PCI Bus, 1–8 axes

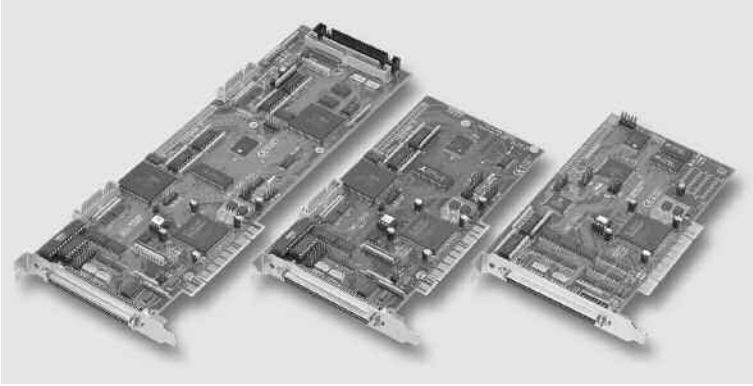
DMC-18x0 and DMC-18x2 Series

Product Description

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

While the DMC-18x0 and DMC-18x2 controllers are 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 the auxiliary FIFO and DPRAM communication channel.

PCI Bus Controllers (left to right) *DMC-1880, DMC-1840, and DMC-1842*



Both controllers incorporate a 32-bit microcomputer and provide 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-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. 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. 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 for each axis and output compare*
- *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. 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 all current versions of Windows, DOS, QNX, and Linux*
- *CE certified*
- *Custom hardware and firmware options available*

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, and DPRAM
- 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 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 — 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/sec^2

Uncommitted Digital I/O

	DIGITAL INPUTS	DIGITAL OUTPUTS	ANALOG INPUTS
DMC-1810 thru -1840	8	8	8
DMC-1850 thru -1880	24	16	8
DMC-18x2	8	8	0

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- (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 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
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-18x0:*
  +5V 750 mA
  -12V 40 mA
  +12V 40 mA
- *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-18x0: 1–4 axes: 8.175" × 4.2"
  5–8 axes: 12.28" × 4.2"
- 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-18x0 and DMC-18x2 Series

Instruction Set

Servo Motor
AF Analog feedback (18x0 only)
DV Dual loop operation (18x0 only)
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/FIFO update rate
DU Dual port RAM enable (18x0 only)
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 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

Interrogation (cont.)
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
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

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

Axis 1–4 DMC-18x0 and DMC-18x2

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*

†(NC for 18x2)

Axis 5–8 DMC-18x0

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) DMC 18x0 only

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) DMC 18x0 only

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

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

J12 Analog 15-pin Male D-sub (DMC-18x0 only)

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

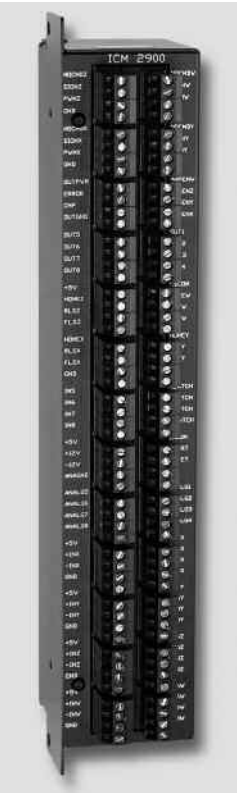
**Active low*

Hardware Accessories

ICM-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" × 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. If using auxiliary encoders with the DMC-18x0, use a CABLE-26-25 26-pin to 25-pin converter to the ICM-1900.

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 or DMC-18x0 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-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.

IOM-1964 I/O Module

The IOM-1964 is an Input/Output module that provides optical isolation for the 64 extended I/O of the DB-14064. Each of the 64 optically isolated inputs and outputs is rated for 25 mA at up to 28 VDC and is configurable as inputs or outputs in groups of eight bits. The IOM-1964 also provides 16 highside outputs capable of 500 mA of current per output. The dimensions are 7.0" × 13.5". Requires CB-50-80 and CABLE-80.

ICB-99000 Interconnect Converter Board

The ICB-99000 interconnect converter board provides interconnectivity between Galil's DMC-21x3 amplifier modules and the DMC-18xx controllers. The DMC-21x3 amplifier connects to the 96-pin DIN connector on the ICB-99000, and the DMC-18xx controller connects to the ICB-99000 through the 100-pin SCSI connector. 4.25" × 5.88"

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, 1–8 axes

DMC-18x0 and DMC-18x2 Series

Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
DMC-1810	1-axis Optima, PCI	$1095	$ 795
DMC-1820	2-axis Optima, PCI	$1495	$ 875
DMC-1830	3-axis Optima, PCI	$1895	$ 935
DMC-1840	4-axis Optima, PCI	$2195	$ 995
DMC-1850	5-axis Optima, PCI	$2595	$1345
DMC-1860	6-axis Optima, PCI	$2795	$1425
DMC-1870	7-axis Optima, PCI	$2995	$1525
DMC-1880	8-axis Optima, PCI	$3195	$1595
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	
CB-50-100-1880	50- to 100-pin converter board; incl. two ribbon cables for DMC-1850 to -1880	$ 75	$ 50
CABLE-26-25	26-pin IDC to 25-pin D type for auxiliary 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
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 for DMC-18x0, DMC-18x2	$ 295	$ 195
CB-50-80	50-pin to 80-pin adaptor for DB-14064	$ 75	$ 50
IOM-1964	Input/output optoisolated module for 64 I/O	$ 695	$ 495
ICB-99000	Interconnect converter board	$ 75	$ 50
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	
WSDK	Set-up, tuning and analysis software	$ 195	
ActiveX Tool Kit	Custom ActiveX controls for Visual Basic, Visual C++, etc.	$ 595	

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