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**Custom engineering**
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# Generation III

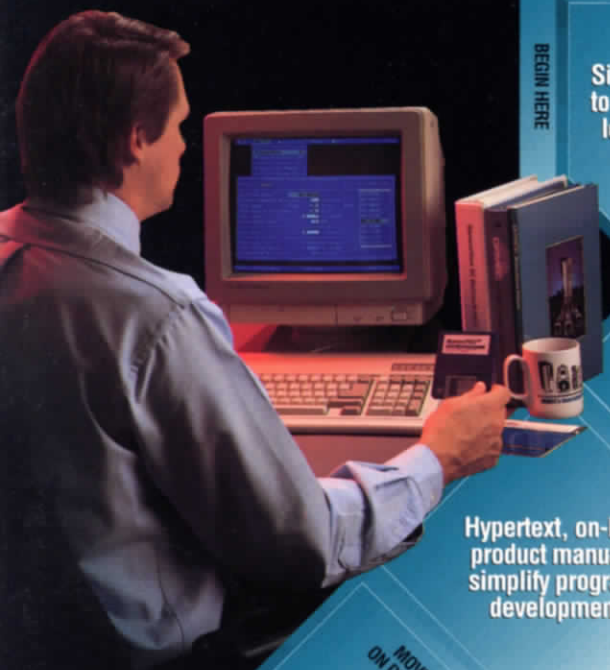



# Product Guide

ORMEC

MOTION CONTROL SOLUTIONS

# Servo motion control that improves your performance



BEGIN HERE

Since you know how to program in BASIC, learning ORMEC's MotionBASIC® saves you time & energy.

MOVE AHEAD

Direct DSP-to-DSP communications every position loop update provides ultra-precise electronic gearing

DSPs can independently "repeat" complex gear or motion sequences to maximize performance & simplify programming.

MOVE AHEAD

Hypertext, on-line product manuals simplify program development

MOVE AHEAD ON DEVELOPMENT



40 MHz digital signal processors provide power to perform accurate, reliable 90° indexes in as little as 10 milliseconds

Generation III's multi-processor architecture always provides 5 MIPs of processing power per axis plus floating point math.

Programming tools make writing software for Man-Machine Interfaces a snap.




MOVE AHEAD WITH TECHNOLOGY

MOVE AHEAD WITH CONFIGURABILITY

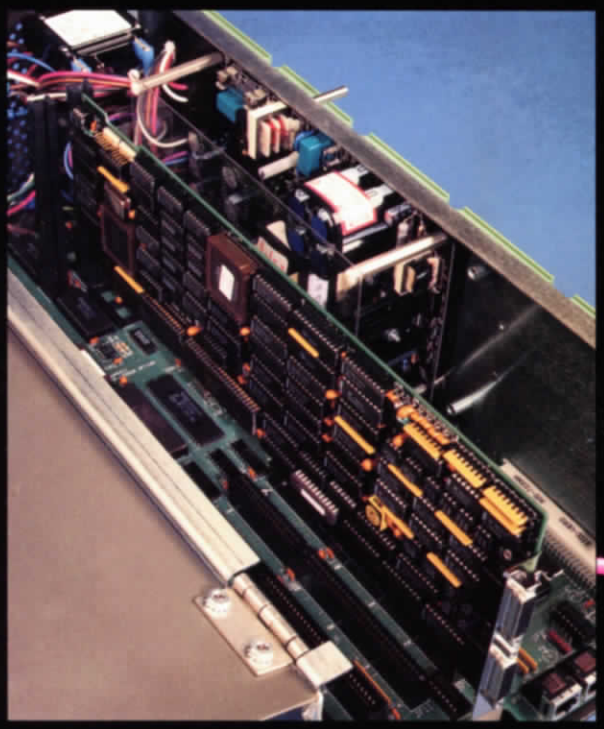
ORMEC's Model 20 & Model 40 controllers provide cost-effective solutions for applications 1½ axis and up.

PC/AT style backplanes in both controllers provides easy access to standard network, video & serial cards.

| APPLICATION SUCCESSES | |
|---|---|
| Reciprocating flying cutoffs | ○ |
| Form-fill-seal machines | ○ |
| Pin insertion machines | ○ |
| Trending registration systems | ○ |
| High speed point-to-point positioning | ○ |
| Composite winding machines | ○ |
| Motor armature winding machines | ○ |
| Paper, foil wind/unwind systems | ○ |
| Bag making machines | ○ |
| Labeling machines | ○ |
| Printing machines | ○ |
| Flying shear controls | ○ |
| Press feed controls | ○ |
| Packaging machines | ○ |
| Cut-to-length controls | ○ |
| Textile machines | ○ |
| Conveyor synchronization systems | ○ |
| Tension controls | ○ |
| Large factory networked systems | ○ |

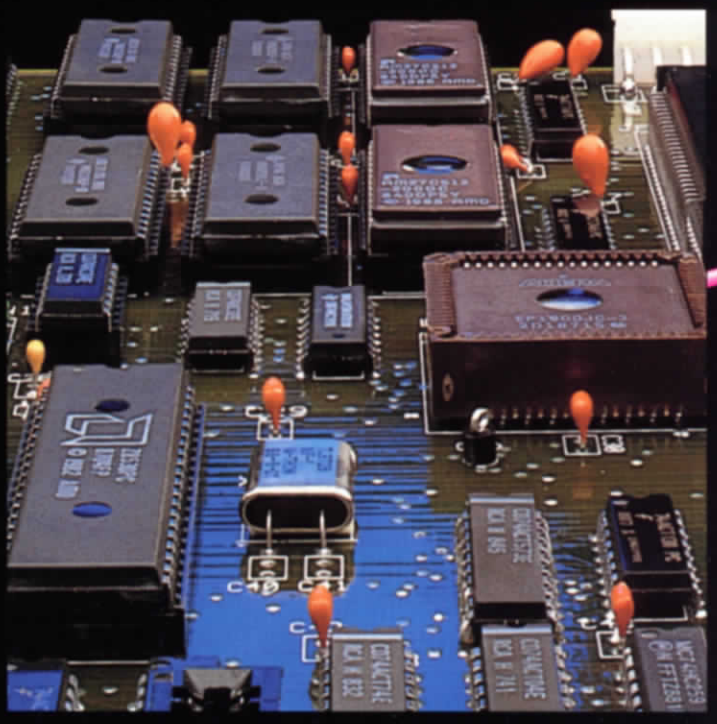
***Seeing is believing! Call us today at (716) 385-3520 to set-up a demo and see how elegantly we can solve these application problems or to discuss your specific project.***

# A fully-integrated solution for multi-axis,



***ORMEC's goal with Generation III is to provide a totally integrated family of servo motion control products. From motion controllers which offer DSP technology and MotionBASIC® programming---to servomotors & drives that reliably deliver power, speed and precision. Plus elegant, rock-solid interfaces which simplify integration with discrete I/O, operator interfaces & PLC networks. A product line built on the concept that "a system is greater than the sum of its parts".***

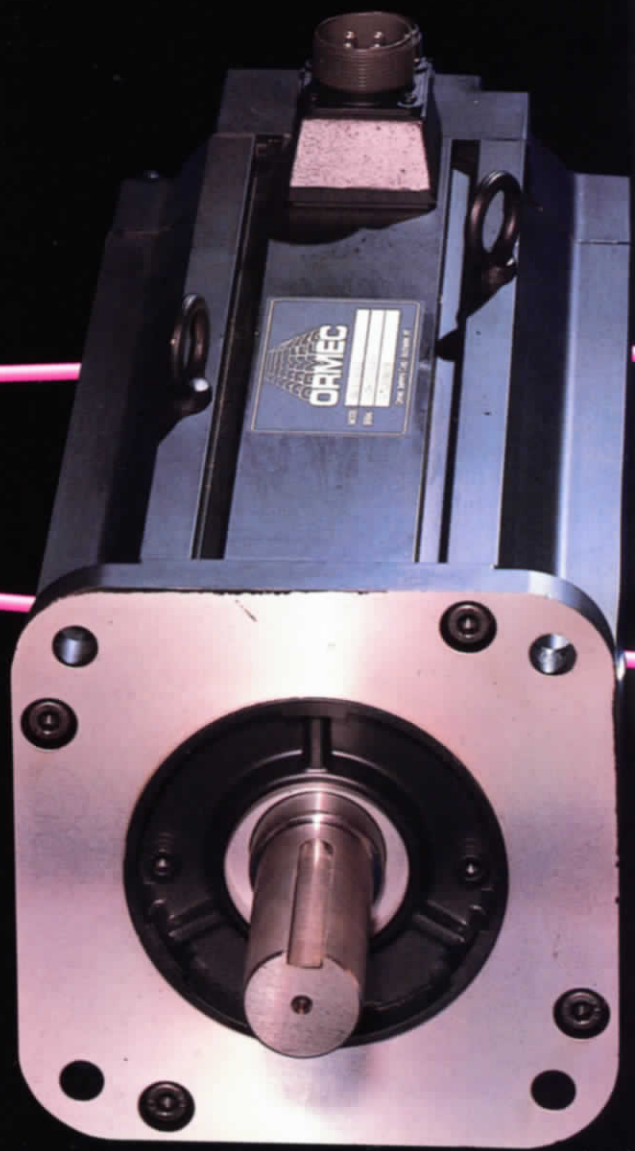
**State-of-the-art hardware is the foundation.**
Generation III is a fully integrated solution for controlling AC brushless servomotors plus operator, machine I/O and host communications. A full-featured servodrive interface---along with fault diagnostics, watchdog timers and industrially-hardened circuitry---makes Generation III a pre-engineered, plug-compatible motion control solution.

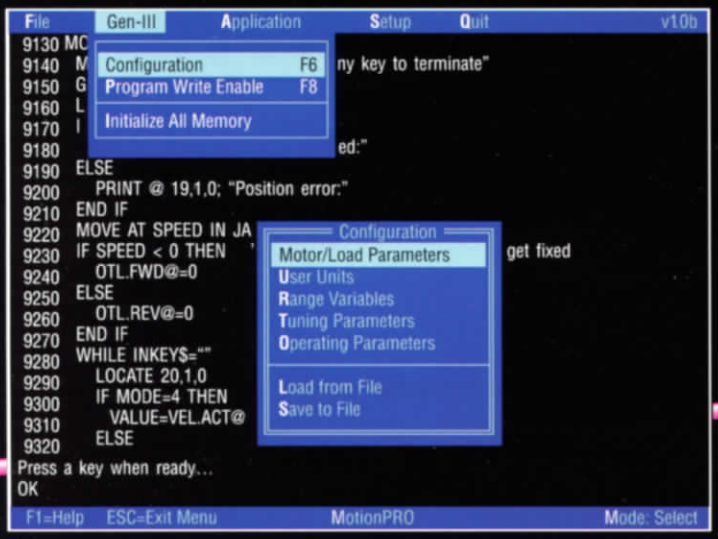


**New all-digital technology.**
Everyone is talking about DSPs (digital signal processors) as the wave of the future for servo motion control; ORMEC has them today. Generation III uses a Texas Instruments DSP (running at 40 MHz) for servo loop control at update rates up to 5,000 times per second. It integrates DSPs with an Intel main processor with a unique shared memory interface. This multi-processor architecture not only delivers superlative performance, but also dramatically reduces the complexity of using servos at prices competitive with microsteppers. Don't be fooled by systems that try to do too much with one microprocessor, or a less sophisticated architecture.

# servo motion control ...





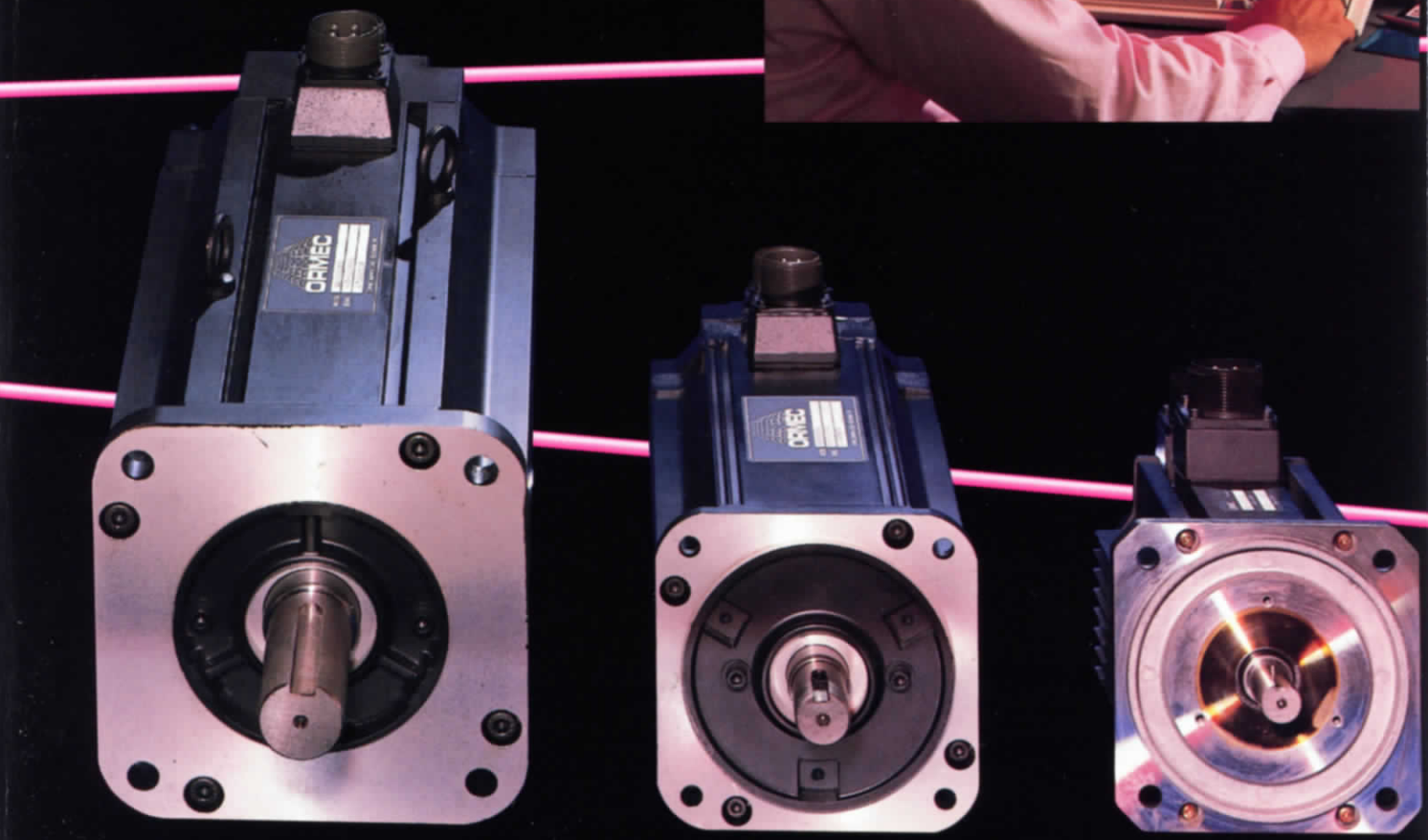

## A Motion PRO At Your Side.

Learning new software can be a frustrating experience. And while it helps to have a detailed manual, nothing beats having a software package that's intuitive, easy to use and provides on-line, context-sensitive documentation. That's why Generation III includes MotionPRO™, a PC-compatible development environment which provides "pull-down" menus and "pop-up" windows to simplify application development. MotionPRO™ features user-friendly menus for configuring your motion control system and a powerful program editor to speed software development. Plus quick, context-sensitive access to an unprecedented level of on-line help.

## Motion programming has never been this BASIC.

At the heart of Generation III, you have a programming language that's both powerful and easy to use. Developed from the ground up, MotionBASIC® is an industrial-strength motion control language which combines the power and simplicity of BASIC with elegant, built-in statements for motion, I/O and operator interface. MotionBASIC® Tools provide a standard menu system, including pre-engineered I/O display and fault handling menus to help you develop your program in record time.








## The future belongs to those who communicate.

As industry worldwide moves toward higher levels flexible manufacturing, communications is increasingly important. That's why Generation III motion controllers offer a variety of communications interfaces. In addition to standard serial ports, Generation III utilizes an IBM PC/AT style backplane for its DSP servo modules and optional I/O adapters. Operator interface devices including industrial terminals, keypads, displays are an integral part of the Generation III solution. Along with high-level PLC network interfaces like Allen-Bradley's Data Highway Plus™ or Modicon's Modbus™ and S908 remote I/O networks.





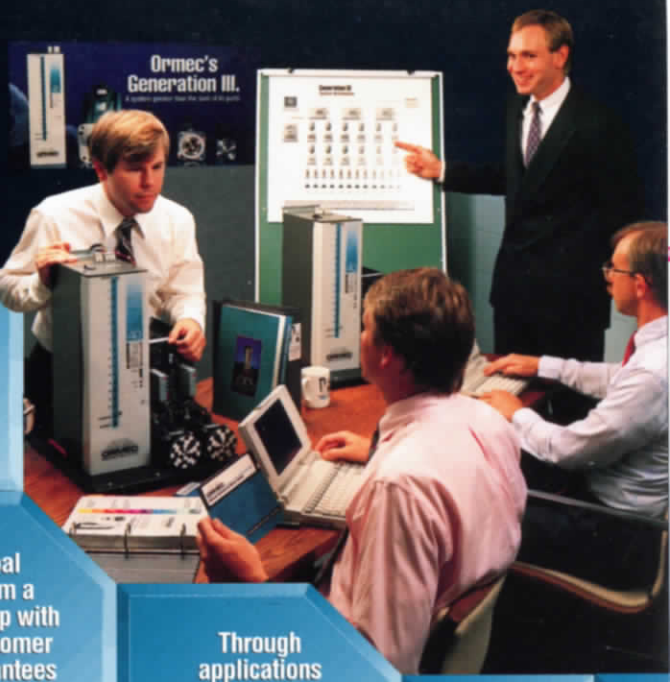







## A system greater than the sum of its parts.

Motion control applications aren't easy. That's why---with Generation III---ORMEC concentrated on developing a complete SYSTEM for servo motion control. Highly integrated hardware to simplify system configuration. A state-of-the-art computer architecture featuring DSPs for the ultimate in all-digital, closed loop performance. Development software, programmer's tools and the industry's first industrial BASIC with fully integrated motion control. Plus interfaces that allow the motion controller to work in concert with the rest of your machine. All developed with one goal: providing servo solutions for your real-world problems.




KEEP MOVING AHEAD

Select from Modbus™, S908/Modbus™ & Data Highway Plus™

You can easily manipulate I/O and send or receive data on popular PLC networks.

Our goal is to form a partnership with each customer that guarantees mutual success.

Through applications support, training and service, we'll keep you moving ahead every step of the way!



Up to 528 analog & digital I/O plus programmable limit switches are fully integrated

ORMEC's torque mode servos eliminate tedious manual system set-up.

Adjustable S-curve motion profiles provide smooth accelerations

Absolute encoders with 100,000 revolution range guarantee your system will always know its position.

MOVE AHEAD WITH FLEXIBILITY

MotionCARD™ Memory Disks provide up to 4 megabytes of program & data storage

...and simplify field installation & maintenance of machine set-up, motion programs & "product recipes"

*Servo motion control offers tremendous potential for improving the speed, reliability and productivity of industrial automation. But tapping this potential requires---first and foremost---applications expertise which can translate technological capability into practical, effective, day-to-day servo control solutions.*

*With Generation III, ORMEC converted years of experience with hundreds of applications into a new family of motion controllers. A full variety of products---motion controllers, servomotors, drives, operator interfaces & networks ---with software to provide all the tools you need for your next project. Plus a staff that is knowledgeable & totally dedicated to service, training and support of servo motion control systems.*

*See for yourself if Generation III can provide the answers for your next project.*

# A family of products with guaranteed

## *A complete array of products guaranteed to work together in your next application*

Motor Selection Charts on pages 50-51.



Generation III is a totally integrated family of products for servo motion control.

From motion controllers, to a wide variety of AC brushless servomotors and drives, to operator interface devices, machine I/O and convenient interfaces to PLC networks---ORMEC offers a full complement of standard hardware and software products guaranteed to work together in your application.

### Motion Controllers

The Generation III Model 20 and Model 40 controllers are the heart of ORMEC's line of servo motion control products. The two controllers are 100% compatible, feature the MotionBASIC® programming language, and are designed to meet the needs of particular applications:

- Model 20 — For 1 1/2 to 4 axis applications
- Model 40 — For 2 1/2 to 8 axis applications
- Models 20 & 40 — Networked in large multi-axis systems

### AC Brushless Servomotors & Drives

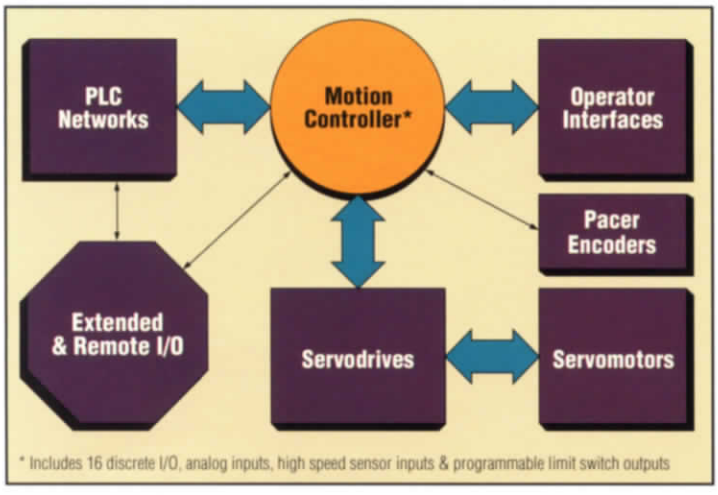
ORMEC's standard line of AC brushless servomotors and drives provide torques from 2 to 560 in/lb, speeds to 4,500 RPM and encoder resolutions up to 24,000 counts per revolution.

### Operator Interface Devices

A compact industrial terminal, an industrial CRT and a numeric keypad offer a spectrum of convenient, cost-effective choices for operator interface. User-friendly software makes programming these devices a snap!

### Machine I/O

Each controller offers 16 discrete I/O, high speed sensor inputs, programmable limit switch outputs and optional analog inputs. To extend machine I/O, you can easily:







*ORMEC's Generation III Model 20 and Model 40 motion controllers.*

- add an I/O rack for up to 24 additional discrete I/O;
- use Opto-22's Pamux for up to 512 analog or digital I/O;
- access additional I/O via a PLC network interface.

### PLC Network Communications

Generation III provides easy-to-use PLC communications via Modbus™, Data Highway/Plus™ or S908/Modbus™ PLC networks. MotionBASIC® *language extensions* provided on plug-in MotionCARDs™ set-up automatic background communications over PLC networks. PLCs and industrial computers can use these networks to access *any* Generation III data including torque, speed, position and diagnostic information. "Product recipe" and machine status information can be easily communicated. With S908/Modbus™, Generation III operates as a remote I/O drop of a Modicon PLC.

### Pacer Encoders

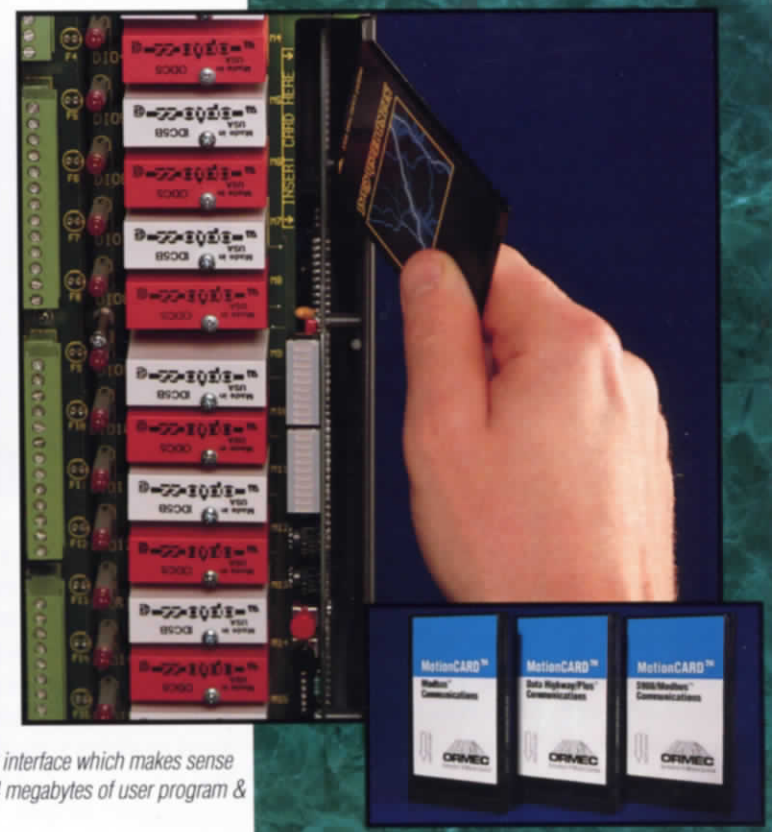
For electronic gearing applications, a "pacer encoder" conveniently interfaced to a DSP Axis Module monitors machine travel allowing precise ratioing and synchronization of multiple servos to existing machinery.

# compatibility ...




*ORMEC's standard line of AC brushless servomotors and drives operate as "torque mode servos"---eliminating manual servodrive set-up and providing direct software control over commanded torque and torque limits.*




*A variety of operator interface options (left) allow you to select a fully integrated operator interface which makes sense for your application. Generation III also features memory disks (right) for adding up to 4 megabytes of user program & data storage plus MotionCARD™ language extensions for PLC communications.*

# A full servo solution using a multi-

## *State-of-the-art hardware and architecture provides a powerful, reliable foundation*

*Motion controller specifications on pages 25-27.*

ORMEC sells motion controllers, but that's not what you're really after. What you want are the things a motion controller can do for you---provide fast, flexible, consistent motion that is easily programmed and exceptionally reliable.

Our goal with Generation III is to supply our customers reliable hardware that provides a fully-integrated, plug-compatible solution. So you can concentrate on an overall control scheme and software that will improve the performance of your automation.

### Fully integrated for your needs

Generation III is a family of integrated, multi-axis motion controllers that provides solutions for a wide variety of application needs. Here's an overview of the new Generation III Model 20 and upgraded Model 40 controllers:

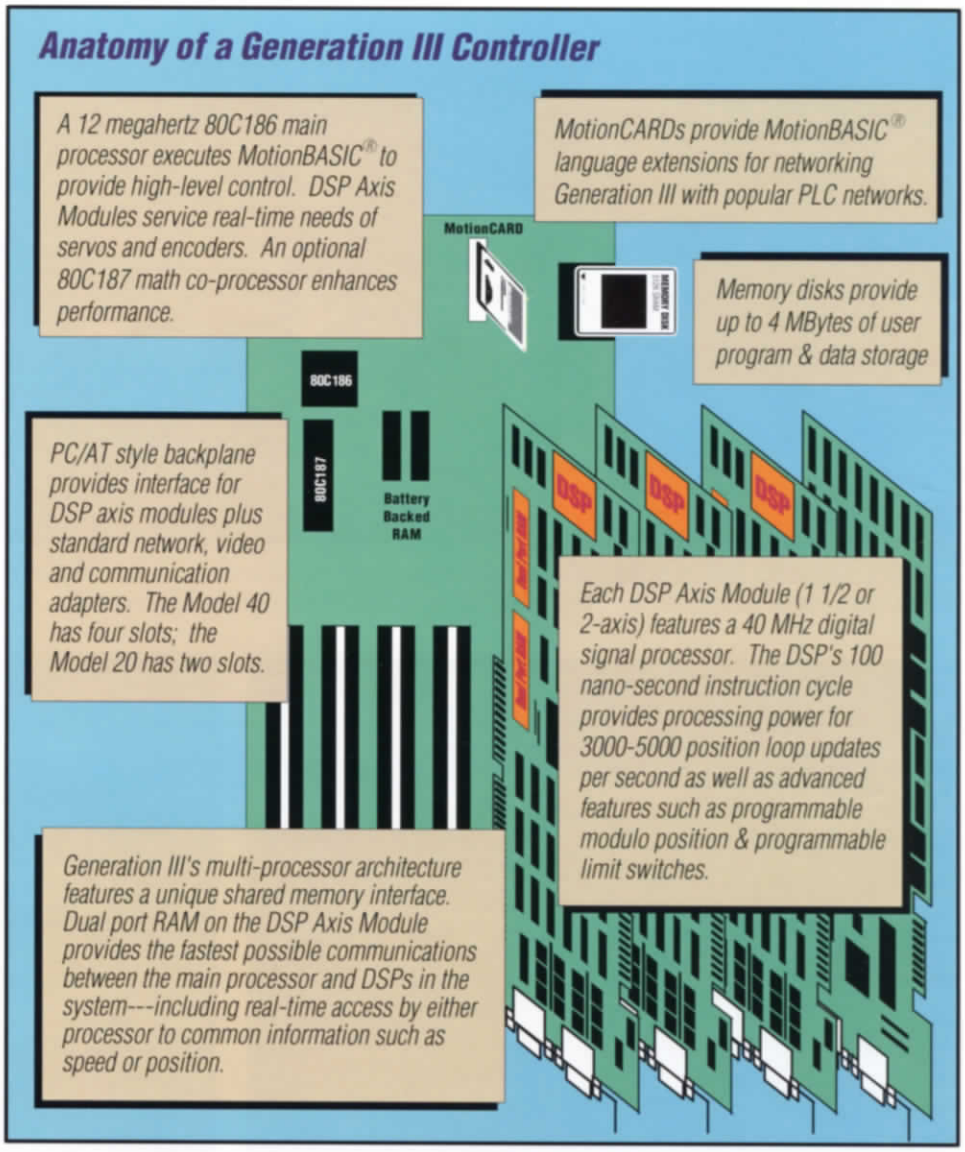
***Multi-Processor Architecture:*** By tightly interfacing the controllers main processor with high-speed digital signal processor(s) on the DSP Axis Modules, Generation III offers unsurpassed motion performance. A shared memory interface, utilizing dual port RAM, guarantees the fastest possible inter-processor communications.

***DSP Performance:*** In addition to the DSP's ability to insure superlative closed loop operation, Generation III features MotionDATA™---a direct DSP-to-DSP link for electronic gearing and multi-axis synchronization applications.

***PC-AT Style Backplane:*** Generation III's open architecture allows you to plug-in DSP Axis Modules (1 1/2 or 2-axis versions)---plus standard network, video and serial cards. ORMEC's optional adapters are also fully integrated into the MotionBASIC® software environment.

***User program storage:*** On-board lithium battery backed CMOS static RAM is adequate for most applications.

### Anatomy of a Generation III Controller




***Memory Disks:*** If your application requires additional memory, PCMCIA-standard memory disk (Flash PROM or Static RAM) technology currently provides up to 4 Mbytes of additional solid-state memory. Removable credit card-sized modules simplify field installation and maintenance of motion programs and product recipes.

***MotionCARDs™:*** MotionBASIC® language extensions for specialized application add-ins such as standard PLC network communications can be installed in the internal MotionCARD™ slot.

***Machine I/O:*** All Generation III motion controllers include 16 discrete I/O points compatible with Opto-22 style modules. They are accessed at pluggable

# processor architecture ...

terminal blocks and are individually software-configurable as inputs or outputs. Inputs can be configured as latches---allowing them to capture high speed sensor signals---and may also be used to interrupt program operation. All analog and digital I/O are accessed by MotionBASIC® as pre-defined arrayed variables.

**Extended Machine I/O:** Generation III's optional Extended I/O Interface includes 24 TTL-level I/O points at a 50-pin Opto-22 compatible connector. These I/O points are configurable as inputs or outputs, or this connector may be used to access 512 analog or digital I/O points using Opto-22's Pamux standard.

**DSP Axis Modules:** Each DSP Axis Module interfaces two servos, or a pacer encoder and a servo, and provides full fault diagnostics including open wire detection, servo alarm codes, and watchdog timer interlocks.

**DSP Axis Module I/O:** Each DSP Axis Module also provides two high-speed sensor inputs, six programmable limit switch outputs and four optional 12-bit analog inputs---as well as software and hardware overtravel limits.

**Motor/Drive Interface:** The servomotor/drive interface has been carefully designed---with a thorough consideration of cabling, shielding and voltage tolerances.

**Communication Ports:** An RS-232 serial port is provided for program development using an IBM-PC or compatible running our MotionPRO™ development software. The built-in, RS-422 serial port is fully supported in software to provide an elegant, inexpensive way to interface with operator keypads, compact terminals or Modbus™ for factory communications.

**System Diagnostics:** Sixteen digital I/O LEDs and 22 diagnostic LEDs make it simple to diagnose many problems immediately without test equipment.

## Why Digital Signal Processors for Motion Control?




The latest buzzword in motion control is the term DSP---which stands for Digital Signal Processor. These revolutionary ICs are hardware intensive microcontrollers developed for digital signal processing, and make it possible for motion controllers to utilize all-digital control algorithms while maintaining the highest level of performance.

General purpose microprocessors can be used to implement motion control algorithms. But they require so much time to perform multiplication instructions that they degrade servo bandwidth and other processing capabilities. A lack of power that also rules out beneficial control algorithms. DSPs, on the other hand, utilize specialized arithmetic logic units (ALUs) and other advanced hardware features such as Harvard architectures which make them capable of the high speed processing needed for discrete-time control applications. A DSP's ALU handles *multiply & accumulate* operations in a single cycle---particularly important for motion control since discrete-time control algorithms are dominated by multiply and accumulate instructions.

### DSP vs. Microprocessor Performance Comparison

| Feature | 320C25 | 8088 | 80C196 | 68020 |
|---|---|---|---|---|
| Frequency (MHz) | 40 | 5 | 12 | 12 |
| Clock Time (ns) | 25 | 200 | 83 | 83 |
| Multiply & Accumulate Clocks | 4 | 188 | 31 | 36 |
| Multiply & Accumulate Time (us) | 0.1 | 37.8 | 2.6 | 3 |
| **Performance Factor** | **100%** | **0.26%** | **3.8%** | **3.3%** |

The virtual absence of analog noise in the loops and the DSPs mathematical precision results in systems which uniquely combine bandwidth, accuracy and quietness of operation. DSPs maintain mathematical precision by implementing 32-bit hardware shifters that assure accuracy on intermediate results and eliminate scaling and truncation errors.

Generation III utilizes the Texas Instruments TMS320C25 digital signal processor for discrete-time control---an innovation that provides benefits for motion control:

***Elimination of Tachometer:*** Superior velocity loop performance is maintained without the disadvantages of analog tachometers because the DSP implements sophisticated and precise velocity observers. The velocity observer derives information from a digital position feedback transducer. Standard encoders provide resolutions up to 24,000 counts per revolution and operate at rates from zero to one million counts per second.

***Accuracy & Precision:*** All tuning parameters are under software control. Implementing integral plus proportional algorithms in both velocity and position loops provides accuracy and stiffness in the presence of real-world loads with varying friction and other disturbances. Loop performance is enhanced by DSP algorithms which provide position, velocity *and* torque loop reference information to minimize dynamic loop inaccuracies. Drift is virtually eliminated using discrete-time algorithms for control.

***Ease of Use:*** Fundamental loop parameters are defined by real-world axis parameters of inertia, motor/servodrive torque gain and the desired velocity loop time constant. All other parameters are automatically scaled to meet the defined performance objective criteria. Though not usually necessary, all loop parameters and performance criteria can be easily modified under program control.

***Flexibility of Control:*** Position velocity or torque mode is software-selectable. Axis position is maintained to 32-bits with programmable limit switches. Or position may be configured to repeat automatically each tooling cycle. In addition, three software-controllable programmable limit switch outputs are provided for each axis.

# Fully-integrated operator interfaces

## *Elegant communications with operator interfaces & PLC networks*

*For more info on operator interface options, see pages 38-41. For more on PLC networking, see pages 42-49.*




Standard PLC network and operator interface solutions are easily interfaced using Generation III's built-in MotionNET™ port or PC/AT bus architecture. ORMEC software elegantly integrates these capabilities with your MotionBASIC® program and greatly simplifies their use.

### Operator Interface

ORMEC's operator interfaces have been selected to cover a wide range of application needs. But whether your application requires a compact industrial terminal, a full-color CRT or a small numeric keypad---a full range of software support makes your job easy.

ORMEC's MotionPRO™ PC development software provides a variety of standard software tools. "Error Handler" and "I/O Status" menus can be linked into your application software and provide elegant software for fault handling---plus the ability to view the status of I/O. Our "menuing system" makes it simple to create operator data entry screens for your application.

### Generation III PLC Networking

PLC Communication MotionCARDs™ provide access to popular PLC factory networks. Supplied on a plug-in MotionCARD™, they include a menu-driven SETUP program and a hypertext on-line manual. Automatic background communications are provided for popular PLC networks including Allen-Bradley's Data Highway/Plus™ as well as Modicon's Modbus™ and S908. Use of a factory network allows a motion controller to easily share information with PLCs and/or supervisory computers. Generation III can easily:

- Communicate any motion control data (e.g. torque, speed,

## *Generation III Operator Interface Options*




### *Compact Industrial Terminal*

*Model: MMI-840*

Description: The MMI-840 (8-line x 40 character display) is a compact industrial terminal that features a 30-key keypad with eight function keys. The keypad is watertight (NEMA 4) and has amply spaced rubber keys which provide tactile feedback and reliable plant floor operation. The terminal interfaces to the Model 20 or Model 40 controllers via either the built-in RS-422 MotionNET™ port or an optional Serial Communications Adapter. It operates from 24 VDC provided by the Generation III motion controller.

Applications: Cost-effective for applications that require data entry, easy-to-understand operator messages and access to diagnostic screens---but don't require the sophistication of a full-blown industrial CRT. Data entry screens are easy-to-create utilizing MotionPRO™ MMI Tools. Standard "Error handler" and 'I/O Display Menu' are easily linked into your application program.



### *Operator Interface Terminal*

*Model: OIT-EGA and OIT-MONO*

Description: Our Operator Interface Terminal is a rugged industrial monitor ideal for plant floor applications. Features 10 function keys, a 3 x 8 data entry keypad and a NEMA 4/12 sealed front panel. Interfaces to Model 20/40 controllers via ORMEC's standard video adapter.

Applications: Ideal for applications that require an industrial CRT. Data entry screens are easy-to-create utilizing MotionPRO™ OIT Tools. Standard "Error handler" and 'I/O Display Menu' are easily linked into your application program.



### *Industrial Numeric Keypad & Display*

*Model: ITM-270*

Description: The ITM-270 (7.1" x 7.1" x 1.06") keypad and display features 10 numeric input keys, six function keys and a 16-character by one-line alphanumeric LCD display. The terminal interfaces to the Model 20/40 controllers via either the built-in RS-422 MotionNET™ port or an optional Serial Communications Adapter. Power can be supplied from the Generation III controller.

Applications: Ideal for applications which require simple data entry---and where cost-efficiency is important.

# & PLC networking ...

position and diagnostic information) with PLCs and operator interfaces

► Send/receive customer product recipes in the form of MotionBASIC® variables

► Operate as a remote I/O drop on a Modicon S908 remote I/O network.

### Modbus™ Communications

Modicon's Modbus™ represents the least expensive PLC network communication alternative.

This approach uses standard serial communications hardware and can conveniently interface to either the Model 20 or 40 using a Communications Adapter or the MotionNET™ port.

Modbus™ is a master/slave network which has a ***single master*** device. The master originates all communications and can be a computer, operator interface or Generation III motion controller. Modbus™ supports up to 247 slave devices which can provide or receive information on the network, but cannot initiate communications.

### Data Highway/Plus™ Communications

Allen-Bradley's Data Highway™ and Data Highway Plus™ are powerful, peer-to-peer network communications products.

Using Data Highway™ or Data Highway Plus™ requires installing a high speed network adapter in Generation III. Its co-processor coordinates with Generation III to maintain MotionBASIC® performance at generally 90% or more---even with heavy network traffic.

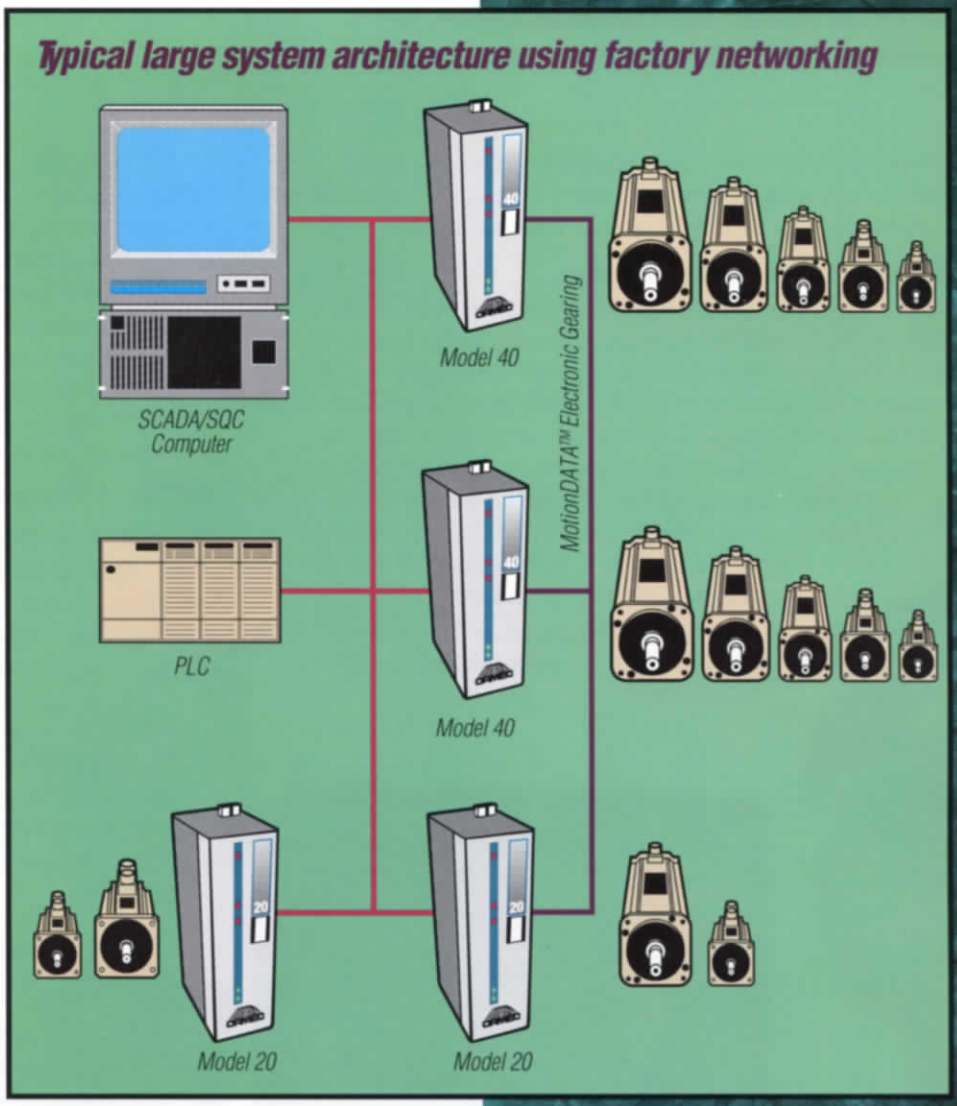
Data Highway Plus™ utilizes a token-passing scheme that rotates mastership among any station on the network---and operates at 57.6 or 115.2 Kbaud over twinax cable. While Data Highway™ allows up to 256 stations, Data Highway Plus™ provides faster communications for most motion control applications which have 20 stations or less.

### S908/Modbus™ Communications

The S908/Modbus™ alternative allows one or more Generation III controllers to be connected to a Modicon 984 PLC as remote I/O drops. The PLC can then read and set I/O points in the Generation III controller in exactly the same way as standard Modicon I/O. A unique feature added by ORMEC allows the PLC to send and read data using Modbus messages on the same high-speed coax cable.

A high-speed network adapter and co-processor is installed in the Generation III controller's backplane. This allows data communications as well as I/O to be transferred at PLC scan rates (typically 4-40 msec). The network operates at 1.5 MHz on coaxial cable, allowing up to 24 integer variables and 64 I/O points to be transferred in a single PLC scan.

**Typical large system architecture using factory networking**



# Motion programming has never been

## *An industrialized superset of Microsoft BASIC enhanced for motion control applications*

**For a free MotionBASIC® Hypertext disk, call ORMEC at (716) 385-3520**

On the software side, Generation III 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. According to Bill Gates, Microsoft's chairman and CEO, "...in the case of BASIC, the language is flourishing. If BASIC becomes a universal macro language, as I think it will, it may outlive all the procedural languages. BASIC may, in fact, outlive us all."




ORMEC's MotionBASIC® is a superset of Microsoft BASIC representing more than 20 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 ... to which we added long integers and sets. A full array of operator and function support is also included.

❒ Long integers provide speed and compactness when dealing with wide-range integer parameters such as 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 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 a wide array of 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".

#### *Development Environment*

❒ MotionPRO™ provides screen oriented system configuration & an interactive development environment on any IBM compatible PC.

❒ A built-in editor integrates multi-level syntax checking.

# this BASIC ...

❒ Powerful program debug features include program flow tracing, tracing changes in variables and line or variable sensitive breakpoint processing.

### *Programming*

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

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

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

❒ PCMCIA 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 industrial CRTs and our compact industrial terminal.

❒ Screen input with "INPUT @ USING" statement is supported by a library of *Motion*BASIC® *Tools* which include a standard menu system and error handler.

### *Program Protection*

❒ Programmers can protect their intellectual property by saving their MotionBASIC® programs in an encrypted format, so it cannot be viewed, changed or saved. Files can also be saved in a format that allows the user to observe the program, but not change or save it.

### *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.

### *High Speed Electrical Connector Assembly Machine*

In this example, two servos control an X-Y Table on which an electrical connector shell is mounted. For each contact position in the connector, the table must be moved into position and the contact inserted.

```
INITIALIZE                              'call the program initialization routine
ENABLE.SERVOS                           'enable the servos & home the table
'
AUTO.CYCLE:
    MOVE TABLE~ TO 0                    'move table to the connector shell load position
    WAIT UNTIL DIO@(PART.AVAILABLE)     'wait for the PART AVAILABLE input
    FOR I=1 TO TOTAL.PINS               'loop to insert contacts in the shell
        AXIS.VAR@(X~)=X.POS(I)          'store the X-position in special axis variable
        AXIS.VAR@(Y~)=Y.POS(I)          'store the Y-position in special axis variable
        WAIT UNTIL DIO@(INSERTER.HOME)  'wait for the inserter to retract
        MOVE TABLE~ TO AXIS.VAR@        'move the table to the next X-Y position
        WAIT 10 AFTER AT.REST@(TABLE~)  'wait for 10 msec after the table comes to rest
        DIO@(INSERT)=50                 'fire the inserter solenoid for 50 msec
    NEXT I                              'go back and do the next pin
GOTO AUTO.CYCLE
'
INITIALIZE:
    X~={1} :Y~={2}                      'axis 1 is the "X-axis" and 2 is the "Y-axis"
    TABLE~=X~+Y~'                       TABLE is the combination of axis X and Y
    DIO.MODE@(1)="IOI"                  'points 1 & 3 are inputs; 2 is an output
    PART.AVAILABLE=1                    'input 1 indicates connector shell is available
    INSERT=2                            'output 2 fires a solenoid to insert a contact
    INSERTER.HOME=3                     'input 3 is ON with the inserter retracted
    TOTAL.PINS=40                       'set the total number of pins in the connector
    DIM X.POS(TOTAL.PINS)               'dimension an array of contact X-positions
    DIM Y.POS(TOTAL.PINS)               'dimension an array of contact Y-positions
RETURN
'
ENABLE.SERVOS:
    AFAULT@(TABLE~) :FAULT@=0           'clear all axis and general faults
    MODE@(TABLE~)=5 :WAIT 50            'enable servos in position mode; wait 50 msec
RETURN
```




***ORMEC's memory disks use PCMCIA-standard memory cards to provide an elegant method for installing and maintaining motion programs, machine set-up files & "product recipes".***

***New files can be loaded by simply plugging the rugged, "credit card-sized" module into the Generation III controller. Especially important for remote plant locations–since it completely eliminates the need for a computer and skilled technician to perform on-site updates.***

***MotionBASIC® & MotionPRO™ development software provide robust memory disk support including: a disk file system similar to MS-DOS, ability to access program overlays for menus and rapid access to data file information.***

# Putting the motion in MotionBASIC®

## *Multi-tasking architecture and language provide motion control software performance*

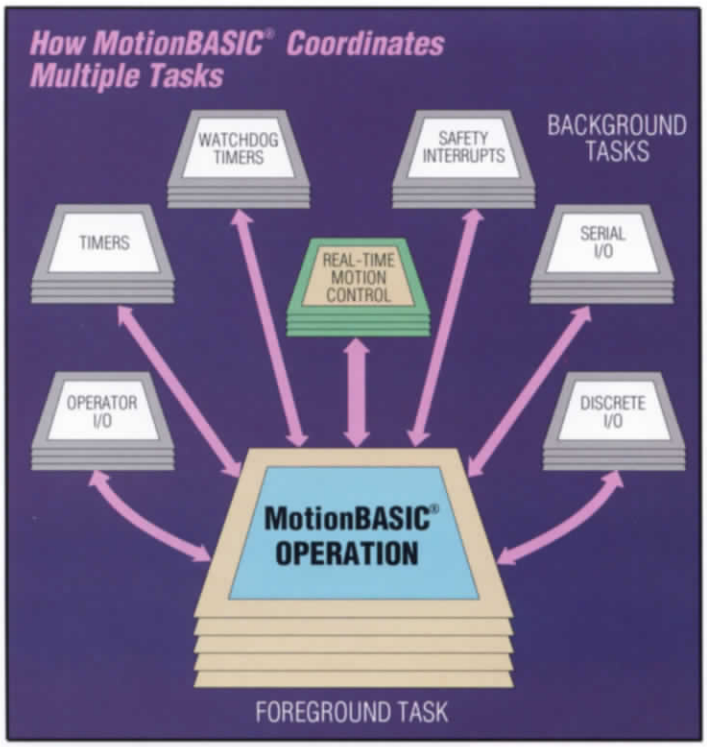
To effectively put the *motion* in MotionBASIC®, Generation III combines the power of a real-time operating system with motion control and I/O handling integrated directly into the language. The result is that interpreted MotionBASIC® (while enjoying the fundamental advantages of an interpreter and a real-time operating system) is both faster and more effective for motion control than systems using compiled languages.

### Real-time Operating System

In a Generation III motion controller, MotionBASIC® statements are executed as the foreground task under a real-time, preemptive, task-switching operating system. This allows MotionBASIC® statements to initiate other tasks which are then executed in the background by a combination of the main-processor and any intelligent I/O in the system.

Intelligent I/O includes timers, counters, I/O controllers and communications adapters, but most notably the system's DSP Axis Modules. Since intelligent I/O does most of the work for these tasks, MotionBASIC® execution proceeds independently at or near full speed while the task is being performed. Functionality handled by the real-time operating system includes:

- ❒ ***Discrete* I/O:** including interrupts and timed outputs
- ❒ ***Serial* I/O**: allowing multi-character messages to be sent or received without requiring attention from MotionBASIC®
- ❒ ***Operator* I/O**: including a "field editor" used by the INPUT @ USING statement to allow the user to update variables while the machine is operating
- ❒ ***Safety features***: including Emergency Stop, No Fault circuitry and watchdog timers
- ❒ ***Motion control***: primarily performed by DSP *Axis Modules*




### DSP Axis Modules

The most computationally intensive task performed by any motion controller is the task of closing velocity and position loops. Integrated with this is the translation of high-level motion parameters from a user program to individual changes in position and velocity command trajectories required for each successive loop update.

In Generation III, this process is performed by individual DSP Axis Modules in the system. Each axis responds to motion commands added to a queue in shared memory by the main processor, computing the new velocity and position targets required for each successive loop update. These targets are compared with the actual velocity and position and a new torque command is calculated based on the digital control algorithm in use. The DSPs, optimally suited to these tasks, maintain the current values of velocity, position and drive output in shared memory. The main processor can access these values as required without disturbing the DSP's operation.

This approach always allows Generation III servo loops to be updated at a high rate of 3,000 to 5,000 times per second independent of the number of servos in the system. Products using a single general purpose processor typically update velocity and position loops at a maximum rate of only 500 to 1,000 times per second. As axes are added, the large computational burden placed on the main processor further degrades servo performance and slows program execution.

### 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:

## How MotionBASIC® coordinates with Generation III's multi-processor architecture

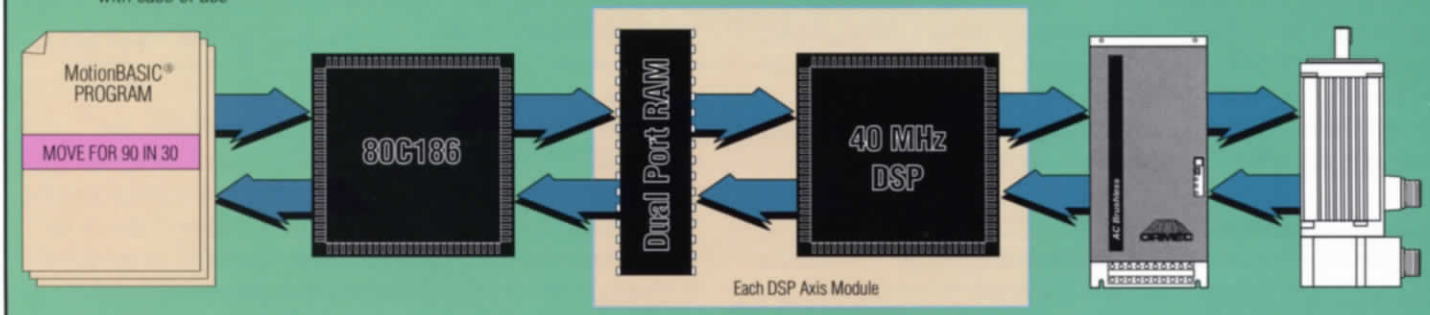
*The combination of a distributed architecture & interpretive MotionBASIC® provides high performance software which combines speed with ease of use*

*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 DSP 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 integrated 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 DSP Axis Module also has analog inputs, high speed sensor inputs & programmable limit switch outputs which can be coordinated with motion*

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 rational numbers.

### 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.

A single MOVE statement can even 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 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.

### Pre-defined Variables

To simplify programming, pre-defined variables allow you to easily integrate motion control and I/O specific information with standard BASIC. There are a total of approximately 100 pre-defined variables, with more than 80% of them arrayed variables indexed on axis number. These variables are used to define and/or observe the operation of the servos in the system and include sets of variables related to the operating mode, programming units, operating ranges and tuning for each axis as well as variables which indicate axis status from a numeric or logical standpoint.

# Electronic gearing for your toughest

## *DSP-to-DSP communications makes Generation III ideal for multi-axis ratioing and synchronization*

Generation III 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. Generation III's combination of state-of-the-art control and advanced electronic gearing offers an alternative with unparalleled flexibility, speed, accuracy and reliability ... as well as simplicity.

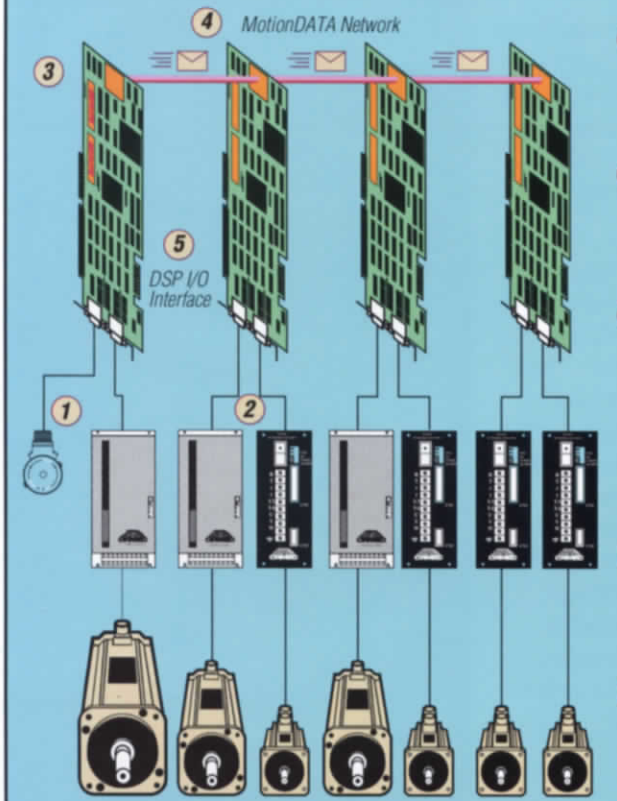
### A Superior Electronic Lineshaft

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 Generation III 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 individual position loop update. This highly precise coordination occurs 3,000 to 4,000 times per second and is integral to Generation III's electronic gearing precision.

In addition to providing unparalleled precision, the MotionDATA™ system 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.

Generation III 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 either commanded or actual position from its "pacer" axis to meet the objectives of your application.

**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 for the axes 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 actual or commanded position.*
4. *MotionDATA packets are sent synchronous to each position loop update and provide pacer movement and error correction information.*
5. *Each DSP I/O interface provides high-response, localized capabilities such as one micro-second position capture, registration sensors and electronic limit switches.*

### 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 the statement GEAR AT 1 TO 1 to maintain perfect synchronization of the output shafts of servo-driven gearboxes even when 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 360° during 180° of pacer rotation.

# applications ...

## MotionBASIC® Program Sampler---Variations on the GEAR & MOVE commands

Part of the power of ORMEC's MotionBASIC® is its ability to provide a wide range of motion using just a few statements. The program sampler below provides a quick overview of how the flexibility of these commands can be used in advanced motion programming.

**PACER~ = (1) : FOLLOWER1~ = (2)**
**FOLLOWER2~ = (3) : FOLLOWER3~ = (4)**
**FOLLOWERS~= (2,3,4) : ALL~ = PACER~ + FOLLOWERS~**
**AXIS.SET@ = FOLLOWERS~**

This segment of MotionBASIC® initializes "set variables" (variables ending with a "~") which name the servo axes and some groups of axes in a four-axis system. The "ORMEC pre-defined variable" (ending with an "@") AXIS.SET@, defines the "set" of axes to be used in motion statements if no axes are specified. For this set of examples, we will assume that all the servos reference position in degrees, velocity in RPM and acceleration in rad/sec$^2$; also, that the PACER~ axis is driving the MotionDATA™ communications link with all the FOLLOWERS~ monitoring it.

**MOVE PACER~ FOR 360 IN 100,50,20**
This statement moves the "PACER" axis for an incremental distance of 360 degrees in 100 msec, with an acceleration time of 50 msec and a deceleration time of 20 msec.

**MOVE FOR 2*360 IN 100**
This statement moves the current AXIS.SET@ (defined above as the FOLLOWERS~) for an incremental distance of 720 degrees (after evaluating the expression 2*360) in 100 msec, using the default acceleration and deceleration specifications of 1/3 of the total time (namely 33.33 msec).

**MOVE FOLLOWERS~ FOR 720 AT 1500 BY 90,180**
This statement explicitly moves the FOLLOWERS (independent of the currently defined value of AXIS.SET@) for an incremental distance of 720 degrees at a top speed of 1500 RPM, reaching speed by the time it's travelled 90 degrees, initiating deceleration when 180 degrees are left in the move (540 degrees)

**MOVE PACER~+FOLLOWER1~ FOR 720 AT 1500 IN 20,40**
This statement explicitly moves the PACER and FOLLOWER1 for an incremental distance of 720 degrees at top speed of 1500 RPM with acceleration/deceleration times of 20 and 40 msec respectively. Though the axes moved are different, the motion specified by this statement turns out to be exactly the same as the preceeding statement. *But, if you want to specify acceleration and deceleration in distance travelled (rather than time in this case), isn't it a lot easier and faster to do it directly than have to calculate it and transfer the results of that calculation into the language of the motion controller?*

**MOVE FOR 720 AT 1500 USING 7854,3927**
The same motion specs again, but this time using specified acceleration and deceleration rates (in rad/sec$^2$).

**MOVE FOR 720**
This could command the same motion again, if the pre-defined variables for max speed, max accel & max decel were set at 1500, 7854 & 3927 respectively. *This short syntax is used to move for the specified distance using the maximum acceleration, top-speed and deceleration.*

**AXIS.VAR@(FOLLOWER1~) = 360**
**AXIS.VAR@(FOLLOWER2~) = -360**
**AXIS.VAR@(FOLLOWER3~) = 720**
**MOVE FOLLOWERS~ FOR AXIS.VAR@ IN 100**
These statements assign distances to be moved to the pre-defined variable AXIS.VAR@ (stored in the shared memory of each axis) and then initiate a simultaneous multi-axis MOVE for the specified distances in 100 msec.

**GEAR FOLLOWERS~ AT 1 TO 1**
This statement gears the FOLLOWERS to the PACER axis at a constant base ratio of 1:1. Once this statement is executed, any movement of the PACER will be tracked by all three followers. (Configuration options allow the PACER to drive the MotionDATA communications link with either actual position or commanded position.) While tracking its MotionDATA input at a constant ratio, any axis can execute MOVE FOR or GEAR FOR statements in either direction to "superimpose" motion on top of the base ratio.

**MOVE PACER~ AT 600,100**
This statement moves the PACER at 600 RPM, specifying a 100 msec accceleration time. All geared followers will move simultaneously.

**MOVE FOLLOWER1~ FOR 45 IN 100,25,50 AFTER ZREF@**
This statement "advances" FOLLOWER1 forward 45 degrees with respect to the PACER in 100 msec, with a 25 msec acceleration time and a 50 msec deceleration time, and with the motion actually initiated by the receipt of one of the high speed sensors on the DSP Axis Module.

**GEAR FOLLOWER1~ FOR 45 IN 360,90,180 AFTER ZREF@**
This statement causes a motion identical to the one above, but only because the PACER is moving at 600 RPM (100 msec per rev), and since the motion is specified to take 360 degrees of PACER travel with 90 degrees for acceleration and 180 degrees for deceleration. Should the PACER slow to half-speed, this motion would be automatically slowed since it is commanded as a function of PACER travel.

**AXIS.SET@ = FOLLOWER2~**
This statement re-assigns the set of default motion axes to include only FOLLOWER2.

**REPEAT GEAR FOR -360*4 AT 1 TO 1 BY 90 AFTER ZREF@**
This statement initiates a repetitive GEARed motion which will "retard" the default set of motion axes (FOLLOWER2) four revolutions each time its feedback encoder's "zero reference" signal is received. Since this motion is superimposed on a 1:1 forward base speed and the specified ratio is 1:1, movement of the follower axis will be completely "cancelled" when the specified motion is at "top speed". Note the accel/decel specification which causes the follower axis to stop 90 degrees after receipt of its "zero reference", and be re-synched with the PACER within 90 degrees of when it re-starts due to the pending completion of the four revolution relative movement.

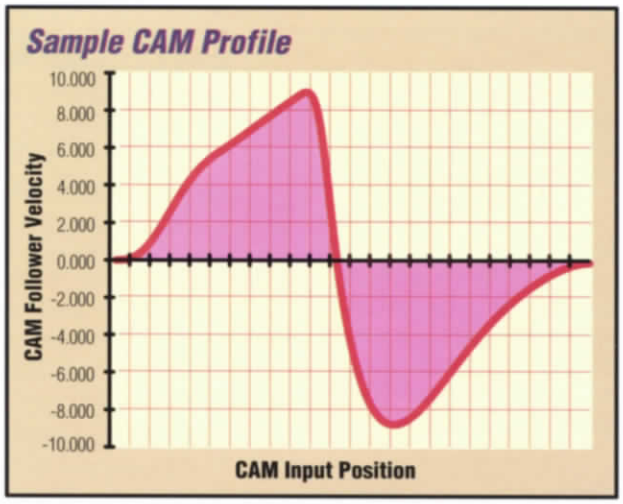
***For a free* MotionBASIC® *Hypertext disk—an on-line electronic manual offering information on our motion control programming—call us at* (716) 385-3520**



# Specialized motion features greatly

## Specialized motion control capabilities makes Generation III the servo of choice

During our more than ten years in electronic motion control field, ORMEC has always worked closely with customers on *solutions* to specific application problems. By integrating our cumulative applications knowledge into our products, we have developed a wide range of features and techniques that are extremely powerful for specific applications.




*Using elegantly defined motion profiles in software, servo-driven electronic CAMs can increase flexibility, shorten lead-times and reduce machinery downtime. Our multi-processor architecture and DSP axis modules are especially powerful in profiled motion applications. CAM profiles can be executed simultaneously on an unlimited number of servo axes with linearly interpolated segments. For the ultimate in performance, CAM segments can be processed at rates up to 3,000 segments per second.*

### *High-speed sensor inputs and zero-references initiate motion*

When MotionBASIC® processes MOVE and GEAR statements, concise data packets defining the desired motion are written into a shared memory FIFO motion queue. Queued motions are processed sequentially by the DSP. They may be executed immediately, at the end of a motion that's already in process, or synchronized with one of the DSP's high-speed sensor or encoder "zero-reference" inputs. When concatenated or synchronized with a DSP input, the motion command is initiated within one position loop update of it (normally 200 to 333 microseconds)

### *Maintaining absolute position information*

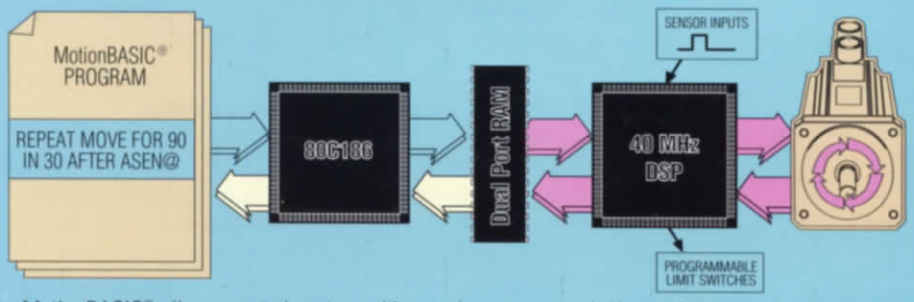
MotionBASIC® provides built-in support for multi-revolution, absolute encoders. These cost-effective encoders measure and maintain absolute position for up to ±49,999 revolutions of motor movement, even with power off. When a motor using one of these encoders is selected from the MotionPRO™ configuration menu, a statement to poll this data is automatically inserted in the MotionBASIC® startup routine.

### *Repeating position in rotary control applications*

As opposed to linear table systems, in which motor position is directly related to tooling position and limited by a physical end of travel, many electronic gearing applications have tooling positions which cycle repetitively as the motor is rotated continuously in one direction.

Generation III allows axis position to be defined with a specified "modulus" or "repeat distance", which when utilized causes the axis position to automatically cycle as the motor is continuously rotated. Absolute encoders can still be used for these axes as long as the number of motor revolutions in each "position cycle" is evenly divisible into 50,000. e.g. 2, 2½, 3⅓, 4 ...

### Performing repetitive motion sequences




*MotionBASIC® allows you to insert repetitive motion sequences in the motion queue for local execution by individual DSP Axis Modules. These motion sequences consist of multiple MOVE and GEAR statements and can include time delays and/or be synchronized with DSP Axis Module sensor inputs. The fact that individual DSP Axis Modules can locally execute complex motion sequences not only enhances motion and synchronization responsiveness and precision, but also extends Generation III's overall processing power and simplifies MotionBASIC® programming. Locally executed motion sequences can be easily monitored, synchronously replaced or halted from MotionBASIC®, and are supported by the full range of Generation III's multi-axis diagnostics and error handling capability.*

# simplify control ...

*Fully integrated programmable limit switches*

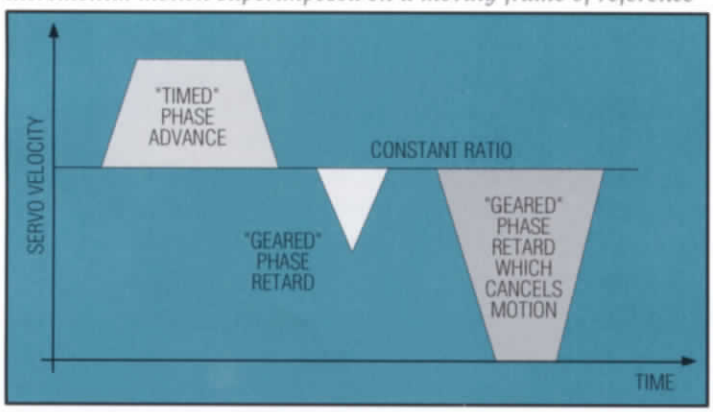
Each axis in Generation III has three "electronic limit switches" which turn ON and OFF whenever the axis position goes "into" or "out of" a specified range. In addition to their hardware outputs, these programmable limit switches are fully integrated with MotionBASIC®, including the specification of their low & high limits as well as their current output condition.

*Position capture provides high-speed registration measurement*

A variety of high-speed registration control applications are made possible because axis position for all servos and encoders in the system can be captured within one microsecond of either edge of their DSP's high speed sensor inputs. In addition, the electronic limit switch capability can be used to "blind" the sensor input for a selected part of the machine cycle.

A pre-defined MotionBASIC® variable indicates that the sensor has been received and a second variable contains the measured position.

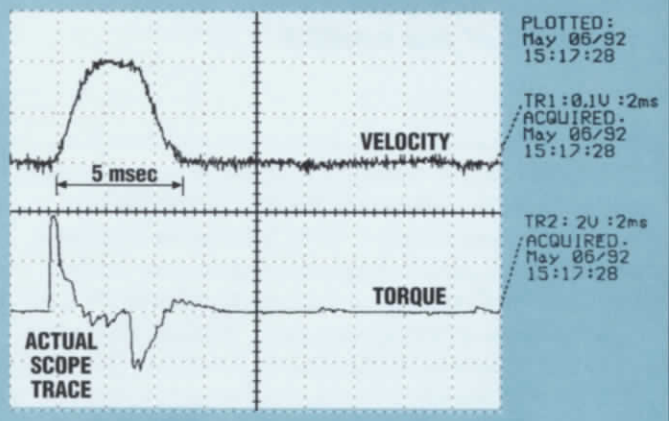
*Incremental motion superimposed on a moving frame of reference*




ORMEC's electronic gearing capability allows any servo to be "GEARED AT" a specified ratio to another servo axis or an external encoder. While moving at a constant ratio, the standard "MOVE FOR" and "GEAR FOR" syntaxes "superimpose" their defined incremental motion on top of the constant ratio base speed, simplifying phase adjustment of servo position to sensed inputs.

*Utilizing distributed feedback to enhance performance*

Applications which have critical positioning requirements and utilize a gearbox, leadscrew or other mechanical component to connect the servomotor to the load can often benefit from distributed feedback. Generation III allows you to combine velocity feedback from the motor shaft with velocity and final positioning feedback from the load itself for an optimal blend of precise final positioning accuracy and high system bandwidth, which provides responsiveness and enhances dynamic accuracy.




## Fast Point-to-Point Positioning

Generation III's distributed architecture with DSP axis processors provide unparalleled performance in rapid point-to-point positioning applications. This capability has improved productivity and quality in a wide range of automation applications such as inserting contacts in electrical connectors, carpet tufting, stamping, forming, inspection and warp knitting. In some cases the motion is time based, while other applications require it to be "geared" to another part of the automatic machine.

Speed and torque plots from a digital storage scope are shown above. Note the trapezoidally profiled velocity illustrated in the top trace which is fully complete in less than six milliseconds. Note also the lower trace which illustrates the torque command sent to the servodrive by the motion controller.

Two key features for fast point-to-point positioning applications are:

❒ Generation III's position loop update rate of 3,000 to 5,000 samples per second, which in the case shown above provides 18 to 30 updates for the motion controller to measure output position and adjust the torque command; and

❒ Generation III's ability for the main processor to queue motion commands at the DSP which can then be initiated within one position loop update of an input signal.

### MORE INFORMATION




ORMEC's *"Motion Control Solutions" video presents a high-speed video segment on point-to-point motion. Call* **(716) 385-3520** *to request a copy of this video.*

# A MotionPRO at your side ...

### *Tools for developing the full potential of your machine*

*For more information on MotionPRO™ see page 35.*

Selecting a motion controller, servomotor and drive is an important first step in creating a solution for your next motion control project. But what comes next ... and becomes of primary importance to you ... is the software development environment you use to set-up and program your controls.

That's why Generation III features MotionPRO™, a PC-compatible development environment. MotionPRO™ offers user-friendly menus for configuring your motion control system, a powerful program editor to speed software development, and both context-sensitive, on-line help and a MotionBASIC® hypertext manual for quick access to **on-line** documentation.

#### Software that works the way you do

MotionPRO™ provides an elegant software interface to your Generation III controller. Configuration menus allow you to easily change system parameters and specify user units familiar to your application. The Multi-Edit™ program editor simplifies writing and editing MotionBASIC® programs for your application. MotionPRO™ makes it easy for you to communicate with Generation III: *"loading"* programs into your controller or *"saving"* programs to your PC development system. It even allows you to *"capture"* a communications dialogue between your development computer and the motion controller.

MotionPRO™ also includes OSA (Ormec Servo Analyst) for analyzing the servomotor/drive required for your project, utilities for printing programs and system configuration files and menu-oriented DOS utilities. Window-DOS™---a powerful, memory-resident file management utility---can be "popped-up" at any time to help you organize your files. If you have a program (a spreadsheet, for example) which you use in your work, it can be easily added to the MotionPRO™ Application menu.

Plus, underlying all your activity in MotionPRO™ is an unprecedented level of documentation support. Context-sensitive on-line help is available simply by pressing the F1 key. But MotionPRO™ goes even further and provides MotionBASIC® Hypertext---putting an on-line, electronic version of the 200+ page MotionBASIC® reference manual at your fingertips.

#### Generation III Configuration

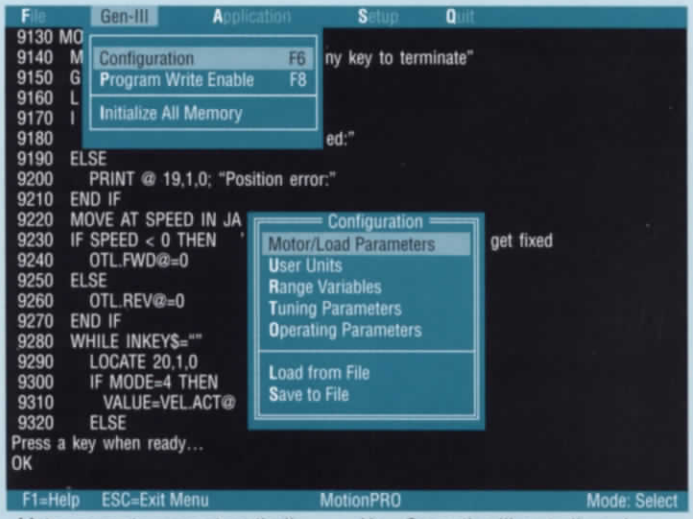
Since Generation III motion controllers are designed to control a wide range of automatic machines, a guiding principle for us is to allow the motion controller to be easily software configured to match the individual application.

By enabling the user to fill out screens from the Generation III configuration menu of our MotionPRO™ development software, you can easily:

## System Configuration

*Gen-III Configuration menu simplifies system set-up using "fill-in" menus*

*Set-up menu allows you to easily select defaults (e.g. com port) for MotionPRO™*

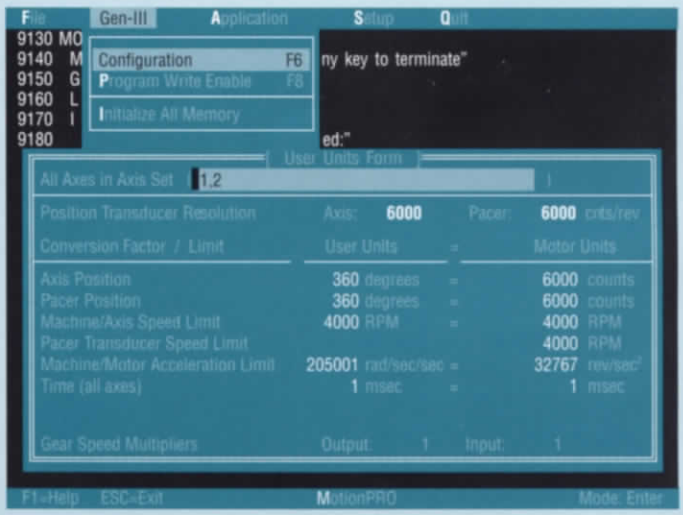



*Motor parameters are automatically loaded from a motor definition file*

*Your Generation III controller arrives configured for your servomotor/drive*

*User Units Form configures motion controller for your application*

*"Axis Set" definition allows parameter selection for multiple axes at a time*




*Motor parameters are automatically loaded from a motor definition file*

*Motor selected in Gen-III Configuration menu defines max speed & accel limits*

❒ select motors from a list, which automatically loads parameters such as position transducer resolution, maximum speed, maximum input voltage, RMS/peak torque, and inertia;
❒ specify a load inertia;
❒ specify the units and limits for position, velocity, acceleration, position error and drive output for each axis;
❒ for electronic gearing applications, specify pacer position units and gear ratio compensation factors; and
❒ if desired, change the direction of forward rotation, select S-Curve accelerations, select a position modulus, and set the high and low limits for the three electronic limit switches per axis.

MotionPRO™ insures consistency among these parameters and when their entry is complete, information is transferred to the controller in the form of a MotionBASIC® configuration routine which assigns values to ORMEC pre-defined variables.

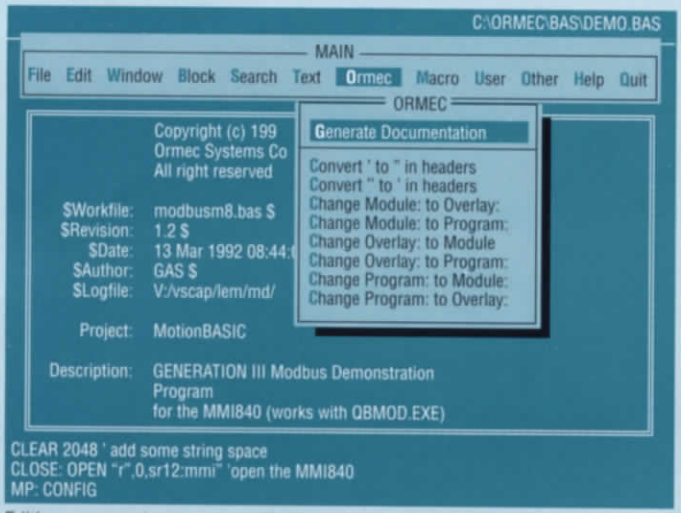
This configuration step effectively customizes the Generation III motion controller to the application, freeing you to work on the application itself in terms and parameter units that make sense. In addition, the motion controller insures that critical maximum parameters are not exceeded by mistake. All of this greatly enhances productivity in the design, commissioning and maintenance of your motion control project.

Note also that all of this setup information is contained in software which becomes part of the MotionBASIC® program operating the motion controller. This means that additional machine controls can be configured with absolutely no manual adjustments, greatly simplifying both maintenance and the commissioning of subsequent machines.

## Program Editor

*Multi-Edit™ is accessed from MotionPRO™ menu for quick editing*

*Context-sensitive help & mouse support makes Multi-Edit™ easy to use*



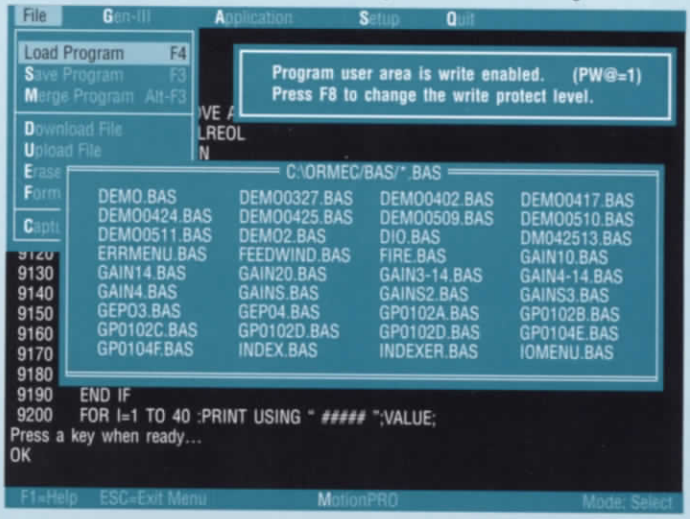

*Editing commands are accessed from pull-down menus or function keys*

*Exiting the editor immediately takes you back to the MotionPRO™ environment*

## Communications

*MotionBASIC® programs can be easily loaded into your Generation III controller*

*Program line numbers can be automatically removed/added during load & save*

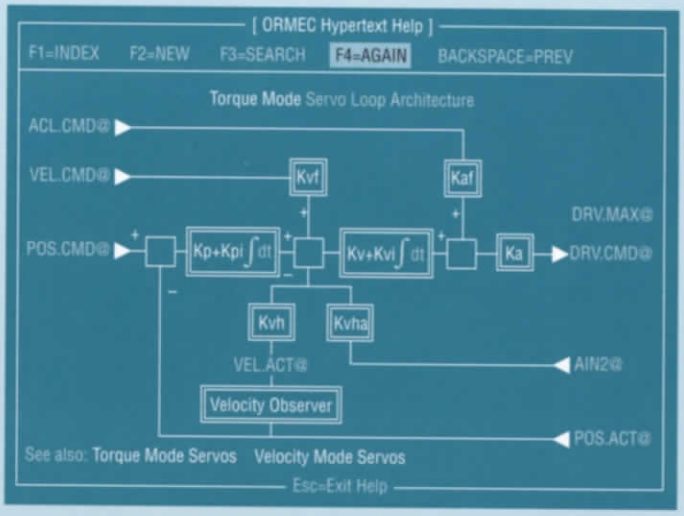



*All file transfers utilize error correction protocols for data integrity*

*The designers of MotionPRO™ understand both motion control applications & software*

## MotionBASIC® Hypertext

*Activating Hypertext (Alt-?) with cursor on POS.CMD@ while in program editor (see previous screen) provides immediate access to appropriate hypertext "chapter"*




*Highlighted text on screen indicates additional information on that topic*

*Many experts predict that hypertext manuals will be the wave of the future*

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