GALIL

2009

MOTION
CONTROL
PRODUCT
CATALOG

WE MOVE THE WORLD

GALIL
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Table of Contents

Galil provides a full line of controllers.
Shown from top: DMC-40x0 Accelera Ethernet controller,
DMC-21x3 Econo Ethernet controller,
DMC-18x6 Accelera PCI controller and
RIO Pocket PLC.

Innovator and Leader

With over 500,000 controllers sold, Galil is the leading manufacturer of motion controllers. Since our introduction of the first microprocessor-based motion controller in 1983, Galil has remained the industry's leading innovator. By offering our customers the most powerful, cost-effective and easy-to-use motion controllers available today, our commitment is to be your primary source for any motion control application. Galil's unparalleled array of motion controllers is backed by superior technical support and can accommodate the most demanding applications—with absolute precision.

Powerful Controllers to Solve Demanding Applications

Galil's motion controllers use a 32-bit microcomputer and are packed with intelligence and speed for handling any application no matter how simple or complex. Modes of motion include point-to-point positioning, linear and circular interpolation, electronic gearing, electronic cam, position following and much more. Galil's latest generation controllers, the Accelera series offer ultra-high speed and precision with 40 microsecond command processing, 32 microsecond servo loop updates, and 22 MHz encoder feedback. Features include PID tuning with notch filter, velocity and acceleration feedforward, non-volatile memory for storing programs, variables and arrays, and plenty of I/O for interfacing to external sensors.

Galil's Accelera motion controllers offer ultra-high performance and speed.
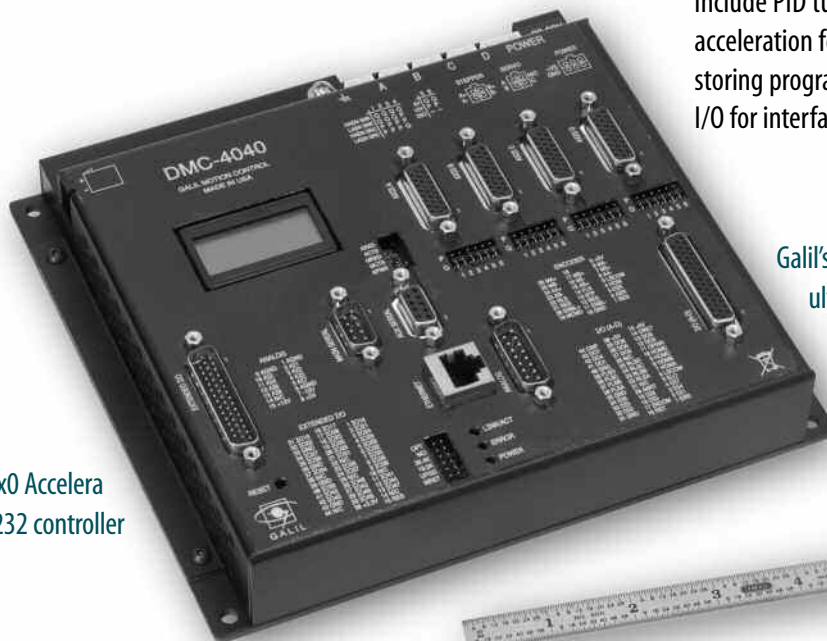
DMC-40x0 Accelera Ethernet/ RS232 controller
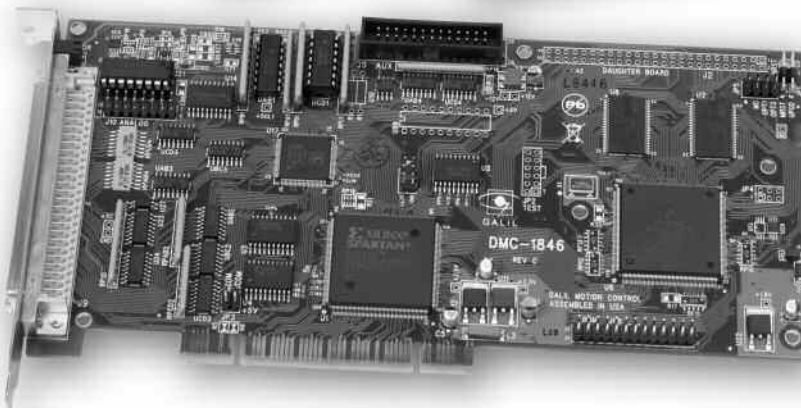
DMC-18x6 Accelera PCI controller

Galil. We Move The World
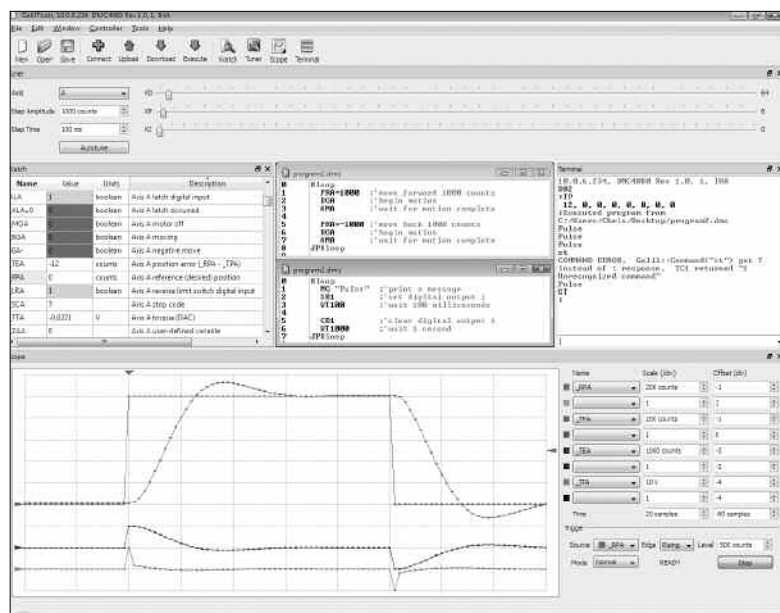
Broad Range of Products

Galil's full product offering can accommodate all your motion and I/O needs. You can choose from single and multi-axis controllers, bus-based and stand-alone, and box-level and card-level controllers. The Accelera Series offers the highest speed and performance while the Econo Series is designed for the lowest cost. Both the Accelera and Econo series are available in PCI bus and Ethernet/RS232 formats. Plug-in drives for steppers and servos save space, cost and wiring. Galil's RIO Pocket PLC provides a compact and cost-effective solution for intelligently handling both analog and digital I/O.

Easy-to-Use Controllers Get You to Market Quickly

It has always been a top priority at Galil to design and make controllers that are easy-to-use. That's why Galil controllers use two-letter, intuitive commands to make programming a snap. For example, the command *BG* begins motion; *SP* specifies the speed; and *ST* stops motion. With over 200 commands, you can quickly and easily program a Galil controller to handle virtually any application. Additionally, Galil provides software tools that simplify system set-up and tuning. The powerful GalilTools software provides "one-button" PID tuning and a multi-trace storage scope for display of real-time data such as position, speed and torque.

Custom Solutions to Fit Any Application

If you cannot find a controller to meet your requirements, then Galil will design one specifically for you. We are geared to build cost-effective controllers to meet your criteria, whether adding a new command, changing connector style or accommodating a special communication network. With all the inherent costs, time and risks involved, there's no reason why you should design your own controller when you can rely on the expertise, cost-efficiency, and proven reliability of Galil.
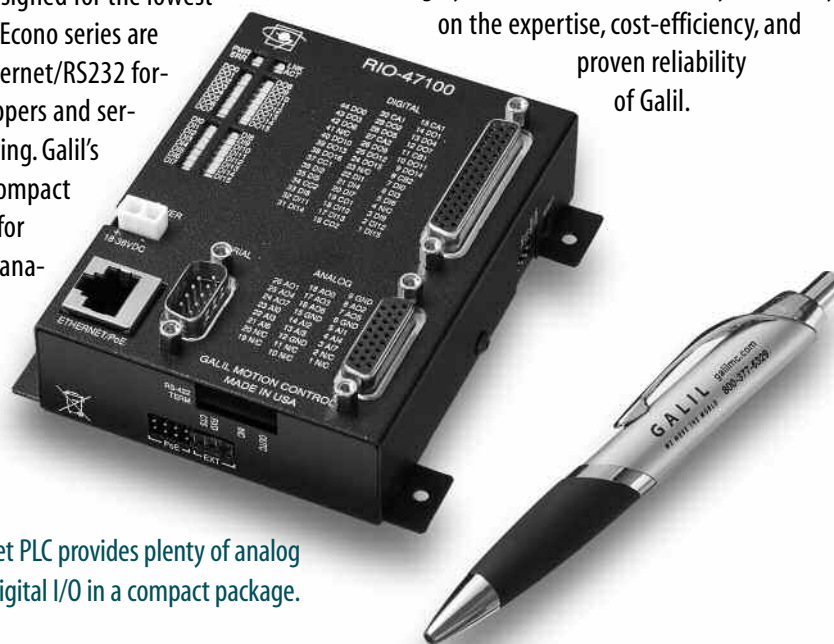
Galil's Pocket PLC provides plenty of analog and digital I/O in a compact package.

Cost-Effective Solutions Give You a Competitive Edge

Galil realizes how critical it is for OEMs to keep their equipment costs down, which is why we designed all of our controllers to give you great value. In fact, we guarantee 100% that our pricing for 100 quantity orders is the lowest in the industry. Go ahead and compare our prices versus the competition. For example, our DMC-1842 4-axis PCI bus controller is just $795 in 100 quantities and $395 in 1000 quantities. That's less than $100 per axis. With prices this low, why bother to make your own controller!

Continuing Education to Grow Your Knowledge

Galil has always made motion control education a priority for our customers. Our content-rich website is filled with information such as white papers, web tutorials, and numerous application examples. Galil also offers its web-based, "Motion Control Made Easy" course at no charge with product purchase. Customers find our 2-day workshop a great way to get a head start on their motion projects. This workshop includes hands-on labs which enable users to practice newly introduced concepts. Users also gain familiarity with tuning and programming motion controllers, and can spend quality one-on-one time with Galil engineers to discuss their individual project.

World-class Support Assures Your Success

Every Galil controller you buy is backed by Galil's commitment to superior customer support. This includes a fully-trained technical support team with well over 100 years of motion control experience. To further assure your success, Galil works with a worldwide network of factory-trained, independent representatives who fully understand the requirements of your specific application and stand ready to demonstrate Galil products. They also represent manufacturers of motors, encoders, and drives which are compatible with Galil controllers.

Galil's application engineers provide prompt technical assistance.

The mission of Galil's experienced Applications Department is to provide prompt and accurate technical assistance to help OEMs successfully deliver their products to market.

Galil. We Move The World

*D*elivering the Best Value — Anywhere

Galil understands your need to work within budgets and keep costs down. That's why Galil absolutely guarantees that, with a minimum order of 100 high performance controllers within a 12-month period, our price in the U.S. will always be less than that of any other manufacturer. In fact, Galil's volume prices are typically half that of the competition.

To be assured of this low price, you simply need to:

■ *Present a competitive price for 100+ controllers from a valid price list published within 90 days from a recognized manufacturer.*

■ *Show that competitive motion controllers are equivalent, i.e. matching bus type, number of axes, I/O options, and quantity ordered.*

■ *Show that competitive motion controllers have the following high performance features: 1) each axis is individually configurable for stepper or servo motors, 2) on-board application program memory is provided with symbolic variables and multi-tasking, and 3) on-board linear and true circular interpolation is provided with unlimited segments and continuous motion.*

∽

With this guarantee, you have the word of Galil's top management that the prices you pay for Galil high performance controllers will be the best you can get — anywhere.

Galil's price guarantee assures cost-effective solutions for OEMs.

Discover www.galilmc.com

At www.galilmc.com, you will find a treasure-trove of valuable information — much of which is free — to keep you at the forefront of motion control technology. Galil welcomes and encourages you to take advantage of Galil's in-depth, technical website with detailed information on products and a wide array of application notes, articles, and on-line tutorials.

■ **Product Specifications.** View product descriptions, pin-outs, command set and pricing on line.

■ **On-line Bulletin Board.** Post a question and have it answered promptly by a Galil applications expert. Or, search the subject index for questions and answers similar to yours.

■ **Motion Code™.** Galil's helpful engineering tool aids in the development of motion applications. Includes step-by-step design and downloadable code for several motion types.

■ **Web-based Training on Motion Control.** Galil's popular "Motion Control Made Easy" class has been converted into a web-based course for your access 24/7. This is available free with your purchase of a Galil controller.

■ **On-line Application Notes, Articles and Product Manuals.** Download complete technical information to stay up to date on technology, trends and products.

■ **Web-based Tutorials.** Browse a library with over 20 technical tutorials on a variety of subjects such as tuning, programming and motor types.

■ **Free Software Downloads.** Download the latest Galil communication drivers for all current versions of Windows, Linux and Dos.

■ **MotorSizer™.** Easy-to-use tool for quickly sizing stepper or servo systems.

Product Overview

Galil Motion Control is the leading supplier of high-performance, cost-effective and easy-to-use controllers with over 500,000 controllers installed world-wide. Galil's complete line of motion controllers includes single and multi-axis; bus-based and stand-alone; and box-level and card-level controllers. The Accelera Series offers the highest speed and performance while the Econo Series is designed for the lowest cost. Galil's Single-Axis controller series offers cost-effective, compact solutions for single-axis applications. Each series is available in PCI and Ethernet/RS232 formats. Plug-in drives for steppers and servos provide a complete motion solution that saves cost, space and wiring. Galil's Pocket PLC series provides an intelligent and cost-effective solution for handling analog and digital I/O.

Galil also provides software tools for its controllers including GalilTools for easy system set-up, communication and tuning. Other accessories include cables and interconnect boards for convenient prototyping.

Accelera Controllers & Drives
Sizzling Speed. Fully Loaded.
DMC-40x0 Ethernet/RS232
DMC-18x6 PCI Bus

Econo Controllers & Drives
For extremely cost-sensitive applications.
DMC-21x3 Ethernet/RS232
DMC-18x2 PCI Bus

Single-Axis Controllers
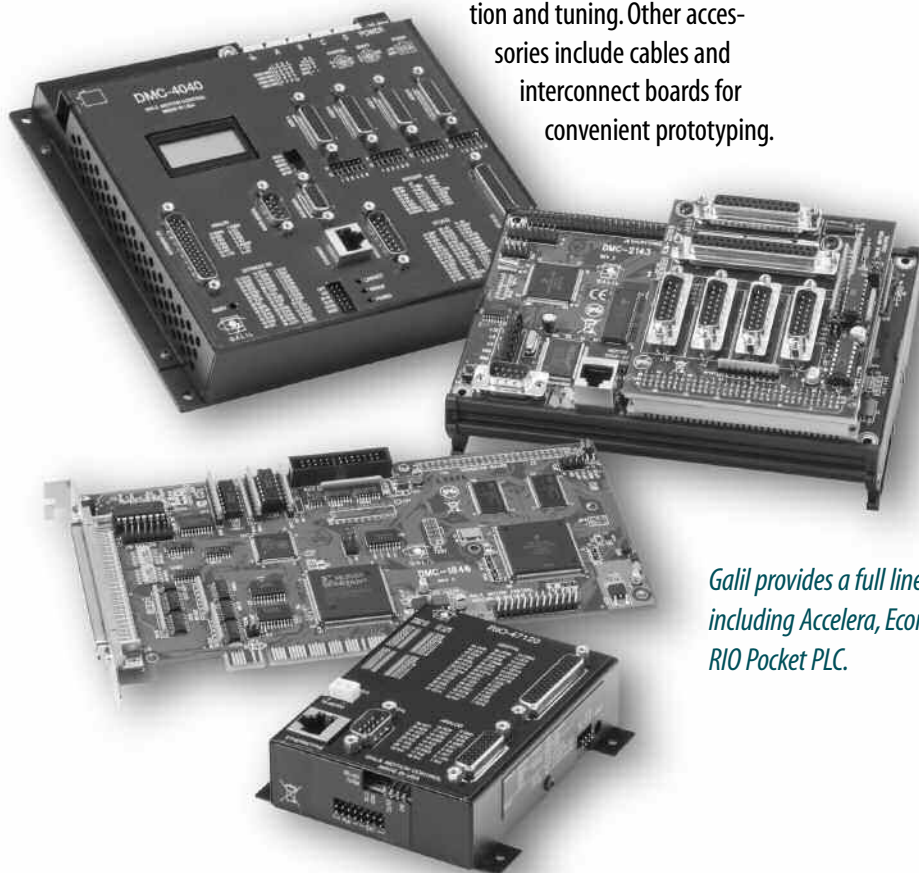Cost-effective solutions for single-axis applications.
DMC-14x5 Ethernet/RS232
CDS-3310 Ethernet/RS232 with 500W servo drive

Pocket PLC Series
Smart. Compact. Low-Cost. Packed with I/O.
RIO-47xxx

Galil provides a full line of controllers including Accelera, Econo and the RIO Pocket PLC.

Accelera Series
Sizzling Speed. Fully Loaded.

It's all about Speed!

Galil's ultra high-speed Accelera Series represents its 5th generation motion controllers. Pumped up with a powerful RISC processor, the Accelera series race along at much higher speeds than prior generation controllers.

- Processes commands in 40 microseconds—10 times faster than prior generations
- Accepts encoder inputs as fast as 22 MHz
- Servo loop updates as high as 32 kHz

All the Bells and Whistles are Standard

- Available in 1- through 8-axis models
- Available with Ethernet or PCI:
  DMC-40x0 Ethernet/RS232
  DMC-18x6 PCI
- Mix-and-Match steppers and servos
- Handles virtually any mode of motion with ease
- 2000 lines x 80 chr program memory; 16000 element arrays; 510 variables
- Multitasking for running up to eight programs simultaneously
- Optically isolated inputs and outputs
- 8 uncommitted analog inputs with 12-bit or 16-bit ADC
- Accepts two encoders for every servo axis
- DMC-40x0 accepts 20–80 VDC input and provides D-type connectors
- Compact size: 1–4 axis: DMC-4040: 8.1" × 7.25" × 1.72"
  5–8 axis: DMC-4080: 11.5" × 7.25" × 1.72"
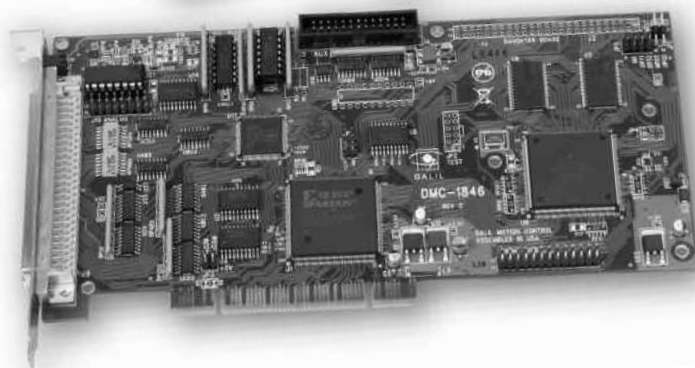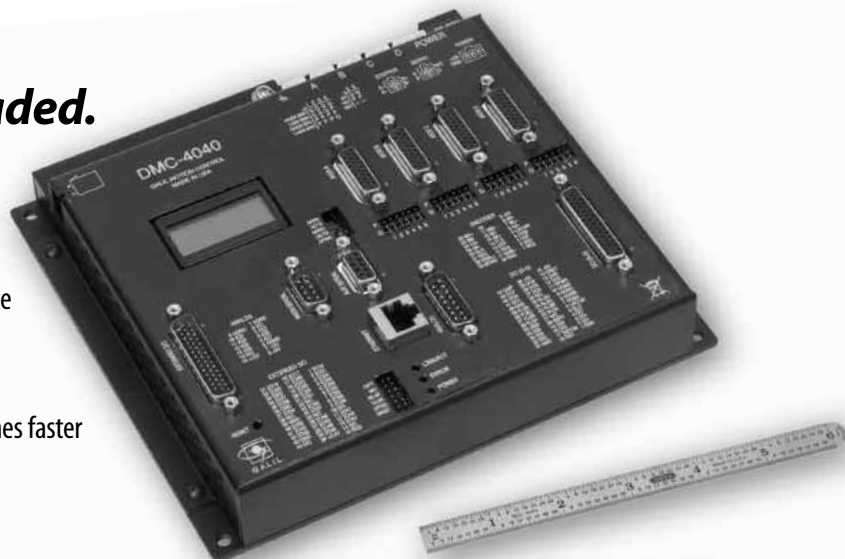
Ultimate Power

The DMC-40x0 is available with internal, multi-axis drives that minimize space, cost and wiring. Drive options are available for steppers and servos. The DMC-40x0 controller can also be easily connected to external drives of any power range. The AMP-195x0 2- and 4-axis packaged drive is available for the DMC-18x6 PCI controller.

DRIVE MODEL	MOTOR TYPE	# OF AXES	CURRENT	VOLTAGE
AMP-43020	Servo	2	7A cont, 10A peak	20–80 VDC
AMP-43040	Servo	4	7A cont, 10A peak	20–80 VDC
AMP-43140	Servo	4	1A max	±12–30 VDC
SDM-44040	Stepper	4	1.4A/phase	12–30 VDC
SDM-44140	Microstep	4	3A/phase	20–60 VDC

Product Description

The DMC-40x0 motion controller is Galil's highest performance, stand-alone motion controller. It belongs to Galil's latest generation motion controller family: the Accelera Series, which accepts encoder inputs up to 22 MHz, provides servo update rates as high as 32 kHz, and processes commands in as fast as 40 microseconds — 10 times faster than prior generation controllers.

DMC-4040 4-axis and DMC-4080 8-axis controllers
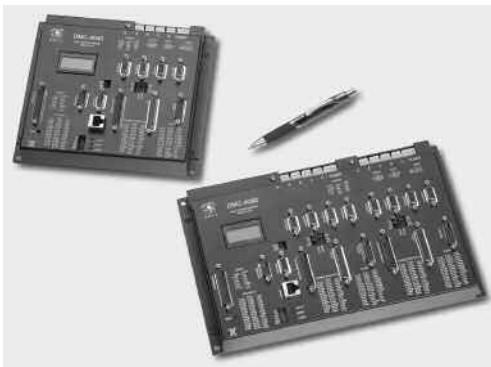
The DMC-40x0 is a full-featured motion controller packaged with optional multi-axis drives in a compact, metal enclosure. The unit operates stand-alone or interfaces to a PC with Ethernet 10/100Base-T or RS232. The controller includes optically isolated I/O, high-power outputs capable of driving brakes or relays, and analog inputs for interfacing to analog sensors. The DMC-40x0 controller and drive unit accepts power from a single 20–80 VDC source.

The DMC-40x0 is available in one through eight axis formats, and each axis is user-configurable for stepper or servo motor operation. Standard programming features include PID compensation with velocity and acceleration feedforward, multitasking for simultaneously running up to eight programs, and I/O processing for synchronizing motion with external events. Modes of motion include point-to-point positioning, position tracking, jogging, linear and circular interpolation, contouring, electronic gearing and ECAM. Like all Galil controllers, the DMC-40x0 controllers use Galil's popular, intuitive command language, making them very easy to program. GalilTools servo design software further simplifies system set-up with "one-button" servo tuning and real-time display of position and velocity information.

Features

- Packaged controller in 1 through 8 axis versions: DMC-40x0 where x=1,2,3,4,5,6,7,8 axes
- (1) 10/100BASE-T Ethernet port with Auto MDIX (2) RS232 ports up to 115 kbaud
- User-configurable for stepper or servo motors on any combination of axes. Optional sinusoidal commutation signals for brushless servo motors.
- Accepts up to 22 MHz encoder frequencies for servos. Outputs pulses up to 6 MHz for steppers
- PID compensation with velocity and acceleration feedforward, integration limits, notch filter and low-pass filter
- Modes of motion include jogging, point-to-point positioning, contouring, linear and circular interpolation, electronic gearing and ECAM. Features ellipse scaling, slow-down around corners, infinite segment feed and feedrate override
- Over 200 English-like commands including conditional statements and event triggers
- Non-volatile memory for programs, variables and arrays. Multitasking for concurrent execution of up to eight programs
- Optically isolated home input and forward and reverse limits for every axis.
- Uncommitted, isolated inputs and isolated outputs 1- through 4-axis models: 8 inputs and 8 outputs 5- through 8-axis models: 16 inputs and 16 outputs
- Isolated, high-power outputs for driving brakes or relays
- High speed position latch for each axis and output compare
- 8 uncommitted analog inputs
- 32 additional 3.3 V I/O (5 V option)
- 2 line x 8 character programmable LCD
- Dual encoder inputs for each servo axis
- Accepts single 20–80 VDC input
- Available with internal stepper and servo drives. Or, connect to external drives of any power range
- Communication drivers for Windows and Linux
- Custom hardware and firmware options available

DMC-40x0 Series

Specifications

System Processor

■ RISC-based, clock multiplying processor with DSP functions

Communications Interface

■ (1) 10/100BASE-T Ethernet port with Auto MDIX

■ (2) RS232 ports up to 115 kbaud

Commands are sent in ASCII. A binary communication mode is also available as a standard feature

Modes of Motion:

■ Point-to-point positioning

■ Position Tracking

■ Jogging

■ 2D Linear and Circular Interpolation with feedrate override

■ Linear Interpolation for up to 8 axes

■ Tangential Following

■ Helical

■ Electronic Gearing with multiple masters and ramp-to-gearing

■ Gantry Mode

■ Electronic Cam

■ Contouring

■ Teach and playback

Memory

■ Program memory size — 2000 lines × 80 characters

■ 510 variables

■ 16,000 total array elements in up to 30 arrays

Filter

■ PID (proportional-integral-derivative) with velocity and acceleration feedforward

■ Notch filter and low-pass filter

■ Dual-loop control for backlash compensation

■ Velocity smoothing to minimize jerk

■ Integration limit

■ Torque limit

■ Offset adjustment

Kinematic Ranges

■ Position: 32 bit (± 2.15 billion counts per move; automatic rollover; no limit in jog or vector modes)

■ Velocity: Up to 22 million counts/sec for servo motors

■ Acceleration: Up to 1 billion counts/sec^2

Uncommitted I/O

	ISOLATED INPUTS	ISOLATED OUTPUTS	ANALOG INPUTS	3.3 V I/O
DMC-4010 thru -4040	8	8	8	32
DMC-4050 thru -4080	16	16	8	32

High Speed Position Latch

■ Uncommitted inputs 1-4 latch A,B,C,D and 9-12 latch E, F, G, H axes (latches within 40 microseconds with optoisolation)

Dedicated Inputs (per axis)

■ Main encoder inputs — Channel A, A-, B,B-, I, I- (±12 V or TTL)

■ Dual encoder (for axes configured as servo) — Channel A, A-, B, B-

■ Forward and reverse limit inputs — optoisolated

■ Home input — optoisolated

■ Selectable high-speed position latch input — optoisolated

■ Selectable abort input for each axis — optoisolated

Dedicated Outputs (per axis)

■ Analog motor command output with 16-bit DAC resolution

■ Pulse and direction output for step motors

■ PWM output also available for servo amplifiers

■ Amplifier enable output

■ Error output (per set of 4 axes)

■ High-speed position compare output (per set of 4 axes)

Minimum Servo Loop Update Time

	STANDARD	-FAST*
■ 1–2 axes:	62 µsec	31 µsec
■ 3–4 axes:	125 µsec	62 µsec
■ 5–6 axes:	156 µsec	94 µsec
■ 7–8 axes:	187 µsec	125 µsec

Maximum Encoder Feedback Rate

■ 22 MHz

Maximum Stepper Rate

■ 6 MHz (Full, half or microstep)

Power Requirements

■ 20 – 80 VDC

Environmental

■ Operating temperature: 0 – 70º C

■ Humidity: 20 – 95% RH, non-condensing

Mechanical

■ 1- thru 4-axis: 8.1" × 7.25" × 1.72"
5- thru 8-axis: 11.5" × 7.25" × 1.72"

Connectors

■ Amplifier I/O: 44-pin HD Male D-sub

■ General I/O: 44-pin HD Female D-sub

■ Encoder: 15-pin HD Female D-sub

■ Analog: 15-pin LD Male D-sub

*Reduced feature set for -FAST.

DMC-40x0 Interconnect and Drive Options

ICM-42000 Interconnect Module (-I000)

The ICM-42000 resides inside the DMC-40x0 enclosure and breaks out the internal CPU board connector into convenient D-sub connectors for interface to external amplifiers and I/O devices. The ICM-42000 provides a 15-pin HD D-sub connector for the encoders on each axis, a 15-pin D-sub for analog inputs, a 44-pin HD D-sub for I/O, and a 44-pin D-sub for the motor command signals. Eight 500 mA highside drive outputs are available (total current not to exceed 3 A). The ICM-42000 is user-configurable for a broad range of amplifier enable options including: High amp enable, Low amp enable, 5 V logic, 12 V logic, external voltage supplies up to 24 V and sinking or sourcing. Two ICMs are required for 5- thru 8-axis controllers.

ICM-42100 Sinusoidal Encoder Interpolation Module (-I100)

The ICM-42100 option resides inside the DMC-40x0 enclosure and accepts sinusoidal encoder signals instead of digital encoder signals as accepted by the ICM-42000. The ICM-42100 provides interpolation of up to four 1-volt differential sinusoidal encoders resulting in a higher position resolution. The AFn command selects sinusoidal interpolation where n specifies 2^n interpolation counts per encoder cycle (n=5 to 12). For example, if the encoder cycle is 40 microns, AF10 results in 2^{10}=1024 counts per cycle, or a resolution of 39 nanometers per count. With the ICM-42100, the sinusoidal encoder inputs replace the main digital encoder inputs. The ICM-42100 provides a 15-pin D-sub connector for the encoders on each axis, a 15-pin D-sub for analog inputs, a 44-pin D-sub for I/O, and a 44-pin D-sub for the motor command signals. Two ICMs are required for 5- thru 8-axis controllers.

ICM-42200 Interconnect Module (-I200)

The ICM-42200 interconnect option resides inside the DMC-40x0 enclosure and provides a pin-out that is optimized for easy connection to external drives. The ICM-42200 uses 26-pin HD D-sub connectors for each axis that includes encoder, limit, home, and motor command signals. Other connectors include a 44-pin HD D-sub for digital I/O, and a 15-pin LD D-sub for analog I/O. The ICM-42200 is configurable on each individual axis for high or low amplifier enable; 5 V, 12 V or isolated input power(up to 24 V); sinking or sourcing. The DMC-40x0 cover does not have to be removed to install these options. Two ICMs are required for 5- through 8-axis controllers.

AMP-430x0 2- and 4-axis 500W Servo Drives (-D3020, -D3040)

The AMP-43040 resides inside the DMC-40x0 enclosure and contains four transconductance, PWM amplifiers for driving brushless or brush-type servo motors. Each amplifier drives motors operating at up to 7 Amps continuous, 10 Amps peak, 20–80 VDC. The gain settings of the amplifier are user-programmable at 0.4 Amp/Volt, 0.7 Amp/Volt and 1 Amp/Volt. The switching frequency is 60 kHz. The drive for each axis is software configurable to operate in either a chopper or inverter mode. The chopper mode is intended for operating low inductance motors. The amplifier offers protection for over-voltage, under-voltage, over-current, short-circuit and over-temperature. Two AMP-43040s are required for 5- thru 8-axis controllers. A shunt regulator option is available. A two-axis version, the AMP-43020 is also available.

AMP-43140 4-axis 20W Servo Drives (-D3140)

The AMP-43140 resides inside the DMC-40x0 enclosure and contains four linear drives for operating small, brush-type servo motors. The AMP-43140 requires a ± 12-30 VDC input. Output power is 20 W per amplifier or 60 W total. The gain of each transconductance linear amplifier is 0.1 A/V at 1 A maximum current. The typical current loop bandwidth is 4 kHz.

SDM-44040 4-axis Stepper Drives (-D4040)

The SDM-44040 resides inside the DMC-40x0 enclosure and contains four drives for operating two-phase bipolar step motors. The SDM-44040 requires a single 12-30 VDC input. The unit is user-configurable for 1.4 A, 1.0 A, 0.75 A, or 0.5 A per phase and for full-step, half-step, 1/4 step or 1/16 step.

SDM-44140 4-axis Microstep Drives (-D4140)

The SDM-44140 resides inside the DMC-40x0 enclosure and contains four microstepping drives for operating two-phase bipolar stepper motors. The drives produce 64 microsteps per full step or 256 steps per full cycle which results in 12,800 steps/rev for a standard 200-step motor. The maximum step rate generated by the controller is 6,000,000 microsteps/second. The SDM-44140 drives motors operating at up to 3 Amps at 12 to 60 VDC (available voltage at motor is 10% less). There are four software-selectable current settings: 0.5 A, 1 A, 2 A and 3 A. Plus, a selectable low-current mode reduces the current by 75% when the motor is not in motion. No external heatsink is required.

Power Supplies — PSR Series

The PSR Series are regulated DC power supplies capable of operating from a 100/240 VAC input, at 50/60 Hz. The power supply includes a shunt regulator and blocking diode.

Model	Power Rating	Dimensions	
PSR-12-24	24 VDC @ 12 A cont.	9" × 6.5" × 2"	3.5 lbs.
PSR-6-48	48 VDC @ 6 A cont.	9" × 6.5" × 2"	3.5 lbs.

ICS D-type to Screw-Terminal Boards

Galil offers various ICS boards which break-out the DMC-40x0 D-type connectors into screw terminals for quick prototyping:

ICS-48015-M 15-pin HD male to terminals — encoder.

ICS-48115-F 15-pin LD female to terminals—analog.

ICS-48044-M 44-pin HD male to terminals — I/O.

ICS-48044-F 44-pin HD female to terminals — drive.

ICS-48032-F 44-pin HD female to terminals — breaks out and optically isolates the 32 extended I/O points. Configurable for inputs and outputs in banks of 8 bits. The ICS-48032-F must only be used with the extended I/O on the DMC-40x0.

ICS-48026-M 26-pin HD male to terminals — for ICM-42200.

RIO Pocket PLC

Galil's RIO I/O controller provides an intelligent solution for adding I/O and PLC functionality to the DMC-40x0 Ethernet control system. Each RIO unit provides a microprocessor, 8 analog inputs, 8 analog outputs, 16 optically isolated inputs, 8 high-power isolated outputs and 8 low-power isolated outputs.

DMC-40x0 Series

Ordering Information

ACCELERA

1- through 4-axis Models:

D M C - 4 0 x 0 - C x x x - I x x x - D x x x x - S R 9 0

Number of Axes
1: 1-axis
2: 2-axes
3: 3-axes
4: 4-axes

Interconnect
000: Digital encoder
100: Sinusoidal encoder
200: Separate Axes
Connectors

**Shunt Regulator
(optional)**

Communication
012: one Ethernet port
and two RS232 ports

**Drive: Axes 1–4
(optional)**
3020: two 500 Watt servo drives
3040: four 500 Watt servo drives
3140: four 20 Watt servo drives
4040: four 1.4 A stepper drives — Full, Half, 1/4, 1/16
4140: four microstep drives

Example: DMC-4030-C012-I000-D3040

5- through 8-axis Models:

D M C - 4 0 x 0 - C x x x - I x x x - I x x x - D x x x x - D x x x x - S R 9 0

Number of Axes
5: 5-axes
6: 6-axes
7: 7-axes
8: 8-axes

**Interconnect
(1st four axes)**
000: Digital encoder
100: Sinusoidal encoder
200: Separate Axes
Connectors

**Shunt Regulator
(optional)**

**Drive—Axes 5–8
(optional)**
3020: two 500 Watt servo drives
3040: four 500 Watt servo drives
3140: four 20 Watt servo drives
4040: four 1.4 A stepper drives — Full, Half, 1/4, 1/16
4140: four microstep drives

**Interconnect
(2nd four axes)**
000: Digital encoder
100: Sinusoidal encoder
200: Separate Axes
Connectors

Communication
012: one Ethernet port
and two RS232 ports

**Drive—Axes 1–4
(optional)**
3020: two 500 Watt servo drives
3040: four 500 Watt servo drives
3140: four 20 Watt servo drives
4040: four 1.4 A stepper drives — Full, Half, 1/4, 1/16
4140: four microstep drives

Example: DMC-4080-C012-I000-I000-D3040-D3040

DMC-40x0 Series

Ordering Information — continued

Options *(opt)*

The *(opt)* specifier is only necessary for special configurations of the DMC, CMB, ICM, SDM and AMP boards. If a special option is required, place the appropriate OPT code inside a parenthesis directly following the respective DMC, CMB, ICM, SDM or AMP part number. Use commas for multiple option specifications within a parenthesis.

DMC Controller

OPT CODE	DESCRIPTION
DIN	DIN Rail mounting option
12 V	12 VDC controller power
16BIT	16-Bit ADC for analog inputs. 12-bits is standard
D400sxxx	Firmware special part number

CMB Communication board

OPT CODE	DESCRIPTION
5 V	5 V for the extended I/O. 3.3 V is standard
422	RS422 on main, auxiliary or both

ICM Interconnect board

OPT CODE	DESCRIPTION
SSI	SSI Encoders.* Quadrature encoders are standard
DIFF	Differential analog motor command outputs. Single-ended is standard
LAEN	Low Amp Enable. High Amp Enable is standard
24 V	24 V Amp enable-sourcing. 5 V–12 V sinking is standard
STEP	Differential Step/Direction outputs. Single-ended is standard
I100	Specify sinusoidal encoder. Digital is standard
I200	Specify separate axis connectors (recommended if using external drives)

SDM and AMP Drives

OPT CODE	DESCRIPTION
100mA	100 mA output capacity for AMP-43140. Default is 1 Amp
ISAMP	Isolation of power between each AMP amplifier
ISCNTL	Isolation of controller power from amplifier power

Example: Specify a DMC-4040 four axis controller with an AMP-43040 four axis amplifier configured for isolation of controller power from amplifier power, 5 V extended I/O, Low amp enable, and 24 V amp enable: DMC-4040(ISCNTL)-C012(5V)-I000(LAEN,24V)-D3040.

An on-line DMC-40x0 part number generator is located at www.galilmc.com.

*Requires NRE for set-up. Consult factory.

ACCELERA

Ordering Information — continued

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-4010-C012-I000	1-axis Ethernet/RS232 controller with ICM-42000	$1595	$ 945
DMC-4020-C012-I000	2-axis Ethernet/RS232 controller with ICM-42000	$1695	$ 995
DMC-4030-C012-I000	3-axis Ethernet/RS232 controller with ICM-42000	$1995	$1095
DMC-4040-C012-I000	4-axis Ethernet/RS232 controller with ICM-42000	$2295	$1195
DMC-4050-C012-I000-I000	5-axis Ethernet/RS232 controller with ICM-42000	$2695	$1495
DMC-4060-C012-I000-I000	6-axis Ethernet/RS232 controller with ICM-42000	$2895	$1595
DMC-4070-C012-I000-I000	7-axis Ethernet/RS232 controller with ICM-42000	$3045	$1695
DMC-4080-C012-I000-I000	8-axis Ethernet/RS232 controller with ICM-42000	$3195	$1795
ICM-42100 (-I100)	Specify sinusoidal encoder inputs instead of digital encoder inputs Replace -I000 with -I100	$ 100 adder	$ 60 adder
ICM-42200 (-I200)	Specify individual 26-pin HD connectors for each axis Replace -I000 with -I200	$ no adder	$ no adder
AMP-43040 (-D3040)	Four 500 W servo drives (use one for 1–4 axis models; Two for 5–8 axes models). Add to above	$ 700	$ 400
AMP-43020 (-D3020)	Two 500 Watt servo drives	$ 450	$ 275
AMP-43140 (-D3140)	Four 20 Watt servo drives	$ 175	$ 155
SDM-44040 (-D4040)	Four 1.4 A stepper drives- Full, Half, 1/4, 1/16	$ 175	$ 155
SDM-44140 (-D4140)	Four microstep drives	$ 600	$ 400
SR-49000 (-SR90)	Shunt regulator (90 Volts). Add to above.	$ 50	$ 35
PSR-12-24	Power supply, 12 A, 24 VDC. Includes shunt regulator	$ 250	$ 175
PSR-6-48	Power supply, 6 A, 48 VDC. Includes shunt regulator	$ 250	$ 175
ICS-48015-M	15-pin D HD male to screw terminals — for encoder signals	$ 50	$ 35
ICS-48115-F	15-pin D LD female to screw terminals — for analog inputs	$ 50	$ 35
ICS-48044-M	44-pin D HD male to screw terminals — for general I/O	$ 75	$ 50
ICS-48044-F	44-pin D HD female to screw terminals — for external drive signals	$ 75	$ 50
ICS-48032-F*	44-pin D HD female to screw terminals — for extended I/O. Provides optical isolation of 32 extended I/O points.	$ 125	$ 80
ICS-48026-M	26-pin D HD male to screw terminals — for axis connectors on ICM-42200	$ 75	$ 50
RIO-47xxx	Remote I/O controller. Pocket PLC	Starts at $ 295	$ 195
GalilTools-Lite	Editor, Terminal, Watch Tools. Includes communication library for developers-supports C++, VB, C#, LabVIEW and more	Free download	
GalilTools	Above with Scope and Tuner	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Microsoft platforms	$ 595	

* ICS-48032-F Options:

ICS-48032-F - x x x x

Bank 4 (I=In, 0=Out(default=sink))
Bank 3
Bank 2
Bank 1

ICS-48032-F-0000-Source All 4 banks configured as outputs, outputs sourcing
ICS-48032-F-00II First 2 banks outputs, second 2 banks inputs, outputs sinking
ICS-48032-F-00II-Source First 2 banks outputs, second 2 banks inputs, outputs sourcing

*Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.*

PCI Bus Accelera Series, 1–8 axes
DMC-18x6 Series

Product Description

The DMC-18x6 PCI bus controllers belong to Galil's latest generation motion controller family: the Accelera Series. Incorporating a 32-bit RISC-based microcomputer, these controllers offer high-speed performance and processing power. Speed improvements include acceptance of encoder inputs up to 22 MHz, servo update rates as low as 31 microseconds/axis, and command execution speeds as low as 40 microseconds. While the DMC-18x6 offers performance enhancements compared to prior generation PCI controllers, the programming language and

DMC-1886 and DMC-1846
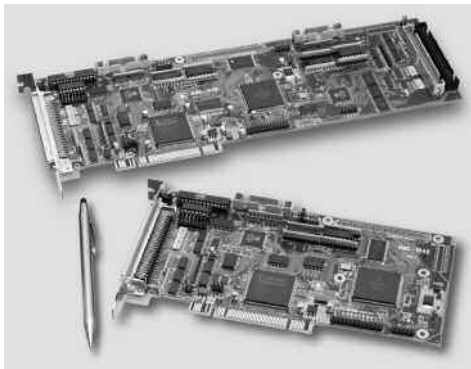
100-pin SCSI connector are virtually the same, making conversion to the DMC-18x6 quick and easy.

The DMC-18x6 is available in one through eight-axis formats, and each axis is user-configurable for stepper or servo motor operation. The controller includes optically isolated inputs including a forward limit, reverse limit and home input for each axis, in addition to uncommitted analog and digital I/O. Up to two encoders are accepted for each servo axis.

Standard programming features include PID compensation with velocity and acceleration feedforward, multitasking for simultaneously running up to eight programs, and I/O processing commands for synchronizing motion with external events. Modes of motion include point-to-point positioning, position tracking, jogging, linear and circular interpolation, contouring, electronic gearing and ECAM. Like all Galil controllers, the DMC-18x6 controllers use Galil's popular, intuitive command language which makes them very easy to program. The new GalilTools software further simplifies system set-up with "one-button" servo tuning and real-time display of position and velocity information.

Features

- PCI card in 1 through 8 axis versions: DMC-18x6 where x=1,2,3,4,5,6,7,8 axes

- User-configurable for stepper or servo motors on any combination of axes. Optional sinusoidal commutation signals for brushless servo motors.

- Accepts up to 22 MHz encoder frequencies for servos. Outputs up to 6 MHz for steppers

- PID compensation with velocity and acceleration feedforward, integration limits, notch filter and low-pass filter

- Modes of motion include jogging, point-to-point positioning, contouring, linear and circular interpolation, electronic gearing and ECAM. Features ellipse scaling, slow-down around corners, infinite segment feed and feedrate override

- Over 200 English-like commands including conditional statements and event triggers

- Non-volatile memory for programs, variables and arrays. Multitasking for concurrent execution of up to eight programs

- Optically isolated home input and forward and reverse limits accepted for every axis.

- 1- through 4-axis: 8 isolated inputs and 8 outputs
  5- through 8-axis: 16 isolated inputs, 16 isolated outputs, 8 digital inputs

- High speed position latch for each axis and output compare

- 8 uncommitted analog inputs

- Dual encoder inputs for each servo axis

- Expansion for 64 I/O with optional DB-14064 board

- 100-pin SCSI connectors for each set of 4 axes. ICM-2900 or ICM-1900 breaks-out 100-pin cable into screw terminals

- AMP-19540 connects to PCI controller with 100-pin cable and provides four amplifiers for 500 W servos

- Communication drivers for Windows, QNX, and Linux

- Custom hardware and firmware options available

PCI Bus Accelera Series, 1–8 axes

DMC-18x6 Series

Specifications

System Processor

- RISC-based, clock multiplying processor with DSP functions

Communications Interface

- PCI with bi-directional FIFO and Dual Port RAM
- 32-bit PCI interface. 64-bit compatible. 5 V/3.3 V

Commands are sent in ASCII. A binary communication mode is also available as a standard feature

Modes of Motion:

- Point-to-point positioning
- Position Tracking
- Jogging
- 2D Linear and Circular Interpolation with feedrate override
- Linear Interpolation for up to 8 axes
- Tangential Following
- Helical
- Electronic Gearing with multiple masters and ramp-to-gearing
- Gantry Mode
- Electronic Cam
- Contouring
- Teach and playback

Memory

- Program memory size — 2000 lines × 80 characters
- 510 variables
- 16,000 total array elements in up to 30 arrays

Filter

- PID (proportional-integral-derivative) with velocity and acceleration feedforward
- Notch filter and low-pass filter
- Dual-loop control for backlash compensation
- Velocity smoothing to minimize jerk
- Integration limit
- Torque limit
- Offset adjustment

Kinematic Ranges

- Position: 32 bit (±2.15 billion counts per move; automatic rollover; no limit in jog or vector modes)
- Velocity: Up to 22 million counts/sec for servo motors
- Acceleration: Up to 1 billion counts/sec^2

Uncommitted Digital I/O

	DIGITAL INPUTS	DIGITAL OUTPUTS	ANALOG INPUTS
DMC-1816 thru -1846	8	8	8
DMC-1856 thru -1886	24	16	8

High Speed Position Latch

- Uncommitted inputs 1-4 latch X,Y, Z,W and 9-12 latch E, F, G, H axes (latches within 40 microseconds with optoisolation)

Dedicated Inputs (per axis)

- Main encoder inputs — Channel A, A-, B,B-,I, I- (±12 V or TTL)
- Dual encoder (for axes configured as servo) — Channel A, A-, B, B-
- Forward and reverse limit inputs — optoisolated
- Home input — optoisolated
- Selectable high-speed position latch input — optoisolated
- Selectable abort input for each axis — optoisolated

Dedicated Outputs (per axis)

- Analog motor command output with 16-bit DAC resolution
- Pulse and direction output for step motors
- PWM output also available for servo amplifiers
- Amplifier enable output
- Error output (per card)
- High-speed position compare output (1 output for each set of 4 axes)

Minimum Servo Loop Update Time

		-FAST[†]
1–2 axes:	62 µsec	31 µsec
3–4 axes:	125 µsec	62 µsec
5–6 axes:	156 µsec	94 µsec
7–8 axes:	187 µsec	125 µsec

Maximum Encoder Feedback Rate

- 22 MHz

Maximum Stepper Rate

- 6 MHz (Full, half or microstep)

Power Requirements

- DMC-18x6: +5V   700 mA
  +3.3V 600 mA
  +12V 150 mA
  -12V   40 mA

Environmental

- Operating temperature: 0–70º C
- Humidity: 20–95% RH, non-condensing

Mechanical

- DMC-18x6: 1–4 axes: 7.850" × 4.2"
 5–8 axes: 12.28" × 4.2"

Connectors

- 100-pin HD SCSI for axes 1–4 and 5–8

[†]Reduced feature set for -FAST.

DMC-18x6 Series

Hardware Accessories

ICM-2900 Interconnect Module

The ICM-2900 breaks-out the 100-pin SCSI cable into screw-type terminals. One ICM-2900 is required for each set of four axes. The ICM-2900-FL has flanges which allow standard screw-type panel mounting. Specify -OPTO for optoisolated outputs. Specify -HAEN for high amp enable and -LAEN for low amp enable. If auxiliary encoders are to be used, use an ICM-2908, a CB-36-25, and a CABLE -36-1M.
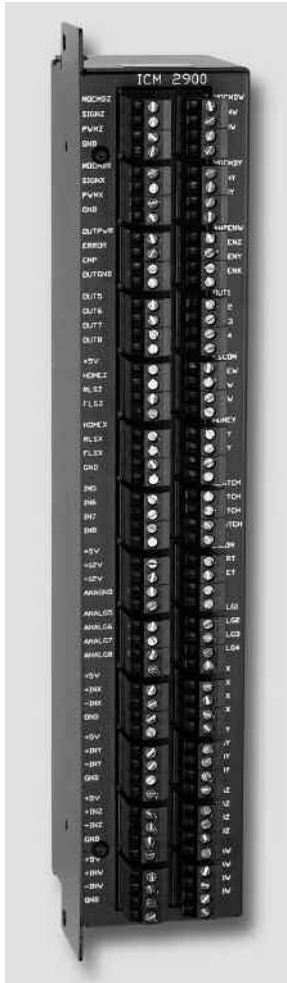
ICM-2900 Interconnect Module with flange

AMP-19540 Interconnect with Four 500 Watt Servo Drives

Galil's AMP-19540 is a 4-axis amplifier for driving brushed or brushless servo motors up to 500 Watts each. By interfacing directly to Galil's DMC-18x6 PCI bus controllers, it provides a cost-effective controller/drive solution for multi-axis applications. The AMP-19540 contains four transconductance, PWM amplifiers. Each amplifier operates at 18 V to 80 V DC, up to 7 Amps continuous, 10 Amps peak. The AMP-19540 gain setting is easily configured with jumpers. The PWM switching frequency is 60 kHz. The AMP-19540 enclosure has dimensions of 6.8" × 8.75" × 1". It interfaces to a PCI bus controller with a single, 100-pin high density SCSI cable. Signals for each axis are brought out through D-type connectors located on the AMP-19540. For applications with less than three axes, the AMP-19520 two-axis model is available. A shunt regulator option is also available. CE certified.
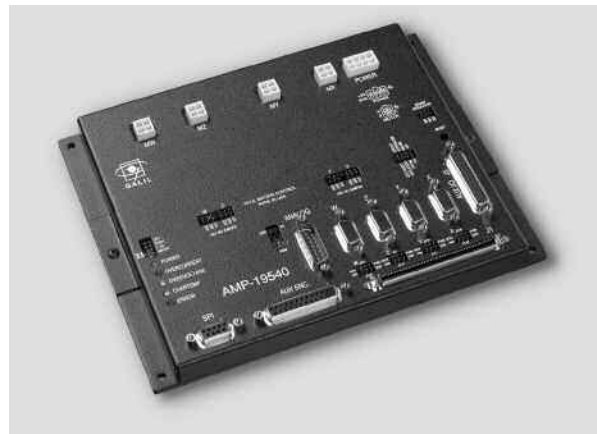
AMP-19540

DB-28104 Sinusoidal Encoder Interpolation Board

The DB-28104 mounts to the DMC-18x6 50-pin header and provides interpolation of up to four 1-volt differential sinusoidal encoders resulting in a higher position resolution. The AF n command selects sinusoidal interpolation where n specifies 2^n interpolation counts per encoder cycle (n= 5 to 12). For example, if the encoder cycle is 40 microns, AF10 results in 2^{10}=1024 counts per cycle, or a resolution of 39 nanometers per count. Each sinusoidal encoder connects to the DB-28104 through its own 9-pin D-sub connector. 3.510" × 3.075".

DB-14064 I/O Expansion

The DB-14064 is an optional board which provides 64 additional I/O for the DMC-18x6 controllers. This board mounts directly onto the back of the controller and provides 64 I/O points configurable by the user for inputs or outputs. The I/O is accessible through two 50-pin headers.

PCI Bus Accelera Series, 1–8 axes

DMC-18x6 Series

Ordering Information

| PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-1816	1-axis Accelera, PCI	$1095	$ 795
DMC-1826	2-axis Accelera, PCI	$1495	$ 875
DMC-1836	3-axis Accelera, PCI	$1895	$ 935
DMC-1846	4-axis Accelera, PCI	$2195	$ 995
DMC-1856	5-axis Accelera, PCI	$2595	$1345
DMC-1866	6-axis Accelera, PCI	$2795	$1425
DMC-1876	7-axis Accelera, PCI	$2995	$1525
DMC-1886	8-axis Accelera, PCI	$3195	$1595
CB-50-100-1886	50- to 100-pin converter board; incl. two ribbon cables for DMC-1856 to -1886	$ 75	$ 50
CABLE-100-1M	100-pin HD cable in 1 meter length	$ 125	$ 95
CABLE-100-2M	100-pin HD cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin HD cable in 4 meter length	$ 150	$ 105
ICM-2900-FL	Interconnect module (use 1 for every 4 axes). Specify -HAEN for high amp enable or -LAEN for low amp enable. Specify -FL for flange	$ 295	$ 195
ICM-2900-OPTO	ICM with optoisolated outputs	$ 345	$ 245
AMP-19520	2-axis amplifier for 500 W servos	$ 595	$ 395
AMP-19540	4-axis amplifier for 500 W servos	$ 795	$ 495
-SR	Shunt regulator option for AMP-195x0	$ 50	$ 25
DB-28104	Sinusoidal Encoder Interpolation Board	$ 395	$ 245
DB-14064	Attachment board for 64 additional I/O	$ 295	$ 195
CB-50-80	50-pin to 80-pin adaptor for DB-14064	$ 75	$ 50
CB-36-25	36-pin adaptor for aux encoders using ICM-2908	$ 50	$ 45
CABLE-36-1M	36-pin HD cable for aux encoders using ICM-2908	$ 90	$ 75
ICM-2908-FL	Aux encoder breakout	$ 125	$ 95
CABLE-26-25	Ribbon cable for aux encoders with ICM-1900 or AMP-19540	$ 15	$ 15
GalilTools-Lite	Editor, Terminal, Watch Tools. Includes communication library for developers-supports C++, VB, C#, LabVIEW and more	Free download	
GalilTools	Above with Scope and Tuner	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Microsoft platforms	$ 595	

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

Econo Series
For Cost-Sensitive Applications.

Galil's Econo Series motion controllers deliver precise, multi-axis control in a low-cost package. Prices for the 4-axis Econo controllers are as low as $395 in 1,000 quantities which is less than $100 per axis. Econo controllers don't stint on performance and can handle any mode of motion with precision and ease. Advanced coordinated motion allows for tightly coupled, high-speed motion among axes without having to burden the host computer.

- Available with Ethernet/RS232 or as PCI card
  DMC-18x2 PCI card. 1-4 axis models.
  DMC-21x3 Ethernet 10Base-T, (1) RS232 ports
     up to 19.2b
- Mix-and-Match steppers and servos
- Handles virtually any mode of motion with ease
- 1000 lines x 80 chr program memory;
  8000 element arrays
- Multitasking for running up to eight programs
  simultaneously
- Uncommitted inputs and outputs
- Din-rail mount for DMC-21x3
- Add-on options for DMC-21x3 include optical isolation, extra I/O, and analog inputs
- Compact size: 1– 4 axis DMC-2143: 4.25" × 7.0"
               5– 8 axis DMC-2183: 4.25" × 10.75"
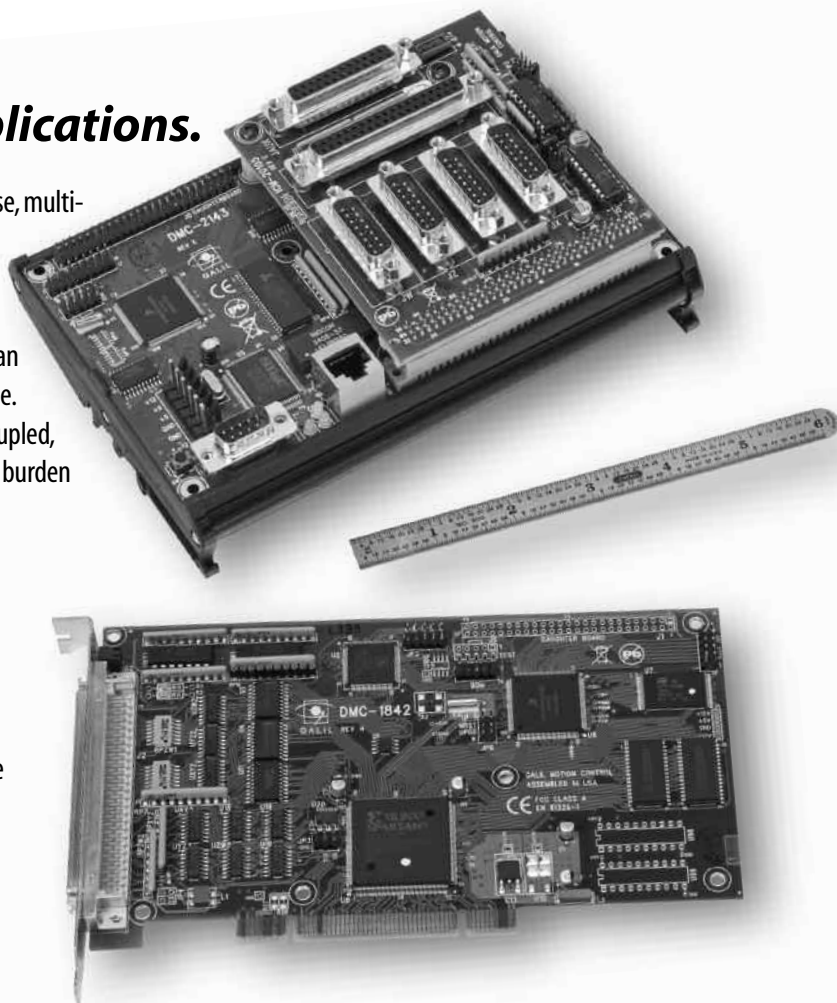
Plug-in Amplifier Options

The DMC-21x3 is available with plug-in, multi-axis drives which minimize space, cost and wiring. Drive options are available for steppers and servos. The DMC-21x3 controller can also be easily connected to external drives of any power range using the ICM-20100. The AMP-195x0, 2- and 4-axis packaged drive is available for the DMC-18x2 PCI controller.

| DRIVE MODEL	MOTOR TYPE	# OF AXES	CURRENT	VOLTAGE
AMP-20341	Servo-brush	4	1A max	±12 – 30 VDC
AMP-204x0	Servo-brush	2 or 4	3.3A max	20 – 60 VDC
AMP-205x0	Servo-brush/brushless	2 or 4	7A cont, 10A peak	20 – 80 VDC
AMP-20542	Servo-brush/brushless	4	3.3A cont, 5A peak	20 – 60 VDC
SDM-20240	Stepper	4	1.4A/phase	12 – 30 VDC
SDM-206x0	Microstep	2 or 4	3A/phase	12 – 60 VDC

ECONO CONTROLLERS

ECONO

Product Description

Galil's DMC-21x3 Ethernet motion controllers are designed for extremely cost-sensitive and space-sensitive applications. The DMC-21x3 controllers are available with a variety of plug-in multi-axis amplifier boards that are designed to eliminate the wiring and any connectivity issues between the controller and drives.

The controllers incorporate a 32-bit microcomputer and provide such advanced features as PID compensation with velocity and acceleration feedforward, pro-

DMC-2143 with mating ICM and DB-28040
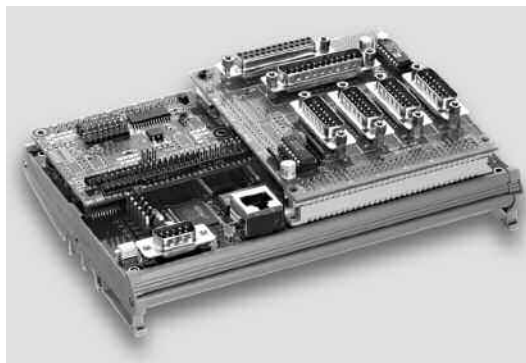
gram memory with multitasking for simultaneously running up to eight programs, and uncommitted I/O for synchronizing motion with external events. Modes of motion include point-to-point positioning, position tracking, jogging, linear and circular interpolation, contouring, electronic gearing and ECAM.

Like all Galil controllers, these controllers use a simple, intuitive command language which makes them very easy to program. GalilTools servo design software further simplifies system set-up with "one-button" servo tuning and real-time display of position and velocity information. Communication drivers are available for Windows, .NET, QNX, and Linux.

Features

- Ethernet 10Base-T port; (1) RS232 port up to 19.2 kbaud
- Ethernet supports multiple masters and slaves. TCP/IP, UDP and Modbus TCP master protocol for communication with I/O devices
- Available in 1 through 8 axis versions
- User-configurable for stepper or servo motors on any combination of axes. Optional firmware for piezo-ceramic motors. Sinusoidal commutation for brushless servo motors
- Accepts up to 12 MHz encoder frequencies for servos. Outputs up to 3 MHz for steppers
- PID compensation with velocity and acceleration feedforward, integration limits, notch filter and low-pass filter
- Modes of motion include jogging, point-to-point positioning, contouring, linear and circular interpolation, electronic gearing and ECAM. Features ellipse scaling, slow-down around corners, infinite segment feed and feedrate override
- Over 200 English-like commands executable by controller. Includes conditional statements and event triggers
- Non-volatile memory for programs, variables and arrays. Concurrent execution of up to eight programs
- Dual encoders, home and limits for each axis
- 8 TTL uncommitted inputs and 8 outputs for 1- to 4-axis, 16 in/16 out for 5- to 8-axis models
- Optically isolated I/O and 500 mA highside outputs available with ICM-20105 (for DMC-21x3)
- Add 8 analog inputs and 40 digital I/O with DB-28040
- High speed position latch and output compare for each axis
- Small size: 1-4 axes card: 4.25" x 7.0"
  5-8 axes card: 4.25" x 10.75"
- DIN-Rail mount option
- Accepts +5 V, ±12 V DC inputs; DC-to-DC converter option for single 9 V to 72 V DC input
- DMC-21x3: 96-pin DIN connectors for each set of 4 axes. ICM-20100 provides D-connectors for each axis
- Distributed control option with DMC-31x3 series
- Communication drivers for Windows, QNX, and Linux
- Custom hardware and firmware options available
- CE certified

Ethernet/RS232 Econo Series, 1–8 axes

DMC-21x3 Series

Specifications

System Processor
- Motorola 32-bit microcomputer

Communications Interface
- Ethernet 10BASE-T. (1) RS232 port up to 19.2 kbaud Commands are sent in ASCII. A binary communication mode is also available as a standard feature

Modes of Motion:
- Point-to-point positioning
- Position Tracking
- Jogging
- 2D Linear and Circular Interpolation with feedrate override
- Linear Interpolation
- Tangential Following
- Helical
- Electronic Gearing with multiple masters
- Gantry Mode
- Electronic Cam
- Contouring
- Teach and playback

Memory
- Program memory size—1000 lines × 80 characters
- 510 variables
- 8000 array elements in up to 30 arrays

Filter
- PID (proportional-integral-derivative) with velocity and acceleration feedforward
- Notch and low-pass filter
- Velocity smoothing to minimize jerk
- Integration limits
- Torque limits
- Offset adjustments
- Option for piezo-ceramic motors

Kinematic Ranges
- Position: 32 bit (±2.15 billion counts per move; automatic rollover; no limit in jog or vector modes)
- Velocity: Up to 12 million counts/sec for servo motors
- Acceleration: Up to 67 million counts/sec^2

Uncommitted Digital I/O
- 8 buffered inputs for 1–4 axes; 16 for 5–8 axes*
- 8 TTL outputs for 1–4 axes; 16 for 5–8 axes*
- 8 analog inputs and 40 digital I/O with DB-28040 (Default I/O is 3.3 V. For 5 V I/O, order DB-28040-5V)
- 8 analog inputs available with AMP-205x0 and SDM-206x0

High Speed Position Latch
- Uncommitted inputs 1–4 latch X,Y,Z,W; 9–12 latch E, F, G, H (latches within 0.1 microseconds)*

Dedicated Inputs (per axis)
- Main encoder inputs — Channel A, A-, B, B-, I, I- (±12 V or TTL)
- Auxiliary encoder inputs for each servo axis
- Forward and reverse limit inputs — buffered*
- Home input — buffered*
- High-speed position latch input — buffered*

Dedicated Outputs (per axis)
- Analog motor command output with 16-bit DAC resolution
- Pulse and direction output for step motors
- Amplifier enable output*
- Error output (one per controller)
- High-speed position compare output (1 output for each set of 4 axes)

Minimum Servo Loop Update Time

	-FAST†
1–2 axes: 250 µsec	125 µsec
3–4 axes: 375 µsec	250 µsec
5–6 axes: 500 µsec	375 µsec
7–8 axes: 625 µsec	500 µsec

Maximum Encoder Feedback Rate
- 12 MHz

Maximum Stepper Rate
- 3 MHz (Full, half or microstep)

Power Requirements

	1–4 axes	5–8 axes
+5 V	0.8 A	1.4 A
-12 V	20 mA	40 mA
+12 V	20 mA	40 mA

- DC-to-DC converter option: 9 V to 18 V for DC12
  18 V to 36 V input for DC24
  36 V to 72 V input for DC48
- Approximate current draw for the DMC-2143 with no external load is about 200 mA for 24 V supply

Environmental
- Operating temperature: 0–70º C
- Humidity: 20–95% RH, non-condensing

Mechanical
- 1–4 axes card: 4.25" × 7.0"
- 5–8 axes card: 4.25" × 10.75"

*Optically isolated I/O available with ICM-20105 option

†Reduced feature set for -FAST.

DMC-21x3 Series

DMC-21x3 with Metal Enclosure

The DMC-21x3 is available with a metal enclosure. The standard configuration is for a 1 through 4-axis DMC-21x3-DC24 with an attached ICM-20105 packaged in an 8.55" × 5.6" × 1.95" metal enclosure (4-axis part number: DMC-2143-DC24-20105-BOX). Please consult the factory for other packaging options. For example, a DMC-2183 can be packaged with an AMP-20540 and AMP-20440 upon special request.

DMC-2143-DC24 and ICM-20105 packaged in a metal enclosure

I/O Expansion Options

DB-28040 I/O Expansion Board

The DB-28040 mounts directly to the DMC-21x3 50-pin header and provides an additional 40 digital inputs and outputs, and eight analog inputs (default I/O is 3.3 V. For 5 V I/O, order DB-28040-5V). Even with the DB-28040 attached there is still room to mount the ICM-20100, ICM-20105, SDM-20240, AMP-20341 or AMP-20440.

The 40 digital I/O signals are available on a 50-pin IDC header, and the analog inputs are available on a 16-pin header. With a controller firmware modification, the I/O board can also be modified to accept feedback from SSI encoders. 2.55" × 3.08".
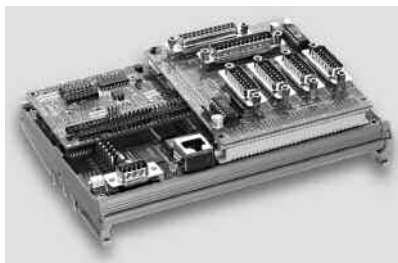
DMC-2143 4-axis controller with attached DB-28040 and ICM-20100

DB-28104 Sinusoidal Encoder Interpolation Board

The DB-28104 mounts to the DMC-21x3 50-pin header and provides interpolation of up to four 1-volt differential sinusoidal encoders resulting in a higher position resolution. The AF n command selects sinusoidal interpolation where n specifies 2^n interpolation counts per encoder cycle (n= 5 to 12). For example, if the encoder cycle is 40 microns, AF10 results in 2^{10}=1024 counts per cycle, or a resolution of 39 nanometers per count. Each sinusoidal encoder connects to the DB-28104 through its own 9-pin D-sub connector. 3.510" × 3.075".
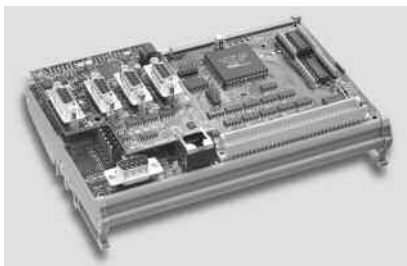
DB-28104 mounted on a DMC-2143 controller

RIO-47xxx Pocket PLC

Galil's RIO I/O controller provides an intelligent solution for adding I/O and PLC functionality to the DMC-21x2/21x3 Ethernet control system. The RIO I/O controller connects to the Ethernet network allowing it to communicate with DMC-21x2/21x3 motion controllers and other devices on the network. The intelligent I/O controller has an on-board microprocessor for coordinating I/O events and performing tasks normally handled by a PLC. Each RIO unit provides 8 analog inputs, 8 analog outputs, 16 optically isolated inputs, 8 high-power isolated outputs and 8 low-power isolated outputs.

RIO-47100 remote I/O controller

Distributed Control Option

The DMC-31x3 is a distributed control firmware option for the DMC-21x3 that allows up to eight axes distributed among several DMC-31x3 controllers to be programmed like a single controller. Typically, axes that are close together or that require tightly coupled coordinated motion are controlled by an individual DMC-31x3 controller. For example, an eight axis application might be constructed with two DMC-3143 4-axis controllers, four separate DMC-3123 2-axis controllers, or eight DMC-3113 1-axis controllers.

Communication overhead and motion coordination issues typical with distributed, single-axis systems are minimized with the DMC-31x3 controllers. All motion coordination tasks are performed by the various DMC-31x3 multi-axis controllers in the network. The communication burden with the host PC is minimized because the PC communicates only to the one DMC-31x3 controller configured as the master, which in turn communicates with all other DMC-31x3 controllers on the network. A special set of commands for distributed control ease communication issues on the network.

Distributed Control Commands

HA	Handle Assignment		SA	Send slave command
HC	Automatic handle configuration		ZA	Ethernet user variable
HQ	Handle Query		ZB	Ethernet user variable
HW	Handle wait			

DMC-21x3 Series

DMC-21x3 Interconnect and Drive Options

ICM-20100 Interconnect Module

The ICM-20100 breaks out the 96-pin connector into convenient D-sub connectors for easy interface to external amplifiers and I/O devices. The ICM-20100 provides 15-pin D-sub connectors for each of the four axes and 25-pin D-sub connectors for the auxiliary encoders and I/O. The ICM may be configured for High or Low amp enable. Default is high Amp Enable (-HAEN). For low Amp Enable, order -LAEN. The ICM-20100 mounts directly to the 96-pin connector on the DMC-21x3. 4.25" × 3.70".

### ICM-20105 Interconnect with Optically Isolated I/O

The ICM-20105 provides optical isolation for DMC-21x3 inputs and outputs, and breaks out the 96-pin connector into convenient D-sub connectors for easy interface to external amplifiers and I/O devices. The ICM-20105 provides four 15-pin D-sub connectors for each of the four axes, a 37-pin D-sub for the digital I/O, home and limits, and a 25-pin D-sub for the auxiliary encoders. The maximum common voltage for the I/O is 28 VDC. Eight 500 mA highside drive outputs are available (total current not to exceed 3 A). The ICM-20105 is user-configurable for a broad range of amplifier enable options including: High amp enable, Low amp enable, 5 V logic, 12 V logic, external voltage supplies up to 24 V and sinking or sourcing. The ICM-20105 mounts directly to the 96-pin connector on the DMC-21x3. 4.25" × 3.70"

ICM-20500 Interconnect Module for AMP-205x0

The ICM-20500 provides a screw terminal interface for the AMP-205x0. The unit also provides optical isolation on digital inputs and outputs to interface with up to 24V I/O. The first four outputs are high power outputs capable of providing up to 500 mA at up to 24 VDC. The ICM-20500 is also available with D-type connectors instead of screw terminals (order as ICM-20500-DTYPE).

This provides optical isolation of the I/O when using an AMP-205x0. The D-type connectors include four 15-pin HD connectors and one 44-pin HD connector. The pinout of the 15-pin connectors are the same as the AMP-205x0. The 44-pin connections are the same except for the following four signals:

Pin 9   Output Supply
Pin 25 Input Common
Pin 39 Output Return
Pin 40 Limit Switch Common
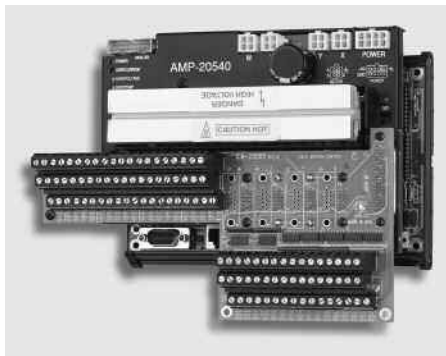
ICM-20500 Interconnect Module attached to AMP-20540 Amplifier

AMP-20341 4-axis 20 W Servo Drives

The AMP-20341 contains four linear drives for operating small brush-type servo motors. The AMP-20341 requires a ± 12 – 30 VDC input.* Output power is 20 W per amplifier or 60 W total. The gain of each transconductance linear amplifier is 0.1 A/V at 1 A maximum current. The typical current loop bandwidth is 4 kHz. The AMP-20341 uses 15-pin D-sub connectors for encoder and limit connections on each axis and a 25-pin D-sub connector for I/O connections. 4.25" × 3.70".

*The default configuration of the AMP-20341 is with J98 removed, which allows operation from a separate dual supply. Specify "install J98" for operation of the AMP-20341 and DMC-21x3 from the same dual supply.
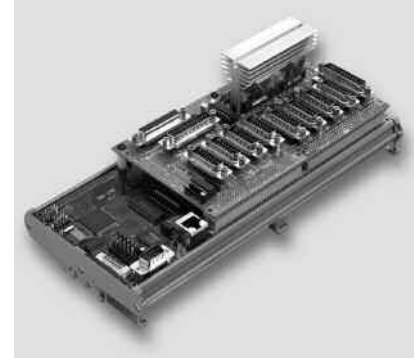
DMC-2183 8-axis controller with mounted ICM-20100 and AMP-20341

AMP-204x0 2- and 4-axis 200 W Servo Drives

The AMP-20440 contains four transconductance, PWM amplifiers for driving brush-type servo motors up to 200 Watts. Each amplifier drives up to 3.3 Amps at 20 – 60 VDC (available voltage at the motor is 10% less). No external heat sink is required. The AMP-20440 uses 2-pin Molex connectors for each motor and a 15-pin high density D-sub connector for encoder, limits and home for each axis. A single 44-pin high density D-sub connector is used for additional I/O signals. A 4-pin Molex is used for the DC voltage input from a single DC power supply ranging from 20 – 60 Volts. A two axis version, the AMP-20420 is also available. 4.95" × 3.75".

AMP-205x0 2- and 4-axis 500 W Servo Drives

The AMP-20540 contains four transconductance, PWM amplifiers for driving brushless or brush-type servo motors. Each amplifier drives motors operating at up to 7 Amps continuous, 10 Amps peak, 18 – 60 VDC (available voltage at the motor is 10% less). The gain settings of the amplifier are user-programmable at 0.4 Amp/Volt, 0.7 Amp/Volt and 1 Amp/Volt. The switching frequency is 60 kHz. The amplifier offers protection for over-voltage, under-voltage, over-current, short-circuit and over-temperature. The amplifier status can be read through the DMC-21x3 controller, and the BS command allows easy hall sensor set-up. A 2-axis amplifier board,
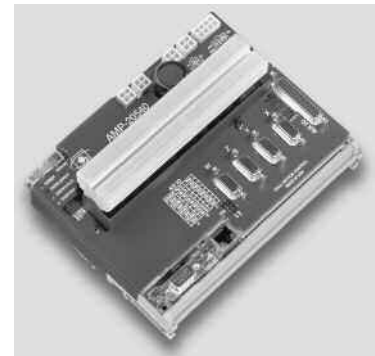
AMP-20540 Interconnect with 4-axis 500 W servo drives

ECONO

DMC-21x3 Series

the AMP-20520 is also available. In a standard configuration the DB-28040 I/O board will not install next to an AMP-20540, however the AMP-20540 provides 8 uncommitted analog inputs with 12-bit ADC (16-bit optional).* The SR-19900 shunt regulator is available for the AMP-20540. 6.92" × 4.85". CE certified

* Please consult factory for special options available
  when using a DB-28040 with an AMP-20540.

AMP-20542 4-axis Servo Drive for Low-Inductance Motors

The AMP-20542 contains four transconductance, PWM amplifiers for driving small, low-inductance brush or brushless servo motors. Each amplifier drives motors operating at 18 – 60 VDC, up to 3.3 A continuous, 5 A peak

(available voltage at the motor is 10% less). The drive for each axis is software configurable to operate in either a chopper or inverter mode. The chopper mode is intended for operating low inductance motors. The AMP-20542 offers protection for over-voltage, under-voltage, over-current

AMP-20542 mounted on a DMC-2143 controller

and short-circuit. The amplifier status can be read through the DMC-21x3 controllers, and the BS command allows easy hall sensor set-up. Unlike the AMP-20540, the AMP-20542 does not provide uncommitted analog inputs. The SR-19900 shunt regulator can be used with the AMP-20542. 6.92" × 4.85".

SDM-20242 4-axis Full/Half Stepper Drives

The SDM-20242 contains four drives for operating two-phase bipolar step motors. The SDM-20242 requires a single 12 – 30 VDC input. The SDM is user-configurable for 1.4 A, 1.0 A, 0.75 A, or 0.5 A per phase and full, half, 1/4 or 1/16 step. Adequate airflow across the board is recommended. The SDM uses 9-pin D-sub connectors for encoder and limit connections on each axis and a 25-pin D-sub connector for I/O connections. 4.25" × 3.70".

Note Regarding Power for AMP and SDM Amplifiers:

The default configuration of the AMP-205xu, AMP-204x0, SDM-20242 and SDM-206x0 amplifiers is to pass their operating voltages to the -DC24 or -DC48 controller supply. If you would like to operate these amplifiers from a separate supply, specify "no J98" on your DMC-21x3 controller and amplifier order. The default configuration of the AMP-20341 is with J98 removed which allows operation from a separate supply. Specify "install J98" for operation of the AMP-20341 and DMC-21x3 from the same dual supply.
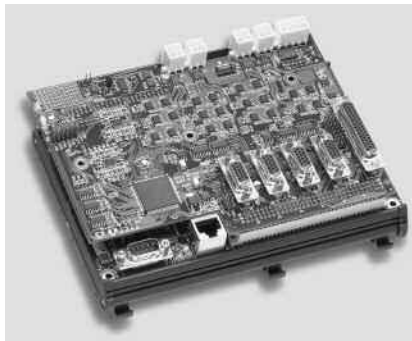
SDM-206x0 2- and 4-axis Microstep Drives

The SDM-20640 contains four microstepping drives for operating two-phase bipolar stepper motors. The drives produce 64 microsteps per full step or 256 steps per full cycle which results in 12,800 steps/rev for a standard 200-step motor. The maximum step rate generated by the controller is 3,000,000 microsteps/second. *Correct motor sizing calculations are critical to achieve stepper performance at speed. Please contact Galil for assistance.* The SDM-20640 drives motors operating at up to 3 Amps at 12 VDC to 60 VDC (available voltage at the motor is 10% less). There are four software-selectable current settings: 0.5 A, 1 A, 2 A and 3 A. Plus, a selectable low-current mode reduces the current by 75% when the motor is not in motion. No external heatsink is required. A two-axis model, the SDM-20620 is also available.
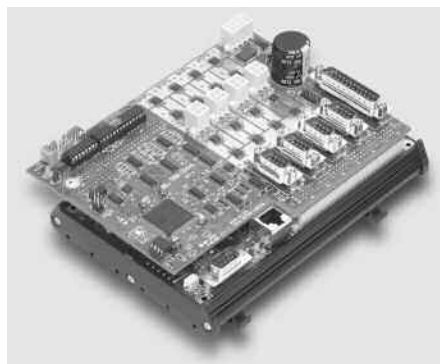
DMC-2143 with SDM-20640 microstep drives

5- Through 8-axis Configurations

For the first four axes, any ICM, AMP or SDM may be used. Due to size constraints, for axes 5 through 8 only the ICM-20100, ICM-20105, AMP-20341, AMP-204x0 or SDM-20242 can be used.

PSR Series

Power Supplies — PSR Series

The PSR Series are regulated DC power supplies capable of operating from 100/240 VAC input, 50/60 Hz. The power supply includes power factor correction, a shunt regulator and blocking diode.

Model	Power Rating	Dimensions	
PSR-12-24	24 VDC @ 12 A cont.	9" × 6.5" × 2"	3.5 lbs.
PSR-6-48	48 VDC @ 6 A cont.	9" × 6.5" × 2"	3.5 lbs.

Ethernet/RS232 Econo Series, 1–8 axes

DMC-21x3 Series

DMC-21x2	- H	- DC24	- DIN	- VP
Axis number	**100-pin & Enet/RS232 Connectors**	**DC-to-DC Converter**	**DIN-rail Mount**	**Molex Power Connector**
x=1 thru 8	H=horizontal (default)	- none (default)	- none (default)	VP = vertical (default)
	V=vertical	- DC24 (18–36 Volts)	- DIN (requires –V option)	HP = horizontal
		- DC48 (36–72 Volts)		

The default configuration of the DMC-21x2 is with horizontal connector mount for the communication and 100-pin connectors and vertical mount for the power connector, no DC-to-DC and no DIN rail mount.

DMC-21x3	- V	- DC24	- DIN	- UP	- VP
Axis number	**Enet/RS232 Connectors**	**DC-to-DC Converter**	**DIN-rail Mount**	**96-pin config.**	**Molex Power Connector**
x=1 thru 8	V= vertical (default)	- none (default)	- none (default)	- UP (default)	VP = vertical (default)
	H=horizontal	- DC24 (18–36 Volts)	- DIN (requires –V	- DOWN	HP = horizontal
		- DC48 (36–72 Volts)	and UP option)	- RA (right angle)	

The default configuration of the DMC-21x3 is with vertical communication and power connector mount, no DC-to-DC, no DIN rail mount and UP 96-pin connector configuration. ICM and AMP modules only mate with DMC-21x3-V-UP-HP. Only -DC and -DIN need to be specified when ordering DMC-21x3 with AMP or ICM.

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-2112	1-axis Ethernet 10BASE-T, RS232 card, 100-pin SCSI	$ 795	$ 595
DMC-2122	2-axis Ethernet 10BASE-T, RS232 card, 100-pin SCSI	$ 895	$ 665
DMC-2132	3-axis Ethernet 10BASE-T, RS232 card, 100-pin SCSI	$1045	$ 725
DMC-2142	4-axis Ethernet 10BASE-T, RS232 card, 100-pin SCSI	$1195	$ 795
DMC-2152	5-axis Ethernet 10BASE-T, RS232 card, 100-pin SCSI	$1295	$ 845
DMC-2162	6-axis Ethernet 10BASE-T, RS232 card, 100-pin SCSI	$1395	$ 895
DMC-2172	7-axis Ethernet 10BASE-T, RS232 card, 100-pin SCSI	$1495	$ 945
DMC-2182	8-axis Ethernet 10BASE-T, RS232 card, 100-pin SCSI	$1595	$ 995
DMC-2113	1-axis Ethernet 10BASE-T, RS232 card, 96-pin DIN	$ 795	$ 595
DMC-2123	2-axis Ethernet 10BASE-T, RS232 card, 96-pin DIN	$ 895	$ 665
DMC-2133	3-axis Ethernet 10BASE-T, RS232 card, 96-pin DIN	$1045	$ 725
DMC-2143	4-axis Ethernet 10BASE-T, RS232 card, 96-pin DIN	$1195	$ 795
DMC-2153	5-axis Ethernet 10BASE-T, RS232 card, 96-pin DIN	$1295	$ 845
DMC-2163	6-axis Ethernet 10BASE-T, RS232 card, 96-pin DIN	$1395	$ 895
DMC-2173	7-axis Ethernet 10BASE-T, RS232 card, 96-pin DIN	$1495	$ 945
DMC-2183	8-axis Ethernet 10BASE-T, RS232 card, 96-pin DIN	$1595	$ 995
DMC-31x3	DMC-21x3 with distributed control functionality	Same price as DMC-21x3	
-DIN	DIN-rail mount option for DMC-21x2/x3	$ 100	$ 50
-BOX	Metal enclosure for DMC-2143 and ICM-20105	$ 100	$ 75
-DC12	DC-to-DC converter for 9 V to18 V	$ 100	$ 70
-DC24	DC-to-DC converter for 18 V to 36 V	$ 100	$ 70
-DC48	DC-to-DC converter for 36 V to 72 V	$ 100	$ 70
DB-28040	I/O expansion board for 8 analog inputs and 40 digital I/O (outputs sink/source 3.3 V)	$ 295	$ 195
DB-28040-5V	I/O expansion board for 40 digital I/O and 8 analog inputs. Outputs sink/source 5 V	$ 295	$ 195
DB-28104	Sinusoidal Encoder Interpolation Board	$ 395	$ 245
ICM-20100	DMC-21x3 Interconnect with D-type connectors (use 1 for every 4 axes)	$ 95	$ 75
ICM-20105	DMC-21x3 Interconnect for optically isolated I/O (use 1 for every 4 axes)	$ 195	$ 145

Accessories for DMC-21x2/x3 are continued on the next page.

ECONO

Ordering Information — continued

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
ICM-20500	AMP-205x0 Interconnect with optical isolation and screw terminals	$ 345	$ 245
ICM-20500-DTYPE	AMP-205x0 Interconnect with optical isolation and D-Type connectors	$ 245	$ 175
SDM-20242*	DMC-21x3 Interconnect with four 1.4 A stepper drivers	$ 195	$ 175
SDM-20620*	DMC-21x3 Interconnect with two microstepping drives (includes 8 analog inputs)	$ 545	$ 345
SDM-20640*	DMC-21x3 Interconnect with four microstepping drives (includes 8 analog inputs)	$ 695	$ 395
AMP-20341*	DMC-21x3 Interconnect with four 20 W servo drives (default J98 removed)	$ 195	$ 175
AMP-20420*	DMC-21x3 Interconnect with two 200 W servo drives	$ 395	$ 245
AMP-20440*	DMC-21x3 Interconnect with four 200 W servo drives	$ 595	$ 295
AMP-20520*	DMC-21x3 Interconnect with two 500 W servo drives (includes 8 analog inputs)	$ 595	$ 395
AMP-20540*	DMC-21x3 Interconnect with four 500 W servo drives (includes 8 analog inputs)	$ 795	$ 495
AMP-20542*	DMC-21x3 interconnect with four servo drives for low-inductance motors	$ 695	$ 395
AMP-205x0-80*	Option for 80 V input (default J98 removed)	No extra charge	
-16BIT ADC	16-bit ADC for analog inputs	$ 100 adder	
SR-19900	Shunt regulator for AMP-205x0	$ 75	$ 40
PSR-12-24	Power supply, 12 A, 24 VDC. Includes shunt regulator	$ 250	$ 175
PSR-6-48	Power supply, 6 A, 48 VDC. Includes shunt regulator	$ 250	$ 175
CABLE-15-1M	15-pin HD D sub to discrete wires—1-meter (for AMP-205x0, -204x0)	$ 25	$ 17
CABLE-15-2M	15-pin HD D sub to discrete wires—2-meter (for AMP-205x0, -204x0)	$ 30	$ 20
CABLE-44-1M	44-pin HD D sub to discrete wires—1-meter (for AMP-205x0, -204x0)	$ 35	$ 24
CABLE-44-2M	44-pin HD D sub to discrete wires—2-meter (for AMP-205x0, -204x0)	$ 40	$ 27
CABLE-100-1M	100-pin HD cable in 1-meter length for DMC-21x2	$ 125	$ 95
CABLE-100-2M	100-pin HD cable in 2-meter length for DMC-21x2	$ 135	$ 100
CABLE-100-4M	100-pin HD cable in 4-meter length for DMC-21x2	$ 150	$ 105
ICM-2900	Interconnect module (use 1 for every 4 axes) for DMC-21x2. Specify -HAEN for high amp enable or -LAEN for low amp enable. Specify -FL for flange	$ 295	$ 195
ICM-2900-OPTO	ICM with optoisolated outputs for DMC-21x2	$ 345	$ 245
AMP-19520	DMC-21x2 Interconnect with two 500 W servo drives; connects to CABLE-100	$ 595	$ 395
AMP-19540	DMC-21x2 Interconnect with four 500 W servo drives; connects to CABLE-100	$ 795	$ 495
SR Option	Shunt regulator for AMP-195x0	$ 50	$ 25
RIO-47xxx	Intelligent I/O controller for Ethernet I/O expansion	Starts at $ 295	$ 195
IOC-7007	Intelligent I/O controller box for Ethernet I/O expansion	$ 595	$ 495
GalilTools-Lite	Editor, Terminal, Watch Tools. Includes communication library for developers-supports C++, VB, C#, LabVIEW and more	Free download	
GalilTools	Above with Scope and Tuner	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Microsoft platforms	$ 595	

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

Note Regarding Power for AMP and SDM Amplifiers: The default configuration of the AMP-205xu, AMP-204x0, SDM-20242 and SDM-206x0 amplifiers is to pass their operating voltages to the -DC24 or -DC48 controller supply. If you would like to operate these amplifiers from a separate supply, specify "no J98" on your DMC-21x3 controller and amplifier order. The default configuration of the AMP-20341 is with J98 removed which allows operation from a separate supply. Specify "install J98" for operation of the AMP-20341 and DMC-21x3 from the same dual supply.

ECONO

Product Description

The DMC-18x2 Series are PCI bus motion controllers for single and multi-axis applications. The Econo Series is designed for the most cost-sensitive applications.

To minimize cost, the following features are not available on the DMC-18x2: five through eight axes of control, optical isolation on inputs, uncommitted analog inputs, dual encoder inputs, and the auxiliary FIFO and DPRAM communication channel.

The DMC-18x2 incorporates a 32-bit microcomputer and provides advanced features such as PID compensation with velocity and acceleration feedfor-

DMC-1842 4-axis PCI controller
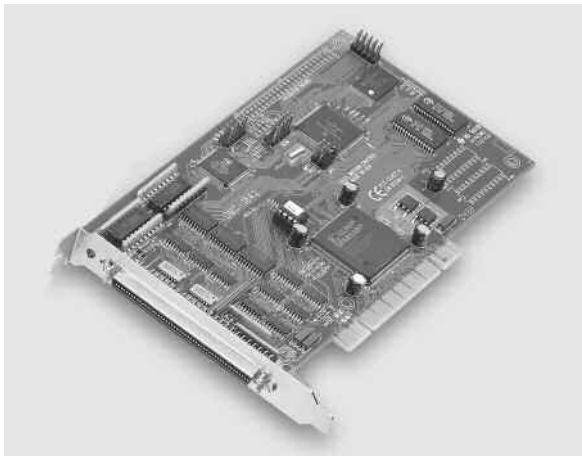
ward, memory with multitasking for simultaneously running up to eight programs, and uncommitted I/O for synchronizing motion with external events. Modes of motion include point-to-point positioning, jogging, linear and circular interpolation, contouring, electronic gearing, and ECAM.

Like all Galil controllers, the DMC-18x2 controllers use a simple, intuitive command language which makes them very easy to program. GalilTools software further simplifies system set-up with "one-button" servo tuning and real-time display of position and velocity information.

Features

- PCI card in 1- through 4-axis versions: DMC-18x2 where x=1,2,3,4 axes
- User-configurable for stepper or servo motors on any combination of axes. Optional sinusoidal commutation for brushless servo motors. Optional firmware for piezo-ceramic motors.
- Accepts up to 12 MHz encoder frequencies for servos. Outputs up to 3 MHz for steppers
- PID compensation with velocity and acceleration feedforward, integration limits, notch filter and low-pass filter
- Modes of motion include jogging, point-to-point positioning, contouring, linear and circular interpolation, electronic gearing and ECAM. Features ellipse scaling, slow-down around corners, infinite segment feed, and feedrate override
- Over 200 English-like commands including conditional statements and event triggers
- Non-volatile memory for programs, variables, and arrays. Multitasking for concurrent execution of up to eight programs
- Home input and forward and reverse limits accepted for every axis
- 8 uncommitted inputs and 8 outputs
- High speed position latch for each axis and output compare
- Expansion for 64 I/O with optional DB-14064 board
- 100-pin SCSI connector. ICM-2900 breaks-out 100-pin cable into screw terminals
- AMP-19540 connects to PCI controller with 100-pin cable and provides four amplifiers for 500 W servos
- Communication drivers for Windows, QNX, and Linux
- CE certified
- Custom hardware and firmware options available

PCI Bus Econo Series, 1–4 axes

DMC-18x2 Series

Specifications

System Processor
- Motorola 32-bit microcomputer

Communications Interface
- DMC-18x2: PCI with bi-directional FIFO
- 32-bit PCI interface. 64-bit compatible. 5 V/3.3 V

Commands are sent in ASCII. A binary communication mode is also available as a standard feature

Modes of Motion:
- Point-to-point positioning
- Position Tracking
- Jogging
- 2D Linear and Circular Interpolation with feedrate override
- Linear Interpolation for up to 4 axes
- Tangential Following
- Helical
- Electronic Gearing with multiple masters and ramp-to-gearing
- Gantry Mode
- Electronic Cam
- Contouring
- Teach and playback

Memory
- Program memory size — 1000 lines × 80 characters
- 254 variables
- 8000 array elements in up to 30 arrays

Filter
- PID (proportional-integral-derivative) with velocity and acceleration feedforward
- Notch filter and low-pass filter
- Velocity smoothing to minimize jerk
- Integration limits
- Torque limits
- Offset adjustments
- Option for piezo-ceramic motors

Kinematic Ranges
- Position: 32 bit ($\pm$2.15 billion counts per move; automatic rollover; no limit in jog or vector modes)
- Velocity: Up to 12 million counts/sec for servo motors
- Acceleration: Up to 67 million counts/sec^2

Uncommitted Digital I/O

	DIGITAL INPUTS	DIGITAL OUTPUTS	ANALOG INPUTS
DMC-18x2	8	8	0

High Speed Position Latch
- Uncommitted inputs 1-4 latch X,Y, Z,W (latches within 0.1 microseconds)

Dedicated Inputs (per axis)
- Main encoder inputs — Channel A, A-, B,B-,I, I- ($\pm$12 V or TTL)
- Forward and reverse limit inputs
- Home input
- Selectable high-speed position latch input
- Selectable abort input for each axis

Dedicated Outputs (per axis)
- Analog motor command output with 16-bit DAC resolution
- Pulse and direction output for step motors
- PWM output also available for servo amplifiers
- Amplifier enable output
- Error output (per card)
- High-speed position compare output (per card)

Minimum Servo Loop Update Time

		-FAST[†]
1–2 axes: 250 µsec		125 µsec
3–4 axes: 375 µsec		250 µsec

Maximum Encoder Feedback Rate
- 12 MHz

Maximum Stepper Rate
- 3 MHz (Full, half or microstep)

Power Requirements
- DMC-18x2:
  +5V   750 mA
  -12V   20 mA
  +12V   20 mA
  +3.3V 100 mA*

Environmental
- Operating temperature: 0 – 70º C
- Humidity: 20 – 95% RH, non-condensing

Mechanical
- DMC-18x2: 7.275" × 4.2"

Connectors
- 100-pin HD SCSI

* DMC-18x2 revision E and higher require 3.3V from PCI bus.
  Order DMC-18x2-3VREG to have a regulator installed to allow 5V only supply.

[†] Reduced feature set for -FAST.

PCI Bus Econo Series, 1–4 axes

DMC-18x2 Series

Hardware Accessories
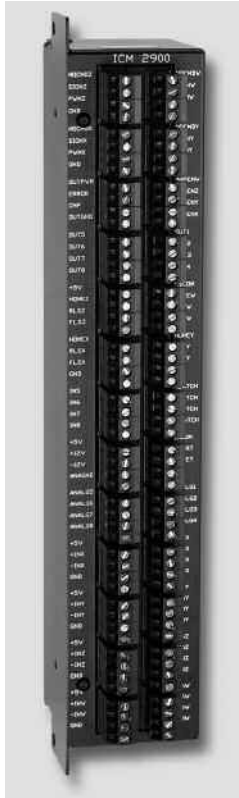
ICM-2900 Interconnect Module

The ICM-2900 breaks-out the 100-pin SCSI cable into screw-type terminals. The ICM-2900-FL has flanges which allow standard screw-type mounting. Specify -OPTO for optoisolated outputs. Specify -HAEN for high amp enable and -LAEN for low amp enable. .

ICM-2900 Interconnect Module with flange

AMP-19540 Interconnect with Four 500 Watt Servo Drives

Galil's AMP-19540 is a 4-axis amplifier for driving brush or brushless motors up to 500 Watts each. By interfacing directly to Galil's DMC-18x2 PCI bus controllers, it provides a cost-effective controller/drive solution for multi-axis applications. The AMP-19540 contains four transconductance, PWM amplifiers for driving brush or brushless motors. Each amplifier operates at 18 V to 80 V DC, up to 7 Amps continuous, 10 Amps peak. The AMP-19540 gain setting is easily configured with jumpers. The PWM switching frequency is 60 kHz. The AMP-19540 enclosure has dimensions of 6.8" × 8.75" × 1". It interfaces to a PCI bus controller with a single, 100-pin high density SCSI cable. Signals for each axis are brought out through D-type connectors located on the AMP-19540. For applications with less than three axes, the AMP-19520 two-axis model is available. A shunt regulator option is also available. CE certified.

AMP-19540

DB-14064 I/O Expansion

The DB-14064 is an optional board which provides 64 additional I/O for the DMC-18x2 controllers. This board mounts directly onto the back of the controller and provides 64 I/O points configurable by the user for inputs or outputs. The I/O is accessible through two 50-pin headers.

ECONO

PCI Bus Econo Series, 1–4 axes

DMC-18x2 Series

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-1812	1-axis Econo PCI	$ 795	$ 595
DMC-1822	2-axis Econo PCI	$ 895	$ 665
DMC-1832	3-axis Econo PCI	$1045	$ 725
DMC-1842	4-axis Econo PCI	$1195	$ 795
-3VREG	Option for 3 Volt regulator which allows for 5V only supply from PCI bus	No extra charge	
CABLE-100-1M	100-pin HD cable in 1 meter length	$ 125	$ 95
CABLE-100-2M	100-pin HD cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin HD cable in 4 meter length	$ 150	$ 105
ICM-2900-FL	Interconnect module (use 1 for every 4 axes). Specify -HAEN for high amp enable or -LAEN for low amp enable. Specify -FL for flange	$ 295	$ 195
ICM-2900-OPTO	ICM with optoisolated outputs	$ 345	$ 245
AMP-19520	2-axis amplifier for 500 W servos	$ 595	$ 395
AMP-19540	4-axis amplifier for 500 W servos	$ 795	$ 495
-SR	Shunt regulator option for AMP-195x0	$ 50	$ 25
DB-14064	Attachment board for 64 additional I/O, DMC-18x2	$ 295	$ 195
GalilTools-Lite	Editor, Terminal, Watch Tools. Includes communication library for developers-supports C++, VB, C#, LabVIEW and more	Free download	
GalilTools	Above with Scope and Tuner	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Microsoft platforms	$ 595	

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

Single-Axis Series

Smart Solutions for 1-axis Applications.
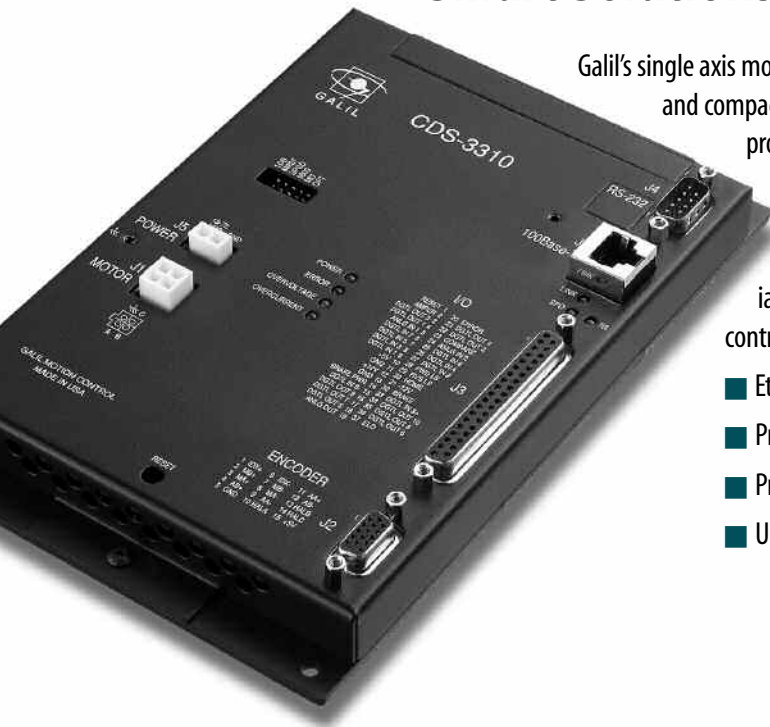
Galil's single axis motion controllers are specially designed to provide a cost-effective and compact solution for single axis or 1 1/2 axis applications. The DMC-1415 provides precise, one axis control of a stepper or servo motor and includes an auxiliary encoder for dual loop or electronic gearing applications. The DMC-1425 provides two axes of control and includes a linear/circular mode of motion (an auxiliary encoder input is not provided). The CDS-3310 is a single axis controller packaged with a 500 W servo drive as a single, compact unit.

- Ethernet/RS232 port
- Precise motion control
- Program memory, variables and arrays
- Uncommitted I/O

	DMC-1415	DMC-1425	CDS-3310
Communications	Ethernet10Base-T RS232 19.2 kb	Ethernet10Base-T RS232 19.2 kb	Ethernet10/100Base-T RS232 19.2 kb
# of Axis	1 1/2	2 servo or 2 stepper	1 1/2
Form-factor	Card 3.75" × 5.0"	Card 3.75" × 5.0"	Box 5.15"× 8.25"
# digital inputs	7	3	8
# digital outputs	3	3	10
# analog I/O	2 in	2 in	2 in, 1 out
Auxiliary encoder	yes	no	yes
Connector	37-pin D; mating ICM-1460 provides screw terminals	37-pin D; mating ICM-1460 provides screw terminals	37-pin D; mating ICM-3300 provides screw terminals
Galil Drive Options	AMP-14110 1-axis 20 W servo drive	AMP-14120 2-axis 20 W servo drive	Internal 500 W servo drive for brush/brushless motors

Product Description

The DMC-1415 and DMC-1425 are economical, one and two axis motion controllers with an Ethernet 10Base-T and RS232 port. The DMC-34x5 is designed for Ethernet-based distributed systems where one DMC-34x5 controller is designated as the master over other DMC-34x5 controllers. Controllers are available as a card-level product or in a metal enclosure with power supply.

DMC-14x5 Controller

With a 32-bit microcomputer, the single and dual axis controllers provide such advanced features as PID compensation with velocity and acceleration feedforward, program memory with multitasking for simultaneously running two applications programs, and uncommitted I/O for synchronizing motion with external events. It handles various modes of motion including point-to-point positioning, jogging, contouring, electronic gearing and ECAM. The DMC-1415 or -3415 single-axis controller accepts inputs from two encoders, which is useful for electronic gearing applications. The DMC-1425 or -3425 dual-axis controller includes linear and circular interpolation for precise, coordinated motion.

Like all Galil controllers, the DMC-14x5 and -34x5 controllers use a simple, English-like command language which makes them very easy to program. Galil's WSDK servo design software further simplifies system set-up with "one-button" servo tuning and real-time display of position and velocity information. Communication drivers are available for Windows, .NET, QNX, and Linux.

Features

- Card-level and box-level , stand-alone motion controllers

- DMC-1415 or DMC-3415: 1-axis card or box
  DMC-1425 or DMC-3425: 2-axis card or box

- Ethernet 10BASE-T and one RS232 port up to 19.2 kb.

- Ethernet supports multiple masters and slaves

- The DMC-1425, -3425 controls two servos or two steppers

- Accepts up to 12 MHz encoder frequencies for servos. Outputs up to 3 MHz for steppers

- Advanced PID compensation with velocity and acceleration feedforward, offsets, notch filter and integration limits

- Modes of motion include jogging, point-to-point positioning, contouring, electronic gearing and ECAM. Accepts input from auxiliary encoder for DMC-1415, -3415 only. Linear and circular interpolation for DMC-1425, -3425 only.

- Over 200 English-like commands directly executable by controller. Includes conditional statements and event triggers

- Non-volatile memory for programs, variables and arrays. Concurrent execution of two application programs

- Home input and forward and reverse limits

- 2 uncommitted analog inputs with 12-bit ADC

- DMC-1415, -3415: 7 Uncommitted digital inputs, 3 digital outputs
  DMC-1425, -3425: 3 Uncommitted digital inputs, 3 digital outputs

- High-speed position latch

- Use Galil's IOC-7007 or DB-14064 for additional I/O

- Uses 37-pin D connector. ICM-1460 interconnect module breaks-out 37-pin cable into screw terminals

- DMC- 14x5, -34x5-Card accepts +5 V, ± 12 V; DMC-14x5, -34x5-BOX accepts 90 – 260 VAC

- Compact size:
  DMC-14x5, -34x5-CARD: 3.75" x 5.0"
  DMC-14x5, -34x5-BOX: 5.1" x 3.0" x 6.8"

- Communication drivers for Windows, QNX, and Linux

- CE certified

- Custom hardware and firmware options available

SINGLE AXIS

Ethernet/RS232, 1- and 2-axis

DMC-14x5 Series

Specifications

System Processor

- Motorola 32-bit microcomputer

Communications Interface

- Ethernet BASE-T and RS232 port up to 19.2k baud

Modes of Motion:

- Point-to-point positioning
- Jogging
- Electronic Gearing
- Electronic Cam
- Contouring
- Linear and circular interpolation for DMC-1425, -3425

Memory

- Program memory size—500 lines × 80 characters
- 126 variables
- 2000 array elements in up to 14 arrays

Filter

- PID (proportional-integral-derivative) with velocity and acceleration feedforward
- Notch filter
- Dual-loop control for backlash compensation (DMC-1415, -3415 only)
- Velocity smoothing to minimize jerk
- Integration limits
- Torque limits
- Offset adjustment
- Option for piezo-ceramic motors

Kinematic Ranges

- Position: 32 bit (±2.15 billion counts per move; automatic rollover; no limit in jog or vector modes)
- Velocity: Up to 12 million counts/sec for servo motors
- Acceleration: Up to 67 million counts/sec^2

Uncommitted Digital I/O

- DMC-1415/3415: 7 buffered inputs; 3 TTL outputs*
- DMC-1425, -3425: 3 buffered inputs; 3 TTL outputs*
- DB-14064: Configurable 64 TTL I/O

Uncommitted Analog Inputs

- 2 individual ±10 V analog inputs with 12-bit resolution (16-bit optional)

High Speed Position Latch

- Latches within 0.1 microseconds

Dedicated I/O

- Main encoder inputs—Channel A, A-, B,B-,I, I- (±12 V or TTL)
- Auxiliary encoder—Channel A, A-, B, B- (not available on DMC-1425, -3425)
- Forward and reverse limit inputs—buffered*
- Home input—buffered*
- High-speed position latch input—buffered*
- Analog motor command output with 16-bit DAC resolution
- Pulse and direction output for step motors
- Amplifier enable output
- Error output
- Encoder output compare

Minimum Servo Loop Update Time

- 250 microseconds
- 125 microseconds with fast firmware (DMC-14x5)

Maximum Encoder Feedback Rate

- 12 MHz

Maximum Stepper Rate

- 3 MHz (Full, half or microstep)

Power Requirements

- DMC-1415 and DMC-1425 cards:
  +5 V 400 mA
  -12 V 40 mA
  +12 V 40 mA
- DMC-1415/1425/34x5 Box: accepts 90–260 V AC 50/60 Hz supply

Environmental

- Operating temperature: 0–70º C for card; 0–60º C for box
- Humidity: 20–95% RH, non-condensing

Mechanical

- DMC-14x5, -34x5 cards: 3.75" × 5.0"
- DMC-14x5, -34x5 boxes: 5.1" × 6.8" × 3.0"

Connectors

- 37-pin D-type

Optically isolated I/O available with ICM-1460-OPTO option.

Hardware Accessories

ICM-1460

The ICM-1460 Interconnect Module provides a breakout to screw termi-nals for the 37-pin D-type cable from the DMC-14x5 or 34x5 for quick connection of system hardware. The ICM-1460 is contained in a metal enclosure with dimensions of 6.9" × 4.9" × 2.6" and 0.2" diameter keyholes for mounting. The ICM is normally shipped configured for high amp enable, +5 V (-HAEN). For low amp enable, order ICM-1460-LAEN.

ICM-1460 OPTO

For applications requiring optoisolation, the ICM-1460 "OPTO" option provides 5 – 24 V optoisolation on all general inputs and outputs, home inputs, limits, and abort input.

*ICM-1460 Interconnect Module
(shown with and without cover)*

DB-14064 I/O Expansion

The DB-14064 is an optional board which provides 64 additional I/O for the DMC-14x5 or 34x5 controller cards. This board mounts directly onto the back of the controller and provides 64 I/O points config-urable by the user for inputs or outputs. The I/O is accessible through two 50-pin headers.

DMC-34x5 Distributed Control Option

The DMC-34x5 Series distributed control system can operate with a sin-gle communication channel between the host and the master controller. This master controller is programmed to maintain communication with each slave. Commands sent by the host computer to the master con-troller are based on the multi-axis convention designating the axes as A, B, C, D, E, F, G, H.

The individual slave controllers can contain their own local application program. A slave program would be written to act as if the slave was operating independent of the distributed control network.

In most cases, the programming is done on a multi-axis level to sim-plify the programming. An application program written at the multi-axis level can command all axes of motion and apply trippoints to all axes. On the other hand, a slave controller program can drive only the local motors and include trippoints which refer to the local axes.

The multi-axis network may be configured automatically with the HC command. This single command is used to configure the number of axes, data update rate and number of IOC devices in the system. DMC-3415 and DMC-3425 controllers may be used in any com-bination for a total of up to 8 axes in the network.
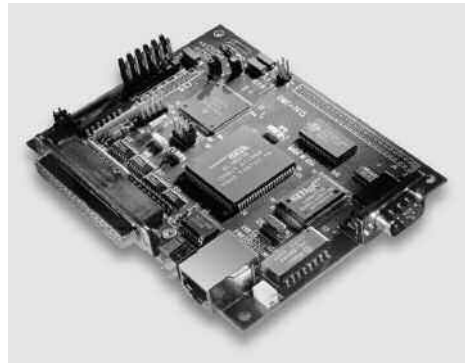
DMC-3425

AMP-14110 1-axis and AMP-14120 2-axis 20W Servo Drives

The AMP-14110 and AMP-14120 are one-axis and two-axis linear drives for operating small brush-type servo motors. The AMP-14110 mounts directly to the DMC-1415 1-axis controller and the AMP-14120 mounts to the DMC-1425 2-axis controller. The amplifiers require a ±12 – 30 VDC input. Output power is 20W per amplifier. The gain of each transconduc-tance linear amplifier is 0.1 A/V at 1 A maximum current. The typical current loop bandwidth is 4 kHz. 100 mA maximum current is available as an option.

SINGLE AXIS

Ethernet/RS232, 1- and 2- axis

DMC-14x5 Series

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-1415-card (or -3415)	1-axis stand-alone with Ethernet & RS232	$ 595	$ 395
DMC-1415-box (or -3415)	DMC-1415 in enclosure with power supply	$ 795	$ 545
DMC-1425-card (or -3425)	2-axis controller for 2 servo motors	$ 695	$ 445
DMC-1425-box (or -3425)	DMC-1425 in enclosure with power supply	$ 895	$ 595
-STEPPER option	Controls 2 step motors instead of 2 servo motors	No extra charge	
CABLE 37-pin D	37-pin D-type cable	$ 25	
ICM-1460	Interconnect Module. Specify -HAEN for high amp enable or -LAEN for low amp enable	$ 145	$ 95
ICM-1460-STEPPER	Interconnect for DMC-1425-STEPPER	$ 145	$ 95
ICM-1460-OPTO	ICM with optoisolated inputs and outputs	$ 195	$ 145
AMP-14110	1-axis 20W servo amplifier board for DMC-1415-card	$ 75	$ 55
AMP-14120	2-axis 20W servo amplifier board for DMC-1425-card	$ 125	$ 105
DB-14064	Expansion board for 64 I/O (for card-level only)	$ 295	$ 195
Galil Utilities	Communication drivers, SmartTERM, DMCDOS	$ 20 for CD; free download	
DMCWIN32	Windows API Tool Kit (VB, C, C++, etc.)	Included with Utilities	
WSDK	Set-up, tuning and analysis software	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Microsoft platforms	$ 595	

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

Product Description

Galil's CDS-3310 is a single-axis controller and drive system for precisely controlling a brush or brushless servo motor. It combines a high-performance, programmable motion controller with a PWM drive in a compact, cost-effective package. The CDS-3310 provides a 10/100 Base-T Ethernet port and up to eight individual CDS-3310 units may be connected on a distributed network and programmed as a single controller. The communication burden is minimized because a host PC only has to talk with the master CDS-3310, which in turn communicates with the other CDS-3310 units in the network.

CDS-3310 Single-axis Controller and Drive System

    The CDS-3310 incorporates a 32-bit microcomputer and provides such advanced features as PID compensation with velocity and acceleration feedforward, program memory with multitasking for simultaneously running up to eight programs, and uncommitted I/O for synchronizing motion with external events. Modes of motion include point-to-point positioning, jogging, contouring, and electronic gearing.

    Like all Galil controllers, these controllers use a simple, English-like command language which makes them very easy to program. Galil's WSDK servo design software further simplifies system set-up with "one-button" servo tuning and real-time display of position and velocity information. Communication drivers are available for Windows, .NET, QNX, and Linux.

Features

■ 1-axis motion controller with on-board PWM drive for a brushed or brushless servo motor; 72 V, 7A continuous drive

■ Ethernet 10/100Base-T; (1) RS232 port up to 19.2 kbaud

■ USB option

■ Distributed control allows connection of up to 8 CDS-3310 units on an Ethernet network

■ Ethernet supports multiple masters and slaves. TCP/IP, UDP and Modbus TCP master protocol for communication with I/O devices

■ Accepts encoder feedback up to 12 MHz

■ PID compensation with velocity and acceleration feedforward, integration limits, notch filter and low-pass filter

■ Modes of motion include jogging, point-to-point positioning, contouring, electronic gearing and ECAM

■ Over 200 English-like commands executable by controller. Includes conditional statements and event triggers

■ Non-volatile memory for programs, variables and arrays. Concurrent execution of up to eight programs

■ Dual encoder, home and limits

■ 8 TTL uncommitted inputs and 10 TTL outputs

■ 2 uncommitted analog inputs and 1 analog output

■ Add 8 analog inputs and 40 digital I/O with DB-28040

■ ICM-3300 interconnect module provides screw terminals and optical isolation of inputs and outputs

■ Brake drive 24V, 0.5A

■ High speed position latch and output compare

■ Small size: 5.15" x 8.25" metal enclosure

■ DIN-Rail mount clip available

■ On-board DC-to-DC converter for single 18 V to 72 V DC input

■ Communication drivers for Windows, QNX, and Linux

■ Custom hardware and firmware options available

■ SSI encoder interface option

Ethernet/RS232 1-axis Controller & Drive

CDS-3310

Distributed Control

In some mechanical systems it is advantageous to have CDS-3310 single axis motion controllers physically distributed throughout the system to reduce wiring. Up to eight CDS-3310 units can be distributed per network.

Communication overhead and motion coordination issues typical with distributed, single-axis systems are minimized with the CDS-3310. The communication burden with a host PC is minimized because the PC communicates to the CDS-3310 controller configured as the master, which in turn communicates with all other CDS-3310 controllers on the network. This allows multiple controllers connected on an Ethernet network to be programmed as a single controller. A special set of commands for distributed control ease communication issues on the network. For example, the command HC configures the network. The complete list of distributed commands is found in the instruction set shown below.

Distributed Control Commands

HA	Handle Assignment
HC	Automatic handle configuration
HQ	Handle Query
HW	Handle wait
SA	Send slave command
ZA	Ethernet user variable
ZB	Ethernet user variable

Servo Drive Specifications

The CDS-3310 contains a transconductance, PWM drive for driving brushless or brush-type servo motors. The amplifier drives motors operating at 18–72 VDC (voltage at motor is 10% less), up to 7 Amps continuous, 10 Amps peak. The gain settings of the amplifier are user-programmable at 0.4 Amp/Volt, 0.7 Amp/Volt and 1 Amp/Volt. The switching frequency is 60 kHz. The amplifier offers protection for over-voltage, under-voltage, over-current, and short-circuit. The amplifier status can be read through the controller, and the BS command allows easy hall sensor set-up. The SR-19900 shunt regulator is available for the CDS-3310.

I/O Expansion Options

DB-28040 I/O Expansion Board

The DB-28040 mounts directly to the CDS-3310 and provides an additional 40 digital inputs and outputs, and eight ±10 V analog inputs (default I/O is 3.3 V. For 5 V I/O, order DB-28040-5V). The small 2.55" × 3.08" board attaches directly to the 50-pin header on the CDS-3310 controller, and no cable is required between the controller and I/O board.

The 40 digital I/O signals are available on a 50-pin IDC header, and the analog inputs are available on a 16-pin header. With a controller firmware modification, the I/O board can also be modified to accept feedback from SSI encoders.

IOC-7007 Controller for Ethernet I/O Expansion

Galil's IOC-7007 I/O controller provides an intelligent solution for adding I/O and PLC functionality to the CDS-3310 Ethernet control system. The IOC-7007 I/O controller connects to the Ethernet network allowing it to communicate with CDS-3310 motion controllers and other devices on the network. The intelligent I/O controller has an on-board microprocessor for coordinating I/O events and performing tasks normally handled by a PLC. The IOC-7007 unit accepts up to seven plug-in I/O modules for easy connection to optoisolated inputs, optoisolated outputs, analog inputs and outputs and dry-contact relays. Packaging options include card-level, box-level and DIN-rail mount. Consult the IOC-7007 datasheet for complete specifications.
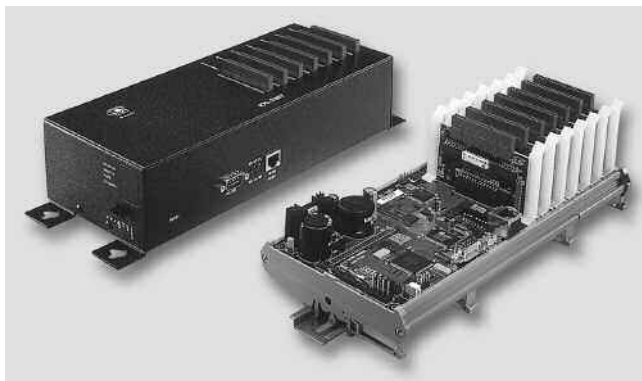
IOC-7007 BOX and IOC-7007-DIN

ICM-3300 Interconnect Module

The ICM-3300 attaches directly to the CDS-3310 and breaks out the 37-pin D-sub connector into convenient screw terminals allowing for quick and easy connection to system elements. The ICM-3300 also provides optical isolation for inputs and outputs with the exception of the following signals: brake output, output compare, reset input and digital input 8. Outputs 1 through 4 are high-side, 500 mA drives. The maximum common voltage for the I/O is 28 VDC. The ICM-3300 includes a high density 15-pin D-sub connector which allows direct connection to Galil's BLM-N23 brushless servo motor.

ICM-3300 attached to CDS-3310

Ethernet/RS232 1-axis Controller & Drive

CDS-3310

Specifications

System Processor

- Motorola 32-bit microcomputer

Communications Interface

- Ethernet 10/100BASE-T. (1) RS232 port up to 19.2 kbaud Commands are sent in ASCII. A binary communication mode is also available as a standard feature
- USB option

Modes of Motion:

- Point-to-point positioning
- Position Tracking
- Jogging
- Electronic Gearing
- Contouring
- Teach and playback

Memory

- Program memory size — 1000 lines × 80 characters
- 510 variables
- 8000 array elements in up to 30 arrays

Filter

- PID (proportional-integral-derivative) with velocity and acceleration feedforward
- Notch and low-pass filter
- Velocity smoothing to minimize jerk
- Integration limit
- Torque limit
- Offset adjustments

Kinematic Ranges

- Position: 32 bit (±2.15 billion counts per move; automatic rollover; no limit in jog or vector modes)
- Velocity: Up to 12 million counts/sec for servo motors
- Acceleration: Up to 67 million counts/sec^2

Uncommitted I/O

- 8 buffered inputs
- 10 TTL outputs
- 2 analog inputs; 0–5 Volts, 12-bit ADC*
- 1 uncommitted analog output ±10 V, 16-bit DAC

High Speed Position Latch

- Latches encoder position within 0.1 microseconds

Dedicated Inputs

- Main encoder inputs — Channel A, A-, B, B-, I, I- (±12 V or TTL)
- Auxiliary encoder inputs
- Forward and reverse limit inputs — buffered**
- Home input — buffered**
- High-speed position latch input — buffered**

Dedicated Outputs

- Analog motor command output with 16-bit DAC resolution
- Error output
- Brake output
- Amp enable
- High-speed position compare output

Minimum Servo Loop Update Time

- 250 microseconds

Maximum Encoder Feedback Rate

- 12 MHz

Power

- 0.5 A, 5 V available for external devices
- 40 mA, +12 V, -12 V available for external devices
- Requires 18 V–72 V input

Drive Specifications

- 18–72 Volt; 7 Amp continuous, 10 Amp peak

Environmental

- Operating temperature: 0–70º C
- Humidity: 20–95% RH, non-condensing

Mechanical

- 5.15" × 8.25" metal enclosure (for high current applications, the metal enclosure should be mounted to a metal backing to dissipate heat)

Connectors

- 37-pin Female D-sub — I/O
- 15-pin HD Female D-sub — encoder

*For ±10 V use DB-28040

**Optically isolated I/O available with ICM-3300 option.

Ethernet/RS232 1-axis Controller & Drive

CDS-3310

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
CDS-3310	1-axis motion controller with 500W servo drive; Ethernet/RS232	$ 745	$ 495
-DIN	DIN-rail mounting clip	$ 25	$ 20
ICM-3300	Screw terminal interface with optical isolation	$ 245	$ 145
DB-28040	I/O expansion board for 8 analog inputs and 40 digital I/O (outputs source 3.3 V)	$ 295	$ 195
DB-28040-5V	I/O expansion board for 40 digital I/O (maximum 24 digital outputs) and 8 analog inputs. Outputs are open collector and sink 5 V	$ 295	$ 195
SR-19900	Shunt regulator for CDS-3310	$ 75	$ 40
CABLE-15-1M	15-pin HD D sub to discrete wires—1 meter	$ 25	$ 17
CABLE-15-2M	15-pin HD D sub to discrete wires—2 meter	$ 30	$ 20
CABLE-Ethernet	Ethernet cables	Consult factory	
CABLE-9-pin D	RS232 cable	$ 10	
IOC-7007	Intelligent I/O controller box for Ethernet I/O expansion	$ 595	$ 495
Galil Utilities	Communication drivers, SmartTERM, DMCDOS	$ 20 for CD; free download	
DMCWIN32	Windows API Tool Kit (VB, C, C++, etc.)	Included with Utilities	
WSDK	Set-up, tuning and analysis software	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Microsoft platforms	$ 595	

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

Pocket PLC Series
Smart. Compact. Low-Cost. Packed with I/O.

Galil's RIO-47xxx Pocket PLC is packed with analog and digital I/O in a compact package. Its powerful RISC processor provides fast I/O handling and logic control. The RIO is easy-to-program with Galil's Ladder Interface Software or intuitive command language. Plus, the RIO is cost-effective at just $295 in single quantity and unlike most PLCs, analog I/O and Ethernet 10/100Base-T are included at no extra charge. Use them stand-alone or network multiple RIOs to handle all the I/O in your machine.

Packed with I/O

- 8 analog inputs, user-configurable for 0–10 V, 0–5 V, ±5 V, ±10 V, 12-bit or 16-bit ADC

- 8 analog outputs, user-configurable for 0–10 V, 0–5 V, ±5 V, ±10 V, 12-bit or 16-bit DAC

- 16 optically isolated digital inputs, 5–24 VDC

- 8 optically isolated digital outputs rated at 25 mA, 5–24 VDC

- 8 optically isolated digital outputs rated at 500 mA, 12–24 VDC

Smart

- RISC processor for fast handling of I/O and logic

- EEPROM memory for non-volatile program storage

- Multitasking, variables, arrays, conditionals, arithmetic and logical operators

- Pulse counter and PID process control loops

- Web interface and email capability

- RS232 and Ethernet 10/100Base-T port; Modbus/TCP master or slave

- Powered by Power-over-Ethernet (PoE) or external 18–36 VDC

Compact

- Measures just 3.88" × 4.26" × 1.30"

- D-type connectors; Available with mating ICS for screw-terminal connections

Use 2-letter Commands or Ladder Logic

- Galil's Ladder Interface Software converts standard Relay Ladder Logic (RLL) program into deterministic code for RIO. Object types for contacts, coils, control relays, boxes (including timers, counters and data manipulation), and analog commands

Product Description

The RIO-47xxx is an intelligent programmable logic controller (PLC) with 100Base-T Ethernet capability. The RIO contains a fast RISC processor for handling I/O logic and is programmed using Galil's easy-to-use, two-letter command language or Ladder Interface Software.

Each RIO-471xx unit is self-contained with numerous analog and digital I/O including: 8 analog inputs, 8 analog outputs, 16 optically isolated inputs, 8 high-power isolated outputs and 8 low-power isolated outputs. Multiple RIO units can be distributed on an Ethernet network allowing I/O expansion.

RIO-471xx Pocket PLC

The RIO receives power from Power-Over-Ethernet (PoE) or an external 18−36 VDC supply. Measuring just 3.88" × 4.26" × 1.30", the RIO-471xx is packaged in a compact metal enclosure and provides D-type connectors for convenient interface. Mating ICS boards provide screw terminals for fast proto-typing. The RIO-47200 is a DIN rail mount unit with screw terminals.

RIO-47200 provides DIN mount and screw terminals
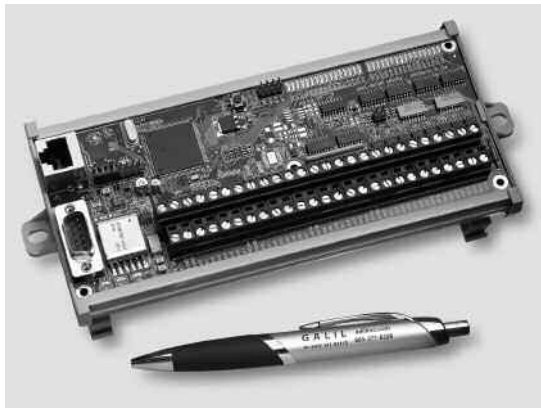
Features

- ◾ Intelligent, Remote Ethernet I/O Controller

- ◾ 10/100Base-T Ethernet Link and 115 kb RS232 port

- ◾ 8 analog inputs —
  RIO-47100: 0-5 V; 12-bit ADC
  RIO-47120: user configurable ±10 V, ±5 V, 0-10 V, 0-5 V
    12-bit ADC standard, 16-bit optional
    Accepts single-ended or differential
  RIO-47200: 0–5 V; 12-bit ADC

- ◾ 8 analog outputs —
  RIO-47100: 0-5 V; 12-bit DAC
  RIO-47120: user configurable ±10 V, ±5 V, 0-10 V, 0-5 V
    12-bit DAC standard, 16-bit optional

- ◾ 16 optically isolated inputs

- ◾ RIO-471xx: 8 high-power, isolated outputs rated at
    500 mA per output
  RIO-47200: 16 high-power, isolated outputs rated at
    500 mA per output

- ◾ 8 isolated outputs rated at 25 mA max per output for RIO-471xx

- ◾ LED indicators for all digital I/O points

- ◾ Contains RISC processor and non-volatile memory for programming I/O events

- ◾ Expanded variables, memory and control loops for RIO-471x2 option

- ◾ Easy-to-use, 2-letter Galil programming language

- ◾ Multitasking threads for simultaneous execution of multiple I/O programs

- ◾ Provides pulse counter and process loop control

- ◾ Easy integration with Galil DMC-40x0 motion controller

- ◾ Web interface and email capability for sending messages

- ◾ Powered by Power-Over-Ethernet (PoE) or external 18−36 V DC input

- ◾ RIO-471xx: 3.88" x 4.26" x 1.30"
  RIO-47200: 7.19" x 3.52" with DIN tray

- ◾ Metal Enclosure for RIO-471xx. DIN for RIO-47200

- ◾ D-type connectors for RIO-471xx.
  Screw terminals for RIO-47200

- ◾ Modbus/TCP master or slave

- ◾ Galil's Ladder Interface Software is available for converting Relay Ladder Logic programs into deterministic code for the RIO

POCKET PLC

Pocket PLC Controller

RIO-47xxx

Specifications

System Processor

- RISC-based clock multiplying processor with DSP functions

Communications Interface

- 10/100Base-T Ethernet port
- RS232 port — 19.2 kbaud, 115 kbaud

Memory (RIO-471x0 and RIO-47200)

- Program memory size: 200 lines x 40 characters
- 126 variables
- 400 array elements in up to 6 arrays
- 2 PID control loops
- 3 Ethernet handles

Memory (RIO-471x2)

- Program memory size: 400 lines x 40 characters
- 254 variables
- 1000 array elements in up to 6 arrays
- 6 PID control loops
- 5 Ethernet handles

I/O

- Digital Outputs 0 – 7 are opto-isolated sourcing power outputs. 12 – 24 VDC, 500 mA* for RIO-471xx. 0 – 15 for RIO-47200
- Digital Outputs 8 – 15 are opto-isolated sinking outputs. 5 – 24 VDC, 25 mA for RIO-471xx
- Digital Inputs 0 – 15 are opto-isolated inputs. 2.2 K series resistor for 5 – 24 V input
- 8 analog inputs —
  RIO-47100 and -47200: 0 – 5 V; 100 K input impedance; 12-bit ADC
  RIO-47120: user configurable ± 10 V, ± 5 V, 0 – 10 V, 0 – 5 V
      12-bit ADC standard, 16-bit optional
      Single-ended: 42 K input impedance
      Differential: 31 K input impedance
- 8 analog outputs —
  RIO-47100: 0 – 5 V; source/sink up to 4 mA; 12-bit DAC
  RIO-47120: user configurable ± 10 V, ± 5 V, 0 – 10 V, 0 – 5 V
      12-bit DAC standard, 16-bit optional; source/sink up to 4 mA

Power

- PoE (Power over Ethernet) or External Power
- Power consumption is 2.5 Watts typical, 4 Watts max.
- External Input is 18 to 36 VDC

Mechanical

- RIO-471xx: 3.88" × 4.26" × 1.30"
  RIO-47200: 7.19" × 3.52" with DIN tray

Environmental

- Operating Temperature: 0 – 70 ℃

Requires external DC supply.

Connectors for RIO-471xx

Serial
9-pin; Male connector and cable

1 NC
2 Transmit data-output
3 Receive data-input
4 NC
5 Ground
6 NC
7 Clear to Send-input
8 Request to Send-output
9 NC

Analog I/O
26-pin HD Female D-sub

1 NC
2 NC
3 Analog input 7
4 Analog input 4
5 Analog input 1
6 Analog Ground
7 Analog output 5
8 Analog output 2
9 Analog Ground
10 NC
11 NC
12 Analog Ground
13 Analog input 5
14 Analog input 2
15 Analog Ground
16 Analog output 6
17 Analog output 3
18 Analog output 0
19 NC
20 NC
21 Analog input 6
22 Analog input 3
23 Analog input 0
24 Analog output 7
25 Analog output 4
26 Analog output 1

Digital I/O
44-pin HD Female D-sub

1 Digital Input 15
2 Digital Input 12
3 Digital Input 9
4 NC
5 Digital Input 6
6 Digital Input 3
7 Digital Input 0
8 Output Common OP1B – Power (Outputs 8-15)
9 Digital Output 13
10 Digital Output 10
11 Output Common OP1A – Ground (Outputs 8-15)
12 Digital Output 7
13 Digital Output 4
14 Digital Output 1
15 Output Common OP0A – Power (Outputs 0-7)
16 NC
17 Digital Input 13
18 Digital Input 10
19 Input Common 1 (Inputs 8-15)
20 Digital Input 7
21 Digital Input 4
22 Digital Input 1
23 NC
24 Digital Output 14
25 Digital Output 11
26 Digital Output 8
27 Output Common OP0B – Ground (Outputs 0-7)
28 Digital Output 5
29 Digital Output 2
30 Output Common OP0A – Power (Outputs 0-7)
31 Digital Input 14
32 Digital Input 11
33 Digital Input 8
34 NC
35 Digital Input 5
36 Digital Input 2
37 Input Common 0 (Inputs 0-7)
38 Digital Output 15
39 Digital Output 12
40 Digital Output 9
41 NC
42 Digital Output 6
43 Digital Output 3
44 Digital Output 0

External Power

1 Ground
2 18-36VDC

Pocket PLC Controller

Instruction Set

Ethernet

DH	DHCP enable
HS	Handle assignment switch
IA	Set IP address
IH	Internet handle
MA	Email server IP address
MB	Modbus
MD	Email destination address
MI	Modbus Integer
MS	Email source address
MV	Modbus Reversal
MW	Modbus wait
SM	Subnet mask

I/O

AO	Analog output voltage
AQ	Analog configuration
CB	Clear bit
II	Input interrupt
IQ	Input configuration
OB	Define output bit
OP	Output port
PC	Pulse counter enable
SB	Set bit
@AN[x]	Value of analog input x
@AO[x]	State of analog output x
@IN[x]	State of digital input x
@OUT[x]	State of digital output x

Interrogation

ID	Identify
LA	List arrays
LL	List labels
LS	List program
LV	List variables
MG	Message command
QR	Data record
QZ	Return data record information
^R^V	Revision
TB	Tell status byte
TC	Tell error code
TE	Tell Error
TH	Tell Ethernet handles
TI	Tell input
TIME	Time operand, internal clock
TR	Trace program
TZ	Tell I/O configuration
WH	Ethernet handle

Math Functions

@SIN[x]	Sine of x
@COS[x]	Cosine of x
@COM[x]	1's complement of x
@ASIN[x]	Arc sine of x
@ACOS[x]	Arc cosine of x
@ATAN[x]	Arc tangent of x
@ABS[x]	Absolute value of x
@FRAC[x]	Fraction portion of x
@INT[x]	Integer portion of x
@RND[x]	Round of x
@SQR[x]	Square root of x
@TAN[x]	Tangent of x
$	Hexadecimal
( )	Parenthesis
+, -, *, /, %	Arithmetic commands
>,<,=,>=,<=,<>	Logical operators
&	Logical AND
|	Logical OR

Control Loop

AF	Analog feedback select
AZ	Analog output select
CL	Control loop update rate
DB	Deadband
IL	Integrator limit
KD	Derivative constant
KI	Integrator constant
KP	Proportional constant
OF	Offset
PS	Control set point

Programming

`	Continuation character
'	Comments
#	Label
#AUTO	Auto subroutine on power-up
#AUTOERR	Auto subroutine on EEPROM error
#TCPERR	Auto subroutine on Ethernet error
#CMDERR	Auto subroutine on command error
#COMINT	Auto subroutine on communication interrupt
#ININT	Auto subroutine on input interrupt
[ ]	Array index operator
;	Command delimiter
AB	Abort program
BK	Breakpoint
CI	Communication interrupt
DA	Deallocate variables/arrays
DL	Download program
DM	Dimension arrays

Programming (cont.)

ED	Edit program
ELSE	Conditional statement
EN	End program
ENDIF	End of conditional statement
HX	Halt execution
IF	If statement
IN	Input variable
JP	Jump
JS	Jump to subroutine
NO	No-operation — for comments
RA	Record array, automatic data capture
RC	Record interval for RA
RD	Record data for RA
RE	Return from error
REM	Remark
RI	Return from interrupt routine
SA	Send command
SL	Single step
UL	Upload program
XQ	Execute program
ZC	User variable
ZD	User variable
ZS	Zero stack

System Configuration

BN	Burn parameters
BP	Burn program
BV	Burn variables and arrays
CF	Configure default port
CW	Data adjustment bit
DR	Configure I/O data record
EO	Echo off
IK	Ethernet port blocking
^L^K	Lock program
LZ	Leading zeros format
PW	Password
QD	Download array
QU	Upload array
RS	Reset
^R^S	Master reset
VF	Variable format

Trippoint

AA	After analog input
AI	After input
AT	At time
WT	Wait for time

POCKET PLC

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RIO-47xxx

Ladder Interface Software

Galil's Ladder Interface Software is a software tool for the RIO-47xxx Pocket PLC. The software converts a relay Ladder Logic program into code for input into the RIO controller. Ladder Logic is often used by programmable logic controller (PLC) programmers to graphically input I/O logic. While direct RIO programming using Galil's two-letter text instructions allows for flexible coding, it is sometimes easier to determine the I/O logic visually with Ladder Logic.

The Ladder Interface Software provides an easy-to-use graphical interface that allows object types for: contacts, coils, control relays, boxes (including timers, counters and data manipulation) and analog I/O. The software generates an RIO program from the specified objects in the flow diagram. In addition to generating optimized code, Galil's Ladder Interface Software automatically adds determinism to the RIO program.

Features

- Object types include:
  – Contacts
  – Coils
  – Control relays (virtual contacts/coils)
  – Boxes (including timers, counters and data manipulation)
  – Analog I/O

- Standard mathematical and logical operators include:
  – Equal, Not Equal, Less than, Greater than
  – AND, OR (normally open or normally closed)
  – Add, Subtract, Multiply, Divide, Increment, Decrement
  – Shift or rotate accumulator left or right

- Galil command box for specifying any valid Galil two-letter command
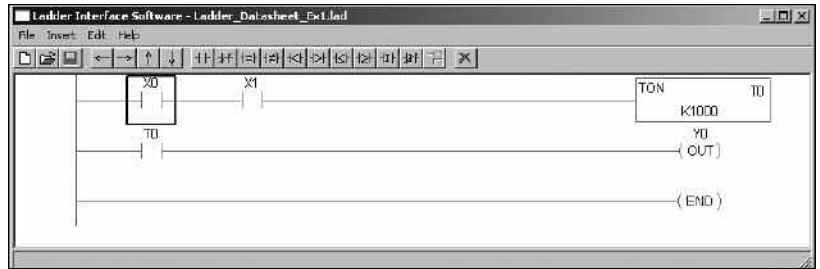
On-Timer (TON) Ladder Logic Example
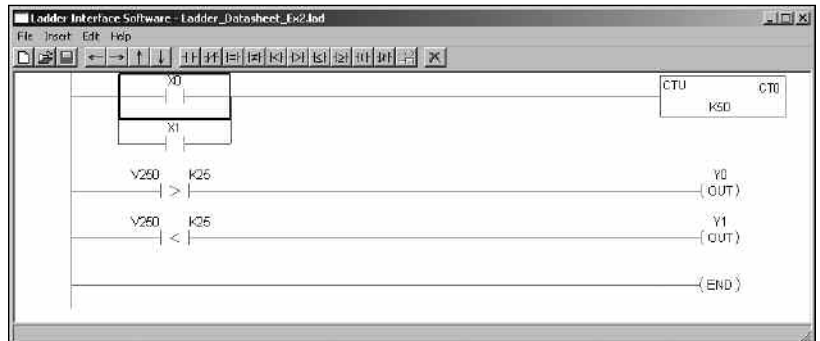
Up-Counter (CTU) and comparative logic example
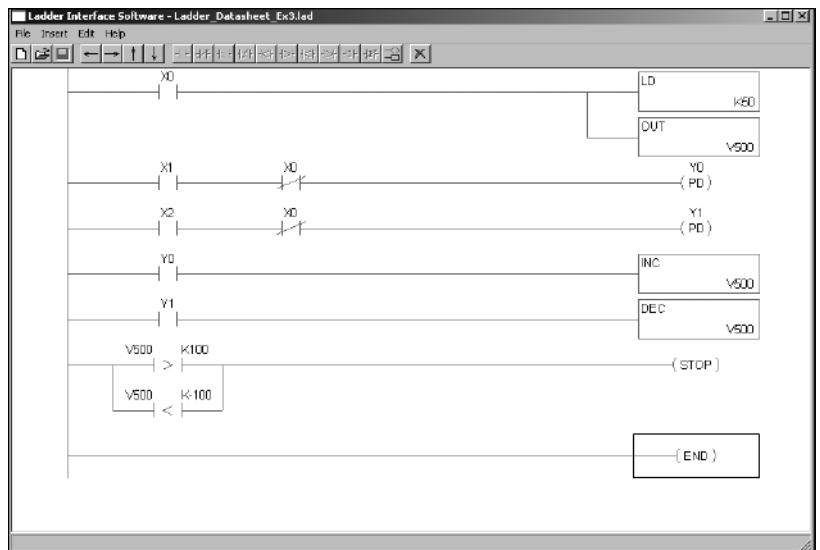
One-shot output (PD) and variable manipulation example

Pocket PLC Controller

RIO-47xxx

High Power Sourcing Outputs (RIO-471xx: 0–7, RIO-47200: 0–15) *Opto-isolated sourcing power outputs. 12–24 VDC with 500 mA of current capability per output*
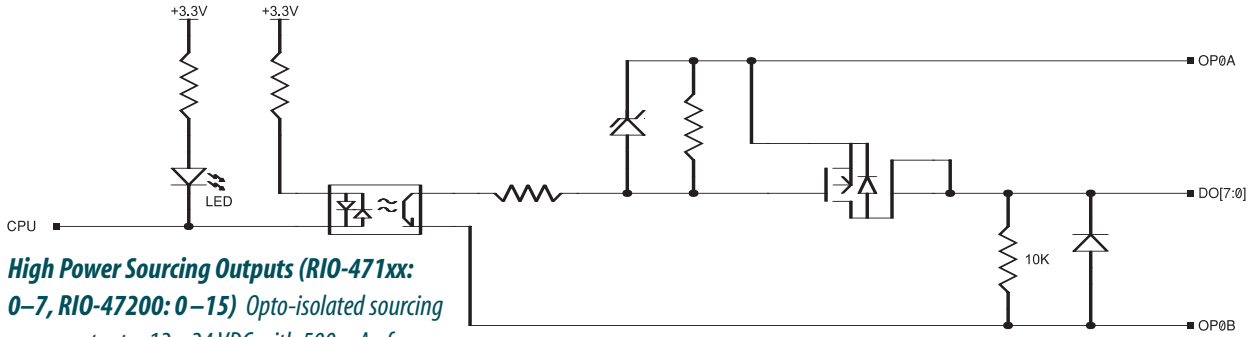
Low Power Sinking Outputs (RIO-471xx: 8–15) *Opto-isolated sinking outputs. 5–24 VDC with 25 mA of current capability in a sinking configuration*

RIO-471xx

Digital Inputs *Digital inputs 0–15 are opto-isolated inputs with a range of 5–24 VDC*
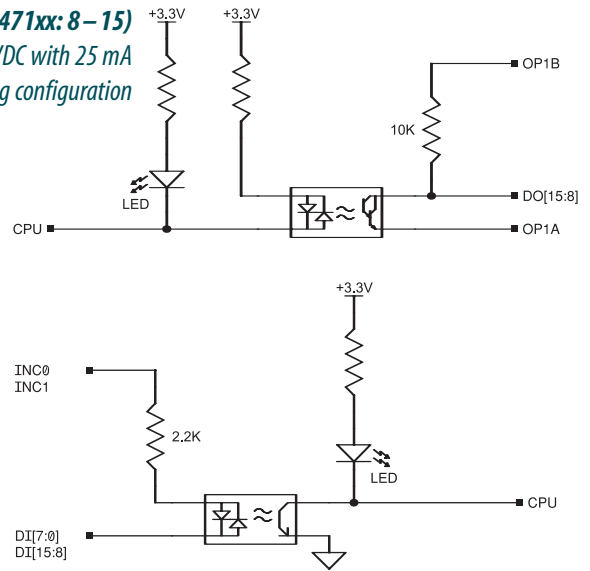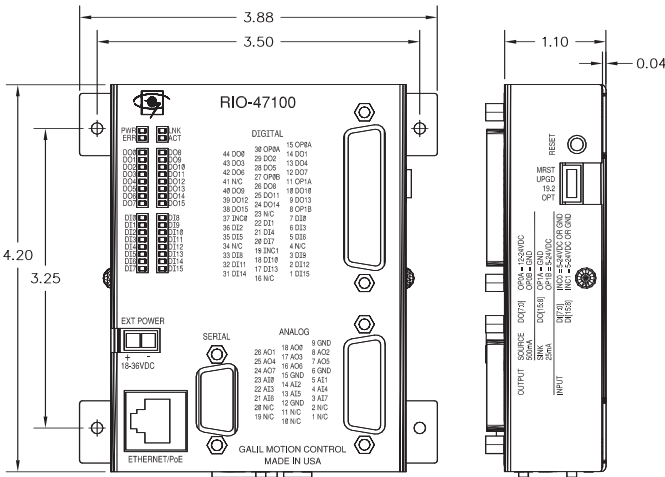
Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
RIO-47100	PLC with 0–5 V analog I/O; 12-bit ADC/DAC	$ 295	$ 195
RIO-47120	PLC with ±10 V analog I/O; 12-bit ADC/DAC	$ 345	$ 245
RIO-4712x-16	16-bit ADC/DAC option for RIO-47120 or -47122	add $ 50	add $ 50
RIO-47102	RIO-47100 with expanded memory	$ 345	$ 245
RIO-47122	RIO-47120 with expanded memory	$ 395	$ 295
-DIN	DIN-rail mounting option for RIO-471xx	$ 25	$ 25
RIO-47200	RIO with screw terminals and DIN. 12-bit, 0–5 VDC analog inputs. Consult factory for options.	$ 345	$ 245
CABLE-44-1M	44-pin D HD male cable to discrete wires	$ 35	$ 24
CABLE-26-1M	26-pin D HD male cable to discrete wires	$ 25	$ 17
ICS-48026-M	26-pin D HD male to screw terminals	$ 75	$ 50
ICS-48044-M	44-pin D HD male to screw terminals	$ 75	$ 50
Ladder Interface Software	Converts Relay Ladder logic into deterministic code for RIO	$ 195	
GalilTools-Lite	Editor, Terminal, Watch Tools. Includes communication library for developers-supports C++, VB, C#, LabVIEW and more	Free download	
GalilTools	Above with Scope and Tuner	$ 195	

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

Product Description

GalilTools is Galil's newest set of software tools for current Galil controllers. It is highly recommended for all first-time purchases of Galil controllers as it provides easy set-up, tuning and analysis. GalilTools replaces the WSDK Tuning software with an improved user-interface, real-time scopes and communications utilities.

The powerful Scope Tool is ideal for system analysis as it captures numerous types of data for each axis in real-time. Up to eight channels of data can be displayed at once, and additional real-time data can be viewed by changing the scope settings. This allows literally hundreds of parameters to be analyzed during a single data capture sequence. A rising or falling edge trigger feature is also including for precise synchronization of data.

GalilTools also includes a Program Editor Tool which allows multiple editors to be open simultaneously for convenient programming of Galil controllers. The Watch Tool displays controller status at a glance and includes units and scale factors for easy viewing. The Tuning Tool helps select PID parameters for optimal servo performance.

GalilTools runs on Windows and Linux platforms as standard with other platforms available on request.

GalilTools-Lite is available at no charge and contains the Editor, Terminal and Watch tools only.

Features

■ Powerful software tools for Galil controllers

■ Terminal Tool for sending and receiving Galil commands

■ Scope Tool with trigger displays up to 8 channels of real-time data

■ Tuning Tool for automatic and manual PID tuning of servo systems

■ Watch Tool with units for displaying controller status such as I/O and motion

■ Easy-to-use interface provides toolbar for access to frequently used tools

■ Multiple Document Interface (MDI) allows display of multiple editors. Features tiling and cascading

■ Dock feature for docking or floating tools

■ Operates with Windows and Linux as standard. Other platforms upon request

■ Automatically displays all available Ethernet, serial and PCI connections

■ Efficient, high-speed communication drivers for Galil controllers

■ Powerful and easy to use Galil Tools Communication Library for use with VB, C#, C++ and more. Includes onInterrupt, onMessage, and onRecord events for easy, event-driven programming.

■ For DMC-40x0, DMC-21x3, and RIO Ethernet controllers, and DMC-18x6 and DMC-18x2 PCI controllers
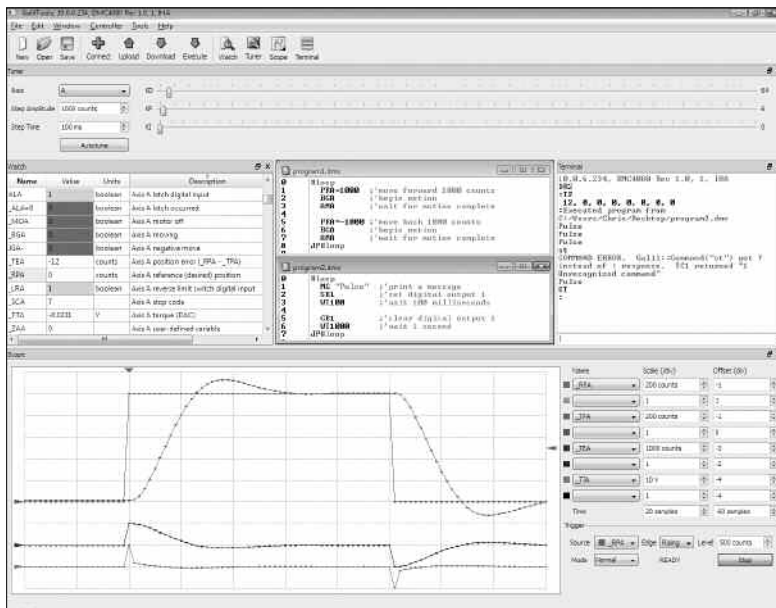
GalilTools Provides Multiple Tools for Set-up and Tuning Motion Systems. The Various Tools such as Tuner, Scope, Terminal, Watch, Editor can be Displayed on a Single Screen or Separately.

SOFTWARE

GalilTools

Watch Tool Displays Controller and I/O status.
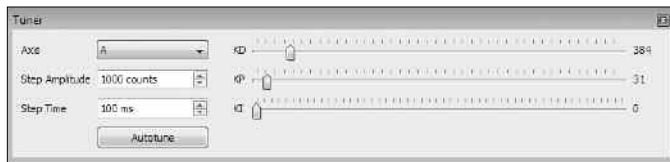
Tuner Tool Automatically or Manually Finds the Best PID Values for a Step Response.

Terminal Tool Allows Controller Commands to be Sent and Received.
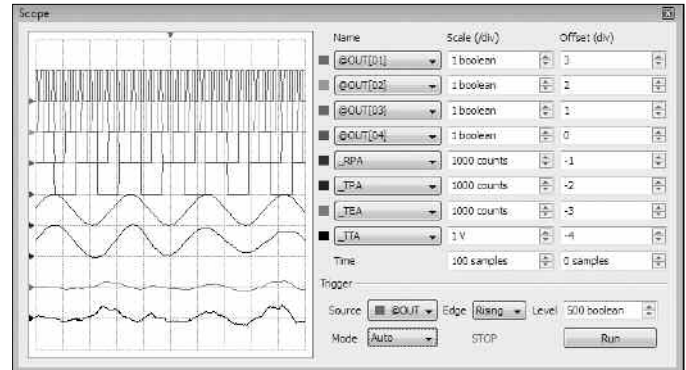
Scope Tool Displays up to 8 Channels of Data (all data is recorded). Includes Trigger.

Editor Tool Allows Application Programs to be Edited, Uploaded and Downloaded.

SOFTWARE

Product Description

Galil's ActiveX Tool Kit is a powerful software package that lets the designer quickly and easily create an operator interface for Galil controllers using any Windows programming language that supports ActiveX.

Pre-built objects include a DMC terminal, polling window, send files and storage scope functions. Dialog boxes allow objects to be easily customized for color, size, location and text.

The Tool Kit shortens the development time of an operator interface from days or weeks to a matter of hours. Plus, the tool kit is easy to use, making it ideal for even the novice programmer.

Microsoft's Visual Basic and Galil's ActiveX Tool Kit make developing an operator interface for the controller quick and easy.

The Polling window object allows responses from the controller to be displayed. You can poll for data such as position, speed and error for any axis.

Features

■ *Provides 32-bit OCXs for handling controller communications including support of interrupts*

■ *Objects install right into the Visual Basic tool box*

■ *Pre-built objects for many functions including:*
- *Terminal for sending commands and editing programs*
- *Polling window for displaying responses from the controller such as position and speed*
- *Storage scope for plotting trajectories such as position vs. time or X vs.Y*
- *Send file for sending DMC files*
- *Continuous array capture for data collection and teach and playback*
- *Graphical display of 2D-motion path*
- *Diagnostics for capturing current configurations*
- *Vector Motion Tools to slow down around corners and tool offset*

■ *Built-in dialog boxes for each object for easy selection of color, size, location and text*

■ *Context sensitive help with hypertext links*

Here, a Visual Basic screen was created for jogging motors while the X and Y real time position is displayed. Motion occurs when the operator clicks on the jog buttons.

SOFTWARE

AutoCAD Translator
CADTODMC

Product Description

CADTODMC is a software tool that translates AutoCAD or equivalent .DXF files into controller motion commands. The designer draws the two-dimensional motion path using AutoCAD software and then uses the translator to obtain a DMC command file. Text macros, which call for specific operations along the path, can be incorporated in the drawing.

This drawing shows how line segments and arcs can be connected to make a continuous path.
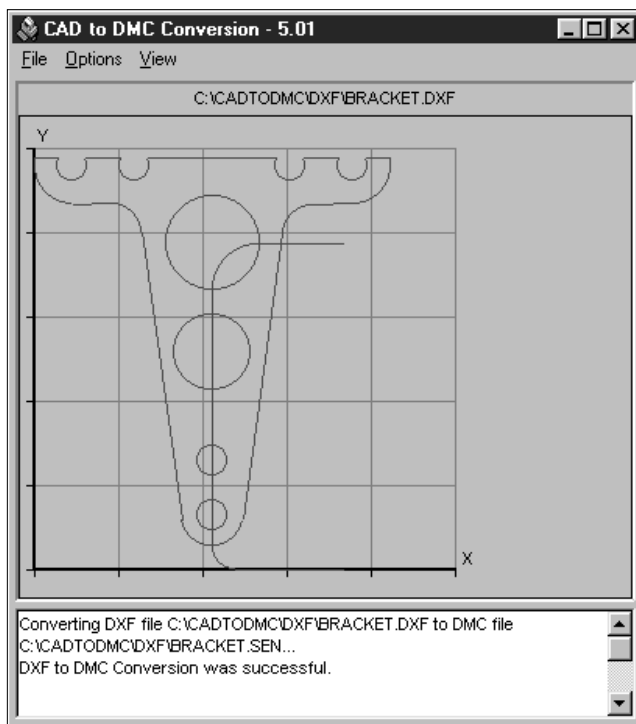
Features

■ Translates AutoCAD® or equivalent .DXF file to .DMC controller file

■ Translates two-dimensional contours including lines and arcs

■ Can specify continuous or stop-start motion along motion path

■ Translates motion dependent I/O events

■ User-definable text macros can be defined on the CAD drawing

■ Tool-offset feature

■ Allows specification of first and last motion segments and path-order numbers
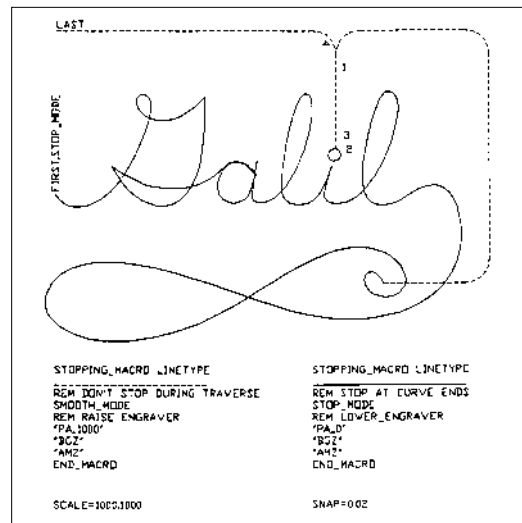
This drawing is a motion description for an engraving machine. The line type directives form two functions. The cutting head is raised and lowered by the Z axis, and the motion mode is changed. The curves operate in STOP_MODE so that large accelerations do not occur at the sharp corners in the letters. SMOOTH_MODE is used for the traverse because the lines and arcs connect smoothly.

SOFTWARE

GalilTools is recommended for DMC-40x0, DMC-18x6, DMC-21x3, DMC-18x2 and RIO. Use the software utilities below for other Galil controllers.

SmartTERM — Terminal program for sending commands, downloading and editing programs, and updating flash firmware. Also includes **DMCNet**, an Ethernet utility for detecting and addressing Ethernet controllers.

DMCSetup — Utility to upload, download, view, and save burned parameters to disk.

DMCDOS — Utility programs and example source code for communicating in the DOS environment.

DMCQNX — QNX6 utilities for PCI.

DMCLNX — Linux Terminal with PCI, and Ethernet drivers.

SmartTERM
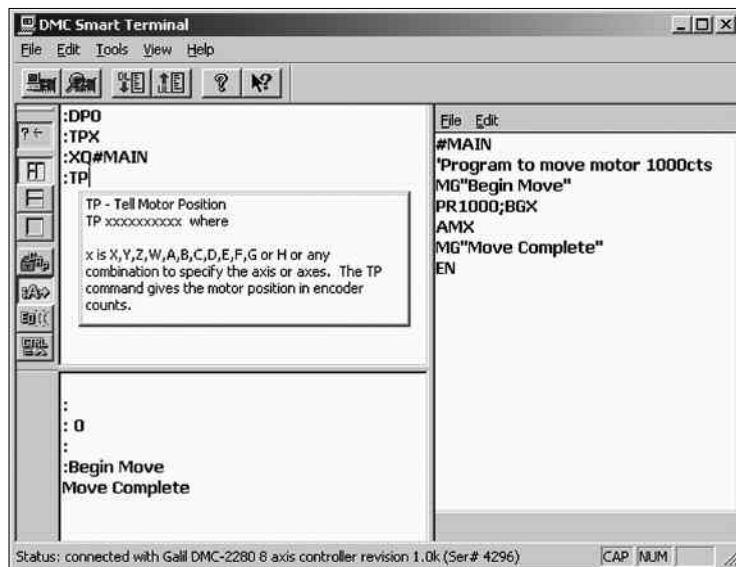
DMCSetup

Galil's Setup software is for easily displaying and editing the configuration parameters of Galil controllers. You can see the contents of the controller registers "at a glance."

You can view motor type, filter parameters, default settings, switch status, etc. To change a parameter, you merely "click" on that parameter with the mouse and enter a new value. This makes setting up the controller a snap.

The software tool also lets you save (and load) parameters to (and from) a file. This is useful prior to master resets or changing firmware. The software also has a terminal and on-line help. This software is included on the Galil software CD.

Web-based MotorSizer™ Tool

Galil's MotorSizer is a free, web-based tool for easy sizing of your motion system. This easy-to-use tool lets you specify your load and motion requirements for various mechanical systems. MotorSizer performs a thorough analysis to select motors and amplifiers (or enter your own) that can drive your load to the motion requirements. Galil's MotorSizer tool analyzes both stepper and servo motor systems. MotorSizer is password protected (registration is required) and automatically saves your data for future reference.

HelloGalil™

Quick Start for PC Programming Languages
For programmers developing Windows applications that communicate with a Galil controller, the HelloGalil library of quick start projects immediately gets you communicating with the controller from the programming language of your choice. In the "Hello World" tradition, each project contains the bare minimum code to demonstrate communication to the controller and simply prints the controller's model and serial numbers to the screen:
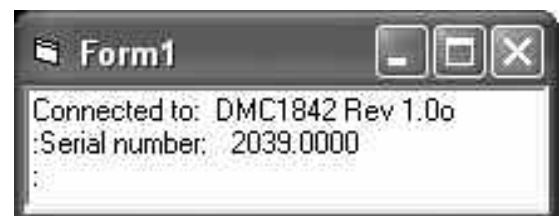
SOFTWARE

Software Tools

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1
GalilTools-Lite	Editor, Terminal, Watch Tools. Includes communication library for developers-supports C++, VB, C#, LabVIEW and more	Free download
GalilTools	Above with Scope and Tuner	$ 195
ActiveX Tool Kit	Custom ActiveX controls for Microsoft platforms	$ 595
CADTODMC	DXF to DMC translator	$ 595
Other Utilities	Installation files for older Galil controllers. Utilities and programming libraries for Windows, Linux, QNX, DOS *Includes:* SmartTERM — terminal to communicate to controller and upload/download programs dmc32.dll — DMCWIN32 API DMCSetup — set-up utility for Galil controllers MotorSizer — motor sizing tool DMCDOS — utilities and programming libraries, DOS DMCQNX — utilities for QNX4, QNX 6.2 for PCI only DMCLNX — Linux terminal and drivers for PCI and Ethernet DMC.NET API — toolkit for .NET development platform *Note: Galil utilities are on the CD included with all software products listed below.*	$ 20 for CD; free download
WSDK	Prior generation tuning software for older controllers	$ 195
ECAM	Electronic CAM set-up utility	$ 195
DMCDDE	Generic DDE server	$ 295
Third-party Software	Consult Galil website for available third-party software such as CNC software	Consult website

™Windows, Visual Basic, and ActiveX are trademarks of Microsoft Corporation.

SOFTWARE

Galil's Optima controllers are prior generation controllers that are still sold and supported by Galil. Galil offers Optima motion controllers in PCI, PC/104, ISA, cPCI and Ethernet/RS232. These controllers are available as full-featured, multi-axis Optima controllers or as single-axis controllers.

Complete specifications are included on Galil's website.

	Multi-Axis Optima: Bus-based	Multi-Axis Optima: Serial	Single Axis
Communication interface	PC/104: DMC-12x0 cPCI: DMC-16x0 ISA: DMC-17x0 PCI: DMC-18x0	Ethernet/RS232: DMC-22x0 USB/RS232: DMC-20x0	ISA: DMC-1410 PC/104: DMC-1411 RS232: DMC-1412 PCI: DMC-1417
Form factor	card	box	card
Number of axes	x=1,2,3,4,5,6,7,8 x=1,2,3,4 for DMC-16x0	x=1,2,3,4,5,6,7,8	1
Connector type	100-pin SCSI	100-pin SCSI	37-pin D 40-pin for DMC-1411
Mating interconnect module	ICM-1900/-2900	ICM-2900	ICM-1460
Power requirement	5V,+/-12V	90-260 VAC	5V,+/-12V
Maximum encoder rate	12 MHz	12 MHz	8 MHz
Maximum stepper rate	3 MHz	3 MHz	2 MHz
Minimum servo update time	125 usec 1-, 2-axes	1-2 axes: 250 μsec 7-8 axes: 625 μsec	375 usec 1-axis
Optoisolated digital inputs	yes, except for DMC-12x0	yes	no
# of uncommitted digital inputs	1-4 ax: 8; 5-8 ax: 16	1-4 ax: 8; 5-8 ax:16	7
# of uncommitted digital outputs	1-4 ax: 8; 5-8 ax: 16	1-4 ax: 8; 5-8 ax:16	3
# of analog inputs	8	8	0
# of programmable I/O	64 (with DB-1x064)	64	0
Dual encoder for each axis	yes	yes	yes
Program memory size (lines x chr)	1000 x 80	1000 x 80	250 x 40
Array size (number of elements)	8000	8000	1000
# of variables	254	510	126
# of tasks for multitasking	8	8	2

OTHER

PC/104, cPCI, ISA, PCI Optima 1–8 axes

DMC-12x0, DMC-16x0, DMC-17x0, DMC-18x0 Series

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-1210, -1710, -1810	1-axis PC/104 or ISA or PCI	$1095	$ 795
DMC-1220, -1720, -1820	2-axis PC/104 or ISA or PCI	$1495	$ 875
DMC-1230, -1730, -1830	3-axis PC/104 or ISA or PCI	$1895	$ 935
DMC-1240, -1740, -1840	4-axis PC/104 or ISA or PCI	$2195	$ 995
DMC-1250, -1750, -1850	5-axis PC/104 or ISA or PCI	$2595	$1345
DMC-1260, -1760, -1860	6-axis PC/104 or ISA or PCI	$2795	$1425
DMC-1270, -1770, -1870	7-axis PC/104 or ISA or PCI	$2995	$1525
DMC-1280, -1780, -1880	8-axis PC/104 or ISA or PCI	$3195	$1595
CB-50-100-1200	50-pin to 100-pin converter board which includes two 50-pin cables	$ 75	$ 50
CABLE-20-25	20-pin IDC to 25-pin D type for dual encoders	$ 15	$ 15
CABLE-100-1M	100-pin HD cable in 1-meter length	$ 125	$ 95
CABLE-100-2M	100-pin HD cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin HD cable in 4-meter length	$ 150	$ 105
CABLESET-1200	(2) 50-pin ribbon, (1) 20-pin ribbon	$ 35	$ 30
ICM-1900	Interconnect module (use 1 for every 4 axes). Specify -HAEN for high amp enable or -LAEN for low amp enable	$ 345	$ 245
ICM-1900-OPTO	ICM with optoisolated outputs	$ 395	$ 295
DB-12064	Attachment board for 64 additional I/O (use DB-14064 for -17x0 or -18x0)	$ 395	$ 245
DMC-1610	1-axis CompactPCI	$1395	$ 945
DMC-1620	2-axis CompactPCI	$1795	$1025
DMC-1630	3-axis CompactPCI	$2195	$1085
DMC-1640	4-axis CompactPCI	$2495	$1145
CABLE-36-1M	36-pin HD cable in 1 meter length	$ 90	$ 75
CABLE-36-3M	36-pin HD cable in 3 meter length	$ 110	$ 90
CABLE-100-1M	100-pin HD cable in 1 meter length	$ 125	$ 95
CABLE-100-2M	100-pin HD cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin HD cable in 4 meter length	$ 150	$ 105
AMP-19520	2-axis amplifier for 500 W servos	$ 595	$ 395
AMP-19540	4-axis amplifier for 500 W servos	$ 795	$ 495
-SR	Shunt regulator option for AMP-195x0	$ 50	$ 25

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

OTHER

Ethernet/RS232 and USB/RS232 Optima 1– 8 axes

DMC-22x0 and DMC-20x0 Series

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-2010 (or 2210)	1-axis USB, RS232 (or 1-axis Ethernet 10/100BASE-T, RS232)	$1595	$ 995
DMC-2020 (or 2220)	2-axis USB, RS232 (or 2-axis Ethernet 10/100BASE-T, RS232)	$1995	$1145
DMC-2030 (or 2230)	3-axis USB, RS232 (or 3-axis Ethernet 10/100BASE-T, RS232)	$2395	$1195
DMC-2040 (or 2240)	4-axis USB, RS232 (or 4-axis Ethernet 10/100BASE-T, RS232)	$2595	$1295
DMC-2050 (or 2250)	5-axis USB, RS232 (or 5-axis Ethernet 10/100BASE-T, RS232)	$2895	$1445
DMC-2060 (or 2260)	6-axis USB, RS232 (or 6-axis Ethernet 10/100BASE-T, RS232)	$3095	$1545
DMC-2070 (or 2270)	7-axis USB, RS232 (or 7-axis Ethernet 10/100BASE-T, RS232)	$3295	$1645
DMC-2080 (or 2280)	8-axis USB, RS232 (or 8-axis Ethernet 10/100BASE-T, RS232)	$3495	$1745
FIBEROPTIC	Ethernet 10/100BASE-F, RS232 fiberoptic link	$ 200	$ 150
ICM-2900	Interconnect module (use 1 for every 4 axes). Specify -HAEN for high amp enable or -LAEN for low amp enable. Specify -FL for flange	$ 295	$ 195
ICM-2900-OPTO	ICM with optoisolated outputs	$ 345	$ 245
ICM-2908	Interconnect module for auxiliary encoders	$ 125	$ 95
CABLE-USB-2M	USB cable, 2-meter	$ 10	$ 10
CABLE-USB-3M	USB cable, 3-meter	$ 15	$ 15
CABLE-9-pin D	RS232 cable	$ 10	$ 10
CABLE-100-1M	100-pin HD cable in 1-meter length	$ 125	$ 95
CABLE-100-2M	100-pin HD cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin HD cable in 4-meter length	$ 150	$ 105
CABLE-36-1M	36-pin HD cable in 1-meter length (for aux encoders)	$ 90	$ 75
CABLE-36-3M	36-pin HD cable in 3-meter length (for aux encoders)	$ 110	$ 90
CABLE-80-1M	80-pin HD cable in 1-meter length (for extended I/O)	$ 125	$ 95
CABLE-80-4M	80-pin HD cable in 4-meter length (for extended I/O)	$ 150	$ 105
AMP-19520	2-axis amplifier for 500 W servos	$ 595	$ 395
AMP-19540	4-axis amplifier for 500 W servos	$ 795	$ 495
-SR	Shunt regulator option for AMP-195x0	$ 50	$ 25
Galil Utilities	Communication drivers, SmartTERM, DMCDOS	$ 20 for CD; free download	
WSDK	Set-up, tuning and analysis software	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Microsoft platforms	$ 595	

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

OTHER

ISA, PC/104, RS232, PCI Single-Axis

DMC-1410, DMC-1411, DMC-1412, DMC-1417

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-1410	1-axis ISA	$ 595	$ 395
DMC-1411	1-axis PC/104	$ 595	$ 395
DMC-1412-card	1-axis stand-alone with RS232 — card	$ 595	$ 395
DMC-1412-box	1-axis stand-alone with RS232 in enclosure with power supply	$ 795	$ 545
DMC-1417	1-axis PCI	$ 595	$ 395
CABLE 37-pin D	37-pin cable for DMC-1410, DMC-1412, DMC-1417	$ 25	
CABLE 40-pin IDC	40-pin to 37-pin cable for DMC-1411	$ 25	
ICM-1460	Interconnect Module for DMC-1400 series. Specify -HAEN for high amp enable or -LAEN for low amp enable	$ 145	$ 95
ICM-1460-OPTO	ICM with optoisolated inputs and outputs	$ 195	$ 145
Galil Utilities	Communication drivers, SmartTERM, DMCWIN software	$ 20 for CD; free download	
DMCWIN32	Windows API Tool Kit (VB, C, C++, etc.)	Included with Utilities	
WSDK	Set-up, tuning and analysis software	$ 195	
ActiveX Tool kit	Custom ActiveX controls for Microsoft platforms	$ 595	

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

Product Description

The IOC-7007 I/O controller provides an intelligent solution for handling inputs and outputs. The IOC-7007 controller base accepts up to seven Galil I/O IOM modules. IOM modules are available with TTL inputs, optoisolated inputs, optoisolated outputs, high power outputs, dry contact relays, analog inputs and analog outputs.

Galil's IOC-7007 has a 10/100 Base-T auto-negotiable Ethernet port allowing it to communicate with multiple devices in an Ethernet network. This allows easy integration of Galil's Ethernet motion controllers with I/O and eliminates the need for an external PLC.
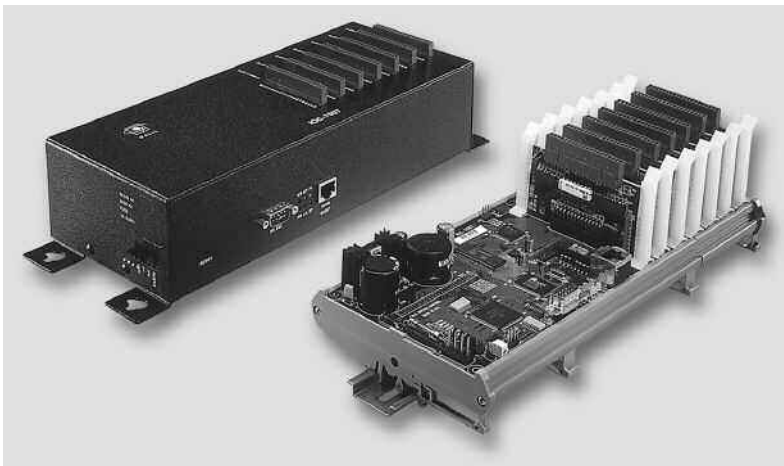
IOC-7007

The IOC-7007 is programmable and includes 500 lines of non-volatile program memory, variables, arrays and multitasking for concurrent execution of up to eight different programs. The controller also includes 1 PLC thread with deterministic timing. The programming language is similar to Galil's motion controller language allowing seamless integration of motion and I/O.

The IOC-7007 is available as a packaged unit, as a DIN rail mount unit, or as a card-level unit. The box-level version accepts 90–260 VAC or 20–60 VDC. The DIN rail and card-level unit accept 20–60 VDC.

Features

■ Intelligent Input/Output Controller IOC includes 32-bit microcomputer with memory and multitasking for programming I/O events.

■ Install up to seven plug-in IOM modules to handle many input and output functions.

■ "Mix and Match" I/O modules to meet specific requirements. I/O modules for:
— 16 TTL Inputs
— 8 optoisolated inputs
— 8 optoisolated outputs
— 8 high power outputs
— 4 dry contact relays
— 4 or 8 analog outputs
— 8 analog inputs

■ Interfaces with other Galil Ethernet motion controllers or Ethernet I/O devices

■ Ethernet 10/100 Base-T with auto-negotiate function for communicating with 100 Base-T or 10 Base-T devices; One RS232 port up to 19.2 kbaud

■ Supports Modbus TCP in both master and slave mode for interface to other Modbus devices.

■ I/O commands and programming are similar to Galil motion controller programming. Additional commands for I/O processing and PLC functions are included. Easy integration of Galil Ethernet motion controller with IOC-7007

■ 8 multitasking threads for simultaneous execution of multiple I/O programs. One additional thread for PLC mode

■ PLC mode for fast I/O scans with deterministic timing

■ Fast command processing time—less than 100 microseconds

■ Non-volatile memory includes 500 line x 80 characters program space; 126 symbolic variables; 2000 elements in up to 14 arrays

■ Accepts 90-260 VAC 50/60 Hz or 20–60 VDC

■ Packaging options include: metal enclosure, DIN rail mount, or card-level

■ 20-pin Molex connectors for easy interface to I/O modules

Ethernet I/O Controller

IOC-7007

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
IOC-7007-BOX-AC	I/O Controller Base; BOX; 90–260 AC	$ 595	$ 495
IOC-7007-BOX-DC	I/O Controller Base; BOX; 20–60 VDC	$ 595	$ 495
IOC-7007-DIN-DC	I/O Controller Base; DIN; 20–60 VDC	$ 595	$ 495
IOC-7007-CARD-DC	I/O Controller Base; CARD; 20–60 VDC	$ 545	$ 445
IOC-7007-CARD-NS	I/O Controller Base; CARD; no supply (requires +5 V, ±12 V inputs)	$ 495	$ 395
IOM-70016	I/O Module — 16 TTL inputs	$ 30	$ 20
IOM-70108	I/O Module — 8 optoisolated inputs	$ 30	$ 20
IOM-70208	I/O Module — 8 optoisolated outputs (24 V @ 25 mA)	$ 30	$ 20
IOM-70308	I/O Module — 8 low-side, high-power outputs (24 V @ 100 mA)	$ 30	$ 20
IOM-70404	I/O Module — 4 dry contact relays (150 V @ 250 mA)	$ 55	$ 40
IOM-70508	I/O Module — 8 high-side, high-power outputs (30 V @ 500 mA)	$ 45	$ 30
IOM-70808	I/O Module — 8 analog inputs (12-bits)	$ 60	$ 45
IOM-70904	I/O Module — 4 analog outputs (12-bits)	$ 30	$ 20
IOM-70908	I/O Module — 8 analog outputs (12-bits)	$ 60	$ 45

Note: One IOC-7007 controller base accepts up to seven (7) IOM modules

Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

Product Description

The BLM-N23-50-1000-B brushless motor with incremental encoder is a low cost, high performance motor well suited for OEM applications. This motor has a high torque to inertia ratio making it ideal for point-to-point applications requiring fast acceleration. The BLM-N23-50-1000-B provides 55 oz-in of continuous torque in a Nema 23 frame size package.

BLM-N23-50-1000-B Brushless Servo Motor with Encoder

Features

- 55 oz-in continuous torque; 120 oz-in peak torque

- 4.6 amp continuous current; 48 Volts for 5000 rpm maximum speed

- Small size: Nema 23 frame

- High torque-to-inertia ratio for fast acceleration and high response point-to-point applications

- Extremely low cogging and smooth low speed performance; accurate motion profiling at all speeds

- 1000 line differential quadrature encoder with differential hall sensor outputs and shielded cable

- HD 15-pin D connects directly to Galil's AMP-205x0 and AMP-195x0 amplifiers

Note: Specify BLM-N23-50-1000-B (for DMC-4000) if connecting the motor to DMC-4000 amplifiers.

Specifications

Differential Quadrature Incremental Encoder

Resolution: 1000 lines, with index pulse

Input Power: 5VDC ±5% at 120 mA max

Output Signals: Line Driver AM26LS31 (20 mA absolute maximum sink or source per output channel)

Moment of Inertia: 3.5×10^{-3} in-oz sec^2 (2.5×10^{-5} kg-m^2)

Maximum Acceleration: 100000 rad/sec^2 max.

Maximum Velocity: 5000 RPM max

Operating Temperature: -20 °C to 100 °C

Storage Temperature: -40 °C to 125 °C

Relative Humidity: 98% non-condensing

Encoder Pin Header

15 Pin, HD D-Type :

	Wire Color	Description
1	Orange	Index+
2	Blue	Channel B+
3	Brown	Channel A+
4	Red/white	Hall V-*
5	Black	GND
6	Yellow	Index-
7	Green	Channel B-
8	White	Channel A-
9	NC	N/A
10	Violet	Hall U+
11	Grey	Hall U-*
12	Yellow/white	Hall W-*
13	Brown/white	Hall V+
14	Orange/white	Hall W+
15	Red	+5V

*Unused with Galil amplifiers

OTHER

Brushless Servo Motor

Specifications

PARAMETER	UNITS	MODEL NUMBER BLM-N23-50-1000-B
K_t–Torque Constant	Nm/A	0.08
	oz-in/A	12.1
T_c– Continuous Torque	Nm	0.39
	oz-in	55
T_p– Peak Torque	Nm	0.83
	oz-in	120
Continuous Current	A	4.9
Peak Current	A	10.4
J_m–Moment of Inertia	kg·m^2	2.5×10^{-5}
	oz-in-s^2	3.5×10^{-3}
Recommended Supply Voltage	volts	48
ω_m–Maximum Speed	rpm	5000
R–Armature Resistance	ohm	1.2
L–Armature Inductance	mH	2.6
R_{th}–Thermal Resistance	°C/W	1.04
T_m– Electro-mechanical Time Constant	msec	4.5
Length with Encoder	in	4.5
Diameter	in	2.2459
Shaft Diameter	in	0.25
Weight	kg	1.0
	lbs	2.2
Encoder Resolution	lines/rev	1000
Price: qty 1		$395
Price: qty 100		$295

BLM-N23-50-1000-B

Phase R—— Red
Phase S—— White
Phase T—— Black
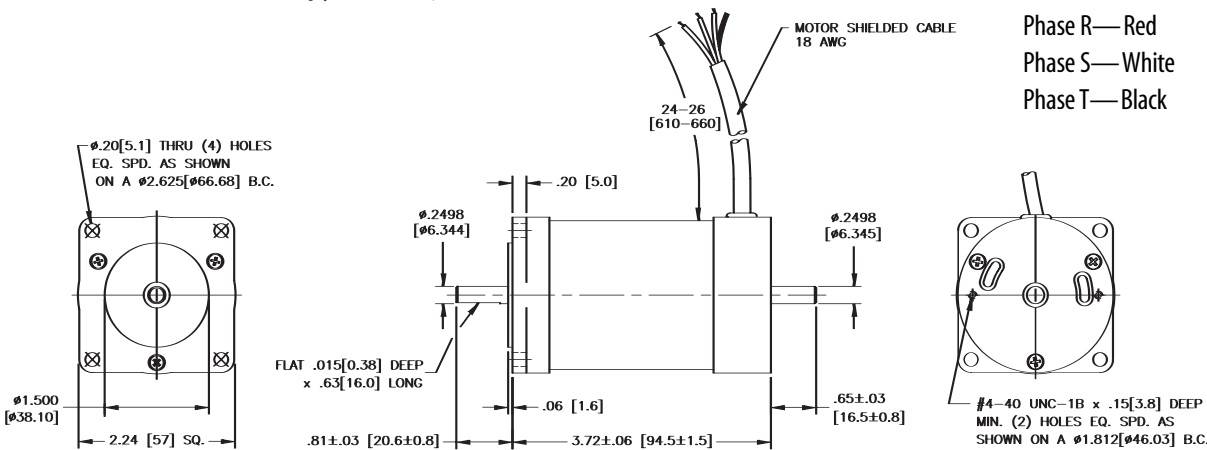
Servo Motor Compensation Features

Galil controllers provide a compensation filter, which includes a PID (Proportional-Integral-Derivative) filter followed by a notch filter and a low-pass filter. The compensation also includes velocity and acceleration feedforward. All filter parameters are adjustable, allowing servo system tuning for best performance. Dual loop control is provided for reducing the effect of backlash.

The dual-loop (DV) feature enables the controller to compensate for mechanical backlash. Typically, dual-loop systems use a rotary encoder on the motor and a linear encoder on the load (most Galil controllers accept inputs from two encoders per axis as a standard feature). Dual-loop control changes the standard PID control and closes the position loop with the load encoder ("PI") and derives the damping terms ("D") from the motor encoder. This method provides smooth and accurate control along the motion path regardless of backlash.

Most Galil controllers also include a sinusoidal commutation feature that allows designers to use lower-cost servo drives. This feature assures smooth motion and reduces torque ripple when using brushless motors. Each axis of sinusoidal commutated motion requires two DAC outputs that are phase shifted by 120°. The servo amplifier generates the third commutation signal. The commutation can be initialized with or without hall sensors. Two controller axes are required for each brushless motor. For example, a two-axis controller is required to drive one brushless motor with sinusoidal commutation.

Command Language

Galil's Command Language is comprised of intuitive, two-letter, English-like ASCII commands that make programming quick and easy. For example, the "BG" command begins motion while the "SP 2000, 4000" command sets the speed of the X-axis as "2000" and the Y-axis to "4000". Commands are included for system set-up, tuning, prescribing motion, error handling and application programming. Custom commands can be created upon request.

One of the more powerful features of all Galil controllers is their ability to store and execute complex application programs designed by the user. Application programs can be downloaded directly to the controller and executed without host intervention. The main benefit is that this frees the PC for system-level tasks. In fact, Galil controllers permit multitasking, which allows up to eight programs to execute simultaneously. Also, special commands are available for application programming including event triggers, IF/THEN/ELSE statements, conditional jumps, subroutines, symbolic variables and arrays.

A list of typical DMC commands is shown at the end of this section.

PID Block Diagram
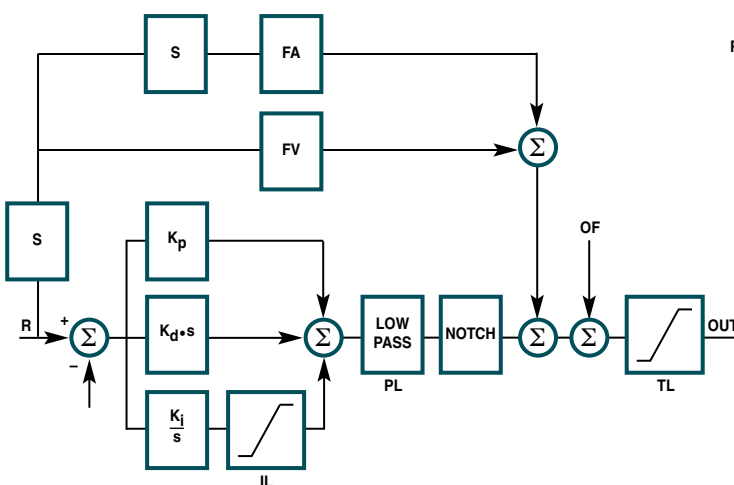
Dual-loop Block Diagram
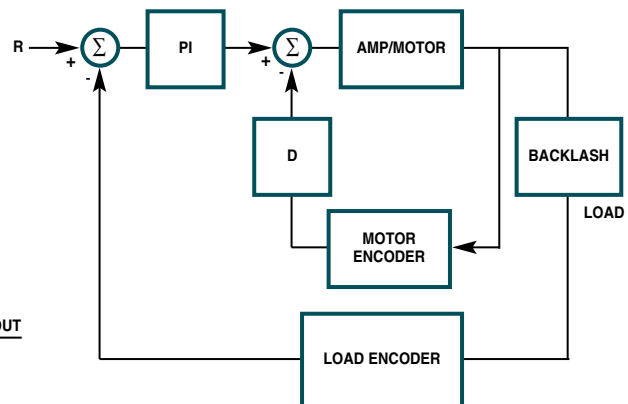
TECHNICAL REF

Modes of Motion

I/O

Error Handling

Dedicated I/O is provided for the following safety controls: forward and reverse limit inputs for each axis, home input for each axis, amplifier enable output for each axis, configurable abort inputs for each axis, master abort input, and error output. Also, the controller provides the following safety functions in software: upper and lower software travel limits, position error limits, and automatic shut-off on excess position error. Program interrupts are provided for error and limit conditions and run-time program errors. The program interrupts cause the program sequencer to automatically branch to an error handling subroutine. In order to provide flexibility and system protection, the error handling subroutine can be customized by the user.

User I/O

In addition to dedicated inputs for home and limits, Galil controllers provide user I/O for synchronizing motion with external events such as switches and relays. The DMC-18x6 controller, for example, includes 8 analog inputs, 8 digital inputs and 8 digital outputs for 1 to 4-axis models; and 8 analog inputs, 24 digital inputs and 16 digital outputs for 5 – 8 axis models. All Galil controllers include many commands for handling I/O such as input interrupts, I/O triggers and timers. The combination of user I/O and application programming often eliminates the need for a PLC. When extra I/O is needed, Galil provides daughter boards and remote I/O units such as the RIO Pocket PLC to expand a controller's I/O capability.

As part of the user I/O, Galil controllers provide a high-speed position capture and position compare feature for each axis. The high-speed position capture latches the exact position within 0.1 microseconds (40 μsec with optoisolation) of the occurrence of an input. Position capture is crucial for applications requiring precise synchronization of position to external events such as coordinate measurement machines.

The high-speed position compare feature produces an output pulse at a precise position. The starting position for the initial pulse and incremental distance for subsequent pulses are programmable.

Modes of Motion

Point-to-Point Motion

Any combination of axes can be operated in the Point-to-Point Motion mode to allow the target position (PA or PR), slew speed (SP), acceleration (AC) and deceleration (DC) to be specified independently for each axis. Upon begin (BG), the controller generates a trapezoidal velocity profile where the speed and acceleration can be changed anytime during motion. For applications that require smooth motion without abrupt velocity transitions, a motion smoothing function (IT) is provided. The position (TP) and position error (TE) may be interrogated at any time.

Position Tracking

The Position Tracking mode allows an axis to precisely follow a dynamic position target. In this mode, a new absolute position may be specified even if the axis is in motion. The controlled axis is commanded to move to the new position following a trapezoidal velocity profile.

The (PT) command places the controller in the Position Tracking mode, which allows the host to issue absolute position commands on the fly. The axis moves to the new position and waits until a new position target is specified and given by the (PA) command. The (ST) Stop command is used to exit the Position Tracking mode.

Example 2—Change Speed on Input, Position Tracking

Move the x-axis forward a distance of 20,000 counts at an initial speed of 50,000 counts/sec and with an acceleration and deceleration of 1,000,000 counts/sec^2. Once the sensor connected to input 1 triggers, reduce the speed to 25,000 counts/sec. Upon motion complete, begin position tracking mode and follow the target as updated by a host PC. Activation of input 2 will end motion. Note: multiple commands can be issued on the same line to conserve program space and give command priority while multitasking.

PROGRAM	INTERPRETATION
#A	Label
PR20000;SP50000	Relative Move, Speed
AC1000000;DC1000000	Accel and Decel
BGX	Begin motion
AI1	Trip point: Wait for sensor input
SP25000	Reduce speed
AMX	Wait for original distance to profile
PT1	Turn on position tracking mode
target=_RPX	Set target to current commanded position
#LOOP	Label
PAX=target	Track target updated by host
JP#LOOP,@IN[2]=1	Repeat unless input two is tripped
STX;AMX;EN	End position tracking mode and program

Example 1—Point-to-Point Motion

PROGRAM	INTERPRETATION
AC 1000000;DC 1000000	Specify acceleration and deceleration
SP20000	Specify slew speed
PR40000	Specify distance
BG	Begin motion

Technical Reference

Modes of Motion

Jogging

In the jog mode, each axis is given a jog speed and direction (JG), acceleration (AC), and deceleration (DC). Upon begin (BG), the controller ramps up to the jog speed at the prescribed acceleration following a trapezoidal profile. A smoothing function (IT) is provided to smooth abrupt velocity transitions. The stop command (ST) stops the motion at the prescribed deceleration rate. The jog speed and direction, acceleration and deceleration may be changed at any time during motion. The average speed can be interrogated at any time using the Tell Velocity (TV) command.

Example 3 — Joystick with Coarse/Fine Speed Control

To control the motor velocity by a potentiometer, connect it to analog input #1 and read its voltage. Set the motor speed in proportion to the analog input with a maximum speed of 100,000 counts/sec for a 10 Volt input. Also, limit the acceleration and deceleration to 500,000 counts/sec^2. The speed scale is selectable by input 1 for fine or coarse velocity.

PROGRAM	INTERPRETATION
#AUTO	#AUTO label executed on powerup
JG0	Initial Speed
AC500000;DC500000	Accel and Decel
BGX	Begin Jog mode
#LOOP	Label
scale=(9*@IN[1])+1	Set scaling, 1 (fine) or 10 (coarse)
JG@AN[1]*1000*scale	Read pot and update speed
JP#LOOP	Repeat
EN	End Program

2D Linear and Circular Interpolation (for controllers with two or more axes)

The Vector Mode (VM) is an extremely powerful mode where any two-dimensional path consisting of straight-line (VP) and arc segments (CR) can be prescribed. Up to 511 segments can be given prior to the start of motion and additional segments can be sent during motion allowing unlimited motion paths to be followed without stopping. The vector speed (VS), vector acceleration (VA), vector deceleration (VD), and motion smoothing (VT/IT) are also prescribed. The vector speed can be changed at any time during motion, permitting feedrate override, slow down around corners and assignment of different speeds to specific segments. Setting the vector speed to zero and increasing the vector speed to resume can easily accomplish a pause during motion.

The vector mode can be operated on two sets of coordinated axes at the same time using the (CA) command, which specifies the plane of motion as S and T. By having dual sets of coordinated motion, users can accomplish completely separate coordinated motion tasks with a single controller. It can even handle more complex motion control functions such as collision avoidance.

Another feature of the vector mode is tangential following that allows a third axis to remain tangent to the trajectory, which is ideal for cutting tools. Helical motion is also possible by commanding the third axis to follow the coordinated path at the same rate.

Example 4 — Vector motion with tangential following and curve slowdown

Perform a move along the trajectory shown in figure 1 starting at the point A and move counter clockwise toward B. Due to accuracy requirements, the vector speed must be limited to 5,000 counts/sec on the circular segments BC and DE. On the linear segments, the motor speed is limited to 25,000 counts/sec. This operation is simplified given the controller's ability to associate two speeds with each segment—upper and lower limits. These limits are designated by the < and > symbols. The resulting vector speed is shown as a function of the path in figure 2 below. A saw is attached to Axes Z and is lowered externally by setting bit 2 and turned on by setting bit 1. The blade will stay tangent to the vector path through the tangential following mode.

PROGRAM	INTERPRETATION
#PATH	Label
CAS	Set coordinate system
VMXYZ	Define XY plane, Z is tangent
TN100,0	Setup Tangential following
VA500000;VD500000	Vector mode accel and decel
VP4000,0<25000>5000	Segment AB, slows for curve
CR500,-90,180	Arc segment BC
VP-1000,1000<25000>5000	Segment CD
CR500,90,180	Arc segment DE
VP0,0<25000	Segment EA
VE	Indicate end of path
PAZ=_TN;BGZ;AMZ	Orient saw blade to tangent
BGS	Start motion sequence
AV4000	Wait 4000 vector distance (B)
SB1;WT100;SB2	Turn on and lower saw
AV6571	Wait 6571 vector distance (D)
CB2;WT500;CB1	Raise and turn off saw
EN	End program
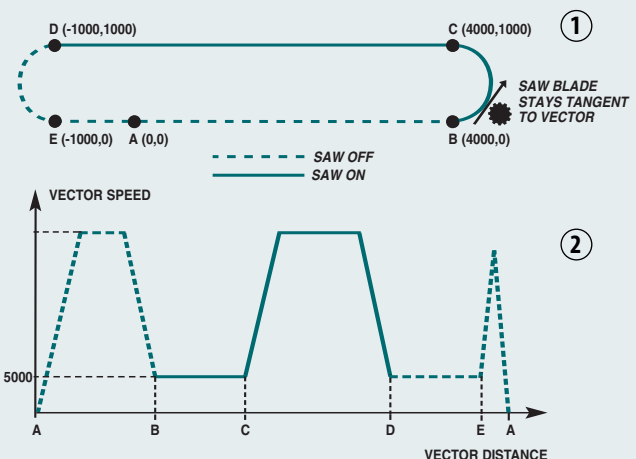
Technical Reference

Modes of Motion

Contouring

The contouring mode (CM) is extremely flexible as it allows any arbitrary profile on any set of axes to be prescribed. Here, the user bypasses the controller profiler and directly inputs the position versus time trajectory. The trajectory is described as the position increment (CD) over a defined time period (DT). Additionally, the controller performs linear interpolation between prescribed points. The contour mode is useful for following complex, computer-generated paths or for "teaching" position paths. An automatic data-recording feature allows the controller to "learn" a path and then follow it in the contour mode.

Example 5 — Contour circle with buffer monitoring

Fill arrays with contour data inscribing a circle with radius of 50000 counts. Contour the data at a time interval of 4 samples. The Accelera series incorporates a buffer of 512 contour segments to allow caching of contour data. The program will monitor this buffer to avoid overruns and fill it with more data when possible.

PROGRAM	INTERPRETATION
#CONTOUR	Label
radius=50000	Set radius variable
DMcdx[720];DMcdy[720]	Dimension arrays for data
i=0;d=0	Index and degrees variables
#CALC	Label
cdx[i]=radius*@COS[d]-radius	Calculate shifted Cosine data
cdy[i]=radius*@SIN[d]	Calculate sin data
d=d+0.5	Increment degrees
i=i+1	Increment index
JP#CALC,i<720	Repeat until arrays are full
i=0	Reset index
CMXY	Start Contour mode
DT2	Setup time slice, 2^2
curx=0;cury=0	Set incremental reference
#PLAY	Label
CD (cdx[i]-curx),(cdy[i]-cury)	Contour with incremental calculation
curx=cdx[i];cury=cdy[i]	Update incremental reference
i=i+1	Increment index
JP#PLAY,(_CM>0)&(i<720)	Repeat while buffer not full & more data remains
JP#END,i=720	Jump to end if data done
#WAIT;JP#WAIT,_CM<100	Wait until buffer has plenty of space
JP#PLAY	Jump back to continue playback
#END	Label for exit
CD0,0=0	Stop contour mode
EN	End of program

Linear Interpolation
(for controllers with two or more axes)

The linear interpolation mode (LM) allows any arbitrary path of up to 8 axes to be defined as a set of linear segments (LI). The vector speed (VS), vector acceleration (VA), vector deceleration (VD), and vector smoothing (VT) are also defined. Up to 511 LI segments can be given prior to the start of motion and additional segments can be sent during motion to allow paths of unlimited length to be followed.

Example 6 — Linear Interpolation with High Speed Latch

Move a 3D Cartesian robot through the following points with the coordinates indicated in inches. Assume that the resolutions of all the axes are 1,000 counts/inch, and set the required speed to 1.2 inches/sec (1,200 counts/sec) and the acceleration and deceleration to 100 in/sec^2 (100,000 counts/sec^2). Note that the LM mode requires defining the segments in incremental form. A sensor will trigger a high speed latch on each axis to indicate a desired or reference position. The latch will store the current position within 40μsec of the sensor trip and the robot will return to this "set" position after the initial move.

Point	Coordinates (inches)	Coordinates (counts)	Incremental length (LI argument)
P0	(0,0,0)	(0,0,0)	0,0,0
P1	(4,2,1)	(4000,2000,1000)	4000,2000,1000
P2	(6,6,2)	(6000,6000,2000)	2000,4000,1000
P3	(8,8,0)	(8000,8000,0)	2000,2000,-2000

PROGRAM	INTERPRETATION
#ROBOT	Label
CAS	Set coordinate system
LMXYZ	Define XYZ space
VS1200;VA100000;VD100000	Vector speed, Accel, Decel
LI4000,2000,1000	Segment P0-P1
LI2000,4000,1000	Segment P1-P2
LI2000,2000,-2000	Segment P2-P3
LE	End of sequence
ALXYZ	Arm latches for axes XYZ
BGS	Begin motion
AMS	Wait for motion to profile
IF _ALX|_ALY|_ALZ	Ensure axes have latched
MG"Not all axes have latched"	Message to operator
ELSE	If not all axes tripped sensor
MG"Tracking back to latch positions"	Message to operator
LMXYZ	Define XYZ space
LI(_RLX-_RPX),(_RLY-_RPY),(_RLZ-_RPZ)	Incremental distance back to latch
LE	End of sequence
BGS	Begin move back to latches
AMS	Wait for motion to profile
MG"Robot in position"	Message to operator
ENDIF	End of IF
EN	End of program

Note: There are many homing and positioning algorithms available.

Technical Reference

Modes of Motion

Electronic Gearing

The electronic gearing mode makes it easy for Galil controllers to simulate the motion of mechanical gears electronically. Any slave axis or set of slave axes can be geared to a master at a prescribed gear ratio defined by the (GR) command. The gear ratio can be changed on-the-fly and the controller permits multiple masters as defined by the (GA) command. A powerful feature of electronic gearing is that an axis can be geared and simultaneously be commanded to perform an independent or vector move. This is useful for the position correction required in packaging applications or when shapes must be cut on a moving conveyer belt. The electronic gearing mode is also useful for gantry applications where a special gantry mode (GM) command tightly couples two axes by ensuring that gearing cannot be disabled.

The gearing mode allows for a gradual ramp-to-gearing which results in smoother transitions when the gear ratio is changed. (GD) sets the distance of the master axis over which the slave will be engaged or changed to a new gear setting. The parameter (_GP) corrects for any accumulated errors in gearing during the ramp-to-gearing phase.

Electronic Cam

Any slave axis or set of slave axes can be linked to a master axis to simulate the motion of a mechanical Cam. Here, the master axis can be a motor-driven axis or a master encoder. The Cam functions are specified by a table that allows complex profiles with varying position ratios to be prescribed. Any follower axis may be engaged or disengaged independently at specific points along a Cam cycle. This allows the user to select engagement and disengagement points where the speed change of the follower is minimal. The electronic Cam is an ideal mode for periodic operation, especially those requiring a varying position ratio along the motion cycle. Applications include flying shears, rotating knives, and packaging systems. Galil's Cam-generating software can assist the user in defining the Cam table.

Example 7 — Electronic Gearing with Correction

Gear Axis X and Z to Y with gear ratios of 2 and -4 respectively. Output the absolute single turn position for X at regular intervals. Assume the resolution of the X axis is 4000 counts per revolution. Upon input 1, automatically issue a correction movement superimposed upon the concurrent gearing.

PROGRAM	INTERPRETATION
#GEAR	Label
GAY,,Y	Specify Y axis as master for X and Z
GR2,,-4	Specify gear ratios for X and Z
PRY=50000;SPY=10000	Specify relative move and speed of Y
ACY=1000000;DCY=1000000	Specify Accel and Decel of Y
II1	Setup Input Interrupt on input 1
BGY	Begin motion on Y axis. X & Z gear
#POS	Label
abposx=_TPX%4000	Current position modulo encoder resolution % available on Accelera Class
MGabposx	Message current single turn position
WT500	Wait 500 ms
JP#POS	repeat
EN	End of program
#CORRECT	Label for #CORRECT
IP-1000,,-1000	X and Y move back 1000 counts, gearing is still engaged.
EN	End of correction program
#ININT	Automatically run on input 1
XQ#CORRECT,1	Run #CORRECT in separate thread
AI1	Wait for input 1 to clear
RI	Return from Interrupt

Galil Instruction Set*

Servo Motor

AF	Analog feedback
AG	Set amplifier gain
AU	Set current loop gain
AW	Report AMP-43040 bandwidth
DV	Dual loop operation
FA	Acceleration feedforward
FV	Velocity feedforward
IL	Integrator limit
IT	Independent time constant
KD	Derivative constant
KI	Integrator constant
KP	Proportional constant
NB	Notch bandwidth
NF	Notch frequency
NZ	Notch zero
OF	Offset
PL	Pole
SH	Servo here
TL	Torque limit
TM	Sample time

Stepper Motor

DE	Define encoder position
DP	Define reference position
KS	Stepper motor smoothing
MT	Motor type
QS	Error magnitude
RP	Report commanded position
TD	Step counts output
TP	Tell position of encoder
YA	Step drive resolution
YB	Step motor resolution
YC	Encoder resolution
YR	Error correction
YS	Stepper position maintenance

Brushless Motor

BA	Brushless axis
BB	Brushless phase
BC	Brushless calibration
BD	Brushless degrees
BI	Brushless inputs
BM	Brushless modulo
BO	Brushless offset
BS	Brushless setup
BZ	Brushless zero

I/O

AL	Arm latch
CB	Clear bit
CO	Configure I/O points
II	Input interrupt
OB	Define output bit
OC	Output compare function
OP	Output port
SB	Set bit
@IN[x]	State of digital input x
@OUT[x]	State of digital output x
@AN[x]	Value of analog input x

System Configuration

BN	Burn parameters
BP	Burn program
BR	Brush motor enable
BS	Brushless set-up
BV	Burn variables and arrays
CE	Configure encoder type
CN	Configure switches
CO	Configure I/O points
CW	Data adjustment bit
DE	Define dual encoder position
DH	DHCP configuration
DP	Define position
DR	Data record update rate
EO	Echo off
HS	Handle switch
IA	Set IP address
IH	Internet handle
IK	Ethernet port blocking
IT	Independent smoothing
^L^K	Program protect
LZ	Leading zeros format
MB	Modbus
MO	Motor off
MT	Motor type
PF	Position format
PW	Password
QD	Download array
QU	Upload array
RS	Reset
^R^S	Master reset
SM	Subnet mask
VF	Variable format

Math Functions

@SIN[x]	Sine of x
@COS[x]	Cosine of x
@COM[x]	1's complement of x
@ASIN[x]	Arc sine of x
@ACOS[x]	Arc cosine of x
@ATAN[x]	Arc tangent of x
@ABS[x]	Absolute value of x
@FRAC[x]	Fraction portion of x
@INT[x]	Integer portion of x
@RND[x]	Round of x
@SQR[x]	Square root of x
%	Modulus operator

Interrogation

ID	AMP ID
LA	List arrays
LL	List labels
LS	List program
LV	List variables
MG	Message command
QH	Query hall state
QR	Data record
QZ	Return data record information
RP	Report command position
RL	Report latch
^R^V	Firmware revision information
SC	Stop code
TA	Tell amplifier status

Interrogation (cont.)

TB	Tell status
TC	Tell error code
TD	Tell dual encoder
TE	Tell error
TI	Tell input
TP	Tell position
TR	Trace program
TS	Tell switches
TT	Tell torque
TV	Tell velocity

Programming

BK	Breakpoint
DA	Deallocate variables/arrays
DL	Download program
DM	Dimension arrays
ED	Edit program
ELSE	Conditional statement
ENDIF	End of cond. statement
EN	End program
HX	Halt execution
IF	If statement
IN	Input variable
JP	Jump
JS	Jump to subroutine
NO	No-operation—for comments
RA	Record array
RC	Record interval
RD	Record data
REM	Remark program
SL	Single step
UL	Upload program
ZA	Data record variables
ZS	Zero stack
'	Comment

Error Control

BL	Backward software limit
ER	Error limit
FL	Forward software limit
LD	Limit disable
OA	Encoder failure
OE	Off-on-error function
OT	Encoder failure period
OV	Encoder failure voltage
SD	Limit deceleration
TL	Torque limit
TW	Timeout for in-position

Trippoint

AD	After distance
AI	After input
AM	After motion profiler
AP	After absolute position
AR	After relative distance
AS	At speed
AT	After time
AV	After vector distance
MC	Motion complete
MF	After motion—forward
MR	After motion—reverse
WT	Wait for time

Independent Motion

AB	Abort motion
AC	Acceleration
BG	Begin motion
DC	Deceleration
FE	Find edge
FI	Find index
HM	Home
HV	Home speed
IP	Increment position
IT	Smoothing time constant
JG	Jog mode
PA	Position absolute
PR	Position relative
PT	Position tracking
SD	Switch deceleration
SP	Speed
ST	Stop

Contour Mode

CD	Contour data
CM	Contour mode
DT	Contour time interval

ECAM/Gearing

EA	ECAM master
EB	Enable ECAM
EC	ECAM table index
EG	ECAM go
EM	ECAM cycle
EP	ECAM interval
EQ	Disengage ECAM
ET	ECAM table entry
EW	ECAM widen
EY	ECAM cycle counter
GA	Master axis for gearing
GD	Engagement distance for gearing
GM	Gantry mode
GP	Correction for gearing
GR	Gear ratio for gearing

Vector/Linear Interpolation

CA	Define vector plane
CR	Circular interpolation move
CS	Clear motion sequence
ES	Ellipse scaling
IT	Smoothing time constant
LE	Linear interpolation end
LI	Linear interpolation segment
LM	Linear interpolation mode
ST	Stop motion
TN	Tangent
VA	Vector acceleration
VD	Vector deceleration
VE	Vector sequence end
VM	Coordinated motion mode
VP	Vector position
VR	Vector speed ratio
VS	Vector speed
VV	Vector Velocity

Typical Instructions. This list is for DMC-40x0 Accelera. Other controllers have a slightly different Instruction Set.

SmartMoves™ Spotlights Series

When innovative companies combine their ingenuity and capabilities to solve a technical challenge or make a better product, the sky truly seems to be the limit. That certainly is the case with the many companies featured in Galil's latest **SmartMoves Spotlights** *Series. These companies represent industries as varied as semiconductors and machine tools, medical, textiles and publishing. They have incorporated Galil motion controllers and worked closely with Galil engineers to create state-of-the-art solutions while cutting costs. Spotlighted applications include cutting-edge equipment that engrave microscopic numbers on diamonds, use ultrasound to destroy cancer cells, measure wafer surfaces in the sub-nanometer range, move complex Broadway sets and simulate giant cranes. They are just a few stories from the more than 500,000 Galil motion controllers that are helping move the world.*
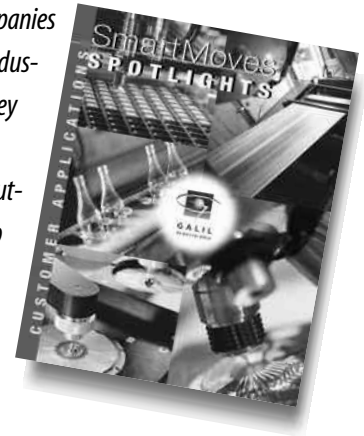
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- **COBRA Placement**—Component placement
- **Andrew NDT Engineering Corp.**—Wafer film deposition measurement
- **Brooks Automation, Inc.**—Wafer handling robot
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- **Focus Surgery, Inc.**—Focused ultrasound to destroy cancer tissue in prostate
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- **TechniScan**—Ultrasonic breast exams

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- **Hudson Scenic Studio, Inc.**—Automated scenery for Broadway productions
- **WET Design**—Water Sculptures
- **MSM Design**—Camera for 3D motion pictures

Machine Tools

- **CamSoft Corporation**—PC-based control for milling machines and lathes
- **Pistorius Machine Company**—Cut-to-length machine for mitering and fastening

Publishing

- **GP2 Technology, Inc.**—Automated book covering

Jewelry

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- **Team Mojavaton**—Autonomous ground vehicle

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- **PVP**—Military Imaging system

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Call Galil to receive a Return Materials Authorization (RMA) number prior to returning product to Galil.

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