



**BM873**  
**restart/loader**

pdp11

digital



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**restart/loader**

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# CHAPTER 1

## DESCRIPTION

### 1.1 INTRODUCTION

This manual describes the operation and theory of the BM873 Restart/Loader. This option is intended for use with the PDP-11 family of processors. The BM873

- serves as general purpose loader for processors of the 11 family,
- contains bootstrap loaders for all common devices,
- provides the capability of loading with a "hidden console",
- permits starting from several sources e.g., pushbutton, Watchdog Timer, MODEM control, power fail, etc.,
- gives PDP-11 systems an initial program load capability,
- contains at least four starting addresses, and
- permits the calling of a special user ROM program.

It is assumed that the reader is thoroughly familiar with the operation of the PDP-11 processor with which this option is used.

### 1.2 GENERAL DESCRIPTION

The BM873 option is contained on a quad-height, extended length module that plugs into a small peripheral controller (SPC) slot. There are four versions of the BM873, YA, YB, YC, and YD. They are described in Table 1-1.

The programs contained in the BM873 can be loaded either from the processor console (Load Address and Start), by a JMP instruction in the program, or by an external contact closure or voltage level. An 8-pin Mate-N-Lok connector is used for the external interface. BM873 specifications are listed in Table 1-2.

### 1.3 FUNCTIONAL DESCRIPTION

The BM873 consists of two basic sections: the Restart Sequencer and the ROM.

Figure 1-1 shows the remote start timing. The Restart Sequencer takes contact closures or voltage levels and, after filtering and delaying, sets one of four Start Address Select flip-flops. The setting of one of the flip-flops causes the Begin Load Sequence flip-flop to set, this, in turn, initiates two one-shots to create a BUS AC LO/BUS DC LO

**Table 1-1**  
**Description of BM873 Versions**

| Version Designation | ROM Size                          | Description                                                                                                                          |
|---------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| BM873-YA            | 128 words<br>(256 words optional) | Contains bootstrap loader programs for several peripheral devices (RF11, RK11, TC11, etc.).                                          |
| BM873-YB            | 256 words                         | Contains bootstrap loader programs for the devices contained in the YA version, plus programs for the Massbus devices.               |
| BM873-YC            | 256 words                         | Contains bootstrap loader programs for the devices contained in the YA version, plus the program for the DU11 Synchronous Interface. |
| BM873-YD            | 256 words                         | Contains bootstrap loader programs for the TC11 DFCtape, RH11/RP04 Disk, and the DFE20 I/O11 Interface.                              |

**Table 1-2**  
**BM873 Specifications**

|                       |                                              |
|-----------------------|----------------------------------------------|
| Capacity              |                                              |
| BM873-YA              | 128 words, read only<br>(256 words optional) |
| BM873-YB, YC, YD      | 256 words, read only                         |
| Word length           | 16 bits                                      |
| ROM cycle time        | 500 ns                                       |
| Voltage requirements  | +5 V $\pm$ 5%<br>-15 V $\pm$ 5%              |
| Current requirements  | 1.0 A max @ +5 V<br>2.0 mA max @ -15 V       |
| Operating temperature | 10° to 50° C                                 |
| Humidity              | 20% to 95%                                   |

sequence. The processor responds to the sequence by performing its normal power-down and power-up trap routines. Prior to the power-up sequence, however, the BM873 option asserts 773000 on the Unibus Address Lines. As a result, when the Program Counter (PC) and Processor Status Word (PSW) are restored, the data is taken from locations 773024/26 (nonvolatile memory systems) or from locations 773224/26 (volatile memory systems). Both of these addresses are locations within the HM873 option. The data from 773024 is 173000; the data from 773026 is 340, establishing a priority level of 7.

The data read from 773024 (173000) will have an offset address OR'd onto Offset Address bits 8 through 1, giving a range of 173000 to 173776. The offset address bits are enabled by one of the four Start Address Select flip-flops via a diode matrix (Paragraph 2.1.1). Each bootstrap loader program has its own starting address, and it is this address that is selected via the offset address bits.

In the BM873-YB, some of the bootstrap loader programs have two starting addresses. The first address automatically selects unit zero and the second address selects the unit specified in the switch register. See Appendix A for device starting addresses for all versions.

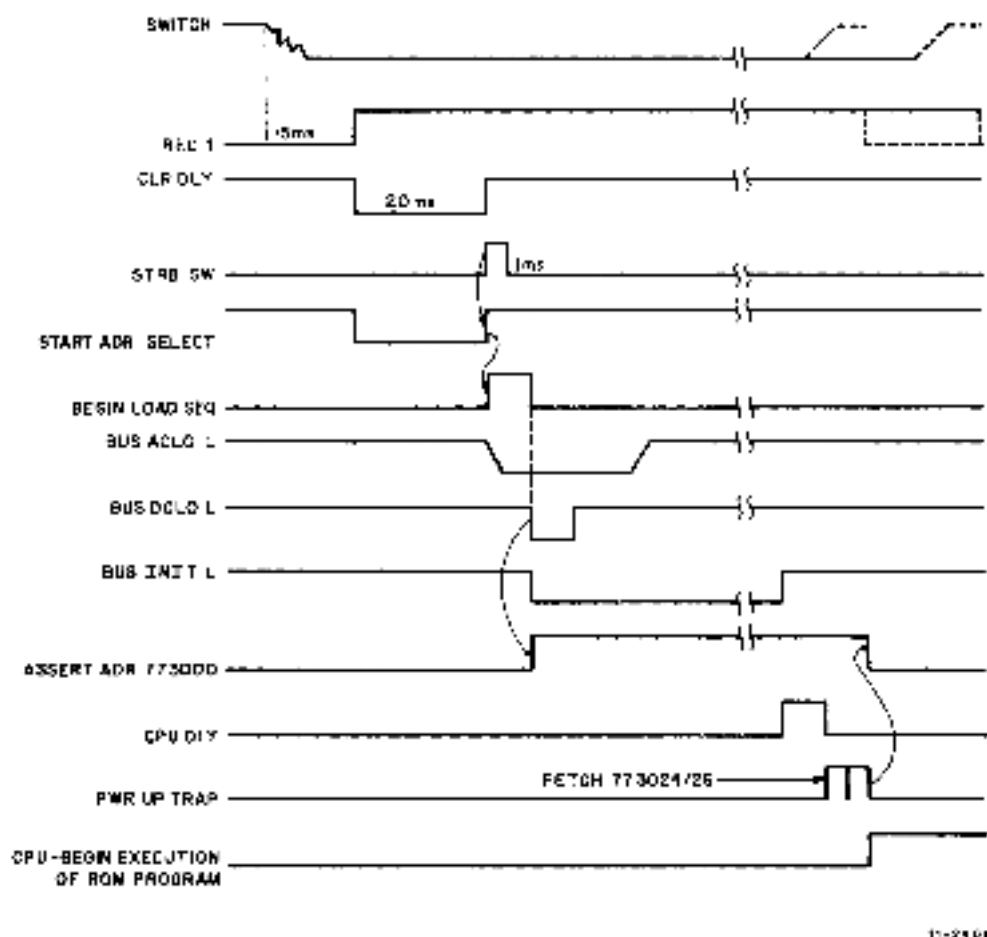


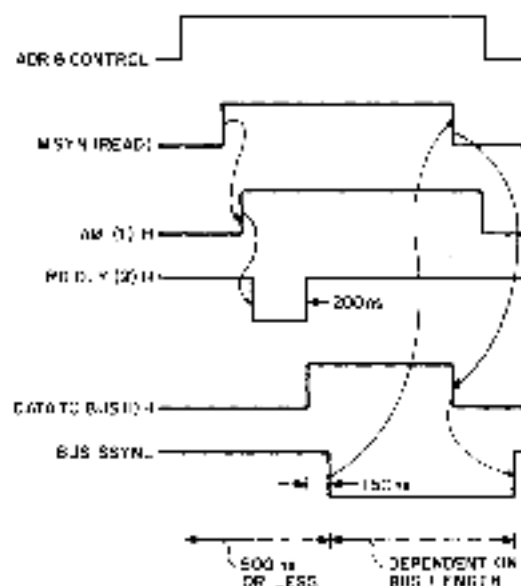
Figure J-1 Remote Start Timing

The following sequence of operations would be typical:

- Close external switch and wait for switch filter delay.
- Assert AC I/O, wait 6 ms.
- Assert DC I/O for 6 ms; then wait 8 ms.
- Drop AC I/O and assert address 773000.
- Wait for INIT to finish.
- The processor enters power-up routine.
- The BM873 option recognizes the fetch of address 773024 or 773224 and asserts 173XXX plus the 8-bit offset address to the data lines.
- The processor reads location 773026 or 773226 which is always 000140 (priority level 7).
- The processor fetches the next instruction from the ROM in address range 773000-773776. From this point, the bootstrap loader program contained in the ROM has control. (In the PDP-11/35 and PDP-11/40 systems, the PSW is fetched before the PC.)

If an actual power fail occurs in a nonvolatile memory system, the BM873 option does nothing, and the power-down and power-up traps work in the normal manner. If an actual power fail occurs in a volatile memory system, the power-up jumpers in the processor are set for 173224. During power-up the processor will fetch from 173224; the combination of address 773224 and no external lines asserted will cause the BM873 option to assert line 1 as a default case. Thus, in this case, the offset address selected for line 1 becomes the bootstrap loader call for power fail.

Data is read from the ROM in two bytes. Address bits 7 through 1 are present at all times via the bus receivers. Address bit 0 is generated on the module. A0 is always clear prior to a read cycle. The asserting of A0 clocks the first byte into a holding register and simultaneously changes the address to gate the second byte to the output drivers. After a delay of about 200 ns, the output gates are enabled and the ROM data is placed on the Unibus. SSYN is asserted about 150 ns later, completing the read cycle. Figure 1-2 illustrates memory read timing.



11-2407

Figure 1-2 Memory Read Timing

## CHAPTER 2

# INSTALLATION AND CHECKOUT

### 2.1 INSTALLATION

Normally the BM873 Restart/Loader is installed at the factory and no further installation is required. However, if this option is added to an existing system, it may be necessary to add wiring to make the AC LO and DC LO signals available. These signals are provided on the PDP-11/05 and PDP-11/45 processors, and on the DD11-B. On the PDP-11/15, PDP-11/20, PDP-11/35, PDP-11/40, and the DD11-A it is necessary to ensure that the SPC slot containing the BM873 has BUS AC LO and BUS DC LO wiring available as follows:

Pin CV1 to B01F1 or B04F1 (BUS AC LO)

Pin CN1 to B01F2 or B04F2 (BUS DC LO)

If the wiring is not present, it must be added by hand-wiring, using a wire color different from that of the existing backplane wiring.

#### NOTE

The BM873 option must be on the CPU side of any bus buffer.

#### 2.1.1 Start Address Selection

Each of the four external interface circuits has an associated address which must be specified for that circuit to be addressed. Each address consists of a fixed high-order portion (773XXX) and a low-order portion (bits 8 through 1) that is selected by adding or cutting diodes (Figure 2-1). With the diode in, a 1 is placed on the Unibus. With the diode out, a 0 is placed on the Unibus. When adding diodes, a low-wattage iron should be used and care should be taken with the plated mounting holes, so that the plating is not filled from the laminate by the heat. The diodes (DEC type 664 or IN3606) should be positioned so that their cathodes point toward the gold fingers of the module.

Appendix A lists starting addresses for various devices used with the BM873-YA, -YB, -YC and -YD Restart/Loaders. The three rightmost digits of the address represent the low-order portion to be selected via diodes.

The diagnostic program for this option contains a listing of the loader program in the comments portion of the Data Compare section. That diagnostic will be updated to contain the starting addresses and listing of future variations.

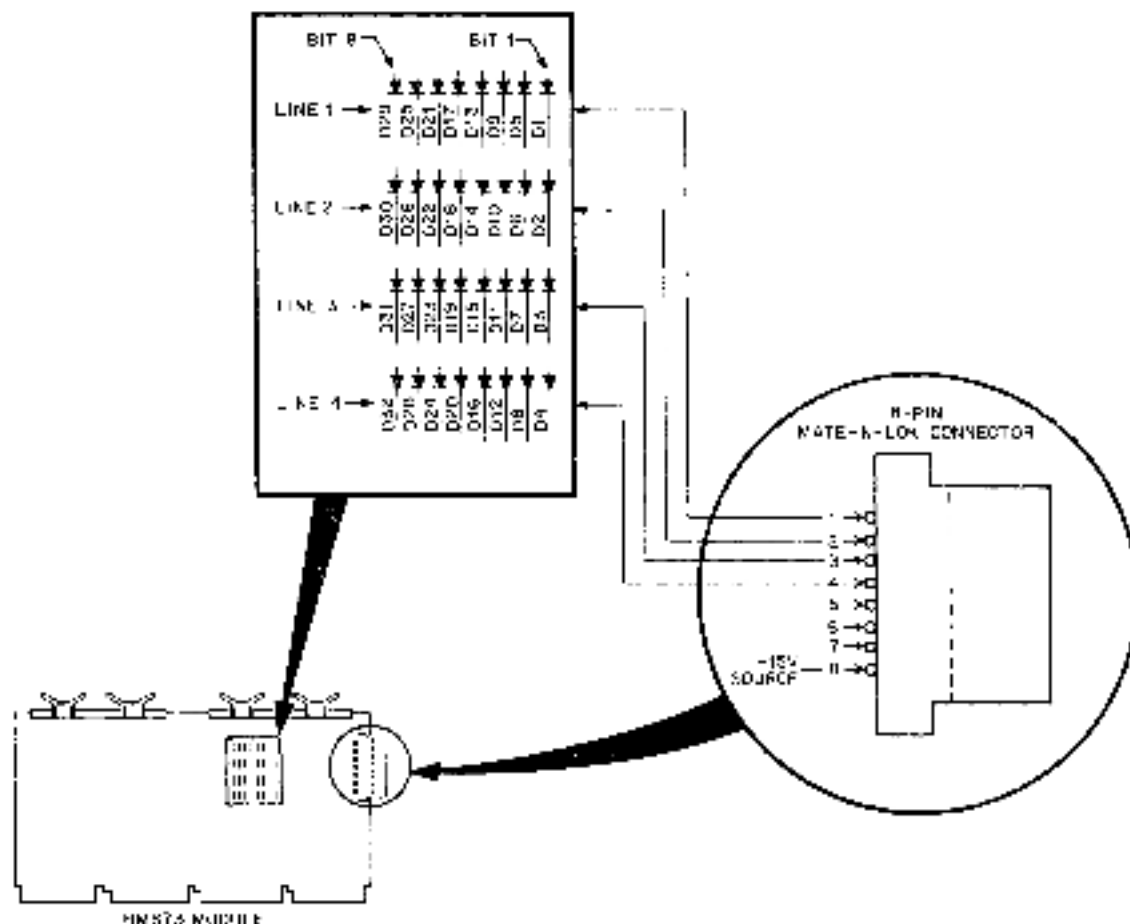


Figure 2-1 External Interface Circuit Diode Matrix

### 2.1.2 Jumper Selection

The BM873 module contains three jumpers that are marked with the numerals 1, 2, and 3. Jumpers 1 and 2 are used to compensate for differences between the PDP-11/40 and 11/35 and all other PDP-11 family processors. Jumper 1 should be installed when the option is used with either the PDP-11/40 or the PDP-11/35. Jumper 2 should be installed for use with any other processor in the PDP-11 family. For the BM873-YD, jumper 1 is always installed and jumper 2 is always removed. Resistor R3 is also removed on the BM873-YD.

Jumper 3 controls access to an extra 128 words of ROM. When this jumper is out, additional addresses from 773400 to 773776 become available. For the BM873-YB, -YC, and -YD versions, this jumper is always out.

### 2.1.3 CPU Addressing with Volatile Memory

When this option is used in computers with volatile memory, the power fail trap address must be jumpered to 773224 if automatic reloading is desired.

For a PDP-11/45 CPU, install jumpers W6, W3, and W1 on the M8100 board. This will provide an address of 773224.

For a PDP-11/40 CPU, connect jumper W7 on the M7235 board for a binary 1. This jumper will provide an address of 7732XX. The last two digits are provided by jumpers 4 and 2.

## 2.2 CHECKOUT

The diagnostic program for the BM873 option is MAINDEC-11-DZBMD-D. This program starts with a dialogue and is self-explanatory. As new ROM programs are implemented, this diagnostic may be modified. However, the basic version may be used on all option variations as long as the user visually checks the ROM data following the first pass.

The diagnostic contains the instructions for its own operation. The opening dialogue establishes which option variation (-YA, -YB, etc.) is being tested.



## CHAPTER 3 PROGRAMMING

This device is a Read-Only Memory and requires no programming. However, certain factors must be considered in system programming as the following paragraphs explain.

### 3.1 POWER FAIL PROGRAMMING

With the BMb73 option installed, the power-down/power-up routines may require modification, depending on the bootstrap used. Use of the external interface causes the power-fail sequence in the CPU when AC LO is detected going low; the power-up trap program is not used, and, therefore, not restored.

This is not a problem when a bootstrap loads into core and over-writes location 24, because the new program will set up the power-fail routine. However, if the new program does not reload location 24, the next power-fail sequence (may be real) will find the power-up restore program instead of the power-down routine.

This condition can be resolved by the power-fail routine testing this option with any DATT instruction. The combination of this option and a real power-fail will cause the DATT to perform in a normal manner. The combination of this option and the external interface active (causing the AC LO and trap) will cause a nonexistent device trap (no SSYN) to location 4.

```

                                MOV          #18,@#4          ; TRAP CATCHER
                                CLR          @#6
                                TST          @#173000         ; DEV BLIND?
                                NOP
25:    MOV          #PWRUP,@#24          ; REAL PWR FAIL
                                (SAVE ROUTINE)
18:    HALT

```

#### Example 1

The above program works because this option goes "blind" (will not return SSYN) when it has been activated by an external interface signal. This condition continues from the assertion of AC LO until the release of DC LO.

### 3.2 REGISTER DESCRIPTION

There are no registers in this device. There are four flip-flops that can be loaded for diagnostic purposes but they cannot be read.



## CHAPTER 4

### OPTIONS

#### 4.1 USER CUSTOM PROGRAM FOR THE BM873-YA

Two etched circuit positions on the BM873-YA board provide an extra 128 words of ROM. To add this extra memory capacity, Jumper 3 must be cut, permitting address recognition of all 256 words.

Figure 4-1 is a sample ROM program data sheet that can be helpful in programming the ROMs. Columns 1 and 2 contain the PDP-11 program listing. From the address data in column 1, the ROM starting address can be determined and the offset diodes cut (diode = 1; no diode = 0). The data in column 2 must be expressed in binary form as in columns 3 and 4. (Note that byte 1 is moved to the line below that of the original entry.) The eight binary digits for each byte are then shifted into columns 5 and 6 under the ROM B and ROM A headings, respectively. Columns 7 and 8 contain the resulting ROM address in binary and decimal form, respectively. Column 9 consists of four columns of decimal addresses, distinguished by the configuration of the 2 MSB of the binary address. Each program data sheet contains 64 ROM locations (32 words); hence four sheets are required to encode all 128 words. Therefore, only one of the four subcolumns of decimal addresses actually applies for each sheet, and the other three should be crossed out to avoid confusion. The 2-column checklist between columns 7 and 8 can be used for checkoff purposes, e.g., checking off ROMs as they are blasted.

A blank program data sheet is included in Chapter 6 to assist the user in programming the read-only memory of the BM873.

Customers who wish to create their own programs can purchase PROMs from integrated circuit vendors or distributors. Some distributors have programming capabilities so that programmed ROMs can be purchased. The following PROMs have been found acceptable:

Intersil type 5603A  
Monolithic Memories Inc. type 6300

The following PROMs have not been tested but according to the manufacturer's data should be acceptable. Any PROM that is specified to be "pin compatible with the 74187" should work in this application.

National Semiconductor type DM8573  
Signetics type 82S26

| Program Listing |            |            |            | ROM Program Data Sheet |         |            |   | 32 Word Block |   |   |    | Address Bits 7 & 6 |     |     |     | Sheet of 4 |   |   |   |
|-----------------|------------|------------|------------|------------------------|---------|------------|---|---------------|---|---|----|--------------------|-----|-----|-----|------------|---|---|---|
| Addr.           | Byte       | Byte "1"   | Byte "0"   | ROM "H"                | ROM "A" | ROM add.   |   | A             | B |   |    | 7.6                | 7.5 | 7.4 | 7.3 | 1          | 2 | 3 | 4 |
| 173000 010702   | 11 000 010 | 11 000 010 | 11 000 010 | 11 000 010             | 00 010  | 00 010 000 | ✓ | ✓             | ✓ | ✓ | 0  | 64                 | 128 | 192 | 197 |            |   |   |   |
| 173002 000455   | 00 101 101 | 00 101 101 | 00 101 101 | 00 101 101             | 11 01   | 00 00 010  | ✓ | ✓             | ✓ | ✓ | 1  | 65                 | 129 | 193 | 194 |            |   |   |   |
| 173004 177462   | 00 110 010 | 00 110 010 | 00 110 010 | 00 110 010             | 00 110  | 00 00 100  | ✓ | ✓             | ✓ | ✓ | 4  | 68                 | 132 | 196 | 198 |            |   |   |   |
| 173006 000005   | 00 000 101 | 00 000 101 | 00 000 101 | 00 000 101             | 01 01   | 00 00 110  | ✓ | ✓             | ✓ | ✓ | 5  | 69                 | 133 | 197 | 199 |            |   |   |   |
| 173010 010702   | 11 000 010 | 11 000 010 | 11 000 010 | 11 000 010             | 00 10   | 00 10 000  | ✓ | ✓             | ✓ | ✓ | 8  | 72                 | 136 | 200 | 201 |            |   |   |   |
| 173012 000455   | 00 101 001 | 00 101 001 | 00 101 001 | 00 101 001             | 10 01   | 00 10 010  | ✓ | ✓             | ✓ | ✓ | 9  | 73                 | 137 | 201 | 202 |            |   |   |   |
| 173014 177406   | 00 000 000 | 00 000 000 | 00 000 000 | 00 000 000             | 01 10   | 00 11 000  | ✓ | ✓             | ✓ | ✓ | 13 | 77                 | 141 | 205 | 206 |            |   |   |   |
| 173070 176716   | 11 001 110 | 11 001 110 | 11 001 110 | 11 001 110             | 11 00   | 11 10 000  | ✓ | ✓             | ✓ | ✓ | 56 | 120                | 184 | 248 | 249 |            |   |   |   |
| 173072 000005   | 00 000 101 | 00 000 101 | 00 000 101 | 00 000 101             | 01 01   | 11 10 010  | ✓ | ✓             | ✓ | ✓ | 58 | 123                | 187 | 250 | 251 |            |   |   |   |
| 173074 010702   | 11 000 010 | 11 000 010 | 11 000 010 | 11 000 010             | 00 10   | 11 11 000  | ✓ | ✓             | ✓ | ✓ | 60 | 126                | 188 | 252 | 253 |            |   |   |   |
| 173076 000417   | 00 001 111 | 00 001 111 | 00 001 111 | 00 001 111             | 00 00   | 11 11 111  | ✓ | ✓             | ✓ | ✓ | 62 | 129                | 190 | 254 | 255 |            |   |   |   |

Figure 4-1 Sample ROM Program Data Sheet

(Choose one  
of four  
sheets, cross  
out the  
other three  
address bits.)

## CHAPTER 5

### INTERFACE

The external interface consists of four separate high-impedance receivers with 4.7-kilohm resistors in series with each one. A  $-15\text{ V}$  source is provided through 10 kilohms to facilitate the use of contact closures. The external interface also accepts single-ended voltage inputs. A signal of 0.5 mA at  $-4\text{ V}$  or greater will cause a Restart sequence. The maximum permissible input is  $\pm 25\text{ V}$ .

These inputs are filtered with RC networks and Schmitt triggers and have a time delay of approximately 10 to 15 ms. The signal must remain for at least 150 ms. Only one external line may be active at a time; two or more active at the time of the sample will cause a race condition until one wins, but the result will be indeterminate.

The interface connector is an 8-pin male Mate-N-Lok (DEC Part Number 13-09340-01). Five pins (D5C Part Number 12-09376) are required for connection—placed as shown in Figure 2-1.

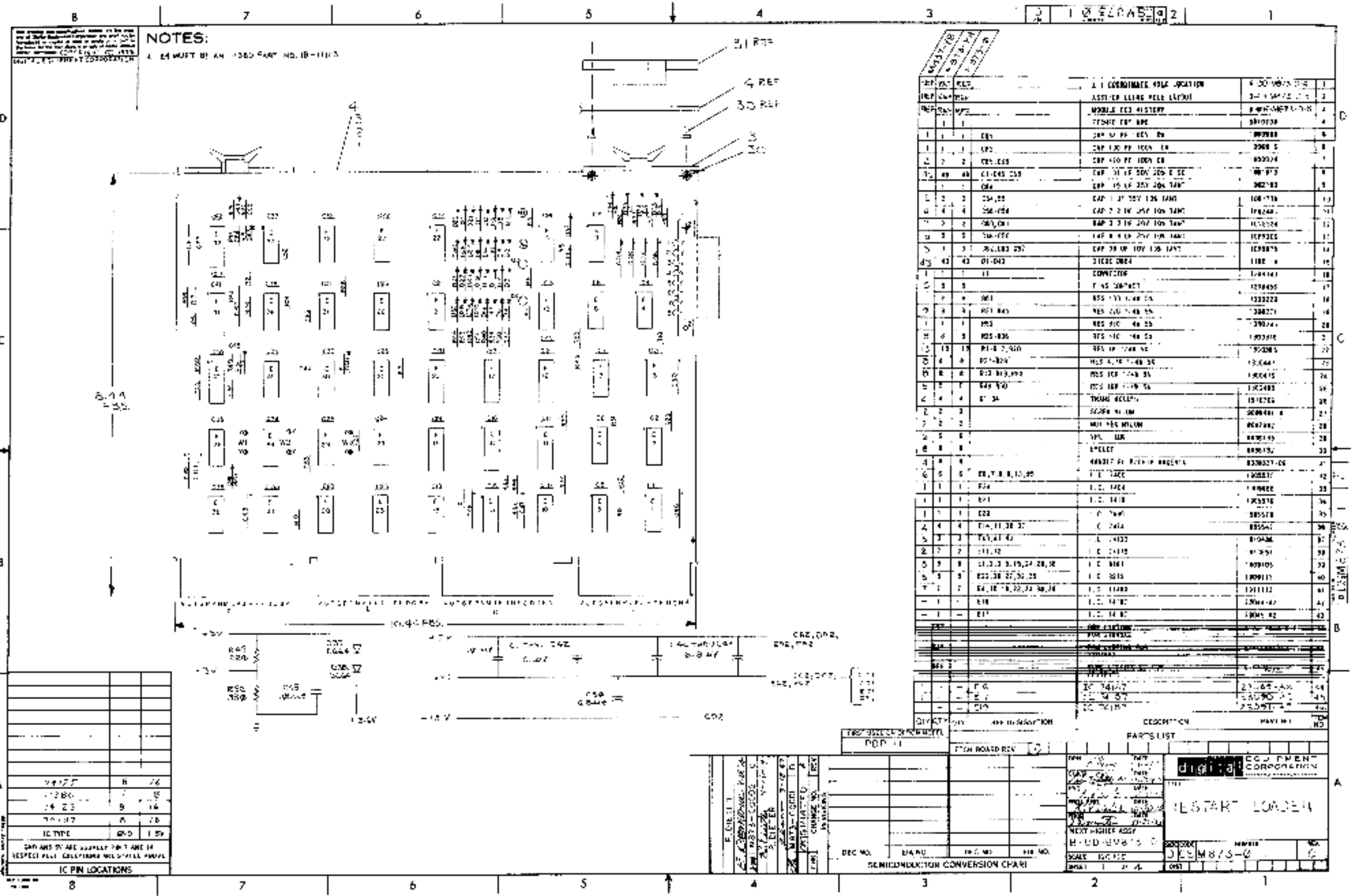


## CHAPTER 6

### ENGINEERING DRAWINGS

This chapter contains the 4-sheet engineering drawing of the BM873 (J1-CS-M873-0-1) and a blank program data sheet for use in programming the read-only memory of this option. Use of these sheets is described in Chapter 4 of this manual.





**NOTES:**

1. 24 WUFT BY AN (320) PART NO. 18-11113

USE APPROVED MANUFACTURERS' PARTS. IN THE EVENT OF A DEFECTIVE COMPONENT, THE USER SHALL BE RESPONSIBLE FOR REPLACING THE DEFECTIVE COMPONENT WITH A PART OF THE SAME OR BETTER QUALITY. THE USER SHALL BE RESPONSIBLE FOR THE PROPER INSTALLATION OF THE COMPONENTS.

| REF. DES. | QTY. | REF. DES. | QTY. | COORDINATE (X, Y) | COORDINATE (X, Y) |
|-----------|------|-----------|------|-------------------|-------------------|
| 1         | 1    | 1         | 1    | 100, 100          | 100, 100          |
| 2         | 1    | 2         | 1    | 200, 100          | 200, 100          |
| 3         | 1    | 3         | 1    | 300, 100          | 300, 100          |
| 4         | 1    | 4         | 1    | 400, 100          | 400, 100          |
| 5         | 1    | 5         | 1    | 500, 100          | 500, 100          |
| 6         | 1    | 6         | 1    | 600, 100          | 600, 100          |
| 7         | 1    | 7         | 1    | 700, 100          | 700, 100          |
| 8         | 1    | 8         | 1    | 800, 100          | 800, 100          |
| 9         | 1    | 9         | 1    | 900, 100          | 900, 100          |
| 10        | 1    | 10        | 1    | 1000, 100         | 1000, 100         |
| 11        | 1    | 11        | 1    | 1100, 100         | 1100, 100         |
| 12        | 1    | 12        | 1    | 1200, 100         | 1200, 100         |
| 13        | 1    | 13        | 1    | 1300, 100         | 1300, 100         |
| 14        | 1    | 14        | 1    | 1400, 100         | 1400, 100         |
| 15        | 1    | 15        | 1    | 1500, 100         | 1500, 100         |
| 16        | 1    | 16        | 1    | 1600, 100         | 1600, 100         |
| 17        | 1    | 17        | 1    | 1700, 100         | 1700, 100         |
| 18        | 1    | 18        | 1    | 1800, 100         | 1800, 100         |
| 19        | 1    | 19        | 1    | 1900, 100         | 1900, 100         |
| 20        | 1    | 20        | 1    | 2000, 100         | 2000, 100         |
| 21        | 1    | 21        | 1    | 2100, 100         | 2100, 100         |
| 22        | 1    | 22        | 1    | 2200, 100         | 2200, 100         |
| 23        | 1    | 23        | 1    | 2300, 100         | 2300, 100         |
| 24        | 1    | 24        | 1    | 2400, 100         | 2400, 100         |
| 25        | 1    | 25        | 1    | 2500, 100         | 2500, 100         |
| 26        | 1    | 26        | 1    | 2600, 100         | 2600, 100         |
| 27        | 1    | 27        | 1    | 2700, 100         | 2700, 100         |
| 28        | 1    | 28        | 1    | 2800, 100         | 2800, 100         |
| 29        | 1    | 29        | 1    | 2900, 100         | 2900, 100         |
| 30        | 1    | 30        | 1    | 3000, 100         | 3000, 100         |
| 31        | 1    | 31        | 1    | 3100, 100         | 3100, 100         |
| 32        | 1    | 32        | 1    | 3200, 100         | 3200, 100         |

| IC TYPE | QTY. | REF. DES. | QTY. |
|---------|------|-----------|------|
| 7418    | 1    | 1         | 1    |
| 7419    | 1    | 2         | 1    |
| 7420    | 1    | 3         | 1    |
| 7421    | 1    | 4         | 1    |
| 7422    | 1    | 5         | 1    |
| 7423    | 1    | 6         | 1    |
| 7424    | 1    | 7         | 1    |
| 7425    | 1    | 8         | 1    |
| 7426    | 1    | 9         | 1    |
| 7427    | 1    | 10        | 1    |
| 7428    | 1    | 11        | 1    |
| 7429    | 1    | 12        | 1    |
| 7430    | 1    | 13        | 1    |
| 7431    | 1    | 14        | 1    |
| 7432    | 1    | 15        | 1    |
| 7433    | 1    | 16        | 1    |
| 7434    | 1    | 17        | 1    |
| 7435    | 1    | 18        | 1    |
| 7436    | 1    | 19        | 1    |
| 7437    | 1    | 20        | 1    |
| 7438    | 1    | 21        | 1    |
| 7439    | 1    | 22        | 1    |
| 7440    | 1    | 23        | 1    |
| 7441    | 1    | 24        | 1    |
| 7442    | 1    | 25        | 1    |
| 7443    | 1    | 26        | 1    |
| 7444    | 1    | 27        | 1    |
| 7445    | 1    | 28        | 1    |
| 7446    | 1    | 29        | 1    |
| 7447    | 1    | 30        | 1    |
| 7448    | 1    | 31        | 1    |
| 7449    | 1    | 32        | 1    |

| REF. DES. | QTY. | REF. DES. | QTY. |
|-----------|------|-----------|------|
| 7418      | 1    | 1         | 1    |
| 7419      | 1    | 2         | 1    |
| 7420      | 1    | 3         | 1    |
| 7421      | 1    | 4         | 1    |
| 7422      | 1    | 5         | 1    |
| 7423      | 1    | 6         | 1    |
| 7424      | 1    | 7         | 1    |
| 7425      | 1    | 8         | 1    |
| 7426      | 1    | 9         | 1    |
| 7427      | 1    | 10        | 1    |
| 7428      | 1    | 11        | 1    |
| 7429      | 1    | 12        | 1    |
| 7430      | 1    | 13        | 1    |
| 7431      | 1    | 14        | 1    |
| 7432      | 1    | 15        | 1    |
| 7433      | 1    | 16        | 1    |
| 7434      | 1    | 17        | 1    |
| 7435      | 1    | 18        | 1    |
| 7436      | 1    | 19        | 1    |
| 7437      | 1    | 20        | 1    |
| 7438      | 1    | 21        | 1    |
| 7439      | 1    | 22        | 1    |
| 7440      | 1    | 23        | 1    |
| 7441      | 1    | 24        | 1    |
| 7442      | 1    | 25        | 1    |
| 7443      | 1    | 26        | 1    |
| 7444      | 1    | 27        | 1    |
| 7445      | 1    | 28        | 1    |
| 7446      | 1    | 29        | 1    |
| 7447      | 1    | 30        | 1    |
| 7448      | 1    | 31        | 1    |
| 7449      | 1    | 32        | 1    |

| REF. DES. | QTY. | REF. DES. | QTY. |
|-----------|------|-----------|------|
| 7418      | 1    | 1         | 1    |
| 7419      | 1    | 2         | 1    |
| 7420      | 1    | 3         | 1    |
| 7421      | 1    | 4         | 1    |
| 7422      | 1    | 5         | 1    |
| 7423      | 1    | 6         | 1    |
| 7424      | 1    | 7         | 1    |
| 7425      | 1    | 8         | 1    |
| 7426      | 1    | 9         | 1    |
| 7427      | 1    | 10        | 1    |
| 7428      | 1    | 11        | 1    |
| 7429      | 1    | 12        | 1    |
| 7430      | 1    | 13        | 1    |
| 7431      | 1    | 14        | 1    |
| 7432      | 1    | 15        | 1    |
| 7433      | 1    | 16        | 1    |
| 7434      | 1    | 17        | 1    |
| 7435      | 1    | 18        | 1    |
| 7436      | 1    | 19        | 1    |
| 7437      | 1    | 20        | 1    |
| 7438      | 1    | 21        | 1    |
| 7439      | 1    | 22        | 1    |
| 7440      | 1    | 23        | 1    |
| 7441      | 1    | 24        | 1    |
| 7442      | 1    | 25        | 1    |
| 7443      | 1    | 26        | 1    |
| 7444      | 1    | 27        | 1    |
| 7445      | 1    | 28        | 1    |
| 7446      | 1    | 29        | 1    |
| 7447      | 1    | 30        | 1    |
| 7448      | 1    | 31        | 1    |
| 7449      | 1    | 32        | 1    |







ROM Program Data Sheet - 32,000 Word Block

| Program Listing |      | Octal List |           | ROM "B" | ROM "A" | ROM Addr.   |   |   | Address Bits 7 & 6 |     |     |     |
|-----------------|------|------------|-----------|---------|---------|-------------|---|---|--------------------|-----|-----|-----|
| Addr.           | Data | Byte "I"   | Byte "II" | 3 2 1 0 | 3 2 1 0 | 5 4 3 2 1 0 | A | B | 7 6                | 7 6 | 7 6 | 7 6 |
|                 |      |            |           |         |         |             |   |   | 00                 | 01  | 10  | 11  |
|                 |      |            |           |         |         | 0 0 0 0 0 0 |   |   | 0                  | 64  | 128 | 192 |
|                 |      |            |           |         |         | 0 0 0 0 0 1 |   |   | 1                  | 65  | 129 | 193 |
|                 |      |            |           |         |         | 0 0 0 0 1 0 |   |   | 2                  | 66  | 130 | 194 |
|                 |      |            |           |         |         | 0 0 0 0 1 1 |   |   | 3                  | 67  | 131 | 195 |
|                 |      |            |           |         |         | 0 0 0 1 0 0 |   |   | 4                  | 68  | 132 | 196 |
|                 |      |            |           |         |         | 0 0 0 1 0 1 |   |   | 5                  | 69  | 133 | 197 |
|                 |      |            |           |         |         | 0 0 0 1 1 0 |   |   | 6                  | 70  | 134 | 198 |
|                 |      |            |           |         |         | 0 0 0 1 1 1 |   |   | 7                  | 71  | 135 | 199 |
|                 |      |            |           |         |         | 0 0 1 0 0 0 |   |   | 8                  | 72  | 136 | 200 |
|                 |      |            |           |         |         | 0 0 1 0 0 1 |   |   | 9                  | 73  | 137 | 201 |
|                 |      |            |           |         |         | 0 0 1 0 1 0 |   |   | 10                 | 74  | 138 | 202 |
|                 |      |            |           |         |         | 0 0 1 0 1 1 |   |   | 11                 | 75  | 139 | 203 |
|                 |      |            |           |         |         | 0 0 1 1 0 0 |   |   | 12                 | 76  | 140 | 204 |
|                 |      |            |           |         |         | 0 0 1 1 0 1 |   |   | 13                 | 77  | 141 | 205 |
|                 |      |            |           |         |         | 0 0 1 1 1 0 |   |   | 14                 | 78  | 142 | 206 |
|                 |      |            |           |         |         | 0 0 1 1 1 1 |   |   | 15                 | 79  | 143 | 207 |
|                 |      |            |           |         |         | 0 1 0 0 0 0 |   |   | 16                 | 80  | 144 | 208 |
|                 |      |            |           |         |         | 0 1 0 0 0 1 |   |   | 17                 | 81  | 145 | 209 |
|                 |      |            |           |         |         | 0 1 0 0 1 0 |   |   | 18                 | 82  | 146 | 210 |
|                 |      |            |           |         |         | 0 1 0 0 1 1 |   |   | 19                 | 83  | 147 | 211 |
|                 |      |            |           |         |         | 0 1 0 1 0 0 |   |   | 20                 | 84  | 148 | 212 |
|                 |      |            |           |         |         | 0 1 0 1 0 1 |   |   | 21                 | 85  | 149 | 213 |
|                 |      |            |           |         |         | 0 1 0 1 1 0 |   |   | 22                 | 86  | 150 | 214 |
|                 |      |            |           |         |         | 0 1 0 1 1 1 |   |   | 23                 | 87  | 151 | 215 |
|                 |      |            |           |         |         | 0 1 1 0 0 0 |   |   | 24                 | 88  | 152 | 216 |
|                 |      |            |           |         |         | 0 1 1 0 0 1 |   |   | 25                 | 89  | 153 | 217 |
|                 |      |            |           |         |         | 0 1 1 0 1 0 |   |   | 26                 | 90  | 154 | 218 |
|                 |      |            |           |         |         | 0 1 1 0 1 1 |   |   | 27                 | 91  | 155 | 219 |
|                 |      |            |           |         |         | 0 1 1 1 0 0 |   |   | 28                 | 92  | 156 | 220 |
|                 |      |            |           |         |         | 0 1 1 1 0 1 |   |   | 29                 | 93  | 157 | 221 |
|                 |      |            |           |         |         | 0 1 1 1 1 0 |   |   | 30                 | 94  | 158 | 222 |
|                 |      |            |           |         |         | 0 1 1 1 1 1 |   |   | 31                 | 95  | 159 | 223 |
|                 |      |            |           |         |         | 1 0 0 0 0 0 |   |   | 32                 | 96  | 160 | 224 |
|                 |      |            |           |         |         | 1 0 0 0 0 1 |   |   | 33                 | 97  | 161 | 225 |
|                 |      |            |           |         |         | 1 0 0 0 1 0 |   |   | 34                 | 98  | 162 | 226 |
|                 |      |            |           |         |         | 1 0 0 0 1 1 |   |   | 35                 | 99  | 163 | 227 |
|                 |      |            |           |         |         | 1 0 0 1 0 0 |   |   | 36                 | 100 | 164 | 228 |
|                 |      |            |           |         |         | 1 0 0 1 0 1 |   |   | 37                 | 101 | 165 | 229 |
|                 |      |            |           |         |         | 1 0 0 1 1 0 |   |   | 38                 | 102 | 166 | 230 |
|                 |      |            |           |         |         | 1 0 0 1 1 1 |   |   | 39                 | 103 | 167 | 231 |
|                 |      |            |           |         |         | 1 0 1 0 0 0 |   |   | 40                 | 104 | 168 | 232 |
|                 |      |            |           |         |         | 1 0 1 0 0 1 |   |   | 41                 | 105 | 169 | 233 |
|                 |      |            |           |         |         | 1 0 1 0 1 0 |   |   | 42                 | 106 | 170 | 234 |
|                 |      |            |           |         |         | 1 0 1 0 1 1 |   |   | 43                 | 107 | 171 | 235 |
|                 |      |            |           |         |         | 1 0 1 1 0 0 |   |   | 44                 | 108 | 172 | 236 |
|                 |      |            |           |         |         | 1 0 1 1 0 1 |   |   | 45                 | 109 | 173 | 237 |
|                 |      |            |           |         |         | 1 0 1 1 1 0 |   |   | 46                 | 110 | 174 | 238 |
|                 |      |            |           |         |         | 1 0 1 1 1 1 |   |   | 47                 | 111 | 175 | 239 |
|                 |      |            |           |         |         | 1 1 0 0 0 0 |   |   | 48                 | 112 | 176 | 240 |
|                 |      |            |           |         |         | 1 1 0 0 0 1 |   |   | 49                 | 113 | 177 | 241 |
|                 |      |            |           |         |         | 1 1 0 0 1 0 |   |   | 50                 | 114 | 178 | 242 |
|                 |      |            |           |         |         | 1 1 0 0 1 1 |   |   | 51                 | 115 | 179 | 243 |
|                 |      |            |           |         |         | 1 1 0 1 0 0 |   |   | 52                 | 116 | 180 | 244 |
|                 |      |            |           |         |         | 1 1 0 1 0 1 |   |   | 53                 | 117 | 181 | 245 |
|                 |      |            |           |         |         | 1 1 0 1 1 0 |   |   | 54                 | 118 | 182 | 246 |
|                 |      |            |           |         |         | 1 1 0 1 1 1 |   |   | 55                 | 119 | 183 | 247 |
|                 |      |            |           |         |         | 1 1 1 0 0 0 |   |   | 56                 | 120 | 184 | 248 |
|                 |      |            |           |         |         | 1 1 1 0 0 1 |   |   | 57                 | 121 | 185 | 249 |
|                 |      |            |           |         |         | 1 1 1 0 1 0 |   |   | 58                 | 122 | 186 | 250 |
|                 |      |            |           |         |         | 1 1 1 0 1 1 |   |   | 59                 | 123 | 187 | 251 |
|                 |      |            |           |         |         | 1 1 1 1 0 0 |   |   | 60                 | 124 | 188 | 252 |
|                 |      |            |           |         |         | 1 1 1 1 0 1 |   |   | 61                 | 125 | 189 | 253 |
|                 |      |            |           |         |         | 1 1 1 1 1 0 |   |   | 62                 | 126 | 190 | 254 |
|                 |      |            |           |         |         | 1 1 1 1 1 1 |   |   | 63                 | 127 | 191 | 255 |

Choose one of four sheets. Cross out the other three address lists.



## APPENDIX A

### DEVICE STARTING ADDRESSES

**BM873-YA Starting Addresses**

| Address | Device Type                                      |
|---------|--------------------------------------------------|
| 773000  | RF11 DECdisk                                     |
| 773010  | RK11 Disk                                        |
| 773020  | Transfer to address contained in switch register |
| 773060  | TC11 DECtape                                     |
| 773060  | TM11 DECmagtape                                  |
| 773100  | RP11 Disk Pack                                   |
| 773144  | RC11 Disk                                        |
| 773210  | KL11/DC11 Console TTY Reader                     |
| 773230  | TA11 Cassette                                    |
| 773312  | PC11 Paper Tape Reader                           |

**BM873-YB Starting Addresses**

| Address | Device Type                                                 |
|---------|-------------------------------------------------------------|
| 773000  | RI11/RS03/RS04 Disk (Unit zero)                             |
| 773002  | RH11/RS03/RS04 Disk (Unit specified in switch register)     |
| 773030  | RK11 Disk (Unit zero)                                       |
| 773032  | RK11 Disk (Unit specified in switch register)               |
| 773070  | TC11 DECtape                                                |
| 773110  | TM11 DECmagtape                                             |
| 773136  | RF11 DECdisk                                                |
| 773150  | RH11/TU16/TM02 Tape Drive                                   |
| 773212  | RC11 Disk                                                   |
| 773230  | RH11 Device Combination (Unit zero)*                        |
| 773231  | RH11 Device Combination (Unit specified in switch register) |
| 773320  | RH11/RP04 Disk (Unit zero)                                  |
| 773322  | RH11/RP04 Disk (Unit specified in switch register)          |
| 773344  | Transfer to address contained in switch register            |
| 773350  | RP11 Disk Pack (Unit zero)                                  |
| 773352  | RP11 Disk Pack (Unit specified in switch register)          |
| 773510  | KL11/DL11 Console TTY Reader                                |
| 773524  | TA11 Cassette (Unit zero)                                   |
| 773526  | TA11 Cassette (Unit specified in switch register)           |
| 773620  | PC11 Paper Tape Reader                                      |

\*If the TM02/TU16 is selected, the value in the console switch register is the position of the TM02 on the RH11, instead of the unit number on the TU16 drive. The slave unit number (number on TU16) should still be zero.

#### BM873-YC Starting Addresses

| Address | Device Type                                      |
|---------|--------------------------------------------------|
| 773000  | RF11 DECdisk                                     |
| 773010  | RK11 Disk                                        |
| 773020  | Transfer to address contained in switch register |
| 773030  | TC11 DECtape                                     |
| 773050  | TM11 DECmagtape                                  |
| 773100  | RP11 Disk Pack                                   |
| 773144  | RC11 Disk                                        |
| 773210  | KL11/DC11 Console TTY Reader                     |
| 773230  | TA11 Cassette                                    |
| 773312  | PC11 Paper Tape Reader                           |
| 773400  | DU11 Synchronous Interface                       |

#### BM873-YD Starting Addresses

| Address | Device Type                                      |
|---------|--------------------------------------------------|
| 773000  | Transfer to address contained in switch register |
| 773014  | TC11 DECtape                                     |
| 773304  | RH11/RP04 Disk                                   |
| 773534  | DFB20 10/11 Interface                            |

## Reader's Comments

BM873 RESTART/LOADER  
EK-BM873-TM-004

Your comments and suggestions will help us in our continuous effort to improve the quality and usefulness of our publications.

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-----  
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-----

-----  
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