

IDENTIFICATION

PRODUCT CODE:	MAINDEC-08-D6UB-D
PRODUCT NAME:	AD01-A DIAGNOSTIC
DATE CREATED:	MARCH 11, 1971
MAINTAINER:	DIAGNOSTIC GROUP
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1. ABSTRACT

FOR THE AD01-A, THIS IS A I/O INSTRUCTION TEST AND A LIMITED TEST OF CALIBRATION AND REPEATABILITY

2. REQUIREMENTS

2.1 EQUIPMENT

PDP-8I AD01-A STANDARD COMPUTER
G735 TEST CARD (OPTIONAL)
APPLY .625 VDC TO CHANNEL 0
OF THE MULTIPLEXER
STORAGE

2.2

2.2.1 PROGRAM STORAGE = THE ROUTINE USES MEMORY
FROM 0000 TO 3000.

3. LOADING PROCEDURE

3.1 METHOD

PROCEDURE FOR NORMAL BINARY TAPES SHOULD BE FOLLOWED.

4. STARTING PROCEDURE

4.1 CONTROL SWITCH SETTING

STARTING AT SA 200 ALL SWITCHES SHOULD BE DOWN OR ZERO.

4.2 STARTING ADDRESS OR ADDRESSES

(A) 200 = NORMAL STARTING ADDRESS
AT 1ST HALT-LOAD INITIAL CHANNEL TO BE TESTED.
AT 2ND HALT-LOAD LAST CHANNEL TO BE TESTED
AND GAIN TO BE USED FOR WAS-15 TEST.
SET SR TO 0YXX, WHERE Y=0,1,2,3 FOR
GAINS OF 1,2,4,8 AND XX=NUMBER OF CHANNELS
1-37.

(B) 201 = RESTART START, USING VALUES SELECTED IN SA 200

(C) 202 = DISPLAYS CONVERTED VALUE IN AC (FOR CHECKING CALIBRATION), ALSO BITS 4 AND 5 CONTROL GAIN

(D) 203 = 107 SCOPE LOOP 55XX,XX EQUALS SR-6-11

(E) 204 = SWITCH REGISTER CONTROLS CONVERSION RATE

(F) 205 = SWITCH REGISTER BIT 7-11 EQUALS MULTIPLEXER CHANNEL, 4 AND 5 EQUAL GAIN OF AMPLIFIER

(G) 206 = READ AND BUFFER TWICE
SWITCH REGISTER 0-11 EQUALS DELAY BETWEEN READINGS

4.3 PROGRAM AND/OR OPERATOR ACTION

LOAD PROGRAM INTO MEMORY.
SET SWITCH REGISTER TO STARTING ADDRESS.
LOAD ADDRESS.
PRESS START.
THE PROGRAM WILL STAY IN SECTION AND LOOP.

5. OPERATING PROCEDURE

5.1 OPERATIONAL SWITCH SETTINGS

5.1.1 AT SA 200 .. THE INSTRUCTION AND LOGIC TEST.
WITH ALL SWITCHES DOWN THE PROGRAM WILL PRINT
OUT ON ERRORS AND CONTINUE IN TEST.

5.1.2 SWITCH SETTINGS ARE

SW0 = 1 OR UP ... HALT ON ERROR
SW1 = 1 OR UP ... SCOPE LOOP
SW2 = 1 OR UP ... INHIBIT PRINTOUT
SW3 = 1 OR UP ... INHIBIT *0R- 1LSB TESTING
SW4 = GAIN
SW5 = GAIN
SW6 = 1 OR UP ... INHIBIT AVERAGING
SW7-SW11 = CHANNELS TO BE TESTED (AT 1ST AND 2ND HALT)

5.1.3

5.2 SUBROUTINE ABSTRACTS

5.2.1 BEGIN SA 200

5.2.2

5.2.3 SCOPE

THIS SUBROUTINE CALL IS PLACED BETWEEN EACH SUBTEST
IN THE INSTRUCTION SECTION. IT RECORDS THE STARTING
ADDRESS OF EACH SUB-TEST AS IT IS BEING ENTERED.
IF A SCOPE LOOP IS REQUESTED, IT WILL JUMP TO THE
START OF THE SUBTEST THAT THE SCOPE LOOP IS RE
QUESTED FOR.

5.2.4 HALT

IS A ROUTINE THAT PRINTS-OUT AN ADDRESS THAT TAGS
THE FAILING SUBTEST, AND THE INCORRECT DATA AT
THE TIME OF THE FAILURE.

(5. OPERATING PROCEDURE CONT'D)

5.3 PROGRAM AND/OR OPERATOR ACTION

5.3.1 LOADING AND STARTING AT 200 WITH ALL SWITCHES DOWN
IS THE INSTRUCTION AND LOGIC TEST. IF AN ERROR
IS DETECTED HERE, THERE WILL BE A PRINTOUT. WHEN
AN ERROR IS DETECTED AND IT IS NECESSARY TO SCOPE
ON IT, PLACE SW0 UP TO HALT ON ERROR, THEN SW1 UP
TO LOOP ON ERROR, THEN SW2 UP TO DELETE PRINTOUTS.

5. ERRORS

5.1 ERROR PRINTOUT
REFER TO LISTING

5.2 ERROR RECOVERY
DEPRESS CONTINUE KEY TO RESUME TESTING AFTER AN ERROR HALT
DEPRESS CONTINUE TO RESTART SECTION

7. RESTRICTIONS

7.1 STARTING RESTRICTION

POLARITY, INITIAL CHANNEL AND NUMBER OF CHANNELS MUST BE SET INITIALLY

7.2 OPERATIONAL RESTRICTION

NONE

3. MISCELLANEOUS

3.1 EXECUTION TIME

NOT APPLICABLE

PROGRAM DESCRIPTION

FOR THE AD01-A, THERE ARE ONLY A LIMITED NUMBER OF CHECKS THAT CAN BE PERFORMED DUE TO THE NATURE OF ANALOG TO DIGITAL CONVERTERS! THESE CONSIST OF TESTING THE FLAG AND THE INTERRUPT AND THE PROGRAMMABLE GAIN. A VOLTAGE SOURCE IS NEEDED TO CHECK THE CALIBRATION AND REPEATABILITY, THE PRINCIPLE OF THE TEST IS THAT THERE SHOULD BE A VOLTAGE APPLIED TO EACH CHANNEL OF THE MULTIPLEXER, (GROUND IS CONSIDERED A VOLTAGE). IT IS DESIRABLE THAT EACH CHANNEL OF THE MULTIPLEXER HAVE A UNIQUE VOLTAGE. THE MULTIPLEXER IS SET TO THE INITIAL CHANNEL AND A CONVERSION IS MADE ON THAT CHANNEL AND THE RESULTS OF THAT CONVERSION IS STORED IN OUR "INITIAL TABLE" (ITABLE). THE MULTIPLEXER IS SET TO THE NEXT CHANNEL AND A CONVERSION MADE, THE RESULTS OF THAT CONVERSION IS STORED IN THE (ITABLE) AND REPEATED UNTIL THE VOLTAGE FOR EACH SELECTION CHANNEL HAS BEEN STORED IN THE TABLE. NEXT A NEW TABLE (NTABLE), IS MADE UP USING THE SET MULTIPLEXER INSTRUCTION, WHEN THE CONVERSIONS HAVE BEEN MADE ON EACH CHANNEL, THE CONTENTS OF THE TWO TABLES ARE COMPARED. IF A POSITION (CHANNEL) IN THE TABLES IS FOUND THAT DOES NOT COMPARE, A PRINTOUT OCCURS SHOWING THE CHANNEL AND THE TWO VOLTAGES. NEXT (NTABLE) IS TRANSFERRED TO (ITABLE) AND (NTABLE) IS NOW UPDATED USING THE INCREMENT INSTRUCTION! THE TABLES ARE COMPARED AND A PRINTOUT OCCURS IF THEY DO NOT AGREE. TRANSFER (NTABLE) TO (ITABLE), UPDATE (NTABLE) USING THE SET MULTIPLEXER INSTRUCTION! THIS SEQUENCE IS REPEATED UNTIL THE PROGRAM IS HALTED BY OPERATOR INTERVENTION. THE BELL WILL RING AFTER 4096 PASSES THRU THIS SEQUENCE.

LISTING

FLOW CHART(S)

0020

*22

/MAINDEC-08-0608
/DIAGNOSTIC FOR AD01A, 32 CHANNEL MUX, 12 BIT CONVERTER
/JUNE 1969
/COPYRIGHT 1969, DIGITAL EQUIPMENT CORP., MAYNARD, MASS.
/CONSTANTS

0021 0000

STALL, 0

/WAIT COUNT

0022 0000

TAPNTB, 0

/TABLE POINTER

0023 2000

XTI, TABLEI

/INITIAL OR PREVIOUS TABLE

0024 2000

XTIA, TABLEI

0025 0000

XTN, TABLEN

/CURRENT TABLE

0026 0000

MC, 0

/MAXIMUM CHANNEL

0027 0000

PNT, 0

/POINTER

0028 1653

XTXTC, TEXTC

0029 1626

XTXTA, TEXTA

0030 1600

XTXTB, TEXTB

0031 1411

XPRINT, PRINTI

0032 1432

XCOMA, COMA

0033 1473

XXFER, XFER

0034 1400

XHOWM, HOWM

0035 1225

XSETMU, SETMUX

0036 0000

LOW, 0

0037 0000

HIGH, 0

0038 0001

K0001, 0001

0039 0017

K0017, 0017

0040 0034

K0034, 0034

0041 0037

K0037, 0037

0042 6000

K6000, 6000

0043 7777

K7777, 7777

0044 6500

K6500, 6500

0045 0077

K0077, 0077

0046 7776

K7776, 7776

0047 0400

K0400, 0400

0048 0300

K0300, 0300

0049 2000

K2000, 2000

0050 0007

K0007, 0007

0051 7740

K7740, 7740

0052 7760

K7760, 7760

0053 7761

K7761, 7761

0054 0000

SAVE1, 0

0055 0000

SAVE2, 0

0056 0000

SAVE3, 0

0057 0000

SAVE4, 0

0058 0000

CNT, 0

0059 0000

CC, 0

0060 0000

CV, 0

0061 1777

CI, TABLEI-1

0062 2077

CN, TABLEN-1

0063 0000

GD, 0

0064 0000

BD, 0

0065 6535

ADSC=6535

0066 6534

ADCV=6534

0067 6531

ADSF=6531

0068 6532

ADRB=6532

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/READ BUFFER, START CONVERT

ADRC=6536

/SET MUX, GAIN, CLR FLAG, CONVERT, CLR AC

/START CONVERT,

/SKIP ON FLAG

/READ BUFFER, CLEAR AC

/CHANNEL, GAIN, READ BUFFER, START CONVERT

/INHIBIT PRINTOUT

/ADDRESS TAG

ALL=6537
XX=7422
XSCOPE, SCOPEA
SCOPE=JMS I XSCOPE
XSIXTY, SIXTY
XIPRIN, IPRINT
XTYPE, VESAGE
XAVERAG, AVERAGE
XDISP, DISP
XDISP3, DISP+3
XINST, INST
XCONVE, CONVER
XSMUX, SMUX
XERADD, ERADD
HALT=JMS I XERADD
AC, 0
CNTR, 0
XREAD, REREAD
FIRST, 0
XSETUP, SETUP
TEMP1=SAVE1
TEMP2=SAVE2

/SR0=1-HALT ON ERROR
/SR1=1-SCOPE LOOP
/SR2=1-INHIBIT PRINTOUT
/SR3=1-INHIBIT PLUS OR MINUS 1LSB TESTING
/SR4=GAIN
/SR5=GAIN
/SR6=1-INHIBIT AVERAGING

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*, 177+1
/SETUP FOR NUMBER TO BE TESTED
JMP AD01A
JMP BEGIN
JMP I XDISP /DISPLAY CONVERTER VALUE
JMP I XINST /INST SCOPE LOOP
JMP I XCONVER /SR.=CONVERSION TIME
JMP I XSMUX /SR=MULTIPLEXER
JMP I XREAD /DO DOUBLE BUFFER READ
AD01A, HLT
LAS
AND K0037
DCA FIRST
HLT
LAS
AND K0037
DCA K7740
JMS I XSETUP
JMP .-5
/TEST FOR NO FLAG
BEGIN, ADSF
SVB

*20

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0200
0200 5207
0201 5221
0202 5501
0203 5503
0204 5504
0205 5505
0206 5511
0207 7402
0210 7604
0211 0044
0212 3112
0213 7402
0214 7604
0215 0044
0216 3056
0217 4513
0220 5213
0221 6531
0222 7410

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0223 4506      HALT      /FLAG NOT      )ARED BY ST KEY
0224 4474      SCOPE
/WILL CONVERT INSTRUCTION SET FLAG
ADRC          /START CONVERT
CLA CLL
DCA STALL
ISZ STALL
JMP .-1
ADSF          /FLAG SHOULD BE SET
          /SKIP ON FLAG
          /FLAG NOT SET
HALT
SCOPE
/WILL READ BUFFER CLEAR FLAG
ADRB          /CLEAR FLAG
ADSF          /FLAG SHOULD BE CLEARED
SKP
HALT          /FLAG SET OR SKIP FAILED
SCOPE
/WILL ADSC SET FLAG
ADSC          /CONVERT
CLA CLL
DCA STALL
ISZ STALL
JMP .-1
ADSF          /CHECK FLAG
          /ADSC DID NOT SET FLAG
HALT
SCOPE
/WILL ADSC CLEAR AC
CLL CLA CMA RAR /ALL ONE EXCEPT FOR INTERRUPT ENABLE
ADSC          /SET CHANNEL, CONVERT, CLEAR AC
ADSF
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*20
0255 5254      JMP .-1
0256 7440      SEA
0257 4506      HALT          /ADSC DID NOT CLEAR AC
0260 4474      SCOPE
/TEST FOR NO INTERRUPT
CLA
TAD .+11
DCA 1
TAD .+10
DCA 2
ION
SKP
HALT
IOF
JMP .+3
JMP I 2
.-4
SCOPE
/RAISE AN INTERRUPT WITH DONE FLAG
CLA STL RAR
ALL
CLA
ADCV
ADSF
JMP .-1
TAD .+7
DCA 2
ION
0261 7200
0262 1273
0263 3001
0264 1274
0265 3002
0266 6001
0267 7410
0270 4506
0271 6002
0272 5275
0273 5402
0274 0270
0275 4474
0276 7330
0277 6537
0300 7200
0301 6534
0302 6531
0303 5302
0304 1313
0305 3002
0306 6001

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0307 7000 NOP /SHOULD INTERRUPT HERE
0310 6002 IOF /INTERRUPT OFF
0311 4506 HALT /FAILED TO INTERRUPT
0312 7412 SKP
0313 0314 +1
0314 4474 SCOPE
0315 6532 ADRB /CLEAR FLAG
/TEST FOR NO INTERRUPT, WITH FLAG SET, ENABLE CLEARED
0316 7200 CLA
ALL
0317 6537 ADRB /CLEAR INT, ENABLE, CONVERT
0320 6531 ADSF /WAIT FOR FLAG
0321 5320 JMP -1
0322 1333 TAD +11
0323 3001 DCA 1
0324 1334 TAD +10
0325 3002 DCA 2
0326 6001 ION
0327 7410 SKP
0330 4506 HALT /INTERRUPT FOUND WITH ENABLE CLEARED
0331 6002 IOF
0332 5335 JMP +3
0333 5402 JMP I 2
0334 0330 -4
0335 4474 SCOPE
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0336 7240 /TEST THAT ADRB JAM TRANSFERS TO AC
0337 6532 CLA CMA /AC=7777
0340 3061 ADRB /IF CLEARS FAILS=7777
0341 6532 DCA TEMP1 /SAVE READING
0342 7041 ADRB /READ BUFFER WITH AC=0
0343 1061 CIA /NEGATE
0344 7440 TAD TEMP1 /SUBTRACT FIRST READING, IF DIFFERENT
0345 4506 SZA /THEN WOULD NOT SKIP
0346 4474 HALT /ADRB DID NOT CLEAR AC.
SCOPE
/WILL SET MULTIPLEXER, SET DONE FLAG?
0347 7200 CLA
0350 6537 ALL /START CONVERT
0351 7300 CLA CLL
0352 3020 DCA STALL
0353 2020 ISE STALL
0354 5353 JMP -1
0355 6531 ADSF /SKIP ON FLAG
0356 4506 HALT /ADSC DID NOT SET DONE FLAG
0357 6532 ADRB /CLEAR FLAG
0360 4474 SCOPE
/WILL ALL CLEAR THE AC
0361 7350 CLL CLA CMA RAR /3777
0362 6537 ALL
0363 6531 ADSF
0364 5363 JMP -1 /WAIT FOR DONE
0365 1177 TAD [4000 /4000+3777=7777
0366 7040 CMA /IF CLR FAILS WOULD=0
0367 7450 SNA
0370 4506 HALT /ALL DID /CLEAR AC
0371 4474 SCOPE
/WILL ADRB JAM TRANSFER TO AC
0372 7300 CLA CLL

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0373	6532	ADRB	/READ BUFFER
0374	3061	DCA TEMP1	/SAVE DATA
0375	7240	CLA CMA	/SET AC=7777
0376	6536	ADRC	/READ BUFFER, CONVERT AGAIN
0377	6531	ADSF	/WITH AC=0
0400	5777	JMP .-1	/WAIT FOR FLAG
0401	7041	CIA	/NEGATE
0402	1061	TAD TEMP1	/SUBTRACT FIRST READING, IF DIFFERENT
0403	7440	SZA	/THEN WOULD NOT SKIP
0404	4506	HALT	/ADRC DID NOT CLEAR AC
0405	4474	SCOPE	
		/WILL ADCV RAISE A DONE FLAG	
		ADCV	/RAISE A FLAG
0406	6534	ISZ STALL	
0407	2020	JMP .-1	/TIME FOR THE FLAG
0410	5207	ADSF	/CHECK FOR FLAG
0411	6531	HALT	/ADCV DID NOT RAISE A FLAG
0412	4506	ADRB	/CLR FLAG
0413	6532	SCOPE	
0414	4474		

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0415	6534	ADCV	/DOES ADCV ZERO THE FLAG	ADCV	/RAISE A FLAG
0416	6531	ADSF			
0417	5216	JMP .-1			
0420	6534	ADCV	/SHOULD CLEAR THE FLAG		
0421	6531	ADSF	/TEST FOR NO FLAG		
0422	7410	SKP			
0423	4506	HALT	/FLAG FOUND TOO SOON		
0424	4474	SCOPE			
		/DOES ADCV ZERO THE FLAG			
		ADCV	/RAISE A FLAG		
0425	6534	ADSF			
0426	6531	JMP .-1			
0427	5226	ADSC	/CLEAR THE FLAG		
0430	6535	ADSF	/TEST FOR NO FLAG		
0431	6531	SKP			
0432	7410	HALT	/FLAG FOUND TOO SOON		
0433	4506	SCOPE			
0434	4474				

0435	6534	ADCV	/DOES ADCV ZERO THE DONE FLAG	ADCV	/RAISE A FLAG
0436	6531	ADSF			
0437	5236	JMP .-1			
0440	6536	ADRC	/CLEAR THE FLAG		
0441	6531	ADSF	/TEST FOR NO FLAG		
0442	7410	SKP			
0443	4506	HALT	/FLAG FOUND TOO SOON		
0444	6531	ADSF			
0445	5244	JMP .-1	/WAIT FOR FINAL FLAG		
0446	6532	ADRB	/CLEAR FLAG		
0447	4474	SCOPE			
0450	5651	JMP 1 .+1			
0451	0600				
		/TEST FOR CORRECT INPUTS FROM SWITCHES			
0452	0000	SETUP, 0			
0453	1112	TADFIRST	/GET FIRST CHANNEL		

0454 7041
0455 1056
0456 7510
0457 5652
0460 7040
0461 3056
0462 1112
0463 1023
0464 3022
0465 2252
0466 5652
0577 0377
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CIA /SUBTRACT LAST CHANNEL
TAD K7740 /IS FIRST > LAST
SPA /YES, TRY AGAIN
JMP I SETUP /NUMBER OF CHANNELS
CMA
DCA K7740
TAD FIRST
TAD XTIA
DCA XTI
ISZ SETUP
JMP I SETUP

*. 177+1

/COMPARE ONE CONVERSION WITH THE AVERAGE 100(8) CONVERSIONS

0600 4474
0601 6537
0602 6531
0603 5202
0604 6532
0605 3061
0606 4500
0607 3062
0610 1062
0611 7041
0612 1061
0613 7650
0614 5226
0615 1062
0616 7040
0617 1061
0620 7450
0621 5226
0622 7001
0623 7040
0624 7440
0625 4506
0626 4474

SCOPE

/CHANGE ZERO, CONVERT

ALL

ADSF

JMP --1

ADRB

DCA SAVE1

JMS I XAVERAG

DCA SAVE2

TAD SAVE2

CIA

TAD SAVE1

SNA CLA

JMP OUT

TAD SAVE2

CMA

TAD SAVE1

SNA

JMP OUT

IAC

CMA

SZA

HALT

SCOPE

/CHECK SWITCH GAIN AMPLIFIER

CLA

ALL

ADSF

JMP --1

JMS I XAVERAG

DCA SAVE1

TAD [100

ALL

ADSF

JMP --1

JMS I XAVERAG

DCA SAVE2

TAD [200

ALL

ADSF

JMP --1

JMS I XAVERAG

DCA SAVE3

TAD [300

ALL

/NOT EQUAL PLUS OR MINUS ONE

/CONVERT GAIN X1

/WAIT FOR FLAG

/AVERAGE 100(8) CONVERSION

/GAIN OF X2

/CONVERT, GAIN X2

/GAIN OF X4

/CONVERT GAIN TIMES 4

/GAIN OF

/CONVERT

) TIMES 8

0653 6531
0654 5253
0655 4500
0656 3064
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*20

ADSF
JMP .-1
JMS I XAVERAG
DCA SAVE4
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/TAKE HIGHEST GAIN DIVIDE THEN COMPARE

0657 1064
0660 7100
0661 7510
0662 7120
0663 7010
0664 7041
0665 1063
0666 4777.
0667 5313
0670 1063
0671 7100
0672 7510
0673 7120
0674 7010
0675 7041
0676 1062
0677 4777.
0700 5313
0701 1062
0702 7100
0703 7510
0704 7120
0705 7010
0706 7041
0707 1061
0710 4777.
0711 7000
0712 5327
0713 1061
0714 4506
0715 7200
0716 1062
0717 4506
0720 7200
0721 1063
0722 4506
0723 7200
0724 1064
0725 4506
0726 4474
0727 6532
0730 7610
0731 7700
0732 2331
0733 5337
0734 1060
0735 3331
0736 5741
0737 5740
0740 0221
0741 1200
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*20

TAD SAVE4
CLL
SPA
STL
RAR
CIA
TAD SAVE3
JMS LIMIT
JMP HALTA
TAD SAVE3
CLL
SPA
STL
RAR
CIA
TAD SAVE2
JMS LIMIT
JMP HALTA
TAD SAVE2
CLL
SPA
STL
RAR
CIA
TAD SAVE1
JMS LIMIT
NOP
JMP HALTB
TAD SAVE1
HALT
CLA
TAD SAVE2
HALT
CLA
TAD SAVE3
HALT
CLA
TAD SAVE4
HALT
SCOPE
ADRB
CLA SKP
7700
IS2 .-1
JMP .+4
TAD K7761
DCA .-4
JMP I .+3
JMP I .+1
BEGIN
GIN

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HALTA, /PRINT THE FOUR GAIN AVERAGES

/ON A ERROR COMPARE

/GAIN OF ONE

/GAIN OF TWO

/GAIN OF FOUR

/GAIN OF EIGHT

/CLEAR FLAG FOR LOOPING

/MUX TEST

/TEST FOR PLUS OR MINUS ONE

```
0777 1000
1000 1000
1001 7402
1002 7450
1003 5212
1004 7040
1005 7450
1006 5212
1007 7001
1008 7040
1009 7640
1010 5777
1011 7200
1012 2200
1013 5000
1014 V141
PAL10

*20

*. 177+1
LIMIT, XX
SNA
JMP OK
CMA
SNA
JMP OK
IAC
CMA
SZA CLA
JMP HALTA
CLA
ISZ LIMIT
JMP I LIMIT
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```

/EQUAL TO EACH

/PLUS ONE

/NOT EQUAL OR PLUS OR MINUS ONE
/MINUS ONE

```
1177 0713
1200 1200
```

*. 177+1
/CONTROL FOR AD01A
GIN,

```
1200 7300
1201 3110
1202 1022
1203 3021
1204 4436
1205 1022
1206 3021
1207 4435
1210 4432
1211 1024
1212 3021
1213 4436
1214 4433
1215 4434
1216 4436
1217 4433
1220 4434
1221 2110
1222 5213
1223 4320
1224 5213

CLA CLL
DCA CNTR
TAD XT1
DCA TAPNTB
JMS I XSETMU
TAD XT1
DCA TAPNTB
JMS I XHOWM
JMS I XPRINT
TAD XTN
DCA TAPNTB
JMS I XSETMU
JMS I XCOMA
JMS I XFER
JMS I XSETMU
JMS I XCOMA
JMS I XFER
ISZ CNTR
JMP GIN1
JMS BELL
JMP GIN1

/CLEAR PASS COUNTER
/TABLEI
/FILL TABLE I
/HOW MANY CHANNELS
/PRINT TABLE I
/TABLE N
/FILL TABLE N (NEW)
/TABLE N=TABLE I
/TRANSFER N TO I
/WITH INCREMENT MUX
/COMPARE
/TABLE N TO TABLE I
/PASS COUNT
/LOOP
/RING BELL
```

/FILL TABLE WITH SET MULTIPLEXER INSTRUCTION

```
1225 7402
1226 1021
1227 3026
1230 1056
1231 3065
1232 1026
1233 0044
1234 3000
1235 7604
1236 0053
1237 1000
1240 6535
1241 6531

SETMUX, XX
TAD TAPNTB
DCA PNT
TAD K7742
DCA CNT
TAD PNT
AND K0037
DCA 0
LAS
AND K0300
TAD 0
ADSC
ADSF

/TABLE POINTER
/POINTER
/MINUS 32
/COUNTER
/POINTER
/SAVE CH
/READ SW FOR GAIN
/MASK GAIN
/MERGE WITH CHANNEL
/MASK CHANNELS
/SKIP ON
```

```

1241 JMP .-1 /WAIT FOR FLAG
1243 JMS AVERAGE /-----NOP FOR NO AVERAGING
1244 DCA I PNT /STORE IN TABLE
1245 ISZ PNT /INCREMENT POINTER
1246 ISZ CNT /DONE
1247 JMP SMUX1 /NO-LOOP
1250 JMP I SETMUX /YES-EXIT

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/AVERAGE 100(8) CONVERSIONS
AVERAG, XX

1251 7402

1252 7604

1253 0173

1254 7650

1255 5260

1256 6532

1257 5651

1260 7300

1261 3037

1262 3040

1263 1172

1264 3171

1265 6536

1266 6531

1267 5266

1270 7100

1271 1054

1272 7104

1273 1037

1274 3037

1275 7430

1276 2040

1277 2171

1300 5265

1301 7300

1302 1170

1303 3171

1304 7300

1305 1040

1306 7010

1307 3040

1310 1037

1311 7010

1312 3037

1313 2171

1314 5304

1315 1037

1316 1045

1317 5651

1320 0000

1321 7600

1322 1330

1323 0046

1324 6041

1325 5624

1326 7600

1327 5720

/INHIBIT AVERAGE

/YES-SKIP

SNA CLA

JMP .+3

ADRB

JMP I AVERAGE

CLA CLL

DCA LOW

DCA HIGH

TAD C-100

DCA CXX /LOOP COUNTER

ADRC

ADSF

JMP .-1

CLL

TAD K2000

CLL RAL

TAD LOW

DCA LOW

SZL

ISZ HIGH

ISZ CXX

JMP AV1

CLA CLL

TAD C-7

DCA CXX

CLA CLL

TAD HIGH

RAR

DCA HIGH

TAD LOW

RAR

DCA LOW

ISZ CXX

JMP AV2

TAD LOW

TAD K6000

JMP I AVERAG

/END OF PASS BELL

0

CLA CLL

TAD DING

TLS

TSF

JMP .-1

CLA CLL

JMP I BELL

/INITIALIZE LOW AND HIGH

/64 DECIMAL

/READ BUFFER, CONVERT

/WAIT FOR FLAG

/CLEAR LINK

/SAVE UPDATED AVERAGE

/SKIP ON NO OVERFLOW

/INCREMENT HIGH VALUE

/100 TIMES

/LOOP

/NOW DIVIDE BY 200(8)-128(10)

/BY DOUBLE WORD ROTATE, RIGHT SEVEN TIMES

/FROM HIGH TO LINK TO LOW

/PARTIAL AVERAGE

/DONE?

/NO--GO BACK AND START

/AVERAGE OF 100 CONVERSIONS

BELL,

```

*20      1330  0207  DING,  207      17:55  PAGE 11
      PAL10  V141  9-MAR-71

      * 177+1
      /HOW MANY CHANNELS ARE BEING TESTED
      HOWM,  XX
      TAD TAPNTB  /TABLE POINTER
      DCA PNT     /POINTER
      TAD K7740   /NUMBER OF CHANNELS
      CIA
      DCA MC
      HOW2,  JMS I XTEXTB  /NUMBER OF CHANNELS
      CLA
      JMP I HOWM  /EXIT
      9-MAR-71  17:55  PAGE 12
      PAL10  V141

```

```

/PRINT TABLE I FOR REFERENCE
PRINTI, XX
      1411  7402  TAD XTI  /TABLE I
      1412  1022  DCA PNT  /POINTER
      1413  3026  TAD K7740 /MAXIMUM CHANNEL
      1414  1056  DCA CNT  /COUNTER
      1415  3065  TAD XTI
      1416  1022  AND K0037
      1417  0044  DCA CC   /CURRENT CHANNEL
      1420  3066  TAD I PNT
      1421  1426  NOP
      1422  7000  DCA GD
      1423  3072  PRINT2, JMS I XTEXTA
      1424  4430  ISZ CC   /CH XX=XXXX
      1425  2066  ISZ PNT  /VOLTAGE POINTER
      1426  2026  ISZ CNT  /DONE?
      1427  2065  JMP PRINT2-3 /NO
      1430  5221  JMP I PRINTI /YES
      1431  5611

```

```

/COMPARE TWO TABLES FOR EQUALITY OR +1-1LSB.
/TEST TABLE I EQUAL TABLE N
COMA,  XX
      1432  7402  TAD CI  /I OLD TABLE
      1433  1070  DCA 11
      1434  3011  TAD CN  /NEW TABLE
      1435  1071  DCA 12
      1436  3012  TAD MC  /NUMBER OF CHANNELS
      1437  1025  CIA
      1440  7041  DCA CNT
      1441  3065  DCA I 11
      1442  1411  DCA GD  /WAS
      1443  3072  TAD I 12
      1444  1412  DCA BD  /IS
      1445  3073  TAD GD
      1446  1072  CIA
      1447  7041  TAD BD
      1450  1073  SNA CLA
      1451  7650  JMP COMA2+1
      1452  5270  LAS
      1453  7604  AND K0400
      1454  0052  SZA CLA
      1455  7640  JMP COMA2
      1456  5267  TAD GD
      1457  1072

```

```

1460 7040
1461 1073
1462 7450
1463 5270
1464 7001
1465 7040
1466 7440
1467 4427
1470 2065
1471 5242
1472 5632
PAL10 V141

COMA2, JMS I XTEXTC /TEST CH X WAS---IS----
ISZ CNT /DONE
JMP COMA1 /NO LOOP
JMP I COMA /YES EXIT
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```

*20

```

/TRANSFER TABLE "N" TO TABLE "I"
XFER, XX
TAD CI
DCA I1
TAD CN
DCA I2
TAD MC
CIA
DCA CNT
XFER1, TAD I 12
DCA I 11
ISZ CNT
JMP XFER1
JMP I XFER
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```

*20

```

1600
1600 7402
1601 4476
1602 4475
1603 0025
1604 1615
1605 1615
1606 4477
1607 4543
1610 2410
1611 0522
1612 0540
1613 0122
1614 0540
1615 0060
1616 4050
1617 7051
1620 4003
1621 1001
1622 1616
1623 0514
1624 2300
1625 5600

XBI,

/INITIAL TABLE PRINT OUT
TEXTA, XX
JMS I XIPRIN
JMS I XSIXTY
CC
XIA1

/NUMBER OF CHANNELS
/MAXIMUM CHANNEL
/THERE ARE XX CHANNELS

```

/CURRENT CHANNEL

1633 1644
1634 4475
1635 0072
1636 1647
1637 1650
1640 4477
1641 4543
1642 0310
1643 4040
1644 6060
1645 4075
1646 4040
1647 6060
1650 6060
1651 0000
1652 5626
PAL10 V141

*20

XTA1
JMS I XSIXTY
GD
XTA2
XTA2+1
JMS I XTYPE
4543
0310
4040
XTA1, 6060
4075
4040
XTA2, 6060
6060
0
JMP I TEXTA
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/CHANNEL ERROR PRINTOUT
TEXTC, XX /CH XX WAS "YY" IS "ZZ"

1653 7402
1654 4476
1655 1072
1656 3072
1657 1073
1660 3073
1661 4475
1662 0011
1663 1700
1664 1700
1665 4475
1666 0072
1667 1704
1670 1705
1671 4475
1672 0073
1673 1710
1674 1711
1675 4477
1676 4543
1677 0310
1700 6060
1701 4027
1702 0123
1703 4040
1704 6060
1705 6060
1706 4011
1707 2340
1710 6060
1711 6060
1712 0000
1713 5653

JMS I XIPRIN
TAD GD
DCA GD
TAD BD
DCA BD
JMS I XSIXTY
11
XTC1
XTC1
JMS I XSIXTY
GD
XTC2
XTC2+1
JMS I XSIXTY
BD
XTC3
XTC3+1
JMS I XTYPE
4543
0310
XTC1, 6060
4027
0123
4040
XTC2, 6060
6060
4011
2340
XTC3, 6060
6060
2
JMP I TEXTC

/CH
/WAS
/IS

*. 177+1
TABLE1, 0
*TABLE1+100
TABLEN, 0
PAUSE
2000 0000
2100 0000

```
2200      * . 177+1
2200      SIXTY, HLT
2201      NOP
2202      NOP
2203      CLA
2204      TAD I .-4
2205      DCA .+2
2206      JMP I .+2
2207      0
2210      SIXTY+12
2211      JMP SIXTY+3
2212      TAD I SIXTY+7
2213      AND K0007
2214      DCA MASKA
2215      TAD I SIXTY+7
2216      AND K0070
2217      DCA MASKB
2220      TAD I SIXTY+7
2221      AND K0700
2222      DCA MASKC
2223      TAD I SIXTY+7
2224      AND K7000
2225      DCA MASKD
2226      TAD MASKC
2227      RTR CLL
2230      RAR
2231      TAD MASKD
2232      RAR
2233      RAR
2234      TAD MASKD+1
2235      DCA MASKC
2236      ISZ SIXTY
2237      JMS SIXTY+10
2240      TAD MASKC
2241      DCA I SIXTY+7
2242      TAD MASKB
2243      RAL
2244      RTL
2245      TAD MASKA
2246      TAD MASKD+1
2247      DCA MASKD
2250      ISZ SIXTY
2251      JMS SIXTY+10
2252      TAD MASKD
2253      DCA I SIXTY+7
2254      TAD SIX12
2255      DCA SIXTY+10
2256      ISZ SIXTY
2257      JMP I SIXTY
2258      PAL10
2259      V141
2260      MASKA, 0
2261      MASKB, 0
2262      MASKC, 0
2263      MASKD, 0
```

```

2264 6060
2265 0070
2266 0700
2267 7000
2270 2212
PAL10 V141
*20
17:55 PAGE 18
9-MAR-71
/SCOPE LOOP CHECK
/SCOPE WITH SWITCH BIT 1=1 (2000)
SCOPEA, XX
LAS
AND K2000
SZA CLA
JMP I RETURN
TAD SCOPEA
DCA RETURN
JMP I SCOPEA
2271 7402
2272 7604
2273 0054
2274 7640
2275 5701
2276 1271
2277 3301
2300 5671
RETURN, BEGIN
JMP I RETURN
2301 0221
2302 5701
/INHIBIT PRINT OUT WHEN BIT 2=1 (1000)

```

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```

2303 7402
2304 3107
2305 7604
2306 7006
2307 7700
2310 5316
2311 1303
2312 1051
2313 3303
2314 1703
2315 3303
2316 5703
2317 7402
2320 2323
2321 5320
2322 5717
2323 0000
PAL10 V141
*20
17:55 PAGE 19
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IPRINT, XX
DCA AC
LAS
RTL
SMA CLA
JMP .+6
TAD IPRINT
TAD K7776
DCA IPRINT
TAD I IPRINT
DCA IPRINT
JMP I IPRINT
WAIT, XX
ISZ .+3
JMP .-1
JMP I WAIT
0
/PRINTOUT CONTENTS OF AC AND ERROR ADDRESS
/TEST FOR INHIBIT PRINT
/TYPE ERROR ADDRESS

```

```

2324 7402
2325 4476
2326 6002
2327 4475
2330 2324
2331 2335
2332 2336
2333 4477
2334 4543
2335 6060
2336 6060
2337 4000
2340 4475
2341 0107
2342 2346
2343 2347
ERADD, XX
JMS I XIPRIN
IOF
JMS I XSIXTY
ERADD
.+4
.+4
JMS I XTYPE
4543
6060
4000
JMS I XSIXTY
AC
.+4
.+4

```

2344 4477
2345 4040
2346 6060
2347 6060
2350 8080
2351 6042
2352 6032
2353 7624
2354 7700
2355 5724
2356 1107
2357 7402
2360 5724
PAL10 V141

*20

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/TEST FOR -AL-

/DIGITAL 8-18-U
/MESSAGE TYPE-OUT
/CALL WITH A JMS MESSAGE
/WITH DATA FOLLOWING
/RETURN FOLLOWING END OF MESSAGE
/CODE(00)

2400 0000
2401 7240
2402 1200
2403 3010
2404 1410
2405 3216
2406 1216
2407 7012
2410 7012
2411 7012
2412 4217
2413 1216
2414 4217
2415 5204
2416 0000

CLA CMA
TAD MESSAGE
DCA 10
TAD I 10
DCA MSRGHT
TAD MSRGHT
RTR
RTR
RTR
JMS TYPECH
TAD MSRGHT
JMS TYPECH
JMP MESSAGE+4
0

*/SET C(AC)=-1
*/ADD LOCATION
*/AUTO-INDEX REGISTER
*/FETCH FIRST WORD
*/SAVE IT

MSRGHT,
TYPECH,
0
AND MASK77
SNA
JMP I 10
TAD M40
SMA
JMP +3
TAD C340
JMP MTP
TAD M3
SZA
JMP +3
TAD C212
JMP MTP
TAD M2
SZA
JMP +3
TAD C215
JMP MTP
TAD C245
TAD C245

*/ROTATE 6 BITS RIGHT
*/TYPE IT
*/GET DATA AGAIN
*/TYPE RIGHT HALF
*/CONTINUE
*/TEMPORARY STORAGE

2417 0000
2420 0250
2421 7450
2422 5410
2423 1251
2424 7500
2425 5230
2426 1252
2427 5243
2430 1253
2431 7442
2432 5235
2433 1254
2434 5243
2435 1255
2436 7442
2437 5242
2440 1256
2441 5243
2442 1257

*/TYPE CHARACTER IN C(AC)6-11
/IS IT END OF MESSAGE?
/YES: EXI-
/SUBTRACT 40
/K40?
/NO
/YES: ADD 30?
/TO CODES K40
/SUBTRACT 3
/IS IT ZERO?
/NO
/YES: CODE 43 15
/SAVE-PC (212)
/SUBTRACT 3
/IS IT ZERO?
/NO
/YES: CODE 45 15
/SAVE-PC (215)
/ADD 232 TO C(AC)6-11

```

2443 6046 MTP, TLS /TRANSMIT CHARACTER.
2444 6041 TSF /WAIT FOR FLAG
2445 5244 JMP --1 /NOT SET YET
2446 7200 CLA /SET: CLEAR C(40)
2447 5617 JMP I TYPECH /RETURN

```

*20 9-MAR-71 17:55 PAGE 21

```

/CONSTANTS
MASK77, 77
M40, -40
C340, 340
M3, -3
C212, 212
M2, -2
C215, 215
C245, 245

LSTALL, XX
2460 7402 ISZ STALL
2461 2020 JMP --1
2462 5261 ISZ STALL
2463 2020 JMP --1
2464 5263 ISZ STALL
2465 2020 JMP --1
2466 5265 ISZ STALL
2467 2020 JMP --1
2470 5267 ISZ STALL
2471 2020 JMP --1
2472 5271 ISZ STALL
2473 5660 JMP I LSTALL

/SET TEST FOR MULTIPLEXER SR SHOULD EQUAL MULTIPLEXER LIGHTS
SMUX, LAS /LOAD CHANNEL AND GAIN
ALL /SET MULTIPLEXER
ISZ STALL /DISPLAY TIME
JMP --1 /LOOP
JMP SMUX /SCOPE SET UP FOR CONVERSION ST=TIME
CONVER, ADRC /START CONVERSION
LAS /READ SW REGISTER
CMA /COMPLEMENT NUMBER
DCA STALL /CONVERSION TIME=
ISZ STALL
JMP --1
JMP CONVER /LOOP
/SCOPE LOOP FOR INSTRUCTIONS
/NOT INSTRUCTION 65XX, XX=SR BITS 6 TO 11
INST, NOP /READ SWITCH
LAS AND K0077 /CREATE INSTRUCTION
TAD K6500 /LOCATION OF INSTRUCTION
DCA --1 /IN CASE OF SKIP
HLT /LOOP
NOP JMP INST+1
/DISPLAY CONVERTED VALUE IN A.C.
DISP, LAS /LOAD SW REGISTER
ALL /SET MUX CHANNEL
ADSF JMP --1

```

*22	2524	6532	ADDR	/READ BUFF	
	2525	4260	JMS LSTALL		
	2526	5322	JMP DISP	/LOOP, SET MUX AND CONVERT	
	2527	0020	?		
	PAL10	V141	9-MAR-71	17:55	PAGE 21-1
*22	PAL10	V141	9-MAR-71	17:55	PAGE 22
	2530	7300	/DOUBLE BUFFER READ AND COMPARE		
	2531	3110	REREAD, CLA CLL		
	2532	7604	DCA CNTR	/CLEAR FIXED DELAY	
	2533	7040	LAS	/GET VARIABLE DELAY FROM SWITCHES	
	2534	3020	CMA	/SET UP	
	2535	6535	DCA STALL	/VARIABLE DELAY	
	2536	6531	ADSC	/SET GAIN=0, CHANNEL=1, CONVERT	
	2537	5336	ADSF	/WAIT FOR FLAG	
	2540	6532	JMP .-1		
	2541	3061	ADRB	/READ BUFFER	
	2542	2110	DCA TEMP1	/SAVE READING	
	2543	5342	ISZ CNTR	/FIXED DELAY	
	2544	2020	JMP .-1		
	2545	5344	ISZ STALL	/VARIABLE DELAY	
	2546	6532	JMP .-1		
	2547	3062	ADRB	/READ BUFFER AGAIN	
	2550	1061	DCA TEMP2	/SAVE SECOND READING	
	2551	7041	TAD TEMP1	/COMPARE READINGS	
	2552	1062	CIA		
	2553	7650	TAD TEMP2	/DIFFERENCE SHOULD BE 0	
	2554	5330	SNA CLA	/DIFFERENCE IS 2	
	2555	1061	JMP REREAD	/DIFFERENCE NOT 2	
	2556	7402	TAD TEMP1	/HALT WITH FIRST READING IN AC	
	2557	7300	HLT		
	2560	1062	CLA CLL		
	2561	7402	TAD TEMP2		
	2562	5330	HLT	/HALT WITH SECOND READING IN AC	
	2562	5330	JMP REREAD		
	0170	7771	\$		
	0171	7402			
	0172	7700			
	0173	0040			
	0174	0300			
	0175	0200			
	0176	0120			
	0177	4020			
*22	PAL10	V141	9-MAR-71	17:55	PAGE 22-1
2222	00000000	00202020	11111111	11111111	11111111
2122	11111111	11112020	00202020	00202020	11111111
2222	11111111	11111111	11111111	11111111	11111111
2322	11111111	11111111	11111111	11111111	11111111
2422	11111111	11111111	11111111	11111111	11111111

5000
5100
5200
5300
5400
5500
5600
5700
6000
6100
6200
6300
6400
6500
6600
6700
7000
7100
7200
7300
7400
7500
7600
#200

PAL10	V141	9-MAR-71	17:55	PAGE 22-3
AC	0107	K0700	2266	TEXTC 1653
ADCV	6534	K2000	0054	TYPECH 2417
AD01A	0207	K6000	0045	WAIT 2317
ADRB	6532	K6500	0047	XAVERA 0100
ADRC	6536	K7000	2267	X81 1615
ADSC	6535	K7740	0056	XCOMA 0033
ADSF	6531	K7760	0057	XCONVE 0104
ALL	6537	K7761	0060	XDISP 0101
AV1	1265	K7776	0051	XDISP3 0102
AV2	1304	K7777	0046	XERADD 0126
AVERAG	1251	LIMIT	1000	XFER 1473
SD	0073	LOW	0037	XFER1 1503
REGIN	0221	LSTALL	2460	XHCWY 0035
PELL	1320	M2	2455	XINST 0103
C212	2454	M3	2453	YIPRIN 0076
C215	2456	M40	2451	XPRINT 0032
C245	2457	MASK77	2450	XREAD 0111
C340	2452	MASKA	2260	XSCOPE 0074
CC	0066	MASKB	2261	XSETM 0036
CI	0070	MASKC	0262	XSETP 0113
CN	0071	MASKD	2263	XSTATY 0079
CNT	0065	MC	0225	XSMUX 0105

CNTR 0110
COMA 1432
COMA1 1442
COMA2 1467
CONVER 2501
CV 0067
RING 1330
DISP 2520
ERADD 2324
FIRST 0112
GD 0072
GIN 1200
GIN1 1213
HALT 4506
HALTA 0713
HALTB 0727
HIGH 0040
HOW2 1406
HOWM 1400
INST 2510
IPRINT 2503
K0001 0041
K0007 0055
K0017 0042
K0034 0043
K0037 0044
K0070 2265
K0077 0050
K0300 0053
K0400 0052
PAL10 V141

MESSAGE 2400
MSRCHT 2416
MTP 2443
OK 1012
OUT 2626
PNT 2226
PRINT2 1424
PRINT1 1411
REREAD 2530
RETURN 2301
SAVE1 0061
SAVE2 0062
SAVE3 0063
SAVE4 0064
SCOPE 4474
SCOPEA 2271
SETMUX 1225
SETUP 0452
SIX12 2272
SIXTY 2200
SMUX 2474
SMUX1 1232
STALL 0020
TABLE1 2000
TABLEN 2100
TAPNTB 0021
TEMP1 0061
TEMP2 0062
TEXTA 1626
TEXTB 1600
17:55

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*20

ERRORS DETECTED: 0
LINKS GENERATED: 5
RUN-TIME: 9 SECONDS
3K CORE USED