DEPARTMENT OF GEOLOGY
SCHOOL OF SCIENCES AND HEALTH PROFESSIONS
OLD DOMINION UNIVERSITY
NORFOLK, VIRGINIA 23508

TECHNICAL REPORT GSTR-86-3

THEORY AND OPERATION OF THE GOULD 32/27
PROGRAMS ABLE-2A AND EBLE FOR THE
TROPOSPHERIC AIR MOTION MEASUREMENT SYSTEM

By
Carolyn Butler

Submitted by Earl C. Kindle, Principal Investigator

Final Report
For the period January 1, 1985 to December 31, 1985

Prepared for the
National Aeronautics and Space Administration
Langley Research Center
Hampton, VA 23665

Under
Research Grant NCC1-28
Dr. Edward Browell, Technical Monitor
Chemistry and Dynamics Branch

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TABLE OF CONTENTS

1. INTRODUCTION.................................. 1
2. TROPOSPHERIC AIR MOTION MEASUREMENT SYSTEM........ 1
3. ABLE-2A PROGRAMS................................ 4
4. EBLE PROGRAMS.................................. 23
5. LOG-ON PROCEDURE AND PROGRAM START PROCEDURES...... 39
6. EDITING AND MODIFYING THE PROGRAMS................... 41
REFERENCES........................................ 44
APPENDIX A: SRTL SUBROUTINE CALLS........................ A1
APPENDIX B: ANALOG-TO-DIGITAL INTERFACE CALLS.......... B1
APPENDIX C: IEEE-488 CONTROLLER CALLS................... C1

LIST OF TABLES

Table                              Page
1ifestyles-2A DATA FORMAT.............. 7
2. EBLE DATA FORMAT.......................... 26

LIST OF FIGURES

Figure                             Page
1. Schematic drawing of the Electra Gould System....... 2
2. Flowcharts of ABLE-2A versions of MAINPROG and SETINTRP... 5
3. Flowchart of ABLE-2A version of ACQUISIT............. 6
4. RTP card cage set-up for ABLE-2A....................... 9
5. Flowcharts of EBLE versions of MAINPROG and SETINTRP... 24
6. Flowchart of EBLE version of ACQUISIT............... 25
7. RTP card cage set-up for EBLE......................... 27
1. INTRODUCTION

This report documents work performed under Research Grant NCCI-28 to develop software for the Tropospheric Air Motion Measurement System (TAMMS). The TAMMS is flown on the NASA/Goddard Flight Center Electra aircraft and serves to collect a number of different types of data that are essential to the various experiment objectives. Two projects have been conducted so far with the TAMMS system operational. In July/August 1985, the Electra was flown to Brazil for ABLE-2A (Amazon Boundary Layer Experiment). During this experiment 19 missions were flown (including the transit flights). The TAMMS system recorded position data, meteorology, flux measurements, aircraft motion and more. The 3-step programs written for this experiment are described in chapter 3. In December 1985, several flights were performed to assess the contamination and boundary layer of the Electra (Electra Boundary Layer Experiment). The Gould recorded position data, flow angles, pressure transducer measurements and more. The programs written for ABLE-2A had to be extensively modified due to timing considerations for this particular experiment. The 3-step programs written for EBLE are described in detail in chapter 4.

The programs have been written in Fortran and designed for hands-off operation. Power up and log-on procedures are discussed in chapter 5. Some additional information on Gould operation and some hints on program hang-ups and aborts are also given in this chapter. Once the computer is powered on and the program started the screen will update data every 5 seconds and the printer will print every ten seconds. The operator need only occasionally monitor the output data -- other than that no operator intervention is required. Fortran was used so that other programmers could easily understand the software. However, the use of interrupts and the need to interrogate peripheral devices (the RTP and CDS) requires the use of subroutines developed by Gould. These subroutines and descriptions of their calling variables or blocks are collected in the appendix (reproduced by permission of Gould).

Chapter 6 describes a few editing techniques for the user who may want to try some modification of the programs.

2. THE TROPOSPHERIC AIR MOTION MEASUREMENT SYSTEM

The TAMMS computer is a Gould 32/27 including an 80 Mbyte Winchester disk drive for program storage and retrieval, a 40 Mbyte cartridge tape drive for data storage, a CRT for communications and real-time data display, and a printer for real-time data presentation. The Gould interfaces to two data acquisition
devices: a Colorado Data Systems (CDS) 53A Smart Hardware System and a Computer Products, Inc. Real Time Peripherals Universal Input/Output Controller (RTP). These will be referred to as the CDS and RTP systems throughout this report. Two RTP's were daisy-chained together during EBLE. The CDS contains ARINC cards which allow the host computer to access inputs from the aircraft's navigation system. The CDS is connected to the Gould through an IEEE interface by fiber optics. The RTP's contain analog input, gate, analog to digital converters, pulse counters and synchro converter cards. The RTP is connected to the Gould through an analog/digital interface board via a high speed serial link. Figure 1 shows a schematic of the TAMMS.

The programs written for both ABLE-2A and EBLE each consist of three programs which run concurrently. The source files for ABLE-2A are stored under the file names BZL1, BZL2, and BZL3 and the source files for EBLE are stored under the names EBLE1, EBLE2, and EBLE3. The load images of either ABLE-2A or EBLE programs are stored under STEP1, STEP2, and STEP3. STEP1 is the main program ("MAINFROG") which the user will execute. This program activates the interrupt driver ("SETINTRP") then waits for a buffer of data to be sent from the third program ("ACQUISIT"). On receiving data, MAINFROG will do necessary conversions and print and display the values of interest. File STEP2 is the short program SETINTRP which uses the Gould internal clock to cause an interrupt at specified intervals. SETINTRP will activate the program ACQUISIT then suspend itself until the next interrupt occurs at which time it will run the program ACQUISIT again, and so on. STEP3 is the program ACQUISIT which performs all the data acquisition from the RTP (subroutine GETRTP) and from the CDS (subroutine GETCDS), buffers the data into one long record of 20 data sets which it then stores on cartridge tape, and sends buffers back to MAINFROG for real-time display. A double-buffering technique is used where one buffer is being filled while the other is being written to tape (each buffer consists of 20 data sets).

Each source file contains the necessary job control commands before and after the listing such that any of the 6 files BZLi or EBLEi can be compiled, catalogued and stored under the file names STEPi (i = 1, 2, or 3). More on program modification will be discussed in chapter 6.
Figure 1. Schematic of the Tropospheric Air Motion Measurement System.
3. ABLE-2A PROGRAMS

The ABLE-2A programs consist of three programs which run simultaneously. The source listings reside in the three files BZL1, BZL2 and BZL3 which when compiled and catalogued are called STEP1, STEP2 and STEP3. The operator executes the file STEP1 (or the batch file GTE which will be discussed in chapter 5). STEP1 automatically activates STEP2 and STEP2 activates STEP3. Flow charts for the three programs are shown in figures 2 and 3.

The data sampled during ABLE-2A consisted of five groups of data — one from the CDS and four from the RTP. One of the data sets from the RTP was sampled at 20 Hz while the other three groups from the RTP as well as the CDS group were sampled at 5 Hz. The interrupt into ACQUISIT was set at 3 tics (1/20 th sec) at which time a fast set and a slow set was sampled:

- interrupt #1: retrieve fast data set
- interrupt #2: retrieve slow data set group A
- interrupt #3: retrieve fast data set
- interrupt #4: retrieve slow data set group B
- interrupt #4: retrieve slow data set group C
- interrupt #4: retrieve fast data set
- interrupt #4: retrieve CDS data set

Each data set is preceded by 4 bytes of time information pinpointing the exact time (hours, minutes, seconds and tics) of that data set. The format and description of the complete data set is shown in Table 1.

Due to a timing problem in the handshake of the Gould IEEE-488 interface and the CDS communication card, the subroutine GETCDS was set up to run independently of the data retrieval. On the first pass through GETCDS control blocks are initialized and the CDS is interrogated for data using the "no-wait" option. That is, the commands are sent to the IEEE controller and the subroutine GETCDS does a return to the main program ACQUISIT. When the IEEE controller signals the program that the data from the CDS is available the program interrupts to a routine that loads the latest data into a storage buffer. The routine then sets up for another CDS interrogation and exits. Meanwhile, when ACQUISIT wants the latest CDS data it retrieves that data from the storage buffer. The four time bytes preceding the CDS data in the data array point to that time when the data was last updated. This handshaking problem will later be eliminated by the purchase of a new programmable communications card for the CDS.

Figure 4 shows the RTP system set-up during the ABLE-2A experiment. Program listings of the files BZL1, BZL2, and BZL3 follow.
PROGRAM MAINPROG

CALL X:RCVR
set up statement 100
as message receiver

CALL M:ACTIV
activate SETINTRP

CALL X:ANYW
wait for message

100 CALL X:GMSP
get message

CALL X:XMSGR
return from message receiver

decode and convert data

10 seconds ?

yes

output to printer

output to CRT

PROGRAM SETINTRP

CALL M:ACTIV
activate ACQUISIT

CALL M:SSPND
suspend this program for 59 tics

CALL M:RSUM
resume ACQUISIT

CALL M:SSPND
suspend this program for 3 tics

Figure 2. Flowcharts of ABLE-2A versions of MAINPROG and SETINTRP.
Figure 3. Flowchart of ABLE-2A version of ACQUISIT.
Table 1. ABLE-2A Data Format

**RTP Fast Data Set**

<table>
<thead>
<tr>
<th>Location in Array</th>
<th># Bytes</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,51,103,157</td>
<td>4</td>
<td>time</td>
<td>Gould clock</td>
</tr>
<tr>
<td>5,55,107,161</td>
<td>2</td>
<td>B-vane</td>
<td>Synchro #1</td>
</tr>
<tr>
<td>7,57,109,163</td>
<td>2</td>
<td>A-vane</td>
<td>Synchro #2</td>
</tr>
<tr>
<td>9,59,111,165</td>
<td>2</td>
<td>Pitch</td>
<td>Synchro #3</td>
</tr>
<tr>
<td>11,61,113,167</td>
<td>2</td>
<td>Roll</td>
<td>Synchro #4</td>
</tr>
<tr>
<td>13,63,115,169</td>
<td>2</td>
<td>Platform Heading</td>
<td>Synchro #5</td>
</tr>
<tr>
<td>15,65,117,171</td>
<td>2</td>
<td>Heading</td>
<td>Synchro #6</td>
</tr>
<tr>
<td>17,67,119,173</td>
<td>2</td>
<td>Static Pressure</td>
<td>Pulse Counter #1</td>
</tr>
<tr>
<td>19,69,121,175</td>
<td>2</td>
<td>Diff. Pressure</td>
<td>Pulse Counter #2</td>
</tr>
<tr>
<td>21,71,123,177</td>
<td>2</td>
<td>CO</td>
<td>A/D #1</td>
</tr>
<tr>
<td>23,73,125,179</td>
<td>2</td>
<td>03</td>
<td>A/D #2</td>
</tr>
<tr>
<td>25,75,127,181</td>
<td>2</td>
<td>05</td>
<td>A/D #3</td>
</tr>
<tr>
<td>27,77,129,183</td>
<td>2</td>
<td>07</td>
<td>A/D #4</td>
</tr>
</tbody>
</table>

**RTP Slow Data Set - Group A**

<table>
<thead>
<tr>
<th>Location in Array</th>
<th># Bytes</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>4</td>
<td>time</td>
<td>Gould clock</td>
</tr>
<tr>
<td>33</td>
<td>2</td>
<td>baro-alt (fine)</td>
<td>Synchro #7</td>
</tr>
<tr>
<td>35</td>
<td>2</td>
<td>baro-alt (coarse)</td>
<td>Synchro #8</td>
</tr>
<tr>
<td>37</td>
<td>2</td>
<td>temp (fast)</td>
<td>A/D #5</td>
</tr>
<tr>
<td>39</td>
<td>2</td>
<td>temp (normal)</td>
<td>A/D #6</td>
</tr>
<tr>
<td>41</td>
<td>2</td>
<td>dew point (high)</td>
<td>A/D #7</td>
</tr>
<tr>
<td>43</td>
<td>2</td>
<td>dew point (low)</td>
<td>A/D #8</td>
</tr>
<tr>
<td>45</td>
<td>2</td>
<td>abs. pressure</td>
<td>A/D #9</td>
</tr>
<tr>
<td>47</td>
<td>2</td>
<td>diff. pressure</td>
<td>A/D #10</td>
</tr>
<tr>
<td>49</td>
<td>2</td>
<td>surf. temp (PRT-5)</td>
<td>A/D #11</td>
</tr>
</tbody>
</table>

**RTP Slow Data Set - Group B**

<table>
<thead>
<tr>
<th>Location in Array</th>
<th># Bytes</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>79</td>
<td>4</td>
<td>time</td>
<td>Gould clock</td>
</tr>
<tr>
<td>83</td>
<td>2</td>
<td>UV flux up</td>
<td>A/D #12</td>
</tr>
<tr>
<td>85</td>
<td>2</td>
<td>UV flux down</td>
<td>A/D #13</td>
</tr>
<tr>
<td>87</td>
<td>2</td>
<td>altitude</td>
<td>A/D #14</td>
</tr>
<tr>
<td>89</td>
<td>2</td>
<td>08</td>
<td>A/D #15</td>
</tr>
<tr>
<td>91</td>
<td>2</td>
<td>DPT warn signal</td>
<td>A/D #16</td>
</tr>
<tr>
<td>93</td>
<td>2</td>
<td>not used</td>
<td>A/D #17 - #21</td>
</tr>
</tbody>
</table>

**RTP Slow Data Set - Group C (A/D #22 - #32 not used)**

**CDS Slow Data Set**

<table>
<thead>
<tr>
<th>Location in Array</th>
<th># Bytes</th>
<th>Description</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>185</td>
<td>4</td>
<td>time</td>
<td>Gould clock</td>
</tr>
<tr>
<td>189</td>
<td>4</td>
<td>latitude</td>
<td>B</td>
</tr>
<tr>
<td>193</td>
<td>4</td>
<td>longitude</td>
<td>A</td>
</tr>
<tr>
<td>201</td>
<td>4</td>
<td>ground speed</td>
<td>A</td>
</tr>
<tr>
<td>205</td>
<td>4</td>
<td>track angle</td>
<td>B</td>
</tr>
<tr>
<td>209</td>
<td>4</td>
<td>true heading</td>
<td>C</td>
</tr>
</tbody>
</table>
CDS Data set (con’t)

<table>
<thead>
<tr>
<th>Location in Array</th>
<th># Bytes</th>
<th>Description</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>213</td>
<td>4</td>
<td>wind speed</td>
<td>D</td>
</tr>
<tr>
<td>217</td>
<td>4</td>
<td>wind dir</td>
<td>E</td>
</tr>
<tr>
<td>Slot Number</td>
<td>Card Address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2 3 4 5 6 7 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>15 14 13 12 11 10 9 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>16 15 14 13 12 11 10 9 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>17 16 15 14 13 12 11 10 9 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>18 17 16 15 14 13 12 11 10 9 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>19 18 17 16 15 14 13 12 11 10 9 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>20 19 18 17 16 15 14 13 12 11 10 9 8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4. RTP card cage set-up for ABLE-2A.
*JOB MAINPROG
*TASK ON TO SLOFOR
*OPTION 5
*EXECUTE FORTRAN

PROGRAM MAINPROG
INTEGER ITASK
INTEGER ITIME(3)
INTEGER TRHD,WARN
INTEGER LAT,LON,LST1,LST2
INTEGER WS,UD,TRKANG,TRHD,GRDSPD
INTEGER CO,ABEALT,BARALT,TEMP,DPT,PRT,UVUP,UVDN,03
INTEGER FAST(12),GRPA(9),GRPB(8),GRPC(11),FAST2(12)
INTEGER GRPD(32)
INTEGER FCB(16),PRB(5),RXB(2)

!PARAMETER BLOCKS

INTEGER IA(280)
DIMENSION SYNC(6)
EQUIVALENCE (SYNC(1),BETA)
EQUIVALENCE (SYNC(2),ALPHA)
EQUIVALENCE (IA(1),ITIME(1))
EQUIVALENCE (IA(21),CO)
EQUIVALENCE (IA(23),03)
EQUIVALENCE (IA(35),BARALT)
EQUIVALENCE (IA(37),TEMP)
EQUIVALENCE (IA(41),DPT)
EQUIVALENCE (IA(49),PRT)
EQUIVALENCE (IA(53),UVUP)
EQUIVALENCE (IA(65),UVDN)
EQUIVALENCE (IA(139),LAT)
EQUIVALENCE (IA(193),LON)
EQUIVALENCE (IA(213),WS)
EQUIVALENCE (IA(217),UD)
EQUIVALENCE (IA(219),TRHD)
EQUIVALENCE (IA(201),GRDSPD)
EQUIVALENCE (IA(205),TRKANG)
EQUIVALENCE (IA(209),TRHD)
EQUIVALENCE (IA(91),WARN)
EQUIVALENCE (IA(5),FAST(1)) !FIRST SET OF FAST DATA
EQUIVALENCE (IA(55),FAST2(1)) !SECOND SET OF FAST DATA
EQUIVALENCE (IA(33),GRPA(1))
EQUIVALENCE (IA(83),GRPB(1))
EQUIVALENCE (IA(135),GRPC(1))
EQUIVALENCE (IA(189),GRPD(1))

INTEGER DOHLEFLAG(4) !FLAG FOR MORE DATA TO PRINT
CALL X:PCUR(*100,ISTAT,*995) !WHEN DATA IS RECEIVED GOTO 109
PRB(1)=ADDR(IA) !ADDRESS OF ARRAY TO BE RECEIVED
PRB(2)=Z 00000000 !# BYTES THAT ARE RECEIVED FROM ACQUISIT
ITASK='SETINTPR!' !ROUTINE THAT SETS INTERRUPTS
CALL X:ACTIV(I TASK,ISTAT,*997) !ACTIVATE INTERRUPT ROUTINE
CALL X:ANY40(I TASK,ISTAT,*996) !WAIT FOR ACQUISIT TO SEND DATA

***** LAT AND LON ARE FROM OMEGA -- HEX FORMAT..............
11

RAW TEXT END
IF(LINE.EQ.49)LINE=0
ITEM=ITEM+1
C **** DATA OUTPUT TO CRT MONITOR
WRITE (3,3000)ITME
3000 FORMAT ('TIME',2(12,';'),12.5X, '**********
WRITE (3,3020)XALT,C,SAT, XDP,T,XPRT
3020 FORMAT ('ALT','F6.0',' SAT','F5.1',' DPT','F5.1,
PR1','F5.1)
WRITE (3,3030)TRKANG,TRUHD,GRCSPD,TAS
3030 FORMAT ('TK','Z6,' TH','Z6,' GS','Z6,' TAS','F4.0)
WRITE (3,3040)LAT,LOH,WS,UD
3040 FORMAT ('LAT','Z6,' LNG','Z6,' WS','Z6,' WD','Z6)
WRITE (3,3050)ALPHA,BETA,WARN
3050 FORMAT ('ALPHA ','F8.3,' BETA ','F8.3,' WARN','I5)
GOTO 90.
C THE FOLLOWING IS THE RECEIVER BUFFER ROUTINE
100 CALL X:GSQCP(PR8,ISTAT,*994)!GET MESSAGE (BUFFER)
LSTAT=IBITS(PR8(1),0,B)
RXB(1)=LSTAT+ADDR(DONEFLAG)
RXB(2)=2
CALL X:XMSGR(RXB,ISTAT,*993)!EXIT THIS ROUTINE
C **** ERROR RETURNS AND MESSAGES ****
993 WRITE (3,2045)ISTAT
2045 FORMAT ('X:XMSGR ERROR: ',I5)
GOTO 999
994 WRITE(3,2040)ISTAT
2040 FORMAT ('X:GSQCP ERROR: ',I5)
GOTO 999
995 WRITE(3,2035)ISTAT
2035 FORMAT ('X:RCUR ERROR: ',I5)
GOTO 999
996 WRITE(3,2030)ISTAT
2030 FORMAT ('X:AHYW ERROR: ',I5)
GOTO 999
997 WRITE(3,2020)ISTAT
2020 FORMAT ('M:ACTIV ERROR: ',I5)
GOTO 999
998 WRITE(3,2015)FCB(4)
2015 FORMAT ('I/O ERROR, FCB(4)=','Z8)
999 STOP
END
$ASSIGN SLN TO SLODMP
$ASSIGN DIR TO IEEEDIR
$ASSIGN LIB TO IEEELIB
$EXECUTE CATALOG
$ASSIGN SI TO SYC
$ASSIGN 2 TO DEV=TY7EC6
$ASSIGN 3 TO LFC=UT
CATALOG MAINPROG
$END
**

*JO**B SETINTRP

*NOTE SET TIMING INTERRUPT FOR 20 TIMES/SECK

*ASS**IGN LD TO SLOFOR

*OPT**ION 5

*EXEC**UTE FORTRAN

- PROGRAM SETINTRP
- INTEGER*3 ITASK2
- ITASK2='ACQUISIT'
- CALL M:ACTIV(1TASK2,*999)  !ACTIVATE ACQUISIT ROUTINE
- CALL M:SSPND(59,*999)   !WAIT WHOLE MINUTE FIRST TIME
- CALL M:SUH(ITASK2,*999) !RESUME DATA ACQUISITION.
- CALL M:SSPND(3,*999)    !SUSPEND THIS JOB FOR 3 TICKS
- GO TO 10
- 999 CONTINUE
- WRITE(6,6000)  !GETS HERE ONLY IF ERROR
- STOP
- END

*ASS**IGN SLD TO SLODMP

*EXEC**UTE CATALOG

*ASS**IGN 6 TO INTERK

CATALOG SETINTRP

*END
**Job Acquisition**

**Note Data Acquisition Program**

**Assign Lo To Slofer**

**Option 5**

**Execute Fortran**

```fortran
PROGRAM ACQUISITION
    INTEGER*3 TASKNAM, DNRNAM, PSEUDO
    INTEGER GROUP
    INTEGER IA(20,40)
    INTEGER PSB(8), RBA(2)

    *********** Determine task h of main program
    TASKNAM='MAINPROG'
    INDEX=0
    ITASK=0
    DNRNAM=0
    PSEUDO=0
    CALL X:ID(INDEX, ITASK, TASKNAM, DNRNAM, PSEUDO, ISTAT, *900)

    *********** Set up PSB for later transmission
    PSB(1)=ITASK ! Task # "MAINPROG" from X:ID
    PSB(2)=0 ! Must be 0
    PSB(3)=200 ! # bytes to transmit
    PSB(5)=Z'100000' ! # bytes to receive (2)
    PSB(6)=ADDR(RBA) ! Pure address of receiver buffer
    PSB(7)=ADDR($800) ! No wait error return
    GROUP=0
    IPRINT=1 ! Print control flag
    IERRORS=0 ! # mag tape errors
    II=1 ! Index thru IA buffer
    JJ=1 ! Index thru IA buffers...
    IFLAG=0 ! Tape done flag

    GROUP=GROUP+1
    CALL GEITF(IA, II, JJ, 0) ! Fast Data Set
    IF (GROUP.LT.4) CALL GEITF(IA, II, JJ, GROUP) ! Get a slow data set.
    IF (GROUP.EQ.4) CALL GETCODS(IA, II, JJ) ! Get cods data set
    IF (GROUP.EQ.4) GROUP=0 ! Rtf Groups and Cds, Group
    IF (II.LT.200) GOTO 500 ! Don't have all the data yet
    II=1 ! Reset array index back to beginning
    IF (JJ.EQ.20) GOTO 420 ! Have we got 20 IA buffers yet?
    IF (JJ.EQ.40) GOTO 420 ! Have we got 20 IA buffers yet?
    GOTO 430

420  IF (IFLAG.EQ.1) GOTO 905 ! Tape ready?
    IFLAG=1 ! Tape will not be ready now
    CALL BUFFEROUT(6,1,IA(1, JJ-19), 110, *805, *910) ! Write to tape

430  IPRINT=IPRINT+1 ! Increment print flag
    IF (IPRINT.LT.25) GOTO 450 ! Send buffer every 5 seconds
    IPRINT=1 ! Ready to send -- reset print flag
    PSB(4)=ADDR(IA(1, JJ)) ! Address of last data buffer.
    CALL X:SMODR(PSB, ISTAT, *915) ! Send buffer to MAINPROG

450  JJ=JJ+1 ! Next IA buffer
    CALL GEBFD(IA, II, JJ, GROUP, 0) ! Fast Data Set
    IFLAG=IFLAG+1 ! Tape ready?
    IF (IFLAG.EQ.1) GOTO 905 ! Tape will not be ready now
    CALL BUFFEROUT(6,1,IA(1, JJ-19), 110, *805, *910) ! Write to tape
```

**Original page quality is poor.**
CALL M:SPND(0,*920)  ! SUSPEND THIS PROGRAM UNTIL INTERRUPT
GOTO 100  ! GOTO 100 WHEN INTERRUPT OCCURS FROM SETHTRP

C  **********  END ACTION ROUTINES  ****

CALL X:MEA  ! EXIT SEND MESSAGE

C (FLAG=0)  ! MAG TAPE DONE

CALL STATUS(6,ISTAT)
IF(ISTAT.NE.2) WRITE(5,8005)ISTAT

8005 FORMAT(' MAGTAPE STATUS ERROR: ',I5)
CALL X:XNUIO

C  **********  ERROR MESSAGES OUTPUT TO FILE "ACQERR"

WRITE(5,9000)ISTAT

900 FORMAT(' X:ID ERROR: ',I5)
GOTO 999

905 MTERRS=MTERRS+1
WRITE(5,9005)MTERRS

9005 FORMAT(' MAGTAPE BUSYF FLAG SET, ERRORS=',I5)
GOTO 500

910 WRITE(5,9010)

910 FORMAT(' MAGTAPE HARDWARE ERROR')
GOTO 999

915 WRITE(5,9015)ISTAT

915 FORMAT(' X:MSGR ERROR: ',I5)
GOTO 999

920 WRITE(5,9020)

920 FORMAT(' M:SPND ERROR')
GOTO 999

999 STUP
END

SUBROUTINE GETRTP(IA,II,IJ,GROUP)

INTEGER KPTS(5)

INTEGER GROUP
INTEGER*1 IA(220,40),ITIME(4)

INTEGER ICHF(3),IOCBF(70),SIZEF
INTEGER IOCHA(3),IOCHA(100),SIZEA
INTEGER IOCHB(3),IOCBB(130),SIZEB
INTEGER IOCHC(3),IOCBC(142),SIZEC
INTEGER BUSY
INTEGER*2 ICHNF(24),OUTF(40)
INTEGER*2 ICHNA(24),OUTA(40)
INTEGER*2 ICHNB(24),OUTB(40)
INTEGER*2 ICHNC(24),OUTC(40)
INTEGER*2 IMP(20)
INTEGER*1 IDATA(40)
INTEGER ADD1,ADD2,ADD3,ADD4,ADD5,ADD6
INTEGER ADD7,ADD8,ADD9,ADD10,ADD11,ADD12
EQUIVALENCE (IDATA,IMP(1))
DATA KPTS/12,9,10,11,15/.

IG=GROUP+1
KPTS=KPTS+IG
IF(INITDONE.GE.1) GOTO 10
C ******* INITIALIZE SECTION *******
C ****** SET UP IOC/IOCB FOR EACH GROUP
1   ADD1=LOCF(ICHNF)
    ADD2=LOCF(INP)
    ADD3=LOCF(OUTF)
    IOCHF(1)=Z’0030000’  'IOM ADDRESS IS 30
    IOCHF(2)=ADDR(IOCBF)
    IOCHF(3)=Z’20002’  'NOP INSTRUCTION
    IOCHF(4)=Z’E2000006’  'SYNCHROS: IN,SEQ,DIG; 6 HALFWORDS
    IOCBF(2)=ADD1
    IOCBF(3)=ADD2
    IOCBF(4)=0
    IOCBF(5)=Z’E2000002’  'PULSE COUNTERS: IN,SEQ,DIG; 2 HALFWORDS
    IOCBF(6)=ADD1+2
    IOCBF(7)=ADD2+12
    IOCBF(8)=0
    L1=1
    L2=16
    L3=0
    LL=0
    DO 101 I=1,4  'A/D CHANNELS 1-4: REQUIRES BOTH DO AND DI
    IOCBF(9+LL)=Z’22000001’  'OUT, RAN, DIG
    IOCBF(10+LL)=ADD1+L1
    IOCBF(11+LL)=ADD3+L3
    IOCBF(12+LL)=0
    IOCBF(13+LL)=Z’A2000001’  'IN, RAN, DIG
    IOCBF(14+L)=ADD1+L1+2
    IOCBF(15+LL)=ADD2+L2
    IOCBF(16+L)=0
    LL=LL+8
    L1=L1+4
    L2=L2+2
    L3=L3+2
101  CONTINUE
    IOCBF(37)=Z’A0000001’  'NO COMMAND CHAIN ON LAST IOCB
    ICHNF(1)=8  'SYNCHRO SLOT ADDRESS IS 8
    ICHNF(2)=6  'PULSE COUNTER SLOT ADDRESS IS 6
    DO 102 I=3,10,2  'A/D
    ICHNF(1)=Z’1000’  'BYPASS READY TEST; A/D IS IN SLOT 0
    ICHNF(1+I)=0
102  CONTINUE
    OUTF(1)=Z’2080’  'GAIN CARD SLOT 1, CHANNEL 0, GAIN 1
    OUTF(2)=Z’3080’  'GAIN CARD SLOT 1, CHANNEL 1, GAIN 1
    OUTF(3)=Z’2090’  'GAIN CARD SLOT 1, CHANNEL 2, GAIN 1
    OUTF(4)=Z’3090’  'GAIN CARD SLOT 1, CHANNEL 3, GAIN 1
    SIZEF=70
    BUSY=LOCF($300)
    CALL ADIUSR(IOCHF,IOCBF,SIZEF,BUSY)  'INITIALIZE FOR GROUP 1
    WRITE (5,5991)
    ADD2=LOCF(ICHNF)  'END OF POOR QUALITY
ADD5=LOCF(INP)
ADD6=LOCF(OUTA)
IOCHA(1)=Z'00300000' !IOM ADDRESS OF 30
IOCHA(2)=ADDR(IOCB)
IOCHA(3)=Z'20002' !NOP
IOCB(1)=Z'E2000002' !SYNCHROS: IN,SEQ,DIG; 2-HALFWORDS
IOCB(2)=ADD4
IOCB(3)=ADD5
IOCB(4)=0
L1=2
L2=1
L3=0.
I1=0
DO 201 I=1,7 'A/D: NEED BOTH DO AND W1
IOCB(A5+L1)=Z'22000001' !OUT,RAN,DIG: 1 HALFWORD
IOCB(6+L1)=ADD4+L1
IOCB(7+L1)=ADD6+L3
IOCB(8+L1)=0
IOCB(9+L1)=Z'A2000001' !IN,RAN,DIG: 1 HALFWORD
IOCB(10+L1)=ADD4+L1+2
IOCB(11+L1)=ADD5+L2
IOCB(12+L1)=0
L1=LL+3
L2=L1+4
L3=L3+2
201 CONTINUE
IOCB(A5)=Z'A0000001' !LAST IOCB DOES NOT CHAIN
IOCHA(1)=Z'00' !SYNCHRON IN SLOT 14
DO 202 I=2,14,2
IOCHA(I)=Z'1000' !BYPASS READY TEST; A/D CARD IN SLOT 0
IOCHA(I+1)=0
202 CONTINUE
OUTA(1)=Z'2040' 'GAIN CARD SLOT 1, CHANNEL 4, GAIN 1
OUTA(2)=Z'3040' 'GAIN CARD SLOT 1, CHANNEL 5, GAIN 1
OUTA(3)=Z'2080' 'GAIN CARD SLOT 1, CHANNEL 6, GAIN 1
OUTA(4)=Z'3080' 'GAIN CARD SLOT 1, CHANNEL 7, GAIN 1
OUTA(5)=Z'20C0' 'GAIN CARD SLOT 1, CHANNEL 8, GAIN 1
OUTA(6)=Z'30C0' 'GAIN CARD SLOT 1, CHANNEL 9, GAIN 1
OUTA(7)=Z'2000' 'GAIN CARD SLOT 1, CHANNEL 10, GAIN 1
SIZE=100
CALL ADIUSR(IOCHA,IOCB,SIZEA,BUSY) !INITIALIZE GROUP 2
WRITE (5,9992)
3
ADD7=LOCF(ICHBA)
ADD8=LOCF(INP)
ADD9=LOCF(OUTB)
IOCB(1)=Z'00300000' !IOM ADDRESS OF 30
IOCB(2)=ADDR(IOCB)
IOCB(3)=Z'20002' !NOP
L1=0
L2=0
L3=0.
L3=0
L2=0
DO 301 I=1,10 'A/D: NEED BOTH DO AND DI
IOCB(1+LL)=Z'22000001'!OUT,RAN,DIG; 1 HALFWORD
IOCB(2+LL)=ADD7+L1
IOCB(3+LL)=ADD9+L3
IOCB(4+LL)=0
IOCB(5+LL)=Z'A2000001'!IN ,RAN,DIG; 1 HALFWORD
IOCB(6+LL)=ADD7+L1+2
IOCB(7+LL)=ADD8+L2
IOCB(8+LL)=0
LL=LL+3
L1=L1+4
L2=L2+4
L3=L3+2
301 CONTINUE
IOCB(77)=Z'A6000001' 'NO CHAIN ON LAST IOCB
DO 402 I=1,19,2
IOCBH(I)=Z'1000' 'BYPASS READY TEST; A/D IN SLOT 0
IOCBH(I)=0
302 CONTINUE
OUTB(1)=Z'30D0' 'GAIN CARD SLOT 1, CHANNEL 11, GAIN 1
OUTB(2)=Z'20E0' 'GAIN CARD SLOT 1, CHANNEL 12, GAIN 1
OUTB(3)=Z'30E0' 'GAIN CARD SLOT 1, CHANNEL 13, GAIN 1
OUTB(4)=Z'20F0' 'GAIN CARD SLOT 1, CHANNEL 14, GAIN 1
OUTB(5)=Z'30F0' 'GAIN CARD SLOT 1, CHANNEL 15, GAIN 1
OUTB(6)=Z'2100' 'GAIN CARD SLOT 2, CHANNEL 0, GAIN 1
OUTB(7)=Z'3100' 'GAIN CARD SLOT 2, CHANNEL 1, GAIN 1
OUTB(8)=Z'2110' 'GAIN CARD SLOT 2, CHANNEL 2, GAIN 1
OUTB(9)=Z'3110' 'GAIN CARD SLOT 2, CHANNEL 3, GAIN 1
OUTB(10)=Z'2120' 'GAIN CARD SLOT 2, CHANNEL 4, GAIN 1
Si=+b=130
CALL ADUSR(IOCBH,IOCB,SIZEB,BUSY) 'INITIALIZE GROUP 3
WR1+E (5,5993)
4 ADD10=LOCF(ICHNC)
ADD11=LOCF(INP)
ADD12=LOCF(OUTC)
IOCHC(1)=Z'00300000' 'IOM ADDRESS OF 36
IOCHC(2)=ADDR(IOCBC)
IOCHC(3)=Z'20002' 'NOP
L1=0
L2=0
L3=0
DO 401 I=1,11 'A/D: NEEDS BOTH DO AND DI
IOCBC(1+LL)=Z'22000001' !OUT,RAN,DIG; 1 HALFWORD
IOCBC(2+LL)=ADD10+L1
IOCBC(3+LL)=ADD12+L3
IOCBC(4+LL)=0
IOCBC(5+LL)=Z'A2000001' !IN,RAN,DIG; 1 HALFWORD
}
IOCBC(/ALL)=ADD11+L2
IOCBC(/H+L)=0
LL=L+4
L1=L1+4
L2=L2+1
L3=L3+2

401 CONTINUE
IOCBC(85)=Z'A0000001'
!NO CHAIN ON LAST IOCBC
DO 402 I=1,21,2
ICHC(1)=Z'1000'
!BYPASS READY TEST; A/D SLOT 0
ICHC(1+1)=0

402 CONTINUE
OUTC(1)=Z'3120'
!GAIN CARD SLOT 2, CHANNEL 5, GAIN 1
OUTC(2)=Z'2130'
!GAIN CARD SLOT 2, CHANNEL 5, GAIN 1
OUTC(3)=Z'3130'
!GAIN CARD SLOT 2, CHANNEL 7, GAIN 1
OUTC(4)=Z'2140'
!GAIN CARD SLOT 2, CHANNEL 8, GAIN 1
OUTC(5)=Z'3140'
!GAIN CARD SLOT 2, CHANNEL 9, GAIN 1
OUTC(6)=Z'2150'
!GAIN CARD SLOT 2, CHANNEL 10, GAIN 1
OUTC(7)=Z'3150'
!GAIN CARD SLOT 2, CHANNEL 11, GAIN 1
OUTC(8)=Z'2160'
!GAIN CARD SLOT 2, CHANNEL 12, GAIN 1
OUTC(9)=Z'3160'
!GAIN CARD SLOT 2, CHANNEL 13, GAIN 1
OUTC(10)=Z'2170'
!GAIN CARD SLOT 2, CHANNEL 14, GAIN 1
OUTC(11)=Z'3170'
!GAIN CARD SLOT 2, CHANNEL 15, GAIN 1
SIZEC=142
CALL ADIUSR(IOCHC, IOCBC, SIZEC, BUSY)  !INITIALIZE GROUP 4
WRITE (5,5994)
5991 FORMAT ('FAST INIT')
5992 FORMAT ('GRP A INIT')
5993 FORMAT ('GRP B INIT')
5994 FORMAT ('GRP C INIT')
INITDNE=1
CONTINUE
GOTO (15, 20, 25, 30) IG
15 CALL ADIUSR(IOCHF, IOCBF, SIZEF, BUSY)
ISTAT=IOCBF(40)
GOTO 50
20 CALL ADIUSR(IOCHA, IOCBA, SIZEA, BUSY)
ISTAT=IOCBA(60)
GOTO 50
35 CALL ADIUSR(IOCHB, IOCBB, SIZEB, BUSY)
ISTAT=IOCBB(80)
GOTO 50
31 CALL ADIUSR(IOCHC, IOCBC, SIZEC, BUSY)
ISTAT=IOCBC(83)
50 CALL H=IDAY(II TIME)
  !GET TIME FOR EACH GROUP
IAC(11, JJ)=II TIME(1)
IAC(11+1, JJ)=II TIME(2)
IAC(11+2, JJ)=II TIME(3)
IAC(11+3, JJ)=II TIME(4)
IBYE=3
G1L 50, 1=1, II IS=2
C **************** SUBROUTINE TO RETRIEVE CDS DATA
CHARACTER*8 CONTNAME
INTEGER CONTUII
INTEGER IA(220,40), ITIME(4)
INTEGER FCB(16), IOCL(130), SENSBUF(4)
INTEGER CMDBUF(9,8) ! INSTRUCTION + LABEL TABLE FOR CDS
INTEGER INBF(64), OUBUF(64)
INTEGER URCL, UTDAA, ESRO, DSRD, CHAIN, SII
CHARACTER*1 NOTALK, NOLINK, ITALK, ISHUL, ULISH
CHARACTER*4 TLKBUF, LSBUF
EXTERNAL TEEXECP, TEEFLOCF, TEEFLOCM, TEEFCST
DATA URCZ/'/"1100000000//, UTDAA/'/"010000000//
DATA ESRO/'/"630000000//
DATA DSRD/'/"300000000//, CHAIN/'/"400000000//
DATA NOTALK/'/", NOLINK/'/", ITALK/'/", ISHUL/'/", ULISH/'/"
DATA TLKBUF/'/", LSBUF/'/";
DATA CMDBUF/'/"Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'08', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'08', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'23', 'Z'08', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40', 'Z'30', 'Z'36', 'Z'41', 'Z'43', 'Z'53', 'Z'00', 'Z'40
FCB(15)=IEEELOCF(*15) ! NO WAIT ERROR RETURN ADDRESS
TLKBUFF=NOTALK//NOLSN//ULSN//ITALK
LSNBUFF=NOTALK//NOLTSN//ILSN//UTALK
IOCL(*1)=UTC+IEEELOCF(TLKBUFF)
IOCL(*2)=CHAIN+2
I_BYTE=0
DO 9 M=1,8
MM=2*0*(M-1)
IOCL(MH+1)=UTC+IEEELOCF(TLKBUFF)+2
IOCL(MM+2)=CHAIN+2 ! SEND ULSN.ITALK
IOCL(MH+3)=UTC+IEEELOCF(CMDSBUF(1,M))
IOCL(MH+4)=CHAIN+7 ! SEND COMMAND + LABEL
IOCL(MH+5)=UTC+IEEELOCF(LSNBUFF)+2
IOCL(MM+6)=CHAIN+2 ! SEND ULSN.UTALK
IOCL(MH+7)=RDIA+IEEELOCF(INPBUFF)+I_BYTE
IOCL(MM+8)=CHAIN+5 ! RECEIVE 5 BYTES
I_BYTE=I_BYTE+3 ! ONLY 3 BYTES OF DATA + CR.LF
9 CONTINUE
IOCL(6A)=5 ! NO CHAIN ON LAST IOCL
CALL IEEEEXCPM(FCB,ISTAT)
GOTO ??? ! DON'T WAIT FOR I/O -- EXIT SUB
C PROGRAM WILL TRAP HERE WHEN I/O IS DONE ......................
10 CALL M:TODAY(QUBUF) ! GET TIME OF THIS DATA SET
DO 12 I=1,IPTS ! TRANSFER DATA TO OUT ARRAY
J=2*(I-1)+1
K=I-1+1
QUBUF(1)=0
QUBUF(J)=INPBUFF(K)
QUBUF(J+1)=INPBUFF(K+1)
QUBUF(J+2)=INPBUFF(K+2)
QUBUF(J+3)=INPBUFF(K+3)
12 CONTINUE
CALL IEEEEXCPM(FCB,ISTAT) ! SET UP ANOTHER TRANSFER
CALL X:XXHID ! EXIT THIS NO-WAIT ROUTINE
C TRAPS HERE ON ERROR ... NEED TO RE-INITIALIZE EVERYTHING
15 IF(IJFLEG.EQ.0) WRITE(5,5998) ! PRINTS THIS MESSAGE ONLY ONCE
I_JFLEG=1
FCB(3)=5 ! CLEAR NO-WAIT, SET TIMEOUT TO 5 SECONDS
FCB(1)=0
FCB(10)=0
CALL IEEEEDST(CONTUNIT,FCB,ISTAT) ! DISCONNECT FROM TASK
IF(ISTAT1.NE.0) GOTO 905
5998 FORMAT('CD S ERROR ON NO-WAIT RETURN')
25 DO 11 I=1,IPTS*3
INPBUFF(I)=0 ! CLEAR THE INPUT BUFFER
11 CONTINUE
INITDNE=0 ! NEXT TIME THRU NEED TO RE-INITIALIZE
CALL X:XXHID ! EXIT THIS NO-WAIT ERRPR ROUTINE
C AFTER INITIALIZATION, A CALL TO CD S WILL COME TO STATEMENT 30...........
C THIS CODE MERELY TRANSFERS THE MOST RECENT VALUES OF QUBUF TO IA......
70 I_BYTE=0
DO 45 I=1,IPTS+1
IA(I+I BYTE,JJ)=OUBUF(I BYTE+1)
IA(I+I BYTE+1,JJ)=OUBUF(I BYTE+2)
IA(I+I BYTE+2,JJ)=OUBUF(I BYTE+3)
IA(I+I BYTE+3,JJ)=OUBUF(I BYTE+4)
IBYTE=IBYTE+4

CONTINUE

C ******************** ERROR RETURNS *******************
900  WRITE(5,5000)ISTAT
5000  FORMAT(' IEEE CST ERROR: ',IB)
GOTO 999.

905  WRITE(5,5005)ISTAT
5005  FORMAT(' IEEE CST ERROR: ',IB)
GOTO 25

915  WRITE(5,5015)FCB(4)
5015  FORMAT(' I/O ERROR, FCB(4)=',ZB)
GOTO 999

920  WRITE(5,5020)ISTAT
5020  FORMAT(' IA E X C P H ERROR, STATUS=',ZB)
700  CONTINUE
999  II=II+4+IPTS*4
RETURN

$ASSIGN LIB TO IEEELIB
$ASSIGN DIR TO IEEEDIR
$ASSIGN SLO TO SLDMP
$EXECUTE CATALOG
ASSIGN 5 TO ACNRN
ASSIGN 5 T0 DEVC=MS1000,BLOC=N
ERUI FEST
CATALOG ACOUTSIT 5
$EOJ
4. EBLE PROGRAMS

The EBLE programs consist of three programs which run simultaneously. The source listings reside in the three files EBLE1, EBLE2 and EBLE3 which when compiled and catalogued are called STEP1, STEP2 and STEP3. The operator executes the file STEP1 (or the batch file GTE which will be discussed in chapter 5). STEP1 automatically activates STEP2 and STEP2 activates STEP3. Flow charts for the three programs are shown in figures 5 and 6.

The data sampled during EBLE consisted of four groups of data -- one from the CDS and three from the RTP's. Sampling of these data sets was done at the rate of 1 Hz. The format and description of the complete data set is shown in Table 2.

The first RTP data set consists of flow angles input from the synchro-to-digital converters on RTP subsystem 0. The second set consists of position data from the aircraft navigation system input through the synchro-to-digital converters in RTP subsystem 1. The third set of RTP data are readings of five pressure transducer rakes, each rake having 11 ports. These are input through two analog input/output cards in RTP subsystem 0. A certain amount of time is required between the output and input to and from the pressure transducers. Therefore, the program logic is set up to output to the transducers, then retrieve one CDS data label, then input from the transducers. This is repeated 11 times (for each of the ports). Time is recorded at the beginning of the entire data set and at the end of the data set.

Figure 7 shows the RTP and CDS systems set-up during the EBLE experiment. Program listings of the files EBLE1, EBLE2 and EBLE3 follow.
PROGRAM MAINPROG

CALL X:RCVR
set up statement 300
as message receiver

CALL M:ACTIV
activate SETINTRP

CALL X:ANYW
wait for message

300 CALL X:GMSP
get message

CALL X:MSGGR
return from message receiver

decode and convert data

14 seconds?

Program SETINTRP

CALL M:ACTIV
activate ACQUISIT

CALL M:SSPND
suspend this program for 600 tics

CALL M:RSUM
resume ACQUISIT

CALL M:SSPND
suspend this program for 60 tics

Figure 5. Flowcharts of EBLE versions of MAINPROG and SETINTRP.
Figure 6. Flowchart of EBLE version of ACQUISIT.
### Table 2. EBLE Data Format

<table>
<thead>
<tr>
<th>Location in Array</th>
<th># Bytes</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2. EBLE Data Format</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>time</td>
<td>Gould clock</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>flow angle 1</td>
<td>Synchro #1 (0)</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>flow angle 2</td>
<td>Synchro #2 (0)</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>flow angle 3</td>
<td>Synchro #3 (0)</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>flow angle 4</td>
<td>Synchro #4 (0)</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>flow angle 5</td>
<td>Synchro #5 (0)</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>pitch</td>
<td>Synchro #1 (1)</td>
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<td>17</td>
<td>2</td>
<td>roll</td>
<td>Synchro #2 (1)</td>
</tr>
<tr>
<td>21</td>
<td>2</td>
<td>heading</td>
<td>Synchro #3 (1)</td>
</tr>
<tr>
<td>21</td>
<td>2</td>
<td>baro-alt (fine)</td>
<td>Synchro #4 (1)</td>
</tr>
<tr>
<td>23</td>
<td>2</td>
<td>baro-alt (coarse)</td>
<td>Synchro #5 (1)</td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>rake 1 - port 1</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>2</td>
<td>rake 2 - port 1</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>2</td>
<td>rake 3 - port 1</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>2</td>
<td>rake 4 - port 1</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>2</td>
<td>rake 5 - port 1</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>2</td>
<td>rake 1 - port 2</td>
<td></td>
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<tr>
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<tr>
<td>125</td>
<td>2</td>
<td>rake 1 - port 11</td>
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<tr>
<td>etc.</td>
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<tr>
<td>133</td>
<td>2</td>
<td>rake 5 - port 11</td>
<td></td>
</tr>
<tr>
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<td>4</td>
<td>track error</td>
<td>Label (hex): 5</td>
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<tr>
<td>139</td>
<td>4</td>
<td>drift</td>
<td>6</td>
</tr>
<tr>
<td>143</td>
<td>4</td>
<td>latitude</td>
<td>8</td>
</tr>
<tr>
<td>147</td>
<td>4</td>
<td>longitude</td>
<td>9</td>
</tr>
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<td>ground speed</td>
<td>A</td>
</tr>
<tr>
<td>155</td>
<td>4</td>
<td>track angle</td>
<td>B</td>
</tr>
<tr>
<td>159</td>
<td>4</td>
<td>true heading</td>
<td>C</td>
</tr>
<tr>
<td>163</td>
<td>4</td>
<td>wind speed</td>
<td>D</td>
</tr>
<tr>
<td>167</td>
<td>4</td>
<td>wind dir</td>
<td>E</td>
</tr>
<tr>
<td>171</td>
<td>4</td>
<td>N/S velocity</td>
<td>B6</td>
</tr>
<tr>
<td>175</td>
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<td>B7</td>
</tr>
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<td>Description</td>
<td>Card Address</td>
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<td>RTF Subsystem 0</td>
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<td>3-4</td>
<td>SYNCHRO 1 (flow angle 1)</td>
<td>0-1</td>
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<tr>
<td>5-6</td>
<td>SYNCHRO 2 (flow angle 2)</td>
<td>2-3</td>
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<td>7-8</td>
<td>SYNCHRO 3 (flow angle 3)</td>
<td>4-5</td>
<td></td>
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<tr>
<td>9-10</td>
<td>SYNCHRO 4 (flow angle 4)</td>
<td>6-7</td>
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<td>SYNCHRO 5 (flow angle 5)</td>
<td>8-9</td>
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<td>13-14</td>
<td>RTF Subsystem 1</td>
<td>10-11</td>
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<td>15-16</td>
<td>SYNCHRO 1 (pitch)</td>
<td>12-13</td>
<td></td>
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<td>SYNCHRO 2 (roll)</td>
<td>14-15</td>
<td></td>
</tr>
<tr>
<td>19-20</td>
<td>SYNCHRO 3 (heading)</td>
<td>16-17</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>SYNCHRO 4 (baro-alt fine)</td>
<td>18-19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SYNCHRO 5 (baro-alt coarse)</td>
<td>20-21</td>
<td></td>
</tr>
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<td>AIO (channels 1-4)</td>
<td>2-3</td>
<td></td>
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<td>AIO (channels 5-8)</td>
<td>4-5</td>
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</tr>
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<td>A/D</td>
<td>6-7</td>
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</table>

Figure 7. RTP card cage set-up for EBLE.
**FILE**

IJOB  MAINPROG
ASSIGN LI TO SLOFUR
$OPTION 5
EXECUTE FORTRAN

**PROGRAM MAINPROG**

INTEGER*8 ITASK
INTEGER*4 ITIME1(4), ITIME2(4)
INTEGER*4 FLOW(5), NAV(5), PT(5,11)
INTEGER*4 LAT, LON
INTEGER*4 US, WD, TRKANG, TRUHD, GRDspd, TRKERR, DRIFT
INTEGER*8 NSVEL, EWEUL
INTEGER*1 IA(200)
DIMENSION SYNC1(5), SYNC2(5), IX(11), XPT(5,11)
EQUIVALENCE (IA(135), TRKERR)
EQUIVALENCE (IA(139), DRIFT)
EQUIVALENCE (IA(1), ITIME1(1))
EQUIVALENCE (IA(179), ITIME2(1))
EQUIVALENCE (IA(143), LAT)
EQUIVALENCE (IA(147), LON)
EQUIVALENCE (IA(151), GRDspd)
EQUIVALENCE (IA(155), TRKANG)
EQUIVALENCE (IA(159), TRUHD)
EQUIVALENCE (IA(163), US)
EQUIVALENCE (IA(167), WD)
EQUIVALENCE (IA(151), NSVEL)
EQUIVALENCE (IA(175), EWEUL)
EQUIVALENCE (IA(5), FLOW(1))
EQUIVALENCE (IA(15), NAV(1))
EQUIVALENCE (IA(25), PT(1,1))
INTEGER*1 GONEFLAG(4) !FLAG FOR MORE DATA TO PRINT
DATA IX/1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11/
C ***** SET UP BUFFER RECEIVER PARAMETERS
CALL X:RCVR(*300, ISTAT, *995) !WHEN DATA IS RECEIVED GOTO 300
PRB(1)=0ANNR(IA) !BYTES THAT ARE RECEIVED FROM ACQUISIT
PRB(2)=0OCB(0000)
C ***** ACTIVATE THE INTERRUPT GENERATING ROUTINE
ITASK= 'SETINTR'
CALL M:ACTIV(ITASK, ISTAT, *997)
C ***** WAIT FOR BUFFER FROM PROGRAM ACQUISIT
90 CALL X:ARYN(0, ISTAT, *996).
C ***** DO THE CONVERSIONS FROM BINARY TO REAL UNITS
DO 555 I=1, 5
FLOW(I)=IB16S(FLOW(I), 2, 14)
NAV(I)=IB16S(NAV(I), 2, 14)
SYNC1(I)=FLOW(I)*0.0219727
SYNC2(I)=NAV(I)*0.0219727
555 CONTINUE
SYNC2(I)=360.-SYNC2(I) !SOME SYNCHROS ARE OFF 360,
SYNC2(5)=(360.0-SYNC2(5))*375. !COARSE ALTIMETER
DO 666 I=1,5
DO 666 J=1,11
XP(I,J)=(PT(I,J)*3.125E-4) !PRESSURE TRANSUCTIONS
666 CONTINUE
C**** LAT AND LON ARE IN HEX
LAT=IBITS(LAT,0,21)
LON=IBITS(LON,0,21)
C**** PRINT TO CRT MONITOR
WRITE(3,3000)ITIME1,ITIME2
3000 FORMAT(10I0,3(I2,':'),I2,10X,3(I2,':'),I2)
WRITE(3,3005)SYNC2(5),LAT,LON,WS,WD,SYNC2(1)
1 SYNC2(2),SYNC2(3)
3005 FORMAT(5X,'ALT',5X,'LAT',5X,'LON',6X,'WS',6X,'WD',3X,'PITCH',4X,'ROLL',4X,'HEAD'/1X,F7.0,4(2X,Z6),3F8.0)
WRITE(3,3010)I1
3010 FORMAT(1X,'SENSOR',3X,11I5,3X,'FLOW')
DO 100 I1=1,5
WRITE(3,3015)I1,(XPT(I1,I),I=1,11),SYNC1(I1)
100 CONTINUE
3015 FORMAT(1X,I3,6X,11F5.2,F7.0)
IF (ITEM.EQ.2)GO TO 444
ITEM=0
C**** PRINT TO PRINTER
WRITE(2,2000)(ITIME1(I),I=1,3),SYNC2(5),LAT,LON,
1 WS,WD,SYNC2(1),SYNC2(2),SYNC2(3)
2000 FORMAT(10H0,6X,'TIME',7X,'ALT',7X,'LAT',7X,'LON',3X,'WIND SP',2X,'WIND DIR',5X,'PITCH',6X,'ROLL',3X,'HEAD',3X,2(I2,':'),I2,F10.0,4(2X,Z6),3F10.0)
WRITE(2,2005)I1
2005 FORMAT(10H0,'STATION / SENSOR',11I7, '/'FLOW AMGLE')
DO 200 I1=1,5
WRITE(2,2010)I1,(XPT(I1,I),I=1,11),SYNC1(I1)
200 CONTINUE
2010 FORMAT(1X,I4,12X,11F7.2,F10.0)
441 ITEM=ITEM+1
GO TO 90
C**** NEW BUFFER IS AVAILABLE
300 CALL X:GMSGP(PROB,DSTT,*994)
LSTAT=IBITS(10,0,8)
RXB=1=LSTAT+ADDR(DONEFLG)
RXB=4=2
C**** EXIT MESSAGE RECEIVER -- RETURN TO STATEMENT FOLLOWING
C THE CALL TO "X:AN?U"
C
C CALL X: XMSGR (RXB,DSTT,*993)
C
C CALL X: GMSGP (PROB,DSTT,*994)
C**** ERROR RETURNS AND MESSAGES ****
993 WRITE(3,2045)ISTAT
2045 FORMAT(9X,'X:MSGR ERROR: ',I5)
GO TO 994
994 WRITE(3,2045)ISTAT
GOTO 999
995 WRITE(3,2035) ISTAT
2035 FORMAT( ' X:RCVR ERROR: ', I5)
GOTO 999
996 WRITE(3,2030) ISTAT
2030 FORMAT( ' X:ANYW-ERROR: ', I5)
GOTO 999
997 WRITE(3,2020) ISTAT
2020 FORMAT( ' M:ACTIV ERROR: ', I5)
GOTO 999
998 WRITE(3,2015) FCB(4)
2015 FORMAT( ' I/O ERROR, FCB(4)=', Z8)
999 STOP
END
$ASSIGN SLO TO SLODMP
$ASSIGN DIR TO IEEEDIR
$ASSIGN LIB TO IEEELIB
$EXECUTE CATALOG
ASSIGN SI TO SYC
ASSIGN 2 TO DEV=TY/EC6
ASSIGN 3 TO LFC=UT
CATALOG MAINPROG
END
**$ JOB SETINTRP**

**$ ASSIGN LO TO SLOFOR**

**$ OPTION 5**

**$ EXECUTE FORTRAN**

```fortran
PROGRAM SETINTRP
INTEGER*8 ITASK2
ITASK2 = 'ACQUISIT'
CALL M:ACTIV(ITASK2, *999) ! ACTIVATE PROGRAM ACQUISIT
CALL M:SSPND(600, *999) ! WAIT WHOLE MINUTE FIRST TIME
CALL M:RSUM(ITASK2, *999) ! RESUME DATA ACQUISITION
CALL M:SSPND(60, *999) ! SUSPEND THIS JOB FOR 60 TICS
GOTO 10
999 CONTINUE
WRITE(6, 5000)
6000 FORMAT(' SETINTRP ERROR') ! GETS HERE ONLY IF ERROR
STOP
END
$ ASSIGN SLO 10 SLODMP
$ EXECUTE CATALOG
$ ASSIGN 6 TO INTERR
CATALOG SETINTRP
$EUJ
```
$JOB ACQUISIT
$NOTE DATA ACQUISITION PROGRAM
$ASSIGN LO TO SLOFOR
$OPTION 5
$EXECUTE FORTRAN
PROGRAM ACQUISIT
INTEGER*8 TASKNAME, OWNNAME, PSEUDO
INTEGER*4 IA(200, 40)
INTEGER PSB(8), RBA(2)
C **** DETERMINE TASK H OF CALLING PROGRAM "MAINPROG"
TASKNAME='MAINPROG'
INDEX=0
ITASK=0
OWNNAME=0
PSEUDO=0
CALL ZQD(INDEX, ITASK, TASKNAME, OWNNAME, PSEUDO, ISTAT, *900)
C **** SET UP PSB FOR LATER TRANSMISSION OF BUFFER
PSB(1)=ITASK  ! TASK H OF "MAINPROG" FROM X:ID
PSB(2)=0  ! MUST BE 0
PSB(3)=200  ! N BYTES TO TRANSMIT
PSB(5)=Z'100000'  ! N BYTES TO RECEIVE BACK (2)...
PSB(6)=ADDR(RBA)  ! PURE ADDRESS OF RECEIVER BUFFER
PSB(7)=ADDR($800).! NO WAIT ERROR RETURN
IPRINT=1  ! PRINT CONTROL
MTERROR=0  ! 'M' MAG TAPE ERRORS
JJ=1  ! INDEX FOR BUFFERS -- 20 WILL BE STACKED
       ! PRIOR TO WRITING TO TAPE
IFLAG=0  ! TAPE ERROR FLAG
100...CALL GETRIPLIA, JJ)  ! GET RJP AND CBS DATA
   IF (JJ.EQ.20) GOTO 420  ! 2 STACKS OF 20 AVAILABLE -- 1 FOR
       IF (JJ.EQ.40) GOTO 420  ! FILLING AND ONE FOR WRITING TO TAPE
       GOTO 430
420...IF (IFLAG.EQ.1) GOTO 905  ! IS MAG TAPE STILL BUSY?
       IFLAG=1
C **** WRITE BUFFER TO TAPE
       CALL BUFFEROUT(6, 1, IA(1, JJ-19), 1000, $B05, $F10)
C **** SEND BUFFER BACK TO CALLING PROGRAM
430...PSB(4)=ADDR(IA(1, JJ))
       CALL X:SMGE(PSB, ISTAT, *915)
450...JJ=JJ+1
       IF (JJ.EQ.41) JJ=1
C **** SUSPEND THIS ROUTINE UNTIL NEXT INTERRUPT
500...CALL H:SPND(0, *920)
       GOTO 100
C **** END ACTION ROUTINES ****
800...CALL X:XMEA  ! EXIT SEND MESSAGE
305...IFLAG=0  ! MAG TAPE DONE
       CALL STATUS(1, ISTAT)  ! "ANY ERRORS?"
       IF (ISTAT.NE.2) WRITE(5, $B05) ISTAT
      FORMAT(' MAG TAPE STATUS ERROR: ' JJ)
CALL X:XMDOID
CALL X:XMDOID
************************** ERROR MESSAGES OUTPUT TO FILE "ACDERR"
900    WRITE(5,9000) ISTAT
9000   FORMAT( 'X:ID ERROR: ',I5)
         GOTO 999
905    MERRS=MERRS+1
         WRITE(5,9005) MERRS
9005   FORMAT( 'MAGTAPE BUSYF FLAG SET, ERRORS=',I5)
         GOTO 500
910    WRITE(5,9010)
9100   FORMAT( 'MAGTAPE HARDWARE ERROR')
         GOTO 999
915    WRITE(5,9015) ISTAT
9150   FORMAT( 'X:SMSR ERROR: ',I5)
         GOTO 999
920    WRITE(5,9020)
9200   FORMAT( 'M:SSPD ERROR')
         GOTO 999
999    STOP
         END
SUBROUTINE GETRTP (IA, JJ)
INTEGER IA, IA(200,40), ITIME(4), IDATA(40)
INTEGER IOCHFA(3), IOCHNF(3), IOCHNF(3,11), IOCH(3)
INTEGER IOCBFA(16), IOCBNF(16), IOCB(16,11), IOCB(20)

C
INTEGER BUSY, SIZE, SIZEN, MSK(4)
INTEGER ADD1, ADD2, ADD3, ADD7, ADD8, ADD9
EQUIVALENCE (IDATA(1), INP(1))

C
IF(INITDONE. GE.1) GOTO 100
C **************************** INITIALIZE SECTION. ****************************
C **************************** SET UP IOCH/IOCB FOR EACH GROUP ****************************
C THE FIRST SET OF BUFFERS ARE TO READ 5 FLOW ANGLES FROM THE SYNCHROS
ADD1=LOCF(ICHNF)      !CHANNEL HALFWORD TABLE ADDRESS
ADD2=LOCF(INP)        !INPUT BUFFER ADDRESS
IOCHFA(1)=Z'00030000' !IDM ADDRESS OF 30
IOCHFA(2)=ADD2(IOCBFA) !IOCB ADDRESS
IOCHFA(3)=Z'20020'    !NOP
IOCBFA(1)=Z'00000005' !DIGITAL INPUT 5 HALFWORDS
IOCBFA(2)=LOCF(IICHNF) !CHANNEL HALFWORD TABLE
IOCBFA(3)=LOCF(INP)   !INPUT BUFFER
IOCBFA(4)=0           !ALWAYS ZERO (CONTAINS STATUS ON RETURN
IICHNF=Z'108'         !FIRST SYNCHRO TO READ IS IN SLOT 11
SIZE=16
BUSY=LOCF(1800)
CALL ADOUSE (IOCHFA, IOCBFA, SIZE, BUSY)   !INITIALIZE FA BUFFERS
WRITE (5,9001)
THIS SECOND SET OF BUFFERS ARE TO READ NAV DATA FROM 5 SYNCHROS
IOCBNH(1)=Z'00000000' !IDM ADDRESS OF 0
IOCBNH(2)=ADD2(IOCBFA) !IOCB ADDRESS
IOCBNH(3)=Z'20020'    !NOP
IOCBNF(1)=Z'00000005' !DIGITAL INPUT 5 HALFWORDS
IOCBNF(2)=LOCF(IICHNF) !CHANNEL HALFWORD TABLE
IOCBNF(3)=LOCF(INP)   !INPUT BUFFER
IOCBNF(4)=0           !ALWAYS ZERO (CONTAINS STATUS ON RETURN
IICHNF=Z'108'         !FIRST SYNCHRO TO READ IS IN SLOT 11
SIZE=16
BUSY=LOCF(1800)
CALL ADOUSE (IOCHNF, IOCBNF, SIZE, BUSY)   !INITIALIZE FA BUFFERS
WRITE (5,9001)
IOCNV(2)=ADDR(IOCBNV)
IOCNV(3)=Z'20002'
IOCNV(1)=Z'E0000005'
IN, SEQ, DIG; 5 HALFWORDS
IOCBNV(2)=LOCF(ICHNNV)
IOCNV(3)=ADD2
IOCBNV(4)=0
ICHNNV=Z'210A'
SUBSYSTEM=1, SLOT=10
CALL ADJUSR (IOCNV, IOCBNV, SIZE, BUSY); INITIAL NV BUFFERS
WRITE (5, 5002)
C THE FOLLOWING SET OF 11 BUFFERS WILL OUTPUT VOLTAGES TO THE
C PRESSURE TRANSDUCERS THRU THE A lD CARDS
DO 10 I=1, 4
ICHND(1)=Z'COI'; 8-CHANNEL I/O SLOT 2; 10V DAC OUTPUT FS
ICHND(1+4)=Z'CO1'; 8-CHANNEL I/O SLOT 1; 10V DAC OUTPUT FS
10 CONTINUE
ADD1=LOCF(ICHND)
DO 40 I=1, 11
ADD3=LOCF(OUTA(I, 1))
40 CONTINUE
IOCHD(1, I)=Z'00300000'
IOM ADDRESS OF 30
IOCHD(2, I)=ADDR(IOCBD(I)
IOCHD(3, I)=Z'20002'
N O P
IOCBD(I, I)=Z'20000008'
OUT, RAN, DIG; 8 HALFWORDS
IOCBD(2, I)=ADD1
IOCBD(3, I)=ADD3
IOB0(I, 4, I)=O
C IN ANY PASS THRUS THIS "DO 40" LOOP THE MSK ARRAY DEFINES WHICH
C LINES TO PASS 10V TO... THEREBY SIGNALLING THE RTF WHICH SIGNALS
C TO PUT ON THE LINES.
MSK(I)=O
MSK(2)=O
MSK(3)=O
MSK(4)=O
II=I-1
IF(I, I.EQ.0) GOTO 25
II=II/2
IF(I1X2.NE.I1) MSK(I)=Z'F F F'
II=II/2
IF(I1X2.NE.I1) MSK(I)=Z'F F F'
II=II/2
IF(I1X2.NE.I1) MSK(I)=Z'F F F'
II=II/2
IF(I1X2.NE.I1) MSK(I)=Z'F F F'
II=II/2
IF(I1X2.NE.I1) MSK(I)=Z'F F F'
II=II/2
25 DO 30 J=1, 4
JJ=J-1
OUTA(J, I)=JJXZ'2000'+MSK(J)
CHANNEL II + VOLTS (0V OR 10V)
OUTA(J+4, I)=OUTA(J, I)
SAME AS ABOVE BUT FOR OTHER A lD
30 CONTINUE
CALL ADJUSR (IOCHD(1, I), IOCBD(1, I), SIZE, BUSY); INIT. OUT BUFFERS
WRITE (5, 5003) 1
10 CONTINUE
THE FOLLOWING 6 BUFFERS WILL READ PRESSURE TRANSDUCERS THRU THE
C AIO CARDS AS DEFINED BY THE PREVIOUS OUTPUT BUFFERS.

ADD8 =LOC8(INP)
ADD9 =LOC8(OUTB)
IOCHI(1)=Z'00300000'  ! IOM ADDRESS OF 30
IOCHI(2)=ADDB(IOCHI)
IOCHI(3)=Z'200002'    ! NOP
L2=0
LL=3
DO 50 I=1,5
   IOCHI(1+LL)=Z'22000001' ! OUT, RAN, DIG; 1 HALFWORD
   IOCHI(2+LL)=LOC8(IOCHI)
   IOCHI(3+LL)=ADD9+L2
   IOCHI(4+LL)=0
   IOCHI(5+LL)=Z'A2000000' ! IN, RAN, DIG; 1 HALFWORD
   IOCHI(6+LL)=LOC8(IOCHI)
   IOCHI(7+LL)=ADD8+L2
   IOCHI(8+LL)=0
   LL=LL+4:
   L2=L2+2
50 CONTINUE
IOCHI(37)=Z'A00000000'  ! NO CHAIN ON LAST IOCB
IOCHI=Z'1100'            ! BYPASS READY TEST, REPEAT ACCESS, SLOT 0
IOCHI=Z'100'            ! REPEAT ACCESS, SLOT 0
OUTB(1)=Z'0081'        ! MODE=3; CARD_SLOT=1; CHANNEL=0; GAIN=2
OUTB(2)=Z'3101'        ! MODE=3; CARD_SLOT=2; CHANNEL=0; GAIN=2
OUTB(3)=Z'3111'        ! MODE=3; CARD_SLOT=2; CHANNEL=1; GAIN=2
OUTB(4)=Z'3121'        ! MODE=3; CARD_SLOT=2; CHANNEL=2; GAIN=2
OUTB(5)=Z'3131'        ! MODE=3; CARD_SLOT=2; CHANNEL=3; GAIN=2
SIZEN=70
CALL ADIUSR(IOCHI, IOCB, SIZEN, BUSY)  ! INIT INPUT BUFFERS
WRITE (5,5004)
5001 FORMAT (' SYN RTP #2 INIT DONE')
5002 FORMAT (' SYN RTP #1 INIT DONE')
5003 FORMAT (' ANALOG CHANNEL #13, INIT DONE')
5004 FORMAT (' ANALOG INPUT INIT DONE')
INITDONE=1
C AFTER INITIALIZATION, A CALL TO RTP ALWAYS COMES HERE ..........
100 CALL M:DAY(ITIME)        ! GET TIME OF DATA SET
   IA1(JJ)=ITIME(1)
   IA2(JJ)=ITIME(2)
   IA3(JJ)=ITIME(3)
   IA4(JJ)=ITIME(4)
   CALL ADIUSR(IOCFIA, IOCBFA, SIZE, BUSY)  ! GET FLOW ANGLES
   ISTAT=IOCBFA(4)
   II=5
   DO 150 I=1,10
      IA(II+1+1,JJ)=IDATA(I)
   150 CONTINUE
   CALL ADIUSR(IOCHNV, IOCBNV, SIZE, BUSY)  ! GET NAVY DATA
   ISTAT=IOCBNV(4)
   II=15
DO 160 I=1,10
   IA(I+1,J)=IDATA(I)
160   CONTINUE
C READING THE PRESSURE TRANSDUCERS IS A TWO STEP PROCESS.  FIRST,
C YOU MUST OUTPUT THE CHANNEL NUMBER AND ALLOW A CERTAIN AMOUNT OF
C TIME FOR THE SIGNALS TO SETTLE ON THE LINES, THEN YOU CAN READ
C THE CHANNELS. IN ORDER TO ASSURE ENOUGH TIME FOR SIGNALS TO SETTLE
C THIS PROGRAM SENDS CHANNELS, THEN READS IN A PIECE OF COS DATA,
C THEN COMES BACK AND READS THE CHANNELS.
DO 200 I=1,11
   CALL ADIUSR(IOCHO(I,1),IOCB0(I,1),SIZE,BUSY); SET SIGNAL LINES
   ISTAT=IOCB0(4,1)
   CALL GETCOS(IA,JJ,1)
   CALL ADIUSR(IOCH1,IOCB1,SIZEN,BUSY); READ SIGNAL LINES
   ISTAT=IOCH1(40)
   II=25*(I-1)*10
   DO 170 I=1,10
      IA(I+J-1,JJ)=IDATA(J)
170   CONTINUE
DO 200 CONTINUE
   CALL M:TDAY(ITIME); GET TIME AT END OF DATA SET
   IA(179,JJ)=ITIME(1)
   IA(180,JJ)=ITIME(2)
   IA(181,JJ)=ITIME(3)
   IA(182,JJ)=ITIME(4)
   GOTO 999
500 WRITE(5,5000)ISTAT
   500 FORMAT(ADJ STATUS ERROR: ,28)
999 RETURN
END
SUBROUTINE GETCOS(IA,JJ,MLAB)
C *************** SUBROUTINE TO RETRIEVE
CHARACTER*8 CONTNAME
INTEGER CONTUNIT
INTEGER*1 IA(200,40),ITIME(4)
INTEGER FCB(16),IOCL(130),SENSBUFF(4)
INTEGER CMDBUF(8,11)
INTEGER INPBUF(64),QUBUF(64)
INTEGER WRTC,UTDA,RDDA,ESRD,DSRD,CHAIN,SIL
CHARACTER*1 NOTALK,NOLISN,ITALK,ILISN,UTALK,ULISN
CHARACTER*1 TLKBUF,LSNBUF
EXTERNAL IEESEXCHP,IEEELOCF,IEEEFSMT,IEEECSI
DATA WRTC/Z'10000000',UTDA/Z'01000000'
DATA RDDA/Z'02000000',ESRD/Z'03000000'
DATA DSRD/Z'73000000',CHAIN/Z'40000000'
DATA SIL/Z'20000000'
DATA NOTALK/'/',NOLISN/'?',ITALK/'@',ILISN:'/
DATA UTALK/'C',ULISN:'/
DATA CMDBUF/Z'40',Z'30',Z'36',Z'41',Z'43',Z'53',Z'03',Z'05'
Z'40',Z'30',Z'36',Z'41',Z'43',Z'53',Z'66',Z'03',Z'05'
Z'40',Z'30',Z'36',Z'41',Z'43',Z'53',Z'66',Z'03',Z'05'
C NEXT STATEMENTS WILL INITIALIZE
C THEY ARE PERFORMED ONLY ON FIRST CALL TO SUBROUTINE ****
IF(INITDONE.EQ.1)GOTO 30
.INITDONE=1
FCB=0
FCB(3)=5
!TIMEOUT AT 5 SECONDS
FCB(10)=Z'1000000'+IEEEOLOC(SNSBUF)
CONUNIT=IEE
CONNAME='U07E80'
CALL IEEECST(CONUNIT,CONNAME,FCB,-1,ISAT)
IF(ISAT.NE.0)GOTO 900
FCB(9)=IEEEOLOC(IOCL(1))
FCB(7)=IEEEOLOC(*915)
!WAIT I/O ERROR RETURN
TLKBuff=NOTALK//NOLISH//ULISN//ITALK
LSHBUFF=NOTALK//NOLISH//ILISN//UTALK
IOCL(1)=WRIT+IEEEOLOC(TLKBUFF)+2
IOCL(2)=CHAIN+2
!ULISN,ITALK
IOCL(4)=CHAIN+7
!COMMAND + LABEL (7 BYTES)
IOCL(5)=WRIT+IEEEOLOC(LSHBUFF)+2
IOCL(6)=CHAIN+2
!ILISN,UTALK
IOCL(7)=RDA+IEEEOLOC(INPBUF)
IOCL(8)=0
!RECEIVE 5 BYTES
C AFTER INITIALIZATION, CALLS TO CDS COME HERE
30 IOCL(3)=WDA+IEEEOLOC(CMDBUF(1,MLAB))
CALL IELEXCPM(FCB,ISTAT)
IF(ISAT.NE.0)GOTO 920
II=(MLAB-1)*4+135
IA:II,JJ=0
IA(I+1,JJ)=INPBUF(1)
IA(I+2,JJ)=INPBUF(2)
IA(I+3,JJ)=INPBUF(3)
GOTO 999
5998 FORMAT(' CDS ERROR ON NO-WAIT RETURN')
C CALL M:END
C ERROR RETURNS ****
900 WRITE(5,5000)ISTAT
5000 FORMAT(' IEECAST ERROR: ',I8)
GOTO 999
905 WRITE(5,5005)ISTAT
5005 FORMAT(' IEEEDST ERROR: ',I8)
915 WRITE(5,5015)FCB(4)
5015 FORMAT(' I/O ERROR, FCB(4)='Z8)
GOTO 999
WRITE(5,5020)ISTAT
5020 FORMAT(' IAEEXCPM ERROR, STATUS=',Z8)
700 CONTINUE
999 RETURN
END
*ASSIGN LIB TO IEEELIB
*ASSIGN DIR 10 IEEEDIR
*ASSIGN SLQ TO SLOOMP
EXECUTE CATALOG
ASSIGN 5 TO ACQERR
ASSIGN 6 TO DEVM=91000 BLOC=N
ENVI RESI
CATALOG ACQUISIT 5
*EOJ
LOG-ON PROCEDURE AND PROGRAM START-UP

1. Turn power on to computer and peripherals.
2. Load cartridge tape.
3. Set CAPS LOCK on keyboard.
4. Hit carriage return (CR).
5. Computer should respond with "operator error" and the prompt //. Then type CLE (CR).
6. Again the prompt //, type RST.
7. Computer will respond with a PSW and INST then prompt //. Type IPL=0800 (CR).
8. Computer will boot from disk and issue the prompt //. Type TE (CR).
9. Computer will initialize memory and then request date and time. Use the format: MM/ DD/ YY; HH: MM: SS (CR).
10. Enter CR in response to question about swap volume channel.
11. Computer will then initialize the terminal set-up and the IEEE-488 controller. The computer will then ask you to press attention for TSM. Type @@A.
12. When asked for the ownername, type SYSTEM (CR).
13. When asked for the key, type CR.
14. You are now in the MPX-32 operating system.

At this point you can enter the text editor (see chapter 6) by typing EDIT XX (CR). Or you can run the batch file GTE which will run the latest load modules STEP1, STEP2, and STEP3 (depending on which files have last been compiled and catalogued of BZLi or EBLEi).

If you run GTE the computer will ask you to mount the cartridge tape. Check to see that the green load light on the tape unit is on before typing in your response R (CR). You will know that all is working well if you are receiving print outs to the CRT and printer. If there is a program hang-up the safest thing to do is to type @@P. When you get the // prompt type HALT (CR). Then proceed from step 5. It is usually best to flick the power switches of the CDS and RTP's before bringing the system back up to clear any possible hang-ups in these devices.

A sample copy of the log-on procedure is shown on the following page.
PSW $0000001 INST $00070001 WAIT HALT
//CLE
//RST
PSW $00000002 INST $00000000 HALT
//1PL-0800

>>TE

MEMORY INITIALIZATION STARTED......
MEMORY INITIALIZATION COMPLETED......
Enter date and time: 05/28/86; 03:30:25
Enter swap volume channel and subaddress
If <CR> if system volume:
INITIALIZATION COMPLETE
TERMINAL SET-UP COMPLETE
IEEE 488 CONTROLLER Initialization
FULL INITIALIZATION
CONTROLLER NAME=U:07E80
CONTROLLER U:07E82: INITIALIZED SUCCESSFULLY
SYSTEM READY. PRESS ATTENTION FOR TSM...

MPX-32 REVISION 2.2 MPXSYS11 TSM
(C) COPYRIGHT '91 GOULD INC., COMPUTER SYSTEMS DIVISION. ALL RIGHTS RESERVED
ENTER YOUR OWNERNAME: SYSTEM
ENTER KEY

0000000000

Gould Inc . Computer Systems Division

* MPX-32 Revision 2 Release 2.2

TSM=GTE

40
6. EDITING AND MODIFYING THE PROGRAMS

A summary of the EDIT directives is shown on pages 42 and 43 (ref. 6). To enter the text editor you type EDIT XX, where XX is any 2-letter workfile name (if it does not exist the editor creates the file for you). Then you would call on the USE directive to select the file you wish to edit (eg. USE BZLi). At this point you would use the other directives to modify your file. The format is as follows:

```
DIR I/J
```

where DIR is the directive, I is the starting line number and J is the ending line number. Some examples:

- **LIST 1/20**  lists lines 1 thru 20
- **DEL 1,2**  deletes lines 1 and 2
- **COL 10**  collects code starting at line 10 and continuing until you type a CR in response to the line number prompt
- **INS 10**  inserts one line of code at line 10
- **CHA 1/10 AAA\BBB\**  change the character string AAA in lines 1 thru 10 to the string BBB
- **COP.3/6 to 10.1**  copies lines 3,4,5,6 to lines 10.1 thru 10.4

The letters L (last), F (first), A (all), C (current), or N (next) can be substituted for the line numbers:

- **LIST F/L**  list from first to last lines of file
- **LIST A**  list all of file (same as above)
- **CHA A AAA\BBB\**  change all occurrences of AAA to BBB

Once you have completed all modification you would store the file under some filename:

```
STO NEWFILE UNN SCR
```

The UNN specifies that the file be stored un-numbered and the SCR specifies that if NEWFILE already exists it should be scratched and replaced by the current contents of your workfile.

Since the files BZLi and EBLEi have all control directives necessary for compiling and cataloguing as batch files you need only type NEWFILE to obtain a load module STEPi of your modified file. If errors have occurred during Fortran compilation you can list the file SLOFOR (LIST SLOFOR) to determine the cause. If an error occurs during cataloguing, you can list the file SLODMP (LIST SLODMP).
### 1.2 Directive Summary

EDIT directives are summarized below and described in detail in the Directives section. Most EDIT directives can be abbreviated to three characters. Valid abbreviations are indicated by underlining. EDIT directives are keywords and cannot be used as file names. Back slashes, forward slashes, and commas are special characters used in EDIT directives and cannot be used in file names.

The break key can be used to interrupt operations in progress. Use of the break key is not recommended during SAVE and STORE operations.

Most EDIT directive parameters can be entered in any order. If directive parameter input is order-dependent, the restriction is noted in the directive description.

<table>
<thead>
<tr>
<th>Directive</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPEND</td>
<td>Appends text to end of a line or group of lines.</td>
</tr>
<tr>
<td>BATCH</td>
<td>Copies work file or specified file into batch stream.</td>
</tr>
<tr>
<td>CHANGE</td>
<td>Replaces a character string with another character string.</td>
</tr>
<tr>
<td>CLEAR</td>
<td>Clears work file.</td>
</tr>
<tr>
<td>COLLECT</td>
<td>Adds lines of text.</td>
</tr>
<tr>
<td>COMMAND</td>
<td>Displays the last four directives performed.</td>
</tr>
<tr>
<td>COPY</td>
<td>Copies existing text to work file.</td>
</tr>
<tr>
<td>DELETE</td>
<td>Deletes lines.</td>
</tr>
<tr>
<td>EXIT</td>
<td>Ends current EDIT session.</td>
</tr>
<tr>
<td>INSERT</td>
<td>Inserts lines of text.</td>
</tr>
<tr>
<td>LIST</td>
<td>Lists text on terminal screen.</td>
</tr>
<tr>
<td>MODIFY</td>
<td>Allows a one-for-one replacement of characters in an existing line.</td>
</tr>
<tr>
<td>MOVE</td>
<td>Moves lines of text within the work file.</td>
</tr>
<tr>
<td>NUMBER</td>
<td>Renumbers lines in work file.</td>
</tr>
<tr>
<td>PREFACE</td>
<td>Inserts characters at beginning of lines.</td>
</tr>
<tr>
<td>PRINT</td>
<td>Copies work file or specified permanent file to SLO file.</td>
</tr>
<tr>
<td>PUNCH</td>
<td>Copies work file or specified permanent file to SBO file.</td>
</tr>
<tr>
<td>REPLACE</td>
<td>Replaces existing lines with new lines.</td>
</tr>
<tr>
<td>Command</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>RUN</td>
<td>Copies work file or specified file into batch stream (same as the BATCH directive).</td>
</tr>
<tr>
<td>SAVE</td>
<td>Saves work file compressed in permanent file.</td>
</tr>
<tr>
<td>SCRATCH</td>
<td>Deletes a permanent file.</td>
</tr>
<tr>
<td>SET DELTA</td>
<td>Sets an increment for line numbering.</td>
</tr>
<tr>
<td>SET TABS</td>
<td>Modifies tab settings.</td>
</tr>
<tr>
<td>SET VFA</td>
<td>Sets automatic verification.</td>
</tr>
<tr>
<td>SET VFN</td>
<td>Inhibits automatic verification.</td>
</tr>
<tr>
<td>SHOW</td>
<td>Shows current line increment, files, or tab settings.</td>
</tr>
<tr>
<td>STORE</td>
<td>Stores work file uncompressed in permanent disc file.</td>
</tr>
<tr>
<td>USE</td>
<td>Copies a permanent file into a cleared work file.</td>
</tr>
<tr>
<td>WORKFILE</td>
<td>Accesses a different work file.</td>
</tr>
</tbody>
</table>
REFERENCES

Gould Inc., S.E.L. Computer Systems Division Manuals:


Computer Products, Inc., Measurement and Control Systems Division:

11. RTP7430 Series Digital and RTP7431/RTP7433 Series Universal Input/Output Controllers, October 1984, PN 980-0070-004X.


15. RTP7438/50 8-Channel Analog Input/Output Card Technical Manual, May 1984, PN 980-0021-244A.
Colorado Data Systems:

16. 53A Smart Hardware System Operating Manual
APPENDIX A

SRTL SUBROUTINE CALLS
4.2.2 M:ACTIV

The M:ACTIV subroutine activates a specified task. The task assumes the owner name of the caller.

Calling Sequence

CALL M:ACTIV (taskname, [istatus], [*label])

- **taskname** (An INTEGER*8 variable that specifies the load module name. This argument must be one to eight ASCII characters, left justified and blank filled.)

- **istatus** (An INTEGER variable. If specified, the type of error that occurred during allocation is returned. Possible istatus values are:
  
  0  Successful activation.
  1  Invalid attempt to multicopy a unique task.
  2  Specified file not in System Directory.
  3  File is password protected.
  4  File does not contain valid data.
  5  No dispatch queue entry available.
  6  Read error on System Directory.
  7  Read error on load module.
  8  No free MIDL space.
  9  Insufficient memory.
  10 No physical memory available.
  50 Missing parameter (e.g., taskname).

- **label** (A statement label to which control is returned if an error exists.)

Programming Consideration

If istatus and *label are omitted and an error occurs, the current task aborts with an RSxx, where xx is one of the listed istatus codes.

4.2.20 M:RSUM

The M:RSUM subroutine resumes a suspended task.

Calling Sequence

CALL M:RSUM (itask, *label)

- **itask** (A task name or task number. A task name must be one to eight ASCII characters, left justified and blank filled. A task number must be right justified in the doubleword and zero filled.)

- **label** (The statement label to which control is returned if the task is not in the CPU dispatch queue.)

Programming Considerations

If the task is not suspended or not in CPU dispatch queue, the request is ignored.

Both the task making the M:RSUM call and the task being resumed must have the same ownername.

The suspended task must have been cataloged into the system directory.
4.2.23 M:SSPND

The M:SSPND subroutine suspends the calling task for either a specified number of time units or an indefinite time, as requested (the time unit is set at SYSGEN). A one-shot timer entry resumes a task suspended for a specified time interval. M:RSUM resumes either a task suspended for an indefinite time interval or a task suspended for a specified number of time units that have not yet expired. To suspend another task, use the subroutine X:SUSP.

Calling Sequence

CALL M:SSPND (itime, *label)

itime An INTEGER variable interpreted as follows:

0 A suspension for an indefinite period of time.
+n The positive number of units to elapse before the caller is resumed. The actual time elapsed can vary by one time unit because of system design.

*label The statement label to which control is returned if timed suspension is requested and no timer entries are available.

4.2.25 M:TDAY

The M:TDAY subroutine returns the time of day as computed from the real-time clock interrupt counter. The counter is initialized by a SYSGEN parameter. The clock rolls over at midnight.

Calling Sequence

CALL M:TDAY (itime)

itime An INTEGER*1 array that contains, upon return, the following four elements:

itime(1) Hours (0-23)
itime(2) Minutes (0-59)
itime(3) Seconds (0-59)
itime(4) Number of interrupts (within current second)
4.3.1 X:ANYW

The X:ANYW subroutine places the calling task in a state waiting for the completion of any no-wait request, the receipt of a message, or a break interrupt. The task is removed from the associated ready-to-run list and placed in the any-wait list. A return is not made until one of the wait conditions has been satisfied or until the specified time-out value has expired.

Calling Sequence

CALL X:ANYW (itime,[istatus],[*label])

itime An INTEGER variable interpreted as follows:

0 If wait for an indefinite period is requested.
-n Contains the negative number of time units to elapse before the wait is terminated. The actual time elapsed can vary by one time unit because of system design.

istatus An INTEGER variable. If specified, istatus is set to a completion code upon return from the subroutine. Possible istatus values are:

0 Normal completion.
47 Invalid time interval request.
50 Missing parameter.
51 Invalid parameter.

*label The statement label to which control is returned if an error exists.

Programming Consideration

If istatus and *label are omitted and an error occurs, the current task aborts with an RSxx, where xx is one of the listed istatus values.
The X:GMSGP subroutine, when called from the message receiver routine of a task that has received a message interrupt, transfers message parameters into the designated receiver buffer and posts the owner name and task number of the sending task into the Parameter Receive Block (PRB).

**Calling Sequence**

CALL X:GMSGP (prbname,[istatus],[*label])

- **prbname** An INTEGER array that specifies the PRB. Refer to the MPX-32 System Reference Manual, Volume 1, for a description of the contents of the PRB. Note that the parameter receiver buffer address within the PRB must be aligned on a word boundary.

- **istatus** An INTEGER variable. If specified, istatus is set to a completion code upon return from the subroutine. Possible istatus values are:
  
<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal status.</td>
</tr>
<tr>
<td>1</td>
<td>Invalid PRB address.</td>
</tr>
<tr>
<td>2</td>
<td>Invalid receiver buffer address.</td>
</tr>
<tr>
<td>3</td>
<td>No active send request.</td>
</tr>
<tr>
<td>4</td>
<td>Receiver buffer length exceeded.</td>
</tr>
</tbody>
</table>

- **label** The statement label to which control is returned if an error exists.

**Programming Consideration**

If istatus and *label are omitted and an error occurs, the current task aborts with an RSxx, where xx is one of the listed istatus values.

### 2.7.6.2 Parameter Receive Block (PRB)

The Parameter Receive Block (PRB) is used to control the storage of passed parameters into the receiver buffer of the destination task. The same format PRB is used for both message and run requests. The address of the PRB must be presented when either the M.GMSGP or M.GRUNP services are invoked by the receiving task.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0</strong> Status</td>
<td>(PRB.ST) Status</td>
</tr>
<tr>
<td></td>
<td>Parameter receiver buffer address</td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>Receiver buffer length (Bytes) (PRB.RBL)</td>
</tr>
<tr>
<td></td>
<td>Number of bytes actually received (PRB.ARQ)</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>Owner name of sending task (Word 1)</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>Owner name of sending task (Word 2)</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>Task number of sending task</td>
</tr>
</tbody>
</table>

*Figure 2-5. Parameter Receive Block (PRB)*
WORD 0

Bits 0-7  Status-value encoded status byte

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal status</td>
</tr>
<tr>
<td>1</td>
<td>Invalid PRB address (PRB.ER01)</td>
</tr>
<tr>
<td>2</td>
<td>Invalid receiver buffer address or size detected during parameter validation (PRB.RBAE)</td>
</tr>
<tr>
<td>3</td>
<td>No active send request (PRB.NSRE)</td>
</tr>
<tr>
<td>4</td>
<td>Receiver buffer length exceeded (PRB.RBLE)</td>
</tr>
</tbody>
</table>

Bits 8-31  Parameter Receiver Buffer Address - This field contains the word address of the buffer, into which the sent parameters are stored.

WORD 1

Bits 0-15  Receiver Buffer Length - Contains the length of the receiver buffer (0-768 bytes).

Bits 16-31  Number of Bytes Actually Received - This value is set by the operating system and is clamped to a maximum equal to the receiver buffer length.

WORDS 2,3

Bits 0-63  Ownername of Sending Task - Set by the operating system to contain the ownername of the task which issued the parameter send request.

WORD 4

Bits 0-31  Task Number of Sending Task - Set by the operating system to contain the task activation sequence number of the task which issued the parameter send request.
The X:ID subroutine obtains information about an active task, including the calling task, when one of the following parameters is known:

- Task number
- Task load module name
- Owner name
- Pseudonym name of the task

The caller must supply at least one of these parameters; remaining parameters are returned by the subroutine. Repeated calls may be made to the subroutine to find all copies of a multicopied task.

**Calling Sequence**

```fortran
CALL X:ID (index, taskno, taskname, ownername, pseudo, istatus, *label)
```

- **index**
  An INTEGER variable that must be zero for the initial search. This argument is used by the system subroutine to control the points at which previous searches are discontinued and a search of the dispatch queue is begun. Index must not be a constant because the X:ID subroutine updates the contents of this parameter for retrieval of further entries when repeated calls are made. When all matching tasks are identified, index is returned with value zero.

- **taskno**
  An INTEGER variable that specifies the task number. It must be set to zero if the task number is unknown.

- **taskname**
  An INTEGER*8 variable or character variable that specifies the task name. This argument must be one to eight ASCII characters, left justified and blank filled.

- **ownername**
  An INTEGER*8 variable or character variable that specifies the task's owner name. This argument must be one to eight ASCII characters, left justified and blank filled. If the task owner name is unknown, ownername must contain either a zero or all blanks.

- **pseudo**
  An INTEGER*8 variable or character variable that specifies pseudonym. This argument must be one to eight ASCII characters, left justified and blank filled. If the pseudonym is unknown, pseudo must contain either a zero or all blanks.

- **istatus**
  An INTEGER variable. If specified, this argument is set to a completion code upon return from the subroutine. Possible istatus values are:

  0  Normal completion.
  50 Missing parameter.
  51 Task not found.
  52 All tasks found.

- ***label**
  The statement label to which control is returned if an error exists.

**Programming Consideration**

If istatus and *label are omitted and an error occurs, the current task aborts with an RSxx, where xx is one of the listed istatus values.
4.3.26 X:RCVR

The X:RCVR subroutine establishes the address of a routine that is to be entered to receive messages sent by other tasks.

Calling Sequence

CALL X:RCVR (*label1, istatus, *label2)

*label1 The statement label of the beginning of the task's message receiver routine.

istatus An INTEGER variable. If specified, this argument is set to a completion code upon return from the subroutine. Possible istatus values are:

0 Normal completion.
50 Missing parameter.
51 Parameter out of range (invalid receiver address).

*label2 The statement label to which control is returned if an error exists.

Programming Consideration

If istatus and *label2 are omitted and an error occurs, the current task aborts with an RSxx, where xx is one of the listed istatus values.

X:RSML
The X:SMSGR subroutine sends up to 768 bytes to a specified destination task. This subroutine may also accept up to 768 bytes as return parameters.

Calling Sequence

CALL X:SMSGR (ipsb,[istatus],[*label])

ipsb  An INTEGER array that specifies the Parameter Send Block (PSB). Note that the send buffer address and the return parameter buffer address within the Parameter Receive Block (PRB) must be aligned on a word boundary.

istatus  An INTEGER variable. If specified, this argument is set to a completion code upon return from the subroutine. Possible istatus values are:

0  Normal initial status.
1  Task not found in Dispatch Queue Entry (DQE).
10 Invalid priority.
11 Invalid send buffer address.
12 Invalid return buffer address.
13 Invalid no-wait mode end-action routine address.
14 Memory pool unavailable.
15 Destination task queue depth exceeded.
16 Invalid PSB address.

*label  The statement label to which control is returned if an error exists.

Programming Consideration

If istatus and *label are omitted and an error occurs, the current task aborts with an RSxx, where xx is one of the listed istatus values.

2.7.6.1 Parameter Send Block (PSB)

The Parameter Send Block (PSB) is used to describe a send request issued from one task to another. The same PSB format is used for both message and run requests. The address of the PSB (doubleword bounded) must be presented as an argument when either the M.SMSGR or M.SRUNR services are invoked.

When a load module name is supplied in Words 0 and 1 of the PSB, the operating system defaults to a search in the system directory only. For activations in other than the system directory, a pathname or RID vector must be supplied.
Please note a task number, not a load module name, must be used if sending a message request or if sending a run request to a multicopied task which is waiting for a run request.

WORD

<table>
<thead>
<tr>
<th>Bit 7-8</th>
<th>Bit 15-16</th>
<th>Bit 23-24</th>
<th>Bit 31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load module name (or task number if message or run request to multicopied task)</td>
<td>Reserved</td>
<td>Number of bytes to be sent (PSB.SQUA)</td>
<td></td>
</tr>
<tr>
<td>Load module name or pathname vector or RID vector if activation (or zero if message or run request to multicopied task)</td>
<td>Reserved</td>
<td>Send buffer address (PSB.SBA)</td>
<td></td>
</tr>
<tr>
<td>Priority (PSB.PRI)</td>
<td>Reserved</td>
<td>Return parameter buffer length (bytes) (PSB.RPBL)</td>
<td>Number of bytes actually returned (PSB.ACRP)</td>
</tr>
<tr>
<td>Reserved</td>
<td>Return parameter buffer address (PSB.RBA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reserved</td>
<td>No-wait request end action address (PSB.EAA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completion status (PSB.CST)</td>
<td>Processing start status (PSB.IST)</td>
<td>User Status (PSB.UST)</td>
<td>Options (PSB.OPT)</td>
</tr>
</tbody>
</table>

Figure 2-4. Parameter Send Block (PSB)

WORD 0

Bits 0-31

For Send Message: Task Number of the task to receive the message.
For Run Request: Zero if using pathname vector or rid vector in word 1, else task number (word 1 must be zero), else characters 1-4 of the name of the load module to receive the run request.
WORD 1

Bits 0-31
For Send Message: Zero.
For Run Request: Zero if using task number in word 0, else pathname vector or rid vector (word 0 must be zero), else characters 5-8 of the load module to receive the run request.

WORD 2

Bits 0-7
Priority - This field contains the send request priority (1-64). When sending messages, this field indicates the priority of the message in the queue. When sending run requests, this field indicates the execution priority of the task to be activated. If the value of this field is zero, the priority defaults to the execution priority of the sending task. This field is examined for all sending tasks. The requested message or run request priority must be within the field's range. For unprivileged tasks, the requested priority must be lower or equal to the sending task's priority. If the requested priority is not within the field's range, an error occurs.

Bits 8-15
Reserved.

Bits 16-31
Number of Bytes to be Sent - This field specifies the number of bytes to be passed (0-768) with the message or run request.

WORD 3

Bits 0-7
Reserved.

Bits 8-31
Send Buffer Address - This field contains the word address of the buffer containing the parameters to be sent.

WORD 4

Bits 0-15
Return Parameter Buffer Length - Contains the maximum number of bytes (0-768) that may be accepted as returned parameters.

Bits 16-31
Number of Bytes Actually Returned - This field is set by the send message or run request service upon completion of the request.

WORD 5

Bits 0-7
Reserved.

Bits 8-31
Return Parameter Buffer Address - Contains the word address of the buffer into which any returned parameters will be stored.
WORD 6

Bits 0-7
Reserved.

Bits 8-31
No-Wait Request End Action Address - Contains the address of a user routine to be executed at an interrupt level upon completion of the request.

WORD 7

Bits 0-7
Completion Status - This bit encoded field contains completion status information posted by the operating system as follows:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning When Set</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Operation in progress (busy).</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Destination task was aborted before completion of processing for this request.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Destination task was deleted before completion of processing for this request.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Return parameters truncated (attempted return exceeds return parameter buffer length).</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Send parameters truncated (attempted send exceeds destination task receiver buffer length).</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>User end action routine not executed because of task abort outstanding for this task (may be examined in abort receiver to determine incomplete operation).</td>
<td></td>
</tr>
<tr>
<td>6-7</td>
<td>Reserved.</td>
<td></td>
</tr>
</tbody>
</table>
Bits 8-15  Processing Start (Initial) Status - This value encoded field contains initial status information posted by the operating system as follows:

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal initial status.</td>
</tr>
<tr>
<td>1</td>
<td>Message request task number invalid.</td>
</tr>
<tr>
<td>2</td>
<td>Run request load module name not found in directory.</td>
</tr>
<tr>
<td>3</td>
<td>Reserved.</td>
</tr>
<tr>
<td>4</td>
<td>File associated with run request load module name does not have a valid load module format.</td>
</tr>
<tr>
<td>5</td>
<td>Dispatch Queue Entry (DQE) space is unavailable for activation of the load module specified by a run request.</td>
</tr>
<tr>
<td>6</td>
<td>An I/O error was encountered while reading the directory to obtain the file definition of the load module specified in a run request.</td>
</tr>
<tr>
<td>7</td>
<td>An I/O error was encountered while reading the file containing the load module specified in a run request.</td>
</tr>
<tr>
<td>8</td>
<td>Memory unavailable.</td>
</tr>
<tr>
<td>9</td>
<td>Invalid task number for run request to multicopied load module in RUNW state.</td>
</tr>
<tr>
<td>10</td>
<td>Invalid priority specification. Note: An unprivileged task may not specify a priority which is higher than its own execution priority.</td>
</tr>
<tr>
<td>11</td>
<td>Invalid send buffer address or size.</td>
</tr>
<tr>
<td>12</td>
<td>Invalid return buffer address or size.</td>
</tr>
<tr>
<td>13</td>
<td>Invalid no-wait mode end action routine address.</td>
</tr>
<tr>
<td>14</td>
<td>Memory pool unavailable.</td>
</tr>
<tr>
<td>15</td>
<td>Destination task receiver queue is full.</td>
</tr>
</tbody>
</table>

Bits 16-23  User Status - As defined by sending and receiving tasks.
### Bits 24-31: Options

This field contains user request control specification. It is bit encoded as follows:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning When Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Request is to be issued in no-wait mode.</td>
</tr>
<tr>
<td>25</td>
<td>Do not post completion status or accept return parameters. This bit is examined only if bit 24 is set. When this bit is set, the request is said to have been issued in the &quot;no call-back mode&quot;.</td>
</tr>
</tbody>
</table>

---

### Calling Sequence

**CALL X:XMEA**

This X:XMEA subroutine exits an end action routine associated with a no-wait message send request.

---

**4.3.36 X:XMEA**

(ref. 5)
4.3.37 X:XMSGR

The X:XMSGR subroutine exits the message receiver routine of the calling task. This subroutine must be called after the task has received a message from another task.

Calling Sequence

CALL X:XMSGR (rxbname,[istatus],[*label])

rxbname An INTEGER array that specifies the Receiver Exit Block (RXB).

istatus An INTEGER variable. If specified, this argument is set to a completion code upon return from the subroutine. Possible istatus values are:

0 Normal completion.
50 Missing parameter.
51 Parameter out of range.

*label The statement label to which control is returned if an error exists.

Programming Consideration

If istatus and *label are omitted and an error occurs, the current task aborts with an RSxx, where xx is one of the listed istatus values.

2.7.6.3 Receiver Exit Block (RXB)

The Receiver Exit Block (RXB) is used to control the return of parameters and status from the destination (receiving) task to the task that issued the send request. It is also used to specify receiver exit-type options. The same format RXB is used for both messages and run requests. The address of the RXB must be presented as an argument when either the M.XMSGR or M.XRUNR services are called.
WORD

<table>
<thead>
<tr>
<th>0</th>
<th>7 8</th>
<th>15 16</th>
<th>23 24</th>
<th>31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return status (RXB.ST)</td>
<td>Return parameter buffer address (RXB.RBA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Options (RXB.OPT)</td>
<td>Reserved</td>
<td>Number of bytes to be returned (RXB.RQ)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2-6. Receiver Exit Block (RXB)

WORD 0

Bits 0-7 Return Status - Contains status as defined by the receiver task. Used to set the user status byte in the Parameter Send Block (PSB) of the task which issued the send request.

Bits 8-31 Return Parameter Buffer Address - Contains the word address of the buffer containing the parameters which are to be returned to the task which issued the send request.

WORD 1

Bits 0-7 Options - This field contains receiver exit control options. It is encoded as follows:

<table>
<thead>
<tr>
<th>Value</th>
<th>Exit Type</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>M.XRUNR</td>
<td>Wait for next run request.</td>
</tr>
<tr>
<td></td>
<td>M.XMSGR</td>
<td>Return to point of task interrupt.</td>
</tr>
<tr>
<td>1</td>
<td>M.XRUNR</td>
<td>Exit task, process any additional run requests. If none exist, perform a standard exit.</td>
</tr>
<tr>
<td></td>
<td>M.XMSGR</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Bits 8-15 Reserved.

Bits 16-31 Number of Bytes to be Returned - This field contains the number of bytes (0-768) of information to be returned to the sending task.
4.3.38  X:XNWIO

The X:XNWIO subroutine must be called to exit a no-wait I/O end action routine (both normal and error end action routines). The subroutine returns control to the point of interruption.

Calling Sequence

CALL X:XNWIO

6.2.4.1  IBITS

The IBITS function extracts a specified bit subfield from a specified argument. The result field is right justified and the remaining bits in the returned value are set to zero.

Calling Sequence

iresult = IBITS (ivalue, isrcpos, len)

ivalue, isrcpos, len   Integer expressions

A bit field is extracted from the value of ivalue, starting from bit position isrcpos and extending left for len bits. The value of (isrcpos+len) must be less than or equal to 32.
APPENDIX B

ANALOG-TO-DIGITAL INTERFACE CALLS
ADIUSR is a subroutine used to support the feature of the ADI accepting a user buffer in which to build the physical IOCBs. ADIUSR is only a calling mechanism, as the user will be responsible for constructing the proper IOCH and IOCBs and defining the user buffer. This service will be available only to resident tasks.

Calling Sequence:

CALL ADIUSR(ioch,userbuff,sizebuff,busy,[eobeaddr])

(or)

BL ADIUSR
DATAW 5W or 4W
ACW IOCH
ACW USERBUFF
ACW SIZEBUFF
ACW BUSY
ACW EOBADDR (Optional)

INTEGER*n

ioch    n=4    specifies the address of the IOCH.
userbuff n=4    specifies address of user buffer in which to build the physical IOCBs.
sizebuff n=4    specifies the size of the user buffer in which to build the physical IOCBs (must be six times the number of IOCBs plus 10 (words)).
baby    n=4    specifies error return address.
eobeaddr n=4    specifies the no-wait I/O EOB end action address (Optional).
1.9.3 Digital Output (DO) Subsystem

Digital Output transfers can be used with the Digital or Universal Input/Output subsystems which contain various types of output option channels.

Output can be performed in the Random, Repeat, or Sequential mode. The Repeat capability is specified by setting bit 7 of the Channel Address Halfword (CAHW) and resetting bit 1 of the IOCB Opcode.

To provide better performance on Digital Outputs using the Sequential mode, the ADI automatically increments the subsystem address after the last channel in a subsystem has been processed. This allows several subsystems to be addressed in sequential mode with a single IOCB, eliminating the need for multiple IOCBs with Command Chaining.

The Output mode provides the capability to bypass the ready test. When bit 3 of the Channel Address Halfword (CAHW) is set, the specified function is performed immediately, whether or not the channel is ready. This feature should be used when processing analog inputs in a Universal subsystem. To process analog inputs, both an output sequence and an input sequence are required. The output sequence is needed to start the digitizing of the data, while the input sequence is needed to input the digitized data. The Bypass Ready Capability should be specified on the output sequence to allow all digitizing to be started in parallel. Without the ability to bypass the ready status, the digitizing of the second channel of multichannel input would not be started until the digitizing of the first channel was complete.
The Command Transfer operation which is specified in the IOCB Opcode is also provided by the ADI controller. When this mode is specified, the ADI transfers only the Channel Address Halfwords (CAHW) to the subsystem and channel selected by the CAHW. The CAHW contains the channel dependent control bits which allow the software to command a block of channels (e.g. enable or disable interrupts) without performing an actual data transfer. These channels may be either input or output.

These channel dependent control bits are also passed to the subsystems on data transfer (Digital Inputs or Digital Outputs). The Command Transfer function should be specified only for Digital Outputs in Random or Sequential transfer modes. The Repeat mode is not available when using command transfers.

1.9.4 Digital Input (DI) Subsystem

Digital Input transfers are used with the Digital or Universal Input/Output subsystems, which contain various types of input option channels. Digital input uses most of the same addressing modes as Digital Output, however the Bypass Ready capability is not provided. A Digital Input transfer will not complete until the channel provides ready status to the ADI. When an operation specifies an input sequence of two channels, the second channel will not be addressed until the first channel has completed the data transfer. This mode of operation will cause the ADI to stop processing a sequence of channels in the event a nonexistent channel is addressed. If required, a software watchdog timer routine can be provided to issue a terminate to recover from such a situation.
### IOCH I/O Control Header (Software Related)

**NOTE:** Register 1 must point to this list.

<table>
<thead>
<tr>
<th>WORD</th>
<th>Mode</th>
<th>Dev Addr</th>
<th>Software Status Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>unsure</td>
<td>unsure</td>
<td>unsure</td>
</tr>
<tr>
<td>1</td>
<td>ZERO</td>
<td>unsure</td>
<td>HARDWARE I/O COMMAND ADDRESS (LOGICAL)</td>
</tr>
<tr>
<td>2</td>
<td>EXECUTABLE INSTRUCTION OR A NOP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 0 | 7 | 8 | 15 | 16 | 31 |

### IOCB I/O Control Block (Hardware Related)

<table>
<thead>
<tr>
<th>WORD</th>
<th>Opcode</th>
<th>Data Halfword Transfer Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>unsure</td>
<td>unsure</td>
</tr>
<tr>
<td>1</td>
<td>ZERO</td>
<td>24 BIT CHANNEL ADDRESS HALFWORD TABLE POINTER (LOGICAL)</td>
</tr>
<tr>
<td>2</td>
<td>ZERO</td>
<td>24 BIT DATA HALFWORD TABLE POINTER (LOGICAL)</td>
</tr>
<tr>
<td>3</td>
<td>STATUS POSTED BY IOM</td>
<td></td>
</tr>
</tbody>
</table>

| 0 | 7 | 8 | 15 | 16 | 31 |

### Figure 2-1. I/O Format Description

(Sheet 1 of 3)
BITS 0-7

<table>
<thead>
<tr>
<th>BIT</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Setting bit zero causes the I/O to be issued in the non-wait mode. If this bit is not set, the user's program will be suspended.</td>
</tr>
<tr>
<td>1</td>
<td>Setting this bit will cause the handler to inhibit the software time out feature of MPX-32.</td>
</tr>
<tr>
<td>2</td>
<td>Setting this bit will prohibit the I/O operation of the other device bus while this I/O command is being serviced by the handler.</td>
</tr>
<tr>
<td>3</td>
<td>Setting this bit specifies the user is to be asynchronously notified upon the completion of processing of an end-of-block (EOB) interrupt. (To use this feature, the I/O request must be issued in the no-wait mode and an EOB end action receiver address (register 8) must be supplied.)</td>
</tr>
<tr>
<td>4</td>
<td>Setting this bit indicates the physical IOCB(s) are to be constructed within the user's defined buffer and not in memory pool. (To use this feature, the user must supply the address of the buffer in register 4 and the size of the buffer in register 5 when initiating the I/O request.)</td>
</tr>
<tr>
<td>5</td>
<td>Setting this bit will convert a TIC I/O operation into an EOL to terminate the I/O operation. This bit has to be set by the user during the TIC I/O operation.</td>
</tr>
<tr>
<td>6, 7</td>
<td>Must be zero.</td>
</tr>
</tbody>
</table>

BITS 8-15

These bits contain the device address of the IOM that the user wishes to address.

BITS 16-31

Software status information. These 16 bits contain the software control and status information as described below.

<table>
<thead>
<tr>
<th>BIT</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>I/O in progress, this bit is set by the SVC processor when the I/O is initiated and is reset by the handler when end of list is recognized.</td>
</tr>
<tr>
<td>17</td>
<td>Error condition present. This bit is set by the handler whenever a hardware error has been detected.</td>
</tr>
<tr>
<td>18</td>
<td>Lost interrupt, this bit is set whenever the lost interrupt timer expires.</td>
</tr>
<tr>
<td>19</td>
<td>Must be zero. (The ADI handler uses bit 19 to indicate I/O completion has been reported to the exec.)</td>
</tr>
<tr>
<td>20</td>
<td>Must be zero. The ADI SVC processor uses bit 20 to indicate the IOCB(s) have been built within the user's buffer and all addresses have been converted to physical for processing by the ADI.</td>
</tr>
<tr>
<td>21-31</td>
<td>Must be zero.</td>
</tr>
</tbody>
</table>

WORD 1

BITS 0-7

Must be zero.

BITS 8-31

Hardware I/O command address pointer. This 24-bit address is placed in the T1 dedicated location to enable the IOM to process the user's IOCBs.

Note: Any unused address bits must be zero (bits 8-12 if 24-bit addressing is not permitted).

WORD 2

WORDS 2 of the IOCH allows the privileged user to have an instruction executed at the SI level of the handler, such as on RI instruction. If the user does not want to use this feature, he must place a NOP/NOP in this word. WORD 2 of the IOCH will be executed whenever an EOB or EOL interrupt occurs. This feature is only provided for the privileged user. WORD 2 of the IOCH is not executed if the user is unprivileged.

Figure 2-1. I/O Format Description
(Sheet 2 of 3)
### IOCB
#### HARDWARE RELATED

**WORD 0**

**OP-CODE - THESE 16 BITS PROVIDE THE USER WITH A MEANS OF CONTROLLING THE VARIOUS REAL-TIME PERIPHERALS WHICH MIGHT BE CONFIGURED.**

<table>
<thead>
<tr>
<th>BIT</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SET = INPUT; RESET = OUTPUT DATA TRANSFERS</td>
</tr>
<tr>
<td>1</td>
<td>SET = SEQUENTIAL; RESET = RANDOM CHANNEL ACCESS</td>
</tr>
<tr>
<td>2</td>
<td>SET = DIGITAL; RESET = ANALOG SUBSYSTEM</td>
</tr>
<tr>
<td>3</td>
<td>SET = CONTINUE; RESET = TERMINATE ON ERROR</td>
</tr>
<tr>
<td>4</td>
<td>SET = INTERRUPT ON END OF BLOCK (IOCB)</td>
</tr>
<tr>
<td>5</td>
<td>SET = TRANSFER IN CHANNEL</td>
</tr>
<tr>
<td>6</td>
<td>SET = COMMAND CHAIN</td>
</tr>
<tr>
<td>7</td>
<td>SET = COMMAND DATA TRANSFER (DO ONLY)</td>
</tr>
<tr>
<td>8 AND 9</td>
<td>= 0</td>
</tr>
<tr>
<td>10</td>
<td>SET = AUTO GAIN RANGE ENABLE (WRAI ONLY)</td>
</tr>
<tr>
<td>11</td>
<td>SET = OTD SCAN (WRAI ONLY)</td>
</tr>
<tr>
<td>12</td>
<td>SET = OTD - NEGATIVE (WRAI ONLY)</td>
</tr>
<tr>
<td>13-15</td>
<td>CONTAIN SUBSYSTEM ADDRESS (ANALOG ONLY)</td>
</tr>
</tbody>
</table>

**BITS 16-31**

TRANSFER QUANTITY. **NOTE:** THE USER IS TO PROVIDE THE HALFWORD TRANSFER QUANTITY.

**WORD 1**

**BITS 0-7**

MUST BE ZERO

**BITS 8-31**

CONTAIN THE 24-BIT CHANNEL ADDRESS HALFWORD TABLE POINTER OR, FOR A TIC, THE ADDRESS OF THE NEXT IOCB (HARDWARE).

**WORD 2**

**BIT 0**

THIS BIT IS SET BY THE ADI SVC PROCESSOR WHEN AN UNPRIVILEGED USER PERFORMS I/O, THIS TELLS THE SYSTEM THAT THIS BUFFER ADDRESS HAS BEEN VALIDATED AND, THEREFORE, REDUCES SYSTEM OVERHEAD.

**BITS 1-7**

MUST BE ZERO

**BITS 8-31**

24-BIT INPUT/OUTPUT DATA BUFFER POINTER.

**WORD 3**

**BITS 0-31**

ARE INITIALLY SET TO ZERO BY THE USER AND WILL CONTAIN ERROR STATUS ONLY WHEN IT OCCURS. SEE FIGURE 2-2.

---

**Figure 2-1. I/O Format Description**

(Sheet 3 of 3)
IOCB status is posted in Word 3 of the last IOCB processed within an IOCL. Status is posted upon normal or abnormal completion.

Figure 2-2. IOCB Status (Word 3 of the IOCB)
**Figure 2-1. RTP Command and Data Word Formats**

RTP7436 Universal Analog Input Gate card (ref.12)
### Table 2-7. PROCOM II Analog Input Addresses: Solid-State, Relay and High-Speed Wide-Range
Gates (8-Channel Differential Inputs)

<table>
<thead>
<tr>
<th>CARD SLOT</th>
<th>CARD DEVICE #</th>
<th>CHANNEL ADDRESSES</th>
<th>CH. #</th>
<th>CH. #</th>
<th>CH. #</th>
<th>CH. #</th>
<th>CH. #</th>
<th>CH. #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>64 ('40')</td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>68 ('44')</td>
<td></td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>72 ('48')</td>
<td></td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>76 ('4C')</td>
<td></td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>80 ('50')</td>
<td></td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
<td>37</td>
</tr>
<tr>
<td>6</td>
<td>84 ('54')</td>
<td></td>
<td>40</td>
<td>41</td>
<td>42</td>
<td>43</td>
<td>44</td>
<td>45</td>
</tr>
<tr>
<td>7</td>
<td>88 ('58')</td>
<td></td>
<td>48</td>
<td>49</td>
<td>50</td>
<td>51</td>
<td>52</td>
<td>53</td>
</tr>
<tr>
<td>8</td>
<td>72 ('5C')</td>
<td></td>
<td>56</td>
<td>57</td>
<td>58</td>
<td>59</td>
<td>60</td>
<td>61</td>
</tr>
</tbody>
</table>

**NOTE:** The A/D card occupies one card slot. Those addresses will not be available for input channels.

YY' = hexadecimal

### Table 2-8. Universal Analog Input Card Set Programmable Gain Bit Selection
For Various Full Scale Input Ranges of the Relay and High-Speed Wide-Range Gates

<table>
<thead>
<tr>
<th>DATA OUTPUT WORD</th>
<th>PROGRAMMABLE GAINS</th>
<th>FULL SCALE INPUT OF RELAY GATE CARD</th>
<th>FULL SCALE INPUT OF SOLID-STATE GATE CARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 12</td>
<td>BIT 13</td>
<td>BIT 14</td>
<td>BIT 15</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

RTP7436 Universal Analog Input —gate card (ref 12).
Figure 3-4. RTP Command (Input Data Transfers): Word Format
RTP7438/50 8-Channel Analog Input/Output (ref. 15)

Figure 3-5. RTP Input (Input Data Transfers): Word Format
RTP7438/50 8-Channel Analog Input/Output (ref. 15)
### Figure 3-6. RTP Output (Input Data Transfers); Word Format

RTP7438/50 8-Channel Analog Input/Output (ref. 15)
Figure 3-8. RTP Command (Output Data Transfers): Word Format

RTP7438/50 8-Channel Analog Input/Output (ref.15)

Figure 3-9. RTP Output (Output Data Transfers): Word Format

RTP 7438/50 8-Channel Input/Output (ref.15)
RTP I/O Card Slot 7, PSI Sensor #1
- Input analog data on
  Pin 404  CH 1

RTP I/O Card Slot 8, PSI Sensors 2,3,4,5
- Input analog data on
  Pin 407  CH 2
  410  CH 3
  413  CH 4
  416  CH 5

Channel Selection Code For ESP-16 I/O Pressure Sensors

<table>
<thead>
<tr>
<th>RTP I/O Pin #5</th>
<th>80 IFB Pin #5</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>301 CH0</td>
<td>29</td>
<td>A0</td>
</tr>
<tr>
<td>304 CH1</td>
<td>27</td>
<td>A1</td>
</tr>
<tr>
<td>307 CH2</td>
<td>25</td>
<td>A2</td>
</tr>
<tr>
<td>310 CH3</td>
<td>21</td>
<td>A3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Channel No.</th>
<th>A3</th>
<th>A2</th>
<th>A1</th>
<th>A0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
### Command Word Format

<table>
<thead>
<tr>
<th>BIT NO.</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMMAND</td>
<td>NOT USED</td>
<td>I^1</td>
<td>I^0</td>
<td>M^1</td>
<td>M^0</td>
<td>NOT USED</td>
<td>C</td>
<td>NOT USED</td>
<td>2^3</td>
<td>2^2</td>
<td>2^1</td>
<td>2^0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Channel Address**:
  - 1: Clear counter to zeros
  - 0: No change in counter

- **Mode**:
  - 0 0: No change in mode
  - 0 1: Selects random access mode
  - 1 0: Selects sequential mode
  - 1 1: Invalid code

- **Interrupt Status**:
  - 0 0: No change in interrupt status
  - 0 1: Disables interrupt
  - 1 0: Enables interrupt
  - 1 1: Invalid code

### Data Input Format

<table>
<thead>
<tr>
<th>BIT NO.</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA</td>
<td>2^15</td>
<td>2^14</td>
<td>2^13</td>
<td>2^12</td>
<td>2^11</td>
<td>2^10</td>
<td>2^9</td>
<td>2^8</td>
<td>2^7</td>
<td>2^6</td>
<td>2^5</td>
<td>2^4</td>
<td>2^3</td>
<td>2^2</td>
<td>2^1</td>
<td>2^0</td>
</tr>
</tbody>
</table>

Figure 3-6. Command and Data Word Formats

RTP7435/33 Pulse Counter (ref. 13)
**Figure 3-1. RTP Command; Word Format**

RTP7438/80 Synchro Resolver-to-Digital (ref. 14)

**Figure 3-2. Data Input Word; Word Format**

RTP7438/80 Synchro Resolver-to-Digital (ref. 14)

**Table 3-1. RTP Data Input Word; Bit Weights**

<table>
<thead>
<tr>
<th>BIT NO</th>
<th>2^N</th>
<th>LSB AS % OF FULL SCALE</th>
<th>RADIANS/BIT</th>
<th>DEGREES/BIT</th>
<th>MINUTES/BIT</th>
<th>SECONDS/BIT</th>
<th>MILLS/BIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
<td>50</td>
<td>3.14159265</td>
<td>180</td>
<td>10,800</td>
<td>64,800</td>
<td>3200</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>25</td>
<td>1.57079633</td>
<td>90</td>
<td>5,400</td>
<td>324,000</td>
<td>1600</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>12.5</td>
<td>.78539816</td>
<td>45</td>
<td>2,700</td>
<td>162,000</td>
<td>800</td>
</tr>
<tr>
<td>3</td>
<td>16</td>
<td>6.25</td>
<td>.39269908</td>
<td>22.5</td>
<td>1,350</td>
<td>81,000</td>
<td>400</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>3.125</td>
<td>.19634954</td>
<td>11.25</td>
<td>675</td>
<td>40,500</td>
<td>200</td>
</tr>
<tr>
<td>5</td>
<td>64</td>
<td>1.5625</td>
<td>.09814777</td>
<td>5.625</td>
<td>337.5</td>
<td>20,250</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>128</td>
<td>0.78125</td>
<td>.04908739</td>
<td>2.8125</td>
<td>168.75</td>
<td>10,125</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>256</td>
<td>0.390625</td>
<td>.02454369</td>
<td>1.40625</td>
<td>84.375</td>
<td>5,062.5</td>
<td>25</td>
</tr>
<tr>
<td>8</td>
<td>512</td>
<td>0.1953125</td>
<td>.1272185</td>
<td>.703125</td>
<td>42.1875</td>
<td>2,531.25</td>
<td>12.5</td>
</tr>
<tr>
<td>9</td>
<td>1024</td>
<td>0.09765625</td>
<td>.06135922</td>
<td>.3515625</td>
<td>21.09375</td>
<td>1,265.625</td>
<td>6.25</td>
</tr>
<tr>
<td>10</td>
<td>2048</td>
<td>0.04882813</td>
<td>.03067966</td>
<td>.1757813</td>
<td>10.54688</td>
<td>632.8125</td>
<td>3.125</td>
</tr>
<tr>
<td>11</td>
<td>4096</td>
<td>0.02441406</td>
<td>.01532358</td>
<td>.0878906</td>
<td>5.27344</td>
<td>316.4062</td>
<td>1.5625</td>
</tr>
<tr>
<td>12</td>
<td>8192</td>
<td>0.01220703</td>
<td>.00766999</td>
<td>.0439453</td>
<td>2.63672</td>
<td>156.2031</td>
<td>0.78125</td>
</tr>
<tr>
<td>13</td>
<td>16384</td>
<td>0.00610352</td>
<td>.00383350</td>
<td>.0219772</td>
<td>1.31836</td>
<td>79.1016</td>
<td>0.390625</td>
</tr>
</tbody>
</table>

15th Least Significant Bit
1 Radian = 57.2957795

**RTP7438/80 Synchro Resolver-to-Digital** (ref. 14)
APPENDIX C

IEEE-488 CONTROLLER CALLS
This subroutine allows a task to gain complete control of an IEEE-488 bus controller, thus creating a single task environment. In a single task environment, you must set up file control blocks (FCB) and logical input/output control lists (IOCL). IEEECST dynamically assigns the controller.

**Calling Sequence**

CALL IEEECST(contunit,name,fcb,time,status)

**Input:**
- **contunit**: an integer word variable or expression specifying the controller unit number.
- **name**: an 8 byte character variable, left-justified and space-filled, holding the controller name as specified to SYSGEN.
- **fcb**: the name of the 16 word FCB integer array to be used in all single task transfers for this controller.
- **time**: an integer word variable used to specify the amount of time the calling routine will wait for connection. A positive value represents the number of timer units to wait before returning an error status. A value of zero signifies an indefinite wait. A negative value signifies that anything but immediate connection will fail.

**Output:**
- **status**: an integer word variable that contains the status after execution of the called procedure.

**5.3.8 IEEEDST**

This subroutine disconnects a task running in single task mode and frees the controller for use by other tasks. Any parallel polls configured by subroutine IEEEPDC are automatically unconfigured by this call.

**Calling Sequence**

CALL IEEEDST(contunit,fcb,status)

**Input:**
- **contunit**: an integer word variable or expression specifying the controller unit number.
- **fcb**: the name of the 16 word FCB integer array used to connect the controller.

**Output:**
- **status**: an integer word variable that contains the status after execution of the called procedure.
5.3.10 IEEELOCF

This subroutine, which is equivalent to LCCF in FORTRAN-77*, returns the logical address of a variable. It is used mainly in the single task environment to establish I0CLs.

**Calling Sequence**

```
address=IEEELOCF(variable)
```

**Input:**

- `variable`: a variable name, subroutine name, or label (FORTRAN-77* only). A label is expressed as *n where n is the label number.

**Output:**

- `address`: the address of the specified variable.

5.3.26 IEEEXCPM

This subroutine provides a FORTRAN interface to the Execute Channel Program (EXCPM) entry for the handler in a single task environment.

**Calling Sequence**

```
CALL IEEEXCPM(fcb, status)
```

**Input:**

- `fcb`: the name of the 16 word FCB integer array used to connect the controller.

**Output:**

- `status`: an integer word variable that contains the status after execution of the called procedure. For further status information, FCB word 3 returns channel and device status while the sense buffer returns controller specific status.

**Programming Considerations**

1. You must set up a file control block (FCB), logical input/output command list (I0CL), and sense buffers before calling this routine.

2. I/O status is only checked for wait I/O. Otherwise, software status is returned in the status parameter. Examine the FCB and sense buffer for I/O status. A status value other than zero or three implies no I/O has been queued.
APPENDIX C

I/O COMMAND DOUBLEWORDS

C.1 Introduction

An I/O Command Doubleword (IOCD) contains information (e.g., command codes, buffer address, transfer count, and flags) describing an I/O operation. An I/O Command List (IOCL) comprises one or more IOCDs. All interface subroutines initiating I/O use IOCDs and IOCLs. In multitask mode, IOCLs are built by the interface subroutine. In single task mode, you are responsible for building IOCLs.

The IEEE-488 bus controller software uses the Execute Channel Program (EXCPM) facility for all I/O you initiate. This gives you direct control of the actions of the hardware. The EXCPM facility allows the use of physical or logical IOCLs, both of which will appear to be the IOCLs used to drive the hardware. However, note the following.

- An IOCL is specified as physical or logical by setting or resetting a bit in the FCB.

- Physical IOCLs use absolute buffer addresses. No address conversion is performed by the operating system. The IOCL is passed directly to the hardware. A task must be privileged and resident to use physical IOCLs.

- Privileged, resident tasks may also specify logical IOCLs.

- The address of the physical or logical IOCL is specified in word nine of the FCB.

- Full access to IOCLs and FCBs is available in the single task environment. Therefore, either physical or logical IOCLs can be used.

- Full access to IOCLs and FCBs is not available in the multitask environment. Therefore, only logical IOCLs can be used. The IOCL order is established by the interface subroutines to execute the required function.
The IOCD command field (Word 1, bits 0-7) specifies the command to be executed. Command codes (see Table C-1) are passed to the IEEE-488 bus controller for action. For example, the write control (WRTC) command instructs the controller to request an IOP write. The controller then transmits the data written to it by the IOP to a device or devices on the IEEE-488 bus (the ATN line is set to indicate the data is interpreted as IEEE-488 commands). The IOCD commands and their definitions are presented in Section C.3. Refer to the IEEE-488 Hardware Technical Manual for detailed information concerning each command.

The real data address field (Word 1, bits 8-31) contains the starting byte address of a data buffer. Data sent across the IEEE-488 bus (either to a device or from a device) as a result of an IOCD being executed are in the form of multiline messages, device dependent commands, or data. These messages, commands, and data are located at the address specified by the real data address field. For example, when a task calls IEEEREAD, untalk (UNT) is the first of several multiline messages sent across the bus to the specified device. The address of these multiline messages is specified in the real data address field of the IOCD. In the execution of an IOCD containing a read data (RDDA) command, the data buffer specified by the real data address field will receive data sent across the bus by the specified device.
The flags field (Word 2, bits 0-7) contains channel programming flag bits. When set, the bits indicate specific action to be taken as follows:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Data chain</td>
<td>The present operation continues once the current IOCD byte count is exhausted. The operation is continued using the real data address, control flags, and byte count of the next IOCD in sequence. The command field of the next IOCD is ignored.</td>
</tr>
<tr>
<td>1</td>
<td>Command chain</td>
<td>IOCL execution continues once the current IOCD byte count is exhausted. Execution continues using the command field, real data address, control flags, and byte count of the next IOCD in sequence.</td>
</tr>
<tr>
<td>2</td>
<td>Suppress incorrect length</td>
<td>When an incorrect length occurs in the status doubleword, command chaining is to continue.</td>
</tr>
<tr>
<td>3</td>
<td>Reserved</td>
<td>Must be zero.</td>
</tr>
<tr>
<td>4</td>
<td>Reserved</td>
<td>The Post Program Controlled Interrupt (PPCI) normally indicated by this flag bit is not available to users of this software.</td>
</tr>
<tr>
<td>5-7</td>
<td>Reserved</td>
<td>Must be zero.</td>
</tr>
</tbody>
</table>

Word 2 bits 8-15 are reserved and must be zero.

The byte count field (Word 2, bits 16-31) specifies the number of bytes to be transferred to or from memory. The byte count field in an IOCD that executes a read data (RDDA), for example, indicates the number of bytes to be transferred to memory beginning at the specified real data address.

C.3 IOCD Commands

Table C-1 lists the IOCD commands and their bit configuration. The IOP software convention for defining data lines differs from the IEEE-488 convention; the most significant bit for the IOP is bit 0, while the most significant bit for the IEEE-488 is bit 8. This manual uses the IOP convention, i.e., bit 0 is the most significant bit.

A brief description of each command follows Table C-1. For more detailed information about the IOCD commands, refer to the IEEE-488 Bus Controller Technical Manual.
C.3.15 Read Data Command \((\text{op code} = 02_{16})\)

The Read Data command causes data to be read by the controller by setting ATN false and requesting a read. If the controller is a slave, the Read Data command causes the controller to wait to be addressed by the master controller before receiving data from the master controller.

C.3.24 Write Control Command \((\text{op code} = 11_{16})\)

The Write Control command instructs the controller to request an IOP write. The data that are written to the controller are then sent across the IEEE-488 bus with the ATN line asserted, i.e., they are interpreted as multiline messages.

C.3.25 Write Data Command \((\text{op code} = 01_{16})\)

The Write Data command causes data to be sent across the IEEE-488 bus with the ATN line deasserted. When the controller is the slave, the write command causes the controller to request a single burst of data from the CPU and then wait to be addressed as a talker by the master controller. The controller then makes another CPU data request and begins transmitting data to the IEEE-488 bus.

C.4 IOCD Execution

IOCDs are executed by the IOP. The command specified within an IOCD is not passed to devices on the bus; rather, the command informs the IOP what operation is to be performed. For example, assume you want to read data from a digital nanovoltmeter on the IEEE-488 bus, and you are in the multitask environment (the necessary IOCDs are built by the interface subroutine). The procedure is as follows:

1. Prepare the bus by transmitting the unlisten multiline message.
2. Command the controller to listen.
3. Command the device, i.e., the nanovoltmeter, to talk.
4. Allow the transfer to take place by deasserting ATN with a command such as RDDA.
5. Prepare the bus once again by transmitting the unlisten and untalk multiline messages.
Figure 7-3. File Control Block
Table 7-3
FCB Bit Interpretations (Page 1 of 2)

C-9
Status for Extended I/O Devices Returned by Handlers

3/10 TIME Last command exceeded timeout value and was terminated
3/16 ECHO Echo on Channel
3/17 INT Post-Task-Controlled interrupt on channel
3/18 LEN Incorrect record length on channel
3/19 PROG Channel program check
3/20 DATA Channel data check
3/21 CTRL Channel control check
3/22 INTF Interface check
3/23 CHAI Channel chaining check
3/24 BUSY Controller/device busy
3/25 ST Controller/device status modified
3/26 CTR Controller end
3/27 ATTN Attention
3/28 CHA Channel end
3/29 DEV Device end
3/30 CHK Unit check
3/31 EXC Unit exception

Status for Non-Extended I/O Devices Returned by Handler

3/8-11 Test Testing Status as received from a 8000 level test
    Status device (TD) issued by handler
3/12-15 DCC Controller status (DCC) as received from a 4000
    Status level TD instruction
3/16-31 Device Device status as received from a 2000 level TD
    Status instruction. Not applicable for PT, CR, or TY. See
    Table 7-4.

Special I/O Status

6/0 No-Wait I/O Normal End Action address not executed.
6/1 No-Wait I/O Error End Action address not executed.
6/2 KILL command. I/O was not issued.

Table 7-3
FCB Bit Interpretations (Page 2 of 2)

C-10
7.6.1 FCB Word Descriptions

7.6.1.1 Word 0

IOCS defines the I/O operation indicated by the task (READ, WRITE, etc.) in terms of the operation allowed on an assigned device or file; user defines the logical file code (Ifc) used externally to assign a file or device for the operation.

Bits 0-3 This field is always zero.

Bits 4-7 Operation Code - IOCS uses a single hex digit to indicate the type of function for the device handler. Allowable functions and their definitions are unique to each peripheral device. (See Table 7-5.)

Bits 8-31 Logical File Code - Any combination of three ASCII characters is acceptable. Must be supplied by user.

7.6.1.2 Word 1

This word (or Words 8 and 9 if bit 6 of Word 2 is set) supplies a Transfer Control Word (TCW) used to access a data buffer or IOCL for I/O (see below). If no TCW definition is supplied, the transfer buffer defaults to location 0 of the task's logical address space (below the operating system) and is 4096 words (4KW) maximum.

Bits 0-11 Count - Three hex digits specify the number of units (bytes, halfwords, or words) to be transferred to or from a device or file. The count must include a carriage control character, if applicable. The units the count relates to are determined by the data buffer address in bits 12-31. The maximum value of this field is 4096 words. For blocked files, 254 bytes is the maximum transfer. For unblocked files, the maximum value of this field is 4096 words. A zero, negative, or greater than maximum count will default to the maximum transfer count.

or

Number of Data or Command Chain Doublewords - For data/command chaining (e.g., to a GPMC or ADI controller via the Execute Channel service) SVC 1,X'25', bits 0-11 indicate the number of data or command chain doublewords in the I/O Command List (IOCL). The address of the list is provided in bits 12-31.
The F bit (12) and C bits (30 and 31) of the data buffer address are set by IOCS according to the definitions in the following bits.

**Bits 12, 30 and 31**  
Format Code - These bits specify byte, halfword, or word addressing for data transfers. They are interpreted as follows:

<table>
<thead>
<tr>
<th>Type of Transfer</th>
<th>F (Bit 12)</th>
<th>CC (Bits 30-31)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte</td>
<td>1</td>
<td>xx</td>
</tr>
<tr>
<td>Halfword</td>
<td>0</td>
<td>y1</td>
</tr>
<tr>
<td>Word</td>
<td>0</td>
<td>00</td>
</tr>
</tbody>
</table>

where:
- xx - Byte number (00, 01, 10 or 11)
- y - 0 Left Halfword 1 Right Halfword
- 00 - Word

If a halfword or word transfer is specified and a device accepts only bytes, IOCS adjusts the count accordingly (x2 or 4). If a byte transfer is specified and a device accepts only halfwords or words, IOCS checks to see that the number of bytes in the buffer is an even multiple of the requested transfer and that the data buffer address is on an acceptable boundary. If these conditions exist, IOCS adjusts count accordingly (times 0, 2, or 4) and initiates the transfer. If the conditions are not met, the request is treated as a specification error. Table 7-6 indicates transfers that are acceptable for various devices. Addresses that will produce specification errors are flagged with an asterisk.

Note that IOCS operations described above enable the user to specify byte transfers beginning on a word boundary or word transfers on any device, whether the device operates on bytes, words, or halfwords.

Doubleword addressing is not allowed; IOCS will abort the task.

**Bits 13-29**  
Data Buffer Address - Specifies the start address of a data buffer reserved by the user for reads and writes. Bounding requirements are indicated in Table 7-6.

or

Data/Command Chain Address - Specifies the address of an IOCL to use when the Execute Channel service (SVC 1,X'25') is called. The IOCL in turn supplies an IOCD entry describing the transfer count, buffer address and other control information for each command or data transfer to the device.
Word 2 provides optional control specifications for I/O.

Bits 0-7 Operational Specifications - These eight bits enable the user to specify that special operations such as no-wait I/O be performed by IOCS. The meaning of each bit is as follows:

0 - If this bit is set, IOCS will return to the user immediately after the I/O operation is queued. If the bit is reset, IOCS will exit to the calling program only when the requested operation has been completed.

1 - If this bit is set, error processing will not be performed by either the device handler or IOCS. Normal error processing for disc and magnetic tape is automatic error retry. Error processing for unit record devices except the system console is accomplished by IOCS typing the message "INOP" to the console which allows the operator to retry or abort the I/O operation. If the operator aborts the I/O operation, or if automatic error retry for disc or magnetic tape is unsuccessful, an error status message is typed to the console. An error return address is not applicable if this bit is set, however, the device status will be posted in the FCB (unless bit 3 is set).

2 - When this bit is set, data formatting is inhibited. Otherwise, data formatting is performed by the appropriate device handler. (See Bits 8 through 12 for further explanation.)

3 - If this bit is set, the device handlers perform no status checking and no status information is returned. Hence all I/O will appear to complete without error.

4 - When this bit is set, file accessing will occur in the random mode. Otherwise, sequential accessing will be performed.

5 - If set, a blocked file is specified (disc or tape assignments only).

6 - Expanded FCB present (Words 8-15). This takes advantage of a larger I/O transfer quantity (in bytes), a 24-bit addressing field, and a 32-bit random access address. For Extended I/O operations, up to two interrupt status words are then returned after I/O complete. When this bit is set, IOCS assumes the FCB is 16 words long. The information in Words 8 and 9 is used instead of the data in Word 1. Also, the random access address in Word 10 is used instead of the data in Word 2.
7 - If this bit is set, a task will not be aborted even if an error condition occurs that would cause the task to be aborted.

Bits 8-12 Device Control Specification - These bits contain control specifications unique to certain devices. Device handlers interpret and process the specifications. A bit setting is meaningful only when a particular type of device is assigned as indicated in Table 7-7, columns 2 and 3. (Column 1 indicates default control.)

Bits 13-31 Random Access Address - This field contains a block number (zero origin) relative to the beginning of a disc file, and specifies the base address for read or write operations.

Note: If bit 6 of Word 2 is set, the expanded random access address in Word 10 is used instead of bits 13-31 above.

For High Speed Data (HSD) Interface applications, Word 2 bit meanings are as follows:

Bit 2 For Execute Channel Program, if set, physical IOCL is specified.

Bit 8 Request Device Status After Transfer - This bit indicates an IOCB should be added to the IOCL to retrieve device specific status after the data transfer has completed.

Bit 9 Send Device Command Prior to Data Transfer - This bit indicates an IOCB should prefix the data transfer to transmit a device command word to the device. The value sent is the 32-bit expanded random access address.

Bit 10 Disable Timeout for this Request - This bit indicates the operation will take an indeterminable period of time and the handler should wait an indefinite period of time for the I/O to complete. This generally only has meaning on read operations.

Bit 11 Set UDDCMD from Least Significant Byte of Word 2 - This bit indicates that the UDDCMD byte in the data transfer IOCB should be set to the least significant byte of the random access field of the FCB. This provides the ability to pass additional control information to the device without modifying the device driver.

Bits 24-31 If bit 11 is set, these bits define the UDDCMD field of the generated IOCB, overriding the default value from a handler table.
7.6.1.4 Word 3

Word 3 returns I/O status. IOCS uses 32 indicator bits to return the status, error, and abnormal conditions detected by handlers during the previous or current device operation. The task can examine these bits as needed. Individual bit assignments for bits 0-7 apply to any device. Bits 8-31 mean different things depending on the device. For extended I/O devices, individual bits are shown in the FCB Word 3 area of Figure 7-3 and described in Table 7-3. For non-extended I/O devices, test status, controller (DCC) status, and device status are returned as described in Table 7-4, which accompanies the FCB diagram in Figure 7-3.

For High Speed Data (HSD) Interface applications, Word 3 error status bits have the following meanings:

- Bits 17-18: Unused
- Bits 19: Record length error
- Bit 20: Parity Error
- Bit 21: Nonpresent memory (NPM)
- Bit 22: Invalid opcode in IOCB Word 0
- Bit 23: Device inoperable
- Bit 24: Data buffer overflow

7.6.1.5 Words 4 and 5

Word 4 defines record length. This word is used by IOCS to indicate the actual number of bytes transferred during a read or write.

Word 5 defines I/O queue address in bits 8-31. This field is set by IOCS to point to the I/O queue for an I/O request initiated from this FCB.

7.6.1.6 Word 6

In bits 0-7, IOCS returns special status bits as described in Table 7-3.

Word 6 defines a wait I/O error return address in bits 8-31. Specify the address to transfer control to in the case of an unrecoverable error. If this field is not defined, an unrecoverable error is detected, and the user has not set bits 1 and 3 of Word 2 to inhibit error processing, IOCS aborts the task.
7.6.1.7 Word 7

Word 7 must not be written by the user. It defines the File Assignment Table (FAT) entry associated with all I/O performed on behalf of this FCB. The FAT address is supplied by IOCS.

7.6.1.8 Word 8

Word 8 begins expanded TCW definition. This area of the FCB can be used to define transfers larger than 4096 words, e.g., for extended I/O devices.

- **Bits 8-31**: Expanded data buffer address - specifies the start address of a data buffer reserved by the user for reads or writes. This must be a logical byte address with no format bit present. Word bounding is required for some devices if unblocked.

  or

- **Expanded Data/Command Chain List Address - Word address that points to the data or command chain list (IOCL) if using Execute Channel service, SVC 1,X'25'.

7.6.1.9 Word 9

Word 9 continues the expanded TCW definition.

- **Bits 0-31**: Expanded transfer count - eight digits specify the number of bytes to be transferred. Note that the transfer count supplied here is always in byte units. Must include the carriage control character, if applicable. A zero or negative count defaults to the maximum allowable count (254 bytes if blocked).

7.6.1.10 Word 10

Word 10 defines expanded random address. This word contains a block number (zero origin relative to the beginning of the disc file). It is the start address for the current read or write operation.

For High Speed Data (HSD) Interface requests in non-Execute Channel Program format, this word defines a device command.
7.6.1.11 Word 11

Word 11 returns status.

Bits 0-31 Status word 1 - for extended I/O, if an error is detected during an I/O operation, these 32 bits are returned by the SENSE command.

or

Status EAI - for communications adapter (CA) interface, returns external asynchronous interrupt (EIA) status if bit 12 of Word 2 is set.

7.6.1.12 Word 12

Word 12 returns status word 2. This is the second status word returned from extended I/O hardware.

For High Speed Data (HSD) Interface applications, this word contains status sent from the user's device.

7.6.1.13 Word 13

Word 13 defines normal return address for no-wait I/O. In bits 8-31, specifies address to transfer control to when a no-wait I/O operation is complete. The code at this address must be terminated with a call to IOCS for post-processing service (SVC 1,X'2C'). See Section 7.4.2.

For High Speed Data (HSD) Interface applications, this address plus 1 word is the location to which control is transferred on asynchronous notification.

7.6.1.14 Word 14

Word 14 defines an error return address for no-wait I/O. In bits 8-31, specifies (optionally) the address to transfer control to when no-wait I/O completes with an error. The code at this address must be terminated with a call to IOCS for post processing service (SVC 1,X'2C'). See Section 7.4.2.

7.6.1.15 Word 15

Word 15 is reserved for I/O service expansion.
DESCRIPTION

The 53A-420 Presorting ARINC-429 Receiver Card is a printed circuit board assembly for use in the 53A System. It is used to receive data from the Mark 33 DITS (Digital Information Transfer System) found on civil aircraft. The 53A System will reformat the data received into 8-bit bytes and retransmit it to the system controller (calculator or computer).

The presorting feature is provided on the Receiver Card to solve the data rate problem imposed on the system controller by the DITS bus. This problem can be stated as follows: the DITS bus can have a data rate of up to 100,000 bits per second, but some labels may appear only once every 1/2 second. Without presorting, to find the most current message of a particular label may require that the system controller sift through a continuous stream of 50,000 bits of data.

With presorting, the DITS data is sorted and stored in RAM located on the Receiver Card, thus allowing immediate access by the system controller to the DITS data associated with a particular label. The presorting can operate in one of two modes:

ALL LABEL Mode - In this mode, the Receiver Card has 256 RAM storage registers, one for each possible DITS word label. The Receiver Card will constantly monitor the incoming data and refresh the appropriate register, therefore, insuring that the most current DITS word, for all labels, is always available to the system controller.

SINGLE LABEL Mode - In this mode, the system controller sets a "trigger label. The Receiver Card then monitors the incoming data for that single trigger label, and when found will store the associated DITS word in RAM. This feature allows the Receiver Card to sequentially store up to 256 DITS words from a single label.

In both of these modes, the system controller can read "on the fly" (read without interrupting the loading of new data) a specified DITS word from RAM. This feature is provided to prevent the RAM from missing a new update while being read by the system controller.

ADDRESS SELECT SWITCH

The Receiver Card has a miniature ten-position switch labeled ADDRESS. The switch is used to select the address (0-9) of the Receiver Card. The cover of the switch hinges open to allow access for reselecting the address. A small flat-blade screwdriver should be used to turn the cam-action wiper to the desired position.
OPERATION

The Receiver Card is programmed by 8-bit bytes issued from the system controller (calculator or computer) to the 53A System Communications Card. The Receiver Card is connected to the Communications Card via the 53A-002 Card Cage backplane.

LABELS

The labels, of the messages that will later be input by the system controller, are first output by the system controller to the Receiver Card. Each label is output as a single byte of data.

Label ARINC - 429

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Ø</td>
</tr>
<tr>
<td>1</td>
<td>Ø</td>
<td>Ø</td>
<td>Ø</td>
<td>1</td>
<td>Ø</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Octal 222 which is VOR Omnibearing.

Bit 7 is the most significant bit of each byte. The numbers Ø through 7 represent the bits as they are labeled on the CDS Backplane.

DATA

ARINC-429 bits 9 through 32 are input by the system controller from the Receiver Card. The ARINC data is returned as three data bytes followed by Carriage-Return and Line-Feed characters. Three typical data bytes are shown below.

<table>
<thead>
<tr>
<th>Bits 9 through 32 of the DITS word.</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9</td>
</tr>
<tr>
<td>1 0 1 1 0 0 0 1 0 1 0 0 1 1 1 1 1 1 1 1 0 0 1 1 1</td>
</tr>
<tr>
<td>M 261 117 347</td>
</tr>
</tbody>
</table>

First Input Byte  Second Input Byte  Third Input Byte

Note: The interpretation of bit 32 will depend on the mode to which the Receiver Card is programmed (SINGLE or ALL LABEL Mode). See: Data Errors Page 420-8.

When programming the Receiver Card the ASCII characters used along with the actions initiated are listed below:

<table>
<thead>
<tr>
<th>ASCII Characters</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>@XYA</td>
<td>This command is used to program the Receiver Card to the &quot;ALL LABEL Mode&quot; of operation. The @ character is a delimiter used by the 53A system. The two characters following the @ are Mainframe and System Card address re-</td>
</tr>
</tbody>
</table>
spectively. Once a System Card is addressed it will remain addressed until the 53A system detects a new @ character.

The X in the command sequence is the Mainframe address (0-9) which has been selected on the Control Card.

The Y in the command sequence is the Receiver Card address (0-9) selected by the card's Address Select Switch.

The A in the command sequence puts the Receiver Card in the "ALL LABEL Mode" of operation. In all the following examples it is assumed that the Receiver Card has address 7 and is located in a Mainframe with address 0.

Example - The command sequence @07A would put the card in the "ALL LABEL Mode."

Status:
Power LED - out.
DDT LED - lit if card is receiving data.
F/S LED - lit if card is set for fast bit rate.
RDE LED - lit if there has been an error.
A/B LED - lit.

ASCII Characters

@XYC

Action

This command will Clear the RDE LED and latch.

See: Data Errors in the Overview Section of this manual.

The @XY characters are as defined previously. The C in the command sequence will Clear the data error latch.

Example - The command sequence @07C would clear the data error latch.

Status:
Power LED - out.
DDT LED - lit if card is receiving data.
F/S LED - lit if card is set for fast bit rate.
RDE LED - out.
A/B LED - lit if system is in "A" mode.
This command is used to set a specific RAM address whose data will be returned the next time the system controller goes to input and requests data.

The @XY characters are as defined previously.

The S in the command sequence is the Set command. The Set command allows the Receiver Card to load the data from the RAM location associated with \( b_i \) into the buffer for input by the system controller.

The RAM locations are numbered from 000 to 377 octal, the same as the labels are numbered in ARINC specification 429 Page 10.

\( b_i \) is a single 8-bit binary label. This label is taken from Page 10 of ARINC specification 429. For example, \( b_i \) could be octal 125 which is the label for "Greenwich Mean Time."

Note: octal 125 would actually be output from the system controller as one 8-bit byte.

When in the "ALL LABEL Mode" RAM locations correspond to individual labels.

When in the "SINGLE LABEL Mode" RAM locations correspond to the sequence in which DITS words are loaded into RAM - i.e., 000 is the first word loaded, 001 the second, 002 the third, and etc.

See: Data Errors, Page 420-8, for a discussion of the DITS Bit-32 returned to the system controller.

Example - This example assumes the Receiver Card is in the "ALL LABEL Mode." If the byte \( b_i \) represents an octal 23, the command sequence @07Sb1 would load data associated with the Receiver Card RAM label 023 (ADF Frequency) into the card's input buffer.

Status:
- Power LED - out.
- DDT LED - lit if card is receiving data.
- F/S LED - lit if card is set for fast bit rate.
- RDE LED - lit if there has been an error.
- A/B LED - lit.

After issuing the S command, the system controller will normally request data from the 53A-420 card. The data returned will consist of three 8-bit binary bytes of ARINC-429 data, followed by Carriage-Return and Line-Feed characters. All five bytes must be input by the system controller. The format of the returned ARINC-429 data is described at the beginning of the OPERATIONS Section.