

UNHOLTZ-DICKIE CORP.

APEX SL

Vibration Control



From the Industry's Premier

Electrodynamic Shaker Supplier

Vibration Test Equipment

www.udco.com



The Apex SL is a versatile and reliable Vibration Controller serving the basic needs of production testing, but also offering advanced control features & analysis capabilities to meet the most demanding engineering test requirements.

This new level of technical capability is made possible by combining a powerful Intel Quad Core processor workstation for graphics display and storage, with a separate SlimLine (SL) control chassis dedicated to signal processing and real time control. Advanced hardware, an intuitive user interface and precise control algorithms are integrated with a Microsoft Windows 7 O/S platform. Apex SL is the new industry standard.



- Host Computer includes Powerful Intel Quad-Core Processor, 20" LCD Display, Microsoft Windows 7 64 Bit Operating System
- Compact Slim Line (SL) Chassis (17" W x 9" D x 1.75"H) and Lightweight Design (6.5 lbs), Rack Mountable in 1U Spacing
- 24-Bit ADC and DAC, 120 dB Dynamic Range (typical)
- "Home Page" Operational Hub provides an easy to use, Familiar Starting Point
- Full Factory Integration, Calibration and Test prior to Shipment
- Extensive Library of Software Control Modules: Random, Sine, Shock, ROR, SOR, SRS, RD, Burst-Chirp, TRAC, Transducer Calibrator
- Extensive Protection and Safety Features
- Simple, Intuitive User Interface
- Basic and Advanced Applications, Data Acquisition & Analysis, Specialized Custom Testing
- Available in 4, 8, 12 or 16 Input Channel Configurations with Constant Current Supply
- Compact for Field Use



Sleek Hardware Design

The **APEX SL's** all new hardware design consists of a Slim Line control chassis (dedicated to real-time control applications) interfaced through a simple high speed USB connection to the host computer (for user test configuration, monitoring and storage). The Slim Line Chassis is readily configured for 4, 8, 12 or 16 input channels. Additional channels (up to 16 total per Slim Line Chassis) can be added in the field with convenient plug-in circuit card modules.

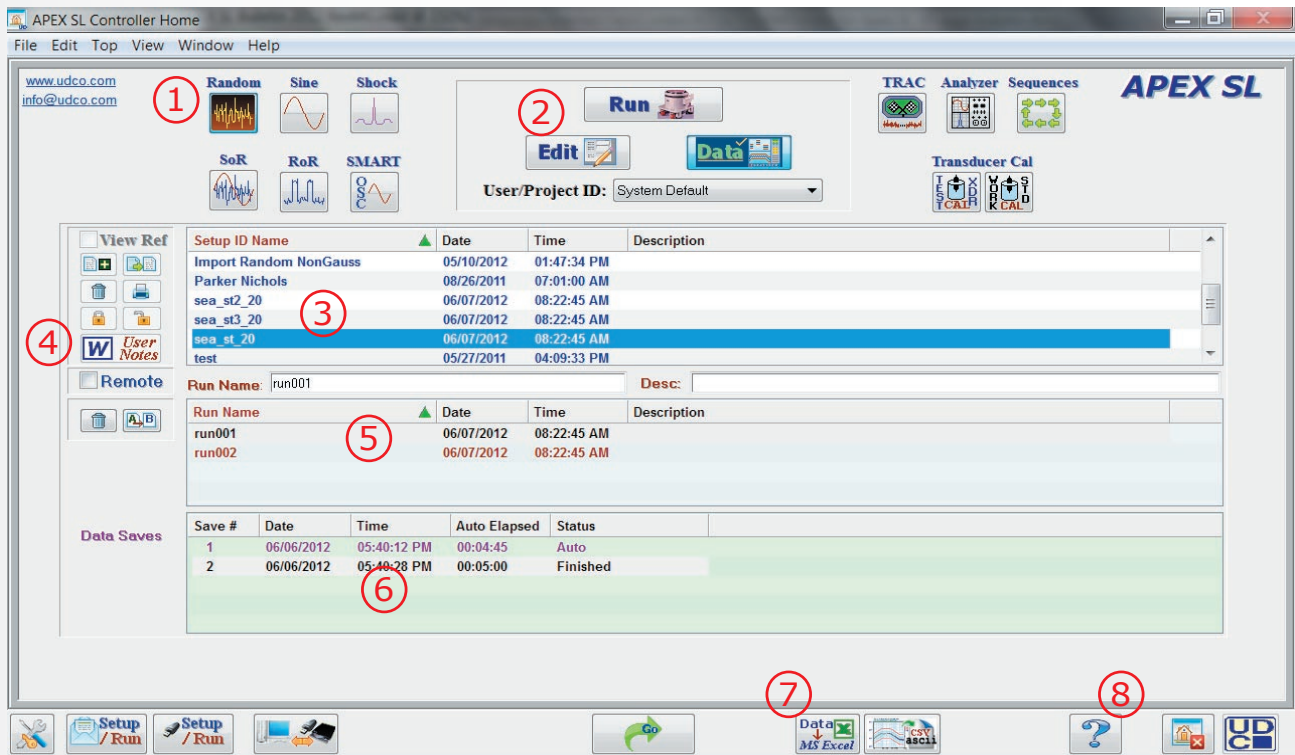
Advanced DSP Architecture

The **APEX SL** advanced architecture incorporates three Digital Signal Processor's from ADI. The versatile and proven SHARC and Blackfin processors are the industry standard for high performance and power efficiency. This powerful hardware set is used exclusively for control loop processing and host communication, assuring accurate real-time control and simultaneous data acquisition, while all graphics related processing is reserved for the host computer's Intel Quad-Core Processor.

APEX SL HOME PAGE

A key APEX SL feature is its **"Home" Page**. The Home Page provides a set of functional "push-button" icons that allow quick and easy, single-click access to all controller functions, including the Run Test, Edit/Create Test and View Test Data modes, and a host of system configuration utilities. Three large scroll-down windows organize and list all test setups and test data currently stored on the system, while Export Data command icons enable extensive data conversion utilities. Simple, organized and intuitive, APEX SL reduces the test engineer's workload while increasing test lab efficiency.

In comparison, most competitive Controllers do not offer a centralized starting location. In these lesser units, controller functions are accessed using overlapping, multi-layered pull-down menus, requiring extensive Windows file manager type operations. Test Setups and Data are scattered in different directories on the hard drive, resulting in a poorly organized conglomeration of files and folders that can lead to mis-placed information and the inability to locate test data when needed.



1. Test & Analysis Modes: Button selection for Random, Sine, Shock, Analyzer, SoR, ROR, etc.

2. Operational Modes: Button selection for Run Test, Create Test, Edit Test, View Test Data

3. Test Setup: Previously created setups are listed and accessible with a convenient scroll-down window. Tests are easily accessed, started, and data retrieved via the setup I.D.

4. User Notes: Save important test information in a Word doc that's exclusively linked to the selected Test Setup. Paste photos (fixture/UUT, accelerometer locations, etc) into this handy reminder document.

5. Test Run Names: Run name is automatically generated based on a sequential numbering system (RUN1, RUN2, RUN3, etc.) each time setup ID is run, or can be customized.

6. Data Saves: Multiple data saves at different times during the test are stored automatically under the run name (above).

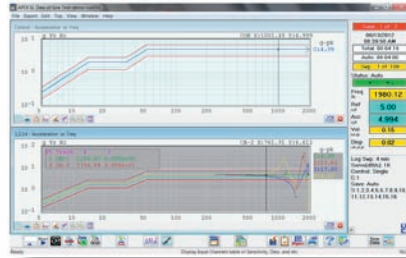
7. Export to Excel: Single click to export data direct to an MS Excel Spreadsheet for off-line processing.

8. On-line Help: Single click to view extensive on-line HELP information.

TEST CONTROL / SPECS

Sine

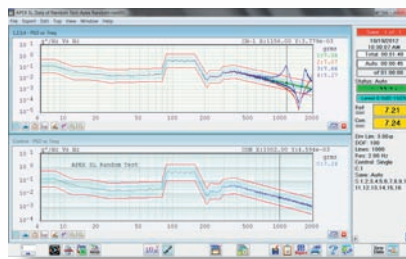
- * 2-5,000 Hz (10kHz option) Frequency Range
- * Sweeps with Constant Accel, Vel, Displ (or slped) Segments (200 segments)
- * Control Types: Single, Average, Extremal Channel, Limiting
- * Digital Tracking Filter Each Channel
- * Log/Linear Sweeps: Selectable Servo Speeds
- * Channel Limiting with Individual Segments
- * Sweep Time 5 sec - 160 minutes (or Sweep Rate)
- * Reference Spectrum Alarm & Abort Limits
- * Individual Channel Abort Limits
- * Amplitude, Phase, Ratio, Spectra Displays
- * Fixed Frequency Tests (100 frequencies with Amplitude and Duration)



- * Manual Hold/Sweep, Reverse, Selectable Frequency & Amplitude
- * C.O.L.A. One Volt Output at Test Frequency with Freq Trim
- * 2000 Displayable Frequency Points
- * Automatic Data Saves and Printing
- * Automatic Search and Listing of Resonances including Ratio, Phase and Q-Value
- * RTH Run Time History Graphs Display Average Amplitudes versus Time
- * Amplitude, Phase, Ratio, Spectra Displays
- * Instantaneous Accel, Vel and Displ Control Amplitudes
- * Input Signal Circuit Clipping Indicator

Random

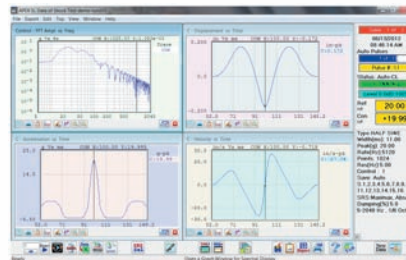
- * 250, 500, 1000, 1250, 2000, 2500, 3000, 4000, 5000 Hz Bandwidths (10kHz option)
- * 250, 500, 1000, 2000, 4000 Lines (0.0625-20 Hz Res)
- * 256 Breakpoints (Freq/Ampl or Slope)
- * Control Types: Single, Average, Extremal
- * DOF Selectable 25 - 1000
- * Level Scheduling & Looping including pre-test levels
- * Instantaneous Level Changes (without resetting averaging)
- * Reference Spectrum Alarm & Abort Limits (selectable # lines)
- * Notch/Limiting with Individual Breakpoint Tables for each Channel (256 points each)
- * Spectrum Alarm & Abort Limits (# lines selectable)



- * Fast Loop Time (100 msec at 10 Hz res)
- * Drive Sigma Limiting (2-5, none)
- * Manual Adjustment of Level and Pause/Resume
- * Use Stored Drive for Quick Starting
- * Automatic Data Saves and Printing
- * Automatic Search and Listing of Resonance
- * Gaussian (std) and non-gaussian (option) Amplitude Distribution
- * RTH Run Time History Graphs Display Average Amplitudes versus Time
- * Import ASCII PSD for Reference
- * Import Time Data and Create Random PSD Reference
- * Input Signal Circuit Clipping Indicator

Shock

- * Halfsine, Sawtooth, Trapezoid, Triangle, Haversine
- * Pulse Width 0.2 msec to 6 sec
- * Sample Rate 1.024 to 51.2 kHz (100 khz for imported waveforms)
- * Sample Points to 8192 (16,394 for imported waveforms)
- * Level Schedule Including Amplitude, Polarity, Delay, Open/Closed Loop, # Pulses & Looping
- * Compensation Pulses provide Optimized Displacement and Velocity; selectable pre & post negative compensation
- * Selectable High Frequency Control Range for Improved Performance



- * Sync Pulse Output for External Triggers
- * Import ASCII Reference Time waveforms for real world crash, bump, drop tests, etc.
- * Impact Pulses (Haversine and Halfsine) Defined by Velocity Change & Pulse Duration, pre & post Coast Time.
- * Automatic Data Saves
- * Individual Channel Abort Limits
- * Average & Maximum Absolute Abort Limits
- * Seismic Pulse Control (30 second waveform) option

SOR (Sine-on-Random)

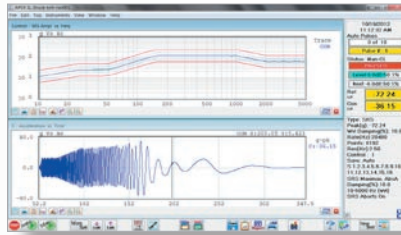
- * Includes General Features of Sine and Random
- * Up to 12 Tones Combined with Random (Harmonic or Non-harmonic)
- * True Tones (not narrowbands of random)
- * Swept or Fixed Tones
- * Digital Tracking Filter for each Tone
- * Shaped Reference for Each Sweeping Tone
- * Multiple Tones with no Random



- * Wide Frequency Range to 5,000 Hz.
- * Separate Sine and Random Spectrum Displays for Test Verification
- * Gunfire (option) Selection of Tone on/off Period
- * Level Scheduling
- * Abort Limits for Each Tone and Random PSD
- * Level Scheduling
- * Manual Mode to Adjust Level and Enable/Disable Selected Tones

TEST CONTROL / SPECS

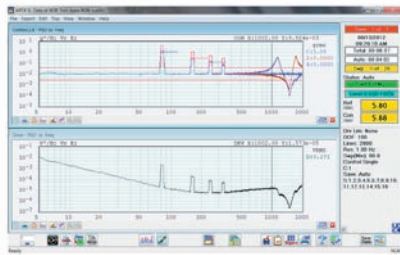
SRS (Shock Response Spectrum)



- * Up to 512 SRS Breakpoints
- * Automatic Iterative Generation of Wavelets, including Frequencies, Polarity, Number of Halfcycles, Delay, and Amplitude
- * Wavelets provide optimized velocity and displacement and smooth FFT (no holes)
- * Edit Mode to Customize Wavelet Parameters
- * Maximax, Positive or Negative Primary
- * Up to 100 Wavelets
- * 1 Hz (min), 10 kHz (max) SRS Control
- * SRS Frequencies – Wavelet Frequencies or Octave Spacing 1/n (n = 1 to 24)
- * Damping of 0 to 25% (Q = 2 to 50)

- * Display Time Waveforms, FFT, SRS, Ratio spectra
- * Measurement of T_e and T_E as defined in Mil Std 810
- * Import ASCII SRS Breakpoint Table (up to 500 points)
- * Narrow Pulse Parameter reduces Pulse width T_e and T_E
- * Selection for Maximizing Waveform Res.
- * Damped Sine and Burst Random Waveforms (option)

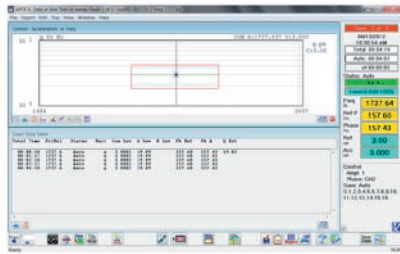
ROR (Random-on-Random)



- * All Features of Random Tests
- * Up to 12 Narrow Sweeping Bands
- * Harmonic or Non-Harmonic Bands
- * Automatic Calculation of Harmonic Narrow Bandwidths and Swept Bandwidths
- * Flat or Shaped Baseband
- * Flat or Shaped Sweeping Narrowbands

- * Minimum 1 Hz Narrow Bandwidth
- * Minimum 2 Hz Sweep Band
- * Sweep Times up to 99 Hours
- * Level Scheduling or Select Number of Sweeps
- * Static and Dynamic Abort Limits

Resonance Dwell



- * Locate, Lock-on and Track Resonance by Phase Lock
- * Amplitude and Phase Control Channel Independently Selectable
- * Amplitude Reference Selectable for Acceleration, Velocity, or Displacement
- * Phase Reference Selectable as Absolute or Difference Between two Channels
- * Phase Amplitude +180 to -180 Degrees

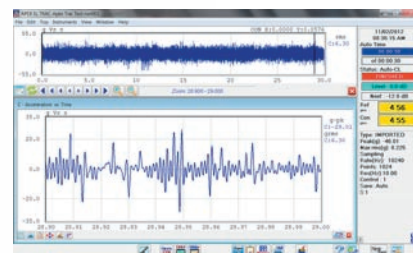
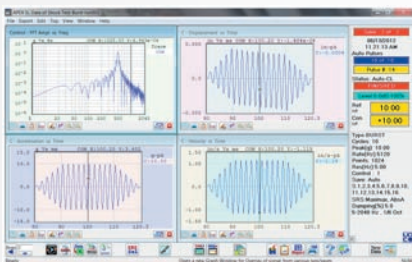
- * Duration Selectable for Time or Cycles
- * Upper/Lower Abort Limits for Freq & Ampl
- * Dwell Log Table Periodically Updated including Frequency, Amplitude, Phase and Time
- * Manual Controls to Modify Amplitude and Phase
- * Strain Control Option
- * Automatic Sweep, Search and Dwell

Burst & Chirp

- * Burst:
 - Short Duration Fixed Frequency Sine Wave (100 msec to 6 seconds)
 - Selectable Amplitude
 - Selectable # of Cycles, Ramp Up and Down Cycles
 - Level Schedule includes Amplitude, # of Pulses
- * Chirp:
 - Short Duration Fast Sinusoidal Sweep (100 msec to 6 seconds)
 - Selectable Frequency Range
 - Selectable Sweep Rate
 - Shaped Envelope (32 Freq/Ampl Pairs)

TRAC (Time Replication Acceleration Control)

- * Time Domain Control (Replicate Time Signal)
- * Closed Loop Real Time Control
- * Long Duration Reference (120 Minutes @1024 Sampling)
- * Utilize DATAcq Saved Data or Other User Acquired Field Data (ASCII File) As Reference
- * Looping / Cycling of All or Part of Waveform
- * Manual Selection of Level and Time Segment(s)
- * Display Full Time Waveform & Zoom
- * FFT Analysis of Zoomed Range
- * Channel Abort Limits (Grms, dB, peak)



SECURITY & SAFETY

WORKSTATION SECURITY

- Secure System Log-on
- Multi-user Password Protection
 - Enable/Disable Individual Test Modes
 - Selectable Delete & Edit Protection
- Default Selections for Setup Parameters and Graph Attributes
- Verification Check of Setup Entries (invalid tests cannot be run)
- Basic Hardware Check at Test Startup
- Abort Checks Active Even While Running Other Windows Applications

SYSTEM DIAGNOSTIC TESTING

- Selectable Open/Closed Loop Operation
- Manual Level and Frequency Adjustment
- SMART Tool Oscillator and Monitor Mode

SHAKER RATING LIMITS

- Maximum Shaker Ratings Entered (Accel, Vel, Displ, Input Voltage)
- Tests Not Permitted that Exceed Ratings

SIGNAL INTEGRITY

- Low level System Startup Check
- Open Channel Continuous Check (broken cable, bad accel, charge amp, etc.)
- Excessive Noise Check (ground loops, faulty cable, elec. pickup, etc.)
- Intermittent Signal Check
- Control Channel Proportionality Check with Drive

CIRCUIT PROTECTION

- Input Over Voltage Protection
- Output Short Circuit Protection
- Selectable Maximum Range

TEST SPECIMEN DYNAMICS CHECKS

- Upper & Lower Control Spectrum Alarm & Abort Limits
- Individual Channel Abort Limits
- Individual Channel Limiting/Notching
- Average & Absolute Error Checks (Shock)
- 100% Real Time Operation
- Single Channel, Average & Extremal
- DC Measurement & Selectable Abort Amplitudes

MANUAL STOP MODES

- Simple Button Click
- Key Command
- Closed Contact Switch Input
- Emergency Stop Button
- Abort Output Status Signal
- Abort "beep" Indicator

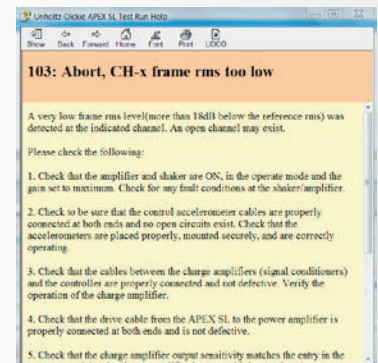
DRIVE SIGNAL SAFETY

- Selectable Maximum Voltage Limit
- Selectable Safe Low Level Startup
- Selectable Ramp-up Rate
- Smoothly Ramped Level Transitions
- Fast Tapered Shutdown
- Selectable Sigma Limiting
- D/A Clipping Check



ABORT DIAGNOSTIC MESSAGE

- Abort Notice Provided
- Recommended Corrective Action
- Automatic Print/Save of Abort Data

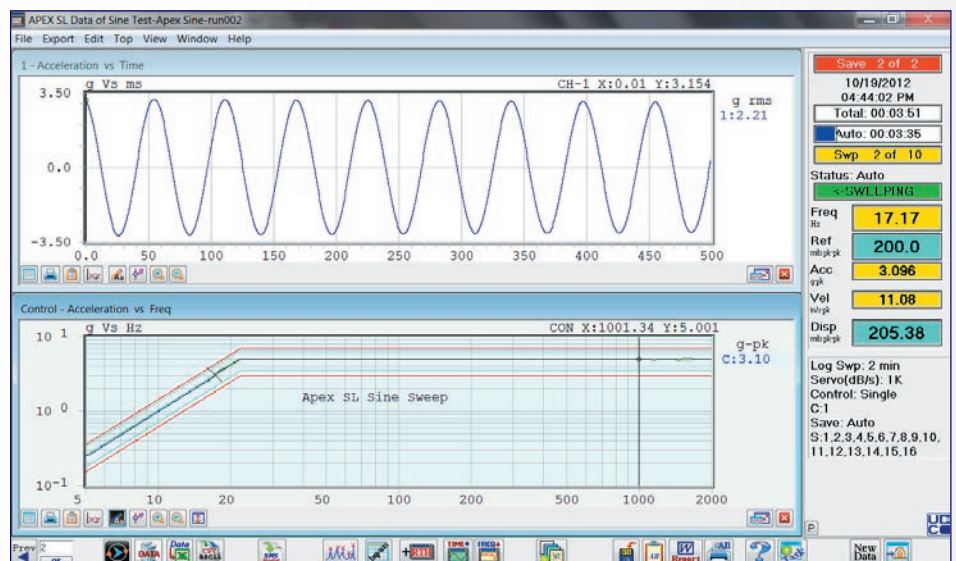


TIME WAVEFORM VIEW

Time graph display inputs are available for Sine, SMART, Random, SOR and ROR Test modes. For off-line data analysis, an optional Stream to Disk feature allows high speed time data streaming direct to an external storage device such as a USB hard disk drive.



Stream TIME DATA to disk



SMART TOOL

The **SMART Tool** is a powerful software addition to the popular APEX SL control/analysis workstation. It not only provides the standard capabilities of a stand-alone sinusoidal oscillator, but also provides measurements and spectrum displays of the resulting vibration when driving the shaker system. These features are extremely useful in establishing system confidence checks of the complete Vibration Test System, performing fixture and test specimen vibration surveys, troubleshooting system faults, and aiding in preventive maintenance.

- Manual, Open Loop adjustment of Sine Drive Voltage and Frequency; 2–5,000 Hz (10 KHz Optional)
- Run "**Pencil Check**" to confirm armature travel matches display on Controller screen
- Run Bare Armature Signature to check armature Fn and evaluate armature suspension health
- Selectable Acceleration, Velocity, Displacement Limits and Voltage Output for Safe Operation
- Verify correctly entered accelerometer sensitivities, plus cable integrity and 60 Hz noise levels
- Perform Fixture/UUT vibration survey to find **resonant** and **anti-resonant** frequencies
- From Survey, **select optimum control accelerometer location(s)**

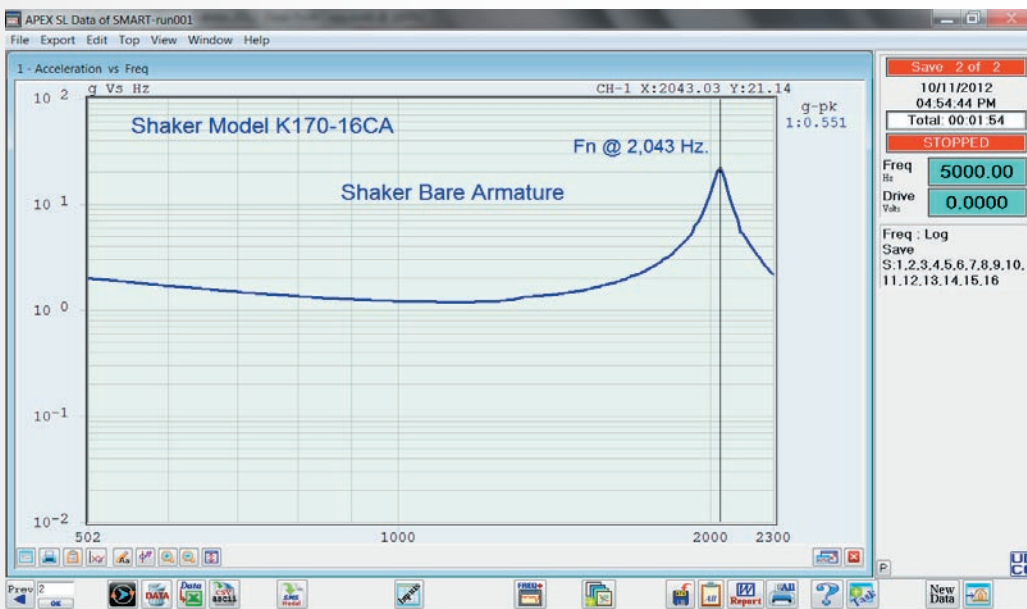
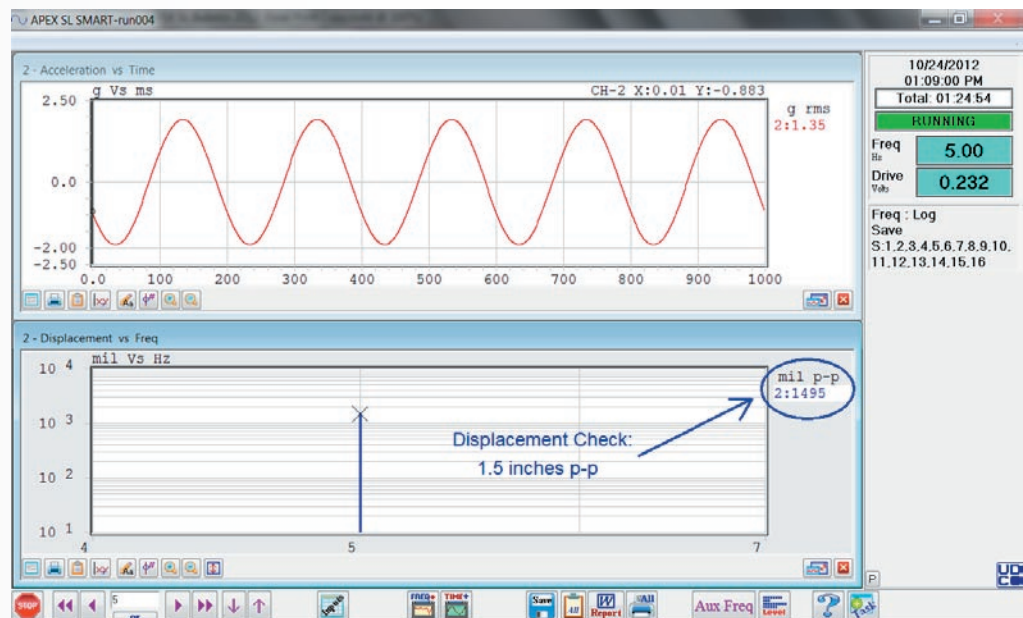


Fig. 1: Bare Armature Signature verifying Armature Fn

Fig. 2: Bare Armature Displacement run used with "Pencil Check" (shown with acceleration vs. time domain waveform display)



FIELD DATA TEST CREATION

Data Collection

Import Data & Process

Shaker Test

Random Spectrum Data



RANDOM (Power Spectral Density)

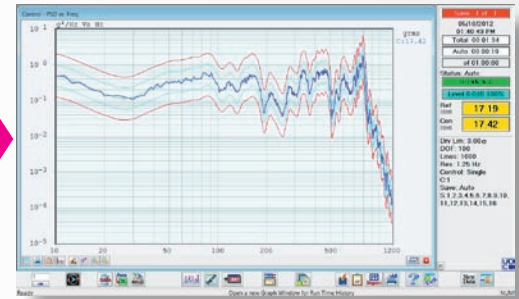
Import and Processing of APEX SL Analyzer Data or other ASCII File PSD Data:

Editing Tools:

- Set Low Frequency
- Set High Frequency
- Display Spectrum
- Rescale Amplitude
- Smoothing Filter
- Modify Amplitudes

Selectable Alarm & Abort Limits (+/-)
Spectrum Summary (Max Accel, Vel, Displ)

Random PSD Test



Random Time Data



RANDOM (Time Data)

Import and Processing of APEX SL Time Data or other ASCII Time Data File:

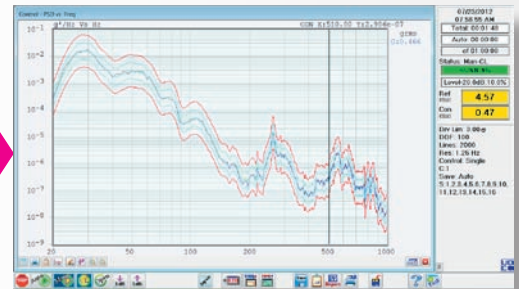
Editing Tools:

View Trends including RMS, Mean, Standard Deviation, Kurtosis and PSD*Freq

View Display Probability Density Function (PDF)

Review min, max and average PSD
Rescale and Smooth
Append Data Files
Delete Sections
Select Gaussian/Non-Gaussian

Random PSD Test



Transient Shock Data



SHOCK (Short Duration Pulses)

Import and Process of APEX SL Transient Capture Data or Other ASCII Time Data File Selections:

Editing Tools:

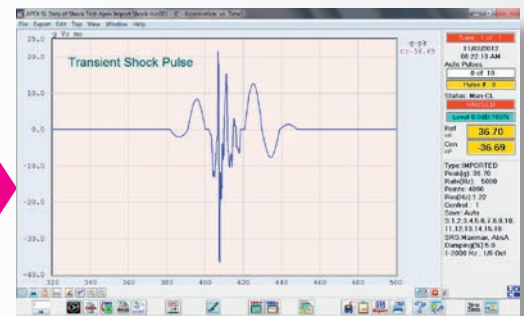
- Rescale Amplitude
- Filter (HP, LP)
- Reposition
- Truncate
- Set Control Frequency
- Expand Frame
- Modify Sample Rate

Display Imported Accel Time Graph:
Calculate & Display Accel., Velocity, Displacement, Time Graphs and Acceleration FFT

Compensation Pulse Selections:

- Compensation (yes/no)
- Type (pre and/or post)
- Pre & Post Coast Time Selection
- Amplitude Limit

Shock Test



Accel (g) vs Time Data



TRAC (Long Duration Waveform)

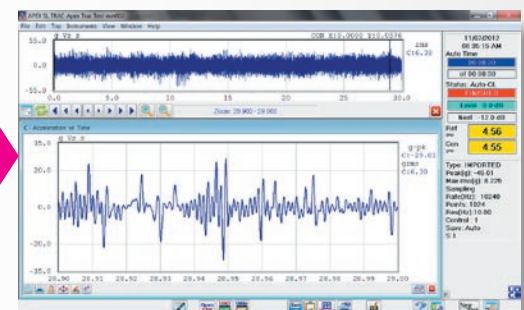
Import and Processing of ASCII Time Data File or Apex SL Data Acquisition file:

Editing Tools:

- Rescale
- Filter (HP, LP)
- Delete Sections
- Append Data Files

Display Imported Time Graphs, FFT, Zoom Time & FFT Waveform Summary (Max Accel, Vel, Displ)

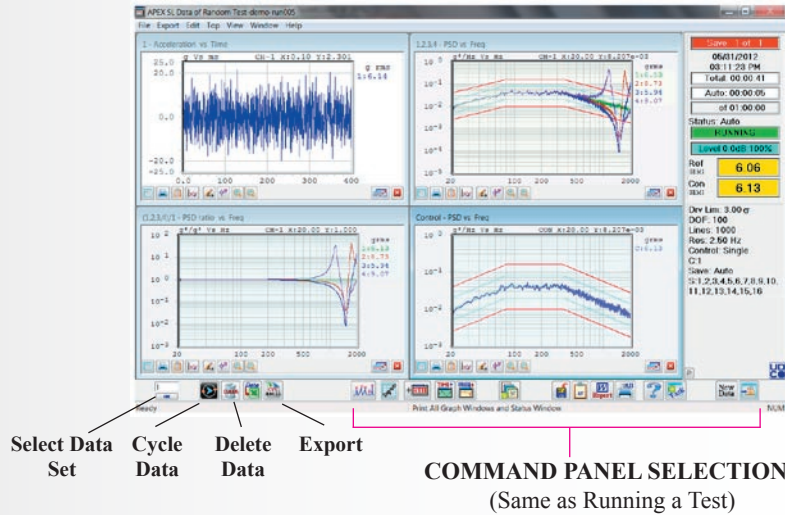
TRAC Test (long time waveform)



DATA STORAGE / RETRIEVAL

APEX SL incorporates a powerful, easy to use **Test Data Manager** utility, which provides extensive listing, retrieval and configuration capabilities of the stored test data. Data can be saved manually during the test and/or automatically at selected intervals throughout the test, at the end of the test or on an abort condition. All test graphs are saved, regardless of which are displayed at the time of save. The retrieved data is conveniently graphed and configured exactly as it appeared during the test or can be reconfigured.

In addition, an **Export Data** utility allows stored data to be exported as a full screen display (see Test Reports below), in tabular format (ASCII), or direct to Excel file format (CSV) and selected SMS Modal and UFF Data.



AUTOMATIC TEST REPORT One mouse click

UNHOLTZ-DICKIE Corporation Random Controller data for MS Excel
 Setup Name demo Run Name run005 Save Number 1
 Saved Date 05/31/2012 Saved Time 03:11:23 PM
 Total time:00:00:05 Auto time:00:00:05
 Test Mode Auto Test Status RUNNING
 Test Level:0.0dB
 DOF:100
 Sigma Drive Limit:3.0
 DOF: 100
 Lines: 1000
 Res: 2.50 Hz
 Control: Single
 C1
 Saw: Auto
 S:1,2,3,4,5,6,7,8,9,10,
 11,12,13,14,15,16

Chan #	Sensitivity mV/(g)EU	Interface	Max. Rate g/Hz	Units	Units	Desc	Description
1	10	SE	100	STD			g
2	10	SE	100	STD			g
3	10	SE	100	STD			g
4	10	SE	100	STD			g
5	10	SE	100	STD			g
6	10	SE	100	STD			g
7	10	SE	100	STD			g
8	10	SE	100	STD			g

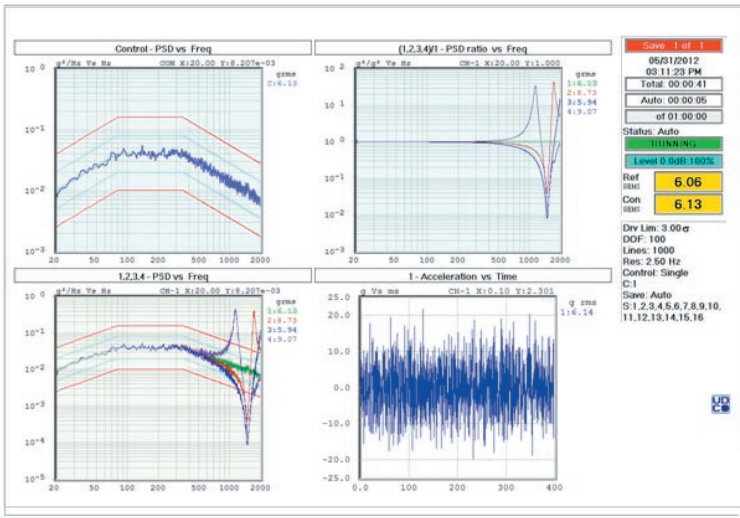
Pt	Frequency (Hz)	Referenc (g ² /Hz)	Control (g ² /Hz)	Drive (V ² /Hz)	HInv (V/g)	Chan:1 (g ² /Hz)	Chan:2 (g ² /Hz)
2	2.5	0	2E-08	0	0	2E-08	3.1E-07
3	5	0	4E-08	0	0	4E-08	2.1E-07
4	7.5	0	1.1E-07	0	0	1.1E-07	2.2E-07
5	10	0	3.3E-07	0	0	3.3E-07	4E-07
6	12.5	0	5.63E-06	0	0	5.63E-06	5.77E-06
7	15	0	0.000285	0	0	0.000285	0.000286
8	17.5	0	0.002993	0	0	0.002993	0.002999
9	20	0.01	0.008207	0.000672	0.284948	0.008207	0.008221
10	22.5	0.01125	0.01079	0.000426	0.207261	0.01079	0.010807
11	25	0.0125	0.011307	0.000349	0.177455	0.011307	0.011326
12	27.5	0.01375	0.014755	0.000289	0.140523	0.014755	0.014777

ABC Corp. Random Test Report

SETUP NAME: demo
 SETUP COMMENTS: Demo Example Setup.
 May be run in loopback (Drive connected to Ch1).
 RUN NAME: run005
 SAVE NUMBER: 1

STATUS INFORMATION

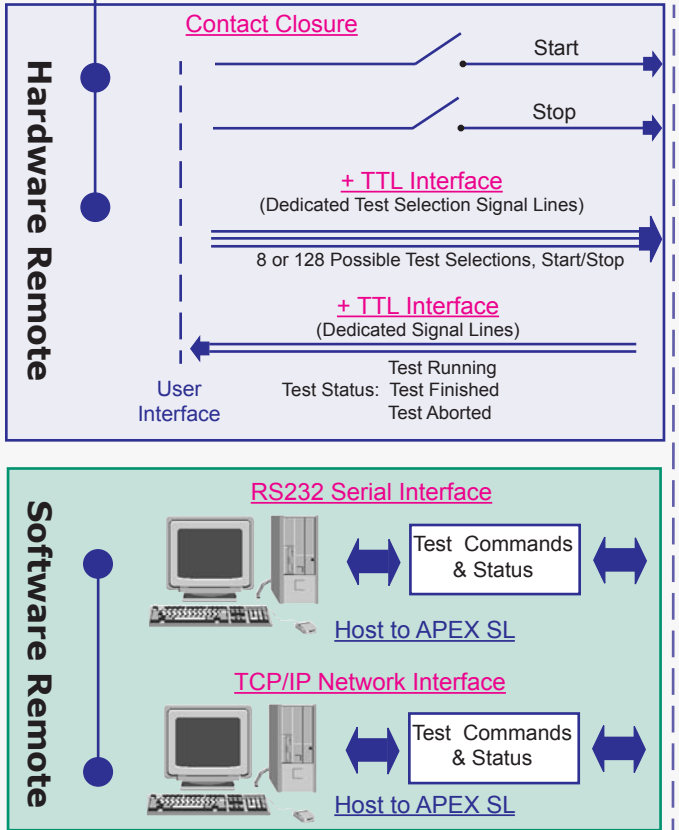
TEST EVENT TIME: Thursday, May 31, 2012 at 03:11:23 PM
 TEST STATUS: RUNNING
 TEST MODE: AUTO
 TOTAL TIME ELAPSED (HH:MM:SS): 00:00:41
 AUTO TIME ELAPSED (HH:MM:SS): 00:00:05
 TEST LEVEL: 0.0 dB
 REFERENCE: 6.06 g rms
 CONTROL: 6.13 g rms



Each Apex SL is supplied with Microsoft Word and Excel Software for convenient test reporting and exporting data.

Apex SL includes an Automatic Report Generator Utility that creates a Test Report as a Word document with one mouse click. Once created, the Test Report can be saved as a Word doc for future review, printed or sent as an email attachment. This single click, template based feature utilizes MS Word, making report editing simple and efficient. Test Reports can be enhanced by pasting in camera shots of the Shaker/Fixture/UUT hardware configuration for a customized, professional Test Report document.

Remote Operations (Optional)



Apex SL offers three Hardware / Software configurations that allow remote control of the vibration test.

- 1. Digital I/O:** Start-Stop-Status-Test Select from Environmental Chamber Event Relay Digital Logic. Two levels are available (3-bit for selection of up to 8 tests, or 8-bit for up to 128 test selection)
- 2. RS232:** Software communication with external host computer over RS232 serial interface.
- 3. TCP/IP:** Software communication with external Host computer through ethernet connection.

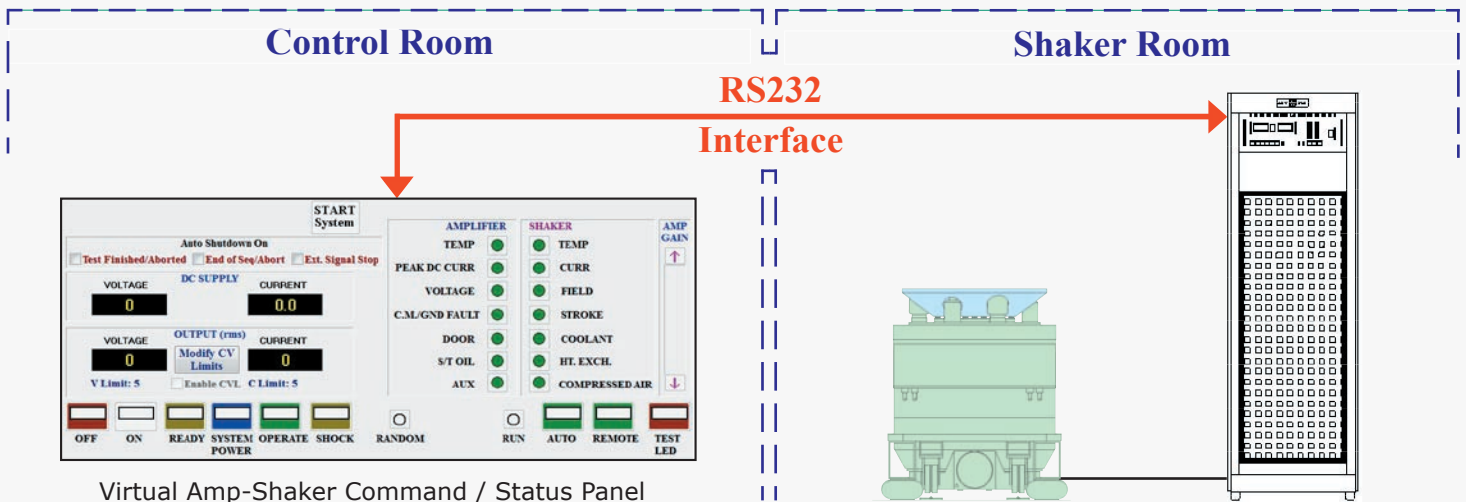


APEX SL



SA-COMMAND LINK (Optional) Amplifier / Shaker Remote Operation

APEX SL offers an optional RS232 Amplifier/Shaker interface which includes a software command/status panel to operate UD's SA type amplifier/shaker systems. The SA-Command Link provides identical functionality as the standard SA Amplifier front panel switch buttons, LED status indicators and current/voltage meters. Amplifier current and voltage limits can be set for added test item and system protection. In addition, it provides a "power save" selection to automatically power down the UD SA Amplifier/Shaker system after a test has finished or aborted. Now the complete UD test system can be initiated, monitored, and controlled from one convenient centralized location!



UNHOLTZ-DICKIE CORPORATION

World Headquarters
West Coast Division
European Division
Website:

6 Brookside Drive, Wallingford, Connecticut 06492
409 N. Pacific Coast Hwy #132, Redondo Beach, CA 90277
Karl-Unsin-Str. 1 D-83059 Kolbermoor, Germany
www.udco.com

Tel: (203)265-3929 FAX: (203)265-2690
Tel: (310)316-0275 FAX: (310)347-4120
Tel: +49 8031 234 734 FAX: +49 8031 234 735
E-mail: info@udco.com