The Data Acquisition Team for Superior Road Simulation Testing – MTS and SoMat

The Integrated Solution for Improved Vehicle Development
Product development just got easier. MTS and SoMat have teamed up to provide you with a turn-key, well integrated solution to speed up your data acquisition and data analysis activities. Accurate data is an essential ingredient to any product development program, for design analysis and optimization, CAE modeling durability and NVH testing, and performance monitoring.

Vehicle manufacturers worldwide use SoMat data acquisition technology along with MTS test equipment and RPC® Pro software to accurately record the field service environment and simulate it in a laboratory setting. The durability of a single component or entire vehicle structure can be quickly evaluated, which reduces the time to market.

The SoMat eDAQ is a modular digital data acquisition system that allows you to create the data acquisition system that best fits your application. The eDAQ system comes standard with plenty of processing power, digital inputs/outputs, pulse counters, and data storage capacity. To that you can add the functionality of analog, strain, temperature, and vehicle bus data collection.

Once the data is recorded, the data files can be quickly brought into the MTS RPC Pro software for integrity checking and extensive analysis options. The small, rugged construction of the SoMat eDAQ makes it ideal for long term, in-vehicle testing, prototype testing, laboratory testing, or fleet vehicle testing. The eDAQ can be applied in many disciplines such as ground vehicle development, aero, geo-civil, railway, and research and development applications.

The vehicle network option allows you to quickly log information from the vehicle bus. You are spared the time-consuming task of re-instrumenting a vehicle to collect data that is already being generated by existing sensors on the vehicle. Of course, if you use an MTS SWIFT Evo® wheel force transducer, instrumentation is no longer much of an issue in most applications.

The SoMat eDAQ system lets you quickly set up your tests and upload the data to your RPC computer via an ethernet connection. The data can be viewed and validated right at the proving ground using MTS RPC Pro analysis software.

The network capabilities of the eDAQ system allow for maximum flexibility. Each eDAQ device can be used as a stand-alone system or synchronized with other eDAQ devices for large channel count applications.

### eDAQ System

#### Advantages of the eDAQ System

**Small and Rugged**
The eDAQ small footprint makes it ideal for long term in-vehicle testing, prototype testing, lab testing, or fleet testing. The eDAQ has been swept sine tested up to 20 g’s, so it is a proven performer in harsh environments. Its sealed enclosure protects it from oil, dust, and moisture.

**Easy to Use**
Setting up tests is very easy with the Windows-based Test Control Environment (TCE) software. TCE offers menu driven operation, automatic calibration of sensors, real time data display, and calculated channel capabilities. Test setups can be easily saved and recalled for future use.

**Easily Configured**
The eDAQ system can be configured with a combination of strain gage conditioning boards, high level boards, or thermocouple boards to specifically meet your unique needs in data acquisition.

**Integrated**
You can easily integrate your eDAQ system with all of your MTS test equipment and processes. Data is easily translated and imported into your MTS test and analysis environment using the MTS RPC® Pro Project Manager and Acquire software package. Analog outputs allow you to connect your conditioned data signals to MTS controllers for laboratory test development.

**Expandable**
The eDAQ system is fully expandable by synchronizing multiple systems together by ethernet on a local network. You can use them separately as stand-alone systems or synchronized together as a larger system for maximum flexibility.

**Collect Vehicle Network Data**
The eDAQ system is capable of collecting data that is transported across the vehicle data bus. Now you can record data from vehicle sensors while also collecting strain or temperature data at other points on the vehicle.

**Turn-key System**
The eDAQ data acquisition system comes complete with the cables and accessories required to immediately start collecting data — right out of the box!
Build an eDAQ System Specific to Your Data Acquisition Needs

The base layer of the eDAQ system includes:
- Ten digital I/Os
- Eight pulse counters
- Four MB SRAM
- Ethernet and serial communication ports
- A PCMCIA slot

The base layer also gives you the opportunity to add a vehicle bus interface.

On top of the eDAQ base layer you can add a variety of transducer boards including low-level boards for strain gage type transducers, high-level boards for recording analog signals or piezo-electric accelerometers with onboard signal conditioning, or thermocouple boards for recording temperature.

The eDAQ system is modular and can be easily tailored to meet your data acquisition needs.

Also, multiple eDAQ systems can be synchronized together when your application requires larger channel counts.

Base System
- Small foot print: 275 mm x 231 mm
- 10 Digital I/Os
- Eight pulse counters
- Ethernet port
- Serial port
- PCMCIA slot
- Four MB SRAM
- Vibration swept sine tested to 20 g’s
- Operating temperature of -20 to +65 degrees Celsius
- Input power (10 to 18 Volts)
- AC adapter provided
- 16 bit ADC resolution

Communication
- Ethernet (10BaseT or 10Basc2)
- Serial

Digital Inputs/Outputs
- 10 digital inputs/outputs included in base layer
- Sample rates up to 2,500 samples per second
- Input threshold: 1.6 volts

Pulse Counters
- Eight pulse counters for pulse width, duty cycle, and frequency measurements are included in the base layer
- Sample rates up to 2,500 samples per second
- Pulse widths: 600 nsec to 3.3 seconds with 200-nsec resolution (yields 1% accuracy at 50 kHz, 0.1% accuracy at 5 kHz, etc.)
- Duty cycle: uses two input channels in pulse width mode
- Pulse count rates: counts up to 1,000,000 pulses per second

Data Storage
All eDAQ systems come with a built-in PCMCIA slot that accommodates Type II and Type III card types in a variety of densities.

Expansion Options
- Low level boards
- High level boards
- Thermocouple boards
- Vehicle bus interface
eDAQ Low Level Board Allows Strain Measurements

The eDAQ low-level board allows you to condition and record eight channels of strain or differential input analog data per board. The low-level board is specifically intended to provide excitation, bridge completion, gain capabilities, shunt calibration, and digital recording of low-level strain gage signals.

The low-level board can be used in combination with the high level board or thermocouple board. A maximum of four layers of low-level boards can be added to the base layer for a total of 32 channels per system.

Key Features:
- Eight channels of strain conditioning per board
- Sample rates up to 10,000 Hz
- Simultaneous sample and hold
- 16 bits ADC resolution
- One analog output per channel
- Full scale input voltage range: ±3 mV to ±10 Volts
- Excitation options of ±2.5, ±5, and ±10 Volts
- Quarter, half, and full bridges
- Internal completion resistors for 120Ω or 350Ω bridges
- Input impedance: 1000 kOhms
- Dynamic range: 70 dB
- Common mode rejection: 70 dB
- Anti-aliasing filter and programmable digital filters

eDAQ High Level Board Provides Analog Measurements

The eDAQ high-level board is a high performance versatile board, which allows the user to record sixteen channels of high-level analog data. The high level board is an ideal mate for the MTS SWIFT Evo wheel force transducer.

Each channel has a programmable power supply intended to supply power for transducers with built in signal conditioning such as certain piezo-electric accelerometers.

Key Features:
- 16 channels of analog data recording per board
- Sample rates up to 10,000 Hz
- Simultaneous Sample and Hold
- 16 bits ADC resolution
- Input voltages from ± 125 mV to ± 80 Volts
- Analog guard filter and programmable digital filters
- One analog output per channel (optional)
- Programmable power supply of 3 to 28 Volts. Each supply can source up to 0.4 Watts or 400 mW of power.
eDAQ Thermocouple Board Provides Temperature Measurements

The eDAQ thermocouple board allows you to simultaneously collect eight channels of temperature data.

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>-200 C to 400 C</td>
</tr>
<tr>
<td>E</td>
<td>-200 C to 1000 C</td>
</tr>
<tr>
<td>J</td>
<td>-200 C to 1200 C</td>
</tr>
<tr>
<td>K</td>
<td>-200 C to 1372 C</td>
</tr>
</tbody>
</table>

**Key Features:**
- Eight channels of thermocouple conditioning per board
- One cold junction sensor per channel
- All channels independently isolated to 500 volts
- Sample Rates: 0.01 Hz to 5 Hz maximum
  (6.4 Hz max for power of two sample rates)
- Accuracy ± 0.5 degrees C typical
- Power consumption approximately three watts per layer
- Standard miniature two prong thermocouple connectors
- Supports K, T, E, or J type thermocouple
- Each board supports only one type of thermocouple

Vehicle Bus Interface Gathers Performance Data

The vehicle bus interface, an optional addition in the base layer of the eDAQ, allows you to connect to the vehicle bus to collect data about vehicle performance. You can easily record vehicle bus data while also collecting strain, temperature, or analog data from other sensors on the vehicle.

With the vehicle network option, you are spared the time consuming task of re-instrumenting a vehicle with sensors to collect data that is already being logged on the vehicle bus. The eDAQ system has an easy to use vehicle bus interface that helps you select what you want to collect from the vehicle bus. You can choose from vehicle speed, voltage, RPM, throttle position, etc. You are only limited by what is available on the vehicle network.

Numerous interface types are currently supported by the eDAQ system including:
- CAN
- J1850 PWM
- J1850 VPW
- SAE 1939
- ISO 9141
Test Control Environment (TCE) Software Makes Test Set Up Easy

TCE is a Windows based application designed to help you set up your test and acquire your test data in a timely and efficient manner. Using TCE you can:

- Create test setup files to define and calibrate transducer channels
- Define data modes
- Define computed channels for on-line data calculations and analysis
- Specify triggering conditions for the collection of test data
- Monitor test data using TCE’s run time display
- Check test and memory status during data acquisition
- Initialize, start, stop, restart, and end tests
- Upload test data to host PC

**Computed Channels**
A computed channel represents either a mathematical or Boolean expression made up of analog inputs, digital inputs, and/or other computed channels. Computed channel expressions can include:

- Mathematical expressions: [ +, -, /, *, ^ (exponent), square root, log, log 10]
- Trigonometry expressions: [sin, cos, tan, asin, acos, atan]
- Logarithmic expressions (log, log 10, exp)
- Boolean expressions: [>, >=, <, <=, equal, not equal]
- Logical expressions [and, or, not]

Others: Up/down sampler, integrator, state mapper, pulse counter, max/min tracker, smoothing filter, etc.

**Data Modes**
Using data modes, you can specify how the measured data is analyzed, reduced, and stored to disk. Data modes allow the eDAQ system to retain the important content of the data while optimizing memory and computational resources. Multiple data modes can run concurrently allowing the eDAQ system to perform the functions of a histogram recorder, a digital tape recorder, and a transient recorder simultaneously. Data modes available are:

**Time History**
The time based sequential storage of input channels at a fixed sampling rate. Output file is an engineering parameter (for example, acceleration) stored as a function of time. Time history is the most commonly used data mode.

**Sequential Peak/Valley**
A peak/valley time history in which only the signal reversal points are stored to disk.

**Burst Time History**
Sequential data is stored for a fixed time interval and is triggered by some event (logical data). It allows data before and after the trigger to be captured. A continuous circular buffer makes this possible. You control the number of bursts recorded, the pre-trigger time, and the total time.

**Time at Level Matrix**
A time at level matrix records the amount of time spent at discrete values of one or more input channels. Up to six dimensions are supported. For example, the amount of time spent at unique combinations of torque, engine RPM, and gear shift position is useful for determining customer usage profiles.

**Peak-Valley and Rainflow Matrices**
Peak-valley and rainflow matrices are used to statistically categorize load histories. Each counts the number of transitions between discrete peak-valley pairs of an input history.

**Triggering**
Boolean computed channels return true or false. Triggering based on these Boolean channels allows the user to set up triggers to start and stop recording data to disk. The triggering options available are:

Gate – Sample data whenever condition is true
Trigger – Sample data forever after a condition is true
Oneshot – Sample data once per false to true transition
RPC Pro software is the latest evolution of the world’s leading software for data validation, analysis, laboratory simulation, and laboratory testing. A portion of this software is now available for viewing, validating, and analyzing data immediately after recording it. This software application is known as the RPC Pro Acquire package. Included in it is the Project Manager and Acquire utilities.

**Project Manager**
The RPC Pro software automatically creates a project structure that intuitively stores your physical data, log files, and project information in a consistent and easy to retrieve structured project format.

**Acquire**
Acquire provides an application for easily transferring the RPC data, SoMat SIF data or nCode DAC data into an RPC Pro project structure. RPC Pro software can also read and write in ASCII format for complete compatibility.

Once in the project, the data can easily and automatically be checked for spikes, missing data, full-scale saturation, improper sample rate, and signal-to-noise resolution. The data can immediately be viewed and analyzed using the time history plotter and analysis tools listed below.

The data can be easily included in test reports as statistical summaries, PSD plots, time history traces, level cross and rainflow histograms, probability distributions, etc.

You can call upon an extensive tool set for interactive analysis and diagnostic options via RPC Pro tools such as:

- Filtering
- Resample
- Channel extract
- Channel transformation
- Level cross
- Rainflow
- Probability distribution functions
- Remove mean
- Remove trend
- Remove offset
- PSD and CSD calculations
- Statistics
- Time shifting
- Tapering

For More Information
Contact your local MTS Field Sales Engineer for more information on the SoMat eDAQ system, RPC Pro, SWIFT Evo wheel force transducer, and the many integrated software and mechanical vehicle development tools available from MTS. Call the phone number on the back page, or e-mail us at: info@mts.com. We invite you to visit our web site at www.mts.com.