MULTICHANNEL MONITORING

Independent vibration monitoring system enables full protection of the test article and shaker

BY JIM CHURCHILL AND GUIDO BOSSAERT

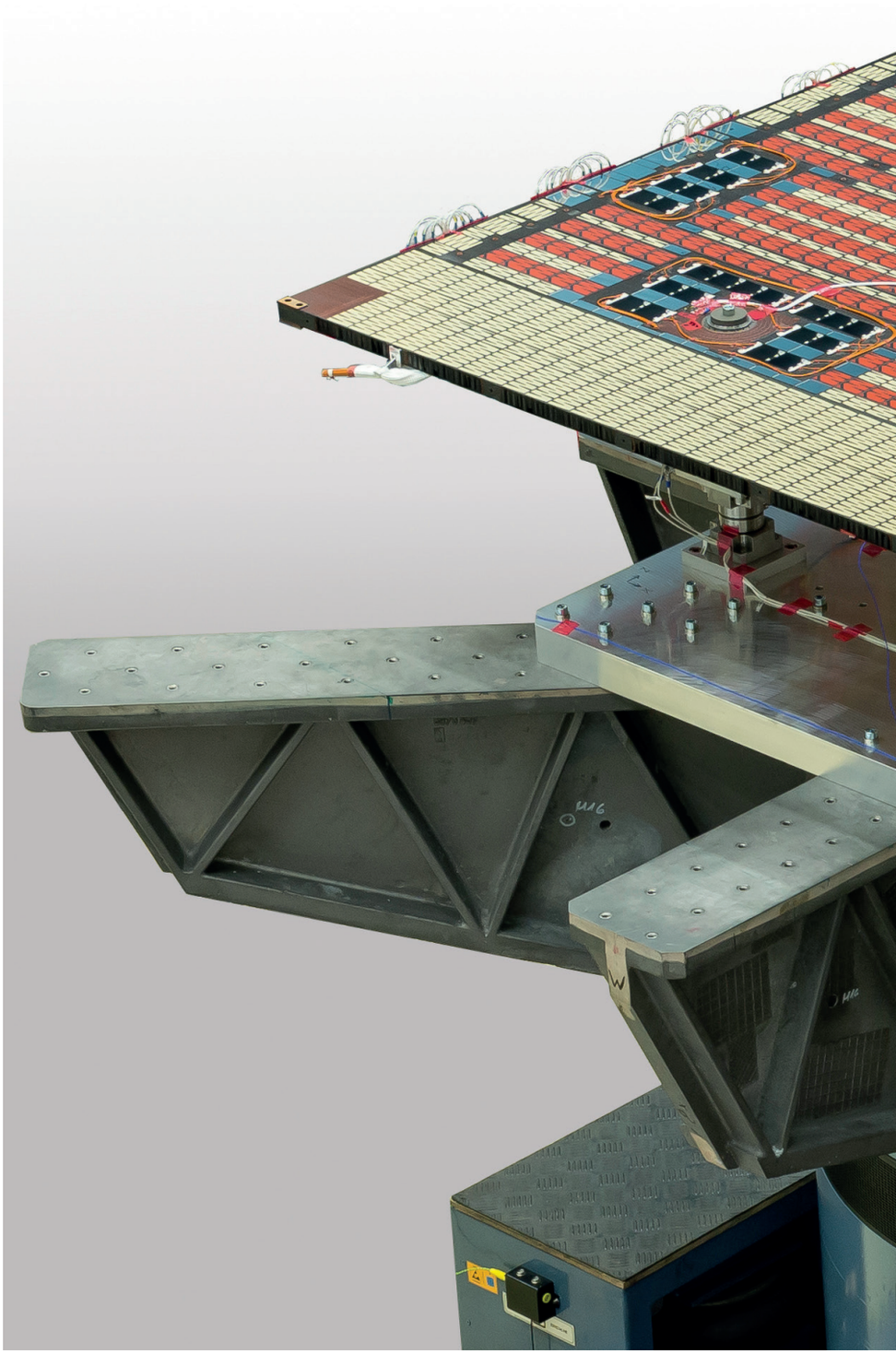
During vibration and acoustic testing of spacecraft, there is a need to monitor more and more signals that are independent from feedback measured for control purposes. Redundancy is key to guaranteeing a safe testing environment without influencing the vibration or acoustic control task and system performance.

Historically, independent specimen protection systems have been limited to a single channel of acceleration, velocity or displacement data. While the intent to provide an independent monitor was met, it also introduced a single point of failure. Additionally, the cost-per-channel for these systems made multiple measurement points cost-prohibitive.

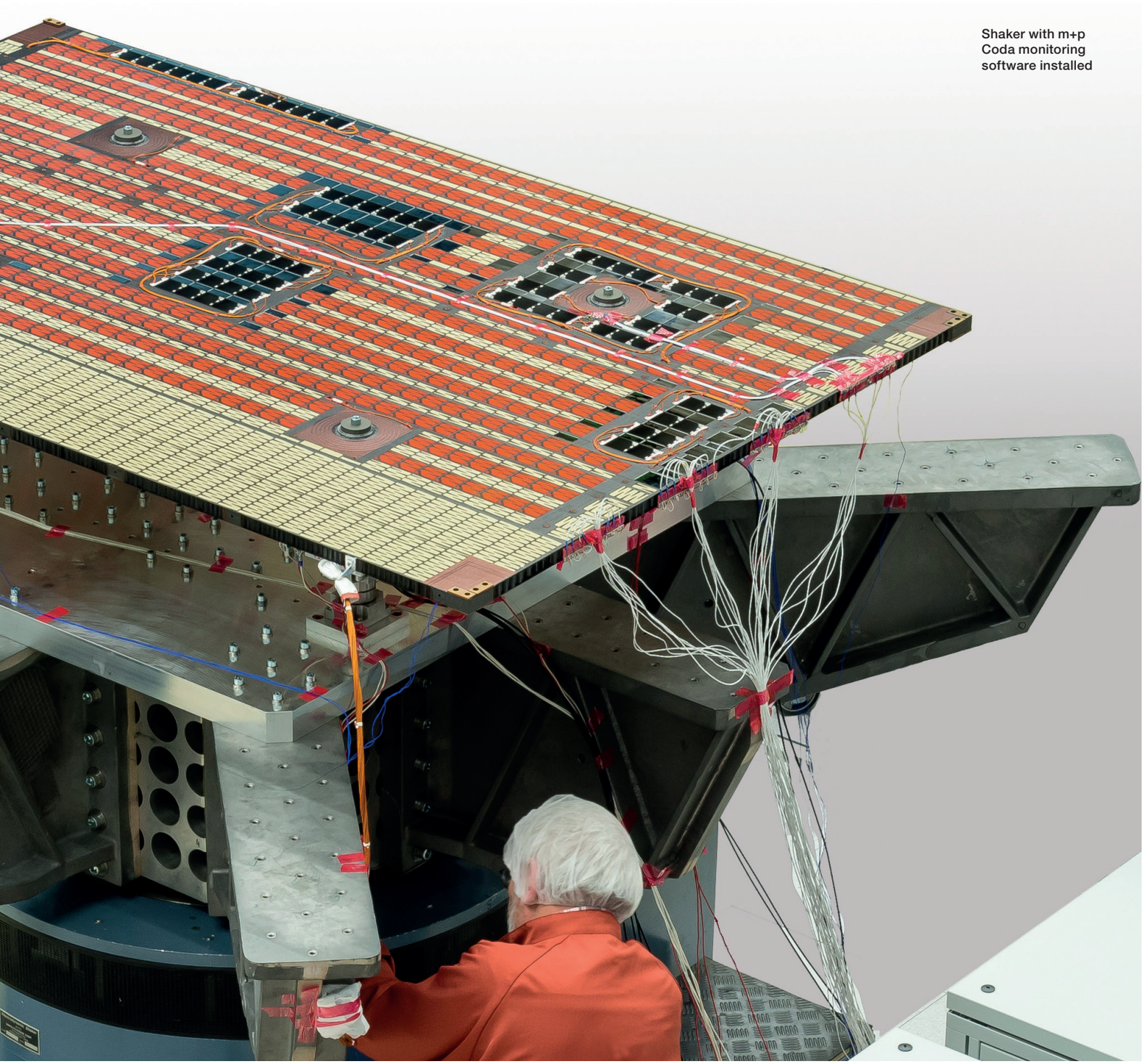
A Southern California aerospace facility was looking for a replacement for an obsolete analog system. The original installation enabled multiple channels of both acceleration and strain sensors to be monitored. They needed a modern replacement that provided similar capabilities of multiple channels with support for mixed signal types.

A monitoring system based on the m+p Coda software package was installed. The system can be used to monitor multiple response data channels in real time, independent of the control system, prior to, during and after the vibration test. The monitoring channels can be of any type, but in this case acceleration and strain was measured to ensure no over-test occurred at any time. A total of 48 channels were measuring and monitoring the feedback signals and comparing them versus user-defined thresholds to not exceed alarm and abort limits. The measurement of the signals is independent of the control system as they can be started any time, and acquire data with independent user-selectable sampling rates.

Once an alarm criterion is exceeded, the operator will be warned on the screen or by audio/visual signals. If an abort criteria is exceeded, different actions can be taken. Typically, in the case of this installation, it was decided to trigger



"ANY KIND OF SENSOR WHATSOEVER MAY BE MONITORED TO GUARANTEE THE SAFETY OF THE TEST ARTICLE OR THE TEST EQUIPMENT"

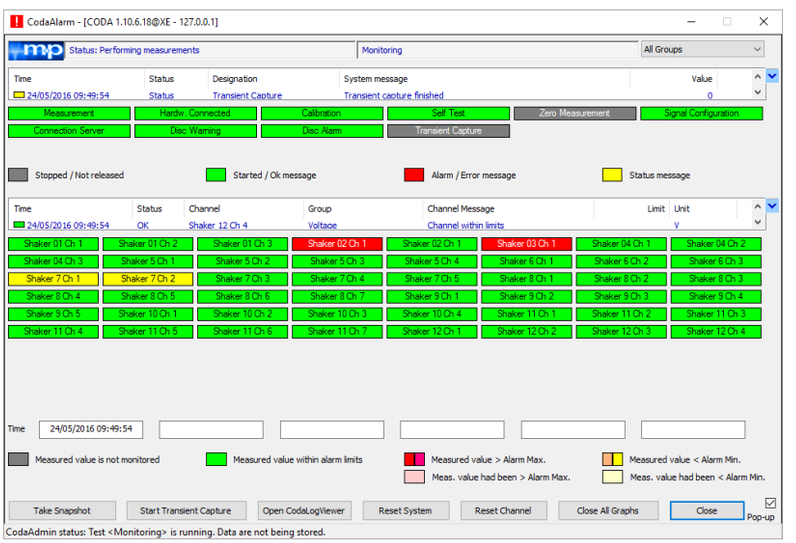


Shaker with m+p Coda monitoring software installed

a relay to stop the vibration test. Other relays, triggered by various events, could have a different influence on the course of the test. Also, different abort situations in general can trigger a user-defined action, such as sending messages to the control system, allowing that system to take appropriate action based on the feedback received from m+p international's Coda system.

SIGNAL TYPES

As mentioned, the signals acquired and monitored can be of any type and types can be mixed using one of the different types of measurement hardware. Also, sampling rates may be user-defined and can vary per channel. The available signal types are: acceleration, displacement, pressure, temperature, DC values, strain, force, current, gas flow and electrostatic radiation. Any electrical signal, from any kind of sensor whatsoever, may be monitored to guarantee the safety of the test article or the test equipment performing the vibration test. The SQL database structure of the m+p Coda software allows for this mixing of signals as well as the ability to create groups of data. This grouping function also allows for filtering by measurement type or measurement hardware, making data management for mixed signals simple and easy. The unique feature of m+p Coda is this capability of monitoring and triggering alarms/aborts based on a mixture of fast (i.e. acceleration) and slow sampling channels (i.e. temperature) and the user-defined actions which are triggered by alarm/abort detection on each channel.



ABOVE: **Full-featured limit checking and alarm monitoring**

If continuous throughput is not needed, a transient capture mode is available. This mode is triggered when an event such as an alarm/abort condition is met which will start storing recording data from all or a selection of channels. A pre-trigger event time and post-trigger event time can be selected so that data, prior to and after the alarm/abort condition is met, will be stored for post-test review. It is important that all channel data in this transient capture mode is synchronized so influences from different feedback channels monitored by the m+p Coda system can be visualized and can lead to a better understanding of the event that triggered the capture. Acceleration changes, both in amplitude and frequency, in one location could lead to a change in behavior of other response channels on the structure or the test equipment resulting in triggering the alarm/abort condition.

m+p Coda also supports different measurement hardware platforms from several manufacturers. It also allows for combinations of different hardware platforms, so the ideal platform can be selected per type of signal to be acquired and monitored. This guarantees a maximum of flexibility by making sure the right signal conditioning is in place for each type of signal. ▮

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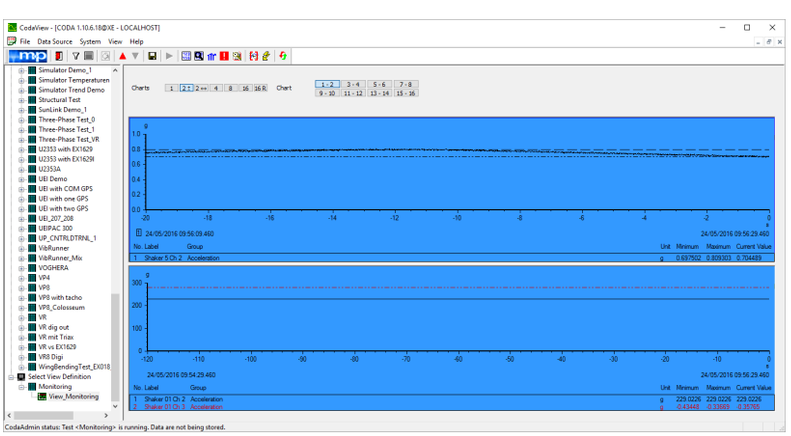

ABOVE: **History of the measured acceleration with alarm limits**