XMICRO BUS

Technical Specifications

V0.5 2021-02-07

Table of Contents

Index of Tables

Index of Figures

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1. General Description

1.1   Features

- Modular Design
- CPU Architecture Independence
- 8-bit Data Field Width
- 1 Megabyte Memory Address Range
- Discrete I/O Address Range
- Asynchronous Data Transfer
- Multiple Masters
- Automatic Resource Allocation
- Hardware Self-Discovery
- ATX Power Supply Compatibility
- Fully Open-source

1.2   Overview

The XMICRO Bus is at its core a collection of signals which are used to interconnect many devices to form a microcomputer system. Discrete modules called "cards" communicate with one another through this bus over a backplane. Each card slot on the backplane is assigned a 256 byte address space and an interrupt request line. This uniform resource allocation allows most cards to be installed in the system with little or no special hardware configuration. Another advantage of this is the ability to use multiple identical cards in the same system without conflicts.

An XMICRO system consists of the following elements:

- Backplane
- Primary Master
- Secondary Masters
- Slaves

A *Backplane* is the basis of any system. In its simplest form, the backplane handles power and signal distribution, decodes I/O addresses, and provides a power-on reset signal. Each backplane contains a number of *slots*, into which *cards* may be inserted to build and expand the system. More complex implementations may add significantly more functionality, including peripherals or an onboard CPU.

A *Primary Master* is a device which acts as the default system controller. Typically this will be the main CPU card. Primary masters must default to this operation unless the bus is requested by another device. Only primary masters handle interrupt signals and bus requests.

A *Secondary Master* is a device with the ability to act as a temporary system controller. This is used for DMA operations by the secondary master.

A *Slave* is a device with no ability to control the system. Slaves are only capable of reading/writing data under the command of a master.

Note: The master/slave designation is used only as a broad classification of the functionality of a device. It may be used to refer to either a discrete subsystem or a card as a whole.

1.3 Terminology

Backplane: The central component of the system which provides bus power and signals to all devices.

Motherboard: A backplane containing an integrated Primary Master

Slot: A uniquely identified set of resources and position on a backplane where a card may be installed.

Card: A discrete module which interfaces with a backplane through a slot.

Master: The current active system controller. This could be either the Primary Master of a Secondary Master.

1.4 Signal Notation

1) Active-low signals are denoted by an $\overline{\text{OVERLINE}}$.

2) A range of similar signals are referred to collectively using the format A<19..0>. This example is an abbreviation of signals A19 through A0.

1.5 Numerical Notation

1) All hexadecimal numbers are indicated by a leading dollar sign ($).

2) All address values are referenced using hexadecimal notation.

3) Memory addresses use a 5-digit hexadecimal value corresponding to the values of A<19..0>. Example: $01234

4) Variable I/O addresses use a two-digit hexadecimal value formatted as $X00, where X indicates a variable slot number. This is because I/O devices only assess eight address bits. See Section *3.1.2.*

2. Signaling

2.1 Signal Lines

2.1.1 Address Lines (A<19..0>)

Twenty unidirectional lines driven by the master to specify a memory or I/O location. Unused address lines must not be left floating.

2.1.2 Data Lines (D<7..0>)

Eight bi-directional lines which carry information between master and slave devices.

2.1.3 Read Strobe ($\overline{\text{RD}}$)

Asserted by the master to indicate that the addressed slave device may place data on the data lines. The data bus is read by the master at the rising edge of $\overline{\text{RD}}$.

2.1.4 Write Strobe ($\overline{\text{WR}}$)

Asserted by the master to indicate that it has placed data on the data lines. The data bus should be read by the slave device at the rising edge of $\overline{\text{WR}}$.

2.1.5 I/O Select ($\overline{\text{IOSEL}}$)

Asserted by the master to access the backplane's card I/O space. When asserted, A<11..8> determine which backplane slot is being addressed.

2.1.6 Card X Select ($\overline{\text{CSX}}$)

This slot-specific signal is driven by the backplane to indicate that the current address is within the range of the slot's allocated address space. While this signal is asserted, A<19..8> may be ignored by the card because their state is known. This is a discrete signal for each card slot.

2.1.7 Main Memory Inhibit ($\overline{\text{INH}}$)

This open-collector signal is used to inhibit general-purpose main memory. When $\overline{\text{INH}}$ is asserted, main memory must be prevented from reading or writing data, or driving the bus. This allows cards to make special-purpose memory available without reconfiguring or replacing the entire memory system. See Section *3.1.1*.

2.1.8 Wait ($\overline{\text{WAIT}}$)

This open-collector line is asserted by a slave device to indicate that the data transaction in progress is not yet ready to be completed. If $\overline{\text{WAIT}}$ is asserted concurrently with $\overline{\text{RD}}$ or $\overline{\text{WR}}$, the master must hold all Group A signals in their current state until after $\overline{\text{WAIT}}$ is deasserted. It is recommended that devices requiring greater than 100ns access time use this signal.

2.1.9 Reset ($\overline{\text{RST}}$)

This open-collector signal resets the system and initializes it to a predictable state. During the power-on sequence, this signal should be asserted by the backplane until at least 100ms after all power supply rails have stabilized. $\overline{\text{RST}}$ may be used by any device for initialization.

2.1.1 Bus Request ($\overline{\text{BUSRQ}}$)

This open-collector signal is asserted by a secondary master to request control of the bus. When the primary master is ready to release control of the bus, it will assert $\overline{\text{BUSAK}}$. See Section *2.4*.

2.1.2 Bus Acknowledge ($\overline{\text{BUSAK}}$)

This signal is asserted by the primary master to indicate that it has released the bus for control by a secondary master. The secondary master may only control the bus while this signal is asserted. See Section *2.4*.

2.1.3 Halt ($\overline{\text{HALT}}$)

This status line is asserted by the primary master to indicate to that it is in a halted state and waiting for an interrupt. Not to be confused with $\overline{\text{WAIT}}$.

2.1.4 Vectored Interrupt Request ($\overline{\text{IRQX}}$)

This slot-specific line is asserted by a card to indicate that it requires the primary master's attention. This allows for interrupt vectoring and prioritization based on card position. This is a level-triggered interrupt signal. This is a discrete signal for each card slot.

2.1.5 Interrupt Vector Lines ($\overline{\text{V<7..0>}}$)

These eight lines correspond to the $\overline{\text{IRQX}}$ signal of slots 7..0 on a backplane. They are used by the primary master for interrupt prioritization and vectoring. A primary master may accept these signals as discrete interrupts from the first eight slots. These signals are provided by the backplane and are not to be driven directly by a card.

2.1.6 Interrupt Summary ($\overline{\text{INTS}}$)

This open-collector signal is asserted by the backplane while any $\overline{\text{IRQX}}$ line is asserted. Therefore, this is a level-triggered interrupt signal. This signal is provided by the backplane and is not to be driven directly by a card.

2.1.7 Non-maskable Interrupt ($\overline{\text{NMI}}$)

Open-collector edge-triggered interrupt signal. Its implementation may vary considerably between primary masters, so it is recommended that this signal be optional on any card using it. $\overline{\text{NMI}}$ should only be used for special signals requiring the immediate attention of the primary master, such as memory errors, power failure, or video timing. When possible, primary masters should give this signal an immediate maximum-priority override of in-progress interrupts.

2.1.8 System Clock (CLK)

This signal is the main system clock. Care should be taken to ensure it is a clean square wave. Its frequency and duty cycle are undefined. The primary master should typically provide this signal, however it may optionally be provided by another card such as a video card. It is recommended that primary masters do not strictly require externally generated clock signals to function. Any card capable of driving this signal must have an option to disable it, to prevent conflicts with other cards.

2.1.9 Instruction Fetch ($\overline{\text{FETCH}}$)

This signal is asserted by the primary master to indicate that the current read/write operation is an instruction fetch. This can be used by coprocessors or debuggers for synchronization and analysis. Implementation of this signal is optional.

2.1.10 Unused Pins (NC)

These pins are not currently used and their use is reserved for future revisions of this specification. These should be individually connected and terminated on the backplane similarly to other signals.

2.1.11 Power Supply Rails (+12V, +5V, +5VSB +3.3V, 0V, -12V)

These lines supply power to the bus. Current capacity is defined by the individual backplane's specifications, as well as Section *4.1*. If more current is required, an external power connection should be added to the card (See Section *4.1.2*). Voltage tolerances match the ATX standard. It is recommended that a standard ATX power supply be used.

Table 2-1: Signal Sources

Group	Signal	Driver	Receiver
A *Information*	A<19..0>	Master	Any
	D<7..0>	Master ($\overline{\text{WR}}$), Slave ($\overline{\text{RD}}$)	Slave ($\overline{\text{WR}}$), Master ($\overline{\text{RD}}$)
	$\overline{\text{RD}}$	Master	Any
	$\overline{\text{WR}}$	Master	Any
	$\overline{\text{IOSEL}}$	Master	Backplane, Memory Systems
	$\overline{\text{CSX}}$	Backplane	Cards
B *Control*	$\overline{\text{INH}}$	Any	Memory Systems
	$\overline{\text{WAIT}}$	Slave	Master
	$\overline{\text{RST}}$	Any	Any
	$\overline{\text{BUSRQ}}$	Secondary Master	Primary Master
C *Status*	$\overline{\text{BUSAK}}$	Primary Master	Secondary Master
	$\overline{\text{HALT}}$	Primary Master	Any
	FETCH	Primary Master	Any
D *Interrupt*	$\overline{\text{IRQX}}$	Any	Primary Master
	V<7..0>	Backplane	Primary Master
	$\overline{\text{INTS}}$	Backplane	Primary Master
	$\overline{\text{NMI}}$	Any	Primary Master
E *Utility*	CLK	Master (Typically)	Any
	NC	None	None
F *Supply*	+12V	Backplane	Any
	+5V	Backplane	Any
	+5VSB	Backplane	Any
	+3.3V	Backplane	Any
	0V	Backplane	Any
	-12V	Backplane	Any

2.2 Address Space Selection

See Section *3.1* for more information on address spaces.

$\overline{\text{IOSEL}}$ is controlled by the master to indicate which address space is being requested. It is effectively an additional address line. Primary masters should be capable of addressing a minimum of 8 slots.

When $\overline{\text{IOSEL}}$ is asserted, backplanes must determine which slot is being addressed, and assert the $\overline{\text{CSX}}$ signal for that slot.

2.3 Data Transfers

Data are transferred asynchronously in 8-bit words (bytes). $\overline{\text{RD}}/\overline{\text{WR}}$ may only be asserted while the address lines A<19..0>, $\overline{\text{IOSEL}}$, and $\overline{\text{CSX}}$ are valid and stable, and must never be asserted simultaneously. During a read operation, the addressed slave places data on D<7..0>, which is read by the master at the rising edge of $\overline{\text{RD}}$. During a write operation, the master places data on D<7..0>, which is read by the slave at the rising edge of $\overline{\text{WR}}$.

The addressed slave may optionally assert $\overline{\text{WAIT}}$ during a data transfer to temporarily pause the sequence until it is ready to send or receive data. During this time, the master may not change the state of A<19..0>, $\overline{\text{IOSEL}}$, $\overline{\text{CSX}}$, $\overline{\text{RD}}$, $\overline{\text{WR}}$, or D<7..0>. When $\overline{\text{WAIT}}$ is high, the master may complete the transfer sequence.

Table 2-2: Data Transfer Timing Parameters

| No.	Symbol	Item	Min.	Max.
1	T_{as}	Address setup time prior to $\overline{RD}/\overline{WR}$ falling edge	10ns	—
2	T_{ah}	Address hold time after $\overline{RD}/\overline{WR}$ rising edge	10ns	—
3	T_{ds}	Data setup time prior to $\overline{RD}/\overline{WR}$ rising edge	20ns	—
4	T_{dhr}	Data hold time after $\overline{RD}$ rising edge	10ns	40ns
5	T_{dhw}	Data hold time after $\overline{WR}$ rising edge	15ns	40ns
6	T_{dwl}	$\overline{WAIT}$ falling edge delay after $\overline{RD}/\overline{WR}$ falling edge	0ns	30ns
7	T_{dwh}	$\overline{RD}/\overline{WR}$ rising edge delay after $\overline{WAIT}$ rising edge	0ns	—
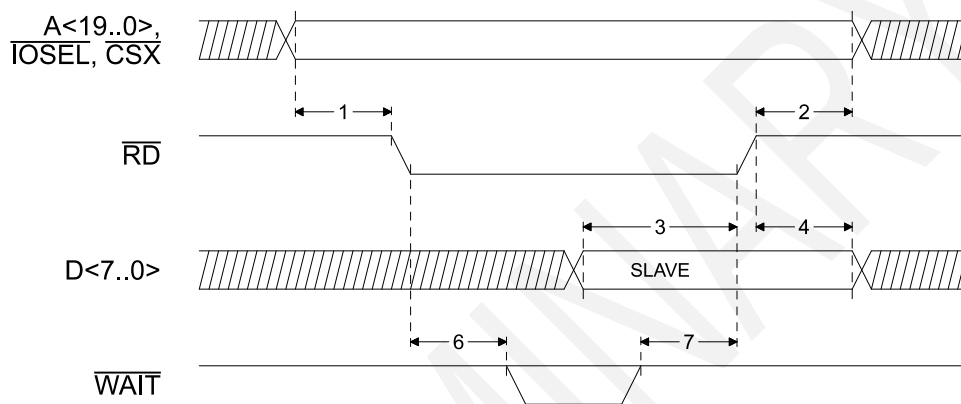
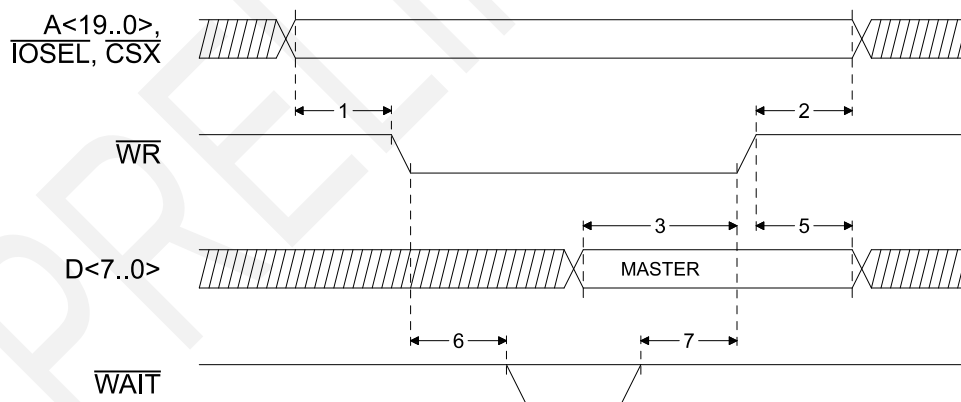*Figure 2-1: Read Operation Timing*

Figure 2-2: Write Operation Timing

2.4   Bus Arbitration

In the system's default state, a primary master has full control of the system bus. By asserting the $\overline{\text{BUSRQ}}$ line, a secondary master may request to temporarily take over control of some signals in order to directly access memory or I/O devices. When $\overline{\text{BUSRQ}}$ is asserted, the primary master gracefully hands over control of Group A signals.

The $\overline{\text{BUSAK}}$ signal indicates that the primary master has placed its Group A signals in a high-impedance state. These signals may be driven by a secondary master only while $\overline{\text{BUSAK}}$ is asserted.

In order to prevent bus contention, secondary masters should wait for a command from the primary master before initiating a bus request, and must not initiate a bus request until the $\overline{\text{BUSRQ}}$ signal is no longer asserted by another device.
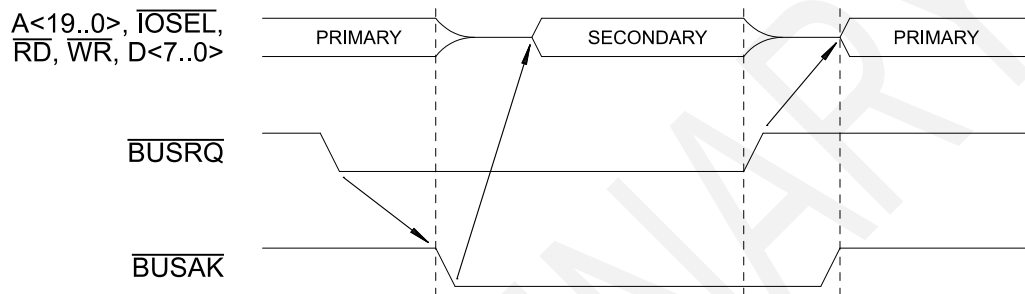

Figure 2-3: Bus Arbitration Sequence

2.5   Interrupts

Each card's interrupt signals must default to a disabled state upon reset, such that they must be enabled through software before the card will assert them.

2.5.1   Level-triggered Interrupts

Level-triggered interrupt signals ($\overline{\text{IRQX}}$, $\overline{\text{V<7..0>}}$, $\overline{\text{INTS}}$) must be asserted by a device until it no longer requires the primary master's attention. A level-triggered interrupt signal which has been asserted and deasserted before it was serviced may be disregarded.

2.5.2   Edge-triggered Interrupts

Edge-triggered interrupt signals ($\overline{\text{NMI}}$), as the name implies, are only sensitive to a falling edge. The state of the signal has no bearing on whether an edge-triggered interrupt should be serviced.

3. System Operation

3.1 Address Spaces

The system is divided into two discrete address spaces – "Memory" and "I/O".

1) When $\overline{\text{IOSEL}}$ is not asserted, the memory address space is selected and read/write operations apply to memory devices.

2) When $\overline{\text{IOSEL}}$ is asserted, the I/O address space is selected and read/write operations apply to I/O devices.

3.1.1 Memory

There are two types of memory that can be added to a system:

1) "Main Memory" is memory that is accessible when $\overline{\text{INH}}$ is not asserted. It is recommended that only one device manages main memory in a system. Main memory is typically populated with general-purpose RAM.

2) "Override Memory", when it is addressed, asserts the $\overline{\text{INH}}$ signal to disable main memory devices occupying the desired location. In this way specialized memory devices may be added to a system without the need to reconfigure the main memory system. In cases where $\overline{\text{INH}}$ is used, the main memory located at those addresses should be considered invalid.

3.1.2 I/O

1) Each card slot on a backplane is assigned 256 bytes of I/O address space, beginning at I/O address $00000. Each 256-byte block of I/O addresses is assigned to a slot number equal to the value of A<19..8>. For example, slot 0 addresses are located from $00000-$000FF, slot 1 from $00100-$001FF, etc.

2) When a slot's I/O block is addressed by the master, the backplane asserts the $\overline{\text{CSX}}$ signal for that card.

3) $\overline{\text{CSX}}$ indicates to a slave that it is being addressed, and that A<7..0> contain the address to be accessed. Slave devices may only use A<7..0> for addressing purposes, and A<19..8> must be ignored by slaves during I/O operations.

4) A backplane's I/O decoding logic may ignore any I/O address bits that are not required to access the number of implemented slots.

3.2 Reserved Addresses

Addresses $XF8-$XFF are reserved for special bus functions. These should not be used except as described in *Table 3-1*.

Table 3-1: Reserved Addresses

Address	Purpose
$XF8	Reserved
$XF9	Reserved
$XFA	Reserved
$XFB	Reserved
$XFC	Reserved
$XFD	Interrupt Vector
$XFE	Card ID (MSB)
$XFF	Card ID (LSB)

3.2.1 Card IDs

Each card should present an identification value at address $XFF which is unique to that type of card in the system. Identical cards should have identical IDs. Cards may be assigned a permanent ID as part of the XMICRO bus specification. Refer to *Appendix A.* for Card ID assignments.

An MSB value of $FF must be taken as $00. In practice the MSB may be ignored altogether, as it is not expected that the number of unique XMICRO-compatible devices will exceed the available pool of single-byte IDs.

3.2.2 Interrupt Vector

In systems with more than eight slots, additional interrupt vectoring may be desired. Address $XFD (Read) may be overridden by the backplane to provide an interrupt vector from 0-254. This value must correspond to the lowest slot number currently asserting $\overline{IRQX}$. When no cards are asserting $\overline{IRQX}$, the value must be $FF.

3.3 Interrupts

Interrupts provide cards with a means of requesting the attention of the primary master. Since interrupt schemes vary considerably between CPUs, the implementation of interrupts in an XMICRO system is relatively loosely defined.

When an interrupt signal is asserted, it is expected that the primary master will respond to it as soon as possible. Table 3-2 lists all interrupt signals on the bus, in order from highest to lowest priority. When multiple interrupt signals are being asserted simultaneously, they should be assessed in order from highest to lowest priority.

Table 3-2: Interrupt Signal Priority

Signal	Priority
$\overline{NMI}$	Highest
$\overline{V0}$	
$\overline{V1}$	
$\overline{V2}$	
$\overline{V3}$	
$\overline{V4}$	
$\overline{V5}$	
$\overline{V6}$	
$\overline{V7}$	
$\overline{INTS}$	Lowest

3.3.1 Vectored Interrupts

$\overline{IRQX}$ is asserted by cards as a general-purpose interrupt request. While any card's $\overline{IRQX}$ line is asserted, $\overline{INTS}$ is also asserted by the backplane as a summary of all interrupt requests.

Slots 7-0 have their IRQX signals broken out into bus signals $\overline{V<7..0>}$. On backplanes larger than 8 slots, a prioritized slot number may be supplied by the backplane. See Section 3.2.2 for more information.

3.3.2 Non-maskable Interrupt

$\overline{NMI}$ is a special interrupt intended for timing-sensitive operations. It has a higher priority than any other interrupt. Where possible, a primary master should immediately respond to an NMI, including interrupting an in-progress interrupt service routine. No other interrupts should interrupt an NMI service routine.

Due to hardware limitations, some primary masters may not be capable of overriding an interrupt routine in progress. In this case, $\overline{NMI}$ should be serviced as soon as possible.

4. Electrical Specifications

4.1 Power Supply Characteristics

4.1.1   Main Power Supply

1) A backplane must supply cards with the following voltages: +12V, +5V, +5VSB, 0V, -12V.

2) Specifications of the power supply are to meet the ATX standard.

3) The use of an ATX-compatible power supply is recommended.

4.1.2   Supplemental Power Supplies

Cards may use an additional connector to supplement the +12V, +5V, and 0V rails. Where such a connector is used, the following requirements apply:

1) All supplemental power rails must match the potential of the bus rails such that no significant current flows between them.

2) Supplemental power must be delivered using connectors as specified in Section *4.3.2*.

4.2 Signal Characteristics

1) A receiver must recognize a voltage of ≤ 0.8V as a logic 0, and a voltage of ≥ 2.0V as a logic 1.

2) The minimum sink current capability of any driver on any line must be 20mA at 0.5V. Further, it is recommended that drivers with minimum source capability of 20mA at 2.4V be used.

3) Receivers with Schmitt trigger characteristics are required for the following open-collector signals: $\overline{\text{INH}}$, $\overline{\text{WAIT}}$, $\overline{\text{RST}}$, $\overline{\text{BUSRQ}}$, $\overline{\text{NMI}}$

Table 4-1: Bus Driver Output Topologies

Signal	Output Device
A<19..0>	Tri-state
D<7..0>	Tri-state
$\overline{\text{RD}}$	Tri-state
$\overline{\text{WR}}$	Tri-state
$\overline{\text{IOSEL}}$	Tri-state
$\overline{\text{CSX}}$	Push-pull
$\overline{\text{BUSAK}}$	Push-pull
$\overline{\text{HALT}}$	Push-pull
$\overline{\text{FETCH}}$	Push-pull
CLK	Push-pull
$\overline{\text{INH}}$	Open-collector
$\overline{\text{WAIT}}$	Open-collector
$\overline{\text{RST}}$	Open-collector
$\overline{\text{BUSRQ}}$	Open-collector
$\overline{\text{IRQX}}$	Open-collector
V<7..0>	Open-collector
$\overline{\text{INTS}}$	Open-collector
$\overline{\text{NMI}}$	Open-collector

4.3 Connectors

4.3.1 Backplane Interconnects

1) Backplanes must be fitted with TE Connectivity 7-5530843-0 or equivalent connectors. Each of these connectors is considered a discrete slot.

2) Cards must be fitted with card-edges compatible with the specified backplane connectors and conforming to physical specifications outlined in Section *5.1*.

3) The average current on any backplane connector pin must not exceed 2A. The recommended maximum current on backplane connectors is 1A for supply pins and 100mA for all other pins.

4) No XMICRO bus signal may be delivered between any two devices except by these backplane interconnects.

Table 4-2: Backplane Interconnect Pinout

Pin	Signal	Pin	Signal
1	+12V	2	+3.3V
3	0V	4	0V
5	+5V	6	+5V
7	-12V	8	+5VSB
9	$\overline{\text{CSX}}$	10	$\overline{\text{RST}}$
11	$\overline{\text{BUSRQ}}$	12	$\overline{\text{BUSAK}}$
13	CLK	14	$\overline{\text{FETCH}}$
15	$\overline{\text{HALT}}$	16	$\overline{\text{WAIT}}$
17	$\overline{\text{INH}}$	18	$\overline{\text{IOSEL}}$
19	$\overline{\text{RD}}$	20	$\overline{\text{WR}}$
21	A0	22	0V
23	A2	24	A1
25	A4	26	A3
27	A6	28	A5
29	A8	30	A7
31	A10	32	A9
33	A12	34	A11
35	A14	36	A13
37	A16	38	A15
39	A18	40	A17
41	0V	42	A19
43	D0	44	D1
45	D2	46	D3
47	D4	48	D5
49	D6	50	D7
51	$\overline{\text{INTS}}$	52	$\overline{\text{IRQX}}$
53	$\overline{\text{V0}}$	54	$\overline{\text{V1}}$
55	$\overline{\text{V2}}$	56	$\overline{\text{V3}}$
57	$\overline{\text{V4}}$	58	$\overline{\text{V5}}$
59	$\overline{\text{V6}}$	60	$\overline{\text{V7}}$
61	$\overline{\text{NMI}}$	62	0V

4.3.2 Supplemental Power

Supplemental power may be delivered using TE Connectivity 174804-1 (Male) or equivalent installed on cards. Pinout and current limits match the ATX standard for peripheral connectors.

Table 4-3: Supplemental Power Connector Pinout

Pin	Signal
1	+12V
2	0V
3	0V
4	+5V

4.4 Termination

4.4.1 Bus Termination

1) Backplanes must incorporate some form of signal termination for all bus signals.

2) When no device is driving a bus line, that line must be pulled to a high state.

3) The DC current of a bus termination should not exceed 20mA per line.

4) The recommended active termination scheme for all bus signal lines is a 270Ω resistor to +2.85V at each end of the bus.

4.5 Grounding

4.5.1 Signal Ground

The 0V supply rail serves as the 0V reference and return path for all bus signals and supply rails.

4.5.2 Chassis Ground

1) A separate chassis ground must be maintained for conductive chassis members. The purpose of the chassis ground is to provide a safe, low-impedance return path for ESD and electrical faults, as well as to avoid stray ground paths between cards which could result in unpredictable operation.

2) Where mechanical mounting holes in cards can be used to make an electrical connection to chassis components or other cards, those holes must be isolated from the signal ground. They are not required to be tied together on the PCB.

3) Where connectors have a separate shield conductor that is not used as a signal ground, the shield should be tied to chassis ground. It is recommended that connector shields be electrically connected to the rear-side mounting holes of the card.

4) Chassis ground should be tied to the signal ground at the backplane.

5. Physical Specifications

5.1 Cards

1) A card's dimensions must not exceed the overall dimensions shown in *Figure 5-1*.

2) Card edge connectors must match the dimensions shown in *Figure 5-1*.

3) Pin 1 of the edge connector must be indicated on the card.

4) Card edges should be gold-plated for reliability. HASL or similar surface finishes are discouraged.

5) Card edges should be chamfered for easier insertion.

6) The use of standard "full-size" and "half-size" card form-factors shown in *Figure 5-1* is strongly encouraged.

7) Standard card mounting holes should be isolated from the backplane's 0V pins and treated as a discrete chassis ground if conductive.

8) I/O connectors may only be placed on the rear edge. Other edges require 0.05" component clearance.

5.2 Backplanes

1) Backplanes must conform to the measurements and orientation shown in *Figure 5-2*.

2) Pin 1 must be indicated on at least one slot.

3) Each slot number must be indicated on the PCB

4) Maximum component height under cards may not exceed the edge connectors

5) All backplane slots must be capable of receiving maximum-dimension cards
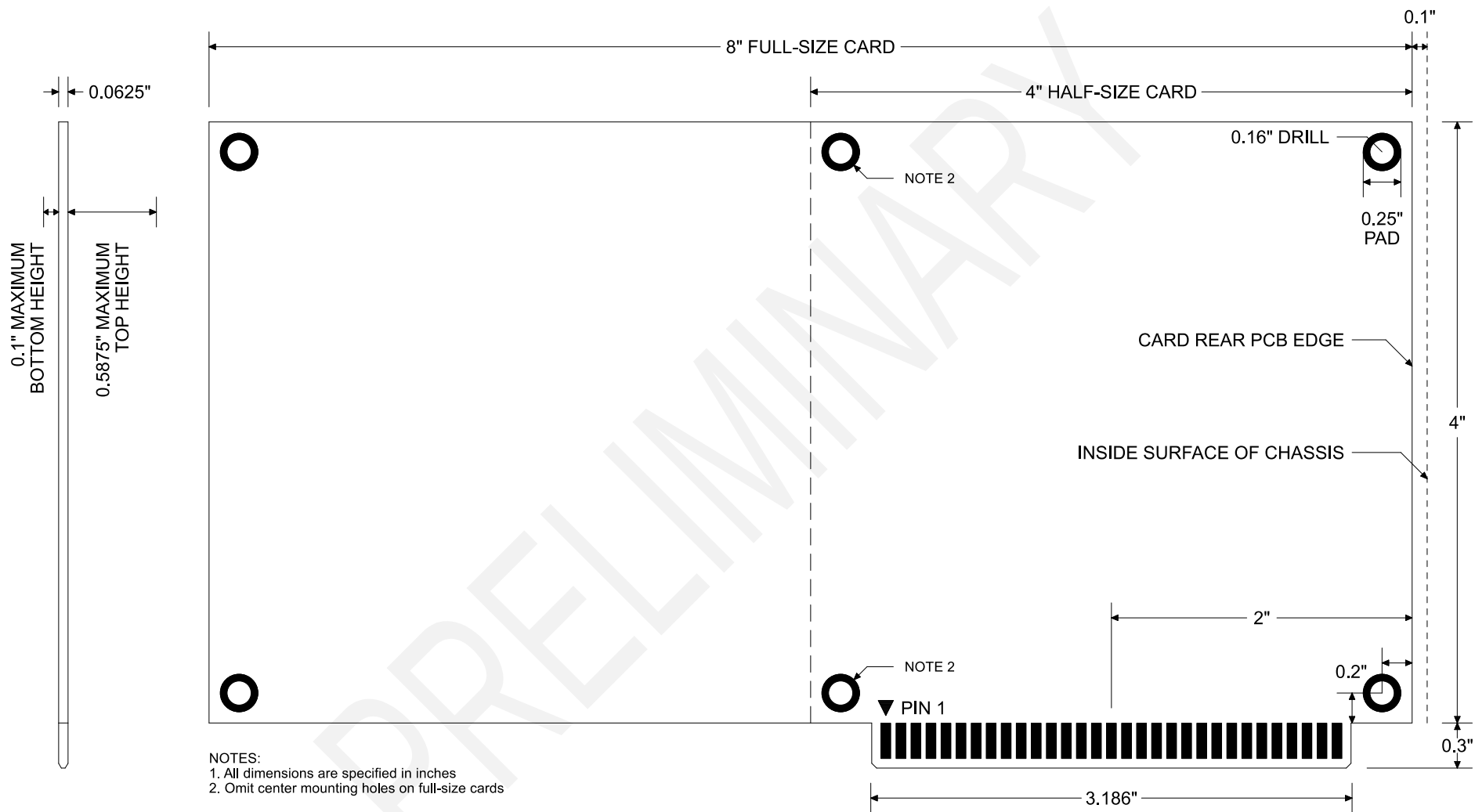
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Figure 5-1: Card Physical Dimensions

NOTES:
1. All dimensions are specified in inches
2. Omit center mounting holes on full-size cards

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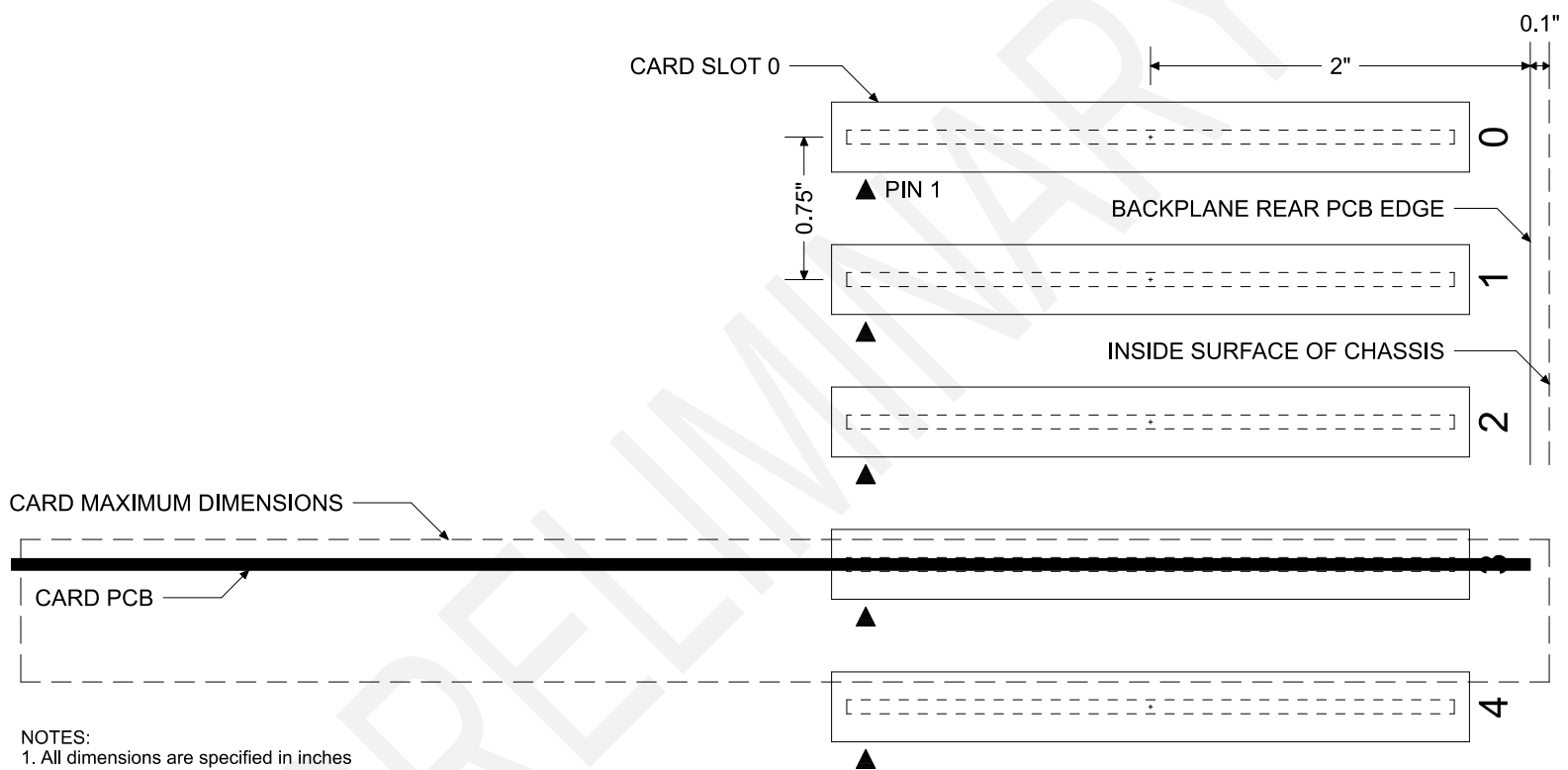*Figure 5-2: Backplane Physical Dimensions*

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Appendix A.   Card IDs

IDs $0000 and $00FF are reserved to indicate that no card is installed in the addressed slot.

IDs $00E0-$00FE will not be assigned to any specific devices and may be used for any device that has not been granted a permanent ID.

Any ID not shown in Table *A-1* is not currently assigned and may not be used.

Table A-1: Card ID Assignments

Value	Device
$0000	Reserved (No card)
$0001	XMICRO-6502
$0002	XMICRO-MEMORY
$0003	XMICRO-7SEG
$0004	XMICRO-SERIAL
$0005	XMICRO-VDP
$00E0-$00FE	Open for any use
$00FF	Reserved (No card)