OPERATIONS
MANUAL

PROM-100

PROM PROGRAMMER

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REVISION A

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SECTION I

1-1 INTRODUCTION

The SD SYSTEMS Prom Programmer Board (PROM-100) provides a low cost means for programming read only memory capability for computers utilizing the S-100 bus structure.

1-2 GENERAL DESCRIPTION

The SD SYSTEMS PROM-100 board is a high performance circuit capable of programming the industry standard 2708 1K X 8 EPROM, Intel's 2758 1K X 8 EPROM, 2716 2K X 8 EPROM, 2732 4K X 8 EPROM and Texas Instruments 2516 2K X 8 EPROM. The PROM-100 is selected for the appropriate EPROM type through dip switches S1 and S2. Another notable feature of the PROM-100 is the 25V programming pulse generated on board, eliminating the need for an external 25V supply.

1-3 PHYSICAL

The SD SYSTEMS Prom Programmer is implemented on a single 7.00" X 10.0" X .065" printed circuit board and is interfaced to the System by connector J-1.

1-4 SPECIFICATION

Table 1-1 lists the overall specifications for the SD SYSTEMS Prom Programmer Board. Table 1-2 lists the pin usages of connector J-1 for the Prom Programmer Board.

TABLE 1-1	
+8 to +10V	300 ma maximum
+16 to 18V	100 ma maximum
-16 to 18V	60 ma maximum
Operating temperature	0°C to 50°C
Interface levels	TTL Compatible
Programming time	100 seconds max for 16,389 bits

TABLE 1-2			
PIN NO	SIGNAL NAME	DIRECTION	DESCRIPTION
1,51	+8V to +10V	INPUT	POWER
2	+16V to +20V	INPUT	POWER
100,50	GND		
79,80,81,31,30 29,82,83	A0-A7	INPUT	ADDRESS BUS
36,35,88,89,38 39,40,90	D0-0 to D0-7	INPUT	DATA BUS OUT
95,94,41,42,91, 92,93,43	DI-0 to DI-7	OUTPUT	DATA BUS IN
77	PWR		WRITE
78	PDBIN		DATA BUS IN
46	SINP		PORT INPUT CYCLE
45	SOUT	INPUT	PORT OUTPUT CYCLE
99	POC	INPUT	POWER ON CLEAR

SECTION II

FUNCTIONAL DESCRIPTION

2-1 INTRODUCTION

Functionally, the PROM Programmer consist of two main portions; hardware, and the software. The hardware allows the computer to select the port bits, generate the programming pulse, and control the decoder. The software must direct the hardware in each of the operations described above. The major functions contained in the PROM Programmer hardware are shown in the block diagram (Figure 2-1).

2-2 DATA OUT BUS

The 8-Bit Data Out Bus is the S-100 path for transferring data from the computer (CPU) to the output ports on the Prom Programmer board.

2-3 DATA IN BUS

The 8-Bit Data In Bus is the S-100 path for transferring data from the input port on the Prom Programmer Board to the computer (CPU).

2-4 A0-A7

The A0-A7 low order eight address lines are used by the computer (CPU) to select the various input/output ports through a decoder on the Prom Programmer Board.

2-5 I/O CONTROL LINES AND READ WRITE CONTROL

The I/O Control Lines consist of $\overline{PWR}$, PD BIN, SINP and SOUT. These lines are used to control the input and output operations from/to the I/O ports on the board.

2-6 ADDRESS DECODER

The Address Decoder detects when a port address used by the Prom Programmer is present on (A0-A7). The output of the decoder is used to gate read and write pulses to the I/O ports.

2-7 OUTPUT PORT 68H

Output port 68H is an 8 bit data register that transfers the data from CPU to ROM.

2-8 OUTPUT PORT 69H

Output port 69H is an 8 bit address register that determines the location in the ROM for the data to be programmed or read.

2-9 OUTPUT PORT 6AH

Output port 6AH is an 8 bit control register with several control functions.

1. Bit 1 & 2 — Two high order address bits A8 & A9 address inputs.
2. Bit 3 — One high order bit A10 (address input for 2716).
3. Bit 4 — One high order bit A11 (address input for 2732).
4. Bit 6 — Program pulse for 2716/58.
5. Bit 7 — Drive MOS clock drive.
6. Bit 8 — Controls port 68H chip select for 2716/58/08.

2-10 INPUT PORT 68 H

Input port 68H is used to read the present data in the ROM.

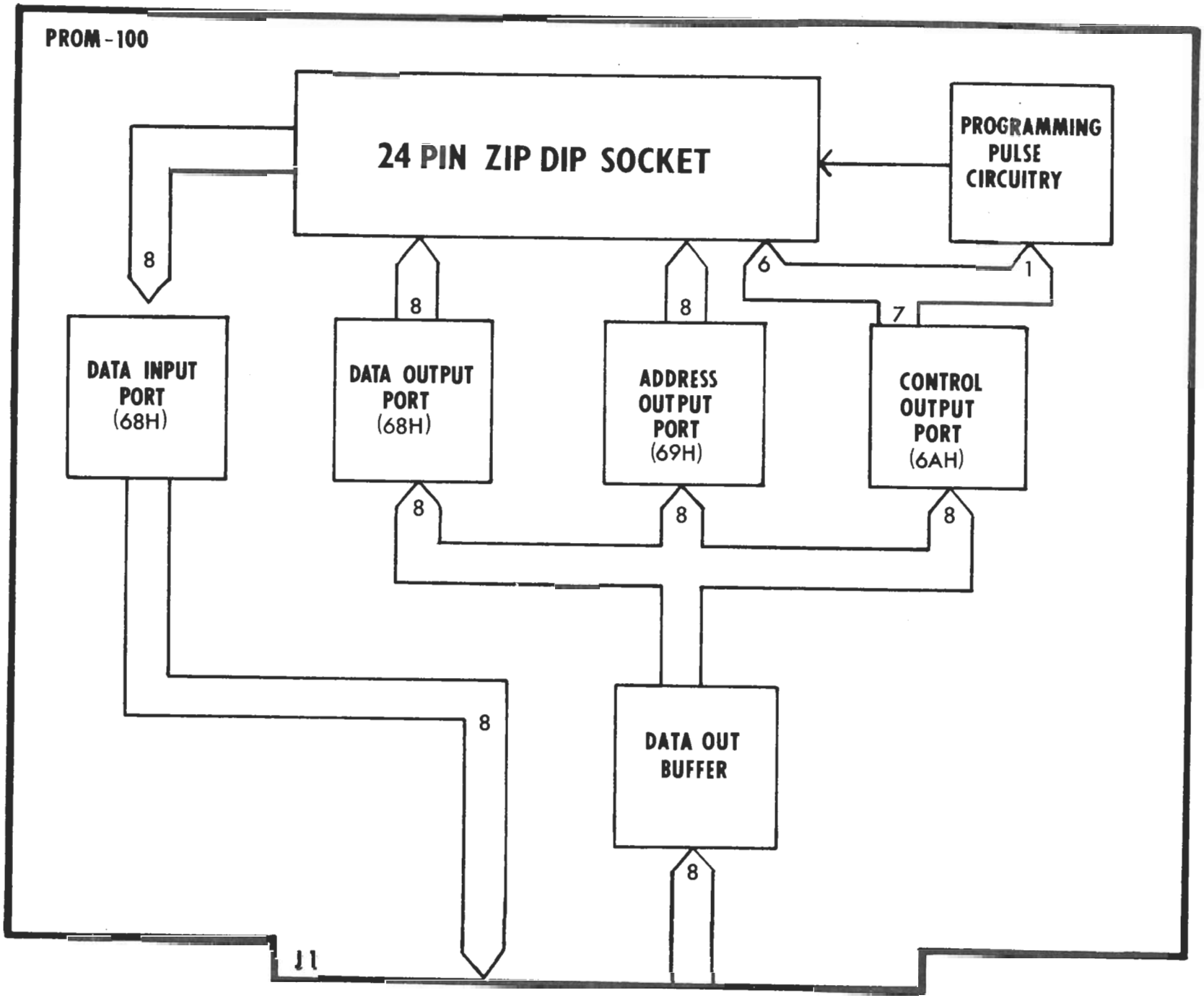

PROM-100
24 PIN ZIP DIP SOCKET
PROGRAMMING PULSE CIRCUITRY
DATA INPUT PORT (68H)
DATA OUTPUT PORT (68H)
ADDRESS OUTPUT PORT (69H)
CONTROL OUTPUT PORT (6AH)
DATA OUT BUFFER
8
8
8
6
1
7
8
8
8
8
8
11

FIGURE 2-1

SECTION III

CONTROL SOFTWARE

3-1 INTRODUCTION

Certain sequences must be executed to ensure proper programming of the prom.

3-2 2758/16/32 PROGRAMMING

Initially, and after each erasure, all bits of the 2716 are in the "high" state. Data is introduced by selectively programming "0's" into the required locations. Although only "0's" will be programmed both "1's" and 0's" can be presented in the data word. The only way to change a "0" to a "1" is by ultraviolet light erasure.

The 2716 is in the programming mode when the VPP power supply is 25V and $\overline{CS}$ is at a low TTL level. The data to be programmed is applied 8 bits in parallel to the data output port. The levels required for the address and data inputs are TTL.

When the addresses and data are stable a 50 MSEC, active high, TTL program pulse is applied to the appropriate input pin on the EPROM.

A program pulse must be applied to each address location to be programmed. The user can program any location at any time - either individually, sequentially, or at random. The program pulse has a maximum width of 55 MSEC.

A verify is performed on the program bits to determine that they are correctly programmed. The verify may be performed with VPP at 25V.

3-3 2708 PROGRAMMING

Initially and after each erasure all 8192 bits are in high state (output high). Information is introduced by selectively programming "0" into the desired bit location. A programmed "0" can be changed to a "1" by UV. erasure.

The circuit is set up for programming operation by raising the CS/WE input (pin 20) to +12V. The word address is selected in the same manner as in the read mode. Data to be programmed is presented 8 bits in parallel to the data output lines (DO_0-DO_7) Logic levels for address and data lines and the supply voltages are the same as for the read mode.

After address and data set up, one program pulse per address is applied to the program input pin 18. One pass through an address is defined as a program loop. The number of loops (N) required is a function of the program pulse width (tpw) allowing to (N) X (tpw) $\geq$ 100. tpw in MSEC.

The width of the program pulse is from 0.1 to 1ms. The number of loops (N) is from a minimum of 100 (tpw=1ms) to greater than 1000 (tpw=0.1). There must be N successive loops through all 1024 addresses. It is not permitted to apply N program pulses to an address and then change to the next address to be programmed.

*The PROM Programmer writes data received from the host computer into the PROM as guided by the address/control outputs supplied by the driver software. Basically, the PROM Programmer manipulates the data and the address/control inputs from the computer so that the subject PROM receives proper data, address and control inputs. The PROM-100 generates the programming pulse for the 2708 from the output of a step up switching voltage regulator provided on the board. The same pulse is used to provide VPP (25V) at pin 21 of 2716/58. This 25V is set up by the driver software of the PROM Programmer.

Driver software for PROM Programmer must meet three requirements. These are: loading the object modules (diskettes) into host computer memory, reading a PROM into memory and programming a PROM. Within the software, the executive system coordinates all three operations while each operation sequence is run by its respective routine. In regards to the PROM Programmer, only the read and program sequences are significant because they involve specific address/control inputs to the PROM Programmer. The requirements imply that, in addition to allocating a memory buffer for the driver software, the host computer must also supply a 1, 2 or 4K byte memory buffer for the data module to be loaded, read, and programmed.

3-4 LOAD SEQUENCE

The load sequence must be able to load data into memory at any location regardless of the routine load address contained in the file. Once the number of bytes to be loaded has been specified, the user may load and program a portion of the file and then return for the rest. For example, if a file to be programmed contains 4K bytes, the user could program 2K bytes into one 2716 PROM and then program the remaining 2K bytes of the module into a second PROM.

3-5 READ SEQUENCE

The read sequence is necessary in order to perform a PROM copy function. Since the PROM programmer contains only one 24 pin ZIP DIP socket, the master PROM must first be read into the 1K, 2K or 4K memory buffer (2708, 58 or 2716/32) and then programmed into an erased PROM. The host computer should offer memory editing to allow modification of the memory buffer before programming the new PROM.

3-6 PROGRAMMING SEQUENCE

The programming sequence actually involves a three step process.

1. Verify that PROM is erased.
2. Program the PROM.
3. Verify that the PROM contains correct data.

The entire PROM is read to verify erasure, that each location contains FF_H. If unerased locations are found, the details are output to the console.

The programming of the PROM involves outputting the data for each of the 1K, 2K or 4K locations sequentially along with the PROM address and the 50ms program pulse for 2758/16/32 or 1ms program pulse for 2708. After this programming attempt is complete, the entire PROM must be read and compared with the memory buffer. If any locations do not match, the address and data should be output to the console.

3-7 CAUTION:

In order to prevent possible destruction of PROMS, PROMS must never be inserted into the ZIP DIP socket on the PROM Programmer until the driver software is running. If the PROM is inserted prior to starting the driver software, the PROM may be subjected to a continuous program pulse which will destroy the PROM. For the same reason, the host computer must not be reset while the PROM is in the socket.

3-8 USING THE PROM PROGRAMMER

The driver software can be used to load object files from diskettes, read object code from PROMS and program object code into PROMS. As the driver software starts, the console prints the start/options message. The sign-on portion of the message indicates that the PROM Programmer software is operative. The options portion consist of the first of three questions about which operations are

to be performed (load a file, read a PROM, and program a PROM), in that order. The user answers the questions by entering a Y (for Yes) or N (for No) at the end of each question. If a Y is entered the respective operation is performed after the necessary parameters are entered.

3-9 LOADING AN OBJECT FILE DISK FILE ONLY

Prior to answering the first question: READY TO LOAD A FILE (Y/N)? the user sets up the object file by specifying the file name, when loading the PROM-100 Software: A> PROM08 filename.Ext. When the user answers the question with a Y, the PROM Programmer software asks the user to enter two parameters (load start address and load size) by printing HEX LOAD address, #Bytes: The parameters must be separated by a comma or space and terminated with a carriage return. If no parameters are entered in front of the carriage return, the object file will be loaded into the RAM locations specified on the module. However, since the PROM Programmer driver software occupies the memory location $Ø100_H$ through $5FF_H$ the object file must not overlay these locations. This condition can be prevented by using the load address parameter which allows relocating the object data to any area of memory. The number of bytes parameter allows the loading of a limited number of bytes of the file into RAM so that object file may be loaded and programmed in blocks. If the load size parameter is not entered, the entire module is loaded. If a period is entered before the end of the parameter, the software repeats

the request for parameters allowing the user to correct the parameter. When the load is complete the PROM Programmer software asks: READY TO PROGRAM A PROM (Y/N)?

3-10 READING A PROM

In the console printout - READY TO READ A PROM (Y/N)? If a Y is entered, the PROM Programmer software asks the user to enter three parameters (MEM start address, MEM end address, PROM start address) by printing MEMORY START, MEMORY END,PROM START: The MEM start and END parameters specify the memory space into which the data is to be read. The PROM START defines the first PROM location to be read. The three parameters must be separated by a comma or space and terminated with a carriage return. If a period is entered before the end of the parameter the software repeats the request for parameters allowing the user to correct the parameters. When the read is complete or when the user answers the question: READY TO READ A PROM (Y/N)? With an N, the PROM Programmer software asks: READY TO PROGRAM A PROM (Y/N)?

3-11 PROGRAMMING A PROM

When the user answers the question: READY TO PROGRAM A PROM (Y/N)? with a Y, the programmer software asks the user to enter three parameters MEM start address, MEM end address and PROM start address by printing MEMORY START, MEMORY END, PROM START: The MEMORY START and END parameters specify the memory space from which the data is to be programmed. The three parameters must be separated by a comma or space and terminated with a carriage return.

If a period is entered before the end of the parameters, the software repeats its request for parameters allowing the user to correct the parameters.

The PROM Programmer software first verifies that the PROM is erased (contains FF_H in all locations). If the PROM Programmer software finds unerased locations, it prints the first unerased location. To check for other unerased locations the user enters a carriage return after each unerased location printed. If the PROM contains unerased location, the PROM must be erased again before starting programming. If there are unerased locations, the user may attempt programming by entering C. If there are no unerased locations, programming begins automatically. During the programming sequence, the PROGRAMMING LED COMES ON and stays on till the program ends. To stop programming during the sequence the user enters a period (.). The PROM Programmer software asks DO YOU WISH TO LOAD A MODULE (Y/N)? when the programming sequence is complete, the PROM Programmer reads the PROM to verify that the data has been programmed correctly. If the PROM Programmer software finds locations with BAD data, it prints the bad locations. To stop the error listing the user enters a period and the software returns to the start asking: READY TO LOAD A FILE (Y/N)? If the PROM contains bad locations it should be re-erased and re-programmed until it is correctly programmed. When programming is done the user can exit the PROM Programmer software by typing a period (.).

3-12 COPYING A PROM

Copying a master PROM into a subject PROM requires only that the master PROM be read as described in paragraph 3-10 and the subject PROM be programmed as described in paragraph 3-11.

SECTION IV

CONSTRUCTION

4-1 INTRODUCTION

The SD SYSTEMS PROM Programmer Board is intended for those people who have had some prior experience with kit building and digital electronics. If you do not fall into this category it is highly recommended that you either [1] find an experienced person to help you in assembly and check out the board. Appendix A shows the parts list for SD SYSTEMS PROM Programmer Board. Double check all parts against this parts list. If any differences are noted please contact SD SYSTEMS.

NOTE: General construction information assembly diagram and schematic diagram can be found in the appendices.

4-2 ASSEMBLY PROCEDURE (SEE APPENDIX C)

.1. Install the IC sockets in their proper locations.

NOTE: No socket or DIP switches: S1 & S2.

2. Install the resistors as follows:

A.	R8	220 Ohm 1/2W 5% (Red,Red,Brown)
B.	R4	22.1K Ohm 1/8W 1% (Precision Resistor)
C.	R5	1 Ohm 1/4W 5% (Black, Red,Black)
D.	R6	270 Ohm 1/4W 5% (Red,Violet,Brown)
E.	R7	100 Ohm 1/4W 5% (Brown,Black,Brown)
F.	R1,2,3	1K Ohm 1/4W 5% (Brown,Black, Red)

3. Install diodes CR1 with banded end as shown on the PC Board.

   A. CR1 1N5803
   B. CR2 Zener Diode 1N75] -5V

4. Install the capacitors as follows.

   A. C1 - C3, C6 - C11, C14, C15 0.1 MF Ceramic
   B. C12, C16 - C18 10 MF 20V Tantalum
   C. C13 .002 MF Ceramic
   D. C4 500 MF 35V Dilectric Axial Leads
   E. C5 300pf

5. Install the voltage regulators with the heatsinks 6106-13 using #6-32 hardware supplies.

   VR1 +5V 7805/LM340T-5

   VR2 +12V 7812/LM340T-12

6. Install L1 coil.

   L1 J12044 500 Micro Henry

7. Double check all solder connections for cold solder joints, unsoldered connections or shorted connections.

4-3 VOLTAGE CHECK

1. Install the board in the computer and measure the output of +5V regulator, +12V regulator and -5V of CR1 respectively.

   A. VR1 = +5V (TOP Pin)
   B. VR2 = +12V (Bottom Pin)
   C. CR1 = -5V (Anode)

NOTE: Do not proceed with board check out until all power supply voltages are correct. The TTL and MOS logic can be permanently damaged if improper voltages are applied.

2. Install the IC's in their sockets observing the Pin 1 designation on each socket marked on the PC Board.

A.	U1	24 Pin Zip Dip socket (Pin 1 lever in lower left.)
B.	U2	TL497ACN
C.	U3	74LS30
D.	U4	74LS155
E.	U6, U8	74LS273
F.	U5, U10	74LS14
G.	U7	74LS373
H.	U9	7406
I.	U11	74LS08
J.	U12, 13	74LS244
K.	U14	DS0025CN

3. Double check all IC's for proper orientation and location.

4. Refer the switch selection option and position then as described in Section V.

SECTION V

SWITCH SELECTION

5-1 INTRODUCTION

PROM Programmer has been designed to accomodate a variety of PROMS. Care must be taken to select the right positions of the switches for the users specific PROM selection. Table 5-1 lists the proper switch positions for each PROM type.

PROM TYPE	S1	S2
2708 ( ) 1K x 8	All other	2708
2758 (5V)	All other	All other
2716 (5V)	All other	All other
2732 (5V)	2732	All other

Table 5-1

SECTION VI

CHECK OUT

6-1 INTRODUCTION

This section will describe some basic checks that should be made on the PROM Programmer.

NOTE: It is assumed at this point that the voltage checks described in Section 4 have been previously made. The following checks require that the CPU board also be plugged into the bus.

6-2 I/O PORT WRITE/READ VERIFICATION

Using the monitor in the system or a short program. Write data to output port 68 and read it back. Verify that the data read back is the same as that was written. This can be done as follows if using the monitor.

.O 6A 80 (cr) - enable Port 68

.O 68 dd (cr) - output data (dd) to port 68

.I 68 (cr) - input from port 68

68 dd - Data Read should be identical to data output

SECTION VII

SOFTWARE REQUIREMENTS

6-1 INTRODUCTION

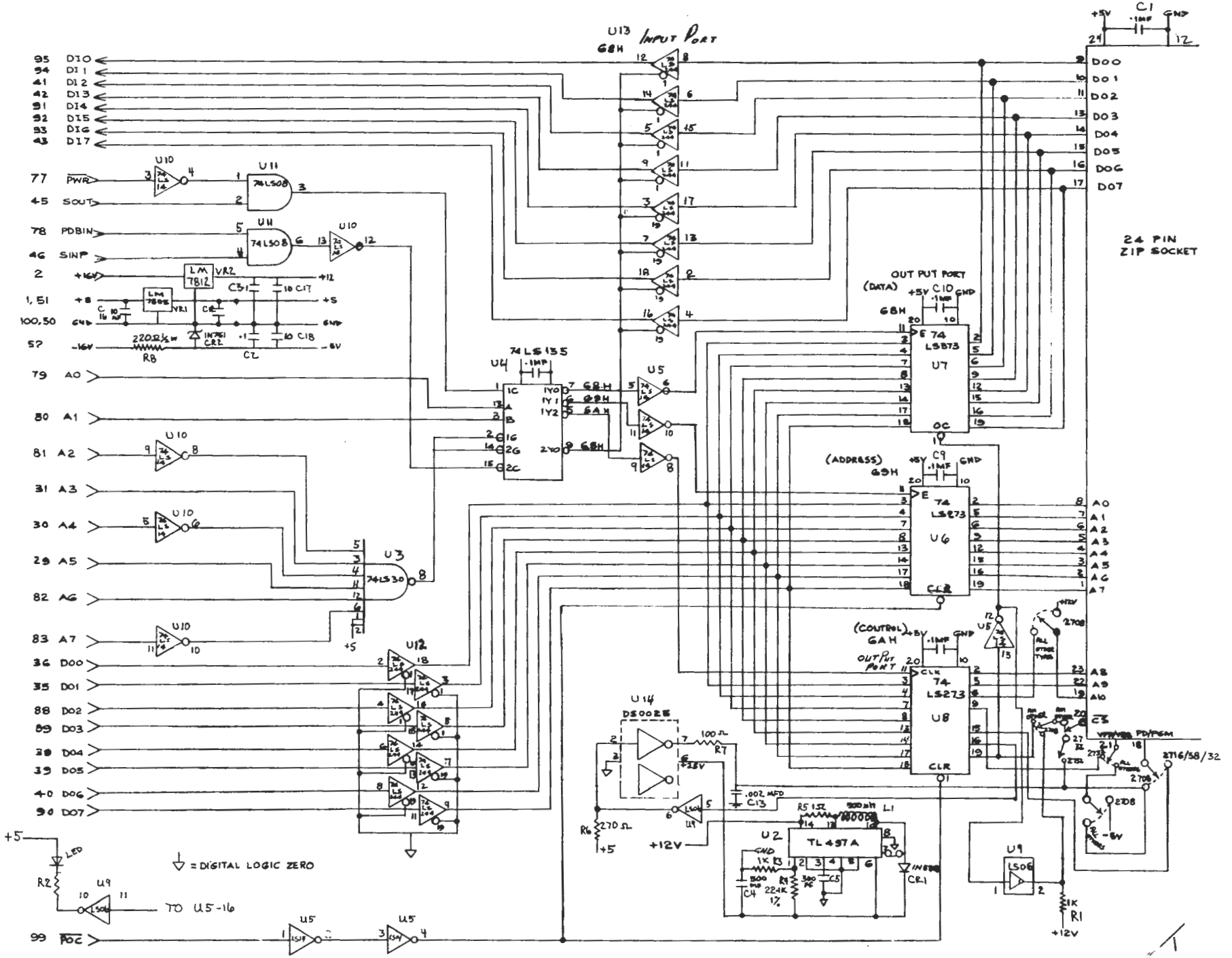
The SD Systems PROM-100 Programming Board software is available on disk on Intel 2716 EPROM.

A listing of the software in EPROM is included in Appendix D, while the disk version is included on the disk. (.PRN extension)

The program in PROM must be moved to 100H prior to execution. PROM 08, the 2708 programming utility, is located in the first 1K section of the PROM (0-3FFH). PROM 16, the Intel 2758, 2716, 2732 programming utility is located in the latter 1K section of the PROM (400_H-7FFH).

APPENDIX A

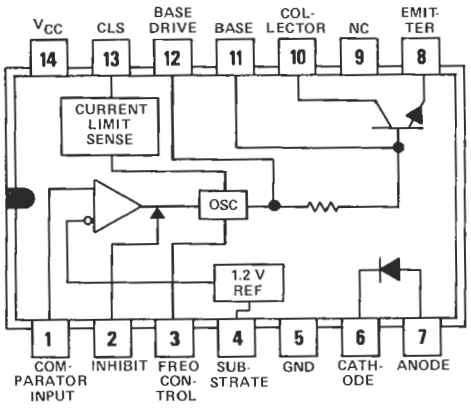
SCHEMATIC


U13 INPUT PORT
68H
24 PIN ZIP SOCKET
OUT PUT PORT (DATA) 68H
(ADDRESS) 69H
(CONTROL) 6AH
OUTPUT PORT
74LS135
74LS30
DS0026
TL497A
2716/58/32
PD/PGM
= DIGITAL LOGIC ZERO
TO U5-16
PWR
SOUT
PDBIN
SINP
POC

TL497A switching voltage regulator for DC-to-DC conversion

- Fixed on time simplifies design
- Single ended output (500 mA)
- Internal current protection of switching components
- Internal temperature stabilized 1.2 volt reference
- Capacitor programmed oscillator
- External inhibit control
- Adjustable output voltage
- Soft-start capability

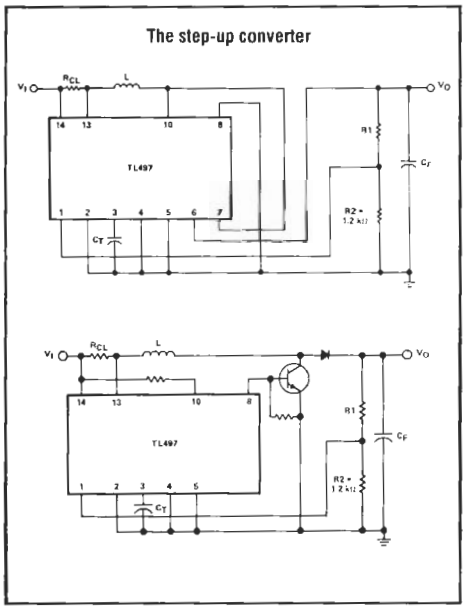
DUAL-IN-LINE PACKAGE
(TOP VIEW)

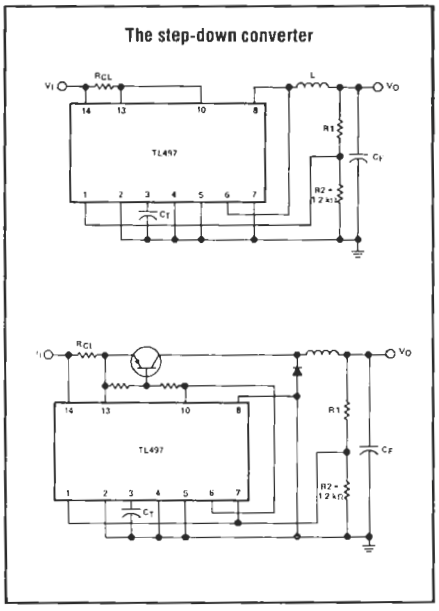


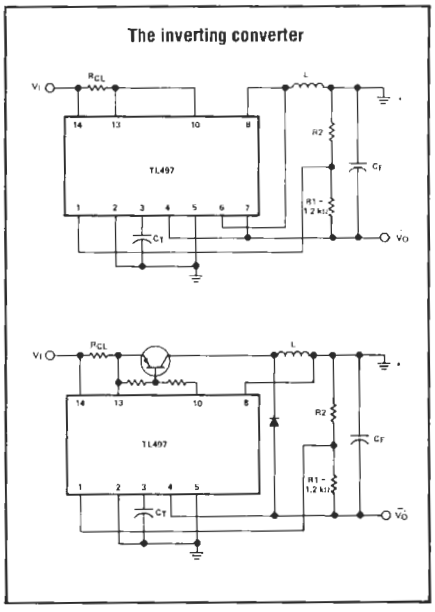
Description

Simplicity of design is a primary feature of the TL497A. With only six external components (three resistors, two capacitors, and one inductor), the TL497A will operate in numerous voltage conversion applications (step-up, step-down, invert) with as much as 85% of the source power delivered to the load. The TL497A replaces the TL497 in all applications.

Typical applications







APPENDIX B

PART LIST

SD Systems

P.O. Box 28810 • Dallas, Texas 75228 214-271-4667

BILL OF MATERIALS

Title: PROM-100	PL No. 0100140	Rev.
Date Released: 5/14/79	Approved: JRA RDB	Sheet 1 Of 2

Item no	Qty	SD-P/N	Description	Unit Cost	Extension
1	1	7010007	7406, U9		
2	1	7010166	74LS08, U11		
3	2	7010172	74LS14, U5, U10		
4	1	7010180	74LS30, U3		
5	1	7010226	74LS155, U4		
6	2	7010264	74LS244, U12, U13		
7	2	7010276	74LS273, U6, U8		
8	1	7010304	74LS373, U7		
9	1	7010353	DS0025CN, U14		
10	1	7010354	TL497ACN, U2		
11	1	7060010	24 PIN ZIP DIP, U1		
12	11	7030007	.1 MF Ceramic, C1-C3, C6-C11, C14-C15		
13	1	7030022	500MF 35V, C4		
14	1	7030006	300 pf, C5		
15	4	7030009	10 MF 20V, C12, C16-18		
16	1	7030034	.002 MF Ceramic, C13		
17	3	7020073	1K Ohm 1/4W 5%, R1-R3		
18	1	7020175	22.1K Ohm, 1%, R4		
19	1	7020001	1 Ohm 1/4W 5%, R5		
20	2	7020059	270 Ohm 1/4W 5%, R6, R7		
21	1	7020177	220 Ohm 1/2W, 5%, R8		
22	1	7060003	16 Pin Socket, 51		
23	1	7120001	L1 Inductor 500 uh J12044		
24	1	7040003	1N751, CR2		

SD Systems

P.O. Box 28810 • Dallas, Texas 75228 214-271-4667

BILL OF MATERIALS

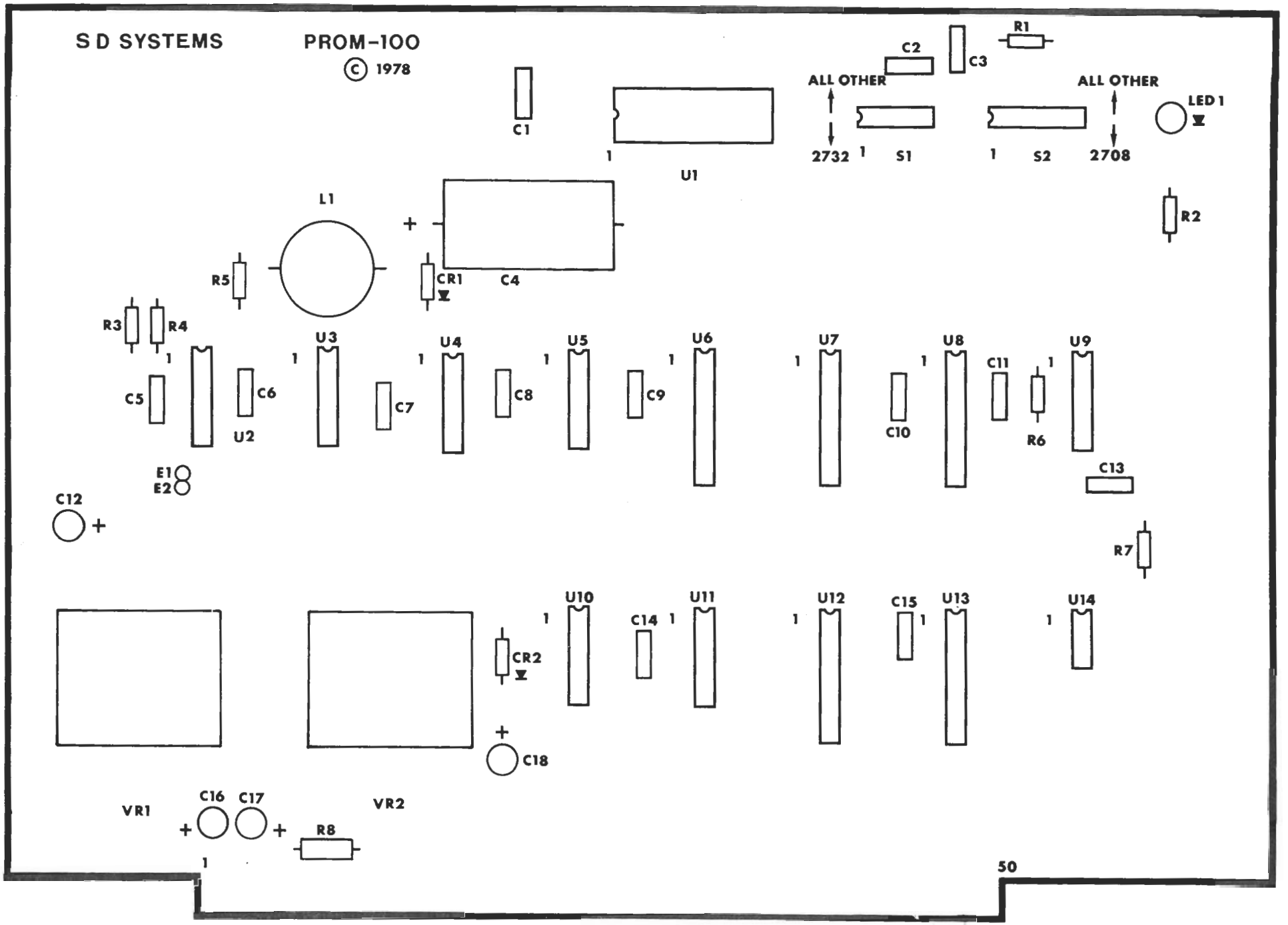
Title:	PL No.	Rev.
PROM-100	0100140	

Date Released:	Approved:	Sheet	Of
5/14/79	JRH RLB DWP	2	2

Item no	Qty	SD-P/N	Description	Unit Cost	Extension
25	1	7040014	1N5803, CR1		
26	1	7050012	Dip Switch, S1 DLS-45D		
27	1	7050013	Dip Switch, S2 DLS-35D		
28	6	7060002	14 Pin Socket		
29	5	7060005	20 Pin Socket		
30	1	7060001	8 Pin Socket		
31	1	7000014	PCB Prom-100 FAB #0100042		
32	1	7160001	7805		
33	1	7160003	7812		
34	2	7130005	Heatsink TMH 6106-14		
35	2	7130006	Screw 6-32x3/8		
36	2	7130007	Nut 6-32		
37	1	7140044	Manual		
38	1	7180002	LED1 RL-4403 Litronix		

APPENDIX C

PARTS PLACEMENT


S D SYSTEMS
PROM-100
© 1978
C1
U1
1
C2
C3
R1
ALL OTHER
2732
1
S1
1
S2
ALL OTHER
2708
LED 1
R2
L1
R5
CR1
C4
R3
R4
1
U3
U4
U5
U6
U7
U8
C11
U9
C5
C6
U2
C7
C8
C9
C10
R6
C13
E1
E2
C12
R7
U10
U11
U12
C15
U13
U14
C14
CR2
C18
VR1
C16
C17
VR2
R8
50

APPENDIX D

SOFTWARE LISTINGS

```
 ADDR  CODE      STMT SOURCE STATEMENT

               0001          NAME    PROM08
               0002 ;
               0003 ;
               0004 ; 2708 PROM PROGRAMMER CONTROL PROGRAM
               0005 ; 8/20/79
               0006 ;
               0007 ; VERSION 1.01  PROM VERSION (NON-DISK I/O)
               0008 ;
               0009 ;
               0010 ; SYSTEM EQUATES
               0011 ;
               0012 ;
>0001          0013 SDATA   DEFL    01H      ; VIDEO DATA PORT
>0000          0014 SSTAT   DEFL    00H      ; VIDEO STATUS PORT
>0002          0015 RXRMSK  DEFL    02H      ; RX RDY MASK
>0004          0016 TXRMSK  DEFL    04H      ; TX RDY MASK
>E003          0017 EXIT    EQU     0E003H
>0100          0018 TBASE   EQU     100H     ; BASE OF TRANSIENT AREA
>0068          0019 DATA    EQU     68H      ; DATA PORT
>0069          0020 LADD    EQU     69H      ; LOW ADDRESS PORT
>006A          0021 HACTL   EQU     6AH      ; HIGH ADDRESS + CONTROL PORT
>0000          0022 RBOUT   EQU     0
>0064          0023 LOOPS   EQU     100
               0024 ;
               0025 ;
               0026 ;
               0027 ;
               0028 ;
               0029 ;
               0030          PSECT   ABS
               0031 ;
>0100          0032          ORG     TBASE    ; START AT 100H
               0033 ;
               0034 ;
               0035 ;
               0036 ; PROGRAM PROM ENTRY POINT
               0037 ;
               0038 ;
               0039 ;
0100  312005   0040 PPG      LD      SP,SPVAL
0103  215B01   0041          LD      HL,MSG1
0106  CD4703   0042          CALL    PTXT     ; "PROM08 VERSION 1.0"
0109  312005   0043 PPG0     LD      SP,SPVAL
010C  AF       0044          XOR     A        ; CLEAR ACC
010D  D36A     0045          OUT     (HACTL),A
010F  CD3803   0046          CALL    CRLF
0112  C3C501   0047          JP      READ2    ; JUMP READ
0115  CD3803   0048 PPG10A   CALL    CRLF
0118  216B01   0049          LD      HL,MSG4
011B  CD4703   0050          CALL    PTXT     ; "READY TO PROG A PROM ?"
011E  CD3901   0051          CALL    YORN
0121  3027     0052          JR      NC,RENTRY-$
0123  CD3803   0053 PPG11    CALL    CRLF
0126  218A01   0054          LD      HL,MSG5
0129  CD4703   0055          CALL    PTXT     ; "MEM START,MEM END,PROM START"
012C  CDBE03   0056          CALL    SCAN
012F  3A1F04   0057          LD      A,(NXCHR)
0132  FE2E     0058          CP      '.'      ; IF '.' EXIT
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

 0134  28ED      0059         JR      Z,PPG11-$
 0136  C31402    0060         JP      PROG
               0061 ;
               0062 ;
               0063 ;
               0064 ;
               0065 ;
 0139  CDAC03    0066 YORN    CALL    ECHO
 013C  FE2E      0067         CP      '.'
 013E  280A      0068         JR      Z,RENTRY-$
 0140  B7        0069         OR      A
 0141  FE4E      0070         CP      'N'
 0143  C8        0071         RET     Z
 0144  FE59      0072         CP      'Y'
 0146  20F1      0073         JR      NZ,YORN-$
 0148  37        0074         SCF
 0149  C9        0075         RET
               0076 ;
               0077 ;
 014A  AF        0078 RENTRY  XOR     A
 014B  D36A      0079         OUT     (HACTL),A
 014D  CD3803    0080         CALL    CRLF
 0150  C303E0    0081         JP      EXIT
               0082 ;
               0083 ;
 0153  7C        0084 PADDR   LD      A,H
 0154  CD5203    0085         CALL    PACC
 0157  7D        0086         LD      A,L
 0158  C32F03    0087         JP      PASP
               0088 ;
               0089 ;
               0090 ;
 015B  50524F4D  0091 MSG1    DEFM    'PROM08  V 1.0'
       30382020
       5620312E
       30
 0168  0A0D      0092         DEFW    0D0AH
 016A  03        0093         DEFB    03H
 016B  52454144  0094 MSG4    DEFM    'READY TO PROGRAM A PROM (Y/N)?'
       5920544F
       2050524F
       4752414D
       20412050
       524F4D20
       28592F4E
       293F
 0189  03        0095         DEFB    03H
 018A  4D454D20  0096 MSG5    DEFM    'MEM START,MEM END,PROM START: '
       53544152
       542C4D45
       4D20454E
       442C5052
       4F4D2053
       54415254
       3A20
 01A8  03        0097         DEFB    03H
 01A9  52454144  0098 MSG6    DEFM    'READY TO READ A PROM (Y/N)?'
       5920544F
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

       20524541
       44204120
       50524F4D
       2028592F
       4E293F
 01C4  03        0099          DEFB    03H
                 0100 ;
                 0101 ;
                 0102 ;
                 0103 ;
                 0104 ; PROM READ SEQUENCE
                 0105 ;
                 0106 ;
                 0107 ;
 01C5  CD3803    0108 READ2    CALL    CRLF    ; READ PROM INTO MEMORY
 01C8  21A901    0109          LD      HL,MSG6
 01CB  CD4703    0110          CALL    PTXT    ; "READY TO READ (Y/N)?"
 01CE  CD3901    0111          CALL    YORN
 01D1  D21501    0112          JP      NC,PPG10A ; NO, THEN PROGRAM
 01D4  CD3803    0113 READ0    CALL    CRLF
 01D7  218A01    0114          LD      HL,MSG5
 01DA  CD4703    0115          CALL    PTXT    ; "MEM START,MEM END,PROM START"
 01DD  CDBE03    0116          CALL    SCAN    ; INPUT PARAMETERS
 01E0  3A1F04    0117          LD      A,(NXCHR)
 01E3  FE2E      0118          CP      '.'
 01E5  28ED      0119          JR      Z,READ0-$
 01E7  3E40      0120          LD      A,40H
 01E9  D36A      0121          OUT     (HACTL),A ; TURN ON PROM VOLTAGE
 01EB  2A2004    0122          LD      HL,(OPR1) ; MEM START ADDR
 01EE  ED5B2404  0123          LD      DE,(OPR3) ; PROM START ADDR
 01F2  CDDA02    0124 READ1    CALL    PREAD   ; READ A BYTE OF PROM
 01F5  77        0125          LD      (HL),A  ; SAVE BYTE IN MEM
 01F6  CD0102    0126          CALL    ADCMP   ; INC ADDR & COMPARE
 01F9  20F7      0127          JR      NZ,READ1-$ ; IF NOT END,THEN JUMP
 01FB  AF        0128          XOR     A
 01FC  D36A      0129          OUT     (HACTL),A
 01FE  C31501    0130          JP      PPG10A  ; WHEN COMPLETE,RETURN
                 0131 ;
                 0132 ;
                 0133 ;
                 0134 ;
                 0135 ; INC HL & DE THEN COMPARE HL WITH (IX)
                 0136 ; EXIT WITH ZERO FLAG SET IF EQUAL
                 0137 ;
                 0138 ;
 0201  13        0139 ADCMP    INC     DE      ; INC PROM ADDR
 0202  7A        0140          LD      A,D
 0203  E607      0141          AND     7H      ; MAX PROM ADDR=7FF
 0205  57        0142          LD      D,A
 0206  23        0143          INC     HL
 0207  D5        0144          PUSH    DE
 0208  E5        0145          PUSH    HL      ; SAVE HL & DE
 0209  ED5B2204  0146          LD      DE,(OPR2) ; GET RAM END ADDR
 020D  13        0147          INC     DE
 020E  A7        0148          AND     A
 020F  ED52      0149          SBC     HL,DE   ; COMPARE
 0211  E1        0150          POP     HL
 0212  D1        0151          POP     DE
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

 0213  C9        0152         RET
               0153 ;
               0154 ;
               0155 ;
               0156 ;
               0157 ; PROGRAMMING SEQUENCE
               0158 ;
               0159 ;
 0214  2A2004    0160 PROG    LD      HL,(OPR1) ; MEM START ADDRESS
 0217  ED5B2404  0161         LD      DE,(OPR3) ; PROM START ADDRESS
 021B  CDDA02    0162 PROG1   CALL    PREAD   ; READ A BYTE (PROM)
 021E  FEFF      0163         CP      0FFH    ; CHECK FOR ERASED BYTES
 0220  2007      0164         JR      NZ,PROG2-$ ; IF NOT ERASED JUMP
 0222  CD0102    0165 PRG1A   CALL    ADCMP   ; INC ADDR & CHECK FOR END
 0225  20F4      0166         JR      NZ,PROG1-$ ; LOOP UNTIL END
 0227  1821      0167         JR      PROG3-$ ; GO PROGRAM PROM
 0229  E5        0168 PROG2   PUSH    HL
 022A  210803    0169         LD      HL,MSG7
 022D  CD4703    0170         CALL    PTXT    ; "NOT ERASED"
 0230  E1        0171         POP     HL
 0231  DB68      0172         IN      A,(DATA)
 0233  CDE902    0173         CALL    PRTER   ; PRINT BAD LOCATION
 0236  CDAC03    0174         CALL    ECHO    ; READ FROM CONSOLE
 0239  FE2E      0175         CP      '.'     ; CHECK FOR PERIOD
 023B  2806      0176         JR      Z,PRG2A-$ ; EXIT
 023D  FE43      0177         CP      'C'     ; CHECK FOR 'C'
 023F  2809      0178         JR      Z,PROG3-$ ; CONTINUE IF 'C' ENTERED
 0241  18DF      0179         JR      PRG1A-$ ; IF NOT ,PRINT NEXT ERROR
 0243  3E00      0180 PRG2A   LD       A,0
 0245  D36A      0181         OUT     (HACTL),A
 0247  C30901    0182         JP      PPG0
 024A  CD3803    0183 PROG3   CALL    CRLF
 024D  0665      0184         LD      B,LOOPS+1
 024F  2A2004    0185 PROG4   LD      HL,(OPR1) ; SET MEM START ADDR
 0252  ED5B2404  0186         LD      DE,(OPR3) ; SET PROM START ADDR
 0256  05        0187         DEC     B
 0257  2818      0188         JR      Z,PROG6-$
 0259  C5        0189 PROG5   PUSH    BC
 025A  CDB502    0190         CALL    PPROG   ; PROGRAM ONE BYTE
 025D  C1        0191         POP     BC
 025E  CD0004    0192         CALL    CONST
 0261  2807      0193         JR      Z,PROG5A-$
 0263  CD0804    0194         CALL    CONIN
 0266  FE2E      0195         CP      '.'
 0268  2843      0196         JR      Z,PROG9-$
 026A  CD0102    0197 PROG5A  CALL    ADCMP   ; INC ADDR & CHECK END
 026D  20EA      0198         JR      NZ,PROG5-$ ; FINISH THIS LOOP
 026F  18DE      0199         JR      PROG4-$
 0271  3E00      0200 PROG6   LD      A,0
 0273  D36A      0201         OUT     (HACTL),A ; TURN OFF ALL CONTROL LINES
 0275  1614      0202         LD      D,20
 0277  AF        0203 PROG6B  XOR     A
 0278  CDD202    0204         CALL    DELAY
 027B  15        0205         DEC     D
 027C  20F9      0206         JR      NZ,PROG6B-$
 027E  2A2004    0207 PROG6A  LD      HL,(OPR1) ; MEM START ADDR
 0281  ED5B2404  0208         LD      DE,(OPR3) ; PROM START ADDR
 0285  CDDA02    0209 PROG7   CALL    PREAD   ; READ PROM DATA
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

 0288  BE        0210          CP      (HL)
 0289  2007      0211          JR      NZ,PROG8-$ ; IF NOT MATCH,JUMP
 028B  CD0102    0212 PRG7A    CALL    ADCMP   ; CHECK FOR END
 028E  20F5      0213          JR      NZ,PROG7-$
 0290  18B1      0214          JR      PRG2A-$ ; EXIT,COMPLETE
 0292  F5        0215 PROG8    PUSH    AF
 0293  E5        0216          PUSH    HL
 0294  211503    0217          LD      HL,MSG8
 0297  CD4703    0218          CALL    PTXT    ; "BAD LOCATION"
 029A  E1        0219          POP     HL
 029B  CD0004    0220          CALL    CONST
 029E  2807      0221          JR      Z,PROG8A-$
 02A0  CD0804    0222          CALL    CONIN
 02A3  FE2E      0223          CP      '.'
 02A5  289C      0224          JR      Z,PRG2A-$
 02A7  F1        0225 PROG8A   POP     AF
 02A8  CDE902    0226          CALL    PRTER   ; PRINT ERROR MESSAGE
 02AB  18DE      0227          JR      PRG7A-$ ; PRINT ALL BAD LOCATIONS
 02AD  211F03    0228 PROG9    LD      HL,MSG9
 02B0  CD4703    0229          CALL    PTXT    ; ABORTED
 02B3  188E      0230          JR      PRG2A-$
                 0231 ;
                 0232 ;
                 0233 ;
                 0234 ; PULSE ONE PROM LOCATION
                 0235 ;
                 0236 ;
 02B5  CDE502    0237 PPROG    CALL    PADD    ; LATCH LSB OF ADDRESS
 02B8  7A        0238          LD      A,D
 02B9  F680      0239          OR      080H
 02BB  D36A      0240          OUT     (HACTL),A
 02BD  7E        0241          LD      A,(HL)  ; FETCH DATA
 02BE  D368      0242          OUT     (DATA),A ; OUTPUT DATA
 02C0  7A        0243          LD      A,D
 02C1  F6C0      0244          OR      0C0H    ; TURN ON PROG PULSE
 02C3  D36A      0245          OUT     (HACTL),A
 02C5  3E01      0246          LD      A,1
 02C7  CDD202    0247          CALL    DELAY   ; 1 MILLISEC DELAY
 02CA  7A        0248          LD      A,D
 02CB  F680      0249          OR      080H
 02CD  E687      0250          AND     087H    ; PROG PULSE OFF
 02CF  D36A      0251          OUT     (HACTL),A
 02D1  C9        0252          RET
                 0253 ;
 02D2  06BF      0254 DELAY    LD      B,191
 02D4  10FE      0255 DELAY1   DJNZ    DELAY1-$
 02D6  3D        0256          DEC     A
 02D7  20F9      0257          JR      NZ,DELAY-$
 02D9  C9        0258          RET
                 0259 ;
                 0260 ;
                 0261 ;
                 0262 ;
                 0263 ; READ ONE LOCATION OF PROM
                 0264 ;
                 0265 ;
 02DA  CDE502    0266 PREAD    CALL    PADD    ; LATCH LSB OF ADDRESS
 02DD  7A        0267          LD      A,D
```

```
ADDR  CODE      STMT SOURCE STATEMENT

02DE  E607      0268          AND     7
02E0  D36A      0269          OUT     (HACTL),A
02E2  DB68      0270          IN      A,(DATA)
02E4  C9        0271          RET
                0272 ;
                0273 ;
                0274 ; LATCH LOWER 8 BITS OF PROM ADDRESS
                0275 ;
                0276 ;
02E5  7B        0277 PADD     LD      A,E
02E6  D369      0278          OUT     (LADD),A
02E8  C9        0279          RET
                0280 ;
                0281 ;
                0282 ;
                0283 ;
                0284 ;
                0285 ; PRINTS ADDR/BAD DATA/GOOD DATA
                0286 ; OF ERROR LOCATION
                0287 ;
                0288 ;
02E9  47        0289 PRTER    LD      B,A
02EA  7A        0290          LD      A,D
02EB  CD5203    0291          CALL    PACC    ; PRINT MSB OF ADDR
02EE  7B        0292          LD      A,E
02EF  CD5203    0293          CALL    PACC    ; PRINT LSB OF ADDR
02F2  0E20      0294          LD      C,20H
02F4  CD1304    0295          CALL    CONOUT
02F7  78        0296          LD      A,B
02F8  CD5203    0297          CALL    PACC    ; PRINT BAD DATA
02FB  0E20      0298          LD      C,20H
02FD  CD1304    0299          CALL    CONOUT
0300  7E        0300          LD      A,(HL)
0301  CD5203    0301          CALL    PACC    ; PRINT GOOD DATA
0304  CD3803    0302          CALL    CRLF
0307  C9        0303          RET
                0304 ;
                0305 ;
                0306 ;
                0307 ;
0308  4E4F5420  0308 MSG7     DEFM    'NOT ERASED  '
      45524153
      45442020
0314  03        0309          DEFB    03H
0315  42414420  0310 MSG8     DEFM    'BAD LOC  '
      4C4F4320
      20
031E  03        0311          DEFB    03H
031F  41424F52  0312 MSG9     DEFM    'ABORTED'
      544544
0326  03        0313          DEFB    03H
                0314 ;
                0315 ;
                0316 ;
                0317 ; TWDG-READ AND CONVERT 2 DIGITS TO BINARY
                0318 ;
                0319 ;
                0320 ;
```

```
 ADDR   CODE      STMT SOURCE STATEMENT

                  0321 ;
                  0322 ;
                  0323 ;
                  0324 ; ASCII TO BINARY CONVERSION
                  0325 ;
                  0326 ;
 0327   D630      0327 ASBIN   SUB     030H
 0329   FE0A      0328         CP      10
 032B   F8        0329         RET     M
 032C   D607      0330         SUB     7
 032E   C9        0331         RET
                  0332 ;
                  0333 ;
                  0334 ;
                  0335 ;
                  0336 ;
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

                 0338 ;
                 0339 ;
 032F  C5        0340 PASP    PUSH    BC
 0330  CD5203    0341         CALL    PACC
 0333  CD4203    0342         CALL    SPACE
 0336  C1        0343         POP     BC
 0337  C9        0344         RET
                 0345 ;
                 0346 ;
                 0347 ;
 0338  0E0D      0348 CRLF    LD      C,0DH
 033A  CD1304    0349         CALL    CONOUT
 033D  0E0A      0350         LD      C,0AH
 033F  C31304    0351         JP      CONOUT
                 0352 ;
                 0353 ;
 0342  0E20      0354 SPACE   LD      C,' '
 0344  C31304    0355         JP      CONOUT
                 0356 ;
                 0357 ;
                 0358 ;
                 0359 ;
                 0360 ;
                 0361 ; PRINT TEXT
                 0362 ;
                 0363 ;
 0347  7E        0364 PTXT    LD      A,(HL)   ; FETCH A BYTE
 0348  FE03      0365         CP      3
 034A  C8        0366         RET     Z
 034B  4F        0367         LD      C,A
 034C  CD1304    0368         CALL    CONOUT
 034F  23        0369         INC     HL
 0350  18F5      0370         JR      PTXT
                 0371 ;
                 0372 ;
                 0373 ; PRINT ACCUMULATOR
                 0374 ;
                 0375 ;
 0352  F5        0376 PACC    PUSH    AF
 0353  0F        0377         RRCA
 0354  0F        0378         RRCA
 0355  0F        0379         RRCA
 0356  0F        0380         RRCA
 0357  CD5B03    0381         CALL    PRVAL
 035A  F1        0382         POP     AF
                 0383 ;
                 0384 ;
 035B  E60F      0385 PRVAL   AND     0FH
 035D  C690      0386         ADD     A,90H
 035F  27        0387         DAA
 0360  CE40      0388         ADC     A,40H
 0362  27        0389         DAA
 0363  4F        0390         LD      C,A
 0364  C31304    0391         JP      CONOUT   ; PRINT IT
                 0392 ;
                 0393 ;
                 0394 ;
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

                 0395 ;
                 0396 ; CHECK FOR VALID HEX CHARACTER
                 0397 ;
                 0398 ;
 0367  FE30      0399 AORN    CP      '0'
 0369  380E      0400         JR      C,AORN2 ; JUMP IF < 30H
 036B  FE3A      0401         CP      '9'+1
 036D  3808      0402         JR      C,AORN1 ; JUMP IF < 3AH
 036F  FE40      0403         CP      'A'-1
 0371  3806      0404         JR      C,AORN2 ; JUMP IF < 'A'
 0373  FE47      0405         CP      'F'+1
 0375  3002      0406         JR      NC,AORN2 ; JUMP IF < 'G'
 0377  AF        0407 AORN1   XOR     A
 0378  C9        0408         RET             ; VALID DATA RET
 0379  AF        0409 AORN2   XOR     A
 037A  3C        0410         INC     A
 037B  C9        0411         RET             ; NOT HEX CHAR
                 0412 ;
                 0413 ;
                 0414 ; CHECK FOR TERMINATOR
                 0415 ;
                 0416 ; SPACE, COMMA, OR CARRIAGE RETURN
                 0417 ;
                 0418 ;
 037C  FE20      0419 TERMCK  CP      ' '
 037E  C8        0420         RET     Z
 037F  FE2C      0421         CP      ','
 0381  C8        0422         RET     Z
 0382  FE2E      0423         CP      '.'
 0384  2803      0424         JR      Z,TCHK0
 0386  FE0D      0425         CP      0DH
 0388  C0        0426         RET     NZ
 0389  C5        0427 TCHK0   PUSH    BC
 038A  CD3803    0428         CALL    CRLF
 038D  C1        0429         POP     BC
 038E  AF        0430         XOR     A
 038F  C9        0431         RET
                 0432 ;
                 0433 ;
                 0434 ; SCAN FOR OPERAND FROM KEYBOARD
                 0435 ;
                 0436 ;
                 0437 ; EXIT WITH DATA IN HL, AND TERMINATOR
                 0438 ; IN C. IF VALID DATA, RETURN WITH
                 0439 ; ZERO FLAG SET. B CONTAINS # OF CHARACTERS ENTERED.
                 0440 ;
                 0441 ;
 0390  210000    0442 KEYIN   LD      HL,0
 0393  45        0443         LD      B,L
 0394  CDAC03    0444 KEY1    CALL    ECHO
 0397  04        0445         INC     B       ; INC CHAR COUNT
 0398  CD7C03    0446         CALL    TERMCK
 039B  C8        0447         RET     Z       ; IF TERMINATOR, RETURN
 039C  CD6703    0448         CALL    AORN    ; VALID DATA CHECK
 039F  C0        0449         RET     NZ      ; IF NOT RETURN
 03A0  79        0450         LD      A,C
 03A1  CD2703    0451         CALL    ASBIN   ; CONVERT TO BINARY
 03A4  29        0452         ADD     HL,HL
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

 03A5  29        0453          ADD     HL,HL
 03A6  29        0454          ADD     HL,HL
 03A7  29        0455          ADD     HL,HL    ;p SHIFT 4 BITS
 03A8  85        0456          ADD     A,L
 03A9  6F        0457          LD      L,A
 03AA  18E8      0458          JR      KEY1
                 0459 ;
                 0460 ;
                 0461 ;
 03AC  CD0804    0462 ECHO     CALL    CONIN
 03AF  4F        0463          LD      C,A
 03B0  C31304    0464          JP      CONOUT
                 0465 ;
                 0466 ;
                 0467 ;
 03B3  0E3F      0468 INVCMD   LD      C,'?'
 03B5  CD1304    0469          CALL    CONOUT
 03B8  3E2E      0470          LD      A,'.'
 03BA  321F04    0471          LD      (NXCHR),A
 03BD  C9        0472          RET
                 0473 ;
                 0474 ;
                 0475 ;
                 0476 ;
                 0477 ;SCAN -- SCANS THE OPERANDS INPUT FROM THE
                 0478 ;  CONSOLE. THE OPERANDS ARE SAVED IN OP1,
                 0479 ;  AS THE ARGUMENTS TO EXECUTE THEIR COMMANDS.
                 0480 ;
 03BE  AF        0481 SCAN     XOR     A        ;INITIALIZE
 03BF  212004    0482          LD      HL,OPRS ;CLEAR OPERANDS
 03C2  E5        0483          PUSH    HL
 03C3  DDE1      0484          POP     IX       ;IX=POINTER TO OPERANDS
 03C5  77        0485          LD      (HL),A
 03C6  010900    0486          LD      BC,9
 03C9  112104    0487          LD      DE,OPRS+1
 03CC  EDB0      0488          LDIR
 03CE  321E04    0489          LD      (OPCNT),A
 03D1  CD9003    0490 SCAN1    CALL    KEYIN    ; GET ONE OPERAND
 03D4  C2B303    0491          JP      NZ,INVCMD
 03D7  79        0492          LD      A,C
 03D8  321F04    0493          LD      (NXCHR),A
 03DB  FE20      0494          CP      ' '
 03DD  2806      0495          JR      Z,SCAN2-$
 03DF  FE2C      0496          CP      ','
 03E1  2802      0497          JR      Z,SCAN2-$
 03E3  05        0498          DEC     B
 03E4  C8        0499          RET     Z        ; IF NO DATA, RET
 03E5  DD7500    0500 SCAN2    LD      (IX),L
 03E8  DD7401    0501          LD      (IX+1),H
 03EB  3A1E04    0502          LD      A,(OPCNT)
 03EE  3C        0503          INC     A
 03EF  321E04    0504          LD      (OPCNT),A
 03F2  DD23      0505          INC     IX
 03F4  DD23      0506          INC     IX       ; POINT TO NEXT OPR
 03F6  79        0507          LD      A,C
 03F7  FE20      0508          CP      ' '
 03F9  28D6      0509          JR      Z,SCAN1-$
 03FB  FE2C      0510          CP      ','
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

 03FD  28D2      0511          JR      Z,SCAN1-$
 03FF  C9        0512          RET
                 0513 ;
                 0514 ;
                 0515 ;
 0400  DB00      0516 CONST    IN      A,(SSTAT)       ; CONSOLE STATUS
 0402  E602      0517          AND     RXRMSK
 0404  C8        0518          RET     Z
 0405  3EFF      0519          LD      A,0FFH
 0407  C9        0520          RET
                 0521 ;
 0408  CD0004    0522 CONIN    CALL    CONST           ; CONSOLE INPUT
 040B  CA0804    0523          JP      Z,CONIN
 040E  DB01      0524          IN      A,(SDATA)
 0410  E67F      0525          AND     7FH
 0412  C9        0526          RET
                 0527 ;
 0413  DB00      0528 CONOUT   IN      A,(SSTAT)       ; CONSOLE OUTPUT
 0415  E604      0529          AND     TXRMSK          ; TX BFR EMPTY
 0417  CA1304    0530          JP      Z,CONOUT
 041A  79        0531          LD      A,C
 041B  D301      0532          OUT     (SDATA),A
 041D  C9        0533          RET
                 0534 ;
 >041E           0535 OPCNT    DEFS    1
 >041F           0536 NXCHR    DEFS    1
 >0420           0537 OPRS     DEFS    6
 >0420           0538 OPR1     EQU     OPRS
 >0422           0539 OPR2     EQU     OPRS+2
 >0424           0540 OPR3     EQU     OPRS+4
 >0520           0541 SPVAL    EQU     OPRS+100H
                 0542 ;
                 0543 ;
                 0544 ;
```

ADDR CODE STMT SOURCE STATEMENT

CROSS REFERENCE LISTING

SYMBOL	VALUE	TYPE	STMT	STATEMENT REFERENCES
ADCMP	0201		0139	0212 0197 0165 0126
AORN	0367		0399	0448
AORN1	0377		0407	0402
AORN2	0379		0409	0406 0404 0400
ASBIN	0327		0327	0451
CONIN	0408		0522	0523 0462 0222 0194
CONOUT	0413		0528	0530 0469 0464 0391 0368 0355 0351 0349 0299 0295
+				
CONST	0400		0516	0522 0220 0192
CRLF	0338		0348	0428 0302 0183 0113 0108 0080 0053 0048 0046
DATA	0068		0019	0270 0242 0172
DELAY	02D2		0254	0257 0247 0204
DELAY1	02D4		0255	0255
ECHO	03AC		0462	0444 0174 0066
EXIT	E003		0017	0081
HACTL	006A		0021	0269 0251 0245 0240 0201 0181 0129 0121 0079 0045
+				
INVCMD	03B3		0468	0491
KEY1	0394		0444	0458
KEYIN	0390		0442	0490
LADD	0069		0020	0278
LOOPS	0064		0023	0184
MSG1	015B		0091	0041
MSG4	016B		0094	0049
MSG5	018A		0096	0114 0054
MSG6	01A9		0098	0109
MSG7	0308		0308	0169
MSG8	0315		0310	0217
MSG9	031F		0312	0228
NXCHR	041F		0536	0493 0471 0117 0057
OPCNT	041E		0535	0504 0502 0489
OPR1	0420		0538	0207 0185 0160 0122
OPR2	0422		0539	0146
OPR3	0424		0540	0208 0186 0161 0123
OPRS	0420		0537	0541 0540 0539 0538 0487 0482
PACC	0352		0376	0341 0301 0297 0293 0291 0085
PADD	02E5		0277	0266 0237
PADDR	0153		0084	
PASP	032F		0340	0087
PPG	0100		0040	
PPG0	0109		0043	0182
PPG10A	0115		0048	0130 0112
PPG11	0123		0053	0059
PPROG	02B5		0237	0190
PREAD	02DA		0266	0209 0162 0124
PRG1A	0222		0165	0179
PRG2A	0243		0180	0230 0224 0214 0176
PRG7A	028B		0212	0227
PROG	0214		0160	0060
PROG1	021B		0162	0166
PROG2	0229		0168	0164
PROG3	024A		0183	0178 0167
PROG4	024F		0185	0199
PROG5	0259		0189	0198

```
 ADDR  CODE      STMT SOURCE STATEMENT

 PROG5A 026A          0197   0193
 PROG6  0271          0200   0188
 PROG6A 027E          0207
 PROG6B 0277          0203   0206
 PROG7  0285          0209   0213
 PROG8  0292          0215   0211
 PROG8A 02A7          0225   0221
 PROG9  02AD          0228   0196
 PRTER  02E9          0289   0226 0173
 PRVAL  035B          0385   0381
 PTXT   0347          0364   0370 0229 0218 0170 0115 0110 0055 0050 0042
 RBOUT  0000          0022
 READ0  01D4          0113   0119
 READ1  01F2          0124   0127
 READ2  01C5          0108   0047
 RENTRY 014A          0078   0068 0052
 RXRMSK 0002          0015   0517
 SCAN   03BE          0481   0116 0056
 SCAN1  03D1          0490   0511 0509
 SCAN2  03E5          0500   0497 0495
 SDATA  0001          0013   0532 0524
 SPACE  0342          0354   0342
 SPVAL  0520          0541   0043 0040
 SSTAT  0000          0014   0528 0516
 TBASE  0100          0018   0032
 TCHK0  0389          0427   0424
 TERMCK 037C          0419   0446
 TXRMSK 0004          0016   0529
 YORN   0139          0066   0111 0073 0051
ERRORS=0000
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

               0001          NAME    PROM16
               0002 ;
               0003 ;
               0004 ; 2716/2758 PROM PROGRAMMER CONTROL PROGRAM
               0005 ; 8/20/79
               0006 ;
               0007 ; VERSION 1.01  PROM VERSION (NON-DISK I/O)
               0008 ;
               0009 ;
               0010 ; SYSTEM EQUATES
               0011 ;
               0012 ;
>0001          0013 SDATA   DEFL    01H      ; VIDEO DATA PORT
>0000          0014 SSTAT   DEFL    00H      ; VIDEO STATUS PORT
>0002          0015 RXRMSK  DEFL    02H      ; RX RDY MASK
>0004          0016 TXRMSK  DEFL    04H      ; TX RDY MASK
>E003          0017 EXIT    EQU     0E003H
>0100          0018 TBASE   EQU     100H     ; BASE OF TRANSIENT AREA
>0068          0019 DATA    EQU     68H      ; DATA PORT
>0069          0020 LADD    EQU     69H      ; LOW ADDRESS PORT
>006A          0021 HACTL   EQU     6AH      ; HIGH ADDRESS + CONTROL PORT
>0000          0022 RBOUT   EQU     0
               0023 ;
               0024 ;
               0025 ;
               0026 ;
               0027 ;
               0028 ;
               0029          PSECT   ABS
               0030 ;
>0100          0031          ORG     TBASE    ; START AT 100H
               0032 ;
               0033 ;
               0034 ;
               0035 ; PROGRAM PROM ENTRY POINT
               0036 ;
               0037 ;
               0038 ;
0100  312405   0039 PPG       LD      SP,SPVAL
0103  215D01   0040           LD      HL,MSG1
0106  CD4703   0041           CALL    PTXT     ; "PROM16 VERSION 1.0"
0109  312405   0042 PPG0      LD      SP,SPVAL
010C  AF       0043           XOR     A        ; CLEAR ACC
010D  D36A     0044           OUT     (HACTL),A
010F  CD3803   0045           CALL    CRLF
0112  C3D301   0046           JP      READ2    ; JUMP READ
0115  CD3803   0047 PPG10A    CALL    CRLF
0118  217301   0048           LD      HL,MSG4
011B  CD4703   0049           CALL    PTXT     ; "READY TO PROGRAM A PROM ?"
011E  CD3A01   0050           CALL    YORN
0121  D24C01   0051           JP      NC,RENTRY
0124  CD3803   0052 PPG11     CALL    CRLF
0127  219201   0053           LD      HL,MSG5
012A  CD4703   0054           CALL    PTXT     ; "MEM START,MEM END,PROM START"
012D  CDC203   0055           CALL    SCAN
0130  3A2304   0056           LD      A,(NXCHR)
0133  FE2E     0057           CP      '.'      ; IF '.' EXIT
0135  28ED     0058           JR      Z,PPG11-$
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

 0137  C32202    0059          JP      PROG
               0060 ;
               0061 ;
               0062 ;
               0063 ;
               0064 ;
 013A  CDB003    0065 YORN     CALL    ECHO
 013D  FE2E      0066          CP      '.'
 013F  CA4C01    0067          JP      Z,RENTRY
 0142  B7        0068          OR      A
 0143  FE4E      0069          CP      'N'
 0145  C8        0070          RET     Z
 0146  FE59      0071          CP      'Y'
 0148  20F0      0072          JR      NZ,YORN-$
 014A  37        0073          SCF
 014B  C9        0074          RET
               0075 ;
               0076 ;
 014C  AF        0077 RENTRY   XOR     A
 014D  D36A      0078          OUT     (HACTL),A
 014F  CD3803    0079          CALL    CRLF
 0152  C303E0    0080          JP      EXIT
               0081 ;
               0082 ;
 0155  7C        0083 PADDR    LD      A,H
 0156  CD5303    0084          CALL    PACC
 0159  7D        0085          LD      A,L
 015A  C32F03    0086          JP      PASP
               0087 ;
               0088 ;
               0089 ;
 015D  50524F4D  0090 MSG1     DEFM    'PROM16  VERSION 1.0'
       31362020
       56455253
       494F4E20
       312E30
 0170  0A0D      0091          DEFW    0D0AH
 0172  03        0092          DEFB    03H
 0173  52454144  0093 MSG4     DEFM    'READY TO PROGRAM A PROM (Y/N)?'
       5920544F
       2050524F
       4752414D
       20412050
       524F4D20
       28592F4E
       293F
 0191  03        0094          DEFB    03H
 0192  4D454D4F  0095 MSG5     DEFM    'MEMORY START,MEMORY END,PROM START: '
       52592053
       54415254
       2C4D454D
       4F525920
       454E442C
       50524F4D
       20535441
       52543A20
 01B6  03        0096          DEFB    03H
 01B7  52454144  0097 MSG6     DEFM    'READY TO READ A PROM (Y/N)?'
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

       5920544F
       20524541
       44204120
       50524F4D
       2028592F
       4E293F
 01D2  03        0098          DEFB    03H
                 0099 ;
                 0100 ;
                 0101 ;
                 0102 ;
                 0103 ; PROM READ SEQUENCE
                 0104 ;
                 0105 ;
                 0106 ;
 01D3  CD3803    0107 READ2    CALL    CRLF    ; READ PROM INTO MEMORY
 01D6  21B701    0108          LD      HL,MSG6
 01D9  CD4703    0109          CALL    PTXT    ; "READY TO READ (Y/N)?"
 01DC  CD3A01    0110          CALL    YORN
 01DF  D21501    0111          JP      NC,PPG10A ; NO, THEN PROGRAM
 01E2  CD3803    0112 READ0    CALL    CRLF
 01E5  219201    0113          LD      HL,MSG5
 01E8  CD4703    0114          CALL    PTXT    ; "MEM START,MEM END,PROM START"
 01EB  CDC203    0115          CALL    SCAN    ; INPUT PARAMETERS
 01EE  3A2304    0116          LD      A,(NXCHR)
 01F1  FE2E      0117          CP      '.'
 01F3  28ED      0118          JR      Z,READ0-$
 01F5  3E40      0119          LD      A,40H
 01F7  D36A      0120          OUT     (HACTL),A ; TURN ON PROM VOLTAGE
 01F9  2A2404    0121          LD      HL,(OPR1) ; MEM START ADDR
 01FC  ED5B2804  0122          LD      DE,(OPR3) ; PROM START ADDR
 0200  CDDA02    0123 READ1    CALL    PREAD   ; READ A BYTE OF PROM
 0203  77        0124          LD      (HL),A  ; SAVE BYTE IN MEM
 0204  CD0F02    0125          CALL    ADCMP   ; INC ADDR & COMPARE
 0207  20F7      0126          JR      NZ,READ1-$ ; IF NOT END,THEN JUMP
 0209  AF        0127          XOR     A
 020A  D36A      0128          OUT     (HACTL),A
 020C  C31501    0129          JP      PPG10A  ; WHEN COMPLETE,RETURN
                 0130 ;
                 0131 ;
                 0132 ;
                 0133 ;
                 0134 ; INC HL & DE THEN COMPARE HL WITH (IX)
                 0135 ; EXIT WITH ZERO FLAG SET IF EQUAL
                 0136 ;
                 0137 ;
 020F  13        0138 ADCMP    INC     DE      ; INC PROM ADDR
 0210  7A        0139          LD      A,D
 0211  E607      0140          AND     7H      ; MAX PROM ADDR=7FF
 0213  57        0141          LD      D,A
 0214  23        0142          INC     HL
 0215  D5        0143          PUSH    DE
 0216  E5        0144          PUSH    HL      ; SAVE HL & DE
 0217  ED5B2604  0145          LD      DE,(OPR2) ; GET RAM END ADDR
 021B  13        0146          INC     DE
 021C  A7        0147          AND     A
 021D  ED52      0148          SBC     HL,DE   ; COMPARE
 021F  E1        0149          POP     HL
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

 0220  D1        0150          POP     DE
 0221  C9        0151          RET
               0152 ;
               0153 ;
               0154 ;
               0155 ;
               0156 ; PROGRAMMING SEQUENCE
               0157 ;
               0158 ;
 0222  3E40      0159 PROG     LD      A,40H
 0224  D36A      0160          OUT     (HACTL),A ; TURN ON PROM VOLTAGE
 0226  2A2404    0161          LD      HL,(OPR1) ; MEM START ADDRESS
 0229  ED5B2804  0162          LD      DE,(OPR3) ; PROM START ADDRESS
 022D  CDDA02    0163 PROG1    CALL    PREAD   ; READ A BYTE (PROM)
 0230  FEFF      0164          CP      OFFH    ; CHECK FOR ERASED BYTES
 0232  2007      0165          JR      NZ,PROG2-$ ; IF NOT ERASED JUMP
 0234  CD0F02    0166 PRG1A    CALL    ADCMP   ; INC ADDR & CHECK FOR END
 0237  20F4      0167          JR      NZ,PROG1-$ ; LOOP UNTIL END
 0239  1821      0168          JR      PROG3-$ ; GO PROGRAM PROM
 023B  E5        0169 PROG2    PUSH    HL
 023C  210803    0170          LD      HL,MSG7
 023F  CD4703    0171          CALL    PTXT    ; "NOT ERASED"
 0242  E1        0172          POP     HL
 0243  DB68      0173          IN      A,(DATA)
 0245  CDE902    0174          CALL    PRTER   ; PRINT BAD LOCATION
 0248  CDB003    0175          CALL    ECHO    ; READ FROM CONSOLE
 024B  FE2E      0176          CP      '.'     ; CHECK FOR PERIOD
 024D  2806      0177          JR      Z,PRG2A-$ ; EXIT
 024F  FE43      0178          CP      'C'     ; CHECK FOR 'C'
 0251  2809      0179          JR      Z,PROG3-$ ; CONTINUE IF 'C' ENTERED
 0253  18DF      0180          JR      PRG1A-$ ; IF NOT ,PRINT NEXT ERROR
 0255  3E00      0181 PRG2A    LD       A,0
 0257  D36A      0182          OUT     (HACTL),A
 0259  C30901    0183          JP      PPGO
 025C  CD3803    0184 PROG3    CALL    CRLF
 025F  2A2404    0185 PROG4    LD      HL,(OPR1) ; SET MEM START ADDR
 0262  ED5B2804  0186          LD      DE,(OPR3) ; SET PROM START ADDR
 0266  CDB502    0187 PROG5    CALL    PPROG   ; PROGRAM ONE BYTE
 0269  CD0404    0188          CALL    CONST
 026C  2807      0189          JR      Z,PROG5A-$
 026E  CD0C04    0190          CALL    CONIN
 0271  FE2E      0191          CP      '.'
 0273  2838      0192          JR      Z,PROG9-$
 0275  CD0F02    0193 PROG5A   CALL    ADCMP   ; INC ADDR & CHECK END
 0278  20EC      0194          JR      NZ,PROG5-$ ; FINISH THIS LOOP
 027A  3E00      0195 PROG6    LD      A,0
 027C  D36A      0196          OUT     (HACTL),A ; TURN OFF ALL CONTROL LINES
 027E  2A2404    0197 PROG6A   LD      HL,(OPR1) ; MEM START ADDR
 0281  ED5B2804  0198          LD      DE,(OPR3) ; PROM START ADDR
 0285  CDDA02    0199 PROG7    CALL    PREAD   ; READ PROM DATA
 0288  BE        0200          CP      (HL)
 0289  2007      0201          JR      NZ,PROG8-$ ; IF NOT MATCH,JUMP
 028B  CD0F02    0202 PRG7A    CALL    ADCMP   ; CHECK FOR END
 028E  20F5      0203          JR      NZ,PROG7-$
 0290  18C3      0204          JR      PRG2A-$ ; EXIT,COMPLETE
 0292  F5        0205 PROG8    PUSH    AF
 0293  E5        0206          PUSH    HL
 0294  211503    0207          LD      HL,MSG8
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

 0297  CD4703    0208          CALL    PTXT    ; "BAD LOCATION"
 029A  E1        0209          POP     HL
 029B  CD0404    0210          CALL    CONST
 029E  2807      0211          JR      Z,PROG8A-$
 02A0  CD0C04    0212          CALL    CONIN
 02A3  FE2E      0213          CP      '.'
 02A5  28AE      0214          JR      Z,PRG2A-$
 02A7  F1        0215 PROG8A   POP     AF
 02A8  CDE902    0216          CALL    PRTER   ; PRINT ERROR MESSAGE
 02AB  18DE      0217          JR      PRG7A-$ ; PRINT ALL BAD LOCATIONS
 02AD  211F03    0218 PROG9    LD      HL,MSG9
 02B0  CD4703    0219          CALL    PTXT    ; ABORTED
 02B3  18A0      0220          JR      PRG2A-$
                 0221 ;
                 0222 ;
                 0223 ;
                 0224 ; PULSE ONE PROM LOCATION
                 0225 ;
                 0226 ;
 02B5  CDE502    0227 PPROG    CALL    PADD    ; LATCH LSB OF ADDRESS
 02B8  7A        0228          LD      A,D
 02B9  F6C0      0229          OR      0C0H
 02BB  D36A      0230          OUT     (HACTL),A
 02BD  7E        0231          LD      A,(HL)  ; FETCH DATA
 02BE  D368      0232          OUT     (DATA),A ; OUTPUT DATA
 02C0  7A        0233          LD      A,D
 02C1  F6E0      0234          OR      0E0H    ; TURN ON PROG PULSE
 02C3  D36A      0235          OUT     (HACTL),A
 02C5  3E32      0236          LD      A,50
 02C7  CDD202    0237          CALL    DELAY   ; 50 MILLISEC DELAY
 02CA  7A        0238          LD      A,D
 02CB  F6C0      0239          OR      0C0H
 02CD  E6C7      0240          AND     0C7H    ; PROG PULSE OFF
 02CF  D36A      0241          OUT     (HACTL),A
 02D1  C9        0242          RET
                 0243 ;
 02D2  06BF      0244 DELAY    LD      B,191
 02D4  10FE      0245 DELAY1   DJNZ    DELAY1-$
 02D6  3D        0246          DEC     A
 02D7  20F9      0247          JR      NZ,DELAY-$
 02D9  C9        0248          RET
                 0249 ;
                 0250 ;
                 0251 ;
                 0252 ;
                 0253 ; READ ONE LOCATION OF PROM
                 0254 ;
                 0255 ;
 02DA  CDE502    0256 PREAD    CALL    PADD    ; LATCH LSB OF ADDRESS
 02DD  7A        0257          LD      A,D
 02DE  F640      0258          OR      40H
 02E0  D36A      0259          OUT     (HACTL),A
 02E2  DB68      0260          IN      A,(DATA)
 02E4  C9        0261          RET
                 0262 ;
                 0263 ;
                 0264 ; LATCH LOWER 8 BITS OF PROM ADDRESS
                 0265 ;
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

                 0266 ;
 02E5  7B        0267 PADD    LD      A,E
 02E6  D369      0268         OUT     (LADD),A
 02E8  C9        0269         RET
                 0270 ;
                 0271 ;
                 0272 ;
                 0273 ;
                 0274 ;
                 0275 ; PRINTS ADDR/BAD DATA/GOOD DATA
                 0276 ; OF ERROR LOCATION
                 0277 ;
                 0278 ;
 02E9  47        0279 PRTER   LD      B,A
 02EA  7A        0280         LD      A,D
 02EB  CD5303    0281         CALL    PACC    ; PRINT MSB OF ADDR
 02EE  7B        0282         LD      A,E
 02EF  CD5303    0283         CALL    PACC    ; PRINT LSB OF ADDR
 02F2  0E20      0284         LD      C,20H
 02F4  CD1704    0285         CALL    CONOUT
 02F7  78        0286         LD      A,B
 02F8  CD5303    0287         CALL    PACC    ; PRINT BAD DATA
 02FB  0E20      0288         LD      C,20H
 02FD  CD1704    0289         CALL    CONOUT
 0300  7E        0290         LD      A,(HL)
 0301  CD5303    0291         CALL    PACC    ; PRINT GOOD DATA
 0304  CD3803    0292         CALL    CRLF
 0307  C9        0293         RET
                 0294 ;
                 0295 ;
                 0296 ;
                 0297 ;
 0308  4E4F5420  0298 MSG7    DEFM    'NOT ERASED  '
       45524153
       45442020
 0314  03        0299         DEFB    03H
 0315  42414420  0300 MSG8    DEFM    'BAD LOC  '
       4C4F4320
       20
 031E  03        0301         DEFB    03H
 031F  41424F52  0302 MSG9    DEFM    'ABORTED'
       544544
 0326  03        0303         DEFB    03H
                 0304 ;
                 0305 ;
                 0306 ;
                 0307 ; TWDG-READ AND CONVERT 2 DIGITS TO BINARY
                 0308 ;
                 0309 ;
                 0310 ;
                 0311 ;
                 0312 ;
                 0313 ;
                 0314 ; ASCII TO BINARY CONVERSION
                 0315 ;
                 0316 ;
 0327  D630      0317 ASBIN   SUB     030H
 0329  FE0A      0318         CP      10
```

```
 ADDR   CODE      STMT SOURCE STATEMENT

 032B   F8        0319          RET     M
 032C   D607      0320          SUB     7
 032E   C9        0321          RET
                  0322 ;
                  0323 ;
                  0324 ;
                  0325 ;
                  0326 ;
```

```
ADDR  CODE      STMT SOURCE STATEMENT

                0328 ;
                0329 ;
032F  C5        0330 PASP   PUSH    BC
0330  CD5303    0331        CALL    PACC
0333  CD4203    0332        CALL    SPACE
0336  C1        0333        POP     BC
0337  C9        0334        RET
                0335 ;
                0336 ;
                0337 ;
0338  0E0D      0338 CRLF   LD      C,0DH
033A  CD1704    0339        CALL    CONOUT
033D  0E0A      0340        LD      C,0AH
033F  C31704    0341        JP      CONOUT
                0342 ;
                0343 ;
0342  0E20      0344 SPACE  LD      C,' '
0344  C31704    0345        JP      CONOUT
                0346 ;
                0347 ;
                0348 ;
                0349 ;
                0350 ;
                0351 ; PRINT TEXT
                0352 ;
                0353 ;
0347  7E        0354 PTXT   LD      A,(HL)  ; FETCH A BYTE
0348  FE03      0355        CP      3
034A  C8        0356        RET     Z
034B  4F        0357        LD      C,A
034C  CD1704    0358        CALL    CONOUT
034F  23        0359        INC     HL
0350  C34703    0360        JP      PTXT
                0361 ;
                0362 ;
                0363 ; PRINT ACCUMULATOR
                0364 ;
                0365 ;
0353  F5        0366 PACC   PUSH    AF
0354  0F        0367        RRCA
0355  0F        0368        RRCA
0356  0F        0369        RRCA
0357  0F        0370        RRCA
0358  CD5C03    0371        CALL    PRVAL
035B  F1        0372        POP     AF
                0373 ;
                0374 ;
035C  E60F      0375 PRVAL  AND     0FH
035E  C690      0376        ADD     A,90H
0360  27        0377        DAA
0361  CE40      0378        ADC     A,40H
0363  27        0379        DAA
0364  4F        0380        LD      C,A
0365  C31704    0381        JP      CONOUT  ; PRINT IT
                0382 ;
                0383 ;
                0384 ;
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

                 0385 ;
                 0386 ; CHECK FOR VALID HEX CHARACTER
                 0387 ;
                 0388 ;
 0368  FE30      0389 AORN    CP      '0'
 036A  380F      0390         JR      C,AORN2 ; JUMR IF < 30H
 036C  FE3A      0391         CP      '9'+1
 036E  3809      0392         JR      C,AORN1 ; JUMP IF < 3AH
 0370  FE40      0393         CP      'A'-1
 0372  3807      0394         JR      C,AORN2 ; JUMP IF < 'A'
 0374  FE47      0395         CP      'F'+1
 0376  D27B03    0396         JP      NC,AORN2 ; JUMP IF < 'G'
 0379  AF        0397 AORN1   XOR     A
 037A  C9        0398         RET             ; VALID DATA RET
 037B  AF        0399 AORN2   XOR     A
 037C  3C        0400         INC     A
 037D  C9        0401         RET             ; NOT HEX CHAR
                 0402 ;
                 0403 ;
                 0404 ; CHECK FOR TERMINATOR
                 0405 ;
                 0406 ; SPACE, COMMA, OR CARRIAGE RETURN
                 0407 ;
                 0408 ;
 037E  FE20      0409 TERMCK  CP      ' '
 0380  C8        0410         RET     Z
 0381  FE2C      0411         CP      ','
 0383  C8        0412         RET     Z
 0384  FE2E      0413         CP      '.'
 0386  CA8C03    0414         JP      Z,TCHK0
 0389  FE0D      0415         CP      0DH
 038B  C0        0416         RET     NZ
 038C  C5        0417 TCHK0   PUSH    BC
 038D  CD3803    0418         CALL    CRLF
 0390  C1        0419         POP     BC
 0391  AF        0420         XOR     A
 0392  C9        0421         RET
                 0422 ;
                 0423 ;
                 0424 ; SCAN FOR OPERAND FROM KEYBOARD
                 0425 ;
                 0426 ;
                 0427 ; EXIT WITH DATA IN HL, AND TERMINATOR
                 0428 ; IN C. IF VALID DATA, RETURN WITH
                 0429 ; ZERO FLAG SET. B CONTAINS # OF CHARACTERS ENTERED.
                 0430 ;
                 0431 ;
 0393  210000    0432 KEYIN   LD      HL,0
 0396  45        0433         LD      B,L
 0397  CDB003    0434 KEY1    CALL    ECHO
 039A  04        0435         INC     B       ; INC CHAR COUNT
 039B  CD7E03    0436         CALL    TERMCK
 039E  C8        0437         RET     Z       ; IF TERMINATOR, RETURN
 039F  CD6803    0438         CALL    AORN    ; VALID DATA CHECK
 03A2  C0        0439         RET     NZ      ; IF NOT RETURN
 03A3  79        0440         LD      A,C
 03A4  CD2703    0441         CALL    ASBIN   ; CONVERT TO BINARY
 03A7  29        0442         ADD     HL,HL
```

```
 ADDR  CODE      STMT SOURCE STATEMENT

 03A8  29        0443         ADD     HL,HL
 03A9  29        0444         ADD     HL,HL
 03AA  29        0445         ADD     HL,HL    ;p SHIFT 4 BITS
 03AB  85        0446         ADD     A,L
 03AC  6F        0447         LD      L,A
 03AD  C39703    0448         JP      KEY1
                 0449 ;
                 0450 ;
                 0451 ;
 03B0  CD0C04    0452 ECHO    CALL    CONIN
 03B3  4F        0453         LD      C,A
 03B4  C31704    0454         JP      CONOUT
                 0455 ;
                 0456 ;
                 0457 ;
 03B7  0E3F      0458 INVCMD  LD      C,'?'
 03B9  CD1704    0459         CALL    CONOUT
 03BC  3E2E      0460         LD      A,'.'
 03BE  322304    0461         LD      (NXCHR),A
 03C1  C9        0462         RET
                 0463 ;
                 0464 ;
                 0465 ;
                 0466 ;
                 0467 ;SCAN -- SCANS THE OPERANDS INPUT FROM THE
                 0468 ;  CONSOLE. THE OPERANDS ARE SAVED IN OP1,
                 0469 ;  AS THE ARGUMENTS TO EXECUTE THEIR COMMANDS.
                 0470 ;
 03C2  AF        0471 SCAN    XOR     A        ;INITIALIZE
 03C3  212404    0472         LD      HL,OPRS ;CLEAR OPERANDS
 03C6  E5        0473         PUSH    HL
 03C7  DDE1      0474         POP     IX       ;IX=POINTER TO OPERANDS
 03C9  77        0475         LD      (HL),A
 03CA  010900    0476         LD      BC,9
 03CD  112504    0477         LD      DE,OPRS+1
 03D0  EDB0      0478         LDIR
 03D2  322204    0479         LD      (OPCNT),A
 03D5  CD9303    0480 SCAN1   CALL    KEYIN    ; GET ONE OPERAND
 03D8  C2B703    0481         JP      NZ,INVCMD
 03DB  79        0482         LD      A,C
 03DC  322304    0483         LD      (NXCHR),A
 03DF  FE20      0484         CP      ' '
 03E1  2806      0485         JR      Z,SCAN2-$
 03E3  FE2C      0486         CP      ','
 03E5  2802      0487         JR      Z,SCAN2-$
 03E7  05        0488         DEC     B
 03E8  C8        0489         RET     Z        ; IF NO DATA, RET
 03E9  DD7500    0490 SCAN2   LD      (IX),L
 03EC  DD7401    0491         LD      (IX+1),H
 03EF  3A2204    0492         LD      A,(OPCNT)
 03F2  3C        0493         INC     A
 03F3  322204    0494         LD      (OPCNT),A
 03F6  DD23      0495         INC     IX
 03F8  DD23      0496         INC     IX       ; POINT TO NEXT OPR
 03FA  79        0497         LD      A,C
 03FB  FE20      0498         CP      ' '
 03FD  28D6      0499         JR      Z,SCAN1-$
 03FF  FE2C      0500         CP      ','
```

```
 ADDR   CODE      STMT SOURCE STATEMENT

 0401   28D2      0501          JR      Z,SCAN1-$
 0403   C9        0502          RET
                  0503 ;
                  0504 ;
 0404   DB00      0505 CONST    IN      A,(SSTAT)       ; CONSOLE STATUS
 0406   E602      0506          AND     RXRMSK
 0408   C8        0507          RET     Z
 0409   3EFF      0508          LD      A,0FFH
 040B   C9        0509          RET
                  0510 ;
 040C   CD0404    0511 CONIN    CALL    CONST           ; CONSOLE INPUT
 040F   CA0C04    0512          JP      Z,CONIN
 0412   DB01      0513          IN      A,(SDATA)
 0414   E67F      0514          AND     7FH
 0416   C9        0515          RET
                  0516 ;
 0417   DB00      0517 CONOUT   IN      A,(SSTAT)       ; CONSOLE OUTPUT
 0419   E604      0518          AND     TXRMSK          ; TX BFR EMPTY
 041B   CA1704    0519          JP      Z,CONOUT
 041E   79        0520          LD      A,C
 041F   D301      0521          OUT     (SDATA),A
 0421   C9        0522          RET
                  0523 ;
                  0524 ;
                  0525 ;
 >0422            0526 OPCNT    DEFS    1
 >0423            0527 NXCHR    DEFS    1
 >0424            0528 OPRS     DEFS    6
 >0424            0529 OPR1     EQU     OPRS
 >0426            0530 OPR2     EQU     OPRS+2
 >0428            0531 OPR3     EQU     OPRS+4
 >0524            0532 SPVAL    EQU     OPRS+100H
                  0533 ;
                  0534 ;
                  0535 ;
```

ADDR CODE STMT SOURCE STATEMENT

CROSS REFERENCE LISTING

SYMBOL	VALUE	TYPE	STMT	STATEMENT REFERENCES
ADCMP	020F		0138	0202 0193 0166 0125
AORN	0368		0389	0438
AORN1	0379		0397	0392
AORN2	037B		0399	0396 0394 0390
ASBIN	0327		0317	0441
CONIN	040C		0511	0512 0452 0212 0190
CONOUT	0417		0517	0519 0459 0454 0381 0358 0345 0341 0339 0289 0285
+				
CONST	0404		0505	0511 0210 0188
CRLF	0338		0338	0418 0292 0184 0112 0107 0079 0052 0047 0045
DATA	0068		0019	0260 0232 0173
DELAY	02D2		0244	0247 0237
DELAY1	02D4		0245	0245
ECHO	03B0		0452	0434 0175 0065
EXIT	E003		0017	0080
HACTL	006A		0021	0259 0241 0235 0230 0196 0182 0160 0128 0120 0078
+				0044
INVCMD	03B7		0458	0481
KEY1	0397		0434	0448
KEYIN	0393		0432	0480
LADD	0069		0020	0268
MSG1	015D		0090	0040
MSG4	0173		0093	0048
MSG5	0192		0095	0113 0053
MSG6	01B7		0097	0108
MSG7	0308		0298	0170
MSG8	0315		0300	0207
MSG9	031F		0302	0218
NXCHR	0423		0527	0483 0461 0116 0056
OPCNT	0422		0526	0494 0492 0479
OPR1	0424		0529	0197 0185 0161 0121
OPR2	0426		0530	0145
OPR3	0428		0531	0198 0186 0162 0122
OPRS	0424		0528	0532 0531 0530 0529 0477 0472
PACC	0353		0366	0331 0291 0287 0283 0281 0084
PADD	02E5		0267	0256 0227
PADDR	0155		0083	
PASP	032F		0330	0086
PPG	0100		0039	
PPG0	0109		0042	0183
PPG10A	0115		0047	0129 0111
PPG11	0124		0052	0058
PPROG	02B5		0227	0187
PREAD	02DA		0256	0199 0163 0123
PRG1A	0234		0166	0180
PRG2A	0255		0181	0220 0214 0204 0177
PRG7A	028B		0202	0217
PROG	0222		0159	0059
PROG1	022D		0163	0167
PROG2	023B		0169	0165
PROG3	025C		0184	0179 0168
PROG4	025F		0185	
PROG5	0266		0187	0194
PROG5A	0275		0193	0189

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 ADDR  CODE      STMT SOURCE STATEMENT

 PROG6  027A          0195
 PROG6A 027E          0197
 PROG7  0285          0199    0203
 PROG8  0292          0205    0201
 PROG8A 02A7          0215    0211
 PROG9  02AD          0218    0192
 PRTER  02E9          0279    0216 0174
 PRVAL  035C          0375    0371
 PTXT   0347          0354    0360 0219 0208 0171 0114 0109 0054 0049 0041
 RBOUT  0000          0022
 READ0  01E2          0112    0118
 READ1  0200          0123    0126
 READ2  01D3          0107    0046
 RENTRY 014C          0077    0067 0051
 RXRMSK 0002          0015    0506
 SCAN   03C2          0471    0115 0055
 SCAN1  03D5          0480    0501 0499
 SCAN2  03E9          0490    0487 0485
 SDATA  0001          0013    0521 0513
 SPACE  0342          0344    0332
 SPVAL  0524          0532    0042 0039
 SSTAT  0000          0014    0517 0505
 TBASE  0100          0018    0031
 TCHK0  038C          0417    0414
 TERMCK 037E          0409    0436
 TXRMSK 0004          0016    0518
 YORN   013A          0065    0110 0072 0050
ERRORS=0000
```