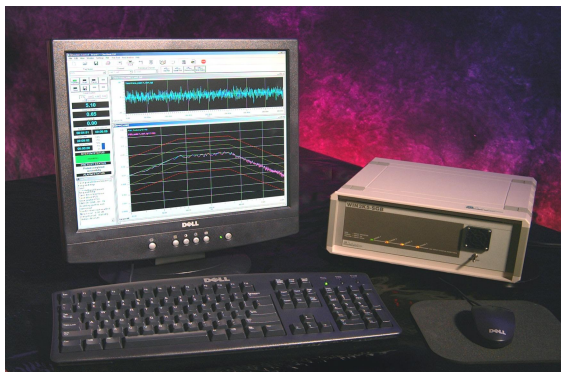
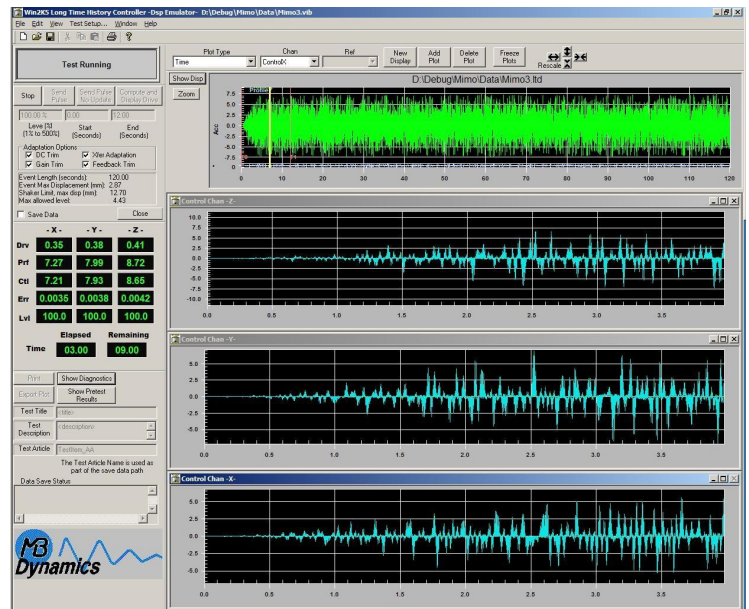




Multi-Axis Vibration Control, on a Budget **CommanderCONTROL-MIMO**

A test item's "End-Use" vibration environment imposes multiple load inputs from multiple directions. A realistic test lab simulation should do the same. Now, MB's **CommanderCONTROL-MIMO** makes it reliable and affordable.

- ❖ **Control up to 4 shakers simultaneously**
- ❖ **Control to unique vibration profiles for each shaker**
- ❖ **Reproduce measured time histories at each load input**
- ❖ **Combine multiple vibration profiles and excite all frequencies simultaneously using PSD random**
- ❖ **Control Skewness and Kurtosis**
- ❖ **Diagnose test item issues and resonances with sine excitation**
- ❖ **Use up to 8 input accelerometers**
- ❖ **Oversee tests with clean and simple displays of control, monitor and drive signals; time and frequency domain**
- ❖ **Perform design verification, durability, qualification, S&R, production/quality audit, MIL-STD, and fatigue tests**
- ❖ **Compensate simultaneously the cross-coupled dynamic responses from multiple shakers**
- ❖ **Error-check test condition with pre-test loop check**
- ❖ **Protect from over-test by limiting any channel with unique alarm/abort profiles**
- ❖ **Protect test item & equipment with continuous loop checks**
- ❖ **Minimize cost of controller for multi-axis tests**
- ❖ **Minimize time from road or field data to running tests with extensive tools for reducing field data and developing test profiles**
- ❖ **Minimize time to learn how to operate, or re-learn for infrequent users**
- ❖ **Minimize risks due to faulty cables & test equipment**
- ❖ **Minimize hassles in scheduling multiple test tasks with CommanderSCHEDULE**
- ❖ **Minimize risk of operator inconsistencies with simplified GUI**



CommanderCONTROL-MIMO is MB's latest in a series of controllers that provide reliable test, measurement, and processing for vibration and shock control of a wide range of single-shaker and multi-shaker test setups. All signal generation, acquisition, and calculations are performed on a dedicated DSP Module connected via a USB cable to a PC running Windows XP. The PC is completely removed from all aspects of the data acquisition and control processes and operates in parallel with the DSP module. The DSP Module houses the analog front-end electronics (ADC and DAC), IEPE accelerometer conditioning and microprocessor. A DSP Module has either 4 input and 2 output channels, via BNCs on the back, or 8 input and 4 outputs. Any input channel may be designated as control or monitor.

Introduction to **CommanderCONTROL-MIMO** Introduction (con't)

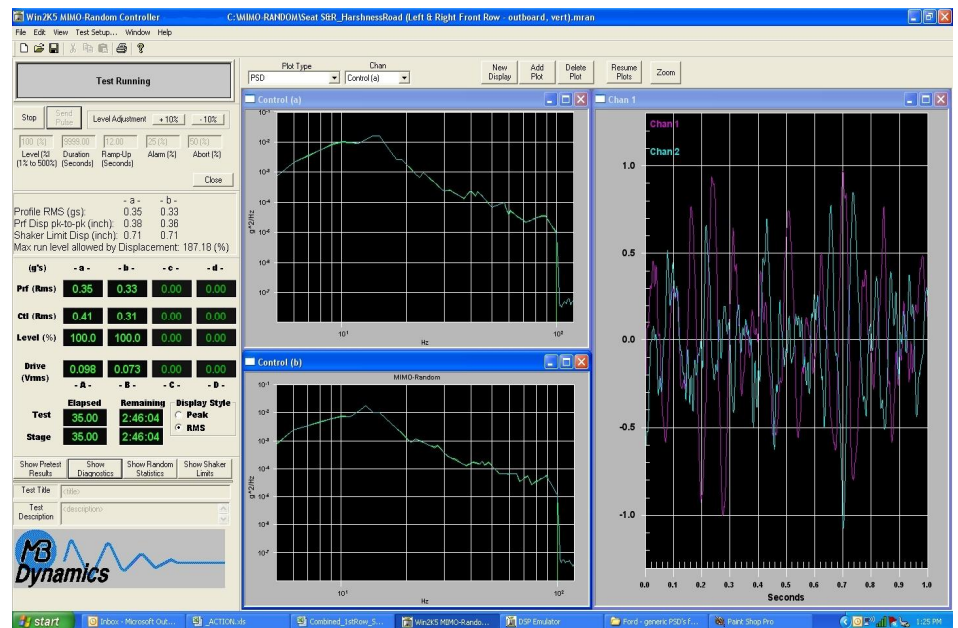
MIMO (multiple input, multiple output) shaker control applications are available for time history replication and PSD random, and single-shaker swept sine vibration. Classical shock pulses are controlled using time history. Sine-on-random, random-on-random, and resonant search and dwell are available. For one-axis-at-a-time tests, the MIMO software can revert to MISO (multiple input, single output). Distinctly different limit profiles with dedicated alarms and aborts can be set up for each shaker.

CONTROL ALGORITHMS

The **CommanderCONTROL-MIMO** software is a natural continuation of real-time signal processing work commenced in 1980, that includes under-constrained, noisy (non-Gaussian noise) multi-degree of freedom dynamic systems. Techniques and proprietary algorithms incorporated into this MIMO implementation include impulse response conditioning, time-domain feedback, and predictive noise-quelling. MIMO uses an ingenious implementation of classic algorithms plus novel treatments and represents continuous improvement of the MB Win2K5, Win2001 and earlier vibration control products on workstations and PCs.

INPUTS

- ❖ Simultaneous data inputs per DSP Module: 4 or 8, and any may be control or monitor
- ❖ IEPE (4mA, 24V open circuit; user-adjustable from 1 to 12mA for longer cable runs) or voltage inputs; all BNC connectors
- ❖ 90 dB dynamic range
- ❖ Anti-aliasing via multi-pole analog filters, oversampled ADC, and digital filters
- ❖ 2 KHz frequency range for 2 shakers; 500Hz for 4 shakers
- ❖ $\pm 10V$ input voltage range
- ❖ Control Accuracy: SINE: 1%; PSD RANDOM: 2% optimized (typically 5% for most tests); TimeHistory: 3%
- ❖ Two (2) digital inputs are available for remote start/stop (including remote E-Stop) control



OUTPUTS

- ❖ Up to 4 analog drive channels
- ❖ Output protection system disconnects DAC from output until test start commanded by DSP
- ❖ Digital reconstruction filter provides $>80dB$ of rejection of frequencies above max output frequency
- ❖ $\pm 10V$ output range with analog isolation to help suppress ground loops
- ❖ $> 90dB$ dynamic range
- ❖ Two (2) digital outputs are available for remote start/stop of external devices

DSP MODULE – DATA ACQUISITION SUBSYSTEM

- ❖ DSP board (Texas Instruments 6711) incorporated into external independent ruggedized enclosure
- ❖ DSP performs real-time shaker control without using PC's CPU
- ❖ Incorporates analog front end electronics, USB communications hardware, and DSP board
- ❖ Rear panel mounted BNC's for each channel – Voltage and IEPE Signal IN; DAC OUT
- ❖ Input Power: 85/264 VAC, 47/63 Hz
- ❖ Power consumption < 120 watts
- ❖ Dimensions for 4 IN; 2 OUT and 8 IN; 4 OUT DSP Module: 4.75"H x 12.6"W x 11.8"D, 9 lbs. (120mm x 320mm x 300mm; 4kg)
- ❖ Operating temperature range $0 < \text{Temp} < 55$ °C
- ❖ Operating humidity range $10\% < \text{RH} < 90\%$, non-condensing

SAFETY

- ❖ Manual abort via ESC key, software button on GUI, or facility E-STOP can be connected
- ❖ Pre-test controlled and limited to maximum pretest level, assures drive waveform is compared to response
- ❖ Continuous loop check for safety and protection
- ❖ Shutdown on open loop, loss of control signal, exceedance of abort and RMS level