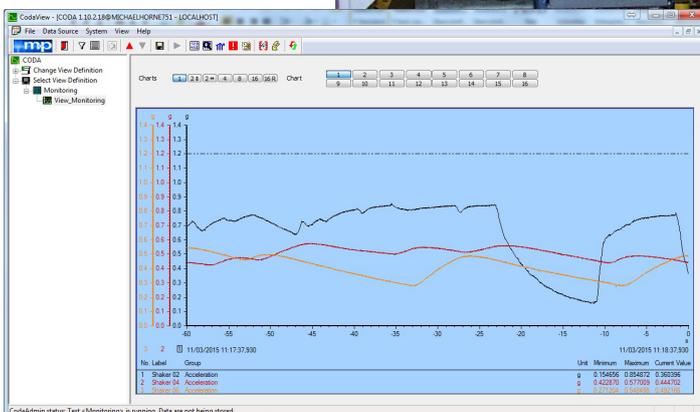
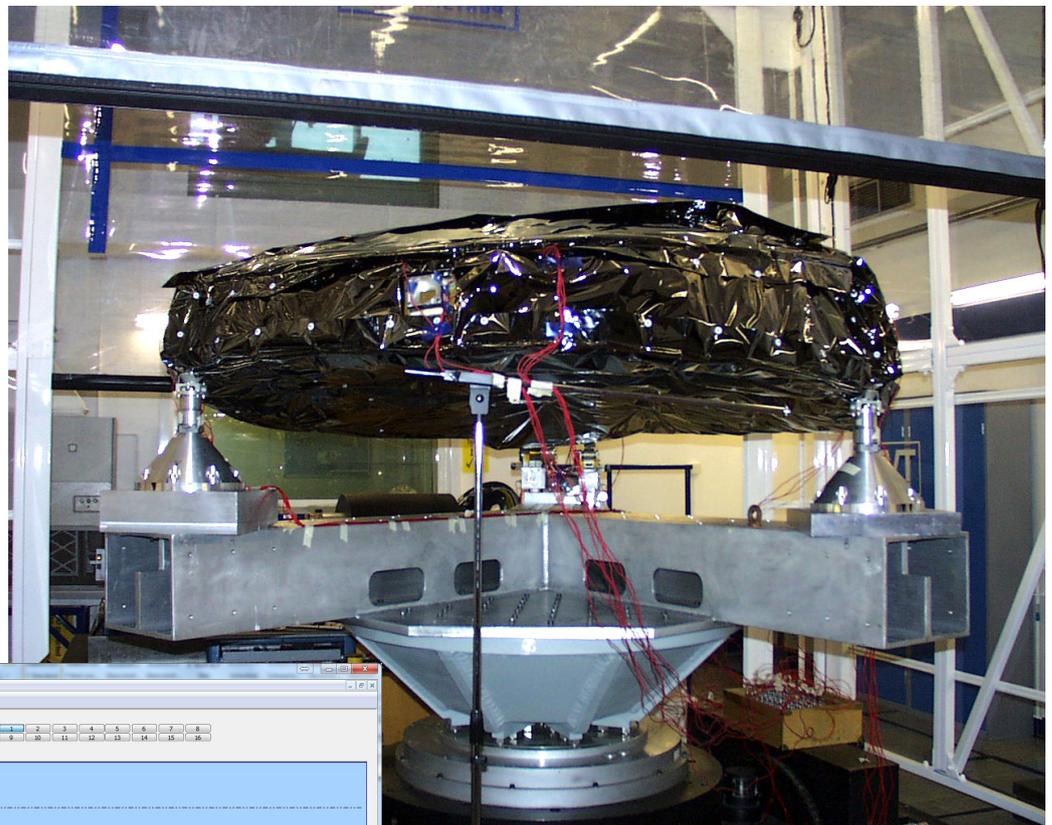


# m+p Coda Vibration Monitoring System

Vibration tests must be safe and reliable and this is especially true for high value specimens in critical aerospace testing applications. Here, m+p Coda offers maximum safety: The monitoring system captures and records data such as acceleration, temperature and strain during vibration tests – irrespective of the vibration control system in use. Each channel can be configured separately for total flexibility.



Monitoring of vibration tests

If the set limits are exceeded, defined events will be generated. For example, a digital output can be triggered to switch off the shaker and abort the vibration test or a relay switching a warning lamp will be set. The active channels are clearly displayed in a separate window, out-of-limit data can be seen at a glance. Alarm events are entered into a log file and can be reviewed at any time.

m+p Coda protects the specimen and shaker reliably, e.g. against misconfiguration or communication loss of the vibration control system. It can also monitor continuously before, during and after a test with the vibration control system on-line or off-line.

To measure accelerations, temperatures and strains, m+p Coda supports the powerful m+p VibRunner acquisition hardware. m+p VibRunner is modular by design: The basic unit is a 19" mainframe that houses up to three front-mounted functional modules. It can be used as a standalone desktop instrument or equipped with mounting brackets for 19" rack mounting.

The following modules can be configured:

- **8-channel A/D module**, 24-bit resolution, 102.4 kHz maximum sampling rate, sigma-delta A/D converter,  $\pm 10$  V input voltage, true differential/single-ended, AC/DC coupling, ICP/TEDS support, BNC connections with LED status information in ICP mode.
- **8-channel bridge module**, 24-bit resolution, 102.4 kHz max. sampling rate,  $\frac{1}{4}$ - ,  $\frac{1}{2}$ - or full bridge for 120, 350 or 1.000  $\Omega$  strain gauges, 0 to  $\pm 5$  V programmable voltage, input voltage for strain gauges  $\pm 100$  mV,  $\pm 1$  V, input voltage for voltage channels  $\pm 100$  mV,  $\pm 1$  V,  $\pm 10$  V, 8-pin RJ45 or LEMO connectors.
- **8-channel temperature module** for thermocouples types B, E, J, K, N, R, S, T or RTDs, 24-bit resolution, 205 Hz max. sampling rate, TEDS support.

When several m+p VibRunner frontends are operated in parallel, data acquisition over all devices and channels will be exactly synchronized. This is made possible by the use of a daisy-chain connection which feeds the clock from the master frame to all slave devices. This is especially useful for measurements on large objects where the m+p VibRunner frontends can be placed close to the measuring points and be synchronized over longer distances.



**Example: 24-channel m+p VibRunner**

- 3 slots for functional cards
- 8/8 digital I/O channels (TTL level)
- Ethernet 1 Gbit TCP/IP IEEE802.3 interface
- Clock-in/clock-out port to synchronize several m+p VibRunner frontends

The following two examples illustrate how m+p Coda is used for efficient monitoring of vibration tests.

### Example 1: Continuous Monitoring of Multiple Shakers at Different Sites

A European customer in the defence industry utilizes m+p Coda for continuous data acquisition, data processing and real-time monitoring of their shakers. They test missiles or subcomponents on their shakers.

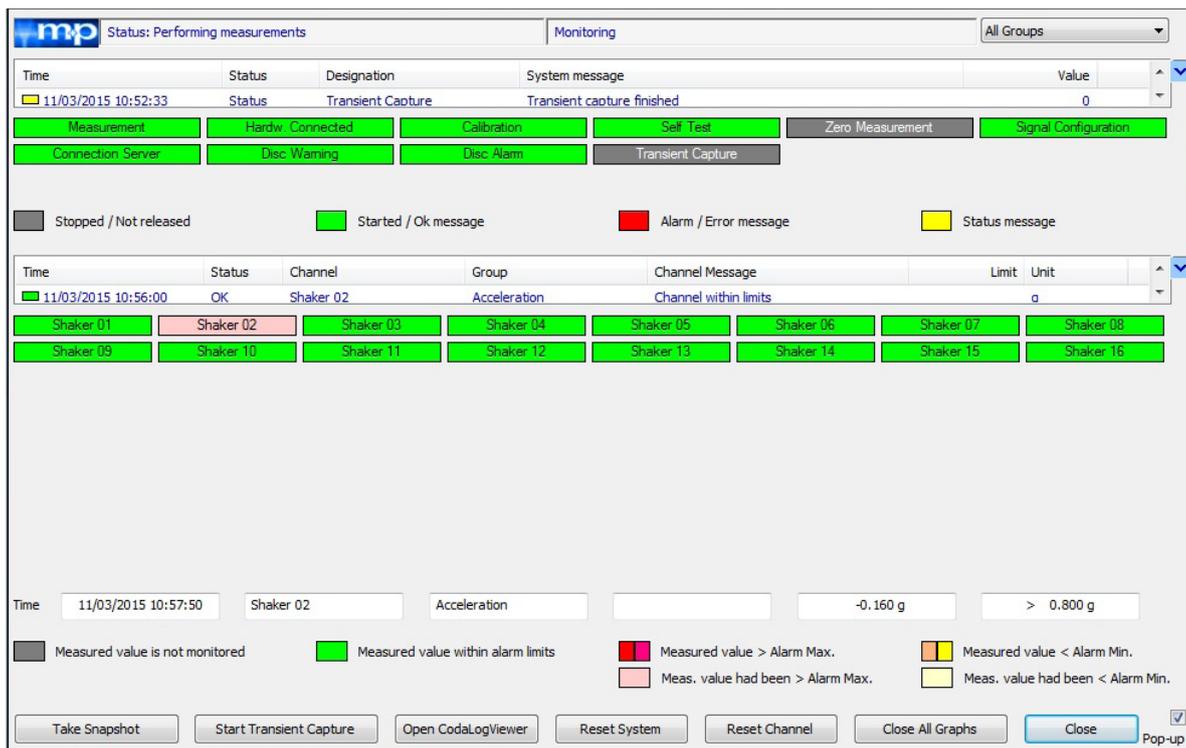
The customer continuously monitors multiple shakers using accelerometers that are mounted to the shakers and the unit under test. The shakers have to be monitored 24 hours per day, 7 days a week. The data acquired from the shakers is stored centrally. If the defined levels are reached, an alarm will be triggered.

The shakers are located in multiple factory buildings. For monitoring purposes, the m+p Coda software is installed on a data acquisition server and m+p VibRunner frontends, one in each building, are connected to this server via Ethernet. The m+p VibRunners have in excess of 20 channels. The channel count can be extended to 48 channels within the existing chassis, if required.

ICP accelerometers are connected to the m+p VibRunner frontends. m+p Coda acquires and stores the data continuously at up to 102.4 kHz. An independent alarm limit can be configured for each accelerometer. The alarm limits can be changed online at any time without stopping the data acquisition.

When the alarm limit is exceeded, a transient capture data block will be generated starting 15 seconds before and ending 20 seconds after the event (time adjustable) and stored separately. Afterwards these transient capture blocks can be selected and analysed in m+p Coda.

The data and alarm limits are visualized on the m+p Coda server and each client PC connected to the server via Ethernet.



m+p Coda: Clearly arranged display of all active channels and out-of-limit data

## Example 2: Real-Time Monitoring and Safety Shutdown for Spacecraft Vibration Testing

Specimen protection systems have been used for many years in aerospace vibration testing as an independent fail-safe system to back up the vibration controller. In most cases the number of independent monitors is limited by the specimen protection systems which also only provide the shutdown capability without the ability to capture the alarm event. The m+p Coda system eliminates these limitations while providing the added capability of capturing the alarm event that triggered a test shutdown.

Our customer, a US-American spacecraft manufacturer, was upgrading an out-dated analog system. They chose the m+p Coda system for their multi-channel specimen protection system. The system they configured is a 48-channel system based on the m+p VibRunner acquisition hardware. The m+p Coda software allows the test engineers to set alarm limits for test shutdown on any of the 48 channels, sampled at up to 102.4 kHz. A digital relay system connects the m+p Coda system to the power amplifiers and the vibration control system. A combination of acceleration and strain signals are monitored for specimen protection.



48-channel m+p Coda monitoring system for specimen protection

One of the greatest benefits to m+p Coda is the ability to capture and record the actual measurement signals that triggered the system. The user can set a pre-trigger and post-trigger time in seconds which will be stored. This greatly enhances the troubleshooting methods.

The customer plans to add 48 additional channels in the next phase of their laboratory upgrades. Future expansion plans may include the ability to monitor, acquire and alarm on facility's temperature, pressure, voltage and currents.

By measuring amplifier current, slip table hydraulic pressure and coolant temperatures the electrodynamic shaker will also be monitored.

**Conclusion:** The independent m+p Coda monitoring system provides all relevant signals from the unit under test and the shaker in a very compact format. The signals are recorded and monitored continuously during the vibration test. m+p Coda ensures that alarm events triggered by defective sensors or misconfiguration are avoided or can be used to switch off the shaker immediately.

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