SPECTRAL DYNAMICS

PUMA BASIC

Classical Shock
Operating Manual

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Puma Basic

Classical Shock Operating Manual

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.Chapter 1 - Introduction

1.1 Introduction

This manual describes the theory and operation of the PUMA Vibration Control System (VCS) when running the Classical Shock Application. Note that the Receiving Checkout Tests (RCT's) are used as examples and should be referred to often.

This manual is presented in eight chapters relating information about the applicable menus required to set up the operating parameters for the Puma Basic VCS.

The presentation of an arrow (⇒) is a substitute for the backslash when listing/navigating a path from the drive to the applicable file or from an application window to a lower level in the application.

1.2 Getting Started

Before beginning, read the PUMA *System Description Manual*. This will help familiarize the user with the system, and give required information for unpacking, assembly and operation.

1.3 Software and Manuals

Software and manuals (along with vendor manuals, calibration devices and service training) are sold in various combinations.

1.3.1 Software

The Classical Shock Function closed-loop vibration control program and options are supplied on CD ROM. This CD ROM contains executable code for Classical Shock Function test parameters, schedule parameters and the micro code for peripheral devices. The **software** is **licensed** and **requires** a **key** to activate it. The key and drivers are supplied on diskette.

1.3.2 Manuals

The PUMA VCS is supplied with this application manual and a system manual.

PUMA System Description

Part Number 2400-0100

Other manuals may be included as purchase options.

1.4 Classical Shock Function Features

The PUMA BASIC VCS and the Classical Shock Function program provide digital real-time closed loop shaker control for production testing, design qualification and reliability testing applications. The system allows the definition, simulation, and closed loop control of a Classical Shock Function vibration excitation shaker system.

The technical specifications of the Classical Shock Function software are listed in Table 1-1.

Table 1-1. Classical Shock Function Technical Specifications

Control Methods	
Control Loop	Patented adaptive control algorithm with transfer function updating and coherence smoothing to accurately and quickly compensate for non-linearity or time varying changes in the dynamic load.
Control Performance	
Dynamic Range	Up to 90 dB.
Pulse Definition	
Types	Half-sine, trapezoidal.
UFF Scale Factor	-40 to +40 dB
Pulse Duration	0.1 to 32,000 ms
Buffer Duration	10 ms to 64 sec
Pulse Amplitude	0.01 to 500 g
Rise Time (Trapezoidal)	0.1 to 10,000 ms
Peak Time (Trapezoidal)	0.1 to 10,000 ms
Fall Time (Trapezoidal)	0.1 to 10,000 ms
Units	g-in/s-in; g-m/s-mm; m/s^2-m/s-mm
Frequency Range	From 50Hz to 10 kHz; dependent on the pulse duration and type of compensation
Frame Size	Automatic selection of 512 – 8192 samples, in squared (power of 2) steps
Pulse Compensation	
Type	Pre- and post-pulse, pre-pulse only, post-pulse only
Displacement Optimization	(Pre- and post-pulse) Single sided, double sided
Compensation Method	(Double Sided) Displacement, symmetrical acceleration, non-symmetrical acceleration
Pre-pulse Amplitude	5 to 100%
Post-pulse Amplitude	5 to 100%
Symmetrical Compensation	5 to 100%
Display Tolerances	
Type	None, MIL-STD 810, user-specified
Specified Segments	+pre-pulse, -pre-pulse; +main pulse, -main pulse; +post-pulse, -post-pulse
Specified Tolerance	1 to 99%; independent for each segment

Table 1-1. Classical Shock Function Technical Specifications - Contd.

Control Parameters	
Mode of Operation	Manual, semi-automatic, automatic
Number of Control Channels	Any one channel selectable as control
Repetitive pulses	1 to 1,000,000
Delay Between Pulses	0 to 8,000 ms
Control Strategy	
Pre-stored drive	User selectable, no/yes
Drive Update	Off, on (Equalization function updated after every pulse)
Output Polarity	+/-
Weighting for Averaging	User selectable, 0.05 to 1
Feedback Gain	User selectable, 0.05 to 1
Equalization Method	Transfer function
Equalization Level	0 to –80 dB
Input for Equalization	Pulse, random, pseudo random
Non-Linear Ampl.Factor	NLAF #set 0.5 to 2.0
Waveform Trend Removal	Disable, enable (Removes DC offset before integrating from Acceleration to Velocity or Displacement)
Start-up Parameters	
Initial Test Level	Equalization level to 0 dB
Level Increment	1 to 20 dB
Equalization Delay	0.0 to 8,000ms
Safety Features	
Shaker Limits	Pretest verification that spectrum dynamic limits are within shaker operational limits (acceleration, velocity, displacement and voltage)
Loop Check Max. Drive	User selectable, 1 to 5,000 mVrms
Loop Check Max. Noise	User selectable, 1 to 1,000 mVrms
Max Average Error Alarm	0.01 to 100%
Max Average Error Abort	0.01 to 100%
Max Peak Error Alarm	0.01 to 100%
Max Peak Error Abort	0.01 to 100%
Control Signal Loss	Continuous automatic detection
Maximum Drive Signal	0.01 to 12V Peak
Test Automation	
Automatic Level Increase	User selectable initial level, level increment, delay between pulses; re-equalization between each pulse
Multiple Pulse	User selectable number of full level pulses and delay between pulses

Table 1-1. Classical Shock Function Technical Specifications - Contd.

Channel Setup	
Channel Type	Control, auxiliary, inactive
Sensitivity	0.001 to 999,999 mV/g
Channel Loop Check	Enabled, disabled
Channel Label	Up to 20 characters for each channel
Transducer Serial Number	Up to 10 characters for each channel
Transducer Power	Constant current source On or Off
On-Line Analysis	
Real-Time Analysis	Pulses and spectra for 1 to all available channels simultaneously displayed
Time Functions	Control, drive, error and auxiliary waveforms
Display Units	Acceleration, Velocity and Displacement
SRS Displays	Maxi-max; Primary and Residual +or -
SRS Resolution	1/1, 1/3, 1/6, 1/12 and 1/24 Octave
SRS Damping	0.1 to 99%, user selectable
SRS Definition	Absolute Acceleration, Relative Displacement
Cursors	X and Y value readout, peak search, trace tagging, multi-window locked positioning
Scaling of Display	Log / linear, auto-scaled / fixed, full control
Data Storage	
Data Storage Setup	Every pulse, last pulse, off
Playback	Scan through the entire test data file, with adjustable delay
Record Annotation	Complete tagging of each record with either static or dynamically
Test Sumary	Fully documented post-test summary, easily printed or incorporated into any document using standard word processing software
Run Message Log	Text file records all system status messages displayed during test run

1.4.1 Safety Features

The Classical Shock Function provides the following safety features to protect the operator, the test equipment and the manufacturing operations:

- Tolerance bands for the reference waveform
- Audible Alarm / Abort to indicate abnormal test conditions
- Pre-test loop check to ensure proper operation of the complete drive signal and response signal paths
- Test abort on loss or excessive fluctuation of the control signal
- User-initiated manual test abort

- Password lockout of test modification to prevent unauthorized changes
- Abort documentation for post-test analysis
- Operator limit of drive amplitude

1.4.2 Options

The following options may be purchased for use with the system.

1.4.2.1 Security

The Security Option package enables the system administrator to place limits on the system including who has access and what level of access is available to individual users.

1.4.3 Compatible Equipment

The PUMA BASIC VCS connects to any commercially available electro-dynamic or electro-hydraulic shaker and amplifier.

1.4.4 Reliability

The PUMA BASIC VCS is designed and manufactured with state-of-the-art components and processes that improve the reliability of the system.

1.4.5 User Interface

The PUMA BASIC VCS, runs under a Microsoft Windows 98 or NT operating system. All user interaction is by keyboard and mouse. Test setup, control and data are displayed on a high-resolution color monitor. User help information is available for all program functions.

The color monitor provides real-time displays of:

- Program control menus
- Test definition parameters
- Spectra showing test conditions, with Abort / Alarm information

1.5 Starting The Program

The Spectral Dynamics Computer Aided Test Suite (CATS) Vibration Controller program is called Puma Basic. It can be started from either a desktop shortcut icon or through the Start button. The path is <Start> ⇨ **PROGRAMS** ⇨ **SPECTRAL TEST SUITE** ⇨ **PUMA BASIC.** Clicking **PUMA BASIC** launches the Splash Screen with the version level listed on it. See Figure 1-1. The Splash Screen will be dismissed after a few seconds but can also be dismissed by clicking it.

1.5.1 Log In

If the **Security** option is in place the **User Log In** Dialog Box (Figure 1-2) appears. If there is no Security option the Splash Screen will appear along with the **New** Dialog Box (Figure 1-3). If the Security Option is present on the system, the user must have a valid users name and password to access the features of the PUMA

BASIC VCS program. See the system administrator for proper users name and password.

Enter a **User Name** and **Password** and click <**LOG IN**>. Click on **CLASSICAL SHOCK,** and then click **OK**. A screen similar to the Spectral Dynamics Viewer (Graph Tool) Default Screen shown in Figure 1-4 appears. Exact screen layout is dependent on the parameters previously set with the menu options under Puma Basic. The top part of Figure 1-4 reflects the appearance of having all four Graph Tool **VIEW** Menu options checked.

Figure 1-1. Puma Basic Splash Screen

Figure 1-2. User Log In Dialog Box

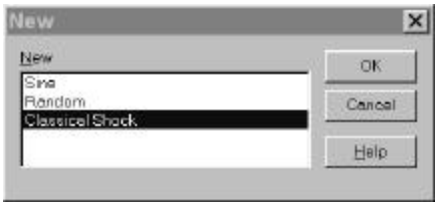

Figure 1-3. NEW Dialog Box

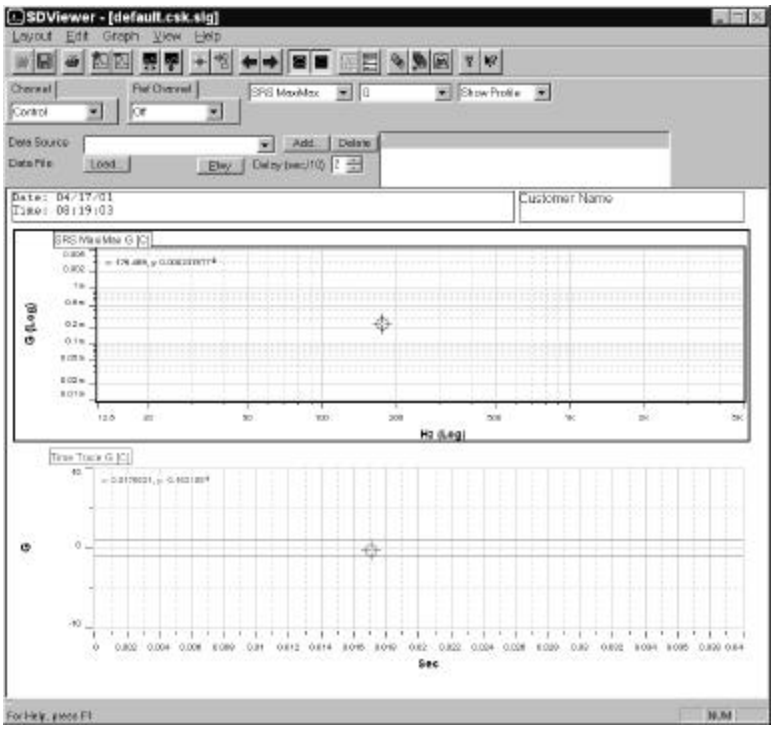

Figure 1-4. Classical Shock log In Screen

1.5.2 Puma Basic Local

The **Puma Basic** Window's Title Bar displays three segments of information (**Puma Basic - Local - [Classical Shock#]).** See Figure 1-5. Puma Basic is the platform hosting the application(s). **Local** indicates the user is running on a Puma Basic system and not across the network. The application listed inside the brackets indicates which number test of that application is being started. If the **Puma Basic** window is inaccessible minimize or drag the **Spectral Dynamics Viewer** window out of the way. Click on the **Puma Basic** Window to select it and start the process of setting test parameters.

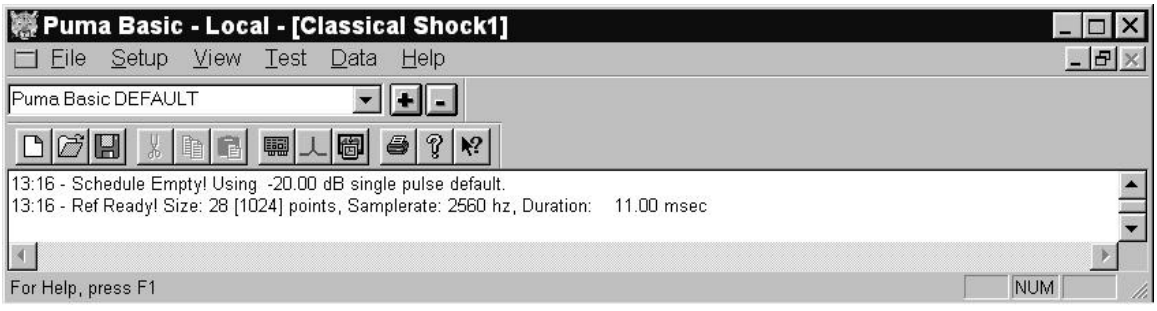

Figure 1-5. Puma Basic Local Window

1.5.3 Classical Shock Function Menus

The **Puma Basic Local** Window's **Classical Shock Function Menu Bar** contains six menu selections used by the PUMA BASIC VCS program. They are: **FILE, SETUP, VIEW, TEST, DATA**, and **HELP**. Each of these is discussed further within their own chapter.

NOTE: Using hotkeys can activate many of the menu selections. For instance use <ALT> +<F> to activate the FILE menu. An underlined letter indicates a hotkey.

When logged in, the **LOG OUT** menu item is available (**LOG IN** is grayed out). Select **LOG OUT** from the **FILE** menu when the system is unattended, and access to the program is to be restricted.

1.5.4 Setting Up Test Parameters

Initiating a test is done by either starting a new one from the very beginning or by running one that has already been set up and saved to a file.

1.5.4.1 New Test

The **SETUP** Menu information is presented in Chapter 4. The following procedure will enable the user to access the **SETUP** Menu options.

Procedural Steps

1. On the PUMA BASIC Local Screen, click **SETUP** ⇨ **CHANNELS** or click the <**Channel Setup**> Button. The **Channel Definition** Window appears. See Figure 1-6.

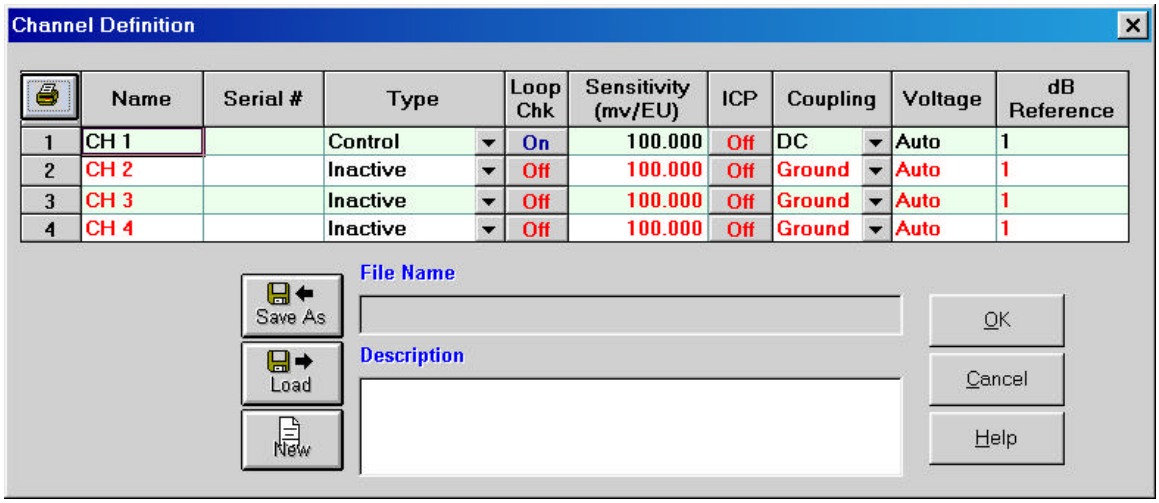

Figure 1-6. Channel Definition Window

2. Input the required parameters and save them to a file.
3. Click **SETUP** ⇨ **PULSE PARAMETERS** or click the <**Setup Pulse Parameters**> Button. The **Profile Settings** Window appears. See Figures 1-7 and 1-8.
4. Input the required parameters and save them to a file.

5. Click **SETUP** ⇨ **SCHEDULE** or the <**Setup Schedules**> Button. The **Schedule Setup** Window appears. See Figure 1-9.
6. On the ***Schedule*** Index Tab, input the required parameters and save them to a file.
7. The test is now ready to run.

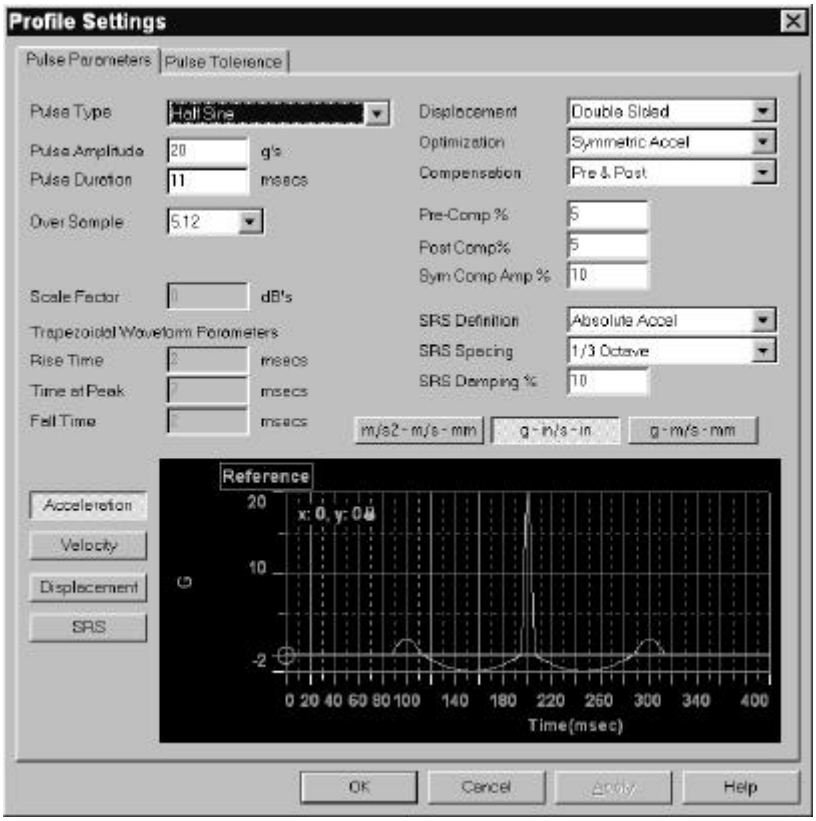

Figure 1-7. Pulse Parameters Tab of the Profile Settings Window

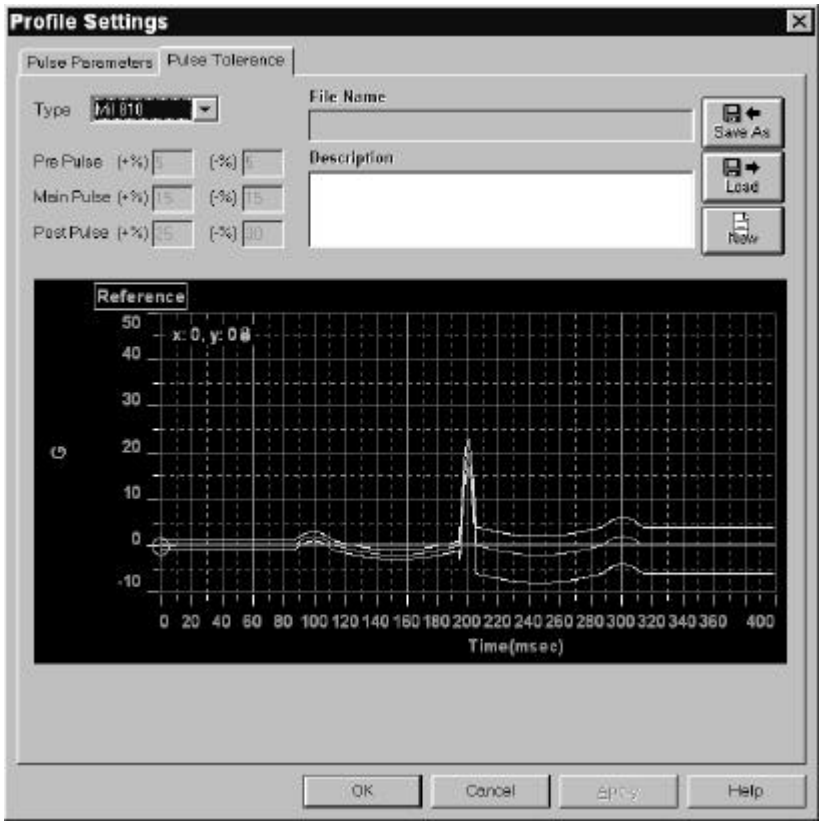

Figure 1-8. Pulse Tolerance Tab of the Profile Settings Window

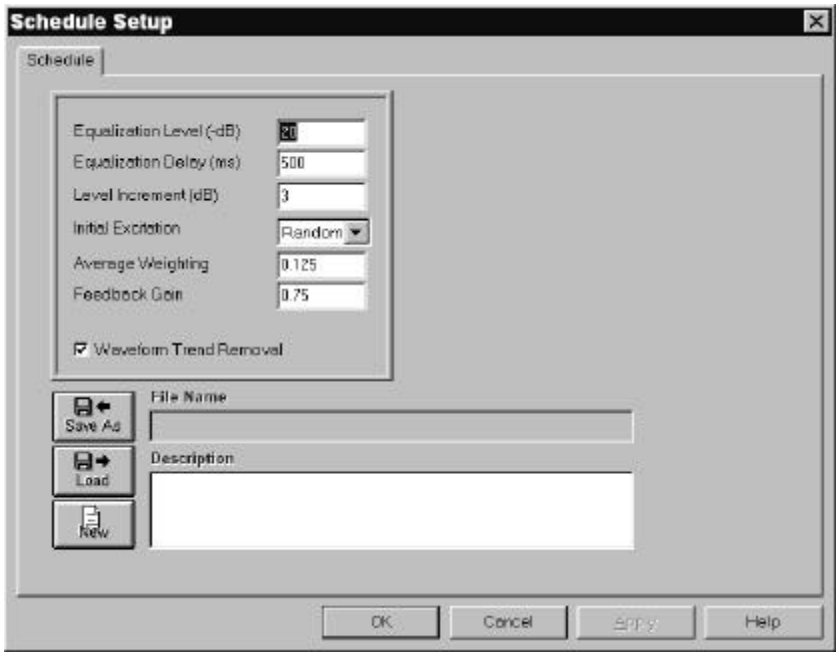

Figure 1-9. Classical Shock Schedule Setup Window

1.5.4.2 Existing Test

Procedural Steps

1. On the PUMA BASIC Local Screen, click **FILE** ⇨ **NEW**. The **New** Dialog Box appears. See Figure 1-3.
2. Click Classical Shock ⇨ <OK>.
3. Click **FILE** ⇨ **OPEN**.
4. Select appropriate drive and file.
5. Click <**Open**> on the standard Windows File **Open** Dialog Box.

The test is ready to run.

1.6 Arranging Screen Components

While running PUMA BASIC there will usually be two windows (or at least portions thereof) on the screen. They are the **Puma Basic** Window and the **Spectral Dynamics Viewer** (Graph Tool) Window. There can also be a Test Control and various status panels. The location of these components is completely customizable. The Puma Basic Desktop Toolbar in the Puma Basic Window (Figure 1-10) allows multiple screen layouts to be saved and recalled.

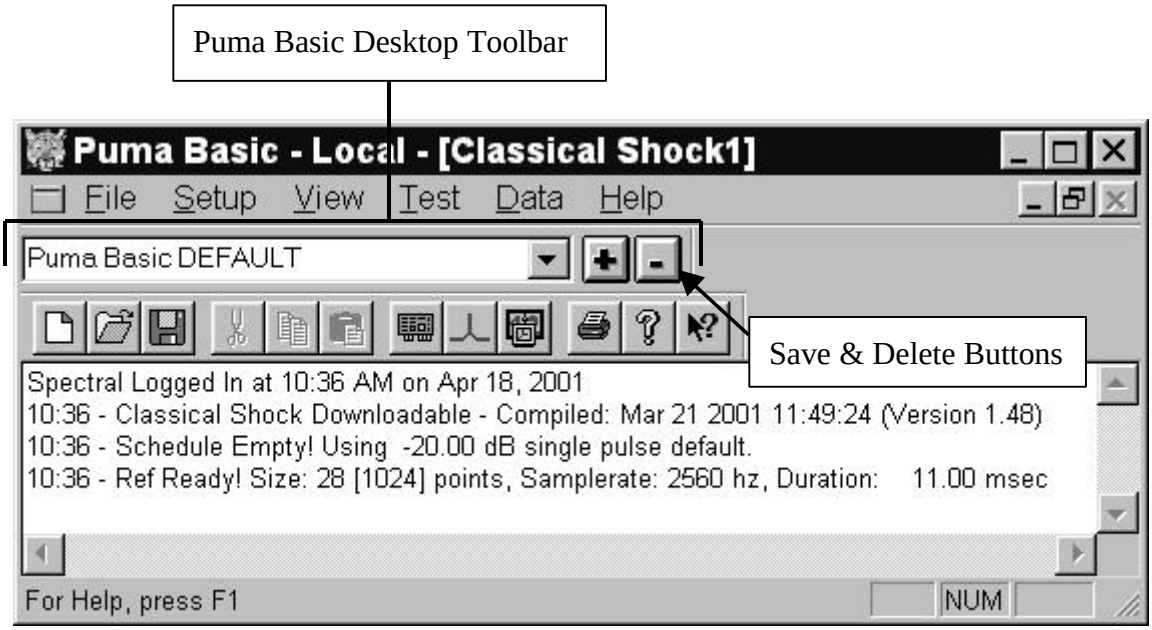

Figure 1-10. Save Screen Location Toolbar

In the example in Figure 1-10, "PumaBasicDEFAULT" is the screen layout name. After sizing windows and arranging status panels, click on the <+> button to the right of the layout name to save it. To create a new layout, enter a new name in the layout name box and click on the save button. Saved layouts are available from the pull down menu button in the layout name box.

1.7 Common Areas of Host Dialogs

The layout of dialog boxes sometimes differs from one menu option to another. Even though the command buttons may be in a different position, they will work the same from one menu option or function to another.

1.7.1 File Selection Box

Throughout PUMA Basic there is a need to save the parameters of tests, load those same parameters for another test or just start on something brand new. The File Selection Box (FSB) (Figure 1-11) is shown in Figures 1-6, 1-8 and 1-9. It is a common Windows tool and is used throughout the PUMA Basic platform though sometimes the format is somewhat different. The components of the FSB are outlined below for the primary setup areas of Channel Definition, Profile Settings (Pulse Parameters) and Schedule Setup.

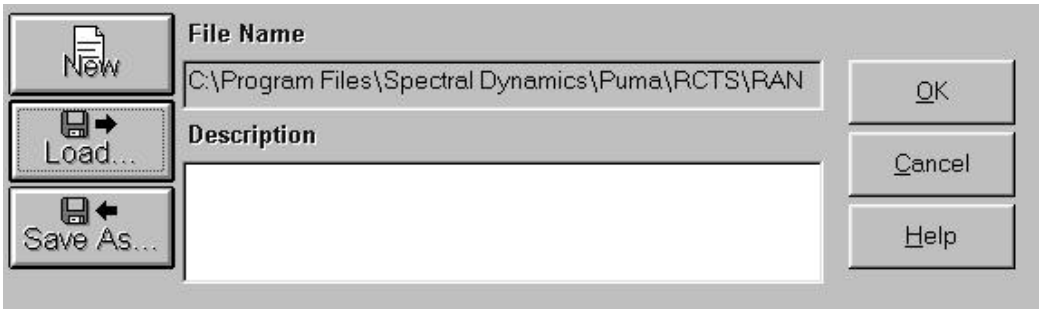

Figure 1-11. File Selection Box

1.7.1.1 New Selection Command Button

When setting up parameters for a test using the **SETUP** Menu option or at any time between tests, any use of the <*NEW*> Command Button will give the following results.

- Channel Definition — The path / name of the currently open file is deleted from the File Name text box. It does not delete the numbers from any of the columns. It is **not** active during a test.
- Profile Settings — Clears all columns of data. It is **not** active during a test.
- Schedule Setup — Clears all columns of data. The path / name of the currently open file is deleted from the File Name text box. It is **not** active during a test.

1.7.1.2 Load File Command Button

This button reacts the same way in all three parameter input areas. The **Open** Dialog Box is displayed for the user to choose a file to be loaded. All three areas are **active** during a test.

1.7.1.3 Save As Command Button

This button also reacts the same way in all three parameter input areas. The **Save As** Dialog Box is displayed for the user to save a file. All three areas are **not** active during a test.

1.7.1.4 OK Command Button

This button accepts any changes made, applies them and closes the active dialog box.

1.7.1.5 Cancel Command Button

This button closes the active dialog box without applying any changes that may have been made.

1.7.1.6 Apply Command Button

This button applies any changes that have been made and keeps the dialog box active.

1.7.1.7 Help Command Button

This button launches the on-line help. If a dialog box is open it must first be closed to launch the help menus.

1.8 Drive Compensation

Drive compensation is used to achieve the reference shock waveform at the control accelerometer. There are two memory areas involved in this function, Dynamic Compensation (DCOMP) and Static Compensation (SCOMP).

The DCOMP is used to compensate the pulse for system dynamics. A DCOMP must be loaded into dynamic memory before it is used for compensating a pulse on the shaker system. The SCOMP is used as a storage area for reading and writing between disk files and the dynamic memory used for compensating the shock pulse for shaker system dynamics.

1.8.1 Compensation Threshold

The Compensation Threshold (CT) refers to the effective dynamic range to be compensated based on the system H(f). A CT of –70 dB means that the frequency based corrections will only be applied to those spectral lines that lie within 70 dB from the maximum spectral line at the H(f). Usually, one would try to use as much dynamic range (say up to 120 dB) as possible, but noise and dispersion (like smearing) can cause problems in anti-resonance. For highly resonant structures, or those with high Q’s, a CT of about 100 dB is recommended.

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Chapter 2 - Test Concepts & Definitions

2.1 Introduction

This section discusses closed-loop shock testing and introduces the terminology used to describe the shock control capabilities provided by the Shock Synthesis Control and Analysis program.

2.2 Closed-Loop Vibration Testing

Vibration testing of a product is conducted by subjecting the product to a stress consisting of a particular type of mechanical vibration. Vibration tests are performed on both prototype and production line products. If you subject a prototype product to the mechanical stresses that the product will encounter during manufacturing, shipment, and use, then any product failures induced by these stresses allow early identification and correction of design problems. By such testing, you can ensure that the product will survive actual shipping and in-use conditions.

In a production-line environment, vibration testing performs rapid stress screening of the products, to detect latent mechanical defects before the products are shipped. This allows product repair at minimum cost, and can help identify faulty components and manufacturing problems, thus improving product quality. Vibration tests can be either open loop or closed-loop. In open loop testing, the product or unit is excited with mechanical vibrations of the desired type, but the actual vibrations induced in the unit are not measured to determine whether or not they match the desired vibrations in amplitude or frequency content.

In addition to open-loop vibration testing, closed-loop vibration testing includes:

Measuring the actual vibration generated during the test at selected points on the unit

Comparing the actual unit vibration with a reference vibration for the unit

Altering the excitation signal sent to the unit to make sure that the actual vibration is the same as the reference vibration

Closed-loop testing is in general more accurate than open-loop testing, because the actual vibration generated in the test unit closely matches the vibration you wished to produce. Product changes based on the results of a closed-loop test are thus more likely to yield the desired improvements.

WARNING !

To protect your test item from excessive vibrations, Spectral Dynamics strongly recommends that all users of the Vibration Control System (VCS) incorporate an independent vibration monitor or limiting device between the measurement channel and the power amplifier.

2.3 Shock Synthesis Testing

The objective of shock testing, in general, is to determine whether a test article can survive (retain its structural integrity), and remain operational when subjected to a specific shock environment. Shock data analysis is a type of transient signal analysis that is used to determine relative damage potential of a shock wave upon a physical system.

Shock test requirements have historically been adapted from, and performed by, mechanical test equipment (such as drop, impact, and rebound test machines). Many mechanical tests can now be performed with shaker equipment driven by an electrical waveform from a digital controller. This equipment can perform faster, and with better repeatability than mechanical test equipment.

Shock test requirements are usually specified in terms of a classical pulse (such as Half Sine, or Sawtooth), or in terms of a prescribed Shock Response Spectrum (SRS). Shock Synthesis allows the operator to specify a reference SRS. The program will then automatically synthesize a time domain reference waveform, satisfying the SRS requirement. The operator may also generate any arbitrary time domain acceleration waveform to be used as the reference waveform.

Because the shaker has a frequency response function of its own that affects the acceleration applied to the test article, we cannot simply drive the equipment with the desired acceleration waveform and expect to get accurate results.

Therefore, the response acceleration must be monitored at the control point on the test article, and the drive waveform must be adjusted according to the system transfer function to produce the required acceleration curve at the response control point. Also, the acceleration waveform for shaker equipment must be constructed in a way that restores the shaker to a rest position (at the end of the output pulse, the final velocity and displacement must be at or near zero).

Shock Synthesis generates acceleration waveforms by summing a set of synthesis components. Each wavelet is constructed such that its final velocity and displacement are zero. The waveforms are synthesized to produce zero final velocity and displacement. Unlike classical pulse waveforms, no additional velocity or displacement compensation is necessary.

The Shock Synthesis software sets up and controls shaker equipment in a closed-loop mode so that specified acceleration pulse waveforms can be accurately achieved at the

control point on the test article. The software then records and analyzes the results for test documentation. To achieve these purposes, the software provides the means to:

Define, generate, and store shock pulse (acceleration and drive) waveforms, based on the user defined SRS.

Compute the external equipment transfer function from the system drive output to the control point response input for H(f) equalization.

Compensate the waveform to account for the transfer function and then output test pulses.

Measure the corresponding response from the control point.

Store the time domain response waveforms to a disk file (if selected). • Analyze the reference and response waveforms for acceleration, velocity, displacement, spectrum (FFT) and SRS.

2.4 Signal and Waveform Definitions

Various signals, real-time waveforms, and computed waveforms are used in the Shock Synthesis program. These are identified by an X in Table 2-1 and are defined as follows:

A signal refers to the time-domain data, either analog or digital, that is input to or output from the vibration controller.

A real-time waveform is a digital, frequency-dependent quantity that is obtained from an input signal or is used to produce an output signal.

- A computed waveform is a function that has been created or modified in the program.
- A User defined waveform is generated from the values you enter in the setup parameters.

All data generated by accelerometers attached to the external load and connected to the system's analog-to-digital (A/D) converter constitute the input signals.

The A/D channels through which the data enters the system are the input channels. Input signals have units of volts when they enter the system, and are then converted by the program to acceleration levels in units of g's (if appropriate), using accelerometer sensitivities supplied as setup parameters.

Table 2-1
Signals and Waveforms

Type	Signal	Real-time Waveform	User Defined Waveform	Computed Waveform
Reference			X	X
Drive (output)	X	X		X
Control (input)	X	X		X
Auxiliary (input)	X	X		X

H(f)				X
Error				X
Coherence				X

2.4.1 Reference

The Reference Shock Response Spectrum (SRS) is defined by the user in the SRS Reference Table. The time domain Reference Waveform (pulse) is synthesized by the program, and is used during the execution of the shock test.

2.4.2 Drive

The Drive waveform is based on the Reference waveform and the Transfer Function of the system. The Drive waveform is compensated by the response from the control loop; when the Drive waveform is output, the desired Control response is obtained.

2.4.3 Control

The control signal (the external load) is the input signal you selected to match (as closely as possible) the Reference. You may choose only one input signal to be the control channel. A control channel cannot be defined as an auxiliary channel, but can be displayed as both the control channel and an auxiliary channel.

2.4.4 Auxiliary

You may specify one or more input channels as auxiliary channels. These channels are for the auxiliary data input signals (measurement channels). The auxiliary channels are used for display purposes (no drive signal is generated).

2.4.5 H(f)

The Transfer Function of the external equipment, H(f), represents the amplitude and phase response versus the frequency. For H(f) equalization, it is required to compensate or "equalize" the system by modifying the Reference waveform to generate a Drive waveform that produces the desired response at the control point, allowing for the frequency characteristics of the equipment.

2.4.6 Error

The Error waveform is the percent (%) difference between the Reference Waveform and the Control response, normalized to the Reference peak.

2.4.7 Coherence

The Coherence function is a measure of the degree of causality between the Control response and Drive. A Coherence of 1.0 indicates that the shaker output (Control response) is entirely due to the shaker input (Drive). Anything less indicates the introduction of noise or other spurious signals within the system.

2.5 Shock Response Spectrum

The Shock Response Spectrum (SRS) process allows the choice of:

Octave resolution from 1-octave up to 1/24-octave

Damping selections from 0.1% up to 99% of critical damping and a selection of:

The absolute acceleration definition of a classical Single Degree of Freedom system

or

The relative displacement definition of a classical Single Degree of Freedom system

NOTE: A classical Single Degree of Freedom (SDOF) system is defined as a mass constrained to just one motion along or about a single axis.

These SRS parameters can be selected in the SRS Reference Table. Shock Synthesis provides three types of SRS: Maxi-Max, Primary Positive, and Primary Negative.

The **SRS Tolerance Bands** are the areas both above and below the Reference SRS Waveform that you define in the test parameters. These bands display on the test display during test and data review.

2.6 Calculated Waveforms

When you select Reference, Control, or Auxiliary for the waveform, you may select the way the waveform is calculated. The following paragraphs describe your choices.

2.6.1 Acceleration

This is the response waveform at the control point on the test article. The positive and negative peak values appear as annotation on the display.

By integrating selected waveform Acceleration data, the Velocity may be computed and displayed.

2.6.2 Displacement

By using double integration of the selected waveform Acceleration data, the Displacement may be computed and displayed.

2.6.3 Spectrum

The Spectrum process computes and displays the Fast Fourier Transform (FFT) spectrum of the time domain waveforms. The Spectrum is a narrow band function with equally spaced fixed-bandwidth filters across the entire frequency range. The frequency resolution (filter spacing) of the Spectrum is the inverse of the time length of the waveform buffers: ÄF = 1 / T. The Spectrum uses a "boxcar" window (i.e. no window).

2.6.4 SRS Maxi-Max

This is the Shock Response Spectrum Maxi-Max of the selected waveform Acceleration data.

2.6.5 SRS Primary Positive

This is the Shock Response Spectrum Primary Positive of the selected waveform Acceleration data.

2.6.6 SRS Primary Negative

This is the Shock Response Spectrum Primary Negative of the selected waveform Acceleration data.

2.7 Control Loop

Figure 2-1 shows the individual steps involved in the closed-loop control process performed by the program. Control loop function is explained by describing the individual steps of the loop, starting with the external load. A description of each step in Figure 2-1, starting with External Load, is given below.

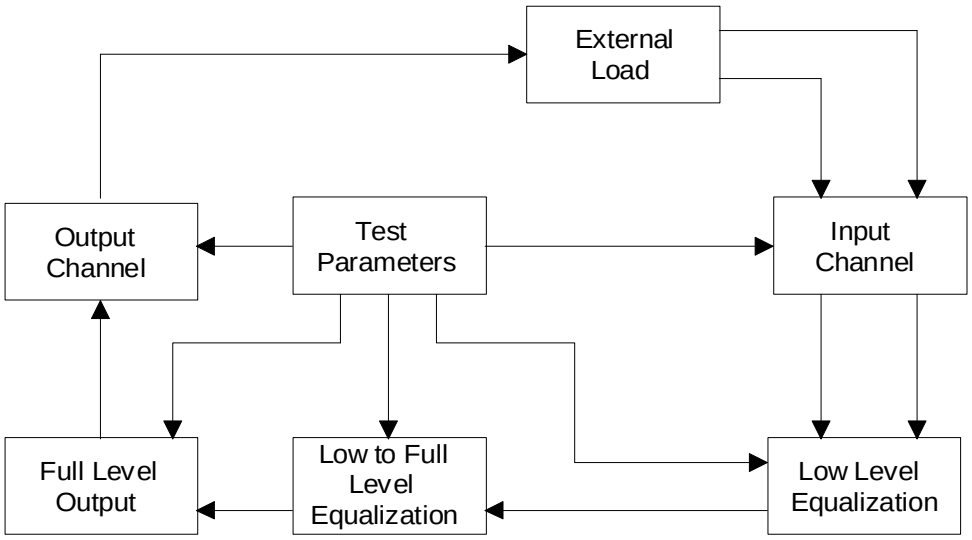

Figure 2-1. Shock Synthesis Control Loop Diagram

2.7.1 External Load

The external load includes the shaker apparatus and the unit under test. A single output channel from the system carries the drive signal to the shaker power amplifier to excite the load. Accelerometers can be attached to points on the load. The output signals from the accelerometer amplifiers are the input signals that the system acquires via input channels.

2.7.2 Input Channels

Each input channel samples the input and supplies the system with digital data. You can specify one input channel to be a control channel, or any of the input channels as auxiliary channels. The control channel affects the drive signal amplitude and thus controls the external load. Auxiliary channels allow display of additional response data.

2.7.3 Low Level Equalization

Using very low-level random excitation, a Loop Check is performed. Within this process, the Internal DC Offsets are nulled, the Ambient Noise is measured, a search for the "Loop OK" Threshold occurs, and the low level System Gain is computed.

For **H(f)** equalization, a System Identification process is executed where the requested drive excitation is generated (Pulse or Random) and the Control response is measured. This is a loop that occurs N times, where N is the reciprocal of the Weighting Factor for Averaging from the Control Parameters. After N averaging loops, the Frequency Response Function [H(f)] is computed. The compensated Drive is then computed and output for the first equalization loop. An Error function is computed as the difference between the Reference acceleration waveform and the Control response acceleration waveform.

For **SRS Amplitude** equalization, the synthesized drive waveform is output for the first equalization loop. For this case the Error function is computed as the difference between the Reference SRS and the SRS of the Control response.

For both equalization methods the peak and average errors are obtained from their respective Error functions. When the Control Parameters Drive Update selection is On and the computed peak and average errors are less than the Maximum Peak and Average Error Alarm limits from the Safety Parameters, the test proceeds to the next level. If the computed errors are greater than or equal to these Alarm limits, a new Drive is computed and output. The program will repeat this loop up to twelve times. When the program finds the computed errors to be less than the Alarm limits, the test will proceed. If the computed errors are still greater than or equal to these Alarm limits at the end of twelve loops, the test will be aborted.

When the Control Parameters Drive Update selection is Off and the computed peak and average errors are less than the Maximum Peak and Average Error Alarm limits from the Safety Parameters, the test proceeds to the next level. If the computed errors are greater than or equal to these Alarm limits, the same Drive is output. The program will repeat this loop up to five times. When the program finds the computed errors to be less than the Alarm limits, the test will proceed. If the computed errors are greater than or equal to these Alarm limits at the end of five loops, the test will be aborted. Additionally, if the Control Parameters Operation Mode is Manual, then the program will only output the first drive waveform without checking the Alarm limits and proceed directly to the Manual operation mode.

2.7.4 Low Level to Full Level Equalization

The output level starts from the Control Parameters Initial Test Level. If the “Automatic Increase to Full Level” feature is enabled, the program computes the next output level, scales and outputs the Drive, and measures the control response. If “Automatic Increase to Full Level” feature is not enabled, the user supplies the next output level (in dB below Full Level) then the program scales and outputs the Drive. The program also measures the control response. The Control response is checked against the Abort limits, and if exceeded, aborts the test. If the alarm limits are

exceeded, a warning is sounded and printed on the monitor. If the 'Drive Update" feature is enabled, the Drive is updated, and the loop is started again.

2.7.5 Full Test Level Output

If the Test Mode is Manual, the user may output pulses from the Test Display Control Panel.

2.7.6 Output Channel

The digital drive signal is converted to analog form. It is attenuated to provide the correct drive amplitude for the current shock pulse, and is output via the system output channel (DBE) to the shaker power amplifier.

2.7.7 Test Parameters

As shown in Figure 2-1, the test setup parameters are used to control all of the processes in the control loop. These parameters are discussed in Section 9 (Setup Parameters).

2.8 Safety Features

Protection of the external load is of the highest importance. The Shock Synthesis control program contains a number of safeguards for this purpose, designed to ensure that no out-of-tolerance condition in the Drive signal level occurs that might damage the test specimen or actuator equipment.

If during a test any of the safety features are exceeded, the test aborts and shuts down . A list of safety features and the frequency with which each feature is monitored is given below.

Feature	**When Monitored**
Loop check function	Once per test
Equalization function	Once per test
Control abort limits	Once per output pulse
Control signal loss	Once per output pulse
Operator abort	Continuous
Drive signal limit	Once per output pulse
Shaker limits	Before test starts

Each feature is designed to protect the external load under a particular set of circumstances. All features except the user abort are automatic and hence do not add to the user workload.

The safety features minimize any possibility of damage to the unit under test. However, you retain final responsibility for proper preparation and maintenance of the external load and signal connections, appropriate use of the safety features and the selection of associated parameters, and careful selection of all maximum signal levels specified for a test.

2.8.1 Loop Check Function

The loop check is a continuity test of the control loop, including all connections to the external load. The loop check verifies that all equipment in the control loop is connected and functioning, using very low drive voltage levels. You can also specify loop check for any Auxiliary channels that are used.

The loop check function should in all cases be applied to an external load before the load undergoes a full test. If the equipment loop is actually open, then control cannot be achieved and the test specimen could be damaged in an unsuccessful attempt to establish control. On the other extreme, if the power or accelerometer amplifier gain settings are too low, the loop may appear open when it is really closed. The loop check presents a means of testing the accelerometer gain settings and the selected loop check maximum drive, to determine that they are appropriate and safe for the external load.

In addition to being an independently executable function, the loop check executes automatically at the beginning of the Test Start function and at the beginning of the Test Resume function. As a pre-test feature, the loop check serves as a final test for loop continuity.

The loop check outputs a very low level drive signal and gradually increases the signal level to the loop check maximum drive level specified in the Test Parameters. The loop check ends successfully when a signal level above a certain threshold is detected on each Control or Auxiliary channel. When this occurs, the drive signal level gradually decreases to zero. The loop check reports an “Open Loop” failure condition (on a channel-by-channel basis) if the drive signal level reaches the specified Loop Check Maximum Drive Level and no signal above the threshold value is detected on one or more channels.

The program will print the System Gain for each defined Control or Auxiliary channel in use. System Gain is the ratio of the drive signal level to the control signal level in decibels.

2.8.2 Equalization Function

During this function, the Maximum Average Error and Maximum Peak Error alarm limits are compared to the measured error. If the absolute value of the measured error is not within the specified limits the test is aborted and a is displayed.

2.8.3 Control Abort Limits

If the absolute value of the measured error exceeds either the Maximum Average Error abort limit, or Maximum Peak Error abort limit, the test is aborted. Control signal loss is detected when the negative peak error is greater than the peak abort limit.

Control signal loss has several potential causes, such as an accelerometer connection has come loose, the accelerometer power has been interrupted, the amplifier gain has been turned down, etc.

2.8.4 Operator Abort

The system keyboard has a specially designated Abort key. The program continuously monitors this key. Pressing the Abort key causes an immediate program shutdown. This safeguards the external load if a dangerous or abnormal situation occurs during a test.

2.8.5 Drive Signal Limit

You can define a test parameter that specifies the maximum drive signal voltage to be output during a test. When this maximum signal is detected during a level increase, from initial test level to full level, the program aborts the test and displays a message in the Messages box.

When the maximum drive is detected during the output of full level pulses, the test is placed into a test-hold state.

2.8.6 Shaker Limit

Shaker Limits allow you to define the maximum limits you particular environment can sustain. If these limits are exceeded, a test will not run. The limits checked are: Acceleration, Velocity, Displacement and Voltage.

2.8.7 Data Review Test Summary

The Data Review function provides summary documentation about the last test function run, and aids in the correct interpretation of any test abort condition that may have occurred. The information in the Test Synopsis message includes the test ID and test heading of the setup parameters in effect for the test, indicates whether the test completed normally or was aborted, and gives the following data about the last pulse output:

- **Pulse Amplitude**
- **Test Level**
- **Polarity**
- **Average Error**
- **Peak Error**
- **Pulses Requested**
- **Pulses Remaining**

Chapter 3 - File Menu

3.1 Introduction

The first of the six menu options in the PUMA BASIC Local Classical Shock function of the PUMA BASIC Vibration Control System (VCS) is the **FILE** Menu option. Refer to following chapters for other menu options.

3.2 The File Menu

When the user selects **FILE** from the Menu Bar, the menu shown in Figure 3-1 will display. The **FILE** menu option has 16 sub-menus and a seven-file list (called a recent-file list) contained in a seven-section drop-down menu list. The recent-file list allows rapid access to files recently worked with.

3.2.1 File Sub-Menus

The sub-menus (Figure 3-1) of the **FILE** Menu option are outlined below.

3.2.1.1 New Menu Option

When **NEW** is selected, the **New** Option List Box will display. See Figure 3-2. This will initialize the test parameter settings for the test application chosen. Only test applications that are licensed for the system will appear in the box. Available test applications are:

- Classical Shock
- Random
- Sine

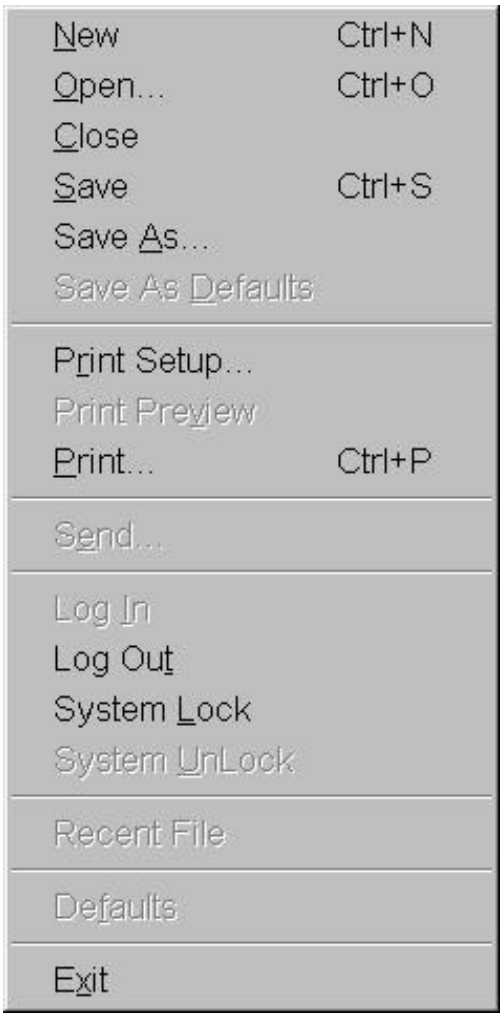

Figure 3-1. File Menu

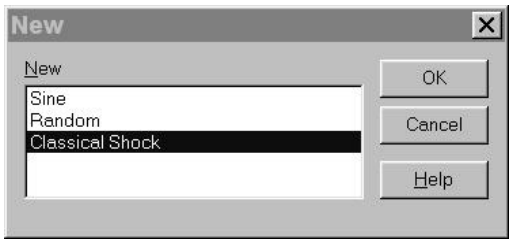

Figure 3-2. New Option List Box

3.2.1.1.1 Sine

The Sine appllication provides a means of applying continuous swept sine vibration excitation over a wide frequency range. A minimum of two input channels simultaneously monitors multiple accelerometers. A digital to analog converter supports drive output rates to 40kHz.

3.2.1.1.2 Random

The Random Test Suite provides digital real-time closed loop shaker control for production testing, design qualification and reliability testing applications. The system allows the definition, simulation and closed loop control for random vibration excitation of a vibration shaker system.

3.2.1.1.3 Classical Shock

Classical Shock provides a means to apply a pulse of specific magnitude, duration and shape to an object under test. The common pulse types are Half Sine and Trapezoidal.

3.2.1.2 Open Menu Option

The **OPEN** menu option allows the user to select a previously stored test setup file. It displays a standard Windows **Open** (file) Dialog Box. The user can navigate to the desired file and open it. If the user wants to load a different test type (e.g. Sine) simply select the setup and Puma Basic will automatically change to the appropriate application.

3.2.1.3 Close Menu Option

The **CLOSE** menu option closes the currently loaded test setup. When **CLOSE** is clicked a **SAVE** prompt is displayed if the current test setup has had changes made to it. If no changes were made the currently displayed window will close.

3.2.1.4 SAVE Menu Option

When **SAVE** is clicked the standard Windows **Save As** Dialog Box appears. It allows the user to save the currently loaded test setup.

3.2.1.5 Save As Menu Option

When **SAVE** is clicked the standard Windows **Save As** Dialog Box appears. It allows the user to save the currently loaded test setup.

3.2.1.6 Print Setup

PRINT SETUP is a standard Windows command that allows the user to select a printer, the size and source of paper and the orientation of the page. These selections will affect how things are printed when the **Print** option is used.

3.2.1.7 Print

Click on **PRINT** to launch the standard Windows **Print** Dialog Box. From here the user may select a printer, what is to be printed and how many copies are required. The option to print to a file is also available.

3.2.1.8 Send

SEND is a standard Windows command for sending files / tests via e-mail.

3.2.1.9 Log In

The **LOG IN** option is not available when the user is already using PUMA BASIC. It becomes available after logging out.

3.2.1.10 Log Out

The **LOG OUT** option is only available when the user is logged in to PUMA BASIC.

3.2.1.11 System Lock /System Unlock

These two features come with the security options. When **SYSTEM LOCK** is selected, the system is locked and that option becomes disabled. The **SYSTEM UNLOCK** option is then enabled. To regain access to the program, the user must select **SYSTEM UNLOCK**. The **User Log In** dialog box will display and allow you to log in.

3.2.1.12 Recent File List

The **RECENT FILE** list is a standard Windows feature that has been adopted for Puma Basic. It allows the user quick access to the most recently used setup files that have been opened. These files are also available from the Windows Start menu. The path for usage is:

<Start> ⇨ DOCUMENTS ⇨ Applicable File Name

3.2.1.13 Exit

EXIT is a standard Windows command. Clicking on this command will cause the current window to close and the application will terminate.

3.2.2 Menus Available During The Test

While a test is running, not all of the **FILE** Menu options are available for use. The available **FILE** Menu options during a test are:

- **PRINT SETUP**
- **PRINT**
- **LOG OUT**
- **SYSTEM LOCK**

Chapter 4 - Setup Menu

4.1 Introduction

The **SETUP** Menu is where all of the test parameters are entered for a Classical Shock test setup. In most of the test setup submenus (e.g. channel definition) the individual test settings may be saved in a separate file that may be recalled by another test setup to speed creation of subsequent tests.

4.2 Sub-Menus

The following paragraphs give information about the six **SETUP** submenu options available. See Figure 4-1. Once the test begins none of the sub-menu options are available for change but the settings can be viewed.

Figure 4-1. Setup Submenus

4.2.1 Channels

The **CHANNELS** Menu option produces a **Channel Definition** Window (Figure 4-2) that allows the user to:

- Print a listing of the Channel Definition settings
- Change any or all of the Channel Definition parameters
- Open a new file
- Load a previously saved test/file
- Use the **Save As** option to name/save a file

- Accept default / user selected file names and initiate selected action
- Cancel selection / window
- Get Help

The Channel Definition Window columns and their functions are discussed in the following paragraphs.

4.2.1.1 Channel Definition

Setting Channel Definition parameters: (Up to four channels can be defined simultaneously).

1. Access the **Channel Definition** Window in accordance with the procedure in paragraph 1.5.
2. Load file or set parameters as required.
3. Save to keep changes (choose **Save As** if information is to be saved independently from a loaded file).

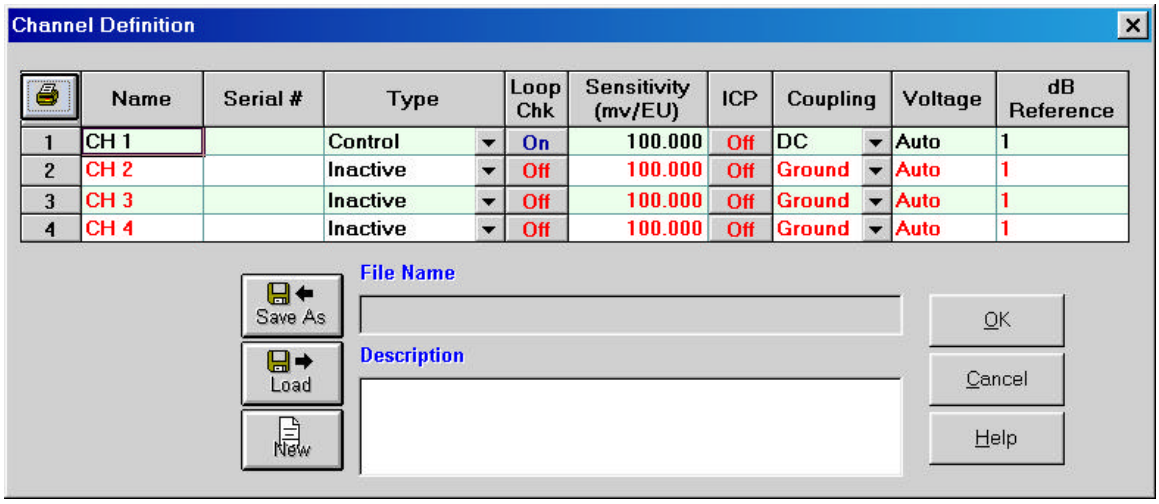

Figure 4-2. Channel Definition Window

4.2.1.1.1 Column Headings

- Print Button / Channel Number Column - Clicking the <**Print**> Button will cause a printout of the window's settings. The channel numbers are constant placeholders for the channels.
- Name Column - Up to 20 characters can be used to designate a unique name for the channel.
- Serial # Column - Up to 10 characters can be used to designate a serial number for the channel.
- Type Column - The three entries allowed are:

Control - Channel is designated as control channel and the Loop Check defaults to **On.**

Inactive - Channel is off and contains no parameters

Measurement - A control channel designated as a measurement channel (ie: active but not to be regarded as in the control scheme)

- Loop Chk Column - The Loop Check option can be either **On** or **Off**. If it is on, an open channel "Safety" check is performed before the test is run.
- Sensitivity mv/EU Column - Transducer sensitivity is entered in milli-volts per Engineering Unit.
- ICP Column - The ICP function can either be **On** or **Off**. It provides a constant DC current source to power ICP type accelerometers.
- Coupling Column - Only three entries are allowed in this column. They are:

  AC– It is used to block the DC component of the signal.

  DC– It is used to pass the DC component of the signal. Ground– It grounds the input channel. Used when channel is inactive.
- Voltage Column - Any value from 0 to 10 may be entered. Zero is the default for Auto.
- dB Reference Column - This is the decibel level that this channel will use as a reference.

4.2.2 Pulse Parameters

The **PULSE PARAMETERS** Menu Option displays the **Profile Settings** Window. See Figures 4-3. It has two tabs. They are: ***Pulse Parameters*** and ***Pulse Tolerance*** and list varied information about the types of channels and the applicable settings for this test profile. Both tabs have the four standard Windows Command Buttons at the bottom.

<*OK*> Command Button - This button accepts any changes made, applies them and closes the open dialog box.

<*CANCEL*> Command Button - This button closes the open dialog box without applying any changes that may have been made.

<*APPLY*> Command Button - This button applies any changes that have been made and keeps the dialog box open.

<*HELP*> Command Button - This button launches the on-line help. If a dialog box is open it must first be closed to launch the help menus.

4.2.2.1 Pulse Parameters Tab

The ***Pulse Parameters*** Tab is divided into an upper and lower section**.**

The drop-down list boxes and their contents are shown in Table 4-1. The text boxes ranges are listed in Table 2. The availability of a particular list or text box for input of information depends on the **Pulse Type** selected. The two pulse type selections available are Half Sine and Trapezoidal..

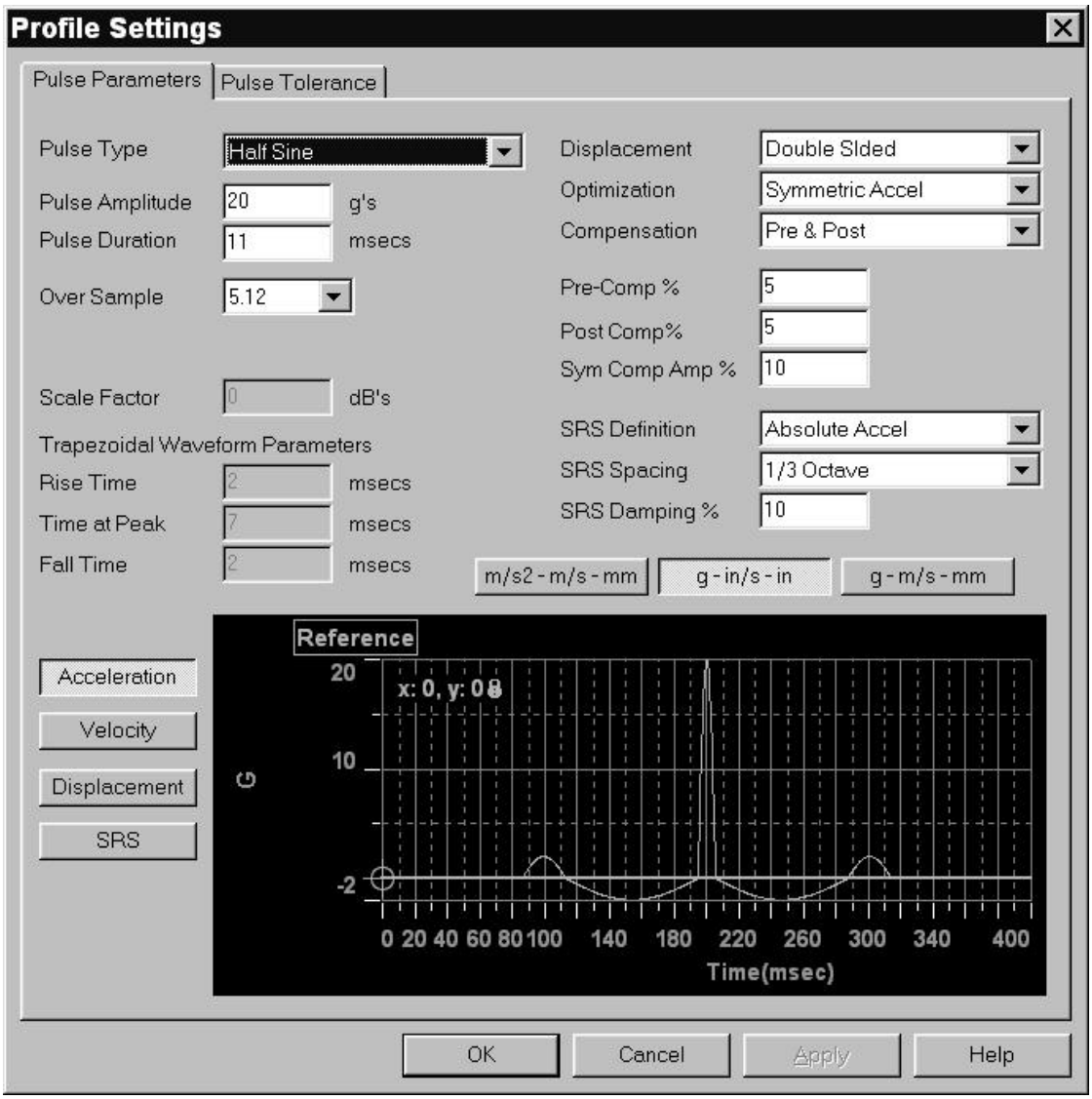

Figure 4-3. Pulse Parameters Tab of Profile Settings Window

Table 4-1. Profile Settings Pulse Parameters Tab Drop-Down List Boxes

Pulse Type	Over Sample	Optimization	Compensation
Half Sine	5.12	Displacement	Pre & Post

Trapezoidal	5.12	Symmetric Accel	Pre Only
		Non-Symmetric Accel	Post Only

Table 4-1. Profile Settings Pulse Parameters Tab Drop-Down List Boxes Cont'd.

Pulse Type	SRS Spacing	SRS Definition	Displacement
Half Sine	1/1 Octave, 1/3 Octave, 1/6 Octave	Absolute Accel	Single Sided
Trapezoidal	1/1 Octave, 1/3 Octave, 1/6 Octave	Relative Displacement	Double Sided

Table 4-2. Profile Settings Pulse Parameters Tab Text Boxes

Text Box Ranges

Pulse Amplitude	0.01 - 50000
Pulse Duration	0.1 – 50000
Pre-Comp %	5 – 100
Post Comp %	5 – 100
Sym Comp Amp %	5 - 100
SRS Damping %	0.1 - 99

Trapezoidal Waveform Parameters

Rise Time	Duration less than 10000
Time at Peak	0.1 – 50000
Fall Time	Duration less than 10000

The lower section consists of four pulse type display selection buttons and a graph window. Clicking a button displays a different pulse graphic. The button labels are:

- ❖ Acceleration
- ❖ Velocity
- ❖ Displacement
- ❖ SRS

4.2.2.2 Pulse Tolerance Tab

The **Pulse Tolerance Tab** (Figure 4-4) consists of one drop-down list box, six text boxes a standard Windows File Selection Box and a graph window.

Type List Box

- ❖ None
- ❖ Mil810
- ❖ Custom

Text Box Ranges*		
	(+%)	**(-%)**
Pre Pulse	1 – 100	1 – 100
Main Pulse	1 – 100	1 – 100
Post Pulse	1 – 100	1 – 100

* Available only with the *Custom* option.

The three choices available in the **Type** List Box represent templates that can be set up for the lower half of the Profile Settings Window. If **NONE** is selected the presentation will include only the pulse and will not show either alarm or abort lines. The **MIL810** template presents the pulse with the alarm / abort lines in accordance with the requirements of Military Standard 810, Environmental Test Methods and Engineering Guidelines. The **CUSTOM** template can be representative of anything the user requires.

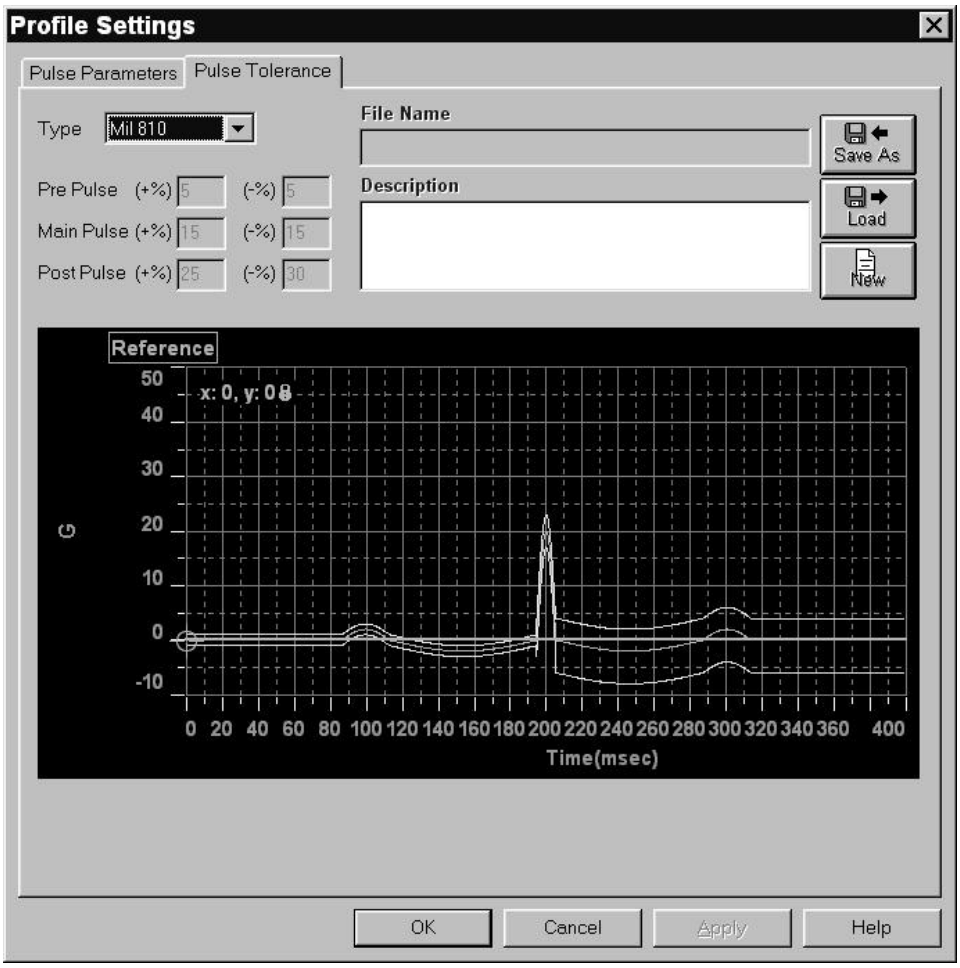

Figure 4-4. Pulse Tolerance Tab of the Profile Settings Window.

4.2.3 Schedules

The **SCHEDULES** Menu option displays the **Schedule Setup** Window with one tab labeled ***Schedule.*** See Figure 4-5.

4.2.3.1 Schedule Tab

The tab has four standard Windows command buttons visible at the bottom. They are: <*OK*>, <*CANCEL*>, <*APPLY*> and <*HELP*>. Please refer to paragraph 4.2.2 for the use of these buttons.

The ***Schedule*** Tab format displays two areas of information. On the upper left side is a horizontal tabular display and the bottom left side has a standard Windows **File Selection Block**.

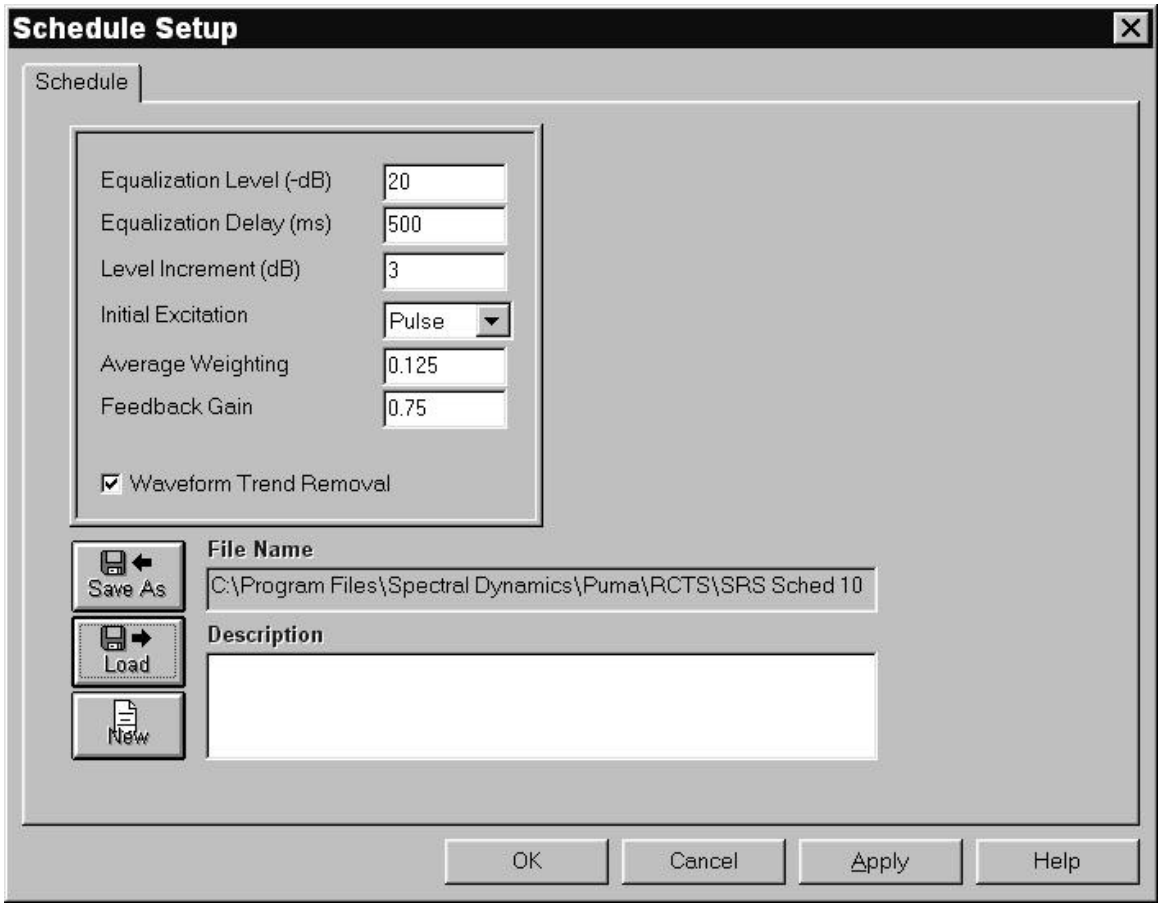

Figure 4-5. Schedule Tab of the Schedule Setup Window

The ***Schedule*** Tab's **Text Boxes** range parameters are listed in Table 4-3.

The other two filled columns display the Level Units and the Polarity. The **Level Units** buttons allow the user to select either **dB** or **G** for the measurement. The **Polarity** column buttons indicate either **Positive** or **Negative** polarity. The NLAF (Non-Linear Adjustment Factor) Column allows the user to apply a global linear scale factor across all frequencies (unlike compensation which is frequency specific).

The gain correction may be applied to the output signal separate from the compensation function. This factor sets the non-linear shaker gain output. The values should be set between 0.1 and 2.0.

On the upper right side is a **vertical tabular display** with seven text boxes, two check boxes and one drop-down list box. The **Initial Excitation** drop-down list box choices are:

- **Pulse**
- **Random**

Table 4-3. Schedule Setup Text Box Ranges

Text Box Titles	Ranges	Text Box Titles	Ranges
Equalization Level (-dB)	0 – 8	Level Increment (dB)	1-20
Equalization Delay (ms)	0 – 8000	Average Weighting	0.05 – 1
	Feedback Gain	0.05 – 1	

The **check box** label is: ❖ Waveform Trend Removal

4.2.4 Control

The **CONTROL** Menu option displays the **Test Settings** Window. This window has one tab titled ***Data Storage***. See Figure 4-6.

At the bottom of each tab are four standard Windows Command Buttons. Please refer to paragraph 4.2.2 for information about them.

4.2.4.1 Data Storage Tab

The ***Data Storage*** Tab has one radio button group box and two toggle button group boxes.

4.2.4.1.1 Data File Name

Data File Name Toggle Button Group Box – Defines the way the file name will be generated. The toggle buttons are:

Auto Generate - Creates a unique file name based on the day, date and time that the test started.

Query - Prompts user for a file name after starting test.

Default – All test data is saved in a default file. The default file is overwritten each time the test starts.

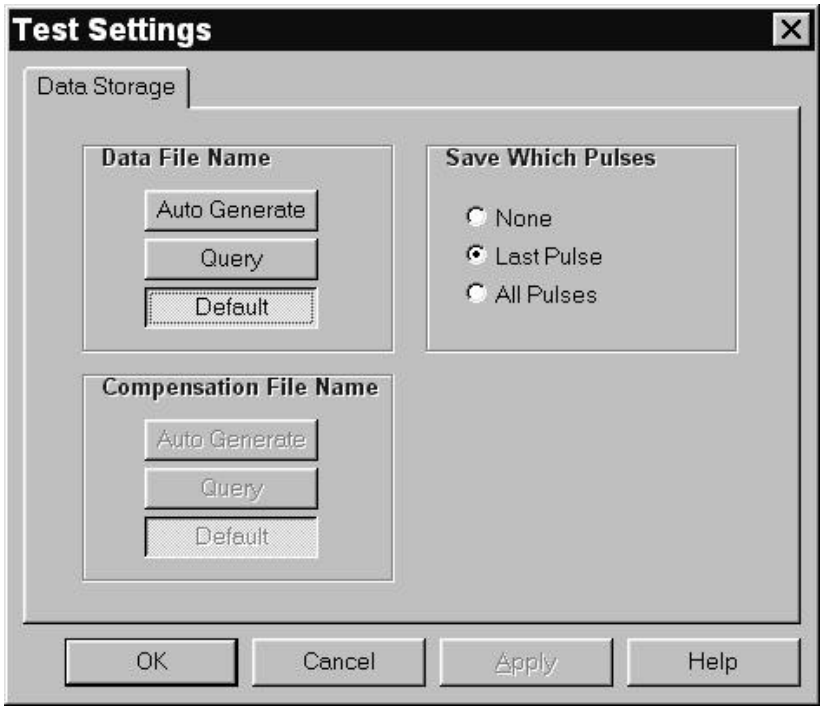

Figure 4-6. Data Storage Tab of the Test Settings Window

4.2.4.1.2 Compensation File Name

Compensation File Name Toggle Button Group Box. Defines the way the file name will be generated.

The toggle buttons are: *Auto Generate*, *Query* and *Default*.

Auto Generate - Creates a unique file name based on the day, date and time that the test started.

Query - Prompts user for a file name after starting test.

Default – All test data is saved in a default file. The default file is overwritten each time the test starts.

4.2.4.1.3 Save Which Pulses

Save Which Pulses Radio Button Group Box. This shows which sweeps the program will save as a frame of data. The choices are:

- None
- Last Pulse
- All Pulses

4.2.5 Limits

The **LIMITS** Menu option displays the **Limit Settings** Window. It has two tabs labeled **Safety Limits** (Figure 4-7) and **Shaker Limits** (Figure 4-8). Both are discussed below.

4.2.5.1 Limit Settings

Both tabs of the **Limit Settings** Window have four standard Windows command buttons visible at the bottom of the tab(s). They are: *<OK>*, *<CANCEL>*, *<APPLY>* and *<HELP>*. Please refer to paragraph 4.2.2 for the use of these buttons.

4.2.5.1.1 Safety Limits Tab

The ***Safety Limits*** Tab has three group boxes. See Figure 4-7.

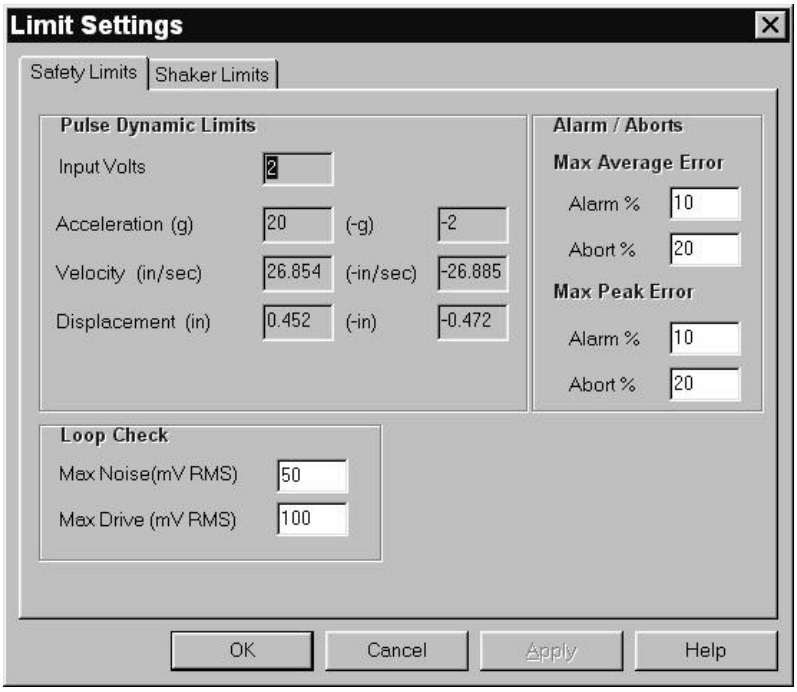

Figure 4-7. Safety Limits Tab on the Limit Settings Window

The **Pulse Dynamic Limits** Group Box text box values cannot be changed. They are for information only.

The **Alarm / Aborts** Group Box values are listed below.

Max Average Error		Max Peak Error	
Alarm %	0.01 – 100	Alarm %	0.01 – 100
Abort %	0.01 – 100	Abort %	0.01 – 100

The **Loop Check** Group Box text box values are listed below.

Max Noise (mVRMS)	0 – 1000
Max Drive (mVRMS)	0 - 5000

4.2.5.1.2 Shaker Limits Tab

The ***Shaker Limits*** Tab of the **Limit Settings** Window has four sets of text boxes. Their ranges are listed below. See Figure 4-8. The check box is labeled **Symmetric Limits**.

Acceleration (g)	0.0001 - 500	(-g)	0.0001 - 500
Velocity (in/sec)	0.0001 - 1000	(-in/sec)	0.0001 - 1000
Displacement (in)	0.0001 – 100	(-in)	0.0001 – 100
Voltage (V)	0.0001 – 100	(-V)	0.0001 - 100

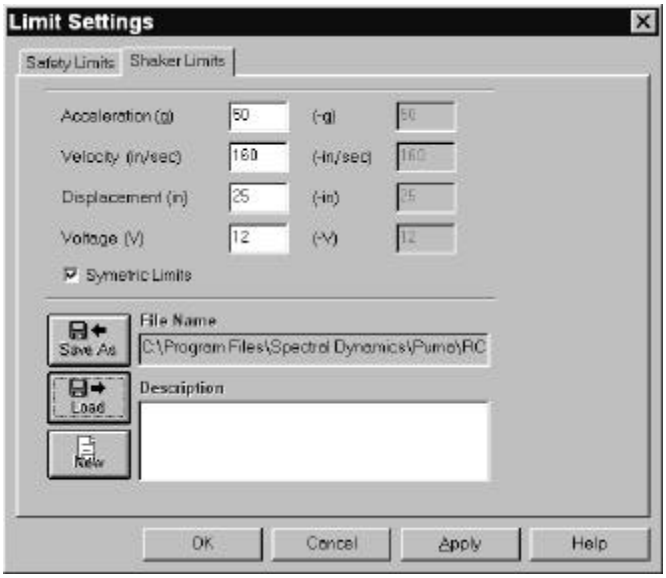

Figure 4-8. Shaker Limits Tab of the Limit Settings Window

4.2.6 Security

The **SECURITY** Menu option displays the **Update Security File** Window. See Figure 4-9. **This is a pruchased option**. This window is used to update the security file by either adding or deleting employees names, their privileges or both.

This window has a list box with access to all employees' names, a list box with all the current privileges available to each employee, two text boxes dealing with a password and five command buttons. The <OK> and <CANCEL> are standard Windows buttons and are explained in the Windows documentation.

The other three command buttons are <ADD USER>, <DELETE USER> and <UPDATE>. The first two are self-explanatory and the last one acts like a **SAVE** menu option.

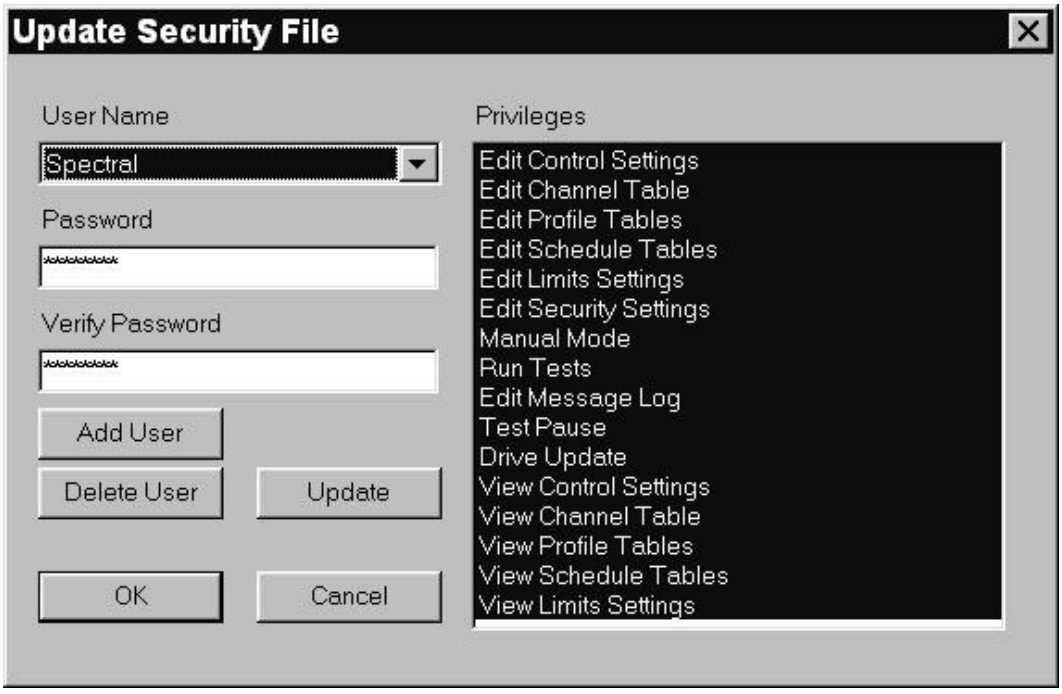

Figure 4-9. Update Security File Window

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Chapter 5 - View Menu

5.1 Introduction

The **VIEW** Menu Option allows the user to view tools, controls and indicators required to keep track of control, schedule and channel status. It also gives access to the Toolbar, Status Bar and the Test Control. When **VIEW** is selected from the Menu Bar, the image shown in Figure 5-1 will display. Checkmarks indicate items that will be seen either in a window or on the desktop during the test.

The **MESSAGE LOG FONT** option displays a standard Windows dialog box that allows editing the font styles. The user can select from different fonts, sizes, italics, underlining or bolding. The choices made affect all of the Log and not just a highlighted segment.

5.2 View Sub-Menus

Each of the remaining **VIEW** sub-menu items is described next.

5.2.1 Toolbar And Status Bar

When the **TOOLBAR** and/or **STATUS BAR** options are selected (Figure 5-1), the Toolbar buttons and Status Bar information will display. See Figure 5-2.

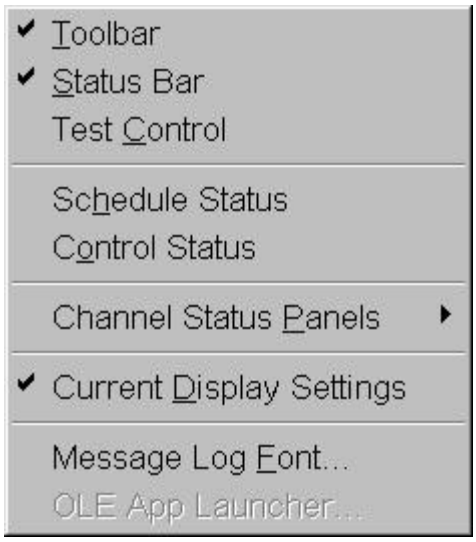

Figure 5-1. View Menu

5.2.1.1 Toolbar

The **TOOLBAR** buttons are shortcuts for various menu items. The first six, and the last three, are standard Windows Toolbar buttons. These are described in your Windows documentation. Information for the other three buttons, **CHANNEL SETUP, SETUP PULSE PARAMETERS**, and **SETUP SCHEDULES**, can be found later in this chapter. A tool tip message displays whenever the cursor touches a shortcut icon.

5.2.1.2 Status Bar

The Status bar gives information about various activities currently running on the system. It also has three boxes that act as message boxes to indicate certain functions are available. Various messages display when the cursor contacts an icon or a menu selection.

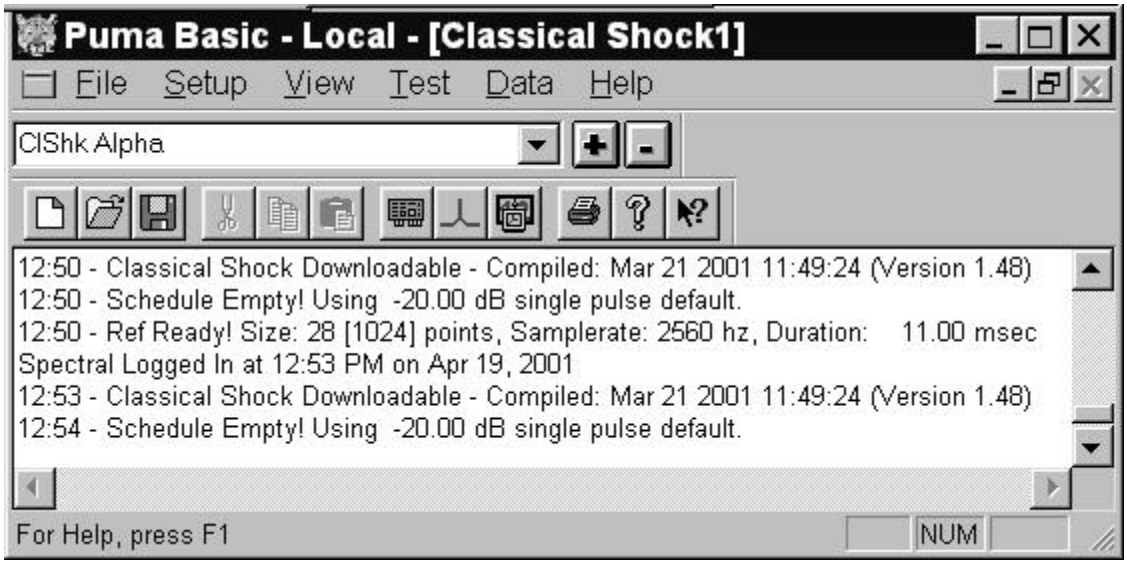

Figure 5-2. Toolbars, Status Bar and Message Log

5.2.2 Test Control

When **TEST CONTROL** is selected from the **VIEW** menu, the Test Control (pre-test) shown in Figure 5-3 will display. The **TEST CONTROL**, described next, has 7 buttons used to control the test and three text boxes giving information about the test. The following paragraphs describe these controls and indicators.

5.2.2.1 Start / Stop

Click the <Start> button to begin the currently loaded test. After starting, the button label changes to read **Stop**. See Figure 5-4.

5.2.2.2 Output

Click the <Output> button to initiate a pulse output cycle.

5.2.2.3 Level Buttons

Allows the user to choose the measurement type of either dB's or G's and shows the numeric value set in the profile.

5.2.2.4 Num Pulses

Allows the user to input the number of pulses to be done during the test cycle.

5.2.2.5 Pulse Delay

Allows the user to set the time delay between pulses.

5.2.2.6 Polarity Buttons

The positive <+> and negative<-> polarity buttons allows the user to set the polarity of the voltage input.

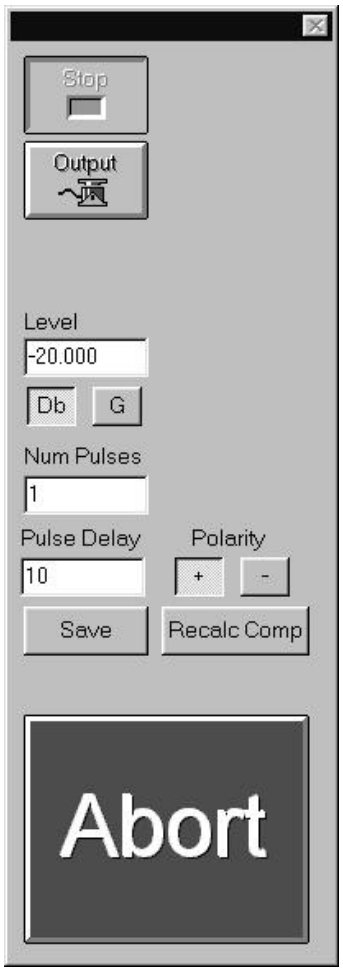

Figure 5-3. Test Control During Test

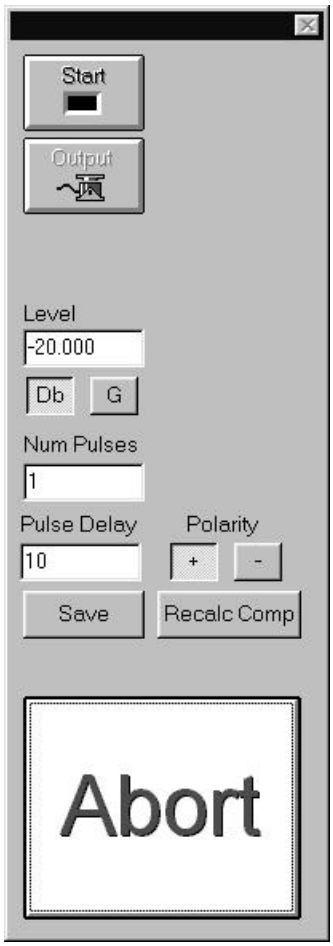

Figure 5-4. Test Control Between Tests

5.2.2.7 Save Button

Click the <Save> button to save (or write) compensation data from static memory into a file.

5.2.2.8 Recalc Comp

Using the Recalc Compensation function allows the user to automatically improve the dynamic compensation. This means that the shock pulse at the accelerometer is a more accurate reproduction. If this button is toggled ON, the dynamic compensation is updated after each pulse. This data can be temporarily stored in static memory or saved to a file.

5.2.2.9 Abort

Allows the user to abort the test. The button is red during the test or when awaiting an output command in the manual mode. It is white after the test is completed.

5.2.3 Schedule Status

When **SCHEDULE STATUS** is selected from the **VIEW** Menu, the window shown in Figure 5-5 will display. This window gives information about the schedule of the currently running test. Information given consists of the current schedule number the test is running, the number of elapsed pulses in the schedule and the remaining pulses in the schedule.

5.2.4 Control Status

When **CONTROL STATUS** is selected from the **VIEW** Menu, the window shown in Figure 5-6 will display. This window gives information about the control status of the currently running test. Information given consists of the current test level in dB, the control level in peak g and the voltage level of the drive.

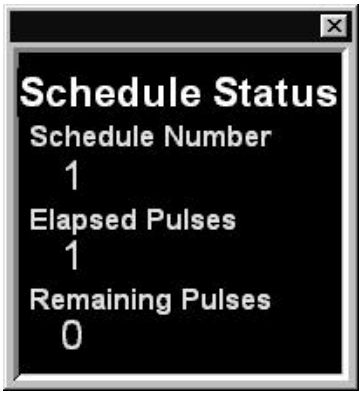

Figure 5-5. Schedule Status Box

Figure 5-6. Control Status Box

5.2.5 Channel Status

When Channel Status options (**CHANNELS 1 TO 4**) are selected, the activated Channel Status Box is displayed. See Figure 5-7. These give Peak G force information about the channels. The measurement is to the nearest one thousandth.

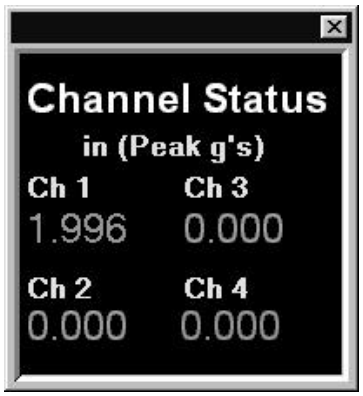

Figure 5-7. Channel Status Box

5.2.6 Current Display Settings

The **CURRENT DISPLAY SETTINGS** Menu Option allows the user to show or hide the Puma Basic Desktop Toolbar. See Figure 5-2.

5.2.7 Message Log Font

When **MESSAGE LOG FONT** is selected from the **VIEW** menu, a standard Windows Font Dialog Box appears. See Figure 5-8. Refer to the Windows documentation for further information. The Message Log is shown in Figure 5-2 below the application toolbar.

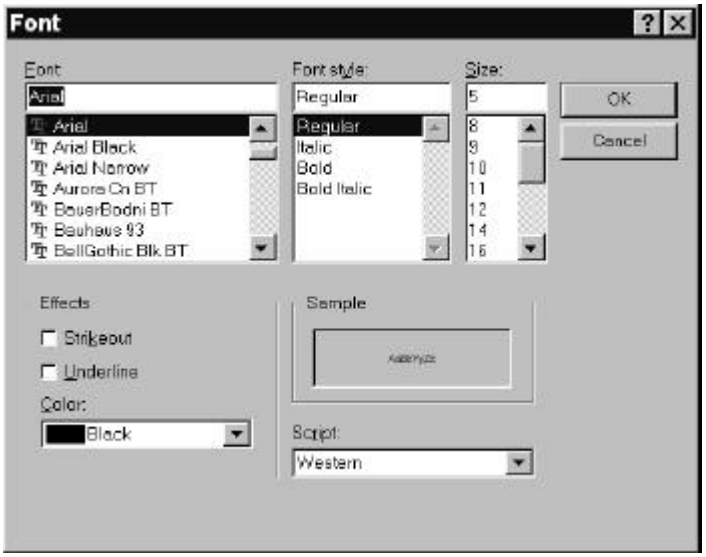

Figure 5-8. Message Log Font Dialog Box

Chapter 6 - Test Menu

6.1 Introduction

When the **TEST** Menu option is selected from the Classical Shock Menu Bar, the image shown in Figure 6-1 displays.

6.2 Test Sub-Menus

Each of the items on the **TEST** Menu is described in the following paragraphs. Use of these sub-menus allows the user to refrain from having to repeatedly hide or recall the Test Control, which is available in the View Menu Option (Chapter 5).

6.2.1 Abort

The **ABORT** Menu Option allows the user to stop the test immediately.

6.2.2 Start

The **START** Menu Option becomes available to start the test if either of two criteria has been met:

6. A previous test file has been loaded
7. Test parameters have manually been input for all phases of the test.

After the test has started, the menu options change. Those available are shown in Figure 6-2. The **START** option is changed to read **STOP**. The **STOP** option will stop the test but it can be started again from the same point. Also, the **OUTPUT** option becomes available.

6.2.3 Restart

The **RESTART** Menu Option restarts the test from the same point that the test was stopped with the **STOP** menu option.

6.2.4 Save Comp

The **SAVE COMP** Menu Option saves (or writes) compensation data from the static memory into a file.

6.2.5 Load Comp

The **LOAD COMP** Menu Option loads (or saves) compensation data into the static memory from a file.

6.2.6 Restore Comp

The **RESTORE COMP** Menu Option moves the static compensation data to the dynamic memory area.

6.2.7 Update Comp

The **UPDATE COMP** Menu Option moves the dynamic compensation data to the static memory area.

6.2.8 Add To Schedule

The **ADD TO SCHEDULE** Menu Option allows the user to add additional pulses to the profile.

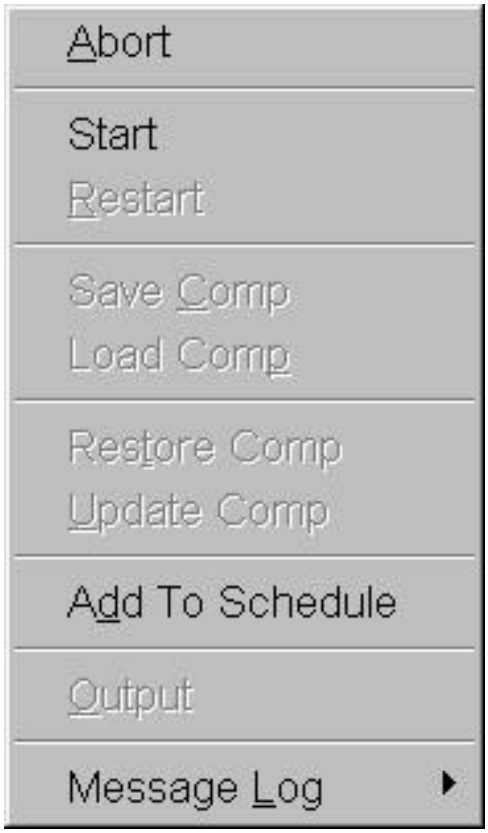

Figure 6-1. The Test Menu Prior To And After The Test

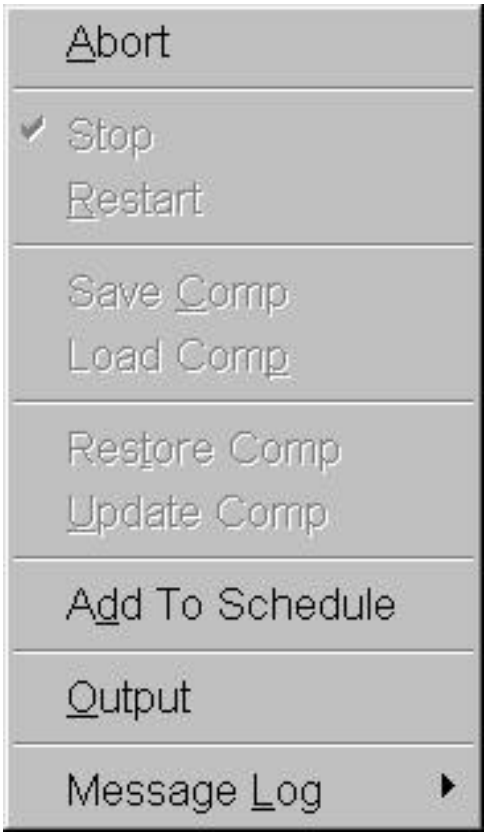

Figure 6-2. Test Menu Options During Test

6.2.9 Output

The **OUTPUT** menu option allows the user to apply test pulses to the shaker. The last line of the Message Log will read *Ready for Pulse Outputs*.

6.2.10 Message Log

The Message Log is the file of information that is being generated and is displayed as the test is running. The **MESSAGE LOG** submenu has submenus of its own. There is a **MESSAGE PRIORITY** selection with its three submenus listed below. See Figure 6-3.

6.2.10.1 Message Priority

The three levels of **MESSAGE PRIORITY** are **HIGH**, **MEDIUM** and **ALL**.

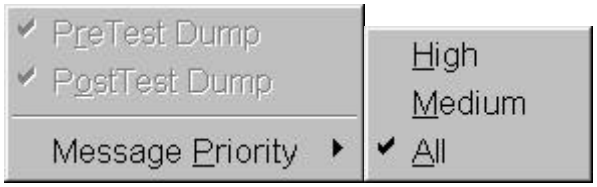

Figure 6-3. Message Log Sub-Menus

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Chapter 7 - Data Menu

7.1 Introduction

When the **DATA** Menu option is selected the menu shown in Figure 7-1 will display if the test has not begun or if no parameters have been loaded. If the test is runningthe menu options available are shown in Figure 7-2. The **DATA** menu items are described in the following paragraphs.

Figure 7-1. Data Menu Options Before Test

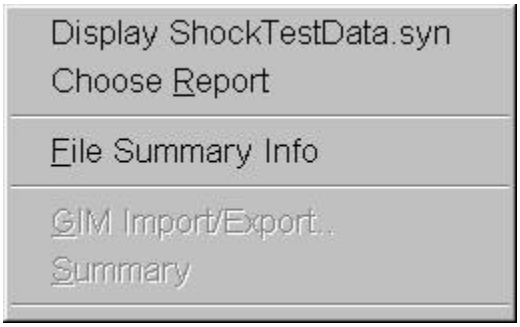

Figure 7-2. Data Menu Options During Test

7.2 Data Sub-Menus

The **DATA** Sub-Menus are described below.

7.2.1 Display / Display Shock Test Data Synopsis

The **DISPLAY SHOCK TESTDATA.SYN** option displays the Test Data Notepad shown in Figure 7-3. After the required parameters are input and the test has been started, the menu option reads: *Display (test name).* If the parameters have not yet been saved the test name will be a synopsis file (*.syn). Figures 7-4 through 7-7 display the sub-menus of the Notepad Menu Bar options.

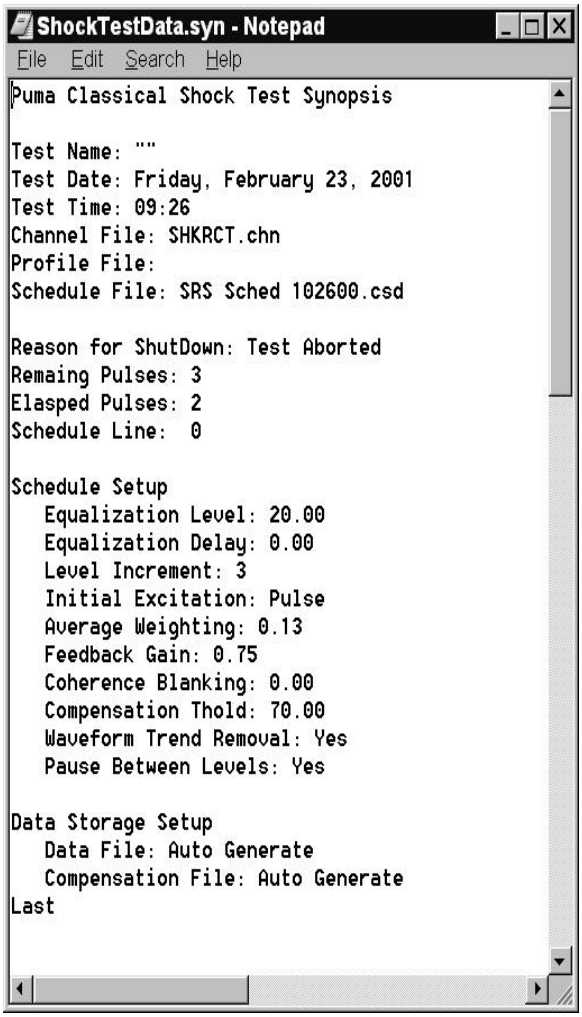

Figure 7-3. Display Shock TestData.syn Screen

Figure 7-4. Notepad File Menu Sub-menus

Figure 7-5. Notepad Edit Menu Sub-menus

Figure 7-6. Notepad Search Menu Sub-menus

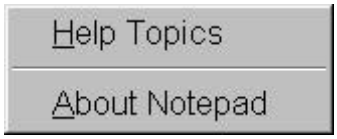

Figure 7-7. Notepad Help Menu Sub-menus

7.2.2 Choose Report

When the **CHOOSE REPORT** Menu Option is selected, the standard Windows **OPEN** Dialog Box displays. The user is allowed to open the desired report.

7.2.3 File Summary Info

When the **FILE SUMMARY INFO** option is selected, the **Document Properties** Dialog Box shown in Figures 7-8 and 7-9 will display. Its tabs are labeled: ***Summary***, and ***Statistics***. At the bottom are the standard Windows buttons <*OK*>, <*Cancel*>, <*Apply*>, and <*Help*>. For further information about these buttons see your Windows documentation. The dialog is used primarily to annotate file information.

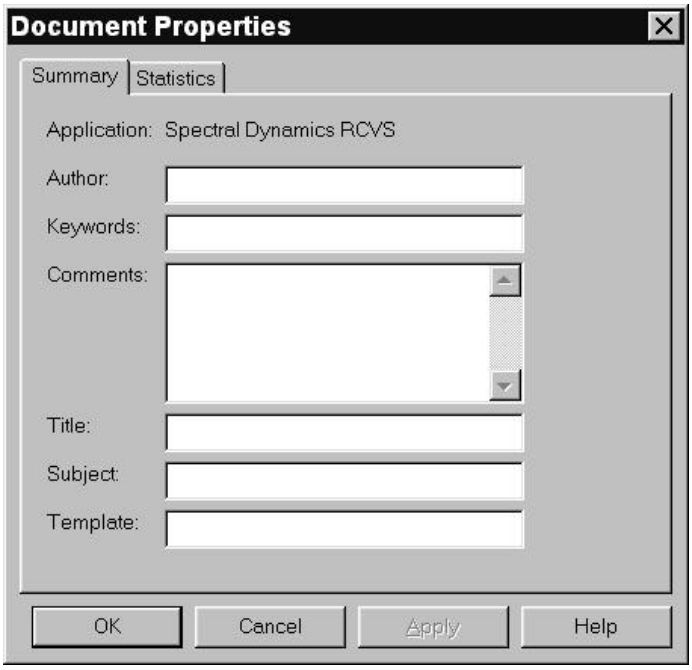

Figure 7-8. File Summary Info Menu's Summary Tab

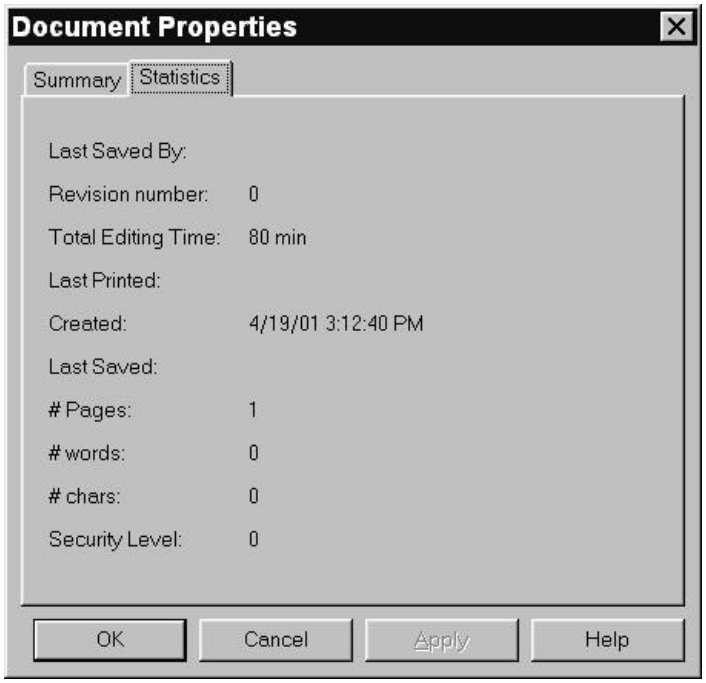

Figure 7-9. File Summary Info Menu's Statistics Tab

7.2.3.1 Summary Tab

The *Summary* Index Tab contains seven fields. The first field Application, names the software program that is currently loaded. The other six fields Author, Keywords, Comments, Title, Subject and Template allow you to add summary information.

7.2.3.2 Statistics Tab

Figure 7-9 displays the ***Statistics*** Index Tab information. It lists ten lines of basic information about when the file was created, how large it is, and so forth.

Chapter 8 - Help Menu

8.1 Introduction

When the **HELP** Menu Option is selected from the Classical Shock menu bar, the menu shown in Figure 8-1 will display. This menu consists of **HINTS**, **SUPPORT**, and **ABOUT PUMA BASIC.**

Figure 8-1. The Help Menu

8.1.3 About PUMA

The About PUMA Window (Figure 8-2) features a rolling, bouncing cube with pictures of a Puma and the CATS PUMA logo. The right side of the window displays version and build information along with copyright information.

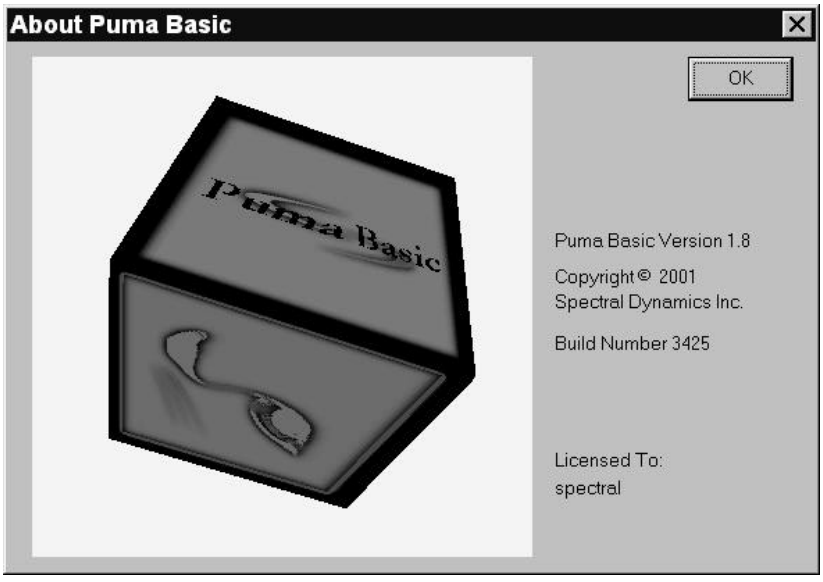

Figure 8-2. Help Menu's About Puma Basic Screen

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PUMA BASIC

Classical Shock
Operating Manual

2400-0125A

May 15, 2001

Spectral Dynamics, Inc.
1010 Timothy Drive – San Jose, CA 95133-1042