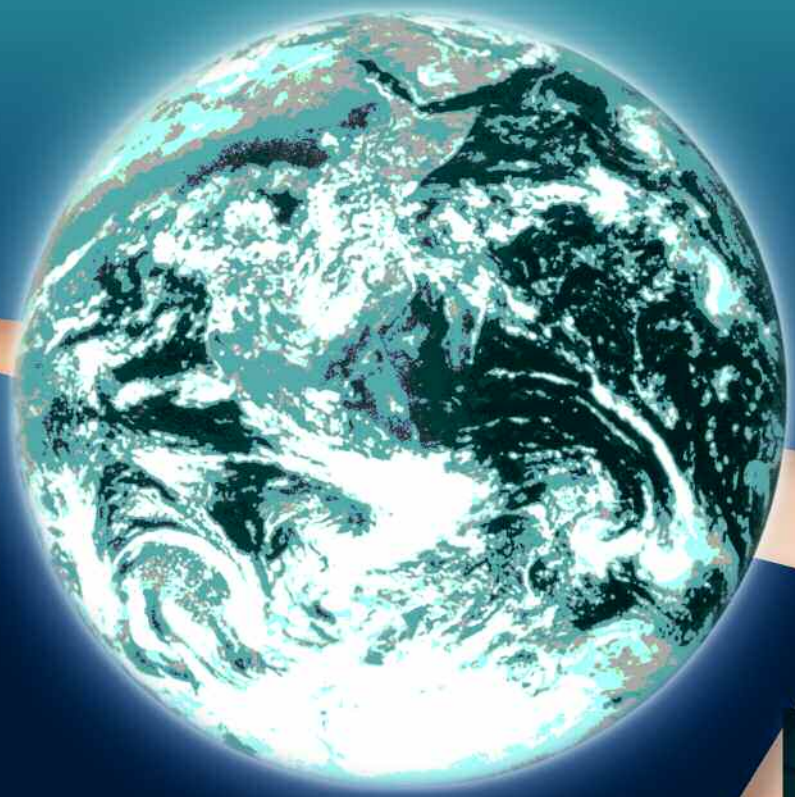
GALIL

WE MOVE THE WORLD

2008 Motion Control Product Catalog



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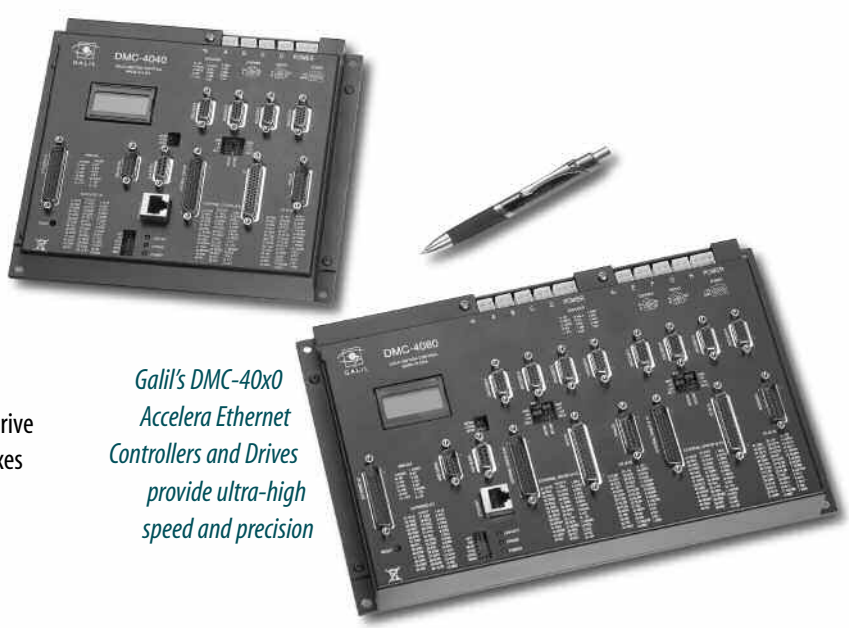


Galil's DMC-40x0 Accelera Ethernet Controllers and Drives provide ultra-high speed and precision

Galil Motion Control

We Move The World™

Ever since they introduced the first microprocessor-based motion controller in 1983, Galil Motion Control has gone on to sell and install over 500,000 controllers worldwide. Galil remains the industry's leading innovator by offering the most powerful, cost-effective and easy-to-use motion controllers available today. Galil's commitment is to be your primary source for any motion control application. Galil offers an unparalleled array of motion controllers that are backed by superior technical support and ready to handle the most demanding applications — with absolute precision.

Powerful Controllers to Solve Demanding Applications

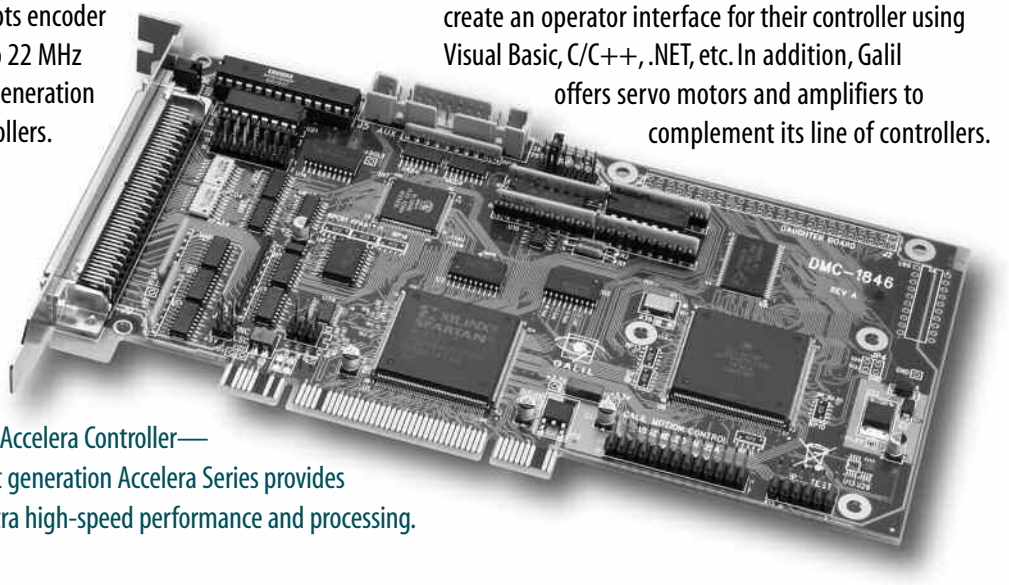
Galil's motion controllers use a 32-bit microcomputer and are packed with powerful features to handle any application no matter how simple or complex. That means you get advanced PID tuning with notch filter, velocity and acceleration feedforward, non-volatile memory with multitasking to execute application programs, and plenty of analog and digital I/O for interfacing to external sensors. They also handle various modes of motion including point-to-point positioning, velocity control, linear and circular interpolation, contouring, electronic gearing and ECAM. A high speed encoder interface accepts encoder feedback up to 22 MHz for the latest generation Accelera controllers.

A Broad Array of Products

Galil's full product offering can accommodate all your motion needs. You can choose from single or multi-axis controllers, bus-based or stand-alone, and box-level or card-level. Interface options include PCI, ISA, PC/104, cPCI, USB, RS232 and Ethernet. Select from 1-, 2-, 3-, 4-, 5-, 6-, 7- or 8-axis controllers; and buy only the number of axes you need. Controllers can be configured to run stepper or servo motors on any combination of axes, and plug-in drives save space, cost and wiring.

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 it be 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 instead on the expertise, cost-efficiency, and proven reliability of Galil.

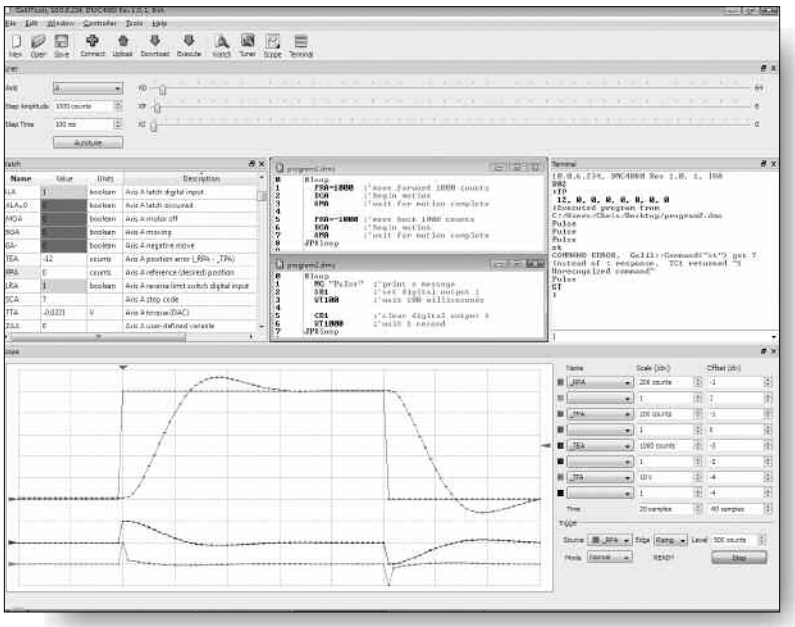
Also, Galil provides numerous accessories such as interconnect modules and cables for fast and easy prototyping. Galil's software tools, such as the new GalilTools for set-up and servo tuning, speed system development. The ActiveX Tool Kit allows users to create an operator interface for their controller using Visual Basic, C/C++, .NET, etc. In addition, Galil offers servo motors and amplifiers to complement its line of controllers.



DMC-18x6 PCI Accelera Controller—
Galil's latest generation Accelera Series provides
ultra high-speed performance and processing.

Easy-to-Use Controllers Get You to Market Quickly

It has always been a top priority at Galil to design and make motion controllers that are easy to use. That's why Galil controllers use two-letter, English-like commands to make programming controllers 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, our new GalilTools software is a great tool for easily optimizing the performance of your servo system. Simple "One-button" tuning automatically selects the best PID parameters for your system and a multi-trace scope displays real-time data such as position, position error, and torque.



GalilTools software makes graphing controller data quick and easy.

Custom Solutions to Fit Any Application

Galil is geared to deliver customized firmware and hardware products built to your specifications — and they can do so quickly and cost-effectively. For example, hardware specials such as modified board size, custom connectors, different communication and additional I/O, are typically completed within a 12-week period with engineering charges as low as $3,000. Firmware specials can be written for an unlimited number of requirements and are typically completed within two weeks with engineering charges as low as $400.

The following is a sampling of custom solutions that Galil has provided:

- *SSI or absolute encoder interface*
- *Compiled application programs for high-speed execution*
- *High resolution gearing*
- *Coordinate transformation*
- *Copy protection for application programs*
- *Battery back-up for memory*
- *Encoder integrity checking*
- *Modulo position*
- *ECAM acceleration*
- *Backlash and leadscrew compensation*
- *Special connectors*
- *Custom communications interface*
- *Special size and shape*
- *Ceramic motor control*
- *And many more!*

Cost-effective Solutions Give You a Competitive Edge

Galil realizes how critical it is for OEM design engineers to keep their equipment costs down, which is why we designed all of our controllers to give you great value—full-featured and very cost-effective. 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. We confidently publish our pricing in our catalog and at our website — one of the few motion control companies that does so. For example, Galil's 4-axis DMC-1842 PCI bus controller costs only $795 in 100 quantity and $395 in 1000 quantity. That's less than $100 per axis. With prices this low, why bother to make your own controller!

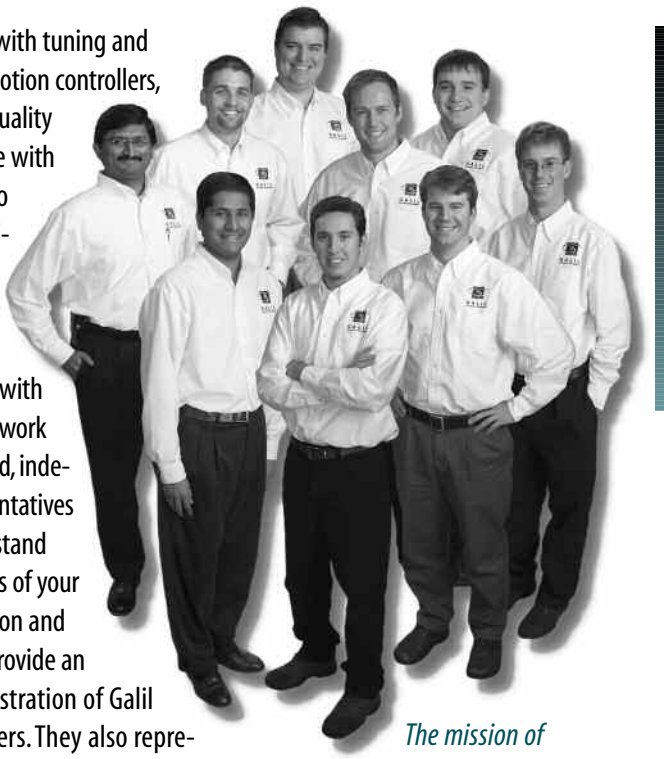
World-class Support Assures Your Success

Every Galil controller you buy is backed by Galil's commitment to superior customer support. This includes a fully-trained technical support team with over 100 man years of motion control experience. Each member has been personally trained by Dr. Jacob Tal, company co-founder and highly respected pioneer and expert in the field of motion control. Galil also offers a content-rich website filled with information such as an on-line bulletin board with a search feature, application bulletins, and web-tutorials.

Galil has always made motion control education a priority for our customers and offers a variety of training classes to accommodate their busy schedules. Training is directed by Dr. Jacob Tal, who has personally taught over 10,000 engineers about motion control. Galil's popular, 4-hour "Motion Control Made Easy" seminar is taught at various locations. It is also available as a web-based class and is on video.

Customers will also 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.

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 provide an effective demonstration of Galil motion controllers. They also represent manufacturers of motors, encoders and drives which are compatible with Galil motion controllers.



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—A Vendor You Can Trust

Galil Motion Control has been at the forefront of motion control technology ever since its founding in 1983 by Jacob Tal, acclaimed author, lecturer and engineer in motion control; and Wayne Baron, an expert in robotics and motion control. Back then, Galil introduced the world's first microprocessor-based, single-axis servo motion controller and the company hasn't stopped innovating since. Now, the installed controller base worldwide exceeds 500,000 units, demonstrating proven product reliability and customer satisfaction. Located in Rocklin, California, USA, Galil is a privately held company that has maintained profitability every year since 1985. You can be assured that when you choose Galil controllers, they are backed by a world-class, superior company with a highly successful track record.

Delivering 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 economical 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 latest engineering tool to aid 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.

Galil Controllers

Selection Guide

Galil offers an extensive array of controllers that meet a wide variety of design requirements. To help determine the best controller for your project, please answer the following and use the controller selection matrix below:

1. Communication

Do you want a controller card that plugs directly into a PC bus, or to reside outside of the PC and connect serially, or do you need the controller to operate stand-alone without a computer ? For a controller that plugs into the PC, the PCI bus is the most popular format. Other bus formats include ISA, cPCI and PC/104. If your controller is located outside of the PC bus or operates stand-alone, Galil offers card-level and box-level controllers with Ethernet/USB/RS232 connectivity.

2. # of Axes

How many axes of motion do you require? Galil offers controller configurations in 1- through 8-axis and — more importantly — lets you purchase only the exact number of axes that your project requires. Should your application require more than 8 axes, then you would use more than one controller. For example, an 11-axis application can use an 8-axis and a 3-axis controller.

3. I/O

What are your I/O requirements? All Galil controllers provide encoder inputs, amplifier enable outputs, forward and reverse limits and a home input for every axis. Galil also offers uncommitted digital inputs and outputs with each controller. If you do not need analog inputs or optically isolated inputs, then choose Econo versions of Galil's popular Ethernet or PCI bus controllers.

Galil Controller Selection Matrix

INTERFACE	# OF AXES	FORMAT	# OF DIGITAL INPUTS, DIGITAL OUTPUTS, ANALOG INPUTS	I/O EXPANSION OPTIONS	MODEL NUMBER
PCI	1	card	7 in, 3 out, 0 analog Econo		**DMC-1417**
PCI	1-4	card	8 in, 8 out, 0 analog Econo	64 I/O with DB-14064	**DMC-18x2**
PCI	1-8	card	8 in, 8 out, 8 analog* Optima	64 I/O with DB-14064	**DMC-18x0**
PCI	1-8	card	8 in, 8 out, 8 analog* Accelera	64 I/O with DB-14064	**DMC-18x6**
Ethernet/RS232	1-8	box	8 in, 8 out, 8 analog* Accelera	32 configurable I/O	**DMC-40x0**
Ethernet/RS232	1-8	card	8 in, 8 out, 0 analog Econo	40 I/O, 8 AN w/DB-28040	**DMC-21x3**
Ethernet/RS232	1	box	8 in, 10 out, 2 analog in, 1 analog out Econo Includes 500W drive for brush/brushless	40 I/O, 8 AN w/DB-28040	**CDS-3310**
Ethernet/RS232	1-2	card or box	3 in†, 3 out, 2 analog Econo	64 I/O with DB-14064	**DMC-14x5**
Ethernet/RS232	1-8	box	8 in, 8 out, 8 analog Optima	64 I/O included	**DMC-22x0**
USB/RS232	1-8	box	8 in, 8 out, 8 analog Optima	64 I/O included	**DMC-20x0**
RS232	1	card or box	7 in, 3 out, 0 analog Econo		**DMC-1412**
PC/104	1	card	7 in, 3 out, 0 analog Econo		**DMC-1411**
PC/104	1-8	card	8 in, 8 out, 8 analog* Optima	64 I/O with DB-12064	**DMC-12x0**
ISA	1	card	7 in, 3 out, 0 analog Econo		**DMC-1410**
ISA	1-8	card	8 in, 8 out, 8 analog* Optima	64 I/O with DB-14064	**DMC-17x0**
cPCI	1-4	card	8 in, 8 out, 8 analog, 64 configurable I/O Optima		**DMC-16x0**

**DMC-18x6, DMC-17x0: 24 in, 16 out for 5 through 8 axes models; DMC-40x0, DMC-2xx0, DMC-12x0: 16 in, 16 out for 5 through 8 axes models*

†7 inputs for 1-axis model, 3 inputs for 2-axis model

Note: "x" denotes the number of axes

Features

The benefits of Galil motion controllers are many, including:

Highest performance

- *32-bit microprocessor for high speed performance and precision*
- *Any mode of motion: point-to-point positioning, jogging, linear and circular interpolation, contouring, electronic gearing, ECAM*
- *Encoder frequencies up to 22 MHz for servos*
  Outputs up to 6 MHz for steppers
- *Advanced PID compensation with velocity feedforward, acceleration feedforward, integration limits, notch filter, and low-pass filter. Optional compensation for piezo-ceramic motors*

Flexibility

- *Buy anywhere from 1 to 8 axes in such formats as ISA, PCI, PC/104, cPCI, USB, Ethernet, and RS232*
- *Mix and match servo motors, stepper motors and hydraulics on any combination of axes*
- *Analog and digital I/O for interface with external devices*
- *Dual encoder inputs for backlash compensation*
- *Position feedback accepted in digital or analog format*

Onboard Intelligence

- *Program memory frees host computer for other tasks*
- *Multitasking allows multiple programs to execute concurrently*
- *Symbolic variables, array space and event triggers*
- *Non-volatile memory for program, parameter and data storage*
- *Sinusoidal commutation for controlling brushless motors with low-cost amplifiers*

Reliability

- *Over 500,000 motion controllers shipped*
- *Typical MTBF is over 250 years*
- *All catalogued products are RoHS compliant*

Ease of Use

- *Intuitive 2-letter commands for quick and easy programming*
- *Wide array of software tools for quick set-up and tuning. Interface to Linux, QNX, DOS, Visual Basic, LabView, C/C++, .NET, AutoCAD, and all current Windows operating systems*

Cost Effective

- *Meets OEM's strict cost demands with a 100+ order price guarantee*
- *Significant discounts for quantity purchases. For example, pay only $100 per axis for 4-axis controller in 1,000 quantity*

Plug-in Amplifier Boards

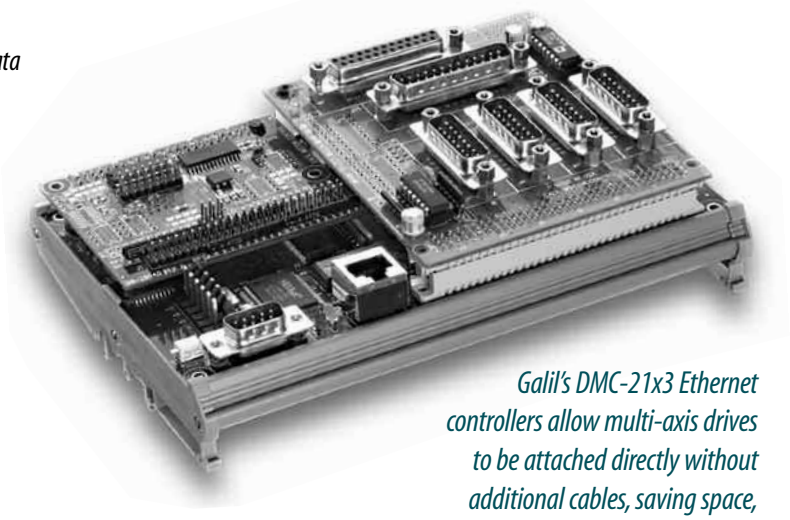
- *DMC-40x0 and DMC-21x3 Ethernet controllers allow multi-axis amplifiers to attach directly saving space, cost and wiring*
- *Easy integration between controller and drives*

Standard Upgrade Options

- *Two sets of PID, anti-friction bias, absolute or SSI encoders, backlash and lead screw error compensation, profile smoothing, anti-resonance profiling, password protection, memory expansion, piezo-ceramic motor compensation*

Custom Built Products

- *Firmware and hardware customized to your specifications*



Galil's DMC-21x3 Ethernet controllers allow multi-axis drives to be attached directly without additional cables, saving space, cost and wiring.

General Description

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.

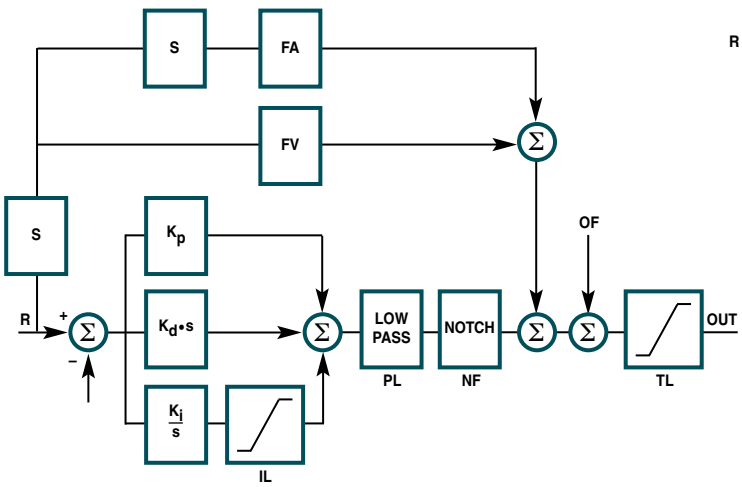
Most Galil controllers also include a sinusoidal commutation feature that allows designers to use lower-cost servo drives. This feature assures smooth motion and reduces torque ripple when using brushless motors. Each axis of sinusoidal commutated motion requires two DAC outputs that are phase shifted 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

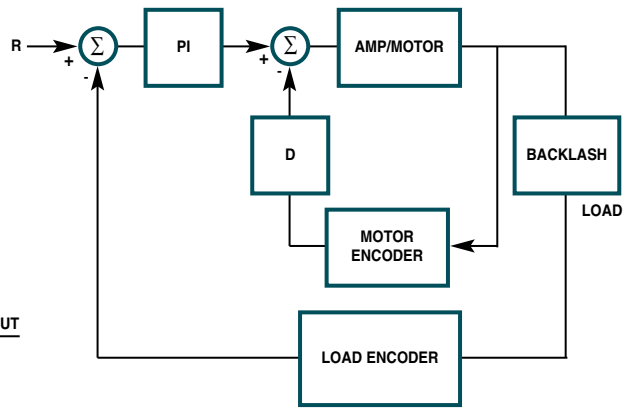
Galil's Command Language is comprised of intuitive, two-letter, English-like ASCII commands that make programming quick and easy. For example, the "BG" command begins motion while the "SP 2000, 4000" command sets the speed of the X-axis as "2000" and the Y-axis to "4000". Commands are included for system 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.

PID Block Diagram



Dual-loop Block Diagram



General Description

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 inputs and 16 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-47100 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.

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*

Position Tracking

The Position Tracking mode allows an axis to precisely follow a randomly generated 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*

General Description

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) 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.

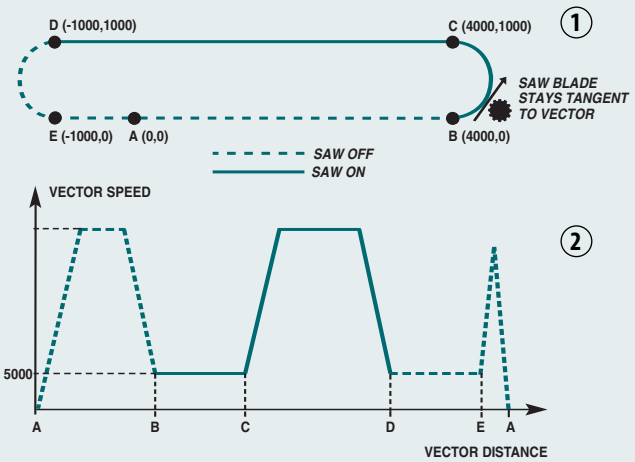
The vector mode can be operated on two sets of coordinated axes at the same time using the (CA) command, which specifies the plane of motion as S and T. By having dual sets of coordinated motion, users can accomplish completely separate coordinated motion tasks with a single controller. It can even handle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



General Description

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.**

General Description

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 gear 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 gear 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*

PCI Bus
Motion Controllers

Galil offers both single and multi-axis controller cards that install directly into the commonly used PCI bus. The DMC-18x6 Accelera Series are Galil's newest generation of motion controllers. Incorporating a 32-bit RISC-based microcomputer, the DMC-18x6 controllers offer ultra high-speed performance and processing power. The DMC-18x6 Accelera Series are full-featured PCI bus controllers for one through eight axes, which include optically isolated digital inputs and uncommitted analog inputs. The DMC-18x2 Econo Series are lower-cost models for one through four axes and do not include optical isolation, analog inputs or dual encoder inputs. The DMC-1417 is a single-axis PCI bus motion controller.

Complete specifications are included in the following pages.

PCI Bus, 1-8 axes, DMC-18x6 Accelera Series, Pages 13–19
PCI Bus, 1-4 axes, DMC-18x2 Econo Series, Pages 20–25
PCI Bus, 1 axis, DMC-1417, Page 82–85

PCI Product Comparison Chart

	DMC-18x6	DMC-18x2	DMC-1417
Communication interface	PCI	PCI	PCI
Form factor	card	card	card
Number of axes	x=1,2,3,4,5,6,7,8	x=1,2,3,4	1
Connector type	100-pin SCSI	100-pin SCSI	37-pin D
Mating interconnect module	ICM-1900/-2900	ICM-1900/-2900	ICM-1460
Maximum encoder input rate	22 MHz	12 MHz	8 MHz
Maximum stepper output rate	6 MHz	3 MHz	2 MHz
Minimum servo update time	1-2 axes: 62 µsec 7-8 axes: 187 µsec	1-2 axes: 250 µsec N/A	1 axis: 375 µsec N/A
Optoisolated digital inputs	yes	no	no (yes with ICM-1460-OPTO)
Number of uncommitted digital inputs	1-4 axes: 8 5-8 axes: 24	8	7
Number of uncommitted digital outputs	1-4 axes: 8 5-8 axes: 16	8	3
Number of analog inputs	8	0	0
I/O expansion	64 with DB-14064	64 with DB-14064	no
Dual encoder for each axis	yes	no	yes
Program memory size (lines x chr)	2000 x 80	1000 x 80	250 x 40
Array size (number of elements)	16000	8000	1000
Number of variables	510	254	126
Number of tasks for multitasking	8	8	2
Command execution speed	40 µsec	400 µsec	400 µsec
Drive options from Galil	AMP-19520 AMP-19540	AMP-19520 AMP-19540	external
Price: qty 1	DMC-1846: $2195	DMC-1842: $1195	DMC-1417: $595
Price: qty 100	DMC-1846: $ 995	DMC-1842: $ 795	DMC-1417: $395

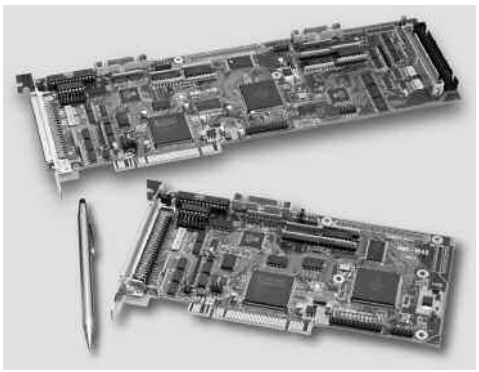
PCI Bus Accelera Series, 1–8 axes

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 new 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 controllers, the programming language and 100-pin SCSI connector are virtually the same, making conversion to the DMC-18x6 quick and easy.

DMC-1886 and DMC-1846



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, memory for 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, English-like 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 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 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*

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: 0–70° C
- Humidity: 20–95% RH, non-condensing

Mechanical

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

†*Reduced feature set for -FAST.*

Instruction Set

Servo Motor

AF	Analog feedback
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
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
DP	Define position
DR	DPRAM update rate
DV	Dual velocity (dual loop)
EI	Enable interrupts
EO	Echo off
IT	Independent smoothing
^L^K	Program protect
LZ	Leading zeros format
MO	Motor off
MT	Motor type
PF	Position format
PW	Password
QD	Download array
QU	Upload array
RS	Reset
^R^S	Master reset
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

LA	List arrays
LL	List labels
LS	List program
LV	List variables
MG	Message command
QR	Data record
QZ	Return data record
RP	Report command position
RL	Report latch
^R^V	Firmware revision information
SC	Stop code
TB	Tell status
TC	Tell error code
TD	Tell dual encoder
TE	Tell error
TI	Tell input

Interrogation (cont.)

TP	Tell position
TR	Trace program
TS	Tell switches
TT	Tell torque
TV	Tell velocity

Programming

BK	Break point
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
UI	User interrupt
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
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

DMC-18x6 Series

Connectors 100-pin, high density; Connector: Amp# 2-178238-9, Cable: Amp# 2-175677-9; Enclosure: Amp# 176793-9

Axis 1–4 DMC-18x6

1	Analog ground	51	NC
2	Ground	52	Ground
3	5 V	53	5 V
4	Error output*	54	Limit common
5	Reset*	55	Home W
6	Encoder–compare output	56	Reverse limit W
7	Ground	57	Forward limit W
8	Ground	58	Home Z
9	Motor command W	59	Reverse limit Z
10	Sign W / dir W	60	Forward limit Z
11	PWM W / step W	61	Home Y
12	Motor command Z	62	Reverse limit Y
13	Sign Z / dir Z	63	Forward limit Y
14	PWM Z / step Z	64	Home X
15	Motor command Y	65	Reverse limit X
16	Sign Y / dir Y	66	Forward limit X
17	PWM Y / step Y	67	Ground
18	Motor command X	68	5 V
19	Sign X / dir X	69	Input common
20	PWM X / step X	70	Latch X/Input 1
21	Amp enable W	71	Latch Y/Input 2
22	Amp enable Z	72	Latch Z/Input 3
23	Amp enable Y	73	Latch W/Input 4
24	Amp enable X	74	Input 5
25	A+ X	75	Input 6
26	A- X	76	Input 7
27	B+ X	77	Input 8
28	B- X	78	Abort*
29	I+ X	79	Output 1
30	I- X	80	Output 2
31	A+ Y	81	Output 3
32	A - Y	82	Output 4
33	B+ Y	83	Output 5
34	B- Y	84	Output 6
35	I+ Y	85	Output 7
36	I- Y	86	Output 8
37	A+ Z	87	5 V
38	A - Z	88	Ground
39	B+ Z	89	Ground
40	B- Z	90	Ground
41	I+ Z	91	Analog in 1
42	I- Z	92	Analog in 2
43	A+ W	93	Analog in 3
44	A - W	94	Analog in 4
45	B+ W	95	Analog in 5
46	B- W	96	Analog in 6
47	I+ W	97	Analog in 7
48	I- W	98	Analog in 8
49	+12 V	99	-12 V
50	+12 V	100	-12 V

**Active low*

Axis 5–8 DMC-18x6

1	NC	51	NC
2	Ground	52	Ground
3	5 V	53	5 V
4	Error output*	54	Limit common
5	Reset*	55	Home H
6	Encoder–compare output	56	Reverse limit H
7	Ground	57	Forward limit H
8	Ground	58	Home G
9	Motor command H	59	Reverse limit G
10	Sign H / dir H	60	Forward limit G
11	PWM H / step H	61	Home F
12	Motor command G	62	Reverse limit F
13	Sign G / dir G	63	Forward limit F
14	PWM G / step G	64	Home E
15	Motor command F	65	Reverse limit E
16	Sign F / dir F	66	Forward limit E
17	PWM F / step F	67	Ground
18	Motor command E	68	5 V
19	Sign E / dir E	69	Input common
20	PWM E / step E	70	Latch E/Input 9
21	Amp enable H	71	Latch F/Input 10
22	Amp enable G	72	Latch G/Input 11
23	Amp enable F	73	Latch H/Input 12
24	Amp enable E	74	Input 13
25	A+ E	75	Input 14
26	A- E	76	Input 15
27	B+ E	77	Input 16
28	B- E	78	Reserved
29	I+ E	79	Output 9
30	I- E	80	Output 10
31	A+ F	81	Output 11
32	A- F	82	Output 12
33	B+ F	83	Output 13
34	B- F	84	Output 14
35	I+ F	85	Output 15
36	I- F	86	Output 16
37	A+ G	87	5 V
38	A- G	88	Ground
39	B+ G	89	Ground
40	B- G	90	Ground
41	I+ G	91	Input 17
42	I- G	92	Input 18
43	A+ H	93	Input 19
44	A- H	94	Input 20
45	B+ H	95	Input 21
46	B- H	96	Input 22
47	I+ H	97	Input 23
48	I- H	98	Input 24
49	+ 12 V	99	-12 V
50	+ 12 V	100	-12 V

Auxiliary Encoder (Axis 1–4)

26-pin IDC

1	5 V	2	Ground
3	AA+X	4	AA-X
5	AB+X	6	AB-X
7	AA+Y	8	AA-Y
9	AB+Y	10	AB-Y
11	+5 V	12	Ground
13	AA+Z	14	AA-Z
15	AB+Z	16	AB-Z
17	AA+W	18	AA-W
19	AB+W	20	AB-W
21	Sample clock	22	NC
23	NC	24	NC
25	NC	26	NC

Auxiliary Encoder (Axis 5–8)

26-pin IDC

1	5 V	2	Ground
3	AA+E	4	AA-E
5	AB+E	6	AB-E
7	AA+F	8	AA-F
9	AB+F	10	AB-F
11	+5 V	12	Ground
13	AA+G	14	AA-G
15	AB+G	16	AB-G
17	AA+H	18	AA-H
19	AB+H	20	AB-H
21	Sample clock	22	NC
23	NC	24	NC
25	NC	26	NC

DMC-18x6 Series

Connectors—AMP-19540 Interconnect with four 500 W servo drives

J1 Power 8-pin AMP Mate-n-lock II

1 Earth
2 +VM (18 V–80 V)
3 +VM (18 V–80 V)
4 +VM (18 V–80 V)
5 Ground
6 Ground
7 Ground
8 Ground

JX1, JY1, JZ1, JW1 Motor Output 4-pin AMP Mate-n-lock II

1 Earth
2 A
3 C
4 B

J3 I/O 44-pin Hi-density Female D-sub

1 PWM/MCMD Z
2 Output 6
3 Output 8
4 Output 5
5 Output 2
6 Abort*
7 Input 6
8 Latch Z/Input 3
9 SIGN/AEN Y
10 Encoder compare output
11 Reverse limit X
12 Reverse limit Y
13 Reverse limit Z
14 Reverse limit W
15 Forward limit W
16 SIGN/AEN W
17 SIGN/AEN Z
18 Output 7
19 Output 4
20 Output 1
21 Output 3
22 Input 7
23 Latch W/Input 4
24 Latch X/Input 1
25 PWM/MCMD X
26 Home X
27 Home Y
28 Home Z
29 Home W
30 Error Output*/INCOM
31 PWM/MCMD W
32 5 V
33 5 V
34 Ground
35 Ground
36 Input 8
37 Input 5
38 Latch Y/Input 2
39 PWM/MCMD Y
40 SIGN/AEN X
41 Forward limit X
42 Forward limit Y
43 Forward limit Z
44 Reset*/LSCOM

J4 X-axis 15-pin Hi-density Female D-sub

1 I+ X
2 B+ X
3 A+ X
4 AB+ X
5 Ground
6 I- X
7 B- X
8 A- X
9 AA- X
10 Hall A X
11 AA+ X
12 AB- X
13 Hall B X
14 Hall C X
15 5 V

J5 Y-axis 15-pin Hi-density Female D-sub

1 I+ Y
2 B+ Y
3 A+ Y
4 AB+ Y
5 Ground
6 I- Y
7 B- Y
8 A- Y
9 AA- Y
10 Hall A Y
11 AA+ Y
12 AB- Y
13 Hall B Y
14 Hall C Y
15 5 V

J6 Z-axis 15-pin Hi-density Female D-sub

1 I+ Z
2 B+ Z
3 A+ Z
4 AB+ Z
5 Ground
6 I- Z
7 B- Z
8 A- Z
9 AA- Z
10 Hall A Z
11 AA+ Z
12 AB- Z
13 Hall B Z
14 Hall C Z
15 5 V

J7 W-axis 15-pin Hi-density Female D-sub

1 I+ W
2 B+ W
3 A+ W
4 AB+ W
5 Ground
6 I- W
7 B- W
8 A- W
9 AA- W
10 Hall A W
11 AA+ W
12 AB- W
13 Hall B W
14 Hall C W
15 5 V

J11 SPI 9-pin Female D-sub (reserved)

J12 Analog 15-pin Male D-sub

1 Analog ground
2 Analog input 1
3 Analog input 3
4 Analog input 5
5 Analog input 7
6 Analog ground
7 -12 V
8 5 V
9 Analog ground
10 Analog input 2
11 Analog input 4
12 Analog input 6
13 Analog input 8
14 Analog ground
15 +12 V

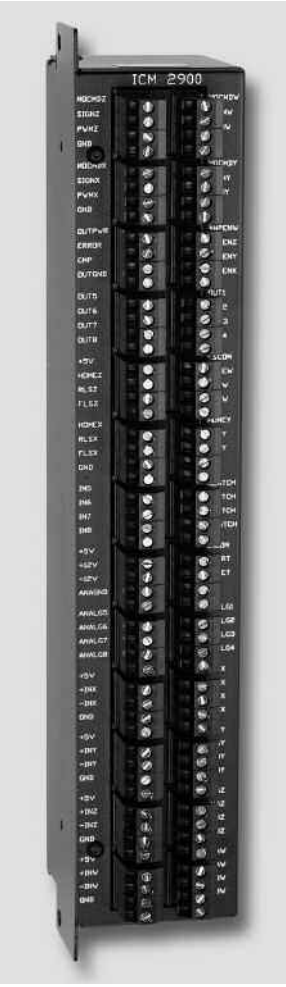
AMP-19540

**Active low*

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 for card-level PCI controllers. 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 brush or brushless 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 for driving brush or brushless motors. Each amplifier operates at 18V to 80V 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" x 8.75" x 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.

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" x 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 high-density cable in 1 meter length	$ 125	$ 95
CABLE-100-2M	100-pin high-density cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin high-density 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 high-density 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
Galil Utilities	Communication drivers, SmartTERM, DMCDOS, .NET	$ 20 for CD; free download	
DMCWIN32	Windows API Tool Kit (VB, C, C++, etc.)	Included with Utilities	
GalilTools	Set-up, tuning and analysis software	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Visual Basic, Visual C++, etc.	$ 595	

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

PCI Bus Econo Series, 1–4 axes

DMC-18x2 Series

Product Description

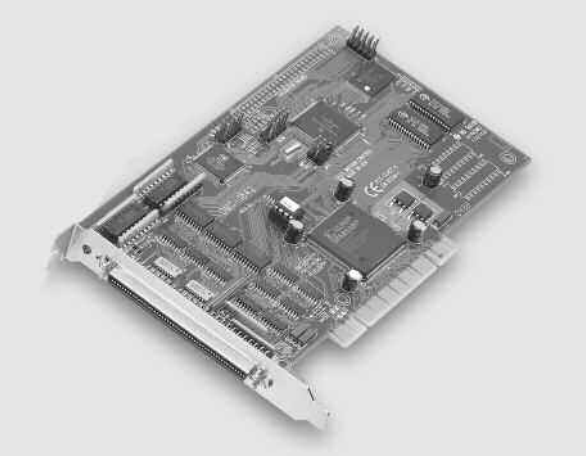
The DMC-18x2 Series are PCI bus motion controllers for single and multi-axis applications. The Econo Series is designed for the most cost-sensitive applications.

Eliminated features include 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 feedforward, 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, English-like 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.

DMC-1842 4-axis PCI controller



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/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*
- *CE certified*
- *Custom hardware and firmware options available*

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 (±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- (±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: 0–70° C
- Humidity: 20–95% RH, non-condensing

Mechanical
- DMC-18x2: 7.275" × 4.2"

** 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.

DMC-18x2 Series

Instruction Set

Servo Motor
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

System Configuration
BN Burn parameters
BP Burn program
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
DP Define position
EI Enable interrupts
EO Echo off
IT Independent smoothing
LZ Leading zeros format
MO Motor off
MT Motor type
PF Position format
QD Download array
QU Upload array
RS Reset
^R^S Master reset
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

Interrogation
LA List arrays
LL List labels
LS List program
LV List variables
MG Message command
QR Data record
QZ Return data record
RP Report command position
RL Report latch
^R^V Firmware revision information
SC Stop code
TB Tell status
TC Tell error code
TD Tell dual encoder
TE Tell error
TI Tell input

Interrogation (cont.)
TP Tell position
TR Trace program
TS Tell switches
TT Tell torque
TV Tell velocity

Programming
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
UI User interrupt
UL Upload program
ZS Zero stack
' Comment

Error Control
BL Backward software limit
ER Error limit
FL Forward software limit
OE Off-on-error function
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
WC Wait for contour data
WT Wait for time

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

Contour Mode
CD Contour data
CM Contour mode
DT Contour time interval
WC Wait for contour data

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
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
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
VT Smoothing time constant—vector

DMC-18x2 Series

Connectors

100-pin, high density; Connector: Amp# 2-178238-9, Cable: Amp# 2-175677-9; Enclosure: Amp# 176793-9

Axis 1–4 DMC-18x2

1	Ground	51	NC
2	Ground	52	Ground
3	5 V	53	5 V
4	Error output*	54	Limit common
5	Reset*	55	Home W
6	Encoder–compare output	56	Reverse limit W
7	Ground	57	Forward limit W
8	Ground	58	Home Z
9	Motor command W	59	Reverse limit Z
10	Sign W / dir W	60	Forward limit Z
11	PWM W / step W	61	Home Y
12	Motor command Z	62	Reverse limit Y
13	Sign Z / dir Z	63	Forward limit Y
14	PWM Z / step Z	64	Home X
15	Motor command Y	65	Reverse limit X
16	Sign Y / dir Y	66	Forward limit X
17	PWM Y / step Y	67	Ground
18	Motor command X	68	5 V
19	Sign X / dir X	69	Input common
20	PWM X / step X	70	Latch X/Input 1
21	Amp enable W	71	Latch Y/Input 2
22	Amp enable Z	72	Latch Z/Input 3
23	Amp enable Y	73	Latch W/Input 4
24	Amp enable X	74	Input 5
25	A+ X	75	Input 6
26	A- X	76	Input 7
27	B+ X	77	Input 8
28	B- X	78	Abort*
29	I+ X	79	Output 1
30	I- X	80	Output 2
31	A+ Y	81	Output 3
32	A - Y	82	Output 4
33	B+ Y	83	Output 5
34	B- Y	84	Output 6
35	I+ Y	85	Output 7
36	I- Y	86	Output 8
37	A+ Z	87	5 V
38	A - Z	88	Ground
39	B+ Z	89	Ground
40	B- Z	90	Ground
41	I+ Z	91	NC
42	I- Z	92	NC
43	A+ W	93	NC
44	A - W	94	NC
45	B+ W	95	NC
46	B- W	96	NC
47	I+ W	97	NC
48	I- W	98	NC
49	+12 V	99	-12 V
50	+12 V	100	-12 V

**Active low*

Connectors—AMP-19540

Interconnect with four 500 W servo drives

J1 Power 8-pin AMP Mate-n-lock II

1	Earth	5	Ground
2	+VM (18 V–80 V)	6	Ground
3	+VM (18 V–80 V)	7	Ground
4	+VM (18 V–80 V)	8	Ground

JX1, JY1, JZ1, JW1 Motor Output 4-pin AMP Mate-n-lock II

1	Earth
2	A
3	C
4	B

J3 I/O 44-pin Hi-density Female D-sub

1	PWM/MCMD Z	23	Latch W/Input 4
2	Output 6	24	Latch X/Input 1
3	Output 8	25	PWM/MCMD X
4	Output 5	26	Home X
5	Output 2	27	Home Y
6	Abort*	28	Home Z
7	Input 6	29	Home W
8	Latch Z/Input 3	30	Error Output*/INCOM
9	SIGN/AEN Y	31	PWM/MCMD W
10	Encoder compare output	32	5 V
11	Reverse limit X	33	5 V
12	Reverse limit Y	34	Ground
13	Reverse limit Z	35	Ground
14	Reverse limit W	36	Input 8
15	Forward limit W	37	Input 5
16	SIGN/AEN W	38	Latch Y/Input 2
17	SIGN/AEN Z	39	PWM/MCMD Y
18	Output 7	40	SIGN/AEN X
19	Output 4	41	Forward limit X
20	Output 1	42	Forward limit Y
21	Output 3	43	Forward limit Z
22	Input 7	44	Reset*/LSCOM

J4 X-axis 15-pin Hi-density Female D-sub

1	I+ X	9	AA- X
2	B+ X	10	Hall A X
3	A+ X	11	AA+ X
4	AB+ X	12	AB- X
5	Ground	13	Hall B X
6	I- X	14	Hall C X
7	B- X	15	5 V
8	A- X		

J5 Y-axis 15-pin Hi-density Female D-sub

1	I+ Y	9	AA- Y
2	B+ Y	10	Hall A Y
3	A+ Y	11	AA+ Y
4	AB+ Y	12	AB- Y
5	Ground	13	Hall B Y
6	I- Y	14	Hall C Y
7	B- Y	15	5 V
8	A- Y		

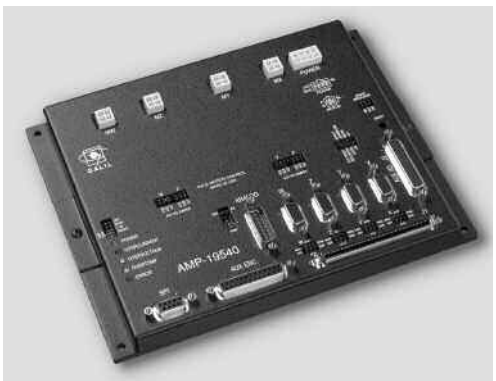
J6 Z-axis 15-pin Hi-density Female D-sub

1	I+ Z	9	AA- Z
2	B+ Z	10	Hall A Z
3	A+ Z	11	AA+ Z
4	AB+ Z	12	AB- Z
5	Ground	13	Hall B Z
6	I- Z	14	Hall C Z
7	B- Z	15	5 V
8	A- Z		

J7 W-axis 15-pin Hi-density Female D-sub

1	I+ W	9	AA- W
2	B+ W	10	Hall A W
3	A+ W	11	AA+ W
4	AB+ W	12	AB- W
5	Ground	13	Hall B W
6	I- W	14	Hall C W
7	B- W	15	5 V
8	A- W		

AMP-19540

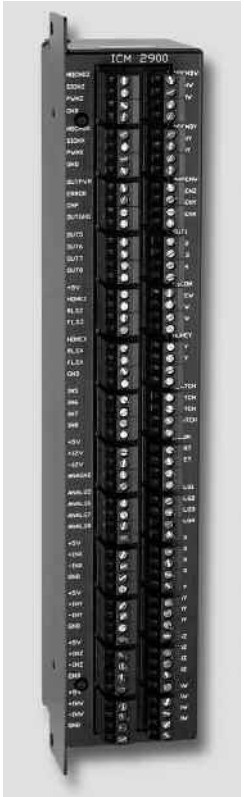


Hardware Accessories

ICM-1900 Interconnect Module

The ICM-1900 Interconnect Module breaks-out the 100-pin main cable into screw-type terminals for quick connection of system hardware. An ICM-1900 is required for each set of four axes. The ICM-1900 is contained in a metal enclosure with dimensions of 13.5" × 2.675" × 6.88" and 1/4" diameter keyholes for mounting. The ICM is normally shipped configured for high amp enable (-HAEN). For low amp enable, order ICM-1900-LAEN. Also specify -OPTO for optoisolated outputs.

ICM-1900 Interconnect Module and AMP-1900 Series



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 mounting for card-level Optima controllers. 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 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 18V to 80V 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" x 8.75" x 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.

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.

CB-1500 Legacy-to-Optima Converter Board

The CB-1500 board provides an interconnect solution for upgrading a Legacy series controller (which uses a 60-pin ribbon cable) to a DMC-18xx controller (which uses a 100-pin SCSI cable). The ribbon cables from the Legacy ICM-1100 interconnect modules plug directly into the CB-1500, which then provides a 100-pin SCSI connector for interface to the DMC-18xx. 3.75" × 3.85"

PCI Bus Econo Series, 1–4 axes

DMC-18x2 Series

Ordering Information

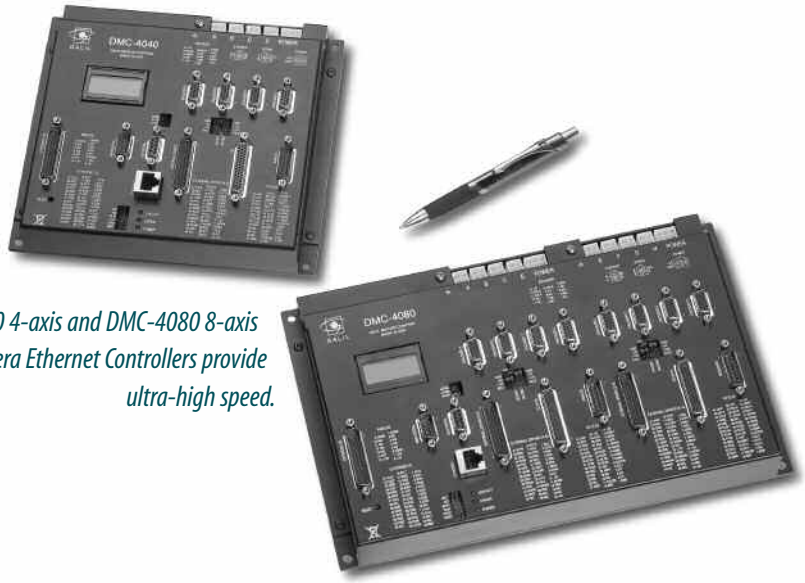
PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-1812	1-axis Econo PCI	$ 795	$ 595
DMC-1822	2-axis Econo PCI	$ 895	$ 665
DMC-1832	3-axis Econo PCI	$1045	$ 725
DMC-1842	4-axis Econo PCI	$1195	$ 795
-3VREG	Option for 3 Volt regulator which allows for 5V only supply from PCI bus	No extra charge	
CABLE-100-1M	100-pin high-density cable in 1 meter length	$ 125	$ 95
CABLE-100-2M	100-pin high-density cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin high-density cable in 4 meter length	$ 150	$ 105
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
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
CB-1500	Legacy-to-Optima converter board	$ 50	$ 45
Galil Utilities	Communication drivers, SmartTERM, DMCDOS	$ 20 for CD; free download	
DMCWIN32	Windows API Tool Kit (VB, C, C++, etc.)	Included with Utilities	
GalilTools	Set-up, tuning and analysis software	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Visual Basic, Visual C++, etc.	$ 595	

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

Ethernet/RS232 Motion Controllers

Galil's stand-alone motion controllers can either operate without a host computer or they can communicate with a host PC via a serial link such as RS232 or Ethernet. Several options are available including box-level and card-level models in both single-axis and multi-axis configurations. The DMC-40x0 Accelera controllers are Galil's latest generation controllers and are full-featured, packaged controllers with optically isolated inputs and outputs. The DMC-21x3 Econo card-level controllers are designed for lowest cost. Both the DMC-40x0 and DMC-21x3 provide plug-in drives that save space, cost and wiring. The CDS-3310 controller/drive system and the DMC-14x5 controllers are an economical solution for applications with just one axis.

Complete specifications are included in the following pages.



DMC-4040 4-axis and DMC-4080 8-axis Accelera Ethernet Controllers provide ultra-high speed.

Ethernet/RS232 Motion Controllers

Ethernet Product Comparison Chart

	DMC-40x0 Accelera	DMC-21x3 Econo	CDS-3310	DMC-14x5 or -34x5
Communication interface	Ethernet 10/100Base-T RS232 x 2 (115 kb)	Ethernet 10Base-T RS232 x 1 (19.2 kb)	Ethernet 10/100 Base-T RS232 x 1 (19.2 kb)	Ethernet 10Base-T RS232 x 1 (19.2 kb)
Form factor	box	card or DIN-rail	box	card or box
Number of axes	x=1,2,3,4,5,6,7,8	x=1,2,3,4,5,6,7,8	x=1	x=1,2
Connector type	D-type	96-pin DIN	37-pin D	37-pin D
Mating interconnect module	N/A	ICM-20100/20105	ICM-3300	ICM-1460
Power requirement	20–80 VDC	5V,+/-12V or 9-72 VDC	18-72 VDC	5V,+/-12V or 100-240 VAC
Maximum encoder rate	22 MHz	12 MHz	12 MHz	12 MHz
Maximum stepper rate	6 MHz	3 MHz	3 MHz	3 MHz
Minimum servo update time	1-2 axes: 62 µsec 7-8 axes: 187 µsec	1-2 axes: 250 µsec 7-8 axes: 625 µsec	250 µsec N/A	250 µsec N/A
Optoisolated digital inputs	yes	yes with ICM-20105	yes with ICM-3300	yes with ICM-1460 option
# of uncommitted digital inputs	1-4 ax: 8; 5-8 ax:16	1-4 ax: 8; 5-8 ax:16	8	1 axis: 7; 2 axis:3
# of uncommitted digital outputs	1-4 ax: 8; 5-8 ax:16*	1-4 ax: 8; 5-8 ax:16	10	3
# of analog inputs	8	8 (with DB-28040)	2 in, 1 out	2
# of extended I/O	32	40 (with DB-28040)	40 (with DB-28040)	64 (with DB-14064)
Dual Encoder for each axis	yes	yes	yes	1 axis: yes; 2 axes: no
Program memory size(lines x chr)	2000 x 80	1000 x 80	1000 x 80	500 x 80
Array size (number of elements)	16000	8000	8000	2000
# of variables	510	510	510	126
# of tasks for multitasking	8	8	8	2
Drive options from Galil	AMP-43020 AMP-43040 AMP-43140 SDM-44040 SDM-44140	AMP-20341 AMP-204x0 AMP-205xx SDM-20242 SDM-206x0	Includes 500W brush or brushless drive	AMP-1460 ICM-1460-20 W
Price: qty 1	DMC-4040: $2295	DMC-2143: $1195	CDS-3310: $745	DMC-1415 card: $595
Price: qty 100	DMC-4040: $1195	DMC-2143: $795	CDS-3310: $495	DMC-1415 card: $395

** DMC-40x0 provides high-power, optically isolated outputs.*

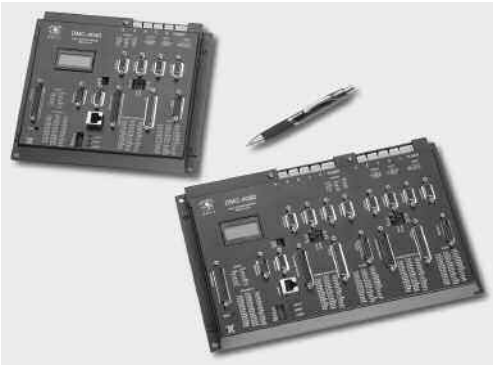
Ethernet/RS232 Accelera Series, 1–8 axes

DMC-40x0 Series

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 the speed of 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 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-40x0 controllers use Galil's popular, English-like 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.

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 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 LCD*
- *Dual encoder inputs for each 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 – 70° 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"

Reduced feature set for -FAST.

DMC-40x0 Series

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

Connectors—Communications

RS-232 Main Port
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

RS232 Auxiliary Port
9-pin; Female connector and cable

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

Ethernet 10/100Base-T
RJ-45 connector

Connectors—Amplifier Board AMP-43040

J2 Power*
6-pin

1 Ground
2 Ground
3 Ground
4 +VM (20 V – 80 V)
5 +VM (20 V – 80 V)
6 +VM (20 V – 80 V)

JA1, JB1, JC1, JD1 Motor Output
4-pin

1 Motor Phase C
2 Motor Phase B
3 NC
4 Motor Phase A

Extended I/O
44-pin Hi-density Male D-sub

1 I/O18
2 I/O21
3 I/O24
4 I/O26
5 I/O29
6 I/O32
7 I/O33
8 I/O36
9 I/O38
10 NC
11 I/O41
12 I/O44
13 I/O47
14 NC
15 Reserved
16 I/O17
17 I/O20
18 I/O23
19 I/O25
20 I/O28
21 I/O31
22 NC
23 I/O35
24 I/O37
25 NC
26 I/O40
27 I/O43
28 I/O46
29 I/O48
30 3.3 V
31 I/O19
32 I/O22
33 Ground
34 I/O27
35 I/O30
36 Ground
37 I/O34
38 NC
39 Ground
40 I/O39
41 I/O42
42 I/O45
43 Ground
44 NC

Connectors—I/O

J1 Amplifier I/O Axes A thru D
44-pin Hi-density Male D-sub

1 Reserved
2 PWM C/Step C
3 Reserved
4 Reserved
5 Sign C/Dir C
6 Reserved
7 Amp enable A
8 Amp enable D
9 NC
10 -12V out
11 Motor command B
12 Reserved
13 NC
14 NC
15 +5V out
16 PWM A/Step A
17 Reserved
18 PWM D/Step D
19 Sign A/Dir A
20 Reserved
21 Sign D/Dir D
22 Amp Enable Common-1
23 Amp Enable C
24 NC
25 +12V out
26 Reserved
27 Motor command C
28 Reserved
29 NC
30 NC
31 PWM B/Step B
32 Reserved
33 Ground
34 Sign B/Dir B
35 Reserved
36 Ground
37 Amp enable B
38 Amp Enable Common-2
39 Ground
40 Motor command A
41 Reserved
42 Motor command D
43 Ground
44 NC

J1 Amplifier I/O Axes E thru H
44-pin Hi-density Male D-sub

1 Reserved
2 PWM G/Step G
3 Reserved
4 Reserved
5 Sign G/Dir G
6 Reserved
7 Amp enable E
8 Amp enable H
9 NC
10 -12V out
11 Motor command F
12 Reserved
13 NC
14 NC
15 +5V out
16 PWM E/Step E
17 Reserved
18 PWM H/Step H
19 Sign E/Dir E
20 Reserved
21 Sign H/Dir H
22 Amp Enable Common-1
23 Amp Enable G
24 NC
25 +12V out
26 Reserved
27 Motor command G
28 Reserved
29 NC
30 NC
31 PWM F/Step F
32 Reserved
33 Ground
34 Sign F/Dir F
35 Reserved
36 Ground
37 Amp enable F
38 Amp Enable Common-2
39 Ground
40 Motor command E
41 Reserved
42 Motor command H
43 Ground
44 NC

**Note: Power can be input through either of the amplifier connectors to power the entire unit due to power pass-thru connectors that connect input power to all modules. For 5- through 8-axis units with two different types of amplifiers, the lower of the maximum voltages is the maximum rating for the unit. However, if you need different voltages, you can specify the ISAMP and/or ISCNTL option to separate the various power inputs.*

When using the AMP-43140 with a power supply lower than +/-20 Volts, a separate supply of 20–80 VDC must be input to the 2-pin connector on the side of the DMC-40X0 or, specify the 12 V option for the DMC controller.

DMC-40x0 Series

Connectors — I/O

J2 General I/O Axes A thru D

44-pin Hi-density Female D-sub

1	Error output*
2	Input 1-isolated
3	Input 4-isolated
4	Input 7-isolated
5	Electronic Lockout-isolated input*
6	Limit switch common
7	Home A-isolated
8	Home B-isolated
9	Home C-isolated
10	Home D-isolated
11	Output power+
12	Output 3-isolated
13	Output 6-isolated
14	Output return-
15	+5V out
16	Reset-isolated*
17	Input Common
18	Input 3-isolated
19	Input 6-isolated
20	Abort-isolated*
21	NC
22	Reverse limit A-isolated†
23	Reverse limit B-isolated†
24	Reverse limit C-isolated†
25	Reverse limit D-isolated†
26	NC
27	Output 2-isolated
28	Output 5-isolated
29	Output 8-isolated
30	+5V out
31	Ground
32	Input 2-isolated
33	Input 5-isolated
34	Input 8-isolated
35	Ground
36	Forward limit A-isolated†
37	Forward limit B-isolated†
38	Forward limit C-isolated†
39	Forward limit D-isolated†
40	Ground
41	Output 1-isolated
42	Output 4-isolated
43	Output 7-isolated
44	Output Compare A–D

J2 General I/O Axes E thru H

44-pin Hi-density Female D-sub

1	Error output*
2	Input 9-isolated
3	Input 12-isolated
4	Input 15-isolated
5	Electronic Lockout-isolated input†
6	Limit switch common
7	Home E-isolated
8	Home F-isolated
9	Home G-isolated
10	Home H-isolated
11	Output power+
12	Output 11-isolated
13	Output 14-isolated
14	Output return-
15	+5V out
16	Reset-isolated†
17	Input Common
18	Input 11-isolated
19	Input 14-isolated
20	Abort-isolated*
21	NC
22	Reverse limit E-isolated†
23	Reverse limit F-isolated†
24	Reverse limit G-isolated†
25	Reverse limit H-isolated†
26	NC
27	Output 10-isolated
28	Output 13-isolated
29	Output 16-isolated
30	+5V out
31	Ground
32	Input 10-isolated
33	Input 13-isolated
34	Input 16-isolated
35	Ground
36	Forward limit E-isolated†
37	Forward limit F-isolated†
38	Forward limit G-isolated†
39	Forward limit H-isolated†
40	Ground
41	Output 9-isolated
42	Output 12-isolated
43	Output 15-isolated
44	Output Compare E–D

JA1, JB1, JC1, JD1 Encoder Axes A thru D

JE1, JF1, JG1, JH1 Encoder Axes E thru H

15-pin Hi-density Female D-sub

1	Index+
2	B+
3	A+
4	Aux B+
5	Ground
6	Index-
7	B-
8	A-
9	Aux A-
10	Hall A
11	Aux A+
12	Aux B-
13	Hall B
14	Hall C
15	+5V out

J3 Analog Inputs

15-pin Low-density Male D-sub

1	Analog Ground
2	Analog input 1
3	Analog input 3
4	Analog input 5
5	Analog input 7
6	Analog Ground
7	-12V out
8	+5V in
9	Analog Ground
10	Analog input 2
11	Analog input 4
12	Analog input 6
13	Analog input 8
14	NC
15	+12 V

**Active low*

†Programmable for Active high or Active low

DMC-40x0 Interconnect and Drive Options

ICM-42000 Interconnect Module (-I000)

The ICM-42000 breaks out the internal CPU board connector into convenient D-sub connectors for easy interface to external amplifiers and I/O devices. The ICM-42000 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. 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 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.

For 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- through 8-axis controllers.

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

The AMP-43040 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. The amplifier status can be read through the controller, and the BS command allows easy hall sensor set-up. 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 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 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 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. Correct motor sizing calculations are critical to achieve stepper performance at speed. Please contact Galil for assistance. The SDM-44140 drive motors operating 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 100/240 VAC input, 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

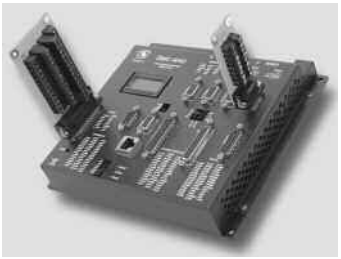
Galil offers various ICS boards which break-out the DMC-40x0 D-type connectors into screw terminals for quick prototyping:

ICS-48015-M 15-pin D high-density male to screw terminals — for encoder signals.

ICS-48115-F 15-pin D low-density female to screw terminals — for analog inputs.

ICS-48044-M 44-pin D high-density male to screw terminals — for general I/O.

ICS-48044-F 44-pin D high-density female to screw terminals — for external drive signals.



DMC-4040 with 15-pin and 44-pin ICS boards attached.

ICS-48032-F 44-pin D high-density female to screw 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.

RIO-47100 Remote I/O Controller

Galil's RIO-47100 I/O controller provides an intelligent solution for adding I/O and PLC functionality to the DMC-40x0 Ethernet control system. The RIO-47100 I/O controller connects to the Ethernet network allowing it to communicate with DMC-40x0 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.

Ethernet/RS232 Accelera Series, 1–8 axes

DMC-40x0 Series

Ordering Information

1- through 4-axis Models:

DMC-40x0-Cxxx-Ixxx-Dxxxx-SR90

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

Communication
012: one Ethernet port and two RS232 ports

Interconnect
000: Digital encoder
100: Sinusoidal encoder

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

Shunt Regulator (optional)

Example: DMC-4030-C012-I000-D3040

5- through 8-axis Models:

DMC-40x0-Cxxx-Ixxx-Ixxx-Dxxxx-Dxxxx-SR90

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

Communication
012: one Ethernet port and two RS232 ports

Interconnect (1st four axes)
000: Digital encoder
100: Sinusoidal encoder

Interconnect (2nd four axes)
000: Digital encoder
100: Sinusoidal encoder

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

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

Shunt Regulator (optional)

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

Ordering Information continued on the next page.

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

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.

Ordering Information continued on the next page.

**Requires NRE for set-up. Consult factory.*

Ethernet/RS232 Accelera Series, 1–8 axes

DMC-40x0 Series

Ordering Information — continued

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-4010-C012-I000	1-axis Ethernet/RS232 controller with D-type connectors	$1595	$ 945
DMC-4020-C012-I000	2-axis Ethernet/RS232 controller with D-type connectors	$1695	$ 995
DMC-4030-C012-I000	3-axis Ethernet/RS232 controller with D-type connectors	$1995	$1095
DMC-4040-C012-I000	4-axis Ethernet/RS232 controller with D-type connectors	$2295	$1195
DMC-4050-C012-I000-I000	5-axis Ethernet/RS232 controller with D-type connectors	$2695	$1495
DMC-4060-C012-I000-I000	6-axis Ethernet/RS232 controller with D-type connectors	$2895	$1595
DMC-4070-C012-I000-I000	7-axis Ethernet/RS232 controller with D-type connectors	$3045	$1695
DMC-4080-C012-I000-I000	8-axis Ethernet/RS232 controller with D-type connectors	$3195	$1795
ICM-42100 (-I100)	Specify sinusoidal encoder inputs instead of digital encoder inputs. Replace -I000 with -I100	$ 100 adder	$ 60 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 high-density male to screw terminals — for encoder signals	$ 50	$ 35
ICS-48115-F	15-pin D low-density female to screw terminals — for analog inputs	$ 50	$ 35
ICS-48044-M	44-pin D high-density male to screw terminals — for general I/O	$ 75	$ 50
ICS-48044-F	44-pin D high-density female to screw terminals — for external drive signals	$ 75	$ 50
ICS-48032-F*	44-pin D high-density female to screw terminals — for extended I/O. Provides optical isolation of 32 extended I/O points.	$ 125	$ 80
RIO-47100	Remote I/O controller	$ 295	$ 195

*** ICS-48032-F Options:**

ICS-48032-F - x x x x

- Bank 4 (I=In, O=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.

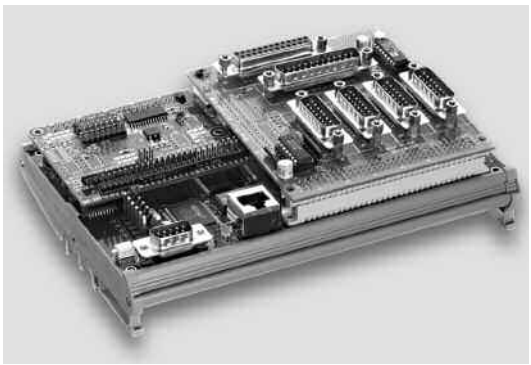
Ethernet/RS232 Econo 1–8 axes

DMC-21x3 Series

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, 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, linear and circular interpolation, contouring, electronic gearing and ECAM.



DMC-2143 with mating ICM and DB-28040

Like all Galil controllers, these controllers use a simple, English-like 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 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: 0–70° 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.

Instruction Set

Servo Motor
AG* Set AMP-20540 gain
AU* Set current loop gain
AW* Report AMP-20540 bandwidth
DV Dual velocity
FA Acceleration feedforward
FV Velocity feedforward
IL Integrator limit
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
TK Set peak current
TL Continuous torque limit
TM Sample time

Stepper Motor
AG† Set SDM-20640 gain
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

† For use with SDM-20640
** For use with AMP-20540*

I/O (cont.)
@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
CF Configure unsolicited messages
CN Configure switches
CW Data adjustment bit
DE Define dual encoder position
DP Define position
DV Dual velocity (dual loop)
EO Echo off
HS Handle switch
IA Set IP address
IH Internet handle
IK Ethernet port blocking
IT Independent smoothing
LO Lockout handle
LZ Leading zeros format
MB ModBus
MO Motor off
MT Motor type
PF Position format
QD Download array
QU Upload array
RS Reset
^R^S Master reset
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

Interrogation
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 info
RP Report command position
RL Report latch

Interrogation (cont.)
^R^V Firmware revision information
SC Stop code
TA* Tell AMP-20540 status
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
ZS Zero stack
' Comment

Error Control
BL Backward software limit
ER Error limit
FL Forward software limit
OE Off-on-error function
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

Independent Motion Commands
WC Wait for contour data
WT Wait for time
AB Abort motion
AC Acceleration
BG Begin motion
DC Deceleration
FE Find edge
FI Find index
HM Home
IP Increment position
IT Smoothing time constant
JG Jog mode
PA Position absolute
PR Position relative
PT Position tracking
SP Speed
ST Stop

Contour Mode
CD Contour data
CM Contour mode
DT Contour time interval
WC Wait for contour data

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
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
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
VT Smoothing time constant—vector

Ethernet/RS232 Econo 1–8 axes

DMC-21x3 Series

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 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" x 5.6" x 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.

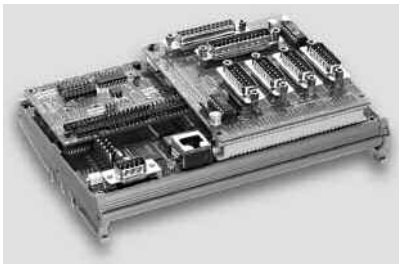
DMC-2143-DC24 and ICM-20105 packaged in a metal enclosure

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.

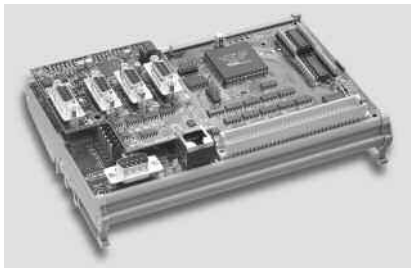
The 40 digital I/O signals are available on a 50-pin IDC header, and the analog inputs are available on a 16-pin header. With a controller firmware modification, the I/O board can also be modified to accept feedback from SSI encoders. 2.55" x 3.08".



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" x 3.075".



DB-28104 mounted on a DMC-2143 controller

RIO-47100 Remote I/O Controller

Galil's RIO-47100 I/O controller provides an intelligent solution for adding I/O and PLC functionality to the DMC-21x2/21x3 Ethernet control system. The RIO-47100 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 contoller

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".

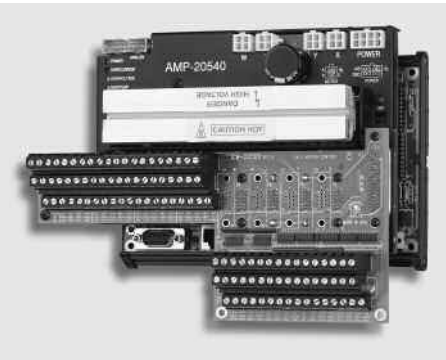
ICM-20105 Interconnect with Optically Isolated I/O

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" x 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 high-density connectors and one 44-pin high-density 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

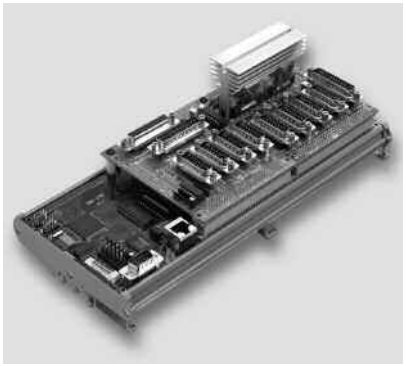


ICM-20500 Interconnect Module attached to AMP-20540 Amplifier

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" x 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,

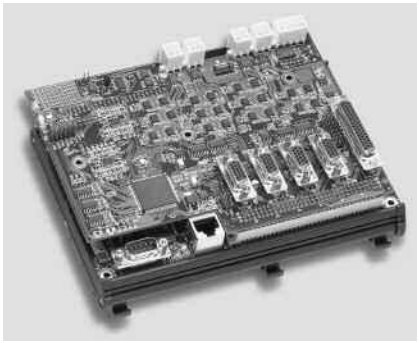
AMP-20540 Interconnect with 4-axis 500 W servo drives

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" x 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 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" x 4.85".



AMP-20542 mounted on a DMC-2143 controller

SDM-20242 4-axis Full/Half Stepper Drives

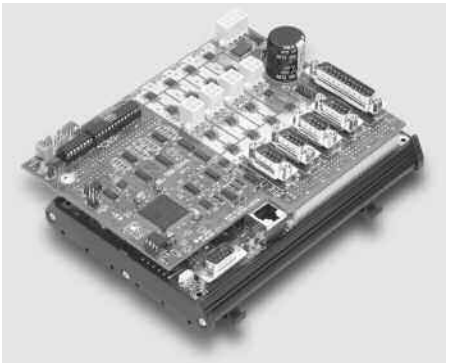
The SDM-20242 contains four drives for operating two-phase bipolar step motors. The SDM-20242 requires a single 12–30 DC Volt input. The SDM is user-configurable for 1.4 A, 1.0 A, 0.75 A, or 0.5 A per phase and full, half, 1/4 or 1/16 step. Adequate airflow across the board is recommended. The SDM uses 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-205xx, 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.

Connectors—DMC-21x3

Axis 1–4 DMC-21x3 J4

96-pin DIN; Connector DIN 41612

1 Ground	33 Ground	65 Ground
2 PWM/step W	34 Sign/dir W	66 Motor command W
3 PWM/step Z	35 Sign/dir Z	67 Motor command Z
4 PWM/step Y	36 Sign/dir Y	68 Motor command Y
5 PWM/step X	37 Sign/dir X	69 Motor command X
6 Amp enable W	38 Ground	70 Output compare
7 Amp enable X	39 Amp enable Y	71 Amp enable Z
8 Home W	40 Reverse limit W	72 Forward limit W
9 Home Z	41 Reverse limit Z	73 Forward limit Z
10 Home Y	42 Reverse limit Y	74 Forward limit Y
11 Home X	43 Reverse limit X	75 Forward limit X
12 Latch X/Input 1	44 Latch Y/Input 2	76 Latch Z/Input 3
13 Latch W/Input 4	45 Input 5	77 Input 6
14 Input 7	46 Input 8	78 Abort*
15 Output 3	47 Output 2	79 Output 1
16 Output 5	48 Ground	80 Output 4
17 Output 8	49 Output 7	81 Output 6
18 A+ X	50 A- X	82 B+ X
19 B- X	51 I+ X	83 I- X
20 A+ Y	52 A- Y	84 B+ Y
21 B- Y	53 I+ Y	85 I- Y
22 A+ Z	54 A- Z	86 B+ Z
23 B- Z	55 I+ Z	87 I- Z
24 A+ W	56 A- W	88 B+ W
25 B- W	57 I+ W	89 I- W
26 Ground	58 Ground	90 Ground
27 AA+ X	59 AA- X	91 AB+ X
28 AB- X	60 AA+ Y	92 AA- Y
29 AB+ Y	61 AB- Y	93 AA+ Z
30 AB+ Z	62 AA+ W	94 Error Output*
31 -12 V Output	63 Reset*	95 +12 V Output
32 5 V Output	64 5 V Output	96 5 V Output

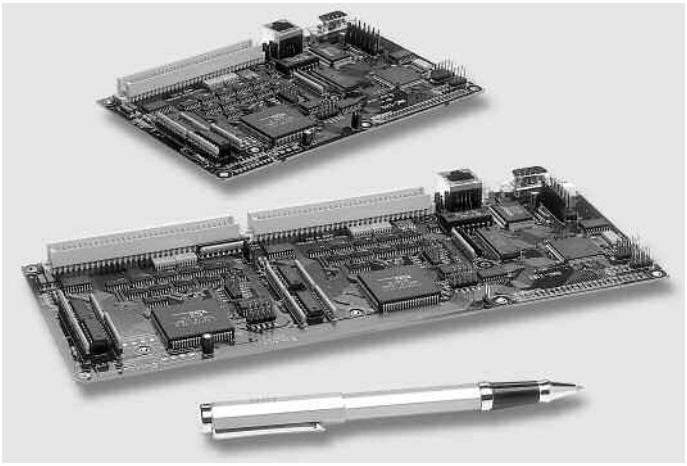
**Active low*

Axis 5 – 8 DMC-21x3 J5

96-pin DIN; Connector DIN 41612

1 Ground	33 Ground	65 Ground
2 PWM/step H	34 Sign/dir H	66 Motor command H
3 PWM/step G	35 Sign/dir G	67 Motor command G
4 PWM/step F	36 Sign/dir F	68 Motor command F
5 PWM/step E	37 Sign/dir E	69 Motor command E
6 Amp enable H	38 Ground	70 Output compare 2
7 Amp enable E	39 Amp enable F	71 Amp enable G
8 Home H	40 Reverse limit H	72 Forward limit H
9 Home G	41 Reverse limit G	73 Forward limit G
10 Home F	42 Reverse limit F	74 Forward limit F
11 Home E	43 Reverse limit E	75 Forward limit E
12 Latch E/Input 9	44 Latch F/Input 10	76 Latch G/Input 11
13 Latch H/Input 12	45 Input 13	77 Input 14
14 Input 15	46 Input 16	78 Reserved
15 Output 11	47 Output 10	79 Output 9
16 Output 13	48 Ground	80 Output 12
17 Output 16	49 Output 15	81 Output 14
18 A+ E	50 A- E	82 B+ E
19 B- E	51 I+ E	83 I- E
20 A+ F	52 A- F	84 B+ F
21 B- F	53 I+ F	85 I- F
22 A+ G	54 A- G	86 B+ G
23 B- G	55 I+ G	87 I- G
24 A+ H	56 A- H	88 B+ H
25 B- H	57 I+ H	89 I- H
26 Ground	58 Ground	90 Ground
27 AA+ E	59 AA- E	91 AB+ E
28 AB- E	60 AA+ F	92 AA- F
29 AB+ F	61 AB- F	93 AA+ G
30 AB+ G	62 AA+ H	94 Error Output*
31 -12 V Output	63 Reset*	95 +12 V Output
32 5 V Output	64 5 V Output	96 5 V Output

Note: The DMC-21x3 comes standard with 96-pin DIN pins UP. It is also available with connector pins at a right angle and facing down.



DMC-2143/2183 cards (vertical connector mount; 96-pin in UP configuration)

Ethernet/RS232 Econo 1–8 axes

DMC-21x3 Series

Connectors—DB-28040

J3 8 Analog inputs (16 pin header)

1 Analog Ground	2 Analog Ground
3 AN1	4 AN2
5 AN3	6 AN4
7 AN5	8 AN6
9 AN7	10 AN8
11 Analog Ground	12 Analog Ground
13 -12V	14 +12V
15 5 V	16 Analog Ground

J1 40 Digital I/O (50-pin header)

1 Bank 4 - Bit40	2 Bank 5 - Bit41
3 Bank 4 - Bit39	4 Bank 5 - Bit42
5 Bank 4 - Bit38	6 Bank 5 - Bit43
7 Bank 4 - Bit37	8 Bank 5 - Bit44
9 Bank 4 - Bit36	10 Bank 5 - Bit45
11 Bank 4 - Bit35	12 Bank 5 - Bit46
13 Bank 4 - Bit34	14 Bank 5 - Bit47
15 Bank 4 - Bit33	16 Bank 5 - Bit48
17 Bank 3 - Bit32	18 Bank 6 - Bit49
19 Bank 3 - Bit31	20 Bank 6 - Bit50
21 Bank 3 - Bit30	22 Bank 6 - Bit51
23 Bank 3 - Bit29	24 Bank 6 - Bit52
25 Bank 3 - Bit28	26 Bank 6 - Bit53
27 Bank 3 - Bit27	28 Bank 6 - Bit54
29 Bank 3 - Bit26	30 Bank 6 - Bit55
31 Bank 3 - Bit25	32 Bank 6 - Bit56
33 Bank 2 - Bit24	34 Ground
35 Bank 2 - Bit23	36 Ground
37 Bank 2 - Bit22	38 Ground
39 Bank 2 - Bit21	40 Ground
41 Bank 2 - Bit20	42 Ground
43 Bank 2 - Bit19	44 Ground
45 Bank 2 - Bit18	46 Ground
47 Bank 2 - Bit17	48 Ground
49 5 V	50 Ground

Connectors—ICM-20100

J1 Power

1 +12 V
2 5 V
3 Ground
4 -12 V

J3 W-Axis 15-pin Male D-sub

1 Forward Limit W
2 Home W
3 5 V
4 A- W
5 B- W
6 I- W
7 Amp enable W
8 Sign/dir W
9 Reverse limit W
10 Ground
11 A+ W
12 B+ W
13 I+ W
14 Motor command W
15 PWM/step W

J4 Z-Axis 15-pin Male D-sub

1 Forward Limit Z
2 Home Z
3 5 V
4 A- Z
5 B- Z
6 I- Z
7 Amp enable Z
8 Sign/dir Z
9 Reverse limit Z
10 Ground
11 A+ Z
12 B+ Z
13 I+ Z
14 Motor command Z
15 PWM/step Z

J5 Y-Axis 15-pin Male D-sub

1 Forward limit Y
2 Home Y
3 5 V
4 A- Y
5 B- Y
6 I- Y
7 Amp enable Y
8 Sign/dir Y
9 Reverse limit Y
10 Ground
11 A+ Y
12 B+ Y
13 I+ Y
14 Motor command Y
15 PWM/step Y

J6 X-Axis 15-pin Male D-sub

1 Forward limit X
2 Home X
3 5 V
4 A- X
5 B- X
6 I- X
7 Amp enable X
8 Sign/dir X
9 Reverse limit X
10 Ground
11 A+ X
12 B+ X
13 I+ X
14 Motor command X
15 PWM/step X

J10 Auxiliary Encoders for X, Y, Z, W 25-pin Female D-Sub

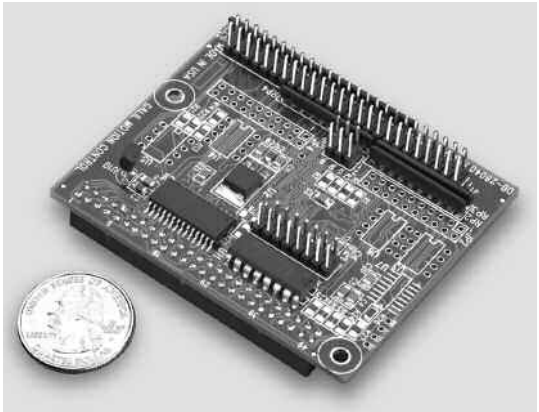
1 Reset*
2 AB- W
3 AA- W
4 AB- Z
5 AA- Z
6 AB- Y
7 AA- Y
8 AB- X
9 AA- X
10 5 V
11 5 V
12 +12 V
13 NC
14 Error Output*
15 AB+ W
16 AA+ W
17 AB+ Z
18 AA+ Z
19 AB+ Y
20 AA+ Y
21 AB+ X
22 AA+ X
23 Ground
24 Ground
25 -12 V

J11 I/O 25-pin Male D-Sub

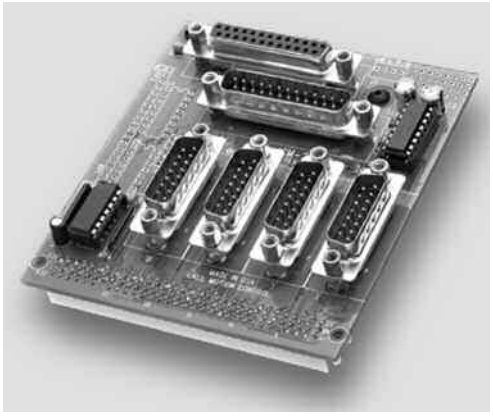
1 Ground
2 Latch X/Input 1
3 Latch Z/Input 3
4 Input 5
5 Input 7
6 Abort*
7 Output 1
8 Output 3
9 Output 5
10 Output 7
11 Ground
12 NC
13 NC
14 5 V
15 Latch Y/Input 2
16 Latch W/Input 4
17 Input 6
18 Input 8
19 Encoder-compare output
20 Output 2
21 Output 4
22 Output 6
23 Output 8
24 5 V
25 NC

**Active low*

DB-28040



ICM-20100



DMC-21x3 Series

Connectors—ICM-20105

Interconnect with Optical Isolation

JX X-axis
15-Pin Male D-sub

1 Amp enable common-1
2 Amp enable X
3 5 V
4 A- X
5 B- X
6 I- X
7 NC
8 Sign/dir X
9 Amp enable common-2
10 Ground
11 A+ X
12 B+ X
13 I+ X
14 Motor command X
15 PWM/step X

JY Y-axis
15-Pin Male D-sub

1 Amp enable common-1
2 Amp enable Y
3 5 V
4 A- Y
5 B- Y
6 I- Y
7 NC
8 Sign/dir Y
9 Amp enable common-2
10 Ground
11 A+ Y
12 B+ Y
13 I+ Y
14 Motor command Y
15 PWM/step Y

JZ Z-axis
15-Pin Male D-sub

1 Amp enable common-1
2 Amp enable Z
3 5 V
4 A- Z
5 B- Z
6 I- Z
7 NC
8 Sign/dir Z
9 Amp enable common-2
10 Ground
11 A+ Z
12 B+ Z
13 I+ Z
14 Motor command Z
15 PWM/step Z

JW W-axis
15-Pin Male D-sub

1 Amp enable common-1
2 Amp enable W
3 5 V
4 A- W
5 B- W
6 I- W
7 NC
8 Sign/dir W
9 Amp enable common-2
10 Ground
11 A+ W
12 B+ W
13 I+ W
14 Motor command W
15 PWM/step W

JAUX Auxiliary Encoders
25-pin D-sub

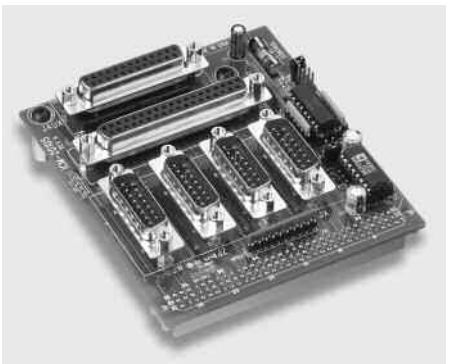
1 NC
2 AB- W
3 AA- W
4 AB- Z
5 AA- Z
6 AB- Y
7 AA- Y
8 AB- X
9 AA- X
10 5 V
11 5 V
12 +12V
13 NC
14 NC
15 AB+ W
16 AA+ W
17 AB+ Z
18 AA+ Z
19 AB+ Y
20 AA+ Y
21 AB+ X
22 AA+ X
23 Ground
24 Ground
25 -12V

J10 I/O
37-Pin Female D-sub

1 Input common
2 Input 2
3 Input 4
4 Input 6
5 Input 8
6 Output supply
7 Output 2
8 Output 4
9 Output 6
10 Output 8
11 Limit switch common
12 Reverse limit X
13 Forward limit Y
14 Home Y
15 Reverse limit Z
16 Forward limit W
17 Home W
18 5 V
19 Ground
20 Input 1
21 Input 3
22 Input 5
23 Input 7
24 Abort*
25 Output 1
26 Output 3
27 Output 5
28 Output 7
29 Output return
30 Forward limit X
31 Home X
32 Reverse limit Y
33 Forward limit Z
34 Home Z
35 Reverse limit W
36 5 V
37 Ground

**Active low*

ICM-20105



Connectors—AMP-20341

Interconnect with four 20 W servo drives

J9 Power 3-pin

1 +VM (+12 V to +30 V)
2 Ground
3 -VM (-12 V to -30 V)

J3 X-axis 15-pin Male D-sub

1 Forward limit X
2 Home X
3 5 V
4 A- X
5 B- X
6 I- X
7 AA- X
8 AB- X
9 Reverse limit X
10 Ground
11 A+ X
12 B+ X
13 I+ X
14 AA+ X
15 AB+ X

J4 Y-axis 15-pin Male D-sub

1 Forward limit Y
2 Home Y
3 5 V
4 A- Y
5 B- Y
6 I- Y
7 AA- Y
8 AB- Y
9 Reverse limit Y
10 Ground
11 A+ Y
12 B+ Y
13 I+ Y
14 AA+ Y
15 AB+ Y

J5 Z-axis 15-pin Male D-sub

1 Forward limit Z
2 Home Z
3 5 V
4 A- Z
5 B- Z
6 I- Z
7 AA- Z
8 AB- Z
9 Reverse limit Z
10 Ground
11 A+ Z
12 B+ Z
13 I+ Z
14 AA+ Z
15 AB+ Z

J6 W-axis 15-pin Male D-sub

1 Forward limit W
2 Home W
3 5 V
4 A- W
5 B- W
6 I- W
7 AA- W
8 AB- W
9 Reverse limit W
10 Ground
11 A+ W
12 B+ W
13 I+ W
14 AA+ W
15 AB+ W

J2 I/O 25-pin Male D-sub

1 Ground
2 Latch X/Input 1
3 Latch Z/Input 3
4 Input 5
5 Input 7
6 Abort*
7 Output 1
8 Output 3
9 Output 5
10 Output 7
11 Ground
12 Reset*
13 nc
14 5 V
15 Latch Y/Input 2
16 Latch W/Input 4
17 Input 6
18 Input 8
19 Encoder-compare output
20 Output 2
21 Output 4
22 Output 6
23 Output 8
24 5 V
25 Error Output*

JX, JY, JZ, JW Motor Outputs

JX1 XMO+
JX2 XMO-
JY1 YMO+
JY2 YMO-
JZ1 ZMO+
JZ2 ZMO-
JW1 WMO+
JW2 WMO-

J8 External Amplifier

1 X Axis Amp Enable
2 X Axis Motor Command
3 Y Axis Amp Enable
4 Y Axis Motor Command
5 Z Axis Amp Enable
6 Z Axis Motor Command
7 W Axis Amp Enable
8 W Axis Motor Command
9 Ground
10 Ground

Ethernet/RS232 Econo 1–8 axes

DMC-21x3 Series

Connectors—AMP-20440 Interconnect with four 200 W servo drives

J1 Power 4-pin
1 +VM (18 V–60 V)
2 Ground
3 +VM (18 V–60 V)
4 Ground

JX1 Motor Output 2-pin Molex
1 XMO-
2 XMO+

JY1 Motor Output 2-pin Molex
1 YMO-
2 YMO+

JZ1 Motor Output 2-pin Molex
1 ZMO-
2 ZMO+

JW1 Motor Output 2-pin Molex
1 WMO-
2 WMO+

J3 I/O 44-pin Hi-density Female D-sub
1 NC
2 Output 6
3 Output 8
4 Output 5
5 Output 2
6 Abort*
7 Input 6
8 Latch Z/Input 3
9 Amp enable Y
10 Encoder-compare output
11 Sign/dir X
12 Sign/dir Y
13 Sign/dir Z
14 Sign/dir W
15 PWM/step W
16 Amp enable W
17 Amp enable Z
18 Output 7
19 Output 4
20 Output 1
21 Output 3
22 Input 7
23 Latch W/Input 4
24 Latch X/Input 1
25 NC
26 Motor command X
27 Motor command Y
28 Motor command Z
29 Motor command W
30 Error Output*
31 NC
32 5 V
33 5 V
34 Ground

J3 I/O 44-pin Hi-density Female D-sub — *continued*
35 Ground
36 Input 8
37 Input 5
38 Latch Y/Input 2
39 NC
40 Amp enable X
41 PWM/step X
42 PWM/step Y
43 PWM/step Z
44 Reset*

J4 X-axis 15-pin Hi-density Female D-sub
1 I+ X
2 B+ X
3 A+ X
4 AB+ X
5 Ground
6 I- X
7 B- X
8 A- X
9 AA- X
10 Forward limit X
11 AA+ X
12 AB- X
13 Home X
14 Reverse limit X
15 5 V

J5 Y-axis 15-pin Hi-density Female D-sub
1 I+ Y
2 B+ Y
3 A+ Y
4 AB+ Y
5 Ground
6 I- Y
7 B- Y
8 A- Y
9 AA- Y
10 Forward limit Y
11 AA+ Y
12 AB- Y
13 Home Y
14 Reverse limit Y
15 5 V

J6 Z-axis 15-pin Hi-density Female D-sub
1 I+ Z
2 B+ Z
3 A+ Z
4 AB+ Z
5 Ground
6 I- Z
7 B- Z
8 A- Z
9 AA- Z
10 Forward limit Z
11 AA+ Z
12 AB- Z
13 Home Z
14 Reverse limit Z
15 5 V

J7 W-axis 15-pin Hi-density Female D-sub
1 I+ W
2 B+ W
3 A+ W
4 AB+ W
5 Ground
6 I- W
7 B- W
8 A- W
9 AA- W
10 Forward limit W
11 AA+ W
12 AB- W
13 Home W
14 Reverse limit W
15 5 V

**Active low*

DMC-21x3 Series

Connectors—AMP-20540/20542

Interconnect with four servo drives (includes 8 analog inputs on AMP-20540)

J1 Power 8-pin AMP Mate-n-lock II

1 Earth
2 +VM (18 V–60 V)
3 +VM (18 V–60 V)
4 +VM (18 V–60 V)
5 Ground
6 Ground
7 Ground
8 Ground

JX1, JY1, JZ1, JW1 Motor Output 4-pin AMP Mate-n-lock II

1 NC
2 A
3 C
4 B

J3 I/O 44-pin Hi-density Female D-sub

1 PWM/MCMD Z
2 Output 6
3 Output 8
4 Output 5
5 Output 2
6 Abort*
7 Input 6
8 Latch Z/Input 3
9 SIGN/AEN Y
10 Encoder compare output
11 Reverse limit X
12 Reverse limit Y
13 Reverse limit Z
14 Reverse limit W
15 Forward limit W
16 SIGN/AEN W
17 SIGN/AEN Z
18 Output 7
19 Output 4
20 Output 1
21 Output 3
22 Input 7
23 Latch W/Input 4
24 Latch X/Input 1
25 PWM/MCMD X
26 Home X
27 Home Y
28 Home Z
29 Home W
30 Error Output*
31 PWM/MCMD W
32 5 V
33 5 V
34 Ground
35 Ground
36 Input 8
37 Input 5
38 Latch Y/Input 2
39 PWM/MCMD Y
40 SIGN/AEN X
41 Forward limit X
42 Forward limit Y
43 Forward limit Z
44 Reset*

J4 X-axis 15-pin Hi-density Female D-sub

1 I+ X
2 B+ X
3 A+ X
4 AB+ X
5 Ground
6 I- X
7 B- X
8 A- X
9 AA- X
10 Hall A X
11 AA+ X
12 AB- X
13 Hall B X
14 Hall C X
15 5 V

J5 Y-axis 15-pin Hi-density Female D-sub

1 I+ Y
2 B+ Y
3 A+ Y
4 AB+ Y
5 Ground
6 I- Y
7 B- Y
8 A- Y
9 AA- Y
10 Hall A Y
11 AA+ Y
12 AB- Y
13 Hall B Y
14 Hall C Y
15 5 V

J6 Z-axis 15-pin Hi-density Female D-sub

1 I+ Z
2 B+ Z
3 A+ Z
4 AB+ Z
5 Ground
6 I- Z
7 B- Z
8 A- Z
9 AA- Z
10 Hall A Z
11 AA+ Z
12 AB- Z
13 Hall B Z
14 Hall C Z
15 5 V

**Active low*

J7 W-axis 15-pin Hi-density Female D-sub

1 I+ W
2 B+ W
3 A+ W
4 AB+ W
5 Ground
6 I- W
7 B- W
8 A- W
9 AA- W
10 Hall A W
11 AA+ W
12 AB- W
13 Hall B W
14 Hall C W
15 5 V

J11 Analog 16-pin Header

1 Analog Ground
2 Analog Ground
3 Analog input 1
4 Analog input 2
5 Analog input 3
6 Analog input 4
7 Analog input 5
8 Analog input 6
9 Analog input 7
10 Analog input 8
11 Analog Ground
12 Analog Ground
13 -12 V
14 +12 V
15 5 V
16 Analog Ground

AMP-20540 attached to a DMC-2143 Controller

Note: The AMP-205x0 and DMC-21x3-DC24 or -DC48 are configured to accept their operating voltages from a single DC supply. If you want to operate the AMP and DMC from two separate supplies, you must remove J98 (10-pin header) on the DMC-21x3 controller. Galil will remove this header upon request if you specify "-no J98" on your DMC-21x3 order.

Ethernet/RS232 Econo 1–8 axes

DMC-21x3 Series

Connectors—SDM-20242

Interconnect with four 1.4 A stepper drives

J1 **Power**
1 +VM (12 V–30 V)
2 Ground
3 +VM (12 V–30 V)
4 Ground

J2, J3, J4, J5
X, Y, Z, W Motor Output
1 Motor phase A+
2 Motor phase A-
3 Motor phase B+
4 Motor phase B-

J6 **X-axis 9-pin Male D-sub**
1 Forward limit X
2 Home X
3 5 V
4 A- X
5 B- X
6 Reverse limit X
7 Ground
8 A+ X
9 B+ X

J7 **Y-axis 9-pin Male D-sub**
1 Forward limit Y
2 Home Y
3 5 V
4 A- Y
5 B- Y
6 Reverse limit Y
7 Ground
8 A+ Y
9 B+ Y

J8 **Z-axis 9-pin Male D-sub**
1 Forward limit Z
2 Home Z
3 5 V
4 A- Z
5 B- Z
6 Reverse limit Z
7 Ground
8 A+ Z
9 B+ Z

J9 **W-axis 9-pin Male D-sub**
1 Forward limit W
2 Home W
3 5 V
4 A- W
5 B- W
6 Reverse limit W
7 Ground
8 A+ W
9 B+ W

J11 **I/O 25-pin Male D-sub**
1 Ground
2 Latch X/Input 1
3 Latch Z/Input 3
4 Input 5
5 Input 7
6 Abort*
7 Output 1
8 Output 3
9 Output 5
10 Output 7
11 Ground
12 Reset*
13 NC
14 5 V
15 Latch Y/Input 2
16 Latch W/Input 4
17 Input 6
18 Input 8
19 Encoder-compare output
20 Output 2
21 Output 4
22 Output 6
23 Output 8
24 5 V
25 Error output*

JP8 **10-pin Header**
1 Amp enable X
2 Motor command X
3 Amp enable Y
4 Motor command Y
5 Amp enable Z
6 Motor command Z
7 Amp enable W
8 Motor command W
9 Ground
10 Ground

**Active low*

Connectors—SDM-20640

Interconnect with four microstepping drives

J1 **Power**
8-pin AMP Mate-n-lock II
1 Earth
2 +VM (12V-60V)
3 +VM (12V-60V)
4 +VM (12V-60V)
5 Ground
6 Ground
7 Ground
8 Ground

JX1, JY1, JZ1, JW1
Motor Output AMP Mate-n-lock II
1 motor phase B+
2 motor phase A+
3 motor phase B-
4 motor phase A-

JX2 **X-axis**
9-pin Male D-sub
1 Forward limit X
2 Home X
3 5 V
4 A- X
5 B- X
6 Reverse limit X
7 Ground
8 A+ X
9 B+ X

JY2 **Y-axis**
9-pin Male D-sub
1 Forward limit Y
2 Home Y
3 5 V
4 A- Y
5 B- Y
6 Reverse limit Y
7 Ground
8 A+ Y
9 B+ Y

JZ2 **Z-axis**
9-pin Male D-sub
1 Forward limit Z
2 Home Z
3 5 V
4 A- Z
5 B- Z
6 Reverse limit Z
7 Ground
8 A+ Z
9 B+ Z

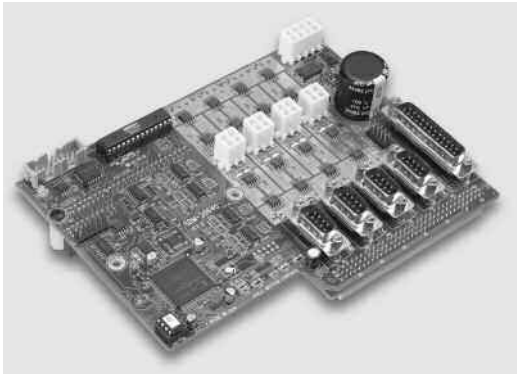
JW2 **W-axis**
9-pin Male D-sub
1 Forward limit W
2 Home W
3 5 V
4 A- W
5 B- W
6 Reverse limit W
7 Ground
8 A+ W
9 B+ W

J3 **I/O**
25-pin Male D-sub
1 Ground
2 Latch X/Input 1
3 Latch Z/Input 3
4 Input 5
5 Input 7
6 Abort*
7 Output 1
8 Output 3
9 Output 5
10 Output 7
11 Ground
12 Reset*
13 NC
14 5 V
15 Latch Y/Input 2
16 Latch W/Input 4
17 Input 6
18 Input 8
19 Encoder-compare output
20 Output 2
21 Output 4
22 Output 6
23 Output 8
24 5 V
25 Error output*

JP8 **10-pin Header**
1 Amp enable X
2 motor command X
3 Amp enable Y
4 motor command Y
5 Amp enable Z
6 motor command Z
7 Amp enable W
8 motor command W
9 ground
10 ground

J11 **Analog**
16-pin Header
1 Analog Ground
2 Analog Ground
3 Analog input 1
4 Analog input 2
5 Analog input 3
6 Analog input 4
7 Analog input 5
8 Analog input 6
9 Analog input 7
10 Analog input 8
11 Analog Ground
12 Analog Ground
13 -12 V
14 +12 V
15 5 V
16 Analog Ground

SDM-20640 Interconnect with four microstepping drives



Ethernet/RS232 Econo 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) V=vertical	- none (default) - DC24 (18–36 Volts) - DC48 (36–72 Volts)	- none (default) - DIN (requires –V option)	VP = vertical (default) HP = horizontal

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) H=horizontal	- none (default) - DC24 (18–36 Volts) - DC48 (36–72 Volts)	- none (default) - DIN (requires –V and UP option)	- UP (default) - DOWN - RA (right angle)	VP = vertical (default) HP = horizontal

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	Sinusodial 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.

Ethernet/RS232 Econo 1–8 axes

DMC-21x3 Series

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 high-density D sub to discrete wires—1-meter (for AMP-205x0, -204x0)	$ 25	$ 17
CABLE-15-2M	15-pin high-density D sub to discrete wires—2-meter (for AMP-205x0, -204x0)	$ 30	$ 20
CABLE-44-1M	44-pin high-density D sub to discrete wires—1-meter (for AMP-205x0, -204x0)	$ 35	$ 24
CABLE-44-2M	44-pin high-density D sub to discrete wires—2-meter (for AMP-205x0, -204x0)	$ 40	$ 27
CABLE-100-1M	100-pin high-density cable in 1-meter length for DMC-21x2	$ 125	$ 95
CABLE-100-2M	100-pin high-density cable in 2-meter length for DMC-21x2	$ 135	$ 100
CABLE-100-4M	100-pin high-density 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-47100	Intelligent I/O controller for Ethernet I/O expansion	$ 295	$ 195
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	
GalilTools	Set-up, tuning and analysis software	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Visual Basic, Visual C++, etc.	$ 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-205xx, 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.*

Ethernet/RS232 1-axis Controller and Drive

CDS-3310

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 brush or brushless servo motor; 72V, 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 and 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.

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

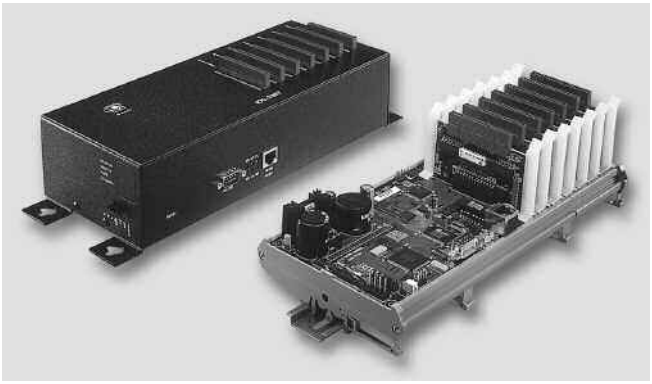
DB-28040 I/O Expansion Board

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

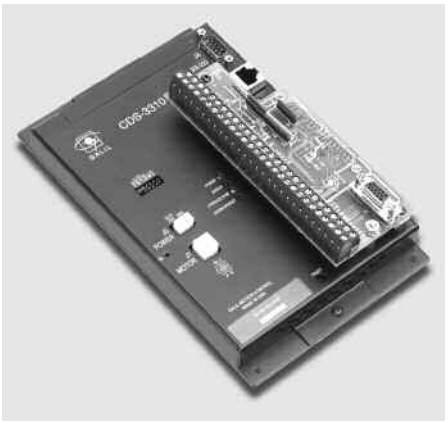
Galil's IOC-7007 I/O controller provides an intelligent solution for adding I/O and PLC functionality to the CDS-3310 Ethernet control system. The IOC-7007 I/O controller connects to the Ethernet network allowing it to communicate with CDS-3310 motion controllers and other devices on the network. The 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 and 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

**For ±10 V use DB-28040*

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: 0–70° 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)

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

Ethernet/RS232 1-axis Controller and Drive

CDS-3310

Instruction Set

Servo Motor

AG	Set AMP gain
AU	Set current loop gain
AW	Report AMP bandwidth
BW	Brake wait
DV	Dual velocity
FA	Acceleration feedforward
FV	Velocity feedforward
IL	Integrator limit
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
TK	Set AMP peak current
TL	Continuous torque limit
TM	Sample time

I/O

AL	Arm latch
AO	Analog out
BW	Brake wait
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
CF	Configure for unsolicited messages
CN	Configure switches
CW	Data adjustment bit
DE	Define dual encoder position
DP	Define position
DV	Dual velocity (dual loop)
EO	Echo off
IA	Set IP address
IH	Internet handle
IK	Ethernet port blocking

System Configuration (cont.)

IT	Independent smoothing
LZ	Leading zeros format
MB	ModBus
MO	Motor off
MT	Motor type
PF	Position format
QD	Download array
QU	Upload array
RS	Reset
^R^S	Master reset
SM	Subnet mask
TF	Tell FPGA version
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

Interrogation

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 info
RP	Report command position
RL	Report latch
^R^V	Firmware revision information
SC	Stop code
TA	Tell AMP status
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 remarks
RA	Record array
RC	Record interval
RD	Record data
'	Remark program
SL	Single step
UL	Upload program
ZS	Zero stack

Error Control

BL	Backward software limit
ER	Error limit
FL	Forward software limit
OE	Off-on-error function
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
WC	Wait for contour data
WT	Wait for time

Independent Motion Commands

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

Contour Mode

CD	Contour data
CM	Contour mode
DT	Contour time interval
WC	Wait for contour data

Gearing

GA	Master axis for gearing
GD	Engagement distance for gearing
_GP	Correction for gearing
GR	Gear ratio for gearing

Distributed Control Commands

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

Ethernet/RS232 1-axis Controller and Drive

CDS-3310

Connectors—CDS-3310

J1 Motor Output 4-pin AMP Mate-n-lock II

1 NC
2 A
3 C
4 B

J2 15-pin, Hi-density Female D-sub

1 I+
2 B+
3 A+
4 AB+
5 Ground
6 I-
7 B-
8 A-
9 AA-
10 Hall A
11 AA+
12 AB-
13 Hall B
14 Hall C
15 5 V

J3 I/O 37-pin Female D-sub

1 Reset*
2 Amp enable/Error
3 Output 3
4 Output 1
5 Analog in 1 (0 V–5 V)
6 Input 7
7 Input 5
8 Input 3
9 Input 1 (latch)
10 5 V
11 Ground
12 +12 V
13 Ground
14 Brake Power
15 Input 8- (differential input)
16 Output 9
17 Output 7
18 Output 5
19 Analog out 1 (16-bit resolution ±10V)
20 Analog ground
21 Output 4
22 Output 2
23 Encoder-compare output
24 Analog in 2 (0 V–5 V)
25 Input 6
26 Input 4
27 Input 2
28 Forward limit
29 Reverse limit
30 Home
31 -12 V
32 Brake output (500mA sinking)
33 Input 8+ (differential input)
34 Output 10
35 Output 8
36 Output 6
37 Abort*

J5 Power 2-pin AMP Mate-n-lock II

1 +VM (18 V–72 V)
2 Ground

**Active low*

Connectors—ICM-3300

Screw Terminals

1 Aux. Encoder B+
2 Aux. Encoder B-
3 Aux. Encoder A+
4 Aux. Encoder A-
5 Main Encoder Index +
6 Main Encoder Index -
7 Main Encoder B+
8 Main Encoder B-
9 Main Encoder A+
10 Main Encoder A-
11 Hall C
12 Hall B
13 Hall A
14 Ground
15 5 V
16 Abort Input†
17 Digital Input 8+
18 Digital Input 8-
19 Digital Input 7†
20 Digital Input 6†
21 Digital Input 5†
22 Digital Input 4†
23 Digital Input 3†
24 Digital Input 2†
25 Digital Input 1†
26 Input Common
27 Limit Switch Common
28 Home Input†
29 Reverse Limit Input†
30 Forward Limit Input†
31 Output Compare
32 Amplifier Enable Output†
33 Ground
34 Output Power Return
35 Output Power Supply
36 Digital Output 10†
37 Digital Output 9†
38 Digital Output 8†
39 Digital Output 7†
40 Digital Output 6†
41 Digital Output 5†
42 Digital Output 4†
43 Digital Output 3†
44 Digital Output 2†
45 Digital Output 1†
46 Brake Power Supply
47 Brake Output (Sinking)
48 -12 V output
49 +12 V Output
50 +5 V Output
51 Analog Output 1
52 Analog Input 2
53 Analog Input 1
54 Analog Input Ground
55 Error Output†
56 Reset Input*

J2 15-pin, Hi-density Female D-sub

1 Main Encoder I+
2 Main Encoder B+
3 Main Encoder A+
4 Aux Encoder B+
5 Ground
6 Main Encoder I-
7 Main Encoder B-
8 Main Encoder A-
9 Aux Encoder A-
10 Hall A
11 Aux Encoder A+
12 Aux Encoder B-
13 Hall B
14 Hall C
15 5 V

†Optically isolated

Ethernet/RS232 1-axis Controller and 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 high-density D sub to discrete wires—1 meter	$ 25	$ 17
CABLE-15-2M	15-pin high-density 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 Visual Basic, Visual C++, etc.	$ 595	

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

Ethernet/RS232 Econo 1–2 axes

DMC-14x5 Series and DMC-34x5 Series

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 the other DMC-34x5 controllers. Controllers are available as a card-level product or in a metal enclosure with power supply.

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.

DMC-14x5 and DMC-34x5 Controllers

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*

Ethernet/RS232 Econo 1–2 axes

DMC-14x5 Series and DMC-34x5 Series

Specifications

System Processor

- Motorola 32-bit microcomputer

Communications Interface

- Ethernet 10BASET 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:
  +5V 400 mA
  -12V 40 mA
  +12V 40 mA
- DMC-1415/1425/34x5 Box: accepts 90–260 V AC 50/60 Hz supply

Environmental

- Operating temperature: 0–70° C for card; 0–60° 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"

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

DMC-14x5 Series and DMC-34x5 Series

Instruction Set

Servo Motor
AF Analog feedback
DV Dual loop operation (1415)
FA Acceleration feedforward
FV Velocity feedforward
IL Integrator limit
KD Derivative constant
KI Integrator constant
KP Proportional constant
NB Notch bandwidth
NF Notch frequency
NZ Notch zero
OF Offset
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
RP Report commanded position
TD Step counts output
TP Tell position of encoder

Brushless Motor (-1415,-3415 only)
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 Commands
AL Arm latch
AO Set analog voltage
CB Clear bit
CI Communication interrupt
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
BV Burn variables and arrays
CE Configure encoder type

System Configuration (cont.)
CF Configure unsolicited messages
CN Configure switches
CO Configure I/O points
CW Data adjustment bit
DE Define dual encoder position
DP Define position
EO Echo off
IA Set IP address
IH Internet handle
IK Ethernet port blocking
IT Independent smoothing
LZ Leading zeros format
MB ModBus
MO Motor off
MT Motor type
PF Position format
QD Download array
QU Upload array
^R^S Master reset
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

Interrogation
LA List arrays
LL List labels
LS List program
LV List variables
MG Message command
QR Data record
QZ Return data record
RP Report command position
RL Report latch
^R^V Firmware revision information
SC Stop code
TB Tell status
TC Tell error code
TD Tell dual encoder
TE Tell error
TH Tell Ethernet handle
TI Tell input
TIME Time operand
TP Tell position

Interrogation (cont.)
TR Trace program
TS Tell switches
TT Tell torque
TV Tell velocity
TZ Tell I/O configuration
WH Which handle

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 for RA
RD Record data for RA
RE Return from Error
REM Remark program
RI Return from interrupt
SA Send command
SL Single step
UL Upload program
XQ Execute program
ZS Zero stack
' Comment

Error Control
BL Backward software limit
ER Error limit
FL Forward software limit
OE Off-on-error function
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

Trippoint (cont.)
WC Wait for contour data
WT Wait for time

Independent Motion
AB Abort motion
AC Acceleration
BG Begin motion
DC Deceleration
FE Find edge
FI Find index
HM Home
IP Increment position
IT Smoothing time constant
JG Jog mode
PA Position absolute
PR Position relative
SP Speed
ST Stop

Contour Mode
CD Contour data
CM Contour mode
DT Contour time interval
WC Wait for contour data

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
GA Master axis for gearing
GM Gantry mode
GR Gear ratio for gearing

Vector/Linear Interpolation (DMC-1425, -3425 only)
CR Circular interpolation move
CS Clear motion sequence
ES Ellipse scaling
LE Linear interpolation end
LI Linear interpolation segment
LM Linear interpolation mode
ST Stop motion
VA Vector acceleration
VD Vector deceleration
VE Vector sequence end
VM Coordinated motion mode
VP Vector position
VR Vector speed ratio
VS Vector speed
VT Smoothing time constant—vector

Ethernet/RS232 Econo 1–2 axes

DMC-14x5 Series and DMC-34x5 Series

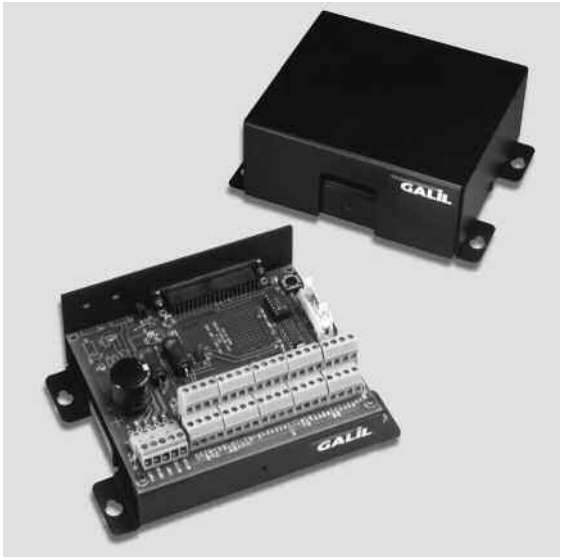
Hardware Accessories

ICM-1460

The ICM-1460 Interconnect Module provides screw terminals 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 configurable by the user for inputs or outputs. The I/O is accessible through two 50-pin headers.

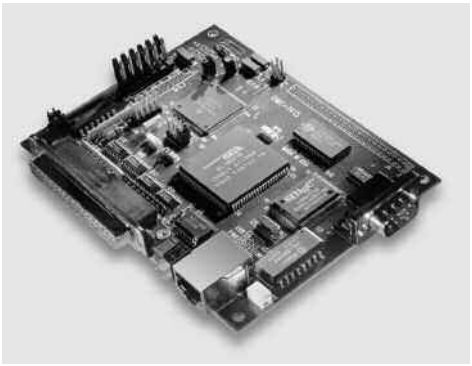
DMC-34x5 Distributed Control Option

The DMC-34x5 Series distributed control system can operate with a single communication channel between the host and the master controller. One controller is programmed to be the master and maintains communication with each slave. Commands sent by the host computer to the master controller 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 simplify 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 combination 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 DC Volt input. Output power is 20W per amplifier. 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.

Ethernet/RS232 Econo 1–2 axes

DMC-14x5 Series and DMC-34x5 Series

Connectors

DMC-1415, 3415 J3

Main 37-pin D-type

1	Reset* (TTL)	20	Error*
2	Amp enable	21	ACMD (STEP for Stepper Motor)
3	Output 3	22	Output 2
4	Output 1	23	Output compare
5	Analog Input 1	24	Analog Input 2
6	Input 7	25	Input 6
7	Input 5	26	Input 4
8	Input 3	27	Input 2
9	Input 1 (and latch)	28	Forward limit
10	+5V	29	Reverse limit
11	Ground	30	Home
12	+12V	31	-12V
13	Ground	32	Main Encoder A+
14	Main Encoder A-	33	Main Encoder B+
15	Main Encoder B-	34	Main Encoder I+
16	Main Encoder I-	35	Auxiliary A+
17	Auxiliary A-	36	Auxiliary B+
18	Auxiliary B-	37	Abort*
19	ACMD Phase B (DIR for Stepper Motor) (For Sinusoidal Commutation)		

DMC-1425, -3425 J3

Main 37-pin D-type

1	Reset*	20	Error*
2	Amp Enable (both motors)	21	ACMDX/STEPX
3	Output 3	22	Output 2
4	Output 1	23	Output compare
5	Analog 1	24	Analog 2
6	Index Y	25	Home Y
7	Reverse limit Y	26	Forward limit Y
8	Input 3	27	Input 2 (Y latch input)
9	Input 1 (X latch input)	28	Forward limit X
10	+ 5V	29	Reverse limit X
11	Ground	30	Home X
12	+12V	31	-12 V
13	Ground	32	X Encoder A+
14	X Encoder A -	33	X Encoder B+
15	X Encoder B -	34	X Encoder I+
16	X Encoder I -	35	Y Encoder A+
17	Y Encoder A -	36	Y Encoder B +
18	Y Encoder B -	37	Abort*
19	ACMDY/DIRX		

**Active low*

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

Remote I/O Controller

RIO-47100

Product Description

The RIO-47100 is an intelligent input and output controller for the Ethernet and can communicate with multiple devices including Galil's DMC-40x0 Ethernet motion controllers. The RIO-47100 contains a fast RISC processor for handling I/O logic and is programmed using Galil's easy-to-use, two-letter command language. The on-board intelligence of the RIO-47100 frees the host for other tasks and allows the RIO to replace PLCs (Programmable Logic Controllers.)

RIO-47100 Remote I/O Controller

Each RIO-47100 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-47100 units can be distributed on an Ethernet network allowing I/O expansion.

The RIO receives power from Power-Over-Ethernet (PoE) or an external 18–36 VDC supply. Measuring just 3.88" x 4.26" x 1.30", the RIO is packaged in a compact metal enclosure and provides D-type connectors for convenient interface.

Features

- *Intelligent, Remote Ethernet I/O Controller*
- *10/100Base-T Ethernet Link and RS232 port*
- *8 analog inputs with 12-bit ADC, 0–5 V*
- *8 analog outputs with 12-bit DAC, 0–5 V*
- *16 optically isolated inputs*
- *8 high-power, isolated outputs rated at 500 mA per output*
- *8 isolated outputs rated at 25mA max per output*
- *LED indicators for all digital I/O points*
- *Contains RISC processor and memory for programming I/O events*
- *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 18–36V DC input*
- *Small Size: 3.88" x 4.26" x 1.30"*
- *Metal Enclosure*
- *D-type connectors for easy interface to I/O*
- *ModBus/TCP master or slave*

Remote I/O Controller

RIO-47100

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

- Program memory size- 200 lines x 40 characters
- 126 variables
- 400 array elements in up to 6 arrays

I/O

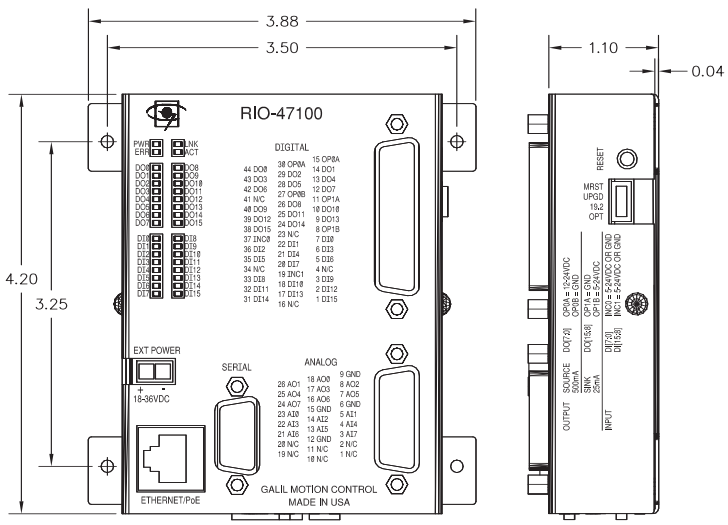
- Digital Outputs 0–7 are opto-isolated sourcing power outputs. 12–24 VDC, 500 mA*
- Digital Outputs 8–15 are opto-isolated sinking outputs. 5–24 VDC, 25 mA
- Digital Inputs 0–15 are opto-isolated inputs. 2.2 K series resistor for 5–24 V input
- Analog Inputs 0–7 are 0–5 VDC, 100 K input impedance. 12-bit ADC
- Analog Outputs 0–7 are 0–5 VDC source/sink, 4 mA. 12-bit DAC

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

- 3.88″× 4.26″× 1.30″



**Requires external DC supply.*

Connectors

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 Hi-density 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 Hi-density 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

Remote I/O Controller

RIO-47100

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
MS	Email source address
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

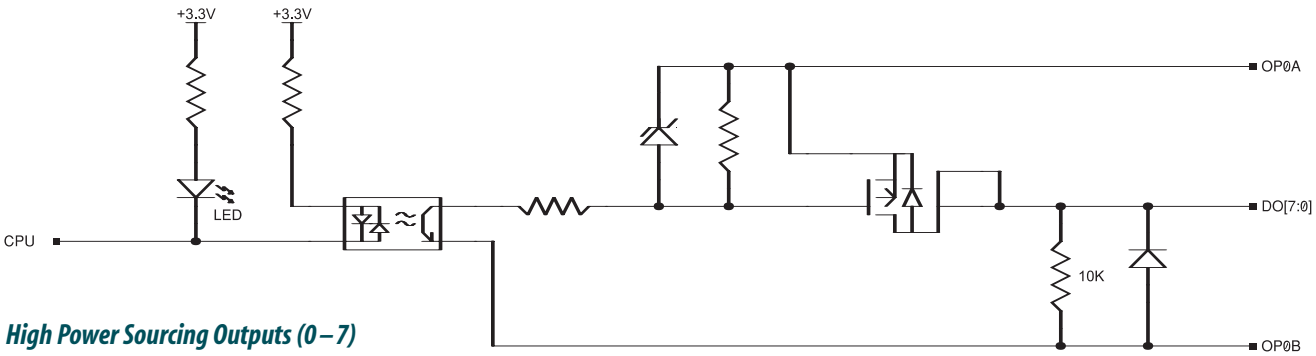
BN	Burn parameters
BP	Burn program
BV	Burn variables and arrays
CF	Configure default port
CW	Data adjustment bit
DR	Configure I/O data record
EO	Echo off
IK	Ethernet port blocking
^L^K	Lock program
LZ	Leading zeros format
PW	Password
QD	Download array
QU	Upload array
RS	Reset
^R^S	Master reset
VF	Variable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

Trippoint

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

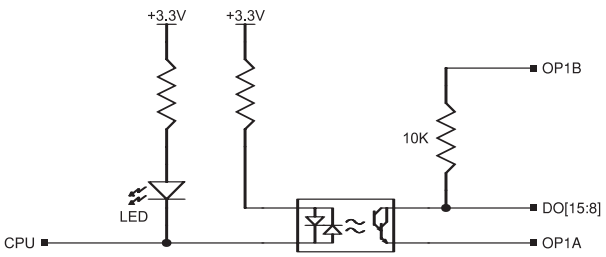
Remote I/O Controller

RIO-47100



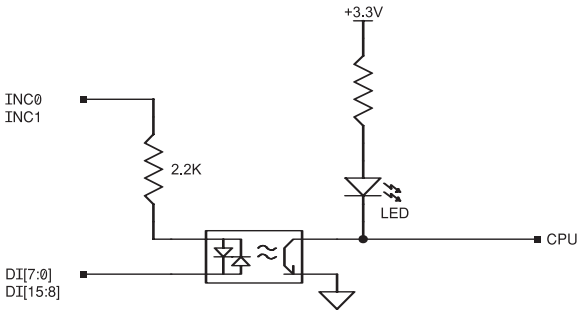
High Power Sourcing Outputs (0 – 7)

Digital Outputs 0 – 7 are opto-isolated sourcing power outputs.
12 – 24 VDC with 500 mA of current capability per output



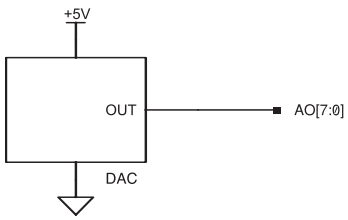
Low Power Sinking Outputs (8 – 15)

Digital Outputs 8 – 15 are opto-isolated sinking outputs.
5 – 24 VDC with 25 mA of current capability in a sinking configuration



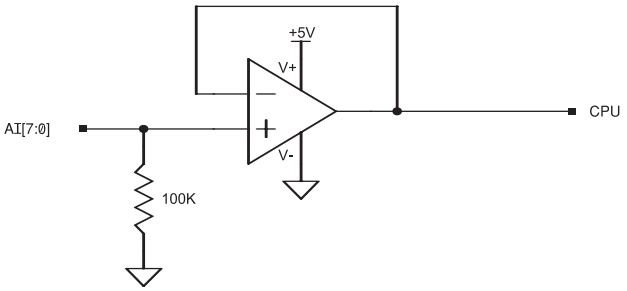
Digital Inputs

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



Analog Outputs

Analog Outputs 0 – 7 have a voltage range of 0 – 5 VDC. 12-bit DAC.
Sink or source up to 4 mA of current



Analog Inputs

Analog Inputs 0 – 7 have a voltage range of 0 – 5 VDC.
12-bit ADC with a 100k input impedance

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
RIO-47100	Remote I/O controller	$ 295	$ 195
-DIN	DIN-rail mounting option	$ 25	$ 25
CABLE-44-1M	44-pin D high-density male cable to discrete wires	$ 35	$ 24
CABLE-26-1M	26-pin D high-density male cable to discrete wires	$ 25	$ 17
ICS-48026-M	26-pin D high-density male to screw terminals	$ 75	$ 50
ICS-48044-M	44-pin D high-density male to screw terminals	$ 75	$ 50

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

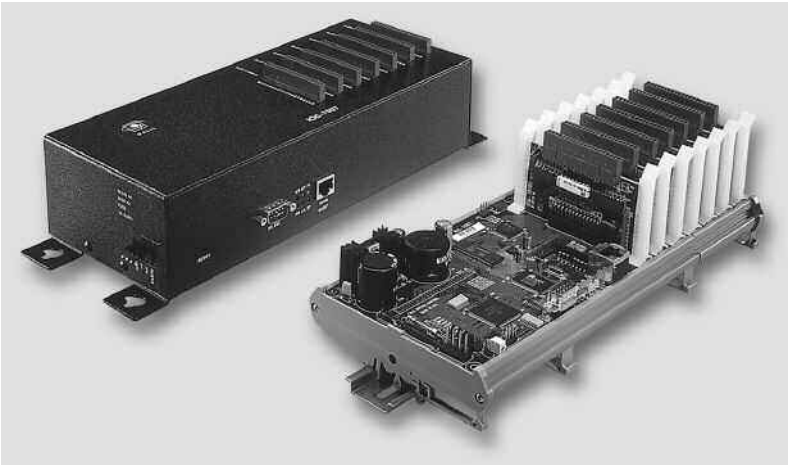
Ethernet I/O Controller

IOC-7007

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*

Application Programming

The IOC-7007 command language is similar to the command language of Galil motion controllers, but the motion-specific commands are removed and additional I/O commands added. The language is comprised of intuitive, two-letter English-like ASCII commands designed to make programming as quick and easy as possible. For example, the command "SB1" sets output bit 1 and "CB1" clears output bit 1. The complete set of commands is described in the Command Table.

Like all Galil motion controllers, the IOC-7007 has the ability to store and execute complex application programs designed by the user. Such application programs can be downloaded directly to the controller and executed without host intervention. Special commands are available for application programming including event triggers, conditional jumps, IF/THEN/ELSE statements, subroutines, symbolic variables and arrays.

The IOC-7007 permits multitasking, which allows up to eight application programs to execute simultaneously. An additional task can be executed in a special PLC mode which is described in the next section.

Example

INSTRUCTION	INTERPRETATION
#TASK1	*Task1 label*
XQ #TASK2,1	*Execute Task2 in thread 1*
WT20000	*Wait for 20 seconds*
HX1	*Stop thread 1*
MG"DONE"	*Print Message*
EN	*End of Program*
#TASK2	*Task2 label*
AT0	*Initialize reference time*
CB1	*Clear Output 1*
#LOOP	*Loop label*
AT 10	*Wait 10 msec from reference time*
SB1	*Set Output 1*
AT -40	*Wait 40 msec from reference time, then initialize reference*
CB1	*Clear Output 1*
JP #LOOP	*Repeat Loop*
EN	*End task*

PLC Mode

The PLC Mode is a special mode of operation that allows fast execution of an application program. The program is compiled into optimized code for faster execution with deterministic timing. This feature provides quick and accurate I/O scans.

The special PLC application program is designated with the label #PLCSCAN. All commands following the #PLCSCAN label are part of the program. A subset of Galil commands that are available for use in the PLC mode are designated in bold in the command list. Variables and arrays are also available in the PLC mode. The CP command compiles the PLC program and the PLC program is executed with the XP command. Precisely the same number of PLC commands are executed per update period which allows for deterministic timing.

Example

INSTRUCTION	INTERPRETATION
#PLCSCAN	*PLC special label*
IF (@IN[5]=1)	*If Input 5 equals one*
CB1	*Clear Output 1*
ELSE	*If Input 5 equals 0*
SB1	*Set Output 1*
ENDIF	*Terminate IF statement*
EN	*End PLC program*

Specifications

System Processor

- Motorola 32-bit microcomputer

Communications Interface

- Ethernet 10/100BASE-T and RS232 port up to 19.2 kbaud

Memory

- Program — 500 lines × 80 characters
- Variables — 126
- Array — 2000 array elements in up to 14 arrays

Power Requirements

- AC option (BOX version only): 90 – 260 VAC 50/60 Hz
- DC option (BOX, DIN, CARD): 20 – 60 VDC input

Mechanical

- IOC-7007 board: 10.75" × 4.25"
- IOC-7007-box: 10.8" × 4.5" × 2.6"
- IOC-7007-DIN: fits standard DIN mount
- IOM modules: 1.8" × 3.2"

IOM Electrical Specifications

- IOM-70016: 16 buffered inputs, 2.2 K ohm pull-up
- IOM-70108: 8 optoisolated inputs, 2.2 K pull-up for 5 V in, 10k for 24 V in
- IOM-70208: 8 optoisolated outputs, 24 V @ 25 mA each
- IOM-70308: 8 low-side, high-power outputs, 24 V @ 100 mA each
- IOM-70404: 4 dry contact relays, 150 V @ 250 mA each
- IOM-70508: 8 high-side, high-power outputs, 30 V @ 500 mA each
- IOM-70808: 8 analog inputs*, 12-bits standard, 16-bit option
- IOM-70904: 4 analog outputs, 12-bits standard, 16-bit option
- IOM-70908: 8 analog outputs, 12-bits standard, 16-bit option

**Analog inputs (± 10 V, 0–10 V, ± 5 V, 0–5 V)*

Ethernet I/O Controller

IOC-7007

Instruction Set

Ethernet

IA	Set IP address
IH	Internet handle
MB	ModBus
MW	ModBus wait

I/O

AO	**Analog output voltage**
CB	**Clear bit**
II	Input interrupt
OB	**Define output bit**
OQ	**Output port**
SB	**Set bit**
@AO[x]	**State of analog output x**
@IN[x]	**State of digital input x**
@OUT[x]	**State of digital output x**
@AN[x]	**Value of analog input x**

Interrogation

LA	List arrays
LL	List labels
LR	Launch slave record
LS	List program
LV	List variables
MG	Message command
QR	Data record
QZ	Return data record information
^R^V	Revision
TB	Tell status
TC	Tell error code
TH	Tell Ethernet handle
TI	Tell input
TIME	**Time operand, internal clock**
TQ	Tell thread execution
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 compliment 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
+,-,*,/	**Arithmetic commands**
>,<,=,>=,<=,<>	**Logical operators**
&	**Logical AND**
|	**Logical OR**

Programming

AB	Abort program
DA	Deallocate variables/arrays
DL	Download program
DM	Dimension arrays
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 remarks**
RA	Record array, automatic data capture
RC	Record interval for RA
RD	Record data for RA
RE	Return from Error
RI	Return from interrupt routine
SA	Send command
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
EO	Echo off
HS	Handle Assignment
IK	Ethernet port blocking
LZ	Leading zeros format
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

PLC Mode

CP	**Compile PLC thread**
HP	**Halt PLC thread**
TX	**Tell PLC execution time**
XP	**Execute PLC thread**

Note: **Commands in bold designate commands available for the PLC mode**

IOC-7007

Connectors

20-pin molex for each IOM module

IOM-70016 16-TTL input module

1	5 VDC supply output (50 mA max)
2	Ground reference for TTL inputs
3	TTL Input 1
4	TTL Input 2
5	TTL Input 3
6	TTL Input 4
7	TTL Input 5
8	TTL Input 6
9	TTL Input 7
10	TTL Input 8
11	TTL Input 9
12	TTL Input 10
13	TTL Input 11
14	TTL Input 12
15	TTL Input 13
16	TTL Input 14
17	TTL Input 15
18	TTL Input 16
19	NC
20	NC

IOM-70108 8 Opto-isolated input module

1	NC
2	NC
3	Opto Input 1 (Anode)
4	Opto Input 1 (Cathode)
5	Opto Input 2 (Anode)
6	Opto Input 2 (Cathode)
7	Opto Input 3 (Anode)
8	Opto Input 3 (Cathode)
9	Opto Input 4 (Anode)
10	Opto Input 4 (Cathode)
11	Opto Input 5 (Anode)
12	Opto Input 5 (Cathode)
13	Opto Input 6 (Anode)
14	Opto Input 6 (Cathode)
15	Opto Input 7 (Anode)
16	Opto Input 7 (Cathode)
17	Opto Input 8 (Anode)
18	Opto Input 8 (Cathode)
19	NC
20	NC

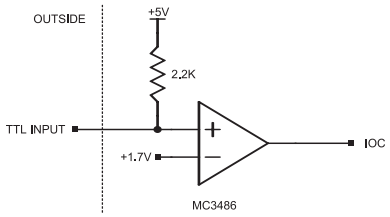
IOM-70208 8 Opto-isolated output module

1	NC
2	NC
3	Opto Output 1 (Collector)
4	Opto Output 1 (Emitter)
5	Opto Output 2 (Collector)
6	Opto Output 2 (Emitter)
7	Opto Output 3 (Collector)
8	Opto Output 3 (Emitter)
9	Opto Output 4 (Collector)
10	Opto Output 4 (Emitter)
11	Opto Output 5 (Collector)
12	Opto Output 5 (Emitter)
13	Opto Output 6 (Collector)
14	Opto Output 6 (Emitter)
15	Opto Output 7 (Collector)
16	Opto Output 7 (Emitter)
17	Opto Output 8 (Collector)
18	Opto Output 8 (Emitter)
19	NC
20	NC

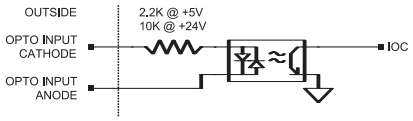
IOM-70308 8 Opto-isolated high power output module

1	NC
2	NC
3	Power Output 1
4	Power Output 2
5	Power Output 3
6	Power Output 4
7	Power Output 5
8	Power Output 6
9	Power Output 7
10	Power Output 8
11	NC
12	NC
13	NC
14	NC
15	NC
16	NC
17	NC
18	NC
19	VIN_ISO, Input for Power supply (+)
20	Ground_ISO, Input for Return supply (-)

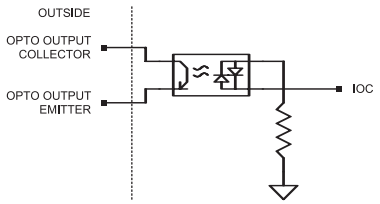
IOM-70016
16 TTL Input Module for IOC-7007



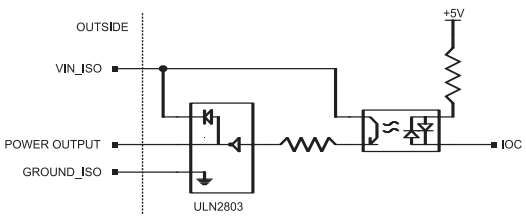
IOM-70108
8 Opto-isolated Inputs



IOM-70208
8 Opto-isolated Outputs



IOM-70308
8 Opto-isolated High Power Outputs



Ethernet I/O Controller

IOC-7007

Connectors

20-pin molex for each IOM module

IOM-70508 8 Opto-isolated high power output module

1	NC
2	NC
3	Power Output 1 (+)
4	Power Output 2 (+)
5	Power Output 3 (+)
6	Power Output 4 (+)
7	Power Output 5 (+)
8	Power Output 6 (+)
9	Power Output 7 (+)
10	Power Output 8 (+)
11	NC
12	NC
13	NC
14	NC
15	VIN_ISO, Input for Power supply (+)
16	VIN_ISO, Input for Power supply (+)
17	VIN_ISO, Input for Power supply (+)
18	VIN_ISO, Input for Power supply (+)
19	VIN_ISO, Input for Power supply (+)
20	Ground_ISO, Input for Return supply (-)

IOM-70404 4 Dry contact relay output module

1	NC
2	NC
3	Relay Output Common 1
4	Relay Output Normally Open 1
5	Relay Output Normally Close 1
6	Relay Output Common 2
7	Relay Output Normally Open 2
8	Relay Output Normally Close 2
9	Relay Output Common 3
10	Relay Output Normally Open 3
11	Relay Output Normally Close 3
12	Relay Output Common 4
13	Relay Output Normally Open 4
14	Relay Output Normally Close 4
15	NC
16	NC
17	NC
18	NC
19	NC
20	NC

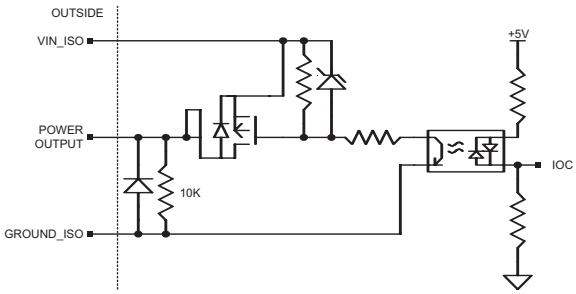
IOM-70808 8 Analog input module

1	+5 V
2	Ground
3	Analog Input 1
4	Analog Ground
5	Analog Input 2
6	Analog Ground
7	Analog Input 3
8	Analog Ground
9	Analog Input 4
10	Analog Ground
11	Analog Input 5
12	Analog Ground
13	Analog Input 6
14	Analog Ground
15	Analog Input 7
16	Analog Ground
17	Analog Input 8
18	Analog Ground
19	NC
20	NC

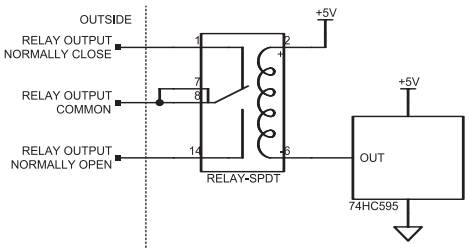
IOM-70908 8 Analog output module

1	+5 V
2	Ground
3	Analog Output 1
4	Analog Ground
5	Analog Output 2
6	Analog Ground
7	Analog Output 3
8	Analog Ground
9	Analog Output 4
10	Analog Ground
11	Analog Output 5
12	Analog Ground
13	Analog Output 6
14	Analog Ground
15	Analog Output 7
16	Analog Ground
17	Analog Output 8
18	Analog Ground
19	NC
20	NC

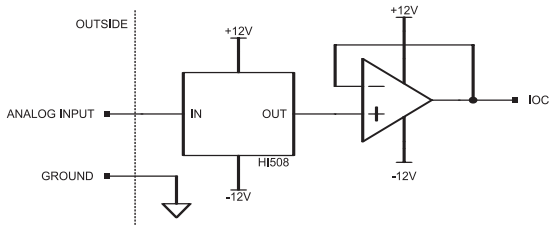
IOM-70508
8 Opto-isolated High Power Outputs



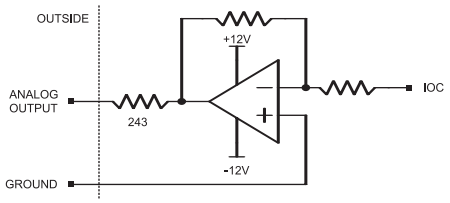
IOM-70404
4 Dry Contact Relay Outputs



IOM-70808-12 8 Analog Inputs



IOM-70908 8 Analog Outputs



Ethernet I/O Controller

IOC-7007

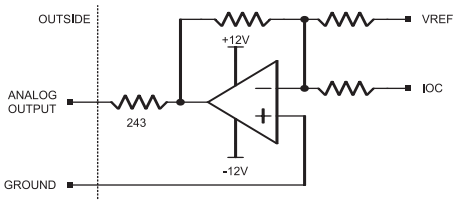
Connectors

20-pin molex for each IOM module

IOM-70904 4 Analog output module

1	+5 V	11	NC
2	Ground	12	NC
3	Analog Output 1	13	NC
4	Analog Ground	14	NC
5	Analog Output 2	15	NC
6	Analog Ground	16	NC
7	Analog Output 3	17	NC
8	Analog Ground	18	NC
9	Analog Output 4	19	NC
10	Analog Ground	20	NC

IOM-70904 4 Analog Outputs



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.

Other — Optima Series
PC/104, ISA, cPCI, PCI, Ethernet/RS232

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 Econo controllers.

Complete specifications are included in the following pages.

PC/104, cPCI, ISA, PCI, Ethernet Optima 1–8 Axes Product Comparison Chart

	DMC-12x0	DMC-16x0	DMC-17x0	DMC-18x0	DMC-22x0
Communication interface	PC/104	cPCI	ISA	PCI	Ethernet 10/100Base-T RS232 x 2 (115 kb)
Form factor	card	card	card	card	box
Number of axes	x=1,2,3,4,5,6,7,8	x=1,2,3,4	x=1,2,3,4,5,6,7,8	x=1,2,3,4,5,6,7,8	x=1,2,3,4,5,6,7,8
Connector type	50-pin IDC x 2	100-pin SCSI	100-pin SCSI	100-pin SCSI	100-pin SCSI
Mating interconnect module	ICM-1900/-2900	ICM-1900/-2900	ICM-1900/-29000	ICM-1900/-2900	ICM-2900
Power requirement	5V,+/-12V	5V,+/-12V	5V,+/-12V	5V,+/-12V	90-260 VAC
Maximum encoder rate	12 MHz	12 MHz	12 MHz	12 MHz	12 MHz
Maximum stepper rate	3 MHz	3 MHz	3 MHz	3 MHz	3 MHz
Minimum servo update time	125 usec 1-, 2-axes	125 usec 1-, 2-axes	125 usec 1-, 2-axes	125 usec 1-, 2-axes	1-2 axes: 250 µsec 7-8 axes: 625 µsec
Optoisolated digital inputs	no	yes	yes	yes	yes
# of uncommitted digital inputs	1-4 ax: 8; 5-8 ax: 16	8	1-4 ax: 8; 5-8 ax: 24	1-4 ax: 8; 5-8 ax: 24	1-4 ax: 8; 5-8 ax:16
# of uncommitted digital outputs	1-4 ax: 8; 5-8 ax: 16	8	1-4 ax: 8; 5-8 ax:16	1-4 ax: 8; 5-8 ax:16	1-4 ax: 8; 5-8 ax:16
# of analog inputs	8	8	8	8	8
# of programmable I/O	64 (with DB-12064)	64	64 (with DB-14064)	64 (with DB-14064)	64
Dual encoder for each axis	yes	yes	yes	yes	yes
Program memory size (lines x chr)	1000 x 80	1000 x 80	1000 x 80	1000 x 80	1000 x 80
Array size (number of elements)	8000	8000	8000	8000	8000
# of variables	254	254	254	254	510
# of tasks for multitasking	8	8	8	8	8
Drive options	AMP-19520 AMP-19540	AMP-19520 AMP-19540	AMP-19520 AMP-19540	AMP-19520 AMP-19540	AMP-19520 AMP-19540
Price: qty 1 (4-axis) ***Price: qty 100 (4-axis)***	DMC-1240: $2195 DMC-1240: $995	DMC-1640: $2495 DMC-1640: $1145	DMC-1740: $2195 DMC-1740: $995	DMC-1840: $2195 DMC-1840: $ 995	DMC-2240: $2595 DMC-2240: $1295

Other—Econo Single Axis
ISA, PC/104, RS232, PCI

ISA, PC/104, RS232, PCI Econo 1 Axis Product Comparison Chart

	DMC-1410	DMC-1411	DMC-1412	DMC-1417
Communication interface	ISA	PC/104	RS232	PCI
Form factor	card	card	card or box	card
Number of axes	1	1	1	1
Connector type	37-pin D	40-pin IDC	37-pin D	37-pin D
Mating interconnect module	ICM-1460	ICM-1460	ICM-1460	ICM-1460
Power requirement	5V,+/-12V	5V,+/-12V	5V,+/-12V card 90-260 VAC box	5V,+/-12V card
Maximum encoder rate	8 MHz	8 MHz	8 MHz	8 MHz
Maximum stepper rate	2 MHz	2 MHz	2 MHz	2 MHz
Minimum servo update time	375 usec 1-axis	375 usec 1-axis	375 usec 1-axis	375 usec 1-axis
Optoisolated digital inputs	no*	no*	no*	no*
# of uncommitted digital inputs	7	7	7	7
# of uncommitted digital outputs	3	3	3	3
# of analog inputs	0	0	0	0
Dual encoder for each axis	yes	yes	yes	yes
Program memory size (lines x chr)	250 x 40	250 x 40	250 x 40	250 x 40
Array size (# of elements)	1000	1000	1000	1000
Number of variables	126	126	126	126
# of tasks for multitasking	2	2	2	2
Price: qty 1	$595	$595	DMC-1412-card $595	DMC-1417 $595
Price: qty 100	$395	$395	DMC-1412-card $395	DMC-1417 $395

**Optical isolation available with ICM-1460-OPTO*

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

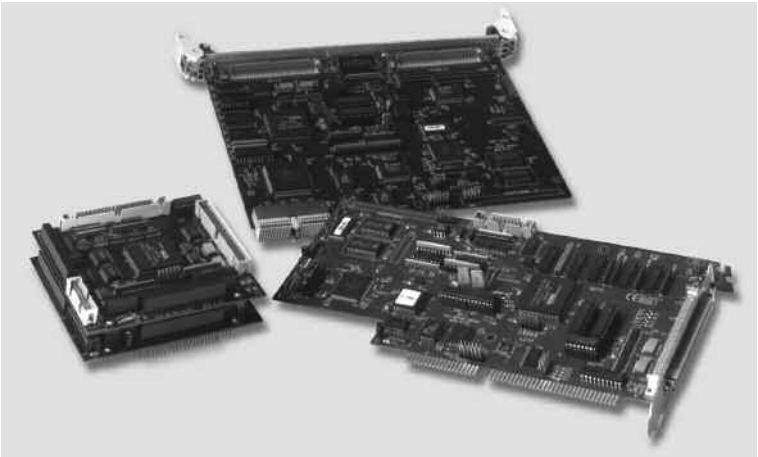
DMC-12x0, DMC-16x0, DMC-17x0, DMC-18x0 Series

Product Description

The DMC-12x0, 16x0, DMC-17x0 and DMC-18x0 are Optima motion controllers which are prior generation. The controllers differ only in their communication interface: DMC-12x0 is for PC/104; DMC-16x0 for cPCI, DMC-17x0 for ISA bus and DMC-18x0 for PCI. For single axis applications, Galil's Econo DMC-1410 (ISA), DMC-1411 (PC/104), DMC-1412 (RS232), or DMC-1417 (PCI) controllers should be considered.

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

Left to right:
DMC-12x0 PC/104
DMC-16x0 CompactPCI
DMC-17x0 ISA



programmable notch, program memory with multitasking for simultaneously running up to eight applications programs, and uncommitted I/O for synchronizing motion with external events. They handle various modes of motion including point-to-point positioning, jogging, linear and circular interpolation, contouring, electronic gearing and ECAM. Additionally, the controllers are user-configurable for stepper or servo motor control on any combination of axes.

Like all Galil controllers, the 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 DOS, Linux and all current Windows operating systems.

Features

- *Available in various communication and axes formats:*
  DMC-12x0: PC/104 x=1,2,3,4,5,6,7,8 axes
  DMC-16x0: cPCI x=1,2,3,4 axes plus 64 extended I/O
  DMC-17x0: ISA x=1,2,3,4,5,6,7,8 axes
  DMC-18x0: PCI x=1,2,3,4,5,6,7,8 axes
- *User-configurable for stepper or servo motors on any combination of axes. Optional firmware for piezo-ceramic motors. Sinusoidal commutation for brushless servo motors*
- *12 MHz encoder frequencies for servos, 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. Concurrent execution of up to eight application programs*
- *Isolated home and forward and reverse limits accepted for every axis. Isolation not available on the DMC-12x0*
- *8 isolated uncommitted inputs and 8 outputs for 1- through 4-axes models, 24 in/16 out for 5- through 8-axis models. Optical isolation not available on the DMC-12x0*
- *High speed position latch for each axis and output compare*
- *8 uncommitted analog inputs*
- *Dual encoder inputs for each axis*
- *DMC-16x0 includes 64 configurable I/O. Additional 64 I/O may be added on DMC-12x0 and DMC-17x0 using the DB-12064 or DB-14064 daughter board*
- *100-pin SCSI connectors for each set of 4 axes. Galil's ICM-1900 interconnect module breaks-out the 100-pin cable into screw terminals*
- *Communication drivers for all current versions of Windows, DOS and Linux*
- *CE certified — DMC-17x0 and DMC-18x0*
- *Custom hardware and firmware options available*

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

Specifications

System Processor

- Motorola 32-bit microcomputer

Communications Interface

- DMC-12x0: PC/104 with bi-directional, high speed FIFO
- DMC-16x0: CompactPCI with bi-directional FIFO plus auxiliary FIFO
- DMC-17xx: ISA with bi-directional FIFO plus auxiliary FIFO
- DMC-18x0: PCI with bi-directional FIFO plus auxiliary FIFO, and DPRAM

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
- 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
- Dual-loop control for backlash compensation
- 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

	DIGITAL INPUTS	DIGITAL OUTPUTS	CONFIGURABLE I/O
DMC-1210 thru -1240*	8	8	64 w/ DB-12064
DMC-1250 thru -1280*	16	16	64 w/ DB-12064
DMC-1610 thru -1640	8	8	64
DMC-1710 thru -1740	8	8	64 w/ DB-14064
DMC-1750 thru -1780	24	16	64 w/ DB-14064
DMC-1810 thru -1840	8	8	64 w/ DB-14064
DMC-1850 thru -1880	24	16	64 w/ DB-14064

Uncommitted Analog Inputs

- 8 individual ±10 V analog inputs with 12-bit resolution (16-bit available as an option)

High Speed Position Latch

- Uncommitted inputs 1–4 latch X, Y, Z, W and 9–12 latch E, F, G, H axes (latches within 0.1 microseconds without optoisolation and 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 — optoisolated*

Dedicated Outputs (per axis)

- Analog motor command output with 16-bit DAC resolution
- Pulse and direction output for step motors
- PWM output 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
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)

** DMC-1200 has TTL limits, home, and general inputs.*

† Reduced feature set for -FAST.

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

Specifications – continued

Power Requirements

+5V 750 mA
-12V 40 mA
+12V 40 mA

Environmental

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

Mechanical

- DMC-12x0
  1–4 axes: 4.4" × 4.15" (2 stacked cards)
  5–8 axes: 4.4" × 4.15" (3 stacked cards)
- DMC-16x0
  1–4 axes: 6U
- DMC-17x0
  1–4 axes: 10.25" × 4.8"
  5–8 axes: 13.25" × 4.8"
- DMC-18x0
  1–4 axes: 8.175" × 4.2"
  5–8 axes: 12.28" × 4.2"

Hardware Accessories

ICM-1900 Interconnect Module

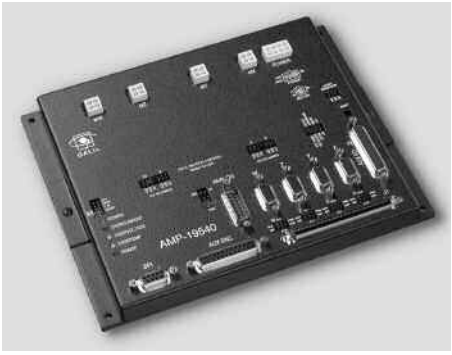
The ICM-1900 Interconnect Module breaks-out the 100-pin main cable and 25-pin auxiliary encoder cable into screw-type terminals for quick connection of system hardware. An ICM-1900 is required for each set of four axes. The ICM-1900 is contained in a metal enclosure with dimensions of 13.5" × 3.0" × 7.0" and 1/4" diameter keyholes for mounting. The ICM is default configured for high amp enable (-HAEN). For low amp enable, order ICM-1900-LAEN. Specify -OPTO for optoisolated outputs.

DB-14064 I/O Expansion

The DB-14064 is an optional board which provides 64 additional I/O for the DMC-17x0, and DMC-18x0 controllers (for the DMC-12x0 use the DB-12064). This board mounts directly onto the back of the controller and provides 64 I/O points configurable by the user as inputs or outputs. The I/O is accessible through two 50-pin IDC headers.

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. By interfacing directly to Galil's Optima 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 the Optima 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.



AMP-19540

ICM-2900 Interconnect Module

The ICM-2900 breaks-out the 100-pin SCSI cable into removable 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 mounting. Specify -OPTO for optoisolated outputs. Specify -HAEN for high amp enable or -LAEN for low amp enable.

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 high-density cable in 1-meter length	$ 125	$ 95
CABLE-100-2M	100-pin high-density cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin high-density 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 high-density cable in 1 meter length	$ 90	$ 75
CABLE-36-3M	36-pin high-density cable in 3 meter length	$ 110	$ 90
CABLE-100-1M	100-pin high-density cable in 1 meter length	$ 125	$ 95
CABLE-100-2M	100-pin high-density cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin high-density 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.

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

DMC-22x0 and DMC-20x0 Series

Product Description

The DMC-20x0 and DMC-22x0 Optima Series are box-level, multi-axis controllers designed for stand-alone applications. The controllers differ only in their type of communication interface: the DMC-20x0 has USB and the DMC-22x0 has an Ethernet 10/100Base-T port. The controllers also include two RS232 serial ports. The DMC-20x0 and DMC-22x0 controllers are available for 1 through 8 axes.

The DMC-2xx0 controllers incorporate a 32-bit microcomputer and provide such advanced features as PID compensation with velocity and acceleration feedforward, programmable notch filter, program memory with multitasking for simultaneously running up to eight application programs, and uncommitted I/O for synchronizing motion with external events. They handle various modes of motion including point-to-point positioning, jogging, linear and circular interpolation, contouring, electronic gearing and ECAM. Additionally, the controllers are user-configurable for stepper or servo motor control on any combination of axes.

DMC-22x0 Stand-alone with Ethernet/RS232

Like all Galil controllers, the DMC-2xx0 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 Linux and Windows operating systems.

Features

- *Box-level, stand-alone motion controllers*
- *Available in 1 through 8 axis versions: where x=1,2,3,4,5,6,7,8 axes*
- *Two RS232/422 ports up to 115 kbaud*
- *DMC-20x0: USB*
  DMC-22x0: Ethernet 10/100 Base-T
- *Ethernet supports multiple masters and slaves. TCP/IP, UDP and ModBus TCP master protocol for communication with I/O*
- *User-configurable for stepper or servo motors on any combination of axes. Optional firmware for piezo-ceramic motors. Sinusoidal commutation for brushless servo motors*
- *12 MHz encoder frequencies for servos; 3 MHz for steppers*
- *PID compensation with velocity and acceleration feedforward, integrator limit, 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 directly executable by controller. Includes conditional statements and event triggers*
- *Non-volatile memory for programs, variables and arrays. Concurrent execution of up to eight application programs*
- *Dual encoders, isolated home and limits for each axis*
- *8 optoisolated uncommitted inputs and 8 outputs for 1- through 4-axis models, 16 in/16 out for 5- through 8-axis models*
- *High speed position latch for each axis and output compare*
- *8 uncommitted analog inputs*
- *Additional 64 configurable digital I/O*
- *Use Galil's IOC-7007 I/O controller for additional I/O*
- *100-pin SCSI connectors for each set of 4 axes. Galil's ICM-2900 interconnect module breaks-out 100-pin cable into screw terminals and attaches directly to DMC-2xx0 metal enclosure*
- *12.1" x 2.2" x 6.3" metal enclosure; Accepts 90-250V AC*
- *CE certified*
- *Custom hardware and firmware options available*

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

DMC-22x0 and DMC-20x0 Series

Specifications

System Processor

- Motorola 32-bit microcomputer

Communications Interface

- DMC-2000: USB 1.1 or 12.5 Mb/sec, expansion hub with two ports. (2) RS232/422 ports up to 115 kb. RS485 option
- DMC-2200: Ethernet 10/100BASE-T. (2) RS232/422 ports up to 115 kb. RS485 option

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
- 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 filter and low-pass filter
- Dual-loop control for backlash compensation
- Velocity smoothing to minimize jerk
- Integration limit
- Torque limit
- 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

	DIGITAL INPUTS	DIGITAL OUTPUTS	CONFIGURABLE I/O
DMC-2x10 thru -2x40	8	8	64
DMC-2x50 thru -2x80	16	16	64

Uncommitted Analog Inputs

- 8 individual ±10 V analog inputs with 12-bit resolution (16-bit available as an option)

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)
- Auxiliary 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 — 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 (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

- *DMC-2xx0 series: accepts 90–250 V AC, 50–60 Hz*

Environmental

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

Mechanical

- DMC-2xx0 series: 1–8 axes, 12.1" × 2.2" × 6.3" metal enclosure

†*Reduced feature set for -FAST.*

DMC-22x0 and DMC-20x0 Series

Hardware Accessories

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. By interfacing directly to Galil's Optima 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 18V to 80V 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" x 8.75" x 1". It interfaces to the Optima 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.

AMP-19540

Left: *ICM-2900 Interconnect Module*
Center: *DMC-2040 with attached ICM-2900*
Right: *ICM-2908*

ICM-2900 Interconnect Module for DMC-2xx0

The ICM-2900 interconnect module for the DMC-2xx0 mounts directly to the DMC-2xx0 enclosure. Use one for every four axes. The ICM-2900 accepts the 100-pin motion controller cable for break-out into screw terminals.

ICM-2908 Interconnect Module for Auxiliary Encoders

The ICM-2908 interconnect module for the DMC-2xx0 accepts the 36-pin cable for auxiliary encoders. One ICM-2908 may be used for up to eight axes.

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 high-density cable in 1-meter length	$ 125	$ 95
CABLE-100-2M	100-pin high-density cable in 2-meter length	$ 135	$ 100
CABLE-100-4M	100-pin high-density cable in 4-meter length	$ 150	$ 105
CABLE-36-1M	36-pin high-density cable in 1-meter length (for aux encoders)	$ 90	$ 75
CABLE-36-3M	36-pin high-density cable in 3-meter length (for aux encoders)	$ 110	$ 90
CABLE-80-1M	80-pin high-density cable in 1-meter length (for extended I/O)	$ 125	$ 95
CABLE-80-4M	80-pin high-density 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 Visual Basic, Visual C++, etc.	$ 595	

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

ISA, PC/104, RS232, PCI Econo 1 axis

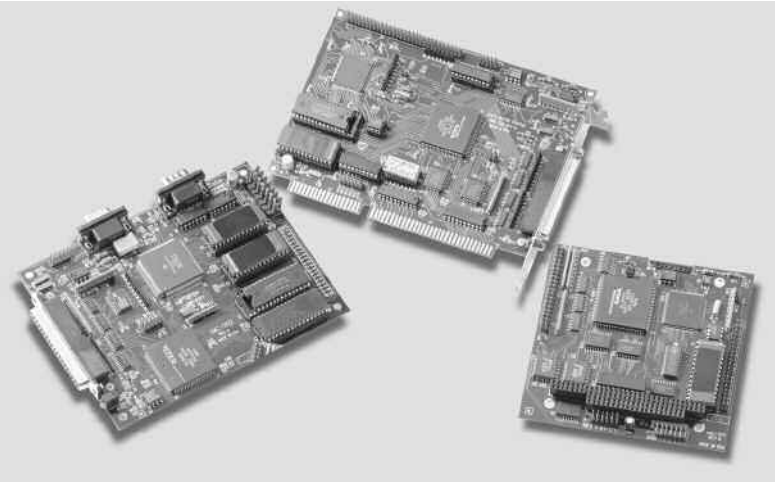
DMC-1410, DMC-1411, DMC-1412, DMC-1417

Product Description

The DMC-1410, DMC-1411, DMC-1412, DMC-1417 are economical, single axis motion control cards with ISA, PC/104, RS/232 and PCI communications, respectively. They have many of the same high-performance features of Galil's multi-axis controllers, but are designed for just one axis. This offers the user both space and cost-savings.

With a 32-bit microcomputer, the single axis controllers provide such advanced features as PID compensation with velocity and acceleration feedforward, program memory with multitasking for simultaneously

Left to right:
DMC-1412, DMC-1410, DMC-1411



running two application 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. Additionally, the controllers accept inputs from two encoders, which is useful for electronic gearing applications. The user can configure the controller for either stepper or servo motor control.

Like all Galil controllers, the DMC-1410, -1411, -1412 and -1417 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 DOS, Linux and all current Windows operating systems.

Features

- *1-axis motion controller*
- *DMC-1410: ISA card*
  DMC-1411: PC/104 card
  DMC-1412: Card with two daisy-chainable RS232 ports up to 38.4 kbaud
  DMC-1412-BOX: Box-level controller
  DMC-1417: PCI card
- *User-configurable for stepper or servo motor control. Sinusoidal commutation for brushless servo motors.**
- *Accepts up to 8 MHz encoder frequencies for servos. Outputs up to 2 MHz for steppers*
- *Advanced PID compensation with velocity and acceleration feedforward, offsets and integration limit*
- *Modes of motion include jogging, point-to-point positioning, contouring, electronic gearing and ECAM. Accepts input from auxiliary encoder for electronic gearing*
- *Over 125 English-like commands including conditional statements and event triggers such as AT TIME and AT POSITION*
- *Memory for application programs, variables and arrays. Multitasking for concurrent execution of two application programs*
- *Home input and forward and reverse limits*
- *7 Uncommitted digital inputs, 3 digital outputs*
- *High-speed position latch*
- *DMC-1410, -1412 and -1417 use 37-pin D connector. DMC-1411 uses a 40-pin IDC connector. ICM-1460 interconnect module breaks-out 37-pin cable into screw terminals.*
- *Communication drivers for all current versions of Windows, DOS and Linux*
- *CE certified — DMC-1410, 1412*
- *Custom hardware and firmware options available*

**DMC-1411 does not support sinusoidal commutation*

ISA, PC/104, RS232, PCI Econo 1 axis

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

Specifications

System Processor

- Motorola 32-bit microcomputer

Communications Interface

- DMC-1410: ISA with bi-directional, high speed FIFO buffer
- DMC-1411: PC/104 with bi-directional, high speed FIFO buffer
- DMC-1412: (2) daisy-chainable RS232 ports up to 38.4 kbaud
- DMC-1417: PCI with bi-directional, high speed FIFO buffer

Modes of Motion:

- Point-to-point positioning
- Jogging
- Electronic Gearing
- Electronic Cam
- Contouring

Memory

- Program memory size — 250 lines × 40 characters
- 126 variables
- 1000 array elements in up to 6 arrays

Filter

- PID (proportional-integral-derivative) with velocity and acceleration feedforward
- 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)
- Velocity: Up to 8 million counts/sec for servo motors
- Acceleration: Up to 67 million counts/sec^2

Uncommitted Digital I/O

- 7 TTL inputs
- 3 TTL outputs

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)
- Dual encoder—Channel A, A-, B, B-
- Forward and reverse limit inputs
- Home input
- High-speed position latch input
- Analog motor command output with 16-bit DAC resolution
- Pulse and direction output for step motors
- Amplifier enable output
- Error output

Minimum Servo Loop Update Time

- 375 microseconds

Maximum Encoder Feedback Rate

- 8 MHz

Maximum Stepper Rate

- 2 MHz (Full, half or microstep)

Power Requirements

- DMC-1410, DMC-1411, DMC-1412-card, DMC-1417:
  +5V 400 mA
  -12V 40 mA
  +12V 40 mA
- DMC-1412 Box: plugs into 90–260 VAC

Environmental

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

Mechanical

- DMC-1410: 7" ISA
- DMC-1411: 4.4" × 4.15"
- DMC-1412-card: 6.0" × 4.375"
- DMC-1412-box: 5.1" × 3.0" × 6.8"
- DMC-1417: 7.3" PCI

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

Connectors

DMC-1410, DMC-1412, DMC-1417 J3

Main 37-pin D-type

1	Reset*	20	Error Output*
2	Amp enable	21	ACMD
3	Output 3	22	Output 2
4	Output 1	23	Reserved
5	PWM or step out	24	Sign or direction
6	Input 7	25	Input 6
7	Input 5	26	Input 4
8	Input 3	27	Input 2
9	Input 1 (and latch)	28	Forward limit
10	+5V	29	Reverse limit
11	Ground	30	Home
12	+12V	31	-12V
13	Ground	32	A+
14	A-	33	B+
15	B-	34	I+
16	I-	35	Auxiliary A+
17	Auxiliary A-	36	Auxiliary B+
18	Auxiliary B-	37	Abort*
19	ACMD Phase B		

DMC-1411 J3

Main 40-pin IDC

1	Reset*	2	Error Output*
3	Amp enable	4	Amp command for servo
5	Output 3	6	Output 2
7	Output1	8	Reserved
9	PWM or step out	10	Sign or direction
11	Input 7	12	Input 6
13	Input 5	14	Input 4
15	Input 3	16	Input 2
17	Input 1 (and latch)	18	Forward limit
19	+5V	20	Reverse limit
21	Ground	22	Home
23	+12V	24	-12V
25	Ground	26	A+
27	A-	28	B+
29	B-	30	I+
31	I-	32	Auxiliary A+
33	Auxiliary A-	34	Auxiliary B+
35	Auxiliary B-	36	Abort*
37	Reserved	38	NC
39	NC	40	NC

**Active low*

DMC-1412 J5

Power 7-pin Molex

1	-12V
2	Ground
3	Ground
4	+5V
5	+5V
6	+12V
7	Earth

DMC-1412

RS232 Main port 9-pin male

1	CTS—output	6	CTS—output
2	Transmit data—output	7	RTS—input
3	Receive data—input	8	CTS—output
4	RTS—input	9	NC
5	Ground		

RS232 Auxiliary port 9-pin female

1	CTS—input	6	CTS—input
2	Transmit data—input	7	RTS—output
3	Receive data—output	8	CTS—input
4	RTS—output	9	NC
5	Ground		

Hardware Accessories

ICM-1460

The ICM-1460 Interconnect Module provides screw terminals for the 37-pin D-type cable from the DMC-1410 or DMC-1412, for quick connection of system hardware. A 40-pin to 37-pin cable allows the ICM-1460 to be used with the DMC-1411. The ICM-1460 is contained in a metal enclosure with dimensions of 6.9" × 4.9" × 2.6"and 0.2" diameter key-holes 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 Interconnect Module (shown with and without cover)

ICM-1460-OPTO

For applications requiring optoisolated inputs and outputs, the ICM-1460 option "OPTO" provides 5–24 V and 25 mA optoisolation on all general inputs and outputs, home inputs, and limits.

ISA, PC/104, RS232, PCI Econo 1 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 Visual Basic, Visual C++, etc.	$ 595	

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

Brush Servo Motor

N23-53-1000

Product Description

Galil's N23 brush-type servo motor allows for quick and easy prototyping of servo systems. The motor includes an attached 1000 line encoder which provides position feedback to Galil controllers.

N23-53-1000

Features

- *High performance brush-type servo motor for precise position and velocity control applications*
- *53 oz-in cont. torque; 300 oz-in peak*
- *6000 rpm top speed*
- *Includes 1000 line differential quadrature encoder*

Encoder Connectors: N23

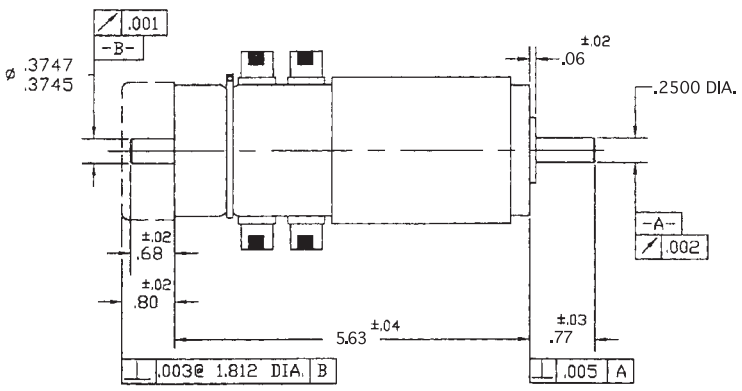
Round Cable with Discrete Wire:

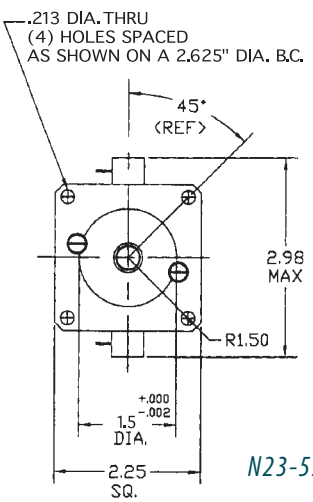
Function	*Wire Color*
+5 V	RED
GND	BLACK
CHA-	YELLOW
CHA+	WHITE
CHB+	GREEN
CHB-	BLUE
INDEX-	BROWN
INDEX+	ORANGE

Encoder outputs use differential line drivers.

Encoder Specifications: N23

Cycles per revolution: 1000 ppr
Maximum output frequency: 100 kHz all channels
Input power: 5V, 135 mA maximum
Output: 26LS31 line driver
Operating temperature: -10° to +80° C





N23-53-1000

Brushless Servo Motor

BLM-N23-50-1000-B

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*
- *Hi-Density 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.

Encoder 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 ℃ to 100 ℃

Storage Temperature: -40 ℃ to 125 ℃

Relative Humidity: 98% non-condensing

Encoder Pin Header

15 Pin, Hi-Density 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

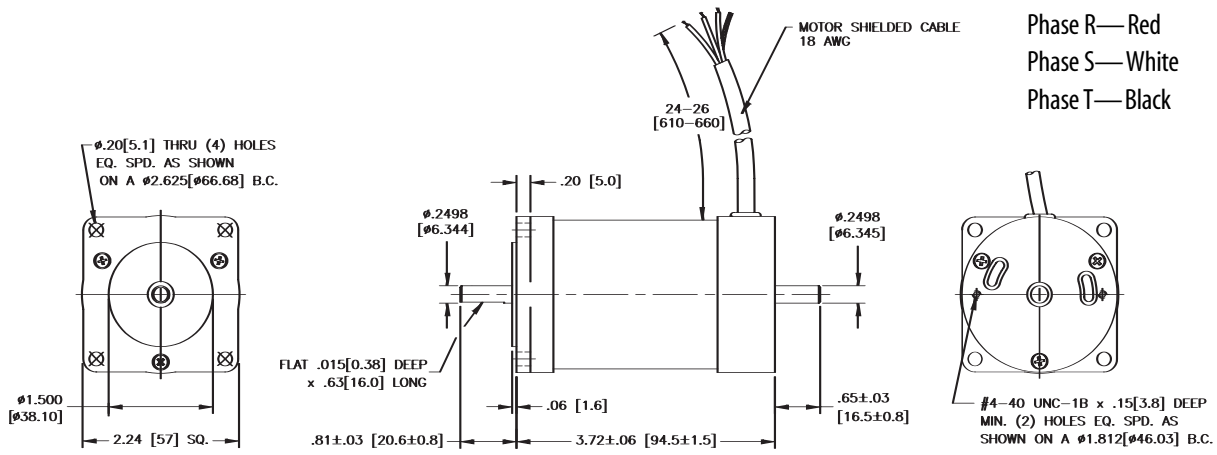
**Unused with Galil amplifiers*

Specifications

PARAMETER	UNITS	MODEL NUMBER N23-53-1000	MODEL NUMBER BLM-N23-50-1000-B
K_t–Torque Constant	Nm/A oz-in/A	0.096 13.6	0.08 12.1
T_c– Continuous Torque	Nm oz-in	0.374 53	0.39 55
T_p– Peak Torque	Nm oz-in	2.118 300	0.83 120
Continuous Current	A	3.9	4.9
Peak Current	A	22	10.4
J_m– Moment of Inertia	$kg \cdot m^2$ $oz\text{-}in\text{-}s^2$	5.86×10^{-5} 0.0083	2.5×10^{-5} 3.5×10^{-3}
Recommended Supply Voltage	volts	72	48
ω_m–Maximum Speed	rpm	6000	5000
R–Armature Resistance	ohm	1.18	1.2
L–Armature Inductance	mH	2.6	2.6
R_{th}–Thermal Resistance	°C/W	3.8	1.04
T_m– Electro-mechanical Time Constant	msec	7.2	4.5
Length with Encoder	in	6.375	4.5
Diameter	in	2.25	2.2459
Shaft Diameter	in	0.25	0.25
Weight	kg lbs	1.95 4.3	1.0 2.2
Encoder Resolution	lines/rev	1000	1000
Price: qty 1		$395	$395
Price: qty 100		$250	$295

BLM-N23-50-1000-B

Phase R— Red
Phase S— White
Phase T— Black



Galil Utilities

SmartTERM, DMCSetup, MotorSizer™, HelloGalil™

Galil Utilities

All Galil software programs can be downloaded from the Galil website or accessed from the CD-ROM. All necessary device drivers and DLL's are included for current Windows operating systems.

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.

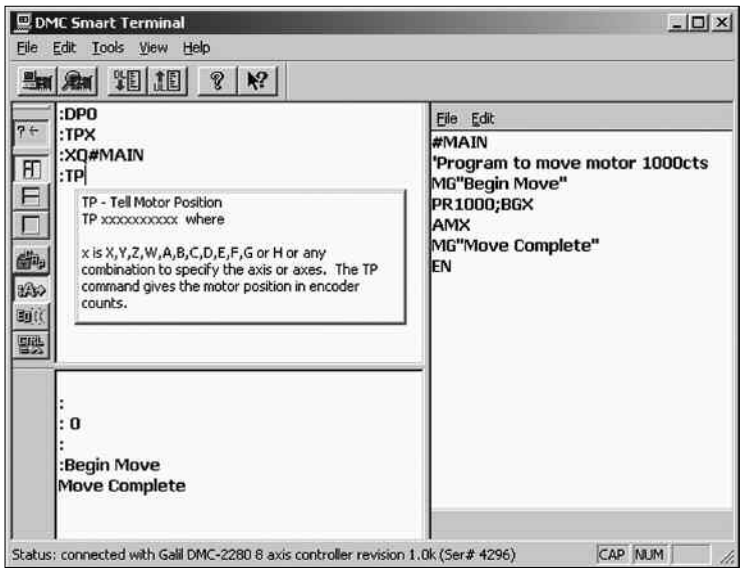
DMCSetup — Utility to upload, download, view, and save burned parameters to disk.

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

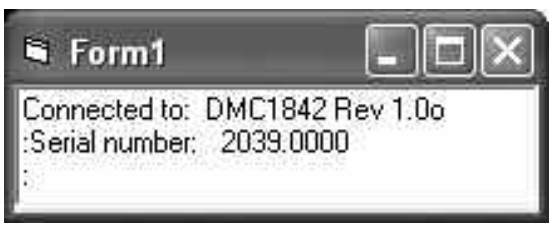
Galil's MotorSizer is a free, web-based tool for easy sizing of your motion system. This easy-to-use tool lets you specify your load and motion requirements for various mechanical systems. MotorSizer performs a thorough analysis to select motors and amplifiers (or enter your own) that can drive your 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.

Access MotorSizer at: http://www.galilmc.com/support/motorsizer/index.html.

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:



www.galilmc.com/support/hello_galil.html

dmc32.dll Communication Library

Galil's communication library for Windows (Linux, DOS and QNX versions are also available) includes sample programs, utilities, a complete terminal program, and full documentation. With this library, all Galil motion controllers can be programmed using C/C++, VB, LabView, etc.

Partial DLL API list:

The following represents a partial list from over 60 API functions.

DMCOpen	Open communications
DMCClose	Close communications
DMCCommand	Send a command
DMCDownloadFile	Download a file from hard disk
DMCArrayUpload	Upload an array

DMC.NET Communication Library

Galil has taken its Application Programming Interface (API) and ported it to .NET (Framework v2.0). This object-oriented API uses .NET native types to provide a communication interface to Galil Motion Controllers. It can be used from any of the VisualStudio.NET managed languages (VB, C++, C#, J#).

The DMC .NET API includes objects for basic communications, data record access, array operations, and Galil registry modifications. Exception-based error handling makes the API versatile and helps reduce programming. Dynamic help files and sample code are also included. Users of the older API should find the new .NET version familiar and that it fits more naturally into the .NET environment.

Galil .NET API objects can be imported to your project by adding a reference to the **DMCdNet.dll** class library. The VB.NET example below shows how the DMCAPI object is used to send "TPX" to the controller and display the response in a text box.

Example C Program tells the controller to move the X-axis motor 1000 counts.

```
#include <windows.h>
#include <Dmccom.h>

long rc;
HANDLEDMC hDmc;
char szBuffer [64];

int main(void)
{
        rc = DMCOpen(1,0,&hDmc);
        rc = DMCCommand(hDmc,"PR1000;BGX;",szBuffer,
sizeof(szBuffer));
        rc = DMCClose(hDmc);
        return 0;
}
```

DMC.NET API Toolkit

```
Imports Galil 'use Galil namespace

Public Class Form1
    Inherits System.Windows.Forms.Form
    'declare controller object
    Dim Controller As DMCAPI

+Windows Form Designer generated code

    Private Sub Form1_Load(ByVal sender As System.Object, _
    ByVal e As System.EventArgs) Handles MyBase.Load

        'allocate memory for controller object
        Controller = New DMCAPI
        'open communications
        Controller.apiOpen(1, System.IntPtr.Zero)
        'declare response string
        Dim sResponse As String
        'send command to controller
        Controller.apiCommand("TPX", sResponse)
        'display response
        TextBox1.Text = "X position: " + sResponse

    End Sub

    Private Sub Form1_Closed(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles MyBase.Closed

        'close communications
        Controller.apiClose()

    End Sub
End Class
```

ActiveX Tools

ActiveX Tool Kit

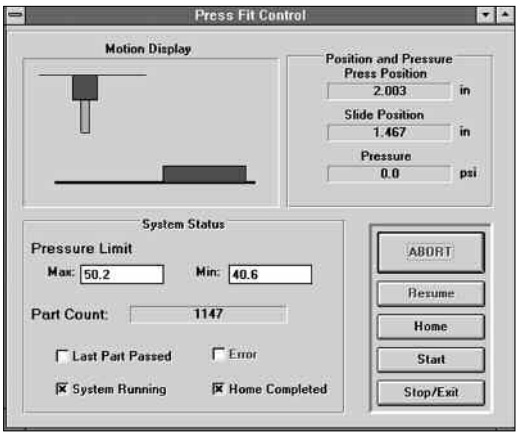
Product Description

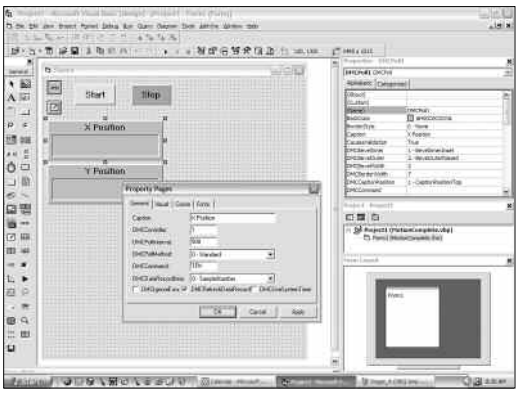
Galil's ActiveX Tool Kit is a powerful software package that lets the designer quickly and easily create an operator interface for Galil controllers using any Windows programming language that supports ActiveX.

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.

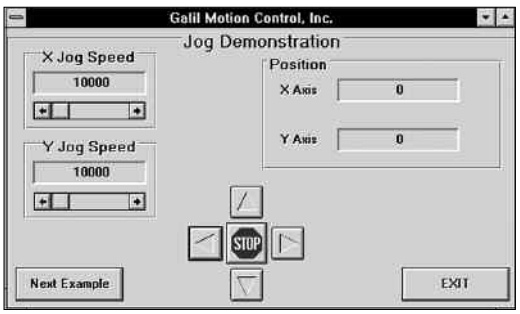




The Polling window object allows responses from the controller to be displayed. You can poll for data such as position, speed and error for any axis.

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.

Editor, Scope, Tuner and Watch Software Tools

GalilTools

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.

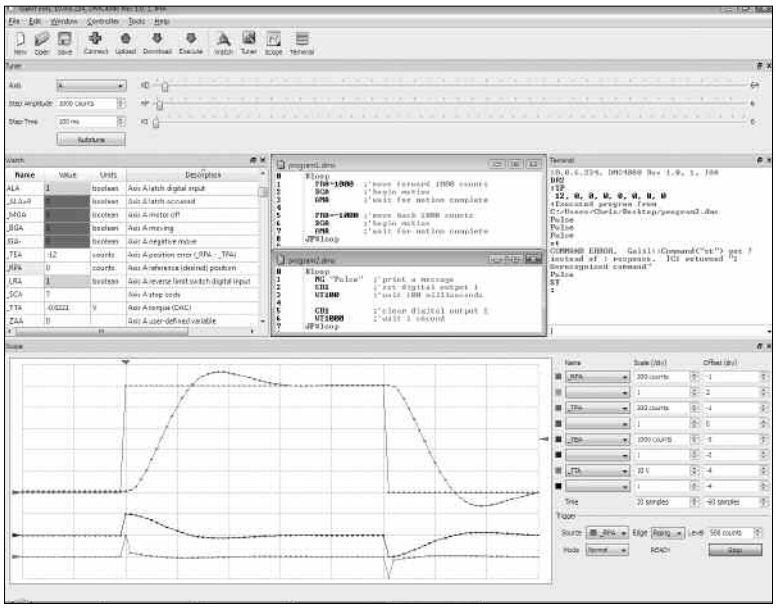
GalilTools also includes a Program Editor Tool which allows multiple editors to be open simultaneously for convenient programming of Galil controllers. The Watch Tool displays controller status at a glance and includes units and scale factors for easy viewing. The Tuning Tool helps select PID parameters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

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

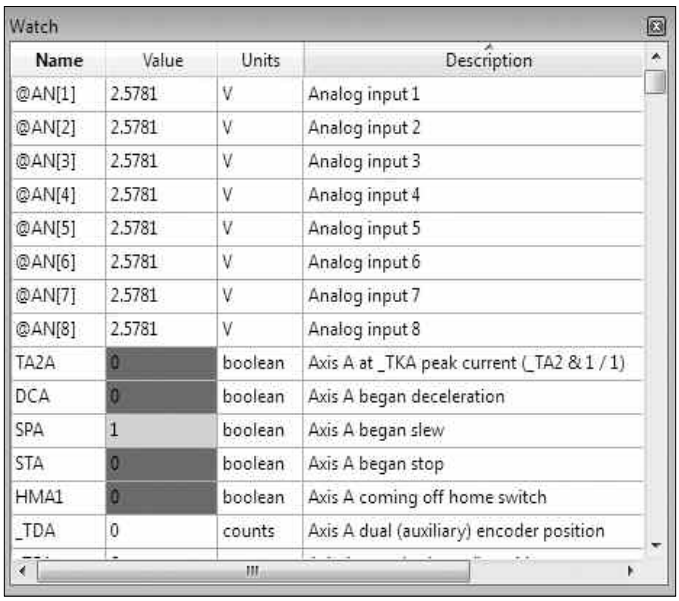
GalilTools-Lite is available at no charge and contains the Editor, Terminal and Watch tools only.

Features

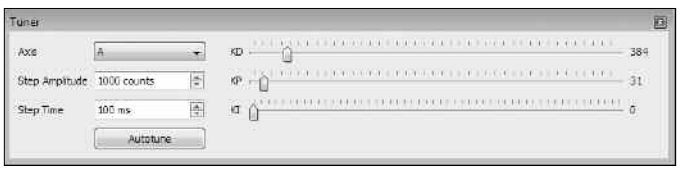
- *Powerful software tools for Galil controllers*
- *Terminal Tool for sending and receiving Galil commands*
- *Scope Tool with trigger displays up to 8 channels of real-time data*
- *Tuning Tool for automatic and manual PID tuning of servo systems*
- *Watch Tool with units for displaying controller 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*
- *For DMC-40x0, DMC-21x3, and RIO-47100 Ethernet controllers, and DMC-18x6 and DMC-18x2 PCI controllers*



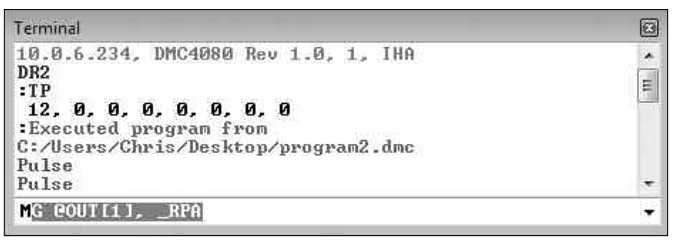
GalilTools Provides Multiple Tools for Set-up and Tuning Motion Systems. The Various Tools such as Tuner, Scope, Terminal, Watch, Editor can be Displayed on a Single Screen or Separately.



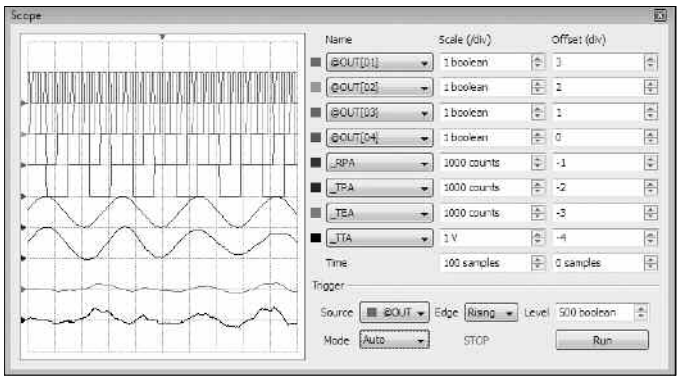
Watch *Tool Displays Controller and I/O status.*



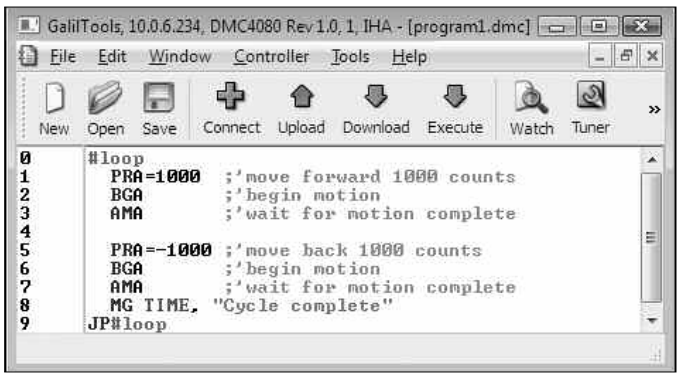
Tuner *Tool Automatically or Manually Finds the Best PID Values for a Step Response.*



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.*

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.

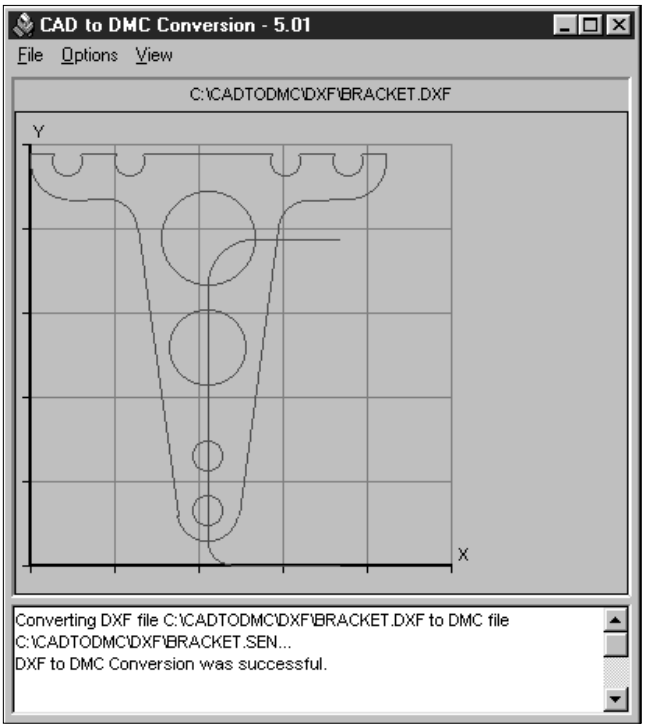
System Requirements

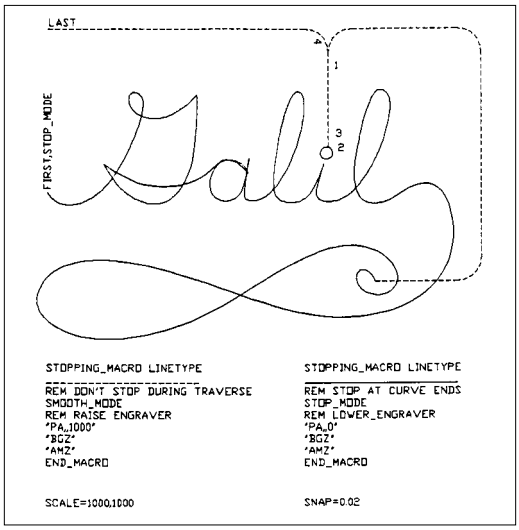
- 16MB minimum
- Windows 98SE or newer

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





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.

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1
Galil Utilities	Installation files for 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
ActiveX Tool Kit	ActiveX™ tools for Visual Basic, Visual C++, etc.	$595
GalilTools	Editor, Terminal, Watch, Scope and Tuner software tools	$195
GalilTools-Lite	Editor, Terminal, Watch software tools	Free download
WSDK	Prior generation tuning software for older controllers	$195
CADTODMC	DXF to DMC translator	$595
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.

™LabView is a trademark of National Instruments.

Galil Motion Control

We Move The World™

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, medicine, 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. See featured videos of customer stories at galilinmotion.com.*

Semiconductor

- **COBRA Placement**— Component placement
- **Andrew NDT Engineering Corp.** — Wafer film deposition measurement
- **Brooks Automation, Inc.** — Wafer handling robot
- **Ultrasonic Systems, Inc.** — Circuit board coating

Medical

- **Tomo Therapy**— Radiation treatment
- **Focus Surgery, Inc.** — Focused ultrasound to destroy cancer tissue in prostate
- **IOL International**— Optical generator of interocular lens
- **Philips Medical** — 3D ultrasound for fetal imaging
- **TechniScan**— Ultrasonic breast exams

Entertainment

- **Hudson Scenic Studio, Inc.** — Automated scenery for Broadway productions
- **WET Design**— Water Sculptures

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

- **PhotoScribe/TeoSys** — Diamond engraving

Automated Manufacturing Equipment

- **CMM/JIT**— Vinyl fence cutting
- **PVA** — Dispensing and spray coating machine

Textiles

- **Gammil/Statler Stitcher** — Automated quilting machine

Test and Measurement

- **Veeco Instruments, Inc.** — Non-contact surface measurement

Simulator Training

- **GlobalSim** — Crane simulator

Automotive

- **Team Mojavaton** — Autonomous ground vehicle

Military

- **PVP** — Military Imaging system

Download any of these real customer stories at www.galilinmotion.com/smartmoves.php or call Galil at 800-377-6329 to request your free *SmartMoves* book. We are looking forward to working with you so you can be our next SmartMoves partner.

Our commitment is to be the leader in providing high-performance, cost-effective, easy-to-use motion controllers that solve real customer problems in the OEM marketplace.

GALIL
WE MOVE THE WORLD

Terms and Conditions

ORDERS

Orders may be placed by calling Galil at 800-377-6329 or fax 916-626-0102. All phone orders require a written confirmation by fax or mail.

LEAD TIME

Typical lead-time for standard products is 1 week ARO. Non-standard products may have a longer lead-time. The actual lead-time will be stated upon receipt of the written order. Shipping promises are made in good faith by Seller, and Seller cannot be held accountable for delays in shipping.

EXPEDITED SERVICE

An expedite fee of $100 will be charged for expedited service. This fee is additional to any rush shipping charges.

SHIPPING

Standard method of shipping is UPS 2nd Day or Federal Express Economy unless otherwise requested.

PRICES

Prices and specifications are subject to change. All prices listed are U.S. prices. Prices outside the U.S. are 10% above list. F.O.B. Rocklin, California. Applicable taxes, insurance, shipping and handling charges are to be paid in full by the purchaser.

QUANTITY DISCOUNTS

Discounts are available for volume purchases on a per-order or blanket-order basis. Consult Galil for a quotation. A cancellation fee will be charged if purchaser does not receive full delivery on quantity ordered.

PAYMENT TERMS

Payment terms are net 30 days from date of invoice, subject to credit approval by Galil. To open a net term account, one bank account reference and three trade-references are required. Accounts past due over 60 days will be charged 1-1/2% per month. Galil reserves the right to defer delivery on past due accounts. Accounts that do not receive credit approval, and accounts that do not pay within the stated terms will be COD.

RETURNED PRODUCTS

Products in good and re-sellable condition may be returned for 90% credit (subject to $25 minimum restock fee) within 30 days of purchase. All credit is subject to product testing and approval by Galil. No returns are accepted after 90 days. Non-standard products may not be returned for credit. Opened software products may not be returned for credit.

NOTICE OF SCHEDULE CHANGE

All changes to the shipping schedule made by the purchaser must be given to the seller in writing with two weeks advance notice.

WARRANTY

All controllers manufactured by Galil Motion Control are warranted against defects in materials and workmanship for a period of 18 months after shipment. Motors, and Power supplies are warranted for 1 year. Extended warranties are available.

In the event of any defects in materials or workmanship, Galil Motion Control will, at its sole option, repair or replace the defective product covered by this warranty without charge. To obtain warranty service, the defective product must be returned within 30 days of the expiration of the applicable warranty period to Galil Motion Control, properly packaged, and with transportation and insurance prepaid. We will reship at our expense only to destinations in the United States and for products within warranty.

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

Any defect in materials or workmanship determined by Galil Motion Control to be attributable to customer alteration, modification, negligence, or misuse is not covered by this warranty.

EXCEPT AS SET FORTH ABOVE, GALIL MOTION CONTROL WILL MAKE NO WARRANTIES EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO SUCH PRODUCTS, AND SHALL NOT BE LIABLE OR RESPONSIBLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

TO PLACE AN ORDER —
PHONE: 800-377-6329 OR FAX: 916-626-0102