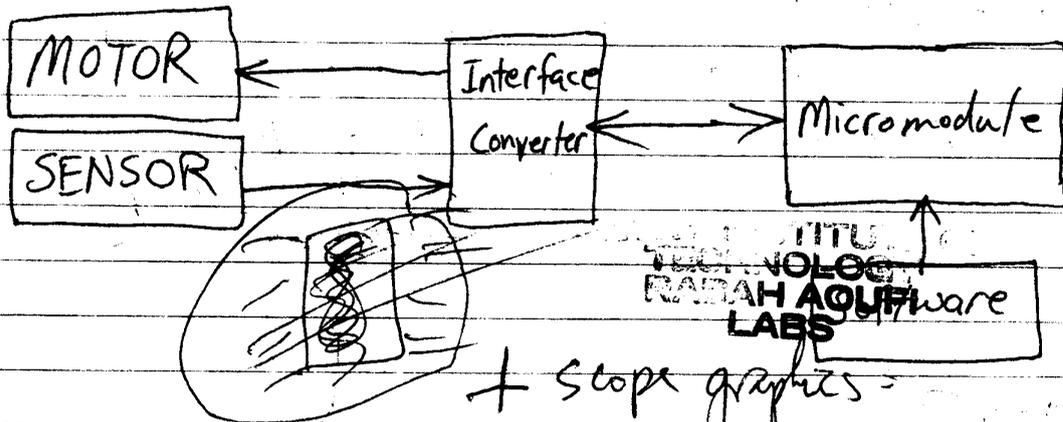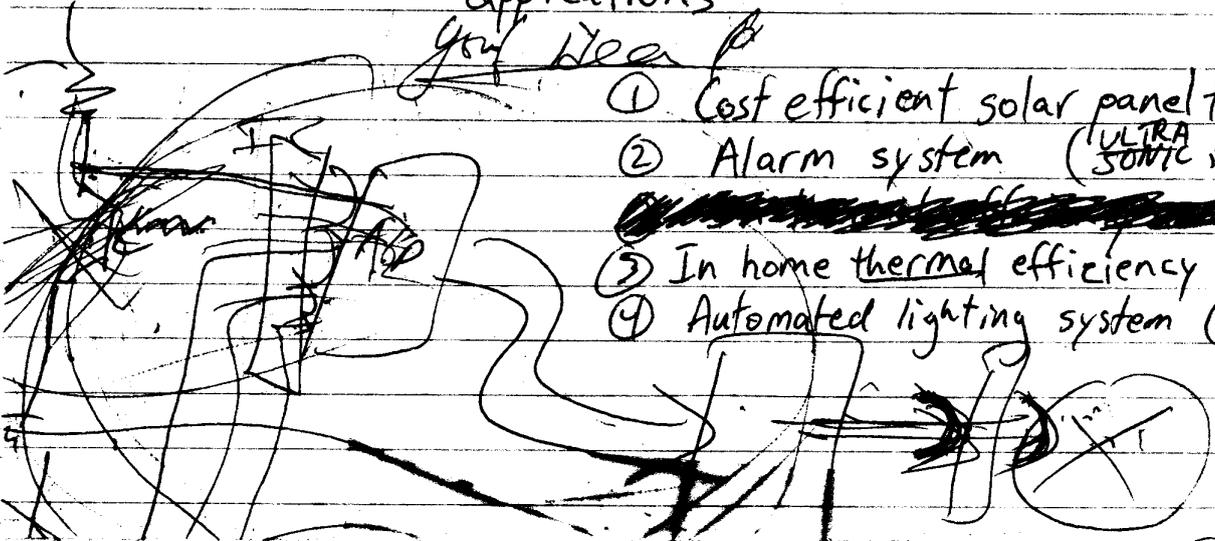Alan Lilly

Light Sensitive Tracking Device

Objective : To construct and make operational
a device that can physically
track a light source of
relatively high intensity
(graphical printout of relative intensities)

MOTOR ← Interface Converter ↔ → Micromodule

SENSOR

+ scope graphics

Application : Depending on the type of
sensor and the software used,
this system can have several
applications

① Cost efficient solar panel tracking
② Alarm system (ULTRA SONIC, LIGHT)
③ In home thermal efficiency analysis
④ Automated lighting system (ULTRA SONIC)

1

Alan Lilly

4-1-87
Determining required parts:

1 Stepper motor (acaurate to within 5°) ✓
2 photo sensitive transistors ✓
1 parabolic reflector ✓
1 spool wire wrap ✓

Note: contruction of base (wood, sheet metal

(DALLAS ELECTRONIC SURPLUS)

Incorporate eprom expansion for software

Consider dual motor control
Consider ultrasonic sensor

3-24-87

Multiplexing might be a cheaper answer
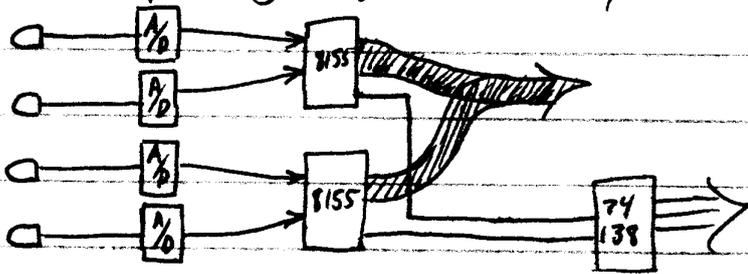
4-8-87

12 x 7.5° stepper motor sequence

white leads - grounded

Brown
Yellow
Red
Blue

Counter Clockwise

Stepper Motor

4 TIP 29 transistors

connect to Port C

optical signal conditioners

Bus Connector

198

215

Software

8155

Motor Controller

A/D

A/D

connect to Port A   connect to Port B
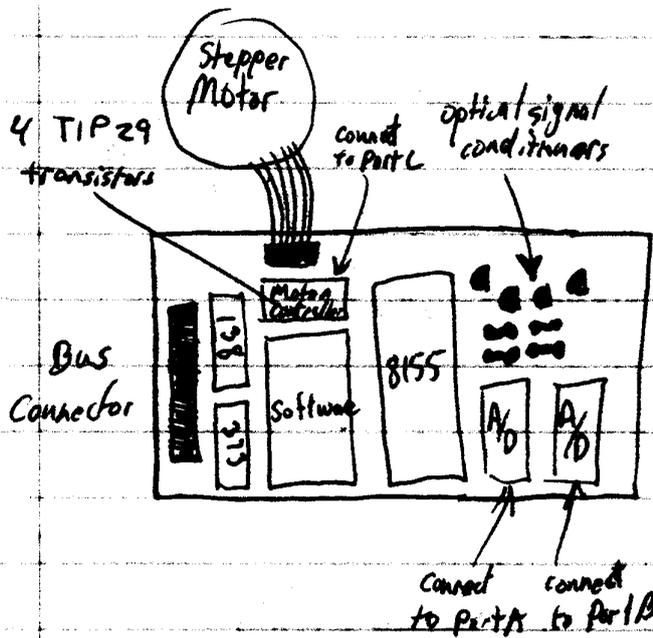
2 3964 (ECG 123AP) ✓
2 2907 (ECG 159)
2 3906 (ECG 159) ✓

DEV~ ~~ TE OF
RAD~~ ~~F1
LABS

4

4-15-87   Alan Lilly

Test TIP29 transistors for
stepper motor controllers

12 volt   } connected to each of the 4 transistors

white } GROUND
white

                    +12v
                     ○

bit 1,2,3,4 ←——   ⟨transistor⟩
of Port C
          5v

              ● MOTOR
              ↓

5
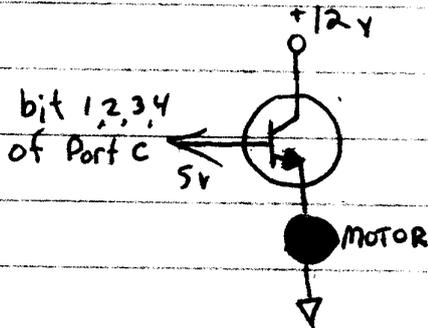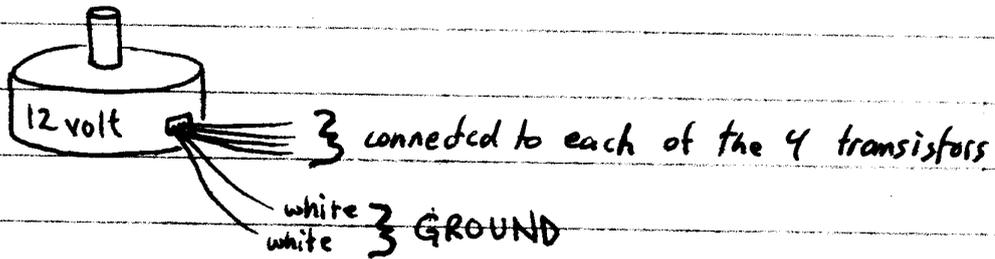
4-15-87   Alan Zilly

Highly sensitive circuit (photo sensor)

+5v

5K-5M   10K   3906

              22K

                    3904   A/D

                         10K

OR

+5v

A/D

6
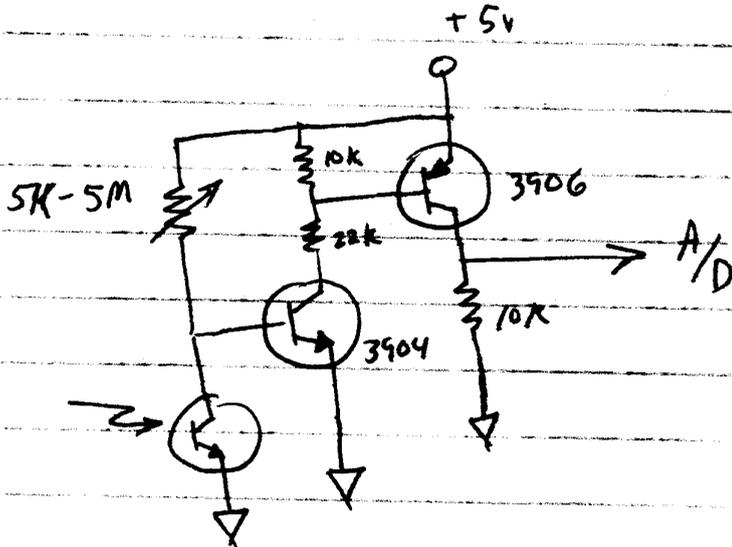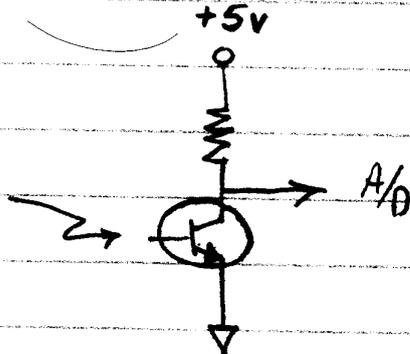
4-22-87   Alan Lilly

Pinout diagram of 1022 D/A

DAC 102X

i_{out_1}	1	16	R feedback
i_{out_2}	2	15	$V_{REF}{}^{IN}$
GND	3	14	▨▨▨▨ V^+
A1 (MSB)	4	13	A10 (LSB)
A2	5	12	A9
A3	6	11	A8
A4	7	10	A7
A5	8	9	A6

Top View

7

4-22-87   Alan Lilly

Tuner

Stack

5V 12V GND

8755?

40 pin socket	8155	A/D	A/D	small dual ganged pot 5MΩ

A/D socket   A/A socket   D/A socket 16   A/A socket 16
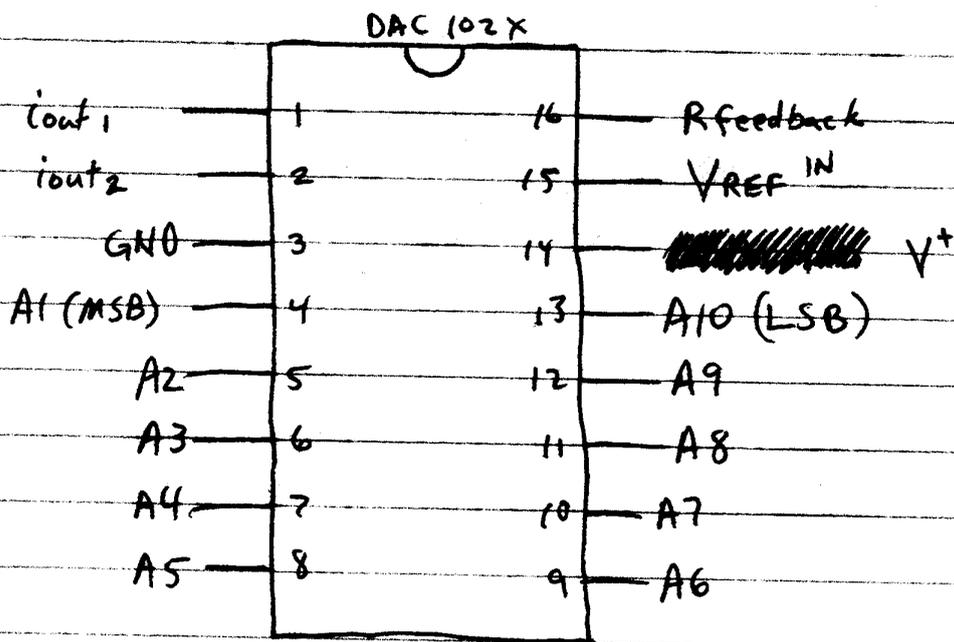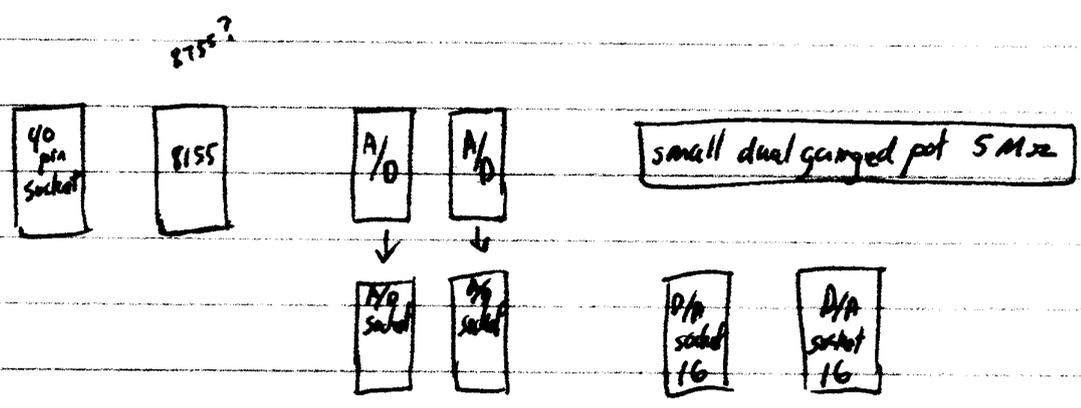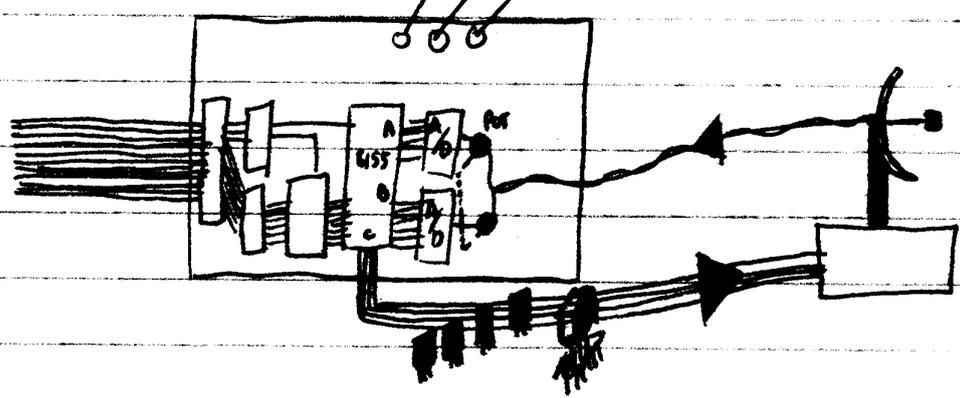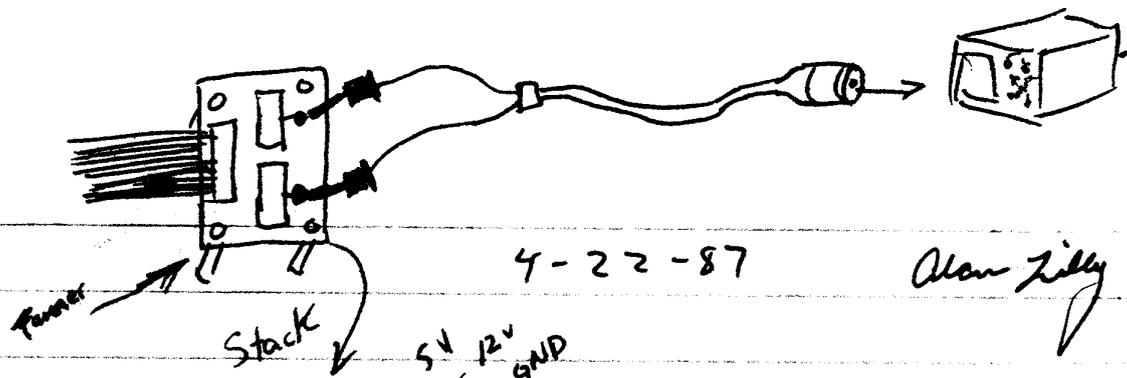
*   1   40 pin socket

*   1   8155

*   2   A/D (804)

    2   A/D sockets ←┐
                      ├ 4 sockets
    2   16 pin socket ←┘

*   1   ganged pot 5MΩ

    1   identical board + spacers (Radio Shack)

8

decoder

8085

4-22-87   Alan Lilly

Photocells

MOTOR

9
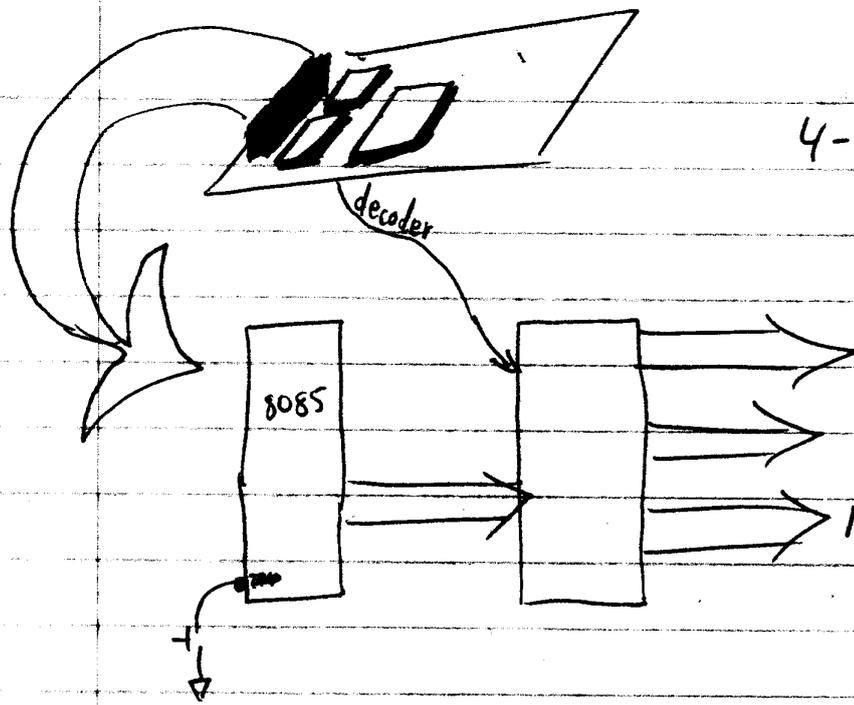
Alan Lilly
4-29-87

Mechanical mount for motor shaft
and parabolic reflector

parabolic reflector

drilled holes $\frac{5}{32}$"

plastic shaft

rout to fit shaft
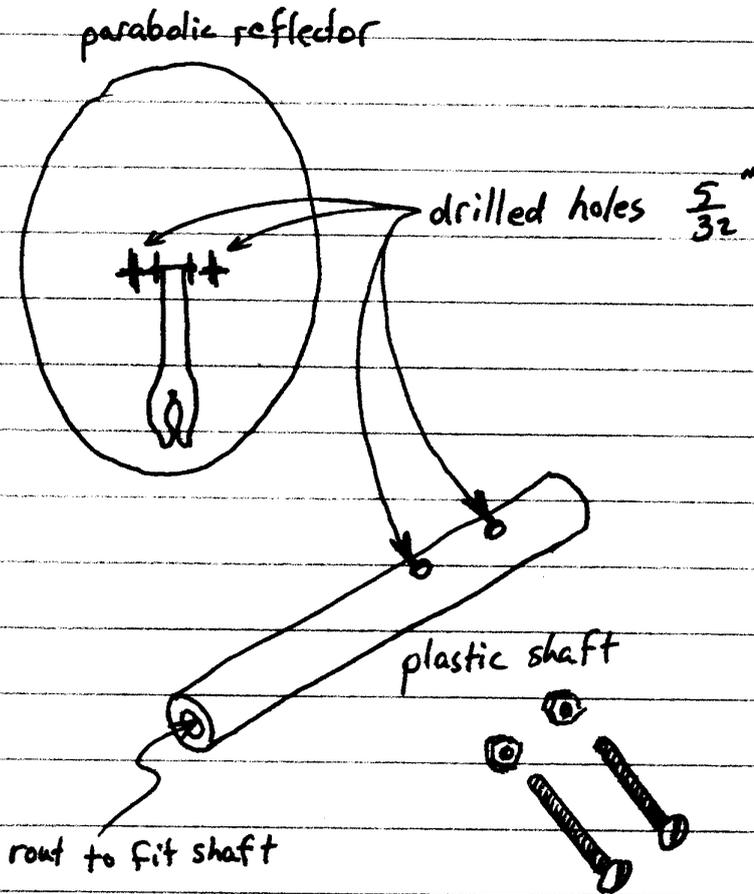
Mounted with 2 screws and bolts

Alan Lilly

Test program (motor)

```
0140 →
        MVI A, OC      CW       "Port C output PA + PB input"
        OUT 18  " 30    C/SR  for pin 3 I/O 74138
        MVI A, 11
        MVI C, OA      "10 steps"
back    OUT 1B          "PC"
        RLC
        MVI B, ~~FF~~ 10        "Bob  Lilly"
Bob   MVI D, FF
JOE   DCR D
        JNZ  JOE
        DCR B
        JNZ  Bob
        DCR C
        JNZ back
```
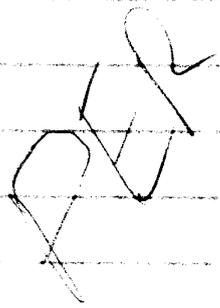
		1400 – 3E	140E – (FF)
		1401 – OC	140F – 15
		1402 – D3	1410 – C2
		1403 – 18	1411 – OF
		1404 – 3E	1412 – 14
		1405 – 11	1413 – 05
		1406 – OE	1414 – C2
* rev		1407 – 64	1415 – OD
		1408 – D3	1416 – 14
		1409 – 1B	1417 – OD
RLC		140A – 07 or	1418 – C2
		140B – 06	1419 – 08
+D		140C – (07)	141A – 14
		140D – 16	141B – FF

* minimum time
```
07
FF
```

11

Alan Lilly

```
C/BR -18        RAM MEMORY   0800-08FF
PA - 19         200 steps = 1 sweep
PB - 1A
PC - 1B
    LXI  SP,0880
    MVI A,0C
    OUT 18
```

	Scan left	Scan Right	
	`MVI B, A0`	`MVI B, A0`	
	`MVI C, C8`	`MVI C, C8`	
	`MVI D, 11`	`MVI D, 11`	
back	`IN 19`	back2	`IN 19`
	`CMP B`		`CMP B`
	`JNC track`		`JNC track`
	`mov A, D`		`mov A, D`
	`OUT 1B`		`OUT 1B`
	`RLC`		`RRC`
	`mov D, A`		`mov D, A`
	`CALL time`		`Call time`
	`DCR C`		`DCR C`
	`JNZ back`		`JNZ back2`
			`JMP Scan left`

12

Alan Tilly

```
                MVI A, OC
track           OUT 18
                MVI D, 11
start   IN 19   < ANI 1111 0001
                MOV E, A   < ANI 1111 0010
                IN 1A          < ANI
                CMP E          JZ start
                JC ahead            PB < PA
                MOV A, D
                RLC            counter clock
                JMP down
ahead   MOV A, D
                RRC            clockwise
down    CALL time
                OUT 1B
                MOV D, A
                JMP start


time            Push PSW   <  Push D
                MVI A, □       Push D
BOB     MVI B, |FF|
JOE     DCR B
                JNZ JOE
                DCR A
                JNZ BOB    <  POP D
                POP PSW       POP B
                RET
```
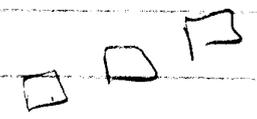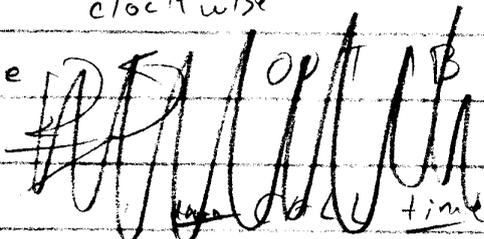
□ □ □ □

13
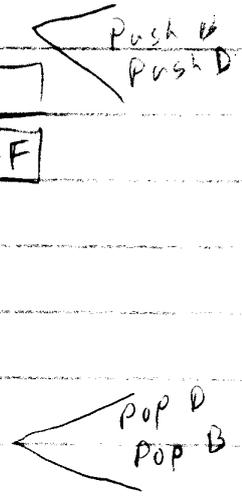
Alan Lilly

Operations testing

① retest motor prog.
   find max motor speed

DISPLAY TEST PROGRAM

	MVI A, 84	1400 - 3E
back	CALL display	1401 - 84
	JMP back	1402 - CD
		1403 - 60
		1404 - 05
		1405 - C3
		1406 - 02
		1407 - 14

A/D CONVERTER TEST PROGRAM

	MVI A, OC			
	OUT 18	1400 - 3E	1409 3E	- C3
	IN 19	1401 - OC	0A - 10	- 04
back	CALL display	1402 - D3	B - 06	- 14
	JMP back	1403 - 18	C - FF	
		1404 - DB	D - 05	
		1405 - 19	E - C2	
Adjust	Q = 00	1406 - CD	F - 0D	
		1407 - 60		- 14
		1408 - 05		- 3D
		3		- C2
				0B 14

31

Column 1:

3B / 80   Stack Pointer
3C / 14
3D / 3E
3E / 0C
3F / D3   Port Setup
40 / 18
41 / 06
42 / E0
43 / 0F
44 / C8   Register setup
45 / 16
46 / 11
47 / DB
48 / 19
49 / B8
4A / D2
4B / [00]
4C / [14]
4D / 7A
4E / D3
4F / 1B
50 / 07
51 / 57
52 / CD
53 / 26
54 /

Column 2:

                14

55 / 0D
56 / C2
57 / 48
58 / 14
59 / 0E
5A / C8
5B / DB
5C / 19
5D / B8
5E / D2
5F / 00
60 / 14
61 / 7A
62 / D3
63 / 1B
64 / 0F
65 / 57
66 / CD
67 / 26
68 / 14
69 / 0D
6A / C2
6B / 5C
6C / 14
6D / C3
6E /

Column 3:

                3B

6F / 14
70 /

15

```
$TITLE (PROJ)

;PROJECT PROGRAM BY ALAN LILLY
STACK           SEGMENT
STACK           ENDS
DATA            SEGMENT     AT 0000H
DATA            ENDS
CODE            SEGMENT     AT 0FF80H
                ASSUME      CS:CODE,DS:DATA,SS:STACK
MAIN            PROC        FAR
                MOV         AX,DATA
                MOV         DS,AX
                MOV         CH,03H
JOE3:           MOV         DX,0FFFFH
AGAIN3:         DEC         DX
                JNZ         AGAIN3
                DEC         CH
                JNZ         JOE3
                MOV         AX,000DH
                OUT         00H,AL
SAMPLE:         MOV         AH,10H
                MOV         BX,00FFH
BACK:           IN          AL,02H
                MOV         DX,0057H
JOE4:           DEC         DX
                JNZ         JOE4
                MOV         [BX-1],AL
                DEC         BX
                JNZ         BACK
START:          MOV         BX,001CH
                MOV         CL,0DH
UPPER:          MOV         AL,[BX]
                ROR         AL,1
                ROR         AL,1
                ROR         AL,1
                ROR         AL,1
                OUT         03H,AL
                DEC         CL
                MOV         AL,CL
                INC         CL
                ROL         AL,1
                ROL         AL,1
                ROL         AL,1
                ROL         AL,1
                OR          AL,0FH
                OUT         01H,AL
                MOV         CH,01H
JOE:            MOV         DX,0650H
AGAIN:          DEC         DX
                JNZ         AGAIN
                DEC         CH
                JNZ         JOE
                DEC         BX
                DEC         CL
                JNZ         UPPER
                MOV         CL,0FH
LOWER:          MOV         AL,[BX]
                ROR         AL,1
                ROR         AL,1
                ROR         AL,1
                ROR         AL,1
                OUT         03H,AL
                DEC         CL
                MOV         AL,CL
                INC         CL
                OR          AL,0F0H
                OUT         01H,AL
                MOV         CH,01H
JOE2:           MOV         DX,0650H
AGAIN2:         DEC         DX
                JNZ         AGAIN2
                DEC         CH
                JNZ         JOE2
                DEC         BX
                DEC         CL
                JNZ         LOWER
                DEC         AH
                JNZ         START
                JMP         SAMPLE
MAIN            ENDP
CODE            ENDS
BOOT            SEGMENT     AT 0FFFFH
                ASSUME      CS:BOOT
                JMP         FAR PTR MAIN
BOOT            ENDS
                END         MAIN
```

```
                            1  "8085"
                            2                  ORG     0000H
          0000  3E0C        3                  MVI     A,0CH
          0002  D308        4                  OUT     08H
          0004  06F0        5  SCAN            MVI     B,0F0H
          0006  0EC8        6                  MVI     C,0C8H
          0008  1611        7                  MVI     D,11H
          000A  DB09        8  BACK            IN      09H
          000C  B8          9                  CMP     B
          000D  D20045     10                  JNC     TRACK
          0010  7A         11                  MOV     A,D
          0011  D30B       12                  OUT     0BH
          0013  07         13                  RLC
          0014  57         14                  MOV     D,A
          0015  2610       15                  MVI     H,10H
          0017  2EFF       16  BOB1            MVI     L,0FFH
          0019  2D         17  JOE1            DCR     L
          001A  C20019     18                  JNZ     JOE1
          001D  25         19                  DCR     H
          001E  C20017     20                  JNZ     BOB1
          0021  0D         21                  DCR     C
          0022  C2000A     22                  JNZ     BACK
          0025  0EC8       23                  MVI     C,0C8H
          0027  DB09       24  AGAIN           IN      09H
          0029  B8         25                  CMP     B
          002A  D20045     26                  JNC     TRACK
          002D  7A         27                  MOV     A,D
          002E  D30B       28                  OUT     0BH
          0030  0F         29                  RRC
          0031  57         30                  MOV     D,A
          0032  2610       31                  MVI     H,10H
          0034  2FFF       32  BOB2            MVI     L,0FFH
          0036  2D         33  JOE2            DCR     L
          0037  C20036     34                  JNZ     JOE2
          003A  25         35                  DCR     H
          003B  C20034     36                  JNZ     BOB2
          003E  0D         37                  DCR     C
          003F  C20027     38                  JNZ     AGAIN
          0042  C30004     39                  JMP     SCAN
          0045  3E0C       40  TRACK           MVI     A,0CH
          0047  D308       41                  OUT     08H
          0049  1611       42                  MVI     D,11H
          004B  DB09       43  START           IN      09H
          004D  E6F8       44                  ANI     0F8H
          004F  5F         45                  MOV     E,A
          0050  DB0A       46                  IN      0AH
          0052  E6F8       47                  ANI     0F8H
          0054  BB         48                  CMP     E
          0055  CA004B     49                  JZ      START
          0058  DA0060     50                  JC      AHEAD
          005B  7A         51                  MOV     A,D
          005C  07         52                  RLC
          005D  C30062     53                  JMP     DOWN
          0060  7A         54  AHEAD           MOV     A,D
          0061  0F         55                  RRC
          0062  2610       56  DOWN            MVI     H,10H
          0064  2EFF       57  BOB3            MVI     L,0FFH

          0066  2D         58  JOE3            DCR     L
          0067  C20066     59                  JNZ     JOE3
          006A  25         60                  DCR     H
          006B  C20064     61                  JNZ     BOB3
          006E  D30B       62                  OUT     0BH
          0070  57         63                  MOV     D,A
          0071  C3004B     64                  JMP     START
```

Errors=   0

```
-page     60,132

TITLE     PROGRAM 4          By Alan Lilly

;Description               :DISPLAY A ROTATING BITS ON I/O MODULE
                           ;
                           ;
                           ;

;Ports used                :
;Procedures used           :
;Registers used            :

;------------------------------------------------------------------------
DATA          SEGMENT
SEED          DB        0
RATE          DB        0
PORTA         DW        0FFF9H
PORTB         DW        0FFFBH
PORTC         DW        0FFFDH
CONTROL       DW        0FFFFH
DATA          ENDS
;------------------------------------------------------------------------
CODE          SEGMENT
              ASSUME    CS:CODE,DS:DATA
              MOV       AX,0010H
              MOV       DS,AX
              MOV       DX,CONTROL
              MOV       AL,99H                          ;SETUP PORTS
              OUT       DX,AL
START:        MOV       DX,PORTA
              IN        AL,DX                           ;READ SWITCHES
              MOV       AH,AL
              AND       AL,0F0H
              MQV       SEED,AL                         ;AL HAS SEED
              NOT       AH
              AND       AH,0FH
              MOV       RATE,AH                         ;AH HAS RATE
              INC       AH
AGAIN:        MOV       CL,AH                           ;PAUSE AT RATE
DELAY:        MOV       BX,0500H
BACK:         DEC       BX
              JNZ       BACK
              DEC       CL
              JNZ       DELAY
              MOV       DX,PORTB
              OUT       DX,AL                           ;LIGHT LEDS
              ROR       AL,1
              MOV       BL,AL
              MOV       DX,PORTC
              IN        AL,DX                           ;CHECK DEBOUNCE BUTTON
              CMP       AL,01H
              JZ        START
              MOV       AL,BL
              JMP       AGAIN
CODE          ENDS
              END
;------------------------------------------------------------------------
```
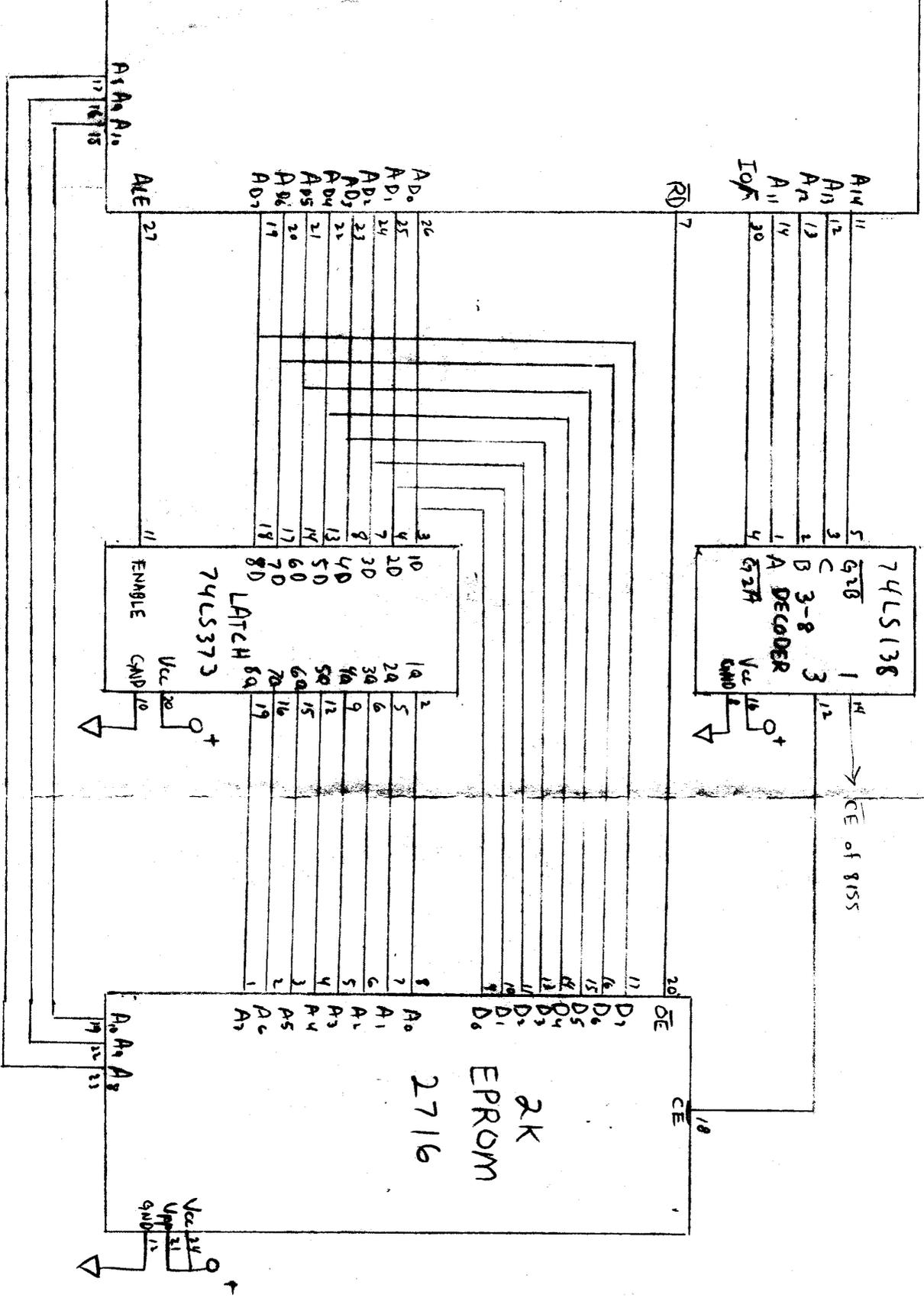
EPROM 2K EXPANSION

Alan Lilly

I/O pin 3
mem enable

1800-1FFF

SID or SOD
for decoder output

CLR
0001 1000
PA   19
PB   1A
PC   1B

18

BUS CONNECTOR

8085

8155

804

804

Motor

+12V

Vcc

Reset
Vcc
56k
1µF
1k

10k
150pf

23kΩ

Vcc