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Approved as an American National Standard by 

American National Standard for VME64 Extensions

Secretariat

VMEbus International Trade Association

Approved October 7, 1998

American National Standards Institute, Inc.



VMEbus INTERNATIONAL TRADE ASSOCIATION

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Abstract

This standard is an extension of the ANSI/VITA 1-1994, VME64 Standard. It defines a set of features that can be added to VME and VME64 boards, backplanes and subracks. These features include a 160 pin connector, a P0 connector, geographical addressing, voltages pins for 3.3V, a test and maintenance bus, and EMI, ESD, and front panel keying per IEEE 1101.10.

American National Standard

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Foreword

This Foreword is not part of ANSI/VITA 1.1-1997

VME became the industrial bus of choice in the 80's with hundreds of manufacturers supplying more than a thousand different boards to the world-wide market place. Thousands of customers utilized VME for a broad number of applications.

In the late 80's, the VME's draft standard was expanded for 64 bit data and address capability, which also doubled the throughput. Locks, Configuration ROM / Control & Status Registers (CR/CSR), rescinding DTACK*, auto system control detection, auto slot ID, plus optional shielded DIN connectors were also added. These additional features effectively transformed VME from an 80's bus to a 90's bus, which allows VME to be used in even more demanding applications for the early 90's. This standard is commonly referred to as VME64.

In the summer of 1993 the VITA Standards Organization (VSO) agreed to publish the VME64 Standard. It was also agreed to use additional standards to add features as they are agreed upon by the VSO membership. This standard is a collection of additional features as agreed upon during 1994, 1995 and the first half of 1996. There will most likely be follow on standards with even more features.

Features added to VME64 in this standard encompass twenty major areas:

- 1) "z" and "d" pin rows to the P1/J1 and P2/J2 connectors for 160 pins in each connector.
- 2) An optional 2 mm hard metric 95 signal pin plus 19 or 38 ground pins P0/J0 connector for more user defined I/O through the backplane.
- 3) Supply voltages of +3.3 and auxiliary volts, plus more +5V power
- 4) 35 more signal ground returns between VME64x boards and VME64x backplanes for a total of 47 signal ground returns.
- 5) 46 more user defined I/O pins on the P2/J2 connector pair.
- 6) 14 bused spare pins and associated bused lines in the backplane, plus 2 unbused spare pins on the P1/J1 connector for future definition.
- 7) Pins allocated for a test and maintenance bus.
- 8) Slot geographical addressing.
- 9) Mechanical support for electromagnetic compatibility (EMC) control.
- 10) Mechanical support for electrostatic discharge (ESD) control.
- 11) Solder side covers with ESD protection.
- 12) An injection/extraction handle with a locking feature.
- 13) User installed board to slot keying
- 14) Alignment pin which supports solid keying, improved connector alignment, front panel ESD protection and EMC gasket alignment.
- 15) Front Panel Safety Ground.
- 16) Reserved area on the front panel for attachment of ID and/or bar code labels.
- 17) Rear I/O transition boards.
- 18) Added CR/CSR definition.
- 19) Supporting specifications for hot swap.
- 20) 2eVME: fast 2 edge protocol.

Some of these features are independent of one another. Others are tied close together, such as the usage of +3.3 V which requires the new 160 pin connector for the P1 connector on VME64x boards and the usage of the VME64x backplane. If the 160 pin connector is used on a VME64x board, the usage of 3.3 volt power, 48 volt power, hot swap control, serial bus, etc. are independent of one another.

Wayne Fischer, Force Computers, was chair of the VSO (VITA Standards Organization) task group that developed the draft for this standard. The following people participated in the ANSI canvass ballot.

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Chapter 1

Introduction to the VME64 Extensions Standard

1.1 VME64 Extension Objectives

This standard documents features that can be added to VME64 boards, backplanes and subracks defined in the VME64 Standard.

The following new features are defined for optional usage in VME64x based applications:

- Addition of z & d rows to P1/J1 and P2/J2 connectors
 - With associated pin assignments
- A 2 mm hard metric P0/J0 connector (area) between P1/J1 and P2/J2 connectors
 - With 95 user defined signal pins and 19 or 38 ground pins
- 35 more signal ground return pins in the P1/J1 and P2/J2 connectors
- +3.3 volt power
- Auxiliary power voltage
- 3 more +5V power pins via the 3 VPC power pins
- Slot geographical addressing
- 12 reserved bused signal lines, plus 2 unbused pins for future expansion
- 46 more user defined pins on the P2/J2 connector
- Pins allocated for a test and maintenance bus (T&Mbus)
- 3 mate first-break-last precharge voltage pins for hot swap applications
 - 2 pins are on the P1/J1 connector and 1 pin on the P2/J2 connector
 - Can also be used for +5V power when board is locked into position
 - Required for hot swap applications
- 3 mate first-break-last precharge ground pins for hot swap applications
 - 2 pins are on the P1/J1 connector and 1 pin on the P2/J2 connector
 - Required for hot swap applications
- 2 reserved pins for individual slot power control for hot swap applications
- Front panel EMC protection
- ESD protection
- Solder side covers for hot swap and ESD protection
- Injector/Extractor handles with optional locking feature
- Board slot keying
- Multifunction alignment pin
- Front panel safety ground
- Reserved area on front panel for ID and bar code labels
- Rear I/O transition boards
- Added CR/CSR definition
- A 2eVME protocol that doubles the theoretical peak data transfer rate to 160 MB/sec

1.1.1 VME64 Extensions and VME64x Usage

The phrase "VME64 Extension" has been shortened to VME64x, where "x" implies the "Extensions" word. In product data sheets, user manuals, advertising and other promotional literature, it is encouraged that only these two phrases be used when referencing this standard.

1.1.2 9U Boards, Backplanes and Subracks

9U VME, VME64 and VME64x boards, backplanes and subracks will not be referenced in this standard. Another VSO standard, ANSI/VITA 1.3-1997, VME64x 9U x 400mm Format, specifically defines this capability.

1.2 Terminology

See Appendix A for the new terminology specific to the added features described in this standard. Terminology described in the VME64 Standard is not repeated in Appendix A.

1.3 References

The following publications are used in conjunction with this standard. When they are superseded by an approved revision, that revision must apply.

ANSI/VITA 1-1994	VME64 Standard, Approved April 10, 1995
IEC 61076-4-113	2.54 mm 160 pin connectors complementary to IEC 603-2 Style C connectors
IEC 61076-4-101	2 mm Hard Metric Connector
IEEE 1101.2-1992	IEEE Standard for Mechanical Core Specifications for Conduction-Cooled Eurocards
IEEE 1101.10-1996	IEEE Standard for additional Mechanical Specification for Microcomputers using the IEEE 1101.1 Equipment Practice
IEEE 1101.11-1998	IEEE Standard for Rear Plug-In Units for Microcomputers using the IEEE 1101.1 Equipment Practice, and the IEEE 1101.10 additional Mechanical Specifications
IEEE 1149.5-1995	IEEE Standard Module Test and Maintenance Bus
VITA 1.4	VME64x Live Insertion Draft Standard
VITA 1.6	Keying for Conduction Cooled VME64x Draft Standard
VITA 2	Enhanced Transceiver Logic Device Standard

1.3.1 Connector Notes

The 160 pin connector defined in the IEC 61076-4-113 connector specification is an expanded 96 pin connector that is complementary to the IEC 603-2 Style C connector. Rows a, b & c are identical in form, fit and function to the 96 pin IEC 603-2 Style C connectors, used in original VME and VME64 applications. Rows z and d adds 64 pins to the outer shell for a total of 160 pins.

The 160 pin connectors are forward and backward compatible to the 96 pin connectors. Boards with 160 pin connectors will plug into backplanes using 96 pin connectors and boards with 96 pin connectors will plug into backplanes using 160 pin connectors.

IEC 61076-4-101 defines a family of 2 mm Hard Metric (HM) connectors. The P0/J0/RJ0/RP0 connectors defined in Chapter 3 use a Type B 25 position 2 mm connector variant with 19 positions. Each position provides 5 signal pins plus one or two ground pins.

1.4 Standard Terminology

To avoid confusion and to make very clear what the requirements for compliance are, many of the paragraphs in this standard are labeled with keywords that indicate the type of information they contain. The keywords are listed below:

- Rule
- Recommendation
- Suggestion
- Permission
- Observation

Any text not labeled with one of these keywords describes the VME64 structure or operation. It is written in either a descriptive or a narrative style. These keywords are used as follows:

Rule <chapter>.<number>:

Rules form the basic framework of this standard. They are sometimes expressed in text form and sometimes in the form of figures, tables or drawings. All rules shall be followed to ensure compatibility between board and backplane designs. All rules use the words "shall" or "shall not" to emphasize the importance of the rule. The words "shall" or "shall not" are reserved exclusively for stating rules in this standard and are not used for any other purpose.

Recommendation <chapter>.<number>:

Wherever a recommendation appears, designers would be wise to take the advice given. Doing otherwise might result in some awkward problems or poor performance. While the VME64x architecture has been designed to support high-performance systems, it is possible to design a system that complies with all the rules but has poor performance. In many cases a designer needs a certain level of experience in order to design boards that deliver top performance. Recommendations found in this standard are based on this kind of experience and are provided to designers to speed their traversal of the learning curve. All recommendations use the words "should" or "should not" to emphasize the importance of the recommendation. The words "should" or "should not" are reserved exclusively for stating permissions in this standard and are not used for any other purpose.

Suggestion <chapter>.<number>:

A suggestion contains advice which is helpful but not vital. The reader is encouraged to consider the advice before discarding it. Some decisions that need to be made in designing boards are difficult until experience has been gained. Suggestions are included to help a designer who has not yet gained this experience. Some suggestions have to do with designing boards that can be easily reconfigured for compatibility with other boards, or with designing the board to make the job of system debugging easier.

Permission <chapter>.<number>:

In some cases a rule does not specifically prohibit a certain design approach, but the reader might be left wondering whether that approach might violate the spirit of the rule or whether it might lead to some subtle problem. Permissions reassure the reader that a certain approach is acceptable and will cause no problems. All permissions use the word "may" to emphasize the importance of the permission. The lower-case word "may" is reserved exclusively for stating permissions in this standard and is not used for any other purpose.

Observation <chapter>.<number>:

Observations do not offer any specific advice. They usually follow naturally from what has just been discussed. They spell out the implications of certain rules and bring attention to things that might otherwise be overlooked. They also give the rationale behind certain rules so that the reader understands why the rule must be followed.

Chapter 2

VME64x Compliance

2.1 Introduction

In order for VME64x boards and VME64x backplanes to be labeled as VME64x Compliant, they are to incorporate a minimum set of functional features. This chapter specifies that minimum set of features for 3U and 6U boards and backplanes.

Each of these features are described and documented in subsequent chapters within this standard.

2.2 Requirements

Rule 2.1:

To claim compliance to this standard, a product shall also comply to all the appropriate rules in ANSI/VITA 1-1994 VME64 Standard.

Rule 2.2:

In the event of any conflicts between this standard and a referenced standard or specification, this standard shall take precedence.

2.2.1 6U VME64x Board's Minimum Features

Rule 2.3:

In order to be labeled as a VME64x compliant board, the 6U board shall incorporate the following minimum functional features:

- Use the IEC 61076-4-113 160 pin connectors for both the P1 and P2 connectors
- Connect all assigned connector ground pins in rows z, a, b, and c to the board's ground plane (row d ground pins are optional)

Observation 2.1:

All the other features defined in this standard are optional.

2.2.2 3U VME64x Board's Minimum Features

Rule 2.4:

In order to be labeled as a VME64x compliant board, the 3U board shall incorporate the following minimum functional features:

- Use the IEC 61076-4-113 160 pin connector for the P1 connector
- Connect all assigned connector ground pins in rows z, a, b, and c to the board's ground plane

Observation 2.2:

All the other features defined in this standard are optional.

2.2.3 6U VME64x Backplane's Minimum Features

Rule 2.5:

In order to be labeled as a VME64x compliant backplane, the 6U backplane shall incorporate the following minimum functional features:

- Monolithic PCB
- Use the IEC 61076-4-113 160 pin connectors for both the J1 and J2 connectors, with properly defined pin tail lengths
- Connect all assigned connector ground pins in all rows to the backplane's ground plane
- Connect the geographical address pins as defined in this standard

- Route and terminate all defined VME64 and VME64x bused signal lines
- Provide power connection and distribution for +5V, +3.3V, +12V, -12V, +V1, +V2, -V1, -V2, VPC and +5V STDBY.
- If rear I/O is to be used on a backplane, rear connector(s) are designed per IEEE 1101.11 for support of rear I/O transition boards.

Observation 2.3:

All the other features defined in this standard are optional.

2.2.4 3U VME64x Backplane's Minimum Features**Rule 2.6:**

In order to be labeled as a VME64x compliant backplane, the 3U backplane shall incorporate the following minimum functional features:

- Use the IEC 61076-4-113 160 pin connector for the J1 connector, with properly defined pin tail lengths
- Connect all assigned connector ground pins in all rows to the backplane's ground plane
- Connect the geographical address pins as defined in this standard
- Route and terminate all defined VME64 and VME64x bused signal lines
- Provide power connection and distribution for +5V, +3.3V, +12V, -12V, +V1, +V2, -V1, -V2, VPC and +5V STDBY.

Observation 2.4:

All the other features defined in this standard are optional.

Chapter 3

P1/J1 & P2/J2 160 Pin Connectors

3.1 Introduction

This chapter specifies the usage (beyond the VME64 Standard) of a 160 pin connector for both the P1/J1 and P2/J2 connector pairs. The 160 pin connector adds two 32 pin rows over the 96 pin (3 X 32) VME and VME64 connectors. The pin definitions for these added rows are defined in this chapter. This 160 pin connector pair is defined in the IEC 61076-4-113 Standard.

These added rows are called the "z" row and "d" row. The z row is adjacent to the a row and the d row is adjacent the c row. The five rows are labeled z, a, b, c and d. Mechanical placement of the 160 pin connectors on VME64x boards and on the VME64x backplanes is defined in IEEE 1101.10.

Each 160 pin connector provides 4 pins that mate-first-break-last (MFBL). The four MFBL pins are d1, d2, d31 and d32. On the P1/J1 connectors all 4 pins are used for hot swap and on the P2/J2 connector, only the lower 2 pins are used for hot swap. Three of these MFBL pins also available for additional +5V power.

3.2 Requirements

3.2.1 160 Pin Connector Placement

Rule 3.1:

VME64x boards shall use the IEC 61076-4-113 160 pin plug connectors for the P1 and P2 connector positions, with a minimum endurance level of 400 mating cycles, which is in accordance to IEC 61076-4-113 performance level 2.

Rule 3.2:

Placement of the P1 and P2 connectors on VME64x boards shall be per IEEE 1101.10.

Rule 3.3:

VME64x backplanes shall use the IEC 61076-4-113 160 pin receptacle connectors for the J1 and J2 connector positions, with a minimum endurance level of 400 mating cycles, which is in accordance to IEC 61076-4-113 performance level 2.

Rule 3.4:

Placement of the J1 and J2 connectors on VME64x backplanes shall be per IEEE 1101.10.

Permission 3.1:

Selective loading only the signal and power pins in the P1 and P2 connectors may be used on VME64x boards.

Rule 3.5:

The ground pins shall always be loaded in the P1 and P2.

Rule 3.6:

All pins in the J1 and J2 connector shall always be loaded.

Observation 3.1:

In some applications, not all pins are needed (used) in the P1 and P2 connectors. Using selectively loaded connectors could provide a cost savings and will reduce insertion/withdrawal forces.

3.2.2 P1/J1& P2/J2 Connectors, Rows z & d Pin Assignments

Rule 3.7:

The signal pin assignment of the P1/J1 and P2/J2 connector pairs, rows z and d shall be as defined in Table 3-1, P1/J1 and P2/J2 Rows z & d Pin Assignments. See Appendix B for definition of these signals.

Table 3-1 P1/J1 and P2/J2 Rows z & d Pin Assignments

Position No.	P1/ J1		P2/ J2	
	Row z	Row d	Row z	Row d
1	MPR	VPC (1)	UD	UD (1)
2	GND	GND (1)	GND	UD (1)
3	MCLK	+V1	UD	UD
4	GND	+V2	GND	UD
5	MSD	RsvU	UD	UD
6	GND	-V1	GND	UD
7	MMD	-V2	UD	UD
8	GND	RsvU	GND	UD
9	MCTL	GAP*	UD	UD
10	GND	GA0*	GND	UD
11	RESP*	GA1*	UD	UD
12	GND	+3.3V	GND	UD
13	RsvBus	GA2*	UD	UD
14	GND	+3.3V	GND	UD
15	RsvBus	GA3*	UD	UD
16	GND	+3.3V	GND	UD
17	RsvBus	GA4*	UD	UD
18	GND	+3.3V	GND	UD
19	RsvBus	RsvBus	UD	UD
20	GND	+3.3V	GND	UD
21	RsvBus	RsvBus	UD	UD
22	GND	+3.3V	GND	UD
23	RsvBus	RsvBus	UD	UD
24	GND	+3.3V	GND	UD
25	RsvBus	RsvBus	UD	UD
26	GND	+3.3V	GND	UD
27	RsvBus	LI/I*	UD	UD
28	GND	+3.3V	GND	UD
29	RsvBus	LI/O*	UD	UD
30	GND	+3.3V	GND	UD
31	RsvBus	GND (1)	UD	GND (1)
32	GND	VPC (1)	GND	VPC (1)

Note: (1) These pins are MFBL (mate-first-break-last) pins

Observation 3.2:

Pins d1 and d2 of the P2 connector will mate before the other pins in rows z, a, b, c and d. Be aware that this could cause problems with user defined I/O signals when these pins mate before the other I/O pins during live insertion operations.

Recommendation 3.1:

Be aware that during live insertion operations, the VPC power could be applied first, therefore boards should be designed to tolerate the application of VPC before GND is connected. The same applies during live removal, where VPC could be the last contact to be removed.

Observation 3.3:

Specification of the +3.3V, +V (+V1 & +V2) & -V (-V1 & -V2) [Auxiliary] and VPC power are defined in Sections 3.2.4, 3.2.5 and 3.2.6 of this standard.

Rule 3.8:

The GND pins shall be connected to the VME64x board's signal ground plane and the VME64x backplane's signal ground plane.

Rule 3.9:

The UD, User Defined, pins shall be treated in the same fashion and have the same rules as the User Defined pins in the VME64 Standard.

Rule 3.10:

The RsvBus (reserved bused) pins shall not be used by VME64x boards and are reserved for future use.

Rule 3.11:

The 14 RsvBus pins, the 5 test and maintenance bus (MPR, MCLK, MSD, MMD & MCTL) pins and the RESP* pin shall be bused and terminated on VME64x backplanes that implement a 160 pin connector for J1 in the same fashion and have the same rules as the other VME64 bused signals defined in the VME64 Standard.

Rule 3.12:

The LI/I* (Live Insertion/Input) and LI/O* (Live Insertion/Output) pins shall be reserved for specification by the VITA 1.4-199x VME64x Live Insertion Draft Standard.

Observation 3.4:

The LI/I*, LI/O* and RsvU pins are not bused but just feed through the backplane.

Rule 3.13:

The five test and maintenance bus signal lines (MPR, MCLK, MSD, MMD & MCTL) shall be reserved for specification by the IEEE 1149.5 MTM-Bus Standard.

Rule 3.14:

The ground (GND) return path on the backplane shall present a maximum peak to peak voltage differential of 50 mV across the backplane, measured between any connector pin making contact with the GND rail, under conditions of maximum current demand and all conditions of loading and noise expected for that system. Backplane termination networks are included in this rule. This applies for all frequencies, including DC.

Rule 3.15:

A voltage differential no greater than 50 mV shall be presented across the +5V, +3.3V, +12V and -12V power rails and 200 mV across the +V and -V power rails, when measured between any two connector pins making contact with the respective power rail, under conditions of maximum current demand and all conditions of loading and noise expected for that system. This applies for all frequencies, including DC.

Observation 3.5:

While VME64x boards (with 160 pin connectors) can physically be plugged into a VME64 backplane (with 96 pin connectors), the two outer rows of pins, z and d, will not be connected to anything.

Recommendation 3.2:

Given Observation 3.5, the user should determine from the vendor whether a specific VME64x compatible board can be configured to operate correctly in a VME64 backplane.

Permission 3.2:

Vendors may design VME64x boards that can only be used in VME64x backplanes.

3.2.3 Geographical Address Pin Assignments**Rule 3.16:**

The 6 geographical address pins (GA0*, GA1*, GA2*, GA3*, GA4* and GAP*) shall be tied to ground or left open (floating) on the backplane J1 connector as defined in Table 3-2, Geographical Address Pin Assignments.

Table 3-2 Geographical Address Pin Assignments

Slot No.	GAP* Pin	GA4* Pin	GA3* Pin	GA2* Pin	GA1* Pin	GA0* Pin
1	Open	Open	Open	Open	Open	GND
2	Open	Open	Open	Open	GND	Open
3	GND	Open	Open	Open	GND	GND
4	Open	Open	Open	GND	Open	Open
5	GND	Open	Open	GND	Open	GND
6	GND	Open	Open	GND	GND	Open
7	Open	Open	Open	GND	GND	GND
8	Open	Open	GND	Open	Open	Open
9	GND	Open	GND	Open	Open	GND
10	GND	Open	GND	Open	GND	Open
11	Open	Open	GND	Open	GND	GND
12	GND	Open	GND	GND	Open	Open
13	Open	Open	GND	GND	Open	GND
14	Open	Open	GND	GND	GND	Open
15	GND	Open	GND	GND	GND	GND
16	Open	GND	Open	Open	Open	Open
17	GND	GND	Open	Open	Open	GND
18	GND	GND	Open	Open	GND	Open
19	Open	GND	Open	Open	GND	GND
20	GND	GND	Open	GND	Open	Open
21.	Open	GND	Open	GND	Open	GND

Observation 3.6:

Boards which use the geographical address signals will most likely use a pull up resistor to Vcc. The device that samples the levels of the geographical address pins will read the inverted value of the slot number into which the board is plugged. When the board is plugged into a VME/VME64 backplane the slot number will be zero with a parity error (GAP* open).

Rule 3.17:

The board shall limit the current through each geographical address pin to a maximum of 2 mA.

3.2.4 +3.3V Power**Rule 3.18:**

The +3.3V power supplied to each slot on the VME64x backplane shall remain within the limits of +3.25V to +3.45V, including regulation variation, noise and ripple frequencies to 20 MHz.

Rule 3.19:

The current drawn for +3.3V pins shall follow the maximum current draw per power pin as specified in the VME64 Standard, Figure 5-7, Current Rating For Power Pins.

Observation 3.7:

If the maximum board ambient temperature is 60° C, the maximum current that can be drawn per power pin in a multi-pin configuration is 1.25 Amp. With 10 +3.3V power pins on the P1/J1 connector pair, a nominal 41 watts of +3.3V power can be supplied to a VME64x board.

Rule 3.20:

+3.3V, +5V, +12V, -12V and Auxiliary power will ramp up and down independently of one another. Boards shall be designed to accommodate any combination of power up and down sequence without causing board failure.

3.2.5 V1/V2 Auxiliary Power**Rule 3.21:**

The V1/V2 auxiliary power supplied to each slot via the +V1, +V2, -V1 and -V2 power pins on the VME64x backplanes shall remain within the limits of 38V to 75V, including regulation variation, noise and ripple frequencies to 20 MHz.

Rule 3.22:

The current drawn for the +V1, +V2, -V1 and -V2 pins shall follow the maximum current draw per power pin specified in the VME64 Standard, Figure 5-7, Current Rating For Power Pins.

Rule 3.23:

Each board's power draw of the V1/V2 power shall be balanced between the +V1 plus +V2 and -V1 plus -V2 power pins, with no more than 1 mA of current going through the ground pins.

Recommendation 3.3:

The V1/V2 leakage current should be kept below 100 uA.

Rule 3.24:

The system auxiliary power supply of the V1/V2 power shall ensure that the +V1 and +V2 voltages are always above or equal to the ground voltage level and that the -V1 and -V2 voltages are always below or equal to the ground voltage level.

Observation 3.8:

If the +V1 and +V2 voltage rails are tied to ground and the +12V power is used, the nominal voltage between the +12V and the -V1 and -V2 power rails is 60 volts. With voltage tolerances, the 60 volt maximum is exceeded. Additional protection might be needed to comply with local and national regulatory agencies.

Recommendation 3.4:

System implementors and users should be aware that the United States Underwriters Laboratory (UL) rules that whenever any two power points within a system (black box) exceeds 60 V, it is considered unsafe for "human operation". The design of boards will allow for larger voltages between any combination of power rails. But, how a "VME64x System" is integrated is the responsibility of the system integrator, and should comply with all applicable laws and regulations with respect to safety and other computer requirements, including EMC.

Observation 3.9:

For some applications, dual V1/V2 power rails are required. It might be necessary to build backplanes that split the +V1 and +V2 into two power rails, and/or split the -V1 and -V2 into two power rails.

Recommendation 3.5:

The usage of single or dual V1/V2 supply and the decision whether the negative or the positive poles will be tied together, is up to the system configuration. Generic VME64x backplanes should provide individual connections for each of the +V1, +V2, -V1, -V2 power rails.

Rule 3.25:

Boards that use the dual V1/V2 power rails shall place diodes or equivalent on each of +V1 and +V2 power lines and on each of the -V1 and -V2 power lines. In event one of the V1/V2 power rails fails, the other power rail will supply the auxiliary power to the board.

3.2.6 VPC Power and Additional +5V Power

VPC is collectively the three pre-charge voltage pins on the P1/J1 and P2/J2 connectors. These three pins mate a minimum of 1.5 mm before the other pins during live insertion. During live withdraw, these pins are the last to break contact. This feature is required to

support the hot swap capability defined in the VITA 1.4-199x VME64x Live Insertion Draft Standard.

Rule 3.26:

If VPC power is used, all three VPC power pins shall be used on 6U boards and both VPC power pins on 3U boards shall be used.

Rule 3.27:

The VPC voltage pins shall be connected directly to the backplane +5V power plane.

Observation 3.10:

Boards used for hot swap need to limit the peak current drawn through each of the VPC power pins during connector mating and disconnect operations. The current limit is defined by the VITA 1.4-199x VME64x Live Insertion Draft Standard.

Permission 3.3:

VPC power pins may be used for additional +5V power when fully plugged in and locked into position.

Rule 3.28:

If the VPC power pins are used for additional +5V power, the current drawn shall follow the maximum current draw per power pin as specified in the VME64 Standard, Figure 5-7, Current Rating For Power Pins.

Observation 3.11:

If VPC power is shorted to +5V power on a board, the board can't be used in hot swap applications.

3.2.7 Reset and ACFail

Rule 3.29:

If +3.3V and/or Auxiliary power is used to power boards plugged into the backplane, the SYSRESET* and ACFAIL* signals operations levels shall include the proper functional levels of +3.3V and Auxiliary.

Observation 3.12:

Rule 3.29 implies that the SYSRESET* and ACFAIL* signal lines can not be released high (normal operation) until the monitored power voltages are in the proper operation levels. When any of the power signals goes outside the proper operation range, the SYSRESET* signal line is asserted. The timing of these two signals remains the same as defined in the VME64 Standard.

3.2.8 Board Power Dissipation

Recommendation 3.6:

Board suppliers should specify a board's maximum power dissipation and identify "hot spots" and any thermally sensitive components, which require higher cooling airflow than normal.

3.2.9 Backplane Termination Network using +3.3V Supply

Permission 3.4:

The +3.3V supply voltage may be used for the backplane termination network's power.

Rule 3.30:

If the +3.3V supply voltage is used for the backplane termination network, the network shall be in compliance with the network shown in Figure 3-1 Backplane Termination Network using +3.3V Power.

Recommendation 3.7:

For VME64x backplanes that use +3.3V power for the termination network, a large warning label should be attached to the back side of the backplane stating that the termination network is supplied by the +3.3V power rails. "+3.3V power is required for proper VME64x system operation."

Observation 3.13:

The backplane voltage tolerance is better than required for the +3.3 V termination network.

3.2.10 Monolithic Backplanes**Rule 3.31:**

6U VME64x backplanes shall be constructed as a single (monolithic) printed circuit board.

Observation 3.14:

The main reason for Rule 3.31 is to provide solid voltage and ground planes on the backplane to minimize the noise and voltage differentials between VME64x boards and VME64x backplanes.

3.2.11 Geographical Address Implementation

This section ties together the implementation of geographical addressing and CR/CSRs if both are implemented on a VME64x board.

Geographical addressing as defined in Section 2.2.3 is to be used by VME64x boards to automatically identify into which VME64x backplane slot it is plugged. Based on that information, software can automatically configure the boards for slot specific functionality. Initialization and configuration of the CR/CSRs is an extension of the capability.

The monarch is generally the first CPU board to gain access to the backplane and system right after power up to configure the system. The monarch might also be the CPU board which controls and manages the main system operation during normal operations.

Rule 3.32:

If a board implements both geographical addressing and CR/CSR capability, the BAR value shall be derived from the geographical address pins.

Observation 3.15:

The above rule will automatically place each board's CR/CSR address in the proper A24 address space. This will allow the system's monarch to search the CR/CSR address space and quickly determine which VME64x boards are plugged into the backplane and then configure the board.

Recommendation 3.8:

Boards implementing Rule 3.32 should parity check the geographical address. If bad parity is found, the local address should be set to decimal 30 (0x1E) (the amnesia address).

Permission 3.5:

If bad geographical address parity is detected the board may not respond to CR/CSR accesses from the bus.

Observation 3.16:

It is up to the system designer to determine how to handle multiple occurrence of geographical parity errors, if multiple parity errors do occur.

Rule 3.33:

Monarchs that search the CR/CSRs space for presence of VME64x boards shall also look for boards at amnesia address 30 (0x1E) and take the appropriate action if one is found at that address.

Permission 3.6:

VME64x boards that need to be backward compatible to original VME backplanes, may add some sense circuitry and 5 switches or 5 jumpers or some programmable logic. When the board senses that none of the GA*[4..0] lines are tied to ground (board not plugged into a VME64x backplane), it will use the state of the 5 switches or 5 jumpers or programmable logic values for the geographical address value.

Observation 3.17:

The BAR bits 7 to 3 defined in the CR/CSR regions, correspond to A[23..19] in the CR/CSR space. See Table 2-31 and Section 2.3.12 in the VME64 Standard for more explanation.

3.2.12 Connector Tail Lengths

Recommendation 3.9:

All backplane J1 and J2 connector tail pins that are connected to bus signal lines should be of the short length, 5 mm or less.

Rule 3.34:

If backplane application is intended to support rear I/O transition boards, then the J2 B row of power and ground pins shall be 17 mm in length.

Observation 3.18:

Recommendation 3.9 provides protection of the electrical properties of all bused signal lines on the backplane.

Rule 3.35:

When straight through I/O is used, a shroud over the rear long tail pins shall be used that meets the mechanical dimensions defined in IEEE P1101.11.

3.2.13 Labels on 96-pin Plug Connectors

Rule 3.36:

All VME64 and VME64x boards that utilize the 96-pin plug connector shall not place labels or any other markings on the outer shroud.

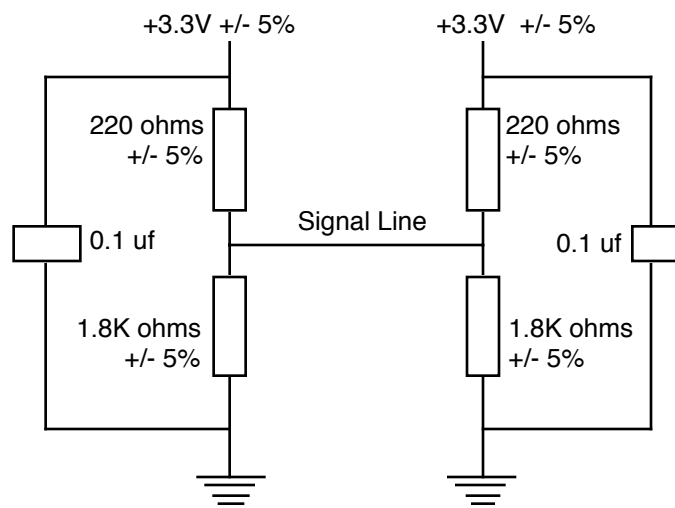
Observation 3.19:

When 96-pin plug connectors are plugged in to a 160-pin receptacle connector, the two outer contact rows contact directly on the outer shroud. Any added material will cause the board's insertion forces to be higher as well as will rub off the labels or any other marking material.

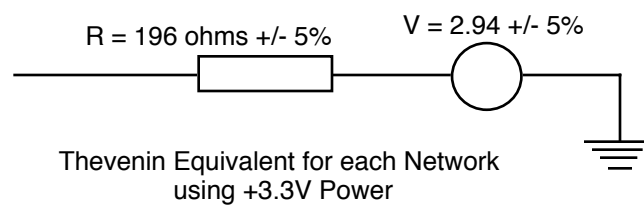
3.2.14 Backplane Connectors with Keying Devices

Observation 3.20:

Some VME boards and backplanes use 96-pin connectors with a built in keying device. A VME64x board with a 160-pin connector cannot be plugged into such a backplane. The outer rows of the 160-pin connector will be blocked by the keying device, preventing the two connectors from mating.



Resistor Networks that Provides the
Required Termination using +3.3V Power



Thevenin Equivalent for each Network
using +3.3V Power

Figure 3-1 Backplane Termination Network using +3.3V Power

Chapter 4

P0/J0 Connector Area and VME64x Backplane End Dimensions

4.1 Introduction

At times manufacturers and users of VME64x boards have a need for additional and sometimes specialized I/O through the backplane. This chapter specifies the requirements and provides observations for implementation of user defined I/O between the P1/J1 and P2/J2 connectors.

This area is commonly called the P0/J0 connector area, even though four connectors are involved: a connector on the front VME64x board (P0), a connector on the front of the backplane (J0), a connector shroud on the rear of the backplane (RJ0) and a connector on the rear board (RP0) or the end of cable which plugs into the rear connector. This is sometimes written as: P0/J0/RJ0/RP0, where the "R" means rear. (The rear connector shroud goes over the long tail pins and provides the necessary alignment and other mechanical support for normal connector mating.)

See Chapter 9 for the definition of rear I/O transition boards and for mechanical alignment with the backplane. See Figure 9-1 for a pictorial of the connector placements on VME64x boards, VME64x backplanes and rear I/O transition boards.

Due to usage of the J0, 2 mm connector, VME64x backplane's left and right end mechanical dimensions are shifted left, to accommodate the connector's added width and position. Section 4.2.7 defines VME64x backplane's left and right end dimension.

4.2 Requirements

Permission 4.1:

Additional user defined I/O connector space may be obtained if the mechanical member between J1 and J2 connector pairs on VME backplanes, shown in Figure 7-18 of the VME64 Standard, is removed.

Rule 4.1:

Whenever a structural member is not used between the J1 and J2 connectors on VME64x backplanes, the VME64x backplane shall maintain sufficient rigidity to meet the mechanical requirements specified in IEEE 1101.1.

Observation 4.1:

VME64x boards using I/O connectors between P1 and P2 could conflict with VME/VME64 backplanes that have a structural member between J1 and J2 connectors.

4.2.1 Connector Selection

Rule 4.2:

For generic use the 19 position, Type B, 2 mm hard metric, IEC 61076-4-101 connector family shall be used. The connectors shall be rated Performance Level 2 or better with a minimum of 250 insertion withdrawal cycles.

Rule 4.3:

For generic uses, the 19 position, Type B, 2 mm hard metric IEC 61076-4-101 free board connector shall be used on VME64x boards.

Rule 4.4:

For generic uses, the 19 position, Type B, 2 mm hard metric IEC 61076-4-101 fixed board connector shall be used on the VME64x backplanes. On the front side, rows z and f shall be length 3 (11.2 mm) and rows a through e shall be length 1 (8.2 mm). On the rear side, the pin tail lengths shall be 16 mm when straight through I/O is used, or less than 5.0 mm when a sub-bus is used.

Rule 4.5:

When straight through I/O is used, a shroud over the rear long tail pins shall be used that meets the mechanical dimensions defined in IEEE P1101.11.

Rule 4.6:

Where the 2 mm hard metric IEC 61076-4-101 connector is used, the z and f row pins on the backplane's fixed board connector shall be connected to the backplane's ground plane as defined in Table 4-1, P0/J0 Connector Pin Labeling.

Rule 4.7:

The z row shield on the free board P0 and RP0 connectors shall only be used if it does not protrude through the board's interboard separation plane, as defined in IEEE 1101.1.

Observation 4.2:

Some of the 2 mm hard metric connector's z shields protrude into the interboard separation plane, and therefore can not be used.

Observation 4.3:

The two outer rows of contacts are connected to ground on the backplane. When only the f row shield is used on the free board connector, 19 ground contacts are supplied to the board. The use of both the f and z row shields provide a total of 38 ground contacts.

4.2.2 Custom Connectors**Permission 4.2:**

Custom I/O connectors such as coaxial cable or fiber may also be used on VME64x boards and VME64x backplanes which require specialized custom I/O in the P0/J0 connector area.

Observation 4.4:

VME64x backplanes with custom I/O connectors will not be compatible with VME64x boards containing a P0 connector per Rule 4.2.

Recommendation 4.1:

The keying scheme defined in this standard should be used for boards and backplane slots that have custom I/O connectors.

Recommendation 4.2:

For applications that are 1101.2 based, the VITA 1.6-199x Keying for Conduction Cooled VME draft standard should be used.

Rule 4.8:

Any custom connector installed on the backplane in the J0 connector area shall allow the front board's rear edge to be installed (come to rest) within 12.5mm of the backplane surface.

Observation 4.5:

A connector with a height of greater than 12.5mm will protrude over the rear edge of a VME64x board when fully inserted into a slot. This would prevent generic boards, that do not have a mating P0 connector, from being inserted into that slot.

4.2.3 P0/J0 Pin Definitions**Rule 4.9:**

The row and column labeling of the contacts in the P0/J0/RJ0/RP0 connector shall be as shown in Table 4-1, P0/J0/RJ0/RP0 Connector Contact Labeling.

Table 4-1 P0/J0/RJ0/RP0 Connector Contact Labeling

Pos.	Row f	Row e	Row d	Row c	Row b	Row a	Row z
1	GND	UD	UD	UD	UD	UD	GND
2	GND	UD	UD	UD	UD	UD	GND
3	GND	UD	UD	UD	UD	UD	GND
4	GND	UD	UD	UD	UD	UD	GND
5	GND	UD	UD	UD	UD	UD	GND
6	GND	UD	UD	UD	UD	UD	GND
7	GND	UD	UD	UD	UD	UD	GND
8	GND	UD	UD	UD	UD	UD	GND
9	GND	UD	UD	UD	UD	UD	GND
10	GND	UD	UD	UD	UD	UD	GND
11	GND	UD	UD	UD	UD	UD	GND
12	GND	UD	UD	UD	UD	UD	GND
13	GND	UD	UD	UD	UD	UD	GND
14	GND	UD	UD	UD	UD	UD	GND
15	GND	UD	UD	UD	UD	UD	GND
16	GND	UD	UD	UD	UD	UD	GND
17	GND	UD	UD	UD	UD	UD	GND
18	GND	UD	UD	UD	UD	UD	GND
19	GND	UD	UD	UD	UD	UD	GND

Observation 4.6:

The J0/RJ0 connectors have seven physical rows of contacts, with the z and f contact rows connected to the backplane's ground plane. On the VME64x board, there is no z row of contact holes. Depending on the connector design, the P0 and RP0 connector ground contacts in the z and f row of the connector (which is on the connector shroud) will alternately connect to the board's f row of ground contacts.

Observation 4.7:

Connector layout and position numbering method is the same as the P1/J1 and P2/J2 connectors. Position 1 is near P1/J1's position 32 and position 19 is near P2/J2's position 1.

4.2.4 P0/J0 Connector Mounting**Rule 4.10:**

Mounting of the 19 position, 5+1 row, Type B, 2 mm hard metric IEC 61076-4-101 free board connector on VME64x boards shall be as shown in Figure 4-1, when implemented.

Rule 4.11:

Mounting of the 19 position, 5+2 row, Type B, 2 mm hard metric IEC 61076-4-101 fixed board connector on VME64x backplanes shall be as shown in Figure 4-2, when implemented.

4.2.5 Pin Current Ratings**Rule 4.12:**

The maximum current load per contact shall be in compliance to the IEC 61076-4-101.

Observation 4.8:

When the ANSI/VITA 1.1, VME64x standard was approved, the maximum current load per contact was defined to be 2.0 amp at 70° C when an alternate chess pattern of

contacts are used for power. When adjacent contacts are grouped together for power, the maximum current per contact is 1.0 amp at 70^o C. The current rating of the shield contacts in rows z & f is 1.5 amp at the same temperature. For power ratings at other temperatures, see IEC 61076-4-101.

Rule 4.13:

The shield contacts are connected to logic ground on the backplane and boards. It is not connected to frame ground. Although the shield contacts will provide a ground return path the current carrying capacity of the pins shall not be used in calculating the overall ground current carrying capacity.

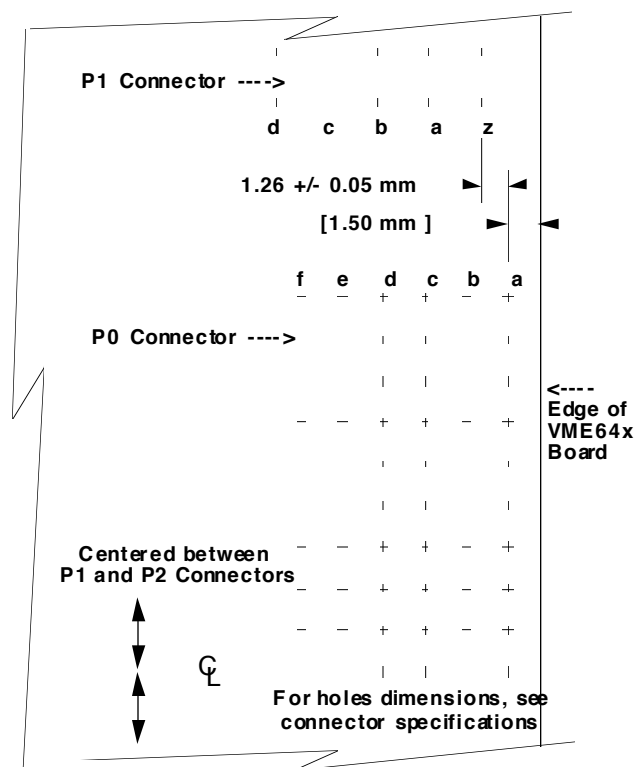


Figure 4-1 P0 Connector Layout Position on VME64x Boards
(component side - top view)

4.2.6 Backplane P0/J0 Keying

In some applications a slot board to backplane keying is required. In particular, IEEE 1101.2 type applications do not use the front panel, but do require slot keying.

Recommendation 4.3:

For applications that need a slot board to backplane keying capability, the keys defined in VITA 1.6-199x Keying for Conduction Cooled VME should be used.

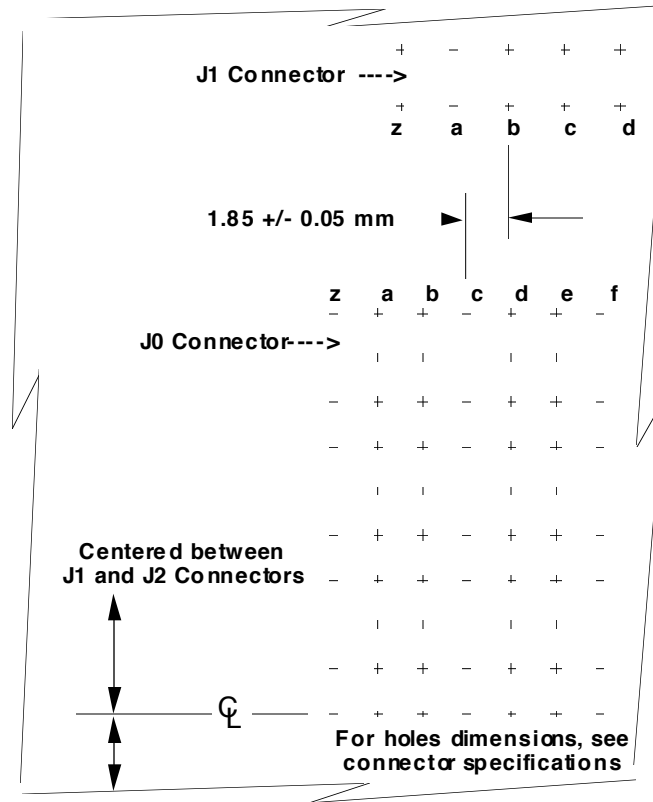


Figure 4-2 J0 Connector Layout Position on VME64x Backplanes
(front view)

4.2.7 VME64x Backplane End Dimensions

Mounting of the J0 2 mm connector on VME64x backplanes causes the backplane to be shifted to the left on both the left and right ends, over VME/VME64 backplanes. Only the two end dimensions are affected. All the other backplane dimensions remain the same as defined in the VME64 Standard.

When two VME64x backplanes of less than 21 slots are mounted next to one another in the same subrack, the gap between the two backplanes is designed to be 1 mm. In the VME64 Standard, this dimension is defined as 1.44 mm. Depending on the specific application needs, backplanes can be made wider. The incremental width needs to be consistent such that when backplanes are mounted next to one another or mounted next to other hardware, such as disk drive or power supplies, the gap always remains the same, regardless of the backplane width and number of slots used.

Rule 4.14:

The left and right end dimensions of minimum width VME64x backplanes shall be as shown in Figure 4-3.

Rule 4.15:

If VME64x backplanes need to be made wider, the incremental end dimensions for both left and right ends shall be in 5.08 mm (1 HP) increments.

Permission 4.3:

For subrack airflow management purposes, the right end of 21 slot sized VME64x backplanes may extend over the last interboard separation plane by 1.54 +0.00 -0.15 mm.

Rule 4.16:

Half shears shall not exceed 1.00 mm in height when used in VME64x applications.

Observation 4.9:

Note that half shears are commonly used on side (end) plates of subracks to prevent rotation and ensure accurate alignment of subrack horizontal members.

Rule 4.17:

Some side (end) plates that utilize half shears for positioning of horizontal members, shall not place half shears in the area of the backplane ends, as shown in Figure 4-3.

Observation 4.10:

All the other backplane dimensions and tolerances remain the same as defined in the VME64 Standard.

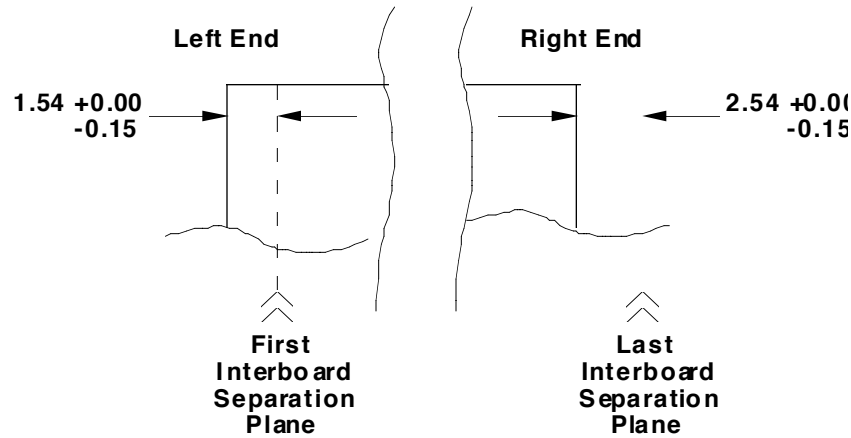


Figure 4-3 VME64x Backplane Left and Right End Dimensions
(front view)

Observation 4.11:

The left end of VME64x backplanes extends over the interboard separation plane by 1.54 mm whereas the right edge of VME/VME64 backplanes are 0.72 mm from the interboard separation plane. Attempting to mount a VME64x backplane to the right of VME/VME64 backplane, while trying to avoid wasting slot space, will result in overlapping of the two backplanes. On the other hand, the right edge of a VME64x backplane can be mounted next to the left edge of a VME/VME64 backplane without mechanical interference in consecutive occupied positions.

Chapter 5

EMC Front Panels and Subracks

5.1 Introduction

This chapter specifies the optional usage of EMC front panels on VME64x boards. In some applications, there is a need to restrict the amount of EMI and RFI being radiated from the front of VME64x subracks, without the aid of a special cover. The EMC front panels and subracks specified in IEEE 1101.10, will provide this capability.

In some applications there is a need for attachment of identification and/or bar code labels on the front panel. This chapter defines three recommended areas that VME64x board suppliers might want to leave open for attachment of special labels.

Note that for VME64x boards and subracks being built according to IEEE 1101.2, IEEE Standard for Mechanical Core Specifications for Conduction-Cooled Eurocards, the EMC design defined in this chapter is not applicable.

5.2 Requirements

5.2.1 EMC Front Panels and Subracks

Rule 5.1:

VME64x boards that require the use of an EMC front panel shall use the EMC front panel as specified in IEEE 1101.10.

Rule 5.2:

If filler panels are used in conjunction with VME64x boards that have EMC front panels, the filler panels shall provide EMC protection. Filler panels shall comply with the filler panels as specified in IEEE 1101.10.

Rule 5.3:

VME64x subracks that are to be used in conjunction with VME64x EMC front panels shall meet the subrack specification given in IEEE 1101.10.

Rule 5.4:

The EMC front panels shall not be electrically connected to the board's logic ground plane nor the ESD strips (if implemented).

Rule 5.5:

Whenever EMC front panels are implemented, the associated alignment pin on the front panel and alignment hole in the subrack defined in IEEE 1101.10 shall also be used to keep boards properly positioned in the subrack.

5.2.2 Solder Side Covers

Recommendation 5.1:

Covers defined in IEEE 1101.10 should be used on the solder side of VME64x board's PCB to prevent scraping of components and the stubs of through hole components by the adjacent left slot's EMC contacts. (This recommendation does not apply to IEEE 1101.2 based boards.)

5.2.3 Front Panel Label Areas

Recommendation 5.2:

An area of 15 mm high by 20 mm wide should be left open at the bottom of VME64x board's front panels for attachment of identification and/or bar code labels. See Figure 5-1, Front Panel Label Areas.

Recommendation 5.3:

Or, an area of 70 mm high by 10 mm wide should be left open on the bottom left side of

VME64x board's front panels for attachment of identification and/or bar code labels. See Figure 5-1, Front Panel Label Areas.

Recommendation 5.4:

Or, an injector/extractor handles should be used with a flat surface on the inside of the handle with a dimension of 15 mm wide by 20 mm long for attachment of labels. See Figure 5-2, Injector/Extractor Handle Label Area.

Recommendation 5.5:

Labels attached on the inside of the injector/extractor handles should have a wear resistance coating since this surface is used to apply pressure while removing VME64x boards from a backplane.

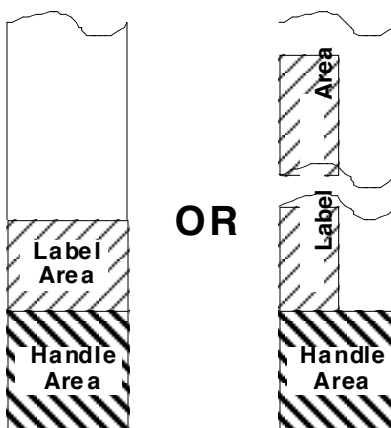


Figure 5-1 Front Panel Label Areas

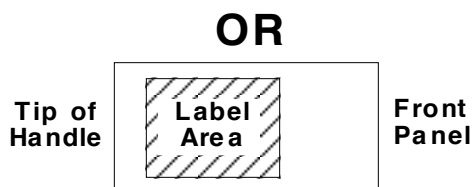


Figure 5-2 Injector/Extractor Handle Label Area
(top view of lower handle)

Chapter 6

Injector/Extractor Handles

6.1 Introduction

In some applications, there might be a need for mechanical assistance during the insertion and/or removal (extraction) of VME64x boards into and out of VME64x subracks. An optional Injector/Extractor Handle and associated subrack defined in IEEE 1101.10 is ideal for this purpose.

The use of screws to secure VME64x boards to VME64x subrack is not allowed in some applications. The screw heads can get damaged, plus the usage of a tool is required to remove and replace VME64x boards from a subrack. A self locking feature in the handle replaces the need for front panel screws and will prevent VME64x boards from falling out under harsh conditions, such as earthquakes, transportation and other high vibration applications.

Note that for VME64x boards and subracks being built according to IEEE 1101.2, the injector/extractor handle design defined in this chapter is not applicable.

6.2 Requirements

6.2.1 Handles

Rule 6.1:

If an Injector/Extractor Handle is used on VME64x boards, it shall be in compliance with the handle defined in IEEE 1101.10.

Recommendation 6.1:

Injector/Extractor Handle that have a self locking feature should be used, which would eliminate the optional use of front panel screws.

Observation 6.1:

The Injector/Extractor Handle is backwards compatible to original VME handles, which allows boards using this handle to be plugged into original VME subracks.

Observation 6.2:

For IEEE 1101.2 based applications, the handles defined in this chapter are not applicable. The handles defined in IEEE 1101.2 are used.

Suggestion 6.1:

In high vibration applications (e.g. military), it may be necessary to use the front panel screws for securing the boards into the subrack.

6.2.2 Subracks

A special Injector/Extractor Handle engagement comb is required on the front of VME64x subracks that will support the use of the referenced Injector/Extractor Handle.

Rule 6.2:

If a VME64x subrack is used that supports the use of the Injector/Extractor Handle, it shall be in compliance with the one defined in IEEE 1101.10.

Observation 6.2:

VME and VME64 boards are forward compatible and can be plugged in to the VME64x subracks.

Chapter 7

Keying and Alignment Pin

7.1 Introduction

In many applications with I/O through the backplane's user defined pins, specific boards are assigned to specific slots. Plugging the wrong board into a pre-defined slot might cause the system to operate improperly. Also, in some applications which assign some of the I/O pins to special power voltages, plugging a board into the wrong slot could have disastrous results. This might include the destruction of the board being plugged in as well as other boards in the same subrack. This becomes even more critical in hot swap applications. Therefore there is the need for keying, where only keyed boards can be plugged into keyed subrack slots.

An optional keying mechanism for VME64x subracks and boards is defined in IEEE 1101.10. This keying mechanism provides for three keying holes on the top and three keying holes on the bottom of each board and each subrack slot. Each keying hole can be keyed with a "No Key" or a keying peg in one of four positions. This effectively provides 5 key combinations per keying hole. With three keying holes on the top and three on the bottom, this keying scheme provides a total of $5 \times 5 \times 5 \times 5 \times 5 \times 5 = 15,625$ keying combinations.

A "No Key" hole in the subrack allows for a "family" of boards to be plugged into a specific slot. Boards with no keys installed can be plugged into any slot, as well as subrack slots with no keys installed will allow for any board to be plugged into the subrack's slot.

The actual number of "hard" combinations, where all holes are keyed in both the board and subrack slots is $4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4,096$ combinations. In applications where both the top and bottom have identical keys, then $4 \times 4 \times 4 = 64$ keying combinations are possible.

An alignment pin and associated alignment hole is to be used as part of the keying mechanism for better alignment during hot swap, for an ESD path from the front panel and for a solid keying blockage if the wrong board is inserted into a keyed slot.

Note that for VME64x boards and subracks being built according to IEEE 1101.2, IEEE Standard for Mechanical Core Specifications for Conduction-Cooled Eurocards, the keying and alignment design defined in this chapter is not applicable.

7.2 Requirements

Observation 7.1:

The features defined in this chapter are not applicable to IEEE 1101.2 based applications.

7.2.1 Subrack Keying

Rule 7.1:

If keying is provided in VME64x subracks, the keying mechanism defined in IEEE 1101.10 for subracks shall be used.

Observation 7.2:

Subrack keying hole positions and associated keying codes for each keying hole are defined in IEEE 1101.10. For information purposes, Figure 7-1 illustrates this subrack keying scheme.

7.2.2 Board Keying

Rule 7.2:

If keying is provided on VME64x boards, the keying mechanism defined in IEEE 1101.10 for boards shall be used.

Observation 7.3:

Board keying hole positions and associated keying codes for each keying hole are defined in IEEE 1101.10. For information purposes, Figure 7-1 illustrates this board keying scheme.

Observation 7.4:

Note that the board keying hole sequence and associated keying position codes is reversed to the subrack when viewing the front of the keying holes.

7.2.3 Keying Number Identification**Recommendation 7.1:**

For consistency within each application and between applications, each subrack's slot key and each board's key should use a 6 digit alpha-numeric code, with a slash "/" between the first three digits and last three digits. This sequence follows the letter position of the keying holes, ABC/DEF. The key codes for each position is numbered "1" through "4" as illustrated in Figure 7-1. When "No Key" is used, the letter "N" should be used to indicate that "No Key" is used in the keying hole.

Observation 7.5:

Boards with a key code of 233/423 can only be plugged into a slot with the same key code of 233/423 when keys are used in all the subrack key hole positions. Boards with a keying code of 24N/11N can be plugged into any subrack slot with key codes of 24x/11x, where x is equal to N, 1, 2, 3 or 4.

7.2.4 User Defined and User Installed

The above keying scheme provides user defined and user installed keying combinations.

Recommendation 7.2:

Manufacturers (suppliers) of subracks and boards with keying capability should produce (ship) subracks and boards without the keys installed.

Recommendation 7.3:

Each application (user) should define the keying combinations as required by the application's specific needs and then install the keys accordingly.

Recommendation 7.4:

End users should purchase the keys required for their specific application.

7.2.5 Multifunction Alignment Pin**Rule 7.3:**

The multifunction alignment pin defined in IEEE 1101.10 on the rear side of the front panel and the alignment hole next to the subrack keying block shall be used whenever the front panel and/or subrack keying mechanism is implemented.

Observation 7.6:

The multifunction alignment pin and associated hole in the subrack keying block provides the following benefits:

- 1) Alignment of boards to the backplane connector for a more uniform connector mating during hot swap,
- 2) A discharge path for any accumulated ESD energy on the front panel and the human operator,
- 3) A much tighter and more positive contact of the keying pins if a board is mis-keyed with the subrack's slot during insertion.
- 4) Proper EMC gasket and front panel alignment when boards are plugged into the subrack.
- 5) A high current connector contact for Front Panel Safety Ground (see section 8.2.5)

Observation 7.7:

The alignment pin might not interoperate with some original subracks that were not designed in compliance with IEEE 1101.1,

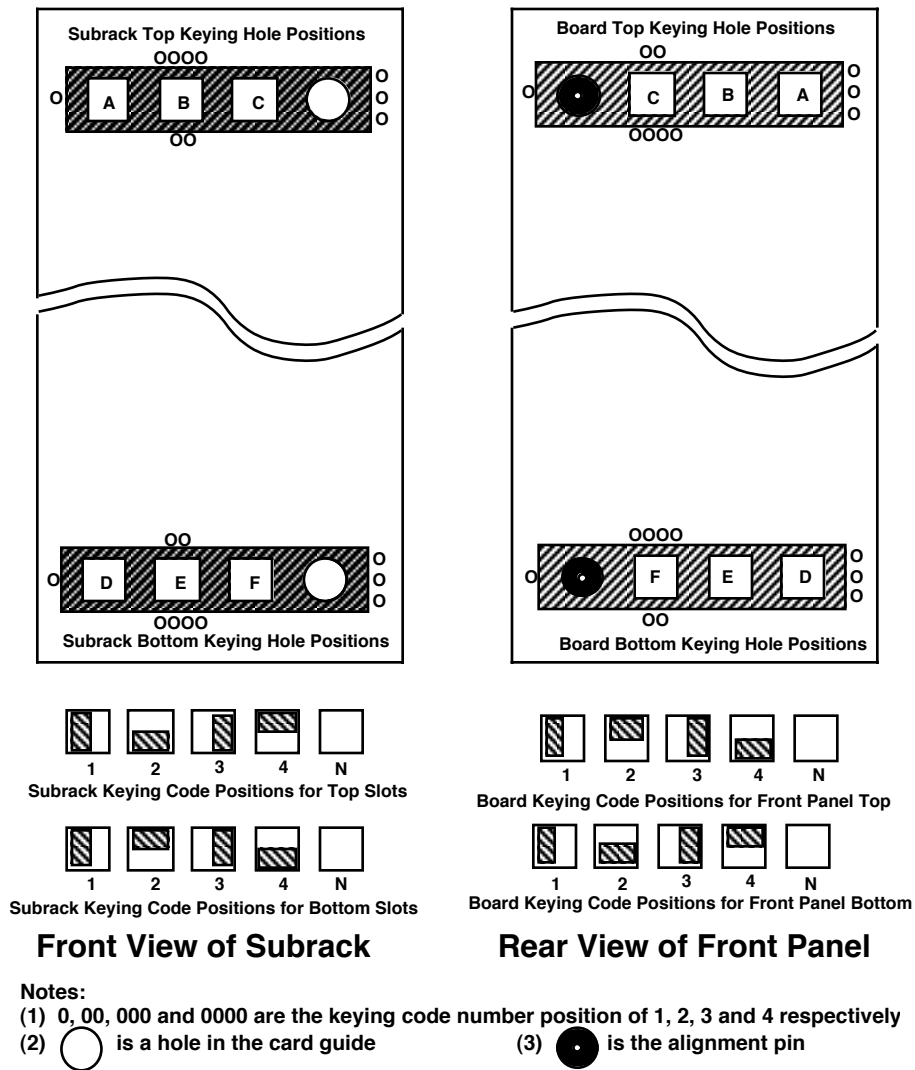


Figure 7-1 Keying Hole Positions and Associated Keying Codes

Chapter 8

ESD and Front Panel Safety Ground Protection

8.1 Introduction

In some VME64x applications, boards being plugged into a VME64x subrack are required to have static electricity bled off prior to contact with the backplane. This is known as electrostatic discharge (ESD) protection. A scheme for implementation of this capability is defined in the IEEE 1101.10.

Also, some VME64x applications need to provide a front panel safety ground where high currents are shorted to earth ground. If the equipment at the other end of an I/O cable faults and attempts to place a high voltage on the ground of an I/O cable, the front panel safety ground feature will keep the voltage low enough to prevent VME64x systems failing as well as prevent the operator from being harmed.

Note that for VME64x boards and subracks being built according to IEEE 1101.2, IEEE Standard for Mechanical Core Specifications for Conduction-Cooled Eurocards, the ESD Protection design defined in this chapter is not applicable.

8.2 Requirements

Observation 8.1:

The features defined in this chapter are not applicable to IEEE 1101.2 based applications.

8.2.1 ESD Strips on VME64 Boards

Rule 8.1:

VME64x boards that are designed to provide electrostatic discharge (ESD) capability shall use one or two ESD strips in one or both of the following locations: bottom edge or the top edge on the component side of the PCB. Position and size of the ESD strip(s) shall be in compliance with the ESD Strips defined in IEEE 1101.10.

Rule 8.2:

Two 1 Meg Ohm resistors, +/- 20%, in series, shall be connected between each of the ESD strip(s) implemented and the board's ground plane for discharge of electrostatic energy.

8.2.2 ESD Clips in Card Guides and Subracks

Rule 8.3:

All VME64x systems that provide ESD protection shall use subracks and card guides with clips on both the top and bottom per the requirements specified in IEEE 1101.10.

Observation 8.2:

The board's ESD strip is in contact with the subrack's ESD clip during most of the boards insertion into a subrack. The ESD strip is disconnected from the ESD clip when the board is fully inserted into the backplane. This feature reduces ground loop problems.

Observation 8.3:

Any ESD build up on the front panel will be discharged into the system chassis through the ESD contacts between the front panel and the chassis.

8.2.3 Solder Side Covers with ESD Protection

Recommendation 8.1:

Solder side covers with ESD protection should be used on VME64x boards as defined in IEEE 1101.10.

Observation 8.4:

This will provide added ESD protection of VME64x boards during operator handling.

Observation 8.5:

This solder side cover is the same cover as recommended in Section 5.2.2.

8.2.4 Front Panel Design for ESD Protection

Recommendation 8.2:

All components mounted on the front panel, such as switches, I/O connectors, LEDs, etc. with metal supports or connector metal shields should be mounted in such a way as to provide ESD protection.

Observation 8.6:

This will provide added ESD protection of VME64x boards during operator handling.

8.2.5 Front Panel Safety Ground Protection

In some applications there is a need to provide a safety ground protection. If an I/O device like a display monitor, a printer, test equipment, etc. fail and short its chassis and I/O cable ground to the main power voltage, both the electronic equipment and human operators are exposed to high voltage shock hazards. A safety ground return for high currents will prevent this from happening.

The safety ground protection system has four elements:

- a) IEEE 1101.10 metallic board front panel with galvanically connection
- b) multifunctional alignment pin
- c) IEEE 1101.10 chassis ground connection
- d) and a low impedance chassis to earth ground connection

Recommendation 8.3:

For applications that need a front panel safety ground return, the following capability should be provided:

- a) support a continuous 25 A current at no more than 100 milliohm for a least 2 minutes.
- b) support a short term 200 A current for 10 ms at 1 s intervals, 10 pulses, at no more than 100 milliohm.

Observation 8.7:

The resistance measurement is between the front panel and earth ground.

Suggestion 8.1:

The 100 milliohm maximum resistance can be divided into three parts as follows:

- a) 40 milliohm maximum between front panel and card guide connector
- b) 40 milliohm maximum between card guide connector and subrack ground frame
- c) 20 milliohm maximum between subrack ground frame and earth ground

Chapter 9

Rear I/O Transition Boards

9.1 Introduction

VME, VME64 and VME64x boards might route I/O through the backplane via the P2/J2/RJ2/RP2 connectors and the P0/J0/RJ0/RP0 connectors. In the P2/J2/RJ2/RP2 connector family, rows a & c provides 64 I/O pins. Rows z & d of the same connector family provide 46 I/O pins for a total of 110 user defined I/O pins. Additionally, 35 pins are available for ground returns in the z & d rows, as defined in Chapter 3.

When the 2 mm hard metric P0/J0/RJ0/RP0 connector family (as defined in Chapter 4) is used, 95 user defined I/O pins are available. Additionally, 19 or 38 pins are available for ground returns.

In some applications that utilize these user defined I/O pins for I/O through the backplane, there is a need for a commonly defined rear I/O transition board scheme. These boards provide the connectors required for specific kinds of I/O functions such as serial ports, parallel ports, video terminals, disk drive ports, T1/E1 communication lines, etc.

IEEE P1101.11, defines the generic mechanics for rear I/O transition boards. This chapter selects the recommended board and slot depth size to be used for VME64x applications.

9.2 Requirements

9.2.1 Mechanical Dimensions

Rule 9.1:

If rear I/O transition boards are being implemented, the mechanics of such an implementation shall be in accordance to IEEE P1101.11.

Recommendation 9.1:

For I/O through 3U and 6U backplanes, the 80 mm deep rear I/O transition boards should be used.

Recommendation 9.2:

3U and 6U subracks supporting rear I/O transition boards should be designed to accommodate the 80 mm depth version.

9.2.2 Mechanical Components

Recommendation 9.3:

It is recommended that the same front panel, the same handles, the same keying, the same alignment pin, the same EMC and the same ESD mechanics be used as on the front VME64x boards, as defined in chapters 5, 6, 7 and 8.

Recommendation 9.4:

It is recommended that the same subrack rails, card guides, EMC support, ESD support, keying, alignment pin hole, and injector/extractor comb be used as on the subrack front side, except for the card guide's depth, as defined in chapters 5, 6, 7 and 8.

Observation 9.1:

Rear I/O transition boards are "in-line" with the front VME64x boards. This means that the front panel of rear I/O transition boards are reversed (mirrored) from the front VME64x boards. This includes the card guides, the keying scheme and the handles. The top handles are on the bottom and the bottom handles are on the top.

Rule 9.2:

If a transition module has an RP0 then it shall have an RP2 connector.

Observation 9.2:

The rear RJ0 shroud does not have any vertical guiding for the RP0 connector. The RP2 connector is necessary since there is a potential for misalignment and the bending of pins in RP0.

Permission 9.1:

An RP2 housing without pins may be mounted on the transition module if no contacts are used in that connector.

9.2.3 Board Layout Orientation**Recommendation 9.5:**

As a visual aid, the typical orientation for a VME board should be positioned with the front panel on the left side and the backplane connectors on the right side. See Figure 9-1 of this standard and Figures 7-2, 7-3, 7-10 and 7-11 in the VME64 Standard.

Recommendation 9.6:

As a visual aid, the typical orientation for a rear I/O transition board should be positioned with the front panel on the right side and the rear backplane connectors on the left side. See Figure 9-1 of this standard.

Observation 9.3:

By following Recommendations 9.5 and 9.6, layout and I/O signal routing errors will be minimized.

9.2.4 Slot Keying Codes**Observation 9.4:**

The same front panels and shortened card guides are used for rear I/O transition boards. Unfortunately all the slot keying holes in both the card guides and front panels will be upside down. The top and bottom holes are swapped as well as the letter labels will be upside down.

Recommendation 9.7:

The same keying code identification and labeling should be used as on the front boards and front card guide.

9.2.5 Connector Pin Labeling**Rule 9.3:**

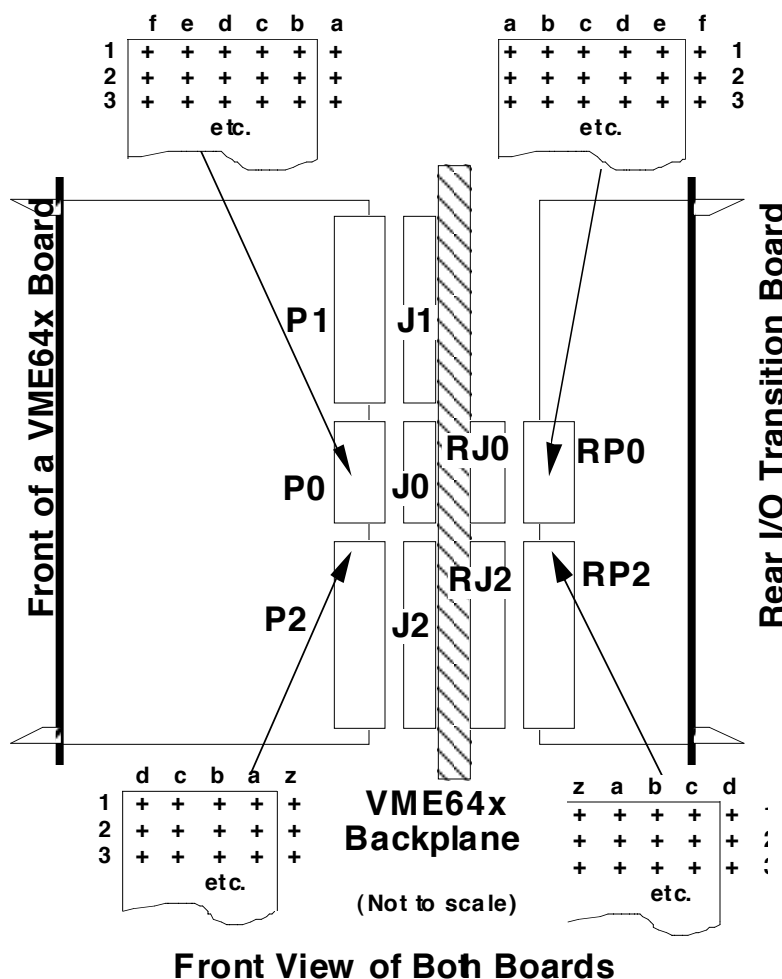
Whenever rear I/O transition boards are implemented, any connector that plugs into the rear of the backplane shall use the same pin numbering scheme, mirror image, as used on the front boards.

Observation 9.5:

Rule 9.3 eliminates confusion and I/O signal pin mapping problems by requiring a 1 for 1 pin mapping. Example, P2, a3 is connected to RP2, a3 and P0, d1 is connected to RP0, d1. See Figure 9-1 above for illustration.

Observation 9.6:

If the same CAD component database is used for connectors on front plug-in boards and rear plug-in boards the pin labels will be incorrect on rear plug-in board connectors. The pin sequence needs to be re-sequenced.



Note: Connectors RJ1 and RP1 are not normally used and therefore are not shown. If these two connectors are used, care should be taken when connecting to the VME64x bused signals and to the power pins.

Figure 9-1 Front and Rear Board Orientation & Connector Pin Labeling
(view of component side on both boards)

9.2.6 Increase in Backplane Height

When rear I/O transition boards are used, the attachment of power connectors and associated power cabling might need to be done outside the normal connector area. It might be necessary to extend the height of VME64x backplanes on either or both the top or bottom edges.

Recommendation 9.7:

The incremental height extensions of VME64x backplanes should be in one half of a 1U increment or 22.22 mm.

9.2.7 Power to Rear I/O Transition Board

In some applications, the rear transition board will have active components. Power can be applied either through the I/O pins from the front board, or from the normal power and ground pins defined as part of the P1/J1 and P2/J2 connectors.

Rule 9.4:

When power is routed through the I/O pins from the front board to the rear I/O transition board, the maximum current through each pin shall be the same as allowed per pin for the normal connector operation.

Rule 9.5:

Backplanes that provide long tail connectors on the rear of the backplane shall design the backplane to accommodate full power being drawn from both the front and rear connectors at the same time.

Chapter 10

Additions to CR/CSR Definition

10.1 Introduction

A Configuration ROM / Control and Status Register (CR/CSR) Space is specified in Section 2.3.12 of the ANSI/VITA 1-1994, VME64 Standard. Standard resources within a VME module to support manufacturer and module identification, initialization, test and configuration are defined by twenty-four bytes in CR and three byte-wide registers in CSR. The use of the remaining 524,148 locations within the 512 KB CR/CSR space was not specified, nor was a method of allocating the space.

In this chapter, the utility of CR/CSR is enhanced in two ways. First, the definition of additional CR parameters and CSR functions makes more standardized information available to the system software, enabling automatic discovery of module and system components and automatic utilization of hardware capabilities. Second, the concept of Configuration RAM (CRAM) is introduced. Configuration RAM can be utilized by Value Added Resellers, System Integrators and End Users to store system configuration and initialization information. Storing such information within the module allows better fault isolation, which simplifies development of high-availability systems.

Following is a review of the characteristics of the VME64 CR/CSR Space as defined by the VME64 Standard.

- 1) Each module's CR/CSR Space is 512 KB in size (0x00000 to 0x7FFFF) and is part of an array of CR/CSR Spaces located in the region of VME64 memory decoded by the 0x2F AM code. A specific module's position in the CR/CSR Space array is determined by its CR/CSR Base Address Register (CR/CSR BAR). As originally written the method of loading the CR/CSR BAR was not specified, but it was implied that the Autoslot-ID mechanism would provide the CR/CSR BAR value. Chapter 3 of this document specifies that the CR/CSR BAR needs to be loaded based on the newly added geographical address capability.
- 2) The addresses within CR/CSR are specified as offset addresses. They are relative to the Base Address of the CR/CSR space. An absolute address in CR/CSR space is created by adding the offset address to the Base Address of CR/CSR space. Pointers specified in CR locations also contain offset addresses.
- 3) Each module's Defined Configuration ROM (CR) Area is located at the "bottom" (offset zero) of its CR/CSR Space. Addresses increase to the "top."
- 4) The CR area is "read-only" to the VMEbus regardless of the internal implementation. Information contained in the CR area should not be changed once a module is "on line" (i.e., ready to respond to bus data transfer cycles).
- 5) CR data can be one, two or four bytes in width. The spacing and access method to be used by VME64 masters when reading a specific module's User CR locations is determined by the module's CR Data Access Width parameter (see the VME64 Standard). The Defined CR Area (from 0x00 to 0x7F) is compatible with the D08(O) access method and utilizes only every fourth byte.
- 6) The Control & Status Register (CSR) area is located at the "top" of the CR/CSR Space.
- 7) The CSR locations can be modified after a module goes "on-line." Once a module is "on-line," its registers can be initialized or modified by itself or any VME64 master in the system.
- 8) CSR data can be one, two or four bytes in width. The spacing and access method to be used by VME64 masters when reading or writing a specific module's User CSR locations is determined by the module's CSR Data Access Width parameter (see the

VME64 Standard). The CSR area offers read and write capability when accessed by VME64 masters.

- 9) The size of the implemented User CR and/or User CSR areas available on a VME64 module can vary by module (or even module revision) and can be zero.
- 10) Offset addresses and pointers are stored in big-endian order. That is, the most-significant byte of the object is stored at the lowest address and the least-significant byte is stored at the highest address.

A summary of the additional concepts and capabilities introduced in these extensions to CR/CSR follows.

- 1) Standard support for optional module-specific CR and CSR locations. This allows vendors the freedom to locate module-specific CRs and CSRs in suitable places (e.g. to ease address decoding) and set their sizes appropriately.
- 2) Standard support for an optional Configuration RAM (CRAM) area within CR/CSR space, including a mechanism to provide cooperating masters exclusive access to it.
- 3) Pointers in the Defined CR Area containing the beginning and ending addresses of a module serial number.
- 4) Characteristic parameters in the Defined CR Area allow identification of master capability, unaligned transfer capability, Read-Modify-Write (RMW) capability, Retry capability, presence of a P2 connector, presence of ETL transceivers, and Address-Only (ADO) cycle support.
- 5) Standardized support for programmable “Address Space Relocation”. The purpose is to enable “plug-and-play” on VME by replacing DIP switches or jumpers with simple programmable address decoding. Parameters in the Defined CR area describe a module’s address decoding capabilities. Registers in the Defined CSR area allow software to set base addresses for each of the possible address spaces within the module. A “Module Enable” bit is defined within the Bit Set / Bit Clear CSRs to allow use of the relocated address spaces once they have been initialized by software.

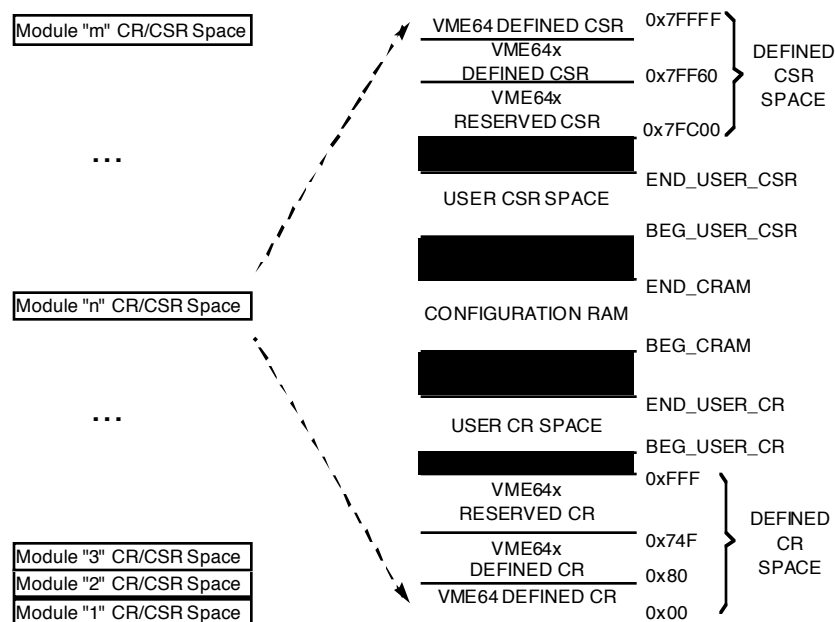


Figure 10-1: Structure of CR/CSR Space

Observation 10.1:

Although Figure 10-1 shows the User CR area below User Configuration RAM and the User CSR area above User Configuration RAM, the areas can be implemented in any sequence as long as they do not overlap.

10.2 Requirements**10.2.1 The Defined CR Area**

The Defined CR Area is composed of the locations at offset addresses 0x00 through 0x7F defined by the VME64 standard plus the additional Defined CR locations and reserved locations specified by this document, which end at offset address 0xFFFF. Table 10-12 specifies the contents of these locations.

Rule 10.1:

The VME64x Defined CR Area shall be from offset addresses 0x000 to 0xFFFF (4KB). These locations shall only be used as specified in the VME64 Standard and as later specified in this document.

Rule 10.2:

All reserved or unimplemented locations in the Defined CR Area shall read as 0x00.

Permission 10.1:

Boards may use volatile memory (e.g., RAM) for the CR Area as long as it retains a "read-only" interface with the VMEbus.

10.2.1.1 CR/CSR Space Specification ID

In the VME64 Standard, the value contained at CR offset 0x1B specifies the revision of the CR/CSR definition. The definition as specified in VME64 is indicated by a value of 0x01. This specification is the second CR/CSR released version and is indicated by a value of 0x02.

Rule 10.3:

In the VME64x Defined CR area, address offset 0x1B shall contain a value of 0x02 when any of the additional CR/CSR features defined in this extension to the VME64 Standard are implemented on a VME64x module.

10.2.1.2 Module Characteristics Parameters

The Defined CR Area includes a Slave Characteristics Parameter and a Master Characteristics Parameter, whose formats are detailed in Tables 10-1 and 10-2. These allow modules to "advertise" their support for certain VMEbus features such as unaligned transfers and Read-Modify-Write (RMW). These are general capabilities. More specific capabilities are encoded in the AM and XAM Capabilities parameters outlined 10.2.1.4.

Table 10-1: Slave Characteristics Parameter

Bit	Value	Meaning
7	0	Slave does not support UnAligned Transfers (UAT)
	1	Slave supports UnAligned Transfers (UAT)
6	0	Slave does not support Read-Modify-Write (RMW)
	1	Slave supports Read-Modify-Write (RMW)
5	0	Slave does not support Address-Only (ADO) cycles
	1	Slave supports Address-Only (ADO) cycles
4	0	Slave does not support Address-Only with Handshake (ADOH) cycles
	1	Slave supports Address-Only with Handshake (ADOH) cycles
3	0	Slave does not support RETRY* and/or RESP*
	1	Slave supports RETRY* and/or RESP*
2	0	Slave does not implement P2 connector
	1	Slave implements P2 connector
1	0	Slave uses TTL transceivers
	1	Slave uses ETL transceivers
0	0	Reserved; always program this value
	1	Not to be used

Table 10-2: Master Characteristics Parameter

Bit	Value	Meaning
7	0	Master does not support UnAligned Transfers (UAT)
	1	Master supports UnAligned Transfers (UAT)
6	0	Master does not support Read-Modify-Write (RMW)
	1	Master supports Read-Modify-Write (RMW)
5	0	Master does not support Address-Only (ADO) cycles
	1	Master supports Address-Only (ADO) cycles
4	0	Master does not support Address-Only with Handshake (ADOH) cycles
	1	Master supports Address-Only with Handshake (ADOH) cycles
3	0	Master does not support RETRY* and/or RESP*
	1	Master supports RETRY* and/or RESP*
2	0	Master does not implement P2 connector
	1	Master implements P2 connector
1	0	Master uses TTL transceivers
	1	Master uses ETL transceivers
0	0	Reserved; always program this value
	1	Not to be used

Rule 10.4:

The Module Characteristics Parameters shall reside in the locations specified in Table 10-12 and follow the formats specified in Tables 10-1 and 10-2.

Permission 10.2:

Immediately following each Characteristics Parameter in the Defined CR Area is a User-defined Characteristics Byte. Vendors may use these bytes for additional module characteristics information.

10.2.1.3 Interrupt Capabilities

Two “Interrupt Capabilities” parameters are specified in the Defined CR Area. The Interrupt Handler Capabilities denotes which interrupt levels a handler can handle, while the

Interrupter Capabilities denotes which levels an interrupter can assert. Both are bit-masks, so a bit programmed to “1” denotes support for the interrupt level corresponding to the bit’s position. For example, a value of 2 denotes support for interrupt level 1 only, while a value of 0xC denotes support for levels 2 and 3. Bits 7-1 are used for interrupt levels 7-1, and bit 0 is reserved.

Rule 10.5:

The Interrupt Capabilities Parameters shall reside in the locations specified in Table 10-12 and follow the bit-mask format given above.

10.2.1.4 Address Space Relocation

Geographically Addressed CR/CSR capability allows a module to be addressed upon system initialization and configuration without manually setting address switches. It avoids address conflicts and allows for modules to be moved around within a system and still be located and addressed without conflict. The addition of registers within the Defined CSR Area to provide software programmable Base Addresses for the functions within a module removes the requirement of providing hardware switch settings for Base Address assignment. System address maps can then be dynamically configured at system initialization by software programming. This is termed “Address Space Relocation”. To avoid conflicts upon power up and during initialization, a module enable bit is provided in the Bit Set / Bit Clear register in the Defined CSR Area. Once the Function Base Address Registers have been programmed, the module can be enabled without conflict.

Support for Address Space Relocation is built on the assumption that a module can provide up to eight distinct “functions” which can be accessed using individual address decoders. Many modules provide only one function, but a specification must be flexible enough to accommodate the most complex cases (preferably without penalty for the simple cases). This specification allows a module designer to encode in CR, for up to eight functions, the data transfer sizes and AM and/or XAM codes it supports, and the bits its address decoder can compare (which implies the required allocation size). It must provide corresponding CSRs to allow programming of each function’s base address. The specification also allows for a function’s allocation size to be dynamic and provide multiple “access windows”, without penalty for implementations not requiring these advanced features. Each function requires a set of CRs (DAWPR, AMCAP, XAMCAP, and ADEM) defined below, and one CSR (ADER) defined in 10.2.2.2.

Observation 10.2:

In some designs, the VME interface needs to be initialized and loaded with parameters, including the BAR. Clearly if the module was addressed before the interface was ready to respond, a BERR would occur. A good module design should ensure that if the VME interface is ready to respond, then all of the CR/CSR addresses are functional and contain valid information. A way to do this in a module design is to disable the VME interface until the module is initialized. If CR/CSR capability is implemented, it could be done starting the initialization with a BAR load of 0 (invalid) to ensure the interface is disabled, followed by module initialization, then interface initialization. The last step of the interface initialization would be to load the correct BAR and finally enable the interface.

10.2.1.4.1 Data Access Width ParameteRs (DAWPRs) Definition

In the Defined CR Area, one Data Access Width Parameter (DAWPR) is assigned to each possible function. These parameters occupy one byte and specify the maximum data transfer bus width the function offers, as shown in Table 10-3.

Table 10-3: Data Access Width Parameter (DAWPR) Definitions

Value	Function
0x00	Feature not implemented
0x01 ... 0x80	Reserved
0x81	Accepts D08(O) cycles only
0x82	Accepts D08(E0) cycles only
0x83	Accepts D16 or D08(E0) cycles
0x84	Accepts D32, D16 or D08(E0) cycles
0x85	Accepts MD32, D16 or D08(E0) cycles
0x86 ... 0xFE	Reserved for future use
0xFF	Not to be used

Rule 10.6:

All implemented Data Access Width Parameters (DAWPRs) shall reside in the locations specified in Table 10-12 and adhere to the definitions in Table 10-3.

Recommendation 10.1:

The indications of support for UAT, RMW, ADOH and Retry are provided in the Slave Characteristics Parameter (Table 10-1). The fact that these are indicated in a single parameter rather than in each DAWPR implies that all functions should provide the same support for these features. This should not be a limitation, because these features are part of the data transfer logic rather than the address decoding.

10.2.1.4.2 AM Capabilities Parameters (AMCAPs)

There are 64 possible AM codes with values from 0x00 to 0x3F. The eight AM Capabilities Parameters (AMCAPs) in the Defined CR Area are 8 bytes wide, providing a 64-position bit-mask. Each bit, when set, indicates that the function can respond to the AM code associated with the position of the bit. For example, the AMCAP (0x00,00,00,01,00,00,08,00) indicates support for AM codes 32 (0x20) and 11 (0xB), because bits 32 and 11 are set. A master reading this parameter can determine all of the address spaces recognized by the function, as well as the block transfer and multiplexed block transfer capabilities of those functions.

Rule 10.7:

All implemented AMCAPs shall reside in the locations specified in Table 10-12 and follow the 64-position bit-mask, where each bit represents the respective implementation of an AM code.

Rule 10.8:

The AM code for CR/CSR Space (0x2F) shall not be set in any AMCAPs, because the corresponding address space relocation is realized by other mechanisms previously defined.

10.2.1.4.3 XAM Capabilities Parameters (XAMCAPs)

Extended Address Modifier Codes are described in Chapter 11 of this document. There are 256 possible extended AM codes with values from 0x00 to 0xFF. The eight XAM Capabilities Parameters (XAMCAPs) in the Defined CR Area are 32 bytes wide, providing a 256-position bit-mask. As with the AMCAPs, each set bit indicates that the function can respond to the Extended AM code associated with the position of the bit. For example, the XAMCAP (0x00,...,04) indicates support for XAM code 2, because bit 2 is set.

Rule 10.9:

All implemented XAMCAPs shall reside in the locations specified in Table 10-12 and follows the 256-position bit-mask, where each bit represents the respective implementation of an XAM code

Rule 10.10:

Functions implementing the “6U” versions of XAM codes shall indicate this by setting the bit for AM code 0x20 in the AMCAP, and the supported XAM code(s) in the XAMCAP. Functions implementing the “3U” versions shall indicate this by setting the bit for AM code 0x21 in the AMCAP, and the supported XAM code(s) in the corresponding XAMCAP. A single function (or window to a function) shall not implement both.

Observation 10.3:

Each set of DAWPR, AMCAP and XAMCAP fully specifies a function’s basic data transfer, BLT and MBLT capabilities.

10.2.1.4.4 Address Decoder Masks (ADEMs)

Address DEcoder Masks (ADEMs) are 32 bits wide, as are the Address DEcoder compaRe registers (ADERs) associated with them in the Defined CSR Area (see 10.2.2.2). Provision is also made for 64-bit decoding; see the table below. The lower eight bits of an ADEM are reserved for special purposes, implying that no less than 256 bytes can be allocated to a function. The remaining bits are the Mask value, indicating which bits in the address the function is capable of comparing for decoding purposes. The contents will be a contiguous field of 1’s (binary) starting at the Most Significant Bit and continuing to the Least Significant Bit in the decoder. The remaining 0’s continuing to bit 8 then indicate the internal addresses the function will use. This is a “lazy” address decoding scheme, because all functions must be allocated a size which is a power of two, even if they actually use less. This makes hardware implementation simpler, and the use of extra addresses is deemed acceptable given the large addressing ranges of modern systems. Table 10-4 shows the definitions of all bits in a given ADEM.

Table 10-4: Address Decoder Mask (ADEM) Definitions

Bit(s)	Mnemonic	Description
31:24	M[31:24]	Mask bits 31-24
23:16	M[23:16]	Mask bits 23-16
15:8	M[15:8]	Mask bits 15-8
7:4	RESERVED	Reserved for future use; will be read as zero
3	FAF	Fixed-Address Function; a 1 here means the function’s ADER is not programmable. See 10.2.2.2.
2	DFS	Dynamic Function Sizing; a 1 here means the mask bits above are not valid because the function’s size is dynamic. See 10.2.2.2.
1	EFD	Extra Function Decoder; a 1 here means the next ADEM provides another decoder for the same function rather than another function.
0	EFM	Extra Function Mask; a 1 here means the next ADEM provides the upper bits’ mask for a 40-bit or 64-bit decoder. In this case, the next ADEM does NOT following the encoding in this table.

The AMCAPs and XAMCAPs for a function imply the decoder’s supported address sizes, and therefore the valid bits in the mask. A 40-bit or 64-bit decoder must use an extra ADEM for

its upper 8 or 32 bits (denoted by setting the “EFM” bit as shown in the table). Generally, a decoder will support only one address size (A16, A24, A32, A40 or A64). When a decoder can decode multiple address sizes, 1’s are to be specified in the upper bits for the largest size it can decode.

Rule 10.11:

All implemented ADEMs shall reside in the locations specified in Table 10-12 and follow the format given in Table 10-4, except those whose immediately-preceding ADEM has its “EFM” bit set. Such ADEMs shall provide M[63:32] (mask bits 63 through 32).

Observation 10.4:

Providing the greatest number of address decoding bits possible will give the greatest flexibility when system addresses are assigned.

Table 10-5 shows some examples of DAWPR/AMCAP/XAMCAP/ADEM combinations. The example module defines the following: two decoders to its first function, capable of decoding the upper 15 bits in an A32 non-privileged address and providing basic D32, BLT, and MBLT transfer capability; plus a single 64-bit decoder for its other function, capable of decoding the upper 40 bits in an A64 address on 2eVME. This requires 4 sets of parameters.

Observation 10.5:

Software is not to attempt to program an ADEM with address in the CR/CSR Space, because the setting of the CR/CSR base address and size is already specified using other mechanisms.

Table 10-5: Address Relocation CR Examples

DAWPR	AMCAP MSB..LSB	XAMCAP MSB..LSB	ADEM	Description
0x84	0x00,00,00,00, 00,00,0F,00	0x0 .. 0x0	0xFFFE0002	Can respond to AM codes 0x8-0xB, D32, decodes upper 15 bits (requires 128KB space)
0x84	0x00,00,00,00, 00,00,0F,00	0x0 .. 0x0	0xFFFE0000	Second window to same function as above
0x84	0x00,00,00,01, 00,00,00,00	0x0 .. 0x4	0xFF000001	Can respond to AM 0x20, XAM 0x2, decodes upper 40 bits (requires 16MB space)
0x0	0x0 .. 00	0x0 .. 0x0	0xFFFFFFFF	“extended ADEM” for 64-bit decoder

10.2.1.5 Master Addressing Capabilities

In order to allow a system monarch to discover the addressing capabilities of other masters in a system, a single set of Master Addressing Capabilities (MADCAPs) are defined, in the form of another DAWPR, AMCAP, and XAMCAP indicating which data transfer sizes, AM codes and XAM codes the master can drive. Also, the Master Characteristics Parameter (see 10.2.1.2) indicates the master’s ability to initiate UAT, RMW, and other special cycles. It is not feasible to invent a complete description of all possible address-map configurations for all masters, so the MADCAPs simply allow discovery of the master’s general capabilities, which might not be applicable for all the master’s possible maps. This allows a monarch to configure slaves in such a way that at least the masters with flexible maps can access them.

Rule 10.12:

If implemented, the MADCAPs (DAWPR, AMCAP and XAMCAP) shall reside in the locations specified in Table 10-12 and follow the formats given in 10.2.1.4.1, 10.2.1.4.2, and 10.2.1.4.3.

10.2.2 The Defined CSR Area

The Defined CSR Area, which was specified from 0x7FFF0 through 0x7FFFF in the VME64 Standard, is now expanded to offset addresses 0x7FC00 through 0x7FFFF for a total of 256 usable locations. The locations from 0x7FF53 to 0x7FFFF are specified in Table 10-13.

Rule 10.13:

The VME64x Defined CSR Area shall be from offset address 0x7FC00 to 0x7FFFF. These locations can only be used as specified in this VME64x document. All bytes in this Defined CSR Area which are not specified are reserved for future use.

Rule 10.14:

All unimplemented locations in the Defined CSR Area shall read as 0x00.

10.2.2.1 Additions to the Bit Set and Bit Clear Registers

Table 10-6 lists the VME64 and VME64x bit assignments for the Bit Set Register. Table 10-7 lists the VME64 and VME64x bit assignments for the Bit Clear Register. Bits have been added for:

- 1) Enabling the module's decoders associated with the Address Space Relocation.
- 2) Reporting on the issuance of the BERR* signal.
- 3) Reporting on the ownership of the module's CRAM (if implemented).

Also, user-defined Bit Set and Bit Clear registers have been added as a convenient place for module-specific features requiring this type of programming.

Table 10-6: Bit Set Register Assignment

Bit	Value	Write	Read	Relevant Standard
7	1	place module in reset mode	module in reset mode	VME64
	0	no effect	module not in reset mode	
6	1	enable SYSFAIL driver	SYSFAIL driver enabled	VME64
	0	no effect	SYSFAIL driver disabled	
5	1	set module fail (test only)	module failed	VME64
	0	no effect	module not failed	
4	1	enable module	module enabled	VME64x
	0	no effect	module disabled	
3	1	set BERR* flag	module issued BERR*	VME64x
	0	no effect	module did not issue BERR*	
2	1	set CRAM_OWNER (test only)	CRAM owned	VME64x
	0	no effect	CRAM available	
1	1	reserved	reserved	
	0	no effect	reserved	
0	1	reserved	reserved	
	0	no effect	reserved	

Table 10-7: Bit Clear Register Assignment

Bit	Value	Write	Read	Relevant Standard
7	1	remove module from reset mode	module in reset mode	VME64
	0	no effect	module not in reset mode	
6	1	disable SYSFAIL driver	SYSFAIL driver enabled	VME64
	0	no effect	SYSFAIL driver disabled	
5	1	clear module fail	module failed	VME64
	0	no effect	module not failed	
4	1	disable module	module enabled	VME64x
	0	no effect	user defined	
3	1	clear BERR* flag	module issued BERR*	VME64x
	0	no effect	module did not issue BERR*	
2	1	clear CRAM_OWNER	CRAM owned	VME64x
	0	no effect	CRAM available	
1	1	reserved	reserved	
	0	no effect	reserved	
0	1	reserved	reserved	
	0	no effect	reserved	

Rule 10.15:

Writes to the Bit Set Register with bit 4 set shall enable the module's address decoding to the functions supporting Address Space Relocation as defined in 10.2.1.3 and 10.2.2.2. Writes to the Bit Clear Register with bit 4 set shall disable this address decoding. Upon reads, bit 4 of either the Bit Set or Bit Clear Register shall indicate the current status (0 for disabled, 1 for enabled) of this address decoding.

Rule 10.16:

When a module generates BERR* for any reason, it shall set the "BERR* Generated" status true. Reads of either the Bit Set or Bit Clear Register shall indicate the current status in bit 3 (0 for false, 1 for true). The "BERR* Generated" Status shall be cleared on reset and power up and upon writes to the Bit Clear Register with bit 3 set.

Observation 10.6:

A slave module is not prepared to be addressed until the ADER registers have been set. After this has been done, the master or monarch establishing system addresses and programming module's ADER registers should then set bit 4 of the Bit Set Register True.

Rule 10.17:

When the CRAM_OWNER register in Defined CSR contains a non-zero value, "CRAM Owned" is true. Reads of either the Bit Set or Bit Clear Register shall indicate the state of "CRAM Owned" in bit 2 (0 for false, 1 for true). Writes to the Bit Set Register with bit 2 set shall have no effect. "CRAM Owned" shall be cleared upon a write to the Bit Clear Register with bit 2 set.

Recommendation 10.2:

Due to the inherently unique behavior of Bit Set/Clear register pairs, a user-defined pair is included so that software will know to expect this behavior at these particular addresses. Therefore, if a module implements additional functions requiring bit set and bit clear programming, it should define bits in these locations for this purpose.

10.2.2.2 Address DEcoder compaRe (ADER) Registers

One set of CSRs is required to work in conjunction with the CRs specified earlier, in order to provide Address Space Relocation. These are Address DEcoder compaRe (ADER) registers. Software programs a value for a function's address decoder to compare a bus address against (after masking). A successful comparison results in selection of the function. Up to eight ADERs can be provided, each corresponding to one set of DAWPR, AMCAP, XAMCAP, and ADEM in CR. Table 10-8 shows the format of an ADER.

Table 10-8: Address Decoder compaRe (ADER) Register Definition

Bit(s)	Mnemonic	Description
31:24	C[31:24]	Compare bits 31-24
23:16	C[23:16]	Compare bits 23-16
15:10	C[15:10]	Compare bits 15-10
9:8	C[9:8] or XAM[7:6]	If the "XAM" bit (see below) is 0, this field contains compare bits 9-8. If the "XAM" bit is 1, this field contains XAM bits 7-6.
7:2	AM[5:0] or XAM[5:0]	If the "XAM" bit (see below) is 0, this field contains an AM code. If the "XAM" bit is 1, this field contains XAM bits 5-0.
1	DFSR	Dynamic Function Size Read. If dynamic function sizing is supported, when this bit is written with a 1, the implementation must latch its actual ADEM value into the C bits for subsequent reading. The writer is responsible for restoring the ADER, which includes writing this bit with a 0.
0	XAM	XAM mode. When 0, the decoder should respond to the AM code programmed in bits 7-2. When 1, it needs to respond to the XAM code set in bits 9-2, using whichever AM code (0x20 or 0x21) the function specified in its AMCAP.

Note that for XAM codes, the actual "granularity" for address decoding (the minimum possible allocation size for a function) is actually 1024 bytes, while for "normal" AM codes, it is 256 bytes. Since the protocols using XAM codes do not provide for A16 or A24, this resolution needs to be acceptable for them.

Rule 10.18:

All implemented ADERs shall reside in the locations specified in Table 10-13 and implement the functionality given in Table 10-8, except those implementing the upper compare bits for a 40-bit or 64-bit decoder (see Rule 10.11).

Rule 10.19:

For each implemented ADEM in CR (one whose value is non-zero), a corresponding ADER shall be implemented.

Observation 10.7:

Up to eight distinct address spaces (i.e., Function 0 through 7) can be accessed, but the maximum number of functions is reduced when multiple ADEM/ADER combinations are implemented for the same address space..

Rule 10.20:

A module which implements VME64x-compliant Address Space Relocation shall obey Rules 10.6 through 10.11, and 10.15, 10.18, and 10.19.

Recommendation 10.3:

Modules should implement Address Space Relocation for as many functions as possible.

Recommendation 10.4:

If a function does not implement Address Space Relocation, the implementation of a read only Address Decoder compaRe (ADER) register is allowed (i.e. to latch a switch setting). This facilitates mapping around a hardware-fixed-address function. In this case, the function's ADEM should have its "FAF" bit set to indicate this.

Recommendation 10.5:

For some functions, it might be desirable or necessary to provide dynamic sizing. That is, the size of a function might not be static, and therefore cannot be in CR. In this case, the implementation should set the "DFS" bit in the corresponding ADEM in CR, and implement the behavior defined for the ADER's "DFSR" bit as described in Table 10-8.

Observation 10.8:

The Address Space Relocation CRs (AMCAPs, XAMCAPs, DAWPRs and ADEMs) allow a board to "present" its capabilities, while the CSRs (ADERS) allow software to select a subset to actually use at a given time.

Rule 10.21:

Software shall not attempt to program an ADER with the CR/CSR Space AM code (0x2F), because modules providing VME64x-compliant Address Space Relocation implicitly support it. Furthermore, setting of the CR/CSR base address is already specified using other mechanisms.

Recommendation 10.6:

The AM codes for the lock commands (and potentially some user-defined AM codes) denote special features rather than actual data transfer capability. Applications should allow presentation of these capabilities, but it would be of limited usefulness to program an ADER to respond to such a code.

Permission 10.3:

The "special" AM codes which do not denote actual data transfer capability may be set in an AMCAP to denote a function's support for them.

Recommendation 10.7:

When Permission 10.3 is taken, a function should respond to the special AM code(s) without requiring them to be explicitly programmed in the ADER.

Table 10-9 shows some examples of ADEM/ADER combinations, with the ADEM values taken from Table 10-5.

Table 10-9: Address Relocation CR/CSR Examples

ADEM	ADER	Description
0xFFFFE002	0x42200024	Programmed to respond to AM code 9 starting at address 0x42200000
0xFFFFE000	0x4222002C	Programmed for AM code 0xB starting at address 0x42220000
0xFF000001	0x00000009	Programmed for XAM code 2 starting at address 0x8000111100000000
0xFFFFFFFF	0x80001111	Programming for upper 32 bits of above

10.2.3 The User CR Area

The optional User CR Area is ROM that appears in a VME64x module's CR/CSR Address Space. It is set aside by a module vendor for extra module-specific data. Generally it will be located in the area just above the Defined CR Area and is usually composed of additional space within the same ROM used to implement the Defined CR Area. The VME64 Standard specifies a Configuration ROM data access width parameter indicating how the User CR Area can be accessed. This chapter specifies two Defined CR parameters for the purpose of locating the User CR Area in a module's CR/CSR Space. `BEG_USER_CR` defines the beginning of the User CR Area by specifying an offset to the address of its first byte.

END_USER_CR defines the end of the User CR Area by specifying an offset to the address of its last byte. Each module contains its own set of CR pointers and user areas.

Observation 10.9:

Implementation of a User CR Area is optional.

Rule 10.22:

If no User CR Area is implemented, then the BEG_USER_CR and END_USER_CR pointers shall be set to zero.

Rule 10.23:

BEG_USER_CR shall always be less than or equal to END_USER_CR.

Observation 10.10:

END_USER_CR points to the last useable byte in the User CR Area. The number of bytes in the User CR Area can be calculated by subtracting BEG_USER_CR from END_USER_CR, dividing by one, two or four as determined by the Configuration ROM Data Access Width parameter and then adding one.

10.2.4 The Configuration RAM (CRAM) Area

The optional CRAM Area is either excess RAM or specifically implemented RAM located between the Defined CR and Defined CSR areas. It is a new feature of CR/CSR space and its contents and use are intended to be completely user defined. Three parameters in the Defined CR Area are specified to locate and access CRAM in a module's CR/CSR Space. CRAM_ACCESS_WIDTH defines how CRAM will be accessed. Its format is specified in Table 10-10. BEG_CRAM defines the beginning of CRAM by specifying an offset to its first byte. END_CRAM defines the end of CRAM by specifying an offset to its last byte. These three Defined CR parameters refer only to the CR/CSR Space of the module in which they are physically contained.

Rule 10.24:

The contents of the CRAM data access width location shall be as in Table 10-10.

Table 10-10: CRAM_ACCESS_WIDTH Definition

Value	Function
0x00	Not to be used
0x01 ... 0x80	Reserved
0x81	Only use D08(O), every fourth byte
0x82	Only use D08(O), every other byte
0x83	Use D16 or D08(E0), every byte used
0x84	Use D32, D16 or D08(E0), every byte used
0x85 ... 0xFE	Reserved for future use
0xFF	Not to be used

Observation 10.11:

The CRAM_ACCESS_WIDTH definition is the same as the Configuration ROM data access width and CSR data access width definitions in Table 2-32 of the VME64 Standard.

Rule 10.25:

If a CRAM Area is not implemented, then the BEG_CRAM and END_CRAM pointers shall be set to zero.

Rule 10.26:

BEG_CRAM shall always be less than or equal to END_CRAM.

Observation 10.12:

END_CRAM points to the last useable byte in the CRAM Area. The number of bytes in the area can be calculated by subtracting BEG_CRAM from END_CRAM, dividing by one, two or four as determined by CRAM_ACCESS WIDTH and then adding one.

The CRAM_OWNER Register is 1 byte in the Defined CSR Area used to allow a master, through a software protocol, to identify itself as the owner of the CRAM contents. The register uses a hardware-supported semaphore scheme to reliably allow a master to acquire access to the CRAM_OWNER Register, even if it does not have Read-Modify-Write Capability or the ability to maintain bus mastership under software control. To support the semaphore protocol the register must conditionally change its response when the register contains a non-zero value. The register works in conjunction with the Bit Clear Register in the Defined CSR Area.

Rule 10.27:

The CRAM_OWNER register shall operate in the following way:

- 1) After reset the CRAM_OWNER register shall be guaranteed to be zero. This state means the semaphore is available, which means the CRAM is available.
- 2) Writing to the CRAM_OWNER register when it contains a non-zero value shall not change the value of the CRAM_OWNER register. This allows the first master that writes a non-zero value to acquire ownership.
- 3) A master wishing to acquire exclusive access to CRAM shall write its unique ID code to the CRAM_OWNER register. The master then reads CRAM_OWNER. If the code read is his, he has acquired ownership. Otherwise, some other master acquired ownership first and is identified by the ID code read.
- 4) Ownership shall be released by writing any value with bit 2 (2²) set (e.g. 0x04) to the CSR Bit Clear Register located at 0x7FFF7. This clears the CRAM_OWNER register and leaves it with a value of zero and also clears the CRAM owned status.

Observation 10.13:

Bit 2 of the Defined CSR Bit Clear and Bit Set Registers also indicates if the CRAM has an owner. This is another way of determining if CRAM is available, in addition to checking that CRAM_OWNER is not equal to zero.

Recommendation 10.8:

It is recommended that ID codes numbered from 1 to 31 mean “module with this geographical address”. The remaining codes from 32 to 255 are to be defined by system software.

10.2.5 The User CSR Area

The User CSR Area is a natural place to locate the design-specific control and status registers required for a module. It could be logic within a Field Programmable Gate Array that also implements the Defined CSR Area registers within the module or could be RAM. User CSR provides both read and write access. Generally it will be located in the area just below the Defined CSR Area. The VME64 Standard specifies a CSR data access width parameter indicating how the User CSR Area can be accessed. This chapter specifies two Defined CR parameters for the purpose of locating User CSR in a module's CR/CSR Space. BEG_USER_CSR defines the beginning of the User CSR Area by specifying an offset to its first byte. END_USER_CSR defines the end of the User CSR Area by specifying an offset to its last byte.

Recommendation 10.9:

Although implementation of a User CSR Area is not mandatory, it is recommended that any module-specific Control and Status Registers be implemented there. It puts them in a well-characterized place and simplifies the module's and system's address maps.

Rule 10.28:

If no User CSR Area is implemented, then the `BEG_USER_CSR` and `END_USER_CSR` pointers shall be set to zero.

Rule 10.29:

`BEG_USER_CSR` shall always be less than or equal to `END_USER_CSR`.

Observation 10.14:

`END_USER_CSR` points to the last useable byte in the User CSR Area. The number of bytes in the User CSR Area can be calculated by subtracting `BEG_USER_CSR` from `END_USER_CSR`, dividing by one, two or four as determined by the CSR Data Access Width parameter and then adding one.

10.2.6 Board Serial Number

The VME64 Standard provided for Manufacturer's ID, Board ID and Revision ID parameters within the Defined CR Area. This chapter adds the ability to provide a Board Serial Number which can uniquely identify a module for characterization, calibration, diagnostic or repair purposes. The parameters `BEG_SN` and `END_SN` are defined in Table 10-12 for the purpose of locating the Serial Number within the module's CR/CSR Space. This flexibility of allowing it to be located in a space determined by the module designer is intended to simplify the address decoding required and make the serial number parameter simple to implement. The length of the serial number field is not fixed, but suggested to be 4 bytes.

Recommendation 10.10:

It is recommended that the module serial number capability be provided. This is especially useful when there are hardware-dependent calibrations or characteristics which can be tracked on a module basis. This capability can also facilitate failure analysis and serve other diagnostic purposes when supported with the appropriate software.

Suggestion 10.1:

Four bytes encoded in Hexadecimal format allows for 8 characters and is easily coded and decoded. Table 10-11 shows how the Serial Number A0123456 would be coded and stored.

Table 10-11: Serial Number Example

Address	Definition
Lower	<code>BEG_SN</code> = 0xA0 (note: this is the least significant byte)
	byte 2 = 0x12
	byte 3 = 0x34
Higher	<code>END_SN</code> = 0x56 (note: this is the most significant byte)

Observation 10.15:

Hexadecimal format is easily generated by switch registers and requires fewer bits than ASCII encoding.

Rule 10.30:

When the serial number capability is provided, the implementation shall insure that normal repair or upgrade of the module, including Firmware or PROM upgrades, shall not change this serial number field.

Rule 10.31:

The minimum access width to the Serial Number field from BEG_SN to END_SN shall be through D08(O), with access to every fourth byte.

Observation 10.16:

All addresses which contain Serial Number information must end with 0x3, 0x7, 0xB or 0xF in order to adhere to Rule 10.31.

Rule 10.32:

BEG_SN must always be less than or equal to END_SN.

Observation 10.17:

The BEG_SN and END_SN pointers allow great flexibility in implementation of the serial number capability. The hardware can be of a different type than User CR, CRAM or User CSR and put into an otherwise unused address space. If the serial number field implementation uses the same hardware as one of the above defined spaces it can be located immediately adjacent to the other space.

**Table 10-12: Defined Configuration ROM Assignments
Part 1**

CR Address [MSB LSB]	Content	Size	Relevant Standard
0x03	Checksum	1 byte	VME64
0x07, 0x0B, 0x0F	Length of ROM	3 bytes	VME64
0x13	Configuration ROM data access width	1 byte	VME64
0x17	CSR Data access width	1 byte	VME64
0x1B	CR/CSR Space Specification ID	1 byte	VME64
0x1F	0x43 (ASCII "C")	1 byte	VME64
0x23	0x52 (ASCII "R")	1 byte	VME64
0x27, 0x2B, 0x2F	Manufacturer's ID (IEEE OUI)	3 bytes	VME64
0x33, 0x37, 0x3B, 0x3F	Board ID supplied by manufacturer	4 bytes	VME64
0x43, 0x47, 0x4B, 0x4F	Revision ID supplied by manufacturer	4 bytes	VME64
0x53, 0x57, 0x5B	Pointer to a null terminated ASCII printable string or 0x000000	3 bytes	VME64
0x5F to 0x7B	RESERVED	8 bytes	VME64
0x7F	Program ID code	1 byte	VME64
0x83, 0x87, 0x8B	Offset to BEG_USER_CR	3 bytes	VME64x
0x8F, 0x93, 0x97	Offset to END_ USER_CR	3 bytes	VME64x
0x9B, 0x9F, 0xA3	Offset to BEG_CRAM	3 bytes	VME64x
0xA7, 0xAB, 0xAF	Offset to END_CRAM	3 bytes	VME64x
0xB3, 0xB7, 0xBB	Offset to BEG_USER_CSR	3 bytes	VME64x
0xBF, 0xC3, 0xC7	Offset to END_ USER_CSR	3 bytes	VME64x
0xCB, 0xCF, 0xD3	Offset to BEG_SN	3 bytes	VME64x
0xD7, 0xDB, 0xDF	Offset to END_SN	3 bytes	VME64x
0xE3	Slave Characteristics Parameter, see Table 10-1	1 byte	VME64x
0xE7	User-defined Slave Characteristics	1 byte	VME64x
0xEB	Master Characteristics Parameter, see Table 10-2	1 byte	VME64x
0xEF	User-defined Master Characteristics	1 byte	VME64x
0xF3	Interrupt Handler Capabilities	1 byte	VME64x
0xF7	Interrupter Capabilities	1 byte	VME64x
0xFB	Reserved, Read as zero	1 byte	VME64x
0xFF	CRAM_ACCESS_WIDTH, see Table 10-10	1 byte	VME64x
0x103	Function 0 Data Access Width DAWPR, see Table 10-3	1 byte	VME64x
0x107	Function 1 Data Access Width	1 byte	VME64x
0x10B	Function 2 Data Access Width	1 byte	VME64x
0x10F	Function 3 Data Access Width	1 byte	VME64x
0x113	Function 4 Data Access Width	1 byte	VME64x
0x117	Function 5 Data Access Width	1 byte	VME64x
0x11B	Function 6 Data Access Width	1 byte	VME64x
0x11F	Function 7 Data Access Width	1 byte	VME64x

**Table 10-12: Defined Configuration ROM Assignments
Part 2**

CR Address [MSB LSB]	Content	Size	Relevant Standard
0x123 ... 0x13F	Function 0 AM Code Mask AMCAP, see Table 10-5	8 bytes	VME64x
0x143 ... 0x15F	Function 1 AM Code Mask	8 bytes	VME64x
0x163 ... 0x17F	Function 2 AM Code Mask	8 bytes	VME64x
0x183 ... 0x19F	Function 3 AM Code Mask	8 bytes	VME64x
0x1A3 ... 0x1BF	Function 4 AM Code Mask	8 bytes	VME64x
0x1C3 ... 0x1DF	Function 5 AM Code Mask	8 bytes	VME64x
0x1E3 ... 0x1FF	Function 6 AM Code Mask	8 bytes	VME64x
0x203 ... 0x21F	Function 7 AM Code Mask	8 bytes	VME64x
0x223 ... 0x29F	Function 0 XAM Code Mask XAMCAP, see Table 10-5	32 bytes	VME64x
0x2A3 ... 0x31F	Function 1 XAM Code Mask	32 bytes	VME64x
0x323 ... 0x39F	Function 2 XAM Code Mask	32 bytes	VME64x
0x3A3 ... 0x41F	Function 3 XAM Code Mask	32 bytes	VME64x
0x423 ... 0x49F	Function 4 XAM Code Mask	32 bytes	VME64x
0x4A3 ... 0x51F	Function 5 XAM Code Mask	32 bytes	VME64x
0x523 ... 0x59F	Function 6 XAM Code Mask	32 bytes	VME64x
0x5A3 ... 0x61F	Function 7 XAM Code Mask	32 bytes	VME64x
0x623 ... 0x62F	Function 0 Address Decoder Mask ADEM, see Table 10-4	4 bytes	VME64x
0x633 ... 0x63F	Function 1 ADEM	4 bytes	VME64x
0x643 ... 0x64F	Function 2 ADEM	4 bytes	VME64x
0x653 ... 0x65F	Function 3 ADEM	4 bytes	VME64x
0x663 ... 0x66F	Function 4 ADEM	4 bytes	VME64x
0x673 ... 0x67F	Function 5 ADEM	4 bytes	VME64x
0x683 ... 0x68F	Function 6 ADEM	4 bytes	VME64x
0x693 ... 0x69F	Function 7 ADEM	4 bytes	VME64x
0x6A3	Reserved, read as zero	1 byte	VME64x
0x6A7	Reserved, read as zero	1 byte	VME64x
0x6AB	Reserved, read as zero	1 byte	VME64x
0x6AF	Master Data Access Width DAWPR, see Table 10-3	1 byte	VME64x
0x6B3 ... 0x6CF	Master AM Capability AMCAP, see Table 10-5	8 bytes	VME64x
0x6D3 ... 0x74F	Master XAM Capability XAMCAP, see Table 10-5	32 bytes	VME64x
0x753 ... 0xFFFF	RESERVED	555 bytes	VME64x

Table 10-13: Defined Control/Status Register (CSR) Assignments

CSR Address [MSB LSB]	Content	Size	Relevant Standard
0x7FFFF	CR/CSR (BAR) Base Address Register	1 byte	VME64
0x7FFFB	Bit Set Register see Table 10-6	1 byte	VME64
0x7FFF7	Bit Clear Register see Table 10-7	1 byte	VME64
0x7FFF3	CRAM_OWNER Register	1 byte	VME64x
0x7FFE7	User-Defined Bit Set Register	1 byte	VME64x
0x7FEB	User-Defined Bit Clear Register	1 byte	VME64x
0x7FE3 ... 0x7FE7	RESERVED	2 bytes	VME64x
0x7FD3 ... 0x7FDF	Function 7 ADER see Table 10-8	4 bytes	VME64x
0x7FC3 ... 0x7FCF	Function 6 ADER	4 bytes	VME64x
0x7FB3 ... 0x7FBF	Function 5 ADER	4 bytes	VME64x
0x7FA3 ... 0x7FAF	Function 4 ADER	4 bytes	VME64x
0x7F93 ... 0x7F9F	Function 3 ADER	4 bytes	VME64x
0x7F83 ... 0x7F8F	Function 2 ADER	4 bytes	VME64x
0x7F73 ... 0x7F7F	Function 1 ADER	4 bytes	VME64x
0x7F63 ... 0x7F6F	Function 0 ADER	4 bytes	VME64x
0x7FC00 ... 0x7FF5F	RESERVED	216 bytes	VME64x

Chapter 11

2eVME Protocol

11.1 Introduction

The 2eVME (**2** edge **VME**) transactions add four important features to the VME64 and VME64x architectures:

1. Theoretical doubling of the peak block data rate to 160 MB/sec
2. Master and slave terminated 2eVME transfers
3. Reduced number of address modes
4. Room to add more features in the future

This protocol will work with either the 96 pin connector on VME64 backplanes or the 160 pin connectors on VME64x backplanes. Just this feature (capability) can be added to VME64 boards and systems. The product can't be called VME64x, but can be marketed as VME64 with 2eVME capability.

11.1.1 2 Edge Handshakes

The method being used to double VME64 and VME64x's backplane performance is a two edge handshake for each data transfer. VME64 transfers use a four edge handshake for each data transfer. With a tightening of the timing parameters, and by making the timing more technology independent, the peak data transfer rate can be doubled to one transfer every 50 nsec, instead of 100 nsec. This translates to a peak block data transfer rate of 160 MB/sec (eight bytes per transfer on a 64 bit bus). For 3U boards, the peak rate is 80 MB/sec with 32 bit transfers.

11.1.2 Address Phases

In order to speed up the address phase, like the data phases, two edge handshakes are also employed. All 2eVME address broadcasts are split into three phases, address phase 1, address phase 2 and address phase 3. Three times as much information can be transferred during the address phase as compared to VME64 address phases.

11.1.3 Remapping the LWORD* Line

In the VME64 standard, the LWORD* signal line is used as a data transfer signal line, during 64 bit data transfers. The LWORD* line is redefined as address bit 0, A[0]. This effectively provides a full 32 bit address bus, labeled A[31:0] and reflects the usage of the line.

11.1.4 Extended AM Codes

Since there are only a few unassigned address modifier codes left, an extended address modifier (XAM) coding scheme is used. AM Code 0x20 is assigned for 6U 2eVME transfers and AM Code 0x21 is assigned for 3U 2eVME transfers. The eight LSB (least significant bits) of the address field A[7:0] are used to carry the extended address modifier code information during the first address phase. See Table 11-1, which maps the address lines to the extended AM code field. With 8 bits, 256 additional address modifier codes are available for each of the 6U and 3U 2eVME transaction sets.

The initial 2eVME definition defines two address modes for 6U boards (Table 11-2) and two address modes for 3U boards (Table 11-3). With 256 possible extended AM codes for each board size the extended address addition leaves plenty of room for future expansion.

Table 11-1 Extended Address Modifier Line Definitions

A7	A6	A5	A4	A3	A2	A1	A0
XAM7	XAM6	XAM5	XAM4	XAM3	XAM2	XAM1	XAM0

Table 11-2 6U 2eVME Extended Address Modifier Codes

XAM Code	Function
00	Reserved
01	A32/D64 2eVME Transfer
02	A64/D64 2eVME Transfer
03-FF	Reserved

Table 11-3 3U 2eVME Extended Address Modifier Codes

XAM Code	Function
00	Reserved
01	A32/D32 2eVME Transfer
02	A40/D32 2eVME Transfer
03-FF	Reserved

11.1.5 Address Modes

For 6U VME64x boards, the 2eVME block data transfers are sized at 64 bits, or 8 bytes per transfer. One address range is defined for A32 type transactions and another for A64 type transactions. Usage of the supervisory / non-privileged and the program / data sub-modes are no longer necessary, with the very large A64 address range. This will most likely provide enough space to map the memory into special functional groups, if that is required by the specific application.

For 3U VME64x boards or those VME64x boards with only a P1/J1 connector, two address ranges are defined: A32 and A40.

11.1.6 Known Length 2eVME Transfers

With many of the new microprocessors that employ caching architectures, as well as DMA controllers, the size of the data being written or requested via a read is known in advance. This size information is presented during address phase two. Address lines A[15:8] are used to carry the beat count. This effectively informs the slave in advance of the amount of data that it is requested to receive in a write transaction or the amount of data it is to supply in a read request. The beat count ranges from 0 to 256 data beats.

All 6U block data transfers are performed with 64 bit data words (eight bytes per transfer). The beat count field is a count of the number of 8 byte transfers, ranging from 1 to 256 transfers. For 6U 2eVME transactions, a maximum of 2 KB can be transferred in a single block. For 3U all 2eVME transactions, the maximum is 1 KB. As with the VME64 MBLT transfers, no 6U 2eVME transaction can cross a 2 KB boundary, and no 3U 2eVME transaction can cross a 1 KB boundary.

The Beat Count field represents a maximum transmission value for the transfer, not the absolute expected size. Hence, boards doing pre-fetching based upon this value have no guarantee that all pre-fetched data will be transferred.

11.1.7 Slave Terminated 2eVME Transfers

In some applications, I/O boards collect a random amount of data, ranging from zero bytes to many kilobytes. Masters reading this data from the slave have no prior knowledge as to the amount of data being retrieved. Slaves can terminate the block transfer at any time. A Master which expects a Slave termination is advised to put the maximum block size that it can receive in the Beat Count bits in the second address phase.

The 6U Slaves indicates this termination by asserting RETRY* and then asserting BERR*. The 3U Slaves indicates this termination by asserting RESP* and then asserting BERR*. This termination method tells the Master that the Slave has no more data and is not expecting a resumption of that transfer.

11.1.8 Slave Suspended 2eVME Transfers

Large 2eVME transfers can be divided into smaller blocks by the slave, simply by terminating the block transfer after a few transfers. Masters can resume the block transfer at the next logical address. Slaves issuing the suspension indicate to the Master that more data can be transferred, just not at this time.

At times a slave board becomes busy and is unable to service a read or write request. This could be due to the resource, such as a dual port memory, being busy, or possibly its input buffer is still full, or whatever. The slave board can signal the requesting master to retry the transaction a little later. In some applications, the master might not rerun a slave terminated transaction, but just go on to the next task.

This same mechanism also works for deadlock resolution. If a board's master is in the process of trying to access another board's resource through a bridge, and at the same time the other board's master is trying to access the first board's resource via the same bridge, one of the masters must back off. By using the suspend protocol, the bridge between the two buses can request one of the two masters to back off and try again, thereby resolving a possible deadlock situation.

6U Slaves requests that a master suspend a transaction by asserting RETRY* and then toggling DTACK*. 3U Slaves requests that a master suspend a transaction by asserting RESP* and then toggling DTACK*. The suspend termination tells the Master that the Slave is stopping this transaction but is expecting a resumption of that transfer at a later time. Suspended transactions always occur on an even beat count

11.1.9 Slave Error State

Slaves which detect an error can signal this condition to the Master by asserting BERR* in response to a transition of DS0* or DS1*. This is similar to the current BERR* usage in VME.

11.1.10 Master Terminated 2eVME Transfers

By definition, the master controls the size of each block transfer, by specifying the beat count. The 2eVME protocol is designed to allow for early master termination, even before the beat count is reached (decremented to zero). This can be used for a variety of special type applications and situations. When the Master terminates it is always on an even beat count.

11.1.11 2eBTO Bus Time Out Timer

The 2eVME protocol holds one of the data strobes low during the entire data transfer cycle. A block transfer could consist of up to 256 data beats plus the address broadcast phase. If each data beat takes 100 nanoseconds then the total data transfer cycle will be over 25.6 microseconds. This requires the VMEbus BTO delay be set to over 25.6 microseconds.

In many systems, this delay is too long for all bus transactions. A specific bus time out timer is defined for 2eVME block transfers, called 2eBTO(x). The 2eBTO(x) bus timer will time out when the bus transaction takes too long.

11.2 Requirements

11.2.1 Transceivers and Connectors

Rule 11.1:

2eVME boards shall use VITA 2-199x Enhanced Transceiver Logic (ETL) bus transceivers, or equivalent for both high and low going edges on all address, data and control bus signal lines.

Rule 11.2:

System integrators using the 2eVME protocol shall ensure that the proper VME64 or VME64x backplane and boards loaded into the system will allow for monotonic rising and falling bus signals, when driven with VITA 2-199x Enhanced Transceiver Logic (ETL) bus transceivers.

Observation 11.1:

The RESP* signal is in the z row of the 160 pin connector, therefore the 160 pin connector needs to be used to run the 2eVME protocol on 3U boards if the RESP* signal

features is used. 6U boards running the 2eVME protocol can use either the 96 pin or the 160 pin connectors.

11.2.2 Extended AM Codes

Rule 11.3:

All 6U VME64x boards that perform 2eVME transactions shall use AM Code 0x20 and shall use the extended AM Codes as defined in Table 11-2, 6U 2eVME Extended AM Codes.

Rule 11.4:

All 3U VME64x boards that perform 2eVME transactions shall use AM Code 0x21 and shall use the extended AM Codes as defined in Table 11-3, 3U 2eVME Extended AM Codes.

Permission 11.1:

6U VME64x boards may also participate in 3U 2eVME transfers using the applicable AM and XAM Codes defined for 3U 2eVME transfers.

11.2.3 Data Size

Rule 11.5:

The maximum number of data beats shall be 256.

Observation 11.2:

Rule 11.6 limits the data transferred to 2 KB, i.e. 256 beats x 8 bytes in a 6U VME64x board and 1 KB in a 3U VME64x board.

Rule 11.6:

A 6U 2eVME transfer shall not cross a 2 KB boundary and a 3U 2eVME transfer shall not cross a 1 KB boundary.

Rule 11.7:

All address and data lines shall be a logical zero for features which are not implemented or are part of Reserved fields.

Rule 11.8:

The beat count shall be sent in A[15:8] during the second address phase. The value is the number of beats divided by two. For example 0x00 = none, 0x01 = 2 beats, 0x80 = 256 beats.

Rule 11.9:

Beat counts 0x81 through 0xFE shall be reserved.

Observation 11.3:

Since the master can only do even beats for master terminated block transfers the modulo 2 number for the beat count is compatible with the specified operation.

Rule 11.10:

The beat count shall be set to 0xFF as a default value when slave termination is expected and the beat count is unknown.

Permission 11.2:

The slave may use the beat count in a read operation to prefetch the required words and thereby increase performance.

Rule 11.11:

The beat count represents a maximum value only. Slaves shall always be prepared for an early termination by the master during 2eVME transfers.

11.2.4 Protocols - General

Permission 11.3:

Usage of both the RESP* and RETRY* signals is optional by both the master and the slave.

Observation 11.4:

RESP* and RETRY* are used as a qualifier on the meaning of a timing response line.

Observation 11.5:

RESP* is used by 3U boards and RETRY* by 6U boards. 6U master boards must use RESP* when communicating with 3U boards while performing 2eVME transactions.

Rule 11.12:

In 2eVME protocols only one timing (DS*) line shall transition in any one bus cycle except when the transaction is ended.

Rule 11.13:

In 2eVME protocols only one timing response (DTACK* or BERR*) line shall transition in any bus cycle except when the transaction is ended.

Observation 11.6:

The support of slave terminated and slave suspended operations are not mandatory for either masters or slaves.

Recommendation 11.1:

Designs for masters conforming to the VME64x standard should implement slave terminated and slave suspend operations.

Rule 11.14:

The master timeout timer shall be set to "T" (as defined in the VME64x Standard).

Observation 11.7:

The time-out value is one half the bus monitor BTO value. See VME64 Standard for full explanation.

11.2.5 Address Phase Protocol and Timing**Rule 11.15:**

Starting addresses shall be aligned on 16 byte boundaries (i.e. 128 bit aligned).

Rule 11.16:

2eVME address timing shall be as defined in Tables 11-6 and 11-7, as measured at connector on the backplane.

Rule 11.17:

2eVME address protocols shall be as defined in Figures 11-1 through 11-4.

Rule 11.18:

BERR* shall only be asserted on the first or third address phase instead of toggling DTACK*. See Figures 11-3 and 11-4.

Rule 11.19:

DTACK* shall be the only valid responses during address phase 2.

Rule 11.20:

Masters shall ignore the RETRY*/RESP* and BERR* during address phase 2.

Observation 11.8:

Slave terminated and slave suspend operations are not supported during address phase 2. Anomalous behavior can result if these responses are sent.

Observation 11.9:

RETRY* and RESP* are not asserted in the first and second address phases.

Observation 11.10:

If RETRY* or RESP* is asserted before DTACK* is toggled on the third address phase the Master interprets that response as indicating that the Slave is suspending the operation but the Master can expect data when it tries again. This can also be interpreted as a Slave suspend response. See Figure 11-2.

Observation 11.11:

If RETRY* or RESP* is asserted before BERR* is asserted in the third address phase the Master interprets that response as indicating that the Slave has no data and the transfer attempt is to be terminated. See Figure 11-3.

Observation 11.12:

Since the target address is in two parts the target device generates DTACK* during the first phase of the address cycle if that portion of the address is recognized. The lowest

byte of the address comes in the second address phase and therefore cannot be used for the address of the target device. The low byte only specifies an internal address.

Rule 11.21:

Address lines A[20:16] in the second address phase shall provide the GA of the Master as defined in Chapter 3 of this standard. If not implemented the value shall be 0x00.

Observation 11.13:

The GA in the second address phase provides a mechanism to determine the bus master for a particular transaction.

Rule 11.22:

Address lines A[31:24] in the second address phase shall provide a subunit number of the master. If not implemented the value shall be 0x00.

Observation 11.14:

The subunit number provides a mechanism for identifying which part of a master initiated a transaction. In the case of a VME module with several processors it could be the processor number.

11.2.6 Data Phase Protocol and Timing**Rule 11.23:**

2eVME data timing shall be as defined in Tables 11-6 and 11-7, as measured at connector on the backplane.

Rule 11.24:

2eVME data protocols shall be as defined in Figures 11-5 through 11-12.

Observation 11.15:

If RETRY* or RESP* is asserted before DTACK* is toggled during the data phase then the Master interprets that response as indicating that the Slave is suspending the operation but the Master can expect data when it tries again. This can also be interpreted as a Slave busy response. Data was not accepted or sent for that DS1* transition. See Figures 11-6 and 11-10.

Observation 11.16:

If RETRY* or RESP* is asserted before BERR* is asserted during the data phase then the Master interprets that response as indicating that the Slave has no data at that time and is finished. Data was not accepted or sent for that DS1* transition. See Figures 11-7, 11-8, 11-11 and 11-12.

Observation 11.17:

The toggling of DTACK* without the assertion of RETRY* or RESP* during the data phase indicates that the Slave has accepted the read or write data. See Figures 11-5 and 11-9.

Observation 11.18:

The assertion of BERR* without RETRY* or RESP* during the data phase indicates that the Slave has had an error and the data was not accepted or sent for that DS1* transition. See Figures 11-7, 11-8, 11-11 and 11-12.

Recommendation 11.2:

Some bus timers are designed to assert BERR* when DS0* or DS1* has been asserted for greater than a set period, without monitoring the state of DTACK*. In such a case, the bus timer could time-out a 2eVME transfer since DS0* is held low for the duration of the transfer. To avoid this, the bus timer should be set to a value greater than the longest expected 2eVME transfer.

Rule 11.25:

Master and Slave 2eVME state machines shall be robust enough to recover gracefully if BERR* is asserted by the bus timer during a 2eVME transfer.

11.2.7 2eBTO(x) Bus Time Out Timer**Recommendation 11.3:**

It is recommended that the 2eBTO(x) bus time out timer be used in conjunction with the 2eVME protocol.

Rule 11.26:

If implemented, the 2eBTO(x) shall monitor the following signal lines: DS0*, DS1*, and DTACK* lines. The BERR* line shall be driven low after x microseconds when either data strobe is low for longer than x microseconds AND no low to high or high to low transition has occurred on either data strobe or DTACK* for longer than x microseconds. The time out time is set by the system integrator.

Table 11-4 6U VME64x Signal Field Definitions

	Address Phase 1	Address Phase 2	Address Phase 3	Data Phase
AM[5:0]	0x20	0x20	0x20	0x20
A[7:0]	XAM Code (Table 11-2)	Internal Address A[7:0]	Reserved	D[39:32]
A[15:8]	Device Address A[15:8]	Beat Count	Reserved	D[47:40]
A[23:16]	Device Address A[23:16]	A[23:21] = 0 A[20:16] = GA of Master	Reserved	D[55:48]
A[31:24]	Device Address A[31:24]	A[31:24] = Subunit number in Master	Reserved	D[63:56]
D[31:0]	Device Address A[63:32] (= 0 for A32)	Reserved	Reserved	D[31:0]

Table 11-5 3U VME64x Signal Field Definitions

	Address Phase 1	Address Phase 2	Address Phase 3	Data Phase
AM[5:0]	0x21	0x21	0x21	0x21
A[7:0]	XAM Code (Table 11-3)	Internal Address A[7:0]	Reserved	D[23:16]
A[15:8]	Device Address A[15:8]	Beat Count	Reserved	D[31:24]
A[23:16]	Device Address A[23:16]	A[23:21] = 0 A[20:16] = GA of Master	Reserved	Reserved
D[7:0]	Device Address A[31:24]	D[7:0] = Subunit number in Master	Reserved	D[7:0]
D[15:8]	Device Address A[39:32] (= 0 for A32)	Reserved	Reserved	D[15:8]

Table 11-6 2eVME Specific Timing Parameters

Timing Parameter	Description	Source (ns)	Destination (ns)
S1	Address and data setup time	-5 min	-11 min
S2	RESP* to DTACK*/BERR* setup time	35 min	10 min
H1	Address or Data hold time	5 min	5 min
T1	Handshake delay time	0 min	0 min

Table 11-7 VME64 Timing Parameters
(From VME64 Standard - Informative Only)

Timing Parameter	Description	At MASTER (ns)	At SLAVE (ns)
4	IACK*, AM[5:0], & Address valid to AS* assertion setup time	35 min	10
6	Time from DTACK* high to time data lines can be driven by MASTER	0 min	0 min
7	Delay time from data line release to MASTER assertion of DS1* (begin Data Phase)	0 min	0 min
8	Data line setup time to DS0*/DS1*	35 min	10 min
10	Delay time from AS* to first assertion of DS0*/DS1*	0 min	-10 min
12	WRITE* valid to DS0*/DS1* setup time	35 min	10 min
16	IACK* and AM[5:0] hold time from last assertion of DTACK* or BERR*	0 min	0 min
18A	AS* negation time from last DTACK* or BERR*	0 min	0 min
23	WRITE* hold time from last negation of DS0*/DS1*	10 min	0 min
26	Delay from first assertion of DS1* to SLAVE assertion of data lines	0 min	0 min
31	Delay from data line release until SLAVE can drive/release DTACK* or BERR* at end of read data phase	0 min	0 min

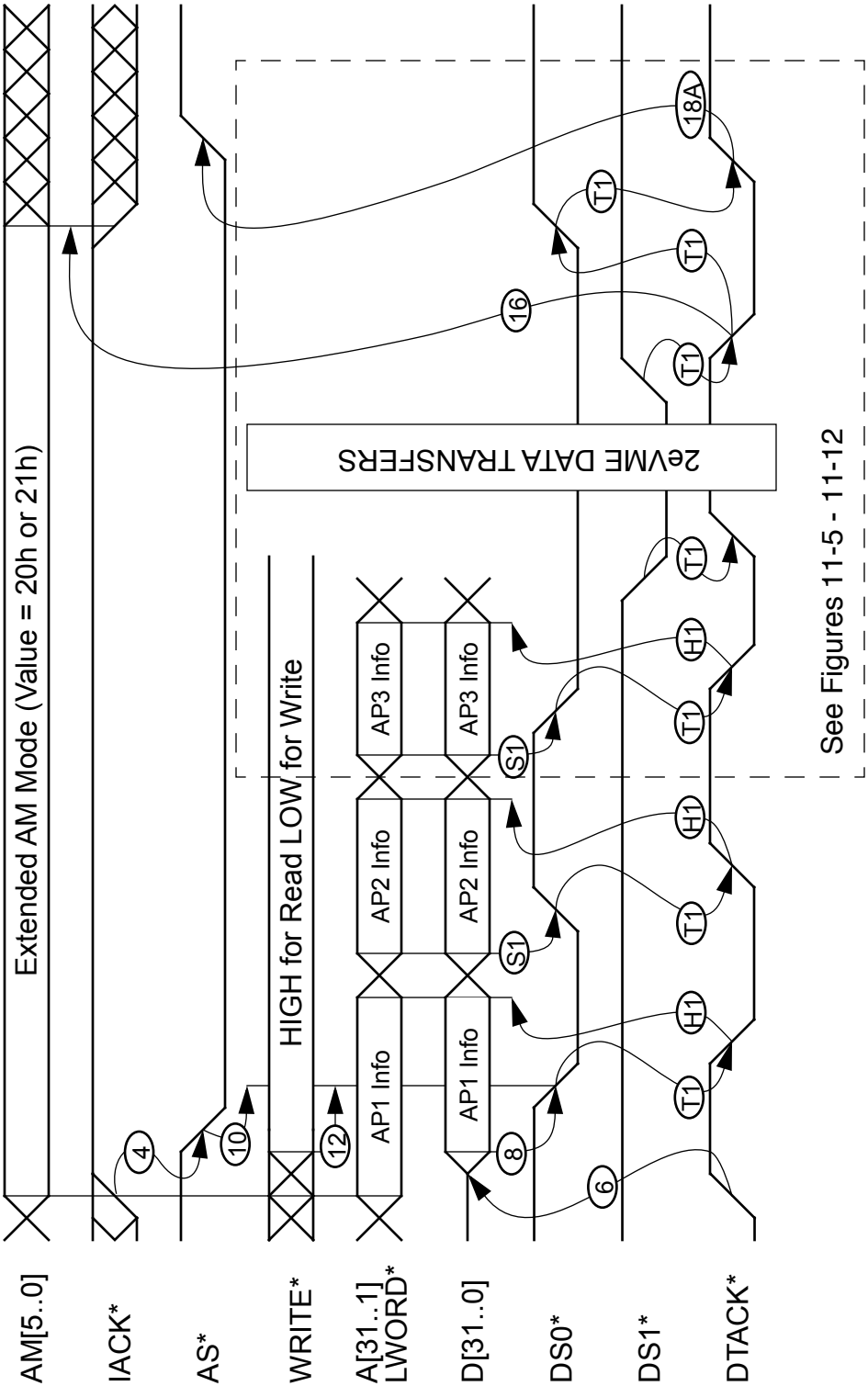


Figure 11-1 2eVME Address Broadcast

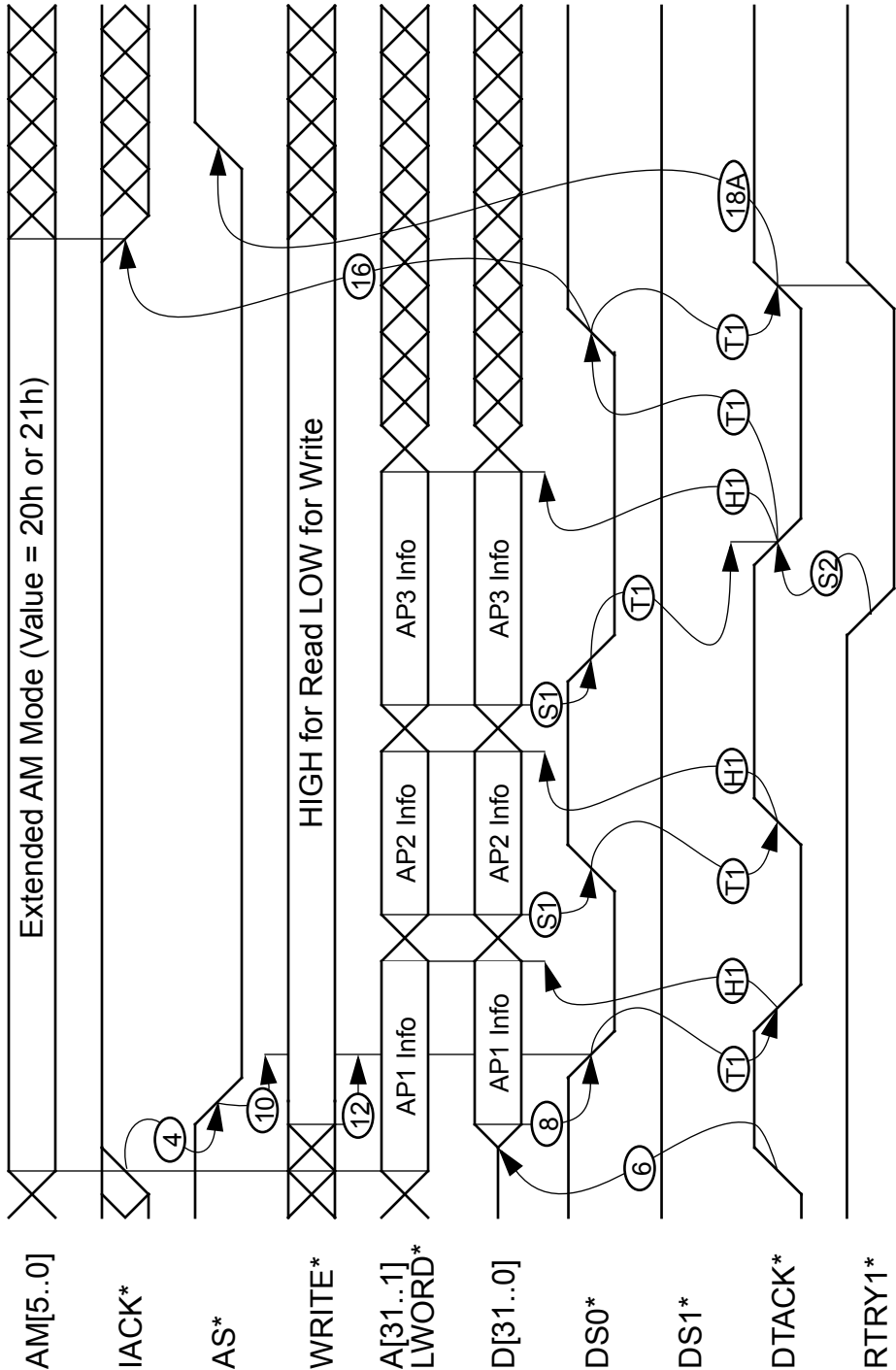


Figure 11-2 2eVME Address Broadcast - Slave Suspend Response

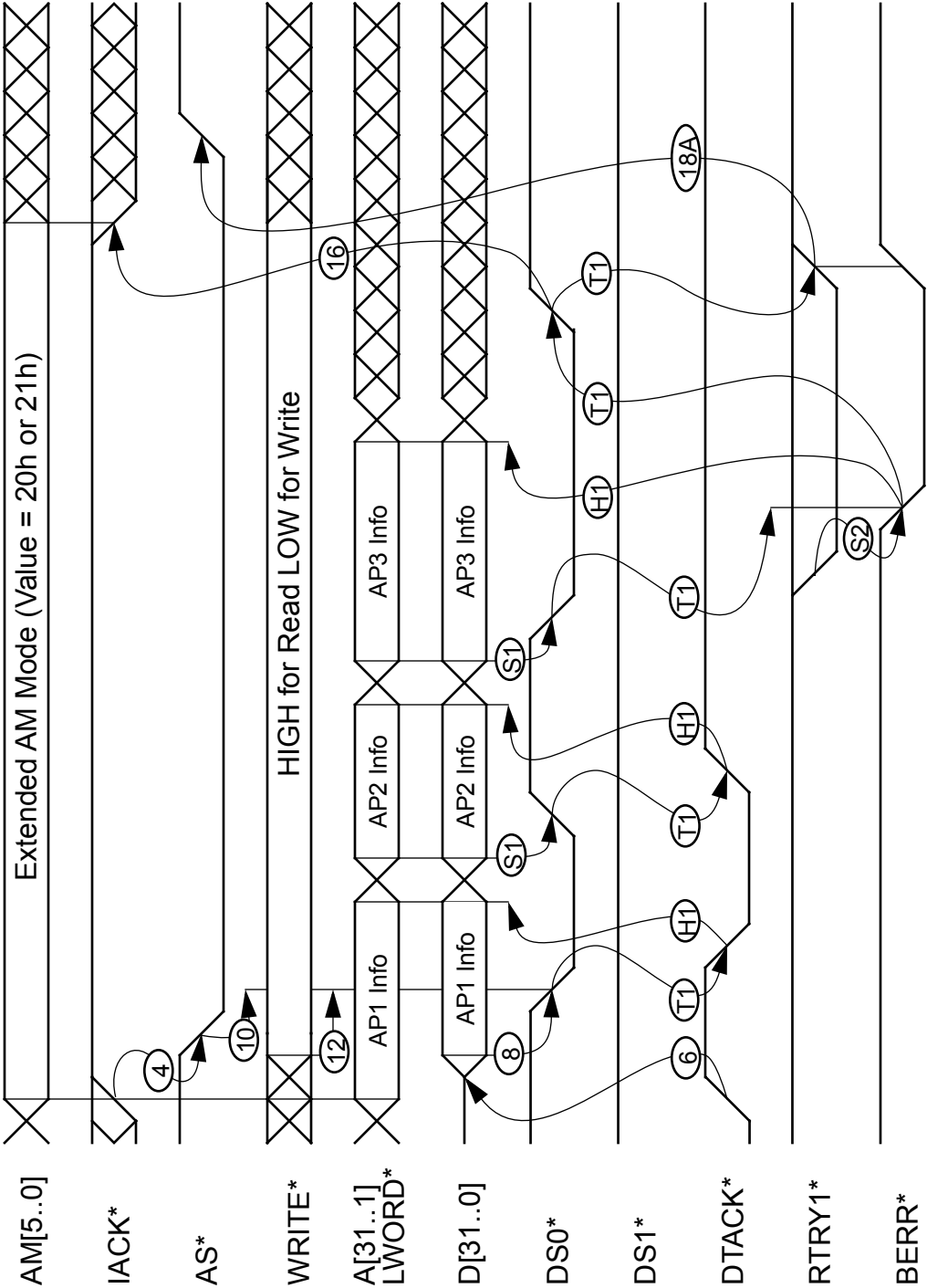


Figure 11-3 2eVME Address Broadcast - Slave Terminated/Error Response

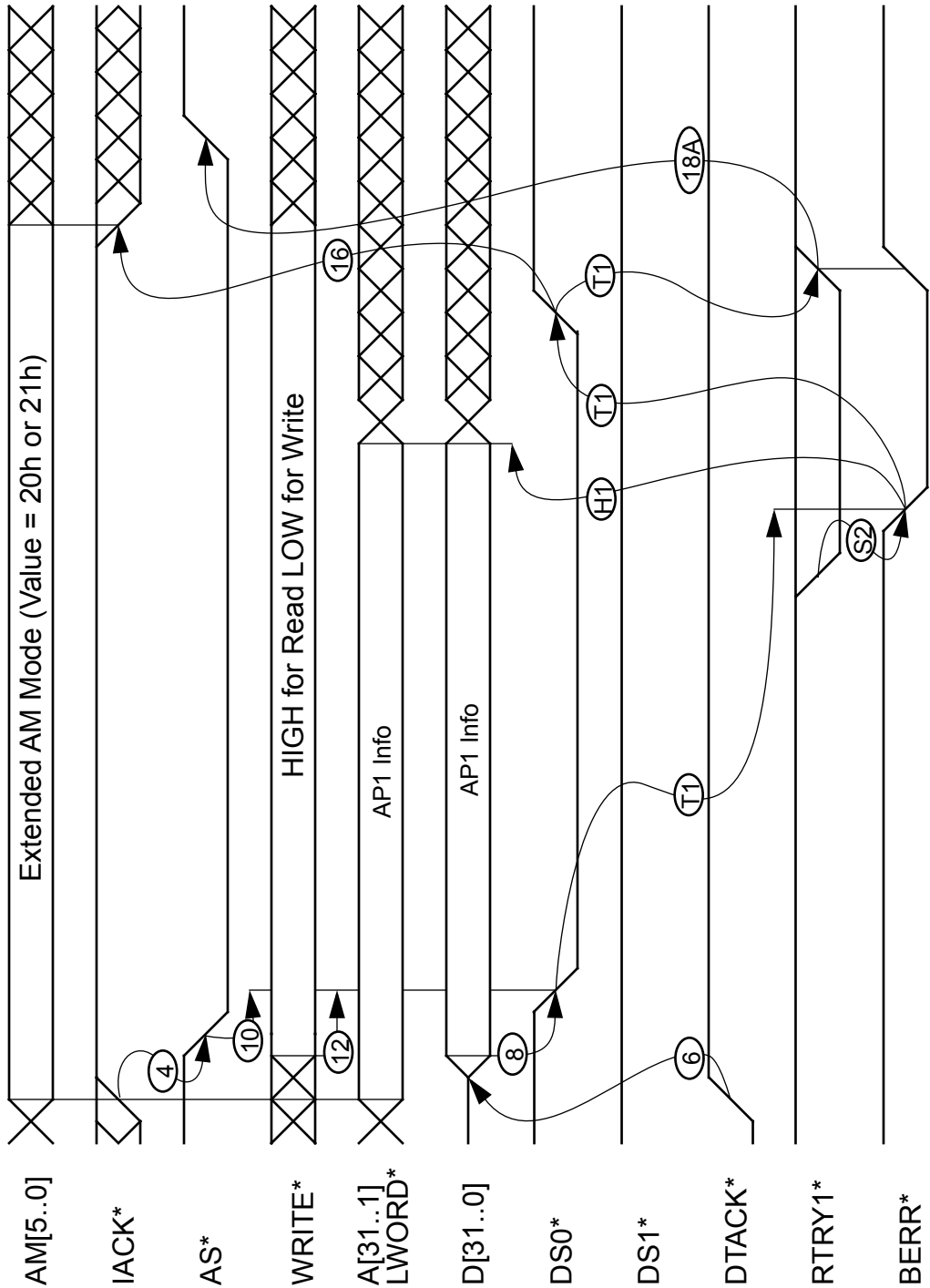


Figure 11-4 2eVME Address Broadcast - Slave Suspend/Terminated/Error Response

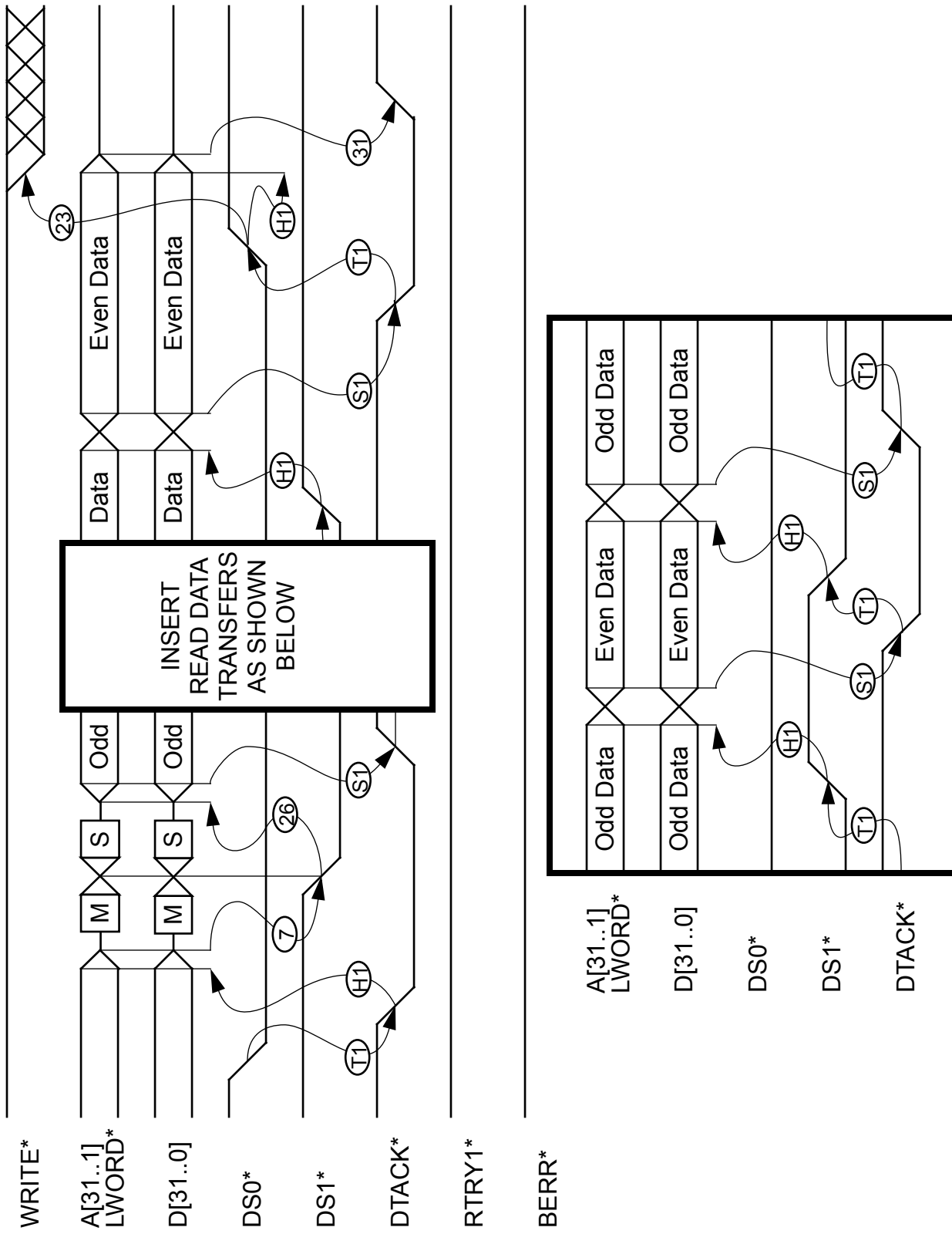


Figure 11-5 2eVME Read Data Transfers - Master Termination

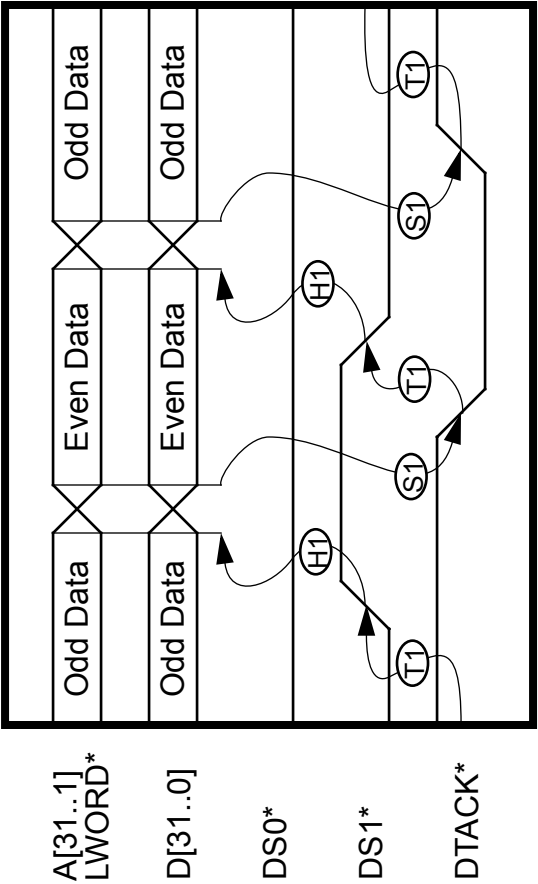
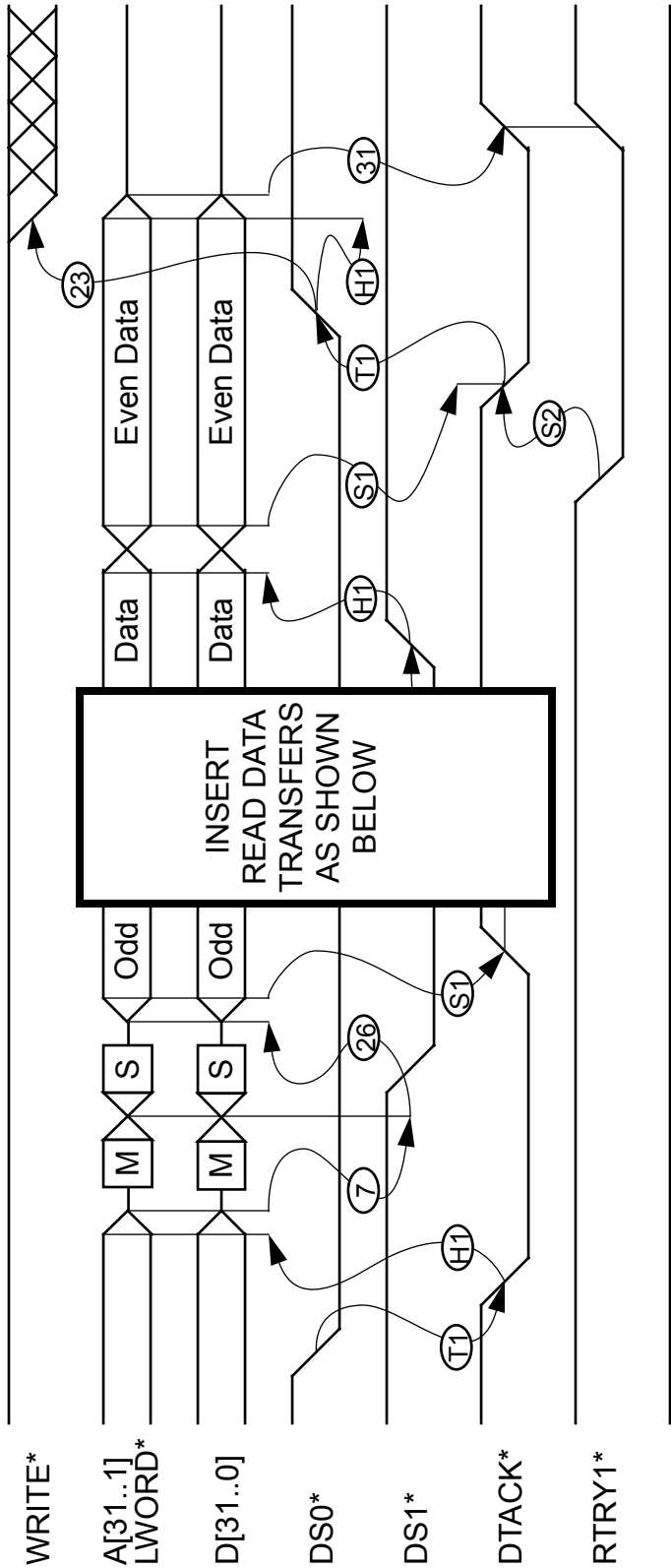


Figure 11-6 2eVME Read Data Transfers - Slave Suspend

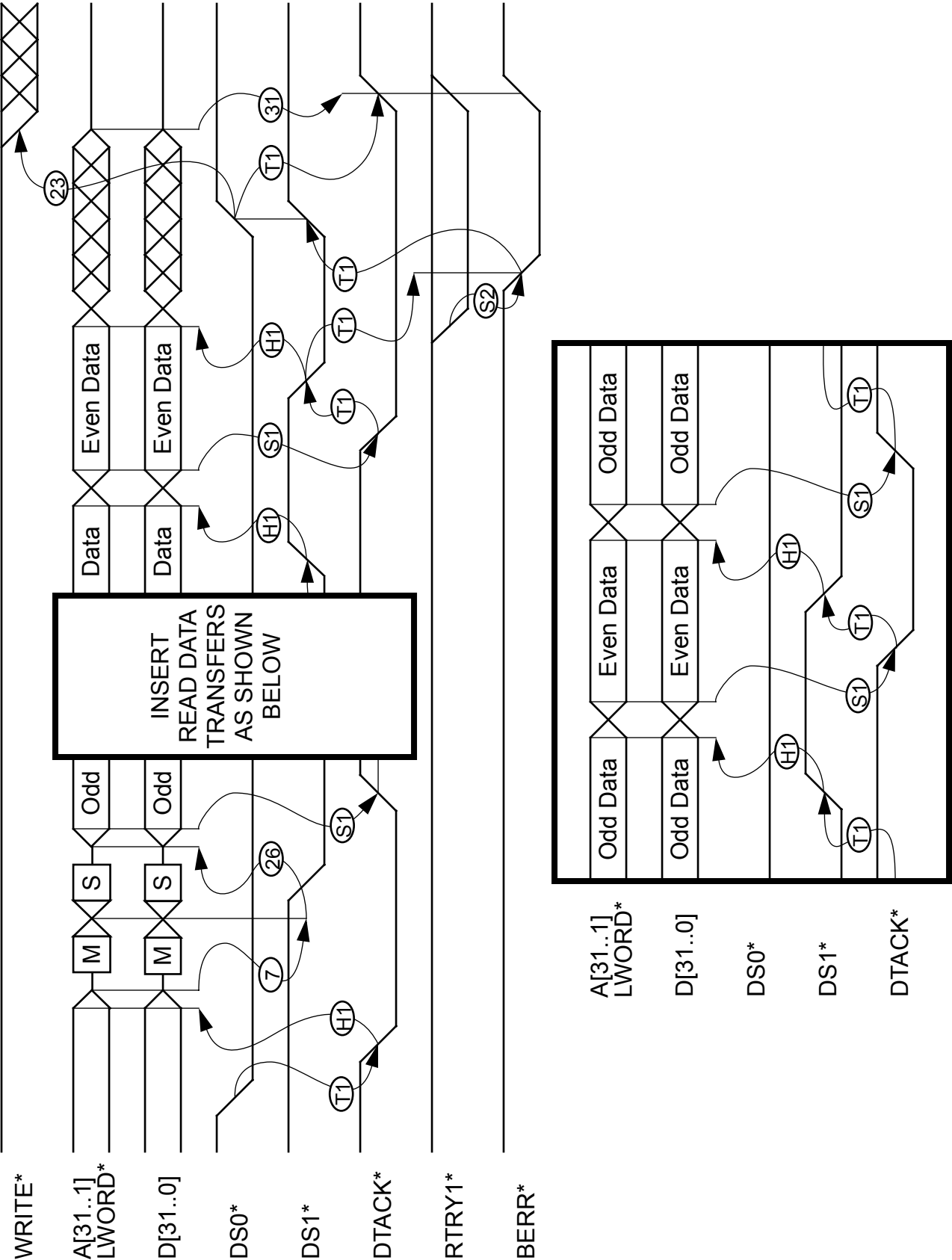


Figure 11-7 2eVME Read Data Transfers - Slave Terminated/Error on Odd Beat

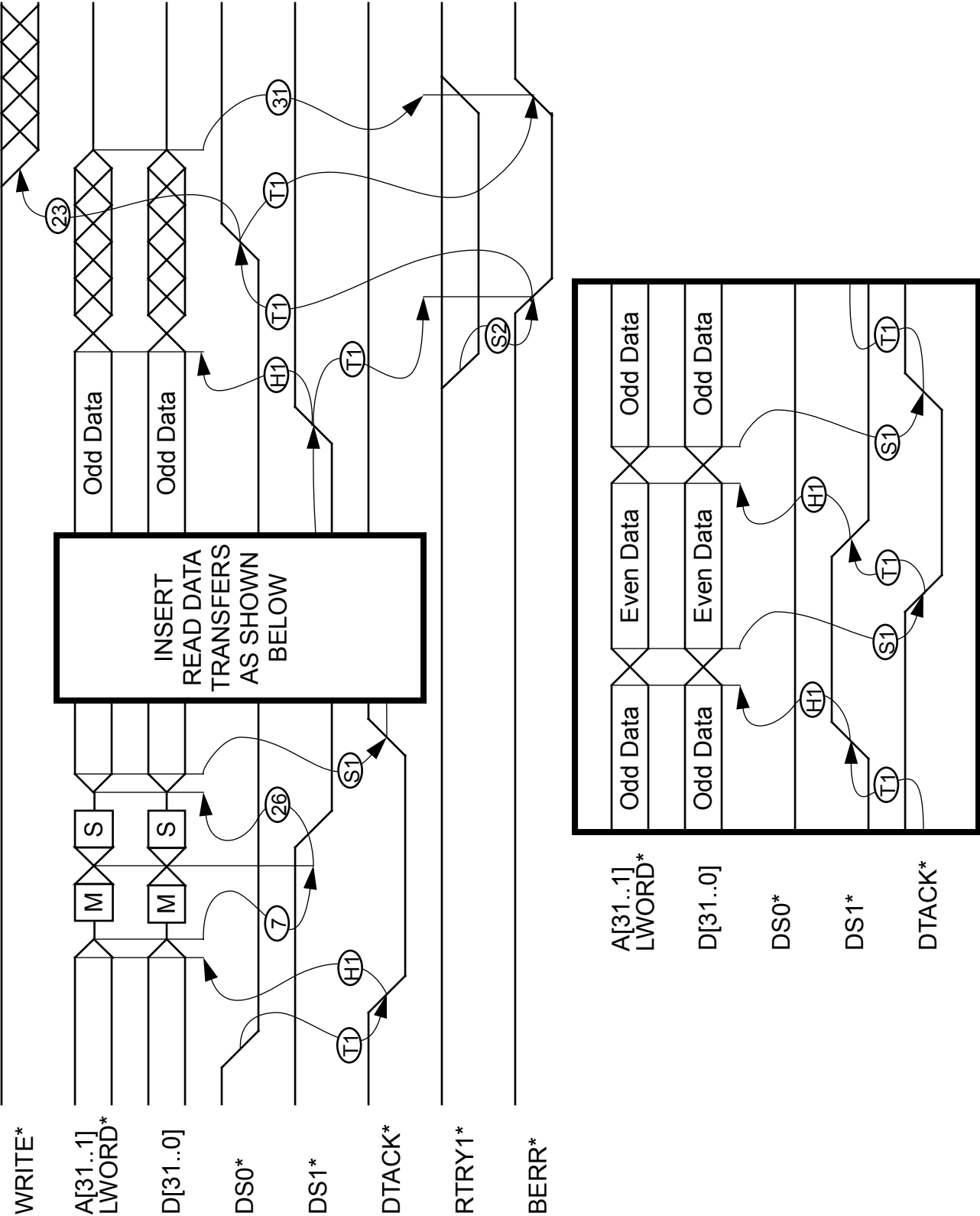


Figure 11-8 2eVME Read Data Transfers - Slave Terminated/Error on Even Beat

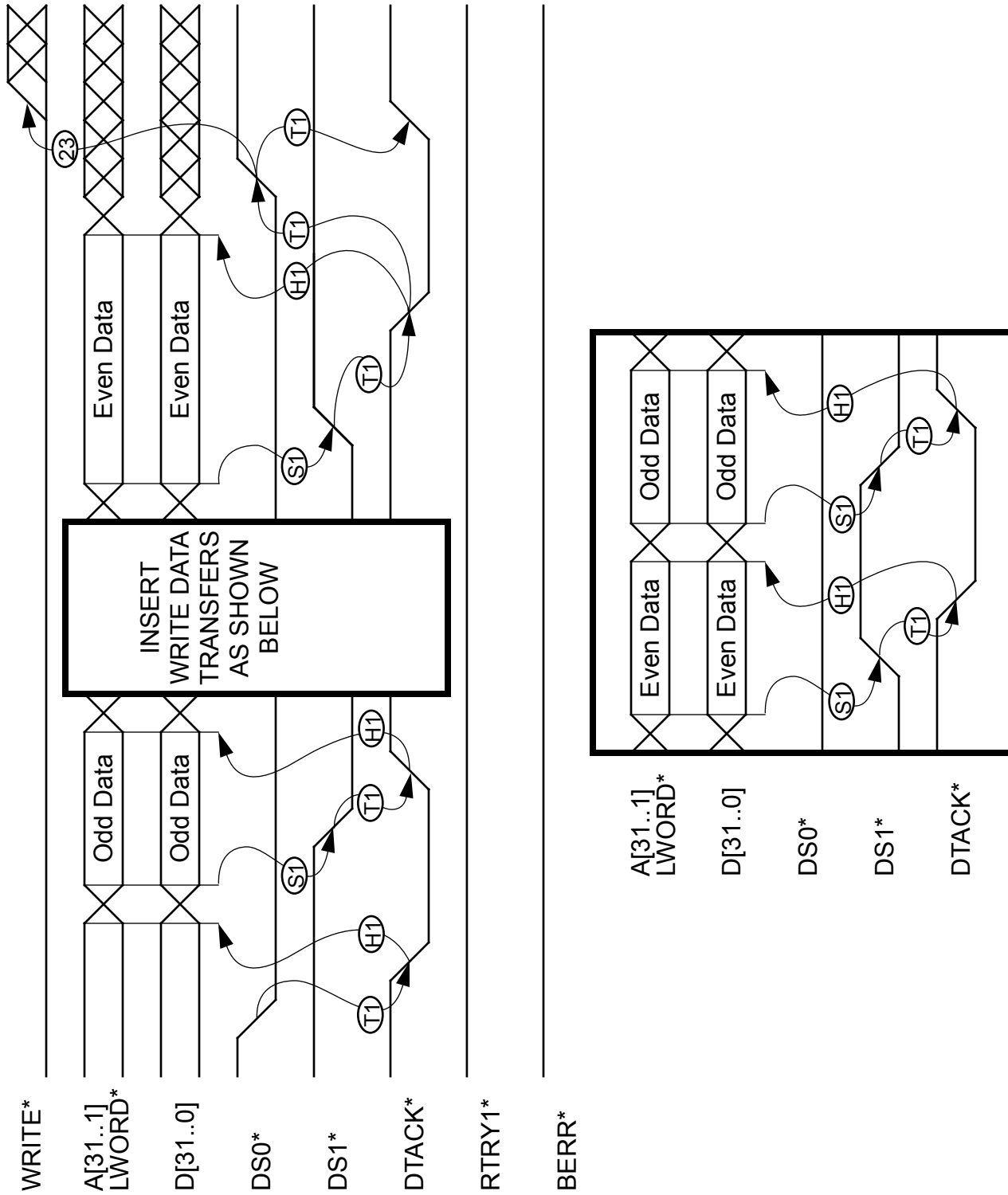


Figure 11-9 2eVME Write Data Transfers - Master Termination

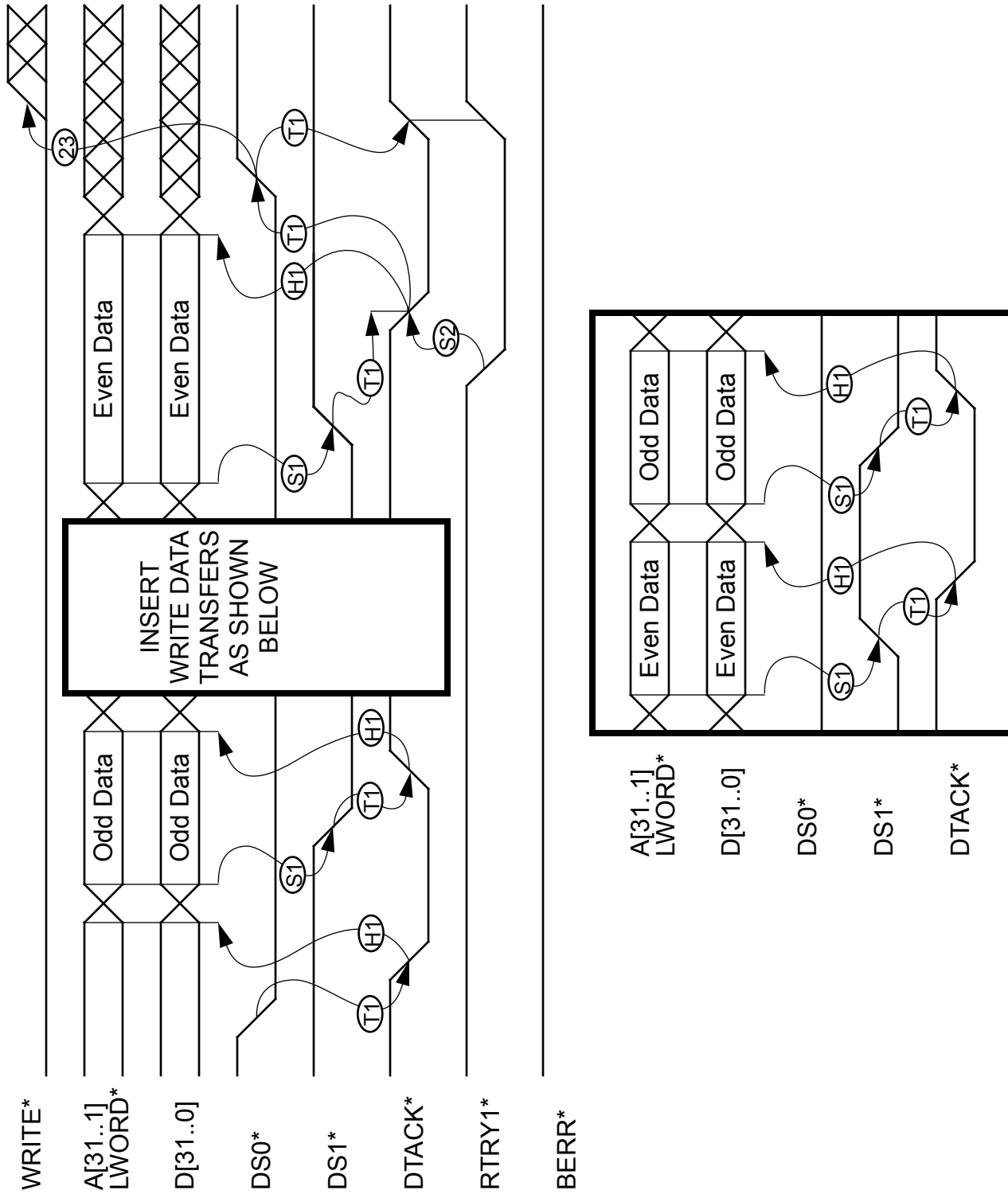


Figure 11-10 2eVME Write Data Transfers - Slave Suspend

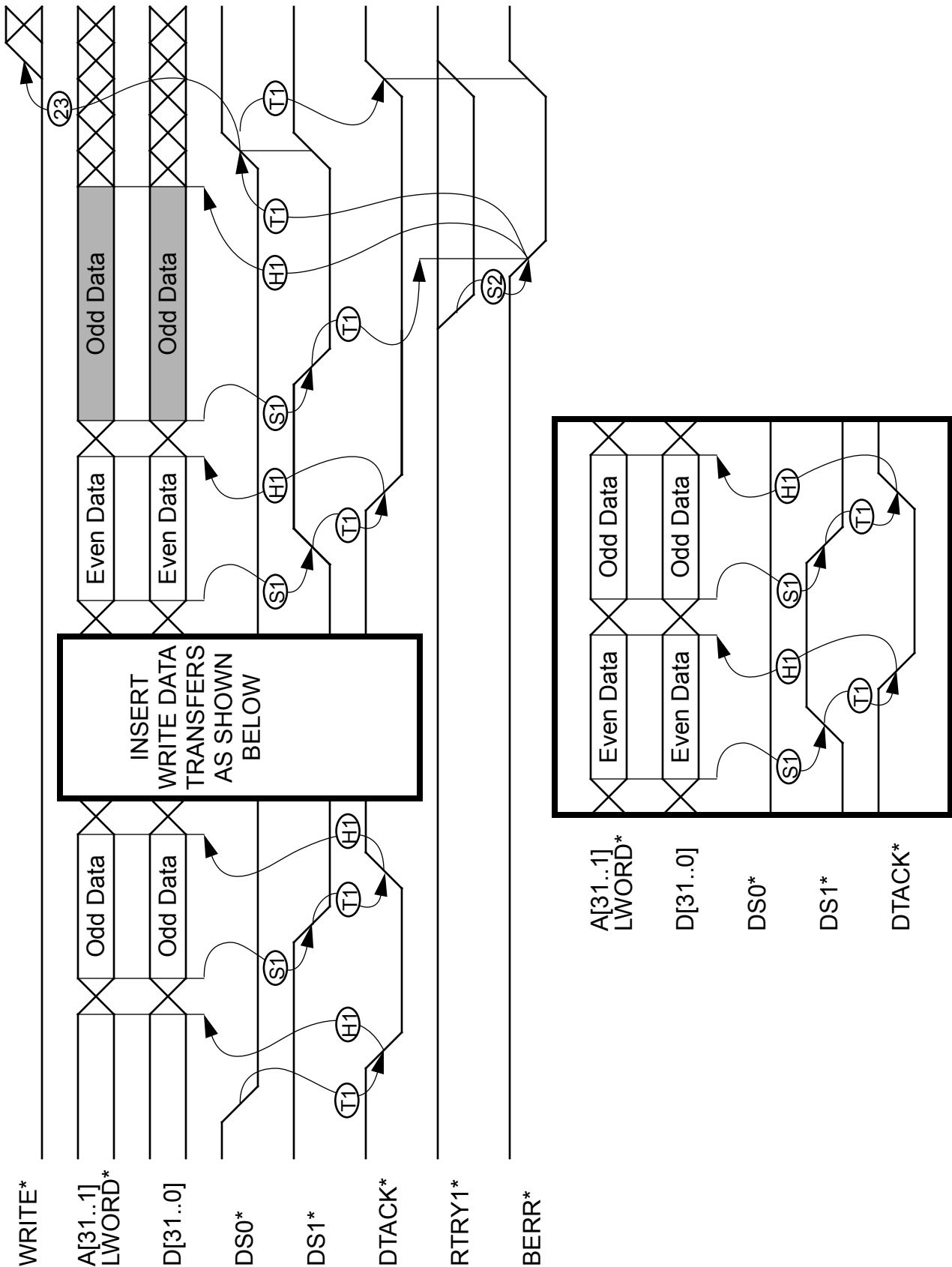


Figure 11-11 2eVME Write Data Transfers - Slave Terminated/Error on Odd Beat

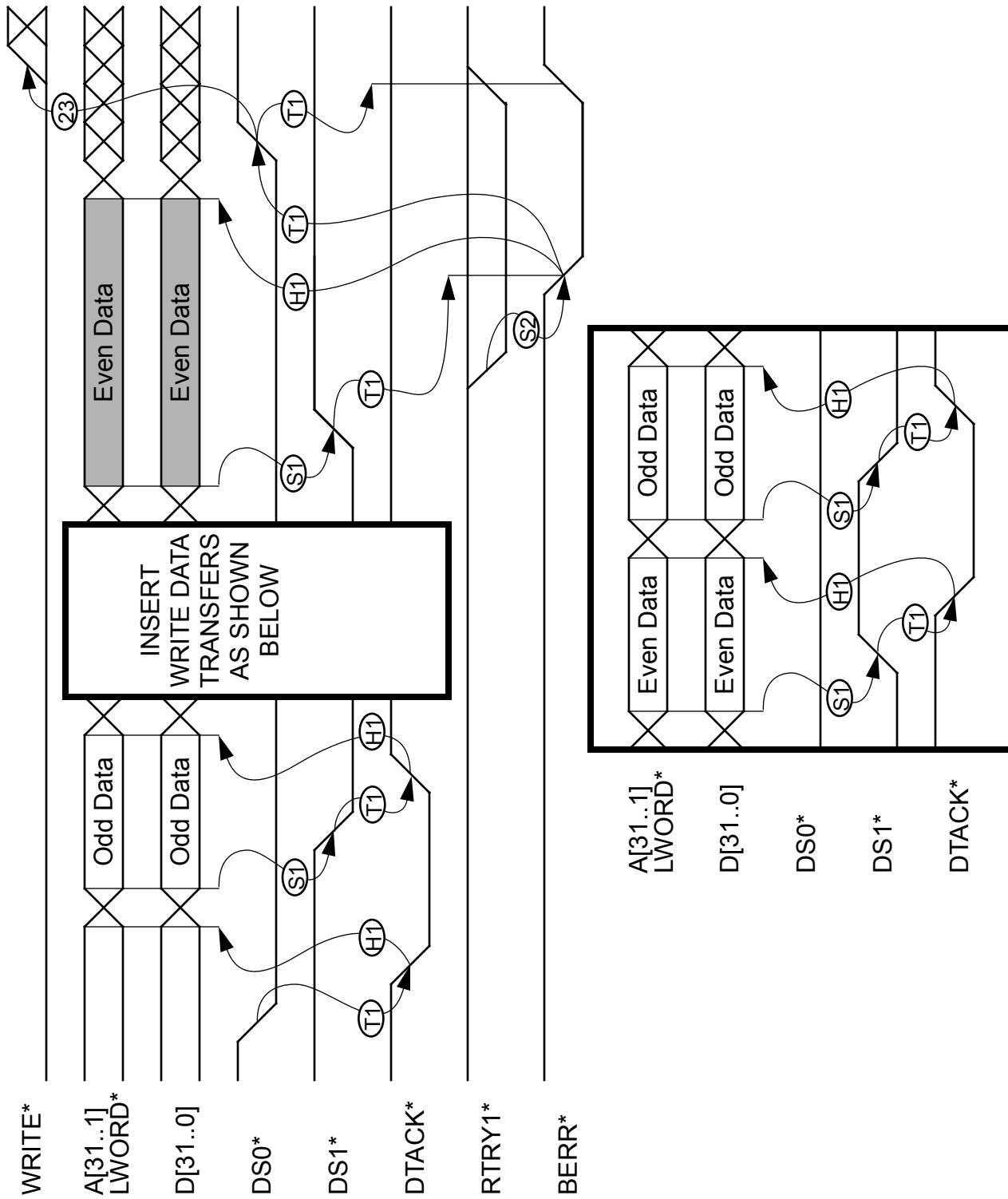


Figure 11-12 2eVME Write Data Transfers - Slave Terminated/Error on Even Beat

Appendix A

Glossary of Additional VME64x Terms

Introduction

This is an extension of the terms defined in the VME64 Standard, Appendix A. Terminology described in the VME64 Standard are not repeated in this standard. Refer to the VME64 Standard for a listing of the VME64 Terminology.

3U

A term used to describe single high VME, VME64 and VME64x boards that are 100 mm in height. Also used to describe backplanes that interface to these same boards.

6U

A term used to describe double high VME, VME64 and VME64x boards that are 233.35 mm in height. Also used to describe backplanes that interface to these same boards.

9U

A term used to describe triple high boards that are 366.70 mm in height. Also used to describe backplanes that interface to these same boards. 9U VME, VME64 and VME64x boards and backplanes are not defined in this standard, but are generally considered an optional size.

* (asterisk)

When appended to a signal's name, the suffix "*" indicates that the logic state of the signal is the opposite state. A high is a logic zero and a low is a logic one.

Address Space Relocation

The ability to change the base address of a contiguous area within a module. Traditionally in VME, this has been done manually with jumpers or switches. Chapter 10 of this document specifies support for software-programmable address space relocation, thus supporting "plug and play" on VME. Also specified is a standard way to latch switch settings for software to read.

Amnesia Address

An address value used when a geographical address parity error is detected. The board does not know its real geographical address, therefore assigns itself a predefined address value stating "I am alive, but don't know the correct slot number".

BAR

Base Address Register in the CR/CSR. The value is set by the geographical address pins or via the auto slot identification function.

Bit Set/Clear Register

A register with two addresses. Writing a "1" to one address causes the referenced bit register to be set (set to a "1") and writing a "1" to the other address causes the bit to be cleared (set to a "0"). A read to either address will return the value of the bit register.

Configuration RAM (CRAM)

This optional area within CR/CSR space could provide "scratch pad" RAM for use by system software. The intended use is storage of configuration data associated with the module, such as driver state data to enable automatic fail over.

Contact

A term used to describe the physical connection within a connector where two mechanical components mate to provide an electrical path between two mating elements, such as a board to a backplane or a cable to board. This term is used to describe the P0/J0 connector (IEC 61076-4-113) contact elements.

Data Beat

A time period in which a unit of data is transferred from the source to the destination in the 2eVME protocol. The unit of data is either 4 or 8 bytes.

Fixed Board Connector

An IEC term used to describe the "receptacle" (also called "male") connector for the 2 mm IEC 61076-4-101 connector system, which mount on the backplane.

Free Board Connector

An IEC term used to describe the "plug" (also called "female") connector for the 2 mm IEC 61076-4-101 connector system, which mount on plug in boards.

Geographical Addressing

An address mechanism which provides the binary number of the board slot.

Mate First Break Last (MFBL)

A set of one or more pins that contact before other pin(s) within a connector or connector group during connector mating, i.e. they mate first. During the disconnection of a connector pair, the set of one or more pins that break contact last.

Monarch

The processor that gains or is assigned control to manage the initialization and configuration of all boards plugged into the backplane. The monarch could also be the processor that manages the total system during normal operation.

On-Line

A board's operational state where it is ready to participate in VME bus transactions.

P0/J0 Connector Area

A term used to describe the area on VME64x boards between the P1 and P2 connectors and on VME64 backplanes between the J1 and J2 connectors. The area is used to mount additional connectors for user defined I/O off VME64x boards through VME64x backplanes.

Pins

A term used to describe a connectors physical mechanism of connecting a signal between a board and backplane. The IEC 61076-4-113 connector, provides additional contacts on the connector's outer shell. These are physically blade-on-beam style contacts. Within this standard, the term "pin" is also used to represent these connector contacts, used for P1/J1 and P2/J2 connectors.

Position

A term used to describe the "short row" of pins in a connector which runs the shorter length of the connector, such as pins z17, a17, b17, c17 and d17.

Precharge voltage

A voltage supplied to the board prior to a board's signal pins contact with the backplane connectors. This voltage is used to precharge bus signal pins on the board and to put the bus transceivers into a high impedance mode prior to live insertion. This voltage is also used by the hot swap control logic. This voltage is also used during the withdrawal of a board from a backplane.

Row

A term used to describe the set of pins in a connector which run the longer length of the connector.

User Defined I/O

A term used to describe the functional definition of a group of connector I/O signal pins. The user in this case can be either the supplier (manufacturer) of the board or the end user of the board. From a "standards" point of view, both are users of the standard, therefore the broad definition of "user defined".

User Space

A space within the CR/CSR address space where specific end user's application code (program or data) can be placed. Suppliers (manufacturers) are not allowed to use this space.

Appendix B

VME64x Signal/Pin Descriptions

Introduction

This appendix describes the additional VME64x signal lines and associated connector pin defined in this standard. See the VME64 Standard, Appendix B for the VME64 signal/pin descriptions. The following table identifies the VME64x signal/pin by mnemonic and describes the signal/pin characteristics.

VME64 Signal Identification

Signal/Pin Mnemonic	Signal/Pin Name and Description
GA[4..0]*	Geographical Address - A set of backplane driven signals that are either tied to ground or floating and are used to carry slot number information.
GAP*	Geographical Address Parity - A backplane driven signal that is either tied to ground or floating and is used to carry geographical address parity.
GND	The DC voltage reference and to carry the power return current for boards and backplanes.
LI/I*	Live Insertion Input - A three-state driven signal that is used to carry hot swap (live insertion) input control information.
LI/O*	Live Insertion Output - A three-state driven signal that is used to carry hot swap (live insertion) output control information.
MCLK	IEEE 1149.5 MTM-Bus Clock - A three-state driven signal that is used to carry the T&Mbus clock signal.
MCTL	IEEE 1149.5 MTM-Bus Control - A three-state driven signal that is used to carry the T&Mbus control signal.
MMD	IEEE 1149.5 MTM-Bus Master Data - A three-state driven signal that is used to carry the T&Mbus master data signal information.
MPR	IEEE 1149.5 MTM-Bus Pause Request - A three-state driven signal that is used to carry the T&Mbus pause request signal information.
MSD	IEEE 1149.5 MTM-Bus Slave Data - A three-state driven signal that is used to carry the T&Mbus slave data signal information.
RESP*	Response - A three-state driven signal that is used to carry the Response signal information as defined by the 2eVME Protocol.
RsvB	Reserved Bused - These reserved bused signals are reserved for future definition by the VITA Standards Organization.
RsvU	Reserved Unbused - These connector pins are reserved for future definition by the VITA Standards Organization.

**Signal/Pin
Mnemonic****Signal /Pin Name and Description**

UD	User Defined - These pins are defined by the user and are used to carry various types of input/output information.
VPC	Voltage PreCharge - A power voltage used by the hot swap logic.
+3.3V	+3.3 VDC Power - Used by on board logic circuits.
+V1	The positive side of the 48 volt supply, usually paired with the +V2 power pin.
+V2	The positive side of the 48 volt supply, usually paired with the +V1 power pin.
-V1	The negative side of the 48 volt supply, usually paired with the -V2 power pin.
-V2	The negative side of the 48 volt supply, usually paired with the -V1 power pin.

Appendix C

VME64 and VME64x Function Mnemonics

Introduction

This appendix lists the functional mnemonics of the VME64 Standard and this standard. The signal/pin mnemonics listed in Appendix B are not included in this appendix. These mnemonics can be used to describe the functional capability of VME, VME64 and VME64x boards, backplanes and systems, where appropriate.

Mnemonic	Description
+12V	Backplane or system provides +12V power or board uses +12V power
+3.3V	Backplane or system provides +3.3V power or board uses +3.3V power
+5V	Backplane or system provides +5V power or board uses +5V power
-12V	Backplane or system provides -12V power or board uses -12V power
2eVME	Board supports the 2eVME protocol
A16	Performs 16 bit address transfers across the backplane
A24	Performs 24 bit address transfers across the backplane
A32	Performs 32 bit address transfers across the backplane
A40	Performs 40 bit address transfers across the backplane
A64	Performs 64 bit address transfers across the backplane
ADO	Board supports address only cycles without handshakes
ADOH	Board supports address only cycles with handshakes
AUX	Backplane or system provides auxiliary power or board uses auxiliary power
BLT	Performs block transfers across the backplane
BTO	Provides the bus timer time out function
CR/CSR	Board supports the CR/CSR function
D08	Performs 8 bit data transfers across the backplane
D16	Performs 16 bit data transfers across the backplane
D32	Performs 32 bit data transfers across the backplane
D64	Performs 64 bit data transfers across the backplane
ESD	Subrack or board supports the VME64x ESD scheme
EMC	Subrack or board supports the VME64x EMC scheme
ETL	Board uses the ETL devices for bus transceivers
FAIR	Bus requester supports the fair bus request mode
GA	Uses or provides geographical address.
GAP	Uses or provides geographical address parity
I(x)	Interrupter, which generates interrupts on level x - Where x ranges between 1 to 7
IE/HDL	Board uses the injection/extraction handles
IEL/HDL	Board uses the injection/extraction/locking handles
IE/COMB	Subrack provides the front rail comb for support of the injection/extraction handles
IH(x)	Interrupt handler processes interrupt level x - Where x ranges between 1 to 7

IH(x-y)	Interrupt handler processes interrupt levels x through y - Where x and y range between 1 to 7
J0	Backplane uses the 95 pin 2 mm connector in the J0 connector area
J0/S	A special connector (e.g. fiber optic or coaxial) in the J0 connector area
J1/96	Backplane uses the 96 pin connector in the J1 connector area
J1/160	Backplane uses the 160 pin connector in the J1 connector area
J2/96	Backplane uses the 96 pin connector in the J2 connector area
J2/160	Backplane uses the 160 pin connector in the J2 connector area
KEY	Subrack or board supports the VME64x keying scheme
Lock	Board support the locked cycles
MBLT	Performs multiplexed block transfers across the backplane
MTM	Board supports the IEEE 1149.5 MTM function
P0	Board uses the 95 pin 2 mm connector in the P0 connector area
P0/S	A special connector (e.g. fiber optic or coaxial) in the P0 connector area
P1/96	Board uses the 96 pin connector in the P1 connector area
P1/160	Board uses the 160 pin connector in the P1 connector area
P2/96	Board uses the 96 pin connector in the P2 connector area
P2/160	Board uses the 160 pin connector in the P2 connector area
PRI	Bus arbiter supports the priority mode
RETRY	Board supports protocols with 6U retry capability
RESP	Board support protocol with 3U response capability
RMW	Performs read-modify-write transfers across the backplane
ROR	Bus requester supports the release-on-request mode
RRS	Bus arbiter supports the round robin mode
RWD	Bus requester supports the release-when-done mode
SysCon	Provides the system controller functions including: BTO, arbitration, interrupt daisy chain driver and 16 MHz system clock driver
UAT	Performs unaligned transfers across the backplane
VPC	Backplane provides or board uses the pre-charge voltage power (Power provided or used must be included in the +5V power ratings)
W+12:x	Max +12V power provided by the backplane or system (in watts) - Or max. +12V power consumed by a board averaged over a one second period
W-12:x	Max -12V power provided by the backplane or system (in watts) - Or max. -12V power consumed by a board averaged over a one second period
W+3.3:x	Max +3.3V power provided by the backplane or system (in watts) - Or max. +3.3V power consumed by a board averaged over a one second period
W+5:x	Max +5V power provided by the backplane or system (in watts) - Or max. +5V power consumed by a board averaged over a one second period
Waux:x	Max auxiliary power provided by the backplane or system (in watts) - Or max. auxiliary power consumed by a board averaged over a one second period

Appendix D

IEEE 1101.2-1992 Background

Introduction

This is an informative appendix that provides some background information on IEEE 1101.2-1992 The Standard for Mechanical Core Specifications for Conduction Cooled Eurocards

Background

The architectural concepts and advantages offered by the VMEbus are already well understood and have been since its inception in October of 1981. However it was recognized in the late 1980's by a handful of defense-oriented board and system-level manufacturers, that the needs of the military marketplace for a more rugged and robust mechanical solution was required rather than the air cooled-only offerings of the time. Physical space is at a premium in tactical and strategic military aircraft, ships and ground vehicles. Conduction-cooling held the key to minimize electronic subsystems volume by ensuring high reliability through efficient thermal management techniques while increasing board and system-level functionality. Thus the need for a 6U x 160 mm VMEbus conduction-cooled standard was born.

The IEEE 1101.2 standard ensures complete mechanical interchangeability and intermateability of multiple vendor's conduction-cooled VMEbus circuit card assemblies (CCAs) into compliant chassis in a format suitable for military and rugged applications. In addition, 1101.2-compliant CCAs are both electrically and physically compatible with existing commercial environment, double-height, 160 mm Eurocard boards and chassis, providing a flexible software development environment. This greatly reduces the costs and mitigates the risk associated with direct technology insertion into deployed military systems, supporting the concept of P3I (Pre-Planned Product Improvement).

Conduction-cooled CCAs are used wherever convection (or forced-air) cooling is not possible nor appropriate for particular severe environment applications. However, conduction-cooled CCAs used in physically hostile and extended temperature environments present certain design challenges. Of prime concern is the layout and protection of relatively fragile electronic components to ensure effective heat transfer to the card edge. For example, the CCA might consist of an electrically insulated, metallic heat conduction plate permanently heat/pressure bonded to a printed wiring board (PWB) or could possibly be represented by a set of copper thermal vias (or pathways) embedded within the layers of the PWB itself. In either case, the heat management layer conducts the heat generated by the board's active and passive components, through the heat management layer, to the edge of the CCA where the heat is extracted by the chassis, reducing thermal gradients and "hot spots" on the board which can adversely affect reliability. In addition, stiffening ribs are added to increase mechanical rigidity. This three-dimensional PWB and thermal management sub-assembly requires tight tolerances to ensure that it does not interfere with other CCAs in the chassis and it provides an accurate, mechanically stable fixed reference platform for repeatable insertion into the chassis slot. The resultant assembly contributes superior resistance to high levels of vibration and shock, guaranteeing a mechanically stable and reliable mounting surface for electronic components capable of surviving severe environments.

It is undeniable that the IEEE 1101.2-1992 standard has assisted in ushering in a new era to the embedded rugged and defense computer marketplace. Yesterday's proprietary, point-solutions are giving way to the adoption of open architecture standards and open systems solutions. This greatly decreases electronic subsystem development times and attributable costs, while also decreasing overall logistics and life-cycle costs by capitalizing on existing defense-oriented corporate infrastructures with the application of logistics control and configuration management. As a test to its founders, the VMEbus continues to migrate and grow with technology advances, continually increasing performance, bandwidth and functionality - while maintaining forward and backward compatibility - securing an enviable position of flourishing well into the next century.

Appendix E

IEEE 1101.x Mechanical Feature References

Introduction

This appendix lists the various mechanical features and associated reference specification. This is provided to as a quick search aid for finding the specific requirement when implementing a specific mechanical features.

IEEE 1101.1-1991 IEEE Standard for Mechanical Core Specifications for Microcomputers Using IEC 603-2 Connectors

Feature	Reference
General PCB sizes and tolerances	Clauses 6, 7, 8 & 9
Front mounted PCB assembly test and inspection dimension (DT2).....	Table 5
General backplane sizes and tolerances.....	Clause 10
Backplane bow; static and dynamic.....	Clause 11 (8)
General non-EMC subrack sizes and tolerances	Clause 11
Subrack assembly test and inspection dimension (Dc)	Table 7
Non-EMC front panels	Figures 13 & 14
Front panel, PCB, connector & backplane relationships.....	Figure 15
Board to board relationship	Figure 16

IEEE 1101.10-1996 IEEE Standard for additional Mechanical Specification for Microcomputers using the IEEE 1101.1 Equipment Practice

Feature	Reference
EMC subrack interface dimensions.....	Clause 5
EMC PCB front panel and filler panel interface dimensions	Clause 5
EMC front panel and PCB relationship	Figure 5
Keying and alignment pin	Clause 6
Programming key.....	Figure 10
Programming of keys	Figure 11
Alignment pin test dimensions.....	Figure 12
Protective solder side cover.....	Clause 7
(for PCB mounting holes, see IEEE 1101.1, Figures 3, 4 and 5)	
Subrack injector/extractor details	Clause 8
Subrack injector/extractor test dimensions	Figure 15
Injector/extractor details.....	Figure 15
Front panel assemble with injector/extractor test dimensions (G)	Table 6
ESD protection.....	Clause 9
160 pin (5 row) connector mounting details.....	Clause 10

IEEE P1101.11 IEEE Standard for Rear Plug-In Units for Microcomputers using the IEEE 1101.1 Equipment Practice, and the IEEE P1101.10 additional Mechanical Specifications, Draft 1.0, July 23, 1996

Feature	Reference
Inline mounting of rear PCB assemblies.....	Clause 5
Rear mounted PCB sizes.....	Clause 6
Rear mounted PCB assembly test and inspection dimension (DT2)	Table 2
Connector orientation and labeling.....	Clause 7
Rear mounted PCB assembly subrack test and inspection dimensions (RDc and RDx).....	Clause 8
Backplane thickness	Clause 9
Connector labeling.....	Clause 10
Connector performance	Clause 12
Connector alignment	Clause 13
Front and rear PCB panel assembly safety ground.....	Clause 15
J0 2mm connector mounting on backplane	Appendix A