

## In Vehicle Data Acquisition System (IVDAS)

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### **The Challenge**

Ford Motor Proving Grounds (Ford) needed a compact, portable user-friendly method of recording and alarming 400 channels of data in a moving vehicle. The system needed to be used to test vehicle temperatures to assure that they do not exceed design limitations in extreme conditions.

### **The NTS Solution**

IVDAS utilizes the power of the modern PC coupled with the power of open architecture instrumentation buses to couple all of the features of the old systems with the power of new technology.

### **Introduction**

The In Vehicle Data Acquisition System (IVDAS) was designed to address the data logging needs of Ford. Traditionally, Ford used proprietary, standalone, data loggers that were built to allow general data logging and some alarming. These systems were text based, large and difficult to work with.

The power of the modern PC coupled with the power of open architecture instrumentation buses has opened the door for a much more powerful and flexible solution. IVDAS utilizes these new paradigms to couple all of the features of the old systems with the power of new technology.

National Instruments' products were chosen for the new application based on the modularity, flexibility and reliability. The heart of IVDAS is a National Instruments' PXI chassis linked to 4 SCXI mainframes filled with thermocouple conditioning modules. The SCXI chassis can be populated with various signal-conditioning modules tailored for the various signals that need to be acquired. This allows for about 400 channels of thermocouple input as well as extra channels for signals such as velocity and oil pressure. The LabVIEW application ties these channels together creating a more user friendly system than before and giving the operator the opportunity to receive readings during the testing as well as adjust the on screen view.



4 SCXI mainframes filled with thermocouple conditioning modules

IVDAS software is first setup by defining the channels. This is accomplished in one of three ways.

1. A user interface panel that allows the user to define channel count, names, scaling, conditioning and alarming can be used if the channel list does not yet exist.
2. A text file that can be created with a separate package such as MS Excel can be imported.
3. A company specific file type can be read into the system to generate a channel list.

Specific setup files can be saved to disk in order to recall them for similar tests. After setup, the user can test run the software to look for open or shorted circuits wired to the SCXI chassis. Once setup and initial checkout are complete, the system is ready to be used by the driver.

The driver panel allows the test driver to start the data logging and alarming process with the touch of a button. No mouse interaction is necessary for the driver for safety reasons. While the driver can pause acquisition during the test, alarming will always be running.

Three types of alarms are available at the setup stage: Max, Min, and Warning. Each of these alarms, when triggered, will change the color of the digital readout for the given channel to a color corresponding to the type of alarm, and will emit a tone specific to the alarm type.

The driver will be able to adjust the on screen view between the following channel sets:

1. Critical; channels with defined alarms.
2. Alarm; channels that are currently in the alarm state.
3. All; all channels.
4. User; a user defined set of channels.

Within each of the channel lists, the driver can scroll through each page of displayed data with the page-up, page-down keys. Data for all channels is logged to disk, and can be converted to a text format for easy data manipulation in almost any software package.

The real strength of IVDAS is the flexibility and upgrade ability. By using PXI and SCXI, additional options are almost unlimited. A few examples of some of the upgrades available will help make this point clear.

**Touch Screen Upgrade:** A touch screen can be added to allow the driver more flexibility and control while driving. This would only require changing the standard flat panel monitor with a touch screen monitor and installing the driver software. Because the software is already mouse and keyboard driven, no changes to the IVDAS software would be required.

**Voice Synthesis Upgrade:** Voice synthesis would be useful to notify the driver of potential problems in a more detailed manner than simple beeps. This would only require changes to the software (since the system already includes sound) to use a toolkit that BBT uses on other projects.

**Voice Recognition Upgrade:** Voice recognition would also help the driver maintain focus on the road. Commands that are given to the computer through voice rather than keystrokes would fit into the basic IVDAS architecture easily. The system would require the addition of a microphone and an adaptation of a voice recognition toolkit into LabVIEW.

**Machine Vision Upgrade:** Machine vision would be a very useful add-on to the system. It can either be used to visually monitor positions of various components, or to monitor temperature of an entire surface. By using a spray on coating that changes color with temperature, various surfaces can be monitored in much more detail than a thermocouple can give.

**Other Options:** Motion control, GPS, telemetry, control of safety equipment such as fire extinguishers, and communications with the automobile's onboard computer are just a few more features than can easily be added to this system. The flexibility of these add-on features is the key reason that IVDAS is the logical replacement for traditional data loggers previously used by Ford.

## Results

With the use of the IVDAS system, development time has been cut in half. The space required for the IVDAS system is significantly less than the previous system allowing for greater freedom of movement by the driver during testing and the increased flexibility and ease of use has combined to make a technologically advanced, yet operator simplified, system providing Ford with the reliable data feed back it has been seeking.

**Products used in this Program**

**PXI Computer & Digitizing System**

PXI-1000 8-Slot 3U Chassis DC  
 DC Power Cord  
 PXI-8155B 333MHz Embedded Computer  
 PXI-8220 2 Slot PCMCIA Card Carrier  
 64 MB SDRAM  
 PXI-6070E Multifunction I/O  
 SoundNote S-16 PC Card with speakers

**Signal Conditioning System**

SCXI-1349 Shielded Cable Assembly  
 SCXI-1000DC 4-Slot Chassis DC (Quantity 4)  
 SCXI-1374 Handle Kit (Quantity 4)  
 SCXI-1346 Shielded Multi-chassis adapter (Quantity 3)  
 Type SH6868 Shielded Cable Assembly (Quantity 3)

**Thermocouple Signal Conditioning Hardware**

SCXI-1102 32-Channel Thermocouple Amp.  
 (Quantity 13)  
 SCXI-1303 32-Channel Terminal Block (Quantity 13)

**Other Signal Conditioning Hardware**

SCXI-1120 8-Channel Isolated Amplifiers (Quantity 2)  
 SCXI-1320 8-Channel Terminal Block (Quantity 2)  
 SCXI-1126 8-Channel Isolated Input Freq.  
 SCXI-1327 8-Channel Terminal Block  
 Connector Panel

**Monitor & Keyboard**

Shark 15" LCD Monitor  
 Industrial Keyboard

**About NTS Test Systems Engineering**

NTS TSE, located in Albuquerque, NM, designs and integrates test, measurement, automation, data acquisition and control systems utilizing diverse hardware platforms, operating systems, and instrumentation standards. Our expertise involves projects ranging from LabVIEW instrument drivers to full-blown automated turnkey systems. The dedicated staff of electrical and mechanical engineers, project managers and technicians of NTS are well versed in designing, integrating and programming real world solutions for industrial applications for a diverse set of operating systems and standards.

Test & Automation Services Include

- Requirements Analysis & Development
- Hardware Design
- Software Design & Architecture
- Instrument Drivers
- Test System Management (TestStand)
- Software Development (LabVIEW)
- Data Management & Analysis (DIAdem)
- Enterprise Solutions
- Fabrication
- Integration
- Installation & Training
- Maintenance & Support



**Contact**

To discuss how NTS can help you solve your next test system engineering challenge, contact Tim Brooks at 505-345-9499 or email [tim.brooks@ntscorp.com](mailto:tim.brooks@ntscorp.com).

