



ORMEC

Motion Controllers

Models 20 & 40

ORMEC's Model 20 and Model 40 motion controllers are the heart of the Generation III family of products.

Both controllers feature a PC/AT style backplane--two board slots for the Model 20 and four for the Model 40--and can be used effectively in a wide variety of system configurations.

Flexible System Architecture

Generation III's PC/AT backplane provides compatibility with a variety of adapters. Elegant interface and ease-of-use is provided for the adapters listed below by an extensive array of ORMEC software. This approach makes it easy to custom-tailor your motion control system to fit the needs of your particular application.

► **DSP Axis Modules:** One version of the DSP Axis Module controls two servomotors. A second version controls one servo with an auxiliary pacer encoder interface. They both operate effectively at very high sampling rates and provide accurate, precise positioning via robust motion control algorithms.

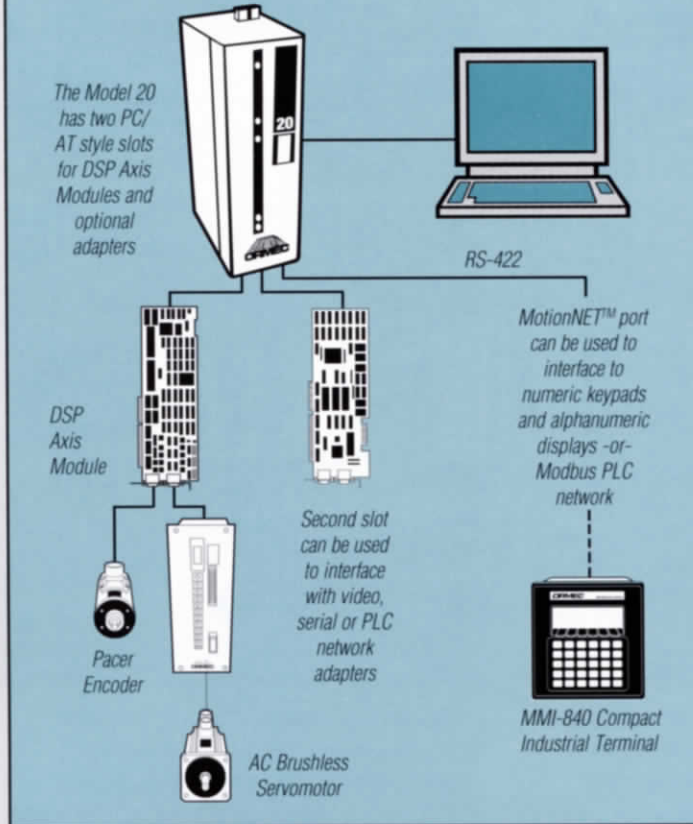
Each module also provides additional I/O which is directly interfaced to the axis processor(s)--two high speed sensor inputs, six programmable limit switch outputs, hardware overtravel limits and four optional 12-bit analog input--providing robust capabilities for multi-axis control systems.

► **Network Adapters:** High-speed network adapters serve as communications co-processors to provide access to either Allen-Bradley's Data Highway/Plus™ or Modicon's S908/Modbus™ factory networks.

► **Video Adapter:** Provides a video interface to IBM-PC compatible color or monochrome industrial monitors.

► **Serial Communications Adapters:** Each Generation III motion controller

1 1/2 Axis Model 20 System Example



The Model 20 motion controller can be effectively used for 1 1/2 to 4-axis applications. Two DSP Axis Modules can control up to four servos. Or the second PC/AT style controller slot can be used to interface the motion control system with an industrial monitor or popular PLC networks such as Data Highway/Plus™ or S908/Modbus™. ORMEC's built-in RS-422 MotionNET™ port provides additional flexibility--since it can be used to interface the Model 20 controller with a compact industrial terminal, numeric keypads, alphanumeric displays or Modbus™ for factory communications.

provides two standard serial ports. An RS-232 development port provides communications with IBM-PC or compatible computers. The RS-422 MotionNET™ port is commonly used to interface operator interface devices or host computers using Modbus™.

Serial Communication Adapters can be added for RS-232 and/or RS-422 serial communication needs beyond Generation III's two standard serial ports.

Controller Options

The Model 20 and Model 40 feature a variety of product options which allow you to select the specific advanced features your application requires. The chart below shows what options are available.

Memory Card Controller

A dual-slot memory card controller--standard on the Model 40 but optional

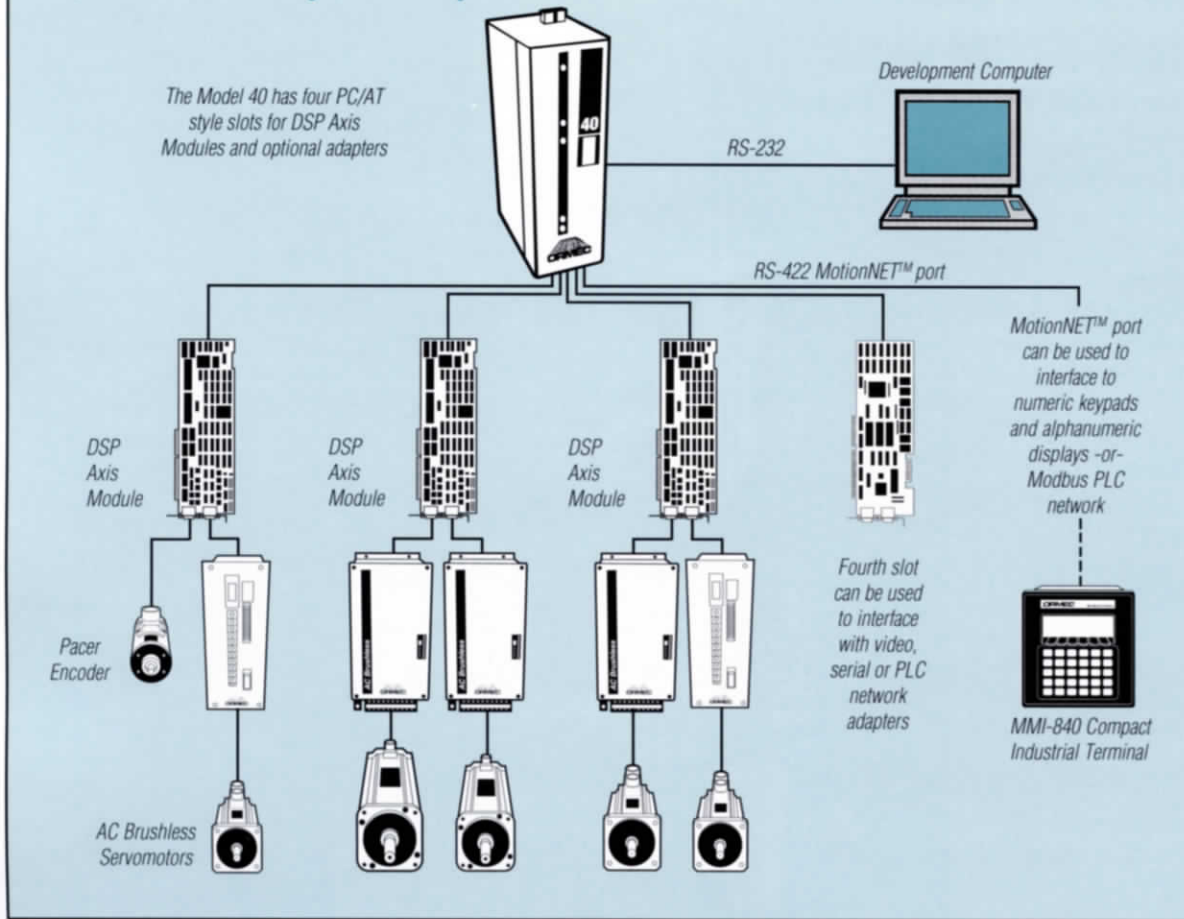
Generation III Model 20 & 40 Options

Features	Model 20	Model 40
PC/AT-style slots	2	4
Targeted Applications: Number of Axes	1 1/2 - 4	2 1/2 - 8
16 Discrete I/O: individually selectable as inputs or outputs	Standard	Standard
Dual-slot memory card controller	Optional	Standard
Keyboard connector/controller	Optional	Standard
Math co-processor	Optional	Optional
Extended I/O (16 Digital I/O, Direct access to 24 slot I/O rack or Pamux Extended I/O support)	Optional	Optional



	Pages
DSP Axis Modules	28-29
Data Highway/Plus™ Adapter	46-47
S908/Modbus™ Adapter	48-49
Video Display Adapter	30
Serial Communications Adapters	30

5 1/2 Axis Model 40 System Example



The Model 40 motion controller is targeted for 2 1/2 to 8-axis applications. Four DSP Axis Modules can control up to eight servos. Or extra PC/AT style controller slots can be used to interface the motion control system with an industrial monitor or popular PLC networks such as Data Highway/Plus™ or S908/Modbus™. ORMEC's built-in RS-422 MotionNET™ port provides additional flexibility--since it can be used to interface the Model 40 controller with a compact industrial terminal, numeric keypads, alphanumeric displays or Modbus™ for factory communications.

on the Model 20---provides access to PCMCIA-standard Memory Disks for additional user program and data storage---and ORMEC MotionCARDS™ which add specialized features to MotionBASIC® such as factory network communications.

Keyboard Controller/Connector

An IBM-PC/AT keyboard interface is standard for the Model 40 and can be added to the Model 20 for convenient input from Industrial CRTs.

Math Co-processor

Many motion control applications require extensive use of math. Generation III provides a full array of math for integer, long integer, and both single and double precision floating point variables. MotionBASIC® includes software support for IEEE-standard floating point math.

For maximum performance and consistency in real-time math, the Model 20/40 controllers offer a co-processor option. The 80C187 math co-processor generally performs floating point operations at speeds up to 10 times as fast as

they would be performed in software.

This also results in consistent MotionBASIC® floating point performance comparable to using integer math. Functions such as sine, cosine, tangent, log and exponentiation can be performed in less than 1.5 milliseconds, even when using double precision floating point.

Extended I/O Interface

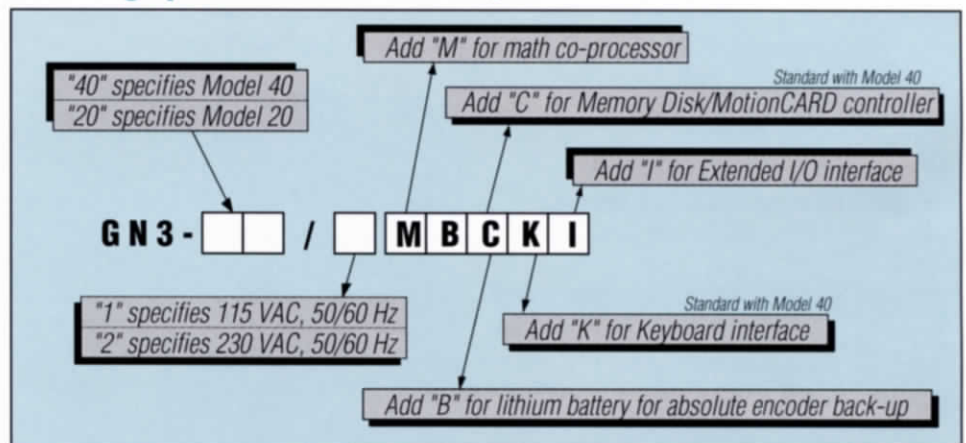
Each Generation III Model 20/40 controller provides 16 discrete I/O, plus

an "Emergency Stop" input fully integrated with the internal watchdog timer circuitry and a normally-open, held-closed "No Fault" relay contact output.

The Extended I/O option adds the ability to interface additional I/O points:

- ▶ 24 TTL-level I/O points are directly interfaced to an Opto-22 compatible 50-pin connector; or alternately
- ▶ up to 512 analog and/or digital I/O points can be accessed via Opto-22's Pamux standard.

Selecting options for the Model 20/40 controllers





Generation III Model 20 & 40 Specifications

MOTION CONTROL

- Each Model 20/40 controller provides closed loop, servo control plus operator interface, machine I/O & communications
- Unique multi-processor computer architecture features Intel 80C186 and Texas Instruments TMS320C25 digital signal processor(s).
- Shared memory interface allows immediate access to key system parameters
- Intel 80C187 math co-processor (optional)
- All-digital servo control algorithms
- Servo loop update up to 5 kHz
- Watchdog timers & integral fail-safe operation
- Drive fault protection
- Non-volatile program memory
- High speed sensor inputs
- High speed position capture (<1 microsecond accuracy)
- RS-232 serial port for software development system

PROGRAMMING

- Multi-tasking, multi-processor operating system
- MotionBASIC® programming language
- Powerful and easy-to-use motion statements
- Pre-defined motion and I/O variables
- Exact user units conversion with rational numbers
- Programs and data stored in non-volatile memory (60.3 kilobytes)
- Supports 32-bit integers and floating point math

COMMUNICATIONS

Operator Interface Options:

- Compact industrial terminal
- Multi-drop industrial numeric keypad & display
- Standard color or mono Industrial CRT with keypad
- Supports IBM-PC/AT compatible keyboard & EGA, VGA or mono monitors

MotionDATA:

- Electronic gearing---linear or cascade control
- 613 KHz DSP to DSP broadcast network for precise multi-axis synchronization and control

Expansion Bus:

- Interface adapters for PLC Communication Networks
- Supports two auxiliary serial ports, RS-232/422 user configurable
- Multi-drop support for serial devices

INPUTS/OUTPUTS

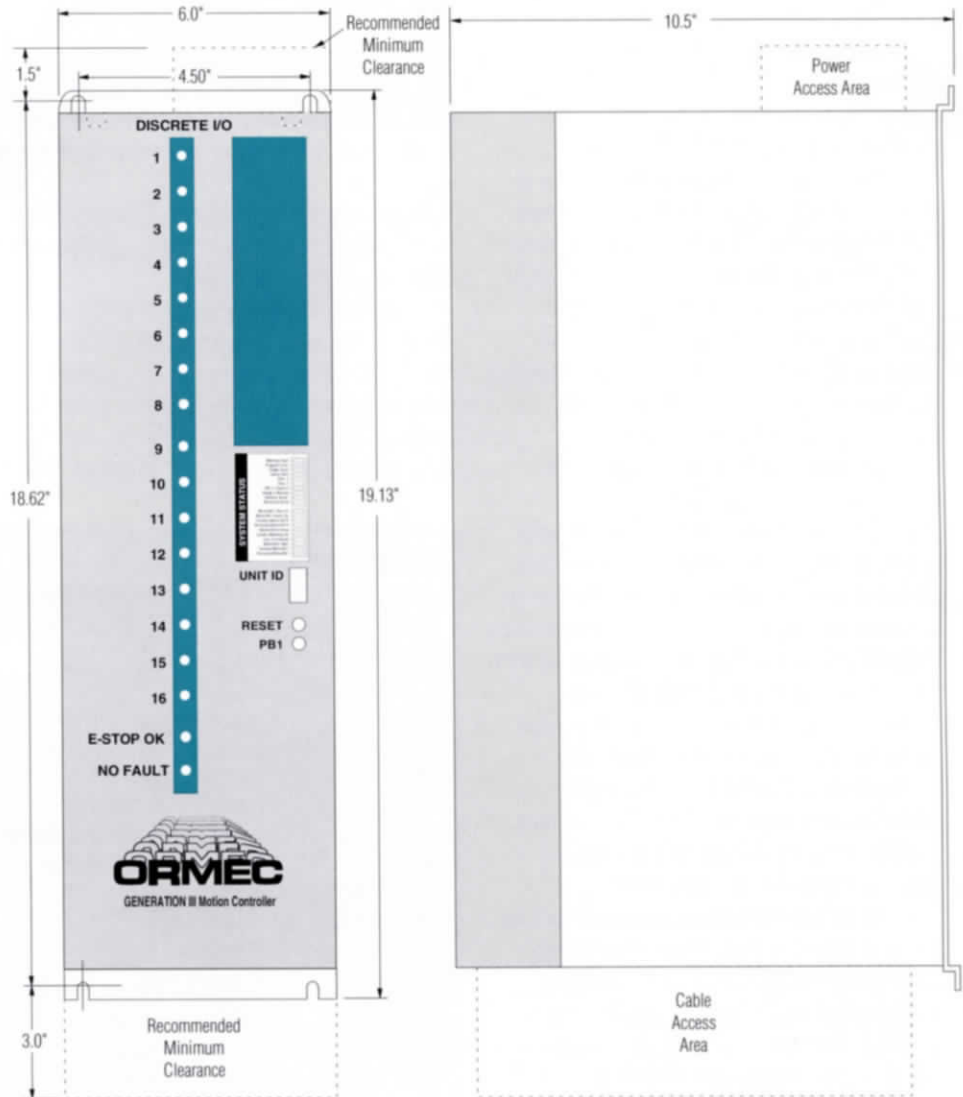
- 16 standard Opto-22 compatible discrete I/O points
- 24 additional digital I/O points via optional expansion connector
- Pamux compatibility for up to 512 analog or digital I/O. Pamux is a parallel multiplexed I/O system which supports up to 512 discrete or analog I/O points added in multiples of 4, 8, 16 or 32.

INDICATORS

- 16 Digital I/O LEDs
- 22 Diagnostic LEDs

GENERAL SPECIFICATIONS

- 19" h x 6.5" w x 10.5" d
- Vertical mounting with 4 each #10 bolts
- Operating Temperature: 0 to 50C
- Storage Temperature: -20 to 85C
- Humidity: 90% (non-condensing)
- Input voltage: 95-127 or 190-253 VAC, 47-63 Hz single phase
- Input power: 175 watts maximum, 10A circuit breaker provides switched drive control power output





ORMEC

DSP Axis Modules & Adapters



DSP Axis Modules:

The Generation III family of products offers two DSP Axis Modules for high performance control: a dual axis unit and a single axis unit with an auxiliary pacer encoder interface.

These DSP modules are full-height, PC/AT style printed circuit boards which plug conveniently into the backplane of the Generation III controller, and use a 40 Mhz Texas Instruments digital signal processor (DSP) to provide axis control algorithms.

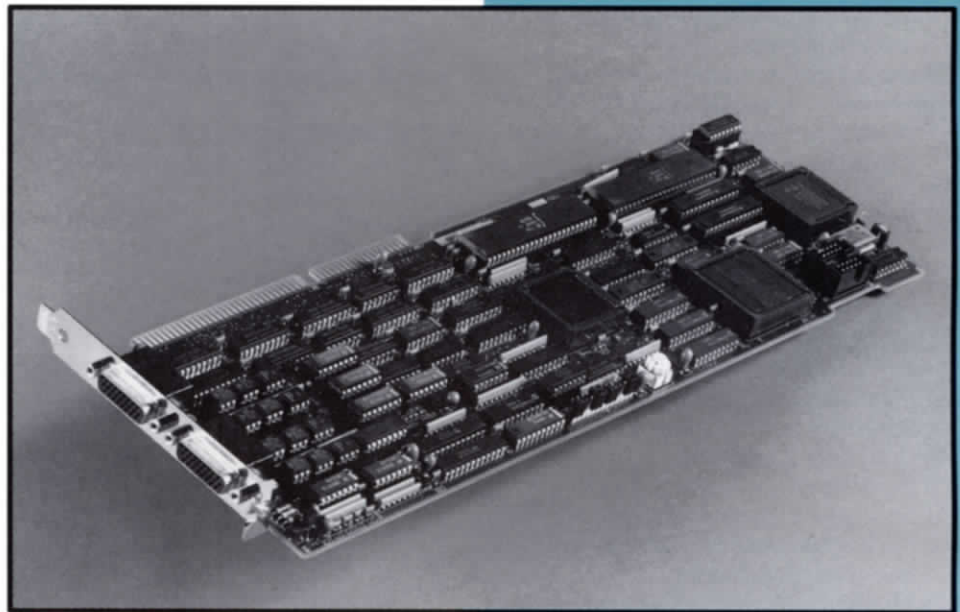
Strengths of the DSP Module

Multi-Processor Architecture: The DSP is interfaced to the main processor through a shared memory interface for maximum speed and flexibility.

This multi-processor architecture, combined with the overall power of the digital signal processor, enables Generation III to operate effectively at very high sampling rates and provide accurate, precise positioning via robust motion control algorithms. It virtually eliminates the need for all analog components including analog tachometers.

MotionDATA™: For multi-axis tightly synchronized motion control applications, MotionDATA™ provides a direct DSP to DSP communications link to share motion reference information at loop update rates. This synchronous data communications channel operates at 613 K bits per second and utilizes user-transparent error correction techniques. MotionDATA™ speed and flexibility allows large systems to be precisely electronically geared to a single *electronic lineshaft* or multiple sub-lineshafts in a cascaded control configuration.

High Speed Sensors: In addition to the zero-reference inputs from the two axis encoders, each DSP Axis Module provides interfaces for two high speed sensors. The DSP can capture real-time axis position for either or both axes within *one microsecond* of assertion of its encoder reference pulse as well as both of the high speed sensors. It can also



ORMEC's DSP Axis Modules: dual axis or single axis with remote "pacer encoder" interface

initiate axis motion on the next position loop update to occur 10-20 microseconds after an input is received.

Electronic Limit Switches: Each axis of Generation III provides three TTL-level electronic limit switch outputs which respond at the position update rate. In addition, the operation of these switches is fully integrated into MotionBASIC® by

the use of pre-defined variables.

Hardware Overtravel Limits: Each axis provides two hardware overtravel limits in addition to selectable software overtravel limits for use when motor travel is limited such as in ballscrew applications.

Analog Inputs: The analog input option provides four 12-bit analog inputs.

ORDERING GUIDE

Generation III Backplane Modules & Accessories

GN3-DSP-AQ Single Axis DSP Module, with Pacer Encoder Interface

GN3-DSP-A2 Dual Axis DSP Servo Module

To add four channels of 12-bit Analog to Digital Converter, append /A to the model numbers above.

CBL-AE/X Axis Interface Cable, DSP Axis Module to E-Series Servodrive, 1-25 ft

CBL-AS/X Axis Interface Cable, DSP Axis Module to S-Series Servodrive, 1-25 ft

CBL-AT/X Axis Interface Cable to Terminal Block, 1-25 ft

TBC-D25 Axis Interface Terminal Block

CBL-AET/X Axis Interface Cable from Terminal Block to E-Series Servodrive, 1-25 ft

CBL-AST/X Axis Interface Cable from Terminal Block to S-Series Servodrive, 1-25 ft

CBL-QE25/X Axis Interface Cable, DSP Axis Module to EDR-25 Series Encoder, 5-150 ft

CBL-DSP-I0/X DSP I/O Cable and Terminal Block, 1-9 ft

CON-2Q GN3-DSP Axis Interface Connector, crimp type

GN3-VDA Video Display Adapter, EGA, Mono or VGA

GN3-VDA/M Video Display Adapter, Data Highway/Plus™ and Modbus/S908™ compatible

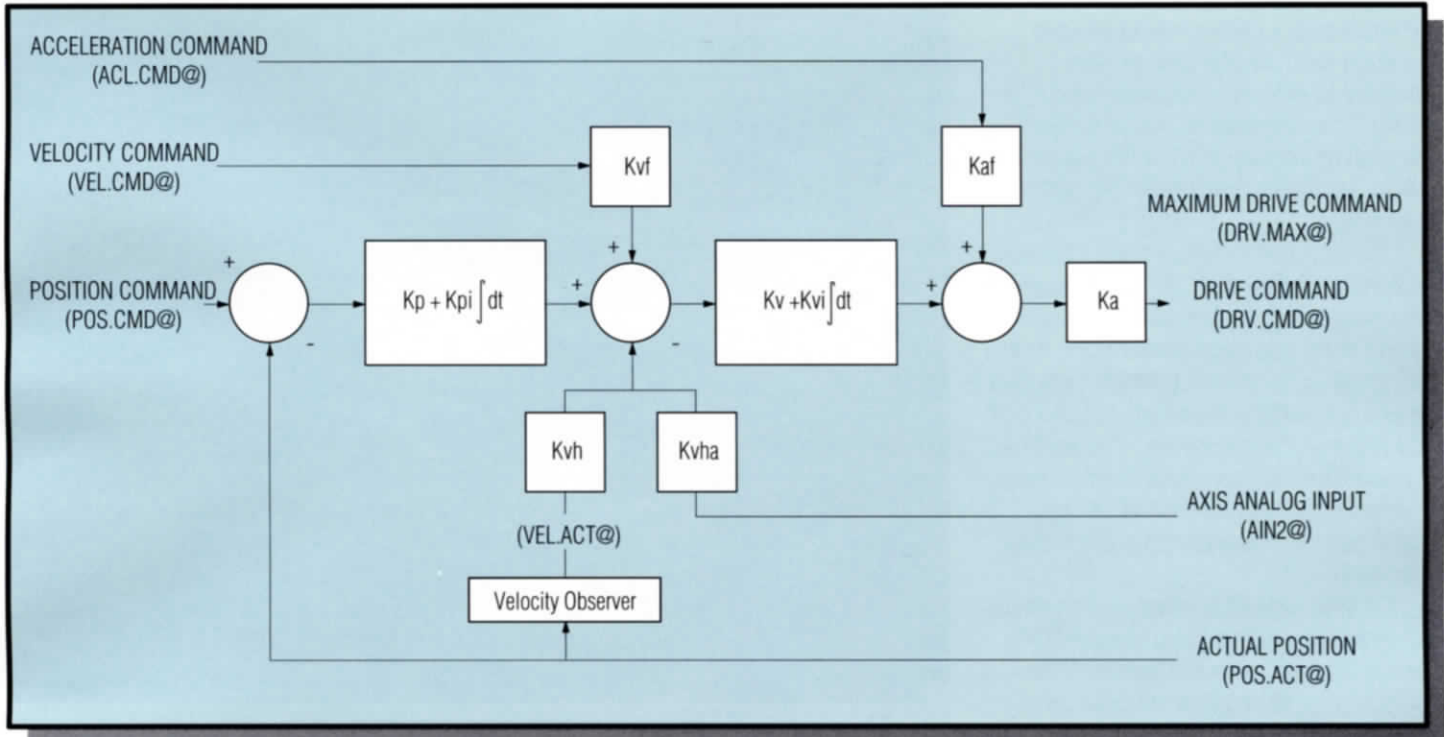
CBL-EGAX/X Video EGA/keyboard Interface Extender, 10-150 ft

CBL-MONX/X Video Mono/keyboard Interface Extender, 10-150 ft

GN3-232 RS-232 Serial Communications Adapter with main and auxiliary ports

GN3-422 Dual RS-422/232 Serial Communications Adapter

DSP Axis Module Loop Architecture



The DSP Axis Module loop architecture is illustrated above. At the left of the diagram is the loop command vector generated by the DSP from information provided in the shared memory by MotionBASIC[®] motion statements. The loop command vector includes acceleration (ACL.CMD@), velocity (VEL.CMD@) and position (POS.CMD@) command information for maximum loop response and accuracy.

The drive command (DRV.CMD@) control output is shown along with a parameter which establishes its maximum output value (DRV.MAX@). With the preferred torque mode servodrives, the value of this parameter is proportional to the torque being commanded by the motion controller. Also shown is the actual position (POS.ACT@) from the axis position transducer. The "actual velocity" (VEL.ACT@) is generated from position information by the DSP velocity observer algorithm. Velocity feedback from the axis analog input can be blended with the output of the velocity observer for distributed feedback systems.

The settings for the loop gains determine the loop characteristics for each axis in the system from real-world parameters such as motor-torque gain, system inertia and velocity loop time constant. Loop parameters such as integrator gains are set as factors which are automatically scaled when the basic velocity loop operation is changed.

MotionPRO[™] allows the user to initialize a number of the axis parameters from a file of motor data. MotionPRO[™] also includes a semi-automatic tuning program called SETUP for interactively fine tuning the system after the load is attached to the motor. The SETUP program, with the factory adjusted gains for the motors purchased with the system, is loaded into the non-volatile memory of each standard motion controller as it's shipped from the factory.

DSP Axis Module Overview

Multi-Processor Architecture

- Texas Instruments TMS-320C25 DSP operating at 40 Mhz
- Proprietary MotionDATA[™] communications direct from DSP to DSP provides tightly coordinated multi-axis electronic gearing
- Shared memory interface to main processor
- Writable control store for DSP program storage is loaded from the main processor at power-up

Feedback & Control

- Direct digital control with update rates to 5 kHz provide wide bandwidth for high positioning accuracy & response

- Quadrature feedback 4x decoding with positioning rates to 1 MBit per second
- Position, velocity or torque mode control
- Full 32-bit absolute or modulo position operation with user-defined units
- Virtual elimination of analog errors and extremely quiet loop operation using direct digital processing of both position and velocity loops with 32 bit intermediate calculation accuracy
- Software controlled position, speed, and current limits
- Velocity and acceleration feedforward for minimum tracking errors and response times

Servodrive Interface

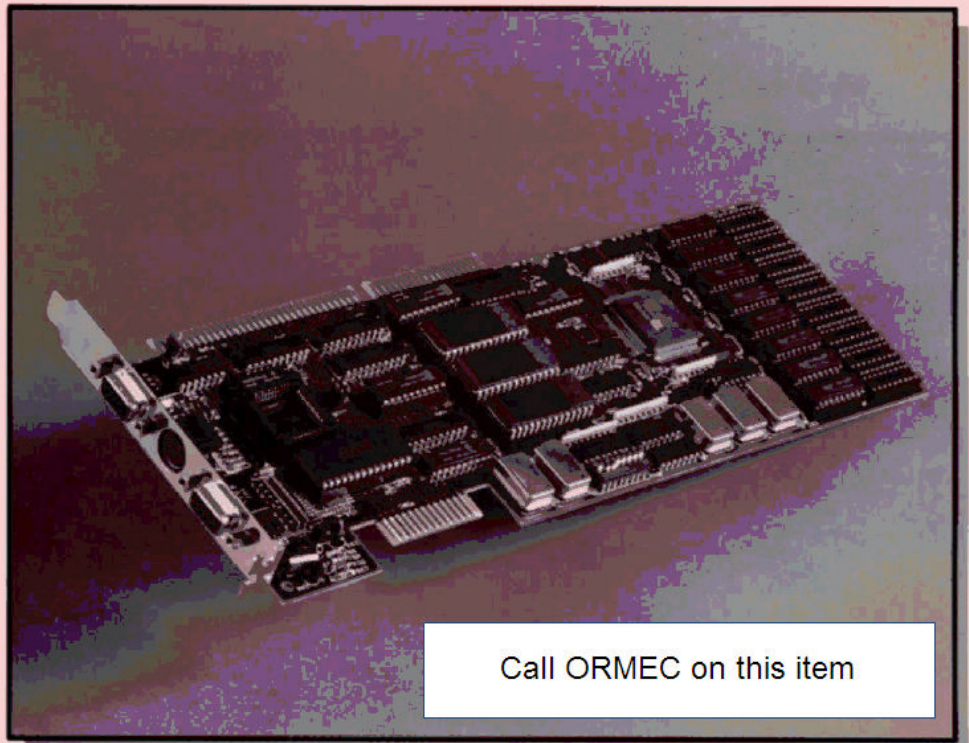
- Compatible with velocity mode drives as well as the preferred torque mode servodrives through individual axis interface connectors
- Pacer encoders for electronic gearing can be interfaced through any standard axis interface connector
- Servodrive remote enable and reset functions are provided by optically coupled outputs
- Open wire detection provided on all differential quadrature feedback inputs
- Failsafe servodrive alarm detection using optically isolated input
- Servodrive alarm decoding is provided by three optically isolated inputs

Video Display Adapter:

Generation III's video display adapter interface module provides a video interface to IBM-PC compatible color or monochrome monitors. Color follows the high resolution EGA or VGA standards. Monochrome follows the MDA standard.

The optional interface takes one slot in the Generation III PC/AT style expansion bus, and is compatible with a wide variety of PC compatible monitors. For industrial applications, ORMEC provides Operator Interface Terminals in both EGA and monochrome versions. The keyboard of these Operator Interface Terminals is interfaced through an IBM-PC/AT keyboard interface connector on the motion controller.

ORMEC Operator Interface Terminals come with six foot cables, however they can be located up to 150 feet from the motion controller using optional interface extenders.



Call ORMEC on this item

Video Display Adapter: EGA, Mono or VGA video interface to operator interface terminal

Serial Communications Interface Adapters:

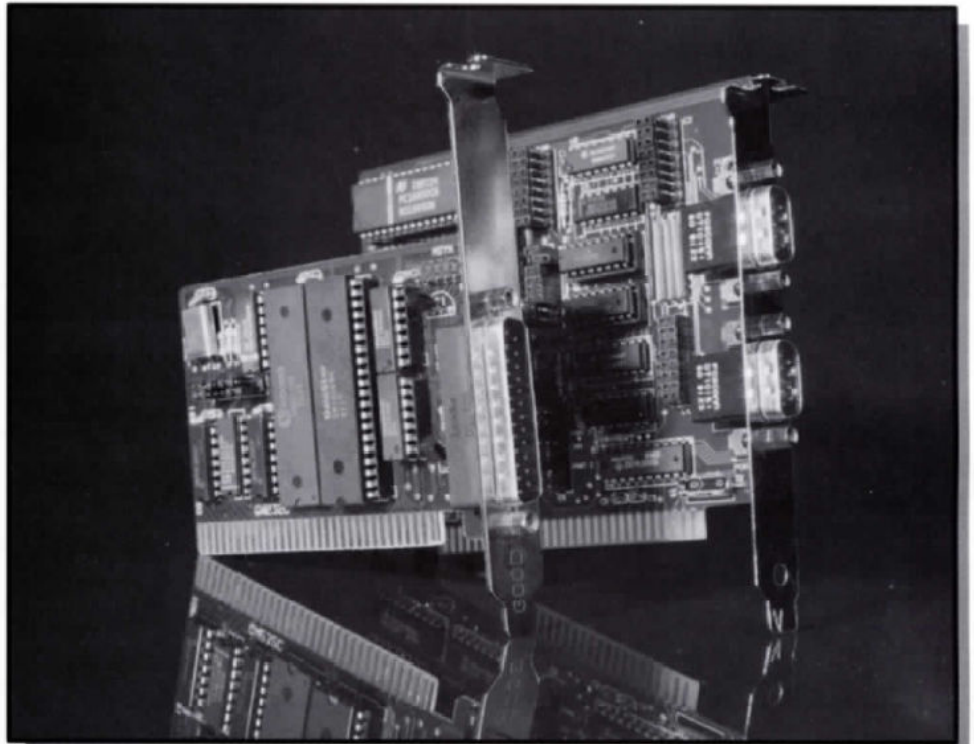
For serial communications beyond the two standard ports, additional serial communications interface adapters are available. They both provide two more serial ports which are accessed from MotionBASIC® as devices COM1 and COM2.

The GN3-232 serial communication adapter provides a primary serial port using a 25-pin, D-series connector and the RS-232 standard. An auxiliary port is interfaced through an external 25-pin connector and bracket.

The GN3-422 communications adapter provides two ports which are individually configurable for RS-232 or RS422/485. Both ports are interfaced through integral 9-pin D-Series connectors.

This optional serial adapter takes one slot in the Generation III PC/AT style expansion bus, and is a convenient method for interfacing to ORMEC's MMI-840 compact industrial terminal and ITM-270 industrial keypad.

Up to 32 keypads and displays may be attached to a single RS-422/485 serial port.



Serial Communications Interface Adapters: simple interface to two additional RS-232 or RS-422/485 serial ports