

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, Σ 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	SR = Channel except for overflow which should = zero

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	<u>Halt (PC)</u>		<u>Function Being Checked</u>
	<u>AF01</u>	<u>ADC1</u>	
	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.

<u>Word Length (No. of Bits)</u>	<u>Max. Switching Point Error * Of INPUT Voltage Range</u>
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
7402
*120
I 0100 5200 JMP NOR /AFC1A ENTRANCE
I 0101 5314 JMP ADC8 /ADC8-A ENTRANCE
I 0102 5322 JMP ADC1 /ADC1 ENTRANCE
I 0103 5204 JMP SMUX /SET TEST FOR MUX, MUX=SR
I 0104 5375 JMP IMUX /INC. TEST FOR MUX, MUX=SR
I 0105 5211 JMP CONVER /SR EQUAL CONVERSION TIME
I 0106 5220 JMP INST /GENERATE 10T 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

*100

0100	5777	JMP	NOR	/AF01A ENTRANCE
0101	5776	JMP	AD08	/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 565XX, XX=SR

*200

/PPP6 CALIBRATION TEST FOR AF01A, 12 BITS

/TEST FOR NO FLAG

```
0200 6531  NOP,   ADRB           /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                ADRB           /SKIP ON FLAG
0214 7402                HALT           /ADCV DID NOT SET FLAG
           /WILL READ BUFFER CLEAR FLAG
0215 6534                ADRB           /CLEAR FLAG
0216 6531                ADRB           /SKIP ON FLAG
0217 7410                SKP
0220 7402                HALT           /AORB 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                ADRB           /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                ADRB           /SKIP ON FLAG
0237 7402                HALT           /ADSC DID NOT SET DONE FLAG
0240 6534                ADRB           /CLEAR FLAG
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        /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      ADSE          /SKIP ON FLAG
0247  7402      HALT          /ADIC DID NOT SET DONE FLAG
0250  6534      ADRB          /CLEAR FLAG
0251  7200      CLA
        /INTERRUPT CHECK
0252  1377  INTENT,          TAB (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          TAB (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          ADSE          /WAIT FOR FLAG
0300  5277          JMP .-1
0301  6532          ADCV          /CONVERT
0302  6531          ADSE          /WAIT FOR FLAG
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

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0376 5567 PAGE
0377 5570
      /PDP8 CALIBRATION FOR ADC0-A
      /TEST FOR NO FLAG
0400 6531 ADC0, ADSE /SKIP ON FLAG
0401 7410 SKP
0402 7402 HALT /FLAG NOT CLEARED BY START KEY
0403 5215 JMP BOTH /COMMON TO BOTH ADC0 AND ADC-1
      /PDP 8 CALIBRATION FOR ADC1 12 BITS
      /TEST FOR NO FLAG
0404 6531 ADC1, ADSE /SKIP ON FLAG
0405 7410 SKP
0406 7402 HALT /FLAG NOT CLEARED
      /WAS BUFFER INITIALIZED TO SEVENS
0407 6534 ADDR /SHOULD EQUAL 7777
0408 7040 CMA
0409 7440 SZA
0410 7402 HALT /BUFFER NOT INITIALIZED
      /WILL CONVERT INSTRUCTION (ADCV) SET FLAG
0411 6532 BOTH, ADCV /START CONVERT
0412 3777 DCA STALL
0413 2777 ISZ STALL /STALL TIME
0414 5215 JMP , -1
0415 6531 ADSE /SKIP ON FLAG
0416 7402 HALT / (ADCV) NOT SET FLAG
      /WILL READ BUFFER CLEAR FLAG
0417 6534 ADDR /CLEAR FLAG
0418 6531 ADSE /SKIP ON FLAG
0419 7410 SKP /SHOULD SKIP
0420 7402 HALT / (ADDR) DID NOT CLEAR FLAG
      /INTERUPT CHECK
0421 7200 CLA
0422 1376 TAD (JMP I E.+5)
0423 3001 DCA 1
0424 6534 ADDR /CLEAR FLAG, DROP INTERRUPT
0425 6001 ION /INTERRUPT ON
0426 7410 SKP /SHOULD NOT INTERRUPT
0427 7402 HALT /INTERRUPT ALWAYS UP
0428 7200 CLA
0429 1375 TAD (JMP I E.+10)
0430 3001 DCA 1
0431 6532 ADCV /START CONVERT
0432 3777 DCA STALL
0433 2777 ISZ STALL /SHOULD INTERRUPT HERE
0434 5241 JMP , -1
0435 6002 IOF
0436 7402 HALT /NO INTERRUPT

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0445 7000

NOP

/DISPLAY CONVERTED VALUE IN AC

/FOR ADC-1 AND AD08

/SW REGISTER EQUAL CONVERSION TIME

0446	6532	ADCV	/START CONVERSION
0447	6531	ADSF	/SKIP ON FLAG
0448	5247	JMP .-1	
0449	7004	LAS	/LOAD SWITCH
0450	7040	CMA	
0451	3777	UCA STALL	
0454	6534	ADRR	/READ BUFFER TO AC
0455	2777	ISZ STALL	/STALL TIME
0456	5255	JMP .-1	
0457	5246	JMP .-11	/LOOP

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0575 5565 PAGE
0576 5566
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 7604 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 6 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

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0174 0607
0175 0404
0176 0400
0177 0200

ERROR COUNT = 0000

ADCC	6541
ADCV	6532
ADC1	0404
ADIC	6544
ADCB	0400
ADSB	6534
ADSC	6542
ADSF	6531
BUGH	0413
CONVER	0614
HALT	7402
IMCX	0600
INST	0623
INTENT	0252
NOX	0200
SMCX	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-existent 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? _____

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