

POSITION

Measurement & Control

Spring 1999

Practical Information on SpaceAge Control, Inc. Position Transducers

Developing a Vehicle Dynamics Data Acquisition System

Ford Motor Company Quantifies "Good Ride"

Editor's Note: Thank you to Keith Van Gorder and William Janitor of Ford Motor Company and Scott Menjoulet of Datepli, Inc. for providing background information for this article.

The Challenge: Develop a portable, user-friendly, easily configurable system for in-vehicle measurement of vehicle dynamics attributes.

The Solution: Use a rugged laptop with a plug-in data acquisition card and a custom signal conditioning enclosure in combination with robust transducers and a software-based data acquisition application to develop a portable, efficient system.

When development engineers at Ford Motor Company needed to replace antiquated equipment for testing automobile vehicle dynamics attributes, they turned to Datepli Inc. (Midland, Michigan USA) in a cooperative effort to develop a new state-of-the-art in-vehicle data acquisition system.

Vehicle dynamics usually refers to the ride and handling of a vehicle, most commonly of an automobile. "Handling" is used to describe the gross, low frequency (less than 50 Hz) motions of the vehicle while it is being driven. The Ford engineers had a set of

specifications that needed to be met and no commercially available system fulfilled all their needs. Datepli was able to take the specifications and, with constant constructive feedback from the test engineers, develop a system that satisfied their hardware and software requirements.

The developed system is called DIVAS (Development In-Vehicle Acquisition System) within the Ford development community. Datepli markets the system as the DRIVE (Data Retrieval In-Vehicle) Data Acquisition System. Currently, there are approximately 50 systems in use by Ford in North America, Europe, and Australia. There are also nearly a dozen systems in use by companies other than Ford. Many benefits have been achieved through the use of the system and the applications keep growing. These include CAE model correlation, driver training, and Design of Experiments. In addition, engineers worldwide have been able to



"In-vehicle" means in-vehicle! Ford's DIVAS system is designed so all data acquisition, processing, and analysis can be performed without bulky support equipment or support vehicles.

reduce product cycle development time, reduce the cost of testing, and increase test efficiency.

The DIVAS hardware consists of a rugged laptop made by Fieldworks, Inc. mounted on top of a signal conditioning unit. A cable



The SpaceAge Control Model 161-1283 position transducer shown feeds suspension displacement data to the Ford DIVAS data acquisition system. The transducer is mounted via a suction cup mount.

transfers the signals from the unit to the data acquisition card in the computer. There are two basic versions of the signal conditioning unit: a sixteen channel version and a thirty-two channel unit. An optional expansion box allows for up to sixty-four channels. The units are powered by twelve volts so they may be conveniently powered by the test vehicle.

Also in the unit is a power supply that takes the twelve volt input and provides power for the filter cards and the computer and also provides ± 15 volt and ± 5 volt excitation for any transducers connected to

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the inputs. There are various connectors on the outside of the unit that provide power to the unit or draw from it, in order to power external devices such as remote display units, i.e. drivers aid or a PC. Input connections are made through a durable, high reliability bayonet style 6-pin mil-spec connec-

When all channels have been set up and tested, the user is ready to begin data acquisition. This is the point at which they enter the log sheet for the particular test they are performing. A log sheet consists of various run types with which each data file may be associated. For example, a lane change test may have among its run types a 45 MPH run



A Ford vehicle with the DIVAS system installed. Note the four SpaceAge Control position transducers mounted on each quarter panel.

tor. The user can also access any of the input signals through BNC connectors on the front of the unit. This is a convenient way to monitor inputs for use on a drivers aid or other remote display. The data acquisition cards used in the system are National Instruments' AT-MIO-16X and 16XE-1016-bit cards.

The software uses a hierarchical structure to organize data. The user creates a vehicle setup, which consists of setting up the channels from which data will be acquired on that vehicle. There can be multiple configurations for each vehicle and each configuration can have any number of tests associated with it. A variety of options from which to choose are presented when the software is started. The user can create vehicle setups, setup transducers and channels, test channels, initiate acquisition, view or analyze data, or convert files from the "Main Menu" screen. They can also see information about the current vehicle, configuration, and test.

Users need to assign a transducer to each channel when setting up the channels. The system uses a transducer library to maintain information about each device that may be used including name, units, range, and conversion factors. There can be multiple libraries on a system and each one is organized by type, model, and serial number to make it easier to find individual transducers.

and a 60 MPH run. When data is recorded, it is associated with one of the types so it may be properly processed later. The user can also specify various display settings such as waveform or XY views of data. A variety of options are also available for triggering including pre- and post-triggers, analog start and stop triggers, and manual triggering. All these options are user configurable for each test in a logsheet editor.

The user can view the acquired data, convert to an ASCII format for use with any spreadsheet application, or analyze it when data acquisition is complete.

Transducers for DIVAS were selected for their robustness, accuracy, ease of setup, and ease of calibration. Transducers required to obtain the vehicle dynamics data include position transducers, steering transducers, speed sensors, height sensors, yaw rate sensors, and accelerometers. Within Ford, DIVAS is used extensively with the SpaceAge Control Model 161-1283 position transducer for measuring suspension deflection, pedal travel, and other displacements.

For more information, please contact:

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References

1. SAE Paper 98PC-209 - The Advantages of Using Standard Vehicle Dynamics Procedures and Analysis Programs
2. SAE Paper 981076 - Effective In-Vehicle Acquisition (DIVAS system)

SAE Show and National Instruments/Datepli

SpaceAge Control, Inc. products can be seen at the National Instruments/Datepli booth of the SAE International Exhibition to be held March 1-4, 1999 at Cobo Center in Detroit, Michigan USA.

The booth will demonstrate SpaceAge Control Model 161-1283 position transducers on the suspension of a vehicle while interfacing with the Datepli DRIVE data acquisition system (see related article on page 1).

To see this demonstration, stop by booth number 5601 and ask for a Datepli representative.

For more information on Datepli's DRIVE system, contact Datepli at (niteam@datepli, www.datepli.com). □

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Space-Based Transducers

Part 1 of a 3-Part Series

(Next issue: ATCS level sensor)

TRW and EG&G Belfab Use SpaceAge Control Transducers for Man-Rated Space Use

Editor's Note: Over the next half-decade, several International Space Station components will be launched with various SpaceAge Control position transducers aboard. SpaceAge Control transducers were chosen for a number of Space Station applications due to their proven reliability, small size, light weight, and high accuracy over a broad temperature range. We will be profiling the application of these products in Position Measurement & Control. Thank you to Bruce Patterson of TRW for providing the material for this article.

The Japanese Experiment Module (JEM) of the International Space Station includes the Exposed Facility (EF), referred to by NASA as "the back porch" of the Space Station. The JEM will be transported from earth for assembly to the Space Station by the Space Shuttle. The EF contains a Thermal Control System (TCS) to maintain temperature. FC-72 is a type of coolant used by the TCS to provide temperature control of the Experiment Exchange Units (EEU). EEUs are attached to the EF and exposed to the hostile space environment for various periods of time. Those experiments are then returned to earth and replaced by other EEUs.

The FC-72 Accumulator is a reservoir for the coolant as well as serving as a fluid capacitor. The 73-liter accumulator has a liquid capacity of 31 liters. A bellows separates the FC-72 coolant from the charge gas. The bellows expands or contracts in response to temperature-induced volume changes in the coolant, while controlling the system pressure. The bellows strokes up to 15 inches. A SpaceAge

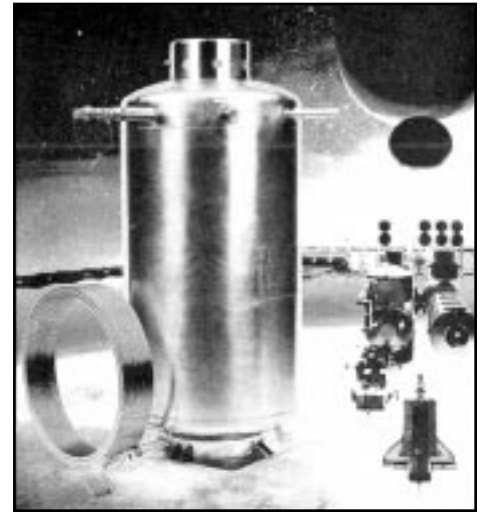
Control position transducer is calibrated as a volume transducer with a 0 to 5 volt output, 5 volts corresponding to the maximum liquid condition. As experiments are exchanged over the 15-year life of the TCS, the accumulator provides make-up fluid for quick disconnect leakage when EEU's are uncoupled.

The FC-72 accumulator for the TCS was manufactured by EG&G Belfab in Daytona Beach, Florida USA under contract to TRW Components International (TRWCI) of Torrance, California USA. TRWCI provided specifications and technical management for the accumulator procurement in support of its Japanese customer, Ishikawajima-Harima Heavy Industries (IHI) in Tokyo, Japan. The ultimate customer in Japan is NASDA, the Japanese Space Agency working with NASA on the International Space Station.

For more information, please contact Bruce Patterson, Assistant Program Manager, TRW Components International (310-214-5536, 310-214-7402 (fax)). □



The FC-72 accumulator developed by TRW and EG&G Belfab is located on the Exposed Facility (EF) of the Japanese Experiment Module (JEM).



The International Space Station's FC-72 accumulator features a SpaceAge Control transducer based on the Series 174 design.

Application Corner

Q. I am having a difficult time cutting the displacement cable to match my application. How do I get the zero point set more accurately?

A. On Series 160, 161, and 162 position single-turn transducers, you can finetune your zero point by loosening the 3 cam locks and turning the sensor (potentiometer or

encoder) to the desired position while monitoring the voltage. This procedure is not valid for units with multi-turn potentiometers (eighth digit of part number is a "3" or "5": 162-3405, for example).

Q. I have a Model 150-0121 position transducer. What errors will I see with changing temperature?

A. All standard analog-output SpaceAge Control position transducers use conductive

plastic potentiometers which are set up as voltage dividers (voltage measurement) and not rheostats (resistance measurement). As such, because the changing temperature is changing the material characteristics of the entire potentiometric element, no errors due to temperature change will be seen.

ISO 9001 Effort Underway



SpaceAge Control is nearing completion of modifying its quality system to meet the requirements of ISO 9001.

To date, a new Quality Manual has been created and approved, operating procedures are complete, and a set of first-phase internal audits is complete. Full compliance with the requirements of ISO 9001 is expected by April 1, 1999.

Previously, the company's quality system met the requirements of Mil-Q-9858A, a US military quality standard that is now obsolete and on which ISO 9001 is based.

For information on our efforts, please contact us. □

New Area Code: 661

Effective February 13, 1999, our area code changes to 661 from 805. Until August 14, 1999, you will be able to use either the 661 or 805 area code. Our new numbers are 661-273-3000 (phone) and 661-273-4240 (fax).

Please update your files and databases. Thank you. □

Flight Data Recorder Product Nominated for Award

The editors of *Aviation Week & Space Technology* have nominated the SpaceAge Control Series 160/170 FDR (flight data recorder) products as candidates

for the magazine's Third Annual Technology Innovation Awards.

The award winners will be selected by a panel of independent judges who represent a cross-section of the aerospace industry. The awards will be announced in the May 10, 1999 issue of *Aviation Week & Space Technology*. □



SpaceAge Control position transducers offer reliability, quick installation, flexible mounting, and varied electrical outputs for flight data recorder use.

Help us save a tree! Check this box □ and fax this side of the newsletter to +661-273-4240 if you no longer wish to receive *Position Measurement & Control*.

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