Apply for 30 mins iso 5 mins	C2P1_ABN_SSV
6		2.2	Average voltage 3 phases	96V to 130V RMS	16.5.3.1.c	Apply for 30 mins iso 5 mins	C2P3_ABN_SSV

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
7	3		Voltage Surge - Fig 1				
8		3.1	Normal Transients	160V for 30ms, 71V for 15ms	16.5.1.5.1.b	Use specified limit iso DO160	C3P0_NORMVSURGE1
9		3.2	Normal Transients	156V for 50ms, 80V for 30ms	16.5.1.5.1.b	Use specified limit iso DO160	C3P0_NORMVSURGE2
10		3.3	Normal Transients	148V for 100ms, 86V for 50ms	16.5.1.5.1.b	Use specified limit iso DO160	C3P0_NORMVSURGE3
11		3.4	Normal Transients	140V for 200ms	16.5.1.5.1.b	No undervoltage test required	C3P0_NORMVSURGE4
12	4		Voltage Surge - Fig 1				
13		4.1	Abnormal Transients	180V for 100ms, 148V for 1 sec	16.5.3.3.1.b		A4P0_ABNVSURGE1
14		4.2	Abnormal Transients	0V for 5 secs	16.5.3.2.b	No undervoltage test required	A4P0_ABNVSURGE2
15		4.3	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests	A4P3_APPENDIX3
16	5		Voltage Spike - Fig 3-A	Peak voltage 1000V	17.4	Requires add'l equipment	
17	6		Switching Transients		n/a		
18		6.1	Appendix 1: Figure A	Table 1.1 - T1 = 10 msec		At 360Hz and 800Hz	C6P0_APP1TransientsA
19		6.2.1	Appendix 1: Figure 1.B	Table 1.1 - N = 1		Run transient at 360Hz.	C6P0_APP1TransientsB_N1_360
20		6.2.2	Appendix 1: Figure 1.B	Table 1.1 - N = 2		Run transient at 360Hz.	C6P0_APP1TransientsB_N2_360

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
21		6.2.3		Table 1.1 - N = 3		Run transient at 360Hz.	C6P0_APP1TransientsB_N3_360
22		6.2.4	Appendix 1: Figure 1.B	Table 1.1 - N = 4		Run transient at 360Hz.	C6P0_APP1TransientsB_N4_360
23		6.2.5	Appendix 1: Figure 1.B	Table 1.1 - N = 5		Run transient at 360Hz.	C6P0_APP1TransientsB_N5_360
24		6.2.6	Appendix 1: Figure 1.B	Table 1.1 - N = 6		Run transient at 360Hz.	C6P0_APP1TransientsB_N6_360
25		6.2.7	Appendix 1: Figure 1.B	Table 1.1 - N = 7		Run transient at 360Hz.	C6P0_APP1TransientsB_N7_360
26		6.2.8	Appendix 1: Figure 1.B	Table 1.1 - N = 8		Run transient at 360Hz.	C6P0_APP1TransientsB_N8_360
27		6.2.9	Appendix 1: Figure 1.B	Table 1.1 - N = 9		Run transient at 360Hz.	C6P0_APP1TransientsB_N9_360
28		6.2.10	Appendix 1: Figure 1.B	Table 1.1 - N = 10		Run transient at 360Hz.	C6P0_APP1TransientsB_N10_360
29		6.2.11		Table 1.1 - N = 11		Run transient at 360Hz.	C6P0_APP1TransientsB_N11_360
30		6.2.1	Appendix 1: Figure 1.B	Table 1.1 - N = 1		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N1_800
31		6.2.2	Appendix 1: Figure 1.B	Table 1.1 - N = 2		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N2_800
32		6.2.3	Appendix 1: Figure 1.B	Table 1.1 - N = 3		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N3_800
33		6.2.4	Appendix 1: Figure 1.B	Table 1.1 - N = 4		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N4_800
34		6.2.5	Appendix 1: Figure 1.B	Table 1.1 - N = 5		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N5_800

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
35		6.2.6	Appendix 1: Figure 1.B	Table 1.1 - N = 6		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N6_800
36		6.2.7	Appendix 1: Figure 1.B			Repeat transient at 800Hz.	C6P0_APP1TransientsB_N7_800
37		6.2.8	Appendix 1: Figure 1.B	Table 1.1 - N = 8		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N8_800
38		6.2.9	Appendix 1: Figure 1.B	Table 1.1 - N = 9		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N9_800
39		6.2.10	Appendix 1: Figure 1.B	Table 1.1 - N = 10		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N10_800
40		6.2.11	Appendix 1: Figure 1.B	Table 1.1 - N = 11		Repeat transient at 800Hz.	C6P0_APP1TransientsB_N11_800
41		6.3.1	Appendix 1: Table 2	Table 2 - N = I		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_I
42		6.3.1	Appendix 1: Table 2	Table 2 - N = II		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_II
43		6.3.1	Appendix 1: Table 2	Table 2 - N = III		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_III
44		6.3.1	Appendix 1: Table 2	Table 2 - N = IV		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_IV
45		6.3.1	Appendix 1: Table 2	Table 2 - N = V		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_V
46		6.3.1	Appendix 1: Table 2	Table 2 - N = VI		Run transient at 360Hz and 800Hz.	C6P0_APP1TransientsT2_VI
47	7		Voltage Modulation	Fig 4-A	16.5.1.2	Replace DO160 Fig 16.1 with Fig 4-A	A7P0_VMOD
48	8		Frequency variations				

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
49		8.1	Normal Frequency variations	Fig 5, limits 1 and 4	16.5.1.6	Slew at 100Hz/sec	C8P0_NORMFREQVARS
50		8.2	Emergency Frequency variations	Fig 5, limits 1 and 4	16.5.1.6	Slew at 500Hz/sec	C8P0_EMERFREQVARS
51	9		Frequency modulation	Fig 6	16.5.3.1		C9P0_FMOD
52	10		Distorted Voltage				
53		10.1	Distorted Voltage 10% - Normal	Par 2.4.2.6.2	n/a	Test condition 2 Normal	C10P0_VDIST10
54		10.2	Distorted Voltage 15% - Emergency	Par 2.4.2.6.2	n/a	Test condition 2 Emergency	C10P0_VDIST15
55		10.3	Distorted Voltage 25% - Emergency	Par 2.4.2.6.2	n/a	Test condition 3 Emergency	C10P0_VDIST25

**7.4.2.4 Table D:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1							
2		1.1	Maximum Voltage - Norm and Emer	30.3V DC	16.5.2.1.b (1)		D1P0_NORM_MAXV
3		1.2		25.5V DC	16.5.2.1.b (2)		D1P0_NORM_MINV
4		1.3	Minimum voltage - Emergency operation	17V DC	16.5.2.1.b (3)		D1P0_EMER_MINV
5	2		Abnormal Steady State Voltage				
6		2.1	Maximum	32.5V DC	16.5.4.1.b (1)	Apply for 30 mins iso 5 mins	D2P0_ABN_MAXV
7		2.2	Minimum	23.5V DC	16.5.4.1.b (2)	Apply for 30 mins iso 5 mins	D2P0_ABN_MINV
8	3		Voltage Surge - Fig 2				
9		3.1	Normal Transients	40V for 30ms, 17V for 15ms	16.5.2.4.b	Replace DO160 28V with 28.8V	D3P0_NORMVSURGE1
10		3.2	Normal Transients	39V for 50ms, 19.5V for 30ms	16.5.2.4.b	Replace DO160 28V with 28.8V	D3P0_NORMVSURGE2
11		3.3	Normal Transients	37V for 100ms, 21V for 50ms	16.5.2.4.b	Replace DO160 28V with 28.8V	D3P0_NORMVSURGE3
12		3.4	Normal Transients	35V for 200ms, 23,5V 100ms	16.5.2.4.b	Replace DO160 28V with 28.8V	D3P0_NORMVSURGE4
13	4		Voltage Surge - Fig 2				
14		4.1	Abnormal Transients	46V for 100ms, 38V for 1 sec	16.5.4.4.c	Apply also Appendix 3 test	D4P0_ABNVSURGE1
15		4.2	Abnormal Transients	0V for 5 secs	16.5.4.3.b	Apply also Appendix 3 test	D4P0_ABNVSURGE2
16		4.3	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests for multiple power input equipment.	D4P3_APPENDIX3
17	5		Voltage Spike - Fig 3-C	Peak voltage 600V	17.4	Requires additional equipment	

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
18	6		Switching Transients	Appendix 1	n/a	Appendix 1 DC Switching Transients	
19		6.1	Cf Figure A	Table 1.1 - T1 >= 10 msec	n/a		D6P0_APP1TransientsA
20		6.2.1	Cf Figure B	Table 1.1 - N=1	n/a		D6P0_APP1TransientsB_N1
21		6.2.2		Table 1.1 - N=2	n/a		D6P0_APP1TransientsB_N2
22		6.2.3	Cf Figure B	Table 1.1 - N=3	n/a		D6P0_APP1TransientsB_N3
23		6.2.4	Cf Figure B	Table 1.1 - N=4	n/a		D6P0_APP1TransientsB_N4
24		6.2.5	Cf Figure B	Table 1.1 - N=5	n/a		D6P0_APP1TransientsB_N5
25		6.2.6	Cf Figure B	Table 1.1 - N=6	n/a		D6P0_APP1TransientsB_N6
26		6.2.7	Cf Figure B	Table 1.1 - N=7	n/a		D6P0_APP1TransientsB_N7
27		6.2.8	Cf Figure B	Table 1.1 - N=8	n/a		D6P0_APP1TransientsB_N8
28		6.2.9	Cf Figure B	Table 1.1 - N=9	n/a		D6P0_APP1TransientsB_N9
29		6.2.10		Table 1.1 - N=10	n/a		D6P0_APP1TransientsB_N10
30		6.2.11	Cf Figure B	Table 1.1 - N=11	n/a		D6P0_APP1TransientsB_N11
31	7		Square wave DC load variations	Fig 7-A and 7-B	n/a	Apply Fig 7-A or 7-B depending on distribution bus bar	
32		7.1	Square wave DC load variations	Figure 7-A	n/a	A380 Version	D7P0_DCFIG7A_A380
33		7.1	Square wave DC load variations	Figure 7-A	n/a	Other Airbus	D7P0_DCFIG7A_AIRB
34		7.2	Square wave DC load variations	Figure 7-B	n/a	A380 Version	D7P0_DCFIG7B_A380
35		7.2	Square wave DC load variations	Figure 7-B	n/a	Other Airbus	D7P0_DCFIG7B_AIRB
36	8		Ripple Voltage		16.5.2.2	Requires additional equipment	

**7.4.2.5 Table E:**

#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
1							
2		1.1	Maximum Voltage - Norm and Emer	32V DC	16.5.2.1.b (1)		E1P0_NORM_MAXV
3		1.2		24V DC	16.5.2.1.b (2)		E1P0_NORM_MINV
4		1.3	Minimum voltage - Emergency operation	18.5V DC	16.5.2.1.b (3)		E1P0_EMER_MINV
5	2		Voltage Surge - Figure 13				
6		2.1	Normal Transients	36V for 100ms	16.5.2.4.b	Use specified limit iso DO160	E2P0_NORMVSURGE1
7		2.2	Normal Transients	35V for 200ms	16.5.2.4.b	Use specified limit iso DO160	E2P0_NORMVSURGE2
8		2.3	Normal Transients	34V for 300ms	16.5.2.4.b	Use specified limit iso DO160	E2P0_NORMVSURGE3
9		2.4	Normal Transients	18.5V for 5 secs	16.5.2.4.b	Use specified limit iso DO160	E2P0_NORMVSURGE4
10	3		Voltage Surge - Figure 13				
11		3.1	Abnormal Transients	36V for 1 sec	16.5.4.4.c	Apply also Appendix 3 test	E3P0_ABNVSURGE1
12		3.2	Abnormal Transients	33V for 3 sec	16.5.4.4.c	Apply also Appendix 3 test	E3P0_ABNVSURGE2
13		3.3	Abnormal Transients	0V for 5 secs	16.5.4.3.b	Apply also Appendix 3 test	E3P0_ABNVSURGE3
14		3.4	Abnormal Transients	Disconnects for 5 secs	n/a	Appendix 3 tests for multiple power input equipment.	E3P3_APPENDIX3
15	4		Voltage Spikes - Fig 3-C	Peak voltage 600V	17.4	Requires additional equipment	
16	5		Switching Transients	Appendix 1	n./a	Appendix 1 DC Switching Transients	
17		5.1	Cf Figure A	Table 1.2 - T1 >= 3 msec	n./a		E5P0_APP1TransientsA
18		5.2.1	Cf Figure B	Table 1.2 - N=1	n./a		E5P0_APP1TransientsB_N1
19		5.2.2	Cf Figure B	Table 1.2 - N=2	n./a		E5P0_APP1TransientsB_N2
20		5.2.3	Cf Figure B	Table 1.2 - N=3	n./a		E5P0_APP1TransientsB_N3



#	Test	No.	Subject	Test Limits	DO160 Ref.	Comments	Test File
21		5.2.4		Table 1.2 - N=4	n./a		E5P0_APP1TransientsB_N4
22		5.2.5	Cf Figure B	Table 1.2 - N=5	n./a		E5P0_APP1TransientsB_N5
23	6		Ripple Voltage	Figure 8	16.5.2.2 and Figure 18.2	Requires additional equipment	
24	7		Starting inrush current	Figure 14	n/a	Refer to ABD0100.1.8 par 2.4.2.3.2.2	E7P0_DCINRUSH

## 8 Option –AMD: Airbus AMD-24 Rev C Tests

The –AMD option supports Airbus AMD-24 rev C voltage and frequency immunity tests in both AC and DC modes (if available).

The –AMD option is based on Airbus A400M Directive: AMD-24 Issue C, Electrical characteristics of aircraft AC and DC systems Appendix C dated March 22, 2005.

Future revisions of the AMD-24 directive may be issued over time and updates may be made available to cover any changes in test levels, durations, procedures etc. Furthermore, the –AMD option is completely data file driven to allow a large degree of customization by the end-user if needed so many changes can be supported without the need for software updates.

This section of the manual explains the limitations of this test option, the use of special features unique to this option, and gives a complete layout of all tests performed by this option.

This manual is **not** intended to elaborate on the intent or purpose of the immunity tests and the expected behavior of the EUT as described in the Airbus documents. It is assumed that the end-user is familiar with the content of the AMD-24 test standard.

**Note:** All three phase California Instruments power sources have a phase rotation of A C B where phase C is +120° from phase A and phase B is +240° from phase A. Some interpretations of this specification call for phase B to be +120° from phase A. The easiest way to accomplish an ABC phase rotation is to simply switch phase B and phase C wires at the EUT input. Alternatively, the programmed phase angles for B and C can be changed but this will require editing of the test scripts and is not recommended.

### 8.1 Test Coverage

The comprehensiveness of the tests that can be performed with the –AMD option is determined primarily by the capabilities of the power source used. Tests that are outside the hardware capabilities of the power source used will not be enabled and cannot be selected. For these tests, additional equipment may be required as indicated.

#### 8.1.1 MX/RS Series –AMD Option Limitations

The extent of coverage of the –AMD option as implemented on the MX/RS Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –AMD tests. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. Additional implementation issues may apply as well as indicated in section 8.1.1.1.

Furthermore, the MX/RS Series does not meet the required 1.25% maximum V<sub>thd</sub> over the 360 to 800Hz frequency range required for the distorted voltage test per Appendix D.

**Note:** The MX15 Series power sources are single phase output only and therefore all three phase tests are not available on the MX15.

No.	Description	Table SVF	Table TVF	Table SCF	Table TCF	No.	Description	Table LDC
101	Steady State Voltage and Frequency	√	√	√	√	101	Steady State Voltage	√
102	Voltage Transients	√	√	√	√	101-APU	Steady State Voltage	√

No.	Description	Table SVF	Table TVF	Table SCF	Table TCF	No.	Description	Table LDC
103	Voltage Modulation	√	√	√	√	102	Voltage Transients	√
104	Voltage Spikes	X	X	X	X	102-APU	Voltage Transients	√
105	Current Distortion	√	√	√	√	103	Voltage Ripple	P
106	Voltage Distortion	P	P	P	P	103-APU	Voltage Ripple	P
107	Inrush Current	X	X	X	X	104	Voltage Spikes	X
108	Frequency Variations	√	√	N/A	N/A	105	Inrush Current	X
109	Frequency Modulation	√	√	√	√	105-APU	Inrush Current	X
110	Voltage DC Content	P	P	P	P	106	Voltage Variations Due to APU Starting	√
111	Voltage Modulation Due to Equipment	X	X	X	X	107	DC Ripple Due to Equipment	X
112	Voltage Spike Due to Load Switching	X	X	X	X	108	Voltage Spike Due to Equipment Load Switching	X
201	Steady State Voltage and Frequency	√	√	√	√	109	Compatibility with SEPDC Voltage Clipping Devices	X
202	Voltage Transients	√	√	√	√	201	Voltage Transients	√
203	Voltage Modulation	N/A	N/A	√	√	201-APU	Voltage Transients	√
204	Frequency Variations	N/A	N/A	√	√	301	Steady State Voltage	√
301	Steady State Voltage and Frequency	√	√	N/A	N/A	302	Voltage Ripple	√
302	Voltage Distortion	P	P	N/A	N/A	303	Inrush Current	X
303	Voltage Distortion Transients	P	P	N/A	N/A	401	Transparency Time	√
304	Frequency Variations	√	√	N/A	N/A	401-APU	Transparency Time	√
305	Voltage Modulation Due to Equipment	X	X	N/A	N/A	402	Voltage Switching Transients 1	√
401	Transparency Time	√	√	√	√	402-APU	Voltage Switching Transients 1	√
402	Voltage Switching Transients 1	√	√	√	√	403	Voltage Switching Transients 2	√
403	Voltage Switching Transients 2	√	√	√	√	403-APU	Voltage Switching Transients 2	√
404	Voltage Switching Transients with Frequency Change	√	√	√	√	501	Power Failure	X

No.	Description	Table SVF	Table TVF	Table SCF	Table TCF	No.	Description	Table LDC
501	Power Failure	X	X	X	X			

Table 8- 1: -AMD Option MX/RS Test Coverage

### 8.1.1.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Airbus AMD tests, some limitations apply, largely due to hardware limitations of the MX/RS power source. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Test	Standard requirement	Actual setting	Reason
SVF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
SVF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
TVF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
TVF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
SCF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
SCF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
TCF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
TCF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
SVF103	390Hz mod by .75Hz	390Hz mod by .8Hz	Resolution
SVF103	620Hz mod by .75Hz	620Hz mod by .8Hz	Resolution
TVF103	390Hz mod by .75Hz	390Hz mod by .8Hz	Resolution
TVF103	620Hz mod by .75Hz	620Hz mod by .8Hz	Resolution
SCF103	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
TCF103	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution

### 8.1.2 AST Series –AMD Option Limitations

The extent of coverage of the –AMD option as implemented on the AST Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –AMD tests. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Pi models or base models with the –ADV option only. Additional implementation issues may apply as well as indicated in section 8.1.1.1.

Furthermore, the AST Series does not meet the required 1.25% maximum V<sub>thd</sub> over the 360 to 800Hz frequency range required for the distorted voltage test per Appendix D.

**Note:** The AST Series power sources model number ending with “1” (eg: AST 751,1501) are single phase output only and therefore all three phase tests are not available on these series.

No.	Description	Table SVF	Table TVF	Table SCF	Table TCF	No.	Description	Table LDC
101	Steady State Voltage and Frequency	√	√	√	√	101	Steady State Voltage	√
102	Voltage Transients	√	√	√	√	101-APU	Steady State Voltage	√
103	Voltage Modulation	√	√	√	√	102	Voltage Transients	√
104	Voltage Spikes	X	X	X	X	102-APU	Voltage Transients	√
105	Current Distortion	√	√	√	√	103	Voltage Ripple	P
106	Voltage Distortion	P	P	P	P	103-APU	Voltage Ripple	P
107	Inrush Current	X	X	X	X	104	Voltage Spikes	X
108	Frequency Variations	√	√	N/A	N/A	105	Inrush Current	X
109	Frequency Modulation	√	√	√	√	105-APU	Inrush Current	X
110	Voltage DC Content	P	P	P	P	106	Voltage Variations Due to APU Starting	√
111	Voltage Modulation Due to Equipment	X	X	X	X	107	DC Ripple Due to Equipment	X
112	Voltage Spike Due to Load Switching	X	X	X	X	108	Voltage Spike Due to Equipment Load Switching	X
201	Steady State Voltage and Frequency	√	√	√	√	109	Compatibility with SEPDC Voltage Clipping Devices	X
202	Voltage Transients	√	√	√	√	201	Voltage Transients	√
203	Voltage Modulation	N/A	N/A	√	√	201-APU	Voltage Transients	√
204	Frequency Variations	N/A	N/A	√	√	301	Steady State Voltage	√
301	Steady State Voltage and Frequency	√	√	N/A	N/A	302	Voltage Ripple	√
302	Voltage Distortion	P	P	N/A	N/A	303	Inrush Current	X

No.	Description	Table SVF	Table TVF	Table SCF	Table TCF	No.	Description	Table LDC
303	Voltage Distortion Transients	P	P	N/A	N/A	401	Transparency Time	√
304	Frequency Variations	√	√	N/A	N/A	401-APU	Transparency Time	√
305	Voltage Modulation Due to Equipment	X	X	N/A	N/A	402	Voltage Switching Transients 1	√
401	Transparency Time	√	√	√	√	402-APU	Voltage Switching Transients 1	√
402	Voltage Switching Transients 1	√	√	√	√	403	Voltage Switching Transients 2	√
403	Voltage Switching Transients 2	√	√	√	√	403-APU	Voltage Switching Transients 2	√
404	Voltage Switching Transients with Frequency Change	√	√	√	√	501	Power Failure	X
501	Power Failure	X	X	X	X			

Table 8- 2: -AMD Option AST Test Coverage

### 8.1.2.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Airbus AMD tests, some limitations apply, largely due to hardware limitations of the AST power source. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Test	Standard requirement	Actual setting	Reason
SVF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
SVF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
TVF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
TVF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
SCF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
SCF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
TCF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
TCF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
SVF103	390Hz mod by .75Hz	390Hz mod by .8Hz	Resolution
SVF103	620Hz mod by .75Hz	620Hz mod by .8Hz	Resolution
TVF103	390Hz mod by .75Hz	390Hz mod by .8Hz	Resolution
TVF103	620Hz mod by .75Hz	620Hz mod by .8Hz	Resolution
SCF103	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
TCF103	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution

### 8.1.3 i/iX Series –AMD Option Limitations

The extent of coverage of the –AMD option as implemented on the iX Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –AMD tests. Tests marked with an ‘I’ apply to standard iX series products only and are not available on Compact iX products. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on iX models or base models with the –ADV option only. Additional implementation issues may apply as well as indicated in section 8.1.3.1.

No.	Description	Table SVF	Table TVF	Table SCF	Table TCF	No.	Description	Table LDC
101	Steady State Voltage and Frequency	√	√	√	√	101	Steady State Voltage	√
102	Voltage Transients	√	√	√	√	101-APU	Steady State Voltage	√
103	Voltage Modulation	√	√	√	√	102	Voltage Transients	√
104	Voltage Spikes	X	X	X	X	102-APU	Voltage Transients	√
105	Current Distortion	√	√	√	√	103	Voltage Ripple	I
106	Voltage Distortion	P	P	P	P	103-APU	Voltage Ripple	I
107	Inrush Current	X	X	X	X	104	Voltage Spikes	X
108	Frequency Variations	√	√	N/A	N/A	105	Inrush Current	X
109	Frequency Modulation	√	√	√	√	105-APU	Inrush Current	X
110	Voltage DC Content	P or C,x	P or C,x	P or C,x	P or C,x	106	Voltage Variations Due to APU Starting	√
111	Voltage Modulation Due to Equipment	X	X	X	X	107	DC Ripple Due to Equipment	X
112	Voltage Spike Due to Load Switching	X	X	X	X	108	Voltage Spike Due to Equipment Load Switching	X
201	Steady State Voltage and Frequency	√	√	√	√	109	Compatibility with SEPDC Voltage Clipping Devices	X
202	Voltage Transients	√	√	√	√	201	Voltage Transients	√
203	Voltage Modulation	N/A	N/A	√	√	201-APU	Voltage Transients	√
204	Frequency Variations	N/A	N/A	√	√	301	Steady State Voltage	√
301	Steady State Voltage and Frequency	√	√	N/A	N/A	302	Voltage Ripple	I
302	Voltage Distortion	P	P	N/A	N/A	303	Inrush Current	X
303	Voltage Distortion Transients	P	P	N/A	N/A	401	Transparency Time	√

No.	Description	Table SVF	Table TVF	Table SCF	Table TCF	No.	Description	Table LDC
304	Frequency Variations	√	√	N/A	N/A	401-APU	Transparency Time	√
305	Voltage Modulation Due to Equipment	X	X	N/A	N/A	402	Voltage Switching Transients 1	√
401	Transparency Time	√	√	√	√	402-APU	Voltage Switching Transients 1	√
402	Voltage Switching Transients 1	√	√	√	√	403	Voltage Switching Transients 2	√
403	Voltage Switching Transients 2	√	√	√	√	403-APU	Voltage Switching Transients 2	√
404	Voltage Switching Transients with Frequency Change	√	√	√	√	501	Power Failure	X
501	Power Failure	X	X	X	X			

Table 8- 3: -AMD Option iX Test Coverage



### 8.1.3.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Airbus AMD tests, some limitations apply, largely due to hardware limitations of the iX power source. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Test	Standard requirement	Actual setting	Reason
SVF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
SVF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
TVF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
TVF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
SCF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
SCF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
TCF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
TCF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
SVF103	390Hz mod by .75Hz	390Hz mod by .8Hz	Resolution
SVF103	620Hz mod by .75Hz	620Hz mod by .8Hz	Resolution
TVF103	390Hz mod by .75Hz	390Hz mod by .8Hz	Resolution
TVF103	620Hz mod by .75Hz	620Hz mod by .8Hz	Resolution
SCF103	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
TCF103	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution

### 8.1.4 Lx/Ls Series –AMD Option Limitations

The extent of coverage of the –AMD option as implemented on the Lx/Ls Series platform is shown in the table below. Tests marked with an ‘x’ generally require additional hardware to be used. Tests marked ‘N/A’ are not applicable to the corresponding table. Tests marked with a ‘√’ are covered by the –AMD tests. Tests marked with a ‘P’ require arbitrary waveform capability, which is available on Lx models or Ls models with the –ADV option only. Additional implementation issues may apply as well as indicated in section 8.1.4.1.

No.	Description	Table SVF	Table TVF	Table SCF	Table TCF	No.	Description	Table LDC
101	Steady State Voltage and Frequency	√	√	√	√	101	Steady State Voltage	X
102	Voltage Transients	√	√	√	√	101-APU	Steady State Voltage	X
103	Voltage Modulation	√	√	√	√	102	Voltage Transients	X
104	Voltage Spikes	X	X	X	X	102-APU	Voltage Transients	X

No.	Description	Table SVF	Table TVF	Table SCF	Table TCF	No.	Description	Table LDC
105	Current Distortion	√	√	√	√	103	Voltage Ripple	X
106	Voltage Distortion	P	P	P	P	103-APU	Voltage Ripple	X
107	Inrush Current	X	X	X	X	104	Voltage Spikes	X
108	Frequency Variations	√	√	N/A	N/A	105	Inrush Current	X
109	Frequency Modulation	√	√	√	√	105-APU	Inrush Current	X
110	Voltage DC Content	X	X	X	X	106	Voltage Variations Due to APU Starting	X
111	Voltage Modulation Due to Equipment	X	X	X	X	107	DC Ripple Due to Equipment	X
112	Voltage Spike Due to Load Switching	X	X	X	X	108	Voltage Spike Due to Equipment Load Switching	X
201	Steady State Voltage and Frequency	√	√	√	√	109	Compatibility with SEPDC Voltage Clipping Devices	X
202	Voltage Transients	√	√	√	√	201	Voltage Transients	X
203	Voltage Modulation	N/A	N/A	√	√	201-APU	Voltage Transients	X
204	Frequency Variations	N/A	N/A	√	√	301	Steady State Voltage	X
301	Steady State Voltage and Frequency	√	√	N/A	N/A	302	Voltage Ripple	X
302	Voltage Distortion	P	P	N/A	N/A	303	Inrush Current	X
303	Voltage Distortion Transients	P	P	N/A	N/A	401	Transparency Time	X
304	Frequency Variations	√	√	N/A	N/A	401-APU	Transparency Time	X
305	Voltage Modulation Due to Equipment	X	X	N/A	N/A	402	Voltage Switching Transients 1	X
401	Transparency Time	√	√	√	√	402-APU	Voltage Switching Transients 1	X
402	Voltage Switching Transients 1	√	√	√	√	403	Voltage Switching Transients 2	X
403	Voltage Switching Transients 2	√	√	√	√	403-APU	Voltage Switching Transients 2	X
404	Voltage Switching Transients with Frequency Change	√	√	√	√	501	Power Failure	X
501	Power Failure	X	X	X	X			

Table 8- 4: -AMD Option Ls/Lx Test Coverage

### 8.1.4.1 Specific Test Limitations and Discrepancies

While every effort has been made to provide comprehensive coverage of the Airbus AMD tests, some limitations apply, largely due to hardware limitations of the Lx/Ls power source. The following table lists specific implementation issues by test number. The deviation from the standard requirement is shown in the “Actual setting” column. The reason for the deviation is shown in the last column.

Test	Standard requirement	Actual setting	Reason
SVF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
SVF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
TVF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
TVF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
SCF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
SCF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
TCF103	115 +/- .18 Vrms	115 +/- .2 Vrms	Resolution
TCF103	115 +/- 1.24 Vrms	115 +/- 1.2 Vrms	Resolution
SVF103	390Hz mod by .75Hz	390Hz mod by .8Hz	Resolution
SVF103	620Hz mod by .75Hz	620Hz mod by .8Hz	Resolution
TVF103	390Hz mod by .75Hz	390Hz mod by .8Hz	Resolution
TVF103	620Hz mod by .75Hz	620Hz mod by .8Hz	Resolution
SCF103	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution
TCF103	400Hz mod by .75Hz	400Hz mod by .8Hz	Resolution

## 8.2 –AMD Power Groups

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The –AMD option supports both AC and DC modes of operation. The correct mode is a function of the EUT to be tested and the operator must select the corresponding operating mode first. This can be done from the front panel if needed or using the Gui program. Use of the Gui program for all settings will be assumed for the remainder of this chapter.

Five power groups are covered in the Airbus A400M AMD-24 directive:

Group	Description
SVF	Single Phase 115VAC / Variable Frequency, 390 – 620 Hz.
TVF	Three Phase 115VAC / Variable Frequency, 390 – 620Hz.
SCF	Single Phase 115VAC / 400 Hz
TCF	Three Phase 115VAC / 400 Hz
LDC	28VDC

The required steady state output settings for each power group must be selected based on the type of EUT to be tested. These settings can be made from the front panel of the power source or from the main Gui control screen.

### 8.3 –AMD Option Special Features

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DC ripple tests for 28VDC EUT's are provided through a separate control screen. This is required to extend the range of the ripple frequency to 5000 Hz. The actual requirement for AMD-24 rev C is testing up to 150 KHz ripple. This is out of the available range of the power source. To test to the full 150 KHz range, an external audio generator and coupling transformer as outlined in RTCA/DO160, Section 16.6.1.2 is required.

The AMD-24 ripple test screen is available from the main screen, **Applications, Airbus, AMD24 DC Ripple Test** menu. Once selected, the DC ripple test control screen is modal and must be closed before any other tests can be run. Opening this screen requires several seconds as the power source is being set up to perform the DC ripple tests. This screen also places the power source in AC+DC mode.

The available test settings are the section to be tested, which nominal voltage(s) to test at, and phase/output selection. For single-phase systems, only phase A can be selected. The test pattern is fixed per the selected section with a ripple frequency range from 16 Hz to 5000 Hz per Figure B-8. The frequency slew rate is 30 minutes for each decade covered or one hour and 15 minutes for each average DC level selected. If both levels are selected, the total test time will be 2 ½ hours.. Tests can be aborted sooner if needed.

**NOTE: Yet to be implemented in virtual Panel GUI.**

*Figure 8-1: AMD-24 DC Ripple Test Window.*

### 8.4 Test Tables

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The tables shown on the next few pages list the test sections covered by the –AMD option. Where relevant, the numbering used matches that of the AMD-24 document. The notes in the right hand column indicate tests that are either not directly supported or require additional external test equipment. Test tables are listed by rev and then by power group.

**8.4.1 Rev C:**

**8.4.1.1 Table SVF:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SVF101		Steady State Voltage and Frequency	104 to 122 Volts RMS	DO160 16.5.1.1.b, 620Hz and 390Hz	SVF101
SVF102		Voltage Transients	Surge to 160Vac max, Sag to 71Vac min	DO160 16.5.1.5.1.b, 620Hz and 390Hz	SVF102
SVF103		Voltage Modulation	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	DO160 16.5.1.2, 620Hz and 390Hz	SVF103
SVF104		Voltage Spikes		Requires Additional Equipment	
SVF105		Current Distortion	115Vnom, 390-620 Hz	Limits defined by Table A.4	SVF105
SVF106		Voltage Distortion	10% distortion	30sec each frequency	SVF106
SVF106	EW	Voltage Distortion - Endurance test with motor	10% distortion	Per Table SVF 106-2	SVF106-EW
SVF106	E	Voltage Distortion - Endurance test without motor	10% distortion	Per Table SVF 106-2	SVF106-E
SVF107		Inrush Current	Test requires multiple load cables	Test not performed with software	
SVF108		Frequency Variations	Slew from 390 to 620Hz, 100Hz/s up and down	3 times each	SVF108
SVF109		Frequency Modulation	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	DO160 16.5.1.3, 620Hz and 390Hz	SVF109
SVF110		Voltage DC Content	+/- .3VDC Offset	30 mins each test	SVF110
SVF111		Voltage Modulation due to Equipment	Test requires special cables	Test not performed with software	
SVF112		Voltage Spike Due to Equipment Load Switching		Requires Additional Equipment	
SVF201		Abnormal Steady State Voltage and Frequency	96 to 130 Volts RMS	DO160 16.5.2.1.b, 620Hz and 390Hz	SVF201
SVF202		Abnormal Voltage Transients	Surge to 180Vac max, Sag to 0Vac min	DO160 16.5.2.2.b, 620Hz and 390Hz	SVF202
SVF203		Abnormal Voltage Modulation	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	DO160 16.5.1.2, 620Hz and 390Hz	SVF203
SVF301		Emergency Steady State Voltage and Frequency	104 to 122 Volts RMS	DO160 16.5.1.1.b, 620Hz and 390Hz	SVF301
SVF302		Emergency Voltage Distortion	15% distortion	30sec each frequency	SVF302

SVF302	EW	Voltage Distortion - Endurance test with motor	15% distortion	Per Table SVF 302-2	SVF302-EW
SVF302	E	Voltage Distortion - Endurance test without motor	15% distortion	Per Table SVF 302-2	SVF302-E
SVF303		Emergency Voltage Distortion Transients	25% distortion	10 times each test	SVF303
SVF304		Emergency Frequency Variations	Slew from 390 to 620Hz, 500Hz/s up and down	3 times each	SVF304
SVF305		Emergency Voltage Modulation due to Equipment	Test requires special cables	Test not performed with software	
SVF401		Transparency Time	10ms dropouts	Per Figure SVF 401-1	SVF401
SVF402		Voltage Switching Transients 1	Test Conditions 1-17, 390Hz	Per Figure SVF 402-1	SVF402-1
SVF402		Voltage Switching Transients 1	Test Conditions 18-27, 390Hz	Per Figure SVF 402-1	SVF402-2
SVF402		Voltage Switching Transients 1	Test Conditions 28-36, 390Hz	Per Figure SVF 402-1	SVF402-3
SVF402		Voltage Switching Transients 1	Test Conditions 37-42, 390Hz	Per Figure SVF 402-1	SVF402-4
SVF402		Voltage Switching Transients 1	Test Conditions 1-17, 620Hz	Per Figure SVF 402-1	SVF402-5
SVF402		Voltage Switching Transients 1	Test Conditions 18-27, 620Hz	Per Figure SVF 402-1	SVF402-6
SVF402		Voltage Switching Transients 1	Test Conditions 28-36, 620Hz	Per Figure SVF 402-1	SVF402-7
SVF402		Voltage Switching Transients 1	Test Conditions 37-42, 620Hz	Per Figure SVF 402-1	SVF402-8
SVF403		Voltage Switching Transients 2	T=1 to T=49, 620Hz	Per Figure SVF 403-1	SVF403-1
SVF403		Voltage Switching Transients 2	T=50 to T=99, 620Hz	Per Figure SVF 403-1	SVF403-2
SVF403		Voltage Switching Transients 2	T=100 to T=200, 620Hz	Per Figure SVF 403-1	SVF403-3
SVF403		Voltage Switching Transients 2	T=1 to T=49, 390Hz	Per Figure SVF 403-1	SVF403-4
SVF403		Voltage Switching Transients 2	T=50 to T=99, 390Hz	Per Figure SVF 403-1	SVF403-5
SVF403		Voltage Switching Transients 2	T=100 to T=200, 390Hz	Per Figure SVF 403-1	SVF403-6
SVF404		Voltage Switching Transients with Frequency Change	50-200ms dropouts	Per Figure SVF 404-1	SVF404
SVF501		Power Failure	Test requires physically removing line cables	Test not performed with software	

**8.4.1.2 Table TVF:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TVF101		Steady State Voltage and Frequency	104 to 122 Volts RMS	DO160 16.5.1.1.b, 620Hz and 390Hz	TVF101
TVF102		Voltage Transients	Surge to 160Vac max, Sag to 71Vac min	DO160 16.5.1.5.1.b, 620Hz and 390Hz	TVF102
TVF103		Voltage Modulation	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	DO160 16.5.1.2, 620Hz and 390Hz	TVF103
TVF104		Voltage Spikes		Requires Additional Equipment	
TVF105		Current Distortion	115Vnom, 390-620 Hz	Limits defined by Table A.5	TVF105
TVF106		Voltage Distortion	10% distortion	30sec each frequency	TVF106
TVF106	EW	Voltage Distortion - Endurance test with motor	10% distortion	Per Table TVF 106-2	TVF106-EW
TVF106	E	Voltage Distortion - Endurance test without motor	10% distortion	Per Table TVF 106-2	TVF106-E
TVF107		Inrush Current	Test requires multiple load cables	Test not performed with software	
TVF108		Frequency Variations	Slew from 390 to 620Hz, 100Hz/s up and down	3 times each	TVF108
TVF109		Frequency Modulation	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	DO160 16.5.1.3, 620Hz and 390Hz	TVF109
TVF110		Voltage DC Content	+/- .3VDC Offset	30 mins each test	TVF110
TVF111		Voltage Modulation due to Equipment	Test requires special cables	Test not performed with software	
TVF112		Voltage Spike Due to Equipment Load Switching		Requires Additional Equipment	
TVF201		Abnormal Steady State Voltage and Frequency	96 to 130 Volts RMS	DO160 16.5.2.1.b, 620Hz and 390Hz	TVF201
TVF202		Abnormal Voltage Transients	Surge to 180Vac max, Sag to 0Vac min	DO160 16.5.2.2.b, 620Hz and 390Hz	TVF202
TVF203		Abnormal Voltage Modulation	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	DO160 16.5.1.2, 620Hz and 390Hz	TVF203
TVF301		Emergency Steady State Voltage and Frequency	104 to 122 Volts RMS	DO160 16.5.1.1.b, 620Hz and 390Hz	TVF301
TVF302		Emergency Voltage Distortion	15% distortion	30sec each frequency	TVF302
TVF302	EW	Voltage Distortion - Endurance test with motor	15% distortion	Per Table TVF 302-2	TVF302-EW



TVF302	E	Voltage Distortion - Endurance test without motor	15% distortion	Per Table TVF 302-2	TVF302-E
TVF303		Emergency Voltage Distortion Transients	25% distortion	10 times each test	TVF303
TVF304		Emergency Frequency Variations	Slew from 390 to 620Hz, 500Hz/s up and down	3 times each	TVF304
TVF305		Emergency Voltage Modulation due to Equipment	Test requires special cables	Test not performed with software	
TVF401		Transparency Time	10ms dropouts	Per Figure TVF 401-1	TVF401
TVF402		Voltage Switching Transients 1	Test Conditions 1-17, 390Hz	Per Figure TVF 402-1	TVF402-1
TVF402		Voltage Switching Transients 1	Test Conditions 18-27, 390Hz	Per Figure TVF 402-1	TVF402-2
TVF402		Voltage Switching Transients 1	Test Conditions 28-36, 390Hz	Per Figure TVF 402-1	TVF402-3
TVF402		Voltage Switching Transients 1	Test Conditions 37-42, 390Hz	Per Figure TVF 402-1	TVF402-4
TVF402		Voltage Switching Transients 1	Test Conditions 1-17, 620Hz	Per Figure TVF 402-1	TVF402-5
TVF402		Voltage Switching Transients 1	Test Conditions 18-27, 620Hz	Per Figure TVF 402-1	TVF402-6
TVF402		Voltage Switching Transients 1	Test Conditions 28-36, 620Hz	Per Figure TVF 402-1	TVF402-7
TVF402		Voltage Switching Transients 1	Test Conditions 37-42, 620Hz	Per Figure TVF 402-1	TVF402-8
TVF403		Voltage Switching Transients 2	T=1 to T=49, 620Hz	Per Figure TVF 403-1	TVF403-1
TVF403		Voltage Switching Transients 2	T=50 to T=99, 620Hz	Per Figure TVF 403-1	TVF403-2
TVF403		Voltage Switching Transients 2	T=100 to T=200, 620Hz	Per Figure TVF 403-1	TVF403-3
TVF403		Voltage Switching Transients 2	T=1 to T=49, 390Hz	Per Figure TVF 403-1	TVF403-4
TVF403		Voltage Switching Transients 2	T=50 to T=99, 390Hz	Per Figure TVF 403-1	TVF403-5
TVF403		Voltage Switching Transients 2	T=100 to T=200, 390Hz	Per Figure TVF 403-1	TVF403-6
TVF404		Voltage Switching Transients with Frequency Change	50-200ms dropouts	Per Figure TVF 404-1	TVF404
TVF501		Power Failure	Test requires physically removing line cables	Test not performed with software	

**8.4.1.3 Table SCF:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
SCF101		Steady State Voltage and Frequency	104 to 122 Volts RMS	DO160 16.5.1.1.b, 410Hz and 390Hz	SCF101
SCF102		Voltage Transients	Surge to 160Vac max, Sag to 71Vac min	DO160 16.5.1.5.1.b, 400Hz	SCF102
SCF103		Voltage Modulation	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	DO160 16.5.1.2, 400Hz	SCF103
SCF104		Voltage Spikes		Requires Additional Equipment	
SCF105		Current Distortion	115Vnom, 400 Hz	Limits defined by Table A.4	SCF105
SCF106		Voltage Distortion	10% distortion	30sec each frequency	SCF106
SCF106	EW	Voltage Distortion - Endurance test with motor	10% distortion	Per Table SCF 106-2	SCF106-EW
SCF106	E	Voltage Distortion - Endurance test without motor	10% distortion	Per Table SCF 106-2	SCF106-E
SCF107		Inrush Current	Test requires multiple load cables	Test not performed with software	
SCF108		Frequency Modulation	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	DO160 16.5.1.3, 400Hz	SCF108
SCF109		Voltage DC Content	+/- .3VDC Offset	30 mins each test	SCF109
SCF110		Voltage Modulation due to Equipment	Test requires special cables	Test not performed with software	
SCF111		Voltage Spike Due to Equipment Load Switching		Requires Additional Equipment	
SCF201		Abnormal Steady State Voltage and Frequency	96 to 130 Volts RMS	DO160 16.5.2.1.b, 400Hz	SCF201
SCF202		Abnormal Voltage Transients	Surge to 180Vac max, Sag to 0Vac min	DO160 16.5.2.2.b, 400Hz	SCF202
SCF203		Abnormal Voltage Modulation	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	DO160 16.5.1.2, 400Hz	SCF203
SCF204		Abnormal Frequency Variations	320Hz to 480Hz		SCF204
SCF401		Transparency Time	10ms dropouts	Per Figure SCF 401-1	SCF401
SCF402		Voltage Switching Transients 1	Test Conditions 1-17, 400Hz	Per Figure SCF 402-1	SCF402-1
SCF402		Voltage Switching Transients 1	Test Conditions 18-27, 400Hz	Per Figure SCF 402-1	SCF402-2

SCF402		Voltage Switching Transients 1	Test Conditions 28-36, 400Hz	Per Figure SCF 402-1	SCF402-3
SCF402		Voltage Switching Transients 1	Test Conditions 37-42, 400Hz	Per Figure SCF 402-1	SCF402-4
SCF403		Voltage Switching Transients 2	T=1 to T=49, 400Hz	Per Figure SCF 403-1	SCF403-1
SCF403		Voltage Switching Transients 2	T=50 to T=99, 400Hz	Per Figure SCF 403-1	SCF403-2
SCF403		Voltage Switching Transients 2	T=100 to T=200, 400Hz	Per Figure SCF 403-1	SCF403-3
SCF501		Power Failure	Test requires physically removing line cables	Test not performed with software	

**8.4.1.4 Table TCF:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
TCF101		Steady State Voltage and Frequency	104 to 122 Volts RMS	DO160 16.5.1.1.b, 410Hz and 390Hz	TCF101
TCF102		Voltage Transients	Surge to 160Vac max, Sag to 71Vac min	DO160 16.5.1.5.1.b, 400Hz	TCF102
TCF103		Voltage Modulation	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	DO160 16.5.1.2, 400Hz	TCF103
TCF104		Voltage Spikes		Requires Additional Equipment	
TCF105		Current Distortion	115Vnom, 400 Hz	Limits defined by Table A.5	TCF105
TCF106		Voltage Distortion	10% distortion	30sec each frequency	TCF106
TCF106	EW	Voltage Distortion - Endurance test with motor	10% distortion	Per Table TCF 106-2	TCF106-EW
TCF106	E	Voltage Distortion - Endurance test without motor	10% distortion	Per Table TCF 106-2	TCF106-E
TCF107		Inrush Current	Test requires multiple load cables	Test not performed with software	
TCF108		Frequency Modulation	Famp = 4.9 Hz to 0.2Hz, Mrate = 0.014Hz to 100Hz	DO160 16.5.1.3, 400Hz	TCF108
TCF109		Voltage DC Content	+/- .3VDC Offset	30 mins each test	TCF109
TCF110		Voltage Modulation due to Equipment	Test requires special cables	Test not performed with software	
TCF111		Voltage Spike Due to Equipment Load Switching		Requires Additional Equipment	

TCF201		Abnormal Steady State Voltage and Frequency	96 to 130 Volts RMS	DO160 16.5.2.1.b, 400Hz	TCF201
TCF202		Abnormal Voltage Transients	Surge to 180Vac max, Sag to 0Vac min	DO160 16.5.2.2.b, 400Hz	TCF202
TCF203		Abnormal Voltage Modulation	Vamp = 0.18V to 1.24V, Mrate = 1Hz to 200Hz	DO160 16.5.1.2, 400Hz	TCF203
TCF204		Abnormal Frequency Variations	320Hz to 480Hz		TCF204
TCF401		Transparency Time	10ms dropouts	Per Figure TCF 401-1	TCF401
TCF402		Voltage Switching Transients 1	Test Conditions 1-17, 400Hz	Per Figure TCF 402-1	TCF402-1
TCF402		Voltage Switching Transients 1	Test Conditions 18-27, 400Hz	Per Figure TCF 402-1	TCF402-2
TCF402		Voltage Switching Transients 1	Test Conditions 28-36, 400Hz	Per Figure TCF 402-1	TCF402-3
TCF402		Voltage Switching Transients 1	Test Conditions 37-42, 400Hz	Per Figure TCF 402-1	TCF402-4
TCF403		Voltage Switching Transients 2	T=1 to T=49, 400Hz	Per Figure TCF 403-1	TCF403-1
TCF403		Voltage Switching Transients 2	T=50 to T=99, 400Hz	Per Figure TCF 403-1	TCF403-2
TCF403		Voltage Switching Transients 2	T=100 to T=200, 400Hz	Per Figure TCF 403-1	TCF403-3
TCF501		Power Failure	Test requires physically removing line cables	Test not performed with software	

**8.4.1.5 Table LDC:**

Test No.	Section	Subject	Test Limits	Comment	File Ref.
LDC101		Steady State Voltage	32 to 24 Volts RMS	DO160 16.6.1.1.b	LDC101
LDC101	APU	Steady State Voltage	32.5 to 23.5 Volts RMS	DO160 16.6.1.1.b	LDC101-APU
LDC102		Voltage Transients	Surge to 36V max, Sag to 18.5V min	Per Table LDC 102-1	LDC102
LDC102	APU	Voltage Transients	Surge to 40V max, Sag to 17V min	Per Table LDC 102-APU	LDC102-APU

LDC103		Voltage Ripple	Maximum 5kHz ripple.	Test performed in ripple window.	
LDC103	APU	Voltage Ripple	Maximum 5kHz ripple.	Test performed in ripple window.	
LDC104		Voltage Spikes		Requires Additional Equipment	
LDC105		Inrush Current	Test requires multiple load cables	Test not performed with software	
LDC105	APU	Inrush Current	Test requires multiple load cables	Test not performed with software	
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LDC201	APU	Abnormal Voltage Transients	46 to 0 Volts	DO160 16.6.2.4.c and 16.6.2.3.b	LDC201-APU
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