LMS Solutions Guide
LMS Test.Lab Environmental

LMS
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Empowering Engineering Innovation

LMS Test.Lab Environmental

Multi-Channel Vibration Control and Data Reduction

LMS Test.Lab Environmental brings you the most advanced and complete range of environmental testing solutions on the market – from the basic component shake-and-bake vibration qualification testing, to measurement systems that monitor and control pre-launch shakedown tests on multi-billion dollar satellites…

LMS Test.Lab provides a powerful, high-speed multichannel vibration control system. Technicians will find it easy to use for routine random, shock, sine, and combined modes tests. Development engineers will find everything they need for state-of-the-art control as well as extensive data analysis. The LMS Test.Lab system also provides a high performance on-line data reduction of random, sine, transient and acoustic signals.

Safety is the primary objective

Real-time control is maintained as the channel count increases, so every data sample is used to protect your structure. In addition to raw control speed, there are plenty of safety features built-in to the hardware and software to ensure a safe and reliable control loop: from comprehensive pre-test checks, to response limiting and notching on any number of channels, to a controlled shutdown if any of the limits are exceeded.

Productivity and convenience

As LMS Test.Lab is designed for maximum productivity, you can arbitrarily map physical inputs to define control, measurement, and monitoring channels; recall calibration values from a database rather than entering them from scratch; monitor what you want and when you want as the test proceeds – and batch plot the results at the end of a run with a single click. You can even animate a geometry afterwards to check if everything worked as expected.

It's all about productivity and performance…

Channel Set-up

With Test.Lab you can control and measure as many parallel channels as you like to monitor the structure at all sensitive points. Set-up procedures use a spreadsheet-like interface to facilitate the entry of repetitive values.

- channel mapping to avoid re-cabling the set-up
- enter or upload transducer calibrations, point-ids etc. from any ODBC database, geometry or directly from TEDS
- channel grouping in terms of control, measurement and limit channels
- immediate interactivity: front-end has color-coded LED displays for active channels, ICP cable check, and ADC status

Control Set-up

Random Control
- defined, measured or synthesized profile
- arbitrary frequency spans
- from 0.01Hz to 20kHz
- resolution to 12,800 lines
- user-definable DOF for control algorithm
- multipoint control strategies: average, maximum or minimum (on a line-by-line basis)
- Advanced time-level test scheduling utility

Sine Control
- arbitrary sweep range: 0.42Hz to 20kHz
- programmable sweep-rate and compression speed
- analog-like sweep quality
- independent amplitude estimators per channel: harmonic, peak, average, rms, on-line THD (Total Harmonic Distortion)
- FRF measurements including phases
- unique "hold-sweep" mode for interactive resonance search and dwelling
- Support multiple sweep to 65535
- Storage repetition of swept sine spectra can be limited to once every N sweeps to limit the database size.

Shock Control
- classical: halfsine, trapezium, rectangle, sawtooth, initial and terminal peak with main pulse length: 0.06 ms to 30sec
- up to 32,768 time samples
- pre- and post-pulses: single sided, double sided, optimized, minimized
- special algorithms to optimize shaker usage
- single shot or repeat modes
- Shock Response synthesis as optional feature
- Measured profile as optional feature
- On-line Shock Response Spectrum

Tracked Sine Dwell :
- Quick and easy resonance finder using Self check FRFs, Swept Sine test FRFs or Spectra, or any other Spectrum
- Multiple response/reference pains can be defined in one set-up using any channel
- Multiple dwells can be defined in one set-up for automatic dwell sequencing

Combined Modes :
- Random and Sine Control algorithms. Work in parallel to allow Secure and complete combined modus set-up
- Sine on Random with up to 10 fixed and sweeping sine tones
- Random on Random with unlimited fixed and sweeping narrow bands
- Sine on Random on Random

Online Random & Acoustic Reduction :
- Perfect synchronisation with Random Control measurement
- Arbitrary frequency spams
- From 0.01 Hz to 80 kHz
- Resolution to 12800 lines
- Different sample rates for vibration and acoustic channels
- Parallel time recording as optional feature

Online Sine Reduction :
- Perfect synchronisation with Sine Control measurement
- Arbitrary sweep range 1Hz to 6000 Hz
- Independent amplitude estimates per channel : harmonic, peak, average, rms, on-line THD (Total Harmonic Distortion)
- Parallel time recording as optional feature

Transient Capture
- Sampling frequency from 1.6 Hz to 204.8 Hz
- Acquisition block size from 256 to 32768
- Parallel time recording
- On-line Shock Response Spectrum
- On-line Spectrum, FRF, Octave, Cross Power, Auto Power an Sound Intensity
- The optional 251 samples/channel FIFO buffers can be configured to reach at least 2 Msamples per channel at high sampling frequency, whatever the number of channels

General
- level sequencing
- notching/limiting: any control or measurement channel(s) against independent arbitrary profile
- manual or automatic monitoring intervals

...total test integrity...

Self Check

Verifies the control loop for integrity and safety, and presents full-level predictions to the operator. The procedure first measures the background noise on all channels. It then injects a low-level shaped random into the loop and automatically ramps up the amplitude in user-defined stages until a specified signal-noise ratio is met, or the drive reaches a specified limit. The system then measures the system responses using a compensated spectrum. If all is well the full-level testing modes are enabled and the user given the "OK to Start" flag. If any errors are discovered they are listed and the system is disabled until corrections are made.

On-line

A wide choice of on-line display options and layouts means that you can see anything that is important – when it is wanted. During control the operator can easily browse through the different channels and make comparison at any time with stored results (such as checking current data with a reading taken two hours previously). There are the usual range of hardware and software safety features and on-line system interactivity.

• User-configurable display layout with 2D, and waterfall displays

• Single, double, harmonic, ratio and crosshair cursors

• Change cursor properties, annotation style, number of decimals, ...
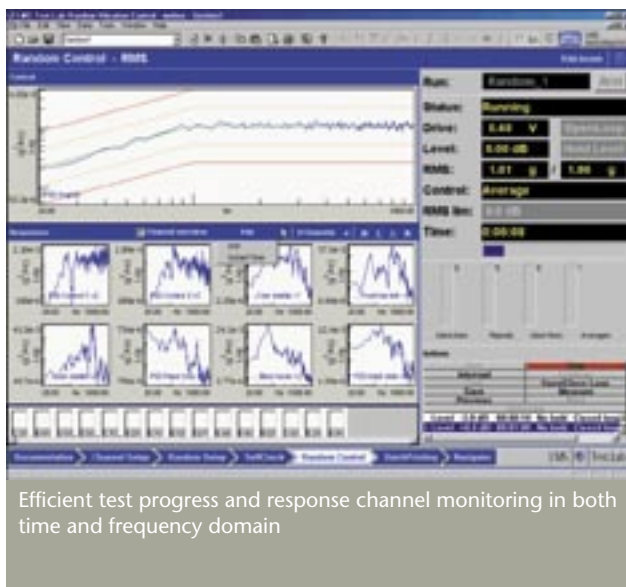
Efficient test progress and response channel monitoring in both time and frequency domain
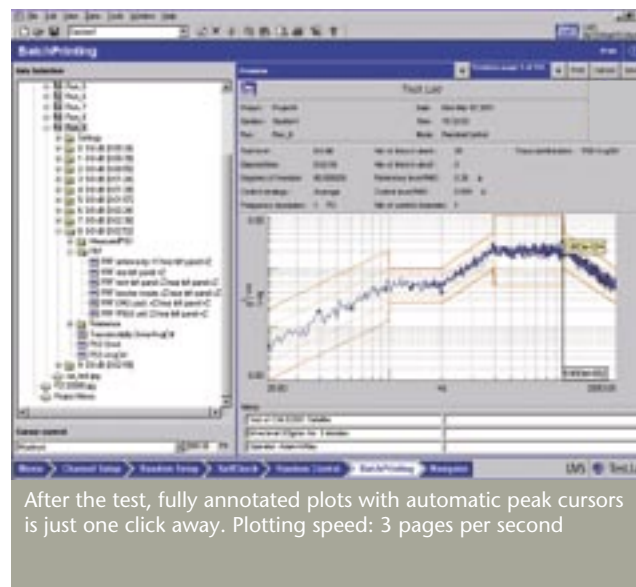
After the test, fully annotated plots with automatic peak cursors is just one click away. Plotting speed: 3 pages per second

…an advanced vibration control solution from a single supplier

Operational Concept

The way of interacting with LMS Test.Lab is very different to the traditional open-ended menu-driven system. In effect, the operator follows a workflow defined by the supervisor: this includes reading overall guidelines (which can include videos and pictures); loading pre-defined transducer sets, using a set reference profile and control strategy (or execution), on-line processing, and reporting. There are no cascading menus, and the operator is in control at all times.

Safety

Safety is the primary concern and numerous safety features are built-in to ensure safe and reliable control.

- Password protection and keyswitch entry into system
- Safety interlocks during set-up
- Shaker physical limits check
- Line-by-line abort checking with user defined tolerances to asymmetrical limits
- Averaged and individual channel rms abort limits
- Continuous open channel, DAC and ADC overload monitoring
- Emergency hardware stops active at all time
- Loss of power does not cause DAC spikes

Hardware platform

The most distinctive feature of the new system is its speed – real-time control is maintained up to 100 channels! The full range of SCADAS III signal conditioning modules are supported, so control is possible from accelerometers while, say, notching inputs from strain gauges. Channel mapping allows total flexibility of which channels are to be used for control and for measurement - as well as more efficient use of the front-end.

- High performance LMS SCADAS III front-end
- Scalable DSP power for unlimited channel counts
- Built-in signal conditioning: accelerometers, bridge, ICP® …
- Visual channel mapping/ transducer integrity checks
- 96dB A/D, 90kHz bandwidth
- 24-bit effective DAC with 'soft' start-up/ shutdown
- On-board calibration for plug & play module swapping

Software platform

- Based upon native Windows NT, enhanced by specific LMS architecture for dedicated functionality
- Takes advantage of multi-processor PCs for maximum performance
- Ergonomic design based on industrial research – no cascading menus
- Workbook concept with embedded workflow
- Tight integration with Windows Office and LMS Reporting Seat for easy documentation
- Seamless integration with LMS analysis software

LMS Test.Lab 8 Channel Qualification Testing

System for closed loop random control

The LMS Test.Lab Qualification Testing system is a complete solution for random vibration control. The system allows safe, accurate and fast reproduction of the target random reference spectra on a shaker installation, using up to 8 control channels. Any channel not used for control can be used as an auxiliary measurement channel. The channels support ICP transducers or any Voltage signal.

The system assists the user, guiding him through the process of defining the setup, validating the hardware instrumentation, productively monitoring the test execution and reporting on the result. In each step, the system provides expert opinion feedback on the status.

This process leads to productive and safe random vibration environment qualification testing, with more than just a passed or failed test article as an end-result. The operator on shift can create a full test report rapidly, including plots and run event logs. Hard-copy notes are no longer needed, and the operator can perform independently, without having to check with the colleague who started the test. Virtually no operator training is required, beyond normal MS Windows usage.

The LMS Test.Lab Qualification Testing system is the right solution for qualifying small structures for random vibration environments, in a wide range of industries. Examples include Printed Circuit Boards, industrial goods, relays, etc. This system is also the ideal step-in investment into a future-oriented and modular hardware and software platform. With limited incremental investment, it can grow into a more versatile system in support of other types of testing, or of testing in support of the mechanical engineering process.

LMS Test.Lab is an industrial solution for safe and efficient qualification testing to support mechanical engineering as well as production.

Reporting on self check results is available as an automatically generated MS Word document.

Well organized sheet for test progress monitoring, combining general test status information views with online graphics.

Features

- Multi-channel 24-bit acquisition hardware with ICP signal conditioning
- Safe, fast and accurate random control software
- Very easy to use, with embedded expert system
- Template support for fixed test procedures
- Fully automatic batch plotting at the end of test run, including automatic peak cursors
- MS-Office Template Reports, including Active Pictures

Benefits

- Can be used by operators without training in structural dynamics
- Ensures consistency in repetitive tasks
- Increases efficiency of managing the workload of a team of operators
- Easy traceability with full documentation, data management and reporting

Solution Pack Content

LMS SCADAS III Hardware
- LMS SCADAS 310 - Master frame with 10 slots, AC power and SCSI interface
- 2 x PQA - 4 channel Programmable V/ICP Signal Conditioner
- 2 x SP92-B - 4 channel 24-bit DSP Signal Processor Module
- 1 x VDAC - Dual DAC Module for Output of Analog Signals

LMS Test.Lab Software
- Desktop
- LMS SCADAS 310 Driver
- Random Control Workbook

Solution Pack Options

LMS SCADAS III Hardware
- PQFA to reduce the risk of ground loops and to support TEDS
- DSCU-DAC Shutdown Control Unit
- Environmental Testing Remote Control

LMS Test.Lab Software
- Shock Control & Response Analysis
- Sine Control Workbook
- Random Response Limiting
- Sine Notching
- Measured Pulse
- Tracked Sine Dwell Workbook
- LMS SCADAS III Smart Transducer TEDS Support
- External File Access

Fully automatic batch plotting at the end of test run, including automatic peak cursors.

Fuel injection system undergoing combined climatic/vibration qualification testing in operating conditions.
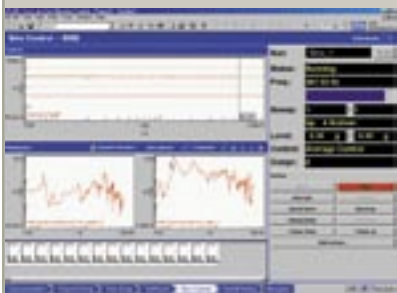
Swept sine testing for both component qualification and resonance search.

Sine dwell testing: find and lock into structural resonance with an accurate amplitude and frequency control algorithm.
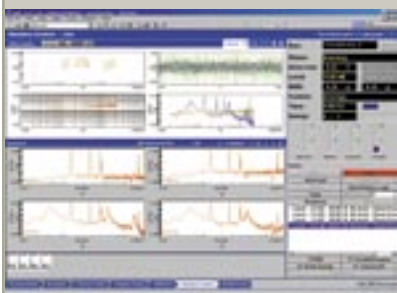
Flexibility and completeness far beyond the basic sine on random test requirements.

LMS Test.Lab 8 Channel Automotive Component Qualification Testing

System for closed loop automotive component qualification

LMS Test.Lab Automotive Component Qualification Testing provides a complete solution for environmental qualification testing through closed-loop shaker control, using up to 8 simultaneous ICP or voltage channels for control or measurement. Intended for qualifying automotive components, it is especially designed for long-duration durability testing (i.e. fatigue testing), phase resonance testing (i.e. tracked sine dwell) and engine-mounted components testing (i.e. to simulate engine run-ups using sine on random).

The Random and Sine Control workbooks support qualification of components in random and swept sine mode, implementing a safe, fast and accurate control loop. The workbooks have been developed taking into account long duration and multiple operator shift tests.

The Tracked Sine Dwell workbook facilitates the set up of phase resonance tests, exciting the structure at a resonance frequency and locking into this resonance for a well-defined number of amplitude-calibrated load cycles. The accurate resonance-tracking algorithm, in parallel to the normal amplitude control, ensures correct damage injection into the test article. Reporting on the test results includes graphs of the resonance frequency, input/response levels and FRF vs. load cycles or test time.

The Sine-on-Random workbook accepts the definition of a random background reference profile as a target for control, in addition to sweeping or fixed sine tones, each with its own burst duty cycle. Pure multi-sine tests, with no background profile defined, can be set up as well. Each tone is individually controlled, after applying a razor-sharp extraction algorithm to determine the amplitude and phase of each individual tone on each of the control channels. Time domain extraction allows to determine the background noise shape and feed it into the standard random control algorithm.

Features	Benefits
• Accurate sine on random control, thanks to accurate sine tone extraction • Flexible sine on random implementation supporting fixed and sweeping, steady or bursting sine tones • Support of multi-sine-only tests • Accurate tracking of shifting resonances, while controlling amplitude • Tracking with response amplitude control possible with optional sine notching option • Dwell sequences set up in one test	• Complete sine on random implementation • Complete sine dwell implementation • Full support for monitoring critical locations • Specialized for automotive applications

Solution Pack Content	Solution Pack Options
LMS SCADAS III Hardware • LMS SCADAS 310 - Master frame with 10 slots, AC power and SCSI interface • 2 x PQA - 4 channel Programmable V/ICP Signal Conditioner • 2 x SP92-B - 4 channel 24-bit DSP Signal Processor Module • 1 x VDAC - Dual DAC Module for Output of Analog Signals • 1 x Environmental Testing Remote Control **LMS Test.Lab Software** • Desktop • LMS SCADAS 310 Driver • Random Control Workbook • Sine Control Workbook • Tracked Sine Dwell Workbook • Sine on Random	**LMS SCADAS III Hardware** • Upgrade PQA-2 to PQFA to reduce the risk of ground loops and to support TEDS • DAC Shutdown Control Unit **LMS Test.Lab Software** • Shock Control & Response Analysis Workbook • Random Response Limiting • Sine Notching • Measured Pulse • LMS SCADAS III Smart Transducer TEDS Support • External File Access

LMS Test.Lab Environmental

LMS Test.Lab 8 Channel MIL-STD Qualification Testing

System for closed loop MIL standard qualification

LMS Test.Lab MIL-STD Qualification Testing is the solution for MIL standard qualification testing on structures, using up to 8 simultaneous ICP or Voltage channels to control a shaker installation in a closed loop fashion. The solution supports swept sine, random, shock, SRS and combined modes qualification. In every phase of the qualification test process and every control mode, the system offers a wealth of safety precautions to protect the test article and test area.

Test results documentation is key. A fully automatic logging mechanism makes reporting extremely easy and complete. Automatic setup and test data archiving, transducer annotation on the stored spectra, visually appealing formatting of run event log files and the support of digital pictures are some examples. All information is available in a very intuitive browser tree, allowing a first draft to be drawn up by anyone. The random, Sine and Classical Shock control workbooks support safe, accurate and productive component qualification testing. All workbooks have been designed with long duration, multiple operator shift testing in mind.

The Shock Response Synthesis solution allows the use of damped sines or wavelets to create a target time history that complies with the target SRS. A fully automatic process will provide a default waveform. If the waveform violates the shaker limits, the system can continue, in a fully interactive optimization process, with individual component parameter editing capability, and a multi-level undo-redo buffer with a continuous refresh of the resulting waveform with its shaker performance requirements. This allows the running of tests with higher SRS levels on the existing installation.
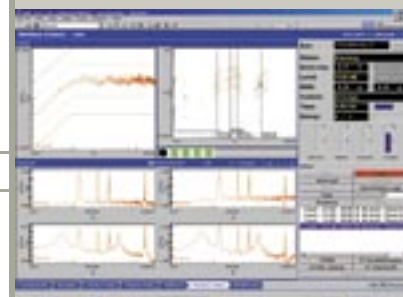
The combined modes workbook allows users to mix and match sweeping and fixed sine tones and narrowbands in all possible ways, allowing you to set up the most exotic combined modes tests imaginable.

Safe qualification testing against the toughest requirements: MIL-STD.

Accurate reproduction of measured transient events on the shaker.

Full flexibility in sine on random setup, fixed and sweeping sine tones with individual burst schedule.

Features	Benefits
• Complete sine on random, random on random and combined modes • Support of arbitrary profiles and burst modes for sweeping sine tones and narrowband • Support of fixed sine tones and narrowbands with burst duty cycle for each individual tone or band • Automatic shock response synthesis procedure with manual mode possibility • Online SRS calculation, also for response channels	• Specialized for MIL standard testing • Very complete combined modes implementation • Gets the most out of your shaker installation, thanks to the world class SRS implementation

Solution Pack Content	Solution Pack Options
LMS SCADAS III Hardware • LMS SCADAS 310 - Master frame with 10 slots, AC power and SCSI interface • 2 x PQA - 4 channel Programmable V/ICP Signal Conditioner • 2 x SP92-B - 4 channel 24-bit DSP Signal Processor Module • 1 x VDAC - Dual DAC Module for Output of Analog Signals **LMS Test.Lab Software** • Desktop • LMS SCADAS 310 Driver • Random Control Workbook • Sine Control Workbook • Shock Control & Response Analysis • Measured Pulse • Shock Response Synthesis • Sine on Random • Random on Random	**LMS SCADAS III Hardware** • PQFA to reduce the risk of ground loops and to support TEDS • DSCU - DAC Shutdown Control Unit • Environmental Testing Remote Control **LMS Test.Lab Software** • Random Response Limiting • Sine Notching • Tracked Sine Dwell Workbook • LMS SCADAS III Smart Transducer TEDS Support • External File Access • Advanced Shock Response Analysis

On line monitoring of background PSD, fixed and sweeping sine tones in both time and frequency domains.
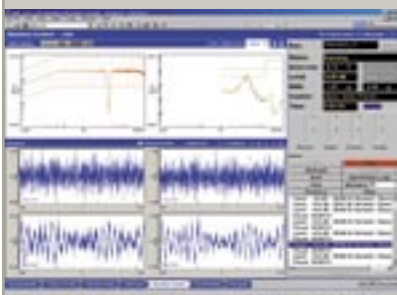
Vibration control in support of fixture design.

Efficient and guided channel setup definition.

Test progress monitoring with drag and drop overlay of saved and life data.

Optional Response limiting for optimal test specimen protection.

LMS Test.Lab 36 Channel Design Validation Testing

System for Closed Loop Vibration Control

The LMS Test.Lab Design Validation Testing solution package is a complete system for closed loop vibration control for random, sine and shock test modes. The system allows safe, accurate and fast reproduction of the target qualification reference profiles, using up to 36 control channels. Any channel, when not used for control, can be used as an auxiliary measurement channel or response-limiting channel for test specimen protection. The channels support ICP transducers or any Voltage signal.

The channel setup definition sheet is designed to support high channel counts and features ODBC and MS Excel interoperability (for instance for transducer information), copy and paste in all related tables, and a built-in status check, all to allow a fast yet safe channel setup definition phase. Extensive pre-test verification is provided by the self-check module, which offers a built-in digital scope function, and performs all the pre-test diagnostics.

During the test, control algorithms provide accurate control and an extensive set of specimen protection measures. Online monitoring is easy, with control loop status parameters, a set of bar graphs of the channel levels and a 1/2/4/8/16 display layout to browse through all channels. Custom monitoring display layouts can be configured and saved to the setup files for specific test monitoring requirements.

After the test, the plots are just one click away, including fully automatic batch plotting with peak cursor annotation. The built-in logging mechanism makes the reporting extremely easy and complete.

The Geometry workbook allows the quick generation of wireframe models for full 3D animation of the test and analysis results. The Operational Deflection Shapes workbook ensures easy navigation and selection of the acquired qualification test data, and animation of the vibration pattern at any given frequency.

Features	Benefits
• Multi-channel 24-bit acquisition hardware with ICP signal conditioning • Automatic test setup validation and an extensive self-check module • Safe, fast, flexible and accurate closed-loop control loops • Guaranteed performance in high channel count conditions • Very easy to use, with embedded expert system • Built-in test logging and data management system • Seamlessly integrated geometry animation	• Facilitates safe and productive validationtesting, with operator guidance and built-in traceability • Expands engineering insight, and efficiently feeds back information to the mechanical design process • Guarantees test-readiness

Solution Pack Content	Solution Pack Options
LMS SCADAS III hardware • LMS SCADAS 310 - Master frame with 10 slots, AC power and SCSI interface • 9 x PQA - 4 channel Programmable V/ICP Signal Conditioner • 9 x SP92-B - 4 channel 24-bit DSP Signal Processor Module • 1 x VDAC - Dual DAC Module for Output of Analog Signals • 1 x DSCU - DAC Shutdown Control Unit **LMS Test.Lab software** • Desktop • LMS SCADAS 310 Driver • Random Control Workbook • Sine Control Workbook • Shock Control & Response Analysis • Run Data Averaging & Comparison Organizer • Geometry Workbook • Operational Deflection Shapes Workbook	**LMS SCADAS III Hardware** • PQFA to reduce the risk of ground loops and to support TEDS • Environmental Testing Remote Control **LMS Test.Lab Software** • External File Access • LMS SCADAS III Smart Transducer TEDS Support • Random Response Limiting • Sine Notching • Measured Pulse • Shock Response Synthesis • Advanced Shock Response Analysis • Tracked Sine Dwell Workbook • Sine on Random • Random on Random • Modal Analysis Workbook • LMS PolyMAX Workbook • Time Animation Workbook • Operational Modal Analysis Workbook

LMS Test.Lab 60 Channel Advanced Design Validation Testing

System for Closed Loop Vibration Control

The LMS Test.Lab Advanced Design Validation Testing solution is a complete system for closed loop vibration control for random, sine and shock test modes, including the advanced random response limiting and sine notching capabilities. The system allows safe, accurate and fast reproduction of the target qualification reference profiles, using up to 60 control channels. Any channel when not used for control can be used as an auxiliary measurement channel or response-limiting channel for test specimen protection. The channels support ICP transducers or any Voltage signal. The test results can be used for post-test 3D animation to help engineers understand the structural dynamics of the test item.

The higher channel count system and the included possibility to apply random response limiting or sine notching, allows an even more complete test item protection as well as to perform accurate post-test analyses without the risk of spatial aliasing.

With the included Compare runs add-in worksheet, engineers have an extremely productive tool to browse through all test data at the end of a run, including an automatic overlay of equivalent curves from any set of previous runs. Any change in dynamic behavior between runs is made immediately visible.

The Geometry workbook allows the quick generation of wireframe models for full 3D animation of the test and analysis results. The Operational Deflection Shapes workbook ensures easy navigation and selection of the acquired qualification test data, and animation of the vibration pattern at any given frequency.
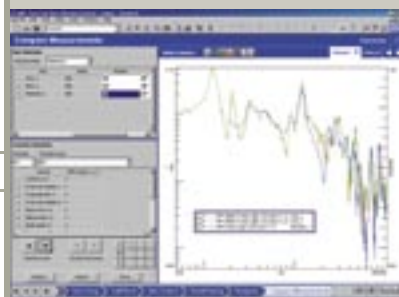
The LMS Test.Lab Advanced Design Validation Testing solution provides data acquisition and vibration control functions for product qualification testing. The system's processing, data management, and analysis tools give the necessary engineering feedback to further guide the design and development effort. It is primarily used in the aviation, space and defense industries. The system is optionally expandable to hundreds of channels.
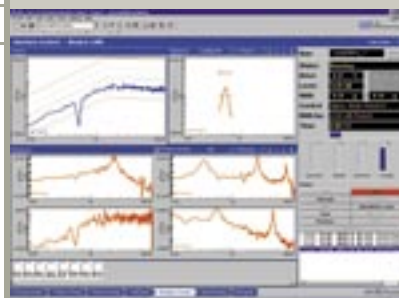

Rosetta spacecraft undergoing vibration testing.

Using TEDS technology, errors in the transducer definition phase are excluded.

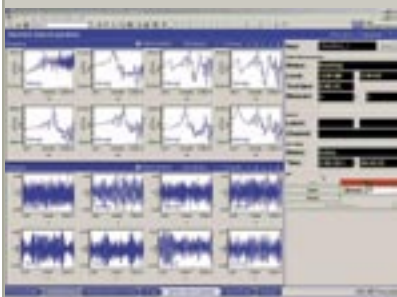The compare run add-in allows fast test result interpretation.

Features	Benefits
• 60 channels • Distributed DSP architecture • TEDS support • Self-check diagnostics with automatic MS Word report generation • Print setup using MS Word • Productive batch printing with automatic peak cursors • Productive tool for comparing runs • Data available for post-test analysis immediately after test • Availability of perfectly integrated high channel count online reduction capability	• Maximum safety during large test campaigns, thanks to the channel-count independent performance and the extensive support features during setup definition phase • Maximum confidence in the test data thanks to extensive and fully automatic test results and event logging • Maximum efficiency thanks to easy and automatic data management

Solution Pack Content	Solution Pack Options
LMS SCADAS III Hardware • LMS SCADAS 316 - Master frame with 16 slots, AC power, SCSI interface • 15 x PQA - 4 channel Programmable V/ICP Signal Conditioner • 15 x SP92-B - 4 channel 24-bit DSP Signal Processor Module • 1 x VDAC - Dual DAC Module for Output of Analog Signals • DSCU - DAC Shutdown Control Unit **LMS Test.Lab Software** • Desktop • LMS SCADAS 316 Driver • Random Control Workbook • Random Response Limiting • Sine Control Workbook • Sine Notching • Shock Control & Response Analysis • Run Data Averaging & Comparison Organizer • Geometry Workbook • Operational Deflection Shapes Workbook	**LMS SCADAS III Hardware** • Upgrade PQA-2 to PQFA to reduce the risk of ground loops and to support TEDS • Environmental Testing Remote Control **LMS Test.Lab Software** • External File Access • LMS SCADAS III Smart Transducer TEDS Support • Measured Pulse • Shock Response Synthesis • Advanced Shock Response Analysis • Tracked Sine Dwell Workbook • Sine on Random • Random on Random • Modal Analysis Workbook • LMS PolyMAX • Time Animation Workbook • Operational Modal Analysis Workbook

All relevant data concerning the test status are available in one well-organized display.
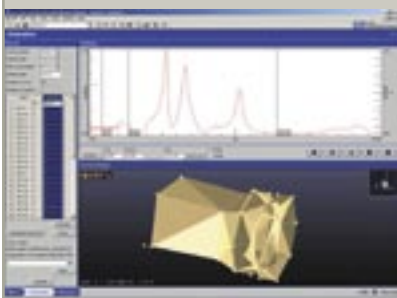
Efficient high channel count test monitoring using networking technology.

Time history throughput in parallel with online processing during random qualification testing, with status link to control system.
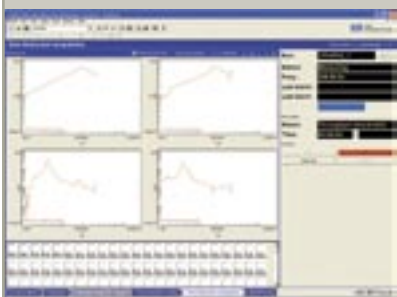
On line sine reduction with tape recorder functionality built in: spectral and time data available on host PC immediately after test.

The ODS workbook allows quick full 3D animation of wireframe models immediately after the test.

LMS Test.Lab 128 Channel Online Sine, Random and Acoustic Data Reduction

Acquisition system for qualification and acceptance testing

The LMS Test.Lab Online Sine, Random and Acoustic Data Reduction system delivers a complete solution for qualification and acceptance testing on large and fragile structures such as spacecrafts and satellites. It is designed for parallel acquisition and online reduction of up to 128 vibration and microphone channels during random or sine closed loop vibration control testing, in reverberant rooms, or for high frequency transient capture in the context of deployment testing.

The system is optimized for online reduction of high channel count tests, with an automatic level and frequency synchronization to the control system. The channels support ICP transducers or any Voltage signal. All relevant functions are calculated online and in parallel. All modes also support a 'back-up tape recorder' function, streaming all raw time data directly to the host disk in parallel to the online calculations (standard in transient capture, optional in random and sine modes).
With the included Compare runs add-in worksheet, engineers have an extremely productive tool to browse through all test data at the end of a run, including an automatic overlay of equivalent curves from any set of previous runs. Any change in dynamic behavior between runs so becomes immediately visible.

The Geometry workbook allows the quick generation of wireframe models for full 3D animation of the test and analysis results. The Operational Deflection Shapes workbook ensures easy navigation and selection of the acquired qualification test data, and animation of the vibration pattern at any given frequency.

This solution allows batch plotting with automatic peak cursors of all test data immediately after the test including a wealth of post-test analysis capabilities. The system is optionally expandable to hundreds of channels.

Features	Benefits
• 128 channels • Distributed DSP architecture • TEDS support • Print setup using MS Word • Productive batch printing with automatic peak cursors • Productive tool for comparing runs • Data available for post-test analysis immediately after test • Availability of perfectly integrated high channel count online reduction capability	• Performance independent from channel count • Extensive support features during the setup definition phase; • Full and automatic test logging • Easy and automatic data management

Solution Pack Content	Solution Pack Options
LMS SCADAS III Hardware • LMS SCADAS 316 - Master frame with 16 slots • LMS SCADAS 317 - Slave frame with 17 slots • 32 x PQA - 4 channel Programmable V/ICP Signal Conditioner • 32 x SP92-B - 4 channel 24-bit DSP Signal Processor Module • 1 x PDT - Programmable Dual Tacho Input Module for Analog and TTL Signals • 1 x PIC 34-0 - 0.4m Parallel Interface Cable for Master/Slave **LMS Test.Lab Software** • Desktop • LMS SCADAS III Master/Slave Driver • Online Sine Reduction Workbook • Online Random and Acoustic Reduction Workbook • Transient Capture Workbook • Run Data Averaging & Comparison Organizer • Geometry Workbook • Operational Deflection Shapes • Time Animation Workbook	**LMS SCADAS III Hardware** • PQFA to reduce the risk of ground loops and to support TEDS • 32 x FIFO-2MEG - 2 Msample /channel FIFO for SP92 • Environmental Testing Remote Control **LMS Test.Lab Software** • Time Recording during Online Random and Acoustic Reduction • Time recording during online sine reduction • External File Access • LMS SCADAS III Smart Transducer TEDS Support • Modal Analysis Workbook • Operational Modal Analysis Workbook • LMS PolyMAX • Advanced Shock Response Analysis

LMS Test.Lab Environmental – Options

LMS SCADAS III Hardware

PQFA - 4 channel floating input and V/ICP/TEDS IEEE 1451.4 signal conditioning module

The Programmable Quad Floating Amplifier (PQFA) module adds a number of features to the basic PQA concept. Floating inputs eliminate the risk of ground loops, and an analog programmable high pass filter removes unwanted low frequency components. Smart transducers (TEDS) can be connected directly to the PQFA module. It will help you to reduce the setup time drastically and even more important, you can avoid cabling errors which could even lead to severe over-testing.

• Input range ±100mV to ±10V

• Floating / single ended inputs

• 4mA ICP supply

• 5 to 75Hz programmable high pass filter

• TEDS support

DSCU - DAC Shutdown Control Unit

The DAC Shutdown Control Unit offers remote shutdown control when connected to the BPROC system controller. It is designed as a hardware backup of the software controlled shutdown. The use of a removable key prevents unauthorized enabling after a shutdown procedure. In addition, the DSCU includes two BNC connectors with normally open and normally closed contacts for connecting external safety devices. The DSCU is connected to the LMS SCADAS III frame via three-pole LEMO connectors and a 10-meter long cable.

Environmental Testing Remote Control

The 20 button remote control unit connects to the host computer through USB and supports the LMS Test.Lab Environmental commands for operator control. It provides a convenient way to control levels, sweep direction and progress, shock firing, etc.

FIFO-2MEG - 2 Msample /channel FIFO for SP92

2 MSamples/channel FIFO buffers complementing the LMS SCADAS III input modules, offering the possibility to capture transients at the highest sample rate of 204 kHz sampling, independent of the number of channels in the configuration, for at least the duration of the 2 MSamples.

Programmable Quad Floating Amplifier, supporting TEDS, IEEE 1451.4 and floating input, locking out transducer definition errors and ground loops.

DSCU-DAC Shutdown Control Unit: Safety device, offering manual test abort function with connectivity to external safety devices. The use of a removable hardware key prevents unauthorized usage.

20 button remote control offering full control overall online functions using standard USB connectivity.

LMS Test.Lab Software

Random Response Limiting

Random Response Limiting profiles enable you to effectively protect your test item against over-testing. While the average control signal level will match its reference spectrum, the response at particular points of the tested object may be very different, due to the resonances of the device under test. High response levels at non-control channels could endanger the structural integrity of the tested object. The spectral limiting allows the vibration level at any channel (control- or measurement) to be limited by an auxiliary reference profile, the response limiting profile. RMS limiting provides a more generic approach to overrule input control and reduce excitation levels for maximum protection of the test item.

Sine on Random

The Sine on Random options offers the user the possibility to define a background noise level combined with up to ten fixed and sweeping sine tones. In combination with the Random on Random license the workbook supports true combined modes tests, mixing fixed and sweeping sine tones and narrow-bands in one test run.

Random on Random

The Random on Random option offers the user the possibility to define a background noise level combined with an unlimited number of fixed and sweeping narrow-band signals. In combination with the Sine on Random license the workbook supports true combined modes tests, mixing narrow-bands with fixed and sweeping sine tones in one test run.

Sine Control Workbook

The Sine Control Workbook offers a complete solution for closed loop shaker sine control testing, providing a safe, fast, accurate and reliable control algorithm. It allows the online acquisition and visualization of both proof-of-qualification and valuable engineering data.

Sine Notching

Sine Notching is a response-limiting option, limiting the vibration level at any channel (control- or measurement) to a maximum value, defined by the notch-profile. While the average control signal level will match its reference spectrum, the response at particular points of the tested object will be very different. Due to the resonances of the device under test, these responses could become unacceptably high, endangering the structural integrity of the tested object. Sine notching will enable you to effectively protect your test item.

Tracked Sine Dwell Workbook

The LMS Test.Lab Tracked Sine Dwell Workbook is a control package that supports in a user-friendly way tracked sine dwell tests, which aim at a structural qualification by injecting a prescribed amount of cycles (load reversals) of prescribed amplitude into the test item, while holding it at resonance condition. Next to an amplitude control loop, the system also closes a frequency control loop, to lock a specified resonance, based on a phase or amplitude criterion. It provides those facilities you need for productively qualifying test subjects on a shaker installation while gaining engineering insight in its dynamics. It allows the online acquisition and visualization of both proof-of-qualification and valuable engineering data.

Shock Control & Response Analysis Workbook

LMS Test.Lab Shock Control Workbook is a time-domain control package. It supports in a user friendly way the complete closed loop shaker control process. The system implements a safe, fast, accurate and reliable control algorithm. The workbook allows safe, real-time closed-loop control and monitoring; online viewing of instantaneous and averaged time histories, spectra and FRFs. It also delivers fast, easy and trouble-free setup definition.

Measured Pulse

LMS Test.Lab Measured Pulse allows the use of a stored pulse as a reference waveform for control, as opposed to a standard waveform such as a half sine pulse. The origin of such a stored pulse can be a measurement or the result of a synthesis exercise.

Advanced Shock Response Analysis

This add-in allows the computation of the shock response spectrum for a set of logarithmically spaced, tuned mass-spring-damper SDOF systems, subjected to base acceleration. The solution procedure provides an exact integration of the equation of motion by assuming a linear variation of the input acceleration over a time step. The analysis consists of two steps: a pre-calculation pulse correction, followed by the Shock Response Spectrum calculations. Overall, Primary and Residual response calculation are supported in positive, negative and absolute terms. Output quanitities include Acceleration, Velocity and Displacement.

Shock Response Synthesis

The SRS module synthesizes a time waveform that corresponds to a user defined shock response using a series of superimposed time wave components. The synthesis module is seamlessly integrated in the shock control workbook. The package accepts both measured and tabulated target SRS spectra in acceleration, velocity and displacement domains.

Time Recording During Online Sine Reduction

Enables the recording of continuous time histories parallel to online analysis based on fixed sampled spectra, without jeopardizing the performance of the online sine reduction. The recorded throughput data are directly written to TDF on a PC-hard disc.

Time Recording During Online Random & Acoustic Reduction

Enables the recording of continuous time histories parallel to online analysis based on fixed sampled spectra, without jeopardizing the performance of the online random & acoustic reduction. The recorded throughput data are directly written to TDF on a PC-hard disc.
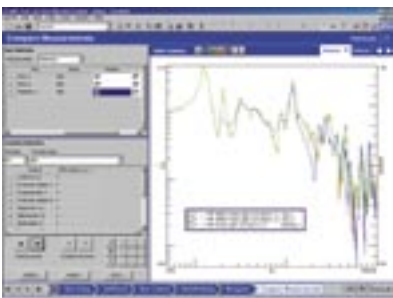
Easy point by point and/or function by function comparison of consecutive test runs for fast structural integrity checking.
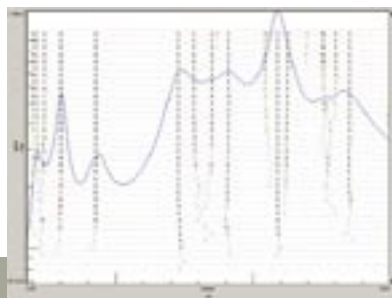
LMS PolyMAX: State-of-the-art modal parameter estimator, for cristal-clear stabilization diagrams, simplifying the modal analysis process and reducing operator dependency.
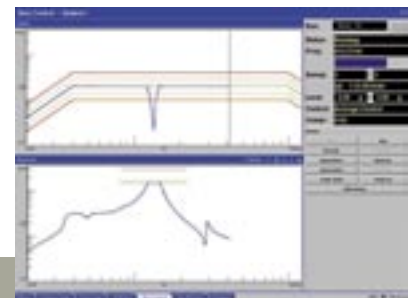
Sine notching option: from simple single point notching to multi-point specimen protection in support of space craft acceptance testing.

LMS SCADAS III Smart Transducer TEDS support

A smart transducer is an ICP type sensor with a programmable read/write memory, called TEDS (Transducer Electronic Data Sheet). Transducer characterics, such as model and serial number, brand name and sensitivity are stored in this memory and can be read through the LMS SCADAS III PQFA modules. The retrieved information is easily inserted in the channel list of all LMS Test.Lab acquisition applications. This automatic matching of transducers and input channels significantly reduces setup time and highly reduces the risk of wiring errors when a high number of sensors are used. Part of the TEDS memory is user-definable. The LMS specific usage of this option allows you to store the measurement point characteristics, such as point ID, position coordinates and Euler angles into the transducer. When this is done, the wireframe geometry can also be read from the transducers, along with the other information. This allows an automatic wireframe geometry creation in the LMS Test.Lab Geometry workbook.

External File Access

This option extends the browse, search, sort and access functionality of the Desktop to genuine SDF, UFF and Matlab file formats, making data from external applications accessible in LMS Test.Lab without file conversions.

Time Animation Workbook

Users can investigate deformation shapes starting from time recordings, and animate the structural deformation scrolling through the time axis like a slow motion camera. Users can select a range in which the animation will automatically scroll, with the possibility to pause and restart the animation at all times. Any analyzed vibration pattern can be stored for future detail analysis or reporting purposes.

Modal Analysis Workbook

The Modal Analysis workbook offers various fast and accurate single or multiple reference parameter estimation algorithms, and a complete set of modal model validation tools, such as MAC and FRF synthesis.

Operational Modal Analysis Workbook

Identification of modal parameters (resonance frequencies, damping and mode shapes), starting from user-selected segments of time data measured on a structure in operating conditions, for example a random or acoustic qualification test. A complete set of modal model validation, data re-synthesis and mode shape visualization tools is available.

LMS PolyMAX

PolyMAX is a state-of-the-art modal parameter estimator that gives superior stabilization diagrams, greatly simplifying the modal analysis process. It yields excellent results on lightly damped and complex structures and enables to effectively identify local modes. With the crystal-clear stabilization diagrams from the LMS PolyMAX parameter estimation algorithm, the analysis process is significantly simplified and operator-dependency of the resulting modal model is reduced.

LMS Test.Lab Environmental Overview

	8 Channel Qualification Testing TL-ENV-QUAL	8 Channel Automotive Component Qualification Testing TL-ENV-AUT	8 Channel MIL-STD Qualification Testing TL-ENV-MIL	36 Channel Design Validation Testing TL-ENV-DV-01	60 Channel Advanced Design Validation Testing TL-ENV-DV-02	128 Channel Online Sine, Random and Acoustic Data Reduction TL-ENV-DR
LMS SCADAS III Hardware						
LMS SCADAS 310 - Master frame with 10 slots, AC power and SCSI interface	1	1	1	1		
LMS SCADAS 316 - Master frame with 16 slots, AC power, SCSI interface					1	1
LMS SCADAS 317 - Slave frame with 17 slots for I/O Modules, AC powered						1
PQA - 4 channel Programmable V/ICP Signal Conditioner	2	2	2	9	15	32
SP92-B - 4 channel 24-bit DSP Signal Processor Module	2	2	2	9	15	32
PIC 34-0 - 0.4m Parallel Interface Cable for Master/Slave Configuration						1
PDT - Programmable Dual Tacho Input Module for Analog and TTL Signals						1
TL-ENV-REM - LMS Test.Lab Environmental Testing Remote Control	O	1	O	O	O	O
DSCU - DAC Shutdown Control Unit	O	O	O	1	1	
VDAC - Dual DAC Module for Output of Analog Signals	1	1	1	1	1	
PQFA - 4 channel floating /V/ICP©/TEDS signal conditioner	O	O	O	O	O	O
FIFO-2MEG - 2 Msample /channel FIFO for SP92						O
LMS Test.Lab Software						
LMS Test.Lab Desktop	•	•	•	•	•	•
LMS Test.Lab SCADAS 310 Driver	•	•	•	•		
LMS Test.Lab SCADAS 316 Driver					•	
LMS Test.Lab SCADAS III Driver (Full-Master/Slave)						•
LMS Test.Lab Random Control Workbook	•	•	•	•	•	
LMS Test.Lab Random Response Limiting	O	O	O	O	•	
LMS Test.Lab Sine on Random		•	•	O	O	
LMS Test.Lab Random on Random		•		O	O	
LMS Test.Lab Sine Control Workbook	O	•	•	•	•	
LMS Test.Lab Sine Notching	O	O	O	O	•	
LMS Test.Lab Tracked Sine Dwell Workbook	O	•	O	O	O	
LMS Test.Lab Shock Control & Response Analysis	O	O	•	•	•	
LMS Test.Lab Measured Pulse	O	O	•	O	O	
LMS Test.Lab Shock Response Synthesis			•	O	O	
LMS Test.Lab Online Sine Reduction Workbook						•
LMS Test.Lab Online Random and Acoustic Reduction Workbook						•
LMS Test.Lab Transient Capture Workbook						•
LMS Test.Lab Run Data Averaging & Comparison Organizer				•	•	•
LMS Test.Lab Geometry Workbook				•	•	•
LMS Test.Lab Operational Deflection Shapes Workbook				•	•	•
LMS Test.Lab Time Animation Workbook				O	O	•
LMS Test.Lab Advanced Shock Response Analysis		O		O	O	O
LMS Test.Lab Time recording during Online sine reduction						O
LMS Test.Lab Time Recording during Online Random and Acoustic Reduction						O
LMS Test.Lab SCADAS III Smart Transducer TEDS support (requires PQFA hardware)	O	O	O	O	O	O
LMS Test.Lab External File Access	O	O	O	O	O	O
LMS Test.Lab Modal Analysis Workbook				O	O	O
LMS Test.Lab Operational Modal Analysis Workbook				O	O	O
LMS Test.Lab PolyMAX				O	O	O

• = standard
o = optional

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