Ethernet/RS232/USB Econo Series, 1–8 axes

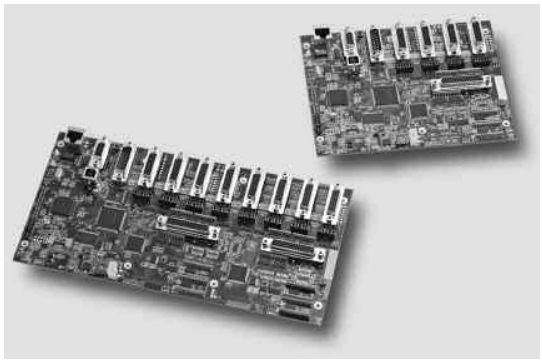
DMC-41x3 Series

Product Description

The DMC-41x3 motion controller is Galil's latest generation Econo motor controller. Compared with the DMC-21x3 Econo controller, the DMC-41x3 offers the following enhancements: 100BASE-T Ethernet, aux RS232 port, USB port, uncommitted analog inputs, accepts 15 MHz encoder frequencies, and faster sample frequencies. The DMC-41x3 also accommodates the same stepper and servo motor drives used in the DMC-40x0 Accelera series and allows two 4-axis 500 W drives to be installed in the 8-axis controller package.

The DMC-41x3 is available as a box-level or card-level motion controller. The unit operates standalone or interfaces to a PC with Ethernet 10/100BASE-T, or USB. It includes optically isolated I/O in addition to analog inputs and outputs. The DMC-41x3 controller and drive unit accepts power from a single 20–60 VDC source.

DMC-41x3 4-and 8-axis controllers. Card-level shown. Metal enclosure is also available with -BOX option.



The DMC-41x3 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, contouring, electronic gearing and ECAM. Like all Galil controllers, the DMC-41x3 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-41x3 where x=1,2,3,4,5,6,7,8 axes*
- *(1) 10/100BASE-T Ethernet port with Auto MDIX*
  (1) USB port–main
  (1) RS232 port up–aux
- *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 15 MHz encoder frequencies for servos. Outputs pulses 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, 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 for every axis*
- *Uncommitted, isolated inputs and isolated outputs*
  1- through 4-axis models: 8 inputs and 8 outputs
  5- through 8-axis models: 16 inputs and 16 outputs
- *High speed position latch for each axis and output compare*
- *8 uncommitted analog inputs*
- *Dual encoder inputs for each servo axis*
- *Accepts single 20–60 VDC input*
- *Available with internal stepper and servo drives. Or, connect to external drives of any power range*
- *Available as card-level or with metal enclosure*
- *Communication drivers for Windows, Mac OSX, and Linux*
- *Custom hardware and firmware options available*

DMC-41x3 Series

Specifications

System Processor

- RISC-based, clock multiplying processor with DSP functions

Communications Interface

- (1) 10/100BASE-T Ethernet port with Auto MDIX
- (1) USB port—main
- (1) RS232 port—aux

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 15 million counts/sec for servo motors
- Acceleration: Up to 1 billion counts/sec^2

Uncommitted I/O

	ISOLATED INPUTS	ISOLATED OUTPUTS	ANALOG INPUTS
DMC-4113 thru -4143	8	8	8
DMC-4153 thru -4183	16	16	8

High Speed Position Latch

- Uncommitted inputs 1-4 latch A,B,C,D 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 (per set of 4 axes)

Minimum Servo Loop Update Time

	STANDARD	*-FAST**
1–2 axes:	125 µsec	62 µsec
3–4 axes:	250 µsec	125 µsec
5–6 axes:	375 µsec	188 µsec
7–8 axes:	500 µsec	250 µsec

Maximum Encoder Feedback Rate

- 15 MHz

Maximum Stepper Rate

- 3 MHz (Full, half or microstep)

Power Requirements

- 20–60 VDC

Environmental

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

Mechanical

- 1- thru 4-axis: 8.1" × 7.25" × 1.5"
  5- thru 8-axis: 11.5" × 7.25" × 1.5"

Connectors

- General I/O: 44-pin HD Female D-sub
- Axes: 26-pin HD Female D-sub
- Analog: 15-pin LD Male D-sub

**Reduced feature set for -FAST.*

DMC-41x3 Series

Instruction Set

Ethernet

DH	DHCP Configuration
HS	Handle switch
IA	Set IP address
IH	Open IP handle
IK	Ethernet port blocking
MB	Modbus
MW	Modbus wait
SA	Send command
SM	Subnet mask

Servo Motor

AF	Analog feedback
AG	Set amplifier gain
AU	Set current loop gain
AW	Report AMP-43040 bandwidth
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 modulo
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
BR	Brush motor enable
BV	Burn variables and arrays
BW	Brake wait
CC	Configure communications port
CE	Configure encoder type
CF	Configuration unsolicited messages handle
CI	Configure communication interrupt
CN	Configure switches
CW	Data adjustment bit
DE	Define dual encoder position
DP	Define position
DR	Data record update rate
EI	Event 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
QU	Upload array
RS	Reset
^R^S	Master reset
UI	User interrupt
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

ID	AMP ID
LA	List arrays
LL	List labels
LS	List program
LV	List variables
MG	Message command
QH	Query hall state
QR	Data record
QU	Upload array
QZ	Return data record information
RL	Report latch
RP	Report command position
^R^V	Firmware revision information
SC	Stop code
TA	Tell amplifier status
TB	Tell status
TC	Tell error code
TD	Tell dual encoder

Interrogation (cont.)

TE	Tell error
TH	Tell handle
TI	Tell input
TP	Tell position
TR	Trace program
TS	Tell switches
TT	Tell torque
TV	Tell velocity
TZ	Tell I/O configuration
WH	Which handle

Programming

BK	Breakpoint
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
RE	Return from error routine
REM	Remark program
RI	Return from interrupt routine
SL	Single step
UL	Upload program
XQ	Execute 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
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
SD	Switch deceleration
SP	Speed
ST	Stop

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

ECONO

Connectors — Communications

RS232 Auxiliary Port

9-pin; Female connector and cable

1 NC
2 Receive data-input
3 Transmit data-output
4 NC
5 Ground
6 NC
7 Request to send-output
8 Clear to send-input
9 5 V

Ethernet 10/100Base-T

RJ-45 connector

USB Connector

Connectors— Amplifier Board AMP-43040

*J2 Power***

6-pin

1 Ground
2 Ground
3 Ground
4 +VM (20 V–55 V)
5 +VM (20 V–55 V)
6 +VM (20 V–55 V)

JA1, JB1, JC1, JD1 Motor Output

4-pin

1 Motor Phase C
2 Motor Phase B
3 NC
4 Motor Phase A

Connectors — I/O

J2 General I/O Axes A thru D

44-pin Hi-density Female D-sub

1 Error output*
2 Input 1-isolated
3 Input 4-isolated
4 Input 7-isolated
5 Electronic Lockout-isolated input*
6 Limit switch common
7 Home A-isolated
8 Home B-isolated
9 Home C-isolated
10 Home D-isolated
11 Output power†
12 Output 3-isolated
13 Output 6-isolated
14 Output return-
15 +5 V
16 Reset-isolated*
17 Input common
18 Input 3-isolated
19 Input 6-isolated
20 Abort-isolated*
21 NC
22 Reverse limit A-isolated†
23 Reverse limit B-isolated†
24 Reverse limit C-isolated†
25 Reverse limit D-isolated†
26 NC
27 Output 2-isolated
28 Output 5-isolated
29 Output 8-isolated
30 +5 V
31 Ground
32 Input 2-isolated
33 Input 5-isolated
34 Input 8-isolated
35 Ground
36 Forward limit A-isolated†
37 Forward limit B-isolated†
38 Forward limit C-isolated†
39 Forward limit D-isolated†
40 Ground
41 Output 1-isolated
42 Output 4-isolated
43 Output 7-isolated
44 Output Compare A–D

J2 General I/O Axes E thru H

44-pin Hi-density Female D-sub

1 Error output*
2 Input 9-isolated
3 Input 12-isolated
4 Input 15-isolated
5 Electronic lockout-isolated input*
6 Limit switch common
7 Home E-isolated
8 Home F-isolated
9 Home G-isolated
10 Home H-isolated
11 Output power†
12 Output 11-isolated
13 Output 14-isolated
14 Output return-
15 +5 V
16 Reset-isolated*
17 Input common
18 Input 11-isolated
19 Input 14-isolated
20 Abort-isolated*
21 NC
22 Reverse limit E-isolated†
23 Reverse limit F-isolated†
24 Reverse limit G-isolated†
25 Reverse limit H-isolated†
26 NC
27 Output 10-isolated
28 Output 13-isolated
29 Output 16-isolated
30 +5 V
31 Ground
32 Input 10-isolated
33 Input 13-isolated
34 Input 16-isolated
35 Ground
36 Forward limit E-isolated†
37 Forward limit F-isolated†
38 Forward limit G-isolated†
39 Forward limit H-isolated†
40 Ground
41 Output 9-isolated
42 Output 12-isolated
43 Output 15-isolated
44 Output Compare E–H

J3 Analog Inputs

15-pin Low-density 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 NC
15 +12 V

Axis Connectors Axes A thru H

26-pin Hi-density Female D-sub

1 Hall 2
2 Amp Enable
3 Direction
4 Home–isolated
5 Limit switch common
6 Aux A-
7 Index+
8 A-
9 +5 V
10 Ground
11 Amp Enable Return
12 Hall 1
13 Step
14 Forward limit–isolated†
15 Aux B+
16 Index-
17 B+
18 Ground
19 Motor command
20 Amp Enable Power
21 Hall 0
22 Reverse limit–isolated†
23 Aux B-
24 Aux A+
25 B-
26 A+

***Note: Power can be input through either of the amplifier connectors to power the entire unit due to power pass-thru connectors that connect input power to all modules. For 5- through 8-axis units with two different types of amplifiers, the lower of the maximum voltages is the maximum rating for the unit. However, if you need different voltages, you can specify the ISAMP and/or ISCNTL option to separate the various power inputs.*

When using the AMP-43140 with a power supply lower than +20 Volts, a separate supply of 20–55 VDC must be input to the 2-pin connector on the side of the DMC-41x3.

**Active low*

†Programmable for Active high or Active low

DMC-41x3 Interconnect and Drive Options

AMP-430x0 2- and 4-axis 500W Servo Drives (-D3020, -D3040)

The AMP-43040 resides inside the DMC-41x3 enclosure and contains four transconductance, PWM amplifiers for driving brushless or brush-type servo motors. Each amplifier drives motors operating at up to 7 Amps continuous, 10 Amps peak, 20–55 VDC. The gain settings of the amplifier are user-programmable at 0.4 Amp/Volt, 0.7 Amp/Volt and 1 Amp/Volt. The switching frequency is 60 kHz. The drive for each axis is software configurable to operate in either a chopper or inverter mode. The chopper mode is intended for operating low inductance motors. The amplifier offers protection for over-voltage, under-voltage, over-current, short-circuit and over-temperature. Two AMP-43040s are required for 5- thru 8-axis controllers. A shunt regulator option is available. A two-axis version, the AMP-43020 is also available.

AMP-43140 4-axis 20W Servo Drives (-D3140)

The AMP-43140 resides inside the DMC-41x3 enclosure and contains four linear drives for operating small, brush-type servo motors. The AMP-43140 requires a ± 12-30 VDC input. Output power is 20 W per amplifier or 60 W total. The gain of each transconductance linear amplifier is 0.1 A/V at 1 A maximum current. The typical current loop bandwidth is 4 kHz. An SSR option is available which guarantees absolutely no current during motor off.

SDM-44040 4-axis Stepper Drives (-D4040)

The SDM-44040 resides inside the DMC-41x3 enclosure and contains four drives for operating two-phase bipolar step motors. The SDM-44040 requires a single 12-30 VDC input. The unit is user-configurable for 1.4 A, 1.0 A, 0.75 A, or 0.5 A per phase and for full-step, half-step, 1/4 step or 1/16 step.

SDM-44140 4-axis Microstep Drives (-D4140)

The SDM-44140 resides inside the DMC-41x3 enclosure and contains four microstepping drives for operating two-phase bipolar stepper motors. The drives produce 64 microsteps per full step or 256 steps per full cycle which results in 12,800 steps/rev for a standard 200-step motor. The maximum step rate generated by the controller is 3,000,000 microsteps/second. The SDM-44140 drives motors operating at up to 3 Amps at 12 to 60 VDC (available voltage at motor is 10% less). There are four software-selectable current settings: 0.5 A, 1 A, 2 A and 3 A. Plus, a selectable low-current mode reduces the current by 75% when the motor is not in motion. No external heatsink is required.

Power Supplies — PSR Series

The PSR Series are regulated DC power supplies capable of operating from a 100/240 VAC input, at 50/60 Hz. The power supply includes a shunt regulator and blocking diode.

Model	*Power Rating*	*Dimensions*
PSR-12-24	24 VDC @ 12 A cont.	9" × 6.5" × 2" 3.5 lbs.
PSR-6-48	48 VDC @ 6 A cont.	9" × 6.5" × 2" 3.5 lbs.

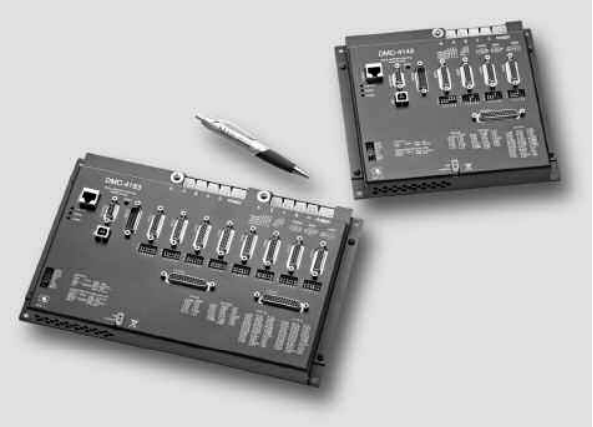
ICS D-type to Screw-Terminal Boards

Galil offers various ICS boards which break-out the DMC-41x3 D-type connectors into screw terminals for quick prototyping:

ICS-48115-F 15-pin LD female to terminals—analog.

ICS-48026-M 26-pin HD male to terminals—for axes.

ICS-48044-M 44-pin HD male to terminals—I/O.



-BOX version of the DMC-41x3 controller

DMC-41x3 Series

Ordering Information

1- through 8-axis Models:

DMC-41x3-Dxxxx-Dxxxx-SR55-BOX

Number of Axes
1: 1-axis
2: 2-axes
3: 3-axes
4: 4-axes
5: 5-axes
6: 6-axes
7: 7-axes
8: 8-axes

Drive — Axes 1–4 (optional)
3020: two 500 Watt servo motor drives
3040: four 500 Watt servo motor drives
3140: four 20 Watt servo motor drives
4040: four 1.4 A stepper motor drives — Full, Half, 1/4, 1/16
4140: four microstep drives

Drive — Axes 5–8 (optional)
3020: two 500 Watt servo motor drives
3040: four 500 Watt servo motor drives
3140: four 20 Watt servo motor drives
4040: four 1.4 A stepper motor drives — Full, Half, 1/4, 1/16
4140: four microstep drives

Shunt Regulator (optional)

Metal enclosure (optional if not using Galil drives. Required for AMPs and SDMs)

Options

DMC Controller

OPT CODE	*DESCRIPTION*
DIN	DIN Rail mounting option
12 V	12 VDC controller power
16BIT	16-Bit ADC for analog inputs. 12-bits is standard
NRExxxx	Customized upgrade
422	RS422 on auxiliary
SSI	SSI encoders. Quadrature encoders are standard
BiSS	BiSS encoders. Quadrature encoders are standard
TRES	Termination resistors
4-20mA	4-20mA analog inputs
HSRC	HIgh power sourcing outputs (default low power sinking)

SDM and AMP Drives

OPT CODE	*DESCRIPTION*
100mA	100 mA output capacity for AMP-43140. Default is 1 Amp
ISAMP	Isolation of power between each AMP amplifier
ISCNTL	Isolation of controller power from amplifier power
SSR	No current during motor off

Note: If a special option is required, place the appropriate OPT CODE inside a parenthesis directly following the respective DMC, CMB, ICM, SDM or AMP part numbers. Use commas for multiple options within a parenthesis.

Ordering Information continued on the next page.