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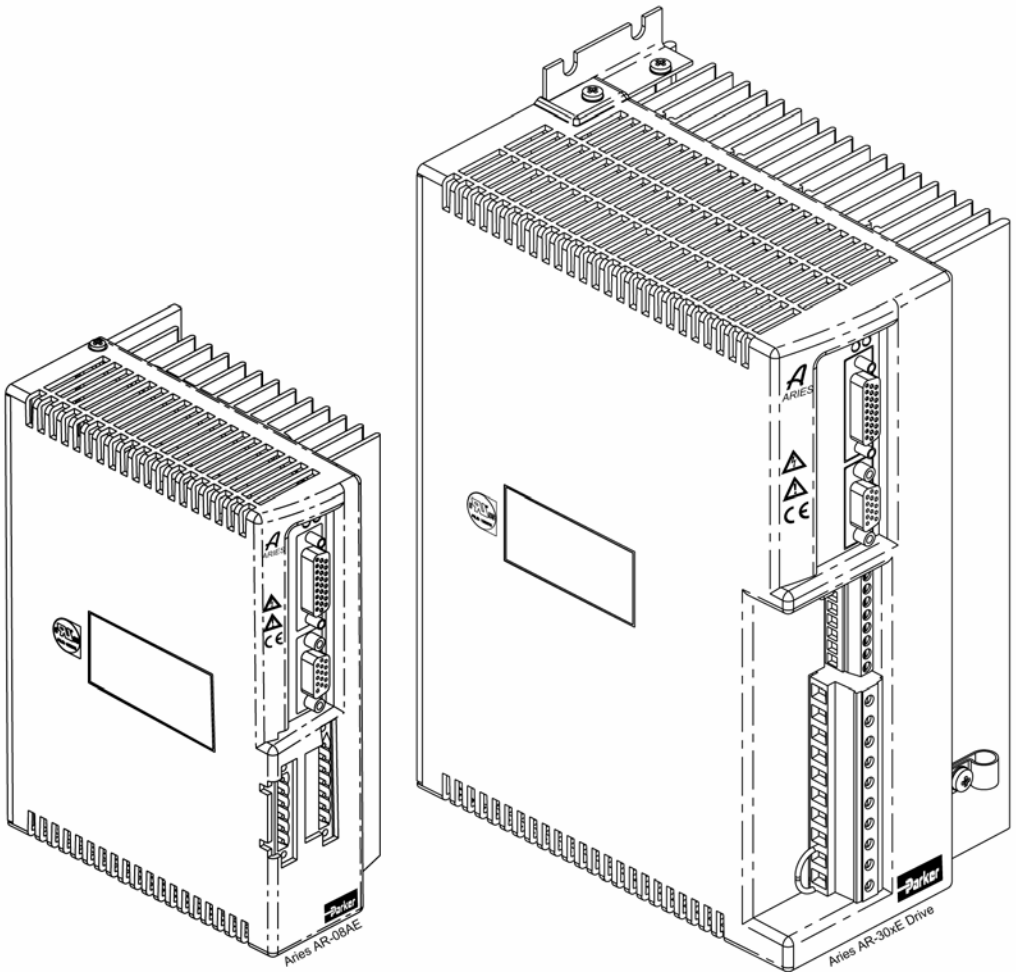
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Parker Automation

p/n 88-021610-01F

Aries User Guide

Effective: August 2006



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User Information



Warning — Aries Series 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.

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Product Type..... Aries Family AR-01Ax, 02Ax, 04Ax, 08Ax, 13Ax, 20AE, and 30AE

..... Aries Family AR-01Sx, 02Sx, 04Sx, 08Sx, 13Sx, 20SE, and 30SE

The above product complies with the requirements of directives:

- EMC Directive 89/336/EEC
- Low Voltage Directive 73/23/EEC
- CE Marking Directive 93/68/EEC

Provided the installation requirements described in this guide are met, and there are no special requirements of the installation and operating environment so that the application may be considered typical.

The above equipment conforms with the protection requirements of Council Directive 89/336/EEC as amended by Directive 92/31/EEC on the approximation of the laws of the Member States relating to Electromagnetic Compatibility when installed, operated and maintained as intended. Also: - The above equipment conforms with the requirements of Council Directive 73/23/EEC (Low Voltage Directive) as amended by Directive 93/68/EEC (CE Marking Directive), when installed, operated, and maintained as intended.

In accordance with IEC 61800-3:1997 (Adjustable speed electrical power drive systems) this product is of the restricted sales distribution class which meets the needs of an industrial environment when installed as directed. However, further measures may need to be taken for use of the product in a domestic environment.

The installation requirements are detailed in the Information supplied with the equipment. The equipment is sold only to competent system builders.

Compliance is demonstrated by the application of the following standards:

- BS EN 61800-3 (1997) including Amendment A11 Adjustable speed electrical Power drive systems Part 3. EMC product standard including specific test methods.
- BS EN 50081-2 (1994) Electromagnetic compatibility—Generic emission standard Part 2. Industrial Environment.
- BS EN 61000-6-2 (1999) Electromagnetic compatibility Part 6-2: Generic Standards – Immunity for industrial environments.
- BS EN 61010-1 (1993) including Amendment A2. Safety requirements for electrical equipment for measurement, control, and laboratory use. Part 1 General Requirements.

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Warning — Risk of damage and/or personal injury

The Aries drives described in this guide contain 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.

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

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Important User 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.

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Change Summary

Revision F Changes

This document, 88-021610-01F, supercedes 88-021610-1E. Changes associated with Aries User Guide revisions, and document clarifications and corrections are as follows:

Topic	Description
Command Reference	Additions to ERES, SFB, and TREV commands for Aries Resolver option.
	Added TIDAC and TIQAC commands.
	Corrected DCMDZ syntax.
	Corrected ranges for DMTIC, DMTIP, DMTKE, DMTRES, and ERES.
Aries Names	Updated part number descriptions to include Resolver and Powerlink Options
LEDs—Drive Status Indicators	Updated to include Autorun mode.
Resolver option	Added Motor Feedback Connector pinout, circuit diagram, and resolver excitation frequency.
Error Messages	Added E50, E51, and E52 error messages

Revision E Changes

This document, 88-021610-01E, supercedes 88-021610-1D. Changes associated with Aries User Guide revisions, and document clarifications and corrections are as follows:

Topic	Description
AC Power Supply Connection	Clarified jumpering two phases of the motor input power to the control input power allows for a single AC connection.
Drive I/O Connector—Internal Circuit Diagram	Corrected circuit for Step+ and Step-.
Drive I/O Connector	Step and Direction is not optically isolated, but is 5V differential compatible (RS-422 logic level compatible).
VM26 Breakout Module	Added appendix describing the VM26 Breakout Module.

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Revision D Changes

This document, 88-021610-01D, supercedes 88-021610-1C. Changes associated with Aries User Guide revisions, and document clarifications and corrections are as follows:

Topic	Description
Regulatory Compliance	Aries is no longer cUL compliant.
Output Power	Corrected to 14.07A
Part Number	In Appendix C, Table 62 Enclosure Mounting Clamps, corrected part number to read R CLAMP KIT.
Environment and Drive Cooling	Removed separate Still Air and Moving Air temperature maximums. Now provides only an Ambient Air temperature.

Revision C Changes

This document, 88-021610-01C, supercedes 88-021610-1B. Changes associated with Aries User Guide revisions, and document clarifications and corrections are as follows:

Topic	Description
Models	Enhancement: Added models AR-13xx, AR-20xE, and AR-30xE, and relevant information.
Regeneration Protection	Enhancement: Added discussion and connections.
DC Inductance Link	Enhancement: Added discussion and connections.
Command Reference	Enhancements: Added the following commands: ALIGN, DMTSWT, DRES, ENCOFF, ESTORE, IANI, OHALL, P163 Modified the following commands: DMTTCM—range DMTTCW—range DMVLIM—range and default DPWM—range and corrected mode information ERROR—now includes messages E47 and E48 SFB—In OS 2.10 or higher, SFB also functions to set feedback type TMTEMP—Added new reporting capabilities for OS 2.10 or higher
Error Messages	Enhancement: Added error messages E47 and E48. See Table 50 on page 147.

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Revision B Changes

This document, 88-021610-01B, supercedes 88-021610-1A. Changes associated with Aries User Guide revisions, and document clarifications and corrections are as follows:

Topic	Description
Fault Operation	Enhancement: Added a discussion about fault operations for the DRIVE I/O connector. See Fault Operation on page 52.
DRIVE I/O connector-internal circuit diagram	Correction: Simplified the circuit diagram for the Enable input. See Figure 34 on page 53.
Inputs—Enable and Reset	Enhancement: Added specifications detailing electrical and timing characteristics on the DRIVE I/O connector. See Table 30 on page 55.
Outputs—Encoder	Enhancement: Added specifications detailing electrical and timing characteristics on the DRIVE I/O connector. See Table 31 on page 55.
Inputs—Step & Direction	Enhancement: Added specifications detailing electrical and timing characteristics on the DRIVE I/O connector. See Table 33 on page 56.
Inputs--Analog	Enhancement: Added specifications detailing electrical and timing characteristics on the DRIVE I/O connector. See Table 34 on page 56.
RS-485 Communication	Correction: Both RS-485 channels are Tx/Rx. See Table 37 on page 60.
Tuning	Enhancements: Added Chapter 5 Tuning, describing servo tuning. Added Appendix D Servo Tuning Flow Diagram.
Command Reference	Enhancements: Added the following commands: DMTD, DMTJ, DNOTAD, DNOTAF, DNOTAQ, DNOTBD, DNOTBF, DNOTBQ, DNOTLD, DNOTLG, SGVF Modified CONFIG—now includes error messages E13-E18.
Error Messages	Enhancement: Added error messages E13-E18. See Table 50 on page 147.

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CHAPTER ONE

1 Introduction

IN THIS CHAPTER	
Aries Products—Overview	2
Compatible Parker Products	3
Checking Your Shipment	4
Illustrations in this Installation Guide	5
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Technical Support	5

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Aries Products—Overview

The Aries drives are a family of super compact, super efficient digital servo drives. Their maximum continuous shaft power ranges from 100 Watts to 3000 Watts (3kW). Ready for direct panel mounting, you can select the precise power level needed for your application.

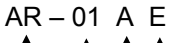
Aries Product Descriptions

Aries Servo Drives can control the torque, velocity, and position of servo motors using a digital current loop. Control of Aries Drives is performed using controllers, which have standard ±10V torque command, ±10V velocity command, or 5V TTL step & direction interface.

For Aries drives using the analog or step and direction command interface, configure the drives through RS-232/485 using the Aries Support Tool on a personal computer (PC), or other standard communication software. For Aries drives using the Ethernet Powerlink command interface, configure the drives through Ethernet using the ACR-View software on a PC. Many advanced features are standard on the product including “plug and play” capabilities with Aries-compatible motors.

Aries Names

The following diagram explains the Aries part numbers:



Drive Type	Aries
Maximum Shaft Power	01 = 100W 02 = 200W 04 = 400W 08 = 750W 13 = 1300W 20 = 2000W 30 = 3000W
Command Interface	A = Analog S = Step & Direction P = Ethernet Powerlink
Motor Feedback	E = Encoder R = Resolver

Input Power

Motor Power

AR-01xx, AR-02xx	
AR-04xx, AR-08xx, AR-13xx	120/240 VAC single-phase mains motor power
AR-20xE	240 VAC single-phase or three-phase mains motor power
AR-30xE	240 VAC three-phase mains motor power only

Control Power

AR-01xx through AR-30xE	120/240 VAC single-phase mains control power

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Output Power Level

Servo Motor Drives

In Table 1, the maximum current is given at 120/240 VAC input, which equates to a motor bus voltage of 170/340 VDC.

Drive	Continuous Current (RMS)	Peak Current (RMS)	Continuous Shaft Output Power
AR-01xx	1A	3A	100W, 0.13 hp*
AR-02xx	1.75A	5.25A	200W, 0.27 hp*
AR-04xx	3A	9A	400W, 0.53 hp*
AR-08xx	4.50A	13.5A	750W, 1.0 hp*
AR-13xx	6.3A	14.07A	1300W, 1.75 hp*
AR-20xE	10A	30A	2000W, 2.7 hp**
AR-30xE	16A	48A	3000W, 4.04 hp**

* Maximum rating at 240 VAC, single-phase

** Maximum rating at 240 VAC, three-phase

Table 1 Output Power Level

Options

For the latest additions, see our website at www.parkermotion.com

Compatible Parker Products

Servo Controller
(±10V torque or velocity mode)..... ACR series or other Parker controller

Stepper Controller (S&D mode)..... ACR series or other Parker controller

Software..... Aries Support Tool

For information about cables, motors, etc., see “Chapter 2 Mechanical Installation”.

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Checking Your Shipment

Inspect your shipment carefully. You should have received the corresponding ship kit along with your drive.

Ship Kit Items

The following items ship with the AR-01xx through AR-13xx drives:

Part	Part Number
Aries Quick Reference Guide AR-01xx AR-02xx, AR-04xx, AR-08xx, & AR-13xx	88-021594-01C
R-Clamp	52-019734-01
Screw (8-32 $^{3}/_{8}$ inch)	51-006055-01
Aries compact disc containing the following: • Aries Hardware Installation Guide • Aries Support Tool	 88-021610-01 Part number N/A

Table 2 Ship Kit Items, AR-01xx through AR-13xx

The following items ship with the AR-20xE and AR-30xE drives:

Part	Part Number
Aries Quick Reference Guide AR-20xE and AR-30xE	88-025222-01A
R-Clamp	50-018127-01
Screw (8-32 $^{3}/_{8}$ inch)	51-006055-01
Aries compact disc containing the following: • Aries Hardware Installation Guide • Aries Support Tool	 88-021610-01 Part number N/A

Table 3 Ship Kit Items, AR-20xE and AR-30xE

Motors

You may have ordered a motor from one of the following families of Parker motors:

- SE/SM Series
- BE Series
- NeoMetric Series
- J Series
- MaxPlus Rotary
- MaxPlus Linear
- LXR Linear Series
- SL Linear Series
- ILM Linear Series
- SME Series
- SMN Series

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Illustrations in this Installation Guide

Typically, the illustrations in this guide show the Aries AR-01xx and the AR-30xE. These two models represent other models with similar features. AR-01xx represents models AR-01xx through AR13xE. Model AR-30xE represents the similar features of AR-20xE, as well.

If there is a need to illustrate *differences* between drives, relevant drawings are shown for each drive.

Assumptions of Technical Experience

The Aries Drive is designed for industrial applications. To effectively install and troubleshoot the Aries Drive, you must have a fundamental understanding of the following:

- Motion control applications
- Electromechanical actuators
- Electrical concepts such as voltage, current, switches, etc.
- Serial Communication (RS-232 or RS-485) depending on which communications protocol you are using.

Technical Support

For solutions to your questions about implementing the Aries 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 on page ii.

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CHAPTER TWO

Mechanical Installation

IN THIS CHAPTER	
Environment & Drive Cooling	7
Dimensions	13
Weight	15
Mounting Guidelines	16

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Environment & Drive Cooling

The Aries drive operates in an ambient temperature range of 0°C (32°F) to 45°C (113°F) ambient air temperature for all models except the AR-13xx. The AR-13xx operates in an ambient temperature range of 0°C (32°F) to 40°C (104°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 heatsink fins are vertical. Figure 8 on page 16 shows the mounting orientation, as well as the minimum top, bottom, and side installation clearances.

The Aries AR-20xE and AR-30xE models (2 and 3 kWs) employ internal fans for additional cooling capacity. The AR-20xE has one fan and the AR-30xE has two. The fans are located at the bottom of the drives. They draw air in from the bottom, force it up over the heatsink, and out the vents in the top of the drive. Fan speed is temperature-dependent in order to minimize audible noise and extend fan operating life.

Notes

- Avoid installing heat-producing equipment directly below a drive.
- Make sure 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 heatsink 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.

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	Environmental Specifications (AR-01xx, AR-02xx, AR-04xx, AR-08xx, AR-20xE, and AR-30xE)
Operating Temperature, Maximum	Ambient Air 45°C (113°F) 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)

Table 4 Environmental Specifications, AR-01xx through AR-08xx, AR-20xE and AR-30xE

	Environmental Specifications (AR-13xx)
Operating Temperature, Maximum	Ambient Air 40°C (104°F) 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)

Table 5 Environmental Specifications, AR-13xx

Cabinet Cooling

For cabinet cooling calculations, use Table 6 and Table 7 to determine the power dissipation per drive.

AR-02xx

The power dissipation in Table 6 for the AR-02xx has been measured using the Parker BE231D motor.

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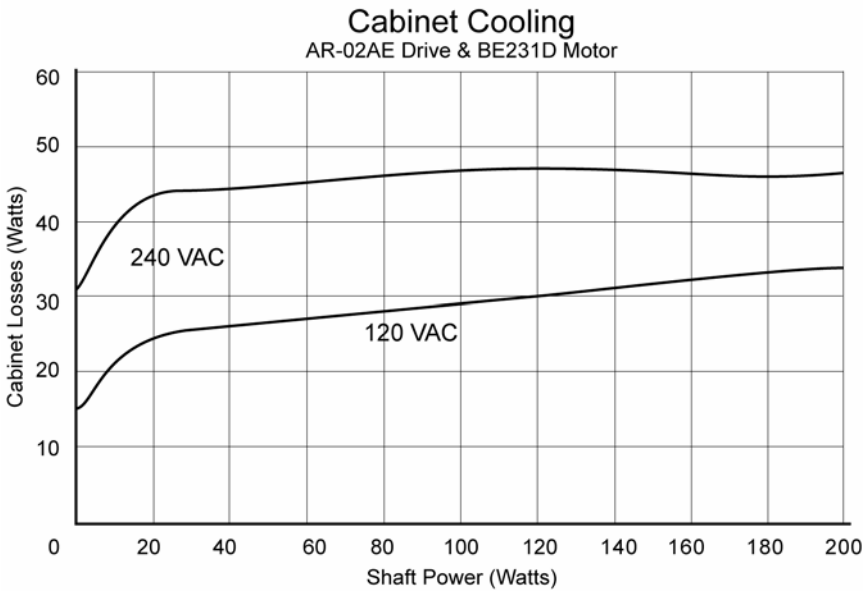


Figure 1 Cabinet Losses for AR-02xx when connected to a Parker BE231D motor

	Shaft Power		
Voltage	**0W***	**20W**	**200W**
120 VAC	15W	25W	34W
240 VAC	32W	44W	47W
* Drive enabled, zero torque.			

Table 6 AR-02xx Power Dissipation

AR-08xx

The power dissipation in Table 7 for the AR-08xx has been measured using the Parker BE343J motor.

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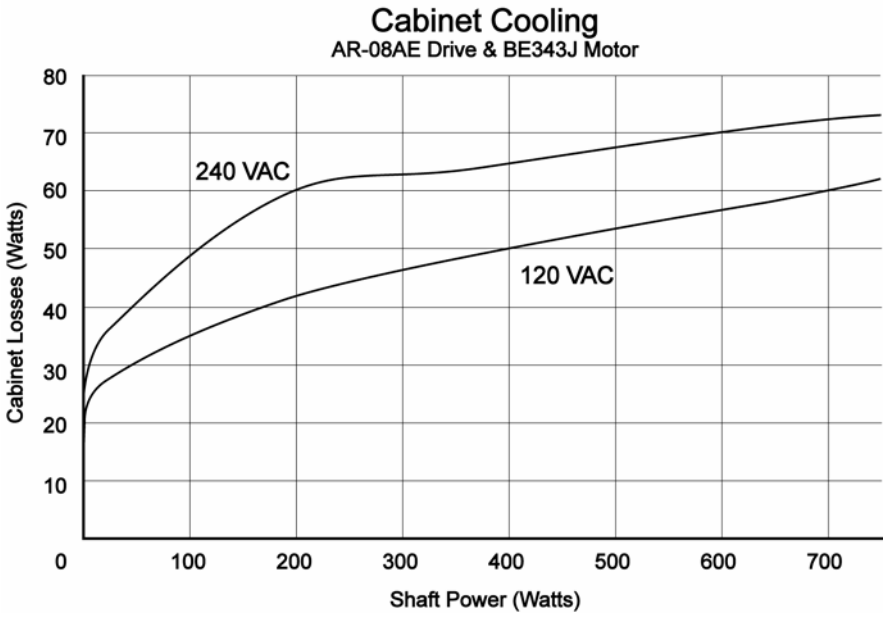


Figure 2 Cabinet losses for AR-08xx when connected to a Parker BE343J motor

	Shaft Power		
Voltage	**0W***	**200W**	**700W**
120 VAC	13W	42W	60W
240 VAC	24W	60W	73W
* Drive enabled, zero torque.			

Table 7 AR-08xx Power Dissipation

AR-13xx

The power dissipation in Table 8 for the AR-13xx has been measured using the Parker MPM1421CSJXXXN motor.

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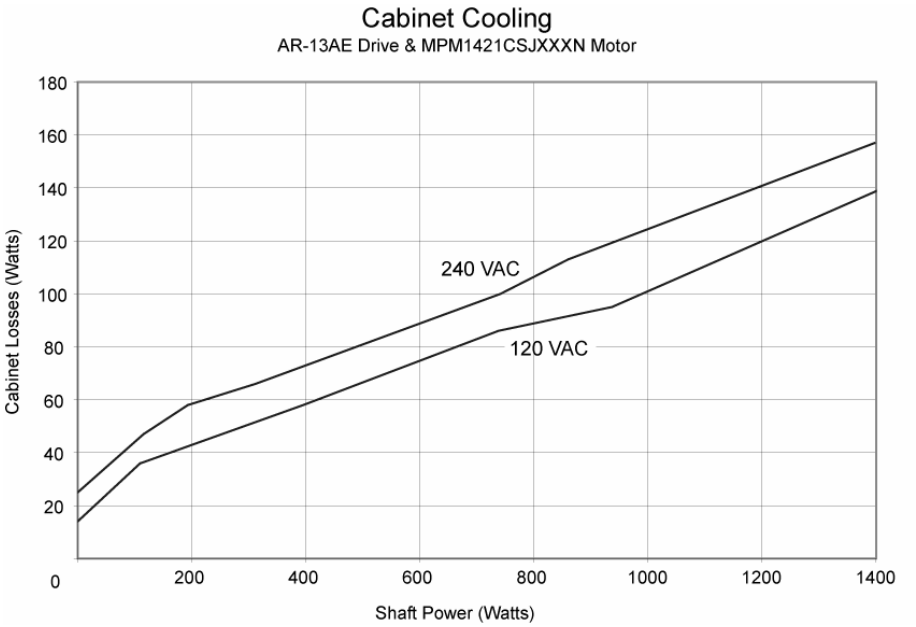


Figure 3 Cabinet losses for AR-13xx when connected to a Parker MPM1421CSJ motor

	Shaft Power		
Voltage	**0W***	**700W**	**1300W**
120 VAC	14W	82W	130W
240 VAC	25W	95W	146W
* Drive enabled, zero torque.			

Table 8 AR-13xx Power Dissipation

AR-30xE

The power dissipation in Table 9 for the AR-30xE has been measured using the Parker MPM1422CSJXXXN motor.

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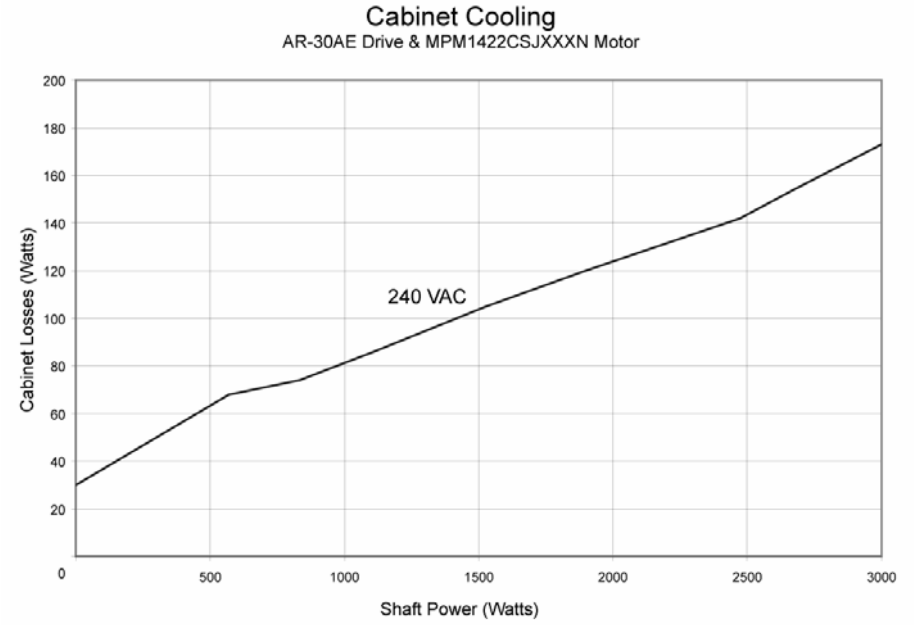


Figure 4 Cabinet losses for AR-30xE when connected to a Parker MPM1422CSJ motor

	Shaft Power		
Voltage	**0W***	**1500W**	**3000W**
240 VAC	35W	103W	172W
* Drive enabled, zero torque.			

Table 9 AR-30xE Power Dissipation

Cabinet Cooling Calculations

Use the motor's speed torque curve to determine the torque when the motor is at running speed for your application. If the torque is not known, use the "knee" (where the peak-torque curve intersects the continuous-torque curve) of the graphed motion—this assumes the worst-case scenario for continuous motion.

$$P_{LOSS} = \frac{P_{MOTOR}}{E_{MOTOR}} * \left(1 - E_{DRIVE}\right)$$

P_{LOSS} = power dissipated to cabinet (Watts)

P_{MOTOR} = shaft power of the motor (Watts)

E_{MOTOR} = efficiency of motor (Percent), approximately 0.85

E_{DRIVE} = efficiency of Aries drive (Percent), approximately 0.90

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Dimensions

There are three basic housing sizes for the Aries drives. However, the height of the heatsink fins varies with each model, except for the AR-20xE and AR-30xE whose dimensions are identical. This section contains the dimensions for all Aries models.

Drive Dimensions—AR-01xx & AR-02xx

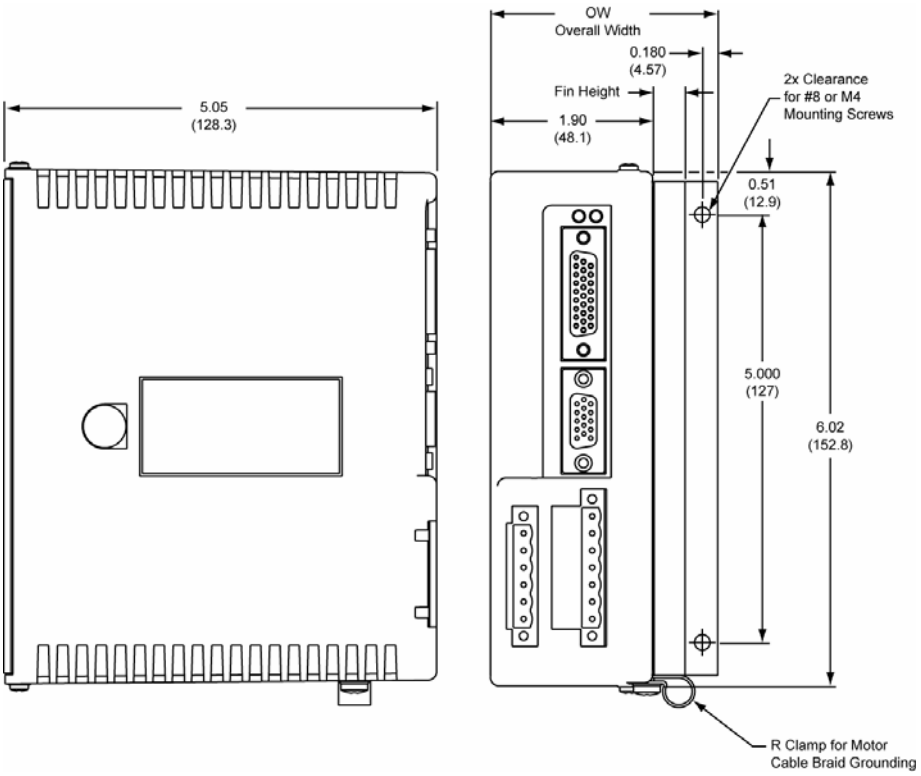


Figure 5 Drive mounting for the AR-01xx & AR-02xx

Drive	Fin Height—in (mm)	Outside Width (OW)—in (mm)	Overall Depth with Cables—in (mm)
AR-01xx	0.01 (0.25)	2.29 (58.2)	7.60 (193.0)
AR-02xx	0.375 (9.5)	2.65 (67.3)	7.60 (193.0)

Table 10 AR-01xx and AR-02xx Drive Dimensions

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Drive Dimensions—AR-04xx, AR-08xx, & AR-13xx

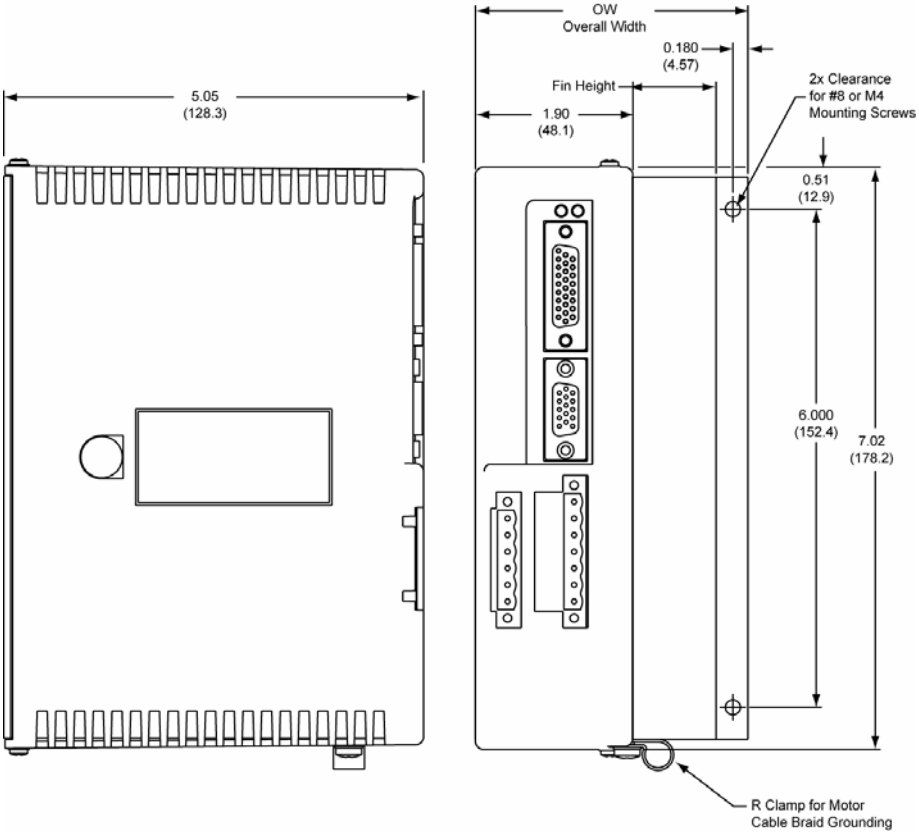


Figure 6 Drive mounting for the AR-04xx, AR-08xx, and AR-13xx

Drive	Fin Height—in (mm)	Overall Width (OW)—in (mm)	Overall Depth with Cables—in (mm)
AR-04xx	0.625 (15.9)	2.90 (73.7)	7.60 (193.0)
AR-08xx	1.00 (25.4)	3.28 (83.3)	7.60 (193.0)
AR-13xx	2.00 (50.8)	4.28 (108.7)	7.60 (193.0)

Table 11 AR-01xx , AR-02xx, & AR-13xx Drive Dimensions

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Drive Dimensions—AR-20xE & AR-30xE

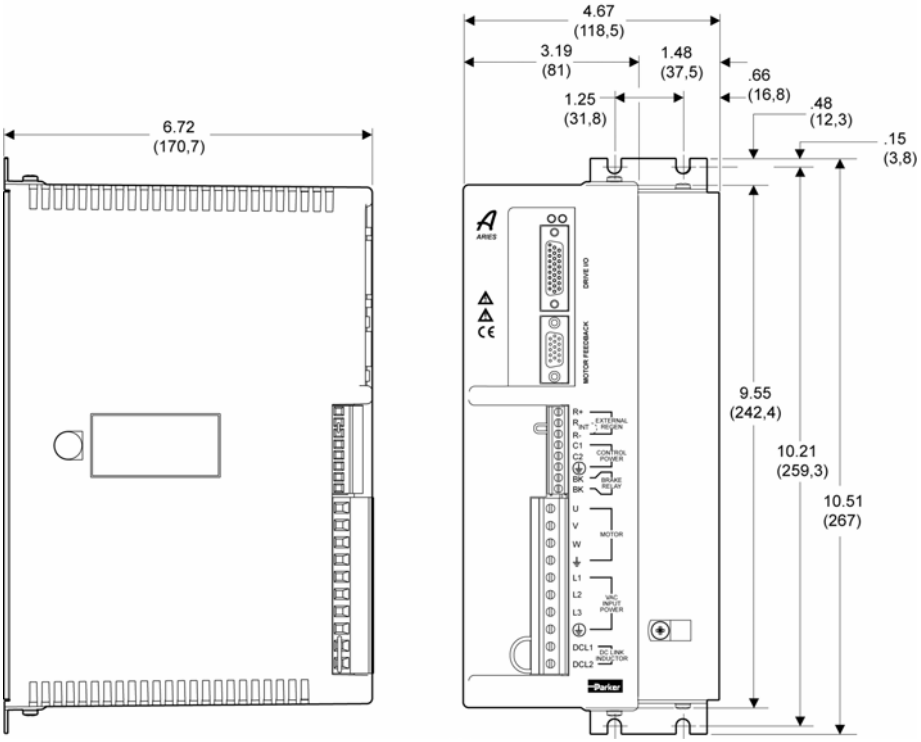


Figure 7 Drive mounting for the AR-20xE and AR-30xE

Drive	Fin Height—in (mm)	Overall Width (OW)—in (mm)	Overall Depth with Cables—in (mm)
AR-20xE & AR-30xE	1.48 (37.5)	4.67 (118.5)	9.27 (235.5)

Table 12 AR-20xE and AR-30xE Drive Dimensions

Weight

Use Table 13 to determine the weight of your drive.

Drive	Weight *pounds (kg)*
AR-01xx	1.68 (0.76)
AR-02xx	1.90 (0.86)
AR-04xx	2.54 (1.15)
AR-08xx	2.82 (1.28)

Drive	Weight *pounds (kg)*
AR-13xx	3.60 (1.63)
AR-20xE	7.35 (3.33)
AR-30xE	7.40 (3.36)

Table 13 Drive Weight

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Mounting Guidelines

The Aries drive is a vented product. To prevent material spilling into the drive, mount it under an overhang or in a suitable enclosure.

Aries products are made available under “Restricted Distribution” for use in the “Second Environment” as described in EN 61800-3 1996, page 9.

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 Mounting

The mounting clearance requirements are the same for all models of the Aries Drive. They are shown in Figure 8.

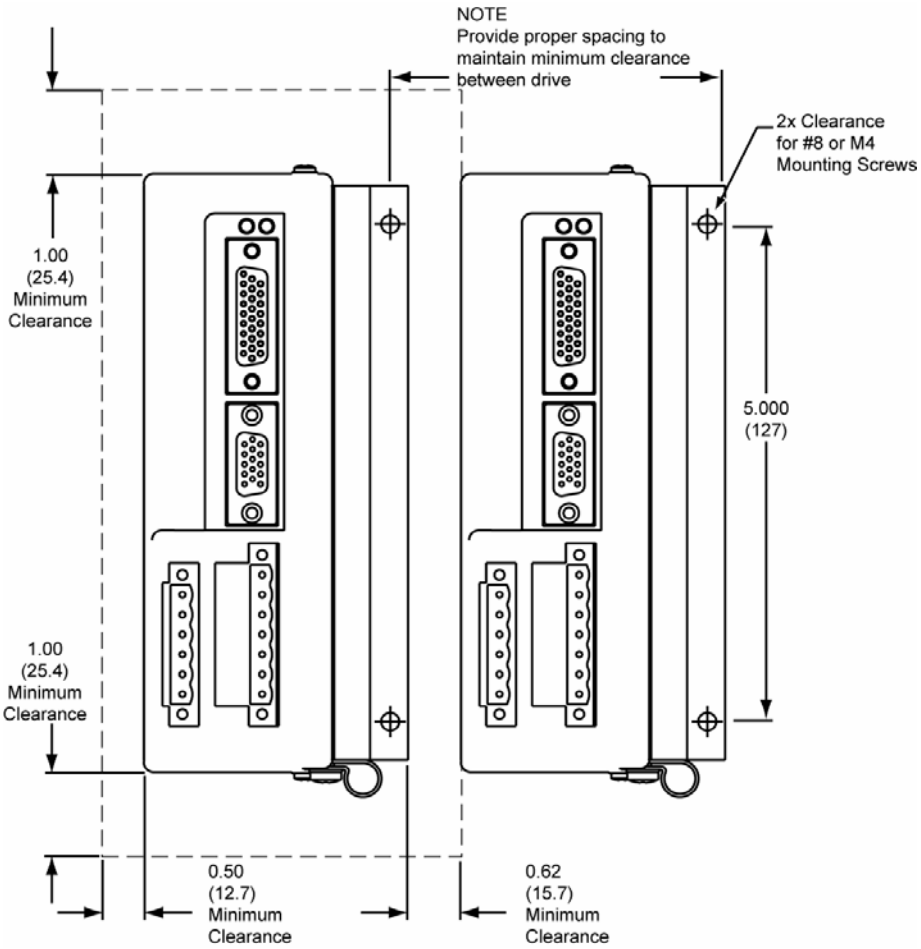


Figure 8 Panel Layout Dimensions for Aries Drives

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CHAPTER THREE

3 Electrical Installation

IN THIS CHAPTER	
Installation Safety Requirements	18
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Brake Relay (Optional)	35
Regeneration Protection	39
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Connector Descriptions	42
Installation Test	57

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Installation Safety Requirements

Aries drives meet the requirements of both the European LVD (Low Voltage Directive) and EMC (Electromagnetic Compliance) directives when installed according to the instructions given within “Appendix C Regulatory Compliance–UL and CE”.

As a rule, it is recommended that you install the drive 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, 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 drive.

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. Label, clearly, the switch or breaker as the disconnecting device.

Auto-Configuration for Encoders

The Aries drive recognizes “smart encoders” attached to Parker motors. You can apply power to the drive, and the drive reads all necessary motor parameters from the motor. The drive and motor are then ready to use.

If a drive is swapped out for any reason, you can insert a replacement—the replacement drive automatically reads the motor parameters.

Several drive related parameters may need additional configuration: `CMDDIR`, `DCMDZ`, and `ADDR`.

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System Installation Overview

The figures in this section illustrate the components necessary for electrical installation and configuration of the Aries drive. Figure 9 represents the installation of models AR-01xx through AR-13xx. Figure 11 shows the installation of models AR-20xE and AR-30xE, whose connectors differ from the other five models.

The illustration shows the use of the Aries dongle (part number 71-021609-01), which connects the Aries drive to both a controller and a personal computer (PC). The dongle is for setup purposes only. Do not use the dongle for permanent installation.

AR-01xx, AR-02xx, AR-04xx, AR-08xx, & AR-13xx Installation

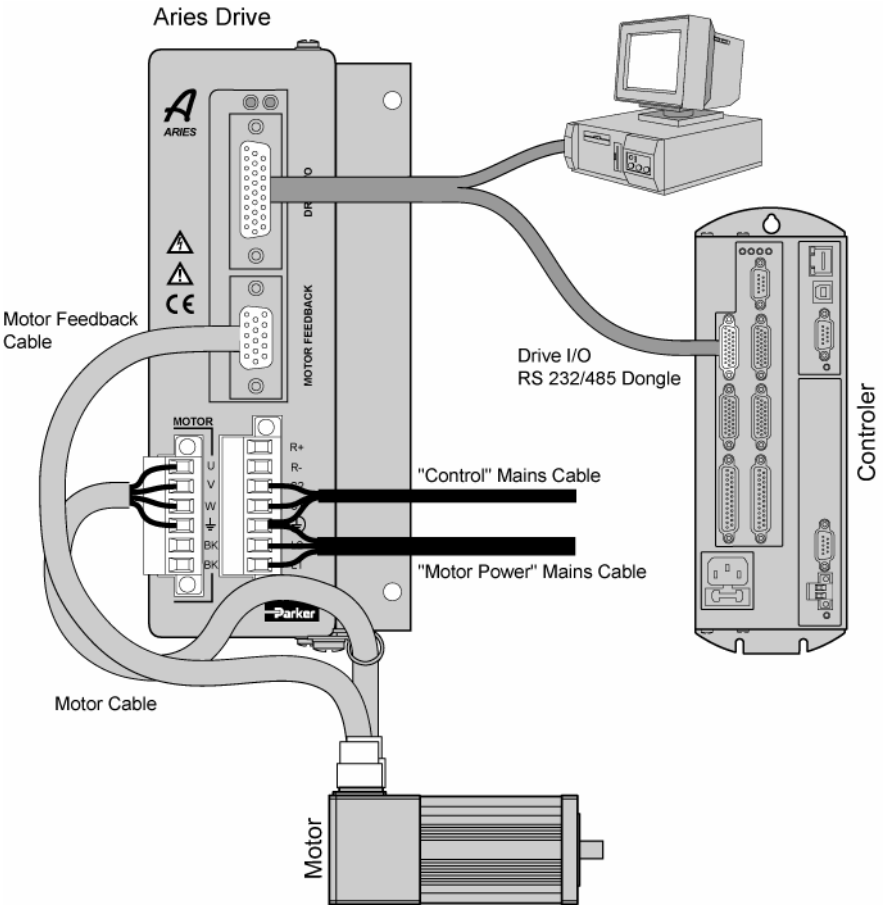


Figure 9 Overview of System Installation for AR-01xx to AR-13xx

Warning — This product has been developed for industrial environments. Due to exposed high voltage terminals, this product must not be accessible to users while under normal operation.

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To operate the Aries drive with separate control and motor AC input, remove the factory installed external jumpers. With the jumpers installed, apply power to the motor power mains only. Figure 10 shows the location of the factory installed jumpers.

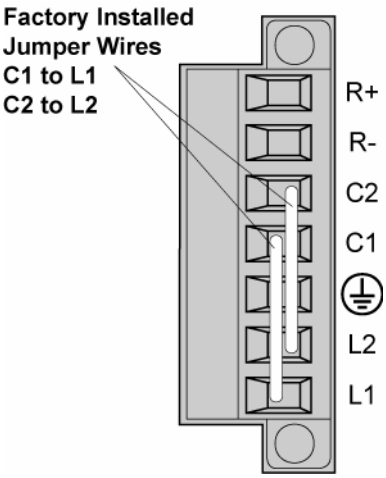


Figure 10 AR-01xx to AR-13xx Factory Installed Jumpers

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AR-20xE and AR-30xE Installation

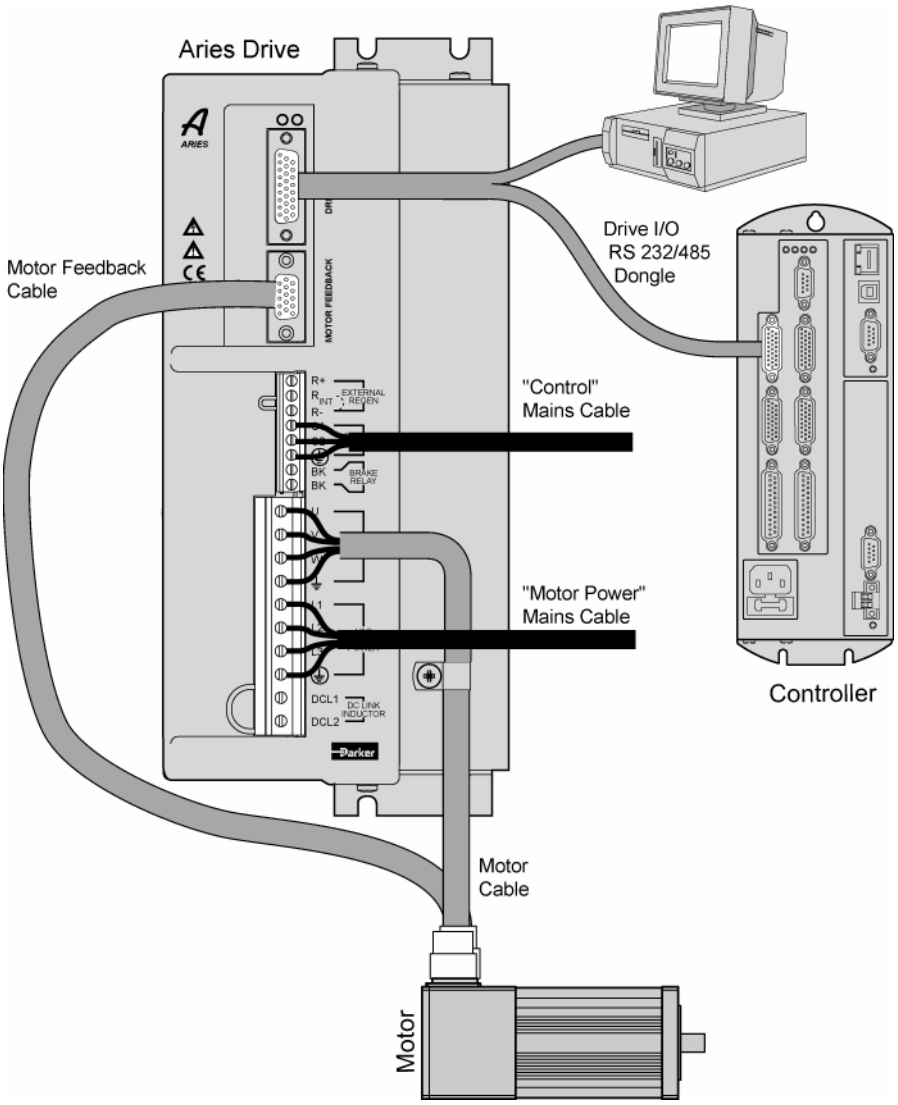


Figure 11 Overview of System Installation for AR-20xE & AR-30xE

Warning — This product has been developed for industrial environments. Due to exposed high voltage terminals, this product must not be accessible to users while under normal operation.

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To operate the Aries drive with separate control and motor AC input, remove the factory installed external jumpers. With the jumpers installed, apply power to the motor power mains only. Figure 12 shows the location of the factory installed jumpers.

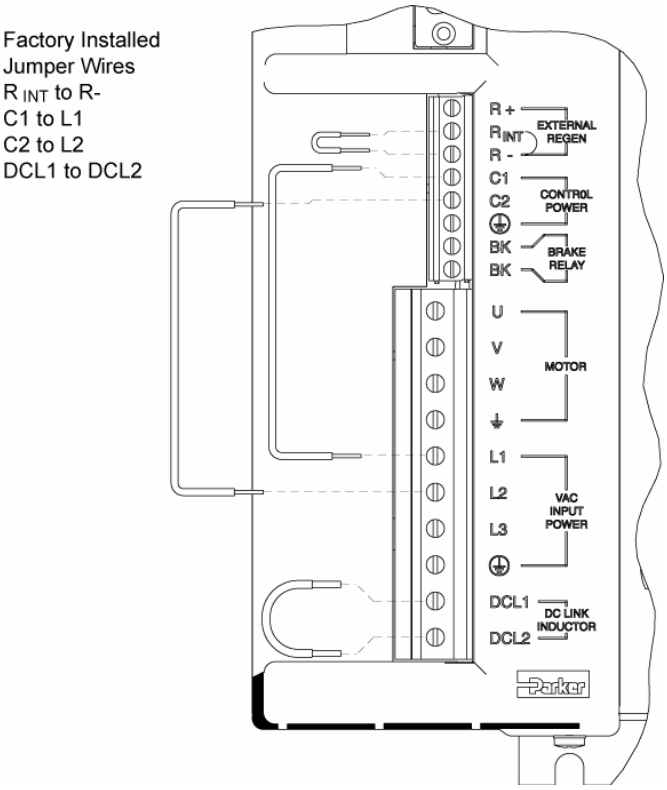


Figure 12 AR-20xE to AR-30xE Factory Installed Jumpers

Connector Locations

All Aries drive models have identical DRIVE I/O and Motor Feedback connectors. However, the connectors for motor and control power, on the AR-20xE and AR-30xE differ from the other models due to their higher power capacity. The two power connectors on models AR-01xx through AR-13xx are removable. The two power connectors on Models AR-20xE and AR-30xE are non-removable. Descriptions of individual connectors and their specifications follow in this chapter. See “Connector Descriptions,” and in “Appendix A Additional Specifications.”

Figure 13 shows the names and location of the connectors on Aries drive models AR-01xx through AR-13xx. Figure 14 shows them on the higher-power models AR-20xE and AR-30xE.

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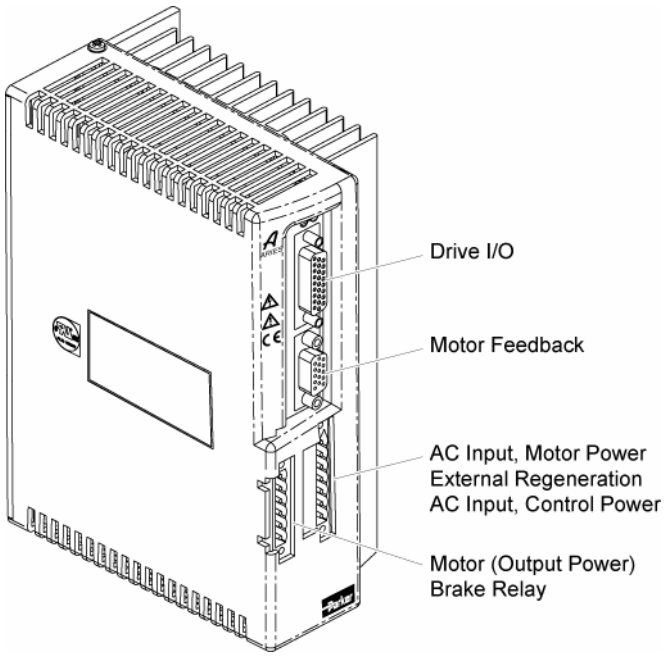


Figure 13 Connectors on Aries Models AR-01xx to AR-13xx

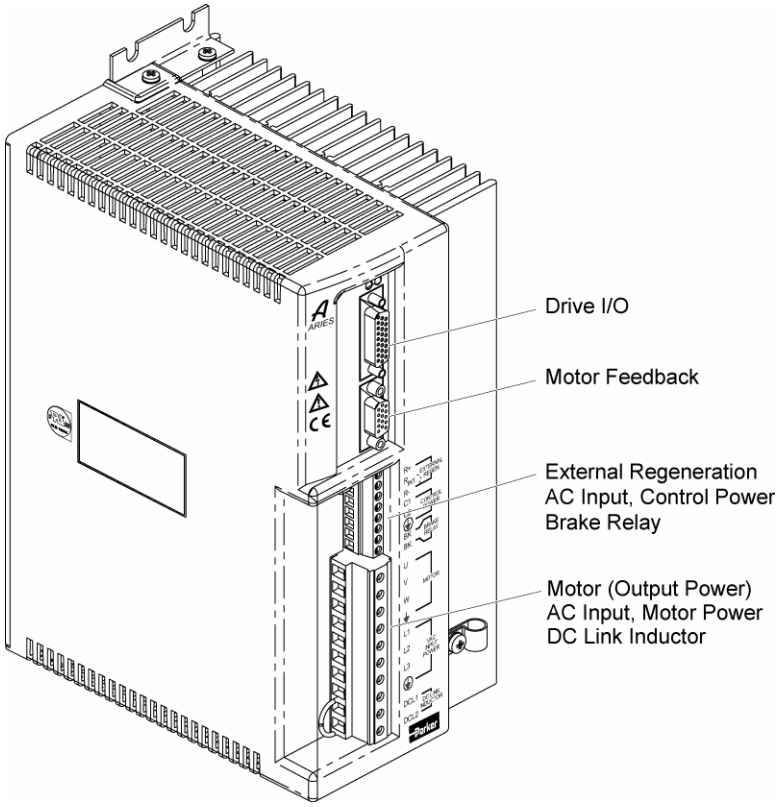


Figure 14 Connectors on Aries Models AR-20xE & AR-30xE

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Power Supply

Input Power

The mains motor power supply and control power supply for the Aries Drive must meet the following requirements.

Model	Requirements
Motor Input Power	
AR-01xx, AR-02xx, AR-04xx, AR-08xx, AR-13xx (L1, L2)	120/240 VAC, 50/60 Hz, single phase
AR-20xE (L1, L2, L3)	240 VAC, 50/60 Hz, single phase or three phase
AR-30xE (L1, L2, L3)	240 VAC, 50/60 Hz, three phase *only*
Control Input Power	
All models (C1, C2)	120/240 VAC, single phase

Figure 15 Input Power Requirements

Mains/Input Power Connector

AR-01xx, AR-02xx,AR-04xx, AR-08xx, AR-13xx

Connector Type..... Removable screw terminal
Terminals 7
Pitch ..... 0.200 in (5.08 mm)
Wire Range .....12-26 AWG
.....14-27 SWG
.....(0.12-3.30 mm^2)
Wire Strip length .. 0.31 in (7.87 mm)
Torque....7.0 in–lbs nom. (0.79 N-m)

AR-20xE, AR-30xE

Connector Type..... *Non-Removable* screw terminal
Terminals 10
Pitch ..... 0.315 in (8 mm)
Wire Range .....10-22 AWG
.....12-23 SWG
.....(0.5-4.0 mm^2)
Wire Strip length .... 0.25 in (6.5 mm)
Torque....7.0 in–lbs nom. (0.79 N-m)

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AC Power Supply Connection

Figure 16 on page 19 shows how to connect the external 120/240 VAC motor power source and control power sources to the drive.

- The AR-20xE can accept single-phase or three-phase 120V or 240V motor power. For single-phase connections, make no connection to terminal labeled L3.
- The AR-30xE can *only* accept three-phase 240V motor power.

Use the terminal connector that is supplied with the drive. For the Protective Earth ground, make the connection directly by means of a low-impedance path less than or equal to 0.1 ohm (no fuses, etc.). Under normal operation, no current should flow through the Protective Earth connection.

If desired, you can jumper two phases of the motor input power to the control input power for a single AC power connection. Jumpers are installed at the factory for this purpose. Remove the jumpers to apply separate control and motor mains power.

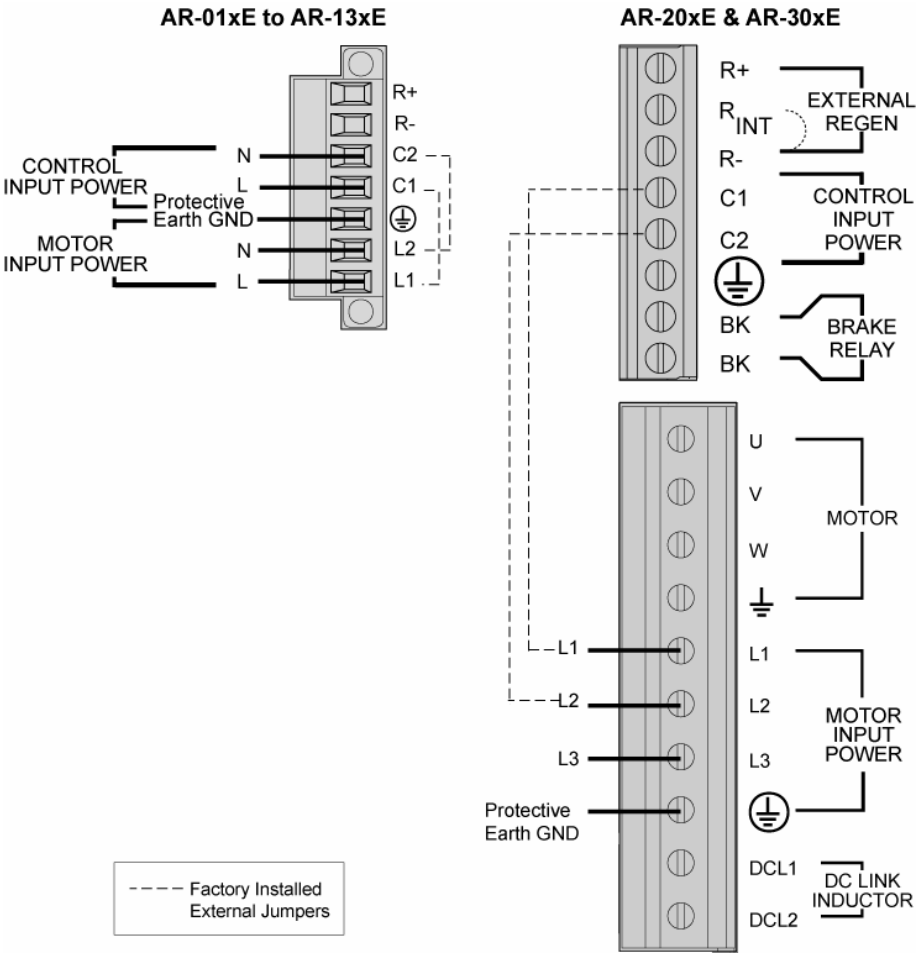


Figure 16 Motor and Control Mains Power Supply Connection

Note: See warnings on next page.

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Warning — You must connect the drive's protective conductor terminal, marked with the earth symbol ⏚, to a reliable system Protective Earth.



Warning — The drive's connector strip terminals have hazardous voltages when power is applied to the drive, and up to several minutes after power is removed. Lower voltages may still be present for several minutes after power is removed. During normal operation, these high voltage terminals must not be accessible to the user.

Motor Power Fuse Information

Aries drives have no user-serviceable internal fuses. For safety, you must provide a fuse in each of the AC Mains Motor power input lines. To determine the proper fuse type and size for your application, see Table 14. (For fuse recommendations for Control-power input lines, see "Control Power Supply" on page 31.)

Drive	AC Voltage	Fuse Style	Rating	Fuse Type
AR-01xx	120 VAC	125 VAC Time Delay	10A	RK5 or better
	240 VAC	250 VAC Time Delay	10A	RK5 or better
AR-02xx	120 VAC	125 VAC Time Delay	10A	RK5 or better
	240 VAC	250 VAC Time Delay	10A	RK5 or better
AR-04xx	120 VAC	125 VAC Time Delay	20A	RK5 or better
	240 VAC	250 VAC Time Delay	20A	RK5 or better
AR-08xx	120 VAC	125 VAC Time Delay	20A	RK5 or better
	240 VAC	250 VAC Time Delay	20A	RK5 or better
AR-13xx	120 VAC	125 VAC Time Delay	30A	RK5 or better
	240 VAC	250 VAC Time Delay	30A	RK5 or better
AR-20xE	240 VAC	250 VAC Time Delay	40A	RK5 or better
AR-30xE	240 VAC	250 VAC Time Delay	40A	RK5 or better

Table 14 Motor Power Fuse Information

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Table 15 lists part numbers (at time of publication) for suitable fuses from several manufacturers. These fuses are type RK5 (time delay fuses).

Amps	Bussmann	Ferraz Shawmut (formerly Gould)	Littelfuse
10	FRN-R-10	TR10R	FLNR10
20	FRN-R-20	TR20R	FLNR20
30	FRN-R-30	TR30R	FLNR30
40	FRN-R-40	TR40R	FLNR40

Table 15 Fuse Part Numbers

Drive Inrush Current

The drive inrush current is limited by an internal thermistor that changes value with the ambient temperature. Drive inrush current is therefore dependent upon the temperature of the surrounding environment (T_{amb}). To determine the drive inrush current for your drive, see Table 16.

Drive Type	AC Voltage	Drive Inrush (25°C T_{amb})	Drive Inrush (50°C T_{amb})
AR-01xx	120 VAC	34A	73A
	240 VAC	68A	146A
AR-02xx	120 VAC	34A	73A
	240 VAC	68A	146A
AR-04xx	120 VAC	17A	36A
	240 VAC	34A	73A
AR-08xx	120 VAC	17A	36A
	240 VAC	34A	73A
AR13xE	120 VAC	17A	36A
	240 VAC	34A	73A
AR-20xE	240 VAC	68A	155A
AR-30xE	240 VAC	68A	155A

Table 16 Drive Motor Power Inrush Current

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Output Power

Table 17 contains the continuous and peak output power ratings for all Aries drive models.

	Continuous Output		Peak Output	
Drive	**Current (Amps, RMS)**	**Shaft Power* (Watts, max)**	**Current (Amps, RMS)**	**Shaft Power (Watts, max)**
AR-01xx	1.0	100	3.0	300
AR-02xx	1.75	200	5.25	600
AR-04xx	3.0	400	9.0	1200
AR-08xx	4.5	750	13.5	2250
AR-13xx	6.3	1300	14.1	3900
AR-20xE	10	2000	30	6000
AR-30xE	16	3000	48	9000
* Maximum shaft power rating at 240 VAC				

Table 17 Output Power-Continuous and Peak

Motor Connector

AR-01xx, AR-02xx, AR-04xx, AR-08xx, AR-13xx

Connector Type..... Removable screw terminal
Terminals 6
Pitch ..... 0.200 in (5.08 mm)
Wire range .....12-26 AWG
.....14-27 SWG
.....(0.12-3.30 mm^2)
Wire strip length..... 0.310 in (8 mm)
Torque....7.0 in–lbs nom. (0.79 N-m)

AR-20xE, AR-30xE

Connector Type..... *Non-Removable* screw terminal
Terminals 10
Pitch ..... 0.315 in (8 mm)
Wire range .....10-22 AWG
.....12-23 SWG
.....(0.5-4.0 mm^2)
Wire strip length..... 0.25 in (6.5 mm)
Torque....7.0 in–lbs nom. (0.79 N-m)

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Output Power Connection

Figure 17 shows how to connect the motor cable to the drive. Use the screw terminal connector that is installed in the drive. Current Parker motor cables are marked with white numbers to indicate the phases. Connect Motor Phase 1 → U, 2 → V, and 3 → W, and Motor Safety Earth to the Protective Earth ground connector.

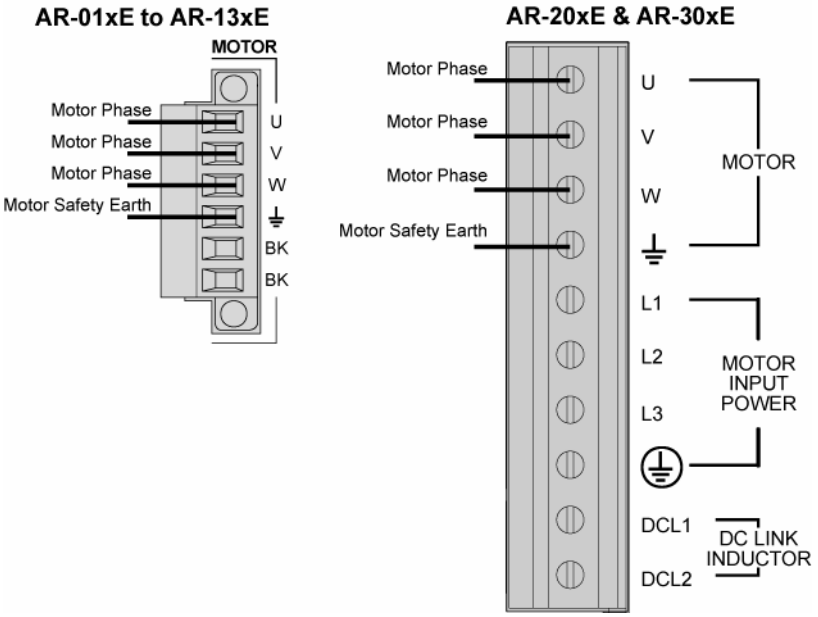


Figure 17 Output Power Connection

Table 18 contains information for making connections with Parker Hannifin motors.

Phase	Hi-Flex/ PS/ Gemini	Legacy Parker Hannifin	Legacy MaxPlus
U	1	Red/Yellow	Red
V	2	White/Yellow	Black
W	3	Black/Yellow	Blue
⏚	Green/Yellow	Green/Yellow	Green

Table 18 Wiring to Motors

Note: On models AR-20xE and AR-30xE, the Motor Brake Relay is on a separate connector. See Figure 22 on page 35.

Warning — You must connect the Motor Safety Earth conductor terminal, marked with the earth symbol ⏚, to the motor cable's motor-safety-earth wire (green/yellow).

Note: See additional warning on next page.

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Warning — The drive's connector strip terminals have hazardous voltages when power is applied to the drive, and up to several minutes after power is removed. Lower voltages may still be present for several minutes after power is removed. During normal operation, these high voltage terminals must not be accessible to the user.

External DC Link Inductor (Optional)

The Aries AR-20xE and AR-30xE drives have two extra terminals that allow an external DC link inductor to be added if required. To add the DC link inductor, remove the factory installed shorting link, and connect the inductor as shown in Figure 18.

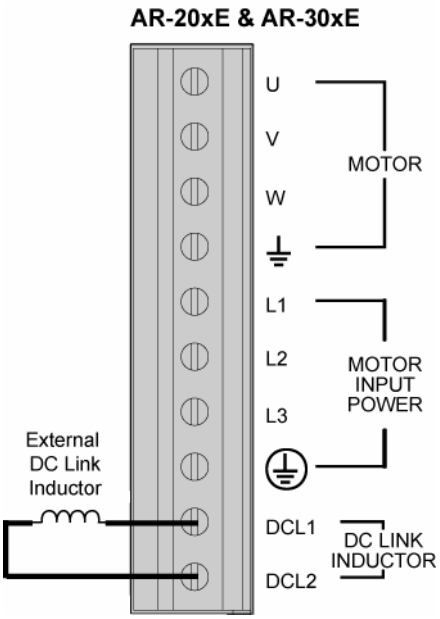


Figure 18 External DC Link Inductor Connection

If a drive is supplied from a low-impedance source (for example, a transformer that has a kVA rating more than 10 times the drive), the input line currents to the drive can be non-sinusoidal. They may have a peak that is two to three times the rms value, compared to 1.4 times for a sinusoidal waveform. This results in higher currents being drawn from the line at rated power and harmonics that might interfere with other equipment. The addition of a DC link inductor reduces the severity of these problems.

Table 19 provides compatible DC link inductors for the Aries AR-20xE and AR-30xE.

Drive Type	Recommended Inductance	DC Current Rating
AR-20xE	1.0 to 3.0 mH	10A
AR-30xE	0.75 to 2.0 mH	15A
Note: Where within the recommended range, the larger inductance gives a better shape to the input current waveform, but at the expense of larger physical size.		

Table 19 AR-20xE & AR-30xE DC Link Inductors

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Control Power Supply

With Mains power applied to the Control power terminals C1 and C2, the drive's internal control board remains powered when the primary motor AC power source (L1, L2 (L3)) is disconnected. When operated in this configuration, the Control power input performs a "keep-alive" function. The keep-alive circuit maintains several important functions, including communications, diagnostics, position feedback, and other logic functions, while removing power from the motor output connection. (See the following section, Fuse Information, for a complete list of Control power functions.)

Remove the factory installed jumpers to use the product with separate control and motor mains AC power input.

Fuse Information

Fuse Rating	1 Amp
Fuse Type	Class CC (Bussmann KTK-R-1 or equivalent UL listed fuse)
Input Voltage Range	120/240 VAC, 50/60 Hz
Input Current	0.2 Amps RMS
Control Power Functions	Communications Diagnostics Motor position feedback Fault output in fault mode Brake relay in brake mode Reset input

Control Power Connector

AR-01xx, AR-02xx,
AR-04xx, AR-08xx, AR-13xx

Connector Type	Removable screw terminal
	Terminals 7
	Pitch ..... 0.200 in (5.08 mm)
	Wire Range .....12-26 AWG
	.....14-27 SWG
	.....(0.12-3.30 mm^2)
	Wire Strip length .. 0.31 in (7.87 mm)
	Torque....7.0 in–lbs nom. (0.79 N-m)

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AR-20xE, AR-30xE

Connector Type..... *Non-Removable* screw terminal
Terminals 8
Pitch ..... 0.400 in (10 mm)
Wire Range .....12-28 AWG
.....14-29 SWG
.....(0.12-3.30 mm^2)
Wire Strip length 0.250 in (6.35 mm)

Control Power Connection

Figure 19 shows how to connect the Control power source to the drive. Use the screw terminal connector that is supplied with the drive.

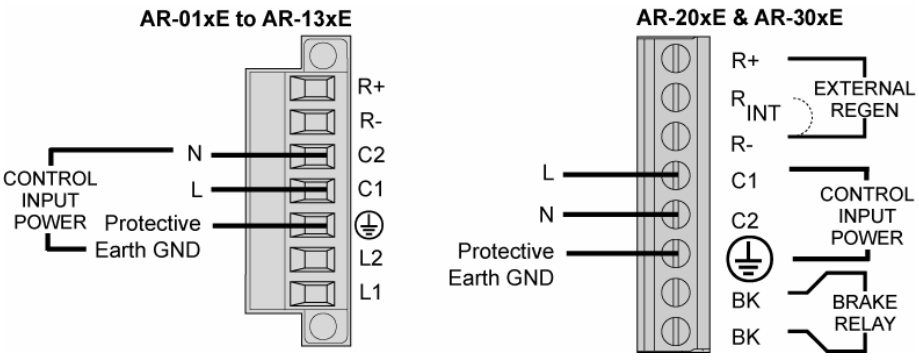


Figure 19 Mains Control Input Power

Warning — You must connect the drive's protective conductor terminal, marked with the earth symbol ⏚, to a reliable system Protective Earth.

Warning — The drive's connector strip terminals have hazardous voltages when power is applied to the drive, and up to several minutes after power is removed. Lower voltages may still be present for several minutes after power is removed. During normal operation, these high voltage terminals must not be accessible to the user.

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Multiple Drive Installations

In a typical cabinet installation, a single mains line connects to a terminal bus inside the cabinet. Then from the terminal bus, make individual connections for Mains and Control power to the corresponding connector(s) on *each drive*. Be sure to install fuses for each drive between the terminal bus and the drive.

Tie each drive's Protective Earth ⏚ conductor terminal directly to the system safety earth location as shown in Figure 20 (for models AR-01xx through AR-13xx) or Figure 21 (for models AR-20xE and AR-30xE). Under normal operation, no current should flow through the Protective Earth ground.

Safety Earth Connections

AR-01xx, AR-02xx, AR-04xx, AR-08xx, and AR-13xx

For multiple drive installations, Parker Hannifin recommends a single point or "star" safety earth configuration. Figure 20 represents a typical star safety earth connection for Aries models AR-01xx through AR-13xx.

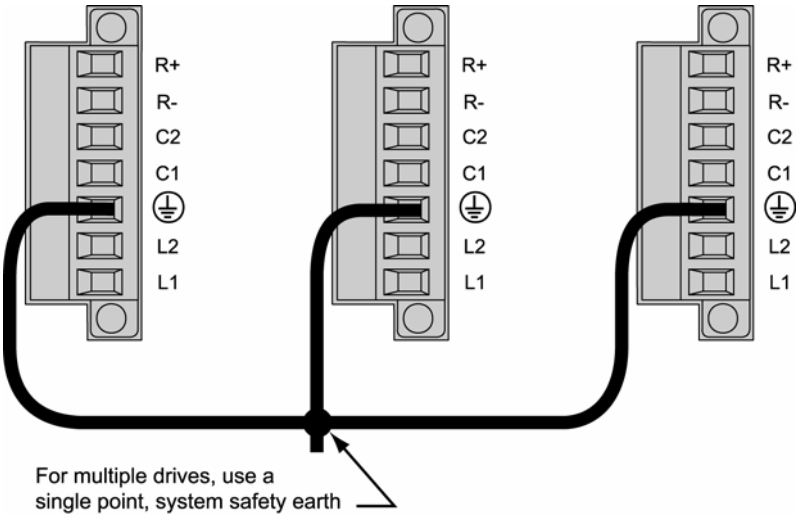


Figure 20 Multiple Drives AR-01xx to AR-13xx: Single Point Safety Earth

AR-20xE and AR-30xE

Figure 21 represents a typical star safety earth connection for Aries models AR-20xE and AR-30xE. Note that the AR-20xE and AR-30xE Motor/Power connector has two Earth ground terminals—one for the motor and one for input power. Be sure to use the VAC INPUT POWER ⏚ terminal.

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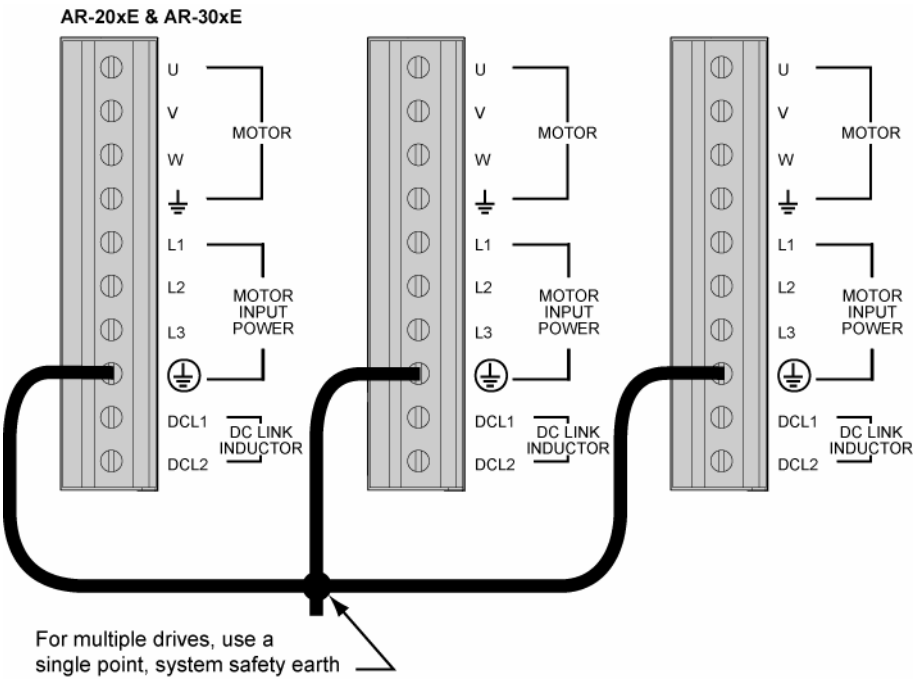


Figure 21 Multiple Drives AR-20xE & AR-30xE: Single Point Safety Earth

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Brake Relay (Optional)

[The Brake Relay connection provides a safety feature for your motion control system, particularly for vertical applications. The drive acts as a control switch for the motor brake (if a brake is present). When 24V is applied from an outside power supply through the drive's BK terminals, the motor brake is disabled. When the power supply is interrupted, or the drive faults or is disabled, the brake is enabled and stops shaft rotation. Connector and wiring information follow in this section.

Brake Relay Connector

AR-01xx, AR-02xx, AR-04xx, AR-08xx, AR-13xx

Connector Type..... Removable screw terminal
Terminals 6
Pitch ..... 0.200 in (5.08 mm)
Wire range .....12-26 AWG
.....14-27 SWG
.....(0.12-3.30 mm^2)
Wire strip length..... 0.310 in (8 mm)
Torque....7.0 in–lbs nom. (0.79 N-m)

AR-20xE, AR-30xE

Connector Type..... *Non-Removable* screw terminal
Terminals 8
Pitch ..... 0.400 in (10 mm)
Wire Range .....12-28 AWG
.....14-29 SWG
.....(0.12-3.30 mm^2)
Wire Strip length 0.250 in (6.35 mm)

Brake Relay Connection

On all models, this set of terminals is optically isolated from the drive's internal logic.

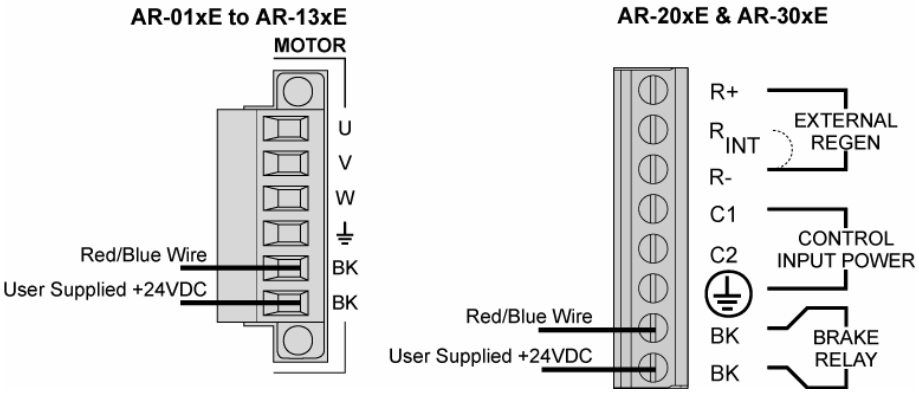


Figure 22 Typical Brake Relay Connection

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Warning — You must connect the drive's protective conductor terminal, marked with the earth symbol ⏚, to a reliable system Protective Earth.

Warning — The drive's connector strip terminals have hazardous voltages when power is applied to the drive, and up to several minutes after power is removed. Lower voltages may still be present for several minutes after power is removed. During normal operation, these high voltage terminals must not be accessible to the user.

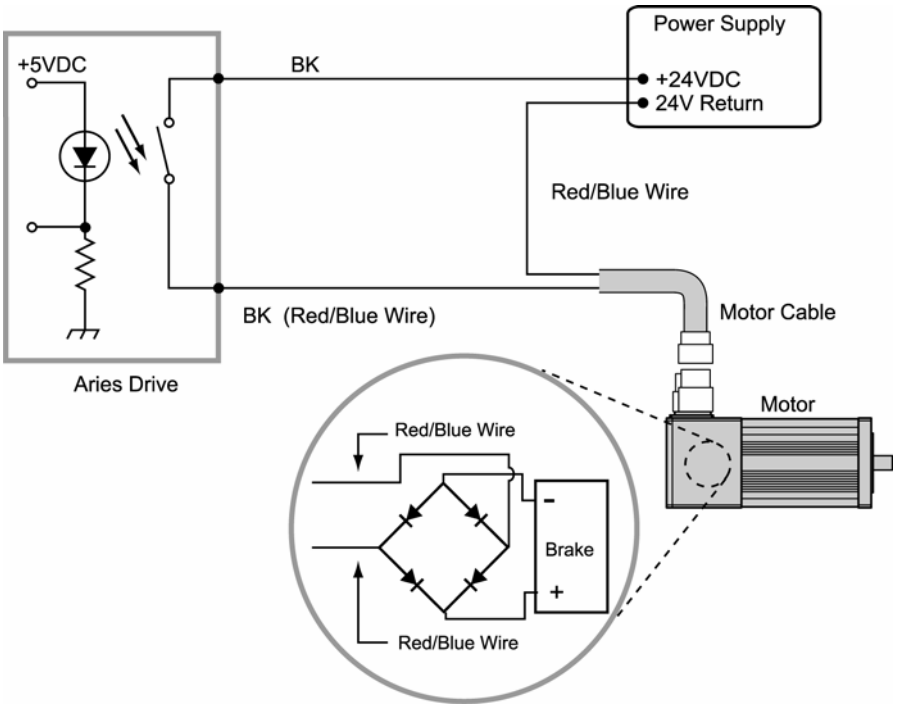
Motor with Full Wave Rectifiers

Some Parker brake motors (BE, SM, SE, NeoMetric, and J series motors, serial numbers greater than 010904xxxxx) contain full wave rectifiers, so connection polarity is not an issue during installation.

Connecting the Brake Relay

1. Connect one red/blue brake wire (Parker Motor cable or equivalent) to the BK terminal of the Motor connector on Aries models AR-01xx to AR-13xx, or the Control connector on models AR-20xE and AR-30xE.
2. Connect the second red/blue brake wire (Parker Motor cable or equivalent) to the 24V return on your power supply.
3. Connect the +24 VDC power supply to the second BK terminal of the Motor connector on Aries models AR-01xx to AR-13xx, or the Control connector on models AR-20xE and AR-30xE.

Figure 23 on page 37 shows a typical application—connecting a motor brake to the relay terminals.



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Figure 23 Brake Relay Connection for Parker Motors

Motors without Full Wave Rectifiers

When using Parker MaxPlus motors, Parker motors with serial numbers less than 010904xxxxx, or non-Parker motors, you must install a fly-back diode. Consult the specifications or the manufacturer of your motor.

Connecting the Brake Relay

1. Connect one red/blue brake wire (Parker Motor cable or equivalent) to the BK terminal of the Motor connector (Aries drive).
2. Connect the second red/blue brake wire (Parker Motor cable or equivalent) to the 24V return on your power supply.
3. Between the two red/blue wires, connect the fly-back diode. See Figure 24.
4. Connect the +24 VDC power supply to the second BK terminal of the Motor connector (Aries drive).

Figure 24 shows a typical installation.

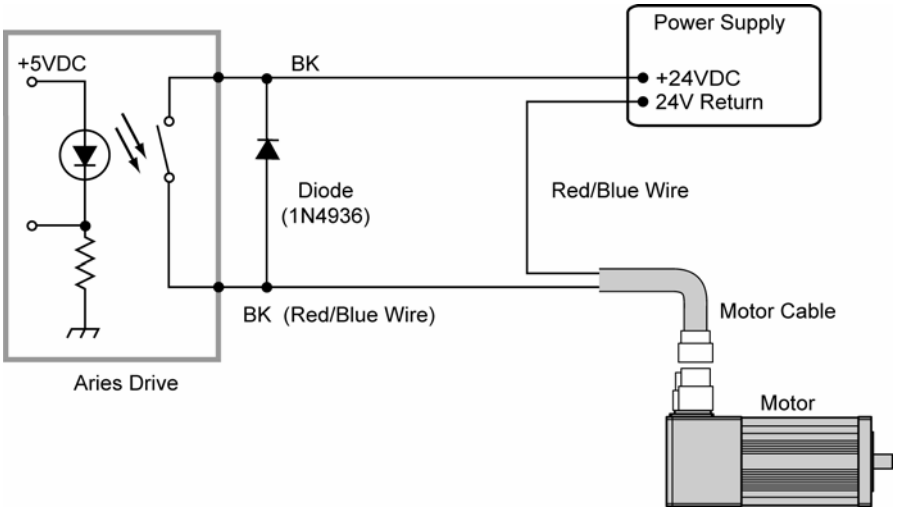


Figure 24 Brake Relay Connection for Non-Parker Motors

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Relay Operation

Drive Condition	Relay State
Enabled	Closed (conducting)
Faulted	Open
No AC power on L1 and L2*, or drive not enabled	Open

* Mains Control power on C1 and C2 does not affect the relay. With mains power applied to C1 and C2, the relay remains open if AC power is *not* applied to the L1 and L2 terminals.

Table 20 Brake Relay Operation

Relay Specifications

Relay Type ..... Solid State Relay
Normally open

Relay Maximum Rating ..... 1 Amp at 24 VDC



Warning — Do not exceed the ratings of the brake relay. If required, control a suitable external relay with this relay to meet your power requirements.

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Regeneration Protection

The Aries drive models AR-20xE and AR-30xE have internal regeneration power dump (dissipation) resistors. Models AR-01xx through AR-13xx do not. However, all models can utilize an external regeneration resistor.

Regeneration Connection

To use a external regeneration (power dump) resistor, connect your external resistor to the R+ and R- terminals as follows:

- For models AR-01x to AR-13xx, use the Mains connector.
- For models AR-20xE and AR-30xE, use the Control connector.

Figure 25 illustrates the external regeneration resistor connections.

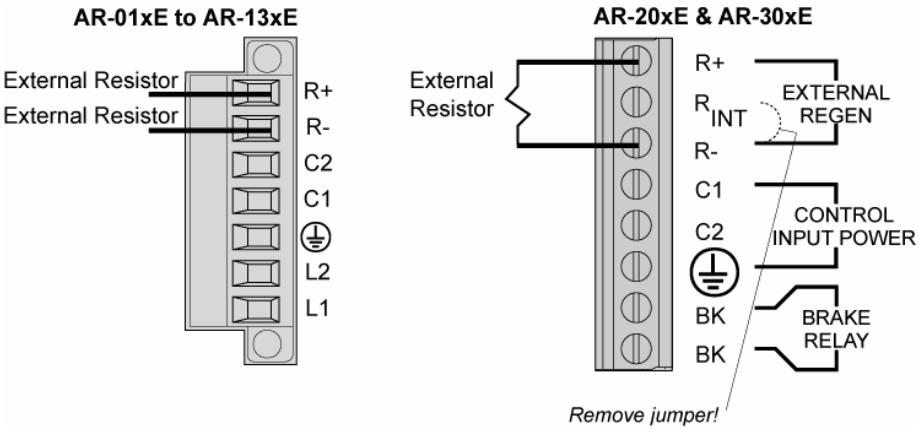


Figure 25 External Regeneration Connection

Important! For models AR-20xE and AR-30xE, you must remove the factory-installed link between R_{INT} and R– when you connect the external regeneration resistor. (Otherwise the internal regeneration resistor will still be in the circuit, and its thermal protection circuit limits the performance).

For information on selecting a suitable external regeneration (power dump) resistor, see “Appendix B External Power-Dump Resistor Selection.”

Warning — The drive’s connector strip terminals are at hazardous voltages when power is applied to the drive, and up to several minutes after power is removed. Lower voltages may still be present for several minutes after power is removed.

During normal operation, these high voltage terminals must not be accessible to the user.

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Internal Regeneration Capability

The internal regeneration resistor of the AR-20xE and AR-30xE is capable of dissipating 1kW for 1 second and up to 100 Watts continuously (depending upon heatsink temperature). If the calculated temperature of the internal regeneration resistor exceeds 150°C (302°F), the drive turns off the regeneration circuit and may experience an over-voltage fault.

Similarly, models AR-01xx through AR-13xx may experience an over-voltage fault if the regeneration exceeds the absorbent capacity of the drive's internal bus capacitors, as shown in Table 21.

Regeneration Absorption

The available absorption varies based on mains voltage and the drive's internal capacitance. The drives can absorb the following amounts of regenerated energy in their internal capacitors:

Drive	Absorb (Joules) 120 VAC	Absorb (Joules) 240 VAC
AR-01xx	28	9
AR-02xx	43	14
AR-04xx	57	19
AR-08xx	72	24
AR-13xx	104	35
AR-20xE	N/A	50
AR-30xE	N/A	50

Table 21 Regeneration Absorption

For more specifications about energy absorption by the Aries drive's capacitors, see Table 58.

For more information about selecting an external power-dump resistor, see "Appendix B External Power-Dump Resistor Selection".

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LEDs—Drive Status Indicators

The drive has two bi-color LEDs. The LED on the left displays yellow or green colors; The LED on the right displays red or green colors. The following tables describe LED illumination states and the conditions they indicate.

Normal Operation

LED–Left	LED–Right	What it means
Off	Green	Power on, enabled
Yellow	Green	Power on, regeneration active
Off	Red	Power on, disabled–No Fault
Yellow	Off	Power on, boot process
Off	Red (flashing)	Waiting for OS download
Yellow (flashing)	Red (flashing)	OS download in process

Table 22 LED Status Indicator-Normal Operation

Internal Drive Faults

LED–Left	LED–Right	What it means
Yellows	Red	Control power mode active
Yellow & 1 Green (flashing)	Red	Bridge Fault
Yellow & 2 Green (flashing)	Red	Feedback Fault
Yellow & 3 Green (flashing)	Red	Thermal Fault
Yellow & 4 Green (flashing)	Red	Other Fault

Table 23 LED Status Indicator-Internal Drive Fault

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Connector Descriptions

Motor Mains Power Connector

The drive's Mains screw terminal connector provides a connection for AC Mains power to your drive. (For connection information, see "Input Power" on page 24.) The connector differs between the two largest Aries models and the others. Specifications for the connectors follow in this section.

On models AR-01xx through AR-13xx, the Mains connector also serves as a connector for Control power (C1 and C2) and a power dissipation resistor (R+ and R–). For more information on these additional connections, see "Control Power Supply" on page 31 "Regeneration Protection" on page 39.) This connector is removable.

On models AR-20xE and AR-30xE, the Motor/Power connector serves as the connector for Motor Mains power (L1, L2, L3, and ⏚), as well as for output power to the motor (U, V, W, and ⏚) and a DC Link Inductor. For more information on these additional connections, see "Output Power" on page 28 and "External DC Link Inductor (Optional)" on page 30. This connector is not removable.

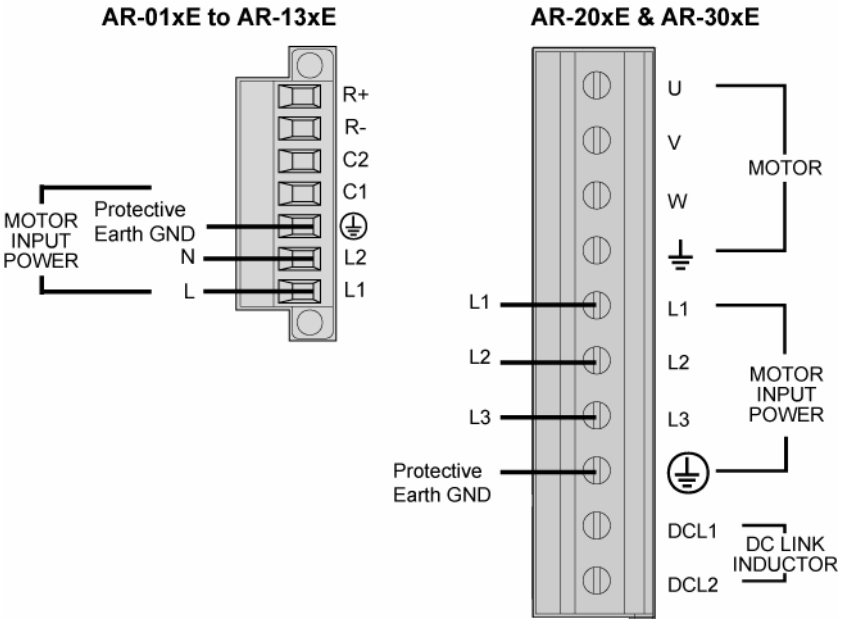


Figure 26 Mains/Input Power Connector

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Mains/Input Power Connector

AR-01xx, AR-02xx, AR-04xx, AR-08xx, AR-13xx ..... Amphenol PCD: ELFA13210E

Parker Hannifin Part Number 43-021069-01

Connector Type ..... Removable screw terminal
Terminals 7
Pitch ..... 0.200 in (5.08 mm)
Wire Range ..... 12-26 AWG
..... 14-27 SWG
..... (0.12-3.30 mm^2)
Wire Strip length .. 0.31 in (7.87 mm)
Torque .... 7.0 in–lbs nom. (0.79 N-m)

AR-20xE, AR-30xE ..... Molex: 39960-0110

Parker Hannifin Part Number ..... N/A

Connector Type ..... *Non-Removable* screw terminal
Terminals 10
Pitch ..... 0.315 in (8 mm)
Wire Range ..... 10-22 AWG
..... 12-23 SWG
..... (0.5-4.0 mm^2)
Wire Strip length .... 0.25 in (6.5 mm)
Torque .... 7.0 in–lbs nom. (0.79 N-m)

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Output Power Connector

The drive's Motor screw terminal connector provides output power to your motor. (For connection information, see "Output Power" on page 28.) The connector differs between the two largest Aries models and the others. Specifications for the connectors follow in this section.

On models AR-01xx through AR-13xx, the Motor connector also serves to connect an external motor brake to the drive's internal solid-state relay (BK). For information on this connection, see "Brake Relay (Optional)" on page 35. This connector is removable.

On models AR-20xE and AR-30xE, the MOTOR/POWER connector serves as the connector for output power to the motor, as well as for Mains power (VAC Input Power) and a DC Link Inductor. For information on these additional connections, see "Input Power" on page 24 and "External DC Link Inductor (Optional)" on page 30. This connector is not removable.

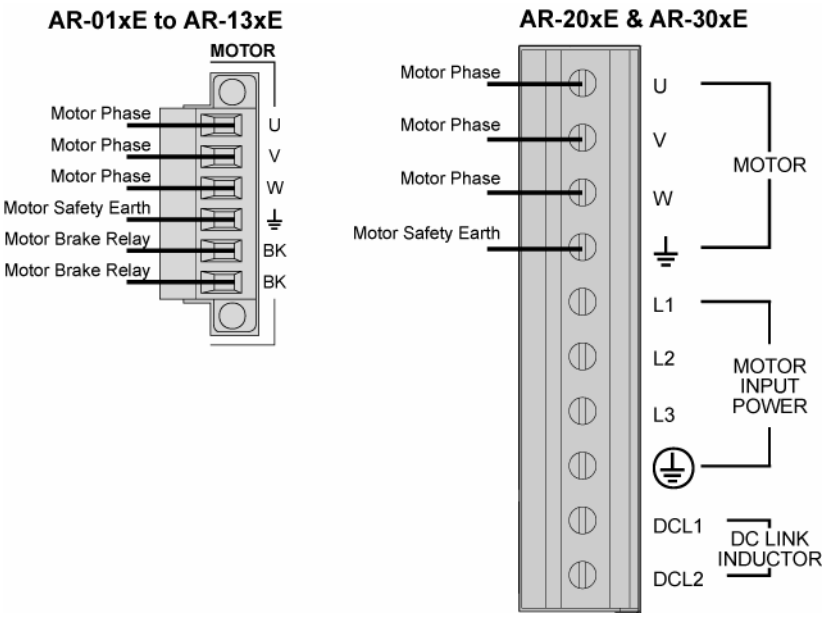


Figure 27 Output (MOTOR) Power Connector

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Motor Connector

AR-01xx, AR-02xx, AR-04xx, AR-08xx, AR-13xx ..... Amphenol PCD: ELFA13210E

Parker Hannifin Part Number..... 43-021068-01

Connector Type..... Removable screw terminal
Terminals 6
Pitch ..... 0.200 in (5.08 mm)
Wire range .....12-26 AWG
.....14-27 SWG
.....(0.12-3.30 mm^2)
Wire strip length..... 0.310 in (8 mm)
Torque....7.0 in–lbs nom. (0.79 N-m)

AR-20xE, AR-30xE ..... Molex: 39960-0110

Parker Hannifin Part Number..... N/A (not replaceable)

Connector Type..... *Non-Removable* screw terminal
Terminals 10
Pitch ..... 0.315 in (8 mm)
Wire range .....10-22 AWG
.....12-23 SWG
.....(0.5-4.0 mm^2)
Wire strip length..... 0.25 in (6.5 mm)
Torque....7.0 in–lbs nom. (0.79 N-m)

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AR-20xE & AR30xE Control Connector

On the AR-20xE & AR 30xE models, the Control connector serves for three connections: an external power dump resistor (EXTERNAL REGEN), a control power circuit (CONTROL INPUT POWER), and a safety brake relay (BRAKE RELAY). The connector is an eight-position non-removable screw terminal. Specifications for the connector follow in this section.

The Control connector has a factory-installed link between R_{INT} and R– for an internal regeneration resistor, which provides thermal protection. For more information, see “Regeneration Protection” on page 39. For information on additional connections, see “Control Power Supply” on page 31 and “Brake Relay (Optional)” on page 35.

AR-20xE & AR-30xE

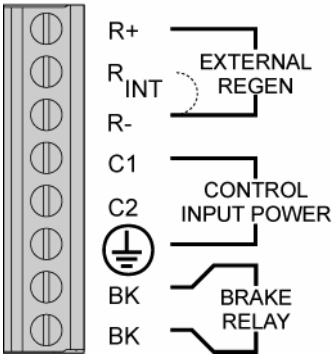


Figure 28 AR-20xE & AR30xE Control Connector

AR-20xE, AR-30xE ..... PCD: ELM021100

Parker Hannifin Part Number..... N/A (not replaceable)

Connector Type..... *Non-Removable* screw terminal
Terminals 8
Pitch ..... 0.400 in (10 mm)
Wire Range .....12-28 AWG
.....14-29 SWG
.....(0.12-3.30 mm^2)
Wire Strip length 0.250 in (6.35 mm)

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Motor Feedback Connector

Inputs for the resolver feedback, motor thermal switch, and hall effects are located on the 15-pin Motor Feedback connector.

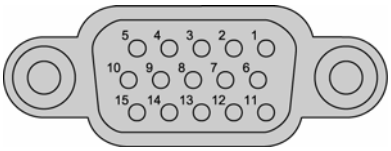


Figure 29 MOTOR FEEDBACK connector, female drive connector pinout

Important — Encoder inputs use a DS26LV32 differential line receiver. Parker Hannifin recommends 26LS31 (or compatible) differential line driven encoders.

Single ended encoders are *not* compatible.

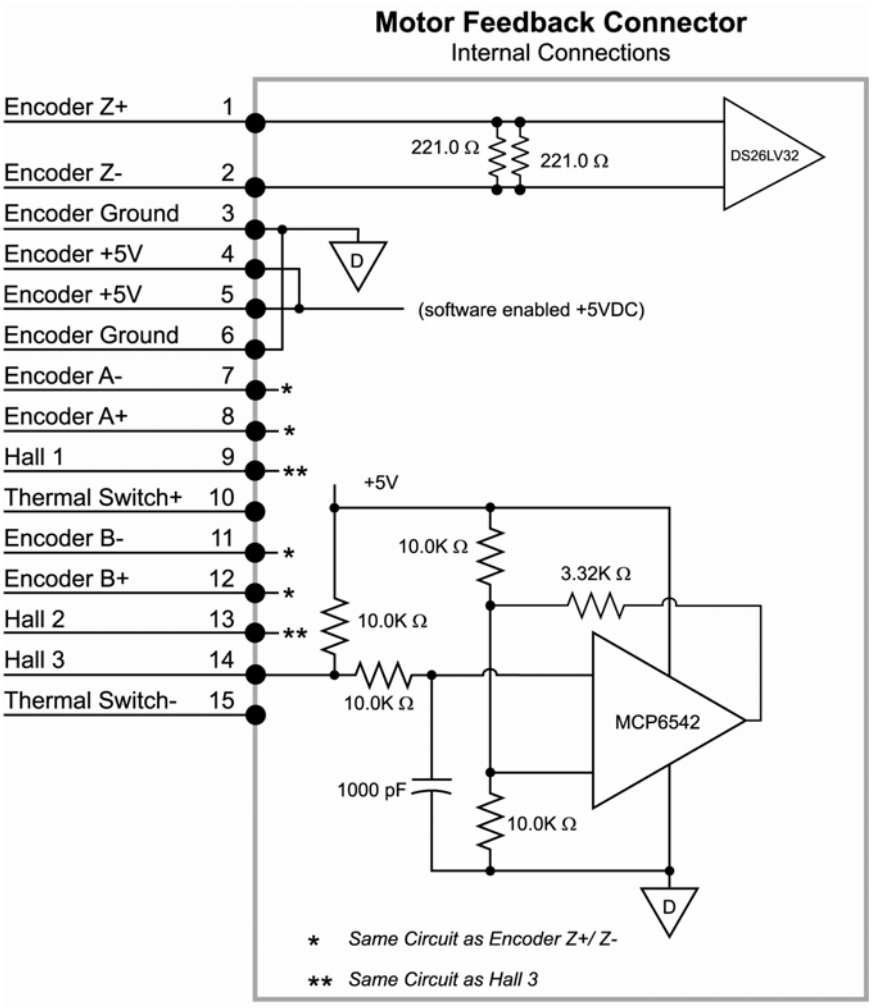


Figure 30 MOTOR FEEDBACK connector, internal circuit diagram

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Pinout—MOTOR FEEDBACK Connector

Note: A box surrounding pins indicates a requirement for twisted pair wiring.

Signal	Pin	Description
ENC Z+ / Data+	1	Encoder Z Channel in
ENC Z– / Data–	2	Encoder Z Channel in
DGND	3	Encoder power return
+5 VDC	4	+5 VDC Encoder power
+5 VDC	5	+5 VDC Hall power
DGND	6	Hall power return
ENC A– / SIN–	7	Encoder A Channel in
ENC A+ / SIN+	8	Encoder A Channel in
Hall 1 / SCLK+ *	9	Hall 1 input
Thermal+	10	Motor thermal switch/thermistor
Thermal–	15	Motor thermal switch/thermistor
ENC B / COS–	11	Encoder B Channel in
ENC B+ / COS+	12	Encoder B Channel in
Hall 2 / SCLK– *	13	Hall 2 input
Hall 3	14	Hall 3 input
* When using the SinCos protocol, pins 9 and 13 require twisted pair wiring.		

Table 24 MOTOR FEEDBACK Connector Pinout

Inputs—Encoder

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
Input Frequency (pre-quadrature)			5	MHz
Note: All parameters are at the connector pin.				

Table 25 Inputs—Encoder Inputs Electrical/Timing Characteristics

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Connector Specification—Aries Drive

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

Connector Specification—Mating Connector

Mating connectors are not provided with Aries drives. Parker cables are available with mating connectors attached.

Manufacturer	AMP or equivalent
Connector Type	15-Pin High Density D-Subminiature (male connector)
Cable Kit	AMP Part Number 748473-1 Includes: 748364-1 connector, shield, enclosure, and two jack screws (does not include contacts or ferrules)
Contacts	Crimp style 30µ" Gold—AMP Part Number 748333-4 Gold Flash—Amp Part Number 748333-7

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Motor Feedback Connector—Resolver

Inputs for the encoder feedback, motor thermal switch, and hall effects are located on the 15-pin Motor Feedback connector.

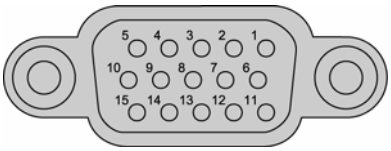


Figure 31 MOTOR FEEDBACK connector, female drive connector pinout

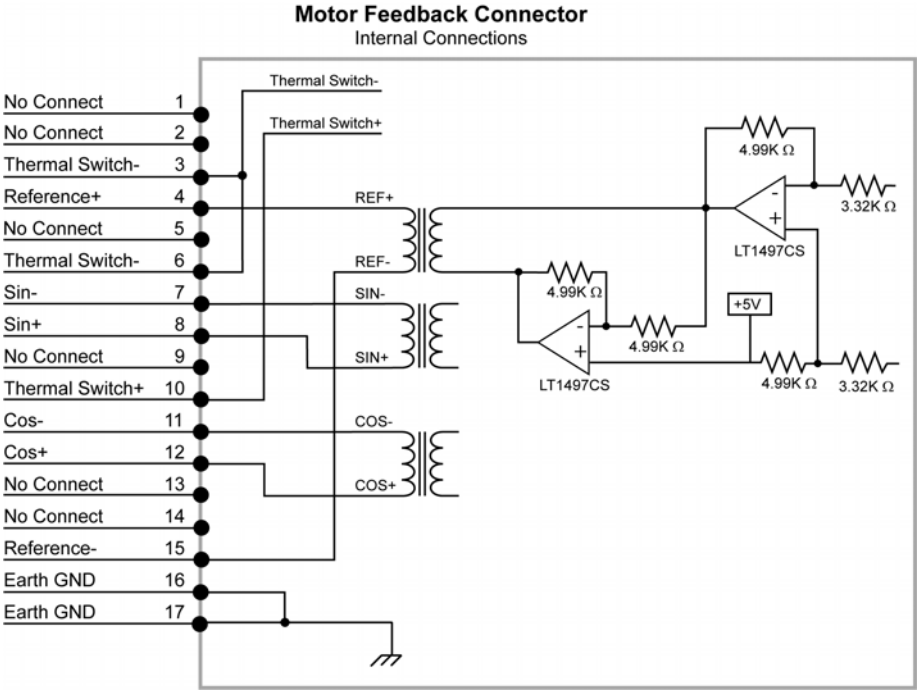


Figure 32 MOTOR FEEDBACK connector for resolver option, internal circuit diagram

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Pinout—MOTOR FEEDBACK Connector for Resolver Option

Note: A box surrounding pins indicates a requirement for twisted pair wiring.

Signal	Pin	Description
No connection	1	—
No connection	2	—
Thermal-	3	Motor thermal switch/thermistor
Reference+	4	Resolver excitation signal
Reference-	15	Resolver excitation signal
No connection	5	—
Thermal-	6	Motor thermal switch/thermistor
Thermal+	10	Motor thermal switch/thermistor
SIN–	7	SIN resolver feedback signal
SIN+	8	SIN resolver feedback signal
No connection	9	—
COS–	11	COS resolver feedback signal
COS+	12	COS resolver feedback signal
No connection	13	—
No connection	14	—

Table 26 MOTOR FEEDBACK Connector Pinout for Resolver Option

Resolver Excitation

Description	Min	Typical	Max	Units
Excitation Frequency	—	10	—	KHz
Note: All parameters are at the connector pin.				

Table 27 Resolver excitation

Drive I/O Connector

The inputs and outputs (I/O) located on the 26-pin DRIVE I/O connector are described below. For preparing your own cable, use differential pair wiring with a minimum of three turns-per-inch (3 TPI).

Optical Isolation

The following describes which differential I/O signals are optically isolated:

- Enable input is optically isolated with both Anodes (+) and Cathodes (–) available.
- Reset input is optically isolated with both Anodes (+) and Cathodes (–) available.

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- Fault output is optically isolated with both Collector (+) and Emitter (–) available.

No Optical Isolation

The following describes which I/O signals are *not* optically isolated:

- Step and Direction inputs are 5V differential compatible (RS-422 logic level compatible.
- Encoder output signals are non-isolated RS-422 compatible differential drivers referenced to DGND.
- RS-485 is non-isolated RS-485 compatible differential signals referenced to DGND.
- AIN+ Analog input is single-ended non-isolated referenced to AIN–, and common mode referenced to DGND.

Fault Operation

When the Aries Drive is enabled and there are no fault conditions, the Fault circuit is closed (conducting). However, the following circumstances can trip the Fault circuit: a fault condition is present (see “Error Messages” on page 144); the Enable circuit is open (see Figure 34); or, Mains power is removed from the drive.

You can use the LED status indicators to help identify internal drive faults. For more information, see Table 23.

Drive Condition	Fault Output
Enabled	Closed (conducting)
Faulted	Open
No AC power on L1 and L2*, or drive not enabled	Open

* Mains Control power on C1 and C2 does not affect the fault circuitry. With mains power applied to C1 and C2, the fault circuit remains open if AC power is *not* applied to the L1 and L2 terminals.

Table 28 Fault Output Operation

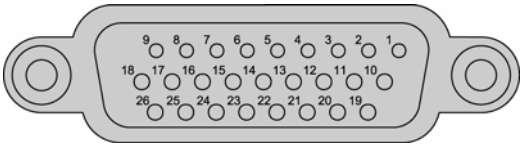


Figure 33 DRIVE I/O connector, female drive connector pinout

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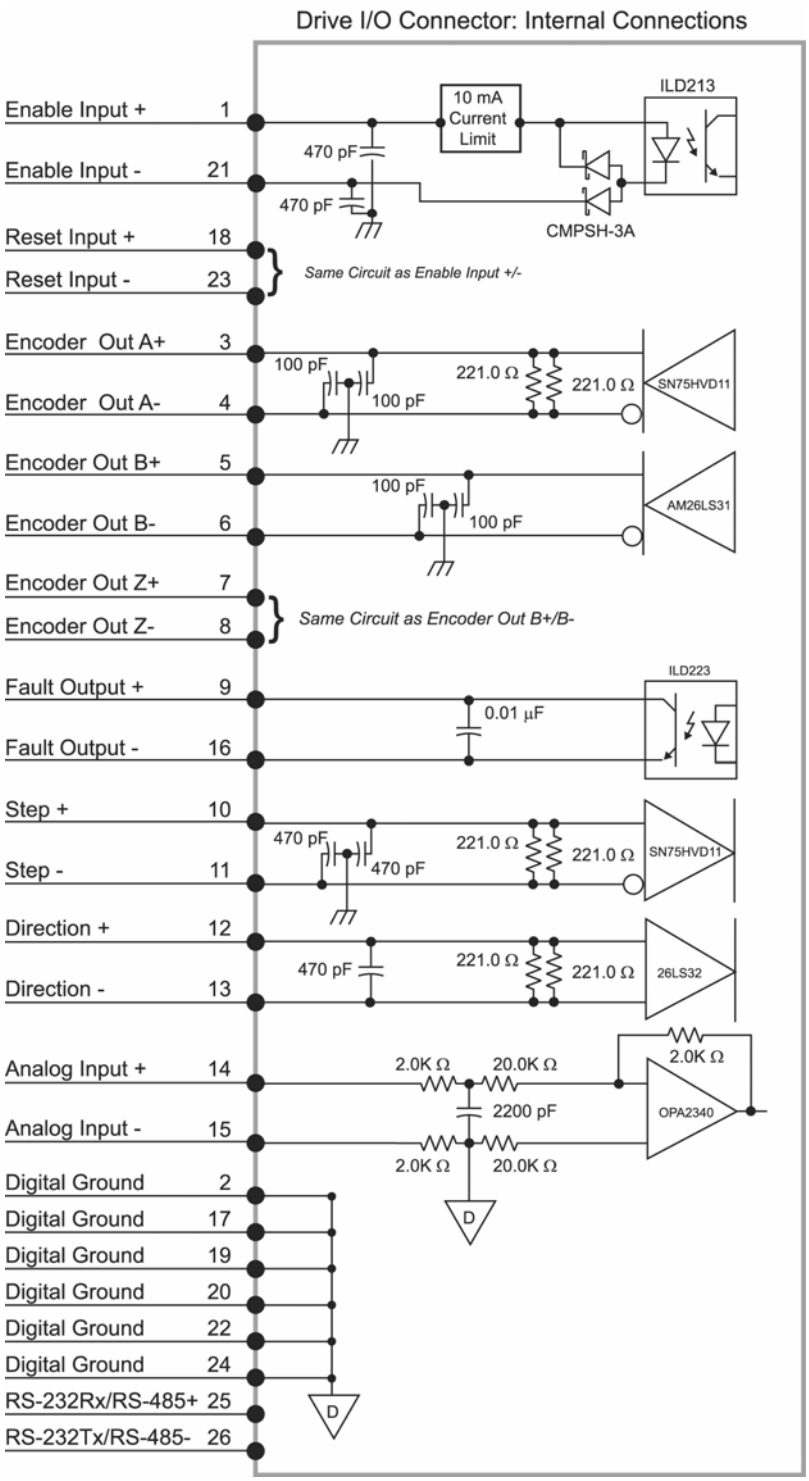


Figure 34 DRIVE I/O connector, internal circuit diagram

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Pinout—DRIVE I/O Connector

Note: A box surrounding pins indicates a requirement for twisted pair wiring.

Signal	Pin	Description
ENABLE+	1	Drive Enable input anode
ENABLE–	21	Drive Enable input cathode
DGND	2	Digital ground
ENC A+	3	Encoder A Channel out
ENC A–	4	Encoder A Channel out
ENC B+	5	Encoder B Channel out
ENC B–	6	Encoder B Channel out
ENC Z+	7	Encoder Z Channel out (Index +)
ENC Z–	8	Encoder Z Channel out (Index –)
FAULT+ *	9	Fault Output collector
FAULT–	16	Fault Output emitter
STEP+	10	5V Differential compatible (RS-422 logic level compatible) position command
STEP–	11	Position command return
DIRECTION+	12	5V Differential compatible (RS-422 logic level compatible) direction command
DIRECTION–	13	Direction command return
AIN+	14	Analog ±10V current command
AIN–	15	±10V return
DGND	17	Digital Ground
RESET+	18	Drive Reset input anode
RESET–	23	Drive Reset input cathode
DGND	19	Digital Ground
DGND	20	Digital Ground
DGND	22	Digital Ground
DGND	24	Digital Ground
RS-232Rx/ RS-485+	25	RS-232Rx/ RS-485+ Half-Duplex
RS-232Tx/ RS-485–	26	RS-232Tx/ RS-485– Half-Duplex

* Opto is ON and conducting when no fault condition is present. When a fault occurs, the opto turns OFF and the transistor does not conduct current. This simulates a normally open relay. For more information, see Table 20.

Table 29 DRIVE I/O Connector Pinout

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Inputs—Enable, Reset

The drive Enable and Reset inputs are optically isolated inputs. Current is limited internally for input voltage control of 5 to 24 volt logic. The 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.			

Table 30 Inputs—Enable and Reset Electrical/Timing Characteristics

Outputs—Encoder

Description	Min	Typical	Max	Units
Output Frequency (pre-quadrature)			5	MHz
Input Voltage High *	2.4			V
Input Voltage Low *			0.5	V
* Based on 120Ω differential load impedance.				
Note: All parameters are at the connector pin.				
Note: Areis encoder is a hardware pass-through; therefore, you cannot change output resolution.				

Table 31 Outputs—Encoder Outputs Electrical/Timing Characteristics

Outputs—Fault

Description	Min	Typical	Max	Units
Blocking Voltage			30	V
Continuous Load Current			10	mA
Output Saturation Voltage (at 1.0 mA)			1.0	V
* Based on 120Ω differential load impedance.				
Note: All parameters are at the connector pin.				

Table 32 Outputs— Fault outputs Electrical/Timing Characteristics

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Inputs—Step & Direction

Description	Min	Typical	Max	Units
Common Mode Range	-7		+7	V
Differential Threshold Voltage	-200		+200	mV
Differential Termination Impedance		120		ohms
Input Frequency (pre-quadrature)			5	MHz
Note: All parameters are at the connector pin.				

Table 33 Inputs—Step & Direction Electrical/Timing Characteristics

Inputs—Analog

Description	Min	Typical	Max	Units
Function Input Range	-10		+10	V
Resolution		14		bits
Impedance			>20	K ohms
Note: All parameters are at the connector pin.				

Table 34 Inputs—Analog Electrical/Timing Characteristics

Connector Specification—Aries Drive

Manufacturer ..... KYCON or equivalent

Connector Type..... 26-Pin High Density D-Subminiature (female socket)

KYCON Part Number..... K66-A26S-NR

Connector Specification—Mating Connector

Mating connectors are not provided with Aries drives. Parker cables are available with mating connectors attached.

Manufacturer ..... AMP or equivalent

Connector Type..... 26-Pin High Density D-Subminiature (male connector)

Cable Kit..... AMP Part Number 748474-1
Includes: 748365-1 connector, shield, enclosure, and two jack screws (does not include contacts or ferrules)

Contacts ..... Crimp style
30µ" Gold—AMP Part Number 748333-4
Gold Flash—Amp Part Number 748333-7

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Installation Test

Once you have made the necessary mechanical and electrical connections, you can test the drive. The Aries Support Tool contains the Auto Run Test Wizard, which exercises basic functions of the Aries drive.

You *must* do the following before testing the drive:

- Configure the drive for the motor to which it is connected. Resolve any configuration errors before proceeding with the test.
- Enable the drive.
- If the Aries drive is connected to a controller, disable the controller's servo loop.
- If the motor is connected to a load, disconnect the motor so that it is free to turn unimpeded.



Safety 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.

Testing the Aries Drive

If the Aries drive has been installed correctly, the motor will spin at one revolution per second. If the motor does not spin, a wiring or configuration error possibly exists.

1. Start the Aries Support Tool.
2. Under **Menu**, click **Operating System Update**.
3. Click **Auto Run Test Wizard**.

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CHAPTER FOUR

Communications

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RS-232/485 Communications

The Aries drive has a single serial port, located on the DRIVE I/O connector on the front of the unit. This chapter refers to it as the COM port. The Aries drive uses ASCII and the RS-232 or RS-485 communication protocols.

Terminal Emulator Configuration

RS-232	RS-485 *
Rx, Tx, Gnd	2-wire plus ground (Talk+, Talk–, Gnd)
9600 baud	9600 baud
8 data bits	8 data bits
1 stop bit	1 stop bit
No parity	No parity
Full-duplex	Half-duplex
	* Twisted pair cabling recommended (e.g. Belden 9842)

Table 35 Terminal Emulator Configuration for RS-232/485 Communication

Establishing Communications

The 26-pin DRIVE I/O connector (female D-subminiature) also functions as the COM port. You can use it with RS-232 or two-wire RS-485 communications.

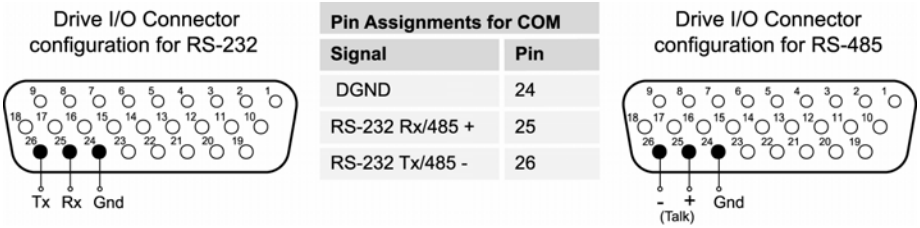


Figure 35 RS-232/485 Connections

For setup purposes, you can connect a personal computer (PC) directly to the Aries drive through its COM port. Before attempting to communicate with the Aries drive, verify your PC's connector pinout—make sure the cable connects the following:

- The PC's transmit terminal (pin 3 of the 9-pin connector) to the Aries's receive terminal (pin 25).
- The PC's receive terminal (pin 2 of the 9-pin connector) to the Aries's transmit terminal (pin 26).
- The PC's ground terminal to the Aries's ground terminal (pin 24).

You can also use the Aries Drive I/O Dongle (sold separately), which allows a PC to simultaneously communicate with the Aries drive while also connected to a controller. For more information, see "RS-232/485 Dongle for Communications Setup" on page 62.

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Depending on the communications protocol you are using, Aries can automatically configure itself.

- If using RS-232, Aries will automatically detect and configure itself for that communications protocol.
- If using RS-485 (two-wire) and the standard bias configuration, Aries will automatically detect and configure itself for that communications protocol.

For automatic detection to work, the RS-485 network must be configured with an up bias on + (Talk) and a down bias on – (Talk).

RS-232 Communications

The Aries drive supports RS-232 communication. However, you *cannot* connect the drive in an RS-232 daisy chain.

Pinout for RS-232 Communication	
Pin	**Description**
25	Rx (receive). Connect to Tx on your computer.
26	Tx (transmit). Connect to Rx on your computer.
24	DGND* (logic ground). Connect to DGND on your computer.
Maximum RS-232 cable length is 50 feet (15.25 meters). * Many PC COM ports connect RS-232 ground to chassis ground.	

Table 36 RS-232 Connector Pinout

RS-485 Communications

The Aries is designed to use RS-485 half-duplex (two-wire). In addition, you can use it in multi-drop networks. For more information about multi-drop, see “RS-485 Multi-Drop” on page 61.

Pinout for 2-wire RS-485 Communication	
Pin	**Description**
25	Connect to Tx/Rx+ on your computer.
26	Connect to Tx/Rx– on your computer.
24	DGND* (logic ground). Connect to DGND on your computer.
• Maximum RS-485 cable length is 1000 feet (305 meters). • Keep wires as short as possible. Termination resistors may be required on long cable runs. • Connect RS-485 cables before applying power to the drive. (Reconnecting the cables with power applied may cause the drive to interpret intermittent connections as RS-232 hardware handshake signals; this may result in shutdown of the RS-485 interface. If this happens, reset the drive to re-enable the RS-485 interface.) • Recommended cable: Belden 9842. * Many PC COM ports connect RS-485 ground to chassis ground.	

Table 37 RS-485 Connector Pinout

For connection information, see Figure 36.

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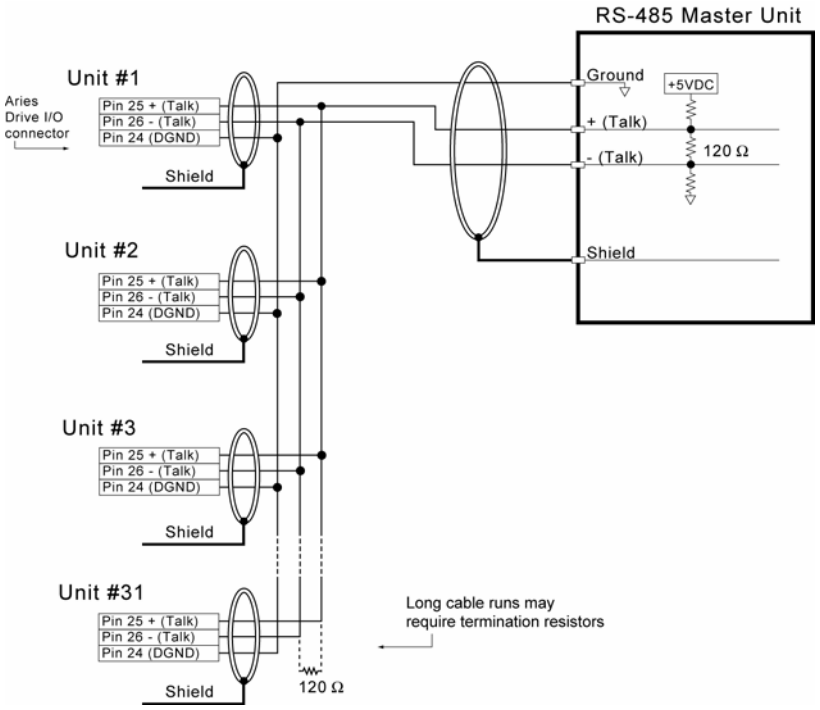


Figure 36 RS-485 Multi-drop Connections

RS-485 Multi-Drop

RS-485 multi-drop lets you connect up to 99 Aries drives together (see Figure 36). Every drive is factory configured with a default address—zero (0). Using the `ADDR` command, you can assign a unique address to each drive. You must address each drive individually before connecting it to the multi-drop network.

Notes

- For RS-485 to work correctly turn off the echo mode (`ECHOØ`).
- Zero (0) is not a valid address for a drive.

Setting up Drives for a Multi-Drop Network

1. Connect the drive you want to configure to a PC that is not part of the multi-drop network.
2. Apply power to the drive.
3. Using terminal emulation software, send the following command—`Ø_ADDRi` (where `i` is the address you want to assign the new unit).
4. Remove power to the drive. The drive can now be installed in the network.
5. After installing and connecting the drives to the multi-drop network, test each drive—use safe methods suitable for your particular application—to ensure each functions correctly.

   To test each unit, send the `i_TREV` command, where `i` represents the address of a drive.

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Warning — Risk of damage and/or personal injury When testing the installation of drives, use safe methods suitable for your particular application.

Replacing a Unit in the Network

If you need to replace a drive, do the following:

1. Remove the old unit from the network.
2. Connect the new drive to a PC that is not part of the multi-drop network.
3. Apply power to the drive.
4. Using terminal emulation software, send the following command—`Ø_ADDRi` (where `i` is the address you want to assign the new unit).
5. If you can communicate with the old drive, upload its configuration using the Aries Support Tool. Alternatively, you can create a new configuration file using the Aries Support Tool. Then download the configuration file to the new drive.
6. Remove power to the drive. The drive can now be installed in the multi-drop network.

Sending Commands to a Specific Unit

You can send ASCII commands from the master unit (for example a personal computer, PLC, or controller) to a specific unit in the multi-drop network. Prefix the command with the unit address and an underscore (_). For example, `3_ERES4ØØØ` sets the encoder resolution to 4000 for unit 3. The master unit can receive data from any unit in the network.

Note: Make sure you can access each unit on the network. See “Setting up Drives for a Multi-Drop Network” on page 61.

RS-232/485 Dongle for Communications Setup

The Aries Dongle is a Y-cable (part number 71-021609-01) that breaks out the RS-232/485 portion of the DRIVE I/O cable so that you may simultaneously communicate with the Aries Drive while it is also connected with a motion controller.

Note: When using the Aries Dongle, you must use a *null-modem (cross-over) cable* between your PC and the Aries drive



Caution — The dongle is designed for setup and troubleshooting purposes only. *Do not* use the dongle in a permanent installation; it *does not* meet EMC requirements.

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CHAPTER FIVE

5 Tuning

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Servo Tuning Overview

The drive uses a *digital control algorithm* to control and maintain the position and velocity. The digital control algorithm consists of a set of numerical equations used to periodically (once every servo sampling period) calculate the value of the control output.

The numerical terms of the equations consist of the current commanded and actual position values (including a few from the previous sampling period), and a set of control parameters. Each control parameter, commonly called a *gain*, has a specific function (for more information, see “Servo System Gains” on page 68). In addition, *tuning* is the process of selecting and adjusting gains to achieve optimal servo performance.

When using the control algorithm described above, the whole servo system acts as a closed-loop system (see Figure 37). It is called closed loop because the control algorithm accounts for both the command (position, velocity, tension, etc.) and the feedback data from the encoder. Therefore, it forms a closed loop of information. When all gains are set to zero, the digital control algorithm is disabled.

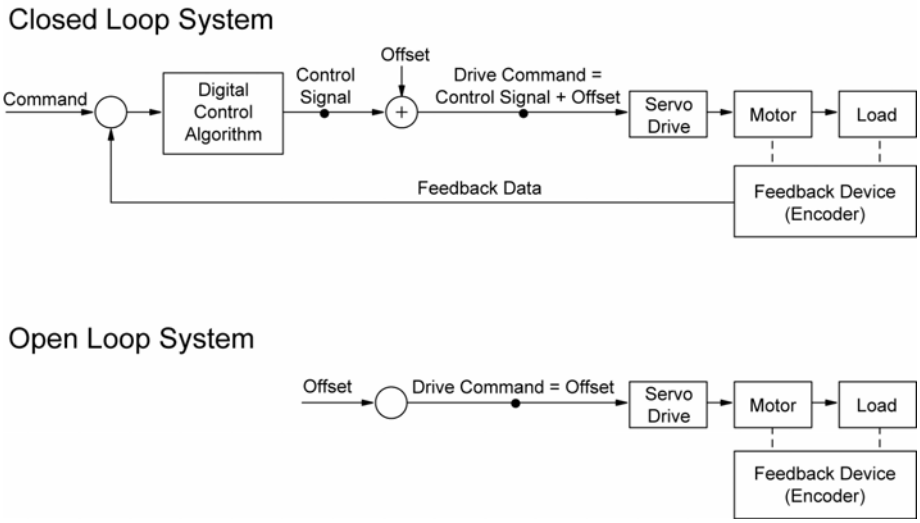


Figure 37 Closed Loop and Open Loop System Comparison

To command a drive, controllers can provide ±10V analog output or step and direction signals. Once the digital control algorithm has calculated the digital control signal, the resultant digital value is sent out from the *DSP* (digital signal processor) to the *DAC* (Digital-to-Analog Converter). The DAC has an analog output range of -10V to +10V.

It is possible for the digital control signal, calculated by the control algorithm, to exceed the DACs output range. If this occurs, the resulting analog output becomes *saturated*—where the analog output signal remains at the limit until the position error changes such that the control algorithm calculates a control signal less than the limit.

The phenomenon of reaching the output limit is called *controller output saturation*. When saturation occurs, increasing the gains *does not* help improve performance because the DAC is already operating at its maximum level.

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Position Variable Overview

In a servo system, the controller uses two types of position information: commanded position and actual position. As these positions change with time, you can use the position values to determine if the system is positioning as you expect.

Commanded Position

The commanded position is calculated by the motion profile routine from the controller and it is updated every servo sampling period. Therefore, the commanded position is the intended position at any given point of time.

To view the commanded position, use the `TPC` (Transfer Commanded Position) command; the response represents the commanded position at the instant the command is received.

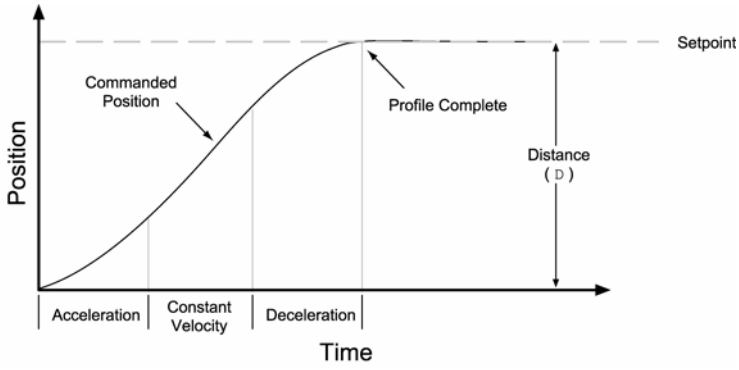


Figure 38 Commanded Position

Actual Position

The actual position of the motor/load is the drive's response to the commanded position, and is measured with the feedback device. The profile resulting from the actual position across time is the *position response* (for more information, see "Servo Response Overview" on page 66).

To view the actual position, use the `TPE` (Transfer Position of Encoder) command; the response represents the actual position at the instant the command is received.

The difference between commanded and actual positions is called *position error*. To view the position error, use the `TPER` (Transfer Position Error) command; the response represents the position error at the instant the command is received.

If the motor is not moving, the position error is called a *steady-state position error*. If a position error occurs when the motor is moving, it is called a *position tracking error*.

Even when the system is properly tuned, the position error can still be quite significant due to a combination of factors such as the desired profile, the motor's limitation, the dynamic characteristics of the system, etc. For example, if the commanded velocity is higher than the maximum velocity the motor can physically achieve, the actual position will always lag behind the

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commanded position. Under these circumstances, a position error will accumulate no matter how high the gains are set.

Servo Response Overview

Stability

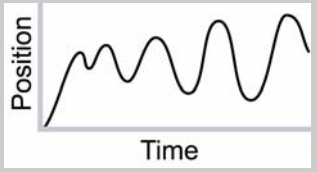
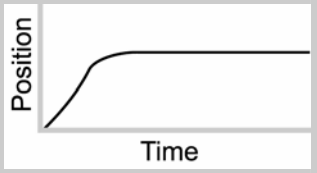
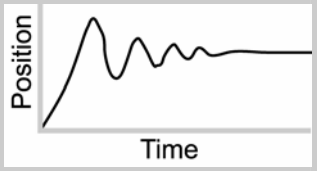
The first objective of tuning is to stabilize the system. The formal definition of system stability is when a bounded input is introduced to the system, the output of the system is also bounded. What this means to a motion control system is if the system is stable, and the position setpoint is a finite value, the final actual position of the system is also a finite value.

In contrast, if the system is unstable, no matter how small the position setpoint or how little a disturbance (motor torque variation, load change, noise from the feedback device, etc.) the system receives, the position error will increase exponentially in almost all cases. In practice, when the system experiences instability, the actual position will oscillate in an exponentially diverging fashion as shown in Table 38.

One common perception is that whenever there is oscillation, the system is unstable. It is important to recognize that a system is considered stable if the oscillation finally diminishes (damps out), even if it takes a long time.

Position Response Types

Table 38 identifies the six basic types of position responses. The primary difference among these responses is due to *damping*—the suppression (or cancellation) of oscillation.

Response	Description	Profile (position/time)
Unstable	Instability causes the position to oscillate in an exponentially diverging fashion.	
Over-damped	A highly damped, or over-damped, system gives a smooth but slower response.	
Under-damped	A slightly damped, or under-damped, system gives a slightly oscillatory response.	

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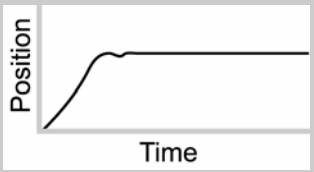
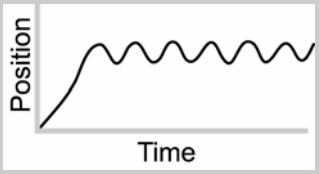
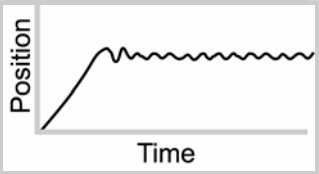
Response	Description	Profile (position/time)
Critically damped	A critically-damped response is the most desirable because it optimizes the trade-off between damping and speed of response.	
Oscillatory	An oscillatory response is characterized by a sustained position oscillation of equal amplitude.	
Chattering	Chattering is a high-frequency, low-amplitude oscillation that is usually audible.	

Table 38 Position Response Types

Performance Measurements

If you plot of the position response versus time, you can make a few measurements to quantitatively assess the performance of the servo. These three measurements are made before or shortly after the motor stops moving:

- **Overshoot**—The measurement of the maximum magnitude that the actual position exceeds the position setpoint. It is usually measured in terms of the percentage of the setpoint value.
- **Rise Time**—The time it takes the actual position to pass the setpoint.
- **Settling Time**—The time between when the commanded position reaches the setpoint and the actual position settles within a certain percentage of the position setpoint. (Note the settling time definition here is different from that of a control engineering text book, but the goal of the performance measurement is still intact.).

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Servo System Gains

Proportional Feedback Control (SGP)

Proportional feedback is the most important feedback for stabilizing a servo system. When the controller uses proportional feedback, the control signal is linearly proportional to the position error (the difference between the commanded position and the actual position—see `TPER` command). The proportional gain is set by the Servo Gain Proportional (`SGP`) command. Proportional feedback can be used to make the servo system more responsive (stiff), as well as reduce the steady state position error.

Because the control is proportional to the position error, whenever there is any disturbance (such as torque ripple or a spring load) forcing the load away from its commanded position, the proportional control can immediately output a signal to move it back toward the commanded position. This function is called *disturbance rejection.*

If you tune your system using only the proportional feedback, increasing the proportional feedback gain (`SGP` value) too much will cause the system response to be oscillatory, under-damped, or in some cases unstable.

Note: Do not set the proportional feedback gain (`SGP`) to zero, except when open-loop operation is desired.

Velocity Feedback Control (SGV)

Using *velocity feedback control*, the control signal is proportional to the feedback device's velocity (rate of change of the actual position). The Servo Gain Velocity (`SGV`) command sets the gain, which is in turn multiplied by the feedback device's velocity to produce the control signal. Because the velocity feedback acts upon the feedback device's velocity, its control action essentially anticipates the position error and corrects it before it becomes too large. Such control tends to increase damping and improve the stability of the system.

A high velocity feedback gain (`SGV`) can also increase the position tracking error when traveling at constant velocity. In addition, setting the velocity feedback gain too high tends to slow down (over-damp) the response to a commanded position change.

Integral Feedback Control (SGI)

Using *integral feedback control*, the value of the control signal is integrated at a rate proportional to the feedback device position error. The rate of integration is set by the Servo Gain Integral (`SGI`) command.

The primary function of the integral control is to overcome friction and/or gravity and to reject disturbances so that steady state position error is minimized or eliminated. This control action is important for achieving high system accuracy. However, if you can achieve acceptable position accuracy by using only the proportional feedback (SGP), then there is no need to use the integral feedback control.

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Controlling Integral Windup

If you are using integral control (SGI) and there is an appreciable position error that persists long enough during the transient period (time taken to reach the setpoint), the control signal generated by the integral action can end up too high; this saturates to the maximum level of the controller's analog control signal output. This phenomenon is called *integrator windup* (see Figure 39).

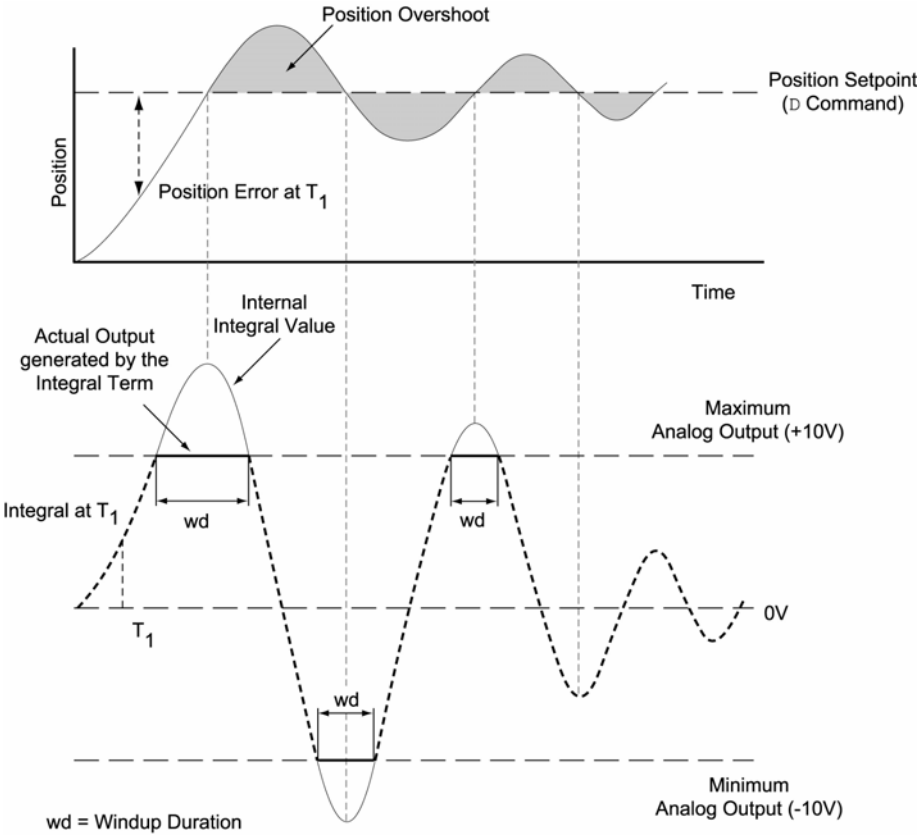


Figure 39 Integrator Windup (Without Using SGILIM Command)

After windup occurs, it takes time before the integrator output returns to a level within the limit of the controller's output. Such a delay causes excessive position overshoot and oscillation.

The integral windup limit (SGILIM) command allows you to set the absolute limit of the integral. The commanded limit, in essence, turns off the integral action as soon as it reaches the limit; consequently, position overshoot and oscillation can be reduced (see Figure 40).

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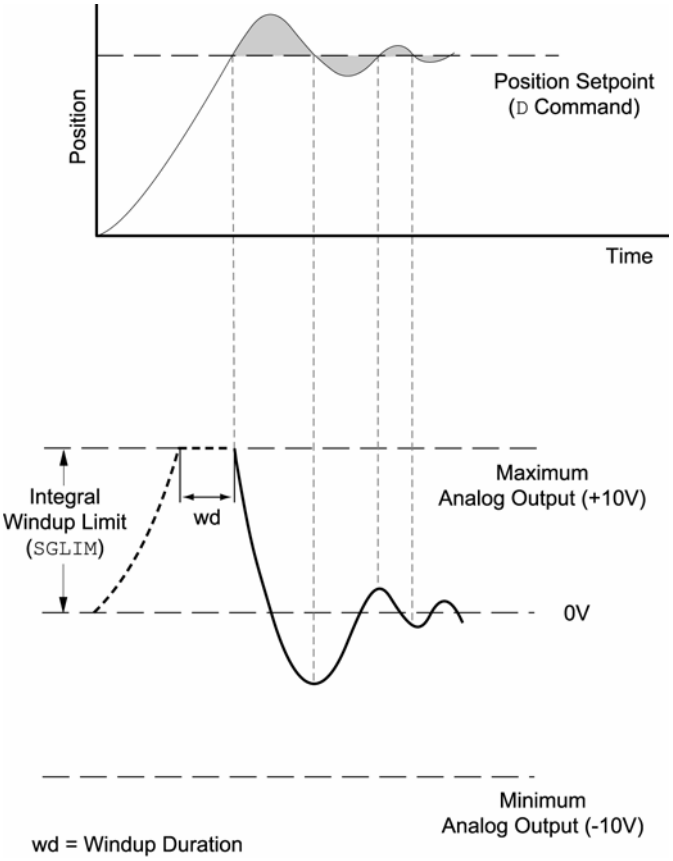


Figure 40 Integrator Windup (using the SGILIM Command)

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Servo Tuning Example

The example below illustrates how to experimentally obtain the highest possible proportional feedback (SGP) and velocity feedback (SGV) gains. For a Servo Tuning flow diagram, see “Appendix A Additional Specifications” on page 152.

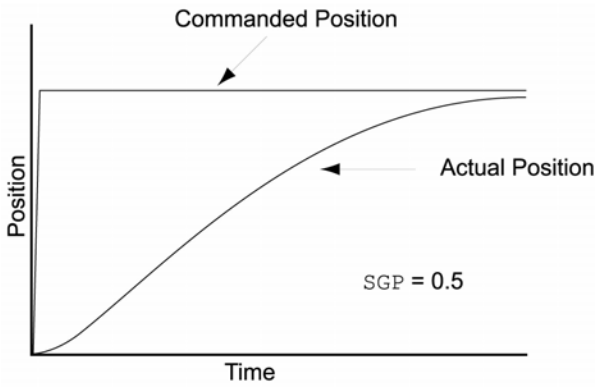
The motion command used for this example is a step command with a step size of 200. The plots shown are as they appear in the Aries Support Tool (X axis = time, Y axis = position).

Note: The steps shown below (steps 1 to 11) represent the *major* steps of the process; the actual progression between these steps may require several iterations.

Step 1

For a starting trial, we set the proportional feedback gain (SGP) to .5. As you can see by the plot, the response is slow.

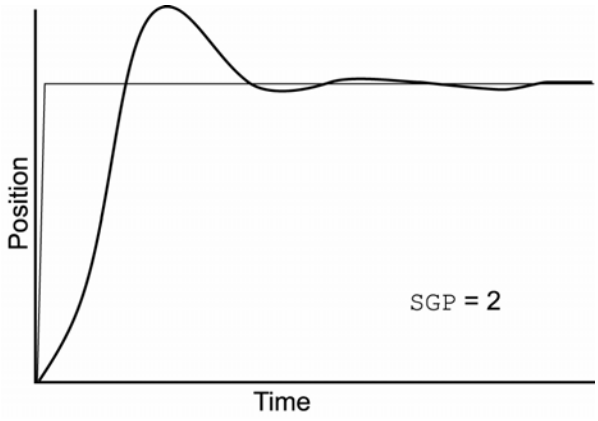
In the next step, we should increase SGP until the response is slightly under damped.



Step 2

With SGP equal to 2, the response becomes slightly under damped (see plot).

Therefore, we should introduce the velocity feedback gain (SGV) to damp out the oscillation.

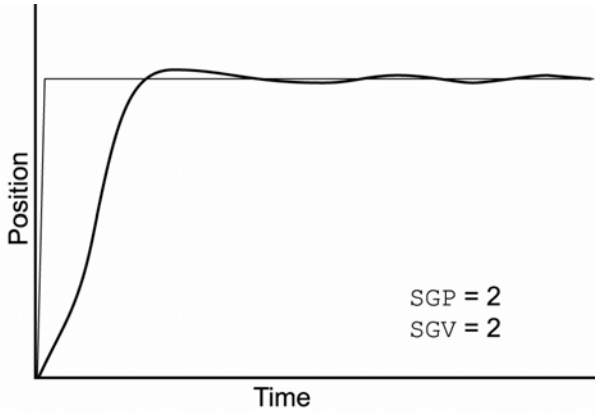


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Step 3

Step 3
With SGV equal to 2, the response is fairly well damped (see plot).

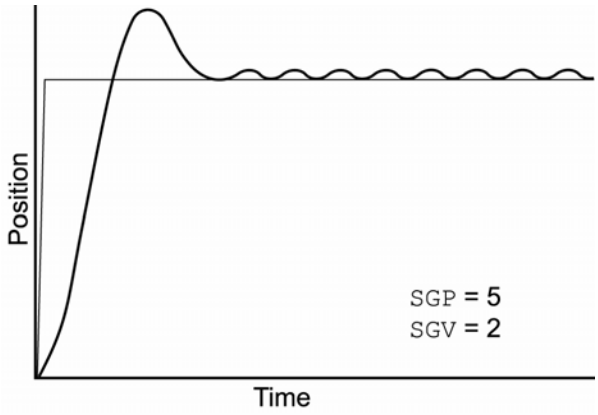
At this point, the SGP should be raised again until oscillation or excessive overshoot appears.



Step 4

As we iteratively increase SGP to 5, overshoot and chattering becomes significant (see plot). This means the SGV gain is too low and/or the SGP is too high.

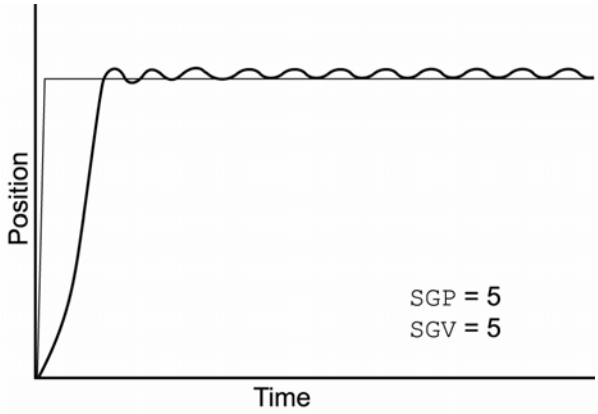
Next, we should try raising the SGV gain to see if it will dampen out the overshoot and chattering.



Step 5

After the SGV gain is raised to 5, the overshoot was reduced but chattering is still quite pronounced. This means either one or both of the gains is too high.

The next step should be to lower the SGV gain first.

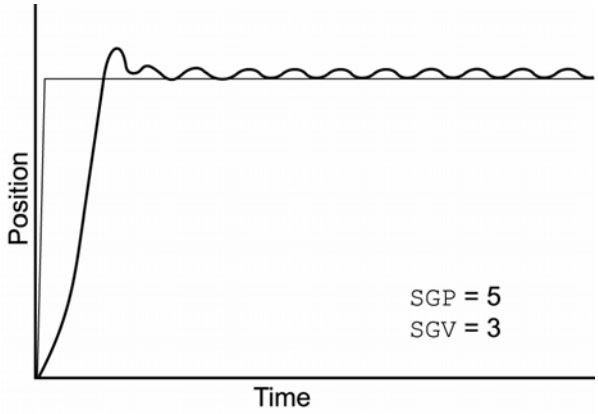


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Step 6

Lowering the SGV gain to 3 does not help reduce the chattering by much.

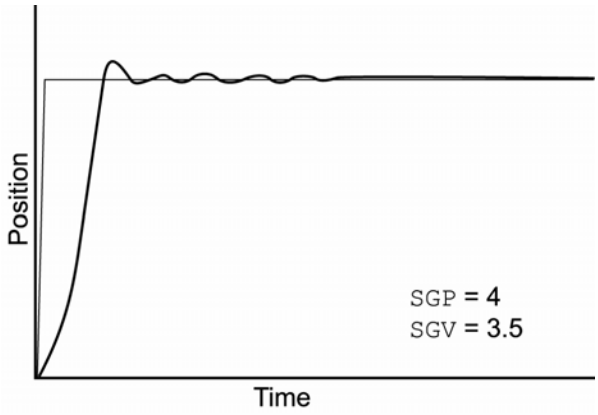
Therefore, we should lower the SGP gain until chattering stops.



Step 7

Chattering stops after reducing the SGP gain to 4 However, the overshoot is still a little too high.

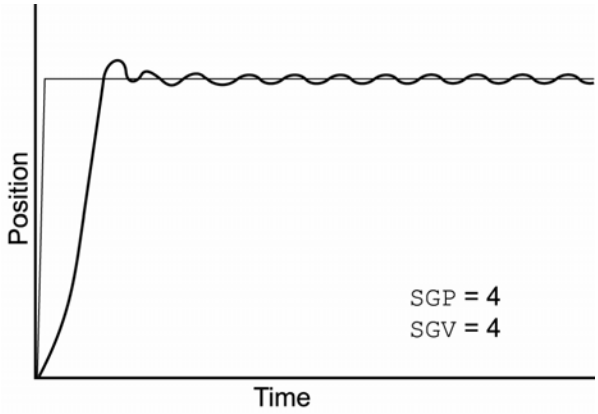
The next step should be to try raising the SGV to damp out the overshoot.



Step 8

After raising the SGV gain to 4, overshoot is reduced a little, but chattering reappears. This means the gains are still too high.

Next, we should lower the SGV gain until chattering stops.

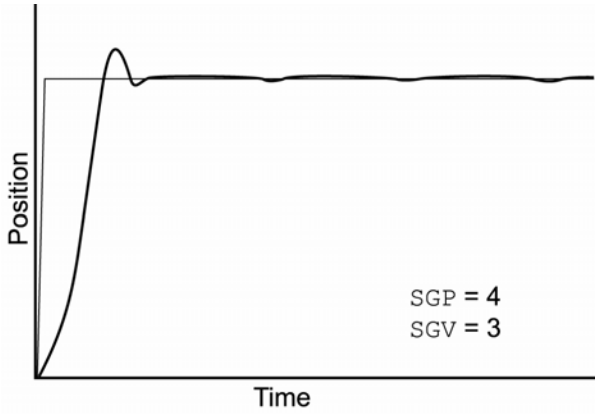


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Step 9

After lowering the SGV gain to 3 (even less than in Step 7—3.5), chattering stops.

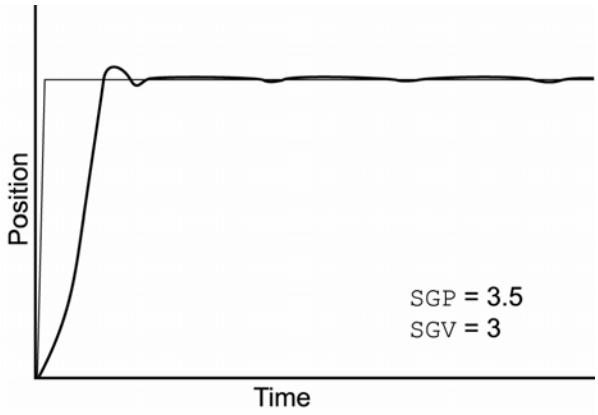
Next we should lower the SGP gain.



Step 10

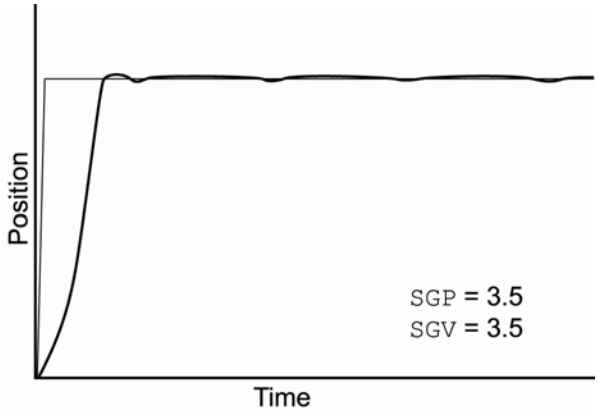
Overshoot is reduced very little after lowering the SGP gain to 3.5. (The SGV gain might have been lowered too much in Step 9.)

Next, we should try raising the SGV gain again until the overshoot is gone.



Step 11

When we raised the SGV gain to 3.5, the step response became fast and very stable.



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Auto-Tuning

The Aries drive can automatically determine the inertia of the load attached to the motor. This is performed by applying a specified torque to the motor and measuring the acceleration and deceleration of the motor. From this, the Aries drive can calculate the load inertia and store the value in the `LJRAT` command.

Note: Excess friction can affect the measured inertia, thereby estimating the value higher than the actual inertia. While the drive can compensate for some friction, it may not compensate for all. If the estimated load inertia seems overly high, this may be the cause.

Note: Use this method of auto-tuning only with the step and direction versions of the Aries drive.

The Auto-Tune process should only last a few seconds, during which time the motor will rotate about one-quarter of a turn in each direction. Following are the two methods to start Auto-Tune mode.

► In the **Aries Support Tool**, select the **Servo Tuner** tab. Then click **Auto-Tune**.

—or—

► Put the drive in position mode (`DMODE6` or `7`). On the drive's ±10V Analog Input, apply a command voltage greater than 3V, then reset the drive.

To return to normal operation, remove the command voltage and reset the drive.

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CHAPTER SIX

6 Command Reference

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Command Descriptions	80

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Aries Communications Set-up

Before you can communicate with the Aries drive, you must configure your terminal emulator. You can use HyperTerminal or an equivalent terminal emulator. For information about setting up communications, see “RS-232/485 Communications” on page 56.

Description of Format

1. 2. 3.

ERES **Encoder Resolution**

4.	**Type**	Encoder Configuration	**Product**	**Rev**
5.	**Syntax**	<a_>ERES<i>	Aries	1.0
6.	**Units**	Rotary motor: i = counts/revolution Linear motor: i = counts/electrical pitch		
7.	**Range**	2ØØ to 1Ø73741823		
8.	**Default**	4ØØØ		
9.	**Response**	ERES: <*>4ØØØ		
10.	**See Also**	DMEPIT, DMTR, TPE		

Number	Description
1.	**Mnemonic Code**: This field contains the command's mnemonic code.
2.	**Full Name**: This field contains the command's full name.
3.	**Valid Product & Revision**: This field lists the Aries Series products and the revision of each product when this command was incorporated or modified per the description. If the command does not apply to that particular product, the Revision is specified as “N/A”. All commands applicable to the standard product versions are applicable to the OEM versions unless otherwise noted (e.g., 6250 commands are applicable to the OEM6250 controller). You can use the TREV command to determine which product revision you are using. For example, if the TREV response is Aries Revision 1.0, The product revision is 1.0
4.	**Type**: This field contains the command’s type.
5.	**Syntax**: The proper syntax for the command is shown here. The specific parameters associated with the command are also shown. Definitions of the parameters are described in the Syntax sections below.
6.	**Units**: This field describes what unit of measurement the parameter (b, d, i, r, or t) in the command syntax represents.
7.	**Range**: The range of valid values that you can specify for an argument (or any other parameter specified).
8.	**Default**: The default setting for the command is shown in this field. A command will perform its function with the default setting if you *do not* provide a value.
9.	**Response**: Some commands allow you to check the status of the command. In the example above, entering the ERES command by itself, you will receive the response <*>4ØØØ. The <*> only appears for RS-485 communication, and *does not* appear for RS-232 communication.
10.	**See Also**: Commands related or similar to the command described are listed here.

Table 39 Commands-Description of Format

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Syntax – Letters and Symbols

The command descriptions provided within this manual use alphabetic letters and ASCII symbols within the Syntax description (see example below) to represent different parameter requirements.

ERES **Encoder Resolution**

Type	Encoder Configuration	**Product**	**Rev**
→ **Syntax**	<a_>ERES<i>	Aries	1.0
Units	Rotary motor: i = counts/revolution Linear motor: i = counts/electrical pitch		
Range	2ØØ to 1Ø73741823		
Default	4ØØØ		
Response	ERES: <*>4ØØØ		

Symbol	Description
a_	Represents an address specifier, numeric value from Ø to 99. An address specifier is required if multiple Aries drives are connected in a daisy-chain or multi-drop configuration; in fact, leaving off the address specifier will cause parameter assignment commands to affect all units and response/transfer commands to request information from all units at the same time (multiple units transmitting characters at one time will garble the communication). To assign unique unit addresses to multiple drives, refer to the ADDR command.
b	Represents the values 1 or Ø; does not require field separator between values. *
c	Represents a character (A to Z, or a to z)
d	Represents the values 1 or Ø, E or e; does not require field separator between values. E or e enables a specific command field.
i	Represents a numeric value that cannot contain a decimal point (integer values only). The numeric range varies by command. Field separator required.
r	Represents a numeric value that may contain a decimal point, but is not required to have a decimal point. The numeric range varies by command. Field separator required.
t	Represents a string of alphanumeric characters from 1 to 16 characters in length. The string must start with an alpha character.
,	(Comma) Represents a field separator. Commands with the symbol r or i in their Syntax description require field separators. Commands with the symbol b or d in their Syntax description do not require field separators (but they may be included). See Table 41.
< >	Indicates that the item contained within the < > is optional, and not required by that command. **Note:** Do not confuse with <cr>, <sp>, and <lf>, which refer to the ASCII characters corresponding to a carriage return, space, and line feed, respectively.
*	The ASCII character b can also be used within a command to precede a binary number. When the b is used in this context, it is not to be replaced with a Ø or 1. For example, comparisons such as ERROR= b1x1.

Table 40 Commands-Syntax

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Syntax – General Guidelines

Guideline Topic	Guideline	Examples
Command Delimiters (<cr> and <lf>)	All commands must be separated by a delimiter. A carriage return is the most commonly used.	
Neutral Characters (<sp>)	Using neutral characters anywhere within a command will not affect the command.	Set velocity limit to 100 rps: DMVLIM<sp>1ØØ<cr>
Case Sensitivity	There is no case sensitivity. Use upper or lower case letters within commands.	Initiate motion: GO1 go1
Comment Delimiter [semi-colon (;) or apostrophe (‘)]	All text between a comment delimiter and a command delimiter is considered *program comments*.	Add a comment to the command: DMVLIM<sp> ; set velocity ; limit
Binary and Hexadecimal Values	When making assignments with or comparisons against binary or hexadecimal values, you must precede the binary value with the letter “b” or “B”, and the hex value with “h” or “H”. In the binary syntax, an “x” simply means the status of that bit is ignored.	Binary: ERRORL = bØ1111x11111111111 Hexadecimal: ERRORL = h7FxF
Note: The command line is limited to 32 characters (including spaces).		

Table 41 Syntax Guidelines

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Command Descriptions

You can use the ASCII commands, provided in this chapter, to configure, check errors, and reset the Aries drive through a terminal emulator. A terminal emulator, however, is not required, Instead, you can use the Aries Supp0ort Tool software to perform the same operations.

Note: The Aries Support Tool does not support the CMDDIR and ADDR commands. You must use a terminal emulator to set the commanded direction and address of each drive.

Before you can communicate with the Aries Drive, you must configure your terminal emulator. You can use HyperTerminal or an equivalent terminal emulator, For more information about setting up communications, see “RS-232/485 Communications” on page 59

ADDR Multiple Unit Address

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>ADDR<i>	**Aries**	**1.0**
Units	i = unit number		
Range	Ø to 255		
Default	Ø		
Response	ADDR: <*>Ø		
See Also	none		

The ADDR command configures the unit address for an RS-485 multi-drop network. The factory default address for an Aries drive is zero (0). The ADDR command allows you to uniquely address up to 255 units (99 unit maximum on a single network).

After establishing a unique address for each Aries drive, you can address commands to specific units. To do this, prefix the command with the unit’s address followed by an underscore (_). For example, 2_ERES reports the resolution on unit 2.

RS-485 Multi-Drop

You must address each unit *before* adding it to the multi-drop network. For example, you want to set up a 4-unit multi-drop network, where the drives are addressed as units 1 through 4. After addressing a drive, you can install it in the multi-drop network.

1. Connect the drive to become unit 1. Through a terminal emulator, send the following command: Ø_ADDR1
2. Connect the drive to become unit 2. Through a terminal emulator, send the following command: Ø_ADDR2
3. Connect the drive to become unit 3. Through a terminal emulator, send the following command: Ø_ADDR3
4. Connect the drive to become unit 4. Through a terminal emulator, send the following command: Ø_ADDR4

If you need to replace a unit in the multi-drop network, connect to the individual device and send the Ø_ADDRi command, where “i”

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represents the address of the new unit. Then connect the drive to the network.

Note: All command responses on an RS-485 network are preceded by <*>.

ALIGN — Align encoder

Type	Drive configuration	**Product**	**Rev**
Syntax	<a_>ALIGN	Aries	1.0
Units	N/A		
Range	N/A		
Default	0		
Response	none		
See Also	DMODE, DRIVE, ENCOFF, ENCPOL, P163, SHALL		

The ALIGN command aligns the encoder on the motor so that the drive can commutate the motor correctly. This command is especially useful for configuring a custom motor. To align the motor, use the following procedure:

1. Remove any load from the shaft. The procedure works best with an unloaded motor.
2. Disable the drive by means of the hardware enable or by typing DRIVE0 into the terminal and pressing **Enter**.
3. Type DMODE3 in the terminal and press **Enter** to enter alignment mode.
4. Enable the drive by means of either the hardware enable or by typing DRIVE1 into the terminal and press **Enter**.
5. Type ALIGN into the terminal and press **Enter** to begin the alignment process.
6. The drive then begins the alignment procedure. This could take up to 20 seconds.

   Note: The motor turns up to 90 degrees during this procedure.
7. The alignment process may modify the following parameters:

   ENCOFF, ENCPOL, SHALL, CMDDIR, P163

These parameters are stored in the drive. If you want to store them in a smart encoder, type the ESTORE command into the terminal and press **Enter**. It takes a couple of seconds to store the motor data in the motor.

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ANICDB Analog Input Center Deadband

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>ANICDB<r>	Aries	2.0
Units	r = volts		
Range	Ø.ØØ to 1Ø.ØØ		
Default	Ø.Ø4		
Response	ANICDB: *ANICDBØ.Ø4		
See Also	DCMDZ, DMTSCL, TANI		

The ANICDB allows the user to specify the voltage deadband for the command input. ANICDB is used with DCMDZ to configure the command input for DMODE2 and DMODE4. The commanded torque, $Trq_{command}$, is calculated from the input voltage, V_{in}, using DMTSCL as follows:

$$Trq_{command} = (V_{in} - \text{DCMDZ} - \text{ANICDB})\frac{\text{DMTSCL}}{10}$$

when $V_{in} > (\text{DCMDZ} + \text{ANICDB})$

$$Trq_{command} = 0$$

when $(\text{DCMDZ} - \text{ANICDB}) \le V_{in} \le (\text{DCMDZ} + \text{ANICDB})$

$$Trq_{command} = (V_{in} - \text{DCMDZ} + \text{ANICDB})\frac{\text{DMTSCL}}{10}$$

when $V_{in} < (\text{DCMDZ} - \text{ANICDB})$

The commanded velocity, $Vel_{command}$, is calculated from the input voltage, V_{in}, using DMVSCL as follows:

$$Vel_{command} = (V_{in} - \text{DCMDZ} - \text{ANICDB})\frac{\text{DMVSCL}}{10}$$

when $V_{in} > (\text{DCMDZ} + \text{ANICDB})$

$$Vel_{command} = 0$$

when $(\text{DCMDZ} - \text{ANICDB}) \le V_{in} \le (\text{DCMDZ} + \text{ANICDB})$

$$Vel_{command} = (V_{in} - \text{DCMDZ} + \text{ANICDB})\frac{\text{DMVSCL}}{10}$$

when $V_{in} < (\text{DCMDZ} - \text{ANICDB})$

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CERRLG Clear the Error Log

Type	Error Handling	**Product**	**Rev**
Syntax	<a_>CERRLG	Aries	1.0
Units	N/A		
Range	N/A		
Default	N/A		
Response	N/A		
See Also	CONFIG, ERRORL, ERROR, TANI, TDHRS, TDMIN, TDSEC, TDTEMP, TERRLG, TMTEMP, TVBUS		

The CERRLG command erases the stored contents of the error log. Clearing the error log is a helpful diagnostic tool; it allows you to start the diagnostic process when the error log is in a known state so that you can check the error log in response to subsequent events.

The error log is updated every time an error occurs. The TERRLG command displays the last ten error conditions that the drive has experienced, as recorded in these status registers:

- TANI (current command input voltage)
- CONFIG (text-based status report of configuration errors)
- ERROR (list of error messages)
- TDHRS (number of hours since the drive was powered up or RESET)
- TDTEMP (measured temperature of the drive in centigrade)
- TMTEMP (estimated temperature of the motor in centigrade)
- TVBUS (measured bus voltage in volts)

CMDDIR Direction of Rotation

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>CMDDIR<b>	Aries	1.0
Units	b = enable bit		
Range	Ø (CW rotation for positive analog input) or 1 (CCW rotation for positive analog input)		
Default	Ø		
Response	CMDDIR <*>Ø		
See Also	ANICDB, DCMDZ, DMTSCL, DRES, ENCPOL, IANI, TANI		

The CMDDIR command determines the direction of shaft rotation (or direction of travel for linear motors) for positive analog input. The default is clockwise shaft rotation for a positive command.

Sending a CMDDIR1 command changes the direction to counter clockwise. In addition, the encoder counts positive for counter clockwise rotation with CMDDIR1.

Note: This command does not take effect until you cycle power to the drive, or send the RESET command.

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Rotary Motors—Positive values represent clockwise motion and negative values represent counter-clockwise motion (assuming CMDDIR = Ø, and that you connected the feedback device according to instructions provided in "Chapter 2 Mechanical Installation" and "Chapter 3 Electrical Installation").

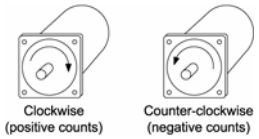


Figure 41 Clockwise/ Counter-clockwise rotation

CONFIG — Configuration Errors and Warnings

		Product	Rev
Type	Error Handling		
Syntax	<a_>CONFIG	Aries	1.0
Units	N/A		
Range	N/A		
Default	N/A		
Response	CONFIG <*>No Errors		
See Also	DMTIC, DMTIND, DMTIP, DMTW, ERROR		

The CONFIG command gives a text-based status report of current configuration errors and warnings (EØ through E24).

Error	Resolution
EØ—Motor Configuration Warning	The motor rating is too high for the drive, and the drive is using its own limits for safety reasons.
E1—Motor Configuration Error	One of the motor parameters is set to zero (0). Look at the additional errors to find which parameters are set at zero (0). Refer to your motor specifications for the correct value.
E3—Max Inductance = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero (0) value. Refer to your motor specifications for the correct value. (DMTIND)
E4—Rated Speed = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DMTW)
E5—DPOLE = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DPOLE)
E6—Resistance = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DMTRES)
E7—Ke = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DMKE)
E8—Continuous Current = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DMTIC)

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Error	Resolution
E9—Peak Current = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DMTIP)
E1Ø—Use Drive Continuous Current	The continuous current of the motor is higher than the continuous current rating of the drive. Use the continuous current rating for the drive.
E11—Torque Rating > Peak Power Rating	The motor's torque rating is too high for the power level of the drive. Use the drive's torque rating.
E12— Use Drive Peak Current	The peak current of the motor is higher than the peak current rating of the drive. Use the drive's value for peak current.
E13 - Inertia = Ø	This parameter is set to zero (0). The drive will not enable Velocity or Position Modes. To correct the error, you must set to a non-zero value. Refer to your motor specifications for the correct value. (DMTJ)
E14 - Damping = Ø	This parameter is set to zero (0). The drive will not enable Velocity or Position Modes. To correct the error, you must set to a non-zero value. Refer to your motor specifications for the correct value. (DMTD)
E15 - Notch filter Calc Error.	The notch filter settings caused an internal calculation error. The last valid value was used. Try different values for the notch filter parameters. (DNOTAF, DNOTAQ, DNOTBF, DNOTBQ)
E16 - Lead < Lag Freq	The lead filter setting (DNOTLD) must be greater than or equal to the lag filter setting. (DNOTLG)
E17 - Lead ≥ 4* Lag Freq	The lead filter setting (DNOTLD) must be less than or equal to 4 times the lag filter setting. (DNOTLG)
E18 - Lag Freq < 2Ø Hz	The lag filter setting (DNOTLG) must be greater than or equal to 20 Hz.
E19-E24	RESERVED

Table 42 Configuration Errors and Warnings

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DCMDZ — Zero the Drive Command Offset

		Product	Rev
Type	Drive Configuration		
Syntax	<a_>DCMDZ=<r>	Aries	1.0
Units	r = volts		
Range	-1Ø.ØØ to 1Ø.ØØ		
Default	Ø.ØØ		
Response	N/A		
See Also	ANICDB, DMODE, TANI		

The DCMDZ command sets the zero point for the command input. When in torque/force mode (DMODE2), this will minimize motor drift.

Executing the DCMDZ command without an argument sets the zero reference point to the last voltage read at the command input. To execute this command correctly, short the AIN + and AIN – pins together on the DRIVE I/O connector, or command zero volts from the servo controller.

You can also use DCMDZ to set the zero point to an arbitrary voltage by entering that value. For example, DCMDZ = Ø.5 makes 0.5 volts equal to a commanded velocity of zero (0) rps. Note that this value is the internal level and does not take into account any offsets in the incoming command signal.

DIBW — Current Loop Bandwidth

		Product	Rev
Type	Tuning		
Syntax	<a_>DIBW<i>	Aries	3.0
Units	Hz		
Range	250-3000		
Default	1200		
Response	DIBW: <*>1200		
See Also	PGAIN, IGAIN, IAUTO		

When used in conjunction with IAUTO1, this command sets the current loop bandwidth. Higher values of DIBW will give a faster response to changes in commanded current, at the expense of some overshoot. Lower values of DIBW, will give a slower response, with much less overshoot.

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DIFOLD — Current Foldback Enable

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>DIFOLD<b>	Aries	1.0
Units	b = enable bit		
Range	Ø (disable) or 1 (enable)		
Default	1		
Response	DIFOLD: <*>Ø		
See Also	none		

The DIFOLD command enables (1) or disables (Ø) the drive's current foldback protection feature. The current foldback feature reduces the drive's continuous current output by 20% when sustained current has the potential to overheat the drive. For the AR-20xE and AR-30xE drives, this feature is *always enabled.*

Each drive has the specifications shown in Table 43. Note that current ratings are for the drive, not for the motor.

	AR-01xx	AR-02xx	AR-04xx	AR-08xx	AR-13xx	AR-20xE	AR-30xE
Drive Continuous Current Rating (100%)	1.0 Arms	1.75 Arms	3.0 Arms	4.5 Arms	6.3 Arms	10 Arms	16 Arms
Max Current Rating	3.0 Arms	5.25 Arms	9.0 Arms	13.5 Arms	14.07 Arms	30 Arms	48 Arms
Max Time at Peak Current Rating	3.375 sec	3.375 sec	3.375 sec	3.375 sec	8.64 sec	3.375 sec	3.375 sec

Table 43 Current Foldback Ratings

If your drive is operating above its continuous rating, see Figure 42 to predict the number of seconds until foldback occurs. For example, the graph shows that at the drive's peak current rating (300% of continuous), foldback occurs after 3.375 seconds.

Note: For model AR-13xx, foldback occurs after 8.64 seconds at its peak rating (225% of continuous).

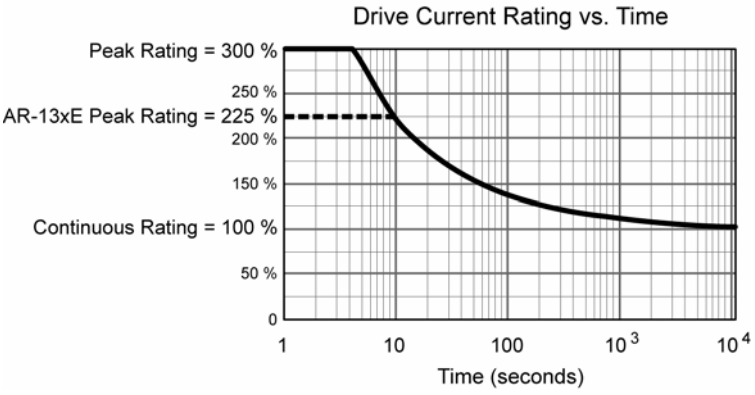


Figure 42 Time until current foldback occurs

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DMEPIT Motor Electrical Pitch

Type	Motor (Linear only)	**Product**	**Rev**
Syntax	<a_>DMEPIT<r>	Aries	1.0
Units	r = millimeters		
Range	Ø to 3ØØ.ØØ : ±Ø.Ø1		
Default	Ø		
Response	DMEPIT: <*>4Ø.ØØ		
See Also	ERES		

Note: This command does not take effect until you cycle power to the drive, or send the RESET command.

The DMEPIT command sets the electrical pitch of the magnets for use with permanent magnet brushless linear motors. The DMEPIT value is required to convert between linear units and rotary units. The electrical pitch can be equated to one revolution in a rotary motor. Mechanically, the definition of the electrical pitch is the linear distance between two magnets comprising a full magnetic cycle. For example, the illustration below shows an electrical pitch of 42 mm (DMEPIT42).

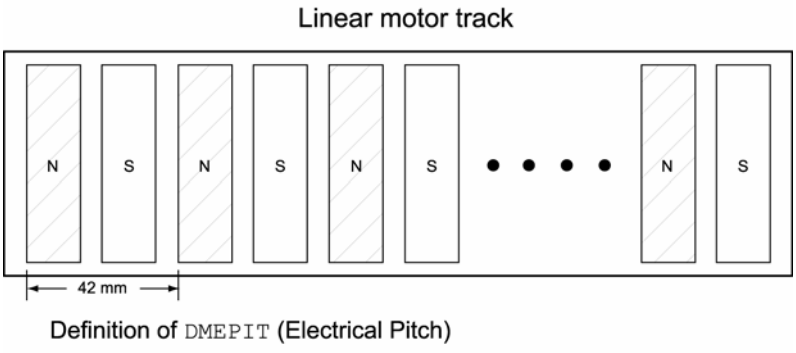


Figure 43 Linear motor track

Important! For rotary motors, set the DMEPIT to zero (0). The Aries drive uses the DMEPIT parameter as the determinant for which type of motor, linear or rotary, is connected.

DMODE Drive Control Mode

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>DMODE<i>	Aries	1.0
Units	i = control mode setting		
Range	1 to 17 (see Table 44)		
Default	2		
Response	DMODE: <*>2		
See Also	none		

Use the DMODE command to select the drive control mode for your Aries drive. For drive mode descriptions and drive compatibility, see Table 44.

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DMODE	Mode	Description
1	Autorun	Rotates the motor at 1 rps/mps. Current is reduced by 10%.
2	Torque/Force Control	Allows direct control of rotary motor torque, or linear motor force.
3	Feedback Alignment	Auto-configure for feedback setup.
4	Velocity Control	Allows direct control of rotary or linear motor velocity.
6	Position Control	Uses 5V Differential compatible (RS-422 logic level compatible) step and direction control.
7	Reversed Position Control	Reverses the polarity of the step and direction signal.

Table 44 Drive Control Mode

Note: dmodes 6 and 7 are available only on the step and direction versions of the Aries drive.

DMPSCL Incoming Pulse Scaling

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>DMPSCL<i>	Aries	2.0
Units	i = multiplier setting		
Range	1 to 127		
Default	1		
Response	DMPSCL: <*>1		
See Also	DMODE, DMTR, DRES		

Use the DMPSCL command to scale the incoming pulses for the step and direction input. A setting of 10 would move the motor 10 encoder pulses for each input pulse. This command is only valid in DMODE6 (Position Mode).

DMTAMB Motor Ambient Temperature

Type	Motor	**Product**	**Rev**
Syntax	<a_>DMTAMB<r>	Aries	1.0
Units	r = Degrees Celsius		
Range	-5Ø.ØØ to 25Ø.ØØ : ±Ø.Ø1		
Default	4Ø.Ø		
Response	DMTAMB: <*>4Ø.Ø		
See Also	DMTMAX, DMTRWC, DMTTCM, DMTTCW		

The DMTAMB command sets the motor ambient temperature used by the software motor thermal model. The DMTAMB value, in conjunction with the motor thermal time constant (DMTTCM), the motor winding time constant

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(DMTTCW), the motor thermal resistance (DMTRWC) and the continuous motor current (DMTIC), is used in a real-time estimation of the motor winding temperature. When the winding temperature exceeds DMTMAX, the drive faults and reports E35-Motor Thermal Fault.

DMTD — Motor Damping

		Product	Rev
Type	Motor		
Syntax	<a_><!>DMTD<r> (does not take effect until RESET or cycle power)	Aries	2.0
Units	Rotary motor: r = uNm/rad/sec Linear motor: r = N/meter/sec		
Range	Rotary motor: Ø.ØØØØØØ to 1ØØØØ : ±1 Linear motor: DMEPIT (electrical pitch) dependent		
Default	Ø.ØØØØØØ		
Response	DMTD: *DMTD2ØØ		
See Also	DMTR		

Note: This command does not take effect until you cycle power to the drive, or send the RESET command.

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

The DMTD command specifies the damping of the motor itself. This includes both magnetic losses and bearing losses.

DMTIC — Continuous Current

		Product	Rev
Type	Motor		
Syntax	<a_>DMTIC<r>	Aries	1.0
Units	r = Amps-RMS		
Range	Ø.ØØ to 2ØØ.ØØ : ±Ø.Ø1		
Default	Ø.ØØ (DMTIC of Ø results in motor configuration warning)		
Response	DMTIC: <*>6.5Ø		
See Also	DMTICD, DMTIP, DMTR, TCI, TDICNT, TDIMAX		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number. Otherwise, the drive reports the configuration errors EØ-Motor Configuration Error and E8-Continuous Current = Ø.
For a list of automatically configured commands, see DMTR.

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The DMTIC command sets the continuous operating current for a motor.

Rotary motors: The internal winding temperature will reach 125°C with a specified heatsink in a 40°C ambient—for Parker motors only.

Linear motors: The winding will reach 90°C in a 25°C ambient—for Parker motors only.

For heatsink dimensions, see pages 13, 14 and 15.

Example

```
DMTIC5          ; Set the motor current to 5 amps rms (equates to
                ; 7.Ø7 amps peak)
```

DMTICD Continuous Current Derating

Type	Motor	**Product**	**Rev**
Syntax	<a_>DMTICD<i>	Aries	1.0
Units	I = Percent derating at rated speed		
Range	Ø.ØØ to 1ØØ.ØØ : ±Ø.Ø1		
Default	Ø.ØØ (DMTICD of Ø results in no current derating)		
Response	DMTICD: <*>5		
See Also	DMTIC, DMTIP, DMTIP, DMTR, DMTW, TCI, TDICNT, TDIMAX		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

The DMTICD command sets the current derating percentage at rated speed (DMTW). This value sets the extent to which continuous current must be reduced at speed to compensate for velocity-related losses in the motor.

For example, DMTICD3 sets the motor's continuous current derating to 3% (or 97% of continuous value DMTIC) at the motor's rated speed (DMTW). At half this speed, it will be reduced 1.5%.

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DMTIND Motor Inductance

		Product	Rev
Type	Motor		
Syntax	<a_>DMTIND<r>	Aries	1.0
Units	r = mH		
Range	Ø.Ø to 2ØØ.Ø : ±Ø.1		
Default	Ø.Ø (DMTIND of Ø results in motor configuration error)		
Response	DMTIND <*>1Ø		
See Also	DMTINF, DMTR		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number. Otherwise, the drive reports the configuration errors E1–Motor Configuration Error and E3–Maximum Inductance = Ø, and shuts down the drive.
For a list of automatically configured commands, see DMTR.

The DMTIND command specifies the maximum value of motor inductance. This usually differs from the nominal nameplate value because actual inductance is usually position dependent. If the maximum value of motor inductance is not known, specify the nominal inductance as listed on the motor's nameplate.

DMTINF Motor Inductance Factor

		Product	Rev
Type	Motor		
Syntax	<a_>DMTINF<r>	Aries	1.0
Units	r = units		
Range	Ø.ØØ to 1.ØØ		
Default	1		
Response	DMTINF <*>1.ØØ		
See Also	CONFIG, DMTIND, DMTR		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number. Otherwise, the drive reports the configuration errors E1–Motor Configuration Error and E3–Maximum Inductance = Ø, and shuts down the drive.
For a list of automatically configured commands, see DMTR.

The DMTINF command specifies the minimum motor inductance divided by the maximum motor inductance. Setting DMTINF to 1.ØØ does not derate the motor.
If the minimum value of the motor inductance is not known, use the nominal inductance as listed on the motor's nameplate (or set DMTINF1.ØØ)

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DMTIP — Peak Current

		Product	Rev
Type	Motor		
Syntax	<a_>DMTIP<r>	Aries	1.0
Units	r = Amps-RMS		
Range	Ø.ØØ to 4ØØ.ØØ : ±Ø.Ø1		
Default	Ø.ØØ (DMTIP of Ø results in motor configuration warning)		
Response	DMTIP: <*>7.5Ø		
See Also	DMTIC, DMTICD, DMTLIM, DMTR, TDIMAX		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number. Otherwise, the drive reports the configuration errors E1-Motor Configuration Error and E9-Peak Current = Ø.
For a list of automatically configured commands, see DMTR.

The DMTIP command sets a limit that the commanded current cannot exceed. This is typically set to three times the motor's continuous current rating (DMTIC) or less.

If DMTIP is set higher than the full-scale value calculated by DMTLIM (torque/force limit) the new DMTIP value will be ignored.

If the DMTIP value exceeds the drive's maximum output current (TDIMAX), the DMTIP value will be ignored and the maximum allowable value will be used (see Table 45). The drive reports EØ-Motor Configuration Warning and E12-Peak Current Too High.

	Maximum Current Rating (RMS)
AR-01xx	3A
AR-02xx	5.25A
AR-04xx	9A
AR-08xx	13.5A
AR-13xx	14.1
AR-20xE	30
AR-30xE	48

Table 45 Peak Current Rating for Aries Drives

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DMTJ — Motor Rotor Inertia / Forcer Mass

		Product	Rev
Type	Motor		
Syntax	<a_><!>DMTJ<r> (does not take effect until RESET or cycle power)	Aries	2.0
Units	Rotary motor: r = kgm2 * 1Ø-6 Linear motor: r = kg		
Range	Rotary motor: Ø.ØØØ to 1ØØØØØØ.ØØØ : ±Ø.ØØ1 Linear motor: DMEPIT (electrical pitch) dependent		
Default	Ø.ØØØ (DMTJ of Ø results in motor config. error)		
Response	DMTJ: *DMTJ2ØØ.6ØØ		
See Also	DMTR, CONFIG		

Note: This command does not take effect until you cycle power to the drive, or send the RESET command.

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
If the drive is powered up when this command is set to zero (for instance, if RFS is executed), the drive reports a motor configuration error with E13, and shuts down the drive (DRIVEØ).
For a list of auto-configured commands, see DMTR.

The DMTJ command sets the motor rotor inertia for rotary motors, or the forcer mass for linear motors.

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DMTKE Motor Ke

Type	Motor	**Product**	**Rev**
Syntax	<a_>DMTKE<r>	Aries	1.0
Units	Rotary motor: r = volts (Ø-peak)/krpm (measured line-to-line) Linear motor: r = volts (Ø-peak)/meter/second (measured line-to-line)		
Range	Rotary motor: Ø.Ø to 8ØØ.Ø : ±Ø.1 Linear motor: DMEPIT (electrical pitch) dependent		
Default	Ø.Ø (DMTKE of Ø results in motor configuration error)		
Response	DMTKE: <*>15.Ø		
See Also	DMEPIT, DMTLIM, DMTR, DMTSCL		

Note: This command does not take effect until you cycle power to the drive, or send the RESET command.

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number. Otherwise, the drive reports the configuration errors E1-Motor Configuration Error and E7-Bad Hall State, and shuts down the drive.
For a list of automatically configured commands, see DMTR.

The DMTKE command specifies the motor voltage constant (Ke). This defaults to the nominal Ke of the motor selected with the DMTR command.

The motor's torque/force constant (Kt) is derived from the motor's voltage constant (Ke) by the following relationship:

$$Kt(Nm/A^{\dagger}) = \frac{3\sqrt{3}}{200\pi} Ke(Volts^{\ddagger}/krpm)$$

Rotary motors: †RMS, ‡0 - peak value

Linear motors:
$$Kt(N/A^{\dagger}) = \frac{3\sqrt{3}}{200\pi} Ke(Volts^{\ddagger}/(meter/\sec))$$

†RMS, ‡0 - peak value

Note: The Aries requires values in rotary units. The Aries Support Tool automatically performs these conversions when you use the Configuration Wizard. If you do not use the Configuration Wizard, you must convert your linear units to rotary units. For more information about conversion, see the DMEPIT command.

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DMTLIM Torque/Force Limit

Type	System	**Product**	**Rev**
Syntax	<a_>DMTLIM<r>	Aries	1.0
Units	Rotary motor: r = Nm Linear motor: r = N		
Range	Rotary motor: Ø.Ø to 5ØØ.Ø (motor/drive dependent): ±Ø.1 Linear motor: DMEPIT (electrical pitch) dependent		
Default	4ØØ.Ø		
Response	DMTLIM: <*>1Ø.5		
See Also	DMODE, DMTIP, DMTKE, DMTR, DMTSCL, TTRQ, TTRQA		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

The DMTLIM command sets a maximum torque/force limit for the system. Requests for higher torque/force will be clamped to this value. This command will default automatically to a value appropriate to the motor selection (DMTR) and the Aries drive you are using, and no changes are required in many cases.

If your mechanical system has torque/force limitations (due, for example, to the limitations of a coupler or belt), you can use this command to limit system torque/force without affecting system scaling or gains.

During initial tuning, this command can be used to limit the torque/force produced if the system becomes unstable, reducing the rate of motor heating and allowing more reaction time for the person tuning the system, and reducing the chances of damage to the mechanical system.

If DMTLIM is set higher than the value allowed by the motor's peak current times the motor's Kt, or the drive's peak current times the motor's Kt (whichever is lower), the new DMTLIM value will be ignored (but not overwritten). In addition, the drive reports EO –Motor configuration Warning and E11–Torque Rating Too High for Drive, and the maximum internal value is used. You can clear the warning by sending the RESET command or cycling power to the drive.

The motor's torque/force constant (Kt) is derived from the motor's voltage constant (Ke, which is set by the DMTKE command) by the following relationship (**Note:** *Ke* is set with the DMTKE command):

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Rotary motors:

$$Kt(Nm/A^{\dagger}) = \frac{3\sqrt{3}}{200\pi} Ke(Volts^{\ddagger}/krpm)$$

†RMS, ‡0 - peak value

Linear motors:

$$Kt(N/A^{\dagger}) = \frac{3\sqrt{3}}{200\pi} Ke(Volts^{\ddagger}/(meter/\sec))$$

†RMS, ‡0 - peak value

DMTMAX Maximum Motor Winding Temperature

Type	Motor	**Product**	**Rev**
Syntax	<a_>DMTMAX<r>	Aries	1.0
Units	r = Degrees Celsius		
Range	Ø.Ø to 2ØØ.Ø : ±Ø.1		
Default	125.Ø		
Response	DMTMAX: <*>125.Ø		
See Also	DMTAMB, DMTIC, DMTR, DMTRWC, DMTTCM, DMTTCW		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

The DMTMAX command sets the maximum motor winding temperature allowed. The DMTMAX value, in conjunction with the motor thermal time constant (DMTTCM), the motor winding time constant (DMTTCW), the motor thermal resistance (DMTRWC) and the continuous motor current (DMTIC), is used in a real-time estimation of the motor winding temperature. When the winding temperature exceeds DMTMAX, a drive fault occurs and the drive reports E35-Motor Thermal Model Fault.

DMTR Identify Motor

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>DMTR<t> this command is only a report back	Aries	1.0
Units	t = Parker motor identification number		
Range	N/A		
Default	"Blank"		
Response	DMTR: <*>SM232AE		
See Also	(Servo Motor Data Parameters below), RESET, RFS, STATUS		

The purpose of the DMTR command is to record and report the identification number of the Parker motor you selected in the Aries Support Tool.

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When you select a specific Parker motor using the Aries Support Tool, the DMTR setting and various motor parameters (see Servo Motor Data Parameters below) are automatically configured for the associated motor. Using the Aries Support Tool, you can save the parameters in a configuration file.

For the DMTR and all the motor parameter commands to take effect after downloading the configuration file to the Aries drive, you must cycle drive power or send the RESET command.

Note: For a non-Parker motor, the default setting is blank (empty). You must set all relevant motor parameters manually.

Avoid using the DMTR *command to change the motor name*, because the new DMTR value may not represent the actual motor parameters that are currently loaded in the drive.

Servo Motor Data Parameters

MEPIT	Motor Electrical Pitch	DMTMAX	Maximum Motor Winding Temperature
DMTD	Motor Damping	DMTRES	Motor Winding Resistance
DMTIC	Continuous Current	DMTRWC	Motor Winding Thermal Resistance
DMTICD	Continuous Current Derating	DMTTCM	Motor Thermal Time Constant
DMTIND	Motor Inductance (max)	DMTTCW	Motor Winding Time Constant
DMTINF	Motor Inductance (min)	DMTW	Motor Rated Speed
DMTIP	Peak Current	DMVLIM	Velocity Limit
DMTJ	Motor rotor Inertia/Forcer Mass	DMVSCL	Velocity Scaling
DMTKE	Motor Ke	DPOLE	Number of Motor Pole Pairs
DMTLIM	Torque/Force Limit	ERES	Encoder Resolution

Although these command values are auto-configured when you select a Parker motor (using the Aries Support Tool), you may individually set the command values with the respective configuration command.

Motor Configuration Error

Many of the above motor parameters, if not configured (i.e. a command remains at its factory default value, or an RFS command is executed) will report a motor configuration warning or error when powering up the Aries drive—E0-Motor Configuration Warning or E1-Motor Configuration Error (an error also disables the drive—DRIVE0). To resolve the error or warning condition, you must select a Parker motor using the Aries Support Tool (or configure each motor parameter command with a value other than zero using a terminal emulator), download the resulting configuration information, and then send the RESET command or cycle power.

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DMTRES Motor Winding Resistance

		Product	Rev
Type	Motor		
Syntax	<a_>DMTRES<r>	Aries	1.0
Units	r = Ohm (measured line-to-line)		
Range	Ø.ØØ to 10Ø.ØØ : ±Ø.Ø1		
Default	Ø.ØØ (DMTRES of Ø results in motor configuration error)		
Response	DMTRES: <*>7.5Ø		
See Also	DMTR		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number. Otherwise, the drive reports the configuration errors E1–Motor Configuration Error and E6–Resistance = Ø, and shuts down the drive.
For a list of automatically configured commands, see DMTR.

The DMTRES command sets the motor winding resistance. This resistance value is measured at 25°C at the *drive end* of the motor cable (motor cable included). This resistance is the phase-to-phase resistance measured at terminals U to V, V to W, or W to U.



Warning — Disconnect the motor cable from the drive before attempting to make this measurement. For best accuracy, and to avoid injury, this measurement must be made with the motor cable disconnected from the drive.

DMTRWC Motor Winding Thermal Resistance

		Product	Rev
Type	Motor		
Syntax	<a_>DMTRWC<r>	Aries	1.0
Units	r = Degrees Celsius/Watt (°C/W)		
Range	Ø.ØØ to 16.ØØ : ±Ø.Ø1		
Default	Ø.5Ø		
Response	DMTRWC: <*>23.6Ø		
See Also	DMTR, DMTTCM, DMTTCW		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

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DMTRWC specifies the temperature rise of the motor winding above motor case temperature per watt of winding power dissipation. Motor heatsinking does not affect this value.

DMTSCL Torque/Force Scaling

		Product	Rev
Type	Drive Configuration		
Syntax	<a_>DMTSCL<r>	Aries	1.0
Units	Rotary motor: r = Nm Linear motor: r = N		
Range	Ø.Ø to 5ØØ.Ø (motor/drive dependent): ±Ø.1		
Default	Ø		
Response	DMTSCL: <*>2Ø.Ø		
See Also	DMEPIT, DMODE, DMTKE, DMTLIM, DMTR, TDIMAX, TTRQ, TTRQA		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

The DMTSCL command scales the torque/force command input. It sets the full-scale torque/force that will be produced from a 10-volt input command. It controls the gain applied to the input. This can be used to scale the input to match application needs. For example, if a torque/force sensor produces 2 volts per Newton-meter, the drive could be scaled to match this by using DMTSCL5 — this sets 10V = 5 N-m (0.5 N-m/Volt). DMTLIM may limit torque/force to less than this full-scale value.

Note: To configure the drive in torque/force mode so that a 10-volt torque/force command produces the rated peak current of the drive (without reference to motor parameters), enter for DMTSCL the result of the following calculation:

$$DMTSCL = TDIMAX\left(\frac{3\sqrt{3}}{200\pi}\right)DMTKE$$

Rotary Motors: V*/krpm

Linear Motors: V*/m/s

* peak value

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DMTSWT Motor temperature switch type

		Product	Rev
Type	Motor configuration		
Syntax	<a_>DMTSWT<i>	Aries	2.10
Units	i = motor temp switch type		
Range	0 (Normally closed switch) 1 (Positive temperature coefficient thermistor) 2 (Normally open switch) 3 (Negative temperature coefficient thermistor)		
Default	DMTSWT0		
Response	DMTSWT: <*>0		
See Also	DTHERM, TMTEMP		

DMTSWT sets the type of motor switch used. Values of 0 or 1 behave exactly the same and are interchangeable. DMTSWT3 specifies a negative temperature coefficient thermistor. In this case TMTEMP reports the higher of the motor thermal model value or the calculated thermistor temperature, once the thermistor temperature is above 60 degrees C. The drive faults with a motor temperature fault at a thermistor temp of 105 degrees C or the motor thermal model setpoint (whichever is lower) when DMTSWT is set to 3.

The default value for this command is DMTSWT0 and will work with both positive temperature coefficient thermistors or normally closed switches.

DMTTCM Motor Thermal Time Constant

		Product	Rev
Type	Motor		
Syntax	<a_>DMTTCM<r>	Aries	1.0
Units	r = minutes		
Range	Ø.Ø to 12Ø.Ø : ±Ø.1		
Default	Ø.Ø		
Response	DMTTCM: <*>3Ø.4		
See Also	DMTR, DMTTCW		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

The DMTTCM command specifies the thermal time constant of the motor and its mounting. The drive uses this value to help protect the motor from thermal damage. It describes the length of time the motor takes to reach 63% of its final temperature, given constant power. Note that the motor mounting affects this measurement.

Continuous current ratings and published time constants for Parker motors are specified when mounted to a 10" x 10" x ¼" aluminum plate in 25°C open air. If your mounting surface provides heat-sinking or thermal mass significantly different from this, a different value may be appropriate to your

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application. Note also that the time constant of the motor winding itself (DMTTCW) is much faster than this; therefore, the rise in winding temperature will initially be much faster than DMTTCM would suggest.

DMTTCW Motor Winding Time Constant

		Product	Rev
Type	Motor		
Syntax	<a_>DMTTCW<r>	Aries	1.0
Units	r = minutes		
Range	Ø.ØØ to 6Ø.ØØ : ±Ø.Ø1		
Default	Ø.ØØ		
Response	DMTTCW: <*>28.4Ø		
See Also	DMTR, DMTRWC, DMTTCM		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

The DMTTCW command specifies the time constant of the motor winding alone. This is the time for the winding to reach 63% of its final temperature rise above the rest of the motor, given constant power. Note that this is *not* the time constant usually specified in motor data sheets (see DMTTCM); the DMTTCW value is typically much faster.

DMTW Motor Rated Speed

		Product	Rev
Type	Motor		
Syntax	<a_>DMTW<r>	Aries	1.0
Units	Rotary motor: r = revolutions/second Linear motor: r = meters/second		
Range	Ø.Ø to 15Ø.Ø : ±Ø.1		
Default	Ø.Ø (DMTW of Ø results in motor configuration error)		
Response	DMTW: <*>15Ø.Ø		
See Also	DMEPIT, DMTICD, DMTR		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number. Otherwise, the drive reports the configuration errors EØ–Motor Configuration Warning and E4–Rated Speed = Ø, and shuts down the drive.
For a list of automatically configured commands, see DMTR.

The DMTW command specifies the rated speed of the motor. This is the lesser of the following:

- (Rotary motor) Motor mechanical limited speed

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- (Rotary motor) Encoder limit of 5 MHz (pre-quadrature)
- Linear motor speed limitations include encoder resolution and track length.
- The corner of the continuous speed/torque or speed/force curve (the point where the continuous and peak torque/force curves meet).

The DMTW value is used in conjunction with DMTICD to protect the motor from thermal damage.

DMVLIM Velocity Limit

Type	System	**Product**	**Rev**
Syntax	<a_>DMVLIM<r>	Aries	1.0
Units	Rotary motor: r = revolutions/second Linear motor: r = meters/second		
Range	Ø.ØØ to 16Ø.ØØ : ±Ø.Ø1		
Default	125.ØØ		
Response	DMVLIM: <*>5Ø.ØØ		
See Also	DMODE, DMTR		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

The DMVLIM command sets a limit that the commanded velocity cannot exceed without affecting gains or scaling. This is typically used to protect parts of the mechanical system.

If the velocity demand from the internal Aries control loops exceeds the limits set by DMVLIM, the Aries invokes the “Override Mode”, in which the drive software clamps the maximum velocity to the value set by DMVLIM.

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DMVSCL Velocity Scaling

		Product	Rev
Type	Drive Configuration		
Syntax	<a_>DMVSCL<r>	Aries	2.0
Units	Rotary motor: r = revolutions/second Linear motor: r = meters/second		
Range	Ø.ØØ to 2ØØ.ØØ (motor/drive dependent): ±Ø.Ø1		
Default	4.ØØ		
Response	DMVSCL: <*>1ØØ.Ø		
See Also	DMODE, DMTR		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to 4.00—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

The DMVSCL command scales the velocity command input. This command is only valid in Velocity mode (DMODE4). It sets the full-scale velocity that will be produced from a 10-volt input command. It controls the gain applied to the input. This can be used to scale the input to match application needs. For example, if an application requires a maximum speed of 10 Rev/Sec, then the DMVSCL could be set to 10. This would scale the input to 1Rev/Sec for every volt applied to the input.

DNOTAD Notch Filter A Depth

		Product	Rev
Type	Tuning		
Syntax	<a_><!>DNOTAD<i>	Aries	2.0
Units	n/a		
Range	Ø.ØØØØ - 1.ØØØØ		
Default	Ø.ØØØØ (depth is zero)		
Response	DNOTAD: *DNOTAD.5		
See Also	DMODE, DNOTAF, DNOTAQ, DNOTBD, DNOTBF, DNOTBQ, DNOTLD, DNOTLG		

The DNOTAD command sets the depth for the commanded torque/force notch filter A. Setting this to zero (0) disables the filter. This command is useful in adjusting the maximum allowable attenuation and phase shift through the filter. The deeper the notch depth, the more attenuation and phase shift. In general, the notch depth is increased until the resonance is diminished. Increasing the depth further, might increase the phase shift to an unacceptable level and decrease the overall system performance.

There are two cascaded notch filters labeled “A” and “B”. Both filters operate in exactly the same way. The diagram below shows the topology of these filters.

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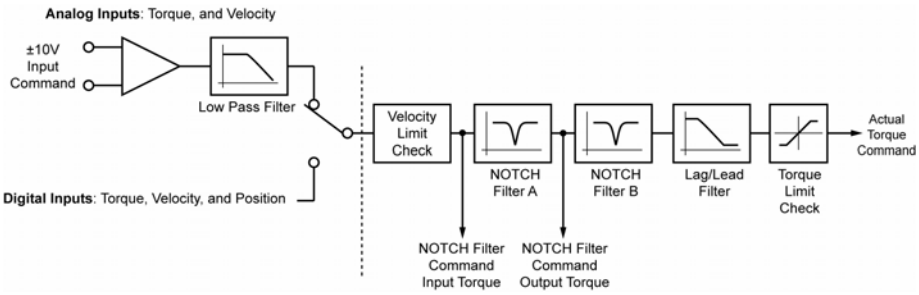


Figure 44 Notch Filter Topology

The graphs below illustrate the transfer function for the magnitude and phase of the notch filter command output torque/force vs. the notch filter command input torque/force. In this example, the notch depths are set to .3, .6, and .9 (DNOTAD.3, DNOTAD.6, DNOTAD.9). The notch center frequency is set to 200 Hz (DNOTAF2ØØ) and the "Q" is set to 1 (DNOTAQ1).

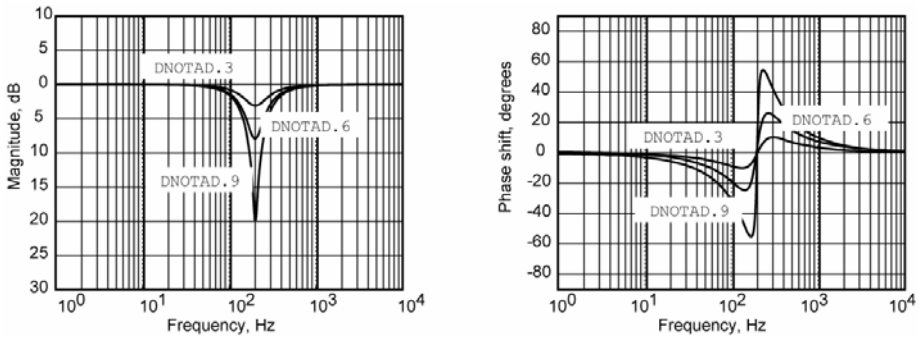


Figure 45 Notch Filter Magnitudes

These filters operate in all DMODE settings except Autorun (DMODE1).

DNOTAF Notch Filter A Frequency

Type	Tuning	**Product**	**Rev**
Syntax	<a_><!>DNOTAF<i>	Aries	2.0
Units	i = Hz		
Range	Ø (disable), or 6Ø-1ØØØ		
Default	Ø (filter is disabled)		
Response	DNOTAF: *DNOTAF2ØØ		
See Also	DNOTAD, DNOTAQ, DNOTBD, DNOTBF, DNOTBQ, DNOTLD, DNOTLG		

The DNOTAF command sets the center frequency for the commanded torque/force notch filter A. Setting this to 0 disables the filter. If setting a value results in an internal calculation error, the last valid value is used, and TE15 is set.

There are two cascaded notch filters labeled "A" and "B". Both filters operate in exactly the same way. The graphs below illustrate the transfer function (magnitude and phase) of the internal commanded torque/force vs. the user commanded torque/force. In this example, the notch frequency is set to 150 Hz (DNOTAF15Ø) and the "Q" is set to 1 (DNOTAQ1).

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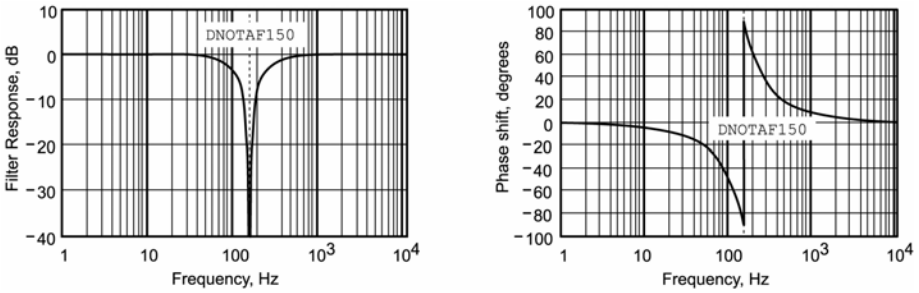


Figure 46 Notch Filter A

These filters operate in all DMODE settings, except Autorun (DMODE1).

DNOTAQ Notch Filter A Quality Factor

		Product	Rev
Type	Tuning		
Syntax	<a_><!>DNOTAQ<r>	Aries	2.0
Units	r = quality factor		
Range	Ø.5 to 2.5		
Default	1		
Response	DNOTAQ: *DNOTAQ1.5		
See Also	DNOTAD, DNOTAF, DNOTBD, DNOTBF, DNOTBQ, DNOTLD, DNOTLG		

The DNOTAQ command sets the quality factor (Q) for notch filter A. The quality factor, or width of the frequency trough, determines how discrete the filter is.

For information about the filter's transfer function characteristics, see DNOTAF.

DNOTBD Notch Filter B Depth

		Product	Rev
Type	Tuning		
Syntax	<a_><!>DNOTBD<i>	Aries	2.0
Units	n/a		
Range	Ø.ØØØØ - 1.ØØØØ		
Default	.ØØØØ (depth is zero)		
Response	DNOTBD: *DNOTBD.5		
See Also	DNOTAD, DNOTAF, DNOTAQ, DNOTBF, DNOTBQ, DNOTLD, DNOTLG		

The DNOTBD command sets the depth for the commanded torque/force notch filter B.

For information about the notch filter depth, see DNOTAD.

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DNOTBF Notch Filter B Frequency

		Product	Rev
Type	Tuning		
Syntax	<a_><!>DNOTBF<i>	Aries	2.0
Units	i = Hz		
Range	Ø (disable), or 6Ø-1ØØØ		
Default	Ø (filter is disabled)		
Response	DNOTBF: *DNOTBF2ØØ		
See Also	DNOTAD, DNOTAF, DNOTAQ, DNOTBD, DNOTBQ, DNOTLD, DNOTLG		

The DNOTBF command sets the center frequency for notch filter B. Setting this to 0 disables the filter. For a description of the filter's transfer function characteristics, refer to the DNOTAF command description.

DNOTBQ Notch Filter B Quality Factor

		Product	Rev
Type	Tuning		
Syntax	<a_><!>DNOTBQ<r>	Aries	2.0
Units	r = quality factor		
Range	Ø.5 to 2.5		
Default	1		
Response	DNOTBQ: *DNOTBQ1.5		
See Also	DNOTAF, DNOTAQ, DNOTBD, DNOTBF, DNOTLD, DNOTLG		

The DNOTBQ command sets the quality factor (Q) for notch filter B. The quality factor, or width of the frequency trough, determines how discrete the filter is.

For information about the filter's transfer function characteristics, see DNOTAF.

DNOTLD Notch Lead Filter Break Frequency

		Product	Rev
Type	Tuning		
Syntax	<a_><!>DNOTLD<i>	Aries	2.0
Units	i = Hz		
Range	Ø (disable), or 8Ø-1ØØØ		
Default	Ø (filter is disabled)		
Response	DNOTLD: *DNOTLD2ØØ		
See Also	DNOTAD, DNOTAF, DNOTAQ, DNOTBD, DNOTBF, DNOTLG		

The DNOTLD command sets the break frequency of the lead filter. This filter cannot be used alone, but must be used in conjunction with the DNOTLG lag

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filter. The DNOTLG lag filter must be configured before the DNOTLD lead filter is configured.

The DNOTLD value must be less than or equal to 4 times the DNOTLG (notch lag frequency) value; otherwise, the new DNOTLD value will be ignored (but not overwritten), the configuration warning bit (E17) will be set, and the last valid DNOTLD value will be used internally. *This warning is cleared with the* RESET *command or by cycling power to the drive.*

This filter operates in all DMODE settings, except Autorun (DMODE1).

In the graphs below, the transfer function is shown relating the internal commanded torque/force vs. the user commanded torque/force. In this example, the lag frequency was set first to 40 Hz (DNOTLG4Ø) and then the lead filter was set to 160 Hz (DNOTLD).

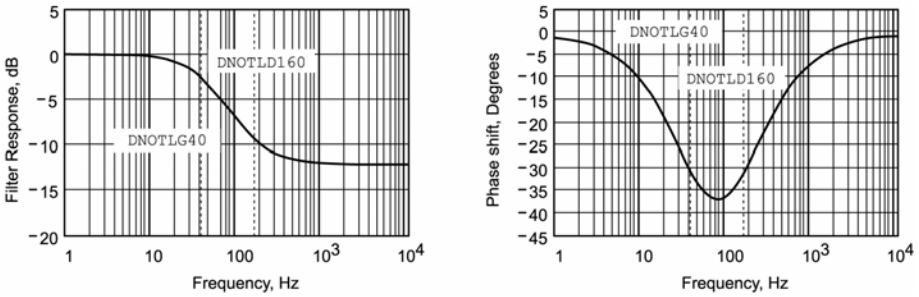


Figure 47 Notch Lead Filter Break Frequency

DNOTLG Notch Lag Filter Break Frequency

Type	Tuning	**Product**	**Rev**
Syntax	<a_><!>DNOTLG<i>	Aries	2.0
Units	i = Hz		
Range	Ø (disable), or 2Ø-1ØØØ		
Default	Ø (filter is disabled)		
Response	DNOTLG: *DNOTLG4ØØ		
See Also	DNOTAD, DNOTAF, DNOTAQ, DNOTBD, DNOTBF, DNOTBQ, DNOTLD		

The DNOTLG command sets the break frequency of the lag filter. This filter can be used alone, or in conjunction with lead filter (DNOTLD) to improve the phase response of the notch filters. In this case, the lag value (DNOTLG) must be greater than or equal to ¼ of the lead value (DNOTLD), but not greater than the DNOTLD value.

If DNOTLG is lower than ¼ the value of DNOTLD, the new DNOTLG value is ignored (but not overwritten), the configuration warning bit (E17) is set, and the last valid DNOTLG value is used internally. *This warning is cleared with the* RESET *command or by cycling power to the drive.*

This filter operates in all DMODE settings, except Autorun (DMODE1).

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DPOLE Number of Motor Pole Pairs

Type	Motor	**Product**	**Rev**
Syntax	<a_>DPOLE<i>	Aries	1.0
Units	i = pole pairs		
Range	1 to 2ØØ		
Default	Ø (DPOLE of Ø results in motor configuration error)		
Response	DPOLE: <*>5Ø		
See Also	DMTR		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number. Otherwise, the drive reports the configuration errors E1–Motor Configuration Error and E5–DPOLE = Ø, and shuts down the drive.
For a list of automatically configured commands, see DMTR.

The DPOLE command sets the number of motor pole pairs. The number of pole pairs is defined as the number of poles (P), divided by 2 (or, P/2). The electrical frequency of the current (ω_e) is related to the mechanical speed (ω_m) of the motor by the pole pairs. The equation (right) shows this relationship.

$$\omega_e = \left(\frac{P}{2}\right)\omega_m$$

Note: All linear motors, regardless of the number of stator poles, are considered one pole-pair (DPOLE1) machines.

DPWM Drive PWM Frequency

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>DPWM <i>	Aries	1.0
Units	i = kHz		
Range	16 or 32 (16 only for models AR-20xE and AR-30xE)		
Default	16 (use the drive's default frequency)		
Response	DPWM: <*>16		
See Also	STATUS		

Note: This command does not take effect until you cycle power to the drive, or send the RESET command.

Use the DPWM command to select the drive's PWM frequency. This value is the internal PWM frequency as seen at the motor windings; the motor ripple current is twice this frequency. In general, for a given drive power level, the higher the switching frequency, the lower the motor ripple current heating and the lower both the peak and continuous current ratings.

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DRES Drive Resolution

Type	Drive configuration	**Product**	**Rev**
Syntax	<a_>DRES<i>	Aries	2.10
Units	i = Input Step Resolution		
Range	200 to 10737141823		
Default	4000		
Response	DRES: <*>0		
See Also	CMDDIR, DMPSCL		

The DRES command is only used in step and direction mode (DMODE6 and 7). Input steps will be scaled to the DRES value so DRES steps on the input would translate to one revolution of the motor. DRES is set to ERES internally if DMPSCL is non-zero for backward compatibility with operating system 2.0. DMPSCL should be set to 0 (a new option in OS 2.10) to enable DRES support.

Note: This command requires a reset to take effect. DMPSCL changes are immediate so it is possible to enable DRES support, then enable DMPSCL, and have both features working at once.

DRIVE Drive Enable

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>DRIVE <b>	Aries	2.0
Units	b = enable bit		
Range	1(enable) or Ø(disable)		
Default	Ø		
Response	DRIVE: <*>Ø		
See Also	ERROR		

The DRIVE command allows you to enable or disable (shut down) the drive.

If the hardware enable input is closed on power-up, the drive is automatically enabled (generates a DRIVE1 command). To disable the drive, either issue the DRIVEØ command or open the hardware enable interlock.

Conversely, if the hardware enable input is open on power-up, the drive is disabled (DRIVEØ). To enable the drive, close the hardware enable input. To verify the hardware enable input is open, query the ERROR command for E46 – Hardware Enable.

Note: Issuing a DRIVE1 command from a DRIVEØ condition will set the position error to zero (TPER = Ø).

All of these “Fault Conditions” automatically cause a shut down (DRIVEØ), as well as activate the “fault” output and open the dry contact relay (“RELAY N.O.”):

- Certain axis “fault” conditions – refer to the status bits denoted with an asterisk (*) in the ERROR description.

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- If operating in the FLTDSB1 mode and the drive received a DRIVEØ command or the hardware enable input was opened.

DTHERM Thermal Switch Checking

		Product	Rev
Type	motor		
Syntax	<a_>DTHERM<b>	Aries	1.0
Units	b = enable bit		
Range	Ø(enable) or 1(disable)		
Default	Ø		
Response	DTHERM: *Ø		
See Also	DMTSWT		

The DTHERM command is used to disable drive faults when the motor thermal switch opens. It is useful when no thermal switch is present on the motor. Send the DTHERMØ command to re-enable thermal switch checking.

ECHO Communication Echo Enable

		Product	Rev
Type	Communication Interface		
Syntax	<a_>ECHO<b>	Aries	1.0
Units	b = enable bit		
Range	Ø (disable) or 1 (enable)		
Default	1		
Response	ECHO: <*>1		
See Also	ADDR, STATUS		

The ECHO command enables/disables command echo. If using an RS-485 multi-drop, *disable* echo.

Note: The ECHO command has no obvious effect. You will always see the characters that you type echoed on the screen. Only after you send a command delimiter (carriage return or line feed) is a command line sent to the Aries drive.

ENCFLT Maximum pre-quadrature encoder frequency

		Product	Rev
Type	Drive configuration		
Syntax	<a_>ENCFLT<i>	Aries	3.0
Units	None		
Range	0 (1.02MHz), 1 (2.67MHz) or 2(5MHz)		
Default	0		
Response	ENCFLT: <*>0		
See Also	None		

For increased noise immunity, rotary motors have increased filtering on the encoder input. The maximum input frequency in 1.02 MHz pre-quadrature for

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rotary motors by default. If a linear motor is configured, the drive sets a 2.67 MHz pre-quadrature maximum input encoder frequency by default.

The ENCFLT command increases the default maximum pre-quadrature encoder frequency from 1.02 MHz to 2.67 MHz or 5 MHz. This allows users to take advantage of the higher input frequency, if necessary, at the expense of some noise immunity.

Note: This command does not take effect until you cycle power to the drive or send the RESET command.

ENCOFF Encoder Offset

		Product	Rev
Type	Motor configuration		
Syntax	<a_>ENCOFF<i>	Aries	1.0
Units	i = encoder offset		
Range	-32768 to 32767		
Default	0		
Response	ENCOFF: <*>0		
See Also	ALIGN, ENCPOL, SHALL, IANI, CMDDIR, P163		

The ENCOFF command specifies the encoder offset. All standard (non-smart) Parker encoders have an encoder offset of 0 degrees. The smart encoders store the encoder offset in the motor, which the drive reads (and stores in the ENCOFF parameter) upon power-up. The offset can vary from –180 degrees (corresponding to ENCOFF=-32768) to +180 degrees (corresponding to ENCOFF = 32767).

Note: To convert from degrees to counts, just multiply the offset in degrees by 182.044.

ENCPOL Encoder Polarity

		Product	Rev
Type	Drive Configuration		
Syntax	<a_>ENCPOL<b>	Aries	2.0
Units	b = polarity bit		
Range	0 (normal polarity), 1 (reverse polarity)		
Default	0		
Response	ENCPOL: <*>0		
See Also	ALIGN, CMDDIR, TPE, TPER		

The ENCPOL command reverses the encoder counting direction.

You can reverse the encoder polarity if the encoder input is counting in the wrong direction (for example, using a custom motor). This reverses the encoder counting direction without having to change the actual wiring to the encoder input.

Notes

- This command does not take effect until you cycle power to the drive or send the RESET command.

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- To reverse the commanded direction of motion, make sure there is a direct correlation between commanded direction and encoder direction. You can then issue the CMDDIR command to reverse both the commanded direction and the encoder direction.

For more information, see CMDDIR.

- The ENCPOL command will not affect the encoder output. If ENCPOL1 is required on the drive for servo stability, the equivalent command will also be required on the controller.

ERES — Encoder Resolution

Type	Encoder Configuration	**Product**	**Rev**
Syntax	<a_>ERES<i>	Aries	1.0
Units	Rotary motor: i = counts/revolution Linear motor: i = counts/electrical pitch		
Range	32 to 1Ø73741823		
Default	4ØØØ (4096 for Resolver option)		
Response	ERES: <*>4ØØØ		
See Also	DMEPIT, DMTR, TPE		

Auto-Setup: When using a Parker motor and the Aries Support Tool, this command is automatically set for the selected motor.
If you did not use the Aries Support Tool, are using non-Parker motors, or sent an RFS command to the drive, the parameter is set to zero (0)—you must *manually set this parameter* to a non-zero number.
For a list of auto-configured commands, see DMTR.

Use the ERES command to establish the encoder resolution (post quadrature) in counts/rev or counts/electrical pitch. (To set a linear motor's electrical pitch, refer to the DMEPIT command).

The servo system's resolution is determined by the resolution of the encoder used with the servo motor. The ERES command establishes the number of counts (post quadrature), per unit of travel. For example, Parker's SM and NeoMetric Series motors with the "E" encoder option use 1,000-line encoders, and therefore have a 4,000 count/rev post-quadrature resolution (requires ERES4ØØØ). If the encoder is mounted directly to the motor, the Aries' resolution (ERES value) must match the encoder's resolution to ensure that the motor will move according to the programmed distance and velocity.

Resolutions for Parker Encoders

Servo axes

BE Series Servo Motors..... BExxxxJ-xxxx: ERES8000

..... BExxxxL-xxxx: ERES20000

SE, SM, N, or J Series Servo Motors ..... SE/SM/N/JxxxxD-xxxx: ERES2000

..... SE/SM/N/JxxxxE-xxxx: ERES4000

MPM Series..... MPMxxxxxxxxJMxx: ERES4000

..... MPMxxxxxxxxJNxx: ERES8000

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.....MPMxxxxxxxxJLxx: ERES10000

.....MPMxxxxxxxxJPxx: ERES12000

.....MPMxxxxxxxxJQxx: ERES20000

.....MPMxxxxxxxxJTxx: ERES24000

.....MPMxxxxxxxxJXxx: ERES4096

.....MPMxxxxxxxxJYxx: ERES8192

.....MPMxxxxxxxxJZxx: ERES16384

Note: Motors with the Smart Encoder option set ERES automatically. Changing the ERES value may cause unpredictable motor responses.
Note: ERES is fixed at 4096 for Aries drives with Resolver option.
Daedal Positioning Tables (encoder options)

-E2.....ERES42000

-E3.....ERES84000

-E4.....ERES420000

-E5.....ERES8400

For linear servo motors, use the following equation to determine the proper ERES, based on both the encoder resolution and the motor's electrical (or magnetic) pitch (DMEPIT).

$$ERES = \frac{DMEPIT\ \ (mm)}{Encoder_resolution\ \ (mm/count)}$$

Example
Linear encoder resolution (post quad) is 1 μm and the electrical pitch is 42 mm (DMEPIT42). ERES is calculated as:

$$ERES = \frac{42\ \ (mm)}{1 \cdot 10^{-3}\ (mm/count)} = 42000$$

ERROR Error-Checking Report-Back

Type	Error Handling	**Product**	**Rev**
Syntax	<a_>ERROR	Aries	1.0
Units	N/A		
Range			
Default	N/A		
Response	ERROR: <*>NO ERRORS		
See Also	none		

The ERROR command gives a text-based status report of drive errors (E25 through E46) that currently prevent the drive from enabling.

To re-enable the drive correct the specified fault, then reset the drive or cycle power to it.

Table 46 contains the possible errors appearing in the text-based report and their descriptions.

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Error	Description
E25—Excessive Command Voltage at Enable	The command voltage (at the ANI+ terminal) was too high when the drive was enabled. Lower the voltage at the ANI+ terminal. Try using the fault on startup voltage. (FLTSTP)
E26—Drive Faulted	The drive is faulted.
E27—Bridge Hardware Fault	Excessive current or short on the H-bridge.
E29—Drive Over-voltage	The bus voltage is too high (>410 VDC). Lower the AC Mains voltage and check for excessive regeneration power. (TVBUS)
E3Ø—Drive Under-voltage	The bus voltage is too low (<85 VDC) or there is overly aggressive acceleration or deceleration. Raise the AC Mains voltage. (TVBUS)
E31—Bridge Foldback	Drive current was limited to prevent overheating (warning only). See DIFOLD.
E32—Power Regeneration Fault	Check the Regeneration resistor for a short.
E34—Drive Temperature Fault	Wait for the drive to cool down. (TOTEMP)
E35—Motor Thermal Model Fault	The motor thermal model has determined the motor is too hot. Wait for the motor to cool, and then re-enable the drive. (TMTEMP)
E36—Motor Temperature Fault	Motor thermal switch has tripped. Wait for the motor to cool, and then re-enable the drive. (TMTEMP)
E37—Bad Hall State	A problem with the Hall sensors exists. Check the Hall state wiring. (THALL)
E38-Feedback Failure	Feedback not present or the signal level is incorrect. (TPE, THALL)
E39—Drive Disabled	The drive is disabled. (DRIVE)
E4Ø—PWM Not Active	The H-bridge is not switching.
E41—Power Regeneration Warning	The drive regenerated (warning only).
E42-Shaft Power Limited Warning	Shaft power is limited to the rated output to protect the drive (warning only).
E43-Excessive Speed at Enable	The motor was turning too fast when the drive was enabled.
E44-Excessive Position Error	Commanded position. Actual Position is greater than the value set by SMPER.
E45-Excessive Velocity Error	Commanded velocity. Actual Velocity is greater than the value set by SMVER.
E46-Hardware Enable	0 = Hardware Enable (Drive I/O Pin 1 and 21) 1 = No Hardware Enable
E47-Low Voltage Enable	No motor power was present when the drive was enabled.
E48-Control Power Active	The drive is in Control power mode. No motor power is present.
E49-Alignment Error	The ALIGN command did not complete successfully. (TPE, THALL)
E50-Flash Error	A problem writing to non-volatile memory exists. (RFS).
E51-Resolver Error	A problem determining the correct resolver angle exists. Applies to Arxx-xR models only. Check the resolver feedback wiring.

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Error	Description
E52-Encoder Loss Fault	The drive determined there was loss of feedback. Check the feedback wiring. (TPE, THALL)

Table 46 Error Status—Text Based Report

ERRORL Error Log Selection

Type	Error Handling	**Product**	**Rev**
Syntax	<a_>ERRORL<b><b>...<b><b> (32 bits)	Aries	1.0
Units	b = enable bit		
Range	Ø (disable) or 1 (enable)		
Default	1111111111111111		
Response	ERRORL: <*>ØØØØ_ØØØØ_ØØØØ_ØØØØ bit 15 ↑ ↑ bit Ø		
See Also	CERRLG, ERROR, TERRLG		

Use the ERRORL command to choose the conditions that will be included in the error log. When an error log bit is enabled (ERRORL11...11), the operating system will respond to a specific execution error by making an entry in the error log. Each bit corresponds to a different error condition (see Table 47). To enable or disable a specific bit, the syntax is ERRORL=B.n-b, where "n" is the error bit number and "b" is either one (1) to enable or zero (Ø) to disable.

Use the TERRLG command to view the error log. Use the CERRLG command to clear the error log.

Bit	Function
0	Enable/Disable (Hardware enable input or software DRIVE command)
1	Bridge Fault
2	No PWM output (H-bridge switching)
3	Over Voltage (DC bus)
4	Under Voltage (DC bus)
5	Startup Voltage (analog command voltage)
6	Drive Over Temperature
7	Motor Over Temperature (calculated by thermal model)
8	Motor Thermal Switch
9	Feedback Error
10	Hall Error
11	Motor Configuration Error
12	Regeneration Fault
13-15	Reserved

Table 47 Error Log—Enable/Disable

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ESTORE Store smart encoder data

Type	Motor configuration	**Product**	**Rev**
Syntax	<a_>ESTORE	Aries	1.0
Units	N/A		
Range	N/A		
Default	0		
Response	<*>Storing <*>Stored		
See Also	Motor configuration commands		

The ESTORE command is used to store all relevant motor configuration data to the smart encoder. If changes are made to the motor configuration (for example, if the current loop gains are tuned higher for the application), you can store the changes by typing ESTORE into the terminal and pressing **Enter**.

The drive responds with Storing, and then Stored once the parameters have been stored. After a reset, the new values are read from the encoder.

Note: The ESTORE command stores the following parameters in the encoder: DMTRES, DMTIND, DMTINF, DMTKE, DMTIC, DMTTCW, DMTTWM, DMTRWC, DMTD, DMTJ, DMTW, DMVLIM, DMTLIM, IGAIN, PGAIN, INTLIM, ENCOFF, DMTSCL, DMTR, DPOLE, DPWM, ENCPOL, P163, DMTSWT

FLTDSB Fault on Drive Disable

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>FLTDSB<b>	Aries	1.0
Units	b = enable bit		
Range	Ø (disable) or 1 (enable)		
Default			
Response			
See Also	ERROR, FLTSTP, TOUT		

Use the FLTDSB command to enable/disable the Fault on Drive Disable mode. If Fault on Drive Disable is enabled (FLTDSB1 – default setting), and the drive is disabled via the Enable input, fault output is activated and the brake relay is opened.

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FLTSTP — Fault on Excessive Startup Voltage

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>FLTSTP<r>	Aries	1.0
Units	Volts		
Range	Ø to 1ØV		
Default	1ØV		
Response	FLTSTP: <*>1		
See Also	DMODE		

Use the FLTSTP command to set the threshold for the Fault on excessive startup voltage. The default is 10.00V, so no command input will fault the drive. If the threshold is set lower, a command voltage above this level, when the drive is enabled, will fault the drive. To re-enable the drive without causing a fault, command an input voltage below the set value.

IANI — Invert Analog Input

Type	Drive configuration	**Product**	**Rev**
Syntax	<a_>IANI<b>	Aries	2.10
Units	b = enable bit		
Range	0 (do-not invert analog input) or 1 (invert analog input)		
Default	0		
Response	IANI <*>0		
See Also	ENCPOL, CMDDIR, DCMDZ,TANI		

Note: This command requires a reset to take effect

The IANI command inverts the polarity of the analog input to the drive. This has the effect of reversing any torque or velocity command. It can be useful when using custom wiring during initial setup of the drive.

Sending an IANI1 command inverts the input polarity. In addition, the command TANI reflects this change.

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IAUTO — Automatically determine Current Loop Gains

Type	Tuning	**Product**	**Rev**
Syntax	<a_>IAUTO<b>	Aries	3.0
Units	none		
Range	0 (disable) or 1 (enable)		
Default	1		
Response	IAUTO: <*>1		
See Also	PGAIN, IGAIN, DIBW		

The IAUTO command allows the drive to automatically determine the current loop gains according to the bandwidth set via the DIBW command, and the motor parameters (Resistance and Inductance). This can give improved current loop response compared to using the default gains set by the support tool.

IGAIN — Integral Gain

Type	Tuning	**Product**	**Rev**
Syntax	<a_>IGAIN	Aries	1.0
Units	none		
Range	Ø.ØØ to 1ØØ.ØØ		
Default	1		
Response	IGAIN: <*>1.ØØ		
See Also	IAUTO, PGAIN, SGI		

The IGAIN command sets the integral gain of the current loop. High gains can emphasize resonance and system noise, adds to heating of both motor and drive, and increases acoustic noise produced by the motor.

INPOS — Enable In Position Output

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>INPOS<b>	Aries	2.0
Units	b = enable bit		
Range	Ø (disable) or 1(enable)		
Default	Ø		
Response	INPOS: <*>Ø		
See Also	INPOSDB, INPOSTM		

Use the INPOS command to replace the Fault output with an In-Position output when using the drive in step & direction modes (DMODES6 and 7). If the In-Position output is enabled, the output will be active when the motor satisfies the In-Position criteria (as specified by the INPOSDB and INPOSTM commands). To restore the Fault Output functionality, use INPOSØ.

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INPOSDB In-Position Deadband

		Product	Rev
Type	Drive Configuration		
Syntax	<a_>INPOSDB<i>	Aries	2.0
Units	i = deadband in counts		
Range	Ø-32767		
Default	Ø		
Response	INPOSDB: <*>Ø		
See Also	INPOSTM, INPOS, TPER		

Use the INPOSDB command to specify the deadband in encoder counts for the In-Position command. For the 'In-Position' output to be classed active, the position error (as specified by the TPER command) should be less than or equal to this value.

INPOSTM In-Position timeout value

		Product	Rev
Type	Drive Configuration		
Syntax	<a_>INPOSTM<i>	Aries	2.0
Units	i = ms		
Range	1-1ØØØØ		
Default	1		
Response	INPOSTM: <*>1		
See Also	INPOSDB, INPOS		

Use the INPOSTM command to specify the time in ms before the In-Position output becomes active when the In-Position deadband criteria is met. The drive must not receive any incoming steps during this time in order for the In-Position output to become active.

LJRAT System Load-to System Load-to-Rotor/Forcer Inertia/Mass Ratio

		Product	Rev
Type	Tuning		
Syntax	<a_>LJRAT<i>	Aries	2.0
Units	Load to Rotor Inertia Ratio		
Range	Ø.Ø - 1ØØ.Ø		
Default	Ø.Ø		
Response	LJRAT: <*>Ø.ØØ		
See Also	IGAIN, PGAIN		

This command is only valid in DMODE4 (velocity mode) and DMODE6 or 7 (position mode). The LJRAT command sets the system's load-to-rotor inertia ratio (rotary motors) or load-to-forcer mass ratio (linear motors). The ratio is expressed in the following equation:

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- Rotary Motors— LJRAT = load inertia / motor rotor inertia
  (Total system inertia = load inertia + motor rotor inertia)
- Linear Motors— LJRAT = load mass / forcer mass
  (Total system mass = load mass + forcer mass)

OHALL — Hall-Only Commutation

		Product	Rev
Type	Drive configuration		
Syntax	<a_>OHALL<i>	Aries	2.10
Units	i = Hall commutation type		
Range	0 (sinusoidal commutation), 1 (trapezoidal commutation) 2 (DC Brushed motor commutation)		
Default	0		
Response	OHALL: <*>0		
See Also	ALIGN		

Note: This command requires a reset to take effect.

The OHALL command sets the commutation type. Use OHALL1 to set trapezoidal commutation and OHALL2 for DC brushed motors. DC brushed motors should be wired to motor phases U&W, if they are used. The default is OHALL0 (sinusoidal encoder commutation once the first hall transition has occurred).

OUTBD — Output Brake Delay

		Product	Rev
Type	Output		
Syntax	<a_>OUTBD<i>	Aries	1.0
Units	milliseconds		
Range	Ø-1ØØØØ		
Default	Ø		
Response	OUTBD: <*>25Ø		
See Also	none		

The OUTBD command specifies the amount of time that the brake relay will remain asserted after the current is applied to the motor windings when the drive is enabled. This allows torque to build up in the motor while the fault output is still high. This is important in vertical applications where the motor must be able to support the load before the brake is released.

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P163 Hall direction P163

Type	Drive configuration	**Product**	**Rev**
Syntax	<a_>P163<i>	Aries	1.0
Units	i = hall direction		
Range	0 (Halls count 623154623… as encoder counts +ve) 1 (Halls count 326451326… as encoder counts +ve)		
Default	0		
Response	P163: <*>0		
See Also	ENCOFF, SHALL, CMDDIR, ENCPOL, IANI		

Note: This command does not take effect until you cycle power to the drive, or send the RESET command

The P163 command determines the order the Hall sensors count as the encoder counts in a +ve direction. The default, P163=0, specifies that as the encoder counts in a +ve direction that the Hall sensors count 6,2,3,1,5,4,6,… P163=1 specifies that the hall sensors count in the opposite direction as the encoder counts in the +ve direction.

This command has the same effect as swapping hall wires A and B to the drive.

PGAIN Proportional Gain

Type	Tuning	**Product**	**Rev**
Syntax	<a_>PGAIN<r>	Aries	1.0
Units	None		
Range	Ø.ØØ to 2ØØ.ØØ		
Default	2Ø.ØØ		
Response	PGAIN: <*>2Ø.ØØ		
See Also	DIBW, IAUTO, IGAIN		

The PGAIN command sets the proportional gain of the current loop. High gains can emphasize resonance and system noise, adds to heating of both motor and drive, and increases acoustic noise produced by the motor.

PSET Establish Absolute Position

Type	Tuning	**Product**	**Rev**
Syntax	<a_>PSET<r>	Aries	2.0
Units	None		
Range	-2,147,483,648 to +2,147,483,647		
Default	N/A		
Response	PSET: N/A		
See Also	TPC, TPE		

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Use the PSET command to offset the current absolute position to establish an *absolute position reference*. All PSET values entered are in counts.

The PSET command will define the present commanded position (TPC) to be the absolute position entered.

Example

```
PSETØ          ; Wherever the present actual or commanded position
               ; happens to be, consider that position to have an
               ; absolute position of zero.
```

RESET Reset

Type	Communication Interface	**Product**	**Rev**
Syntax	<a_>RESET	Aries	1.0
Units	N/A		
Range	N/A		
Default	N/A		
Response	RESET: (Displays power applied message)		
See Also	RFS, TREV		

The RESET command affects the Aries drive the same as cycling power, or activating the hardware Reset inputs (pins 18 and 23 on the DRIVE I/O connector). The drive's parameters are retained in non-volatile memory.

Note: After sending the RESET command to the Aries, wait until you see the power-applied message before communicating with the Aries.

RFS Return to Factory Settings

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>RFS	Aries	1.0
Units	N/A		
Range	N/A		
Default	N/A		
Response	N/A		
See Also	RESET, TDHRS, TREV		

The RFS command returns all settings to factory default, with the exception of the TDHRS value. A RESET command is automatically sent following this command; therefore, no prompt will be returned.

When is the RFS event finished? The RFS process can take several seconds. When RFS is finished, the drive transmits the power-applied message.

Recommendation: When finished configuring the drive using the Aries Support Tool, save the configuration file to your personal computer's (PC) hard drive for safekeeping. If, after executing the RFS command, you need to restore the previous configuration, re-download the configuration file and

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program files to your drive. (Remember to reset the drive to invoke new configuration settings).

SFB — Set Feedback Type

Type	Drive configuration	**Product**	**Rev**
Syntax	<a_>SFB<i>	Aries	1.0
Units	i = feedback source		
Range	0 (unknown) 1 (OS 1.0,2.0: Standard Encoder OS2.10 or greater: Auto-Detect) 2 (OS 2.10 or greater: specify Standard Encoder) 3 (OS 3.10 or greater: Resolver option identified) 5 (OS 2.10 or greater: specify Smart Encoder) 6 (OS 2.10 or greater: reserved for absolute encoder)		
Default	1		
Response	SFB: <*>5		
See Also	STATUS		

In operating systems 2.0 or earlier, the SFB value reflected the type of motor that the drive auto-detected. In operating system 2.10 and beyond, you also can set a feedback type with the SFB command.

SFB1 sets auto-detect mode and is the default setting. In auto-detect mode the SFB command reports the detected drive-type upon power-up. If SFB is set to a value other than 1, the drive assumes that type of encoder is attached and does not try to auto-detect the feedback type.

In operating system 3.10 and beyond, the Aries Resolver option will report an SFB value of 3. Changing the value will not affect the drive operation and it will return to 3 on power-up.

SGI — Servo Gain Integral

Type	Tuning	**Product**	**Rev**
Syntax	<a_>SGI<i>	Aries	2.0
Units	i = gain value		
Range	Ø.ØØ to 1ØØØ.ØØ		
Default	Ø.ØØ		
Response	SGI: <*>Ø.ØØ		
See Also	SGILIM, SGP, SGV, IGAIN		

This command is only valid in DMODE4 (velocity mode) and DMODE6 or 7 (position mode). Use the Integral Gain (SGI) command to set the gain of the integral term in the control algorithm. The primary function of the integral gain is to reduce or eliminate final position error (e.g., due to friction, gravity, etc.) and improve system accuracy during motion. If a position error exists (commanded position not equal to actual position—see TPER command), this control signal will ramp up until it is high enough to overcome the friction and drive the motor toward its commanded position. *If acceptable position*

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accuracy is achieved with proportional gain (SGP), then the integral gain (SGI) need not be used.

If the integral gain is set too high relative to the other gains, the system may become oscillatory or unstable. The integral gain can also cause excessive position overshoot and oscillation if an appreciable position error has persisted long enough during the transient period (time taken to reach the position setpoint); this effect can be reduced by using the SGILIM command to limit the integral term windup.

SGILIM — Integral Windup Limit

Type	Tuning	**Product**	**Rev**
Syntax	<a_>SGILIM<i>	Aries	2.0
Units	i = Limit value		
Range	Ø to 32767		
Default	1		
Response	SGILIM: <*>1		
See Also	SGI, SGP, SGV		

This command is only valid in DMODE4 (velocity mode) and DMODE6 or 7 (position mode). If integral control (SGI) is used and an appreciable position error has persisted long enough during the transient period (time taken to reach the setpoint), the control signal generated by the integral action can end up too high and saturate to the maximum level of the drive's analog control signal output. This phenomenon is called *integrator windup*

After windup occurs, it will take a while before the integrator output returns to a level within the limit of the controller's output. Such a delay causes excessive position overshoot and oscillation. Therefore, the integral windup limit (SGILIM) command is provided for you to set the absolute limit of the integral and, in essence, turn off the integral action as soon as it reaches the limit; thus, position overshoot and oscillation can be reduced.

SGP — Servo Gain Proportional

Type	Tuning	**Product**	**Rev**
Syntax	<a_>SGP<i>	Aries	2.0
Units	i = gain value		
Range	Ø.ØØ to 1Ø0Ø.ØØ		
Default	Ø.6Ø		
Response	SGP: <*>Ø.6Ø		
See Also	SGILIM, SGI, SGV, PGAIN		

This command is only valid in DMODE4 (velocity mode) and DMODE6 or 7 (position mode). SGP allows you to set the gain of the proportional term in the servo control algorithm. The output of the proportional term is proportional to the difference between the commanded position and the actual position read from the feedback device. The primary function of the proportional term is to

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stabilize the system and speed up the response. It can also be used to reduce the steady state position error.

When the proportional gain (SGP) is used alone (i.e., the other gain terms are set to zero), setting this gain too high can cause the system to become oscillatory, under damped, or even unstable.

SGV — Servo Gain Velocity

		Product	Rev
Type	Tuning		
Syntax	<a_>SGV<i>	Aries	2.0
Units	i = gain value		
Range	Ø.ØØ to 1ØØØ.ØØ		
Default	1.4Ø		
Response	SGV: <*>1.4Ø		
See Also	SGILIM, SGI, SGP		

This command is only valid in DMODE4 (velocity mode) and DMODE6 or 7 (position mode). SGV allows you to control the velocity feedback gain in the servo algorithm. Using velocity feedback, the controller's output signal is made proportional to the velocity, or rate of change, of the feedback device position. Since it acts on the rate of change of the position, the action of this term is to anticipate position error and correct it before it becomes too large. This increases damping and tends to make the system more stable.

If this term is too large, the response will be slowed to the point that the system is over-damped.

Since the feedback device signal has finite resolution, the velocity accuracy has a limit. Therefore, if the velocity feedback gain (SGV) is too high, the errors due to the finite resolution are magnified and a noisy, or *chattering*, response may be observed.

SGVF — Velocity Feedforward Gain

		Product	Rev
Type	Tuning		
Syntax	<a_><!>SGVF<i>	Aries	2.0
Units	N/A		
Range	Ø-5ØØ		
Default	1ØØ		
Response	SGVF: *SGVF1ØØ		
See Also	DMTD, LJRAT		

Use the SGVF command to set the velocity feedforward gain. Velocity feedforward control improves position tracking performance when the system is commanded to move at constant velocity. The velocity tracking error is mainly attributed to viscous friction.

The SGVF value is multiplied by the *commanded velocity* calculated by the Aries drive's move profile routine to produce an estimated torque command that gets added to the servo control signal. The value is normalized to the

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current setting of both the motor and load viscous damping terms (DMTD) as shown in the equation below.

$$\text{Estimated velocity torque} = \underbrace{\text{DMTD}}_{\text{SGVF value}=100\%} \cdot \text{velocity command}$$

Setting SGVF to one (1) theoretically produces zero (0) following errors during the constant velocity portion of a move profile. This assumes that the drive or motor are not being current limited, the values for viscous damping are accurate and the models used for analysis are correct. The value of SGVF can be adjusted from zero to as high as five (5) times (SGVF5) the theoretical value.

Example

```
SGVF2          ; Set velocity feedforward to 200% of theoretical value
```

SHALL — Hall Sensor Configuration

Type	Drive Configuration	**Product**	**Rev**
Syntax	<a_>SHALL<i>	Aries	1.0
Units	i = control option number		
Range	Ø (do not invert) or 1 (invert)		
Default	Ø		
Response	SHALL: <*>Ø		
See Also	ALIGN, RESET, THALL		

Note: This command does not take effect until you cycle power to the drive, or send the RESET command.

The SHALL command controls the logic sense of the Hall sensors. To invert the sensors, use the SHALL1 command. To check the present value of the Hall sensors, use the THALL command.

SMAV — Maximum Acceleration in Velocity Mode

Type	Tuning	**Product**	**Rev**
Syntax	<a_>SMAV<i>	Aries	2.0
Units	i = Acceleration in rev/sec^2		
Range	Ø.ØØ to 1ØØØØ.ØØ		
Default	1ØØ.ØØ		
Response	SMAV: <*>1ØØ.ØØ		
See Also	DMODE		

This command is only valid in DMODE4 (velocity mode). SMAV allows you to control the maximum acceleration permitted in velocity mode. Use this command to protect the mechanical systems from overly aggressive velocity changes. This command is scaled by the (ERES) command.

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SMPER Maximum Allowable Position Error

		Product	Rev
Type	Servo		
Syntax	<a_>SMPER<i>	Aries	2.0
Units	i = Feedback device steps		
Range	Ø to 2,147,483,647		
Default	4ØØØ		
Response	SMPER: <*>4ØØØ		
See Also	ERES, TPE, TPC, TPER		

This command is only valid in DMODE6 or 7 (position mode). SMPER allows you to set the maximum position error allowed before an error condition occurs. The position error, monitored once per system update period, is the difference between the commanded position and the actual position as read by the feedback device selected with the last SFB command. When the position error exceeds the value entered by the SMPER command, an error condition is latched (ERROR bit #44) and the Aries drive issues a shutdown and sets its analog output command to zero volts. The DRIVE1 command re-enables the drive, clears ERROR bit #44, and sets the commanded position (TPC) equal to the actual feedback device position (TPE) – incremental devices will be zeroed.

If the SMPER value is set to zero (SMPERØ), the position error condition is not monitored, allowing the position error to accumulate without causing a fault.

When SMPER is set to a non-zero value, the maximum position error acts as the servo system fault monitor; if the system becomes unstable or loses position feedback, the drive detects the resulting position error, shuts down the drive, and sets an error status bit.

SMVER Maximum Allowable Velocity Error

		Product	Rev
Type	Servo		
Syntax	<a_>SMVER<i>	Aries	2.0
Units	i = Rev/Sec		
Range	Ø.ØØ to 2ØØ.ØØ		
Default	Ø.ØØ		
Response	SMVER: <*>Ø.ØØ		
See Also	ERES, TPE, TVEL, TVELA, TVER		

This command is only valid in DMODE4 (velocity mode). SMVER determines the maximum velocity error allowed before an error condition occurs. The velocity error is the difference between the commanded velocity (TVEL) and estimated actual velocity (TVELA). If the error exceeds this value, a fault will result in which the drive is shut down (DRIVEØ) and ERROR bit #45 is set. The DRIVE1 command re-enables the drive, clears ERROR bit #45, and sets TVEL equal to TVELA.

You can check the actual velocity error with the TVER command.

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If the SMVER value is set to zero (SMVERØ), the velocity error condition is not monitored, allowing the velocity error to accumulate without causing a fault.

STATUS Status (full-text report)

		Product	Rev
Type	Transfer		
Syntax	<a_>STATUS	Aries	1.0
Units	N/A		
Range	N/A		
Default	N/A		

Response

```
STATUS:   <*>GENERAL:
          <*>     OS Revision: Aries Revision 1.Ø
          <*>     Power Level: 75ØW
          <*>     Control Power: INACTIVE
          <*>MOTOR:
          <*>     Motor Name: SM232AE
          <*>     Motor Type: ROTARY
          <*>     Feedback Type: SMART ENCODER
          <*>     Motor Temp: 4ØC
          <*>DRIVE
          <*>     Drive: DISABLED
          <*>     PWM Frequency: 16 kHz
          <*>     Feedback Resolution: 8ØØØ
          <*>     Drive Temperature: 35C
          <*>     Bus Voltage: 85V
```

See Also DMTR, DPWM, ERES, TDTEMP, TMTEMP, TREV, TVBUS

The STATUS command provides full-text report of the current drive status. It includes general features such as the OS Revision and Control power mode. Control power mode is active when TVBUS is less than 85 VDC. Additionally, it includes motor parameters and drive status.

TANI Transfer Analog Input Voltage

		Product	Rev
Type	Transfer		
Syntax	<a_>TANI	Aries	1.0
Units	Volts		
Range	-1ØV to +1ØV		
Default	N/A		

Response

```
TANI:      <*>-4.34
```

See Also ANICDB, CMDDIR, DCMDZ, DMTSCL, IANI

The TANI command returns the voltage level present at the ANI analog input. The value reported with the TANI command is measured in volts.

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TCI — Transfer Commanded Current

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TCI	Aries	1.0
Units	Amps		
Range	N/A		
Default	N/A		
Response	TCI: <*>5.ØØ		
See Also	DMTIC, DMTICD, DMTIP, TDICNT, TDIMAX		

The TCI command reports the commanded motor current in amps (peak of sine).

TDHRS — Transfer Operating Hours

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TDHRS	Aries	1.0
Units	Lifetime operating hours (resolution is hours)		
Range	Hour counter rolls over at 536854528 hours		
Default	N/A		
Response	TDHRS: <*>16		
See Also	RESET, TERRLG		

The TDHRS command reports the lifetime number of hours that the Aries drive has had power applied (AC mains or Control power).

TDICNT — Transfer Continuous Current Rating

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TDICNT	Aries	1.0
Units	Amps rms		
Range	Drive Dependant		
Default	N/A		
Response	TDICNT: <*>1Ø		
See Also	DMTIC, DMTICD, DMTIP, TCI, TDIMAX		

The TDICNT command reports the continuous current rating of the drive in *amps rms*.

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TDIMAX Transfer Maximum Current Rating

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TDIMAX	Aries	1.0
Units	Amps rms		
Range	N/A		
Default	N/A		
Response	TDIMAX: <*>1Ø		
See Also	DMTIC, DMTICD, DMTIP, TCI, TDICNT		

The TDIMAX command reports the maximum current rating of the drive in *amps rms*.

TDMIN Transfer Operating Minutes

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TDMIN	Aries	1.0
Units	Minutes		
Range	Ø to 59		
Default	N/A		
Response	TDMIN: <*>35		
See Also	TDHRS, TDSEC, TERRLG		

The TDMIN command reports the minutes portion of the lifetime operating hours that the Aries drive has had power applied (AC Mains or Control power).

TDSEC Transfer Operating Milliseconds

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TDSEC	Aries	1.0
Units	Milliseconds		
Range	Ø to 59999		
Default	N/A		
Response	TDSEC: <*>35678		
See Also	TDHRS, TDMIN		

The TDSEC command reports the milliseconds portion of the lifetime operating hours that the Aries drive has had power applied (AC Mains or Control power).

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TDTEMP Transfer Drive Temperature

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TDTEMP	Aries	1.0
Units	Degrees Celsius		
Range	N/A		
Default	N/A		
Response	TDTEMP: <*>5Ø		
See Also	STATUS, TERRLG		

The TDTEMP reports the measured temperature (internal) of the drive.

TERRLG Transfer Error Log

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TERRLG	Aries	1.0
Units	N/A		
Range	N/A		
Default	N/A		
Response	TERRLG: <*>Operating hours: 1Ø5.25 <*>Power on Time: 5hrs 1Ø min 45.35 s <*>Drive Temp: 35C <*>Motor Temp: 85C <*>Bus voltage: 163V <*>Command Voltage: 5.35V <*>Active Errors: E26-Drive Faulted E27-Bridge Hardware Fault <*>[Power Cycle]		
See Also	CERRLG, CONFIG, ERROR, ERRORL, OHALL, TANI, TDHRS, TDMIN, TDSEC, TDTEMP, TMTEMP, TVBUS		

The error log is updated every time an error occurs or the power is cycled. The TERRLG command displays the last ten error conditions or power cycles. The command displays them in order of earliest to latest, and returns a text-based status report. When each error is logged, the following parameters are saved:

- Operating Hours (TDHRS, TDMIN, TDSEC)
- Power-on Time
- Drive Temperature (TDTEMP)
- Motor Temperature (TMTEMP)
- Bus Voltage (TVBUS)
- Command Voltage (TANI)
- Active Errors (ERROR)

The CERRLG command erases the stored contents of the error log. Clearing the error log is a helpful diagnostic tool; it allows you to start the diagnostic process when the error log is in a known state so that you can check the error log in response to subsequent events.

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THALL Transfer Hall Sensor Values

Type	Transfer	**Product**	**Rev**
Syntax	<a_>THALL	Aries	1.0
Units	N/A		
Range	1 to 6 (Ø or 7 is a fault condition)		
Default	N/A		
Response	THALL: <*>6		
See Also	ALIGN, SHALL		

Encoder Motors: The THALL command reports the present Hall sensor value. There are six distinct Hall states, from 1 to 6. Rotating the motor shaft clockwise, the Hall state order should be 6, 2, 3, 1, 5, 4, 6, 2, 3, 1, 5, 4, 6…

THALL values Ø and 7 are invalid and will fault the drive, and report E37-Bad Hall State.

For a complete description on how to troubleshoot Hall sensors, especially for non-Parker Hannifin motors, see Hall Sensor Configuration/Troubleshooting on page 147.

Note: For auto-configured “smart encoders”, the THALL only reports the initial hall state of the encoder when power is applied.

TIDAC Transfer D Quatrature Current

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TCI	Aries	3.10
Units	Amps		
Range	N/A		
Default	N/A		
Response	TCI: <*>5.ØØ		
See Also	DMTIC, DMTICD, DMTIP, TDICNT, TDIMAX		

The TIDAC command reports the actual “d” quatrature motor current in amps (peak of sine).

TIQAC Transfer Q Quatrature Current

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TCI	Aries	3.10
Units	Amps		
Range	N/A		
Default	N/A		
Response	TCI: <*>5.ØØ		
See Also	DMTIC, DMTICD, DMTIP, TDICNT, TDIMAX		

The TIQAC command reports the actual “q” quatrature motor current in amps (peak of sine).

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TMTEMP Transfer Motor Temperature

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TMTEMP	Aries	1.0
Units	Degrees Celsius		
Range	N/A		
Default	N/A		
Response	TMTEMP: <*>45		
See Also	DMTRWC, DMTTCM, DMTTCW, STATUS, TERRLG		

The TMTEMP reports the predicted temperature of the motor winding for Parker motors. The temperature is estimated using the winding and motor time constants, the rated continuous current, and the winding thermal resistance. The motor will fault (and the drive reports E35-Motor Thermal Model Fault) at an estimated winding temperature of 125°C, assuming the ambient temperature is 40°C.

In OS 2.10, If DMTSWT equals 3, and the thermal temperature is greater than 60°C, TMTEMP reports the higher of the motor model thermistor temperature or the NTC thermistor temperature.

If you are using a non-Parker motor, the TMTEMP value depends on parameters you supply for DMTRWC, DMTTCM and DMTTCW.

TOUT Transfer Output Status

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TOUT	Aries	1.0
Units	N/A		
Range	Ø (inactive) or 1 (active)		
Default	N/A		
Response	TOUT: <*>ØØØØ_ØØØØ_ØØØØ_ØØ11		
See Also	none		

The TOUT command returns the present status of the brake relay (bit 1) and fault output (bit 0). Bits 2 through 15 are reserved. The return of one (1) indicates the relevant output is active and a zero (Ø) indicates it is inactive.

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TPC — Transfer Position Commanded

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TPC	Aries	2.0
Units	Encoder counts		
Range	-2147483648 to +2147483647		
Default	N/A		
Response	TPC: <*> Ø		
See Also	ERES, TPE, SMPER		

This command is only valid in DMODE4 (velocity mode) and DMODE6 or 7 (position mode). This command allows you to display the *commanded position*.

Note: The reported value is measured in commanded counts (AKA: “motor counts”).

TPE — Transfer Position of Encoder

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TPE	Aries	1.0
Units	Encoder counts		
Range	-2147483648 to +2147483647		
Default	N/A		
Response	TPE: <*> Ø		
See Also	ERES, TPC, SMPER		

The TPE command reports the present feedback device position, based on the encoder resolution (ERES).

TPER — Transfer Position Error of Encoder

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TPER	Aries	2.0
Units	Encoder counts		
Range	-2147483648 to +2147483647		
Default	N/A		
Response	TPER: <*> Ø		
See Also	ERES, INPOSDB, TPE, SMPER		

This command is only valid in DMODE6 or 7 (position mode).The TPER command reports the present position error. The error is reported in feedback device counts and is based on the encoder resolution (ERES). The position error is calculated every 62.5 µs.

Note: When the drive is set to DMODE6 or DMODE7, the position error is the difference between the commanded position and the actual position read by

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the feedback device. TPER *does not apply* in DMODE2 (torque/force control mode) and in DMODE4 (velocity control mode); TPER reports zero in these modes.

TREV — Transfer Revision Level

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TREV	Aries	1.0
Units	N/A		
Range	N/A		
Default	N/A		
Response	TREV: <*>Aries OS Revision 1.Ø		
See Also	RESET, RFS, STATUS		

The Transfer Revision Level (TREV) command reports the software revision of the Aries firmware.

The Aries Resolver option reflects the Resolver feedback capability by stating 'Aries Resolver' in the software revision reportback instead of 'Aries'.

Updating the drive's operating system: The operating system file is located in the "Support & Downloads" section on the *Parker Hannifin Motion Online* website (www.parkermotion.com).

TSSPD — Transfer PWM Update Period

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TSSPD	Aries	1.0
Units	Microseconds		
Range	N/A		
Default	N/A		
Response	TSSPD: <*>62.5Ø		
See Also	DPWM		

The TSSPD command reports the current PWM update period in microseconds. This is not the current loop update rate, which is fixed at 62.5 µs.

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TTRQ — Transfer Commanded Torque/Force

		Product	Rev
Type	Transfer		
Syntax	<a_>TTRQ	Aries	1.0
Units	Newton Meters (Rotary) or Newtons (Linear)		
Range	-DMTLIM TO +DMTLIM ± Ø.Ø1		
Default	N/A		
Response	TTRQ: <*>1.2Ø		
See Also	DMODE, DMTLIM, DMTSCL, TTRQA		

The TTRQ command reports the commanded motor torque/force.

TTRQA — Transfer Actual Torque/Force

		Product	Rev
Type	Transfer		
Syntax	<a_>TTRQA	Aries	1.0
Units	Newton Meters (Rotary) or Newtons (Linear)		
Range	Rotary motor: Ø.Ø to 5ØØ.Ø (motor/drive dependent): ±Ø.1 Linear motor: DMEPIT (electrical pitch) dependent		
Default	N/A		
Response	TTRQA: <*>1.2Ø		
See Also	DMTKE, DMTLIM, DMTSCL, TTRQ		

The TTRQA command reports the calculated torque/force, based on the motor's current and the motor's Ke. The measured motor's Ke value may vary by ±10%; Therefore, the TTRQA may vary by ±10% of the actual torque at the motor.

TVBUS — Transfer Bus Voltage

		Product	Rev
Type	Transfer		
Syntax	<a_>TVBUS	Aries	1.0
Units	Volts		
Range	N/A		
Default	N/A		
Response	<*>17Ø.45		
See Also	ERROR, STATUS		

The TVBUS command reports the DC bus voltage available from the drive in Volts.

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TVEL — Transfer Current Commanded Velocity

		Product	Rev
Type	Transfer		
Syntax	<a_>TVEL	Aries	2.0
Units	Revolutions per second or meters per second		
Range	N/A		
Default	N/A		
Response	TVEL: <*> 1.55		
See Also	CMDDIR, DMEPIT, DMVLIM, IANI, TVELA		

This command is only valid in DMODE4 (velocity mode) and DMODE6 or 7 (position mode).

In velocity mode (DMODE4), TVEL reports the commanded ±10V value from the user before any internal limits are checked.

In position mode (DMODE6-7), TVEL reports the internal velocity command and is limited by DMVLIM.

TVELA — Transfer Current Actual Velocity

		Product	Rev
Type	Transfer		
Syntax	<a_>TVELA	Aries	1.0
Units	Revolutions per second or meters per second		
Range	N/A		
Default	N/A		
Response	TVELA: <*> 1.55		
See Also	CMDDIR, DMEPIT, DMVLIM, IANI		

The TVELA command reports the velocity as derived from the feedback device. The sign determines the direction of motion.

Rotary Motors—Positive values represent clockwise motion and negative values represent counter-clockwise motion (assuming CMDDIR = Ø, and that you connected the feedback device according to instructions provided in "Chapter 2 Mechanical Installation" and "Chapter 3 Electrical Installation").

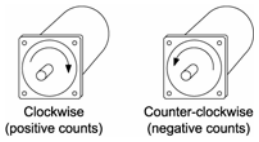


Figure 48 Clockwise/ Counter-clockwise rotation

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TVER — Transfer Current Commanded Velocity Error

Type	Transfer	**Product**	**Rev**
Syntax	<a_>TVER	Aries	2.0
Units	Revolutions per second or meters per second		
Range	N/A		
Default	N/A		
Response	TVER: <*> 1.55		
See Also	DMEPIT, DMVLIM, TVELA, TVEL		

This command is only valid in DMODE4 (velocity mode) and DMODE6 or DMODE7 (position mode).

In velocity mode (DMODE4), TVEL reports the commanded ±10V value from the user before any internal limits are checked.

In position mode (DMODE6-7), TVEL reports the internal velocity command and is limited by DMVLIM.

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CHAPTER SEVEN

7 Troubleshooting

IN THIS CHAPTER
Troubleshooting Guidelines ..... 141 LEDs ..... 142 RS-232/485 Communication Problems ..... 143 Smart Encoders ..... 147 • Note: The CMDDIR is fixed for smart encoders. To invert the direction, use `IANI1;` however, for the ACR9000 do not use `IANI1.` Hall Sensor Configuration/Troubleshooting 147

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Troubleshooting Guidelines

If your system is not functioning properly, try the following steps.

First Troubleshooting Steps (verify LEDs)

- Is the Right LED illuminated?

If not, look for problems with AC power. Check the AC power source. Also check connections at the L1, L2, and ⏚ terminals of the motor mains connector, and at the C1 and C2 terminals of the control mains connector).

- Is the Right LED illuminated red?

Try to enable the drive by connecting ±5–24 VDC to pin 1 (+), and common (GND) to pin 21 (–) of the DRIVE I/O connector. The right LED should turn green.

- Cycle power to the drive (this clears most faults). As the drive powers up, watch the right LED.

Does the LED color change from off to red? Power is reaching the drive, but the drive is not enabling.

Does the LED change from off to green? The drive is powered up and enabled—power is not a problem.

- Remove all connections to the drive (DRIVE I/O, MOTOR, MOTOR FEEDBACK, and R+/R–), leaving Mains power (L1, L2, and ⏚ terminals) connected. Apply power to the drive.

Does the Right LED change from off to red? Then a short exists in the disconnected cables.

- Check Mains wiring and feedback connections.

If these steps do not solve your problem, follow the general troubleshooting procedure outlined below.

General Troubleshooting Procedure

- Check the LEDs (see “LEDs—Drive Status Indicators” on page 142)
- Launch the Aries Support Tool
- Verify the RS-232/485 communications are functioning correctly.
- In the Aries Support Tool, look to the Status Panel to identify problems with the drive.
- Check for non-Drive problems (problems with other parts of the system)

Detailed procedures for each of these topics are given in the rest of this chapter.

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LEDs—Drive Status Indicators

The drive has two bi-color LEDs. The LED on the left displays yellow or green colors; The LED on the right displays red or green colors. The following tables describe LED illumination states and the conditions they indicate.

Normal Operation

LED–Left	LED–Right	What it means
Off	Green	Power on, enabled
Yellow	Green	Power on, regeneration active
Off	Red	Power on, disabled–No Fault
Yellow	Off	Power on, boot process
Off	Red (flashing)	Waiting for OS download
Yellow (flashing)	Red (flashing)	OS download in process

Table 22 LED Status Indicator-Normal Operation

Internal Drive Faults

LED–Left	LED–Right	What it means
Yellows	Red	Control power mode active
Yellow & 1 Green (flashing)	Red	Bridge Fault
Yellow & 2 Green (flashing)	Red	Feedback Fault
Yellow & 3 Green (flashing)	Red	Thermal Fault
Yellow & 4 Green (flashing)	Red	Other Fault

Table 23 LED Status Indicator-Internal Drive Fault

Establish Communications & Verify Drive Configuration

If you cannot enable the drive, and examining LED conditions has not solved your problem, then launch the Aries Support Tool and establish communications with the drive. (For detailed instructions on establishing communications, see “Establishing Communications” on page 59.)

If you are unable to establish communications, see “RS-232/485 Communication Problems“ on page 143.

Save the Configuration File

Because further troubleshooting steps can change the drive configuration, upload the current drive configuration file, and save it to your personal computer. This ensures you have a backup copy of the drive configuration. To save a backup configuration file, use the Aries Support Tool.

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Reconfigure the Drive

To verify proper configuration, you may wish to reconfigure the drive. Pay particular attention to selecting proper configuration settings for the motor that you have installed, as motor configuration problems can cause a variety of errors. Download the new configuration to the drive; the changes take effect after you send the `RESET` command or cycle power.

RS-232/485 Communication Problems

If you cannot establish RS-232 or RS-485 communications, the next sections give instructions for procedures to help isolate problems.

RS-232	**RS-485** *
Rx, Tx, Gnd	2-wire plus ground (Talk+, Talk–, Gnd)
9600 baud	9600 baud
8 data bits	8 data bits
1 stop bit	1 stop bit
No parity	No parity
Full-duplex	Half-duplex
	* Twisted pair cabling recommended (e.g. Belden 9842)

Table 48 Terminal Emulator Configuration for RS-232/485 Communication

Ensure the RS-232 or RS-485 wiring is connected prior to powering up the Aries drive. When applying power, the drive will detect either RS-232 or RS-485 and configure accordingly.

Testing the COM Port

Using the Aries Support Tool, you can test COM port connections.

► Under **Communications**, select the COM port and then click **Test**.

RS-232 communications might require that you use a null modem cable. For information about connecting to the COM port, see “Establishing Communications” on page 59. Additionally, refer to the pinout diagram for the RS-232/485 connector, also located on page 59.

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Error	Resolution
Invalid COM port number	Select a different COM port
Unable to open COM port	No COM port has been specified, or the COM port is being used by other software. Select a different COM port.
No response from Aries drive	Power is not supplied to the drive, the drive is not powered up, the power connection is mis-wired, or the RS-232/485 cable is mis-wired. Check the drive to verify that the power supply is connected, wired correctly. Then apply power to the drive. Verify the wiring on the RS-232/485 cable.
Incorrect response from Aries drive	A different drive or serial device might be connected to the selected COM port. Verify that an Aries drive is connected to the selected COM port.
OS needs to be downloaded	Download the operating system to the Aries drive.
Cycle power and download OS	The Aries drive has encountered an error while downloading an operating system. Cycle power to the drive and download the operating system again.

Table 49 Communications Port Errors and Resolutions

Error Messages

If the drive will not enable, you can view full-text reports of the drive configuration (`EØ` through `E24`) and drive errors (`E25` through `E46`). In a terminal emulator, type `CONFIG` or `ERROR`, depending which information you want to view.

You can also view the errors using the Aries Support Tool software.

► In the **Menu**, select **Status Panel**. You can view the errors under **Bit Status**.

The following is a list of Error messages and a brief corrective action:

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Error	Resolution
EØ—Motor Configuration Warning	The motor rating is too high for the drive, and the drive is using its own limits for safety reasons.
E1—Motor Configuration Error	One of the motor parameters is set to zero (0). Look at the additional errors to find which parameters are set at zero (0). Refer to your motor specifications for the correct value.
E3—Max Inductance = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero (0) value. Refer to your motor specifications for the correct value. (DMTIND)
E4—Rated Speed = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value.
E5—DPOLE = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DPOLE)
E6—Resistance = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DMTRES)
E7—Ke = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DMKE)
E8—Continuous Current = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DMTIC)
E9—Peak Current = Ø	This parameter is set to zero (0). To correct the error, you must set a non-zero value. Refer to your motor specifications for the correct value. (DMTIP)
E1Ø—Continuous Current Too High	The continuous current of the motor is higher than the continuous current rating of the drive. Use the continuous current rating for the drive.
E11—Torque Rating Too High for Drive	The motor's torque rating is too high for the power level of the drive. Use the drive's torque rating.
E12—Peak Current Too High	The peak current of the motor is higher than the peak current rating of the drive. Use the drive's value for peak current.
E13 - Inertia = Ø	This parameter is set to zero (0). The drive will not enable Velocity or Position Modes. To correct the error, you must set to a non-zero value. Refer to your motor specifications for the correct value. (DMTJ)

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Error	Resolution
E14 – Damping = Ø	This parameter is set to zero (0). The drive will not enable Velocity or Position Modes. To correct the error, you must set to a non-zero value. Refer to your motor specifications for the correct value. (DMTD)
E15 – Notch filter Calc Error.	The notch filter settings caused an internal calculation error. The last valid value was used. Try different values for the notch filter parameters. (DNOTAF, DNOTAQ, DNOTBF, DNOTBQ)
E16 – Lead < Lag Freq	The lead filter setting (DNOTLD) must be greater than or equal to the lag filter setting. (DNOTLG)
E17 – Lead ≥ 4* Lag Freq	The lead filter setting (DNOTLD) must be less than or equal to 4 times the lag filter setting. (DNOTLG)
E18 – Lag Freq < 2Ø Hz	The lag filter setting (DNOTLG) must be greater than or equal to 20 Hz.
E19–E24	RESERVED
E25—Excessive Command Voltage at Enable	The command voltage (at the ANI+ terminal) was too high when the drive was enabled. Lower the voltage at the ANI+ terminal. Try using the fault on startup voltage. (FLTSTP)
E26—Drive Faulted	The drive is faulted.
E27—Bridge Hardware Fault	Excessive current or short on the H-bridge.
E29—Drive Over-voltage	The bus voltage is too high (>410 VDC). Lower the AC Mains voltage and check for excessive regeneration power. (TVBUS)
E3Ø—Drive Under-voltage	The bus voltage is too low (<85 VDC) or there is overly aggressive acceleration or deceleration. Raise the AC Mains voltage. (TVBUS)
E31—Bridge Foldback	Drive current was limited to prevent overheating (warning only). See DIFOLD.
E32—Power Regeneration Fault	Check the Regeneration resistor for a short.
E34—Drive Temperature Fault	Wait for the drive to cool down. (TOTEMP)
E35—Motor Thermal Model Fault	The motor thermal model has determined the motor is too hot. Wait for the motor to cool, and then re-enable the drive. (TMTEMP)
E36—Motor Temperature Fault	Motor thermal switch has tripped. Wait for the motor to cool, and then re-enable the drive. (TMTEMP)
E37—Bad Hall State	A problem with the Hall sensors exists. Check the Hall state wiring. (THALL)
E38-Feedback Failure	Feedback not present or the signal level is incorrect. (TPE, THALL)
E39—Drive Disabled	The drive is disabled. (DRIVE)
E4Ø—PWM Not Active	The H-bridge is not switching.
E41—Power Regeneration Warning	The drive regenerated (warning only).
E42-Shaft Power Limited Warning	Shaft power is limited to the rated output to protect the drive (warning only).
E43-Excessive Speed at Enable	The motor was turning too fast when the drive was enabled.
E44-Excessive Position Error	Commanded position. Actual Position is greater than the value set by SMPER.

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Error	Resolution
E45-Excessive Velocity Error	Commanded velocity. Actual Velocity is greater than the value set by SMVER.
E46-Hardware Enable	0 = Hardware Enable (Drive I/O Pin 1 and 21) 1 = No Hardware Enable
E47-Low Voltage Enable	No motor power was present when the drive was enabled.
E48-Control Power Active	The drive is in Control power mode. No motor power is present.
E49-Alignment Error	The ALIGN command did not complete successfully. (TPE, THALL)
E50-Flash Error	A problem writing to non-volatile memory exists. (RFS).
E51-Resolver Error	A problem determining the correct resolver angle exists. Applies to Arxx-xR models only. Check the resolver feedback wiring.
E52-Encoder Loss Fault	The drive determined there was loss of feedback. Check the feedback wiring. (TPE, THALL)

Table 50 Error Messages

Smart Encoders

Several drive related parameters may need additional configuration: CMDDIR, DCMDZ, and ADDR.

If the Aries drive does not initialize correctly when connected to a Smart Encoder (Parker motors only) , check the following:

1. Verify the motor phases are wired correctly. Incorrectly wired motor phases can produce any combination of the following symptoms in the motor: runs backwards; produces low torque, or gets warm.
2. Check that the feedback cables are wired correctly.
3. Apply power to the Aries drive.
   a. Send the SFB command. It should report 5. If the response is not <*>5, then check the feedback cable (if using a non-Parker cable, check that it is correctly wired). If the cable is correctly wired and connected, the problem might be the encoder.
   b. Send the THALL command. It should report a number in the range of 1-6, which indicates the phase wires are connected correctly. If the response is ∅ or 7, a fault exists. Check the motor phase wiring
   c. Send the TPE command and turn the motor shaft. Verify the encoder is counting in the correct direction. Turning the shaft clockwise results in positive encoder counts. If not, check the encoder feedback wires and reset the drive.

Note: The CMDDIR is fixed for smart encoders. To invert the direction, use IANI1; however, for the ACR9000 do not use IANI1.

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Hall Sensor Configuration/Troubleshooting

This section can help resolve a “Bad Hall State” error. Use the Troubleshooting Checklist (below) to determine the cause of the error.

This section will assist you in resolving a Hall fault (`ERROR` bit `E37-Bad Hall State`). Several problems can cause a Hall fault. The following list will help identify these problems.

Troubleshooting Checklist

1. Does `THALL` report either 0 or 7?
   If yes, see Problem 1 or 2, below.
2. Does `THALL` change if you move the motor by hand?
   If no, see Problem 2, below.
3. Does `THALL` have six distinct Hall states from 1 to 6? (No numerical order is necessary.)
   If no, see Problem 2, below.
4. Does `THALL` report the six distinct Hall states *n* times as the rotor turns one revolution, where *n* is equal to the number of pole-pairs (`DPOLE`)? (Linear motors: *n* = pitch)
   If no, see Problem 2 or 3, below.
5. Does `THALL` report the Hall state sequence [1, 5, 4, 6, 2, 3, 1...] as the motor turns clockwise? (Clockwise means `TPE` is increasing when `CMDDIR` set to zero (0); it is also the direction the motor turns in `DMODE1`.)
   If no, see Problem 4, below.
6. Does `ERROR` report a Hall fault each time the drive is enabled (`DRIVE1`), even though the Hall state sequence is correct?
   If yes, see Problem 4, below.
7. Does the Hall fault occur irregularly?
   If yes, see Problem 5 or 6 below.

Possible Problems

1. No Hall states are seen by the drive.
2. The cable is not connected, or is connected incorrectly (mis-wired).
3. `DPOLE` or `DMEPIT` is not set correctly.
4. Either the motor wires or the Hall wires are connected incorrectly.

   Use Procedure 1 to fix this problem by changing the motor wires.

   Use Procedure 2 to fix this problem by changing the Hall wires.
5. The Hall wires or the encoder wires may have loose connections, causing intermittent faults.
6. Noise induced on the Hall signals from routing the motor feedback cable next to high-voltage cables (for example, strapped to motor power cables).

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Procedure 1

Use this procedure to connect your *motor wires* to the Aries.

1. With the motor's feedback cable connected to the Aries drive, randomly connect two motor power wires and slowly apply a positive voltage with respect to the third.

   Note: A variable low voltage (5 to 24V) current limiting (less than continuous current rating of motor) power supply is preferred.



Warning — This procedure could damage the motor. Slowly increase the voltage until the motor moves. Do not exceed the rated current.



Safety 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.

2. If `THALL` reports a 1,, 2, or 4, change `SHALL` from either 0 to 1 or from 1 to 0. After you change `SHALL`, reset the drive.
3. Repeat step 1 until `THALL` reports a value of 6.
4. The wire on the negative voltage or ground is motor wire W. The two wires at the positive voltage are U and V.

   Now there are two possibilities:

   a. Connect the motor wires to the terminals. Operate the drive in `DMODE1`. If the motor does not turn in the clockwise direction, exchange motor wires U and V. Verify that the `CMDDIR` command is set to zero (0).

   b. Put positive voltage on motor wire W together with either U or V and put negative voltage or ground on the remaining wire. If `THALL` reports a value of 3, the wire at the negative voltage is V. If `THALL` reports a value of 5, the wire at the negative voltage is U.

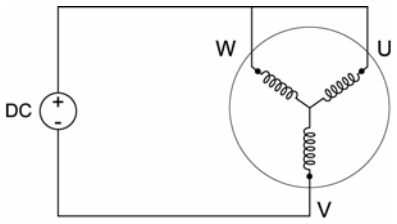


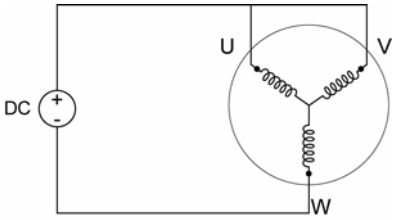
Figure 49 Hall Connection Diagram

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Procedure 2

Use this procedure to connect your *Hall wires* to the Aries.

1. First operate the drive in DMODE1 and verify that the motor turns clockwise. If not, swap any two motor wires.
2. Remove the motor power leads, leaving the feedback cable connected to the Aries drive. Connect motor power wires U and V and slowly apply a positive voltage with respect to W.



Note: A variable low voltage (5-24V) current limiting (less than continuous current rating of motor) power supply is preferred.



Warning — This procedure could damage the motor. Slowly increase the voltage until the motor moves. Do not exceed the rated current.



Safety 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.

3. If THALL reports a value of 1, 2 or 4, change SHALL from either 0 to 1 or from 1 to 0. After you change SHALL, reset the drive.
4. Change the Hall wires until THALL reports a value of 6.
5. Connect motor wires U and W and slowly apply a positive voltage with respect to V.
6. If THALL does not report a value of 3, change Hall wires B and C.
   If THALL reports a value of 3, the wires are connected correctly.

Table 51 summarizes phase voltages and their corresponding Hall states. Starting with SHALLØ and the phase voltages as shown, the THALL command should report the Hall states that match the “Correct” column. If instead THALL reports Hall states that match the “Use SHALL1” column, enter SHALL1 and reset the drive. The Hall states should now match the “Correct” column. For more information, see Figure 50.

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Phase			Hall State	
U	V	W	Correct	Use HALL1
–	–	+	1	6
–	+	+	5	2
–	+	–	4	3
+	+	–	6	1
+	–	–	2	5
+	–	+	3	4

Table 51 Configuring Hall Sensors

Figure 50 illustrates the alignment of phases U, V, and W with Halls 1, 2, and 3 as viewed from the front of the shaft. The illustration assumes the following:

- Hall signals that are High equal TRUE signals.
- Hall 1 is the least significant bit (LSB).
- Hall 3 is the most significant bit (MSB).
- There is one hall cycle and one electrical cycle per pole pair on the motor.

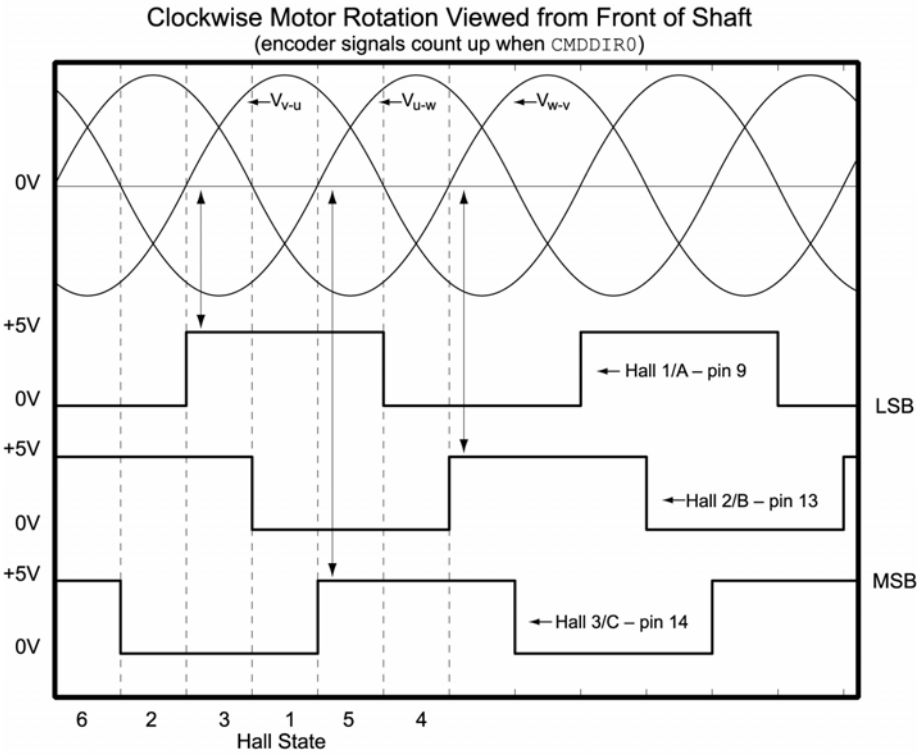


Figure 50 Motor Terminal Voltages (back EMF) and Hall Sensor Signals

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APPENDIX A

Additional Specifications

IN THIS CHAPTER	
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Amplifier

Control Power: all models	120/240 VAC Single Phase Mains Control Power
AR-01xx, AR-02xx, AR-04xx, AR-08xx, and AR-13xx	Single Phase AC Input, 120/240 VAC 16 or 32 kHz switching frequency (motor dependant), pulse-width modulated (PWM) with 3-phase motor output
Current Loop Update Rate	62.5 µs
Velocity and Position Loop	250 µs
AR-20xE and AR-30xE	Single or Three Phase AC Input (AR-30xE is three phase only) 240 VAC 16 kHz switching frequency, pulse-width modulated (PWM) with 3-phase motor output
Current Loop Update Rate	62.5 µs
Velocity and Position Loop	250 µs

Feedback

Encoder	Differential Quadrature Encoder
Encoder Accuracy	±1 encoder count; encoder dependent
Resolver	Single Speed
Resolver Accuracy	±11 arc minutes (12-bit A to D)
Resolver Excitation	10 KHz
Transformation Ratio	0.5
Maximum Pulse Input/Output Frequency	5 MHz (5V TTL Only)

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Protective Circuits

Short Circuit Protection

The Aries drive has an internal circuit that protects it from short circuits between one motor terminal to another (phase to phase), or from any motor terminal to earth.

Short Circuit Fault—Cause ..... Phase-to-phase short circuit
Phase-to-earth short circuit

Results of Fault ..... Power to motor is turned off
Fault output is activated

LED Left	LED Right
Yellow & 1 Green (blinking)	Red

Table 52 LED Short Circuit Fault

Resetting the fault

To clear the latched fault, choose one of the following methods:

► Cycle power to the Aries drive.

–or–

► Open the Aries Support Tool. Then select Operating System Update from the menu and click Reset Drive.

Drive Over-Temperature Protection

The Aries drive's over-temperature circuit monitors the drive's internal temperature. If the sensors exceed the threshold temperature, the drive issues an over-temperature fault.

Threshold Temperature

AR-01xx, AR-02xx, AR-04xx,
AR-08xx, and AR-13xx ..... 80°C (176°F)

AR-20xE and AR-30xE ..... 90°C (194°F)

Results of Fault ..... Power to motor is turned off
Fault output is activated

LED Left	LED Right
Yellow & 3 Green (blinking)	Red

Table 53 LED Drive Over-Temperature Fault

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Resetting the fault

After the internal temperature has dropped below the values shown in Table 54, you can clear the latched fault. There are two methods available:

► Cycle power to the Aries drive.

–or–

► Open the Aries Support Tool. Then select Operating System Update from the menu and click Reset Drive.

Model	Reset Temperature
AR-01xx, AR-02xx, AR-04xx, AR-08xx, and AR-13xx	75°C (167°F)
AR-20xE and AR-30xE	85°C (185°F)

Table 54 Reset Temperature Values

Under-Voltage Protection

The Aries drive's under voltage protection circuit monitors AC input voltage. If the voltage falls below a specific value while the drive is operating, the drive issues an under-voltage fault and turns off power to the motor output terminals (MOTOR connector). This allows the motor to freewheel to a stop.



Warning — When an under-voltage protection fault occurs, the drive disables power to its motor output terminals on the Motor connector. This cuts all control to the motor and allows the load to freewheel to a stop.

Threshold Voltage

AR-01xx, AR-02xx, AR-04xx,
AR-08xx, and AR-13xx ..... Voltage below 70 VAC trips fault

AR-20xE and AR-30xE ..... Voltage below 160 VAC trips fault

Results of Fault ..... Power to motor is turned off
Fault output is activated

LED Left	LED Right
Yellow	Red

Table 55 LED Under-Voltage Fault

Resetting the fault

To clear the latched fault, choose one of the following methods:

► Cycle power to the Aries drive.

–or–

► Open the Aries Support Tool. Then select **Operating System Update** from the menu and click **Reset Drive.**

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Over-Voltage Protection

The Aries drive's over-voltage circuit protects the drive from excessive regeneration. If the voltage on the motor output terminals rises above the threshold voltage, the drive issues an over-voltage fault and turns off power to the motor output terminals (Motor connector). This allows the motor to freewheel to a stop.



Warning — When an over-voltage protection fault occurs, the drive disables power to its motor output terminals on the Motor connector. This cuts all control to the motor and allows the load to freewheel.

Threshold Voltage

All Models..... 410 VDC

Results of Fault ..... Power to motor is turned OFF
Fault output is activated

LED Left	LED Right
Yellow & 4 Green (blinking)	Red

Table 56 LED Over-Voltage Fault

Resetting the fault

To clear the latched fault, choose one of the following methods:

► Cycle power to the Aries drive.

–or–

► Open the Aries Support Tool. Then select **Operating System Update** from the menu and click **Reset Drive.**



Warning — Over-voltage protection monitors only the motor output terminals (DC motor bus). It does not protect against an over voltage on the AC input terminals, which can permanently damage the drive.

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Current Foldback

The Aries drive's current foldback circuit helps to protect the drive from damage due to prolonged high currents.

If your Drive is operating above its continuous current rating, see Figure 51 to predict the number of seconds until foldback will occur. For example, the figure shows that at the Aries drive's peak current rating (250% of continuous), foldback will occur after six seconds. After operating at the drive's peak current, the drive will reduce the drive current to 80% of the drive's continuous rating for 60 seconds. This is to ensure the drive's average continuous current rating is not exceeded.

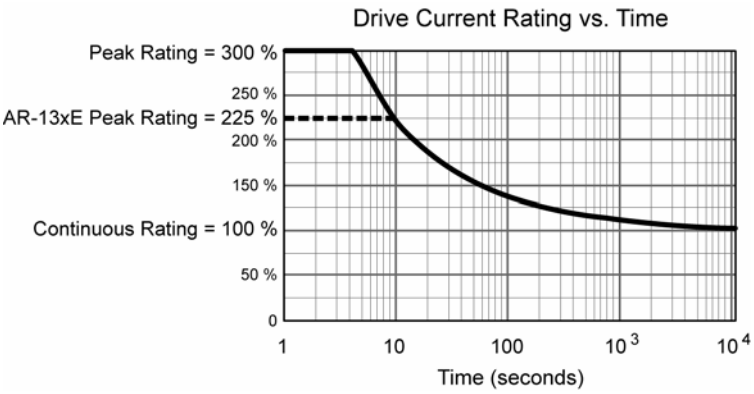


Figure 51 Time until current foldback occurs

Cables

EMC Ready Cables

Many Parker cables are EMC installation ready. If installed according to instructions provided under "A Highly-Immune, Low-Emission Installation – Meeting the Requirements of the Electromagnetic Compatibility (EMC) Directive" on page 176, these cables are designed to aid the user in gaining European Compliance, and are thus an integral part of a CE system solution. EMC cables add RF screening and bonding to reduce emissions, increase immunity, and provide high integrity safety Earth bonding. They also help to reduce problems in high electrical noise environments.

Non-EMC Cables

Parker also offers non-EMC cables, for applications where CE compliance is not required, and where ambient electrical noise does not cause problems. Because these cables are either unshielded, or contain simple foil shielding terminated by a drain wire, they do not provide significant shielding of electrical noise at high frequencies.

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APPENDIX B

External Power Dump Resistor Selection

IN THIS CHAPTER

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Calculating Resistance—Rotary Motors 161
Resistor Specifications 165
Calculating Resistance—Linear Motors 167
Resistor Specifications 171

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External Power-Dump Resistor Selection

Deceleration generates excess kinetic and potential energy. You can remove the energy through regeneration—a process where the motor acts as generator. Regeneration allows you to transfer the excess energy from the motor and load back to the power supply.

When the drive and assorted losses cannot remove all the stored kinetic energy, you must connect an external power-dump resistor. Connecting an external power-dump resistor to the Aries drive helps dissipate the excess kinetic and potential energy.

While the Aries drive contains circuitry to control an external power dump resistor, resistor selection depends on the requirements of your particular application.

There are two methods for selecting the appropriate external power-dump resistor:

- "Simplified Resistor Selection" provides quick recommendations for Parker drive and motor combinations.
- "Calculating Resistance—Rotary Motors" steps you through the relevant formulas to determine the needs of your particular application.

Note: Both methods assume regeneration occurs during a trapezoidal move.



Important — It is possible to overload an Aries drive or the combination of an Aries drive and power dump resistor.

If at the end of the calculations you find the required resistor is less than allowed for your specific Aries model, or requires a watt rating greater than the rated resistors available, do not use the Aries drive in your application.

Aries drive models AR-01xx, AR-02xx, AR-04xx, AR-08xx, and AR-13xx, require external resistance values of 22 Ohms or greater.

Aries drive models AR-20xE and AR-30xE require external resistance values of 8 Ohms or greater

Simplified Resistor Selection

Many applications do not require a power-dump resistor because the drive can absorb or dissipate the regenerative deceleration energy. However, if a drive faults from over-voltage during a deceleration event, an external power dump resistor is probably required.

Table 57 contains recommended power-dump resistors for specific Aries drive and Parker Hannifin motor combinations. The recommendations are based on the calculations presented in the section titled "Calculating Resistance—Rotary Motors". These recommendations assume a worst-case load-to-rotor inertia ratio of 10 to 1, maximum duty cycle and maximum deceleration from maximum velocity for that specific motor/drive pairing.

These are recommendations only—while not optimized for your particular application, they will work in most situations.

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Drive	AC Voltage	Motor	Resistor Rating (Resistance—Ohms)	Resistor rating (Continuous Power—Watts)	Isotek Part Number
AR-01xx	120	SM162Z	100	100	BRK-100R-10-L2, 4
	240	BE164B			See note1
AR-02xx	120	SM162Z			See note1
		SM161A			See note1
		SM162A			See note1
		SM230A			See note1
		SM231A	47	200	BRM-47R0-10-L2, 4
		SM232A	47	200	BRM-47R0-10-L2, 4
	240	BE230D			See note1
		BE231D			See note1
AR-04xx	240	SM233A	47	200	BRM-47R0-10-L2, 4
		BE232D			See note1
		BE233D			See note1
		BE233F			See note1
AR-08xx	120	BE230F			See note1
		BE231F			See note1
		BE232F			See note1
	240	BE341F			See note1
		BE342H			See note1
		NO702F	22	300	BRQ-22R0-10-L2, 4
		NO703F	22	300	BRQ-22R0-10-L2, 4
		NO704F	22	300	BRQ-22R0-10-L2, 4
AR-13xx	240	BE344L	22	300	BRQ-22R0-10-L2,3,4
		MPM1141ASG	22	300	BRQ-22R0-10-L2,3,4
		SMN1002S2F-KPN	22	300	BRQ-22R0-10-L2,3,4
AR-20xE	240	1141BSG	8	800	IRP20008R0J2, 4
		1142BSG	8	1100	IRP30008R0J2, 4
		1421BSG	8	1100	IRP30008R0J2, 4
AR-30xE	240	1142ASG	8	1800	IRP60008R0J2, 4
		1143ASG	8	1800	IRP60008R0J2, 4
		1901BSG	8	1800	IRP60008R0J2, 4

1. External power dump resistor not needed. However, higher operating voltage, higher load to rotor inertia ratio, and higher duty cycles can increase the need.
2. Higher friction loads, lower speeds, lower deceleration rates, lower load to rotor inertia ratio, and lower duty cycles can decrease the need for this resistor.
3. Minimum resistance allowed for AR-13 is 22 Ohms, therefore the maximum deceleration rate and/or duty cycle may need to be reduced.
4. Isotek resistor or equivalent

Table 57 Simplified Selection of External Power-Dump Resistor

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Calculating Resistance—Rotary Motors

Because there are different types of motion profiles and application specific conditions, you may need to modify the results to suit your particular application. To keep it simple, the formulas assume a trapezoidal move profile, in which the deceleration event is a single constant deceleration to zero (0) velocity. For other motion profiles, you can modify the basic concepts presented below.

Calculating the amount of energy to dissipate requires the motion profile parameters, and the motor, drive, and load information. While significantly more information is required, the calculations help tailor the size of power-dump resistor to your application.

This is a multi-step process:

1. Calculate the motor's kinetic energy.
2. Calculate the motor's potential energy—vertical applications only.
3. Calculate the energy that can be absorbed by the drive capacitors
4. Calculate energy dissipated in the motor winding resistance
5. Calculate energy dissipated in load
6. Using the results from the previous four calculations, calculate the amount of energy to dissipate through an external power-dump resistor.

With that result, you can then calculate the resistor necessary to dissipate the excess energy.

Total Kinetic Energy

A body in motion produces energy. To stop motion, that energy must be absorbed or dissipated elsewhere.

That energy can be defined in terms of inertia and velocity.

$$E_K = \tfrac{1}{2}\left(J_M + J_L\right)\omega^2$$

Where

E_K = rotational kinetic energy (Joules)

J_M = rotor inertia in kilogram meter squared ($kg \cdot m^2$)

J_L = load inertia in kilogram meter squared ($kg \cdot m^2$)

ω = rotational speed in radians per sec (1 revolution/sec = $2 \cdot \pi \cdot$radians/sec)

Total Potential Energy

A body at rest stores energy relative to the position of the body. When the body moves, the potential energy is released and translated into kinetic energy.

For purely horizontal applications, potential energy is negligible and therefore not necessary for inclusion in your calculations. However, for vertical applications, potential energy can greatly affect the selection of power dump resistor. Regardless whether the incline is gentle or steep, it is important to calculate the potential energy that must be absorbed or dissipated elsewhere.

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$$E_p = mgh$$

Where

E_p = potential energy (Joules)

m = mass of forcer and load (kg)

g = gravitational constant (9.81 m/s^2)

h = vertical height change during deceleration (m)

Energy Absorbed by Drive Capacitors

The Aries drive's capacitors can store energy. With motor deceleration, the drive capacitors absorb some of the kinetic and potential energy. While the capacitors absorb energy, the bus voltage increases. Later, the capacitors release that potential energy in subsequent accelerations, or into typical drive losses.

If too much energy is absorbed by the capacitors, the Aries drive faults from over-voltage. Under these circumstances, an external power dump resistor is required.

That ability to absorb energy can be defined in terms of capacitance and voltage.

$$E_C = \frac{1}{2} C (V_{TRIP}{}^2 - V_{NOM}{}^2)$$

Where

E_C = energy that can be absorbed by the drive capacitors (Joules)

C = drive capacitance (Farads)

V_{TRIP} = power dump trip DC voltage (400 VDC for Aries drives)

V_{NOM} = nominal DC motor voltage (typically AC mains voltage at $\sqrt{2}$; for example, 120 VAC * $\sqrt{2}$ = 170 VDC)

Fortunately, for a given drive the capacitance and voltages are fixed. Table 58 provides the needed information and results from the above calculation.

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Drive	Capacitance (uF)	V_{TRIP} (VDC)	E_C (120 VAC) Joules	E_C (240 VAC) Joules
AR-01xx	440	400	28	9
AR-02xx	660	400	43	14
AR-04xx	880	400	57	19
AR-08xx	1100	400	72	24
AR-13xx	1590	400	104	35
AR-20xE	2240	400	N/A	50
AR-30xE	2240	400	N/A	50
When the voltage drops below 385 VDC, the Aries drive stops dissipating power through the power dump resistor.				

Table 58 Drive Capacitor Absorption

Energy Dissipated in Motor Winding Resistance

Some energy is dissipated in the motor windings. Because the energy is converted to wasted heat in the motor, it is referred to as *copper losses*.

The energy during deceleration can be derived from the inertia, deceleration rate, motor resistance, and motor torque constant. If some of the parameters are not known, the energy dissipated in the motor windings (E_W) can conservatively be assumed zero (0).

This is based on current and motor winding resistance.

$$E_W = \frac{1}{2} I^2 R_M \cdot t_D = \frac{1}{2} \cdot \left(\frac{(J_M + J_L) \cdot \omega}{k_T \cdot t_D} \right)^2 \cdot R_M \cdot t_D$$

Where

E_W = energy dissipated in the motor windings (Joules) – copper losses

I = current through the windings ($Amps_{rms}$)

R_M = line to line motor resistance (Ohms)

t_D = deceleration time (Seconds)

J_M = rotor inertia ($kg \cdot m^2$)

J_L = load inertia ($kg \cdot m^2$)

k_T = motor torque constant (Nm/Amp_{rms})

ω = rotational speed in radians per sec (1 revolution/sec = $2 \cdot \pi \cdot$radians/sec)

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Energy Dissipated in Load

The load dissipates energy through friction losses, viscous damping, and other motor/load related losses. These losses are known as load losses. If some of the parameters are not known, the energy dissipated in the load (E_L) can conservatively be assumed zero (0).

This can be derived from the torque required during the constant velocity portion of the move profile, either measured or calculated.

$$E_L = \frac{1}{2} T\omega \cdot t_D$$

Where

- E_L = energy dissipated by the load (Joules) – load losses
- T = torque at constant velocity (Nm)
- ω = rotational speed in radians per sec (1 revolution/sec = $2 \cdot \pi \cdot$radians/sec)
- t_D = deceleration time (Seconds)

Energy to Dissipate in the External Power-Dump Resistor

To stop a motor, kinetic and potential energy must go somewhere. Through the previous calculations, you have determined the total kinetic and potential energy, and the energy lost to various paths.

From the total kinetic and potential energy, subtract the energy dissipated through the drive capacitors, motor windings, and load loss. If the copper losses (E_W) or load losses (E_L) are not easily determined, you can conservatively assume they are zero (0).

The resulting sum represents the power for dissipation in an external power dump resistor.

$$E_R = E_K + E_P - E_C - E_W - E_L$$

Where

- E_R = energy to be dissipated in the external resistor (Joules)
- E_K = rotational kinetic energy (Joules)
- E_P = potential energy (Joules)
- E_C = energy that can be absorbed by the drive capacitors (Joules)
- E_W = energy dissipated in the motor windings (Joules) – copper losses
- E_L = energy dissipated by the load (Joules) – load losses

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Resistor Specifications—Rotary Motors

Having determined the amount of energy to dump (E_R), you can then calculate the resistor specifications.

- Maximum resistance
- Peak dissipation
- Average dissipation

Maximum Resistance

This calculation determines the maximum value of resistance needed for the external power-dump resistor. We recommend that you select a lower value resistance, typically in the 22 to 100 ohm range.



Important — It is possible to overload an Aries drive or the combination of an Aries drive and power dump resistor.

If at the end of the calculations you find the required resistor is less than allowed for your specific Aries model, or requires a watt rating greater than the rated resistors available, do not use the Aries drive in your application.

Aries drive models AR-01xx, AR-02xx, AR-04xx, AR-08xx, and AR-13xx, require external resistance values of 22 Ohms or greater.

Aries drive models AR-20xE and AR-30xE require external resistance values of 8 Ohms or greater

$$R_R = \frac{V}{I} = \frac{V_{TRIP} \cdot k_T \cdot t_D}{(J_M + J_L) \cdot \omega}$$

Where

R_R = maximum external power dump resistance (Ohms)

V = voltage across the resistor (V_{TRIP})

I = current through the resistor (drive current required to decelerate the load)($Amps_{rms}$)

V_{TRIP} = power dump trip DC voltage (400 volts for Aries drives)

k_T = motor torque constant (Nm/Amp_{rms})

J_M = rotor inertia ($kg \cdot m^2$)

J_L = load inertia ($kg \cdot m^2$)

t_D = deceleration time (Seconds)

ω = rotational speed in radians per sec (1 revolution/sec = $2 \cdot \pi \cdot$radians/sec)

Peak Dissipation

During a single deceleration, all the calculated power-dump energy (E_R) must dissipate in the external resistor. The external power-dump resistor then slowly dissipates that energy as heat. This peak power must not exceed the

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capabilities of the resistor, which is typically 10 times the average power rating.

$$P_{PEAK} = \frac{E_R}{t_D}$$

Where

P_{PEAK}= peak power into the external power dump resistor (Watts)

E_R = energy to be dissipated in the external resistor (Joules)

t_D = deceleration time (Seconds)

Average Dissipation

Repetitive moves need to dump the energy each time the deceleration occurs. The duty cycle of this repetition determines the average power the resistor must dissipate. This average power must not exceed the capabilities of the resistor.

Power resistors are rated based on ideal heatsink and airflow conditions, and are therefore often over-rated by the manufacturers. To ensure the average energy dissipation of the resistor exceeds the average power dump for the application, the regenerative power should never exceed 50% of the resistor's average power rating.

$$P_{AVG} = P_{PEAK} \cdot \frac{t_D}{t_C}$$

Where

P_{AVG} = average power into the external power dump resistor (Watts)

P_{PEAK} = peak power into the external power dump resistor (Watts)

t_D = deceleration time (Seconds)

t_C = cycle time or time between each deceleration event (Seconds)



Important — Under normal operation the external power-dump resistor could operate in excess of 200 °C. Keep the resistor away from thermally sensitive components, such as cables or plastic hardware.

Proper installation may require the use of thermal compound and proper thermal connection to a heat absorbing metal surface.

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Calculating Resistance—Linear Motors

Because there are different types of motion profiles and application specific conditions, you may need to modify the results to suit your particular application. To keep it simple, the formulas assume a trapezoidal move profile, in which the deceleration event is a single constant deceleration to zero (0) velocity. For other motion profiles, you can modify the basic concepts presented below.

Calculating the amount of energy to dissipate requires the motion profile parameters, and the motor, drive, and load information. While significantly more information is required, the calculations help tailor the size of power-dump resistor to your application.

This is a multi-step process:

1. Calculate the motor's kinetic energy.
2. Calculate the motor's potential energy—vertical applications only.
3. Calculate the energy that can be absorbed by the drive capacitors
4. Calculate energy dissipated in the motor winding resistance
5. Calculate energy dissipated in load
6. Using the results from the previous four calculations, calculate the amount of energy to dissipate through an external power-dump resistor.

With that result, you can then calculate the resistor necessary to dissipate the excess energy.

Total Kinetic Energy

A body in motion produces energy. To stop motion, that energy must be absorbed or dissipated elsewhere.

That energy can be defined in terms of mass and velocity.

$$E_K = \tfrac{1}{2}\left(M_F + M_L\right)v^2$$

Where

E_K = rotational kinetic energy (Joules)

M_F = mass of forcer in kilograms (kg)

M_L = mass of load in kilograms (kg)

v = velocity in meters per second (m/s)

Total Potential Energy

A body at rest stores energy relative to the position of the body. When the body moves, the potential energy is released and translated into kinetic energy.

For purely horizontal applications, potential energy is negligible and therefore not necessary for inclusion in your calculations. However, for vertical applications, potential energy can greatly affect the selection of power dump resistor. Regardless whether the incline is gentle or steep, it is important to calculate the potential energy that must be absorbed or dissipated elsewhere.

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$$E_p = mgh$$

Where

Ep = potential energy (Joules)

m = mass of forcer and load (kg)

g = gravitational constant (9.81 m/s2)

h = vertical height change during deceleration (m)

Energy Absorbed by Drive Capacitors

The Aries drive's capacitors can store energy. With motor deceleration, the drive capacitors absorb some of the kinetic and potential energy. While the capacitors absorb energy, the bus voltage increases. Later, the capacitors release that potential energy in subsequent accelerations, or into typical drive losses.

If too much energy is absorbed by the capacitors, the Aries drive faults from over-voltage. Under these circumstances, an external power dump resistor is required.

That ability to absorb energy can be defined in terms of capacitance and voltage.

$$E_C = \frac{1}{2} C(V_{TRIP}{}^2 - V_{NOM}{}^2)$$

Where

EC = energy that can be absorbed by the drive capacitors (Joules)

C = drive capacitance (Farads)

VTRIP = power dump trip DC voltage (400 VDC for Aries drives)

VNOM = nominal DC motor voltage (typically AC mains voltage at $\sqrt{2}$; for example, 120 VAC * $\sqrt{2}$ = 170 VDC)

Fortunately, for a given drive the capacitance and voltages are fixed. Table 59 on page 169 provides the needed information and results from the above calculation.

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Drive	Capacitance (uF)	V_{TRIP} (VDC)	E_C (120 VAC) Joules	E_C (240 VAC) Joules
AR-01xx	440	400	28	9
AR-02xx	660	400	43	14
AR-04xx	880	400	57	19
AR-08xx	1100	400	72	24
AR-13xx	1590	400	104	35
AR-20xE	2240	400	N/A	50
AR-30xE	2240	400	N/A	50
When the voltage drops below 385 VDC, the Aries drive stops dissipating power through the power dump resistor.				

Table 59 Drive Capacitor Absorption

Energy Dissipated in Motor Winding Resistance

Some energy is dissipated in the motor windings. Because the energy is converted to wasted heat in the motor, it is referred to as *copper losses*.

The energy during deceleration can be derived from the mass, deceleration rate, motor resistance, and motor force constant. If some of the parameters are not known, the energy dissipated in the motor windings (E_W) can conservatively be assumed zero (0).

This is based on current and motor winding resistance.

$$E_W = \frac{1}{2} I^2 R_M \cdot t_D = \frac{1}{2} \cdot \left(\frac{(M_F + M_L) \cdot v}{k_F \cdot t_D} \right)^2 \cdot R_M \cdot t_D$$

Where

E_W = energy dissipated in the motor windings (Joules) – copper losses

I = current through the windings ($Amps_{rms}$)

R_M = line to line motor resistance (Ohms)

t_D = deceleration time (Seconds)

M_F = mass of forcer in kilograms (kg)

M_L = mass of load in kilograms (kg)

k_F = motor force constant (N/Amp_{rms})

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Energy Dissipated in Load

The load dissipates energy through friction losses, viscous damping, and other motor/load related losses. These losses are known as load losses. If some of the parameters are not known, the energy dissipated in the load (E_L) can conservatively be assumed zero (0).

This can be derived from the force required during the constant velocity portion of the move profile, either measured or calculated.

$$E_L = \frac{1}{2} F \cdot v \cdot t_D$$

Where

E_L = energy dissipated by the load (Joules) – load losses

F = force at constant velocity in Newtons (N)

v = velocity in meters per second (m/s)

t_D = deceleration time (Seconds)

Energy to Dissipate in the External Power-Dump Resistor

To stop a motor, kinetic and potential energy must go somewhere. Through the previous calculations, you have determined the total kinetic and potential energy, and the energy lost to various paths.

From the total kinetic and potential energy, subtract the energy dissipated through the drive capacitors, motor windings, and load loss. If the copper losses (EW) or load losses (EL) are not easily determined, you can conservatively assume they are zero (0).

The resulting sum represents the power for dissipation in an external power dump resistor.

$$E_R = E_K + E_P - E_C - E_W - E_L$$

Where

ER = energy to be dissipated in the external resistor (Joules)

EK = rotational kinetic energy (Joules)

EP = potential energy (Joules)

EC = energy that can be absorbed by the drive capacitors (Joules)

EW = energy dissipated in the motor windings (Joules) – copper losses

EL = energy dissipated by the load (Joules) – load losses

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Resistor Specifications—Linear Motors

Having determined the amount of energy to dump (ER), you can then calculate the resistor specifications.

- Maximum resistance
- Peak dissipation
- Average dissipation

Maximum Resistance

This calculation determines the maximum value of resistance needed for the external power-dump resistor. We recommend that you select a lower value resistance, typically in the 22 to 100 ohm range.



Important — It is possible to overload an Aries drive or the combination of an Aries drive and power dump resistor.
If at the end of the calculations you find the required resistor is less than allowed for your specific Aries model, or requires a watt rating greater than the rated resistors available, do not use the Aries drive in your application.
Aries drive models AR-01xx, AR-02xx, AR-04xx, AR-08xx, and AR-13xx, require external resistance values of 22 Ohms or greater.
Aries drive models AR-20xE and AR-30xE require external resistance values of 8 Ohms or greater

$$R_R = \frac{V}{I} = \frac{V_{TRIP} \cdot k_F \cdot t_D}{(M_F + M_L) \cdot v}$$

Where

R_R = maximum external power dump resistance (Ohms)

V = voltage across the resistor (V_{TRIP})

I = current through the resistor (drive current required to decelerate the load)($Amps_{rms}$)

V_{TRIP} = power dump trip DC voltage (400 volts for Aries drives)

k_F = motor force constant (N/Amp_{rms})

M_F = mass of forcer in kilograms (kg)

M_L = load mass in kilograms (kg)

t_D = deceleration time (Seconds)

v = velocity in meters per second (m/s)

Peak Dissipation

During a single deceleration, all the calculated power-dump energy (ER) must dissipate in the external resistor. The external power-dump resistor then slowly dissipates that energy as heat. This peak power must not exceed the capabilities of the resistor, which is typically 10 times the average power rating.

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$$P_{PEAK} = \frac{E_R}{t_D}$$

Where

PPEAK= peak power into the external power dump resistor (Watts)

ER = energy to be dissipated in the external resistor (Joules)

tD = deceleration time (Seconds)

Average Dissipation

Repetitive moves need to dump the energy each time the deceleration occurs. The duty cycle of this repetition determines the average power the resistor must dissipate. This average power must not exceed the capabilities of the resistor.

Power resistors are rated based on ideal heatsink and airflow conditions, and are therefore often over-rated by the manufacturers. To ensure the average energy dissipation of the resistor exceeds the average power dump for the application, the regenerative power should never exceed 50% of the resistor's average power rating.

$$P_{AVG} = P_{PEAK} \cdot \frac{t_D}{t_C}$$

Where

PAVG = average power into the external power dump resistor (Watts)

PPEAK = peak power into the external power dump resistor (Watts)

tD = deceleration time (Seconds)

tC = cycle time or time between each deceleration event (Seconds)



Important — Under normal operation the external power-dump resistor could operate in excess of 200 °C. Keep the resistor away from thermally sensitive components, such as cables or plastic hardware.

Proper installation may require the use of thermal compound and proper thermal connection to a heat absorbing metal surface.

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APPENDIX C

Regulatory Compliance UL and CE

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System Installation Overview

This appendix contains information related to installation methods and practices that can be used to aid the systems integrator or machine builder in designing a compliant installation, meeting the needs of global regulatory agencies.

The installation overview is divided in to two sections—“Safety” and “Electromagnetic Compatibility (or EMC)”.

It is recommended that the installer *read this entire overview*, prior to taking any action, as some of the required installation methods can be leveraged across both Safety and EMC installations.

Although Aries drives are technically considered motion control components and are therefore not within the scope of the European union’s CE (Conformité Européenne) directives, Parker has taken the initiative to provide its customers with easy to integrate motion control products that meet global requirements.

The following constitutes what is typically required to install Aries drives into a CE compliant system. Additional installation measures may be required at some locations. The machine builder has ultimate responsibility for machine compliance.

General Safety Considerations

These products are intended for installation according to the appropriate safety procedures including those laid down by the local supply authority regulations. The recommendations provided are based on the requirements of the Low Voltage Directive and specifically on EN61010. Remember, never compromise safety to achieve EMC compliance. Therefore, in the event of a conflict between safety regulations and the following EMC recommendations, *safety regulations always take precedence*.

General EMC Considerations

The Aries product is a motion control component and as such will be built in to another machine that will in turn be required to comply with the relevant directives of the marketplace.

It is important to remember that for specific installations, the full protection requirements of the EMC directive 89/336/EEC need to be met before the system is taken in to service. This must be verified either by inspection or by testing. The following EMC installation recommendations are intended to assist in ensuring that the requirements of the EMC directive are met. It may be necessary to take additional measures in certain circumstances and at specific locations.

It should be stressed that although these recommendations are based on the expertise acquired during the design and development of the Aries products, and on tests carried out on similar products, it is impossible for Parker to guarantee compliance of any particular installation. This will be strongly influenced by the physical and electrical details of the installation and the performance of other system components. Nevertheless, it is important to follow *all* the installation recommendations if an adequate level of compliance is to be achieved.

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Installing the Aries Drive

Only qualified, skilled electrical technicians familiar with local safety requirements should install this product. For service, the drive must be returned to an authorized service center. There are no user serviceable parts inside the chassis. In certain circumstances, opening the cover may void the product warranty.

The Aries drive is a vented product. To prevent material spilling into the drive, mount it under an overhang or in a suitable enclosure.

Aries products are made available under “Restricted Distribution” for use in the “Second Environment” as described in EN 61800-3 1996, page 9. This means only those individuals familiar with the EMC requirements of power drive systems should install this product and that this product is designed for connection to mains distribution networks other than low-voltage networks, which may supply domestic premises. The drives can tolerate atmospheric pollution degree 2, which means only dry, non-conductive pollution is acceptable.

Aries drives have been shown to meet the requirements of both the European LVD & EMC directives when installed according to the recommendations given within this section. It is recommended the drive be installed in an enclosure to protect it from atmospheric and industrial process contaminants and to prevent operator access while it has power applied. Metal equipment cabinets are ideally suited for housing the equipment since they can provide operator protection, 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 interlocks to open circuit the motor phase connections while the system is still powered, as this could cause damage to the drive.

Precautions

During installation, take the normal precautions against damage caused by electrostatic discharges. Wear earth wrist straps. A switch or circuit breaker must be included in the installation, which must be clearly marked as the disconnecting device and should be within easy reach of the machine operator.

The Aries Drive has exposed high voltage terminals. In order to comply with the safety requirements pertaining to European Compliance, and other authorities, the drive must be mounted in such a way as to restrict access to these terminals during normal operation.

A Safe Installation – Meeting the Requirements of the Low Voltage Directive (LVD)

In order to comply with the requirements of the European Union’s Low Voltage Directive, the following installation measures must be taken.

- Mains fuses must be installed on all mains input lines carrying operating current. For more information, see “Motor Power Fuse Information” on page 26 and page 31.
- Drive Protective Earth Conductor must be connected directly to a reliable system safety Earth point. Total resistance from Drive’s Protective Conductor Terminal to a Reliable System Safety Earth

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must not exceed 0.1 Ohm, and must be capable of carrying 25A of Fault Current.

- Motor safety earth conductor (for motor voltages greater than or equal to 75 volts) must be connected to the drive's Motor Earth terminal, marked with ⏚.
- The drive must be installed in a manner that prevents operator access to hazardous live terminals during normal operation.

Additional safety measures may be required within your particular market, please consult you local regulatory agency for additional requirements.

A Highly-Immune, Low-Emission Installation – Meeting the Requirements of the Electromagnetic Compatibility (EMC) Directive

The following information was compiled to aid the machine builder or systems integrator in gaining EMC compliance. For effective control of Conducted and Radiated Emissions, along with maximizing the Aries Drive's inherent noise immunity, the following recommendations should be followed. A drawing of a typical EMC installation is shown below.

- Mount the Drive and all components to a clean (not painted), earthed, metal panel.

Important!

To reduce the risk of electrical noise entering your system you must properly earth ground the enclosure, and remove all paint and other non-conductive surface coatings from the panel mounting surface and RF earth bonding locations.

If you mount the Aries drive in an equipment cabinet, terminate cable braids (screens) at the entrance of the enclosure. This can be easily accomplished using the "additional EMC installation hardware" shown below.

The only exception is for the motor braid, which must return to the drive's R-Clamp (located on the bottom of the Aries drive. *Do not* return the motor braid to any other location, its function is to return high-frequency chopping current back to the drive. This may require mounting the connector on a sub-panel insulated from the main cabinet, or using a connector having an insulated internal screen from the connector housing.

The shields of all other cables that enter or exit the enclosure must be RF bonded to the enclosure entrance point using an R-Clamp, bulkhead clamshell clamp, or other 360° bonding technique. This ensures that no stray noise will enter or exit the enclosure. The following drawing illustrates 360° bonding techniques.

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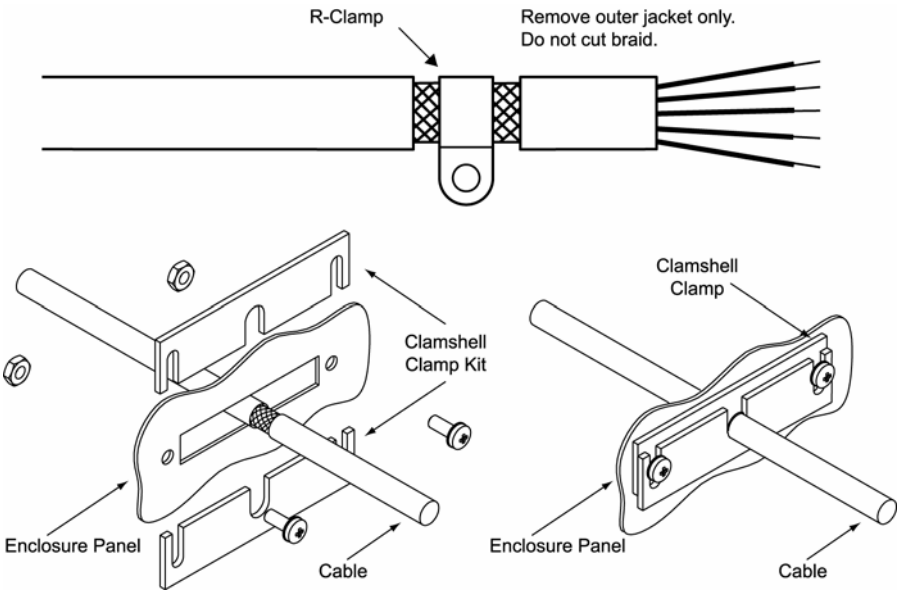


Figure 52 360° Bonding Techniques

All braid termination connections must remain secure. For small diameter cables, it may be necessary to fold back the braid to increase the effective diameter of the cable so that R-Clamps are secure.

Within the cabinet itself, all the motor cables should lie in the same trunking as far as possible. Keep the cables separate from any low-level control signal cables. This applies particularly where the control cables are unscreened and run close to the drive.

There must be no break in the 360° coverage that the screen provides around the cable conductors.

A steel equipment cabinet will screen radiated emissions provided all panels are bonded to a central earth point. Separate earth circuits are commonly used within equipment cabinets to minimize the interaction between independent circuits. A circuit switching large currents and sharing a common earth return with another low-level signal circuit could conduct electrical noise into the low level circuit, thereby possibly interfering with its operation. For this reason, so called ‘dirty earth’ and ‘clean earth’ circuits may be formed within the same cabinet, but all such circuits will eventually need to be returned to the cabinet’s main star earth point.

Mount the individual drives and EMC filter on a metal earth plane. The earth plane will have its own individual star point earth that should be hard wired (using an insulated copper conductor) back to the cabinet’s ‘clean earth’ connection point.

Panel mounting can provide a similar measure of EMC performance if strict attention is paid to cable screen termination and cable layout.

Again, the machine builders primary focus should be on ensuring operators are kept safe from all hazards.

- Install a Mains filter. Aries drives require an EMC mains supply filter to meet EMC emission requirements. It is recommended that the drive is mounted on a conductive panel which is shared with the EMC filters. If the panel has a paint finish, it will be necessary to

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remove the paint in certain areas to ensure filters and drive make a good large-area metal to metal contact between filter case and panel.

You must install a filter on both the Motor power mains and Control power mains if both are used. Use Table 60 and Table 61 to determine the correct filter for your specific application.

Control Power

Control power is 1 Amp, maximum. Any of the following filters works with all models of the drive.

Filter	Manufacturer
6EP1 (160937-5)	Corcom
10EP1 (160937-7)[1,	Corcom
FN2070-10/06	Schaffner
1. Available from Parker:	10 Amp filter—part number 47-016140-01 16 Amp filter—part number 47-017900-01

Table 60 Control Power Filter Selection

Mains Motor Power

Filter	Continuous Current (Amps)	AR-01xx	AR-02xx	AR-04xx	AR-08xx	AR-13xx	AR-20xE	AR-30xE
6EP1 (160937-5)[1]	5 at 240 VAC	×	×					
10EP1 (160937-7)[1, 3]	8 at 240 VAC	×	×	×	×	x		
FN2070-10/06[2]	10 at 240 VAC	×	×	×	×	x		
FN2070-12/06	12 at 240 VAC	×	×	×	×	x		
FN2070-16/06[2, 3]	16 at 240 VAC			×	×	x		
16FCD10[1]	16 at 240 VAC						x	
25FCD10[1]	25 at 240 VAC						x	x
Product with applicable mains filter denoted by "×" 1. Corcom (a division of Tyco Electronics) 2. Schaffner 3. Available from Parker: 10 Amp filter—part number 47-016140-01 16 Amp filter—part number 47-017900-01								

Table 61 Mains Motor Power Filter Selection

- Install Transient suppressors.

Single Phase Input

You must install varistors or other voltage surge limiting devices in order to meet the requirements of EN61000-4-5. Place a Littelfuse V275LA2ØC, or an equivalent varistor, from line to line and from lines to earth before the mains filter, as shown in the *EMC Installation* drawings. (Intersil, General Electric, and Littelfuse manufacture equivalent varistors.)

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Three Phase Input

Control Power – You must install varistors or other voltage surge limiting devices in order to meet the requirements of EN61000-4-5. Level 3 Voltage Surge (1000V line-to-line, 2000V line-to-earth) protection can be achieved by placing a Littelfuse V275LA20C, or an equivalent varistors from line-to-line and from line-to-earth before the mains filter as shown in Figure 54 Typical LVD/EMC Installation, AR-20xE & AR-30xE on page 182.

Mains Motor Power – The three-phase AC power Aries drives (models AR-20xE and AR-30xE) are designed to meet Level 3 Voltage Surge (1000V line-to-line, 2000V line-to-earth) without the need for external voltage surge limiting devices. If a higher level of mains surge immunity is required, external voltage sure limiting devices, such as varistors, can be installed before the mains filter. Figure 54 Typical LVD/EMC Installation, AR-20xE & AR-30xE on page 182 illustrates this installation.

Note: Intersil, General Electric, and Littelfuse manufacture equivalent varistors.

- Use an EMC-ready motor or a motor that has demonstrated acceptable EMC performance.

Motors with shielded cabling or pipe thread style cabling options allow the easiest integration into machines required to bear the CE mark for EMC.

Note: Motors may bear the CE mark. This mark indicates the motor meets the requirements of construction and safety—*not EMC compliance*.

- Use shielded cabling with braided and bonded headshells.

Parker EMC cabling—requires no additional cable preparation.

All motor connections must be made using a high quality braided-screen cable. Cables using a metalized plastic bandage for an earth screen are unsuitable and in fact provide very little screening. Care must be taken when terminating the cable screen, the screen itself is comparatively fragile; bending it round a tight radius can seriously affect the screening performance. The selected cable must have a temperature rating which is adequate for the expected operating temperature of the motor case.

All cables must maintain high integrity 360 degree shielding. Parker CE cables are fully shielded and provide the required screening. When you install limit switches and other inputs/outputs, you must observe these noise immunity procedures and practices.

- Route cables as shown in Figure 53 Typical LVD/EMC Installation, AR-02xx to AR-13xx on page 181 and Figure 54 Typical LVD/EMC Installation, AR-20xE & AR-30xE on page 182.

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.

Mount filters close to the drive and keep the supply wiring as short as practical. Attempt to layout the wiring in a way that minimizes cross coupling between filtered and non-filtered conductors. This means avoiding running wires from the output of a filter close to those connected to its input. Where you wish to minimize the cross coupling between wires avoid running them side-by-side one another, if they

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must cross, cross them at 90° to each other. Keep wiring supported and close to cabinet metalwork.

- Cables may require the use of ferrite core suppressors.

Some installations may require that you take additional EMC measures. To further increase product immunity and reduce product emissions, you may add clip-on ferrite absorbers to all cables. Parker recommends ferrites with at least 200 ohm impedance at 100 MHz, such as the following:

Steward Ferrite	Part number 28A2024
Fair-Rite	Part number 0443164151

Note: These ferrites are available from Parker Hannifin, part number 47-015956-01.

For larger diameter cables (up to 0.722 in O.D.), Fair-Rite part number 0444176451 is recommended.

- Your Installation may require additional EMC installation hardware (as shown in illustrations).

The following clamp kits are available from Parker:

Clamp Type	Parker Part Number
R-Clamp Kit (10 per) for models AR-02xx to AR-13xx	R CLAMP KIT
R-Clamp Kit (10 per) for models AR-20xE and AR-30xE	R LARGE CLAMP KIT
Clamshell Clamp Kit (2 per) for all models	CLAMSHELL KIT

Table 62 Enclosure Mounting Clamps

Note: The Control power input also requires a mains power line filter, varistors, and fuses in order to comply with the relevant CE directives.

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Panel Installation, AR-02xx to AR-13xx

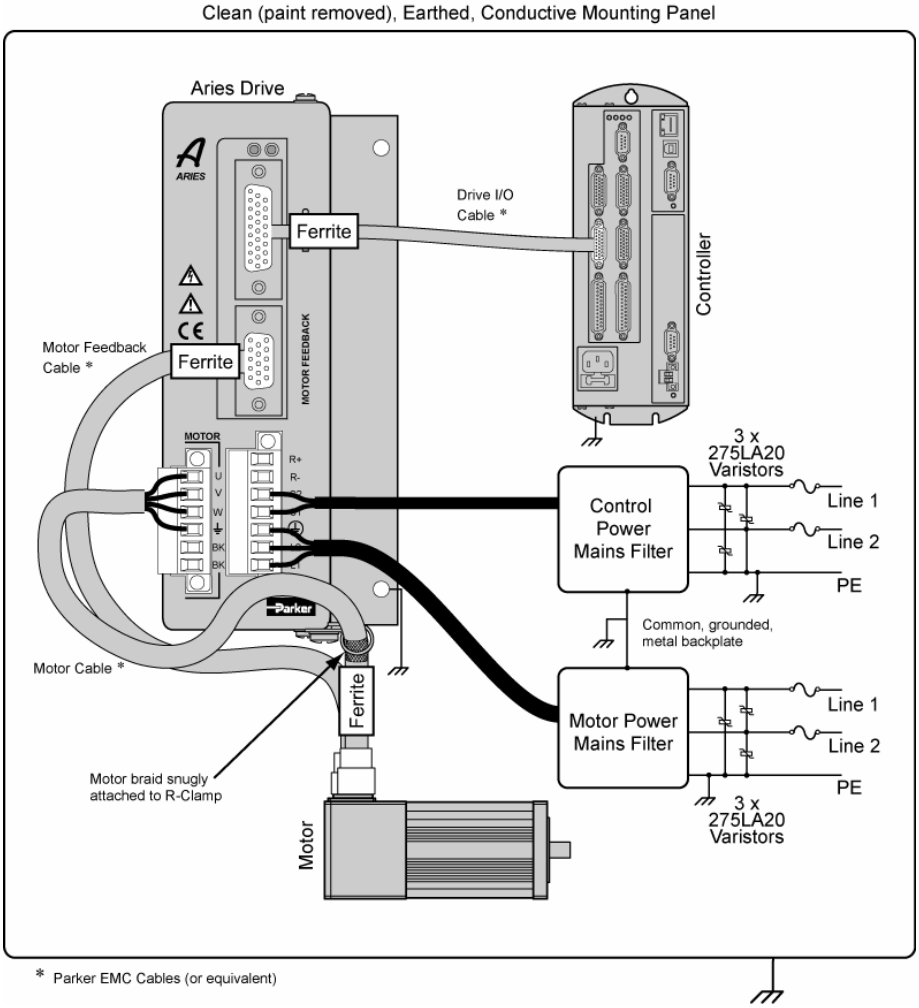


Figure 53 Typical LVD/EMC Installation, AR-02xx to AR-13xx

Warning — This product has been developed for industrial environments. Due to exposed high voltage terminals, this product must not be accessible to users while under normal operation.

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Panel Installation, AR-20xE & AR-30xE

Aries models AR-20xE and AR-30xE require 240 VAC input power and three-phase wiring.

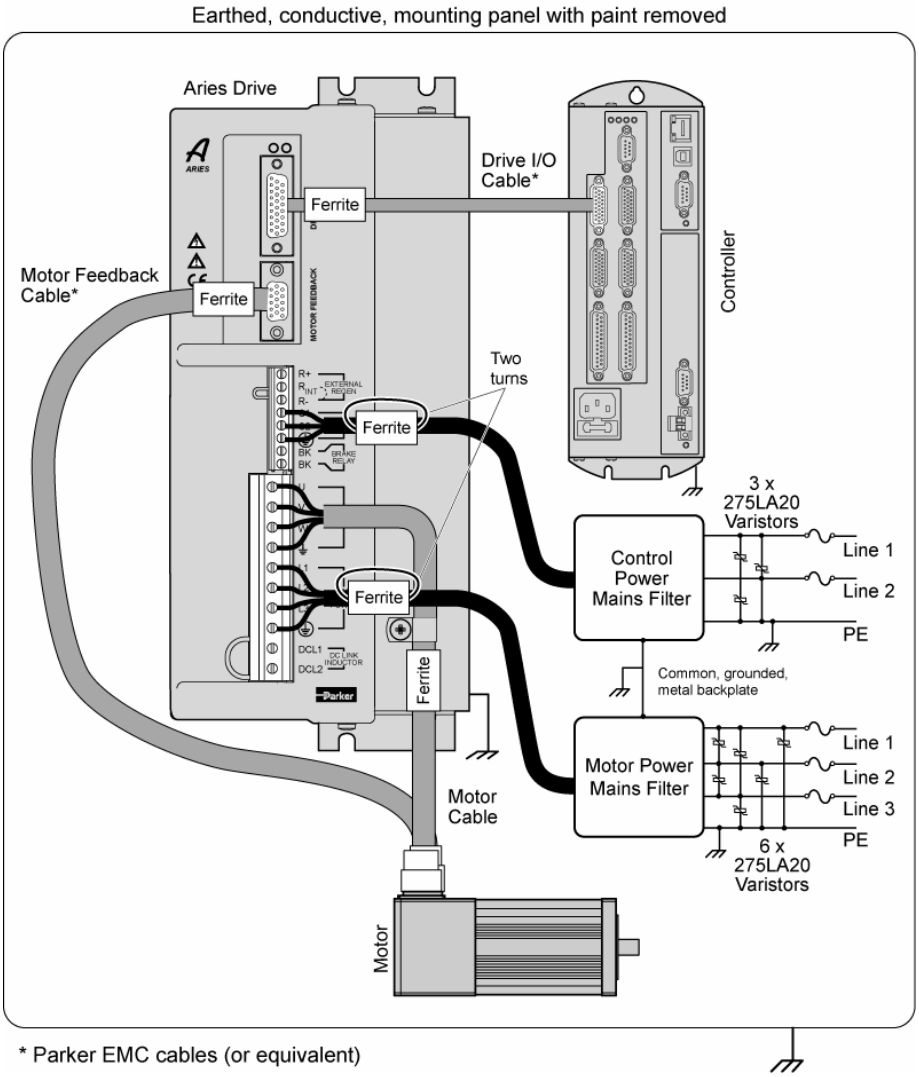


Figure 54 Typical LVD/EMC Installation, AR-20xE & AR-30xE

Warning — This product has been developed for industrial environments. Due to exposed high voltage terminals, this product must not be accessible to users while under normal operation.

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Panel Mounting

The mounting clearance requirements are the same for all Aries drive models. They are shown in Figure 55.

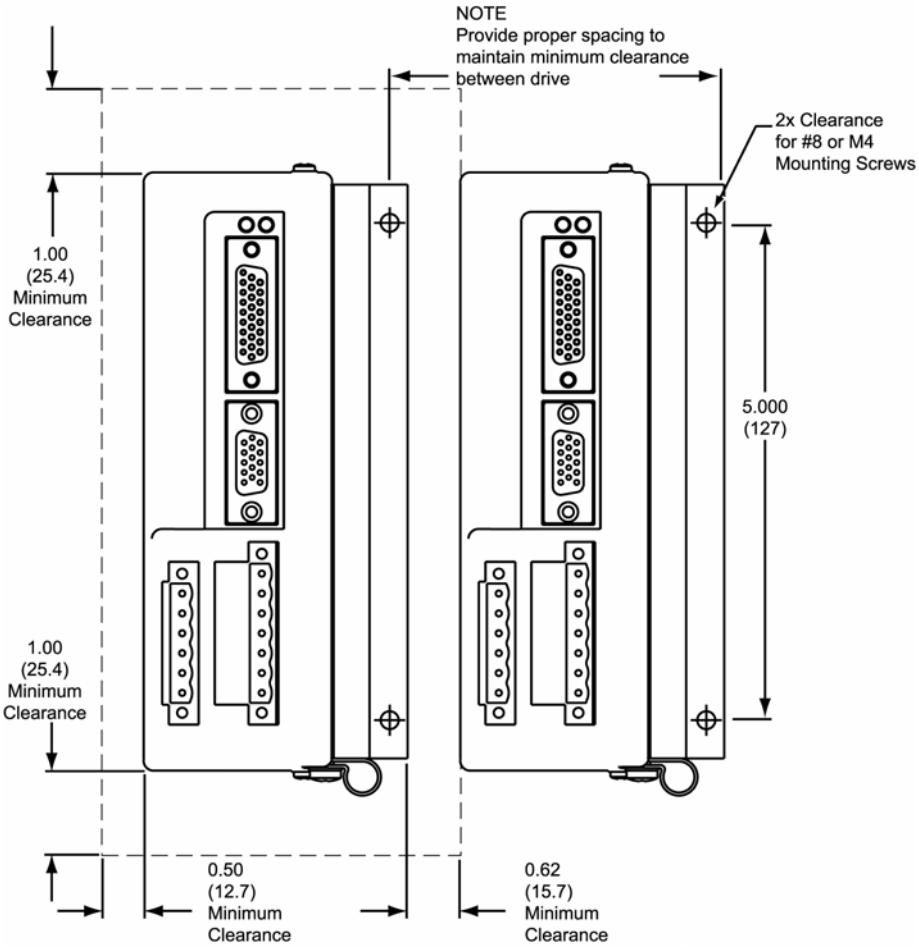


Figure 55 Panel Layout Dimensions for the Aries Drive

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Regulatory Agencies

The Aries family of products is designed to meet the requirements of global regulatory agencies.

Aries products have shown compliance with the regulatory agencies in the following list. The list also shows additional steps users must take to ensure compliance.

Agency	Additional Steps User Must Take
UL,	Mains fuses
CE (LVD)	Mains fuses; earth connection for drive and motor (if applicable), proper installation
CE (EMC)	Varistors, mains filter, EMC cabling, EMC ready motor, proper installation

Table 63 Regulatory Agencies

Standards of Compliance

UL	508C	
CE for LVD	72/23/EEC	
	BS EN 61010-1 (1993) including Amendment A2.	Safety requirements for electrical equipment for measurement, control, and laboratory use. Part 1. General Requirements.
CE for EMC	89/336/EEC	
	BS EN 61800-3 (1997) including Amendment A11	Adjustable speed electric power drive systems Part 3. EMC product standard including specific test methods.
	BS EN 50081-2 (1994) Electromagnetic compatibility	Generic emission standard Part 2. Industrial Environment.
	BS EN 61000-6-2 (1999) Electromagnetic compatibility Part 6-2: Generic Standards	Immunity for industrial environments.

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APPENDIX D

Servo Tuning Flow Diagram

IN THIS CHAPTER
Appendix D Servo Tuning Flow Diagram 185

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Servo Tuning Flow Diagram

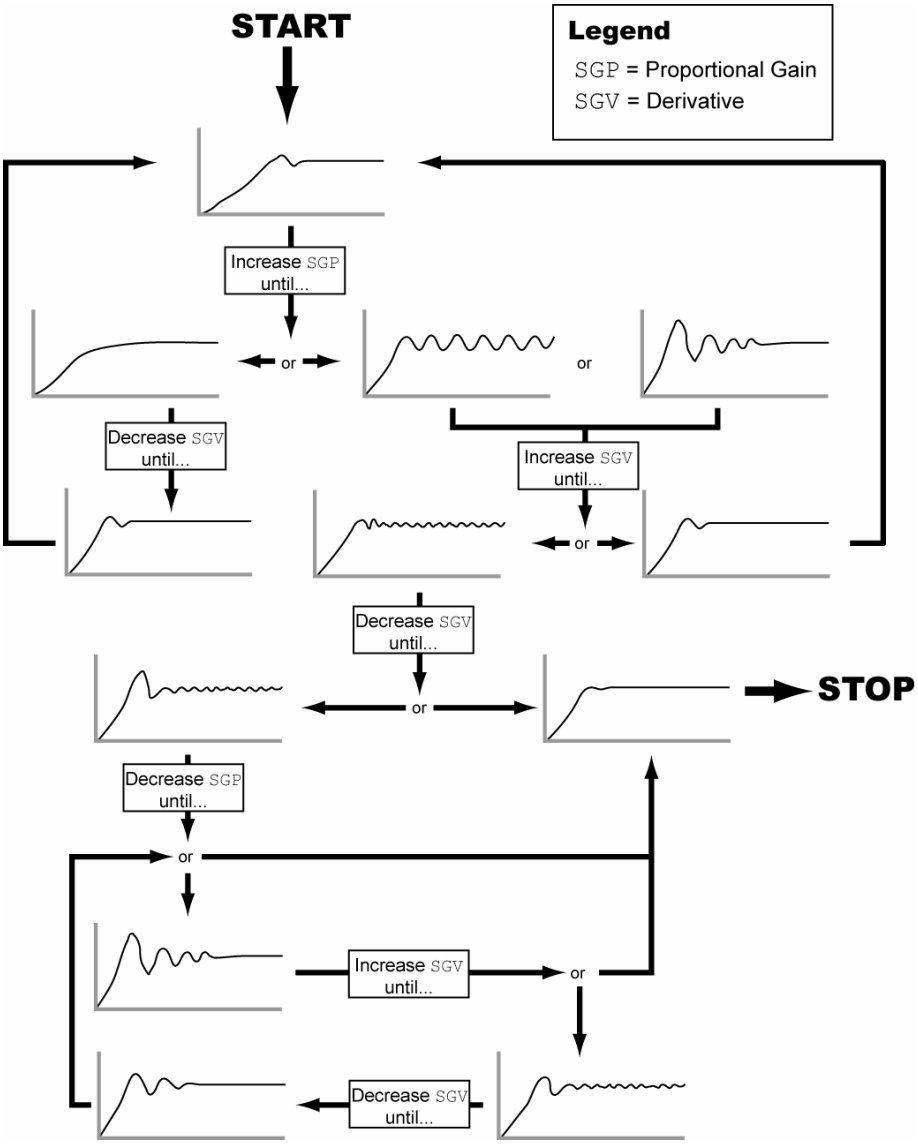


Figure 56 Servo Tuning Flow Diagram

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APPENDIX E

VM26 Expansion Module

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Overview

The VM26 expansion module provides screw-terminal connections for the Drive I/O connectors on the Aries drive. The VM26 comes with a 2-foot cable (609.6 mm) that provides easy connection between the VM26 module and the drive's 26-pin I/O connectors. 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).

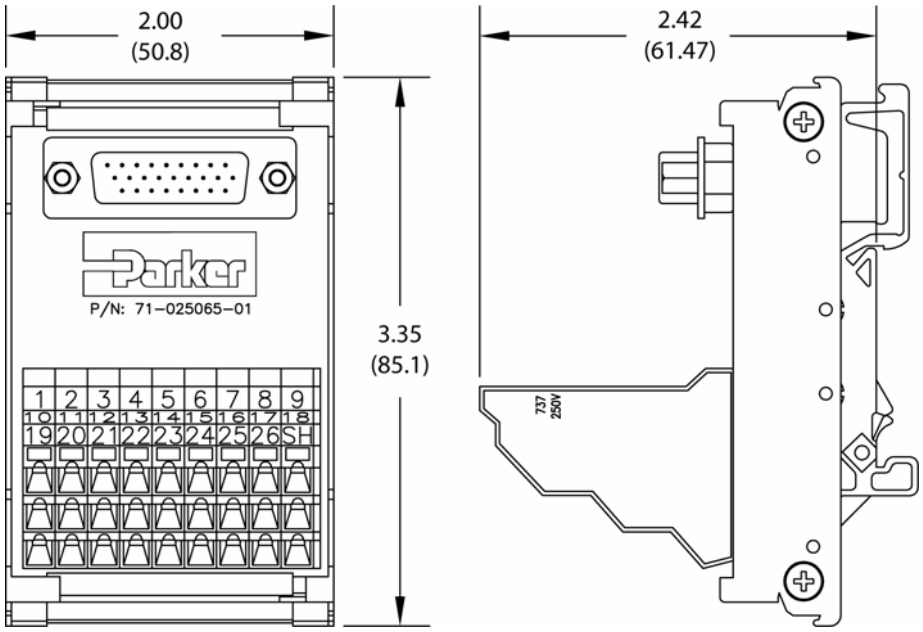


Figure 57 VM26 Breakout Module

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