Product Description

The DMC-18x6 PCI bus motor 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 times 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, PVT, 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 firmware for piezo-ceramic motors. Configurable for sinusoidal commutation
- 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, PVT, linear and circular interpolation, electronic gearing and electronic cam. Features elliptical 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 end-of-travel limits accepted for every axis.
- 1- through 4-axis: 8 isolated inputs and 8 outputs
  5- through 8-axis: 16 isolated inputs, 16 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, Mac OSX, and Linux
- Custom hardware and firmware options available
PCI Bus Accelera Series, 1–8 axes

DMC-18x6 Series

Specifications

System Processor
- RISC-based, clock multiplying processor with DSP functions

Communications Interface
- PCI with bi-directional FIFO and Dual Port RAM
- 32-bit PCI interface. 64-bit compatible. 5 V/3.3 V
Commands are sent in ASCII. A binary communication mode is also available as a standard feature

Modes of Motion:
- Point-to-point positioning
- Position Tracking
- Jogging
- 2D Linear and Circular Interpolation with feedrate override
- Linear Interpolation for up to 8 axes
- Tangential Following
- Helical
- Electronic Gearing with multiple masters and ramp-to-gearing
- Gantry Mode
- Electronic Cam
- Contouring
- PVT (Position-Velocity-Time)
- 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 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

<table>
<thead>
<tr>
<th></th>
<th>Digital Inputs</th>
<th>Digital Outputs</th>
<th>Analog Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMC-1816 thru -1846</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>DMC-1856 thru -1886</td>
<td>24</td>
<td>16</td>
<td>8</td>
</tr>
</tbody>
</table>

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 (one per controller)
- High-speed position compare output (1 per set of 4 axes)

Minimum Servo Loop Update Time

<table>
<thead>
<tr>
<th></th>
<th>STANDARD</th>
<th>-FAST†</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–2 axes:</td>
<td>62 µsec</td>
<td>31 µsec</td>
</tr>
<tr>
<td>3–4 axes:</td>
<td>125 µsec</td>
<td>62 µsec</td>
</tr>
<tr>
<td>5–6 axes:</td>
<td>156 µsec</td>
<td>94 µsec</td>
</tr>
<tr>
<td>7–8 axes:</td>
<td>187 µsec</td>
<td>125 µsec</td>
</tr>
</tbody>
</table>

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
  CB-50-100-18X6 required for 5–8 axes. (Occupies two PCI bays, one PCI slot)

†Reduced feature set for -FAST.
PCI Bus Accelera Series, 1–8 axes

DMC-18x6 Series

Instruction Set

**Servo Motor**
- AF: Analog feedback
- DV: Dual loop operation
- 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: Peak torque
- TL: Torque limit
- TM: Sample time

**Stepper Motor**
- KS: Stepper motor smoothing
- LC: Low current
- QS: Error magnitude
- YA: Step drive resolution
- YB: Step motor resolution
- YC: Encoder resolution
- YR: Error correction
- YS: Stepper position maintenance

**Internal Sine Commutation**
- BA: Brushless axis
- BB: Brushless phase
- BC: Brushless calibration
- BD: Brushless degrees
- BI: Brushless inputs
- BM: Brushless leads
- BO: Brushless offset
- BS: Brushless setup
- BZ: Brushless zero

**I/O**
- AL: Arm latch
- AQ: Analog configuration
- 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
- @AN[x]: Value of analog input x
- @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
- CW: Data adjustment bit
- DE: Define dual encoder position
- DP: Define position
- DR: DPRAM update rate
- EI: Enable interrupts
- EO: Echo
- IT: Independent smoothing
- “L”K: Program protect (Lock)
- LZ: Leading zeros format
- MO: Motor off
- MT: Motor type
- PF: Position format
- PW: Password
- QD: Download array
- RS: Reset
- “R’S”: Master reset
- VF: Variable format

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

**Interrogation**
- LA: List arrays
- LL: List labels
- LS: List program
- LV: List variables
- MG: Message command
- QU: Upload array
- RQ: Return data record
- RL: Report latch
- RP: Report command position
- “R’V”: Firmware version information
- SC: Stop code
- TB: Tell status
- TC: Tell error code
- TD: Tell dual encoder
- TE: Tell error
- TI: Tell input
- TP: Tell position

**Interrogation (cont.)**
- TR: Trace program
- TS: Tell switches
- TT: Tell torque
- TV: Tell velocity
- T2: Tell I/O configuration

**Programming**
- BK: Break point
- DA: Dealocate variables/arrays
- DL: Download program
- DM: Dimension arrays
- ED: Edit program
- ELSE: Conditional statement
- ENDIF: End of cond. statement
- EN: End program
- EK: 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
- RE: Return from error routine
- REM: Remark program
- RI: Return from interrupt routine
- SL: Single step
- UI: User interrupt
- UL: Upload program
- X0: Execute program
- ZA: Data record variables
- ZS: Zero stack

**Error Control**
- BL: Backward software limit
- BR: Brake limit
- FL: Forward software limit
- LD: Limit disable
- OA: Encoder failure
- OE: Off-on-error function
- OT: Encoder failure period
- OV: Encoder failure voltage
- TW: Timeout 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: Motion enter—forward
- MR: Motion enter—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: Step

**Contour Mode**
- CD: Contour data
- CM: Contour mode
- DT: Contour time interval

**PVT Mode**
- PV: Position, velocity, time
- BT: Coordinate start

**ECAM/Gearing**
- EA: ECAM master
- EB: Enable ECAM
- EC: ECAM table index
- EG: ECAM go
- EM: ECAM modulus
- 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: Elliptical 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

#### Axis 1–4 DMC-18x6

<table>
<thead>
<tr>
<th>Connector</th>
<th>Description</th>
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<tbody>
<tr>
<td>1-20</td>
<td>100-pin, high density; Connector: Amp# 2-178238-9, Cable: Amp# 2-175677-9; Enclosure: Amp# 176793-9</td>
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#### Axis 5–8 DMC-18x6

<table>
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<th>Connector</th>
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<tr>
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#### Auxiliary Encoder (Axis 1–4)

<table>
<thead>
<tr>
<th>Connector</th>
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<tr>
<td>1-13</td>
<td>26-pin IDC</td>
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#### Auxiliary Encoder (Axis 5–8)

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<tr>
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<td>26-pin IDC</td>
</tr>
</tbody>
</table>
PCI Bus Accelera Series, 1–8 axes

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 Motor phase A
3 Motor phase B
4 Motor phase C

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

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

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

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

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

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

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

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

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

*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. 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.

**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 motor controller/drive solution for multi-axis applications. The AMP-19540 contains four transconductance, PWM amplifiers. Each amplifier operates at 18 V to 80 V DC, up to 7 Amps continuous, 10 Amps peak. The AMP-19540 gain setting is easily configured with jumpers. The PWM switching frequency is 60 kHz. The AMP-19540 enclosure has dimensions of 6.8” × 8.75” × 1”. It interfaces to a PCI bus controller with a single, 100-pin high density SCSI cable. Signals for each axis are brought out through D-type connectors located on the AMP-19540. For applications with less than three axes, the AMP-19520 two-axis model is available. A shunt regulator option is also available. CE certified.

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

**DB-14064 I/O Expansion**
The DB-14064 is an optional board which provides 64 additional I/O for the DMC-18x6 controllers. This board mounts directly onto the back of the controller and provides 64 I/O points configurable by the user for inputs or outputs. The I/O is accessible through two 50-pin headers.
## PCI Bus Accelera Series, 1–8 axes

### DMC-18x6 Series

## Ordering Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QUANTITY 1</th>
<th>QUANTITY 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMC-1816</td>
<td>1-axis Accelera, PCI</td>
<td>$1095</td>
<td>$ 795</td>
</tr>
<tr>
<td>DMC-1826</td>
<td>2-axis Accelera, PCI</td>
<td>$1495</td>
<td>$ 875</td>
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<tr>
<td>DMC-1836</td>
<td>3-axis Accelera, PCI</td>
<td>$1895</td>
<td>$ 935</td>
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<tr>
<td>DMC-1846</td>
<td>4-axis Accelera, PCI</td>
<td>$2195</td>
<td>$ 995</td>
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<tr>
<td>DMC-1856</td>
<td>5-axis Accelera, PCI</td>
<td>$2595</td>
<td>$1345</td>
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<tr>
<td>DMC-1866</td>
<td>6-axis Accelera, PCI</td>
<td>$2795</td>
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<td>DMC-1876</td>
<td>7-axis Accelera, PCI</td>
<td>$2995</td>
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<tr>
<td>DMC-1886</td>
<td>8-axis Accelera, PCI</td>
<td>$3195</td>
<td>$1595</td>
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<tr>
<td>CB-50-100-1886</td>
<td>50- to 100-pin converter board; incl. two ribbon cables for DMC-1856 to -1886</td>
<td>$ 75</td>
<td>$ 50</td>
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<tr>
<td>CABLE-100-1M</td>
<td>100-pin HD cable in 1 meter length</td>
<td>$ 165</td>
<td>$ 125</td>
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<tr>
<td>CABLE-100-2M</td>
<td>100-pin HD cable in 2-meter length</td>
<td>$ 180</td>
<td>$ 135</td>
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<tr>
<td>CABLE-100-4M</td>
<td>100-pin HD cable in 4 meter length</td>
<td>$ 195</td>
<td>$ 145</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>
<td>$ 195</td>
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<tr>
<td>ICM-2900-OPT0</td>
<td>ICM with optoisolated outputs</td>
<td>$ 345</td>
<td>$ 245</td>
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<tr>
<td>AMP-19520</td>
<td>2-axis amplifier for 500 W servo motors</td>
<td>$ 595</td>
<td>$ 395</td>
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<tr>
<td>AMP-19540</td>
<td>4-axis amplifier for 500 W servo motors</td>
<td>$ 795</td>
<td>$ 495</td>
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<tr>
<td>-SR</td>
<td>Shunt regulator option for AMP-195x0</td>
<td>$ 50</td>
<td>$ 25</td>
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<tr>
<td>DB-28104</td>
<td>Sinusoidal Encoder Interpolation Board</td>
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<tr>
<td>DB-14064</td>
<td>Attachment board for 64 additional I/O</td>
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<td>$ 195</td>
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<tr>
<td>CB-50-80</td>
<td>50-pin to 80-pin adaptor for DB-14064</td>
<td>$ 75</td>
<td>$ 50</td>
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<tr>
<td>CB-36-25</td>
<td>36-pin adaptor for aux encoders using ICM-2908</td>
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<td>CABLE-36-1M</td>
<td>36-pin HD cable for aux encoders using ICM-2908</td>
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<td>ICM-2908</td>
<td>Aux encoder breakout</td>
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<td>CABLE-26-25</td>
<td>Ribbon cable for aux encoders with ICM-1900 or AMP-19540</td>
<td>$ 15</td>
<td>$ 15</td>
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<tr>
<td>GalilTools-Lite</td>
<td>Editor, Terminal, Watch Tools. Includes communication library for developers-supports C++, VB, C#, LabVIEW and more</td>
<td>Free download</td>
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<tr>
<td>GalilTools</td>
<td>Above with Scope and Tuner</td>
<td>$ 195</td>
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<tr>
<td>ActiveX Tool Kit</td>
<td>Custom ActiveX controls for Microsoft platforms</td>
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*Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.*