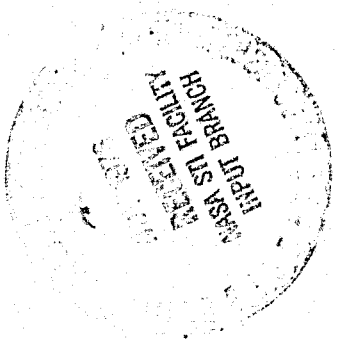
NASA TECHNICAL MEMORANDUM

NASA TM X-73976

NASA TM X- 73976

An Interface Between a Datametrics 1085A Manometer and a Hewlett-Packard 2100S Computer



By Mervin E. Hillard, Jr. and James I. Clemmons

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER, HAMPTON, VIRGINIA 23665

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TM X-73976		

4. Title and Subtitle	5. Report Date
An Interface Between a Datametrics 1085A Manometer and a Hewlett-Packard 2100S Computer	September 13, 1976
	6. Performing Organization Code 1291
7. Author(s)	8. Performing Organization Report No.
Mervin E. Hillard, Jr. and James I. Clemmons	
	10. Work Unit No. 505-06-43-03
9. Performing Organization Name and Address NASA Langley Research Center Hampton, Va. 23665	11. Contract or Grant No.
	13. Type of Report and Period Covered Technical Memorandum
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546	14. Sponsoring Agency Code

15. Supplementary Notes

Special technical information release, not planned for formal NASA publication.

16. Abstract

A hardware/software interface designed to mate a Datametrics model 1085A electronic manometer to a Hewlett-Packard (HP) model 2100S computer is described. The software driver operates in the Basic Control System (BCS) and requires 173 words of memory; the hardware interface uses an HP data source interface (DSI) card which requires one computer input-output (I/O) channel.

Results obtained by incorporating this interface into a data acquisition system indicate that the interface operates successfully.

17. Key Words (Suggested by Author(s)) (STAR category underlined)	18. Distribution Statement
Data Recording, Computer, Digital	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	22	$3.25

*Available from The National Technical Information Service, Springfield, Virginia 22161

AN INTERFACE BETWEEN A DATAMETRICS 1085A MANOMETER AND A HEWLETT-PACKARD 2100S COMPUTER

Mervin E. Hillard, Jr. and James I. Clemmons
Langley Research Center

SUMMARY

A hardware/software interface designed to mate a Datametrics model 1085A electronic manometer[1] to a Hewlett-Packard (HP) model 2100S computer is described. The software driver operates in the Basic Control System[2] (BCS) and requires 173 words of memory; the hardware interface uses an HP data source interface (DSI) card which requires one computer input-output (I/O) channel.

Results obtained by incorporating this interface into a data acquisition system indicate that the interface operates successfully.

INTRODUCTION

This work was undertaken as part of the development of a Raman scattering gas density measurement system. Routine use of the Raman technique requires careful calibration and repeated spot checks for precision density measurements. To facilitate the use of this measurement process in wind tunnels, methods for automatically performing the necessary calibration procedure have been developed. Part of the calibration procedure utilizes a Datametric manometer for static pressure measurements.

No interface was found for operating the Datametrics manometer with the HP computer, so a hardware/software interface was designed and tested to provide the pressure measurements needed for the Raman system calibration. The manometer has a six-digit readout in torr with a resolution of 0.01 torr. It provides for remote measurement initiation and for detection of

measurement completion. A Basic Control System software driver was written to input the digital pressure data to the Raman calibration system and to make the manometer and computer electrically compatible.

PROGRAM PROCEDURE

The software driver operates in the interrupt mode through the non-buffered I/O control subroutine (.IOC.) of the Basic Control System. It does not use direct memory access. The driver consists of two sections: the initiator section in which the manometer, hardware interface, and driver are made ready for data transfer and the continuation section where the data transfers are completed. A flow chart of these two sections is provided in Appendix A and a complete assembly listing of the driver is given in Appendix B.

The data input process is controlled by the standard BCS assembly language calling sequences for READ, STATUS, and CLEAR operations.

Data Buffer Format

The basic and minimum buffer length required to input one data point is 5 words. If multiple data transfers are desired from a single READ request, 5 consecutive storage locations must be allocated for each data point. No check is made to insure that the request contains the correct buffer length. The number of data points that will be transferred by a READ request equals the buffer length ÷ 5. Each word in the data buffer is described below; this data format will repeat for each data point if multiple data readings are requested.

Data word 1. - This word contains an error indicator for data words 2-5.

Word = 0_8, no error
1_8, manometer overload
2_8, negative pressure value

Data words 2-5. - These words contain the actual measured pressure value (in torr) in ASCII code. They contain the sign, six significant digits, and the decimal location. For example, the pressure value ± ABCD.EF (torr) is output as follows:

Word 2	PLUS or MINUS	A
Word 3	B	C
Word 4	D	PERIOD
Word 5	E	F

Each byte of words 2-5 contains the ASCII code for the measured value as labelled above.

System Generation

To include this manometer driver in a Basic Control System, the I/O channel where the hardware interface is placed and the entry points for the software driver must be specified when the BCS system is generated. The position of the hardware interface within the computer defines the priority of the manometer within the total BCS system. For the Raman system in which this hardware/software interface is operational the manometer is a low priority device and therefore is assigned a high select code. The entry point for the initiator section of the driver is labelled "D.55"; this label

must be used to generate the equipment table. The continuator entry point is labelled "I.55"; this must be specified for the interrupt linkage.

The memory requirement for this driver is 173 words.

HARDWARE PROCEDURE

This interface requires one computer I/O channel. It provides compatibility between the electronic manometer and the computer by using an HP data source interface (DSI) card (model HP 12604B).[3]

Interconnecting Cable

On the rear panel of the model 1085A manometer is a connector labelled "J2"; the interconnecting cable links this connector to the DSI card. All the pin connections for this cable are shown in figure 1 with a description of the signal which each pin represents.

Interface Jumper Selection

The DSI card jumper selections required for compatibility with the manometer are shown in figure 2. A brief description of the function of each jumper is also given.

Electrical Modifications

The Datametrics manometer and the DSI card are not directly compatible. Figure 3 shows the changes required for compatibility. The remote sample input (pin D) on the manometer requires TTL logic levels. The encode line (pin 12) on the DSI card is a negative true signal of +13.5 V to ground. The 1N914 diode shown in figure 3 provides compatibility. Next the positive logic signal level of the manometer is tied to pin N to provide a reference

voltage for the DSI card. Finally, the record command from the manometer is input to a monostable multivibrator (74121) to produce a negative-true 30 microsecond pulse. This is input to a nand buffer which inverts the signal, drives the interconnecting cable, and provides the positive true pulse required by the DSI card. All other data lines are compatible.

CONCLUSION

A hardware/software interface between a Datametric manometer and HP computer has been developed. Hardware interfacing was achieved by modifying a standard HP data source interface circuit. A Basic Control System software driver has been developed. The driver operates in the interrupt mode through a nonbuffered I/O control subroutine. It consist of an initiation section and data transfer section and does not use direct memory access. Memory requirement for the driver is 173 words.

REFERENCES

1. Hewlett-Packard Co., "A Pocket Guide to Interfacing the HP 2100 Computer," Part No. HP 5951-4498, March 1973.

2. Hewlett-Packard Co., "Data Source Interface Computer Interface Kit, Operating and Service Manual," Part No. HP 12604-90002, Sept. 1970.

3. Datametrics, "Instruction Manual, Model 1085 Electronic Manometer," Oct. 1974.

Cable Diagram for Datametrics Electronic Manometer

HP2100S/2155A -
12604B Data Source
Interface Card

Model 1085
Inv. No. 173534
Serial No. 124

Computer		Instrument (J2 - Input/Output)	
Signal Name	Pin	Pin	Signal Name
1	4	B	Overload Out
2	B	A	Neg. Out
4	J	14	Remote Sample Gnd
8	L	14	Remote Sample Gnd
1 (10^0)	T	14	Remote Sample Gnd
2	V	14	
4	6	14	
8	8	14	
1 (10^1)	2	3	1
2	D	5	2
4	F	6	4
8	N	4	8
1 (10^2)	R	U	10
2	X	V	20
4	Z	18	40
8	10	17	80
1 (10^3)	5	c	100K (overrange)
2	C	14	Remote Sample Gnd
4	K	14	
8	M	14	
1 (10^4)	U	Y	100
2	W	Z	200
4	7	22	400
8	9	21	800
1 (10^5)	3	c	1K
2	E	d	2K
4	H	26	4K
8	P	25	8K
1 (10^6)	S	h	10K
2	Y	j	20K
4	AA	30	40K
8	11	29	80K
-Encode	12	D	Remote Sample
+Record Command	16	L	+Record
+Reference	14	N	+Reference
+Hold	13	E	Transfer Delay
Ground	24, BB	14	Remote Sample Gnd
IOI Output	A		Tied together
IOI Return	1		

Figure 1

DSI CARD JUMPER SELECTION CHART

Jumper	Position	Description
W1	Installed	not important
W2	B	allows the +Record command to remove the Encode signals
W3	Installed	not important
W4	Installed	enables the -Encode signal
W5	Installed	not important
W6	Installed	enables automatic removal of Encode signals after 60-80 microseconds
W7	Installed	gives 1 millisecond settling time

Note: There are two slide switches on this card for the Encode and Hold lines. The Encode switch must be "on," the Hold switch may be "off."

Figure 2.

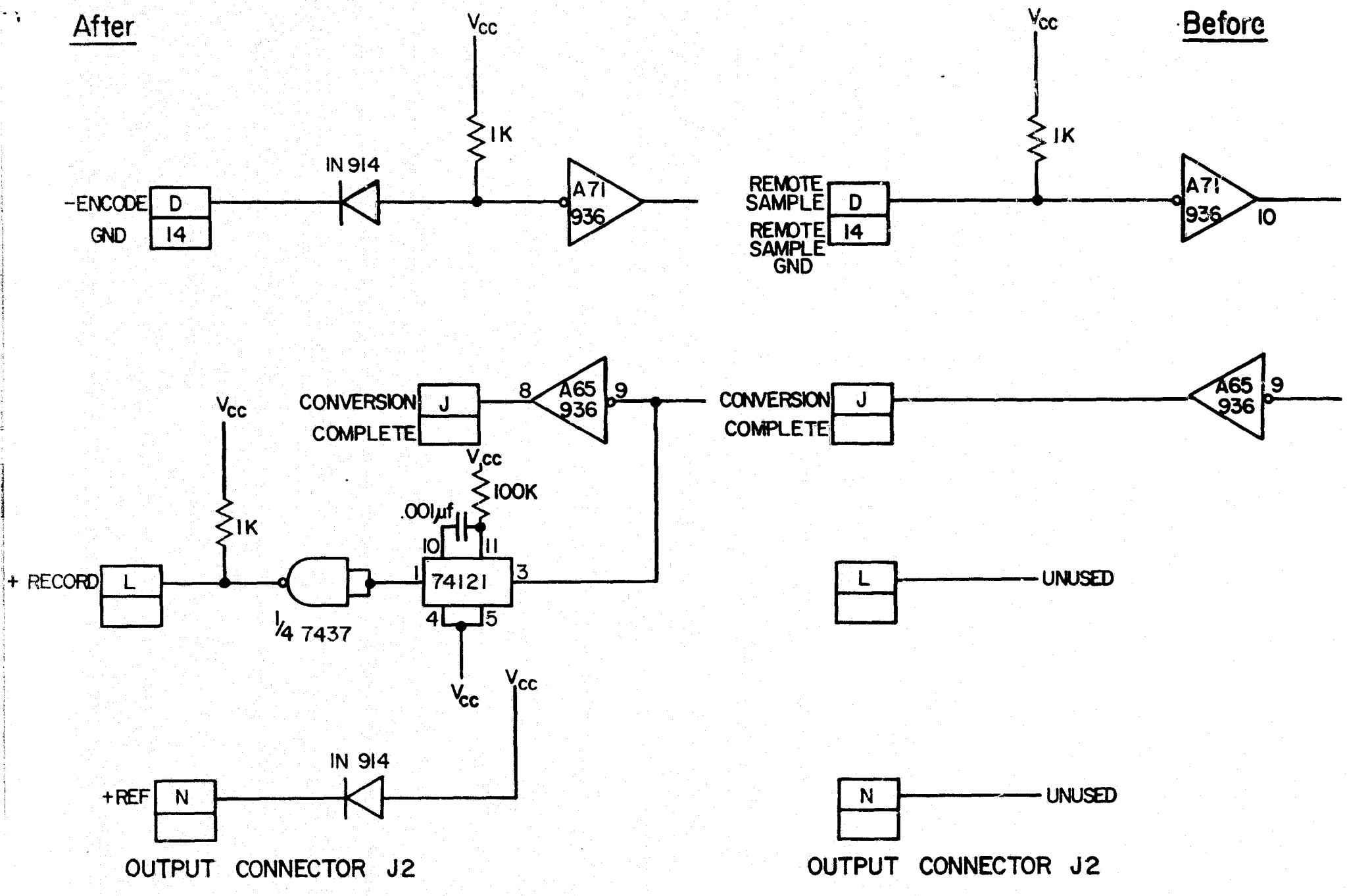


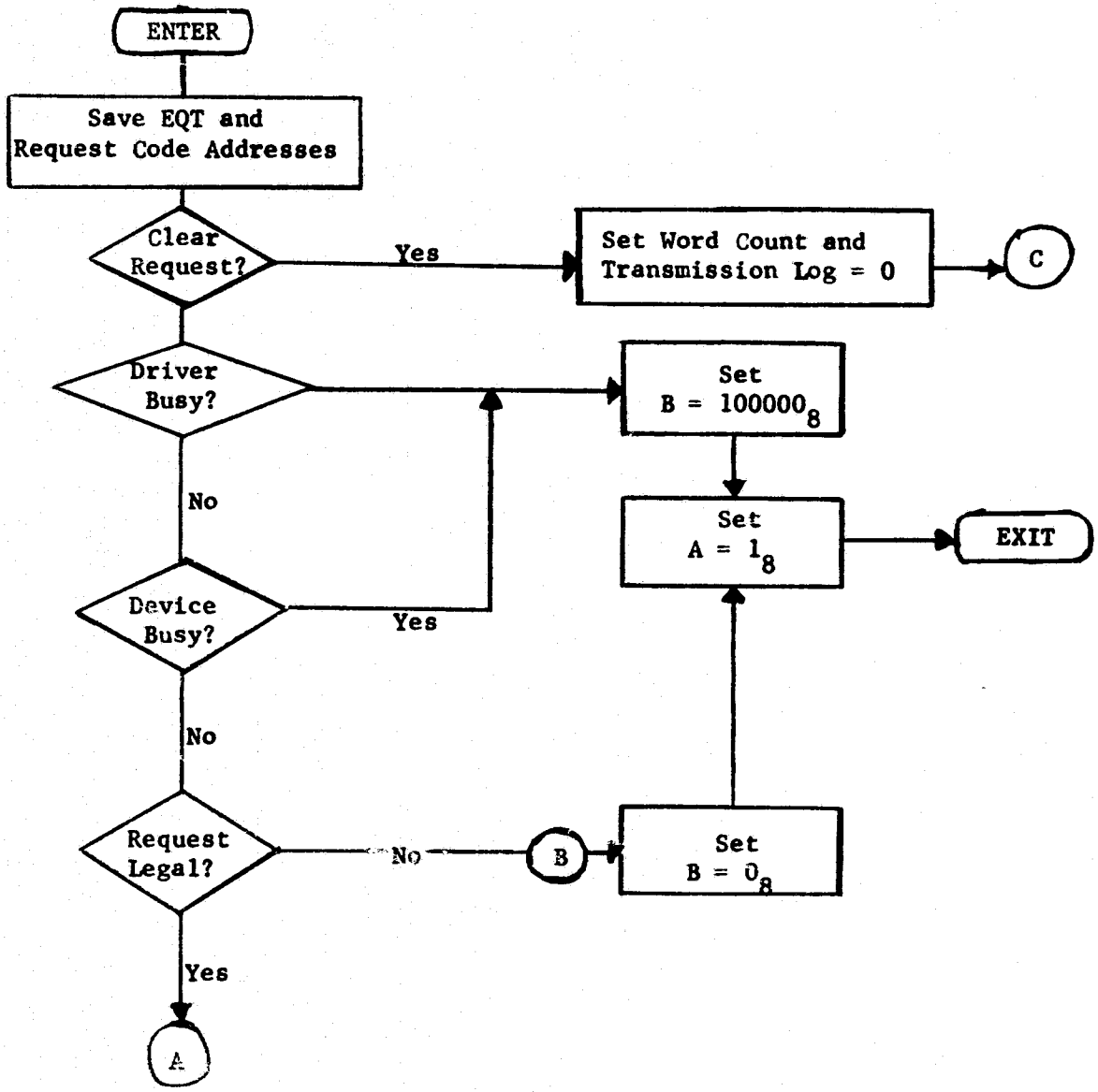
Figure 3. Circuit Modification

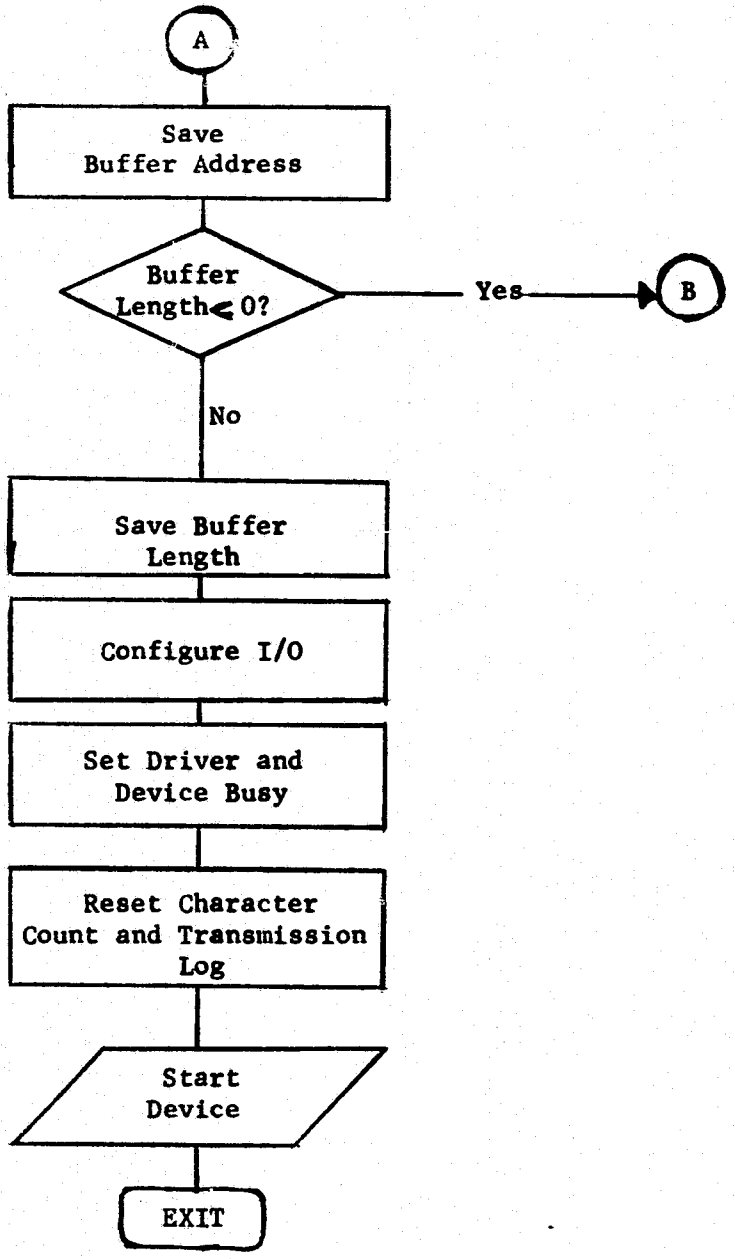
APPENDIX A

FLOW CHART

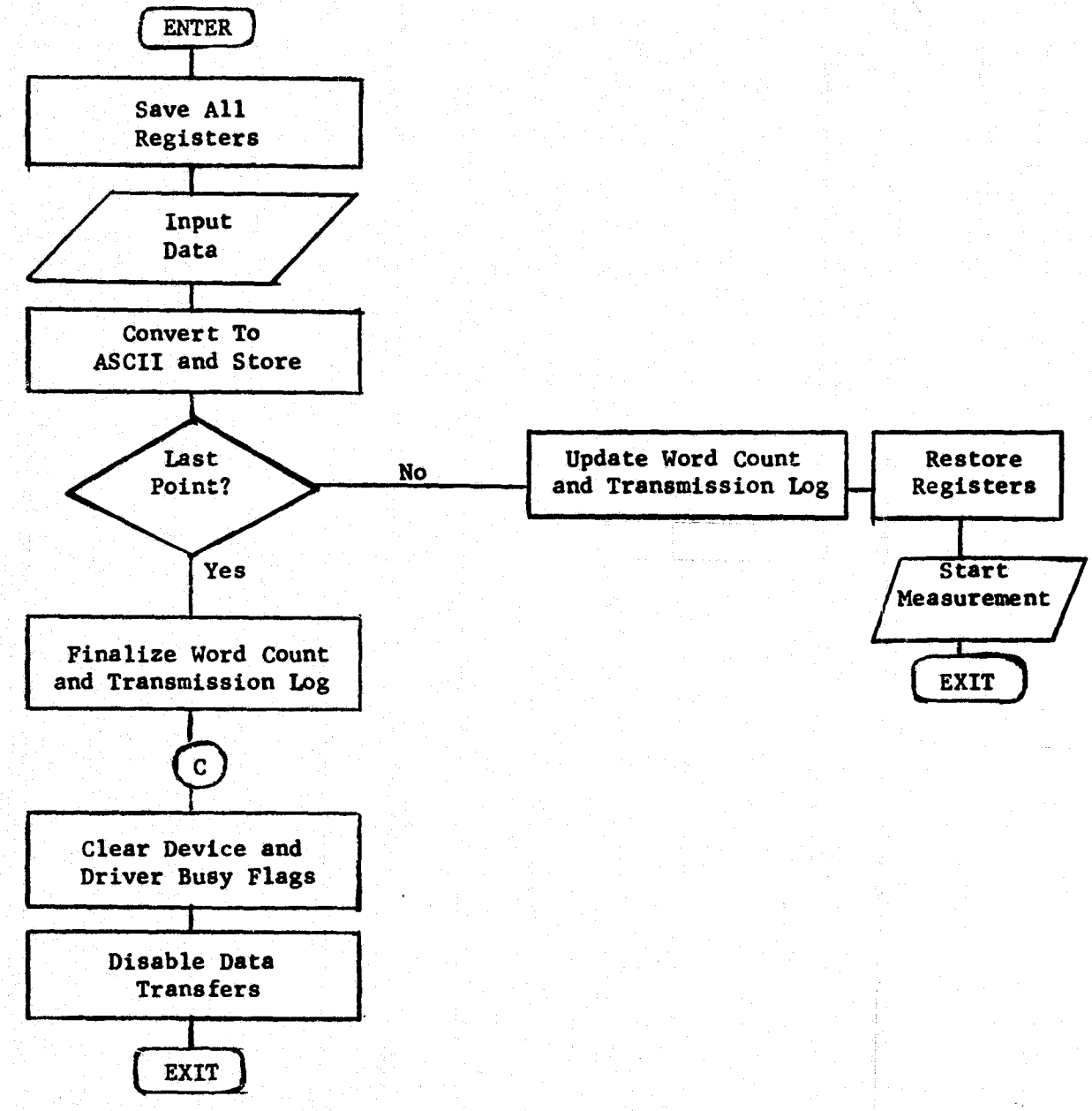
Flow Chart for Datametrics Model 1085A
Electronic Manometer Driver, D.55

Initiation Section




A
Save
Buffer Address
Buffer
Length < 0?
Yes
B
No
Save Buffer
Length
Configure I/O
Set Driver and
Device Busy
Reset Character
Count and Transmission
Log
Start
Device
EXIT

Continuation Section



APPENDIX B

SYMBOL TABLE, ASSEMBLY LISTING,

AND CROSS-REFERENCE TABLE

```
0001                        ASMB,R,L,T
D.55   R 000000
I.55   R 000105
I.1    R 000010
I.4    R 000012
D55.1  R 000017
I.2    R 000064
I.3    R 000077
RCER   R 000101
REJB   R 000102
R.0    R 000114
R.1    R 000116
EXIT   R 000153
STATI  R 000154
X.6    R 000167
I.5    R 000175
UNPAK  R 000177
STORE  R 000212
A        000000
B        000001
EQTA   R 000221
EQT3   R 000222
A2     R 000223
RCA    R 000224
M17    R 000225
SAVAX  R 000226
DFLG   R 000227
M77    R 000230
SFSI   R 000231
M15    R 000232
BUF    R 000233
LENG   R 000234
CHC    R 000235
SAVBX  R 000236
SAVEX  R 000237
LOW    R 000240
HIGH   R 000241
M360   R 000242
C7400  R 000243
PLUS   R 000244
MINUS  R 000245
DECPT  R 000246
MST    R 000247
LIAM   R 000250
LIBM   R 000251
STC    R 000252
CLC    R 000253
ASCII  R 000254
SIZE   R 000255
**  NO ERRORS PASS#1 **RTE ASMB 750420**
```

```
0001                    ASMB,R,L,T
0002*
0003*
0004* THIS DRIVER INPUTS BCD DATA FROM THE MODEL 1085A
0005* ELECTRONIC MANOMETER AND STORES THIS DATA IN THE
0006* USER'S BUFFER IN ASCII FORM. AN ERROR FLAG
0007* IS PROVIDED IF AN OVERRANGE OR NEGATIVE PRESSURE CONDITION IS
0008* DETECTED DURING THE MEASUREMENT. THE FIRST WORD OF
0009* THE DATA BUFFER CONTAINS THE ERROR FLAG:
0010*          0 - NO ERROR
0011*          1 - OVERRANGE
0012*          2 - NEGATIVE PRESSURE
0013*
0014* MEMORY REQUIREMENT: 173 WORDS
0015*
0016*
0018*
0019*
0020  00000                 NAM D.55
0021*
0022*
0023                        ENT D.55,I.55
0024*
0025*
0026* A DETAILED DESCRIPTION OF THIS DRIVER IS GIVEN
0027* IN THE PROGRAM PROCEDURE.
0028*
0029*
0030*     ************************************************
0031*     *                                              *
0032*     * D.55 BCS DRIVER FOR DATAMETRICS MODEL 1085A *
0033*     *                                              *
0034*     ************************************************
0035*
0036*
0037*
0038*** *** INITIATOR SECTION *** ***
0039*
0040*
0041  00000 000000  D.55  NOP             SAVE EQT
0042  00001 072221R       STA EQTA        ADDRESS. SAVE REQUEST
0043  00002 076224R       STB RCA         CODE ADDRESS.
0044*
0045  00003 160001        LDA B,I         FETCH REQUEST
0046  00004 001700        ALF             CODE AND
0047  00005 012225R       AND M17         ISOLATE REQUEST.
0048  00006 002002        SZA             IS IT A CLEAR REQUEST?
0049  00007 026017R       JMP D55.1       NO, CONTINUE.
0050*
0051*
0052*** *** TERMINATE OPERATION FOR CODE = 0
0053*
0054*
0055  00010 126000R I.1   JMP D.55,I      YES, DISABLE
0056  00011 072226R       STA SAVAX       INTERFACE.
0057  00012 102100  I.4   STF 0           SET FLAG.
```

```
0058  00013 062000R        LDA D.55      GO TERMINATE
0059  00014 072105R        STA I.55      OPERATION, RESET
0060  00015 002400         CLA           BUSY FLAGS, AND
0061  00016 026154R        JMP STAT1     TRANSMISSION LOG.
0062*
0063*
0064  00017 066227R D55.1   LDB DFLG      TEST DRIVER FLAG.
0065  00020 006002         SZB           IS DRIVER BUSY?
0066  00021 026102R        JMP REJB      YES, REJECT.
0067*
0068  00022 000065         CLE,ERA       IS THIS A
0069  00023 002002         SZA           LEGAL REQUEST?
0070  00024 026101R        JMP RCER      NO, REJECT.
0071*
0072  00025 036224R        ISZ RCA       FETCH BUFFER
0073  00026 036224R        ISZ RCA       ADDRESS.
0074  00027 062224R        LDA RCA       OMIT ALL
0075  00030 160000         LDA A,I       INDIRECTS
0076  00031 001275         RAL,CLE,SLA,ERA  AND
0077  00032 026030R        JMP *-2       STORE FINAL
0078  00033 072233R        STA BUF       ADDRESS.
0079*
0080  00034 036224R        ISZ RCA       FETCH BUFFER
0081  00035 162224R        LDA RCA,I     LENGTH.
0082  00036 002020         SSA           IS IT < 0?
0083  00037 026101R        JMP RCER      YES, REJECT.
0084  00040 003004         CMA,INA       NO, NEGATE
0085  00041 072234R        STA LENG      AND SAVE.
0086*
0087  00042 162221R        LDA EQTA,I    FETCH SELECT
0088  00043 012230R        AND M77       CODE FOR DEVICE.
0089*
0090  00044 032231R        IOR SFSI      COMBINE WITH SFS
0091  00045 072064R        STA I.2       INSTRUCTION.
0092  00046 022251R        XOR LIBM      COMBINE WITH LIB
0093  00047 072114R        STA R.0       INSTRUCTION.
0094  00050 022250R        XOR LIAM      COMBINE WITH LIA
0095  00051 072116R        STA R.1       INSTRUCTION.
0096  00052 022252R        XOR STC       COMBINE WITH STC,C
0097  00053 072077R        STA I.3       INSTRUCTION.
0098  00054 072175R        STA I.5
0099  00055 022253R        XOR CLC       COMBINE WITH CLC
0100  00056 072010R        STA I.1       INSTRUCTION.
0101  00057 022251R        XOR LIBM      COMBINE WITH
0102  00060 072012R        STA I.4       STF INSTRUCTION.
0103*
0104  00061 062221R        LDA EQTA      SAVE ADDRESS
0105  00062 042223R        ADA A2        OF TRANSMISSION
0106  00063 072222R        STA EQT3      LOG.
0107*
0108  00064 102300  I.2     SFS 0         IS DEVICE BUSY?
0109  00065 026102R        JMP REJB      YES,REJECT.
0110*
0111  00066 036221R        ISZ EQTA      NO, LOCATE
0112  00067 162221R        LDA EQTA,I    EQT WORD 2
0113  00070 032232R        IOR M15       AND SET
```

```
0114  00071 172221R        STA EQTA,I     DRIVER
0115  00072 072227R        STA DFLG       BUSY.
0116*
0117  00073 002400         CLA            RESET CHARACTER
0118  00074 072235R        STA CHC        COUNT AND
0119  00075 036221R        ISZ EQTA       TRANSMISSION
0120  00076 172221R        STA EQTA,I     LOG.
0121*
0122  00077 103700  I.3     STC 0,C        START MEASUREMENT
0123  00100 126000R         JMP D.55,I     AND RETURN.
0124*
0125*
0126*** *** REJECT SECTION *** ***
0127*
0128*
0129  00101 006401  RCER    CLB,RSS        SET B=0.
0130  00102 066232R REJB    LDB M15        SET B=100000.
0131  00103 002404          CLA,INA        SET ERROR FLAG.
0132  00104 126000R         JMP D.55,I     TAKE ERROR EXIT.
0133*
0134*
0135*** *** CONTINUATOR SECTION *** ***
0136*
0137*
0138  00105 000000  I.55    NOP            SAVE
0139  00106 072226R         STA SAVAX      ALL
0140  00107 076236R         STB SAVBX      REGISTERS
0141  00110 001520          ERA,ALS        A,
0142  00111 102201          SOC            B,
0143  00112 002004          INA            O,
0144  00113 072237R         STA SAVEX      E.
0145*
0146  00114 106500  R.0     LIB 0          INPUT
0147  00115 076240R         STB LOW        PRESSURE DATA
0148  00116 102500  R.1     LIA 0          AND
0149  00117 072241R         STA HIGH       SAVE.
0150*
0151  00120 062223R         LDA A2          LOCATE STATUS
0152  00121 002004          INA            AND STORE
0153  00122 010001          AND B          IN
0154  00123 064000          LDB A          USER'S
0155  00124 016212R         JSB STORE      BUFFER.
0156*
0157  00125 005100          BRS            IS THE
0158  00126 062244R         LDA PLUS       MEASURED VALUE
0159  00127 004010          SLB            <0?
0160  00130 062245R         LDA MINUS      YES, SET NEGATIVE.
0161*
0162  00131 066241R         LDB HIGH       NO, IS EXTENDED
0163  00132 004010          SLB            RANGE SET?
0164  00133 002004          INA            YES, SET FLAG.
0165  00134 016212R         JSB STORE      NO, STORE DATA.
0166*
0167  00135 062241R         LDA HIGH       FETCH NEXT TWO
0168  00136 001727          ALF,ALF        BCD DIGITS AND
0169  00137 016177R         JSB UNPAK      STORE IN USER'S BUFFER.
```

```
0170*
0171  00140 062241R        LDA HIGH      FETCH NEXT
0172  00141 012242R        AND M360      DIGIT, INSERT
0173  00142 001700          ALF           DECIMAL POINT
0174  00143 032246R        IOR DECPT     AND STORE IN
0175  00144 016212R        JSB STORE     USER'S BUFFER.
0176*
0177  00145 062240R        LDA LOW       FETCH LAST TWO
0178  00146 001727          ALF,ALF       BCD DIGITS AND
0179  00147 016177R        JSB UNPAK     STORE.
0180*
0181  00150 062235R        LDA CHC       IF NOT LAST DATA
0182  00151 172222R        STA EQT3,I    POINT, UPDATE TRANSMISSION
0183  00152 026167R        JMP X.6       LOG AND RESTART.
0184*
0185  00153 062235R EXIT    LDA CHC       MAKE FINAL CHARACTER
0186  00154 172222R STAT1   STA EQT3,I    COUNT AND TRANSMISSION-
0187  00155 003400          CCA           LOG UPDATE.
0188  00156 042222R        ADA EQT3      FETCH EQT
0189  00157 070001          STA B         WORD 2.
0190  00160 160001          LDA B,I       RESET
0191  00161 012247R        AND MST       BUSY
0192  00162 170001          STA B,I       FLAG.
0193*
0194  00163 002400          CLA           RESET DRIVER-
0195  00164 072227R        STA DFLG      BUSY FLAG.
0196  00165 062010R        LDA I.1       SET CLC,H AS
0197  00166 072175R        STA I.5       LAST INSTRUCTION.
0198*
0199  00167 062237R X.6     LDA SAVEX     RESTORE ALL
0200  00170 103101          CLO           REGISTERS:
0201  00171 000036          SLA,ELA       E,
0202  00172 102101          STF 1         O,
0203  00173 062226R        LDA SAVAX     A,
0204  00174 066236R        LDB SAVBX     B.
0205  00175 103700  I.5     STC 0,C       EITHER RESTART OR
0206  00176 126105R        JMP I.55,I    TERMINATE MEASUREMENT.
0207*
0208  00177 000000  UNPAK   NOP           THIS ROUTINE
0209  00200 072224R        STA RCA       CONVERTS TWO
0210  00201 001700          ALF           BCD DIGITS
0211  00202 012243R        AND C7400     TO TWO
0212  00203 070001          STA B         ASCII
0213  00204 062224R        LDA RCA       CHARACTERS
0214  00205 012225R        AND M17       AND
0215  00206 032254R        IOR ASCII     STORES THE
0216  00207 030001          IOR B         ASCII DATA
0217  00210 016212R        JSB STORE     IN THE USER'S
0218  00211 126177R        JMP UNPAK,I   BUFFER.
0219*
0220  00212 000000  STORE   NOP           THIS ROUTINE
0221  00213 172233R        STA BUF,I     STORES DATA
0222  00214 036233R        ISZ BUF       POINTS IN USER'S
0223  00215 036235R        ISZ CHC       BUFFER, UPDATES
0224  00216 036234R        ISZ LENG      WORD COUNT AND CHECKS
0225  00217 126212R        JMP STORE,I   FOR BUFFER FULL.
```

```
0226   00220 026153R        JMP EXIT
0227*
0228*
0229*** *** CONSTANTS *** ***
0230*
0231*
0232   00000          A      EQU 0
0233   00001          B      EQU 1
0234   00221 000000   EQTA   NOP
0235   00222 000000   EQT3   NOP
0236   00223 000002   A2     OCT 2
0237   00224 000000   RCA    NOP
0238   00225 000017   M17    OCT 17
0239   00226 000000   SAVAX  NOP
0240   00227 000000   DFLG   OCT 0
0241   00230 000077   M77    OCT 77
0242   00231 102300   SFSI   SFS 0
0243   00232 100000   M15    OCT 100000
0244   00233 000000   BUF    NOP
0245   00234 000000   LENG   NOP
0246   00235 000000   CHC    NOP
0247   00236 000000   SAVBX  NOP
0248   00237 000000   SAVEX  NOP
0249   00240 000000   LOW    NOP
0250   00241 000000   HIGH   NOP
0251   00242 000360   M360   OCT 360
0252   00243 007400   C7400  OCT 7400
0253   00244 025460   PLUS   ASC 1,+0
0254   00245 026460   MINUS  ASC 1,-0
0255   00246 030056   DECPT  ASC 1,0.
0256   00247 037400   MST    OCT 37400
0257   00250 004000   LIAM   OCT 4000
0258   00251 004600   LIBM   OCT 4600
0259   00252 001200   STC    OCT 1200
0260   00253 005000   CLC    OCT 5000
0261   00254 030060   ASCII  ASC 1,00
0262   00255          SIZE   EQU *
0263*
0264*
0265                         END
**   NO ERRORS *TOTAL **RTE ASMB 750420**
```

CROSS-REFERENCE SYMBOL TABLE

A	00232	00075	00154				
A2	00236	00105	00151				
ASCII	00261	00215					
B	00233 00216	00045	00153	00189	00190	00192	00212
BUF	00244	00078	00221	00222			
C7400	00252	00211					
CHC	00246	00118	00181	00185	00223		
CLC	00260	00099					
D.55	00041	00023	00055	00058	00123	00132	
D55.1	00064	00049					
DECPT	00255	00174					
DFLG	00240	00064	00115	00195			
EQT3	00235	00106	00182	00186	00188		
EQTA	00234 00119	00042 00120	00087	00104	00111	00112	00114
EXIT	00185	00226					
HIGH	00250	00149	00162	00167	00171		
I.1	00055	00100	00196				
I.2	00108	00091					
I.3	00122	00097					
I.4	00057	00102					
I.5	00205	00098	00197				
I.55	00138	00023	00059	00206			
LENG	00245	00085	00224				
LIAM	00257	00094					
LIBM	00258	00092	00101				
LOW	00249	00147	00177				

CROSS-REFERENCE SYMBOL TABLE

M15	00243	00113	00130				
M17	00238	00047	00214				
M360	00251	00172					
M77	00241	00088					
MINUS	00254	00160					
MST	00256	00191					
PLUS	00253	00158					
R.0	00146	00093					
R.1	00148	00095					
RCA	00237	00043	00072	00073	00074	00080	00081
	00209	00213					
RCER	00129	00070	00083				
REJB	00130	00066	00109				
SAVAX	00239	00056	00139	00203			
SAVBX	00247	00140	00204				
SAVEX	00248	00144	00199				
SFSI	00242	00090					
@SIZE	00262						
STATI	00186	00061					
STC	00259	00096					
STORE	00220	00155	00165	00175	00217	00225	
UNPAK	00208	00169	00179	00218			
X.6	00199	00183					