**PB1 2708/2716 Programmer & 4K/8K EPROM Board**

**Features:**

**System Compatibility**
- S-100 bus computer systems.

**EPROM Programmer**
- 2 separate programming sockets for 2708 or 2716 (5V) EPROMs.
- Meets all manufacturers data sheet requirements for programming.
- Programming voltage generated on board—no need for an external power supply.
- Programming sockets are DIP switch addressable to any 4K boundary.
- Software control of 2708/2716 programming selection—no hardware reconfiguration required.
- Provisions for 2 optional ZIP sockets from Textool for easier insertion and removal of EPROMs being programmed.
- Special safety features to prevent accidental programming include LED indicator for programming mode and an on-off switch for programming voltage.

**On-Board EPROMS**
- 4 separate sockets for 4K of 2708 or 8K of 2716 EPROMs.
- Addressable by DIP switch to any 4K or 8K boundary above 8000 Hex.
- Unused EPROM sockets do not enable data bus drive so the board is never committed to the full 4K or 8K of memory.
- Jumper selectable wait states (0 to 4) for fast or slow EPROMs.

**Software**
- Complete subroutines for checking EPROM erasure, programming and verification.

**ER Features**
- Address and data lines fully buffered.
- Solder masked PC board with gold plated edge connector contacts.
- Low profile sockets provided for all ICs.
- Power requirements: +8V @ 500ma, +16V @ 25ma (less EPROM), -16V @ 5ma (less EPROM).

We used to be Solid State Music. We still make the blue boards.
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ASSEMBLY DRAWING
PARTS LIST
SCHEMATIC
PB1 EPROM PROGRAMMER BOARD

1.0 ASSEMBLY INSTRUCTIONS (refer to figure 1)

☐ Check kit contents against parts list.

☐ Check PC board for possible warpage and straighten if required. To straighten the board, bend with the hands (not a vise) against the warp. Sight down the edge of the board after bending to check if the warp was removed, if not then try bending again.

☐ Insert 11-16 pin sockets (U1-6,16,19,20,27,28) and 11-14 pin sockets (U7-10,15,18,21,24,29,32) into the component side of the board with the pin 1" index toward the top of the board. (The component side is the side on which "PB1" is printed.) Do NOT insert 2-24 pin sockets into the two horizontal 24 pin patterns at the upper left-hand corner of the board. Insert 4-24 pin sockets into the middle of the board with "pin 1" toward the top of the board.

☐ Place a flat piece of stiff cardboard of appropriate size on top of the board to hold them in place.

☐ Holding the cardboard in place against the sockets, turn the board over and lay it on a flat surface. (Be sure that all of the socket pins are through the holes.)

☐ On each socket, solder two of the corner pins, choosing two that are diagonally opposite of each other.

☐ Once the sockets are secured, lift the board and check to see if they are flat against the board. If not, seat the sockets by pressing on the top while reheating each soldered pin.

☐ Complete soldering the remaining pins of each socket. Keep the iron tip against the pin and pad just long enough to produce a filet between pin and pad.

☐ Insert and solder 2-2.2 ohm resistors (R37A & R37B).

☐ Insert and solder:

2- 470 ohm (R16 & R20)
1- 1.2K ohm (R38)
4- 3.3K ohm(R3,R5,R17,R34)
2- 4.7K ohm (R7,R25)
1- 6.8K ohm (R24)
3- 10K ohm (R2,R6,R35)
1- 20K ohm (R18)
3- 51K ohm (R19,R21,R22)

☐ Insert:

2- 2.7K ohm (R41 & R42) (near SW3)
1- 47K ohm (R1) (near U22)
These parts must be mounted vertically on the board with the top lead bent back down along the part. Solder.

- Insert and solder:
  - 6- 2.7K ohm (R8,R23,R33,R39,R40,R43)
  - 1- 47K ohm (R4)

- Insert and solder 2-2.7K ohm SIPs (R9-15,R26-32).

- Insert and solder 1-50K trim-potentiometer (R36).
  Set knob to mid scale or full clockwise rotation. You can save a step if you make the resistance setting of (R36). As stated in the second sentence of 2.4 at this time.

- Insert and solder:
  - 1- 15pf (C2)
  - 3- 220pf (C7,C27,C37)
  - 1- 330pf (C26)
  - 1- 0.001uf (C8)
  - 18- 0.1uf (C4,C5,C9-C15,C19)
  - (C21-C25,C33,C35,C36)

- Observing polarity, insert and solder 3.3uf timing capacitor (C6).

- Insert:
  - 2- 0.27/0.74uf (C18,C28)
  - 1uf (C3,C20)
  - 4.7uf (C30,C31,C32,C34)
  - 2- 22uf (C16,C29)
  - 1- 47uf Dip (C17)
  - 1- 1000uf (C1)

Observing polarity, (marked with plus sign) and solder.
1.0 ASSEMBLY INSTRUCTIONS (continued)

Insert and solder 1 diode and 1 LED (light-emitting diode). The Diode (D1) should have its banded end to the right. The LED (D2) should be mounted with the positive lead to the right.

- Insert and solder 1-220μH coil (L1).
- Insert and solder 8 transistors (Q1 thru Q8) (observe emitter orientation).
- Insert and solder 2-8 position dip switches (SW2 & SW3) and 1 SPST PC board switch (SW1).

If you are using Textool sockets for programming, insert and solder 2-24 pin sockets with the levers pointing toward the right side of the PC board. If you are not going to use Textool sockets, then insert and solder two standard 24 pin sockets into the upper left-hand side of the board.

- Carefully bend the leads of the 3 voltage regulators to the proper PC board mounting configuration. (U30, U31 U33)

- Mount each regulator along with a heatsink to the PC board using a 6-32 X 3/8" screw, #6 lock-washer and nut. Note that the nut is on the component side of the board.

- Solder all leads of the 3 voltage regulators.

  NOTE: U30, U31 & U33 are different voltage ratings, don't mix-up these regulators when installing.

- Do not install any IC's at this time.
2.0 FUNCTIONAL CHECK

WARNING! DO NOT INSTALL OR REMOVE BOARD WITH POWER ON. DAMAGE TO THIS AND OTHER BOARDS COULD OCCUR.

2.1 If an ohmmeter is available, measure the resistance between the following pins:

<table>
<thead>
<tr>
<th>Negative Probe</th>
<th>Positive Probe</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus pin 50</td>
<td>Bus pin 1</td>
<td>greater than 20</td>
</tr>
<tr>
<td>Bus pin 50</td>
<td>Bus pin 2</td>
<td>greater than 20</td>
</tr>
<tr>
<td>Bus pin 52</td>
<td>Bus pin 50</td>
<td>greater than 30</td>
</tr>
</tbody>
</table>

If your reading is below these values, check for electrical shorts on your card.

2.2 Apply power (+8v to +10v) to board by plugging into the computer or by connection to a suitable power supply. Measure the output of the +5v regulator (U30).

The voltage should be between +4.8v and +5.2v. If the regulator doesn't meet this test, then check the board for shorts or errors.

CAUTION: WHILE IT HAS NEVER HAPPENED TO US, SHORTED REGULATORS HAVE BEEN KNOWN TO EXPLODE WITH POSSIBLE INJURY TO EYES OR HANDS. BETTER SAFE THAN SORRY --- KEEP FACE AND HANDS CLEAR OF THE REGULATOR SIDE OF THE BOARD DURING THIS TEST.

2.3 Apply power +14v to +19v to Bus pin 2 and -14v to -19v to Bus pin 52 with Bus pin 50 ground. Verify that the outputs U31 and U33 are about +12 volts and -5 volts respectively.

2.4 Remove power from the board. Set trimpot R36 to less than 5K ohm, when measured with an ohmmeter between U32, pin 1 & U32, pin 6. Insert U32. Apply power and adjust R36 until the output of the DC-DC converter reads +26.5v (C1, plus lead end with respect to ground).

2.5 Remove power and insert the remaining IC's (except EPROMs). Apply power and again measure the outputs of +5v, +12v and -5v regulators.

2.6 Set DIP switch SW2 to decode an unused 4K block of memory and an unused I/O port for the programming sockets. Temporarily jumper the board for one wait state. Refer to section 3 for jumper and switch settings.

2.7 Examine any memory location in the selected 4K block and verify that the LED is off.

2.8 Output 01 to the selected I/O port and verify that the LED is on. Repeat step 7 to verify the LED goes out.
2.0 FUNCTIONAL CHECK (continued)

2.9 Output 02 to the selected I/O port and verify that the LED is on. Repeat step 7 to verify the LED goes out.

2.10 Verify that SW1 is in the off position. Place a 2708 with known data into the socket for U22 and examine the selected 4K memory block. The data should repeat four times in the 4K boundary.

2.11 If available place a 2716 with known data into the socket for U23 and examine the selected 4K block. The data should repeat twice.

2.12 Remove any EPROMs from the sockets for U22 and U23. With the sockets empty, follow the procedures in section 4 for programming a 2708 and then a 2716. Check the programming time for each EPROM type. If an oscilloscope is available check for the following program pulse waveforms.

```
+26v

  0v
  .5 to .7 msec
   2708 (pin 18)

+5v

  0v
  45 to 55 msec
   2716 (pin 18)
```

2.13 If you have been able to verify the above steps, then you are ready to program EPROMs.

2.14 If you have decided to use the on-board 2708 or 2716 EPROM area, set DIP switch SW3 to decode an unused 4K (2708) or 8K (2716) memory block. Jumper the board for the type of EPROM selected. Refer to section 3 for jumper and switch settings.

2.15 Place an appropriate EPROM (2708 or 2716) with known data successively into the sockets U11 through U14 and examine the respective 1K or 2K memory block. Select one or more wait states if required.

2.16 Finally, to test the on-board EPROM memory disable circuit, set DIP switch SW3 to decode a currently used memory area (RAM or ROM) in your system. Remove all EPROMs to simplify this test. Exercise this memory area and verify that no conflicts arise.
3.0 SET-UP

3.1 Address Selection of Programming Sockets
The PB-1 card reserves a 4K block of memory for the programming sockets. This block can be set to any 4K boundary using DIP switch SW2 positions 1 through 4.

<table>
<thead>
<tr>
<th>Starting Address</th>
<th>A15</th>
<th>A14</th>
<th>A13</th>
<th>A12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decimal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW2 - 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW2 - 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW2 - 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW2 - 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OFF = SWITCH OPEN
ON = SWITCH CLOSED

3.2 Selection of Memory Block Containing Data to be Programmed
The PB-1 card can receive a program or data from any section of memory into EPROM except for the 4K block addressing the programming sockets. Any part of the block of on-board read-only EPROMs can also be used, allowing for very convenient copying of EPROMs. The high order byte of the starting address of the data is contained at location 10D of the program (see software in section 4.0), while the low order byte is at location 10C.

3.3 Origin of System Monitor
The programs in section 4 end with a jump to the system monitor at location F021 (entry address of SSM $0800$ monitor). To adapt this to the origin of your system monitor enter the low byte of this origin at program location $11F$ and the high byte at location $120$. If the user does not want this feature replace the last instruction with a halt.

<table>
<thead>
<tr>
<th>Loc</th>
<th>Code</th>
<th>Mnemonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>$11E$</td>
<td>76</td>
<td>HLT</td>
</tr>
</tbody>
</table>
3.4 Output Port Address Selection

To enable programming, data must be written to an output on the PB-1 card. This port can be set to any one of 16 addresses using DIP switch SW2 positions 5 through 8.

Port Address

<table>
<thead>
<tr>
<th>Hex</th>
<th>Decimal</th>
<th>SW2 - 5</th>
<th>SW2 - 6</th>
<th>SW2 - 7</th>
<th>SW2 - 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>0</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>10</td>
<td>16</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>20</td>
<td>32</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>30</td>
<td>48</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>40</td>
<td>64</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>50</td>
<td>80</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>60</td>
<td>96</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>70</td>
<td>112</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>80</td>
<td>128</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>90</td>
<td>144</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>A0</td>
<td>160</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>B0</td>
<td>176</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>C0</td>
<td>192</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>D0</td>
<td>208</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>E0</td>
<td>224</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>F0</td>
<td>240</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

NOTE: The port address must differ from the high order byte of the address of the programming sockets.

3.5 Selection of EPROM Type

Four sockets for on-board read only memory are provided. These sockets are jumper selectable for 2708 or 2716 (5 volt) operation. To select this area install the following jumpers:

2708
A-E (A10)  B-E (A11)
B-D (A11)  C-D (A12)
F-H (-5v)  F-G (+5v)
J-K (+12v)  J-L (A10)

2716

3.6 Address Selection of EPROM Area For 2708's

The PROM area is addressable to any 4K (2708) boundary above 8000 (HEX) using DIP switch SW3. (Be sure jumpers installed per 3.5).

OFF = SWITCH OPEN   ON = SWITCH CLOSED

Set SW3-1 to "OFF".

<table>
<thead>
<tr>
<th>ADDRESS</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>A000</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>C000</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>E000</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>
3.6 Address selection of EPROM Area for 2708's (continued)

<table>
<thead>
<tr>
<th>Address</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>B000</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>D000</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>F000</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

3.7 Address Selection of EPROM Area for 2716's

The PROM area is addressable to any 8K (2716) boundary above 8000 (Hex) using DIP switch SW3. (Be sure jumpers installed per 3.5).

OFF = SWITCH OPEN  ON = SWITCH CLOSED

Set SW3-1 to 'on'

<table>
<thead>
<tr>
<th>Address</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>A000</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>C000</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>E000</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

3.8 EPROM Socket Disable

The PB-1 board is equipped with automatic disable circuitry for unused PROM sockets. The user can have only 1 or 2K of active PROM area by inserting just one or two 2708's, the unused sockets will automatically disable the card from the data bus. This means you can have a RAM area at an address within the range of the PB-1 block if there is no PROM in the socket at that address.

If you do not need the on-board 4K/8K EPROM area, but just the two programming sockets, then switch SW3 - 4, 5, 6, & 7 to OFF (open) to disable all four sockets.

3.9 Wait State Selection

The PB-1 can be set for zero to four wait states. These refer to read operations only on either the programming sockets or the read only area. To select wait states connect the following jumpers:

Wait States

<table>
<thead>
<tr>
<th>Jumpers</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-S</td>
<td>S-T,Q-P</td>
<td>S-T,Q-O</td>
<td>S-T,Q-n</td>
<td>S-T,Q-M</td>
<td></td>
</tr>
</tbody>
</table>

3.10 Ready Line Selection

The PB-1 requires the use of the READY signal to the CPU for programming and wait states (if used). To add flexibility, the user can select S-100 bus pin 3 or 72.

PRDY-(bus pin 3)\[PRDY:\]

WRDY-(bus pin 72)\[WRDY:\]

Jumper U-V\[Jumper U-V:\]
Be sure the CPU board is set-up for wait-states per page 21 of the North Star Manual. Set-up J2 option by installing jumper J1W. If the CPU isn't set-up for wait-states, then the programming time will be a couple of seconds which will not program an EPROM.
4.0 PROGRAMMING

4.1 Step by Step Procedure

4.1.1 Make sure the programming sockets are empty, SW1 is off (switch lever to the right side), and the LED is off. If the LED is on, perform a read command with your monitor for a location in the programming socket address block.

4.1.2 Make sure the data you wish to program is in memory.

4.1.3 Insert the EPROM in the appropriate socket - U22 for 2708, U23 for 2716. Verify it is erased. (Section 4.4)

4.1.4 Enter the program of section 4.2 or 4.3 at location 100H. Modify the starting address of the memory to be copied to match where your data is located. (Section 3.2)

4.1.5 Turn SW1 to the ON position.

4.1.6 You are now ready to program the EPROM. Execute the routine at location 100.

4.1.7 During programming the LED should be lit. Programming time for the 2708 should be about 160 seconds, for the 2716, 100 seconds. After programming is complete the LED will turn off and control will be returned to your monitor.

4.1.8 Turn off SW1.

4.1.9 Verify the data was programmed correctly by comparing data in memory to data in EPROM. (Section 4.5)
; A SIMPLE ROUTINE FOR PROGRAMMING 2708'S.
; COPYRIGHT BY SOLID STATE MUSIC, 1978

; REGISTER USAGE:
; REG.A....PASS DATA FROM MEMORY TO THE PROGRAMMER
; REG.B....REPEATED PROGRAMMING CYCLES
; REG.C....SIZE = 256(REG.C +1)
; REG.DE....ROM CARD ADDRESS
; REG.HL....DATA ADDRESS TO BE COPIED

0100  LOC EQU 10EH
0103  PROM EQU @D000H ; PROGRAMMING SOCKET
0106  RAM EQU @8000H ; DATA TO BE COPIED
0109  CPORT EQU 10H ; CONTROL PORT FOR PBI
010C  MONIT EQU @F021H ; EXIT ADDR. SET BY USER.

0100  ORG LOC

; START OF PROGRAM.
; INITIALIZE BOARD.
0108  3E01  PROG0: MVI A, 01 ; S1 = 2708 ROM
010B  D310  OUT CPORT ; PRESET BOARD

; SET UP PARAMETERS.
; NUMBER OF PROGRAMMING CYCLES
0104  06FF  MVI B, 0FFH ; 256 CYCLES FOR 2708

; NUMBERS OF BYTES = 256(C +1)
0106  0E03  MVI C, 03 ; 103 = 2708

; SET UP ADDRESSES FOR TRANSFER
0108  1100D7  PROG1: LXI D, PROM
010B  210040  LXI H, RAM

; PROGRAM THE EPROM.

; PROG1
010E  7E  MOV A, M
010F  12  STAX D
0110  13  INX D
0111  23  INX H
0112  7A  MOV A, D
0113  A1  ANA C
0114  83  ORA E
0115  C20E01  JNZ PROG2
0118  05  DCR B
0119  C20E01  JNZ PROG1
011C  1A  DCR D
011D  1A  LDAX D ; RESET PBI
011E  C321FD  JMP MONIT ; BACK TO MONITOR

0000  END
; A SIMPLE ROUTINE FOR PROGRAMMING 2716'S.
; COPYRIGHT BY SOLID STATE MUSIC. 1978

; REGISTER USAGE:
; REG.A....PASS DATA FROM MEMORY TO THE PROGRAMMER
; REG.B....REPEATED PROGRAMMING CYCLES
; REG.C....SIZE = SIZE = 256 (REG.C + 1)
; REG.DE....PROM CARD ADDRESS
; REG.FL....DATA ADDRESS TO BE COPIED

0100   LOC     EQU  130H
0200   PROM    EQU  35000H ; PROGRAMMING SOCKET
0400   RAM     EQU  4002H ; DATA TO BE COPIED
0510   CPRT    EQU  186H ; CONTROL PORT FOR PBI
F021   MONIT   EQU  6F021H ; EXIT ADDR. SET BY USER.

0109   ORG     LOC

; START OF PROGRAM.
; INITIALIZE BOARD.
0100 3E02   PROG1: MOV A, C
0102 D310   OUT CPRT ; PRESET BOARD

; SET UP PARAMETERS.
; NUMBER OF PROGRAMMING CYCLES
0104 0601   MOV A, 331 ; 1 CYCLE FOR 2716

; NUMBERS OF BYTES = 256 (C+1)
0106 0E07   MOV A, C+7 ; 107 = 2716

; SET UP ADDRESSES FOR TRANSFER
0108 1100D0   PROG2: LXI D, PROM
010B 210040   LXI H, RAM

; PROGRAM THE PROM.
010E 7E     PROG3: MOV A, M
0110 12      STAX D
0110 13      INX D
0111 23      INX H
0112 7A      MOV A, D
0113 A1      ANA C
0114 B3      BPL B
0115 C20E01   JNZ PROG2
0118 05      DCR D
0119 C20E01   JNZ PROG1
011C 1B      DCX D
011D 1A      JNCX B ; PRESET PBI
011E C321F0   JMP INCY, 700H TO MONITOR

0000   END
A SIMPLE ROUTINE FOR CHECKING IF THE EPROM IS ERASED. PRINTS P=PASS, F=FAIL.
COPYRIGHT BY SOLID STATE MUSIC, 1978

REGISTERS USED:
REG A......TEST AND PASS A CHARACTER
REG B......NOT USED
REG C......SIZE
REG DE......PROM CARD ADDRESS
REG HL......NOT USED

0140   LOG EQU 140H
0300   PROM EQU 0D000H ;PROGRAMMING SOCKET
F021   MONIT EQU 0F021H ;EXIT TO USER
F009   CO EQU 0F009H ;CONSOLE OUT ROUTINE
0143   ORG LOG

;CHECKING EPROM START.

0148 0E03   ERASE: MVI C,03 ;03=2708, 07=2716
0142 100D0   LXI D,PROM ;EPROM ADDRESS
0145 1A   ERI: LDAX D ;READ EPROM
0146 13   INX D
0147 FEFF   CPI 0FFH ;TEST FOR ERASE
0149 3E46   MVI A,'F' ;FAIL CHARACTER
014A C25601   JNZ ERROR
014E 7A   MOV A,D
014F A1   ANA C
0150 83   ORA E ;DONE YET?
2131 C24501   JNZ ERI
0154 3E50   MVI A,'P' ;PASS CHARACTER
0156 4F   ERROR: MOV C,A

;OUTPUT ROUTINE CALLS USER MONITOR ENTRY
;POINT FOR CONSOLE OUTPUT. DATA IS IN REG.-C.
;BE SURE TO CHANGE THIS TO MEET YOUR NEEDS.
0157 CD09F0   CALL CO
015A C321F0   JMP MONIT

0000   END
; A SIMPLE ROUTINE FOR VERIFYING THE ORIGINAL
; SOURCE DATA IN MEMORY AGAINST THE EPROM COPY.
; PRINTS P=PASS, F=FAIL.
; COPYRIGHT BY SOLID STATE MUSIC, 1978

; REGISTER USAGE:
; REGA...TEST AND PASS CHARACTERS
; REGB...ORIGINAL DATA
; REGC...SIZE SIZE=256(REGC +1)
; REGD...PROM CARD ADDRESS
; REGE...ADDRESS OF ORIGINAL

3183 LOC EQU 180H
3000 PROM EQU 0D000H ;PROGRAMMING SOCKET
3488 RAM EQU 4000H ;ORIGINAL DATA ADDRESS
3281 MONIT EQU 0F021H ;EXIT TO USER
3289 CO EQU 0F009H ;CONSOLE OUTPUT

3132 ORG LOC

; START OF VERIFY
3163 0E83, VERFl: MVI C, 03 ;E3=2788, C7=2716
3182 1100D0 LXI H, PROM ;SOCKET ADDRESS OF COPY
3185 210040 LXI H, RAM ;POINT TO RAM MASTER
3188 46 VERFl: MQV B, M ;GET ORIGINAL DATA
3189 1A LDAX D
318A 13 INX D
318B 23 INX H
318C B8 CMP B ;ARE THEY ALIKE?
318D 3E46 MVI A, 'F'
318F C29A01 JNZ ERROR
3192 7A MOV A, D
3193 61 ANA C
3194 B8 ORA E
3195 C2801 JNZ VERFl ;GO BACK FOR NEXT BYTE
3198 3E50 MVI A, 'P'

; OUTPUT ERROR CHARACTER.
319A 4F ERROR: MOV G, A
319B CD09F0 CALL CO ;OUTPUT IT.
319E C321F0 JMP MONIT

4000 END
5.0 TROUBLESHOOTING HINTS

5.1 Check for proper setting of the DIP switches and jumper arrangements.

5.2 Verify that all IC's are in the correct sockets.

5.3 Visually inspect all IC's to be sure that pins are in the sockets and not bent under the IC.

5.4 Verify that the output voltage of each regulator is correct. (See section 2.0)

5.5 Inspect back side of the board for solder bridges. Run a small sharp knife blade between traces that appear suspicious.

5.6 If you have an addressing problem:
   a. Check the address line buffers U1, U2 & U3 for shorts, or opens to the sockets or a defective IC.
   b. Check the address decoders U16, U18, U24 & U26 for shorts, or opens to the sockets or a defective IC.
   c. Check general logic U6, U10 or U21 for shorts, or opens to the sockets or a defective IC.

5.7 If incorrect data is transferred on a read (or write):
   a. Check the data buffers U4, U5 & U6 for shorts, or opens to the socket or a defective IC.
   b. Check general logic U7, U8 & U9 for shorts, or opens to the socket or a defective IC.

5.8 If you can read a PROM in the programming socket, but cannot program it:
   a. Check the DC-to-DC converter (U32) for the correct voltage (+26.5 volt) on C1 the + end. Check if the voltage drops out of regulation when you are programming a PROM, and if so, inspect the circuitry around U32 for shorts or opens.
   b. Check pin 18 of U22 & U23 for the correct pulse widths during programming (refer to 2.12 for pulse widths).

5.9 If the PBI puts the computer into an infinite wait-state:
   a. PSYNC signal on the bus is very noisy, and presets U29 for additional wait-states. This condition can be corrected in some mainframes by adding a 1000pf filter capacitor between U29, pin 10 and U29, pin 7 on the back of the board.
   b. U28, pin 12 is not changing states. Check U27 & U28 monostables for correct operation.
6.0 THEORY OF OPERATION

6.1 Usage

1) U1-U3 (Hex Tri-state buffers 74LS367) are used to buffer the address lines onto the card and RDY onto the bus.

2) U4-U6 (Hex Tri-state buffers 74LS367) are used to buffer the data bus and various other signals (address decode, SW0 status).

3) U7 (Hex inverter 74LS04) is used to buffer various signals on the card and drive the LED.

4) U9 (triple 3 input NAND 74LS10) is used to enable or reset the programming flip flop and to generate the data output enable for memory read.

5) U9 (triple 3 input AND 74LS11) is used to enable the data set-up one shot, enable the wait state circuit U20, and buffer SEMER onto the board.

6) U10 (triple 3 input NAND 74LS10) is used to form part of the programming flip flop, generate CS to the programming sockets and to enable the PROM block decoder, U16.

7) U11-U14 are the sockets for 4K of 2708 or 8K of 2716 read-only-memory.

8) U15 (8 input NAND 74LS30) is a detector for 1F (Hex) bytes.

9) U16 (Dual 1 of 4 decoder 74LS139) decodes the address of the U11-U14 PROM block.

10) U17 (D1P switch) selects the address for the PROM block.

11) U18 (Quad 2 input NOR open collector 7433) decodes the 4 LSB of the output port address and enables the RDY buffer.

12) U19 (Quad latch 74LS175) latches data bits 0 and 1 to select 2708 or 2716 programming circuitry.

13) U20 (4-bit register 74LS179) generates read cycle wait-states for the PROMs.

14) U21 (Quad 2 input NAND 74LS00) forms part of the programming flip flop, buffers 02 and gates wait-state signals to the buffer (U3).

15) U22 2708 programming socket.

16) U23 2716 programming socket.

17) U24 (Quad 2 input exclusive-OR 74LS10) is used to decode an address to enable the programming socket.

18) U25 is an addressing bit for U24. The upper four switch positions address the programming sockets. The lower four positions address the programming flip flop.
19) U26 (Quad 2 input exclusive-or, 74LS136) is used to decode a 4K block for the programming sockets.

20) U27, U28 (Dual one shot, 74LS123) control set-up, hold and programming pulse times for 2708, 2716.

21) U29 (Dual flip flop 74LS74) controls wait-state circuitry for read and programming cycles.

22) U30 +5 volt regulator.

23) U31 +12 volt regulator.

24) U32 (DC to DC converter TL497) generates +26.5V programming voltage.

25) U33 -5 volt regulator.
6.2 Operation

Addressing

The P81 has three address circuits:

a) Addressing for the programming sockets (U22 & U23).
   b) Addressing for on-board PROM (U11 thru U14).
   c) One I/O port for PROM select (2708 vs. 2716).

U26 is used to decode a 4K boundary of memory for the two programming sockets. The output of U26 is buffered by U6, pin 14, and is sent U10, pin 4, to control the chip select of U22 & U23 and also can reset the programming flip-flop by enabling U8, pin 3, for a SMEMR cycle.

U16 generates four chip select signals for PROMs U11 thru U14 by setting the jumpers A thru E and the DIP switch SW3 (U17). Address line A15 must be a one to U16, pin 10 to enable U16, so the valid PROM addresses are any 4K or 8K boundary from 8000 Hex to F000 Hex.

U24 decodes the programming flip-flop's I/O address. U18 pins 2, 3, 11 & 12 must be zero to enable the output of U24. U18 detects if A6 thru A3 is zero and then U24 decodes the upper four address lines, A4 thru A7. The programming flip-flop can therefore be addressed to any Hex port where the lower digit is zero (like port 00, 10, 20, 30, etc.).

Programming

Programming is controlled by a flip-flop made up of U10, pin 12 and U21, pin 8. Power-on-clear (bus pin 99) will reset the programming flip-flop to a non-programming mode, and also a memory read cycle to the programming sockets.

When U8, pin 11 receives a logic one (valid I/O address), U8, pin 10 gets a write pulse and U8, pin 9 detects the status for an output instruction, then the programming flip-flop is set. The LED (D2) turns on to indicate the flip-flop is set.

U8, pin 8 which sets the programming flip-flop also clocks a couple of 8-bit flip flops (U19) to save data bits D0 & D1 which will be used later to control a monostable U27.

U19 controls the clear lines of U27 (Dual monostable). If U19 receives a 01 Hex code, then U27, pin 13 is held reset and U27, pin 5 is allowed to give 0.6 ms pulses to program a 2708 EPROM. If U19 receives a 02 Hex code, then U27, pin 5 is held reset and U27, pin 13 is allowed to give 50 ms pulses to program a 2716 EPROM. Therefore outputting a binary code to the programming flip-flop port also sets which PROM will be programmed.

If the programming flip-flop is set, a write instruction (SW0) to the programming socket address area will produce a logic one on U9, pin 6 which triggers U28, pin 2, starting the setup time. The end of the setup pulse from U28 triggers U27, pin 5 or U27, pin 13 depending on which is not cleared. U27, pin 13 generates the programming pulse for the 2708 on U23, pin 18. U27, pin 5 generates the programming pulse for the 2716 and is level shifted by Q1, Q2 & Q3 to produce a high voltage programming pulse on U22, pin 18. The trailing edge of either programming pulse triggers U28, pin 12 to generate a negative pulse to release the processor to proceed to the next data byte, therefore controlling the data hold time.
6.2 Operation (continued)

**Wait Circuitry**
The wait-state cycles for reading any of the on-board PROM is controlled by
U20 which is connected up to act like a four bit shift register. PSYNC re-
sets this shift register, then \( Q_2 \) is used as a clock to shift a one through
the register. The number of wait-state cycles is selected by a jumper to one
of the shift register's stages. The two D-flip flops (U29) are preset by
PSYNC to a logic 1. U29, pin 9 controls programming wait cycles and U29, pin
5 controls the memory read wait cycles. U29's outputs are combined by U21
to make a wait-request signal which can be enabled or disabled by U18, pin
10.

In the programming mode, U20 is inhibited and the wait-state period ends at
the completion of the data hold time which is signified by the rising edge
of a logic signal on U29, pin 11. In the memory read mode, U20 is enabled
and the wait cycles are shifted out until a rising logic state is sent to U29,
pin 3. (Jumper T to S must be connected for read wait-states.)

**Programming Voltage**
The programming voltage is generated by a switching power supply designed
around U32. The current is stored in C1 (1000mfd) and the capacitor is charg-
ed to+26.5Vfor programming. The switch SW1 is used to pass on the programming,
voltage to the PROMs to allow for manual defeat to prevent accidental pro-
gramming. The programming voltage drives a pulse shaping circuit (Q1, Q2 & Q3)
(for 2708's) and an enable circuit (Q4 & Q5) (for 2716's) for the high voltage
to U22 & U23. During the programming mode, Q6, Q7 & Q8 control the CS pin of
U22, which is at +12V during programming, +5V when not selected and +0V when
selected for reading.
7.0 Warranty

SSM warrants its products to be free from defects in materials and/or workmanship for a period of 90 days for kits and bare boards, and one (1) year for factory assembled boards. In the event of malfunction or other indication of failure attributable directly to faulty workmanship and/or material, then, upon return of the product (postage paid) to SSM at 2116 Walsh Ave., Santa Clara, California, 95050 "Attention Warranty Claims Department", SSM will, at its option, repair or replace the defective part or parts to restore said product to proper operating condition. All such repairs and/or replacements shall be rendered by SSM without charge for parts or labor when the product is returned within the specified period of the date of purchase. This warranty applies only to the original purchaser.

This warranty will not cover the failure of SSM products which at the discretion of SSM, shall have resulted from accident, abuse, negligence, alteration, or misapplication of the product. While every effort has been made to provide clear and accurate technical information on the application of SSM products, SSM assumes no liability in any events which may arise from the use of said technical information.

This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability and fitness for use. In no event will SSM be liable for incidental and consequential damages arising from or in any way connected with the use of its products.
### PBI Parts List

#### Chip Pack

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<th>Quantity</th>
<th>Part</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>U21</td>
<td>74LS00</td>
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<tr>
<td>1</td>
<td>U7</td>
<td>74LS04</td>
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<tr>
<td>2</td>
<td>U8, U10</td>
<td>74LS10</td>
</tr>
<tr>
<td>1</td>
<td>U9</td>
<td>74LS11</td>
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<td>U15</td>
<td>74LS30</td>
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<tr>
<td>1</td>
<td>U18</td>
<td>74LS33/7433</td>
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<td>U29</td>
<td>74LS74/7474</td>
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<td>2</td>
<td>U27, U28</td>
<td>74123</td>
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<td>2</td>
<td>U24, U26</td>
<td>74LS136</td>
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<td>U16</td>
<td>74LS139</td>
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<td>U20</td>
<td>74LS173/74173</td>
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<td>U19</td>
<td>74LS175</td>
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<td>6</td>
<td>U1-U6</td>
<td>74LS367/74367</td>
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<td>1</td>
<td>U32</td>
<td>TL497; DC-DC converter</td>
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#### Socket Pack

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<tr>
<td>1</td>
<td>SW1</td>
<td>SPST PCB Switch</td>
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<tr>
<td>2</td>
<td>SW2 (U25), SW3(17)</td>
<td>8 Position DIP Switch</td>
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<td>1</td>
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<td>14 Pin Sockets</td>
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<td>16 Pin Sockets</td>
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<td>24 Pin Sockets</td>
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<td>2</td>
<td>U22, U23</td>
<td>24 Pin Sockets (Regular or Textool)</td>
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<tr>
<td>1</td>
<td>D1</td>
<td>1N4001/1N4002/1N4003 Diode</td>
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<td>1</td>
<td>D2</td>
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<td>8</td>
<td>Q1-Q8</td>
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#### Hardware Pack

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<td>U30</td>
<td>340T-5/7805 Regulator I.C.</td>
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<td>U31</td>
<td>340T-12/7812 Regulator I.C.</td>
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<td>320T-5/7905 Regulator I.C.</td>
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<td>C2</td>
<td>15pF Ceramic Cap. (Radial)/20pF Ceramic Cap (Radial)</td>
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<tr>
<td>3</td>
<td>C7, C27, C37</td>
<td>220pF Ceramic Cap. (Radial)</td>
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<td>C26</td>
<td>330pF Ceramic Cap. (Radial)</td>
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<td>1</td>
<td>C8</td>
<td>.001uF Ceramic Cap. (Radial)</td>
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<td>18</td>
<td>C4, C5, C9-C15</td>
<td>.1uF Dip Tant. (Radial)</td>
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Capacitor Pack Cont'd

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Resistor Pack

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Misc.

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PC Board

14 Pin Sockets

16 Pin Sockets

Instruction Manual
B870: 21 00 80
B873: 36 FF
5: 23
6: 7C
7: FE 90 73 B8 (88)
8: C2 C9
9: D2 EF FF FF FF
B880: 21 00 88
B882: 11 00 80
B886: 7E
7: 12
8: 23
9: 13
A: 7C
B: FE 90
D: C2 86 B8
B890: C9

SP
S 88800
T G

FILLM:
LXI H, 80FFH
FIL:
MVI M3, 00FFH
INX H
MOV A0, H
CPI 90H
JNZ FILL
RET

MOVEM:
LXI H, 8800
LXI D, 80FFH
MOVMA
MOV A5, M
STAX D
INX H
INX D
MOV A5, H
CPI 90H
JNZ MOVEM
RET

B846: CD
B869: CD
B849: 76
B86C: 76

PROBLEM: should change TRAP when fall while RET.