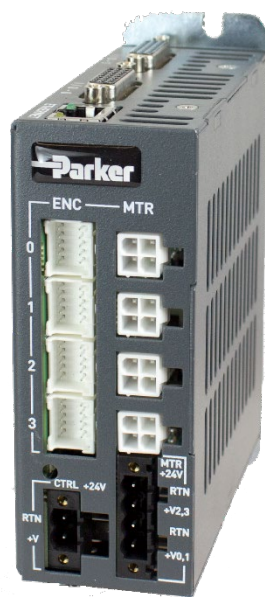


PARKER Hardware Guide

ACR7000 Stepper Controller



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88-033561-01A

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Important User 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 is capable of producing 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.

The information in this user guide, including any apparatus, methods, techniques, and concepts described herein, are the proprietary property of Parker Hannifin or its licensors, 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 of its products, we reserve the right to modify equipment and user guides without prior notice. No part of this user guide may be reproduced in any form without the prior consent of Parker Hannifin.

Product Overview

The ACR7000 family includes integrated stepper drive/controllers based on the ACR9000 and IPA platforms. Setup and programming is accomplished using the AcroBASIC language within the Parker Motion Manager programming environment. The ACR7000 provides an Ethernet interface which gives the user a variety of different machine control options.

Micro stepping drives are integrated with the multi-axis motion controller into a single package, saving space, cabling, and reducing installation complexity. The ACR7000 series is perfect building block for customer specific motion system solutions.

Operating System

The multi-tasking, real time operating system (or firmware) for the ACR7000 is stored in protected flash memory and is automatically loaded on each power cycle. Firmware is periodically updated by Parker as features and fixes are added. The user can load new firmware using PMM. The VER command is used to report the current firmware revision.

Configuration

The ACR7000 requires a short set up process before motion or programming is possible. PMM assists the user with these settings in a step-by-step configuration wizard. The user is prompted to input key application information such as motor model number, mechanical scaling, limits conditions, etc. The configuration process is completed with the download of the System Code.

AcroBASIC

AcroBASIC is a proprietary, text based motion programming language that has been developed and proven over five generations of motion controllers. The user can either store AcroBASIC routines in the controller to execute complex sequences or stream commands over Ethernet for immediate execution. In addition to text commands the user can directly monitor and modify controller parameter and flags within AcroBASIC programs or from external devices such as PCs, PLCs and HMIs. The majority of AcroBASIC commands are available in the ACR7000 with the exception of commands that are specific to hardware that is not present on the ACR7000 (e.g. EPL, CANopen).

Refer to the ACR Programmers guide and Command Language reference for complete details. The Parameter and Bit References guides document user accessible data in all ACR family controllers. Additional commands, bits and parameter specific to the ACR7000 are detailed at the end of this document.

Ethernet

The ACR7000 supports TCP/IP, UDP and EtherNet/IP communications. Up to five separate connections are available at any time. The controller automatically manages the incoming connections and assigns STREAM1-5 on a first come first server basis.

PC Based Applications

The ACR7000 controller can be interfaced to PC applications through the ComACRserver, an API and communication interface. The ComACRserver provides methods and functions that allow the user to create custom PC applications in VB, C++, .NET, LabView, and other programming environments that support COM objects. The ComACRserver is installed with and used by Parker Motion Manager.

The ComACRserver includes methods for reading and writing any bits or parameters on the ACR. These are efficient binary packets that can be set-up for regular polling or one time calls. Much of the ACR's functionality can be controlled via these bits and parameters, including coordinated move commands. For functions that cannot be called this way, the ComACRserver includes a Terminal interface for sending ASCII commands and uploading and downloading programs.

The ComACRserver is a wrapper for lower level communication API called the Binary Host Interface. Most applications will use the ComACRserver but some users prefer to use the native Binary commands directly. Using the Binary Host Interface natively allows users to optimize the performance of applications by eliminating the COMACRservers overhead. It also provides a communication option for non-Windows applications (e.g. Linux) as the ComACRserver uses the MS COMobject model. Details about the Binary Host Interface can be found in the ACR Programmers Guide.

Users can establish PC to ACR Ethernet communications outside of ACR-View or ComACRserver applications. Detailed information is available in the Ethernet Specification for ACR Products, which describes the base level TCP and UDP connections and data formats. Connections are made to the controller's IP address with a specific port designation.

Port 5002 is an ASCII connection, allowing the application to send any AcroBASIC commands to the controller in the same way as the terminal emulator in ACR-View.

Port 5006 is a managed binary connection that expects to see commands in a specific format. 5006 is well suited for PC applications and constructing drivers.

HMI Based Applications

Parker Xpress and InteractX HMI families include a built-in driver for communications with the ACR7000. The Acroloop CIP Ethernet driver supports exchange of flag/bit data, 32-bit integers and floating parameters and ASCII strings. Multiple ACR7000 controllers can be associated with the communications driver. Details of using this communication driver can be found in the help files installed with Xpress Manager and InteractX software. The ACR9000 and IPA series controllers also use the Acroloop CIP driver.

CE Declaration of Conformity



EC DECLARATION OF CONFORMITY

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

Equipment: ACR7xT-A4V2C1
Description of Equipment: ~~Multi~~axis Stepper Controller with Integrated drives 24 VDC
Year in which CE mark affixed: 2018

The above apparatus conforms 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

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

Compliance is demonstrated by the application of the following standards:

Electrical Safety

EN 61800-5-1:2007 (2nd Edition) + A1:2017

Safety requirements for adjustable speed electrical power drive systems
Part 5.1: Safety Requirements – Electrical, Thermal, and Energy

Electromagnetic Compatibility

IEC 61800-3 ed2.1

Adjustable speed electrical power drive systems –
Part 3: EMC requirements and specific test methods

Signed:

Date: 9/24/2018

Name: Stuart E. Goodnick
Position: Division Engineering Manager, Parker Hannifin EMN, NA

88-033492-01A



Protective Circuits

The ACR7000 drive/controllers include several built-in protective circuits listed below.

Protection	Circuit
Short Circuit	Motor Input Power Control Power Enable Input Motor Output
Over-Voltage	Motor Input Power 30VDC Control Power 30VDC Enable Input 30VDC
Over-current	Motor Input Power Control Power Enable Input
Over-temperature	Internal Drive Temperature 130C



WARNING: This product does not incorporate electronic motor overload protection and does not incorporate motor over-temperature protection.

Mechanical Installation

Environment & Cooling

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

For drive cooling, you must install the drive so that the cooling vents permit vertical air flow. Figure 2 on page 23 shows the mounting orientation, as well as the minimum top, bottom, and side installation clearances.

- Avoid installing heat-producing equipment directly below a drive.
- Ensure that the ambient air temperature entering the drive or rising up to the drive is within acceptable ambient temperature limits. Under normal use, the temperature of air leaving the drive 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 drive 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)

Mounting Guidelines

The ACR7000 drive/controllers are vented products. To prevent material spilling into the drive, mount it under an overhang or in a suitable enclosure.

ACR7000 products are made available under “Restricted Distribution” for use in the “Second Environment” as described in the publication EN 61800-3 ed2.0.

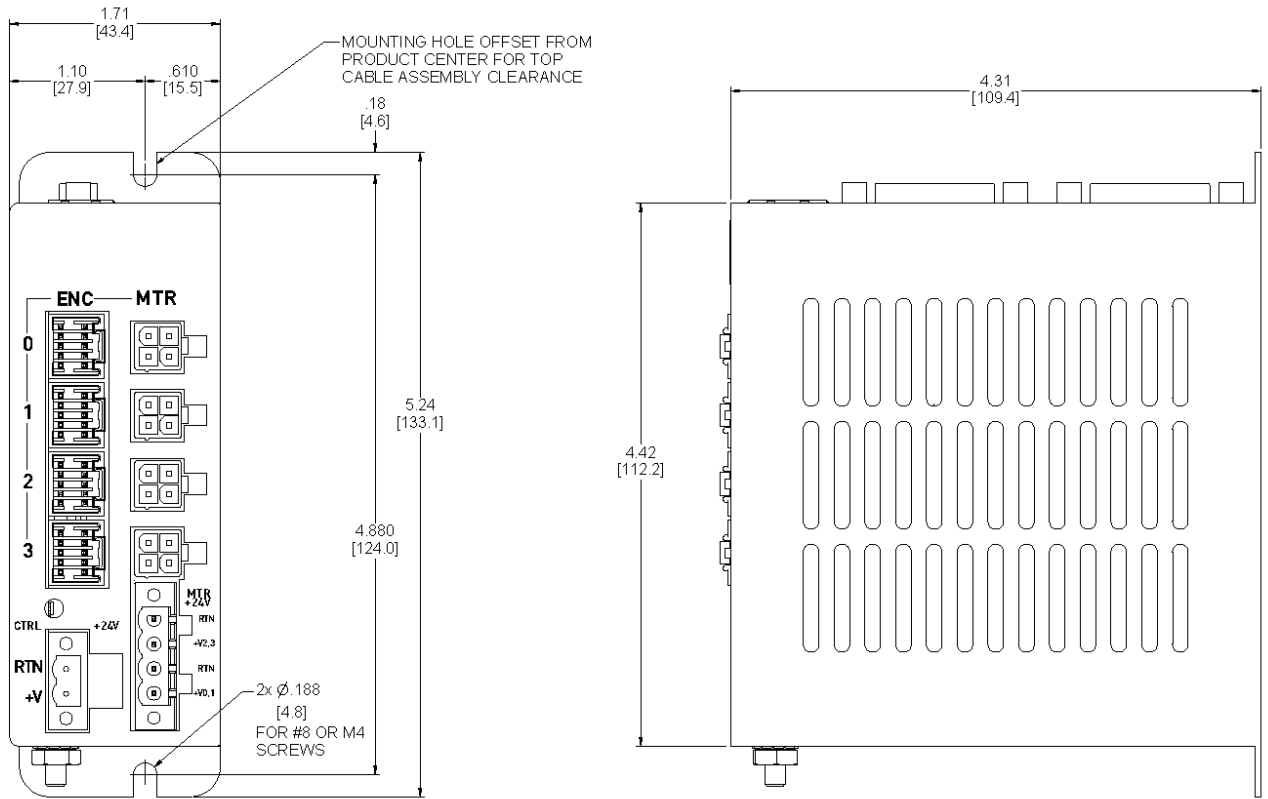
Cable Routing

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.

Panel Routing

The minimum clearance between products is 0.62 inches (15.75mm). The minimum clearance above and below a drive is 1 inch (25.4 mm).

Dimensions



Electrical Installation

Installation Safety Requirements

ACR7000 series meets the requirements of both the European LVD (Low Voltage Directive) and EMC (Electromagnetic Compliance) directives when installed according to the instructions given within

As a rule, it is recommended that the drive/controller is 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 they 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.

Do not arrange the interlocks to open circuit the motor phase connections while the system is still powered as this could damage the product

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.

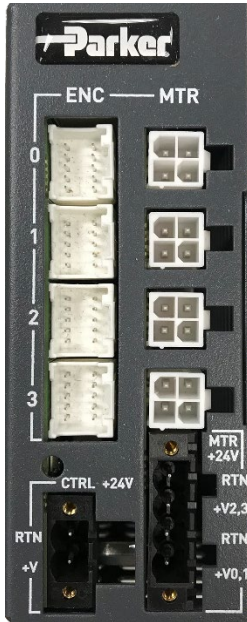


Warning: High-performance motion control equipment is capable of producing rapid movement and very high forces. Unexpected motion may occur especially during the development of controller programs. **KEEP WELL CLEAR** of any machinery driven by stepper or servo motors. Never touch any part of the equipment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

Connectors

CAUTION: Before inserting or removing any connectors or wires, always remove power from the unit.

Front View



Connector	Function
ENC	Encoder Inputs Axis 0-3
MTR	Motor Outputs, Axis 0-3
CTRL	Control Power Input
MTR +24V	Motor Power Inputs
I/O - 0, 1	Inputs/Outputs
ETHERNET	Ethernet Communications

Top View



Input Power Connections

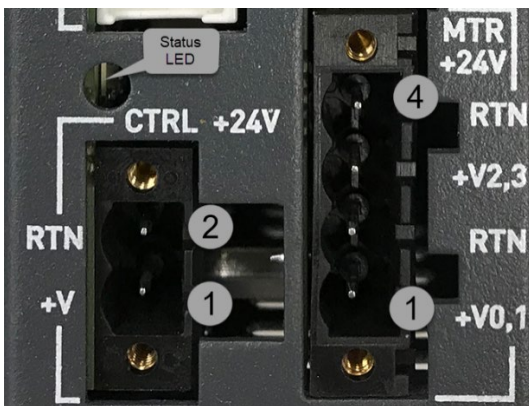
Separate power inputs are required for the motors and control power. Motors power inputs are shared by two motors. Control Power is necessary for all logic and communication.

Removable mating connectors are provided with the product.

CAUTION: Before inserting or removing any connectors or wires, always remove power from the unit.

Input Power Requirements

Connector	Input Power	Requirements	Functions
MTR +24V	Motor Input Power	24VDC @ 0.75 x Motor Rated Current	Motor Power
CTRL	Control Input Power	24VDC @ 1 amp	Communications Diagnostics Encoder feedback



CTRL		
Pin	Label	Signal
2	RTN	GND24V
1	+V	+24VDC

MTR +24V		
Pin	Label	Signal
4	RTN	GND24V
3	+2,3	Motor 2/3 PWR
2	RTN	GND24V
1	+0,1	Motor 0/1 PWR

Control Power Connector Specifications

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 mm ²)
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)

Drive Input Power Connector Specifications

Description	Specification
Connector Type	Removable screw terminal
Terminals	4
Pitch	0.200 in (5.08 mm)
Wire range	12-24 AWG (0.34-2.5 mm ²)
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	OSTTJ040152 (black) OSTTJ045152 (green)

Motor Output Connectors

The Motor power connectors provide output power to the two phase stepper motors. The number of activated motor connectors is dependent on the controller configuration. Each Motor connector is dedicated to a specific AXIS object that controls the output signal.

CAUTION: Before inserting or removing any connectors or wires, always remove power from the unit.



Pin	Signal
1	Motor A2 (A-)
2	Motor B2 (B-)
3	Motor A1(A+)
4	Motor B1 (B+)

Motor Connector Specification

Description	Specification
Connector Type	4 Pin, Mini-Fit Jr. Header
Manufacturer	Molex or equivalent
Molex	5569-04A2-210/39-30-0040

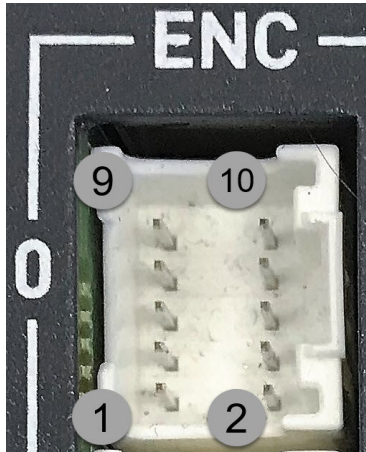
Motor Connector Specification—Mating Connector*

Description	Specification
Connector Type	4 Pin, Mini-Fit Jr. Receptacle housing
Manufacturer	Molex or equivalent
Connector Housing:	Molex Part Number 5557-04R-210/39-01-2045
Contacts	Mini-Fit Female crimp terminal Molex part number : 5556T/39-00-0038

*Not included with product

Encoder Feedback Connectors

The Encoder feedback connectors provide inputs for incremental encoders. Each encoder connector is dedicated to a specific ENCODER object that can be assigned to axes within the software.



Pin	Signal
1	A+
2	A-
3	B+
4	B-
5	Z+
6	Z-
7	5V
8	GND
9	Earth
10	Earth

Encoder Connector Specification

Description	Specification
Connector Type	10 Pin, MicroClasp Header, 2mm pitch
Manufacturer	Molex or equivalent
Molex	55959-1030

Encoder Connector Specification—Mating Connector(not included with product)

Description	Specification
Connector Type	10 Pin, 2.00mm Pitch MicroClasp
Manufacturer	Molex or equivalent
Connector Housing:	Molex Part Number 51353-1000
Contacts	Crimp terminal 22-28 AWG Molex part number : 56134-9100

Encoder Inputs

Description	Min	Typical	Max	Units
Common Mode Range	-7		+7	V
Current—Encoder		50mA	250	mA
Differential Threshold Voltage	-200		+200	mV
Differential Termination Impedance		120		ohms
Maximum Encoder Input Frequency (pre-quadrature)			1.6	MHz

I/O Connections

Each 26-pin Drive I/O connector includes ten inputs and four outputs. Input and output signals are NOT optically isolated.

Connector I/O - 0 also included the dedicated Motion Enable Input.

Inputs are pulled up to 24V supply. Sink the inputs to ground to assert.

Four sinking outputs are available to the user. Total current of 1 amp is available using 24VDC from PIN 19.

Parker breakout modules **VM26-PM** can be used for easy access to these pins.

I/O - 0	I/O - 1
Inputs 0-5, Trigger inputs 24-27	Inputs 6-11, Trigger inputs 28-31
Outputs 32-35	Outputs 36-39
Motion Enable Input	



I/O Connector 0	
Pin	Signal
1	Input 0
2	Input 1
3	Input 2
4	Input 3
5	Input 4
6	Input 5
7	Input 24
8	Input 25
9	Input 26
10	Input 27
11	GND
12	Output 32
13	Output 33
14	Output 34
15	Output 35
16	GND
17	Motion Enable Input
18	GND
19	24VDC - output
20-26	GND

I/O Connector 1	
Pin	Signal
1	Input 6
2	Input 7
3	Input 8
4	Input 9
5	Input 10
6	Input 11
7	Input 28
8	Input 29
9	Input 30
10	Input 31
11	GND
12	Output 36
13	Output 37
14	Output 38
15	Output 39
16	GND
17	GND
18	GND
19	24VDC - output
20-26	GND

I/O Connector Specification

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

I/O Connector Specification -Mating Connector	
Description	Specification
Connector Type	26-pin, high density D-sub, 3-row (male connector)
Manufacturer	AMP or equivalent
AMP	AMP Part Number 748474-1 Includes: 748365-1 connector, shield, enclosure, and two jack screws (does not include contacts or ferrules)

Motion Enable Input

The Motion Enable Input MUST be connected to 24VDC in order to enable/power the motors.

The input is considered active when 24 VDC is applied to PIN 17 of I/O connector 0. If the input goes inactive, that inactive state is latched and the ACR7000 reacts by doing the following:

- Disabling the drives
- Blocking the step generation output.

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.

Stepper Drive Operation

The integrated stepper drives in the ACR7000 are configured using the Configuration Wizard in Parker Motion Manager Software. The necessary flags and parameters are included in the controller configuration and downloaded as part of the user project along with scaling, limits, program memory settings, etc. The following provides detail about these drive settings how the drives operate.

The values required to properly control and configure the drives are stored in axis specific parameters. These values are saved with the ESAVE command and are automatically restored on power up. The values are automatically asserted to the integrated drive on power up. The parameter values may be changed by the user during operation, but will not be asserted to the integrated drive until the user sets a control bit requesting configuration update.

During power up and during any configuration update, a status bit will indicate that an update is underway. When the drive configuration update is complete, a different bit will indicate that configuration is complete.

If any of the configuration values provided by the user are out of range, then the user's configuration request or the power up configuration will fail and the integrated drive will be configured with the product's default values. In this case a status bit will indicate the failure and an error code will indicate the reason for failure.

Fault and warning flags are available and can be used to diagnose improper operation. If any fault flag is present, it will be latched and result in a drive fault, disabling the drive. The latched bit is cleared by re-enabling the drive. The control bits clear themselves automatically.

Applying Drive Settings

Drive configuration settings (motor current, resolution, standby current and delay) are applied either on power-up or when the axis **Assert Drive Configuration** flag is SET. The configuration values should be saved with the ESAVE command to be retained on power cycle. In a typical set-up sequence the motor current, resolution and standby values would be set for the axis, followed by the **Assert Drive Configuration** flag. For example:

REM AXIS0 Settings

P7938= 1.5 : REM User Maximum motor current (Amps)

P7944= 50 : REM Standby Current Percentage

P7945= 10 : REM Standby Current Delay (msec.)

SET 15618 : REM Enable Auto Standby

P7945= 128 : REM Micro-steps per full step (power of 2) = 25600

SET 15616 : REM Apply Drive Configuration settings

ESAVE : REM save value to retained memory

Motor Current

The maximum motor current available for each axis is 4.0 amps. The user can specify a value to limit the current applied to the motor. The minimum setting for drive current is 0.5. This current value a peak of sine rating.

P7938= 1.5 : REM User Maximum motor current (Amps)

Standby Current

In order to reduce the overall temperature of the motor, the user can specify a reduced motor current to be applied while the motor is idle. **Standby Current Percentage** parameter is the percent of the user selected maximum motor current that current should drop to after the standby period has elapsed.

Standby Current Delay is time in milliseconds after the end of all motion profiles before the current drops to the standby level. Note that in some cases such as Cam and Gear profiles there may be no steps generated, but the axis is still considered to be in motion if the cam or gear is still engaged. If the axis is at standby current and a new motion profile is started, the current will automatically and immediately be restored to user selected maximum motor current.

P7944= 50 : REM Standby Current Percentage

P7945= 10 : REM Standby Current Delay (msec.)

SET 15618 : REM Enable Auto Standby

Drive Resolution

The default resolution of drives is 256 micro-steps per full step. With typical 200 step per revolution motor, this results in an overall resolution of 51200 micro-steps per revolution. The user can select the number micro-steps per full step, with the constraint that the value must be a power of 2 between 1 and 256. Any other number will be considered invalid and result in a failed configuration request.

Resolution (with 200 step/rev motor)	Micro-steps per full step Setting
200	1
400	2
800	4
1600	8
3200	16
6400	32
12800	64
25600	128
51200	256