PCI Bus, 1–8 axes
DMC-18x0 and DMC-18x2 Series

Product Description

The DMC-18x0 and DMC-18x2 Series are PCI bus motion controllers designed for multi-axis applications. For single axis PCI applications, Galil's DMC-1417 controller is recommended.

While the DMC-18x0 and DMC-18x2 controllers are both similar in performance, the Econo DMC-18x2 has a few less features that result in a cost-savings. Eliminated features include five through eight axes of control, optical isolation on inputs, uncommitted analog inputs, dual encoder inputs, and only one FIFO communication channel.

Both controllers incorporate a 32-bit microcomputer and provide such advanced features 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-18x0 and DMC-18x2 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.

Features

- PCI card in 1 through 8 axis versions:
  - DMC-18x0 where x=1,2,3,4,5,6,7,8 axes
  - DMC-18x2 where x=1,2,3,4 axes
- User-configurable for stepper or servo motors on any combination of axes. 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. Optical isolation on the DMC-18x0 only
- 8 Uncommitted inputs and 8 outputs for 1- through 4-axis models, 24 inputs and 16 outputs for 5- through 8-axis models. Optical isolation on the DMC-18x0 only
- High speed position latch and output compare for each axis
- 8 uncommitted analog inputs for the DMC-18x0 only
- Dual encoder inputs for the DMC-18x0 only
- Expansion for 64 I/O with optional DB-14064 board
- 100-pin SCSI connectors for each set of 4 axes. Galil's ICM-2900 interconnect module breaks-out 100-pin cable into screw terminals
- Communication drivers for all current versions of Windows, DOS and Linux
- CE certified
- Custom hardware and firmware options available
PCI Bus, 1–8 axes
DMC-18x0 and DMC-18x2 Series

Specifications

System Processor
- Motorola 32-bit microcomputer

Communications Interface
- DMC-18x0: PCI with bi-directional FIFO plus auxiliary FIFO
- DMC-18x2: PCI with bi-directional FIFO

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

Modes of Motion:
- Point-to-point positioning
- 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 (DMC-18x0 only)
- 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/sec²

High Speed Position Latch
- Uncommitted inputs 1–8 latch X,Y,Z,W,E,F,G,H axes (latches within 0.1 microsecond 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- (for DMC-18x0 only)
- Forward and reverse limit inputs — optoisolated on DMC-18x0
- Home input — optoisolated on DMC-18x0
- Selectable high-speed position latch input
- Selectable abort input

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 Rate
- 1–2 axes: 125 microseconds
- 3–4 axes: 250 microseconds
- 5–6 axes: 375 microseconds
- 7–8 axes: 500 microseconds

Maximum Encoder Feedback Rate
- 12 MHz

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

Power Requirements
- DMC-18x0: +5V 750mA, -12V 40mA, +12V 40mA
- DMC-18x2: +5V 750mA, -12V 20mA, +12V 20mA

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

Mechanical
- DMC-18x0: 1–4 axes: 11.15” × 4.8”
- 5–8 axes: 12.3” × 4.8”
- DMC-18x2: 9” × 4.23”
PCI Bus, 1–8 axes

DMC-18x0 and DMC-18x2 Series

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
RP  Report commanded position
TD  Step counts output
TP  Tell position of encoder

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
UI  User interrupts

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  DMA/FIFO update rate
DV  Dual velocity (dual loop)
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/Special 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
@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
LS  List program
LV  List variables
MG  Message command
QR  Data record
QZ  Return DMA information
RP  Report command position
RL  Report latch
‘R’V  Firmware revision information
SC  Stop code
TB  Tell status

Interrogation (cont.)
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
DA  Deallocate variables/arrays
DL  Download program
DM  Dimension arrays
ED  Edit program
ELSE  Conditional statement
END  End of cond. statement
EN  End program
EX  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
REM  Remark program
UI  User interrupt
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
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
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
## PCI Bus, 1–8 axes

### DMC-18x0 and DMC-18x2 Series

#### Connectors

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

<table>
<thead>
<tr>
<th>Axis 1–4 DMC-18x0 and DMC-18x2</th>
<th>Axis 5–8 DMC-18x0</th>
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<tbody>
<tr>
<td>1 Analog ground</td>
<td>1 NC</td>
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<tr>
<td>2 Ground</td>
<td>2 Ground</td>
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<tr>
<td>3 5 V</td>
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<tr>
<td>4 Error output</td>
<td>4 Error output</td>
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<tr>
<td>5 Reset</td>
<td>5 Reset</td>
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<tr>
<td>6 Encoder—compare output</td>
<td>6 Encoder—compare output</td>
</tr>
<tr>
<td>7 Ground</td>
<td>7 Ground</td>
</tr>
<tr>
<td>8 Ground</td>
<td>8 Ground</td>
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<tr>
<td>9 Motor command W</td>
<td>9 Motor command H</td>
</tr>
<tr>
<td>10 Sign W / dir W</td>
<td>10 Sign H / dir H</td>
</tr>
<tr>
<td>11 P WM W / step W</td>
<td>11 P WM H / step H</td>
</tr>
<tr>
<td>12 Motor command Z</td>
<td>12 Motor command G</td>
</tr>
<tr>
<td>13 Sign Z / dir Z</td>
<td>13 Sign G / dir G</td>
</tr>
<tr>
<td>14 P WM Z / step Z</td>
<td>14 P WM G / step G</td>
</tr>
<tr>
<td>15 Motor command Y</td>
<td>15 Motor command F</td>
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<tr>
<td>16 Sign Y / dir Y</td>
<td>16 Sign F / dir F</td>
</tr>
<tr>
<td>17 P WM Y / step Y</td>
<td>17 P WM F / step F</td>
</tr>
<tr>
<td>18 Motor command X</td>
<td>18 Motor command E</td>
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<tr>
<td>19 Sign X / dir X</td>
<td>19 Sign E / dir E</td>
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<tr>
<td>20 P WM X / step X</td>
<td>20 P WM E / step E</td>
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<td>22 Amp enable Z</td>
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<td>46 B- W</td>
<td>46 B- H</td>
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<td>48 I- W</td>
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<td>49 +12 V</td>
<td>49 +12 V</td>
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<tr>
<td>50 +12 V</td>
<td>50 +12 V</td>
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*NC (for 18x2)
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 $13.5\times2.675\times6.88$ 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. If using auxiliary encoders with the DMC-18x0, use a CABLE-26-25 26-pin to 25-pin converter to the ICM-1900.

**AMP-19x0 Interconnect Module with Amplifiers**
The AMP-19x0 series is an ICM module above with 1 to 4 PWM amplifiers for brush-type servo motors. Each amplifier provides 6 amps continuous, 10 amps peak at up to 80 Volts. The gain of the amplifier is 1 A/V and requires an external DC supply from 20 to 80 Volts. The minimum motor inductance is 1 mH and the PWM frequency is 30 kHz.

**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.

**DB-14064 I/O Expansion**
The DB-14064 is an optional board which provides 64 additional I/O for the DMC-18x0 and 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. A CB-50-80 adaptor can be used to convert the IDC connectors to an 80-pin connector. Using the adaptor and the Cable-80 allows for direct connection to the Galil IOM-1964 opto-isolation module.
# PCI Bus, 1–8 axes

## DMC-18x0 and DMC-18x2 Series

### Ordering Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QUANTITY 1</th>
<th>QUANTITY 100</th>
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<tbody>
<tr>
<td>DMC-1810</td>
<td>1-axis Optima, PCI</td>
<td>$1095</td>
<td>$795</td>
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<td>DMC-1820</td>
<td>2-axis Optima, PCI</td>
<td>$1495</td>
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<td>DMC-1830</td>
<td>3-axis Optima, PCI</td>
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<td>DMC-1840</td>
<td>4-axis Optima, PCI</td>
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<td>$995</td>
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<td>CB-50-100-1880</td>
<td>50- to 100-pin converter board; incl. two ribbon cables for DMC-1850 to -1880</td>
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<td>CABLE-26-25</td>
<td>26-pin IDC to 25-pin D type for auxiliary encoders</td>
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<tr>
<td>CABLE-100-1M</td>
<td>100-pin high-density cable in 1 meter length</td>
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<tr>
<td>CABLE-100-2M</td>
<td>100-pin high-density cable in 2-meter length</td>
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<tr>
<td>CABLE-100-4M</td>
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<tr>
<td>ICM-1900</td>
<td>Interconnect module (use 1 for every 4 axes). Specify -HAEN for high amp enable or -LAEN for low amp enable</td>
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<tr>
<td>ICM-1900-OPTO</td>
<td>ICM with optoisolated outputs</td>
<td>$395</td>
<td>$295</td>
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<tr>
<td>ICM-2900-FL</td>
<td>Interconnect module (use 1 for every 4 axes). Specify -HAEN for high amp enable or -LAEN for low amp enable. Specify -FL for flange</td>
<td>$295</td>
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<tr>
<td>ICM-2900-OPTO</td>
<td>ICM with optoisolated outputs</td>
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<tr>
<td>DB-14064</td>
<td>Attachment board for 64 additional I/O for DMC-18x0, DMC-18x2</td>
<td>$395</td>
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<tr>
<td>CB-50-80</td>
<td>50-pin to 80-pin adaptor for DB-14064</td>
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<tr>
<td>IOM-1964</td>
<td>Input/output optoisolated module for 64 I/O</td>
<td>$695</td>
<td>$495</td>
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<tr>
<td>Galil Utilities</td>
<td>Communication drivers, SmartTERM, DMCDOS</td>
<td>$20 for CD; free download</td>
<td></td>
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<tr>
<td>CTOOLKIT</td>
<td>C/C++ documentation and examples</td>
<td>Included with Utilities</td>
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<tr>
<td>WSDK</td>
<td>Set-up, tuning and analysis software</td>
<td>$195</td>
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<tr>
<td>ActiveX Tool Kit</td>
<td>Custom ActiveX controls for Visual Basic or Visual C++</td>
<td>$595</td>
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</table>

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