

DR-111  
MEMORY SYSTEM  
INSTALLATION MANUAL

06011

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## 1.0 GENERAL INSTALLATION PROCEDURE

### 1.1 Introduction

Dataram Corporation's DR-111 memory system can be installed into various models of the PDP-11\* series computers, which are:

PDP-11/05  
PDP-11/10  
PDP-11/15  
PDP-11/20  
PDP-11/35  
PDP-11/40  
PDP-11/45  
ME11-L Expansion Unit  
MF11-L Assembly Unit

In general, the DR-111 memory system is inserted into the appropriate connectors so that the A and B plugs interface with the UNIBUS\* connectors. The component side of the DR-111 electronics board faces the same direction as the component side of the standard PDP-11 circuit boards. The DR-111 stack board, which is plugged into the rear of the DR-111 electronics board, blocks the next connector slot.

The DR-111 memory system will not operate in the following configurations: ME11-LP, MF11-LP, MF11-U, MF11-UB, MF11-UC, MF11-UP, MF11-UR and MF11-US.

The ME11-LP and MF11-LP assembly and expansion units are wired for the MM11-LP memories. These systems are 8K x 18 parity units. The DR-111 is a 16 bit word system and does not have the two parity bits for this configuration.

The MF11-U series assembly units are wired for the MM11-U and MM11-UP 16K x 16 or 18 memory systems. These memory modules utilize supply voltages which are different from the voltages used by the DR-111 modules. The DR-111 will be damaged if it is plugged into these assembly units!

### 1.2 Unpacking and Inspection

Each DR-111 is shipped in an individual, foam-lined shipping container for protection. This container and black plastic wrapper should be saved for future use if the unit is returned for repair.

After unpacking the DR-111, it is important to inspect the unit for obvious physical damage prior to installation.

\*PDP-11 and UNIBUS are registered trademarks of the Digital Equipment Corporation.

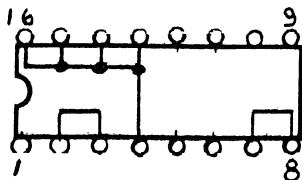
### 1.3 Address Strapping

Each memory module in a system must have a different block starting address to prevent more than one module from responding to the same address from the processor or DMA device. This is accomplished by "strapping" addresses A13 through A17 on each module via a 16-pin dual in-line strapping plug and socket and wire wrap jumpers. The initial address may be any of the following:

#### JUMPER LOCATIONS FOR MEMORY STRAPPING

| Initial Address | From Pin 2 To | From Pin 7 To | From Pin 4 To |          | Wire Wrap Jumpers |               |
|-----------------|---------------|---------------|---------------|----------|-------------------|---------------|
|                 |               |               | 8K            | 16K      | R To              | W To          |
| 0               | 3             | 8             | 16,15         | 16-13    | P                 | V             |
| 4K              | 3             | 8             | 15,14         | 15-12    | P                 | V             |
| 8K              | 3             | 8             | 14,13         | 14-11    | P                 | V             |
| 12K             | 3             | 8             | 13,12         | 13-10    | P                 | V             |
| 16K             | 3             | 8             | 12,11         | 12-9*    | P                 | V             |
| 20K             | 3             | 8             | 11,10         | 11-9 & 5 | U                 | V             |
| 24K             | 3             | N/C           | 10,9*         | 15 & 10  | P                 | U             |
| 32K             | 3             | 6             | 16,15         | 16-13    | P                 | V             |
| 40K             | 3             | 6             | 14,13         | 14-11    | P                 | V             |
| 48K             | 3             | 6             | 12,11         | 12-9     | P                 | V             |
| 56K             | 3             | N/C           | 10,9          | 9 & 5    | P                 | U             |
| 64K             | 1             | 8             | 16,15         | 16-13    | P                 | V             |
| 72K             | 1             | 8             | 14,13         | 14-11    | P                 | V             |
| 80K             | 1             | 8             | 12,11         | 12-9     | P                 | V             |
| 88K             | 1             | N/C           | 10,9          | 15 & 10  | P                 | U             |
| 96K             | 1             | 6             | 16,15         | 16-13    | P                 | V             |
| 104K            | 1             | 6             | 14,13         | 14-11    | P                 | V             |
| 112K            | 1             | 6             | 12,11         | 12-10    | P                 | V (124K Max.) |
| 120K            | 1             | N/C           | 10            | N/A      | P                 | U             |

\*Jumper T-S for 31K Operation



Plug shown for Initial Address of 0, 16K Memory System

#### 1.4 Address Strapping DEC\*MM11-L Memory System

When increasing the capacity of a PDP-11 computer, it may become necessary to remove one or more DEC MM11-L systems. For example, a PDP-11/05 with 16K of memory (two MM11-L systems) can be expanded to 24K by replacing one of the 8K MM11-L systems with a 16K DR-111 system.

As with the DR-111 system, the MM11-L systems are also "strapped" for different block starting addresses. For the given example, one module is strapped 0-8K and the other 8-16K.

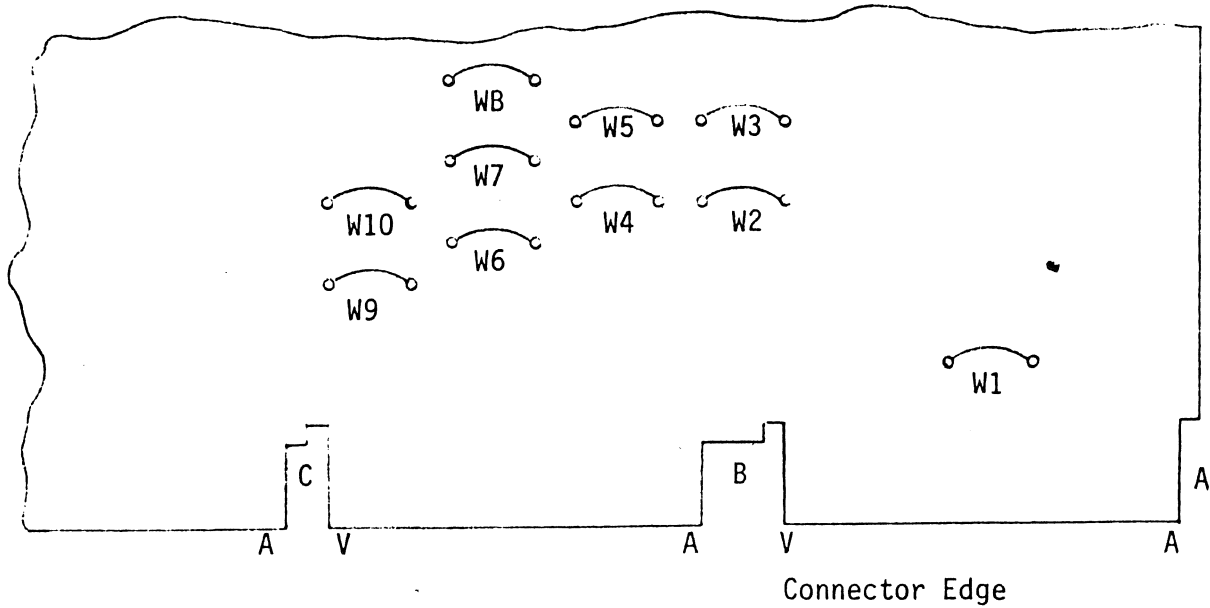
The modules strapped for 8-16K must be removed. This strapping, shown in Figure 1, is accomplished with four jumpers (W2, W3, W4 and W6) located on the G110 Control Module.

The MM11-L memory system consists of three modules: G110 Control Module, G231 Memory Driver Module, and H214 Memory Stack Module. All three modules must be removed when replacing an MM11-L with a DR-111.

\*DEC is a registered trademark of Digital Equipment Corporation

CONTROL MODULE G110

Component Side



Jumper locations W1, W5, W9 and W10 are shown for reference only.

Device Address Jumpers

| Memory Bank<br>(words) | W6          | W4  | W3  | W2   |
|------------------------|-------------|-----|-----|------|
|                        | A14 'or A01 | A15 | A16 | A17L |
| 0-8K                   | In          | In  | In  | In   |
| 8-16K                  | Out         | In  | In  | In   |
| 16-24K                 | In          | Out | In  | In   |
| 24-32K                 | Out         | Out | In  | In   |
| 32-40K                 | In          | In  | Out | In   |
| 40-48K                 | Out         | In  | Out | In   |
| 48-56K                 | In          | Out | Out | In   |
| 56-64K                 | Out         | Out | Out | In   |
| 64-72K                 | In          | In  | In  | Out  |
| 72-80K                 | Out         | In  | In  | Out  |
| 80-88K                 | In          | Out | In  | Out  |
| 88-96K                 | Out         | Out | In  | Out  |
| 96-104K                | In          | In  | Out | Out  |
| 104-112K               | Out         | In  | Out | Out  |
| 112-120K               | In          | Out | Out | Out  |
| 120-128K               | Out         | Out | Out | Out  |

DEC ADDRESS STRAPPING  
Figure 1

## 2.0 INSTALLATION IN PDP-11/05 and PDP-11/10

### 2.1 Standard DEC PDP-11/05 and PDP-11/10 Configurations

There are two configurations of the 5¼" PDP-11/05 and PDP-11/10 assembly units which are shown in Figure 2. The 10½" PDP-11/05 and PDP-11/10 assembly units have one configuration and this is shown in Figure 3.

Configuration 1 of the 5¼" unit is wired for 16K of DEC memory (6 boards) with one small peripheral controller slot.

Configuration 2 of the 5¼" assembly unit is wired for 8K of memory with four small peripheral controller slots.

The 10½" assembly unit is wired for 16K of memory. The computer chassis also has space available for 3 nine slot system units.

The DR-111 modules may be installed in various combinations with or without the MM11-L memories. No modification of the computer backplane is necessary. The following subsections describe typical memory configurations.

NOTE: When removing MM11-L memories, all three cards (G110, G231 and H214) must be removed. Verify and change, if necessary, address strapping of remaining MM11-L memories for contiguous address blocks starting from 0.

CONNECTOR COLUMNS

| A                  | B     | C                             | D | E | F | SLOT<br>▼ |
|--------------------|-------|-------------------------------|---|---|---|-----------|
| MAINT              | MAINT | **PERIPHERAL CONTROLLER       |   |   |   | 1         |
| *UNIBUS TERMINATOR |       | DEC MEMORY STACK 1 H214       |   |   |   | 2         |
|                    |       | *** DEC MEMORY DRIVER 1 G231  |   |   |   | 3         |
|                    |       | *** DEC MEMORY CONTROL 1 G110 |   |   |   | 4         |
| UNIBUS TERMINATOR  |       | DEC MEMORY STACK 2 H214       |   |   |   | 5         |
|                    |       | *** DEC MEMORY DRIVER 2 G231  |   |   |   | 6         |
|                    |       | *** DEC MEMORY CONTROL 2 G110 |   |   |   | 7         |
|                    |       | PROCESSOR                     |   |   |   | 8         |
|                    |       | PROCESSOR                     |   |   |   | 9         |

COMPONENT SIDE  
SOLDER SIDE

\*OR EXTERNAL CABLE  
\*\*OR GRANT CONTINUITY CARD  
\*\*\*UNIBUS IS WIRED IN THESE SLOTS

DEC PDP-11/05 and PDP-11/10 Standard Module Utilization  
Configuration 1 (16K)

CONNECTOR COLUMNS

| A                  | B     | C                           | D | E | F | SLOT<br>▼ |
|--------------------|-------|-----------------------------|---|---|---|-----------|
| UNUSED             |       | **PERIPHERAL CONTROLLER     |   |   |   | 1         |
| MAINT              | MAINT | **PERIPHERAL CONTROLLER     |   |   |   | 2         |
| *UNIBUS TERMINATOR |       | **PERIPHERAL CONTROLLER     |   |   |   | 3         |
| UNIBUS             |       | **PERIPHERAL CONTROLLER     |   |   |   | 4         |
| UNIBUS TERMINATOR  |       | DEC MEMORY STACK H214       |   |   |   | 5         |
|                    |       | *** DEC MEMORY DRIVER G231  |   |   |   | 6         |
|                    |       | *** DEC MEMORY CONTROL G110 |   |   |   | 7         |
|                    |       | PROCESSOR                   |   |   |   | 8         |
|                    |       | PROCESSOR                   |   |   |   | 9         |

COMPONENT SIDE  
SOLDER SIDE

\*OR EXTERNAL CABLE  
\*\*OR GRANT CONTINUITY CARD  
\*\*\*UNIBUS IS WIRED IN THESE SLOTS

DEC PDP-11/05 and PDP-11/10 Standard Module Utilization  
Configuration 2 (8K)

Figure 2



| CONNECTOR COLUMNS          |                       |     |   |       |       | SLOT |
|----------------------------|-----------------------|-----|---|-------|-------|------|
| A                          | B                     | C   | D | E     | F     | ▼    |
| DF11                       |                       | SCL |   | MAINT | MAINT | 1    |
| PROCESSOR                  |                       |     |   |       |       | 2    |
| PROCESSOR                  |                       |     |   |       |       | 3    |
| ** DEC MEMORY CONTROL G110 |                       |     |   |       |       | 4    |
| ** DEC MEMORY DRIVER G231  |                       |     |   |       |       | 5    |
| UNIBUS TERMINATOR          | DEC MEMORY STACK H214 |     |   |       |       | 6    |
| ** DEC MEMORY CONTROL G110 |                       |     |   |       |       | 7    |
| ** DEC MEMORY DRIVER G231  |                       |     |   |       |       | 8    |
| *UNIBUS TERMINATOR         | DEC MEMORY STACK H214 |     |   |       |       | 9    |

COMPONENT SIDE  
SOLDER SIDE

\*OR EXTERNAL CABLE  
\*\*UNIBUS IS WIRED IN THESE SLOTS

Figure 3 - 10½" DEC PDP-11/05 and PDP-11/10 Standard Module Configuration (16K)

## 2.2 Installation in Configuration 1 of 5¼" Assembly Unit

### 2.2.1 24K Word Configuration (Figure 4)

The 24K word configuration uses one DR-111 module and one MM11-L system.

The DR-111 is installed in slot 3. The stack blocks slot 4. The UNIBUS terminator remains in connectors 5A/5B. UNIBUS signals are available in slots 2A/2B and a UNIBUS terminator or external cable can be inserted in this location.

| CONNECTOR COLUMNS       |       |                         |   |   |   | SLOT |
|-------------------------|-------|-------------------------|---|---|---|------|
| A                       | B     | C                       | D | E | F | ▼    |
| MAINT                   | MAINT | **PERIPHERAL CONTROLLER |   |   |   | 1    |
| *UNIBUS TERMINATOR      |       | NOT AVAILABLE           |   |   |   | 2    |
| DR-111                  |       |                         |   |   |   | 3    |
|                         |       |                         |   |   |   | 4    |
| UNIBUS TERMINATOR       |       | DEC MEMORY STACK H214   |   |   |   | 5    |
| DEC MEMORY DRIVER G231  |       |                         |   |   |   | 6    |
| DEC MEMORY CONTROL G110 |       |                         |   |   |   | 7    |
| PROCESSOR               |       |                         |   |   |   | 8    |
| PROCESSOR               |       |                         |   |   |   | 9    |

\*OR EXTERNAL CABLE  
\*\*OR GRANT CONTINUITY CARD

Figure 4 - 24K Word Installation Configuration 1 of PDP-11/05 and PDP-11/10

### 2.2.2 32K Word Configuration (Figure 5)

The 32K word configuration uses two DR-111 modules and no MM11-L.

The DR-111 modules are installed in slots 3 and 5. The stack board blocks the adjacent slots 4 and 6, respectively. The UNIBUS terminator board normally located in connectors 5A/5B is moved to connectors 7A/7B. The UNIBUS signals are also available in connectors 2A/2B. A UNIBUS terminator or cable can be inserted in this location.

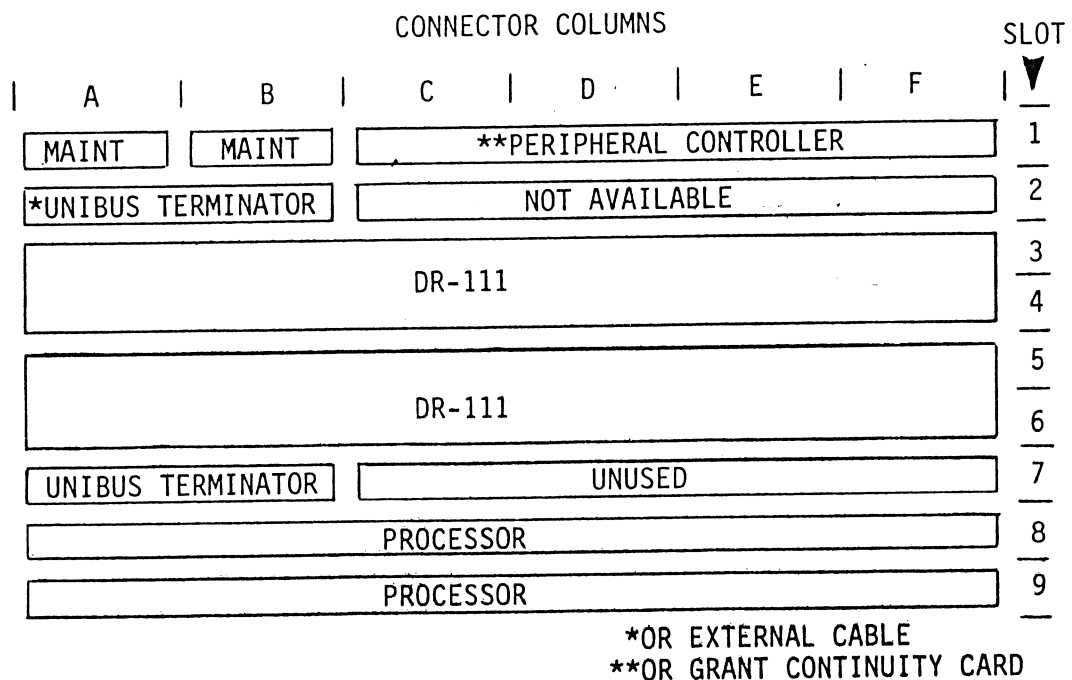


Figure 5 - 32K Word Installation Configuration 1 of PDP-11/05 and 11/10

## 2.3 Installation in Configuration 2 of 5¼" Assembly Unit

### 2.3.1 16K Word Configuration (Figure 6)

The 16K word configuration has one DR-111 module, four peripheral controllers and no MM11-L.

The DR-111 is installed in slot 5. Slot 6 is blocked by the stack board. The UNIBUS terminator normally located in connectors 5A/5B is moved to connectors 7A/7B. Connectors 3A/3B and 4A/4B are available for installation of either a second terminator or UNIBUS cable.

| CONNECTOR COLUMNS  |       |                         |   |   |   | SLOT |
|--------------------|-------|-------------------------|---|---|---|------|
| A                  | B     | C                       | D | E | F | ▼    |
| UNUSED             |       | **PERIPHERAL CONTROLLER |   |   |   | 1    |
| MAINT              | MAINT | **PERIPHERAL CONTROLLER |   |   |   | 2    |
| *UNIBUS TERMINATOR |       | **PERIPHERAL CONTROLLER |   |   |   | 3    |
| UNIBUS             |       | **PERIPHERAL CONTROLLER |   |   |   | 4    |
| DR-111             |       |                         |   |   |   | 5    |
|                    |       |                         |   |   |   | 6    |
| UNIBUS TERMINATOR  |       | NOT USED                |   |   |   | 7    |
| PROCESSOR          |       |                         |   |   |   | 8    |
| PROCESSOR          |       |                         |   |   |   | 9    |

\*OR EXTERNAL CABLE  
\*\*OR GRANT CONTINUITY CARD

Figure 6 - 16K Word Installation in Configuration 2 of PDP-11/05 and PDP-11/10

### 2.3.2 24K Word Configuration (Figure 7)

The 24K word configuration has one DR-111 module, one MM11-L and two peripheral controllers.

The DR-111 module is installed in slot 3. Although the stack partially blocks slot 4, there is sufficient room available to plug a UNIBUS cable in connectors 4A/4B and a Grant Continuity Card in connector 4D. If it is necessary to terminate the UNIBUS in connectors 4A/4B, a special terminator board, DRC part number 61106, may be purchased from Dataram for installation in this location. The standard DEC M930 terminator will not fit mechanically in this application.

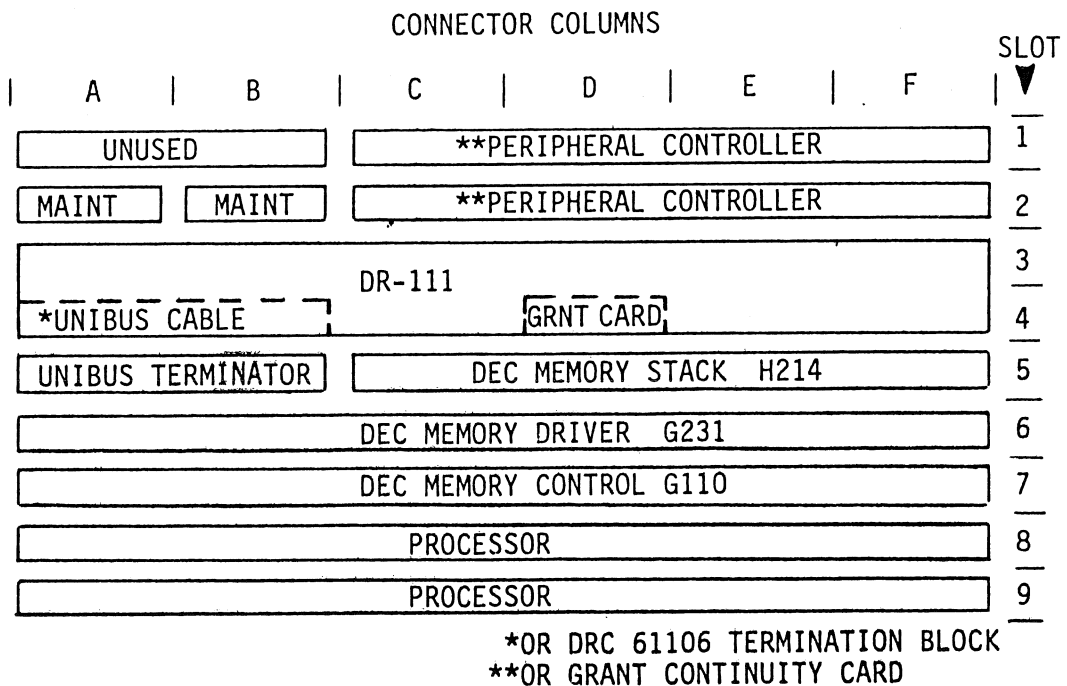


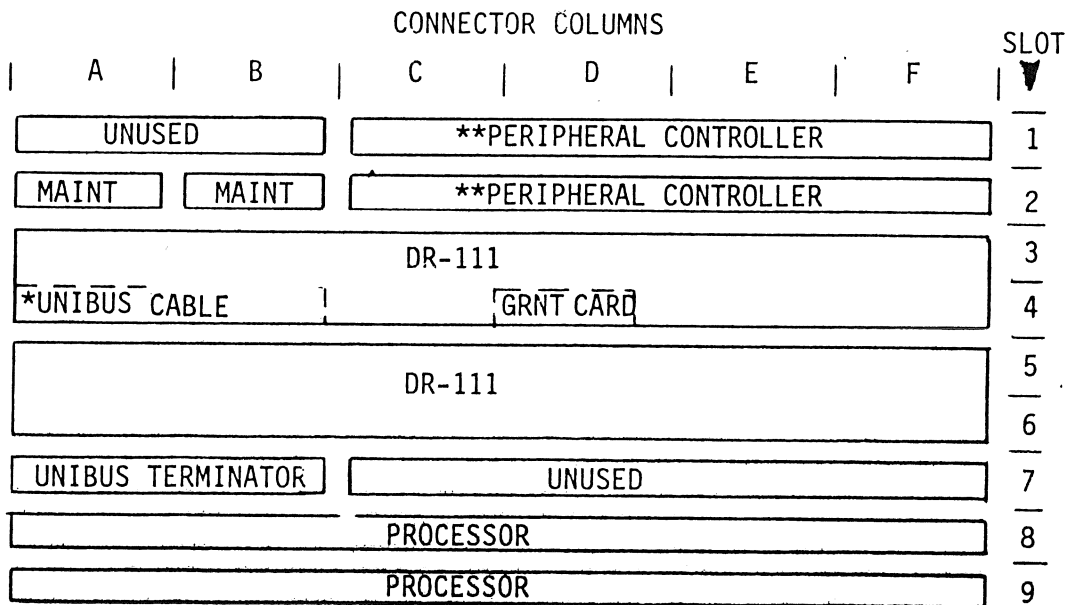
Figure 7 - 24K Word Installation Configuration 2 of PDP-11/05 and PDP-11/10

### 2.3.3 32K Word Configuration (Figure 8)

The 32K word configuration has two DR-111 modules and two peripheral controllers.

The DR-111 modules are installed in slots 3 and 5. The stack partially blocks slots 4 and 6.

The UNIBUS terminator normally located in connectors 5A/5B is moved to connectors 7A/7B. Although the stack partially blocks slot 4, there is sufficient room available to plug a UNIBUS cable in connectors 4A/4B and a Grant Continuity Card in connector 4D. If it is necessary to terminate the UNIBUS in connector 4A/4B, a special terminator board, Dataram part number 61106, may be purchased from Dataram for installation in this location.



\*OR DRC 61106 TERMINATION BLOCK  
\*\*OR GRANT CONTINUITY CARD

Figure 8 - 32K Word Installation Configuration 2 of PDP-11/05 and PDP-11/10

## 2.4 Installation in 10½" Assembly Unit

### 2.4.1 24K Word Configuration (Figure 9)

The 24K word configuration uses one DR-111 module and one MM11-L system.

The DR-111 is installed in slot 4. The stack blocks slot 5. The UNIBUS terminator remains in connectors 6A/6B. UNIBUS signals are available in slots 9A/9B and a UNIBUS terminator or external cable can be inserted in this location.

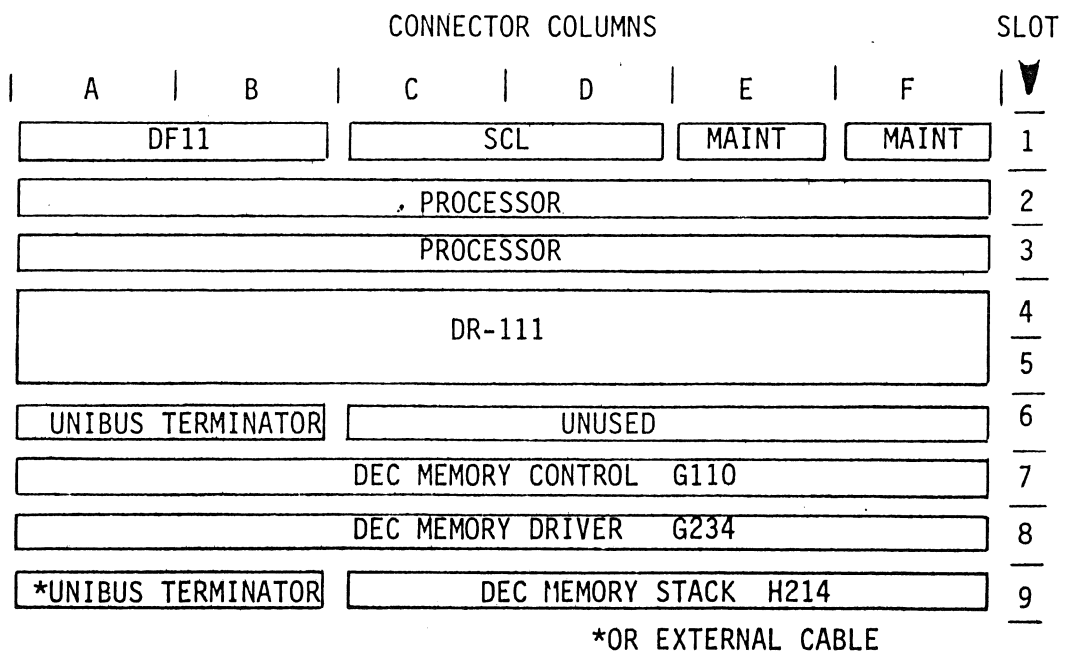


Figure 9 - 24K Word Installation in 10½" PDP-11/05 and PDP-11/10

### 2.4.2 32K Word Configuration (Figure 10)

The 32K word configuration uses two DR-111 modules and no MM11-L.

The DR-111 modules are installed in slots 4 and 7. The stack board blocks the adjacent slots 5 and 8, respectively. The UNIBUS terminator board is located in connectors 6A/6B. The UNIBUS signals are also available in connectors 9A/9B. A UNIBUS terminator or cable can be inserted in this location.

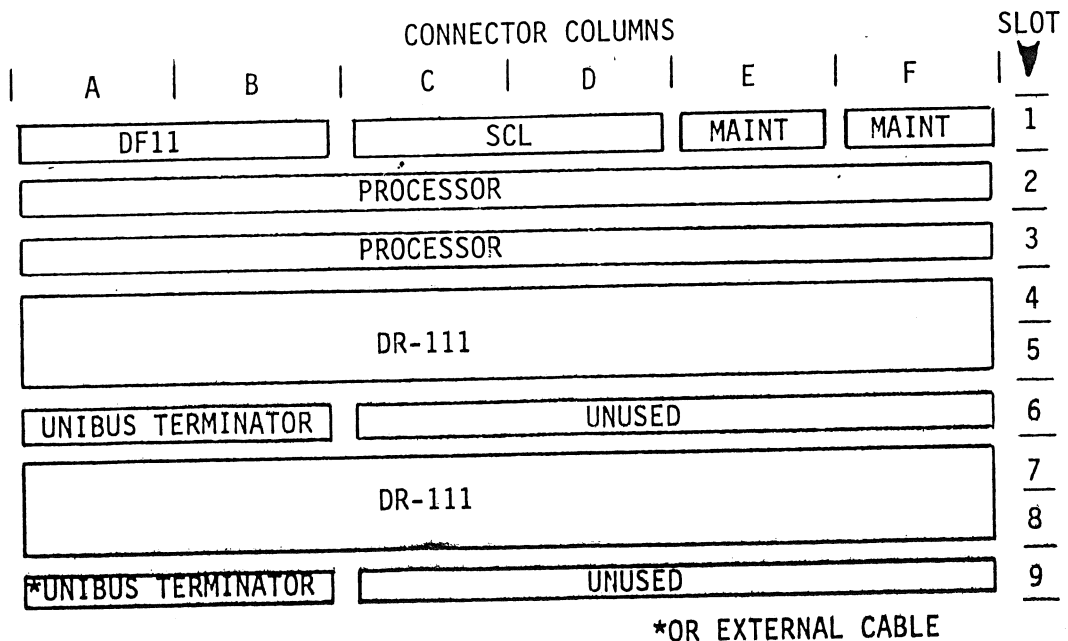


Figure 10 - 32K Word Installation in 10½" PDP-11/05 and PDP-11/10



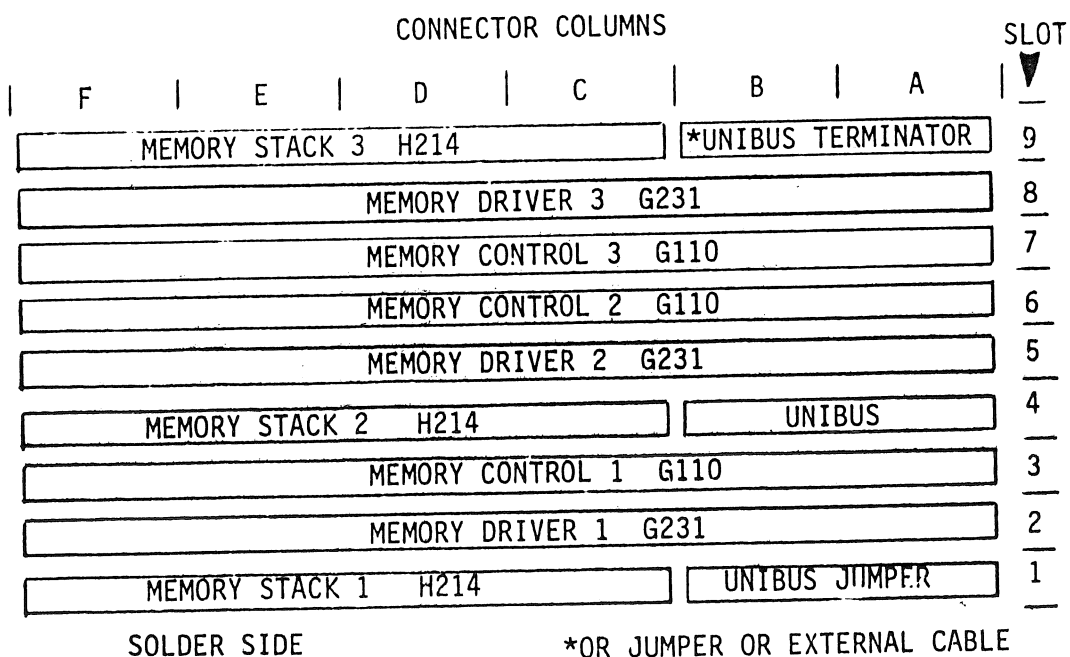
### 3.0 INSTALLATION IN THE MF11-L ASSEMBLY UNIT OF THE PDP-11/35, PDP-11/40, PDP-11/45 COMPUTERS AND ME11-L EXPANSION CHASSIS

#### 3.1 Standard DEC Configurations

The basic PDP-11/35, 40 and 45 computers consist of two double system units, each unit containing nine rows of connectors. The first nine slot system unit contains the processor and associated option boards and is not used for memory installation. The second nine slot system unit is prewired for DEC memory modules. In many installations, this double system unit is an MF11-L assembly unit which generally contains 8K to 24K of MM11-L memory. There is room in each computer for additional MF11-L system units for memory expansion. Some installations may contain other memory assembly units which are discussed in Section 5.

The ME11-L is a completely self-contained system. It is an MF11-L mounted in a 5¼" high box that includes a power supply. The ME11-L is used for memory expansion for all PDP-11 computers, such as, the PDP-11/05, PDP-11/10, PDP-11/15, PDP-11/20, PDP-11/35, PDP-11/40 and PDP-11/45.

This section describes typical installation details for mounting DR-111 modules in the MF11-L assembly with or without MM11-L memories. Memory expansion beyond the basic unit is identical when other MF11-L backplanes are installed. Figure 11 shows slot allocation for a fully expanded 24K MF11-L assembly using MM11-L memories. Connectors 1A/1B and 9A/9B are used either to extend or to terminate the UNIBUS. The standard UNIBUS jumper is used to extend the bus from system unit to system unit. The terminator is installed in the last system unit at or near the end of the bus. Using these requirements, the following subsections describe various word capacities using DR-111 modules.



SOLDER SIDE

\*OR JUMPER OR EXTERNAL CABLE

COMPONENT SIDE

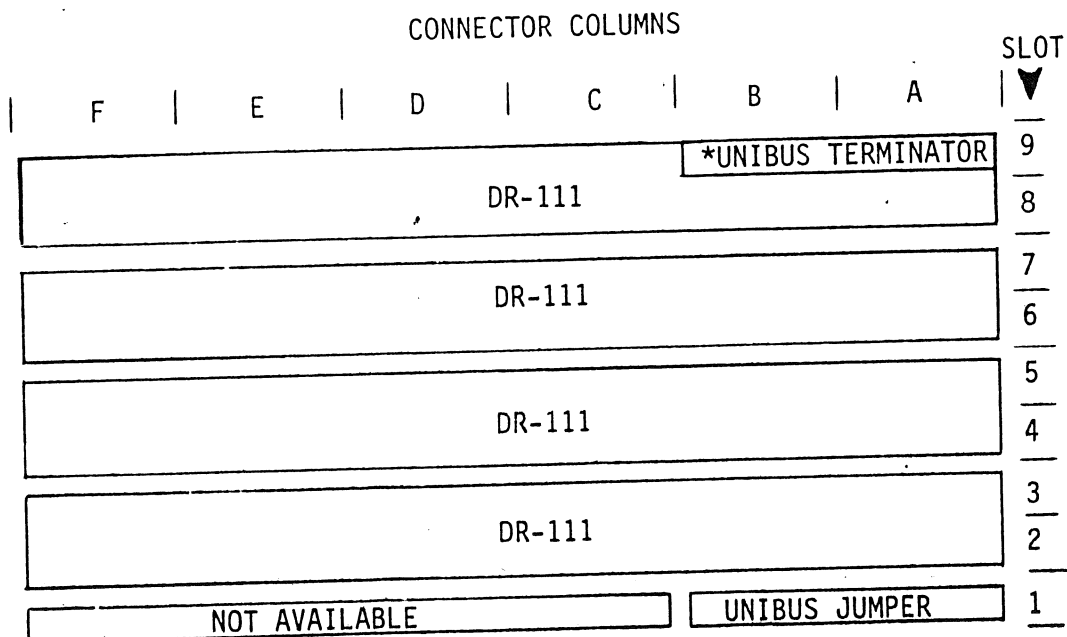
Figure 11 - Standard DEC MF11-L Memory Configuration

### 3.2 16K, 32K, 48K and 64K Word Configurations (Figure 13)

These configurations use up to three DR-111 modules. Memory Management is required for the 48K word and 64K word configurations. For 48K words, the DR-111 modules are installed in slots 2, 4 and 6.

A 32K word capacity can be configured by installing two DR-111 modules in slots 2 and 4. Similarly, 16K words can be configured by installing one DR-111 module in slot 2.

The 64K word capacity can be configured by installing another DR-111 module in slot 8. Although the stack partially blocks slot 9, the UNIBUS cable or jumper will fit in connector 9A/9B. If it is necessary to terminate the UNIBUS in connector 9A/9B, a special terminator, DRC part number 61106, may be purchased from Dataram for installation in this location.



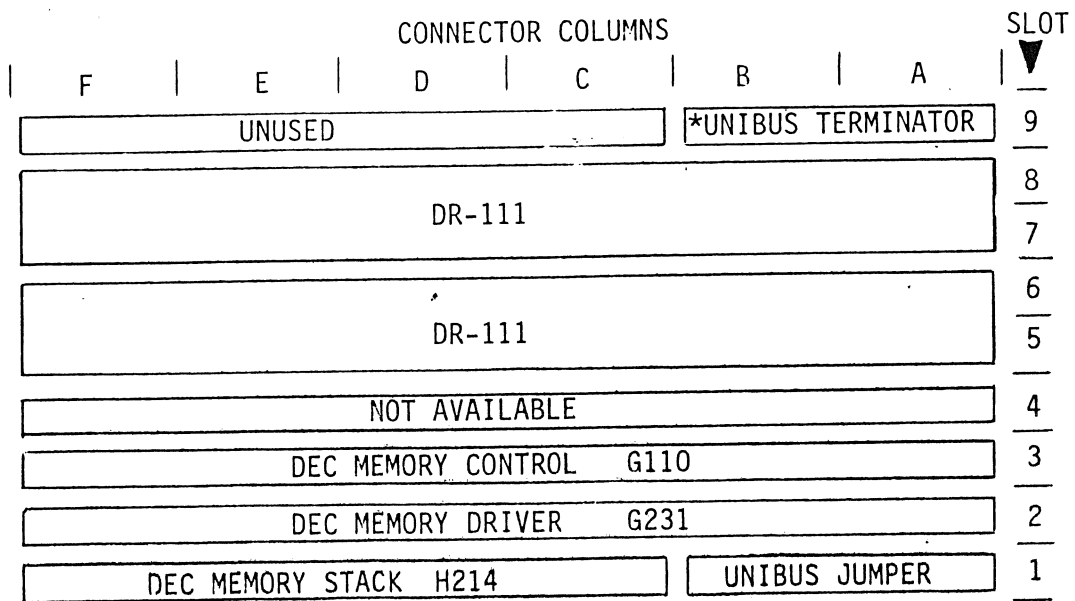
\*OR JUMPER OR EXTERNAL CABLE  
USE DRC P/N 61106 TERMINATION  
BLOCK IF DR-111 IS PLUGGED  
INTO SLOT 8.

Figure 13 -48K Word Configuration in MF11-L

### 3.3 24K Word and 40K Word Configurations (Figure 12)

These configurations use one MM11-L memory and up to two DR-111 modules. Memory Management is required for the 40K word configuration. The DR-111 modules are installed in slots 5 and 7.

A 24K word capacity can be configured by installing only one DR-111 module in slot 5.



\*OR JUMPER OR EXTERNAL CABLE

Figure 12 - 40K Word Installation in MF11-L

### 3.4 32K Word Configuration (Figure 14)

This configuration uses two MM11-L memories and one DR-111 module.

The DR-111 module is installed in slot 7.

| CONNECTOR COLUMNS     |   |   |   |                    |   | SLOT |
|-----------------------|---|---|---|--------------------|---|------|
| F                     | E | D | C | B                  | A | ▼    |
| UNUSED                |   |   |   | *UNIBUS TERMINATOR |   | 9    |
| DR-111                |   |   |   |                    |   | 8    |
|                       |   |   |   |                    |   | 7    |
| MEMORY CONTROL 2 G110 |   |   |   |                    |   | 6    |
| MEMORY DRIVER 2 G231  |   |   |   |                    |   | 5    |
| MEMORY STACK 2 H214   |   |   |   | UNIBUS             |   | 4    |
| MEMORY CONTROL 1 G110 |   |   |   |                    |   | 3    |
| MEMORY DRIVER 1 G231  |   |   |   |                    |   | 2    |
| MEMORY STACK 1 H214   |   |   |   | UNIBUS JUMPER      |   | 1    |

\*OR JUMPER OR EXTERNAL CABLE

Figure 14 - 32K Word Configuration in MF11-L

#### 4.0 INSTALLATION IN THE PDP-11/15 AND PDP-11/20 COMPUTERS

Although the DR-111 is electrically compatible with the PDP-11/15 and PDP-11/20 UNIBUS signals, it cannot physically fit inside the BA11-CC or BA11-CS mounting boxes.

However, there are application where the basic machine is expanded with an ME11-L extension box. DR-111 modules can be installed in this equipment as described in section 3.0.

## 5.0 SPECIAL DEC CONFIGURATIONS

### 5.1 MF11-LP Assembly Unit and ME11-LP Extension Box

The MF11-LP and ME11-LP are wired for the MM11-LP memories. These memories (8K x 18) contain two extra bits for parity signals. The DR-111 modules are 16K x 16 systems and cannot be used for these applications. If the DR-111 module is inserted accidentally into the MF11-LP or ME11-LP, the DR-111 or CPU will not be damaged.

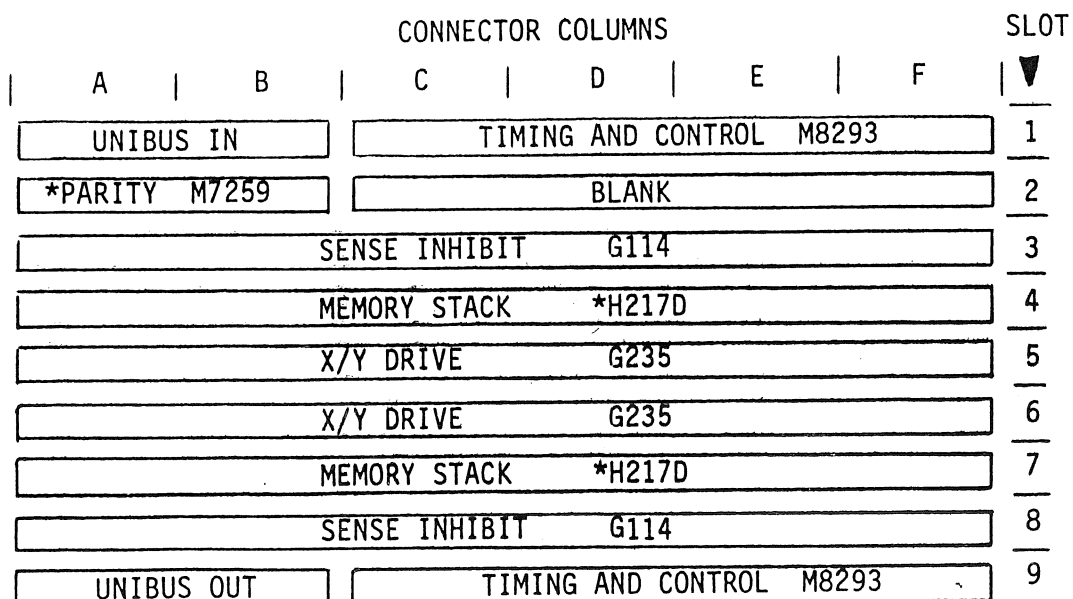
### 5.2 MF11-U, MF11-UB, MF11-UC, MF11-UP, MF11-UR and MF11-US Assembly Units

The MF11-U series assembly units are double system units wired to accept two DEC MM11U or MM11-UP 16K x 16 memory systems. The MM11-U and MM11-UP memory modules are designed to operate from different supply voltages than the MM11-L modules. The backplane wiring of the MF11-U series assembly units is such that these voltages appear at connector pins used by the DR-111 modules. If a DR-111 module is installed in the MM11-U series assembly units, COMPONENTS ON THE DR-111 WILL BE DAMAGED!

The drawing in Figure 15 shows the configuration of the MF11-U series assembly units.

For identification purposes, the following is a list of the modules used to configure an MM11-U memory:

|       |                               |
|-------|-------------------------------|
| M8293 | Timing and Control Module     |
| G114  | Sense and Inhibit Module      |
| G235  | X/Y Driver Module             |
| H217D | Memory Stack Module           |
| H217C | Memory Stack Module (MM11-UP) |
| M7259 | Parity Module (MM11-UP)       |



\*MF11-UP USES H217C and M7259

Figure 15 - MF11-U Series Standard DEC Module Utilization (32K)

COMPONENT SIDE  
SOLDER SIDE