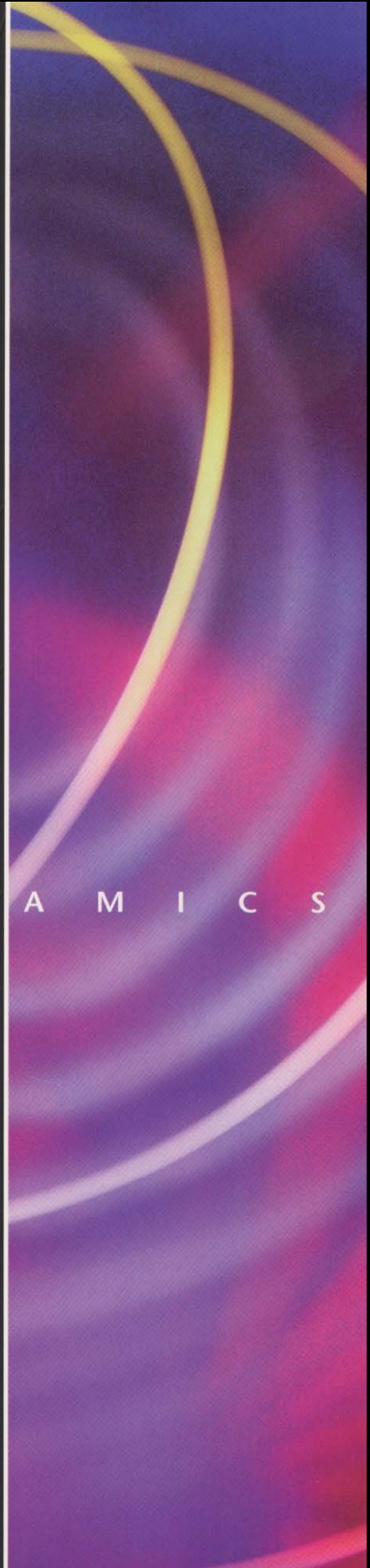


# PUMA

vibration control & analysis

S P E C T R A L D Y N A M I C S



# REVOLUTIONIZING Rotating Machinery Data Acquisition and Analysis...

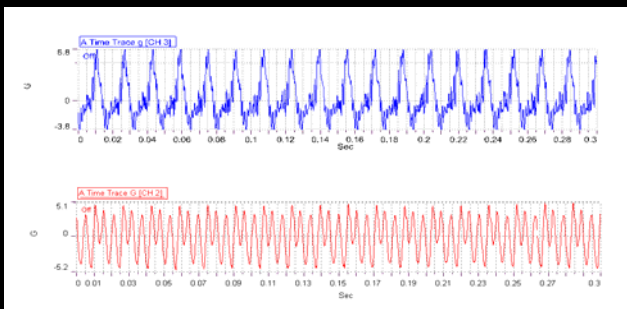


## READY TO TEST.

Designed and manufactured by Spectral Dynamics, PUMA, hardware and software, arrives thoroughly tested - ready to run.



## PROCESS IT.



**YOU NEED TO SHORTEN PRODUCT DESIGN CYCLES, LOWER** product costs, and enhance product quality. What's the most reliable and affordable instruments to meet these challenges? The PUMA from Spectral Dynamics, now with quad data input cards.

PUMA features Spectral Dynamics' innovative **COMPUTER AIDED TEST SUITE** architecture. This architecture take full advantage of powerful INTEL® and Windows® technology. Optimized for multi-tasking, and founded on industry standard connectivity and data interchange protocols, PUMA will forever change the way you test, analyze data, and communicate results.

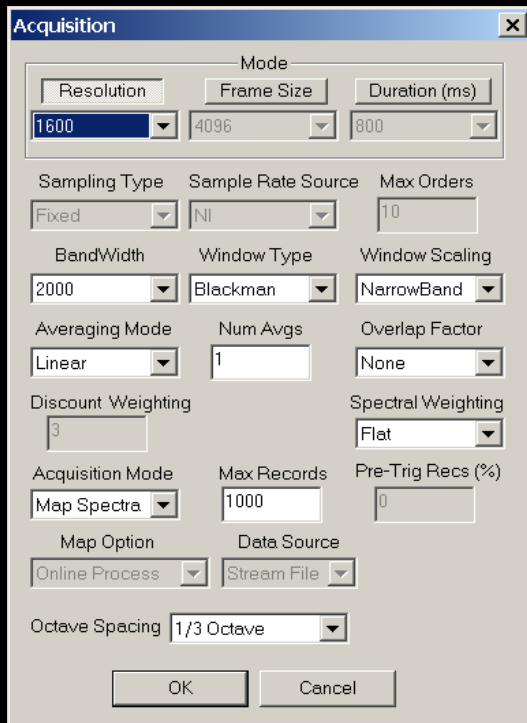
**PUMA'S POWERFUL, SCALEABLE DESIGN SUPERBLY HANDLES** real-time processing tasks by providing outstanding processing capabilities. Each channel card uses multiple 150-Mhz, 32-bit floating point DSP's for high-speed parallel processing and high accuracy. Optimized for rapid data transmission, the 32-bit 132 Mbyte/second PCI bus eliminates bottlenecks in transferring data to the host computer. PUMA's INTEL® Core 2, Pentium, or Celeron processors, used as the host computer, are the de facto standard for 32-bit computing.

**TRUE MULTI-TASKING STARTS WITH PUMA'S DSP ENGINE** handling digital signal processing independently from the host INTEL processor. As a result, data collection, data analysis and vibration control times are fast and safety is optimized. Vibration signals are continuously monitored and recorded without interruption or delay due to multi-tasking latency in the host computer. The host computer power is maximized for real-time, high resolution displays, data storage, and printer output, and networking tasks. True multi-tasking, the SD way, assures that your test is always totally under control.

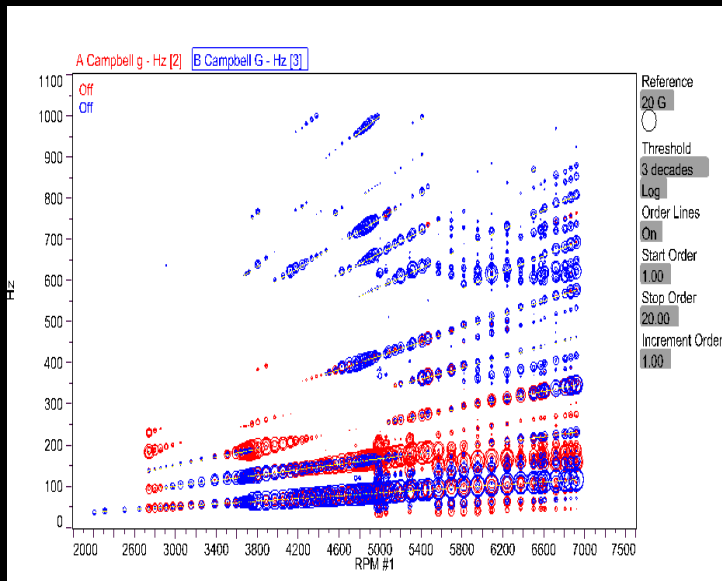
**MICROSOFT® WINDOWS OPERATION AND FULL MFC (Microsoft Foundation Class library)** implementation virtually eliminates the learning curve. While testing, you can analyze and compare data from prior tests, use word processor and spreadsheet software to write reports or do offline analysis.

**PUMA IS A COMPLETE ANALYSIS TEST SOLUTION FEATURING** advanced multiple DSP design, stable and accurate instrumentation quality hardware, fixed seven pole anti-aliasing filters, 24-bit 102.4 K Sample/second A/D converters, and down-loadable digital filters. Creating the most reliable accuracy analysis system available.

PUMA Quad meets the most stringent needs for dynamic test data acquisition and simulation with comprehensive capabilities for:



...from setup to report delivery.  
**CAPTURE IT.**



- Time Domain
  - Spectrum Analysis
  - Sine
  - Transient
  - Shock SRS
  - Modal Analysis
  - Rotating Machinery Analysis
  - Environmental Data Reduction
  - Signal Analysis
  - Acoustic Analysis
- and more capabilities on the way.

**PUMA'S MODULAR DESIGN BEGINS WITH FOUR 102.8 KSample/second INPUT** channels, a high fidelity 52-bit output channel, a COLA output port, IEPE-(ICP) compatible signal conditioning, and a network ready "WINTEL" host computer. As technology advances, upgrading the system is easy since every piece of the system is modular. As your test requirements grow, you can easily add input channel boards and increase processor memory, for more control and measurement capability. Or address new test requirements by adding application software or a remote communication interface.

**PUMA'S GRAPHICAL USER INTERFACE PROVIDES TEST** operators with friendly operation from setup to report generation. The user interface is fully Windows compliant and designed for ease of use and enhanced productivity. With full Windows capability one can create simple or the most powerful view of the test desired in real-time. Pull down menus, spreadsheet entry formats, and simple dialog boxes with valid input checking, and icon toolbars allow you to set up and run error-free tests quickly and easily.

A startup wizard gets you up and running fast. On-line help lets you master operation quickly and allows you to maximize system usage. User defined interface tailoring permits PUMA to be a simple production test tool or a flexible design and research aide.

**SHARED SETUP TABLES ELIMINATE THE NEED FOR** repetitive entry of test parameters and reduces setup time. You enter a setup table for transducer channels, shaker limits, level schedules, or test schedules just once. Then, you can easily load the same setup table into any new test for any application.

**SIMPLIFY PARAMETER ENTRY WITH TABLES.** Straightforward spreadsheet style entry with immediate assimilation by the application software assures simple, quick tests generation.

**TEST AND LEVEL SCHEDULING SLASH TEST TIME BY** combining an unlimited number of tests into an automatic sequence. Duration and delay are both selectable - whether hours, days, or weeks. Scheduling of multi-application tests, such as random, sine, and shock allows automated Mission Profile simulation. Puma facilitates the extension of test automation to integrate

Channel Setup								
	Name	Serial #	Type	Engineering Units	Sensitivity (mv/Unit)	mV Offset	Transducer Units	dB Reference
17	G0658C01		Measure	MPa(p-p)	12.034	0.000	g	1
18	G0659C01		Measure	MPa(p-p)	12.073	0.000	g	1
19	G0660B01		Measure	MPa(p-p)	12.097	0.000	g	1
20	G0363A01		Measure	MPa(p-p)	12.160	0.000	g	1
21	G0363J01		Measure	MPa(p-p)	12.688	0.000	g	1
22	G0364AA2		Measure	MPa(p-p)	12.237	0.000	g	1
23	G0364AT2		Measure	MPa(p-p)	12.138	0.000	g	1
24	G0364JT2		Measure	MPa(p-p)	12.119	0.000	g	1
25	G0365AT1		Measure	MPa(p-p)	11.814	0.000	g	1
26	G0657A01		Measure	MPa(pk)	13.679	0.000	g	1
27	G0658A01		Measure	MPa(pk)	14.670	0.000	g	1
28	G0660A01		Measure	MPa(pk)	13.917	950.000	g	1
29	NI		Tacho HW				Hz	
30	NH		Tacho HW				Hz	
31								
32								

Cancel

environmental tests such as temperature, pressure, and humidity by using an optional Remote Communication Interface.

## ACTIVE X AUTOMATION, MODULAR TEMPLATE SETUPS, AND ADVANCED NETWORKING SLASH TEST TIME BY

combining an unlimited number of tests into an automatic sequence. Test Configurations are selectable – even from a remote control processor. Data Acquisition tasks can be programmed just once and then adapted to the most demanding structures. Data can be collected in both time and frequency formats at the same time for quick entry to CATS ODS Analysis during the test and for advanced processing and replay back at the laboratory.

**CUSTOMIZE THE TEST SCREEN TO MEET YOUR NEED AND** insure easy monitoring of critical test conditions. Status monitors that describe all aspects of the progress of your test and annotation tags that allow personalization of information on screen during the test, allow you to display the information you need. Monitor the control spectrum, alarm conditions, test status information, and more, all a glance.

**INCREDIBLE DISPLAY FLEXIBILITY AND FAST DATA UPDATES** monitoring an on-line analysis of test data. Simultaneous display data for any or all of the input channels along with all desired control functions. You also have complete control over sizing and placement of data displays and windows.

A complete set of data format tools helps you customize presentations of test information, making it easier to interpret results. Enhance your presentations by controlling zooming, panning, automatic or manual scaling, custom colors, grid and tic patterns and many other display manipulation options. Use markers to provide live XY cursors with values conveniently listed outside the data display. Display defaults and templates free you from the tedium of redefining display attributes for each new graph, or display window formats for each new test. You can quickly set graph attributes to a standard lab format or use you own customized formats.

**CHOOSE THE MONITOR PARAMETERS.** Tags make test monitoring easier by displaying test parameters that update in real-time. You choose the critical test parameters to display - including the control level, maximum error, drive level, DOF, channels voltage level, elapsed or remaining time, schedule number, schedule cycle, and many other test parameters and conditions. Position and size tags so that it is easy to monitor the test even from across the lab.

Schedule Setup					
Level Schedule			Test Schedule		
	Status	Level (dB)	Time at Level	Time to Level	Alarm Action
1	On	0.0000	0001:000:000	0000:000:030	Ignore
2	Off				
3	Off				
4	Off				
5	Off				
6	Off				
7	Off				
8	Off				
9	Off				
10	Off				

Acquisition Range

Start Up Rate (dB/sec) 20

Shut Down Rate (dB/sec) 30

Level Increment (dB) 3

Initial Test Level (-dB) 12

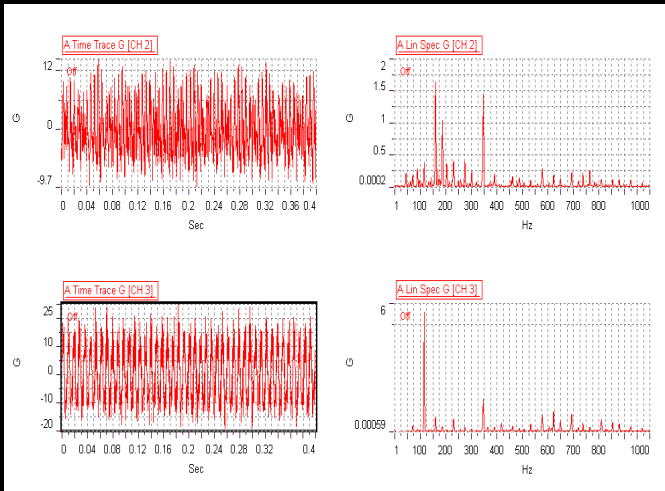
Time at Initial Level (Loops) 5

File Name: C:\Program Files\Spectral Dynamics\Fume\RCTS\LAN\RCT.sch

Description:

OK Cancel Apply Help

PROCESS IT.



**CUSTOMIZE**  
for easy operation...

**REPORT IT.**

**WITH 32 SIMULTANEOUS INPUT CHANNELS, EACH QUAD INPUT CARD HAVING A** high-speed 32-bit floating point DSP processor for local input signal processing. By performing the numerically intensive input signal computation is done in dedicated DSP's, allowing PUMA to maintain throughput speeds even with multiple processes and measurement channels active.

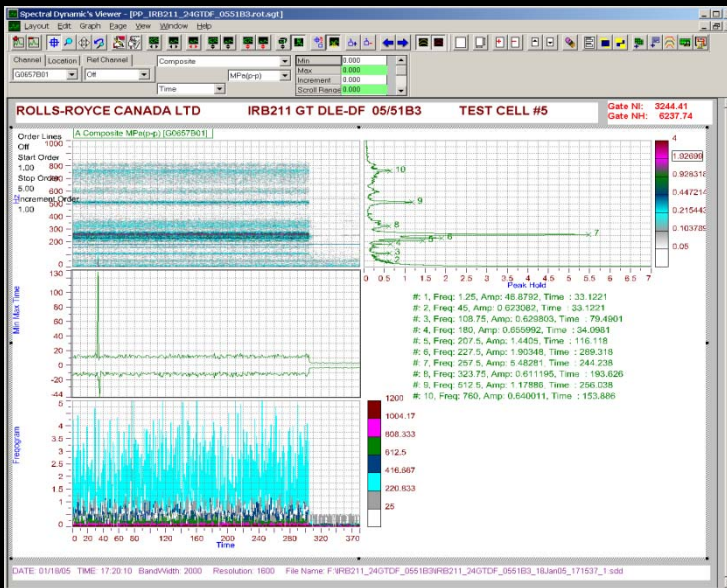
**EXPANDABLE UP TO 128 CHANNELS WITH PUMA MULTI\_CHASSIS UPGRADE.** Combine multiple chassis to increase channel count beyond thirty two channels. Multiple chassis are synchronized to allow for cross chassis phase measurements and to utilize a single tachometer input for all measurement channels. The data set is expanded to 128 channels and the internal throughput to disk gap free time domain data can be combined into a single time domain data file for post test analysis.

**SPECTRAL DYNAMICS' ABILITY TO DYNAMICALLY REPROGRAM** the input and output channel DSP's allows us to empower PUMA with our industry leading application sensitive digital filtering. In addition to high quality analog low pass input filters, sharp digital low pass filters for random, true tracking filters for sine, and linear phase filters for TRANSIENT are available. Similarly, reprogrammable DSP processors give PUMA's output channels the performance to generate true Gaussian random noise and analog-quality swept or stepped sine.

**PUMA ASSURES DATA INTEGRITY BY PROTECTING AGAINST** under/over-test conditions. Erroneous test results due to aliasing or imaging are also eliminated. Accurate measurements are assured by combining 7 pole analog anti-alias filters, Delta Sigma, A/D converters, and sharp (120 db/Octave roll off) digital filters to guarantee that all input alias components are eliminated. Output digital smoothing filters prevent leakage of sigma energy above the test bandwidth and uncontrolled excitation of out-of-band resonances. When combined with PUMA's analog anti-imaging filters they guarantee high output signal fidelity and low harmonic distortion.\* These assurances are only possible through the use of both analog and digital filtering, a feature unique to PUMA among PC-based vibration systems.

**PUMA GIVES YOU FLEXIBILITY TO ASSIGN ALL 32 CHANNELS** to either reference or measurement functions, in any combination. Whether your application is Modal Analysis or Rotating Machinery you have confidence that the channel-to-channel phase match is within 0.7%.

**AN IDEAL DESIGN ANALYSIS TOOL TO REPRODUCE REAL** world conditions, PUMA can acquire, analyze and store multi-channel data and



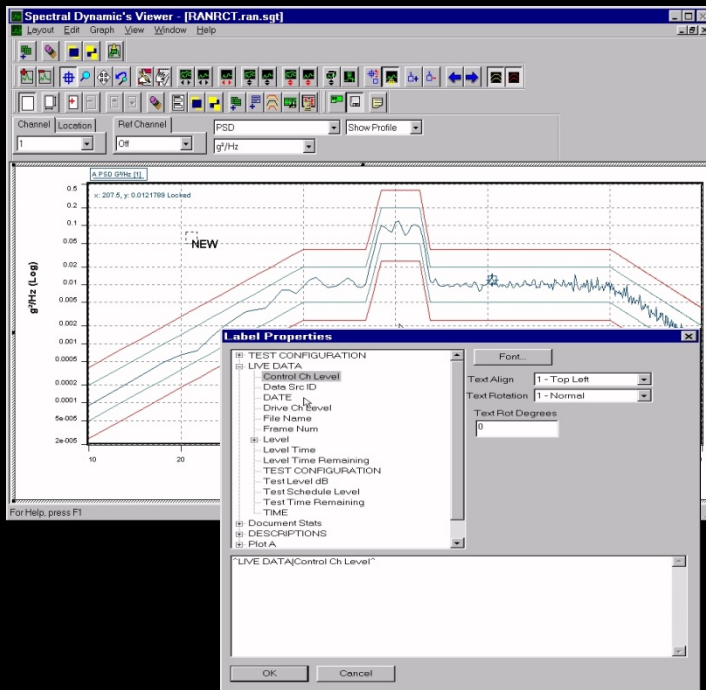
**CUSTOMIZE YOUR TEST SCREEN.**

Choose our templates or build your own. Position the test control panel how you like. Place status monitors to see critical test conditions such as control, drive or input channels levels, elapsed test time, sweeps or pulses, and schedule status

*report it*  
INFORMATION COMMUNICATION

**CUSTOMIZE**  
....and superior control.

*process it*  
CONCURRENT ANALYSIS.



reproduce field environments in the laboratory. Any measurement acquired by PUMA may be used as a reference for vibration control or you can quickly cut-and-paste a reference from a spreadsheet.

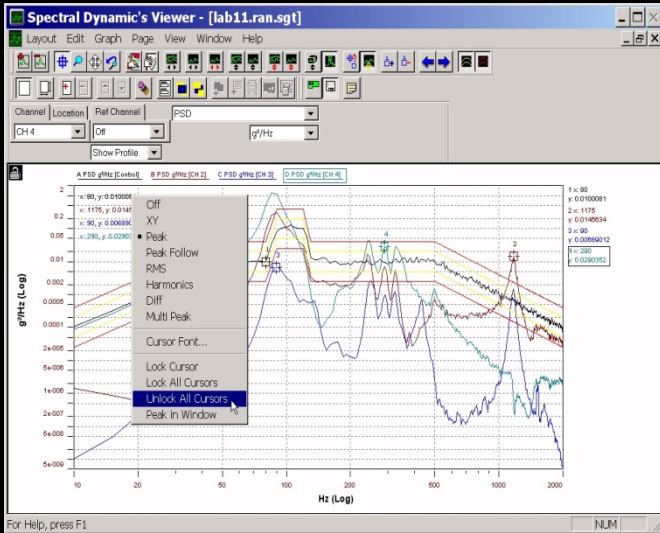
**TRUE MULTITHREADED WINDOS OPERATION INSURES FUNCTIONAL MODULARITY** The most advanced imaging tools from Microsoft and Open GL. CATS MODAL and STAR v6 have earned their reputation as the fastest Model System ever created. Model creation can be as simple as simply taking digital pictures of your test object, entering them into the sketch box and using the Sketch Box toll kit to quickly create a complete Modal Model. Such rapid Model creation eliminates the cumbersome and time consuming task of transferring a sub set of the very complicated Finite Element Model and trying to adapt a 30,000 Model into something useful for Modal analysis.

**MULTILEVEL, PASSWORD SECURITY ENHANCES PROTECTION** of test equipment and allows tailoring system operation to meet the requirements for individual operators. Security levels can be set to selectively restrict editing of test parameters, access to on-line controls, or even viewing of sensitive information.

**TAILOR THE DATA PROCESSING TO BEST SUIT YOUR ANALYSIS** requirements. Enhance your analysis flexibility for random analysis by setting the measurement channel DOF and averaging made independently from the output settings. For sine testing, you can independently set each measurement channel for RMS, proportional bandwidth, or fixed bandwidth tracking filter processing. Comparing RMS and tracking filter results allows direct assessment of the excitation of harmonics related to test article dynamics. Tracking filters also enhance data accuracy by providing enhanced noise suppression. Selectable over sample rates for TRANSIENT testing improve waveform peak detection accuracy.

**COMPARE LIVE AND STORED DATA.** Simultaneously run a test, analyze data, and compare it with data taken yesterday or last year.

**PUMA'S VIRTUAL CALCULATOR FUNCTION PROVIDES THE IDEAL** toll for automatically performing special calculations. Using pushbutton functions and algebraic formulas, you can program processing for a channel, or set of channels, with results displayed in any desired units. Once programmed a 'virtual channel' can be treated like



any other physical channel, extending the functionality of your PUMA.

### HIGHLIGHT DATA WITH CURSORS, MARKERS AND ANNOTATIONS.

Single and dual cursors allow highlighting and tabulation of data points. Find peak, peak follow, and locked cursors movement for synchronous cursor positioning on all graphs, enhance data analysis. Use markers to extract precise data values. Annotation tags make it easy to add commentary anywhere on the data display.

### PUMA STORES DATA AUTOMATICALLY DURING TESTING,

either continuously or at predetermined events you specify. You can specify the storage interval in seconds, or save data on alarm conditions, by external command, or at any time you choose.

Retrieve data stored to disk and display it with all the flexibility available during test operation. A playback mode of operation allows automatic scanning of all data stored during the test. Selectable playback speed enables you to set playback for a quick review of the entire test or a slower, more detailed, examination of each test phase.

### DATA MANAGEMENT IS MADE EASY WITH QUICK ACCESS.

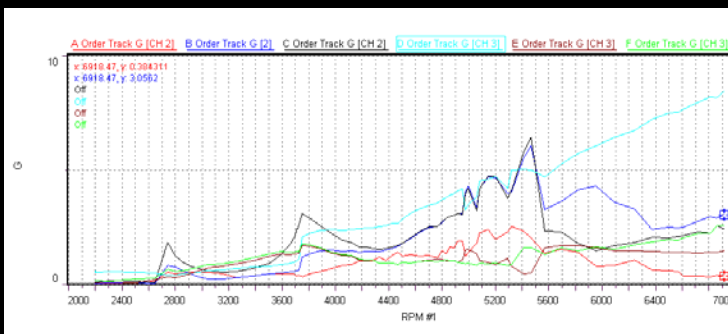
It provides a convenient interface to advanced database software for rapid access to any stored data. You can quickly and easily prepare templates that take the tedium out of making data queries. Now you can find data not just by file names, but by test profiles, product types, or any other parameter - any way you want.

### AUTOMATIC REPORT GENERATION.

User defined templates accelerate report generation. Define report templates including data plots, test conditions, error summaries, setup parameters, and operator commentary into a customized page layout for effortless printing. Data and test conditions are automatically updated for every test. These templates provide ideal report generation capabilities within the control software.

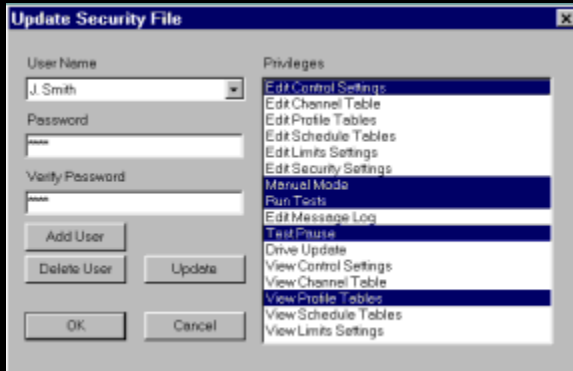
### PUMA GIVES YOU TRACEABILITY BY AUTOMATICALLY

documenting every event occurring during a test. The run messaging log records all status messages, error condition reports, and operator commands for each test. Recorded as ASCII data, the run message log information is ready for word processing or other software used for report generation or analysis.



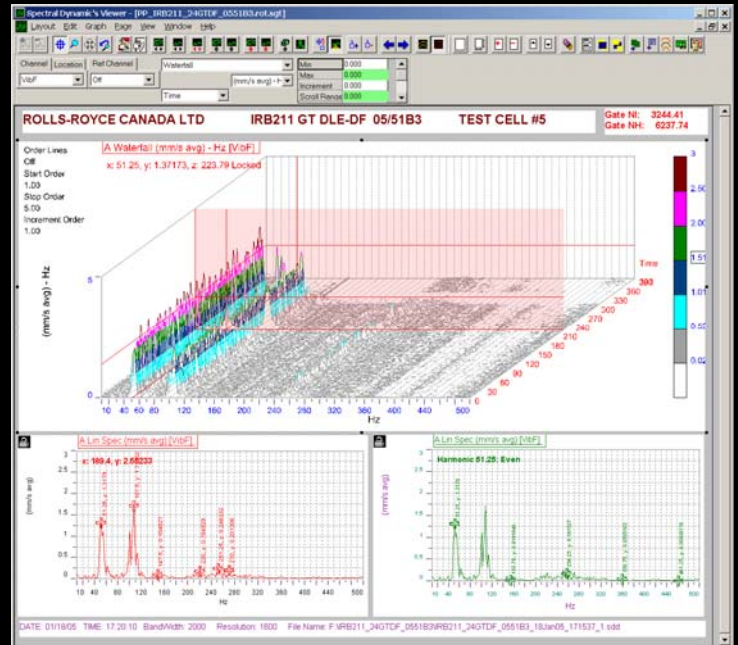
REPORT IT.

**PROCESS IT.**



**SET SECURITY LEVELS FOR EACH USER.**

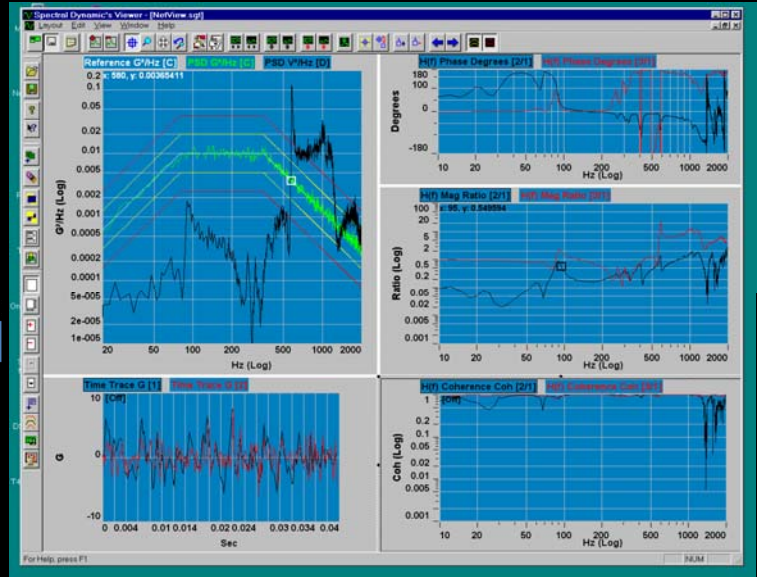
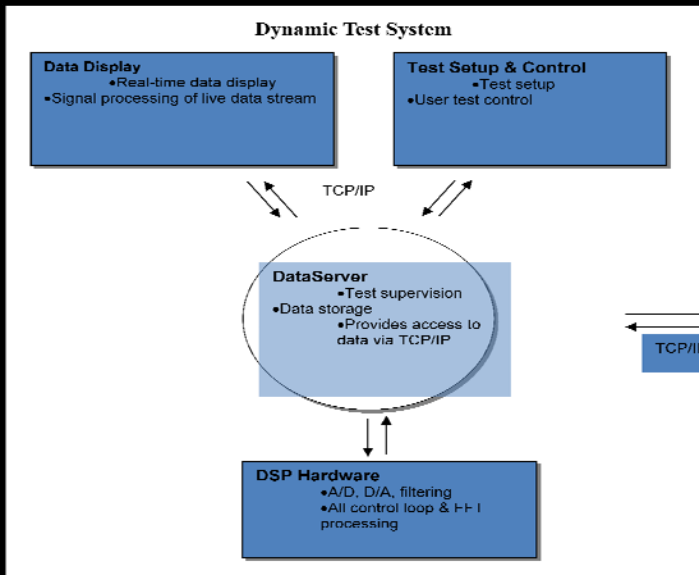
Each operator may be authorized for their appropriate level of system control.



**insightful ANALYSIS during the test...**

**OLE TRANSFERS**

PUMA OFFERS ACCESING COM SERVICES





# PUMA QUAD SPECIFICATIONS:

## Input Subsystems

Dynamic range	>94 dB
Analog-to-digital converter	24-bit
Amplitude accuracy	Within $\pm 0.20\%$ of value or $\pm 0.03\%$ of full scale
Amplitude linearity	$\pm 0.03\%$ of full scale or $\pm 0.2\%$ of measured value, whichever is greater
Voltage ranges	440 mV, 2.5V, Or 12V full Scale.
Overload detection	Full scale on all channels, analog and digital detection
Voltage coupling	AC or DC
ICP power	4 mA (20V maximum into open circuit)
Maximum rated input signal	$\pm 35$ Volts peak
Sampling rate	102,400 samples per second
Multichannel sampling interval	Simultaneous sampling on all channels-no interval
Frequency accuracy	$\pm 5$ ppm
Frequency range reduction	Digital decimation and filtering using on-board DSPs
Anti-aliasing filters	
Analog	
Type	Seven Pole Matched
Cutoff frequency	Fixed at 225 kHz
Alias attenuation	>96dB
Passband ripple	Within $\pm 0.10$ dB
Digital	
Cutoff frequency	Variable
Stopband attenuation	>96 dB at 1.56 times cutoff frequency
Passband ripple	Within $\pm 0.15$ dB
Channel-to-channel match	
Amplitude (compensated)	Better than $\pm 0.25$ dB
Phase (compensated)	Better than $\pm 1.0$ degree to 20 kHz
Crosstalk	> -90 dB below full scale
Offset removal	
Type	Digitally controlled offset rejection
Accuracy (compensated)	Better then $\pm 0.5\%$ of full scale, for each Input range
Input impedance	1 Megaohm shunted by <120 pf
Connector type	BNC
Connection type	Pseudo-differential, 10 Ohms to system ground, low side return
Calibration	Internal digital calibration, NIST referenced
Calibration constants	Digital calibration constants stored in nonvolatile RAM

## Output Subsystems

Dynamic range	90 dB	
Digital-to-analog converter	Precision 16-bit	
Maximum output amplitude	$\pm 12$ Volts peak	
Maximum output current	16 mA	
Voltage range attenuator	Programmable 48-bit	
Attenuator range	0 to -160dB	
Attenuator step resolution	0 to -90dB	
	0.05 dB	
	<b>-90 to -110dB</b>	<b>0.10 dB</b>
	-110 to -135 dB	0.20 dB
	-135 to -160 dB	0.30 dB
	-150 to -160 dB	0.40 dB
Attenuator accuracy	$\pm 0.01\%$ of full scale or $\pm 1.0\%$ of value, whichever is greater	
Maximum attenuator rate	>4000 dB/sec	
Sampling rate	51,200 samples per second	
Image attenuation	96 dB	
Frequency accuracy	$\pm 5$ ppm	
Frequency range reduction	Digital interpolation and smoothing filters	
Smoothing filters		
Analog		
Cutoff frequency	Fixed at 30 kHz	
Image attenuation	>96 dB	
Passband ripple	Within $\pm 0.15$ dB	
Digital		
Cutoff frequency	Variable	
Stopband attenuation	>96 dB at 1.58 times cutoff frequency	
Passband ripple	Within $\pm 0.07$ dB	
Output offset removal		
Type	Digitally controlled refecton of internal and external offsets	
Accuracy	Better than $\pm 0.5\%$ of full scale	
Output impedance	60ohms	
Unattenuated output	Signal available on separate BNC connector	
Unattenuated output level	1Volt peak, generated after analog smoothing filter	
Output connector type	BNC	
Output type	Pseudo-differential, 10 Ohms to system ground low side return	
Output cable	Designed to drive up to 50 feet of shielded 50 ohm coaxial cable	
Calibration	Automatic Internal digital Calibration, NIST referenced	
Calibration constants	Digital calibration constants stored in nonvolatile RAM	

**AFTER INVENTING THE FIRST DIGITAL VIBRATION FFT ANALYZER** over 30 years ago, Puma is our most flexible Digital vibration system. Puma is ever advancing, now featuring quad 24-bit input cards. Puma can use the most advanced Core 2 Duo processors running Windows XP or Windows Vista. We have partnered with test engineers ever since to meet your constant evolving needs.

**TRAINING ON YOUR PUMA SYSTEM ACCELERATES YOUR** productivity. We offer regularly scheduled courses on Vibration testing and system operation. The courses serve as a convenient forum for the exchange of ideas. We will gladly arrange for on-site training in small or large groups to suit your requirements.

**OUR TECHNICAL ASSISTANCE CENTER (TAC)** is available daily via telephone from 08:00 to 17:00 Pacific Time. Our engineers can draw on more than 50man years of dynamic test experience to help you resolve problems. Spectral Dynamics also offers a variety of service plans to protect your investment. These plans prolong the life of your equipment and help you to budget maintenance costs.

The digital nature of the system makes calibration very simple and very accurate. Our systems can be calibrated on-site or at our authorized service centers. Our process is a true calibration and not simply a determination if the system is running to specification.

**OUR COMMITMENT TO CONTINUED RESEARCH MEANS YOU** can expect us to continue to create enhancements to the Puma as market needs evolve. In digital filtering and signal processing, advanced control algorithms, or test automation, our continued research brings you better solutions for dynamic testing and analysis.



[www.spectraldynamics.com](http://www.spectraldynamics.com)

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