

KXJ11-CA Single-Board Computer

Installation Guide

KXJ11-CA Single-Board Computer

Installation Guide

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Chapter 1

Introduction

This guide describes how to install the KXJ11-CA module.

NOTE

Before changing the factory shipped jumper configuration, make sure the jumpers match the jumpers shown in Figure 2-1, and verify that the module is operating as described in Section 6.2.

Installation includes the following activities.

1. Selecting operating characteristics and installing appropriate jumpers (Chapter 2)
2. Determining power supply requirements (Chapter 3)
3. Installing the board into a backplane (Chapter 4)
4. Selecting and connecting cables from serial and parallel I/O interfaces to external devices (Chapter 5)
5. Verifying proper operation (Chapter 6)

Chapter 2

Selecting Operating Features

Several characteristics of the KXJ11-CA are defined by jumper settings. This section describes the characteristics that are part of the factory-shipped configuration. It also shows how to change these characteristics by changing the appropriate jumpers.

Figure 2-1 illustrates the factory-shipped jumper settings. Table 2-1 summarizes the meaning of each jumper setting. The sections that follow describe the various jumper setting alternatives available.

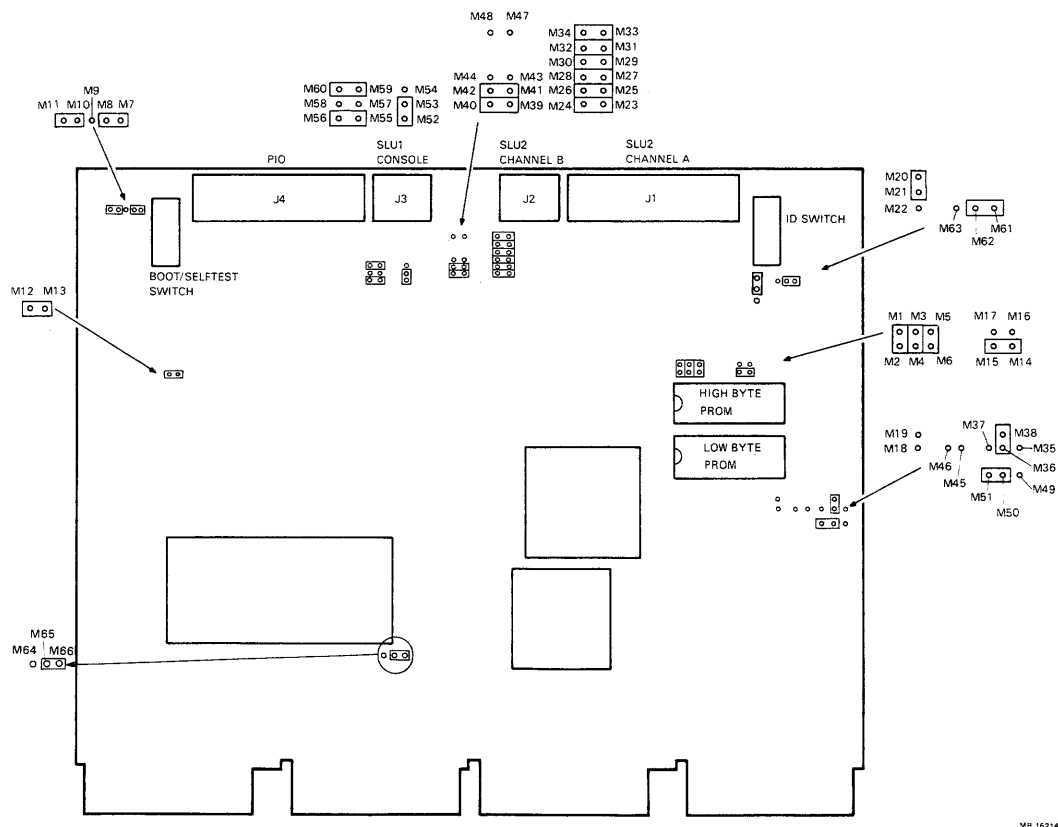


Figure 2-1 KXJ11-CA Jumper Layout

Table 2-1 Factory Shipped Jumper Configuration

| Function | Setting | Jumpers Installed |
|---------------------------------------|----------------|--|
| Q-Bus Size | 22 bits | M3 to M4 M5 to M6 |
| Q-Bus Base Address | 17760240 | M1 to M2 |
| ID Switch Position | 5 | |
| DMA Requests | | |
| SLU2 Channel A Receiver | Enabled | M10 to M11 |
| 8036 Counter/Timer | Disabled | |
| SLU2 Channel A Transmitter | Enabled | M7 to M8 |
| Locked Instruction Enable | Disabled | M65 to M66 |
| BREAK Enable | Enabled | M12 to M13 |
| HALT Option Selection | MicroODT | M14 to M15 |
| Power-Up Option Selection | Firmware | No jumper |
| PROM Addressing | 15-bit | No jumper |
| SLU1 Baud Rate | 9600 | M56 to M55 M60 to M59 |
| SLU1 Transmitter | RS423 | M62 to M61 |
| SLU1 Receiver | RS423 | No jumper |
| SLU2 Channel A Receiver | RS422 | M34 to M33 M32 to M31 M30 to M29 M28 to M27 M26 to M25 M24 to M23 |
| SLU2 Channel B Transmitter | RS422 | M38 to M36 M51 to M50 |
| SLU2 Channel B Receiver | RS422 | M42 to M41 M40 to M39 M20 to M21 |
| Real-Time Clock Interrupt | 60 Hz | M52 to M53 |
| Boot/Self-Test Switch Position | 5 | |

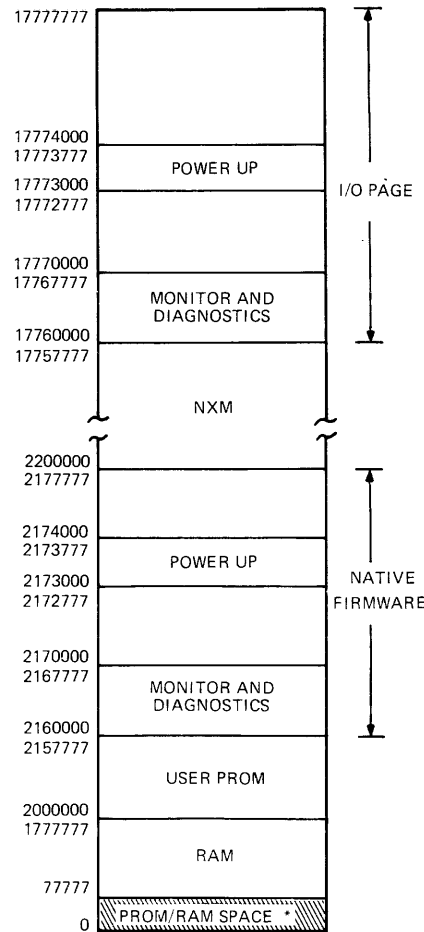
NOTE

The SLU2 Channel A Transmitter is not configured with jumpers, but is configured by selecting appropriate signals on connector J1.

2.1 Boot/Self-Test Switch

The boot/self-test switch is a 16-position switch that is used if the board is configured to execute firmware (rather than MicroODT) upon power-up. It has three functions.

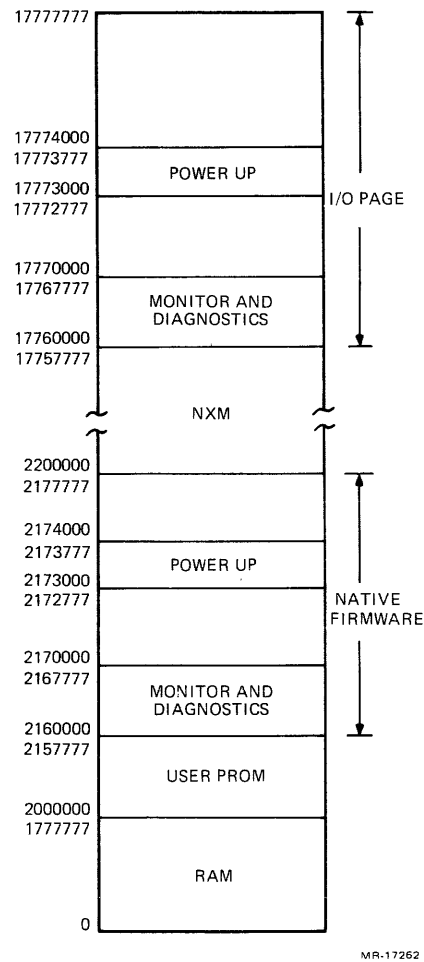
1. It determines how the KXJ11-CA will act when a special interrupt condition exists, including whether or not self-tests will run (see Section 3.5, *The KXJ11-CA Single-Board Computer User's Guide*, EK-KDJCA-UG-001).
2. It determines whether special interrupt handling is performed either by user code or by firmware.
3. It determines where in memory the on-board PROM is mapped. There are two alternatives — low memory or high memory. The memory maps associated with low and high PROM mapping are shown in Figures 2-2 and 2-3, respectively.



* ADDRESSES 77777-0 MATCH ADDRESSES 2077777-2000000

VR-17263

Figure 2-2 Memory Mapping — PROM in Low Memory



MR-17262

**Figure 2-3 Memory Mapping —
PROM in High Memory**

The location of the boot/self-test switch is shown in Figure 2-4. Table 2-2 summarizes the functions associated with each switch position.

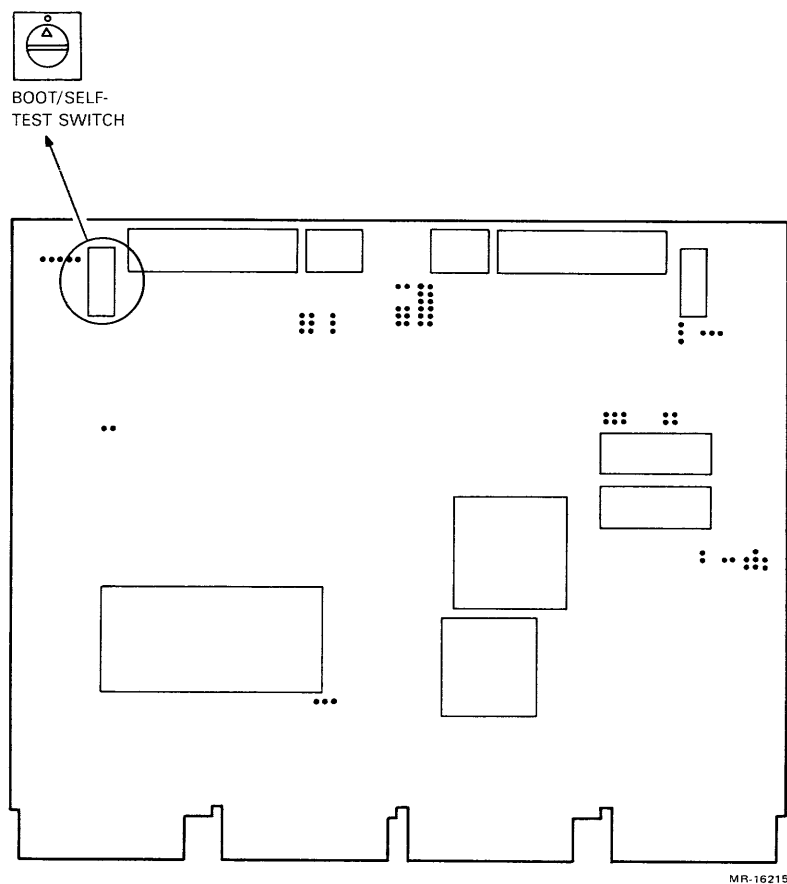


Figure 2-4 Boot/Self-Test Switch

Table 2-2 Boot/Self-Test Switch Functions

| Switch Position | KXJ11-CA Special Interrupt Response | Special Interrupt Handling | PROM Mapping |
|-----------------|--|----------------------------------|-----------------|
| 0 | User PROM application code is executed. No self-tests are performed. | Firmware | Low |
| 1 | User PROM application code is executed. Auto self-tests are performed. | Firmware | Low |

Table 2-2 Boot/Self-Test Switch Functions (Cont)

| Switch Position | KXJ11-CA Special Interrupt Response | Special Interrupt Handling | PROM Mapping |
|------------------------|---|---|-------------------------|
| 2 | User PROM application code is executed. Auto self-tests are performed. The user (P)ROM checksum test is also performed. | Firmware | Low |
| 3 | Application code is booted from a TU58 via SLU1. Auto self-tests are performed, then the TU58 primary bootstrap is executed. | Firmware | High |
| 4 | MicroODT is entered. No self-tests are performed. | Firmware | High |
| 5 | Auto self-tests are performed. The KXJ11-CA awaits command from the arbiter via TPR0. | Firmware | High |
| 6 | No self-tests are performed. The KXJ11-CA awaits a command from the arbiter via TPR0. | Firmware | High |
| 7 | Auto self-tests are performed continuously. No application code is booted or executed. Loopback connectors (see Section 5.3) are installed for these tests. | None | High |
| 8 | User PROM application code is executed. No self-tests are performed. | User Code | Low |
| 9 | User PROM application code is executed. Auto self-tests are performed. | User Code | Low |
| 10 | User PROM application code is executed. Auto self-tests are performed. The user (P)ROM checksum test is also performed. | User Code | Low |
| 11 | Application code is booted from a TU58 via SLU1. Auto self-tests are performed, then the TU58 primary bootstrap is executed. | User Code | High |
| 12 | MicroODT is entered. No self-tests are performed | User Code | High |

Table 2-2 Boot/Self-Test Switch Functions (Cont)

| Switch Position | KXJ11-CA Special Interrupt Response | Special Interrupt Handling | PROM Mapping |
|-----------------|--|----------------------------|--------------|
| 13 | Auto self-tests are performed. The KXJ11-CA awaits a command from the arbiter via TPR0. | User Code | High |
| 14 | No self-tests are performed. The KXJ11-CA awaits a command from the arbiter via TPR0. | User Code | High |
| 15 | Auto self-tests are performed continuously. No application code is booted or executed. Loopback connectors (see Section 5.3) are installed for these tests. | None | High |

NOTES

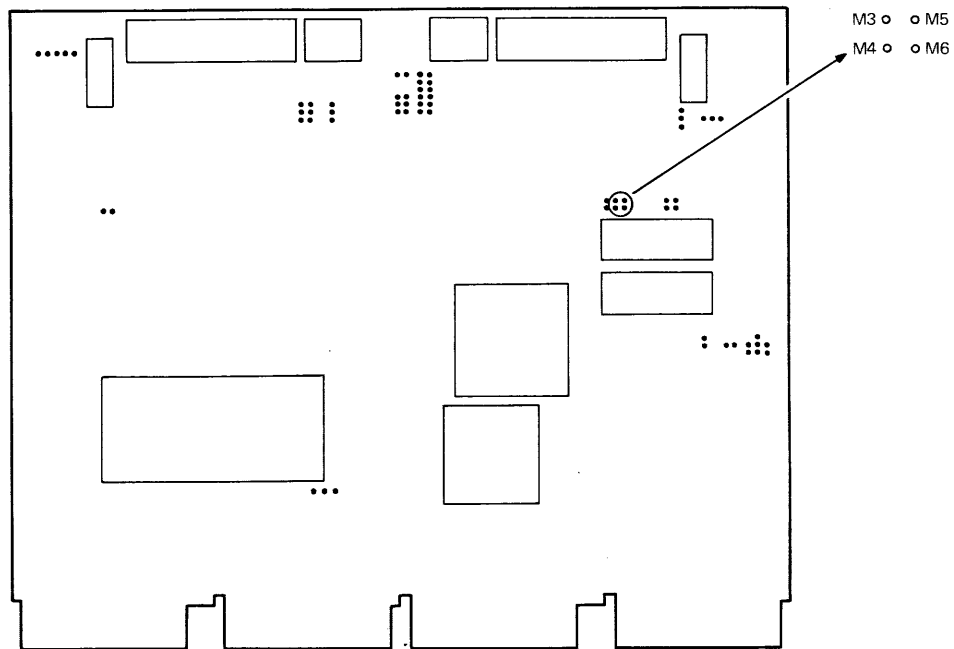
- Switch position 5 is the factory-shipped configuration.
- The encoded value of the boot/self-test switch position is available in the KXJCSRB register in bits <7:4>. For example, switch position 1 would be encoded as 0001 in KXJCSRB <7:4>.
- The user (P)ROM checksum test looks for a checksum at the highest word address of user (P)ROM. Similarly, the firmware checksum test looks for a checksum at the highest word address of the firmware PROM. Either checksum is calculated and checked according to the following DECPROM algorithm:

CHECKSUM = 0
FOR I = number of PROM addresses to be checksummed
DO CHECKSUM = CHECKSUM + contents of address
(high order carry from addition is discarded)
CHECKSUM = ROTATE_LEFT_ONE_BIT (bit0 → bit1,
bit1 → bit2, ..., bit15 → bit0) NEXT I
- Special interrupt handling can be performed by user code in switch positions 8-15. This function is useful in applications that need to continue running after the Q-Bus signal BHALT or the Q-Bus signal BINIT has been asserted. For switch positions 0 through 7, special interrupt handling is done by firmware.
- If the KXJ11-CA is in standalone mode, switch positions 5, 6, 13, and 14 should not be used. These positions cause the KXJ11-CA to idle and wait for a command. In standalone mode, the KXJ11-CA will idle indefinitely, waiting for an arbiter command that will never come.

2.2 Q-Bus Size

The KXJ11-CA may be configured to handle 16-, 18-, or 22-bit Q-Bus addressing. This is accomplished with the Q-Bus size jumpers (see Figure 2-5). 22-bit addressing is selected as part of the factory-shipped configuration.

| Jumper Connection | | | | Description |
|-------------------|---|---|----|-----------------------------|
| M3 | ○ | ○ | M5 | 22-bit addressing selected* |
| M4 | ○ | ○ | M6 | |
| M3 | ○ | ○ | M5 | 18-bit addressing selected |
| M4 | ○ | ○ | M6 | |
| M3 | ○ | ○ | M5 | 16-bit addressing selected |
| M4 | ○ | ○ | M6 | |



MR-16216

Figure 2-5 Q-Bus Size Selection

* Factory-shipped configuration

2.3 Q-Bus Base Address Selection

In systems with multiple I/O processor boards, make sure each board has a unique Q-Bus base address to distinguish the boards from one another. This is accomplished on the KXJ11-CA by setting the ID switch and installing or removing a jumper which connects M1 and M2.

Table 2-3 lists the base addresses that can be selected. Table 2-3 lists 22-bit addresses. If the KXJ11-CA is configured for 16- or 18-bit addressing, use the lower 16 or 18 bits of the addresses specified in Table 2-3.

Table 2-3 Q-Bus Base Address Selection

| ID Switch Position | Base Address (Jumper IN) | Base Address (Jumper OUT) |
|---------------------------|-------------------------------------|--------------------------------------|
| 0 | * | * |
| 1 | * | * |
| 2 | 17760100 | 17762100 |
| 3 | 17760140 | 17762140 |
| 4 | 17760200 | 17762200 |
| 5† | 17760240† | 17762240 |
| 6 | 17760300 | 17762300 |
| 7 | 17760340 | 17762340 |
| 8 | 17775400 | 17777400 |
| 9 | 17775440 | 17777440 |
| 10 | 17775500 | 17777500 |
| 11 | 17775540 | 17777540 |
| 12 | 17775600 | 17777600 |
| 13 | 17775640 | 17777640 |
| 14 | 17775700 | 17777700 |
| 15 | 17775740 | 17777740 |

* These switch positions disable the Q-Bus interface. That is, the KXJ11-CA is running in standalone mode.

† Factory-shipped configuration

Figure 2-6 shows the locations of jumper connections M1 and M2, and the ID switch. The factory-shipped base address is 17760240.

| Jumper Connection | Description |
|-------------------|-------------------------------|
| o M1 | Factory-shipped configuration |
| o M2 | Base address = 17760240 |

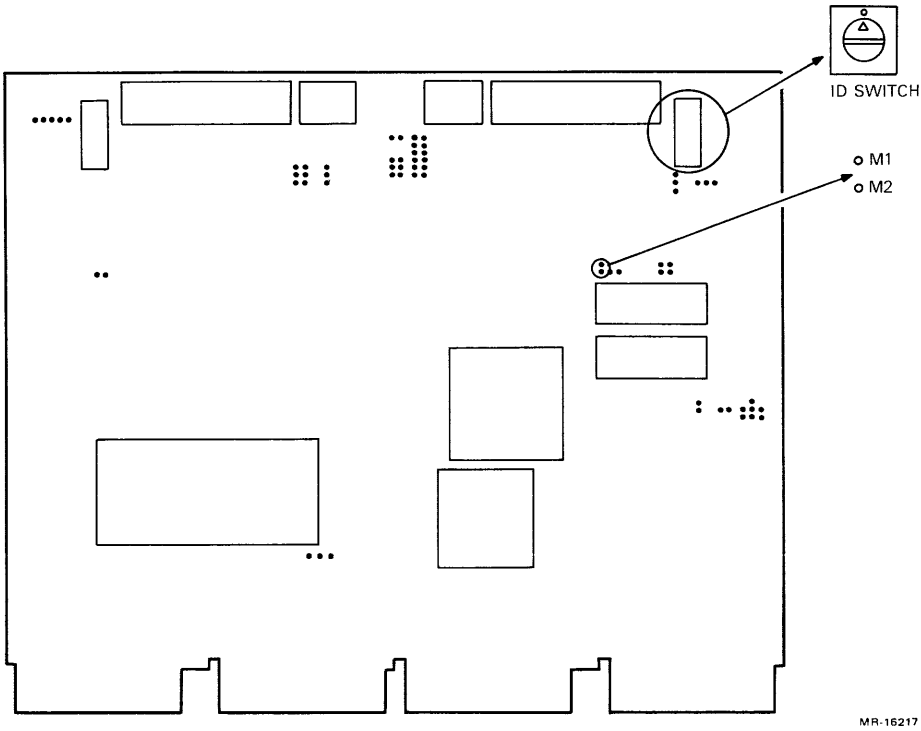


Figure 2-6 Q-Bus Base Address Selection

2.4 DMA Requests

DMA requests to the on-board DMA transfer controller (DTC) may come from several sources. The KXJ11-CA has a set of jumpers that enable or disable DMA requests from: (1) the SLU2 channel A receiver, (2) the SLU2 channel A transmitter, or (3) the on-board 8036 PIO counter/timer. The location of these jumpers is shown in Figure 2-7. Only two of the three sources may be specified (jumped) at one time. The two sources that are jumpered as part of the factory configuration are SLU2 channel A receiver and SLU2 channel A transmitter.

| Jumper Connection | | | | | Description |
|-------------------|-----|-----|-----|----|--|
| M11 | M10 | M9 | M8 | M7 | Allows DMA channel 0 requests from SLU2 channel A receiver* |
| o—o | | o | o | o | |
| M11 | M10 | M9 | M8 | M7 | Allows DMA channel 1 requests from PIO counter/timer (pin C1 used as request line) |
| o | o | o—o | o | o | |
| M11 | M10 | M9 | M8 | M7 | Allows DMA channel 1 requests from SLU2 channel A transmitter* |
| o | o | o | o—o | | |

NOTE

Do not connect a jumper between M10 and M9. This configuration is not supported.

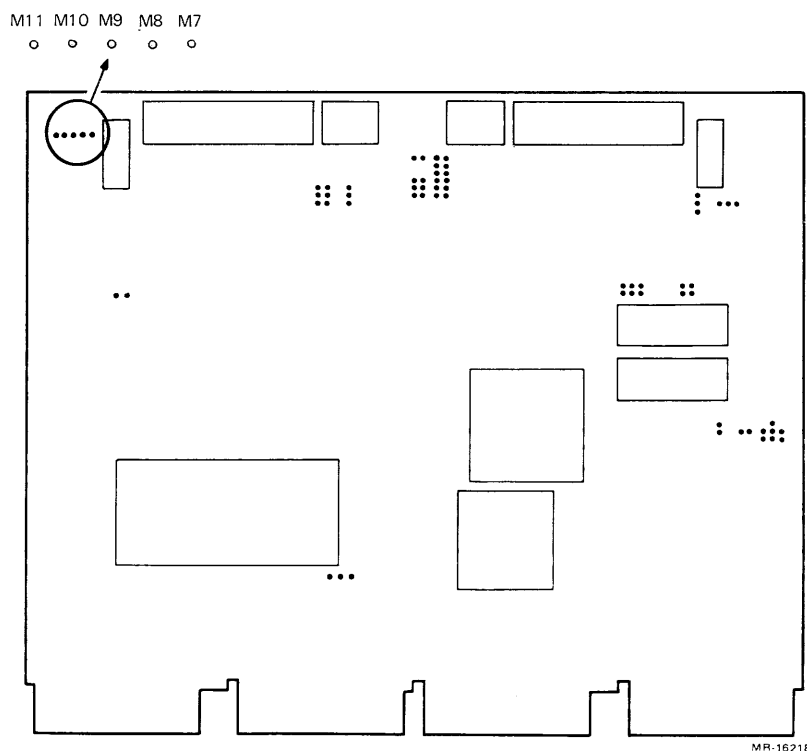


Figure 2-7 DMA Requests

* Factory-shipped configuration

2.5 Locked Instruction Enable

The KXJ11-CA has a set of jumpers that enable or disable the locking characteristic of the WRTLCK, TSTSET, and ASRB interlocked instructions. The location of the jumpers is shown in Figure 2-8. Locking is disabled as part of the factory-shipped configuration. For most applications, locking must be disabled. If locking is enabled, a Q-Bus timeout may cause a trap to location 4 if the Q-Bus is heavily loaded, and one of these instructions is executed.

| Jumper Connection | | | Description |
|-------------------|-------|-----|--|
| M64 | M65 | M66 | The locking characteristic of the WRTLCK, TSTSET, and ASRB instructions is enabled |
| o — o | o | | |
| M64 | M65 | M66 | The locking characteristic of the WRTLCK, TSTSET, and ASRB instructions is disabled* |
| o | o — o | | |

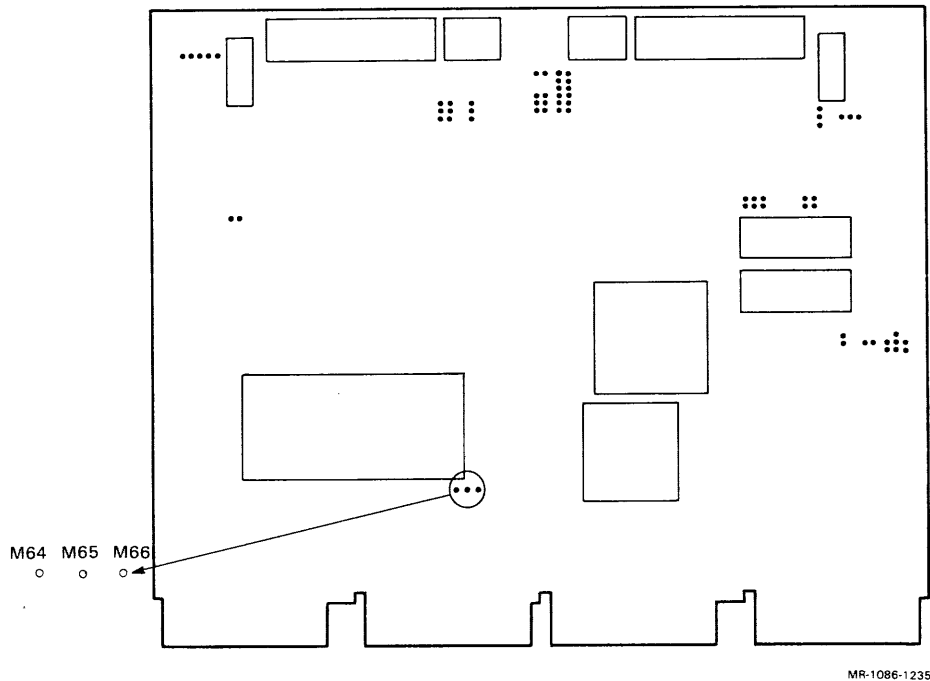


Figure 2-8 Locked Instruction Enable

* Factory-shipped configuration

2.6 BREAK Enable Selection

There is a jumper on the board that enables or disables console BREAK requests from SLU1 (the on-board DLART) to the J-11. The location of this jumper is shown in Figure 2-9. A BREAK is generated by SLU1 when a console terminal is attached to the system and the BREAK key on the console keyboard is pressed. When BREAK is received, the J-11 executes MicroODT. BREAK requests are enabled as part of the factory-shipped configuration.

| Jumper Connection | | | Description |
|-------------------|-------|-----|---------------------------------|
| M13 | o — o | M12 | Console BREAK requests enabled* |
| M13 | o o | M12 | Console BREAK requests disabled |

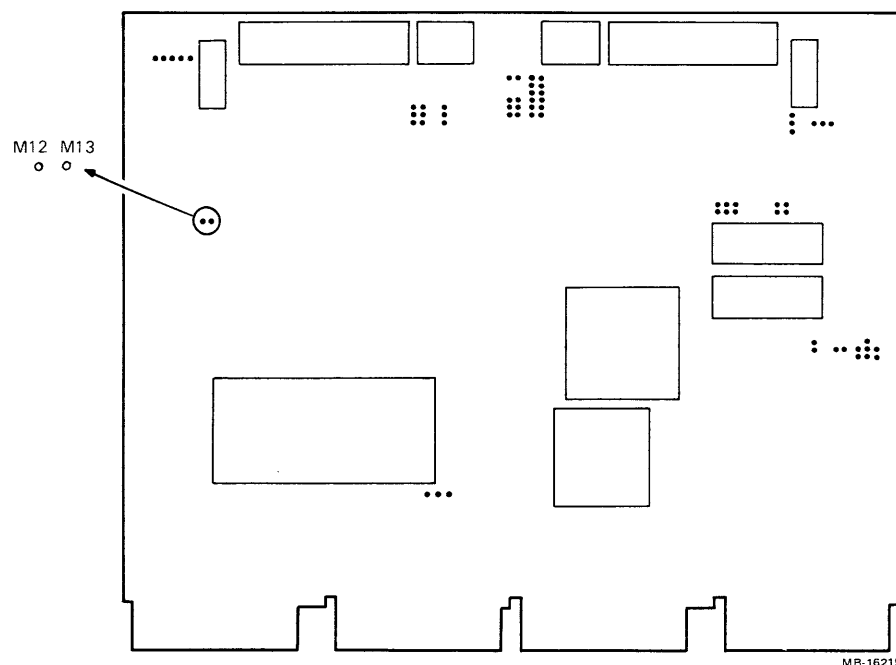


Figure 2-9 BREAK Enable

* Factory-shipped configuration

2.7 HALT Option Selection

A jumper on the KXJ11-CA determines what action will be taken if a HALT instruction is executed in kernel mode. The location of this jumper is shown in Figure 2-10. The jumper affects the state of bit 3 of the Maintenance Register (see Section 3.2.10, *The KXJ11-CA Single-Board Computer User's Guide*, EK-KXJCA-UG-001). If the jumper is installed (the factory-shipped configuration), a HALT instruction executed in kernel mode causes the processor to enter MicroODT. If the jumper is not installed, the KXJ11-CA traps to location 4 in kernel instruction space and sets bit 7 in the CPU error register.

| Jumper Connection | Description |
|-------------------------|--|
| M15 o — o M14 | MicroODT is entered when a HALT instruction is executed in kernel mode* |
| M15 o o M14 | KXJ11-CA traps to location 4 in kernel instruction space and sets bit 3 of the CPU error register if a HALT instruction is executed in kernel mode |

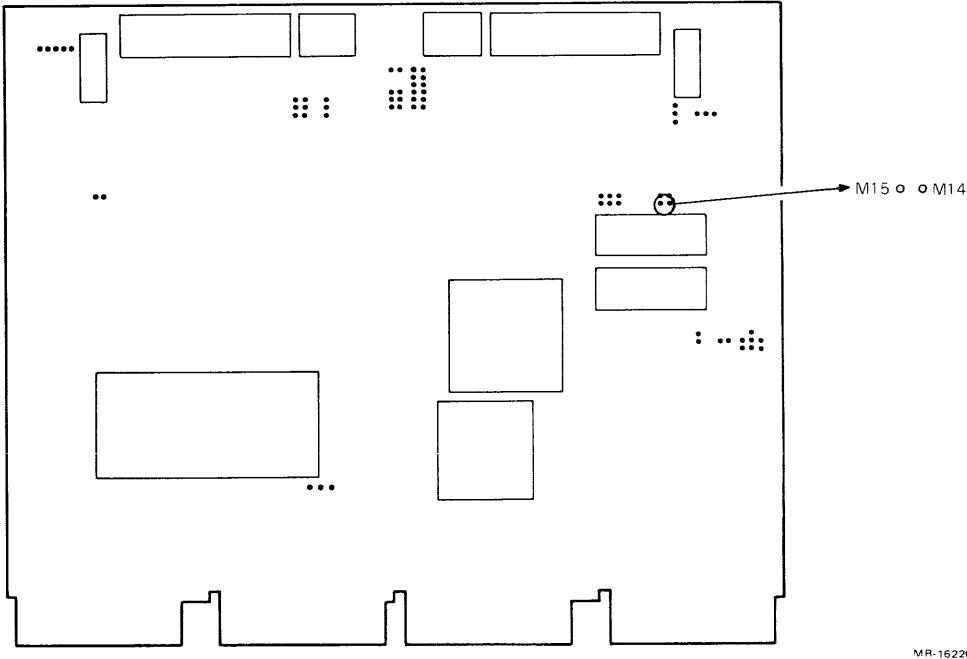


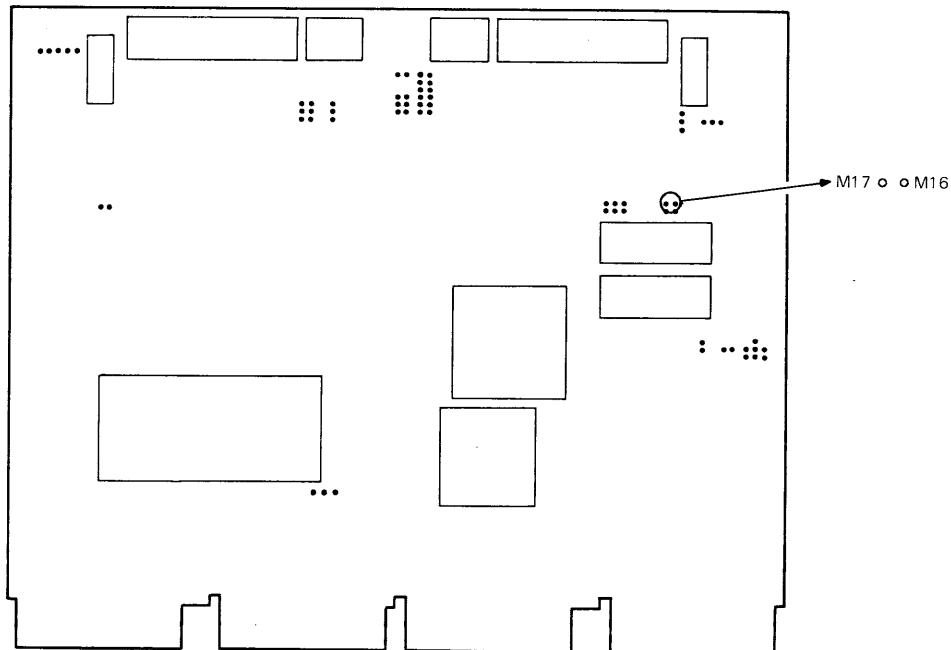
Figure 2-10 HALT Option Selection

* Factory-shipped configuration

2.8 Power-Up Option Selection

The power-up jumper (see Figure 2-11) determines what action the KXJ11-CA will take when the board is powered up or reset. The jumper affects the state of bit 2 of the Maintenance Register (see Section 3.2.10, *The KXJ11-CA Single-Board Computer User's Guide*, EK-KXJCA-UG-001). At power-up, if the jumper is installed, the processor enters MicroODT with the PS register cleared. This is also known as power-up option 1. If the jumper is not installed, (the factory-shipped configuration), the KXJ11-CA executes the firmware power-up code at location 173000 during power-up (PC = 173000, PS = 340). This is also known as power-up option 3. Only power-up options 1 and 3 are used for the KXJ11-CA.

| Jumper Connection | Description |
|-------------------|---|
| M17 o — o M16 | MicroODT is entered during power-up |
| M17 o o M16 | The KXJ11-CA boots through location 173000 during power-up* |



MR-16221

Figure 2-11 Power-Up Option Selection

2.9 PROM Addressing

The KXJ11-CA can be jumpered to accommodate various PROM types. The location of the PROM addressing jumper is shown in Figure 2-12. If the jumper is not installed, the on-board PROMs use 15-bit addresses. PROMs such as the Intel 2764 (8K × 8) and 27128 (16K × 8) use 15-bit addresses. If the jumper is installed, the PROMs use 16-bit addresses. This accommodates PROMs such as the Intel 27256 (32K × 8) that use 16-bit addresses. 15-bit PROM addressing is specified as part of the factory-shipped configuration.

| Jumper Connection | | Description |
|-------------------|-----|-----------------------------|
| o | M19 | 15-bit addressing selected* |
| o | M18 | |
| o | M19 | 16-bit addressing selected |
| o | M18 | |

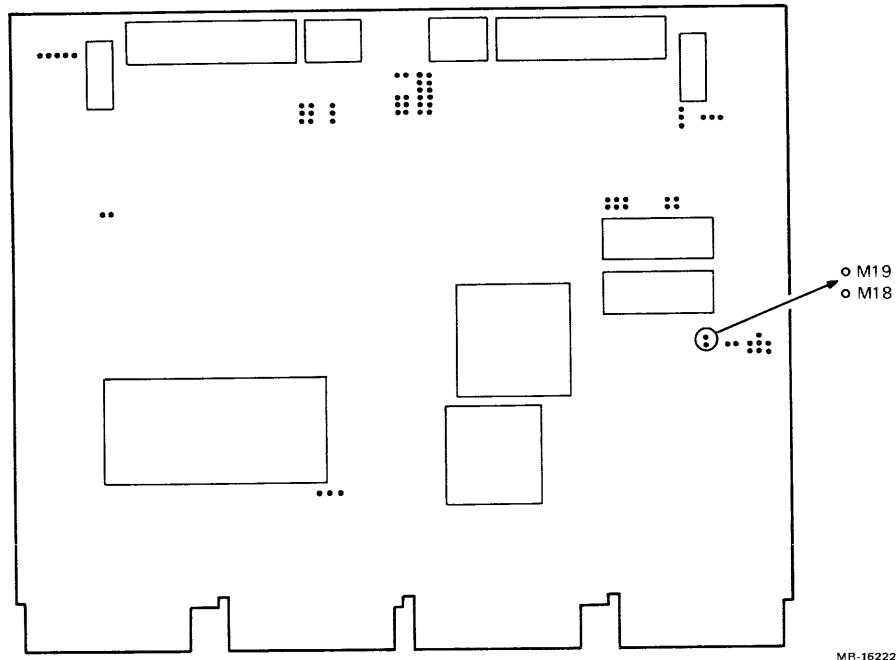


Figure 2-12 PROM Addressing

* Factory-shipped configuration

2.10 SLU1 Baud Rate

The jumpers shown in Figure 2-13 select the default baud rate for the SLU1 transmitter and receiver. The default baud rate for SLU1 is set when the KXJ11-CA is powered up or reinitialized. This rate can be changed under software control, if KXJCSRJ<3> is set. Table 2-4 shows the various baud rates that can be selected. A default baud rate of 9600 is specified as part of the factory-shipped configuration.

| Jumper Connection | | Description | |
|-------------------|-------|-------------|-------------------------------|
| M60 | o — o | M59 | Factory shipped configuration |
| M58 | o o | M57 | 9600 baud |
| M56 | o — o | M55 | |

M60 o o M59
M58 o o M57
M56 o o M55

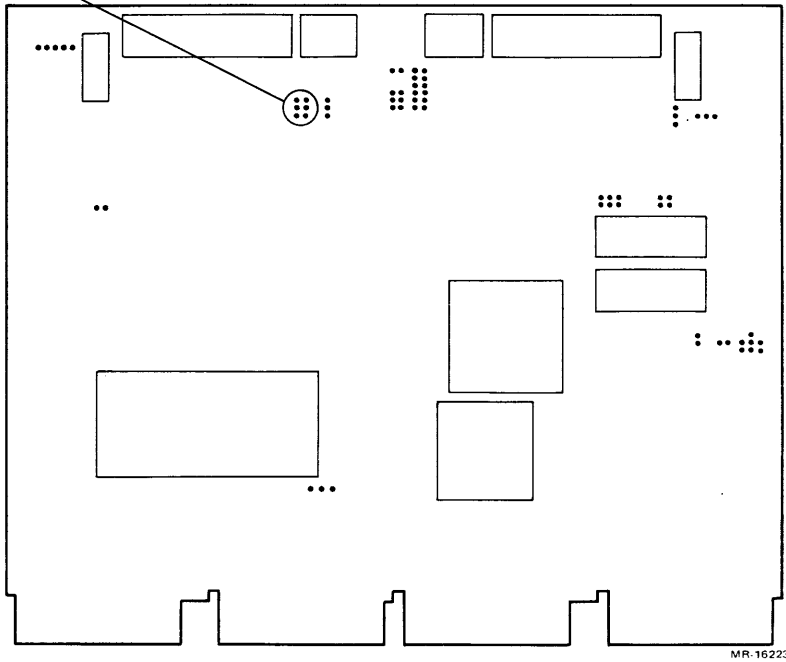


Figure 2-13 SLU1 Baud Rate

Table 2-4 SLU1 Baud Rate Jumpering

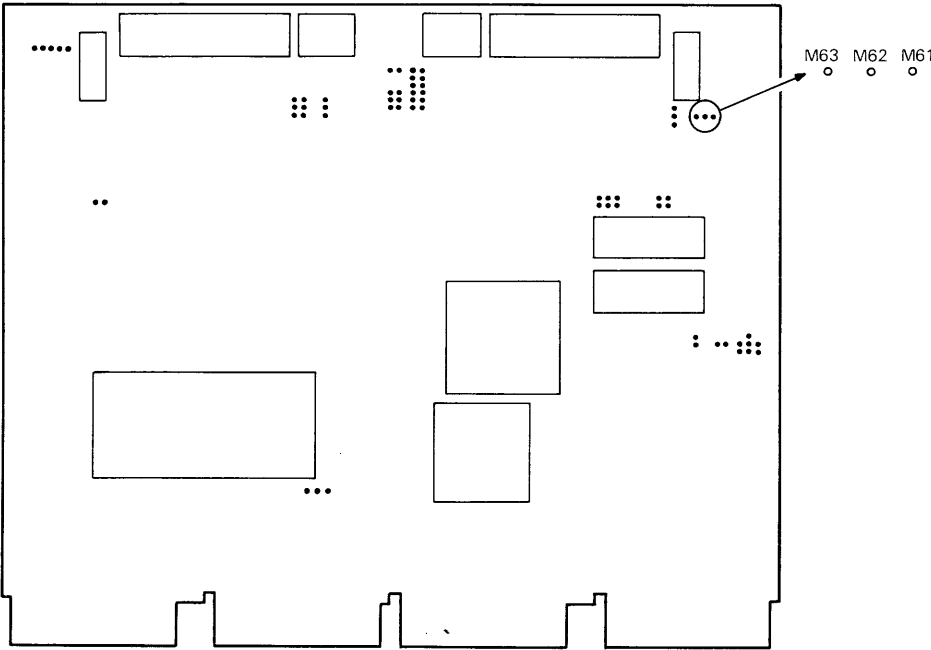
| Baud Rate | M56 to M55 | M58 to M57 | M60 to M59 |
|------------------|-------------------|-------------------|-------------------|
| 38400 | In | In | In |
| 19200 | In | In | Out |
| 9600* | In | Out | In |
| 4800 | In | Out | Out |
| 2400 | Out | In | In |
| 1200 | Out | In | Out |
| 600 | Out | Out | In |
| 300 | Out | Out | Out |

* Factory-shipped configuration

2.11 SLU1 Transmitter

The SLU1 transmitter can be jumpered to send either single-ended (RS423) or differential (RS422) asynchronous serial data via connector J3. The location of the jumpers is shown in Figure 2-14. RS423 transmission is selected as part of the factory-shipped configuration.

| Jumper Connection | Description |
|-----------------------------|------------------------------|
| M63 M62 M61 o o-----o | RS423 transmission selected* |
| M63 M62 M61 o-----o o | RS422 transmission selected |



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Figure 2-14 SLU1 Transmitter

* Factory-shipped configuration

2.12 SLU1 Receiver

The SLU1 receiver can be jumpered to receive either single-ended (RS423) or differential (RS422) asynchronous serial data via connector J3. The location of the jumper is shown in Figure 2-15. RS423 reception is selected as part of the factory-shipped configuration.

| Jumper Connection | Description |
|-------------------|---------------------------|
| M48 M47 o — o | RS422 reception selected |
| M48 M47 o o | RS423 reception selected* |

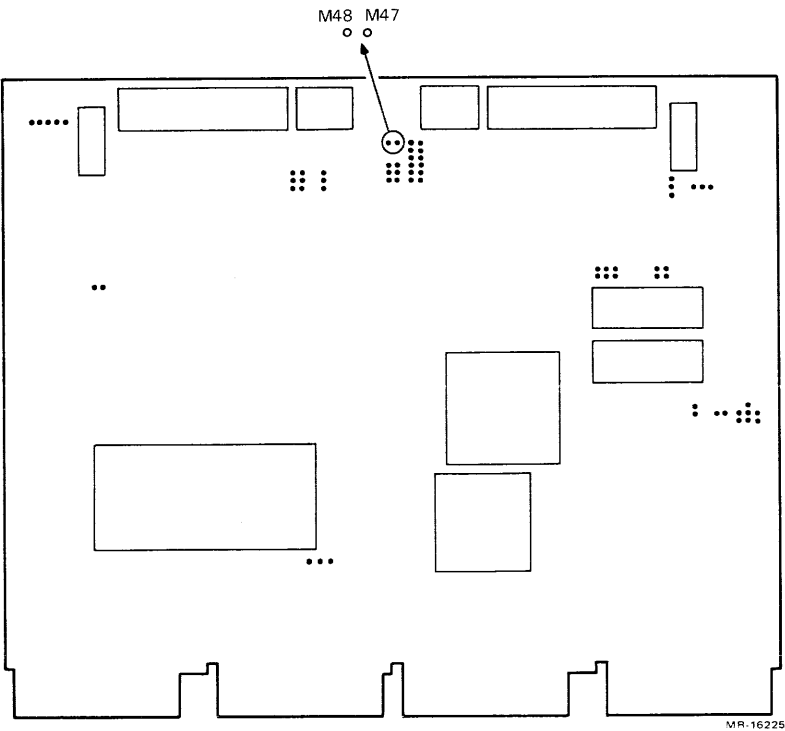


Figure 2-15 SLU1 Receiver

* Factory-shipped configuration

2.13 SLU2 Channel A Receiver

The SLU2 channel A receiver can be jumpered to receive either single-ended (RS423) or differential (RS422) serial data via connector J1. The location of the jumpers is shown in Figure 2-16. RS422 reception is selected as part of the factory-shipped configuration.

| Jumper Connection | | | Description |
|-------------------|-------|-----|---------------------------|
| M34 | o—o | M33 | RS422 reception selected* |
| M32 | o—o | M31 | |
| M30 | o—o | M29 | |
| M28 | o—o | M27 | |
| M26 | o—o | M25 | |
| M24 | o—o | M23 | |
| M34 | o o | M33 | RS423 reception selected |
| M32 | o o | M31 | |
| M30 | o o | M29 | |
| M28 | o o | M27 | |
| M26 | o o | M25 | |
| M24 | o o | M23 | |

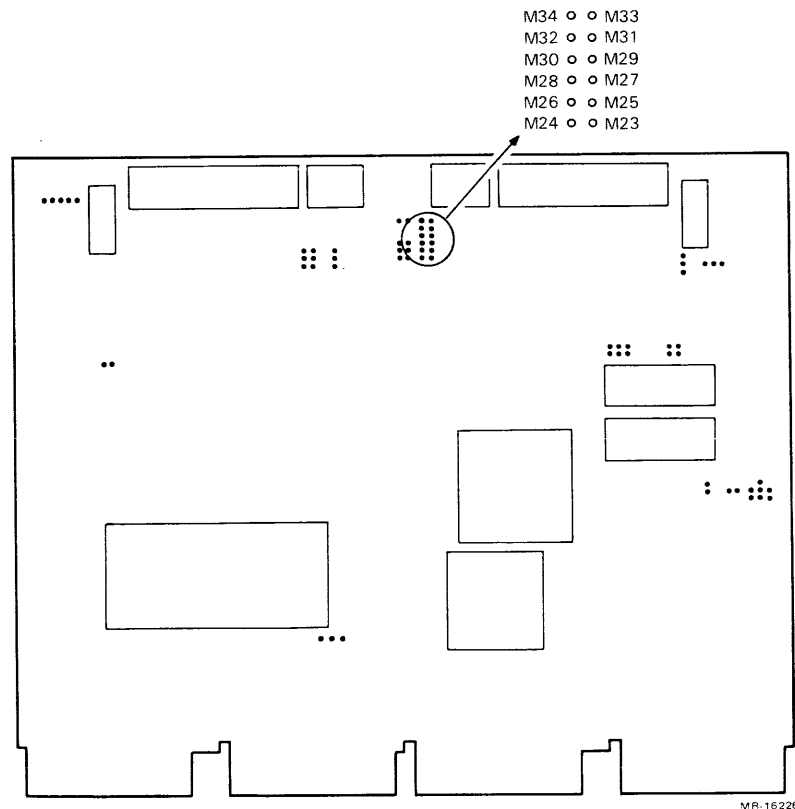


Figure 2-16 SLU2 Channel A Receiver

* Factory-shipped configuration

2.14 SLU2 Channel B Transmitter

The SLU2 channel B transmitter can be jumpered to send single-ended (RS423), differential (RS422), or party line (CCITT R1360) serial data via connector J2. The location of the jumpers is shown in Figure 2-17. RS422 transmission is selected as part of the factory-shipped configuration.

| Jumper Connection | | | | | Description |
|-------------------|-----|-----|-----|-----|----------------------------------|
| | | | M38 | | RS422 transmission selected* |
| M46 | M45 | M37 | o | M35 | |
| o | o | o | o | o | |
| | | | M36 | | |
| | | o | o | o | |
| | | M51 | M50 | M49 | |
| | | | M38 | | RS423 transmission selected |
| | | | o | | |
| M46 | M45 | M37 | | M35 | |
| o | o | o | o | o | |
| | | | M36 | | |
| | | o | o | o | |
| | | M51 | M50 | M49 | |
| | | | M38 | | Party line transmission selected |
| | | | o | | |
| M46 | M45 | M37 | | M35 | |
| o | o | o | o | o | |
| | | | M36 | | |
| | | o | o | o | |
| | | M51 | M50 | M49 | |

* Factory-shipped configuration

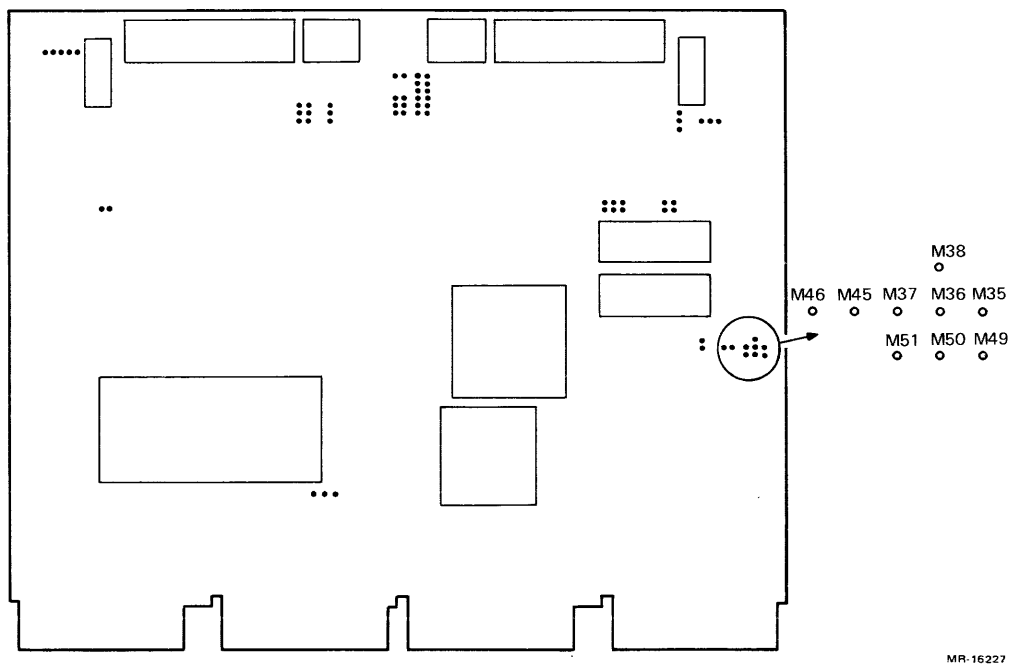


Figure 2-17 SLU2 Channel B Transmitter

2.15 SLU2 Channel B Receiver

The SLU2 channel B receiver can be jumpered to receive single-ended (RS423), differential (RS422), or party line (CCITT R1360) serial data via connector J2. Two groups of jumpers are involved and shown in Figure 2-18. RS422 reception is selected as part of the factory-shipped configuration.

| Jumper Connection | | | | | Description | |
|-------------------|---|---|-----|---|-------------|-------------------------------|
| M44 | o | o | M43 | o | M20 | RS422 reception selected* |
| M42 | o | o | M41 | o | M21 | |
| M40 | o | o | M39 | o | M22 | |
| M44 | o | o | M43 | o | M20 | RS423 reception selected |
| M42 | o | o | M41 | o | M21 | |
| M40 | o | o | M39 | o | M22 | |
| M44 | o | o | M43 | o | M20 | Party line reception selected |
| M42 | o | o | M41 | o | M21 | |
| M40 | o | o | M39 | o | M22 | |

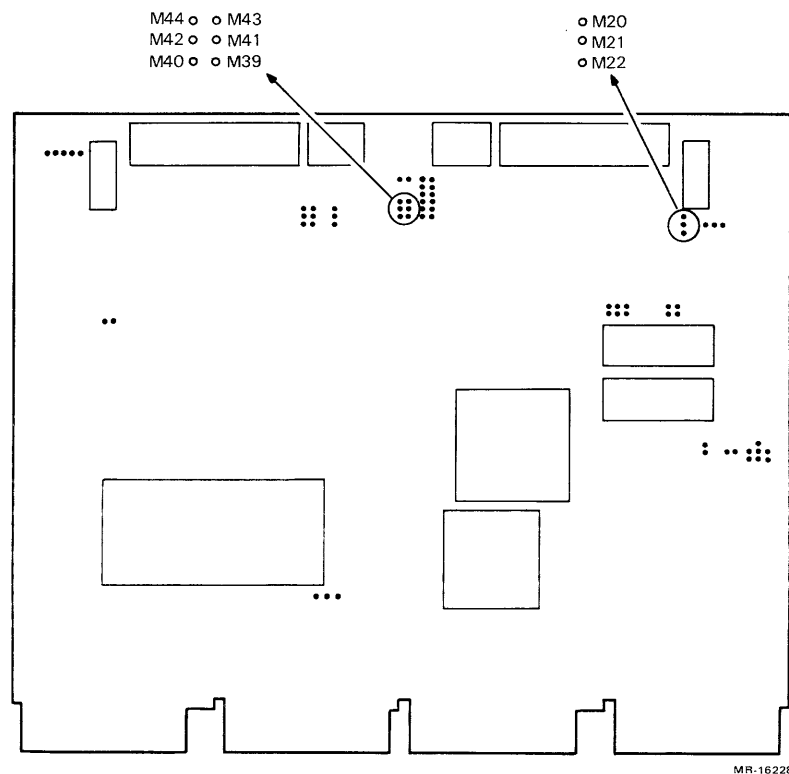


Figure 2-18 SLU2 Channel B Receiver

* Factory-shipped configuration

2.16 Real-Time Clock Interrupt

SLU1 (the on-board DLART) can generate real-time clock interrupts at frequencies of 50 and 60 Hz. Jumpers M52, M53, and M54 select either the 50 Hz or the 60 Hz real-time clock as input to the interrupt control logic. If interrupts are enabled, each clock “tick” results in a maskable priority level 6 interrupt request to the on-board J-11. The location of the real-time clock interrupt jumpers is shown in Figure 2-19. A real-time clock rate of 60 Hz is specified as part of the factory-shipped configuration.

| Jumper Connection | Description |
|-------------------------|---------------------------------|
| o M54 o M53 o M52 | 60 Hz real-time clock selected* |
| o M54 o M53 o M52 | 50 Hz real-time clock selected |

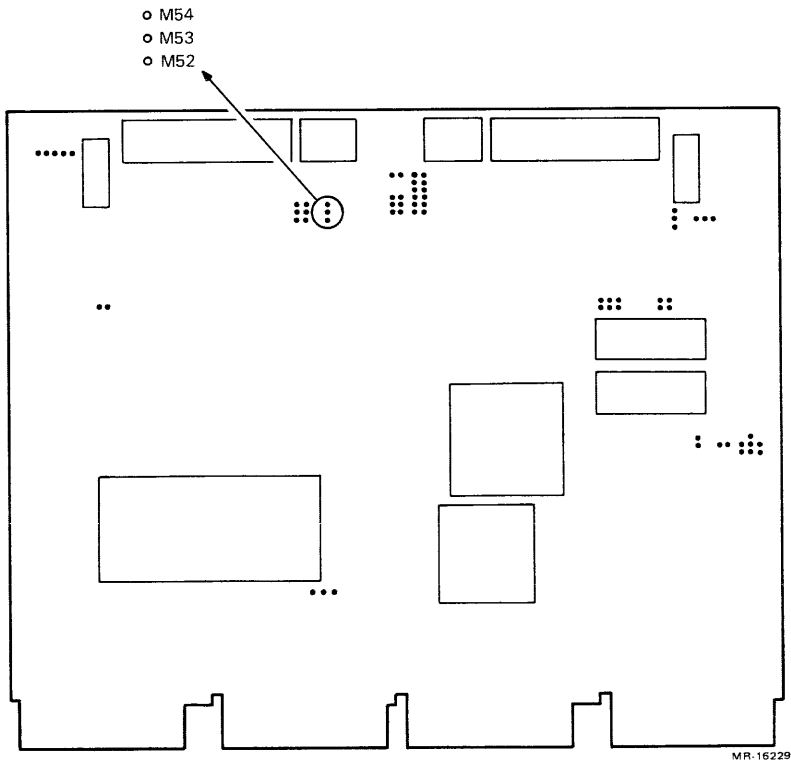


Figure 2-19 Real-Time Clock Interrupt

* Factory-shipped configuration

Chapter 3

Power Supply Considerations

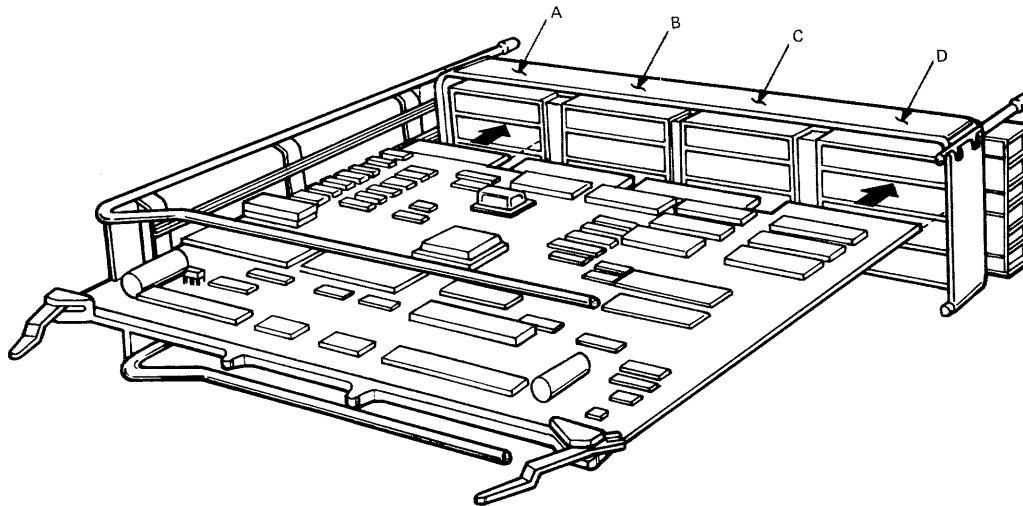
When installing the KXJ11-CA, make sure the power supply can handle the extra load presented by the board. The KXJ11-CA draws a maximum of 6A at +5V. In addition, the KXJ11-CA draws a maximum of 1.4A at +12V, for systems with the DLV11-KA option, or .4A maximum at +12V, for systems without the DLV11-KA option. The board adds 2.7 ac loads and 1.0 dc loads to the bus.

In standalone mode, at least four power fingers (backplane connections) and four ground fingers for +5 Vdc must be connected to the power supply. In addition, at least two power fingers and two ground fingers for +12 Vdc must be connected to the power supply.

Chapter 4

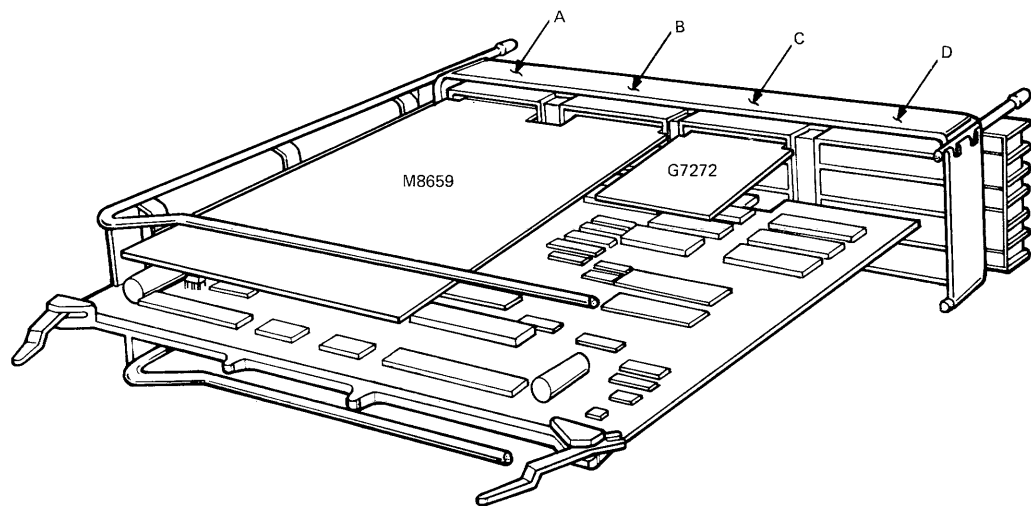
Installing the KXJ11-CA in a Backplane

The KXJ11-CA plugs into any Digital standard quad-height Q-Bus backplane (see Figure 4-1). No special backplane wiring or jumpering is required to accommodate the KXJ11-CA. However, the grant structure must be preserved if there are blank slots between the KXJ11-CA and the top of the backplane. This can be accomplished by inserting grant cards where appropriate. (Figure 4-2 is an example of the use of grant cards.) The dual-height grant card (M8659) preserves grant continuity for slots A and B, and grant card G7272 preserves both the DMA and interrupt grant continuity for slot C. The KXJ11-CA board must also be configured for the proper Q-Bus address size.



MR-12021

Figure 4-1 Backplane Installation



MR-12020

Figure 4-2 Using Grant Cards

4.1 Edge Connector Pin Assignments

Table 4-1 summarizes the edge connector pin assignments for the KXJ11-CA. The board is designed to mate with Digital standard quad height backplanes for Q-Bus based systems.

Table 4-1 KXJ11-CA Pin Identification

| Component Side | | Solder Side | |
|----------------|--------------------|-------------|--------------------|
| Pin | KXJ11-CA Signal | Pin | KXJ11-CA Signal |
| AA1 | NC | AA2 | +5V |
| AB1 | NC | AB2 | NC |
| AC1 | BDAL16 L | AC2 | GND |
| AD1 | BDAL17 L | AD2 | NC |
| AE1 | NC | AE2 | BDOUT L |
| AF1 | NC | AF2 | BRPLY L |
| AH1 | NC | AH2 | BDIN L |
| AJ1 | GND | AJ2 | BSYNC L |
| AK1 | NC | AK2 | BWTBT L |
| AL1 | NC | AL2 | BIRQ4 L |
| AM1 | GND | AM2 | BIAKI L |
| AN1 | BDMR L | AN2 | BIAKO L |
| AP1 | BHALT L | AP2 | BBS7 L |
| AR1 | NC | AR2 | BDMGI L |
| AS1 | NC | AS2 | BDMGO L |
| AT1 | GND | AT2 | BINIT L |
| AU1 | NC | AU2 | BDAL0 L |
| AV1 | +5VB | AV2 | BDAL1 L |
| | | | |
| BA1 | BDCOK H | BA2 | +5V |
| BB1 | BPOK H | BB2 | NC |
| BC1 | BDAL18 L | BC2 | GND |
| BD1 | BDAL19 L | BD2 | +12V |
| BE1 | BDAL20 L | BE2 | BDAL2 L |
| BF1 | BDAL21 L | BF2 | BDAL3 L |
| BH1 | NC | BH2 | BDAL4 L |
| BJ1 | GND | BJ2 | BDAL5 L |
| BK1 | NC | BK2 | BDAL6 L |
| BL1 | NC | BL2 | BDAL7 L |
| BM1 | GND | BM2 | BDAL8 L |
| BN1 | BSACK L | BN2 | BDAL9 L |
| BP1 | NC | BP2 | BDAL10 L |
| BR1 | NC | BR2 | BDAL11 L |
| BS1 | NC | BS2 | BDAL12 L |
| BT1 | GND | BT2 | BDAL13 L |
| BU1 | NC | BU2 | BDAL14 L |
| BV1 | +5V | BV2 | BDAL15 L |

Table 4-1 KXJ11-CA Pin Identification (Cont)

| Component Side | | Solder Side | |
|----------------|--------------------|-------------|--------------------|
| Pin | KXJ11-CA Signal | Pin | KXJ11-CA Signal |
| CA1 | NC | CA2 | +5V |
| CB1 | NC | CB2 | NC |
| CC1 | NC | CC2 | GND |
| CD1 | NC | CD2 | NC |
| CE1 | NC | CE2 | NC |
| CF1 | NC | CF2 | NC |
| CH1 | NC | CH2 | NC |
| CJ1 | NC | CJ2 | NC |
| CK1 | NC | CK2 | NC |
| CL1 | NC | CL2 | NC |
| CM1 | NC | CM2 | IAK L (Note 2) |
| CN1 | NC | CN2 | IAK L (Note 2) |
| CP1 | NC | CP2 | NC |
| CR1 | NC | CR2 | DMG L (Note 3) |
| CS1 | NC | CS2 | DMG L (Note 3) |
| CT1 | GND | CT2 | NC |
| CU1 | NC | CU2 | NC |
| CV1 | NC | CV2 | NC |
| | | | |
| DA1 | NC | DA2 | +5V |
| DB1 | NC | DB2 | NC |
| DC1 | NC | DC2 | GND |
| DD1 | NC | DD2 | NC |
| DE1 | NC | DE2 | NC |
| DF1 | NC | DF2 | NC |
| DH1 | NC | DH2 | NC |
| DJ1 | NC | DJ2 | NC |
| DK1 | NC | DK2 | NC |
| DL1 | NC | DL2 | NC |
| DM1 | NC | DM2 | NC |
| DN1 | NC | DN2 | NC |
| DP1 | NC | DP2 | NC |
| DR1 | NC | DR2 | NC |
| DS1 | NC | DS2 | NC |
| DT1 | GND | DT2 | NC |
| DU1 | NC | DU2 | NC |
| DV1 | NC | DV2 | NC |

NOTES

1. NC = Not connected
2. Pin CM2 is jumpered to pin CN2 for the interrupt acknowledge daisy chain.
3. Pin CR2 is jumpered to pin CS2 for the DMA grant daisy chain.

Chapter 5

Connectors and External Cabling

The KXJ11-CA communicates with external devices via a parallel I/O connector (J4) and three serial I/O connectors (J1, J2, and J3). This section specifies the pin assignments of these connectors and lists the types of cables that can be used with each connector.

5.1 Parallel I/O Interface (J4)

The parallel I/O (PIO) interface signals appear at connector J4. These signals are buffered. They can be driven over a 50-foot distance via a ribbon cable, or round cable with a 40-pin AMP contact housing (AMP part number 746473-9) at each end. A PIO cable is not provided with the KXJ11-CA. The following PIO cables are recommended for use in the KXJ11 and are available from Digital Equipment Corporation.

- Shielded ribbon cable BC06 R
- "Mirror image" cable BC05 L

Figure 5-1 lists the pin assignments for J4, the parallel I/O connector.

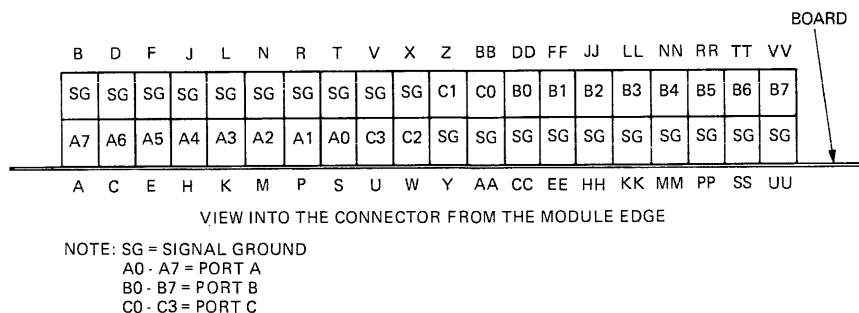


Figure 5-1 Parallel I/O Interface Pin Assignments

5.2 Serial I/O Lines (J1, J2, J3)

The KXJ11-CA has three serial I/O lines.

- SLU2 channel A (J1), a synchronous/asynchronous serial line with modem control
- SLU2 channel B (J2), a synchronous/asynchronous serial line without modem control
- SLU1 (J3), the console asynchronous serial line (no modem control)

Each serial line is compatible with the EIA RS232-C and RS422/RS423 protocols. In addition, SLU2 channel B (J2) is compatible with the CCITT R1360 party line protocol. To interface the KXJ11-CA with a 4-20 mA current loop device via the serial lines, use the DLV11-KA option.

Users must supply their own serial line cables. The following cables are recommended for use for the J2 and J3 serial I/O lines and are available from Digital Equipment Corporation.

| | |
|----------|---|
| BC20N-05 | A 5-foot EIA RS232-C null modem cable for a direct connection between the KXJ11-CA and an EIA terminal. This cable has a 10-pin (2 × 5) AMP female connector on one end and a 25-pin RS232-C female connector on the other. |
| BC21B-05 | A 5-foot EIA RS232-C modem cable for a connection between the KXJ11-CA and a modem or acoustic coupler. This cable has a 10-pin (2 × 5) AMP female connector on one end and a 25-pin RS232-C male connector on the other. |
| BC20M-50 | A 50-foot EIA RS422 or RS423 cable for a direct connection between the KXJ11-CA and a remote processor. Used in applications requiring high data transmission speeds (up to 19.2 K baud), this cable has a 10-pin (2 × 5) AMP female connector on each end. |

The pin designations for J2 and J3 are shown in Figure 5-2.

All three serial lines are factory configured to handle differential inputs and outputs. If you change the configuration of any of the serial lines to handle single-ended inputs or outputs, make sure the return (-) signal(s) on the cable are tied to signal ground.

Because there is no standard cable available from Digital Equipment Corporation for SLU2 channel A, you need to construct your own cable. A standard 40-pin AMP connector may be used (AMP part number 746473-9) for connection to J1. Figure 5-3 illustrates the pin assignments for SLU2 channel A (J1).

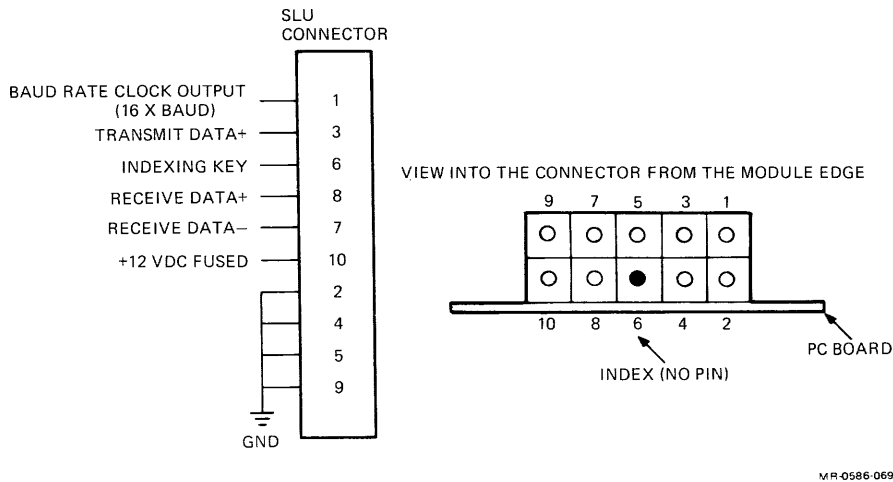


Figure 5-2 J2 and J3 Pin Assignments (10-Pin)

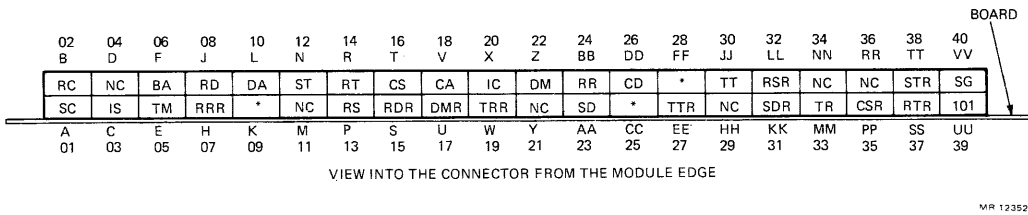


Figure 5-3 J1 Pin Assignments (40-Pin)

Tables 5-1 through 5-3 show the correspondence between the pins of the standard connectors for the RS422/RS423, RS232, and CCITT protocols, and the pins of J1. These tables make it easy to construct an appropriate cable. The KXJ11-CA register address associated with each signal is specified in the last column of each table for ease of programmer reference. For further details, see the register descriptions in Chapters 3 and 6 of *The KXJ11-CA Single-Board Computer User's Guide* (EK-KXJCA-UG-001).

Table 5-1 RS422/RS423 Interface to J1

| Pin | Circuit | Direction | Function | RS-232 | CCITT | Pin | Location |
|-----|---------|------------|--|--------|------------|---------------|----------|
| 1 | SHIELD | — | Protective Ground | | | — | |
| 2 | SI | From Modem | | CI | 112 | 5,E | 17777522 |
| 3 | SPARE | | | | | — | |
| 4 | SD | To Modem | Send Data (+) | BA | 103 | 23,AA 6,F | 17775706 |
| 5 | ST | From Modem | Send Timing (+) | DB | 114 | 12,N | 17777520 |
| 6 | RD | From Modem | Receive Data (+) | BB | 104 | 8,J | 17775702 |
| 7 | RS | To Modem | Request to Send (+) | CA | 105 | 13,P 18,V | 17775704 |
| 8 | RT | From Modem | Receive Timing (+) | DD | 115 | 14,R | 17775720 |
| 9 | CS | From Modem | Clear to Send (+) | CB | 106 | 16,T | 17775700 |
| 10 | LL | To Modem | Local Loop | | 141 | 25,CC Gen. | Dummy |
| 11 | DM | From Modem | Data Mode (+) | CC | 107 | 22,Z | 17775710 |
| 12 | TR | To Modem | Terminal Ready (+) | CD | 108/2 | 33,M 26,DD | 17777520 |
| 13 | RR | From Modem | Receiver Ready (+) | CF | 109 | 24,BB | 17775700 |
| 14 | RL | To Modem | Remote Loop | | 140 | 9,K Gen. | Dummy |
| 15 | IC | From Modem | Incoming Call | CE | 125 | 20,X | 17775710 |
| 16 | SF/SR | To Modem | Select Frequency Signal Rate Select | CH | 126 111 | 3,C 3,C | 17777520 |
| 17 | TT | To Modem | Terminal Timing (+) | DA | 113 | 30,JJ 10,L | 17777530 |
| 18 | TM | From Modem | Test Mode | | 142 | 5,E | 17777522 |
| 19 | SG | To Modem | Signal Ground | AB | 102 | 40,W | |
| 20 | RC | From Modem | Receive Common | | 102b | 2,B | |
| 21 | SPARE | | | | | — | |
| 22 | SDR | To Modem | Send Data (-) | | | 31,KK | |
| 23 | STR | From Modem | Send Timing (-) | | | 38,TT | |
| 24 | RDR | From Modem | Receive Data (-) | | | 15,S | |
| 25 | RSR | To Modem | Request to Send (-) | | | 32,LL | |

Table 5-1 RS422/RS423 Interface to J1 (Cont)

| Pin | Circuit | Direction | Function | RS-232 | CCITT | Pin | Location |
|-----|---------|------------|---------------------|--------|-------|-------|------------|
| 26 | RTR | From Modem | Receive Timing (-) | | | 37,SS | |
| 27 | CSR | From Modem | Clear to Send (-) | | | 35,PP | |
| 28 | IS | To Modem | Terminal in Service | | | 3,C | 17777520 |
| 29 | DMR | From Modem | Data Mode (-) | | | 17,V | |
| 30 | TRR | To Modem | Terminal Ready (-) | | | 19,W | |
| 31 | RRR | From Modem | Receiver Ready (-) | | | 7,H | |
| 32 | SS | To Modem | Select Standby | | 116 | 28,FF | Dummy Gen. |
| 33 | SQ | From Modem | Signal Quality | CG | 110 | — | |
| 34 | NS | To Modem | New Signal | | | — | |
| 35 | TTR | To Modem | Terminal Timing (-) | | | 27,EE | |
| 36 | SB | From Modem | Standby Indication | | 117 | — | |
| 37 | SC | To Modem | Send Common | | 102a | 1,A | |

NOTES

1. Pins K 9, 25 CC, and 28 FF are driven by dummy generators that disable RL (CCITT 140), LL (CCITT 141), and SS (CCITT 116) respectively.
2. The label NC indicates no connection.
3. The suffix R in a three-letter pin label (such as RDR) signifies that the pin is associated with the return side of a differential driver or receiver.
4. Circuit IS can be redefined to mean SF. Or IS can be redefined as SR. In the second case, TM is also redefined as SI.

Table 5-2 RS232-C Interface to J1

| Pin | Circuit | Direction | Function | CCITT | Pin | Location |
|-----|---------|--------------|----------------------------|-------|-------|----------|
| 1 | AA | — | Protective Ground | 101 | 39,UU | |
| 2 | BA | To Modem | Transmitted Data | 103 | 6,F | 17775706 |
| 3 | BB | From Modem | Received Data | 104 | 8,J | 17775702 |
| 4 | CA | To Modem | Request to Send | 105 | 18,V | 17775704 |
| 5 | CB | From Modem | Clear to Send | 106 | 16,T | 17775700 |
| 6 | CC | From Modem | Data Set Ready | 107 | 22,Z | 17775710 |
| 7 | AB | — | Signal Ground | 102 | 40,W | |
| 8 | CF | From Modem | Receiver Ready | 109 | 24,BB | 17775700 |
| 9 | — | (From Modem) | (+ DC Test Voltage) | | — | |
| 10 | — | (To Modem) | (- DC Test Voltage) | | — | |
| 11 | — | — | Unassigned | | — | |
| 12 | SCF | From Modem | Secondary Carrier Detector | 122 | — | |
| 13 | SCB | From Modem | Secondary Clear to Send | 121 | — | |
| 14 | SBA | To Modem | Secondary Transmitted Data | 118 | — | |
| 15 | DB | From Modem | Transmitter Clock | 114 | 12,N | 17775720 |
| 16 | SBB | From Modem | Secondary Received Data | 119 | — | |
| 17 | DD | From Modem | Receiver Clock | 115 | 14,R | 17775720 |
| 18 | — | To Modem | Receiver Dibit Clock | | | |
| 19 | SCA | To Modem | Secondary Request to Send | 120 | — | |
| 20 | CD | To Modem | Data Terminal Ready | 108/2 | 26,DD | 17775720 |
| 21 | CG | From Modem | Signal Quality Detector | 110 | — | |
| 22 | CE | From Modem | Ring Indicator | 125 | 20,X | 17775710 |
| 23 | CH/CI | To Modem | Data Rate Selector | 111 | 5,E | 17775722 |
| | | | | 112 | 3,C | 17775720 |
| 24 | DA | To Modem | External Transmitter Clock | 113 | 10,L | 17775730 |
| 25 | CN | To Modem | Force Busy | | — | |

Table 5-3 CCITT/V.35 Interface to J1

| Pin | Circuit | Direction | Function | RS232 | RS449 | Pin | Location |
|-----|---------|------------|---------------------|-------|-------|-------|----------|
| A | 101 | — | Protective Ground | AA | | 39,UU | |
| B | 102 | — | Signal Ground | AB | SG | 40,W | |
| C | 105 | To Modem | Request to Send | CA | RS | 18,V | 17775704 |
| D | 106 | From Modem | Ready for Sending | CB | CS | 16,T | 17775700 |
| E | 107 | From Modem | Data Set Ready | CC | DM | 22,Z | 17775710 |
| F | 109 | From Modem | RCV Line Signal Det | CF | RR | 24,BB | 17775700 |
| H | 108/1 | To Modem | Connect Data Set | | | | |
| | 108/2 | To Modem | Data Terminal Ready | CD | TR | 26,DD | 17775720 |
| J | 125 | From Modem | Calling Indicator | CE | IC | 20,X | 17775710 |
| R | 104 | From Modem | Received Data A | BB | RD | 8,J | 17775702 |
| T | 104 | From Modem | Received Data B | | RD | — | |
| V | 115 | From Modem | Receive Timing A | DD | RT | 14,R | 17775720 |
| X | 115 | From Modem | Receive Timing B | | RT | — | |
| Y | 114 | From Modem | Transmit Timing A | DB | ST | 12,N | 17775720 |
| AA | 114 | From Modem | Transmit Timing B | | ST | — | |
| P | 103 | To Modem | Transmit Data A | BA | SD | 6,F | 17775706 |
| S | 103 | To Modem | Transmit Data B | | SD | — | |
| U | 113 | To Modem | Terminal Timing A | DA | TT | 10,L | 17775730 |
| W | 113 | To Modem | Terminal Timing B | | TT | — | |

5.3 Loopback Connectors

Loopback connectors (not provided with the KXJ11-CA) are attached to the serial or parallel communication ports to determine whether or not they are operating correctly (see Figure 5-4). They are typically used in conjunction with the running of diagnostic programs, and in some firmware self-tests (see Section 2.1). These connectors may be ordered from Digital Equipment Corporation or may be built by the user.

There are three different types of loopback connectors available from Digital. A 10-pin loopback connector (Digital part number H3270) is plugged into either J2 to test SLU2 channel B, or into J3 to test SLU1. A 40-pin loopback connector (Digital part number H3022) is plugged into J1 to test SLU2 channel A. This loopback connector can also be configured to test RS422 or RS423 operation (see Figure 5-4). The third type of loopback connector is also 40 pins (Digital part number H3021), and is plugged into J4 to test the parallel I/O port.

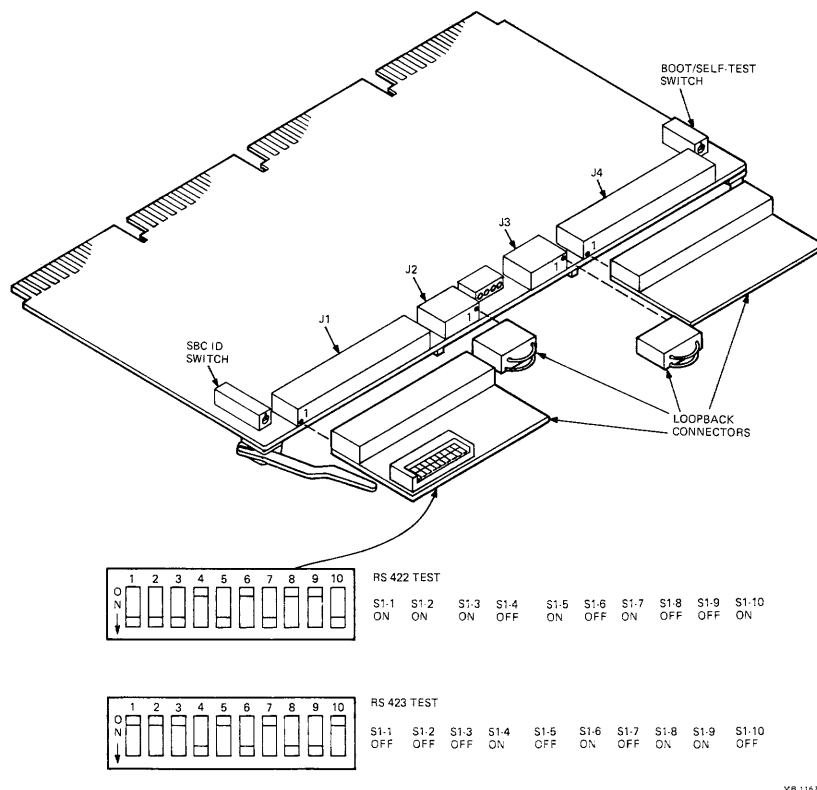


Figure 5-4 Loopback Connectors

Chapter 6

Diagnostics

6.1 Error Detection and Reporting with the LEDs

There are four LEDs on the edge of the KXJ11-CA board that the native firmware uses to indicate the state of the board. These are especially useful for diagnostic purposes during power-up or reinitialization. These LEDs verify that the board is operating properly or, if there is a problem with the board, can help the user locate the difficulty. Table 6-1 summarizes the conditions the LEDs can indicate.

Upon power-up or reinitialization, all four LEDs are illuminated for approximately 1/2 second, if they are working properly. When the KXJ11-CA is installed in a backplane in a box, the LEDs are labeled L4 through L1 from left to right. If the KXJ11-CA runs its self-tests (this is determined by the setting of the boot/self-test switch), L4 is off and L3 - L1 should be on as the self-tests run. If one of the self-tests fails, L4 is illuminated, and L3 - L1 indicate the test that failed. Self-tests are run in the order listed in Table 6-1. Thus, if a test fails, the user can also determine which tests (if any) passed.

If all the self-tests run without error, the KXJ11-CA performs a boot operation. The boot/self-test switch setting determines which function is performed. L4 remains off and L3 - L1 indicate the status of the executing code. Note that the boot/self-test switch may be set so self-tests are not run. If self-tests have not been run, then L4 is off, and L3 - L1 indicate the state of the board as it executes code.

Table 6-1 LED Display Definitions

| L4 | LEDs | | | Meaning |
|----|------|----|----|---|
| | L3 | L2 | L1 | |
| x | x | x | x | All LEDs on for 1/2 second at the start of a power-up or reinitialization operation |
| x | x | x | x | Can't access Control/Status Registers in I/O page (fatal error); or the power-up jumper (M16-M17) is installed, which precludes self-tests. |
| x | o | o | o | DMA or RTC test failed |
| x | o | o | x | RAM test failed |
| x | o | x | o | ROM checksum test failed |
| x | o | x | x | Serial line test of SLU1 failed |
| x | x | o | o | Serial line test of SLU2 channel A failed |
| x | x | o | x | Serial line test of SLU2 channel B failed |
| x | x | x | o | Parallel port test failed |
| o | x | x | x | Auto self-tests running. Auto self-tests do not require loopback connectors. |
| o | x | x | o | Loopback tests and auto self-tests running |
| o | x | o | x | Q-Bus ODT mode |
| o | x | o | o | Unused |
| o | o | x | x | Waiting for command |
| o | o | x | o | Performing DTC load |
| o | o | o | x | TU58 primary bootstrap executing |
| o | o | o | o | Executing non-native code |

Quick LED Reference

| L4 | LEDs | | | Meaning |
|----|------|----|----|-----------------------------------|
| | L3 | L2 | L1 | |
| x | - | - | - | Self-test error detected |
| x | x | x | x | Fatal self-test error detected |
| o | - | - | - | No self-test errors detected |
| o | o | o | o | Application running without error |

Legend

x = On
 o = Off
 - = Don't care (either On or Off)

6.2 Diagnostic Testing with XXDP +

The KXJ11-CA can be tested by running XXDP+, a diagnostic operating system that is booted from the user's system disk. This section explains how to run the XXDP+ diagnostics to test the KXJ11-CA. More information on XXDP+ is found in *The XXDP+ System User's Manual* (AC-F348F-MC).

When you have successfully booted XXDP+ from the system disk, a message such as the one shown below appears on the console terminal. The items that are blank (underscore) indicate values that are system-dependent.

```
BOOTING UP XXDP-_____ MONITOR

XXDP-SM _____ MONITOR VERSION _____
BOOTED FROM _____
_____KW OF MEMORY
NON-UNIBUS SYSTEM

RESTART ADDR: _____
THIS IS XXDP= _____ TYPE "H" or "H/L" FOR HELP
.
```

When the "period" (.) prompt appears, the user types in

```
R ZKXA??<CR>
```

This initiates the running of the tests. The message

```
ZKA____.BIN
```

appears on the console, followed by several lines of system information (the underscore indicates characters that are system dependent). Then the following message should appear.

```
USE <ESC> TO HALT

KXJ FUNCTIONAL TEST

SWR      OCTAL      FUNCTION

15      100000      HALT ON ERROR
14      040000      INHIBIT ERROR SUMMARY
13      020000      INHIBIT ERROR REPORTS
12      010000      IOP IO# KNOWN GOOD FOR TESTING
11      004000      TEST STAND ALONE IOP
10      002000      ENABLE EXTENDED MEMORY TESTS
09      001000      LOOP ON ERROR
08      000400      LOOP ON TEST IN SWR<6:0>
07      000200      INHIBIT TEST NUMBER/TITLE

SWR = 140000 NEW =
```


At this point, type <CR>, which runs the tests until an error is detected. As the tests run, their results are displayed on the console. If an error is detected, a self-explanatory error message is displayed, and the tests halt if bit 15 in the SWR is set to 1. The halt causes an entry into MicroODT. To continue after an error has caused a halt, type

P<CR>

using the console keyboard.

If no errors are detected, testing can be terminated, if the BREAK enable jumper is installed, by pressing the ESCAPE key (which halts the KXJ11-CA and causes micro-ODT to be entered), or by pressing the BREAK key (which halts the arbiter).

READER'S COMMENTS

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

1. Which of the following most closely describes your job?

- (a) Administrative support (d) Scientist/Engineer (g) Educator/Trainer
(b) Programmer/Analyst (e) Systems Manager (h) Computer Operator
(c) Software support (f) Sales (i) Other _____

1 ☐ a ☐ b ☐ c ☐ d ☐ e
☐ f ☐ g ☐ h ☐ i

2. How many years of experience do you have with computers?

- (a) Less than 1 (b) 1 to 3 (c) 4 to 6 (d) 7 to 9 (e) 10 or more

2 ☐ a ☐ b ☐ c ☐ d ☐ e

3. What did you like *most* about this manual?

4. What did you like *least* about this manual?

5. How do you rate this manual?

Indicate your opinion of the quality of the manual. For each aspect of quality, darken your response on the five-point scale, where (1) = POOR and (5) = EXCELLENT

- | | | | | | |
|--|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| (a) Accuracy | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (b) Completeness | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (c) Usefulness of Examples/Figures | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (d) Clearness of Language | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (e) Helpfulness of Index/Table of Contents | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (f) Consistency in Presenting Information | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (g) Logical Organization | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (h) Visual Appeal | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (i) Relevance of Information | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (j) Ease of Learning | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
| (k) Ease of Use | <input type="radio"/> 1 | <input type="radio"/> 2 | <input type="radio"/> 3 | <input type="radio"/> 4 | <input type="radio"/> 5 |
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6. List any errors you found in the manual. (Reference page, table, or figure numbers.)

7. Do you have any additional comments?

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digital



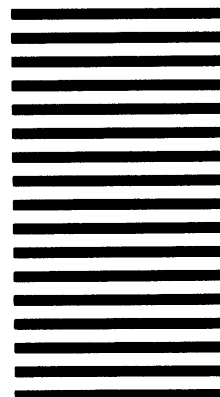
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