IDENTIFICATION

Product Code:	MAINDEC-08-D6GC-D
Product Name:	A/D Calibration Check
Date Created:	October 14, 1968
Maintainer:	Diagnostic Group
Author:	J. Hittell

1. ABSTRACT

The A/D Calibration check for the converters is to be used to ascertain the accuracy of converter adjustments. This tape is to be used with an adjustable voltage source. The converted value will be displayed in the AC, and the switch register will be used to select multiplexer channels. (Passing of these checks do not guarantee 100% monotonicity, steady state accuracy, since all of the 4096 possible conditions are not checked.)

2. REQUIREMENTS

2.1 Equipment

PDP-8, PDP-8/I or 8/S Standard Computer
A/D Converter
Adjustable Voltage Source (0.01% or better, $Z_{out} < 1.0\ \Omega$)

2.2 Storage

2.2.1 Program Storage - The routine uses memory from address 100 to 650 and location 0 and 1.

3. LOADING PROCEDURE

3.1 Methods

Procedure for normal binary tape should be followed.

4. STARTING PROCEDURE

For normal operation all switches should be down.
Starting address is:

a. 100 for AF01A
b. 102 for ADC1

4.1 Program and/or Operation Action

Connect voltage source to input connector.
Load the program into memory.
Set switch register to Starting Address.

Load Address.

Select multiplexer channel using switch register 6 to 11 = 1 (AF01 only)

Press Start.

5. OPERATING PROCEDURE

Set the voltage source to the voltage desired, inspect the AC for the correct converted value.

For Starting Address 102	SR = Conversion Display Time
SA 103 Routine for Setting Multiplexer	SR = Channel
SA 104 Routine for Incrementing Multiplexer which should = zero	SR = Channel except for overflow

6. If alignment errors are severe the converter should be recalibrated. See maintenance section in A-D Converter manual.

6.1 Error Halts

6.1.1 Halt (PC)

AF01	ADC1	Function Being Checked
203	407	Flag cleared by Start Key
207	413	Buffer initialized by Start Key
215	421	Convert Instruction sets the flag
221	425	Read Buffer Instruction clears the flag
230	---	Clear Multiplexer, sets the flag
240	---	Set Multiplexer, sets the flag
250	---	Index Multiplexer, sets the flag
263	445	Interrupt Up
271	434	Interrupt Down

For more information see listing.

7. RESTRICTIONS

None

8. MISCELLANEOUS

9. PROGRAM DESCRIPTION

This routine checks both the interrupt and conversion done flags. Uses the switch register, bits 6 to 11 as the desired multiplexer channel, converts the voltage on the selected channel. Displays it in the AC. After a delay checks to see if a new multiplexer channel is selected, converts, displays in the AC.

Word Length (No. of Bits)	Max. Switching Point Error * Of INPUT Voltage Range
6	±1.6%
7	±0.8%
8	±0.4%
9	±0.2%
10	±0.1%
11	±0.5%
12	±0.025%

* ± 1/2 LSB for quantizing error.

```
                                /PDP-8 A/D CALIBRATION
                                /
                                /A/D CONVERTER ENTRANCE ADDRESS
                  74Ø2          HALT=74Ø2
                  Ø1ØØ          *1ØØ
I       Ø1ØØ      52ØØ                JMP NOR          /AFC1A ENTRANCE
I       Ø1Ø1      5314                JMP ADC8                 /ADC8-A ENTRANCE
I       Ø1Ø2      532Ø                JMP ADC1                 /ADC1 ENTRANCE
I       Ø1Ø3      52Ø4                JMP SMUX                 /SET TEST FOR MUX, MUX=SR
I       Ø1Ø4      5375                JMP IMUX                 /INC. TEST FOR MUX, MUX=SR
I       Ø1Ø5      5211                JMP CONVER       /SR EQUAL CONVERSION TIME
I       Ø1Ø6      522Ø                JMP INST                 /GENERATE IOT 565XX, XX=SR
```

```
            /PDP-8 A/D CALIBRATION
            /
            /A/D CONVERTER ENTRANCE ADDRESS
            ADSF=6531
            ADRB=6534
            ADCV=6532
            ADCC=6541
            ADSC=6542
            ADIC=6544
            HALT=7402
            *1000
0100  5777          JMP NOR                 /AF01A ENTRANCE
0101  5776          JMP ADU8                /AD08-A ENTRANCE
0102  5775          JMP ADC1                /ADC1 ENTRANCE
0103  5774          JMP SMUX                /SET TEST FOR MUX, MUX=SR
0104  5773          JMP IMUX                /INC. TEST FOR MUX, MUX=SR
0105  5772          JMP CONVER      /SR EQUAL CONVERSION TIME
0106  5771          JMP INST                /GENERATE IOT 6650X, XX=SR
```

```
          *200
          /PDP8 CALIBRATION TEST FOR AF01A, 12 BITS
             /TEST FOR NO FLAG
0200  6531  NOF,    ADSF            /SKIP ON FLAG
0201  7410          SKP
0202  7402          HALT            /FLAG NOT CLEARED BY START KEY
          /WAS BUFFER INITIALIZED TO SEVENS?
0203  6534          ADRB            /READ BUFFER
0204  7040          CMA             /SHOULD BE=7777
0205  7440          SZA             /WORD LENGTH=12 BITS?
0206  7402          HALT            /BUFFER WAS NOT 7777
          /WILL CONVERT INSTRUCTION (ADCV) SET FLAG?
0207  6532          ADCV            /START CONVERT
0210  3273          DCA STALL
0211  2273          ISZ STALL
0212  5211          JMP .-1
0213  6531          ADSF            /SKIP ON FLAG
0214  7402          HALT            /ADCV DID NOT SET FLAG
          /WILL READ BUFFER CLEAR FLAG
0215  6534          ADRB            /CLEAR FLAG
0216  6531          ADSF            /SKIP ON FLAG
0217  7410          SKP
0220  7402          HALT            /ADRB DID NOT CLEAR FLAG
          /WILL CLEAR MULTIPLEXER SET DONE FLAG?
0221  7200          CLA
0222  6541          ADCC            /START CONVERT
0223  3273          DCA STALL
0224  2273          ISZ STALL
0225  5224          JMP .-1
0226  6531          ADSF            /SKIP ON FLAG
0227  7402          HALT            /ADCC DID NOT SET FLAG
0230  6534          ADRB            /CLEAR FLAG
          /WILL SET MULTIPLEXER, SET DONE FLAG?
0231  7200          CLA
0232  6542          ADSC            /START CONVERT
0233  3273          DCA STALL
0234  2273          ISZ STALL
0235  5234          JMP .-1
0236  6531          ADSF            /SKIP ON FLAG
0237  7402          HALT            /ADSC DID NOT SET DONE FLAG
0240  6534          ADRB            /CLEAR FLAG
```

```
                /WILL INCREMENT MULTIPLEXER SET DONE FLAG?
0241  7200          CLA
0242  6544          ADIC            /START CONVERT
0243  3273          DCA STALL
0244  2273          ISZ STALL
0245  5244          JMP .-1
0246  6531          ADSF            /SKIP ON FLAG
0247  7402          HALT            /ADIC DID NOT SET DONE FLAG
0250  6534          ADRB            /CLEAR FLAG
0251  7200          CLA
                /INTERRUPT CHECK
0252  1377  INTEN,          TAD (JMP I L.+11
0253  3001          DCA 1           /SET UP FOR INTERRUPT
0254  6532          ADCV            /CONVERT
0255  6001          ION
0256  3273          DCA STALL
0257  2273          ISZ STALL               /SHOULD INTERRUPT HERE
0260  5257          JMP .-1
0261  6002          IOF
0262  7402          HALT            /NO INTERRUPT
0263  1376          TAD (JMP I L.+5
0264  3001          DCA 1
0265  6534          ADRB            /CLEAR DONE FLAG
0266  6001          ION
0267  7410          SKP
0270  7402          HALT            /INTERRUPT ALWAYS UP
0271  6002          IOF
0272  7410          SKP
0273  0000  STALL, 0
                /DISPLAY CONVERTED VALUE IN A.C.
0274  7604          LAS             /LOAD SW REGISTER
0275  6542          ADSC            /SET MUX CHANNEL
0276  7200          CLA
0277  6531          ADSF            /WAIT FOR FLAG
0300  5277          JMP .-1
0301  6532          ADCV            /CONVERT
0302  6531          ADSF            /WAIT FOR FLAGS
0303  5302          JMP .-1
0304  6534          ADRB            /READ BUFFER
0305  2273          ISZ STALL               /WAIT 36 MILL SEC
0306  5305          JMP .-1                 /DISPLAY IN AC
0307  2273          ISZ STALL
0310  5307          JMP .-1
0311  5274          JMP .-15                /LOOP, SET MUX AND CONVERT
0312  0000          0
```

```
0376  5567   PAGE
0377  5770
        /PDP8 CALIBRATION FOR ADC8-A
           /TEST FOR NO FLAG
0400  6531   ADC8,   ADSF            /SKIP ON FLAG
0401  7410            SKP
0402  7402            HALT            /FLAG NOT CLEARED BY START KEY
0403  5215            JMP BOTH                /COMMON TO BOTH ADC8 AND ADC-1
        /PDP 8 CALIBRATION FOR ADC1 12 BITS
           /TEST FOR NO FLAG
0404  6531   ADC1,   ADSF            /SKIP ON FLAG
0405  7410            SKP
0406  7402            HALT            /FLAG NOT CLEARED
        /WAS BUFFER INITIALIZED TO SEVENS
0407  6534            ADRB            /SHOULD EQUAL 7777
0410  7040            CMA
0411  7440            SZA
0412  7402            HALT            /BUFFER NOT INITIALIZED
        /WILL CONVER INSTRUCTION (ADCV) SET FLAG
0413  6532   BOTH,           ADCV             /START CONVERT
0414  3777            DCA STALL
0415  2777            ISZ STALL                /STALL TIME
0416  5215            JMP .-1
0417  6531            ADSF            /SKIP ON FLAG
0420  7402            HALT            /(ADCV) NOT SET FLAG
        /WILL READ BUFFER CLEAR FLAG
0421  6534            ADRB            /CLEAR FLAG
0422  6531            ADSF            /SKIP ON FLAG
0423  7410            SKP             /SHOULD SKIP
0424  7402            HALT            /(ADRB) DID NOT CLEAR FLAG
        /INTERRUPT CHECK
0425  7200            CLA
0426  1376            TAD (JMP I .+5
0427  3001            DCA 1
0430  6534            ADRB            /CLEAR FLAG, DROP INTERRUPT
0431  6001            ION             /INTERRUPT ON
0432  7410            SKP             /SHOULD NOT INTERRUPT
0433  7402            HALT            /INTERRUPT ALWAYS UP
0434  7200            CLA
0435  1375            TAD (JMP I .+1
0436  3001            DCA 1
0437  6532            ADCV            /START CONVER
0440  3777            DCA STALL
0441  2777            ISZ STALL                /SHOULD INTERRUPT HERE
0442  5241            JMP .-1
0443  6002            IOF
0444  7402            HALT            /NO INTERRUPT
```

0445 7000 NOP

```
          /DISPLAY CONVERTED VALUE IN AC
          /FOR ADC-1 AND ADDM
          /SW REGISTER EQUAL CONVERSION TIME
0446  6532          ADCV            /START CONVERSION
0447  6531          ADSF            /SKIP ON FLAG
0450  5247          JMP .-1
0451  7604          LAS             /LOAD SWITCH
0452  7040          CMA
0453  3777          DCA STALL
0454  6534          ADRB            /READ BUFFER TO AC
0455  2777          ISZ STALL               /STALL TIME
0456  5255          JMP .-1
0457  5246          JMP .-11                /LOOP
```

```
0575  5565  PAGE
0576  5560
0577  0273
        /SPECIAL TEST FOR MULTIPLEXER INCREMENTING
        /SWITCH REGISTER SHOULD EQUAL MULTIPLEXER LIGHTS
0600  7604  IMUX,  LAS             /LOAD CHANNEL
0601  1377          TAD (-1                 /MINUS ONE
0602  6542          ADSC            /SET MULTIPLEXER
0603  6544          ADIC            /INCREMENT MULTIPLEXER
0604  2776          ISZ STALL
0605  5204          JMP .-1                 /DISPLAY TIME
0606  5200          JMP IMUX                /LOOP
        /SET TEST FOR MULTIPLEXER SR SHOULD EQUAL MULTIPLEXER LIGHTS
0607  7604  SMUX,  LAS             /LOAD CHANNEL
0610  6542          ADSC            /SET MULTIPLEXER
0611  2776          ISZ STALL
0612  5211          JMP .-1                 /DISPLAY TIME
0613  5207          JMP SMUX                /LOOP
        /SCOPE SET UP FOR CONVERSION ST=TIME
0614  6532  CONVER,        ADCV            /START CONVERSION
0615  7004          LAS             /READ SW REGISTER
0616  7040          CMA             /COMPLEMENT NUMBER
0617  3776          DCA STALL
0620  2776          ISZ STALL               /CONVERSION TIME=
0621  5220          JMP .-1
0622  5214          JMP CONVER      /LOOP
        /SCOPE LOOP FOR INSTRUCTIONS
        /IOT INSTRUCTION 65XX, XX=SR BITS 5 TO 11
0623  7000  INST,  NOP
0624  7604          LAS             /READ SWITCH
0625  0375          AND (0077
0626  1374          TAD (6500               /CREATE INSTRUCTION
0627  3230          DCA .+1
0630  7402          HLT             /LOCATION OF INSTRUCTION
0631  7000          NOP             /IN CASE OF SKIP
0632  5224          JMP INST+1      /LOOP
0774  6500  $
0775  0077
0776  0273
0777  7777
0165  0445
0166  0433
0167  0270
0170  0263
0171  0623
0172  0614
0173  0600
```

```
0174   0067
0175   0404
0176   0404
0177   0203

ERROR COUNT = 0000
```

ADCC	6541
ADCV	6532
ADC1	0404
ADIC	6544
ADC8	0400
ADRB	6534
ADRC	6542
ADSF	6531
AUTH	0413
CONVER	0014
HALT	7402
INDX	0619
INST	0623
INTEMI	0252
JUMP	0200
SMUX	0607
STALL	0273

MAINDEC EVALUATION REQUEST

After sufficient familiarization with the operation and documentation of this MAINDEC, please indicate your assessment of the following areas and return this form to Digital Equipment Corporation.

IDENTIFICATION: MAINDEC NO._____ Program Title_____

USAGE: Used by: Field Service ☐ Production ☐ Other_____ ☐

Frequency of Usage: Daily ☐ Weekly ☐ Monthly ☐

SUGGESTIONS FOR IMPROVEMENT

1. Are the program loading and operating instructions: clear? ☐, incomplete? ☐, difficult to follow? ☐

2. Do the error reports and program documentation provide sufficient diagnostic information: in all cases? ☐, in most cases? ☐, in very few cases? ☐. Suggestions for improvement:

_____

_____

_____

3. Is the program effective in isolating malfunctions: in all cases? ☐, in most cases? ☐, in very few cases? ☐. Would additional Scope loops or Switch Register control be helpful?_____ Suggestions for improvement:

_____

_____

_____

4. Does the program ever fail to detect malfunctions exposed by other software?_____ Were Margins used?_____ Please describe malfunction in detail:

_____

_____

_____

5. Does the program ever report non-existant malfunctions?_____ Please indicate erroneous report and any pertinent operating conditions:

_____

6. Does this MAINDEC ever expose malfunctions in the Central Processor or other peripheral units not detected by the appropriate MAINDEC?_____ Please describe malfunction and MAINDEC(S) used:

_____

7. Does the document provide a general understanding of the functional programming requirements of the system? Good ☐, Fair ☐, None ☐. Would a general description of programming requirements increase the effectiveness of this MAINDEC?_____

Remarks:

_____

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