A High Speed Data Acquisition and Analysis System for Transonic Velocity, Density, and Total Temperature Fluctuations

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Abstract

This report describes the high speed Dynamic Data Acquisition System (DDAS) which provides the capability for the simultaneous measurement of velocity, density, and total temperature fluctuations. The system of hardware and software is described in context of the wind tunnel environment.

The DDAS replaces both a recording mechanism and a separate data processing system. The data acquisition and data reduction process has been combined within DDAS. DDAS receives input from hot wires and anemometers, amplifies and filters the signals with computer controlled modules, and converts the analog signals to digital with real-time simultaneous digitization followed by digital recording on disk or tape. Automatic acquisition (either from a computer link to an existing wind tunnel acquisition system, or from data acquisition facilities within DDAS) collects necessary calibration and environment data. The generation of hot wire sensitivities is done in DDAS, as is the application of sensitivities to the hot wire data to generate turbulence quantities. The presentation of the raw and processed data, in terms of root mean square values of velocity, density and temperature, and the processing of the spectral data is accomplished on demand in near-real-time with DDAS.

This paper describes the interface to DDAS and the internal mechanisms of DDAS. A summary of operations relevant to the use of the DDAS is also provided.
Symbols

$A_1-A_8$ Constants in equation (1)

$E$ mean voltage across wire

$e'$ instantaneous voltage across wire (less the mean)

$G_w$ instrumentation amplifier scalar

$S_u$ velocity sensitivity $\frac{\partial \log e}{\partial \log u} \rho, T_0, T_w$

$S_\rho$ density sensitivity $\frac{\partial \log e}{\partial \log \rho} \ u, T_0, T_w$

$S_{T0}$ temperature sensitivity $\frac{\partial \log e}{\partial \log T_0} \ u, \rho, T_w$

$T_0$ mean total temperature

$T_w$ mean temperature of heated wire

$u$ mean velocity

$\rho$ mean density

1. INTRODUCTION

Recent advancements have been made in hot wire anemometry techniques which allow a three wire probe to separate three components of the perturbations in the flow field. Velocity, density and total temperature fluctuations can be determined as a function of three parallel hot wires, since at subsonic and transonic speeds it is generally conceded that the voltage measured across a heated wire mounted normal to the flow and operated with a constant temperature anemometer is a function of velocity, density and total temperature. Under these conditions, a single equation is obtained
for the fluctuating voltage across a single wire which is a function of the three variables - velocity, density, and total temperature. Quantitative measurements for the three fluctuations in the flow variables have used probes with three wires mounted normal to the flow and operated at three different "overheats".

The development of a dedicated hardware and software system to support hot wire anemometry at NASA Langley Research Center in the Fluid Dynamics Branch of the Transonic Aeronautics Division was precipitated by the necessity to process simultaneous hot wire data from three wire probes more rapidly than previously possible.

Prior to the development of the DDAS, all data was acquired on FM tape, and all processing was done in an off-line batch mode. This method delayed recognition of faulty or incomplete data, and test results were often delayed several months.

During a flow diagnostics test in the 8 Foot Transonic Pressure Tunnel (8’TPT) at NASA Langley Research Center in January of 1988, the DDAS was connected in parallel to the existing test instrumentation systems to provide an initial test bed for the new system. See Figure 1. The DDAS was not designated as a primary data acquisition or reduction system, but it soon became apparent that the data logging capabilities would be especially helpful in collecting the hot wire calibration data in an easily manageable format. The hot wire calibration data and the generation of hot wire sensitivities were processed only by the DDAS and the calibration data and sensitivities were used both by DDAS and by other data processing facilities. As a test of the digitization and recording capability, dynamic data was routinely digitized in parallel with the FM tape recordings. As soon as adequate calibration data was collected, the DDAS processed some of the data, and provided velocity, density, and total
temperature turbulence measurements. These results compared favorably with subsequent off-line batch data processing.

A second test was supported to compare hot wire techniques and laser velocimetry techniques in the Basic Aerodynamic Research Facility (B.A.R.F.).

The DDAS provides the processes necessary to:

1) acquire the hot wire calibration data
2) acquire the dynamic hot wire data
3) generate hot wire coefficients and sensitivities
4) compute velocity, density, and total temperature fluctuations
5) compute other statistical relationships
6) provide spectral analysis
7) manage data
8) produce reports and plots

2. SYSTEM DESCRIPTION

DDAS is a system of hardware and software based on systems purchased from Data Laboratories, Ltd., Precision Filters, Inc., and Hewlett Packard Corporation. Modifications and enhancements to the software and hardware have converted a waveform recorder into a hot wire anemometry acquisition and processing system specifically tailored to the three wire technique that yields separate velocity, density and total temperature components of turbulence.

2.1. HARDWARE
The system (fig. 1) is divided into an analog front end, and a computer-based processing and display section. The analog front end consists of a filter/amplifier subsystem, a high speed digitizer, and a low speed digitizer (or a data link to another acquisition computer). All are fully computer controlled. The processing and display subsystem controls the analog subsystems, and receives the digitized data, processes the data, displays the data, and stores the data in a permanent file.

2.1.1. Amplifier and Filter Subsystem

The analog signals from the hot wire anemometers are first routed to the Precision Filters, Inc. precision amplifier and filter subsystem. This subsystem is currently configured for four channels, providing support for only one three wire probe. Each channel successively passes the anemometer signal through a pre amplifier, high pass filter, low pass filter, and a post amplifier. The full bandwidth capability of each channel is .1Hz to 200KHz, but the high pass and low pass filters usually provide a narrower bandwidth (1Hz to 5KHz). The high pass filter acts as the anti-aliasing filter for the high speed digitizer.

2.1.2. High Speed Digitizer Subsystem

A high speed digitizer, called a Multitrap modular waveform recorder by Data Laboratories, Ltd., is configured to digitize up to 14 channels of fluctuating hot wire data (three channels are required for each 3-wire probe) at rates of up to one million (1M) samples per second (6 channels at up to 1M samples/sec, and 8 channels at up to 256 thousand (256K) samples/second. This data is stored temporarily in the Multitrap buffer memories (up to 256,000 samples per channel), and then transferred to the
HP 9000/330 computer at about 100,000 samples per second - one channel memory at a time - via a dedicated 16 bit parallel bus (GPIO).

2.1.3. Low speed digitizer

This subsystem is not currently implemented, and an existing wind tunnel data acquisition system provided DDAS the functions of a low speed digitizer subsystem. However, the optional low speed digitizer subsystem would consist of a multiplexer and digitizer selected for collection of mean values, not fluctuating values. This subsystem would be used to collect calibration data and tunnel parameter data, which would be logged for further processing of the calibration and fluctuating data.

2.1.4. Computer link to tunnel computer

The General Purpose Interface Bus (GPIB), an IEEE488 standard bus, is used to receive static data from the existing tunnel data acquisition system computer. The tunnel computer transmits a packet of data relevant to the tunnel conditions and hot wire calibration data. This link was selected because of its availability in both the tunnel computer and in the DDAS computer. It provides an 82,000 byte per second transfer rate, which is more than adequate to receive as many as four complete ASCII data packets per second. The tunnel computer actually sent only one packet per second.

Use of the existing tunnel data acquisition system to collect the tunnel conditions and the additional mean values related to the hot wire calibration data eliminates the need for a parallel hardware system (the low speed digitizer), and the need to develop instrument calibration software and hardware. It does, however, provide additional work for the tunnel computer personnel to configure their acquisition setup to handle
the additional channels, and to provide the GPIB software to generate the data packets for the DDAS.

The link is configured with the DDAS end as not system controller, and as device 01. This was accomplished by setting switches on the HP 98624A HP-IB Interface Card inserted into the computer specifically for the link. The select code was set to 8; interrupts are not relevant, since they are not used. The wind tunnel computer providing the data packet is configured as system controller, and outputs ASCII data packets at a rate set by the wind tunnel computer.

The packet is read into a DDAS packet buffer with one program statement in the subroutine Get_packet in module MODUSR2: ENTER Pkt_sc;Pkt$(*), where Pkt_sc is equal to 8, and the Pkt$ array was sized for 47 each 80 character strings.

The packet format is shown in Table 1.

2.1.5. Computer Peripherals

2.1.5.1. Disk storage

75Mb of non removable disk storage is available for programs and data. In addition, a 1.2Mb removable disk drive is available for program development and hot wire calibration data.

2.1.5.1.1. 55Mb hard disk

The computer then transfers the data to a 55Mb hard disc at about the same 100,000 samples per second - one channel at a time.
2.1.5.1.2. 20Mb hard disk

Programs and support software is stored on the 20Mb hard disk.

2.1.5.2. Tape storage

Once the data disc is full, the data is copied to a 67Mb tape cartridge for permanent storage.

2.1.5.3. Display

A color CRT is the system console and data display.

2.1.5.4. Plotter

An 8 pen autoload flatbed plotter is available for plot generation, and is used to display dynamic data and hot wire calibration data.

2.1.5.5. Printer

A dot matrix printer is available for data display. It can produce screen dumps, but is used primarily to generate a record of the hot wire calibration data, and, as data processing is accomplished, the results of the processing are printed.

2.2. SOFTWARE

2.2.1. Software environment
All DDAS programs operate under a BASIC operating system, in an interpretive BASIC language. Several compiled subroutines are a part of the ACQUIRE software system to enhance computational speed in some parts of the software.

2.2.2. Baseline software

The ACQUIRE software system, provided by Data Laboratories, Ltd. is the basis for the Dynamic Data Acquisition System (DDAS) used for the acquisition of hot wire anemometry data.

Since the ACQUIRE package is an off-the-shelf product, no attempt to describe its full capability will be made.

ACQUIRE has been slightly modified in only one area - the addition of a sequence number to a dynamic data disk file was inhibited if it was not necessary to discriminate between two files with the same name. See Section 2.2.6.2.1.2 for further discussion on the requirement for the modification.

2.2.3. Hot wire application software

Major additions were made to ACQUIRE in the form of two sub-programs: MODUSR1 and MODUSR2. These user written modules are configured according to guidelines provided by ACQUIRE, so that they will be automatically included in ACQUIRE. Appendix A contains the full program listings of these two modules.

The functions implemented in both MODUSR1 and MODUSR2 are listed in Appendix B.
2.2.4. **Configuration files**

Configuration files used by ACQUIRE for the 8'TPT test include acquisition setup parameters, hardware configuration parameters, and default display parameters. They are set, saved, and stored by a variety of ACQUIRE functions.

2.2.5. **Sequence program files**

The sequence program functions of ACQUIRE provide a mechanism for specifying a series of functions to be accomplished. Both the initialization and acquisition sequence program files used to tailor the DDAS for support of the 8'TPT test are listed in Appendix C.

Although the configuration files and sequence files are not the easiest to configure, the result is a system that is literally a "turnkey" system. Turn on the hardware, allow the hardware and software to be configured, and press a button to simultaneously acquire calibration and dynamic data.

2.2.6. **Hot wire data acquisition**

The ACQUIRE software system was augmented to support the specific requirements of hot wire anemometry systems currently in use at NASA Langley Research Center in the Fluid Dynamics Branch of the Transonic Aeronautics Division. Software design and implementation followed both form and style of the supplied ACQUIRE software, maintaining the appearance of a seamless environment within ACQUIRE. This feature resulted in a software system for an instrument that has evolved from a waveform recorder to a hot wire anemometry system designed to acquire and process both mean hot wire calibration data and fluctuating hot wire data.
The end result has been an easily used flow diagnostics instrument that minimizes the researchers workload.

With hot wires, there are most often two concurrent tasks: calibration of the wires, and acquisition of the dynamic, or fluctuating data. This system is designed to calibrate and process three wire probe data. The current implementation supports two three wire probes, and acquires, processes, and stores them separately.

Once the instrument is configured, each data point is acquired with the push of a single button -- one button recording. Data processing does require a few more button sequences, but only because the researcher provides more direction in the data reduction process.

For the 8'TPT flow diagnostics test in January of 1988, the hot wires had not been previously calibrated, so concurrent calibration data and dynamic data acquisition was necessary.

2.2.6.1. **Calibration**

Calibration of three wire probes require a complete data system to acquire mean (static) conditions of both the operational environment and of the mean hot wire values.

It is assumed that the hot wires are sensitive to velocity, density, and total temperature. To determine what the sensitivity is to each variable, the mean voltage output of each hot wire must be measured at each combination of velocity, density, and temperature. The tunnel run schedule was configured to assure that adequate data points are taken to provide a realistic profile of sensitivities.
The run schedule was also selected to expose the hot wire probe to the highest dynamic pressures first, so that if a wire is going to break, then the least amount of tunnel time will be lost.

Each of the three parallel hot wires on a probe are operated at different overheats, to encourage a wide separation of sensitivity between each hot wire.

The calibration data consists of mean values, which do not require the high sampling rates normally invoked to digitize the dynamic data, so the calibration data is not acquired through the high speed digitizers. An existing wind tunnel data acquisition system collected the data, and then transferred it through a GPIB link to the DDAS computer. Several data packets of data are averaged and then stored in a formatted record on disk.

2.2.6.1.1. Observation files

This calibration data is stored in a file called an observation file. Other related mean data is also stored in the observation file:

- tunnel conditions,
- test identification parameters,
- auxiliary data (such as RMS microphone readings, and amplifier gain settings), and
- simple calculated data (such as density, velocity, static temperature, the logs of a variety of data, and the products of the logs of a variety of data.)
The observation "file" is really several files. The first is a file containing the data received from a packet sent from the MODCOMP via the HP-IB link. (Actually, several packets are averaged, and the average is stores as an observation in the first observation file.) The second and third files each contain data related only to a specific three wire probe. These files also contain tunnel condition and test identification data as well, but only the tunnel computer data and simple, computed values related to a specific probe is contained in these files.

The internal format of the observation files was carefully selected to conform to the format specifications of an existing statistics package. The Basic Data Statistics package from HP has historically been the statistics package used to reduce the hot wire calibration data, so the file format was made compatible with that package.

2.2.6.2. Dynamic data

The acquisition of the dynamic hot wire data is entirely accomplished by the off-the-shelf ACQUIRE software. ACQUIRE has all the mechanisms necessary to configure the actual data acquisition hardware and the capability to manage the data once it has been digitized and buffered by the high speed digitizer hardware, which includes the transfer from the buffer to computer memory, and the transfer of the data to disk. These functional modules are "strung together" in a sequence program mechanism, which is also an inherent part of ACQUIRE.

2.2.6.2.1. Fluctuating data
Fluctuating data is either digitized data from the hot wire anemometers, or it is calculated data from the process of computing velocity, density, and temperature fluctuations, which is discussed later. In either case, the result is a time varying array of samples of data.

2.2.6.2.1.1. Fluctuating data volume

The sheer volume of fluctuating data is worth note: since each channel can handle 256K samples (512K bytes) at a time, and there are 3 channels per probe, and the same amount of results exist, $256K \times 2 \times 3 \times 2 = 31457K$ bytes per observation. For 117 observations (8' Transonic Pressure Tunnel Test 934), 368M bytes of data storage becomes necessary.

2.2.6.2.1.2. Fluctuating data disk file naming convention

DDAS collects and generates multiple channels of fluctuating data files for each test condition or observation. These files are related to a specific record in an observation file, which contains non-fluctuating scalar data related to the observation. The relationship of the fluctuating data file names to the test condition and to the observation file and record within the observation file is specifically defined by convention. The use of a naming convention allows data reduction programs to associate all data files necessary for data reduction and for naming resultant fluctuating data files. Table 2 details the naming format.

The dynamic data samples digitized by the MULTITRAP digitizer hardware are stored by the waveform recorder function of ACQUIRE on a channel-per-file basis. Fluctuating data names are generated whenever a hot wire
calibration observation is logged, so that a naming convention is followed - should a request to digitize hot wire fluctuating data be processed.

2.2.7. **Coefficient calculations**

The process of providing the sensitivities necessary to convert three hot wire data arrays into velocity, density and temperature fluctuation arrays first requires that the calibration data be processed by multiple linear regression techniques to produce a set of coefficients for each of the three hot wires. Since the relationship of the performance of the hot wire is highly nonlinear in relationship to the velocity, density, and temperature, up to 10 coefficients are required (Eight are in use, as shown\(^1\):

\[
\log E = A_1 + A_2 \log u + A_3 \log \rho + A_4 \log T_0 \\
+ A_5 \log u \log \rho + A_6 \log u \log T_0 \\
+ A_7 \log \rho \log T_0 \\
+ A_8 \log u \log \rho \log T_0
\]  

(1)

Since velocity, density, and temperature are all known for each observation (as collected by the DDAS form the tunnel data acquisition system - in the form of \(P_T, P_S, \) and \(T_T\)), the most direct solution is through multiple linear regression.

Whenever requested by the operator, a Multiple Linear Regression routine (which is a specifically modified version of the Hewlett Packard routine MLR which was purchased as part of a statistics package) is invoked, which calculates coefficients for each hot wire on each probe. These
coefficients can then be stored in a coefficient disk file related to each probe. (This internal MLR routine is not currently implemented.)

Alternatively, coefficients calculated in a separate multiple linear regression package may be read from a disk file generated by that package, or the coefficients may be manually entered through the keyboard.

2.2.7.1. Sensitivity calculations

The coefficients, which represent the hot wire relationship to velocity, density, and temperature, are combined with specific test conditions, which have been stored in an observation record of the observation file.

\[
S_u = A_2 + A_5 \log \rho + A_6 \log T_0 \\
+ A_8 \log \rho \log T_0 \\
\]

(2a)

\[
S_\rho = A_3 + A_5 \log u + A_7 \log T_0 \\
+ A_8 \log u \log T_0 \\
\]

(2b)

\[
S_{T_0} = A_4 + A_6 \log u + A_7 \log \rho \\
+ A_8 \log u \log \rho \]

(2c)

New ACQUIRE functions created in MODUSR2 allow the appropriate calibration file to be specified, and the beginning and ending observations and beginning and ending probes to be selected for the computations. For each observation and each probe, the log values of velocity, density and temperature are retrieved from the appropriate record in the observation file. Once the computation is completed for each probe, the resultant sensitivities are inserted into existing, but as yet unused variables in the previously recorded observation.
2.2.7.2. Calculating velocity, density, and temperature fluctuations

Once the sensitivities have been calculated, the operator may request that the dynamic data for a given set of observations and probes be processed in a way that yields dynamic waveforms representing fluctuating velocity, density and temperature (instead of 3 fluctuating voltages) and with turbulence figures and other statistical performance characteristics.

The equation that defines the relationship of voltages to turbulence parameters is:

\[
\begin{align*}
\begin{bmatrix}
  e' \\
  e' \\
  e'
\end{bmatrix}
= S_{u_1} \frac{u'}{U} + S_{\rho_1} \frac{\rho'}{\rho} + S_{T_0} \frac{T_0'}{T_0} \\
\begin{bmatrix}
  e' \\
  e' \\
  e'
\end{bmatrix}
= S_{u_2} \frac{u'}{U} + S_{\rho_2} \frac{\rho'}{\rho} + S_{T_0} \frac{T_0'}{T_0} \\
\begin{bmatrix}
  e' \\
  e' \\
  e'
\end{bmatrix}
= S_{u_3} \frac{u'}{U} + S_{\rho_3} \frac{\rho'}{\rho} + S_{T_0} \frac{T_0'}{T_0}
\end{align*}
\]

To solve for the three unknowns \((\frac{u'}{U}, \frac{\rho'}{\rho}, \frac{T_0'}{T_0})\) in the three equations, rearrange, and organize for a matrix operation:

\[
\begin{bmatrix}
  \begin{bmatrix}
    \frac{e'}{E} \\
    \frac{e'}{E} \\
    \frac{e'}{E}
  \end{bmatrix}
\end{bmatrix}
= \begin{bmatrix}
  S_{u_1} & S_{\rho_1} & S_{T_0} \\
  S_{u_2} & S_{\rho_2} & S_{T_0} \\
  S_{u_3} & S_{\rho_3} & S_{T_0}
\end{bmatrix}
\begin{bmatrix}
  \frac{u'}{U} \\
  \frac{\rho'}{\rho} \\
  \frac{T_0'}{T_0}
\end{bmatrix}
\]
By rearranging again, which involves inverting the sensitivity matrix, solve for the three unknowns:

\[
\begin{bmatrix}
  \frac{u'}{U} \\
  \frac{\rho'}{\rho} \\
  \frac{T_0'}{T_0}
\end{bmatrix}
= \begin{bmatrix}
  S_{u_1} & S_{\rho_1} & S_{T_0_1} \\
  S_{u_2} & S_{\rho_2} & S_{T_0_2} \\
  S_{u_3} & S_{\rho_3} & S_{T_0_3}
\end{bmatrix}^{-1}
\begin{bmatrix}
  \frac{e'}{E} & \frac{1}{G_w}
\end{bmatrix}
\]

The computation of the instantaneous velocity, density, and temperature is accomplished as shown:

for each probe and each observation to be processed,

for each of the three hot wires
the mean hot wire voltage (E) is retrieved
the gain (G) for the fluctuating hot wire voltage is retrieved
the three sensitivities (u, \(\rho\), T0) are retrieved and placed in the sensitivity matrix
the dynamic data file is retrieved from disk, and placed in memory
the sensitivity matrix is inverted
for each of the instantaneous samples
for each of the three hot wires
compute:

\[
\frac{e'}{E} \frac{1}{G_w}
\]

and store in the independent variable matrix
matrix multiply the inverted sensitivity array by the independent variable array, and place the instantaneous turbulence ratios \( \frac{U'}{U}, \frac{\rho'}{\rho}, \text{ and } \frac{T_0'}{T_0} \) in memory.

compute the RMS values of \( \frac{U'}{U}, \frac{\rho'}{\rho}, \text{ and } \frac{T_0'}{T_0} \)

store the RMS values of velocity, density, and temperature

\[
\left[ \frac{U'}{U}, \frac{\rho'}{\rho}, \frac{T_0'}{T_0} \right]
\]

for each observation into existing, but as yet unused variables in the previously recorded observation.

store the fluctuating velocity, density, and temperature waveforms in disk files for later spectral investigations, utilizing existing functions of ACQUIRE.

2.2.8. **Precision filter system control**

The computer control of the filters and amplifiers allows adaptive processing of various hot wire signals, which are dependent upon a variety of operational parameters. The software interface allows full control of each functional module within the Precision Filter system - including the calibration module, and also allows the interrogation of all status and condition data - including the calibration module. The modules are connected to provide a full calibration sequence, and to allow full operator control, semiautomatic or automatic operation. (This feature not implemented as of April 88).
2.2.9. Utility Functions

Other utility functions were implemented to enhance operational characteristics of the system. The ability to eject plots, and the ability to plot "special" hot wire calibration data, are "plot utilitys". The ability to list categories of files on the disk, to purge extraneous files - or groups of files, the ability to copy or move files - or groups of files - to another disk (or tape) are "file utilitys".

Function LOGFILLE TO PC was used to transfer observation files containing logged and computed data to another system. A GPIB bus connects DDAS to the PC, where a GPIB card (National Instruments or HP) is installed. Appendix D contains the PC BASIC program used with the HP GPIB card to receive and store the data on the PC disk.

3. OPERATION

Operation of DDAS begins prior to the tunnel operation. Configuration of both the ACQUIRE software and the high speed digitizer is accomplished from within the software. Configuration files of various types are generated by the software and are recallable either at power on time or from within a sequence program.

3.1. System setup - hardware

The initial configuration of hardware is accomplished only once. The assignment of device addresses is as follows:

GPIB devices:

<table>
<thead>
<tr>
<th>Device</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>printer</td>
<td>701</td>
</tr>
<tr>
<td>20Mb program disk</td>
<td>703,0</td>
</tr>
</tbody>
</table>
67Mb data tape 703,1
plotter 705
high speed digitizer 708
   (control link)
computer link 801
55Mb data disk 1400

GPIO (16 bit parallel) devices:

   high speed digitizer 12
      (data link)

3.2. System setup - software

The ACQUIRE operating system was configured to operate within the memory constraints of 4Mbytes, and to be configured for 14 channels of digitizers, and 14 channels of data memory. Refer to the ACQUIRE operations manual for further details.

3.3. ACQUIRE installation

Upon receipt of the software, the installation procedure defined by the manufacturer allows the software to be configured for existing hardware, including amount of computer memory, number of digitizers in the digitizer chassis, and the maximum number of channels in the computer memory at any one time.

3.4. System variables
A file structure is maintained in the ACQUIRE software for containing a wide variety of currently selected operating parameters. This mechanism allows the operator to interactively select preferred operational conditions, and then store the "sysvars" on disk for later retrieval. These parameters include, but are not limited to, display format, memory length for each channel, waveform file names, waveform channel selection, system variables file name, binary switch name, plot file name, and sequence file name. To recall a specific set of system variables automatically at power on time, the system variables are stored in a file called "AUTOVARS".

3.5. **Binary switches - digitizer configuration - MULTITRAP**

The high speed digitizer is configured utilizing an interactive session to select sampling rates, gains, trigger modes, data block size, etc., and then the configuration of the binary switches within the digitizer are saved in a binary switch configuration file. To recall a specific configuration for the digitizer automatically at power on time, the binary switches are stored in a file called "AUTOSW".

3.6. **Plot setup**

The format of a plot is defined interactively and may then be saved on a plot file. The actual data is not saved in the file. Once the waveform channel in memory is selected, the position, scaling, and labeling of the axis is defined, and waveform labeling is determined. Once all channels are positioned and defined, the plot title is defined, and the plot configuration is saved to disk.

3.7. **Sequence program - initialization**
An initialization sequence program is interactively generated, which will determine a sequence of functions to be performed to set up DDAS to a configuration relevant to a specific wind tunnel test. See Appendix C for a listing of the initialization sequence used for the 8'TPT test. To recall the initialization sequence program at power on time, the sequence is stored in a file called "AUTOSEQ".

3.8. **Sequence program - acquisition**

A run sequence program is interactively generated, which will determine a sequence of functions to be performed to:

- log calibration data
- digitize and store fluctuating data
- plot hot wire mean voltages vs. mass flow, \( \rho_u \), (see Fig. 2)
- print a report displaying many parameters of the current observation whenever the operator presses a single button. See Appendix C for a listing of the run sequence used for the 8'TPT test. The run sequence program is automatically loaded by the initialization sequence program, so that once all configurations are defined, powering on the system, and pressing a button is all that is necessary to simultaneously acquire both calibration and fluctuating hot wire data.

3.9. **File transfer to PC**

The probe log data files - one or both - can be transferred to a PC via a dedicated GPIB cabled between DDAS and a PC. The PC BASIC program "XFR.HP" (see Appendix D) should be started first, and then, before providing the requested file name, invoke the DDAS function LOGFILE TO PC. Refer to the relevant function sheet in Appendix B for details on proper configuration prior to starting the transfer. When the file name is then
entered into the PC, which defines where the data is to be stored, the transfer will begin.

4. SYSTEM STRENGTHS

4.1. ACQUIRE

ACQUIRE, in combination with the hardware is a very versatile waveform recorder:

- It controls all the hardware associated with the system.
- It manages hardware and software configuration - via files.
- It manages process, or "sequence" files.
- It manages dynamic data files and internal arrays of data.
- It provides a choice of operator dialogue techniques, including: cursor, menu, and command line entry.
- It provides data display management.
- It provides the waveform plotting capabilities.
- A Digital Signal Processing package is included which provides:
  - Fast Fourier Transforms
  - filters
  - power spectrum
  - transfer functions

The acquisition of the dynamic data, and the storing of the dynamic data is a very significant strength of ACQUIRE. But most importantly, the internal design allowed application routines to be written into ACQUIRE, which produces a set of software that appears to the user to be a single entity, without seams, and fully integrated.
4.2. Data logging

The internal log file format allows direct access by a commercially available statistics package, which includes a multiple linear regression analysis capability necessary to generate coefficients used in creating hot wire sensitivities.

4.3. Computer link

4.3.1. DDAS to tunnel computer

A software/hardware link is currently used with the MODCOMP data acquisition computer to receive mean data values, but a self-contained, accurate and reliable static data acquisition subsystem could be integrated, making the DDAS self-contained. The use of an existing data acquisition system for the collection of mean values transfers the instrument calibration requirements for those values to another system.

4.3.2. DDAS to PC

The LOGFILE TO PC function to transmit the logged and computed parameters to another system, where the data is reformatted and imported to a spreadsheet program (Lotus Symphony) for further analysis and data presentation.

5. LIMITATIONS

5.1. Uncalibrated wires
Hot wire calibration currently consumes the major portion of the tunnel operation time. Although not a limitation of the DDAS, the process of calibrating hot wire probes relative to temperature, density and pressure is currently the most expensive part of the three wire technique.

Pre-calibrated wires would allow real time processing of the voltages from the three wires into the velocity, density, and temperature components of turbulence. The facility would be much less expensive to construct and operate than the wind tunnel to be supported, since the size could be much smaller, and the tolerable turbulence levels could be higher, since only the mean values of velocity, density, and temperature are used in determining hot wire sensitivities.

For wind tunnels not capable of independently controlling velocity, density (or total pressure) and temperature, the three wire technique requires that the wires be pre-calibrated, since the sensitivities could not be properly determined in such a wind tunnel.

Although a hot wire calibration tunnel has been partially constructed, it is not yet operational due to manpower and funding constraints. A data logging program module developed for DDAS is available as a module for eventual integration with an instrumentation system expressly for the hot wire calibration facility.

5.2. Data storage

The acquisition of 2.5 seconds (50KHz bandwidth) of fluctuating data representing a single 3-wire probe hot wire output requires the rapid digitization, processing, display and storage, of 1.5Mb of data. 150Mb of data could easily be collected in 8 hours of transonic wind tunnel
testing. The hardware originally purchased with ACQUIRE can adequately digitize 14 hot wire channels of the dynamic components. Modifications have been made to rapidly transfer the digitized data to the computer. Adequate hardware exists to transfer the data to permanent storage. But only 55Mb of conventional disk space is available for data. A Write Once, Read Many (WORM) laser disk drive ($14K) would dramatically improve the storage capability, since WORM drives can typically store 600-800Mb of data per disc.

5.3. Compute speed

5.3.1. Hardware - central processing unit (CPU)

The real limitation of this system was - and is - in the processing speed of the CPU. The original HP 9000/310 CPU was about as fast as an IBM PC/AT, and often took minutes to perform a simple evaluation of a few thousand points of dynamic data from a single channel. The upgrade to an HP 9000/330 (for $13K) in the beginning of 1988 improved the processing performance somewhat, but the array processing problem is still not being met head on.

5.3.2. Data structure

For each computation the array structure requires an indexing algorithm to access each sample. Through the indexing mechanism, and by representing sample values in an integer format, at least a four-fold savings of computer memory and disk space is realized. But the saving of space (memory) has become an unnecessary and unacceptable tradeoff. All generated data had been simply rescaled (as ratios) existing data, so the linear coefficients were easily determined for the new integer data
arrays. However, the solution for three unknowns in three simultaneous equations does not allow for a simple determination for the linear coefficients to scale the integer data. To compute instantaneous turbulence fluctuation, each instantaneous voltage must be translated to floating point by applying first order coefficients. Then the floating point computations (a floating point matrix multiply operation is in itself not a fast operation) are accomplished for each instant in time. But the answers are in a floating point format and no linear coefficients have been determined to convert the floating point answers to a range of integer values. Therefore, the hot wire computations are accomplished twice - once to determine linear coefficients, and once to store the instantaneous turbulence fluctuation in an integer format. Both the integer format and the index algorithm produce excessively slow computing processes.

5.3.3. Operating system

The existing BASIC operating system is a single user, single task executive. It cannot support high speed communication via Ethernet. It cannot support concurrent operations; program development, data acquisition, data processing, and data communications cannot all be executing concurrently.

5.3.4. Programming language

The BASIC language is an interpreter, rather than a compiler, which trades off execution speed for ease of program development and maintenance. Although the ACQUIRE software takes advantage of some compiled and assembled subroutines - for speed - all of the application software is still interpreted.
6. RECOMMENDATIONS

Several solutions exist - they all require much larger investments of time and money than a mere doubling of financial resources.

6.1. Improvement options

6.1.1. Array processor hardware

A dedicated array processor is available from Analogic Corp ($27K) which is designed to interface to both the HP 9000/330 and the HP software. Modifications to the ACQUIRE Digital Signal Processing software (DSP), or development of a user-provided DSP routine to replace the ACQUIRE DSP software (3 man-months, est.) would be required.

6.1.2. Faster CPU

A larger HP 9000/350 CPU ($29K) would quadruple the processing speed, and still be able to run the existing ACQUIRE software.

A combination of the Analogic array processor and the HP 9000/350 would provide the best performance possible - without abandoning the ACQUIRE software.

6.1.3. Utilize UNIX operating system

Provide the multitasking, multiuser environment necessary to support concurrent operations, Ethernet (TCP/IP) communications, a choice of programming languages - including interpretive and compiled, and a wider marketplace for software and hardware solutions like nine track magnetic
tape support, laser printer support, graphics and statistics support, and data management support.

6.1.4. Abandon ACQUIRE

Abandon the ACQUIRE software system, and actively search for a software system that operates in the UNIX environment, has the potential for supporting the high speed digitizer, can acquire, process, display, and save both the mean data and fluctuating data more rapidly than ACQUIRE.

6.1.5. Remote processing

Processing the data elsewhere: ACD, MODCOMP or other larger computer resource. The solution is suggested by the existence of other computational resources that may be made available, including the tunnel computer, and would provide parallel processing of the DDAS data once the hot wire sensitivities are available, and once the instantaneous data has been acquired and transferred to the other resource. This approach assumes that a viable communications link like Ethernet is available. At NASA LaRC, this capability is called LaRCNET. Although this link is proposed for the East Area of LaRC - where 8'TPT is located, its presence is still about 2 years distant. LaRCNET also implies - by its very existence - that the ACD computational resources will be in great demand. The MODCOMP connection, however, proposes a much closer solution. Although not an array processor machine, and not yet capable of communicating via LaRCNET, the access via a local Ethernet (to eventually be a part of LaRCNET) is scheduled for the forth quarter of 1988.

6.2. Preferred solution
The preferred solution is: abandon ACQUIRE for a UNIX compatible set of software, translate existing hot wire programs to the UNIX environment, purchase new statistical software, and purchase an array processor and a faster CPU (the HP 9000/350). About 1 man-month would be required for conversion of the hot wire software, and about 3 man-months would be required to integrate all the various software and hardware modules. This solution minimizes the engineering integration risks attendant in any system of this complexity.
References:


2. P. C. Stainback; Some Influences of Approximate Values for Velocity, Density and Total Temperature Sensitivities on Hot Wire Anemometer Results; AIAA-86-0506


4. G. S. Jones, P. C. Stainback; A New Look At Wind Tunnel Flow Quality for Transonic Flows; SAE-88-1452

Figure 1. DDAS System Block Diagram
Figure 2. Plot: hotwire voltage vs. mass flow
**Figure 3. Observation Report**
Figure 4. Plot: Waveforms - Floor strut
Figure 5. Plot: Waveforms - Wall strut
<table>
<thead>
<tr>
<th>Pkt$</th>
<th>&lt;stx&gt;</th>
<th>(ignored)</th>
</tr>
</thead>
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</tr>
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<td>TIME</td>
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</tr>
<tr>
<td>6</td>
<td>DATE</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Ps</td>
<td>tunnel static pressure (psf)</td>
</tr>
<tr>
<td>8</td>
<td>Pt</td>
<td>tunnel total pressure (psf)</td>
</tr>
<tr>
<td>9</td>
<td>Tt</td>
<td>Tunnel total temperature (deg F)</td>
</tr>
<tr>
<td>10</td>
<td>Mach number</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Reynolds number (per chord foot)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>PtS1</td>
<td>Strut 1 (Wall) total pressure (psf)</td>
</tr>
<tr>
<td>13</td>
<td>PsS1</td>
<td>static pressure (psf)</td>
</tr>
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<td>14</td>
<td>TtS1</td>
<td>total temperature (deg F)</td>
</tr>
<tr>
<td>15</td>
<td>PtS2</td>
<td>Strut 2 (Floor) total pressure (psf)</td>
</tr>
<tr>
<td>16</td>
<td>PsS2</td>
<td>static pressure (psf)</td>
</tr>
<tr>
<td>17</td>
<td>TtS2</td>
<td>total temperature (deg F)</td>
</tr>
<tr>
<td>18</td>
<td>PtS3</td>
<td>Strut 3 (Unused)</td>
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<tr>
<td>19</td>
<td>PsS3</td>
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<tr>
<td>20</td>
<td>TtS3</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>P1HW1</td>
<td>Strut 1 Hot wire 1 mean voltage</td>
</tr>
<tr>
<td>22</td>
<td>P1HW2</td>
<td>2 mean voltage</td>
</tr>
<tr>
<td>23</td>
<td>P1HW3</td>
<td>3 mean voltage</td>
</tr>
<tr>
<td>24</td>
<td>P1HW4</td>
<td>4 mean voltage</td>
</tr>
<tr>
<td>25</td>
<td>P2HW1</td>
<td>Strut 2 Hot wire 1 mean voltage</td>
</tr>
<tr>
<td>26</td>
<td>P2HW2</td>
<td>2 mean voltage</td>
</tr>
<tr>
<td>27</td>
<td>P2HW3</td>
<td>3 mean voltage</td>
</tr>
<tr>
<td>28</td>
<td>P3HW1</td>
<td>Strut 3 Hot wire 1 mean voltage</td>
</tr>
<tr>
<td>29</td>
<td>P4HW1</td>
<td>Strut 4 Hot wire 1 mean voltage</td>
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<td>30</td>
<td>P5HW1</td>
<td>Strut 5 Hot wire 1 mean voltage</td>
</tr>
<tr>
<td>31</td>
<td>Kulitel</td>
<td>Microphone RMS voltage</td>
</tr>
<tr>
<td>32</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>4</td>
<td></td>
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<tr>
<td>35</td>
<td>5</td>
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</tr>
<tr>
<td>36</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>HW1-4GAIN</td>
<td>Gain code representing instrument gain</td>
</tr>
<tr>
<td>38</td>
<td>HW5GAIN</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>HW6GAIN</td>
<td>Wires 5, 6, and 7 are on probe 2,</td>
</tr>
<tr>
<td>40</td>
<td>HW7GAIN</td>
<td>wires 1, 2 and 3</td>
</tr>
<tr>
<td>41</td>
<td>KulitelGAIN</td>
<td>Gain code representing instrument gain</td>
</tr>
<tr>
<td>42</td>
<td>2</td>
<td></td>
</tr>
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<td>43</td>
<td>3</td>
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<td>46</td>
<td>6</td>
<td></td>
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Table 1. Fluctuating Data File Name Format
### Fluctuating Data File Name Format

<table>
<thead>
<tr>
<th>character</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>R</td>
<td>Real time digitized data</td>
</tr>
<tr>
<td>P</td>
<td>Playback (FM tape) digitized data</td>
</tr>
<tr>
<td>V</td>
<td>Velocity ratio - computed data</td>
</tr>
<tr>
<td>D</td>
<td>Density ratio - computed data</td>
</tr>
<tr>
<td>T</td>
<td>Temperature ratio - computed data</td>
</tr>
<tr>
<td>A</td>
<td>&quot;A&quot; 3-wire probe (wall strut - test 934)</td>
</tr>
<tr>
<td>B</td>
<td>&quot;B&quot; 3-wire probe (floor strut - test 934)</td>
</tr>
<tr>
<td>rr</td>
<td>Run number (00-99)</td>
</tr>
<tr>
<td>pp</td>
<td>Point number (00-99)</td>
</tr>
<tr>
<td>cc</td>
<td>Channel number (00-07)</td>
</tr>
<tr>
<td>ss</td>
<td>Sequence number - if any assigned</td>
</tr>
</tbody>
</table>

**Example:** RA171203 makes real time, probe A, run 17, point 12, no sequence number assigned.

The ACQUIRE software module MODUSR2 has been written to utilize the fluctuating data file naming conventions described above.

The ACQUIRE software module MODGEN (provided by Data Laboratories) was modified to not automatically add a sequence number in column 9 if not necessary to differentiate between two files with the same name (in columns one through eight).

**Table 2. Fluctuating Data File Name Format**
APPENDICES
APPENDIX A. Program Listings

This appendix contains the DDAS program listings for all the application specific code to acquire, process, display, store and transmit the hot wire data.

The program is separated into two modules: MODUSR1 provides general utility functions. MODUSR2 provides all hot wire specific functions.
This program becomes a part of "ACQUIRE", and provides additional utility functions. As the need for additional functions increases, so will the functions implemented in this program.
m_obs_plotted
26088 COM /Usrl/ From_disk$[10],To_disk$[10],File_grp$[10],File_nam$[10]
26089 COM /Usr2/ Sfn$,REAL Hwsens(*),Sensinv(*),Mean(*),Mean_param(*),Enorm(*),Stdev_param(*),Max_param(*),Min_param(*),Vo_param(*),Vs_param(*)
26090 COM /Usr2/ Gain_code_L4(*),Gain_code_L7(*)
26091 COM /Usr2/ C_names$(*),P_c(*)
26092 COM /Usr2/ Log_fn$,Data_set_title$,Logged_var_name$(*),Obs_rec(*),Pkt_sc,Pkt$(*),Pkt_avg(*),Num_avgs,Max_vars,Rcvd_vars
26093 COM /Usr2/ Subfile_names$(*),Subfile_chartst(*),Initial_obs,Ending_obs,Num_obs_rec,Num_obs_printed,Max_obs_rec,Tag_pkt$(*)
26094 COM /Usr2/ Initial_probe,Ending_probe
26095 COM /Usr2/ A_fn$,A_set_title$,A_var_name$(*),A_rec(*)
26096 COM /Usr2/ A_subfile_names$(*),A_sub_chartst(*)
26097 COM /Usr2/ B_fn$,B_set_title$,B_var_name$(*),B_rec(*)
26098 COM /Usr2/ B_subfile_names$(*),B_sub_chartst(*)
26099 COM /Usr2/ C_fn$,C_set_title$,C_var_name$(*),C_rec(*)
26100 COM /Usr2/ C_subfile_names$(*),C_sub_chartst(*)
26101 COM /Usr2/ Hw_rms(*)
26102 INTEGER V(3)
26103 INTEGER I
26104 DIM VS[30]
26105 SELECT Routine
26106 CASE 1 ! init pass !
26107 RESTORE Menulist
26108 LOOP
26109 READ VS
26110 EXIT IF VS=***
26111 READ V(*)
26112 CALL Chkmitem(V(*),VS)
26113 END LOOP
26114 CASE 2 ! init pass 2
26115 RESTORE Keylist
26116 LOOP
26117 Errfl=0
26118 Errtype=1
26119 READ V(1)
26120 EXIT IF V(1)<0
26121 READ V(2)
26122 CALL Chkkey(V(1),V(2))
26123 END LOOP
26124 !
26125 Menulist: !
26126 ! LABEL,Function,Flag1,Flag2
26127 DATA "UTILITY",4000,0,6
26128 DATA "PLOT UTILITY",4001,0,6
26129 DATA "PLOT EJECT",4002,0,262
26130 DATA "TAG PLOT",4003,0,262
26131 DATA "TAG PICTURE",4004,0,262
26132 DATA "PLOT LOG_E",4005,0,262
26133 DATA "PICTURE LOG_E",4006,0,262
26134 DATA "FILE UTILITY",4020,0,6
26135 DATA "CAT GROUP",4021,8704,260
26136 DATA "PURGE",4022,0,6
26137 DATA "PURGE GROUP",4023,8704,390
26138 DATA "PURGE FILE",4024,8704,390
26139 DATA "FILE COPY",4025,0,6
26140 DATA "FROM DISK",4026,8704,22
26141 DATA "TO DISK",4027,8704,22
26142 DATA "FILE GROUP",4028,8704,22
26143 DATA "COPY FILES",4029,8704,394
DATA "MOVE FILES",4030,8704,394
DATA "***"

Keylist: !

DATA 0,4000
DATA 100,4001
DATA 110,4002
DATA 120,4003
DATA 130,4004
DATA 140,4005
DATA 150,4006
DATA 200,4020
DATA 210,4021
DATA 220,4022
DATA 221,4023
DATA 222,4024
DATA 240,4025
DATA 241,4026
DATA 242,4027
DATA 243,4028
DATA 245,4030
DATA 247,4029
DATA -1,-1

CASE 3
!RUN TIME INITIALIZATION
Fil_nam$=""
Fil_grp$=""
RESTORE Symbols
READ Sym_cbl$(*)
Symbols: !
DATA "+"
DATA "X"
DATA "o"
DATA "*"

CASE 4
! Power on initializations:
Num_obs_plotted=0

CASE ELSE
Usercode:!
SELECT Code
CASE 4002
!PLOT EJECT
SELECT Routine
CASE 31
OUTPUT Plotdev;"PG"
Num_obs_plotted=0 !RESET OBSERVATIONS POINTER for Function 4005
Num_obs_printed=0 !RESET OBSERVATIONS PRINTED for Function 4107
END SELECT
CASE 4003,4004
!PLOT TAG PICTURE TAG
SELECT Routine
CASE 31
Errf=0
IF Errf=0 AND Code=4003 THEN PLOTTER IS Plotdev,"HPGL"
IF Errf=0 THEN
OFF TIMEOUT 7
Yminoff=0
Ymoff=1
X_gdu_min=0
X_gdu_max=100*RATIO
Y_gdu_min=0
Y_gdu_max=100
DEG
PEN 1
IF Titlesize<-.8 THEN Titlesize=4
CSIZE .65*Titlesize*Ymoff,.65*RATIO*.5
LONG 3
LDIR 0
VIEWPORT X_gdu_min,X_gdu_max,Y_gdu_min*Ymoff+Yminoff,Y_gdu_max*Ymoff+Yminoff
WINDOW X_gdu_min,X_gdu_max,Y_gdu_min,Y_gdu_max
MOVE X_gdu_max-.20*X_gdu_max,Y_gdu_max-10
FOR I=1 TO 10
SELECT I
CASE 1,2,5!TEST, RUN, DATE only
!####
LABEL Logged_var_name$(I)"&Tag_pkt$(I)
END SELECT
NEXT I
FOR Probe=Initial_probe TO Ending_probe
SELECT Probe
CASE 1
PEN 1
LABEL "WALL PROBE"
PEN 2
LABEL "FLOOR PROBE"
CASE 2
END SELECT
NEXT Probe
END IF
PENUP
VIEWPORT X_gdu_min,X_gdu_max,Y_gdu_min,Y_gdu_max
WINDOW X_gdu_min,X_gdu_max,Y_gdu_min,Y_gdu_max
MOVE X_gdu_max,Y_gdu_max
PLOTTER IS CRT,"INTERNAL"
END SELECT
CASE 4005,4006
SELECT Routine
CASE 31
IF Num_obs_plotted=0 THEN !Get the axis plotted
IF Code=4005 THEN OUTPUT Plotdev;"PG"!Eject old plot
Mvar$(3)="RhoU"
CALL Routine(22,618) !PLOT NAME=RhoU
CALL Routine(31,616) !LOAD PLOT
IF Code=4005 THEN
CALL Routine(31,615)!PLOT PICTURE
ELSE
CALL Routine(31,612)!REDRAW PICTURE
END IF
END IF
END IF
IF Code=4005 THEN
PLOTTER IS Plotdev,"HPGL"
OFF TIMEOUT 7
ELSE
PLOTTER IS CRT,"INTERNAL"
END IF
END IF
Yminoff=0
Ymoff=1
IF Titlesize<-.8 THEN Titlesize=4
FOR Probe=Initial_probe TO Ending_probe
   PEN Probe
   FOR This_obs= Initial_obs TO Ending_obs
      SELECT Probe
      CASE 1
         Num_wires=4
      CASE 2
         Num_wires=3
      CASE ELSE
         Num_wires=1
      END SELECT
      VIEWPORT Xstart(1),Xend(1),Ystart(1)*Ymoff+Yminoff,Yend(1)*Ymoff+Yminoff
      WINDOW Xmin(l),Xmax(l),Ymin(l),Ymax(l)
      FOR Wire= 1 TO Num_wires
         FOR Wire= 1 TO Num_wires
            SELECT Probe
            CASE 1
               Pressure= A_rec(4,This_obs)
               X_val= MAX(-E6,A_rec(13,This_obs))
               Y_val= MAX(-E6,A_rec(21+Wire,This_obs))
            CASE 2
               Pressure= B_rec(4,This_obs)
               X_val= MAX(-E6,B_rec(13,This_obs))
               Y_val= MAX(-E6,B_rec(21+Wire,This_obs))
            END SELECT
            MOVE X_val,Y_val
            SELECT Pressure
            CASE 700. TO 720.
               LABEL Sym_tbl$(1)
            CASE 850. TO 880.
               LABEL Sym_tbl$(2)
            CASE 1400. TO 1500.
               LABEL Sym_tbl$(3)
            CASE 1700. TO 1800.
               LABEL Sym_tbl$(4)
            END SELECT
            NEXT Wire
         NEXT Wire
      IF Probe= 1 THEN
         MOVE 1.,.6639
         DRAW 1.54,.7732
         LINE TYPE 4
         PEN Probe+3
         MOVE 1.,.67889
         DRAW 1.58,.72076
         LINE TYPE -1
      END IF
      NEXT Probe
   END SELECT
   PLOTTER IS CRT,"INTERNAL"
END SELECT
CASE 4021 !CAT A SELECT GROUP OF FILES
SELECT Routine
CASE 21
   Mvar$(3)= Fil_grp$
CASE 22
   Fil_grp$= Mvar$(3)
CASE 31
CAT; SELECT Fil_grp$
END SELECT
CASE 4023
PURGE A SELECT GROUP OF FILES
SELECT Routine
CASE 21
Mvar$(3)=Fil_grp$
CASE 22
Fil_grp$=Mvar$(3)
CASE 31
CAT TO Cat_array$(*) SELECT Fil_grp$, NO HEADER, COUNT Num_in_grp
FOR I=1 TO Num_in_grp
Fil_nam$=Cat_array$(I)[1:10]
PURGE Fil_nam$
NEXT I
END SELECT
CASE 4024
PURGE A FILE
SELECT Routine
CASE 21
CASE 22
END SELECT
CASE 4026
FROM DISK
SELECT Routine
CASE 21
Mvar$(3)=From_disk$
CASE 22
From_disk$=Mvar$(3)
END SELECT
CASE 4027
TO DISK
SELECT Routine
CASE 21
Mvar$(3)=To_disk$
CASE 22
To_disk$=Mvar$(3)
END SELECT
CASE 4028
FILE GROUP
SELECT Routine
CASE 21
Mvar$(3)=File_grp$
CASE 22
File_grp$=Mvar$(3)
END SELECT
CASE 4029, 4030
COPY OR MOVE A SELECT GROUP OF FILES
(! Copy leaves the files on both from and to disks.)
(! Move leaves the files only on the to disk, by purging the files successfully copied from the 'from' disk.)
SELECT Routine
CASE 21
Mvar$(3)=File_grp$
CASE 22
File_grp$=Mvar$(3)
CASE 31
CALL Pline(0,"Selecting files. Please wait....")
CAT From_disk$ TO Cat_array$(*) SELECT File_grp$, NO HEADER, COUNT
T Num_in_grp
26382 !
26383 ! PRINTER IS PRT;WIDTH 108
26384 PRINT CHR$(12) ! Form Feed
26385 PRINT Num_in_grp;" files have been selected for copying."
26386 PRINT
26387 PRINT " FORM";TAB(30);"TO"
26388 PRINT From_disk$;TAB(30);To_disk$
26389 PRINT
26390 FOR I=1 TO Num_in_grp
26391 PRINT TAB(20);Cat_array$(I)[1,10]
26392 NEXT I
26393 PRINTER IS CRT
26394 PRINT
26395 PRINT
26396 PRINTER IS CRT
26397 !
26398 Number_copied=0
26399 PRINTER IS PRT
26400 PRINT "The following files"&CHR$(27)&"&D"&" HAVE BEEN COPIED 
&CHR$(27)"&"to "&To_disk$
26401 PRINT
26402 PRINTER IS CRT
26403 FOR I=1 TO Num_in_grp
26404 ON ERROR GOTO 26414
26405 File_name$=Cat_array$(I)[1,10]
26406 COPY File_name$&From_disk$ TO File_name$&To_disk$
26407 CALL Pline(0,"FILE"&CHR$(129)&" File_name$" &CHR$(128)&" HAS BEEN COPIED FROM DISK "&From_disk$&" TO DISK "&To_disk$)
26408 PRINTER IS PRT;WIDTH 108
26409 Number_copied=Number_copied+1
26410 Cat_array$(Number_copied)[1,10]=File_name$
26411 PRINT "FILE"&CHR$(129)" File_name$" &CHR$(128)&"HAS BEEN 
COPYED FROM DISK "&From_disk$&" TO DISK "&To_disk$
26412 PRINTER IS CRT
26413 GOTO 26420
26414 PRINT TAB(10);"File ",File_name$&" was NOT successfully cop
ied..."
26415 PRINT ERRMS$
26416 PRINTER IS PRT
26417 PRINT TAB(10);"File ",File_name$&" was NOT successfully cop
ied..."
26418 PRINT ERRMS$
26419 PRINTER IS CRT
26420 NEXT I
26421 ON ERROR CALL Error
26422 CALL Pline(0,"&CHR$(129)&" FILE COPYYS COMPLETE 
"&CHR$(128)&"")
26423 !
26424 !
26425 IF Code=4030 THEN ! If a MOVE, then purge the origional file
26426 PRINTER IS PRT;WIDTH 108
26427 PRINT
26428 PRINT Number_copied;" FILES HAVE BEEN COPIED; PURGING ORIGI
26429 ONALS"
26430 ON ERROR GOTO 26432
26431 FOR I=1 TO Number_copied
26432 PURGE Cat_array$(I)[1,10]&From_disk$
26433 NEXT I
26434 ON ERROR CALL Error
PRINT "MOVE FILES function is complete"
PRINT
PRINTER IS CRT
END IF
END SELECT
END SELECT
END SELECT
END SELECT
SUBEND
!
!
This routine logs mean value data received from another CPU via the HP-IB bus. This bus is SC-8, and the primary address is 01. This end is NOT System Controller!

The variables are logged in a disc file that contains a header record, a variable names record, and 100 observation records. It is an ASCII file.

This routine also computes coefficients of calibration for multiple 3 wire probes thru the use of multiple linear regression. Alternatively, the coefficients can be entered either by reading a coefficient file, or by manually keying in the coefficients -

With the calibration coefficients, this routine can generate sensitivities for the designated probe for each observation previously logged.

This routine can then apply the sensitivities to dynamic HOTWIRE data! which is automatically loaded:

in trace and returns:

1 HOTWIRE 1 fluctuating velocity (u) in trace 4
2 HOTWIRE 2 fluctuating density (p) in trace 5
3 HOTWIRE 3 fluctuating temperature (To) in trace 6

These calculations are performed only between cursor positions - if both cursors of trace 1 are active; or from the only cursor to the end of the memory.

Otherwise, sensitivity coefficients are applied to the entire sample.

Traces 1, 2, and 3 are automatically loaded from disk files that were previously recorded using a naming convention defined here:

If the log filename is of the format "XXX" [where XXX is the test number]
then the hotwire data disk file names would have the format:

"MPXXXYZZnn"

[where M is the mode as follows:
R - Real time digitization
P - Playback digitization]
P is the probe selection as follows:
A - probe A
B - probe B

XX is the RUN number
YY is the POINT number

of the data most recently logged, and therefore most likely to define related mean conditions, and will contain calculated sensitivities, gains of the fluctuating voltages, etc
ZZ is the digitizer channel number (this naming convention assumes a 1-to-1 relationship:

probe "A"
chan 1 - hotwire 1
2   2
3   3

probe "B"
5   1
6   2
7   3

nn is the "serial number" automatically applied (unfortunately) by ACQUIRE, and must be ignored.

NOTE: the hotwire data disk file name is defined by ACQUIRE function "FILENAME".

Using the sensitivities, mean voltages, and gains from the "A" or "B" probe file,
traces 4, 5, and 6 are scaled and created to represent the ratios:
trace 4 = velocity fluctuations / mean velocity
trace 5 = density fluctuations / mean density
trace 6 = temperature fluctuations / mean temperature

The mean value is removed from these ratios, and an rms value of the three ratios is stored as variables 47, 48, and 49 of the appropriate probe file - "A" or "B".

Additionally, the ratios above can be retrieved and used to compute correlations between velocity, density, and temperature fluctuations, and then, using these correlations, go on and compute massflow and pressure fluctuations. These results are stored much as the ratios above are stored.

OPTION BASE 1

COM /Arr/ INTEGER Arrowvar(*)
COM /Cross/ Crval(*),INTEGER Crvar(*),Crtab(*),Crmptr
COM /Curs/ Caddm(*),INTEGER Cincr(*),Cpos(*),Scursor(*),Cactive,Cpixmin(*),Cpixmax(*),Cflag
COM /Error/ INTEGER Errf,Errtype
COM /Genvar/ Filename$(*),Discdev$,INTEGER Discmap(*),Recordnum
COM /Input/ Inpstr$,INTEGER Kposx,Kposy,Quitcode
COM /Keys/ Keylab$(*),INTEGER Keymap(*),Keymenu,Keyincr,Okeytype,Okeymenu
COM /Localvar/ Lvar$
COM /Mem/ Bsw$(*),Sw$(*),Sw(*),INTEGER X(*),Isw(*),Memlenb(*),Memlenu(*),Memstartb(*),Memstartu(*),Nummem,Maxmem,Memmaxl,Tnmem
COM /Menu/ Menulab$,Mvar$(*),Mlit$,Mvar(*),INTEGER Mivar(*),Menutab(*),Keycode(*),Sysmod(*),Nummitems,Nummods,Nkeys,Menuptr,Xindex,Yindex
COM /Param/ Mval$,Mval(*),INTEGER Mstack(*),Mvallist(*),Mstackptr,Mvalptr,Mvalstrptr
COM /Rcl/ Rclstr$,INTEGER Rclstr_ptr(*),Rclptr,Rclnum
COM /Screen/ INTEGER Garray(*),Ctextx(*),Ctexty,Ctextn,Ctextw,Opco(*),Osptr,Ostype,Updatetype
The A, B, and C files below contain the "calculated" variables related to: A) wall strut, B) floor strut, and C) Kulites (and ‘other’ ‘big end’ wires)
24205 READ V(2)
24206 CALL Chkkey(V(1),V(2))
24207 END LOOP
24208 !
24209 Menulist: !
24210 !   LABEL,Function,Flag1,Flag2
24211 DATA "HOTWIRE MENU",4100,0,6
24212 DATA "COEF FILENAME",4101,8704,22
24213 DATA "LOAD COEFS",4102,0,262
24214 DATA "ENTER COEFS",4103,0,388
24215 DATA "CALC VEL etc",4104,0,262
24216 DATA "LOG FILENAME",4105,8704,22
24217 DATA "LOAD LOGFILE",4106,0,262
24218 DATA "PRNT LOGFILE",4107,0,262
24219 DATA "LOG DATA POINT",4108,0,390
24220 DATA "LOG DATA",4109,0,6
24221 DATA "SAMPLES TO AVG",4110,24608,22
24222 DATA "COMPUTE SENS.",4111,0,390
24223 DATA "INITIAL OBS",4112,24608,22
24224 DATA "ENDING OBS",4113,24608,22
24225 DATA "HOTWIRE CALC",4120,0,6
24226 DATA "GET COEF",4122,0,6
24227 DATA "COMPUTE COEFS",4123,0,390
24228 DATA "STORE COEFS",4124,0,262
24229 DATA "CODE TO GAINS",4125,0,388
24230 DATA "FILE TRANSFERS",4126,0,6
24231 DATA "LOGFILE TO PC",4127,0,388
24232 DATA "Remake Probe",4128,0,388
24233 DATA "SELECTOR",4129,0,6
24234 DATA "INITIAL PROBE",4130,24608,22
24235 DATA "ENDING PROBE",4131,24608,22
24236 DATA "COMPUTE R etc",4132,0,388
24237 DATA "EDIT COEFS",4133,0,388
24238 DATA "***"
24239 !
24240 Keylist: !
24241 DATA 0,4100 !HOTWIRE MENU
24242 DATA 300,4129 !SELECTOR
24243 DATA 320,4112 !INITIAL OBS
24244 DATA 330,4113 !ENDING OBS
24245 DATA 340,4130 !INITIAL PROBE
24246 DATA 350,4131 !ENDING PROBE
24247 DATA 370,4110 !SAMPLES TO AVG
24248 DATA 400,4120 !HOTWIRE CALC
24249 DATA 420,4122 !GET COEFS
24250 DATA 421,4101 !COEF FILENAME
24251 DATA 422,4102 !LOAD COEFS
24252 DATA 423,4103 !ENTER COEFS
24253 DATA 424,4133 !EDIT COEFS
24254 DATA 425,4123 !COMPUTE COEFS
24255 DATA 427,4124 !STORE COEFS
24256 DATA 430,4111 !COMPUTE SENS
24257 DATA 440,4104 !CALC VEL etc
24258 DATA 450,4132 !COMPUTE E etc
24259 DATA 460,4125 !XLATE GAIN CODES
24260 DATA 470,4128 !Remake Probe Data
24261 DATA 500,4109 !LOG DATA
24262 DATA 510,4105 !LOG FILENAME
24263 DATA 520,4106 !LOAD LOGFILE
24264 DATA 530,4107 !PRNT LOGFILE
DATA 570,4108     !LOG DATA POINT
DATA 600,4126     !FILE TRANSFERS
DATA 610,4127     !LOGFILE TO PC
DATA -1,-1

CASE 3          ! RUN TIME VARIABLE INITIALIZATION
RESTORE Coef_names
READ C_names$(*)

Coef_names:     ! THESE ARE THE ORDER IN WHICH THE COEFFICIENTS ARE PROCESSED

DATA "CONSTANT"
DATA "L(U)"
DATA "L(Rho)"
DATA "L(TO)"
DATA "L(R)L(TO)"
DATA "L(R)L(U)"
DATA "L(U)L(TO)"
DATA "LULRLTO"
DATA "(L(U))**2"
DATA "unused"

RESTORE Code-14

DATA 0      ! CODE 0    off; not defined
DATA .25    ! 1
DATA .5     ! 2
DATA 1.
DATA 1.99
DATA 3.98
DATA 7.84
DATA 15.8
DATA 31.6
DATA 63.
DATA 125.
DATA 251.
DATA 501.
DATA 1000.
DATA 1995.
DATA 3981.
DATA 7943.

RESTORE Code-57

DATA 0      ! CODE 0
DATA 1.     ! CODE 1
DATA 2.
DATA 5.
DATA 10.
DATA 20.
DATA 50.
DATA 100.
Max_obs_rec=300
Max_vars=50
Rcvd_vars=45

CASE 4          ! POWER ON VARIABLE INITIALIZATION

Sfn$="C2"        !COEFFICIENT FILENAME
Initial_probe=1
Ending_probe=2
CASE ELSE
  SELECT Code
  !
  CASE 4101
    !enter HW COEFFICIENT FILE NAME
    SELECT Routine
    CASE 21
      !get old data, set up parameters
      Mvar$3=Sfn$
      !present setting
    CASE 22
      !store new data
      Sfn$=Mvar$3
    END SELECT
  END SELECT
CASE 4111
  ! COMPUTE SENSITIVITIES
  SELECT Routine
  CASE 31
    FOR R=Initial_obs TO Ending_obs
      FOR W=1 TO 3
        SELECT Probe
        CASE 1
          ! S(U) = A2 + A6 * Log(Rho) + A7
          *Log(T0) + A8 *Log(Rho)Log(T0)+A9*2.*Log(U)
          A_rec(29+W,R)=P_c(W,2)+P_c(W,6)*A_rec(11,R)+P_c(W,7)*A_rec(12,R)+P_c(W,8)*A_rec(14,R)+P_c(W,9)*A_rec(10,R)
          S(Rho) = A3 + A5 *Log(T0) + A6
          *Log(U) + A8 *Log(U)Log(T0)
          A_rec(33+W,R)=P_c(W,3)+P_c(W,5)*A_rec(12,R)+P_c(W,6)*A_rec(10,R)+P_c(W,8)*A_rec(16,R)
          S(T0) = A4 + A5 *Log(Rho) + A7
          *Log(U) + A8 *Log(U)Log(Rho)
          A_rec(37+W,R)=P_c(W,4)+P_c(W,5)*A_rec(11,R)+P_c(W,7)*A_rec(10,R)+P_c(W,8)*A_rec(15,R)
          S(U) = A2 + A6 *Log(Rho) + A7
          *Log(T0) + A8 *Log(Rho)Log(T0)+A9*2.*Log(U)
          B_rec(29+W,R)=P_c(W,2)+P_c(W,6)*B_rec(11,R)+P_c(W,7)*B_rec(12,R)+P_c(W,8)*B_rec(14,R)+P_c(W,9)*B_rec(10,R)
          S(Rho) = A3 + A5 *Log(T0) + A6
          *Log(U) + A8 *Log(U)Log(T0)
          B_rec(33+W,R)=P_c(W,3)+P_c(W,5)*B_rec(12,R)+P_c(W,6)*B_rec(10,R)+P_c(W,8)*B_rec(16,R)
          S(T0) = A4 + A5 *Log(Rho) + A7
          *Log(U) + A8 *Log(U)Log(Rho)
          B_rec(37+W,R)=P_c(W,4)+P_c(W,5)*B_rec(11,R)+P_c(W,7)*B_rec(10,R)+P_c(W,8)*B_rec(15,R)
        END SELECT
        NEXT W
        NEXT R
        NEXT Probe
      GOSUB Log_vars ! Update the disk files
      END SELECT
    !
    GOSUB Log_fn$ = "LOGFILE"
  END SELECT

CASE 4123
SELECT Routin1
CASE 31
CALL Mr!Perform Multiple Linear Regression
! for the probes selected
END SELECT
CASE 4124
SELECT Routin1
CASE 31
Errf=0
CREATE BDAT Sfn$,1,256
ASSIGN @Disk TO Sfn$
IF Errf=0 THEN OUTPUT @Disk;P_c(*)
ASSIGN @Disk TO *
END SELECT
CASE 4102
SELECT Routin1
CASE 31
Errf=0
ASSIGN @Disk TO Sfn$
IF Errf=0 THEN ENTER @Disk;P_e(*)
ASSIGN @Disk TO *
PRINTER IS PRT
PRINT CHR$(12)
PRINT "THESE ARE THE COEFFICIENTS FROM COEFFICIENT FILE ";Sfn$
PRINT
PRINT
PRINT
PRINT TAB(5);"WIRE 1";TAB(25);"WIRE 2";TAB(45);"WIRE 3"
PRINT
FOR I=1 TO 10
PRINT P_c(I,1);TAB(20);P_c(2,I);TAB(40);P_c(3,I)
NEXT I
PRINTER IS CRT
END SELECT
CASE 4103,4133
! ENTER COEF file; EDIT COEF file
CASE 31
IF Code=4133 THEN GOTO Edit_coefs
FOR I=1 TO 3
BEEP
FOR J=1 TO 10
CALL Pline(0,"Enter the " &C_names$(J)&" (A" &VAL$(J)&")
coefficient for wire " &VAL$(I)&":"
ON ERROR RECOVER 24418
Temp$=FNInput$(3)
P_c(I,J)=VAL(Temp$)
ON ERROR CALL Error
NEXT J
NEXT I
Edit_coefs: !
REPEAT
CALL Pline(2,"wire1 wire2 wire3")
FOR Coef_num=1 TO 10
CALL Pline(2+Coef_num,VAL$(P_c(1,Coef_num))&
"&VAL$(P_c(2,Coef_num))&" &VAL$(P_c(3,Coef_num))
NEXT Coef_num
CALL Pline(17,"ARE THESE COEFFICIENTS CORRECT FOR PROBE " &V
AL$(Initial_probe)&"?")
Ans$=FNInput$(2,"NO")
CALL Pline(17,"")
SELECT Ans$
CASE "YES", "YE", "Y"
CASE ELSE
CALL Pline(15, "Enter the wire # (1-3) whose coefficient needs changing:")
I=VAL(FNInput$(3,"1"));
IF I<1 OR I>3 THEN GOTO 24433
CALL Pline(15, "Enter the coefficient number (A#) which is to be entered:")
J=VAL(FNInput$(3,"1"));
IF J<1 OR J>10 THEN GOTO 24436
CALL Pline(15, "Enter the "&C_names$(J)&" (A"&VAL$(J)&") coefficient for wire "&VAL$(I)&":")
ON ERROR RECOVER 24443
Temp$=FNInput$(2)
P_c(I,J)=VAL(Temp$)
ON ERROR CALL Error
CALL Pline(2+J,VAL$(P_c(I,J))&"&VAL$(P-c(3,J)))
UNTIL Ans$="Y" OR Ans$="YES" OR Ans$="YE"
Schg=BINOR(Schg,2^6+2^7)!CLEAR SCREEN+CLEAR GRAPHICS
END SELECT
CASE 4125
SELECT Routine
CASE 31
FOR This_obs=Initial_obs TO Ending_obs
FOR Probe=Initial_probe TO Ending_probe
! GET MEAN VALUE & GAIN FROM THE LOG FILE
SELECT Probe
CASE 1
FOR Wire=1 TO 4
!####
SELECT Obs_rec(36, This_obs)
SELECT 1
CASE 1 TO 16
!####
Wire_gain(Wire)=Gain_code_14(Obs_rec(36, This_obs)+1)
Wire_gain(Wire)=Obs_rec(36, This_obs)
A_rec(41+Wire, This_obs)=Wire_gain(Wire)
A_var_name$(41+Wire)="GAIN ",&VAL$(Wire)
CASE ELSE
Obs_rec(36, This_obs)=0!DEFAULT GAIN
A_var_name$(41+Wire)="GAIN ",&VAL$(Wire)
END SELECT
NEXT Wire
CASE 2
FOR Wire=1 TO 3
!####
SELECT Obs_rec(36+Wire, This_obs)
SELECT 1
CASE 1 TO 7
!####
Wire_gain(Wire)=Gain_code_57(Obs_rec(36+Wire, This_obs)+1)
Wire_gain(Wire)=Obs_rec(36+Wire, This_obs)
B_rec(41+Wire, This_obs)=Wire_gain(Wire)
B_var_name$(41+Wire)="GAIN "&VAL$(Wire)
CASE ELSE
B_rec(41+Wire,This_obs)=0!Default gain = 0
B_var_name$(41+Wire)="GAIN "&VAL$(Wire)
END SELECT
NEXT Wire
END SELECT
NEXT Probe
NEXT This_obs
GOSUB Log_vars
END SELECT
!
CASE 4128 !REMAKE PROBE DATA
SELECT Routine
CASE 31
FOR This_obs=Initial_obs TO Ending_obs
CALL Pline(Staty,"Recalculating Tunnel parameters for observation ",&VAL$(This_obs))
GOSUB Tun_vars
FOR Probe=Initial_probe TO Ending_probe
SELECT Probe
CASE 1
CALL Pline(Staty,"Recalculating probe A for observation "&VAL$(This_obs)&" ")
GOSUB Wall_vars
CASE 2
CALL Pline(Staty,"Recalculating probe B for observation "&VAL$(This_obs)&" ")
GOSUB Floor_vars
END SELECT
NEXT Probe
CALL Pline(Staty,
"
"
NEXT This_obs
GOSUB Log_vars
END SELECT
!
CASE 4132 !COMPUTE R [CORRELATIONS] etc
SELECT Routine
CASE 31
CLEAR ALL DATA TRANSFERS TO START
Mivar(14)=0
Mivar(2)=0
CALL Routine(22,239) !DATA FILE MAP
LOAD ONLY CHANNELS 2,3,4
FOR I=2 TO 4
Mivar(2)=1
Mivar(14)=I
CALL Routine(22,239) !DATA FILE MAP
NEXT I
FOR Probe=Initial_probe TO Ending_probe
FOR This_obs=Initial_obs TO Ending_obs
DISP "PROBE ",&VAL$(Probe)&" ; OBS ",&VAL$(This_obs)&" ";
SPECIFY FILENAMES:
FOR I=2 TO 4
Filename$(I)=" 
SELECT I
CASE 2
CASE 3
   Filename$(I)[1,1]="D"
   Filename$(I)[7,8]="05"
END SELECT

SELECT INT(Obs_rec(2,This_obs))
CASE 0 TO 9
   Filename$(I)[3,4]="0"&VAL$(Obs_rec(2,This_obs))
!Run
CASE 10 TO 99
   Filename$(I)[3,4]=VAL$(Obs_rec(2,This_obs))
END SELECT
SELECT INT(Obs_rec(3,This_obs))
CASE 0 TO 9
   Filename$(I)[5,6]="0"&VAL$(Obs_rec(3,This_obs))
!Point
CASE 10 TO 99
   Filename$(I)[5,6]=VAL$(Obs_rec(3,This_obs))
END SELECT
Mivar(14)=I
CALL Routine(21,232) !DISPLAY THE FILENAME
NEXT I
LOAD THE THREE CHANNELS INTO MEMORIES 2,3,4
(2-V 3-D 4-T):
CALL Routine(31,235) !LOAD DATA
FOR Xp=1 TO 3
   DISP "CORRELATION ",VAL$(Xp)&" ";
   Mivar(14)=1
   SELECT Xp
   CASE 1
      ! COPY MEMORY 3 TO MEMORY 1, leaving D in 1 and V in 2:
      Mvar(2)=3
      CALL Routine(22,280)!MEMORY COPY V TO 1
   CASE 2
      ! COPY MEMORY 4 TO MEMORY 1, leaving T in 1 and V in 2:
      Mvar(2)=4
      CALL Routine(22,280)!MEMORY COPY T TO 1
   CASE 3
      ! COPY MEMORY 3 TO MEMORY 1, and
      ! COPY MEMORY 4 TO MEMORY 2, leaving D in 1 and T in 2:
      Mvar(2)=3
      CALL Routine(22,280)!MEMORY COPY D TO 1
      Mivar(14)=2
      Mvar(2)=4
      CALL Routine(22,280)!MEMORY COPY T TO 2
   END SELECT
   ! MULTIPLY MEMORY 1 BY MEMORY 2:
   Mivar(14)=0
   CALL Routine(31,533)!MEMORY MULTIPLY
   ! FIND MEAN OF MEMORY 1
   Mivar(14)=1
   CALL Routine(31,511)!MEAN
   Temp_mean=Mvar(3)
! STORE MEAN INTO DATA BASE AS D*V, V*T, or D*T CORRELATION
SELECT Probe
CASE 1
SELECT Xp
CASE 1!D*V
   Temp rms=A rec(48,This_obs)*A rec(47,This_obs)*
bs)! (d'/D)*(v'/V)
CASE 2!V*T
   Temp rms=A rec(47,This_obs)*A rec(49,This_obs)*
bs)! (v'/V)*(t'/T)
CASE 3!D*T
   Temp rms=A rec(48,This_obs)*A rec(49,This_obs)*
bs)! (d'/D)*(t'/T)
END SELECT
A rec(25+Xp,This_obs)=Temp mean/Temp rms
CASE 2
SELECT Xp
CASE 1!D*V
   Temp rms=B rec(48,This_obs)*B rec(47,This_obs)*
bs)! (r'/V)*(v'/V)
CASE 2!V*T
   Temp rms=B rec(47,This_obs)*B rec(49,This_obs)*
bs)! (v'/V)*(t'/T)
CASE 3!D*T
   Temp rms=B rec(48,This_obs)*B rec(49,This_obs)*
bs)! (d'/D)*(t'/T)
END SELECT
B rec(25+Xp,This_obs)=Temp_mean/Temp rms
END SELECT
SELECT Probe
CASE 1
   A var name$(26)="R(RhoU)"
   A var name$(27)="R(UTO)"
   A var name$(28)="R(RhoTO)"
CASE 2
   B var name$(26)="R(RhoU)"
   B var name$(27)="R(UTO)"
   B var name$(28)="R(RhoTO)"
END SELECT
GOSUB Log-vars
NEXT Xp
NEXT This_obs
NEXT Probe
Etc4132:!
      COMPUTE M'/M, P'/P
FOR Probe=Initial_probe TO Ending_probe
   FOR This_obs=Initial_obs TO Ending_obs
      Mach=Obs rec(9,This_obs)
      M2=Mach*Mach
   SELECT Probe
      CASE 1
         U=A rec(47,This_obs)
         Rho=A rec(48,This_obs)
         TO=A rec(49,This_obs)
      CASE 2
         U=B rec(47,This_obs)
         Rho=B rec(48,This_obs)
MASSFL is \( M'/M \)

\[
\begin{align*}
\text{Massfl} &= \sqrt{U^2 + 2R_{urho}U\rho + \rho \rho} \\
\text{Press} &= \rho \rho + M^2 M^2 (1.44T0 + .16U^2) \\
\text{Press} &= \text{Press} + M^2 M^2 (-0.96) R_{ut} U T0 \\
\text{Press} &= \text{SQR(Press)}
\end{align*}
\]

SELECT Probe

CASE 1

A\_rec(41,This\_obs) = Massfl
A\_rec(46,This\_obs) = Press

CASE 2

B\_rec(41,This\_obs) = Massfl
B\_rec(46,This\_obs) = Press

END SELECT

GOSUB Log\_vars

NEXT This\_obs

SELECT Probe

CASE 1

A\_var\_name$(41) = "M'/M"
A\_var\_name$(46) = "P'/P"

CASE 2

B\_var\_name$(41) = "M'/M"
B\_var\_name$(46) = "P'/P"

END SELECT

NEXT Probe

END SELECT

CALC VEL etc

CASE 4104

Perform translation from voltages to
velocity, density, temperature

SELECT Routine

CASE 31

!perform action

Idiag=O

FOR Probe=Initial\_probe TO Ending\_probe

FOR This\_obs=Initial\_obs TO Ending\_obs! Do one observation

FOR ALL SAMPLES IN THE MEMORIES - AS DEFINED BY THE CURSORS OF
OF TRACE 1, CALCULATE THE EQUIVALENT INSTANTANEOUS:

VELOCITY, DENSITY, TEMPERATURE

Mivar(14)=-1
Mvar(2)=0
CALL Routine(21,239)!Turn off all data files (maps)

FOR Wire=1 TO 3

SELECT Probe! GET MEAN VALUE & GAIN FROM THE LOG FI
CASE 1
    Mean(Wire)=A_rec(17+Wire,This_obs)
    Wire_gain(Wire)=A_rec(41+Wire,This_obs)
CASE 2
    Mean(Wire)=B_rec(17+Wire,Initial_obs)
    Wire_gain(Wire)=B_rec(41+Wire,This_obs)
END SELECT
FOR Sens=1 TO 3! GET THE SENSITIVITY FROM THE LOG
SELECT Probe
CASE 1
    Hwsens(Wire,Sens)=A_rec(25+(Sens*4)+Wire,Th
CASE 2
    Hwsens(Wire,Sens)=B_rec(25+(Sens*4)+Wire,Th
CASE 3
    Hwsens(Wire,Sens)=C_rec(25+(Sens*4)+Wire,Th
END SELECT
NEXT Sens
SET UP DATA FILE MAP FOR TRACES 1,2,3 ONLY
Mivar(14)=Wire
Mvar(2)=1
CALL Routine(22,239)! TURN ON data files 1,2,or3
Mivar(14)=3+Wire
Mvar(2)=0
CALL Routine(22,239)! TURN OFF data files 4,5,or6
Temp][1]="R"
Temp][2]=CHR$(64+Probe)
SELECT INT(Obs_rec(2,This_obs))
CASE 0 TO 9
    Temp][3,4]="0"&VAL$(INT(Obs_rec(2,This_obs)))!RUN
    Temp][5,6]="0"&VAL$(INT(Obs_rec(3,This_obs)))!POINT
CASE 10 TO 99
    Temp][3,4]=VAL$(INT(Obs_rec(2,This_obs)))!RUN
END SELECT
SELECT INT(Obs_rec(3,This_obs))
CASE 0 TO 9
    Temp][5,6]="0"&VAL$(INT(Obs_rec(3,This_obs)))!POINT
END SELECT
CASE 10 TO 99
    Temp][5,6]=VAL$(INT(Obs_rec(3,This_obs)))!POINT
END SELECT
SELECT Probe
CASE 1
    Temp][7,8]="0"&VAL$(Wire)
CASE 2
    Temp][7,8]="0"&VAL$(Wire+4)
END SELECT
Temp][9,9]="1"
DISP Temp$
WAIT 1
Filename$(Wire)=Temp$
Mivar(14)=Wire
CALL Routine(21,232)! DISPLAY THE FILENAME
TRANSFER CHANNEL CHARACTERISTICS
! TO COMPUTED CHANNELS

FOR I=1 TO 15
   Sw(Wire+3,I)=Sw(Wire,I)
NEXT I
NEXT Wire

CALL Routine(43,235) ! LOAD DATA
CALL Routine(31,235)

FOR I=1 TO 3 ! For each channel
   CLEAR MEMORY TAGS FOR "REMOVE MEAN" FUNCTION
      FOR J=0 TO 2
         Sw$(I,13+J)=""
      NEXT J
   Mivar(14)=I
   CALL Routine(31,524) ! REMOVE MEAN
   CALL Routine(31,513) ! FIND RMS
   Hw_rms(I)=Mvar(3)
NEXT I

TRACE 1, 2, AND 3 POINT TO THE MEMORIES CONTAINING THE FLUCTUATING COMPONENT ONLY

SET UP DATA FILE MAP FOR RESULTS: 4, 5, 6 ONLY

FOR Results=4 TO 6
   Mivar(14)=Results-3
   Mvar(2)=0
   CALL Routine(22,239) ! TURN OFF data files 1, 2, 3
   Mivar(14)=Results
   Mvar(2)=1
   CALL Routine(22,239) ! TURN ON data files 4, 5, 6
NEXT I

SELECT Results
   CASE 4 ! Velocity
      Temp$[1]="V"
   CASE 5 ! Density
      Temp$[1]="D"
   CASE 6 ! Temperature
      Temp$[1]="T"
END SELECT

SELECT Probe
   CASE 1
   Temp$[5,6]=VAL$(INT(Obs_rec(3,This_obs)))!POINT
   END SELECT

SELECT
   CASE 10 TO 99
      Temp$[5,6]=VAL$(INT(Obs_rec(3,This_obs)))!POINT
   END SELECT
SELECT Probe
   CASE 1
      Temp$[7,8]="0"&VAL$(Results)
   END SELECT
Temp$[7,8]="0"&VAL$(Results+4)
END SELECT
Filename$(Results)=Temp$
Mivar(14)=Results
CALL Routine(21,232)! DISPLAY THE FILENAME
NEXT Results

! FILENAMES SET UP TO STORE DATA FILES

MAT Sensinv= INV(Hwsens)

DETERMINE SCALING (from a sampling of the data)

Wtr-1
Numb_samp=Sw(Wtr,2)
SELECT Numb_samp
CASE <100
   Numb_sub=Numb_samp
   CASE 100 TO 10000
      Numb_sub=100
   CASE >10000
      Numb_sub=Numb_samp/100
END SELECT

DETERMINE Mean, Standard deviation, Min, Max, range, Offset, Scale of velocity, density, and temperature.

Value=0
FOR Wtr=1 TO 6!pick up trace number
   Wmem(Wtr)=Trmem(Wtr)!pick up the memory number
   IF (BIT(Cactive,Wtr*2-1)) THEN ! ACTIVE 1st CURSOR
      Wmark(Wtr,1)=Caddrx(Wtr*2-1)!get the position of first cursor
   END IF
   IF (BIT(Cactive,Wtr*2)) THEN ! ACTIVE 2nd CURSOR
      Wmark(Wtr,2)=Caddrx(Wtr*2)
   ELSE ! IN-ACTIVE 2nd CURSOR
      Wmark(Wtr,2)=Sw(Wtr,2)!no second cursor; use last point in memory
   END IF
   END IF
   ELSE ! IN-ACTIVE 1st CURSOR
   IF (BIT(Cactive,Wtr*2)) THEN ! ACTIVE 2nd CURSOR
      Wmark(Wtr,1)=Caddrx(Wtr*2)!get the position of second cursor
   ELSE
      Wmark(Wtr,1)=0
   END IF
   END IF
   IF Wmark(Wtr,1)>Wmark(Wtr,2) THEN ! assure starting position is <=
      Temp=Wmark(Wtr,1)! to ending position
      Wmark(Wtr,1)=Wmark(Wtr,2)
      Wmark(Wtr,2)=Temp
   END IF
   Xch(Wtr)=((FNMems(1,Wmem(Wtr))+Wmark(Wtr,1)) DIV 10
   Xpt(Wtr)=((FNMems(1,Wmem(Wtr))+Wmark(Wtr,1)) MOD 10
   Nch(Wtr)=(Wmark(Wtr,2)-Wmark(Wtr,1)) DIV 1024! number
FOR THE SAMPLE POINTS:
FOR I=Strtpt TO Stoppt STEP Numb_samp/Numb_sub
FOR Wire=1 TO 3
IF FN Mem(l,Trmem(Wire))+I<=Sw(Wire,2) THEN
Xsch(Wire)=((FN Mem(l,Trmem(Wire))+I) DIV 1024)+1
Xspt(Wire)=((FN Mem(l,Trmem(Wire))+I) MOD 1024)+1
Temp=X(Xsch(Wire),Xspt(Wire))
Value=((Temp/65536)-Vo(Wire))*Vs(Wire)
Enorm(Wire)=Value/(Mean(Wire)*Wire-gain(Wire))
END IF
END FOR
END FOR
NEXT Wire
MAT Vdp=Sensinv*Enorm
FOR Ip=1 TO 3
SELECT I
CASE Strtpt
Max_param(Ip+3)=Vdp(Ip)
Min_param(Ip+3)=Vdp(Ip)
Sum_param(Ip)=Vdp(Ip)
Sumsq_param(Ip)=Vdp(Ip)*Vdp(Ip)
CASE ELSE
IF Vdp(Ip)>Max_param(Ip+3) THEN Max_param(Ip+3)=Vdp(Ip)
IF Vdp(Ip)<Min_param(Ip+3) THEN Min_param(Ip+3)=Vdp(Ip)
Sum_param(Ip)=Sum_param(Ip)+Vdp(Ip)
Sumsq_param(Ip)=Sumsq_param(Ip)+(Vdp(Ip)*Vdp(Ip))
END SELECT
END FOR
END FOR
NEXT I
CALCULATE THE SLOPE (Vs_param) AND INTERCEPT (Vo_param)
FOR Ip=1 TO 3
Mean_param(Ip)=Sum_param(Ip)/Numb_sub
IF ((Sumsq_param(Ip) - (Numb_sub*Mean_param(Ip)*Mean_param(Ip)))/(Mean_param(Ip)-1)) > 0 THEN
Stddev_param(Ip) = SQR((Sumsq_param(Ip) - (Numb_sub*Mean_param(Ip)*Mean_param(Ip)))/(Mean_param(Ip)-1))
ELSE
Stddev_param(Ip) = 0
END IF

Vo_param(Ip+3) = (Max_param(Ip+3) + Min_param(Ip+3))/2.
IF Max_param(Ip+3) - Vo_param(Ip+3) > 0 THEN
Vs_param(Ip+3) = 10*((Max_param(Ip+3) - Vo_param(Ip+3))/32767)
ELSE
Vs_param(Ip+3) = 10.
END IF

STORE OFFSETS AND SLOPES IN THE MEMORIES POINTED TO BY TRACES 4, 5, 6
Sw(Ip+3, 28) = Vo_param(Ip+3)
Sw(Ip+3, 27) = Vs_param(Ip+3)
IDENTIFY DISPLAY AS USER UNITS
Isw(Ip+3, 13) = 1
SELECT Ip
CASE 1
Sw$(Ip+3, 11) = "u'/U"
CASE 2
Sw$(Ip+3, 11) = "p'/P"
CASE 3
Sw$(Ip+3, 11) = "t'/T"
END SELECT
NEXT Ip

COMPUTE u, p, To

FOR I = Startpt TO Stoppt
FOR Wire = 1 TO 3
Temp = X(Xch(Wire), Xpt(Wire))
Value = ((Temp/65536) - Vo(Wire)) * Vs(Wire)
Enorm(Wire) = Value / (Mean(Wire) * Wire_gain(Wire))
Xpt(Wire) = Xpt(Wire) + 1
IF Xpt(Wire) > 1024 THEN
Xpt(Wire) = 1
Xch(Wire) = Xch(Wire) + 1
END IF
NEXT Wire
MAT Vdp = Sensinv * Enorm
IF Idiag THEN
PRINTER IS PRT; WIDTH 134
FOR I = Startpt THEN
PRINT "MAX_P: "; Max_param(*)
PRINT "MIN_P: "; Min_param(*)
PRINT "SLOPE: "; Vs_param(*)
PRINT "INTERCEPT: "; Vo_param(*)
PRINT "Means: "; Mean(*)
PRINT "Gains: "; Wire_gain(*)
PRINT
END IF
PRINTER IS CRT
END IF
FOR Ip = 4 TO 6! PUT u, p, To IN MEMORIES UNDER TRAC
\[ \text{Value} = \text{INT}\left(\frac{\text{Vdp}(Ip-3) - \text{Vo_param}(Ip)}{\text{Vs}_{\text{param}}(Ip)}\right) \]

\[ \text{IF Idiag AND Ip=6 THEN} \]
\[ \text{IF I MOD 100=0 AND I<1500 THEN} \]
\[ \text{PRINTER IS PRI; WIDTH 134} \]
\[ \text{PRINT "SAMPLE: ";} \text{I; TRACE: ";} \text{Ip, "Vdp: "} \]
\[ \text{PRINTER IS CRT} \]
\[ \text{END IF} \]
\[ \text{SELECT Value! Limit the range to the 16 bit int} \]
\[ \text{CASE -32768 TO 32767} \]
\[ \text{X(Xch(Ip),Xpt(Ip))=} \text{Value} \]
\[ \text{CASE >32767} \]
\[ \text{X(Xch(Ip),Xpt(Ip))=} -32767 \]
\[ \text{CASE <32768} \]
\[ \text{X(Xch(Ip),Xpt(Ip))=} -32768 \]
\[ \text{END SELECT} \]
\[ \text{Xpt(Ip)=Xpt(Ip)+1} \]
\[ \text{IF Xpt(Ip)>1024 THEN} \]
\[ \text{Xpt(Ip)=1} \]
\[ \text{Xch(Ip)=Xch(Ip)+1} \]
\[ \text{END IF} \]
\[ \text{NEXT Ip} \]
\[ \text{DISP 1} \]
\[ \text{NEXT I} \]
\[ \text{FOR Ip=1 TO 3! For each ratio (u',p'/P,tO'/TO)} \]
\[ \text{FOR I=4 TO 6! CLEAR MEMORY TAGS FOR "REMOVE MEAN" F} \]
\[ \text{FUNCTION} \]
\[ \text{NEXT J} \]
\[ \text{NEXT I} \]
\[ \text{Mivar(14)=Ip+3} \]
\[ \text{CALL Routine(31,524) ! REMOVE MEAN} \]
\[ \text{CALL Routine(31,513) ! FIND RMS} \]
\[ \text{Value=Mvar(3)} \]
\[ \text{SELECT Probe} \]
\[ \text{CASE 1} \]
\[ \text{A_rec(46+Ip,This_obs)=Value} \]
\[ \text{CASE 2} \]
\[ \text{B_rec(46+Ip,This_obs)=Value} \]
\[ \text{END SELECT} \]
\[ \text{NEXT Ip} \]
\[ \text{CALL Routine(43,234) ! STORE FLUCTUATING DATA} \]
\[ \text{CALL Routine(31,234)} \]

\[ \text{RESTORE A_names} \]
\[ \text{READ A_var_name$(*)} \]
\[ \text{RESTORE B_names} \]
\[ \text{READ B_var_name$(*)} \]

\[ \text{GOSUB Log_vars} ! \text{Save the computed values on disc} \]
BSERVATION # ";This_obs

PRINT
PRINT "TEST ";Obs_rec(1,This_obs)
PRINT "RUN ";Obs_rec(2,This_obs)
PRINT "POINT ";Obs_rec(3,This_obs)
PRINT "P_TOTAL ";Obs_rec(7,This_obs)
PRINT "P_STATIC ";Obs_rec(6,This_obs)
PRINT "T_TOTAL ";Obs_rec(8,This_obs)
PRINT "MACH ";Obs_rec(9,This_obs)
PRINT
PRINT TAB(20);"WIRE 1";TAB(40);"WIRE 2";TAB(60);"WIRE 3"

PRINT "V_mean";TAB(20);Mean(1);TAB(40);Mean(2);TAB(60);Mean(3)
0;Hw_rms(3)
TAB(60);Wire_gain(3)
TAB(60);Hwsens(3,1)
TAB(60);Hwsens(3,2)
TAB(60);Hwsens(3,3)
SELECT Probe
CASE 1
Vel_f=A_rec(47,This_obs)
Dens_f=A_rec(48,This_obs)
Temp_f=A_rec(49,This_obs)
CASE 2
Vel_f=B_rec(47,This_obs)
Dens_f=B_rec(48,This_obs)
Temp_f=B_rec(49,This_obs)
END SELECT
PRINT
PRINT "u'/U_rms";TAB(20);Vel_f
PRINT "p'/P_rms";TAB(20);Dens_f
PRINT "t'/T_rms";TAB(20);Temp_f
PRINT
PRINTER IS CRT
NEXT This_obs
NEXT Probe
END SELECT
Schg=BINIOR(Schg,16384) !SET BIT 14 TO SAY WAVEFORMS CHANGED

CASE 4105 !enter LOG FILE NAME
SELECT Routinl
CASE 21 !get old data, set up parameters
Mvar$(3)=Log_fn$ !present setting
CASE 22 !store new data
25091 Log_fn$ = Mvar$(3)
25092 END SELECT
25093 CASE 4106
25094 select Routin
25095 CASE 31
25096 ON ERROR GOTO No_file
25097 ASSIGN @Disk TO Log_fn$
25098 ON ERROR CALL Error
25099 ENTER @Disk,1;Data_set_title$,Max_obs_rec,Max_vars,Logged_var_name$(*)
25100 Subfile_names$(*)
25101 Num_obs_rec=Subfile_chartst(1)
25102 REDIM Obs_rec(Max_vars,Max_obs_rec),A_rec(Max_vars,Max_obs_rec)
25103 ,B_rec(Max_vars,Max_obs_rec)
25104 ENTER @Disk,2
25105 ENTER @Disk;Obs_rec(*)
25106 ! Set up WALL strut file
25107 ASSIGN @Diska TO Log_fn$&"A"
25108 ENTER @Diska,1;A_set_title$,Dummy,Dummy,A_var_name$(*)
25109 ENTER @Diska,2
25110 ENTER @Diska;A_rec(*)
25111 ! Set up FLOOR strut file
25112 ASSIGN @Diskb TO Log_fn$&"B"
25113 ENTER @Diskb,1;B_set_title$,Dummy,Dummy,B_var_name$(*)
25114 ENTER @Diskb,2
25115 ENTER @Diskb;B_rec(*)
25116 ! Set up OTHER strut file
25117 ASSIGN @Diskc TO Log_fn$&"C"
25118 ENTER @Diskc,1;C_set_title$,Dummy,Dummy,C_var_name$(*)
25119 ENTER @Diskc,2
25120 ENTER @Diskc;C_rec(*)
25121 GOTO Got-it
25122 No_file: !NO FILE. !OK, SO CREATE THE FILE
25123 ON ERROR CALL Error
25124 Errf=0
25125 CREATE BDAT Log_fn$,INT(8*Max_vars*Max_obs_rec/1280)+2,1280
25126 ASSIGN @Disk TO Log_fn$
25127 CREATE BDAT Log_fn$&"A",INT(8*Max_vars*Max_obs_rec/1280)+2,1280
25128 ASSIGN @Diska TO Log_fn$&"A"
25129 CREATE BDAT Log_fn$&"B",INT(8*Max_vars*Max_obs_rec/1280)+2,1280
25130 ASSIGN @Diskb TO Log_fn$&"B"
25131 CREATE BDAT Log_fn$&"C",INT(8*Max_vars*Max_obs_rec/1280)+2,1280
25132 ASSIGN @Diskc TO Log_fn$&"C"
25133 File_comments$=""
25134 DISP "ENTER THE LOG FILE DATA SET TITLE - Return IF NONE";
25135 INPUT ",File_comments$
25136 IF LEN(File_comments$)>0 THEN
25137 Data_set_title$=File_comments$
25138 A_set_title$="WALL STRUT :::"&File_comments$
25139 B_set_title$="FLOOR STRUT :::"&File_comments$
25140 C_set_title$="KULITE, MISC :::"&File_comments$
25141 ELSE
25142 Data_set_title$=""
25143 A_set_title$=""
25144 B_set_title$=""
C_set_title$=""
END IF
Num_obs_rec=0
Num_subfile=0
MAT Subfile_names$=""
MAT A_subfile_names$=""
MAT B_subfile_names$=""
MAT C_subfile_names$=""
MAT Subfile_chartst=0
MAT A_sub_chartst=0
MAT B_sub_chartst=0
MAT C_sub_chartst=0
MAT Obs_rec=\(-9999999.99999\)
MAT A_rec=\(-9999999.99999\)
MAT B_rec=\(-9999999.99999\)
MAT C_rec=\(-9999999.99999\)
RESTORE Var_names
NOTE:
IN FUTURE LINKS, THESE NAMES WILL PRECEDE
THE VALUES IN THE DATA PACKET RECEIVED.
READ Logged_var_name$(*)
Var_names:
THE VARIABLE NAMES THAT EACH OBSERVATION RECORD CONTAINS:
DATA "TEST"
DATA "RUN"
DATA "POINT"
DATA "TIME"
DATA "DATE"
DATA "Ps"
DATA "Pt"
DATA "Tt"
DATA "MACH"
DATA "REYNO"
DATA "PsS1"
DATA "PsS1"
DATA "TtS1"
DATA "PtS2"
DATA "PsS2"
DATA "TtS2"
DATA "PtS3"
DATA "PsS3"
DATA "TtS3"
DATA "P1HW1"
DATA "P1HW2"
DATA "P1HW3"
DATA "P1HW4"
DATA "P2HW1"
DATA "P2HW2"
DATA "P2HW3"
DATA "P3HW1"
DATA "P4HW1"
DATA "P5HW1"
DATA "KULITE1"
DATA "KULITE2"
DATA "KULITE3"
DATA "KULITE4"
DATA "KULITE5"
DATA "KULITE6"
DATA "HW1-4 GAIN"
DATA "P2HW1GAIN"
DATA "P2HW2GAIN"
DATA "P2HW3GAIN"
DATA "K1 GAIN"
DATA "K2 GAIN"
DATA "K3 GAIN"
DATA "K4 GAIN"
DATA "K5 GAIN"
DATA "K6 GAIN"
DATA ""*"!
DATA ""
DATA ""
DATA ""
DATA ""
DATA "K1 GAIN"
DATA "K2 GAIN"
DATA "K3 GAIN"
DATA "K4 GAIN"
DATA "K5 GAIN"
DATA "K6 GAIN"

Subfile_chartst(l)-Num_obs_rec
data_set_title$,Max_obs_rec,Max_vars,Logged_var_name$(*),Numsubfile,Subfile_names$(*),Subfile_chartst(*)
STATUS @Disk,3;Norecs,Nobpr
CONTROL @Disk,7;Norecs,Nobpr
ENTER @Disk,2
OUTPUT @Disk;Obs_rec(*)

RESTORE A_names ! NOTE:
! THESE ARE THE VARIABLE NAMES FOR THE WALL STRUT DATA FILE "A"

READ A_var_name$(*)

A_names: ! THE VARIABLE NAMES THAT EACH "A" DATA RECORD CONTAINS:
DATA "TEST" ! 1
DATA "RUN" ! 2
DATA "POINT" ! 3
DATA "PsSl"
DATA "PsSl"
DATA "TsSl"
DATA "TsSl"
DATA "VELOCITY"
DATA "DENSITY"
DATA "Ts"
DATA "L(U)"
DATA "L(Rho)"
DATA "L(TO)"
DATA "L(RhoU)"
DATA "L(R) L(TO)"
DATA "L(R) L(U)"
DATA "L(U) L(TO)"
DATA "LULRLTO"
DATA "P1HW1" !18
DATA "P1HW2"
DATA "P1HW3"
DATA "P1HW4"
DATA "LOG(P1HW1)" !22
DATA "LOG(P1HW2)"
DATA "LOG(P1HW3)"
DATA "LOG(P1HW4)"
DATA "R(RhoU)" !26
DATA "R(UT0)"
DATA "R(RhoT0)"
DATA ""
DATA "S(U)1" !30
DATA "S(U)2"
DATA "S(U)3"
DATA ""!
DATA "S(Rho)1" !34
DATA "S(Rho)2"
DATA "S(Rho)3"
DATA ""
DATA "S(T0)1" !38
DATA "S(T0)2"
DATA "S(T0)3"
DATA "M'/M" !41
DATA "GAIN 1" !42
DATA "GAIN 2"
DATA "GAIN 3"
DATA "GAIN 4"
DATA "P'/P" !46
DATA "u'/U" !47
DATA "p'/P"
DATA "to'/To"
DATA ""
!
OUTPUT @Diska,1;A_set_title$,Max_obs_rec,Max_vars,A_var_ne$(*),Numsubfile,A_subfile_names$(*),Subfile_chartst(*)

STATUS @Diska,3;Norecs,Nobpr
CONTROL @Diska,7;Norecs,Nobpr
ENTER @Diska,2
OUTPUT @Diska;A_rec(*)
!
RESTORE B_names ! NOTE:
READ B_var_name$(*)
B_names: ! THE VARIABLE NAMES THAT EACH "B" DATA RECORD CONTAINS:
DATA "TEST" ! 1
DATA "RUN" ! 2
DATA "POINT" ! 3
DATA "PtS2"
DATA "PsS2"
DATA "TcS2"
DATA "VELOCITY"
DATA "DENSITY"
DATA "Ts"
DATA "L(U)"
DATA "L(Rho)"
DATA "L(T0)"
DATA "L(RhoU)"
DATA "L(R) L(T0)"
DATA "L(R) L(U)"
DATA "L(U) L(T0)"
DATA "LULRLTO"
DATA "P2HW1" !18
DATA "P2HW2"
DATA "P2HW3"
DATA ""
DATA "LOG(P2HW1)" !22
DATA "LOG(P2HW2)"
DATA "LOG(P2HW3)"
DATA ""
DATA "R(RhoU)" !26
DATA "R(UTO)"
DATA "R(RhoTO)"
DATA "" 25323
DATA "S(U)1" 25324
DATA "S(U)2" 25325
DATA "S(U)3" 25326
DATA "" 25327
DATA "S(Rho)1" 25328
DATA "S(Rho)2" 25329
DATA "S(Rho)3" 25330
DATA "" 25331
DATA "S(T0)1" 25332
DATA "S(T0)2" 25333
DATA "S(T0)3" 25334
DATA "M'/M" 25335
DATA "GAIN 1" 25336
DATA "GAIN 2" 25337
DATA "GAIN 3" 25338
DATA "" 25339
DATA "P'/P" 25340
DATA "u'/U" 25341
DATA "p'/P" 25342
DATA "to'/To" 25343
DATA "" 25344

! 25345

OUTPUT @Diskb,1;B_set_title$,Max_obs_rec,Max_vars,B_var_name$(*),Numsubfile,B_subfile_names$(*),Subfile_chartst(*)
STATUS @Diskb,3;Norecs,Nobpr
CONTROL @Diskb,7;Norecs,Nobpr
ENTER @Diskb,2
OUTPUT @Diskb;B_rec(*)

RESTORE C_names 25333

NOTE:
! THESE ARE THE VARIABLE NAMES FOR THE
! 'OTHER' STRUT DATA FILE "C"

READ C_var_name$(*)

C_names::! THE VARIABLE NAMES THAT EACH "C" DATA RECORD CONTAINS:
DATA "TEST" ! 1
DATA "RUN" ! 2
DATA "POINT" ! 3
DATA "PtS3"
DATA "PsS3"
DATA "TtS3"
DATA "VELOCITY"
DATA "DENSITY"
DATA "Ts"
DATA "L(U)"
DATA "L(Rho)"
DATA "L(T0)"
DATA "L(RhoU)"
DATA "L(R) L(T0)"
DATA "L(R) L(U)"
DATA "L(U) L(T0)"
DATA "LULRLTO"
DATA "P3HW1"
DATA "P4HW1"
DATA "P5HW1"
DATA ""
DATA "LOG(P3HW1)" ! 22
DATA "LOG(P4HW1)"
DATA "LOG(P5HW1)"

DATA " "
25383 DATA " "
25384 DATA " "
25385 DATA " "
25386 DATA " "
25387 DATA "S(U)1" 130
25388 DATA "S(U)2"
25389 DATA "S(U)3"
25390 DATA " "
25391 DATA "S(Rho)1" 134
25392 DATA "S(Rho)2"
25393 DATA "S(Rho)3"
25394 DATA " "
25395 DATA "S(TO)1" 138
25396 DATA "S(TO)2"
25397 DATA "S(TO)3"
25398 DATA " "
25399 DATA " "
25400 DATA " "
25401 DATA " "
25402 DATA " "
25403 DATA " "
25404 DATA ""/U""
25405 DATA "P/P"
25406 DATA ""/To"
25407 DATA " "
25408 !
25409 !
25410 !!!! OUTPUT @Diskc,1;C_set_title$,Max_obs_rec,Max_vars,C_var_name$(*)
25411 !!!! STATUS @Diskc,3;Norecs,Nobpr
25412 !!!! CONTROL @Diskc,7;Norecs,Nobpr
25413 !!!! ENTER @Diskc,2
25414 !!!! OUTPUT @Diskc,C_rec(*)
25415 !
25416 Got_it: !
25417 ASSIGN @Disk TO *
25418 ASSIGN @Diska TO *
25419 ASSIGN @Diskb TO *
25420 !!!! ASSIGN @Diskc TO *
25421 Num_obs_plotted=0
25422 Num_obs_printed=0
25423 Initial_obs=Num_obs_rec+1
25424 Ending_obs=Initial_obs
25425 END SELECT
25426 CASE 4107 ! PRINT LOG FILE INFO
25427 SELECT Routin1
25428 CASE 31
25429 Errorf=0
25430 !
25431 !
25432 ASSIGN @Disk TO Log_fn$
25433 IF Errorf=0 THEN ENTER @Disk,1;Data_set_title$,Max_obs_rec,Max_vars,Logged_var_name$(*)
25434 Num_obs_rec=Subfile_chartst(1)
25435 !
25436 REDIM Obs_rec(Max_vars,Max_obs_rec),A_rec(Max_vars,Max_obs_rec)
25437 !
25438 ENTER @Disk,2
IF Errf=0 AND Num_obs_rec>1 AND Num_obs_rec<Max_obs_rec THEN
ENTER @Disk;Obs_rec(*)
ASSIGN @Disk TO *

Errorf=0
ASSIGN @Disk TO Log_fn$&"A"
IF Errorf=0 THEN ENTER @Diska,1:A_set_title$,Dummy,Dummy,A_var_name$(*),Dummy,A_subfile_names$(*),A_sub_chartst(*)
ENTER @Diska,2
IF Errorf=0 AND Num_obs_rec>1 AND Num_obs_rec<Max_obs_rec THEN
ENTER @Diska:A_rec(*)
ASSIGN @Disk TO *

Errorf=0
ASSIGN @Diskb TO Log_fn$&"B"
IF Errorf=0 THEN ENTER @Diskb,1:B_set_title$,Dummy,Dummy,B_var_name$(*),Dummy,B_subfile_names$(*),B_sub_chartst(*)
ENTER @Diskb,2
IF Errorf=0 AND Num_obs_rec>1 AND Num_obs_rec<Max_obs_rec THEN
ENTER @Diskb:B_rec(*)
ASSIGN @Disk TO *

Errorf=0
ASSIGN @Diskc TO Log_fn$&"C"
IF Errorf=0 THEN ENTER @Diskc,1:C_set_title$,Dummy,Dummy,C_var_name$(*),Dummy,C_subfile_names$(*),C_sub_chartst(*)
ENTER @Diskc,2
IF Errorf=0 AND Num_obs_rec>1 AND Num_obs_rec<Max_obs_rec THEN
ENTER @Diskc:C_rec(*)
ASSIGN @Disk TO *

GOSUB Print_log_data
GOTO End_4107

Print_log_data: !Subroutine to print a formatted report.

IF Num_obs_printed=0 THEN Num_obs_printed=Initial_obs-1
WHILE Num_obs_printed<Ending_obs
Num_obs_printed=Num_obs_printed+1
PRINTER IS PRT;WIDTH 108
PRINT CHR$(12) !Form feed
PRINT Data_set_title$;TAB(60);"OBSERVATION # ";Num_obs_printed
PRINT TAB(23);"TUNNEL";TAB(46);"PROBE";TAB(69);"PROBE"
PRINT TAB(23);"TUNNEL";TAB(46);"PROBE";TAB(69);"PROBE"
PRINT U_$=CHR$(27)"&dDn!Underline
PRINT Nu$_=CHR$(27)"&d@"No underline
PRINT TAB(23);U$_&"CONDITIONS"&Nu$_;TAB(54);U$_&"CONDITIONS"&Nu$_
PRINT "Mach";TAB(23);Obs_rec(9,Num_obs_printed)
PRINT "Reynolds No.";TAB(23);Obs_rec(10,Num_obs_printed)
PRINT "Pc";TAB(23);Obs_rec(7,Num_obs_printed);TAB(46);A_rec(4,Num_obs_printed);TAB(69);B_rec(4,Num_obs_printed)
PRINT "Ps";TAB(23);Obs_rec(6,Num_obs_printed);TAB(46);A_rec(5,Num_obs_printed);TAB(69);B_rec(5,Num_obs_printed)
PRINT "Tc";TAB(23);Obs_rec(3,Num_obs_printed);TAB(46);A_rec(6,Num_obs_printed);TAB(69);B_rec(6,Num_obs_printed)
PRINT "Velocity";TAB(23);Obs_rec(46,Num_obs_printed);TAB(69);B_rec(7,Num_obs_printed)
PRINT "Density";TAB(23);Obs_rec(47,Num_obs_printed);TAB(46);A_rec(8,Num_obs_printed);TAB(69);B_rec(8,Num_obs_printed)
PRINT "LOG(RhoU)";TAB(46);A_rec(11,Num_obs_printed);TAB(69);B_rec(11,Num_obs_printed)
PRINT "MEAN(HWl)";TAB(46);A_rec(18,Num_obs_printed);TAB(69);B_rec(18,Num_obs_printed)
PRINT "MEAN(HW2)";TAB(46);A_rec(19,Num_obs_printed);TAB(69);B_rec(19,Num_obs_printed)
PRINT "MEAN(HW3)";TAB(46);A_rec(20,Num_obs_printed);TAB(69);B_rec(20,Num_obs_printed)
PRINT "S(U) (HWl)";TAB(46);A_rec(30,Num_obs_printed);TAB(69);B_rec(30,Num_obs_printed)
PRINT "S(Rho)(HWl)";TAB(46);A_rec(34,Num_obs_printed);TAB(69);B_rec(34,Num_obs_printed)
PRINT "S(To) (HWl)";TAB(46);A_rec(38,Num_obs_printed);TAB(69);B_rec(38,Num_obs_printed)
PRINT "S(U) (HW2)";TAB(46);A_rec(31,Num_obs_printed);TAB(69);B_rec(31,Num_obs_printed)
PRINT "S(Rho)(HW2)";TAB(46);A_rec(35,Num_obs_printed);TAB(69);B_rec(35,Num_obs_printed)
PRINT "S(To) (HW2)";TAB(46);A_rec(39,Num_obs_printed);TAB(69);B_rec(39,Num_obs_printed)
PRINT "S(U) (HW3)";TAB(46);A_rec(32,Num_obs_printed);TAB(69);B_rec(32,Num_obs_printed)
PRINT "S(Rho)(HW3)";TAB(46);A_rec(36,Num_obs_printed);TAB(69);B_rec(36,Num_obs_printed)
PRINT "S(To) (HW3)";TAB(46);A_rec(40,Num_obs_printed);TAB(69);B_rec(40,Num_obs_printed)
PRINT "u'/U (rms)";TAB(46);A_rec(47,Num_obs_printed)
PRINT "p'/P (rms)";TAB(46);A_rec(48,Num_obs_printed)
PRINT "to'/To (rms)";TAB(46);A_rec(49,Num_obs_printed)
PRINT "R(RhoU)";TAB(46);A_rec(26,Num_obs_printed)
PRINT "R(UTO)";TAB(46);A_rec(27,Num_obs_printed)
PRINT "R(RhoU)";TAB(46);A_rec(26,Num_obs_printed)
PRINT "R(UTO)";TAB(46);A_rec(27,Num_obs_printed)
25521 END IF
25522!
25523 PRINTER IS CRT
25524!
25525 END WHILE
25526!
25527 RETURN
25528!
25529 END_4107:END SELECT
25530!
25531!
25532 CASE 4108
25533 SELECT Routin1
25534 CASE 31
25535 Load_data: !
25536 THIS ROUTINE IS THE ACQUISITION AND DATA LOGGING PORTION OF THE HOTWIRE
25537 DYNAMIC DATA SYSTEM.
25538!
25539 STEVE CLUKEY, VIGYAN RESEARCH ASSOCIATES, SEPTEMBER, 1987
25540!
25541 DATA IS RECEIVED FROM ANOTHER COMPUTER (MODCOMP) VIA HP-IB IN ASCII.
25542 UPON REQUEST OF THE OPERATOR, THIS DATA IS AVERAGED, AND STORED (LOGGED)
25543 ON DISK AS AN OBSERVATION IN AN X-Y ARRAY. SOME VALUES ARE CALCULATED
25544 AND STORED ALONG WITH THE DATA RECEIVED FROM THE OTHER COMPUTER.
25545 THESE DATA OBSERVATIONS WILL BE USED TO COMPUTE HOTWIRE SENSITIVITIES,
25546 AND THEREFORE THE FORMAT OF THE DISK FILE SHOULD BE COMPATIBLE WITH
25547 THE COMPUTATIONAL PROGRAMS.
25548!
25549 FOR EACH OBSERVATION, "Max vars" VARIABLES ARE STORED:
25550!
25551!
25552! THE PROCESS IS:
25553!
25554 !1. CREATE AN OBSERVATION FILE, OR DECLARE AN EXISTING FILE, AND SET UP
25555! TO APPEND (WITH ADDITIONAL RECORDS) ADDITIONAL OBSERVATIONS.
25556!2. WHEN REQUESTED BY THE OPERATOR, DATA IS READ FROM THE OTHER COMPUTER
25557! VIA HP-IB. BOTH THE DATA HOTWIRE DATA AND THE TUNNEL PARAMETER DATA
25558! ARE AVERAGED, AND STORED IN THE NEXT AVAILABLE RECORD.
25559!3. WHEN REQUESTED BY THE OPERATOR, THE FILE IS CLOSED.
25560! AT SOME LATER TIME, THE FILE WILL BE PROCESSED TO PROVIDE A HOTWIRE
25561! SENSITIVITY FILE.
25562!
25563!
25564!
25565!
25566 CALL Pline(0,"OBSERVATION LOGGING STARTED")
25567 WAIT 1
25568!
25569 Pkt_sc=8
25570 MAT Pkt_avg=(0)
25571 I=0
25572 FOR I=1 TO Num_avgs
25573 GOSUB Enable_link
25574 GOSUB Get_packet
25575 IF I=1 THEN !Don't average test, run, point.....
25576 FOR J=1 TO 3
25577 Pkt_avg(J)=VAL(Pkt$(J+l))*Num_avgs
25578 NEXT J
25579 FOR J=4 TO 5
25580 Pkt Avg(J)=0! THIS WAS DATE AND TIME
NEXT J
FOR J=1 TO 10! SAVE THE FIRST 10 FOR "TAG PLOT, PICTURE"
Tag_pkt$(J)=Pkt$(J+1)
NEXT J
END IF
FOR J=6 TO Rcvd_vars
ON ERROR GOTO 25589! Ignore error if not a good VAL
Pkt_avg(J)=Pkt_avg(J)+VAL(Pkt$(J+1))
ON ERROR CALL Error
NEXT J
END IF
NEXT I
GOSUB Disable_link
MAT Pkt_avg=Pkt_avg/(Num_avgs)! FIND THE AVERAGE

!! ! Get ready to log data - by opening files
ASSIGN @Disk TO Log_fn$
ASSIGN @Diska TO Log_fn$&"A"
ASSIGN @Diskb TO Log_fn$&"B"
ASSIGN @Diskc TO Log_fn$&"C"
!! !

!! Find out where we are - retrieve number of observations recorded
ENTER @Disk,1;Data_set_title$,Max_obs_rec,Max_vars,Logged_var_names$(*),Numsubfile,Subfile_names$(*),Subfile_chartst(*)
Num_recd=Subfile_chartst(1)
This_obs=MAX(Num_recd+1,1)! bump the observations pointer
IF This_obs<Max_rec THEN! move the data to the observation record
FOR I=1 TO Rcvd_vars
Obs_rec(I,This_obs)=Pkt_avg(I)
NEXT I
Num_recd=This_obs! prepare to save the observation pointer
Ending_obs=Num_recd
Subfile_chartst(1)=Num_recd
!! ! FOR I=1 TO Nummem
SET UP DATA FILE MAP FOR TRACES 1 THRU NUMMEM
Mivar(14)=I
Mvar(2)=1
CALL Routine(22,239)! TURN ON data files
!! !
Temp$[1]="R"
SELECT I
CASE 1 TO 4
Temp$[2]="A"
CASE 5 TO 7
Temp$[2]="B"
CASE 8 TO 99
Temp$[2]="C"
END SELECT
SELECT INT(Obs_rec(2,This_obs))
CASE 0 TO 9
Temp$[3,4]="0"&VAL$(INT(Obs_rec(2,This_obs)))! RUN
CASE 10 TO 99
Temp$[3,4]=VAL$(INT(Obs_rec(2,This_obs)))! RUN
END SELECT
SELECT INT(Obs_rec(3,This_obs))
CASE 0 TO 9
Temp$[5,6]="0"&VAL$(INT(Obs_rec(3,This_obs)))! POINT
CASE 10 TO 99
    Temp$(5,6)=VAL$(INT(Obs_rec(3,This_obs)))*POINT
END SELECT
SELECT I
CASE 1 TO 9
    Temp$(7,8)="0"&VAL$(I)
CASE 10 TO 99
    Temp$(7,8)=VAL$(I)
END SELECT
Filename$(I)=Temp$
Mivar(14)=I
CALL Routine(21,232) ! DISPLAY THE FILENAME
PRINT "FOR OBS # ",Recnum;", THE FILENAME IS: ";Filename $(I)
PRINT IS CRT
NEXT I
GOSUB Compute_vars
GOSUB Log_vars
Ending_obs=Num_obs_rec
ELSE
    CALL Pline(0," LOG FILE FULL ")
    WAIT 1
    CALL Pline(0,""
END IF
CALL Pline(0,"OBSERVATION LOGGING COMPLETE"
WAIT 1
CALL Pline(0,""
GOTO End_4108
Enable_link:! SEND A PACKET TO THE OTHER CPU WHICH CONTAINS THE "GO" WORD
Go_word$="GO"
OUTPUT Pkt_sc;Go_word$
RETURN
PRINTER IS PRT
CALL, Pline(0,"RECEIVED PACKET FOR SAMPLE ";Pkt$(*)
RETURN
Enable_link:! SEND A PACKET TO THE OTHER CPU WHICH CONTAINS THE "STOP" WORD
Go_word$="STOP"
OUTPUT Pkt_sc;Go_word$
RETURN
Get_packet: !
FOR Vars_ctr=1 TO RCVD_vars
PRINT Pkt$(Vars_ctr+1)
NEXT Vars_ctr
PRINTER IS CRT
RETURN
!
!
!
Compute_vars: ! compute values associated with mean logged_vars
GOSUB Tun_vars
FOR Probe=Initial_probe TO Ending_probe
SELECT Probe
CASE 1
GOSUB Wall_vars
CASE 2
GOSUB Floor_vars
CASE 3
GOSUB OTHER_VARS
END SELECT
NEXT Probe
RETURN

Tun_vars: !
! Construct variables for the tunnel conditions
Strut$="TUNNEL"
GOSUB Compute_u_rho_m!Compute velocity, density, massflow
Obs_rec(46,This_obs)=Local_velocity
Obs_rec(47,This_obs)=Local_density
RETURN

Wall_vars: !
! Construct variables for the wall strut computed variables logfile (A)
A_rec(1,This_obs)=Obs_rec(1,This_obs)!TEST
A_rec(2,This_obs)=Obs_rec(2,This_obs)!RUN
A_rec(3,This_obs)=Obs_rec(3,This_obs)!POINT
A_rec(4,This_obs)=Obs_rec(11,This_obs)!P_TOTAL
A_rec(5,This_obs)=Obs_rec(12,This_obs)!P_STATIC
A_rec(6,This_obs)=Obs_rec(8,This_obs)+460 !T_TOTAL (local) !Us
e TUNNEL total
A_rec(7,This_obs)=Local_velocity
A_rec(8,This_obs)=Local_density
A_rec(9,This_obs)=Ts
IF A_rec(7,This_obs)>0 THEN
  A_rec(10,This_obs)=LGT(A_rec(7,This_obs)) !Log(U)
END IF
IF A_rec(8,This_obs)>0 THEN
  A_rec(11,This_obs)=LGT(A_rec(8,This_obs)) !Log(Rho)
END IF
IF A_rec(6,This_obs)>0 THEN
  A_rec(12,This_obs)=LGT(A_rec(6,This_obs)) !Log(T0)
END IF
IF Local_mass_flow>0 THEN
  A_rec(13,This_obs)=LGT(Local_mass_flow) !Log(Rho_inf*U)
END IF
A_rec(14,This_obs)=A_rec(11,This_obs)*A_rec(12,This_obs)!Log(Rh
\*Log(\text{U})
25755 \quad \text{A}_{\text{rec}}(15,\text{This\_obs})=\text{A}_{\text{rec}}(10,\text{This\_obs})\cdot\text{A}_{\text{rec}}(11,\text{This\_obs})\cdot\text{Log(\text{U})} \\
\*Log(\text{Rho})
25756 \quad \text{A}_{\text{rec}}(16,\text{This\_obs})=\text{A}_{\text{rec}}(10,\text{This\_obs})\cdot\text{A}_{\text{rec}}(12,\text{This\_obs})\cdot\text{Log(\text{U})} \\
\*Log(\text{T0})
25757 \quad \text{A}_{\text{rec}}(17,\text{This\_obs})=\text{A}_{\text{rec}}(15,\text{This\_obs})\cdot\text{A}_{\text{rec}}(12,\text{This\_obs})\cdot\text{Log(\text{U})} \\
\*Log(\text{Rho})\cdot\text{Log(\text{T0})}

FOR \text{Wire}=1 \text{ TO } 4
25758 \quad \text{A}_{\text{rec}}(17+\text{Wire},\text{This\_obs})=\text{Obs\_rec}(19+\text{Wire},\text{This\_obs})
25759 \quad \text{IF } \text{A}_{\text{rec}}(17+\text{Wire},\text{This\_obs})>0 \text{ THEN}
25760 \quad \quad \text{A}_{\text{rec}}(21+\text{Wire},\text{This\_obs})=\text{LGT(\text{A}_{\text{rec}}(17+\text{Wire},\text{This\_obs}))}\cdot\text{Log(\text{E})}
25761 \quad \text{END IF}
25762 \quad \text{SELECT } \text{Obs\_rec}(36,\text{This\_obs})
25763 \quad \text{CASE 1 TO 16}
25764 \quad \quad \text{A}_{\text{rec}}(41+\text{Wire},\text{This\_obs})=\text{Gain\_code\_14(\text{Obs\_rec}(36,\text{This\_obs})+1)}
25765 \quad \text{CASE ELSE}
25766 \quad \quad \text{A}_{\text{rec}}(41+\text{Wire},\text{This\_obs})=0\text{Default gain=0}
25767 \quad \text{END SELECT}
25768 \quad \text{NEXT Wire}
25769 \quad \text{RETURN}
25770
25771 \text{Floor\_vars: !}
25772 \text{Construct variables for the floor strut computed variables logfile (B)}
25773 \text{B\_rec(1,This\_obs)=Obs\_rec(1,This\_obs)!TEST}
25774 \text{B\_rec(2,This\_obs)=Obs\_rec(2,This\_obs)!RUN}
25775 \text{B\_rec(3,This\_obs)=Obs\_rec(3,This\_obs)!POINT}
25776 \text{B\_rec(4,This\_obs)=Obs\_rec(14,This\_obs)!P\_TOTAL (local)}
25777 \text{B\_rec(5,This\_obs)=Obs\_rec(15,This\_obs)!P\_STATIC(local)}
25778 \text{B\_rec(6,This\_obs)=Obs\_rec(8,This\_obs)+460 !T\_TOTAL (local)}
25779
\text{Use TUNNEL total}
25780 \text{!}
25781 \text{Strut$="FLOOR"}
25782 \text{GOSUB Compute\_u\_rho\_m!Compute velocity,density,mass flow}
25783 \text{B\_rec(7,This\_obs)=Local\_velocity}
25784 \text{B\_rec(8,This\_obs)=Local\_density}
25785 \text{B\_rec(9,This\_obs)=Ts}
25786 \text{IF } \text{B\_rec(7,This\_obs)>0 \text{ THEN}}
25787 \quad \quad \text{B\_rec(10,This\_obs)=LGT(\text{B\_rec}(7,\text{This\_obs})) \cdot \text{Log(U)}}
25788 \text{END IF}
25789 \text{IF } \text{B\_rec(8,This\_obs)>0 \text{ THEN}}
25790 \quad \quad \text{B\_rec(11,This\_obs)=LGT(\text{B\_rec}(8,\text{This\_obs})) \cdot \text{Log(Rho)}}
25791 \text{END IF}
25792 \text{IF } \text{B\_rec(6,This\_obs)>0 \text{ THEN}}
25793 \quad \quad \text{B\_rec(12,This\_obs)=LGT(\text{B\_rec}(6,\text{This\_obs})) \cdot \text{Log(T0)}}
25794 \text{END IF}
25795 \text{IF Local\_mass\_flow>0 \text{ THEN}}
25796 \quad \quad \text{B\_rec(13,This\_obs)=LGT(Local\_mass\_flow) \cdot \text{Log(Rho\_inf*U)}}
25797 \text{END IF}
25798 \text{B\_rec(14,This\_obs)=B\_rec(11,This\_obs)\cdot B\_rec(12,This\_obs)} \text{Log(Rho)}
25799 \text{\*Log(T0)}
25800 \text{B\_rec(15,This\_obs)=B\_rec(10,This\_obs)\cdot B\_rec(11,This\_obs)} \text{Log(U)}
25801 \text{\*Log(T0)}
25802 \text{FOR \text{Wire}=1 \text{ TO } 3}
25803 \quad \quad \quad \text{B\_rec(17+Wire,This\_obs)=Obs\_rec(23+Wire,This\_obs)
IF B_rec(17+Wire,This_obs)>0 THEN
  B_rec(21+Wire,This_obs)=LGT(B_rec(17+Wire,This_obs))
END IF
SELECT Obs_rec(36+Wire,This_obs)
CASE 1 TO 7
  B_rec(41+Wire,This_obs)=Gain_code_57(Obs_rec(36+Wire,This_obs)+1)
CASE ELSE
  B_rec(41+Wire,This_obs)=0!Default gain=0
END SELECT
NEXT Wire
RETURN

Other_vars:
Construct variables for the 'other' strut computed variables logfile (C)
C_rec(1,This_obs)=Obs_rec(1,This_obs)!TEST
C_rec(2,This_obs)=Obs_rec(2,This_obs)!RUN
C_rec(3,This_obs)=Obs_rec(3,This_obs)!POINT
C_rec(4,This_obs)=Obs_rec(17,This_obs)!P_TOTAL (local)
C_rec(5,This_obs)=Obs_rec(18,This_obs)!P_STATIC(local)
C_rec(6,This_obs)=Obs_rec(19,This_obs)!T_TOTAL (local)
Strut$="OTHER"
GOSUB Compute_u_rho_m!Compute velocity,density,mass flow
C_rec(7,This_obs)=Local_velocity
C_rec(8,This_obs)=Local_density
C_rec(9,This_obs)=Ts
IF C_rec(7,This_obs)>0 THEN
  C_rec(10,This_obs)=LGT(C_rec(7,This_obs)) !Log(U)
END IF
IF C_rec(8,This_obs)>0 THEN
  C_rec(11,This_obs)=LGT(C_rec(8,This_obs)) !Log(Rho)
END IF
IF C_rec(6,This_obs)>0 THEN
  C_rec(12,This_obs)=LGT(C_rec(6,This_obs)+460) !Log(TO)
END IF
IF Local_mass_flow>0 THEN
  C_rec(13,This_obs)=LGT(Local_mass_flow) !Log(Rho_inf*U)
END IF
C_rec(14,This_obs)=C_rec(11,This_obs)*C_rec(12,This_obs)!Log(Rho)*Log(TO)
C_rec(15,This_obs)=C_rec(10,This_obs)*C_rec(11,This_obs)!Log(U)*Log(Rho)
C_rec(16,This_obs)=C_rec(10,This_obs)*C_rec(12,This_obs)!Log(U)*Log(TO)
C_rec(17,This_obs)=C_rec(15,This_obs)*C_rec(12,This_obs)!Log(U)*Log(Rho)*Log(TO)
FOR Wire=1 TO 3
  C_rec(17+Wire,This_obs)=Obs_rec(23+Wire,This_obs)
  IF C_rec(17+Wire,This_obs)>0 THEN
    C_rec(21+Wire,This_obs)=LGT(C_rec(17+Wire,This_obs))
  END IF
NEXT Wire
RETURN
CASE "TUNNEL"
  Pt=Obs_rec(7,This_obs)
  Ps=Obs_rec(6,This_obs)
  Tt=Obs_rec(8,This_obs)+460
CASE "WALL"
  Pt=A_rec(4,This_obs)
  Ps=A_rec(5,This_obs)
  Tt=A_rec(6,This_obs)
CASE "FLOOR"
  Pt=B_rec(4,This_obs)
  Ps=B_rec(5,This_obs)
  Tt=B_rec(6,This_obs)
CASE "OTHER"
  Pt=C_rec(4,This_obs)
  Ps=C_rec(5,This_obs)
  Tt=C_rec(6,This_obs)
END SELECT

IF Ps=0 THEN
  Prat=0
GOTO 25883
END IF

P_rat=Ps/Pt
IF P_rat>1 THEN P_rat=1
IF P_rat<0 THEN
  Ts=MAX(.1,Tt)
  Local_velocity=0.
  Local_density=Ps/(53.3*Ts)
  Local_mass_flow=0.
ELSE
  Ts=(Tt)/(P_rat^(-.285714285))
  IF P_rat=1 THEN
    Local_velocity=0.
  END IF
ELSE
  Sound=SQR(2402.764*Ts)
  Local_mach=SQR(5*(P_rat^(-.285714285))-1))
  Local_velocity=Local_mach*Sound! U
END IF
Local_density=Ps/(53.3*Ts) ! Rho
Local_mass_flow=Local_velocity*Local_density! M

END IF
RETURN

Log_vars: ! LOG THE CURRENT OBSERVED VARIABLES

ASSIGN @Disk TO Log_fn$
OUTPUT @Disk,1;Data_set_title$,Max_obs_rec,Max_vars,Logged_var_name$(*),Numsubfile,Subfile_names$(*),Subfile_chartst(*)
ENTER @Disk,2
OUTPUT @Disk;Obs_rec(*)
ASSIGN @Disk TO *
ASSIGN @Diska TO Log_fn$&"A"
OUTPUT @Diska,1;A_set_title$,Max_obs_rec,Max_vars,A_var_name$(*),Numsubfile,A_subfile_names$(*),A_sub_chartst(*)
25917 ENTER @Diska,2
25918 OUTPUT @Diska;A rec(*)
25919 ASSIGN @Diska TO *
25920 !
25921 ASSIGN @Diskb TO Log_fn$&"B"
25922 !
25923 OUTPUT @Diskb,1;B set_title$,Max_obs_rec,Max_vars,B var_name$(*)
25924 ENTER @Diskb,2
25925 OUTPUT @Diskb;B rec(*)
25926 ASSIGN @Diskb TO *
25927 !
25928 !!!!! ASSIGN @DISKC TO LOG_FN$&"C"
25929 !
25930 !!!!! OUTPUT @Diskc,1;C set_title$,Max_obs_rec,Max_vars,C var
25931 !!!!! name$(*)
25932 !!!!! OUTPUT @Diskc;C rec(*)
25933 !!!!! ASSIGN @Diskc TO *
25934 !
25935 !
25936 RETURN
25937 !
25938 !
25939 !
25940 End_4108: !
25941 END SELECT
25942 CASE 4110 ! "SAMPLES TO AVG"
25943 SELECT Routin1
25944 CASE 21
25945 Mvar(2)-Num_avgs
25946 Mvar(4)-1
25947 Mvar(5)-1.
25948 Mvar(6)-300.
25949 Mivar(9)-0
25950 CASE 22
25951 Num_avgs=Mvar(2)
25952 END SELECT
25953 CASE 4112 ! "INITIAL OBS"
25954 SELECT Routin1
25955 CASE 21
25956 Mvar(2)=Initial_obs
25957 Mvar(4)-1
25958 Mvar(5)-1.
25959 Mvar(6)-300.
25960 Mivar(9)-0
25961 CASE 22
25962 Initial_obs=Mvar(2)
25963 END SELECT
25964 CASE 4113 ! "ENDING OBS"
25965 SELECT Routin1
25966 CASE 21
25967 Mvar(2)=Ending_obs
25968 Mvar(4)-1
25969 Mvar(5)-1.
25970 Mvar(6)-300.
25971 Mivar(9)-0
25972 CASE 22
25973 Ending_obs=Mvar(2)
25974 END SELECT
CASE 4130  !  "INITIAL PROBE"
SELECT Routine
CASE 21
Mvar(2)-Initial_probe
Mvar(4)=1
Mvar(5)=1.
Mvar(6)=2.
Mivar(9)=0
CASE 22
Initial_probe=Mvar(2)
END SELECT
CASE 4131  !  "ENDING PROBE"
SELECT Routine
CASE 21
Mvar(2)-Ending_probe
Mvar(4)=1
Mvar(5)=1.
Mvar(6)=2.
Mivar(9)=0
CASE 22
Ending_probe=Mvar(2)
END SELECT
CASE 4127  !  "LOGFILE TO PC"
SELECT Routine
CASE 31
Pc_device=8  !  Send data out thru HP-IB bus 8
bus 8 is NOT system controller
FOR Probe-Initial_probe TO Ending_probe
SELECT Probe
CASE 1
OUTPUT Pc_device;VAL$(Ending_obs-Initial_obs+1),VAL$(Max_vars)
FOR I=1 TO Max_vars
DISP "NAME(\"&VAL$(I)\"\") IS: \"&A_var_name$(I)\""
OUTPUT Pc_device;A_var_name$(I)[1,10]
NEXT I
FOR This_obs-Initial_obs TO Ending_obs
FOR I=1 TO Max_vars
OUTPUT Pc_device;A_rec(I,This_obs)
NEXT I
NEXT This_obs
CASE 2
OUTPUT Pc_device;VAL$(Ending_obs-Initial_obs+1),VAL$(Max_vars)
FOR I=1 TO Max_vars
DISP "NAME(\"&VAL$(I)\"\") IS: \"&B_var_name$(I)\""
OUTPUT Pc_device;B_var_name$(I)[1,10]
NEXT I
FOR This_obs-Initial_obs TO Ending_obs
FOR I=1 TO Max_vars
OUTPUT Pc_device;B_rec(I,This_obs)
NEXT I
NEXT This_obs
END SELECT
26033    NEXT Probe
26034    END SELECT
26035    END SELECT
26036    END SELECT
26037    SUBEND
26038    !
26039    !
26040    !
26041    !
APPENDIX B. Function definitions

This appendix contains the DDAS functions added to ACQUIRE by the user to provide the necessary functionality to acquire, process, display, store and transmit the hot wire data.

The function definition sheets provide essential definition data for each function. Full documentation for each function is contained within the program source code listings.
This function computes velocity, density and temperature fluctuations as ratios of the fluctuating quantities to the mean quantities:

\[ \frac{u'}{U}, \frac{p'}{P}, \frac{t'}{T} \]

The log file for each observation in the range of INITIAL OBS to ENDING OBS is processed for each probe in the range of INITIAL PROBE to ENDING PROBE. For each observation, and each probe, the three fluctuating data files related to the Run and Point (variables 2 and 3 in the observation record) are loaded into traces (and memories) 1, 2, and 3.

The computations retrieve mean values, sensitivities, and gains related to the data in channels 1, 2 and 3. For each simultaneous sample in each of the three traces (the beginning and ending samples are defined by the cursors on trace 1) the instantaneous value is divided by the equivalent mean value and the gain. Then the three ratios are matrix multiplied by the nmatrix inversion of the sensitivities. This process essentially solves a set of simultaneous equations for three unknowns: \( \frac{u'}{U} \), \( \frac{p'}{P} \), and \( \frac{t'}{T} \).

The solutions are placed in traces (memories) 4, 5, and 6. The mean value is removed, and the RMS (root mean square) value of each of the answers is stored in the log file for the appropriate observation and probe. Traces 4, 5, and 6 are then stored in separate disk files.

[ CALC VEL etc ]-----------------]

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: CAT GROUP
Function Number: 4021
Module: MODUSR1*

This function catalogs all selected files. The selection criteria is defined in detail in the HP BASIC language reference manual for HP function CAT (SELECT).

[ CAT GROUP ]---------------------------------------------
|
| | [--[ = ]--[ name ]--] |

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>string expression</td>
<td>any valid characters that are allowed in a file name</td>
</tr>
</tbody>
</table>

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
This function computes actual voltage gains from gain codes. The fluctuating data is gained to provide adequate voltage for filtering and digitization, and the gain codes are sent in a data packet from the static data computer during the logging of a data point. For the probes in the range INITIAL PROBE to ENDING PROBE, and for observations in the range INITIAL OBS to ENDING OBS, the gain codes are retrieved from the observation file, and through a table lookup algorithm, the actual gains are retrieved, and stored back into the appropriate place in the logfile for the probe and observation being processed.

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: COEF FILENAME
Function Number: 4101
Module: MODUSR2*

This function selects the file name relevant to the hotwire coefficient file being processed. See functions LOAD COEFS and STORE COEFS.

[* COEF FILENAME ]---------------------]

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NASl-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
This function computes hotwire coefficients for the probe previously selected - by function INITIAL PROBE - utilizing a custom multiple linear regression routine that generates up to 10 coefficients based on calibration data already in the logfile. These coefficients are then stored - by function STORE COEFS - in a coefficient file whose name has been previously defined - by function COEF FILENAME. Function COMPUTE SENS utilizes these coefficients to generate sensitivities necessary to compute velocity, density and temperature turbulence ratios - by function CALC VAL etc.

This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: COMPUTE R etc
Function Number: 4132
Module: MODUSR2

This function computes the correlations between velocity, density and temperature fluctuations and then computes mass flow fluctuation \([m'/M(rms)]\) and pressure fluctuation \([p'/P(rms)]\) using the correlation between velocity, density, and temperature fluctuations.

The log file for each observation in the range of INITIAL OBS to ENDING OBS is processed for each probe in the range of INITIAL PROBE to ENDING PROBE.

For each observation, and each probe, the three fluctuating data files related to the Run and Point (variables 2 and 3 in the observation record) are loaded into traces (and memories) 2, 3, and 4.

As each pair of traces is multiplied together, the resulting trace ends up in trace 1. The correlation of the two traces multiplied is the ratio of the rms value of the first trace multiplied by the rms value of the second trace to the mean value of trace 1. The rms values of the first and second traces have been previously calculated by function CALC VEL etc, and were called \(u'/U\), \(p'/P\), and \(t'/T\).

The correlation between these three components of turbulence are stored in the appropriate observation record for the observation and probe being processed as \(R(\text{RhoU})\), \(R(\text{UTO})\), and \(R(\text{RhoT0})\).

Massflow and pressure fluctuations are then computed from the correlations just computed, and these are also stored in the appropriate logfile as \(M'/M\) and \(P'/P\).

[ COMPUTE R etc ]-------------------

This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: COMPUTE SENS
Function Number: 4111
Module: MODUSR2

This function computes hotwire sensitivities for the probes in the range INITIAL PROBE to ENDING PROBE for all observations in the range INITIAL OBS to ENDING OBS. The hotwire coefficients previously defined - see functions GET COEFS, COEF FILENAME, LOAD COEFS, ENTER COEFS, EDIT COEFS, STORE COEFS, AND COMPUTE COEFS.

The computed sensitivities are stored in the appropriate probe file for each appropriate observation.

These sensitivities are read from the logfile - by function CALC VAL etc - to compute velocity, density and temperature turbulence ratios.

[ COMPUTE SENS ]-------------------]

This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
This function allows the operator to manually edit hot wire calibration coefficients (up to 10) for three wires. These coefficients have been previously generated. The operator views a list of the entered coefficients, and, by responding to prompts, select the coefficient to be edited. After each coefficient is edited, the operator may accept the coefficients, or be prompted to select another coefficient to be edited. The operator should then invoke function STORE COEFS.

NOTE: This function is highly interactive, and is not recommended for inclusion in a SEQUENCE PROGRAM.
This function declares the ending observation to be processed by other MODUSR2 functions - see function INITIAL OBS. Functions utilizing this feature to define the range of observations to be processed are: COMPUTE SENS, LOG DATA POINT, CODE TO GAINS, CALC VEL etc., COMPUTE R etc., Remake probe and LOGFILE TO PC.

Item | Description | Range
--- | --- | ---
value | numeric integer | 1 to 300, the max number of observations

*. This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: ENTER COEFS
Function Number: 4103
Module: MODUSR2*

This function allows the operator to manually enter hot wire calibration coefficients (up to 10) for three wires. These coefficients have been previously generated elsewhere, and are not available for entry via disc (see function LOAD COEFS). The operator is prompted for each coefficient by wire, number, and name. Once all 30 coefficients are entered (unused coefficients should be set to 0.0), the operator views a list of the entered coefficients, and chooses to accept or reject the coefficients. If they are accepted, the function is complete. The operator should then invoke function STORE COEFS. If the coefficients are not accepted - because they are not correct, this function automatically enters the EDIT COEFS function.

NOTE: This function is highly interactive, and is not recommended for inclusion in a SEQUENCE PROGRAM.

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: FILE COPY
Function Number: 4025
Module: MODUSR1*

This function serves merely as a label for the path for accessing other related functions via the softkeys.

[ FILE COPY ]-------------|

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: FILE GROUP
Function Number: 4028
Module: MODUSR1

This function defines the files to be selected for copying - function COPY FILES - or moving - function MOVE FILES. The files selected will begin with, or be equal to the character(s) defined by this function. For example, if this function defines "ABC", then all of the files in the TO DISK device that begin with "ABC" would be selected for copying or moving. Note that this function only defines the character(s): no selection is done until COPY FILES or MOVE FILES is invoked.

FILE GROUP

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>string expression</td>
<td>any valid characters that are allowed in a file name</td>
</tr>
</tbody>
</table>

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: FILE TRANSFERS
Function Number: 4126
Module: MODUSR2*

This function serves merely as a label for the path for accessing other related functions via the softkeys.

*This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: FILE UTILITYS
Function Number: 4020
Module: MODUSRI*

This function serves merely as a label for the path for accessing other related functions via the softkeys.

[ FILE UTILITYS ]-----------|

*: This routine - MODUSRI1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 35. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: FROM DISK
Function Number: 4026
Module: MODUSR1*

This function defines the mass storage device from which the files will be copied - function COPY FILES - or moved - function MOVE FILES.

Item | Description | Range
-----|-------------|------
value | MSI | any valid HP storage device
Function Name: GET COEF
Function Number: 4122
Module: MODUSR2

This function serves merely as a label for the path for accessing other related functions via the softkeys.

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: HOTWIRE MENU
Function Number: 4100
Module: MODUSR2

This function serves merely as a label for the path for accessing other related functions via the softkeys.

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: HOTWIRE CALC
Function-Number: 4100
Module: MODUSR2*

This function serves merely as a label for the path for accessing other related functions via the softkeys.

[ HOTWIRE CALC ]---------------------]

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
This function declares the beginning observation to be processed by other MODUSR2 functions - see function ENDING OBS. Functions utilizing this feature to define the range of observations to be processed are: COMPUTE SENS, LOG DATA POINT, CODE TO GAINS, CALC VEL etc, COMPUTE R etc, Remake probe and LOGFILE TO PC.

```
[ INITIAL OBS ]-----------------------------
    |                                      |
    |                                      |
    |--[ = ]--[value]--|
```

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>value</td>
<td>numeric integer</td>
<td>1 to 300, the max number of observations</td>
</tr>
</tbody>
</table>

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: INITIAL PROBE  
Function Number: 4130  
Module: MODUSR2*

This function declares the beginning probe to be processed by other MODUSR2 functions - see function ENDING PROBE. Functions utilizing this feature to define the range of probes to be processed are: COMPUTE SENS, LOG DATA POINT, CODE TO GAINS, CALC VEL etc, COMPUTE R etc, Remake Probe and LOGFILE TO PC.

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: LOAD COEFS
Function-Number: 4102
Module: MODUSR2*

This function loads coefficients previously stored by function STORE COEFS.

The coefficient filename must have been previously defined - see function COEF FILENAME.

[ LOAD COEFS ]------------------|

*. This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: LOAD LOGFILE
Function Number: 4106
Module: MODUSR2*

This function loads the files used to log hotwire calibration observation data. The function LOG FILENAME declares the file name, and function DISC DEVICE declares the Mass Storage Identifier. See LOG FILENAME for a description of the files loaded into memory.

NOTE: This function must be performed before the function LOG DATA POINT can be invoked.

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: LOAD LOGFILE
Function Number: 4106
Module: MODUSR2*

This function loads the files used to log hotwire calibration observation data. The function LOG FILENAME declares the file name, and function DISC DEVICE declares the Mass Storage Identifier. See LOG FILENAME for a description of the files loaded into memory.

[ LOAD LOGFILE ]------------------|

NOTE: This function must be performed before the function LOG DATA POINT can be invoked.

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NASl-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: LOG DATA
Function Number: 4109
Module: MODUSR2*

This function serves merely as a label for the path for accessing other related functions via the softkeys.

[ LOG DATA ]---------------------|

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: LOG DATA POINT
Function Number: 4108
Module: MODUSR2

This function logs the hotwire calibration observation data into the logfile(s). The function LOG FILENAME declares the file name, and function DISC DEVICE declares the Mass Storage Identifier. See LOG FILENAME for a description of the files which receive the data.

The hotwire calibration data is received from a static data acquisition system - MODCOMP, other HP, etc - thru a GPIB interface in the form of an ASCII data packet. The static data system is regularly sending about 1 packet per second, and it contains the necessary data in engineering units, including test conditions and test identification.

This function also calculates various data items for inclusion in some of the data files.

This function also generates fluctuating data file names base on the RUN, POINT and channel of the data. These names relate to the data being logged, and allow storing of the fluctuating data in appropriately named files. See functions STORE or TF/STORE ALL.

Example: "RA031701"
R =Realtime digitization
A =probe A
03=RUN
17=POINT
01=data channel 1

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: LOGFILE TO PC
Function Number: 4127
Module: MODUSR2*

This function transfers logfile data to another computer via a GPIB. The information transmitted is all in ASCII to assure compatibility between systems.

For each probe in the range INITIAL PROBE to ENDING PROBE and for observations in the range INITIAL OBS to ENDING OBS, the appropriate observations records are transmitted. Prior to transmitting the set of each probes observations, the names of the variables contained in the observation record are transmitted.

*[ LOGFILE TO PC ]-------------------]*

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.*
Function Name: MOVE FILES
Function Number: 4030
Module: MODUSR1

This function defines the files to be selected for moving, and then copy the selected files from a disk device to a disk device using the HP COPY command. When the files are selected, a report is generated on the printer which declares the number of files selected, the from device, the to device, and the files selected for copying. As each file is actually copied, a message is displayed on the CRT, and printed on the printer. Once all selected files have been copied, all successfully copied files are purged from the from device, completing the "move". Functions FROM DISK, TO DISK, AND FILE GROUP all effect the results of this function. Selection of files by indicating a group name with this function overrides the group name selection previously made by function FILE GROUP.

[ MOVE FILES ]-----------------------------
| | ( [ = ] - [ name ] - ) |

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>string expression</td>
<td>any valid characters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>that are allowed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in a file name</td>
</tr>
<tr>
<td></td>
<td></td>
<td>see FILE GROUP for</td>
</tr>
<tr>
<td></td>
<td></td>
<td>details</td>
</tr>
</tbody>
</table>

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: PICTURE LOG E
Function Number: 4006
Module: MODUSR1

This function generates x-y plots on the CRT which represent the Log(RhoU) vs. Log(E) for each hotwire. The axes, titles, etc are internally generated using a plot file called "RhoU" - see function PLOT NAME. (It should be noted that this 'RhoU' picture is actually generated for dynamic channels 8 and 9 - which are assumed to be 1 point long, - and offscale as well.)

This function represents data from all observations in the range INITIAL OBS to ENDING OBS for all probes in the range INITIAL PROBE TO ENDING PROBE.

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NASI-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: PLOT EJECT
Function Number: 4002
Module: MODUSR1*

This function sends a "PG" command to the plot device (if the plot device is not the CRT device.

This function also resets the 'number of observations plotted' pointer, the number of observations printed' pointer, and the 'ending observations' pointer, which affects the operation of functions ENDING OBS, PRNT LOGFILE, PLOT LOG_E and PICTURE LOG_E.

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: PLOT LOG E
Function Number: 4005
Module: MODUSR1*

This function generates x-y plots on the Plotter which represent the Log(RhoU) vs. Log(E) for each hotwire. The axes, titles, etc are internally generated using a plot file called "RhoU" - see function PLOT NAME. (It should be noted that this 'RhoU' picture is actually generated for dynamic channels 8 and 9 - which are assumed to be 1 point long, - and offscale as well.)

This function represents data from all observations in the range INITIAL OBS to ENDING OBS for all probes in the range INITIAL PROBE TO ENDING PROBE.

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April,1988.
Function Name: PLOT UTILITYS  
Function Number: 4001  
Module: MODUSR1*  

This function serves merely as a label for the path for accessing other related functions via the softkeys.

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: PRNT LOGFILE
Function Number: 4107
Module: MODUSR2*

This function prints the data hotwire calibration observation data currently in the logfile(s). The function LOG FILENAME declares the file name, and function DISC DEVICE declares the Mass Storage Identifier. See LOG FILENAME for a description of the files which contain the data printed. The format of the printout is customized to best demonstrate the hotwire calibration data. This function prints all observations beginning with INITIAL OBS, and ending with ENDING OBS unless previously printed. When the program first starts, and when the PLOT EJECT function is invoked, the number of observations printed is reset to zero, causing all observations already logged to be printed when PRNT LOGFILE is invoked. This technique allows the easy implementation of a sequence program loop including both function LOG DATA POINT and PRNT LOGFILE without having to manipulate observation pointers.

[ PRNT LOGFILE ]---------------------|

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: PURGE
Function Number: 4022
Module: MODUSR1*

This function serves merely as a label for the path for accessing other related functions via the softkeys.

[ PURGE ]----------------------]

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: PURGE FILE  
Function Number: 4024  
Module: MODUSR1*

This function defines the file to be selected for purging (deleting) from the disk, and then purges the selected file.

[ PURGE FILE ]---------------------------------  
|  
|  
| -[ = ]-[ name ]--

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>string expression</td>
<td>any valid characters that are allowed in a file name</td>
</tr>
</tbody>
</table>

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: PURGE GROUP
Function Number: 4023
Module: MODUSR1*

This function purges all selected files. The selection criteria is defined in detail in the HP BASIC language reference manual for HP function PURGE (SELECT).

```
[ PURGE GROUP ]------------------------|
|                                    |
|                                    |
| ![PURGE GROUP syntax](image)        |

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>string expression</td>
<td>any valid characters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>that are allowed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in a file name</td>
</tr>
</tbody>
</table>

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: Remake Probe
Function Number: 4128
Module: MODUSR2 *

This function reproduces the computations normally accomplished during the execution of the function LOG DATA POINT, but without actually acquiring any new data. The purpose is to recompute data should modifications to the computations become necessary.

This function performs these calculations for all probes in the range INITIAL PROBE to ENDING PROBE, and for all observations in the range INITIAL OBS to ENDING OBS.

NOTE:
This function permanently overwrites previous data in the logfiles.

[ LOG DATA POINT ]-----------------]

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: SAMPLES TO AVG  
Function Number: 4110  
Module: MODUSR2*  

This function declares the number of data samples to be included in an average of the hotwire calibration data. See LOG DATA POINT for a description of the actual data acquisition process.

[ SAMPLES TO AVG ]-------------------|

* This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: STORE COEFS
Function Number: 4124
Module: MODUSR2

This function stores coefficients previously defined by functions ENTER COEFS, LOAD COEFS, COMPUTE COEFS, etc.

The coefficient filename must have been previously defined - see function COEF FILENAME.

[ STORE COEFS ]----------
Function Name: TAG PICTURE
Function Number: 4004
Module: MODUSR1

This function "tags" the picture with the first few parameter names and values from the current observation. These few values are intended to identify the environment from which the "picture" was taken. This function is therefore intended to be invoked just after function REDRAW PICTURE or PICTURE LOG E.

[ TAG PICTURE ]------------|

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: SELECTOR
Function Number: 4129
Module: MODUSR2*

This function serves merely as a label for the path for accessing other related functions via the softkeys.

[* SELECTOR ]-------------------

This routine - MODUSR2 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: TAG PLOT
Function Number: 4003
Module: MODUSR1*

This function "tags" the plot with the first few parameter names and values from the current observation. These few values are intended to identify the environment from which the plot was taken. This function is therefore intended to be invoked just after function REDRAW PLOT or PLOT LOG E.

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: TO DISK
Function Number: 4027
Module: MODUSRI*

This function defines the mass storage device to which the files will be copied - function COPY FILES - or moved - function MOVE FILES.

* This routine - MODUSRI1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
Function Name: UTILITY
Function Number: 4000
Module: MODUSR1*

This function serves merely as a label for the path for accessing other related functions via the softkeys.

* This routine - MODUSR1 - was written by Steven J. Clukey of Vigyan Research Associates, Inc. for NASA LaRC TAD/FDB under contract NAS1-17919, Task 36. This work was done beginning in October, 1986 and continues thru April, 1988.
APPENDIX C. Sequence Programs
APPENDIX C.1. Initialization Sequence Program - "8FTINI"
APPENDIX C.2. Run Sequence Program - "8FTRSEQ"
APPENDIX D. PC BASIC Program - "XFR.HP"
'Initialization from "EXAMPLE.BAS" of the HP-IB Command Library

Copyright Hewlett-Packard 1984, 1985

Set up program for MS-DOS HP-IB I/O Library
For use independent of the PC instrument bus system

PCIB.DIR$ represents the directory where the library files are located
PCIB is an environment variable which should be set from MS-DOS
i.e. A: > SET PCIB=A:\LIB

If there is insufficient environment space a direct assignment can be made here, i.e
PCIB.DIR$ = "A:\LIB"

Using the environment variable is the preferred method

PCIB.DIR$ = ENVIRON$("PCIB")
I$ = PCIB.DIR$ + ":\PCIBILC.BLD"
BLOAD I$, &HFEEO
CALL I(PCIB.DIR$, I%, J%)
PCIB.SEG = I%
IF J%=0 THEN GOTO 370
PRINT "Unable to load.";
PRINT " (Error ="; J%; ")"
STOP

Define entry points for setup routines

DEF SEG = PCIB.SEG
O.S = 5
C.S = 10
I.V = 15
I.C = 20
L.P = 25
LD.FILE = 30
GET.MEM = 35
L.S = 40
PANELS = 45

Establish error variables and ON ERROR branching
DEF.ERR = 50
PCIB.ERR$ = STRINGS(64, 32)
PCIB.NAMES$ = STRINGS(16, 32)
CALL DEF.ERR(PCIB.ERR, PCIB.ERR$, PCIB.NAMES$, PCIB.GLERR)
PCIB.BASERR = 255
ON ERROR GOTO 870

J = -1
I$ = PCIB.DIR$ + "\HPIB.SYN"
CALL O.S(I$)

IF PCIB.ERR<>0 THEN ERROR PCIB.BASERR

Determine entry points for HP-IB Library routines

I=0
CALL I.V(I, IOABORT, IOCLEAR, IOCONTROL, IOENTER)
IF PCIB.ERR<>0 THEN ERROR PCIB.BASERR
CALL I.V(I, IOENTERA, IOENTERS, IOEOI, IOEOL)
IF PCIB.ERR<>0 THEN ERROR PCIB.BASERR
CALL I.V(I, IOGETTERM, IOLLOCKOUT, IOLOCAL, IOMATCH)
IF PCIB.ERR<>0 THEN ERROR PCIB.BASERR
CALL I.V(I, IOOUTPUT, IOOUTPUTA, IOOUTPUTS, IOPPOL)
IF PCIB.ERR<>0 THEN ERROR PCIB.BASERR
CALL I.V(I, IOPPOLLC, IOPPOLLU, IOREMOTE, IORESET)
IF PCIB.ERR<>0 THEN ERROR PCIB.BASERR
CALL I.V(I, IOSEND, IOSPOLL, IOSTATUS, IOTIMEOUT)
IF PCIB.ERR<>0 THEN ERROR PCIB.BASERR
CALL I.V(I, IOTRIGGER, J, J, J)
IF PCIB.ERR<>0 THEN ERROR PCIB.BASERR
CALL C.S
I$=PCIB.DIR$+"\HPIB.PLD"
CALL L.P(I$)
IF PCIB.ERR<>0 THEN ERROR PCIB.BASERR
GOTO 1000

Error handling routine

IF ERR=PCIB.BASERR THEN GOTO 900
PRINT "BASIC error "; ERR; " occurred in line "; ERL
STOP

TMPERR = PCIB.ERR
IF TMPERR = 0 THEN TMPERR = PCIB.GLBERR
PRINT "PC Instrument error "; TMPERR; " detected at line "; ERL
PRINT "Error: "; PCIB.ER$S
STOP

COMMON declarations are needed if your program is going to chain
to other programs. When chaining, be sure to call DEF.ERR as
well upon entering the chained-to program

COMMON PCIB.DIR$, PCIB.SEG
COMMON LD.FILE, GET.MEM, PANELS, DEF.ERR
COMMON PCIB.BASERR, PCIB.ERR, PCIB.ER$, PCIB.NAME$, PCIB.GLBERR
COMMON IOABORT, IOCLEAR, IOCONTROL, IOENTER, IOENTERS, IOEOI, IOEOL, IOTERM, IOLLOCKOUT, IOLOCAL, IOMATCH, IOOUTPUT, IOOUTPUTA, IOOUTPUTS, IOPPOL, IOPPOLLC, IOPPOL

FALSE  = 0
TRUE   = NOT FALSE
NOERR  = 0
EUNKNOWN = 100001!
ESEL   = 100002!
ERANGE = 100003!
ETIME  = 100004!
ECTRL  = 100005!
EPASS  = 100006!
ENUM   = 100007!
EADDR  = 100008!
COMMON FALSE, TRUE, NOERR, EUNKNOWN, ESEL, ERANGE, ETIME, ECTRL, EPASS, EN
Set up HP-IB addressing and initialize system

OPTION BASE 1
MAX. VARIABLES = 50
DIM NAMES$ (MAX. VARIABLES)
DIM X(3)
ACT. VARIABLES = 0
NAMES$ = SPACE$(50)

Input FILS.

If PCIB.ERR <> NOERR THEN ERROR PCIB.BASERR
TIMEOUT = 5
CALL IOTIMEOUT (ISC, TIMEOUT)
IF PCIB.ERR <> NOERR THEN ERROR PCIB.BASERR
CALL IOCLEAR (ISC)
IF PCIB.ERR <> NOERR THEN ERROR PCIB.BASERR

Print "DO YOU WISH TO RECEIVE A FILE FROM THE HP COMPUTER? (Y or N)"
Input ANS$.
If ANS$="N" then GOTO 1730
If ANS$ <> "Y" then GOTO 1491
Print "ENTER THE NAME OF THE FILE TO RECEIVE TRANSFERED DATA: ".
Input FILS.
Open FILS FOR OUTPUT AS #1
For J=1 TO 2
MM=6 : AA=0
T$(J)=SPACE$(MM)
CALL IOENTERS (DEV,T$(J),MM,AA)
If PCIB.ERR <> NOERR THEN ERROR PCIB.BASERR
N(J)=VAL(LEFT$(T$(J),AA-2))
Print N(J)
Next J
NOBS=N(1)+1 : NVARS=N(2)
For J=1 TO NOBS
For I=1 TO NVARS
M=20 : A=0
TEMP$=SPACE$(M)
CALL IOENTERS (DEV,TEMP$,M,A)
If PCIB.ERR <> NOERR THEN ERROR PCIB.BASERR
NAMES$(I)=LEFT$(TEMP$,A-2)
Print "Record ",I" item ",NAMES$(I)
If J=1 then Print #1,NAMES$(I) else Print #1,VAL(NAMES$(I))
Next I
1720 NEXT J
1721 CLOSE #1
1722 GOTO 1490
1730 END
Ok
A High Speed Data Acquisition and Analysis System for Transonic Velocity, Density, and Total Temperature Fluctuations

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This report describes the high speed Dynamic Data Acquisition System (DDAS) which provides the capability for the simultaneous measurement of velocity, density, and total temperature fluctuations. The system of hardware and software is described in context of the wind tunnel environment.

The DDAS replaces both a recording mechanism and a separate data processing system. The data acquisition and data reduction process has been combined within DDAS. DDAS receives input from hot wires and anemometers, amplifies and filters the signals with computer controlled modules, and converts the analog signals to digital with real-time simultaneous digitization followed by digital recording on disk or tape. Automatic acquisition (either from a computer link to an existing wind tunnel acquisition system, or from data acquisition facilities within DDAS) collects necessary calibration and environment data. The generation of hot wire sensitivities is done in DDAS, as is the application of sensitivities to the hot wire data to generate turbulence quantities. The presentation of the raw and processed data, in terms of root mean square values of velocity, density and temperature, and the processing of the spectral data is accomplished on demand in near-real-time with DDAS.

A comprehensive description of the interface to the DDAS and of the internal mechanisms will be presented. A summary of operations relevant to the use of the DDAS will be provided.