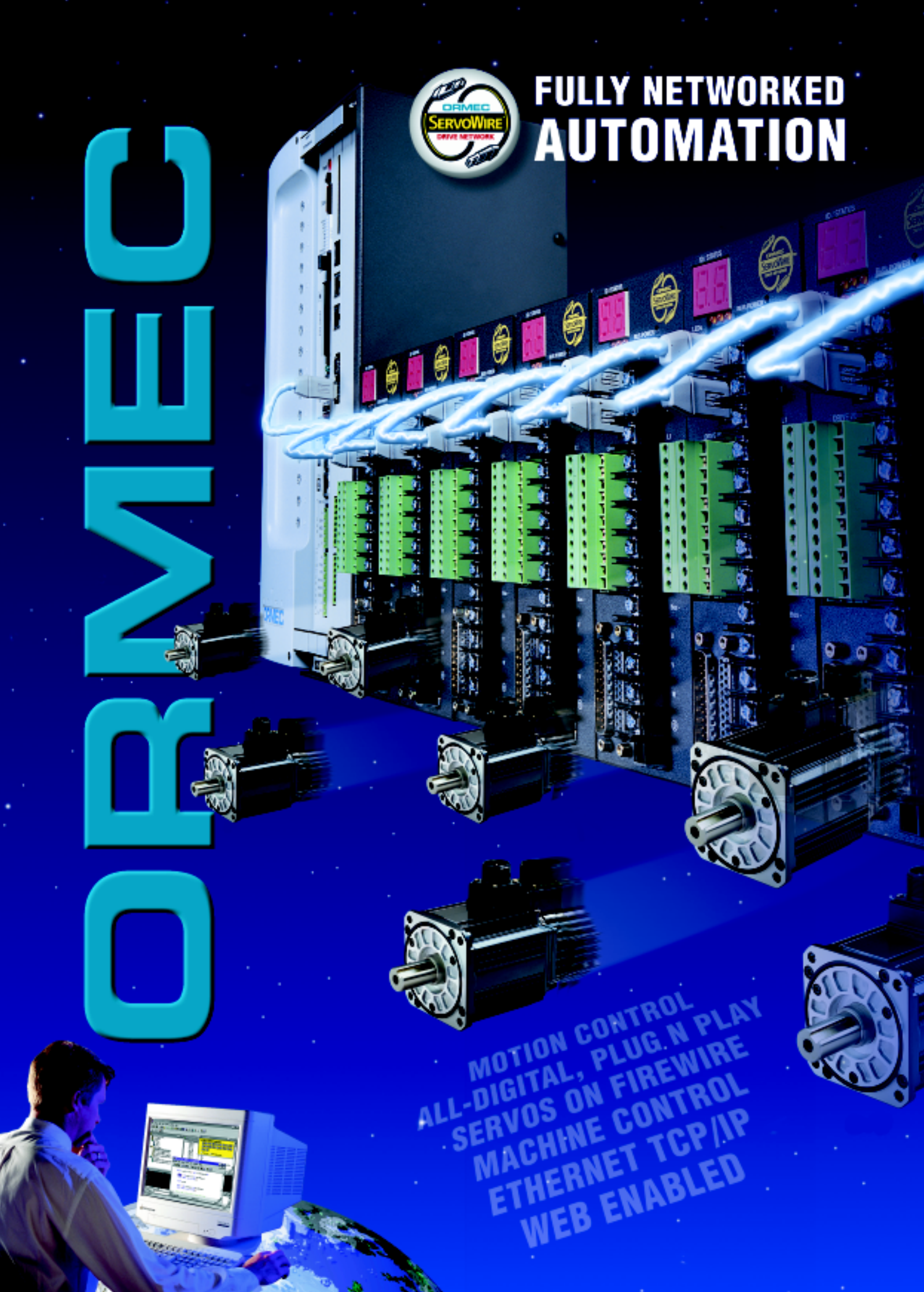
ORMEC

ORMEC SERVOWIRE DRIVE NETWORK

FULLY NETWORKED AUTOMATION



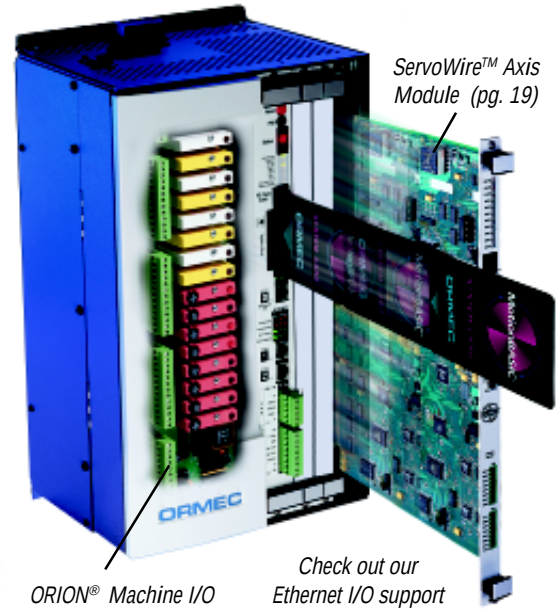
MOTION CONTROL
ALL-DIGITAL, PLUG N PLAY
SERVOS ON FIREWIRE
MACHINE CONTROL
ETHERNET TCP/IP
WEB ENABLED

ORMEC ORION® PRODUCTS

Check out the ORION® Products Overview beginning on page 3.

INDUSTRIAL PC-BASED CONTROLLERS

Overview on pages 3, 8-9.



ServoWire™ Axis Module (pg. 19)

ORION® Machine I/O (pgs. 5, 21)

Check out our Ethernet I/O support (pages 23-24)

ORION® Industrial PC-based Controllers

The ORION® family of products is a fully integrated set of hardware and software products for servo-driven automation control projects. ORION® utilizes industry-standard hardware (PC motherboards including Intel architecture processors up to the Pentium 233 MMX and Ethernet adapters) plus open standards (IEEE-1394, PC Cards and TCP/IP communications) to create value for customers. (pgs. 8-9,16)

ServoWire™ Drive Network

ORION® controllers utilize the ServoWire™ drive network to implement a 200 Mbps all-digital network for real-time servo communications. ServoWire™ eliminates the ±10 volt analog interface & dramatically reduces total installed system cost. (pgs. 8, 43-46)

MotionBASIC® System Card (pg. 25)

SOFTWARE

Overview on pages 3, 10-15.

ORION® Software Development & Programming Tools

ORMEC provides an integrated set of Windows-based development tools for motion control project development and touchscreen interface design. All software required for an ORION® application is stored on removable Flash System PC Card.

- *MotionDesk™ development environment for motion projects ..... pg. 27*
- *QuickDesigner touchscreen panel layout and object editor ..... pg. 32*
- *MotionBASIC® to program motion, I/O and communication needs ..... pg. 29*
- *MotionBASIC® Extensions (MBXs) provide software connectivity to AB Ethernet, Modbus TCP, Profibus DP and more. ..... pg. 36*

HMIs

Overview on page 7.

QuickPanel Touchscreens

Hardware panels and design software for creating effective touchscreen interfaces. Available in sizes from 5 to 12.1 inches, QuickPanel touchscreens provide a cost effective interface that is highly integrated with the ORION® controller. (pg. 34)

COMMUNICATIONS

Overview on page 6.

ORION® Connectivity Options

The combination of TCP/IP and standard Ethernet hardware and protocols provide outstanding connectivity to PLCs and PCs running popular HMI software --- plus popular Ethernet I/O products. Plus ORION® will co-exist on any TCP/IP Ethernet network already implemented.

Ethernet I/O Support ..... pg. 23
Snap Ethernet I/O ..... pg. 24
A-B Ethernet ..... pg. 36
Modbus TCP ..... pg. 38
Profibus DP ..... pg. 41

SERVOS

Overview on page 4.

ServoWire™ Digital Drives & AC Brushless Servomotors

"Servos on FireWire™" brings a new level of performance, ease of use and low cost to servo systems using IEEE-1394 communications.

ServoWire™ drives provide all-digital torque mode operation, and excellent performance with two series of brushless servomotors

ServoWire Digital Drives ..... pg. 43
Servomotor Overview ..... pg. 47
G-Series Servomotors ..... pg. 51
D-Series Servomotors ..... pg. 64
Pacer Encoders ..... pg. 75

A Fully-Integrated Automation Control Solution

Combining Open Standards, Industrial PC-based Control, Servos, Machine I/O, Human-Machine Interfaces (HMIs) & Connectivity

ORION®
AUTOMATION CONTROL

The goal of ORION® automation control is to offer an industrial PC-based platform for multi-axis motion control applications including servos, machine I/O, Human-Machine Interfaces (HMIs) and connectivity.

A fully-integrated control solution provides hardware and software building blocks that are engineered to plug together and work as a system.

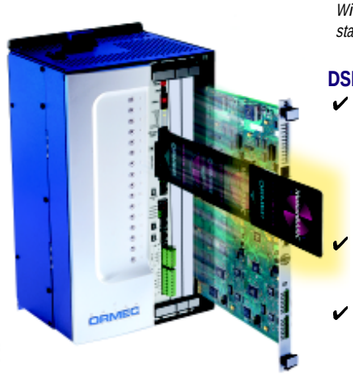
ORMEC utilizes industry-standard PC hardware (motherboards and Ethernet adapters) and open standards (IEEE-1394, PC Cards and TCP/IP) to create increased value for its customers.

ORION® and the ServoWire™ Drive Network provide state-of-the-art automation and motion control for up to 32 axes --- and provides solutions for interfacing the servo system with machine I/O, HMI & connectivity requirements.

Industrial PC-Based Controller

- ✔ Fully-integrated, Industrial PC-based platform for effective multi-axis servo control of up to 32 axes
- ✔ Pentium Power: a family of X86 compatible microprocessors up to 233 MHz Pentiums
- ✔ Two PC Card slots: one dedicated for Flash RAM MotionBASIC® System Card; one available for memory card or communications.
- ✔ Industrially-hardened

TCP/IP development communications support serial connections, standard Windows Networking and a variety of standard Ethernet hardware.



DSP-based Axis Control

- ✔ ServoWire™ Axis Module controls 1 to 8 axes. Servo loop update rates selectable based on application requirements (2 kHz for 8 servos; 4 kHz for 4 servos)
- ✔ ServoWire™ interface provides high speed serial bus for servodrive network.
- ✔ Plug-N-Play: No Axis Module switches to set. Axis IDs are selected on ServoWire Drives as assigned in MotionDesk.
- ✔ No customer configurable jumpers to set.
- ✔ Optional four or eight 12-bit analog inputs
- ✔ Multi-processor architecture: ORION® tightly integrates main Intel processor to ServoWire™ Axis Modules via dual port RAM. A high-speed Texas Instruments digital signal processor (DSP) on axis card provides real-time servicing of servo system.

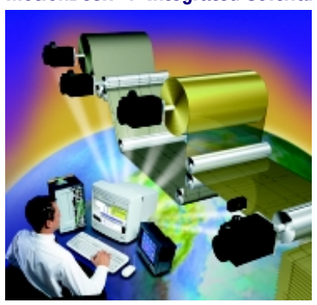
Integrated Software Approach

All ORION® software loads and runs from the MotionBASIC® System Card. Both the MotionBASIC® real-time operating system and user application software are stored on the Flash RAM PC Card.

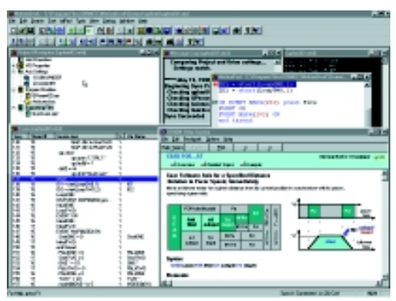
As user applications are developed, program modules, supporting files (e.g., touchscreen panels) and configuration files are loaded on the PC Card. Since all the software for the system is on the Flash Card, users can deploy, monitor and upgrade software worldwide (including operator adjustments) --- via a remote TCP/IP link or by changing the PC card at the machine location.

ORMEC provides a suite of software development tools to help create, manage and maintain motion control projects. (1) MotionDesk is a Windows compatible integrated development environment for motion control; (2) MotionBASIC® is a superset of Microsoft BASIC with enhancements for motion and I/O control; (3) QuickDesigner is a potent tool for developing touchscreen panel applications and; (4) MotionBASIC® Extensions (MBXs) add language capabilities including software for connectivity.

MotionDesk™: Integrated Software Development



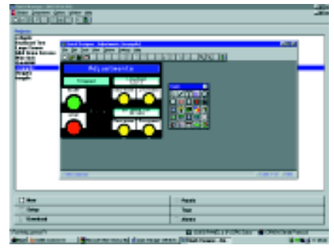
- ✔ Outstanding software tools for motion project management.
- ✔ Wizards simplify set-up/configuration of machine and system parameters.
- ✔ Powerful MotionPad Editor includes dynamic "data tips" for variables and multi-document searching.
- ✔ Integrated tools for tracing, debugging, console communications
- ✔ Automatic synchronization between development computer & ORION®
- ✔ Dynamic display and adjustment of tuning parameters
- ✔ Effective tools to upgrade software via ORMEC User website.
- ✔ VCR-like icons used to control program execution.
- ✔ MotionDesk™ can be run remotely over Ethernet or by using standard Windows Networking.



Complete desktop for developing motion control applications.

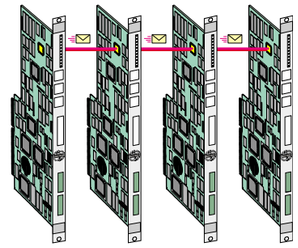
QuickDesigner: Touchscreen Panel Development

- ✔ Easy to use panel layout and object editor allows you to build graphical panels with "drag and drop" objects.
- ✔ Panel objects easily mapped to variables (bit & word data, strings, I/O) for elegant background communications to both ORION® and PLCs that support RS-485 Modbus.
- ✔ Outstanding design tools, control objects library, project management tools

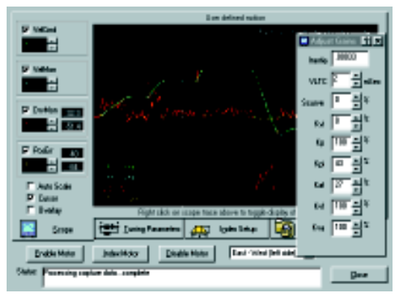


MotionBASIC®: Power, Flexibility & Ease of Use

- ✔ Simple, flexible, modern MotionBASIC® programming provides software for motion and I/O control -- plus communications needs.
- ✔ Motion control software ideally suited for high-speed, line-oriented, repetitive manufacturing operations.
- ✔ MotionBASIC® gearing has added software programmability to thousands of electronic lineshafts. Delivers precise, repeatable performance with ability to easily superimpose motion. Configurable for a variety of gearing topologies.



MotionDATA™ broadcasts real-time position data between Axis Modules during each position loop update for precise master/slave, multi-axis control.



Unique motion profiles can be dynamically displayed using "AxisTune" -- and adjusted for optimal system performance.

- ✔ Electronic cams: Position-based cams and time-based profiles
- ✔ Blended moves: Ability to "move through" defined positions provides power for cartesian-coordinate material handling, metal-working and robotic applications.
- ✔ Concurrency: Software is simplified by designing independent machine operations as program threads. Priorities assign processing power to individual threads--effectively distributing the processing power of ORION®.
- ✔ The Power of MotionBASIC®: The world's most widely used programming language---BASIC---enhanced for industrial automation applications. Ability to get the job done when other programming methods can't. Easy to learn and master, easy to support in the field.

www.ormec.com
Check out ORMEC's website for the latest on software products, applications literature, presentations & more!

SERVOS

SERVOWIRE™ OFFERS PERFORMANCE, EASE OF USE & LOW COST

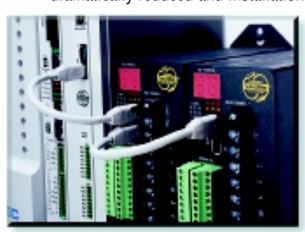
ORMEC offers a powerful approach to networking servodrives using open standard IEEE-1394 communications … "Servos on FireWire™".

The ServoWire™ Drive network provides a high-speed (200 megabits per second), real-time, serial communications link between each ORION® ServoWire Axis Module and up to eight servodrives and servomotors.

ServoWire replaces the standard plus/minus 10 volts analog servodrive interface with a new all-digital interface. This high response, digital control network incorporates both servos, pacer encoders, high speed sensors, I/O and programmable limit switches … offering performance, flexibility and ease of use.

ServoWire™ Overview

- ✔ Servodrive network implemented using open standard IEEE-1394 (also known as FireWire™) communications technology.
- ✔ High performance: ServoWire's "tree-structured" network operates at 200 Mbps. The servo loop update is selectable from 1-5 kHz based on number of servodrives per ServoWire Axis Module. IEEE-1394 provides isochronous data transfers to guarantee real-time network determinism. Asynchronous communications provide application flexibility.
- ✔ Easy to Use: IEEE-1394 provides true Plug N Play functionality. All motion control and drive parameters are software-driven. No configuration jumpers or DIP switches. Field replacement of drives has never been easier.
- ✔ Low cost: Digital interface replaces bulkier drive interfaces. Wiring costs are dramatically reduced and installation is simplified.



ServoWire™ digital servodrives.

ORMEC's AC brushless servomotors and ServoWire™ digital torque-mode servodrives offer tested and guaranteed performance with the ORION® controllers. The result is maximum performance from a tightly integrated, pre-engineered package that simplifies everything from system integration to maintenance.

Fully digital control offers compelling benefits---eliminating manual servodrive set-up and providing real-

time software access to all parameters. ServoWire drives provide motor output torque proportional to a 16-bit drive command variable. In an ORION® positioning system, position and velocity loops are closed by digital signal processors on the ServoWire® Axis Modules. Velocity observer software eliminates the need for analog tachometers, and potentiometers are eliminated since all gain and compensation parameters are set in software. All loop adjustments are automatically computed when a motor and its load inertia are specified in MotionDesk™ --- greatly simplifying servo system tuning.

G-Series AC Brushless Servomotors.

ServoWire® drives offer output current from 3/6 to 60/120 amps (continuous/peak current), and feature sinusoidal or trapezoidal commutation, smart IGBT power blocks and totally software configured operation.

Drive I/O provides high speed sensors, hardware overtravel switches and programmable limit switch outputs.

Full Range of Servomotors and Drives

- ✔ Continuous stall torques from 3 to 665 lb-in (0.32 to 75 N-m)
- ✔ Speeds up to 7,000 RPM; feedback up to 32,768 counts/rev
- ✔ Performance: High torque-to-inertia ratios and excellent continuous/peak torque performance in a compact package
- ✔ Drive I/O: three high speed sensors, hardware overtravel switch inputs and six programmable outputs per drive
- ✔ Drives offer optional auxiliary encoder interface for pacer position feedback, analog velocity and torque monitors and support for delay counters
- ✔ Optional multi-rev absolute encoder tracks position while power is off.
- ✔ UL and CE Approvals

MACHINE I/O

SPEED, FLEXIBILITY & OPTIONS FOR I/O INTERFACES

ORION® provides a multi-tiered, flexible approach to meeting machine I/O requirements. It offers a unique ability to interface high speed drive-based I/O for microsecond level response to registration sensors. It also provides sub-millisecond programmable limit switch outputs that are tightly coupled to the motion control.

General purpose I/O resources include 16 integral discrete I/O (can serve as high-speed MotionBASIC® interrupts) and an Extended I/O interface for 24 additional discrete I/O.

Ethernet I/O options are fully supported in both ORMEC's development and programming software. Use a variety of industry -standard Ethernet hardware like Opto 22 Snap Ethernet I/O, Momentum TSX or Sixnet EtherTrak, and take advantage of ORION's Ethernet communications features.

Snap Ethernet I/O

Options for Machine I/O Control

- ✔ 16 built-in discrete I/O, software configuration options include usage as MotionBASIC® interrupts
- ✔ Ethernet-based I/O options fully supported by ORMEC software include Opto 22 Snap Ethernet I/O, Momentum TSX and Sixnet EtherTrak.
- ✔ Optional I/O expansion connector provides access to 16 or 24-slot racks
- ✔ Each ServoWire Drive provides high speed sensor inputs, programmable limit switch outputs, additional configurable outputs and hardware travel limit inputs. ServoWire Axis Modules provide optional analog inputs.
- ✔ ORION® Connectivity Options include cost-effective Allen-Bradley Ethernet, Modbus TCP and Profibus for access to a wide variety of popular PLCs. PLC registers are easily mapped to MotionBASIC® variables providing elegant background communications.

CONNECTIVITY

EVERY MACHINE CAN BENEFIT FROM CONNECTIVITY

Standard factory networks and PC-based hardware solutions are creating more factory connectivity options than ever before. ORION® not only supports standard PC hardware, but also provides the *software connectivity* to simplify communications in your application.

Standard Ethernet factory network protocols provide connectivity to:

- ✔ Popular PLCs like the A-B SLC and Modicon Quantum
- ✔ PC-based HMI packages like Wonderware, Intellution (Fix), US Data (FactoryLink) and CI Technologies.
- ✔ Vision systems like DVT SmartSensors
- ✔ Ethernet I/O and a growing number of other devices from a wide variety of automation control suppliers.

MotionBASIC Extensions

The most recent additions to ORMEC's factory connectivity line-up are MotionBASIC® Extensions (MBXs) for Allen-Bradley Ethernet and Modbus TCP communications. Utilizing industry-standard Ethernet hardware — an ISA bus or PC Card adapter — A-B Ethernet or Modbus TCP communications provides an inexpensive and fast connectivity solution.

Using the A-B Ethernet or Modbus TCP communications MBX, ORION® can simultaneously operate in client and server modes. The architecture allows peer-to-peer communications, high performance and low cost. The Modbus TCP communications scheme is similar to Modbus, using register-based mapping to access variable values including long, float and strings.

Benefits and Uses of Connectivity

- ✔ Interface to a variety of PLCs: integrate ORION® into system architectures that incorporate industry standard PLCs --- and other compatible factory network devices.
- ✔ Communicate with standard HMI packages: PC-based HMI packages integrate seamlessly with ORION®. ORMEC's MAP software implements effective communications using register-based background communications.
- ✔ Remote Development, Maintenance and Reporting: the benefits of remote development communications, diagnostics and maintenance, and production scheduling, monitoring and reporting. Use of widely accepted protocols using TCP/IP as a base network technology.

ORION® Connectivity Overview

Options	Speed	Cost	Uses	Advantages
Allen-Bradley Ethernet	10M	Low	Versatile**	Low cost, fast, standard, versatile, A-B PLC, HMI & remote connectivity
Modbus TCP	10M	Low	Versatile**	Low cost, fast, standard, versatile, Quantum PLC, HMI & remote connectivity
Profibus DP Slave	12M	Medium	I/O, Data	Siemens PLC, HMI connectivity, interface wide range of Profibus devices
Data Highway/Plus	230.4K	High	Data, I/O	Connectivity to Allen-Bradley PLCs and HMI options
Modbus	115.2K	Low	Data, I/O	Low cost, master/slave protocol, Modbus & HMI connectivity
A-B SLC-500 (DF1)	19.2K	Low	Data, I/O	Low cost, low performance point-to-point interface to A-B SLC-500 PLCs
GE Genius	153K	High	Data, I/O	Global data/datagram communications to GE 90-70 and 90-30 PLCs
S908 Remote I/O	1.5M	High	I/O, Data	Remote I/O communications extended with Modbus messaging

***Unlike typical factory networks, A-B Ethernet or Modbus TCP communications can co-exist on a corporate LAN or intranet, combining usual factory network functionality with remote development, maintenance and reporting over the LAN.*

Remote Development, Maintenance & Reporting

The combination of TCP/IP, Ethernet and standard Windows networking is radically changing the cost and attractiveness of remote connectivity for factory automation.

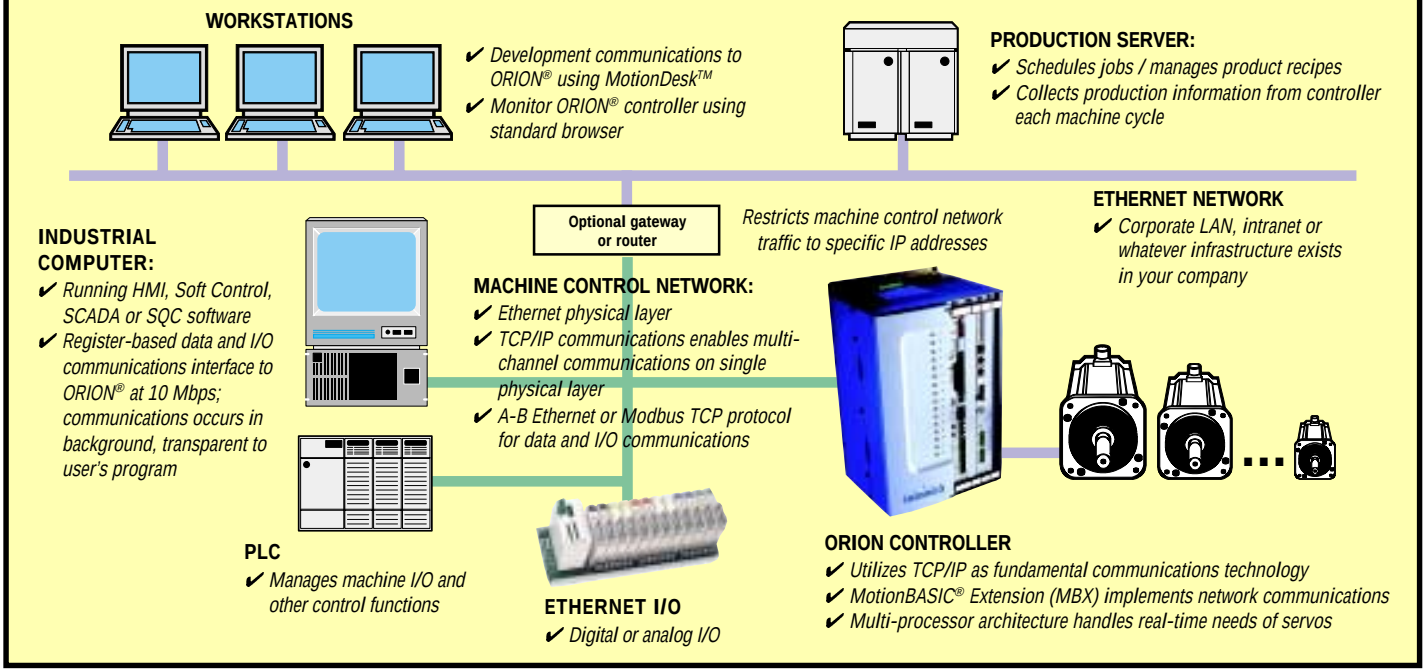
Nearly all automation systems can benefit from the ability to perform remote development, maintenance and reporting, but now the cost & complexity of achieving these goals is low.

Benefits

- ✔ High-speed development communications --- from your office desktop computer to support automation anywhere in the world.
- ✔ Use ORMEC's development tools on a remote link (LAN, intranet or modem connection) to upgrade firmware, tune servo loops, update software, change machine set-up & more.

- ✔ Continue to perfect machine application software after machine is in production.
- ✔ Reduce service calls by running diagnostic software & implement software changes via remote link.
- ✔ View/monitor system operation while machine is operating.
- ✔ Download production schedules and recipes to ORION® controller using standard FTP software.
- ✔ Browse your ORION® controller using Internet Explorer or Netscape Navigator. New ORMEC "Web Tools" eliminate programming and are easily integrated into any project.
- ✔ Collect production management and statistical reports: access via browser or interface to database.
- ✔ Utilize built-in TCP/IP sockets and interface to Visual BASIC, Java, Access, Excel and other programs.

Using Ethernet Factory Networks for HMI, Soft Control, Remote Connectivity & I/O



The architecture of an ORION®-based automation system can be easily adapted to individual system requirements by using one of ORMEC's connectivity options. The example above illustrates an Ethernet network, and how ORION® can be interfaced to a wide variety of factory automation applications including PLCs, popular HMI packages and others. ORION® and either A-B Ethernet or Modbus TCP communications (implemented in ORION® as a MotionBASIC® Extension) has the added advantage that, since the physical layer is industry-standard Ethernet hardware, it will co-exist on any TCP/IP Ethernet network already implemented. It provides connectivity for remote development, maintenance and reporting, and takes full advantage of your company's computer infrastructure.

HMIs

GRAPHICAL TOUCHSCREEN INTERFACES

ORMEC's QuickPanel touchscreen panels offer an outstanding, cost-effective operator interface for servo control applications.

QuickPanels and the QuickDesigner development system are fully integrated with MotionDesk™ and ORION. They provide the ability to develop and maintain attractive panels to increase operator effectiveness, and add programmable functions to your machine design.

Open standards and ORMEC's connectivity options also make it simple to interface ORION® with popular PC-based HMI products (Wonderware, Intellution, U.S. Data, CI Technologies, etc.) by utilizing industry-standard factory communications.

Human-Machine Interfaces

- ✔ QuickPanel touchscreens available in sizes from 5-inches to 12.1 inches, and resolutions up to 800 x 600 pixels. Options for monochrome/color. RS-422/485 communications with ORION®.
- ✔ Handheld QuickPanel provides effective teach pendant solution.
- ✔ Keypad adds 15 data entry & 26 function keys to 5/6-inch models.
- ✔ ORION® Connectivity (A-B Ethernet, Modbus TCP, Profibus DP, Data Highway/Plus, Modbus, GE Genius and others) can be used to communicate data and I/O to industrial PCs running popular HMI software. Mapping PLC registers to MotionBASIC® variables provides elegant background communications transparent to user's program.

FREE CD-ROM

Free Multimedia CD-ROM

Our new ORMEC Multimedia CD-ROM includes a 31-minute presentation of our ORION Industrial PC-based controllers and new ServoWire Drive Technology. The presentation is interactive, and allows you to explore factory automation topics at your leisure using a exciting, information-packed environment. Here is a listing of the topics covered:

ORION Overview (approximately 13 minutes)
- ❒ Introduction to Industrial PC-based Controllers
- ❒ Motion Control Software and Development Tools
- ❒ Solutions for Operator Interfaces
- ❒ Factory networking solutions using Ethernet & TCP/IP
- ❒ Remote connectivity to ORION automation systems

ServoWire Overview (approximately 18 minutes)
- ❒ Introduction to ORMEC's new drive networking technology
- ❒ What is IEEE-1394?
- ❒ How ServoWire Works, Architectural overview
- ❒ ServoWire Technology: Fast, Digital, Consistent, Flexible, Plug N Play, Easy to Install, Low Cost

Call ORMEC today at: **1 (800) 656-7632**

In Europe, call: **+41 (1) 420-1300**

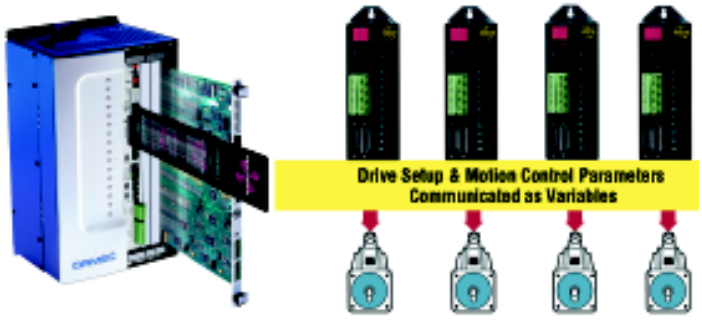
All-digital, scalable architecture

System architecture offers all-digital performance, ease of use, scalability and distributed processing.

The combination of ORION® Industrial PC-based controllers and the ServoWire® network provides a unique and effective architecture for automation control systems.

Most importantly, it provides compelling benefits for servo-driven automation:

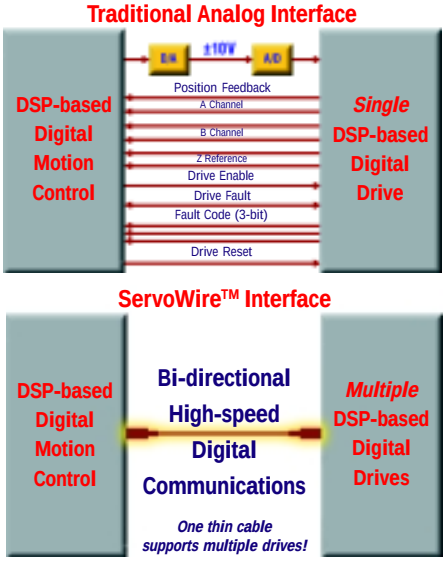
- ✔ **All-Digital Operation:** All drive setup and motion control parameters are defined in software and are managed on a high speed serial network. Manual adjustments, jumpers and switches are eliminated.



- ✔ **Flexibility & Scalability:** Use of industry standards provides you *choices* on selection of machine I/O, PLCs, operator interfaces and factory network connectivity. Plus, an ORION® system easily and cost-effectively expands up to 32 axes without sacrificing servo performance.
- ✔ **Distributed, real-time control:** ORION® utilizes a multi-processor architecture featuring Intel architecture main processors and DSP-based axis control for servicing the real-time needs of the servo system.
- ✔ **Low Cost:** The digital interface replaces bulkier traditional drive interfaces --- dramatically reducing wiring costs and providing installation simplicity.

ServoWire™ is all-digital.

The ServoWire™ Drive Network provides a high-speed (200 Mbps), real-time, serial communications link between an ORION® controller and up to 32 axes. Each ServoWire™ Axis Module interfaces up to eight servomotors and/or pacer encoders.



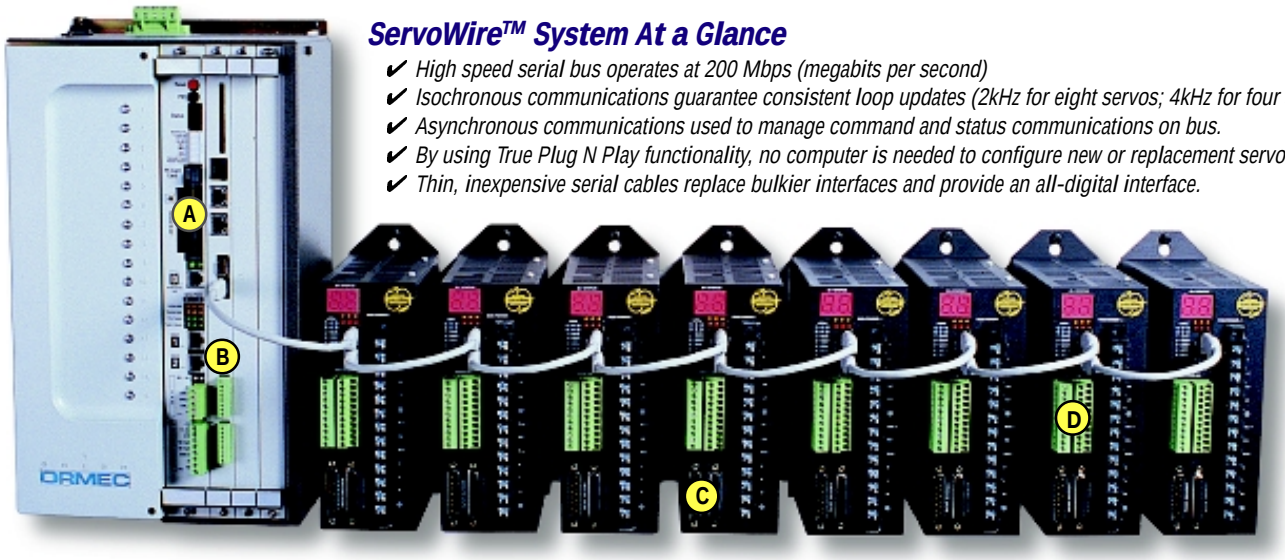
ServoWire™ replaces the standard plus/minus 10 volts analog drive interface with a new all-digital interface. This high response, digital control network supports servos, pacer encoders, high speed sensors, I/O and programmable limit switches … offering performance, flexibility & ease of use.

No more digital-to-analog conversions at the controller, and no more analog-to-digital conversions at the servodrive. When most controllers are powered by DSPs, and all the modern servodrives are also DSP-based, it's obvious that digital communications between them makes sense. But until now, high cost and lack-of-speed have kept most servo installations mired in analog transmission of servodrive commands, and using phase-quadrature position feedback.

Digital communications allow all drive parameters in a

ServoWire™ System At a Glance

- ✔ *High speed serial bus operates at 200 Mbps (megabits per second)*
- ✔ *Isochronous communications guarantee consistent loop updates (2kHz for eight servos; 4kHz for four servos)*
- ✔ *Asynchronous communications used to manage command and status communications on bus.*
- ✔ *By using True Plug N Play functionality, no computer is needed to configure new or replacement servodrives.*
- ✔ *Thin, inexpensive serial cables replace bulkier interfaces and provide an all-digital interface.*

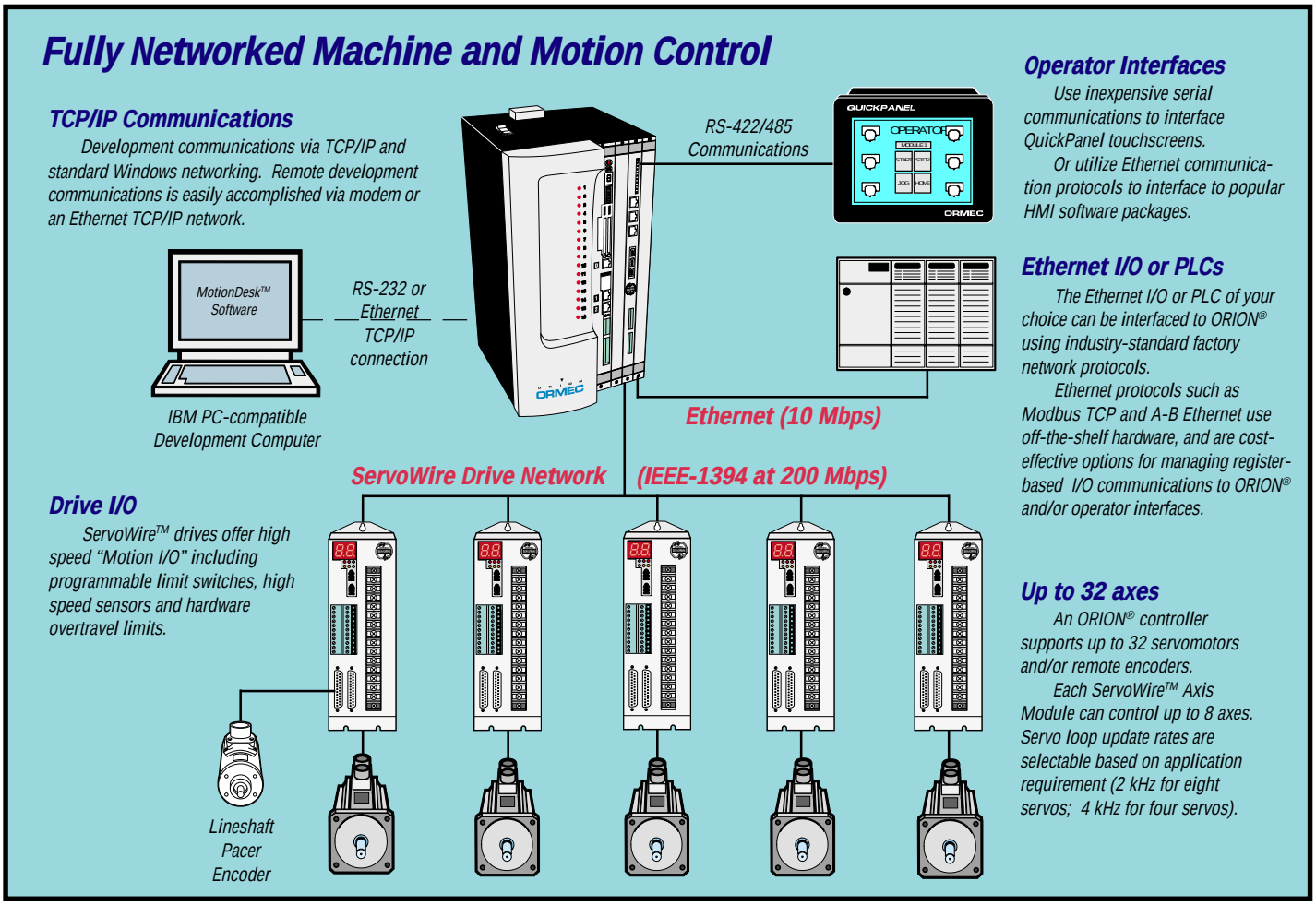


A *ServoWire™ replaces all physical settings --- jumpers, potentiometers, ID switches --- with software stored on a removable PC Card.*

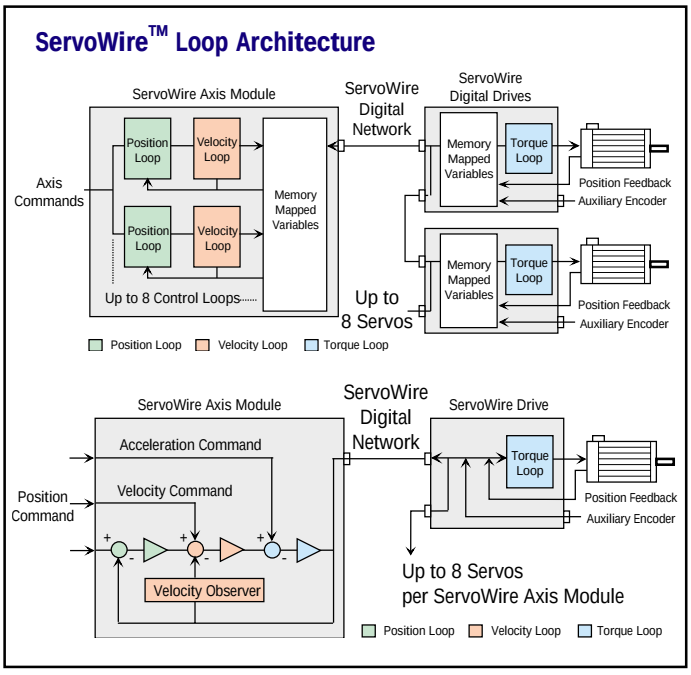
B *ServoWire™ Axis Module provides DSP power for up to eight servos --- and optional 12-bit analog inputs.*

C *Convenient interfaces for position feedback from remote encoder and feedback from servomotor.*

D *ServoWire™ Drive I/O provides ten high-speed I/O points to support sensors, hardware overtravel limits, programmable limit switches, etc.*



Use of industry standard hardware and software (ISA bus, Ethernet adapters, TCP/IP, IEEE-1394 and standard factory network protocols) in an ORION® system provides flexibility and scalability when specifying your solution for machine I/O control, operator interfaces, PLCs and factory network connectivity.



ServoWire™ (top diagram) uses IEEE-1394 to create a potent architecture for multi-axis motion control and synchronization. The system uses an IEEE-1394 memory mapped model where all drive setup and motion control parameters are defined as software variables and communicated in real-time.

Position and velocity loops (bottom) are closed in the ServoWire Axis Module by transmitting digital torque control and reading position feedback over the ServoWire network. Up to 8 simultaneous torque commands are transmitted to the drives digitally as 16-bit variables, eliminating the cost and limitations of traditional D-to-A converters and analog torque signals.

ServoWire™ system to be defined in software ... not by potentiometers. At startup, setup parameters are delivered automatically by the controller if required --- reading them from the system PC Card --- a fact that greatly simplifies installation of a replacement drive in the field.

Advantages of ORION®/ServoWire™ Architecture

- ✔ **Networked Servodrives:** Servodrive network communications implemented using open standard IEEE-1394 (FireWire™) communications technology eliminates traditional ±10 volt analog drive interface.
- ✔ **Performance:** Serial bus operates at 200 Mbps. Servo loop updates based on number of drives on network (2kHz for 8 axes; 4kHz for 4 axes) as well as software features enabled. IEEE-1394 guarantees real-time network determinism & provides bandwidth for communication transfers.
- ✔ **Ease of Use:** IEEE-1394 provides true Plug N Play. All motion control & drive parameters are software-driven. No physical settings or off-line computer setup required---simplifying field replacement of drives.
- ✔ **Multi-processor architecture:** Main Intel architecture processor processes MotionBASIC® and is interfaced to digital signal processor (DSP) on the ServoWire™ Axis Module via a shared memory interface. The DSP handles the real-time servicing of the servo system.
- ✔ **Flexibility and scalability:** ORION® architecture and use of PC technology provides wide range of options when specifying machine I/O, operator interface and factory network connectivity.
- ✔ **Industry-standard factory networking:** Use of standard PC hardware provides cost effective physical layer. Industry-standard factory network protocols --- especially A-B Ethernet and Modbus TCP --- provide connectivity to major PLC and HMI suppliers such as Wonderware, Intellution, U.S. Data and CI Technologies.
- ✔ **Remote Connectivity:** The combination of TCP/IP, Ethernet and Windows networking provide a low cost method to implement remote communications for development, maintenance and reporting.

Easy to use software tools

Software tools provide integrated development environment for automation control projects.

ORION® software is developed using an elegant, easy to learn and master, Windows interface.

The MotionBASIC® System Card stores all the software required for your application.

QuickPanel screens are easily integrated into an ORION® project.

ORION® supports standard hardware for a variety of communication needs.

INTEGRATED SOFTWARE ENVIRONMENT

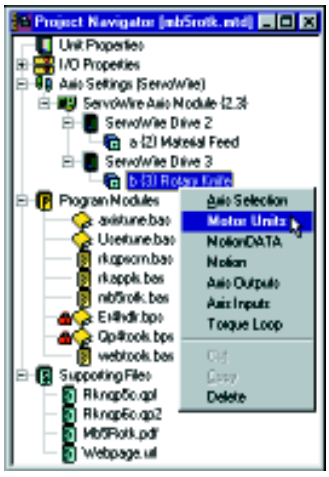
User-friendly, integrated software is a key distinctive that makes ORION® a potent solution for multi-axis control.

At the center of ORMEC's integrated software environment is MotionDesk™ --- our Windows 95/98/NT/2000 based development tool. MotionDesk™ provides a graphical user interface (GUI) and effective tools to help create, manage and maintain motion control projects. It plays the central role in integrating motion and I/O programming with operator touchscreen panels and communication needs.

Motion Control "Projects"

MotionDesk™ offers a "project-oriented interface" where all the software components required for an application are created, maintained and managed.

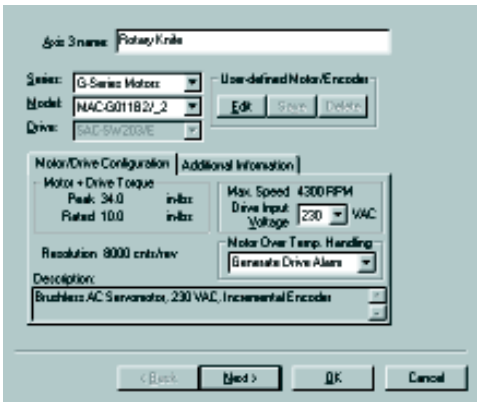
The "Project Navigator" (at right) provides an overall "roadmap" to all the hardware and software components required for your application.



- ✔ **Project Navigator:** Graphical user interface simplifies set-up & organization of your motion projects. All software components, including touchscreen panels, are conveniently integrated into your project for easy editing and updating.
- ✔ **Project Printing:** Easy way to produce system documentation.
- ✔ **Project Archival:** All project files automatically "zipped" into an archive file -- simplifying the process of transferring files to another computer.

"Wizards" Simplify Setup & Configuration

Once a system component is added to the Project Navigator, MotionDesk™ provides a comprehensive group of "setup wizards" to simplify system configuration. Each hardware component added to the Project Navigator is customized (by editing its "Properties") for the specific needs of your application.



When an "axis" is added, a series of wizards leads you through defining default configuration of the servos in the system.

- ✔ **ORION® Unit and I/O Properties:** Defines configuration of controller including Axis Modules, I/O setup and Ethernet communications adapter.
- ✔ **Axis Configurator:** Series of wizards to configure all system parameters for Axis Modules, servodrives, servomotors and encoders. ORMEC servomotors and encoders are selected from database. User-defined motors can be added to database.

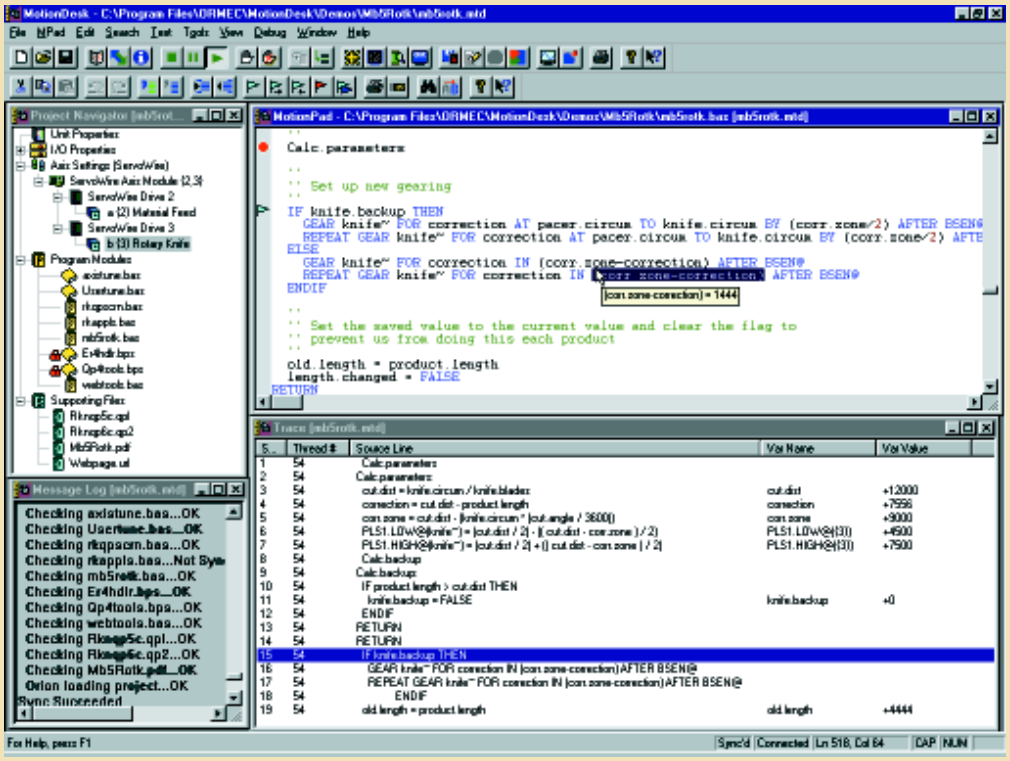
Integrated Software Development Tools

MotionDesk™ offers a complete set of integrated development tools --- a program editor, trace and debug tools and an outstanding Help System --- to simplify software development, debug and management.

- ✔ **MotionPad Editor:** Powerful program editor with sophisticated text editing capabilities. Provides bookmarks, error reporting, program execution control featuring single step and setting breakpoints and context-sensitive help. Dynamic "data tips" allow you to query real-time status of variables and program labels from within the editor.
- ✔ **Debug & Diagnostic Tools:** Integrated tools include program trace window, console communications and direct mode windows. Tightly integrated with MotionPad editor to speed system development.

MotionDesk™ Features

- ✔ **Windows Look & Feel:** Familiar software environment is easy to learn, master and use. Provides software elegance that boosts productivity.
- ✔ **Project management tools:** Intuitive software makes it simple to effectively manage your software projects.
- ✔ **Powerful editing:** State-of-the-art software, integrated editor and debug are all fully integrated into the interface.
- ✔ **Local or remote operation:** Use the power of MotionDesk™ and TCP/IP to communicate to your ORION® controller via a direct cable connection, modem or Ethernet LAN.



- ✔ **System/Version Information:** Provides detailed informaton on ORION® system components and software revision levels.

Axis Tune

When selecting a motor and specifying a load inertia, MotionDesk™ automatically adjusts tuning parameters to meet most application requirements.

Axis Tune provides a color scope to report real-time feedback on position error, velocity command, actual velocity and torque response. After exercising the motor using a trapezoidal motion profile and viewing the results, Axis Tune allows fine-tuning of motor loop parameters using floating menu selections. Adjustments to motor loop parameters are conveniently saved in your project.

- ✔ Custom motion profiles can also be used to tune loop parameters to your specific application needs.

Upgrade Director

It's simple to upgrade an ORION® controller in the field to a new version of MotionBASIC®, a new MBX, or new ServoWire™ drive firmware using Upgrade Director.

Software updates are available on the ORMEC User website, and can be communicated to an ORION® controller via either direct cable connect, an Ethernet LAN or Windows networking.

Integrate QuickDesigner Panels

A MotionDesk™ project provides a convenient way to integrate QuickDesigner touchscreen panel layout files. Screen files are managed by MotionDesk™, stored on the ORION® PC Card, and are available for download to the QuickPanel.

TCP/IP Communications

All communications between MotionDesk™ and the ORION® controller utilize industry-standard TCP/IP protocols. As a result, MotionDesk™ can be used effectively on desktop or laptop computers and can access ORION® controllers via a modem or Ethernet LAN using standard Windows networking.

The Basics of MotionBASIC®

An industrialized superset of Microsoft BASIC enhanced for motion control applications

MotionBASIC® System Card provides solid state memory for ORION®, and stores all the software required for your application.

On the software side, ORION® provides the world's most widely used programming language—BASIC—now enhanced with features for high performance real-time motion control.

Motion + BASIC = MotionBASIC®

Initially developed at Dartmouth in 1962, BASIC is the most widely used programming language in the world. Virtually all engineering students worldwide, and many high-school students, take courses in BASIC. It has been under continuous development throughout its history, resulting in many improvements over the years. Unlike many other programming languages developed since, BASIC continues to play a vital role in computing.

ORMEC's MotionBASIC® is a superset of Microsoft BASIC representing more than 40 man-years of development. Designed and built from the ground up to integrate motion control and industrial I/O with a widely used implementation of BASIC, it uses English-like motion statements and pre-defined variables. MotionBASIC® builds on BASIC's strengths—its standardization, its completeness as a language, as well as the simplicity, user protection and power of an interpreter, plus English-like keywords and syntax—to create a comprehensive software solution for industrial motion control.

BASICs of MotionBASIC®

Variables, Operators & Functions

❒ Standard BASIC offers a full set of variable types including integers, strings, floating point and double precision floating point; we added long integers and sets. An array of operator and function support is also included.

❒ Long integers provide speed and compactness for use with wide-range integer parameters (i.e. axis position).

❒ "Set variables" are 32-bit variables for dealing with "groups of items", and their primary use in MotionBASIC® is to define "groups of axes" for multi-axis operations.

❒ MotionBASIC® includes IEEE standard single and double precision floating point. If required, real-time floating point math performance rivaling that of integers and longs is provided by an integral math co-processor.

❒ A rich set of arithmetic, trigonometric, relational and logical operators work with multiple variable types.

❒ More than 50 functions are provided to support arithmetic, string, conversion, I/O and system operations.

❒ Many competitive products provide only fixed point numeric variables and extremely limited capabilities with respect to functions and operators in their "languages".

Programming

❒ Block programming structures including WHILE ... WEND & multi-line IF ... THEN ... ELSEIF ... ELSE ... ENDIF simplify development and minimize programming errors.

❒ Symbolic program labels both speed program execution and enhance the development environment by eliminating program references to line numbers.

How MotionBASIC® coordinates with the ORION® controller's multi-processor architecture

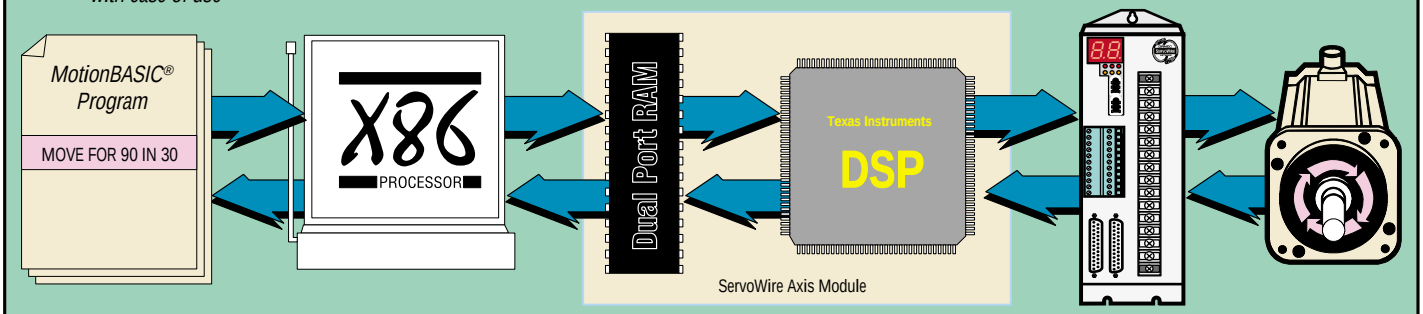
The combination of a distributed architecture & interpretive MotionBASIC® provides high performance software which combines speed with ease of use

Main processor interprets MotionBASIC® MOVE and GEAR statements & writes data packet(s) in a shared memory FIFO motion queue

Data packets concisely define distances, speeds and accelerations for the Axis Module(s) from MotionBASIC® parameters

The processing power and numerical precision of the DSP makes it ideal for high performance real-time loop control ... freeing the main processor for other tasks

Each DSP updates position and velocity up to 5,000 times per second and handles all the real-time servicing of the servo system



Servodrive fault diagnostics and system error reporting are fully intergrated with MotionBASIC®

MotionBASIC® access to real-time information is simplified by pre-defined parameters for each axis or group of axes and includes automatic user unit conversion

Key motion parameters such as speed, torque and position maintained in dual-port RAM by the DSP can be accessed directly by the main processor

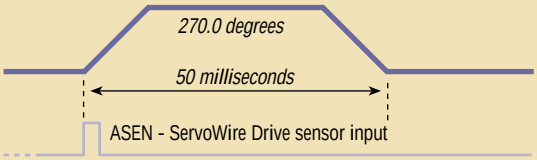
Each ServoWire Axis Module has analog inputs, and each drive has high speed sensor inputs and programmable limit switch outputs which can be coordinated with motion

Flexibility of MotionBASIC® Motion Statements

Conditional Moves

All motion commands can include an input condition for the purpose of holding off the execution or interrupting the progress of a motion. Combining an 'Until', 'After', or 'Stop' conditions together with a high speed ServoWire™ drive I/O on the end of a MotionBASIC® statement provides a high degree of flexibility and control over all motion commands.

MOVE axis FOR 2700 in 50 after ASEN@

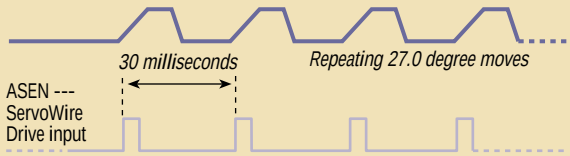


Sensor input, driven from a photo eye, starts a move command which is ready and waiting in the command queue.

Repeat Moves

The REPEAT prefix added to any motion command will allow the command to stay in the command queue and repeat its execution. MotionBASIC® allows multiple motion commands to be added to the queue to form a loop that will repeat for as many times as needed. Execution within the repeat loop can be controlled with the input conditions.

REPEAT MOVE axis FOR 270 by 50,10 after ASEN@

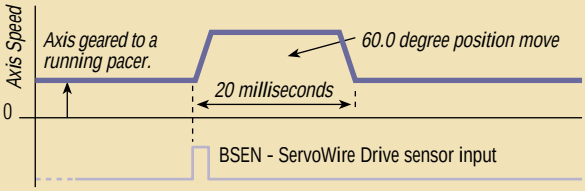


Sensor input, driven from a photo eye, repeats the move contained in the queue.

Superimposed Moves

Superimposition is the process of combining a motion command to an axis that is already being driven by another source through the GEAR command. The command is added to the motion based on time or distance traveled by the source axis.

MOVE axis FOR 600 in 20 after BSEN@

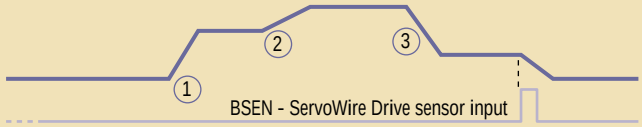


Sensor input, driven from a programmable limit switch (PLS), superimposes this MOVE command onto a running axis. It modifies relative positions by 60 degress at a precise point determined by the PLS.

Blended Moves

Blended moves provide a method to construct motion profiles that allow both speed changes and/or changes to final position targets while the motion command is executing. With blended moves, multiple axes can be time-synchronized to reach multiple target points forming a complex continuous path in multi-dimensional space.

1. MOVE axis FOR 1800 at 1000
2. BLEND MOVE axis FOR 600 at 1500
3. BLEND MOVE axis FOR 600 at 500 stop BSEN@



Sensor input, driven by a registration mark sensor, is enabled at start of section 3. and stops execution of the motion command when sensor is true.

❒ Hardware interrupt processing using the ON EVENT GOSUB statement provided for the 16 integral discrete I/O.

❒ PC Card™ standard memory cards are supported by BASIC compatible disk commands and file operations.

Operator I/O

❒ Device drivers redirect screen-oriented program I/O to alternate consoles such as a flatpanel touchscreen

Error Handling and Safety Interlocks

❒ MotionBASIC® offers built-in, run-time error handling to protect user programs ... always maintaining safe motion controller operation.

❒ Extensive error checking fully integrates built-in hardware features such as "Emergency Stop", "Drive Fault", "Encoder Wire Open", "No Fault" and "Watchdog Timers" with the MotionBASIC® error handling facility.

The Motion in MotionBASIC®

For simplicity, a minimum number of statements are required to specify and initiate motion in MotionBASIC®. The English-like syntax and a rich complement of options insure that these statements have sufficient flexibility to allow you to easily create single or multi-axis motion which meets your application's objectives.

User Units

All MotionBASIC® parameters are expressed in the units of your choice ... degrees, inches, millimeters, RPM, msec, etc., making your BASIC program easy to understand. For example: MOVE FOR 90 (degrees) IN 30 (msec). User units are exact because they are always converted to the units of the individual position transducers using a ratio of integers.

MOVE statement

The MOVE statement provides a powerful way to command motion for one or more servomotors. It can be used to MOVE AT a specified speed, MOVE FOR a desired distance or MOVE TO an absolute position. Acceleration and deceleration can be specified independently as a function of time, distance, or directly as rates.

The MOVE statement can be used to simultaneously MOVE multiple axes AT independent speeds, FOR independent distances or TO independent positions.

MotionBASIC® supports S-curve acceleration profiles for MOVE statements. Shape is adjusted by specifying the percentage of the acceleration and deceleration zones which should use S-curve.

S-curve is functionally derived & updated at each position loop update (3,000 to 5,000 times per second). It automatically maintains the S-curve shape for all motions independent of the specified distances, speeds & accelerations.

The Motion in MotionBASIC®

System architecture offers all-digital performance, scalability and advantages of distributed processing.

ORION® is particularly well suited to control line-oriented applications common to packaging, web processing, assembly and textile machines. These types of machines have traditionally relied on mechanical lineshafts, gearboxes & complex mechanical devices such as differentials, geneva mechanisms, cams, linkages and crank mechanisms. The combination of state-of-the-art control, concurrent MotionBASIC® and advanced electronic gearing in ORION®offers an alternative with unparalleled flexibility, speed, accuracy and reliability ... as well as simplicity.

A Superior Electronic Lineshaft

Not all electronic lineshafts are created equal ... especially when it comes to building one that consistently provides higher accuracy than sophisticated mechanical systems. This is accomplished in ORION® using a direct DSP-to-DSP broadcast communications network we call MotionDATA™. MotionDATA™ employs synchronous error correcting broadcast communications to transmit real-time position information. These data packets are processed by a virtually unlimited number of servo axes within a few millionths of a second of each other during each position loop update. This highly precise coordination occurs 1,000 to 4,000 times per second and is integral to electronic gearing precision.

In addition to providing unparalleled precision, MotionDATA™ guarantees integrity and prevents occasional spurious electrical interference from compromising the accuracy of your automation and the quality of the products it produces. These capabilities simply can't be provided by products which utilize quadrature signals as the basis for their electronic lineshaft.

ORION® allows you to configure your machine drive system in software, allowing all the servo axes to be linked to the same source of information, or alternatively establishing sub-lineshafts as appropriate. In addition, each electronic lineshaft (or sub-lineshaft) can be driven by commanded or actual position from its "pacer" axis to meet the needs of your application.

GEAR statement

The GEAR statement provides an elegant way to coordinate the motion of one or more servo axes to the motion of an electronic lineshaft pacer encoder or master axis. User unit conversion factors allow a GEAR AT 1 TO 1 statement to maintain perfect synchronization of the output shafts of servo-driven gearboxes even if the servos have different position transducer resolutions and/or gear ratios.

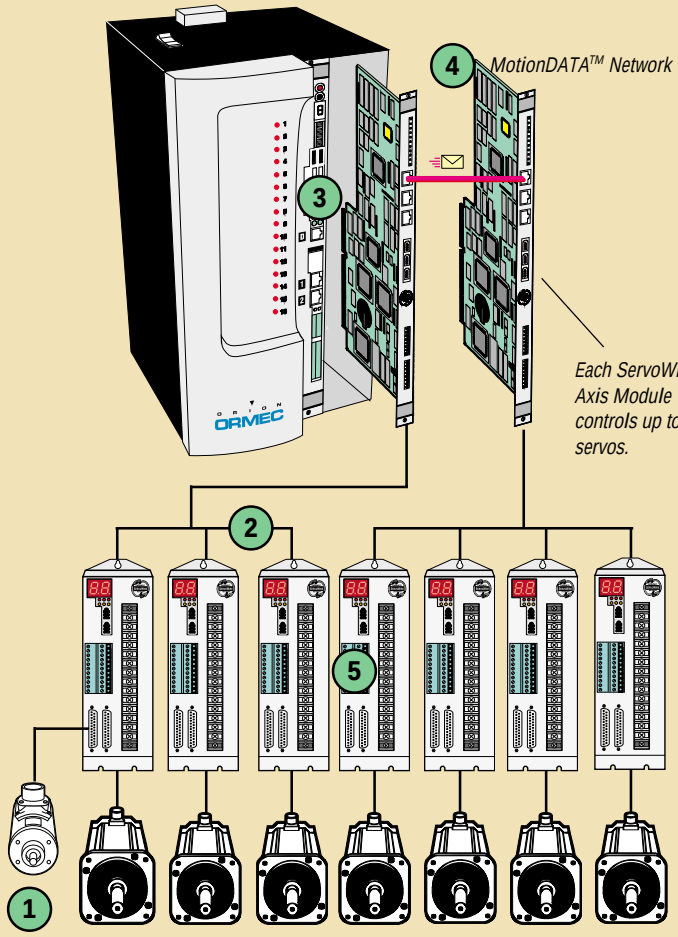
The GEAR statement also allows the follower servo to engage an intermittent motion to the pacer as a function of travel of either the pacer or the follower axis. For user-units of degrees, the statement GEAR FOR 180 IN 360 causes the follower to rotate for 180° during 360° of pacer rotation.

Motion Contouring

For motion control applications which require contouring, ORION® provides the combination of processing muscle, elegant system architecture and flexible MotionBASIC® software to get the job done.

MotionBASIC® supports both position-based (CAM statement) and time-based (PROFILE statement) contouring.

Electronic Gearing using the MotionDATA™ Broadcast Network



1. *Each pacer encoder is interfaced as an "axis"--- allowing ORMEC pre-defined variables to be used for configuration and status.*
2. *Any or all of the Servo Axes in the system can be electronically geared to their individual pacer input and/ or operate independently.*
3. *Pre-defined MotionDATA™ mode variables configure the overall electronic gearing topology. Each axis can monitor or ignore incoming MotionDATA™ . It can also configure its MotionDATA™ output to pass-thru input packets or provide either its own or commanded position.*
4. *MotionDATA™ packets are sent synchronous to each position loop update and provide pacer movement and error correction information.*
5. *Each Drive I/O interface terminal block provides local, high-response I/O such as one microsecond position capture registration sensors & Programmable Limit Switches.*

ORION® Architecture Ideal for Contouring

Both the CAM and PROFILE statements utilize motion tables (up to 32,000 entries) to define a series of sequential motion segments. These MotionBASIC® arrays can be loaded from CAD systems, spreadsheet programs or generated by a MotionBASIC® program.

The motion tables are prepared and downloaded into the Motion Memory on the Axis Module ready for execution. The DSP processes these arrays in real-time at rates up to 5,000 per second to create complex motion contours.

Multiple arrays stored in motion memory, the ability to switch between motion tables in real-time and motion table queuing and repeating allows maximum versatility for tough applications---but are also simple to implement in software.

Error codes and diagnostic information are also provided to help debug motion execution, table placement, and linking.

Position-based Contouring

The MotionBASIC® CAM statement generates motion profiles on a FOLLOWER axis based on the position of a PACER axis (another servomotor or a remote encoder). The relative speed and distance covered by the FOLLOWER axis depends on PACER motion.

CAM commands execute motion that is linked to the cycle of the machine. As the machine speed increases or decreases, the PACER speed increases or decreases as well, causing the CAM motion profile to stay synchronized with the machine cycle.

Generating position-based motion tables electronically simulates complicated mechanical cam action. Data segments in the cam table can be interpolated for smoother segment transition during execution.

Time-based Contouring

The MotionBASIC® PROFILE statement generates motion profiles that are defined by an array of position and time parameters.

PROFILE statements are used when one or more servo axes must follow a specified contour in a fixed amount of time. PROFILE statements can be used to execute motion that is time-independent of machine speed, but can also be triggered to start at a pre-determined point in the machine cycle. As the machine speed increases or decreases, the execution time of the motion profile stays constant.

Executing Contoured Motions Defined in Arrays

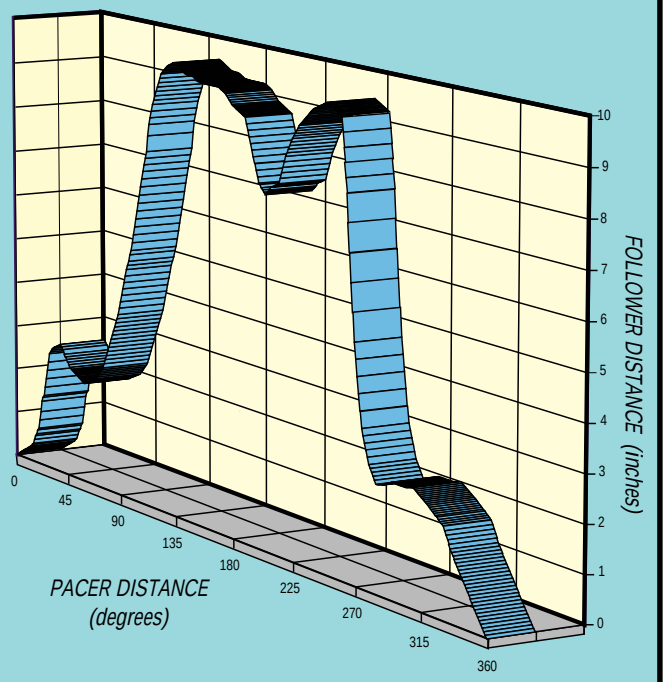
When the application calls for implementing motion with special move requirements, contouring provides a method to place a customized array of motion segments in the DSP motion memory, and execute it.

Special move requirements include speed and/or distance contours that cannot be performed using simple trapezoidal motion profiles. This information is loaded by MotionBASIC® into the on-board motion memory of the appropriate Axis Module(s).

When a CAM or PROFILE statements is executed, the Axis Module(s) begins processing the data in the motion memory, executing the defined motion.

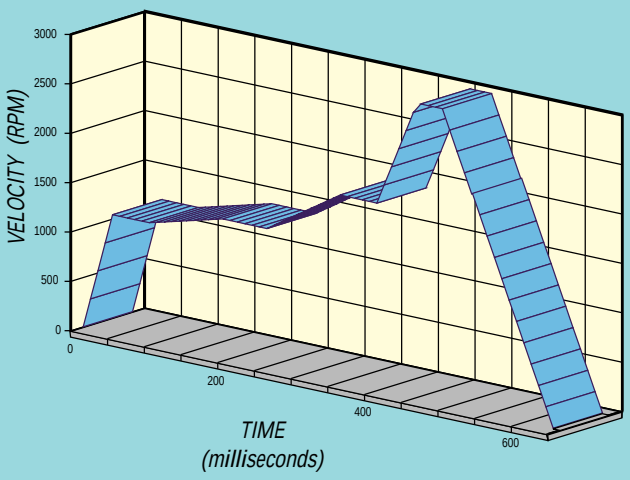
Versatile ways to initiate table execution are available with MotionBASIC® contouring. The point to start and stop motion is specified as a command variable with automatic wraparound or one-shot execution capability.

Position-based Electronic Cam Profiles



The CAM statement provides the ability to execute a position-based motion curve replicating the operation of a mechanical CAM-follower mechanism. Programmable CAMs generated in software are faster to develop, easily modified and can be adapted to the specific needs of the application.

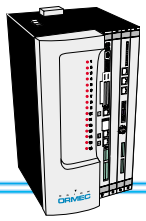
Time-based Velocity Profiles



The PROFILE statement provides the ability to generate customized velocity profiles that are always completed in a specific cycle time. Motion segments (defined by an array of distance and time parameters) allow you to create highly customized velocity contours.

Contouring Development Environment

Motion segments contained in a motion table are incremental distances to be moved during the execution of that segment. Different motion table formats are provided to handle regularly spaced segments, and also irregularly spaced segments. Diagnostic variables are provided containing status about loading, conversion and execution of contouring commands.



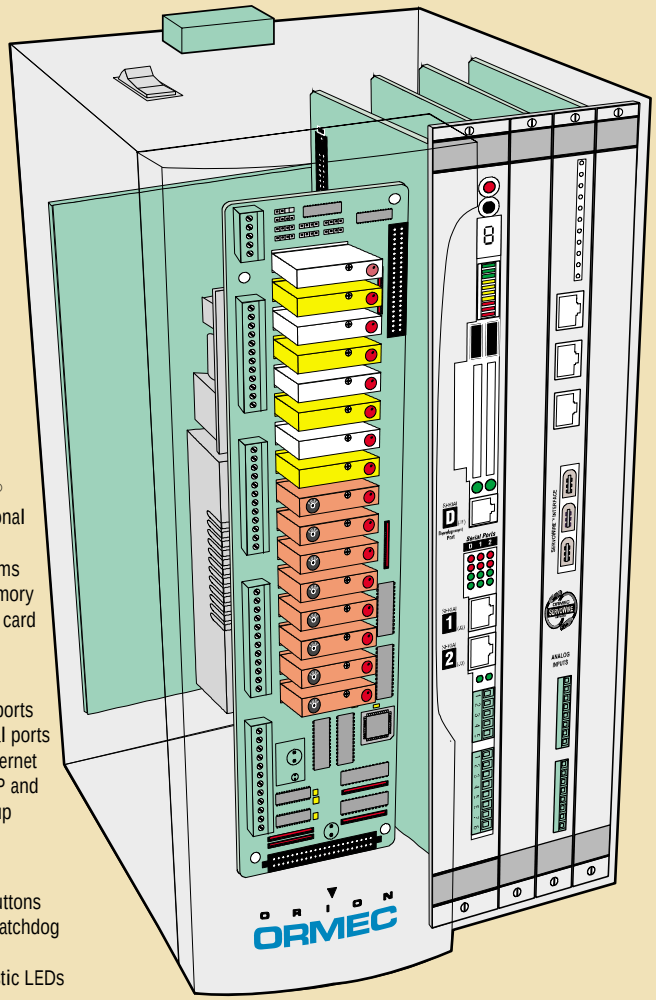
ORMEC

ORION® Motion Controllers

ORMEC's Model 30, 50 & 70 motion controllers are the heart of the ORION® family of products.

Each motion controller features a PC/AT backplane and user expansion slots for a variety of system configurations. The Models 30/50/70 feature three, five and seven expansion slots respectively.

Anatomy of an ORION® Motion Controller



1. Controller Motherboard

- Intel architecture microprocessor (Pentium MMX 233 MHz, Pentium/133, 80586/133, 80486-DX2/66 or DX4/100)
- PC-AT bus with up to seven expansion slots
- 4 Mbytes DRAM
- 256K external cache
- Keyboard connector

2. ORION® System Module

PC Card Slots

- Slot 1: MotionBASIC® System Card & additional user memory for most motion control programs
- Slot 2: Additional memory card, communications card or hard drive

Communications

- RS-232 development ports
- Two RS-422/485 serial ports
- Supports standard Ethernet hardware using TCP/IP and Windows 95/NT dial-up networking

System Resources

- Reset and user pushbuttons
- System Status LED, Watchdog Timers
- Monitoring & Diagnostic LEDs
- No-Fault Relay Output
- Non-volatile memory for machine configuration parameters

3. Discrete I/O Board

- 16 Opto-22 G4 discrete I/O
- Expansion connector to 16 or 24-slot I/O rack or Opto-22's Pamux standard for up to 512 analog and/or digital I/O

4. MotionBASIC® System Card

- 6 to 136 Mbytes Flash RAM
- DOS Operating System extended for real-time, multi-tasking
- MotionBASIC® Programming Language
- MotionBASIC® Extensions (MBX) which provide additional software---primarily support for a variety of factory network communications (A-B Ethernet, Modbus TCP, Profibus DP Slave, Modbus™, S908, Data Highway/Plus™ GE Genius and connectivity to Allen Bradley SLC-500 series PLCs).

5. ServoWire™ Axis Module

Servo Control

- Interfaces up to eight servos using ServoWire™ drive network. Servo loop update rates selectable based on application requirements (2kHz for 8 servos; 4 kHz for 4 servos).
- Digital signal processor operating at 80 MHz provides real-time servicing of servo systems
- Dual port RAM shared memory interface to main Intel microprocessor
- MotionDATA™ DSP-to-DSP communications for highly coordinated, multi-axis motion performance

Motion I/O

- Analog inputs (4 or eight channels of 12-bit analog inputs) available as option
- High-speed drive I/O (programmable limit switches, high-speed sensors) communicated to Axis Module via ServoWire™ interface at loop update rate.

ORION® Controllers

The ORION® motion controllers feature high performance computing capability. Using the industry standard family of X86 & Pentium 32-bit processors with five speed options provides cost-effective compute power for multi-axis applications. Intensive math calculations performed in MotionBASIC® take advantage of the processor's high-speed integral floating point hardware.

Memory access speed adds to the performance of the controller. The X86 ORION® has a memory bus that is 32 bits wide featuring four megabytes of main memory and 256K byte cache memory and the Pentium models feature a 64 bit wide bus, eight megabytes of main memory and 512K byte cache memory to enhance access speed between processor and memory.

Open PC Bus Standard

Use of the 16-bit ISA PC bus standard provides an effective platform for building multi-axis motion control systems. PC/AT ISA bus expansion slots interface to ServoWire™ Axis Module(s) plus adapters for factory network connectivity.

An industry standard PC BIOS is installed for booting the operating system to RAM from PC-card flash memory and performing power-on system testing for the motherboard backplane.

Battery-backed time and date hardware is used to log application events during system operation and for dating DOS file directory updates.

Integral Industrial Power Supply

Providing clean and consistent voltage while isolating the motion controller from industrial power sources is achieved by the integral power supply design. ORION® motion controllers include industrial grade multi-voltage power supplies, EMI line filters, transient protection and fuses. Input voltage selection is automatic, allowing the user to simply attach

either 115 or 230 VAC, 50/60 Hz power to the removable terminal block connector.

ORION® System Module

The System Module integrates a number of important features for industrial control into ORION®.

► A dual slot PC Card™ (PCMCIA) interface provides access to mass memory that is nonvolatile, removable, compact and reliable. A Type II slot is provided for the MotionBASIC® System Card (6-136 Mbytes of Flash RAM) which normally includes all operating system and user software. A Type III slot provides the ability to add a second memory card or hard drive.

► 32K bytes of battery-backed memory can be used for nonvolatile MotionBASIC® variables, which are kept intact while power is off and available when the system is back online.

► A removable terminal block provides access to the fail-safe, optically-isolated "Emergency Stop" input and the "No Alarm" output, which is a normally-open, held-closed dry relay contact. Overall system integrity and safety are preserved by the fact that the No Alarm relay contact is held closed only if there is current in the input circuitry of the Emergency Stop input and the main processor continues to strobe the onboard Watchdog Timer circuit.

System integrity is further insured by individual watchdog timers on each ServoWire™ Axis Module, open-wire detection from each motor's position feedback, and fail-safe, opto-isolated "No Alarm" signal to each servodrive.

► Ten status LEDs and a single-character, alphanumeric display provide maintenance personnel with clear diagnostic indication of alarms, faults and operating status.

ORION® TCP/IP communications support serial connections, Windows 95/NT dial-up networking and a variety of standard Ethernet hardware.

Ordering Guide --- ORION® Motion Controllers

ORN - 30 / A F D H

Base Unit, 115/230 VAC, 50/60 Hz
30/ - 3 slot ISA adapter bus
50/ - 5 slot ISA adapter bus
70/ - 7 slot ISA adapter bus

Microprocessor Type*

A - 80486-DX2	66 MHz
B - 80486-DX4	100 MHz
C - 80586	133 MHz
D - Pentium	133 MHz
E - Pentium MMX	233 MHz

I/O Power Supply
F - 24 volt DC at 1500 milliamps
X - No 24 volt supply

Miscellaneous Options
H - Integral cooling fan
S - Delete CAN interface hardware

Discrete I/O Board Options
D - Pluggable terminal block connectors
E - Pluggable terminal block connectors with Extended I/O support hardware

U - Fixed terminal block connectors
T - Fixed terminal block connectors with Extended I/O support hardware

For a detailed description of Discrete I/O Board operation, refer to page 21.

**Note: The Pentium type selections are only available with the ORION® Model 30 controllers.*

Operating System Software

PCC-SYS5/xxxx	MotionBASIC® System Card, PC-Card flash memory, contains operating system. For ordering details, reference page 25. For an overview of the MotionBASIC® Programming Language, see page 29.

Motion Control

ORN-SW-AM/xxx	ServoWire™ Axis Module -- see page 19 for ordering details & available options.

Application Program Development Software

MDK-SW/C	MotionDesk Servo Developer's Kit, an integrated development environment that runs on Windows 95/NT platforms (see page 27 for details)

Additional Serial Communications Accessories

ORN-ENE2000	Ethernet ISA Adapter, with RJ45 & BNC connectors
ORN-E3C509X	Ethernet ISA Adapter, with RJ45, BNC & AUI connectors
PCC-E3C589E	Ethernet PC Card Adapter, with extension cable for RJ45 & BNC connectors
ORN-422	Dual RS-422/485 Serial Communications ISA Adapter
ORN-232	RS-232 Serial Communications ISA Adapter

For factory networking options available for the ORION® controller, refer to pages 36 - 42.

► A Reset pushbutton clears faults and automatically reloads the interrupted program from Flash memory.

► A program override pushbutton (PB1) allows the user to control program loading from the front panel, simplifying software distribution and/or machine diagnostics.

► An RS-232 serial Development Port is used to communicate with an IBM-compatible PC running ORMEC's MotionDesk™ software.

► Two RS-422/485 serial communication ports can be used to interface the ORION® controller to a touchscreen or compact industrial terminal and/or provide connectivity to a Modbus™ factory network or Allen-Bradley SLC-500 PLCs.

► Four status LEDs for each serial port simplify troubleshooting.

► A CAN interface, including removable terminal blocks and status LEDs, is optionally provided for future connectivity. Call ORMEC for details.

Machine I/O

Machine I/O connectivity and flexibility is accomplished through the Discrete I/O board located behind the ORION® front cover. The Discrete I/O board conveniently integrates machine application inputs, interrupts and output configurations into the MotionBASIC® language structure. Machine I/O is optically isolated and can accept AC or DC input modules. Additional I/O can be added using the Extended I/O interface.

User Expansion Slots

The Models 30/50/70 feature three, five and seven 16-bit ISA expansion slots designed to accommodate ServoWire™ Axis Modules and/or PC compatible adapters such as factory network communications boards.

ORION® Motion Controller Specifications

MULTI-PROCESSOR ARCHITECTURE

- ❒ Model 30/50/70 controllers provide servo control, operator interface, machine I/O & communications
- ❒ Unique multi-processor architecture features Intel x86 and Pentium family main processors, and the Texas Instruments TMS320C52 digital signal processors for motion control.
- ❒ 256K & 512K bytes of cache memory between program memory and main processor
- ❒ Non-volatile memory for setup and user defined program variables
- ❒ Shared memory interface to DSPs provide fast access.

MOTION CONTROL

- ❒ All-digital servo control algorithms featuring velocity and acceleration feedforward eliminating following error
- ❒ Servo loop update rates up to 5 kHz
- ❒ High speed sensor inputs routed directly to DSP axis processor
- ❒ High speed position capture hardware (<1 microsecond response)
- ❒ Drive fault protection circuits, watchdog timers, and integrated diagnostics for fail-safe operation

MotionDATA™ Electronic Gearing

- ❒ Electronic gearing---linear or cascade
- ❒ Contour motion---electronic cams and time-based multispeed profiles
- ❒ 625 kHz DSP-to-DSP broadcast network for precise multi-axis synchronization and control

PROGRAMMING

- ❒ Multi-tasking, multiprocessor operating system with DOS compatibility
- ❒ MotionBASIC® programming language with concurrent mode operation
- ❒ Powerful and easy-to-use motion statement language.
- ❒ Predefined motion and I/O variables
- ❒ Exact user units conversion with rational numbers
- ❒ Program and data memory area of 512 kilobytes with 32K bytes of non-volatile memory for variables
- ❒ 32-bit integers and hardware double precision floating point math is standard

COMMUNICATIONS

Serial Communications Interface:

- ❒ RS-232 serial port for software development system (Port D) with TCP/IP stack and modem support.
- ❒ Two RS-422/485 serial ports for operator interfaces and controller networking

Operator Interface Options:

- ❒ Compact industrial terminal
- ❒ Standard color or mono multi-drop industrial LCD terminals with touchscreens or with keypad & display
- ❒ Supports IBM-PC/AT compatible keyboard input connector.

PC/AT ISA Expansion Slots

- ❒ Interface adapters for PLC Networks including TCP/IP Ethernet.
- ❒ Supports serial communications adapter providing two auxiliary serial ports, RS-232/422, user configured
- ❒ Multi-drop support for serial devices

INPUTS/OUTPUTS

- ❒ 16 standard Opto-22 compatible Generation 4 discrete I/O points
- ❒ 24 additional digital I/O points via optional expansion connector, or
- ❒ 512 remote analog or discrete I/O using Pamux which is an open, industry-standard parallel multiplexed I/O system.

INDICATORS

- ❒ 14 system diagnostic LEDs
- ❒ 5x7 dot matrix alphanumeric LED
- ❒ 12 Serial port status LEDs

GENERAL SPECIFICATIONS

Input Power:

- ❒ Model 30: 315 watts maximum
- ❒ Model 50: 340 watts maximum
- ❒ Model 70: 415 watts maximum

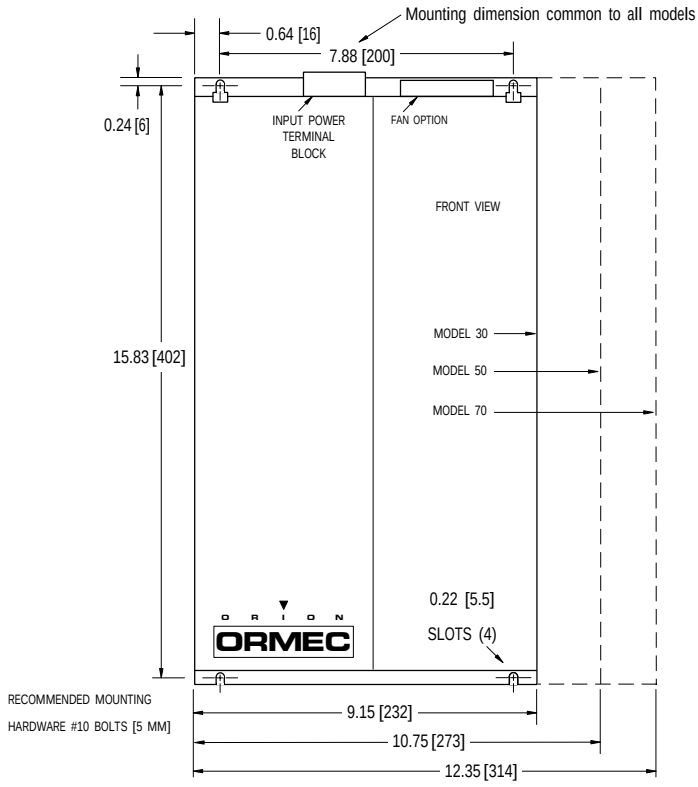
All Models

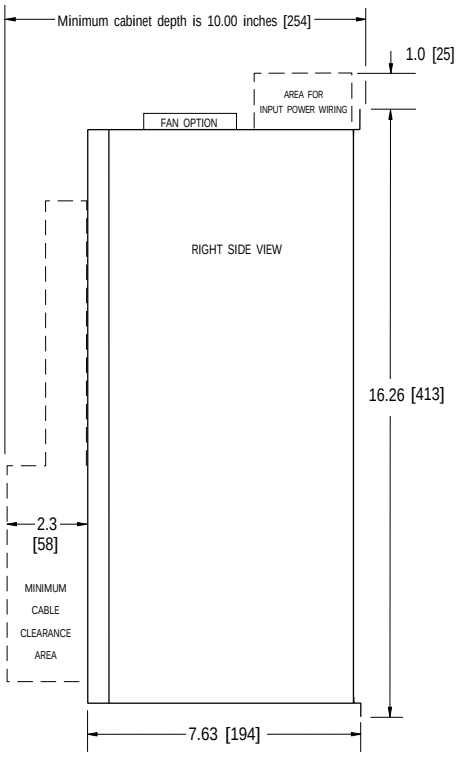
- ❒ Input voltage: 90-127 or 190-253 VAC, 47-63 Hz single phase
- ❒ 10/15/20A circuit breaker provides switched drive control power
- ❒ Operating Temperature: 0 to 50C
- ❒ Storage Temperature: -20 to 85C
- ❒ Humidity: 90% (non-condensing)

Weight:

- ❒ Model 30: 17.2 lbs (7.8 kg)
- ❒ Model 50: 18.2 lbs (8.3 kg)
- ❒ Model 70: 19.9 lbs (9.0 kg)
- ❒ Axis Module: 1.2 lbs (0.54 kg)

MOUNTING AND DIMENSIONING INFORMATION





DIMENSIONS KEY: xx.xx in [mm]

ORMEC
ServoWire Axis Module

The ServoWire Axis Module provides high performance motion control utilizing up to eight axes of servomotors and/or remote encoders.

ServoWire™ Axis Modules are metal-edged printed circuit boards which plug conveniently into the 16-bit ISA backplane of the ORION® motion controller, and use a 80 Mhz Texas Instruments digital signal processor (DSP) to provide axis control algorithms. The Axis Module also includes diagnostic LEDs, MotionDATA electronic gearing, ServoWire™ network interfaces, and optional analog inputs.

Depending on the requirements of the application, the servo loop update on the Axis Module can be configured up to 2kHz (eight servos) or 4kHz (four servos).

Strengths of the Axis Module

Multi-Processor Architecture: The DSP on the Axis Module is interfaced to the main Intel architecture processor through a 16K byte shared memory for maximum speed and flexibility.

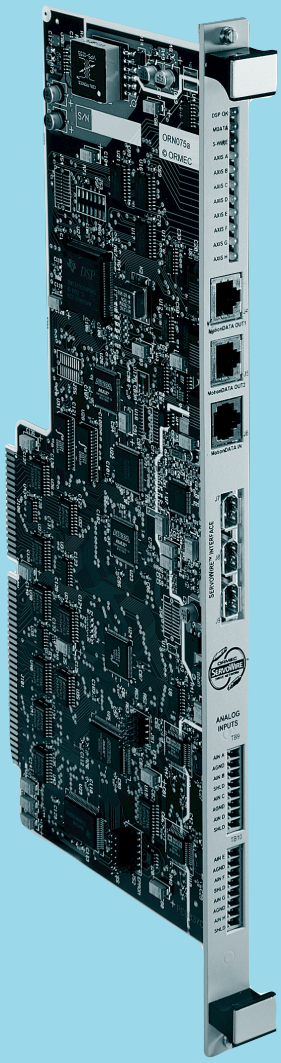
The resulting multiprocessor architecture, combined with the overall power of the DSP, enables ORION® to operate effectively at high sampling rates to provide accurate positioning via robust motion control algorithms. It also eliminates analog components including tachometers.

ServoWire™ Network Interface: Reliable, simple to configure, scalable, all digital control interface to the ServoWire™ motor/drive axes.

MotionDATA™: For multi-axis tightly synchronized motion control applications, MotionDATA™ provides a direct axis module to axis module communications link to share motion reference information at loop update rates. This synchronous data communications channel operates at 625 Kbits per second and utilizes user-transparent error correction techniques.

MotionDATA™ speed and flexibility allows large systems to be precisely electronically geared to a single *electronic lineshaft* or multiple sub-lineshafts in a cascaded control configuration.

ServoWire™ Axis Module: At A Glance



✔ ***Plug and Play Convenience***
No address jumpers to set. Axis Modules are automatically recognized and configured by the ORION® controller. Dual port multiprocessor architecture interfaces the MotionBASIC® programming language to the on-board Digital Signal Processor (DSP) through the ISA bus.

✔ ***Diagnostic LEDs***
Three system status LEDs (DSP OK, MotionDATA active, and ServoWire™ network) plus eight dual-color axis status LEDs give consistent indication of system integrity.

✔ ***MotionDATA™ Electronic Gearing***
Axis module to Axis module link transporting servomotor or encoder position information between multiple drives on different networks.

✔ ***ServoWire™ Drive Network***
Standard IEEE-1394 cables, high-speed network communication to eight servodrives. All drive parameters downloaded at power-up. Straightforward drive setup process, real-time drive parameter changes allowed. Extensive alarm and fault status reporting for each drive.

✔ ***Analog Inputs***
Option to add four or eight channels of 12-bit analog to digital converters with digital filters provided to interface external control devices.

ORMEC's ServoWire™ Axis Module: controls up to eight servomotors and/or remote encoders.

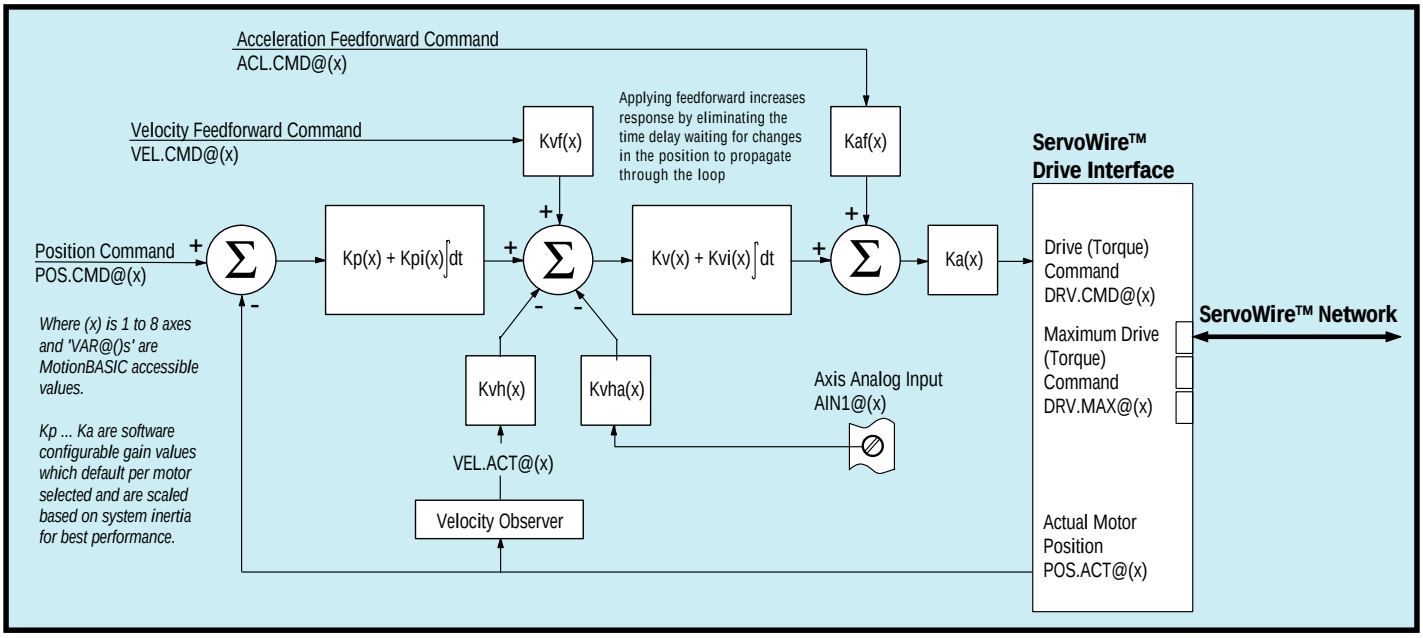
ServoWire™ Axis Module Options

Analog Inputs: This option provides four or eight12-bit analog inputs that allow external devices to interface to the servo control loop. Software configured digital filtering eliminates having to install external filtering components on the analog input.

ORDERING GUIDE
ServoWire™ Axis Modules & Accessories

ORN-SW-AM/X	ServoWire™ Axis Module, ISA adapter for up to 8 servo axes
Analog Inputs Option:	*(Must be specified; append to model number.)*
0	No
4	Four channels of 12-bit Analog to Digital Converter
8	Eight channels of 12-bit Analog to Digital Converter
CBL-SW/x	ServoWire™ Cable, where x =1 ft. (0.3 m), 2 ft. (0.7 m), 6 ft. (2.0 m) or 14 ft. (4.5 m)
CBL-MOD8/3	MotionDATA™ Cable, 8-wire modular, 3 ft.
ORN-SW-TB8	ServoWire™ Axis Module Analog I/O (TB8 & TB9) terminal block plug

ServoWire™ Axis Module Loop Architecture



ServoWire™ uses IEEE-1394 to create a potent architecture for multi-axis motion control and synchronization. The system uses the IEEE-1394 memory mapped model where all drive setup and motion control parameters are defined as software variables and communicated in real-time over the IEEE- 1394 bus.

Servo loops are managed in real-time over the bus, implementing a digital torque control network for up to 8 axes and eliminating all digital-to-analog conversions. Actual torque commands to the drives are transmitted digitally as 16-bit variables, eliminating the cost and limitations of traditional 12-bit, D-to-A converters and analog torque signals.

Digital torque control combines the fundamental advantages of torque-mode control (greater control flexibility, acceleration feedforward and torque information) with the advantages of digital networking and performance.

In this digital system, a velocity observer eliminates the need for an analog tachometer, and all potentiometers are replaced by software parameters. All loop adjustments are automatically computed when a motor, load inertia and the velocity loop time constant are selected from a configuration software menu. System parameters such as “peak motor output torque” are also set in software.

With the elimination of analog conversions, the ServoWire™ drive network provides both high bandwidth and outstanding noise immunity. Digital servo loops (including 32-bit intermediate results on calculations) provide precise control algorithms that result in drift-free operation.

The user’s application program can easily adjust for changing factors (i.e. -- load inertia) by dynamically changing drive settings or loop parameters. An all-software torque-mode positioning system also provides outstanding performance monitoring, with easily accessible real-time values for position, velocity, acceleration and torque.

ServoWire™ Axis Module Overview

Multi-Processor Architecture

- ❒ Texas Instruments Digital Signal Processor (DSP) operating at 80 Mhz.
- ❒ MotionDATA™ communications provides tightly coordinated, multi-axis electronic gearing. Connectors provide method for linking MotionDATA™ between adapters.
- ❒ 16K byte shared memory interface to main processor to queue motion commands from MotionBASIC®
- ❒ 128K byte on-board memory for DSP program and data space, as well as motion profile and cam data

Feedback & Control

- ❒ Direct digital control of drive through the ServoWire™ Network with update rates to 5 kHz (configuration dependent) provide wide bandwidth for high positioning accuracy & response
- ❒ Position, velocity or torque control supported.
- ❒ Full 32-bit position count or modulo position in user’s units.
- ❒ Elimination of analog interface errors and extremely quiet servo loop operation using direct digital processing of both position and velocity with 32 bit intermediate calculation accuracy
- ❒ Software controlled position, speed, and current limits
- ❒ Velocity and acceleration feedforward for minimum tracking errors and response times

Servodrive Interface

- ❒ High speed industry standard platform (IEEE-1394) providing drive isolation and reliable connections to up to eight ServoWire™ drives.
- ❒ Each Axis Module provides three network interface connectors for flexibility configuring connections on the ServoWire™ network.
- ❒ ServoWire™ drive remote enable, reset functions, status monitoring, motor parameter configuration and firmware updates provided through the ServoWire™ Network.

Diagnostic LEDs

- ❒ Status Indicators: Axis Module, MotionDATA™ Status, and ServoWire™ Network status
- ❒ Axis Status Indicators: Dual color status led for each drive on the network

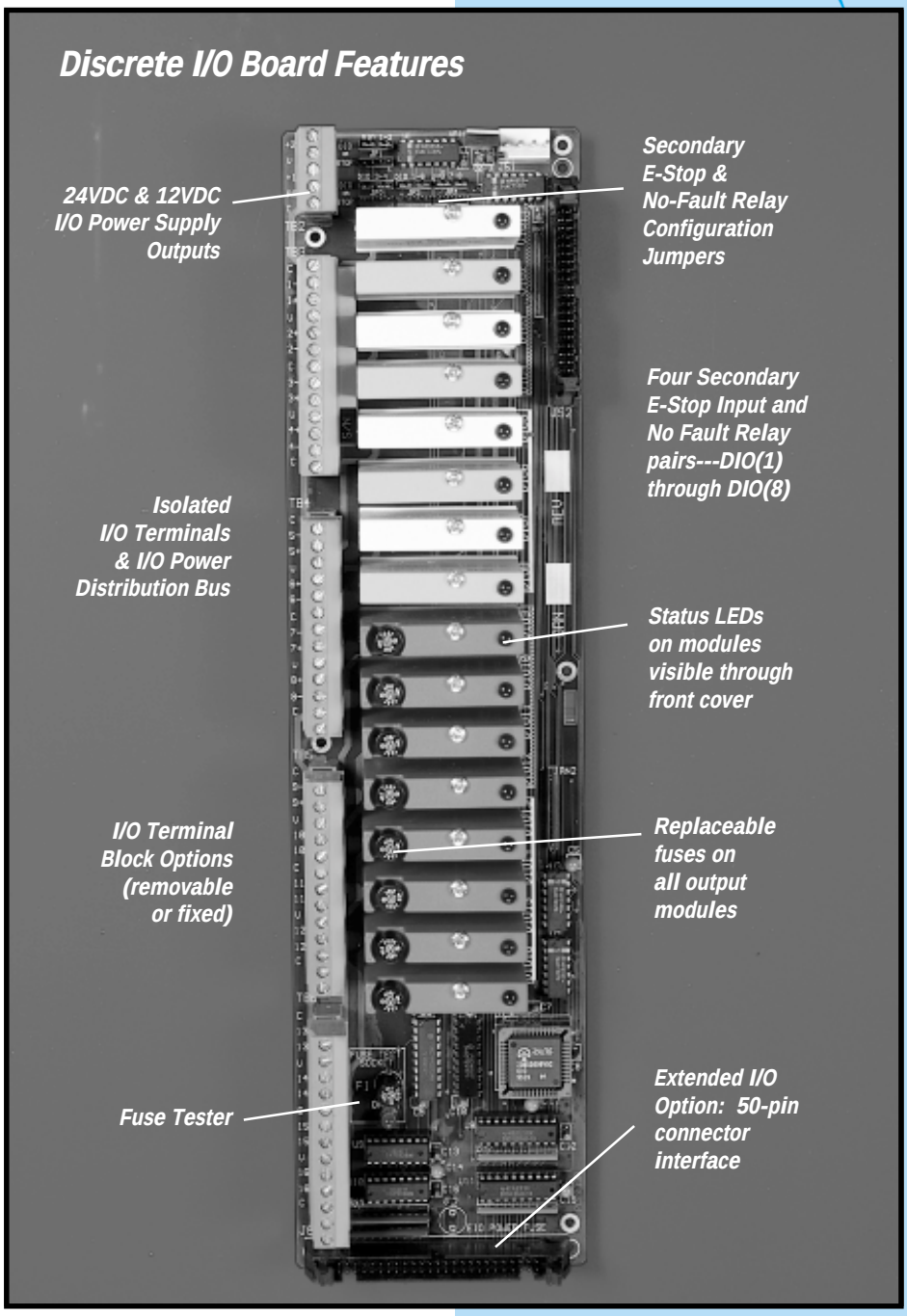
Axis Module I/O (per axis module)

- ❒ Four or eight optional analog inputs on two pluggable terminal blocks.

Integral machine I/O for the ORION® motion controllers is conveniently located behind the hinged front cover.

An I/O circuit board is directly interfaced to the controller's System Module and provides:

- 16 integral discrete I/O points which include sockets to mount Generation 4 (G4) Opto-22 style I/O modules which have integral replaceable fuses and status LEDs,
- Optional Extended I/O interface for 24 discrete I/O or access to 512 remote discrete and analog I/O via Opto-22's Pamux standard,
- Emergency Stop, No-Fault Interlocks, and
- 24 VDC & 12VDC I/O power.



Integral Discrete I/O

Each ORION® controller includes 16 integral discrete I/O points. Machine I/O signals are conveniently wired to the controller at removable terminal blocks on the discrete I/O board, and are interfaced to the system through G4 Opto-22 style plug-in modules. These industry standard G4 I/O modules provide optical isolation for these machine signals, and support a wide range of AC and DC voltages and currents.

All sixteen I/O points are independently selectable through software as inputs or outputs. When used as inputs, they are configured to be read directly or be "latched" on either "high" or "low" transitions of the input voltage. These inputs are used to "interrupt" and cause "events" in the MotionBASIC® program.

The MotionDesk development software allows the user to interactively select the configuration of each of these I/O points as well as the extended I/O points. Configuration is accomplished by simply moving the cursor to the appropriate I/O point number in the window and scrolling through the available options.

Dual Voltage I/O Power

An isolated 24 VDC power supply rated at 1.6 amps is provided to power the discrete I/O circuitry and sensors as well as Emergency Stop and No Fault interlock circuitry. A 12 VDC power supply is regulated from it, providing up to 500 milliamps at the terminal block to power low voltage sensors and modules. These power sources are interfaced at a removable terminal block on the discrete I/O board. A common I/O power bus V+ and C can be conveniently jumpered to either power supply and its return.

E-Stop and No Fault Relay I/O

Four independent secondary Emergency Stop/No-Fault Relay positions are provided to implement independent E-stop switches to independent machine control circuits. Once configured in the system configuration file, holding an E-stop input "on" will keep the corresponding No-Fault Relay "on" only if defined fault conditions in the ORION® motion controller

Specifications for Discrete I/O Modules

AC Input Modules	Units	G4-IAC-5	G4-IAC-5A
Input Voltage	VAC	90-140	180 - 280
Operate Voltage (ON)	VAC min	90	180
Release Voltage (OFF)	VAC max	45	45
Input Current at Max. Input Voltage	mA max	11	11
Input Current at Rated Release Voltage	mA max	3	3
Turn on time	msec max	20	20
Turn off time	msec max	20	20

DC Output Modules	Units	G4-ODC-5	G4-ODC-5R
Load Voltage, maximum	VDC	60	100 (130 VAC)
Load Voltage, range	VDC	5-60	0 to max
Current Rating at 45C	amps	3	0.5
Current Rating at 70C	amps	2	0.5
Output Voltage Drop	VDC max	1.6	0.3
Off state current leakage	mA max (60VDC)	1.0	0.0
Turn on time	msec max	0.5	0.5
Turn off time	msec max	0.5	0.5
Contact Bounce	msec max	n/a	0.25

AC Output Modules	Units	G4-OAC-5	G4-OAC-5A
Load Voltage, nominal	VAC (25 to 65Hz)	120	240
Load Voltage, range	VAC	12-140	24 - 280
Repetitive Blocking Voltages	volts peak	500	500
Current Rating at 45C	amps	3	3
Current Rating at 70C	amps	2	2
One cycle surge current	amps max	80	80
Output Voltage Drop	VAC max	1.6	1.6
Off state current leakage	mA max RMS @ 60Hz	5	2.5
Turn on time	cycle max (0 volts)	1/2	1/2
Turn off time	cycle max (0 amps)	1/2	1/2

DC Input Modules	Units	G4-IDC-5	G4-IDC-5B
Input Voltage	VDC	10-32	4-16
Reverse Voltage Protection	volts	32	16
Operate Voltage (ON)	volts	10	3
Release Voltage (OFF)	volts	3	1
Input Current at Maximum Input Voltage	mA max	25	45
Input Current at Rated Release Voltage	mA max	1	0.7
Turn on time	msec max	5	0.05
Turn off time	msec max	5	0.10

GENERAL SPECIFICATIONS: Isolation Input to Output: 4000 Volts RMS, Storage Temperature: -40 to 85C, Operating Temperature: -30 to 70C

are satisfied and cleared. A normally-open, held-closed dry contact relay (G4-ODC-5R) is available for each No-Fault Relay position. Both AC & DC voltages can be switched with this relay.

Input / Output Modules

Input/Output modules provide a means of reliably interfacing between ORION® motion controllers and external input devices and loads such as switches, sensors, solenoids, valves and motor starters.

Eight I/O modules are offered in six optically isolated types:

- ❒ AC & DC inputs,
- ❒ AC & DC outputs,
- ❒ a fast DC input and;
- ❒ a Relay Module.

The I/O modules are color coded by function and provide a high degree of isolation and noise immunity between the motion controller and external components.

The AC output modules utilize zero voltage turn-on and zero current turn-off of the load to greatly reduce generated EMI and RFI. They also feature an internal dv/dt snubber network for protection from voltage transients on the line.

All I/O modules feature internal LED indicators and all output modules also have a replaceable fuse.

MotionBASIC® Interface

All discrete and analog I/O points in the system are accessed from MotionBASIC® as ORMEC pre-defined array variables DIO@ and AIO@, with the array indexed on the I/O point number or group I/O point number.

Extended I/O Interface

Selecting the ORION® Extended I/O option adds an interface connector to the bottom of the I/O board.

The extended I/O interface provides access to 24 additional TTL-level I/O points which are interfaced through a 50-pin header connector. When configured as discrete I/O, this connector provides plug compatibility with G4 Opto-22 I/O racks. These racks have sites for 8, 16 or 24 optically isolated I/O points. With discrete mode selected, these I/O points are indexed between 17 and 40. The first eight I/O points may be software configured as inputs or outputs individually. The second and third groups of eight are software configured as inputs or outputs as a group.

ORDERING GUIDE

I/O Modules

G4-IDC-5	DC Input Module, 10-32 VDC & 12-32 VAC
G4-IDC-5B	DC Input Module, Fast Response, 4-16 VDC
G4-IAC-5	AC Input Module, 90 to 140 VAC/DC
G4-IAC-5A	AC Input Module, 180 to 280 VAC/DC
G4-ODC-5	DC Output Module, 60 VDC max, 3 amps
G4-ODC-5R	Relay Module, N.O. contact, 100 VDC / 130 VAC max, 0.5 amps
G4-OAC-5	AC Output Module, 12 to 140 VAC, 3 amps
G4-OAC-5A	AC Output Module, 24 to 280 VAC, 3 amps

Mounting Racks and Cable for Extended i/O

G4-MIO-PB24	Machine I/O Module Mounting Rack, 24 units
G4-MIO-PB16H	16 Position Single Channel I/O Mounting Rack
G4-MIO-PB8H	8 Position Single Channel I/O Mounting Rack
CBL-EIO/x	Extended I/O Cable, x ft

Power Supply

PSU-024/3.8A	Machine I/O Power Supply, 24 VDC @ 3.8 amps, 115/230 VAC

ORMEC
ORION® Ethernet I/O Overview

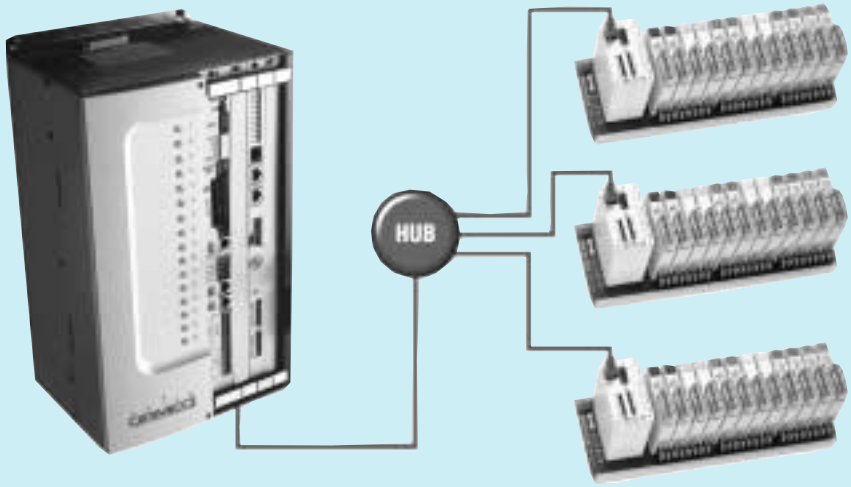
ORION supports a variety of popular Ethernet I/O products in motion control applications. Fully integrated software includes elegant setup, configuration and programming tools to greatly simplify using Ethernet I/O.

Utilizing ORMEC's Ethernet I/O communications MBX, users can select from among WAGO Ethernet I/O, Opto 22 Snap Ethernet I/O, Modicon TSX Momentum or Sixnet EtherTrak I/O for specific application requirements.

With the Ethernet I/O MBX installed, the Ethernet I/O modules are configurable from the development system using MotionDesk.

All I/O mapping and communications are handled by the MBX, and the programmer can utilize standard MotionBASIC statements (DIO@ and AIO@) to integrate analog and digital Ethernet I/O into their application program.

Advantages of Using Ethernet I/O with ORION® Controller



On the Software Side …

- ✔ *Tightly integrated with MotionDesk development software and MotionBASIC to simplify application programming.*
- ✔ *Flexibility to utilize WAGO Ethernet I/O, Opto22 Snap Ethernet I/O, Modicon TSX Momentum or Sixnet EtherTrak I/O.*
- ✔ *Use Ethernet TCP/IP for both I/O and development communications.*
- ✔ *WebTools software provides capability to monitor I/O remotely using web browser.*

On the Hardware Side …

- ✔ *Select the "best of breed" Ethernet I/O hardware best suited to your application.*
- ✔ *Utilize cost effective Ethernet adapters, either ISA or PC Card adapters to interface to the ORION controller.*
- ✔ *Standard cabling is cost-effective and provides distances up to 500 ft.*
- ✔ *Cost-effective hubs provide tools to create effective machine control networks and limit network traffic.*

Ethernet I/O Approaches

Since different I/O vendors have designed their products to address differing customer needs, ORMEC is supporting multiple Ethernet I/O products. The MBX is designed to support a growing number of Ethernet I/O solutions in the future.

Vendors have taken two approaches to meeting the user's Ethernet I/O needs:

"*Modular I/O*" combines a rack and controller for each node. The user can mix and match module types (AC In/Out, DC In/Out, sinking/sourcing, Analog current/voltage, etc.) within the rack. Modular I/O provides maximum flexibility when there is a need to mix I/O types and provides a solution for small numbers of distributed I/O.

WAGO Ethernet I/O and Opto22 Snap Ethernet I/O are examples of modular Ethernet I/O solutions.

"*Brick I/O*" are enclosed modules which contain both inputs and outputs, but the "type" is fixed. For example, some options include 16 DC inputs (10-32V) plus 16 DC outputs (10-32V) or 10 DC inputs (24V) and 8 relay outputs. Depending on the mix of I/O required for your application, the "brick I/O" approach may be an attractive and cost-effective solution.

Modicon TSX Momentum and Sixnet EtherTrak are examples of "brick I/O" solutions.

Performance

The Ethernet I/O MBX has been optimized for I/O handling --- running as a priority task under MotionBASIC to maximize data throughput.

The performance of Ethernet I/O is very deterministic if it's on an isolated network or separated from other network traffic by a switching hub. MotionBASIC supports multiple Ethernet adapters in the same controller to ease creating a separate I/O network.

Standard Ethernet Hardware

A key advantage of ORMEC's approach is it allows the system designer to utilize off-the-shelf Ethernet adapters, cabling and network hubs and/or switches.

The ORION controller provides a PC-AT bus with up to seven expansion slots and a PC card slot which can be used for Ethernet connectivity.

ORDERING GUIDE

Ethernet I/O MotionBASIC MBX

MBX-EIO-5	MotionBASIC Extension (MBX) providing connectivity to Ethernet I/O products including Wago Ethernet I/O, Opto 22 Snap Ethernet I/O, Modicon TSX Momentum and Sixnet EtherTrak I/O. The MBX requires 200 ORION MotionCredits.

Model numbers for Ethernet adapters can be found on page 17.

ORMEC
Wago I/O Connectivity

WAGO Ethernet and Profibus DP I/O feature a wide variety of analog and digital I/O modules that reliably interface the ORION® motion controller to industrial devices such as switches, sensors, solenoids, valves and motor starters.

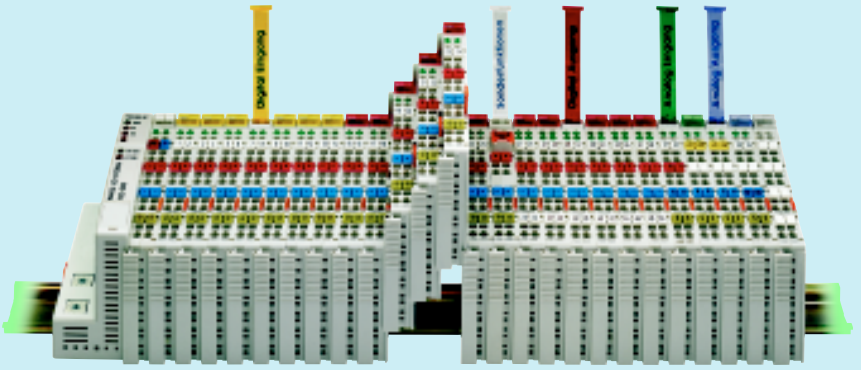
WAGO I/O utilizes either an Ethernet or Profibus DP Fieldbus Coupler for each node, which is connected to DIN rail mounted I/O modules. The user can select appropriate modules (AC In/Out, DC In/Out, sinking/sourcing, Analog current/voltage, etc.) for their specific application.

The WAGO Fieldbus Couplers are compact, flexible, high-performance processors that provide the interface between the I/O modules and either a dedicated Ethernet or Profibus DP network. DIN rail mounted modules provide an efficient method for mounting that minimizes panel space.

The I/O modules are color coded by function and provide a high degree of isolation and noise immunity between the motion controller and external components. Optional labeling components are available to clearly indicate I/O point number, power and ground connections for easier installation and maintenance.

The 24 VDC discrete input modules include built-in noise filters, available with either a 3.0 or 0.2 msec time constant. These filter time constant options allow the user to select the appropriate level of noise filtration for their application and environment.

All discrete I/O modules feature internal LED indicators. Digital output modules below include electronic short-circuit protection.



WAGO I/O: Quick Overview

- ✔ **Standard Connectivity Solutions** - WAGO Ethernet and Profibus DP I/O provide standard connectivity solutions for interfacing digital and analog I/O to the ORION motion controllers that is easy to implement, operate and maintain. High-speed digital and analog signals can interface to the ORION controller using either an industry standard Ethernet network that's dedicated for I/O control or a Profibus DP fieldbus network.
- ✔ **Flexible Interface** - All supported WAGO I/O modules connect to an ORION using a Fieldbus Coupler, one per rack. The Fieldbus Coupler interfaces to the Ethernet or Profibus DP network providing a high-speed connection to all I/O in the rack. I/O can be remotely distributed throughout the machine.
- ✔ **Digital I/O Modules** - WAGO I/O provides a full line of digital I/O modules. DC inputs (5 & 24 VDC), DC outputs (5 & 24 VDC), AC inputs (80 to 230 VAC) and AC outputs (0 to 230 VAC) provide flexible interface options. All digital modules feature a compact 2 and 4 channel designs. Each module incorporates CAGE CLAMP connection system for vibration-proof, fast and maintenance-free wiring with test points for easy access to signals with wiring in place.
- ✔ **Analog I/O Modules** - Analog voltage inputs ranges from 0 to 10 volts, +/- 10 volts, and 4-20 mA. Analog output modules provide 0 to 10 volts, +/- 10 volts ranges. Analog input modules are available as efficient 2-channel devices. Interface to temperature sensors, load cells, dancer control systems, and other industrial analog voltage or current control points.
- ✔ **Minimum Panel Space** - Compact 12 mm (0.47 in) and 24 mm (0.94 in) wide, DIN rail mounted module designs allow the OEM designer to use a minimum amount of panel space.
- ✔ **I/O Functionality** - Basic I/O operations are supported for all WAGO I/O modules using Profibus DP and a subset using Ethernet, including the products listed in the Ordering Guide.

ORDERING GUIDE

Fieldbus Coupler Kits

WAGO-ETH-KIT	Ethernet Fieldbus Coupler Kit, 10baseT, 64 I/O modules (256 points) max. (includes one End Module and two 10 mm End Stops)
WAGO-PFB-KIT	Profibus DP Fieldbus Coupler Kit, 12 Mbaud, 64 I/O modules (256 points) max. (includes one End Module and two 10 mm End Stops)

Digital I/O

WAGO-750-400	2-Channel DC Input, Sourcing (high-side switch), 24 VDC, 3.0 msec filter
WAGO-750-401	2-Channel DC Input, Sourcing (high-side switch), 24 VDC, 0.2 msec filter, high speed
WAGO-750-402	4-Channel DC Input, Sourcing (high-side switch), 24 VDC, 3.0 msec filter
WAGO-750-403	4-Channel DC Input, Sourcing (high-side switch), 24 VDC, 0.2 msec filter, high speed
WAGO-750-405	2-Channel AC Input, 230 VAC (see note 1 below)
WAGO-750-406	2-Channel AC Input, 120 VAC (see note 1 below)
WAGO-750-408	4-Channel DC Input, Sinking (low-side switch), 24 VDC, 3.0 msec filter
WAGO-750-409	4-Channel DC Input, Sinking (low-side switch), 24 VDC, 0.2 msec filter, high speed
WAGO-750-414	4-Channel DC Input, Sourcing (high-side switch), 5 VDC, 0.2 msec filter, high speed (see note 1 below)
WAGO-750-501	2-Channel DC Output, Sourcing (high-side switch), 24 VDC, 0.5 A
WAGO-750-502	2-Channel DC Output, Sourcing (high-side switch), 24 VDC, 2.0 A
WAGO-750-504	4-Channel DC Output, Sourcing (high-side switch), 24 VDC, 0.5 A
WAGO-750-519	4-Channel DC Output, Sourcing (high-side switch), 5 VDC, 20 mA (see note 1 below)
WAGO-750-516	4-Channel DC Output, Sinking (low-side switch), 24 VDC, 0.5 A
WAGO-750-509	2-Channel AC/DC Output, SSR, 230 VAC/VDC, 300 mA (see note 1 below)
WAGO-750-513	2-Channel AC/DC Output, Isolated relay, 250 VAC, 30 VDC, 2A (AC/DC) (see note 2 below)

Analog I/O Modules

WAGO-750-476	2-Channel Analog Input, +/-10 V, 16-bit, single-ended
WAGO-750-478	2-Channel Analog Input, 0-10 V, 16-bit, single-ended
WAGO-750-474	2-Channel Analog Input, 4-20 mA, 16-bit, single-ended
WAGO-750-550	2-Channel Analog Output, 0-10 V, 12-bit (see note 2 below)
WAGO-750-556	2-Channel Analog Output, +/-10 V, 12-bit (see note 2 below)

Power Supplies and Accessories

WAGO-787-912	Power Supply 2 A, 24 VDC
WAGO-787-903	Power Supply 5 A, 24 VDC
WAGO-787-904	Power Supply 10 A, 24 VDC
WAGO-750-601	Supply module with fuse, 24 VDC
WAGO-750-602	Supply module, 24 VDC
WAGO-750-609	Supply module with fuse, 230 VAC
WAGO-750-612	Supply module,0-230 AC/DC (incl. 5 VDC modules)
WAGO-750-615	Supply module with fuse, 120 VAC
WAGO-750-622	Binary Spacer Module
WAGO-247-PWR	Power and Ground Label Strip Pack: blue “0V”, blue “-”, red “24V”, red “+”, light green ground symbol, light green “PE”, 100 each
WAGO-247-513/522	I/O Point Numbering Label Strip Pack, digits 00-99, 10 each

NOTE 1: Any WAGO Digital I/O modules operating at voltages other than 24 VDC require a Power Supply and Supply Module with the appropriate voltage rating for input power and isolation. Refer to the WAGO Ethernet or Profibus I&O Manual or the WAGO Web Site for further information.

NOTE 2: WAGO Analog Output and 2-Channel AC/DC Output Isolated Relay modules do not pass the power supply onto the other modules in the rack. A supply module will be required for any I/O modules to the right of an Analog Output or Isolated Relay module in a WAGO I/O system. Refer to the WAGO Ethernet or Profibus I&O Manual or the WAGO Web Site for further information.

ORMEC
Snap Ethernet I/O

Opto22 Snap Ethernet I/O features a wide variety of analog and digital I/O modules that reliably interface the ORION® motion controller to industrial devices such as switches, sensors, solenoids, valves and motor starters.

Snap Ethernet I/O combines a rack and controller for each node. The user can select appropriate modules (AC In/Out, DC In/Out, sinking/sourcing, Analog current/voltage, etc.) for their specific application.

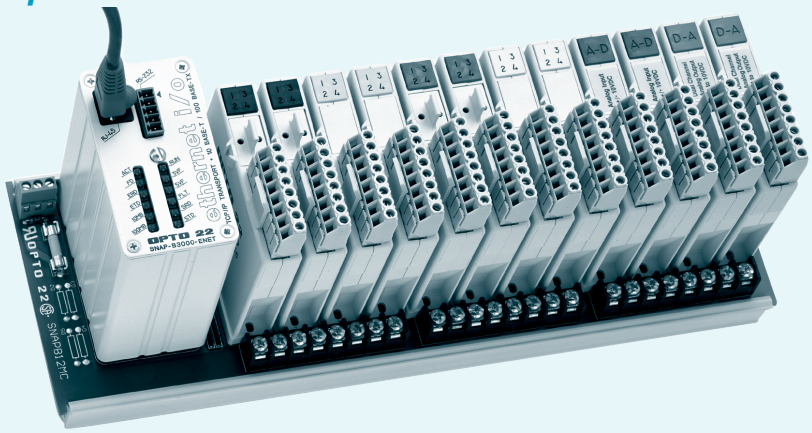
The Snap I/O brain modules are compact, flexible, high-performance processors that provide the interface between the I/O modules mounted to the rack and a dedicated Ethernet network. Industrial racks provide an efficient method for mounting that minimizes panel space.

Pluggable I/O modules are color coded by function and provide a high degree of isolation and noise immunity between the motion controller and external components.

The AC output modules utilize zero voltage turn-on and zero current turn-off of the load to greatly reduce generated EMI and RFI. They also feature an internal dv/dt snubber network for protection from voltage transients on the line.

All discrete I/O modules feature internal LED indicators. Digital output modules below (except for the ODC5R) include replaceable fuses.

Snap Ethernet I/O -- At A Glance



- ✓ Standard Connectivity Solution -- Snap Ethernet I/O provides a standard connectivity solution for interfacing digital and analog I/O to the ORION motion controllers that is easy to implement, operate and maintain. High speed digital and analog signals can interface to the ORION controller using an industry standard Ethernet network that's dedicated for I/O control.
- ✓ Flexible Ethernet Interface -- All Snap I/O racks connect to ORION using a Brain module, one per rack. The Brain module interfaces to the Ethernet network providing a high speed connection to all I/O in the rack. I/O can be remotely distributed throughout the machine.
- ✓ Digital I/O Modules -- Snap Ethernet I/O provides a full line of digital I/O modules. DC inputs (2.5 to 32 VDC), DC outputs (5 to 60 VDC), AC inputs (90 to 280 VAC) and AC outputs (12 to 280 VAC) provide flexible interface options. All digital modules feature a compact 4 channel design. Each module incorporates a pluggable interface connector for easy wiring.
- ✓ Analog I/O Modules -- Analog voltage inputs range from -10 to +10 volts. Analog output modules provide 0 to 10 volts, +/- 10 volts, and 4-20 mA ranges. Analog input modules are available as efficient 2-channel and 4-channel devices. Interface to temperature sensors, load cells, dancer control systems, and other industrial analog voltage or current control points.
- ✓ Minimum Panel Space -- Full range of racks will accept either digital and analog I/O modules. From 4 position to 16 position racks with one 16 position provided for only digital modules allow the OEM designer to use a minimum amount of panel space. DIN-Rail mounting adapters are available.
- ✓ I/O Functionality -- Basic I/O operations are supported for virtually all Opto Snap I/O modules including the products listed below. See our Ethernet I/O Application Note for more details.

ORDERING GUIDE

Analog and Digital I/O

SNAP-B3000-ENET	SNAP-B3000 Ethernet Brain
SNAP-B4M	4-Module Rack
SNAP-B8MC	8-Module Rack, with field wiring power terminal block
SNAP-B12MC	12-Module Rack, with field wiring power terminal block
SNAP-B16MC	16-Module Rack, with field wiring power terminal block

Digital I/O

SNAP-ENET-D64	SNAP Ethernet Brain for Digital I/O only
SNAP-D64RS	16-Module Rack

Digital Input Modules

SNAP-IAC5	4-Channel, AC Input, 90-140VAC/VDC, 5VDC logic
SNAP-IAC5A	4-Channel, AC Input, 180-280VAC/VDC, 5VDC logic
SNAP-IDC5	4-Channel, DC Input, 10-32VDC/VAC, 5VDC logic
SNAP-IDC5D	4-Channel, DC Input, 2.5-28VDC, 5VDC logic
SNAP-IDC5-FAST	4-Channel, DC Input, 2.5-16VDC, 5VDC logic, High-speed
SNAP-IDC5-FASTA	4-Channel, DC Input, 18-32VDC, 5VDC logic, High-speed
SNAP-IDC5-SW	4-Channel, Switch Status Input

Digital Output Modules

SNAP-OAC5	4-Channel, AC Output, 12-280VAC, 5VDC logic
SNAP-ODC5SRC	4-Channel, DC Output, 5-60VDC, 5VDC logic source
SNAP-ODC5SNK	4-Channel, DC Output, 5-60VDC, 5VDC logic sink
SNAP-ODC5R	4-Channel, Dry Contact Output

Analog Input Modules

SNAP-AIV	2-Channel, Analog Voltage Input, -10VDC to +10VDC
SNAP-AIV-4	4-Channel, Analog Voltage Input, -10VDC to +10VDC

Analog Output Modules

SNAP-AOA-23	2-Channel, Analog Output Current, 4-20mA
SNAP-AOV-25	2-Channel, Analog Output Voltage, 0 to +10VDC
SNAP-AOV-27	2-Channel, Analog Output Voltage, -10 to +10VDC

Power Supplies for Brain Modules

SNAP-PS5	Power supply, 5VDC @ 4A, 110 VAC
SNAP-PSDIN	DIN rail adapter kit for power supply

Accessories

SNAP-LABEL4B	4-Module Label Holder with Labels, 25-Pack
SNAP-RACKDIN	SNAP Rack DIN-Rail Adapter Clip

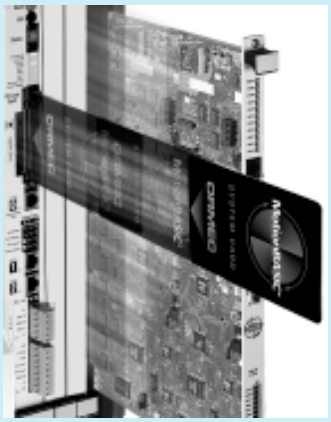
ORMEC
MotionBASIC® System Card

The MotionBASIC® System Card provides an innovative, convenient method for loading all software into an ORION® motion controller.

Since the System Card plugs into a PC Card™ slot (formerly PCMCIA) on the front of the controller, it is easily accessible for all software updates---whether "product recipe" files, user programs, machine setup or system software. Changing PROMs is a thing of the past, as are all other awkward update procedures.

For anyone who supports automation at multiple sites worldwide, the simplicity and ruggedness of the System Card provides an elegant method for maintaining and upgrading every aspect of a motion control application---eliminating the need for a computer and skilled personnel on-site. Updating "product recipe" files, application programs, machine set-up parameters and/or system software is as simple as plugging a rugged, "credit card-sized" module into the PC Card™ slot and pressing the reset button.

Innovative Use of PC Card™ Technology



- Supporting automation in remote locations is greatly simplified.
- Front loading software is easily accessible.
- No more burning PROMs to update software in your motion controller.
- A PC industry standard Flash File system simplifies file management--and makes file archival a snap on any PC.
- All software required for your application is stored on the card---your motion control program, machine set-up parameters & "product recipe" files. Along with all MotionBASIC® software and extensions (MBX) required for the application.

The MotionBASIC® System Card provides front loading of all system and motion control software.

File Management

Since the ORION® motion controller supports a PC industry standard Flash file system, file management is straightforward and is easily accomplished using a laptop with a PC Card™ slot. ORMEC's MotionDesk™ development software supports file management using RS-232 or Ethernet communications.

Flash RAM Memory Disks

The MotionBASIC® System Card is supplied on a Flash RAM memory card---which features *inherently non-volatile* PROM technology. Flash RAM cards (6 to 136 megabytes) feature "write speeds" approaching conventional disk drives with RAM-drive "read speeds". The System Card acts as an integral disk drive for the ORION® motion controller, without the moving parts of a traditional hard disk.

MotionBASIC® Extensions

MotionBASIC® Extensions (MBX) for specialized application needs like factory network communications are simply added to the System Card as dynamic link library (DLL) files.

Specifying System Card Options

To specify your MotionBASIC® System Card, specify two or three model numbers.

(1) A System Card (with six to 136 Mbytes of memory). Six Mbytes is standard and acceptable for most applications.

(2) An ORION® Hardware Key with a MotionCredit limit for your application. Along with the hardware key, you will need 275 credits for each servomotor under control. Additional credits authorize you to run specific MBX software extensions.

(3) The MotionBASIC® Extensions required (if any) for your application. Your System Card will come with the MBX files pre-loaded on your memory card.

ORDERING GUIDE

MotionBASIC® System Card

PCC-SYS5/0006	MotionBASIC® System Card, Flash RAM, 6 to 136 Mbytes (6 Mbytes as shown is standard; specify memory size in the four digits after the "/" in model number.) 0006, 0009, 0016, 0032, 0064 & 0136
ORN-KEY/00275	ORION® Hardware Key & 275 MotionCredits required per servomotor. See credits (below) required for software extensions.

	MotionCredits	*MotionBASIC® Extension*
MBX-ABE-5	500	Allen-Bradley Ethernet communications
MBX-QE-5	400	Modbus TCP communications (Quantum PLCs)
MBX-EIO-5	200	Ethernet I/O communications
MBX-DPM-5	500	Profibus DP Master communications
MBX-PFB-5	300	Profibus DP Slave communications
MBX-DH-5	500	Data Highway/Plus communications
MBX-DF1-5	300	SLC-500 DF1 communications
MBX-MDB-5	300	Modbus communications
MBX-S908-5	500	S908 communications
MBX-GE-5	500	GE Genius communications
MBX-QP-5	200	QuickPanel™ communications

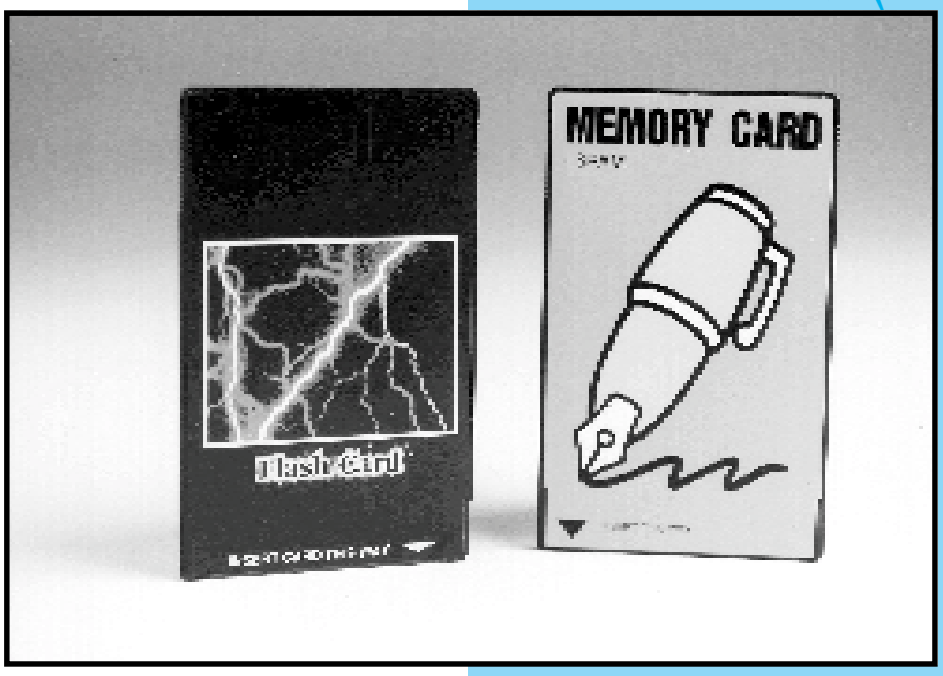
MB-UPG-5	MotionBASIC® Upgrade Disk, available free on website
MBX-UPG-5	MotionBASIC® Extensions Upgrade Disk, available free on website

ORMEC
Memory Cards & Hard Drives

Industry standard PC Card™ solid-state memory cards and hard drives allow ORION® motion controllers to access substantial mass memory.

The MotionBASIC® System Card provides adequate amounts of user memory for most applications. But if your application has high data storage requirements --- or requires very fast data logging --- a memory card or hard drive is a simple, elegant solution. By simply plugging a rugged, front-loading "credit card-sized" module into the second ORION® drive slot, users can access substantial mass memory and/or perform real-time data logging.

The PC Card™ standard (formerly referred to as PCMCIA) has rapidly emerged---fueled by its use in laptop computers---and provides a highly reliable, cost-effective standard for program and data storage.



PC Card™ Flash and SRAM memory cards provide a reliable, removable program and data storage media.

Flash RAM Memory Cards

Flash RAM memory cards feature *inherently non-volatile* PROM technology which make them ideal for archival, installation and maintenance of motion control programs on the plant floor. Flash RAM memory cards (4 to 85 megabytes) feature “write speeds” approaching conventional disk drives with RAM-drive “read speeds”.

SRAM Memory Cards

SRAM memory cards (1, 2 & 4 megabytes) are battery-backed, and feature RAM-drive “read” and “write” speeds. Battery life is four years, not counting the time that power is applied to the card. The PC Card standard insures data reliability, and memory will survive a few days with the battery removed from the card. SRAM is ideal for dynamically changing information where the fastest real-time performance is important.

PC Card™ Hard Disks

PC Card™ hard disks provide large amounts of additional data storage for specialized needs for user program and data storage. Hard disks are available with up to 260 megabytes.

Using Memory Cards

Memory Cards act as an integral disk drive to an ORION® motion controller. Since the ORION® motion controller supports a DOS-compatible Flash file system, file management is straightforward and can be easily accomplished using a laptop with a PC Card™ drive slot. ORMEC's MotionDesk™ also provides file management support utilizing the motion controller's RS-232 development port.

Supporting Remote Automation: For manufacturers who support automation at multiple sites worldwide, the simplicity and ruggedness of memory disks provide an elegant method for updating motion control systems---eliminating the need for a computer and skilled personnel to perform on-site updates.

Storing Product Recipes: An application may need to reference setup or “recipe” data based on an operator selection of a specific product run for the automated machine. The controller program can access Memory Card files to retrieve data relevant to the operator selection. Should machine performance information need to be collected during a production run, data can be written to a Memory Card file, providing permanent storage of "live" process data.

Sequential & Random Access Files: MotionBASIC® also includes statements that provide access to sequential and random-access data files on memory disk. Sequential data files, for example, can be used to save "on disk" mathematical array values that define complex wind segments for traverse winding "recipes". Random access data files have been used to define "pin patterns" and "locations" for machines that insert pins into electrical connectors.

ORDERING GUIDE

PC Card™ Memory Cards & Hard Drives

PCC-FLASH/0020	Memory Card, Non-volatile, Flash RAM, 20 Mbytes (4, 6, 10, 40 & 85 also available)
PCC-SRAM/0002	Memory Card, Battery-backed, SRAM, 2 Mbytes (1 & 4 also available)
PCC-DISK/0260	PC Card™ Hard Drive, 260 Mbytes

Note: Call ORMEC for up-to-date information on memory options for memory cards and hard drives. Memory size (in megabytes) is indicated by the 4-digit placeholder after the “/”.

ORMEC

MotionDesk™ Development Kit

ORMEC's MotionDesk™ Development Kit provides a complete *motion programming environment* on any IBM-PC or compatible computer running Windows 95, 98, NT or 2000. The MotionDesk™ Development Kit provides software tools to simplify the configuration, development and maintenance of ORMEC motion control systems.

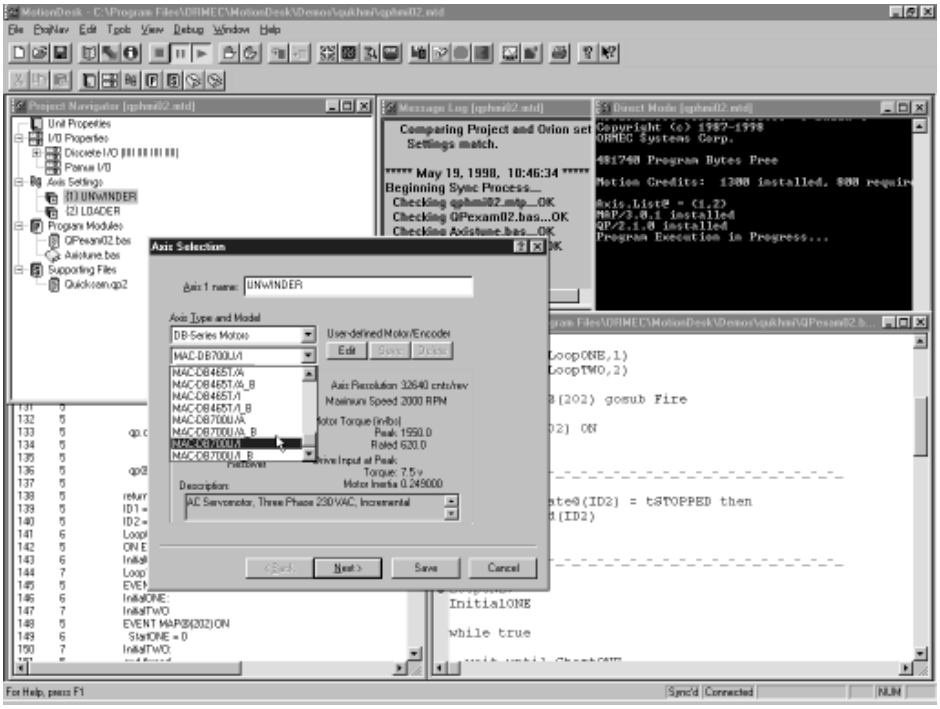
MotionDesk™ is a fully integrated, Windows-oriented "desktop" for motion control. It utilizes drop-down menus, toolbars and dialog boxes and presents a graphical user interface (GUI) to ORION® controllers that is both intuitive and powerful.

Multi-Window Development

The MotionDesk™ Development Console provides an elegant multi-window development environment that includes multiple local windows on your PC as well as a multi-window interface to your motion controller.

MotionDesk™ uses TCP/IP (Transmission Control Protocol/ Internet Protocol) to implement high speed serial communications with ORION® motion controllers. TCP/IP enables the MotionDesk™ to simultaneously open multiple communication channels with ORION® and provide windows to modify, control and view program operation.

MotionDesk™ Development Kit	
Project Navigator incorporates "wizards"	✓
Automatic screen-oriented system configuration	✓
Development Console Windows	✓
Direct mode window for on-line program execution	✓
Program debug tools with multithread source line tracing	✓
Axis Tune facility for matching servo system response to motion profile	✓
ORION® file management utilities	✓
Integrated with Windows Explorer as FTP folder for user files	✓
Upgrade Director to manage MotionBASIC® system files	✓
ORION® Help System	✓
Full on-line reference volume for MotionDesk and MotionBASIC®	✓
Built-in TCP/IP communications software	✓
Interface to the ORION® motion controller's serial port or utilize Ethernet	✓
MotionPad editor	✓
Full-featured program and text editor	✓
MotionBASIC® program development/management utilities	✓
Libraries of Operator Interface Development Tools	✓
QuickPanel programming example files	✓
Error Logging and Handling programming example files	✓
QuickDesigner 2 Touchscreen Development Tool	Optional



The MotionDesk™ Project Navigator provides effective tools for managing motion control projects. Set-up wizards lead you through a process of matching your software with the configuration of your machine.

Project Navigator

A key element of MotionDesk™ is the ORION® Project Navigator that simplifies the process of configuring your motion control system. It includes multiple screens for unit and axis parameters as well as servo gearing and I/O configurations.

The "wizard" approach leads the user through a series of screens that simplify configuration. You are then led through only the pertinent screens based on your prior choices.

MotionPad Editor

The MotionPad editor provides powerful program editing tools and macro capabilities to speed the process of developing your program. Key features of MotionPad are:

- context-sensitive help on menus, toolbars and MotionBASIC® keywords
- colored emphasis of MotionBASIC® keywords helps highlight programming problems while editing
- complete text editing and file management capabilities

- ability to edit one or multiple files in multiple windows
- multi-level undo capability
- MotionPad activates whenever a programming error is detected in the ORION® controller during system testing. Reported errors are presented to the developer through a MotionPad window with the proper module open and pointed to the source line causing the error.

Windows Help

The ORION® Help System utilizes the latest Windows-based tools to provide access to MotionBASIC® and ORION® information. Full text searching capabilities and multi-level folders provide a graphical interface for exploring topics using dynamic links and hypertext tools. The MotionPad editor is linked to the Help System making it simple to initiate searches from the editor by highlighting a word and invoking the Help System.

File Management

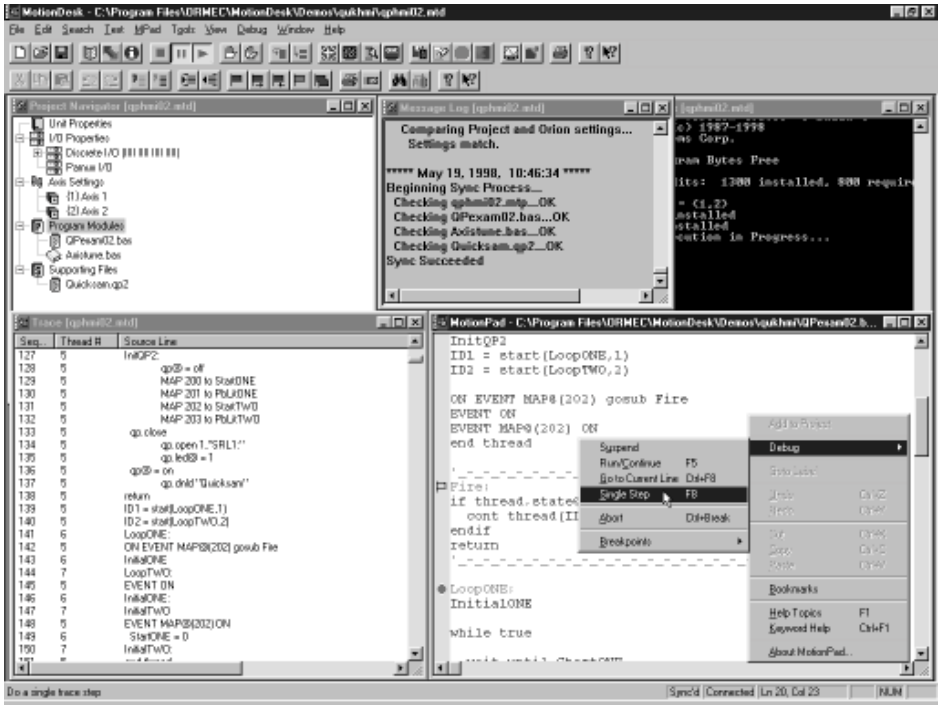
MotionDesk™ provides a full set of file management features that are fully integrated into the Windows Explorer as an FTP folder using TCP/IP communications for managing user files on the ORION® controller.

Upgrade Director

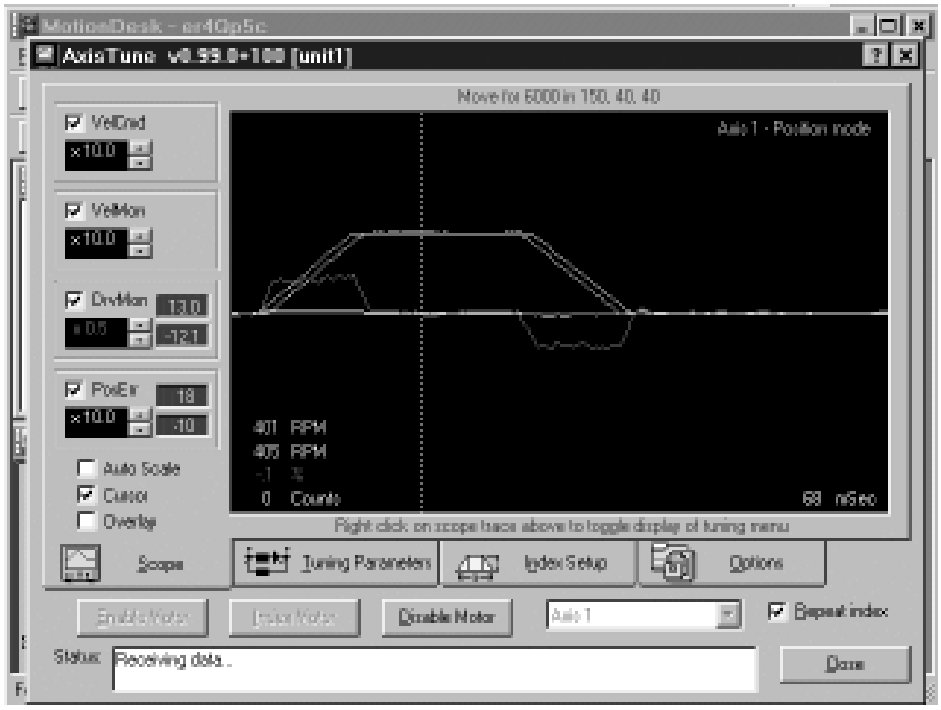
Installing the latest version of MotionBASIC® or a new MotionBASIC® Extension, along with the appropriate Help files, is easy with the Upgrade Director. Integrated into the MotionDesk™ environment, the Upgrade Director presents a complete menu allowing you to install only what you need for your application. In addition to upgrades, all MotionBASIC® extensions are available on the ORMEC User web site (password required).

Axis Tune

No programming is required to get the motor/drive systems tuned to your system load. Built-in and user modifiable motion profiles with default parameters are automatically adjusted to meet your system inertia load requirements for quick and easy fine tuning of your system's loop response. All modifications to loop parameters are implemented dynamically with visual feedback displayed on the integral color scope. Final adjustments can be stored in the configuration file of your project.



The MotionPad Editor combines sophisticated text editing capabilities with context sensitive help, bookmarks, error reporting, program execution control featuring single step and setting breakpoints. Provides realtime display of data variables and program label information with one mouse click.



MotionDesk™ provides a system tuning facility called AxisTune which allows modification of the control system parameters to provide the proper response to motion profiles specific to your application with a real-time record of position error, velocity command, actual velocity and torque response.

ORDERING GUIDE

MotionDesk™ Development Software and Accessories

MDK-SW/C*	MotionDesk™ version 3.x for use with MotionBASIC© 5.x, CD-ROM
CBL-SER-AT	Serial Coil Cord, 6-wire modular, 3/12 ft, 9-pin D, IBM-AT
CBL-SER-PC	Serial Coil Cord, 6-wire modular, 3/12 ft, 25-pin D, IBM-PC
CBL-MOD6/15	Cable, 6-wire modular, 15 ft ($1/ft for other lengths)
CON-MOD6-AT	Connector from CBL-MOD6 to IBM-AT (9-pin D)
CON-MOD6-PC	Connector from CBL-MOD6 to IBM-PC (25-pin D)

**Note: MotionDesk™ kits include coil cable and connectors to communicate to either IBM-PC or IBM-AT styles.*

ORMEC
MotionBASIC® Programming Language

MotionBASIC® provides both language enhancements and elegant development tools for machine developers ready to incorporate servomotor technology in their next design project.

MotionBASIC® Language Features

- Motion generation statements that provide a full featured programming interface to the ServoWire™ Axis Modules and Drives --- along with associated high-speed, on-board hardware
- Multi-tasking operating system and multi-threaded user program execution with priority event thread processing and error reporting
- I/O control statements for processing discrete points, analog conversions, serial line data control, PC-card file access, and TCP/IP sockets
- Language extensions for connectivity to popular factory networks provide consistent register mapping methods to link MotionBASIC® information to numbered PLC registers on the network

Motion Statements

MOVE, GEAR, BLEND, CAM and, PROFILE motion statements allow the user to create custom motion profiles ranging from simple trapezoidal to complex trajectories. One of the central features of MotionBASIC® statements is the ability to express servo controlled motion profiles in plain English, with the motion definition based on either time, speed, or distance traveled by either a pacer axis or the axis under control.

MotionBASIC® statements are sent to the appropriate axes through a FIFO queue in each Axis Module's dual-port RAM. They can be executed unconditionally or conditionally based on the state of a DSP sensor input. They can also be repeated indefinitely by prefixing the motion statement with the REPEAT keyword. In fact, by using the REPEAT prefix on a sequence of motion statements multiple statements can be executed in a loop without intervention by the main processor.

MOVE statements create common trapezoidal motion profiles, and can be based on time, speed or distance.

GEAR statements synchronize motion to an electronic lineshaft. Gearing can be done at a constant ratio or engaged over a distance traveled of the lineshaft or other axis under control. Gearing can also be engaged for a programmable distance, with a variety of ways to express acceleration requirements. Gearing is ideal for creating motion sequences needed in traverse wind, reciprocating and rotary flying shear applications, and for phase adjustments on continuous web applications.

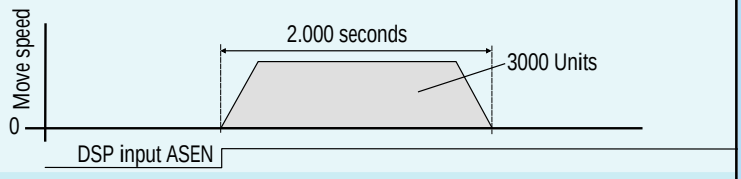
BLEND statements dynamically extend a motor's target position --- allowing speed and acceleration to change on a motion in progress. This capability is useful for creating Cartesian path trajectories in X-Y-Z system designs or for changing speed to utilize the STOP condition when searching for a registration mark.

CAM motion statements produce follower axis motion in response to pacer movement based on a table of follower distances. The table's data can be indexed with regular motion increments from the pacer axis or be expanded to use pairs of pacer and follower distances for irregularly defined cam profiles. CAM tables can

MotionBASIC® programming statements for generating motion commands

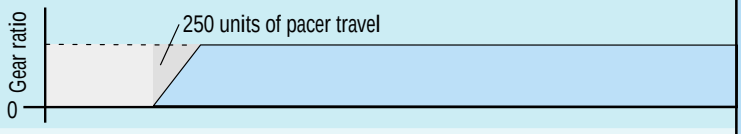
MOVE (axis) FOR 3000 IN 2000 AFTER ASEN@

A total distance of 3000 units is traveled in 2.000 seconds once the "A" sensor input turns on.



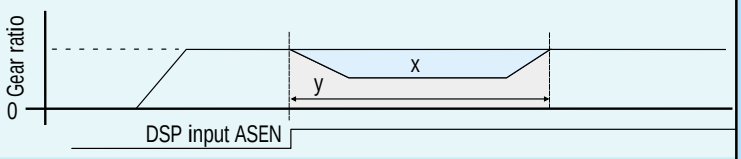
GEAR (axis) AT 1000 TO 1000 IN 250

An exact ratio to 1:1 between follower and pacer axes is achieved during 250 pacer units of travel.



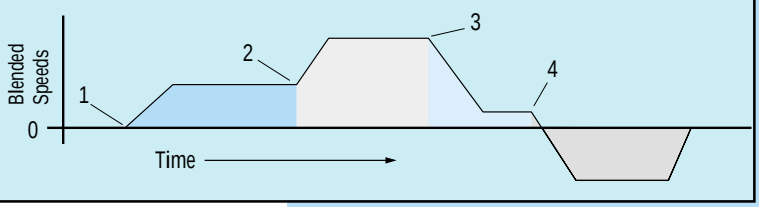
GEAR (axis) FOR -X IN Y AFTER ASEN@

For a precise phasing adjustment triggered at the "A" sensor input, a total distance of "-X " units is superimposed onto the current geared motion over an exact distance "Y" traveled by the pacer axis.



1 **MOVE (axis) FOR 3600 AT 400 BY 600**
2 **BLEND MOVE (axis) FOR 7200 AT 750 BY 1500**
3 **BLEND MOVE (axis) FOR 1080 AT 100 BY 1000**
4 **BLEND MOVE (axis) FOR -3600 AT 500 BY 300**

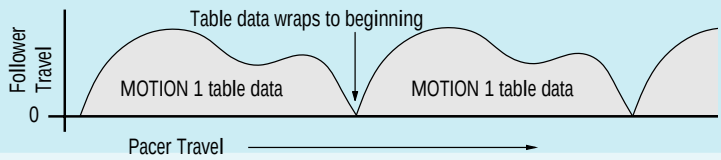
The total distance traveled along this path is 3600 +7200+1080-3600 = 8280 units.



MotionBASIC® programming statements for generating motion commands

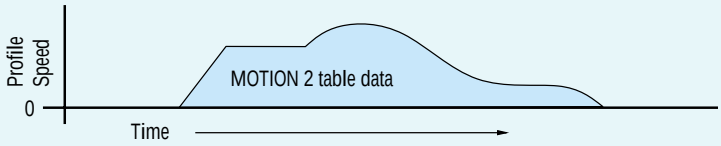
CAM (axis) CLOSED MOTION 1

Follower axis uses a motion sequence previously loaded into the DSP memory area, identified as motion 1. Pacer axis position is used to drive the follower axis.



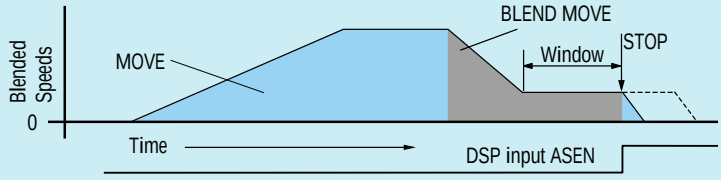
PROFILE (axis) MOTION 2

Using time as a base the DSP performs motion 2, previously defined as an array of distance traveled per time interval.



MOVE (axis) FOR 4000 AT 1000 BY 600
BLEND MOVE (axis) FOR 4000 AT 300 BY 200,35 STOP ASEN@

Axis moves for 8000 units unless the "A" sensor is asserted during the window; at which point the axis will stop the defined distance (35 units) after the sensor.



be defined as either opened or closed. And if closed, pacer movement beyond the ends of the table results in follower motion defined by wrapping around the table, like a mechanical cam.

PROFILE statements are similar to CAM statements, except that the axis follower's incremental distance is defined as a function of time.

Superimposed Motion

When gearing a servo to an electronic lineshaft at a constant ratio, motions defined by both MOVE FOR and GEAR FOR can be superimposed onto that constant ratio for phase adjustments.

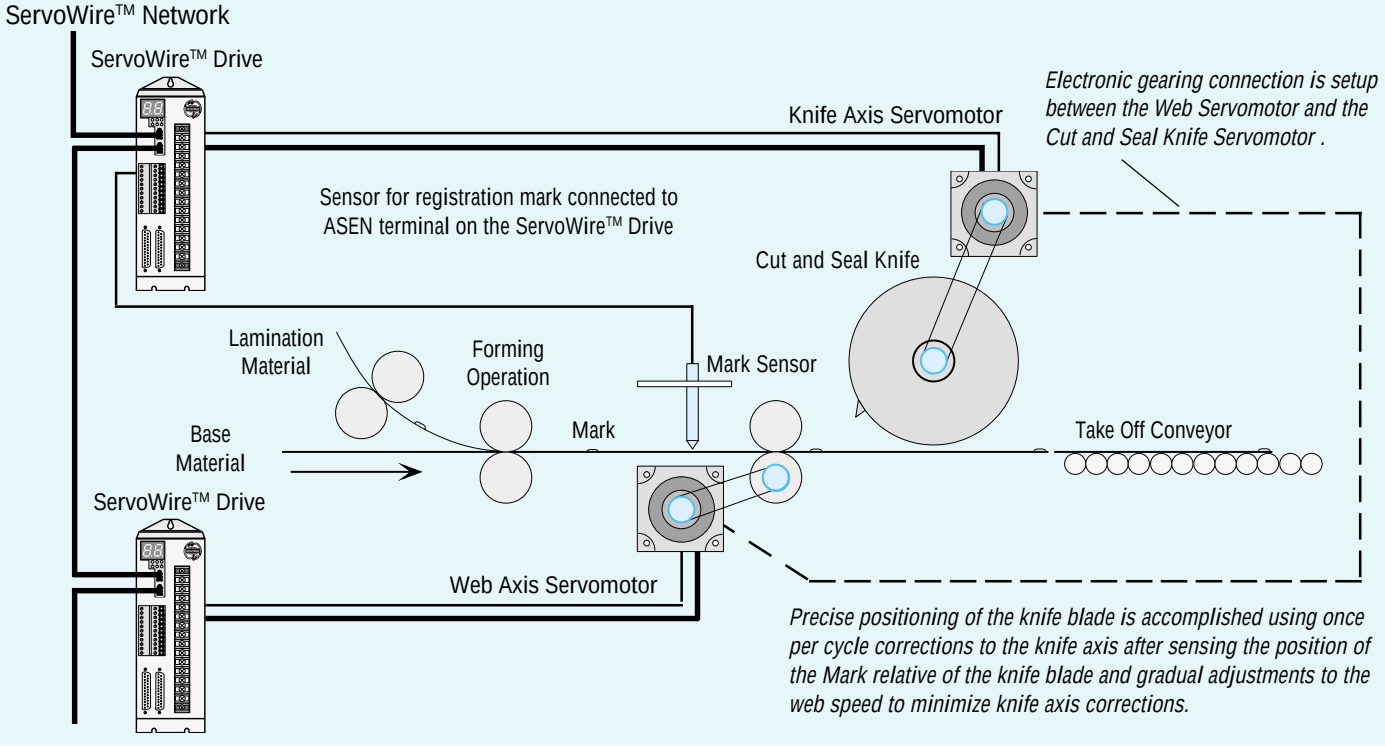
Program Access to Drive I/O

MotionBASIC® coordinates the high speed interaction between the logic state of the inputs and servo motor actions needed to complete the tough application requirements encountered in today's factory automation. MotionBASIC® provides the programmer access into the Axis Module's servo functions and tightly coupled, high speed ServoWire™ drive I/O hardware.

Inputs for High Speed Sensors

ServoWire™ drive sensor inputs are used by any of the MOVE, GEAR, CAM, COUNT and BLEND statements to start, continue, and/or stop motion commands loaded in the DSP command queue in the ServoWire™ Axis Module. Commands in the command queue will respond to sensor inputs within one position update cycle (125 to 333 microseconds). Sensor inputs are individually programmable to can react to the rising or falling edge of their change in state.

Example of a ORION® System Programmed using MotionBASIC®

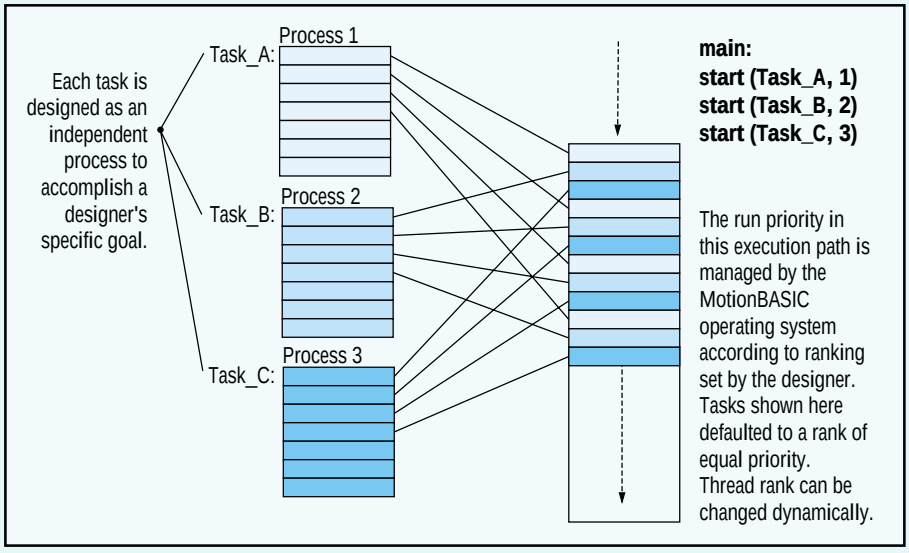


MotionBASIC® programming statements give access to axis functions, digital I/O and analog I/O points, system file access, servo loop parameters, etc.

MotionBASIC® multi-threaded programming statements provides concurrency

MotionBASIC® offers concurrent programming which allows the user to create modern multi-threaded software modules where,

- ❒ multiple processes run simultaneously as separate threads of execution.
- ❒ thread priority can be modified by the executing program.
- ❒ event and/or error threads interrupt process threads to respond to critical machine operations.
- ❒ several axes can be defined as a machine group and allocated their own E-stop circuit. Up to four different machine groups can be handled by each ORION® controller.



MotionBASIC® provides concurrent program execution with a multi-threading real-time operating system.

Using the modern technique of multi-threaded processing, the software designer has better control over all sections of the motion control program. Dynamic control over the priority of each process allows re-tuning for performance when real-time situations demand a temporary change in the process' primary emphasis. Any process can be independently started, stopped, and continued. Process synchronization is available when multiple processes are accessing a global resource such as a memory area or external device.

Position Capture Registers

High speed shaft position measurements are made with 32 bit position capture registers that are linked directly to the sensor inputs on the ServoWire™ Drive insuring microsecond response. MotionBASIC® variables provide direct access to the capture status and captured data allowing sophisticated software solutions to applications such as registration control.

Programmable Limit Switches

Independent optically isolated electronic programmable limit switches (PLS) are accessible from the front panel of the ServoWire™ drive. Each switch is programmed by using MotionBASIC® variables to set the 'turn-on' and 'turn-off' points at defined positions using user units. Each PLS is configured with its own driving source, and cycle distance.

With internal connections built into sensor logic on the ServoWire™ drive, a PLS can also be configured to control how sensor inputs are used during certain portions of the machine cycle.

Position Delay Counters

A ServoWire™ drive provides optional dual high-speed counter circuits that are driven by encoder feedback and can be programmed by the user to:

- ❒ detect the presence of a sensor within a specified encoder count. Counter can be set to down-count and the input sensor can re-trigger the counter.
- ❒ measure distance between two sensors. Sensor inputs can start, stop, or reload the counter register.
- ❒ link counter's output signal to trigger a motion statement loaded into the ServoWire™ axis module command queue delaying action until some distance has passed.

Axis Module Performance

The Axis Module DSP firmware included with MotionBASIC® provides selectable servo loop update rates, feedforward gain adjustments for both velocity and acceleration, access to all servo loop parameters, plus automatic parameter adjustments based on load inertia. These performance features provide tighter servo loop position control resulting in higher accuracy and fast response time.

Client/Server Sockets using TCP/IP

Serial PPP or Ethernet LAN connections to the ORION® are established in MotionBASIC® using OPEN SOCKET statements for client and/or server port communications that utilize internet TCP/IP protocols. A PPP connection uses either a direct cable or a remote modem dial-up link through the development port. An Ethernet link to the ORION® and MotionBASIC® is provided by either a PC-card installed into the second slot of the system module or a ISA based board installed in the ORION® backplane.

Project Management Structure

The MotionBASIC® system card contains all files relevant to your motion control project. All source modules, support files, and ORION® system software, which includes the operating and Axis Module DSP firmware, are on one convenient Flash memory PC-card format.

Integrated Development Tools

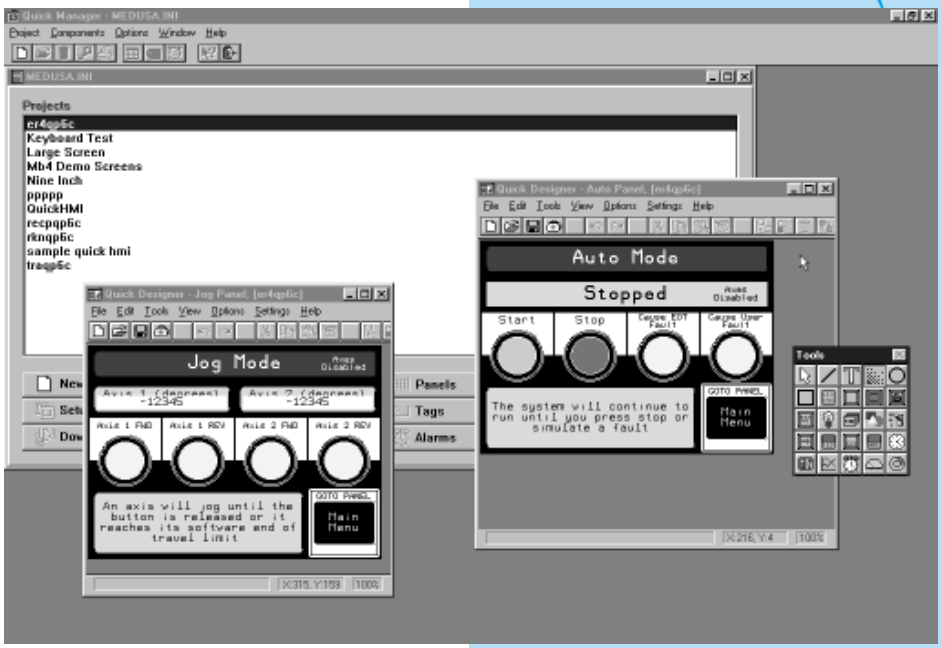
MotionDesk™ is an integrated development and maintenance environment which is interfaced to the ORION® using a TCP/IP connection to each window providing:

- ❒ software project navigation,
- ❒ source file editing,
- ❒ source module debugging,
- ❒ real-time program execution capture with trace mode,
- ❒ direct execution of statements from the Direct Mode window,
- ❒ system software update wizard providing on-line access for all software enhancements.

ORMEC
QuickDesigner Development Tool

ORMEC's QuickDesigner software development tool is a time-saving, easy-to-master, editing and configuration program created to build control panel screens for the QuickPanel touchscreen operator interface.

QuickDesigner provides panel layout and object editing to create graphical operator control panels. It also includes a object library to store and retrive any object and/or complete panel. Finished designs are placed in the project manager called QuickManager for efficiently managing panel files and multiple projects.



QuickDesigner includes the panel object toolbox and a tool for managing multiple panel design projects.

Control Panel Objects

Graphical control panel objects are an excellent representation of their hardware equivalents. Details such as shapes, colors, size, action and legends for each control object are effectively presented and easily modified with the QuickDesigner panel editor which includes the ability create custom graphical shapes that are layered over existing objects.

Pushbuttons and pilot lights can be sized to fit your layout, rectangular or round in shape, with colors and legends that change when the button is depressed or the pilot light turns on.

Pushbuttons can be specified as ON, OFF, momentary or toggled. Text display can be also specified with color and size attributes.

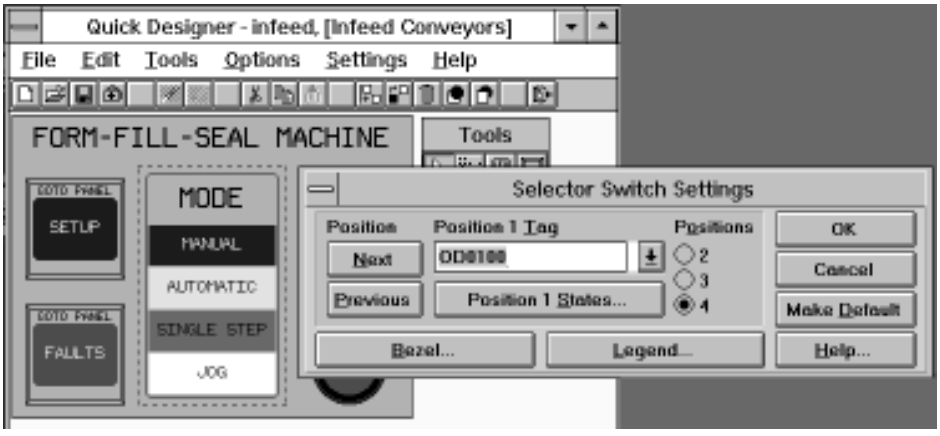
Display and control objects range from simple to sophisticated. Pilot lights, text display and numeric data display are examples of simple objects. Time display, bar graph display & alarm displays are examples of sophisticated control objects.

Multifunction control objects represent the most complex objects available in the QuickPanel unit. The illuminated push button provides two control functions, one for the light and one for the switch. Numeric data entry is done with a twelve-key touchpad that is placed on the screen. Analog meters and the trending chart's unique functionality effectively offloads complex tasks from the main process to make displaying realtime data efficiently.

Control Object Configuration

Most control objects have one or more registers associated with them, and each register is labelled with an identification tag. The tag is attached to the register during the editing process, and is mapped to a MotionBASIC® variable in ORION®.

The control object's current status is indicated by the value of the corresponding MotionBASIC® variable. Changes made at the QuickPanel automatically modify values in associated MotionBASIC® variables. Depending on the object, the data format of its associated variable can be Boolean, integer or long integer (32-bit), floating point, text strings and I/O points.



QuickDesigner uses drag and drop objects that are easily configured to meet your application requirements.

QuickPanel Communications

MotionBASIC® variable values are transferred back and forth between the ORION® motion controller and the QuickPanel operator interface on a regular basis.

In the case of a numeric display object, the ORION® controller simply modifies the value of the associated MotionBASIC® variable. When the QuickPanel receives the updated value, it will change the display as appropriate.

Project Management

QuickManager is used to manage multiple operator panel projects.

Individual projects can use different screen sizes and models which are stored with each project.

Panel Design

QuickDesigner is used to configure panels within a project. Individual panels are constructed using the tool box palette for fast and efficient selection of the proper object.

Each object in the tool box represents a typical panel device used for machine control. Once the object is selected, placed and sized, a double click on the mouse presents the configuration screen to edit the device object to meet the requirements of the designer.

The following objects are available in the tool box:

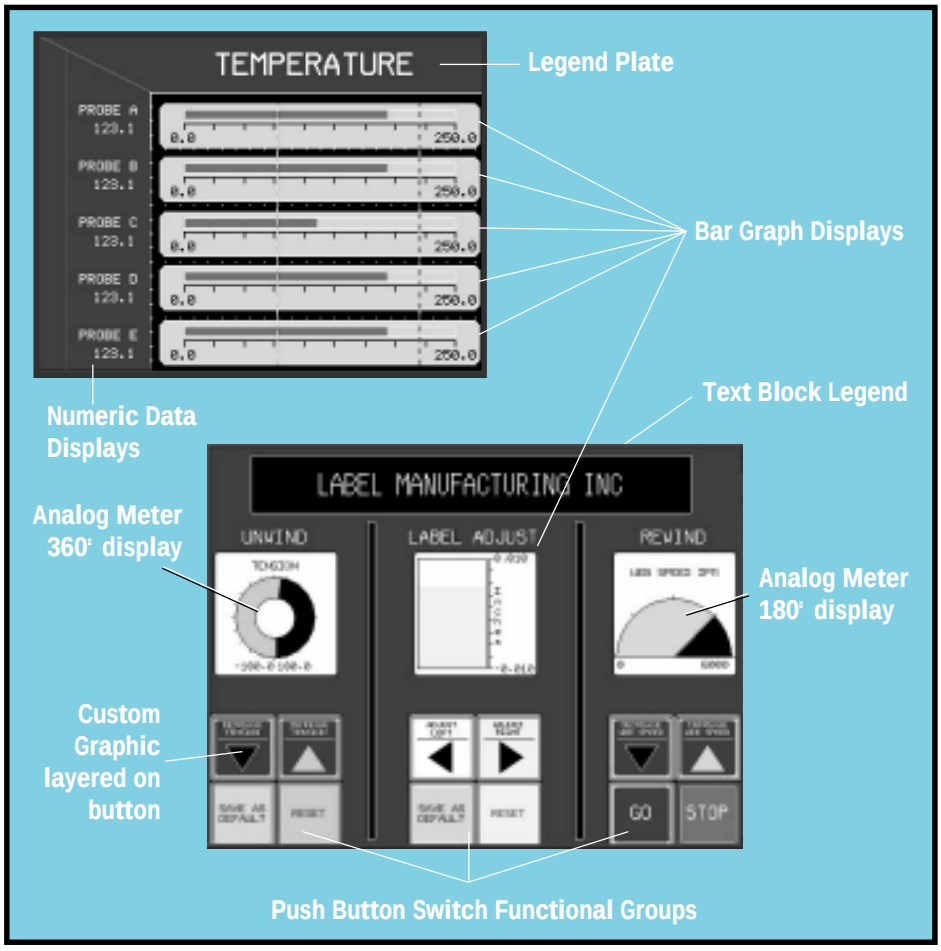
Tool Box Palette Control

Switch Objects & Properties

- ***Push Button Switch*:** circular or square, button color, touch color, fixed legend plate, Boolean data format.
- ***Illuminated Push Button*:** square or rectangular, ON and OFF color, touch color, ON and OFF text, Boolean data format with two associated variables.
- ***Selector Switch*:** choose from two, three or four position switches, ON and OFF color, text on each button, Boolean data format with multiple associated variables.
- ***Panel Selection:*** function that allows the operator to access different control panels, integer format variable indicates or selects a panel.

Data Entry Functions

- ***Numeric Data Entry:*** formatted data entry, field width, decimal position, automatic data entry keypad touch area for numeric data; displays data in decimal, hex, octal or binary format.
- ***Word Push Button*:** similar to the pushbutton object with the addition of an arithmetic or logical operation on the associated variable when button is pressed, operations include addition, subtraction, AND, OR and XOR boolean operations.



QuickPanel Layout Examples using the QuickDesigner Development Tool.

Indicators and Labels

- ***Pilot Light:*** circular or square, ON and OFF color, ON and OFF text, Boolean data format.
- ***Legend Plate:*** rectangular three text sizes, configurable legend.
- ***Bit Map:*** import image file (*.bmp) created with any image editor.
- ***Custom Graphic Objects:*** line, rectangular, or polyline drawings, filled or unfilled, can be created and stored in an object library. Overlapping layers are allowed.

Data Display Functions

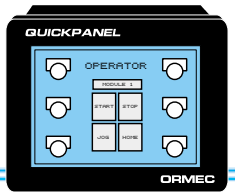
- ***Numeric Data Display:*** rectangular or square, three text sizes, legend included, colors selectable, displays decimal, hex, octal and binary data format.
- ***Time Display:*** internal time clock displayed, standard or military format.
- ***Bar Graph Display:*** graph indicates value of the associated variable, selectable bar color and orientation, text legend, integer data format.
- ***360° & 180° Analog Meters:*** indicates value of the associated variable, selectable color, orientation, text legend, and integer data format.
- ***Graphic Display Control:*** an array of graph objects are grouped together under one integer variable. The data in the variable indexes the array to control which object is displayed.

Message Display Functions

- ***Local Message Display:*** text entered into a table with editor, text is display by indexing with integer value in tagged register. Index up to 256 message blocks.
- ***Alarm Display:*** indexed alarm messages, time and date stamped, stored in memory, keeps history of events.

ORDERING GUIDE

MDK-QDx/3	QuickDesigner Developer's Kit, 3.5" disks (*Includes download cable, CBL-QP-AT/10)*
CBL-QP-AT/10	QuickPanel Executive Software Download Cable, 10 ft



ORMEC
QuickPanel Touchscreens

ORMEC's QuickPanel flatpanel touchscreens provide a variety of sizes and functionally of the human-machine interfaces. QuickPanel units are available in the five, six, nine, and ten and twelve inch screen sizes, along with monochrome, active and passive color, and electroluminescent displays.

The QuickPanel touchscreen is designed to provide the operator an effective way to control machine operation. The operator can easily be alerted to machine alarms and status conditions. Different panels can be quickly selected to present different sets of machine functions typically found for setup, maintenance, changing product runs and fault conditions.

Direct communication using one serial cable simplifies installation and lowers cost. Operator control functionality can be built into the QuickPanel representing a typical factory operator panel without the bulky hardware, I/O modules & wiring needed to build it.

Each individual panel can be designed and built in minutes using "drag and drop" graphical objects using QuickDesigner running in a Windows environment. When upgrading a machine, the "look and feel" of an existing physical panel can be kept to reduce operator retraining. After the design and installation of a QuickPanel is complete its flexibility allows the designer to add and change control functions and remotely update screen files, without having to physically add switches, legend plates, I/O modules and their associated wiring.

Operation

Communications with an ORION® controller use the MotionBASIC® Extension for QuickPanel Communications (MBX-QP) to transfer bit and word register data generated when a screen object is touched or a programmed variable is changed on the ORION®. Screen objects are tagged to input and output registers that are mapped to input and output variables in the user's program. Touching the screen object sets the state of the

ORMEC's QuickPanel touchscreen units provide a fully graphical, easy to use human-machine interfaces.

Ordering Guide ---- QuickPanel Products

MMI-QPN/6 C E 4X

Screen Size
- 2/5 - 5.0" diagonal, 320w x 240h pixels
- 2/6 - 6.0" diagonal, 320w x 240h pixels
- 2H/6 - 6.0" diagonal, 320w x 240h pixels
- 3/9 - 9.0" diagonal, 640w x 400h pixels
- 3/10 - 10.5" diagonal, 640w x 480h pixels
- 2/12 - 12.1" diagonal, 800w x 600h pixels

Enclosure Rating
- blank - Mounted, NEMA 4/13, IP65
- blank - Handheld, NEMA 1, IP63
- 4X - NEMA 4X on mounted units

Unit Configuration
- blank - 120v AC (/9, /10, & /12 only)
- U - 24v DC (/5, /6, H/6, /10 only)
- E - 24v DC w/CE (/5, /6, /9, /10 only)

Screen Technology
- M - Monochrome LCD (/5, /6, H/6, /10 only)
- E - Electroluminescent (/9 only)
- C - Color LCD Dual Scan (/5, /6, H/6, /10 only)
- T - Color LCD Thin Film Transistor (/10, /12 only)

Note: *Screens developed for the older QP are easily converted to the new QP format with the QuickDesigner software developer's kit.*

Accessories

MMI-QP2-KPD	Keypad for the 5" and 6" mounted units only, panel size 11.30"W x 7.20"H.
TBC-QP2H	Terminal Block, Handheld QP cable to 25-pin D-sub and screw terminals.
MMI-QP3-COV/x	Protective Overlay Sheets for QP2 or QP3 models, 20/pack, where x is 5 or 6.
PSU-024/3.8A	Power Supply, 24 VDC @ 3.8 Amps, 115/230 VAC

Replacement Parts

MMI-QPx-SCN/x	Replacement Clear Screen Overlay where x is 5, 6, 9, or 10.
MMI-QPx-CCT/x	Replacement Backlight Tube, where x is 5, 6, 10, or 12.

Cables and Connectors

CBL-MOD8/x	Cable, 8-pin modular to 8-pin modular, x ft
CON-QPMOD8	Connector, 25 pin D-sub to MOD8 Connector
CON-MOD8-Y	Connector, MOD8 female bus expansion (1 in - 2 out)
CBL-QPPWR/x	Power Cable, 24 VDC, x ft.
CBL-QP2-AT/10	Download cable for system software, 10 ft.
CBL-QP2H-TB/12	Cable, Handheld QP to Terminal Block, 12 ft.
CBL-QP2H-PRNT/10	Cable,QuickPanel to Laser Printer, 10 ft.

Development Software

MDK-QDx/3	Developer's Kit QuickDesigner 2, 3.5" disks, manual, includes download cable.

variable. How the change of state is used in the program defines the object's control function.

Graphical Panel Objects

- ❒ Push Buttons
- ❒ Pilot Lights
- ❒ Selector Switches
- ❒ Illuminated Push Buttons
- ❒ Numeric Data Word Entry
- ❒ Numeric Data Word Display
- ❒ Local Message Displays
- ❒ Local Graphic Displays
- ❒ Variable Text Displays
- ❒ Analog Bar Graphs
- ❒ Analog Meters 180° and 360°
- ❒ Bit and Word Alarm Monitors
- ❒ Bit and Word Alarm Displays
- ❒ Bit Mapped Graphic Display
- ❒ Time Display
- ❒ Event Logging with Time and Date
- ❒ Print Screen Push Button
- ❒ Trending Multi-Pen Chart Display

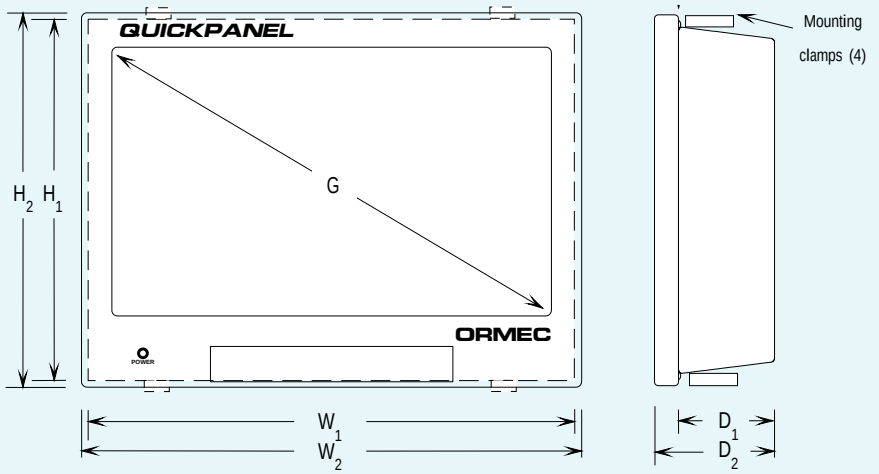
Mounting & Sealing

QuickPanels are cabinet mounted, and feature a gasket to maintain NEMA 4/13 rating. Only one cutout in the panel is required for a NEMA 4/13 installation and each includes four mounting clamps. Units with NEMA 4X ratings are available.

Keypad Accessory

QuickPanel five inch and six inch units can be fitted with the optional keypad accessory. The keypad adds 15 data entry keys and 26 function keys with tactile feedback.

Cabinet Mounted Unit Dimensions



	Dimension	MMI-QP2/5	MMI-QP2/6	MMI-QP3/9	MMI-QP3/10	MMI-QP3/12
Mounting & Cutout	G	5.0" 128 mm	6.0" 152 mm	9.0" 230 mm	10.5" 267 mm	12.1" 307 mm
	H1	4.45" 113 mm	4.90" 123 mm	7.91" 200 mm	8.97" 228 mm	10.16" 258 mm
	W1	6.20" 158 mm	6.10" 155 mm	10.20" 258 mm	11.28" 302 mm	13.07" 332 mm
	D1	2.1" 54 mm	2.3" 57 mm	1.9" 49 mm	3.1" 78 mm	2.9" 74 mm
Overall	H2	5.0" 127 mm	5.4" 138 mm	8.5" 216 mm	9.6" 243 mm	10.7" 272 mm
	W2	6.8" 172 mm	6.7" 171 mm	10.8" 274 mm	12.5" 317 mm	13.62" 346 mm
	D2	2.3" 59 mm	2.4" 62 mm	2.0" 57 mm	3.4" 85 mm	3.2" 81 mm

Handheld Unit

The QuickPanel Handheld Unit is available as a six inch mono or color self-enclosed model. Unit features E-Stop and "dead man" switches plus 12 function keys mounted to the right and left sides of the screen.

UL and CE Unit Configurations

QuickPanel 24VDC cabinet mounted units can be provided with either UL and CE approval. The UL units are approved for use in Class 1, Division 2, Groups A, B, C, and D applications. The CE Mark units have been tested to European Union directives EN50082-2: 1995, EN55022 Class A (94).

General Specifications

Touch panel type	Resistive
Color Type	
Monochrome LCD	White/grey plus flash
Electroluminescent	Amber plus flash
Color LCD	8 colors plus 8 flash
Touch Resolution	
5 and 6 inch	15W x 11H sections
9 and 10 inch	32W x 20H sections
Installation	
All sizes	Cabinet Mount
H/6_ only	Self-enclosed
Vibration	10 to 25Hz 2Gs on each x, y, z plane for 30 min.
Temperature	
Operating	0C to 50C (40C for H/6 unit)
Storage	-10C to 60C (-20c for H/6 unit)
Relative Humidity	
Operating	20% to 85% non-condensing
Storage	5% to 85% non-condensing
Enclosure Ratings	
NEMA 4/13	cabinet mounted units
NEMA 4X	available for mounted units only
NEMA 1	for handheld unit (H/6)
IP-63	for handheld unit
IP-65	for all CE marked units
Weight	
*2/5_ , 2/6_*	1.54 lbs (0.7 kg)
*2H/6_*	1.9 lbs (0.87 kg)
*3/9_*	4.4 lbs (2.0 kg)
*3/10_*	6.6 lbs (3.0 kg)
*2/12_*	8.4 lbs (3.8 kg)
Input Power	
24 Volt DC Unit Configurations	
*/5M_, /6M_*	20.4 to 27.6 VDC @ 500ma
*/5C_, /6C_*	20.4 to 27.6 VDC @ 625ma
*/9_, /10_*	20.4 to 27.6 VDC @ 2100ma
120 Volt AC Unit Configurations	
/9, /10, /12	85 to 135VAC 50/60Hz, 50 VA

ORMEC
A-B Ethernet Communications

ORMEC's MotionBASIC® Extension (MBX) for Allen-Bradley Ethernet communications adds to the network capability of the ORION® controller. A-B Ethernet provides a fast and low cost method to send and receive application data between controllers on an Ethernet network using A-B Ethernet communications. The MBX adds MotionBASIC® statements that make it simple to use Ethernet to communicate between ORION® controllers, Allen-Bradley PLCs and PCs running popular HMI packages.

Features and Benefits

Using the A-B Ethernet MBX as a communication method provides a number of key advantages:

- ❏ Interface an ORION® controller directly to SLC-5/05 PLCs and PLC5 family PLCs that support Ethernet.
- ❏ Connect an ORION® controller to popular HMI packages that use A-B Ethernet to transfer of integers and floating point variables as object tags for operator input and output.
- ❏ Using standard Ethernet cards provides a low cost physical interface to the ORION® controller.
- ❏ Based on standard Internet technologies ... TCP/IP protocol is layered on high speed 10base Ethernet networks.
- ❏ Enhances the flexibility and performance of message transfers by allowing peer-to-peer connections between network nodes.

Overview

The A-B Ethernet MBX extends the MotionBASIC® operating system to provide connectivity between ORION® controllers, Allen-Bradley PLCs and PCs running popular HMI packages by using A-B Ethernet communications. An ORION® controller with an Ethernet link installed and configured with the A-B Ethernet MBX, can open an A-B connection to send application data to any A-B server node on the network. The ORION® controller also has the ability to start a server node that will accept any connection from another A-B node and receive application data.

ORMEC provides standard Ethernet installation hardware for the ORION® A-B Ethernet MBX option.

Multiprotocol capability

Software development for a system with multiple ORION® controllers using the full capabilities of A-B communications can now be performed with one PC. Since Ethernet is a multiprotocol network, any PC connected to the network can establish a TCP/IP connection, communicate to an ORION® and run the MotionDesk™ for program development over the same wire at basically the same time A-B communications are also going on.

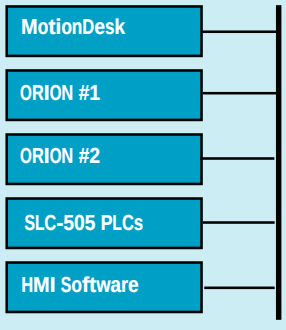
A-B Ethernet Architecture

ORION® A-B Ethernet consists of a physical layer based on 10baseT, 10base2, or 10base5 type Ethernet communication standards along with a client/server transport protocol (TCP/IP stack) to provide reliable peer-to-peer communications in the ORION® controller. At the application level the MBX-ABE uses a protocol developed for PLC networking to transfer register data as messages between controllers. All transfers happen as a background task concurrent with the user's main application program.

User access at the application programming interface level consists of MotionBASIC® extensions for making the connection to the destination server and the specifying source and destination registers for a read or a write multiple register transfer to that connected server. Concurrent multiple connections can be made to multiple servers on the network for a

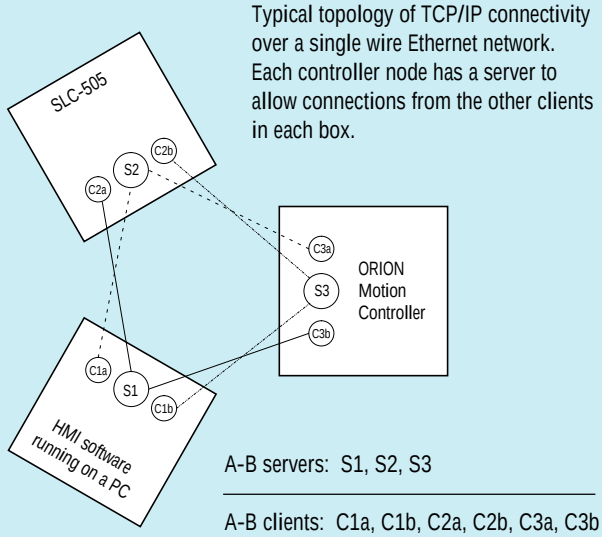
A partial list of PLCs, popular Human Machine Interface (HMI) packages and OCX software controls that can communicate with an ORION controller incorporating the A-B Ethernet MBX.

- ❏ PLCs: Allen-Bradley SLC-5/05 PLCs and PLC5s that support Ethernet communications
- ❏ HMI Packages: RsView32 by Rockwell Automation, InTouch by Wonderware, Fix by Intellution, FactoryLink by U.S. Data and Citect by CI Technologies
- ❏ OCX Software Controls: ASABETHERNET an OCX by Automation Solutions, ABEther an OCX by Parijat, Inc., IN-GEAR 32 an OCX by CimQuest, Inc.

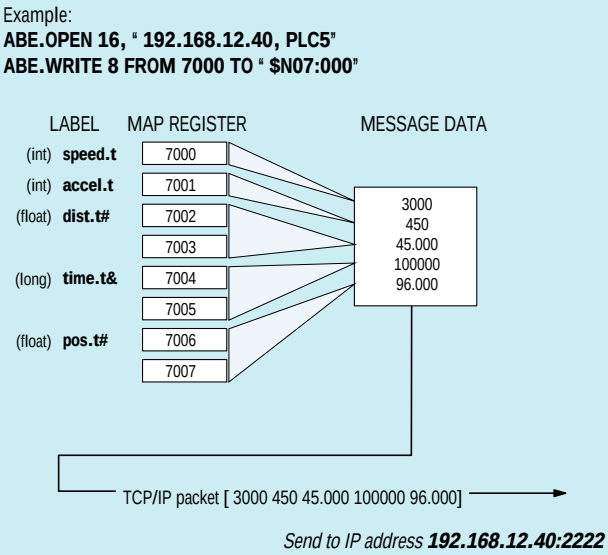


Physical layer of the Ethernet connections between multiprotocol network nodes.

Ethernet connectivity: multiple servers and multiple clients



Register mapping; sending application variables as one message



flexible and efficient arrangement for updating application data between a variety of system components.

For constructing messages, the ORMEC includes MotionBASIC® mapping methods (MBX-MAP) to simplify data organization at the PLC register level for the user.

ORION® Variable Mapping

MBX-MAP extends the capability of MotionBASIC® by providing a method to map PLC register values to any MotionBASIC® variable in the controller. Typically, PLC registers are addressed numerically but MotionBASIC® uses symbolic labels to address variables. With mapping the MotionBASIC® variable's symbolic label can be simultaneously defined as a PLC register address value. Register mapping values can range from 0 to 32367. The main purpose of this mapping feature is to allow the MBX to quickly assemble the content of various variables such as integers, and floats that reside in different areas of the controller's memory, into an ordered list of data and transferred over the network as one message.

MBX-MAP also provides the ability to monitor the changes in selected variables. Any change in the data contained in the variable selected, can result in an event interrupt. The event interrupt, if enabled, will in execute a user defined subroutine designed to respond to the changes in the data as a result of receiving the message.

Allen-Bradley, PLC5 and SLC are trademarks of Rockwell Automation Inc.

A-B Ethernet MotionBASIC® Extensions

❑ MBX-ABE Statements

ABE.OPEN <device%>**,"IP_address,PLC5"**	Open client connection to a PLC5 server.
ABE.OPEN <device%>**,"IP_address,SLC"**	Open client connection to a SLC-505 server.
ABE.OPEN <device%>**,"IP_address,server"**	Open server connection to accept PLC5 or SLC.
ABE.READ [qty of reg(s)] **FROM** <starting src_register> **TO** <starting dest_register>	
ABE.WRITE [qty of reg(s)] **FROM** <starting src_register> **TO** <starting dest_register>	
ABE.CLOSE [<device%>]	Close one connection or all connections.

❑ MBX-ABE Control functions and access variables

ABE@ = ON	Set mapped register access enabled.
ABE.SOCKOPEN@(device%)	Get status of TCP/IP connection.
ABE.DEST@ = device%	Set destination connection for next client command.
ABE.MSG@(device%)	Get client reply received status.
ABE.LED@ = <led value>	Set MBX-ABE to use the front panel MB LED indicator.
ABE.CTR@(ctr%)	Get 1 of 32 error status counts of client and server connection activity during data transfers.
ABE.STS@(device%)	Get the response code for last exception that occurred.

❑ Diagnostic Commands that display to the Direct Mode window in MotionDesk

ABE.TRACE@= ON	Enable real-time display of message transfer activity.
ABE.DUMP	Display the current settings and information for all current connections.
PING <IP address>	Check to make sure that the destination IP address is available and listening on the network.

❑ MBX-MAP MotionBASIC® Mapping Statements

MAP <regnum> TO <variable>	Relate a register number 0 to 32767 to a MotionBASIC® variable name.
ON EVENT MAP@(regnum) GOSUB [label]	Call subroutine when value mapped to regnum changed.

ORDERING GUIDE

MotionBASIC® Extension (MBX) and Network Adapter selection for A-B Ethernet

MBX-ABE-5	MotionBASIC® Extension for ORION® A-B Ethernet, peer-to-peer communications. The MBX-ABE requires 500 ORION® MotionCredits.
ORN-ENE2000	Ethernet ISA Adapter, with RJ45 & BNC connectors
ORN-E3C509B	Ethernet ISA Adapter, with RJ45, BNC & AUI connectors
PCC-E3C589C	Ethernet PC Card Adapter, with extension cable for RJ45 & BNC connectors

Use utilities provided in the MotionDesk™ development software to assist in the hardware and software installation procedures for an ORION® MBX.

ORMEC
Modbus TCP Communications

ORMEC's MotionBASIC® Extensions for Modbus TCP Communications adds to the network capability of the ORION® motion controller. Modbus TCP is an provides a fast and low cost method to send and receive application data to any other controller on an Ethernet network installed as a Quantum communication node. The MBX also adds a full list of MotionBASIC® statements to configure, control and monitor Quantum PLC activity.

ORMEC provides two types of Ethernet installation hardware for the Modbus TCP MBX option.

Features and Benefits

Using Modbus TCP communications provides a number of key advantages:

- ❏ A low cost physical interface to the ORION® controller ... using standard Ethernet cards.
- ❏ Based on standard internet technologies ... TCP/IP protocol layered on a high speed 10base Ethernet network.
- ❏ Enhances the flexibility and performance of message transfers by allowing peer-to-peer connections between network nodes.
- ❏ Provides reliable connectivity to popular HMI packages that use Modbus TCP to transfer of integers, floating point and text string variables as object tags for operator input and output.
- ❏ Based on open standards for effective integration to other third party components.

Overview

Modbus TCP communications extends the MotionBASIC® operating system to provide high speed connectivity between multiple ORION® controllers as well as to third party PLCs and HMI packages that communicate with the Modbus TCP protocol over an Ethernet network. An ORION® controller, with an Ethernet link installed and configured with the MBX software extensions, can open a Modbus TCP connection to send application data to any Modbus TCP server node on the network. The ORION® also has the ability to start a server node that will accept any connection from another Modbus TCP node and receive application data.

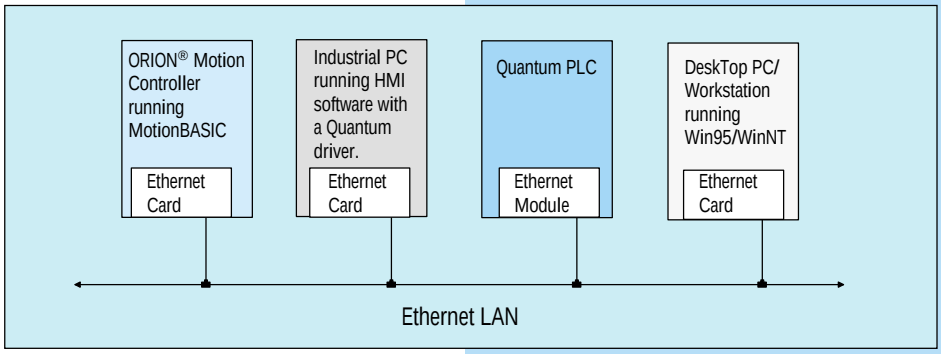
Multiprotocol capability

Software development for a system with multiple ORION® controllers using the full capabilities of Modbus TCP communications can now be performed with one PC. Since Ethernet is a multiprotocol network, any PC connected to the network can establish a TCP/IP connection, communicate to an ORION® and run the MotionDesk™ for program development over the same wire at basically the same time Modbus TCP communications are also going on.

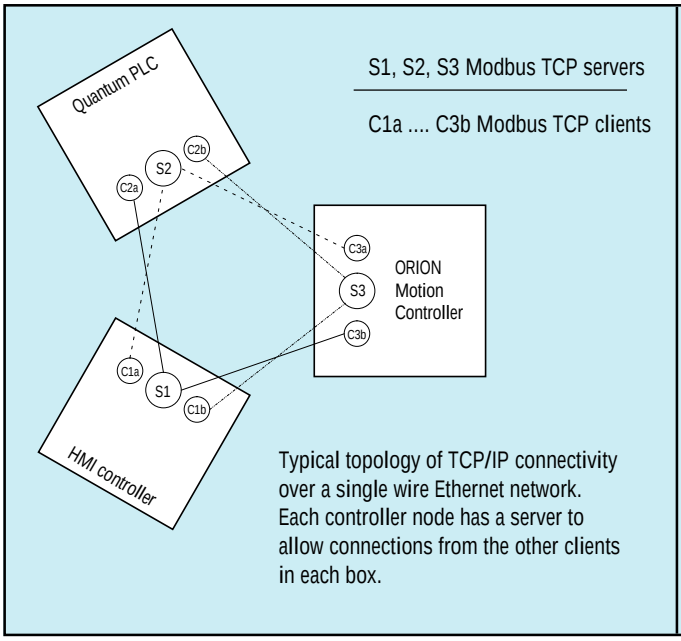
Modbus TCP Architecture

ORION® Modbus TCP consists of a physical layer based on 10baseT, 10base2, or 10base5 type Ethernet communication standards along with a client/server transport protocol (TCP/IP stack) to provide reliable peer-to-peer communications in the ORION® controller. At the application level, the MBX uses the Modbus protocol developed for the PLC industry to transfer register data as messages between controllers. All transfers happen as a background task concurrent with the user's main application program.

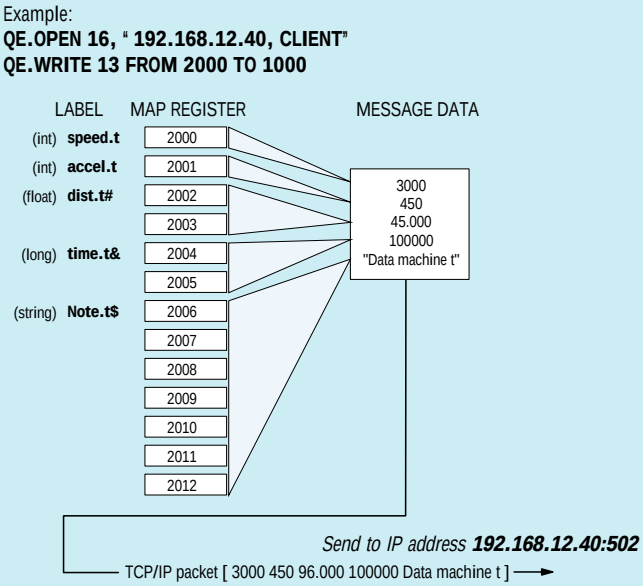
User access at the application programming interface level consists of MotionBASIC® extensions for making the connection to the destination server and the specifying source and destination registers for a read or a write multiple register transfer to that connected server. Concurrent multiple connections can be made to multiple servers on the network for a flexible and efficient arrangement for updating application data between a variety of system components.



Physical layer of the Ethernet connections between multiprotocol network nodes.



ORION® Ethernet connectivity utilizing multiple servers and multiple clients.



Using register mapping, application variables are sent as one message.

For constructing messages, the MBX provides MotionBASIC® mapping capabilities to simplify data organization at the PLC register level for the user.

ORION® Variable Mapping

The ability to map variables provides a way to map PLC register values to any MotionBASIC® variable in the controller. Typically, PLC registers are addressed numerically, but MotionBASIC® uses symbolic labels to address its variables.

With mapping, the symbolic label of the MotionBASIC® variable can be simultaneously defined as a PLC register address value. Register mapping values can range from 0 to 32367. The main purpose of this mapping feature is to allow the MBX to quickly assemble the content of various variables such as integers, floats and strings that reside in different areas of the controller's memory, into an ordered list of data and transferred over the network as one message.

The MBX also provides the ability to monitor the changes in selected variables. Any change in the data contained in the variable selected, can result in an event interrupt. The event interrupt, if enabled, will in turn execute a user defined block of code (subroutine) designed to respond to the changes in the data as a result of receiving the message.

Modicon and Modbus are trademarks of Schneider Electric

Modbus TCP MotionBASIC® Extensions

❑ MBX Statements

QE.OPEN <device%>,"ip_adr,CLIENT | SERVER [,TM<timeout>]	Open a Server or a Client connection to a Server
QE.READ [qty of reg(s)] **FROM** <starting src_register> **TO** <starting dest_register>	
QE.WRITE [qty of reg(s)] **FROM** <starting src_register> **TO** <starting dest_register>	
QE.FC coil%**,** state%	Force a single coil to be on or off
QE.CLOSE [<device%>]	Close one connection or all connections

❑ MBX Control functions and access variables

QE@ = ON	Set mapped register access enabled
QE.SOCKOPEN@(device%**)**	Get status of TCP/IP connection
QE.DEST@ = device%	Set destination connection for next client command
QE.MSG@(device%**)**	Get client reply received status
QE.LED@ = <led value**>**	Set MBX to use the front panel MBX LED indicator.
QE.CTR@(ctr%**)**	Get 1 of 32 error status counts of client and server connection activity during data transfers.
QE.STS@(device%**)**	Get the response code for the last exception that occurred.

❑ Diagnostic Commands that display to the Direct Mode window in MotionDesk.

QE.TRACE@= ON	Enable real-time display of message transfer activity.
QE.DUMP	Display the current settings and information for all current connections.
PING <IP address>	Check to make sure that the destination IP address is available and listening on the network.

❑ MBX General MotionBASIC® Mapping Statements

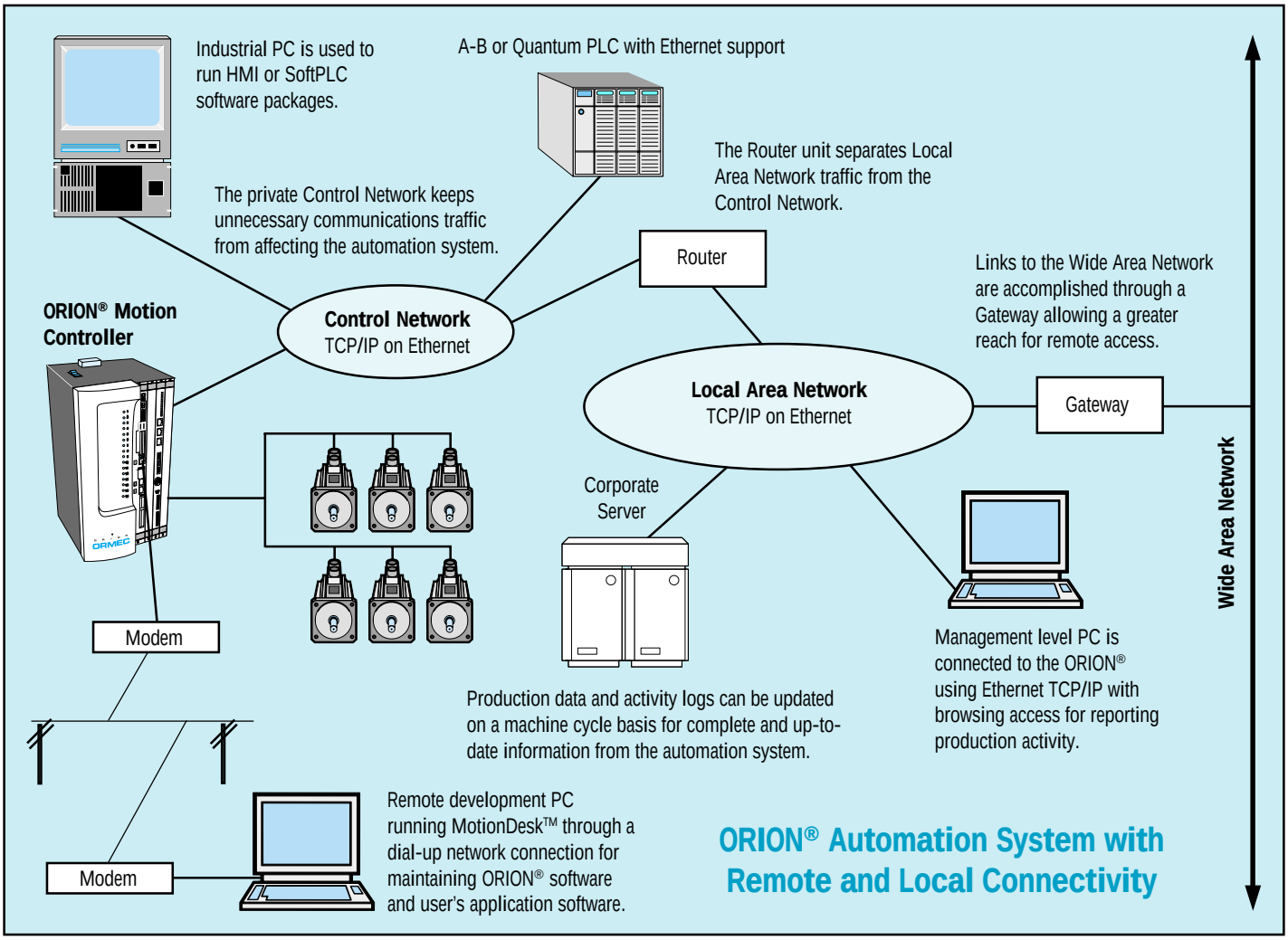
MAP <regnum> TO <variable>	Relate a register number 0 to 32767 to a MotionBASIC variable name.
ON EVENT MAP@(regnum) GOSUB [label]	Call subroutine when value mapped to regnum changed.

ORDERING GUIDE

MotionBASIC® Extension (MBX) and Network Adapters for Modbus TCP communications

ORN-ENE2000	Ethernet ISA Adapter, with RJ45 & BNC connectors
ORN-E3C509B	Ethernet ISA Adapter, with RJ45, BNC & AUI connectors
PCC-E3C589C	Ethernet PC Card Adapter, with extension cable for RJ45 & BNC connectors
MBX-QE-5	MotionBASIC® Extension for ORION® Modbus TCP, peer-to-peer communications. The MBX requires 400 ORION® MotionCredits.

Use utilities provided in the MotionDesk™ development software to assist in the hardware and software installation procedures for an ORION® MBX.



TCP/IP Network Protocol Overview

TCP & IP are two separate protocols that along with others make up what is known as the "Internet Protocol Suite". Because these are the two best known protocols in the collection, people use TCP/IP to refer to the entire collection.

TCP stands for Transfer Control Protocol. It is responsible for breaking up data into packets, called datagrams, to be sent, and then reconstructing the original data at the other end when it is received. It also handles transmission errors, re-sending lost or corrupt packets.

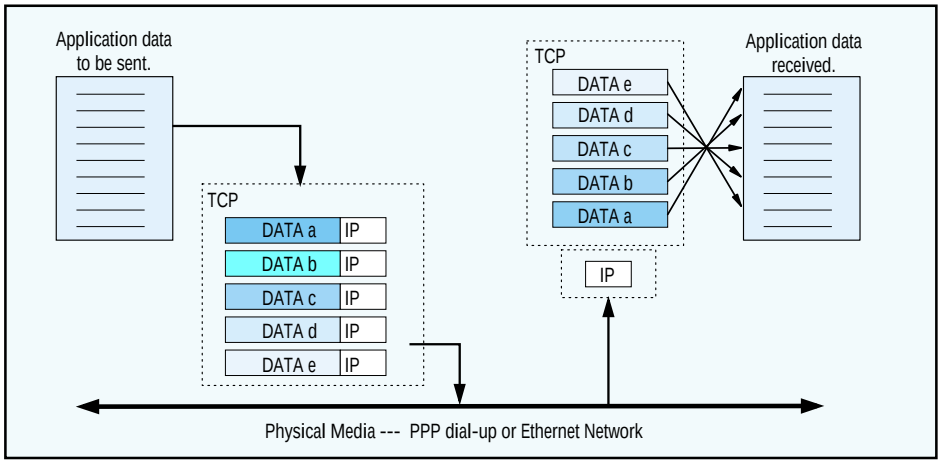
IP stands for Internet Protocol. TCP calls on IP to route datagrams to their correct destinations. TCP supplies IP with the destination address and IP handles all the details of how to get the datagrams through routers, gateways, and other network links ensuring the data will always arrive at the correct location.

Protocols below the IP layer manage the physical media such as the Point-to-Point Protocol (PPP) dial-up service for modem access or networks like Ethernet.

The TCP/IP protocols are "low level" components of the Internet Protocol Suite. The other protocols in the collection deal more with what is being sent and are referred to as "application level" protocols.

The two application protocols that are used by MotionDesk™ to communicate with the ORION® are FTP for file transfers & TELNET to give specific commands. When an A-B Ethernet or Modbus TCP MBX is installed on the ORION®, a new application protocol is added to communicate with either A-B or Quantum controllers. Custom application protocols may be programmed by the user using MotionBASIC® statements that support TCP/IP sockets.

The ORION® controller uses TCP/IP and manages all of these protocols simultaneously providing reliable connections to a variety of different sources.

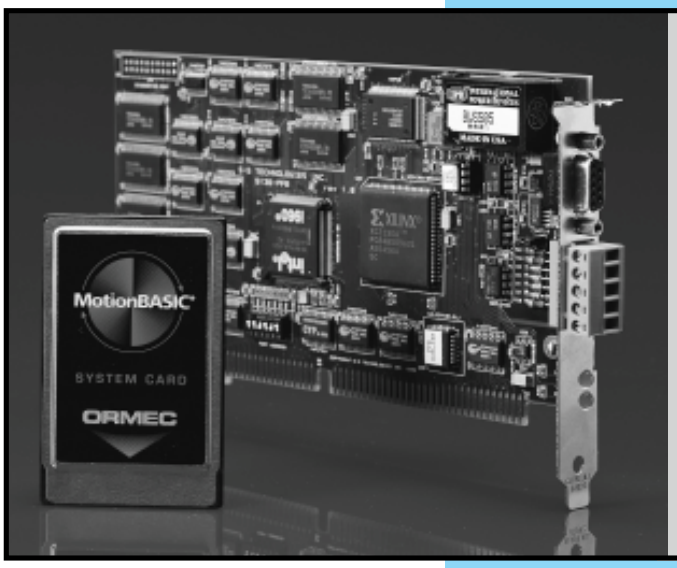


Open standard protocols ensure reliable peer-to-peer data transfers over multiple media environments.

ORMEC
Profibus DP Communications

ORMEC provides Profibus connectivity to the ORION® motion controllers by using a standard Profibus communications adapter and a MotionBASIC® Extension (MBX) to implement either Profibus DP Master or Slave communications.

Connectivity to the ORION® controller provides the machine developer with a modern approach to machine control networking using Profibus DP communications.



A Profibus communications adapter and MotionBASIC® Extension provide ORION® Profibus DP connectivity. Users can integrate ORION® with Siemens PLCs or PCs running HMI or SoftPLC programs, and use the open Profibus DP network for distributed I/O.

Features and Benefits

Profibus DP communications provides a number of key advantages:

❒ *Factory connectivity*: Profibus DP provides a convenient way to integrate ORION® with PLCs or PCs running HMI or soft PLC programs and using the open Profibus DP network for distributed I/O.

❒ *High-speed, cost-effective*: A standard Profibus adapter provides performance up to 12 Mbits/sec using a master-slave protocol with up to 126 nodes.

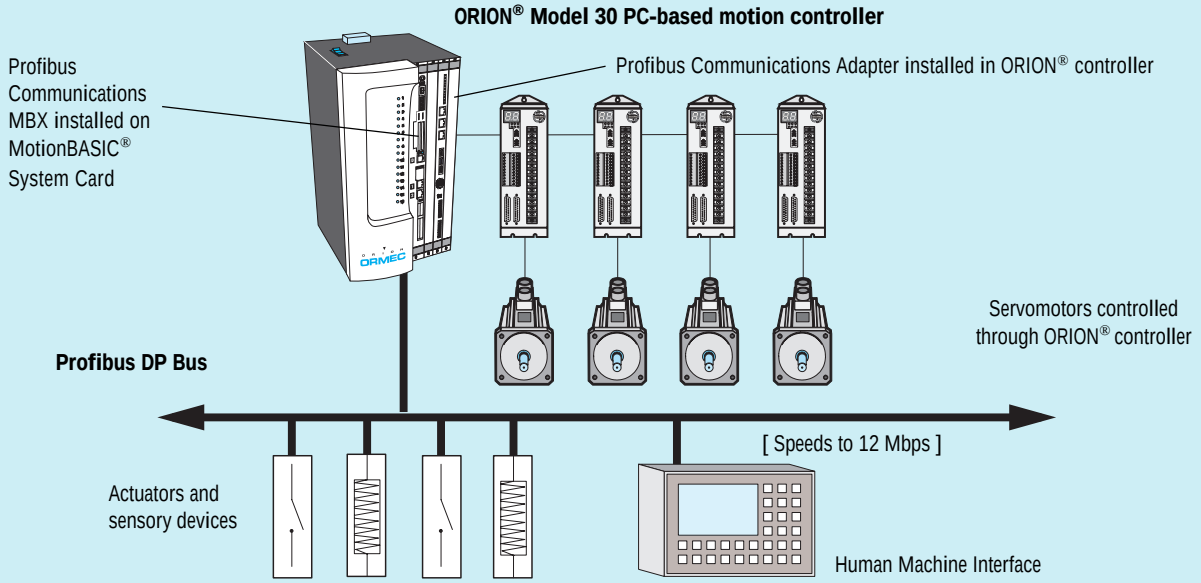
❒ *Minimal impact on MotionBASIC program execution speed*: Once initialized, Profibus communications between the Master and Slave(s) takes place as a background task controlled by a processor on the Profibus Adapter, minimizing application program complexity and workload on the ORION controller.

Overview

Profibus is a vendor-independent, open fieldbus standard for a wide range of applications in manufacturing.

Vendor independence and openness are guaranteed by the Profibus standard EN 50170. With Profibus, a developer provides uniformity between devices of different manufacturers by using a fast and efficient communications protocol. Profibus can be used for both high-speed time critical data transmission and extensive complex communication tasks without interface modifications.

Profibus DP - Field level machine control bus architecture using the ORION® motion controller



High-speed, time-critical data transmission at the fieldbus level is defined by the Profibus DP specification.

Profibus DP Bus Interface

The combination of a Profibus Communications Adapter and Profibus MBXs gives Profibus DP Master or Slave functionality to an ORION® motion controller.

Slaves on a Profibus DP bus appear as I/O drops with up to 244 bytes of inputs and 244 bytes of outputs each. The inputs and outputs can be divided between bit data and 16-bit word data. The word data is used to pass system parameter and status information between the Slave and a Profibus DP Master.

Profibus DP Architecture

Profibus DP defines the technical and functional characteristics of a serial Fieldbus which interconnects distributed digital field devices in the low (sensor/ actuator level) up to the medium (cell level) performance range. The basic system architecture consists of one or more master devices and one or more slave devices. Any master device can control the bus. When it has the right to access the bus, a master will transfer messages without waiting for a remote request.

Slave devices are peripheral devices that have no bus access rights - i.e. they may only acknowledge received messages or, at the request of a master, transmit messages.

Profibus DP Configuration

A network configuration program and device configuration file (*.GSD) are supplied with the Profibus adapter. The device configuration file is used by the network configuration program to create the configuration data file that is read by the DP Master. The device configuration file tells the network configuration program what the capabilities of the node are and whether the user can choose how much data to transfer. In the case of a simple solenoid bank or proximity sensor, the amount of data available from the node is predetermined and fixed. In the case of a configurable node the user can program the amount of data the node is able to exchange.

In either case, each slave device needs a configuration data file to use at initialization time to know how the node will present its data on the network and how many inputs and outputs each node will have.

The Profibus Communications adapter used with ORION as a DP Slave provides this type of configurable node. Network configuration file (netslv.ncf) and a slave configuration file (slave.scf), modified by the user, tell the Profibus DP Slave MBX driver how to split up 244 bytes of input data and 244 bytes of output data between bits and words, how many bytes of inputs and outputs are being transferred, its node address and the baud rate of the card. The PFB.DUMP commands and PFBLOG.TXT file verify installation.

The Profibus Communications adapter used with an ORION as a DP Master uses the configuration data file to initialize all the configurable nodes on the network at startup. The configuration data file also tells the Profibus DP Master MBX how much of each data type to read from each DP Slave node.

MotionBASIC® Extensions for Profibus DP Master

❑ **DATA AND I/O ACCESS STATEMENTS**

Digital Data

DPM.DIO@ (bit#)	read or write value of a single bit of data from the table

Analog Data

DPM.AIO@ (word#)	read or write a word value (8 or 16 bits wide) of data local to the table

❑ **LOCAL STATUS QUERY STATEMENTS**

Programming Level for error handling and recovery control

DPM.PORTOPEN@	flag - indicates adapter firmware driver is installed
DPM.CTR@	23 counters recording the real-time DP network activity and statistics
DPM.SLVERROR@	indicates 11 possible error conditions detected during bus initialization
DPM.STATUS@	non-zero value indicating condition of adapter after powerup

❑ **BUS STATUS QUERY COMMANDS and INFORMATION**

User Level for maintenance and system level debugging

DPM.DUMP	print current setting of Profibus adapter to MotionDesk screen
DPM.DUMP DPS	display the I/O configuration file to MotionDesk screen
DPMLOG.TXT	text file written to System Card during the bootup sequence

❑ **PROFIBUS MASTER HARDWARE CONTROL STATEMENTS**

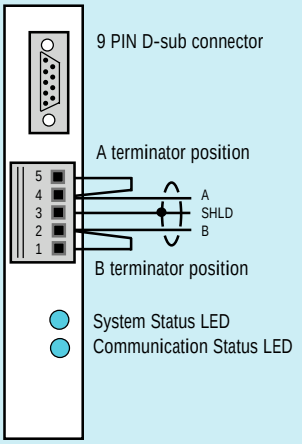
DPM.INIT	routine to initalize the Profibus adapter driver
DPM.RESETCTR	reset DP network counters
DPM.VER@	floating point number indicating driver version installed in adapter

ORDERING GUIDE

MotionBASIC® Extension (MBX) and Adapter for Profibus Communications

ORN-PFB	Profibus Communications Adapter board.
MBX-DPM-5	Profibus DP Master communications MBX provided on a 3.5" disk (MBX-UPG) with all MotionBASIC® Extensions. Also available via free download from the ORMEC User website. *Requires 500 MotionCredits in the ORION® hardware key to enable this software.*
MBX-PFB-5	Profibus DP Slave communications MBX provided on a 3.5" disk (MBX-UPG) with all MotionBASIC® Extensions. Also available via free download from the ORMEC User website. *Requires 300 MotionCredits in the ORION® hardware key to enable this software.*

Profibus Adapter Connectors



Hardware Interface

The Profibus communications MBX uses the adapter installed in the ORION's ISA bus backplane. Two LEDs on the card provide system status and bus network status indications. The bus interface is a 9-pin D-sub connector. A Siemens 6GK1500-0FC00 (or equivalent) is included with the Profibus Adapter. No special tools or soldering is required to attach the Profibus Cable to the Siemens 9-pin connector.

Physical Layer

The recommended cable is Belden Profibus Cable 3079A. A Profibus network must be terminated at devices located at each end. Siemens 9-pin cable connectors have switches in their shell to turn the terminator on and off. The default bus transfer rate is set at 12M bps. Scan rates are dependent on the total number of inputs and outputs on all nodes of the bus.

Profibus DP Slave Installation

To install Profibus DP Slave communications in an ORION® motion controller, simply:

- ❒ insert the communications adapter and connect the physical communications link;
- ❒ install the Profibus DP Slave MBX (MBX-PFB-5) on to the MotionBASIC® System (PCC-SYS5) Card using the Upgrade Director in MotionDesk.
- ❒ modify the network configuration file (*.ncf) and a slave configuration file (*.scf)
- ❒ add the configuration files to the MotionDesk Project and Synch
- ❒ reset the ORION controller and test the interface.

MotionBASIC® Extensions for Profibus DP Slave

❑ DATA AND I/O ACCESS STATEMENTS

Input Data

PFB.I@ (bit#)	read value of a single bit of data from the table.
PFB.AI@ (word#)	read a word value (16 bits wide) of any data from the table.

Output Data

PFB.Q@ (bit#)	write value of a single bit of data to the table
PFB.AQ@ (word#)	write a word value (16 bits wide) of data local to the table

❑ LOCAL STATUS QUERY STATEMENTS

Programming Level for error handling and recovery control

PFB.PORTOPEN@	flag - indicates adapter firmware driver is installed
PFB.CFG@	flag - DP Master received configuration file, slave can access data
PFB.CTR@ (y)	23 counters recording the real-time DP network activity and statistics
PFB.SLVERROR@	indicates 8 possible error conditions detected during bus initialization
PFB.STATUS@	non-zero value indicating condition of adapter after powerup

❑ BUS STATUS QUERY COMMANDS and INFORMATION

User Level for maintenance and system level debugging

PFB.DUMP	print current setting of Profibus adapter to MotionDesk screen
PFB.DUMP DPS	display the I/O configuration file to MotionDesk screen
PFBLOG.TXT	text file written to System Card during the bootup sequence

❑ ORN-PFB HARDWARE CONTROL STATEMENTS

PFB.INIT	routine to initalize the Profibus adapter driver
PFB.RESETCTR	reset DP network counters
PFB.VER@	floating point number indicating driver version installed in adapter

Profibus DP Master Installation

To install Profibus DP Slave communications in an ORION® motion controller, simply:

- ❒ insert the communications adapter and connect the physical communications link;
- ❒ install the Profibus DP Master MBX (MBX-DPM-5) on to the MotionBASIC® System (PCC-SYS5) Card using the Upgrade Director in MotionDesk.
- ❒ create the network configuration data file (config.bss) using the network configuration program included with the Profibus Adapter.
- ❒ add the configuration file to the MotionDesk Project and synchronize the project
- ❒ reset the ORION controller and test the interface.

Profibus is a trademark of Nutzer-Organization. Siemens is a trademark of Siemens AG.

ORMEC

ServoWire® Digital Drives

ServoWire® digital drives provide high performance servo operation utilizing digital networking technology based on IEEE-1394 (FireWire™). This network not only provides high speed, but also ease of use through cost-effective, industry-standard cabling. Each ServoWire® drive supports a wide variety of high performance, encoder-based servomotors. Consult ORMEC for OEM applications of user-supplied brushless rotary or linear motors---as well as DC brush-type and voice-coil motors.

Eight drive models range from 600 to 15,000 watts, and offer continuous current output from 2.4 to 60 amps RMS/phase. All ServoWire® drives utilize reliable IGBT-based intelligent power modules and provide a cost effective solution for today's motion control applications. ServoWire® drives operate on 115 or 230 VAC input power, and provide both output short circuit and overvoltage protection.

All-digital design eliminates the troublesome analog interface between controller and drive systems, replacing it with a modern high speed network based on the IEEE-1394 standard.

Performance

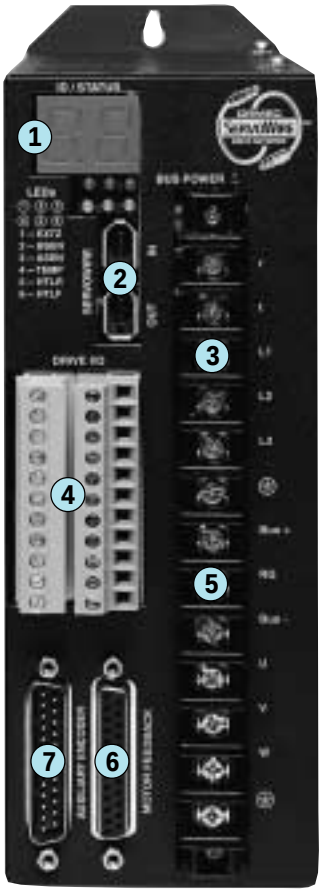
ServoWire® drives combine all-digital operation with DSP technology to produce fast update rates and current loop bandwidths up to 1200Hz. High bandwidth current loops teamed with high resolution motor feedback combine for quick and accurate torque, velocity and position control.

Programmable Drive Configuration

ServoWire® drives have no pots, jumpers or field component changes whatsoever. Even factory adjustments are digital, automatically calibrated and stored in Flash memory. All user configurations are done in software using axis configuration tools in our MotionDesk™ software. Motor types are selected from a database of ORMEC standard products or the custom motor editor can be used to add other motor types to the database.

ServoWire® Drives -- At A Glance

- ✓ **Eight models:** offering continuous output currents from 2.4 to 60 amps RMS/phase.
- ✓ **All-digital design:** eliminates all manual drive setup including pots and jumpers
- ✓ **Small footprint:** provides high power density and reduces space requirements.
- ✓ **Sinusoidal commutation:** improves low speed torque ripple and system efficiency.
- ✓ **Trapezoidal commutation & DC operation:** provide user flexibility.
- ✓ **Integral shunt regulators:** add protection (All models except SAC-SW203 & SW205).
- ✓ **UL/CE approvals:** UL Listed and CE Mark (low voltage directive & EMC).



1. **Status Indicators:** Large two-digit display for showing network ID and drive status plus six LED indicators which show condition of sensors, travel limits and motor over-temperature.
2. **ServoWire® Network Interface:** Two connectors provide an all-digital control link to ServoWire® Drive Network. Network interface is galvanically isolated from the drive and powered by the ServoWire® Axis Module.
3. **Drive Power Inputs:** Universal voltage input power accepts 115 or 230 VAC nominal featuring separate logic and bus power supplies with overvoltage protection.
4. **Flexible Drive I/O:** ServoWire® drives provide three high speed sensor inputs, up to six optically isolated programmable limit switch (PLS) outputs--(one of the PLSs can be used as a user-configurable fail-safe brake control output), two overtravel limit switch inputs, plus two high quality analog outputs for monitoring motor velocity and torque. Convenient screw terminal pluggable connectors.
5. **External Regen & Bus Connections:** Allows bus power to be shared between drives and/or the addition of an external resistor for dissipating regenerative energy from the system (All models except SAC-SW203 & SW205).
6. **Brushless Motor Feedback Interface:** Versatile encoder feedback interface accommodates differential or single-ended hall tracks, quadrature feedback, and optionally support the multi-revolution, absolute encoders available on ORMEC's D-Series motors.
7. **Auxiliary Encoder Input Option:** Provides an additional connector for a pacer encoder when applications require addition positioning information for web control applications. Also to be used for distributed feedback applications.

Configurations for each drive containing the motor parameters, all operational limits for torque and speeds, I/O configurations, load inertia and servo loop tuning parameters are stored in the ORION® controller as part of a system project and automatically downloaded at power up over the ServoWire® network. Simple cabling accommodates up to eight drives per network, and provide for quick and reliable installation.

Standard Motor Interface

ServoWire® drives interface encoder based motors using

quadrature feedback and hall track information. They provide smooth output torque using three phase sinusoidal commutation. An optional multi-revolution absolute encoder interface supports our D-series motors.

Integrated Drive I/O

Integration of digital drive technology with a high speed input and output interface gives the user greater flexibility and tighter control over the interaction between motion and external sensors and actuators. External sensors can initiate motion within one servo loop update, capture position with microsecond resolution, or reset PLS positions.

Versatile limit switch outputs are independently programmable and can be referenced from the motor position, motor command, another axis, or an on-board timer. Three optically isolated PLS outputs per axis can drive external actuators, can be wired to sensor inputs to initiate motion, and used to control when a sensor input is allowed to be seen by the drive during sensor 'blinding operations'.

Auxiliary Encoder Interface Option

An auxilary encoder interface option is available for applications requiring a pacer encoder or dual encoder feedback. This option includes three additional PLS outputs plus a virtual axis command generator that can be used during maintenance when encoder motion is not available.

Safety & Maintainability

Safety interlocks are standard in all ServoWire® drives. The network's integral safety interlocks and comprehensive alarm detection provide safe operation for ServoWire® drives, axis modules and ORION® controllers. System maintainability is enhanced by alarm detection and reporting.

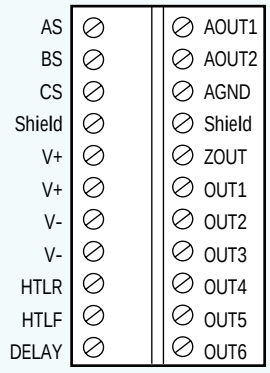
Integrated Drive I/O Interface

High Speed Sensors: Each drive provides interfaces for three high speed sensors. The AS, BS, and CS inputs, along with the internal encoder reference signal, can capture real-time axis position for either or both axes within *one microsecond* of assertion. They can initiate axis motion on the next position loop update (between 0.2 and 1.0 milliseconds delay--depending on loop rate).

Overtravel Limits: Each axis provides both hardware overtravel limits (HTLR, HLTF) as well as software overtravel limits for use when motor travel is limited. e.g. ballscrews

Delay Counter: This optional 20-bit counter can be used to delay a sensor or encoder reference signal by the specified number of encoder counts. It can be configured in several operating modes providing a wide range of flexibility. The DELAY counter output is fully integrated into MotionBASIC® and can be used to initiate motion and/or capture position.

Analog Monitors: Two analog outputs (AOUT1, AOUT2) are provided to monitor torque and speed of the servomotor.



Brake Output: A user-configurable output (OUT6) is provided for control of fail-safe brakes. Brake options are available for G-Series and D-Series servomotors.

Zero Reference Output: The motor's zero reference (index mark) output signal (ZOUT) is available on this terminal.

Programmable Limit Switches: Each axis on the ServoWire™ Network provides three optically coupled programmable limit switch (PLS) outputs which respond at the position update rate. Each PLS is independently driven with actual or commanded position of an axis, or through the MotionDATA™ network. OUT4, OUT5 & OUT6 functionality is included with the auxiliary encoder option.

Understanding the ServoWire® Drive Model Numbers

SAC - SW2 05/ E P D A N

- N = Delete pluggable terminal blocks
- A = Absolute Encoder
- D = Delay Counter
- P = Auxiliary Encoder Input
- Encoder Feedback Interface
- Continuous current (amps)

ORDERING GUIDE

ServoWire® Drives: Single Phase 115 or 230 VAC Input

SAC-SW203/E	Servodrive, 2.4/4.2 amps RMS, encoder feedback
SAC-SW205/E	Servodrive, 4.1/7.1 amps RMS, encoder feedback

ServoWire® Drives: Three Phase 230 VAC Input

SAC-SW210/E	Servodrive, 8.2/14 amps RMS, encoder feedback
SAC-SW217/E	Servodrive, 14/24 amps RMS, encoder feedback
SAC-SW220/E	Servodrive, 16/28 amps RMS, encoder feedback
SAC-SW225/E	Servodrive, 25/50 amps RMS, encoder feedback
SAC-SW235/E	Servodrive, 35/70 amps RMS, encoder feedback
SAC-SW260/E	Servodrive, 60/120 amps RMS, encoder feedback

Specify options below by adding letter to servodrive model number

Option 1:	P	Auxiliary pacer encoder (incremental)
Option 2:	D	Delay counter hardware added
Option 3:	A	Absolute encoder support added
Option 4:	N	No pluggable I/O connectors (TB1)

Accessories

MIO-DC605-3	Solid-state relay for fail-safe brake circuit, panel mount, 3-32 VDC logic, 60 VDC switched load, 3 amps

Panel Mount Regen Resistors

SAC-SWRR/0055	Regen Resistor, 55 watts, 50 ohms, for SAC-SW210
SAC-SWRR/0095	Regen Resistor, 95 watts, 40 ohms, for SAC-SW217 & SW220
SAC-SWRR/0700	Regen Resistor, 700 watts, 54 ohms, for SAC-SW210
SAC-SWRR/0845	Regen Resistor, 845 watts, 40 ohms, for SW217 & SW220
SAC-SWRR/0846	Regen Resistor, 846 watts, 10 ohms, for SAC-SW225 & SW235
SAC-SWRR/1700	Regen Resistor, 1,700 watts, 6.5 ohms, for SAC-SW260

UL Listed Line Filters

SAC-LF215U	Line Filter, 115/230 VAC, 1-phase, 15 amps, 4.2"l, 2.9"w, 2.0"d
SAC-LF230U	Line Filter, 115/230 VAC, 1-phase, 30 amps, 5.5"l, 3.0"w, 2.8"d
SAC-LF30C	Line Filter, 230 VAC, 3-phase, 30 amps, 13.9"l, 2.4"w, 5.9"d
SAC-LF55C	Line Filter, 230 VAC, 3-phase, 55 amps, 14.8"l, 3.1"w, 7.3"d
SAC-LF100C	Line Filter, 230 VAC, 3-phase, 100 amps, 17.2"l, 3.5"w, 8.7"d

SPECIFICATIONS

Main Circuit Power

- ❒ 115 or 230 VAC +15%, -20%, 50/60 Hz, single phase or three phase
- ❒ 600 to 15,000 watts of incoming service power (see Servomotor Selection Charts for power requirements on matching drives)

Control Circuit Power

- ❒ 115 or 230 VAC, +15%, -20%, 50/60 Hz, 56 watts RMS, single phase

Torque Command

- ❒ 16 bit digital command from the ServoWire® Axis Module over the Drive Network.
- ❒ Current loop bandwidth up to 1.2 kHz

ServoWire® Drive Output

- ❒ IGBT pulse width-modulated with sinusoidal or trapezoidal commutation
- ❒ Large heat sinks with temperature monitor (fan cooled on SAC-SW220 - SW260)
- ❒ Internal shunt regulator for regenerative load dissipation on all except SW203 & SW205
- ❒ Peak currents up to 200% of RMS continuous capability
- ❒ DC Bus voltage of 325 VDC at nominal input of 230 VAC and 163 VDC at 115 VAC

External Analog Monitors

- ❒ Torque Monitor output ±3.0V @ 100% rated torque
- ❒ Speed Monitor output ±10.0V @ 1.0V /1000 RPM, 2.0V/1000 RPM, or 5.0V/1000 RPM; scale depends on motor's max speed.

ServoWire® Drive I/O

- ❒ Sensors inputs are software configurable for either NPN or PNP output transistor types and level or edge triggered response
- ❒ Inputs provide one microsecond response time to capture machine position and initiate motion within one servo update cycle
- ❒ Optically isolated interface for programmable limit switches, motor reference and delay counter outputs updated every servo cycle with a maximum sink current of 33ma per output
- ❒ External I/O power supply connections will accept 5-24 VDC (285mA maximum) to power input and output circuits

Motor Feedback Interface

- ❒ Three differential input channels for encoder position feedback with 5.3 volt encoder power supplied
- ❒ Quadrature feedback 4x decoding with positioning rates to 4 Mbps
- ❒ Three differential input channels for motor commutation feedback
- ❒ Open-wire detection on all differential encoder connections
- ❒ Support for absolute encoder when option is installed
- ❒ Input connections for thermal contact from motor windings.
- ❒ Industry standard D-sub connector (25 pin female) interface.

Auxiliary Feedback Interface

- ❒ Industry standard D-sub connector (25 pin male) interface.
- ❒ Three differential input channels for encoder position feedback with 5.3 volt encoder power supplied
- ❒ Three additional programmable limit switch outputs

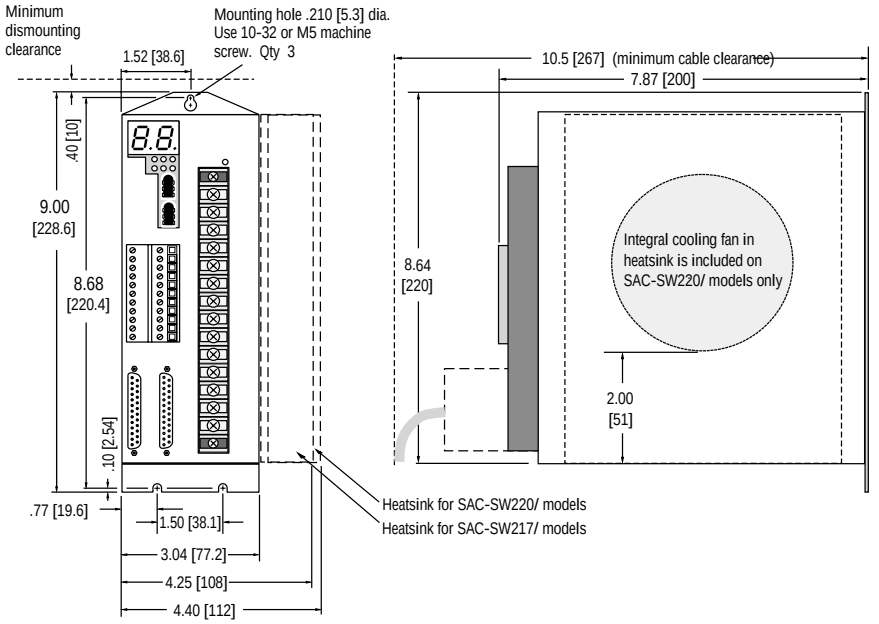
Environmental

- ❒ Ambient operating is 0 to 50C
- ❒ Ambient storage is -20 to 70C
- ❒ Humidity operating/storage is 90% RH or less (non-condensing).

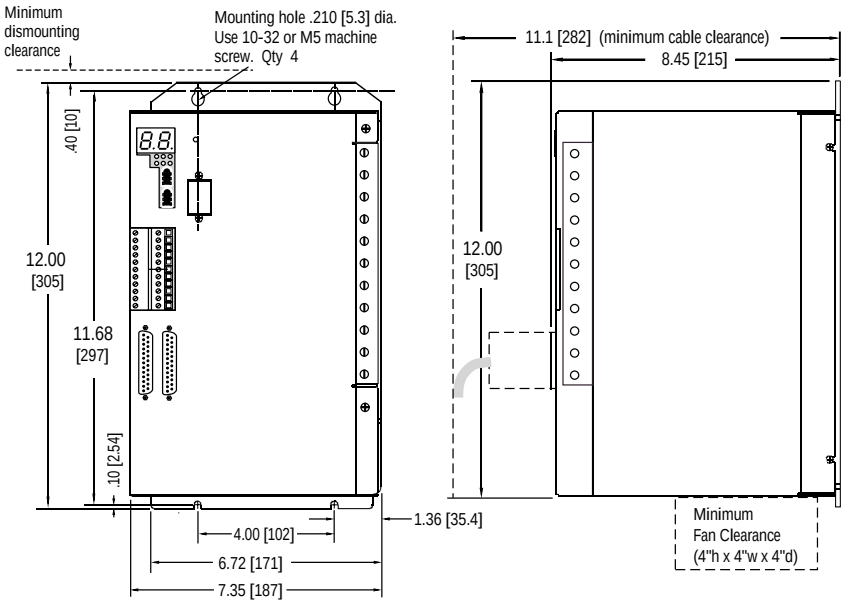
Drive Weights

- ❒ SAC-SW203/E 3.8 lbs (1.7 kg)
- ❒ SAC-SW205/E 3.8 lbs (1.7 kg)
- ❒ SAC-SW210/E 4.2 lbs (1.9 kg)
- ❒ SAC-SW217/E 5.9 lbs (2.7 kg)
- ❒ SAC-SW220/E 6.7 lbs (3.1 kg)
- ❒ SAC-SW225/E 17.8 lbs (8.1 kg)
- ❒ SAC-SW235/E 17.8 lbs (8.1 kg)
- ❒ SAC-SW260/E 17.8 lbs (8.1 kg)

Mounting Information for SAC-SW203, SW205, SW210, SW217 & SW220

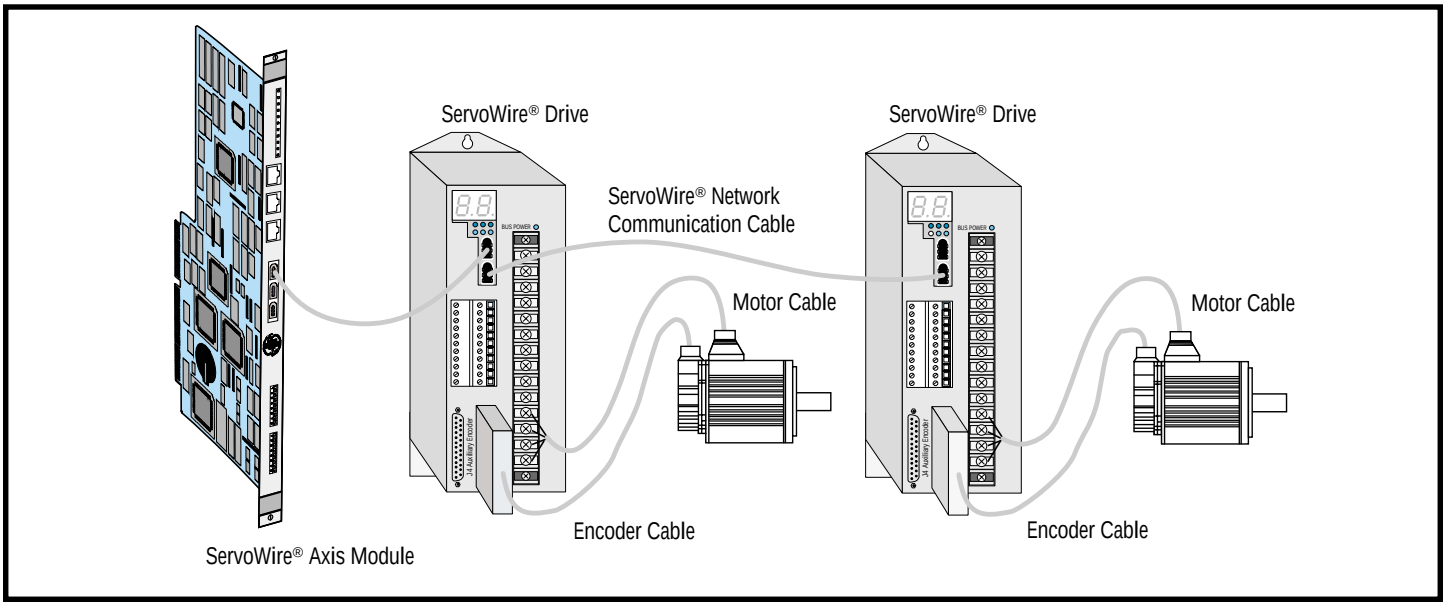


Mounting Information for SAC-SW225, SW235 & SW260



Dimensions in inches [millimeters]

ServoWire® Cable Ordering Guide



ServoWire® cable interconnection diagram for G-series servomotors.

ServoWire® Drive Interface Cables and Connectors

ORMEC offers standard, 100% computer-tested servomotor, servodrive and encoder cables for reliably interfacing to all of our G-series AC brushless servomotors.

ServoWire® Drive Network Cables

CBL-SW/1	ServoWire® Cable, 1 ft. (305 mm)
CBL-SW/2	ServoWire® Cable, 2 ft. (710 mm)
CBL-SW/6	ServoWire® Cable, 6 ft. (1.8 meters)
CBL-SW/14	ServoWire® Cable, 14 ft. (4.3 meters)

Drive I/O Interface Connectors

CON-SW-TB1L	ServoWire® Drive, Drive I/O (TB1) left terminal block plug, pins 1-11
CON-SW-TB1R	ServoWire® Drive, Drive I/O (TB1) right terminal block plug, pins 12-22

G-Series Encoder and Motor Cables

Standard	*IP-67 Sealing*	*Brake Option*	*Brake w/IP-67 Sealing*	
CBL-GMSW/X	CBL-GMSWV/X	(p/o motor cable)	(p/o motor cable)	Encoder cables for MAC-G016 & G030 - G115 motors, 1-150 ft
CBL-GMSW/X	CBL-GMSWV/X	CBL-GMSWB/X	CBL-GMSWVB/X	Encoder cables for MAC-G130 - G640 motors, 1-150 ft
CBL-GMSW1/X		CBL-GMSWB1/X		Motor/Encoder cables for MAC-G005 - G015, & G019 motors with ServoWire drives (SW203, SW205, SW210, SW217 & SW220), 1-150 ft

Standard	*IP-67 Sealing*	*Brake Option*	*Brake w/IP-67 Sealing*	
CBL-GMSW2/X	CBL-GMSWV2/X	CBL-GMSWB2/X	CBL-GMSWVB2/X	Motor cables for MAC-G016 & G030-G115 with ServoWire® drives (SW203, SW205, SW210, SW217 & SW220), 1-150 ft
CBL-GMSWT2/X	CBL-GMSWVT2/X	CBL-GMSWBT2/X	CBL-GMSWVBT2/X	Motor cables for MAC-G080A2 & G115A2 with ServoWire® drives (SW225 & SW235), 1-150 ft
CBL-GMSW3/X	CBL-GMSWV3/X	(p/o encoder cable)	(p/o encoder cable)	Motor cables for MAC-G130 - G210 with ServoWire® drives (SW210, SW217 & SW220), 1-150 ft
CBL-GMSWT3/X	CBL-GMSWVT3/X	(p/o encoder cable)	(p/o encoder cable)	Motor cables for MAC-G130A2 with ServoWire® drive (SW225) 1-150 ft
CBL-GMSWT5/X	CBL-GMSWVT5/X	(p/o encoder cable)	(p/o encoder cable)	Motor cables for MAC-G210, MAC-G280A4 & G360A4 with ServoWire® drives (SW225 & SW235), 1-150 ft
CBL-GMSWT6/X	CBL-GMSWVT6/X	(p/o encoder cable)	(p/o encoder cable)	Motor cables for MAC-G280A2 & G360A2 with ServoWire® drives (SW235 & SW260), 1-150 ft
CBL-GMSWT9/X	CBL-GMSWVT9/X	(p/o encoder cable)	(p/o encoder cable)	Motor cables for MAC-G640A2 with ServoWire drive (SW260), 1-150 ft

Note: For all cables above, specify length of the cable by adding the numerical length in the "X" placeholder in the Model Number.

ORMEC Servomotor Overview

To satisfy the motor requirements of the automation engineer, ORMEC has a complete line of servomotors. These motors integrate with our ServoWire™ drives to provide a broad range of capability.

A motor database included in the MotionDesk™ software simplifies system configuration and setup. Motor parameters are automatically stored on the ORION® controller for hassle-free replacement.

Servomotor Features

- ▶ A broad spectrum of speed, torque and resolution is covered by ORMEC's lineup of servomotors.
- ▶ The D-Series motors have been divided into three subgroups depending on construction, maximum speed and resolution.
- ▶ G-series has a wider selection of speed/torque combinations, allowing for cost-effective integration with a variety of ServoWire® drives.
- ▶ Compact rare-earth designs provide high horsepower to motor volume ratios.
- ▶ All G- and D-series motors provide position feedback devices that are directly coupled with zero backlash.
- ▶ D-Series servomotors provide absolute encoder feedback over 100,000 turns as an option.
- ▶ Motor are all flange mounted and available in metric sizes. G-series motors also include standard NEMA mounting for some models.
- ▶ All standard motors include MS-style connectors.
- ▶ Motor cables are manufactured to the nearest foot to meet your length requirements.

General Specifications	G-Series	DE-Series	DA-Series	DB-Series
Continuous Stall Torques (lb-in) (N-m)	5 - 640 0.56 - 72	2.8 - 42 0.32 - 4.8	28 - 140 3.2 - 16	25 - 665 2.8 - 75
Peak Torques (lb-in) (N-m)	10 - 1,239 1.1 - 140	5.1 - 73 0.58 - 8.3	68 - 321 7.7 - 36	44 - 1,128 4.9 - 127
Rated Power (watts)	150 - 10,000	100 - 1,500	1,000 - 4,900	440 - 11,000
Maximum speeds (RPM)	7,000	4,500	4,500	3,000
Max. Cont. stall torque/inertia (radians/sec^2)	72,993	49,123	19,858	5,017
Position Feedback Transducer Incremental counts per revolution	encoder 12000 (options below[1])	encoder 8192	encoder 16384	encoder 32768
Multi-rev Absolute Encoder Counts per revolution	No ---	Optional 4096	Optional 32768	Optional 32768
Integral Fail-safe Brakes	Optional	Optional	Optional	Optional
Motor Construction	TENV, IP-65	TENV, IP-55	TENV, IP-67[2]	TENV, IP-67[2]
Stainless Steel Shaft	Yes	No	No	No
Shaft seal	Standard, Viton	No	Optional	Optional
Motor-mounted connectors	Yes	No	Yes	Yes
Integral Thermal Overload Switch	Yes	No	No	No
Custom Feature Availability	Call ORMEC[3]	None	None	None
Servomotor Certification	UL Recognized & CE Marked	UL Recognized	UL Recognized	UL Recognized

1 -- G Series feedback resolutions: 8000, 12000 & 24000 . 2 -- IP-67 except shaft opening, optional shaft seal available.
3 -- Includes windings, flanges, housings, shafts, and termination options. Quotes available in one week.

G-Series Servomotors & Matching Servodrives

Servomotor Model Number	Max. Speed[1] (RPM)	Peak / Stall Torque lb-in (N-m)	Motor Inertia lb-in-sec^2 (kg-m^2)	Motor Length in (mm)	Motor /E Flange in (mm)	Motor /M Flange mm (in)	Input Power[2] [3] watts/amps
MAC-G005A1	5,000	10/5.0 (1.1/0.56)	0.074 x 10^{-3} (0.084 x 10^{-4})	5.60 (143)	2.25 (57)	66 (2.60)	170 / 1.5
MAC-G006A1	6,800	12/5.8 (1.4/0.66)	0.127 x 10^{-3} (0.14 x 10^{-4})	5.05 (128)	---	72 (2.84)	300 / 2.7
MAC-G006A2	4,600	14/5.8 (1.6/0.66)	0.127 x 10^{-3} (0.14 x 10^{-4})	5.05 (128)	---	72 (2.84)	250 / 1.1
MAC-G010A1	5,500	17/10 (1.9/1.1)	0.137 x 10^{-3} (0.15 x 10^{-4})	6.90 (173)	2.25 (57)	66 (2.60)	340 / 3.1
MAC-G010B1	3,500	16/9.4 (1.8/1.1)	0.137 x 10^{-3} (0.15 x 10^{-4})	6.90 (173)	2.25 (57)	66 (2.60)	220 / 2.0
MAC-G011A1	7,000	26/11 (3.0/1.3)	0.247 x 10^{-3} (0.28 x 10^{-4})	5.80 (147)	---	72 (2.84)	600 / 5.4
MAC-G011A2	5,600	24/11 (2.7/1.3)	0.247 x 10^{-3} (0.28 x 10^{-4})	5.80 (147)	---	72 (2.84)	500 / 2.2
MAC-G011B2	3,800	28/11 (3.2/1.3)	0.247 x 10^{-3} (0.28 x 10^{-4})	5.80 (147)	---	72 (2.84)	320 / 1.4
MAC-G015A1	6,300	25/15 (2.9/1.7)	0.357 x 10^{-3} (0.40 x 10^{-4})	6.55 (166)	---	72 (2.84)	750 / 6.8
MAC-G015A2	5,600	24/15 (2.7/1.7)	0.357 x 10^{-3} (0.40 x 10^{-4})	6.55 (166)	---	72 (2.84)	670 / 2.9
MAC-G015B2	3,700	29/15 (3.2/1.7)	0.357 x 10^{-3} (0.40 x 10^{-4})	6.55 (166)	---	72 (2.84)	430 / 1.9
MAC-G016A2	5,000	35/16 (4.0/1.8)	0.328 x 10^{-3} (0.37 x 10^{-4})	7.24 (184)	3.31 (84)	89 (3.50)	615 / 2.7
MAC-G016B2	2,500	42/16 (4.7/1.8)	0.328 x 10^{-3} (0.37 x 10^{-4})	7.24 (184)	3.31 (84)	89 (3.50)	300 / 1.3
MAC-G019A1	5,625	41/19 (4.7/2.1)	0.467 x 10^{-3} (0.53 x 10^{-4})	7.30 (185)	---	72 (2.84)	935 / 8.5
MAC-G019A2	5,000	50/19 (5.6/2.1)	0.467 x 10^{-3} (0.53 x 10^{-4})	7.30 (185)	---	72 (2.84)	850 / 3.7
MAC-G019B2	3,700	29/17 (3.2/2.0)	0.467 x 10^{-3} (0.53 x 10^{-4})	7.30 (185)	---	72 (2.84)	550 / 2.4
MAC-G030A2	5,000	68/30 (7.7/3.4)	0.828 x 10^{-3} (0.94 x 10^{-4})	8.74 (222)	3.31 (84)	89 (3.50)	1,250 / 5.3
MAC-G030B2	2,600	67/30 (7.6/3.4)	0.828 x 10^{-3} (0.94 x 10^{-4})	8.74 (222)	3.31 (84)	89 (3.50)	620 / 2.7
MAC-G040A2	3,500	102/39 (11/4.4)	1.23 x 10^{-3} (1.39 x 10^{-4})	10.3 (260)	3.31 (84)	89 (3.50)	1,100 / 4.8
MAC-G040B2	1,700	61/39 (6.9/4.4)	1.23 x 10^{-3} (1.39 x 10^{-4})	10.3 (260)	3.31 (84)	89 (3.50)	480 / 2.1
MAC-G055A2	3,500	102/54 (11/6.1)	2.43 x 10^{-3} (2.74 x 10^{-4})	8.61 (219)	5.00 (127)	114 (4.50)	1,430 / 6.2
MAC-G055A4	1,850	102/54 (11/6.1)	2.43 x 10^{-3} (2.74 x 10^{-4})	8.61 (219)	5.00 (127)	114 (4.50)	850 / 3.7
MAC-G080A2	3,500	173/83 (20/9.4)	4.93 x 10^{-3} (5.57 x 10^{-4})	11.1 (282)	5.00 (127)	114 (4.50)	2,310 / 10
MAC-G080A4	1,850	203/83 (23/9.4)	4.93 x 10^{-3} (5.57 x 10^{-4})	11.1 (282)	5.00 (127)	114 (4.50)	1,320 / 5.7
MAC-G115A2	3,500	203/116 (23/13)	7.23 x 10^{-3} (8.17 x 10^{-4})	13.6 (345)	5.00 (127)	114 (4.50)	3,300 / 14
MAC-G115A4	1,850	203/116 (23/13)	7.23 x 10^{-3} (8.17 x 10^{-4})	13.6 (345)	5.00 (127)	114 (4.50)	1,870 / 8.1
MAC-G130A2	2,700	220/130 (25/15)	9.43 x 10^{-3} (10.7 x 10^{-4})	11.3 (287)	---	142 (5.59)	2,750 / 12
MAC-G130A4	1,750	213/130 (24/15)	9.43 x 10^{-3} (10.7 x 10^{-4})	11.3 (287)	---	142 (5.59)	1,870 / 8.1
MAC-G210A2	2,700	458/210 (52/24)	19.0 x 10^{-3} (21.5 x 10^{-4})	14.0 (355)	---	142 (5.59)	4,730 / 21
MAC-G210A4	1,750	361/210 (41/24)	19.0 x 10^{-3} (21.5 x 10^{-4})	14.0 (355)	---	142 (5.59)	3,190 / 14
MAC-G280A2	2,700	641/280 (72/32)	28.6 x 10^{-3} (32.3 x 10^{-4})	16.7 (423)	---	142 (5.59)	6,270 / 27
MAC-G280A4	1,750	752/280 (85/32)	28.6 x 10^{-3} (32.3 x 10^{-4})	16.7 (423)	---	142 (5.59)	4,180 / 18
MAC-G360A2	2,000	851/360 (96/41)	38.2 x 10^{-3} (43.2 x 10^{-4})	19.4 (493)	---	142 (5.59)	6,270 / 27
MAC-G360A4	1,750	752/360 (85/41)	38.2 x 10^{-3} (43.2 x 10^{-4})	19.4 (493)	---	142 (5.59)	5,390 / 23
MAC-G640A2	2,400	1,239/640 (140/72)	71.8 x 10^{-3} (81.2 x 10^{-4})	15.7 (398)	---	190 (7.48)	11,000 / 48

[1] Actual maximum speed is dependent on motor encoder resolution. Refer to "Understanding the G-Series Servomotor Model Numbers" on page 1 for further information.

[2] Power listed is the required incoming line power in watts when the motor is operating at rated output. To determine total incoming power requirements, add up the listed values for each servomotor/drive combination in the system.

[3] Current listed in amps is the recommended slow-blow fuse capacity for each leg of the three phase power. To select fuses for the system, add the recommended fuse capacities for each servomotor/drive combination in the system.

G-Series Compatibility Chart

ORMEC's all-digital drive technology provides the ability to control a variety of servomotors with a single servodrive. The chart below provides an overview of ServoWire drive compatibility with the G-series servomotors.

The recommended servodrive (✪) below provides sufficient power to provide the continuous and peak torques specified for the corresponding servomotor.

Compatible servodrives (✔) may be used instead of the recommended servodrive to increase the amount of peak torque, and also allow each servodrive model to support a wider range of motors, simplifying the stocking of spare parts.

Servomotor Model Number	Single Phase Drives (No Regen)			Three Phase Drives (External Regen)					
	SAC-SW203 SMS-203 G03	SAC-SW205 SMS-205 G05	SAC-SW210 SMS-210 G10	SAC-SW217 SMS-217 G17	SAC-SW220 SMS-220 G20	SAC-SW225 SMS-225 G25	SAC-SW235 SMS-235 G35	SAC-SW260 SMS-260 G60	
MAC-G005A1	✪	✔	✔						
MAC-G006A1		✪	✔						
MAC-G006A2	✪	✔	✔						
MAC-G010A1		✪	✔	✔					
MAC-G010B1	✪	✔	✔						
MAC-G011A1			✪	✔	✔				
MAC-G011A2		✪	✔						
MAC-G011B2	✪	✔	✔						
MAC-G015A1			✪	✔	✔				
MAC-G015A2		✪	✔	✔					
MAC-G015B2	✪	✔	✔						
MAC-G016A2		✪	✔						
MAC-G016B2	✪	✔	✔						
MAC-G019A1				✪	✔				
MAC-G019A2			✪	✔	✔				
MAC-G019B2	✪	✔	✔						
MAC-G030A2			✪	✔	✔				
MAC-G030B2		✪	✔						
MAC-G040A2			✪	✔	✔				
MAC-G040B2	✪	✔	✔						
MAC-G055A2			✪	✔	✔				
MAC-G055A4		✪	✔						
MAC-G080A2				✪	✔	✔			
MAC-G080A4			✪	✔	✔				
MAC-G115A2					✪	✔	✔		
MAC-G115A4			✪	✔	✔				
MAC-G130A2				✪	✔	✔			
MAC-G130A4			✪	✔	✔				
MAC-G210A2					✪	✔	✔		
MAC-G210A4				✪	✔	✔			
MAC-G280A2							✪	✔	
MAC-G280A4						✪	✔		
MAC-G360A2							✪	✔	
MAC-G360A4						✪	✔		
MAC-G640A2								✪	

✪ Recommended drive model ✔ Compatible drive model

D-Series Servomotors & Matching Servodrives

Servomotor Model Number	Max. Speed (RPM)	Peak / Stall Torque lb-in (N-m)	Motor Inertia lb-in-sec^2 (kg-m^2)	Motor Length in (mm)	Motor Flange in (mm)	Input Power[1] [2] watts/amps
MAC-DE003A1	4,500	5.1/2.8 (0.58/0.32)	0.057 x 10^{-3} (0.065 x 10^{-4})	2.24 (57)	2.36 (60)	110 / 1.0
MAC-DE003A2	4,500	8.2/2.8 (0.93/0.32	0.057 x 10^{-3} (0.065 x 10^{-4})	2.24 (57)	2.36 (60)	110 / 0.5
MAC-DE006B1	4,500	14/5.6 (1.5/0.64)	0.185 x 10^{-3} (0.209 x 10^{-4})	2.44 (62)	3.15 (80)	210 / 1.9
MAC-DE006B2	4,500	11/5.6 (1.3/0.64)	0.185 x 10^{-3} (0.209 x 10^{-4})	2.44 (62)	3.15 (80)	210 / 0.9
MAC-DE008C1	4,500	25/8.4 (2.8/0.95)	0.308 x 10^{-3} (0.347 x 10^{-4})	3.23 (82)	3.15 (80)	320 / 2.4
MAC-DE011C2	4,500	28/11 (3.2/1.3)	0.308 x 10^{-3} (0.347 x 10^{-4})	3.23 (82)	3.15 (80)	440 / 1.9
MAC-DE021D2	4,500	34/21 (3.9/2.4)	1.87 x 10^{-3} (2.11 x 10^{-4})	3.21 (82)	4.72 (120)	825 / 3.6
MAC-DE042E2	4,300	73/42 (8.3/4.8)	3.57 x 10^{-3} (4.03 x 10^{-4})	4.31 (110)	4.72 (120)	1,650 / 7.2
MAC-DA030F	4,500	68/28 (7.7/3.2)	1.54 x 10^{-3} (1.74 x 10^{-4})	5.87 (149)	3.15 (80)	1,100 / 4.8
MAC-DA055G	4,500	101/56 (11/6.3)	2.82 x 10^{-3} (3.19 x 10^{-4})	7.80 (198)	3.15 (80)	2,100 / 9.1
MAC-DA090H	4,500	217/87 (24/9.8)	6.20 x 10^{-3} (7.01 x 10^{-4})	7.83 (199)	5.12 (130)	3,300 / 14
MAC-DA110J	4,500	207/112 (23/13)	8.50 x 10^{-3} (9.60 x 10^{-4})	9.29 (236)	5.12 (130)	4,290 / 19
MAC-DA140K	4,500	321/140 (36/16)	10.9 x 10^{-3} (12.3 x 10^{-4})	10.87 (176)	5.12 (130)	5,390 / 23
MAC-DB025L	3,000	44/25 (4.9/2.8)	6.41 x 10^{-3} (7.24 x 10^{-4})	5.39 (137)	5.12 (130)	485 / 2.1
MAC-DB055M	3,000	88/53 (10/6.0)	12.3 x 10^{-3} (13.9 x 10^{-4})	6.30 (160)	5.12 (130)	940 / 4.1
MAC-DB080N	3,000	152/74 (17/8.4)	18.2 x 10^{-3} (20.6 x 10^{-4})	7.24 (184)	5.12 (130)	1,430 / 6.2
MAC-DB100P	3,000	155/102 (18/12)	28.1 x 10^{-3} (31.8 x 10^{-4})	6.50 (165)	7.09 (180)	1,980 / 8.6
MAC-DB200Q	3,000	312/196 (35/22)	40.7 x 10^{-3} (46.0 x 10^{-4})	7.83 (199)	5.12 (130)	3,190 / 14
MAC-DB300R	3,000	479/300 (54/34)	59.8 x 10^{-3} (67.6 x 10^{-4})	8.86 (225)	7.09 (180)	4,840 / 21
MAC-DB330S	3,000	728/345 (82/39)	78.8 x 10^{-3} (89.0 x 10^{-4})	10.20 (259)	7.09 (180)	6,050 / 26
MAC-DB465T	3,000	839/450 (95/51)	111.0 x 10^{-3} (125.4 x 10^{-4})	13.11 (333)	7.09 (180)	8,250 / 36
MAC-DB700U	2,000	1,128/665 (127/75)	249.0 x 10^{-3} (281.4 x 10^{-4})	13.27 (337)	8.66 (220)	12,100 / 53

[1] Power listed is the required incoming line power in watts when the motor is operating at rated output. To determine total incoming power requirements, add up the listed values for each servomotor/drive combination in the system.

[2] Current listed in amps is the recommended slow-blow fuse capacity for each leg of the three phase power. To select fuses for the system, add the recommended fuse capacities for each servomotor/drive combination in the system.

D-Series Compatibility Chart

Servomotor Model Number	Single Phase Drives (No Regen)			Three Phase Drives (External Regen)					
	SAC-SW203 SMS-203 G03	SAC-SW205 SMS-205 G05	SAC-SW210 SMS-210 G10	SAC-SW217 SMS-217 G17	SAC-SW220 SMS-220 G20	SAC-SW225 SMS-225 G25	SAC-SW235 SMS-235 G35	SAC-SW260 SMS-260 G60	
MAC-DE003A1	✪	✔	✔						
MAC-DE003A2	✪	✔	✔						
MAC-DE006B1		✪	✔	✔					
MAC-DE006B2	✪	✔	✔						
MAC-DE008C1			✪	✔					
MAC-DE011C2		✪	✔	✔					
MAC-DE021D2		✪	✔						
MAC-DE042E2			✪	✔	✔				
MAC-DA030F			✪	✔	✔				
MAC-DA055G				✪	✔	✔			
MAC-DA090H						✪	✔		
MAC-DA110J						✪	✔	✔	
MAC-DA140K							✪	✔	
MAC-DB025L		✪	✔						
MAC-DB055M			✪	✔	✔				
MAC-DB080N				✪	✔				
MAC-DB100P					✪	✔			
MAC-DB200Q					✪	✔	✔		
MAC-DB300R							✪	✔	
MAC-DB330S								✪	
MAC-DB465T								✪	
MAC-DB700U								✪	

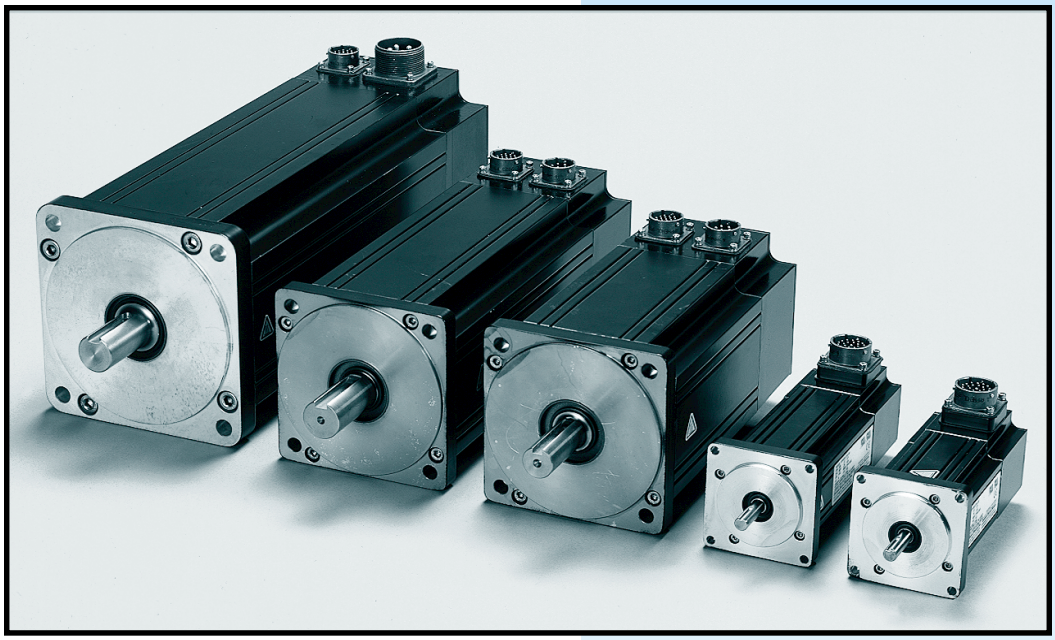
✪ Recommended drive model ✔ Compatible drive model

ORMEC

G-Series Servomotors

ORMEC's G-series AC brushless servomotors provide high torque-to-inertia ratios and excellent continuous torque and peak torque performance in a compact design. These industrial-quality servomotors incorporate high-energy, rare earth, neodymium-iron-boron magnets for excellent power density.

The G-Series servomotors also completely eliminate brush wear maintenance problems, and feature extremely durable construction which includes heavy duty bearings. Rugged MS connectors provide reliable interconnections to both motor and optical encoder.



ORMEC's G-series servomotors offer continuous stall torques from 5 to 640 lb-in (0.56 to 72 N-m).

Features

- ❒ Continuous stall torques from 5 to 640 in-lb (0.56 to 72 N-m)
- ❒ High peak torques from 10 to 1,239 in-lb (1.1 to 140 N-m)
- ❒ Rated power from 150 to 10,000 watts (0.20 to 13 HP)
- ❒ High maximum speeds up to 7,000 RPM
- ❒ Encoder resolutions of 8,000 counts per revolution standard (12,000 and 24,000 counts per revolution optional)
- ❒ Class F insulation providing long winding life under rated operating conditions
- ❒ Metric dimensions standard. NEMA mounting available for MAC-G005, G010, G016 & G030 through G115.
- ❒ Totally Enclosed, Non-Ventilated (TENV) IP-65 construction
- ❒ Stainless steel shaft standard on all models except MAC-G640
- ❒ Viton shaft seals are standard.
- ❒ Thermal overload switch mounted in motor windings is standard.
- ❒ Fail-safe holding brakes as option
- ❒ UL Recognized and CE Marked standard

Motor/Drive Combinations

Torque/speed performance for the G-Series is determined by the selected servodrive. All configuration parameters for matching drive to motor are stored on the ORION® controller and are downloaded automatically after each power-up.

Peak torques are also dependent on the selected servodrive, as is peak torque duration -- typically two seconds for the recommended drive.

Refer to the following pages for design information on G-Series servomotors.

G Series References

Understanding the G-Series Servomotor Model Numbers

MAC - G 030 A2 / M 2 B

- *Servomotor Series*
- *Continuous stall torque (lb-in)*
- *Winding designator*
- *Mounting flange*
  - *M = Metric*
  - *E = English (NEMA)*
  - *(E flange is only available for MAC-G005, G010, G016 & G030-G115)*
- *Feedback*
  - *2 = 2,000 linecount encoder, (6,000 RPM max speed)*
  - *3 = 3,000 linecount encoder, (4,000 RPM max speed)*
  - *6 = 6,000 linecount encoder, (2,000 RPM max speed)*
- *B = 24 VDC Fail-Safe Brake*

G-Series Servomotors & Matching Servodrives

Servomotor Model Number	Max. Speed[1] (RPM)	Peak / Stall Torque lb-in (N-m)	Motor Inertia lb-in-sec^2 (kg-m^2)	Motor Length in (mm)	Motor /E Flange in (mm)	Motor /M Flange mm (in)	Input Power[2] [3] watts/amps
MAC-G005A1	5,000	10/5.0 (1.1/0.56)	0.074 x 10^{-3} (0.084 x 10^{-4})	5.60 (143)	2.25 (57)	66 (2.60)	170 / 1.5
MAC-G006A1	6,800	12/5.8 (1.4/0.66)	0.127 x 10^{-3} (0.14 x 10^{-4})	5.05 (128)	---	72 (2.84)	300 / 2.7
MAC-G006A2	4,600	14/5.8 (1.6/0.66)	0.127 x 10^{-3} (0.14 x 10^{-4})	5.05 (128)	---	72 (2.84)	250 / 1.1
MAC-G010A1	5,500	17/10 (1.9/1.1)	0.137 x 10^{-3} (0.15 x 10^{-4})	6.90 (173)	2.25 (57)	66 (2.60)	340 / 3.1
MAC-G010B1	3,500	16/9.4 (1.8/1.1)	0.137 x 10^{-3} (0.15 x 10^{-4})	6.90 (173)	2.25 (57)	66 (2.60)	220 / 2.0
MAC-G011A1	7,000	26/11 (3.0/1.3)	0.247 x 10^{-3} (0.28 x 10^{-4})	5.80 (147)	---	72 (2.84)	600 / 5.4
MAC-G011A2	5,600	24/11 (2.7/1.3)	0.247 x 10^{-3} (0.28 x 10^{-4})	5.80 (147)	---	72 (2.84)	500 / 2.2
MAC-G011B2	3,800	28/11 (3.2/1.3)	0.247 x 10^{-3} (0.28 x 10^{-4})	5.80 (147)	---	72 (2.84)	320 / 1.4
MAC-G015A1	6,300	25/15 (2.9/1.7)	0.357 x 10^{-3} (0.40 x 10^{-4})	6.55 (166)	---	72 (2.84)	750 / 6.8
MAC-G015A2	5,600	24/15 (2.7/1.7)	0.357 x 10^{-3} (0.40 x 10^{-4})	6.55 (166)	---	72 (2.84)	670 / 2.9
MAC-G015B2	3,700	29/15 (3.2/1.7)	0.357 x 10^{-3} (0.40 x 10^{-4})	6.55 (166)	---	72 (2.84)	430 / 1.9
MAC-G016A2	5,000	35/16 (4.0/1.8)	0.328 x 10^{-3} (0.37 x 10^{-4})	7.24 (184)	3.31 (84)	89 (3.50)	615 / 2.7
MAC-G016B2	2,500	42/16 (4.7/1.8)	0.328 x 10^{-3} (0.37 x 10^{-4})	7.24 (184)	3.31 (84)	89 (3.50)	300 / 1.3
MAC-G019A1	5,625	41/19 (4.7/2.1)	0.467 x 10^{-3} (0.53 x 10^{-4})	7.30 (185)	---	72 (2.84)	935 / 8.5
MAC-G019A2	5,000	50/19 (5.6/2.1)	0.467 x 10^{-3} (0.53 x 10^{-4})	7.30 (185)	---	72 (2.84)	850 / 3.7
MAC-G019B2	3,700	29/17 (3.2/2.0)	0.467 x 10^{-3} (0.53 x 10^{-4})	7.30 (185)	---	72 (2.84)	550 / 2.4
MAC-G030A2	5,000	68/30 (7.7/3.4)	0.828 x 10^{-3} (0.94 x 10^{-4})	8.74 (222)	3.31 (84)	89 (3.50)	1,250 / 5.3
MAC-G030B2	2,600	67/30 (7.6/3.4)	0.828 x 10^{-3} (0.94 x 10^{-4})	8.74 (222)	3.31 (84)	89 (3.50)	620 / 2.7
MAC-G040A2	3,500	102/39 (11/4.4)	1.23 x 10^{-3} (1.39 x 10^{-4})	10.3 (260)	3.31 (84)	89 (3.50)	1,100 / 4.8
MAC-G040B2	1,700	61/39 (6.9/4.4)	1.23 x 10^{-3} (1.39 x 10^{-4})	10.3 (260)	3.31 (84)	89 (3.50)	480 / 2.1
MAC-G055A2	3,500	102/54 (11/6.1)	2.43 x 10^{-3} (2.74 x 10^{-4})	8.61 (219)	5.00 (127)	114 (4.50)	1,430 / 6.2
MAC-G055A4	1,850	102/54 (11/6.1)	2.43 x 10^{-3} (2.74 x 10^{-4})	8.61 (219)	5.00 (127)	114 (4.50)	850 / 3.7
MAC-G080A2	3,500	173/83 (20/9.4)	4.93 x 10^{-3} (5.57 x 10^{-4})	11.1 (282)	5.00 (127)	114 (4.50)	2,310 / 10
MAC-G080A4	1,850	203/83 (23/9.4)	4.93 x 10^{-3} (5.57 x 10^{-4})	11.1 (282)	5.00 (127)	114 (4.50)	1,320 / 5.7
MAC-G115A2	3,500	203/116 (23/13)	7.23 x 10^{-3} (8.17 x 10^{-4})	13.6 (345)	5.00 (127)	114 (4.50)	3,300 / 14
MAC-G115A4	1,850	203/116 (23/13)	7.23 x 10^{-3} (8.17 x 10^{-4})	13.6 (345)	5.00 (127)	114 (4.50)	1,870 / 8.1
MAC-G130A2	2,700	220/130 (25/15)	9.43 x 10^{-3} (10.7 x 10^{-4})	11.3 (287)	---	142 (5.59)	2,750 / 12
MAC-G130A4	1,750	213/130 (24/15)	9.43 x 10^{-3} (10.7 x 10^{-4})	11.3 (287)	---	142 (5.59)	1,870 / 8.1
MAC-G210A2	2,700	458/210 (52/24)	19.0 x 10^{-3} (21.5 x 10^{-4})	14.0 (355)	---	142 (5.59)	4,730 / 21
MAC-G210A4	1,750	361/210 (41/24)	19.0 x 10^{-3} (21.5 x 10^{-4})	14.0 (355)	---	142 (5.59)	3,190 / 14
MAC-G280A2	2,700	641/280 (72/32)	28.6 x 10^{-3} (32.3 x 10^{-4})	16.7 (423)	---	142 (5.59)	6,270 / 27
MAC-G280A4	1,750	752/280 (85/32)	28.6 x 10^{-3} (32.3 x 10^{-4})	16.7 (423)	---	142 (5.59)	4,180 / 18
MAC-G360A2	2,000	851/360 (96/41)	38.2 x 10^{-3} (43.2 x 10^{-4})	19.4 (493)	---	142 (5.59)	6,270 / 27
MAC-G360A4	1,750	752/360 (85/41)	38.2 x 10^{-3} (43.2 x 10^{-4})	19.4 (493)	---	142 (5.59)	5,390 / 23
MAC-G640A2	2,400	1,239/640 (140/72)	71.8 x 10^{-3} (81.2 x 10^{-4})	15.7 (398)	---	190 (7.48)	11,000 / 48

[1] Actual maximum speed is dependent on motor encoder resolution. Refer to "Understanding the G-Series Servomotor Model Numbers" on page 1 for further information.

[2] Power listed is the required incoming line power in watts when the motor is operating at rated output. To determine total incoming power requirements, add up the listed values for each servomotor/drive combination in the system.

[3] Current listed in amps is the recommended slow-blow fuse capacity for each leg of the three phase power. To select fuses for the system, add the recommended fuse capacities for each servomotor/drive combination in the system.

G-Series Compatibility Chart

ORMEC's all-digital drive technology provides the ability to control a variety of servomotors with a single servodrive. The chart below provides an overview of ServoWire drive compatibility with the G-series servomotors.

The recommended servodrive (✪) below provides sufficient power to provide the continuous and peak torques specified for the corresponding servomotor.

Compatible servodrives (✔) may be used instead of the recommended servodrive to increase the amount of peak torque, and also allow each servodrive model to support a wider range of motors, simplifying the stocking of spare parts.

Servomotor Model Number	Single Phase Drives (No Regen)			Three Phase Drives (External Regen)					
	SAC-SW203 SMS-203 G03	SAC-SW205 SMS-205 G05	SAC-SW210 SMS-210 G10	SAC-SW217 SMS-217 G17	SAC-SW220 SMS-220 G20	SAC-SW225 SMS-225 G25	SAC-SW235 SMS-235 G35	SAC-SW260 SMS-260 G60	
MAC-G005A1	✪	✔	✔						
MAC-G006A1		✪	✔						
MAC-G006A2	✪	✔	✔						
MAC-G010A1		✪	✔	✔					
MAC-G010B1	✪	✔	✔						
MAC-G011A1			✪	✔	✔				
MAC-G011A2		✪	✔						
MAC-G011B2	✪	✔	✔						
MAC-G015A1			✪	✔	✔				
MAC-G015A2		✪	✔	✔					
MAC-G015B2	✪	✔	✔						
MAC-G016A2		✪	✔						
MAC-G016B2	✪	✔	✔						
MAC-G019A1				✪	✔				
MAC-G019A2			✪	✔	✔				
MAC-G019B2	✪	✔	✔						
MAC-G030A2			✪	✔	✔				
MAC-G030B2		✪	✔						
MAC-G040A2			✪	✔	✔				
MAC-G040B2	✪	✔	✔						
MAC-G055A2			✪	✔	✔				
MAC-G055A4		✪	✔						
MAC-G080A2				✪	✔	✔			
MAC-G080A4			✪	✔	✔				
MAC-G115A2					✪	✔	✔		
MAC-G115A4			✪	✔	✔				
MAC-G130A2				✪	✔	✔			
MAC-G130A4			✪	✔	✔				
MAC-G210A2					✪	✔	✔		
MAC-G210A4				✪	✔	✔			
MAC-G280A2							✪	✔	
MAC-G280A4						✪	✔		
MAC-G360A2							✪	✔	
MAC-G360A4						✪	✔		
MAC-G640A2								✪	

✪ Recommended drive model ✔ Compatible drive model

G-Series AC Brushless Servomotors

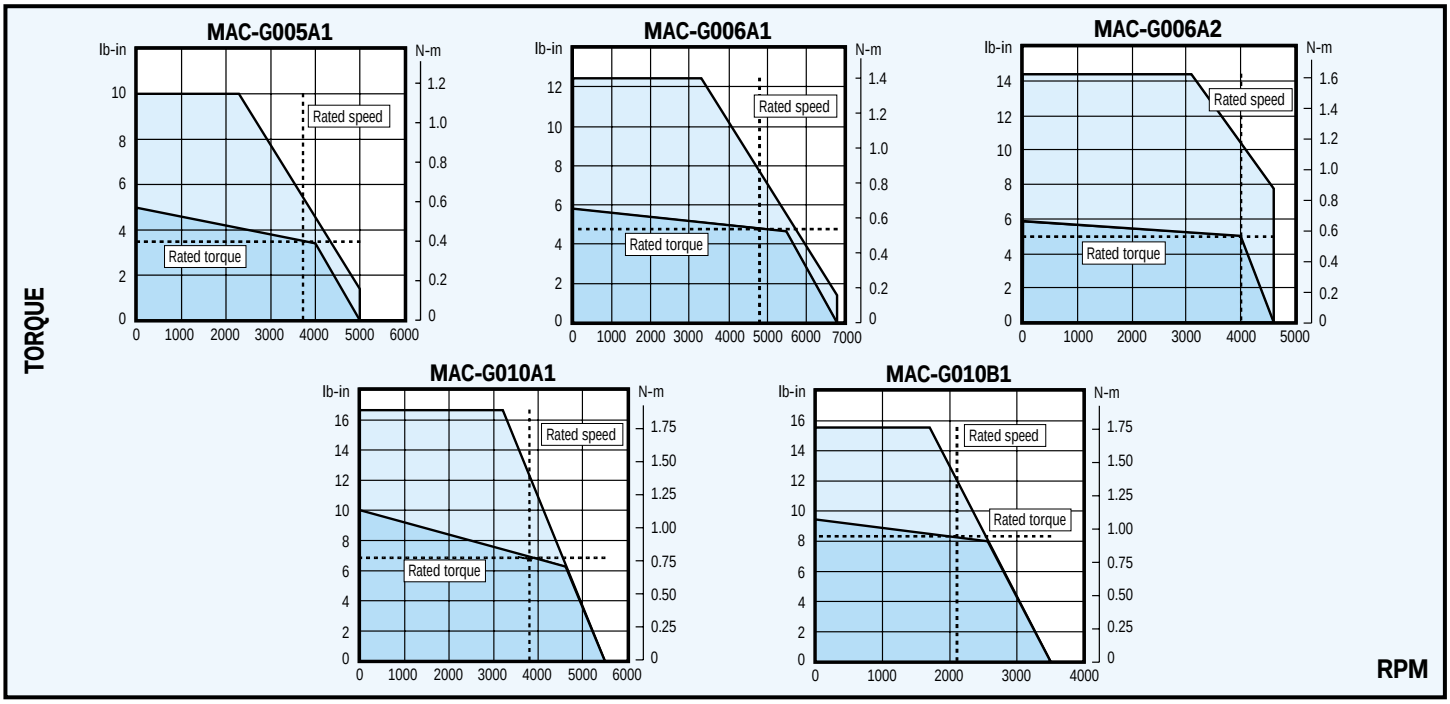
All specifications and "Torque/Speed Curves" shown on this page reflect performance with the specific servodrive models listed below.

Performance Specifications (1)	Units	G005A1	G006A1	G006A2	G010A1	G010B1
Maximum Speed(2)	RPM	5,000	6,800	4,600	5,500	3,500
Continuous Stall Torque	lb-in	5.0	5.8	5.8	10.0	9.4
	N-m	0.56	0.66	0.66	1.1	1.1
Rated Speed	RPM	3,700	4,800	4,000	3,800	2,100
Rated Torque	lb-in	3.5	4.8	5.0	7.0	8.4
(at rated speed)	N-m	0.40	0.55	0.56	0.79	0.95
Rated Power	HP	0.20	0.36	0.31	0.42	0.27
	watts	150	270	230	310	200
Peak Torque(4)	lb-in	10	12	14	17	16
	N-m	1.1	1.4	1.6	1.9	1.8
Continuous Stall Torque/Inertia	radians/sec^2	67,568	45,669	45,669	72,993	68,613
Mechanical/Thermal Specifications						
Moment of Inertia	lb-in-sec^2 x10^{-3}	0.074	0.127	0.127	0.137	0.137
	kg-m^2 x10^{-4}	0.084	0.143	0.143	0.155	0.155
Friction Torque, Static	lb-in	0.50	0.60	0.60	0.80	0.80
	N-m	0.056	0.068	0.068	0.090	0.090
Servomotor Weight	lbs	3.0	3.5	3.5	4.0	4.0
	kg	1.4	1.6	1.6	1.8	1.8
Maximum Radial Shaft Load	lbs	20	35	35	20	20
(centered 1" (25mm) from motor face)	N	89	156	156	89	89
Maximum Axial Shaft Load	lbs	15	20	20	15	15
	N	67	89	89	67	67
Electrical Specifications						
Torque Sensitivity	lb-in/Amps$_{Rms/Ø}$	2.4	1.8	3.6	2.5	3.9
	N-m/Amps$_{Rms/Ø}$	0.28	0.21	0.40	0.28	0.44
Servodrive Model Numbers		SAC-SW203 SMS-203 G03-AE	SAC-SW205 SMS-205 G05-AE	SAC-SW203 SMS-203 G03-AE	SAC-SW205 SMS-205 G05-AE	SAC-SW203 SMS-203 G03-AE
Servodrive Input Power	volts AC	115	115	230	115	115
Continuous Motor Current(5)	Amps$_{Rms/Ø}$	2.0	3.1	1.6	4.1	2.5
Peak Motor Current(5)	Amps$_{Rms/Ø}$	6.2	9.8	4.9	12	7.7

NOTES: (1) Ratings are obtained with servomotor ambient temperature of 25C with motor mounted to a 10" x 10" x ¼" (MAC-G005 & G010) or 6" x 6" x ¼" (MAC-G006) aluminum heatsink. Maximum case temperature is 100C---except for model MAC-G006 which has a maximum case temperature of 85C. (2) Actual maximum motor speed dependent on motor encoder resolution. Refer to chart on page 1. (3) Insulation Class for all models is: F. (4) Motor's peak torque is limited by peak current of the servodrive. The next larger drive may be used to increase the amount of peak torque available. Consult ORMEC for details. (5) Motor current specifications independent of drive selected.

Torque vs. Speed Characteristics

A: Intermittent Duty Zone B: Continuous Duty Zone



G-Series AC Brushless Servomotors

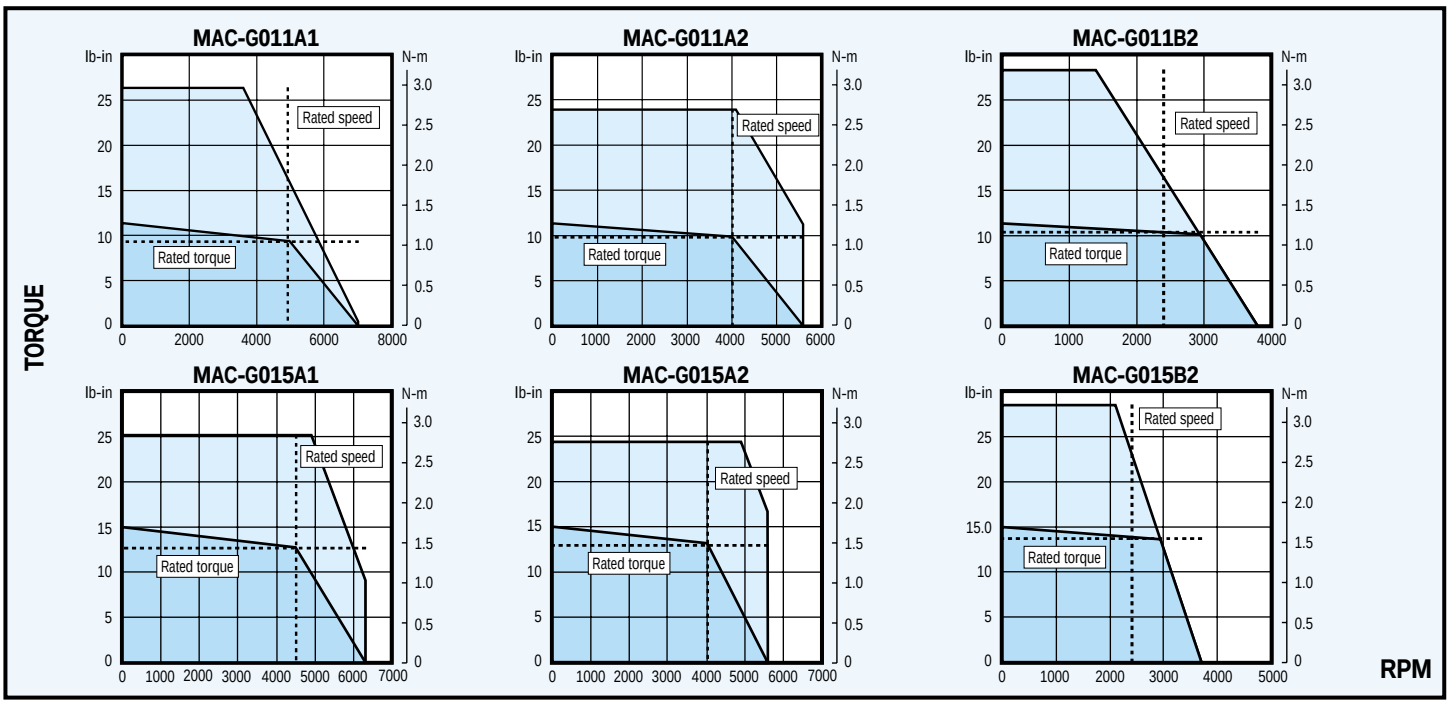
All specifications and "Torque/Speed Curves" shown on this page reflect performance with the specific servodrive models listed below.

Performance Specifications (1)	Units	G011A1	G011A2	G011B2	G015A1	G015A2	G015B2
Maximum Speed(2)	RPM	7,000	5,600	3,800	6,300	5,600	3,700
Continuous Stall Torque	lb-in	11	11	11	15	15	15
	N-m	1.3	1.3	1.3	1.7	1.7	1.7
Rated Speed	RPM	4,900	4,000	2,400	4,500	4,000	2,400
Rated Torque	lb-in	9.4	9.8	10	13	13	14
(at rated speed)	N-m	1.1	1.1	1.2	1.4	1.5	1.6
Rated Power	HP	0.72	0.62	0.39	0.91	0.82	0.52
	watts	540	460	290	680	610	390
Peak Torque (4)	lb-in	26	24	28	25	24	29
	N-m	3.0	2.7	3.2	2.9	2.7	3.2
Continuous Stall Torque/Inertia	radians/sec^2	44,534	44,534	44,534	42,017	42,017	42,017
Mechanical/Thermal Specifications							
Moment of Inertia	lb-in-sec^2 x10^{-3}	0.247	0.247	0.247	0.357	0.357	0.357
	kg-m^2 x10^{-4}	0.279	0.279	0.279	0.403	0.403	0.403
Friction Torque, Static	lb-in	0.80	0.80	0.80	1.0	1.0	1.0
	N-m	0.090	0.090	0.090	0.11	0.11	0.11
Servomotor Weight	lbs	4.4	4.4	4.4	5.3	5.3	5.3
	kg	2.0	2.0	2.0	2.4	2.4	2.4
Maximum Radial Shaft Load	lbs	35	35	35	35	35	35
(centered 1" (25mm) from motor face)	N	156	156	156	156	156	156
Maximum Axial Shaft Load	lbs	15	15	15	15	15	15
	N	67	67	67	67	67	67
Electrical Specifications							
Torque Sensitivity	lb-in/Amps$_{Rms/Ø}$	2.0	3.6	7.0	1.9	3.6	7.1
	N-m/Amps$_{Rms/Ø}$	0.22	0.40	0.79	0.21	0.41	0.80
Servodrive Model Numbers		SAC-SW210 SMS-210 G10-AE	SAC-SW205 SMS-205 G05-AE	SAC-SW203 SMS-203 G03-AE	SAC-SW210 SMS-210 G10-AE	SAC-SW205 SMS-205 G05-AE	SAC-SW203 SMS-203 G03-AE
Servodrive Input Power	volts AC	115	230	230	115	230	230
Continuous Motor Current (5)	Amps$_{Rms/Ø}$	5.8	3.2	1.6	8.0	4.2	2.1
Peak Motor Current (5)	Amps$_{Rms/Ø}$	17	9.8	4.8	24	12	6.4

NOTES: (1) Ratings are obtained with servomotor ambient temperature of 25C with motor mounted to a 6" x 6" x ¼" aluminum heatsink. Maximum case temperature is 85C. (2) Actual maximum motor speed dependent on motor encoder resolution. Refer to chart on page 1. (3) Insulation Class for all models is: F. (4) Motor's peak torque is limited by the peak current of the servodrive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details. (5) Motor current specifications independent of drive selected.

Torque vs. Speed Characteristics

A: Intermittent Duty Zone B: Continuous Duty Zone



G-Series AC Brushless Servomotors

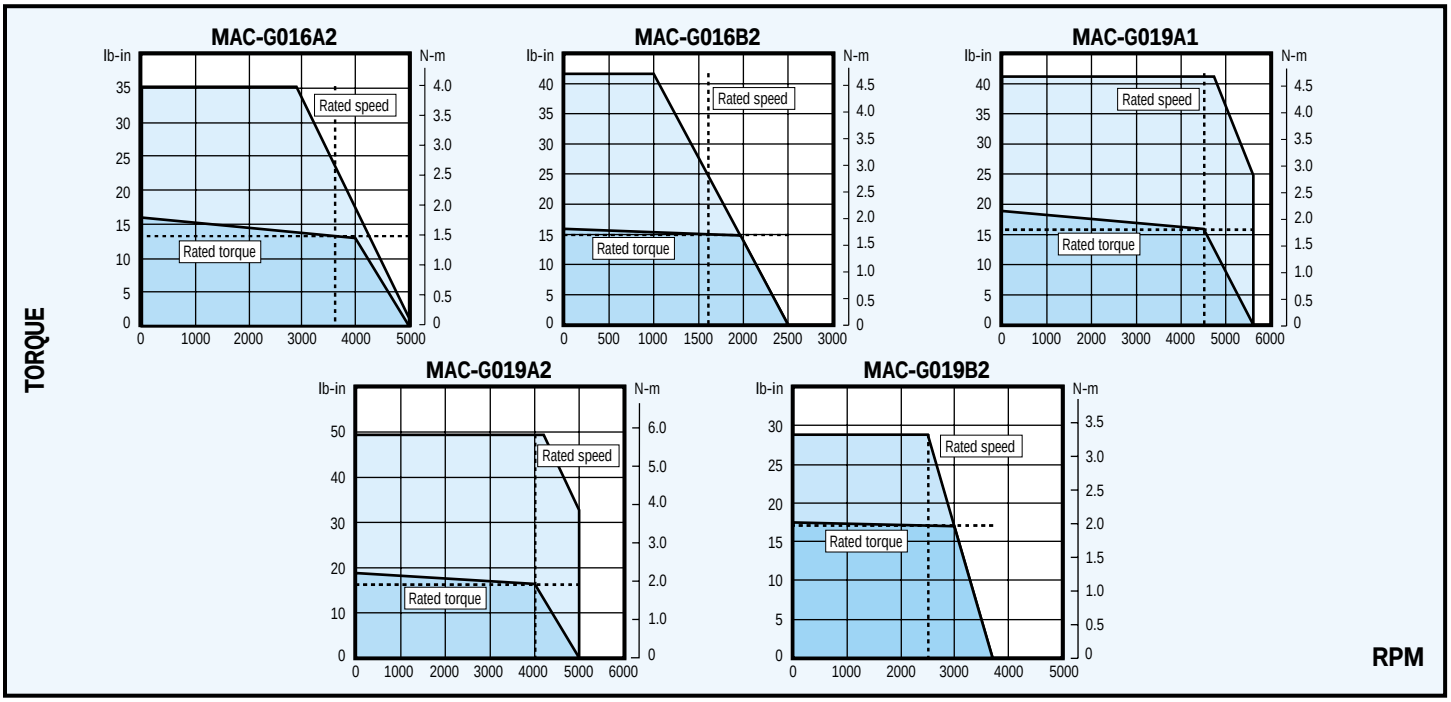
All specifications and "Torque/Speed Curves" shown on this page reflect performance with the specific servodrive models listed below.

Performance Specifications (1)	Units	G016A2	G016B2	G019A1	G019A2	G019B2
Maximum Speed(2)	RPM	5,000	2,500	5,625	5,000	3,700
Continuous Stall Torque	lb-in	16	16	19	19	17
	N-m	1.8	1.8	2.1	2.1	2.0
Rated Speed	RPM	3,600	1,600	4,500	4,000	2,500
Rated Torque	lb-in	13	15	16	16	17
(at rated speed)	N-m	1.5	1.7	1.8	1.8	1.9
Rated Power	HP	0.75	0.38	1.1	1.0	0.67
	watts	560	280	850	770	500
Peak Torque (4)	lb-in	35	42	41	50	29
	N-m	4.0	4.7	4.7	5.6	3.2
Continuous Stall Torque/Inertia	radians/sec^2	48,780	48,780	40,685	40,685	36,403
Mechanical/Thermal Specifications						
Moment of Inertia	lb-in-sec^2 x10^{-3}	0.328	0.328	0.467	0.467	0.467
	kg-m^2 x10^{-4}	0.371	0.371	0.528	0.528	0.528
Friction Torque, Static	lb-in	0.40	0.40	1.2	1.2	1.2
	N-m	0.045	0.045	0.14	0.14	0.14
Servomotor Weight	lbs	8.3	8.3	6.2	6.2	6.2
	kg	3.8	3.8	2.8	2.8	2.8
Maximum Radial Shaft Load	lbs	40	40	35	35	35
(centered 1" (25mm) from motor face)	N	178	178	156	156	156
Maximum Axial Shaft Load	lbs	25	25	15	15	15
	N	111	111	67	67	67
Electrical Specifications						
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	5.2	10	1.8	3.7	7.1
	N-m/Amp$_{Rms/Ø}$	0.59	1.2	0.21	0.42	0.81
Servodrive Model Numbers		SAC-SW205 SMS-205 G05-AE	SAC-SW203 SMS-203 G03-AE	SAC-SW217 SMS-217 G17-AE	SAC-SW210 SMS-210 G10-AE	SAC-SW203 SMS-203 G03-AE
Servodrive Input Power	volts AC	230	230	115	230	230
Continuous Motor Current (5)	Amps$_{Rms/Ø}$	3.1	1.6	11	5.1	2.6
Peak Motor Current (5)	Amps$_{Rms/Ø}$	11	5.7	31	16	7.9

NOTES: (1) Ratings are obtained with servomotor ambient temperature of 25C with motor mounted to a 10" x 10" x ¼" (MAC-G016) or 6" x 6" x ¼" (MAC-G019) aluminum heatsink. Maximum case temperature is 100C. (2) Actual maximum motor speed dependent on motor encoder resolution. Refer to chart on page 1. (3) Insulation Class for all models is: F. (4) Motor's peak torque is limited by the peak current of the servodrive. The next larger drive may be used to increase peak torque available. Consult an ORMEC Applications Engineer for details. (5) Motor current specifications independent of drive selected.

Torque vs. Speed Characteristics

A: Intermittent Duty Zone B: Continuous Duty Zone



G-Series AC Brushless Servomotors

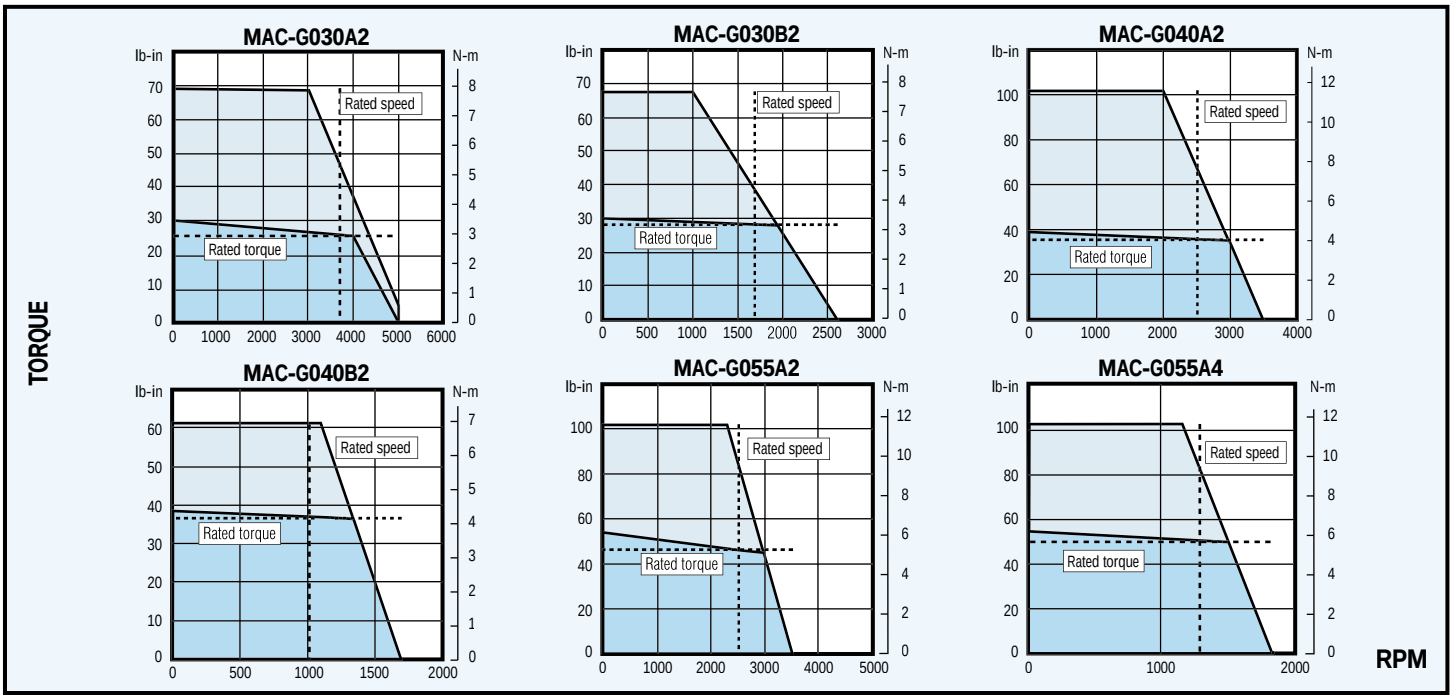
All specifications and "Torque/Speed Curves" shown on this page reflect performance with the specific servodrive models listed below.

Performance Specifications (1)	Units	G030A2	G030B2	G040A2	G040B2	G055A2	G055A4
Maximum Speed(2)	RPM	5,000	2,600	3,500	1,700	3,500	1,850
Continuous Stall Torque	lb-in	30	30	39	39	54	54
	N-m	3.4	3.4	4.4	4.4	6.1	6.1
Rated Speed	RPM	3,700	1,700	2,500	1,000	2,500	1,300
Rated Torque	lb-in	26	28	36	37	47	50
(at rated speed)	N-m	2.9	3.2	4.0	4.2	5.3	5.7
Rated Power	HP	1.5	0.75	1.3	0.58	1.7	1.0
	watts	1,100	560	1,000	430	1,300	770
Peak Torque (4)	lb-in	68	67	102	61	102	102
	N-m	7.7	7.6	11	6.9	11	11
Continuous Stall Torque/Inertia	radians/sec^2	36,232	36,232	31,707	31,707	22,222	22,222
Mechanical/Thermal Specifications							
Moment of Inertia	lb-in-sec^2 x10^{-3}	0.828	0.828	1.23	1.23	2.43	2.43
	kg-m^2 x10^{-4}	0.936	0.936	1.39	1.39	2.74	2.74
Friction Torque, Static	lb-in	0.50	0.50	0.60	0.60	1.0	1.0
	N-m	0.056	0.056	0.068	0.068	0.11	0.11
Servomotor Weight	lbs	12	12	15	15	20	20
	kg	5.4	5.4	6.6	6.6	9.1	9.1
Maximum Radial Shaft Load	lbs	40	40	40	40	100	100
(centered 1" (25mm) from motor face)	N	178	178	178	178	445	445
Maximum Axial Shaft Load	lbs	25	25	25	25	50	50
	N	111	111	111	111	222	222
Electrical Specifications							
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	5.1	10	7.6	15	7.6	15
	N-m/Amp$_{Rms/Ø}$	0.58	1.1	0.86	1.7	0.86	1.7
Servodrive Model Numbers		SAC-SW210 SMS-210 G10-AE	SAC-SW205 SMS-205 G05-AE	SAC-SW210 SMS-210 G10-AE	SAC-SW203 SMS-203 G03-AE	SAC-SW210 SMS-210 G10-AE	SAC-SW205 SMS-205 G05-AE
Servodrive Input Power	volts AC	230	230	230	230	230	230
Continuous Motor Current (5)	Amps$_{Rms/Ø}$	6.0	3.0	5.1	2.4	7.1	3.6
Peak Motor Current (5)	Amps$_{Rms/Ø}$	22	11	19	9.1	25	12

NOTES: (1) Ratings are obtained with servomotor ambient temperature of 25C with motor mounted to a 10" x 10" x ¼" (MAC-G030 & G040) and 10" x 10" x ½" (MAC-G055) aluminum heatsink. Maximum case temperature is 100C. (2) Actual maximum motor speed dependent on motor encoder resolution. Refer to chart on page 1. (3) Insulation Class for all models is: F. (4) Motor's peak torque is limited by the peak current of the servodrive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details. (5) Motor current specifications independent of drive selected.

Torque vs. Speed Characteristics

A: Intermittent Duty Zone B: Continuous Duty Zone



G-Series AC Brushless Servomotors

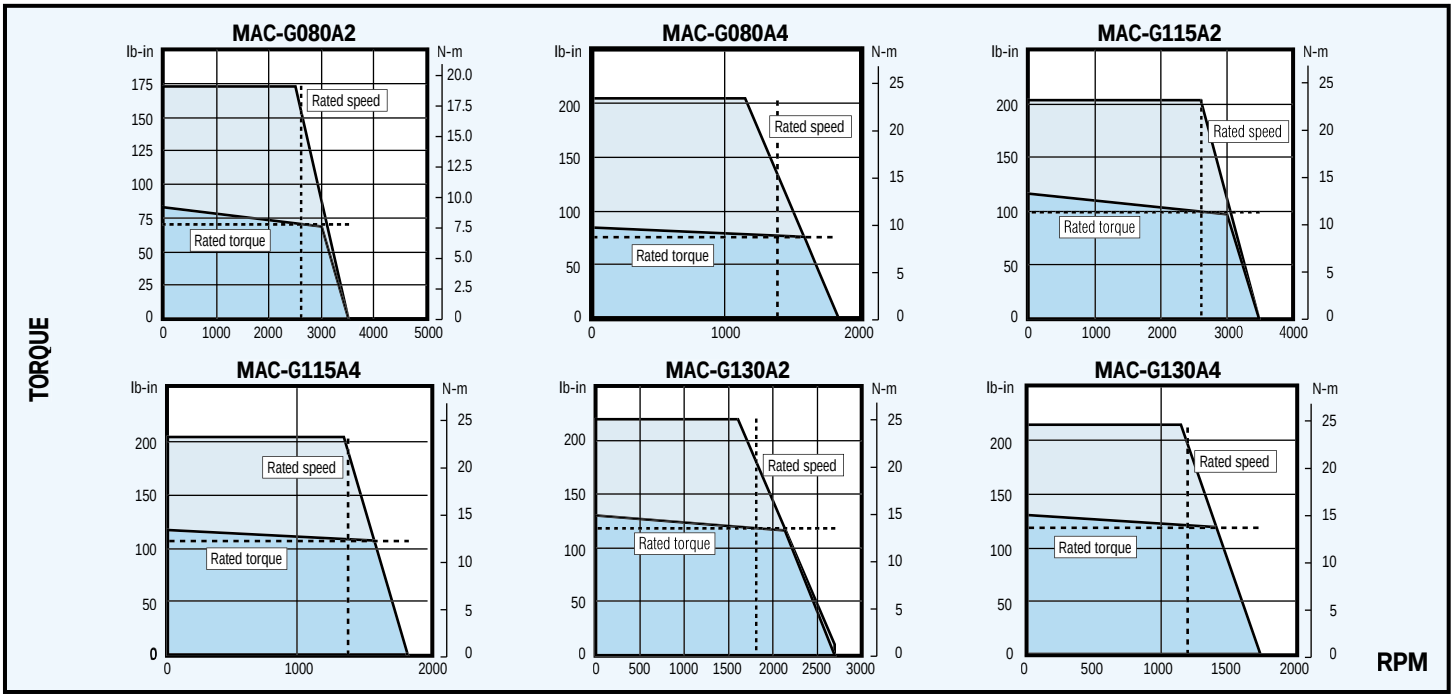
All specifications and "Torque/Speed Curves" shown on this page reflect performance with the specific servodrive models listed below.

Performance Specifications (1)	Units	G080A2	G080A4	G115A2	G115A4	G130A2	G130A4
Maximum Speed(2)	RPM	3,500	1,850	3,500	1,850	2,700	1,750
Continuous Stall Torque	lb-in	83	83	116	116	130	130
	N-m	9.4	9.4	13	13	15	15
Rated Speed	RPM	2,600	1,400	2,600	1,400	1,800	1,200
Rated Torque	lb-in	71	76	100	107	119	121
(at rated speed)	N-m	8.0	8.6	11	12	13	14
Rated Power	HP	2.8	1.6	4.0	2.3	3.4	2.3
	watts	2,100	1,200	3,000	1,700	2,500	1,700
Peak Torque (4)	lb-in	203	203	203	203	220	213
	N-m	23	23	23	23	25	24
Continuous Stall Torque/Inertia	radians/sec^2	16,836	16,836	16,044	16,044	13,786	13,786
Mechanical/Thermal Specifications							
Moment of Inertia	lb-in-sec^2 x10^{-3}	4.93	4.93	7.23	7.23	9.43	9.43
	kg-m^2 x10^{-4}	5.57	5.57	8.17	8.17	10.7	10.7
Friction Torque, Static	lb-in	1.4	1.4	1.8	1.8	2.4	2.4
	N-m	0.16	0.16	0.20	0.20	0.27	0.27
Servomotor Weight	lbs	29	29	37	37	36	36
	kg	13	13	17	17	16	16
Maximum Radial Shaft Load	lbs	100	100	100	100	150	150
(centered 1" (25mm) from motor face)	N	445	445	445	445	667	667
Maximum Axial Shaft Load	lbs	50	50	50	50	50	50
	N	222	222	222	222	222	222
Electrical Specifications							
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	7.6	15	7.6	15	9.6	16
	N-m/Amp$_{Rms/Ø}$	0.86	1.7	0.86	1.7	1.1	1.8
Servodrive Model Numbers		SAC-SW217 SMS-217 G17-AE	SAC-SW210 SMS-210 G10-AE	SAC-SW220 SMS-220 G20-AE	SAC-SW210 SMS-210 G10-AE	SAC-SW217 SMS-217 G17-AE	SAC-SW210 SMS-210 G10-AE
Servodrive Input Power	volts AC	230	230	230	230	230	230
Continuous Motor Current (5)	Amps$_{Rms/Ø}$	11	5.5	15	7.7	13	8.2
Peak Motor Current (5)	Amps$_{Rms/Ø}$	38	19	54	27	39	24

NOTES: (1) Ratings are obtained with servomotor ambient temperature of 25C with motor mounted to a 12" x 12" x ½" aluminum heatsink. Maximum case temperature is 100C. (2) Actual maximum motor speed dependent on motor encoder resolution. Refer to chart on page 1. (3) Insulation Class for all models is: F. (4) Motor's peak torque is limited by the peak current of the servodrive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details. (5) Motor current specifications independent of drive selected.

Torque vs. Speed Characteristics

A: Intermittent Duty Zone B: Continuous Duty Zone



G-Series AC Brushless Servomotors

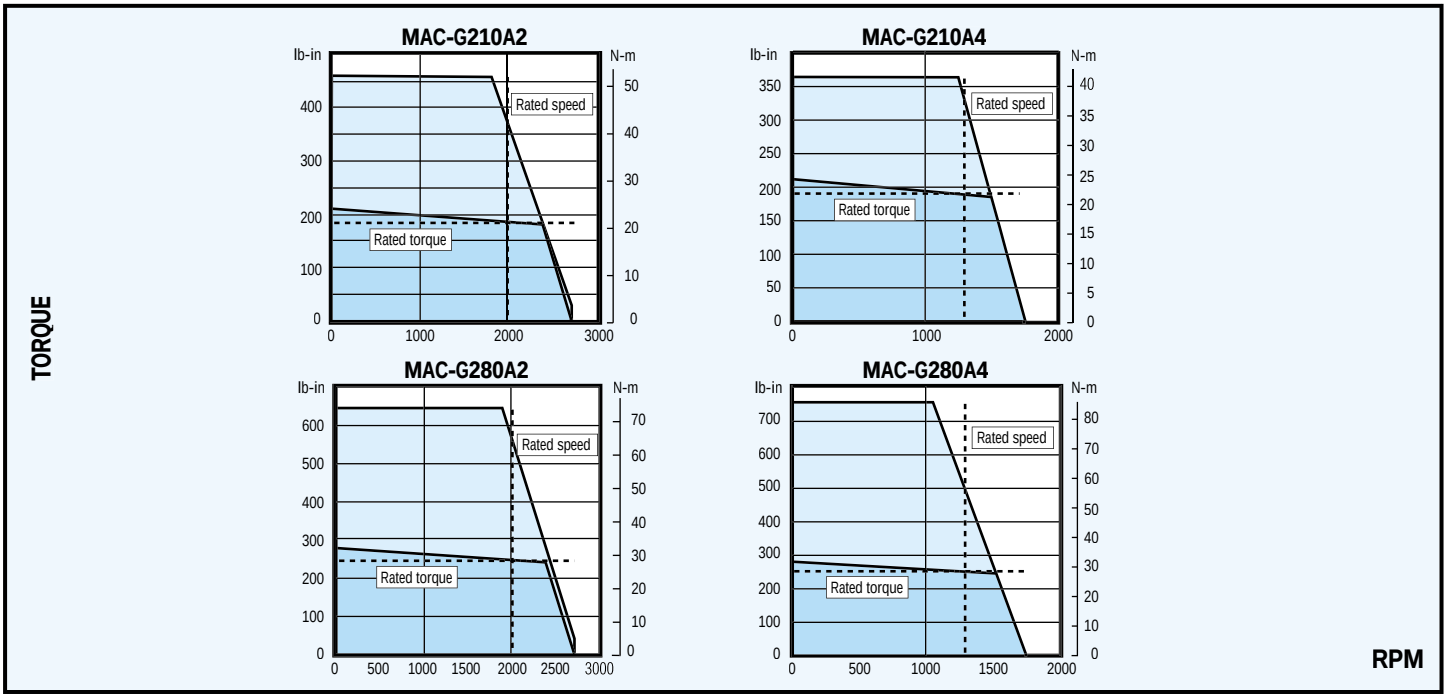
All specifications and "Torque/Speed Curves" shown on this page reflect performance with the specific servodrive models listed below.

Performance Specifications (1)	Units	G210A2	G210A4	G280A2	G280A4
Maximum Speed(2)	RPM	2,700	1,750	2,700	1,750
Continuous Stall Torque	lb-in	210	210	280	280
	N-m	24	24	32	32
Rated Speed	RPM	2,000	1,300	2,000	1,300
Rated Torque	lb-in	184	191	245	252
(at rated speed)	N-m	21	22	28	28
Rated Power	HP	5.8	3.9	7.6	5.1
	watts	4,300	2,900	5,700	3,800
Peak Torque (4)	lb-in	458	361	641	752
	N-m	52	41	72	85
Continuous Stall Torque/Inertia	radians/sec^2	11,053	11,053	9,790	9,790
Mechanical/Thermal Specifications					
Moment of Inertia	lb-in-sec^2 x10^{-3}	19.0	19.0	28.6	28.6
	kg-m^2 x10^{-4}	21.5	21.5	32.3	32.3
Friction Torque, Static	lb-in	3.0	3.0	3.6	3.6
	N-m	0.34	0.34	0.41	0.41
Servomotor Weight	lbs	51	51	66	66
	kg	23	23	30	30
Maximum Radial Shaft Load	lbs	150	150	150	150
(centered 1" (25mm) from motor face)	N	667	667	667	667
Maximum Axial Shaft Load	lbs	50	50	50	50
	N	222	222	222	222
Electrical Specifications					
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	9.6	16	9.6	16
	N-m/Amp$_{Rms/Ø}$	1.1	1.8	1.1	1.8
Servodrive Model Number		SAC-SW225 SMS-225 G25-AE	SAC-SW217 SMS-217 G17-AE	SAC-SW235 SMS-235 G35-AE	SAC-SW225 SMS-225 G25-AE
Servodrive Input Power	volts AC	230	230	230	230
Continuous Motor Current (5)	Amps$_{Rms/Ø}$	22	13	29	17
Peak Motor Current (5)	Amps$_{Rms/Ø}$	65	38	87	51

NOTES: (1) Ratings are obtained with servomotor ambient temperature of 25C with motor mounted to a 12" x 12" x ½" aluminum heatsink. Maximum case temperature is 100C. (2) Actual maximum motor speed dependent on motor encoder resolution. Refer to chart on page 1. (3) Insulation Class for all models is: F. (4) Motor's peak torque is limited by the peak current of the servodrive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details. (5) Motor current specifications independent of drive selected.

Torque vs. Speed Characteristics

A: Intermittent Duty Zone B: Continuous Duty Zone



G-Series AC Brushless Servomotors

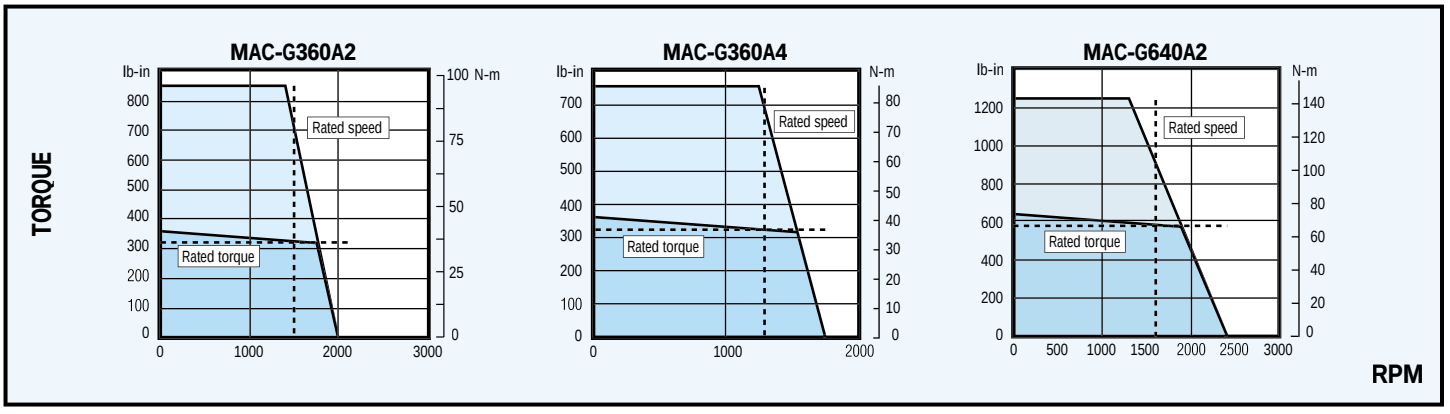
All specifications and "Torque/Speed Curves" shown on this page reflect performance with the specific servodrive models listed below.

Performance Specifications (1)	Units	G360A2	G360A4	G640A2
Maximum Speed(2)	RPM	2,000	1,750	2,400
Continuous Stall Torque	lb-in	360	360	640
	N-m	41	41	72
Rated Speed	RPM	1,500	1,300	1,600
Rated Torque	lb-in	321	323	580
(at rated speed)	N-m	36	36	66
Rated Power	HP	7.6	6.6	13
	watts	5,700	4,900	10,000
Peak Torque (4)	lb-in	851	752	1,239
	N-m	96	85	140
Continuous Stall Torque/Inertia	radians/sec^2	10,286	10,286	8,989
Mechanical/Thermal Specifications				
Moment of Inertia	lb-in-sec^2 x10^{-3}	35.0	35.0	71.2
	kg-m^2 x10^{-4}	39.6	39.6	80.5
Friction Torque, Static	lb-in	4.2	4.2	9.8
	N-m	0.47	0.47	1.1
Servomotor Weight	lbs	83	83	98
	kg	38	38	44
Maximum Radial Shaft Load	lbs	150	150	250
(centered 1" (25mm) from motor face)	N	667	667	1,112
Maximum Axial Shaft Load	lbs	50	50	100
	N	222	222	445
Electrical Specifications				
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	13	16	11
	N-m/Amp$_{Rms/Ø}$	1.4	1.8	1.2
Servodrive Model Numbers		SAC-SW235 SMS-235 G35-AE	SAC-SW225 SMS-225 G25-AE	SAC-SW260 SMS-260 G60-AE
Servodrive Input Power	volts AC	230	230	230
Continuous Motor Current (5)	Amps$_{Rms/Ø}$	28	22	59
Peak Motor Current (5)	Amps$_{Rms/Ø}$	83	66	163

NOTES: (1) Ratings are obtained with servomotor ambient temperature of 25C with motor mounted to a 12" x 12" x ½" (MAC-G360) or 14" x 14" x ¾" (MAC-G640) aluminum heatsink. Maximum case temperature is 100C. (2) Actual maximum motor speed dependent on motor encoder resolution. Refer to chart on page 1. (3) Insulation Class for all models is: F. (4) Motor's peak torque is limited by the peak current of the servodrive. The next larger drive may be used to increase peak torque available. Consult an ORMEC Applications Engineer for details. (5) Motor current specifications independent of drive selected.

Torque vs. Speed Characteristics

A: Intermittent Duty Zone B: Continuous Duty Zone



Specifications for G-Series Servomotors with Fail-Safe Brakes

Frame Size Ref [1]	Servomotor Model Number	Brake Holding Torque[2] lb-in (N-m)	Continuous Stall Torque to Inertia Ratio (rad/sec^2)	Motor Moment of Inertia lb-in-sec^2 (kg-m^2)	Motor Length in (mm)	Motor Weight lb (kg)	Brake Current @24 Vdc (milliamps)
A	MAC-G005A1	10 (1.1)	50,556	0.099×10^{-3} (0.112×10^{-4})	6.80 (173)	3.8 (1.7)	210
B	MAC-G006A1	24 (2.7)	29,457	0.197×10^{-3} (0.222×10^{-4})	6.55 (167)	6.5 (2.9)	600
	MAC-G006A2	24 (2.7)	29,457	0.197×10^{-3} (0.222×10^{-4})	6.55 (167)	6.5 (2.9)	600
A	MAC-G010A1	10 (1.1)	61,767	0.162×10^{-3} (0.183×10^{-4})	8.00 (203)	4.8 (2.2)	210
	MAC-G010B1	10 (1.1)	58,296	0.162×10^{-3} (0.183×10^{-4})	8.00 (203)	4.8 (2.2)	210
B	MAC-G011A1	24 (2.7)	35,658	0.317×10^{-3} (0.358×10^{-4})	7.45 (186)	7.4 (3.4)	600
	MAC-G011A2	24 (2.7)	35,658	0.317×10^{-3} (0.358×10^{-4})	7.45 (186)	7.4 (3.4)	600
	MAC-G011B2	24 (2.7)	35,658	0.317×10^{-3} (0.358×10^{-4})	7.45 (186)	7.4 (3.4)	600
	MAC-G015A1	24 (2.7)	35,137	0.427×10^{-3} (0.482×10^{-4})	8.05 (207)	8.3 (3.8)	600
	MAC-G015A2	24 (2.7)	35,137	0.427×10^{-3} (0.482×10^{-4})	8.05 (207)	8.3 (3.8)	600
	MAC-G015B2	24 (2.7)	35,137	0.427×10^{-3} (0.482×10^{-4})	8.05 (207)	8.3 (3.8)	600
C	MAC-G016A2	60 (6.8)	33,473	0.478×10^{-3} (0.540×10^{-4})	8.74 (222)	10.5 (4.8)	520
	MAC-G016B2	60 (6.8)	33,473	0.478×10^{-3} (0.540×10^{-4})	8.74 (222)	10.5 (4.8)	520
B	MAC-G019A1	24 (2.7)	35,016	0.537×10^{-3} (0.607×10^{-4})	8.80 (224)	9.2 (4.2)	600
	MAC-G019A2	24 (2.7)	35,016	0.537×10^{-3} (0.607×10^{-4})	8.80 (224)	9.2 (4.2)	600
	MAC-G019B2	24 (2.7)	32,521	0.537×10^{-3} (0.607×10^{-4})	8.80 (224)	9.2 (4.2)	600
C	MAC-G030A2	60 (6.8)	30,675	0.978×10^{-3} (1.11×10^{-4})	10.3 (261)	10.5 (4.8)	520
	MAC-G030B2	60 (6.8)	30,675	0.978×10^{-3} (1.11×10^{-4})	10.3 (261)	10.5 (4.8)	520
	MAC-G040A2	60 (6.8)	28,302	1.38×10^{-3} (1.56×10^{-4})	11.8 (299)	16.8 (7.6)	520
	MAC-G040B2	60 (6.8)	28,302	1.38×10^{-3} (1.56×10^{-4})	11.8 (299)	16.8 (7.6)	520
D	MAC-G055A2	240 (27)	16,226	3.33×10^{-3} (3.76×10^{-4})	10.6 (270)	26.0 (11.8)	880
	MAC-G055A4	240 (27)	16,226	3.33×10^{-3} (3.76×10^{-4})	10.6 (270)	26.0 (11.8)	880
	MAC-G080A2	240 (27)	14,242	5.83×10^{-3} (6.59×10^{-4})	13.1 (333)	34.6 (15.7)	880
	MAC-G080A4	240 (27)	14,242	5.83×10^{-3} (6.59×10^{-4})	13.1 (333)	34.6 (15.7)	880
	MAC-G115A2	240 (27)	14,296	8.13×10^{-3} (9.18×10^{-4})	15.6 (397)	43.0 (19.5)	880
	MAC-G115A4	240 (27)	14,296	8.13×10^{-3} (9.18×10^{-4})	15.6 (397)	43.0 (19.5)	880
E	MAC-G130A2	360 (41)	11,113	11.7×10^{-3} (13.2×10^{-4})	14.0 (356)	48.0 (21.8)	1,130
	MAC-G130A4	360 (41)	11,113	11.7×10^{-3} (13.2×10^{-4})	14.0 (356)	48.0 (21.8)	1,130
	MAC-G210A2	360 (41)	9,860	21.3×10^{-3} (24.1×10^{-4})	16.7 (424)	63.0 (28.6)	1,130
	MAC-G210A4	360 (41)	9,860	21.3×10^{-3} (24.1×10^{-4})	16.7 (424)	63.0 (28.6)	1,130
	MAC-G280A2	360 (41)	9,062	30.9×10^{-3} (34.9×10^{-4})	19.4 (492)	78.0 (35.4)	1,130
	MAC-G280A4	360 (41)	9,062	30.9×10^{-3} (34.9×10^{-4})	19.4 (492)	78.0 (35.4)	1,130
	MAC-G360A2	360 (41)	9,652	37.3×10^{-3} (42.1×10^{-4})	22.1 (561)	93.0 (42.2)	1,130
	MAC-G360A4	360 (41)	9,652	37.3×10^{-3} (42.1×10^{-4})	22.1 (561)	93.0 (42.2)	1,130
F	MAC-G640A2	1,080 (122)	8,027	79.7×10^{-3} (90.1×10^{-4})	18.7 (494)	122 (55.3)	1,400

[1] Frame Option Availability Chart

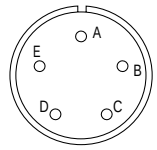
Ref	Frame	Metric (/M)		NEMA (/E)
A	2 inch	66 mm	or	Size 23
B	2.75 inch	72 mm		--
C	3 inch	89 mm	or	Size 34
D	4 inch	114 mm	or	Size 56
E	6 inch	142 mm		--
F	8 inch	190 mm		--

[2] Caution: The built-in fail-safe brake is designed for holding and not for decelerating the motor. In normal operation, the brake should be applied only after the motor is stopped. Fail-safe brakes are useful in applications when a servomotor is used to control a vertical axis. A servomotor with a fail-safe brake prevents the movable part from dropping due to gravity when the system power is turned off.

Servomotor Connectors

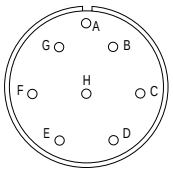
MOTOR CONNECTORS

A	Phase V
B	Phase U
C	Phase W
D	Case Gnd
E	N.C.



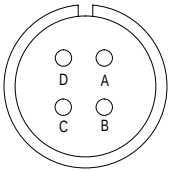
PT02E-14-5P

A	Phase V
B	Phase U
C	Phase W
D	Case Gnd
E	Brake Shield
F	+ Brake
G	- Brake
H	N.C.



PT02E-16-8P

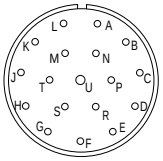
A	Phase V
B	Phase U
C	Phase W
D	Case Gnd



MS-3102A-22-22P,
MS-3102A-32-17P

FEEDBACK CONNECTOR

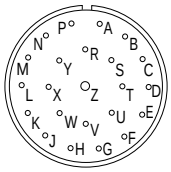
A	Thermal Sensor
B	Channel B
C	Channel /B
D	UVW Shield
E	Channel W
F	Channel V
G	Channel U
H	N.C.
J	N.C.
K	+5vDC Input
L	Thermal Sensor
M	Channel Z
N	Channel A
P	Channel A/
R	Channel W/
S	Channel V/
T	Encoder Gnd
U	Channel Z/



PT02E-14-18P

MOTOR / FEEDBACK CONNECTOR

A	Phase V
B	Phase U
C	Phase W
D	Case Gnd
E	+5vDC Input
F	Channel B
G	Channel A
H	Channel Z
J	Channel W
K	Channel W/
L	Channel V/
M	Channel U/
N	UVW Shield
P	+ Brake or N.C.
R	Thermal Switch
S	Thermal Switch
T	Encoder Gnd
U	Channel B/
V	Channel A/
W	Channel Z/
X	Channel V
Y	Channel U
Z	- Brake or N.C.



PT02E-16-23P

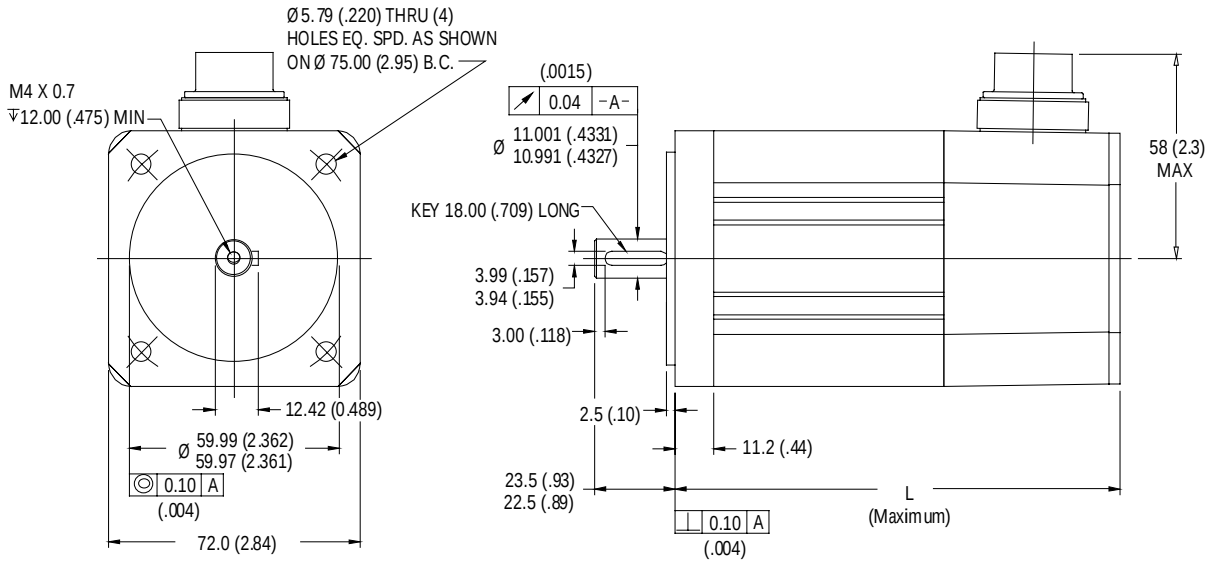
MATING CONNECTOR SELECTION CHART

Motor Type	Motor Connector	Mating	Feedback Connector	Mating
Motors (no brake)				
MAC-G005, 006, 010, 011, 015, 019	PT02E-16-23P	PT06E-16-23S(SR)	----	----
MAC-G016, 030, 040, 055, 080, 115	PT02E-14-5P	PT06E-14-5S(SR)	PT02E-14-18P	PT06E-14-18S(SR)
MAC-G130, 210, 280, 360	MS-3102A-22-22P	MS-3106F-22-22S	PT02E-14-18P	PT06E-14-18S(SR)
MAC-G640	MS-3102A-32-17P	MS-3106F-32-17S	PT02E-14-18P	PT06E-14-18S(SR)
Motors (with fail-safe brake)				
MAC-G005, 006, 010, 011, 015, 019	PT02E-16-23P	PT06E-16-23S(SR)	----	----
MAC-G016, 030, 040, 055, 080, 115	PT02E-16-8P	PT06E-16-8S(SR)	PT02E-14-18P	PT06E-14-18S(SR)
MAC-G130, 210, 280, 360	MS-3102A-22-22P	MS-3106F-22-22S	PT02E-16-23P	PT06E-16-23S(SR)
MAC-G640	MS-3102A-32-17P	MS-3106F-32-17S	PT02E-16-23P	PT06E-16-23S(SR)

Outline Drawings:

METRIC FRAME All dimensions in millimeters (inches)

G006A1/M, G006A2/M, G011A1/M, G011A2/M, G011B2/M, G015A1/M, G015A2/M, G015B2/M, G019A1/M, G019A2/M & G019B2/M



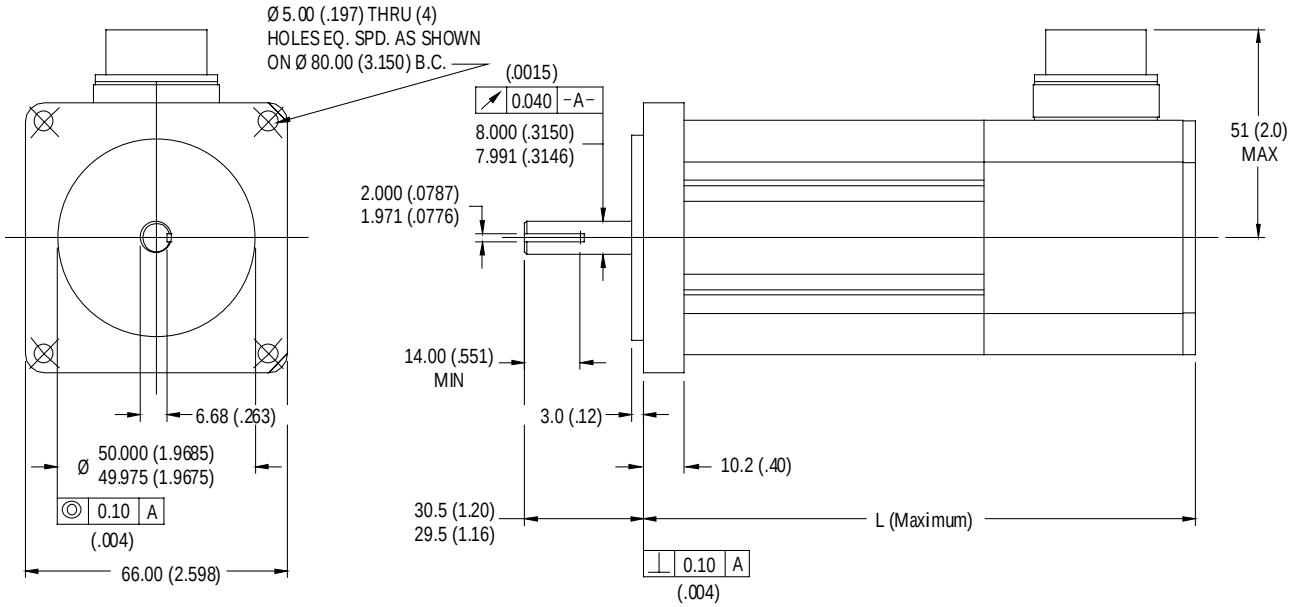
Dimensions	L
MAC-G006A1 & A2	128.1 (5.05)
MAC-G011A1, A2 & B2	147.3 (5.80)
MAC-G015A1, A2 & B2	166.4 (6.55)
MAC-G019A1, A2 & B2	185.4 [7.30]

Notes:
Brake option adds 38.1 mm (1.5 inches) to L.
Minimum cable clearance from motor centerline for the motor cable is 191 mm (7.5 inches)

Outline Drawings:

METRIC FRAME All dimensions in millimeters (inches)

G005A1/M, G010A1/M & G010B1/M



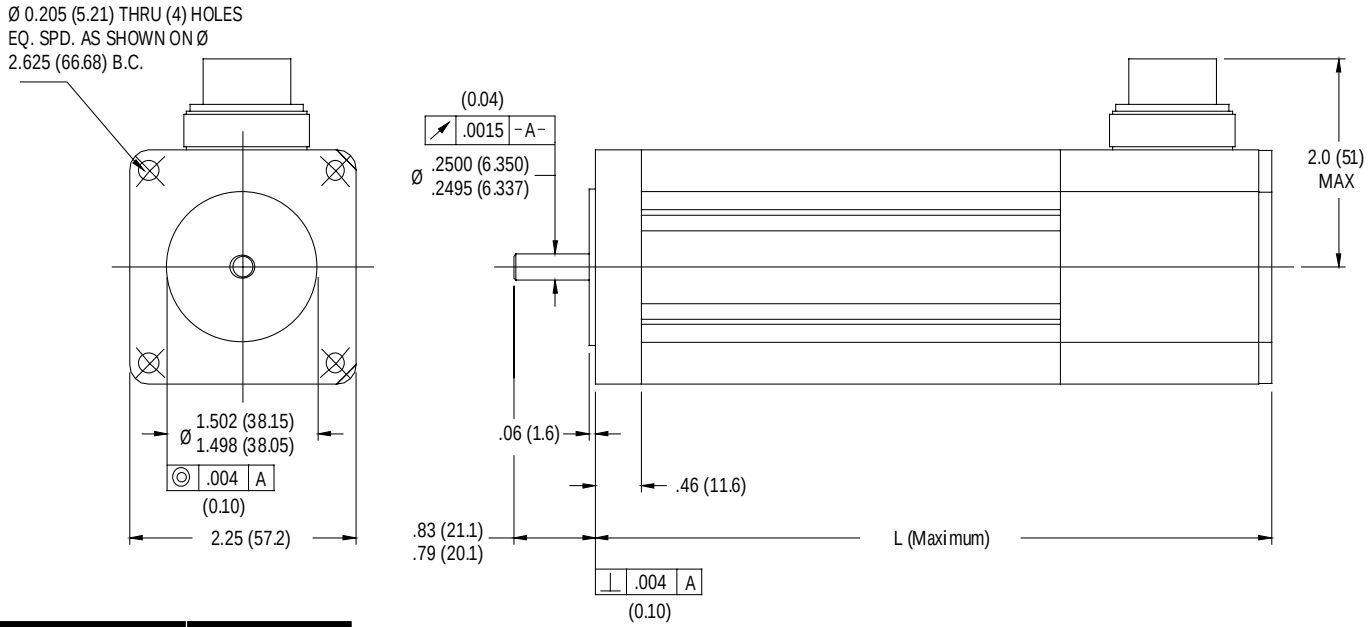
Dimensions (/M)	L
MAC-G005A1	140.0 (5.5)
MAC-G010A1 & B1	170.0 (6.7)

Notes:
Brake option adds 30.5 mm (1.2 inches) to L.
Minimum cable clearance from motor centerline for the motor cable is 178 mm (7.0 inches).

Outline Drawings:

NEMA FRAME SIZE: 23 All dimensions in inches (millimeters)

G005A1/E, G010A1/E & G010B1/E



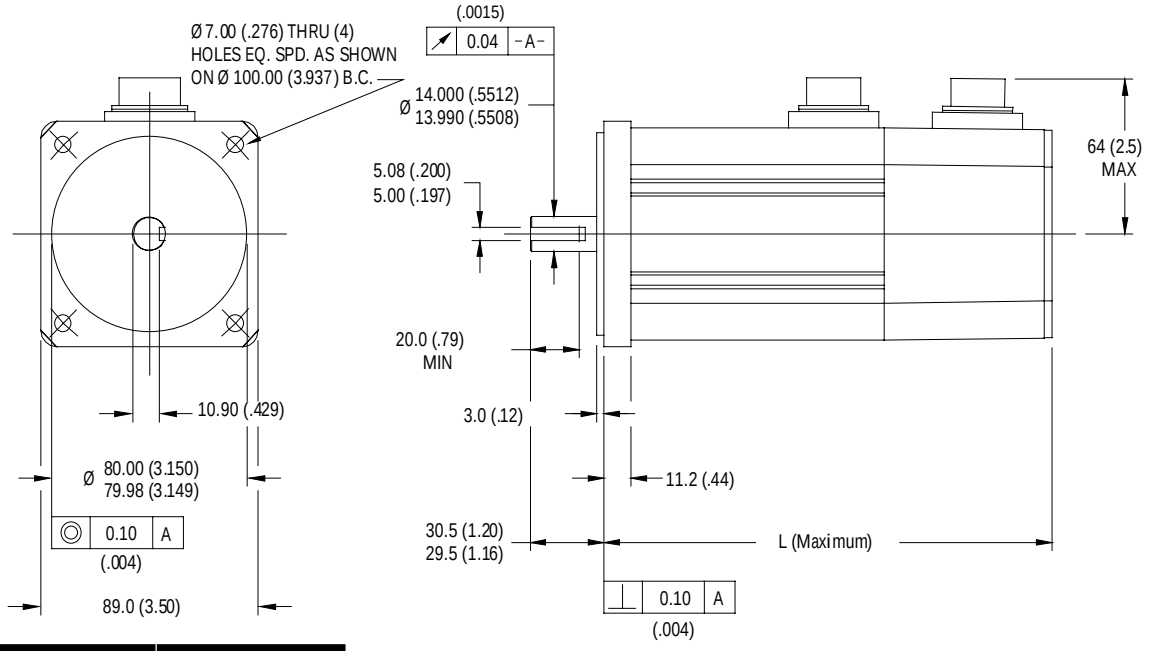
Dimensions (/E)	L
MAC-G005A1 & B1	5.6 (141)
MAC-G010A1 & B1	6.8 (172)

Notes:
Brake option adds 1.2 inches (30.5 mm) to L.
Minimum cable clearance from motor centerline for the motor cable is 7.0 inches (178 mm).

Outline Drawings:

METRIC FRAME All dimensions in millimeters (inches)

G016A2/M, G016B2/M, G030A2/M, G030B2/M, G040A2/M & G040B2/M



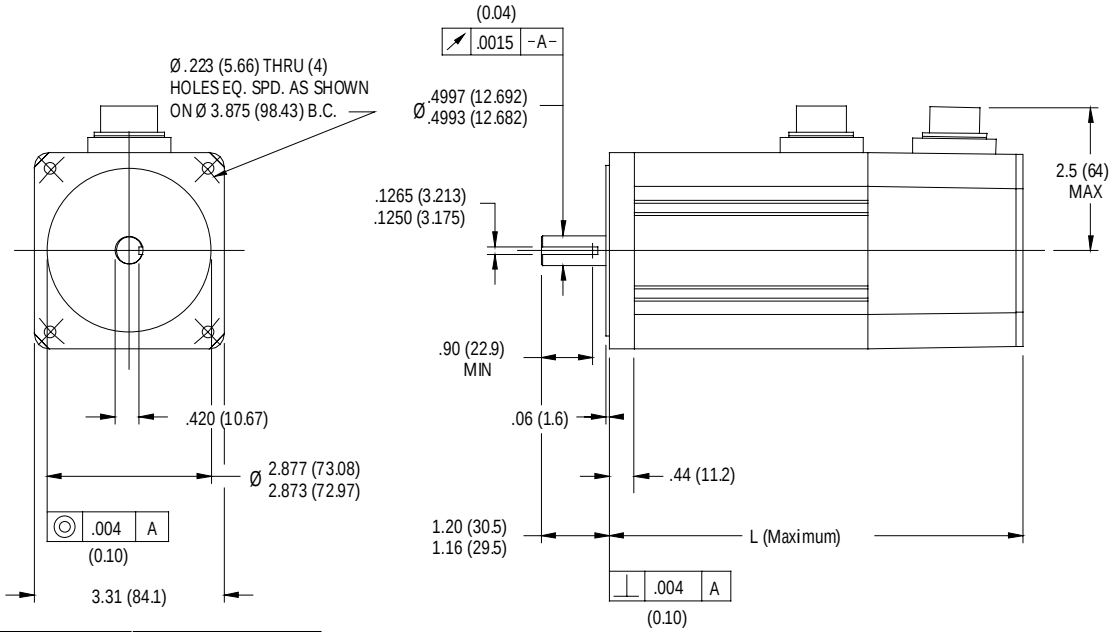
Dimensions (/M)	L
MAC-G016A2 & B2	183.9 (7.24)
MAC-G030A2 & B2	222.0 (8.74)
MAC-G040A2 & B2	260.1 (10.24)

Notes:
Brake option adds 38.1 mm (1.5") to L.
Minimum cable clearance from motor centerline for the encoder cable is 178 mm (7.0 inches); for the motor cable it is 178 mm (7.0 inches).

Outline Drawings:

NEMA FRAME SIZE: 34 All dimensions in inches (millimeters)

G016A2/E, G016B2/E, G030A2/E, G030B2/E, G040A2/E & G040B2/E

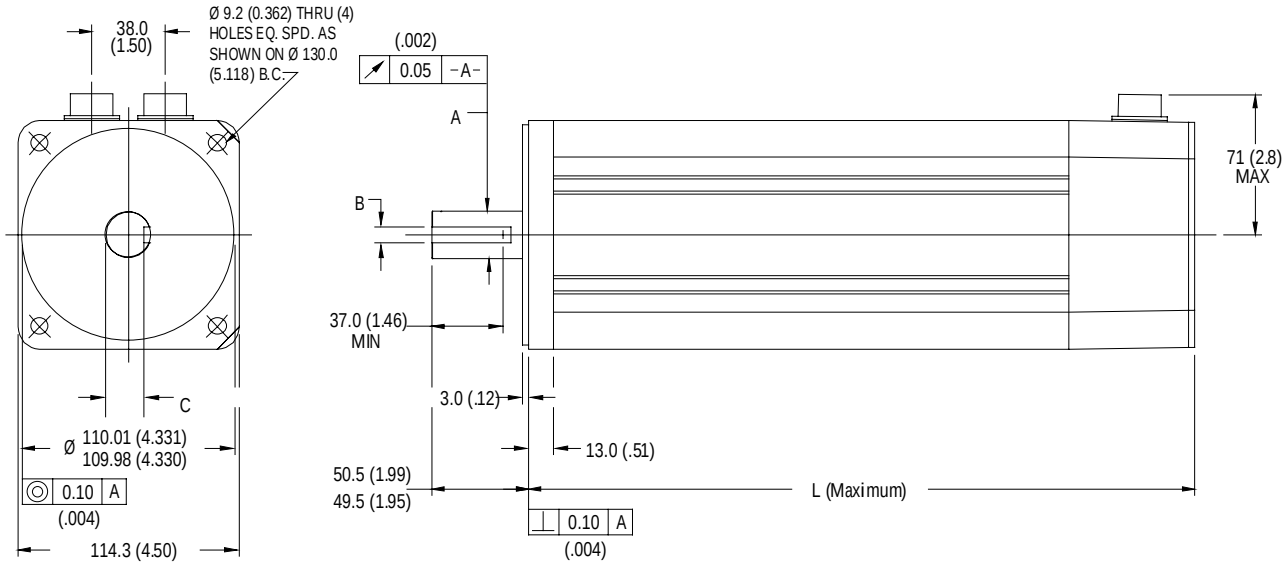


Dimensions (/E)	L
MAC-G016A2 & B2	7.24 (183.9)
MAC-G030A2 & B2	8.74 (222.0)
MAC-G040A2 & B2	10.24 (260.1)

Notes:
Brake option adds 1.5 inches (38.1 mm) to L.
Minimum cable clearance from motor centerline for the encoder cable is 7.0 inches (178 mm); for the motor cable it is 7.0 inches (178 mm)

Outline Drawings: METRIC FRAME All dimensions in millimeters [inches]

G055A2/M, G055A4/M, G080A2/M, G080A4/M, G115A2/M & G115A4/M

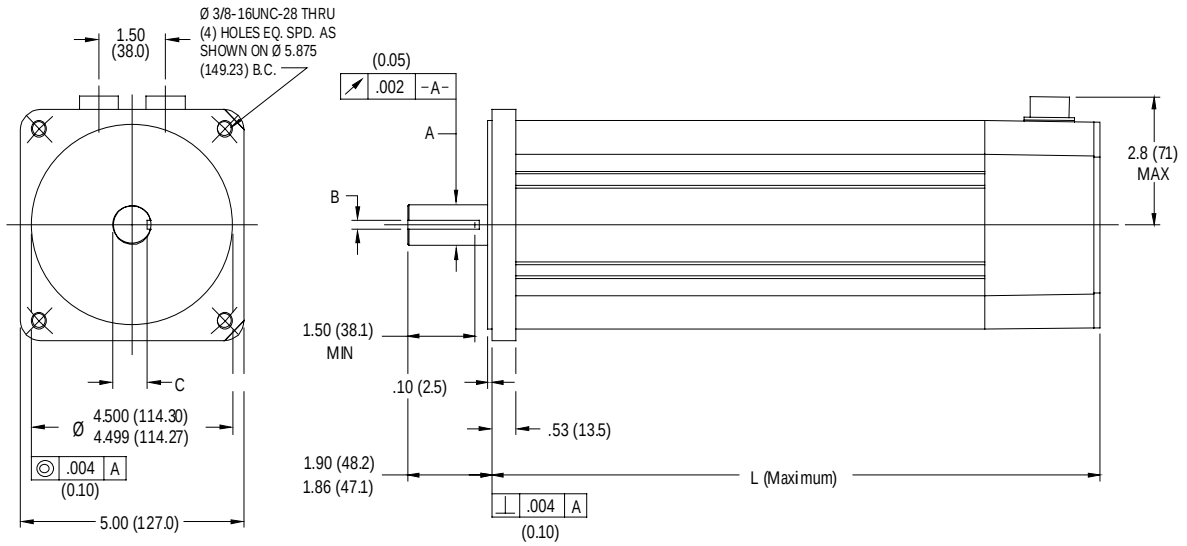


Dimensions (/M)	A	B	C	L
MAC-G055A2 & A4	Ø 19.000 (.7480) 18.987 (.7475)	6.00 (.240)	15.5 (.61)	218.2 (8.59)
MAC-G080A2 & A4	Ø 24.000 (.9449) 23.987 (.9444)	8.00 (.315) 7.96 (.313)	20.0 (.79)	281.7 (11.09)
MAC-G115A2 & A4			20.0 (.79)	345.2 (13.59)

Notes:
Brake option adds 50.8 mm (2.0 inches) to L.
Minimum cable clearance from motor centerline for the encoder cable is 191mm (7.5 inches); for the motor cable it is 191 mm (7.5 inches).

Outline Drawings: NEMA FRAME SIZE: 56 All dimensions in inches [millimeters]

G055A2/E, G055A4/E, G080A2/E, G080A4/E, G115A2/E & G115A4/E



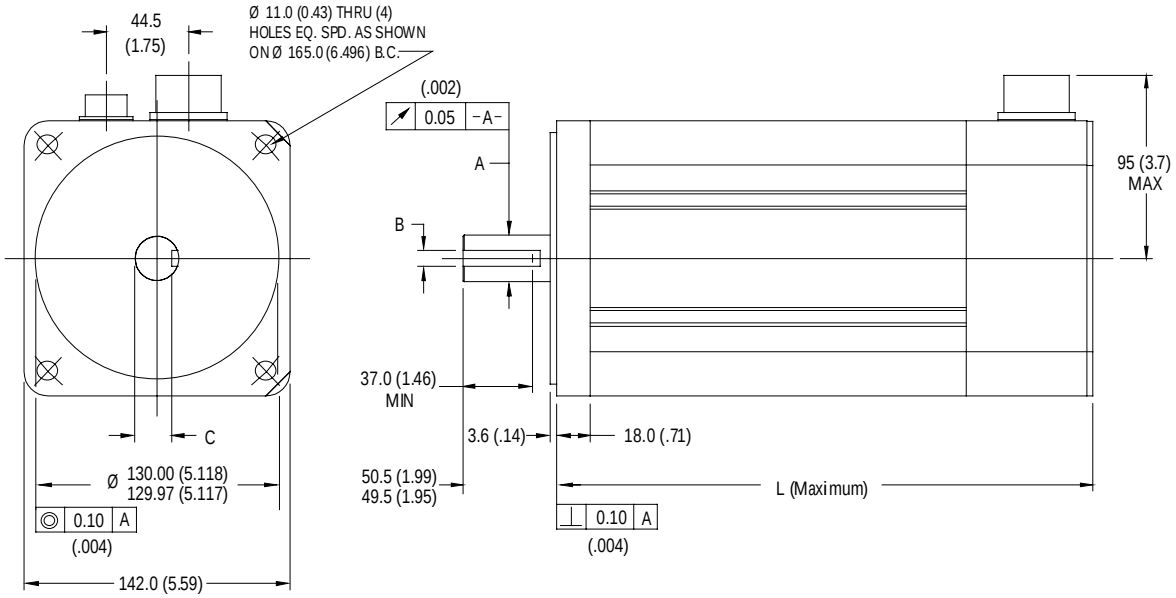
Dimensions (/E)	A	B	C	L
MAC-G055A2 & A4	Ø .6245 (15.862) .6241 (15.852)	.1890 (4.801) .1875 (4.763)	.51 (13.0)	8.61 (218.7)
MAC-G080A2 & A4	Ø .8750 (22.225) .8745 (22.212)		.77 (19.6)	11.11 (282.2)
MAC-G115A2 & A4			.77 (19.6)	13.61 (345.7)

Notes:
Brake option adds 2.0 inches (50.8 mm) to L.
Minimum cable clearance from motor centerline for the encoder cable is 7.5 inches (191 mm); for the motor cable it is 7.5 inches (191 mm).

Outline Drawings:

METRIC FRAME All dimensions in millimeters (inches)

G130A2/M, G130A4/M, G210A2/M, G210A4/M, G280A2/M, G280A4/M, G360A2/M & G360A4/M



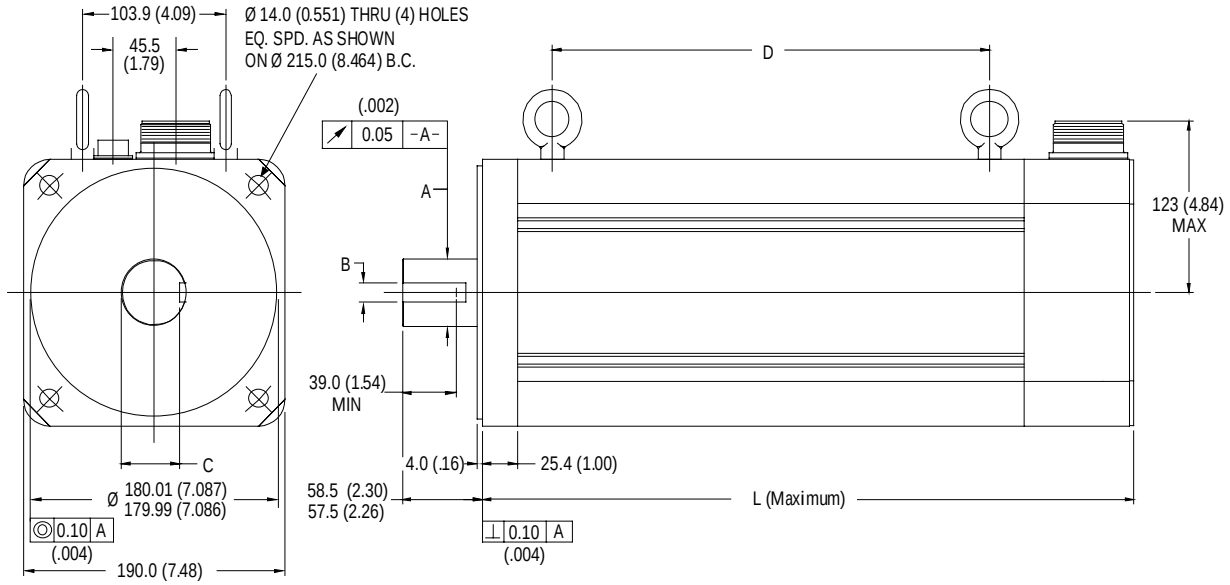
Dimensions (/M)	A	B	C	L
MAC-G130A2 & A4	Ø 24.000 (.9449) 23.987 (.9444)	Ø 8.00 (.315) 7.96 (.313)	20.0 (.79)	287.0 (11.29)
MAC-G210A2 & A4			20.0 (.79)	355.0 (13.99)
MAC-G280A2 & A4	Ø 32.000 (1.2598) 31.987 (1.2593)	Ø 10.00 (.394) 9.96 (.392)	27.0 (1.06)	423.0 (16.69)
MAC-G360A2 & A4			27.0 (1.06)	492.5 (19.39)

Notes:
Brake option adds 68.6 mm (2.7 inches) to L.
Minimum cable clearance from motor centerline for the encoder cable is 178 mm (7.0 inches); for the motor cable it is 204 mm (8.0 inches).

Outline Drawing:

METRIC FRAME All dimensions in millimeters [inches]

G640A2/M



Dimensions (/M)	A	B	C	D	L
MAC-G640A2	Ø 32.018 (1.2605) 31.998 (1.2598)	Ø 10.000 (.3937) 9.964 (.3923)	27.00 (1.063) 26.80 (1.055)	241.3 (9.50)	397.5 (15.65)

Notes:
Brake option adds 76.2 mm (3.0 inches) to L and D.
Minimum cable clearance from motor centerline for the encoder cable is 191 mm (7.5 inches); for the motor cable it is 204 mm (8.0 inches).

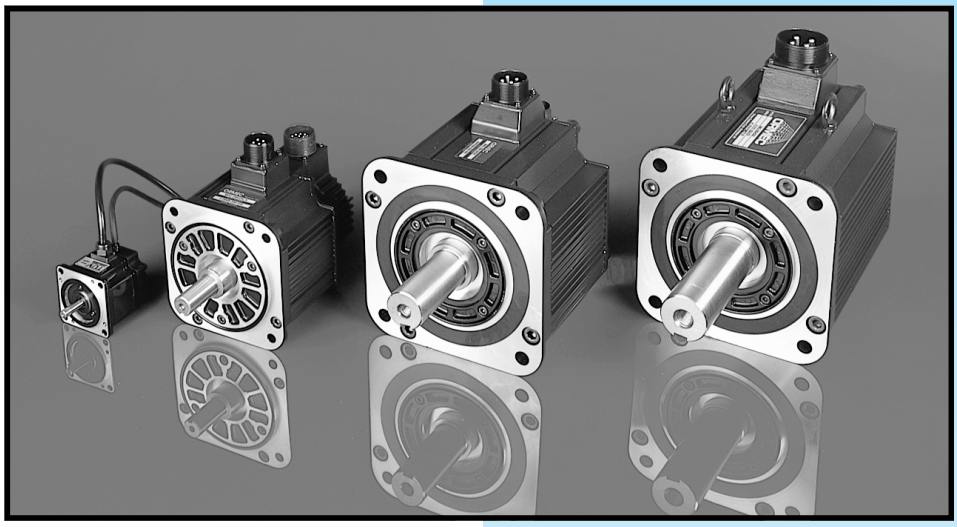
ORMEC

D-Series Servomotors

ORMEC's D-series AC brushless servomotors provide high torque-to-inertia ratios and excellent continuous torque and peak torque performance in a compact design. These industrial-quality servomotors incorporate high-energy, rare earth, neodymium-iron-boron magnets and a highly efficient stator winding design which results in excellent power density.

The D-series servomotors also completely eliminate brush wear maintenance problems, and feature extremely durable construction which includes heavy duty bearings.

Rugged MS connectors provide reliable interconnections to both motor and optical encoder (except for D-Series with IP-67 option selected).



ORMEC's D-series servomotors offer continuous stall torques from 3 to 665 lb-in (0.32 to 75 N-m).

Features

- ❒ Continuous stall torques from 3 to 665 in-lb (0.32 to 75 N-m)
- ❒ High peak torques from 8 to 1,000 in-lb (0.96 to 113 N-m)
- ❒ Output power from 100 to 11,000 watts (0.13 to 15 HP)
- ❒ Compact design with 40% less volume than previous design
- ❒ High maximum speeds from 3,000 to 4,500 RPM
- ❒ Encoder resolutions up to 32,768 counts per revolution
- ❒ Optional absolute encoders feature multi-rev operation
- ❒ Class B or F insulation providing long winding life under rated operating conditions
- ❒ Minimum torque ripple & cogging for smooth low-speed performance
- ❒ Totally Enclosed Non-Ventilated (TENV) standard IP-67 except shaft opening, optional shaft oil seal is available.
- ❒ Fail-safe holding brakes as option

Motor/Drive Combinations

The performance of these servomotors is a direct function of the factory-matched servomotor/drive combination.

ORMEC's ServoWire® drives provide software controlled all-digital performance for consistent operation that totally eliminates analog potentiometer adjustments. High bandwidth current mode operation and a quality high resolution encoder provide the response & accuracy for demanding applications. Peak torques up to three times the rated torque are available for a few seconds, allowing the motor/drive to handle high inertial loads & heavy duty cycle requirements.

Each drive's motor parameters are configured in software for high performance and RMS current limiting.

Absolute Encoder Option

Cost-effective absolute encoder support provides axis position over a range of 100,000 revolutions. In continuous uni-directional operation, the position count continually "wraps" through the full range while maintaining absolute position within the cycle. Position is maintained through power cycles by a lithium battery (optional) on the ServoWire® digital drive and a supercapacitor in the servomotor.

Understanding the D-Series Servomotor Model Numbers

MAC - DE 021 E 2 / A V B

- *Subgroup Types (DE, DA or DB-Series)*
- *Continuous stall torque (lb-in)*
- *Drive matching reference (A to U)*
- *1 = 110 VAC [1] 2 = 230 VAC None = 230 VAC (DA & DB-Series only)*
- *A = Absolute Encoder [2] I = Incremental Encoder*
- *V = Shaft Oil Seal [3] (DA & DB only)*
- *B = 24 VDC Fail-Safe Brake [4]*

[1] *110 VAC operation is only available on a select number of the DE servomotor subgroup.*
[2] *Specify ServoWire drive with absolute encoder support when ordering this motor.*
[3] *Cables are available with an IP-67 rating for all motors in the DA and DB series.*
[4] *Specify cables with the brake option when selecting a motor with a Fail-Safe brake.*

D-Series Servomotors & Matching Servodrives

Servomotor Model Number	Max. Speed (RPM)	Peak / Stall Torque lb-in (N-m)	Motor Inertia lb-in-sec^2 (kg-m^2)	Motor Length in (mm)	Motor Flange in (mm)	Input Power[1] [2] watts/amps
MAC-DE003A1	4,500	5.1/2.8 (0.58/0.32)	0.057 x 10^{-3} (0.065 x 10^{-4})	2.24 (57)	2.36 (60)	110 / 1.0
MAC-DE003A2	4,500	8.2/2.8 (0.93/0.32	0.057 x 10^{-3} (0.065 x 10^{-4})	2.24 (57)	2.36 (60)	110 / 0.5
MAC-DE006B1	4,500	14/5.6 (1.5/0.64)	0.185 x 10^{-3} (0.209 x 10^{-4})	2.44 (62)	3.15 (80)	210 / 1.9
MAC-DE006B2	4,500	11/5.6 (1.3/0.64)	0.185 x 10^{-3} (0.209 x 10^{-4})	2.44 (62)	3.15 (80)	210 / 0.9
MAC-DE008C1	4,500	25/8.4 (2.8/0.95)	0.308 x 10^{-3} (0.347 x 10^{-4})	3.23 (82)	3.15 (80)	320 / 2.4
MAC-DE011C2	4,500	28/11 (3.2/1.3)	0.308 x 10^{-3} (0.347 x 10^{-4})	3.23 (82)	3.15 (80)	440 / 1.9
MAC-DE021D2	4,500	34/21 (3.9/2.4)	1.87 x 10^{-3} (2.11 x 10^{-4})	3.21 (82)	4.72 (120)	825 / 3.6
MAC-DE042E2	4,300	73/42 (8.3/4.8)	3.57 x 10^{-3} (4.03 x 10^{-4})	4.31 (110)	4.72 (120)	1,650 / 7.2
MAC-DA030F	4,500	68/28 (7.7/3.2)	1.54 x 10^{-3} (1.74 x 10^{-4})	5.87 (149)	3.15 (80)	1,100 / 4.8
MAC-DA055G	4,500	101/56 (11/6.3)	2.82 x 10^{-3} (3.19 x 10^{-4})	7.80 (198)	3.15 (80)	2,100 / 9.1
MAC-DA090H	4,500	217/87 (24/9.8)	6.20 x 10^{-3} (7.01 x 10^{-4})	7.83 (199)	5.12 (130)	3,300 / 14
MAC-DA110J	4,500	207/112 (23/13)	8.50 x 10^{-3} (9.60 x 10^{-4})	9.29 (236)	5.12 (130)	4,290 / 19
MAC-DA140K	4,500	321/140 (36/16)	10.9 x 10^{-3} (12.3 x 10^{-4})	10.87 (176)	5.12 (130)	5,390 / 23
MAC-DB025L	3,000	44/25 (4.9/2.8)	6.41 x 10^{-3} (7.24 x 10^{-4})	5.39 (137)	5.12 (130)	485 / 2.1
MAC-DB055M	3,000	88/53 (10/6.0)	12.3 x 10^{-3} (13.9 x 10^{-4})	6.30 (160)	5.12 (130)	940 / 4.1
MAC-DB080N	3,000	152/74 (17/8.4)	18.2 x 10^{-3} (20.6 x 10^{-4})	7.24 (184)	5.12 (130)	1,430 / 6.2
MAC-DB100P	3,000	155/102 (18/12)	28.1 x 10^{-3} (31.8 x 10^{-4})	6.50 (165)	7.09 (180)	1,980 / 8.6
MAC-DB200Q	3,000	312/196 (35/22)	40.7 x 10^{-3} (46.0 x 10^{-4})	7.83 (199)	5.12 (130)	3,190 / 14
MAC-DB300R	3,000	479/300 (54/34)	59.8 x 10^{-3} (67.6 x 10^{-4})	8.86 (225)	7.09 (180)	4,840 / 21
MAC-DB330S	3,000	728/345 (82/39)	78.8 x 10^{-3} (89.0 x 10^{-4})	10.20 (259)	7.09 (180)	6,050 / 26
MAC-DB465T	3,000	839/450 (95/51)	111.0 x 10^{-3} (125.4 x 10^{-4})	13.11 (333)	7.09 (180)	8,250 / 36
MAC-DB700U	2,000	1,128/665 (127/75)	249.0 x 10^{-3} (281.4 x 10^{-4})	13.27 (337)	8.66 (220)	12,100 / 53

[1] Power listed is the required incoming line power in watts when the motor is operating at rated output. To determine total incoming power requirements, add up the listed values for each servomotor/drive combination in the system.

[2] Current listed in amps is the recommended slow-blow fuse capacity for each leg of the three phase power. To select fuses for the system, add the recommended fuse capacities for each servomotor/drive combination in the system.

D-Series Compatibility Chart

Servomotor Model Number	Single Phase Drives (No Regen)			Three Phase Drives (External Regen)					
	SAC-SW203 SMS-203 G03	SAC-SW205 SMS-205 G05	SAC-SW210 SMS-210 G10	SAC-SW217 SMS-217 G17	SAC-SW220 SMS-220 G20	SAC-SW225 SMS-225 G25	SAC-SW235 SMS-235 G35	SAC-SW260 SMS-260 G60	
MAC-DE003A1	✪	✔	✔						
MAC-DE003A2	✪	✔	✔						
MAC-DE006B1		✪	✔	✔					
MAC-DE006B2	✪	✔	✔						
MAC-DE008C1			✪	✔					
MAC-DE011C2		✪	✔	✔					
MAC-DE021D2		✪	✔						
MAC-DE042E2			✪	✔	✔				
MAC-DA030F			✪	✔	✔				
MAC-DA055G				✪	✔	✔			
MAC-DA090H						✪	✔		
MAC-DA110J						✪	✔	✔	
MAC-DA140K							✪	✔	
MAC-DB025L		✪	✔						
MAC-DB055M			✪	✔	✔				
MAC-DB080N				✪	✔				
MAC-DB100P					✪	✔			
MAC-DB200Q					✪	✔	✔		
MAC-DB300R							✪	✔	
MAC-DB330S								✪	
MAC-DB465T								✪	
MAC-DB700U								✪	

✪ Recommended drive model ✔ Compatible drive model

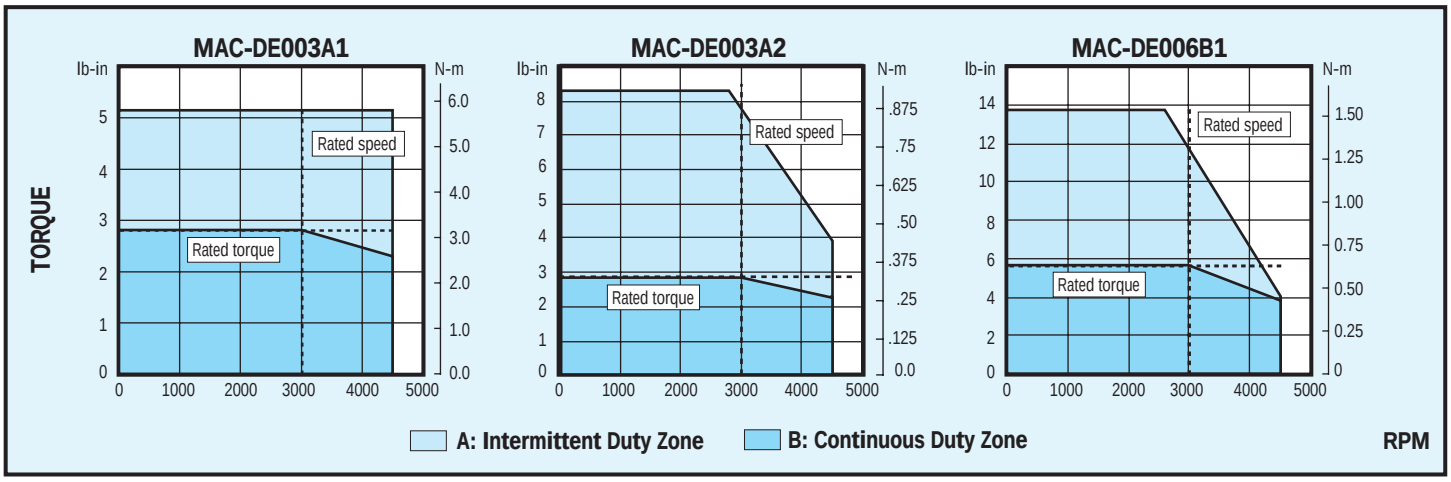
D-Series AC Brushless Servomotors

-- Absolute Encoder Model Specifications
(Inertia specifications for Brake Models on page 11.)

Performance Specifications (1)	Units	DE003A1	ABS	DE003A2	ABS	DE006B1	ABS
Maximum Speed	RPM	4,500		4,500		4,500	
Continuous Stall Torque	lb-in	2.8		2.8		5.6	
	N-m	0.32		0.32		0.64	
Rated Speed	RPM	3,000		3,000		3,000	
Rated Torque	lb-in	2.8		2.8		5.6	
	N-m	0.32		0.32		0.64	
Rated Power	HP	0.13		0.13		0.25	
	watts	100		100		190	
Peak Torque(2)	lb-in	5.1		8.2		14	
	N-m	0.58		0.93		1.5	
Continuous Stall Torque/Inertia	radians/sec^2	49,123	35,443	49,123	35,443	30,270	27,053
Mechanical Specifications							
Moment of Inertia	lb-in-sec^2 x 10^{-3}	0.057	0.079	0.057	0.079	0.185	0.207
	kg-m^2 x 10^{-4}	0.065	0.089	0.065	0.089	0.209	0.234
Friction Torque, Static	lb-in	0.048		0.048		0.11	
	N-m	0.0054		0.0054		0.012	
Servomotor Weight	lbs	1.5	2.0	1.5	2.0	3.1	3.5
	kg	0.7	0.9	0.7	0.9	1.4	1.6
Maximum Radial Shaft Load	lbs	17		17		55	
(centered 0.2" from end of shaft)	N	78		78		245	
Maximum Axial Shaft Load	lbs	11		11		15	
	N	49		49		68	
Electrical Specifications							
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	1.4		3.5		2.3	
	N-m/Amp$_{Rms/Ø}$	0.16		0.39		0.26	
Servodrive Model Number	SAC-	SAC-SW203/E SMS-203/E G03-AY	SAC-SW203/EA SMS-203/EA	SAC-SW203/E SMS-203/E G03-AY	SAC-SW203/EA SMS-203/EA	SAC-SW205/E SMS-205/E G05-AY	SAC-SW205/EA SMS-205/EA
Servodrive Input Power	volts AC	115		230		115	
Continuous Motor Current	Amps$_{Rms/Ø}$	2.2		0.89		2.7	
Peak Motor Current	Amps$_{Rms/Ø}$	7.1		2.8		8.4	
Motor Thermal Specifications							
Ambient Temperature	degrees C	40		40		40	
Insulation Class		B		B		B	
Encoder Specifications							
Encoder Resolution	counts/revolution	8192	4096	8192	4096	8192	4096

(1) Ratings are obtained with servomotor ambient temperature of 40C, and armature winding temperature of 100C. (2) Motor's peak torque is limited by the peak current of the servodrive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details.

Torque vs. Speed Characteristics



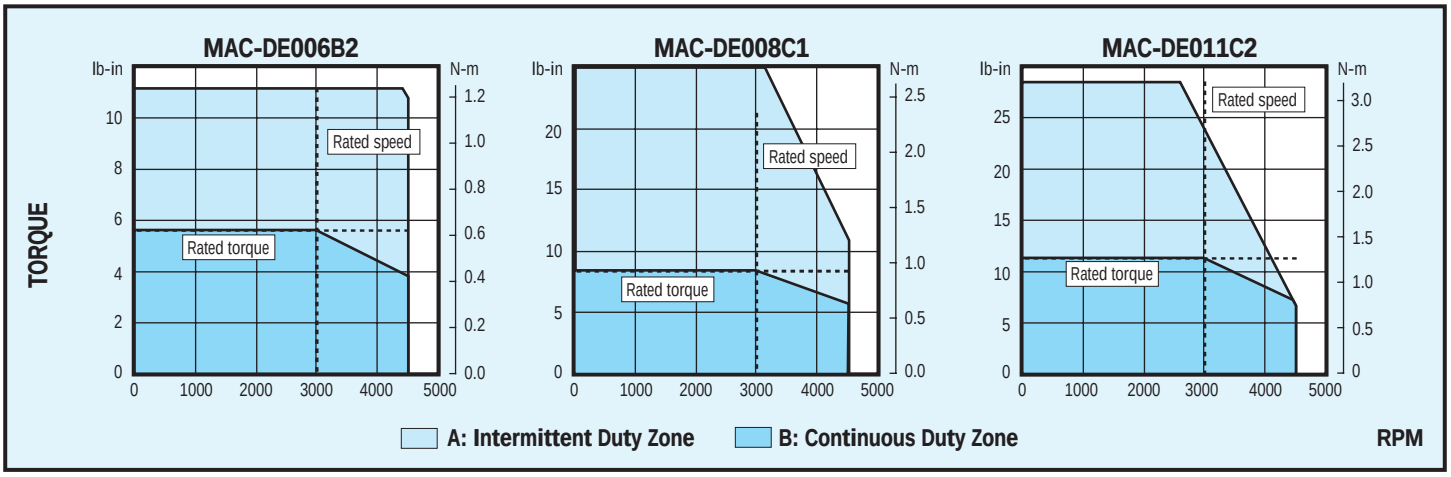
D-Series AC Brushless Servomotors

-- Absolute Encoder Model Specifications
(Inertia specifications for Brake Models on page 11.)

Performance Specifications (1)	Units	DE006B2	ABS	DE008C1	ABS	DE011C2	ABS
Maximum Speed	RPM	4,500		4,500		4,500	
Continuous Stall Torque	lb-in	5.6		8.4		11	
	N-m	0.64		0.95		1.3	
Rated Speed	RPM	3,000		3,000		3,000	
Rated Torque	lb-in	5.6		8.4		11	
	N-m	0.64		0.95		1.3	
Rated Power	HP	0.25		0.39		0.54	
	watts	190		290		400	
Peak Torque(2)	lb-in	11		25		28	
	N-m	1.3		2.8		3.2	
Continuous Stall Torque/Inertia	radians/sec^2	30,270	27,053	27,273	25,532	35,714	33,435
Mechanical Specifications							
Moment of Inertia	lb-in-sec^2 x 10^{-3}	0.185	0.207	0.308	0.329	0.308	0.329
	kg-m^2 x 10^{-4}	0.209	0.234	0.347	0.372	0.347	0.372
Friction Torque, Static	lb-in	0.11		0.20		0.20	
	N-m	0.012		0.022		0.022	
Servomotor Weight	lbs	3.1	3.5	4.6	5.1	4.6	5.1
	kg	1.4	1.6	2.1	2.3	2.1	2.3
Maximum Radial Shaft Load	lbs	55		55		55	
(centered 0.2" from end of shaft)	N	245		245		245	
Maximum Axial Shaft Load	lbs	15		15		15	
	N	68		68		68	
Electrical Specifications							
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	3.1		2.2		4.7	
	N-m/Amp$_{Rms/Ø}$	0.35		0.25		0.54	
Servodrive Model Number		SAC-SW203/E SMS-203/E G03-AY	SAC-SW203/EA SMS-203/EA	SAC-SW210/E SMS-210/E G10-AY	SAC-SW210/EA SMS-210/EA	SAC-SW205E SMS-205/E G05-AY	SAC-SW205/EA SMS-205/EA
Servodrive Input Power	volts AC	230		115		230	
Continuous Motor Current	Amps$_{Rms/Ø}$	2.0		4.3		2.6	
Peak Motor Current	Amps$_{Rms/Ø}$	6.0		14		8.0	
Motor Thermal Specifications							
Ambient Temperature	degrees C	40		40		40	
Insulation Class		B		B		B	
Encoder Specifications							
Encoder Resolution	counts/revolution	8192	4096	8192	4096	8192	4096

(1) Ratings are obtained with servomotor ambient temperature of 40C, and armature winding temperature of 100C. (2) Motor's peak torque is limited by the peak current of the ServoWire™ drive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details.

Torque vs. Speed Characteristics



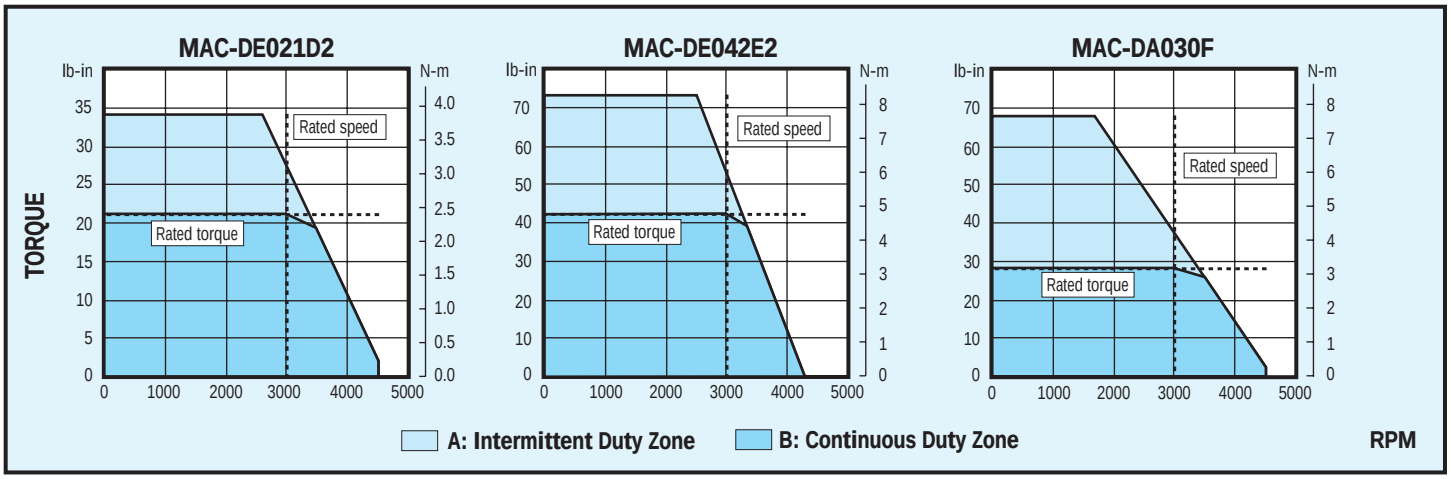
D-Series AC Brushless Servomotors

-- Absolute Encoder Model Specifications
(Inertia specifications for Brake Models on page 11.)

Performance Specifications (1)	Units	DE021D2	ABS	DE042E2	ABS	DA030F	ABS
Maximum Speed	RPM	4,500		4,300		4,500	
Continuous Stall Torque	lb-in	21		42		28	
	N-m	2.4		4.8		3.2	
Rated Speed	RPM	3,000		3,000		3,000	
Rated Torque	lb-in	21		42		28	
	N-m	2.4		4.8		3.2	
Rated Power	HP	1.0		2.0		1.3	
	watts	750		1500		1000	
Peak Torque(2)	lb-in	34		73		68	
	N-m	3.9		8.3		7.7	
Continuous Stall Torque/Inertia	radians/sec^2	11,230	11,111	11,765	11,699	18,182	16,970
Mechanical Specifications							
Moment of Inertia	lb-in-sec^2 x 10^{-3}	1.87	1.89	3.57	3.59	1.54	1.65
	kg-m^2 x 10^{-4}	2.11	2.14	4.03	4.06	1.74	1.86
Friction Torque, Static	lb-in	0.32		0.53		0.43	
	N-m	0.036		0.060		0.049	
Servomotor Weight	lbs	10	11	15	16	10	11.0
	kg	4.6	4.8	6.6	7.1	4.6	5.0
Maximum Radial Shaft Load	lbs	88		110		154(3)	
(centered 0.2" from end of shaft)	N	392		490		686(3)	
Maximum Axial Shaft Load	lbs	33		33		44	
	N	147		147		196	
Electrical Specifications							
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	5.7		6.1		5.7	
	N-m/Amp$_{Rms/Ø}$	0.64		0.69		0.64	
Servodrive Model Number		SAC-SW205/E SMS-205/E G05-AY	SAC-SW205/EA SMS-205/EA	SAC-SW210/E SMS-210/E G10-AY	SAC-SW210/EA SMS-210/EA	SAC-SW210/E SMS-210/E G10-AY	SAC-SW210/EA SMS-210/EA
Servodrive Input Power	volts AC	230		230		230	
Continuous Motor Current	Amps$_{Rms/Ø}$	4.1		7.5		6.0	
Peak Motor Current	Amps$_{Rms/Ø}$	13		28		17	
Motor Thermal Specifications							
Ambient Temperature	degrees C	40		40		40	
Insulation Class		B		B		F	
Encoder Specifications							
Encoder Resolution	counts/revolution	8192	4096	8192	4096	16384	32768

(1) Ratings are obtained with servomotor ambient temperature of 40C, and armature winding temperature of 100C. (2) Motor's peak torque is limited by the peak current of the ServoWire™ drive. The next larger drive may be used to increase the amount of peak torque available. Consult an Ormec Applications Engineer for details. (3) Load centered at end of shaft.

Torque vs. Speed Characteristics



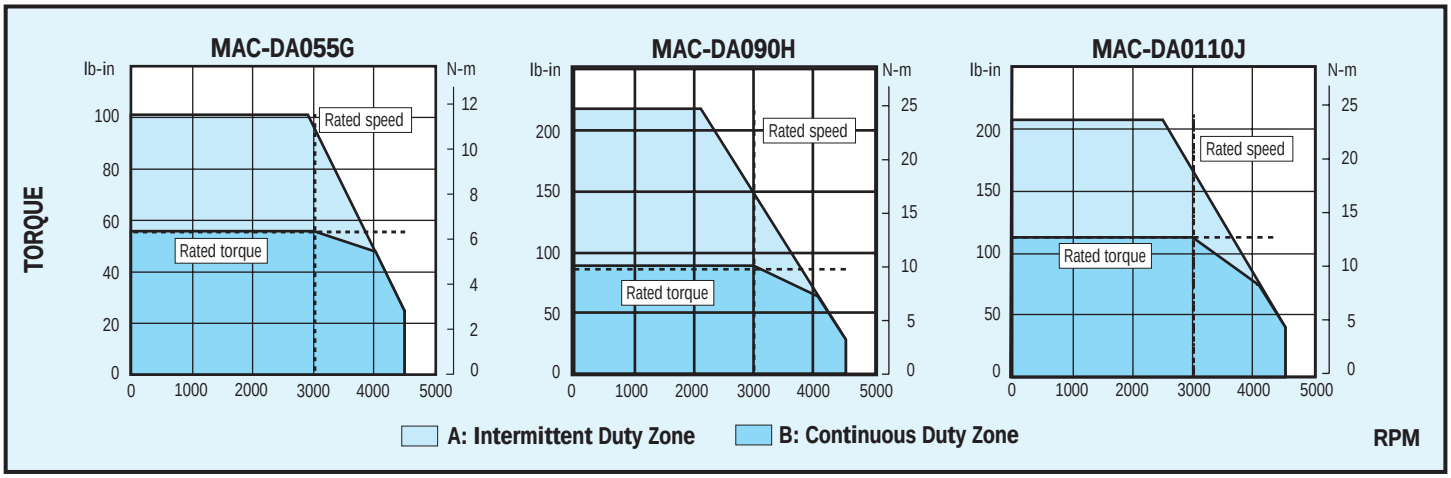
D-Series AC Brushless Servomotors

-- Absolute Encoder Model Specifications
(Inertia specifications for Brake Models on page 11.)

Performance Specifications (1)	Units	DA055G	ABS	DA090H	ABS	DA110J	ABS
Maximum Speed	RPM	4,500		4,500		4,500	
Continuous Stall Torque	lb-in	56		87		112	
	N-m	6.3		9.8		13	
Rated Speed	RPM	3,000		3,000		3,000	
Rated Torque	lb-in	56		87		112	
	N-m	6.3		9.8		13	
Rated Power	HP	2.5		4.0		5.2	
	watts	1900		3,000		3,900	
Peak Torque(2)	lb-in	101		217		207	
	N-m	11		24		23	
Continuous Stall Torque/Inertia	radians/sec^2	19,858	19,113	14,032	13,788	13,176	13,008
Mechanical Specifications							
Moment of Inertia	lb-in-sec^2 x 10^{-3}	2.82	2.93	6.20	6.31	8.50	8.61
	kg-m^2 x 10^{-4}	3.19	3.31	7.01	7.13	9.60	9.73
Friction Torque, Static	lb-in	0.62		0.74		0.95	
	N-m	0.070		0.083		0.11	
Servomotor Weight	lbs	15	16	24	25	31	32
	kg	7.0	7.4	11	12	14	15
Maximum Radial Shaft Load	lbs	154		221		265	
(centered at end of shaft)	N	686		980		1,176	
Maximum Axial Shaft Load	lbs	44		88		88	
	N	196		392		392	
Electrical Specifications							
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	5.0		5.1		4.9	
	N-m/Amp$_{Rms/Ø}$	0.56		0.58		0.55	
Servodrive Model Number		SAC-SW217/E SMS-217/E G17-AY	SAC-SW217/EA SMS-217/EA	SAC-SW225/E SMS-225/E G25-AY	SAC-SW225/EA SMS-225/EA	SAC-SW225/E SMS-225/E G25-AY	SAC-SW225/EA SMS-225/EA
Servodrive Input Power	volts AC	230		230		230	
Continuous Motor Current	Amps$_{Rms/Ø}$	12		19		24	
Peak Motor Current	Amps$_{Rms/Ø}$	42		56		77	
Motor Thermal Specifications							
Ambient Temperature	degrees C	40		40		40	
Insulation Class		F		F		F	
Encoder Resolution							
Encoder Resolution	counts/revolution	16384	32768	16384	32768	16384	32768

(1) Ratings are obtained with servomotor ambient temperature of 40C, and armature winding temperature of 100C. (2) Motor's peak torque is limited by the peak current of the ServoWire™ drive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details.

Torque vs. Speed Characteristics



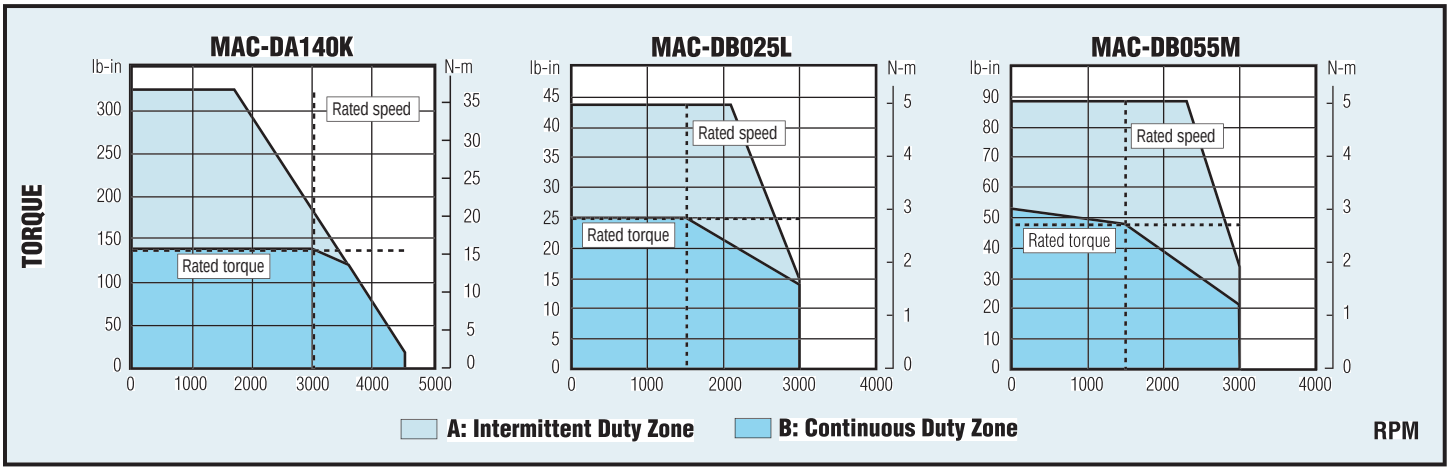
D-Series AC Brushless Servomotors

-- Absolute Encoder Model Specifications
(Inertia specifications for Brake Models on page 11.)

Performance Specifications (1)	Units	DA140K	ABS	DB025L	ABS	DB055M	ABS
Maximum Speed	RPM	4,500		3,000		3,000	
Continuous Stall Torque	lb-in	140		25		53	
	N-m	16		2.8		6.0	
Rated Speed	RPM	3,000		1,500		1,500	
Rated Torque	lb-in	140		25		48	
	N-m	16		2.8		5.4	
Rated Power	HP	6.6		0.59		1.1	
	watts	4,900		440		850	
Peak Torque(2)	lb-in	321		44		88	
	N-m	36		4.9		10	
Continuous Stall Torque/Inertia	radians/sec^2	12,844	12,727	3,900	3,846	4,309	4,274
Mechanical Specifications							
Moment of Inertia	lb-in-sec^2 x 10^{-3}	10.9	11.0	6.41	6.50	12.3	12.4
	kg-m^2 x 10^{-4}	12.3	12.4	7.24	7.34	13.9	14.0
Friction Torque, Static	lb-in	1.1		0.43		0.65	
	N-m	0.13		0.049		0.074	
Servomotor Weight	lbs	37	39	12	13.0	17	18
	kg	17	18	5.5	5.9	7.6	8.0
Maximum Radial Shaft Load	lbs	265		110		110	
(centered at end of shaft)	N	1,176		490		490	
Maximum Axial Shaft Load	lbs	88		22		22	
	N	392		98		98	
Electrical Specifications							
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	5.4		7.3		7.3	
	N-m/Amp$_{Rms/Ø}$	0.61		0.82		0.83	
Servodrive Model Number		SAC-SW235/E SMS-235/E G35-AY	SAC-SW235/EA SMS-235/EA	SAC-SW205/E SMS-205/E G05-AY	SAC-SW205/EA SMS-205/EA	SAC-SW210/E SMS-210/E G10-AY	SAC-SW210/EA SMS-210/EA
Servodrive Input Power	volts AC	230		230		230	
Continuous Motor Current	Amps$_{Rms/Ø}$	28		3.8		7.1	
Peak Motor Current	Amps$_{Rms/Ø}$	84		11		17	
Motor Thermal Specifications							
Ambient Temperature	degrees C	40		40		40	
Insulation Class		F		F		F	
Encoder Specifications							
Encoder Resolution	counts/revolution	16384	32768	32768	32768	32768	32768

(1) Ratings are obtained with servomotor ambient temperature of 40C, and armature winding temperature of 100C. (2) Motor's peak torque is limited by the peak current of the ServoWire™ drive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details.

Torque vs. Speed Characteristics



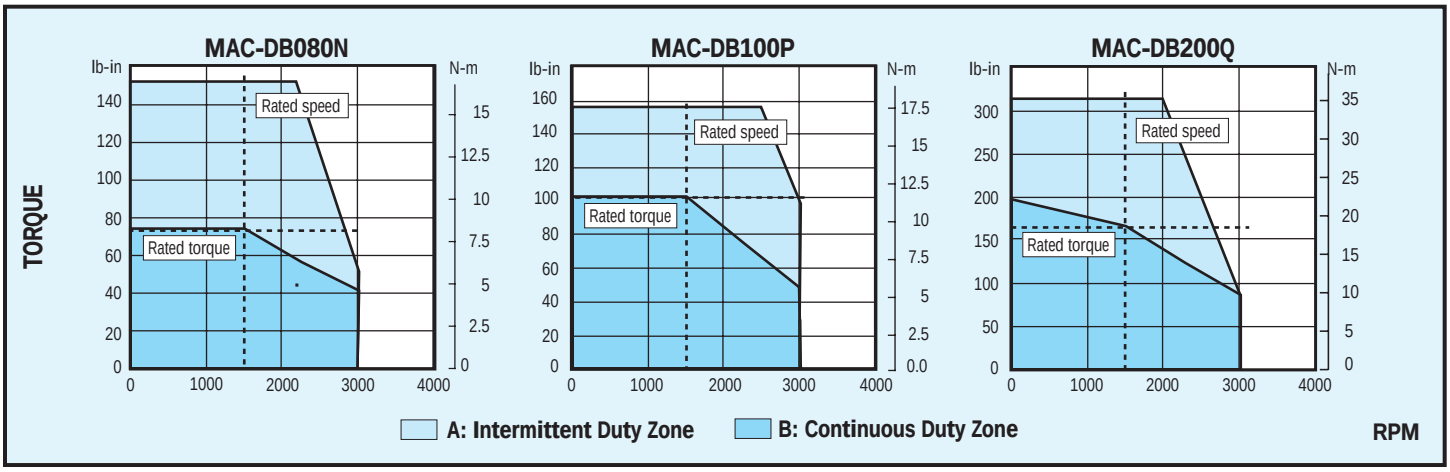
D-Series AC Brushless Servomotors

-- Absolute Encoder Model Specifications
(Inertia specifications for Brake Models on page 11.)

Performance Specifications (1)	Units	DB080N	ABS	DB100P	ABS	DB200Q	ABS
Maximum Speed	RPM	3,000		3,000		3,000	
Continuous Stall Torque	lb-in	74		102		196	
	N-m	8.4		12		22	
Rated Speed	RPM	1,500		1,500		1,500	
Rated Torque	lb-in	74		102		165	
	N-m	8.4		12		19	
Rated Power	HP	1.7		2.4		3.9	
	watts	1,300		1,800		2,900	
Peak Torque(2)	lb-in	152		155		312	
	N-m	17		18		35	
Continuous Stall Torque/Inertia	radians/sec^2	4,066	4,044	3,630	3,617	4,816	4,804
Mechanical Specifications							
Moment of Inertia	lb-in-sec^2 x 10^{-3}	18.2	18.3	28.1	28.2	40.7	40.8
	kg-m^2 x 10^{-4}	20.6	20.7	31.8	31.9	46.0	46.1
Friction Torque, Static	lb-in	0.87		1.0		1.4	
	N-m	0.098		0.12		0.16	
Servomotor Weight	lbs	21	22	31	31	40	41
	kg	9.6		14	14	18	19
Maximum Radial Shaft Load	lbs	154		265		331	
(centered at end of shaft)	N	686		1,176		1,470	
Maximum Axial Shaft Load	lbs	77		110		110	
	N	343		490		490	
Electrical Specifications							
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	7.4		6.5		7.3	
	N-m/Amp$_{Rms/Ø}$	0.84		0.73		0.83	
Servodrive Model Number	SAC-	SW217/E SMS-217/E G17-AY	SW217/EA SMS-217/EA	SW220/E SMS-220/E G20-AY	SW220/EA SMS-220/EA	SW225/E SMS-225/E G25-AY	SW225/EA SMS-225/EA
Servodrive Input Power	volts AC	230		230		230	
Continuous Motor Current	Amps$_{Rms/Ø}$	11		17		24	
Peak Motor Current	Amps$_{Rms/Ø}$	28		42		56	
Motor Thermal Specifications							
Ambient Temperature	degrees C	40		40		40	
Insulation Class		F		F		F	
Encoder Specifications							
Encoder Resolution	counts/revolution	32768	32768	32768	32768	32768	32768

(1) Ratings are obtained with servomotor ambient temperature of 40C, and armature winding temperature of 100C. (2) Motor's peak torque is limited by the peak current of the ServoWire™ drive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details.

Torque vs. Speed Characteristics



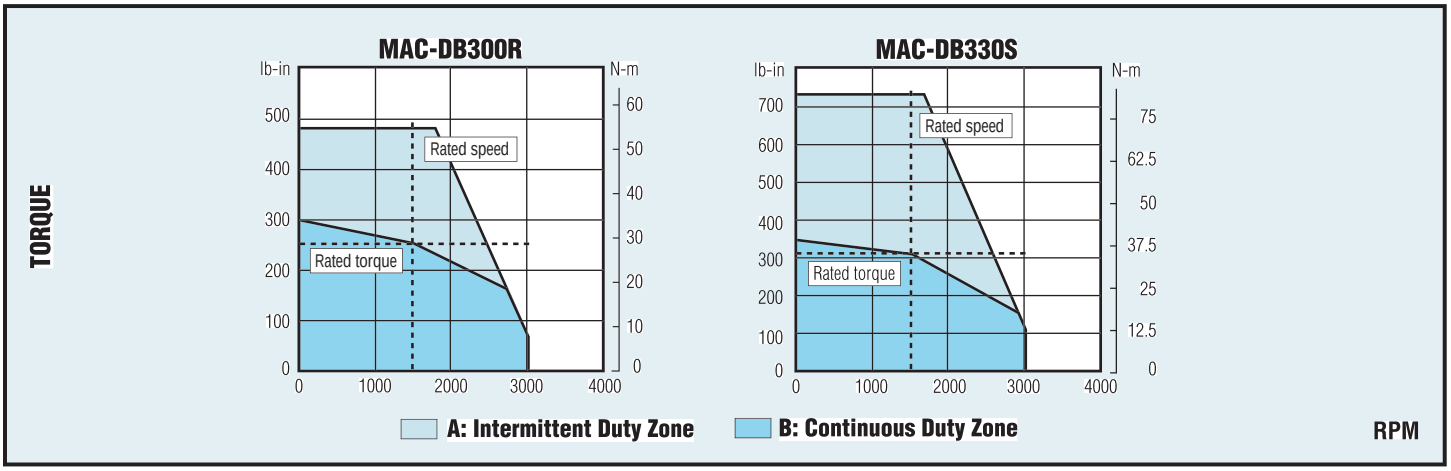
D-Series AC Brushless Servomotors

-- Absolute Encoder Model Specifications
(Inertia specifications for Brake Models on page 11.)

Performance Specifications (1)	Units	DB300R	ABS	DB330S	ABS
Maximum Speed	RPM	3,000		3,000	
Continuous Stall Torque	lb-in	300		345	
	N-m	34		39	
Rated Speed	RPM	1,500		1,500	
Rated Torque	lb-in	252		310	
	N-m	28		35	
Rated Power	HP	5.9		7.4	
	watts	4,400		5,500	
Peak Torque(2)	lb-in	479		728	
	N-m	54		82	
Continuous Stall Torque/Inertia	radians/sec^2	5,017	5,008	4,378	4,323
Mechanical Specifications					
Moment of Inertia	lb-in-sec^2 x 10^{-3}	59.8	59.9	78.8	79.8
	kg-m^2 x 10^{-4}	67.6	67.7	89.0	90.2
Friction Torque, Static	lb-in	2.3		3.0	
	N-m	0.25		0.33	
Servomotor Weight	lbs	51	53	66	65
	kg	23	24	30	30
Maximum Radial Shaft Load	lbs	331		397	
(centered at end of shaft)	N	1,470		1,764	
Maximum Axial Shaft Load	lbs	110		132	
	N	490		588	
Electrical Specifications					
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	8.1		7.8	
	N-m/Amp$_{Rms/Ø}$	0.91		0.88	
Servodrive Model Number		SAC-SW235/E SMS-235/E G35-AY	SAC-SW235/EA SMS-235/EA	SAC-SW260/E SMS-260/E G60-AY	SAC-SW260/EA SMS-260/EA
Servodrive Input Power	volts AC	230		230	
Continuous Motor Current	Amps$_{Rms/Ø}$	33		42	
Peak Motor Current	Amps$_{Rms/Ø}$	84		110	
Motor Thermal Specifications					
Ambient Temperature	degrees C	40		40	
Insulation Class		F		F	
Encoder Specifications					
Encoder Resolution	counts/revolution	32768	32768	32768	32768

(1) Ratings are obtained with servomotor ambient temperature of 40C, and armature winding temperature of 100C. (2) Motor's peak torque is limited by the peak current of the ServoWire™ drive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details.

Torque vs. Speed Characteristics



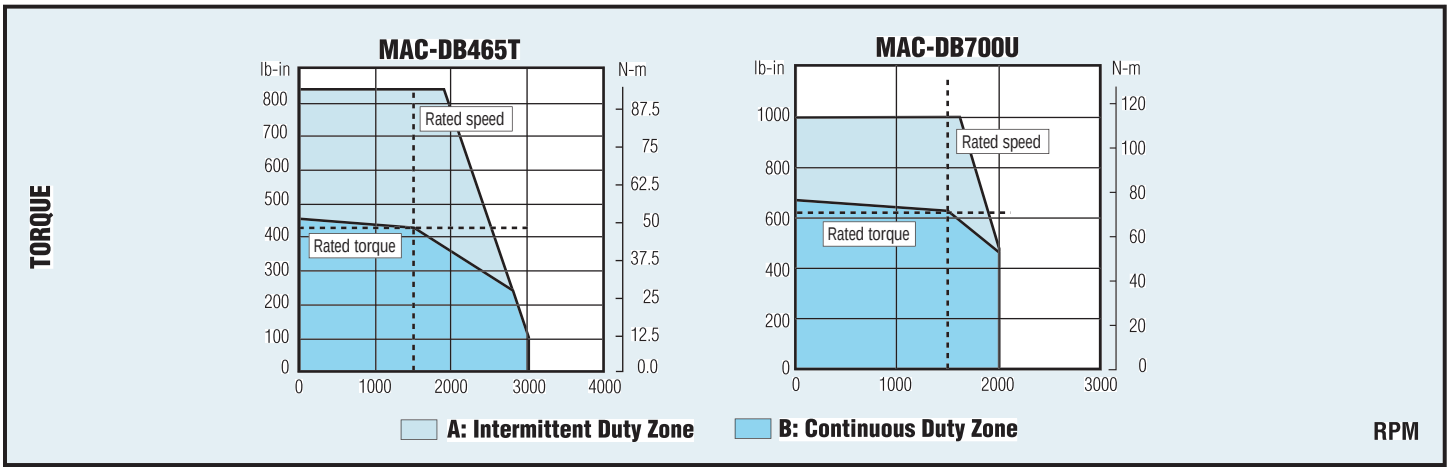
D-Series AC Brushless Servomotors

-- Absolute Encoder Model Specifications
(Inertia specifications for Brake Models on page 11.)

Performance Specifications (1)	Units	DB465T	ABS	DB700U	ABS
Maximum Speed	RPM	3,000		2,000	
Continuous Stall Torque	lb-in	450		665	
	N-m	51		75	
Rated Speed	RPM	1,500		1,500	
Rated Torque	lb-in	425		620	
	N-m	48		70	
Rated Power	HP	10		15	
	watts	7,500		11,000	
Peak Torque(2)	lb-in	839		1,000	
	N-m	95		113	
Continuous Stall Torque/Inertia	radians/sec^2	4,054	4,054	2,671	2,671
Mechanical Specifications					
Moment of Inertia	lb-in-sec^2 x 10^{-3}	111.0	111.0	249.0	249.0
	kg-m^2 x 10^{-4}	125.4	125.4	281.4	281.4
Friction Torque, Static	lb-in	4.2		7.2	
	N-m	0.47		0.81	
Servomotor Weight	lbs	88	88	127	127
	kg	40	40	58	58
Maximum Radial Shaft Load	lbs	397		397	
(centered at end of shaft)	N	1,764		1,764	
Maximum Axial Shaft Load	lbs	132		132	
	N	588		588	
Electrical Specifications					
Torque Sensitivity	lb-in/Amp$_{Rms/Ø}$	8.2		11	
	N-m/Amp$_{Rms/Ø}$	0.93		1.2	
Servodrive Model Number		SAC-SW260/E SMS-260/E G60-AY	SAC-SW260/EA SMS-260/EA	SAC-SW260/E SMS-260/E G60-AY	SAC-SW260/EA SMS-260/EA
Servodrive Input Power	volts AC	230		230	
Continuous Motor Current	Amps$_{Rms/Ø}$	55		59	
Peak Motor Current	Amps$_{Rms/Ø}$	130		140	
Motor Thermal Specifications					
Ambient Temperature	degrees C	40		40	
Insulation Class		F		F	
Encoder Specifications					
Encoder Resolution	counts/revolution	32768	32768	32768	32768

(1) Ratings are obtained with servomotor ambient temperature of 40C, and armature winding temperature of 100C. (2) Motor's peak torque is limited by the peak current of the ServoWire™ drive. The next larger drive may be used to increase the amount of peak torque available. Consult an ORMEC Applications Engineer for details.

Torque vs. Speed Characteristics

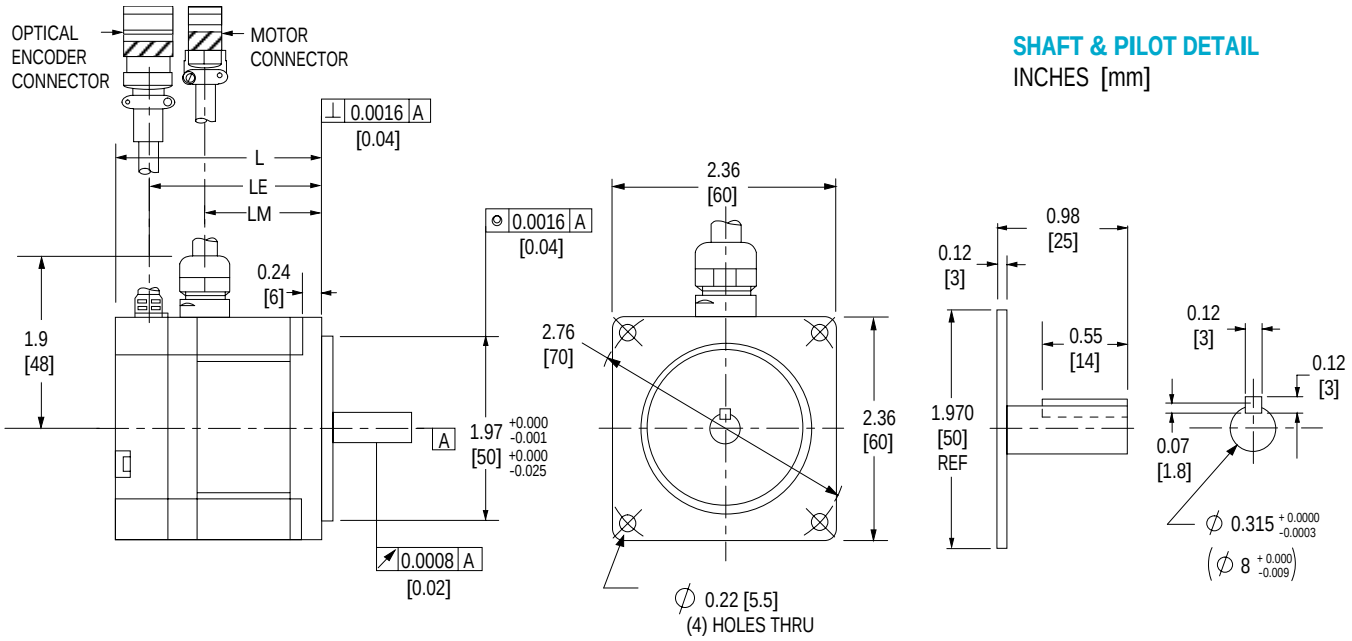


Specifications for D-Series Servomotors with Fail-Safe Brakes

		MODEL with BRAKE				MODEL with BRAKE & ABSOLUTE ENCODER			
Servomotor Model Number	**Brake Holding Torque[1] (lb-in / N-m)**	**Continuous Stall Torque to Inertia Ratio (radians/sec²)**	**Moment of Inertia (lb-in-sec² / kg-m²)**	**Motor Length (in / mm)**	**Motor Weight (lb / kg)**	**Continuous Stall Torque to Inertia Ratio (radians/sec²)**	**Moment of Inertia (lb-in-sec² / kg-m²)**	**Motor Length (in / mm)**	**Motor Weight (lb / kg)**
MAC-DE003A1	4.3 0.49	30,770	0.091×10^{-3} 0.103×10^{-4}	3.39 86	2.0 0.9	24,779	0.113×10^{-3} 0.128×10^{-4}	5.16 131	2.7 1.2
MAC-DE003A2	4.3 0.49	30,770	0.091×10^{-3} 0.103×10^{-4}	3.39 86	2.0 0.9	24,779	0.113×10^{-3} 0.128×10^{-4}	5.16 131	2.7 1.2
MAC-DE006B1	8.7 0.98	20,588	0.272×10^{-3} 0.307×10^{-4}	3.68 94	4.2 1.9	19,048	0.294×10^{-3} 0.332×10^{-4}	4.65 118	4.6 2.1
MAC-DE006B2	8.7 0.98	20,588	0.272×10^{-3} 0.307×10^{-4}	3.68 94	4.2 1.9	19,048	0.294×10^{-3} 0.332×10^{-4}	4.65 118	4.6 2.1
MAC-DE008C1	17 1.9	21,320	0.394×10^{-3} 0.446×10^{-4}	4.47 114	5.7 2.6	20,192	0.416×10^{-3} 0.470×10^{-4}	5.43 138	6.2 2.8
MAC-DE011C2	17 1.9	27,919	0.394×10^{-3} 0.446×10^{-4}	4.47 114	5.7 2.6	26,442	0.416×10^{-3} 0.470×10^{-4}	5.43 138	6.2 2.8
MAC-DE021D2	32 3.6	9,417	2.23×10^{-3} 2.52×10^{-4}	4.65 118	13 5.9	9,292	2.26×10^{-3} 2.55×10^{-4}	5.59 142	13.7 6.2
MAC-DE042E2	63 7.1	9,677	4.34×10^{-3} 4.91×10^{-4}	5.75 146	18 8.2	9,633	4.36×10^{-3} 4.93×10^{-4}	6.69 170	19.0 8.6
MAC-DA030F	66 7.8	16,185	1.73×10^{-3} 1.95×10^{-4}	7.60 193	13 5.9	15,217	1.84×10^{-3} 2.08×10^{-4}	8.15 207	14.3 6.5
MAC-DA055G	66 7.8	18,605	3.01×10^{-3} 3.40×10^{-4}	9.53 242	19 8.6	17,949	3.12×10^{-3} 3.53×10^{-4}	10.08 256	19.8 9.0
MAC-DA090H	177 20	11,097	7.84×10^{-3} 8.86×10^{-4}	9.33 237	31 14	10,943	7.95×10^{-3} 8.98×10^{-4}	9.88 251	32.0 14.5
MAC-DA110J	177 20	11,089	10.1×10^{-3} 11.5×10^{-4}	10.79 274	38 17	10,874	10.3×10^{-3} 11.6×10^{-4}	11.34 288	38.6 17.5
MAC-DA140K	177 20	11,200	12.5×10^{-3} 14.2×10^{-4}	12.36 314	44 20	11,024	12.7×10^{-3} 14.4×10^{-4}	12.91 328	45.2 20.5
MAC-DB025L	39 4.4	3,106	8.05×10^{-3} 9.10×10^{-4}	6.93 176	17 7.7	3,071	8.14×10^{-3} 9.20×10^{-4}	7.48 190	17.4 7.9
MAC-DB055M	112 13	3,813	13.9×10^{-3} 15.8×10^{-4}	7.83 199	21 9.5	3,786	14.0×10^{-3} 15.8×10^{-4}	8.39 213	22.0 10.0
MAC-DB080N	112 13	3,737	19.8×10^{-3} 22.4×10^{-4}	8.78 223	26 12.0	3,719	19.9×10^{-3} 22.5×10^{-4}	9.33 237	26.5 12.0
MAC-DB100P	380 43	2,914	35.0×10^{-3} 39.5×10^{-4}	8.54 217	42 19.0	2,914	35.0×10^{-3} 39.5×10^{-4}	9.09 231	43.0 19.5
MAC-DB200Q	380 43	4,118	47.6×10^{-3} 53.7×10^{-4}	9.57 243	52 24	4,118	47.6×10^{-3} 53.8×10^{-4}	10.12 257	51.8 23.5
MAC-DB300R	380 43	4,498	66.7×10^{-3} 75.3×10^{-4}	10.91 277	63 29	4,498	66.7×10^{-3} 75.4×10^{-4}	11.46 291	63.9 29.0
MAC-DB330S	646 73	4,026	85.7×10^{-3} 96.8×10^{-4}	12.24 311	77 35	4,026	85.7×10^{-3} 96.8×10^{-4}	12.80 325	79.3 36.0
MAC-DB465T	646 73	3,814	118×10^{-3} 133×10^{-4}	15.16 385	100 45.4	3,814	118×10^{-3} 133×10^{-4}	15.71 399	110.2 50.0
MAC-DB700U	744 84	2,548	261×10^{-3} 295×10^{-4}	15.08 383	143 64.9	2,548	261×10^{-3} 295×10^{-4}	15.63 397	144.4 65.5

[1]Caution: The built-in fail-safe brake is designed for holding and not for decelerating the motor. In normal operation the brake should be applied only after the motor is stopped. Fail-safe brakes are useful in applications when a servomotor is used to control a vertical axis. A servomotor with a fail-safe brake prevents the moveable part from dropping due to gravitation when the system power is turned OFF.

DE003A1 & DE003A2 Outline Drawings



SHAFT & PILOT DETAIL
INCHES [mm]

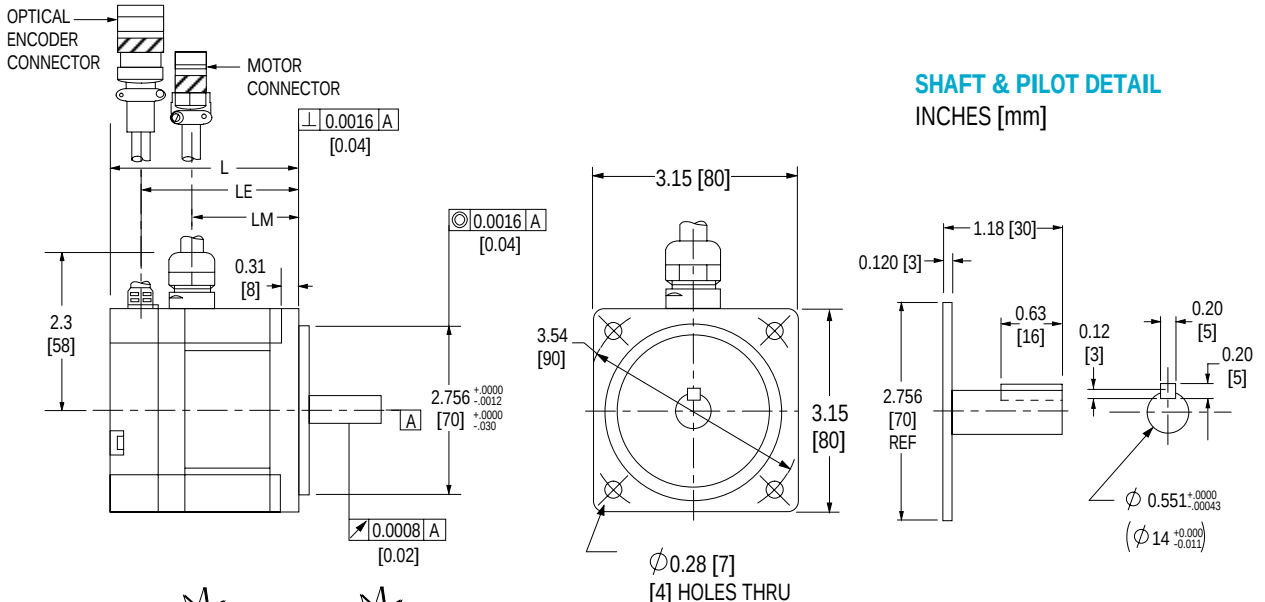
Dimensions	L	ABS	LE	ABS	LM
MAC-DE003A1	2.3 [57]	4.1 [102]	1.9 [48]	3.7 [94]	1.3 [32]
MAC-DE003A2	2.3 [57]	4.1 [102]	1.9 [48]	3.7 [94]	1.3 [32]

Note: Minimum cable clearance from motor centerline for encoder cable is 2.8 inches 71 mm); for motor cable is 3.8 inches (97 mm). Cable lengths to connector approximately 11 inches [280 mm].

For length of models with brake and absolute encoder options selected, see page 11. Call for design details.

All dimensions in inches [millimeters]

DE006B1, DE006B2, DE008C1 & DE011C2 Outline Drawings

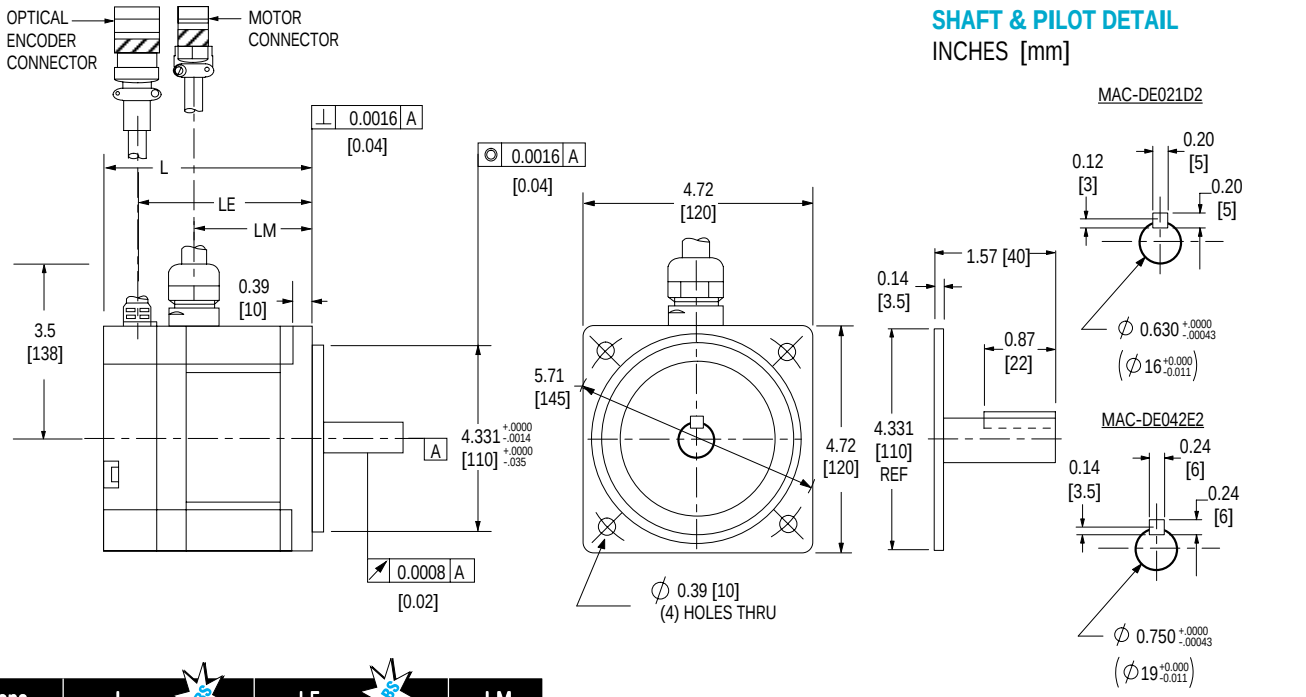


SHAFT & PILOT DETAIL
INCHES [mm]

Dimensions	L	ABS	LE	ABS	LM
MAC-DE006B1	2.5 [63]	3.5 [87]	2.1 [53]	2.9 [75]	1.6 [40]
MAC-DE006B2	2.5 [63]	3.5 [87]	2.1 [53]	2.9 [75]	1.6 [40]
MAC-DE008C1	3.3 [84]	4.2 [107]	2.9 [73]	3.7 [95]	2.4 [60]
MAC-DE011C2	3.3 [84]	4.2 [107]	2.9 [73]	3.7 [95]	2.4 [60]

Note: Minimum cable clearance from motor centerline for encoder cable is 3.2 inches (81 mm); for motor cable is 4.2 inches (107 mm). Cable lengths to connector approximately 11 inches [280 mm].

DE021D2 & DE042E2 Outline Drawings



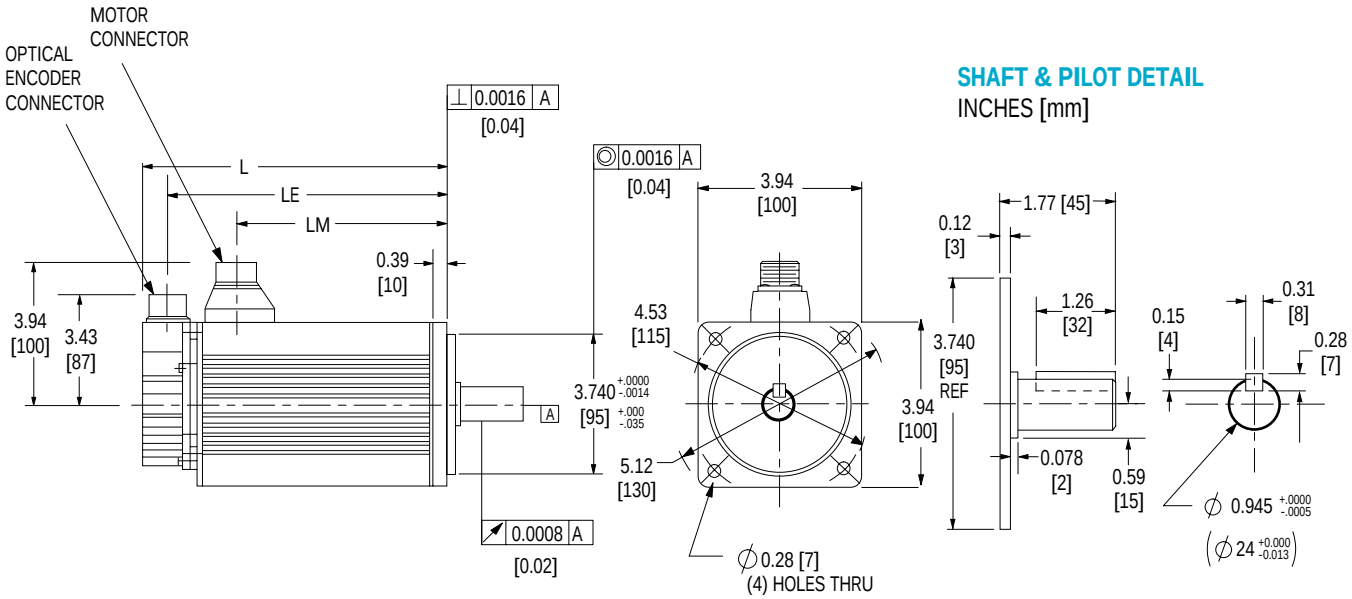
Dimensions	L		LE		LM
	ABS		ABS		
MAC-DE021D2	3.2 [82]	4.2[106]	2.8 [72]	3.5 [89]	2.2 [56]
MAC-DE042E2	4.3 [110]	5.3 [134]	3.9 [100]	4.7 [120]	3.3 [84]

Note: Minimum cable clearance from motor centerline for encoder cable is 4.0 inches (102 mm); for motor cable is 5.0 inches (127 mm). Cable lengths to connector approximately 11 inches [280 mm].

For length of models with brake and absolute encoder options selected, see page 11. Call for design details.

All dimensions in inches [millimeters]

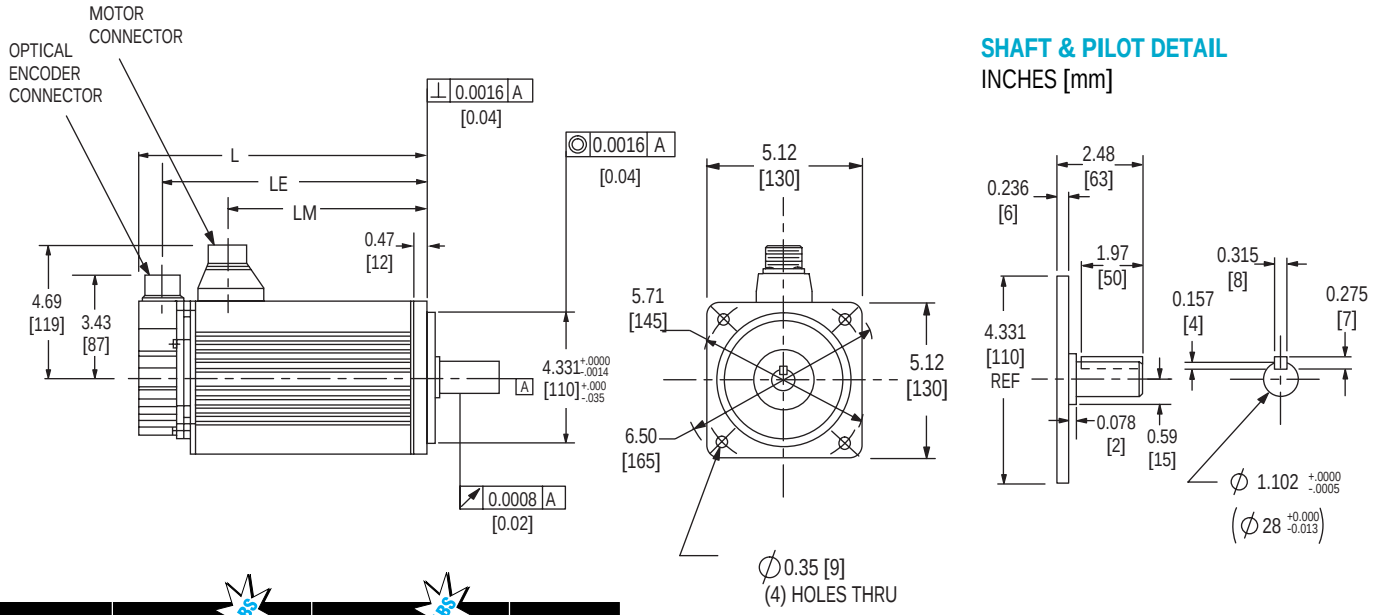
DA030F & DA055G Outline Drawings



Dimensions	L		LE		LM
	ABS		ABS		
MAC-DA030F	5.9 [150]	6.4 [163]	5.1 [130]	5.6 [142]	3.0 [76]
MAC-DA055G	7.8 [200]	8.4 [212]	7.0 [178]	7.5 [191]	4.9 [125]

Note: Minimum cable clearance from motor centerline for Encoder Cable is 6.2 inches (157 mm); for Motor Cable is 6.6 inches (168 mm).

DA090H, DA110J & DA140K Outline Drawings



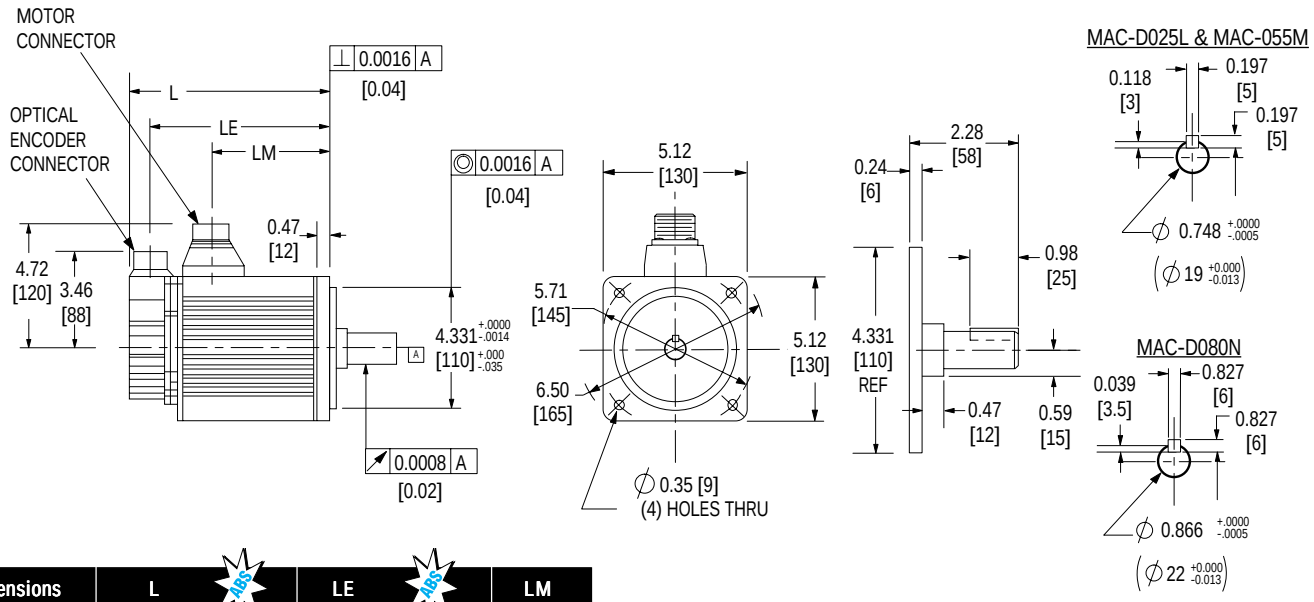
Dimensions	L		LE		LM
	ABS		ABS		
MAC-DA090H	7.9 [200]	8.4 [213]	7.0 [177]	7.6 [192]	4.8 [122]
MAC-DA110J	9.3 [236]	9.9 [250]	8.4 [213]	9.0 [229]	6.2 [157]
MAC-DA140K	10.9 [277]	11.5 [290]	10.0 [254]	10.6 [269]	7.8 [198]

Note: Minimum cable clearance from motor centerline for encoder cable is 6.2 inches (157 mm); for motor cable is 7.5 inches (191 mm).

For length of models with brake and absolute encoder options selected, see page 11. Call for design details.

All dimensions in inches [millimeters]

DB025L, DB055M & DB080N Outline Drawings

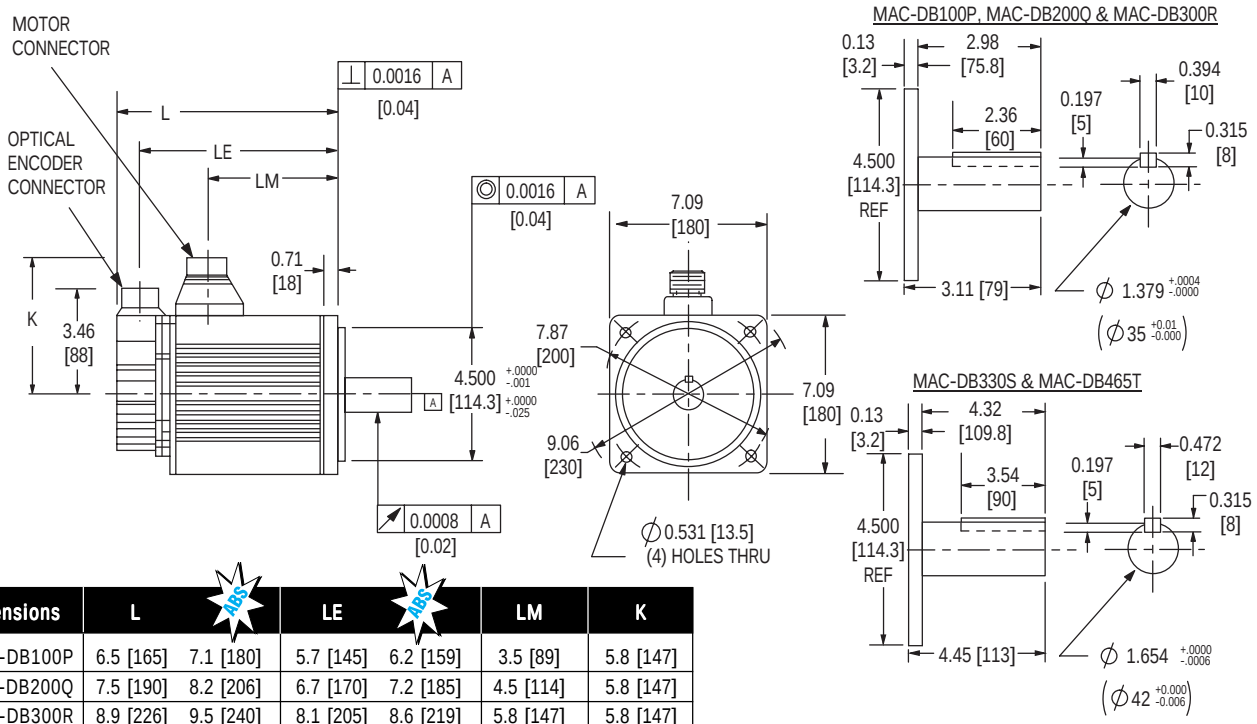


Dimensions	L		LE		LM
	ABS		ABS		
MAC-DB025L	5.4 [137]	6.0 [152]	4.6 [117]	5.1 [131]	2.5 [64]
MAC-DB055M	6.3 [160]	6.9 [175]	5.5 [140]	6.0 [154]	3.4 [86]
MAC-DB080N	7.3 [185]	7.9 [199]	6.4 [162]	7.0 [178]	4.4 [112]

Note: Minimum cable clearance from motor centerline for encoder cable is 6.3 inches (160 mm); for motor cable is 7.0 inches (178 mm).

DB100P, DB200Q, DB300R, DB330S & DB465T Outline Drawings

SHAFT & PILOT DETAIL INCHES [mm]



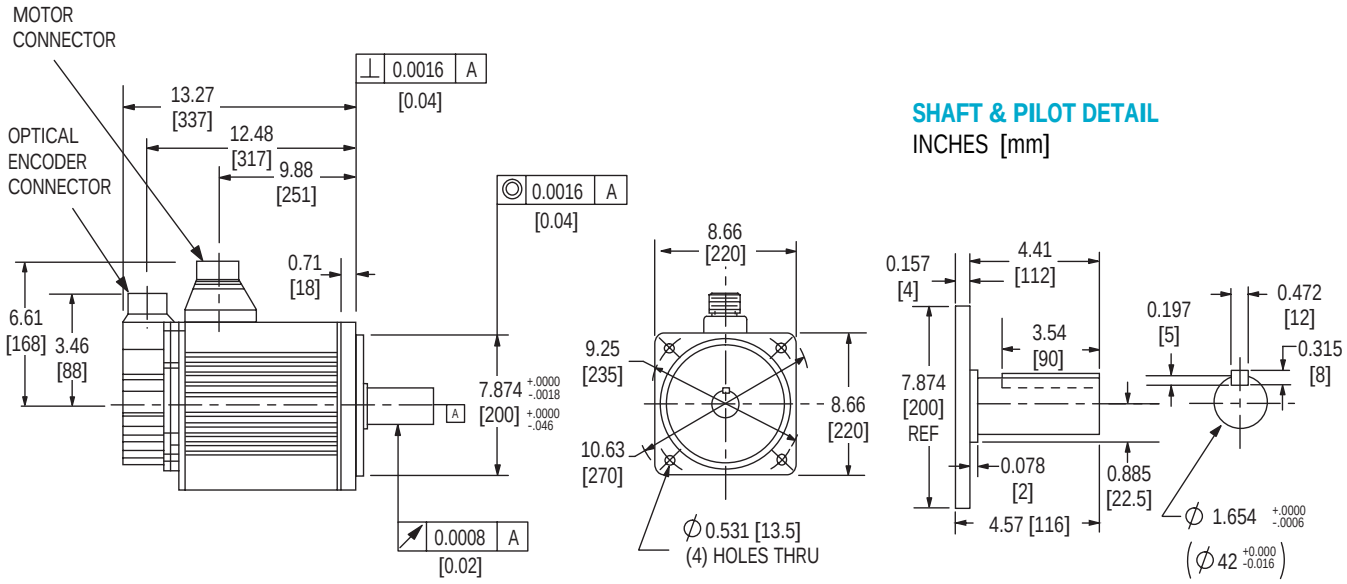
Dimensions	L		LE		LM	K
	ABS		ABS			
MAC-DB100P	6.5 [165]	7.1 [180]	5.7 [145]	6.2 [159]	3.5 [89]	5.8 [147]
MAC-DB200Q	7.5 [190]	8.2 [206]	6.7 [170]	7.2 [185]	4.5 [114]	5.8 [147]
MAC-DB300R	8.9 [226]	9.5 [240]	8.1 [205]	8.6 [219]	5.8 [147]	5.8 [147]
MAC-DB330S	10.2 [259]	10.8 [274]	9.4 [239]	9.9 [253]	6.8 [173]	5.9 [150]
MAC-DB465T	13.2 [335]	13.7 [348]	12.3 [312]	12.8 [327]	9.7 [246]	5.9 [150]

Note: Minimum cable clearance from motor centerline for encoder cable is 6.3 inches (160 mm); for motor cable is 9.5 inches (241 mm)

For length of models with brake and absolute encoder options selected, see page 11. Call for design details.

All dimensions in inches [millimeters]

DB700U Outline Drawing



Dimensions	L		LE		LM
	ABS		ABS		
MAC-DB700U	13.3 [337]	13.9 [352]	12.5 [314]	13.0 [331]	9.8 [249]

Note: Minimum cable clearance from motor centerline for encoder cable is 6.3 inches (160 mm); for motor cable is 9.5 inches (241 mm)

Servomotor Connectors

MOTOR / POWER RECEPTACLES

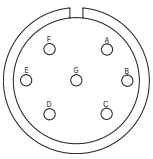


Fig. W

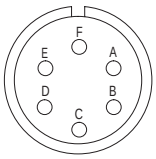


Fig. Y

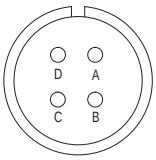


Fig. X

A	1	Phase U	RED
B	2	Phase V	WHT
C	3	Phase W	BLU
D	4	Ground	GRN
E	5	Brake Term	RED
F	6	Brake Term	BLK

Connector Type	Manufactured by
97F...	Deiichi Deshi
CE05...	Deiichi Deshi
JL04...	Japan Aviation Ind.
MS....	Amphenol

BRAKE CONNECTOR (Figure B)

A	Brake Term
B	Brake Term
C	--

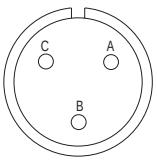


Fig. B

ENCODER FEEDBACK RECEPTACLES (Figure U)

A	1	Channel B output
B	2	Channel B/ output
C	3	Channel A output
D	4	Channel A/ output
E	5	Channel Z output
F	6	Channel Z/ output
G	8	0V
H	7	+5VDC
J	12	Case Ground
N	11	Reset
P	10	0V (battery)
R	9	+3.6V(battery)

Terminals used for absolute encoders only.

T, S, M, L, K -- No connection

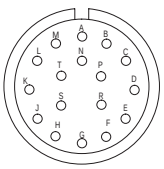


Fig. U

MOTOR / FEEDBACK / OPTION -- MATING CONNECTOR CHART

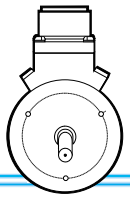
MOTOR TYPE	FIG	MOTOR/POWER	MATING	FIG	FEEDBACK	MATING
Motors (incremental or absolute feedback)						
All of MAC-DE series motors	Y	MS-3101A18-12P	MS-3106F18-12S	U	MS-3101A20-29P	MS-3106F20-29S
MAC-DA030F, DA055G, DB025L, DB055M, DB080N	X	MS-3102A18-10P	MS-3106F18-10S	U	MS-3102A20-29P	MS-3106F20-29S
MAC-DA090H, DA110J, DA140K, DB100P, DB200Q, DB300R	X	MS-3102A22-22P	MS-3106F22-22S	U	MS-3101A20-29P	MS-3106F20-29S
MAC-DB330S, DB465T & DB700U	X	MS-3102A32-17P	MS-3106F32-17S	U	MS-3101A20-29P	MS-3106F20-29S
Motors with IP-67						
MAC-DA030F, DA055G, DB025L, DB055M, DB080N	X	CE05-2A18-10PD	MS3106A18-10S(D190)	U	97F3102A20-29P	MS-3106F20-29S(D190)
MAC-DA090H, DA110J, DA140K, DB100P, DB200Q, DB300R	X	JL04HV-2E22-22PE-B	JL04-6A22-22S	U	97F3102A20-29P	MS-3106F20-29S(D190)
MAC-DB330S, DB465T & DB700U	X	JL04V-2E32-17PE-B	JL04-6A32-17SE	U	97F3102A20-29P	MS-3106F20-29S(D190)
Motors with Fail-safe Brake						
MAC-DA030F, DA055G, DB025L, DB055M, DB080N	W	MS-3102A20-15P	MS-3106F20-15S	U	MS-3101A20-29P	MS-3106F20-29S
MAC-DA090H, DA110J, DA140K, DB100P, DB200Q, DB300R	W	MS-3102A24-10P	MS-3106F24-10S	U	MS-3101A20-29P	MS-3106F20-29S
MAC-DB330S, DB465T & DB700U	X	MS-3102A32-17P*	MS-3106F32-17S*	U	MS-3101A20-29P	MS-3106F20-29S
	B	MS-3102A10SL-3P*	MS-3106F10SL-3S*			
Motors with IP-67 and Fail-safe Brake						
MAC-DA030F, DA055G, DB025L, DB055M, DB080N	W	JL04V-2E20-15PE	JL04-6A20-15SE	U	97F3102A20-29P	MS-3106F20-29S(D190)
MAC-DA090H, DA110J, DA140K, DB100P, DB200Q, DB300R	W	JL04V-2E24-10PE-B	JL04-6A22-22S	U	97F3102A20-29P	MS-3106F20-29S(D190)
MAC-DB330S, DB465T & DB700U	X	JL04V-2E32-17PE-B*	JL04-6A32-17SE*	U	97F3102A20-29P	MS-3106F20-29S(D190)
	B	CE05-2A10SL-3PC*	MS-3106A10SL-3S(D190)*			

* Brake option requires separate motor and brake cables (both incremental and absolute).

D-Series Encoder and Motor Cables

Standard	*IP-67 Sealing*	*Brake Option*	*Brake w/IP-67 Sealing*	
CBL-DMSW/X				Encoder cable for all MAC-DE motors, 1-150 ft
CBL-DMSW/X	CBL-DMSWV/X			Encoder Cable for MAC-DA & DB motors , 1-150 ft
CBL-DEMSW1/X		CBL-DEMSWB1/X		Motor cables for all MAC-DE motors, 1-150 ft
CBL-DMSW1/X	CBL-DMSWV1/X	CBL-DMSWB1/X	CBL-DMSWVB1/X	Motor cables for MAC-DA030, DA055, DB025, DB055 & DB080 motors, 1-150 ft. For use with ORMEC drives (SW210 - SW220, G10 - G20 and SMS-210 - SMS-220)
CBL-DMSWT1/X	CBL-DMSWVT1/X	CBL-DMSWBT1/X	CBL-DMSWVBT1/X	Motor cables for MAC-DA055, 1-150 ft. For use with ORMEC drives (SW225, G25 and SMS-225).
CBL-DMSWT2/X	CBL-DMSWVT2/X	CBL-DMSWBT2/X	CBL-DMSWVBT2/X	Motor cables for MAC-DA090, DA110 & DB200, 1-150 ft. For use with ORMEC drives (SW225 -SW260, G25 -G60 and SMS-225 - SMS-260).
CBL-DMSWT3/X	CBL-DMSWVT3/X	CBL-DMSWBT3/X	CBL-DMSWVBT3/X	Motor cables for MAC-DA140 & DB300, 1-150 ft. For use with ORMEC drives (SW235 -SW260, G35 -G60 and SMS-235 - SMS-260).
CBL-DMSW4/X	CBL-DMSWV4/X	CBL-DMSWB4/X	CBL-DMSWVB4/X	Motor cables for MAC-DB100, 1-150 ft. For use with ORMEC drives (SW220, G20 and SMS-220).
CBL-DMSWT4/X	CBL-DMSWVT4/X	CBL-DMSWBT4/X	CBL-DMSWVBT4/X	Motor cables for MAC-DB100, 1-150 ft. For use with ORMEC drives (SW225, G25 and SMS-225).
CBL-DMSWT5/X	CBL-DMSWVT5/X	CBL-DMSWT5/X & CBL-DMACB/X	CBL-DMSWVT5/X & CBL-DMACVB/X	Motor cables for MAC-DB330, 1-150 ft. For use with ORMEC drives (SW260, G60 and SMS-260).
CBL-DMSWT6/X	CBL-DMSWVT6/X	CBL-DMSWT6/X & CBL-DMACB/X	CBL-DMSWVT6/X & CBL-DMACVB/X	Motor cables for MAC-DB465 & DB700, 1-150 ft. For use with ORMEC drives (SW260, G60 and SMS-260).

Note: For all cables above, specify length of the cable by adding the numerical length in the "X" placeholder in the Model Number.



ORMEC
Lineshaft Pacer Encoders

The ability to interface a position encoder to a ServoWire™ Drive can provide vital position information to the motion control system.

This approach is simple, yet effective, because information for the "encoder axis" is available to be used in the same way that information is used from any "servo axis".

Uses of Remote Encoders

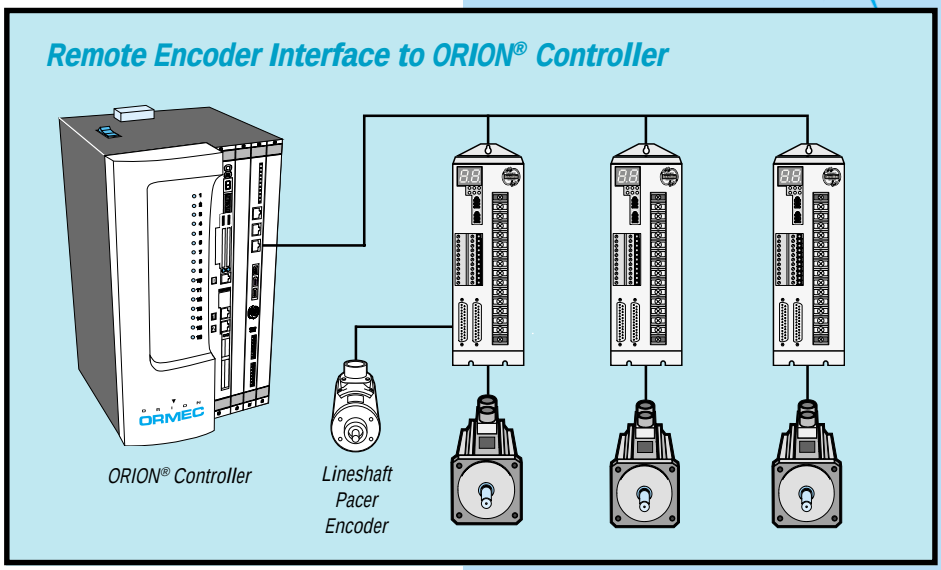
1) ***Pacer Encoders*** measure real-time shaft position data of a machine axis to be sent to other servo axes in the system when ***electronic gearing*** and/or ***cam profiling*** are used in an application.
2) ***Programmable limit switches*** on each ServoWire™ drive can be configured to turn on or off based on pacer encoder position.
3) ***Position and velocity information*** is accessible from the MotionBASIC® language for every encoder used with an ORION® system.
4) ***Remote Feedback Encoders*** can be used to provide position feedback directly from the load under control, usually used in conjunction with velocity feedback from the servomotor shaft to provide an additional level of precision for the control system.

ServoWire™ Drive Interface

The encoder interface is a partial servo axis interface, consisting only of differentially received quadrature A and B channels and a reference Z-channel. Selecting the "encoder input" axis control mode disables servodrive alarm detection but still provides open wire detection to insure encoder position information integrity.

FEATURES

- ❒ Heavy duty sealed bearings and NEMA 4X housing
- ❒ Flange mount with integral coupling and servo mount configurations available
- ❒ 200 KHz frequency response for all channels
- ❒ Optional 2X, 4X, 5X and 10X cycle interpolation
- ❒ Maximum data rate increases to match cycle interpolation
- ❒ LED light sources



ServoWire™ drives provide a convenient interface to encoders used primarily for electronic gearing.

Optical Position Encoders

ORMEC's Model EDR-25 optical, incremental position encoders are ideal for a wide variety of rugged industrial applications where reliability is a prime concern.

LED light sources rated for 100K hours MTBF, 40 pound axial/35 pound radial shaft loading capability, 200 KHz frequency response allow these encoders to be effective in harsh, industrial applications.

The EDR-25 provides a 1/4 cycle wide gated zero reference output. Models with cycle interpolation have maximum resolutions up to 200,000 counts per shaft revolution.

Electrical Specifications

Resolution range: Discs can be provided with up to 5000 lines. This results in resolutions up to 50,000 counts per revolution with standard ORION® quadrature decoding, or to 200,000 counts per revolution with internal 10X cycle interpolation.

Light sources: Gallium Aluminum Arsenide LEDs rated for 100,000 hours MTFB (manufacturer's specification)

Light sensors: Photovoltaic

Excitation voltages: 5 VDC @ 245 mA maximum. Units with cycle interpolation require a maximum of 450 mA.

Output format: Two outputs (A and B) in phase quadrature with a zero reference (Z) output

Quadrature specification: 90° +12°; with internal cycle interpolation: 90° +45° (at 10KHz output frequency)

Symmetry specification: 180° ±5° (at 10 KHz output frequency)

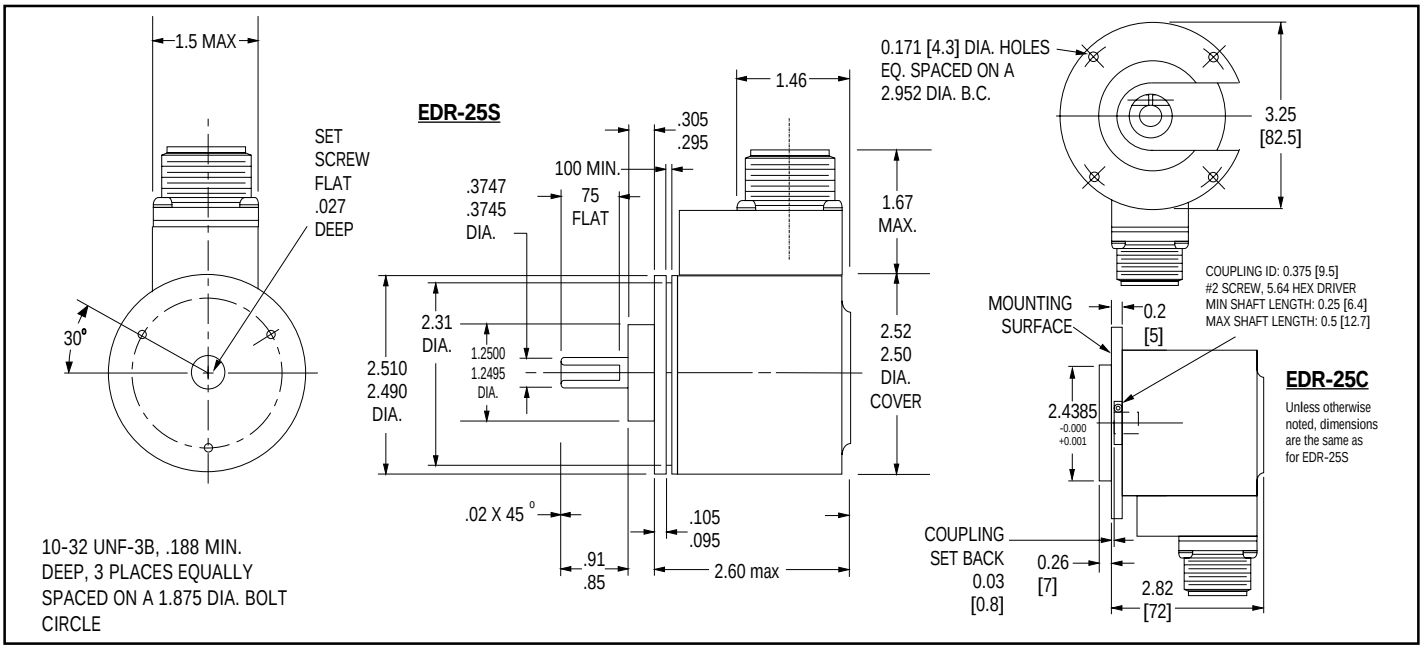
Rise & Fall times: 1 usec (maximum) into 1000 pf of load capacitance

Frequency response: Units without cycle interpolation: 200 KHz for all channels. Units with cycle interpolation obtain 400, 800 & 1000 KHz.

Zero Reference angular width: 1 ±1/4 count channel cycle. Units provide a 1/4 cycle wide gated zero (Z) reference.

Phase sense: Channel A leads Channel B for CCW rotation of the shaft as viewed from shaft end (face end) of the unit.

Output Specifications: Output stage is an MC3487 (or performance equivalent) differential line driver with 40 ma sink and -40 ma source current.



Mechanical Specifications

Maximum Shaft loading: 40 lbs. axially, 35 lbs. radially

Shaft radial runout: 0.001" T.I.R.

Maximum Starting torque at 25C: EDR-25C *(without shaft seal)*: 2.0 oz-in *EDR-25S (with shaft seal)*: 5.0 oz-in

Shaft angular acceleration: 10^5 radians/sec^2 (maximum)

Moment of inertia: 4.7 x 10^{-4} oz-in-sec^2

Bearing type: Sealed class ABEC 7

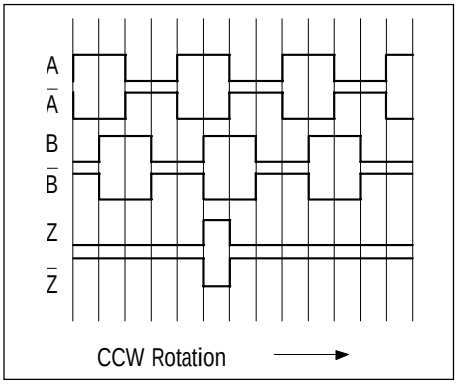
Minimum Bearing Life: 2 x 10^9 revolutions at rated shaft loading. (Bearing life increases to 5 x 10^{10} revolutions at 10% of rated shaft loading.)

Shaft: 303 stainless

Maximum shaft speed: 6000 RPM or 200 KHz count channel output frequency, whichever occurs first (before cycle interpolation).

Weight: 17 oz. (maximum)

Error: ±0.5 bits maximum (based on ORION® 4X counting circuitry); ±1.0 bits maximum (applies to units with cycle interpolation)



Coupling Specifications (EDR-25C)

Maximum Wind-up: 30 arc-seconds per oz-in

Maximum Angular Misalignment: 5°

Maximum Axial Play: +0.010 in

Maximum Parallel Misalignment: 0.010 in

Environmental Specifications

Operating temperature range: 0 to +70C

Storage temperature range: -25 to +90C

Maximum Shock: 50G's for 11 milliseconds duration

Vibration: 20 Hz to 2000 Hz at 20G's

Maximum Humidity: 98% R.H. (non-condensing)

Connector Pinout

Pin	Description
A	Channel A
B	Channel B
C	Channel Z
D	+5VDC (+5%) only
E	Test Waveform*
F	Common
G	Case Ground
H	Channel A'
I	Channel B'
J	Channel Z'

*-only available on units with cycle interpolation

ORDERING GUIDE

Lineshaft Pacer Encoders

EDR-25S/A1000	Position Encoder: "1000 linecount, servo mount" provides 4,000 counts per rev
EDR-25S/A1250	Position Encoder: "1250 linecount, servo mount" provides 5,000 counts per rev
EDR-25S/A2500	Position Encoder: "2500 linecount, servo mount" provides 10,000 counts per rev
EDR-25S/A5000	Position Encoder: "5000 linecount, servo mount" provides 20,000 counts per rev
EDR-25S/B5000	Position Encoder: "10,000 linecount, servo mount" provides 40,000 counts per rev using "2X" cycle interpolation
EDR-25S/E2500	Position Encoder: "12,500 linecount, servo mount" provides 50,000 counts per rev using "5X" cycle interpolation
EDR-25S/D5000	Position Encoder: "20,000 linecount, servo mount" provides 80,000 counts per rev using "4X" cycle interpolation
EDR-25S/E5000	Position Encoder: "25,000 linecount, servo mount" provides 100,000 counts per rev using "5X" cycle interpolation
EDR-25S/F5000	Position Encoder: "25,000 linecount, servo mount" provides 100,000 counts per rev using "5X" cycle interpolation
EDR-25S/G5000	Position Encoder: "50,000 linecount, servo mount" provides 200,000 counts per rev using "10X" cycle interpolation

Note: To specify encoder with flange mount and integral coupling, replace "25S" in model numbers above with "25C".

CBL-QE25SW/X	Encoder Cable, EDR-25 to ServoWire Drive, 5-150 ft
CBL-QE25SWV/X	Encoder Cable, EDR-25 to ServoWire Drive, IP-67, water-resistant, 5-150 ft
CON-E25	Encoder Connector, for EDR-25 Encoders

ORMEC
Motion Control Training

Institute for
Advanced Motion Control

ORMEC established its Training Department to offer a valuable service to our customers. ORMEC conducts formal courses for engineers and technicians interested in electronic motion control. These courses provide quality instruction on servo control technology, application development, system design and troubleshooting.

ORMEC's training courses are held on a regular schedule in Rochester NY, and are conducted classroom style combining lecture, discussion, and lab sessions. The labs are popular confidence builders with our students as they reinforce the course materials through "hands-on" interaction with the motion control hardware and software.

On-Site Courses

As an alternative to attending classes in Rochester NY, customers may arrange for On-Site classes held at their own facilities. The On-Site training service becomes economically feasible when a large group at a customer location requires maintenance or programming training. Often maintenance training sessions benefit when the training course is tailored to the customer's application. Customized training services are available from ORMEC, and can be arranged by contacting the Training Department.

ORMEC Training Offerings: At a Glance

- ✔ *Courses designed to meet needs of Application Developers & Maintenance Technicians*
- ✔ *"ORION Application Development" course provides students the experience of developing an application from start to finish. Lectures, labs and materials develop skills to make students productive immediately --- including training on MotionDesk development software, motion and I/O programming, Human-Machine Interface software and networking connectivity.*
- ✔ *"ORION Maintenance and Troubleshooting" course provides skills for technicians who will maintain ORION motion control systems. Hands-on approach builds confidence to pinpoint problems and re-start systems. Overviewing ORMEC's motion control concepts develops a useful understanding for troubleshooting system operation.*
- ✔ *Courses emphasize hands-on, lab-oriented training featuring two-axis demo unit.*
- ✔ *Extensive class notes, labs, sample programs and CD-ROM product documentation*
- ✔ *Students gain knowledge and skills to make them more productive immediately*

Course Overview and Descriptions

ORION Application Development

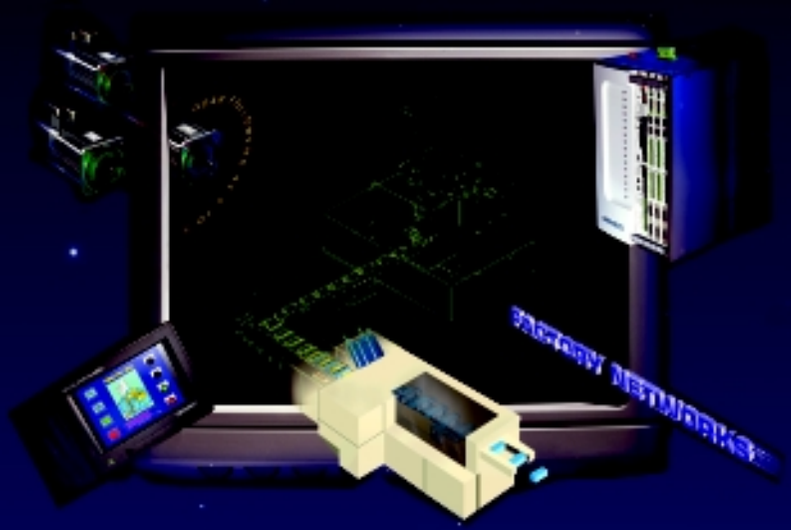
This five (5) day class is a concentrated course for control system designers, engineers, and programmers. In this class the student develops an entire application project from start to finish. ORION motion controller architecture and hardware are emphasized as well as ServoWire Drives. The student uses MotionDesk programming environment software to configure and program an application which increases in complexity as the class progresses. At class conclusion the finished project includes a multi-threaded application program which runs independent machines with an error handler that implements failure recovery and error logging. The finished application also features a touchpanel HMI as well as network communications. (This course is generally not recommended for technicians, electricians or those interested in learning only general capabilities or maintenance of ORION systems.)

ORION Maintenance & Troubleshooting

This two and one-half (2½) day class is ideal for technicians who will maintain ORION motion control systems. ORION hardware and architecture are covered with an introduction to pertinent programming commands. Students perform the steps necessary to pinpoint failed components, and restart a system. Students should acquire the confidence and ability to locate problem hardware in an ORION application. Both MotionPRO & MotionDesk programming environments are covered --- providing skills to support systems using traditional analog drives and ORMEC's latest ServoWire drive technology.

More about ORMEC ...

In North America, call 1-800-656-7632 for more information.



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Visit our website for the latest news, on-line product catalog, product presentations, applications information and more.

ORMEC's network of sales partners throughout North America and Europe provide outstanding technical support.

Use the web to locate your local contact: (http://www.ormec.com/contacts)

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