

Galil Motion Control



DMC - 40x0

Datasheet

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Product Description

The DMC-40x0 is Galil's highest performance, stand-alone motor controller. It belongs to Galil's latest generation motion controller family which accepts encoder inputs up to 22 MHz, provides servo update rates as high as 16 kHz, and processes commands in as fast as 40 microseconds—10 times faster than prior generation 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 for synchronizing motion with external events. Modes of motion include point-to-point positioning, position tracking, jogging, linear and circular interpolation, PVT, contouring, electronic gearing and electronic cam (ECAM). Like all Galil controllers, the DMC-40x0 controllers use Galil's popular, intuitive command language, making 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
- (2) 10/100 Base-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.
- Available with internal, multiaxis servo or stepper drives. Or, connect to external drives.
- Accepts up to 22 MHz encoder frequencies for servos; Outputs up to 6 MHz for steppers
- Sample times as low as 31 microseconds per axis; fast command processing
- Advanced PID compensation with velocity and acceleration feedforward, integration limits, notch filter and low-pass filter
- Modes of motion include jogging, point-to-point positioning, position tracking, contouring, linear and circular interpolation, electronic gearing and electronic cam.
- Ellipse scaling, slow-down around corners, infinite segment feed and feedrate override
- Multitasking for concurrent execution of up to eight application programs. Ultra-fast command processing
- Expanding, non-volatile memory for application programs, variables and arrays
- Optically isolated home input, forward and reverse limits for every axis
- Uncommitted, isolated I/O:
 - 1-4-axis: 8 inputs and 8 outputs
 - 5-8-axis: 16 inputs and 16 outputs
 - Isolated, high-power outputs for driving brakes or relays
 - 8 uncommitted analog inputs
 - High speed position latch and output compare
 - 32 additional 3.3 TTL V I/O (5 V optional); Add more I/O with RIO-471xx PLC
- 2 line x 8 character programmable LCD
- Accepts single 20–80 VDC input
- Communication drivers for Windows and Linux
- Custom hardware and firmware options available

| Motion Controller | |
|----------------------|---|
| Processor | RISC-based clock multiplying processor with DSP functions, Galil's 5th generation ASIC |
| Communication | 10/100 Base-T Ethernet with Auto MDIX Main and Aux RS232 serial ports More options available see below. |
| Program memory size | 4000 lines x 80 characters |
| # of Variables | 510 |
| # of Arrays | 24000 array elements in 30 arrays |
| Position Range | 32-bit, automatic rollover |
| Maximum Velocity | 22 million counts/s |
| Maximum Acceleration | 1 billion counts/s ² |

| Power and Mechanical | |
|-------------------------|--|
| Power requirements | 20-80 V _{DC} , 12-16 W @ 25 deg C |
| Operational temperature | 0 – 70 deg C |
| Humidity | 20 – 95 % RH, non-condensing |
| Dimensions | 1-4 axes models: 8.05" x 7.25" x 1.41" 5-8 axes models: 11.5" x 7.25" x 1.41" |



| Configurable Filter Features |
|------------------------------|
| Proportional |
| Torque limit |
| Backlash compensation |
| Integral |
| Offset |
| Profile filtering |
| Derivative |
| Feed-forward acceleration |
| Low-pass filter (Pole) |
| Notch |
| Dual-loop feedback mode |
| Feed-forward velocity |

| Modes of Motion | |
|---------------------------------------|--|
| Position Relative & Position Absolute | Absolute and relative positioning following a trapezoidal velocity profile. Phase correction and profile smoothing available. |
| Jogging | Velocity control where no final endpoint is prescribed. |
| Vector Mode | 2D motion path consisting of linear and arc segments. Motion along the path is continuous at the prescribed vector speed even at transitions between linear and circular segments. |
| Linear Interpolation | 1-8 axes of coordinated linear profiling. |
| Gearing & Gantry Mode | Electronic gearing and gantry mode with ramped gearing. |
| Electronic Camming (ECAM) | Following an arbitrary trajectory based upon a master encoder position. |
| Contour | Allows any arbitrary profile and any set of axes to be prescribed. |
| PVT | Motion path described in incremental position, velocity, and change of time. |

| Minimum Servo Update Rate | |
|---------------------------|-------------------|
| # of axes | Standard Firmware |
| 1-2 | 62 usec, 16 kHz |
| 3-4 | 125 usec, 8 kHz |
| 5-6 | 156 usec, 6.4 kHz |
| 7-8 | 187 usec, 5.4 kHz |

| General Purpose I/O | | | | |
|-----------------------------------|---------------|----------|---|---|
| | Number of I/O | | Voltage | Details |
| | 1-4 axis | 5-8 axis | | |
| Opto-isolated inputs ¹ | 8 | 16 | 5-24 V _{DC} | Can be configured for use as high-speed latch (position capture). |
| Opto-isolated outputs | 8 | 16 | 12-24 V _{DC} | 500mA Sourcing, can be configured as brake output. |
| Analog Inputs | 8 | 8 | ±10, ±5, 0-5, 0-10 V | 12-bit, 16-bit optional, can be used as position feedback |
| Extended I/O ¹ | 32 | 32 | 3.3 V _{DC} , 5V _{DC} optional | Input or Output configurable in banks of 8 |

| Feature Specific I/O | | | | |
|------------------------------------|-------------------------|----------|--|--|
| | Number of I/O | | Description | Details |
| | 1-4 axis | 5-8 axis | | |
| Reverse/Forward Limit Switches | per Axis | | 5-24 V _{DC} opto-isolated | |
| Home Input | per Axis | | 5-24 V _{DC} opto-isolated | |
| Amplifier Enable Output | per Axis | | +5, +12V _{DC} controller powered or 5-24V _{DC} opto-isolated | See ICM Modules for all AMP enable options. |
| Stepper (Step/Dir signals) | per Axis | | 0-5 V _{DC} Step/Dir TTL Signal | 6 MHz max output |
| Servo control (Motor command line) | per Axis | | ±10V analog output | 16-bit resolution |
| Quadrature Encoder Inputs | 2 per Axis ¹ | | +/-12V _{DC} or TTL | 22 MHz input max See ICM Modules for all feedback options |
| Hall inputs | per Axis | | 3x 0-5V TTL inputs | When equipped with some AMP Modules |
| Abort | 1 | | 5-24V _{DC} opto-isolated | |
| Reset | 1 | | 5-24V _{DC} opto-isolated | |
| Electronic lock-out | 1 | | 5-24V _{DC} opto-isolated | When equipped with AMP Modules |
| Output compare | 1 | 2 | 0-5V TTL | Also known as pulse on position |
| Error out | 1 | | 0-5V TTL | |

¹ Each unused auxiliary encoder can be used as 2 additional digital inputs.

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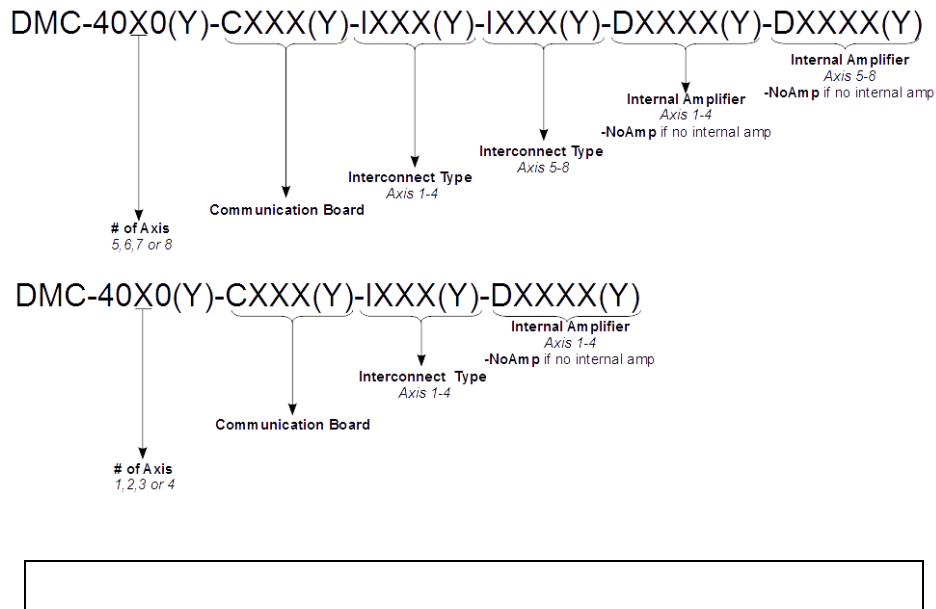
Ordering Options

Internal to a DMC-40x0 unit are several modular boards that change the connector layout, pin-out, and functionality of the unit. In order to provide a full DMC-40x0 part number for 1-4 axis units, the user must specify a communication board (CMB), interconnect module (ICM), and controller board (DMC). 5-8 axis models require the specification of an additional ICM module. Both 1-4 and 5-8 axis models have options for internal servo (AMP) and stepper (SDM) modules. In addition to the flexibility of choosing various modules, each module features additional options.



1-4 axis DMC-40x0 model (left); 5-8 axis DMC-40x0 model (right)

The following diagram shows the layout of a complete DMC-40x0 part number for both 1-4 axes and 5-8 axes models. X designates the part numbers that will distinguish the different module options and Y designates the various options that modify the module. Often, several Y-options can be stacked on a single module and are separated by commas.



| Example Part Numbers | |
|---|---|
| DMC-4040-C012-I000(SSI,24V,HAEN,Sink)-D3540 | <p>4-Axis Stand-Alone Controller</p> <p>C012, default: 100-BaseT Ethernet, 32 Extended I/O, LCD, RS-232</p> <p>I000, default: ICM with 15-pin D-sub connectors</p> <p>5-24V opto-isolated, high amplifier enable, sinking</p> <p>SSI feedback option</p> <p>D3540: Four 600W Sinusoidal Servo Drives for Brush / Brushless motors</p> |
| DMC-4060(12V)-C022-I200-I200 | <p>6-Axis Stand-Alone Controller</p> <p>12V controller power option</p> <p>C1022: Dual 100-BaseT Ethernet, 32 Extended I/O, LCD, RS-232</p> <p>I200: ICM with 26 pin High Density D-type connectors</p> <p>I200: ICM with 26 pin High Density D-type connectors</p> <p>Notes</p> <ul style="list-style-type: none"> No internal amplifiers are selected. The default amplifier enable is 5V internally powered, high amplifier enable sinking. Amplifier enables circuits that can be specified by a Y-option in the ICM. |

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DMC-40x0

DMC-40x0(Y) – CXXX(Y) – IXXX(Y) – DXXXX(Y)

By default, the DMC-40x0 is paired with the CMB-41012 (-C012) and ICM-42000 (-I000) thus the DMC-40x0-C012-I000 and DMC-40x0-C012-I000-I000 are the default part numbers for 1-4 axes and 5-8 axes, respectively, and where x specifies the number of axes.



Default 1-4 axes model (left), default 5-8 axes model (right)

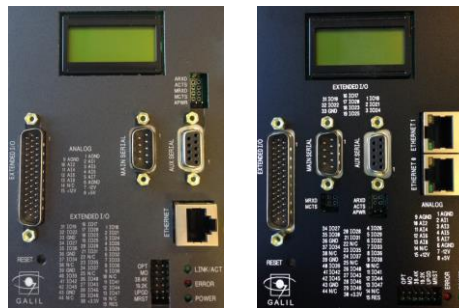
DMC-40x0 Options

| Part Number | Description |
|-------------|--|
| DIN | DIN Rail Mount |
| 12V | Power Controller with 12 V _{DC} |
| 16bit | 16-bit analog inputs |
| 4-20mA | 4-20mA analog inputs |
| ISCNTL | Isolate Controller Power |
| TRES | Encoder terminating resistors |
| ETL | ETL certification |
| MO | Motor off jumper installed by default |

CMB Modules

DMC – 40x0(Y) - CXXX(Y) – IXXX(Y) – DXXXX(Y)

The CMB (communication board) provides the DMC-40x0 with a communication interface to external devices, an LCD screen for displaying default status codes or customized messages, and 32 configurable TTL I/O. The default CMB-41012 (-C012) provides both Ethernet and an RS232 as main communication ports and an auxiliary RS232 port for communication with HMI's and other devices. The CMB-41022 (-C022) adds an additional Ethernet port for daisy chaining.



Default CMB-41012 (-C012) (left). CMB-41022 (-C022) (right).

| Modules | Description |
|----------------------------|---|
| CMB-41012 (-C012, default) | Default communication board |
| CMB-41022 (-C022) | Dual Ethernet communication board |
| Options | |
| Part Number | Description |
| 5V | Upgrades extended TTL I/O to 5V |
| P1422 | RS-422 on main serial port |
| P2422 | RS-422 on auxiliary serial port |
| P422 | RS-422 on both main and auxiliary serial port |

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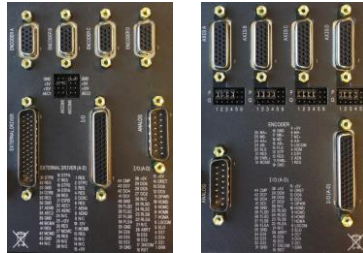
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ICM Modules

DMC – 40x0(Y) – CXXX(Y) – IXXX(Y) – DXXXX(Y)

ICM (interconnect modules) provide the pin-out interface from the I/O of the DMC controller to external devices. These pin-outs include signals for driving external amplifiers, limit switches, homing, opto-isolated inputs/outputs, and more.



ICM-42000 (-I000) and ICM-42100 (-I100) (left). ICM-42200 (-I200) (right).

| Modules | Description |
|------------------------------------|---|
| ICM-42000 (-I000, default) | Default interconnect board |
| ICM-42100 (-I100) | Same mechanical layout and pin-out as ICM-42000 (-I000). Allows additional internal hardware for Sin/Cos feedback signals. Encoder inputs are terminated with 120Ω. |
| ICM-42200 (-I200) | 26-pin encoder connector that includes external amplifier I/O. Recommended for use when interfacing with external amplifiers. |

| Options | | | | | |
|---|---------------------|--|-----------------------|------------------|-------------|
| Part Number | | Description | | | |
| SSI | | SSI Feedback | | | |
| BiSS | | BiSS Feedback | | | |
| DIFF | | Differential ±10 motor command outputs | | | |
| STEP | | Differential STEP/DIR outputs | | | |
| Amplifier Enable | | | | | |
| The amplifier enable part number requires one option to be specified from the following three categories: | | | | | |
| Voltage | | Logic | | Sinking/Sourcing | |
| Part Number | Description | Part Number | Description | Part Number | Description |
| 5V | +5V internal power | HAEN | High amplifier enable | Sink | Sinking |
| 12V | +12V internal power | LAEN | Low Amplifier enable | Source | Sourcing |
| 24V | 5-24V optoisolated | | | | |

AMP Modules

DMC – 40x0(Y) – CXXX(Y) – IXXX(Y) – DXXXX(Y)

| | AMP-430x0 (-D30x0) | AMP-43140 (-D3140) | AMP-43240 (-D3240) | AMP-435x0 (-D35x0) | AMP-43640 (-D3640) | AMP-43740(D3740) |
|--|-----------------------------|-------------------------|-----------------------------|-----------------------------|--------------------|-----------------------------|
| Motor type | Brushed/ 3φ Brushless servo | Brushed Servo | Brushed/ 3φ Brushless servo | Brushed/ 3φ Brushless servo | 3φ Brushless servo | Brushed/ 3φ Brushless servo |
| Amplifier Axes | 4 or 2 | 4 | 4 | 4 or 2 | 4 | 4 |
| Current Drive | PWM | Linear | PWM | PWM | Linear | PWM |
| Drive Mode | Chopper, Inverter | Linear | Chopper | Phase Shift | Linear | Phase Shift |
| Commutation | Trap w/120° halls | Brushed only | Trap w/120° halls | Sinusoidal | Sinusoidal | Sinusoidal |
| Power per axis (Watts per channel) | 500 | 20 | 750 | 600 | 20 | 1200 |
| Cont. Current (Amps) | 7 | 1 | 10 | 8 | 1 | 16 |
| Peak Current (Amps) | 10 | 1 | 20 | 15 | 2 | 30 |
| Bus Voltage (VDC) | 20 or 80 ¹ | +/- 12-30 bipolar | 20-80 ¹ | 20-80 ¹ | 15-40 | 20-80 |
| Gains (A/V) | 0.4, 0.7, 1.0 | 0.01 ² , 0.1 | 0.5, 1.0, 2.0 | 0.4, 0.8, 1.6 | 0.2 | 0.8, 1.6, 3.2 |
| Switching Freq. (kHz) | 60 or 140 ³ | – | 24 | 33 | – | 20 |
| Max Current loop BW (kHz) ⁴ | 8 | 10 | 3 | 4 | 8 | 2.5 |
| Min. Inductance (mH) | 0.2 - 0.5 | .05 | 0.8 | 0.5 | .05 | 1 |
| Over-Voltage | Yes | No | Yes | Yes | No | Yes |
| Under-Voltage | Yes | No | Yes | Yes | No | Yes |
| Over-Current | Yes | Fused | Yes | Yes | Fused | Yes |
| Short Circuit | Yes | Fused | Yes | Yes | Fused | Yes |
| Over-Temperature | Yes | Thermal Shutdown | Yes | Yes | Thermal Shutdown | Yes |
| ELO | Yes | Yes | Yes | Yes | Yes | Yes |
| Adjustable Current Loop | Yes | No | Yes | Yes | No | Yes |
| Shunt Option | Yes | No | Yes | Yes | Yes | Yes |
| SSR Option | No | Yes | No | No | No | No |

¹ Contact Galil regarding the 160 V_{DC} option.

² Available by ordering the 100mA option.

³ Contact Galil regarding the 140kHz option.

⁴ Current loop bandwidth is system dependent. These values are what can be typically expected.

⁵ 0.75 mH @ 24 V_{DC} bus voltage and 1.2 mH minimum @ 48 V_{DC} bus voltage

⁶ 0.2 mH when using chopper mode, 0.5 when using inverter mode

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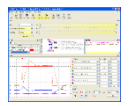
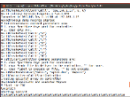

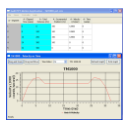



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| SDM Modules | | |
|---|---|-----------------------|
| The following embedded stepper amplifier drives are in the same black box as the DMC. Like our servo options, they are available in banks of 2 or 4-axes; note the 2-axes options take up the same space as a bank of 4-axes. | | |
| | SDM-440x0 (-D40x0) | SDM-44140 (-D4140) |
| Motor type | Stepper | Stepper |
| Amplifier Axis | Bank of 2 or 4 axis | Bank of 4 axis |
| Microstepping | $1, \frac{1}{2}, \frac{1}{4}, \frac{1}{16}$ | $\frac{1}{64}$ |
| Power per axis | 42 W | 180 W |
| Peak Current | 1.4 A/φ | 3.0 A/φ |
| Bus Voltage | 12-30 V _{DC} | 20-60 V _{DC} |
| Gains | 0.5, 0.75, 1.0, 1.4 | 0.5, 1.0, 2.0, 3.0 |
| Switching Freq. | 27 kHz (nominal) | 60 kHz |
| Min. Inductance | 0.5 mH | 0.5 mH |
| Over-Voltage | No | No |
| Under-Voltage | No | Yes |
| Over-Current | Yes | Yes |
| Short Circuit | Yes | Yes |
| Over-Temperature | No | No |
| ELO | Yes | Yes |
| Low Current Mode (LC) | Yes | Yes |

| AMP/SDM Options | |
|--|--|
| The following options can apply to both our servo and stepper (AMP/SDM) modules. | |
| Part Number | Description |
| HALLF ¹ | Filtered hall sensors |
| SSR ¹ | Solid state relay |
| ISAMP | Isolates power between amplifiers (two banks of AMP/SDMs required) |

1 Not available for all amplifier options

| Accessories | | |
|---|-----------------------------|--|
| Image | Part Number | Description |
|  | GALILSUITE SOFTWARE | Servo Tuning and Analysis with Program Editor and Terminal |
|  | GALILTOOLS SOFTWARE | GalilTools programming software for Galil controllers |
|  | EPICS SOFTWARE | Communication Drivers and Device Support to create a Galil EPICS IOC |
|  | FREQUENCY ANALYSIS SOFTWARE | Servo Tuning in Frequency Domain |
|  | GALILPVT | Galil PVT Software for PVT mode of Motion |
|  | PSR-12-24 | 12A-24 VDC Power supply |
|  | PSR-6-48 | 6A-48 VDC Power Supply |
|  | BLM-N23-50-1000-B | Nema 23 Brushless Motor with 1000-line encoder |

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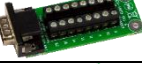

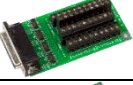
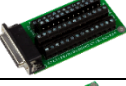
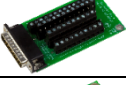
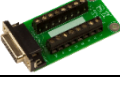
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| Accessories | | |
|---|---------------|--|
| Image | Part Number | Description |
|  | CABLE-15-1M | 15-pin HD male D to discrete wires-1 meter |
|  | CABLE-15-2M | 15-pin HD male D-sub to discrete wires, 2 meter |
|  | CABLE-26-1M | 26-pin HD male D-sub to discrete wires, 1 meter |
|  | CABLE-44F-1M | 44-pin HD female D to discrete wires-1 meter |
|  | CABLE-44M-1M | 44-pin HD male D to discrete wires-1 meter |
|  | CABLE-9-PIN-D | RS232 female to female straight through cable |
|  | ICS-48015-M | 15-pin D HD male to screw term |
|  | ICS-48026-M | 26-pin D HD male to screw terminals |
|  | ICS-48032-F | 44-pin D HD female to screw term with opto-isolation |
|  | ICS-48044-F | 44-pin D HD female to screw term |
|  | ICS-48044-M | 44-pin D HD male to screw terminals |
|  | ICS-48115-F | 15-pin D LD female to screw term |

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