SignalStar™ Matrix

Single and Multi Axis Vibration Testing

Single Shaker

- High Measurement Channel Count
- Multi Channel Notching and Limiting
- Random and Swept Sine Testing
- Classical Shock and Transient
- SRS Synthesis and Analysis
- Mixed Mode Testing

Multi Shaker

- Control up to 16 shakers
- Control Single or Multiple Axes
- Random, Sine, Shock and SRS Testing
- Motion Replication
- Phase Control and Notching in Sine
- Phase & Coherence Control in Random



SignalStar Matrix unites the highly acclaimed Data Physics vibration control algorithms with high precision industry-standard Agilent VXI modular hardware to create a uniquely high performance shaker control system.

DATA PHYSICS CORPORATION SOLUTIONS IN SIGNAL PROCESSING

The Complete Solution

Redefining the boundaries

The real vibration environment for a structure is complex with multiple excitation sources. Even equipment spending most of its life on a desk or laboratory bench experiences the rigors of transportation from its place of manufacture. Critical components often operate in a harsh and hostile vibration environment. Using SignalStar Matrix, it is practical to perform more precise and realistic testing than ever before, using multiple shakers to simulate the complex environment realistically.



The SignalStar Matrix Solution

SignalStar Matrix is a uniquely high performance vibration controller that offers all of the features you need:

- Multi Shaker control for Random, Sine, Shock and Motion Replication applications
- Single shaker control for all control strategies including mixed mode
- Agilent VXI hardware
- Windows Operating System

Now it is possible for one vibration controller to serve the full spectrum of your testing needs. With SignalStar Matrix you can run all classical vibration applications including Random, Sine, Shock and Mixed modes with a clearer understanding of the responses all over the test item. SignalStar Matrix not only delivers unparalleled performance for every type of single axis shaker test, it also delivers the ability to control up to 16 shakers in multi-axis tests, working equally well with hydraulic and electrodynamic shakers. You can even reproduce real world environments using the Motion Replication software and perform Modal tests specific to validating design models.

When a structure is excited and controlled in a single axis, cross-axis motion is spurious and sometimes harmful to the device under test. Limiting or notching channels might be used to prevent damaging response levels. Special dynamic considerations apply when the structure is controlled in more than one axis. The SignalStar Matrix controller uses continuous control to adapt to the dynamics of the system under test. By compensating the cross-coupled dynamic responses to the multiple inputs simultaneously, control accuracy is kept high. Matrix offers independent reference definition of each control point with defined phase and coherence between control points.

Single Axis Single Shaker

Single axis single shaker testing is the backbone of vibration testing where the payload is mounted by fixture to the shaker table. This form of testing is ideal for vibration qualification and screening of components and substructures, which are compact and are easily attached to a fixture.

Single Axis Multi Shaker

Large products, particularly those that are physically long, such as missiles or space vehicles, may require more complex testing where more than one shaker is used to provide controlled vibration at different parts of the structure. This can involve the control of the individual vibration profiles and of the phase relationships between them.

Multi Axis Multi Shaker (Table)

Components and substructures can be tested on specially designed shaker tables with motion in many degrees of freedom. Seismic qualification tests are performed by mounting a test item to a large multi axis shaker table. Automotive sub-assemblies are tested on smaller multi axis tables.

Multi Axis Multi Shaker (Direct)

Entire automobiles, aircraft, turbomachinery and other large structures are subjected to the simultaneous excitation of multiple shakers, each directly attached to a point of environmental load input. This provides a realistic simulation of the operational loading under laboratory control. Motion Replication, such as road simulation, is often performed in this configuration.

Basics of Single Shaker Control

In single shaker control, the most basic objective is to make the shaker table (the *control* point) exhibit a defined motion, usually referred to as the *reference*, which may be defined in either frequency or time domain. The shaker is driven by a waveform computed to produce the defined motion on the shaker, which takes into account the system transfer function, **H**, between the *drive* signal and the measured *control* signal.

If the system consisting of the amplifier, shaker, fixturing setup and the device under test were a perfectly linear and time invariant system, achieving the required motion is relatively simple. In the frequency domain, the drive signal may be computed by multiplying the *reference spectrum* by the *inverse system transfer function*, $\mathbf{H^{-1}}$. In the time domain this is equivalent to convolving the *reference waveform* by the *inverse system impulse response*.

Unfortunately, even relatively well behaved systems such as electrodynamic shakers are not sufficiently linear, nor do they remain time invariant under test conditions. A closed loop control is required between the *drive* signal and the *control* signal that continuously adjusts the *drive* signal to maintain a match between the *reference* and *control*.

In continuous vibration modes, such as random, sine, time history replication or combinations of random and sine, substantial realtime computations are required to sustain the control loop. The filtering process, implemented as multiplication in the frequency domain or convolution in the time domain, receives continuous updates of $\mathbf{H^{-1}}$ from a realtime transfer function measurement process. Due to issues involving measurement accuracy and the time constant of measurement, an error between *control* and *reference* may develop, in which case the feed forward component of drive signal generated by the filter process is combined with a feedback component based on the error signal.

In more advanced operations, several measurement points may be combined to form the control signal by a *weighted average* or an *extremal average*. This permits averaging table acceleration at several locations to de-emphasize dynamic fixture deflection, for example.

Other measurements at critical locations within the test object may be used as “notching” inputs, each with a “do not exceed” profile. These measurement channels become part of an automated “cross-over control” scheme wherein any location in danger of being over-tested immediately becomes part of the control loop. Additional channels may be defined as “limit channels” that serve as watchdog measurements to log an alarm or stop the test when any prescribed limit profile is exceeded.

In order that the user can observe the match between reference and control, a display has to be sustained, either in frequency domain or time domain depending on the mode or type of vibration test. This display is maintained by a separate measurement and analysis process.

Understanding Multiple Shaker Control

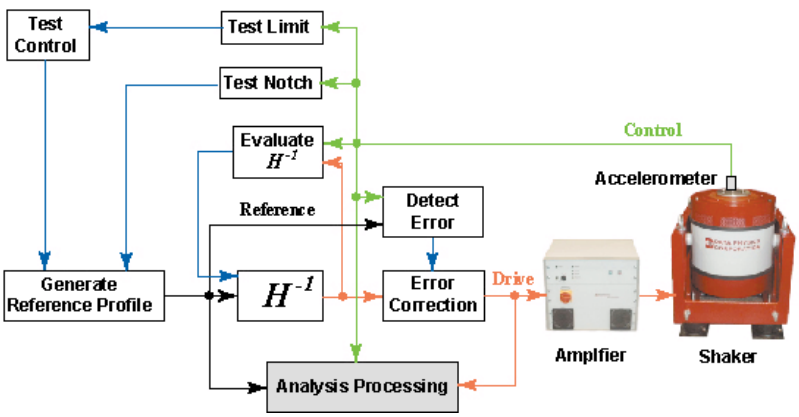
Controlling multiple shakers to simultaneously produce vibration that matches multiple references is not essentially different except for the complexity resulting from each control point receiving a contribution from every shaker. The solution therefore involves the measurement of a multiple input multiple output (MIMO) matrix of transfer functions between all the shakers and control points. Sometimes the number of control points has to be more than the number of shakers because not all control locations will experience sufficient vibration from every one of the shakers to enable the continuous measurement and evaluation of the transfer function matrix. This situation referred to as ‘over specified’ reference, requires a statistical error reduction technique, adding complexity to an already complex mathematical process.

Today SignalStar vibration controllers deliver higher accuracy and performance due to the superior control algorithms resulting from better appreciation of physics and the ever increasing computational rates of the processors.

Control Versus Analysis Parameters

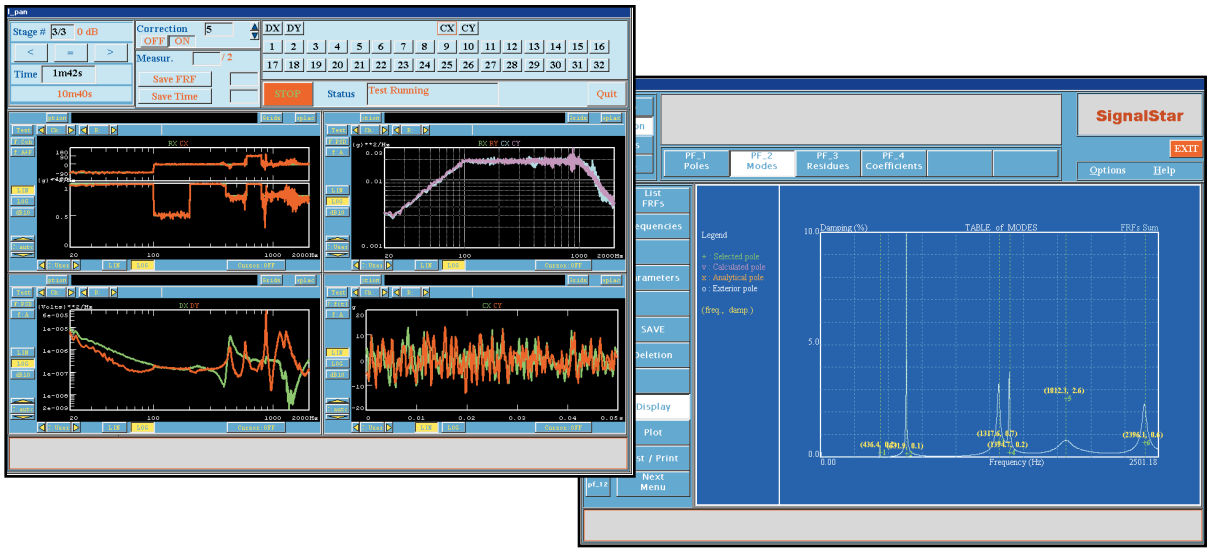
Control parameters match the loop dynamics to the device under test and provide excitation in accordance with a prescribed profile. These parameters include bandwidth, averaging methods and constants and control loop filter characteristics. The control loop must be optimized for continuous and rapid response to system changes during the test.

Analysis parameters describe the type and characteristics of additional measurements extracted from the test. Analysis measurements may be averaged over a longer fixed or moving interval to derive the statistical confidence required by test specifications.



Random

Random control is the backbone of vibration testing methods used in most environmental test labs today. Multi shaker random testing simulates the real environment more effectively than using only a single shaker. Whereas single shaker random testing excites all structural responses simultaneously, it does so within the constraints of the fixture and frequently by testing the product several times in different axis. By applying controlled vibration at more than one point in the same axis, or in different axes, the test can be performed more effectively and in a fraction of the time taken with a single shaker test. Phase and coherence control between shakers allows the interactions between these sources to be realistically modeled.



Random Single Shaker Control

Matrix defines the industry standard for random testing with key features including rapid loop response, high dynamic control range and independent on line analysis capability. During the test, transfer functions, auto & cross spectra and time histories can be measured and stored. The measurement parameters are entirely independent of the control loop parameters and may be optimized for the analysis task.

High Channel Count Response Measurement

Matrix provides the ability to monitor hundreds of response points during the test. This permits complete characterization of the test item.

Notching (Single and Multi Shaker Control)

For very critical payloads such as space vehicles, it is often necessary to provide additional protection to the test object by monitoring key parts of the structure to ensure that safe levels of vibration are not exceeded. This is accomplished by assigning one or more measurement channels to be Notching inputs. Each of these is continuously compared to its own uniquely specified spectral profile and Grms level. When the limiting levels are reached on any notching channel, shaker control automatically changes to the notching criteria, reducing input to protect the test object.

Alarm and Abort Limiting (Single and Multi Shaker Control)

The control profile specification includes both Alarm (log event) and Abort (stop test) limit profiles to guard against over/under testing. Similar profiles may be assigned to any measurement that is designated as a Limit channel.

Random Multi Shaker Control

In a multi shaker random test, Matrix excites all shakers simultaneously to maintain the desired response at each control point. Individual profiles for each control point, together with the desired phase relationships and coherence levels drive this process. Measured Auto and Cross Power Spectral Density data on file can also be used for a closer reproduction of real operating conditions.

Reference profiles can be defined in different ways. Power Spectral Density profiles always define each control point. They may specified by a breakpoint table or measured and stored auto spectra. If the multiple control points are not to be related to each other, this description is complete. For phase control between control points, one of the two following specifications must be made:

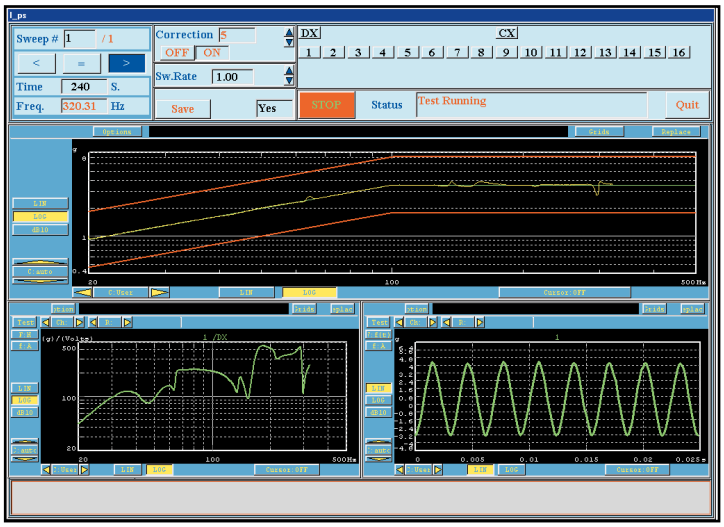
- Cross Power Spectral Density profiles between control points (Magnitude & Phase) from stored measurements
- Coherence and Phase profiles between control points entered as breakpoint tables

Modal Analysis From High Energy Shaker Tests

Curve fitting, modal parameter extraction and animated display can be performed from data acquired during a random test using an optional software module. Unlike conventional modal analysis methods, this approach allows the modal parameters to be measured at energy levels comparable with the real environment and is particularly useful for the testing of nonlinear structures. Use of multiple shakers permits distributed energy input, avoiding local over stressing.

Sine testing can be extremely severe. Structural resonances can be excited to high response levels and fatigue can be efficiently induced.

By extending the traditional single shaker swept sine test to multi shakers, potential failure modes can be more efficiently simulated and studied. Phase control between multiple shakers adds the ability to specifically seek or suppress particular vibration patterns. SignalStar Matrix is capable of controlling up to 8 shakers in this mode while simultaneously analyzing and acquiring data.



Sine

Single Shaker Sine Control

SignalStar Matrix performs sine testing to the highest control standards in the industry. Its high channel count capability assures that all critical locations within the payload may be monitored, analyzed and protected by notching and limiting.

Low Frequency Control

At low frequencies displacement is high and acceleration is low. Control at low frequency using an accelerometer measurement can be virtually impossible. Matrix allows the combined use of displacement transducers and accelerometers for low frequency control. A smooth and progressive transition between these sources provides robust control.

Predictive Control

In swept sine control, the instantaneous evolution of the transfer function always lags the current excitation frequency. Hence, its contribution to the control loop can only be *predictive*, using $\mathbf{H^{-1}}$ measured from a prior sweep. The sine control loop is fundamentally stabilized by *instantaneous* error feedback. Including *predictive* feedforward can provide smoother and more precise control. Matrix allows the operator to specify how influential (0–10) the predictive feedforward component will be on the total control.

The transfer function measured during selfcheck is used to initially predict the response and assist the controller in achieving accurate stable control at all frequencies. The system continuously refines this predictive transfer function as a multi sweep test progresses, assuring an ever improving control result while remaining sensitive to possible structural changes.

Resonance Search & Dwell

Sine testing is ideal for the study of structural responses at resonance. Typically, when held at resonance, a structure rapidly develops fatigue, leading to eventual failure. The key control requirement when performing resonance dwell is to continuously excite the resonance, automatically tracking the changing characteristics of the structure under test.

The operator can use system cursors to select which resonances are tracked after the search phase. Tolerance boundaries can be defined for the system to abort or alarm when pre-defined criteria are breached. SignalStar Matrix has a unique capability to define the control profile used during the dwell phase to be different from the profile used during the search phase. In this way the severity of the initial search can be kept low with an automatic transition to a different severity of test for the resonance dwell.

Multi Shaker Sine Control

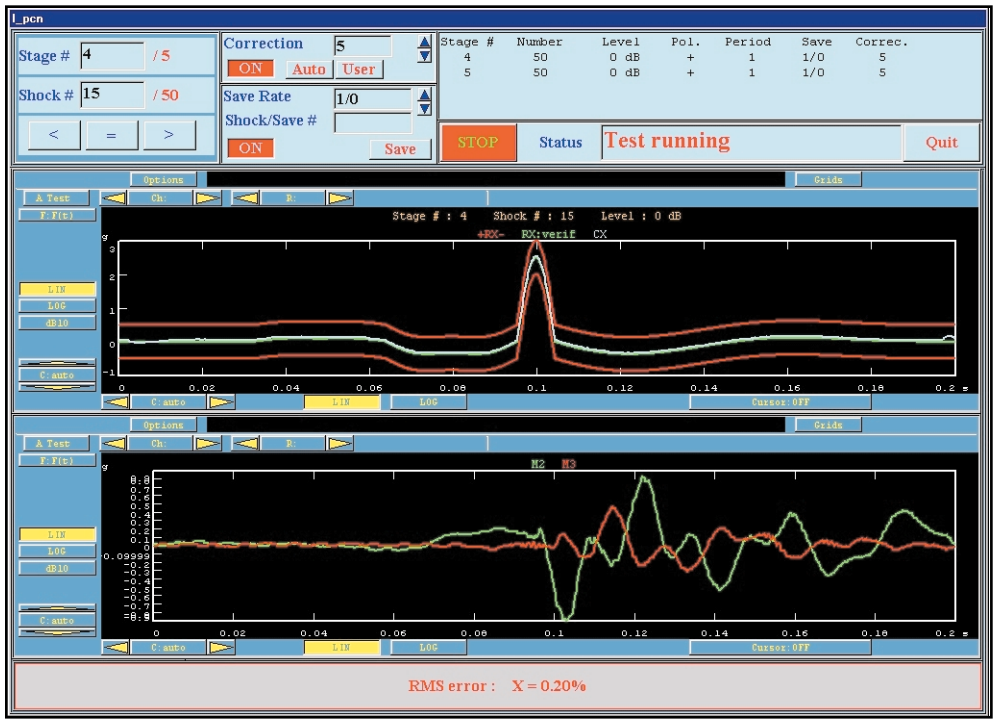
Multi shaker sine testing is used widely in the automotive and defense industries on large or complex shaped structures where two or more shakers are employed to provide excitation in one or more axis. Matrix controls up to 8 shakers in sine on one payload simultaneously.

Phase Control Between Control Points

Each control point may be defined by a magnitude and phase profile. If the phase between control points is not required to be controlled only the magnitude profiles are specified. The SignalStar matrix system has efficient algorithms for maintaining controlled responses in amplitude and phase in real time.

Notching and Limiting

Payloads such as space vehicles are extremely delicate and irreplaceable if damaged. SignalStar Matrix allows precise protection of sensitive parts of the payload with notching and or limit functions in both single and multi axis control modes. Limit channels can be assigned to provide alarm or abort functions and notching channels actively modify the control level to ensure that maximum vibration amplitudes are not exceeded on critical parts of the structure. The notching function is flexible and can be based on a level or individual spectral profile for each channel.



Many shock tests can be achieved on electromagnetic or hydraulic shaker systems. Classical and transient shock testing on a shaker is an efficient alternative to drop testing bringing the advantages of better accuracy and repeatability. Performing shock testing using an electrodynamic shaker imposes physical limitations due to the available armature displacement and shaker/amplifier power rating. Shock testing using hydraulic shakers can solve the displacement problem but introduces other limitations such as poor high frequency response and non-linearity. SignalStar Matrix shock algorithms have evolved to make the best possible use of available armature displacement and to efficiently handle the dynamics of shock testing with both electrodynamic and hydraulic shakers. Extending the shock test to multiple shakers allows testing of products and components more effectively and with greater efficiency.

Shock Control

SignalStar Matrix excels in both single and multi shaker shock control roles. All tests are performed with the same degree of flexibility in either single or multi shaker control applications. Up to 16 shakers can be controlled in multiple degrees of freedom with a SignalStar Matrix system. Up to 20 individually controlled shocks per second can be sustained.

SignalStar Matrix excels in reproducing classical shock waveforms or real life (measured) transients. Measured data can be imported from an ASCII file or transferred directly from any of the Data Physics SignalCalc family of dynamic signal analyzers. The transients can be defined and controlled in Acceleration, Velocity, Displacement, Force or User Defined units.

Shock Response Spectrum Analysis

SRS analysis of the control and measurement waveforms can be performed, either as an online function during the test or as a post processing function with any of the SRS analysis functions derived from: Primary, Residual, Positive, Negative and Maximum. The analyzed SRS profile can be used as the RRS (required response spectrum) reference in the SRS control module.

Optimized Control

PreTest

The feasibility phase of test preparation enables the specified capabilities of the shaker system with payload to be compared with the demands of the shock test. If the feasibility stage advises so, the operator can go ahead with the test in confidence. The feasibility module allows prediction using “what if” scenarios so that an understanding of the maximum feasible test levels can be obtained without the need to perform a full level shaker test.

Correction Strategy

To provide the maximum flexibility when dealing with non-linear test situations, the user can specify the type of correction strategy as time domain, frequency domain or a combination of time and frequency strategy.

Limit Channels

The structure can be protected using limiting channels. Any of the available measurement channels on the system can be assigned as limiting channels so that should a predefined response level be reached during the test, the limit channel will either alert the operator with an alarm or will stop the test.

Shock Response Spectrum (SRS) is an appropriate way to characterize the damage potential of a transient. SRS characterizes an input transient in the frequency domain whereas transient control requires the reproduction of a time history reference profile. Control is effected by generating sine wavelet trains at discrete frequencies with controlled delay, phase, amplitude and shape. The precise characteristic of the series of wavelets is synthesized so that the required shock response spectrum profile is achieved. FFT techniques are not adequate to represent transient environments. SRS control applies a concept of equivalence between different time histories. For example, two different time histories will have two different FFTs but they could have the same SRS, hence the same severity. SignalStar Matrix provides an accurate, high speed SRS Synthesis & Analysis capability to facilitate SRS testing in either single or multi shaker modes.



SRS Control

The design stages of product development frequently involve Finite Element modeling (FEM) where the transient response of sub structures is usually characterized using SRS techniques. The SRS control reference (RRS) can be obtained from the average or the envelope of several transients; it can also be edited taking into account some areas of the frequency bandwidth where adjustments to the severity are required. SRS vibration control involves synthesizing a complex time history (accelerogram) constructed from a series of sinusoidal wavetrains (wavelets). The frequencies generated correspond exactly to the frequencies in an SDOF array; the timing or phase relationship between wavelets and the number of cycles in each wavelet is controlled.

Efficient Synthesis

Matrix synthesis algorithms optimize the crucial and difficult process of generating the accelerogram automatically. Optimization of the polarity and phase relationship between the component frequencies assures a balanced and natural SRS transient that is similar to the actual environment. In the past, the synthesis process has consumed relatively long periods of time. Matrix performs the calculations in a fraction of a second with full convergence within a few seconds reducing test time.

Wavelet Components

Each component is compensated to finish at zero velocity and displacement for full protection of the structure. Damped Sine provides a better physical shape. Sine Beat components can also be used in some cases. For example, Sine Beat can sometimes enable a high energy RRS to be run with a lower acceleration and displacement requirement than damped sine. Sine Beat can be useful for pyrotechnic shock. SignalStar Matrix offers a choice of wavelet components to match your testing requirements.

Powerful SRS Calculation Algorithm

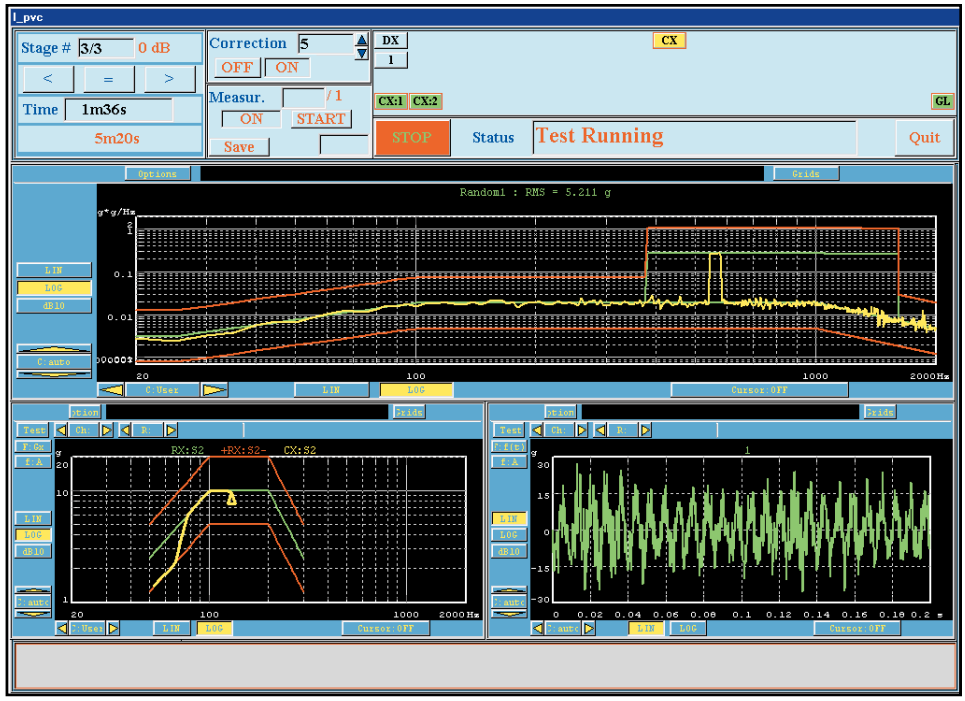
SRS calculation is performed with a highly refined algorithm that enables the SRS of the control and all measurement channels to be calculated in real time.

Correction Strategies

The control reference is selectable as time domain, RRS or frequency domain, each has its own benefits:

- Time domain control places priority on the reproduction of the synthesized accelerogram. This mode can be advantageous when the structure under test is nonlinear, where the transfer function matrix is poor or if an external time domain reference is being used.
- RRS correction strategy places priority on conformance to the SRS profile.
- Frequency domain correction is useful for repetitive testing, where an equalized transfer function can be stored and used immediately to restart a previously equalized test. For some types of test a mixed correction strategy is useful; in this case, either RRS+Frequency or Time+Frequency can be used.

Mixed Mode*



Mixed mode testing is a complex control task, which combines a shaped random background profile with separate sinusoidal or narrowband random components superimposed and controlled independently.

This form of testing is used to simulate the vibration environment on a structure where there is a mixture of broadband and cyclic or repeating energy. For example, vibration induced in a helicopter from the engine and the rotor blades is simulated by mixing sine tones and random. Gunfire is simulated by mixing narrow band random with broadband random. The narrowband components can be turned on and off rapidly to simulate the gunfire more realistically.

Mixed Mode Control

In Mixed Mode testing, the control loop must function to maintain strict control against a reference that is the simultaneous combination of a continuous random background and pulsed or swept components which may be sinusoids or narrowband random signals. SignalStar Matrix provides for the generation of this “mixture” of inputs and provides separate analysis paths for each signal type.

The broadband random component is defined in exactly the same way as for a conventional random test. A profile defined in the random control module can be used in a mixed mode test. Matrix mixed mode supports up to 16 different sine or narrowband components superimposed on random for a single test.

Each of the 16 components can be programmed as stationary or sweeping. Each sweeping component can have its own independent profile with its own sweep rate, start frequency and programmed time for starting during the test. Gunfire components are narrow random bands programmed to burst on and off at defined repeat and duration rates.

Displays

Individual windows can be assigned for Random and Sine component displays. Additionally, the behavior of each tone can be plotted as a function of time for the entire duration of the test proving that a tone, which has been programmed to change in level or to modulate on and off during the test, has fulfilled its programmed function.

OnLine Interactivity

The online control of the test adds even more flexibility. The test status area at the top right corner of the graphics display not only shows the status of each measurement channel, control and drive channel, it also shows the status of each programmed tone. Using simple mouse commands, any of the superimposed tones can be turned on or off, and put in sweep or pause mode. For each tone, the online display provides an indication of sweep number, current frequency and level.

* Single Shaker Only



Motion replication enables a product or structure to be tested with real life data rather than approximating the environment using random or sinusoidal vibration test techniques.

By using recorded data from road or flight tests for example, a more realistic vibration environment can be reproduced assuring a higher level of quality in the test results.

Motion Replication

Offline Control vs. Online Control

Until recently, replication of even a short segment of road/flight required many hours of computational time to create and iterate an equalized drive signal for a reasonably accurate simulation. Data Physics engineers have created innovative algorithms, which allow this process to be performed continuously during the test with only a short pre test preceding the full test. Today, SignalStar Matrix can replicate a recorded history of unlimited time length online without resorting to hours or days of offline computation. This is possible even when multiple shakers (up to 16) are used to simultaneously replicate the time histories at multiple test points

SignalStar Matrix enhances test integrity by incorporating limiting channels for offline control where response levels can be continuously monitored and the test shut down or an alarm provided to alert the operator in the event that the defined alarm levels are reached.

Reference Editing

Digitized files are ready for instant use in SignalStar Matrix simulation. Frequently though it is necessary to manipulate the data first before the simulation process is run. For example, the final file used in the test might consist of sections cut from several other files to represent different road surfaces, or the data may need to be passed through a digital filtering process to remove unwanted frequencies, or it may need to be converted from one form to another.

The SignalStar Calculator pre and post processing tool set performs these and many other tasks. It consists of a programmable signal processing calculator module, a file database and search module, an import export module and a utility for temporarily holding data files while they are being processed. A scanner module enables the whole throughput file to be viewed as a single compressed display and then for the operator to zoom in to a display of selected portions. The zoom window can be scanned through the entire file for detailed visual inspection and to identify and mark the areas.

Data Acquisition and Analysis

The time history to be reproduced is generally part of a larger file or is a selection of time histories from different files that have been combined to form a sequential test. Matrix captures the data if necessary or transfers (imports) the data digitally if it has already been acquired. A standard digitizing tool called SCOPE is included with the SignalStar Matrix simulation software. SCOPE enables live or tape recorded data to be acquired through the Agilent VXI front end for high accuracy digitized versions of the original time history.



Additional Features

Data Review & Report Generation

Data review and report generation is smooth and efficient with Matrix systems. Report layouts can be designed using the page design toolkit. Design the page with precisely positioned logo's, bitmap images, borders, test parameter information and up to four graphics windows. An unlimited number of designed pages can be stored for immediate recall. The SignalStar Matrix system also stores text files which record not only the set up for each run but also a log of every action taken by the user and every system message generated during the test. Plotting and generation of reports can be automated for efficient reduction of large volumes of data.

Test Sequencer & Remote Control

Using the test sequencer module, any number of vibration tests can be sequenced to run automatically. Tests can be any control mode in any sequence or order. Simply browse the test directory and drop the required tests into the run table. SignalStar controllers can be interconnected with Automatic Test systems or chamber controllers using logic signals or relay closures to initiate the test operation. The status of the test can be monitored from a remote location using status bit outputs from the remote control module.

Offline Processing with Calculator and Toolbox

The Matrix calculator and toolbox module is a powerful stand alone utility for the management, post processing and administration of stored data. The module has 3 main modes, Calculator, Import/Export and Display/Report Generation.

The report generator is the standard module included with all Matrix application packages giving the user a powerful and flexible tool for professional quality hard copy. Stored data can be dragged from the data base list and dropped into two or 3 dimensional display windows, all necessary scaling and units information is automatically carried with the data which can then be measured and viewed with the cursor toolbox ready for reporting.

If the stored data is not already in the final form required, the Signal Processing Calculator can be used to perform math functions and scientific/engineering manipulation.

The calculator looks and operates like a desktop scientific calculator. It performs its functions on numeric arrays including stored measurements. Simple keystroke operators perform basic math functions. A macro facility provides user key programming, allowing a sequence of operations to be performed rapidly and repeatably. A library of pre-defined macros is included with functions such as low, high or band pass filtering of time domain data.

The calculator and toolbox module is a natural companion to the Motion Replication software. Time history data can be prepared by segmenting, splicing, filtering, etc to create the final files for use.

Although designed primarily for use with Data Physics SignalStar or SignalCalc products, the calculator and toolbox module is compatible for both import and export of data with Universal Files and ASCII files.



Field Upgradeable

Any SignalStar Matrix system purchased as a single shaker or multi shaker system may be field upgraded to provide both types of control. Input and output channel count may be expanded in the field. Every software module may be subsequently added to expand the repertoire of a system initially purchased for more limited applications. The modular nature of SignalStar Matrix provides convenience, economy and unrestricted growth potential to the user.

Scalable Hardware Solution

Agilent VXI modules (described overleaf) are housed in mainframes, which are available in several sizes. Because the VXI system is *plug and play* you can bring many modules together for your large channel count testing needs, and retain the ability to build several smaller systems for more routine lower channel count work.

Industry Standard Interface

IEEE-1394 FireWire is a very high-speed interface which is standard on many computers and which can be added at very low cost to your existing PC. Alternatively the National Instruments MXI-2 interface can be used for large systems, offering synchronous sampling across multiple mainframes.

Industry Standard Modular Hardware

The SignalStar Matrix Hardware System

SignalStar Matrix operates on industry standard Agilent VXI hardware. The VXI input and output modules contain on-board DSP and are housed in a mainframe linked by a high-speed interface to a Windows NT computer. Varying types of mainframe and input/output modules provide a highly flexible system that can be optimized for any size of application.

- VXI is an industry standard with plug and play architecture, where modules can be added or removed easily without the need for special installation support. The VXI mainframe interconnects with the host computer using either an IEEE-1394 FireWire interface or a National Instruments MXI-2 interface.
- Multichannel systems generate large amounts of data, fast. Matrix software, together with the VXI data acquisition system operate in harmony to deliver the highest degrees of data integrity with ultra low noise and high dynamic range.



Input Modules

20 kHz Bandwidth

The Agilent **E1432A** module is ideal for most shaker controller applications. It provides 4, 8 or 16 simultaneously sampled 16 bit input channels. It has a maximum sample rate of 51.2 Ksps delivering a usable bandwidth of up to 20 kHz for all channels.

76.8 kHz Bandwidth

The Agilent **E1433B** module is ideal for systems where very high sample rates are required such as in high frequency shock testing. It provides 4 or 8 simultaneously sampled input channels of 16 bit precision and has a maximum sample rate of 196 ksps, delivering a usable bandwidth of up to 76.8 kHz.

These data acquisition modules can be supplied with voltage coupled inputs or (optional) Charge, ICP or microphone signal conditioning.

Output Channels

1 to 16 low noise, wide dynamic range shaker drive outputs can be configured on each Matrix controller to match the number of shakers being driven by the system.

Multiple Output requirements

The Agilent **E1434A** is a high precision multichannel output module offering two or four 16 bit shaker drive outputs and two constant output level analog (COLA) companion signals. Agilent option **1D4** adds a fifth drive with COLA.

Single Output requirements

Each Agilent **E1432A** or **1433B** input module can support one Agilent **1D4** option delivering a 16 bit shaker drive signal and COLA, making it an ideal selection for single shaker systems.

VXI Mainframes

Compact and Portable

The Agilent **E8408A** 4-slot "C size" mainframe is ideal for small systems with up to 32 input channels and 2 shaker drives.

Mid Range

The Agilent **E1421B** 6-slot "C size" mainframe serves mid-range systems of up to 80 input channels and 5 shaker drives.

Very High Channel Count

The Agilent **E1401B** 13-slot "C size" mainframe supports large systems such as 16 shaker drives with 144 input channels or 176 input channels and up to 11 drive outputs.

Mainframe to PC Connection

Single Mainframe Systems

The Agilent **E8491B** module provides IEEE-1394 FireWire interface to your PC. Option **001** provides the complimentary PCI board for your computer. FireWire provides "hot plug-in" operation and uses a flexible 4.5 M cable.

Multiple Mainframe Systems

The National Instruments **VXI-PCI 8015** provides a VXI module and PCI card communicating over a two-cable Multisystem eXtensing Interface (MXI-2).

Computer Requirements

- Windows NT or 2000 Operating System
- 800 MHz Pentium III CPU or faster
- 128 MB RAM or more
- 30 MB of available hard disk space
- 1024 x 768 or higher resolution monitor
- FireWire port or available PCI slot
- CD-ROM drive; 3 button mouse

Solutions for Noise and Vibration Applications

Data Physics designs and markets high performance solutions for noise and vibration applications.

SignalStar Shaker Controllers

The SignalStar family of controllers includes Matrix for multi-shaker, multi-axis control and Vector for single-axis control. SignalStar Matrix is scalable and flexible, addressing the entire range of shaker testing from single shaker to multiple shaker applications in one or more axes controlling up to 16 shakers. This high-end controller provides Random, Sine, Sine-on- Random, Random-on-Random, Sine & Random-on-Random, Shock, SRS, Road Simulation, and Sine Reduction. Vector covers all modes of shaker control and is the choice for single shaker applications offering a powerful solution for stress screening, environmental test, production test, remote control, remote monitoring and automated test.

SignalCalc Dynamic Signal Analyzers

The SignalCalc family of Dynamic Signal Analyzers provides highly accurate measurements in the time, frequency, amplitude, and order domains. Data Physics offers a range of hardware platforms including the 1.8 ounce, two channel SignalCalc ACE, the portable variable channel SignalCalc 430 in your PC, the SignalCalc Mobilyzer which is a network peripheral configurable as 2 to 16 channels and the high channel count SignalCalc 620 which uses Agilent VXI hardware. SignalCalc Dynamic Signal Analyzers offer Connectivity across networks and applications through ActiveX technology. Consistency of the intuitive user interface design across all products results in higher productivity for both casual and experienced users. Compatibility of data and results gathered by Data Physics controllers and analyzers with other industry standards ensures efficient interchange with popular design and analysis programs.

• Connectivity **• Consistency** **• Compatibility**

DATA PHYSICS CORPORATION SOLUTIONS IN SIGNAL PROCESSING

Data Physics Corporation has offices throughout the U.S., wholly owned subsidiaries in France, Germany, and the UK, a branch office in China, and distributors in major markets around the world. To place an order, obtain pricing, delivery, or other information, please contact the Data Physics representative near you.

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