IADS FESAA

Flutter Excitation System Automated Analysis

Quick Start Guide

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1. Introduction

Curtiss-Wright IADS provides an advanced capability called the FES Automated Analysis (FESAA) to automatically extract frequency and damping results from the time domain data output from the usage of a Flutter Excitation System (FES) installed on the test vehicle.

This FESAA is part of the Client workstation software (product code is IADS-TELEM-CLEINT) and therefore can be used in both real time and playback. Further information can be found in the IADS help system by searching for “FES Parameters Table”.

2. Purpose

The purpose of this document is to provide an overview of the FESAA process and enough information to get started using this feature. For use of other more advanced features, such as the Flutter Summary log or issues with usage in real time, it is recommended that you contact Curtiss-Wright IADS for assistance.

3. Background

The primary purpose of the FESAA tool is to increase efficiency for test point clearance during flutter testing. Other test programs have shown substantial time savings when using this process, especially when clearing many test point during a single test session.

FESAA setup is accomplished within several areas of the IADS Client, here are the steps:

1) Fill-out the FES Parameters Table (see section 4.1).
2) Add needed parameters in the Parameter Defaults Table (see section 4.2).
3) Build displays with Stripcharts to view resultant data and FESAA outputs such as Event Markers and overlays.
4) Using the Stripchart property dialog to setup the FES parameter type (see section 4.3).

During run-time the user can interact with system in several ways:

1) Using the right-click menu options from the FES panel on the Dashboard (see Section 5.1)
2) Creating displays, primarily Stripcharts for visualization where the user can scroll-back to review results (see Figure 5-3)
3) Reviewing analysis results on Stripcharts or in the Analysis log for verification.

During real time operation or in playback mode the FESAA is a background task that looks for a trigger to begin operation. Once the trigger occurs the FESAA automatically performs the point selection to form the data range, adjust filter settings and performs the frequency and damping calculations using either the Logarithmic Decrement technique (LogDec) or a Pseudo Random Decrement-LogDec (PRD-LD) for burst mode. Finally, the results are presented on the displays and saved to the results in the Analysis Log.

4. FESAA Setup

4.1. FES Parameters Table

The FESAA requires certain parameters in IADS in order to control its processing to match the desired computational analysis. The FES Parameters Table, located in the Configuration Tool under the Automation tab, is required in order to match required FES Output data, such as the "Arm" parameter with the actual parameter name as defined in the Parameter Defaults Table. The following is an example of this table with all the required FES Output types.

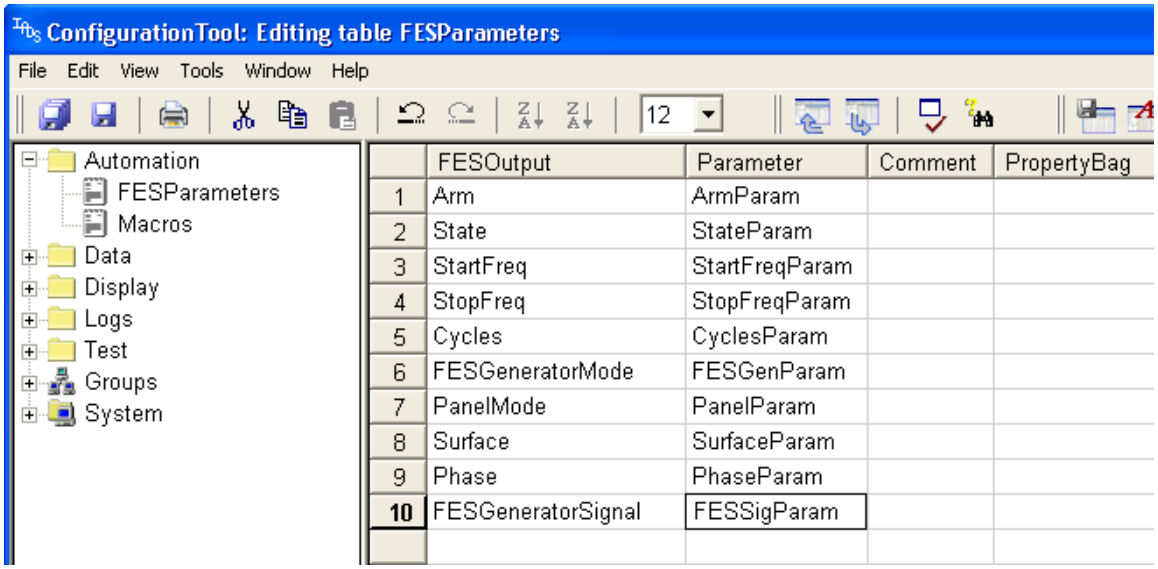


Figure 4-1 FES Parameter Table

Following is the definition of the FES Outputs needed:

1) **Arm** (required) - FES Arm State - This parameter is used to determine the start and stop of an "FES" event. Typically, the pilot arms the FES whereby this bit would go high. An event is triggered to perform the automated analysis when the bit goes low. This creates a "frame" of time around which the response signal will be processed. An IADS Local Derived parameter is created and assigned to the "Arm" parameter in this FES Parameters table within the IADS Configuration file. Please note that all of these bit pick local derived parameters can use the "table lookup" column so that a user readable string can be viewed in an alphanumeric display instead of a number.

2) **State** - Not currently used.

3) **Start/Stop Frequency** (required*) - These values are taken at the start of the Arm on. These values are not used by the FESAA, but by the auto-filtering. Also used by the Dashboard FES panel display.

4) **Cycles** (required*) - Used to determine the number of successive bursts being applied. Can be used to determine if the FES generated the correct number and duration of bursts before beginning processing or cancel altogether. Used by the Dashboard front panel display.

5) **FES Generator Mode** - Identifies the mode the FES system is operating. For example, Stripcharts will only compute automated LogDec or PRD in "Burst" mode, and will respond to automated filter changes differently depending on mode (see Stripchart properties, the auto tab). Frequency Response plots will respond to "Sweep" modes for automated Peak Hold reset. Used by the Dashboard front panel display.

6) **Panel Mode** (required*) - Used to limit the response to modes that the user doesn't care about, for example, PID and Flutter. Not used in the FESAA. Used by the Dashboard front panel display

7) **Surface/Phase** (required*) - Both the surface and phase values are sent as part of the "Arm" trigger event to each Stripchart, where from the property sheet, it is set to match the signal's surface and phase with that sent as part of the event. This is how a response signal in a Stripchart is matched to the FES event that was triggered. Both are used by the dashboard front panel display.

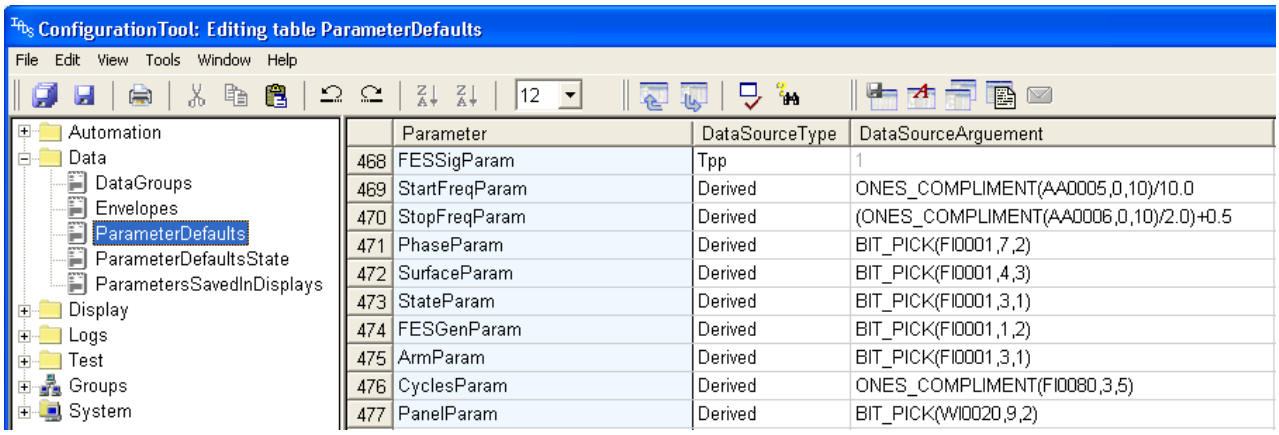
8) **FES Generator Signal** (required) – This is the excitation signal from the aircraft's FES system. This parameter is used to determine the location of the excitation within the response parameters and forms the data range where the automated analysis picks the correct points for the LogDec computation or locates the start and stop data ranges for each burst for the PRD computation (Requires multiple bursts per ARM on/off cycle)

* These values can be hardcoded with a derived parameter value if you do not have data for them.

Note: To verify the frequency and damping computations are operating properly, data for the response parameters is needed that was generated during the FES test in response to the excitation from the "FES Generator Signal"

4.2. Adding FES Output Parameters to the Parameter Defaults Table

Each FES system is unique and therefore it is very likely that IADS Derived parameters will have to be created for several of the required FES Output values in order to provide the required data states to perform the FES process. These include; the Arm, FES Generator Mode, Panel Mode and Surface and Phase. The other FES Output parameters can most likely be used from the test vehicle without further processing. FESAA expects data outputs the match its preset algorithmic expectations. Figure 4-2 below shows an example set of FES parameter entries in the Parameter Defaults Table. The parameter names are user defined and are used in the FES Parameters Table as detailed in section 4.1. Table 4-1 describes the required output data values.



	Parameter	DataSourceType	DataSourceArguement
468	FESSigParam	Tpp	1
469	StartFreqParam	Derived	ONES_COMPLIMENT(AA0005,0,10)/10.0
470	StopFreqParam	Derived	(ONES_COMPLIMENT(AA0006,0,10)/2.0)+0.5
471	PhaseParam	Derived	BIT_PICK(FI0001,7,2)
472	SurfaceParam	Derived	BIT_PICK(FI0001,4,3)
473	StateParam	Derived	BIT_PICK(FI0001,3,1)
474	FESGenParam	Derived	BIT_PICK(FI0001,1,2)
475	ArmParam	Derived	BIT_PICK(FI0001,3,1)
476	CyclesParam	Derived	ONES_COMPLIMENT(FI0080,3,5)
477	PanelParam	Derived	BIT_PICK(WI0020,9,2)

Figure 4-2 Parameter Defaults Table with Sample FES Derived Parameters

The following table describes the values the FES Output parameters must provide in order for the FESAA to operate properly:

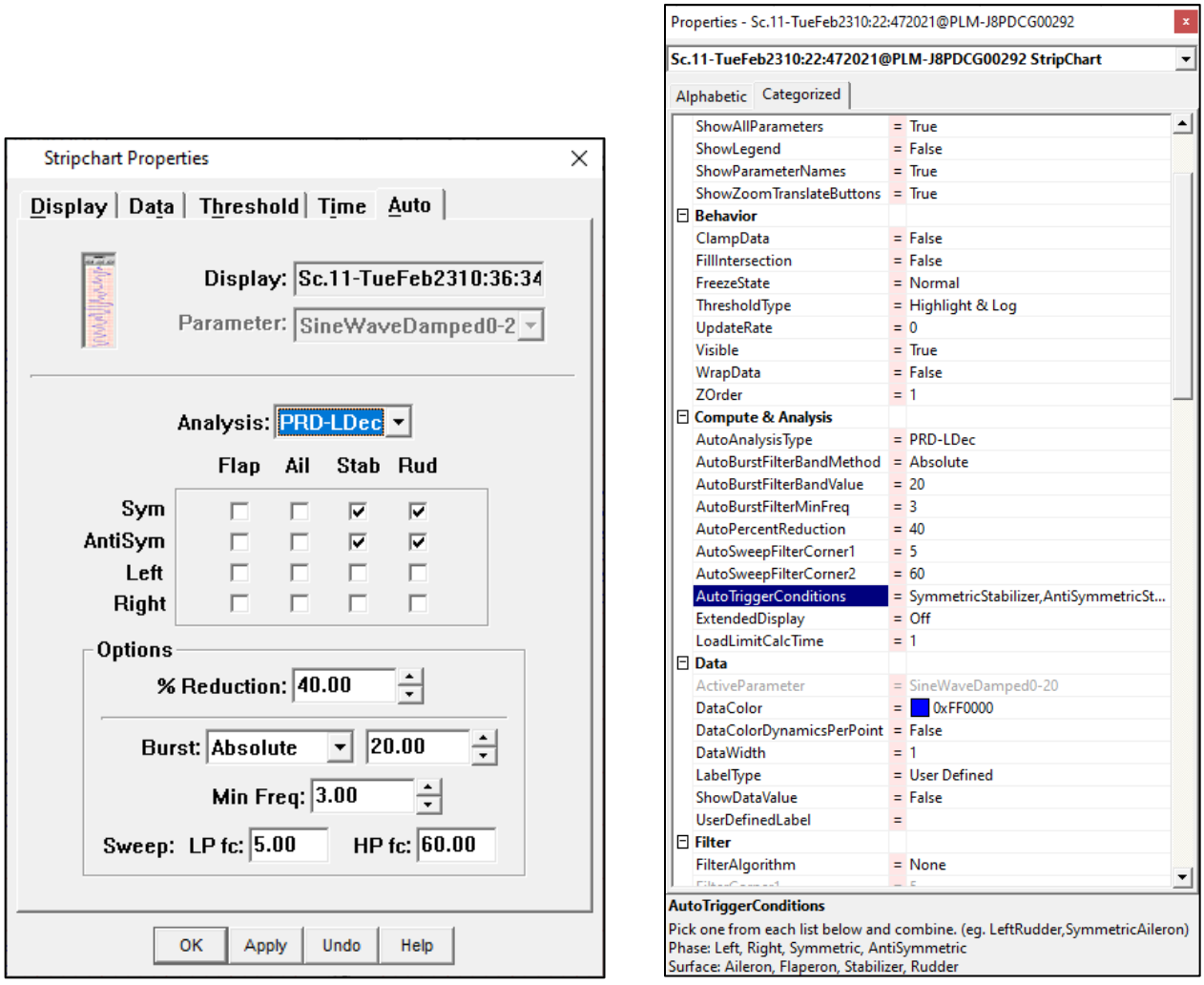
FES Output	*Required Output Value*	
Arm	0 = “Disarm”	
	1 = “Armed”	
FES Generator Mode	0 = “Dsweep”	
	1 = “Burst”	
	2 = “Sweep”	
	3 = “Continuous”	
	4 = “Random”	
Panel Mode	0 = “PID”	
	1 = “Flutter”	
	2 = “SC”	
Phase	0 = Right-side surfaces	
	1 = Left-side surfaces	
	2 = AntiSymmetric surfaces	
	3 = Symmetric surfaces	
Surface	0 = RightAUX	Phase = 0
	1 = RightNOZ	
	2 = RightLEFlap	
	3 = RightFlaperon	
	4 = RightFlaperon	
	5 = RightAileron	
	6 = RightRudder	
	7 = RightStabilizer	
	0 = LeftAUX	Phase = 1
	1 = LeftNOZ	
	2 = LeftLEFlap	
	3 = LeftFlaperon	
	4 = LeftFlaperon	
	5 = LeftAileron	
	6 = LeftRudder	
	7 = LeftStabilizer	

FES Output	*Required Output Value*	
Surface	0 = AntiSymmetricAUX	Phase = 2
	1 = AntiSymmetricNOZ	
	2 = AntiSymmetricLEFlap	
	3 = AntiSymmetricFlaperon	
	4 = AntiSymmetricFlaperon	
	5 = AntiSymmetricAileron	
	6 = AntiSymmetricRudder	
	7 = AntiSymmetricStabilizer	
	0 = SymmetricAUX	Phase = 3
	1 = SymmetricNOZ	
	2 = SymmetricLEFlap	
	3 = SymmetricFlaperon	
	4 = SymmetricFlaperon	
	5 = SymmetricAileron	
	6 = SymmetricRudder	
	7 = SymmetricStabilizer	

Table 4-3 Required FES Output Data Values

4.3. Building Displays for FES Check-Out and Real Time Operation

It is recommended that several displays be built for the FESAA system. Build a display for the FES Output parameter checkout, which will aid in determining if the FES Output parameters have the required data output values as described in Table 4-3; then build a display for each surface under test, for example “Flutter-Vertical Tail” would have several displays with Stripcharts containing the response parameters, several Frequency plots, and other textual displays. Another may be “Flutter-Wing”, and so on. The Stripchart “Auto” tab is used to communicate the type of parameter attached to the FESAA process so that it can properly process the data. For more information on the individual dialog items please see the IADS help system, search for “Stripcharts, Customizing - The Property Sheet”.



Classic Property Sheet (deprecated) **Advanced Property Sheet**

Figure 4-4 Stripchart Dilaog showing the Auto Tab

5. Using the FESAA System

5.1. Setting FES Panel Right-Click Menu Options

Several options are available from the Dashboard/FES Panel to set run-time conditions and post trigger events. Figure 5-1 below shows an example of this menu.

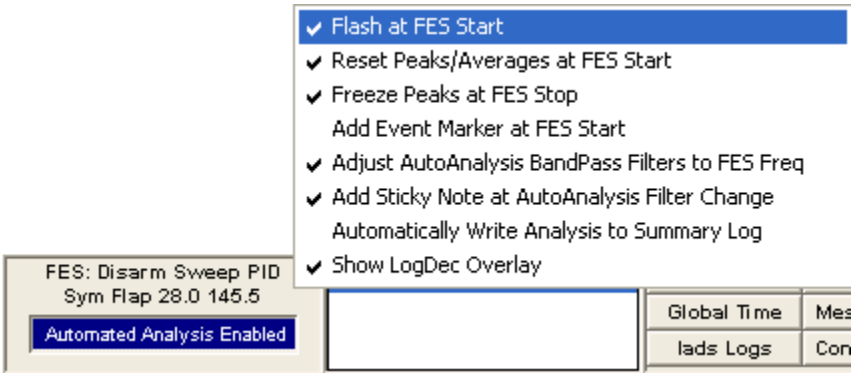


Figure 5-1 FES Panel Right-Click Menu Options

1) Flash at FES Start – Enable this to Flash the Stripcharts with the Response parameters under test.

2) Reset Peaks/Averaged at FES Start – Enable this to reset the Peaks on Frequency Plots associated with the response parameters.

3) Add Event Marker at FES Stop – Enable this to add event markers at the end of the FES trigger event.

4) Adjust AutoAnalysis BandPass Filters to FES Freq – This will enable a tracking bandpass filter for the response parameters under test based on the filter setting on the Stripchart Property dialog.

5) Add Sticky not at AutoAnalysis Filter Change – Enable this option to show on the Stripchart when the FESAA changed a filter setting.

6) Automatically Write Analysis to Summary Log – Enable this to push results from the Analysis Log to the Summary Log. The Summary log is a living log in that results are maintained across multiple tests.

Note: This is an advanced feature that is not covered in this guide. Contact IADS for more information at Email: iads-support@curtisswright.com or Phone: 661-273-7003 x 210.

7) Show LogDec Overlay – Will show the computed overlay on the Response parameter for which the LogDec computation was performed.

5.2. Monitoring Displays and Computational Results

Once the IADS system is running in real time, the "Automated Analysis Enabled" button on the FES dashboard panel must be selected in order to have the FESAA process enabled. Here are the items to watch for during an FES event:

1) The FES panel on the Dashboard will flash upon start and during an FES cycle as defined by the Arm trigger parameter.

2) Visual indicators will be automatically added to the Strip charts including for such items as Auto Filter changes (see Figure 5-2), Burst data selection, LogDec overlays, and the computed frequency and damping.

3) Upon trigger complete, the computations will be performed and displayed on the enabled Stripcharts. See Figure 6 for a typical display with FES results.

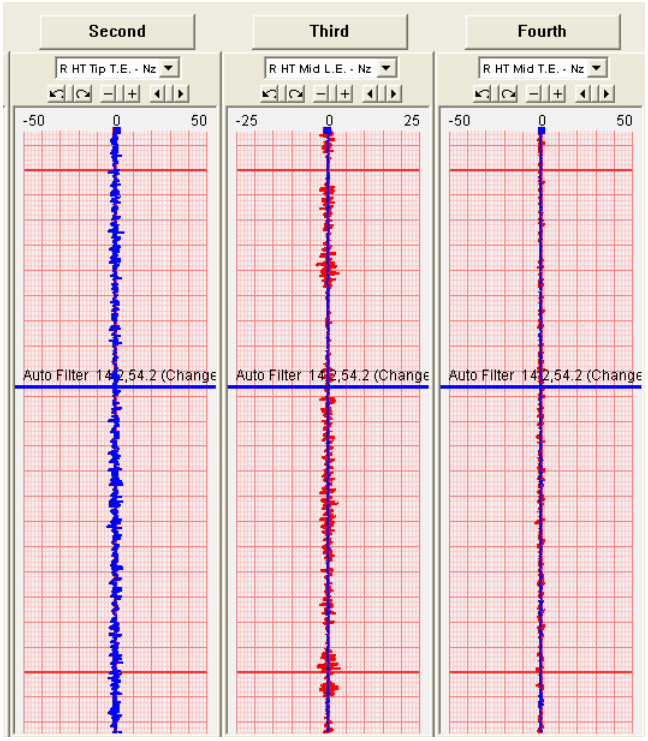


Figure 5-2 Auto Filter Change

After the FES event is complete, computations are performed, and various visual elements are added to the displays. Analysis results are visually shown on the appropriate Stripcharts displays and saved to the Analysis log. It is typical for Test Engineers to review results during the test point and to scroll back and review previous results during momentary downtimes.

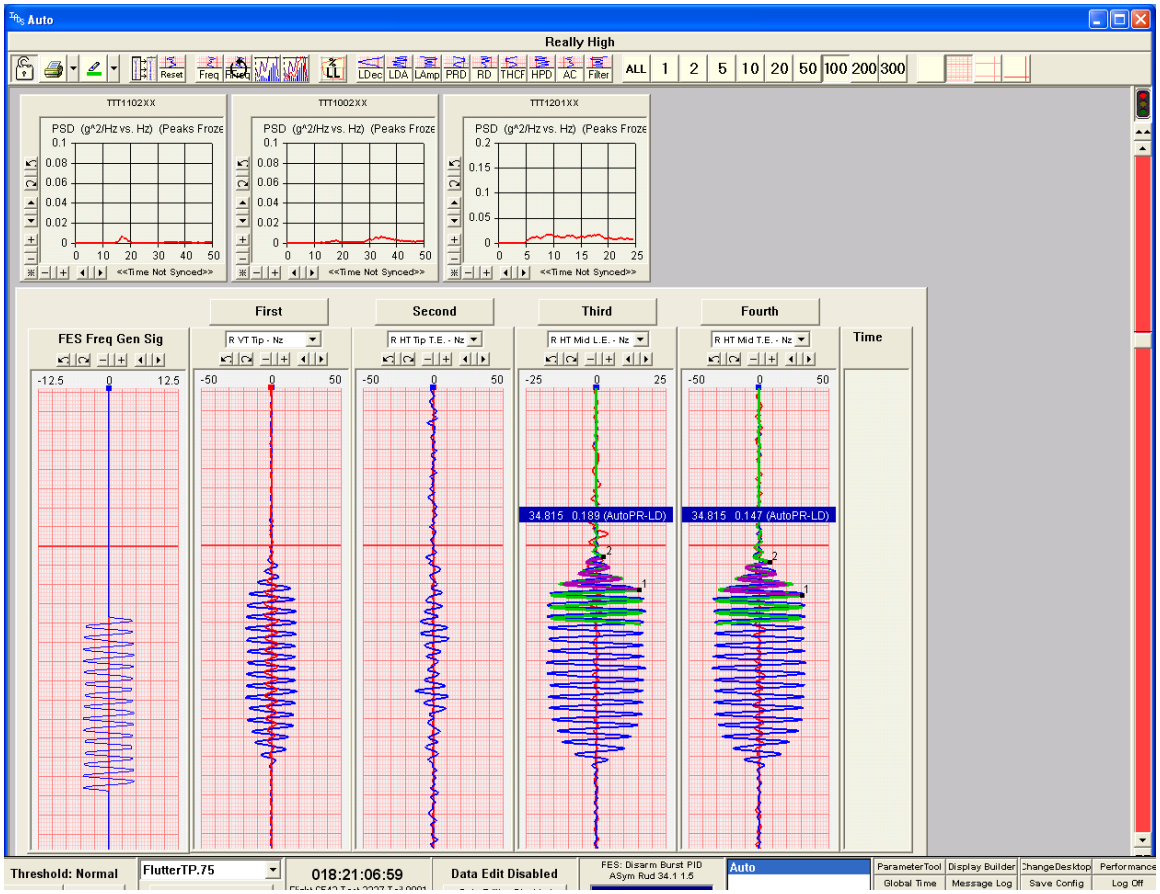


Figure 5-3 Example of Completion of a FESAA Event

6. Conclusion

The IADS FESAA is a core capability provided to increase the number of test points processed during a test. This capability is a unique feature of the IADS system which utilizes many internal architectural features, such as Stripcharts, Frequency Plots, Visual markers, and the Analysis Log. Since most FES systems are unique, customer specific derived parameters will need to be created in order to use this capability. The end user will need to decide if the setup time required to setup the FESAA processing is necessary given the number of flutter test points to clear.