Model 3922

Parallel Bus Crate Controller

INSTRUCTION MANUAL

February 16, 1999

Special Option

Model 3922-S001

Parallel Bus Crate Controller

March, 2006

Special Option

Model 3922-S001

The Model 3922-S001 is the same as the Model 3922-Z1B but has been modified so that the Inhibit line is NOT set on power-up.

March, 2006

Model 3922

CONTENTS

FIGURES

Schematic Drawing #122189-C-5857   See Reply Card Following Warranty
        #122189-C-5860   See Reply Card Following Warranty

Warranty

Parallel Bus Crate Controller

Features

- Interfaces to:
  - the PCI bus with an associated 2915 card
  - the VME bus with an associated 2917 card
  - PC's with an associated 2927 card
- Field-selectable as a main or auxiliary crate controller
- Up to eight crate controllers addressed on a single bus
- Supports DMA with the 2915 and 2927 and block transfers with the 2917
- Includes a 24-bit LAM mask
- Interface connection made via a 40-wire, rear ribbon cable
- Contains RS-485 balanced-line signaling for high noise immunity
- Supports interface bus lengths up to 300 feet (91 meters)

Typical Applications

- Interface to PCI bus computers
- Interface to VME-based computers
- Interface to IBM PC compatibles
- General-purpose data acquisition and control
- Laboratory automation
- Industrial process control
- Remote distributed systems

(Product specifications and descriptions in this document subject to change without notice.)

General Description

The 3922 is a double-width CAMAC crate controller that connects to the associated computer interface card via a parallel bus. When used with the 2927 interface card, the combination forms a computer-based CAMAC system with a PC-compatible host. The 2915 interface card can be used with the 3922 to form a PCI-bus based CAMAC system. A VME-based computer is interfaced using the 2917.

Up to eight 3922s can be addressed on the interface bus. The crate address (0 through 7) is selected by a front-panel switch. A single 40-wire ribbon cable is connected to the computer interface card and looped-through the crate controllers. Interface bus connections are made at the rear of each 3922. The last 3922 terminates the bus. RS-485 balanced-line signaling is used on the interface bus to allow reliable operation with up to 91 meters (300 feet) of total bus length. Twisted-pair, flat-ribbon bus cable enhances data integrity The eight-bit interface bus is multiplexed for address and data transfer. Appropriate control/response signals are also included.

The 3922 supports the DMA capabilities of the 2915 and 2927 adapters. Sixteen-bit DMA data is transferred at rates up to one megabyte per second for the 2915 as well as 800 kilobytes per second for the 2927. Block transfers are supported when interfacing to a computer with the 2917 VME adapter.

A 24-bit LAM mask is included to simplify the host software. A "Selected LAM Present" causes a service request to the computer interface. A parallel poll is per formed to determine which 3922s are requesting service.

This module is configured at the factory as a mail crate controller. It can be changed in the field to function as an auxiliary crate controller. An additional 40-contact, rear-panel connector is then used for the Auxiliary Controller Bus.
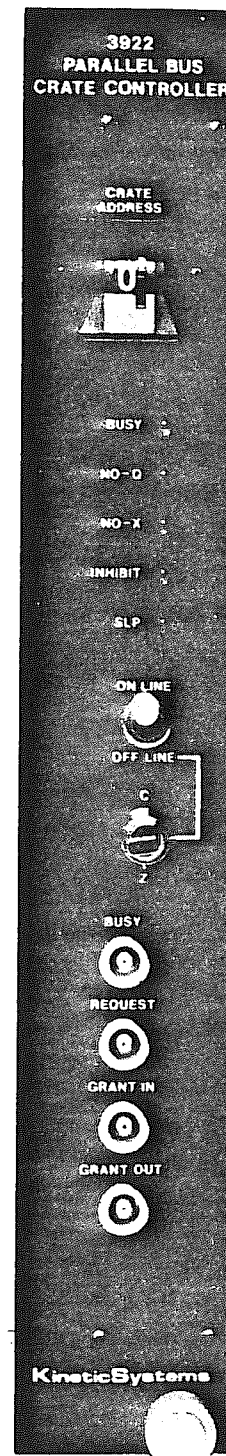
3922 *(continued)*

Internal Registers (N=30)

Command		Q	Description
F(1)·A(0)	RD2	on-line	Reads Control/Status register
F(1)·A(12)	RD2	on-line	Reads LAM Pattern
F(1)·A(13)	RD2	on-line	Reads LAM Mask
F(17)·A(0)	WT2	on-line	Writes Control/Status register
F(17)·A(13)	WT2	on-line	Writes LAM Mask

Notes: 1. X = 1 for all valid addressed commands.
          2. Q = 1 for all valid addressed commands when the 3922 is set on-line by the front-panel switch.

Typical Configuration

Up to 8 3922s

To/from Host Computer

Computer Interface (2917, 2917 or 2927)

3922 Crate Controller

3922 Crate Controller

Terminator (Supplied with each 3922)
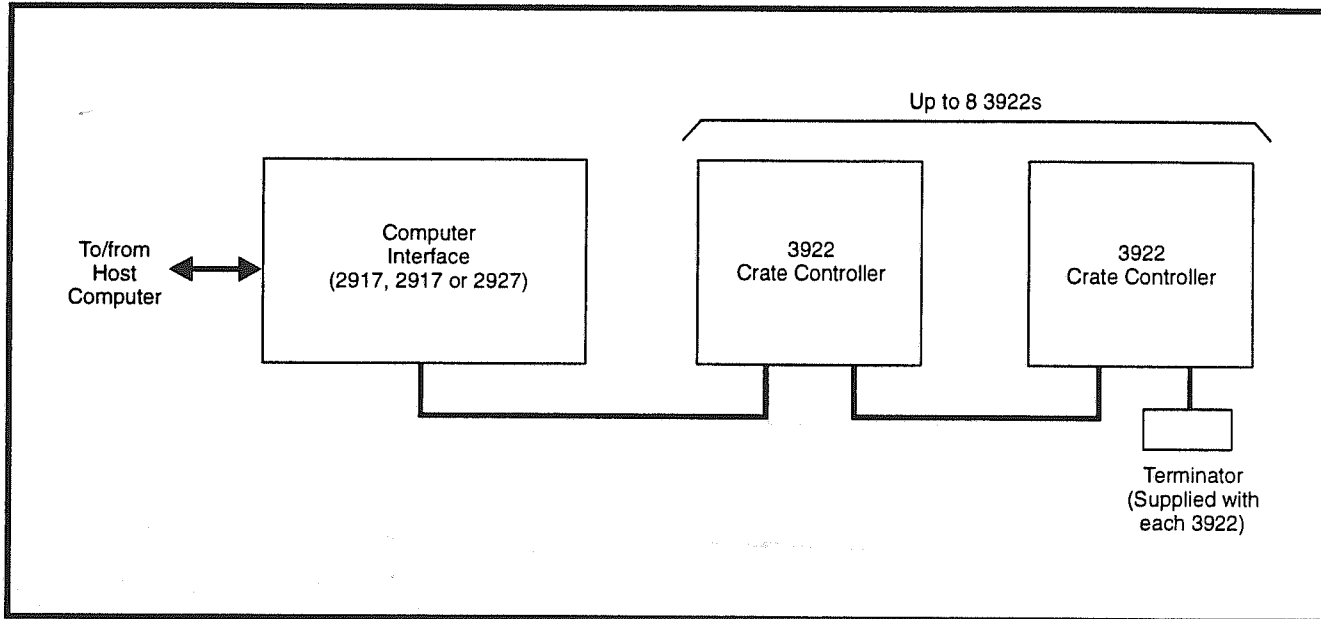
Power Requirements

+6 volts: 3300 mA

Ordering Information

Model 3922-Z1B   Crate Controller, parallel bus input. (Use with models 2915, 2917, 2922, 2927, 2928, 2932.)

Related Products

Model 5843-Txyz   Twisted-pair, Flat-ribbon Cable Assembly (required)
Model 2915-Z1A   PCI Interface with DMA
Model 2917-Z1A   VME Interface with DMA
Model 2927-Z1A   IBM PC/AT Interface with DMA

SECTION OF FRONT PANEL

AUX
C.C.

ACB
CABLE

REQUEST

MAIN
C.C.

REQUEST

IN ORDER FOR MAIN CRATE
CONTROLLER TO PERFORM DATA-
WAY OPERATIONS, THIS JUMPER
MUST BE INSTALLED.

GRANT
IN

GRANT
OUT

GRANT
IN

GRANT
OUT

(5857-B30K)
CABLE

IN ORDER FOR AUXILIARY CRATE
CONTROLLER TO PERFORM DATA-
WAY OPERATIONS, THIS JUMPER
MUST BE INSTALLED.
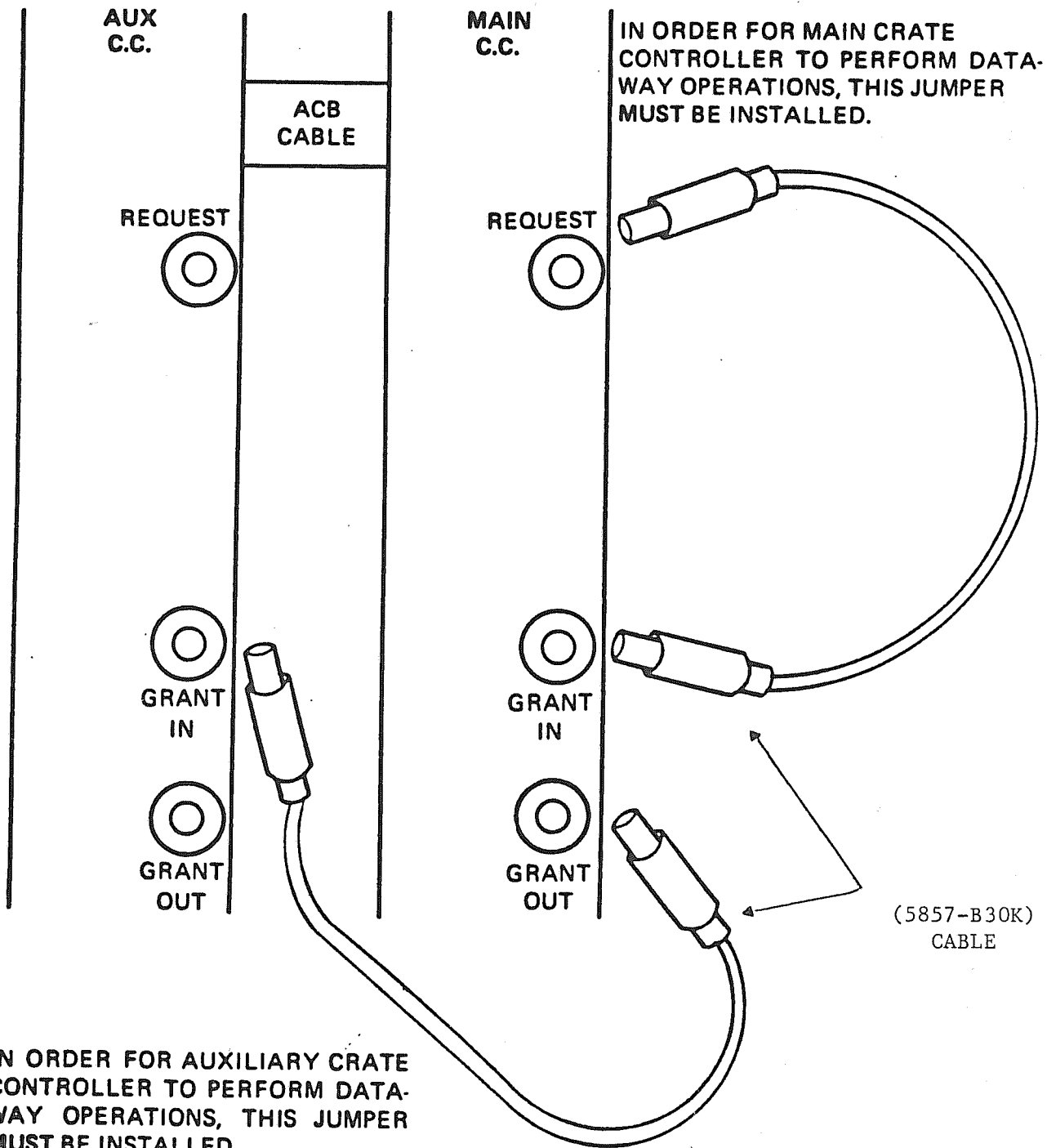
AND THE ACB CABLE MUST BE
CONNECTED BETWEEN THE MAIN
AND AUXILIARY CONTROLLERS.

CAPABILITIES OF THE 2926/3922

The Model 2926 IBM PC Interface and up to eight Model 3922 Crate Controllers add the power of CAMAC real-time I/O to the IBM Personal Computer (PC, XT, and AT) as well as other fully compatible computers, such as the Compaq Portable or the Compaq Deskpro. The 2926 is installed in any available expansion slot of the personal computer. Each 3922 can be installed in a CAMAC crate as a main or an auxiliary crate controller. The 2926 and 3922(s) are interconnected by flat ribbon cable. More than one 2926 can be installed in the PC, increasing the possible number of 3922s. The 2926 supports both interrupts and DMA transfers. DMA transfer rates up to 250 kilobytes/second can be achieved. The 2926 performs only byte transfers on the PC or AT family of computers.

MODEL 3922 CRATE CONTROLLER

Features and Operation

The Model 3922 meets all the requirements of IEEE Standard 583 for CAMAC crate controllers. It forms the communications link between the 2922 DEC or the 2926 PC Interface and the I/O modules in the CAMAC crate. When used with these interfaces, the 3922 performs a wide variety of CAMAC commands to modules in the crate. The interface/3922 combination supports program transfers as well as high-speed DMA operations. The 3922 also contains several internal registers that can be read or written at pseudo-address N(30). As a main crate controller, the 3922 supports auxiliary crate controllers as specified by IEEE Standard 675. The 3922 can also easily be field-changed to become an auxiliary crate controller itself.

One to eight 3922s can be connected to a single interface. Each 3922 includes a front-panel switch that allows address selection from 0 to 7. Multiple 3922s are interconnected on a loop-through basis and the last 3922 can be up to 300 feet from the interface. This 3922 includes a termination card inserted into one of its connectors.

To achieve higher speed DMA data transfers, the 3922's Read and Write Data Registers can be double-buffered. This allows a Dataway cycle to be requested and executed while data is transferred across the interface/3922 bus. This buffering produces a side effect during Read operations. When the 2926 terminates a DMA transfer, the 3922 has already performed one or more Dataway operations to fill its buffer. This can cause a problem in some instances. Two operating states are provided for DMA Read operations. By clearing the bit in the 3922 Status Register, the single-buffer mode performs a Read operation only when the interface requests data. By setting this bit, double-buffer mode is selected. Double buffering results in some increase in throughput. Single-buffer mode should be used for Q-Repeat and Q-Scan operations or for other Read transfers where extra Dataway cycles result in lost data.

Address Selection

A front-panel thumb-wheel switch allows you to select each 3922's address. Any address from 0 to 7 can be selected. However, all 3922s connected to a single interface should have this switch set to different addresses.

Registers

CAMAC commands are performed to modules within the crate using Station address 1 through 23. Internal registers in the 3922 are accessed in the same manner as module registers by pseudo-address N(30). There are five 3922 internal registers. These are: Read Status, Read LAM Pattern, Read LAM Mask, Write Status, and Write LAM Mask. The N(30) Commands are shown here:

Command	Q-Response	Action
F(1).A(0)	ONLINE	Read Status
F(1).A(12)	ONLINE	Read LAM Pattern
F(1).A(13)	ONLINE	Read LAM Mask
F(17).A(0)	ONLINE	Write Status
(17).A(13)	ONLINE	Write LAM Mask

Notes:

1. N=30 for all commands.

2. X=1 is returned for all valid commands.

3. Q=0 is returned if the front-panel, on-line switch is in an "off-line" position. The only command that will be executed when the 3922 is off-line is N(30).F(1).A(0), Read Status Register.

Status Register, N(30).F(17).A(0), N(30).F(1).A(0)

Bit	Write Operation	Read Operation
1	Generate Z	0
2	Generate C	0
3	Set Inhibit	Inhibit (Crate Controller Register State)
4	0	0
5	0	0
6	0	0
7	0	Dataway Inhibit
8	Double-Buffer Mode	Double-Buffer Mode
9	Enable Service Request	Service Request Enabled
10	Set Internal L24	Internal L24 Set
11	0	0
12	0	0
13	0	0
14	0	Front-Panel Switch Off-line
15	0	Buffer Full
16	0	Selected LAM Present
17-24	0	0

A detailed description of the bits in the 3922 Status Register is provided here:

Bit	Description
1	By setting this bit with the 3922 on-line, the crate controller executes a CAMAC Initialize (Z) operation. This bit is always read back as zero.
2	By setting this bit with the 3922 on-line, the crate controller executes a CAMAC Clear (C) operation. This bit is always read back as zero.
3	By setting this bit, the 3922 asserts the Dataway Inhibit line. With the 3922 asserting the Inhibit line, both bits 3 and 7 will return a value of ONE when the Status Register is read.
7	This Read-only bit indicates the state of the Inhibit line on the CAMAC Dataway. Note that other modules such as the 3655 can assert the Inhibit line.
8	By setting this bit, all DMA Read operations are executed in double-buffer mode. In this mode, a Dataway Read operation is executed and transferred to the 3922 buffer as soon as a DMA transfer request is made. This double-buffering allows extra Dataway operations to occur when the block is terminated. If this bit is cleared (single-buffer mode), a DMA Dataway Read operation is executed only after the interface requests data. Single-buffered mode should be used for Q-Repeat and Q-Scan operations or other transfers where extra Dataway operations will result in lost data. This bit is Read/Write.
10	This bit sets the internal L24 signal. The L24 signal can be used for software and hardware testing associated with the Service Request. This bit is Read/Write.
14	This Read-only bit indicates the status of the front-panel, on-line switch. With the 3922 in the off-line state, only the Status Register can be read. No other commands will be executed by the 3922.
15	This read-only bit indicates that data is remaining in the write data buffer and is only used when a write operation terminates due to an error condition. When a CAMAC write operation terminates with an error, the host software driver must have an indication if the 3922 contains a CAMAC data word that has not been successfully written to a module. This is necessary to determine the actual number of valid CAMAC write operations that occurred when the operation terminated. This bit should be ignored for all other operations.
16	This Read-only bit indicates if a selected LAM is present in the CAMAC crate. This "SLP" condition is TRUE only when one or more LAM requests (L1 to L24) are asserted AND the LAM Mask bit(s) associated with the LAM request(s) are TRUE.

LAM Register N(30).F(1).A(12)

This is a 24-bit register which indicates the present state of all LAM requests in the CAMAC crate. Each bit corresponds to the appropriate Station in the crate {L(9) is associated with N(9), etc.}.

LAM Mask Register N(30).F(1).A(13), N(30).F(17).A(13)

The LAM Mask Register is used to select those LAM requests from modules that cause a Request-for-Service (Selected LAMs Present) to be forwarded to the interface. For example, if Bits 2, 3, and 8 are TRUE in the LAM Mask Register and all other bits are FALSE, only L(2), L(3), or L(8) causes a Service Request.

3922 FRONT PANEL

<u>Switches:</u>

Crate Address	A thumb-wheel switch which selects the crate address for the 3922. The address ranges from 0 to 7.
On-Line	Manually places the 3922 on-line or off-line. No Dataway operations are executed when the 3922 is off-line.
Z/C	Performs a manual Dataway Z or C to the CAMAC crate. Note that the 3922 must be off-line for this switch to have any effect.

<u>LEDs:</u>

BUSY	Flashes whenever the 3922 is performing a Dataway operation.
NO-Q	The last CAMAC operation, including an N(30) command, sets this LED "ON" when a Q=0 condition occurs.
NO-X	The last CAMAC operation, including an N(30) command, sets this LED "ON" when an X=0 condition occurs.
Inhibit	This LED is "ON" whenever the Dataway Inhibit line is asserted.
SLP	This LED is "ON" when a selected LAM is present.

<u>LEMOs:</u>

BUSY	A low-true TTL signal when Dataway BUSY is TRUE.
Request	Part of the auxiliary crate controller (ACC) protocol. Note that Request MUST be patched to Grant In for a main crate controller (even when no ACCs are used).
Grant IN	Part of the ACC protocol. Patched to Request or Grant Out from a higher priority crate controller.
Grant Out	Part of the ACC protocol. Patched to Grant In from a lower priority crate controller.

INSTALLING THE CRATE CONTROLLER

<u>Operating Option Selections</u>

Determine if the 3922 is to be used as a main crate controller (in a stand-alone system) or as an auxiliary crate controller (with another computer being the main host for the crate). The 3922 is shipped from the factory as a main crate controller. If it is to be used as such, proceed to **Installing the 3922.**

If the 3922 is to be used as an auxiliary crate controller, remove the resistor packs and the resistors from both the left and right (A and B) boards of the 3922. Otherwise, proceed to **Installing the 3922.** To convert the 3922 from a main to an auxiliary crate controller, perform the following operations:

1.   Remove the rear panel from the 3922. Retain the screws and PC finger insulation.

2.   Remove the two screws that hold the A board to the front-panel (the left board when viewed from the front-panel).

3.   Gently separate the A board from the B board. It might be helpful to loosen **slightly** the two screws that hold the B board to the front-panel.

4.   On the B board, remove the nine resistor packs located by the Dataway fingers.

5.   On the A board, remove the six resistor packs that are loaded in sockets located on the left-hand side of the PC board. These are marked RP1-RP6.

6.   Store the resistor packs for future use.

7.   Reassemble the 3922 crate controller.

To convert the 3922 back to a main controller, reinstall the resistor packs on the A and B boards. Refer to Figure 1 for resistor pack locations.

INSTALLING THE 3922

Located the 3922 Crate Controller. Locate the front end of the bus cable from the interface. All main crate controllers must be inserted into the right-hand stations of the crate (slots 24 and 25 of a full-size crate). Auxiliary crate controllers can be placed in any available stations except the main station. Starting from the rear of the crate, "thread" the bus cable through the rear I/O opening in the area where the 3922 will be placed. **BE SURE THAT POWER TO THE CRATE IS "OFF".**

Referring to Figure 2, note the location of the data-bus connectors, DB1 and DB2, on the A board and the Auxiliary Controller Bus (ACB) connector on the B board. With the 3922 facing left side up, connect the bus cable from the 2926 to connector DB1. Match the key indicator (arrow) on the 3922 connector to the cable connector. This key indicates Contact 1 and should be facing toward the bottom of the module. If using only one 3922, connect the terminator to connector DB2. Note that the terminator should also have its key indicator toward the bottom of the module. If two or more 3922s are used, find the bus cable for interconnecting a 3922 with the next one on the bus. Thread this cable through the rear I/O opening in the crate and connect it to connector DB2 (with the key toward the bottom of the module). Repeat this operation for all crates on the bus. The last 3922 on the bus will use the terminator in connector DB2.

Slide the 3922 into the appropriate slots in the crate. Be sure that the bus cable does not "snap." When the 3922 is almost fully inserted, tighten the jackscrew until it is fully seated.

STRAP SELECTION

The A board of the 3922-Z1B has two straps located near the front of the board. The strap labeled P2-/P2 is used to enable or disable the P2 hold option of the 3922. With the strap in the P2 position, the 3922 will hold the Dataway while the CAMAC P2 line is asserted. The 3922 will not execute a Dataway cycle until P2 is negated. With the strap in the /P2 position, the CAMAC P2 line has no effect on 3922 Dataway operation.

The strap labeled QENA-QDIS is used to enable or disable the Q-Repeat time out function of the 3922. With this strap in the QENA position, the 3922 will generate a time out condition. If the K-BUS is in a Q-Repeat mode and the 3922 does not detect a CAMAC Q=1 within 2 m seconds of Cycle Initiation, the 3922 will terminate the K-BUS operation. With the strap in the QDIS position, the 3922 will attempt the CAMAC cycle until a Q=1 is received regardless of the time taken to get the desired response.

Front-panel Setup

Set the front-panel, thumb-wheel, address switch to the desired address. This is generally "1" for a single-crate system. In multicrate systems, verify that no other 3922 has the same address. The order of addresses need not bear any relationship to the physical order of the crates on the bus. Connect the Request, Grant In, and Grant Out LEMO connectors as appropriate for the system.
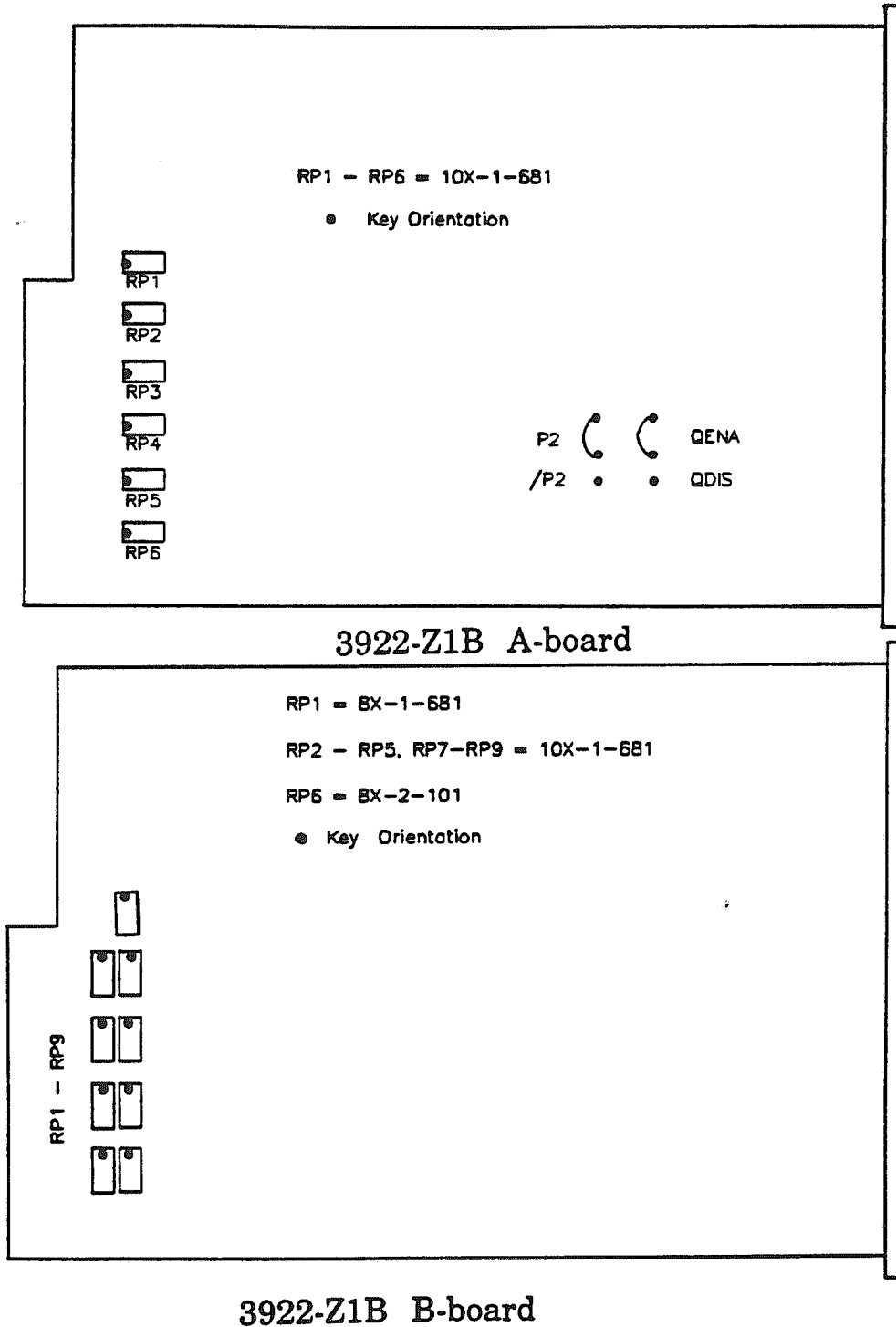
RP1 — RP6 = 10X—1—681

⊛ Key Orientation

RP1
RP2
RP3
RP4
RP5
RP6

P2   QENA
/P2   QDIS

3922-Z1B A-board

RP1 = 8X—1—681

RP2 — RP5, RP7—RP9 = 10X—1—681

RP6 = 8X—2—101

⊛ Key Orientation

RP1 – RP9

3922-Z1B B-board

FIGURE 1 - DATAWAY PULLUP RESISTOR PACK LOCATIONS & VALUES

Note that, in a single-controller system, Request MUST be connected to Grant In before the 3922 can function.

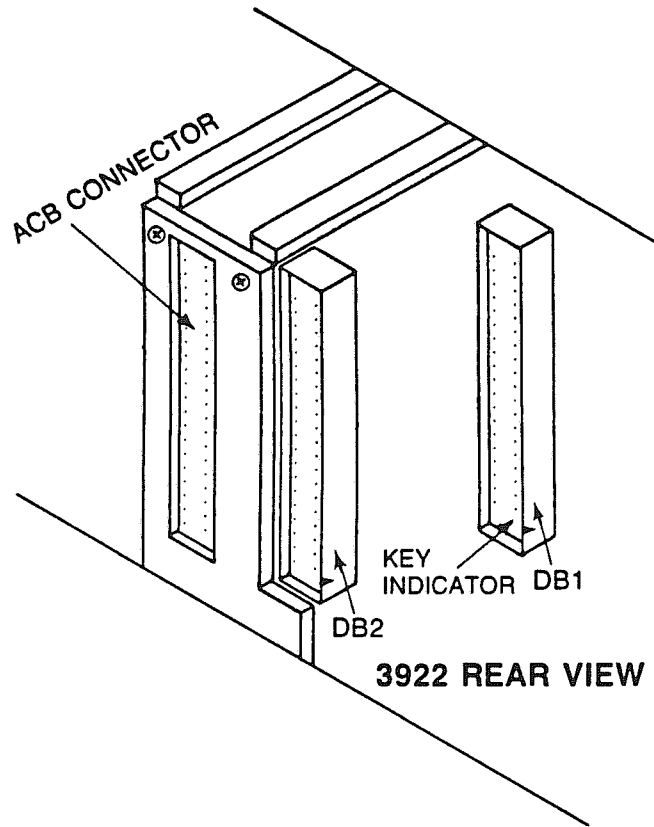Power can now be applied to the CAMAC crate(s).

Figure 2: Connector locations on the 3922

Double-Buffer Operation

Understanding the 2922 or 2926/3922 Parallel Bus is a great help in debugging any problems that might arise due to the hardware or software. For normal Program Transfers, the double-buffer of the 3922 has no affect. One word (8, 16, or 24 bits) is transferred between the CAMAC Dataway and the computer via the 2922 or 2926/3922 Interface. The double-buffer of the 3922 is only used for DMA operations and can be disabled for DMA read operations if necessary.

DMA read operations transfer data from the CAMAC Dataway to the computer's memory. Upon setting the GO bit on the interface, a header byte is sent on the parallel bus. This header byte contains the crate address, number of bits per CAMAC transfer and the type of DMA operation to be executed by the 3922. Upon receiving this header and being set to do CAMAC reads, a Dataway cycle is initiated. This data is stored in Reg. 2 (See Figure 2) and if the transmit register, Reg. 1, is empty, it is moved from Reg. 2 to Reg. 1. With Reg. 2 empty, another Dataway cycle is started to fill Reg. 2, unless the double-buffer mode is disabled. While the second Dataway cycle is being executed, the data in Reg. 1 is being transferred to the data register in the interface, and then from the interface's data register to memory with the PC's DMA controller handling that transaction.
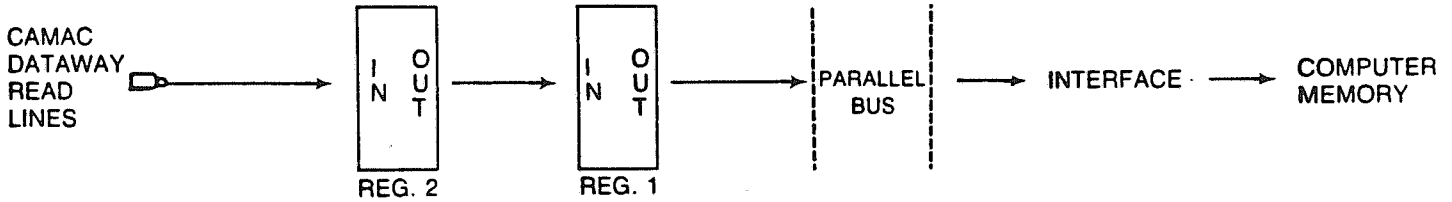
9

Figure 3: DMA Transfers of CAMAC Read Data

If operating in single-buffer mode, the next Dataway cycle will not be executed until both Reg. 1 and Reg. 2 are empty and the read data is requested by the interface.

DMA write operations transfer data from the PC's memory to a module on the CAMAC Dataway. The header byte is sent as in a DMA read operation. After the header byte, the data is transmitted to the 3922 from the computer's memory via the interface. The first set of data (8, 16, or 24 bits) is stored in Reg. 2 (See Figure 3) and if Reg. 1 is empty, this data shifted from Reg. 2 to Reg. 1. After this transfer is complete, the Dataway cycle is initiated and a new set of data can be loaded into Reg. 2. After the Dataway cycle is completed, data can then be shifted into Reg. 1 once Reg. 2 is full.
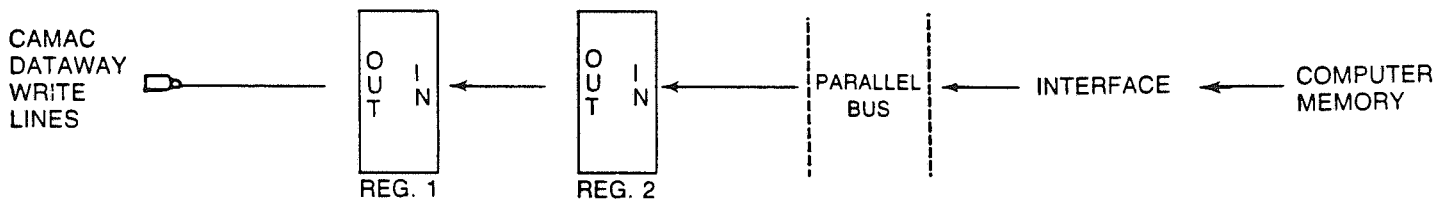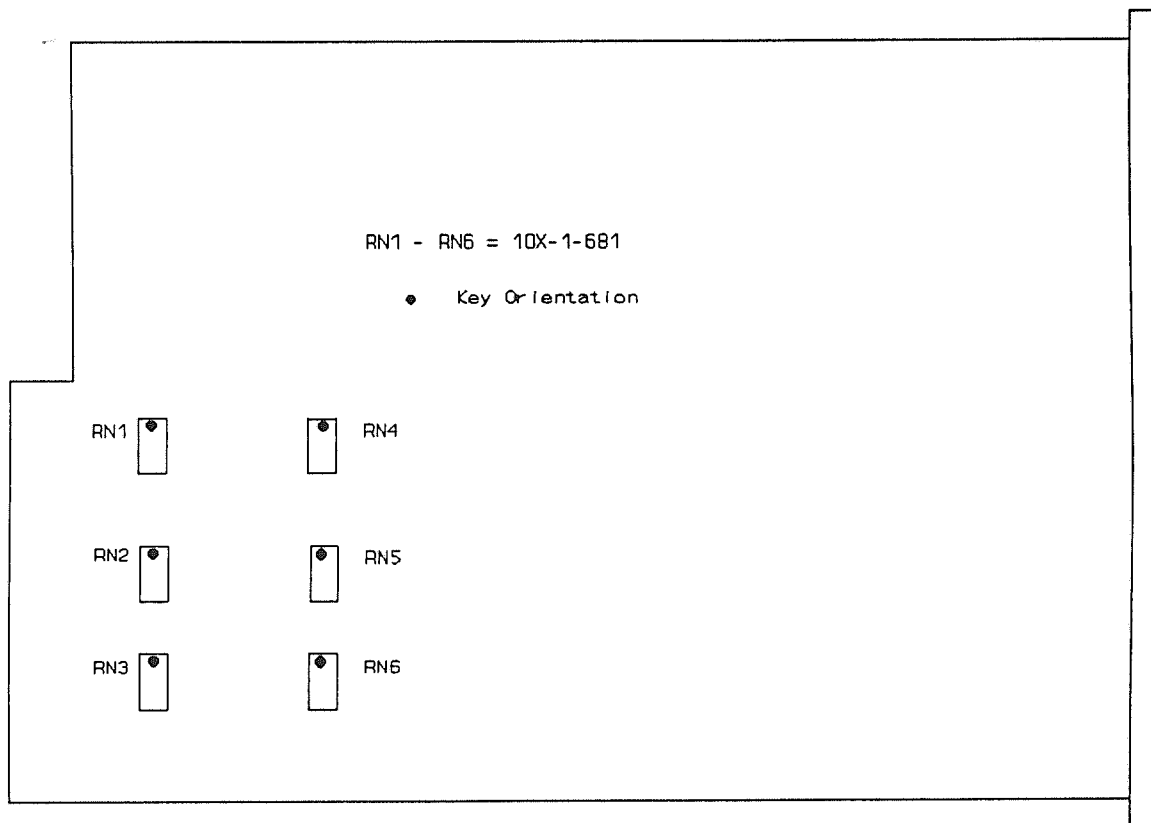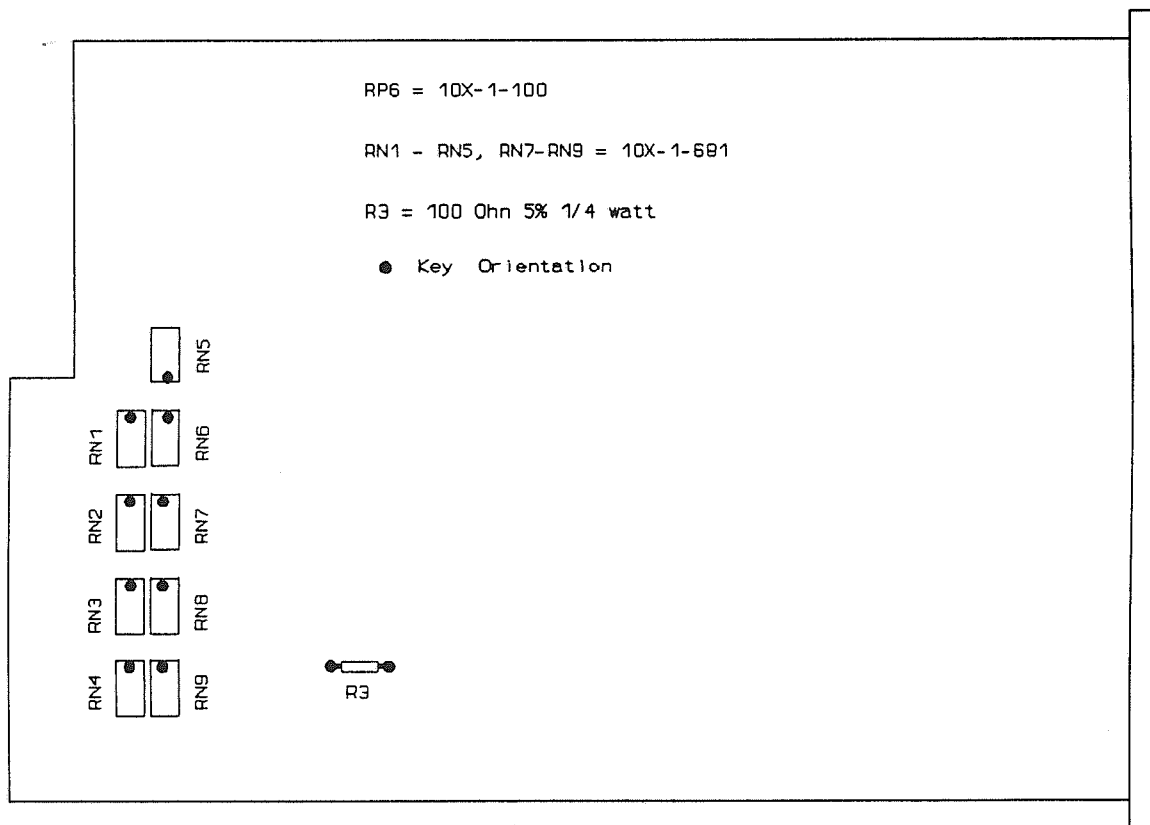

Figure 4: DMA Transfers of CAMAC Write Data

This double-buffer will affect the word count in the computer if the 3922 has to terminate a DMA operation prior to the word count being depleted, i.e., Q=0 received in Q-Stop, N 23 in Q-Scan, or No Q received in Q-Repeat. For Example: In Q-Stop mode if a Dataway cycle give Q=0, the 3922 will not terminate the transfer until another set of data is loaded in Reg. 2. This guarantees that the TCR will be one count set short of the actual number of bytes transferred to the CAMAC Dataway. The termination is similar for modes 2 and 3, Q-Repeat and Q-Scan, respectively.

APPENDIX

RN1 - RN6 = 10X-1-681

● Key Orientation

RN1

RN4

RN2

RN5

RN3

RN6

3922-Z1A A-Board

APPENDIX

RP6 = 10X-1-100

RN1 - RN5, RN7-RN9 = 10X-1-681

R3 = 100 Ohn 5% 1/4 watt

● Key Orientation

RN5

RN1   RN6

RN2   RN7

RN3   RN8

RN4   RN9

R3

3922-Z1A B-Board

WARRANTY

KineticSystems Company, LLC warrants its standard hardware products to be free of defects in workmanship and materials for a period of one year from the date of shipment to the original end user. Software products manufactured by KineticSystems are warranted to conform to the Software Product Description (SPD) applicable at the time of purchase for a period of ninety days from the date of shipment to the original end user. Products purchased for resale by KineticSystems carry the original equipment manufacturer's warranty.

KineticSystems will, at its option, either repair or replace products that prove to be defective in materials or workmanship during the warranty period.

Transportation charges for shipping products to KineticSystems shall be prepaid by the purchaser, while charges for returning the repaired warranty product to the purchaser, if located in the United States, shall be paid by KineticSystems. Return shipment will be made by UPS, where available, unless the purchaser requests a premium method of shipment at their expense. The selected carrier shall not be construed to be the agent of KineticSystems, nor will KineticSystems assume any liability in connection with the services provided by the carrier.

The product warranty may vary outside the United States and does not include shipping, customs clearance, or any other charges. Consult your local authorized representative or reseller for more information regarding specific warranty coverage and shipping details.

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1. Contact KineticSystems and discuss the problem with a Technical Service Engineer.
2. Obtain a Return Authorization (RA) Number.
3. Initiate a purchase order for the estimated repair charge if the product is out of warranty.
4. Include a description of the problem and your technical contact person with the product.
5. Ship the product prepaid with the RA Number marked on the outside of the package to:

KineticSystems Company, LLC
Repair Service Center
900 North State Street
Lockport, IL 60441

Telephone: (815) 838-0005
Facsimile: (815) 838-4424
Email: tech-serv@kscorp.com