User Guide

ACR7000 Controller

Effective: September 2020
Document Number: 88-033593-01A

ENGINEERING YOUR SUCCESS.

User Information

Warning: **ACR7000 products are used to control electrical and mechanical components of motion control systems. You should test your motion system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.**

ACR7000 products and the information in this guide are the proprietary property of Parker Hannifin Corporation or its licensers, and may not be copied, disclosed, or used for any purpose not expressly authorized by the owner thereof.

Since Parker Hannifin constantly strives to improve all its products, we reserve the right to change this guide, and software and hardware mentioned therein, at any time without notice.

In no event will the provider of the equipment be liable for any incidental, consequential, or special damages of any kind or nature whatsoever, including but not limited to lost profits arising from or in any way connected with the use of the equipment or this guide.

Contact Information for Technical Assistance

Contact your local automation technology center (ATC) or distributor.

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EU DECLARATION OF CONFORMITY

88-033629-01A

Equipment:	ACR7xC-A0V2C1-ANI
Name of Manufacturer:	Parker Hannifin Corporation Electromechanical & Drives, NA
Address of Manufacturer:	5500 Business Park Drive Rohnert Park, CA 94928 USA tel (800) 358-9068 fax (707) 584-8015

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Object of the Declaration: Multi-axis Servo/Stepper Controller 24 VDC

Model Numbers ACR7xC-A0V2C1 (x is number of axes: 2,4,6,8)

Model Numbers ACR7xC-A0V2C1-ANI (-ANI includes Analog Input Option)

The object of the declaration described above is in conformity with the protection requirements of the following Council Directives on the approximation of the laws of the Member States relating to Electromagnetic Compatibility when installed, operated and maintained as intended:

2014/30/EU	Electromagnetic Compatibility Directive
2011/65/EU	Restriction of Hazardous Substances Directive

Compliance is demonstrated by the application of the following standards:

Electromagnetic Compatibility

IEC 61800-3:2018

Adjustable speed electrical power drive systems –

Part 3: EMC requirements and specific test methods

The installation requirements are detailed in the User Guide supplied with the equipment.

Year in which CE mark first affixed:2020

Warning: **Risk of damage and/or personal injury.**
The ACR7000 Controller described in this guide contains no user-serviceable parts. Attempting to open the case of any unit, or to replace any internal component, may result in damage to the unit and/or personal injury. This may also void the warranty.

The following symbols appear in this guide:

Symbols	Description
	Protective Earth Ground
	Functional Earth (Ground) Terminal
	Shield, Frame, or Chassis Terminal
	Digital Ground
	Isolated Ground
	Caution Risk of Electrical Shock
	Caution, Refer to Accompanying Documentation

Important Safety Information

It is important that motion control equipment is installed and operated in such a way that all applicable safety requirements are met. It is your responsibility as an installer to ensure that you identify the relevant safety standards and comply with them; failure to do so may result in damage to equipment and personal injury. In particular, you should study the contents of this user guide carefully before installing or operating the equipment.

The installation, set up, test and maintenance procedures given in this user guide should only be carried out by competent personnel trained in the installation of electronic equipment. Such personnel should be aware of the potential electrical and mechanical hazards associated with mains-powered motion control equipment—please see the safety warnings below. The individual or group having overall responsibility for this equipment must ensure that operators are adequately trained.

Under no circumstances will the suppliers of the equipment be liable for any incidental, consequential or special damages of any kind whatsoever, including but not limited to lost profits arising from or in any way connected with the use of the equipment or this guide.

Warning: **High-performance motion control equipment can produce rapid movement and very high forces. Unexpected motion may occur especially during the development of controller programs. KEEP WELL CLEAR of any machinery driven by stepper or servo motors. Never touch any part of the equipment while it is in operation.**

This product is sold as a motion control component to be installed in a complete system using good engineering practice. Care must be taken to ensure that the product is installed and used in a safe manner according to local safety laws and regulations. In particular, the product must be positioned such that no part is accessible while power may be applied.

This and other information from Parker Hannifin Corporation, its subsidiaries, and authorized distributors provides product or system options for further investigation by users having technical expertise. Before you select or use any product or system, it is important that you analyze all aspects of your application and review the information concerning the product in the current product catalog. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, safety, and warning requirements of the application are met.

If the equipment is used in any manner that does not conform to the instructions given in this user guide, then the protection provided by the equipment may be impaired.

Contents

CHAPTER 1
Introduction

ACR7000 Controller - Overview

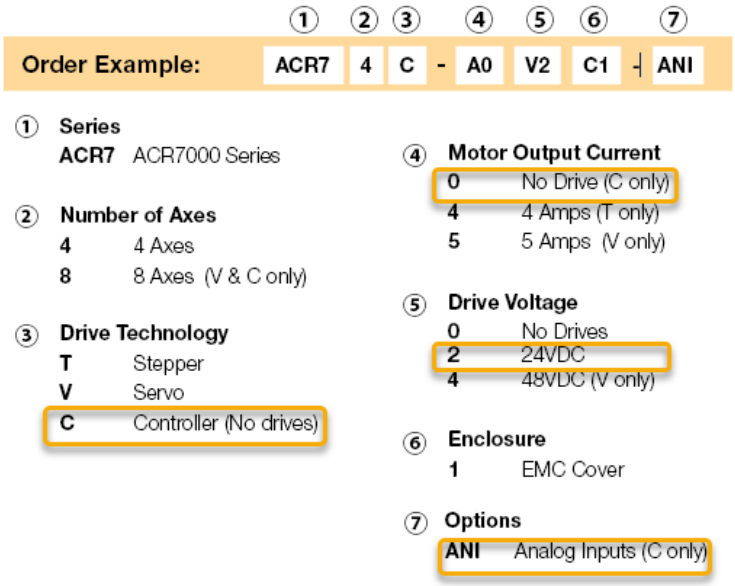
The ACR7000 Controller, part of the ACR7000 family, is a multi-axis motion controller. Setup and programming are accomplished using the AcroBASIC language within the Parker Motion Manager programming environment.

Product Description

The ACR7000 Controller shares the control capability and ACROBasic programming language with the ACR7000 family of controllers and integrated drive products.

ACR7000 Part Numbers

The following diagram explains the ACR7000 part numbers:



Four unique controller models are available. Except for the number of axes and physical dimensions almost all specifications are shared between the 2 models. This manual will use the designation ACR7xC or ACR7000 Controller when referring to common specifications.

Model	Description
ACR74C-A0V2C1	4 Axis Controller
ACR78C-A0V2C1	8 Axis Controller
ACR74C-A0V2C1-ANI	4 Axis Controller with Analog Inputs
ACR78C-A0V2C1-ANI	8 Axis Controller with Analog Inputs

Checking Your Shipment

Confirm that you have received all items in the table below. If you are missing an item, call the factory. For contact information, see Contact Information for Technical Assistance at the beginning of this guide.

The following items ship with the ACR7000 Controller. The connectors are inserted in the controller during shipment and are not packaged separately.

Part Name	QTY per Controller
	ACR7xC
Connector 2 pin (Enable and Control power)	2
Connector 16 pin (Analog Inputs	1 (Only with -ANI option)

Assumptions of Technical Experience

To effectively install and troubleshoot the ACR7000, you must have a fundamental understanding of the following:

- Motion control applications
- Electromechanical actuators
- Voltage, current, switches, and other electrical concepts
- Basic Programming

Technical Support

For solutions to questions about implementing the drive, first refer to this manual. If you cannot find the answer in this documentation, contact your local Automation Technology Center (ATC) or distributor for assistance.

If you need to talk to our in-house Application Engineers, please contact us at the telephone numbers listed in the "Contact Information for Technical Assistance" table on page 2.

CHAPTER 2
Mechanical Installation

Environment & Drive Cooling

The ACR7000 Controllers operate in an ambient temperature range of 0°C (32°F) to 50°C (120°F) ambient air temperature. The product can tolerate atmospheric pollution degree 2. Only dry, non-conductive pollution is acceptable. Therefore, it is recommended that the product be mounted in a suitable enclosure.

For proper cooling, the ACR7000 must be installed so that the cooling vents allow for vertical air flow. Figure 3 on page 17 shows the mounting orientation, as well as the minimum top, bottom, and side installation clearances.

NOTES:

- **Avoid installing heat-producing equipment directly below a controller.**
- **Make sure the ambient air temperature entering the controller or rising to the controller is within acceptable ambient temperature limits. Under normal use, the temperature of air leaving the controller and heat sink may be 25°C (45°F) above ambient temperature.**
- **After installation, verify that the ambient air temperature directly below the top-most controller does not exceed the maximum Ambient Air Operating Temperature shown below. In addition, make sure that nothing obstructs the circulating airflow.**

Environmental Specifications

Operating Temperature	Maximum 50°C (120°F)
Ambient Air	Minimum 0°C (32°F)
Storage Temperature	–40°C to 85°C (–40°F to 185°F)
Humidity	0 to 95%, non-condensing
Shock	15g, 11 ms half-sine
Vibration	10 to 2000 Hz at 2g
Pollution Degree	2 (per IEC 61010)
Installation Category	2 (per IEC 61010)

Dimensions

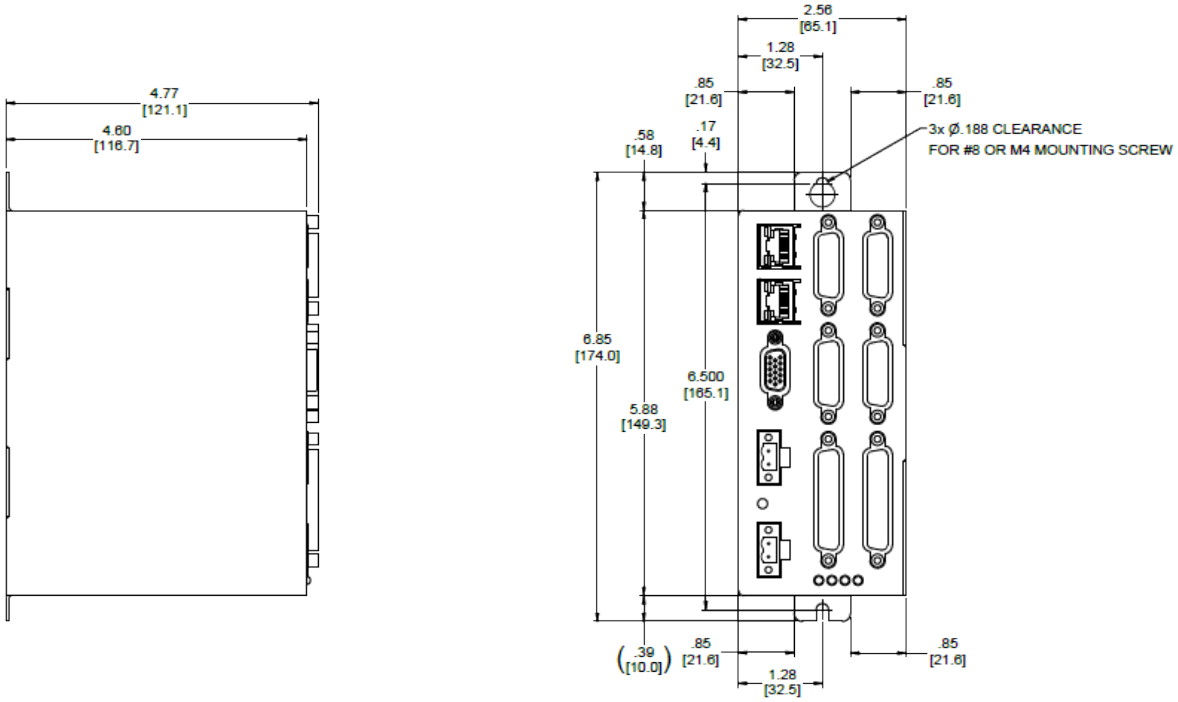


Figure 1. - *ACR74C Dimensions*

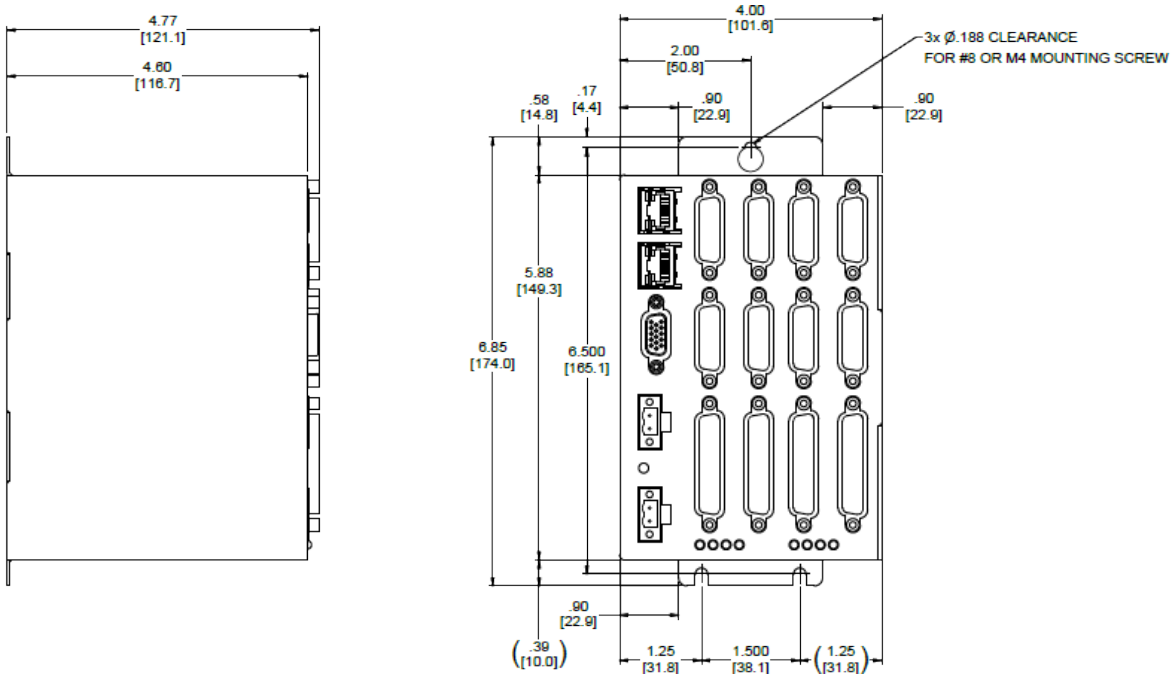


Figure 2. - *ACR78C Dimensions*

Mounting Orientation

The ACR7000 should be mounted to a vertical surface in the orientation shown below to allow for vertical air flow through the cooling vents on the top and bottom of the product

Consult factory to review applications where vertical mounting is not possible.

Note	Inch (mm)
A -Top/Bottom	1.0 (25)
C - Sides	0.25 (6)

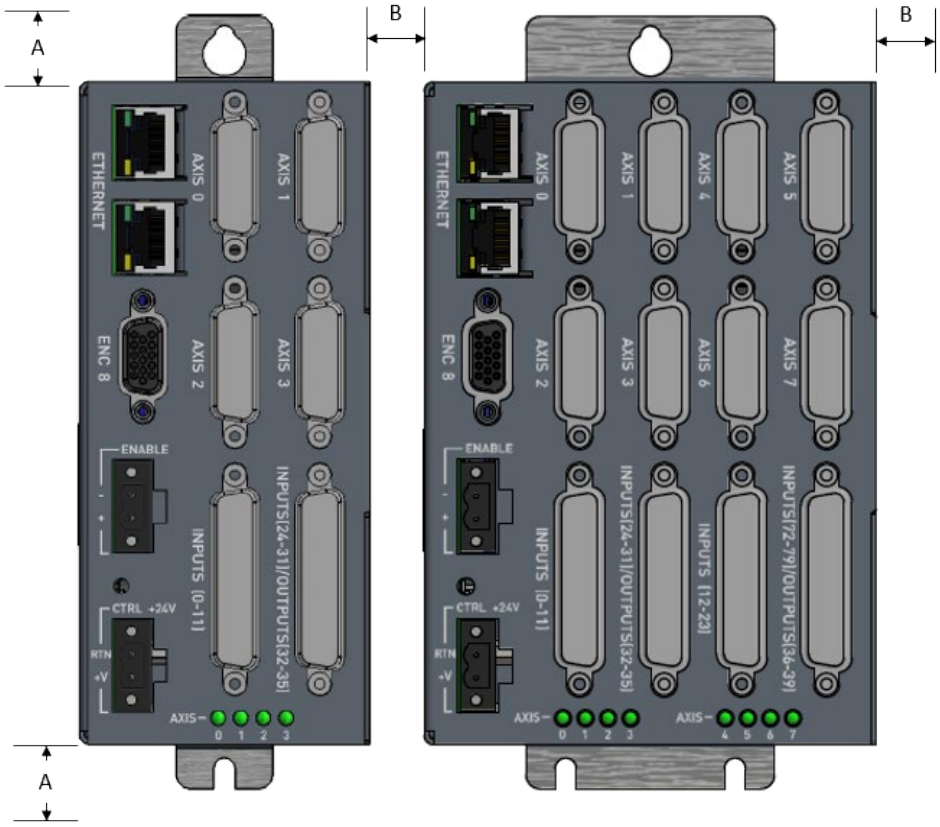


Figure 3. - *Mounting Clearance*

Weight

The following table lists the weight of each controller model.

Controller Weights

Model	Weight pounds (kg)
ACR74C	1.9 (0.9)
ACR78C	2.7 (1.2)

Mounting Guidelines

The ACR7000C Controllers are vented products. To prevent material spilling into the controller, mount it under an overhang or in a suitable enclosure and mounted to a metallic, grounded (RF fashion) mounting plate is required to meet the EMC performance required by IEC 61800-3.

ACR7000C products are made available under "Restricted Distribution" for use in the "Second Environment" as described in the publication EN 61800-3 ed2.0.

Cable Routing

Route high power cables (motor and mains) at right angles to low power cables (communications and inputs/outputs). Never route high and low power cables parallel to each other.

CHAPTER 3
Electrical Installation

Installation Safety Requirements

The ACR7000 Controller has been shown to meet the CE requirements for Electromagnetic Compatibility (IEC 61800-3 ed2.0 per 204/108/EC) when installed, operated and maintained as described in the product User Guide.

As a rule, it is recommended that the ACR7xC be installed in an enclosure to protect it from atmospheric contaminants and to prevent operator access while power is applied. Metal equipment cabinets are ideally suited for housing the equipment because such cabinets provide operator protection and EMC screening, and can be fitted with interlocks arranged to remove all hazardous motor and drive power when the cabinet door is opened.

Precautions

During installation, take the normal precautions against damage caused by electrostatic discharges.

- Wear earth wrist straps.
- Include a mains power switch or circuit breaker within easy reach of the machine operator. Clearly label the switch or breaker as the disconnecting device.

Warning: **High-performance motion control equipment can produce rapid movement and very high forces. Unexpected motion may occur especially during the development of controller programs. KEEP WELL CLEAR of any machinery driven by stepper or servo motors. Never touch any part of the equipment while it is in operation.**

System Installation Overview

This section details the components and configuration necessary for electrical installation of the ACR7000 Controller.

Installation of a motion control system requires an ACR7000, one or more compatible drive and motor 24VDC Power Supplier and access to a computer. Refer to the following figure for a diagram of this system.

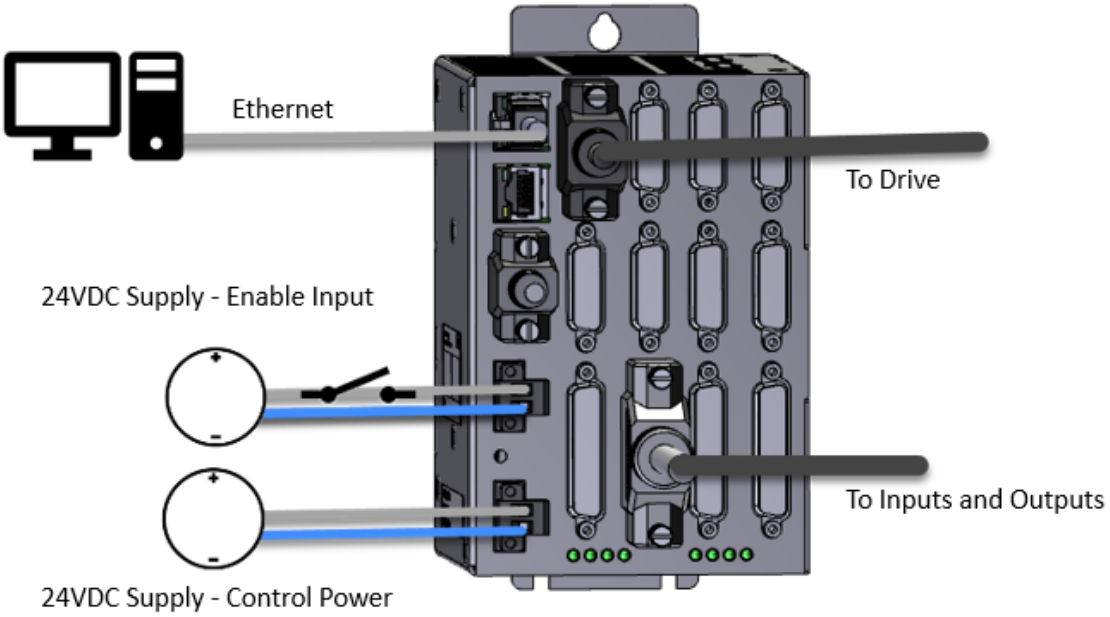


Figure 4. - *System Installation Overview*

Startup Process

1. Before powering the system for the first time, disconnect power from the Enable Input.
2. Complete wiring connections outlined in Chapter 3
3. Establish communications via Ethernet. Chapter 4
4. Generate controller configuration. Chapter 5.
5. Engage enable input and test motion. If undesired motion occurs, disengage Enable Input to stop motion immediately

Warning: **Before inserting or removing any connectors or wires from the controller, all Input power should be turned off.**

Connectors

Connector specifications are in this section.

The following figure shows the name and location of the connectors.

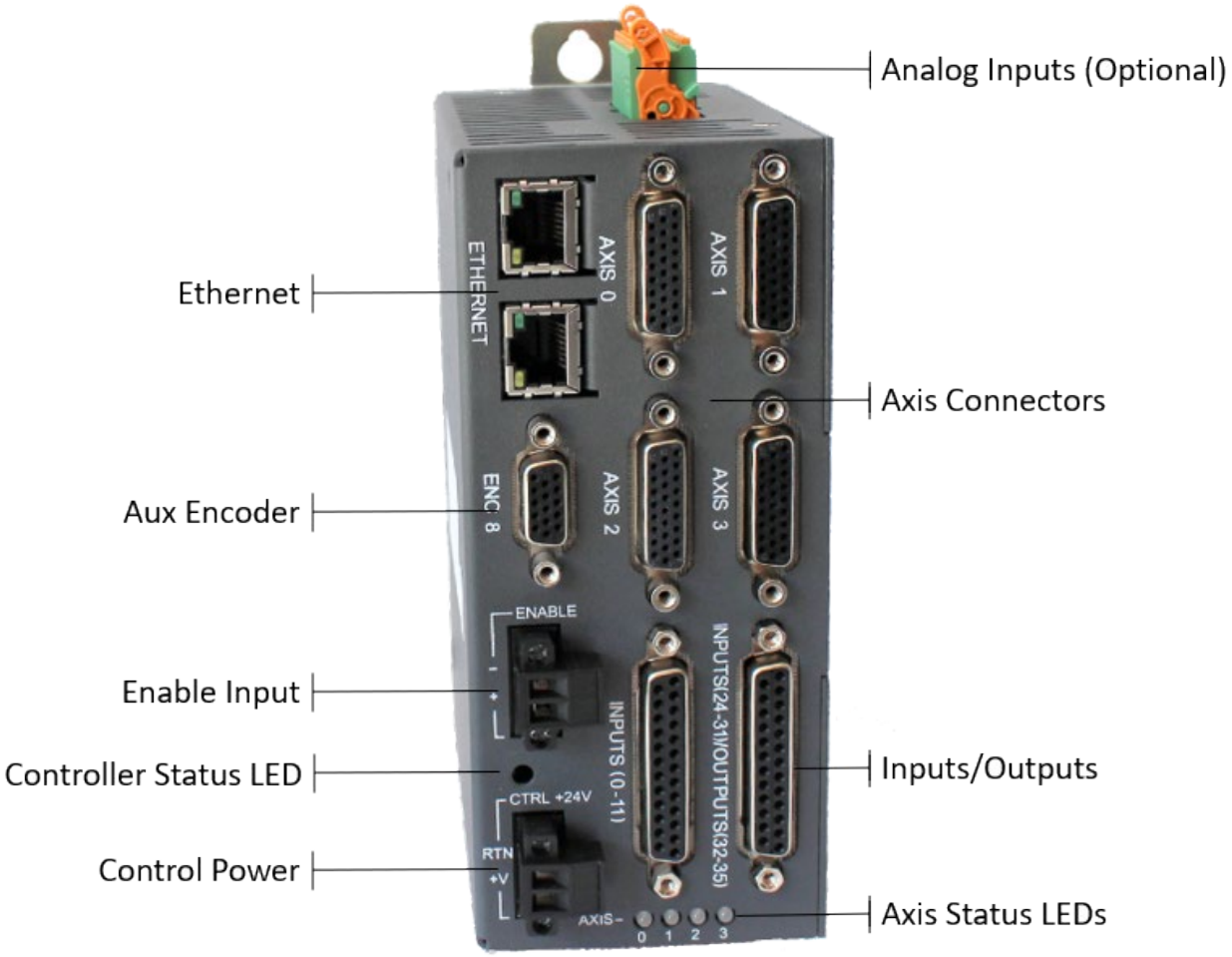


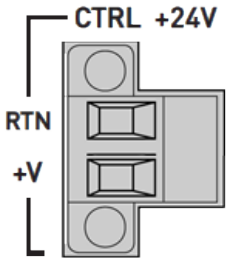
Figure 5. - *ACR74C Connectors*

CTRL - Control Power Connector

The Control power connector provides power for:

- Logic for the controller
- Communications
- Encoders
- +5V for Drive I/O

Control Power Connector



Description	Specification
Connector Type	Removable screw terminal
Terminals	2
Pitch	0.200 in (5.08 mm)
Wire range	12-24 AWG (0.34-2.5 mm2)
Wire strip length	0.3 in (7-8 mm)
Torque	5 in–lbs. nom. (0.5 N-m)
Manufacturer	OnShore or equivalent
OnShore Part Number	OSTTJ020152 (black) OSTTJ025152 (green)

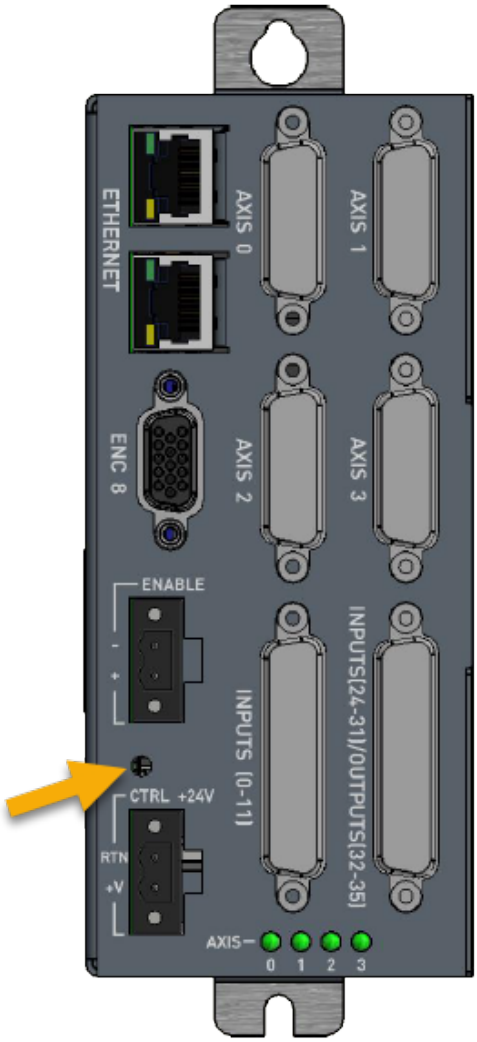
Control Power Rating

Description	ACR74C	ACR78C
Nominal Operating Voltage	24VDC	
Minimum Voltage	19VDC	
Maximum Voltage	30VDC	
Minimum Current (no encoders)	0.2A	0.3A
Maximum Current	1.5	2.5A
Protection	Reverse Polarity, Overvoltage	

The power required for the control input depends on what external devices are supplied through the controller.

Warning: **To avoid possible memory corruption, do NOT cycle power during FLASH memory operations**

Control Power LED



The Control power LED indicates the operating status of the controller.

Note: LED does not have a plastic lens cover. Open hole in sheet metal exposes LED on internal circuit board

Color	Status
Off	Control Power is off.
Red	Booting (less 2 seconds)
Green	Ready

ENABLE – Enable Input Connector

The Enable Input must be connected to 24VDC in order to enable external drives and provide command signals. If the input goes inactive, that inactive state is latched and the ACR7000 reacts by doing the following:

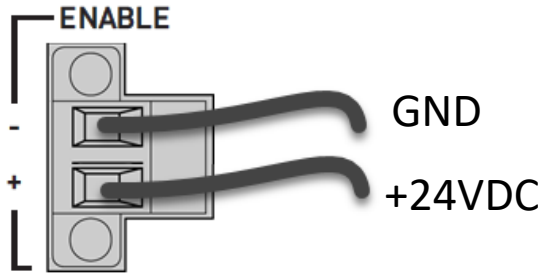
- Disabling the drives
- Blocking motion command signals

The status of the motion enable input is shown in BIT5646, where active is a cleared or 0 state, and inactive is a set or 1 state.

When the enable input goes inactive, BIT5645 is set and latched until voltage is present again on the enable input and either:

- The DRIVE ON command is issued for one of the Axes or,
- Clear Motion Enable Input Latch bit is asserted, SET BIT 5647

NOTE: The Motion Enable Input can be used as a part of a circuit to prevent motion and remove power from the motors. Note that if the input is deactivated while in motion, motors will stop immediately without a deceleration ramp.



Enable Connector

Description	Specification
Connector Type	Removable screw terminal
Terminals	2
Pitch	0.200 in (5.08 mm)
Wire range	12-24 AWG (0.34-2.5 mm2)
Wire strip length	0.3 in (7-8 mm)
Torque	5 in–lbs. nom. (0.5 N-m)
Manufacturer	OnShore or equivalent
OnShore Part Number	OSTTJ020152 (black) OSTTJ025152 (green)

Axis Connectors

The ACR7000 controllers employ a single connector that handles both the encoder and drive signals—the Axis connector. Depending on the configuration of the ACR7000 controller, there are four or eight axis connectors on the front panel. They are labeled AXIS 0 through AXIS 7. The axis connector is a 26-pin, female D-sub, high-density connector.

Functionality includes:

- +/-10V Analog command
- Step/Direction
- Drive Enable and Reset Output
- Drive Fault Input
- 5VDC source for Drive I/O
- Encoder Input
- 5VDC source for Encoder

Parker offers cables for connecting the ACR7000 controller to servo and stepper drives. Cables are listed in the Appendix.

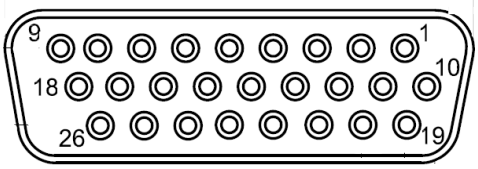


Figure 6. - *I/O Connectors*

Axis Connector Specification

Description	Specification
Connector Type	26-Pin D-Subminiature (female socket)
Manufacturer	KYCON or equivalent
KYCON Part Number	K66X-A26S-NR

Axis Connector Specification—Mating Connector[1]

Description	Specification
Connector Type	26-pin, high density D-sub, 3-row (male connector)
Manufacturer	TE Connectivity AMP Connectors or equivalent
Cable Kit	AMP Part Number 1658679-1 includes: • 1658679-1 connector • shield • enclosure • two jack screws • (does not include contacts or ferrules)
Contacts	Crimp style: TE Connectivity AMP Part Number 1658670-2

[1] Mating connectors are not provided

Axis Connector Pinout

Pinout configuration for the Axis connectors are listed in the following table.

Note: If the Enable Drive I/O flag is set, then the AcroBASIC direct I/O commands can only report the output status and not set or clear the output state. The default state for all axes is Enable Drive I/O flag set.

I/O Connector Pinout

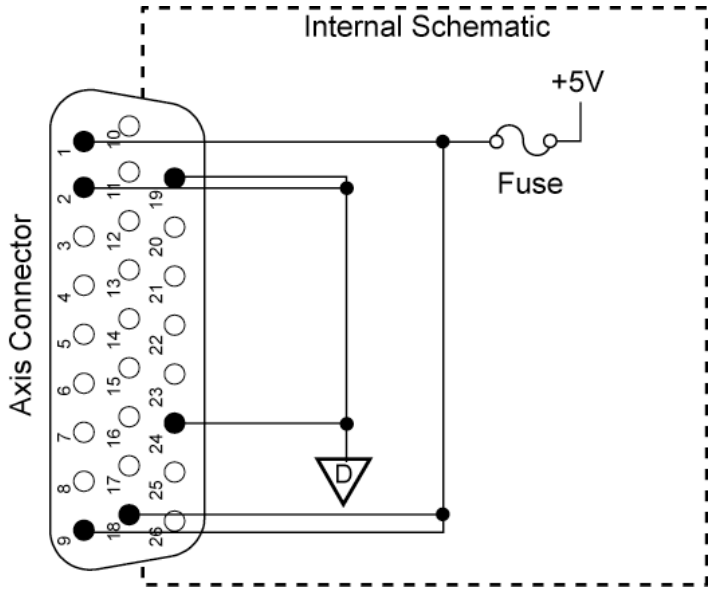
	Axis Connector	AcroBASIC Direct I/O Reference							
Pin	Signal	Axis0	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7
1	5 VDC PWR								
2	DC RETURN								
3	Encoder CHA+								
4	Encoder CHA−								
5	Encoder CHB+								
6	Encoder CHB−								
7	Encoder CHZ+	MRK 0	MRK 1	MRK 2	MRK 3	MRK 4	MRK 5	MRK 6	MRK 7
8	Encoder CHZ−								
9	5VDC PWR								
10	Step+								
11	Step−								
12	Direction+								
13	Direction−								
14	Analog Out+	P6400	P6416	P6432	P6448	P6464	P6480	P6496	P6512
15	Analog Out-								
16	Drive Fault+	BIT64	BIT65	BIT66	BIT67	BIT68	BIT69	BIT70	BIT71
17	Drive Fault−								
18	5VDC PWR								
19	Drive GND								
20	Drive Enable−	BIT40	BIT41	BIT42	BIT43	BIT44	BIT45	BIT46	BIT47
21	Drive Enable+								
22	Drive Reset−	BIT48	BIT49	BIT50	BIT51	BIT52	BIT53	BIT54	BIT55
23	Drive Reset+								
24	Drive GND								
25	No Connect								
26	No Connect								

Axis Connector Power Source

Each Axis (and Auxiliary Encoder) connector has a nominal +5 VDC power source to aid application installations. The power source typically is used to power:

- An external encoder
- Optical inputs and/or outputs between the ACR7000 and an external drive

Description	Min	Max	Units
Continuous current, +5V	--	150[1]	mA
Trip current, +5V	700	1200	mA
Voltage tolerance from +5V (@ 150 mA or less)	4.9	5.5	VDC
1. Maximum current draw per Axis/Encoder Connector is 250 mA, not to exceed a combined 1500 mA for eight axis connectors and two auxiliary encoder connectors.			
Note: All parameters are at the connector pin.			



Equivalent Circuit for Axis Power Source

Axis Connector Fuse

The Axis connector has a +5V voltage source for powering an encoder and/or drive I/O, and includes a fuse, as shown in Figure 8 above. In the event the +5V source shorts to ground, the internal reset-able fuse disables the +5V source. When the short-circuit condition is removed and the fuse cools, the fuse automatically resets.

Drive Electrical/Timing Characteristics

Outputs—Drive Step and Drive Direction

Description	Min	Max	Units
Output voltage low at –30 mA	--	1	VDC
Output voltage high at +10 mA	3.7	--	
Output voltage high at +30 mA	3.5	--	VDC
Step output frequency	0	2.5	MHz
Note: All parameters are at the connector pin.			

Outputs—Drive AOUT

Description	Min	Max	Units
Output voltage	-10	+10	VDC
DAC resolution	--	16	bits
Load impedance	2k	--	ohms
Note: All parameters are at the connector pin.			

Inputs—Drive Fault

- optically isolated
- Current is limited internally for input voltage control of 5 to 24-volt logic.
- Anode (+) and Cathode (–) are on separate connector pins to allow significant flexibility in wiring to different styles of interface

Description	Min	Max	Units
Turn-on time	–	1	ms
Turn-off time	–	1	ms
Guaranteed on voltage	4	–	VDC
Guaranteed off voltage	–	2	VDC
Maximum forward voltage	–	30	VDC
Maximum reverse voltage	-30	–	VDC
Forward current	3	12	mA
Note: All parameters are at the connector pin.			

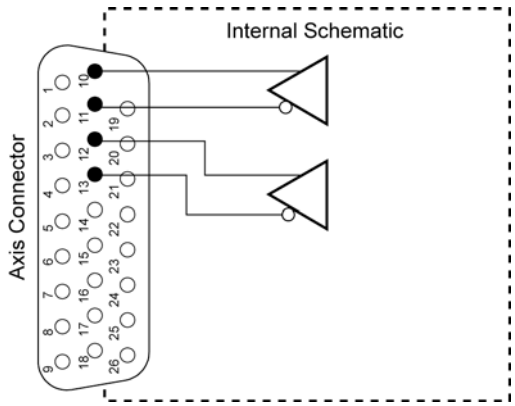
Outputs—Drive Enable and Drive Reset

- not polarity sensitive and can be controlled regardless of polarity
- optically isolated. The drain and source are on separate connector pins to allow significant flexibility in wiring to different styles of interface.

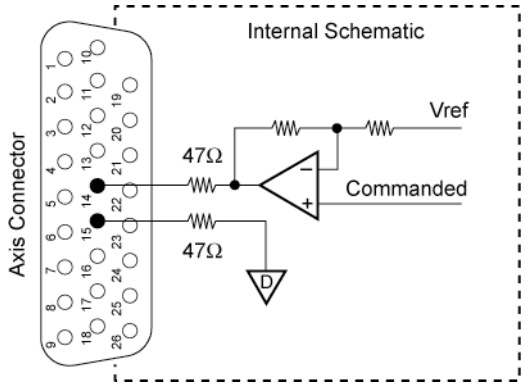
Description	Min	Typical	Max	Units
Turn-on time	—	—	2	ms
Turn-off time	—	—	1	ms
Working Voltage	–30	—	30	VDC
On-time voltage drop ($I_L \leq 10$ mA)	—	—	0.4	VDC
On-time voltage drop (10 mA < $I_L \leq$ 100 mA)	—	—	4.0	VDC
Load current ($T_A \leq 35$ °C)	—	—	100	mA
Load current, I_L (35 °C < $T_A \leq 50$ °C)	—	—	80	mA
Short-circuit trip current	—	200	—	mA
Note: All parameters are at the connector pin.				

Drive Internal Schematics

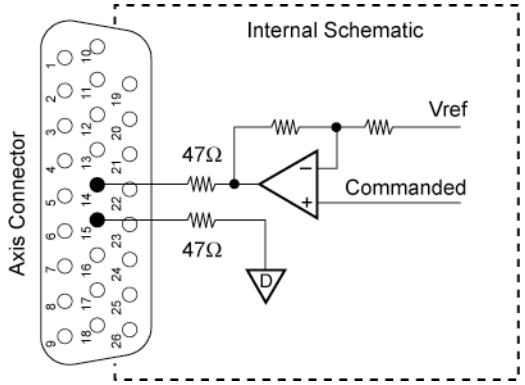
Outputs—Drive Step and Drive Direction



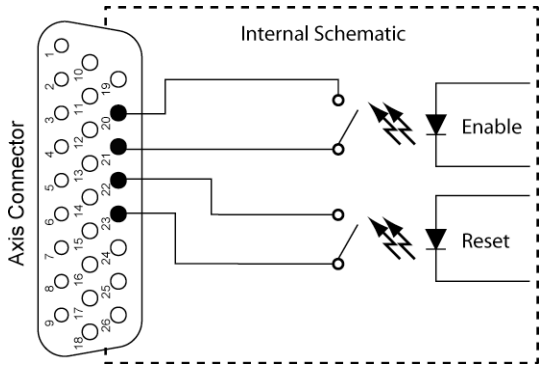
Drive AOUT Outputs



Drive Fault Inputs



Drive Enable and Reset Outputs



Encoder Functions

Each axis connector includes an encoder input.

Modes of Operation

The encoder feature has four modes of operation:

- Quadrature
- Step and Direction
- CW and CCW
- SSI (Synchronous Serial Interface)

Quadrature Mode

In Quadrature mode, two differential signals drive the onboard circuits: Encoder CHA and Encoder CHB. When Encoder CHA leads Encoder CHB, (usually by 90 degrees) the motion is positive by convention. When Encoder CHA lags Encoder CHB, the motion is negative by convention.

Step and Direction Mode

In Step and Direction mode, two differential signals drive the onboard circuits: STEP and DIR. A high DIR signal and a positive edge of the STEP signal indicates a positive count, while a low DIR signal and a positive edge of the STEP signal indicates a negative count. On the connector, Encoder CHA and STEP use the same pins and Encoder CHB and DIR use the same pins.

CW and CCW Mode

In CW and CCW mode, two differential signals drive the onboard circuits: CW or CCW. A low CCW signal and a positive edge of the CW signal indicates a positive count. A low CW signal and a positive edge of the CCW signal indicates a negative count. On the connector, Encoder CHA and CW use the same pins and Encoder CHB and CCW use the same pins.

SSI Mode

In SSI mode, one differential signal is driven out to a device, and one differential signal is received from the device: SCLK (clock out) and SDATA (data in). The first falling edge on SCLK causes the remote device to latch its current position value. The device then responds by synchronously shifting the data out using the SCLK rising edge to qualify SDATA. On the connector, Encoder CHA and SCLK use the same pins, and Encoder CHB and SDATA use the same pins. For more information on SSI mode commands, refer to ENC CLOCK, ENC DST, ENC SRC, and ENC WIDTH in the ACR Command Language Reference (Online Help System in the Parker Motion Manager software).

For more information on encoder modes of operation, refer to the ENC SRC command in the ACR Command Language Reference (Online Help System in the Parker Motion Manager software).

Encoder Signal Assignments

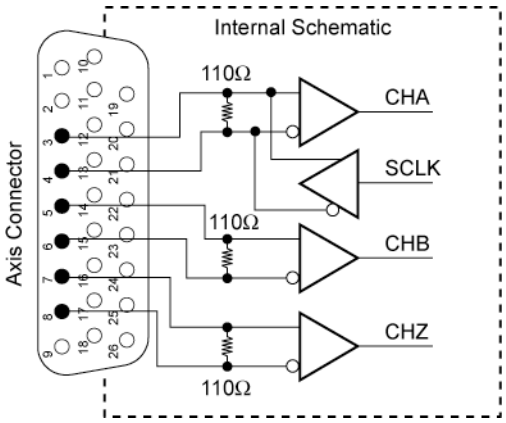
Mode	Axis Connector Signal		Supported Features
	Encoder CHA	Encoder CHB	Position Capture[1]
Quadrature	CHA	CHB	Yes
Step and Direction	STEP	DIR	Yes
CW and CCW	CW	CCW	Yes
SSI	SCLK	SDATA	No

1. For more information on position capture, refer to the `INTCAP` command in Online Help System in Parker Motion Manager software

Encoder Electrical/Timing Characteristics

Description	Min	Max	Units
Pre-Quadrature frequency	0	5.0	MHz
Post-Quadrature frequency	0	20.0	MHz
Duty cycle (pre-quad frequency ≤ 2.5 MHz)	30	70	%
Duty cycle (pre-quad frequency > 2.5 MHz)	40	60	%
Receiver Differential Threshold, V_{TH}	–200	+200	mV
Common mode range, V_{CM}	–10	13.2	VDC
Note: All parameters are at the connector pin.			

Encoder Circuit Schematic



General Purpose Inputs/Outputs

The 4 Axis Configuration provides 20 general purpose (GP) digital inputs and four digital outputs through two connections. They are labeled INPUTS (0-11) and INPUTS (24-31) / OUTPUTS (32-35). The 8 Axis Configuration provides 40 inputs and eight outputs through four connections. The four connectors are labeled INPUTS (0-11), INPUTS (24-31) / OUTPUTS (32-35), INPUTS (12-23), and INPUTS (72-79) / OUTPUTS (36-39).

The digital inputs and digital outputs are optically isolated from the digital logic. For inputs, current is limited internally for input voltage control of 24-volt logic. The connectors are 25-pin female, D-subs.

I/O Connector Specification

Description	Specification
Connector Type	25-pin D-sub, 2-row (female socket)
Manufacturer	KYCON or equivalent
KYCON Part Number	K42X-B25S/S-A4NJ

I/O Connector —Mating Connector[1]

Description	Specification	
Connector Type	25-pin, D-sub, 2-row (male connector)	
Manufacturer	TE Connectivity AMP Connectors or equivalent	
Cable Kit	AMP Part Number 1658659-1includes:	• 1658659-1 connector • shield • enclosure • two jack screws • (does not include contacts or ferrules)
Contacts	Crimp style:	TE Connectivity AMP Part Number 166293-1

[1] Mating connectors are not provided

I/O Connector Pinout

Pin	INPUTS (0-11)	INPUTS (24-31) / OUTPUTS (32-35)	INPUTS (12-23)	INPUTS (72-79) / OUTPUTS (36-39)
25	Input 5-	Trigger Input 29-	Input 17-	Trigger Input 77-
24	Input 0-	Trigger Input 24-	Input 12-	Trigger Input 72-
23	Input 0+	Trigger Input 24+	Input 12+	Trigger Input 72+
22	Input 1-	Trigger Input 25-	Input 13-	Trigger Input 73-
21	Input 1+	Trigger Input 25+	Input 13+	Trigger Input 73+
20	Input 2-	Trigger Input 26-	Input 14-	Trigger Input 74-
19	Input 2+	Trigger Input 26+	Input 14+	Trigger Input 74+
18	Input 3-	Trigger Input 27-	Input 15-	Trigger Input 75-
17	Input 3+	Trigger Input 27+	Input 15+	Trigger Input 75+
16	Input 4-	Trigger Input 28-	Input 16-	Trigger Input 76-
15	Input 4+	Trigger Input 28+	Input 16+	Trigger Input 76+
14	No connect	No connect	No connect	No connect
13	Input 5+	Trigger Input 29+	Input 17+	Trigger Input 77+
12	Input 6-	Trigger Input 30-	Input 18-	Trigger Input 78-
11	Input 6+	Trigger Input 30+	Input 18+	Trigger Input 78+
10	Input 7-	Trigger Input 31-	Input 19-	Trigger Input 79-
9	Input 7+	Trigger Input 31+	Input 19+	Trigger Input 79+
8	Input 8-	Output 32-	Input 20-	Output 36-
7	Input 8+	Output 32+	Input 20+	Output 36+
6	Input 9-	Output 33-	Input 21-	Output 37-
5	Input 9+	Output 33+	Input 21+	Output 37+
4	Input 10-	Output 34-	Input 22-	Output 38-
3	Input 10+	Output 34+	Input 22+	Output 38+
2	Input 11-	Output 35-	Input 23-	Output 39-
1	Input 11+	Output 35+	Input 23+	Output 39+

Input/Output Electrical/Timing Characteristics

GP Inputs 0–11, 12–23

Description	Min	Max	Units
Turn-on time	--	1	ms
Turn-off time	--	1	ms
Guaranteed on voltage	21	--	VDC
Guaranteed off voltage	--	3	VDC
Maximum forward voltage	--	30	VDC
Maximum reverse voltage	–30	--	VDC
Forward current	6.3	15	mA

Note: All parameters are at the connector pin.

Trigger Inputs 24–31, 72–79

Description	Min	Max	Units
Turn-on time	--	400	ns
Turn-off time	--	400	ns
Guaranteed on voltage	21	--	VDC
Guaranteed off voltage	--	3	VDC
Maximum forward voltage	--	30	VDC
Maximum reverse voltage	–30	--	VDC
Forward current	6.3	15	mA

Note: All parameters are at the connector pin.

Propagation delay due to filtering and isolation is ~400 ns, or encoder capture resolution of +/– 5 counts at 10 MHz.

GP Outputs 32–39

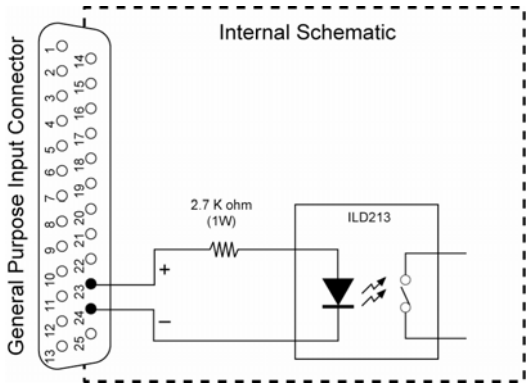
Description	Min	Typical	Max	Units
Turn-on time	--	--	2	ms
Turn-off time	--	--	1	ms
Working voltage	-30[1]	--	30	VDC
On-Time voltage drop ($I_L \leq 10$ mA)	--	--	0.4	VDC
On-time voltage drop (10 mA < $I_L \leq$ 100 mA)	--	--	4.0	VDC
Load current ($T_A \leq 35$ °C)	--	--	100	mA
Load current, I_L (35 °C < $T_A \leq 50$ °C)	--	--	80	mA
Short-Circuit trip current	--	200	--	mA

1. The output is not polarity sensitivity and can be controlled regardless of polarity.

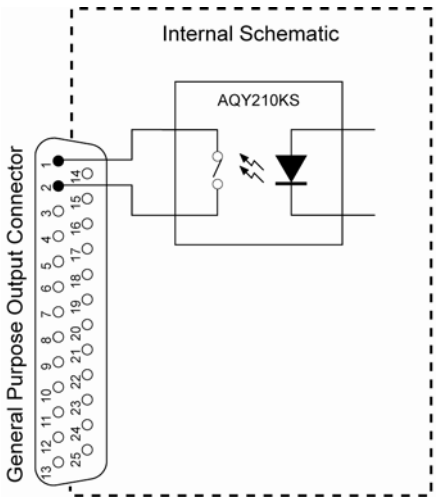
Note: All parameters are at the connector pin.

Input/Output Connector Circuit Schematics

Equivalent Circuit for GP Inputs/Trigger Inputs Connector

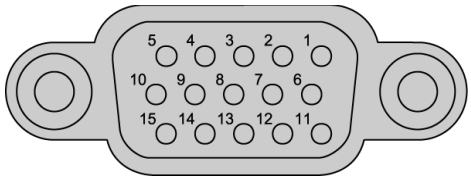


Equivalent Circuit for Outputs



ENC 8 – Auxiliary Encoder Connector

Encoder 8 utilizes a 15-pin connector but only supports quadrature encoders (no SSI). Encoder 8 can be used as a source for GEAR and CAM following. Two digitals inputs are included to support position capture functions.



Encoder Connector, Female

Encoder Connector Specification

Description	Specification
Connector Type	15-Pin High Density D-Subminiature (female socket)
Manufacturer	KYCON or equivalent
KYCON Part Number	K66-E15S-NR

Encoder Connector Specification—Mating Connector[1]

Description	Specification
Connector Type	15-Pin High Density D-Subminiature (male connector)
Manufacturer	TE Connectivity AMP or equivalent
Cable Kit includes:	TE Connectivity AMP Part Number 1658678-1: • 1658678-1 connector • shield • enclosure • two jack screws • (does not include contacts or ferrules)
Contacts	Crimp style: • TE Connectivity AMP Part Number 1658670-2

Mating connectors are not provided with the drive. Parker cables are available with mating connectors attached.

IMPORTANT: Encoder inputs use a SN65C1168E differential line receiver. Parker Hannifin recommends 65C11 (or compatible) differential line driven encoders. Single ended encoders are supported but not recommended for noisy environments.

Encoder Connector (ENC8) Pinout

Pinout configuration for the Encoder connectors 8 is listed in the following table. A box surrounding pins indicates a requirement for twisted pair wiring.

Two digital inputs are present on ENC8 connector

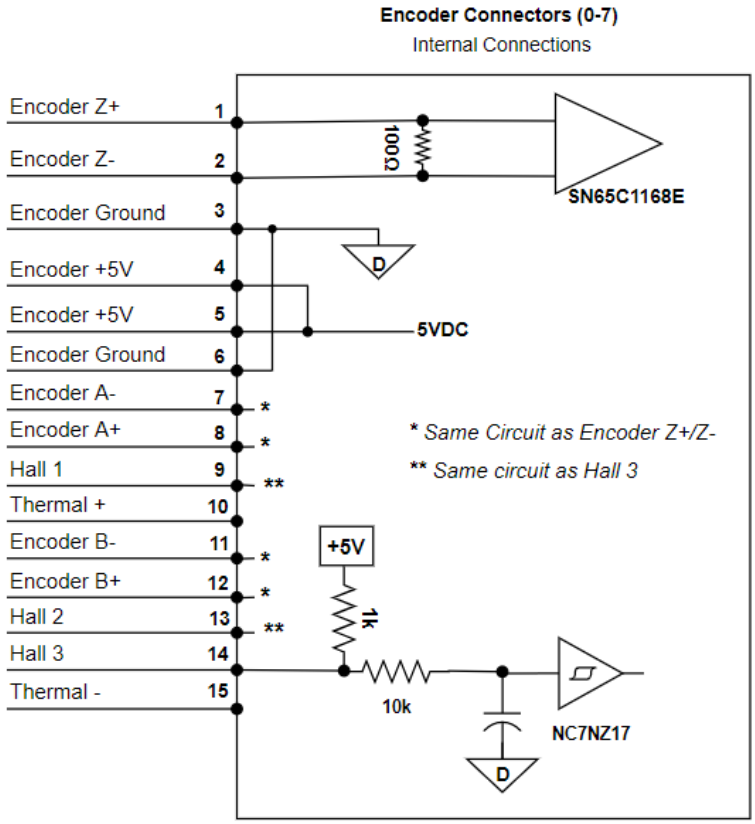
- High speed for encoder position capture functions (INTCAP)
- Schmitt Trigger with Zener Diode and RC filter, non-isolated.
- Short circuited protected
- 24VDC pull-up, 4.75k resistor
- Inputs are active when switched to DGND
- Compatible with NPN sensors

Encoder 8 Connector Pinout

Signal	Pin	Incremental Encoder
ENC Z+ ENC Z–	1 2	Encoder Z Channel in Encoder Z Channel in
DGND +5 VDC	3 4	Encoder power return +5 VDC Encoder power
+5 VDC DGND	5 6	+5 VDC Encoder power Encoder power return
ENC A– ENC A+	7 8	Encoder A Channel in Encoder A Channel in
N/A	9	No Connect
DGND	10	Digital Ground
ENC B– ENC B+	11 12	Encoder B Channel in Encoder B Channel in
Hall 2	13	Hall 2 input
Hall 3	14	Hall 3 input
DGND	15	Digital Ground

Internal Encoder 8 Connections

The following figure shows a schematic diagram of the internal connections for the Encoder 8 connector.



Encoder Inputs Specifications

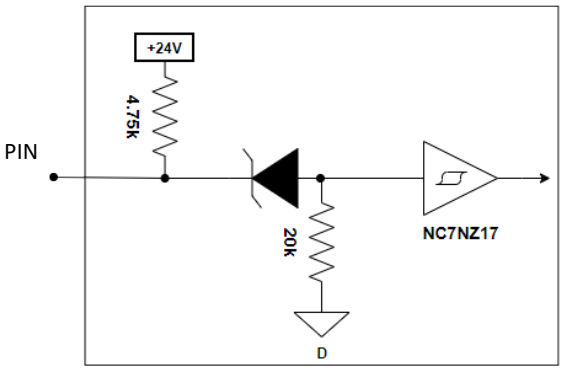
Description	Min	Typical	Max	Units
Common Mode Range	-7		+7	V
Current—Encoder			250	mA
Current—Hall			250	mA
Differential Threshold Voltage	-200		+200	mV
Differential Termination Impedance		120		ohms
Thermal Switch Current			2	mA
Thermal Switch Voltage Maximum (supplied)			15	V
Encoder Input Frequency (pre-quadrature)			2.5	MHz

Encoder Trigger Input Specification

Description	General Purpose	High Speed
Turn-on time*	20 µs	300 ns
Turn-off time*	20 µs	300 ns
Threshold voltage rising	16.1V	16.1V
Threshold voltage falling	11.6V	11.6V

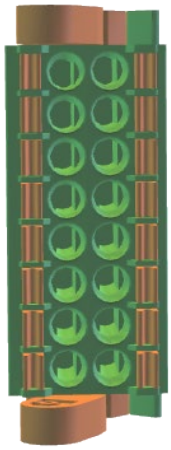
*On/Off time indicates propagation delay only. When used as general input, state change is detected at the PERIOD.

Encoder trigger Input Circuit



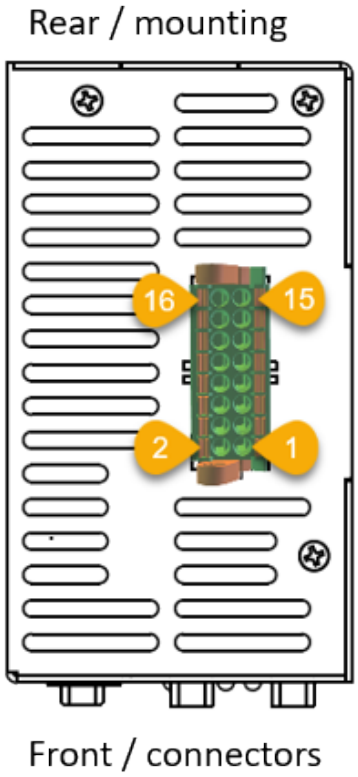
Analog Inputs (- ANI Option)

For controllers with the -ANI option, a removeable16-pin spring-cage connector provides access to eight single-ended analog inputs, all referencing ground. The analog inputs can also be configured as four differential inputs by connecting the input signals in pairs (connect to the inputs; do not connect to the grounds.)



Description	Specification
Connector Type	16-Pin Push-in spring cage connector
Manufacturer	Phoenix Contact
Phoenix Part Number	1790548
Connector Locking	Lock and release lever
Wire range	16-24 AWG (0.2 mm² to 1.5 mm²)
Wire strip length	0.4 in (10 mm)
Wire Connection Method	Push-in spring connection
Ferrules without insulating collar	Cross section: 0.25 mm²; Length: 5 mm ... 7 mm Cross section: 0.34 mm²; Length: 7 mm Cross section: 0.5 mm²; Length: 8 mm ... 10 mm Cross section: 0.75 mm²; Length: 8 mm ... 10 mm Cross section: 1 mm²; Length: 8 mm ... 10 mm Cross section: 1.5 mm²; Length: 10 mm
Ferrules with insulating collar	Cross section: 0.14 mm²; Length: 8 mm Cross section: 0.25 mm²; Length: 8 mm ... 10 mm Cross section: 0.34 mm²; Length: 8 mm ... 10 mm Cross section: 0.5 mm²; Length: 8 mm ... 10 mm Cross section: 0.75 mm²; Length: 8 mm ... 10 mm

Analog Input Pinout



Pin	Signal		Signal	Pin
16	Analog Ground 7		Analog Input 7	15
14	Analog Ground 6		Analog Input 6	13
12	Analog Ground 5		Analog Input 5	11
10	Analog Ground 4		Analog Input 4	9
8	Analog Ground 3		Analog Input 3	7
6	Analog Ground 2		Analog Input 2	5
4	Analog Ground 1		Analog Input 1	3
2	Analog Ground 0		Analog Input 0	1

Analog Input Specifications

Description	
Input Voltage	15-bit A/D converter, ±10 VDC; bipolar range selectable ADC GAIN command; ±10V (default), ±5V, ±2.5V, ±1.25V
Voltage Limit	±15 VDC (referenced to AGND)
Input Current (worst case load)	±160 µA
Fault Tolerance	±16.5V
Input Impedance	10^{13} Ω
Sample Rate* (8 inputs)	86.5 µs

CHAPTER 4
Communications

Overview

The ACR7000 Controller communicates in a standard Ethernet network, thereby providing a direct link for sending commands through the Parker Motion Manager software installed on a PC. This chapter describes how to establish the standard Ethernet connection.

The controllers have a dual-stack, standard RJ-45 connector, which provides two communications ports. The two ports act as a hub, with a single IP address.

Ethernet Specifications

Ethernet Cable Specification

Use a braid over foil twisted pair cable (straight or crossover) for connection to a PC. An example of this type of cable is L-COM TRD855SIG-XX. The maximum recommended cable length is 30m.

Ethernet Connector

A standard RJ-45 socket connector, located on the front panel of the drive/controller, provides two communication ports that accommodate ETHERNET connections. The two sockets of the connector are identical, and either may be used for direct connection to a PC network card.

To provide top noise performance, the connector contains isolation transformers and common mode chokes for both the transmit and receive signal pairs.

Connector Specifications

Description	Specification
Manufacturer	Abracom
Connector Type	8-Pin, RJ-45 (female socket)
Abracom Part Number	ARJ11D-MBSK-A-B-IMU2

Ethernet Connector Pinout

The following table contains the Ethernet connector pinout.

RJ-45 Connector Pinout

Signal	Pin	Wire Color	Description
RX+	1	White with orange	Differential Receive positive side
RX-	2	Orange	Differential Receive negative side
TX+	3	White with green	Differential Transmit positive side
	4	Blue	Not used
	5	White with blue	Not used
TX-	6	Green	Differential Transmit negative side
	7	White with brown	Not used
	8	Brown	Not used
Note: Pin assignment follows EIA/TIA T568B guidelines.			

RJ-45 LED Ethernet Status Indicators

LEDs located on the RJ-45 socket connector indicate Ethernet status. The next table describes the LED states and their meanings.

RJ-45 Ethernet Status LED Indications

Signal	Steady	Flash	Description
Ethernet Link/Activity	Off	—	No Ethernet link detected
	Yellow	—	Ethernet link established, no activity
	—	Yellow	Ethernet link established and active
Ethernet Speed	Off	—	Ethernet 10Mbps
	Green	—	Ethernet 100Mbps

Connecting to a PC

Connect one end of an Ethernet cable to the PC. Connect the other end to one of the ACR7000 Controllers two RJ-45 socket connectors. The two RJ-45 sockets can be used interchangeably.

Turn on Control Power to the ACR7000.

The ACR7000 has a programmed IP address. The factory default address is shown below. This address can be changed later in software after initial communication is established. The IP address for the PC will need to be assigned to a compatible address to communication with the ACR. These steps are detailed below.

Default IP Address— ACR7000 Controller

The factory assigns the following to each ACR7000 Controller

IP Address	Subnet Mask (fixed)
192.168.100.01	255.255.255.0

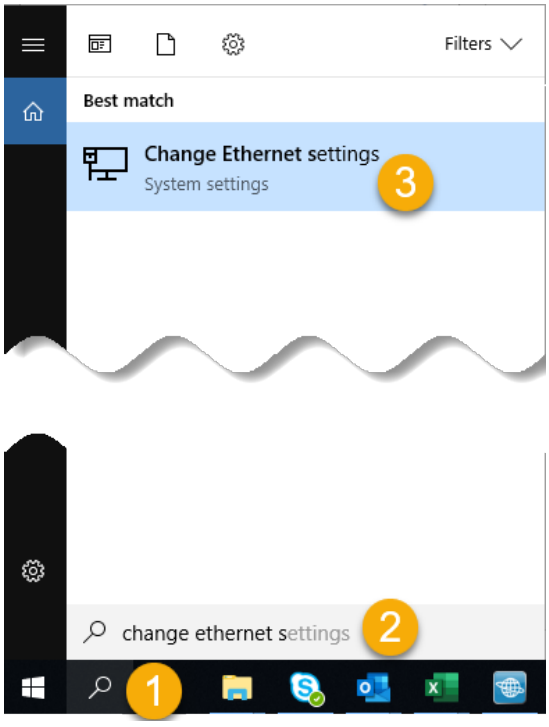
Setting the IP Address and Subnet Mask—PC

Set the IP address and Subnet mask for your PC. (These instructions are for Windows 10 users. If you have another Windows version, the steps may vary. Please consult your Network Administrator.)

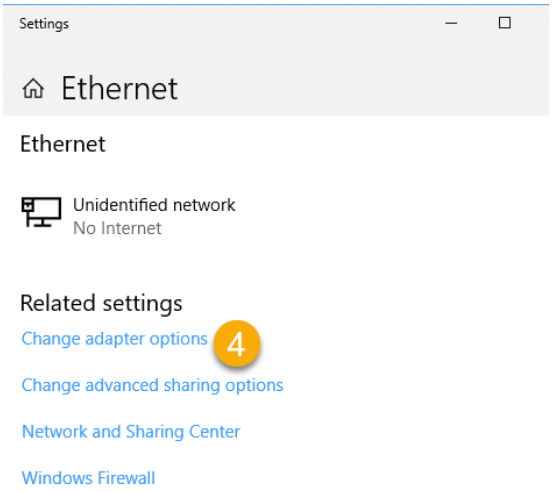
1 Open the Window Search tool

2 Enter **Change Ethernet Setting**

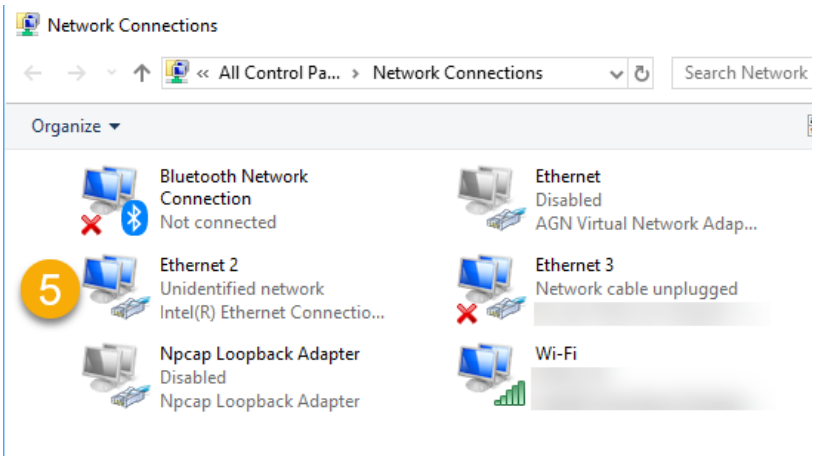
3 Select **Change Ethernet settings**



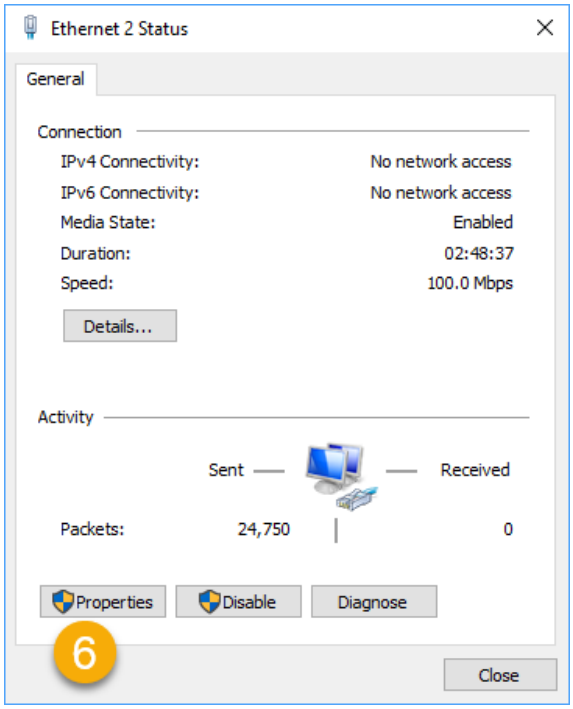
4 Select **Change adapter options**.



5 Select **Ethernet.** More that one Ethernet connections may be displayed. When a cable is inserted to ACR and PC and ACR is powered on the Ethernet connections will show as "Unidentified network"

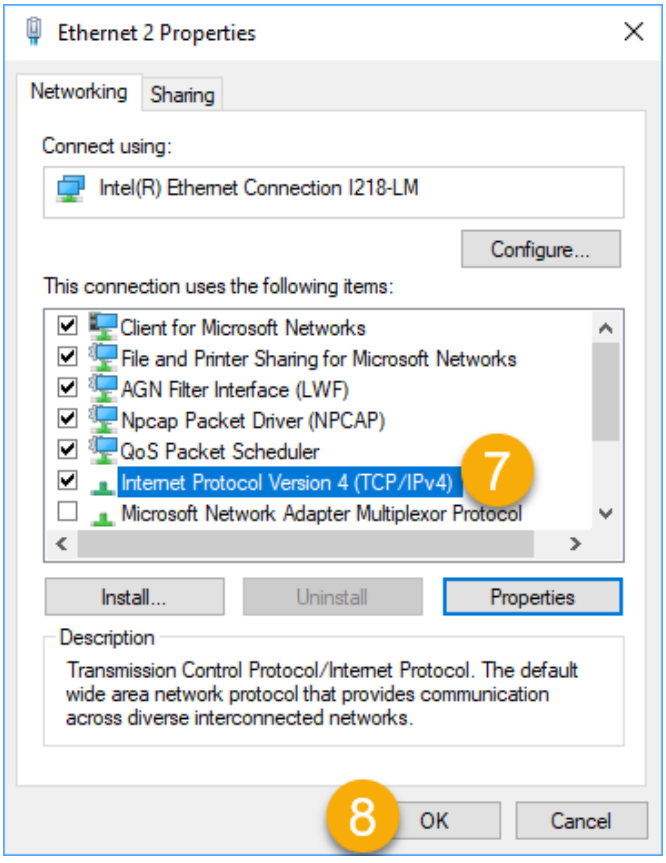


6 Click **Properties.** Administrator rights may be required.



7 Select **Internet Protocol Version 4 (TCP/IPv4)**

8 Click **Properties**.



9 Click the radio button next to **Use the following IP address**

10 Enter an IP address with the same first three octets as the default ACR7000 IP address (192.168.100). The last octet of the ACR7000 is by default "1". Select a different number for the PC in the valid range is 1 to 254. Using 000 or 255 is not valid. In the example the IP address is set to 192.168.100.222. Set the Subnet mask value to 255.255.255.0. Your window should look like the following:

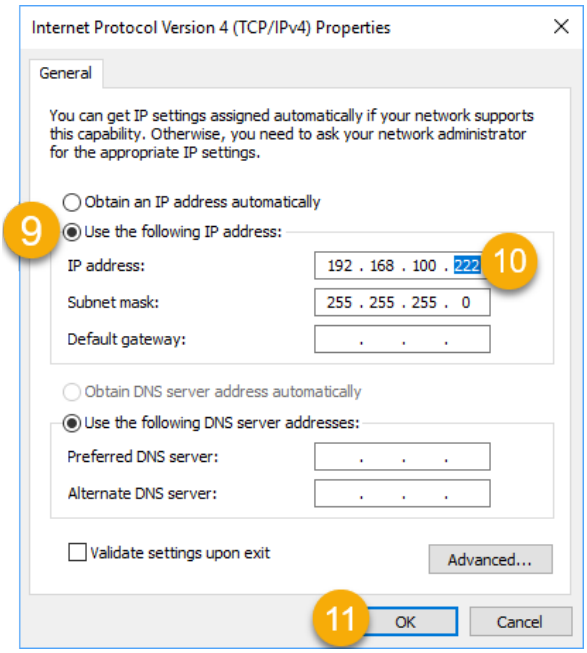


Figure 7. - *Internet Protocol Properties Screen Completed*

11 Click **OK**. It is now safe to close these windows.

IMPORTANT: It is good practice to isolate the ACR7000 and related devices on their own subnet so that their performance is not affected by high volume network traffic.

Verifying the IP Address

The following verifies the Ethernet is set up correctly.

1 In Parker Motion Manager, the IP Address box is the value for the controller.

2 In the dialog box, click **Connect**.

3 In the Terminal Emulator, type VER. If the Ethernet is set up correctly, the terminal emulator reports the firmware version information for the ACR7000 Controller.

CHAPTER 5
Basic Operation

Basic Operation

The ACR7000 Controller controllers are programmable products that support a wide array or servo and stepper drives. Other motion control functions such as limit and home switches, programming units and axis scaling are also configurable. The controller is delivered as a blank slate and the user will need to tailor the settings to meet the needs of each application.

Parker Motion Manager

Parker provides a software development tool to facilitate the setup and programming of the ACR controllers: Parker Motion Manager (PMM). Parker Motion Manager includes a configuration wizard, program editors, a terminal emulator, status panels and software oscilloscopes. PMM also includes a Help system with extensive documentation on using all the ACR family controllers. A section is dedicated to the ACR7000 Controller.

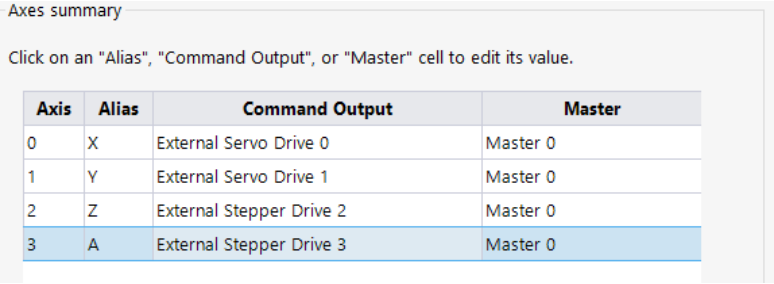
Configuration Wizard

The Configuration Wizard guides the user through the necessary steps for controller setup. Below is a summary of each step.

Axes

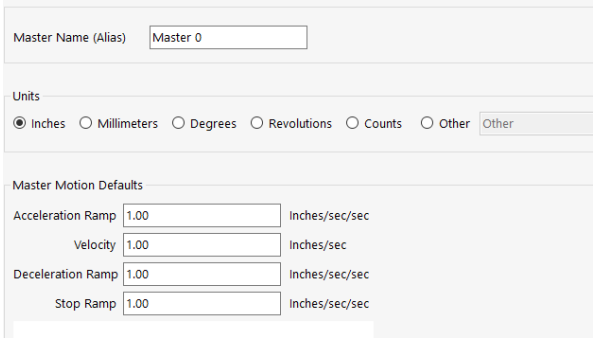
Create an *Alias* or nickname for each axis, remove unused axes from the configuration and assign the axes to a *Master* or axis group. Axes assigned to the same group can participate in interpolated motion.

- Select External Servo to control axes with a +/-10V analog signal
- Select External Stepper Drive to control axes with step & direction signal



Master

Select the desired programming units for the axes in the Master group.

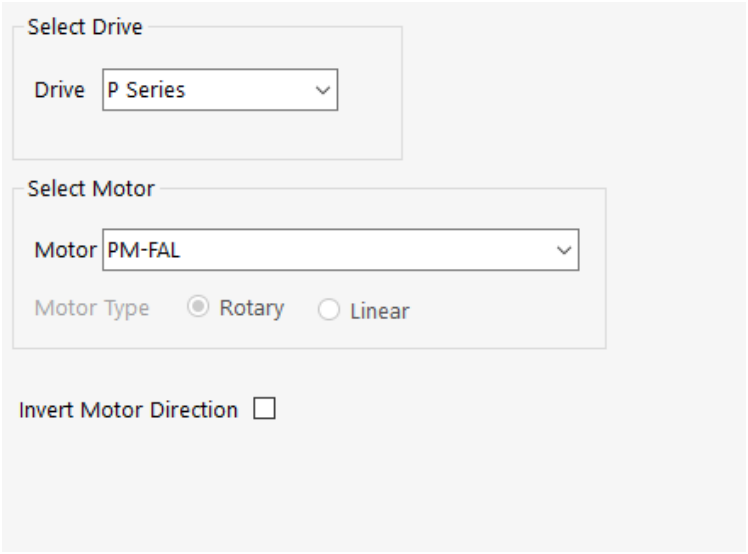


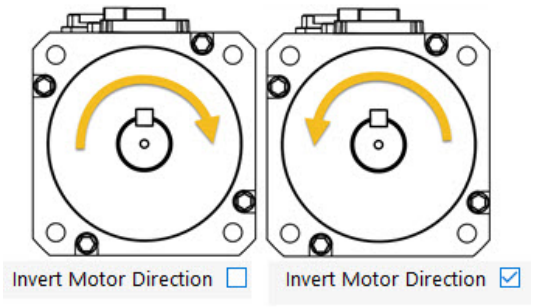
Drive/Motor

For each axis, select the drive and motor that will be attached

- Configuration only requires drive family to set-up drive I/O functions
- Motor family and feedback code will be used to apply proper scaling
- By default, a positive motion command will turn a motor in the clockwise direction. Select invert to change motor direction as needed.

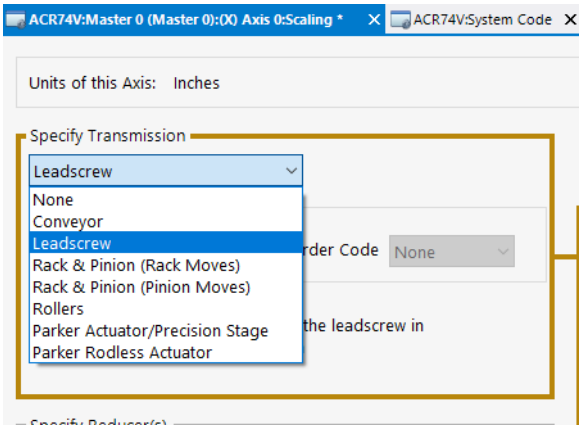
NOTE: most drive will require separate set-up procedure. Refer to the appropriate user guides for the drives.





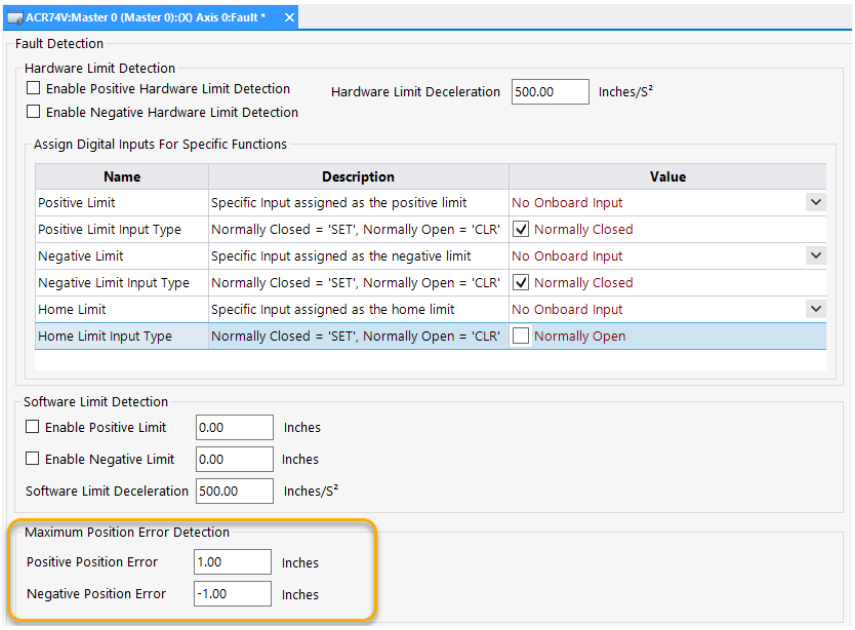
Scaling

Enter information about the system mechanics to create the axis scaling.



Fault

Position error settings must be non-zero values. Note that units are user programming units. Optionally select inputs used for hardware limit and home operation and soft limit detection.



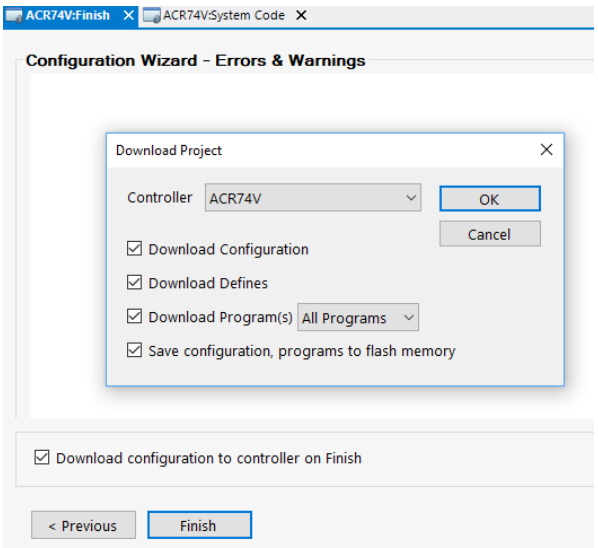
Memory

Allocate memory for user programs. Default values are a useful starting point for most applications. These values can be refined later as needed.

Finish

Download the configuration to the controller. Note that when *Download Configuration* is selected all Defines and User programs will be cleared first.

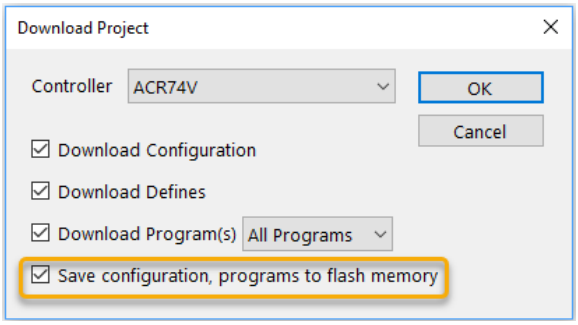
DO NOT CYLCE POWER DURING DOWNLOAD AND SAVE.



Memory

The ACR7000 Controller utilizes FLASH memory for saving programs and some system and user variables. Storing programs and variable values in FLASH memory requires the use of the FLASH IMAGE command while programs are stopped. Non-Volatile User FRAM store values automatically.

ESAVE command is issued with any configuration or program download. FLASH IMAGE is issued when checked



FLASH IMAGE operation can take approximately thirty seconds.

Memory Commands	
ERASE	Erases motor configuration parameters and drive setup parameters and sets to default. Resets system set-up and axis configuration parameters.
FLASH ERASE	Clears stored programs and user variables
FLASH RES	Clears all programs, set-up parameter, motor configuration and user memory. Used to return controller to factory settings.
ESAVE	Saves system configuration and axis set-up parameters. ESAVE is sent automatically with ACR-View downloads
FLASH SAVE	Saves user programs to FLASH memory
FLASH IMAGE	Saves user programs, local and global variables to FLASH MEMORY. User is prompted by PMM to FLASH IMAGE on project and program downloads.

Warning: **To avoid possible memory corruption, do NOT cycle power during FLASH memory operations**

Appendix A
Accessories

Controller to Drive Cables

The ACR7000 Controller are compatible with most servo and stepper drives that accept step/direction or +/-10V command signals. The following table lists available cables for connecting the ACR to drives.

Drive	Part Number	Description
P Series (PD-xxP)	71-032478-xx	ACR to Pseries (analog and step & direction), 4ft or 10ft
Compax 3 (I10T10 versions)	71-021108-xx	ACR to Compax3 command cable (analog only), 4ft or 10ft
E-AC, Zeta, E-DC, OEM750	71-021113-xx	ACR to Stepper (E-AC, E-DC, Zeta, etc) command cable, 4ft or 10ft
ViX	71-021110-xx	ACR to ViX command cable, 4ft or 10ft
Aries (AE/SE)	71-021599-xx	ACR to Aries command cable, 4ft or 10ft
Gemini (GV)	71-021112-xx	ACR to Gemini command cable (analog only), 4ft or 10ft
Gemini (GV)	71-022316-xx	ACR to Gemini (step & dir) cable, 4ft or 10ft
Generic	71-022344-xx	ACR controller to flying leads cable, 4ft or 10ft

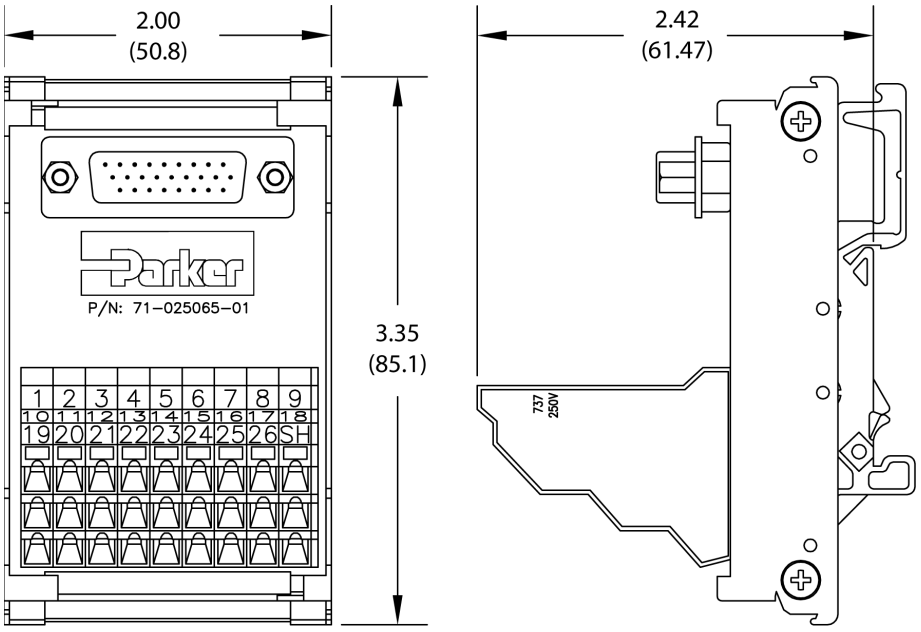
Note: Each cable comes in a 4-foot (1,219 mm) or 10-foot length (3,048 mm) in the part number -xx (-04 or -10).

VM26 Breakout Module

The VM26 expansion module provides screw-terminal connections for the Axis connections. The VM26 comes with a 2-foot cable (609.6 mm) that provides easy connection between the VM26 module and the axis 26-pin connector. The VM26 expansion module is ordered separately (part number VM26-PM).

Notes

- The VM26 module ships with DIN-rail mounting clips installed.
- The overall cabinet depth with cable-bend radius is 5 inches (127 mm).



VM25 Breakout Module

The VM25 expansion module provides screw-terminal connections for I/O connectors. The VM25 comes with a 2-foot cable (609.6 mm) that provides easy connection between the VM25 module and the 25-pin I/O connectors. The VM25 expansion module is ordered separately (part number VM25-MC-02).

Notes

- The VM25 module ships with DIN-rail mounting clips installed.
- The overall cabinet depth with cable-bend radius is 5 inches (127 mm).