

PCI Bus Accelera Series, 1–8 axes

DMC-18x6 Series

Product Description

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

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

The DMC-18x6 is available in one through eight-axis formats, and each axis is user-configurable for stepper or servo motor operation. The controller includes

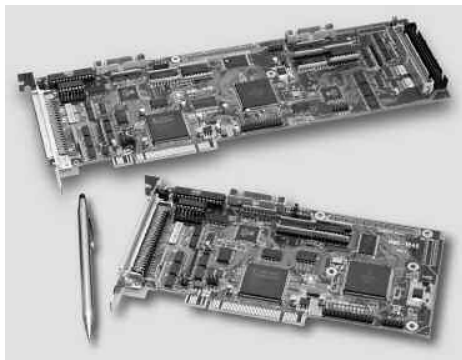
optically isolated inputs including a forward limit, reverse limit and home input for each axis, in addition to uncommitted analog and digital I/O. Up to two encoders are accepted for each servo axis.

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

Features

- *PCI card in 1 through 8 axis versions:
DMC-18x6 where x=1,2,3,4,5,6,7,8 axes*
- *User-configurable for stepper or servo motors on any combination of axes. Optional sinusoidal commutation signals for brushless servo motors.*
- *Accepts up to 22 MHz encoder frequencies for servos. Outputs up to 6 MHz for steppers*
- *PID compensation with velocity and acceleration feedforward, integration limits, notch filter and low-pass filter*
- *Modes of motion include jogging, point-to-point positioning, contouring, linear and circular interpolation, electronic gearing and ECAM. Features ellipse scaling, slow-down around corners, infinite segment feed and feedrate override*
- *Over 200 English-like commands including conditional statements and event triggers*
- *Non-volatile memory for programs, variables and arrays. Multitasking for concurrent execution of up to eight programs*
- *Optically isolated home input and forward and reverse limits accepted for every axis.*
- *1- through 4-axis: 8 isolated inputs and 8 outputs
5- through 8-axis: 16 isolated inputs, 16 isolated outputs, 8 digital inputs*
- *High speed position latch for each axis and output compare*
- *8 uncommitted analog inputs*
- *Dual encoder inputs for each servo axis*
- *Expansion for 64 I/O with optional DB-14064 board*
- *100-pin SCSI connectors for each set of 4 axes. ICM-2900 or ICM-1900 breaks-out 100-pin cable into screw terminals*
- *AMP-19540 connects to PCI controller with 100-pin cable and provides four amplifiers for 500 W servos*
- *Communication drivers for Windows, QNX, and Linux*
- *Custom hardware and firmware options available*

DMC-1886
and DMC-1846



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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/sec²

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 μ sec 31 μ sec
- 3–4 axes: 125 μ sec 62 μ sec
- 5–6 axes: 156 μ sec 94 μ sec
- 7–8 axes: 187 μ sec 125 μ sec

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"

Connectors

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

[†]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

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ACCELERA

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

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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

*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 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



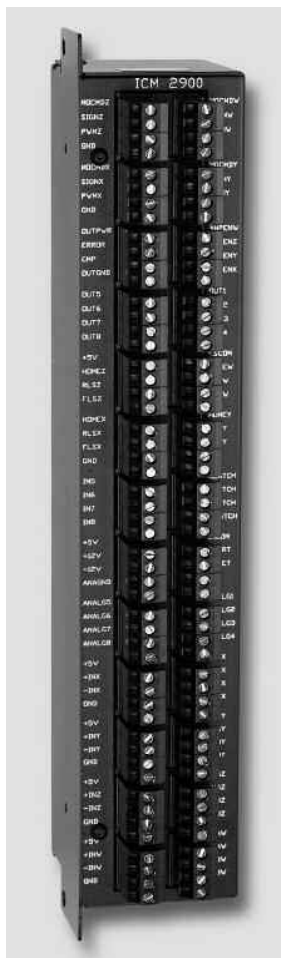
DMC-18x6 Series

Hardware Accessories

ICM-2900 Interconnect Module

The ICM-2900 breaks-out the 100-pin SCSI cable into screw-type terminals. One ICM-2900 is required for each set of four axes. The ICM-2900-FL

has flanges which allow standard screw-type panel mounting. Specify -OPTO for optoisolated outputs. Specify -HAEN for high amp enable and -LAEN for low amp enable. If auxiliary encoders are to be used, use an ICM-2908, a CB-36-25, and a CABLE -36-1M.



ICM-2900 Interconnect Module
with flange

AMP-19540 Interconnect with Four 500 Watt Servo Drives

Galil's AMP-19540 is a 4-axis amplifier for driving brushed or brushless servo motors up to 500 Watts each. By interfacing directly to Galil's DMC-18x6 PCI bus controllers, it provides a cost-effective controller/drive solution for multi-axis applications. The AMP-19540 contains four transconductance, PWM amplifiers. Each amplifier operates at 18 V to 80 V DC, up to 7 Amps continuous, 10 Amps peak. The AMP-19540 gain setting is easily configured with jumpers. The PWM switching frequency is 60 kHz. The AMP-19540 enclosure has dimensions of 6.8" 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.



AMP-19540

DB-28104 Sinusoidal Encoder Interpolation Board

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