ORMEC

19 Linden Park   Rochester, NY 14625 (716) 385-3520

The MCS-S Series is a complete line of off-the-shelf, AC-Brushless Motion Control Systems which deliver high performance electronic motion control for single or multi-axis applications. Eight standard models include integral Programmable Motion Control and AC Brushless Servodrives. ORMEC's standard Motion Programming Language, now with integrated math capabilities (MPL+MATH), makes them ideal for closed loop servo control applications.

These units close the current, velocity and position loops in hardware to create the highest bandwidth position control system on the market. ORMEC's proprietary software controlled, tuning circuitry eliminates the use of potentiometers and provides the industry's fastest speed of response. The A-series motors can, for example, perform 36° indexes at rates in excess of 3,000 moves per minute.

A special function of the S-Series is its ability to provide electronic lineshafting for up to 32 servomotors. The electronic lineshaft consists of a two-wire motion reference bus which can be "driven" or "followed" by any individual MCS system under software control. High resolution ratioing (precisions finer than one part in 250 million), zero drift gear ratioing, distributed processing and the ability for a separate position encoder to drive the electronic lineshaft provide maximum flexibility.

The MCS-S Series can be easily interfaced to either host computers or programmable controllers. Operator interface devices such as thumbwheel switches, digital readouts and industrial keypads are easily integrated into an MCS-S system.

These units are available in eight standard power ranges from 300 watts to 6.0 kilowatts. Compatible brushless motors feature a wide range of continuous torques from 10 to 560 lb-in. and include integral, highly reliable, digital position encoders with solid state light sources and resolutions to 24,000 counts per revolution.

ORMEC'S MCS-S Series
Integral Programmable Motion Control and AC Brushless Servodrive
★ 16 discrete I/O points, expandable to 40
★ optional analog inputs, analog output & serial port
★ multi-drop bussed serial communications
Powerful yet Simple Motion Programming Language.
★ Calculator like simplicity with integrated 32-bit math
★ Engineering units, logical operators & 10 non-volatile registers
★ Wide variety of operator interface devices
Compatible AC Brushless Motors with Speeds to 4000 RPM
★ Power to over 8 HP, Torques from 25 to 945 lb-in peak
★ Acceleration rates to 50,000 radians/sec²
★ Position resolution to 24,000 cts/rev
Electronic Lineshafting Capability
★ Up to 32 units on two-wire bus with distributed processing
★ Speed resolution finer than one part in 250,000,000
★ Zero Drift operation for virtually any gear ratio

The MCS-S is easy to use. Simply hook up power and plug in the servomotor to create a high performance AC brushless servo system.

Easy to Use AC Brushless Motion Control

Using ORMEC's MCS-S Series is as easy as hooking up three-phase power, plugging in a compatible AC brushless servomotor and interactively commanding motion or programming it as you would a calculator.

You don't have to worry about integrating the servodrive, selecting the right logic or machine I/O power supplies or specifying the correct circuit breakers because it's all been done for you. This integrated, pre-engineered package removes all those worries and offers an integrated, modular approach which allows you to concentrate on improving your machine's performance.

The MCS-S series comes with ORMEC's full Motion Programming Language (MPL), now enhanced with math and operator I/O capabilities to provide standard software for a wide range of applications. MPL is "calculator-like" in simplicity, intuitive, and easy to learn which shortens the time needed to write motion control programs.
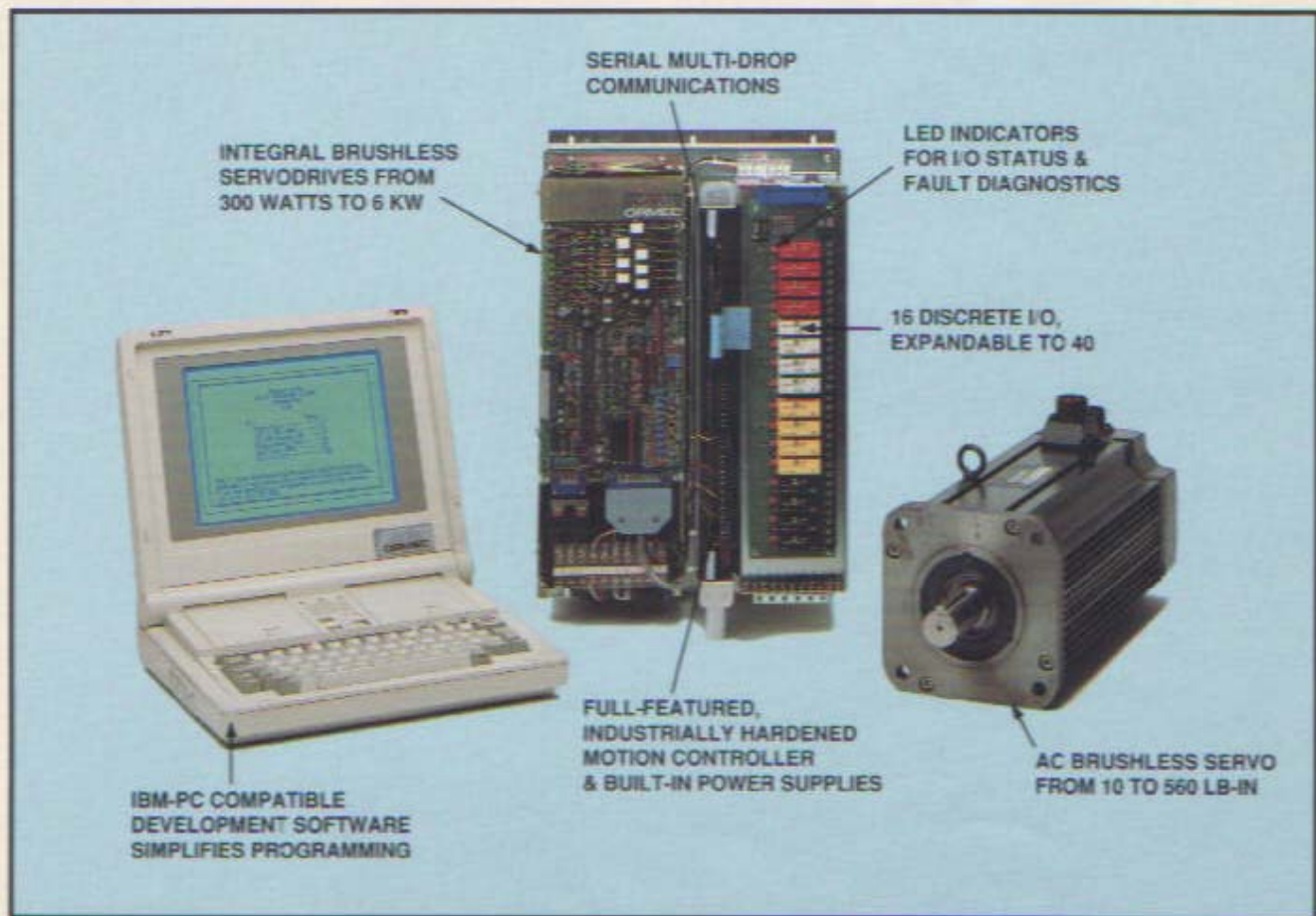
PROVEN TECHNOLOGY

While the MCS S-Series is at the forefront of electronic motion control technology, its internal components are field proven. Thousands of units are currently operating in the field in tough industrial applications, many of which are in 24 hour per day operation.

The high level of integration and modularity of this approach, combined with the reasonable price of the MCS-S Series, make it one of the most cost effective approaches in the market today. This is especially true if hidden costs associated with assembling a hodge-podge of motion control equipment into an integrated system is taken into account.

If you would like to see how easy the MCS-S series is to use, call ORMEC today and prove it to yourself. We guarantee that this new system is so easy to install and use that you'll be creating motion and writing MPL programs in less than one hour.

SERIAL MULTI-DROP COMMUNICATIONS

INTEGRAL BRUSHLESS SERVODRIVES FROM 300 WATTS TO 6 KW

LED INDICATORS FOR I/O STATUS & FAULT DIAGNOSTICS

16 DISCRETE I/O, EXPANDABLE TO 40

IBM-PC COMPATIBLE DEVELOPMENT SOFTWARE SIMPLIFIES PROGRAMMING

FULL-FEATURED, INDUSTRIALLY HARDENED MOTION CONTROLLER & BUILT-IN POWER SUPPLIES

AC BRUSHLESS SERVO FROM 10 TO 560 LB-IN

The MCS-S Series offers a plug-together AC brushless motion control system which has the performance needed for the most stringent applications. This highly integrated, modular approach provides a motion system which is cost-effective for single and multi-axis applications. Simply apply power and hook up your motor, and you're ready

Powerful Single Axis Motion Controller and Language

To meet the needs of today's flexible automation applications, a motion controller must do more than create motion. It must provide a wide range of standard motion control software, methods for coordinating machine I/O functions and the ability to work with a wide number of operator interface devices.

PROGRAMMING LANGUAGE

The MCS-S Series Motion Controllers feature a full Motion Programming Language, called MPL, which is "calculator like" in simplicity, yet powerful and fast in operation. (Reaction times are normally on the order of 1 millisecond.) This language operates independent of the motion being created allowing the motion controller to deal with information about the motion in process as well as machine I/O.

MOTION CONTROL WITH MATH

MPL now has a fully integrated math capability. Not just four-function arithmetic, but 20 numeric and logical functions, combined with ten 32 bit non-volatile registers. Math formulas and logical expressions can be used directly in MPL's intuitive commands for setting motion parameters and controlling motion. In addition, math formulas and logical expressions can be programmed to utilize real-time motion information such as current position or speed.

ENGINEERING UNITS
AND MUCH MORE

MPL with MATH can interface with a variety of I/O devices like thumbwheel switches, operator keypads and displays in engineering units. It also has the power to display information, provide English language prompting, and calculate multiple operating parameters such as accelerations, velocities and positional delays from one operator input such as machine speed (in units per minute). Conditional program branching and function calls based on the functions and registers are also provided.

EXTENDED I/O CAPABILITY

The standard MCS system, in addition to its serial communications port has 16 discrete I/O lines. With the optional EIO-900 daughter board, the user can add an additional RS-485/422 serial device, twenty-four discrete I/O points, two 8-bit analog inputs and one 8-bit analog output.

EXTENDED HARDWARE
COUNTER CAPABILITY

In conjunction with an optional EBC-900 daughter board, the user has access to an AM-9513 LSI counter chip which provides five 16-bit up/down counters which can be used in many, many ways.
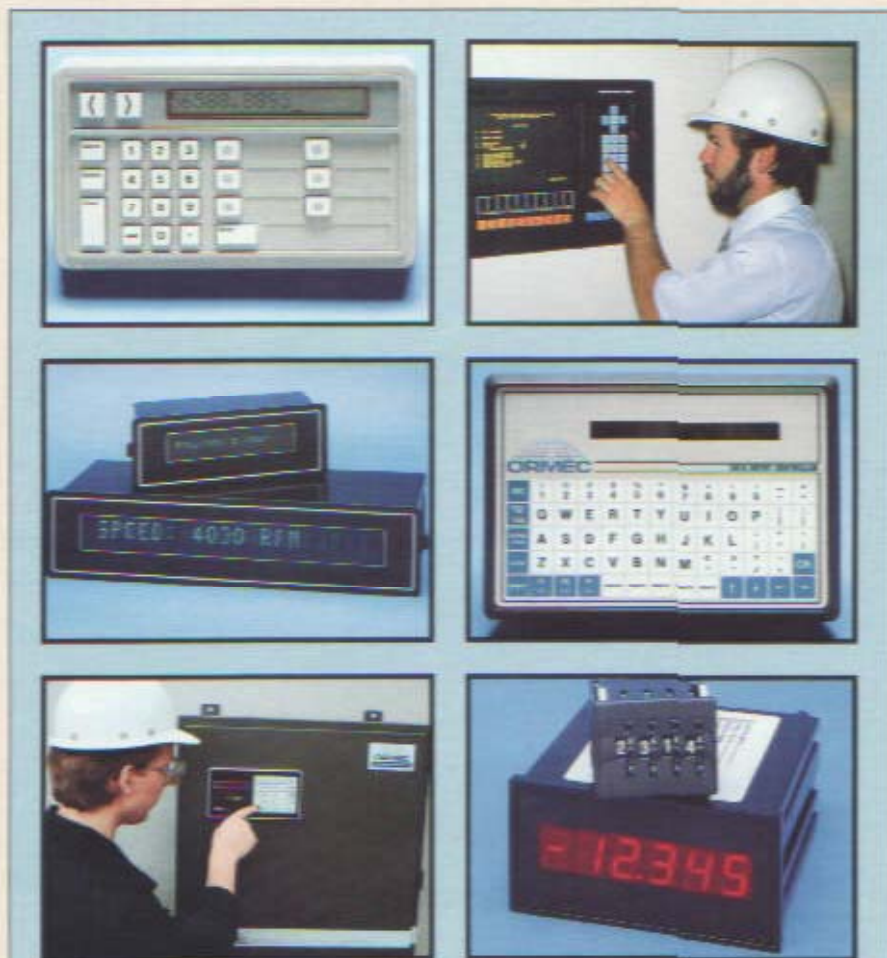
WIDEST VARIETY OF OPERATOR INTERFACE DEVICES
MPL MATH provides the ability for the MCS system to work with a wide variety of operator interface devices. An MCS can interface to industrial control panels or data entry controllers and can easily deal with Industrial Keypads, up to five thumbwheel switches (totaling up to 28 decades), up to thirty-two 20 character by 1 line alphanumeric displays, four six-digit numeric readouts, and virtually any "dumb terminal like" serial device.

Highest Quality of Controlled Motion

The quality of controlled motion is greatly underrated as a factor in selecting motion control equipment. Yet the quality of motion is not only a primary factor in overall system performance, but also key to system reliability. ORMEC takes this issue seriously, and has made quality closed loop motion a primary goal of the MCS-S Series products.

CLOSES ALL THREE MOTION CONTROL LOOPS

The MCS closes the current, velocity and position loops in hardware, creating the highest bandwidth position control system on the market. The benefit to the user is not just speed of response, but also quality and precision of the machine motion. This results in higher productivity from not only higher speed of response, but also greater overall machine reliability and improved product quality. Examples of the effect of bandwidth on product quality include superior surface finish when grinding under servo control and tracking precision in manufacturing media products, such as data tape and optical disks.

NO POTENTIOMETERS FOR TUNING

The MCS product closes both analog velocity and digital position loops in hardware, but with software controlled gains and loop compensators. Velocity loop feedforward and Type-2 position loops are enabled with software commands. Software controlled loop parameters provide many benefits including the ability to vary the tuning during machine operation and the ability of the system to compensate for a wide range of load inertias.

HIGHEST PRECISION

Our B and C Series AC Brushless motors feature a standard encoder resolution of 24,000 counts per revolution. Our phase lock loop positioning technol-

TYPICAL MOTION PROFILE

V - TOP VELOCITY

I - INDEX DISTANCE
(area under curve)
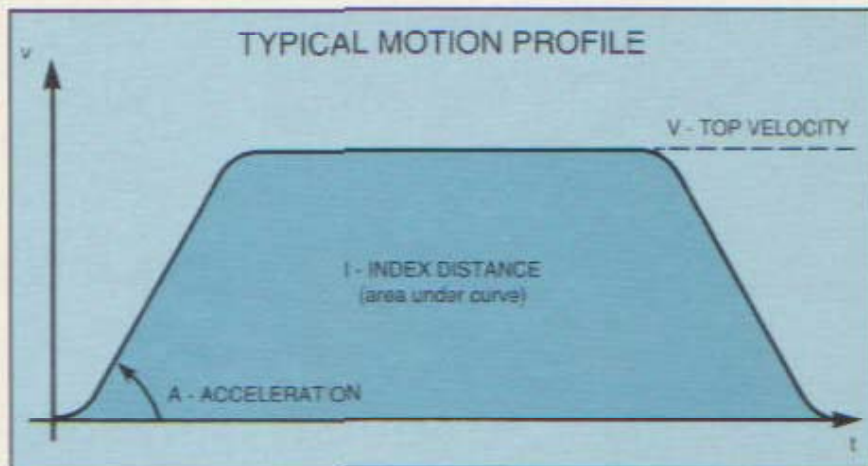
A - ACCELERATION

ORMEC motion control technology provides s-curve, linear and parabolic accelerations as standard. For a small non-recurring engineering charge, you can order your own custom acceleration profile.

ogy allows these motors to track commanded motion at the full accuracy of the encoder. ORMEC positioning technology has been used in rotary applications with greater than 250,000 counts per revolution and in linear applications to precision of less than a micron.

DISTRIBUTED FEEDBACK

Many high precision systems, using either rotary or linear feedback, benefit from placing the position transducer directly on the machine under control. While affording precise position feedback from the functional part of the machine, this can result in loss of control precision from the reduced bandwidth of the position loop due to mechanical considerations. ORMEC positioning technology allows *distributed feedback*, with the analog velocity loop still closed around the motor for maximum response, and the digital position loop closed around the total machine for maximum precision. And all the feedback loop parameters are software controlled.

FASTEST SPEED OF RESPONSE

The MCS-S Series, in conjunction

with our A-Series AC Brushless motors, allows 36° indexes, settling to an accurate final position in 10 milliseconds. A-Series AC Brushless motors have torques ranging from 26 to 257 lb-in peak, and provide acceleration rates up to 50,000 radians/sec². While the B and C-Series motors have slightly higher inertias than the A-Series, they provide peak torques to 945 lb-in.

QUICKEST REACTION TIME

A double buffered sensor input allows the MCS family to initiate motions in as little as 4 micro-seconds (yes microseconds). This feature has allowed high response servomotor based systems to function as continuous motion registration controllers, high speed press feeds, registration controlled rotary flying shears, as well as many other difficult applications.

SELECTABLE TORQUE LIMITS

The MCS-S Series provides a selectable torque limit which allows the forward and reverse torque limits to be set differently and/or be remotely set with analog voltages.

Multi-Axis Capabilities & Precision Electronic Lineshafting

The MCS-S Series is a modular motion controller which can be easily integrated into multi-axis systems. Simply select the proper units to meet your system's various speed and torque needs; hook up three phase standard AC power (no isolation transformers are required); connect the units via ORMEC's multi-drop serial bus with mass termination cable; and, optionally attach the two-wire electronic lineshaft if precise multi-axis synchronization is key to the success of the application.

The result is a multi-axis system which features distributed processing power making it cost-effective, flexible, powerful and easy to program.

ELECTRONIC LINESHAFTING

The MCS series motion controllers have a long heritage of electronic lineshafting, along with some new improvements to that heritage. The electronic lineshaft consists of a two-wire motion reference bus which can be "driven" or "followed" by any individual MCS system. In addition, individual systems can operate independently of the electronic lineshaft as appropriate under software control. Up to 32 servomotors can be synchronized on this bus.

HIGHEST RESOLUTION RATIOING

Standard on the MCS motion controllers is the ability to operate at a ratio to the electronic lineshaft to a precision finer than one part in 250 million. This capability has proven invaluable in precise winding and spooling applications.

ZERO DRIFT GEAR RATIOING

Even systems with a resolution of one part in 250 million can "drift" (a very small, but unacceptable amount) when attempting to run at a gear ratio specified by a rational number such as 1/3 or 23/67. ORMEC's electronic lineshafting technology allows specifying the gear ratio as a fraction, with both the numerator and denominator specified as 16 bit integers, providing zero drift operation.

ELECTRONIC CAMS, LINKAGES, AND SYNCHRONOUS INDEXES

A major benefit of electronic lineshafting is the flexibility with which the individual servomotors can operate with respect to the lineshaft. Programming an individual servomotor for synchronous or asynchronous operation with the electronic lineshaft is as easy as typing a few strokes on a calculator.

DISTRIBUTED PROCESSING POWER

The fact that each MCS unit can execute its own MPL programs, while both controlling the servomotor and communicating with a host computer makes high response multi-axis systems not only possible, but easy to program.

CONTOURING

Contouring capability is provided and has proven useful in a number of application specific instances, particularly in the area of electronic lineshafted systems, but also for other applications like X-Y Tables.

ENCODER DRIVEN LINESHAFT

The electronic lineshaft can also be driven by a remotely mounted position encoder, enabling the motion controllers to operate in synchronism with non-servo controlled machines.
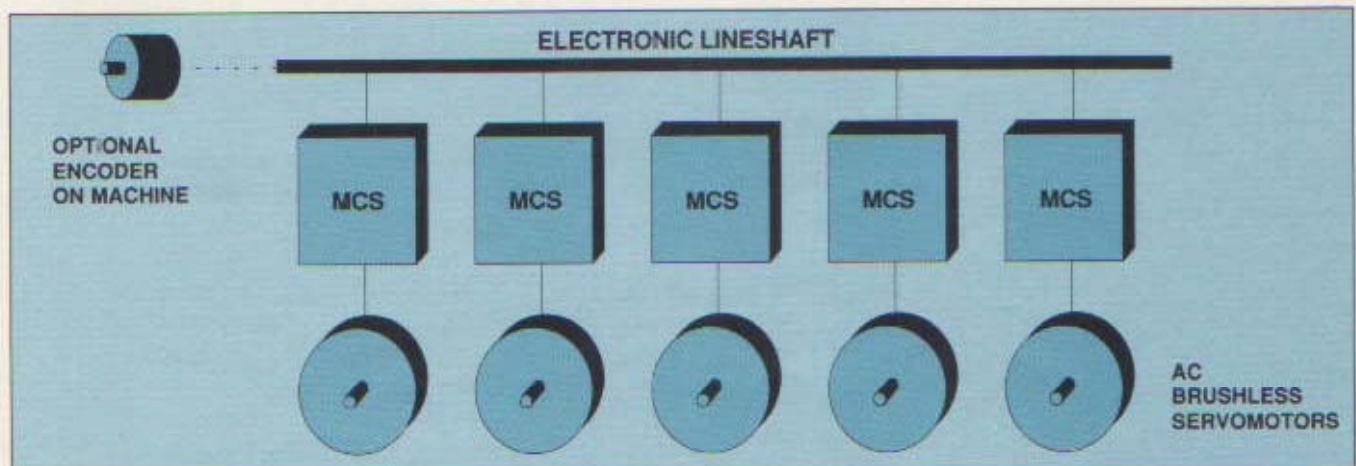
Up to 32 individual MCS systems can be attached to the electronic lineshaft. Any motion controller can drive the electronic lineshaft, or it can also be driven by a remotely mounted position encoder. Individual MCSs, with their attached servomotors, take the place of traditional gearboxes, differential gearboxes, speed variators, cams, four-bar linkages, crank mechanisms and other mechanical devices. They provide the flexibility to individually control motion in synchronism with, or independent of, the electronic lineshaft under computer control.

Unique Host Computer & Programmable Controller Interfaces

A standard MCS-S Series system can be used stand-alone, but many applications are part of an overall integrated automation system. These machine control systems utilize a variety of approaches, including programmable controllers and host computers. It is often a requirement for the motion controller to interface cleanly to the total machine control environment, either receiving or providing information to a host system. ORMEC has developed a number of cost-effective and powerful host interfaces for a wide range of application needs.

SERIAL MULTI-DROP BUSSED COMMUNICATIONS

Up to 32 MCS-S Series Motion Controllers can be attached to one serial port of a host computer on a multi-drop serial communications bus. The serial bus approach provides a significant speed and reliability advantage over competitive "loop communications" approaches. A simple two character attention sequence is used by the host to "dial up" the motion controller of choice. Communications are at speeds up to 38.4k baud, which takes 250 microseconds per character.

EASILY INTEGRATED WITH PROGRAMMABLE CONTROLLERS

The MCS-S Series is easily integrated with programmable controllers, whether large or small. There are two approaches to multi-axis motion control applications using Programmable Controllers.

Up to 8k of "canned" motion control routines can be written and easily executed under the control of even the smallest programmable controller through discrete I/O points.

Any programmable controller with ASCII I/O capability can coordinate the activities of up to 32 MCS systems over the serial communications bus as described above. ORMEC and its customers have experience using ASCII I/O interfaces with a number of programmable controllers including Allen Bradley, G.E. and Modicon.

### EASILY INTEGRATED WITH OTHER COMPUTERS

MCS-S Series Motion Controllers can have their activities coordinated by virtually any host computer over the serial communications bus. ORMEC and its customers have experience interfacing this technology with IBM-PC's, STD-Bus Computers, Multibus Computers, DEC LSI-11 and VAX Computers, and others.

SYSTEM STATUS POLLING

This unique feature allows considerable host communications even while the MCS system is executing an MPL program, including: reading and writing ten 32 bit registers, polling for an error, checking the current velocity, position or position error, status of the digital I/O and more.

COMMUNICATIONS ERROR CHECKING

MPL's *communications checksum* feature allows the host computer to do communications error checking prior to starting critical motion functions.
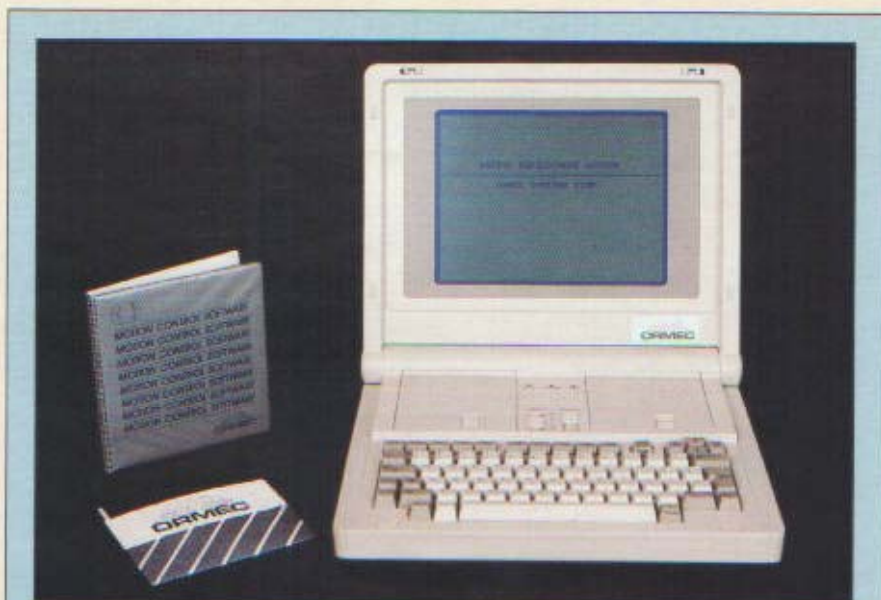
IBM-PC COMPATIBLE DEVELOPMENT SYSTEM
An example of ORMEC's powerful host communications is our *Laptop Development System* used to develop and maintain motion control systems. Standard software shipped with this system allows the user to interactively develop and/or troubleshoot single or multi-axis servo systems. It provides convenient upload/download features and a powerful documentation environment including a built-in text editor for editing and later archiving motion control programs. Real-time performance of your machine can be easily monitored without disturbing programs and the system can be interrogated to simplify maintenance. A servo analysis program provided calculates the torque requirements, G-forces, linear parameters & the voltage requirements of your machine to help select appropriate motors & drives.

Integrated Safety Features and Fault Detection

An extremely important, yet often overlooked, aspect of electronic motion control is operator safety. The MCS-S Series feature integral circuit breakers for both control power and main power, as well as integrated Emergency Stop, fault detection and dynamic braking capabilities. MCS-S Series based motion controllers have a well thought out, and easily implemented approach to these issues, whether the system is single axis or multi-axis.

FAULT DETECTION & DIAGNOSTICS

The MCS-S Series will detect the following errors and take the action indicated. All sixteen of the errors shown in the table on the right can be diagnosed from the LEDs on the package, without the need for any test equipment whatever. MPL-MATH also provides the flexibility to both trap errors and take appropriate action which makes for fully robust applications programs.

BUILT-IN FAULT DETECTION FEATURES

Error	Action
Servo Bus Overvoltage	Dynamically Brake to a Stop[1]
Servo Bus Undervoltage	Dynamically Brake to a Stop
Excess Main Circuit Current	Dynamically Brake to a Stop
Main Circuit Breaker Trip	Dynamically Brake to a Stop
Control Circuit Breaker Trip	Dynamically Brake to a Stop
Regeneration Circuit Failure	Dynamically Brake to a Stop
Loss of Feedback	Dynamically Brake to a Stop
Open Phase in Main Power	Dynamically Brake to a Stop
I/O Power Supply Failure	Dynamically Brake to a Stop
PMC +5vdc Power Supply Failure	Dynamically Brake to a Stop
Servodrive CPU Failure	Dynamically Brake to a Stop
Drive Heat Sink Overheat	Dynamically Brake to a Stop
Motion Controller RAM Failure	Flash LED on PMC[2]
Motion Controller ROM Failure	Flash LED on PMC
MPL Program Memory Failure	Flash LED on PMC
MPL Program Error	MPL+MATH allows the user the flexibility to trap on any MPL programming error(s) and take user defined action such as dynamically braking to a stop.

[1]Anytime the system detects a fault and dynamically brakes to a stop, the fault must be reset at the servodrive before the system can resume operation. Four LED Diagnostic Indicators and a seven-segment Alarm Indicator Display are provided to describe the fault.

[2]If these failures are detected at powerup, the motion controller will not run its "startup program" or enable the servodrive. In addition, the application program can check for failures and automatically disable the servodrive and dynamically brake the motor.

General Specifications

Environmental:
Operating Temperature: 0 to +50°C
Storage Temperature: -20 to +85°C
Operating & Storage Humidity:
0 to 90%, non-condensing

Incoming Power:
200-230 VAC, 3 phase, ±10%, 50/60 Hz
220 VAC, 3 phase, +10/-13%, 50/60 Hz

Available User Power Supplies:
+5VDC @ 500 ma
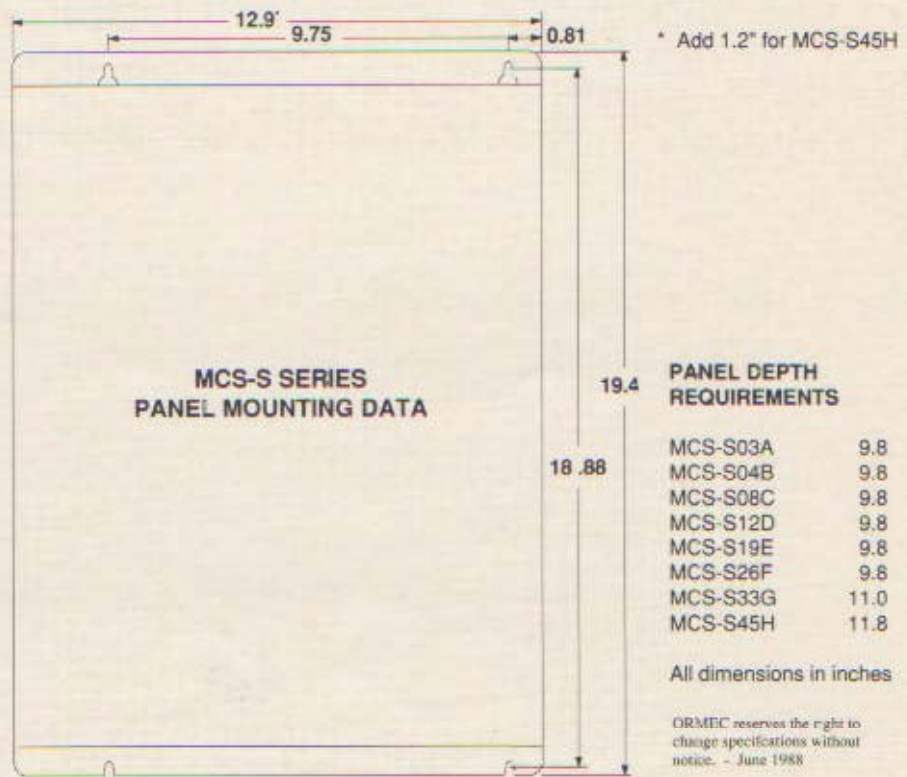+12VDC @ 200 ma
+24VDC @ 1.0 amps

Serial Communications:
RS-232C, RS-422/485/449 multi-drop, autobauds at rates of 38.4k, 19.2k, 9600, 4800, 2400, 1200, 600 or 300

Mounting:
Vertically oriented base mounting,
4 each #10 bolts
bolt pattern:18 7/8"h x 9 3/4" w

MCS-S SERIES PANEL MOUNTING DATA

12.9' — 9.75 — 0.81   * Add 1.2" for MCS-S45H
19.4   18.88

PANEL DEPTH REQUIREMENTS

MCS-S03A	9.8
MCS-S04B	9.8
MCS-S08C	9.8
MCS-S12D	9.8
MCS-S19E	9.8
MCS-S26F	9.8
MCS-S33G	11.0
MCS-S45H	11.8

All dimensions in inches

ORMEC reserves the right to change specifications without notice. – June 1988

System Performance Specifications & Ordering Guide

Model No	Power[1]	Weight	Current[2]	Compatible Servomotors		
MCS-S03A	0.8 kw	38 lbs.	8.5/3.1	MAC-A010A	4,000 RPM	26/10 lb-in
			8.5/3.0	MAC-B010A	2,500 RPM	26/10 lb-in
			8.5/3.0	MAC-B020A	2,500 RPM	52/20 lb-in
MCS-S04B	1.2 kw	38 lbs.	11/4.3	MAC-A015B	4,000 RPM	36/15 lb-in
			11/5.8	MAC-B025B	2,500 RPM	80/26 lb-in
MCS-S08C	2.1 kw	38 lbs.	16/5.3	MAC-A030C	4,000 RPM	65/30 lb-in
			17/6.2	MAC-B050C	2,500 RPM	135/53 lb-in
MCS-S12D	3.1 kw	38 lbs.	28/10.4	MAC-A055D	4,000 RPM	122/55 lb-in
			28/9.7	MAC-B080D	2,500 RPM	220/80 lb-in
MCS-S19E	4.1 kw	45 lbs.	36/15	MAC-B110E	2,500 RPM	302/110 lb-in
MCS-S26F	6.0 kw	50 lbs.	57/26	MAC-A110F	4,000 RPM	257/110 lb-in
			57/20	MAC-B200F	2,500 RPM	480/200 lb-in
			57/26	MAC-C290F	2,000 RPM	570/290 lb-in
MCS-S33G	8.0 kw	50 lbs.	77/30	MAC-B330G	2,500 RPM	675/330 lb-in
			70/33	MAC-C410G	1,500 RPM	818/410 lb-in
MCS-S45H	11.0 kw	54 lbs.	81/45	MAC-C560H	1,500 RPM	945/560 lb-in

[1] Power listed is the recommended incoming power-line service   [2] Current listed is peak/continuous PWM output current with the specified motor.

OPTIONAL MODULES

EIO-900   **Extended I/O Module:** Optional module adds I/O capability to MCS-S Series:
- ❏ 24 digital I/O points for discrete I/O, thumbwheels or numeric displays
- ❏ two 8-bit analog inputs and one 8-bit analog output
- ❏ one RS-485/422 serial port for operator interface devices

EBC-900   **Encoder Back-up Compensator:** Optional module provides five 16-bit software configurable up/down counters, and allows MCS-S Series systems to precisely synchronize motion with other machinery by using an optical incremental encoder as the machine position transducer

REGENERATIVE DISCHARGE

SAC-SRDU   **Regenerative Discharge Unit:** Panel-mounted unit required for MCS-S45H only

MACHINE I/O ACCESSORIES

Each MCS-S series unit is equipped with a 16-slot, Opto22 compatible I/O rack for coordinating machine I/O functions, and may be omitted if it is not required for your application. I/O modules are not included with the unit, but are available separately.

IDC-5   **DC Input Module:** 32 VDC max; white; optically isolated

IDC-5B   **DC Input Module, Fast Response:** 32 VDC max; white; optically isolated

IAC-5   **AC Input Module:** 140 VAC max; yellow; optically isolated

ODC-5   **DC Output Module:** 60 VDC max; red; optically isolated

OAC-5   **AC Output Module:** 140 VAC max; 3A; black; optically isolated; zero-crossover load switching