

DTIC FILE COPY

AAMRL-TR-89-035



AD-A218 048

**BOOM EVENT ANALYZER
RECORDER (BEAR):
System Description**

Robert A. Lee
Doug Mazurek
Dale Price

Monty Crabill
Barbara Palmer

BIODYNAMIC ENVIRONMENT BRANCH
WRIGHT-PATTERSON AIR FORCE BASE, OH 45433-6573

DTIC
ELECTE
FEB 20 1990
S D D

AUGUST 1989

FINAL REPORT FOR DEVELOPMENT: OCTOBER 1985 - AUGUST 1989

Approved for public release; distribution is unlimited.

HARRY G. ARMSTRONG AEROSPACE MEDICAL RESEARCH LABORATORY
HUMAN SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6573

90 02 16 015

NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

Please do not request copies of this report from the Harry G. Armstrong Aerospace Medical Research Laboratory. Additional copies may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield VA 22314

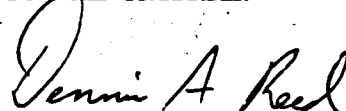
TECHNICAL REVIEW AND APPROVAL

AAMRL-TR-89-035

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

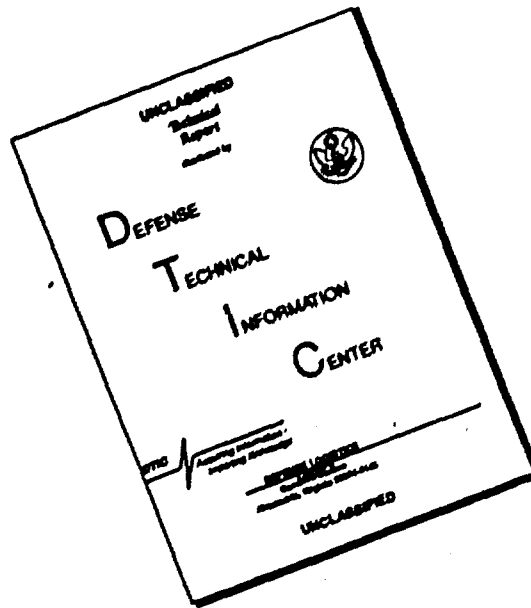
This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



DENNIS A. REED, Lt Col, USAF, BSC
Associate Director
Biodynamics and Bioengineering Division
Harry G. Armstrong Aerospace Medical Research Laboratory

DISCLAIMER NOTICE



**THIS DOCUMENT IS BEST
QUALITY AVAILABLE. THE COPY
FURNISHED TO DTIC CONTAINED
A SIGNIFICANT NUMBER OF
PAGES WHICH DO NOT
REPRODUCE LEGIBLY.**

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
1a REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b RESTRICTIVE MARKINGS N/A		
2a SECURITY CLASSIFICATION AUTHORITY			3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.		
2b DECLASSIFICATION/DOWNGRADING SCHEDULE			5 MONITORING ORGANIZATION REPORT NUMBER(S)		
4 PERFORMING ORGANIZATION REPORT NUMBER(S) AAMRL-TR-89-035			7a NAME OF MONITORING ORGANIZATION		
6a NAME OF PERFORMING ORGANIZATION Harry G. Armstrong, Aerospace Medical Research Laboratory		6b OFFICE SYMBOL (If applicable) AAMRL/BBE	7b ADDRESS (City, State, and ZIP Code)		
6c ADDRESS (City, State, and ZIP Code) Wright-Patterson AFB OH 45433-6573			9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8a NAME OF FUNDING/SPONSORING ORGANIZATION		8b OFFICE SYMBOL (If applicable)	10 SOURCE OF FUNDING NUMBERS		
8c ADDRESS (City, State, and ZIP Code)			PROGRAM ELEMENT NO 62202F	PROJECT NO 7231	TASK NO 34
			WORK UNIT ACCESSION NO 08		
11 TITLE (Include Security Classification) (U) Air Force Boom Event Analyzer Recorder (BEAR): System Description					
12 PERSONAL AUTHOR(S) Robert A. Lee, Monty Crabill, Doug Mazurek, Barbara Palmer and Dale Price					
13a TYPE OF REPORT Final		13b TIME COVERED FROM Oct 85 TO Aug 89		14 DATE OF REPORT (Year, Month, Day) August 1989	
15 PAGE COUNT					
16 SUPPLEMENTARY NOTATION					
17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Acoustics, noise, sonic boom, environmental noise, recorders, monitors, community noise exposure.		
20	01				
19 ABSTRACT (Continue on reverse if necessary and identify by block number)					
From Oct 1985 to Aug 1989 AAMRL/BBE developed, tested, built and used in field studies several Boom Event Analyzer Recorders (BEARs). These BEAR's operate unattended to capture the wave form of Impulsive Acoustic Events (e.g. Sonic Booms) and their time of occurrence while excluding all other acoustic events. These BEARs are designed to operate unattended for up to 10 days and can store over 50 normal (less than 250 milliseconds in duration) sonic booms. These BEAR systems have been used successfully to capture the sonic boom signature from all US supersonic aircraft. This report is a complete system description of the BEAR covering data collection, theory of operation, data storage and retrieval, operation and complete hardware and software description. The comparison test done in cooperation with NASA and field studies using these BEARs are detailed in companion reports.					
20 DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS			21 ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED		
22a NAME OF RESPONSIBLE INDIVIDUAL ROBERT A. LEE			22b TELEPHONE (Include Area Code) (513) 255-3664		22c OFFICE SYMBOL AAMRL/BBE

DD Form 1473, JUN 86

Previous editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

PREFACE

This report is a technical manual describing the Boom Event Analyzer Recorder (BEAR) that was built by Systems Research Laboratories under contract to the Armstrong Aerospace Medical Research Laboratory at Wright-Patterson Air Force Base, Ohio. This development was conducted by the Biodynamic Environment Branch (AAMRL/BBE) under Task 723134, "Exploratory Noise and Sonic Boom Research". Partial funding for this effort was received from the Noise and Sonic Boom Impact Technology (NSBIT) advanced development program office under Project 3037.

Accession For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution	
Availability Codes	
Dist	Avail and/or Special
A-1	

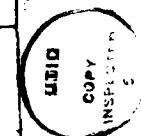


TABLE OF CONTENTS

	<u>Page</u>
Preface	iii
Table of Contents	v
List of Figures	vii
1. Introduction	1-3
1.1 System Description	1
1.2 Companion Hardware/Software	3
2. Theory of Operation	4-16
2.1 Start-up Routine	4
2.2 Boom Capture Operation	4
2.3 Key Pad Operation	11
2.4 Parameter Ranges and Default Settings	16
3. BEAR Software Description	17-134
3.1 Overview	17
3.2 Startup	17
3.3 System Initialization	19
3.4 Run Routines	24
3.5 Stored Data Examples	45
3.6 Error Messages and Recovery Procedures	50
3.7 Software Listing	52
4. BEAR Hardware Description	135-172
4.1 Overview	135
4.2 Parts List	136
4.3 Drawings	150
4.4 Calibration Guide	166
4.5 BEAR Address Map	169
4.6 BEAR Voltage to SPL Conversion	170

LIST OF FIGURES

<u>Number</u>	<u>Page</u>
1. BEAR data collection and transfer	2
2. Clean N-Wave	5
3. Ragged N-Wave	6
4. Focussed N-Wave	7
5. Boom near Lateral Cutoff	9
6. Boom evaluation criteria	10
7. BEAR software block diagram	18
8. BEAR system initialization flow chart	21
9. BEAR system initialization flow chart (cont.).....	22
10. BEAR system initialization flow chart (cont.).....	23
11. A/D interrupt routine flow chart	25
12. A/D interrupt routine flow chart (cont.).....	26
13. A/D interrupt routine flow chart (cont.).....	27
14. Running Average Table flow chart	29
15. A/D interrupt routine flow chart	31
16. Event evaluation flow chart	32
17. Event evaluation flow chart (cont.).....	33
18. Event evaluation flow chart (cont.).....	34
19. Event evaluation flow chart (cont.).....	35
20. Event evaluation flow chart (cont.).....	36
21. Event evaluation flow chart (cont.).....	37
22. KEYPAD interrupt flow chart	39
23. GETKEY flow chart	40
24. A function routine flow chart	41
25. B function routine flow chart	42

<u>Number</u>	<u>Page</u>
26. C function routine flow chart	43
27. D function routine flow chart	44
28. BEAR CPU, Reset and Interrupt Circuitry Diagram ..	151
29. BEAR Clock and Miscellaneous Logic Diagram	152
30. BEAR cashe SRAM Diagram	153
31. BEAR EPROM's 1 Diagram	154
32. BEAR EPROM's 2 Diagram	155
33. BEAR Battery RAM and RAT memory Diagram	156
34. BEAR RAM module array Diagram	157
35. BEAR BBRAM power on/off Circuitry Diagram	158
36. BEAR Data Acquisition Circuit Diagram	159
37. BEAR ADC Port Circuit Diagram	160
38. BEAR Liquid Crystal Display Circuit Diagram	161
39. BEAR Keypad Interface Circuit Diagram	162
40. BEAR Real Time Clock Circuit Diagram	163
41. BEAR Power Supply Circuit Diagram	164
42. BEAR Low Battery Indicator Circuit Diagram	165
43. BEAR Address Map	169

1. INTRODUCTION

1.1 System Description

The Boom Event Analyzer Recorder (BEAR) is a 16 bit microprocessor based instrument that continuously samples the background noise then captures and stores the digital waveform of any loud impulsive noise. The recorder can discern a sonic boom from the normal background noise and capture it in permanent solid state random access memory (RAM) storage for later analysis.

The BEAR digitizes the noise environment at 8 kHz and analyzes it during the downtime between the sampling intervals (125 microseconds) giving it real time screening for sonic boom events. The BEAR examines the event level, duration, positive pulse time and negative time to determine if it should be stored as a boom event. These four parameters are selectable via the input key pad to make the BEAR a very flexible instrument with which to capture a wide variety of impulsive events. Along with setting the boom evaluation criteria, the key pad allows input of date, time, test number, location and serial number of the unit. This information is stored in the same RAM modules as data every time any parameter is changed. The operator can also select two other modes from this key pad: calibration or data save. In the calibration mode the BEAR simply displays the root-mean-square level of two seconds of the input signal to the microphone for checking against a standard 124 dB sound pressure level pistonphone calibrator. No data is saved to the RAM modules in this mode. The second mode allows the operator to collect one second of data with no screening. This allows the operator to collect and store background noise, the calibrator signal or anything else that is desired. The BEAR unit, upon startup, runs through an internal self test routine that verifies all the hardware components; then, cues the operator that it is "READY" for date, time and parameter inputs.

The BEAR has a frequency response of 0.5 Hz to 2,500 Hz for reproducing a sonic boom time-history adequate for environmental impact analysis. The maximum overpressure the BEAR can accurately record is 165.3 dB (76.9 pounds per square foot or 3639 pascals) with an 80 dB usable dynamic range. The RAM modules on a single unit have 512K of memory allowing the BEAR to store over 100 "normal" sonic booms (duration of .250 seconds) or 32 "save" events (1 second of data stored via keypad save routine).

The BEAR is designed to operate with a PCB Inc, model # 106850, piezoelectric microphone that is totally sealed and extremely rugged making the BEAR able to operate in the environmental extremes of temperature typical of USAF supersonic areas (0 - 65 degrees C.). This microphone is used with the BEAR systems in an inverted position (see figure 1). This essentially collects the pressure waveform being

BOOM EVENT ANALYZER RECORDER (BEAR)

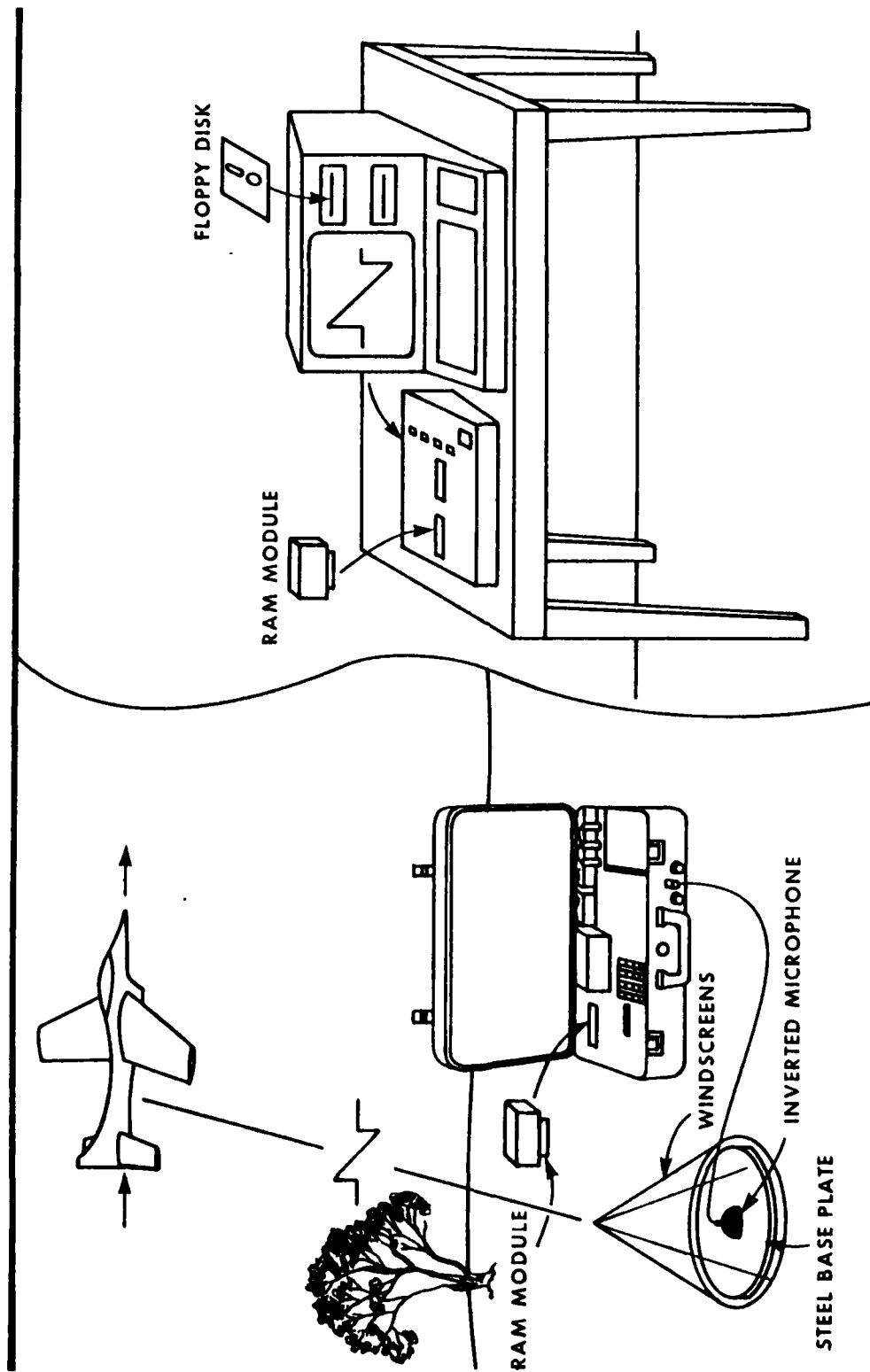


Figure 1. BEAR Data Collection and Transfer

reflected from the steel base plate. This procedure produces virtually identical results over this frequency range with that measured by a flush mounted microphone and is much easier to set up. The low profile also helps in reducing the wind noise (a major contributor of low frequency noise) to the microphone system. The BEAR system and microphone setup were validated in a test conducted at Edwards AFB, CA in Sep 1986. This validation is described in the report "AAMRL-TR-88-039, AIR FORCE BOOM EVENT ANALYZER RECORDER (BEAR): Comparison with NASA Boom Measurement System, R.Lee, July 1988".

1.2 Companion Hardware/Software

Once data has been collected by the BEAR unit the data is stored on its RAM modules. The RAM modules can then be interfaced with a Data Retrieval Unit (DRU) to transfer the information to a Zenith Z-100 microcomputer (figure 1). The microcomputer displays each recorded event, time of occurrence and summary information for all the data stored. Along with the DRU AMRL/BBE also developed several hardware items and software programs for use with the BEAR systems. These items include a security case, windscreen, sunscreen, battery charger (for proper battery charging) and multiple boom processing programs. Complete descriptions of these are detailed in the following appendices:

- Appendix A. Data Retrieval Unit (DRU)
- Appendix B. BEAR Software Programs (BEARWARE)
- Appendix C. BEAR additional Hardware

2. THEORY OF OPERATION

2.1 Start-up Routine

The BEAR is designed such that after turning the unit on it will do an internal self analysis and come up ready to capture sonic boom data. This internal analysis checks the BEAR EPROM, all internal hardware operation, and the RAM modules. If the RAM modules contain valid data no other check is made to the modules. If the modules are empty the BEAR will write valid data to each address of the modules, read and compare each location, write zero's to all address and verify that the zeros were written. The BEAR will then initialize the RAM modules writing the setup parameters to the first address space. The BEAR will now display a "READY" message and is ready to collect sonic boom data. The BEAR default parameters are set for normal unattended use for the majority of USAF supersonic operations. For this use the operator need only place the unit at the monitoring location, turn it on, set the "A" parameters for current date and time and set the "B" parameters for specific test number and site number for later identification (see section 2.3 Key Pad Operation for a complete description of these functions). This default mode will capture any sonic boom greater than 0.1 PSF (107 dB). If the boom is larger than 76.9 PSF, the BEAR will capture the event but the top of the N wave will be clipped. The BEAR will operate unattended for 1 day on the internal rechargeable small batteries and for 8 days on the 3 external rechargeable batteries. The batteries operating the removable RAM modules are good for approximately 7 years.

2.2 Boom Capture Operation

A normal sonic boom propagating under quiescent atmospheric conditions will produce a typical N-shaped pressure signature as shown in Figure 2. A clean N-wave like this will have a typical rise time of .5 to 5 milliseconds to reach the peak overpressure. Its positive pulse time will be about 1/2 of the total boom duration (typically longer than 50 milliseconds). As a clean boom propagates through atypical or non quiescent atmospheric weather conditions the peak of the N-wave will become ragged as in Figure 3. This can effectively cause the risetime (i.e. time to rise to the signatures peak) to be dramatically increased to the range of 5 to 30 milliseconds and cause a slight shortening of the positive pulse time. If the aircraft is accelerating, decelerating, climbing, diving or turning, the boom signature can become focussed causing an increase in the peaks to be superimposed on the N-wave as per Figure 4. In extreme cases this focusing effect can cause the N-wave to be distorted to a typical U-wave. This will cause a dramatic shortening of the positive pulse time. As a boom approaches the lateral cutoff point (the point on the ground where the atmospheric conditions have bent the boom

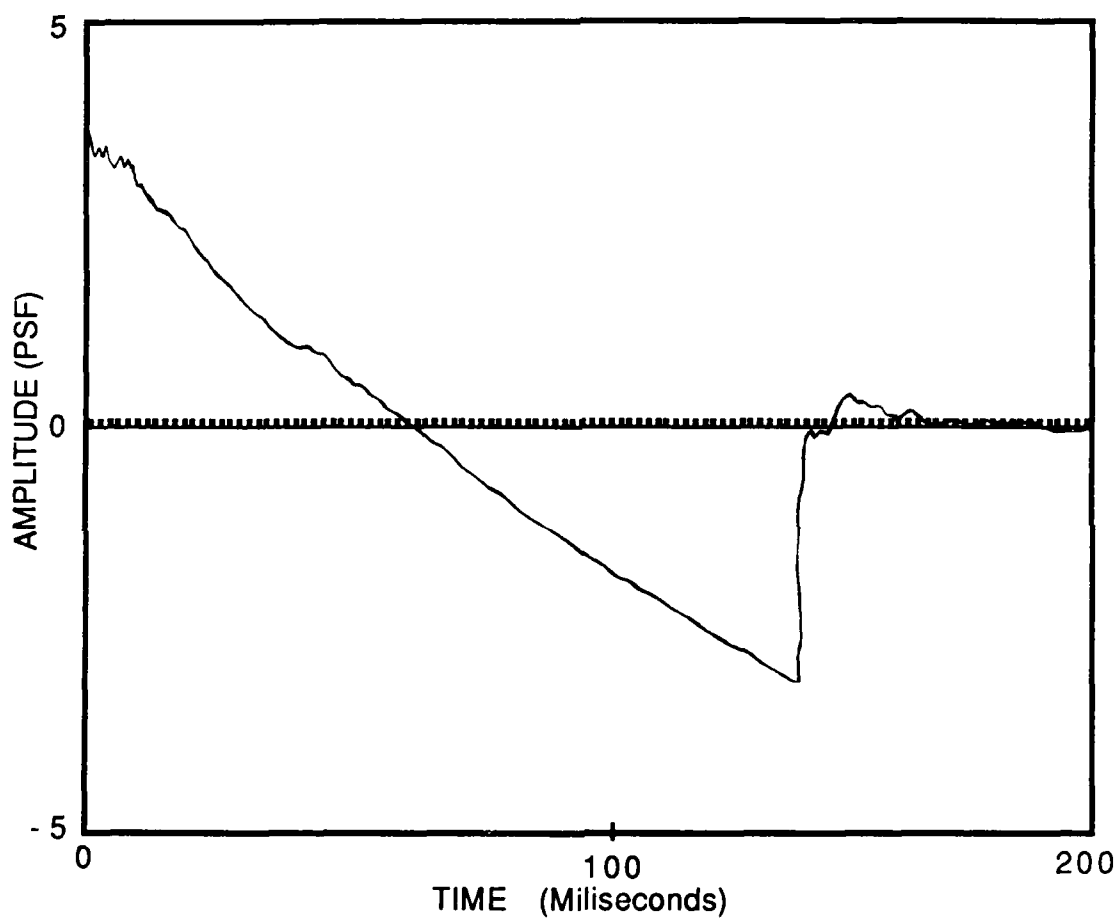


Figure 2. Clean N-Wave

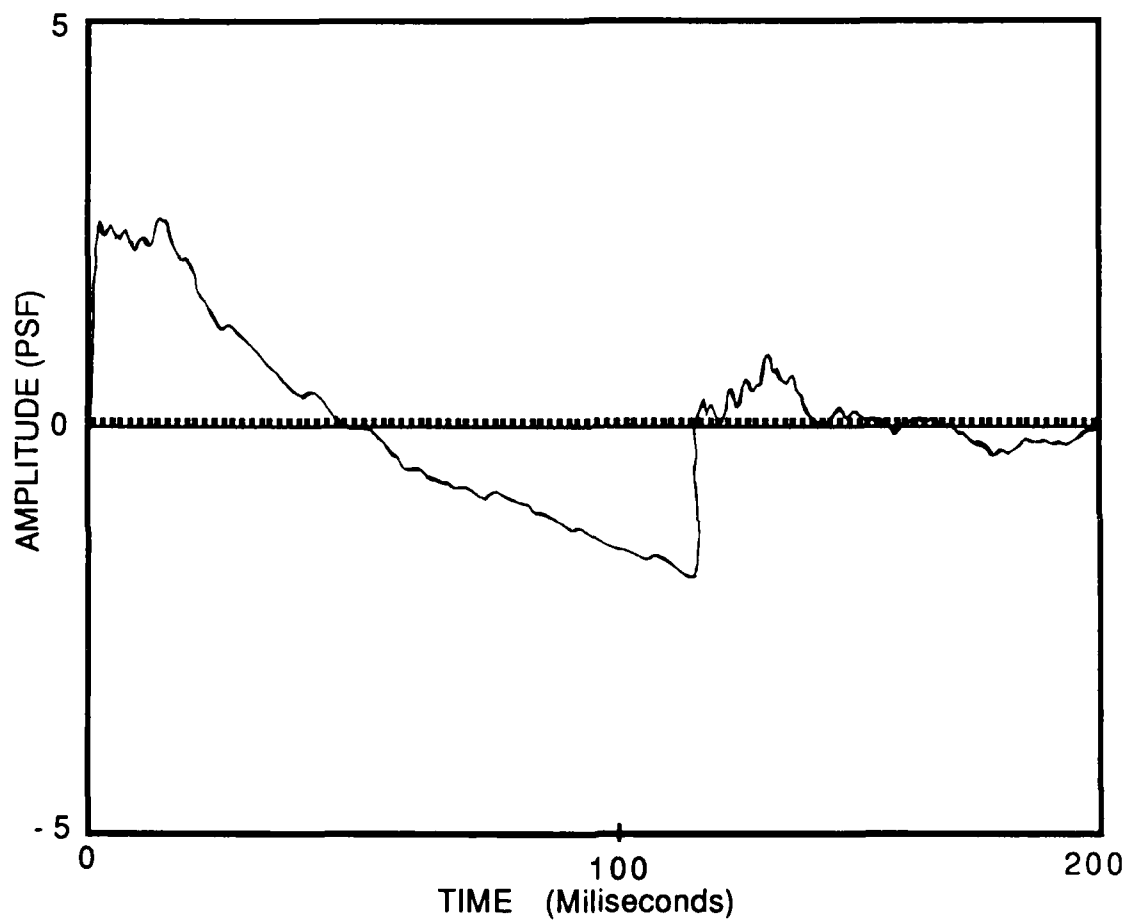


Figure 3. Ragged N-Wave

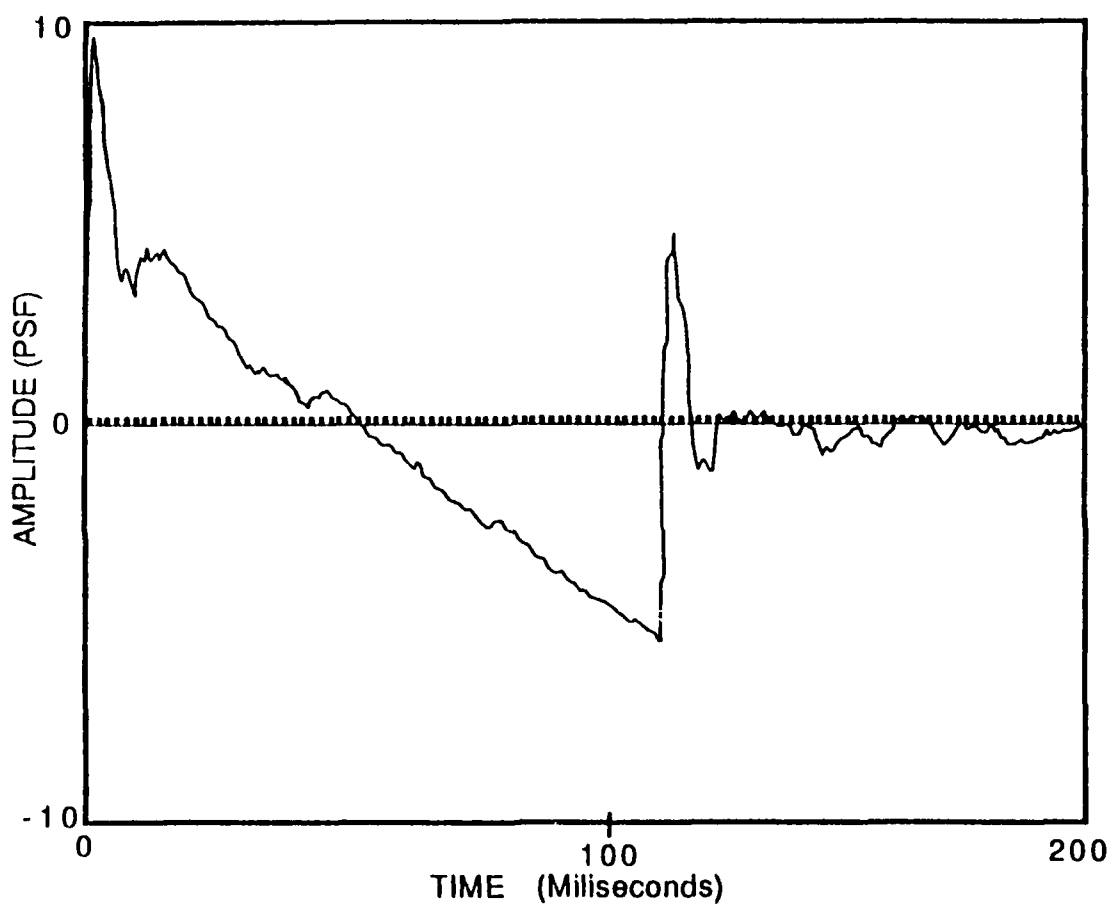


Figure 4. Focussed N-Wave

ray path upward), it is refracted up and away from the ground causing the boom to degenerate into non-impulsive subsonic noise. Figure 5 is a boom signature very close to the lateral cutoff point.

To accomodate this wide variety in sonic boom signatures the BEAR discerns boom events from other noisy events with an internal screening methodology as shown in Figure 6. The BEAR continuously monitors the noise environment, digitizing and examining the noise signature every 125 microseconds. When the noise level rises above the Trigger 2 Level the BEAR considers the signal a possible boom event and starts to write the digitized values to the RAM modules and starts the event timer. As the possible boom event is being stored, the BEAR flags the first local peak, the absolute peak, the absolute negative peak and the last downward threshold (point where signature goes below Trigger 2) crossing. Upon reaching a downward threshold crossing, the BEAR starts the cycle timer. Whenever the signal raises back above the threshold the cycle timer is stopped and reset again on the next down crossing. When either timer times out (reaches the end of its preset time value), the possible boom event is examined for the following three conditions:

1. To have a valid Peak the peak level must be above the Trigger 3 level.
2. To have a valid Positive Pulse the time from the peak to the peak time plus the positive pulse time must have all the data points greater than the Trigger 2 level and the time from the negative peak to the negative peak time minus one third the positive pulse time must have the absolute value of all the data points greater than the Trigger 2 level.
3. The rise time to the absolute peak must be steeper than the input rise time values or the rise time to the first local peak must be steeper than one third of the input rise time value. Specifically, the rise time from the absolute peak is calculated by comparing the data value at the time of (the absolute peak time minus the input risetime time value) to the peak value. This data value must be less than the peak value minus the input rise time dB value. For the first local peak, the value to be compared is found at (the time of the first local peak time minus one third of the input risetime time value). If either of these risetimes pass the test, then the possible boom event is considered to have a valid risetime.

If the event passes all three of these tests, it is considered a valid boom; the "Yes" counter is incremented by one and the date, time and parameter sets are stored with the event. If the event fails any of the three tests, it is not considered a valid boom; the "No" counter is incremented by one and the data are allowed to be overwritten by any new incoming data.

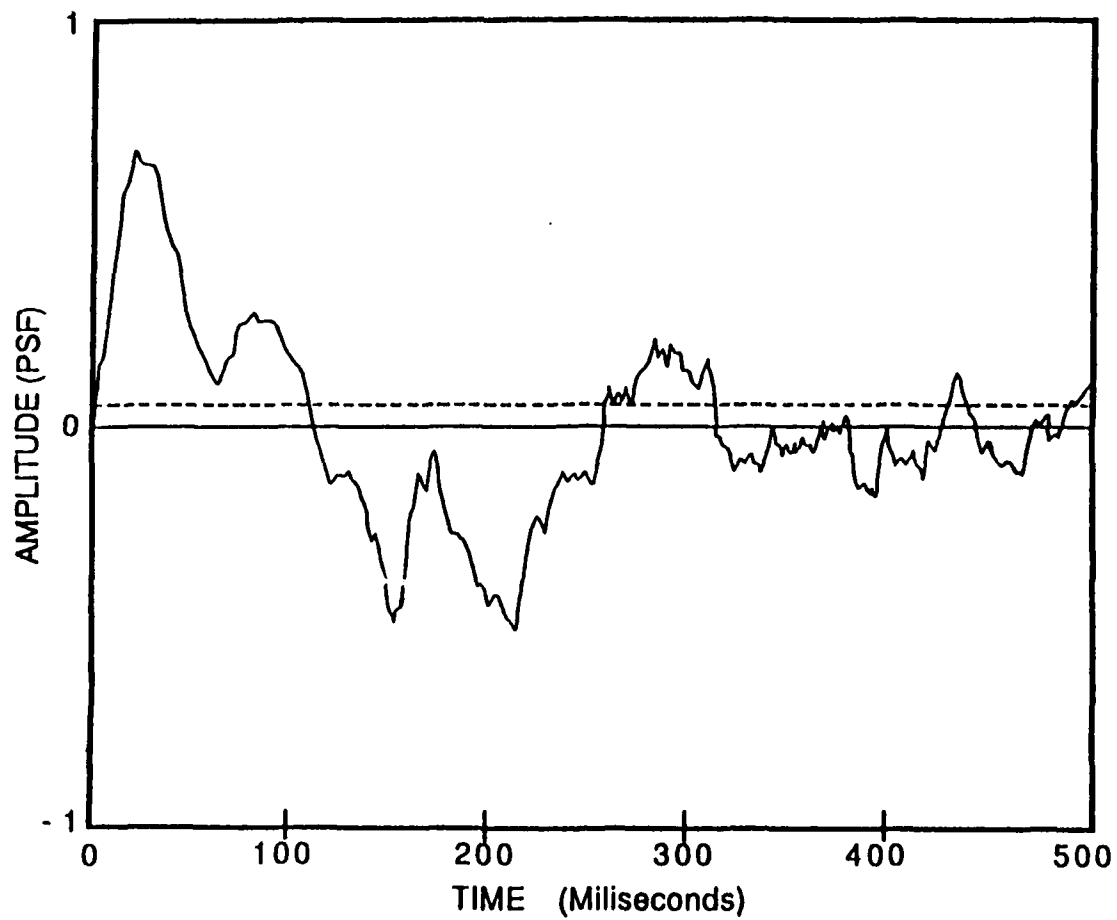


Figure 5. Boom Near Lateral Cutoff

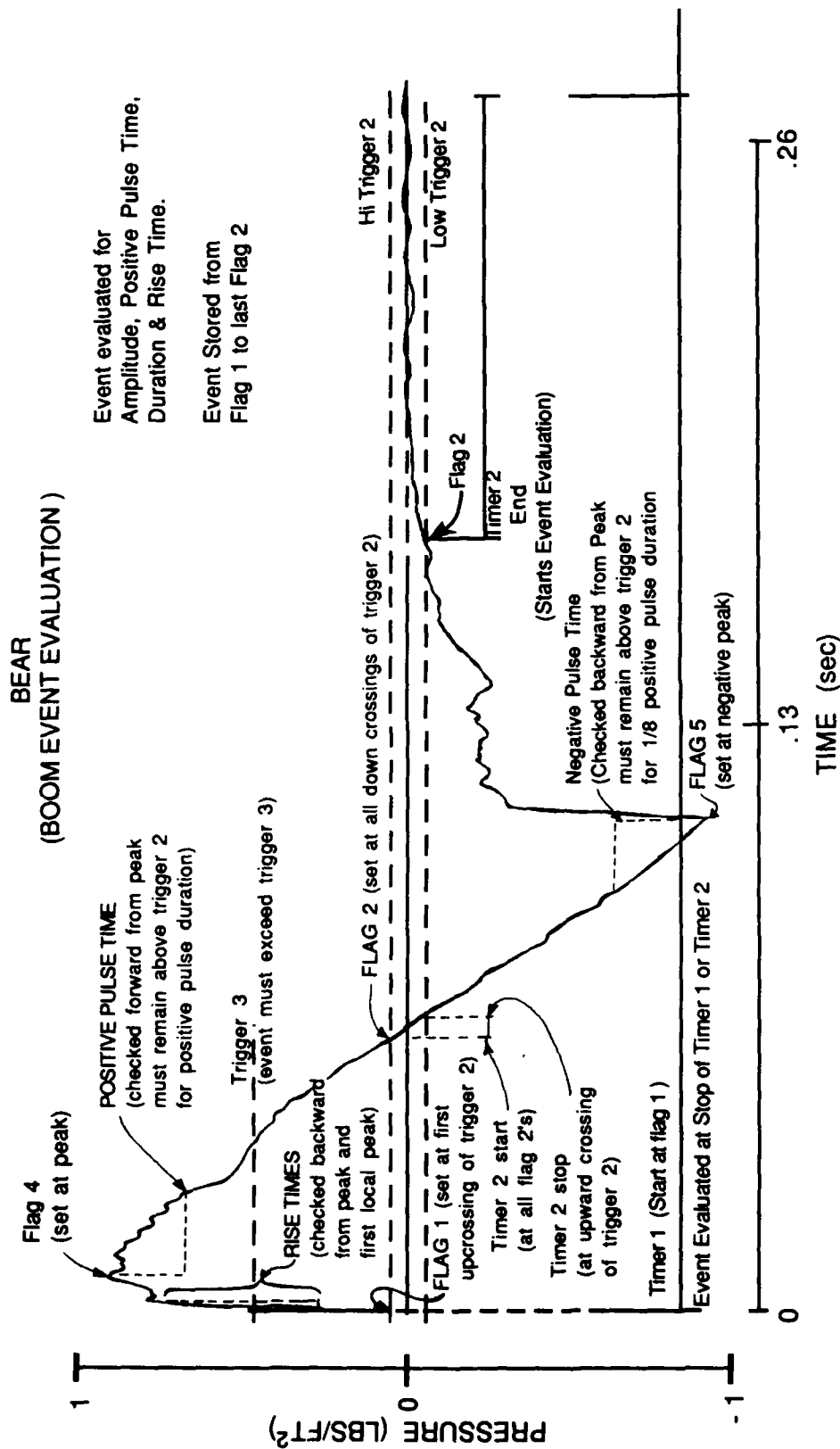


Figure 6. Boom Evaluation Criteria

2.3 Key Pad Operation

The Key Pad allows for the user to perform various functions on the BEAR. The user can set and read date, time, site number, test number, timers, trigger levels, and positive pulse time, read the system calibrator and capture background sample data. These functions are accomplished as follows:

READ TIME

PUSH "*" AND THEN
PUSH "A" AND DISPLAY SHOWS:
YYMMDD.HH.mm.SS
WHERE YY IS THE YEAR ; 00-99
MM IS THE MONTH ; 00-12
DD IS THE DAY ; 00-31
HH IS THE HOUR ; 00-23
mm IS THE MINUTES ; 00-59
SS IS THE SECONDS ; 00-59
THEN PUSH "*" (TURNS OFF DISPLAY)

SET TIME

PUSH "*" AND THEN
PUSH "A" AND THEN (DISPLAY CURRENT REAL TIME)
PUSH "ENT" (CLEARS CURRENT DISPLAY FOR ENTRY)
THEN ENTER REAL TIME IN THE FOLLOWING ORDER:
PUSH DIGIT FOR HIGH YEAR DIGIT; 0-9
PUSH DIGIT FOR LOW YEAR DIGIT; 0-9
PUSH DIGIT FOR HIGH MONTH DIGIT; 0-1
PUSH DIGIT FOR LOW MONTH DIGIT; 0-9
PUSH DIGIT FOR HIGH DAY DIGIT; 0-3
PUSH DIGIT FOR LOW DAY DIGIT; 0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH HOURS DIGIT; 0-2 (24 Hour clock)
PUSH DIGIT FOR LOW HOURS DIGIT; 0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH MINUTES DIGIT; 0-5
PUSH DIGIT FOR LOW MINUTES DIGIT; 0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH SECONDS; 0-5
PUSH DIGIT FOR LOW SECONDS; 0-9
THEN PUSH "ENT" IF DISPLAY INDICATES DESIRED REAL TIME
ENTRY
THEN PUSH "*" (TURNS OFF DISPLAY)

NOTE: IF AN ERROR IS MADE ANY TIME BEFORE THE LAST "ENT",
ENTRY,
PUSH "CLR," PUSH "A," PUSH "ENT," AND REENTER DIGITS.

READ STATUS/TIMER

PUSH "*" AND THEN
PUSH "B" AND DISPLAY SHOWS:
TT.SS.T1.T2.SNUM
WHERE
TT IS THE TEST NUMBER ; 00-99
SS IS THE SITE NUMBER ; 00-99
T1 IS THE EVENT TIMER (TIMER #1) ; 00-99 SECONDS
T2 IS THE CYCLE TIMER (TIMER #2) ; 0.0-9.9 SECONDS
SNUM IS THE BEAR SERIAL NUMBER ; 00-3999
THEN PUSH "*" (TURNS OFF DISPLAY)

SET STATUS/TIMER

PUSH "*" AND THEN
PUSH "B" AND THEN (DISPLAY CURRENT STAT/TIMER INFO)
PUSH "ENT" (CLEARS CURRENT DISPLAY FOR ENTRY)
PUSH DIGIT FOR HIGH TEST NUMBER DIGIT ; 0-9
PUSH DIGIT FOR LOW TEST NUMBER DIGIT ; 0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH SITE NUMBER DIGIT ; 0-9
PUSH DIGIT FOR LOW SITE NUMBER DIGIT ; 0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR TIMER #1 HIGH DIGIT (TENS OF SECONDS);
0-9
PUSH DIGIT FOR TIMER #1 LOW DIGIT (SECONDS); 0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR TIMER #2 HIGH DIGIT (SECONDS); 0-9
PUSH DIGIT FOR TIMER #2 LOW DIGIT (TENTHS OF SECONDS);
0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT 1 OF SERIAL NUMBER
PUSH DIGIT 2 OF SERIAL NUMBER
PUSH DIGIT 3 OF SERIAL NUMBER
PUSH DIGIT 4 OF SERIAL NUMBER
PUSH "ENT" IF DISPLAY INDICATES DESIRED STAT/TIMER DATA.
PUSH "*" (TURNS OFF DISPLAY)

NOTE: IF AN ERROR IS MADE ANY TIME BEFORE THE LAST "ENT"
ENTRY,
PUSH "CLR," PUSH "B," PUSH "ENT," AND REENTER DIGITS.

CALIBRATION MODE

PUSH "C"

SELECT "1" OR "2"

IF "1" IS SELECTED THE SYSTEM WILL THEN CONTINUOUSLY READ THE INPUT DATA, CONVERT IT TO ITS CORRESPONDING dB VALUE, AND DISPLAY IT. THIS WILL CONTINUE UNTIL THE DISPLAY IS TURNED OFF.

IF "2" IS SELECTED THE SYSTEM WILL THEN CONTINUOUSLY READ THE INPUT DATA AND DISPLAY THE HEX VALUE OF THE OUTPUT OF THE A/D CONVERTER. THIS VALUE IS UPDATED TO THE DISPLAY EVERY 1/2 SECOND.

PUSH "*" TO TURN OFF THE DISPLAY.

NOTE: THIS CALIBRATION MODE ONLY DISPLAYS ACCURATE RMS VALUES FOR AN INPUT RANGE OF 115 dB TO 135 dB SPL DUE TO ROUND OFF AND OVERFLOW IN THE 68000 MICROPROCESSOR.

READ BOOM PARAMETER VALUES

PUSH "*" AND THEN
PUSH "D" AND DISPLAY SHOWS:

TR3.TR2.PP.RV.RT

WHERE TR3 IS THE 3 DIGIT TRIGGER #3 VALUE ; 000-199
(MINIMUM PEAK IN dB)

TR2 IS THE 3 DIGIT TRIGGER #2 VALUE ; 000-199
(THRESHOLD IN dB)

PP IS THE 2 DIGIT POSITIVE PULSE VALUE ; 00-99
(IN MILLISECONDS)

RV IS THE 2 DIGIT RISETIME VALUE ; 00-99
(IN dB)

RT IS THE 2 DIGIT RISETIME ; 00-99
(COUNTED BACKWARDS FROM THE PEAK IN
MILLISECONDS)

THEN PUSH "*" (TURNS OFF DISPLAY)

SET BOOM PARAMETER VALUES

PUSH "*" AND THEN

PUSH "D" AND THEN (DISPLAY CURRENT VALUES)

PUSH "ENT" (CLEARS CURRENT DISPLAY FOR ENTRY)

PUSH DIGIT FOR HIGHEST DIGIT OF TRIGGER #3; 0-1

PUSH DIGIT FOR MIDDLE DIGIT OF TRIGGER #3; 0-9

PUSH DIGIT FOR LOWEST DIGIT OF TRIGGER #3; 0-9

PUSH "." (DECIMAL POINT)

PUSH DIGIT FOR HIGHEST DIGIT OF TRIGGER #2; 0-1

PUSH DIGIT FOR MIDDLE DIGIT OF TRIGGER #2; 0-9

PUSH DIGIT FOR LOWEST DIGIT OF TRIGGER #2; 0-9

PUSH "." (DECIMAL POINT)

PUSH DIGIT FOR HIGH DIGIT OF POSITIVE PULSE VALUE
(TENS OF MILLISECONDS); 0-9

PUSH DIGIT FOR LOW DIGIT OF POSITIVE PULSE VALUE
(MILLISECONDS); 0-9

PUSH "." (DECIMAL POINT)

PUSH DIGIT FOR HIGH DIGIT OF RISETIME dB VALUE; 0-9

PUSH DIGIT FOR LOW DIGIT OF RISETIME dB VALUE; 0-9

PUSH "." (DECIMAL POINT)

PUSH DIGIT FOR HIGH DIGIT OF RISETIME
(TENS OF MILLISECONDS); 0-9

PUSH DIGIT FOR LOW DIGIT OF RISETIME (MILLISECONDS); 0-9

THEN PUSH "ENT" IF DISPLAY INDICATES DESIRED SOFTWARE

ANALYSIS PARAMETER VALUES

THEN PUSH "*" (TURNS OFF DISPLAY)

NOTE: IF AN ERROR IS MADE ANY TIME BEFORE THE LAST "ENT"
ENTRY,

PUSH "CLR," PUSH "D," PUSH "ENT," AND REENTER DIGITS.

READ MEMORY REMAINING

PUSH "*" AND THEN

PUSH "E" THE SYSTEM WILL DISPLAY THE AMOUNT OF DATA
STORAGE MEMORY REMAINING ON THE CURRENT MODULE
PAIR.

SAVE DATA MODE

PUSH "*" AND THEN

PUSH "F" THE SYSTEM WILL SAVE THE NEXT 7661 DATA POINTS
FROM THE TIME OF PRESSING THE "F" KEY. THESE
DATA ARE SAVED JUST LIKE A NORMAL BOOM EVENT
BY STAMPING THE DATE, TIME, SITE NUMBER, TEST
NUMBER AND ALL THE PARAMETER SETS AT THE END
OF THE SAVED DATA FILE. WHEN THE SYSTEM IS
FINISHED SAVING DATA IT AUTOMATICALLY RETURNS
TO THE NORMAL DATA ACQUISITION MODE DISPLAYING
THE "XXX YES/NO XXX" COUNTER.

2.4 Parameter Ranges and Default Settings

ALLOWABLE PARAMETER SETTINGS

The following are the allowable ranges for input to the BEAR. Parameters set outside these ranges will cause the BEAR to not accept the input for that line of information. The correct information must then be reentered.

<u>KEY</u>	<u>READ</u>	<u>SET</u>		<u>RANGE ALLOWED</u>
B	X	X	TIMER #1	00-99
B	X	X	TIMER #2	00-99
B	X	X	TEST NUMBER	00-99
B	X	X	TEST SITE NUMBER	00-99
B	X	X	BEAR SERIAL NUMBER	00-3999
D	X	X	POSITIVE PULSE VALUE	00-99
D	X	X	TRIGGER #2	000-199
D	X	X	TRIGGER #3	000-199
D	X	X	RISETIME dB	00-99
D	X	X	RISETIME TIME	00-99

DEFAULT PARAMETER SETTINGS

The date and time must always be set using the A key function on power up of the BEAR. The boom capture parameters will be set upon successful power up to the following defaults that will allow capture of most normal sonic booms.

POSITIVE PULSE VALUE	.10 SECONDS
TRIGGER #2	100 dB
TRIGGER #3	107 dB
TIMER #1	2 SECONDS
TIMER #2	.2 SECONDS
RISETIME dB	6 dB
RISETIME TIME	.35 SECONDS
TEST NUMBER	00
SITE NUMBER	00
SERIAL NUMBER	0000

3. BEAR SOFTWARE DESCRIPTION

3.1 Overview

The Boom Event Analyzer Recorder (BEAR) is a software controlled instrument that digitizes acoustic signals and analyzes them using programmable parameters to determine if the signal was a sonic boom. The data of an event are retained in the removable battery RAM modules that can be later processed for further analyses. The software was written in 68000 assembler language and is detailed in the Software block diagram (Figure 7.). The devices that are being controlled are:

- o 16 bit A/D being sampled at 8 Khz.
- o Keypad for parameter entry.
- o Alphanumeric display for parameter display and error messages.
- o Real-time clock for time and date information.
- o Two programmable timers for defining event windows.

3.2 Startup

As described in the software block diagram, the system first performs diagnostics when the power is applied. Checks are made on the EPROMs, static RAM, and battery RAM modules. An error message is displayed if the test fails. The next function performed is the initialization of the display, timers, and the real-time clock. The timers and real-time clock are initialized with the default parameters. The initial parameter list is also stored in the battery RAM. Finally, the interrupts are enabled and the software goes into a wait loop for either an A/D interrupt, keypad interrupt, or a timer interrupt. When a A/D interrupt is detected, the digitized data are read and compared to the threshold value. If below the threshold, the data are processed by the running average table routine which averages the background noise over a 2 second period. If the data are above the threshold, a new event is triggered and data recording begins. At the beginning of the event, timers 1 and 2 are activated to determine the end of the event.

When a keypad interrupt is detected, "KEYPAD" reads and parses the key entered. The first key that must be entered is the display on/off key (*). While the display is on, the A/D interrupt routine (DAC) does not process A/D data. The next key that must be entered is a function key. The allowable functions are:

- o Set Real-Time Clock
- o Set Status and Timers
- o Enter Calibration Mode
- o Set Boom Identification Parameters
- o Read Memory Remaining
- o Enter Data Capture Mode

BEAR SOFTWARE BLOCK DIAGRAM

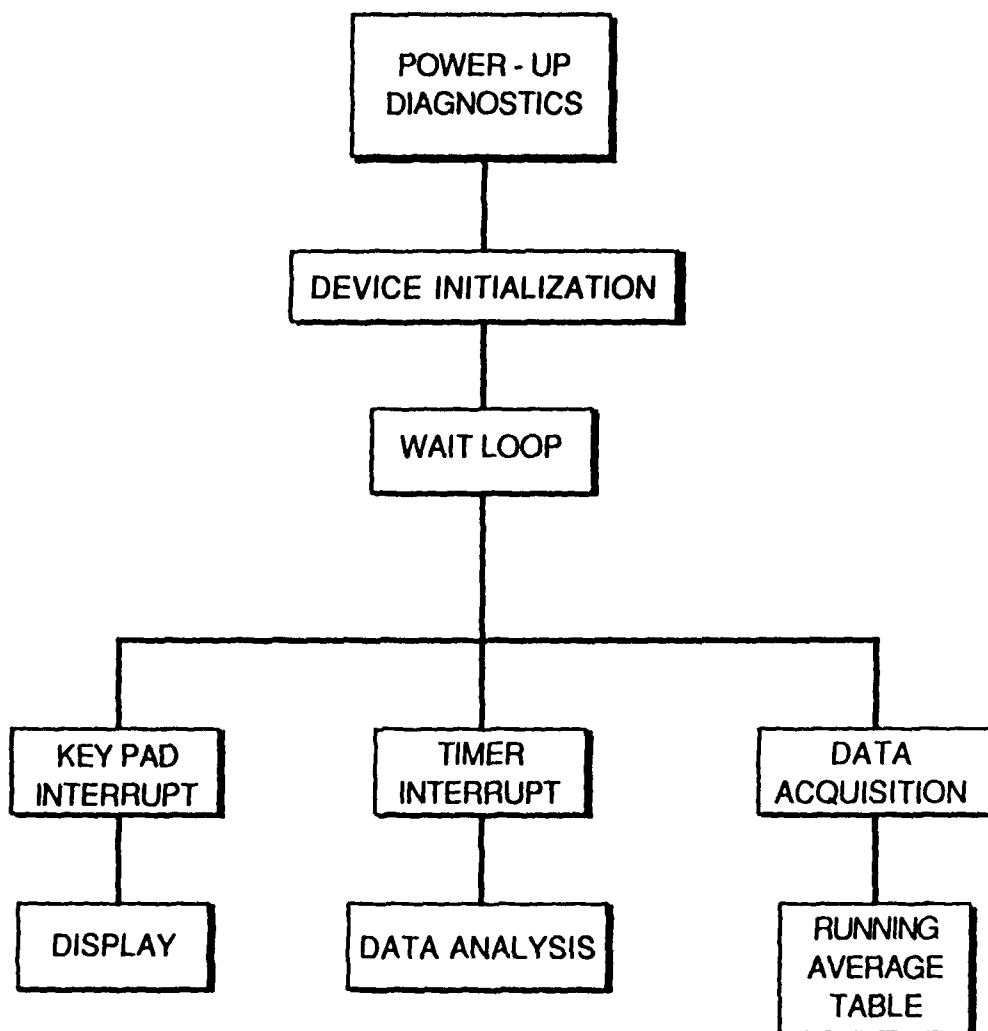


Figure 7. BEAR Software Block Diagram

Once the function key is entered, the current values for that function are displayed. If new parameter values are to be entered, the "ENT" key must be pressed followed by the values. All parameter changes are recorded in battery RAM for analysis purposes. If parameter changes are not required, the on/off key (*) may be pressed; the display is turned off; and the event data continues to be processed. If any invalid keypad entry is detected, "KEYPAD" will display an error message.

When a timer interrupt is detected, it indicates the end of an event. The event is analyzed to determine if it was a valid sonic boom or not. Either timer 1 or 2 will cause the interrupt to occur; if timer 1 was the cause, the event will be checked to determine if the peak was within 100 ms of the end. If it was timer 1 will be extended by 100 ms. If not the event will be evaluated to determine if it is a sonic boom. The other tests performed in validating the data are: the peak signal must be high enough, and the slope of the peak must be fast enough. If the event is determined to be a valid sonic boom, the data are retained and the current time and date along with the running average value are recorded at the end of the data file. The "YES" event message counter is also incremented. If the event was invalid, the data file pointer is reset to the beginning of the file, and the next event will record over the data. The "NO" event message counter is also incremented. Events will continue to be recorded until the battery RAM is filled at which time the "BAT RAM FULL" message is displayed and event processing is halted. If any errors are detected by the system during power-up diagnostics or parameter entry, appropriate error messages are displayed. All error recovery procedures are explained in section 3.6.

3.3 System Initialization

The BEAR software program has two methods of initializing the system. If the system was powered on with new battery RAM modules installed, the EPROMs are checked, the battery RAMs are checked and zeroed, the status RAM is checked, and the I/O devices are initialized. If the BEAR system is powered on with valid data existing in the battery RAM modules; the battery RAM diagnostic is bypassed and the system is initialized with the parameter values that existed when the BEAR was powered off. Data storage then begins after the barker code (this is a hexadecimal code of 90 EB 90 EB 90 EB used to separate data entries) of the last valid data block in the battery RAM (see Section 3.5 for examples of how the data is stored).

The first device that is checked is the EPROM. The program sums each location in EPROM and compares the check-sum result with the predetermined value. Next, (only

if the RAM modules are without valid data) each byte of static RAM is written with the values AAH, 55H, and zero to verify its integrity. Finally, each byte of battery RAM is written with the values AAH, 55H, and zero. During the battery RAM test, two things are achieved: integrity check of the RAM and zeroing of the RAM. If any errors occur during the diagnostic, an error message is displayed. Once the diagnostics are passed, the program transfers the system constants from either the EPROM or battery RAM (depending on the type of initialization with or without valid boom data already on the RAMs) to static RAM for use by the other routines in the system.

The next device to be initialized is the Peripheral Interface Adaptor (PIA) chip. This allows I/O transfer between the CPU and the display, keyboard, real-time clock, and the timers. This also determines the circumstances for generating an interrupt. Once the PIA is initialized, the real-time clock, timers, and display are initialized. Finally, the interrupts are enabled and the system waits for any interrupt to occur. The possible interrupts and their vectors are:

- o Vector 2, DAC, A/D Interrupt
- o Vector 5, KEYPD, Key pad Interrupt
- o Vector 6, TIMER, Timer Interrupt

See Figures 8-10 for System Initialization Flow Chart.

System Initialization

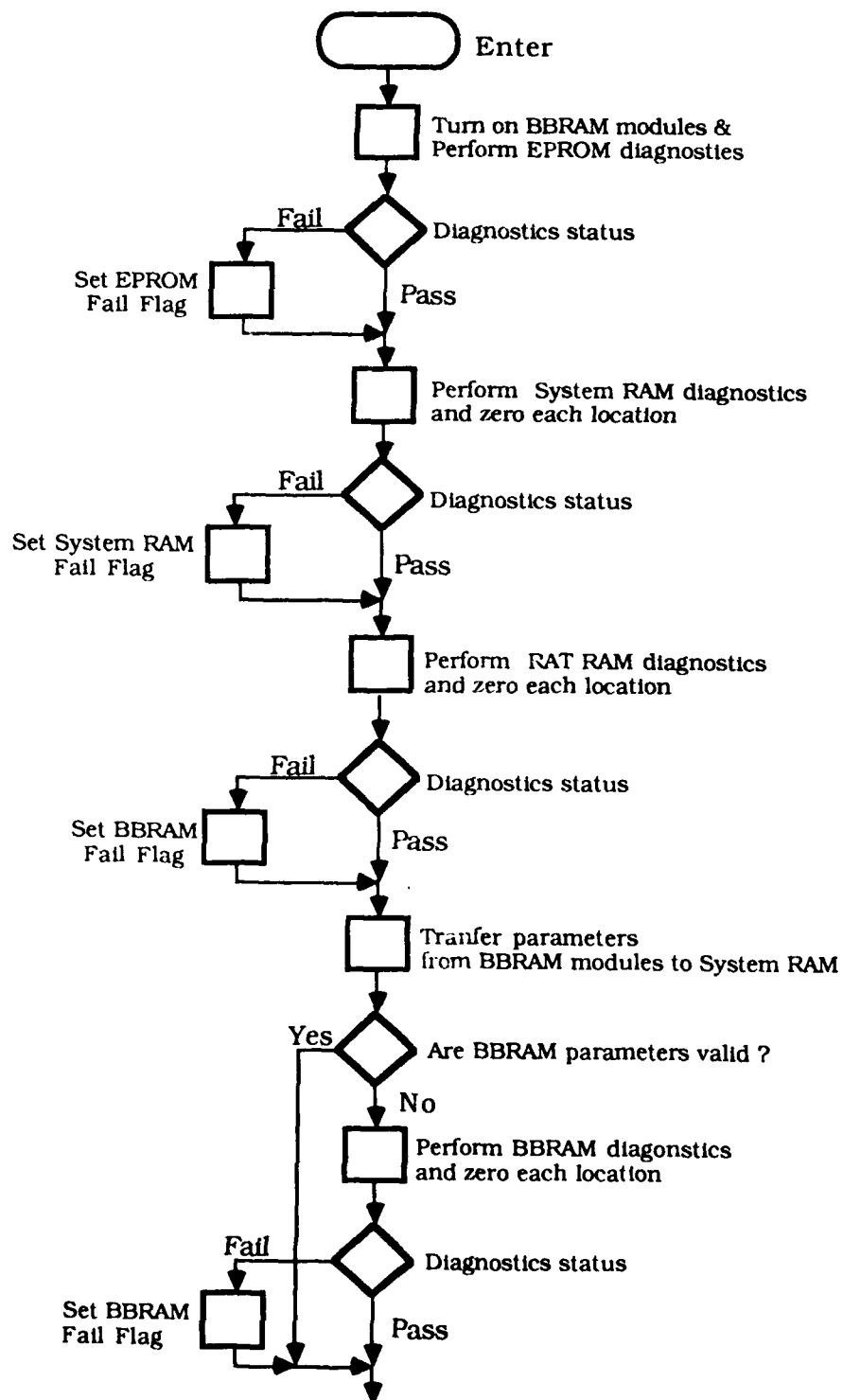


Figure 8. BEAR System Initialization Flow Chart

System Initialization

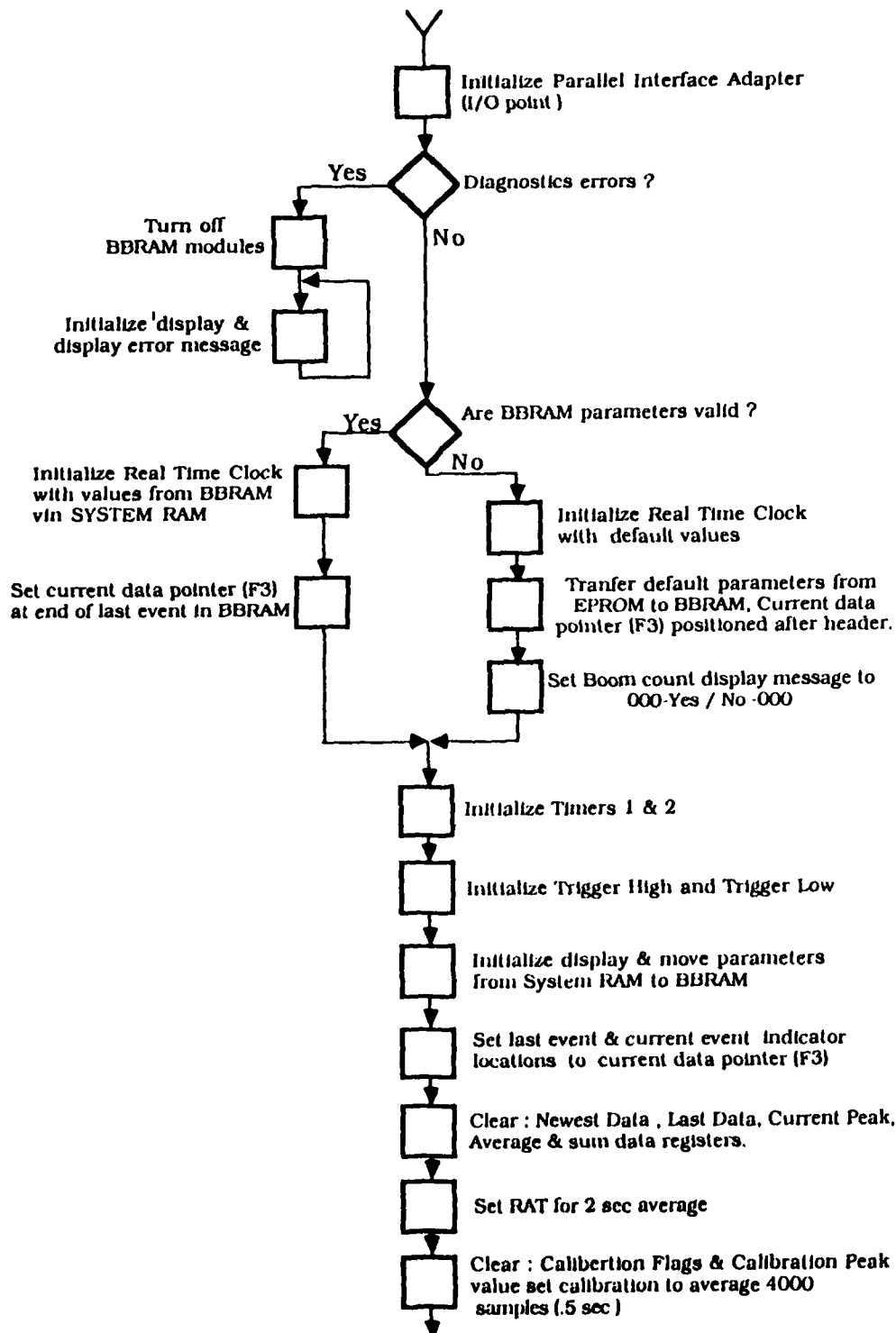


Figure 9. BEAR System Initialization Flow Chart (continued)

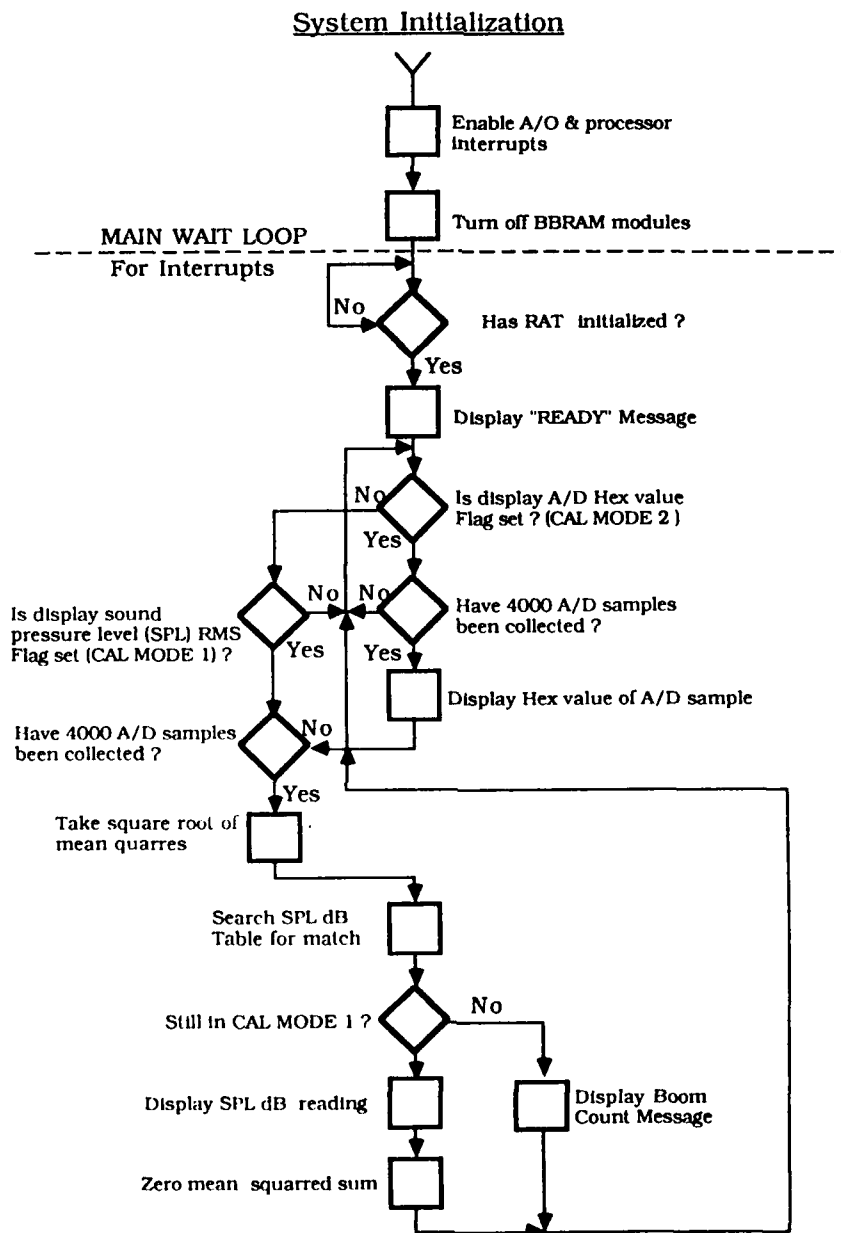


Figure 10. BEAR System Initialization Flow Chart (continued)

3.4 Run Routines

A/D INTERRUPT ROUTINE (DAC)

The data acquisition (DAC) routine reads the A/D data on an interrupt. These interrupts occur every 125 microseconds so this routine must process the data quickly. The purpose of DAC is to determine if an event is occurring. If DAC determines an event is not occurring, the data are processed by running average table (RAT) which maintains a running average. If an event is occurring, DAC compares the data with the predetermined parameters, (TRIGGER 2, or TRIGGER 3) to know when to activate the timers. DAC also keeps track of the peak values, positive and negative, during the event. This is performed by the timer interrupt routine (TIMER). All data read during an event are stored in battery RAM in count format.

See Figures 11-13 for A/D Interrupt Flow Chart.

(DAC)
A/D Interrupt Service Routine

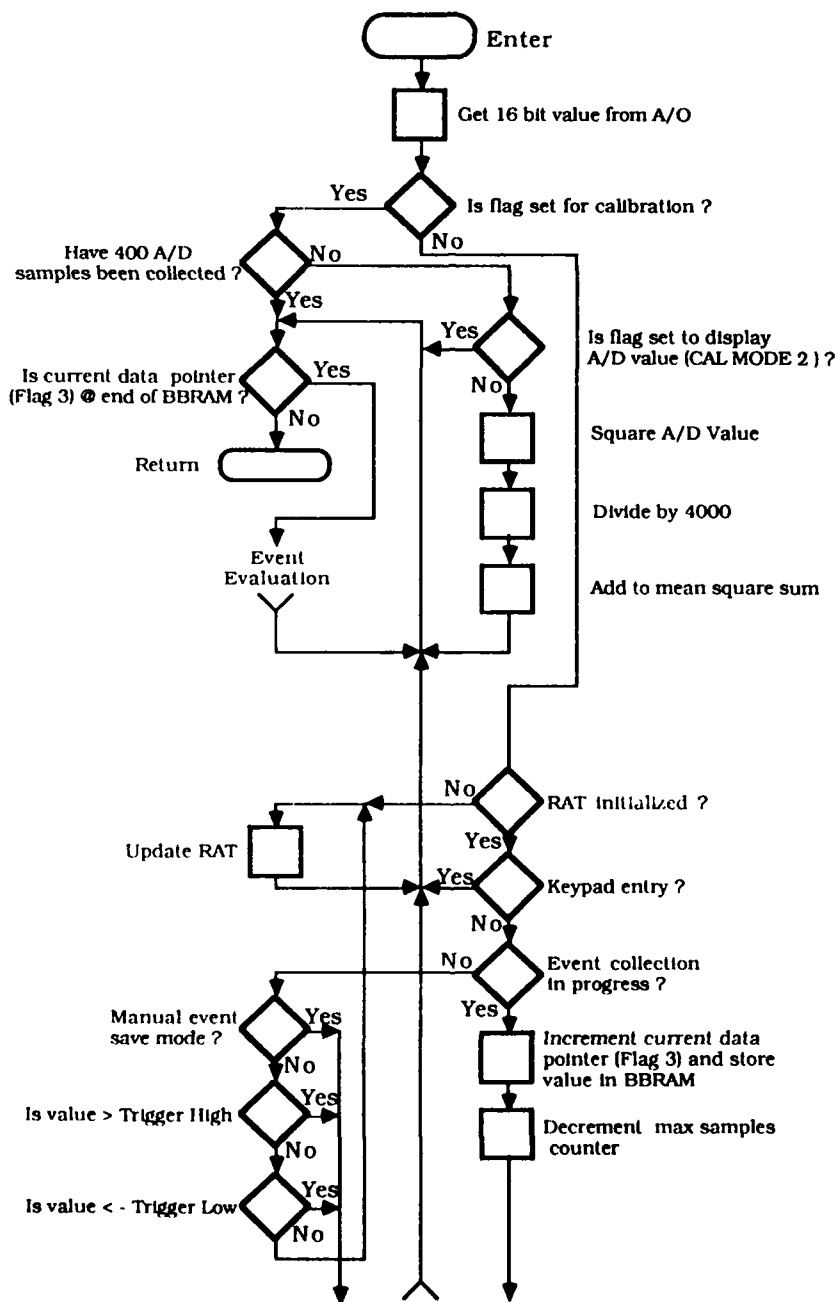


Figure 11. A/D Interrupt Routine Flow Chart

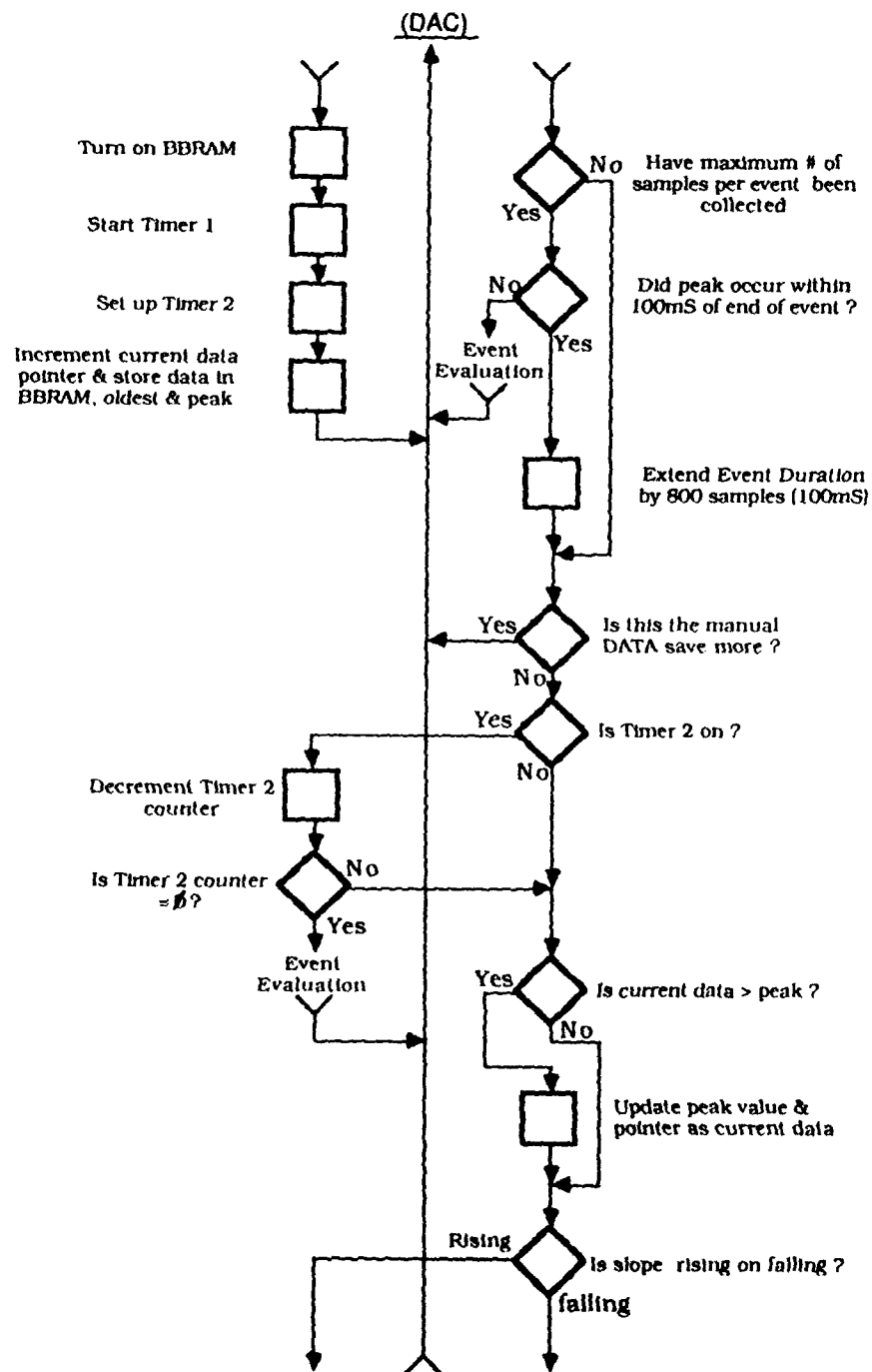


Figure 12. A/D Interrupt Routine Flow Chart (continued)

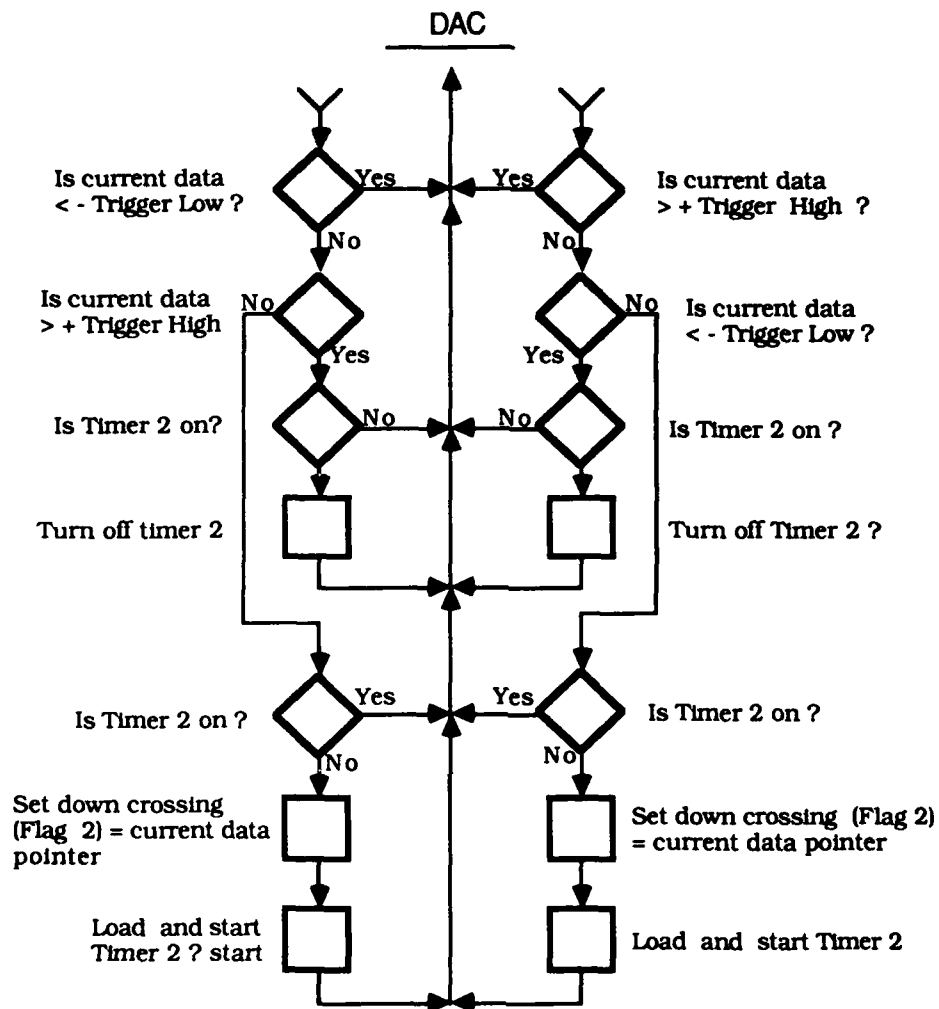


Figure 13. A/D Interrupt Routine Flow Chart (continued)

RUNNING AVERAGE TABLE (RAT)

During the power-up diagnostics, the battery RAM modules are checked and each location is set to zero. Since there can be a variable number of modules implemented, the end of RAM is determined and that address is saved in ENDRAT. The beginning of the average table is calculated by using the address ENDRAT-16,384. This sets the Running Average Table for 2 seconds. The address of the beginning of the table is maintained in register A5 and the latest table pointer in A6. The running average is maintained in register D3 with the moving sum in D4. The average is stored with each valid boom event to determine any prior offset or microphone drift.

See Figure 14 for Running Average Table Flow Chart.

RAT
RUNNING AVERAGE TABLE

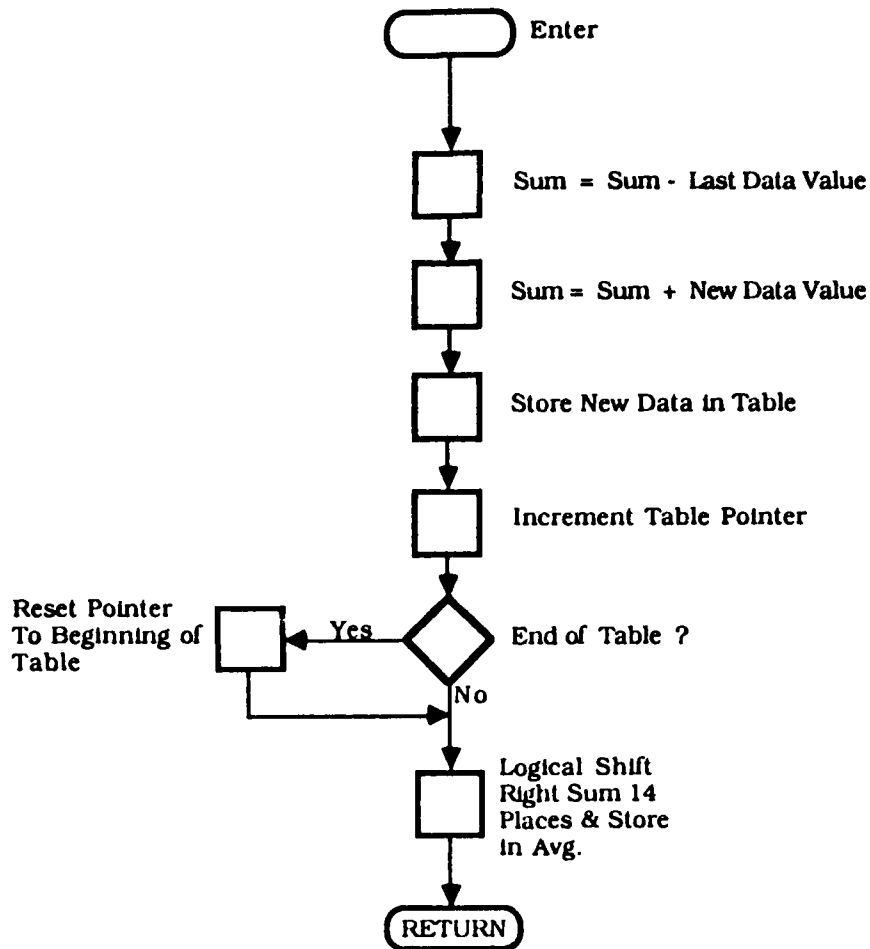


Figure 14. Running Average Table Flow Chart

TIMER INTERRUPT ROUTINE (TIMER)

The TIMER routine services the timer interrupt which is used to trigger an end of an event. There are two timers which can generate an interrupt: Timer 1 which is started at the beginning of an event and Timer 2 which is started at a down crossing point (see Figure 6). Once the interrupt occurs, TIMER analyzes the data to determine if the event was a sonic boom. There are several parameters that are checked to validate the event. They are:

- o Sufficient Peak Value
- o Data Maintained a Positive an Negative Pulse times after the Peaks.
- o Peak Slope Was Fast Enough

If the event was valid, the time, date, and average is stored after the data followed by three barker codes. If the event was invalid, TIMER resets the data pointers to the beginning of the event and the next event is recorded over the top of the invalid event. Finally, the event counter is incremented and the updated "YES/NO" message is displayed. Before exiting the timer routine, the system parameters and data pointer are saved in battery RAM.

See Figure 15 for Timer Interrupt Flow Chart.

See Figures 16-21 for Event Evaluation Flow Charts.

TIMER INTERRUPT

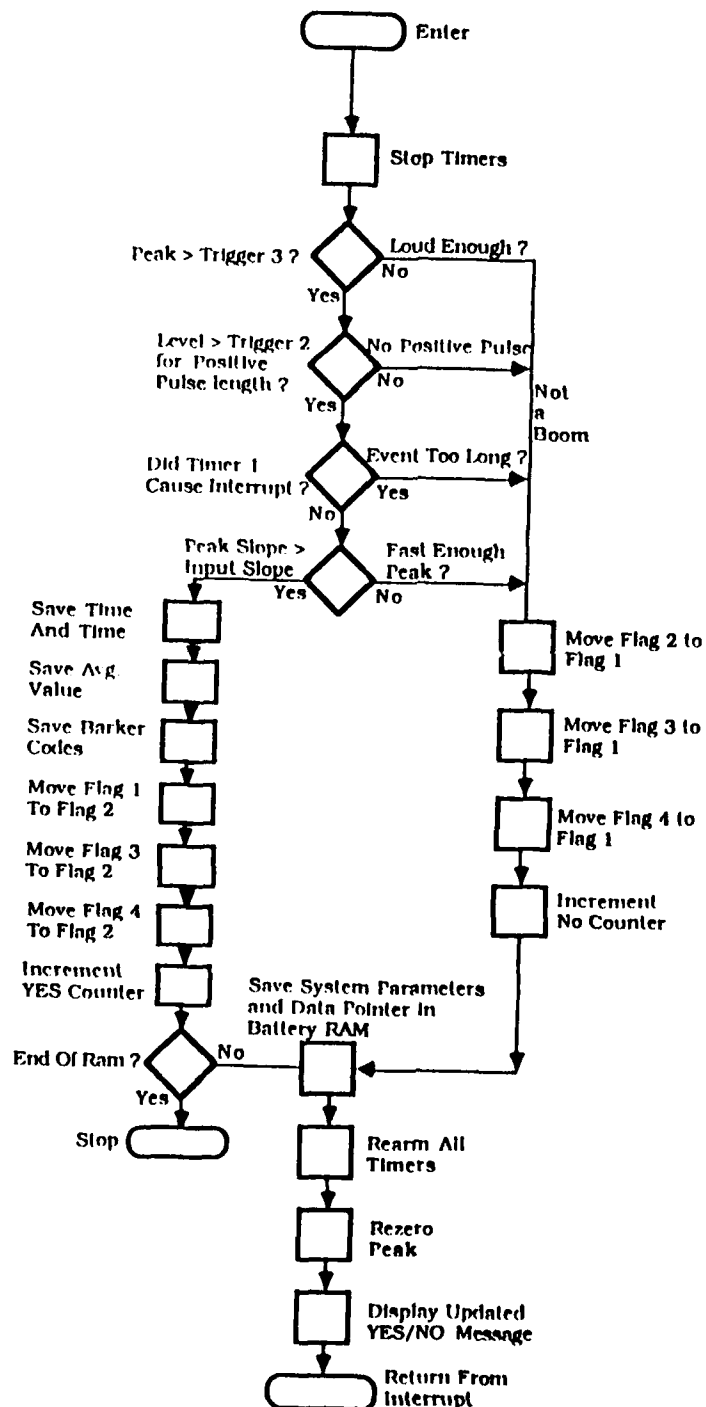


Figure 15. A/D Interrupt Routine Flow Chart

EVENT EVALUATION

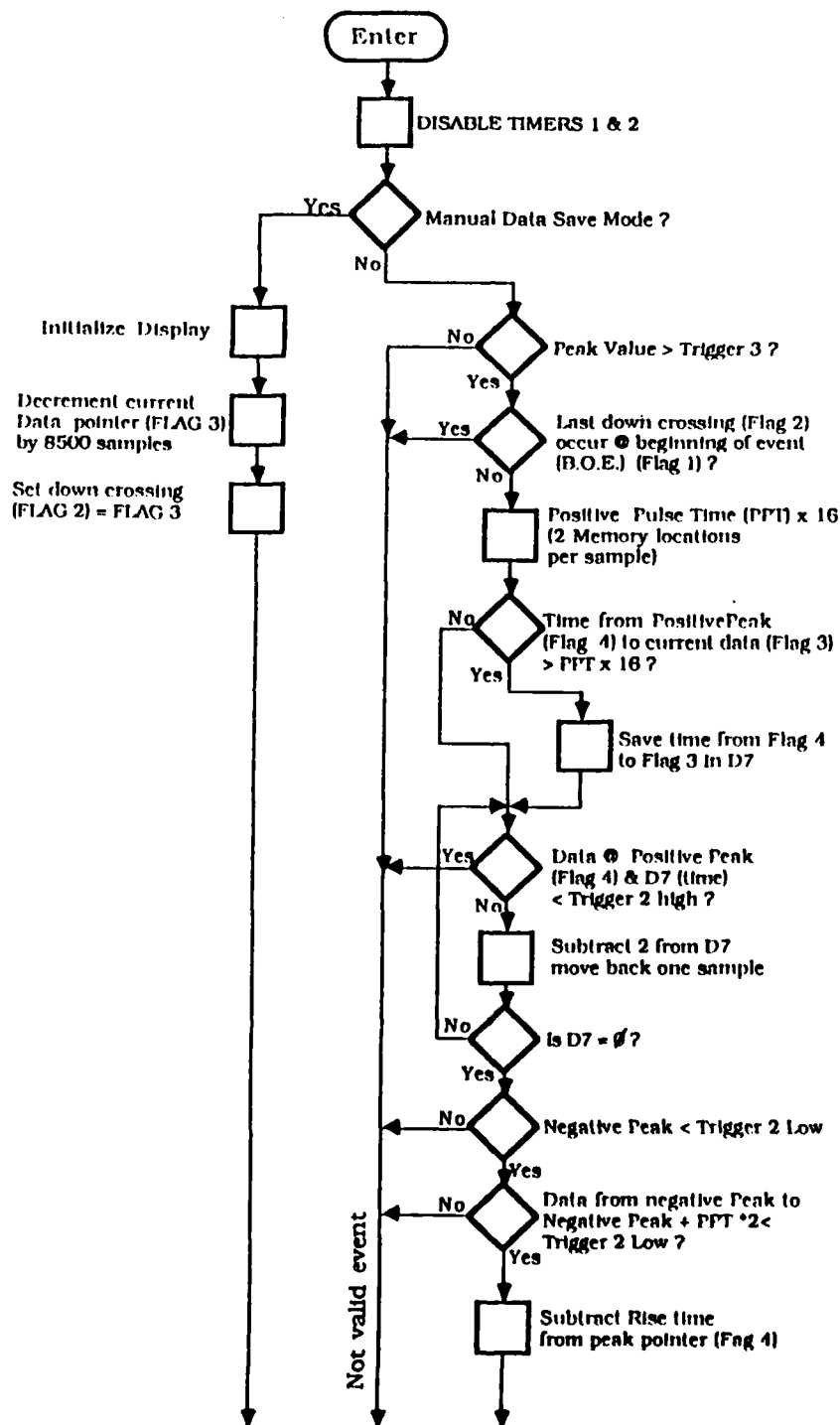


Figure 16. Event Evaluation Flow Chart

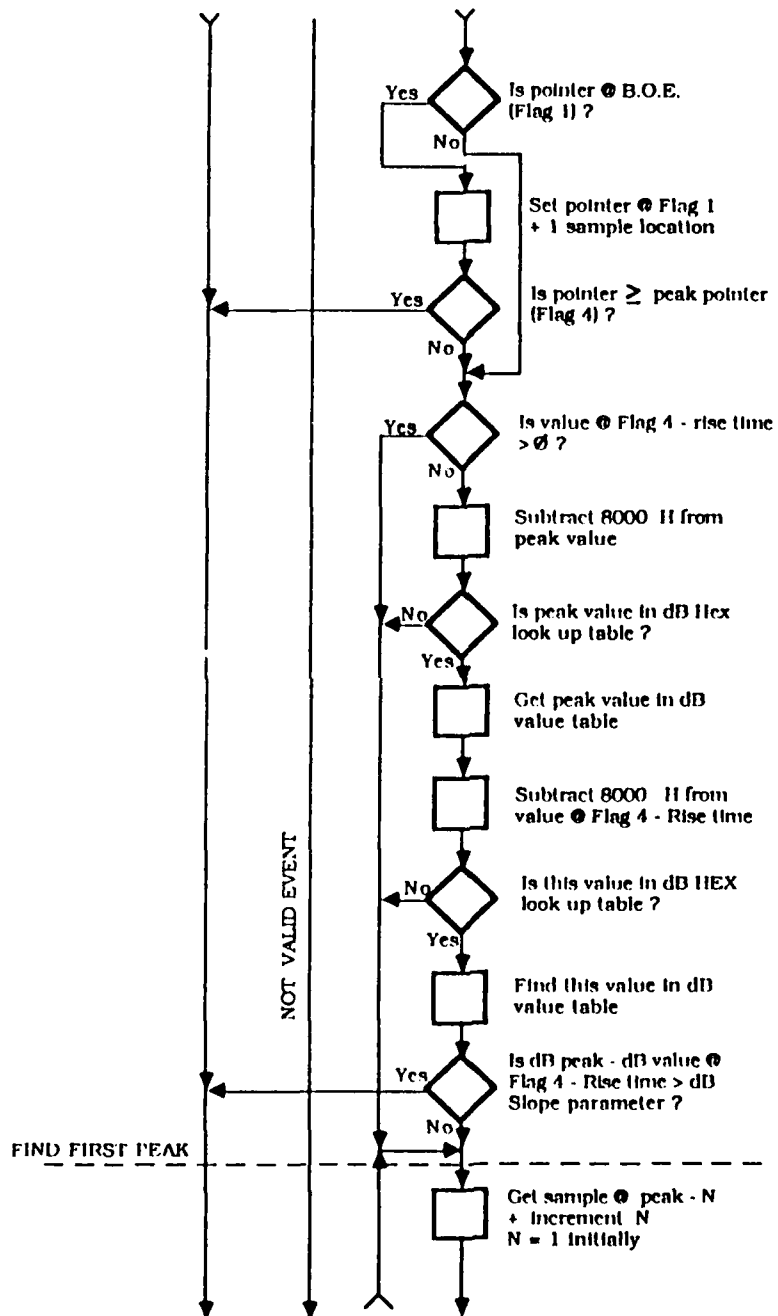


Figure 17. Event Evaluation Flow Chart (continued)

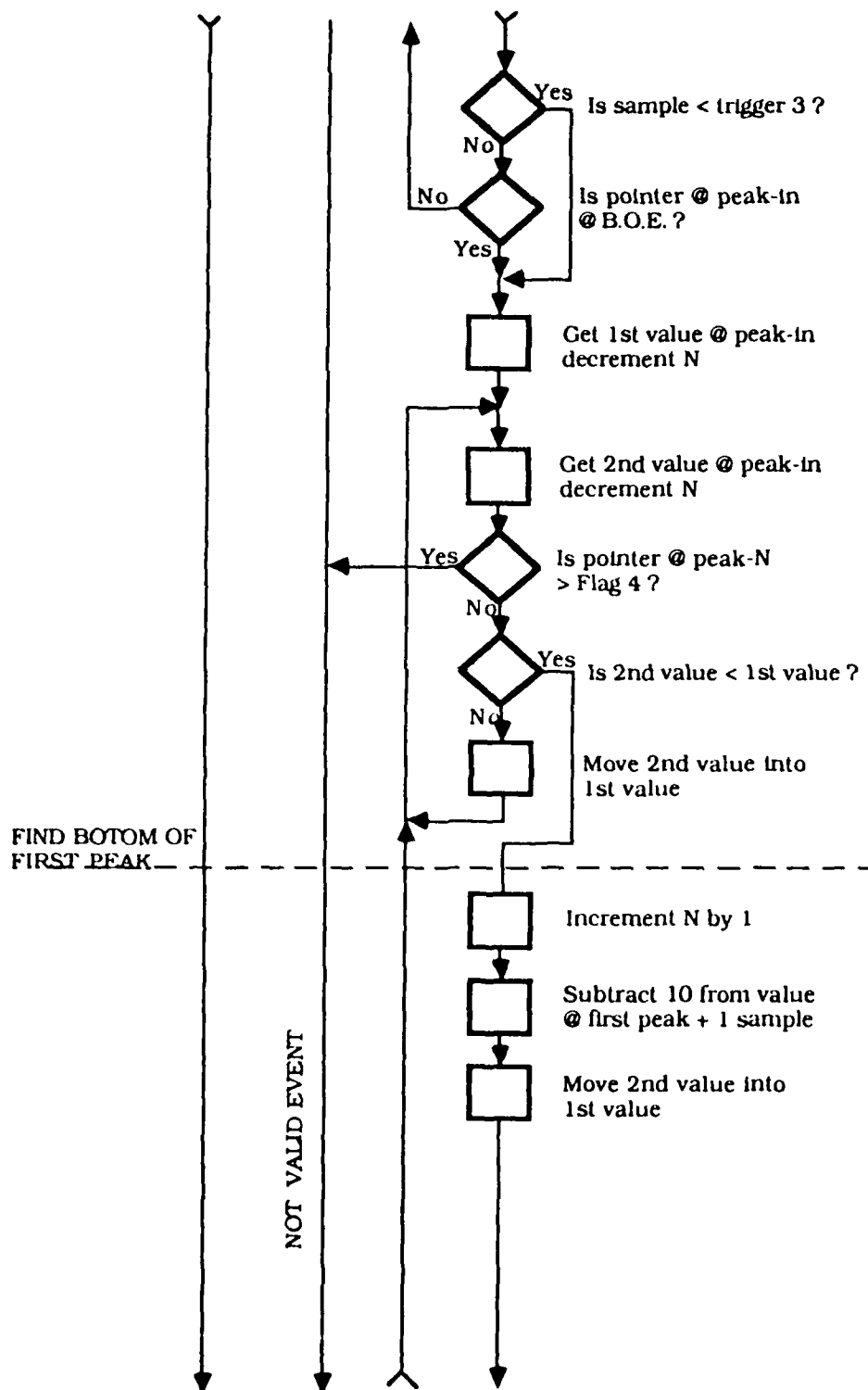


Figure 18. Event Evaluation Flow Chart (continued)

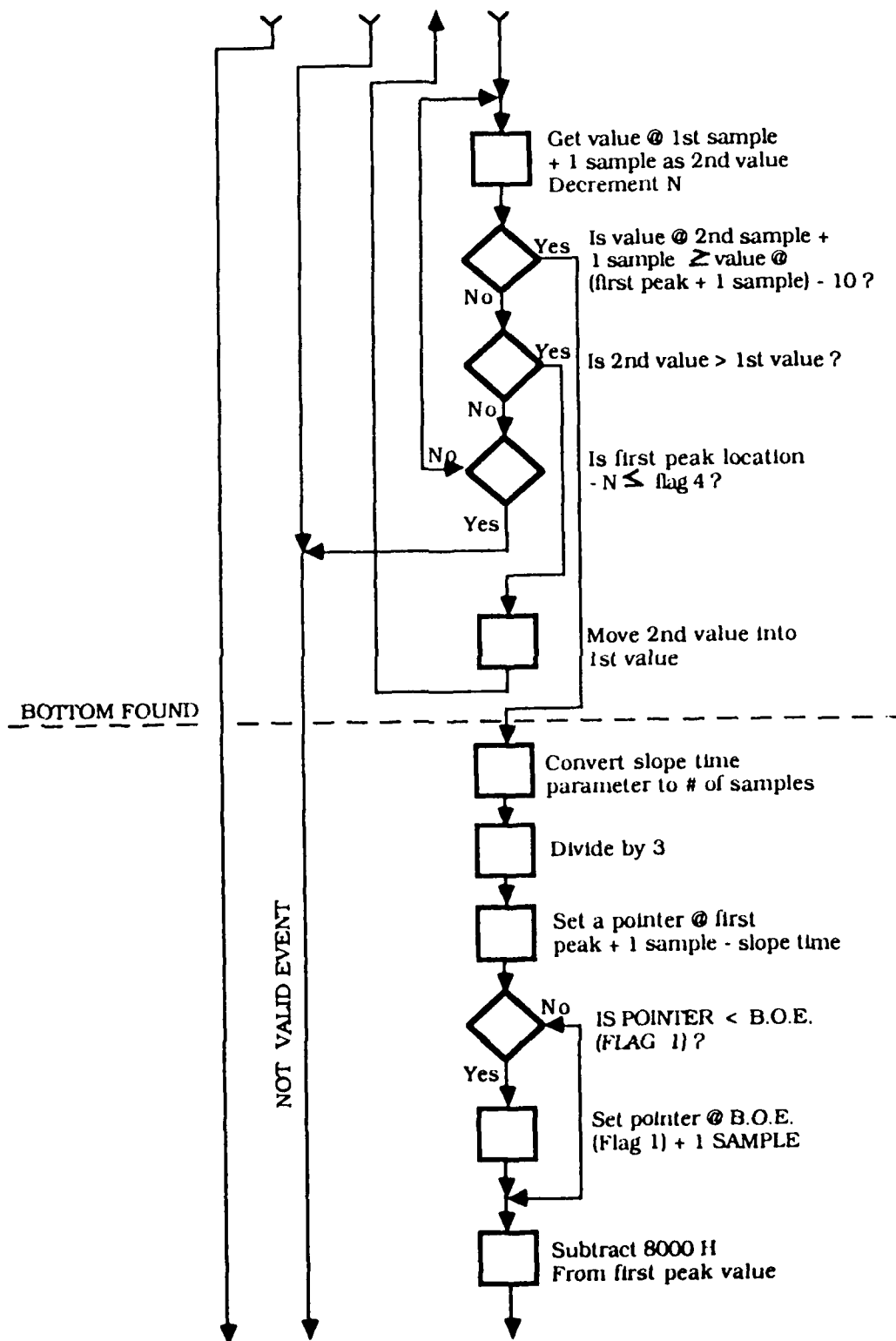


Figure 19. Event Evaluation Flow Chart (continued)

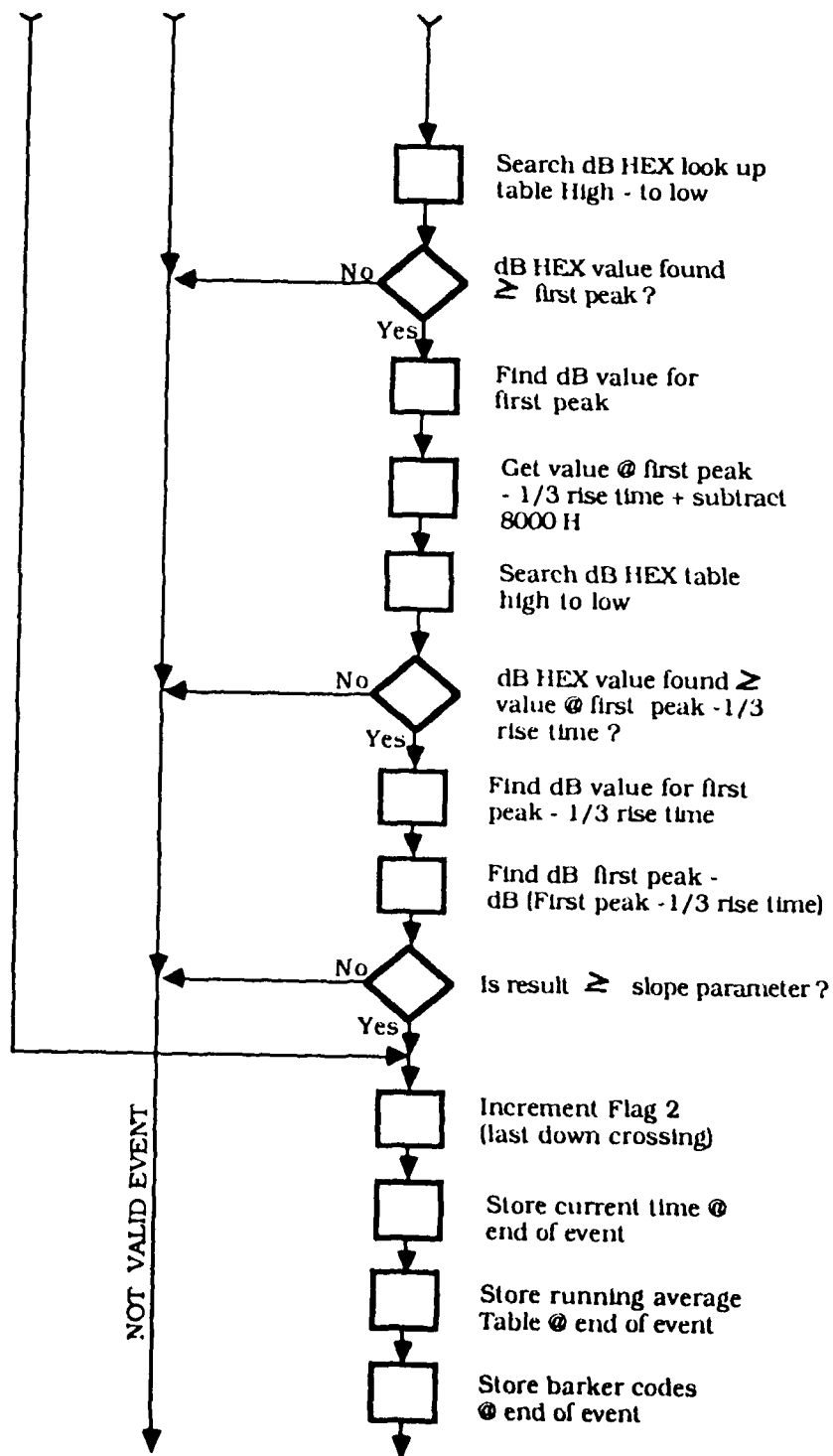


Figure 20. Event Evaluation Flow Chart (continued)

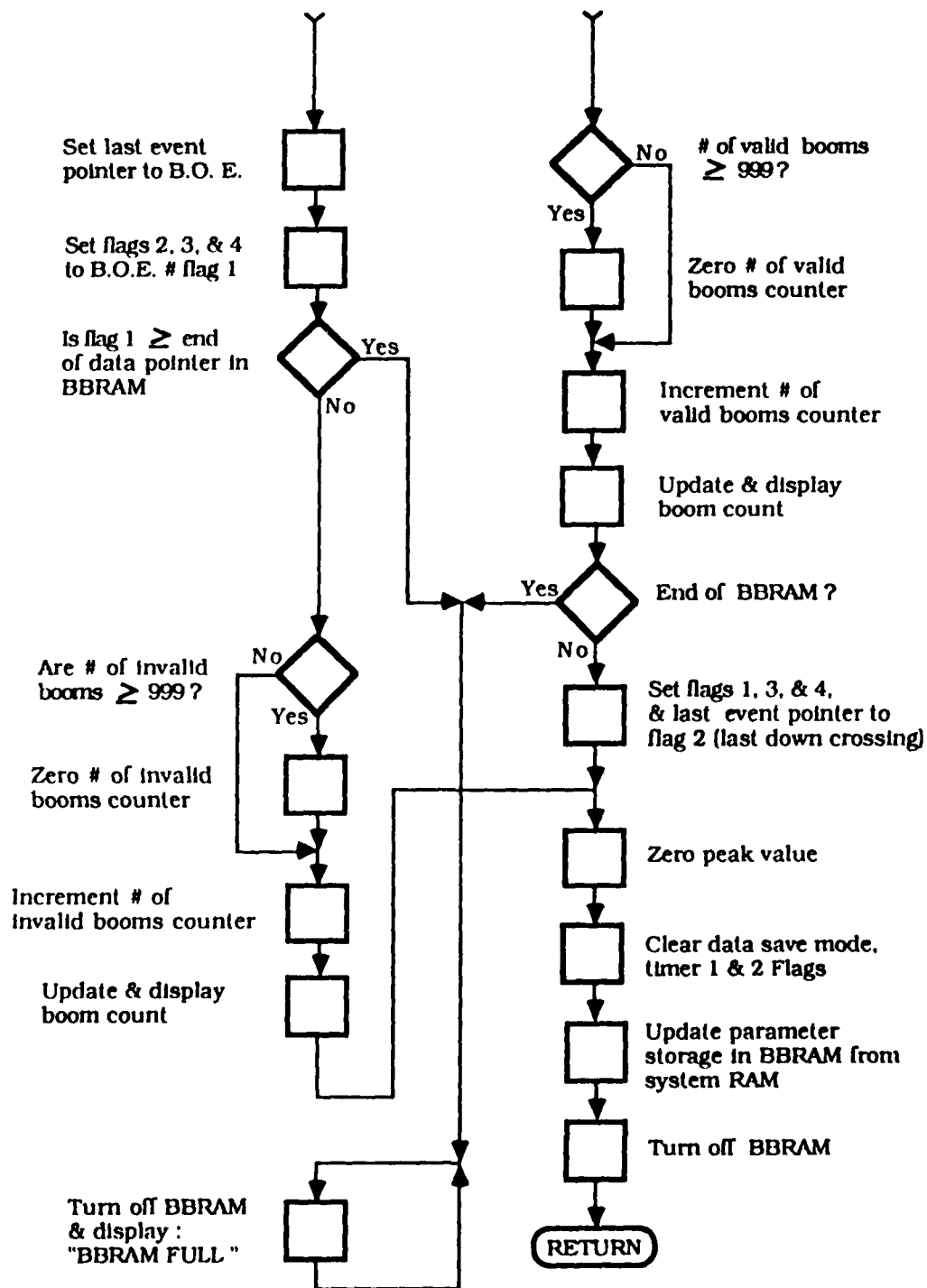


Figure 21. Event Evaluation Flow Chart (continued)

KEY PAD INTERRUPT ROUTINE (KEYPAD)

The KEY PAD routine services the interrupt generated by a key pad entry. It interprets the key by calling GETKEY and processes the function that is requested. The functions available on the BEAR are:

<u>Function Code</u>	<u>Description</u>
A	Set time and date.
B	Set ID and timer values (Test No., Site No., Serial No., Timer 1, and Timer 2).
C	Set calibration.
D	Set soft values: (Trigger 3, Trigger 2, Positive Pulse Time, risetime dB, and risetime).
E	Display Memory Remaining
F	Save Data

Once the function code is entered, KEY PAD determines if the values entered are valid. If an incorrect value is entered, an error message is displayed. The KEY PAD routine outputs the entered data to the display to provide operator feedback. Once the last entry is made, the system parameters are updated with the new values and a change message is formulated and stored in battery RAM as well as a copy of all the systems parameters. Once the display is turned on by entering "*", data acquisition is bypassed to prevent data analysis being performed with invalid parameters.

See Figure 22 for Keypad Interrupt Flow Chart.

See Figure 23 for GETKEY Flow Chart.

See Figure 24 for A Function routine Flow Chart.

See Figure 25 for B Function routine Flow Chart.

See Figure 26 for C Function routine Flow Chart.

See Figure 27 for D Function routine Flow Chart.

KEYPAD INTERRUPT ROUTINE

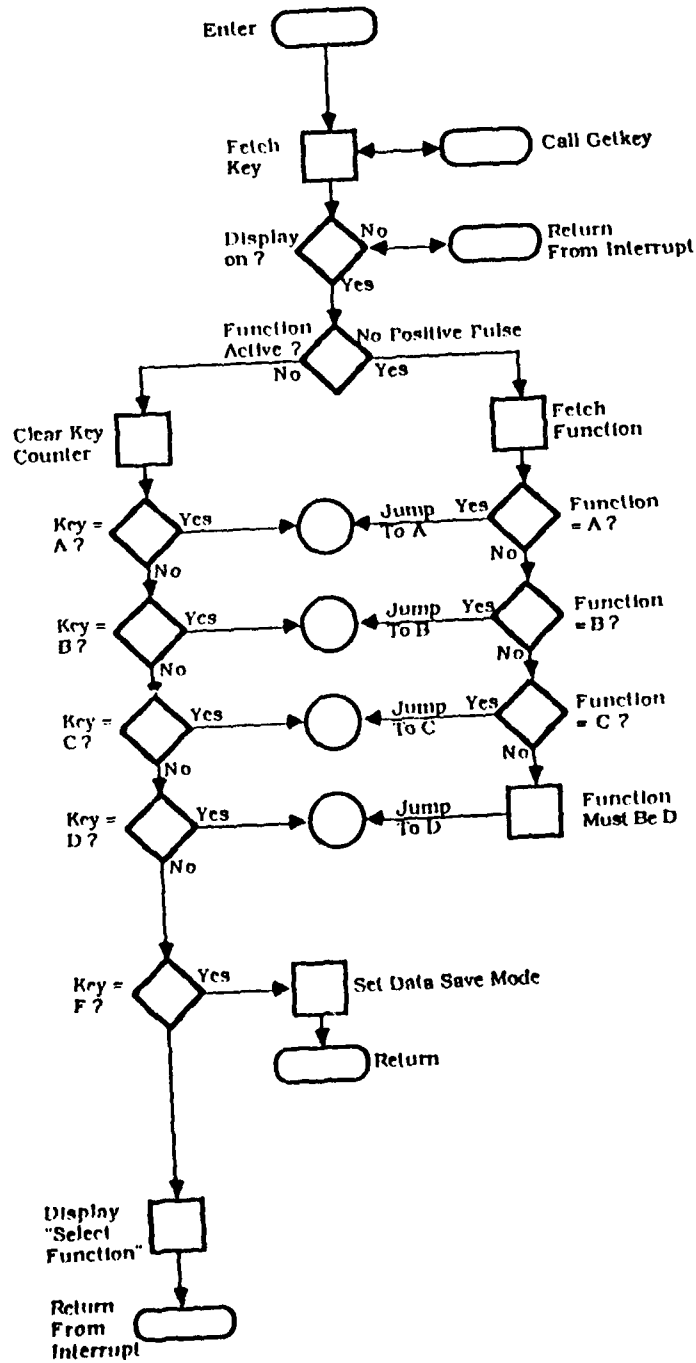


Figure 22 KEYPAD Interrupt Flow Chart

GETKEY - PARSE KEYPAD INPUT

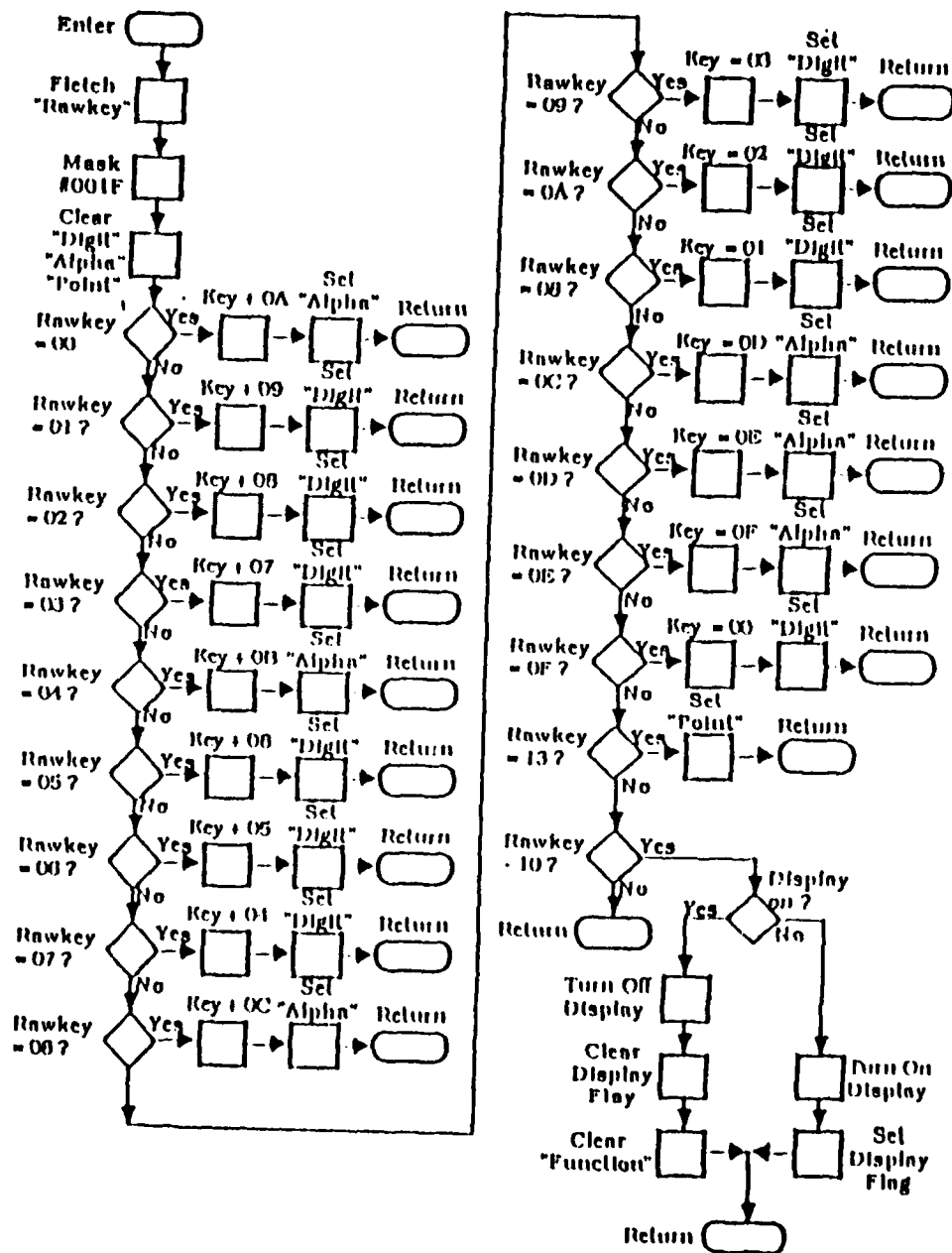


Figure 23. GETKEY Flow Chart

"A" FUNCTION ROUTINE

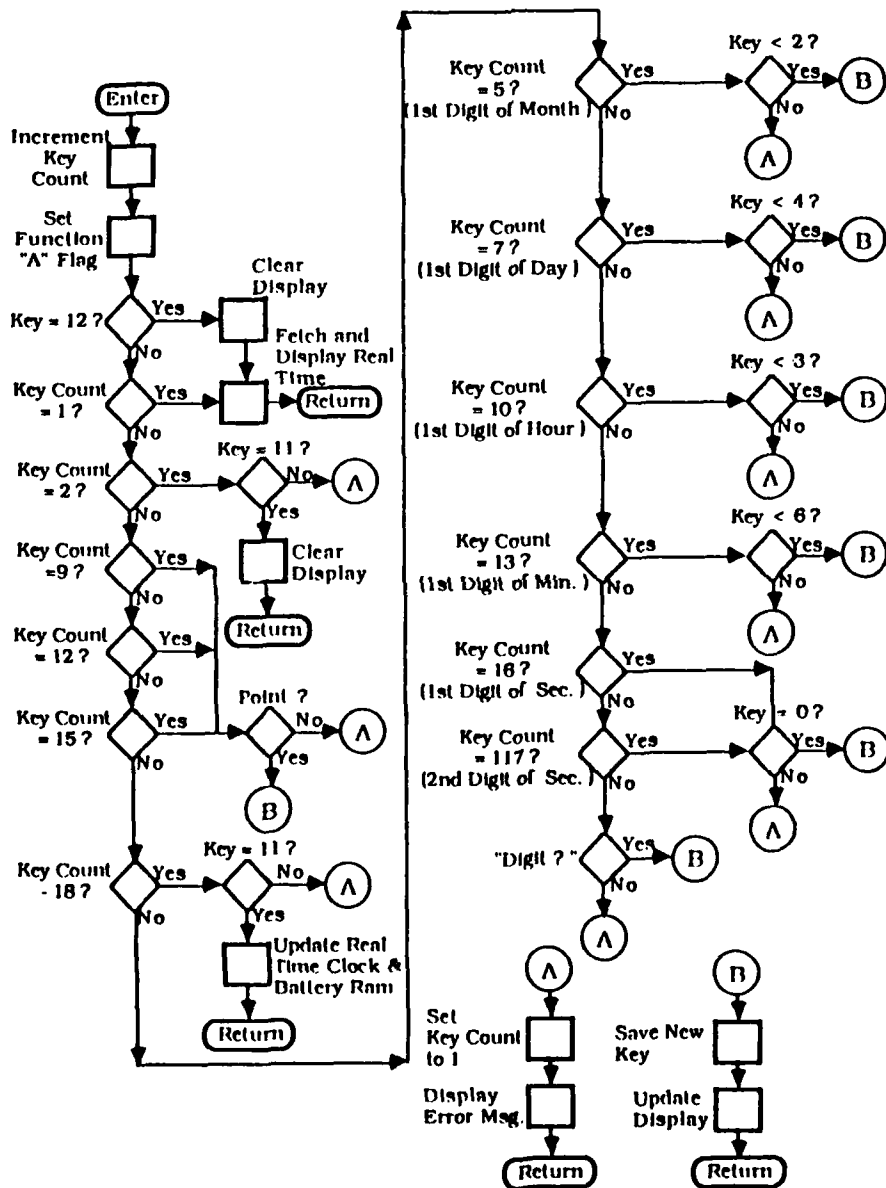


Figure 24. A Function Routine Flow Chart

"B" FUNCTION ROUTINE

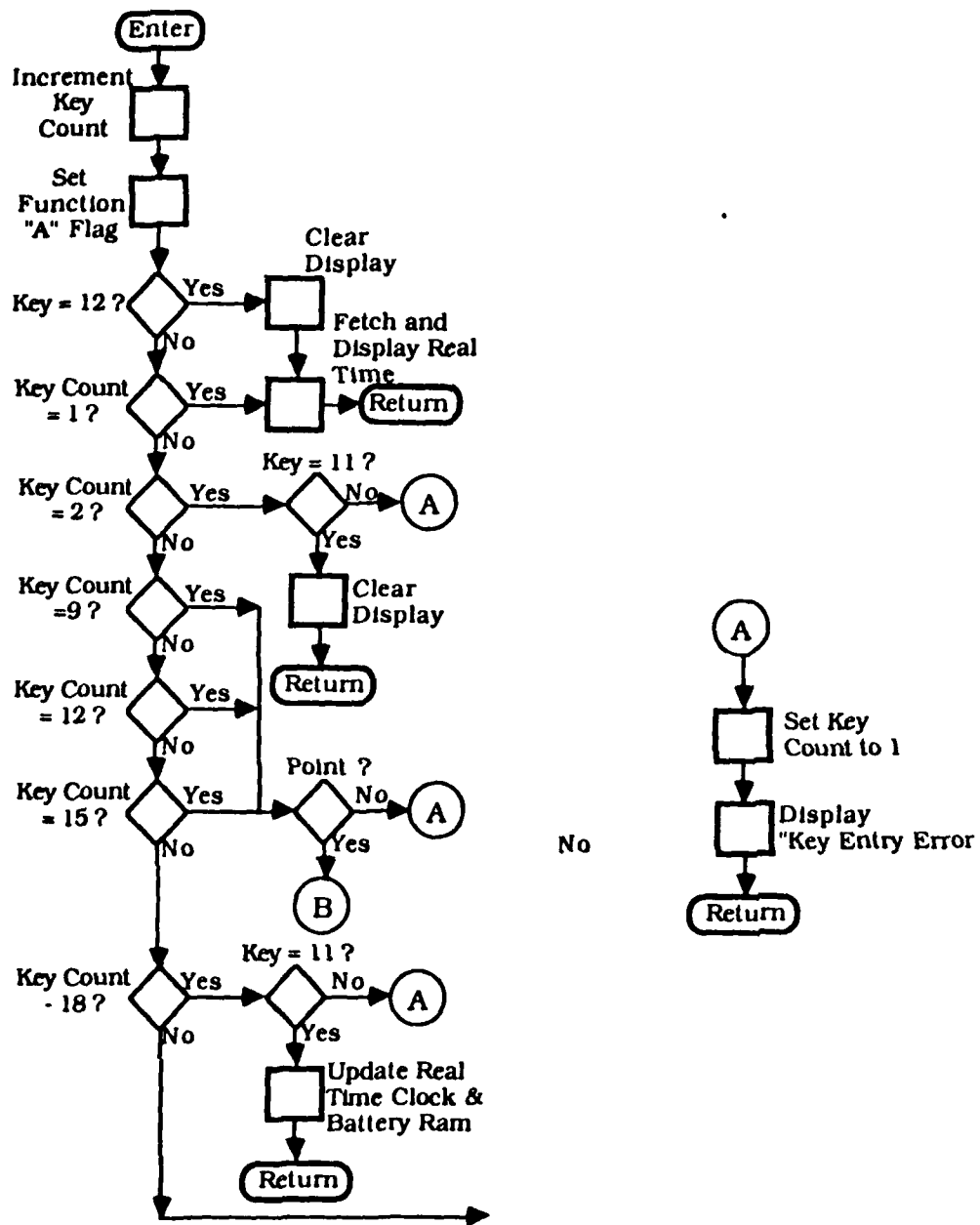


Figure 25. B Function Routine Flow Chart

"C" FUNCTION ROUTINE

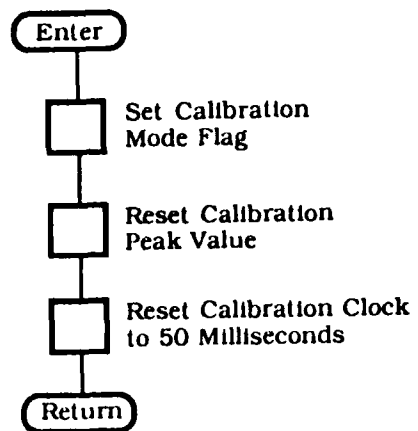


Figure 26. C Function Routine Flow Chart

"D" FUNCTION ROUTINE

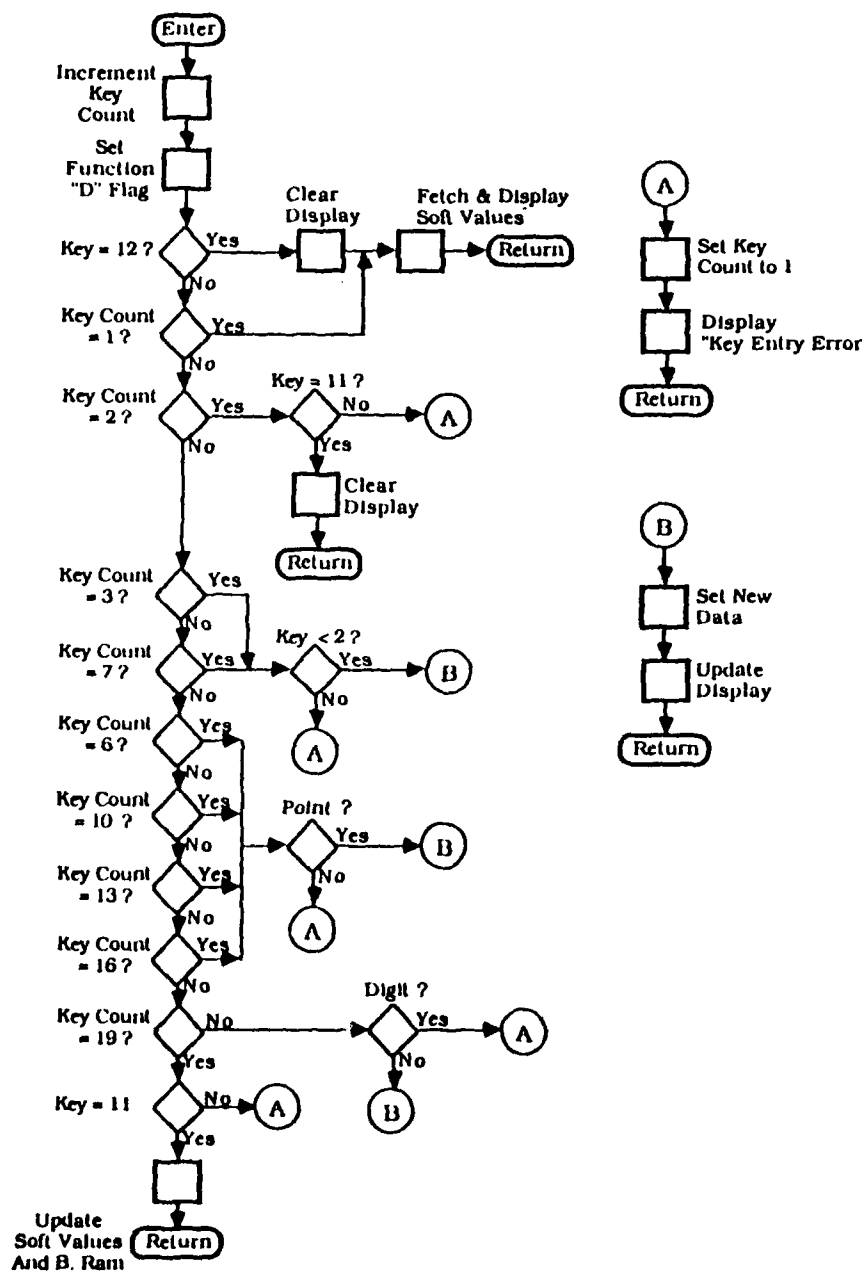


Figure 27. D Function Routine Flow Chart

3.5 Stored data examples

INITIALIZATION DATA

The following example illustrates some typical data formats from different types of events occurring in the BEAR. These represent the data as it is stored on the RAM modules and transferred to the raw data files.

The first event to occur following application of power to the BEAR is the initialization diagnostics. Following their successful completion, the working cache SRAM is loaded with the default working parameters. Then the following data set is loaded into the first RAM module pair (least significant address shown first). These values represent the default parameters. EB and 90 are the data values we chose to be our barker code used to separate events in the RAM storage. Please note that only on the very first writing of barker codes is a set of five data values of EB90 written. All other events, be they sonic boom or keypad events, are always separated by a set of three barker codes, which are always preceded by a three word group of data representing the current real-time. All of the programable parameters are set off with a mask of 1000_{16} to 9000_{16} . If the parameters are too big to fit into the mask then they are written in the next word after the mask. The data values are obtained by subtracting the mask value from the stored value.

HEX VALUE	MSB	LSB	DESCRIPTION
EB90	11101011 ₂	10010000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code
1000	00010000 ₂	00000000 ₂	Test Number Default = 00_{10} With mask of 1000_{16}
2000	00100000 ₂	00000000 ₂	Site Number Default = 00_{10} With mask of 2000_{16}
3000	00110000 ₂	00000000 ₂	BEAR Serial Number Default = 00_{10} With mask of 3000_{16}
4000	01000000 ₂	00000000 ₂	Mask Word for Timer #1 The next word contains the Timer #1 count value divided by 10_{16} . 1 count = 1/8000 Second
03E8	00000011 ₂	11101000 ₂	Timer #1 Default Value of 1000_{10} (This is the value stored for a 2 Second Timer 1)

($1000_{10} * 10_{16} = 16000_{10}$ counts
= 2 sec event timer)

5000	01010000 ₂ 00000000 ₂	Mask Word for Timer #2 The next word contains the Timer #2 count value divided by 10_{16}
03E8	00000011 ₂ 11101000 ₂	Timer #2 Default Value of 1000_{10} (This is the value stored for a .2 Second Timer 2) ($1000_{10} * 10_{16} = 16000_{10}$ counts = 2 sec; interpreted by program as .2 sec cycle timer)
600A	01100000 ₂ 00001010 ₂	Positive Pulse Default Value = 10_{10} With mask of 6000_{16}
7000	01110000 ₂ 00000000 ₂	Mask Word for Trigger #2 The next word contains the Trigger #2 count value
8012	10000000 ₂ 00010010 ₂	Trigger #2 Default of count = 18_{10} Value = 100 dB
8000	10000000 ₂ 00000000 ₂	Mask Word for Trigger #3 The next word contains the Trigger #3 value
0040	00000000 ₂ 01000000 ₂	Trigger #3 Default Value count = 64_{10} Value = 107dB
9006	10010000 ₂ 00000110 ₂	Peak Slope Rise dB Default = 6 With mask of 9000_{16}
9035	10010000 ₂ 00110101 ₂	Peak Slope Risettime Default = 35 With mask of 9000_{16}
0000	00000000 ₂ 00000000 ₂	Default: Minutes and Seconds (2 words Min 00 - Sec 00)
2000	00100000 ₂ 00000000 ₂	Default: Days and Hours (2 words Day 20 - Hr 00)
8805	10001000 ₂ 00000101 ₂	Default: Years and Months (2 words Yr 88 - Mn May)
EB90	11101011 ₂ 10010000 ₂	barker Code
EB90	11101011 ₂ 10010000 ₂	barker Code
EB90	11101011 ₂ 10010000 ₂	barker Code

PARAMETER CHANGE DATA

When any parameter is changed it is stored in the Battery Ram just like any other data. It is distinguished from real Boom data or stored data by its length. Any event less than 10 data points is considered a parameter change. To change any parameter like trigger #3, or any "D" key value, all "D" key parameters must be entered, not just those to be changed. For example, if the "D" key parameters were set at 105.095.00.05.02 and you wanted to change the value of trigger #3 (high trigger) to 137 dB, press * the ENT and enter the new value 137.095.00.05.02 and press ENT. This procedure applies to "A" and "B" keys also. Keys C, E, and F are not for data entry. The "F" key allows storage of 1 second of data, or 7661 data points. To save data, press * and then F.

The following is an example of a time change on the "A" key.

HEX VALUE	MSB	LSB	DESCRIPTION
EB90	11101011 ₂	10010000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code
(These three are the previous event's ending barker Code, not to be rewritten)			
3700	00100101 ₂	00000000 ₂	Real-Time: Minutes and Seconds
2313	00100011 ₂	00010011 ₂	Real-Time: Days and Hours
8908	10001001 ₂	00001000 ₂	Real-Time: Years and Months
EB90	11101011 ₂	10010000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code

The following is an example of a site, test and serial number change on the "B" key.

HEX VALUE	MSB	LSB	DESCRIPTION
EB90	11101011 ₂	20020000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code
EB90	11101011 ₂	10010000 ₂	barker Code
(These three are the previous event's ending barker Code, not to be rewritten)			
1001	00010000 ₂	00000001 ₂	Test Number changed to 01 ₁₀

With mask of 1000_{16}

2002	00100000 ₂ 00000010 ₂	Site Number changed to 02_{10} With mask of 2000_{16}
37D7	00110111 ₂ 11010111 ₂	BEAR Serial Number changed to 2007_{10} With mask of 3000_{16}
4000	01000000 ₂ 00000000 ₂	Mask Word for Timer #1 The next word contains the Timer #1 count value divided by 10_{16} 1 count = 1/8000 Second
03E8	00000011 ₂ 11101000 ₂	Timer #1 left at Value of 1000_{10} (This is the value stored for a 2 Second Timer 1) ($1000_{10} * 10_{16} = 16000_{10}$ counts = 2 sec event timer)
5000	01010000 ₂ 00000000 ₂	Mask Word for Timer #2 The next word contains the Timer #2 count value divided by 10_{16}
09C4	00001001 ₂ 11000100 ₂	Timer #2 changed to Value of 2500_{10} (This is the value stored for a .5 Second Timer 2) ($2500_{10} * 10_{16} = 40000_{10}$ counts = 5 sec; interpreted by program as .5 sec cycle timer)
3705	00100101 ₂ 00000101 ₂	Real-Time: Minutes and Seconds
2315	00100011 ₂ 00010101 ₂	Real-Time: Days and Hours
8908	10001001 ₂ 00001000 ₂	Real-Time: Years and Months
EB90	11101011 ₂ 10010000 ₂	barker Code
EB90	11101011 ₂ 10010000 ₂	barker Code
EB90	11101011 ₂ 10010000 ₂	barker Code

EVENT DATA

The next example is that of a partial listing of any actual event which would be saved assuming the use of the default parameters in the system. Note that the length of an actual event is always very long (greater than ten data points) when compared to a keypad event. Also, the last data point just after the real-time clock information is the average value from the running average table just prior to the recording of this event. This piece of information is the only data not retrievable from the system data for post test analysis and is included here for analysis purposes. All data are stored in raw A/D counts.

HEX VALUE	BINARY VALUE	DESCRIPTION
EB90	1110101110010000	barker Code
EB90	1110101110010000	barker Code
EB90	1110101110010000	barker Code
0010	0000000000010000	First Data Point
	.	(voltage value for 99 dB)
	.	
0041	0000000001000001	
05B7	0000010110110111	
392C	0011100100101100	Peak Value (count of 14636 = voltage value for 158.3 dB)
	.	
	.	
	.	Other Data Points for recorded Boom Event
000C	000000000001100	
0006	000000000000110	Last Data Point (count of 6 = voltage value for 90.6 dB)
xxxx	xxxxxxxxxxxxxxxxxx	Real-Time: Minute and Second
xxxx	xxxxxxxxxxxxxxxxxx	Real-Time: Day and Hour
xxxx	xxxxxxxxxxxxxxxxxx	Real-Time: Year and Month
0001	0000000000000001	2 seconds Average Noise Level Prior to this Event (count of 1 = voltage value for 75 dB)
EB90	1110101110010000	barker Code
EB90	1110101110010000	barker Code
EB90	1110101110010000	barker Code

3.6 Error Messages and Recovery Procedures

<u>MESSAGE</u>	<u>REASON AND/OR RECOVERY</u>
RAM	CHECK SUM MISMATCH IN PROM DURING POWER-UP DIAGNOSTICS RECOVERY: POWER DOWN UNIT POWER ON UNIT IF ERROR STILL OCCURS, SERVICE IS REQUIRED
STATIC RAM ERROR	READ/WRITE ERROR IN THE STATIC RAM DURING POWER-UP DIAGNOSTICS RECOVERY: POWER DOWN UNIT POWER ON UNIT IF ERROR STILL OCCURS, SERVICE IS REQUIRED
BAT RAM ERROR	READ/WRITE ERROR IN THE BATTERY RAM MODULES DURING POWER-UP DIAGNOSTICS RECOVERY: POWER DOWN UNIT RESEAT BATTERY RAM
MODULES	POWER ON UNIT IF ERROR STILL OCCURS, POWER DOWN UNIT.
REPLACE	BATTERY RAM MODULES POWER ON UNIT IF ERROR STILL OCCURS, SERVICE IS REQUIRED
KEY ENTRY ERROR	DISPLAYED WHEN AN INVALID KEYPAD ENTRY IS MADE DURING A PARAMETER CHANGE RECOVERY: PRESS THE "CLR" KEY PRESS THE FUNCTION KEY DESIRED PRESS THE "ENT" KEY
INVALID NUMBER	DISPLAYED WHEN AN INVALID OR OUT OF RANGE VALUE IS ENTERED FOR A PARAMETER DURING A PARAMETER CHANGE RECOVERY: SAME AS "KEY ENTRY ERROR"

NOT ACTIVE	DISPLAYED WHEN AN INVALID FUNCTION KEY IS SELECTED RECOVERY: PRESS "*" TO TURN DISPLAY OFF PRESS "*" TO TURN DISPLAY ON ENTER A DIFFERENT FUNCTION KEY
ENTER CODE	DISPLAYED WHEN THE FULL SYSTEM RESET FUNCTION IS SELECTED. THE OPERATOR SHOULD ENTER THE RESET CODE SEQUENCE
READY	DISPLAYED AFTER THE POWER-UP DIAGNOSTICS HAVE BEEN SUCCESSFULLY COMPLETED
000-YES/NO-000	DISPLAYS THE NUMBER OF VALID SONIC BOOMS (YES), AND INVALID EVENTS (NO) THAT HAVE BEEN DETECTED. THESE COUNTERS ARE RESET DURING POWER-UP OR SYSTEM RESET
BAT RAM FULL	DISPLAYED WHEN THE EVENTS RECORDED HAVE FILLED THE BATTERY RAM MODULES RECOVERY: POWER DOWN THE UNIT REPLACE THE BATTERY RAMs WITH NEW MODULES POWER THE UNIT ON
SYSTEM IS RESET	DISPLAYED AFTER THE FULL SYSTEM RESET FUNCTION HAS BEEN SUCCESSFULLY COMPLETED. WHEN DIAGNOSTICS HAVE BEEN COMPLETED, THE "READY" MESSAGE IS DISPLAYED

3.7 Software Listing

LOCATION	OBJECT CODE LINE	SOURCE LINE
	1	'68000'
	2	
	3	
	4 *	
	5 *****	
	6 *	
	7 *	BEAR
	8 *	
	9 *	This program records sonic data onto the battery ram
	10 *	modules in search of a sonic boom. Once an end of event
	11 *	is detected, the data is analyzed to determine if the
	12 *	event was a sonic boom. If so, the data is retained. The
	13 *	BEAR program also services the keypad which allows an
	14 *	operator to enter time and date information, as well as
	15 *	parameters for analyzing the data.
	16 *	Once the software system is initialized, the BEAR is
	17 *	strictly interrupt driven. The interrupts that are
	18 *	served are: the A/D interrupt for data collection,
	19 *	and the keypad interrupt for parameter entry. Timers 1 & 2,
	20 *	which determine the end of an event collection, are software
	21 *	maintained timers.
	22 *	As part of the initialization, a power up diagnostic
	23 *	is performed in which the integrity of the EPROM's,
	24 *	System Static Ram, Running Average Table (RAT) Ram and Battery Ram
	25 *	are checked and zeroed. The Battery Ram is zeroed only if valid
	26 *	events are detected upon power up. If an error is detected,
	27 *	an appropriate error message is displayed.
	28 *	The A/D interrupt routine (DAC) processes the input data.
	29 *	It maintains the running average through calls to RAT,
	30 *	and determines when an event has begun. When an event is
	31 *	detected, DAC activates the timers at the appropriate
	32 *	times.
	33 *	The end of an event is caused by either timer1 or timer2 expiring.
	34 *	If the event evaluation routine determines that the data is a
	35 *	sonic boom, the data is retained, else the data pointer
	36 *	is reset and new data will be written over it.
	37 *	The keypad interrupt is serviced by the routine (KEYPD).
	38 *	Whenever a key is depressed, this routine is executed.
	39 *	KEYPD determines if the entry was valid, and if so, stores
	40 *	the data in the systems parameter arrays, as well as, in
	41 *	the Battery Ram. KEYPD also outputs the entered information
	42 *	to the display to provide operator feedback.
	43 *	
	44 *	The default parameters for the BEAR are:
	45 *	
	46 *	Time: seconds - 0
	47 *	minutes - 0
	48 *	hour - 0

```

49 *      day      - 01
50 *      month    - 10
51 *      year     - 87
52 *
53 *      Test Number      - 0
54 *      Site Number     - 0
55 *      Serial Number   - 0
56 *      Timer 1        - 2 sec.
57 *      Timer 2        - .2 sec.
58 *      Jump Value     - 10
59 *      Trigger 2      - 100 db
60 *      Trigger 3      - 107 db
61 *      Peak Slope db   - 6 db
62 *      Peak Slope time - 35 msec.
63 *
64 *      The register utilization by the BEAR is :
65 *
66 *      D0 - NEWEST DATA      A0 - GENERAL USE
67 *      D1 - OLDEST DATA     A1 - BEGINNING OF EVENT (FLAG 1)
68 *      D2 - CURRENT PEAK     A2 - DOWN CROSSING (FLAG 2)
69 *      D3 - AVERAGE          A3 - CURRENT DATA POINT (FLAG 3)
70 *      D4 - MOVING TOTAL     A4 - PEAK VALUE POINTER (FLAG 4)
71 *      D5 - GENERAL USE      A5 - NEGATIVE PEAK POINTER
72 *      D6 - '                A6 - OLDEST RAT VALUE POINTER
73 *      D7 - '                A7 - STACK POINTER
74 *
75 *
76 *      TRIGR1 - POSITIVE PULSE TIME
77 *      TRIGR2 - SECOND JUMP VALUE
78 *      TRIGR3 - PEAK TRIGGER VALUE
79 *      TIMR1  - EVENT TIMER
80 *      TIMR2  - INTERVAL TIMER
81 *      TEST   - STATUS WORD
82 *
83 *      BIT 0      1 = RISING SLOPE  0 = FALLING SLOPE
84 *      BIT 1      1 = TIMER 1 ON   0 = TIMER 1 OFF
85 *      BIT 2      1 = TIMER 2 ON   0 = TIMER 2 OFF
86 *      BIT 3      1 = INITIALIZE RAT 0 = INIT. COMPLETE
87 *
88 *
89 * *****
90 *
91 *
<0000> 92 PROM EQU 0000H FROM START ADDRESS
<7FFE> 93 ENDPRM EQU 7FFEH FROM END ADDRESS
<8000> 94 SRAM EQU 8000H STATIC RAM START
<8FFF> 95 ENDSRM EQU 8FFFH STATIC RAM END
<00018001> 96 BRAMON EQU 18001H BAT. RAM ON/OFF LOC.
<00800000> 97 BRAM EQU 800000H BATTERY RAM START
<0087FDF0> 98 ENDBRM EQU 87FDF0H END OF BAT. RAM

```

<0087A030>	99	ENDDATA	EQU	87A030H	END OF VALID DATA
<0087FE00>	100	VARSTR	EQU	87FE00H	PARAMETER STORAGE
	101	* ENDRAT	EQU	8DFFFEH	END OF RAT TABLE (MODEL BBE)
	102	* SIZE1	EQU	8DBFFCH	% 1 SEC. AVG START (MODEL BBE)
	103	* SIZE2	EQU	8D7FFCH	2 SEC. AVG START (MODEL BBE)
	104	* SIZE3	EQU	8CFFFEH	% 4 SEC. AVG START (MODEL BBE)
	105	* SIZE4	EQU	8C0000H	% 8 SEC. AVG START (MODEL BBE)
<008C0000>	106	STRAT	EQU	8C0000H	START OF RAT RAM
<008CFFFE>	107	ENDRAT	EQU	8CFFFEH	% END OF RAT TABLE (MODEL 1020)
<008CC000>	108	SIZE1	EQU	8CC000H	% 1 SEC. AVG START (MODEL 1020)
<008C8000>	109	SIZE2	EQU	8C8000H	% 2 SEC. AVG START (MODEL 1020)
<008C0000>	110	SIZE3	EQU	8C0000H	% 4 SEC. AVG START (MODEL 1020)
<008C0000>	111	SIZE4	EQU	8C0000H	% 8 SEC. AVG START (MODEL 1020) NON-FUNC
<00010000>	112	ADC	EQU	10000H	A/D DATA ADDRESS
<00020000>	113	DISPLY	EQU	20000H	DISPLAY ADDRESS
<00028000>	114	PIA	EQU	28000H	I/O ADDRESS
<0001>	115	ADATA	EQU	1	PIA A DATA REGISTER
<0001>	116	ADDR	EQU	1	PIA A DIR REGISTER
<0003>	117	ACNTL	EQU	3	PIA STATUS/CONTROL
<0005>	118	BDATA	EQU	5	PIA B DATA REGISTER
<0005>	119	BDDR	EQU	5	PIA B DIR REGISTER
<0007>	120	BCNTL	EQU	7	PIA B STATUS/CONTROL
<0020>	121	HOLD	EQU	20H	RTC HOLD
<0060>	122	READ	EQU	60H	RTC READ/HOLD
<00A0>	123	WRITE	EQU	0A0H	RTC WRITE/HOLD
<0082>	124	TIMCONT	EQU	82H	TIMER CONTROL
<00E1>	125	IRQEN	EQU	0E1H	TIMER ONE SHOT
<00A0>	126	STTIM3	EQU	0A0H	TIMER 3 ENABLE
<00E0>	127	STTIM	EQU	0E0H	START TIMERS
<0035>	128	ADENA	EQU	35H	ENABLE A/D INT.
<0005>	129	T1MSB	EQU	5	TIMER 1 MSB
<0007>	130	T1LSB	EQU	7	TIMER 1 LSB
<0009>	131	T2MSB	EQU	9	TIMER 2 MSB
<000B>	132	T2LSB	EQU	0BH	TIMER 2 LSB
<000D>	133	T3MSB	EQU	0DH	TIMER 3 MSB
<000F>	134	T3LSB	EQU	0FH	TIMER 3 LSB
<00A1>	135	DIST2	EQU	0A1H	DISABLE TIMER 2
<0001>	136	T1CNTRL	EQU	1	TIMER 1 CONTROL
<0003>	137	T2CNTRL	EQU	3	TIMER 2 CONTROL
<00030000>	138	TIMADDR	EQU	30000H	TIMER ADDRESS
<0001>	139	TSTAT	EQU	1	TIMER STATUS
<0020>	140	PRVTRP	EQU	20H	PRIVILEGE TRAP VECTOR
<0064>	141	AUTOV1	EQU	64H	AUTOVECTOR 1
<0068>	142	AUTOV2	EQU	68H	2
<006C>	143	AUTOV3	EQU	6CH	3
<0070>	144	AUTOV4	EQU	70H	4
<0074>	145	AUTOV5	EQU	74H	5
<0078>	146	AUTOV6	EQU	78H	6
<007C>	147	AUTOV7	EQU	7CH	7
	148				

(20202020)	149	BLNK	EQU	.	BLANK WORD
(EB90)	150	BARKER	EQU	0EB90H	BARKER CODE
(8FFE)	151	STACK	EQU	8FFEH	START OF SYSTEM STACK
(8F00)	152	SYSTK	EQU	8F00H	START OF SYSTEM STACK
(0000)	153	TNUM	EQU	0	TEST NUMB.
(0002)	154	SITE	EQU	2	SITE NUMBER
(0004)	155	SERIAL	EQU	4	SERIAL NUMBER
(0006)	156	TMFLG1	EQU	6	
(0008)	157	TMVAL1	EQU	8	TIMER 1 VAL
(000A)	158	TMFLG2	EQU	10	
(000C)	159	TMVAL2	EQU	12	TIMER VALUE 2
(000E)	160	TRG1	EQU	14	TRIGGER 1
(0010)	161	TRG2FL	EQU	16	
(0012)	162	TRG2	EQU	18	TRIGGER 2 VALUE
(0014)	163	TRG3FL	EQU	20	
(0016)	164	TRG3	EQU	22	TRIGGER 3 VALUE
(0018)	165	PSLOP	EQU	24	PEAK SLOPE IN DB
(001A)	166	PSLTM	EQU	26	PEAK SLOPE IN TIME
(001C)	167	MSTIM	EQU	28	MINUTES/SEC.
(001E)	168	DYTIM	EQU	30	DAY/HOUR
(0020)	169	YMTIM	EQU	32	YEAR/MONTH
(0000)	170	NUL	EQU	0	
	171	ORG	SRAM		START OF STATIC RAM
008000 0000	172	TRIGR1H	DC.W	0	
008002 0000	173	TRIGR1	DC.W	0	TRIGGER 1 IN COUNTS
008004 0000	174	TRIGR2H	DC.W	0	
008006 0000	175	TRIGR2	DC.W	0	TRIGGER 2 IN COUNTS
008008 0000	176	TRIGR3H	DC.W	0	
00800A 0000	177	TRIGR3	DC.W	0	TRIGGER 3 IN COUNTS
00800C 0000	178	TIMER1	DC.W	0	TIMER 1 IN COUNTS
00800E 0000	179	TIMER2	DC.W	0	TIMER 2 IN COUNTS
008010	180	TSTINF	DS.W	17	CONTAINS THE TEST INFO FROM THE
(8030)	181	INFEND	EQU	8-2	HEADER BLOCK
008032 0000	182	CLK1	DC.W	0	MIN/SEC VALUE
008034 0000	183	CLK2	DC.W	0	HOURLY / DAY VALUE
008036 0000	184	CLK3	DC.W	0	YEAR / MONTH VALUE
008038	185	SEC1	DS.B	1	SECONDS
008039	186	MIN1	DS.B	1	MINUTES
00803A	187	HOURL1	DS.B	1	HOURS
00803B	188	DAY1	DS.B	1	DAYS
00803C	189	MONTH1	DS.B	1	MONTH
00803D	190	YEAR1	DS.B	1	YEARS
00803E	191	PORTAD	DS.B	1	PORT A DATA
00803F	192	PORTAC	DS.B	1	PORT A COMMAND
008040	193	PORTBD	DS.B	1	PORT B DATA
008041	194	PORTBC	DS.B	1	PORT B COMMAND
008042	195	KEYIN	DS.B	1	KEYBOARD INPUT VALUE
008044 0000	196		DC.W	0	
008046	197	CURPPT	DS.L	1	SAVE AREA FOR CURRENT DATA POINTER
00804A	198	CURAVG	DS.W	1	SAVE AREA FOR CURRENT AVERAGE

00804C 0000 0000	199	TEMPT1	DC.L	0	
008050 0000 0000	200	TEMPT2	DC.L	0	
008054 0000 0000	201	NEGPK	DC.L	0	NEGATIVE PEAK VALUE
008058 0000 0000	202	BOTRAT	DC.L	0	BOTTOM OF RAT
00805C 0000 0000	203	EVNTCNT	DC.L	0	COUNTER FOR EVENT DURATION
008060 0000 0000	204	T2CNT	DC.L	0	COUNTER FOR TIMER 2 DURATION
008064 0000	205	MEMSTAT	DC.W	0	STATUS OF MEMORY DIAGNOSTIC
008066 0000	206	VBOOM	DC.W	0	VALID BOOM COUNT
008068 0000	207	NVBOOM	DC.W	0	NON-VALID BOOM COUNT
00806A	208	BOOMSG1	DS.B	13	BOOM COUNT MSG
008077	209	BOOMSG2	DS.B	3	CONTINUED
00807A 0000	210		DC.W	0	
00807C	211	CALMSG	DS.B	16	CAL DISPLAY MSG BUFFER
00808C	212	ADMSG	DS.B	6	CAL 2 DISPLAY MSG
008092	213	DATMSG	DS.B	10	
00809C	214	MEMMSG	DS.B	16	MEMORY LEFT MESSAGE
0080AC 0000	215	PWRUP	DC.W	0	POWER UP FLAG
0080AE 0000	216	PWRCNT	DC.W	0	
0080B0 0000	217	CALFLG	DC.W	0	CAL MODE FLAG
0080B2 0000 0000	218	CALSUM	DC.L	0	SUM VALUE DURING CAL.
0080B6 0000	219	CALTIM	DC.W	0	CAL. PERIOD
0080B8 00	220	HUND	DC.B	0	DECIMAL CONVERSION VALUE (100'S)
0080B9 00	221	TEN	DC.B	0	(10'S)
0080BA 00	222	UNIT	DC.B	0	(1'S)
0080BC 0000	223		DC.W	0	
0080BE	224	AKDATA	DS.B	16	A FUNCTION DATA
0080CE	225	BKDATA	DS.B	16	B FUNCTION DATA
0080DE	226	DKDATA	DS.B	16	D FUNCTION DATA
0080EE 00	227	TEST	DC.B	0	TEST STATUS
0080F0 0000	228		DC.W	0	
0080F2 0000 0000	229	LSTEVT	DC.L	0	LAST EVENT ADDR.
0080F6 0000	230	ESTFLG	DC.W	0	
0080F8 0000	231	ESTMSK	DC.W	0	
0080FA 0000	232	MSTEST	DC.W	0	
0080FC 0000	233	DATSAV	DC.W	0	
0080FE 0000	234	ADVAL	DC.W	0	A/D VAL FOR CAL 2
008100 0000	235	ADSPFLG	DC.W	0	CAL 2 FLAG
008102 0000	236	BOOMFLG	DC.W	0	
008104 0000 0000	237	TR2HIGH	DC.L	0	POS. TRIG 2
008108 0000 0000	238	TR2LOW	DC.L	0	NEG. TRIG 2
00810C 0000	239		DC.W	0	
(810E)	240	ENDVAR	EQU	#	END OF PARAMETERS
(00F8)	241	MSKOFF	EQU	ESTMSK-SRAM	% ADDRESS OFFSET
	242	;.....;			
	243	; DECLARE STORAGE FOR KEYPAD VARIABLES			
	244	;.....;			
	245				
00810E 00	246	DSPADR	DC.B	0H	CHARACTER LOCATION TO DISPLAY
00810F 00	247	DUMMY	DC.B	0H	PUTS EVERYTHING ON A WORD BOUNDARY
008110 0000	248	DIGITS	DC.W	0H	SAVE AREA FOR MULT

008112 0000	249 KEY	DC.W	OH	KEY ENTERED
008114 0000	250 FUNCT	DC.W	OH	LAST FUNCTION CODE ENTERED
008116 0000	251 OFF	DC.W	OH	DISPLAY ON/OFF FLAG
008118 0000	252 ERRNUM	DC.W	OH	KEYBOARD ERROR CODE
00811A 0000	253 ALPHA	DC.W	OH	LAST ALPHA CHARACTER ENTERED
00811C 0000	254 COUNT	DC.W	OH	KEYPAD CHARACTER COUNT
00811E 0000	255 POINT	DC.W	OH	DECIMAL POINT ON/OFF FLAG
008120 0000	256 HIYR	DC.W	OH	BEGINNING OF AKEY DATA
008122 0000	257 LOYR	DC.W	OH	YEAR
008124 0000	258 HIMO	DC.W	OH	MONTH
008126 0000	259 LOMO	DC.W	OH	
008128 0000	260 HIDA	DC.W	OH	DAY
00812A 0000	261 LODA	DC.W	OH	
00812C 0000	262 HIHR	DC.W	OH	HOURL
00812E 0000	263 LOHR	DC.W	OH	
008130 0000	264 HIMN	DC.W	OH	MINUTE
008132 0000	265 LOMN	DC.W	OH	
008134 0000	266 HISC	DC.W	OH	SECOND
008136 0000	267 LOHC	DC.W	OH	
008138 0000	268 HITT	DC.W	OH	BEGINNING OF BKEY DATA
00813A 0000	269 LOTT	DC.W	OH	TEST NUMBER
00813C 0000	270 HISN	DC.W	OH	SITE NUMBER
00813E 0000	271 LOSN	DC.W	OH	
008140 0000	272 HIT1	DC.W	OH	TIMER 1
008142 0000	273 LOT1	DC.W	OH	
008144 0000	274 HIT2	DC.W	OH	TIMER 2
008146 0000	275 LOT2	DC.W	OH	
008148 0000	276 SN1	DC.W	OH	SERIAL NUMBER
00814A 0000	277 SN2	DC.W	OH	
00814C 0000	278 SN3	DC.W	OH	
00814E 0000	279 SN4	DC.W	OH	
008150 0000	280 HITE3	DC.W	OH	BEGINNING OF DKEY DATA
008152 0000	281 MITE3	DC.W	OH	TRIGGER 3
008154 0000	282 LOTR3	DC.W	OH	
008156 0000	283 HITE2	DC.W	OH	TRIGGER2
008158 0000	284 MITE2	DC.W	OH	
00815A 0000	285 LOTR2	DC.W	OH	
00815C 0000	286 HIJV	DC.W	OH	JUMP VALUE
00815E 0000	287 LOJV	DC.W	OH	
008160 0000	288 HIRV	DC.W	OH	RISE DB
008162 0000	289 LORV	DC.W	OH	
008164 0000	290 HIRT	DC.W	OH	RISE TIME
008166 0000	291 LORT	DC.W	OH	
008168 0000	292 YEAR	DC.W	OH	YEAR CONVERTED
00816A 0000	293 MONTH	DC.W	OH	MONTH .
00816C 0000	294 DAY	DC.W	OH	DAY .
00816E 0000	295 HOUR	DC.W	OH	HOUR .
008170 0000	296 MINUTE	DC.W	OH	MINUTE .
008172 0000	297 SECOND	DC.W	OH	SECOND .
008174 0000	298 TESTNM	DC.W	OH	TEST NO. .

008176 0000	299	SITENM	DC.W	OH	SITE NO.	
008178 0000	300	TIMER1	DC.W	OH	TIMER 1	
00817A 0000	301	TIMER2	DC.W	OH	TIMER 2	
00817C 0000	302	SERNO	DC.W	OH	SERIAL NO.	
00817E 0000	303	TRIG3	DC.W	OH	TRIGGER 3	
008180 0000	304	TRIG2	DC.W	OH	TRIGGER 2	
008182 0000	305	JMPVAL	DC.W	OH	JUMP VAL.	
008184 0000	306	RISEDB	DC.W	OH	RISE DB	
008186 0000	307	RISETM	DC.W	OH	RISE TIME	
	308					
	309					
	310					
	311					
	312					
	313	ORG	PROM		START OF PROM (ADDR. 0)	
	314					
000000 0000 8F00	315	DC.L	SYSTK		SYSTEM STACK	
000004 0000 03FC	316	DC.L	BEAR		START OF PROGRAM	
000008 0000 10BE	317	DC.L	BUSERR		BUS ERROR TRAP	
00000C 0000 10C0	318	DC.L	ADDRERR		ADDRESS ERROR TRAP	
000010 0000 0000	319	DC.L	NUL,NUL,NUL,NUL			
000020 0000 03FC	320	DC.L	BEAR		START OF PROGRAM	
000024 0000 0000	321	DC.L	NUL,NUL,NUL			
000030 0000 0000	322	DC.L	0,0,0			
00003C 0000 0000	323	DC.L	NUL			
000040 0000 0000	324	DC.L	0,0,0,0			
000050 0000 0000	325	DC.L	0,0,0,0			
000060 0000 0000	326	DC.L	NUL			
000064 0000 0000	327	DC.L	NUL	START OF AUTOVECTOR	VECTOR 1	
000068 0000 0A52	328	DC.L	DAC	A/D INTERRUPT	VECTOR 2	
00006C 0000 25B6	329	DC.L	LITNG	LIGHTNING INTERRUPT	VECTOR 3	
000070 0000 0000	330	DC.L	NUL		VECTOR 4	
000074 0000 10C2	331	DC.L	KEYPD	KEY PAD IRQ	VECTOR 5	
000078 0000 2184	332	DC.L	TIMER	PROGM TIMER IRQ	VECTOR 6	
00007C 0000 0000	333	DC.L	NUL		VECTOR 7	
000080 0000 0000	334	DC.L	NUL			
000084	335	DS.L	11			
0000B0 0000 0000	336	DC.L	NUL			
0000B4 0000 0000	337	DC.L	NUL			
0000B8 0000 0000	338	DC.L	NUL			
0000BC	339	EMPTY	DS.L	208		
	340					
	341					
	342					
0003FC 4E71	343	BEAR	NOP			
0003FE 4FF9 0000	344	LEA.L	STACK,A7			
000404 46FC 2700	345	MOVE.W	#2700H,SR			
000408 4FF9 0000	346	LEA.L	SYSTK,A7			
	347					
00040E 08B9 0000	348	BCLR	#0,BRANON	TURN ON BAT. RAM		

000416 243C	349	MOVE.L	*100,D2	
00041C 6100 0C9A	350	BSR	DELAY	
000420 4287	351	CLR.L	D7	
	352			
	353 *			
	354 *****			
	355 *			
	356 *	THIS SECTION BEGINS THE POWER UP DIAGNOSTICS.		
	357 *	IT PERFORMS A CHECK SUM CHECK OF THE PROM THEN		
	358 *	DOES A WRITE AND READ CHECK OF THE STATIC RAM ,		
	359 *	AND BATTERY RAM .		
	360 *			
	361 *	ERROR STATUS IS STORED IN D7 :		
	362 *	0 - EPROM ERROR		
	363 *	1 - SYSTEM STATIC RAM ERROR		
	364 *	2 - BAT OR BATTERY RAM ERROR		
	365 *			
	366 *****			
	367 *			
	368			
	369 *	DIGSTRT	MOVE.W	*0,RSTFLG CLEAR RESET FLAG
000422 41F8 0000	370	ROMDIG	LEA.L	PROM,A0 GET START OF PROM
000426 203C	371		MOVE.L	*ENDPRM,D0 GET END OF PROM
00042C 4281	372		CLR.L	D1 ZERO SUMMING REG.
00042E D258	373	ROMLP	ADD.W	[A0],D1 SUM PROM ON WORD BOUNDARY
000430 B1C0	374		CMPLA.L	D0,A0 CHECK FOR END OF PROM
000432 86FA	375		BNE	ROMLP
000434 B250	376		CMP.W	{A0},D1 CHECK CHECKSUM
000436 6700 0006	377		BEQ	SRAMDIG IF NOT = GOTO ERR
00043A 08C7 0000	378		BSET	*0,D7 SET ERROR BIT
00043E 41F9 0000	379	SRAMDIG	LEA.L	SRAM,A0 GET START OF STATIC RAM
000444 203C	380		MOVE.L	*ENDSRM,D0 GET END OF STATIC RAM
00044A 323C AAAA	381		MOVE.W	*0AAAAH,D1 INIT FIRST MASK
00044E 343C 5555	382		MOVE.W	*5555H,D2 INIT SECOND MASK
000452 3081	383	SLOOP	MOVE.W	D1,{A0} WRITE MASK
000454 B250	384		CMP.W	{A0},D1 READ/CMPE MASK
000456 6700 0006	385		BEQ	SLP1
00045A 08C7 0001	386		BSET	*1,D7 SET ERROR BIT
00045E 3082	387	SLP1	MOVE.W	D2,{A0} WRITE SECOND MASK
000460 B450	388		CMP.W	{A0},D2 READ/CMPE
000462 6700 0006	389		BEQ	SLP2
000466 08C7 0001	390		BSET	*1,D7 SET ERROR BIT
00046A 4250	391	SLP2	CLR.W	{A0} ZERO MEMORY LOCATION
00046C D1FC	392		ADDA.L	*2,A0 INCR ADDR POINTER
000472 B1C0	393		CMPLA.L	D0,A0 CHECK FOR END
000474 6FDC	394		BLE	SLOOP
000476 41F9 008C	395	RATRAM	LEA.L	STRAT,A0 GET START OF RAT RAM
00047C 203C	396		MOVE.L	*ENDRAT,D0 GET END
000482 223C	397		MOVE.L	*0A5A5H,D1 LOAD MASK
000486 30C1	398	RATWRT	MOVE.W	D1,{A0} WRITE MASK

00048A B1C0	399	CMPL.L	DO,A0	CHECK FOR END OF RAT
00048C 6FFA	400	BLE	RATWRT	WRITE NEXT WORD
00048E 41F9 008C	401	LEA.L	STRAT,A0	GET START OF RAT
000494 3410	402 RATLP	MOVE.W	[A0],D2	FETCH DATA
000496 B441	403	CMP.W	D1,D2	CHECK DATA
000498 6800 000C	404	BNE	ENDTST	TEST FAILED
00049C 4258	405	CLR.W	[A0]+	ZERO WORD
00049E B1C0	406	CMPL.L	DO,A0	CHECK FOR END OF RAT
0004A0 6FF2	407	BLE	RATLP	DO AGAIN
0004A2 6000 0006	408	BRA	CONBRAM	PASSED TEST
0004A6 08C7 0002	409 ENDTST	BSET	*2,D7	FAILED TEST
0004AA 41F9 0087	410 CONBRAM	LEA.L	VARSTR,A0	% GET BRAM PARAMETERS START ADDR
0004B0 0C68 ABCD	411	CMPI.W	*0ABCDH,MSKOFF[A0]	% CHECK BRAM DATA GOOD MASK
0004B6 6800 001E	412	BNE	BRANDIG	% IF NO GOOD, PERFORM BRANDIAG
0004BA 43F9 0000	413	LEA.L	SRAM,A1	% ELSE MOVE PARAMETERS TO STATIC RAM
0004C0 12D8	414 RELOAD	MOVE.B	[A0]+,[A1]+	%
0004C2 B3FC	415	CMPL.L	*ENDVAR,A1	%
0004C8 6DF6	416	BLT	RELOAD	%
0004CA 33FC 0001	417	MOVE.W	*1,RSTFLG	% FLAG BRAM AS GOOD
0004D2 6000 003E	418	BRA	INIPIA	% INITIALIZE PIA
	419 *	CONBRAM LEA.L	VARSTR,A0	LOAD PARAMETERS FROM BRAM
	420 *	LEA.L	SRAM,A1	TO STATIC RAM
	421 *	RELOAD MOVE.B	[A0]+,[A1]+	
	422 *	CMPL.L	*ENDVAR,A1	
	423 *	BLT	RELOAD	
	424 *	CMP.W	*0ABCDH,RSTMASK	IF BRAM DATA STILL GOOD
	425 *	BNE	BRANDIG	
	426 *	MOVE.W	*1,RSTFLG	
	427 *	BRA	INIPIA	GO TO DATA ACQ.
0004D6 41F9 0080	428 BRANDIG	LEA.L	BRAM,A0	START OF RAT. RAM
0004DC 203C	429	MOVE.L	*ENDBRM,DO	
0004E2 223C	430	MOVE.L	*0A5A5H,D1	SET UP MASK
0004E8 30C1	431 BRMWRT	MOVE.W	D1,[A0]+	
0004EA B1C0	432	CMPL.L	DO,A0	CHECK FOR END
0004EC 6FFA	433	BLE	BRMWRT	
0004EE 41F9 0080	434	LEA.L	BRAM,A0	GET START ADDRESS
0004F4 203C	435	MOVE.L	*ENDBRM,DO	END ADDRESS
0004FA 3410	436 BLOOP	MOVE.W	[A0],D2	READ DATA
0004FC B441	437	CMP.W	D1,D2	
0004FE 6800 0008	438	BNE	ENDRAM	IF WE THIS IS END OF RAM
000502 4258	439	CLR.W	[A0]+	ZERO BRAM
000504 B1C0	440	CMPL.L	DO,A0	CHECK FOR END
000506 6FF2	441	BLE	BLOOP	
000508 B1C0	442 ENDRAM	CMPL.L	DO,A0	CHECK FOR GOOD TEST
00050A 6C00 0006	443	BGE	INIPIA	TEST PASSED
00050E 08C7 0002	444	BSET	*2,D7	FAILED
	445			
	446			
	447 *			
	448 *	INITIALIZATION SECTION		

```

449 *
450 *
451 *
452 *   INITIALIZE THE I / O PORTS
453 *
454 *
000512 41F9 0002 455 INIPIA LEA.L   PIA,A0      GET I/O PORT ADDRESS
000518 117C 0000 456         MOVE.B  #0,ACNTL[A0]  CLEAR CONTROL
00051E 117C 0000 457         MOVE.B  #0,BCNTL[A0]
000524 117C 00E0 458         MOVE.B  #0E0H,ADDR[A0] SET DIRECTION OF PORT
00052A 117C 00F0 459         MOVE.B  #0F0H,BDDR[A0]
000530 117C 003F 460         MOVE.B  #3FH,ACNTL[A0] SET CONTROL BITS
000536 13FC 003F 461         MOVE.B  #3FH,PORTAC
00053E 117C 0000 462         MOVE.B  #0,ADATA[A0]  ZERO DATA REGISTER
000544 13FC 0000 463         MOVE.B  #0,PORTAD
00054C 117C 0036 464         MOVE.B  #36H,BCNTL[A0] SET CONTROL OF OTHER PORT
000552 13FC 0036 465         MOVE.B  #36H,PORTBC
00055A 117C 0000 466         MOVE.B  #0,BDATA[A0]  ZERO DATA REGISTER
000560 13FC 0000 467         MOVE.B  #0,PORTBD
000568 0C87      468         CMP.L   #0,D7      SEE IF THERE WERE ANY DIAG ERROR
00056E 6600 0AA2 469         BNE     MEMERR    YES,DISPLAY ERROR
000572 0C79 0001 470         CMPI.W  #1,RSTFLG   % IF NOW RESET
00057A 6600 0010 471         JNE     NONRST    INIT. BRAM PARAMETERS
00057E 6100 081C 472         BSR     WRTCLK
000582 2679 0000 473         MOVEA.L LSTEV, A3    ELSE MOVE POINTER TO LAST
474         MOVE.W  #0,RSTFLG      DATA POINT
000588 6000 0178 475         BRA     TIMINI
476
477
00058C 13FC 0000 478 NONRST MOVE.B  #0,SEC1    INITIALIZE TIME OF DAY CLOCK
000594 13FC 0000 479         MOVE.B  #00,MIN1    MINUTES = 0
00059C 13FC 0000 480         MOVE.B  #00,HOURL    HOUR = 0
0005A4 13FC 0020 481         MOVE.B  #20H,DAY1  % DAY = 20
0005AC 13FC 0005 482         MOVE.B  #05H,MONTH1  % MONTH = 05
0005B4 13FC 0088 483         MOVE.B  #88H,YEAR1    YEAR = 88
0005BC 6100 07DE 484         BSR     WRTCLK    WRITE DATA TO REAL TIME CLOCK
0005C0 41F9 0000 485         LEA.L   AKDATA,A0    LOAD DISPLAY INFO
0005C6 43F9 0000 486         LEA.L   AKINIT,A1    TRANSFER INITIAL VALUES FROM
0005CC 203C      487         MOVE.L   #47,D0    ROM TO STATIC RAM
0005D2 10D9      488 KDATIN MOVE.B  {A1}, {A0}+
0005D4 51C8 FFFC 489         DBRA     D0,KDATIN
0005D8 47F9 0080 490         LEA.L   BRAM,A3      GET START OF BATTERY RAM
0005DE 41F9 0000 491         LEA.L   HEADR,A0    GET HEADER INFO
0005E4 323C 000E 492         MOVE.W  #14,D1    LOAD MESSAGE COUNT
0005EB 36FC EB90 493         MOVE.W  #BARKER,{A3}+ PUT IN FIRST BARKER CODES
0005EC 36FC EB90 494         MOVE.W  #BARKER,{A3}+
0005F0 36FC EB90 495         MOVE.W  #BARKER,{A3}+
0005F4 36FC EB90 496         MOVE.W  #BARKER,{A3}+
0005F8 36FC EB90 497         MOVE.W  #BARKER,{A3}+
0005FC 36D8      498 INILP  MOVE.W  {A0}, {A3}+ STORE DEFAULT VALS. IN BRAM

```

0005FE 0441 0001	499	SUB.W	*1,D1	
000602 66F8	500	BNE	INILP	
000604 6100 086E	501	BSR	RDCLK	GET TIME OF DAY
000608 36F9 0000	502	MOVE.W	CLK1,[A3]+	STORE CURRENT TIME OF DAY
00060E 36F9 0000	503	MOVE.W	CLK2,[A3]+	
000614 36F9 0000	504	MOVE.W	CLK3,[A3]+	
00061A 36FC EB90	505	MOVE.W	*BARKER,[A3]+	PUT IN NEXT BARKER CODES
00061E 36FC EB90	506	MOVE.W	*BARKER,[A3]+	
000622 36BC EB90	507	MOVE.W	*BARKER,[A3]	
000626 41F9 0000	508	LEA.L	HEADR,A0	PUT HEADER INFO
00062C 43F9 0000	509	LEA.L	TSTINF,A1	INTO SRAM ARRAY
000632 3218	510	MOVE.W	{A0}+,D1	GET TEST NUMBER
000634 0241 0FFF	511	AND.W	*OFFFH,D1	MASK OFF CODE
000638 32C1	512	MOVE.W	D1,[A1]+	AND STORE
00063A 3218	513	MOVE.W	{A0}+,D1	GET SITE NUMBER
00063C 0241 0FFF	514	AND.W	*OFFFH,D1	
000640 32C1	515	MOVE.W	D1,[A1]+	
000642 3218	516	MOVE.W	{A0}+,D1	GET SERIAL NUMBER
000644 0241 0FFF	517	AND.W	*OFFFH,D1	
000648 32C1	518	MOVE.W	D1,[A1]+	
00064A D1FC	519	ADDA.L	*2,A0	BUMP PAST FLAG
000650 D3FC	520	ADDA.L	*2,A1	
000656 33D0 0000	521	MOVE.W	{A0},TIMER1	
00065C 32D8	522	MOVE.W	{A0}+,{A1}+	STORE TIMER 1 VALUE
00065E D1FC	523	ADDA.L	*2,A0	BUMP PAST FLAG
000664 D3FC	524	ADDA.L	*2,A1	
00066A 33D0 0000	525	MOVE.W	{A0},TIMER2	
000670 32D8	526	MOVE.W	{A0}+,{A1}+	STORE TIMER 2 VALUE
000672 3218	527	MOVE.W	{A0}+,D1	GET TRIGGER 1
000674 0241 00FF	528	AND.W	*00FFH,D1	
000678 32C1	529	MOVE.W	D1,[A1]+	
00067A 33C1 0000	530	MOVE.W	D1,TRIGR1	
000680 D1FC	531	ADDA.L	*2,A0	BUMP PAST FLAG
000686 D3FC	532	ADDA.L	*2,A1	
00068C 33D0 0000	533	MOVE.W	{A0},TRIGR2	
000692 32D8	534	MOVE.W	{A0}+,{A1}+	GET TRIGGER 2
000694 D1FC	535	ADDA.L	*2,A0	BUMP PAST FLAG
00069A D3FC	536	ADDA.L	*2,A1	
0006A0 33D0 0000	537	MOVE.W	{A0},TRIGR3	
0006A6 32D8	538	MOVE.W	{A0}+,{A1}+	GET TRIGGER 3
0006A8 3218	539	MOVE.W	{A0}+,D1	GET PEAK SLOPE DB VALUE
0006AA 0241 0FFF	540	AND.W	*OFFFH,D1	
0006AE 32C1	541	MOVE.W	D1,[A1]+	
0006B0 3218	542	MOVE.W	{A0}+,D1	GET PEAK SLOPE TIME VALUE
0006B2 0241 0FFF	543	AND.W	*OFFFH,D1	
0006B6 32C1	544	MOVE.W	D1,[A1]+	
0006B8 32F9 0000	545	MOVE.W	CLK1,[A1]+	GET MIN. / SEC. VALUE
0006BE 32F9 0000	546	MOVE.W	CLK2,[A1]+	GET DAY / HOUR VALUE
0006C4 32F9 0000	547	MOVE.W	CLK3,[A1]+	GET YEAR / MONTH VALUE
0006CA 41F9 0000	548	LEA.L	BOMMSG,A0	

0006D0	43F9	0000	549	LEA.L	BOOMSG1,A1	
0006D6	22D8		550	MOVE.L	{A0}+,{A1}+	MOVE IN BOOM COUNT MSG
0006D8	22D8		551	MOVE.L	{A0}+,{A1}+	TO STATIC RAM
0006DA	22D8		552	MOVE.L	{A0}+,{A1}+	
0006DC	2290		553	MOVE.L	{A0},{A1}	
0006DE	33FC	0000	554	MOVE.W	*0,VBOOM	
0006E6	33FC	0000	555	MOVE.W	*0,NVBOOM	
0006EE	41F9	0000	556	LEA.L	MEMTEXT,A0	MOVE MEMORY LEFT MSG
0006F4	43F9	0000	557	LEA.L	MEMMSG,A1	TO STATIC RAM
0006FA	22D8		558	MOVE.L	{A0}+,{A1}+	
0006FC	22D8		559	MOVE.L	{A0}+,{A1}+	
0006FE	22D8		560	MOVE.L	{A0}+,{A1}+	
000700	2290		561	MOVE.L	{A0},{A1}	
			562			
			563			
			564			
			565			
			566	****	INITIALIZE TIMERS	***
			567			
			568			
000702	41F9	0003	569	TIMINI LEA.L	TIMADDR,A0	GET TIMER I/O ADDRESS
000708	3039	0000	570	MOVE.W	TIMR1,D0	GET TIMER 1 VALUE
00070E	1200		571	MOVE.B	D0,D1	
000710	E088		572	LSR.L	*8,D0	CONVERT TO TICKS
000712	1140	0005	573	MOVE.B	D0,T1MSB[A0]	STORE TICK COUNT
000716	1141	0007	574	MOVE.B	D1,T1LSB[A0]	
00071A	3039	0000	575	MOVE.W	TIMR2,D0	GET TIMER 2
000720	1200		576	MOVE.B	D0,D1	
000722	E088		577	LSR.L	*8,D0	CONVERT TO TICKS
000724	1140	0009	578	MOVE.B	D0,T2MSB[A0]	STORE TICK COUNT
000728	1141	000B	579	MOVE.B	D1,T2LSB[A0]	
00072C	117C	0000	580	MOVE.B	*0,T3MSB[A0]	STORE TIMER 3 TICK COUNT
000732	117C	0032	581	MOVE.B	*50,T3LSB[A0]	
000738	117C	0082	582	MOVE.B	*TIMCNT,T1CNTRL[A0]	DISABLE TIMERS (RESET)
00073E	117C	00A1	583	MOVE.B	*DIST2,T2CNTRL[A0]	
000744	117C	00A1	584	MOVE.B	*DIST2,T1CNTRL[A0]	
00074A	3C39	0000	585	MOVE.W	TIMR2,D6	
000750	1E06		586	MOVE.B	D6,D7	
000752	E08E		587	LSR.L	*8,D6	
000754	1146	0009	588	MOVE.B	D6,T2MSB[A0]	SEND TIMER 2 VALUE
000758	1147	000B	589	MOVE.B	D7,T2LSB[A0]	
00075C	117C	00E1	590	MOVE.B	*IRQEN,T2CNTRL[A0]	ENABLE TIMER INTERRUPTS
000762	117C	00E1	591	MOVE.B	*IRQEN,T1CNTRL[A0]	
000768	41F9	0000	592	LEA.L	CALMSG,A0	POINT TO CAL. MESSAGE BUF.
00076E	20FC		593	MOVE.L	*BLNK,{A0}+	BLANK FILL BUFFER
000774	20FC		594	MOVE.L	*BLNK,{A0}+	
00077A	20FC		595	MOVE.L	*BLNK,{A0}+	
000780	20BC		596	MOVE.L	*BLNK,{A0}	
000786	41F9	0000	597	LEA.L	ADMSG,A0	BLANK CAL 2 DISPLAY MSG
00078C	20FC		598	MOVE.L	*BLNK,{A0}+	

000792 20FC	599	MOVE.L	*BLNK,[A0]+	
000798 20FC	600	MOVE.L	*BLNK,[A0]+	
00079E 20BC	601	MOVE.L	*BLNK,[A0]	
0007A4 33FC 0000	602	MOVE.W	*00,ADSPFLG	CLEAR CAL 2 FLG
0007AC 2C39 0000	603	MOVE.L	TRIGR2H,D6	CALC TR2 HIGH/LOW
0007B2 23C6 0000	604	MOVE.L	D6,TR2HIGH	
0007B8 0486	605	SUB.L	*8000H,D6	
0007BE 23FC	606	MOVE.L	*8000H,TR2LOW	
0007C8 9DB9 0000	607	SUB.L	D6,TR2LOW	
	608			
	609			
	610			
0007CE 33FC 0000	611	MOVE.W	*00,BOOMFLG	
0007D6 6100 196E	612	BSR	INITDS	INITIALIZE THE DISPLAY
	613			
	614			
	615	****	INITIALIZE A / D	****
	616			
	617			
0007DA 23CB 0000	618	MOVE.L	A3,LSTEST	
0007E0 23CB 0000	619	MOVE.L	A3,CURPWT	
0007E6 33FC ABCD	620	MOVE.W	*0ABCDH,RSTMSK	
0007EE 6100 1D42	621	BSR	SAVPAR	
0007F2 224B	622	MOVE.L	A3,A1	INITIALIZE REGISTERS FOR RUN
0007F4 244B	623	MOVE.L	A3,A2	
0007F6 284B	624	MOVE.L	A3,A4	
0007F8 2A4B	625	MOVE.L	A3,A5	
0007FA 23FC	626	MOVE.L	*SIZE2,BOTRAT	INIT FOR 2 SEC. RAT
000804 2C7C	627	MOVE.L	*SIZE2,A6	
00080A 4280	628	CLR.L	D0	NEWEST DATA = 0
00080C 4281	629	CLR.L	D1	LAST DATA = 0
00080E 4282	630	CLR.L	D2	CURRENT PEAK = 0
000810 4283	631	CLR.L	D3	AVERAGE = 0
000812 4284	632	CLR.L	D4	MOVING TOTAL = 0
000814 23FC	633	MOVE.L	*8000H,NEGPK	INIT NEGATIVE PEAK VALUE
00081E 33FC 000F	634	MOVE.W	*15,PWRUP	SET POWER UP DELAY - 15 SEC.
000826 33FC 0FA0	635	MOVE.W	*4000,PWRCHT	
00082E 33FC 0000	636	MOVE.W	*00,DATSAV	
000836 33FC 0000	637	MOVE.W	*00,CALFLG	CLEAR CALIBRATION FLAG
00083E 23FC	638	MOVE.L	*00,CALSUM	INIT CAL. PEAK VALUE
000848 33FC 0FA0	639	MOVE.W	*4000,CALTIM	INIT CAL. PERIOD TO 5 MSEC.
000850 13FC 0000	640	MOVE.B	*0,TEST	CLEAR TEST STATUS
000858 08F9 0003	641	BSET	*3,TEST	SET FOR RAT INITIALIZATION
000860 46FC 2000	642	MOVE.W	*2000H,SR	ENABLE INTERRUPTS
000864 41F9 0002	643	LEA.L	PIA,A0	
00086A 13FC 0035	644	MOVE.B	*ADENA,PORTBC	
000872 117C 0035	645	MOVE.B	*ADENA,BCNTL[A0]	ENABLE A/D INTERRUPT
000878 3E39 0001	646	MOVE.W	ADC,D7	
00087E 1E28 0005	647	MOVE.B	BDATA[A0],D7	
000882 08F9 0000	648	BSET	*0,BRAMON	TURN OFF BAT. RAM

```

649
650
651 *
652 *****
653 *
654 *   THIS IS THE MAIN WAIT LOOP OF THE SYSTEM.THE SYSTEM
655 *   WILL STAY IN THIS LOOP UNTIL AN INTERRUPT OCCURS.
656 *   AFTER THE INTERRUPT IS SERVICED,IT WILL RETURN
657 *   TO THIS LOOP.
658 *
659 *****
660 *
661
00088A 4E71 662 DLOOP  NOP
00088C 0839 0003 663      BTST    *3,TEST    WAIT FOR INIT OF RUNNING
000894 66F4 664      BNE     DLOOP    AVERAGE TABLE
000896 41F9 0000 665      LEA.L   RDYMSG,A0
00089C 6100 07DA 666      BSR     DSPMSG
0008A0 4E71 667 TLOOP  NOP
0008A2 0839 0000 668      BTST    *0,ADSPFLG
0008AA 6600 0010 669      BNE     TLOOPI
0008AE 0839 0000 670      BTST    *00,CALFLG  SEE IF IN CAL MODE 1
0008B6 6600 0080 671      BNE     CALDSP    IF YES, DO RMS CAL.
0008BA 60E4 672      BRA     TLOOP
0008BC 0C79 0000 673 TLOOPI  CMPI.W  *0,CALTIM
0008C4 66DA 674      BNE     TLOOP
0008C6 33C0 0000 675      MOVE.W  D0,ADVAL    GET A/D VALUE
0008CC 41F9 0000 676      LEA.L   DATMSG,A0  LOAD DISPLAY MSG POINTER
0008D2 4286 677      CLR.L   D6
0008D4 3C39 0000 678      MOVE.W  ADVAL,D6    GET LSB OF A/D VALUE
0008DA E04E 679      LSR.W   *08,D6
0008DC E84E 680      LSR.W   *04,D6
0008DE 6100 0038 681      BSR     CVTAD    CONVERT A/D VALUE TO ASCII
0008E2 3C39 0000 682      MOVE.W  ADVAL,D6    GET NEXT NIBBLE OF A/D VAL
0008E8 E04E 683      LSR.W   *08,D6
0008EA 6100 002C 684      BSR     CVTAD    CONVERT TO ASCII
0008EE 3C39 0000 685      MOVE.W  ADVAL,D6    GET MSB OF A/D VALUE
0008F4 E84E 686      LSR.W   *4,D6
0008F6 6100 0020 687      BSR     CVTAD    CONVERT TO ASCII
0008FA 3C39 0000 688      MOVE.W  ADVAL,D6    GET HIGH NIBBLE
000900 6100 0016 689      BSR     CVTAD    CONVERT TO ASCII
000904 41F9 0000 690      LEA.L   ADMSG,A0  DISPLAY A/D VALUE
00090A 6100 076C 691      BSR     DSPMSG
00090E 33FC 0FA0 692      MOVE.W  *4000,CALTIM
000916 6088 693      BRA     TLOOP    WAIT FOR INTERRUPTS
694
695
000918 0246 000F 696 CVTAD  AND.W   *0FH,D6    MASK OFF UPPER NIBBLE
00091C 0C46 0009 697      CMP.W   *09,D6    IF > 9 THEN ALPHA CHAR.
000920 6E00 000A 698      BGT     ALCHAR

```

000924 0006 0030	699	ORI.B	*30H,D6	ELSE NUM. CONVERSION
000928 6000 000A	700	BRA	STCHAR	
00092C 0406 000A	701	ALCHAR SUB.B	*0AH,D6	ALPHA CONVERSION
000930 0606 0041	702	ADD.B	*41H,D6	
000934 10C6	703	STCHAR MOVE.B	D6,[A0]+	STORE CHAR IN DISPLAY BUF.
000936 4E75	704	RTS		
	705			
	706			
	707			
	708 *			
	709 *****			
	710 *			
	711 *	THIS ROUTINE TAKES THE A/D VALUE READ BY DAC IN D2 AND		
	712 *	CONVERTS IT TO A DB VALUE BY SEARCHING THROUGH THE		
	713 *	DB TABLE . THE DB VALUE IS THEN CONVERTED TO ASCII AND		
	714 *	DISPLAYED . THIS PROCESS IS ONLY PERFORMED WHILE IN		
	715 *	CALIBRATION MODE.		
	716 *			
	717 *****			
	718 *			
000938 4286	719	CALDSP CLR.L	D6	
00093A 0C79 0000	720	CMP.W	*0,CALTIM	CHECK FOR END OF PERIOD
000942 8600 FF5C	721	BNE	TLOOP	IF NOT RETURN
000946 2C39 0000	722	MOVE.L	CALSUM,D6	STORE SUM VALUE
00094C 6100 00E4	723	BSR	SQRT	CALC SQ. ROOT OF MEAN SQ.
000950 2E3C	724	MOVE.L	*DBLEN,D7	GET END OF DB TABLE
000956 0487	725	SUB.L	*DBHEX,D7	CALC LENGTH OF DB TABLE
00095C 41F9 0000	726	LEA.L	DBHEX,A0	POINT TO BEGINNING OF DB TABLE
000962 BC70 7000	727	CALOP CMP.W	0[A0,D7],D6	SEARCH TABLE FOR IN VALUE
000966 8C00 0010	728	BGE	CALFND	MATCH FOUND
00096A 0487	729	SUB.L	*1,D7	DECR. TABLE POINTER
000970 51CF FFF0	730	DBRA	D7,CALOP	
000974 6000 FF2A	731	BRA	TLOOP	RETURN IF SEARCH FAILED
000978 41F9 0000	732	CALFND LEA.L	DBTAB,A0	POINT TO DB TRANSLATION TAB.
00097E 3C30 7000	733	MOVE.W	0[A0,D7],D6	SAVE DB VALUE
000982 41F9 0000	734	LEA.L	CALMSG,A0	POINT TO CAL MSG. BUFFER
000986 D1FC	735	ADD.L	*5,A0	POINT TO MIDDLE OF MSG.
00098E 4247	736	CLR.W	D7	ZERO DIGIT COUNTER
000990 10BC 0020	737	MOVE.B	*20H,[A0]	SPACE FIRST DIGIT
000994 0C46 2710	738	CMP.W	*10000,D6	SEE IF >= 10,000
000998 6D00 000A	739	BLT	CAL1	
00099C 0446 2710	740	SUB.W	*10000,D6	
0009A0 10BC 0031	741	MOVE.B	*31H,[A0]	STORE ASCII 1
0009A4 D1FC	742	CAL1 ADD.L	*1,A0	INCR MSG PTR
0009AA 0C46 03E8	743	CAL2 CMP.W	*1000,D6	CONVERT THOUSANDS DIGIT
0009AE 6D00 000C	744	BLT	CAL2A	
0009B2 0446 03E8	745	SUB.W	*1000,D6	
0009B6 0647 0001	746	ADD.W	*1,D7	
0009BA 60EE	747	BRA	CAL2	
0009BC 0007 0030	748	CAL2A OR.B	*30H,D7	CONVERT DIGIT TO ASCII

0009C0 10C7	749	MOVE.B	D7,[A0]+	
0009C2 4247	750	CLR.W	D7	
0009C4 0C46 0064	751 CAL3	CMP.W	*100,D6	CONVERT HOUNDRS DIGIT
0009C8 6D00 000C	752	BLT	CAL3A	
0009CC 0446 0064	753	SUB.W	*100,D6	
0009D0 0647 0001	754	ADD.W	*1,D7	
0009D4 60EE	755	BRA	CAL3	
0009D6 0007 0030	756 CAL3A	OR.B	*30H,D7	CONVERT DIGIT TO ASCII
0009DA 10C7	757	MOVE.B	D7,[A0]+	
0009DC 10FC 002E	758	MOVE.B	*2EH,[A0]+	
0009E0 4247	759	CLR.W	D7	
0009E2 0C46 000A	760 CAL4	CMP.W	*10,D6	
0009E6 6D00 000C	761	BLT	CAL4A	CONVERT TENS DIGIT
0009EA 0446 000A	762	SUB.W	*10,D6	
0009EE 0647 0001	763	ADD.W	*1,D7	
0009F2 60EE	764	BRA	CAL4	
0009F4 0007 0030	765 CAL4A	OR.B	*30H,D7	
0009F8 10C7	766	MOVE.B	D7,[A0]+	
0009FA 0006 0030	767	OR.B	*30H,D6	CONVERT UNITS DIGIT
0009FE 1086	768	MOVE.B	D6,[A0]	
000A00 41F9 0000	769	LEA.L	CALMSG,A0	POINT TO CAL MESSAGE BUFFER
000A06 0839 0000	770	BTST	*0,CALFLG	SEE IF STILL IN CAL MODE
000A0E 6600 0008	771	BNE	CALEND	YES-DISPLAY CAL MSG
000A12 41F9 0000	772	LEA.L	BOOMSG1,A0	ELSE DISPLAY BOOM MSG
000A18 6100 065E	773 CALEND	BSR	DSPMSG	DISPLAY CAL MESSAGE
000A1C 23FC	774	MOVE.L	*00,CALSUM	RESET CAL. SUM
000A26 33FC 0FA0	775	MOVE.W	*4000,CALTIM	RESET CAL. CLOCK
000A2E 6000 FE70	776	BRA	TLOOP	RETURN TO WAIT LOOP
	777			
	778 *			
	779 *****			
	780 *			
	781 *	THIS ROUTINE CALCULATES THE SQUARE ROOT OF THE		
	782 *	VALUE IN D6 . THE RESULT IS RETURNED IN D6. REGISTERS		
	783 *	D5 AND D7 ARE USED FOR SCRATCH		
	784 *			
	785 *****			
	786 *			
000A32 2E06	787 SQRT	MOVE.L	D6,D7	SAVE INITIAL VALUE
000A34 E287	788 HLFLOP	ASR.L	*01,D7	HALVE THE VALUE
000A36 2A07	789	MOVE.L	D7,D5	
000A38 CAC5	790	MULU	D5,D5	SQUARE THE HALF
000A3A BA86	791	CMP.L	D6,D5	SEE IF CLOSE
000A3C 6EF6	792	BGT	HLFLOP	IF NOT DO AGAIN
000A3E 0687	793 INCLOP	ADD.L	*01,D7	INCR. BACK UP
000A44 2A07	794	MOVE.L	D7,D5	SAVE FOR SQUARE
000A46 CAC5	795	MULU	D5,D5	SQUARE THE VALUE
000A48 BA86	796	CMP.L	D6,D5	SEE IF SQRT MATCH
000A4A 6DF2	797	BLT	INCLOP	IF NOT DO AGAIN
000A4C 4286	798	CLR.L	D6	

```

000A4E 3C07      799      MOVE.W    D7,D6      PUT SQUARE ROOT IN D6
000A50 4E75      800      RTS
801
802
803
804 *
805 #####
806 *
807 *                      DAC
808 *
809 *      THIS IS THE A/D INTERRUPT SERVICE ROUTINE. AN INTERRUPT
810 *      WILL OCCUR EVERY 125 USEC. THE INPUT DATA IS EITHER
811 *      STORED IN BRAM IF IT IS AN EVENT OR AVERAGED BY CALLING
812 *      RAT. DAC ALSO MAINTAINS THE PEAK VALUE DURING AN EVENT
813 *      AND CHECKS FOR FALLING SLOPES TO ENABLE TIMER 2.
814 *
815 *      THE REGISTERS MAINTAINED BY DAC ARE :
816 *
817 *      D0 - NEWEST DATA      A0 - GENERAL USE
818 *      D1 - OLDEST DATA     A1 - BEGINNING OF EVENT (FLAG 1)
819 *      D2 - CURRENT PEAK     A2 - DOWN CROSSING (FLAG 2)
820 *      D3 - AVERAGE         A3 - CURRENT DATA POINT (FLAG 3)
821 *      D4 - MOVING TOTAL     A4 - PEAK VALUE POINTER (FLAG 4)
822 *      D5 - GENERAL USE     A5 - NEGATIVE PEAK POINTER
823 *      D6 - "               A6 - OLDEST RAT VALUE POINTER
824 *      D7 - "               A7 - STACK POINTER
825 *
826 *
827 *      TRIGR1 - POSITIVE PULSE TIME
828 *      TRIGR2 - SECOND JUMP VALUE
829 *      TRIGR3 - PEAK TRIGGER VALUE
830 *      TIMR1  - EVENT TIMER
831 *      TIMR2  - INTERVAL TIMER
832 *      TEST   - STATUS WORD
833 *
834 *      BIT 0      1 = RISING SLOPE  0 = FALLING SLOPE
835 *      BIT 1      1 = TIMER 1 ON    0 = TIMER 1 OFF
836 *      BIT 2      1 = TIMER 2 ON    0 = TIMER 2 OFF
837 *      BIT 3      1 = INITIALIZE RAT 0 = INIT. COMPLETE
838 *
839 *
840 #####
841 *
842
843
000A52 4E71      844 DAC      NOP
000A54 48E7 0380 845      MOVEM.L  D6-D7/A0,-(A7) SAVE REGISTERS
000A58 4280      846      CLR.L    D0
000A5A 3039 0001 847      MOVE.W    ADC,D0      GET A/D DATA
848

```

000A60	0839	0000	849	BTST	*0,CALFLG	CHECK FOR CAL. MODE
000A68	6700	0042	850	BEQ	DACCONT	IF NOT CONTINUE
000A6C	0C79	0000	851	CMP.W	*0,CALTIM	CHECK FOR END OF CAL PERIOD
000A74	6700	0222	852	BEQ	DACRET	IF YES RETURN
000A78	0479	0001	853	SUB.W	*1,CALTIM	ELSE DECR. PERIOD COUNTER
000A80	0839	0000	854	BTST	*0,ADSPFLG	
000A88	6600	020E	855	BNE	DACRET	
000A8C	4286		856	CLR.L	D6	
000A8E	3C00		857	MOVE.W	D0,D6	GET A/D VALUE
000A90	0486		858	SUB.L	*8000H,D6	SUBTRACT A/D OFFSET
000A96	CDC6		859	MULS	D6,D6	SQUARE INPUT VALUE
000A98	8CFC	0FA0	860	DIVU	*4000,D6	DIVIDE BY NO. OF SAMPLES
000A9C	0286		861	AND.L	*0FFFFH,D6	MASK OFF REMAINDER
000AA2	DDB9	0000	862	ADD.L	D6,CALSUM	SUM RESULT
000AA8	6000	01EE	863	BRA	DACRET	RETURN
000AAC	0839	0003	864	DACCONT	BTST	IS IT RAT INIT
000AB4	6600	01DC	865	BNE	AMBAVG	YES; GO AVERAGE DATA
000AB8	0C79	0001	866	CMPI.W	*01H,OFF	IF DISPLAY IS ON
000AC0	6700	01D6	867	BEQ	DACRET	RETURN
000AC4	B7C9		868	CMPA.L	A1,A3	FLAG1 = FLAG3 ?
000AC6	6700	013C	869	BEQ	AMBIENT	YES
000ACA	D7FC		870	SAVEVT	ADDA.L	INCR. FLAG3
000AD0	3680		871	MOVE.W	D0,[A3]	STORE NEW DATA
000AD2	04B9		872	SUB.L	*1,EVTTCNT	DECR TIMER 1 COUNTER
000ADC	6600	001A	873	BNE	CONSAV	IF = 0; END EVENT
000AE0	2C0B		874	MOVE.L	A3,D6	SAVE CURRENT POINTER
000AE2	9C8C		875	SUB.L	A4,D6	SUB PEAK LOCATION
000AE4	0C86		876	CMP.L	*1600,D6	IS PEAK WITHIN 100 MS
000AEA	6C00	01DA	877	BGE	ENDBOOM	IF NO THEN END OF EVENT
000AEE	06B9		878	ADD.L	*800,EVTTCNT	ELSE ADD ANOTHER 100 MS
000AF8	0C79	0001	879	CONSAV	CMPI.W	*1,DATSAV
000B00	6700	0196	880	BEQ	DACRET	
000B04	0839	0002	881	BTST	*2,TEST	IF TIMER 2 ACTIVE
000B0C	6700	0010	882	BEQ	CONEVNT	
000B10	04B9		883	SUB.L	*1,T2CNT	DECREMENT TIMER COUNTER
000B1A	6700	01AA	884	BEQ	ENDBOOM	IF 0; END EVENT
000B1E	B082		885	CONEVNT	CMP.L	D2,D0
000B20	6F00	0006	886	BLE	CHKMPK	NO
000B24	2400		887	MOVE.L	D0,D2	ELSE, RESET PEAK, AND
000B26	284B		888	MOVEA.L	A3,A4	RESET PEAK PTR (FLAG4)
000B28	B0B9	0000	889	CHKMPK	CMP.L	NEGPK,D0
000B2E	6E00	000A	890	BGT	GETSLOP	CHECK NEG. PEAK
000B32	23C0	0000	891	MOVE.L	D0,NEGPK	
000B38	2A4B		892	MOVEA.L	A3,A5	
			893			
			894			
			895			
			896			
000B3A	B081		897	GETSLOP	CMP.L	D1,D0
000B3C	6E00	0006	898	BGT	RISING	CHK NEW DATA WITH OLD
						IF LARGER, RISING SLOPE

000B40 6D00 0070	899	BLT	FALLING	ELSE DECREASING SLOPE
	900			
	901 *			
	902 *	SLOPE OF DATA IS RISING		
	903 *			
	904			
	905			
000B44 08F9 0000	906 RISING	BSET	*0,TEST	SET SLOPE BIT TO RISING
000B4C B0B9 0000	907	CMP.L	TR2LOW,D0	IF NEW DATA < TRG LOW
000B52 6D00 0144	908	BLT	DACRET	RETURN
000B56 B0B9 0000	909	CMP.L	TR2HIGH,D0	IF NEW DATA > TRG HIGH
000B5C 6E00 0012	910	BGT	RISE1	CHECK IF T2 ACTIVE
000B60 0839 0002	911	BTST	*2,TEST	IF T2 NOT ACTIVE
000B68 6700 0082	912	BEQ	STRT2	START T 2
000B6C 6000 012A	913	BRA	DACRET	ELSE RETURN
000B70 0839 0002	914 RISE1	BTST	*2,TEST	IF T2 NOT ACTIVE
000B78 6700 011E	915	BEQ	DACRET	RETURN
000B7C B4B9 0000	916 RSTT2	CMP.L	TRIGR3H,D2	WAS LAST PEAK HIGH ENOUGH?
000B82 6E00 0022	917	BGT	RST2CON	YES-CONTINUE
000B86 2649	918	MOVEA.L	A1,A3	ELSE RESET DATA POINTERS
000B88 D7FC	919	ADDA.L	*2,A3	
000B8E 3680	920	MOVE.W	D0,[A3]	
000B90 2400	921	MOVE.L	D0,D2	
000B92 284B	922	MOVEA.L	A3,A4	
000B94 2A4B	923	MOVEA.L	A3,A5	
000B96 23C0 0000	924	MOVE.L	D0,NEGPK	
000B9C 23F9 0000	925	MOVE.L	TEMPT1,EVNTCNT	
000BA6 08B9 0002	926 RST2CON	BCLR	*2,TEST	ELSE RESET TIMER 2
	927			
	928 *	TURN OFF TIMER 2		
	929			
	930			
000BAE 6000 00E8	931	ERA	DACRET	RETURN
	932			
	933 *			
	934 *	SLOPE OF DATA IS FALLING		
	935 *			
	936			
	937			
000BB2 08B9 0000	938 FALLING	BCLR	*0,TEST	SET SLOPE BIT TO FALLING
000BBA B0B9 0000	939	CMP.L	TR2HIGH,D0	IF NEW DATA > TRG HIGH
000BC0 6E00 00D6	940	BGT	DACRET	RETURN
000BC4 B0B9 0000	941	CMP.L	TR2LOW,D0	IF NEW DATA < TRG LOW
000BCA 6D00 0012	942	BLT	FALL1	CHECK IF T2 ACTIVE
000BCE 0839 0002	943	BTST	*2,TEST	IF T2 NOT ACTIVE
000BD6 6700 0014	944	BEQ	STRT2	START T2
000BDA 6000 00BC	945	BRA	DACRET	ELSE RETURN
000BDE 0839 0002	946 FALL1	BTST	*2,TEST	IF T2 NOT ACTIVE
000BE6 6700 00B0	947	BEQ	DACRET	RETURN
000BEA 6090	948	BRA	RSTT2	ELSE RESET T2

000BEC 244B	949	STRT2	MOVEA.L	A3,A2	ELSE SET XING POINT (FLAG2)
000BEE 08F9 0002	950		BSET	#2,TEST	SET TIMER2 BIT ON
	951				
	952 *			START TIMER 2	
	953				
000BF6 23F9 0000	954		MOVE.L	TEMPT2,T2CNT	
000C00 6000 0096	955		BRA	DACRET	RETURN
	956				
	957 *				
	958 *			CHECK FOR START OF AN EVENT	
	959 *				
	960				
	961				
000C04 4E71	962	AMBIENT	NOP		
000C06 0C79 0001	963		CMPI.W	#1,DATSAV	
000C0E 6700 001A	964		BEQ	NEW EVT	
000C12 B0B9 0000	965		CMP.L	TR2HIGH,D0	NEW DATA > TRG HIGH
000C18 6E00 0010	966		BGT	NEW EVT	YES - NEW EVENT
000C1C B0B9 0000	967		CMP.L	TR2LOW,D0	NEW DATA < TRG LOW
000C22 6D00 0006	968		BLT	NEW EVT	YES - NEW EVENT
000C26 6000 006A	969		BRA	AMBAVG	ELSE AVG NOISE
	970				
	971 *				
	972 *			A NEW EVENT HAS BEEN DETECTED	
	973 *				
	974				
	975				
000C2A 4E71	976	NEW EVT	NOP		
000C2C 08B9 0000	977		BCLR	#0,BRAMON	TURN ON BAT. RAM
000C34 343C 0028	978		MOVE.W	#40,D2	SET DELAY COUNT
000C38 6100 047E	979		BSR	DELAY	DELAY 40 USEC.
	980			* START TIMER 1	
	981				
000C3C 08F9 0001	982		BSET	#1,TEST	SET TIMER 1 STATUS ON
000C44 4286	983		CLR.L	D6	
000C46 3C39 0000	984		MOVE.W	TIMER1,D6	
000C4C CCFC 0010	985		MULU	#16,D6	SET UP COUNTER FOR TIMER1
000C50 0686	986		ADD.L	#160,D6	
000C56 23C6 0000	987		MOVE.L	D6,TEMPT1	
000C5C 23F9 0000	988		MOVE.L	TEMPT1,EVTTCNT	
000C66 4286	989		CLR.L	D6	
000C68 3C39 0000	990		MOVE.W	TIMER2,D6	
000C6E 8CFC 0005	991		DIVU	#5,D6	
000C72 CCFC 0008	992		MULU	#8,D6	
000C76 23C6 0000	993		MOVE.L	D6,TEMPT2	
000C7C D7FC	994		ADDA.L	#2,A3	INCR. FLAG3 (CUR. DATA)
000C82 3680	995		MOVE.W	D0,[A3]	STORE DATA POINT
000C84 2200	996		MOVE.L	D0,D1	STORE IN OLD DATA
000C86 2400	997		MOVE.L	D0,D2	
000C88 23C0 0000	998		MOVE.L	D0,NEGPK	

000C8E 6000 0008	999	BRA	DACRET	RETURN
	1000			
	1001 *			
	1002 *	NOW EVENT SO JUST AVERAGE THE DATA		
	1003 *			
	1004			
	1005			
000C92 6100 0052	1006	AMBAVG	BSR	RAT
000C96 2200	1007	MOVE.L	D0,D1	UPDATE AVG TABLE
	1008			STORE NEW DATA IN OLD
	1009 *			
	1010 *	RETURN FROM INTERRUPT		
	1011 *			
	1012			
	1013			
000C98 4E71	1014	DACRET	NOP	
000C9A B7FC	1015	CMPL.L	*ENDBRM,A3	CHECK FOR END OF RAM
000CA0 6C00 3024	1016	BGE	ENDBOOM	YES; EVALUATE LAST EVENT
000CA4 41F9 0002	1017	LEA.L	PIA,A0	
000CAA 1E39 0000	1018	MOVE.B	PORTBC,D7	RESET A/D INTERRUPT
000CB0 08C7 0000	1019	BSET	*0,D7	
000CB4 0887 0001	1020	BCLR	*1,D7	
000CB8 1147 0007	1021	MOVE.B	D7,BCNTL[A0]	
000CBC 1E28 0005	1022	MOVE.B	BDATA[A0],D7	
000CC0 4CDF 01C0	1023	MOVEM.L	[A7]+,D6-D7/A0	RESTORE REGISTERS
000CC4 4E73	1024	RTE		
	1025			
	1026 *			
	1027 *	END OF EVENT DETECTED		
	1028 *			
	1029			
	1030			
000CC6 4E71	1031	ENDBOOM	NOP	
000CC8 6100 14C2	1032	BSR	TIMSUB	GO ANALYZE DATA
000CCC 60CA	1033	BRA	DACRET	RETURN
	1034			
000CCE 4E71	1035	RAMFL	NOP	
000CD0 08F9 0000	1036	BSET	*0,BRAMON	TURN OFF BAT. RAM
000CD8 41F9 0000	1037	LEA.L	FULLMSG,A0	BRAM FULL MESSAGE DISPLAYED
000CDE 6100 0398	1038	BSR	DSPMSG	
000CE2 4E71	1039	ENDLES	NOP	
000CE4 60FC	1040	BRA	ENDLES	ENDLESS LOOP
	1041			
	1042 *			
	1043	*****		
	1044 *			
	1045 *	RAT - THIS ROUTINE MAINTAINS A RUNNING AVERAGE OF THE INPUT		
	1046 *	DATA . THIS AVERAGES OUT THE NOISE RECEIVED. THIS		
	1047 *	ROUTINE IS ONLY CALLED WHILE NO EVENT IS BEING		
	1048 *	RECORDED .		

```

1049 *
1050 * D0 - NEWEST DATA
1051 * D3 - AVERAGE          BOTRAT - BOTTOM OF RAT
1052 * D4 - MOVING TOTAL      A6 - OLDEST RAT VALUE POINTER
1053 *
1054 *
1055 * TRIGGER1 - FIRST JUMP VALUE (OFFSET)
1056 * SIZE1 - 1 SEC. SIZE BUFFER VAL
1057 * SIZE2 - 2 SEC. SIZE BUFFER VAL
1058 * SIZE3 - 4 SEC. SIZE BUFFER VAL
1059 * SIZE4 - 8 SEC. SIZE BUFFER VAL
1060 *
1061 *
1062 *
1063
1064 *****
1065 *
1066
000CE8 0C79 0002 1067 RAT      CMPI.W    *2,PWRUP
000CEE 6E00 004A 1068      BGT      PWRDEL
000CF2 4286      1069      CLR.L    D6
000CF4 3C16      1070      MOVE.W   {A6},D6
000CF6 9886      1071      SUB.L    D6,D4      SUM = SUM - OLD AVG.
000CF8 D880      1072      ADD.L    D0,D4      SUM = SUM + NEW DATA
000CFA 3C80      1073      MOVE.W   D0,{A6}    SAVE DATA IN RAT TABLE
000CFC 2604      1074      MOVE.L    D4,D3      MOVE IN SUM FOR DIVIDE
000CFE E083      1075      ASR.L     *8,D3      START THE DIVIDE
000D00 DDFC      1076      ADDA.L    *2,A6      INCR RAT POINTER
000D06 BDFC      1077      CMPA.L    *ENDRAT,A6  A6 > TOP OF RAT
000D0C 6F00 004C 1078      BLE      ONESEC   NO GO TO SHIFTS
000D10 2C79 0000 1079      MOVE.L    BOTRAT,A6  ELSE RESET RAT POINTER
000D16 0839 0003 1080      BTST     *3,TEST  CHECK FOR PWR UP DELAY BIT
000D1E 6700 003A 1081      BEQ      ONESEC   IF OFF CONTINUE
000D22 0479 0001 1082      SUB.W     *1,PWRUP  DECR PWR UP DELAY COUNTER
000D2A 6800 002E 1083      BNE      ONESEC
000D2E 08B9 0003 1084      BCLR     *3,TEST  CLEAR RAT INIT STAT
000D36 6000 0022 1085      BRA      ONESEC
000D3A 0479 0001 1086 PWRDEL  SUBI.W    *1,PWRCNT
000D42 6800 0054 1087      BNE      STOREND
000D46 0479 0001 1088      SUBI.W    *1,PWRUP
000D4E 33FC 0FA0 1089      MOVE.W    *4000,PWRCNT
000D56 6000 0040 1090      BRA      STOREND
1091
1092
000D5A 0CB9      1093 ONESEC  CMP.L     *SIZE1,BOTRAT  1 SEC. AVG. ?
000D64 6800 0008 1094      BNE      TWOSEC   NO,CHECK NEXT
000D68 E883      1095      ASR.L     *04,D3    SHIFT
000D6A 6000 002C 1096      BRA      STOREND   EXIT
1097
000D6E 0CB9      1098 TWOSEC  CMP.L     *SIZE2,BOTRAT  2 SEC. AVG ?

```

000D78 6600 0008	1099	BNE	FOURSEC	NO,CHECK NEXT
000D7C EC83	1100	ASR.L	*06,D3	SHIFT
000D7E 6000 0018	1101	BRA	STOREND	EXIT
	1102			
000D82 0CB9	1103	FOURSEC CMP.L	*SIZE3,BOTRAT	4 SEC. AVG ?
000D8C 6600 0008	1104	BNE	EIGHTSEC	NO,CHECK NEXT
000D90 EC83	1105	ASR.L	*06,D3	SHIFT
000D92 6000 0004	1106	BRA	STOREND	EXIT
	1107			
000D96 EE83	1108	EIGHTSEC ASR.L	*07,D3	MUST BE 8 SEC. AVG.
	1109			
000D98 4E71	1110	STOREND NOP		
000D9A 4E75	1111	RTS		RETURN
	1112			
	1113			
	1114 *			
	1115 *****			
	1116 *			
	1117 *			THIS IS WHERE THE REAL TIME CLOCK IS SET. THE TIME DATA
	1118 *			IS CONTAINED IN THE ARRAY SEC1 WITH THE ADDRESS BYTES
	1119 *			IN CLKTB. THE TIME IS OUTPUT 1 BYTE AT A TIME WITH THE
	1120 *			DATA IN THE LOW NIBBLE AND THE ADDRESS IN THE HIGH
	1121 *			NIBBLE. THE TIME IS OUTPUT IN THE ORDER SS,MM,HH,DD,MM,YY.
	1122 *			
	1123 *****			
	1124 *			
	1125			
000D9C 48E7 E0F0	1126	WRTCLK MOVEM.L	D0-D2/A0-A3,-[A7]	
000DA0 41F9 0002	1127	LEA.L	PIA,A0	GET I/O PORT ADDRESS
000DA6 08B9 0002	1128	BCLR.B	*2,PORTBC	MAKE IT A DIR. PORT
000DAE 1179 0000	1129	MOVE.B	PORTBC,BCNTL[A0]	OUTPUT DIRECTION
000DB6 117C 00FF	1130	MOVE.B	*0FFH,BDDR[A0]	MAKE ALL BITS OUTPUT
000DBC 0039 000C	1131	OR.B	*0CH,PORTBC	
000DC4 1179 0000	1132	MOVE.B	PORTBC,BCNTL[A0]	
000DCC 117C 0020	1133	MOVE.B	*HOLD,ADATA[A0]	HOLD CLOCK
000DD2 45F9 0000	1134	LEA.L	SEC1,A2	GET TIMER TABLE
000DD8 47F9 0000	1135	LEA.L	CLKTB,A3	GET TIMER CONTROL WORDS
000DDE 7E05	1136	MOVEQ	*5,D7	SET COUNTER
000DE0 0039 0080	1137	OR.B	*80H,HOUR1	SET FOUR 24 HOUR CLOCK
000DE8 1012	1138	WRTCLK1 MOVE.B	[A2],D0	GET TIME VALUE
000DEA 0200 000F	1139	AND.B	*0FH,D0	GET LOWER NIBBLE
000DEE 801B	1140	OR.B	[A3]+,D0	STICK ON CONTROL BITS
000DF0 6100 0052	1141	BSR	WRITEC	GO OUTPUT VALUE
000DF4 101A	1142	MOVE.B	[A2]+,D0	GET VALUE AGAIN
000DF6 E808	1143	LSR.B	*4,D0	SHIFT DOWN UPPER NIBBLE
000DF8 801B	1144	OR.B	[A3]+,D0	STICK ON CONTROL
000DFA 6100 0048	1145	BSR	WRITEC	GO OUTPUT VALUE
000DFE 51CF FFE8	1146	DBRA	D7,WRTCLK1	IF MORE,DO IT AGAIN
000E02 08B9 0002	1147	BCLR	*2,PORTBC	MAKE IT A DIR PORT
000E0A 1179 0000	1148	MOVE.B	PORTBC,BCNTL[A0]	OUTPUT CTRL

```

000E12 117C 00F0 1149      MOVE.B    *0F0H,BDDR[A0] SET DATA FOR OUTPUT
000E18 08F9 0002 1150      BSET.B    *2,PORTBC    MAKE IT A DATA PORT
000E20 08B9 0003 1151      BCLR.B    *3,PORTBC
000E28 117C 0000 1152      MOVE.B    *0,ADATA[A0]  ZERO DATA
000E2E 1179 0000 1153      MOVE.B    PORTBC,BCNTL[A0]
000E36 0239 003F 1154      AND.B     *3FH,HOURL    RESET 24 HOUR BIT
000E3E 4CDF 0F07 1155      MOVEM.L   [A7]+,D0-D2/A0-A3
000E42 4E75          1156      RTS
                                1157
                                1158
000E44 243C          1159 WRITEC  MOVE.L    *500,D2
000E4A 6100 026C 1160      BSR        DELAY
000E4E 1140 0005 1161      MOVE.B    D0,BDATA[A0]
000E52 243C          1162      MOVE.L    *100,D2
000E58 6100 025E 1163      BSR        DELAY
000E5C 117C 00A0 1164      MOVE.B    *WRITE,ADATA[A0]
000E62 243C          1165      MOVE.L    *6,D2
000E68 6100 024E 1166      BSR        DELAY
000E6C 117C 0020 1167      MOVE.B    *HOLD,ADATA[A0]
000E72 4E75          1168      RTS
                                1169
                                1170
                                1171 *
000E72 *****
000E73 *
000E74 * THIS SECTION READS THE CURRENT TIME FROM THE REAL TIME CLOCK.
000E75 * THE TIME DATA READ IS STORED IN CLK1,CLK2,CLK3,AND THE DISPLAY
000E76 * BUFFER AKDATA.TO READ THE TIME, THE ADDRESS BYTE IN CLKTB
000E77 * IS OUTPUT AND THEN THE CORRESPONDING TIME VALUE IS READ. THE
000E78 * TIME IS READ IN THE ORDER OF : SEC,MIN,HOURL,DAY,MONTH,YEAR.
000E79 *
000E80 *****
000E81 *
000E82
000E83
000E74 48E7 E0F0 1184 RDCLK  MOVEM.L   D0-D2/A0-A3,-[A7]
000E78 41F9 0002 1185      LEA.L     PIA,A0      GET I/O PORT ADDRESS
000E7E 08F9 0003 1186      BSET.B    *3,PORTBC
000E86 1179 0000 1187      MOVE.B    PORTBC,BCNTL[A0] OUTPUT CONTROL
000E8E 117C 0020 1188      MOVE.B    *HOLD,ADATA[A0] HOLD RTC
000E94 45F9 0000 1189      LEA.L     SEC1,A2      GET TOP OF TIMER TABLE
000E9A 47F9 0000 1190      LEA.L     CLKTB,A3     GET ADDRESS TABLE FOR RTC
000EA0 7E05          1191      MOVEQ     *5,D7      SET COUNT FOR SIX PARAMETERS
000EA2 343C 0064 1192      MOVE.W    *100,D2     DELAY 100 USEC.
000EA6 6100 0210 1193      BSR        DELAY
000EAA 4246          1194 RDCLK1  CLR        D6
000EAC 101B          1195      MOVE.B    [A3]+,D0     PUT ADDRESS IN D0
000EAE 6100 0140 1196      BSR        READC      GET TIMER VALUE
000EB2 1C00          1197      MOVE.B    D0,D6      SAVE PARAMETER
000EB4 101B          1198      MOVE.B    [A3]+,D0     GET NEXT LOWER NIBBLE ADDRESS

```

000EB6	6100	0138	1199	BSR	READC	GET VALUE
000EBA	E948		1200	LSL	*4,D0	SHIFT INTO HIGH NIBBLE
000EBC	8C00		1201	OR.B	D0,D6	COMBINE WITH LOW NIBBLE
000EBE	14C6		1202	MOVE.B	D6,[A2]+	SAVE IN TABLE
000ECO	51CF	FFE8	1203	DBRA	D7,RDCLK1	CONTINUE FOR SIX TIMES
000EC4	117C	0000	1204	MOVE.B	*0,ADATA[A0]	TURN OFF HOLD
000ECA	08B9	0003	1205	BCLR.B	*3,PORTBC	
000ED2	1179	0000	1206	MOVE.B	PORTBC,BCNTL[A0]	OUTPUT CONTROL
000EDA	41F9	0000	1207	LEA.L	SEC1,A0	GET TOP OF TIMER TABLE
000EE0	43F9	0000	1208	LEA.L	CLK1,A1	
000EE6	0239	003F	1209	AND.B	*3FH,HOURL	RESET 24 HOUR BIT
000EEE	343C	0002	1210	MOVE.W	*2,D2	SET COUNTER FOR 3 PARAMETERS
000EF2	1018		1211	COMBIN	MOVE.B	[A0]+,D0
000EF4	1218		1212	MOVE.B	[A0]+,D1	GET SECOND VALUE
000EF6	0240	00FF	1213	AND.W	*00FFH,D0	MASK OFF EXTRA BITS
000EFA	0241	00FF	1214	AND.W	*00FFH,D1	MASK OFF EXTRA BITS
000EFE	E149		1215	LSL.W	*8,D1	MOVE TO HIGH BYTE
000F00	8041		1216	OR.W	D1,D0	COMBINE THE VALUES
000F02	32C0		1217	MOVE.W	D0,[A1]+	STORE IN CLK TABLE
000F04	51CA	FFEC	1218	DBRA	D2,COMBIN	
000F08	4280		1219	CLR.L	D0	
000F0A	43F9	0000	1220	LEA.L	AKDATA,A1	UPDATE DISPLAY ARRAY
000F10	1039	0000	1221	MOVE.B	YEAR1,D0	
			1222 *			
			1223 *		THIS CODE GETS EACH DIGIT OF THE TIME & DATE AND	
			1224 *		CONVERTS IT TO ASCII BEFORE STORING IT INTO THE	
			1225 *		DISPLAY ARRAY AKDATA.	
			1226 *			
000F16	E808		1227	LSR.B	*4,D0	000F18 0200 000F 1228 AND.B *0FH,D0
000F1C	0000	0030	1229	OR.B	*30H,D0	
000F20	12C0		1230	MOVE.B	D0,[A1]+	
000F22	1039	0000	1231	MOVE.B	YEAR1,D0	
000F28	0200	000F	1232	AND.B	*0FH,D0	
000F2C	0000	0030	1233	OR.B	*30H,D0	
000F30	12C0		1234	MOVE.B	D0,[A1]+	
000F32	1039	0000	1235	MOVE.B	MONTH1,D0	
000F38	E808		1236	LSR.B	*4,D0	
000F3A	0200	000F	1237	AND.B	*0FH,D0	
000F3E	0000	0030	1238	OR.B	*30H,D0	
000F42	12C0		1239	MOVE.B	D0,[A1]+	
000F44	1039	0000	1240	MOVE.B	MONTH1,D0	
000F4A	0200	000F	1241	AND.B	*0FH,D0	
000F4E	0000	0030	1242	OR.B	*30H,D0	
000F52	12C0		1243	MOVE.B	D0,[A1]+	
000F54	1039	0000	1244	MOVE.B	DAY1,D0	
000F5A	E808		1245	LSR.B	*4,D0	
000F5C	0200	000F	1246	AND.B	*0FH,D0	
000F60	0000	0030	1247	OR.B	*30H,D0	
000F64	12C0		1248	MOVE.B	D0,[A1]+	
000F66	1039	0000	1249	MOVE.B	DAY1,D0	000F6C 0200 000F 1250 AND.B *0FH,D0

000F70	0000	0030	1251	OR.B	*30H,D0		
000F74	12C0		1252	MOVE.B	D0,[A1]+		
000F76	12FC	002E	1253	MOVE.B	*2EH,[A1]+		
000F7A	1039	0000	1254	MOVE.B	HOUR1,D0		
000F80	E808		1255	LSR.B	*4,D0		
000F82	0200	000F	1256	AND.B	*0FH,D0		
000F86	0000	0030	1257	OR.B	*30H,D0		
000F8A	12C0		1258	MOVE.B	D0,[A1]+		
000F8C	1039	0000	1259	MOVE.B	HOUR1,D0		
000F92	0200	000F	1260	AND.B	*0FH,D0		
000F96	0000	0030	1261	OR.B	*30H,D0		
000F9A	12C0		1262	MOVE.B	D0,[A1]+		
000F9C	12FC	002E	1263	MOVE.B	*2EH,[A1]+		
000FA0	1039	0000	1264	MOVE.B	MIN1,D0		
000FA6	E808		1265	LSR.B	*4,D0		
000FA8	0200	000F	1266	AND.B	*0FH,D0		
000FAC	0000	0030	1267	OR.B	*30H,D0		
000FB0	12C0		1268	MOVE.B	D0,[A1]+		
000FB2	1039	0000	1269	MOVE.B	MIN1,D0		
000FB8	0200	000F	1270	AND.B	*0FH,D0		
000FBC	0000	0030	1271	OR.B	*30H,D0		
000FC0	12C0		1272	MOVE.B	D0,[A1]+		
000FC2	4280		1273	CLR.L	D0		
000FC4	12FC	002E	1274	MOVE.B	*2EH,[A1]+		
000FC8	1039	0000	1275	MOVE.B	SEC1,D0		
000FCE	E808		1276	LSR.B	*4,D0		
000FD0	0200	000F	1277	AND.B	*0FH,D0		
000FD4	0000	0030	1278	OR.B	*30H,D0		
000FD8	12C0		1279	MOVE.B	D0,[A1]+		
000FDA	1039	0000	1280	MOVE.B	SEC1,D0		
000FE0	0200	000F	1281	AND.B	*0FH,D0		
000FE4	0000	0030	1282	OR.B	*30H,D0		
000FEB	12C0		1283	MOVE.B	D0,[A1]+		
000FEA	4CDF	0F07	1284	MOVEM.L	{A7!},D0-D2/A0-A3		
000FEE	4E75		1285	RTS			
000FF0	1140	0005	1286	READC	MOVE.B D0,BDATA[A0] OUTPUT ADDRESS		
000FF4	117C	0060	1287		MOVE.B *READ,ADATA[A0] OUTPUT READ COMMAND		
000FFA	343C	0006	1288		MOVE.W *6,D2 000FFE 6100 00B8 1289 BSR DELAY		
001002	1028	0005	1290		MOVE.B BDATA[A0],D0 GET DATA		
001006	0200	000F	1291		AND.B *0FH,D0 MASK OFF EXTRA BITS		
00100A	117C	0020	1292		MOVE.B *HOLD,ADATA[A0] HOLD CLOCK		
001010	4E75		1293		RTS		
			1294				
			1295				
			1296 *				
			1297 *	MEMORY DIAGNOSTIC ERROR ROUTINE			
			1298 *	THIS ROUTINE DISPLAYS THE APPROPRIATE ERROR DETERMINED			
			1299 *	BY THE BITS SET IN D7.			
			1300 *	BIT 0 - ROM CHECK SUM ERROR			
			1301 *	BIT 1 - STATIC RAM ERROR			

```

1302 *   BIT 2 - BATTERY RAM ERROR
1303 *
1304
001012 08F9 0000 1305 MEMERR BSET    #0,BRAMON  TURN OFF BAT. RAM
00101A 48E7 0100 1306        MOVEM.L D7,-[A7]  SAVE D7 DIAGNOSTICS STATUS
00101E 6100 1126 1307        BSR      INITDS    INITIALIZE DISPLAY
001022 4CDF 0080 1308        MOVEM.L [A7]+,D7
001026 0807 0000 1309        BTST    #0,D7      CHECK FOR ROM ERROR
00102A 6700 000C 1310        BEQ     MEM1      GET ROM MESSAGE
00102E 41F9 0000 1311        LEA.L   ROMMSG,A0
001034 6000 001A 1312        BRA     MEMSG
001038 0807 0001 1313 MEM1   BTST    #1,D7      CHECK FOR RAM ERROR
00103C 6700 000C 1314        BEQ     MEM2
001040 41F9 0000 1315        LEA.L   SRAMSG,A0  GET RAM ERROR MESSAGE
001046 6000 0008 1316        BRA     MEMSG
00104A 41F9 0000 1317 MEM2   LEA.L   BRAMSG,A0  MUST BE RAT OR BATTERY ERROR
001050 13FC 0000 1318 MEMSG  MOVE.B   #00,DSPADR  SET UP START ADDRESS POINTER
001058 7C0F      1319        MOVEQ   #15,D6    INIT CHARACTER COUNT
00105A 1E18      1320 MEM3LP  MOVE.B   [A0]+,D7  GET DATA BYTE
00105C E14F      1321        LSL      #8,D7
00105E 1E39 0000 1322        MOVE.B   DSPADR,D7  GET ADDRESS BYTE
001064 6100 1034 1323        BSR      WRDISP   GO WRITE DATA TO DISPLAY
001068 0639 0001 1324        ADD.B   #1,DSPADR  INCR. INDEX
001070 51CE FFE8 1325        DBRA    D6,MEM3LP  DECR. CHARACTER COUNT
001074 4E71      1326 MEMSTP  NOP
001076 60FC      1327        BRA     MEMSTP
1328 *
1329 *****
1330 *
1331 *   THIS ROUTINE DISPLAYS THE MESSAGE POINTED TO
1332 *   BY A0 ONTO THE DISPLAY
1333 *
1334 *****
1335 *
1336
001078 0C79 0000 1337 DSPMSG  CMPI.W   #00,BOOMFLG  IF NOT IN AN EVENT
001080 6700 0010 1338        BEQ     DSPCONT  CONTINUE
001084 0C79 0001 1339        CMPI.W   #01,OFF    IF DISPLAY OFF - EXIT
00108C 6700 0004 1340        BEQ     DSPCONT
001090 4E75      1341        RTS
001092 13FC 0000 1342 DSPCONT  MOVE.B   #00,DSPADR  SET UP START ADDRESS POINTER
00109A 7C0F      1343        MOVEQ   #15,D6    INIT CHARACTER COUNT
00109C 1E18      1344 DSPMLP  MOVE.B   [A0]+,D7  GET DATA BYTE
00109E E14F      1345        LSL      #8,D7
0010A0 1E39 0000 1346        MOVE.B   DSPADR,D7  GET ADDRESS BYTE
0010A6 6100 0FF2 1347        BSR      WRDISP   GO WRITE DATA TO DISPLAY
0010AA 0639 0001 1348        ADD.B   #1,DSPADR  INCR. INDEX
0010B2 51CE FFE8 1349        DBRA    D6,DSPMLP  DECR. CHARACTER COUNT
0010B6 4E75      1350        RTS
1351

```

```

1352 *****
1353 *
1354 *   DELAY ROUTINE - USE THE VALUE IN D2 TO COUNT
1355 *   THE CONTENTS OF D2 CONTAINS THE NUMBER OF USEC'S TO DELAY.
1356 *
1357 *****
1358
0010B8 51CA FFFE 1359 DELAY   DBRA       D2,DELAY
0010BC 4E75      1360         RTS
1361
1362
0010BE 4E73      1363 BUSERR   RTE           BUS ERROR INTERRUPT
0010C0 4E73      1364 ADDRERR RTE           ADDRESS ERROR INTERRUPT
1365
1366
1367 ;::::::::::::::::::::::::::::::::::::::::::::::::::
1368 ;           ROUTINE 'KEYPAD'                               :
1369 ;                                                       :
1370 ; This routine services a keypad interrupt,parses the user :
1371 ; and provides user interface.                             :
1372 ; All function keys are serviced and numeric input         :
1373 ; decoded and stored. Written in 68000 assembler using HP64000 :
1374 ;                                                       :
1375 ;::::::::::::::::::::::::::::::::::::::::::::::::::
1376
0010C2 4E71      1377 KEYPD    NOP
0010C4 48E7 FFFE 1378      MOVEM.L  D0-D7/A0-A6,-[A7]
0010C8 23C9 0000 1379      MOVE.L   A1,CURPNT   SAVE CURRENT DATA POINTER
0010CE 33C3 0000 1380      MOVE.W   D3,CURAVG
0010D4 4EB9 0000 1381      JSR      GETKEY       GET USER INPUT
0010DA 0C79 00FF 1382      CMPI.W   *OFFH,KEY   OFF OR ON REQUEST?
0010E2 6700 00E0 1383      BEQ      OFFON
0010E6 0C79 0001 1384      CMPI.W   *01H,OFF     IF NOT, IS DISPLAY ON?
0010EE 6700 0012 1385      BEQ      BRAFTN     YES, MOVE TO APPROPRAITE FUNCTION
0010F2 0C79 00CC 1386      CMPI.W   *0CCH,KEY
0010FA 6700 0068 1387      BEQ      TOGDSP
0010FE 6000 0FCC 1388      BRA      KEYRET     NO, WAIT TO RECEIVE A DSPON CMD
1389
1390 ;::::::::::::::::::::::::::::::::::::::::::::::::::
1391 ; INPUT FOR KEYS 'A' THROUGH 'F' HAVE BEEN CODED INTO VARIABLE
1392 ; 'FUNCT' USING A - F (HEX) VALUES. CHECK TO SEE WHICH FUNCTION
1393 ; WAS SELECTED, THEN MOVE TO THAT ROUTINE.
1394 ;::::::::::::::::::::::::::::::::::::::::::::::::::
1395
001102 0C79 0000 1396 BRAFTN   CMPI.W   *00H,FUNCT   FUNCTION ACTIVE?
00110A 6700 0088 1397      BEQ      GETFTN     IF NOT, CONVERT INPUT
00110E 0C79 000A 1398      CMPI.W   *0AH,FUNCT   A - TIME AND DATE
001116 6700 01B8 1399      BEQ      AKEY
00111A 0C79 000B 1400      CMPI.W   *0BH,FUNCT   B - STATISTICAL INFO
001122 6700 0578 1401      BEQ      BKEY

```

001126 0C79 000C	1402	CMPI.W	*0CH,FUNCT	C - CALIBRATION
00112E 6700 0916	1403	BEQ	CKEY	
001132 0C79 000D	1404	CMPI.W	*0DH,FUNCT	D - SOFT VALUES
00113A 6700 0990	1405	BEQ	DKEY	
00113E 0C79 000E	1406	CMPI.W	*0EH,FUNCT	E - MEMORY LEFT
001146 6700 0E36	1407	BEQ	EKEY	
00114A 0C79 000F	1408	CMPI.W	*0FH,FUNCT	F - DATA SAVE
001152 6700 0EA0	1409	BEQ	FKEY	
001156 33FC 0002	1410	BADFTN	MOVE.W	*2H,ERRNUM
00115E 4EF9 0000	1411	JMP	ERROR	'SELECT FUNCTION'
	1412			
	1413			
001164 0C79 0000	1414	TOGDSP	CMPI.W	*0,BOOMFLG
				CHECK FOR DISPLAY BLANKING
00116C 6700 0016	1415	BEQ	BOOMON	
001170 4279 0000	1416	CLR.W	BOOMFLG	
001176 41F9 0000	1417	LEA.L	BOOMSG1,A0	
00117C 6100 FEFA	1418	BSR	DSPMSG	
001180 6000 0F4A	1419	BRA	KEYRET	
001184 33FC 00FF	1420	BOOMON	MOVE.W	*OFFH,BOOMFLG
00118C 6100 0FB8	1421	BSR	INITDS	
001190 6000 0F3A	1422	BRA	KEYRET	
	1423			
	1424			
	1425			; INPUT IS EITHER USER FUNCTION A-F, A COMMAND TO CLEAR,
	1426			; ON/OFF, OR IS AN ERROR. SET FUNCTION CODE OR BRANCH TO
	1427			; APPROPRIATE ROUTINE.
	1428			
	1429			
001194 0C79 0001	1430	GETFTN	CMPI.W	*1H,ALPHA
				WAS LETTER INPUT?
00119C 6600 0010	1431	BNE	NOTFTN	IF NOT, CHECK COMMANDS
0011A0 33F9 0000	1432	MOVE.W	KEY,FUNCT	IF SO, SET FUNCTION CODE
0011AA 4EF8 1102	1433	JMP	BRAFTN	...FIND FUNCTION ROUTINE
0011AE 0C79 00CC	1434	NOTFTN	CMPI.W	*0CCH,KEY
				WAS 'CLEAR' INPUT?
0011B6 6600 0068	1435	BNE	ERROR	'KEY ENTRY ERROR'
0011BA 6100 0F8A	1436	BSR	INITDS	CLEAR DISPLAY
0011BE 4EF9 0000	1437	JMP	KEYRET	
	1438			
	1439			
	1440			; TURNS DISPLAY OFF OR ON.
	1441			
	1442			
0011C4 33FC 0000	1443	OFFON	MOVE.W	*00H,FUNCT
				CLEAR FUNCTION FLAG
0011CC 33FC 0000	1444		MOVE.W	*00H,COUNT
				CLEAR KEY COUNT
0011D4 13FC 0000	1445		MOVE.B	*00H,DSPADR
				RESET DISPLAY ADDR
0011DC 6100 0F68	1446	BSR	INITDS	CLEAR DISPLAY
0011E0 0C79 0000	1447	CMPI.W	*00H,OFF	IS DISPLAY OFF?
0011E8 6700 0028	1448	BEQ	DSPON	IF SO, TURN IT ON
	1449			
0011EC 33FC 0000	1450	DSPOFF	MOVE.W	*00H,OFF
				TURN DISPLAY OFF
0011F4 08B9 0000	1451	BCLR	*0,CALFLG	CLEAR CALIBRATION FLAG

0011FC 4279 0000	1452	CLR.W	ADSPFLG	CLEAR CAL 2 FLAG
001202 41F9 0000	1453	LEA.L	BOOMSG1,A0	
001208 6100 FE6E	1454	BSR	DSPMSG	
00120C 4EF9 0000	1455	JMP	KEYRET	
	1456			
001212 33FC 0001	1457	DSPON	MOVE.W *01H,OFF	TURN DISPLAY ON
00121A 4EF9 0000	1458	JMP	KEYRET	
	1459	1460 ;		
	1461 ;	ERROR SUBROUTINE PRINTS ERROR MESSAGE TO DISPLAY, DELAYS 3		
	1462 ;	SECONDS, CLEARS VARIABLES, THEN RETURNS.		
	1463 ;			
	1464			
001220 4E71	1465	ERROR	NOP	
001222 3439 0000	1466	MOVE.W	ERRNUM,D2	ERROR * INTO D2
001228 E94A	1467	LSL	*4,D2	MULTIPLY BY 16
00122A 41F9 0000	1468	LEA.L	ERRMSG,A0	ERROR MESSAGE BASE ADDR
001230 D0C2	1469	ADDA	D2,A0	ADDRESSES CORRECT ERR MSG
001232 33FC 0000	1470	MOVE.W	*00,ERRNUM	CLEAR ERRNUM
00123A 6100 FE3C	1471	BSR	DSPMSG	
00123E 0C79 000A	1472	CMPI.W	*0AH,FUNCT	IS FUNCTION A ON?
001246 6600 0016	1473	BNE	TRYB	
00124A 720B	1474	MOVEQ	*11,D1	12 WORDS TO CLEAR
00124C 45F9 0000	1475	LEA.L	HITB,A2	START CLEARING AT HITB
001252 34FC 0000	1476	CLEARA	MOVE.W *00H,[A2]+	ZERO OUT BUFFERS
001256 51C9 FFFA	1477	DBRA	D1,CLEARA	
00125A 6000 003E	1478	BRA	NONEBON	
00125E 0C79 000B	1479	TRYB	CMPI.W *0BH,FUNCT	IS FUNCTION B ON?
001266 6600 0016	1480	BNE	TRYD	
00126A 7207	1481	MOVEQ	*7,D1	8 WORDS TO CLEAR
00126C 45F9 0000	1482	LEA.L	HITD,A2	START CLEARING AT HITD
001272 34FC 0000	1483	CLEARB	MOVE.W *00H,[A2]+	ZERO OUT BUFFERS
001276 51C9 FFFA	1484	DBRA	D1,CLEARB	
00127A 6000 001E	1485	BRA	NONEBON	
00127E 0C79 000D	1486	TRYD	CMPI.W *0DH,FUNCT	IS FUNCTION D ON?
001286 6600 0012	1487	BNE	NONEBON	NO FUNCTIONS ARE ON
00128A 720B	1488	MOVEQ	*11,D1	12 WORDS TO CLEAR
00128C 45F9 0000	1489	LEA.L	HITB3,A2	START CLEARING AT HITB3
001292 34FC 0000	1490	CLEARD	MOVE.W *00H,[A2]+	ZERO OUT BUFFERS
001296 51C9 FFFA	1491	DBRA	D1,CLEARD	
00129A 33FC 0000	1492	NONEBON	MOVE.W *00H,FUNCT	CLEAR FUNCTION FLAG
0012A2 33FC 00FF	1493	MOVE.W	*OFFH,KEY	CLEAR KEY
0012AA 33FC 0000	1494	MOVE.W	*00H,ALPHA	CLEAR ALPHA FLAG
0012B2 33FC 0000	1495	MOVE.W	*00H,COUNT	CLEAR KEY COUNT
0012BA 13FC 0000	1496	MOVE.B	*00H,DSPADR	RESET DISPLAY ADDR
0012C2 33FC 0000	1497	MOVE.W	*00H,POINT	CLEAR DECIMAL POINT
0012CA 4EF9 0000	1498	JMP	KEYRET	
	1499			
	1500 ;			
	1501 ;	AKY	-	KEY SERVICE ROUTINE FOR DATE AND TIME
	1502 ;			

```

1503 ; FORMATTING OF DATA IS AS FOLLOWS:
1504 ;
1505 ;      <on> <A> <enter> YYMMDD.HH.MM.SS <enter>
1506 ;
1507 ;      WHERE YY REPRESENT THE FIRST AND SECOND DIGITS OF
1508 ;      THE CURRENT YEAR, MM LIKEWISE REPRESENTS THE MONTH,
1509 ;      DD THE DAY, HH THE HOUR, MM THE MINUTES, AND SS THE
1510 ;      SECONDS. VALID ENTRIES FOR THESE NUMBERS ARE ANY
1511 ;      VALID DATE AND TIME.
1512 ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
1513
0012D0 0679 0001 1514 AKEY   ADDI.W  *1H,COUNT      INCREMENT KEYSTROKE COUNT
0012D8 0C79 00CC 1515 CMPI.W  *0CCH,KEY    CLEAR COMMAND?
0012E0 6700 0270 1516 BEQ     ACLEAR
0012E4 0C79 0001 1517 CMPI.W  *1H,COUNT      FIRST KEY?
0012EC 6700 0268 1518 BEQ     ISTIME        IF SO, DISPLAY TIME
0012F0 0C79 0002 1519 CMPI.W  *2H,COUNT      SECOND KEY?
0012F8 6700 003E 1520 BEQ     AENT          SHOULD BE 'ENTER'
0012FC 0C79 0009 1521 CMPI.W  *9H,COUNT      POINT FOLLOWS DAY
001304 6700 0D0E 1522 BEQ     DECPTS
001308 0C79 000C 1523 CMPI.W  *0CH,COUNT     POINT FOLLOWS HRS
001310 6700 0D02 1524 BEQ     DECPTS
001314 0C79 000F 1525 CMPI.W  *0FH,COUNT     POINT FOLLOWS MINUTES
00131C 6700 0CF6 1526 BEQ     DECPTS
001320 0C79 0012 1527 CMPI.W  *12H,COUNT     SHOULD BE AN 'ENTER'
001328 6600 0024 1528 BNE     ISDIGA
00132C 0C79 00EE 1529 CMPI.W  *0EEH,KEY      'ENTER' COMMAND
001334 6700 023E 1530 BEQ     AENTER
1531
001338 0C79 00EE 1532 AENT   CMPI.W  *0EEH,KEY
001340 6600 FEDE 1533 BNE     ERROR          'KEY ENTRY ERROR'
001344 6100 0E00 1534 BSR     INITDS
001348 4EF9 0000 1535 JMP     KEYRET
1536
1537 ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
1538 ;      ISDIGA - CHECKS FORMAT AND RANGE FOR INPUT
1539 ;      5, 7, A, D, 10 AND 11 ARE SPECIAL CASES IN WHICH THE
1540 ;      NUMBERS MUST NOT EXCEED PREDETERMINED VALUES.
1541 ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
1542
00134E 0C79 000A 1543 ISDIGA CMPI.W  *0AH,KEY      IS KEY > 10?
001356 6C00 FEC8 1544 BGE     ERROR          'KEY ENTRY ERROR'
00135A 0C79 0005 1545 CMPI.W  *05H,COUNT     IS 5TH KEY?
001362 6600 001A 1546 BNE     CHKA7
001366 0C79 0002 1547 CMPI.W  *2H,KEY        FIRST DIGIT OF MONTH
00136E 6D00 009E 1548 BLT     SAVEA
001372 33FC 0003 1549 MOVE.W  *3H,ERRNUM     'INVALID NUMBER'
00137A 4EF8 1220 1550 JMP     ERROR
1551
00137E 0C79 0007 1552 CHKA7  CMPI.W  *07H,COUNT     7TH KEY?

```

001386	8600	001A	1553	BNE	CHKAA	
00138A	0C79	0004	1554	CMPI.W	*04H,KEY	FIRST DIGIT OF DAY
001392	8D00	007A	1555	BLT	SAVEA	
001396	33FC	0003	1556	MOVE.W	*3H,ERRNUM	'INVALID NUMBER'
00139E	4EF8	1220	1557	JMP	ERROR	
			1558			
0013A2	0C79	000A	1559	CHKAA	CMPI.W	*0AH,COUNT
0013AA	6600	001A	1560	BNE	CHKAD	10TH KEY?
0013AE	0C79	0003	1561	CMPI.W	*03H,KEY	FIRST DIGIT OF HOURS
0013B6	8D00	0056	1562	BLT	SAVEA	
0013BA	33FC	0003	1563	MOVE.W	*3H,ERRNUM	'INVALID NUMBER'
0013C2	4EF8	1220	1564	JMP	ERROR	
			1565			
0013C6	0C79	000D	1566	CHKAD	CMPI.W	*0DH,COUNT
0013CE	6600	001A	1567	BNE	CHKA10	13TH KEY?
0013D2	0C79	0006	1568	CMPI.W	*06H,KEY	FIRST DIGIT OF MINUTES
0013DA	8D00	0032	1569	BLT	SAVEA	
0013DE	33FC	0003	1570	MOVE.W	*3H,ERRNUM	'INVALID NUMBER'
0013E6	4EF8	1220	1571	JMP	ERROR	
			1572			
0013EA	0C79	0010	1573	CHKA10	CMPI.W	*10H,COUNT
0013F2	6600	001A	1574	BNE	SAVEA	16TH KEY?
0013F6	0C79	0006	1575	CMPI.W	*6H,KEY	FIRST DIGIT OF SECONDS
0013FE	8D00	000E	1576	BLT	SAVEA	
001402	33FC	0003	1577	MOVE.W	*3H,ERRNUM	ONLY ZERO INPUT FOR SECS
00140A	4EF8	1220	1578	JMP	ERROR	
			1579			
			1580			
			1581	:	:	:
			1582	:	SAVEA	STORES INPUT DIGIT FOR FUTURE USE
			1583	:	:	:
			1584	:	:	:
00140E	0C79	0003	1585	SAVEA	CMPI.W	*3H,COUNT
001416	6600	0012	1586	BNE	A04	
00141A	33F9	0000	1587	MOVE.W	KEY,HIYR	SAVE FIRST DIG OF YEAR
001424	4EF9	0000	1588	JMP	PUTKEY	WRITE TO DISPLAY
00142A	0C79	0004	1589	A04	CMPI.W	*04H,COUNT
001432	6600	0012	1590	BNE	A05	
001436	33F9	0000	1591	MOVE.W	KEY,LOYR	SAVE SECOND DIG OF YEAR
001440	4EF9	0000	1592	JMP	PUTKEY	WRITE TO DISPLAY
001446	0C79	0005	1593	A05	CMPI.W	*05H,COUNT
00144E	6600	0012	1594	BNE	A06	
001452	33F9	0000	1595	MOVE.W	KEY,HIM0	SAVE FIRST DIG OF MONTH
00145C	4EF9	0000	1596	JMP	PUTKEY	WRITE TO DISPLAY
001462	0C79	0006	1597	A06	CMPI.W	*06H,COUNT
00146A	6600	0012	1598	BNE	A07	
00146E	33F9	0000	1599	MOVE.W	KEY,LOM0	SAVE SECOND DIG OF MONTH
001478	4EF9	0000	1600	JMP	PUTKEY	WRITE TO DISPLAY
00147E	0C79	0007	1601	A07	CMPI.W	*07H,COUNT
001486	6600	0012	1602	BNE	A08	

00148A 33F9 0000	1603	MOVE.W	KEY,HIDA	SAVE FIRST DIG OF DAY
001494 4EF9 0000	1604	JMP	PUTKEY	WRITE TO DISPLAY
00149A 0C79 0008	1605 A08	CMPI.W	*08H,COUNT	
0014A2 8600 0012	1606	BNE	AA	
0014A6 33F9 0000	1607	MOVE.W	KEY,LODA	SAVE SECOND DIG OF DAY
0014B0 4EF9 0000	1608	JMP	PUTKEY	WRITE TO DISPLAY
0014B6 0C79 000A	1609 AA	CMPI.W	*0AH,COUNT	
0014BE 6600 0012	1610	BNE	AB	
0014C2 33F9 0000	1611	MOVE.W	KEY,HIHR	SAVE FIRST DIG OF HOUR
0014CC 4EF9 0000	1612	JMP	PUTKEY	WRITE TO DISPLAY
0014D2 0C79 000B	1613 AB	CMPI.W	*0BH,COUNT	
0014DA 6600 0012	1614	BNE	AD	
0014DE 33F9 0000	1615	MOVE.W	KEY,LOHR	SAVE SECOND DIG OF HOUR
0014E8 4EF9 0000	1616	JMP	PUTKEY	WRITE TO DISPLAY
0014EE 0C79 000D	1617 AD	CMPI.W	*0DH,COUNT	
0014F6 6600 0012	1618	BNE	AE	
0014FA 33F9 0000	1619	MOVE.W	KEY,HIMH	SAVE FIRST DIG OF MINUTES
001504 4EF9 0000	1620	JMP	PUTKEY	WRITE TO DISPLAY
00150A 0C79 000E	1621 AE	CMPI.W	*0EH,COUNT	
001512 6600 0012	1622	BNE	A10	
001516 33F9 0000	1623	MOVE.W	KEY,LOMH	SAVE SECOND DIG OF MINUTES
001520 4EF9 0000	1624	JMP	PUTKEY	WRITE TO DISPLAY
001526 0C79 0010	1625 A10	CMPI.W	*10H,COUNT	
00152E 6600 0012	1626	BNE	A11	
001532 33F9 0000	1627	MOVE.W	KEY,HISC	SAVE FIRST DIGIT OF SECONDS
00153C 4EF9 0000	1628	JMP	PUTKEY	WRITE TO DISPLAY
001542 33F9 0000	1629 A11	MOVE.W	KEY,LOSC	SAVE SECOND DIG OF SECONDS
00154C 4EF9 0000	1630	JMP	PUTKEY	WRITE TO DISPLAY
	1631			
	1632	;		
	1633	ACLEAR	-	CLEAR CURRENT DISPLAY
	1634	;		
	1635			
001552 8100 0BF2	1636	ACLEAR	BSR	INITDS
	1637			
	1638	;		
	1639	ISTIME	-	DISPLAYS WORKING VALUES FOR CURRENT TIME
	1640	;		
	1641			
001556 4E71	1642	ISTIME	NOP	
001558 6100 F91A	1643	BSR	RDCLK	GET CURRENT TIME AND DATE
00155C 41F9 0000	1644	LEA.L	AKDATA,A0	
001562 6100 FB14	1645	BSR	DSPMSG	
001566 13FC 0000	1646	MOVE.B	*00H,DSPADR	RESET DISPLAY ADDR
00156E 4EF9 0000	1647	JMP	KEYRET	
	1648			
	1649	;		
	1650	AENTER	-	STORES INPUT DATA IN SPECIFIC BUFFERS
	1651	;		
	1652			

001574 4E71	1653	AENTER	NOP	
001576 45F9 0000	1654		LEA.L HIYR,A2	ADDR OF DATA
00157C 47F9 0000	1655		LEA.L YEAR,A3	ADDR OF ANSWERS
001582 4281	1656		CLH.L D1	
001584 321A	1657		MOVE.W [A2]+,D1	
001586 E949	1658		LSL.W #4,D1	
001588 825A	1659		OR.W [A2]+,D1	
00158A 36C1	1660		MOVE.W D1,[A3]+	
00158C 321A	1661		MOVE.W [A2]+,D1	
00158E E949	1662		LSL.W #4,D1	
001590 825A	1663		OR.W [A2]+,D1	
001592 36C1	1664		MOVE.W D1,[A3]+	
001594 321A	1665		MOVE.W [A2]+,D1	
001596 E949	1666		LSL.W #4,D1	
001598 825A	1667		OR.W [A2]+,D1	
00159A 36C1	1668		MOVE.W D1,[A3]+	
00159C 321A	1669		MOVE.W [A2]+,D1	
00159E E949	1670		LSL.W #4,D1	
0015A0 825A	1671		OR.W [A2]+,D1	
0015A2 36C1	1672		MOVE.W D1,[A3]+	
0015A4 321A	1673		MOVE.W [A2]+,D1	
0015A6 E949	1674		LSL.W #4,D1	
0015A8 825A	1675		OR.W [A2]+,D1	
0015AA 36C1	1676		MOVE.W D1,[A3]+	
0015AC 321A	1677		MOVE.W [A2]+,D1	
0015AE E949	1678		LSL.W #4,D1	
0015B0 825A	1679		OR.W [A2]+,D1	
0015B2 36C1	1680		MOVE.W D1,[A3]+	
0015B4 33FC 0000	1681		MOVE.W *00H,FUNCT	NO FUNCT ACTIVE
0015B6 33FC 0000	1682		MOVE.W *00H,COUNT	KEY COUNT CLEARED
0015C4 13FC 0000	1683		MOVE.B *00H,DSPADR	RESET DISPLAY ADDR
0015CC 33FC 0000	1684		MOVE.W *00H,ALPHA	CLEAR ALPHA FLAG
0015D4 33FC 0000	1685		MOVE.W *00H,POINT	CLEAR DECIMAL POINT
0015DC 3239 0000	1686		MOVE.W YEAR,D1	RE-INIT REAL TIME CLOCK
0015E2 13C1 0000	1687		MOVE.B D1,YEAR1	WITH NEW TIME AND DATE
0015E8 3239 0000	1688		MOVE.W MONTH,D1	
0015EE 13C1 0000	1689		MOVE.B D1,MONTH1	
0015F4 3239 0000	1690		MOVE.W DAY,D1	
0015FA 13C1 0000	1691		MOVE.B D1,DAY1	
001600 3239 0000	1692		MOVE.W HOUR,D1	
001606 13C1 0000	1693		MOVE.B D1,HOUR1	
00160C 3239 0000	1694		MOVE.W MINUTE,D1	
001612 13C1 0000	1695		MOVE.B D1,MIN1	
001618 3239 0000	1696		MOVE.W SECOND,D1	
00161E 13C1 0000	1697		MOVE.B D1,SEC1	
001624 08B9 0000	1698		BCLR #0,BRAMON	TURN ON BAT. RAM
00162C 243C	1699		MOVE.L #50,D2	SET FOR 50 USEC. DELAY
001632 6100 FA84	1700		BSR DELAY	DELAY
001636 6100 F764	1701		BSR WBTCLX	
00163A 243C	1702		MOVE.L #100,D2	

001640	6100	FA76	1703	BSR	DELAY	
001644	6100	F82E	1704	BSR	RDCLK	
001648	2679	0000	1705	MOVE.L	CURPNT,A3	PUT NEW TIME IN BRAM
00164E	D7FC		1706	ADD.L	#2,A3	
001654	36F9	0000	1707	MOVE.W	CLK1,[A3]+	
00165A	36F9	0000	1708	MOVE.W	CLK2,[A3]+	
001660	36F9	0000	1709	MOVE.W	CLK3,[A3]+	
001666	36FC	EB90	1710	MOVE.W	*BARKER,[A3]+	
00166A	36FC	EB90	1711	MOVE.W	*BARKER,[A3]+	
00166E	36BC	EB90	1712	MOVE.W	*BARKER,[A3]	
001672	23CB	0000	1713	MOVE.L	A3,CURPNT	
001678	23CB	0000	1714	MOVE.L	A3,LSTEVN	SAVE LAST POINTER
00167E	6100	0EB2	1715	BSR	SAVPAR	SAVE ALL PARAMETERS
001682	0839	0001	1716	BTST	#1,TEST	SEE IF IN AN EVENT
00168A	6600	000A	1717	BNE	CONTA	YES,LEAVE BRAM ON
00168E	08F9	0000	1718	BSET	#0,BRAMON	TURN BRAM OFF
001696	4EF9	0000	1719	CONTA	JMP	KEYRET
			1720			
			1721	;.....		
			1722	BKEY	-	SERVICES STATUS INPUTS
			1723			FORMAT FOR INPUT IS AS FOLLOWS:
			1724			
			1725			<on> <enter> TT.SW.T1.T2 <enter>
			1726			
			1727			WHERE TT IS THE TEST NUMBER,
			1728			SW IS THE SITE NUMBER,
			1729			T1 IS TRIGGER1,
			1730			T2 IS TRIGGER2.
			1731			VALID INPUT CONSISTS OF ANY DIGIT IN ANY VARIABLE.
			1732	;.....		
			1733			
00169C	0679	0001	1734	BKEY	ADDI.W	#01H,COUNT INCREMENT KEYSTROKE COUNTER
0016A4	0C79	00CC	1735	CMPI.W	#0CCH,KEY	CLEAR COMMAND?
0016AC	6700	01D4	1736	BEQ	BCLEAR	
0016B0	0C79	0001	1737	CMPI.W	#01H,COUNT	FIRST KEY?
0016B8	6700	01CC	1738	BEQ	ISSTAT	DISPLAY CURRENT ENTRIES
0016BC	0C79	0002	1739	CMPI.W	#02H,COUNT	SECOND KEY?
0016C4	6700	001A	1740	BEQ	BENT	SHOULD BE ENTER NEW DATA
0016C8	0C79	0013	1741	CMPI.W	#13H,COUNT	19TH KEY?
0016D0	6600	0024	1742	BNE	ISDIGB	
0016D4	0C79	00EE	1743	CMPI.W	#0EEH,KEY	ENTER?
0016DC	6700	01C2	1744	BEQ	BENTER	
			1745			
0016E0	0C79	00EE	1746	BENT	CMPI.W	#0EEH,KEY
0016E8	6600	FB36	1747	BNE	ERROR	'KEY ENTRY ERROR'
0016EC	6100	0A58	1748	BSR	INITDS	
0016F0	4EF9	0000	1749	JMP	KEYRET	
			1750			
			1751	;.....		
			1752	ISDIGB	-	CHECKS FORMAT AND RANGE FOR DATA

```

1753 ;      5, 8 AND B ARE CHECKED TO BE DECIMAL POINTS.
1754 ;.....
1755
0016F6 0C79 0005 1756 ISDIGB CMPI.W *05H,COUNT      5TH DIGIT IS DECIMAL
0016FE 6700 0914 1757      BEQ      DECPTS
001702 0C79 0008 1758      CMPI.W *08H,COUNT      8TH DIGIT IS DECIMAL
00170A 6700 0908 1759      BEQ      DECPTS
00170E 0C79 000B 1760      CMPI.W *0BH,COUNT      11TH DIGIT IS DECIMAL
001716 6700 08FC 1761      BEQ      DECPTS
00171A 0C79 000E 1762      CMPI.W *0EH,COUNT      14TH DIGIT IS DECIMAL
001722 6700 08F0 1763      BEQ      DECPTS
001726 0C79 000A 1764      CMPI.W *0AH,KEY      OTHER KEYS ACCEPT ANY DIGIT
00172E 6C00 FAF0 1765      BGE      ERROR
1766
1767 ;.....
1768 ;      SAVEB - STORES INPUT DIGITS FOR FURTHER USE.
1769 ;.....
1770
001732 0C79 0003 1771 SAVEB CMPI.W *03H,COUNT      3RD KEY?
00173A 6600 0012 1772      BNE      B4
00173E 33F9 0000 1773      MOVE.W KEY,HITT      FIRST DIGIT OF TEST NUMBER
001748 4EF9 0000 1774      JMP      PUTKEY      DISPLAY
1775
00174E 0C79 0004 1776 B4 CMPI.W *04H,COUNT      4TH KEY
001756 6600 0012 1777      BNE      B6
00175A 33F9 0000 1778      MOVE.W KEY,LOTT      SECOND DIGIT OF TEST NUMBER
001764 4EF9 0000 1779      JMP      PUTKEY      DISPLAY
1780
00176A 0C79 0006 1781 B6 CMPI.W *06,COUNT      6TH KEY
001772 6600 0012 1782      BNE      B7
001776 33F9 0000 1783      MOVE.W KEY,HISN      FIRST DIGIT OF SITE NUMBER
001780 4EF9 0000 1784      JMP      PUTKEY      DISPLAY
1785
001786 0C79 0007 1786 B7 CMPI.W *07,COUNT      7TH KEY
00178E 6600 0012 1787      BNE      B9
001792 33F9 0000 1788      MOVE.W KEY,LOSN      SECOND DIGIT OF SITE NUMBER
00179C 4EF9 0000 1789      JMP      PUTKEY
1790
0017A2 0C79 0009 1791 B9 CMPI.W *09,COUNT      9TH KEY
0017AA 6600 0012 1792      BNE      BA
0017AE 33F9 0000 1793      MOVE.W KEY,HIT1      FIRST DIGIT OF TIMER1
0017B8 4EF9 0000 1794      JMP      PUTKEY
1795
0017BE 0C79 000A 1796 BA CMPI.W *0AH,COUNT      11TH KEY
0017C6 6600 0012 1797      BNE      BC
0017CA 33F9 0000 1798      MOVE.W KEY,LOT1      SECOND DIGIT OF TIMER1
0017D4 4EF9 0000 1799      JMP      PUTKEY
1800
0017DA 0C79 000C 1801 BC CMPI.W *0CH,COUNT      12TH KEY
0017E2 6600 0012 1802      BNE      BD

```

0017E6 33F9 0000	1803	MOVE.W	KEY,HIT2	FIRST DIGIT OF TIMER2
0017F0 4EF9 0000	1804	JMP	PUTKEY	
	1805			
0017F6 0C79 000D	1806 BD	CMPI.W	*0DH,COUNT	SECOND DIGIT OF TIMER2
0017FE 6600 0012	1807	BNE	BS1	
001802 33F9 0000	1808	MOVE.W	KEY,LOT2	
00180C 4EF9 0000	1809	JMP	PUTKEY	
001812 0C79 000F	1810 BS1	CMPI.W	*0FH,COUNT	DIG. 1 OF S.W.
00181A 6600 001E	1811	BNE	BS2	
00181E 0C79 0004	1812	CMPI.W	*04H,KEY	DIG. 1 < 4 ?
001826 6C00 F9F8	1813	BGE	ERROR	MAX S.W. IS 3999
00182A 33F9 0000	1814	MOVE.W	KEY,SW1	
001834 4EF9 0000	1815	JMP	PUTKEY	
00183A 0C79 0010	1816 BS2	CMPI.W	*10H,COUNT	DIG. 2 OF S.W.
001842 6600 0012	1817	BNE	BS3	
001846 33F9 0000	1818	MOVE.W	KEY,SW2	
001850 4EF9 0000	1819	JMP	PUTKEY	
001856 0C79 0011	1820 BS3	CMPI.W	*11H,COUNT	DIG. 3 OF S.W.
00185E 6600 0012	1821	BNE	BS4	
001862 33F9 0000	1822	MOVE.W	KEY,SW3	
00186C 4EF9 0000	1823	JMP	PUTKEY	
001872 33F9 0000	1824 BS4	MOVE.W	KEY,SW4	DIG. 4 OF S.W.
00187C 4EF9 0000	1825	JMP	PUTKEY	
	1826			
	1827 ;			
	1828 ;	BCLEAR	-	CLEARs CURRENT DISPLAY
	1829 ;			
	1830			
001882 6100 08C2	1831 BCLEAR	BSR	INITDS	
	1832			
	1833 ;			
	1834 ;	ISSTAT	-	RETRIEVES CURRENT STAT VALUe. FOR DISPLAY
	1835 ;			
	1836			
001886 4E71	1837 ISSTAT	NOP		
001888 41F9 0000	1838	LEA.L	BKDATA,A0	
00188E 6100 F7E8	1839	BSR	DSPMSG	
001892 13FC 0000	1840	MOVE.B	*00H,DSPADR	RESET DISPLAY ADDR
00189A 4EF9 0000	1841	JMP	KEYRET	
	1842			
	1843 ;			
	1844 ;	BENTER	-	STORES INPUT DATA IN SPECIFIED BUFFERS
	1845 ;			
	1846			
0018A0 4E71	1847 BENTER	NOP		
0018A2 243C	1848	MOVE.L	*3,D2	CONVERT DATA TO ASCII AND
0018A8 45F9 0000	1849	LEA.L	HITT,A2	STORE IN DISPLAY ARRAY
0018AE 47F9 0000	1850	LEA.L	BKDATA,A3	
0018B4 321A	1851 DENLP	MOVE.W	[A2]+,D1	
0018B6 0001 0030	1852	OR.B	*30H,D1	

0018BA 18C1	1853	MOVE W	D1,[A3]+	
0018BC 321A	1854	MOVE W	[A2]+,D1	
0018BE 0001 0030	1855	OR.B	*30H,D1	
0018C2 18C1	1856	MOVE.B	D1,[A3]+	
0018C4 16FC 002E	1857	MOVE.P	*2EE,[A3]+	
0018C8 51CA FFEA	1858	DBRA	D2,DEMLP	
0018CC 321A	1859	MOVE.W	[A2]+,D1	S.N. 1
0018CE 0001 0030	1860	OR.B	*30H,D1	
0018D2 18C1	1861	MOVE.B	[A3]+	
0018D4 321A	1862	MOVE.W	[A2]+,D1	S.N. 2
0018D8 0001 0030	1863	OR.B	*30H,D1	
0018DA 18C1	1864	MOVE.B	D1,[A3]+	
0018DC 321A	1865	MOVE.W	[A2]+,D1	S.N. 3
0018DE 0001 0030	1866	OR.B	*30H,D1	
0018E2 18C1	1867	MOVE.B	D1,[A3]+	
0018E4 321A	1868	MOVE.W	[A2]+,D1	S.N. 4
0018E6 0001 0030	1869	OR.B	*30H,D1	
0018EA 18C1	1870	MOVE.B	D1,[A3]+	
0018EC 45F9 0000	1871	LEA.L	HITT,A2	ADDR OF DATA
0018F2 47F9 000C	1872	LEA.L	TESTNM,A3	ADDR OF ANSWER
0018F8 223C	1873	MOVE.L	*0,D1	* OF DIGITS/ANSWER
0018FE 243C	1874	MOVE.L	*3,D2	* OF ANSWERS
001904 6100 0732	1875	BSR	MULTIPL	MULTIPLY DATA TO GET ANSWERS
001908 45F9 0000	1876	LEA.L	SN1,A2	
00190E 47F9 0000	1877	LEA.L	SERNO,A3	
001914 223C	1878	MOVE.L	*2,D1	
00191A 243C	1879	MOVE.L	*0,D2	
001920 6100 0716	1880	BSR	MULTIPL	
001924 47F9 0000	1881	LEA.L	TSTINF,A3	MOVE DATA MESSAGE INTO BRAM
00192A 3779 0000	1882	MOVE.W	TESTNM,TNUM[A3]	
001932 3779 0000	1883	MOVE.W	SITENM,SITE[A3]	
00193A 3779 0000	1884	MOVE.W	SERNO,SERIAL[A3]	
001942 4281	1885	CLR.L	D1	
001944 3239 0000	1886	MOVE.W	TIMER1,D1	
00194A C2FC 01F4	1887	MULU	*500,D1	
00194E 3741 0008	1888	MOVE.W	D1,TMVAL1[A3]	
001952 33C1 0000	1889	MOVE.W	D1,TIMR1	
001958 4281	1890	CLR.L	D1	
00195A 3239 0000	1891	MOVE.W	TIMER2,D1	
001960 C2FC 01F4	1892	MULU	*500,D1	
001964 3741 000C	1893	MOVE.W	D1,TMVAL2[A3]	
001968 33C1 0000	1894	MOVE.W	D1,TIMR2	
00196E 08B9 0000	1895	BCLR	*0,BRAMON	TURN ON BAT. RAM
001976 243C	1896	MOVE.L	*50,D2	SET UP FOR 50 USEC. DELAY
00197C 6100 F73A	1897	BSR	DELAY	DELAY
001980 6100 F4F2	1898	BSR	RDCLK	
001984 223C	1899	MOVE.L	*1000H,D1	
00198A 45F9 0000	1900	LEA.L	TSTINF,A2	
001990 2679 0000	1901	MOVE.L	CURFMT,A3	
001996 D7FC	1902	ADD.L	*2,A3	

00199C 826A 0000	1903	OR.W	TNUM[A2],D1	
0019A0 36C1	1904	MOVE.W	D1,[A3]+	
0019A2 0241 F000	1905	AND.W	*0F000H,D1	
0019A6 0641 1000	1906	ADD.W	*1000H,D1	
0019AA 826A 0002	1907	OR.W	SITE[A2],D1	
0019AE 36C1	1908	MOVE.W	D1,[A3]+	
0019B0 0241 F000	1909	AND.W	*0F000H,D1	
0019B4 0641 1000	1910	ADD.W	*1000H,D1	
0019B8 826A 0004	1911	OR.W	SERIAL[A2],D1	
0019BC 36C1	1912	MOVE.W	D1,[A3]+	
0019BE 0241 F000	1913	AND.W	*0F000H,D1	
0019C2 0641 1000	1914	ADD.W	*1000H,D1	
0019C6 36C1	1915	MOVE.W	D1,[A3]+	
0019C8 36EA 0008	1916	MOVE.W	TWVAL1[A2],[A3]+	
0019CC 0641 1000	1917	ADD.W	*1000H,D1	
0019D0 36C1	1918	MOVE.W	D1,[A3]+	
0019D2 36EA 000C	1919	MOVE.W	TWVAL2[A2],[A3]+	
0019D6 36F9 0000	1920	MOVE.W	CLK1,[A3]+	
0019DC 36F9 0000	1921	MOVE.W	CLK2,[A3]+	
0019E2 36F9 0000	1922	MOVE.W	CLK3,[A3]+	
0019E8 36FC EB90	1923	MOVE.W	*BARKER,[A3]+	
0019EC 36FC EB90	1924	MOVE.W	*BARKER,[A3]+	
0019F0 36BC EB90	1925	MOVE.W	*BARKER,[A3]	
0019F4 23CB 0000	1926	MOVE.L	A3,CURPNT	
0019FA 33FC 0000	1927	MOVE.W	*00H,FUNCT	NO ACTIVE FUNCTION
001A02 33FC 0000	1928	MOVE.W	*00H,COUNT	KEY COUNT CLEARED
001A0A 13FC 0000	1929	MOVE.B	*00H,DSPADR	RESET DISPLAY ADDR
001A12 33FC 0000	1930	MOVE.W	*00H,ALPHA	CLEAR ALPHA FLAG
001A1A 33FC 0000	1931	MOVE.W	*00H,POINT	CLEAR DECIMAL POINT
001A22 23CB 0000	1932	MOVE.L	A3,LSTEVT	
001A28 6100 0B08	1933	BSR	SAVPAR	
001A2C 0839 0001	1934	BTST	*1,TEST	SEE IF IN AN EVENT
001A34 6600 000A	1935	BNE	CONTB	YES, LEAVE BRAM ON
001A38 08F9 0000	1936	BSET	*0,BRAMON	ELSE,TURN BRAM OFF
001A40 4EF9 0000	1937	CONTB	JMP	KEYRET
	1938			
	1939			
	1940			
	1941			
	1942			
001A46 0679 0001	1943	CKEY	ADDI.W	*1,COUNT
001A4E 0C79 0001	1944		CMPI.W	*1,COUNT
001A56 6700 0064	1945		BEQ	CALRET
001A5A 0C79 0001	1946		CMPI.W	*1,KEY
001A62 6700 001A	1947		BEQ	CALMD1
001A66 0C79 0002	1948		CMPI.W	*2,KEY
001A6E 6700 002E	1949		BEQ	CALMD2
001A72 33FC 0003	1950		MOVE.W	*3,ERRNUM
001A7A 6000 F7A4	1951		BRA	ERROR
001A7E 08F9 0000	1952	CALMD1	BSET	*00,CALFLG

001A86	23FC	1953	MOVE.L	*0,CALSUM	RESET SUM VALUE
001A90	33FC 0FA0	1954	MOVE.W	*4000,CALTIM	RESET CAL PERIOD
001A98	4EF9 0000	1955	JMP	KEYRET	RETURN
001A9E	08F9 0000	1956	CALMD2	BSET *0,ADSPFLG	SET CAL 2 FLG
001AA6	08F9 0000	1957	BSET	*0,CALFLG	
001AAE	33FC 0FA0	1958	MOVE.W	*4000,CALTIM	
001AB6	4EF9 0000	1959	JMP	KEYRET	
001ABC	41F9 0000	1960	CALRET	LEA.L CALPRMT,A0	
001AC2	6100 F5B4	1961	BSR	DSPMSG	DISPLAY CAL PROMPT
001AC6	4EF9 0000	1962	JMP	KEYRET	
		1963			
		1964			
		1965	DKEY	- SERVICES SOFT VALUES	
		1966		INPUT IS OF THE FOLLOWING FORMAT:	
		1967			
		1968		<on> <D> <enter> TR3.TR2.PP.RV.ET <enter>	
		1969			
		1970		WHERE TR3 IS TRIGGER3,	
		1971		TR2 IS TRIGGER2,	
		1972		PP IS POSITIVE PULSE TIME	
		1973		RV IS RISETIME IN dBs,	
		1974		ET IS RISETIME IN	
		1975			
		1976			
001ACC	0679 0001	1977	ADD.W	*01H,COUNT	INCREMENT KEYSTROKE COUNT
001AD4	0C79 00CC	1978	CMPI.W	*0CCH,KEY	CLEAR?
001ADC	6700 00C4	1979	BEQ	DCLEAR	
		1980			
001AE0	0C79 0001	1981	CMPI.W	*01H,COUNT	FIRST KEY?
001AE8	6700 00BC	1982	BEQ	ISVAL	
		1983			
001AEC	0C79 0002	1984	CMPI.W	*02H,COUNT	SECOND KEY?
001AF4	6700 0096	1985	BEQ	DENT	SHOULD BE ENTER NEW DATA
		1986			
001AF8	0C79 0003	1987	CMPI.W	*03H,COUNT	TRIGGER3
001B00	6600 001A	1988	BNE	CHK7	
001B04	0C79 0002	1989	CMPI.W	*02H,KEY	KEY SHOULD BE 0 OR 1
001B0C	6D00 032C	1990	BLT	SAVED	
001B10	33FC 0003	1991	MOVE.W	*03,ERRNUM	'INVALID NUMBER'
001B18	4EF8 1220	1992	JMP	ERROR	
		1993			
001B1C	0C79 0007	1994	CMPI.W	*07H,COUNT	TRIGGER2
001B24	6600 001A	1995	BNE	CHK6	
001B28	0C79 0002	1996	CMPI.W	*02H,KEY	KEY SHOULD BE 0 OR 1
001B30	6D00 0308	1997	BLT	SAVED	
001B34	33FC 0003	1998	MOVE.W	*03,ERRNUM	'INVALID NUMBER'
001B3C	4EF8 1220	1999	JMP	ERROR	
		2000			
001B40	0C79 0006	2001	CMPI.W	*06H,COUNT	FIELDS 6,A,D,10 SHOULD HAVE
001B48	6700 04CA	2002	BEQ	DECPTS	A DECIMAL AS THEIR VALUE

	2003			
001B4C 0C79 000A	2004	CMPI.W	*0AH,COUNT	
001B54 6700 04BE	2005	BEQ	DECPTS	
	2006			
001B58 0C79 000D	2007	CMPI.W	*0DH,COUNT	
001B60 6700 04B2	2008	BEQ	DECPTS	
	2009			
001B64 0C79 0010	2010	CMPI.W	*010H,COUNT	
001B6C 6700 04A6	2011	BEQ	DECPTS	
	2012			
001B70 0C79 0013	2013	CMPI.W	*13H,COUNT	19TH KEY MUST BE 'ENTER'
001B78 6700 0046	2014	BEQ	DENTER	
	2015			
001B7C 0C79 000A	2016	CMPI.W	*0AH,KEY	OTHER KEYS MAY BE ANY DIGIT
001B84 6D00 02B4	2017	BLT	SAVED	
001B88 6C00 F696	2018	BGE	ERROR	'KEY ENTRY ERROR'
	2019			
001B8C 0C79 00EE	2020	DENT CMPI.W	*0EEH,KEY	
001B94 6600 F68A	2021	BNE	ERROR	'KEY ENTRY ERROR'
001B98 6100 05AC	2022	BSR	INITDS	
001B9C 4EF9 0000	2023	JMP	KEYRET	
	2024			
	2025	;.....		
	2026	; DCLEAR - CLEARS DISPLAY		
	2027	;.....		
	2028			
001BA2 6100 05A2	2029	DCLEAR BSR	INITDS	
	2030			
	2031	;.....		
	2032	; ISVAL - DISPLAYS CURRENT SOFT VALUES		
	2033	;.....		
	2034			
001BA6 4E71	2035	ISVAL	NOP	
001BA8 41F9 0000	2036	LEA.L	DKDATA,A0	
001BAE 6100 F4C8	2037	BSR	DSPMSG	
001BB2 13FC 0000	2038	MOVE.B	*00H,DSPADR	RESET DISPLAY ADDR
001BBA 4EF9 0000	2039	JMP	KEYRET	
	2040			
	2041	;.....		
	2042	; DENTER - CHANGES SOFT VALUES ACCORDING TO INPUT		
	2043	;.....		
	2044			
001BC0 0C79 00EE	2045	DENTER CMPI.W	*0EEH,KEY	'ENTER'?
001BC8 6600 F656	2046	BNE	ERROR	
001BCC 45F9 0000	2047	LEA.L	HITR3,A2	UPDATE DISPLAY ARRAY WITH
001BD2 47F9 0000	2048	LEA.L	DKDATA,A3	THE NEW D FUNCTION DATA
001BD8 321A	2049	MOVE.W	[A2]+,D1	
001BDA 0001 0030	2050	OR.B	*30H,D1	
001BDE 16C1	2051	MOVE.B	D1,[A3]+	
001BE0 321A	2052	MOVE.W	[A2]+,D1	

001BE2 0001 0030	2053
001BE8 16C1	2054
001BE8 321A	2055
001BEA 0001 0030	2056
001BEE 16C1	2057
001BF0 16FC 002E	2058
001BF4 321A	2059
001BF6 0001 0030	2060
001BFA 16C1	2061
001BFC 321A	2062
001BFE 0001 0030	2063
001C02 16C1	2064
001C04 321A	2065
001C06 0001 0030	2066
001C0A 16C1	2067
001C0C 16FC 002E	2068
001C10 321A	2069
001C12 0001 0030	2070
001C16 16C1	2071
001C18 321A	2072
001C1A 0001 0030	2073
001C1E 16C1	2074
001C20 16FC 002E	2075
001C24 321A	2076
001C26 0001 0030	2077
001C2A 16C1	2078
001C2C 321A	2079
001C2E 0001 0030	2080
001C32 16C1	2081
001C34 16FC 002E	2082
001C38 321A	2083
001C3A 0001 0030	2084
001C3E 16C1	2085
001C40 321A	2086
001C42 0001 0030	2087
001C46 1681	2088
001C48 45F9 0000	2089
001C4E 47F9 0000	2090
001C54 223C	2091
001C5A 243C	2092
001C60 6100 03D6	2093
001C64 45F9 0000	2094
001C6A 47F9 0000	2095
001C70 223C	2096
001C76 243C	2097
001C7C 6100 03BA	2098
001C80 4281	2099
001C82 3239 0000	2100
001C88 C2FC 0064	2101
001C8C 45F9 0000	2102

OR.B	*30H,D1
MOVE.B	D1,[A3]+
MOVE.W	[A2]+,D1
OR.B	*30H,D1
MOVE.B	D1,[A3]+
MOVE.B	*2EH,[A3]+
MOVE.W	[A2]+,D1
OR.B	*30H,D1
MOVE.B	D1,[A3]+
MOVE.W	[A2]+,D1
OR.B	*30H,D1
MOVE.B	D1,[A3]+
MOVE.W	[A2]+,D1
OR.B	*30H,D1
MOVE.B	D1,[A3]+
MOVE.B	*2EH,[A3]+
MOVE.W	[A2]+,D1
OR.B	*30H,D1
MOVE.B	D1,[A3]+
MOVE.W	[A2]+,D1
OR.B	*30H,D1
MOVE.B	D1,[A3]+
MOVE.W	[A2]+,D1
OR.B	*30H,D1
MOVE.B	D1,[A3]+
MOVE.B	*2EH,[A3]+
MOVE.W	[A2]+,D1
OR.B	*30H,D1
MOVE.B	D1,[A3]+
MOVE.W	[A2]+,D1
OR.B	*30H,D1
MOVE.B	D1,[A3]
LEA.L	HIT3,A2
LEA.L	TRIG3,A3
MOVE.L	*1,D1
MOVE.L	*1,D2
BSR	MULTIPL
LEA.L	H1JV,A2
LEA.L	JMPVAL,A3
MOVE.L	*0,D1
MOVE.L	*2,D2
BSR	MULTIPL
CLR.L	D1
MOVE.W	TRIG3,D1
MULU	*100,D1
LEA.L	DBTAB,A2

ADDRESS OF DATA
 ADDRESS OF ANSWER
 * OF DIGITS/ANSWER
 * OF ANSWERS

001C92 203C	2103	MOVE.L	*DBLEN,D0	
001C98 0480	2104	SUB.L	*DBHEX,D0	
001C9E B272 0000	2105 DENLP1	CMP.W	0(A2,D0),D1	
001CA2 8C00 000C	2106	BGE	TR3FND	
001CA6 0480	2107	SUB.L	*1,D0	
001CAC 51C8 FFF0	2108	DBRA	D0,DENLP1	
001CB0 47F9 0000	2109 TR3FND	LEA.L	DBHEX,A3	
001CB6 33F3 0000	2110	MOVE.W	0(A3,D0),TRIGR3	
001CBE 0079 8000	2111	OR.W	*8000H,TRIGR3	
001CC6 3239 0000	2112	MOVE.W	TRIG2,D1	
001CCC C2FC 0064	2113	MULU	*100,D1	
001CD0 203C	2114	MOVE.L	*DBLEN,D0	
001CD6 0480	2115	SUB.L	*DBHEX,D0	
001CDC B272 0000	2116 DENLP2	CMP.W	0(A2,D0),D1	
001CE0 8C00 000C	2117	BGE	TR2FND	
001CE4 0480	2118	SUB.L	*1,D0	
001CEA 51C8 FFF0	2119	DBRA	D0,DENLP2	
001CEE 33F3 0000	2120 TR2FND	MOVE.W	0(A3,D0),TRIGR2	
001CF6 0079 8000	2121	OR.W	*8000H,TRIGR2	
001CFE 33F9 0000	2122	MOVE.W	JMPVAL,TRIGR1	
001D08 45F9 0000	2123	LEA.L	TSTINF,A2	
001D0E 3579 0000	2124	MOVE.W	TRIGR1,TRG1(A2)	
001D16 3579 0000	2125	MOVE.W	TRIGR2,TRG2(A2)	
001D1E 3779 0000	2126	MOVE.W	TRIGR3,TRG3(A3)	
001D26 3579 0000	2127	MOVE.W	RISEDB,PSLOP(A2)	
001D2E 3579 0000	2128	MOVE.W	RISETM,PSLTM(A2)	
001D36 08B9 0000	2129	BCLR	*0,BRAMON	TURN BAT. RAM ON
001D3E 243C	2130	MOVE.L	*50,D2	SET FOR 50 USEC. DELAY
001D44 6100 F372	2131	BSR	DELAY	DELAY
001D48 6100 F12A	2132	BSR	RDCLK	
001D4C 2679 0000	2133	MOVE.L	CURPNT,A3	
001D52 D7FC	2134	ADD.L	*2,A3	
001D58 203C	2135	MOVE.L	*6000H,D0	
001D5E 2200	2136	MOVE.L	D0,D1	
001D60 8279 0000	2137	OR.W	TRIGR1,D1	
001D66 36C1	2138	MOVE.W	D1,{A3}+	
001D68 0680	2139	ADD.L	*1000H,D0	
001D6E 36C0	2140	MOVE.W	D0,{A3}+	
001D70 36F9 0000	2141	MOVE.W	TRIGR2,{A3}+	
001D76 0680	2142	ADD.L	*1000H,D0	
001D7C 36C0	2143	MOVE.W	D0,{A3}+	
001D7E 36F9 0000	2144	MOVE.W	TRIGR3,{A3}+	
001D84 0680	2145	ADD.L	*1000H,D0	
001D8A 3200	2146	MOVE.W	D0,D1	
001D8C 826A 0018	2147	OR.W	PSLOP(A2),D1	
001D90 36C1	2148	MOVE.W	D1,{A3}+	
001D92 0680	2149	ADD.L	*1000H,D0	
001D98 3200	2150	MOVE.W	D0,D1	
001D9A 826A 001A	2151	OR.W	PSLTM(A2),D1	
001D9E 36C1	2152	MOVE.W	D1,{A3}+	

001DA0 36F9 0000	2153	MOVE.W	CLK1,[A3]+		
001DA6 36F9 0000	2154	MOVE.W	CLK2,[A3]+		
001DAC 36F9 0000	2155	MOVE.W	CLK3,[A3]+		
001DB2 36FC EB90	2156	MOVE.W	*BARKER,[A3]+		
001DB6 36FC EB90	2157	MOVE.W	*BARKER,[A3]+		
001DBA 36BC EB90	2158	MOVE.W	*BARKER,[A3]		
001DBE 2039 0000	2159	MOVE.L	TRIGR2H,D0		
001DC4 23C0 0000	2160	MOVE.L	D0,TR2HIGH		
001DCA 0480	2161	SUB.L	*8000H,D0		
001DD0 23FC	2162	MOVE.L	*8000H,TR2LOW		
001DDA 91B9 0000	2163	SUB.L	D0,TR2LOW		
001DE0 23CB 0000	2164	MOVE.L	A3,CURPNT		
001DE6 4280	2165	CLR.L	D0		
001DE8 3039 0000	2166	MOVE.W	CURAVG,D0		
001DEE 33FC 0000	2167	MOVE.W	*00H,FUNCT	NO FUNCTION ACTIVE	
001DF6 33FC 0000	2168	MOVE.W	*00H,COUNT	KEY COUNT CLEARED	
001DFE 13FC 0000	2169	MOVE.B	*00H,DISPADR	RESET DISPLAY ADDR	
001E06 33FC 0000	2170	MOVE.W	*00H,ALPHA	CLEAR ALPHA FLAG	
001E0E 33FC 0000	2171	MOVE.W	*00H,POINT	CLEAR DECIMAL POINT	
001E16 23CB 0000	2172	MOVE.L	A3,LSTEVY		
001E1C 6100 0714	2173	BSR	SAVPAR		
001E20 0839 0001	2174	BTST	*1,TEST	SEE IF IN AN EVENT	
001E28 6600 000A	2175	BNE	CONTD	YES,LEAVE BRAM ON	
001E2C 08F9 0000	2176	BSET	*0,BRAMON	TURN BRAM OFF	
001E34 4EF9 0000	2177	CONTD	JMP	KEYRET 2178	
	2178	;			
	2180	;	SAVED -	STORES DIGITS TEMPORARILY FOR LATER USE	
	2181	;			
	2182				
001E3A 0C79 0003	2183	SAVED	CMPI.W	*03H,COUNT	THIRD KEY?
001E42 6600 0012	2184		BNE	D04	
001E46 33F9 0000	2185		MOVE.W	KEY,HITR3	FIRST DIGIT OF TRIGGER 3
001E50 4EF9 0000	2186		JMP	PUTKEY	DISPLAY
	2187				
001E56 0C79 0004	2188	D04	CMPI.W	*04H,COUNT	FOURTH KEY
001E5E 6600 0012	2189		BNE	D05	
001E62 33F9 0000	2190		MOVE.W	KEY,MITR3	SECOND DIGIT OF TRIGGER 3
001E6C 4EF9 0000	2191		JMP	PUTKEY	DISPLAY
	2192				
001E72 0C79 0005	2193	D05	CMPI.W	*05H,COUNT	FIFTH KEY
001E7A 6600 0012	2194			D07	
001E7E 33F9 0000	2195		MOVE.W	KEY,LOTR3	THIRD DIGIT OF TRIGGER3
001E88 4EF9 0000	2196		JMP	PUTKEY	DISPLAY
	2197				
001E8E 0C79 0007	2198	D07	CMPI.W	*07H,COUNT	SEVENTH KEY
001E96 6600 0012	2199		BNE	D08	
001E9A 33F9 0000	2200		MOVE.W	KEY,HITR2	FIRST DIGIT OF TRIGGER2
001EA4 4EF9 0000	2201		JMP	PUTKEY	DISPLQY
	2202				
001EAA 0C79 0008	2203	D08	CMPI.W	*08H,COUNT	EIGHTH KEY

001EB2 6600 0012	2204	BNE	D09	
001EB6 33F9 0000	2205	MOVE.W	KEY,MITR2	SECOND DIGIT OF TRIGGER2
001EC0 4EF9 0000	2206	JMP	PUTKEY	
	2207			
001EC6 0C79 0009	2208 D09	CMPI.W	*09H,COUNT	9TH KEY
001ECE 6600 0012	2209	BNE	DB	
001ED2 33F9 0000	2210	MOVE.W	KEY,LOTR2	THIRD DIGIT OF TRIGGER2
001EDC 4EF9 0000	2211	JMP	PUTKEY	DISPLAY
	2212			
001EE2 0C79 000B	2213 DB	CMPI.W	*0BH,COUNT	11TH KEY
001EEA 6600 0012	2214	BNE	DC	
001EEE 33F9 0000	2215	MOVE.W	KEY,HIJV	FIRST DIGIT OF PEAK PERIOD
001EF8 4EF9 0000	2216	JMP	PUTKEY	DISPLAY
	2217			
001EFE 0C79 000C	2218 DC	CMPI.W	*0CH,COUNT	12TH KEY
001F06 6600 0012	2219	BNE	DE	
001F0A 33F9 0000	2220	MOVE.W	KEY,LOJV	SECOND DIGIT OF PEAK PERIOD
001F14 4EF9 0000	2221	JMP	PUTKEY	DISPLAY
	2222			
001F1A 0C79 000E	2223 DE	CMPI.W	*0EH,COUNT	14TH KEY
001F22 6600 0012	2224	BNE	DF	
001F26 33F9 0000	2225	MOVE.W	KEY,HIRV	FIRST DIGIT OF RISETIME dB
001F30 4EF9 0000	2226	JMP	PUTKEY	DISPLAY
	2227			
001F36 0C79 000F	2228 DF	CMPI.W	*0FH,COUNT	15TH KEY
001F3E 6600 0012	2229	BNE	D11	
001F42 33F9 0000	2230	MOVE.W	KEY,LORV	SECOND DIGIT OF RISETIME dB
001F4C 4EF9 0000	2231	JMP	PUTKEY	DISPLAY
	2232			
001F52 0C79 0011	2233 D11	CMPI.W	*11H,COUNT	17TH KEY
001F5A 6600 0012	2234	BNE	D12	
001F5E 33F9 0000	2235	MOVE.W	KEY,HIRT	FIRST DIGIT OF RISETIME mSEC
001F68 4EF9 0000	2236	JMP	PUTKEY	DISPLAY
	2237			
001F6E 33F9 0000	2238 D12	MOVE.W	KEY,LORT	SECOND DIGIT OF RISETIME mSEC
001F78 4EF9 0000	2239	JMP	PUTKEY	DISPLAY
	2240			
	2241			
	2242 ;			
	2243 ;			
	2244 ;	E FUNCTION KEY PROCESSOR		
	2245 ;	DISPLAY REMAINING MEMORY		
	2246 ;			
	2247 ;			
	2248			
001F7E 203C	2249 EKEY	MOVE.L	*ENDBRM,D0	GET END OF MEMORY
001F84 90B9 0000	2250	SUB.L	CURPWT,D0	SUB CURRENT DATA PTRR
001F8A 4281	2251	CLR.L	D1	CONVERT DIFFERENCE TO
001F8C 80FC 03E8	2252	DIVU	*1000,D0	DECIMAL/ASCII AND
001F90 41F9 0000	2253	LEA.L	MEMMSG,A0	STORE INTO DISPLAY MSG

```

001F96 10FC 0020 2254      MOVE.B  #20H,[A0]+
001F9A 0C40 0064 2255 EKEY1  CMP.W   #100,D0
001F9E 6D00 000C 2256      BLT     EKEY1A
001FA2 0641 0001 2257      ADD.W   #1,D1
001FA6 0440 0064 2258      SUB.W   #100,D0
001FAA 60EE      2259      BRA     EKEY1
001FAC 10BC 0020 2260 EKEY1A  MOVE.B  #20H,[A0]
001FB0 0C41 0000 2261      CMP.W   #0,D1
001FB4 6700 0008 2262      BEQ     EKEY1B
001FB8 0001 0030 2263      OR.B    #30H,D1
001FBC 1081      2264      MOVE.B  D1,[A0]
001FBE 4241      2265 EKEY1B  CLR.W   D1
001FC0 D1FC      2266      ADDA.L  #1,A0
001FC6 0C40 000A 2267 EKEY2  CMP.W   #10,D0
001FCA 6D00 000C 2268      BLT     EKEY2A
001FCE 0641 0001 2269      ADD.W   #1,D1
001FD2 0440 000A 2270      SUB.W   #10,D0
001FD6 60EE      2271      BRA     EKEY2
001FD8 0001 0030 2272 EKEY2A  OR.B    #30H,D1
001FDC 10C1      2273      MOVE.B  D1,[A0]+
001FDE 0000 0030 2274      OR.B    #30H,D0
001FE2 1080      2275      MOVE.B  D0,[A0]
001FE4 41F9 0000 2276      LEA.L   MEMMSG,A0
001FEA 6100 F08C 2277      BSR     DSPMSG
001FEE 4EF9 0000 2278      JMP     KEYRET
2279
2280 ;::::::::::::::::::::::::::::::::::::::::::::::::::
2281 ;   F FUNCTION KEY PROCESSOR
2282 ;   MANUAL SAVE DATA
2283 ;::::::::::::::::::::::::::::::::::::::::::::::::::
2284
001FF4 33FC 0001 2285 FKEY   MOVE.W  #1,DATSAV
001FFC 41F9 0000 2286      LEA.L   SAVMSG,A0
002002 6100 F074 2287      BSR     DSPMSG
002006 33FC 0000 2288      MOVE.W  #0,OFF
00200E 4EF9 0000 2289      JMP     KEYRET
2290
2291 ;::::::::::::::::::::::::::::::::::::::::::::::::::
2292 ;   DECPTS - HANDLE DECIMAL POINTS FOR EACH FUNCTION.
2293 ;::::::::::::::::::::::::::::::::::::::::::::::::::
2294
002014 4E71      2295 DECPTS  NOP
002016 0C79 0001 2296      CMPL.W  #01,POINT      IS DECIMAL POINT TURNED ON?
00201E 6600 F200 2297      BNE     ERROR          'KEY ENTRY ERROR'
002022 33FC 002E 2298      MOVE.W  #02EH,KEY
00202A 33FC 0000 2299      MOVE.W  #00H,POINT      CLEAR DECIMAL POINT
002032 4EF9 0000 2300      JMP     PUTKEY
2301
2302 ;::::::::::::::::::::::::::::::::::::::::::::::::::
2303 ;   MULTIPL - MULTIPLY DATA SENT AND RETURN VALUES

```

```

2304 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
2305
002038 4E71 2306 MULTIPL NOP
00203A 48E7 E0F0 2307 MOVEM.L D0-D2/A0-A3,-[A7]
00203E 33C1 0000 2308 MOVE.W D1,DIGITS
002044 4280 2309 CLR.L D0
002046 D05A 2310 MULTI ADD.W [A2]+,D0
002048 C0FC 000A 2311 MULU.W #0AH,D0
00204C 51C9 FFF8 2312 DBRA D1,MULTI
002050 D05A 2313 ADD.W [A2]+,D0
002052 36C0 2314 MOVE.W D0,[A3]+
002054 4280 2315 CLR.L D0
002056 3239 0000 2316 MOVE.W DIGITS,D1
00205C 51CA FFE8 2317 DBRA D2,MULTI
002060 4CDF 0F07 2318 MOVEM.L [A7]+,D0-D2/A0-A3
002064 4E75 2319 RTS
2320
2321 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
2322 ; PUTKEY - SEND 1 BYTE OF OUTPUT DATA TO WRDISP
2323 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
2324
002066 4E71 2325 PUTKEY NOP
002068 4287 2326 CLR.L D7
00206A 3E39 0000 2327 MOVE.W KEY,D7 MOVE RAW INPUT INTO REGISTER
002070 0C79 002E 2328 CMPI.W #02EH,KEY IF A DECIMAL POINT DON'T OR
002078 8700 0006 2329 BEQ PTFND
00207C 0007 0030 2330 OR.B #30H,D7 CONVERT TO ASCII
002080 E14F 2331 PTFND LSL #8,D7 SHIFT LEFT 8 BITS
002082 1E39 0000 2332 MOVE.B DSPADR,D7 DISPLAY ADDR IN LOWER BYTE
002088 6100 0010 2333 BSR WRDISP WRITE OUT INPUT KEY
00208C 0639 0001 2334 ADD.B #01,DSPADR INCREMENT THE DISPLAY
002094 4EF9 0000 2335 JMP KEYRET GET NEXT INPUT
2336
2337 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
2338 ; WRDISP - OUTPUT DATA TO LCD DISPLAY
2339 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
2340
00209A 48E7 0380 2341 WRDISP MOVEM.L D6-D7/A0,-[A7]
00209E 41F9 0002 2342 LEA.L DISPLY,A0 A0 PTS TO THE LCD DISPLAY
0020A4 1C28 0001 2343 LAB1 MOVE.B 1[A0],D6 GET STATUS
0020A8 8BFA 2344 BMI.S LAB1 BRANCH IF NOT READY
0020AA 6100 00C4 2345 BSR DSPDEL
0020AE 0007 0080 2346 OR.B #80H,D7 TURN BIT 7 ON
0020B2 1147 0001 2347 MOVE.B D7,1[A0]
0020B6 1C28 0001 2348 LAB2 MOVE.B 1[A0],D6 CHECK STATUS AGAIN
0020BA 8BFA 2349 BMI.S LAB2 BRANCH IF NOT READY
0020BC 6100 00B2 2350 BSR DSPDEL
0020C0 E04F 2351 LSR #8,D7 SHIFT DATA BACK TO LOWER BYTE
0020C2 1147 0003 2352 MOVE.B D7,3[A0]
0020C6 4CDF 01C0 2353 MOVEM.L [A7]+,D6-D7/A0 POP REGISTERS

```

0020CA 4E75	2354	RTS	
	2355		
	2356	*****	
	2357	*	
0020CC 4E71	2358	KEYRET	NOP
0020CE 4CDF 7FFF	2359	MOVEM.L	[A7]+,D0-D7/A0-A6
0020D2 2679 0000	2360	MOVE.L	CURPNT,A3
0020D8 224B	2361	MOVE.L	A3,A1
0020DA 244B	2362	MOVE.L	A3,A2
0020DC 284B	2363	MOVE.L	A3,A4
0020DE 4E71	2364	NOP	
0020E0 4E73	2365	RTE	
	2366		
	2367	;.....	
	2368	; GETKEY - OBTAINS INPUT DATA	
	2369	;.....	
	2370		
0020E2 4E71	2371	GETKEY	NOP
0020E4 41F9 0002	2372	LEA.L	PIA,A0
0020EA 4285	2373	CLR.L	D5
0020EC 45F9 0000	2374	LEA.L	KEYLIST,A2
0020F2 1A28 0001	2375	MOVE.B	ADATA(A0),D5
0020F6 D5C5	2376	ADDA.L	D5,A2
0020F8 4285	2377	CLR.L	D5
0020FA 1A12	2378	MOVE.B	[A2],D5
0020FC 33C5 0000	2379	MOVE.W	D5,KEY
002102 0C79 0013	2380	CMPI.W	*13H,KEY
00210A 8600 000C	2381	BNE	NOTPT
00210E 33FC 0001	2382	MOVE.W	*01H,POINT
002116 4E75	2383	RTS	
002118 0C79 0010	2384	NOTPT	CMPI.W *10H,KEY
002120 6D00 0004	2385	BLT	CONTIN
002124 4E75	2386	RTS	
002126 0C79 000A	2387	CONTIN	CMPI.W *0AH,KEY
00212E 6C00 000C	2388	BGE	SETALF
002132 33FC 0000	2389	MOVE.W	*00H,ALPHA
00213A 4E75	2390	RTS	
00213C 33FC 0001	2391	SETALF	MOVE.W *01,ALPHA
002144 4E75	2392	RTS	
	2393		
	2394	;.....	
	2395	; INITDS - INITIALIZES THE LCD DISPLAY	
	2396	;.....	
	2397		
002146 48E7 COC0	2398	INITDS	MOVEM.L D0-D1/A0-A1,-[A7]
00214A 41F9 0002	2399	LEA.L	DISPLY,A0
002150 43F9 0000	2400	LEA.L	DSLST,A1
002156 7204	2401	MOVEQ	#4,D1
002158 1028 0001	2402	INITDS1	MOVE.B 1[A0],D0
00215C 6BFA	2403	BMI.S	INITDS1

00215E 6100 0010	2404	BSR	DSPDEL	
002162 1159 0001	2405	MOVE.B	[A1]+,1[A0]	
002166 51C9 FFF0	2406	DBRA	D1,INITDS1	
00216A 4CDF 0303	2407	MOVEM.L	[A7]+,D0-D1/A0-A1	
00216E 4E75	2408	RTS		
	2409			
	2410 *			
	2411 *	DISPLAY DELAY ROUTINE		
	2412			
002170 48E7 0200	2413	DSPDEL	MOVEM.L D6,-[A7]	
002174 3C3C 0032	2414	MOVE.W	*50,D6	
002178 4E71	2415	DDLOOP	NOP	
00217A 51CE FFFC	2416	DBRA	D6,DDLOOP	
00217E 4CDF 0040	2417	MOVEM.L	[A7]+,D6	
002182 4E75	2418	RTS		
	2419			
	2420 *	TIMER IRQ *		
	2421			
002184 4E71	2422	TIMER	NOP	
002186 6100 0004	2423	BSR	TIMSUB	
00218A 4E73	2424	RTE		
	2425			
00218C 48E7 0380	2426	TIMSUB	MOVEM.L D6-D7/A0,-[A7]	
002190 41F9 0003	2427	LEA.L	TIMADDR,A0	
002196 1C28 0001	2428	MOVE.B	TSTAT[A0],D6	GET TIMER STATUS
00219A 117C 00E1	2429	MOVE.B	*IRQEN,T1CNTRL[A0]	DISABLE TIMER 2
0021A0 117C 00E1	2430	MOVE.B	*IRQEN,T2CNTRL[A0]	
0021A6 0C79 0001	2431	CMPI.W	*1,DATSAV	
0021AE 6600 001A	2432	BNE	TIMSCON	
0021B2 B7FC	2433	CMPL.L	*ENDBRM,A3	* ADDED 6/7/88
0021B8 6C00 EB14	2434	BGE	RAMFL	* ADDED 6/7/88
0021BC 6188	2435	BSR	INITDS	
0021BE 97FC	2436	SUBA.L	*17000,A3	
0021C4 244B	2437	MOVEA.L	A3,A2	
0021C6 6000 0242	2438	BRA	CONFMD	
0021CA 4287	2439	TIMSCON	CLB.L D7	
0021CC 3E14	2440	MOVE.W	[A4],D7	
0021CE BEB9 0000	2441	CMPL	TRIGR3H,D7	SEE IF PEAK WAS ENOUGH
0021D4 6D00 02C8	2442	BLT	NOEVENT	NO - ERASE EVENT
	2443			
	2444 *	CHECK PEAK SLOPE		
	2445			
0021DE B5C9	2446	CMPL.L	A1,A2	SEE IF VALID DATA
0021DA 6700 02C2	2447	BEQ	NOEVENT	FLAG1 = FLAG2
0021DE 4287	2448	CLB.L	D7	
0021E0 3E39 0000	2449	MOVE.W	TRIGR1,D7	
0021E6 0C47 0000	2450	CMPL.W	*0,D7	
0021EA 6700 005C	2451	BEQ	NEGCHK1	
0021EE E94F	2452	LSL.W	*4,D7	
0021F0 2C0B	2453	MOVE.L	A3,D6	

0021F2 9C8C	2454	SUB.L	A4,D6	
0021F4 BE46	2455	CMP.W	D6,D7	
0021F6 6D00 0004	2456	BLT	NEGCHK	
0021FA 3E06	2457	MOVE.W	D6,D7	
0021FC 3A06	2458 NEGCHK	MOVE.W	D6,D5	
0021FE 4286	2459	CLR.L	D6	
002200 3C34 7000	2460	MOVE.W	0[A4,D7],D6	
002204 BCB9 0000	2461	CMP.L	TRIGR2H,D6	
00220A 6D00 0292	2462	BLT	NONEVNT	
00220E 0447 0002	2463	SUB.W	*2,D7	
002212 66E8	2464	BNE	NEGCHK	
002214 4286	2465 NEGPKCHK	CLR.L	D6	
002216 2C39 0000	2466	MOVE.L	NEGPK,D6	
00221C BCB9 0000	2467	CMP.L	TR2LOW,D6	
002222 6E00 027A	2468	BGT	NONEVNT	
002226 4286	2469	CLR.L	D6	
002228 4285	2470	CLR.L	D5	
00222A 3A39 0000	2471	MOVE.W	TRIGR1,D5	
002230 E34D	2472	LSL.W	*1,D5	
002232 4445	2473	NEG.W	D5	
002234 3C35 5000	2474 NEGPLP	MOVE.W	0[A5,D5.W],D6	
002238 BCB9 0000	2475	CMP.L	TR2LOW,D6	
00223E 6E00 025E	2476	BGT	NONEVNT	
002242 0645 0002	2477	ADD.W	*2,D5	
002246 66EC	2478	BNE	NEGPLP	
002248 4287	2479 NEGCHK1	CLR.L	D7	
00224A 4286	2480	CLR.L	D6	
00224C 41F9 0000	2481	LEA.L	TSTINF,A0	GET PARAMETER TABLE
002252 3C28 0018	2482	MOVE.W	PSLOP[A0],D6	GET SLOPE PARAMETER
002256 CCFC 006A	2483	MULU	*100,D6	
00225A 3E28 001A	2484	MOVE.W	PSLTW[A0],D7	GET SLOPE TIME PARAMETER
00225E E98F	2485	LSL.L	*4,D7	*16 TO CNVRT MSEC. TO SAMPLES
002260 204C	2486	MOVE.L	A4,A0	SAVE PEAK POINTER
002262 91C7	2487	SUB.L	D7,A0	SUBTRACT SLOPE TIME
002264 B1C9	2488	CMP.L	A1,A0	SEE IF POINTER BEFORE BOE
002266 6E00 0010	2489	BGT	CHKCONT	
00226A 2049	2490	MOVE.L	A1,A0	SET TO BEGIN OF EVENT
00226C D1FC	2491	ADDA.L	*2,A0	POSITION PMTR TO BOD
002272 B1CC	2492	CMPA.L	A4,A0	
002274 6C00 0194	2493	BGE	CONFND	
002278 2E3C	2494 CHKCONT	MOVE.L	*DBLEN,D7	GET LENGTH OF DB TABLE
00227E 0487	2495	SUB.L	*DBHEX,D7	
002284 3A10	2496	MOVE.W	[A0],D5	GET PEAK-TIME VALUE
002286 0C45 0000	2497	CMPI.W	*0,D5	
00228A 6E00 006A	2498	BGT	CHKFPK	
00228E 41F9 0000	2499	LEA.L	DBHEX,A0	POINT TO DB HEX TABLE
002294 0442 8000	2500	SUB.W	*8000H,D2	
002298 B470 7000	2501 PLOOP	CMP.W	0[A0,D7],D2	SEACH FOR PEAK IN DB
00229C 6C00 0010	2502	BGE	PFOUND	PEAK FOUND
0022A0 0487	2503	SUB.L	*1,D7	

0022A6 51CF FFF0	2504	DBRA	D7,PLOOP	ELSE DECR. POINTER
0022AA 6000 004A	2505	BRA	CHKFPK	IF PTR GOES - NO DB
0022AE 41F9 0000	2506 PFIND	LEA.L	DBTAB,A0	GET DBTABLE
0022B4 3430 7000	2507	MOVE.W	0[A0,D7],D2	GET PEAK VAL IN DB
0022B8 41F9 0000	2508	LEA.L	DBHEX,A0	POINT BACK TO HEX TABLE
0022BE 2E3C	2509	MOVE.L	*DBLEN,D7	
0022C4 0487	2510	SUB.L	*DBHEX,D7	
0022CA 0445 8000	2511	SUB.W	*8000H,D5	
0022CE BA70 7000	2512 PSLOOP	CMP.W	0[A0,D7],D5	LOOK FOR DB OF OTHER POINT
0022D2 6C00 0010	2513	BGE	SFIND	MATCH FOUND
0022D6 0487	2514	SUB.L	*1,D7	
0022DC 51CF FFF0	2515	DBRA	D7,PSLOOP	ELSE DECR. POINTER
0022E0 6000 0014	2516	BRA	CHKFPK	IF D7 GOES - NOT IN TABLE
0022E4 41F9 0000	2517 SFIND	LEA.L	DBTAB,A0	POINT TO DBTABLE
0022EA 3A30 7000	2518	MOVE.W	0[A0,D7],D5	GET OTHER DB VALUE
0022EE 9445	2519	SUB.W	D5,D2	GET DIF. OF PEAK & OTHER VAL.
0022F0 BC42	2520	CMP.W	D2,D6	IS SLOPE .LE. SLOPE PARAMETER
0022F2 6F00 0116	2521	BLE	CONFND	NO
0022F6 4286	2522 CHKFPK	CLR.L	D6	
0022F8 204C	2523	MOVE.L	A4,A0	SAVE PEAK
0022FA 3C20	2524 PKEND	MOVE.W	-(A0),D6	GET PEAK VALUE
0022FC BCB9 0000	2525	CMP.L	TRIGB3H,D6	PEAK < PEAK THRESHOLD
002302 6D00 0006	2526	BLT	FNDST	YES - GO FIND FIRST PEAK
002306 B1C9	2527	CMPA.L	A1,A0	AT BEGINNING OF DATA?
002308 6EF0	2528	BGT	PKEND	NO - CONTINUE
00230A 4285	2529 FNDST	CLR.L	D5	
00230C 3A18	2530	MOVE.W	[A0]+,D5	SAVE FIRST VALUE
00230E 3C18	2531 FNDPK	MOVE.W	[A0]+,D6	GET NEXT VALUE
002310 B1CC	2532	CMPA.L	A4,A0	
002312 6E00 018A	2533	BGT	NONEVNT	
002316 BC85	2534	CMP.L	D5,D6	VALUE < PREVIOUS VALUE?
002318 6D00 0006	2535	BLT	FNDBOT	YES - FIRST PEAK FOUND
00231C 3A06	2536	MOVE.W	D6,D5	NO - SET PREVIOUS VALUE
00231E 60EE	2537	BRA	FNDPK	
002320 2E08	2538 FNDBOT	MOVE.L	A0,D7	
002322 0487	2539	SUB.L	*4,D7	
002328 3406	2540	MOVE.W	D6,D2	
00232A 0442 000A	2541	SUB.W	*10,D2	
00232E 3A06	2542	MOVE.W	D6,D5	
002330 3C18	2543 BOTCONT	MOVE.W	[A0]+,D6	
002332 BC82	2544	CMP.L	D2,D6	
002334 6F00 0010	2545	BLE	BOTFND	
002338 BC85	2546	CMP.L	D5,D8	
00233A 6E00 0010	2547	BGT	NITPK	
00233E B1CC	2548	CMPA.L	A4,A0	
002340 6C00 015C	2549	BGE	NONEVNT	
002344 60EA	2550	BRA	BOTCONT	
002346 2047	2551 BOTFND	MOVEA.L	D7,A0	
002348 6000 0006	2552	BRA	PKFND	
00234C 2A06	2553 NITPK	MOVE.L	D6,D5	

00234E 60BE	2554	BRA	FNDPK	
002350 2408	2555	PKFND	MOVE.L	A0,D2
002352 49F9 0000	2556	LEA.L	TSTINF,A4	SAVE FIRST PEAK POINTER
002358 4287	2557	CLR.L	D7	GET SLOPE TIME PARAMETER
00235A 3E2C 001A	2558	MOVE.W	PSLTM[A4],D7	
00235E E98F	2559	LSL.L	#4,D7	
002360 8EFC 0003	2560	DIVU	#3,D7	TAKE 1/3 OF TIME
002364 0287	2561	ANDI.L	#OFFFEH,D7	
00236A 8487	2562	SUB.L	D7,D2	MOVE POINTER BACK IN TIME
00236C B489	2563	CMP.L	A1,D2	SEE IF BEFORE EVENT
00236E 6E00 000A	2564	BGT	FPCONT	
002372 2409	2565	MOVE.L	A1,D2	
002374 0682	2566	ADD.L	#2,D2	
00237A 4285	2567	FPCONT	CLR.L	D5
00237C 3A10	2568	MOVE.W	[A0],D5	GET FIRST PEAK VALUE
00237E 0445 8000	2569	SUB.W	#8000H,D5	
002382 2E3C	2570	MOVE.L	#DBLEN,D7	
002388 0487	2571	SUB.L	#DBHEX,D7	
00238E 49F9 0000	2572	LEA.L	DBHEX,A4	
002394 BA74 7000	2573	FPLOP	CMP.W	0[A4,D7],D5
002398 6C00 0010	2574	BGE	FPPND	FIND IN DB TABLE
00239C 0487	2575	SUB.L	#1,D7	
0023A2 51CF FFF0	2576	DBRA	D7,FPLOP	
0023A6 6000 00F6	2577	BRA	NONEVNT	IF NOT IN TABLE - NON-EVENT
0023AA 49F9 0000	2578	FPPND	LEA.L	DBTAB,A4
0023B0 3A34 7000	2579	MOVE.W	0[A4,D7],D5	GET VALUE OF DB PEAK
0023B4 49F9 0000	2580	LEA.L	DBHEX,A4	
0023BA 2E3C	2581	MOVE.L	#DBLEN,D7	
0023C0 0487	2582	SUB.L	#DBHEX,D7	
0023C6 2042	2583	MOVEA.L	D2,A0	
0023C8 4282	2584	CLR.L	D2	
0023CA 3410	2585	MOVE.W	[A0],D2	
0023CC 0482	2586	SUB.L	#8000H,D2	
0023D2 B474 7000	2587	FPSLOP	CMP.W	0[A4,D7],D2
0023D6 6C00 0010	2588	BGE	FPSFND	FIND FIRST POINT IN DB TABLE
0023DA 0487	2589	SUB.L	#1,D7	
0023E0 51CF FFF0	2590	DBRA	D7,FPSLOP	
0023E4 6000 00B8	2591	BRA	NONEVNT	IF NOT IN TABLE - NON EVENT
0023E8 49F9 0000	2592	FPSFND	LEA.L	DBTAB,A4
0023EE 3434 7000	2593	MOVE.W	0[A4,D7],D2	GET DB VALUE OF FIRST POINT
0023F2 8A42	2594	SUB.W	D2,D5	CALC DB DIFFERENCE
0023F4 49F9 0000	2595	LEA.L	TSTINF,A4	
0023FA 4286	2596	CLR.L	D6	
0023FC 3C2C 0018	2597	MOVE.W	PSLOP[A4],D6	GET SLOPE PARAMETER
002400 CCFC 0064	2598	MULU	#100,D6	
002404 BC45	2599	CMP.W	D5,D6	IF SLOPE < PARAMETER
002406 6E00 0096	2600	BGT	NONEVNT	NON - EVENT
00240A D5FC	2601	CONFND	ADDA.L	INCR BOOM POINTER
002410 6100 EA62	2602	BSR	RDCLK	GET CURRENT TIME
002414 34F9 0000	2603	MOVE.W	CLK1,[A2]+	STORE CURRENT TIME

00241A 34F9 0000	2604	MOVE.W	CLK2,[A2]+				
002420 34F9 0000	2605	MOVE.W	CLK3,[A2]+				
002426 34C3	2606	MOVE.W	D3,[A2]+	STORE AVERAGE			
002428 34FC EB90	2607	MOVE.W	*BARKER,[A2]+	MOVE IN BARKER CODES			
00242C 34FC EB90	2608	MOVE.W	*BARKER,[A2]+				
002430 34BC EB90	2609	MOVE.W	*BARKER,[A2]				
002434 0C79 03E7	2610	CMP.W	*999,VBOOM				
00243C 6D00 000A	2611	BLT	CONT1				
002440 33FC 0000	2612	MOVE.W	*0,VBOOM				
002448 0679 0001	2613	ADD.W	*1,VBOOM	INCR. VALID BOOM COUNT			
002450 3439 0000	2614	MOVE.W	VBOOM,D2				
002456 6100 00FA	2615	BSR	HEXCNT	CONVERT TO DECIMAL ASCII			
00245A 41F9 0000	2616	LEA.L	BOOMSG1,A0	STORE IN DISPLAY MSG			
002460 10F9 0000	2617	MOVE.B	HUND,[A0]+	STORE 100 DIGIT			
002466 10F9 0000	2618	MOVE.B	TEN,[A0]+	STORE 10 DIGIT			
00246C 10B9 0000	2619	MOVE.B	UNIT,[A0]	STORE 1 DIGIT			
002472 41F9 0000	2620	LEA.L	BOOMSG1,A0				
002478 6100 EBFE	2621	BSR	DSPMSG	DISPLAY MESSAGE			
00247C B7FC	2622	CMPLA.L	*ENDBRM,A3	CHECK FOR END OF RAM			
002482 6C00 E84A	2623	BGE	RAMFL	IF YES STOP			
002486 224A	2624	MOVEA.L	A2,A1	ELSE RESET FLAGS			
002488 264A	2625	MOVEA.L	A2,A3				
00248A 284A	2626	MOVEA.L	A2,A4				
00248C 2A4A	2627	MOVEA.L	A2,A5				
00248E 23CA 0000	2628	MOVE.L	A2,LSTEV				
002494 23CA 0000	2629	MOVE.L	A2,CURPNT				
00249A 6000 0062	2630	BRA	TIMEXT	AND EXIT			
00249E 2279 0000	2631	MOVE.L	LSTEV,A1	RESET FLAGS			
0024A4 2449	2632	MOVEA.L	A1,A2				
0024A6 2649	2633	MOVEA.L	A1,A3				
0024A8 2849	2634	MOVEA.L	A1,A4				
0024AA 2A49	2635	MOVEA.L	A1,A5				
0024AC B3FC	2636	CMPLA.L	*ENDDATA,A1		0024B2 6C00 E81A	2637	BGE RAMFL
0024B6 0C79 03E7	2638	CMP.W	*999,NVBOOM				
0024BE 6D0C 000A	2639	BLT	CONT2				
0024C2 33FC 0000	2640	MOVE.W	*0,NVBOOM				
0024CA 0679 0001	2641	ADD.W	*1,NVBOOM	INCR NON-BOOM COUNT			
0024D2 3439 0000	2642	MOVE.W	NVBOOM,D2				
0024D8 6100 0078	2643	BSR	HEXCNT	CONVERT TO DECIMAL ASCII			
0024DC 41F9 0000	2644	LEA.L	BOOMSG2,A0				
0024E2 10F9 0000	2645	MOVE.B	HUND,[A0]+	STORE COUNT IN MSG			
0024E8 10F9 0000	2646	MOVE.B	TEN,[A0]+				
0024EE 10B9 0000	2647	MOVE.B	UNIT,[A0]				
0024F4 41F9 0000	2648	LEA.L	BOOMSG1,A0				
0024FA 6100 EB7C	2649	BSR	DSPMSG	DISPLAY COUNT MESSAGE			
0024FE 4282	2650	CLRL	D2	ZERO PEAK VALUE			
002500 23FC	2651	MOVE.L	*8000,NEGPK				
00250A 33C2 0000	2652	MOVE.W	D2,DATSAV				
002510 08B9 0001	2653	BCLR	*1,TEST	CLEAR TIMER 1 FLAG			
002518 08B9 0002	2654	BCLR	*2,TEST	CLEAR TIMER 2 FLAG			

002520 6100 0010	2655	BSR	SAVPAR	
002524 08F9 0000	2656	BSET	*0,BRAMON	TURN OFF BAT. RAM
00252C 4CDF 01C0	2657	MOVEM.L	[A7]+,D6-D7/A0	
002530 4E75	2658	RTS		
	2659			
	2660 *			
	2661 *			
002532 48E7 00C0	2662 SAVPAR	MOVEM.L	A0-A1,-[A7]	
002536 41F9 0087	2663	LEA.L	VARSTR,A0	
00253C 43F9 0000	2664	LEA.L	SRAM,A1	
002542 10D9	2665 PARLOP	MOVE.B	[A1]+,[A0]+	
002544 B3FC	2666	CMPL.L	*ENDVAR,A1	
00254A 6DF6	2667	BLT	PARLOP	
00254C 4CDF 0300	2668	MOVEM.L	[A7]+,A0-A1	
002550 4E75	2669	RTS		
	2670			
	2671			
	2672 *	THIS ROUTINE CONVERTS THE VALUE IN D2		
	2673 *	TO DECIMAL ASCII.THE RESULT IS RETURNED IN		
	2674 *	HUND,TEN,UNIT.THE INPUT VALUE MUST BE BETWEEN		
	2675 *	0 AND 999 DECIMAL.		
	2676 *			
	2677			
002552 13FC 0000	2678 HEXCNVT	MOVE.B	*0,HUND	
00255A 13FC 0000	2679	MOVE.B	*0,TEN	
002562 13FC 0000	2680	MOVE.B	*0,UNIT	
00256A 0C42 0064	2681 HUNLP	CMP.W	*100,D2	
00256E 6D00 0010	2682	BLT	TENLP	
002572 0442 0064	2683	SUB.W	*100,D2	
002576 0639 0001	2684	ADD.B	*1,HUND	
00257E 60EA	2685	BRA	HUNLP	
002580 0C42 000A	2686 TENLP	CMP.W	*10,D2	
002584 6D00 0010	2687	BLT	UNITLP	
002588 0442 000A	2688	SUB.W	*10,D2	
00258C 0639 0001	2689	ADD.B	*1,TEN	
002594 60EA	2690	BRA	TENLP	
002596 13C2 0000	2691 UNITLP	MOVE.B	D2,UNIT	
00259C 0039 0030	2692	OR.B	*30H,HUND	
0025A4 0039 0030	2693	OR.B	*30H,TEN	
0025AC 0039 0030	2694	OR.B	*30H,UNIT	
0025B4 4E75	2695	RTS		
	2696			
	2697			
0025B6 4E73	2698 LITMG	RTS		
	2699			
	2700			
	2701			
	2702			
	2703 ;	;		
	2704 ;	;		

```

2705 ; DB TABLE
2706 ;
2707 ::::::::::::::::::::::::::::::::::::::::::::::::::::
2708
2709 ;          DB VAL  HEX  DECIMAL
2710
0025B8 1B58 2711 DBTAB  DC.W  7000    0  0
0025BA 1E14 2712      DC.W  7700    1  1
0025BC 1FA4 2713      DC.W  8100    2  2
0025BE 20D0 2714      DC.W  8400    3  3
0025C0 21FC 2715      DC.W  8700    4  4
0025C2 22C4 2716      DC.W  8900    5  5
0025C4 2328 2717      DC.W  9000    6  6
0025C6 23F0 2718      DC.W  9200    7  7
0025C8 2454 2719      DC.W  9300    8  8
0025CA 24B8 2720      DC.W  9400    9  9
0025CC 251C 2721      DC.W  9500   A  10
0025CE 2580 2722      DC.W  9600   B  11
0025D0 25E4 2723      DC.W  9700   D  13
0025D2 2648 2724      DC.W  9800   E  14
0025D4 26AC 2725      DC.W  9900  10  16
0025D6 2710 2726      DC.W 10000  12  18
0025D8 2774 2727      DC.W 10100  14  20
0025DA 27D8 2728      DC.W 10200  16  22
0025DC 283C 2729      DC.W 10300  19  25
0025DE 28A0 2730      DC.W 10400  1C  28
0025E0 2904 2731      DC.W 10500  20  32
0025E2 2968 2732      DC.W 10600  23  35
0025E4 29CC 2733      DC.W 10700  28  40
0025E6 2A30 2734      DC.W 10800  2D  45
0025E8 2A94 2735      DC.W 10900  32  50
0025EA 2AF8 2736      DC.W 11000  38  56
0025EC 2B5C 2737      DC.W 11100  3F  63
0025EE 2BC0 2738      DC.W 11200  47  71
0025F0 2C24 2739      DC.W 11300  4F  79
0025F2 2C88 2740      DC.W 11400  59  89
0025F4 2CEC 2741      DC.W 11500  64  100
0025F6 2D50 2742      DC.W 11600  70  112
0025F8 2DB4 2743      DC.W 11700  7E  126
0025FA 2E18 2744      DC.W 11800  8D  141
0025FC 2E7C 2745      DC.W 11900  9E  158
0025FE 2EE0 2746      DC.W 12000  B2  178
002600 2F44 2747      DC.W 12100  C8  200
002602 2F58 2748      DC.W 12120  CC  204
002604 2F6C 2749      DC.W 12140  D1  209
002606 2F80 2750      DC.W 12160  D6  214
002608 2F94 2751      DC.W 12180  DB  219
00260A 2FAB 2752      DC.W 12200  E0  224
00260C 2FBC 2753      DC.W 12220  E5  229
00260E 2FD0 2754      DC.W 12240  EA  234

```

002610 2FE4	2755	DC.W	12260	F0 240
002612 2FF8	2756	DC.W	12280	F5 245
002614 300C	2757	DC.W	12300	FB 251
002616 3020	2758	DC.W	12320	101 257
002618 3034	2759	DC.W	12340	107 263
00261A 3048	2760	DC.W	12360	10D 269
00261C 305C	2761	DC.W	12380	113 275
00261E 3070	2762	DC.W	12400	11A 282
002620 3084	2763	DC.W	12420	120 288
002622 3098	2764	DC.W	12440	127 295
002624 30AC	2765	DC.W	12460	12E 302
002626 30C0	2766	DC.W	12480	135 309
002628 30D4	2767	DC.W	12500	13C 316
00262A 30E8	2768	DC.W	12520	144 324
00262C 30FC	2769	DC.W	12540	14B 331
00262E 3110	2770	DC.W	12560	153 339
002630 3124	2771	DC.W	12580	15B 347
002632 3138	2772	DC.W	12600	163 355
002634 314C	2773	DC.W	12620	16B 363
002636 3160	2774	DC.W	12640	174 372
002638 3174	2775	DC.W	12660	17C 380
00263A 3188	2776	DC.W	12680	185 389
00263C 319C	2777	DC.W	12700	18E 398
00263E 31B0	2778	DC.W	12720	197 407
002640 31C4	2779	DC.W	12740	1A1 417
002642 31D8	2780	DC.W	12760	1AB 427
002644 31EC	2781	DC.W	12780	1B5 437
002646 3200	2782	DC.W	12800	1BF 447
002648 3264	2783	DC.W	12900	1F5 501
00264A 32C8	2784	DC.W	13000	232 562
00264C 332C	2785	DC.W	13100	277 631
00264E 3390	2786	DC.W	13200	2C4 708
002650 33F4	2787	DC.W	13300	31A 794
002652 3458	2788	DC.W	13400	37B 891
002654 34BC	2789	DC.W	13500	3E8 1000
002656 3520	2790	DC.W	13600	462 1122
002658 3584	2791	DC.W	13700	4EB 1259
00265A 35E8	2792	DC.W	13800	585 1413
00265C 364C	2793	DC.W	13900	631 1585
00265E 36B0	2794	DC.W	14000	6F2 1778
002660 3714	2795	DC.W	14100	7CB 1995
002662 3778	2796	DC.W	14200	8BF 2239
002664 37DC	2797	DC.W	14300	9D0 2512
002666 3840	2798	DC.W	14400	B02 2818
002668 38A4	2799	DC.W	14500	C5A 3162
00266A 3908	2800	DC.W	14600	DDC 3548
00266C 396C	2801	DC.W	14700	F8D 3981
00266E 39D0	2802	DC.W	14800	1173 4467
002670 3A34	2803	DC.W	14900	1394 5012
002672 3A98	2804	DC.W	15000	15F7 5623

002674 3AFC	2805	DC.W	15100	18A6 6310
002676 3B60	2806	DC.W	15200	1BA7 7079
002678 3BC4	2807	DC.W	15300	1F07 7943
00267A 3C28	2808	DC.W	15400	22D1 8913
00267C 3C8C	2809	DC.W	15500	2710 10000
00267E 3CF0	2810	DC.W	15600	2BD4 11220
002680 3D54	2811	DC.W	15700	312D 12589
002682 3DB8	2812	DC.W	15800	372D 14125
002684 3E1C	2813	DC.W	15900	3DE9 15849
002686 3E80	2814	DC.W	16000	4577 17783
002688 3EE4	2815	DC.W	16100	4DF1 19953
00268A 3F48	2816	DC.W	16200	5773 22387
00268C 3FAC	2817	DC.W	16300	621F 25119
00268E 4010	2818	DC.W	16400	6E18 28184
002690 4074	2819	DC.W	16500	7B87 31623
002692 40D8	2820	DC.W	16600	7FFF 32767
	2821			
002694 0000	2822 DBHEX	DC.W	0H	
002696 0001	2823	DC.W	1H	
002698 0002	2824	DC.W	2H	
00269A 0003	2825	DC.W	3H	
00269C 0004	2826	DC.W	4H	
00269E 0005	2827	DC.W	5H	
0026A0 0006	2828	DC.W	6H	
0026A2 0007	2829	DC.W	7H	
0026A4 0008	2830	DC.W	8H	
0026A6 0009	2831	DC.W	9H	
0026A8 000A	2832	DC.W	0AH	
0026AA 000B	2833	DC.W	0BH	
0026AC 000D	2834	DC.W	0DH	
0026AE 000E	2835	DC.W	0EH	
0026B0 0010	2836	DC.W	10H	
0026B2 0012	2837	DC.W	12H	
0026B4 0014	2838	DC.W	14H	
0026B6 0016	2839	DC.W	16H	
0026B8 0019	2840	DC.W	19H	
0026BA 001C	2841	DC.W	1CH	
0026BC 0020	2842	DC.W	20H	
0026BE 0023	2843	DC.W	23H	
0026C0 0028	2844	DC.W	28H	
0026C2 002D	2845	DC.W	2DH	
0026C4 0032	2846	DC.W	32H	
0026C6 0038	2847	DC.W	38H	
0026C8 003F	2848	DC.W	3FH	
0026CA 0047	2849	DC.W	47H	
0026CC 004F	2850	DC.W	4FH	
0026CE 0059	2851	DC.W	59H	
0026D0 0064	2852	DC.W	64H	
0026D2 0070	2853	DC.W	70H	
0026D4 007E	2854	DC.W	7EH	

0026D6 008D	2855	DC.W	8DH
0026D8 009E	2856	DC.W	9EH
0026DA 00B2	2857	DC.W	0B2H
0026DC 00C8	2858	DC.W	0C8H
0026DE 00CC	2859	DC.W	0CCH
0026E0 00D1	2860	DC.W	0D1H
0026E2 00D6	2861	DC.W	0D6H
0026E4 00DB	2862	DC.W	0DBH
0026E6 00E0	2863	DC.W	0E0H
0026E8 00E5	2864	DC.W	0E5H
0026EA 00EA	2865	DC.W	0EAH
0026EC 00F0	2866	DC.W	0F0H
0026EE 00F5	2867	DC.W	0F5H
0026F0 00FB	2868	DC.W	0FBH
0026F2 0101	2869	DC.W	101H
0026F4 0107	2870	DC.W	107H
0026F6 010D	2871	DC.W	10DH
0026F8 0113	2872	DC.W	113H
0026FA 011A	2873	DC.W	11AH
0026FC 0120	2874	DC.W	120H
0026FE 0127	2875	DC.W	127H
002700 012E	2876	DC.W	12EH
002702 0135	2877	DC.W	135H
002704 013C	2878	DC.W	13CH
002706 0144	2879	DC.W	144H
002708 014B	2880	DC.W	14BH
00270A 0153	2881	DC.W	153H
00270C 0153	2882	DC.W	153H
00270E 0163	2883	DC.W	163H
002710 016B	2884	DC.W	16BH
002712 0174	2885	DC.W	174H
002714 017C	2886	DC.W	17CH
002716 0185	2887	DC.W	185H
002718 018E	2888	DC.W	18EH
00271A 0197	2889	DC.W	197H
00271C 01A1	2890	DC.W	1A1H
00271E 01AB	2891	DC.W	1ABH
002720 01B5	2892	DC.W	1B5H
002722 01BF	2893	DC.W	1BFH
002724 01F5	2894	DC.W	1F5H
002726 0232	2895	DC.W	232H
002728 0277	2896	DC.W	277H
00272A 02C4	2897	DC.W	2C4H
00272C 031A	2898	DC.W	31AH
00272E 037B	2899	DC.W	37BH
002730 03E8	2900	DC.W	3E8H
002732 0462	2901	DC.W	462H
002734 04EB	2902	DC.W	4EBH
002736 0585	2903	DC.W	585H
002738 0631	2904	DC.W	631H

00273A 06F2	2905	DC.W	6F2H
00273C 07CB	2906	DC.W	7CBH
00273E 08BF	2907	DC.W	8BFH
002740 09D0	2908	DC.W	9D0H
002742 0B02	2909	DC.W	0B02H
002744 0C5A	2910	DC.W	0C5AH
002746 0DDC	2911	DC.W	0DDCH
002748 0F8D	2912	DC.W	0F8DH
00274A 1173	2913	DC.W	1173H
00274C 1394	2914	DC.W	1394H
00274E 15F7	2915	DC.W	15F7H
002750 18A6	2916	DC.W	18A6H
002752 1BA7	2917	DC.W	1BA7H
002754 1F07	2918	DC.W	1F07H
002756 22D1	2919	DC.W	22D1H
002758 2710	2920	DC.W	2710H
00275A 2BD4	2921	DC.W	2BD4H
00275C 312D	2922	DC.W	312DH
00275E 372D	2923	DC.W	372DH
002760 3DE9	2924	DC.W	3DE9H
002762 4577	2925	DC.W	4577H
002764 4DF1	2926	DC.W	4DF1H
002766 5773	2927	DC.W	5773H
002768 621F	2928	DC.W	621FH
00276A 6E18	2929	DC.W	6E18H
00276C 7B87	2930	DC.W	7B87H
00276E 7FFF	2931	DC.W	7FFFH
(276E)	2932 DBLEN	EQU	8-2
	2933		
	2934		
002770 06 34 0E	2935 DSLIST	DC.B	6,34H,0EH,1,3,0
002776 0A 09 08	2936 KEYLIST	DC.B	0AH,09H,08H,07H,0BH,06H,05H,04H
00277E 0C 03 02	2937	DC.B	0CH,03H,02H,01H,0DH,0EH,0FH,00H
002786 FF EE CC	2938	DC.B	OFFH,0EH,0CCH,013H
00278A 2A 2A 2A	2939 RDYMSG	DC.B	'*** READY ***'
00279A 20 20 53	2940 SAVMSG	DC.B	' SAVING DATA '
0027AA 20 20 20	2941 MEMTEXT	DC.B	' K BYTES LEFT '
0027BA 20 42 41	2942 FULLMSG	DC.B	' BAT. RAM FULL '
0027CA 2A 2A 20	2943 ROMMSG	DC.B	'** ROM ERROR **'
0027DA 53 54 41	2944 SRAMSG	DC.B	'STATIC RAM ERROR'
0027EA 20 42 41	2945 BRAMSG	DC.B	' BAT. RAM ERROR '
0027FA 30 30 30	2946 ROMMSG	DC.B	'000-YES / NO-000'
00280A 45 4E 54	2947 CALPRMT	DC.B	'ENTER CAL. CODE'
00281A 4B 45 59	2948 ERMSG	DC.B	'KEY ENTRY ERROR'
00282A 4E 4F 54	2949	DC.B	'NOT ACTIVE'
00283A 53 45 4C	2950	DC.B	'SELECT FUNCTION'
00284A 49 4E 56	2951	DC.B	'INVALID NUMBER'
00285A 38 38 30	2952 AKINIT	DC.B	38H,38H,30H,35H,32H,30H,2EH,30H
002862 30 2E 30	2953	DC.B	30H,2EH,30H,30H,2EH,30H,30H,20H
00286A 30 30 2E	2954 BKINIT	DC.B	30H,30H,2EH,30H,30H,2EH,30H,32H

002872 2E 30 32	2955	DC.B	2EH,30H,32H,2EH,30H,30H,30H,30H	
00287A 31 30 37	2956 DKINIT	DC.B	31H,30H,37H,2EH,31H,30H,30H,2EH	
002882 31 30 2E	2957	DC.B	31H,30H,2EH,30H,36H,2EH,33H,35H	
	2958			
00288A 1000	2959 HEADR	DC.W	1000H	TEST NUMBER
00288C 2000	2960	DC.W	2000H	SITE NUMBER
00288E 3000	2961	DC.W	3000H	SERIAL NUMBER
002890 4000	2962	DC.W	4000H	TIMER 1 FLAG
002892 03EH	2963	DC.W	03EH	TIMER 1 DEFAULT VAL.
002894 5000	2964	DC.W	5000H	TIMER 2 FLAG
002896 03EH	2965	DC.W	03EH	TIMER 2 DEFAULT VAL.
002898 600A	2966	DC.W	600AH	PEAK PERIOD DEFAULT
00289A 7000	2967	DC.W	7000H	TRIGGER 2 FLAG
	2968 *	DC.W	800CH	TRIGGER 2 DEFAULT VAL.
00289C 8012	2969	DC.W	8012H	% TRIGGER 2 DEFAULT VAL.
00289E 8000	2970	DC.W	8000H	TRIGGER 3 FLAG
0028A0 8028	2971	DC.W	8028H	TRIGGER 3 DEFAULT VAL.
0028A2 9008	2972	DC.W	9008H	PEAK SLOPE DB VALUE
0028A4 A023	2973	DC.W	0A023H	PEAK SLOPE TIME VAL.
0028A6 0000	2974	DC.W	0	MIN/SEC INIT VAL.
0028A8 0000	2975	DC.W	0	DAY/HOUR INIT VAL.
0028AA 0000	2976	DC.W	0	YEAR/MONTH INIT VALUE
	<28AA> 2977 ENDHED	EQU	#-2	END OF HEADER INFO
0028AC 00	2978 CLKTB	DC.B	0	SECONDS UNITS
0028AD 10	2979	DC.B	10H	TENS
0028AE 20	2980	DC.B	20H	MINUTES UNITS
0028AF 30	2981	DC.B	30H	TENS
0028B0 40	2982	DC.B	40H	HOURS UNITS
0028B1 50	2983	DC.B	50H	TENS
0028B2 70	2984	DC.B	70H	DAYS UNITS
0028B3 80	2985	DC.B	80H	TENS
0028B4 90	2986	DC.B	90H	MONTH UNITS
0028B5 A0	2987	DC.B	0A0H	TENS
0028B6 B0	2988	DC.B	0B0H	YEAR UNITS
0028B7 C0	2989	DC.B	0C0H	TENS
0028B8 0000	2990 ROMCS	DC.W	0	
	2991	END		

Errors= 0

LINE#	SYMBOL	TYPE	REFERENCES
***	A	U	181,192,224,234,247,328,645,675,678,681,682,685,690, 647,857,858,1018,1128,1147,1150,1398,1472,2002,2328 2380,2389,2721
1589	A04	A	1586
1593	A05	A	1590
1597	A06	A	1594
1601	A07	A	1598
1605	A08	A	1602
1625	A10	A	1622
1629	A11	A	1626
1609	AA	A	1606
1613	AB	A	1610
***	ACCEPT	U	1764
1636	ACLEAR	A	1516
117	ACWTL	A	456,460
***	ACTIVE	U	881,910,911,914,942,943,946,1396,1681,1927,2167
1617	AD	A	1614
115	ADATA	A	462,1133,1152,1164,1167,1188,1204,1287,1292,2375
112	ADC	A	646,847
***	ADD	U	878
***	ADDED	U	2433,2434
1364	ADDERR	A	318
116	ADDR	A	229,313,392,410,458,1445,1448,1496,1646,1654, 1655,1683,1840,1871,1872,1929,2038,2169,2332
***	ADDRESS	U	241,318,434,435,455,569,1127,1185,1190,1195,1198,1286,1318, 1322,1342,1346,2089,2090
***	ADDRESSES	U	1469
128	ADENA	A	644,645
212	ADMSG	A	597,690
235	ADSPFLG	A	602,668,854,1452,1956
234	ADVAL	A	675,678,682,685,688
1621	AE	A	1618
1532	AENT	A	1520
1653	AENTER	A	1530
***	AGAIN	U	407,792,797,1142,2348
224	AKDATA	A	485,1220,1644
1514	AKEY	A	256,1399
2952	AKINIT	A	486
701	ALCHAR	A	698
***	ALL	U	1130,1715
253	ALPHA	A	253,697,701,1430,1494,1494,1684,1684,1930,1930,2170,2170, 2384,2387,2389,2391
1006	AMBAVG	A	865,969
962	AMBIENT	A	869
***	AM	U	1337,1527,1716,1934,2174
***	ANALYZE	U	1032
***	AND	U	512,887,1398,1643,1687,1848,2252,2630
***	ANOTHER	U	878

*** ANSWER	U 1872,1873,2090,2091
*** ANSWERS	U 1855,1874,1875,2092
*** ANY	U 468,1764,2016
*** ARE	U 1487
*** AREA	U 197,198,248
*** ARRAY	U 509,1220,1849,2047
*** AS	U 417,2002
*** ASCII	U 681,684,687,689,741,748,756,1848,2252,2330,2615,2643
*** AT	U 1475,1482,1489,2527
141 AUTOV1	A
142 AUTOV2	A
143 AUTOV3	A
144 AUTOV4	A
145 AUTOV5	A
146 AUTOV6	A
147 AUTOV7	A
*** AUTOVECTOR	U 327
*** AVERAGE	U 198,631,664,2606
*** AVG	U 969,1006,1071,1093,1098,1103,1108
*** B	U 185,186,187,188,189,190,191,192,193,193,194,194,195, 208,209,211,212,213,214,220,221,222,224,225,225,226, 227,246,247,414,456,457,458,459,460,461,462,463,464, 465,466,467,478,479,480,481,482,483,488,571,573,574, 576,578,579,580,581,582,583,584,586,588,589,590,591, 640,644,645,647,699,701,702,703,737,741,748,749,756 757,758,765,766,767,768,1018,1021,1022,1128,1129,1130, 1131,1132,1133,1137,1138,1139,1140,1142,1143,1144 1148,1149,1150,1151,1152,1153,1154,1161,1164,1167,1186, 1187,1188,1195,1197,1198,1201,1202,1204,1205,1206 1209,1211,1212,1221,1227,1228,1229,1230,1231,1232,1233, 1234,1235,1236,1237,1238,1239,1240,1241,1242,1243 1244,1245,1246,1247,1248,1249,1250,1251,1252,1253,1254, 1255,1256,1257,1258,1259,1260,1261,1262,1263,1264 1265,1266,1267,1268,1269,1270,1271,1272,1274,1275,1276, 1277,1278,1279,1280,1281,1282,1283,1286,1287,1290 1291,1292,1318,1320,1322,1324,1342,1344,1346,1348,1400, 1445,1479,1496,1646,1683,1687,1689,1691,1693,1695 1697,1840,1852,1853,1855,1856,1857,1860,1861,1863,1864, 1866,1867,1869,1870,1929,2038,2050,2051,2053,2054 2056,2057,2058,2060,2061,2063,2064,2066,2067,2068,2070, 2071,2073,2074,2075,2077,2078,2080,2081,2082,2084 2085,2087,2088,2169,2254,2260,2263,2264,2272,2273,2274, 2275,2330,2332,2334,2343,2346,2347,2348,2352,2375 2378,2402,2405,2428,2429,2430,2617,2618,2619,2645,2646, 2647,2665,2678,2679,2680,2684,2689,2691,2692,2693 2694,2722,2935,2936,2937,2938,2939,2940,2941,2942,2943, 2944,2945,2946,2947,2948,2949,2950,2951,2952,2953 2954,2955,2956,2957,2978,2979,2980,2981,2982,2983,2984, 2985,2986,2987,2988,2989
*** B02	U 2798

*** B2	U 2746
1776 B4	A 1772
1781 B6	A 1777
1786 B7	A 1782
1791 B9	A 1787
1796 BA	A 1792
*** BACK	U 793,2351,2508,2562
1410 BADFTN	A
150 BARKER	A 493,493,494,495,496,497,505,505,506,507,1710,1711,1712,1923,1924,1925,2156,2157,2158,2607,2607,2608,2609
*** BASE	U 1468
*** BAT	U 348,428,648,977,1036,1305,1698,1895,2129,2656
*** BATTERY	U 490,1317
1601 BC	A 1797
1831 BCLEAR	A 1736
120 BCNTL	A 457,464,645,1021,1129,1132,1148,1153,1187,1206
1806 BD	A 1802
118 BDATA	A 466,647,1022,1161,1286,1290
119 BDDR	A 459,1130,1149
*** BE	U 1108,1317,1520,1527,1740,1985,1989,1996,2013,2016
343 BEAR	A 316,320
*** BEFORE	U 2488,2563
*** BEGIN	U 2490
*** BEGINNING	U 256,268,280,726,2527
1746 BENT	A 1740
1847 BENTER	A 1744
*** BIT	U 378,386,390,906,938,950,1080,1154,1209,2346
*** BITS	U 460,1130,1140,1213,1214,1291,2331
225 BKDATA	A 1838,1850
1734 BKEY	A 268,1401
2954 BKINIT	A
*** BLANK	U 593,597
*** BLANKING	U 1414
149 BLWX	A 593,594,595,596,598,599,600,601
*** BLOCK	U 181
436 BLOOP	A 441
*** BOD	U 2491
*** BOE	U 2488
2946 BOMMSG	A 548
*** BOOM	U 206,207,208,550,772,2601,2613,2641
236 BOOMFLG	A 611,1337,1414,1416,1420
1420 BOOMON	A 1415
208 BOOMSG1	A 549,772,1417,1453,2616,2620,2648
209 BOOMSG2	A 2644
2543 BOTCONT	A 2550
2551 BOTFED	A 2545
202 BOTRAT	A 626,1079,1093,1098,1103
*** BOTTOM	U 202
*** BOUNDARY	U 373
*** BOUNDRY	U 247

1396	BRAFTN	A	1385,1433
97	BRAM	A	410,411,417,428,434,438,471,490,498,1037,1705,1718,1881,2176
428	BRANDIG	A	412
96	BRAMON	A	348,648,977,1036,1305,1698,1718,1895,1936,2129,2176,2656
2945	BRAMSG	A	1317
***	BRANCH	U	2344,2349
431	BRMWET	A	433
1810	BS1	A	1807
1818	BS2	A	1811
1820	BS3	A	1817
1824	BS4	A	1821
***	BUF	U	592,703
***	BUFFER	U	211,593,734,769
***	BUFFERS	U	1476,1483,1490
***	BUMP	U	519,523,531,535
***	BUS	U	317
1363	BUSERR	A	317
***	BY	U	860,1467
***	BYTE	U	1215,1320,1322,1344,1348,2332,2351
***	C	U	1402
***	C5A	U	2799
***	C8	U	2747
***	CAL	U	211,212,217,218,219,234,235,592,597,602,638,639,670,734,769, 770,771,773,774,775,849,851,1452,1946,1948 1954,1956,1961
742	CAL1	A	739
743	CAL2	A	747
748	CAL2A	A	744
751	CAL3	A	755
756	CAL3A	A	752
760	CAL4	A	764
765	CAL4A	A	761
***	CALC	U	603,723,725,2594
719	CALDSP	A	671
773	CALEND	A	771
217	CALFLG	A	637,670,770,849,1451,1952,1957
732	CALFWD	A	728
***	CALIBRATION	U	637,1402,1451,1952
1952	CALMD1	A	1947
1956	CALMD2	A	1949
211	CALMSG	A	592,734,769
727	CALOP	A	730
2947	CALPRMT	A	1960
1960	CALRET	A	1945
218	CALSUM	A	638,722,774,862,1953
219	CALTIM	A	639,673,692,720,775,851,853,1954,1958
***	CC	U	2748
***	CHAR	U	697,703
***	CHARACTER	U	246,253,254,1319,1325,1343,1349
***	CHECK	U	374,376,393,399,403,406,411,432,440,442,720,849,851, 889,910,942,1015,1080,1309,1313,1414,1944,2348,2622

***	CHECKSUM	U	376
***	CHK	U	897
2001	CHK6	A	1995
1994	CHK7	A	1988
1573	CHKA10	A	1567
1552	CHKA7	A	1546
1559	CHKAA	A	1553
1566	CHKAD	A	1560
2494	CHKCOMT	A	2489
2522	CHKFPK	A	2498,2505,2516
889	CHKMPK	A	886
1943	CKEY	A	1403
***	CLEAR	U	456,602,637,640,1084,1436,1443,1444,1446,1451,1452, 1470,1474, 1481,1488,1492,1493,1494,1495,1497,1515 1684,1685,1735,1930,1931,1978,2170,2171,2299,2653,2654
1476	CLEARA	A	1477
1483	CLEARB	A	1484
1490	CLEARC	A	1491
***	CLEARED	U	1682,1928,2168
***	CLEARING	U	1475,1482,1489
***	CLK	U	1217
182	CLK1	A	502,545,1208,1707,1920,2153,2603
183	CLK2	A	503,546,1708,1921,2154,2604
184	CLK3	A	504,547,1709,1922,2155,2605
2978	CLKTB	A	1135,1190
***	CLOCK	U	478,484,775,1133,1137,1292,1686
***	CLOSE	U	791
***	CMPR	U	384,388
***	CNTROL	U	1148
***	CNVRT	U	2485
***	CODE	U	250,252,511,1432,1944
***	CODES	U	493,505,2607
1211	COMBIN	A	1218
***	COMBINE	U	1201,1216
***	COMMAND	U	192,194,1287,1515,1529,1735
410	COMBRAM	A	408
885	COMEVNT	A	882
2601	CONFWD	A	2438,2493,2521
879	CONSAV	A	873
2613	CONT1	A	2611
2620	CONT1A	A	
2641	CONT2	A	2639
1719	CONTA	A	1717
***	CONTAINS	U	180
1937	CONTB	A	1935
2177	CONTD	A	2175
2387	CONTIN	A	2385
***	CONTINUE	U	850,917,1081,1203,1338,2528
***	CONTROL	U	456,460,464,1135,1140,1144,1187,1206
***	CONVERSION	U	220,699,701

*** CONVERT	U	572,577,681,684,687,689,743,748,751,756,761,767,1848,2251,2330,2615,2643
*** CONVERTED	U	292
*** CORRECT	U	1469
254 COUNT	A	206,207,208,254,492,550,573,578,580,978,1191,1319, 1325, 1343,1349,1444,1444,1495,1495,1514,1514,1517,1519 1521,1523,1525,1527,1545,1552,1559,1566,1573,1585,1589, 1593,1597,1601,1605,1609,1613,1617,1621,1625,1682 1682,1734,1737,1739,1741,1756,1758,1760,1762,1771,1776, 1781,1786,1791,1796,1801,1806,1810,1816,1820,1928 1928,1943,1944,1977,1977,1981,1984,1987,1994,2001,2004, 2007,2010,2013,2168,2168,2183,2188,2193,2198,2203 2208,2213,2218,2223,2228,2233,2613,2641,2645,2649
*** COUNTER	U	203,204,736,853,872,883,985,1082,1136,1734
*** COUNTS	U	173,175,177,178,179
*** COUTER	U	1210
*** CUR	U	994
198 CURAVG	A	1380,2166
197 CURPNT	A	619,1379,1705,1713,1901,1926,2133,2164,2250,2360,2629
*** CURRENT	U	197,198,502,630,874,1379,1643,1738,2250,2602,2603
696 CVTAD	A	681,684,687,689
*** D	U	226,234,328,645,675,678,681,682,685,690,847,857,858, 1018,1404,1486,2048,2723
2188 D04	A	2184
2193 D05	A	2189
2198 D07	A	2184
2203 D08	A	2199
2208 D09	A	2204
2233 D11	A	2229
2238 D12	A	2234
844 DAC	A	328
864 DACCONT	A	850
1014 DACRET	A	852,855,863,867,880,908,913,915,931,940,945,947,955,999,1033
*** DATA	U	191,193,197,224,225,226,256,268,280,402,403,411,436, 462,466,484,628,629,847,871,885,897,907,909,918,939 941,965,967,994,995,996,1007,1032,1072,1073,1149,1150, 1152,1290,1320,1323,1344,1347,1379,1408,1654,1740 1848,1871,1875,1881,1985,2048,2089,2250,2351,2446,2527
*** DATE	U	1398,1643,1687
213 DATMSG	A	676
233 DATSAV	A	636,879,963,2285,2431,2652
294 DAY	A	183,260,294,478,481,501,502,546,1521,1554,1603,1607,1690,2975
188 DAY1	A	481,1244,1249,1691
*** DAYS	U	188,2984
2213 DB	A	288,306,539,724,725,726,732,733,2209,2494,2499, 2505,2507,2518,2579,2592,2594,2751,2972
2822 DBHEX	A	725,726,2104,2109,2115,2495,2499,2508,2510,2571,2572,2580,2582
2932 DBLEN	A	724,2103,2114,2494,2509,2570,2581
2711 DBTAB	A	732,2102,2506,2517,2578,2592
*** DBTABLE	U	2506,2517
2218 DC	A	2214

2029	DCLEAR	A	1979
***	DDC	U	2800
2415	DDLOOP	A	2416
2223	DE	A	2219
***	DECIMAL	U	220,255,1497,1685,1756,1758,1760,1762,1931,2002, 2171,2252,2296,2299,2328,2380,2615,2643
2295	DECPST	A	1522,1524,1526,1757,1759,1761,1763,2002,2005,2008,2011
***	DECR	U	729,853,872,1082,1325,1349,2504,2515
***	DECREASING	U	899
***	DECREMENT	U	883
***	DEFAULT	U	498,2963,2965,2966,2969,2971
1359	DELAY	A	350,634,978,979,979,1080,1082,1160,1163,1166,1192,1193, 1289,1359,1699,1700,1700,1703,1896,1897,1897,2130 2131,2131
1851	DEMLP	A	1858
2105	DEMLP1	A	2108
2116	DEMLP2	A	2119
2020	DENT	A	1985
2045	DENTER	A	2014
2228	DF	A	2224
168	DHTIM	A	
***	DIAG	U	468
***	DIAGNOSTIC	U	205
***	DIAGNOSTICS	U	1306
***	DIF	U	2519
***	DIFFERENCE	U	2251,2594
***	DIG	U	1587,1591,1595,1599,1603,1607,1611,1615,1619,1623,1629,1810,1812,1816,1820,1824
***	DIGIT	U	736,737,743,748,751,756,761,767,1547,1554,1561,1568, 1575,1627,1756,1758,1760,1762,1764,1773,1778,1783 1788,1793,1798,1803,1806,2016,2185,2190,2195,2200,2205, 2210,2215,2220,2225,2230,2235,2238,2389,2617,2618,2619
248	DIGITS	A	1873,2091,2308,2316
***	DIR	U	1128,1147
***	DIRECTION	U	458,1129
***	DISABLE	U	582,2429
***	DISPLAY	U	211,212,246,251,485,597,612,676,690,703,771,772,773, 866,1220,1307,1323,1339,1347,1414,1436,1445,1446 1447,1450,1457,1496,1588,1592,1596,1600,1604,1608,1612, 1616,1620,1624,1628,1630,1646,1683,1738,1774,1779 1784,1840,1849,1929,1961,2038,2047,2169,2186,2191,2196, 2211,2216,2221,2226,2231,2236,2239,2253,2332,2334 2342,2616,2621,2649
***	DISPLAYED	U	1037
***	DISPLQY	U	2201
113	DISPLY	A	2342,2399
135	DIST2	A	583,584
***	DIVIDE	U	860,1074,1075
226	DKDATA	A	2036,2048
1977	DKEY	A	280,1405
2956	DKINIT	A	

662	DLOOP	A	664
***	DO	U	407,792,797
***	DON	U	2328
***	DOWN	U	1143
2935	DSLST	A	2400
246	DSPADR	A	1318,1322,1324,1342,1346,1348,1445,1496,1646,1683,1840, 1929,2038,2169,2332,2334
1342	DSPCONT	A	1338,1340
2413	DSPDEL	A	2345,2350,2404
1344	DSPMLP	A	1349
1337	DSPMSG	A	666,691,773,1038,1418,1454,1471,1645,1839,1961,2037, 2277,2287,2621,2649
1450	DSPOFF	A	
1457	DSPON	A	1448
247	DUMMY	A	
***	DURATION	U	203,204
***	DURING	U	218
***	E	U	1406,2724
***	E0	U	2752
***	E5	U	2753
***	EA	U	2754
***	EIGHTH	U	2203
1108	EIGHTSEC	A	1104
2249	EKEY	A	1407
2255	EKEY1	A	2259
2260	EKEY1A	A	2256
2265	EKEY1B	A	2262
2267	EKEY2	A	2271
2272	EKEY2A	A	2268
***	ELSE	U	413,473,699,772,853,878,887,899,913,918,926,945,948, 949,969,1079,1936,2504,2515,2624
339	EMPTY	A	
***	ENABLE	U	590,642,645
***	END	U	240,371,374,380,393,396,399,406,432,435,438,440,720, 724,851,877,1015,2249,2622,2977
1031	ENDBOOM	A	877,884,1016
98	ENDBRM	A	429,435,1015,2249,2433,2622
99	ENDDATA	A	2636
2977	ENDHED	A	
1039	ENDLES	A	1040
***	ENDLESS	U	1040
93	ENDPRM	A	371
442	ENDRAM	A	438
107	ENDRAY	A	396,1077
95	ENDSRM	A	380
409	ENDTST	A	404
240	ENDVAR	A	415,2666
***	ENOUGH	U	916,2441
***	ENTER	U	1740,1743,1985
***	ENTERED	U	249,250,253

*** ENTRIES	U 1738
*** ERASE	U 2442
*** ERR	U 377,1469
2948 ERRMSG	A 1468
252 ERRNUM	A 1410,1466,1470,1470,1549,1556,1563,1570,1577,1950,1991,1998
1465 ERROR	A 252,317,318,378,386,390,468,1309,1313,1315,1317,1411, 1435,1466,1468,1533,1544,1550,1557,1564,1571,1578 1747,1765,1813,1951,1992,1999,2018,2021,2046,2297
*** EVENT	U 203,229,877,966,968,1337,1716,1934,2174,2442,2490,2563,2577,2591,2600
*** EVERYTHING	U 247
203 EVNTCNT	A 872,878,925,988
*** EXIT	U 1096,1101,1106,1339,2630
*** EXTRA	U 1213,1214,1291
*** F	U 1408
*** F0	U 2755
*** F5	U 2756
*** F8D	U 2801
*** FAILED	U 404,409,444,731
946 FALL1	A 942
938 FALLING	A 899
*** FB	U 2757
*** FETCH	U 402
*** FIELDS	U 2001
*** FIFTH	U 2193
*** FILL	U 593
*** FIND	U 1433,2526
*** FIRST	U 381,493,737,1211,1517,1547,1554,1561,1568,1575,1587, 1595,1603,1611,1619,1627,1737,1773,1783,1793,1803 1981,2185,2200,2215,2225,2235,2526,2530,2535,2555,2568,2592
2285 FKEY	A 1409
*** FLAG	U 215,217,235,251,255,417,519,523,531,535,637,1443, 1451,1452,1492,1494,1684,1930,1952,2170,2653,2654,2962 2964,2967,2970
*** FLAG1	U 868,2447
*** FLAG2	U 949,2447
*** FLAG3	U 868,870,994
*** FLAG4	U 888
*** FLAGS	U 2624,2631
*** FLG	U 602,1956
2538 FNDBOT	A 2535
2531 FNDPK	A 2537,2554
2529 FNDST	A 2526
*** FOLLOWS	U 1521,1523,1525
*** FOR	U 197,198,203,204,234,248,374,393,399,406,432,440,442, 622,626,641,663,693,720,794,849,851,985,1015,1074 1080,1149,1190,1191,1203,1210,1309,1313,1414,1577,1699, 1896,1944,2130,2622
*** FOUND	U 728,2502,2513,2535
*** FOUR	U 1137
1103 FOURSEC	A 1099

*** FOURTH	U 2188
2567 FPCONT	A 2564
2578 FPFND	A 2574
2573 FPLOP	A 2576
2592 FPSFND	A 2588
2587 FPSLOP	A 2590
*** FROM	U 180,486
*** FULL	U 1037
2942 FULLMSG	A 1037
*** FUNC	U 1944
250 FUNCT	A 1396,1398,1400,1402,1404,1406,1408,1432,1443,1472, 1479,1486,1492,1681,1681,1927,2167
*** FUNCTION	U 224,225,226,250,1396,1432,1433,1443,1472,1479,1486,1492,1927,2048,2167
*** FUNCTIONS	U 1487
*** GET	U 370,371,379,380,395,396,401,410,434,455,490,491,501, 510,513,516,534,538,539,542,545,546,547,569,570,575 675,678,682,685,688,724,847,857,1134,1135,1138,1139, 1142,1185,1189,1190,1196,1198,1199,1207,1211,1212 1290,1311,1315,1320,1322,1344,1346,1381,1643,1875,2249, 2335,2343,2428,2481,2482,2484,2494,2496,2506,2507 2518,2519,2524,2531,2556,2568,2579,2592,2597,2602
1430 GETFTM	A 1397
2371 GETKEY	A 1381
897 GETSLOP	A 890
*** GETY	U 327
*** GO	U 1032,1078,1141,1145,1323,1347,2526
*** GOES	U 2505,2516
*** GOOD	U 411,412,417,442
*** GOTO	U 377
*** GRT	U 1127
*** HALF	U 790
*** HALVE	U 788
*** HEADER	U 181,491,508,2977
2959 HEADR	A 491,508
*** HEX	U 2499,2508
2678 HEXCHVT	A 2615,2643
260 HIDA	A 1603
*** HIGH	U 603,688,909,916,939,965,1200,1215
262 HIHR	A 1611
266 HIJV	A 2094,2215
264 HIMM	A 1619
258 HIMO	A 1595
290 HIRT	A 2235
288 HIRV	A 2225
266 HISC	A 1627
270 HISM	A 1783
272 HIT1	A 1793
274 HIT2	A 1803
283 HITR2	A 2200
280 HITR3	A 1489,1489,2047,2089,2185

268	HITT	A	1482,1482,1773,1849,1871
256	HIYR	A	1475,1475,1587,1654
788	HLFLOP	A	792
121	HOLD	A	1133,1133,1167,1188,1188,1204,1292,1292
***	HOUNDREDS	U	751
295	HOUB	A	183,262,295,480,546,1137,1154,1209,1611,1615,1692,2975
187	HOUR1	A	480,1137,1154,1209,1254,1259,1693
***	HOURS	U	187,1561,2982
***	HRS	U	1523
220	HUND	A	2617,2645,2678,2684,2692
2681	HUNLP	A	2685
***	I	U	455,569,1127,1185
***	IF	U	377,412,438,468,470,670,671,697,721,731,738,770,791, 792,796,797,850,852,866,873,877,881,884,898,907,909 910,911,914,939,941,942,943,946,1081,1146,1337,1339, 1384,1397,1431,1432,1448,1518,1716,1934,2174,2328 2344,2349,2441,2446,2488,2505,2516,2563,2577,2591,2599,2623
***	IN	U	173,175,177,178,179,493,498,505,550,670,703,770,799, 996,1007,1073,1074,1195,1202,1217,1337,1705,1716 1849,1934,2174,2332,2507,2516,2562,2577,2591,2607,2616,2645
793	INCLOP	A	797
***	INCR	U	392,742,793,870,994,1076,1324,1348,2601,2613,2641
***	INCREMENT	U	1514,1734,1977,2334
***	INDEX	U	1324,1348
181	INFEND	A	
***	INFO	U	180,485,491,508,1400,2977
498	INILP	A	500
455	INIPIA	A	418,443
***	INIT	U	381,382,471,626,633,638,639,663,864,1084,1319,1343,1686,2974,2975,2976
2398	INITDS	A	612,1307,1421,1436,1446,1534,1636,1748,1831,2022,2029,2435
2402	INITDS1	A	2403,2406
***	INITIAL	U	486,787
***	INITIALIZATION	U	641
***	INITIALIZE	U	418,478,612,622,1307
***	INPUT	U	195,859,1381,1430,1434,1577,2327,2333,2335
***	INTERRUPT	U	328,329,645,1018
***	INTERRUPTS	U	590,642,693
***	INTO	U	509,1200,1466,1881,2253,2327
***	IRQ	U	331,332
125	IRQEN	A	590,591,2429,2430
***	IS	U	438,864,866,876,1447,1472,1479,1486,1543,1545,1756,1758, 1760,1762,1813,1946,1948,2296,2380,2384,2387,2389,2520
1543	ISDIGA	A	1528
1756	ISDIGB	A	1742
1837	ISSTAT	A	1738
1642	ISTIME	A	1518
2035	ISVAL	A	1982
***	IT	U	864,1128,1147,1150,1946,1948
305	JMPVAL	A	2095,2122
***	JUMP	U	286,305

488 KDATIN
249 KEY

A 489
A 249,331,1382,1386,1432,1434,1444,1493,1493,1495,1515,
1517,1519,1529,1532,1543,1543,1545,1547,1552,1554
1559,1561,1566,1568,1573,1575,1587,1591,1595,1599,1603,
1607,1611,1615,1619,1623,1627,1629,1682,1735,1737
1739,1741,1743,1746,1764,1771,1773,1776,1778,1781,1783,
1786,1788,1791,1793,1796,1798,1801,1803,1808,1812
1814,1818,1822,1824,1928,1946,1948,1978,1981,1984,1989,
1989,1996,1996,2013,2016,2020,2045,2168,2183,2185
2188,2190,2193,2195,2198,2200,2203,2205,2208,2210,2213,
2215,2218,2220,2223,2225,2228,2230,2233,2235,2238
2298,2327,2328,2333,2379,2380,2380,2384,2384,2387,2387,2389

*** KEYBOARD
195 KEYIN
2936 KEYLIST
*** KEYPAD
1377 KEYPD
2358 KEYRET

U 195,252
A
A 2374
U 254
A 331
A 1388,1419,1422,1437,1455,1458,1498,1535,1647,1719,1749,1841,
1937,1955,1959,1962,2023,2039,2177,2278,2289,2335

*** KEYS
*** KEYSTROKE
*** L

U 1764,2016
U 1514,1734,1977
U 197,199,200,201,202,203,204,218,229,237,238,315,316,
317,318,319,320,321,322,323,324,325,326,327,328,329
330,331,332,333,334,335,336,337,338,339,344,346,349,
351,370,371,372,374,379,380,392,393,395,396,397,399
401,406,410,413,415,428,429,430,432,434,435,440,442,
455,468,473,485,486,487,490,491,508,509,519,520,523
524,531,532,535,536,548,549,550,551,552,553,556,557,
558,559,560,561,569,572,577,587,592,593,594,595,596
597,598,599,600,601,603,604,605,606,607,618,619,622,
623,624,625,626,627,628,629,630,631,632,633,638,643
665,676,677,690,719,722,724,725,726,729,732,734,735,
742,769,772,774,787,788,789,791,793,794,796,798,845
846,856,858,861,862,868,870,872,874,875,876,878,883,
885,887,888,889,891,892,897,907,909,916,918,919,921
922,923,924,925,939,941,949,954,965,967,983,986,987,
988,989,993,994,996,997,998,1007,1015,1017,1023,1037
1069,1071,1072,1074,1075,1076,1077,1079,1093,1095,1098,
1100,1103,1105,1108,1126,1127,1134,1135,1155,1159
1162,1165,1184,1185,1189,1190,1207,1208,1219,1220,1273,
1284,1308,1308,1311,1315,1317,1378,1379,1417,1453
1468,1475,1482,1489,1644,1654,1655,1656,1699,1702,1705,
1706,1713,1714,1838,1848,1849,1850,1871,1872,1873
1874,1876,1877,1878,1879,1881,1885,1890,1896,1899,1900,
1901,1902,1926,1932,1953,1960,2036,2047,2048,2089
2090,2091,2092,2094,2095,2096,2097,2099,2102,2103,2104,
2107,2109,2114,2115,2118,2123,2130,2133,2134,2135
2136,2139,2142,2145,2149,2159,2160,2161,2162,2163,2164,
2165,2172,2249,2250,2251,2253,2266,2276,2286,2307
2309,2315,2318,2326,2341,2342,2353,2359,2360,2361,2362,

2363,2372,2373,2374,2376,2377,2398,2399,2400,2407
 2413,2417,2426,2427,2433,2436,2437,2439,2441,2446,2448,
 2453,2454,2459,2461,2465,2466,2467,2469,2470,2475
 2479,2480,2481,2485,2486,2487,2488,2490,2491,2492,2494,
 2495,2499,2503,2506,2508,2509,2510,2514,2517,2522
 2523,2525,2527,2529,2532,2534,2538,2539,2544,2546,2548,
 2551,2553,2555,2556,2557,2559,2561,2562,2563,2565
 2566,2567,2570,2571,2572,2575,2578,2580,2581,2582,2583,
 2584,2586,2589,2592,2595,2596,2601,2616,2620,2622
 2624,2625,2626,2627,2628,2629,2631,2632,2633,2634,2635,
 2638,2644,2648,2650,2651,2657,2662,2663,2664,2666,2668

2343	LAB1	A	2344
2348	LAB2	A	2349
***	LARGER	U	898
***	LAST	U	229,250,253,473,629,916,1714
***	LCD	U	2342
***	LE	U	2520
***	LEFT	U	214,556,1406,2331
***	LENGTH	U	725,2494
***	LETTER	U	1430
***	LIGHTNING	U	329
2698	LITNG	A	329
***	LOAD	U	397,485,492,676
***	LOCATION	U	246,391,875
261	LODA	A	1607
263	LOHR	A	1615
287	LOJV	A	2220
265	LOMM	A	1623
259	LOMO	A	1599
***	LOOP	U	776,1040
291	LORT	A	2238
289	LORV	A	2230
267	LOSC	A	1629
271	LOSN	A	1788
273	LOT1	A	1798
275	LOT2	A	1808
285	LOTE2	A	2210
282	LOTE3	A	2195
269	LOTT	A	1778
***	LOW	U	603,907,941,967,1201
***	LOWER	U	1139,1198,2332,2351
257	LOYR	A	1591
***	LSB	U	678
229	LSTEVT	A	473,618,1714,1932,2172,2628,2631
***	MAKE	U	1128,1130,1147,1150
***	MASK	U	361,382,383,384,387,397,398,411,430,511,696,861,1213,1214,1291
***	MATCH	U	728,796,2513
***	MAX	U	1813
***	MAY	U	2016
***	MEAN	U	723

1313	MEM1	A	1310
1317	MEM2	A	1314
1320	MEM3LP	A	1325
1305	MEMERR	A	469
214	MEMMSG	A	557,2253,2276
***	MEMORY	U	205,214,391,556,1406,2249
1318	MEMSG	A	1312,1316
205	MEMSTAT	A	
1326	MEMSTP	A	1327
2941	MEMTEXT	A	556
***	MESSAGE	U	214,492,592,769,773,1037,1311,1315,1468,1881,2621,2649
***	MIDDLE	U	735
***	MIN	U	182,545,2974
186	MIN1	A	479,1264,1269,1695
296	MINUTE	A	264,296,1694
***	MINUTES	U	186,479,1525,1568,1619,1623,2980
284	MITR2	A	2205
281	MITR3	A	2190
***	MODE	U	217,670,770,849
293	MONTH	A	184,189,258,293,482,547,1547,1595,1599,1688,2976,2986
189	MONTH1	A	482,1235,1240,1689
***	MORE	U	1146
***	MOVE	U	413,473,550,556,1074,1215,1881,2327,2562,2607
***	MOVING	U	632
***	MS	U	876,878
***	MSB	U	685
***	MSEC	U	639,2485
***	MSG	U	208,211,212,550,556,597,676,734,735,742,771,772,1469,2253,2616,2645
241	MSKOFF	A	411
167	MSTIM	A	
232	MSTEST	A	
***	MULT	U	248
2310	MULTI	A	2312,2317
2306	MULTIPL	A	1875,1880,2093,2098
***	MULTIPLY	U	1467,1875
***	MUST	U	1108,1317,2013
***	N	U	1810,1813,1816,1820,1824,1859,1862,1865,1868
***	NE	U	438
***	NEG	U	238,889
2458	NEGCHK	A	2456,2464
2479	NEGCHK1	A	2451
***	NEGATIVE	U	201,633
201	NEGPK	A	633,889,891,924,998,2466,2651
2465	NEGPKCHK	A	
2474	NEGPLP	A	2478
***	NEW	U	871,885,897,907,909,939,941,965,966,967,968,1007,1072,1687,1705,1740,1985,2048
***	NEWEST	U	628
976	NEWEST	A	964,966,968
***	NEXT	U	400,505,682,1198,2335,2531

*** NIBBLE	U 682,688,696,1139,1143,1198,1200,1201
*** NO	U 298,299,302,412,860,877,886,1078,1094,1099,1104,1388, 1487,1681,1927,2167,2442,2505,2521,2528,2536
*** NOISE	U 969
*** NON	U 207,470,2384,2577,2591,2600,2641
1492 NONERON	A 1478,1485,1487
2631 NONEVMT	A 2442,2447,2462,2468,2476,2533,2549,2577,2591,2600
478 NONRST	A 471
*** NOT	U 377,721,792,797,850,911,914,943,946,1337,1384,1397, 1431,2344,2349,2516,2577,2591
1434 NOTFTN	A 1431
2384 NOTPT	A 2381
170 NUL	A 319,319,319,319,321,321,321,323,326,327,330,333,334,336,337,338
*** NUM	U 699
*** NUMBER	U 269,270,276,510,513,516,1773,1778,1783,1788,2959,2960,2961
*** NUMERIC	U 2384
207 NVBOOM	A 555,2638,2640,2641,2642
2553 NXXPK	A 2547
*** O	U 455,569,1127,1185
*** OD	U 682
*** OF	U 202,205,240,256,268,280,313,316,320,327,370,371,374, 379,380,395,399,401,406,428,438,458,464,478,490,501 502,663,678,685,720,723,724,725,726,735,851,860,877, 1015,1077,1189,1207,1547,1554,1561,1568,1575,1587 1591,1595,1599,1603,1607,1611,1615,1619,1623,1627,1629, 1654,1655,1773,1778,1783,1788,1793,1798,1803,1806 1810,1816,1820,1824,1871,1872,1873,1874,2089,2090,2091, 2092,2185,2190,2195,2200,2205,2210,2215,2220,2225 2230,2235,2238,2249,2490,2494,2519,2527,2560,2579,2592, 2622,2977
251 OFF	A 251,255,511,648,696,861,866,1036,1081,1204,1213,1214, 1291,1305,1339,1339,1382,1384,1447,1447,1450,1450 1457,1718,2176,2288,2656
1443 OFFON	A 1383
*** OFFSET	U 241,858
*** OLD	U 897,996,1007,1071
*** OM	U 247,251,255,348,373,866,950,977,982,1140,1144,1382, 1457,1472,1479,1486,1487,1698,1895,2129,2296,2346
1093 ONESEC	A 1078,1081,1083,1085
*** ONLY	U 1577
*** OR	U 1317,1382,1989,1996
*** OTHER	U 464,1764,2016,2518,2519
*** OUT	U 1476,1483,1490,2333
*** OUTPUT	U 1129,1130,1141,1145,1148,1149,1187,1206,1286,1287
*** PAD	U 331
*** PARAMETER	U 1197,2481,2482,2484,2520,2556,2597,2599
*** PARAMETERS	U 240,410,413,471,1191,1210,1715
2665 PARLOP	A 2667
*** PASSED	U 408,443
*** PAST	U 519,523,531,535

*** PEAK	U	201,539,542,630,633,638,875,876,885,887,888,889,916, 2215,2220,2441,2486,2496,2502,2507,2519,2523,2524 2525,2525,2526,2535,2555,2568,2579,2650,2966,2972,2973
*** PERIOD	U	219,639,720,851,853,1954,2215,2220,2966
2506 PFIND	A	2502
114 PIA	A	418,455,643,1017,1127,1185,2372
2524 PKEND	A	2528
2555 PKFWD	A	2552
2501 PLOOP	A	2504
*** PTR	U	742,888,2250,2491,2505
255 POINT	A	255,592,726,732,734,735,769,949,995,1497,1497,1521, 1523,1525,1685,1685,1931,1931,2171,2171,2296,2296 2299,2299,2328,2382,2499,2508,2517,2592
*** POINTER	U	197,392,473,676,729,874,1076,1079,1318,1342,1379,1714, 2486,2488,2504,2515,2555,2562,2601
*** POINTERS	U	918
*** POP	U	2353
*** PORT	U	191,192,193,194,455,458,464,1127,1128,1147,1150,1185
192 PORTAC	A	461
191 PORTAD	A	463
194 PORTBC	A	465,644,1018,1128,1129,1131,1132,1147,1148,1150,1151, 1153,1186,1187,1205,1206
193 PORTBD	A	467
*** POS	U	237
*** POSITION	J	2491
*** POWER	U	215,634
*** PREVIOUS	U	2534,2536
*** PROG	U	332
*** PROGRAM	U	316,320
92 PROM	A	313,313,370,370,371,373,374
*** PROMPT	U	1961
140 PRVTRP	A	
2512 PSLOOP	A	2515
165 PSLOP	A	2127,2147,2482,2597
166 PSLTM	A	2128,2151,2484,2558
*** PT	U	2380
2331 PTFWD	A	2329
*** PTS	U	2342
*** PUT	U	493,505,508,799,1195,1705
2325 PUTKEY	A	1588,1592,1596,1600,1604,1608,1612,1616,1620,1624,1628, 1630,1774,1779,1784,1789,1794,1799,1804,1809,1815 1819,1823,1825,2186,2191,2196,2201,2206,2211,2216,2221, 2226,2231,2236,2239,2300
*** PUTS	U	247
*** PWR	U	1080,1082
216 PWRCHT	A	635,1080,1089
1086 PWRDEL	A	1068
215 PWRUP	A	634,1067,1082,1088
*** RAM	U	348,379,380,395,413,428,438,487,490,551,557,648,977, 1015,1036,1305,1313,1315,1698,1895,2129,2622,2656

1035	RAMFL	A	2434,2623,2637
1067	RAT	A	202,395,399,401,406,626,641,864,1006,1073,1076,1077,1079,1084,1317
402	RATLP	A	407
395	RATRAM	A	
398	RATWRT	A	400
***	RAW	U	2327
1184	RDCLK	A	501,1643,1704,1898,2132,2602
1194	RDCLK1	A	1203
2939	RDYMSG	A	665
***	RE	U	1686
122	READ	A	384,388,436,1287,1287
1286	READC	A	1196,1199
***	READY	U	2344,2349
***	REAL	U	484,1686
***	REG	U	372
***	REGISTER	U	462,466,2327
***	REGISTERS	U	622,845,1023,2353
414	RELOAD	A	416
***	REMAINDER	U	861
***	REQUEST	U	1382
***	RESET	U	470,582,774,775,887,888,918,926,948,1018,1079,1154, 1209,1445,1496,1646,1683,1840,1929,1953,1954,2038 2169,2624,2631
***	RESTORE	U	1023
***	RESULT	U	862
***	RETURN	U	721,731,776,852,863,867,908,913,915,931,940,945,947,955,999,1033,1955
***	RISE	U	288,290,306,307
914	RISE1	A	910
306	RISEDB	A	2127
***	RISETIME	U	2225,2230,2235,2238
307	RISETM	A	2128
906	RISING	A	898,906
***	ROM	U	487,1309,1311
2990	ROMCS	A	
370	ROMDIG	A	
373	ROMLP	A	375
2943	ROMMSG	A	1311
***	ROOT	U	723,799
***	ROUTINE	U	1433
926	RST2CON	A	917
230	RSTFLG	A	417,470
231	RSTMSK	A	241,620
916	RSTT2	A	948
***	RTC	U	1188,1190
***	RUN	U	622
***	RUNNING	U	663
***	S	U	1810,1813,1816,1820,1824,1859,1862,1865,1868,2344,2349,2403
***	SAMPLES	U	860,2485
***	SAVE	U	197,198,248,733,787,794,845,874,1073,1197,1202,1306, 1379,1408,1587,1591,1595,1599,1603,1607,1611,1615

		1619,1623,1627,1629,1714,1715,2486,2523,2530,2555
1585	SAVEA	A 1548,1555,1562,1569,1574,1576
1771	SAVEB	A
2183	SAVED	A 1990,1997,2017
870	SAVEVT	A
2940	SAVMSG	A 2286
2662	SAVPAR	A 621,1715,1933,2173,2655
***	SEARCH	U 731
***	SEC	U 182,545,626,634,1093,1098,1103,1108,2974
185	SEC1	A 478,1134,1189,1207,1275,1280,1697
297	SECOND	A 266,297,382,387,1212,1519,1591,1599,1607,1615,1623, 1629,1696,1739,1778,1788,1798,1806,1984,2190,2205 2220,2230,2238
***	SECONDS	U 185,1575,1627,1629,2978
***	SECS	U 1577
***	SEE	U 468,670,738,770,791,796,1716,1934,2174,2441,2446,2488,2563
***	SEND	U 588
155	SERIAL	A 276,302,516,1884,1911,2961
302	SERNO	A 1877,1884
***	SET	U 378,386,390,430,458,460,464,634,641,906,938,949,950, 978,982,985,1136,1137,1149,1191,1210,1318,1342,1432 1699,1896,1952,1956,2130,2490,2536
2391	SETALF	A 2388
***	SEVENTH	U 2198
2517	SFIND	A 2513
***	SHIFT	U 1095,1100,1105,1143,1200,2331,2351
***	SHIFTS	U 1078
***	SHOULD	U 1520,1527,1740,1985,1989,1996
154	SITE	A 270,299,513,1783,1788,1883,1907,2960
299	SITENM	A 1883
***	SIX	U 1191,1203
108	SIZE1	A 1093
109	SIZE2	A 626,627,1098
110	SIZE3	A 1103
111	SIZE4	A
383	SLOOP	A 394
***	SLOPE	U 539,542,899,906,938,2482,2484,2487,2520,2520,2556,2597,2599,2972,2973
387	SLP1	A 385
391	SLP2	A 389
276	SN1	A 1814,1876
277	SN2	A 1818
278	SN3	A 1822
279	SN4	A 1824
***	SO	U 1432,1448,1518
***	SOFT	U 1404
***	SPACE	U 737
***	SQ	U 723,723
787	SQRT	A 723,796
***	SQUARE	U 790,794,795,799,859
94	SRAM	A 171,241,379,413,509,2664

379	SRANDIG	A	377
2944	SRAMSG	A	1315
151	STACK	A	315,344
***	START	U	313,316,320,327,370,379,395,401,410,428,434,490,912, 944,1075,1318,1342,1475,1482,1489
***	STAT	U	1084
***	STATIC	U	379,380,413,487,551,557
***	STATISTICAL	U	1400
***	STATUS	U	205,227,640,982,1306,2343,2348,2428
703	STCHAR	A	700
***	STICK	U	1140,1144
***	STILL	U	770
***	STOP	U	2623
***	STORE	U	498,502,512,522,526,573,578,580,703,722,741,871,995, 996,1007,1217,1849,2253,2603,2606,2616,2617,2618 2619,2645
1110	STOREND	A	1087,1090,1096,1101,1106
106	STRAT	A	395,401
949	STRT2	A	912,944
127	STTIM	A	
126	STTIM3	A	
***	SUB	U	875,2250
***	SUBTRACT	U	858,2487
***	SUM	U	218,373,722,774,862,1071,1071,1072,1072,1074,1953
***	SUMMING	U	372
***	SYSTEM	U	315
152	SYSTK	A	315,346
***	T	U	912
136	T1CNTRL	A	582,584,591,2429
130	T1LSB	A	574
129	T1MSB	A	573
***	T2	U	910,911,914,942,943,944,946,948
204	T2CNT	A	883,954
137	T2CNTRL	A	583,590,2430
132	T2LSB	A	579,589
131	T2MSB	A	578,588
134	T3LSB	A	581
133	T3MSB	A	580
***	TAB	U	732
***	TABLE	U	864,724,725,726,729,1006,1073,1134,1189,1190,1202,1207, 1217,2374,2481,2494,2499,2508,2516,2577,2591
***	TAKE	U	2560
199	TEMPT1	A	925,987,988
200	TEMPT2	A	954,993
221	TEM	A	2618,2646,2679,2689,2693
2686	TEMLP	A	2682,2690
***	TEMS	U	761,2979,2981,2983,2985,2987,2989
227	TEST	A	180,227,269,298,404,408,409,442,443,510,640,640,641, 663,864,881,906,911,914,926,938,943,946,950,982,1080 1084,1716,1773,1778,1934,2174,2653,2654,2959

298	TESTNM	A	1872,1882
***	THE	U	180,180,612,788,790,795,1075,1216,2048,2334,2342
***	THEIR	U	2002
***	THEM	U	697,877
***	THERE	U	468
***	THIRD	U	2183,2195,2210
***	THIS	U	438
***	THOUSANDS	U	743
***	THRESHOLD	U	2525
***	TICK	U	573,578,580
***	TICKS	U	572,577
138	TIMADDR	A	569,2427
124	TIMCONT	A	582
***	TIME	U	290,307,478,484,501,502,542,1138,1398,1643,1686,1687, 1705,2484,2487,2496,2556,2560,2562,2602,2603,2973
2422	TIMER	A	178,179,204,272,274,300,301,332,332,522,526,569,570, 575,580,588,590,872,881,883,926,982,1134,1135,1189 1196,1207,2428,2429,2653,2654,2962,2963,2964,2965
300	TIMER1	A	985,1793,1798,1886
301	TIMER2	A	950,1803,1806,1891
***	TIMERS	U	582
***	TIMES	U	1203
2650	TIMEXT	A	2630
569	TIMINI	A	475
178	TIMR1	A	521,570,984,1889
179	TIMR2	A	525,575,585,990,1894
2439	TIMSCON	A	2432
2426	TIMSUB	A	1032,2423
667	TLOOP	A	672,674,693,721,731,776
673	TLOOP1	A	669
156	TMFLG1	A	
158	TMFLG2	A	
157	TMVAL1	A	1888,1916
159	TMVAL2	A	1893,1919
153	TNUM	A	1882,1903
***	TO	U	246,413,473,484,487,551,557,572,577,592,639,681,684, 687,689,726,732,734,735,748,756,769,776,906,1078 1215,1323,1347,1474,1481,1488,1588,1592,1596,1600,1604, 1608,1612,1616,1620,1624,1628,1630,1848,1875,2251 2330,2342,2351,2485,2485,2490,2491,2499,2508,2517,2615,2643
***	TOFALLING	U	938
1414	TOGDSP	A	1387
***	TOP	U	1077,1189,1207
***	TOTAL	U	632
***	TR2	U	603
2120	TR2FND	A	2117
237	TR2HIGH	A	604,909,939,965,2160
238	TR2LOW	A	606,607,907,941,967,2162,2163,2467,2475
2109	TR3FND	A	2106
***	TRANSFER	U	486

***	TRANSLATION	U	732,2374
***	TRAP	U	317,318
***	TRG	U	907,909,939,941,965,967
160	TRG1	A	2124
162	TRG2	A	2125
161	TRG2FL	A	
164	TRG3	A	2126
163	TRG3FL	A	
***	TRIG	U	237,238
304	TRIG2	A	2112
303	TRIG3	A	2090,2100
***	TRIGGER	U	173,175,177,281,303,304,527,534,538,2185,2190,2967,2969,2970,2971
***	TRIGGER2	U	283,1994,2200,2205,2210
***	TRIGGER3	U	1987,2195
173	TRIGR1	A	530,2122,2124,2137,2440,2471
172	TRIGR1H	A	
175	TRIGR2	A	533,2120,2121,2125,2141
174	TRIGR2H	A	603,2159,2461
177	TRIGR3	A	537,2110,2111,2126,2144
176	TRIGR3H	A	916,2441,2525
1479	TRYB	A	1473
1486	TRYD	A	1480
139	TSTAT	A	2428
180	TSTINF	A	509,1881,1900,2123,2481,2556,2595
***	TURN	U	348,648,977,1036,1204,1305,1450,1457,1698,1718,1895, 2129,2176,2346,2656
***	TURNED	U	2296
1098	TWOSEC	A	1094
222	UNIT	A	2619,2647,2680,2691,2694
2691	UNITLP	A	2687
***	UNITS	U	767,2978,2980,2982,2984,2986,2988
***	UP	U	215,430,634,793,985,1080,1082,1318,1342,1896
***	UPDATE	U	1006,1220,2047
***	UPPER	U	696,1143
***	USEC	U	979,1192,1699,1896,2130
***	USER	U	1381
***	VAL	U	234,305,682,2507,2519,2963,2965,2969,2971,2973,2974,2975
***	VALID	U	206,207,2446,2613
***	VALS	U	498
***	VALUE	U	182,183,184,195,201,218,220,286,522,526,539,542,545, 546,547,570,588,633,638,675,678,681,685,690,722,733 787,788,795,857,859,1138,1141,1142,1145,1196,1199,1211, 1212,1953,2002,2496,2518,2524,2530,2531,2534,2534 2536,2568,2579,2592,2650,2972,2976
***	VALUES	U	486,1216,1404
100	VARSTR	A	410,2663
206	VBOOM	A	554,2610,2612,2613,2614
***	VECTOR	U	327,328,329,330,331,332,333
***	W	U	172,173,174,175,176,177,178,179,180,182,183,184,196, 198,205,206,207,210,215,216,217,219,223,228,230,231

232, 233, 234, 235, 236, 239, 248, 249, 250, 251, 252, 253, 254,
 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267
 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280,
 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293
 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306,
 307, 345, 373, 376, 381, 382, 383, 384, 387, 388, 391, 398, 402
 403, 405, 411, 417, 431, 436, 437, 439, 470, 492, 493, 494, 495,
 496, 497, 498, 499, 502, 503, 504, 505, 506, 507, 510, 511, 512
 513, 514, 515, 516, 517, 518, 521, 522, 525, 526, 527, 528, 529,
 530, 533, 534, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546
 547, 554, 555, 570, 575, 585, 602, 611, 620, 634, 635, 636, 637,
 639, 642, 646, 673, 675, 678, 679, 680, 682, 683, 685, 686, 688
 692, 696, 697, 720, 727, 733, 736, 738, 740, 743, 745, 746, 750,
 751, 753, 754, 759, 760, 762, 763, 775, 799, 847, 851, 853, 857
 866, 871, 879, 920, 963, 978, 984, 990, 995, 1067, 1070, 1073,
 1082, 1086, 1088, 1089, 1192, 1210, 1213, 1214, 1215, 1216
 1217, 1288, 1337, 1339, 1380, 1382, 1384, 1386, 1396, 1398, 1400,
 1402, 1404, 1406, 1408, 1410, 1414, 1416, 1420, 1430, 1432
 1434, 1443, 1444, 1447, 1450, 1452, 1457, 1466, 1470, 1472, 1476,
 1479, 1483, 1486, 1490, 1492, 1493, 1494, 1495, 1497, 1514
 1515, 1517, 1519, 1521, 1523, 1525, 1527, 1529, 1532, 1543, 1545,
 1547, 1549, 1552, 1554, 1556, 1559, 1561, 1563, 1566, 1568
 1570, 1573, 1575, 1577, 1585, 1587, 1589, 1591, 1593, 1595, 1597,
 1599, 1601, 1603, 1605, 1607, 1609, 1611, 1613, 1615, 1617
 1619, 1621, 1623, 1625, 1627, 1629, 1657, 1658, 1659, 1660, 1661,
 1662, 1663, 1664, 1665, 1666, 1667, 1668, 1669, 1670, 1671
 1672, 1673, 1674, 1675, 1676, 1677, 1678, 1679, 1680, 1681, 1682,
 1684, 1685, 1686, 1688, 1690, 1692, 1694, 1696, 1707, 1708
 1709, 1710, 1711, 1712, 1734, 1735, 1737, 1739, 1741, 1743, 1746,
 1756, 1758, 1760, 1762, 1764, 1771, 1773, 1776, 1778, 1781
 1783, 1786, 1788, 1791, 1793, 1796, 1798, 1801, 1803, 1806, 1808,
 1810, 1812, 1814, 1816, 1818, 1820, 1822, 1824, 1851, 1854
 1859, 1862, 1865, 1868, 1882, 1883, 1884, 1886, 1888, 1889, 1891,
 1893, 1894, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910
 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921,
 1922, 1923, 1924, 1925, 1927, 1928, 1930, 1931, 1943, 1944
 1946, 1948, 1950, 1954, 1958, 1977, 1978, 1981, 1984, 1987, 1989,
 1991, 1994, 1996, 1998, 2001, 2004, 2007, 2010, 2013, 2016
 2020, 2045, 2049, 2052, 2055, 2059, 2062, 2065, 2069, 2072, 2076,
 2079, 2083, 2086, 2100, 2105, 2110, 2111, 2112, 2116, 2120
 2121, 2122, 2124, 2125, 2126, 2127, 2128, 2137, 2138, 2140, 2141,
 2143, 2144, 2146, 2147, 2148, 2150, 2151, 2152, 2153, 2154
 2155, 2156, 2157, 2158, 2166, 2167, 2168, 2170, 2171, 2183, 2185,
 2188, 2190, 2193, 2195, 2198, 2200, 2203, 2205, 2208, 2210
 2213, 2215, 2218, 2220, 2223, 2225, 2228, 2230, 2233, 2235, 2238,
 2255, 2257, 2258, 2261, 2265, 2267, 2269, 2270, 2285, 2288
 2296, 2298, 2299, 2308, 2310, 2311, 2313, 2314, 2316, 2327, 2328,
 2379, 2380, 2382, 2384, 2387, 2389, 2391, 2414, 2431, 2440
 2449, 2450, 2452, 2455, 2457, 2458, 2460, 2463, 2471, 2472, 2473,
 2474, 2474, 2477, 2482, 2484, 2496, 2497, 2500, 2501, 2507

2511,2512,2518,2519,2520,2524,2530,2531,2536,2540,2541,
 2542,2543,2558,2568,2569,2573,2579,2585,2587,2593
 2594,2597,2599,2603,2604,2605,2606,2607,2608,2609,2610,
 2612,2613,2614,2638,2640,2641,2642,2652,2681,2683
 2686,2688,2711,2712,2713,2714,2715,2716,2717,2718,2719,
 2720,2721,2722,2723,2724,2725,2726,2727,2728,2729
 2730,2731,2732,2733,2734,2735,2736,2737,2738,2739,2740,
 2741,2742,2743,2744,2745,2746,2747,2748,2749,2750
 2751,2752,2753,2754,2755,2756,2757,2758,2759,2760,2761,
 2762,2763,2764,2765,2766,2767,2768,2769,2770,2771
 2772,2773,2774,2775,2776,2777,2778,2779,2780,2781,2782,
 2783,2784,2785,2786,2787,2788,2789,2790,2791,2792
 2793,2794,2795,2796,2797,2798,2799,2800,2801,2802,2803,
 2804,2805,2806,2807,2808,2809,2810,2811,2812,2813
 2814,2815,2816,2817,2818,2819,2820,2822,2823,2824,2825,
 2826,2827,2828,2829,2830,2831,2832,2833,2834,2835
 2836,2837,2838,2839,2840,2841,2842,2843,2844,2845,2846,
 2847,2848,2849,2850,2851,2852,2853,2854,2855,2856
 2857,2858,2859,2860,2861,2862,2863,2864,2865,2866,2867,
 2868,2869,2870,2871,2872,2873,2874,2875,2876,2877
 2878,2879,2880,2881,2882,2883,2884,2885,2886,2887,2888,
 2889,2890,2891,2892,2893,2894,2895,2896,2897,2898
 2899,2900,2901,2902,2903,2904,2905,2906,2907,2908,2909,
 2910,2911,2912,2913,2914,2915,2916,2917,2918,2919
 2920,2921,2922,2923,2924,2925,2926,2927,2928,2929,2930,
 2931,2959,2960,2961,2962,2963,2964,2965,2966,2967
 2969,2970,2971,2972,2973,2974,2975,2976,2990
 *** WAIT U 663,693,776
 *** WAS U 916,1430,1434,2441
 *** WERE U 468
 *** WITH U 897,1201,1687,2047
 *** WITHIN U 876
 *** WORD U 247,373,400,405
 *** WORDS U 1135,1474,1481,1488
 2341 WRDISP A 1323,1347,2333
 123 WRITE A 383,387,398,400,484,1164,1323,1347,1588,1592,1596,
 1600,1604,1608,1612,1616,1620,1624,1628,1630,2333
 1159 WRITEC A 1141,1145
 1126 WRTCLK A 472,484,1701
 1138 WRTCLK1 A 1146
 *** KING U 949
 292 YEAR A 184,257,292,483,547,1587,1591,1655,1686,2976,2988
 190 YEAR1 A 483,1221,1231,1687
 *** YEARS U 190
 *** YES U 469,671,771,852,865,869,917,966,968,1016,1385,1717,1935,
 2175,2526,2535,2623
 169 YMTIM A
 *** ZERO U 372,391,405,439,462,466,736,1152,1476,1483,1490,1577,2650
 *** - U 966
 *** dB U 2225,2230
 *** mSEC U 2235,2238

4. BEAR HARDWARE DESCRIPTION

4.1 Overview

The Boom Event Analyzer Recorder (BEAR) is a software controlled instrument that digitizes the sound pressure level present at the BEAR' microphone and analyzes these data using programmable parameters to determine if the signal was a sonic boom. The date of an event is retained in the removable battery RAM modules that can be later processed for further analyses. The software was written in 68000 assembler language. The devices that are being controlled are:

- o 16 bit A/D converter being sampled at 8 khz.
- o Key pad for parameter entry.
- o Alphanumeric display for parameter display and error messages.
- o Real-time clock for time and date information.
- o Two programmable timers for defining event windows.

4.2 Parts List

ENCLOSURE CASE

August 16, 1989

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
Zero Case	105x, Zero, Halliburton Corp	1
Zero Panel Brackets	ZP 20653 (two modified in house) Zero, Halliburton Corp	7
Connectors	EGG2B303CNL Lemo Connector	3
Connector Dust Caps	RA 2295 Lemo Caps	3
Isolated BNC	31-10, Amphenol	1
BNC Cover	31-6, Amphenol	1

BEAR MODEL 1020 FRONT PANEL

August 16, 1989

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
Adjustable Grip Latch	27-10-311-20, Southco Inc.	1
Push Button Switch	MSPF-101C, Alco	1
Toggle Switch	MTF1060, Alco	1
Analog Meter	50-281011 NDND, General Electric	1
Key Pad	PTS1-51224-P630, IEE, Industrial Electronic Engineer	1
Front Panel	MFG - See Drawing SRL "Front Panel"	1
Battery Case	MFG - See Drawing SRL "Battery Case"	1

BEAR MODEL 1020 DATA ACQUISITION BOARD

August 16, 1989

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
C1,3,5,7,9,11, C13,15,17,19, 23,25,27,29,32, 34,35,37,39,41, 45,47,49,51	C320C104K5R5CA, .1uf 50 WVDC X7R Ceramic Capacitor, Kemet	24
C2,4,6,10,12, 14,16,18,20,22, 24,26,28,30,33, 36,38,40,42,46, 48,50,52,54	T350E106K025AS, 10uf 25 WVDC Tantalum Capacitor, Kemet	24
C8	X363UW, 15uf 100 WVDC Polypropylene Capacitor, TRW (American Shizuki)	1
C31	C330C103K1G5CA, NPO 10% 100 WVDC .01uF Ceramic Cap, Kemet	1
C21,53	203A14 .02uF 14 Pin Decoupling Caps for U6 and U10, Rogers	2
C43,44	C315C102K1G5CA, NPO 10% 100 WVDC .001uF Ceramic Capacitor, Kemet	2
CR1 thru CR4	1N5819, Schottky Barrier Diode, Motorola	4
R1	RN55E2491F, 2.49K ohm 1/8w 1% 25 ppm Metal Film Resistor	1
R2	RN55E2212F, 22.1K ohm 1/8w 1% 25 ppm Metal Film Resistor	1
R4	3266W-1-103, 10K ohm Potentiometer, Bourns	1
R3,R5	RN55D1000F, 100 ohm 1/8w 1% 100 ppm Metal Film Resistor	2
R6	RN55E1542F, 15.4K ohm 1/8w 1% 25 ppm Metal Film Resistor	1

BEAR MODEL 1020 DATA ACQUISITION BOARD
(continued)

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
R7	3266W-1-102, 1K ohm Potentiometer, Bourns	1
R8	3266W-1-203, 20K ohm Potentiometer, Bourns	1
R17,R20	RN55D10ROF, 10 ohm 1/8 w 1% 100 ppm Metal Film Resistor	2
R19	RN55D7152F, 71.5K 1/8 w 1% 100 ppm Metal Film Resistor	1
R18	RN55D1242F, 12.4K 1/8 w 1% 100 ppm Metal Film Resistor	1
R9,R11	RN55E2211B, 2.21K 1/8w .1% 25 ppm Metal Film Resistor	2
R10,R12	RN55E1821B, 1.82K 1/8w .1% 25 ppm Metal Film Resistor	2
R14	RN55D1001F 1.0K 1/8w 1% 100 ppm Metal Film Resistor	1
R13	RN55D4702F, 47K 1/8w 1% 100 ppm Metal Film Resistor	1
R15	RN55D22R1F, 22.1 ohm 1/8w 1% 100 ppm Metal Film Resistor	1
R16	RN55D05ROF, 5 ohm 1/8 w 1% 100 ppm Metal Film Resistor	1
J5	609-2634E, 26 Pin Ribbon Cable Header, Ansley Connector (26 pin cable fabricated in house)	1
J1	Straight Square 4 Pin Friction Lock Header, 22-11-2042, Molex 6373 Series	1
J2	4578, BNC Female PC Mount, Pomona	1
Jump 1-4	TSW-103-08-GS, 3 Pin Jumper Stakes, SAMTEC	4
Shunt Plugs	CA-02-SJC-B, 2 Pin Jumper Plugs, SAMTEC	4

BEAR MODEL 1020 DATA ACQUISITION BOARD
(continued)

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
U2	AD584LH, Voltage Reference, Analog Devices	1
U4	678-2K0, Anti-Aliasing Filter, Frequency Devices	1
U9	CS5016-JC16, 16 Bit Analog to Digital Convertor, Crystal Semiconductor	1
U1,U3	OPA 111 BM, Op Amp, Burr-Brown	2
U11	RC4194TK, Dual Tracking Regulator T0-66, Raytheon	1
U5,U8	OPA27EZ, Op Amp, Burr Brown	2
U7	REF10KM, Precision 10 Volt Reference, Burr-Brown	1
U10	74HC04N, High Speed CMOS Hex Inverter	1
U6	74HC74N, High Speed CMOS Dual Flip Flop	1
S1	840AG11D, 40 pin Gold Plated Contact Socket for U9, Augat	1
P1	4 pin Polarized Housing with locking Ramp, 22-01-3047 (cable fabricated in house), Molex, 2695 Series	1
P2	31-335, Crimp Right Angle BNC Male Plug (cable fabricated in house), Amphenol	1
	08-50-0114 Molex 2759 Series Crimp Terminals	4
	Model 1020 A/D MultiLayer P.C.B.	1

BEAR MODEL 1020 MOTHER BOARD

August 16, 1989

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
	Circuit Board	1
R1,R2	Not Used	
R3,R4,R19-R21	RCR07G332JS, 3.3K ohm 1/4 w 5% carbon, Allen Bradley	5
R5,R12	RCR07G471JS, 470 ohm 1/4 w 5% carbon, Allen Bradley	2
R6,R7,R9,R24	RCR07G103JS, 10K ohm 1/4 w 5% carbon, Allen Bradley	4
R8,R14,R16-R18	RCR07G102JS, 1K ohm 1/4 w 5% carbon, Allen Bradley	5
R10,R11	RCR07G105JS, 1 Meg ohm 1/4 w 5% carbon, Allen Bradley	2
R13,R15,R22,R23	RCR07G472JS, 4.7K ohm 1/4 w 5% carbon, Allen Bradley	4
R25	5063JD154K0F, 154K ohm, 1/8 w 1% 150 ppm Metal Film Resistor, Mepco Electra	1
R26	5063JD20K00F, 20K ohm, 1/8 w 1% 150 ppm Metal Film Resistor, Mepco Electra	1
R27	5063JD5M110F, 5.11 Meg, 1/8 w 1% 150 ppm Metal Film Resistor, Mepco Electra	1
C1-C3,C6,C19, C22-C33,C36, C39-C40	1C1025U104M050B, .1uF 50WVDC Ceramic Capacitor, Sprague	19
C4,C5	Not Used	
C7-C14,C17,C18	T350G156K025AS, 15uF 25WVDC, Tantalum Kemet	10
C34,C35,C38	T350E106K025AS, 10uF 25WVDC Tantalum, Kemet	3
C37,C41	T350A105K025AS, 1uF 25WVDC Tantalum, Kemet	2
C15,C16,C20,C21	Not Used	

BEAR MODEL 1020 MOTHER BOARD
(continued)

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
Q1,Q2	Not Used	
Q3,Q4	VN0104N3, Power MosFet, General Electric	2
CR1,CR2	Not Used	
VR1-VR4	LM7805, +5 volt regulator, Motorola	4
VR5	Not Used	
HS1-HS4	THM62073, Heat Sink, Thermalloy	4
HS5	Not Used	
Y1	X0-53B, 16.0 Mega Hertz, Dale	1
RP1,RP2	CSC-08-103G, 10K ohm Resistor Pack, Dale	2
J1	Molex, 4 pin receptacle, 22-11-2042	1
P2	15-31-1026, Connector, Molex	1
P3	25-0517-90C, Pin Line Collet, Airies or SS-132-G-2 Socket Strip Samtech	1
P4	3802-08-016, LCD, IEE, Industrial Electronic Engineer	1
P5	609-2634E, Connector, Ansley	1
U1-U3,U29	MC74HC4017N, Motorola	4
U4,U22,U42	MC74HC08N, Motorola	3
U5	Not Used	
U17,U18	MC74HC245N, Motorola	2
U6,U14	HM1-65162-9, 2Kx8 static RAM, Harris	2
U7,U8,U15,U16	HN27C64G-15, Hitachi	4
U9,U10	32Kx8 Memory SIP, SRL	2
U11	966, DC/DC Convertor, Analog Devices	1

BEAR MODEL 1020 MOTHER BOARD
(continued)

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
U12,U13	100-096-153, 96 Pin Connector, Panduit	2
U19	MC68HC000P8, CMOS Microprocessor, Motorola	1
U20	MC74HC27N, Motorola	1
U21	MC74HC00N, Motorola	1
U23,U24,U33	MC74HC32N, Motorola	3
U25	MC74HC139N, Motorola	1
U26,U27	MC74HC138N, Motorola	2
U28,U39	MC74HC373N, Motorola	2
U32,U35,U50	74HC04N, Motorola	3
U51	ICL8211CPA, Voltage Detector, Intersil	1
U30	LM555N, National	1
U31	MC74HC20N, Motorola	1
U34	MC74HC02N, Motorola	1
U36	Not Used	
U37	MC74HC147N, Motorola	1
U38	MM74C906N, National	1
U40	MC6340P, Motorola	1
U41,U43	MC74HC03N, Motorola	2
U44	MC74HC175N, Motorola	1
U45,U46	MC74HC74N, Motorola	2
U47	MM74C923N, National	1
U48	MC6821P, Motorola	1
U49	RTM3, Catalyst, Research Corp	1
Micro Q Capacitor	u14.02, Rogers Corporation	17

BEAR MODEL 1020 MOTHER BOARD
(continued)

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
Micro Q Capacitor	u16.03, Rogers Corporation	5
Micro Q Capacitor	u20.03, Rogers Corporation	5
Micro Q Capacitor	u24.07, Rogers Corporation	2
Micro Q Capacitor	u28.07, Rogers Corporation	5
Augat Socket	564-AG12D	1
Augat Socket	528-AG12D	5
Augat Socket	524-AG12D	2
Augat Socket	540-AG12D	1

BEAR MODEL 1020 MEMORY MODULES

August 16, 1989

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
	Circuit Board	3
J1	4-102887 Right Angle Header Amp (36 pin)	1
RP1	CSC10A-01-103G, 10 Pin SIP 9-10K Resistors, Dale	1
U1-U4	SRM 20256 C10 256K Bit Static Ram SMOS Systems	4
U5	74HC138, 1:8 Demux, Motorola	1
B1	B1000 2.8V Lithium Iodine Battery Catalyst Research	1
J1	100-96-459, 96 pin Wire Wrap Connector Panduit	1
R1	RCR07C472JS, 4.7K 1/4W 5% Resistor Allen Bradley	1
U1	DRM2, Memory Module Catalyst Research	1
Zero Box	Z48-80A-2.40BB, Rectangular Box w/ Nut Plates, Zero Halliburton Corp	1
Cover	Cover 1/16 x 3" x 5" Jade Tool	1
Micro Q Capacitor	u14.02, Rogers Corporation	1
Micro Q Capacitor	u28.07, Rogers Corporation	4

BEAR MODEL 1020 MISCELLANEOUS HARDWARE

August 16, 1989

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
2-56 x 1/4"	Flat Head Screws Slotted (Keyboard Mount)	4
2-56 x 3/8"	Nylon Roundhead Screws Slotted (LCD Mount)	4
2-56 x 3/16"	Nylon Space RS (LCD Mount) P/N 4000 HH Smith	4
2-56	Nylon Nuts (LCD Mount)	4
4-40 x 1/2"	Round Head (Memory Module)	2
4-40 x 1/2"	Flat Head Screws Slotted (A/D Panel)	4
4-40 x 1/4"	Pan Head Screws Slotted (A/D Panel) (Heat Sinks)(Memory Module)	16
4-40 x 1/4"	Threaded Standoff Nylon (Memory Module) P/N 4050, H H Smith	4
4-40 x 1"	Threaded Standoff (A/D Panel) (P/N 46F2317)	4
4-40	Hex Nut (Heat Sinks, Memory Module)	6
4-40	Lock Washer (Heat Sinks)	4
8-32 x 1/2"	Pan Head (Memory Module)	4
6-32 x 3/4"	Flat Head Screws Phillips (Mother Board Mount)	15
6-32 x 5/16"	Nylon Spacers (Mother Board Mount)(P/N 4010) HH Smith	15
6-32	Nylon Nuts (Mother Board Mount)	15
10-32 x 1/2"	Oval Head Screws Slotted Front Panel Mount	5
33F1362	Female Nylon Insulated Disconnect (small battery) (22-18 gauge)	6
31N558	Ring Terminal (large battery) (16-14 gauge 1/4" stud size)	6
1/4" x 20 x 3/4"	Hex Head Bolt (large battery)	6
1/4" x 20	Hex Nut (large battery)	6

BEAR MODEL 1020 MISCELLANEOUS HARDWARE
(continued)

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
1/4"	Lock Washer (Internal Star) (large battery)	6
34142	Ring Terminal (22-16 gauge) (meter leads)	2

MODEL 1020 MISCELLANEOUS OTHER

August 16, 1989

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
10" Microdot BNC Cable	002B00.10, PCB	1
Microphone	106B50, PCB	1
25' Coax Cable	RG58 wire, (Fabricated in house)	1
BNC Connector	(for coax cable) PN 5285, Crimp BNC Male Cable Plug, Pomona	2
10" Ribbon Cable	26 pin ribbon cable w/connectors Ansley flat cable p/n 201-26	1
26 Pin Conn.	Ansley Connector p/n 609-2641	2
2 wire 16 awg	5432 (Alpha)	-
18 awg (red) wire	A1833-3 (Alpha)	-
16 awg (black) wire	A1834 (Alpha)	-
4 awg Glass Sleeving	P1F200-4	-
Shrinkable Tubing (Black)	FIT221-1/4 (Alpha)	-
Shrinkable Tubing (Red)	FIT221-1/4 (Alpha)	-
Shrinkable Tubing (Black)	FIT221-1/2 (Alpha)	-
Shrinkable Tubing (Black)	FIT221-1/8 (Alpha)	-
2 wire 18 awg	9708 (Beldon) Clear Wire (small battery)	-
Hinge	1581A39 Blank Aluminum Continuous Hinge McMaster Carr (For A/D Door on Front Panel)	-
Power Sonic Battery	PS 1265, 6.5 Amp (Small Battery)	3

MODEL 1020 MISCELLANEOUS OTHER
(continued)

<u>Designator</u>	<u>Part No., Description, Manufacturer</u>	<u>Quantity</u>
Johnson Control Battery	GC 12800-1B, 12 Amp (Large Battery)	3
Molex Connector	19-09-2029 Male Plug	3
Molex Connector	19-09-1029 Female Receptacle	4
Molex Terminal Pins	02-09-1104 Female	6
Molex Terminal Pins	02-09-2103 Male	8
Lemo Connector	FGG2B303CNAD99 Straight Plug 3 pin Male	3
Molex Connector 4 Pin	22-01-2047 Series 2695	2
Molex Crimp Pins	08-50-0114 (Cable made in house)	8
Foam Rubber	2lb Density Charcoal Polyester 20" L x 3½" W x 3" H Miami Valley Gasket	1
6-32 x 3/8"	Pan Head Slotted Screw	2
6-32	Metal Nut	2
#10	Flat Washers	2
#10	Lock Washers	2
8-32 x ¼"	Pan Head Slotted Screw	4

4.3 Drawings

The following are the electronic circuitry schematics for the BEAR systems. Full scale schematics are available from :

Systems Research Laboratories
2800 Indian Ripple Road
Dayton, Ohio 45440-3696

Telephone (513)426-6000



Figure 28. BEAR CPU, Reset and Interrupt Circuitry Diagram



Figure 29. BEAR Clock and Miscellaneous Logic Diagram

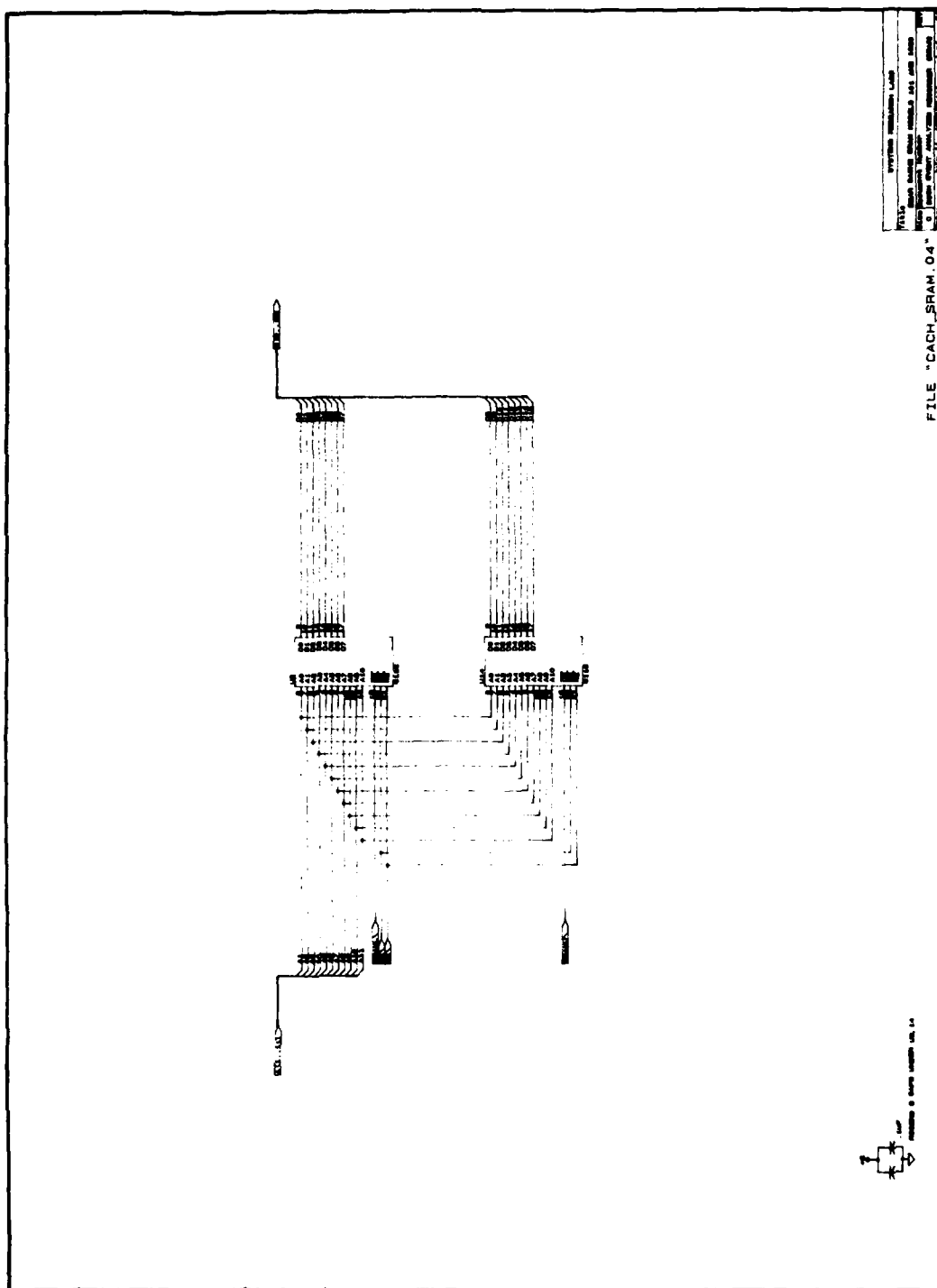


Figure 30. BEAR Cashe SRAM Diagram

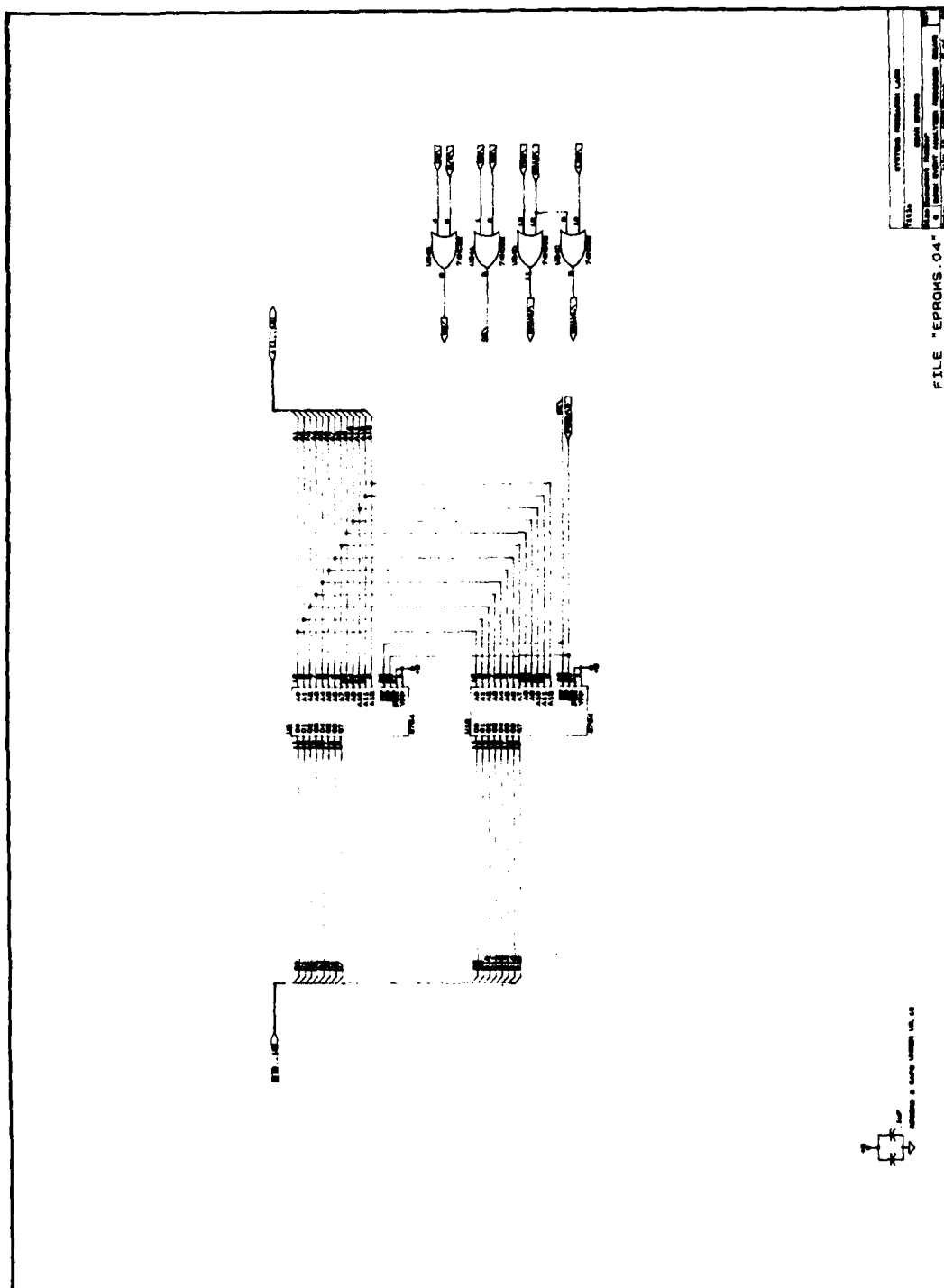
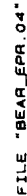
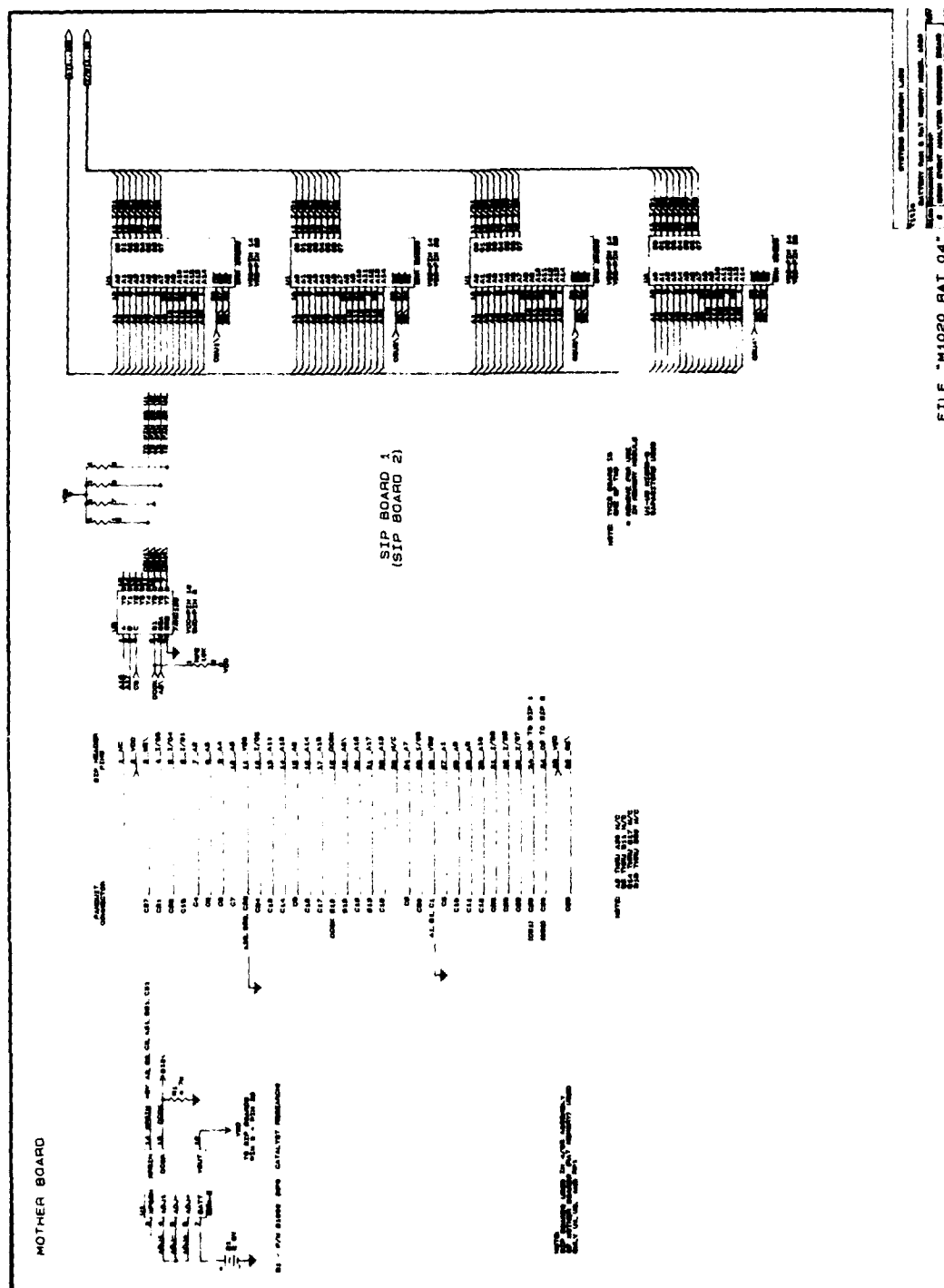


Figure 31. BEAR EPROM's 1 Diagram



155



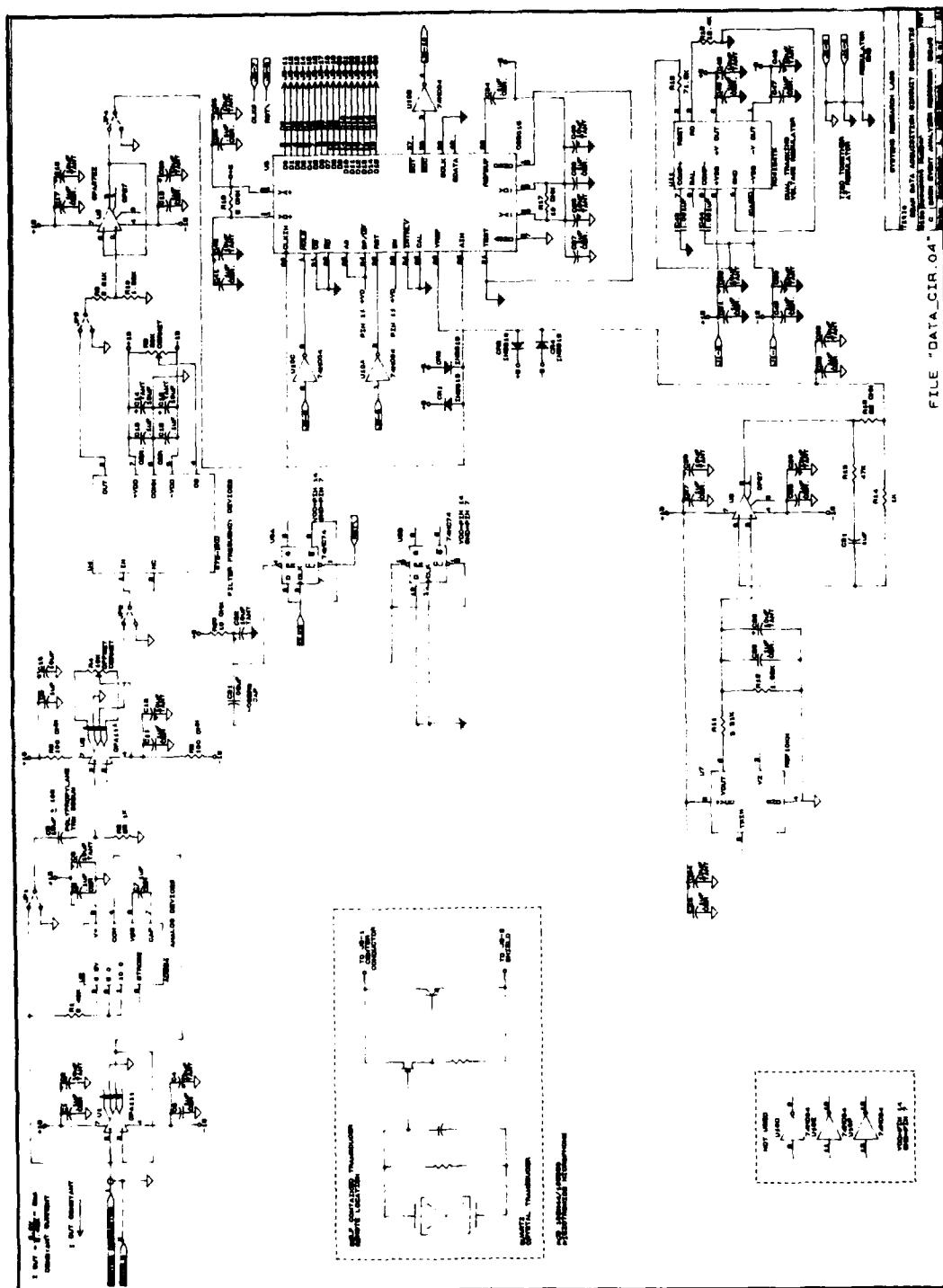


Figure 36. BEAR Data Acquisition Circuit Diagram

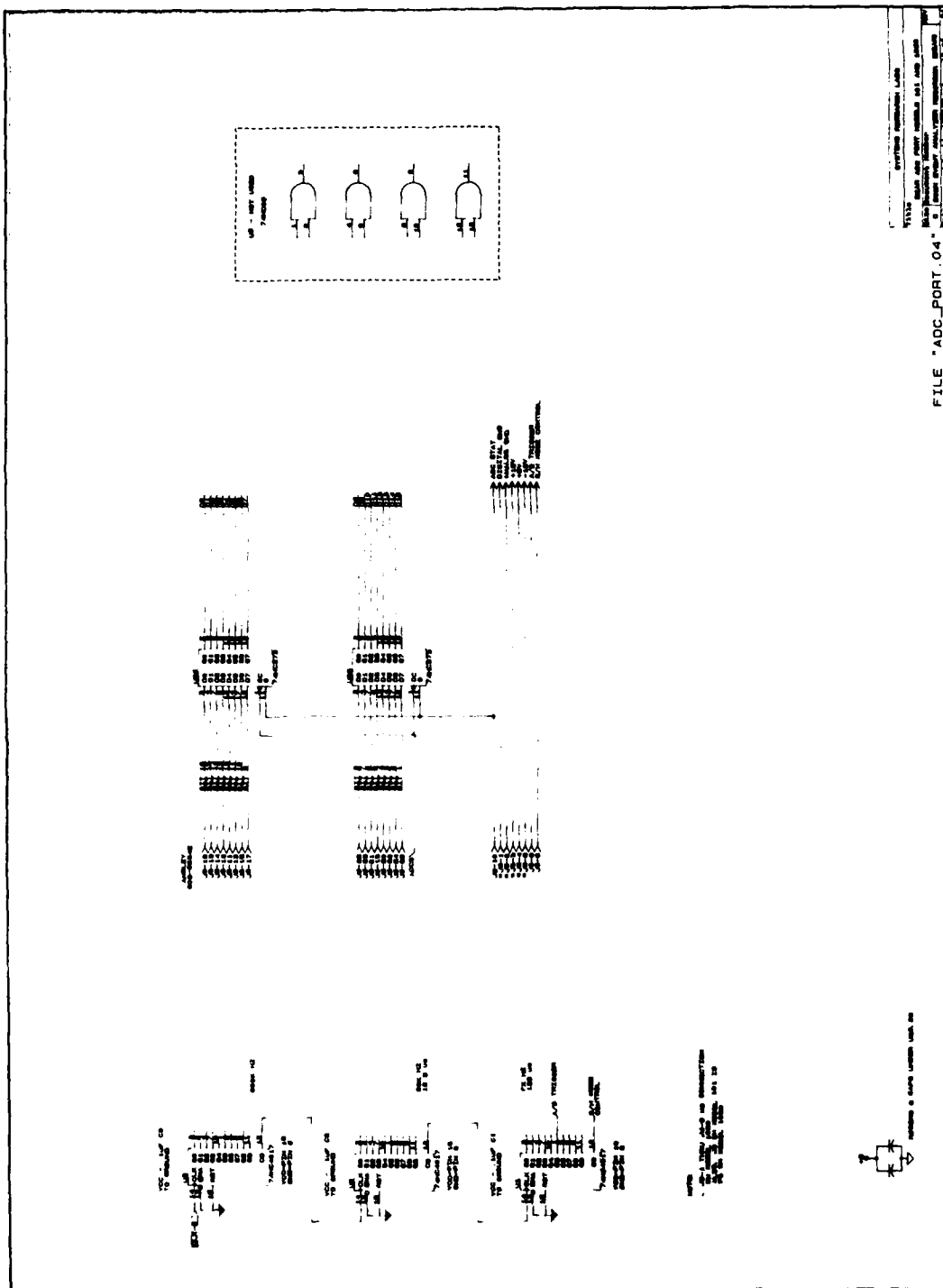


Figure 37. BEAR ADC Port Circuit Diagram

Figure 38. BEAR Liquid Crystal Display Circuit Diagram

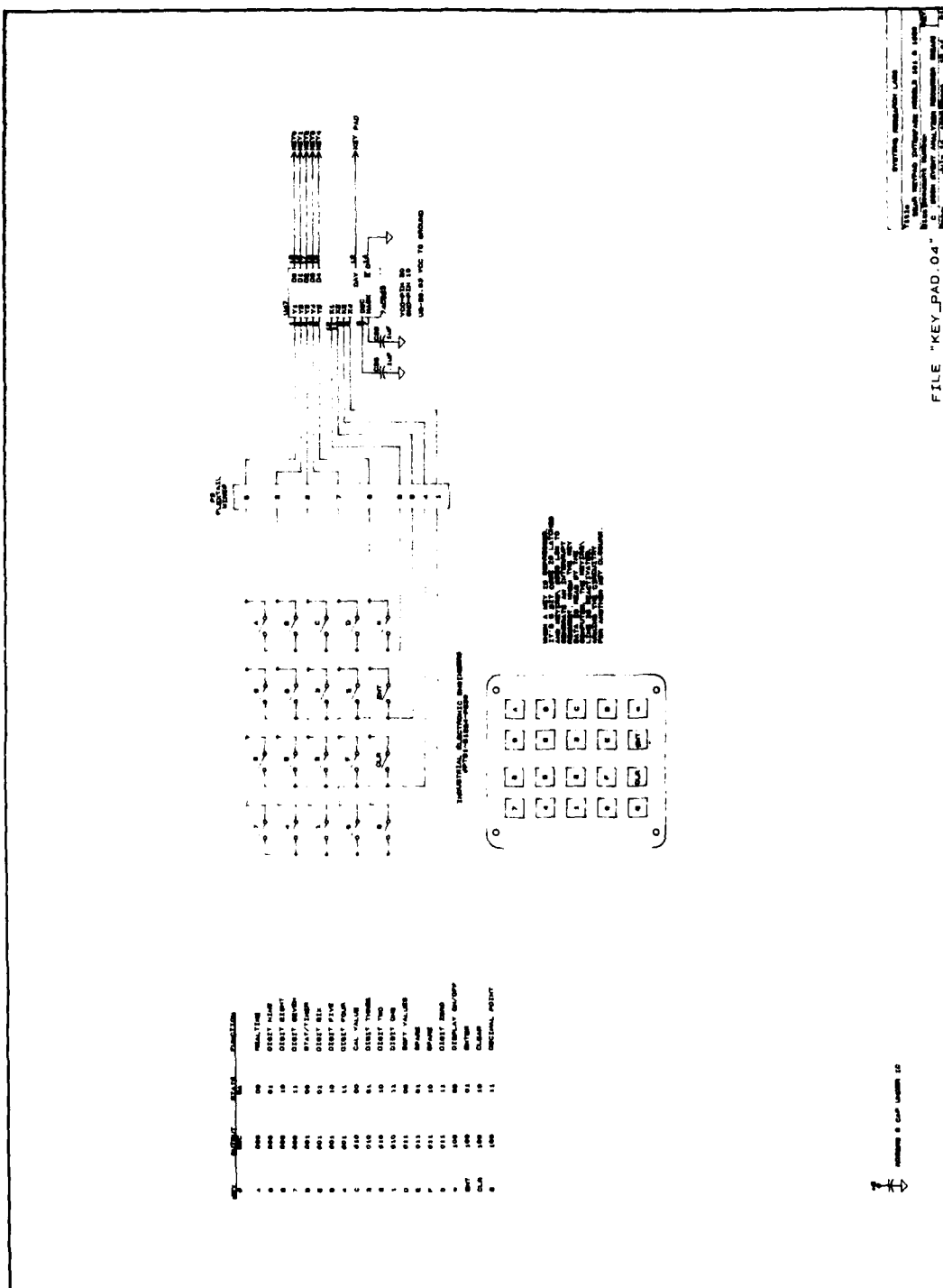


Figure 39. BEAR Keypad Interface Circuit Diagram

Figure 41. BEAR Power Supply Circuit Diagram

Figure 42. BEAR Low Battery Indicator Circuit Diagram

4.4 BEAR Calibration Guide

BEAR A/D CARD SET-UP PROCEDURES

Refer to the "BEAR data Acquisition Circuit Schematic" for making these adjustments. The order in which the offset adjustments are to be made is as follows:

1. A/D Convert S55016 (U9)
2. A/D Buffer Amp OPA27EZ (U5)
3. Anti-Aliasing Filter 678-2K0 (U4)
4. Gain Block op Amp OPA-111 (U3)

Prior to making adjustments:

Turn the BEAR unit on and enter CALIBRATION MODE #2 by entering "*" "C" "2" on the keypad. Allow a 3 minute stabilization period before any checks or offset adjustments are made. The test points and adjustments are located and are clearly marked on the A/D card accessible through the front panel hinged door.

CRYSTAL SEMICONDUCTOR CS5016 16 BIT A/D

Operational check:

1. With the BEAR unit in CALIBRATION MODE #2, the display will show the A/D output as a hex value.
2. Short the A/D input to ground by placing the jumper plug at JMP 4 over the middle and GROUND (silkscreened "G" designator) stakes.
3. The front panel display should read between 7FFF and 8000.
4. If the display reading is outside the 7FFF-8000 range, the A/D section is not operating correctly and needs to be repaired.
5. Reconnect the A/D input by reversing JMP 4 jumper plug.

BURR BROWN OPA27EZ A/D BUFFER AMP

Operational check:

1. Short the buffer Amp input to ground by placing a jumper plug at JMP 3 between the middle and GROUND stakes.
2. The front panel display should read between 7FFF and 8000.
3. If the display reading is outside the 7FFF and 8000 range, the A/D buffer Amp is not operating correctly and needs to be repaired.

4. Reconnect the A/D Buffer Amp input by reversing JMP 3 jumper plug.

FREQUENCY DEVICES 678-2K0 ANTI-ALIASING FILTER

Filter offset adjustment:

1. Short the filter input to ground by placing a jumper plug at JMP 2 between the middle and GROUND stakes.
2. Adjust the filter 20K ohm offset pot (R8) to obtain a front panel display reading that toggles between 7FFF and 8000.
3. Reconnect the filter input by reversing JMP 2 jumper plug.

BURR BROWN OPA-111 GAIN BLOCK AMPLIFIER

OPA-111 offset adjustment:

1. Short the signal input to ground by placing a jumper at JMP 1 between the middle and GROUND stakes.
2. Allow the A/C output reading to settle due to the charging of the 15uF D.C. blocking capacitor.
3. Adjust the OPA-111 offset adjustment pot R4 to obtain a front panel as close as possible to 7FFF to 8000.
4. Reconnect the signal input by reversing JMP 1 jumper plug.
5. Connect a PCB model 106M or 106B microphone to the BNC connector on the front of the BEAR unit. Insure that a jumper plug is installed at JMP 1 to connect the excitation voltage to the microphone. Place the microphone on a piece of foam and insert the microphone into the pistonphone calibrator (B&K type 4220 or equivalent) and to assure not to vibrate the microphone for the remaining adjustments.
6. Allow the A/D output reading to settle due to the charging of the 15uF D.C blocking capacitor.
7. Repeat adjusting the OPA-111 offset adjustment pot R4 to obtain a display reading as close as possible to 7FFF or 8000.

OPA-111 GAIN ADJUSTMENT

1. Enter the BEAR CALIBRATION MODE #1 by entering "*" "C" "1" which calculates a sound pressure level (SPL) reading and displays it in dB.
2. Leave the microphone in the pistonphone calibrator laying on the foam and turn the calibrator on.
3. Adjust the OPA-111 gain pot R7 to obtain a display reading of 124.00 dB.
4. The microphone, used for the OPA-111 offset and gain adjustments for a particular BEAR unit, must stay with that unit for accurate measurements.
5. After the calibration procedure is completed, close and secure the hinged door and the unit is ready for data acquisition.

4.5 BEAR Address Map

X = DO NOT CARES																								- = AS DECODED BY TARGET DEVICE											
A23	A22	A21	A20	A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	ADDRESSES	COMMENTS											
0	0	0	0	0	0	0	0	0	X	-	-	-	-	-	-	-	-	-	-	-	-	-	000000>003FFF	EPROMS											
0	0	0	0	0	0	0	0	1	X	X	-	-	-	-	-	-	-	-	-	-	-	-	0080000>008FFF	SRAM											
0	0	0	0	0	0	0	1	0	X	X	X	X	X	X	X	X	X	X	X	X	X	-	010000	ADC											
0	0	0	0	0	0	0	0	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	018000	BAT RAM ON/OFF											
0	0	0	0	0	0	1	0	0	X	X	X	X	X	X	X	X	X	X	X	X	X	-	020001>020003	DISP											
0	0	0	0	0	0	1	0	1	X	X	X	X	X	X	X	X	X	X	X	X	-	-	028001>028007	PIA											
0	0	0	0	0	0	1	1	0	X	X	X	X	X	X	X	X	X	X	X	-	-	-	03001>03000F	PTM											
0	0	0	0	0	0	1	1	1X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	03800	SPARE2											
1	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	800000>81FFFF	BRAM P#1											
1	0	0	0	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	820000>83FFFF	BRAM P#2											
1	0	0	0	0	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	840000>85FFFF	BRAM P#3											
1	0	0	0	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	860000>87FFFF	BRAM P#4											
1	0	0	0	1	1	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	8C0000	RUNNING AVG RAM											
1	0	0	0	1	1	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	8E0000	RUNNING AVG RAM											

NOTES:

Only the lowest possible addresses are shown for devices accessed with partial decoding (those that contain "do not cares")

Spare #2 is a synchronous address block

4.6 BEAR Voltage to Sound Pressure Level Conversion

The BEAR systems are set up with the lowest A/D count set equal to 75.0 dB overpressure with the normal 20 micropascal reference. This makes the BEAR's full A/D count to be over 76 Pounds per Square Foot (PSF) and over 165 dB overpressure.

BEAR SYSTEM VALUES

A/D COUNT	DB	PSF	A/D VOLTAGE
1 -----	75.0 -----	0.002 -----	0.000305
2 -----	81.0 -----	0.005 -----	0.000610
3 -----	84.5 -----	0.007 -----	0.000916
4 -----	87.0 -----	0.009 -----	0.001221
5 -----	89.0 -----	0.012 -----	0.001526
6 -----	90.6 -----	0.014 -----	0.001831
7 -----	91.9 -----	0.016 -----	0.002136
8 -----	93.1 -----	0.019 -----	0.002441
9 -----	94.1 -----	0.021 -----	0.002747
10 -----	95.0 -----	0.023 -----	0.003052
11 -----	95.8 -----	0.026 -----	0.003357
12 -----	96.6 -----	0.028 -----	0.003662
13 -----	97.3 -----	0.031 -----	0.003967
14 -----	97.9 -----	0.033 -----	0.004273
15 -----	98.5 -----	0.035 -----	0.004578
16 -----	99.1 -----	0.038 -----	0.004883
17 -----	99.6 -----	0.040 -----	0.005188
18 -----	100.1 -----	0.042 -----	0.005493
19 -----	100.6 -----	0.045 -----	0.005799
20 -----	101.0 -----	0.047 -----	0.006104
21 -----	101.4 -----	0.049 -----	0.006409
22 -----	101.8 -----	0.052 -----	0.006714
23 -----	102.2 -----	0.054 -----	0.007019
24 -----	102.6 -----	0.056 -----	0.007324
25 -----	103.0 -----	0.059 -----	0.007630
26 -----	103.3 -----	0.061 -----	0.007935
27 -----	103.6 -----	0.063 -----	0.008240
28 -----	103.9 -----	0.066 -----	0.008545
29 -----	104.2 -----	0.068 -----	0.008850
30 -----	104.5 -----	0.070 -----	0.009156
31 -----	104.8 -----	0.073 -----	0.009461
32 -----	105.1 -----	0.075 -----	0.009766
33 -----	105.4 -----	0.078 -----	0.010071
34 -----	105.6 -----	0.080 -----	0.010376
35 -----	105.9 -----	0.082 -----	0.010681
36 -----	106.1 -----	0.085 -----	0.010987
37 -----	106.4 -----	0.087 -----	0.011292
38 -----	106.6 -----	0.089 -----	0.011597
39 -----	106.8 -----	0.092 -----	0.011902
40 -----	107.0 -----	0.094 -----	0.012207

BEAR SYSTEM VALUES

dB	PSF	A/D VOLTAGE	A/D COUNT
105.0	0.074	0.009651	32
106.0	0.083	0.010828	35
107.0	0.094	0.012150	40
108.0	0.105	0.013632	45
109.0	0.118	0.015295	50
110.0	0.132	0.017162	56
111.0	0.148	0.019256	63
112.0	0.166	0.021605	71
113.0	0.187	0.024242	79
114.0	0.209	0.027200	89
115.0	0.235	0.030519	100
116.0	0.264	0.034242	112
117.0	0.296	0.038421	126
118.0	0.332	0.043109	141
119.0	0.372	0.048369	158
120.0	0.418	0.054270	178
121.0	0.469	0.060892	200
122.0	0.526	0.068322	224
123.0	0.590	0.076659	251
124.0	0.662	0.086013	282
125.0	0.743	0.096508	316
126.0	0.833	0.108284	355
127.0	0.935	0.121496	398
128.0	1.049	0.136321	447
129.0	1.177	0.152955	501
130.0	1.321	0.171618	562
131.0	1.482	0.192559	631
132.0	1.663	0.216055	708
133.0	1.866	0.242417	794
134.0	2.094	0.271997	891
135.0	2.349	0.305185	1,000
136.0	2.636	0.342423	1,122
137.0	2.957	0.384205	1,259
138.0	3.318	0.431086	1,413
139.0	3.723	0.483686	1,585
140.0	4.177	0.542705	1,778
141.0	4.687	0.608924	1,995
142.0	5.259	0.683224	2,239
143.0	5.900	0.766590	2,512
144.0	6.620	0.860129	2,818
145.0	7.428	0.965080	3,162
146.0	8.334	1.082838	3,548
147.0	9.351	1.214964	3,981
148.0	10.492	1.363212	4,467
149.0	11.773	1.529549	5,012
150.0	13.209	1.716182	5,623

BEAR SYSTEM VALUES

dB	PSF	A/D VOLTAGE	A/D COUNT
151.0	14.821	1.925588	6,310
152.0	16.629	2.160546	7,079
153.0	18.658	2.424172	7,943
154.0	20.935	2.719965	8,913
155.0	23.489	3.051852	10,000
156.0	26.356	3.424234	11,220
157.0	29.572	3.842053	12,589
158.0	33.180	4.310854	14,125
159.0	37.228	4.836859	15,849
160.0	41.771	5.427045	17,783
161.0	46.868	6.089243	19,953
162.0	52.586	6.832245	22,387
163.0	59.003	7.665907	25,119
164.0	66.202	8.601284	28,184
165.0	74.280	9.650798	31,623
165.3	76.970	10.000000	32,768