Introducing the Disassembler

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An unassembler (or disassembler) is a program which takes machine language and converts it into what appears to be assembly language. The input to the disassembler is generally a program which is contained in computer memory and the output is generally printed output which looks much like an assembly language listing.

The one thing which a disassembler cannot do is generate the meaningful labels and comments which appeared in the original source program, but it can be very helpful as a debugging aid. For example, if you have purchased a new printer and want to interface it to the I/O routines of your computer system's BASIC interpreter you may have to modify those routines. Even though you do not have source code for those I/O routines, you can disassemble them and have something much easier to work with than an octal or hexadecimal memory dump. If you have written a program in machine code, you can also use the disassembler to document your program.

The Design

The disassembler presented here was designed to operate on a SWTPC 6800 system. The design should work with any computer and the program presented can be easily modified to work with any 6800 based system. Also, if Motorola comes out with the new 680X superchip to replace the 6800, the unassembler should be easy to update as the decoding is performed by the use of tables. The only portion of the decoding operation which is hard coded (instead of using tables) is the address mode (relative, indexed, etc.) of the instructions. If you desired to make the design even more flexible, this information could also be added to the tables.

In order to perform the disassembly function, two tables are used. Table 1, called the op code table, has an entry for every possible operation code (0 through 255). Each table entry is 2 bytes long and contains the following information:

1. An index into the mnemonic table.
2. Indicators for the accumulator used (if any).
3. The length of the instruction in bytes.
4. A flag to indicate if this instruction is an unconditional transfer of control (JMP, RTS, etc.).

An entry in this table is illustrated in Fig. 1.

The second table, called the mnemonic table, contains all the valid assembler mnemonics for the possible machine instructions. Note that pseudo operations such as EQU and FCC do not appear in the table. These do not generate instructions (although FCC does use memory space) and therefore could never be generated through the disassembly process. An entry in this table is illustrated in Fig. 2.

Table 1 shows the assumptions that were made concerning the address mode of the instructions. The exception (we always have an exception) is that op code 8D is the BSR instruction and is therefore relative, not immediate as would be expected.

OP CODE				L	B	C
INDEX	A	B		A	Y	N
				B	T	T

Op code index — Pointer into the Mnemonic table.
A — Indicates A register used if set.
B — Indicates B register used if set.
LAB — Indicates unconditional transfer instruction.
BYT CNT — Length of instruction in bytes.

Fig. 1. Layout of an op code Table Entry.

The Program

The program flow is straightforward. Once the user sets location A002 and A003 to the address of the program to be disassembled and initiates execution of the unassembler the following takes place.

The first byte of data (program to be disassembled) is picked up, multiplied by 2 and used to compute the address of the appropriate op code table entry. The data address (from A002 and A003) is converted to a character string and put into the output line buffer.

Next, using the op code table entry the mnemonic is picked up from the mnemonic table and transferred to the output line buffer. Then the address field is converted and placed in the print line, using the A and B fields and the length field from the op code table. If the address mode is relative, the offset is added to the address of the next instruction and saved in the print line as the absolute address. The print routine is then called to print the data contained in the output buffer.

Finally, if the op code table entry had the lab bit set indicating that we have just processed an unconditional transfer instruction, a period is placed in position 7 of the print buffer so that the next line printed will have a flag indicating that it should have a label. This is because the only path to this instruction would be through a transfer of control instruction such as BRA.

If decoding the op code does not yield a valid mnemonic (mnemonic index of 0) three asterisks are printed in the operation field followed by the op code byte displayed in hexadecimal.

Using the Unassembler on a SWTPC 6800

If you have a SWTPC 6800 system configured with the AC-30 cassette interface on I/O port 1 and PR-40 printer on I/O port 7 and at least 8K bytes of memory then the following procedure would load the unassembler and cause it to unassemble itself:

First 4 bits of op code (hex)	Address Mode
1,3,4 or 5	Inherent
2	Relative
6,A or E	Indexed
7,B or F	Extended
8,C	Immediate
9,D	Direct

Table 1. Address Mode Decoding.

1. Load the object tape using the MIKBUG L key-in.
2. Using the MIKBUG M key-in set location A002 to the address of the program to be disassembled. In this case it is 2B36, the first instruction of the disassembler.
3. Enter G to start program execution.
4. When the disassembler has decoded enough push reset to stop execution.

Typing G will cause the disassembler to resume operation at the next location. Also, by changing the contents of A002 and typing G the disassembler will resume operation at the new starting address.

Modifications

With only minor modifications the disassembler can be changed to operate with almost any 6800 based system. To change it to print on the control interface it is only necessary to delete the PR-40 handler code and insert the following:

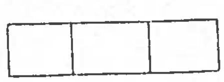
```
BINIT    RTS
PDATA1 EQU $E07E
```

For anyone who does not use MIKBUG it is only necessary to replace the code at BINIT with the necessary printer initialization code and the code at PDATA1 with code which will print the ASCII string pointed to by the index register. Note that the end of string is signified by an ASCII EOT (hex 04) character.

If you have any occasional problems with strange looking output it is most likely an error in the tables. Check carefully, one missing byte can skew all the other data and generate very strange results. ■

```
1B36        LDS    #1B0?
1B39        JSR    1C??
1B3C        LDX    A002
1B3F        LDA A  00,X
1B41        STA A  1B0A
1B44        ASL A
1B45        LDX    #1C??
1B48        STX    1B0B
1B4B        BCC    1B50
1B4D        INC    1B0B
1B50        LDA B  1B0C
1B53        ABA
1B54        STA A  1B0C
1B57        BCC    1B5C
1B59        INC    1B0B
1B5C        LDX    #1B0E
1B5F        LDA A  A002
1B62        JSR    1B70
1B65        LDA A  A003
1B68        JSR    1B70
1B6B        LDX    1B0B
1B6E        LDA A  00,X
1B70        STA A  1B0D
1B72        LDA B  01,X
1B75        STA B  1B0D
1B78        AND B  #03
1B7A        LDX    A002
1B7D        LDA A  01,X
1B7F        STA A  1B08
1B82        LDA A  02,X
1B84        STA A  1B09
1B87        INX
1B88        DEC B
1B89        BNE    1B87
1B8B        STX    A002
1B8E        LDA A  1B0D
1B91        TAB
1B92        LDX    #1CD8
1B95        STX    1B0B
1B98        ASL A
1B99        BCC    1B9F
1B9B        INC    1B0B
1B9E        CLC
1B9F        ABA
1BA0        BCC    1BA5
1BA2        INC    1B0B
1BA5        CLC
1BA6        ADD A  1B0C
1BA9        BCC    1BAC
1BAB        INC    1B0B
1BAE        STA A  1B0C
1BB1        LDX    1B0B
1BB4        LDA A  00,X
1BB6        STA A  1B1F
1BB9        LDA A  01,X
1BBB        STA A  1B20
1BBE        LDA A  02,X
1BC0        STA A  1B21
1BC3        LDA B  #20
1BC5        STA B  1B22
1BC8        LDA A  1B0D
1BCB        BIT A  #?0
1BCD        BEQ    1BD7
1BCF        BPL    1BD5
1BD1        LDA B  #41
```

Example A. Sample Program Execution (disassembly of portion of Disassembler Program).



3 ASCII character mnemonic

Fig. 2. Layout of Mnemonic Table Entry.

Program A. Listings for Disassembler Program.

```
PAGE  001   UNASS

                        NAM    UNASS
                        OPT    0
                        OPT    S
                        OPT    NOP
                        OPT    G
                 * 1A002 CONTAINS START
                 * ADDRESS OF CODE TO
                 * DISASSEMBLE
                 *
                 * EQU'S
                 * PR-40 PIA ADDRESS
      801C       PRPIA  EQU    $801C
                 *
2B00                    ORG    $1B00
                 * STACK SAVE
2B00 0008               RMB    8
     1B08        SSAV   EQU    *
1B08 0002        OPER   RMB    2                 OPER
1B0A 0001        SAVA   RMB    1
1B0B 0002        TMP    RMB    2
1B0D 0001        BAF    RMB    1
1B0E 20          LIN    FCC    40,
1B0F 20
1B10 20
1B11 20
1B12 20
1B13 20
1B14 20
1B15 20
1B16 20
1B17 20
1B18 20
1B19 20
1B1A 20
1B1B 20
1B1C 20
1B1D 20
1B1E 20
1B1F 20
1B20 20
1B21 20
1B22 20
1B23 20
1B24 20
1B25 20
1B26 20
1B27 20
1B28 20
1B29 20
1B2A 20
1B2B 20
1B2C 20
1B2D 20
1B2E 20
1B2F 20
1B30 20
1B31 20
1B32 20
1B33 20
1B34 20
1B35 20
                 *
     1B36        UNAS   EQU    *
2B36 8E 2B08            LDS    #SSAV
1B39 BD 1C97            JSR    BINIT
     1B3C        AGN    EQU    *
                 * START ADDRESS
1B3C FE A002            LDX    1A002
1B3F A6 00              LDA A  0,X
1B41 B7 1B0A            STA A  SAVA

1B44 48                 ASL A
```

MIKBUG

Dissassembler is now located at 2B00
set PGM CNTR TO 2B36 TO START

```
1845 CE 1002        LDX   #OPS
1848 FF 100C        STX   TMP
184B 24 03          BCC   NOC
184D 7C 100D        INC   TMP
1850 F6 100C NOC    LDA B TMP+1
1853 1B             ABA

1854 B7 100C        STA A TMP+1
1857 24 02          BCC   NOD
1859 7C 100B        INC   TMP
                * ADDRESS
185C    NOD         EQU   *
185C CE 100E        LDX   #LIN
185F D6 A002        LDA A $A002
1862 BD 1070        JSR   OUT
1865 B6 A003        LDA A $A003
1868 BD 1070        JSR   OUT
                * OPS INDEX
186B FE 100B        LDX   TMP
186E A6 00          LDA A 0,X
1870 B7 100B        STA A TMP
                * REG/LENGTH
1873 C6 01          LDA B 1,X
1875 F7 100D        STA B BAR
1878 C4 03          AND B #03
187A FE A002        LDX   $A002
                * SAVE POSSIBLE OPERANDS
187D A6 01          LDA A 1,X
187F B7 1008        STA A OPER
1882 A6 02          LDA A 2,X
1884 B7 1009        STA A OPER+1
                * UPDATE INST POINTER
1887 08         NOPE    INX

1888 5A                 DEC B
1889 26 FC              BNE   NOPE
188B FF A002            STX   $A002
188E BD 100B            LDA A TMP
1891 16                 TAB

1892 CE 1060            LDX   #INST
1895 FF 100C            STX   TMP
1898 48                 ASL A

1899 24 04              BCC   NOE
189B 7C 100C            INC   TMP
189E 0C                 CLC

189F 1B         NOE     ABA

18A0 24 03              BCC   NOF
18A2 7C 100B            INC   TMP
18A5 0C         NOF     CLC
18A6 DB 100C            ADD A TMP+1
18A9 24 03              BCC   NOG
18AB 7C 100B            INC   TMP
18AE B7 100C NOG        STA A TMP+1
18B1 FE 100B            LDX   TMP
18B4 A6 00              LDA A 0,X
18B6 B7 101F            STA A LIN+17
18B9 A6 01              LDA A 1,X
18BB B7 1020            STA A LIN+18
18BE A6 02              LDA A 2,X
18C0 B7 1021            STA A LIN+19
18C3 C6 20              LDA B #' '

18C5 F7 1022            STA B LIN+20
18C8 D6 100D            LDA A BAR
18CA 85 C0              BIT A #$C0
18CC 27 08              BEQ   SREG
18CE 2A 04              BPL   BREG
18D0 C6 42              LDA B #'B
18D2 20 02              BRA   SREG
18D4 C6 47      BREG    LDA B #'G
18D6 F7 1023 SREG       STA B LIN+21
```

```
18D9 CE 1020            LDX   #LIN+24
18DC D6 101F            LDA A LIN+17
18DE 81 2A              CMP A #'*
18E0 26 08              BNE   NOTBRO
18E2 96 0A              LDA A SAVA
18E4 BD 1070            JSR   OUT
18E7 BD 1070            JSR   OUT
18EA 20 40              BRA   NOOPR
18EC D6 1000 NOTBRO     LDA A DAS
18EF 85 02              BIT A #$02
18F1 27 39              BEQ   NOOPR
18F3 96 0A              LDA A SAVA
18F5 81 80              CMP A #$80
18F7 27 12              BEQ   NOTIMM
18F9 84 F0              AND A #$F0
18FB B7 1000            STA A SAVA
18FE 81 00              CMP A #$00
1900 27 04              BEQ   IMM
1902 81 C0              CMP A #$C0
1904 26 05              BNE   NOTIMM
                * FLAG IMM ADDRESS
1906 86 23      IMM     LDA A #'#
1908 B7 00              STA A 0,X
190B 08                 INX

190C    NOTIMM  EQU   *
                * CHECK FOR REL ADDRESS
190C D6 100A            LDA B SAVA      GET
190F C1 55              CMP B #$55      BRA
1911 27 55              BEQ   REL       YES
1913 84 F0              AND A #$F0
1915 81 20              CMP A #$20      OTH
1917 27 4F              BEQ   REL       YES
1919 B6 1008            LDA A OPER
191C BD 1070            JSR   OUT
191F D6 100D            LDA A BAR
1922 85 01              BIT A #$1
1924 27 04              BEQ   NOOPR
1926 96 1009            LDA A OPER+1
1928 BD 1070            JSR   OUT
192B    NOOPR   EQU   *
192B D6 100F            LDA A SAVA
192F 81 6A              CMP A #$6A
1931 27 08              BEQ   INDXD
1933 81 AA              CMP A #$AA
1935 27 04              BEQ   INDXD
1937 81 EA              CMP A #$EA
1939 26 04              BNE   NOTX
                * PUT ',X' IN LINE
193B 86 2C      INDXD   LDA A #',
193D A7 00              STA A 0,X
193F 08                 INX

1940 86 58              LDA A #'X
1942 A7 00              STA A 0,X
1944 08                 INX

1945    NOTX    EQU   *
                * PRINT LINE
1945 86 0D              LDA A #$0D
1947 A7 00              STA A 0,X
1949 86 0A              LDA A #$0A
194B A7 01              STA A 1,X
194D 86 04              LDA A #$04
194F A7 02              STA A 2,X
1951 CE 1020            LDX   #LIN
1954 BD 1045            JSR   PDATA1
                * IF THE LAST INST WAS
                * UNCONDITIONAL XFER THEN
                * FLAG LABEL FIELD ON THE
                * NEXT LINE
1957 86 20              LDA A #'

                * CHECK LAB BIT
1959 D6 1000            LDA B DAR
195C C4 10              AND B #$10
195E 27 02              BEQ   NOLAB
1960 86 2E              LDA A #'.
1962 B7 1014 NOLAB      STA A LIN+6
```

```
1065 7E 1030          JMP   MAIN
                    * COMPUTE RELATIVE ADDR
1068 4F             REL   CLR A
1069 F6 1808              LDA B  OFFP
106C 2A 01                BPL   NNREL
106E 4A                   DEC A

106F 0C             NNREL CLC

1070 FB A003              ADD B  $A003    L O
1073 B9 A002              ADC A  $A002    H O
1076 8D 05                BSR   CDH     CONV
1078 17                   TBA

1079 8D 02                BSR   CDH     CONV
107B 20 08                BRA   NXTX
     1070           CDH   EQU   *
                    *
                    *  CONVERT BINARY NUMBER
                    * IN A-REG TO 2 HEX
                    *   CHRS AND SAV IN
                    *  ADDR IN X-REG
                    * INC X-REG
107D 36                   PSH A
107E 8D 06                BSR   CBHLH
1080 32                   PUL A

1081 08                   INX

1082 8D 06                BSR   CBHRH
1084 08                   INX

1085 39                   RTS

1086 44             CBHLH LSR A

1087 44                   LSR A

1088 44                   LSR A

1089 44                   LSR A

108A 84 0F          CBHRH AND A  #$F
108C 8B 30                ADD A  #$30
108E 81 39                CMP A  #$39
1090 23 02                BLS   CBHOK
1092 8B 07                ADD A  #$7
1094 A7 00          CBHOK STA A  0,X
1096 39                   RTS

                    ************
                    * PR-40 HANDLER
                    *
                    * REPLACE THIS CODE
                    * WITH :
                    *  BINIT  RTS
                    *  PORTA1 EQU DEATE
                    * TO OUTPUT TO CONTROL INTERFACE
                    *
                    *
                    * PR-40 INITIALIZATION
1097 86 FF          BINIT LDA A  #$FF
1099 B7 8010              STA A  PRPIA
109C 86 3E                LDA A  #$3E
109E B7 8010              STA A  PRPIA+1
10A1 39                   RTS

                    *
                    *
     10A2           PORTA2 EQU   *
10A2 8D 08                BSR   OUTCH
10A4 08                   INX

                    * PRINT LINE ON PR-40
     10A5           PORTA1 EQU   *
10A5 A6 00                LDA A  0,X
10A7 81 04                CMP A  #4
10A9 26 F7                BNE   PORTA2

10AB 39                   RTS

     10AC           OUTCH  EQU   *
10AC B7 8010              STA A  PRPIA
10AF B6 8010              LDA A  PRPIA
10B2 7D 8010        PLUP  TST   PRPIA+1
10B5 2A FB                BPL   PLUP
10B7 39                   RTS

                    *
                    * END OF PR-40 HANDLER
                    ************************
                    *
10B8 20             MNET  FCC   /***/
10BB 2A
10BC 20
10BD 4E                   FCC   /NOP/
10BE 4F
10BF 50
10C0 54                   FCC   /TAP/
10C1 41
10C2 50
10C3 54                   FCC   /TPA/
10C4 50
10C5 41
10C6 49                   FCC   /INX/
10C7 4E
10C8 58
10C9 44                   FCC   /DEX/
10CA 45
10CB 58
10CC 43                   FCC   /CLV/
10CD 4C
10CE 56
10CF 53                   FCC   /SEV/
10D0 45
10D1 56
10D2 43                   FCC   /CLC/
10D3 4C
10D4 43
10D5 53                   FCC   /SEC/
10D6 45
10D7 43
10D8 43                   FCC   /CLI/
10D9 4C
10DA 49
10DB 53                   FCC   /SEI/
10DC 45
10DD 49
10DE 53                   FCC   /SBA/
10DF 42
10E0 41
10E1 43                   FCC   /CBA/
10E2 42
10E3 41
10E4 54                   FCC   /TAB/
10E5 41
10E6 42
10E7 41
                    *  10
10E8 54                   FCC   /TBA/
10E9 41
10EA 41
10EB 41                   FCC   /ABA/
10EC 42
10ED 41
10EE 42                   FCC   /DAA/
10EF 41
10F0 41
10F1 42                   FCC   /BHI/
10F2 48
10F3 49
10F4 42                   FCC   /BLS/
10F5 4C
10F6 53
10F7 42                   FCC   /BCC/
```

```
1CF6 41
1CF7 43
1CF8 42                FCC   /BCS/
1CF9 43
1CFA 42
1CFB 4E
1CFC 45
1CFD 42                FCC   /BNE/
1CFE 4E
1CFF 45
1D00 42                FCC   /BEQ/
1D01 45
1D02 51
1D03 42                FCC   /BVC/
1D04 56
1D05 43
1D06 42                FCC   /BVS/
1D07 56
1D08 53
1D09 42                FCC   /BPL/
1D0A 50
1D0B 4C
1D0C 42                FCC   /BMI/
1D0D 4D
1D0E 49
1D0F 42                FCC   /BGE/
1D10 47
1D11 45
1D12 42                FCC   /BLT/
1D13 4C
1D14 54
1D15 42                FCC   /BGT/
1D16 47
1D17 54

* $20

1D18 42                FCC   /BLE/
1D19 4C
1D1A 45
1D1B 54                FCC   /TSX/
1D1C 53
1D1D 58
1D1E 49                FCC   /INS/
1D1F 4E
1D20 53
1D21 50                FCC   /PUL/
1D22 55
1D23 4C
1D24 44                FCC   /DES/
1D25 45
1D26 53
1D27 54                FCC   /TXS/
1D28 58
1D29 53
1D2A 50                FCC   /PSH/
1D2B 53
1D2C 48
1D2D 52                FCC   /RTS/
1D2E 54
1D2F 53
1D30 52                FCC   /RTI/
1D31 54
1D32 49
1D33 57                FCC   /WAI/
1D34 41
1D35 49
1D36 53                FCC   /SWI/
1D37 57
1D38 49
1D39 4E                FCC   /NEG/
1D3A 45
1D3B 47
1D3C 43                FCC   /COM/
1D3D 4F
1D3E 4D
1D3F 4C                FCC   /LSR/
1D40 53
1D41 52
1D42 52                FCC   /ROR/
1D43 4F
1D44 52
1D45 41
1D46 53
1D47 52

1D48 41                FCC   /ASL/
1D49 53
1D4A 4C
1D4B 52                FCC   /ROL/
1D4C 4F
1D4D 4C
1D4E 44                FCC   /DEC/
1D4F 45
1D50 43
1D51 49                FCC   /INC/
1D52 4E
1D53 43
1D54 54                FCC   /TST/
1D55 53
1D56 54
1D57 43                FCC   /CLR/
1D58 4C
1D59 52
1D5A 4A                FCC   /JMP/
1D5B 4D
1D5C 50
1D5D 53                FCC   /SUB/
1D5E 55
1D5F 42
1D60 43                FCC   /CMP/
1D61 4D
1D62 50
1D63 53                FCC   /SBC/
1D64 42
1D65 43
1D66 41                FCC   /AND/
1D67 4E
1D68 44
1D69 42                FCC   /BIT/
1D6A 49
1D6B 54
1D6C 4C                FCC   /LDA/
1D6D 44
1D6E 41
1D6F 45                FCC   /EOR/
1D70 4F
1D71 52
1D72 41                FCC   /ADC/
1D73 44
1D74 43
1D75 4F                FCC   /ORA/
1D76 52
1D77 41
1D78 41                FCC   /ADD/
1D79 44
1D7A 44
1D7B 43                FCC   /CPX/
1D7C 50
1D7D 58
1D7E 42                FCC   /BSR/
1D7F 53
1D80 52
1D81 4A                FCC   /JSR/
1D82 53
1D83 52
1D84 4C                FCC   /LDS/
1D85 44
1D86 53
1D87 54                FCC   /STS/
1D88 53
1D89 52
1D8A 4C                FCC   /LDX/
1D8B 44
1D8C 58
1D8D 53                FCC   /STX/
1D8E 54
1D8F 58
1D90 52

                       * OPCODES
                       * COL 1
1D91 0001      OPS     FDB   $0001
1D93 0101              FDB   $0101
1D95 0201              FDB   $0201
1D97 0001              FDB   $0001
1D99 0001              FDB   $0001
1D9B 0001              FDB   $0001
1D9D 0001              FDB   $0001
1D9F 0201              FDB   $0201
1DA1 0701              FDB   $0701
1DA3 0401              FDB   $0401
1DA5 0501              FDB   $0501
1DA7 0001              FDB   $0001
1DA9 0701              FDB   $0701
1DAB 0001              FDB   $0001
1DAD 0901              FDB   $0901
1DAF 0001              FDB   $0001
1DB1 0001              FDB   $0001
1DB3 0001              FDB   $0001
1DB5 0001              FDB   $0001
1DB7 0001              FDB   $0001
1DB9 0001              FDB   $0001
1DBB 0001              FDB   $0001
1DBD 0001              FDB   $0001
1DBF 0E01              FDB   $0E01
1DC1 0F01              FDB   $0F01
1DC3 0001              FDB   $0001
1DC5 1001              FDB   $1001
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1DD9 1401              FDB   $1401
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1DEB 1D01              FDB   $1D01
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1E17 0001              FDB   $0001
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1E1D 0001              FDB   $0001
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1EBF 3C02           FDB   $3C02
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1EDF 3C02           FDB   $3C02
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1EE9 4002           FDB   $4002
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TMP      100B
BAP      100C
LIN      100E
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AGN      1E3C
NOC      1050
NOD      1E5C
MORE     1087
NOE      109F
NOF      10A5
NOG      10AE
BREG     1005
SREG     1007
NOTBAD   10E0
INM      1007
NOTIMM   100C
NOOPR    102C
INDXD    1039
NOTX     1045
NOLAD    1062
REL      1069
NNREL    106F
CCH      107D
CBHLH    1096
CBHAH    109A
CAHOK    10A4
BINIT    1027
PDATA2   10A7
PDATA1   10A5
OUTCH    10AC
PLUP     10B2
NNET     10B5
OPS      1093

TOTAL ERRORS 00000
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PROGRAM NAME _____ WRITTEN BY _____

DATE SUBMITTED _____ PAGE _____ OF _____

ACTUAL LOCATION	PSEUDO ADDRESS	#	MNEMONIC INSTRUCTIONS & DATA	OCTAL CODE	COMMENTS
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2C9A			80		
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2C9D			# 45		
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2C9F			80		
2CA0			00		
2CA1		39	RTS		
2CAC		C6	LDA.B	02	
2CAD			02		
2CAE		F5	BIT B	8000	
2CAF			80		
2CB0			00		
2CB1		27	BEQ.	2CAE	
2CB2			FB.		

PROGRAM NAME _____ WRITTEN BY _____

DATE SUBMITTED _____ PAGE _____ OF _____

OCTAL LOCATION	PSEUDO ADDRESS	#	MNEMONIC INSTRUCTIONS & DATA	OCTAL CODE	COMMENTS
1CB3		B7	STA. A.	8001	
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1CB7		39	RTS		