SOFTWARE PROCESSING
FOR THE
REAL TIME DATA ACQUISITION SYSTEM
(RDAPS)

Tommy N. Tucher
Electronic Engineer
U. S. Army
Edwards Ai r Force Base
and
Michael P. Hutchinson
Data Systems Division
Sangamo Weston, Inc.
Sarasota Florida

ABSTRACT

In the early months of 1977, the United States Army Aviation Engineering Flight Activity began a study into the requirement for purchasing a replacement for the aging telemetry system that had been installed at that activity in 1969. Colonel Dennis Boyle, then acting commander of the activity, oversaw the selection of a five man committee whose job it was to find a suitable replacement system that fell within specific management guidelines. Any replacement system would take advantage of state of the art capabilities, but stop short of depending on broad based technology developments not yet proven. Aircraft flight test data would have to be processed virtually independent of source, so as to accommodate the needs of the Amy, airframe manufactures, and other government agencies. The last major management guideline proved to be critical to the development of the system, involving the makeup of the five man committee and the primary objective for the system. Definition of the new system should result from a user oriented committee, whose charter would be the develop a tool for use by the activity, that would result in activity cost savings, manpower reductions, and reduction of test cycle time.

This primary objective is one that almost any system designer lists as a high priority goal, but generally only to justify the system purchase. Throughout the creation of the system that resulted from this study, however, this objective remained paramount. Formulation of the group was built around the user aero engineer, with only one electronic engineer and one mathematician compared to two aero engineers and one equipment operator. Early studies centered on defining activity products required of the system. Past habits and

personal desires of the activity user community were separated from true functional requirements, again with the emphasis on meeting activity goals and objectives with the least expenditure of resources and time. Other possible user needs were solicited during personal visits to other facilities by the committee members. Operational techniques were also observed for possible application in the new system design. Following these visits, a strawman specification began to surface with the emphasis heavily on functionality. To accompany this specification, a user scenerio was developed in an effort to insure that a clear understanding of the operational intent for the system was enjoyed by all individuals that would involve themselves with the system development. A broad scope of system vendors were interviewed over and over again in an effort to fill out the specification with realistic hardware and software requirements that supported the system functionality definition. The final version of the specification represented a well defined telemetry system with achievable performance requirements and operationally consistent with the goals and objectives of the United States Army Aviation Engineering Flight Activity.

The purpose of this walk down memory lane is to emphasize a common sense aspect of developing a system that is often lacking to the necessary degree in both customer and vendor approaches; functionality for the purpose of making an organization with specific goals and objectives more efficient and therefore more productive. It should be realized that this implies a good system design and represents an integration of organizational functions into a well channeled flow of information, while making each individual job easier and obtaining the paramount objective of increasing the overall organizational productivity. Simply developing a system architecture around linking existing equipment or present individual job functions steers the effort away from the mainstream concept of overall productivity increase. Vendors of not only telemetry systems, but office automation systems and numerous other computer aided systems face this same problem to an ever increasing extent and will be forced into sifting through customer organizations for the true value of systems they choose to provide. In the final marketing analysis, it will be the customer's happiness with items such ease of use and productivity gains that result in increased market penetration not successful adherence to individual technical specifications such as latency in disk access.

The challenge to a system vendor faced with the type of goals just discussed is not only how to meet the needs of this customer, but how to develop an approach with broad industry appeal. He must create an architecture that represents a marriage of the customer requirements and his corporate marketing strategy for other potential customers. At one time, vendors were successful at marketing telemetry equipment by providing more data handling in their box than the next guy. Altough size reduction is always advantageous in general, most educated user communities expect that a new system can provide nearly any capability they choose to specify. It is the methodology of providing these capabilities to the user that gets far too little attention, not only by the vendor supplying the system, but

the user himself as he develops a specification. For instance, users often end up as human peripherals, providing linkage between machine processes simply for lack of thinking through the operational character of their designs to ensure that ease of use and productive increases are achieved. Human interface with a well designed system should be a requirement for functionality, not a result of a design shortcoming.

In past efforts to provide individual customer satisfaction, vendors have developed highly specialized systems. Often these systems have required not only highly individualized, one of a kind, hardware and software, but also customization of any host computer operating system. The resulting systems may have provided these individual customers with easy to use systems, having the potential for substantial productivity increases, but the likelihood of those systems having broad market appeal was slight. Today's advances in electronics and computer science have provided the system designer with the tools to meet the objectives of both the individual customer and the corporate marketing elements. Sangamo Weston has provided to the Army the Real Time Data Acquisition and Processing System (RDAPS) under the specification developed by the Army as outlined previously. This design is a state of the art telemetry system emboding not only the attributes necessary to satisfy the Army requirements for which it was developed, but it also provides a base-line system architecture that can be molded to embrace the needs of a large customer community.

The focal point of the design is an enormously capable telemetry front end designed to synchronize with and pre-process incoming information. Pre-processing consists of those functions such as limit checking, slope checking, data compression, data tagging, and engineering unit conversion that are generally common to all customers. This compliment of front end equipment is extremely flexible and allows the user to expand his capability through future additions of plug-in cards and micro-code changes. These items are vendor supported augmentations and result in a front-end that not only can be configured to a particular customer's needs, but provides a basis for a building block style of increasing functional capability in data preprocessing. While the front-end capabilities center around data pre-processing, a major key to this successful architecture is the formulation of data outputs by the front-end for input to the host computer (DEC VAX 11/780), to an array processor (CSPI MAP 200), and to a 300 megabyte disk for time history purposes. By using the front-end to handle these data formatting and routing functions, the host computer of the system has available at any instant in time the necessary information required to conduct specialized operations for the specific needs of the customer. Satisfaction of these needs is accomplished without modifying the VAX 11/780 operating system. Other RDAPS peripheral equipment, such as graphic terminals, printer/plotter, and programmable function keyboard directly communicate with the VAX 11/780 and are augmented with software to tailor their actions around the functional system requirements. In short, the functionality of the system is channeleon in nature and can be molded to fit a

particular customer's functional requirements through changes in software and peripheral hardware. Specifically, the 715 Engineering Unit Converter provides output data to variety of processes simultaneously and in specialized formats for each. By doing so, data is provided to each process in a manner consistent with the most effective and efficient operation of that process.

OPERATING SYSTEM

The RDAPS system was a VAX 11/780 with VMS (Virtual Memory System). VAX/VMS is a multiuser, multi-process operating system. Main memory is shared between processes and is allocated and deallocated as necessary. The system supports native mode (FORTRAN and assembly language) and compatibility mode (assembly language and BASIC). A design goal of the system was to provide easy quick access to the data in a manner that did not include any changes to the operating system therefore allowing upgrades to future releases of VMS. This was done by tailoring the inputs to the VAX into a form that resulted in a minimum of system overhead in delivering the data to the user. This was done using the EMR 715 to route and format the data to the destinations; CVT in VAX memory, CSPI MAP 200 Array Processor, and 300 megabyte disk. The software is primarily written in FORTRAN, with isolated programs written in MACRO when required to get to specialized VAX features or when using existing off the shelf software.

SOFTWARE

The software has two primary modes of operation, off-line and on-line. See Figure 1.

The off-line mode allows the Telemetry Operator and Flight Test engineer to prepare the system for a test. Both the operator and engineer interact with the system via full menus and appropriate prompts. The off-line mode can be divided into two areas, setup and utilities.

The Telemetry Operator can interface to the system to manipulate the following:

- Master Measurement List File
- Telemetry Front End Files
    - ∫ Multiplexer Encoder
    - ∫ Subframe Synchronizers
    - ∫ Simulator
    - ∫ Programmable Word Selector
    - ∫ Pre-Processor
    - ∫ Bit Synchronizer
    - ∫ Time Code Equipment

- Ꞩ CBW and PBW Calibrators
- Ꞩ Switch Matrix
- Ꞩ Receiver
- Calibration File
- Telemetry Operator Display Options
- Archive Files to Digital Tape
- Use Another Aircraft and Test as Baseline.

The Flight Test Engineer can interface to the system to use the following functions:
- Master Constants File
- Master Derived Parameters File
- Test Options
- Header Display Options
- Strip Chart Options
- Vibration Analysis Options
- Tab Data Options
- Sequential Plot Options
- Cross Plot Options
- Limit and Slope Check Options
- Derived Parameter Options
- Analysis Menus
- Calibration File Review
- Use Another Aircraft and Test as Baseline.

The on-line mode is used for data reduction of telemetry date in the following modes:
- (a) Simulation
- (b) Data Collection
- (c) Analog tape
- (d) Playback

The Simulation mode provides a means to test the system. This mode allows known data values to be input to the processing system, hence predictable results can be obtained. The PCM simulator, which is contained in the Model 710, will automatically be connected directly to the bit synchronizer without passing through the switching subsystem. All other functions on the system operate identically allowing the operators to feel that they are not in simulation.

The Data Collection mode is used to receive data via the RF telemetry link. The output of the telemetry receiver is coupled through the ITI switching subsystem to the FM and PCM subsystem. The time code generator data is derived from the timing signal in the test aircraft which has been encoded in the PCM telemetry data stream. The embedded time in

the PCM stream is received at the computer, reformatted and output to the timing system upon computer command thus synchronizing the airborne and ground times. The digital outputs from the FM, PCM, and the time subsystems are input to the Model 715 for processing.

The Analog Tape mode is used to process telemetry data which has been previously recorded on board the test aircraft. The reproduced outputs of the analog tape recorder are routed through the ITI switching subsystem to the PCM, FM, and time subsystems. The timing subsystem is operated in the translator mode to read the time code signal which was previously recorded on a single track of the tape recorder. The digital outputs of the FM, PCM and timing subsystem are routed to the 715 for further processing.

The above three modes operate identically except for data routing in the telemetry front end. Figure 2 shows the software flow when operating in one of these three modes.

The playback mode of operation does not require the use of the Model 715, or any of the other telemetry front end subsystems. All the data which is processed in the playback mode is obtained from the Time History File which was previusly stored on a 300 mb disk. All operations are virtually identical to the other on-line modes of operation, therefore, reducing operator training.

All modes appear essentially the same to the operators except where specifically specified. To avoid confusion, the software will be described as operating in the Data Collection Mode.

After the Telemetry Operator brings the system into the online-data collection mode data can be viewed at one of three locations:

- Telemetry Operator Station (TOS)
- Flight Test Engineer Operator Station (FTOS)
- Strip Charts (Printer/Plotter provides strip charts in playback mode).

The TOS may display on its Megatek a page of parameters from a list containing all parameters on the system. The operator may page forward, page backward, ask for a page update, get continuous data updates, or exit the system when the test is complete. The TOS screen also contains a status line which is updated once a second with the following information:

- On-line Mode
- Aircraft and Test Ids
- Telemetry Lock/Sync Status

- Test Maneuver Number
- Current Value Table Status
- Disk Write Status
- Embedded Time
- Timecode Time
- Derived Parameter Status
- Setup status.

The FTOS Megatek contains the same status line as the TOS when online is reached; Online Mode, Timecode Time, etc. In addition, the Flight Test Engineer can select the following functions via a Function Keyboard.

- Current Value Table
- Header
- Strip Charts
- Limit/Slope Checking
- Write EU Data to Disk
- Tabular Data Display
- Cross Plot Display
- Sequential Plot
- Vibration Analysis
- Vibration Tabular Data
- Vibration Plots
- Time Synchronization
- Revise Setup
- Analysis Menu.

Data coming into the CVT consists of one of three types:

- DEC Floating Point (Data converted to Engineering Units by the 715)
- Integer (converted to twos complement by the 715)
- Discrete (passed unconverted by the 715).

Software in the VAX can now operate on the data without any preprocessing to convert from BCD, sign magnitude, etc.

CURRENT VALUE TABLE (CVT)

The FTOS operator can push the CVT function key causing the system to start to ingest data into the CVT in the VAX memory. The CVT is a global common area that allows access to data by many programs simultaneously. The 715 tag is used as an offset into the

buffer and the data sample is placed in its pre-determined slot in VAX mamory. Each sample is available instantaneously in the VAX memory since a buffer is not built. In addition, no interrupts are required because the latest samples are always available in memory, hence the name current value table. Once the CVT is started, any function that requires data from the 715 can be selected using the function keyboard. When the CVT is started, the calculation of the Derived Parameters begins automatically. The calculated parameters are deposited into the CVT allowing access to Derived Parameters to be identical to parameters provided by the TFE, measured parameters.

HEADER

By pushing the Header function key the FTOS operator tells the software to display up to 12 parameters at the top of the Megatek screen. Each of the 12 items displayed will include: current value updated once a second, parameter name, and the parameter's units of engineering. Parameters can be displayed whether they are EU, discrete, or raw.

STRIP CHARTS

The strip chart software gathers data from the CVT on a clocked basis, 1 to 100 times a second. The software can pickup EU converted parameters received from the 715 or Derived Parameters calculated in the VAX. In real time these are not sent to the strip charts via a Programmable Word Selector. In playback the software outputs to the systems printer/plotter. In both modes discretes can be outputted. With TFE strip charts the discretes go to an edge track and with the printer/plotter they go to a channel and are scaled to show a significant difference between zero and one. In real time the system is capable of putting raw FM data, raw PCM data, and measured EU data from the VAX, and Derived Parameters from the VAX simultaneously to the strip charts. Figure 3 contains examples of printer/plotter strip charts.

LIMIT/SLOPE CHECKING

A function key also enables the limit/slope function. This consists of three separate checks: upper limit, lower limit, and slope. The measured parameters are limit checked by the 715 while derived parameters are checked by software in the VAX. Each parameter is checked for a limit violation if one is detected the maximum value out of limits (minimum value for lower limit checking) is determined. In addition in upper and lower checking, the elspsed time out of limits is calculated. These values are stored in the CVT where they are easily acessible for display on the FTOS Megatek. A separate key is provided to reset the maximum values collected and to reset the elapsed time. Space is reserved on the screen for a limited number of violations, after which the plot portion of the screen will be over written.

WRITE EU DATA TO DISK

A function key is provided to initiate gathering and storing of data on disk. In addition, this indicates the start of a "maneuver". A maneuver is a period of time when the vehicle being tested goes thru a predetermined flight action. During this period special processing may take place in addition to putting data to disk.

- First and last frame of data in the maneuver is collected for selected parameters.

- The number of samples, sum and sum of the parameter squared are gathered allowing the average and standard deviation to be calculated as soon as a maneuver competes.

- The frame of data when an event occurs may also be collected.

The EU Data start may also be triggered by a predetermined event rather than by pushing a function key.

TABULAR DATA DISPLAY

Within seconds of collecting the EU data for a maneuver, the FTOS user may push the function key to bring up the TAB Data Display on the FTOS Megatek. This is a tabular display containing the following information for parameters selected.

- Parameter Name
- Parameter Units
- Maximum Value
- Minimum Value
- Average Value
- Standard Deviation (in non-playback this is not available for Derived Parameters)
- First Frame Value
- Last Frame Value
- Event Frame Value

Twenty-one parameters can be displayed on the screen simultantously and the ability to page forward or backward is provided. See Figure 4 for an example of a Tabular Data Display.

CROSS PLOT DISPLAY

By pushing the cross plot function key the FTOS operator can view up to eight pages of plots. These plots are plots of the averages of one parameter against the averages of another parameter. Each of these plots can be one of eight different formats. The different formats can show from one to six different plots involving from two to eight parameters. Each time the function key is pressed, the next page appears on the screen. Separate function keys enable curve fitting (first thru fifth order), extrapolation, and resealing. The plots may contain measured parameters from the TFE as well as derived parameters. Figure 5 is an example of a Cross Plot Display.

SEQUENTIAL PLOTS

The sequential plots may be brought up on the FTOS Megatek screen by pushing a function key. This display plots from one to six parameters against time. The display is updated once a second with the latest data. This results in a continuously moving display with the newest data appearing on one side and the oldest scrolling off the other side. The plot may contain measured and derived parameters intermixed on the screen. The X axis which contains time can be set from 12 seconds to 600 seconds. Figure 6 is an example of a Sequential Plot.

VIBRATION ANALYSIS

Once data has started going to disk, a maneuver has started, the operator may select to start vibration analysis. EU data is routed from the 715 to the CSPI which does the FFT processing. In the RDAPS system the results of the FFT are summed in the CSPI. At the end of the vibration analysis period, the average power for each parameter is returned to the VAX and stored on disk. During setup of the system the FTOS operator can select to have the vibration analysis start and stop automatically with acquiring data for the disk. In this case the FTOS operator does not need to use the function key and it is not made available for use. See Figure 7 for an example of Vibration Tabular Display.

VIBRATION TABULAR DATA

After acquiring vibration data the FTOS engineer may review the data in tabular form by pressing the appropriate function key. A menu will appear containing the parameters that were processes by the CSPI. After selecting a parameter, the display will show two columns of data. The first contains amplitude and the second contains frequency. The operator can page forward or backward thru all the data available for that parameter or may examine another parameter. Figures 8 and 9 are examples of the two kinds of vibration plots.

VIBRATION PLOTS

In addition to the tabular display of vibration data, the FTOS engineer may select vibration plots by pressing a key on the function keyboard. The plots consist of two types, a frequency plot for each parameter and harmonic plots for each parameter. The frequency plot is a plot of the frequency (X axis) and amplitude data (Y axis) as shown in the tabular display. Pushing the function key again brings up the corresponding harmonic plot which. plots selected harmonics of the fundamental frequency against the average of a preselected parameter. Each time the function key is pressed, a new plot is presented until the parameter is exhausted and then the sequence starts over with the frequency plot for the next parameter.

TIME SYNCHRONIZATION

Whenever the FTOS engineer desires he may synchronize the ground time code equipment by pressing the time sync function key. The software will read PCM time from the CVT, reformat the time, and sent it to the time code equipment.

REVISE SETUP

A number of setup parameters can be dynamically changed during real time. The FTOS engineer by pressing the revise setup function key can bring up a menu allowing changes to the following functions:

- Override a Master Constant
- Override a Measured Parameter
- Override a Strip Chart Scaling
- Delete a Strip Chart Channel
- Delete a Slope Check Parameter
- Delete an Upper Limit Check Parameter
- Delete a Lower Limit Check Parameter.

These changes are not made permanent and will be lost when the current real time run is exited.

ANALYSIS MENU

The FTOS engineer may press the analysis menu function key when he is not in a maneuver. Pressing this key brings up a menu of user programs, defined during setup. The engineer selects the programs he wishes to run and they are submitted as batch jobs to VMS and executed.

PERFORMANCE SUMMARY

The keys to meeting the performance goals in the system are the 715 Pre-Processor and the 760 Buffered Datsa Channel generated CVT (Current Value Table). These two items allowed the software to process the data without a lot of routing, sorting, or converting. The following three sample cases demonstrate the systems performance.

Sample Case 1

Input	88,000 samples/second
EU Convert	44,000 samples/second
Disk Storage	132,000 words/second (16 bits)
Limit/Slope Check	27,100 per second
Derived Parameter Calculations 5,000 per second	

Standard Deviation Gathering   5000 samples/second
(min, max, N, sum, sum of squares)
Vibration Analysis   24,000 samples/second
Strip Charts   2,200 samples/second

Sample Case 2

Input	45,200 samples/second
EU Convert	45,000 samples/second
Disk Storage	135,000 words/second (16 bit words)
Limit/Slope Check	42,500 per second
Derived Parameter Calculations	4,000 per second
Standard Deviation Gathering	600 samples/second

(min, max, N, sum, sum of squares)
Vibration Analysis   40,000 samples/second
Strip Charts   2,000 samples/second

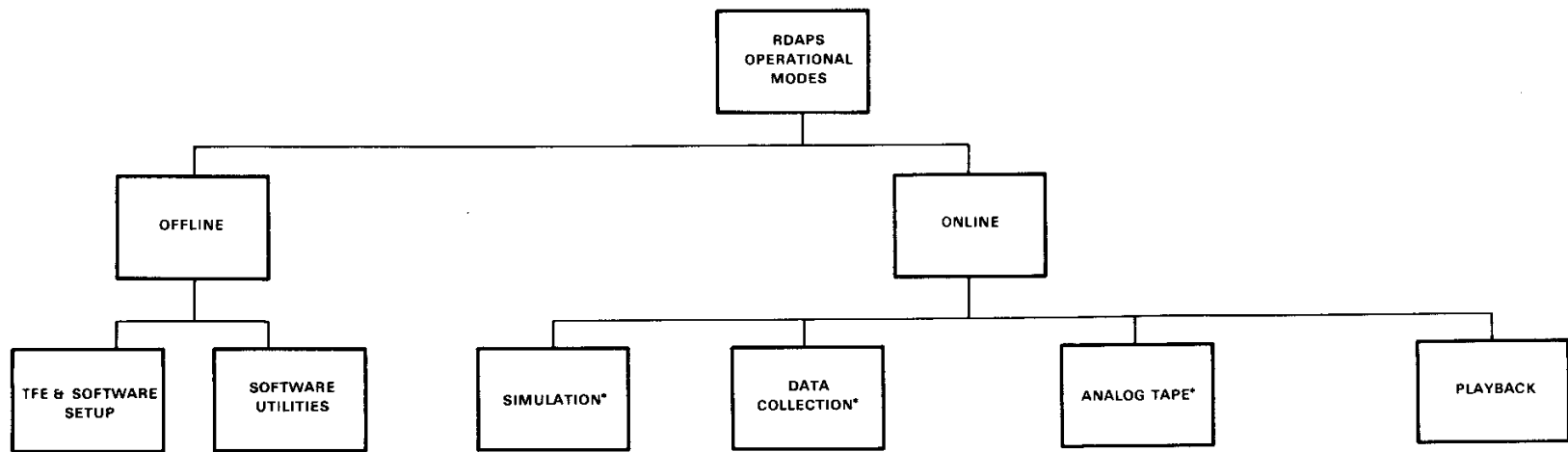## Sample Case 3

Input	45,600 samples/second
EU Convert	37,100 samples/second
Disk Storage	111,300 words/second (16 bit words)
Limit Slope Checks 25,300 per second	
Derived Parameter Calculations	2,500 per second
Standard Deviation Calbulations 8000 samples/second	

(min, max, N, sum, sum of squares)

Vibration Analysis   20,000 samples/second
Strip Charts   1,900 samples/second

Within twenty seconds of the end of a flight maneuver, with data still coming into the VAX (limit/slope checking still active and device parameters still active) the operator can view the following:

- Plot of amplitude vs frequency (output from FFT)
- Harmonic plot of vibration data (output from FFT)
- Cross plots of average data
- Tabular FFT data (amplitude and frequency)
- Tabular min, max, average, and standard deviation data.

In summary, the RDAPS system is a state of the art telemetry system which provides the optimum processing of telemetry information available, on a mini or super-mini computer. The systems users can obtain outputs of processed data between flight maneuvers, providing much greater control over flight testing and therefore resulting in a more more efficient and timely flight test program. Since this system is transportable, the requirement to send data to a central computer system and wait for the results to be sent back is hereby eliminated, resulting in shorter flight test programs.

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                    ┌─────────────┐
                    │    RDAPS     │
                    │ OPERATIONAL  │
                    │    MODES     │
                    └─────────────┘
           ┌───────────────┴───────────────┐
      ┌─────────┐                      ┌─────────┐
      │ OFFLINE │                      │ ONLINE  │
      └─────────┘                      └─────────┘
     ┌─────┴─────┐        ┌─────────┬─────┴─────┬─────────────┐
┌──────────┐┌──────────┐┌──────────┐┌──────────┐┌──────────┐┌──────────┐
│TFE & SOFT││ SOFTWARE ││SIMULATION*││  DATA    ││ANALOG    ││ PLAYBACK │
│WARE SETUP││UTILITIES ││          ││COLLECTION*││ TAPE*    ││          │
└──────────┘└──────────┘└──────────┘└──────────┘└──────────┘└──────────┘
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* THESE MODES USE THE 715 FOR
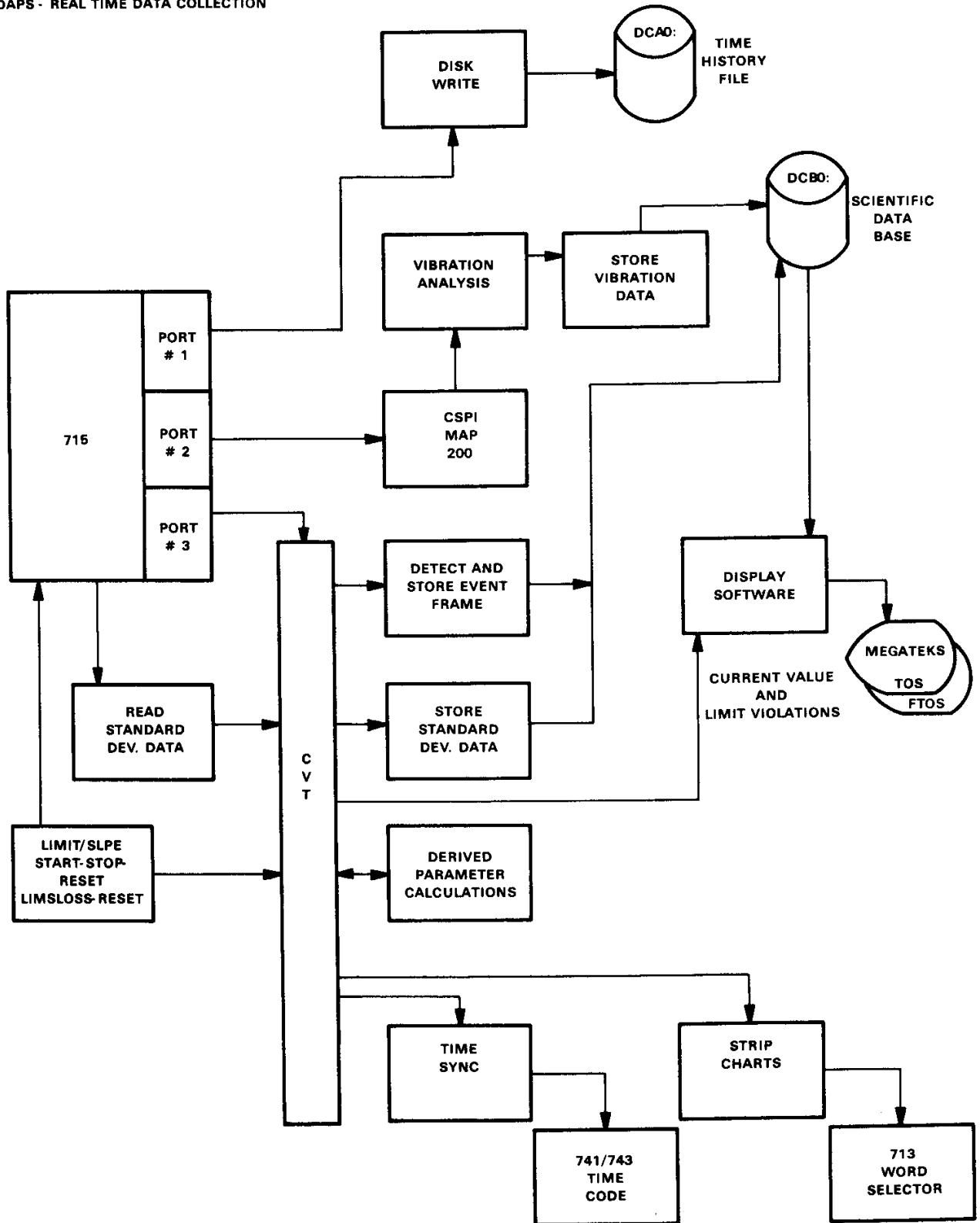DATA INPUT TO THE VAX AND ARE
IDENTIFIED AS REAL TIME

FIGURE 1. RDAPS MODES

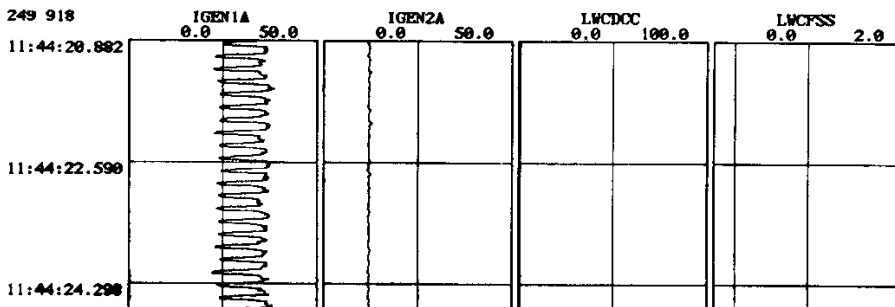**FIGURE 2. RDAPS SOFTWARE FLOW**
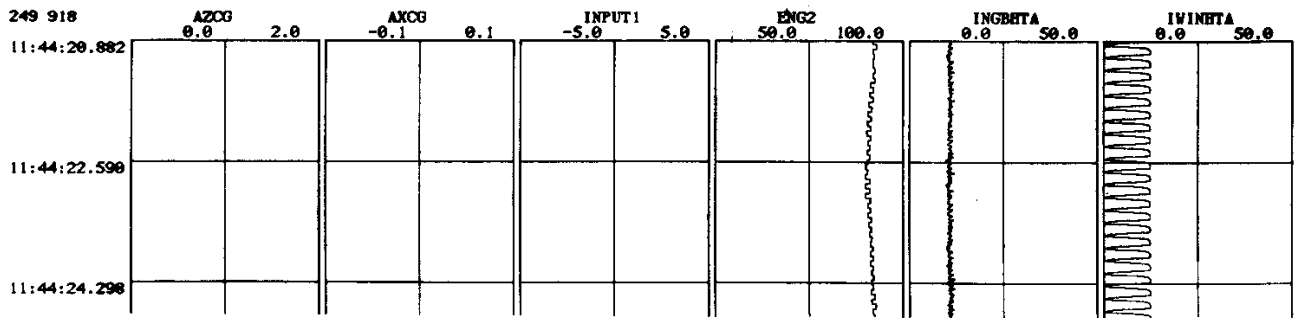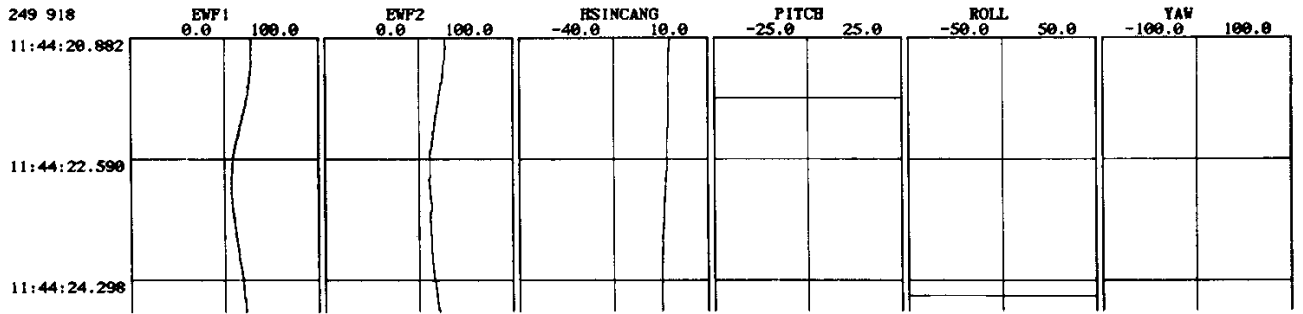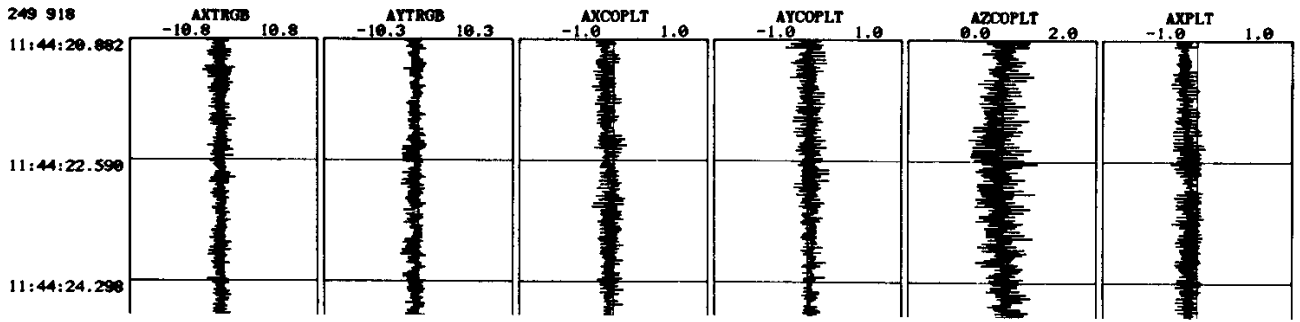
FIGURE 3. STRIP CHART

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EMBEDTME ??? 11 45 43  RDAPSMDE  PLAY   THFWRITE   NO  MAN # 04 P  SYNCLOSS 00000  TFESYNC          AC 249 TS 918
TIMECODE     11 45 43  DPCOUNTS     0   DPTIME      0  SETUP   OK  CUMMLOSS 00000  CVTUPDATE   NO  PROJ 918
IND  MNEMONIC VIOLATION CURRENT VALUE   TOLERANCE   UNITS   MAXIMUM OUT TIME OUT
```

MENU: TAB DATA DISPLAY   PAGE 1 OF 7

(1) PAGE FORWARD
(2) PAGE BACKWARD
(3) EXIT TAB DATA DISPLAY

MNEMONIC	UNITS	MAX VALUE	MIN VALUE	AVG VALUE	STD DEV	FIRST FRAME	LAST FRAME	EVENT FRAME
DELE	INCHES	5.3	4.7	5.0	0.1	5.0	5.1	5.0
DELA	INCHES	4.4	3.7	4.0	0.1	3.9	4.1	3.9
DELR	INCHES	3.5	3.2	3.3	0.1	3.3	3.3	3.3
DELC	INCHES	7.4	5.8	6.7	0.4	6.8	6.9	6.8
PITCH	DEG	183.8	−183.8	148.9	105.1	180.6	182.0	180.6
ROLL	DEG	179.3	−181.6	−70.0	163.3	177.5	−177.4	177.5
YAW	DEG	194.5	169.5	180.5	8.0	174.1	194.5	174.1
Q	DEG/SEC	2.0	−1.8	0.4	0.7	0.3	0.4	0.3
P	DEG/SEC	63.6	61.9	63.1	0.3	63.1	63.3	63.1
R	DEG/SEC	2.5	−2.1	0.0	1.0	−1.0	1.7	−1.0
RPMMR	RPM	521.6	521.6	521.6	0.1	521.6	521.6	521.6
INGBHTA	AMPS	12.5	9.9	11.0	0.5	10.7	10.4	10.7
IWINHTA	AMPS	12.5	0.5	8.4	4.6	1.4	0.9	1.4
IBLDDIA	AMPS	0.7	0.5	0.6	0.1	0.5	0.7	0.5
BATVOLT	VOLTS	33.6	33.6	33.6	0.0	33.6	33.6	0.0
IGEN1A	AMPS	39.6	20.9	32.3	4.9	22.5	25.1	22.5
IGEN2A	AMPS	12.7	11.7	12.1	0.1	11.8	12.3	11.8
TAPLTWA	DEG C	13.0	8.3	10.5	1.2	10.2	11.1	10.2
TPECSOUT	DEG C	45.5	39.9	42.7	1.0	43.3	40.5	43.3
TACPGWL	DEG C	18.3	13.6	15.9	0.8	17.1	15.2	17.1
TCPSECSO	DEG C	20.2	11.7	15.9	1.7	17.7	13.3	17.7

INPUT:

ENTER DESIRED OPTION

FIGURE 4. TABULAR DATA DISPLAY

EMBEDTME ??? 11 45 43 RDAPSMDE PLAY THFWRITE   NO MAN # 04 P SYNCLOSS 00000 TFESYNC   AC 249 TS 918
TIMECODE   11 45 43 DPCOUNTS   0 DPTIME   0 SETUP   OK CUMMLOSS 00000 CVTUPDATE   NO PROJ 918
IND MNEMONIC VIOLATION CURRENT VALUE   TOLERANCE   UNITS   MAXIMUM OUT TIME OUT
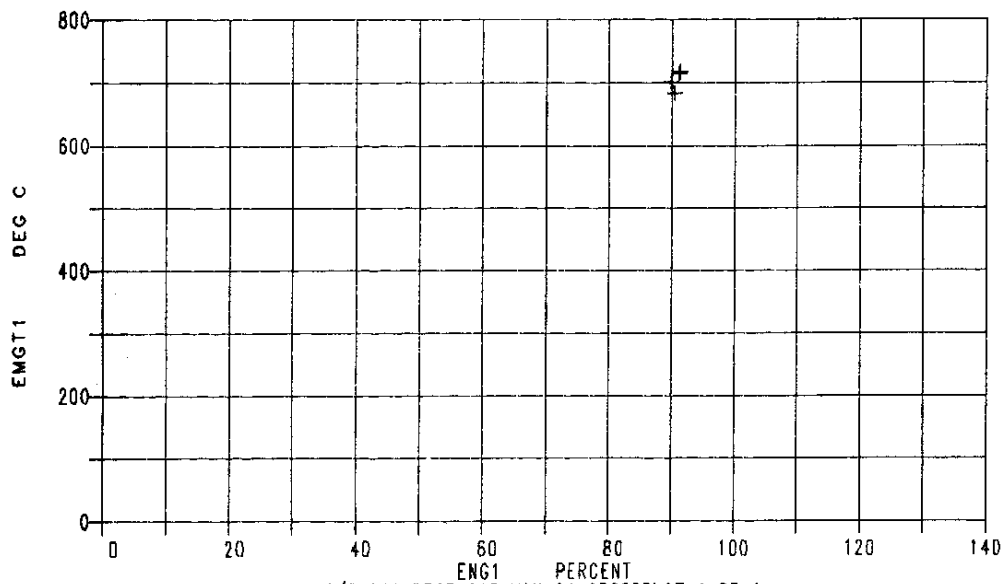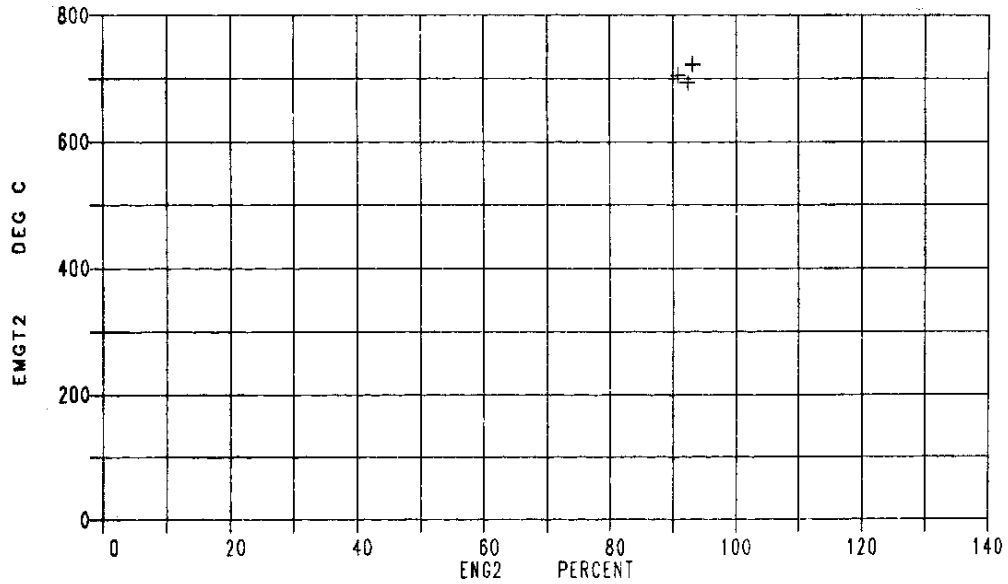
FIGURE 5. CROSSPLOT

```
 VIC        106.9  KNOTS   VT          111.6  KNOTS   HP       4476.  FEET    HD         2926.  FEET
 TA          -6.6  DEG C   TAPE         ON    EVENT   GW      16565.  POUNDS  FSCG       355.6  INCHES
 NR         257.9  RPM     STAB          4.4  DEGREES ICE       0.18  GRAM/M3 RUN           0.  RUN
 EMBEDTIME 20 10 48 ??  RDAPSMDE  TAPE  THFWRITE  YES  MAN # 01 X  SYNCLOSS    0  TFCSYNC
 TIMECODE  08 15 17  DPCOUNTS   54  DPTIME   202  SETUP  ERR  CUMMLOSS    8  CVTUPDATE  YES
 IND  MNEMONIC VIOLATION CURRENT VALUE   TOLERANCE   UNITS    MAXIMUM OUT TIME OUT
```


Sequential Plot
Aircraft 717 Test 026 Maneuver 01
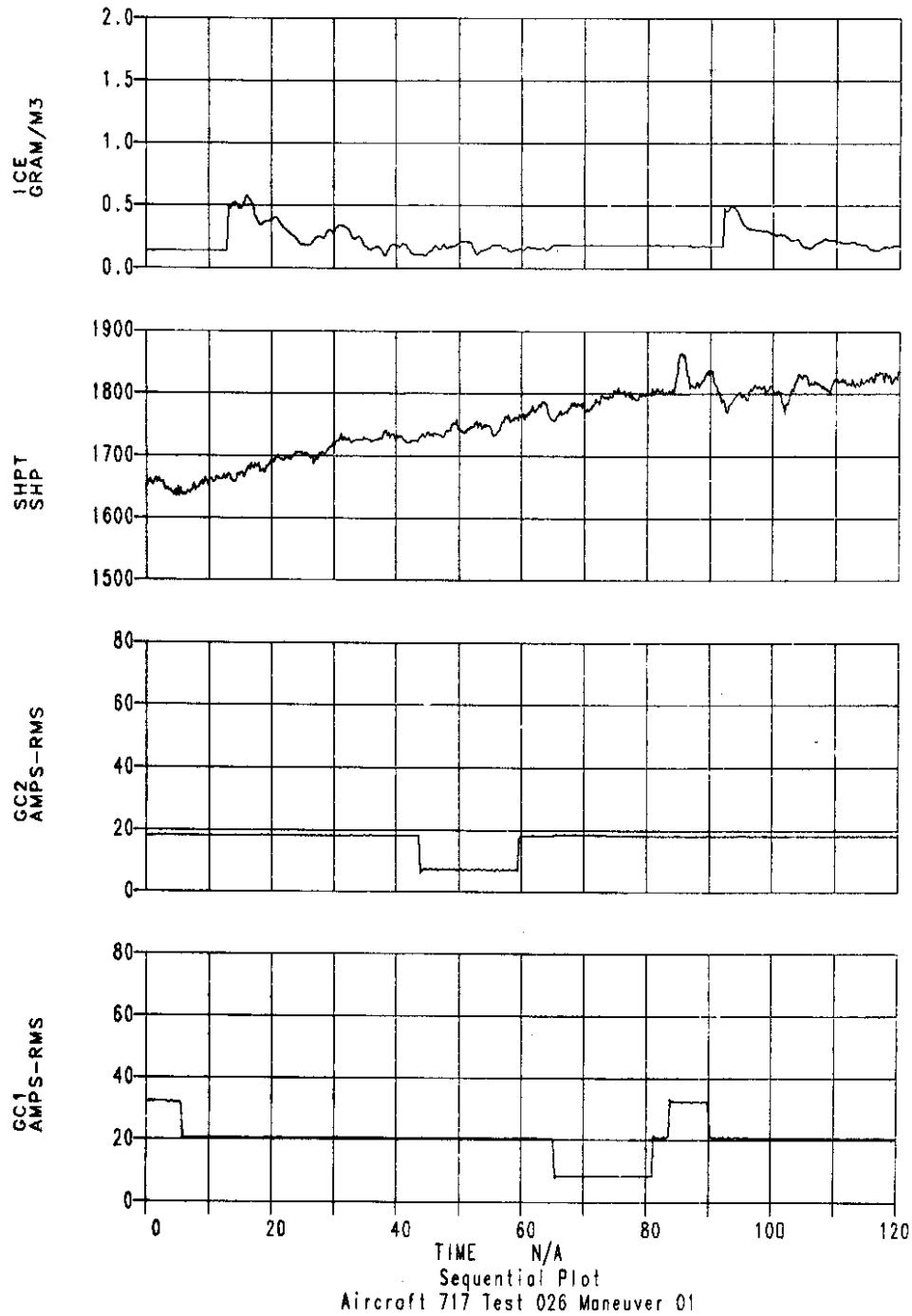
FIGURE 6 . SEQUENTIAL PLOTS

```
EMBEDTME ??? 11 45 43  RDAPSMDE  PLAY  THFWRITE   NO  MAN # 04 P  SYNCLOSS 00000  TFESYNC        AC 249 TS 918
TIMECODE     11 45 43  DPCOUNTS    0  OPTIME       0  SETUP   OK  CUMMLOSS 00000  CVTUPDATE   NO  PROJ 918
IND  MNEMONIC VIOLATION CURRENT VALUE   TOLERANCE   UNITS   MAXIMUM OUT TIME OUT
```

MENU: VIBRATION TAB DISPLAY

(1) PAGE FORWARD
(2) PAGE BACKWARD
(3) EXIT TAB DATA DISPLAY

```
   AXPLT        AYPLT        AZPLT        AXCOPLT      AYCOPLT     AZCOPLT
   AXTRGB       AYTRGB       INPUT1       AZCLTRM
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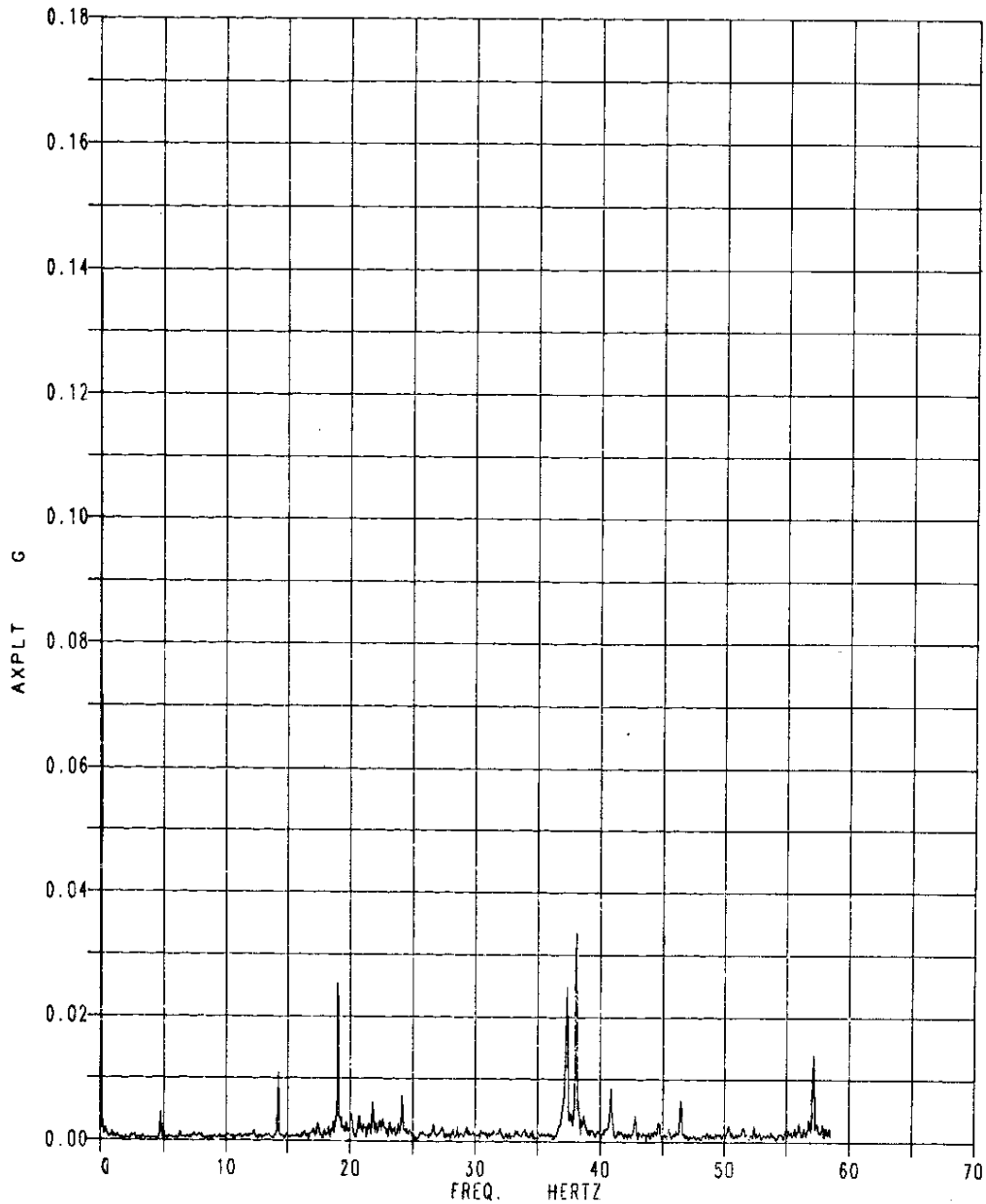
	AMPLITUDE	FREQUENCY
0001.	0.1384355E+00	0.0000000E+00
0002.	0.1392465E+00	0.5712891E-01
0003.	0.3804397E-02	0.1142578E+00
0004.	0.2656258E-02	0.1713867E+00
0005.	0.1394249E-02	0.2285156E+00
0006.	0.1033387E-02	0.2856445E+00
0007.	0.1659954E-02	0.3427734E+00
0008.	0.1986257E-02	0.3999023E+00
0009.	0.1241775E-02	0.4570313E+00
0010.	0.1104899E-02	0.5141602E+00
0011.	0.1112461E-02	0.5712891E+00
0012.	0.8474567E-03	0.6284180E+00
0013.	0.4548978E-03	0.6855469E+00
0014.	0.7681567E-03	0.7426758E+00
0015.	0.7517273E-03	0.7998047E+00
0016.	0.8887420E-03	0.8569336E+00
0017.	0.1224672E-02	0.9140625E+00
0018.	0.1363291E-02	0.9711914E+00
0019.	0.5583921E-03	0.1028320E+01
0020.	0.1006026E-02	0.1085449E+01
0021.	0.8127422E-03	0.1142578E+01
0022.	0.4207396E-03	0.1199707E+01
0023.	0.7078811E-03	0.1256836E+01
0024.	0.8686637E-03	0.1313965E+01
0025.	0.4659770E-03	0.1371094E+01
0026.	0.5418702E-03	0.1428223E+01
0027.	0.4965318E-03	0.1485352E+01
0028.	0.2689154E-03	0.1542480E+01
0029.	0.2866436E-03	0.1599609E+01
0030.	0.5648173E-03	0.1656738E+01
0031.	0.4927374E-03	0.1713867E+01
0032.	0.2221816E-03	0.1770996E+01

INPUT:

ENTER DESIRED MNEMONIC

FIGURE 7. VIBRATION TAB DISPLAY

EMBEDTME ??? 11 45 43 RDAPSMDE PLAY   THFWRITE   NO MAN # 04 P SYNCLOSS 00000 TFESYNC   AC 249 TS 918
TIMECODE   11 45 43 DPCOUNTS   0   DPTIME   0 SETUP   OK CUMMLOSS 00000 CVTUPDATE   NO PROJ 918
IND MNEMONIC VIOLATION CURRENT VALUE   TOLERANCE   UNITS   MAXIMUM OUT TIME OUT

Frequency vs. Amplitude, Plot 1 of 10
Aircraft 249 Test 918 Maneuver 04

FIGURE 8. FREQUENCY/AMPLITUDE PLOT

```
EMBEDTME ??? 11 45 43  RDAPSMDE  PLAY  THEWRITE   NO  MAN # 04 P  SYNCLOSS 00000  TFESYNC        AC 249 TS 918
TIMECODE    11 45 43  DPCOUNTS    0  DPTIME     0  SETUP  OK  CUMMLOSS 00000  CVTUPDATE   NO  PROJ 918
IND  MNEMONIC VIOLATION CURRENT VALUE   TOLERANCE   UNITS   MAXIMUM OUT TIME OUT
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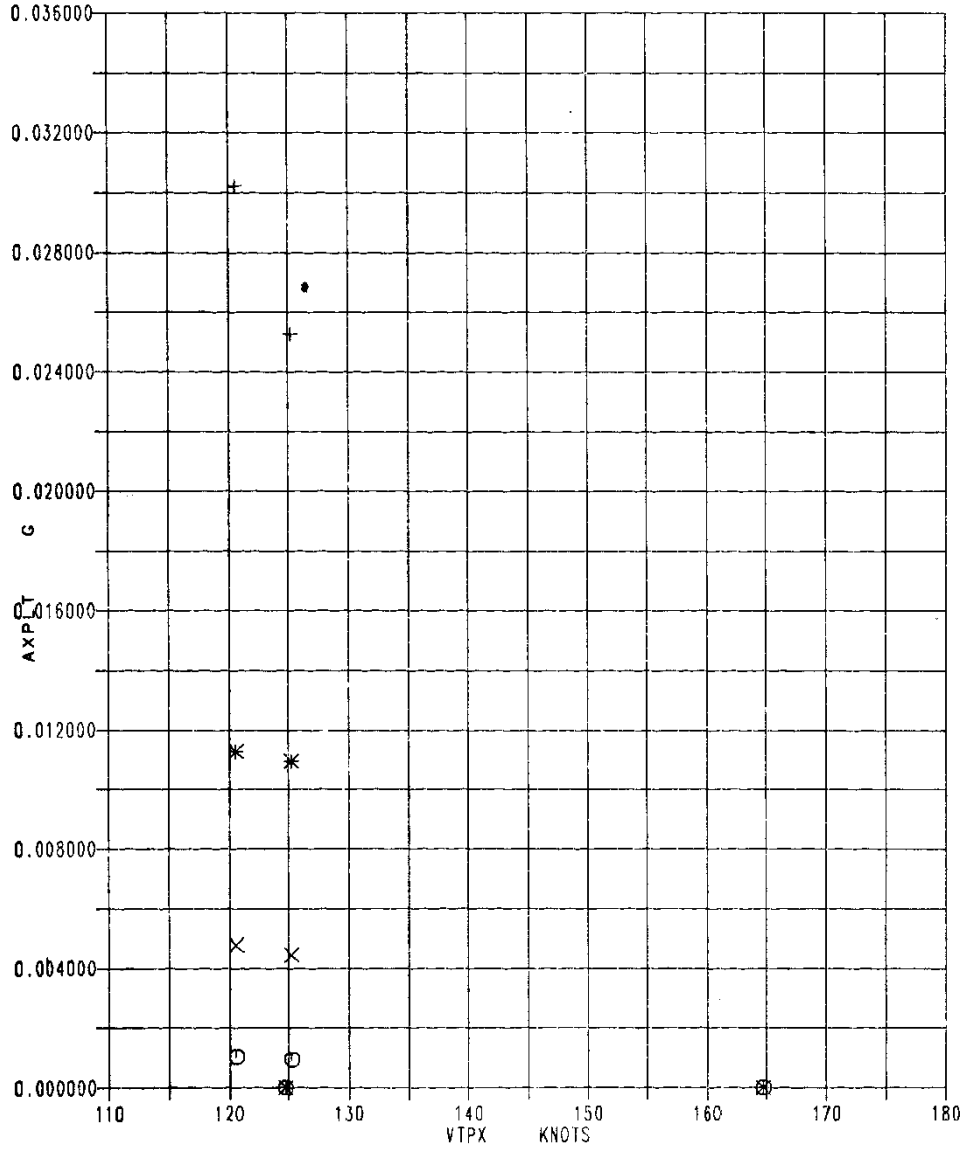

Harmonics, Plot 1 of 10
Aircraft 249 Test 918 Maneuver 04 Page 1 of 1

Legend
+ 4th Harmonic
* 3rd Harmonic
◇ 2nd Harmonic
x 1st Harmonic

FIGURE 9. HARMONIC PLOT