CGRS MICROTECH
PETDISK
6502PDS

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CGRS Microtech Inc.

DATA 1

Data Acquisition And Control System

TABLE OF CONTENTS

1) INTRODUCTION

The CGRS Microtech DATA 1 is a printed circuit board which adds data acquisition and control capability to the Commodore 64.
It contains five sections:

1) Analog to Digital Converter
2) Digital to Analog Converter
3) Digital Inputs
4) Digital Outputs
5) Real Time Clock

2) General Description

The DATA 1 is supplied with a 5.25 inch diskette which contains software that controls all on-board devices, and allows easy data transfer between all devices. To load all the software, perform the following two loads:

```
LOAD "MACODE",8,1
LOAD "BRTC",8
```

The Data 1 board plugs into the expansion connector of the commodore 64. The +5V DC supply voltage is provided from the 64. The on board +12V DC, -12V DC are generated using DC-DC converters. These voltages provide power for the A/D converter and the D/A converter. The ribbon cable headers are provided for connection to external devices.
All devices on board are memory mapped into the area from $DFFC to $DFFF. They may be accessed from basic, forth, machine code etc. Drivers are provided on diskette which allow the user to communicate with each device easily. See each section for detailed operating instructions.

3) Analog to Digital Converter

The DATA 1 board uses an Intersil ICL7109 12 bit A/D converter chip. This chip allows analog voltages to be converted into digital form and placed into the Commodore's memory.
A 16 channel analog multiplexer (IH6116) steered by the channel register together with the ICL7109 provides 16 seperate analog inputs. The input voltage range is from 0 to 10 volts. (This is adjustable by changing the precision resistors between the mux and the A/D.) The internal refernce of the 7109 provides the precision refernce voltage required by the A/D converter. A voltage divider R7 and R8 divide the 0-10 volt signal down to a 4.096 full scale voltage which the ICL7109 accepts as its input range. The range can be modified by changing the precision resistors R7 and R8. The conversion value may be scaled by adjusting potentiometer R10 which changes the reference voltage. The Reference voltage is factory set at 2.096 VDC. In order to obtain a channel measurement, the following procedure should be followed:

1) Load the Basic file " BRTC ".
2) Place the desired A/D channel into the variable CHAN in line 1010.
3) Run the program starting at line 1000 and the 12 bit decimal value will be printed on the screen.

4) DIGITAL TO ANALOG CONVERTER

The DAATA 1 board uses an Analog Devices 7542N 12 bit D/A converter. The D/A provides an analog voltage directly proportional to the contents of its 12 bit register. An on board pin programmable precision voltage reference AD584 provides precision output voltages of 10.000V,7.500, 5.000V and 2.500V. This voltage is fed to the DAC to form the full scale voltage output. The output voltage is programmable from on board jumpers. The 12 bit value to be written to the DAC is first placed in two bytes of Ram. A machine language routine is then called to transfer the two bytes of information from Ram to the DAC 12 bit output register.
An AD542 precision BiFet op amp is used as the Dac output amplifier.
To place a 12 bit value into the DAC registers:

1) Load the file "BRTC" from the supplied diskette. Load the Machine Code file "MAC-CODE",8,1 from the diskette.
2) Set the variable LOBYT in line 2040 to the desired 8bit lo byte value and the variable HIBYT in line 2050 to the desired high 4 bit nibble. Always set the 4 most siginificant bits of HIBYT to zeroes.
3) Type RUN 2030 and the DAC output will reflect the value placed in it's registers.
To clear the DAC registers type run2020.

5) DIGITAL OUTPUTS

The DATA 1 uses a 74LS374 octal latch and a 74LS174 hex latch to provide 10 TTL compatible digital outputs. The outputs may be used to drive digital displays, control multiplexers, solid state relays etc... The value to be written to the outputs is poked from BASIC to transfer data to the output registers.

To place bits 0-7 on the first port:

```
POKE 57343,VALUE1
```

Each bit of VALUE1 represents a power of 2 from 2**0 to 2**7.

```
bit1=2**0=1
bit2=2**1=2 etc.
```

All bits are summed together to form the decimal value to be poked to location 57343.

To place bits 8,9 on the second port:

```
POKE 57342,VALUE2
```

The first four bits of VALUE2 are the A/D Converter channel address bits. The fifth and sixth bits of VALUE2 are the ninth and tenth digital outputs.

The outputs must be buffered to drive conventional type relays or devices requireing more current than 2.6mA at +5VDC. and 24mA at ground.

6) DIGITAL INPUTS

The DATA 1 uses a 74LS244 Octal buffer and a 74LS367 hex buffer to provide 12 TTL conpatible (0-5V) digital inputs. The inputs allow monitoring of switches, contact closures an other TTL logic etc...They are read in the following manner.

```
To read Inputs 0-7
PRINT PEEK ( 57343 )
```

Once again each bit represents a power of 2 from 2**0 to 2**7.

```
To read inputs 8-11
PRINT PEEK ( 57342 )
```

The first two inputs of this latch are for monitoring the run status of the real time clock and the A/D Converter. Mask them off and look at the 4 most significant bits.

7) REAL TIME CLOCK

The DATA 1 board uses an OKI MSM58321RS Cmos real time clock calender chip. This crystal controlled chip allows the Commodore 64 computer to keep track of the year, month, day of month, day of week, hours, minutes and seconds.
A basic program (BRTC)prompts the user to enter the time and date and places this into Ram. They are later transferred into the 58321 registers using a machine language program (MC). When you wish to print the time and date on the screen, just call the 'Basic' subroutine and the information will appear on the screen. An on board battery keeps the Real Time Clock running when the power is not available. Set the clock once and forget it. The battery should be replaced once a year.
To load the real time clock softwaretype Load "brtc",8 with the supplied diskette in the disc drive. When READY appears, type Load "MC",8,1 to load the machine code program.
To enter the time and date type RUN 500, once the DATA 1 software has been loaded. The program will prompt you for the year, month, day of month, day of week, hours, minutes and seconds. Enter all parameters and the program will load them into the RTC chip and perform a read afterwards.
To read the time and date just type RUN. The time and date as well as a header will appear on the screen. Modifications may be made to the format of the print statements as necessary, or eliminated completely if events based on times are required to be initiated.

DATAONE CONNECTOR PIN OUT

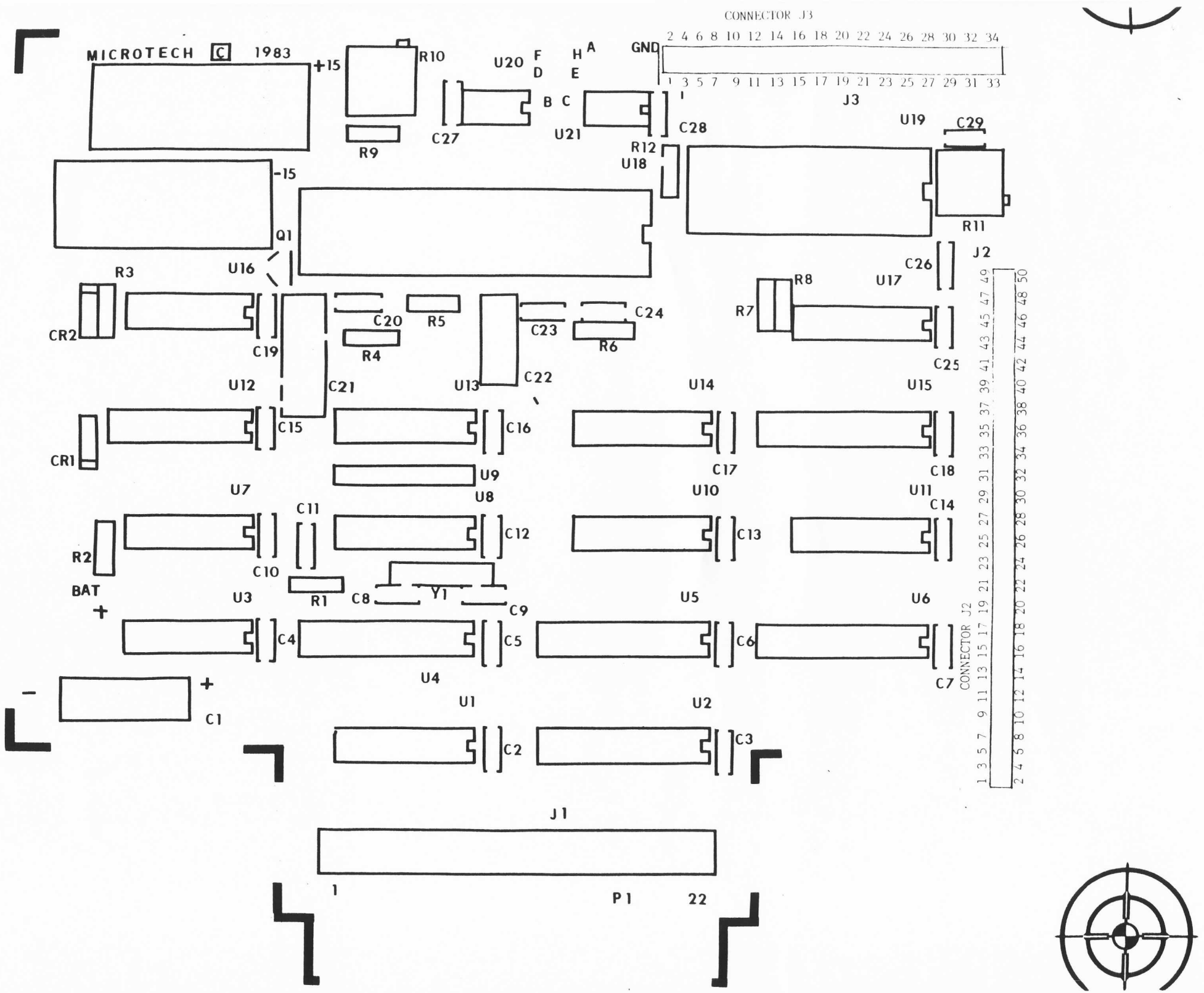
Connector J3 has all even number pins connected to ground. All odd number pins are signal level.
J3 is all analog input signals.

PIN NUMBER	DESCRIPTION
	ANALOG INPUT
7	AI 0
11	AI 1
15	AI 2
19	AI 3
23	AI 4
27	AI 5
31	AI 6
33	AI 7
3	AI 8
5	AI 9
9	AI10
13	AI11
17	AI12
21	AI13
25	AI14
29	AI15

ANALOG OUTPUT
The analog output signal is to the left of J3 and it is labled A and GND.

Connector J2 is used for all the digital input and digital output signals.

PIN NUMBER	DISCRIPTION
	DIGITAL INPUT
15	DI 0
7	DI 1
13	DI 2
5	DI 3
11	DI 4
3	DI 5
9	DI 6
1	DI 7
23	DI 8
17	DI 9
19	DI10
21	DI11
	DIGITAL OUTPUT
39	DO 0
37	DO 1
35	DO 2
33	DO 3
31	DO 4
29	DO 5
27	DO 6
25	DO 7
41	DO 8
43	DO 9


MICROTECH © 1983
+15
-15
R10
R9
C27
U20
F
D
H
A
E
B
C
U21
C28
R12
U18
U19
C29
R11
J2
C26
U17
R8
R7
C25
Q1
U16
R3
CR2
C19
C20
R5
R4
C23
C24
R6
C22
U13
U12
C21
C15
CR1
C16
U14
C17
U15
C18
U9
U7
U8
U10
U11
C14
C11
C10
C12
C13
R2
BAT
R1
C8
Y1
C9
U3
U5
U6
C4
C5
C6
C7
U4
C1
U1
U2
C2
C3
J1
1
P1
22
GND
J3
CONNECTOR J3
CONNECTOR J2

```
],

END OF MAE PASS!

                        0010            ; FILE ARTC
                        0020            ; REAL TIME CLOCK DRIVER
                        0030            .BA $9400
                        0040            .OS $9400
                        0050 INIT       .DE $DFFF
                        0060 STAT       .DE $DFFE
                        0070 DDAD       .DE $DFFD
                        0080 CTBUF      .DE $DFFC
9400-                   0090 ARR        .DS 15                  ; ARRAY STORAGE
                        0100            ;
                        0110 BUSY
940F- 48                0120            PHA
9410- AD FE DF          0130 CHK        LDA STAT                ; LOAD STATUS OF RTC BUSY
9413- 29 01             0140            AND #01                 ; MASK OFF ALL BUT RTC STA
9415- F0 F9             0150            BEQ CHK                 ; YES-CHECK AGAIN
9417- 68                0160            PLA                     ; NO-RETURN
9418- 60                0170            RTS
                        0180            ;
                        0190            ;
9419- 48                0200 READ       PHA                     ; SAVE A
941A- 8A                0210            TXA
941B- 48                0220            PHA                     ; SAVE X
941C- A9 00             0230            LDA #00                 ; DISABLE ALL CTRL LINES,
941E- 8D FC DF          0240            STA CTBUF
9421- A2 0D             0250            LDX #13
9423- CA                0255 AGA        DEX
9424- 8E FD DF          0260            STX DDAD                ;PLACE RTC ADDR ON BUS
9427- 20 0F 94          0270            JSR BUSY
942A- A9 01             0280            LDA #01                 ; RAISE ADDR WR LINE
942C- 8D FC DF          0290            STA CTBUF
942F- EA                0300            NOP
9430- A9 10             0310            LDA #$10                ; LOWER AD WR LINE, DISABL
9432- 8D FC DF          0320            STA CTBUF
9435- A9 13             0330            LDA #$13                ; RAISE READ LINE
9437- 8D FC DF          0340            STA CTBUF
943A- EA                0350            NOP
943B- EA                0360            NOP
943C- EA                0370            NOP
943D- EA                0380            NOP
943E- EA                0390            NOP
943F- EA                0400            NOP
9440- AD FC DF          0410            LDA CTBUF               ; READ RTC REG
9443- 29 0F             0420            AND #15
9445- 9D 00 94          0430            STA ARR,X               ; STORE IN ARRAY
9448- A9 0A             0440            LDA #10                 ; LOWER READ LINE
944A- 8D FC DF          0450            STA CTBUF
944D- 8A                0460            TXA                     ; SET N FLAG
944E- D0 D3             0470            BNE AGA
9450- 68                0480            PLA
9451- AA                0490            TAX                     ; RESTORE X
9452- 68                0500            PLA                     ; RESTORE A
9453- 60                0510            RTS
                        0520            ;
                        0530            ;
                        0540            ;
```

```
9454- 48          0550 WRITE    PHA                 ; SAVE A
9455- 8A          0560          TXA
9456- 48          0570          PHA                 ; SAVE X
9457- A9 00       0580          LDA #00             ; DISABLE CTRL LINES
9459- 8D FC DF    0590          STA CTBUF
945C- A2 0D       0600          LDX #13             ; # OF RTC REG'S
945E- CA          0605 DEC      DEX
945F- 8E FD DF    0610          STX DDAD            ; PUT REG ON B BUS
9462- 20 0F 94    0620          JSR BUSY
9465- A9 01       0630          LDA #01
9467- 8D FC DF    0640          STA CTBUF           ; RAISE AW, KEEP DDAD ENAB
946A- EA          0650          NOP
946B- A9 00       0660          LDA #00             ; LOWER AW ,KEEP DDAD ENAB
946D- 8D FC DF    0670          STA CTBUF
9470- BD 00 94    0680          LDA ARR,X           ; FETCH DATA FROM ARRAY
9473- 8D FD DF    0690          STA DDAD            ; PLACE DATA ON B BUS
9476- A9 02       0700          LDA #02             ; RAISE WR LINE
9478- 8D FC DF    0710          STA CTBUF
947B- EA          0720          NOP
947C- EA          0730          NOP
947D- EA          0740          NOP
947E- A9 00       0750          LDA #00             ; LOWER WR LINE
9480- 8D FC DF    0760          STA CTBUF
9483- 8A          0770          TXA
9484- D0 D8       0780          BNE DEC
9486- A9 10       0790          LDA #$10            ; DISABLE DDAD REG
9488- 8D FC DF    0800          STA CTBUF
948B- 68          0810          PLA
948C- AA          0820          TAX                 ; RESTORE X
948D- 68          0830          PLA                 ; RESTORE A
948E- 60          0840          RTS
                  0850          .EN
END OF MAE PASS!
```

--- LABEL FILE ---

```
AGA =9423         ARR =9400         BUSY =940F
CHK =9410         CTBUF =DFFC       DDAD =DFFD
DEC =945E         INIT =DFFF        READ =9419
STAT =DFFE        WRITE =9454
//0000,948F,948F
```

```
END OF MAE PASS!

                        0010              ; FILE "A7542"
                        0015              ; D/A MACHINE CODE DRIVER
                        0016              ; DAC  AD7542JN
                        0020              ;
                        0030              .BA $94A0
                        0040              .OS $94A0
                        0050 CTBUF        .DE $DFFC
                        0060 DDREG        .DE $DFFD
94A0-                   0070 ARR          .DB 02
                        0080              ;
94A2- A9 FF             0090 TRY          LDA #$FF
94A4- 8D A0 94          0100              STA ARR
94A7- A9 FF             0110              LDA #$FF
94A9- 8D A1 94          0120              STA ARR+1
94AC- 48                0125 FIRST        PHA
94AD- AD A0 94          0130              LDA ARR :FETCH REG DATA
94B0- 29 0F             0140              AND #$0F :MASK OFF SECOND NIBBLE
94B2- 8D FD DF          0150              STA DDREG :PLACE DATA ON B BUS
94B5- 20 E1 94          0160              JSR WR
                        0170              ;
94B8- AD A0 94          0180 SEC          LDA ARR : FETCH REG DATA
94BB- 29 F0             0190              AND #$F0
94BD- 18                0200              CLC
94BE- 6A                0210              ROR A
94BF- 6A                0220              ROR A
94C0- 6A                0230              ROR A
94C1- 6A                0240              ROR A
94C2- 09 10             0250              ORA #$10 :ADD REG ADDRESS TO B4&B5
94C4- 8D FD DF          0260              STA DDREG
94C7- 20 E1 94          0270              JSR WR
                        0280              ;
94CA- AD A1 94          0290 THRD         LDA ARR+1 :FETCH REG DATA
94CD- 29 0F             0300              AND #$0F
94CF- 09 20             0310              ORA #$20 : ADD REG ADDR
94D1- 8D FD DF          0320              STA DDREG : PLACE ON B BUS
94D4- 20 E1 94          0330              JSR WR
                        0340              ;
94D7- A9 30             0350 OUT          LDA #$30                : REG ADDR 03
94D9- 8D FD DF          0360              STA DDREG
94DC- 20 E1 94          0370              JSR WR
94DF- 68                0375              PLA
94E0- 60                0380              RTS
                        0390              ;
94E1- A9 05             0400 WR           LDA #5
94E3- 8D FC DF          0410              STA CTBUF :ACTIVATE DAC WR LINE
94E6- A9 00             0420              LDA #00
94E8- 8D FC DF          0430              STA CTBUF : RESET CTRL REG
94EB- 60                0440              RTS
                        0450              ;
94EC- 48                0460 CLDAC        PHA
94ED- A9 14             0470              LDA #$14 :LOWER DAC CLEAR LINE
94EF- 8D FC DF          0480              STA CTBUF
94F2- A9 10             0490              LDA #$10 :CLEAR CTRL REG
94F4- 8D FC DF          0500              STA CTBUF
```

```
94F7- 68          0505              PLA
94F8- 60          0510              RTS
                  0520              .EN
END OF MAE PASS!


 ---  LABEL FILE:  ---


ARR =94A0                 CLDAC =94EC               CTBUF =0FFC
DDREG =0FFD               FIRST =94AC               OUT =94D7
SEC =94B8                 THRD =94CA                TRY =94A2
WR =94E1
//0000,94F9,94F9
```

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ADDEDNUM FOR DATA 1

To make the DATA 1 Board read both positive and negative input, you need to add the following Basic statements:

```
1121 LET T = PEEK(A) AND 32
1122 IF T>0 THEN PRINT"+";
1123 IF T=0 THEN PRINT"-";
```

You can also do the same to check for overrange:

```
1124 LET U=PEEK(A) AND 16
1125 IF T>0 PRINT"OVERRANGE";
```

If you want to change the D/A voltage reference, you can do the following:

	OUTPUT VOLTAGE	PIN PROGRAMMING
1-	7.5V	Connect pin 2 to pin 3(U20) or connect Jumper D to F
2-	5.0V	Connect pin 2 to pin 1(U20) or connect Jumper B to D
3-	2.5V	Connect pin 3 to pin 1(U20) or connect jumper B to F