p/n YPM08122

Parker Automation

ACR1500
Hardware Manual

Effective: October 7, 2002

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CHANGE NOTICE

ACR1500 Hardware Manual P/N PM08122 Version Change:
From: Version 1.01 Dated 6/17/2000
To: Version 1.02, Dated 12/5/2001

1. Page 10, Interrupt Select Jumper(JP9)	Corrected Table 1.5 jumper location.
2. Page 24, ACR1500 Technical Specification	Corrected operating temperature range. Added tolerances to power consumption values.

ACR1500 Hardware Manual P/N PM08122 Version Change:
From: Version 1.00 Dated 9/30/1999
To: Version 1.01, Dated 6/17/2000

1. Page 18, ACR1500 Board Hardware Wiring, TTL Digital I/O	Added warning about using opto-isolation.

ACR1500 Hardware Manual P/N PM08122 Version Change:
From: Version 1.00 Beta Release September 14, 1999
To: Version 1.00, Dated 9/30/1999

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INTRODUCTION

This document provides hardware connection information for the Acroloop ACR1500 motion controller.

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CHAPTER 1

ACR1500 BOARD HARDWARE SETUP

CHAPTER 1 OVERVIEW

This section contains diagrams of the jumpers and switches on the ACR1500 board.

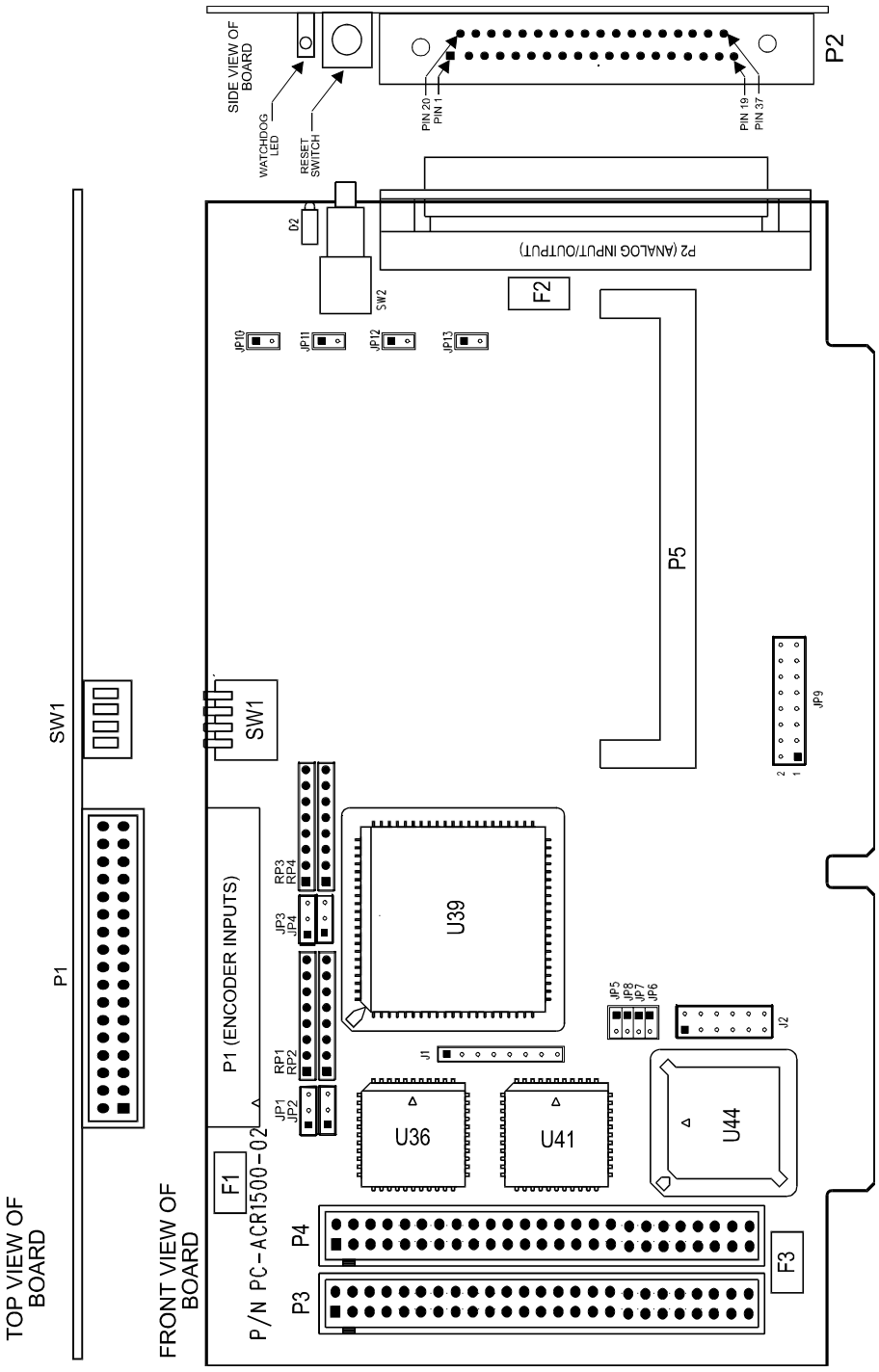
Encoder pull-up jumpers must be set correctly based on the types of encoders being used. Failure to set these jumpers correctly may cause damage to the encoders or to the receivers on the controller card.

There are no analog adjustment "pots" on the board. All analog gain and offset is under software control. The analog outputs must be wired to differential control signal inputs on a servo amplifier. The DAC outputs provide an analog control voltage of ±10 volts.

Stepper outputs provide open-collector step and direction signals. There are no pull-up resistors provided on the Stepper outputs.

DAC/Stepper Output configuration is set at the factory and is not field configurable.

Factory default jumper settings for the ACR1500 board are highlighted within the following jumper tables.



NOTE: Square pin indicates Pin 1.

Figure 1. ACR1500 Board Outline

ACR1500 BOARD SWITCHES

Address Selection Switch (SW1)

The ACR1500 can receive and transmit data through I/O ports on a PC BUS. The addresses of these ports are selectable using SW1 on the ACR1500 board. The data port is used to both transmit and receive. Both the transmit and receive channels are connected to 512 byte First In / First Out (FIFO) hardware buffers.

Refer to Figure 1 for switch location.

The status port is used to see if data is waiting to be received from the card and if it is OK to send data to the card. The byte read from the status port is defined as follows:

BIT	Definition	Description
BIT7	Transmit Not Full	Clear to send one byte
BIT6	Transmit Not Half Empty	Clear to send up to 255 bytes
BIT5	Receive Not Empty	Data Available
BIT4	Transmit Not Empty	Still something in the buffer

Table 1.1 ACR1500 PC BUS Status Port Bits

The following table shows how the switch positions relate to the ACR1500 card number and I/O port addresses.

Note that Switch 4 should be left in the "OFF" position, unless using the Flash Bypass Mode of operation. Flash Bypass Mode is selected when the user does not want to load the program information from flash at power-up or reset. The card will not communicate via the PC BUS at Card Number 15, so after the board is powered-up or reset in Flash Bypass Mode, the SW1 settings must be placed back to a valid card number.

Card Number	SW1 Settings				Addresses	
	4	3	2	1	Data	Status
0	OFF	OFF	OFF	OFF	0x300	0x302
1	OFF	OFF	OFF	ON	0x304	0x306
2	OFF	OFF	ON	OFF	0x308	0x30A
3	OFF	OFF	ON	ON	0x30C	0x30E
4	OFF	ON	OFF	OFF	0x310	0x312
5	OFF	ON	OFF	ON	0x314	0x316
6	OFF	ON	ON	OFF	0x318	0x31A
7	OFF	ON	ON	ON	0x31C	0x31E
8-14	RESERVED					
15	ON	ON	ON	ON	Flash Bypass Mode	

Table 1.2 ACR1500 PC BUS Port Addresses

ACR1500 BOARD JUMPERS

Jumper Table List

The following is a list of the jumper functions on the ACR1500 motherboard:

JUMPER	JUMPER FUNCTION
JP1	ENC0 Pull-up Voltage Select (Page 8)
JP2	ENC1 Pull-up Voltage Select (Page 8)
JP3	ENC2 Pull-up Voltage Select (Page 8)
JP4	ENC3 Pull-up Voltage Select (Page 8)
JP5	Reserved
JP6	Reserved
JP7	Reserved
JP8	Reserved
JP9	ISA Interrupt Select (Page 10)
JP10	Channel 0 DAC/Stepper Select (Page 11)
JP11	Channel 1 DAC/Stepper Select (Page 11)
JP12	Channel 2 DAC/Stepper Select (Page 11)
JP13	Channel 3 DAC/Stepper Select (Page 11)
J1	Factory Programming Header**
J2	Factory Test Header**

** Connecting external signals to these headers may cause board failure or damage to IC's.

ACR1500 BOARD JUMPERS

Encoder Pull-up Select Jumpers (JP1 thru JP4)

The ACR1500 is capable of handling various types of incremental open-collector and line driver encoders. Care must be taken to setup each channel to match the encoder type as described below:

Open Collector Encoders:

When using open-collector encoders, the encoder channels must be pulled to either +5 or +12 volts, depending upon the application. Pulling up to +12 volts provides higher noise immunity, but causes a slower response time. For high frequency applications (encoder rates higher than 1 megahertz) the +5 volt pull-up section may be necessary.

Line Driver Encoders:

When using line driver (or balanced pair) encoders, the corresponding resistor pack should be removed from it's socket. Leaving the resistor pack in the socket can cause faulty encoder operation and possibly severe encoder damage. Optionally, the resistor pack can be replaced with an 8-pin isolated resistor pack to supply termination resistance for the balanced signal pairs.

Pull-up Selection:

The following table lists the pull-up jumper settings for each encoder:

WARNING

Wiring a line driver encoder with the pull-up selected to +12 volts will permanently damage the encoder.

Encoder Pull-Up Jumpers				
Encoder	Resistor	Jumper	+5V	+12V
0	RP1	JP1	1-2	2-3
1	RP2	JP2	1-2	2-3
2	RP3	JP3	1-2	2-3
3	RP4	JP4	1-2	2-3

Table 1.3 ACR1500 Encoder Pull-Up Jumpers

Refer to Figure 1 for jumper location.

ACR1500 BOARD JUMPERS

Miscellaneous Function Jumpers (JP5 thru JP8)

These four (4) jumpers are reserved for future use.

Miscellaneous Jumpers	
Jumper	Function
JP5	RESERVED
JP6	RESERVED
JP7	RESERVED
JP8	RESERVED

Table 1.4 ACR1500 Miscellaneous Jumpers

Refer to Figure 1 for jumper location.

ACR1500 BOARD JUMPERS

Interrupt Select Jumper (JP9)

The ACR1500 can be instructed to interrupt a PC host through the parallel bus by issuing a SET 112 command in immediate mode or from within a program. Interrupt driven software at the host level is an advanced topic and should only be attempted by someone with a thorough knowledge of interrupt driven code.

In order for the PC to see the interrupt, the proper jumper selection from the following table must be made. IRQ5 is usually a good choice since printer code seldom uses interrupts and use of the secondary printer port (LPT2) is even rarer.

Level	JP9	Common Function
Disabled	1-3*	Not Applicable
IRQ3	1-2	Secondary Serial (COM2)
IRQ4	3-4	Primary Serial (COM1)
IRQ5	5-6	Secondary Parallel (LPT2)
IRQ7	7-8	Primary Parallel (LPT1)
IRQ10	9-10	Reserved (unused)
IRQ11	11-12	Reserved (unused)
IRQ12	13-14	Reserved (unused)
IRQ15	15-16	Reserved (unused)

Table 1.5 ACR1500 PC BUS Interrupt Select Jumpers

Refer to Figure 1 for jumper location.

IMPORTANT NOTE:

When the ACR1500 is used in a Pentium™ processor based PCI board, the selected interrupt must be configured in the PCI board BIOS as a Legacy ISA interrupt (or Used By ISA in some BIOS'), since the ACR1500 is an ISA board.

ACR1500 BOARD JUMPERS

DAC/Stepper Output Configuration Jumpers (JP10 thru JP13)

These four (4) jumpers are used to connect/disconnect the analog ground outputs to the P2 connector, based on the DAC/Stepper Configuration of the ACR1500 board.

When a DAC Output is present, installing the jumper provides connection from the analog ground to the P2 connector signal.

When a Stepper Output is present, removing the jumper disconnects the analog ground from the Direction signal at the P2 connector.

These jumpers are configured at the factory, based on the DAC/Stepper Outputs built onto the ACR1500 Board as follows:

DAC/Stepper Configuration Jumpers				
Jumper	P2 Output Channel	DAC4 Configuration	STEPPER4 Configuration	DAC2/STEPPER2 Configuration
JP10	Channel 0	IN	OUT	IN
JP11	Channel 1	IN	OUT	IN
JP12	Channel 2	IN	OUT	OUT
JP13	Channel 3	IN	OUT	OUT

Table 1.6 ACR1500 DAC/Stepper Configuration Jumpers

Refer to Figure 1 for jumper location.

ACR1500 BOARD HARDWARE WIRING

This section contains diagrams of the connectors on the ACR1500 board.

Encoder Inputs (P1)

There is one 34-pin header provided on the ACR1500 for encoder feedback. The 34-pin header provides up to four (4) axes of encoder feedback. Refer to Figure 1 for connector location.

Note: P1 is a 34-pin shrouded male header.

P1			
Usage	**Pin**	**Usage**	**Pin**
CHA0	1	CHA0’	2
CHB0	3	CHB0’	4
MRK0	5	MRK0’	6
VCC	7	GND	8
CHA1	9	CHA1’	10
CHB1	11	CHB1’	12
MRK1	13	MRK1’	14
VCC	15	GND	16
CHA2	17	CHA2’	18
CHB2	19	CHB2’	20
MRK2	21	MRK2’	22
VCC	23	GND	24
CHA3	25	CHA3’	26
CHB3	27	CHB3’	28
MRK3	29	MRK3’	30
VCC	31	GND	32
N/C	33	N/C	34

Table 1.7 ACR1500 Encoder Input Connector

Encoder Inputs (P1), Continued

The ACR1500 can accept any feedback device that supplies either a +5V or +12V differential signal to the ACR1500. The most common type of device is a differential encoder. Refer to the table below for common encoder setups.

Encoder Type	ACR1500 Pull-up/Jumper Setting	Length of Cable/Type
Differential Line Driver (+5 Volt Outputs)	Remove Pull-ups	100 ft. (Beldon 9330 Shielded Twisted Pair)
Open Collector Driver (No Pull-ups on Encoder)	Install Pull-ups and Jumper to +12V	75 ft. (Beldon 9330 Shielded Twisted Pair)
Open Collector Driver (With Pull-ups to +5 V on Encoder)	Install Pull-ups and Jumper to +5V	50 ft. (Beldon 9330 Shielded Twisted Pair)
TTL Driver (+5 Volt Outputs)	Remove Pull-ups	50 ft. (Beldon 9330 Shielded Twisted Pair)

When using a single-ended encoder (an encoder without the A-, B-, or Z- outputs), additional pull-ups and pull-down resistors must be added externally to the ACR1500 board in order for the ACR1500 to read the encoder signals. Warning: This is not a recommended mode of operation. Noise immunity is significantly reduced.

Refer to the ACR1500 Typical Connection Diagram section of this manual for details on wiring a single-sided encoder to the ACR1500.

Encoder Inputs (P1), Continued

A fused +5VDC Encoder Output (EVCC) is available on the P1 connector for use with wiring the encoders. The maximum recommended output rating for EVCC is 100 milliamps per encoder (400 milliamps, maximum).

See Figure 1 for fuse F1 location.

Encoder +5VDC Output Fuse			
Fuse	Circuit	Amps	Littelfuse Part No.
F1	EVCC	0.750	154.750

Table 1.8 ACR1500 Encoder Power Fuses

Analog Input/Output (P2)

The analog input/output connections are made through a 37-pin D-style connector on the side of the ACR1500 motion controller. Refer to Figure 1 for connector location.

Note: P2 is a standard 37-pin female D-plug.
Pin definitions in parentheses are for stepper modules.

P2				
Definition	**Pin**	**Pin**	**Definition**	**Function**
ASIG-0 (STEP-0)	1	20	AGND-0 (DIR-0)	Channel 0 DAC/Stepper
ASIG-1 (STEP-1)	2	21	AGND-1 (DIR-1)	Channel 1 DAC/Stepper
ASIG-2 (STEP-2)	3	22	AGND-2 (DIR-2)	Channel 2 DAC/Stepper
ASIG-3 (STEP-3)	4	23	AGND-3 (DIR-3)	Channel 3 DAC/Stepper
SVCC	5	24	SVCC	Stepper VCC
SVCC	6	25	SVCC	
	7	26		
	8	27		
AIN-0	9	28	AIN-1	ADC Input Module (P5)
AIN-2	10	29	AIN-3	
AIN-4	11	30	AIN-5	
AIN-6	12	31	AIN-7	
(LCUR-0)	13	32	(LCUR-1)	Channel 0/1 Stepper
(LCUR-2)	14	33	(LCUR-3)	Channel 2/3 Stepper
	15	34		
	16	35		
GND	17	36	WATCHDOG	Watchdog Output
GND	18	37	WATCHDOG#	Watchdog Output
AGND	19			ADC Input Module

Table 1.9 ACR1500 Analog I/O Connector

Analog Input/Output (P2), continued

A fused +5VDC Stepper Output (SVCC) is available on the P2 connector for use with wiring the Stepper outputs. The maximum recommended output rating for SVCC is 250 milliamps.

See Figure 1 for fuse F2 location.

Stepper +5VDC Output Fuse			
Fuse	Circuit	Amps	Littelfuse Part No.
F2	SVCC	0.500	154.500

Table 1.10 ACR1500 Stepper Power Fuses

TTL Digital Inputs / Outputs (P3/P4)

☠ WARNING

Wiring TTL Digital Inputs and Outputs without using an Opto-22 Compatible opto-isolation interface or equivalent may cause intermittent board operation or permanently damage the ACR1500 circuitry.

There are two 50-pin Opto-22 Compatible headers provided on the ACR1500 for TTL Digital I/O Interface. Refer to Figure 1 for connector location.

TTL Digital I/O signals I/O-00 thru I/O-47 are programmable in groups of eight (8) inputs or outputs and are defined in software by the user. The logic polarity (i.e. positive logic or negative logic) of the inputs and outputs is also programmable. Refer to the User's Guide, Config Command, for programming details.

The TTL Digital I/O signals are wired directly to 82C55 programmable interface IC's. The inputs and outputs of the 82C55 IC's are TTL-compatible. Outputs have a 2.5mA drive capability. At power-up or reset, the 82C55 IC's I/O are set as inputs. After the board has completed initialization (the Watchdog output at the P2 connector will also become active at this time -- approximately 0.5 to 0.7 seconds), the 82C55 IC's inputs and outputs are set to the user's configured mode of operation.

The default mode of operation for the ACR1500 Digital I/O is Mode 0 (24 Inputs/24 Outputs). The default logic level for the inputs and outputs is set at negative polarity (negative logic), which is compatible with the Opto-22 negative logic levels. This will ensure that any unconnected inputs will be in the "OFF" state. There are no pull-up or pull-down resistors provided on-board.

The following table shows the definitions of the negative and positive logic for the digital input and output levels.

Input/Output State	Negative Logic Input TTL Level	Positive Logic Input TTL Level
ON	Logic Level Low	Logic Level High
OFF	Logic Level High	Logic Level Low

Table 1.11 ACR1500 TTL Digital I/O Logic Levels

TTL Digital Inputs / Outputs, continued

Note: P3 and P4 are 50-pin shrouded male headers. These headers are Opto-22 compatible.

P3			
Usage	**Pin**	**Pin**	**Usage**
I/O-47	1	2	GND
I/O-46	3	4	GND
I/O-45	5	6	GND
I/O-44	7	8	GND
I/O-43	9	10	GND
I/O-42	11	12	GND
I/O-41	13	14	GND
I/O-40	15	16	GND
I/O-39	17	18	GND
I/O-38	19	20	GND
I/O-37	21	22	GND
I/O-36	23	24	GND
I/O-35	25	26	GND
I/O-34	27	28	GND
I/O-33	29	30	GND
I/O-32	31	32	GND
I/O-31	33	34	GND
I/O-30	35	36	GND
I/O-29	37	38	GND
I/O-28	39	40	GND
I/O-27	41	42	GND
I/O-26	43	44	GND
I/O-25	45	46	GND
I/O-24	47	48	GND
IOVCC	49	50	GND

P4			
Usage	**Pin**	**Pin**	**Usage**
I/O-23	1	2	GND
I/O-22	3	4	GND
I/O-21	5	6	GND
I/O-20	7	8	GND
I/O-19	9	10	GND
I/O-18	11	12	GND
I/O-17	13	14	GND
I/O-16	15	16	GND
I/O-15	17	18	GND
I/O-14	19	20	GND
I/O-13	21	22	GND
I/O-12	23	24	GND
I/O-11	25	26	GND
I/O-10	27	28	GND
I/O-09	29	30	GND
I/O-08	31	32	GND
I/O-07	33	34	GND
I/O-06	35	36	GND
I/O-05	37	38	GND
I/O-04	39	40	GND
I/O-03	41	42	GND
I/O-02	43	44	GND
I/O-01	45	46	GND
I/O-00	47	48	GND
IOVCC	49	50	GND

Table 1.12 ACR1500 Digital I/O Connectors

TTL Digital Inputs / Outputs (P3/P4), continued

The following table provides the IO Mode configuration information, as well as the Bit Flag location for each group of inputs and outputs.

The Bit Flag locations for the ACR1500 TTL Digital I/O are mapped to the standard Input Bit Flags 0 thru 31 (parameter P4096) and Output Bit Flags 32 thru 63 (parameter P4097). When the number of inputs or outputs configured exceeds 32, they are mapped to the Expansion Input Bit Flags 256 thru 271 (parameter P4104) and/or Expansion Output Bit Flags 288 thru 303 (parameter P4105).

There is also one bit (Bit 116, Reference User's Guide, Miscellaneous Outputs Flags) which acts as an expansion enable control bit. For proper operation of Acroloop Motion Control Systems ACROCUT/ACROMILL application software, this enable bit must be set when using IO modes that use expansion input or output bit flags.

CONFIG IO MODE	I/O00-I/O07	I/O08-I/O15	I/O16-I/O23	I/O24-I/O31	I/O32-I/O39	I/O40-I/O47
0	INPUTS BIT0-7	INPUTS BIT8-15	INPUTS BIT16-23	OUTPUTS BIT32-39	OUTPUTS BIT40-47	OUTPUTS BIT48-55
1	INPUTS BIT0-7	INPUTS BIT8-15	INPUTS BIT16-23	OUTPUTS BIT32-39	OUTPUTS BIT40-47	INPUTS BIT24-31
2	INPUTS BIT0-7	INPUTS BIT8-15	OUTPUTS BIT56-63	OUTPUTS BIT32-39	OUTPUTS BIT40-47	OUTPUTS BIT48-55
3	INPUTS BIT0-7	INPUTS BIT8-15	INPUTS BIT16-23	OUTPUTS BIT32-39	INPUTS BIT256-263	INPUTS BIT24-31
4	INPUTS BIT0-7	OUTPUTS BIT288-295	OUTPUTS BIT56-63	OUTPUTS BIT32-39	OUTPUTS BIT40-47	OUTPUTS BIT48-55
5	INPUTS BIT0-7	INPUTS BIT8-15	INPUTS BIT16-23	INPUTS BIT264-271	INPUTS BIT256-263	INPUTS BITS24-31
6	OUTPUTS BIT296-303	OUTPUTS BIT288-295	OUTPUTS BIT56-63	OUTPUTS BIT32-39	OUTPUTS BIT40-47	OUTPUTS BIT48-55

Table 1.13 ACR1500 Digital I/O Mode Configuration Table

TTL Digital Inputs / Outputs (P3/P4), continued

A fused +5VDC IO Output (IOVCC) is available on the P3/P4 connectors for use with Opto-22 input and output racks.

See Figure 1 for fuse F3 location.

Digital IO +5VDC Output Fuse			
Fuse	Circuit	Amps	Littelfuse Part No.
F3	IOVCC	2	154.002

Table 1.14 ACR1500 Digital IO Power Fuses

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CHAPTER 2
SPECIFICATIONS

ACR1500 SPECIFICATION

ITEM	SPECIFICATION
CPU:	32 Bit Floating Point DSP @ 40 MHz
Processor Type:	Texas Instruments TMS320C32
Board Size:	1 Slot 7.3" x 4.25" Half-Size PC Form Factor
Axis Configuration:	2 or 4 axes configurations
Weight:	7 ounces
Operating Temperature:	0°C to 50°C (32°F to 122°F)
Humidity:	0 to 95%, Non-Condensing
Power Consumption:	+5 +/- 0.2 VDC @ 1.5A +12 +/- 0.5 VDC @ 0.15A -12 +/- 0.5 VDC @ 0.15A Note: Power consumption does not include any additional power required for external components (Encoders, Stepper Outputs, etc.).
Encoder Inputs:	Up to 4 per card Differential Quadrature Encoder Open-Collector or Line Driver 0.1 Hz to 8 MHz Frequency Range Fused +5VDC Encoder Output available on P1 connector, up to 100mA maximum power source per channel
DAC/Stepper Outputs:	Up to 4 per card DAC Outputs: +/- 10VDC @ 5mA, maximum Programmable Output (DAC GAIN, DAC OFFSET) 16 Bit Resolution Single Ended input amplifiers can be used if caution is used to avoid ground loops. Stepper Outputs: Open-Collector Step, Direction, and Low Current Outputs (no pull-up resistors on-board); 30 milliamps, maximum output drive capability, Fused +5VDC Stepper Output available on P2 connector up to 250 mA. Step Output Frequency : 0 to 6 KHz, pulse width 167us 6 kHz to 4 MHz, approx. 50% duty cycle

ACR1500 SPECIFICATION, continued

ITEM	SPECIFICATION
Feedback Types:	Any Differential 5VDC or 12VDC including: - Quadrature Encoder - Glass Scales - Analog (Optional)
Watchdog Output:	Open-Collector Output (no pull-ups on board), 30milliamps, max. output drive capability Active-High and Active-Low Signals available Hardwired through the P2 analog header
Digital Inputs/Outputs:	48 TTL-Compatible Inputs/Outputs, Programmable in groups of 8, Opto-22 Compatible Interface
A/D Inputs (On-Board Option):	Up to 8 single-ended or up to 4 differential 12 bit or 16 bit resolution available Configurable for various analog inputs
Communications:	PC-Bus standard
Serial Communications:	Not Available

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CHAPTER 3

ACR1500 MECHANICAL DRAWINGS

ACR1500 MECHANICAL DIMENSIONS

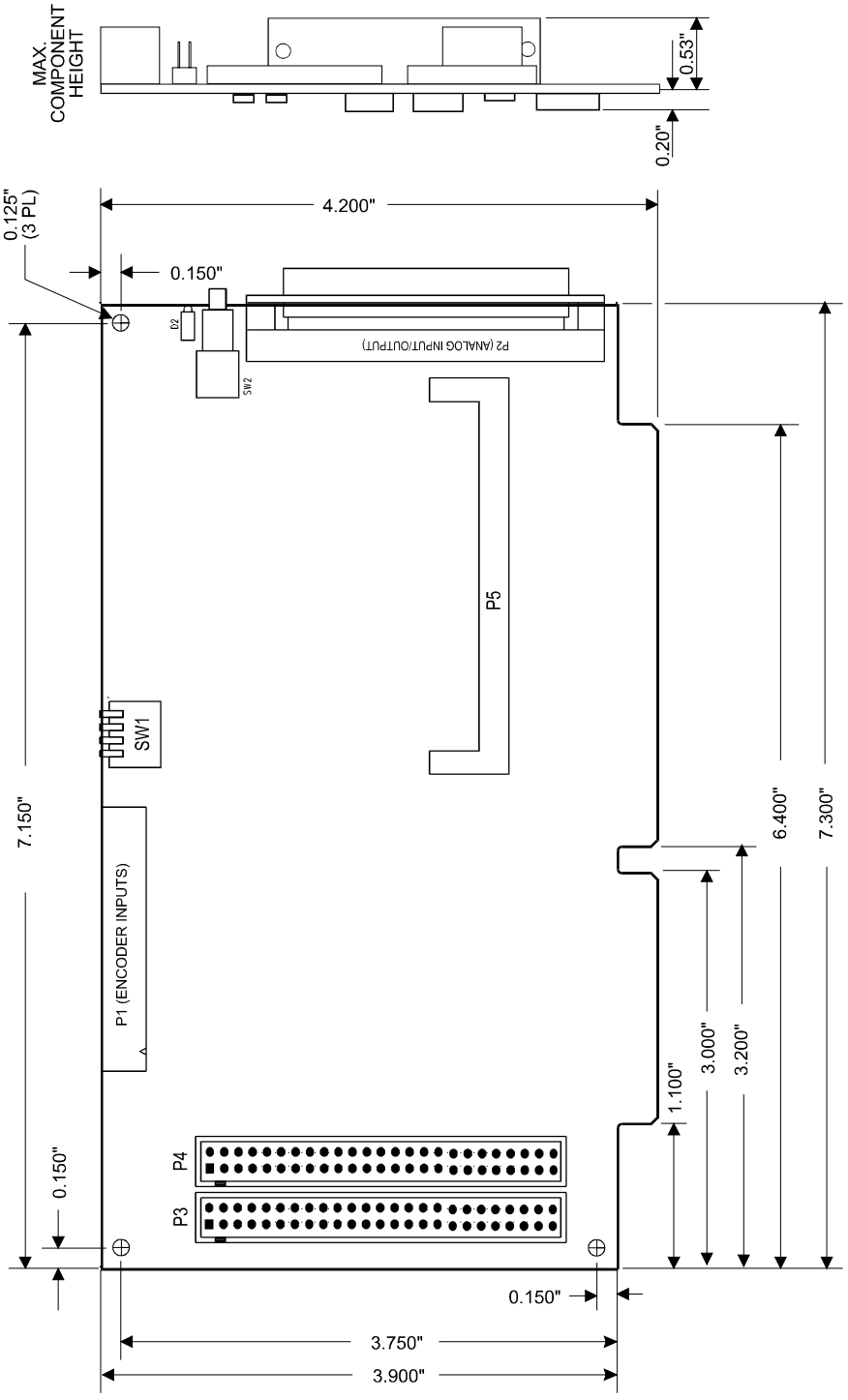

Figure 2. ACR1500 Mechanical Dimensions

ACR1500 TYPICAL CONNECTION DIAGRAMS

The following schematic sheets represent some typical connection and wiring diagrams for the ACR1500 Board and associated plug-in modules:

For electronic media, refer to the typical connection drawing file, ACR1500 TYPICAL CONNECTIONS.PDF, supplied separately on the AMCS CD P/N CD2000 under the \DOCS directory.