

# MCC/3000

## Motion Control Chip-Set

### Features

- Controls the motion of a DC motor or brushless DC motor
- Point-to-point positioning, velocity profiling and torque control
- Generates trapezoidal velocity profile
- Programmable acceleration and slew rates
- Velocity level can be changed on the fly
- Speed range of 30,000:1
- Communicates via RS232, microprocessor bus or local switches
- Generates an analog and pulse-width-modulated output
- Accepts feedback from an incremental encoder or resolver
- No analog feedback needed
- Complete status, position and error reporting

### Applications

- Positioning tables
- Automated manufacturing
- Robotics
- Industrial control

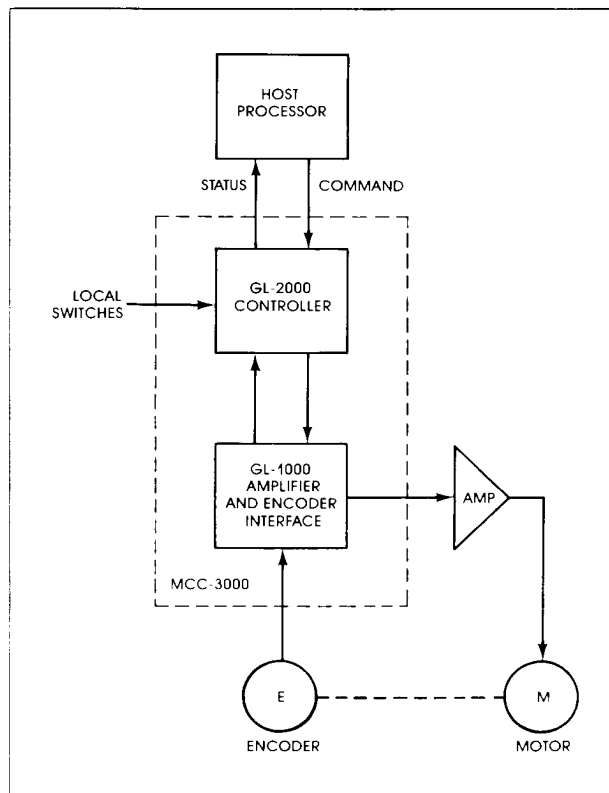
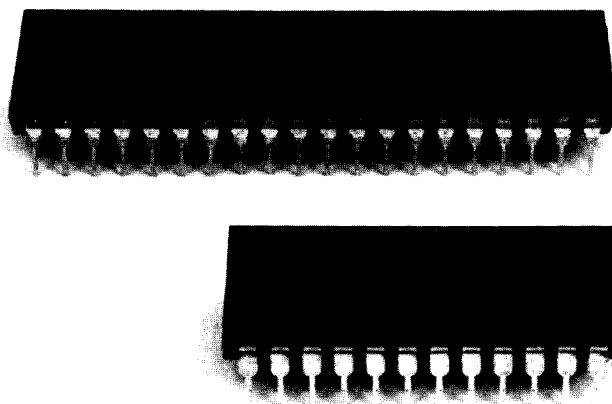
### General Description

The MCC-3000 is a two-chip general purpose controller for DC motors. It generates the motor command to drive the amplifier. The feedback comes from an incremental encoder and no additional velocity feedback is required.

As a true general purpose controller, MCC-3000 can operate in numerous modes, and there is no limit on the size of the motor it can control. It can receive commands from the Microprocessor Bus, RS232 or local switches.

The system block diagram is shown below. The MCC-3000 consists of the GL-1000 chip which performs the encoder interface and amplifier interface functions and the GL-2000 chip which performs the digital control functions.

A schematic of a circuit utilizing the MCC-3000 chip-set is shown at the end of this datasheet. This schematic shows communication with the chip-set by RS232 or STD bus. The chip-set interface, however, can be easily modified to fit other bus types.



*Motion Control System*

## Microprocessor Bus—Communication

The MCC-3000 is configured for an I/O card. There are three registers used for communication, the Write Data Register for transmitting data, the Read Data Register for receiving data, and the Status Register for handshaking. The Read Data and Write Data registers occupy the same address, N. The status register occupies the next address, N + 1. The address, N, is selectable by a set of jumpers labeled A7 through A1.

### Microprocessor Bus Registers

Address	R/W	Description
N	Read only	Read data
N	Write only	Write data
N + 1	Read only	Status D <sub>0</sub> -data in output register* D <sub>1</sub> -ready to receive data D <sub>2</sub> -sequence complete* D <sub>3</sub> -excessive error*

## RS232-Communication

### Configuration

8-bits data No parity  
One start and one stop bit No handshake  
Full duplex

### Baud Rate

The RS2 and RS1 jumpers select the baud rate as follows:

RS1	RS2	Baud Rate
0	0	1200
0	1	300
1	1	9600

## Electrical Specifications

	Min	Typ	Max	Unit	Comments
i <sub>supply</sub> + 5V		300	400	mA	
Encoder			62.5	KHz	Full encoder cycles, 1 CMOS load
Local inputs					Pull up with 1K resistor

## Jumpers

**RS2 AND RS1:** Select baud rate for RS232

**UP:** Selects microprocessor bus communication

**OPT:** Selects resolver instead of encoder for feedback

**MOF:** Selects motor-off on power up

## Inputs

**Encoder:** 2 channel, quadrature encoder. TTL. An option for differential encoder inputs is also available. The controller performs quadrature decoding of the encoder signals and all units are in quadrature counts (4 x encoder cycles).

**Remote/local\*:** Selects the control mode, local or remote. In the local mode, the MCC-3000 ignores all remote commands.

**Stop/start\*:** When input is low, the motor accelerates to the slow speed. When input goes high, the motor decelerates to a stop. Can be used to start and stop motion in local mode or in remote mode when SS1 and ES1 commands are given.

**Direction:** High or low selects the direction of motion in the local mode or when the DS1 or FE command is given in the remote mode.

**Forward limit switch\*:** When this input is low, no further motion in the forward direction is permitted.

**Reverse limit switch\*:** When this input is low, no further motion in the reverse direction is permitted.

**Abort\*:** Stops any motion instantaneously when low.

**Reset\*:** Resets all position counters to zero. Inhibits motor command output. Control parameters reset to default values.

## Outputs

**Pulse-width-modulated motor command:** Inverter mode: PWM signal is 0% duty cycle for full negative voltage, 50% for 0 voltage and 99.6% for full positive voltage. Switching frequency is 19.6% KHz. Chopper mode: PWM signal is 0% for 0 voltage, 99.2% for full voltage and sign of the motor command is in the sign signal. Chopper mode is selected by the instruction SM1. The PWM command may be filtered as shown in the schematic to produce an analog command.

**Error\*:** This output goes low if the position error exceeds 1023 quadrature counts.

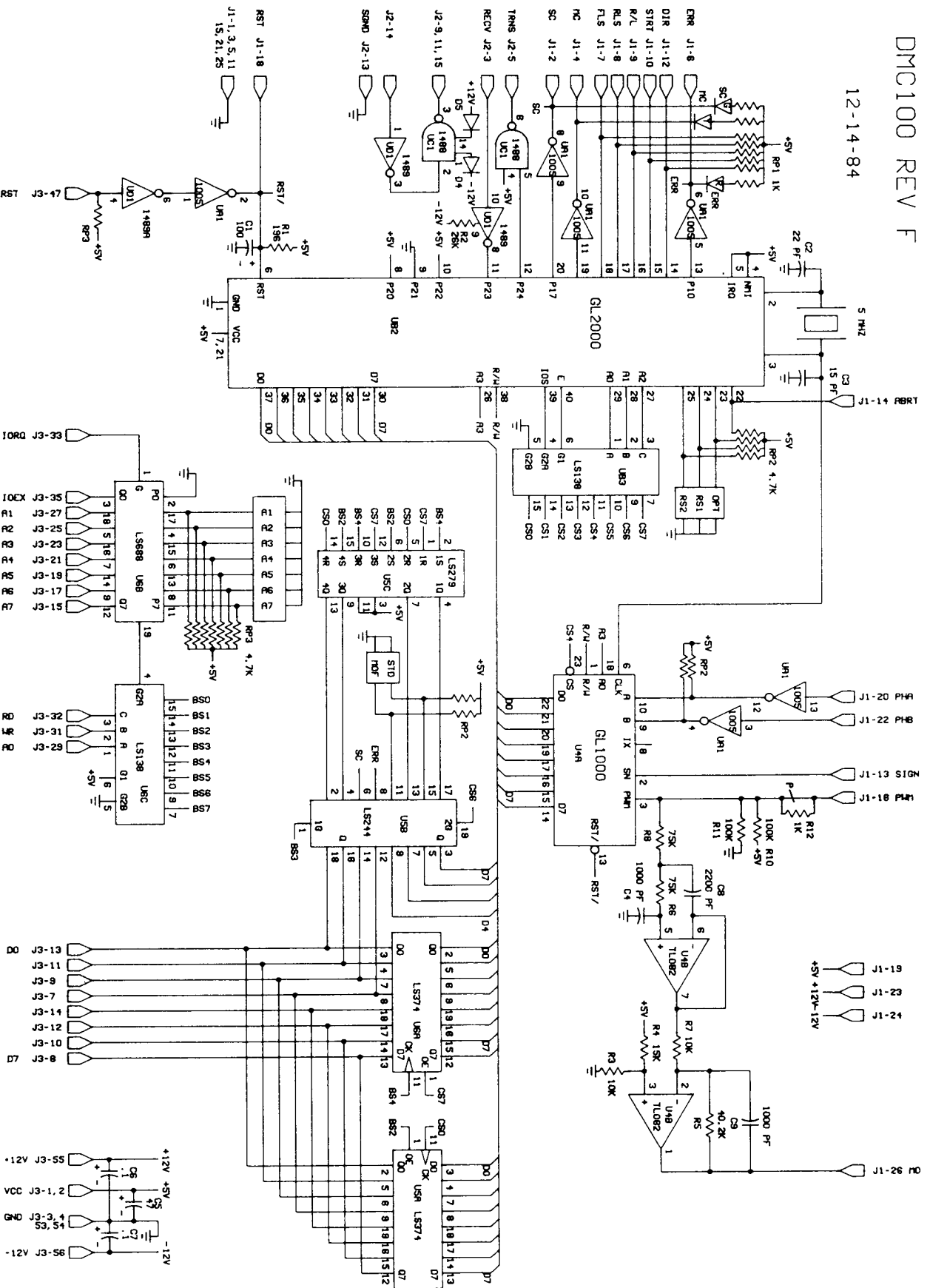
**Sequence complete\*:** Output goes low when the MCC-3000 has completed generating the motion sequence defined by the instructions RP or RR.

**Motion complete\*:** Output goes low when the MCC-3000 has completed generating the last position command of the motion profile.

\*Active low

# DMC100 REV F

12-14-84



## Instruction Set

Each instruction is a two character operation code followed by an operand, n, where noted. Instructions must be sent to the MCC-3000 in uppercase ASCII. The MCC-3000 returns a : if the command was accepted or a ? if it was not.

Op Code	Decimal Range	Function
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### Control Parameters

GN	n	0-255	Compensation gain #
ZR	n	0-255	Compensation zero #
PL	n	0-255	Compensation pole #
DB	n	0-127	Deadband of $\pm$ n #
OF	n	0-127	Offset of $\pm$ n #
TM	n	500-65000	Controller sample time in microseconds

### Control Modes

SV	—	Servo mode #
MO	—	Motor off mode #
VM	—	Velocity mode
TQ	n 0-127	Torque mode, sets torque level to n units. Speed must be greater than 2048. #
DH	—	Define home. Defines current position as absolute zero.
FE	—	Find edge. Search for a position where a transition occurs in the direction switch.

### Profiling Parameters

PR	n	0- $\pm 8 \times 10^6$	Relative position in quadrature counts
PA	n	0- $\pm 8 \times 10^6$	Absolute position in quadrature counts
SP	n	0-250000	Speed rate in quadrature counts/sec. Resolution is 8 counts/sec. #
AC	n	0-1.3x10 <sup>8</sup>	Acceleration rate in quadrature counts/sec <sup>2</sup> . Resolution is 16,000 counts/sec <sup>2</sup> .
DF	.		Direction is FWD in VM mode.
DR	—		Direction is REV in VM mode.
DS	—		Direction by local input.

### Start/stop

BG	—	Begin motion	
ST	—	Stop motion at deceleration rate #	
AB	—	Stop motion immediately #	
RP	n	0-32000	Repeat motion n times. If n = 0, repeat indefinitely.
RR	n	0-32000	Same as RP, with direction alternately reversed.
WT	n	0-32000	A delay between moves in repeat sequence (milliseconds) #
SS	n	0 or 1	Start on switch if n = 1 and when stop/start* input goes low after BG command.
ES	n	0 or 1	Stop on switch if n = 1 and when stop/start* input goes high.
TO	n	0-4x10 <sup>6</sup>	Stop motion after n milliseconds. If n = 0, command inactive.
OE	n	0 or 1	Shut off motor if position error > 1024 counts and if n = 1. #

### Numbering System

DC	—	Input in decimal, output in HEX #
HX	—	Input in HEX, output in HEX #

### Interrogate

TP	0-FFFFFF(hex)	Tell absolute position #
TE	0-FFFF(hex)	Tell position error #
TV	0-FFFFFF(hex)	Tell velocity. Resolution is 2048 counts/sec #
TI	00-FF(hex)	Tell inputs and status #
	Bit 7	Executing sequence *
	6	Executing move*
	5	FWD limit switch*
	4	REV limit switch*
	3	Remote/local*
	2	Stop/start*
	1	Direction switch
	0	Excessive position error
RD	n	0 or 1
		Report H if N = 1 and when motion command is complete

### Other

SM	n	0 or 1	n = 0, PWM duty cycle is 50% n = 1, PWM duty cycle is 0% when motor command is zero.
RS			Reset controller to default value

### Default Parameters

The controller wakes up in the SV mode if MOF is not jumpered. The default values of the controller are:

GN = 8  
ZR = 232  
PL = 0  
AC = 262144  
SP = 30720

*Galil Motion Control reserves the right to make changes in this data sheet without prior written notification.*

# GALIL

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# These instructions may be applied while the motor is moving  
\* Active low