Galil Motion Control

DMC - 500x0

Datasheet

Product Description

The DMC-500x0 EtherCAT Controller is Galil Motion Control's newest entry in its latest generation of digital motion controllers. Incorporating all of the features of our flagship Accelera series controller and designed with compatibility and flexibility in mind, the DMC-500x0 allows integration of remote EtherCAT drives into new and existing applications with just a handful of configuration commands.

The DMC-500x0 is offered in 1 through 8 axis formats. Axes 1 - 4 can be configured as either local or EtherCAT drives while axes 5 – 8 can be configured for additional EtherCAT drives. Unique to the motion control industry, this ability to mix and match local and EtherCAT drives on the same controller provides increased flexibility for any application. In addition, the DMC-500x0 is fully compatible with Galil's internal servo and stepper motor amplifiers as well as third party external drives.

EtherCAT drives can be configured in software to close the PID control loop on the controller or on the drive. In the first mode, torque commands are sent to the motor amplifier after closing the control loop using Galil's on board PID control algorithm. This mode allows access to the Galil's standard PID control loop features, including advanced PID compensation, velocity feedforward, acceleration feedforward, integrator limits, notch filter, low pass filter and backlash compensation. In the second mode, the servo control loop is closed on the EtherCAT drive with the Galil controller sending motion profile commands at rates of up to 2.5 kHz on a 1-4 axis controller.

Standard opto-isolated inputs for each local axis include a forward limit, reverse limit and homing input. The controller also features 8 uncommitted opto-isolated inputs and 8 uncommitted opto-isolated high power outputs. The DMC-500x0 includes 8 uncommitted analog inputs, allowing the controller to interface with analog sensors such as joysticks and temperature sensors. Inputs from two separate encoders are available for each local servo axis. Local auxiliary encoder inputs are also available for axes configured for EtherCAT, providing access to Galil's dual feedback PID control loop.

One Ethernet port and two RS-232 ports are provided for communication with a host PC. Multiple EtherCAT drives can be connected in a daisy chain configuration and connected to the controller's EtherCAT port, simplifying wiring and decreasing setup time.

Features

- Configurable controller for up to 8 axes of EtherCAT Master with any of the first 4 axes for local control or EtherCAT Master
- 10/100BASE-T Ethernet port; (1) EtherCAT Port; (2) RS232 ports up to 115 kbaud
- Available with internal, multi-axis servo or stepper drives. Or, connect to conventional external drives (only first four axes)
- For local axes, accepts up to 22 million counts per second of quadrature encoder for servos; Outputs up to 6 MHz for steppers; EtherCAT command speed up to 1 billion counts per second
- Sample times as low as 375 microseconds for 1-4 axes and 750 microseconds for 5-8 axes
- First four axes, 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, ECAM and PVT
- Ellipse scaling, slow-down around corners, infinite segment feed and feed rate override
- Multitasking for concurrent execution of up to eight application programs
- Non-volatile memory for application programs (4000 Lines), variables and arrays (24000)
- Dual encoders for every local servo axis
- Optically isolated home input, forward and reverse limits for every local axis. EtherCAT axes use for home and limit switches at drive.
- Uncommitted, I/O:
  - 8 optically isolated inputs and 8 optically isolated outputs
  - Isolated, high-power outputs for driving brakes or relays (local axis only)
  - 8 uncommitted analog inputs
  - High speed position latch and output compare
  - 32 additional 3.3V TTL I/O (5V option)
  - More I/O available with RIO PLC
- 2 line x 8 character 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	2 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	8.05" x 7.25" x 1.41"

3137106

RoHS Compliant

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

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

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

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

Ordering Options

The DMC-500x0 is modular by nature, meaning that a customer must specify several components in order to create a full part number. The user must specify the main control board (DMC), the communication board (CMB), and the interconnect module (ICM) to have a complete unit. The user can also specify an optional internal amplifier (AMP or SDM). How these models stack up internally is shown in Figure 1.1.

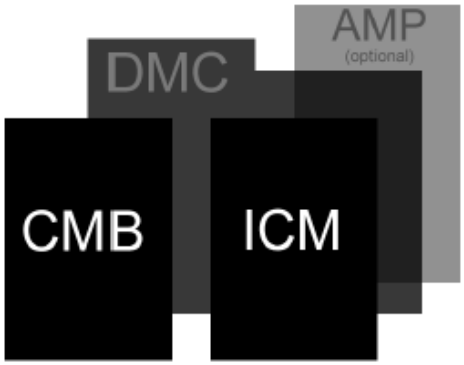


Figure 1.1: Abstract internal layout of the DMC-500x0

Each module has its own set of part numbers and configuration options that make the full part number of a DMC-500x0 unit. The DMC has the part number format "DMC-500x0(Y)," the CMB is "-C023(Y)," the ICM is "-IXXX(Y)," and the AMP/SDM is "-DXXX(Y)," where X designates different module options and Y designates different configuration options for these modules. The full DMC-500x0 part number would be the full string of individual module part numbers combined as shown in Figure 1.2.

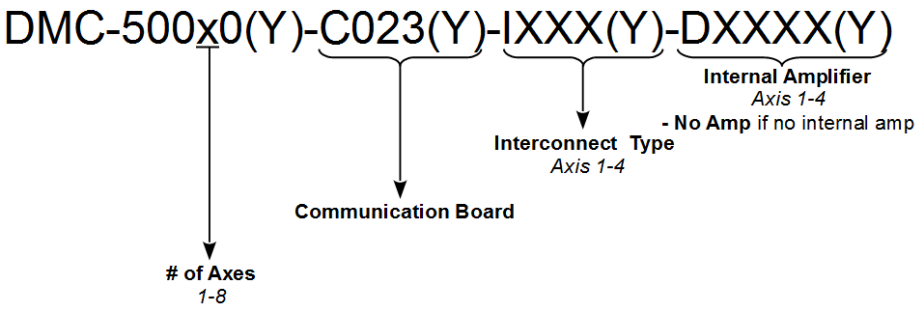


Figure 1.2: Layout of a complete DMC-500x0 part number

Example Part Numbers	
DMC-50060-C023-I000-D3540	6-axis Ethernet/EtherCAT internal/external drives **C023, default:** 100-BaseT Ethernet, EtherCAT, 32 Extended I/O **I000, default:** Axis connector with D-type connectors **D3540:** Four 600W servo drives w/ sine commutation
DMC-50040-C023-(5V)-I200	4-axis Ethernet/EtherCAT internal/external drives **C023, default:** 100BaseT Ethernet, EtherCAT, 32 Extended I/O, 5V option **I200:** Separate axis connector for external Amps Notes • 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.

DMC-500x0

DMC-500x0(Y) – C023(Y) – IXXX(Y) – DXXXX(Y)

DMC-500x0

DMC-500x0 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 – 500x0(Y) – **C023(Y)** – IXXX(Y) – DXXXX(Y)

The CMB (communication board) provides the DMC-500x0 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 CMB-41023 has 1 Ethernet port and 1 EtherCAT port.

DMC-500x0

Modules	Description
CMB-41023 (-C023, default)	1 Ethernet port and 1 EtherCAT port

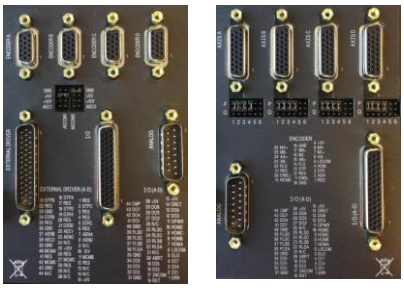
Options

Part Number	Description
5V	Configures extended I/O for 5V logic
P422	RS-422 on Main and Aux serial port
P1422	RS-422 on main serial port only
P2422	RS-422 on auxiliary serial port

ICM Modules

DMC – 500x0(Y) – C023(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
DIFF	Differential ±10 motor command outputs
STEP	Differential STEP/DIR outputs

Amplifier Enable (local drive only)
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 opto-isolated				

AMP Modules

DMC – 500x0(Y) – C023(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
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 130 kHz 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

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

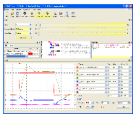
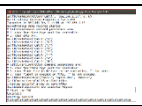
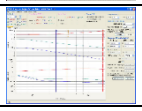
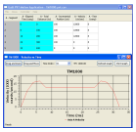
AMP/SDM Options

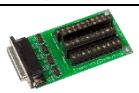
The following options can apply to both our servo and stepper (AMP/SDM) modules.

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
	CABLE-15-1M	15-pin HD male D to discrete wires-1 meter

Accessories		
Image	**Part Number**	**Description**
	CABLE-15-2M	15-pin HD male D to discrete wires-2 meter
	CABLE-26-1M	26-pin HD male D 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