# BYTEMOVER

SOFTWARE SUPPLIED WITH THE BYTESAVER

CROMEMCO
ONE FIRST STREET
LOS ALTOS, CALIFORNIA
94022

# BYTEMOVER 3.0 OPERATING INSTRUCTIONS

THE CROMEMCO BYTESAVER$^{TM}$ is supplied with BYTEMOVER$^{TM}$ software. This software is pre-programmed into the 2704 PROM that comes with the BYTESAVER.

The 2704 PROM containing the Bytemover software is normally inserted into PROM location 0 on the Bytesaver board. The Bytemover software can be used to program a PROM in any of the PROM locations on the Bytesaver board. The Bytemover software can also be used to transfer programs from PROM to RAM. The operation of the Bytemover software is controlled by the setting of the front panel sense switches on the Altair computer. To use the Bytemover software there must be a RAM board in the Altair beginning at location zero in memory; further, this RAM board must be unprotected for proper execution of the Bytemover software.

## STEP-BY-STEP INSTRUCTIONS

1) Before using the Bytesaver you must install three jumper wires to set the location of the Bytesaver in memory space. This is shown in Figure 1. The assembled Bytesaver comes with A13, A14, and A15 each tied to the corresponding "Hi" pad to position the board at the very top of memory. In the following instructions it is assumed that this is the jumper connection used.

2) With the Altair 8800 power turned off, plug the Bytesaver board into the computer.

3) Be sure that the program power on the Bytesaver is turned OFF (program power switch in the down position.)

4) Turn on the Altair. Raise the reset switch, then raise the stop switch, and then raise the reset switch once again to initialize the Altair.

5) Raise address switches A15, A14, and A13. All other address switches should be down.

6) Raise the examine switch. You are now examining the contents of the first byte of PROM in PROM location zero of the Bytesaver memory board (memory location 340 000). If the PROM supplied with your Bytesaver is in this PROM location the data lights will read "061", the first byte of the Bytemover program.

EXAMPLE: Transfer the Bytemover program from PROM to RAM beginning at location zero in RAM.

1) Raise the reset switch.

2) Depress the unprotect switch (on the Altair front panel).

3) Raise A15, A14, and A13. Raise the examine switch. The data lights should read "061" octal.

4) Now set the sense switches for the task to be done, refering to Fig. 2.

| | | |
|---|---|---|
| A15 | Down to transfer from PROM to RAM | |
| A14 | Down for the transfer of 1K bytes. | |
| A13 | Down | All down since we are transferring from the same PROM that contains BYTEMOVER (PROM 0) |
| A12 | Down | |
| A11 | Down | |
| A10 | Down | All down for storage to begin at location zero in RAM. |
| A9 | Down | |
| A8 | Down | |

5) Push the run switch. In less than one second the contents of PROM will be transferred to RAM. (Of course the contents of the PROM are unaffected by this operation.

6) Raise the STOP switch.

7) Raise the reset switch. Note that the data lights read "061".

EXAMPLE: Program a 2708 PROM inserted in PROM location 1. This PROM is to be programmed with the contents of the first 1K bytes of RAM beginning at location zero in memory. The Bytemover software is still in the PROM in PROM location zero on the Bytesaver board.

1) Raise the reset switch.

2) Depress the unprotect switch (on the Altair front panel)

3) Raise A15, A14, and A13. Raise the examine switch. The data lights should read "061" octal.

4) Raise the protect switch on the Bytesaver board (i.e. program power switch to the ON position). The protect light on the Altair front panel should go off when this switch is raised.

5) Now set the sense switches for the task to be done:

| | | |
|---|---|---|
| A15 | Up to program a PROM | |
| A14 | Down (always down for PROM programming) | |
| A13 | Down | To select the PROM 1K higher in memory than the PROM that contains BYTEMOVER |
| A12 | Down | |
| A11 | Up | |
| A10 | Down | All down for transfer to begin at location zero in RAM. |
| A9 | Down | |
| A8 | Down | |

6) Push the RUN switch. Note that panel light A9 is blinking at a rate of about twice per second. When this light stops blinking the PROM programming is complete.

7) Raise the STOP switch.

8) Now note the INTE light on the Altair front panel. If this light is on, the BYTEMOVER VERIFIER has verified that the contents of the programmed PROM are indeed identical to the contents of the selected 1K bytes of RAM. If this light is off, the PROM has not programmed correctly; this could be due, for example, to a defective PROM.

<u>EXAMPLE</u>: Altair 8K BASIC can be stored in seven 2708 PROMs. Given that these seven PROMs are in PROM locations 1 through 7 on the BYTESAVER board, 8K BASIC can easily be transferred into RAM using the following procedure:

1) Raise the RESET switch.

2) Depress the unprotect switch (on the Altair front panel).

3) Raise A15, A14, and A13. Raise the examine switch. The data lights should read "061" octal.

4) Now set the sense switches for the task to be done:

A15 - Down to transfer from PROM to RAM.
A14 - Up for a 7K transfer
A13 - Down
A12 - Down
A11 - Up
To begin transfer from the PROM 1K higher in memory than the BYTEMOVER program.
A10 - Down
A9 - Down
A8 - Down
All down for storage to begin at location zero in RAM.

5) Push the RUN switch. In less than one second BASIC will be loaded into RAM (it sure beats paper tape!). Raise the STOP switch.

<u>EXAMPLE</u>: If you do not have BYTEMOVER in PROM, you can program a PROM with BYTEMOVER that is stored in RAM. The BYTEMOVER software (a listing of which is attached) must first be loaded into RAM beginning at location zero in memory. The BYTEMOVER software can then be burned into a PROM using the following procedure:

1) Raise the reset switch.

2) Depress the unprotect switch (on the Altair front panel).

3) Insert an erased PROM into PROM location 0 on the BYTESAVER board.

4) Examine location 000 240 in memory.

5) Raise the program power switch on the BYTESAVER board.

6) Set the sense switches with A15 and A14 and A13 up.

7) Push the RUN switch. When light A9 stops blinking the programming is complete. The INTE light will be on to verify correct programming.

8) Turn off PROM program power by depressing the switch on the BYTESAVER.

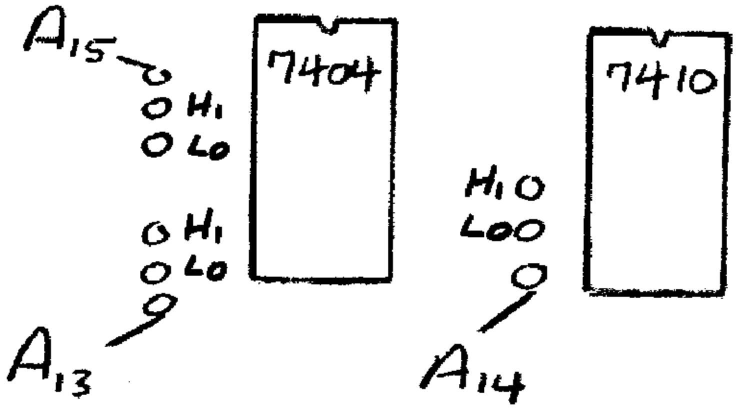


Fig. 1. How to set the Bytesaver address in memory. The built Bytesaver comes with A15, A14, and A13 connected to the corresponding "Hi" terminals so that memory address occurs when these three bits are high. Any or all of these address lines may be connected to the corresponding "Lo" terminal to move the memory board lower in memory. There are thus eight positions in memory that this board can be used.

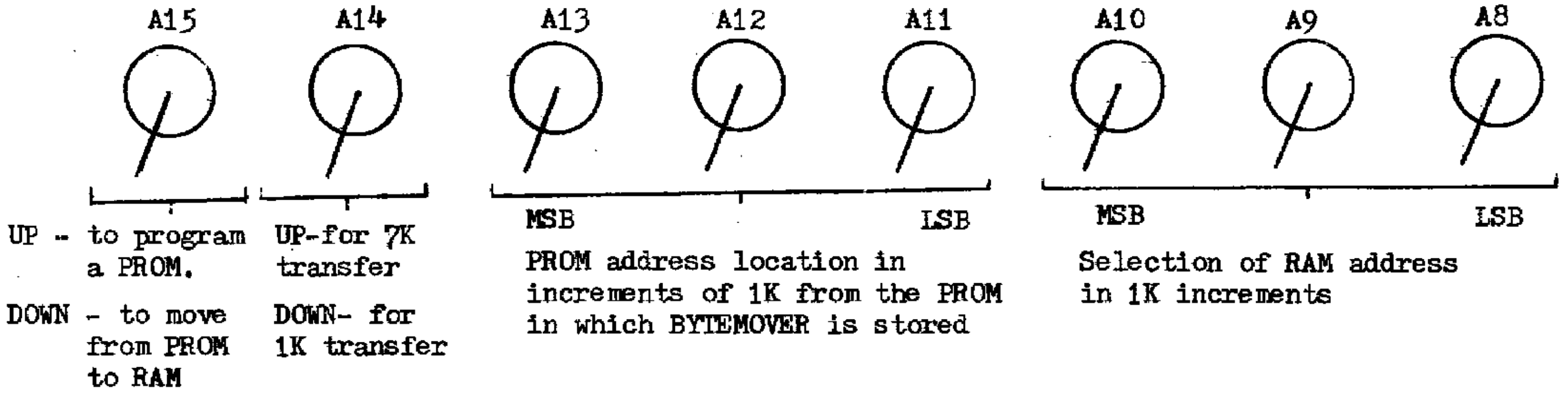
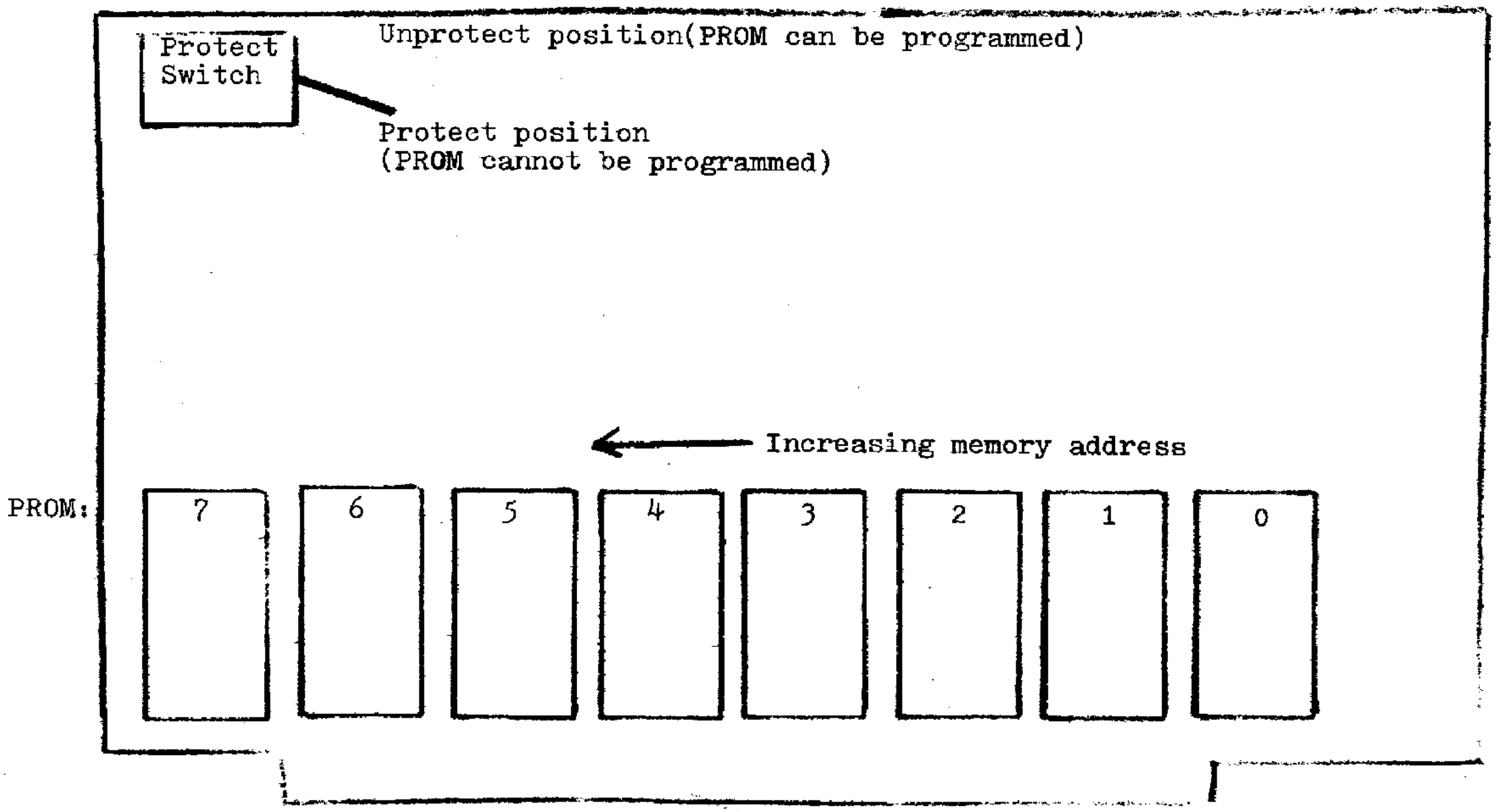

A15
A14
A13
A12
A11
A10
A9
A8
UP - to program a PROM.
DOWN - to move from PROM to RAM
UP-for 7K transfer
DOWN- for 1K transfer
MSB
LSB
PROM address location in increments of 1K from the PROM in which BYTEMOVER is stored
MSB
LSB
Selection of RAM address in 1K increments

FIGURE 2. FUNCTION OF THE SENSE SWITCHES IN THE BYTEMOVER PROGRAM.

Fig. 3. Bytesaver physical layout.


Protect Switch
Unprotect position(PROM can be programmed)
Protect position
(PROM cannot be programmed)
Increasing memory address
PROM:
7
6
5
4
3
2
1
0

# BYTESAVER ASSEMBLY LANGUAGE LISTING

```
0000                     0000 * BYTEMØVER (T,M.) SØFTWARE FØR
0000                     0001 * CRØMEMCO 8K BYTESAVER (T.M.)
0000                     0002 * VERSIØN 3.0
0000                     0003 * SELF-RELØCATING SØFTWARE LØCATABLE AT ANY
0000                     0004 * 1024 BYTE (1K) BØUNDARY IN MEMØRY
0000                     0009 * RØUTINE TØ FIND ØNESELF IN MEMØRY
0000                     0010 SP EQU 6
0000                     0019 * DEFINE FIRST 4 BYTES IN MEMØRY AS STACK
0000 31 00 00            0020  LXI SP, 0
0003                     0029 * SAVE FIRST FOUR BYTES IN REGISTERS
0003 C1                  0030  PØP B
0004 D1                  0040  PØP D
0005                     0049 * REPLACE BYTE 0 WITH A 'RETURN'
0005 2E C9               0050  MVI L, 0C9H
0007 00                  0051  NØP
0008 E5                  0060  PUSH H
0009 E5                  0070  PUSH H
000A 00                  0080  NØP
000B 00                  0081  NØP
000C 00                  0082  NØP
000D 31 04 00            0090  LXI SP, 4
0010 CD 00 00            0100  CALL 0
0013                     0101 * RØM LØCATIØN NØW IN BYTE 3
0013 31 02 00            0110  LXI SP, 2
0016 E1                  0120  PØP H
0017                     0129 * RETURN BYTES 0-3
0017 31 04 00            0130  LXI SP,4
001A D5                  0140  PUSH D
001B C5                  0150  PUSH B
001C                     0159 * STØRE RØM LØCATIØN IN SP
001C F9                  0160  SPHL
001D 0E 00               0170  MVI C, 0
001F 59                  0180  MØV E,C
0020 69                  0190  MØV L,C
0021                     0199 * INPUT SENSE SW CØMMANDS
0021 DB FF               0200  IN 255
0023 57                  0210  MØV D,A
0024                     0219 * STRIP RAM ADDRESS
0024 E6 07               0220  ANI 7
0026 07                  0230  RLC
0027 07                  0240  RLC
0028                     0249 * STØRE RAM ADDRESS IN BC
0028 47                  0250  MØV B,A
0029 7A                  0260  MØV A,D
002A                     0269 * STRIP RØM ADDRESS
002A E6 38               0270  ANI 56
002C 0F                  0280  RRC
002D 00                  0290  NØP
002E 67                  0300  MØV H,A
002F 39                  0310  DAD SP
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```
0030 2E 00                 0320  MVI L, 0
0032 7A                    0330  MØV A,D
0033 EB                    0340  XCHG
0034                       0341 * ADDRESS ØF RØM BEING PRØCESSED IN DE
0034                       0349 * BRANCH TØ TRANSFER ØR PRØGRAM RØUTINE
0034 E6 80                 0350  ANI 128
0036 0F                    0360  RRC
0037 0F                    0370  RRC
0038 C6 2D                 0380  ADI 45
003A 21 00 00              0390  LXI H, 0
003D 6F                    0400  MØV L,A
003E 39                    0410  DAD SP
003F E9                    0420  PCHL
0040                       0500 * RØUTINE TØ TRANSFER RØM TØ RAM
0040 F9                    0510  SPHL
0041 21 0B 00              0520  LXI H, 11
0044 39                    0530  DAD SP
0045 EB                    0550  XCHG
0046 F9                    0560  SPHL   STACK CØNTAINS RØM LOCATIØN
0047 EB                    0570  XCHG   H&L CØNTAIN LOOP ADDRESS
0048 11 00 00              0580  LXI D, 0
004B                       0588 * START ØF TRANSFER LØØP
004B                       0589 * INCREMENT RØM ADDRESS
004B 3B                    0590  DCX SP
004C                       0599 * MØVE DATA FRØM RØM TØ RAM
004C F1                    0600  PØP 6
004D 02                    0610  STAX B
004E                       0619 * INCREMENT RAM ADDRESS
004E 03                    0620  INX B
004F                       0629 * INCREMENT BYTE CØUNT
004F 13                    0630  INX D
0050 7A                    0640  MØV A,D
0051 E6 04                 0650  ANI 4
0053 07                    0660  RLC
0054 07                    0670  RLC
0055 00                    0680  NØP
0056 85                    0690  ADD L
0057 6F                    0700  MØV L,A
0058 E9                    0710  PCHL
0059 00                    0716  NØP
005A 00                    0717  NØP
005B                       0719 *  JUMP TØ 00B1 FRØM TRANSFER RØUTINE
005B 3E 56                 0720  MVI A, 56H
005D 85                    0725  ADD L
005E 6F                    0730  MØV L,A
005F E9                    0740  PCHL
0060                       1000 * RØUTINE TØ PRØGRAM RØM
0060 00                    1010  NØP
0061                       1019 * MØVE RAM ADDRESS INTØ HL
0061 69                    1020  MØV L,C
0062 7C                    1030  MØV A,H
0063 60                    1040  MØV H,B
0064                       1049 * MØVE RAM ADDRESS INTØ SP
0064 F9                    1050  SPHL
0065 67                    1060  MØV H,A
0066 2E 6B                 1070  MVI L, 107
0068                       1079 * INCREMENT RAM ADDRESS
0068 01 00 00              1080  LXI B, 0
006B                       1089 * INCREMENT RAM ADDRESS
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006B 39                 1090  DCX SP
006C                    1098 * USE STAX AND PØP 6 (PSW)
006C                    1099 * TØ MØVE DATA FRØM RØM TØ RAM
006C F1                 1100  PØP 6
006D 12                 1110  STAX D
006E                    1119 * INCREMENT RØM ADDRESS
006E 13                 1120  INX D
006F                    1129 * INCREMENT BYTE CØUNT
006F 03                 1130  INX B
0070                    1138 * B STØRES TWØ CØNSTANTS
0070                    1139 * # CØMPLETE PASSES & IN RØM CNT
0070 78                 1140  MØV A,B
0071                    1149 * # PASSES = 32 ?
0071 FE FC              1150  CPI 252
0073 3F                 1160  CMC
0074 1F                 1170  RAR
0075 1F                 1180  RAR
0076                    1198 * SET 64 TØ 0 FØR TWØ MINUTE TIMER VERSIØN
0076 E6 40              1200  ANI 64
0078                    1201 * A=64 IF CØMPLETED 32 PASSES
0078 2E 7D              1205  MVI L, 7DH
007A 85                 1210  ADD L
007B 6F                 1220  MØV L,A
007C E9                 1225  PCHL
007D 2E 6B              1226  MVI L, 6BH
007F 78                 1230  MØV A,B
0080 E6 04              1240  ANI 4
0082                    1241 * A=4 IF END ØF 1024 BYTE PASS
0082 07                 1250  RLC
0083 07                 1260  RLC
0084 07                 1270  RLC
0085 85                 1280  ADD L
0086 6F                 1290  MØV L,A
0087                    1291 * GØ BACK TØ 1090 UNLESS ØVERFLØW
0087                    1292 * THEN GØ TØ 1380 FØR
0087                    1293 * ADDRESS SUBTRACTIØN
0087                    1294 * ØR 2135 FØR QUITS
0087 E9                 1300  PCHL
0088 00                 1350  NØP
0089 00                 1360  NØP
008A 00                 1370  NØP
008B                    1378 * ANØTHER PRØGRAM PASS TØ BE DØNE
008B                    1379 * ADJUST RØM AND RAM ADDRESSES
008B 7C                 1380  MØV A,H
008C 21 00 FC           1390  LXI H, 64512
008F                    1399 * SUBTRACT 1024 FRØM RØM ADDRESS
008F 39                 1400  DAD SP
0090 F9                 1410  SPHL
0091 21 00 FC           1420  LXI H, 64512
0094                    1429 * SUBTRACT 1024 FRØM RAM ADDRESS
0094 19                 1430  DAD D
0095 EB                 1440  XCHG
0096 67                 1450  MØV H,A
0097 2E 6B              1460  MVI L,107
0099 78                 1470  MØV A,B
009A E6 F8              1480  ANI 248
009C                    1489 * INCREMENT PASS CØNTER BY ØNE
009C C6 08              1490  ADI 8
009E 47                 1495  MØV B,A
009F                    1499 * GØ BACK TØ 1090
009F E9                 1500  PCHL
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```
00A0                    2000 * RØUTINE TØ LØAD BYTEMØVER INTØ RØM
00A0 DB FF              2010  IN 255
00A2 47                 2020  MØV B,A
00A3 E6 E0              2030  ANI 224
00A5 1E 00              2040  MVI E, 0
00A7 4B                 2050  MØV C,E
00A8 57                 2060  MØV D,A
00A9 78                 2070  MØV A,B
00AA E6 1F              2080  ANI 31
00AC 47                 2090  MØV B,A
00AD 67                 2100  MØV H,A
00AE 2E 60              2110  MVI L, 96
00B0 E9                 2120  PCHL
00B1                    2121 * CHECK FØR 7K TRANSFER ØF RØM TØ RAM
00B1 C6 1A              2122  ADI 1AH
00B3 6F                 2123  MØV L,A
00B4 DB FF              2124  IN 255
00B6 E6 40              2125  ANI 64
00B8 0F                 2126  RRC
00B9 0F                 2127  RRC
00BA 85                 2128  ADD L
00BB 6F                 2129  MØV L,A
00BC E9                 2130  PCHL
00BD                    2133 * PRØGRAMMER VERIFICATIØN RØUTINE
00BD                    2134 * PART 1
00BD 7C                 2135  MØV A,H
00BE 21 00 FC           2145  LXI H, 64512
00C1 39                 2155  DAD SP
00C2 F9                 2165  SPHL
00C3 2E CD              2175  MVI L, 0CDH
00C5 67                 2185  MØV H,A
00C6 E9                 2195  PCHL
00C7 00                 2205  NØP
00C8 00                 2210  NØP
00C9 00                 2215  NØP
00CA 00                 2220  NØP
00CB                    2229 * RØM TØ RAM TRANSFER STØP RØUTINE
00CB FB                 2230  EI
00CC E9                 2240  PCHL
00CD                    2248 * PRØGRAMMER VERIFICATIØN RØUTINE
00CD                    2249 * PART 2
00CD 7C                 2250  MØV A,H
00CE 21 00 FC           2260  LXI H,64512
00D1 19                 2270  DAD D
00D2 EB                 2280  XCHG
00D3 2E F1              2290  MVI L, 0F1H
00D5 67                 2300  MØV H,A
00D6 01 00 00           2310  LXI B, 0
00D9 E9                 2320  PCHL
00DA 00                 2625  NØP
00DB                    2629 * 7K TRANSFER COMPLETIØN CHECK
00DB D6 20              2630  SUI 20H
00DD 6F                 2640  MØV L,A
00DE 7A                 2650  MØV A,D
00DF C6 04              2660  ADI 4
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00E1 57                     2670  MØV D,A
00E2 FE 38                  2680  CPI 56
00E4 3F                     2685  CMC
00E5 3E 00                  2690  MVI A, 0
00E7 1F                     2700  RAR
00E8 85                     2710  ADD L
00E9 6F                     2720  MØV L,A
00EA E9                     2730  PCHL
00EB                        2879 * RØM PRØGRAMMER STØP RØUTINE
00EB 00                     2880  NØP
00EC 00                     2881  NØP
00ED FB                     2885  EI
00EE E9                     2890  PCHL
00EF E9                     2900  PCHL
00F0 E9                     2906  PCHL
00F1                        2918 * PRØGRAMMER VERIFICATIØN RØUTINE
00F1                        2919 * PART 3
00F1 3B                     2920  DCX SP
00F2 F1                     2930  PØP 6
00F3 EB                     2940  XCHG
00F4                        2949 * CØMPARE FØR GREATER
00F4 BE                     2950  CMP M
00F5 EB                     2960  XCHG
00F6 17                     2970  RAL
00F7 E6 01                  3000  ANI 1
00F9 2F                     3010  CMA
00FA 3C                     3011  INR A
00FB 85                     3015  ADD L
00FC 6F                     3020  MØV L,A
00FD 3B                     3030  DCX SP
00FE 3B                     3040  DCX SP
00FF                        3050 * CØMPARE FØR LESSER
00FF F1                     3055  PØP 6
0100 2F                     3056  CMA
0101 EB                     3058  XCHG
0102 86                     3059  ADD M
0103 EB                     3060  XCHG
0104 C6 07                  3061  ADI A,1
0106 3F                     3065  CMC
0107 17                     3070  RAL
0108 E6 01                  3090  ANI 1
010A 2F                     3100  CMA
010B 3C                     3101  INR A
010C 85                     3105  ADD L
010D 6F                     3110  MØV L,A
010E 03                     3130  INX B
010F 13                     3140  INX D
0110 78                     3150  MØV A,B
0111 E6 04                  3180  ANI 4
0113 2F                     3190  CMA
0114 3C                     3191  INR A
0115 85                     3195  ADD L
0116 6F                     3200  MØV L,A
0117 E9                     3210  PCHL
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# BYTEMOVER 3.0 OCTAL LISTING

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BYTEMØVER VERSIØN 3.0

ØCTAL LISTING

061 000 000 301 321 056 311 000 345 345 000 000 000 061 004 000
315 000 000 061 002 000 341 061 004 000 325 305 371 016 000 131
151 333 377 127 346 007 007 007 107 172 346 070 017 000 147 071
056 000 172 353 346 200 017 017 306 055 041 000 000 157 071 351
371 041 013 000 071 353 371 353 021 000 000 073 361 002 003 023
172 346 004 007 007 000 205 157 351 000 000 076 126 205 157 351
000 151 174 140 371 147 056 153 001 000 000 073 361 022 023 003
170 376 374 077 037 037 346 100 056 175 205 157 351 056 153 170
346 004 007 007 007 205 157 351 000 000 000 174 041 000 374 071
371 041 000 374 031 353 147 056 153 170 346 370 306 010 107 351
333 377 107 346 340 036 000 113 127 170 346 037 107 147 056 140
351 306 032 157 333 377 346 100 017 017 205 157 351 174 041 000
374 071 371 056 315 147 351 000 000 000 000 373 351 174 041 000
374 031 353 056 361 147 001 000 000 351 000 326 220 157 172 306
004 127 376 070 077 076 000 037 205 157 351 000 000 373 351 351
351 073 361 353 276 353 027 346 001 057 074 205 157 073 073 361
057 353 206 353 306 007 077 027 346 001 057 074 205 157 003 023
170 346 004 057 074 205 157 351 000 000 000 000 000 000 000 000
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