

# Ethernet/RS232 1-axis Controller & Drive

## CDS-3310

### Product Description

Galil's CDS-3310 is a single-axis controller and drive system for precisely controlling a brush or brushless servo motor. It combines a high-performance, programmable motion controller with a PWM drive in a compact, cost-effective package. The CDS-3310 provides a 10/100 Base-T Ethernet port and up to eight individual CDS-3310 units may be connected on a distributed network and programmed as a single controller. The communication burden is minimized because a host PC only has to talk with the master CDS-3310, which in turn communicates with the other CDS-3310 units in the network.

*CDS-3310  
Single-axis  
Controller and  
Drive System*



The CDS-3310 incorporates a 32-bit microcomputer and provides such advanced features as PID compensation with velocity and acceleration feedforward, program memory with multitasking for simultaneously running up to eight programs, and uncommitted I/O for synchronizing motion with external events. Modes of motion include point-to-point positioning, jogging, contouring, and electronic gearing.

Like all Galil motor controllers, these controllers use a simple, English-like command language which makes them very easy to program. Galil's WSDK servo design software further simplifies system set-up with "one-button" servo tuning and real-time display of position and velocity information. Communication drivers are available for Windows, .NET, and Linux.

### Features

- 1-axis motion controller with on-board PWM drive for a brushed or brushless servo motor; 72 V, 7A continuous drive
- Ethernet 10/100Base-T; (1) RS232 port up to 19.2 kbaud
- USB option
- Distributed control allows connection of up to 8 CDS-3310 units on an Ethernet network
- Ethernet supports multiple masters and slaves. TCP/IP, UDP and Modbus TCP master protocol for communication with I/O devices
- Accepts encoder feedback up to 12 MHz
- 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, electronic gearing and electronic cam
- Over 200 English-like commands executable by controller. Includes conditional statements and event triggers
- Non-volatile memory for programs, variables and arrays. Concurrent execution of up to eight programs
- Dual encoder, home and limits
- 8 TTL uncommitted inputs and 10 TTL outputs
- 2 uncommitted analog inputs and 1 analog output
- Add 8 analog inputs and 40 digital I/O with DB-28040
- ICM-3300 interconnect module provides screw terminals and optical isolation of inputs and outputs
- Brake drive 24V, 0.5A
- High speed position latch and output compare
- Small size: 5.15" x 8.25" metal enclosure
- DIN-Rail mount clip available
- On-board DC-to-DC converter for single 18 V to 72 V DC input
- Communication drivers for Windows, and Linux
- Custom hardware and firmware options available
- SSI encoder interface option

SINGLE AXIS

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## Specifications

### System Processor

- Motorola 32-bit microcomputer

### Communications Interface

- Ethernet 10/100BASE-T. (1) RS232 port up to 19.2 kbaud  
Commands are sent in ASCII. A binary communication mode is also available as a standard feature
- USB option

### Modes of Motion:

- Point-to-point positioning
- Position Tracking
- Jogging
- Electronic Gearing
- Contouring
- Teach and playback

### Memory

- Program memory size—1000 lines × 80 characters
- 510 variables
- 8000 array elements in up to 30 arrays

### Filter

- PID (proportional-integral-derivative) with velocity and acceleration feedforward
- Notch and low-pass filter
- Velocity smoothing to minimize jerk
- Integration limit
- Torque limit
- Offset adjustments

### Kinematic Ranges

- Position: 32 bit ( $\pm 2.15$  billion counts per move; automatic rollover; no limit in jog or vector modes)
- Velocity: Up to 12 million counts/sec for servo motors
- Acceleration: Up to 67 million counts/sec<sup>2</sup>

### Uncommitted I/O

- 8 buffered inputs
- 10 TTL outputs
- 2 analog inputs; 0–5 Volts, 12-bit ADC\*
- 1 uncommitted analog output  $\pm 10$  V, 16-bit DAC

### High Speed Position Latch

- Latches encoder position within 0.1 microseconds

### Dedicated Inputs

- Main encoder inputs—Channel A, A-, B, B-, I, I- ( $\pm 12$  V or TTL)
- Auxiliary encoder inputs
- Forward and reverse limit inputs—buffered\*\*
- Home input—buffered\*\*
- High-speed position latch input—buffered\*\*

### Dedicated Outputs

- Analog motor command output with 16-bit DAC resolution
- Error output
- Brake output
- Amp enable
- High-speed position compare output

### Minimum Servo Loop Update Time

- 250 microseconds

### Maximum Encoder Feedback Rate

- 12 MHz

### Power

- 0.5 A, 5 V available for external devices
- 40 mA, +12 V, -12 V available for external devices
- Requires 18 V–72 V input

### Drive Specifications

- 18–72 V; 7 Amp continuous, 10 Amp peak

### Environmental

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

### Mechanical

- 5.15" × 8.25" metal enclosure (for high current applications, the metal enclosure should be mounted to a metal backing to dissipate heat)

### Connectors

- 37-pin Female D-sub—I/O
- 15-pin HD Female D-sub—encoder

\*For  $\pm 10$  V use DB-28040

\*\*Optically isolated I/O available with ICM-3300 option.

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## Instruction Set

### Ethernet

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 AMP gain
AU	Set current loop gain
AW	Report AMP bandwidth
BW	Brake wait
DV	Dual velocity
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	Set AMP peak current
TL	Continuous torque limit
TM	Sample time

### I/O

AL	Arm latch
AO	Analog out
BW	Brake wait
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
BS	Brushless set-up
BV	Burn variables and arrays
CC	Configure communications port
CE	Configure encoder type

### System Configuration (cont.)

CF	Configure for unsolicited messages
CI	Configure communication interrupt
CN	Configure switches
CW	Data adjustment bit
DE	Define dual encoder position
DP	Define position
EO	Echo
IH	Internet handle
IT	Independent smoothing
LZ	Leading zeros format
MO	Motor off
MT	Motor type
PF	Position format
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

### Interrogation

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 info
RL	Report latch
RP	Report command position
*R^V	Firmware revision information
SC	Stop code
TA	Tell AMP status
TB	Tell status
TC	Tell error code
TD	Tell dual encoder
TE	Tell error
TF	Tell FPGA version
TH	Tell handle

### Interrogation (cont.)

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 remarks
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
ZS	Zero stack
XQ	Execute program
'	Remark program

### Error Control

BL	Backward software limit
ER	Error limit
FL	Forward software limit
OE	Off-on-error function
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
WC	Wait for contour data
WT	Wait for time

### Independent Motion Commands

AB	Abort motion
AC	Acceleration
BG	Begin motion
DC	Deceleration
FE	Find edge
FI	Find index
HM	Home
IP	Increment position
IT	Smoothing time constant
JG	Jog mode
PA	Position absolute
PR	Position relative
PT	Position tracking
SP	Speed
ST	Stop

### Contour Mode

CD	Contour data
CM	Contour mode
DT	Contour time interval
WC	Wait for contour data

### Gearing

GA	Master axis for gearing
GD	Engagement distance for gearing
_GP	Correction for gearing
GR	Gear ratio for gearing

### Distributed Control Commands

HA	Handle Assignment
HC	Automatic handle configuration
HQ	Handle Query
HS	Handle switch
HW	Handle wait
LO	Lockout handle
SA	Send slave command
ZA	Ethernet user variable
ZB	Ethernet user variable

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## Connectors—CDS-3310

### **J1** Motor Output 4-pin AMP Mate-n-lock II

- 1 NC
- 2 Motor phase A
- 3 Motor phase C
- 4 Motor phase B

### **J2** 15-pin, Hi-density Female D-sub

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

### **J3** I/O 37-pin Female D-sub

- 1 Reset\*
- 2 Amp enable/Error output
- 3 Output 3
- 4 Output 1
- 5 Analog in 1 (0V–5V)
- 6 Input 7
- 7 Input 5
- 8 Input 3
- 9 Input 1 (latch)
- 10 5V
- 11 Ground
- 12 +12V
- 13 Ground
- 14 Brake Power
- 15 Input 8- (differential input)
- 16 Output 9
- 17 Output 7
- 18 Output 5
- 19 Analog out 1 (16-bit resolution  $\pm 10V$ )
- 20 Analog ground
- 21 Output 4
- 22 Output 2
- 23 Encoder-output compare
- 24 Analog in 2 (0V–5V)
- 25 Input 6
- 26 Input 4
- 27 Input 2
- 28 Forward limit
- 29 Reverse limit
- 30 Home
- 31 -12V
- 32 Brake output (500mA sinking)
- 33 Input 8+ (differential input)
- 34 Output 10
- 35 Output 8
- 36 Output 6
- 37 Abort\*

### **J5** Power 2-pin AMP Mate-n-lock II

- 1 +VM (18V–72V)
- 2 Ground

\*Active low

## Connectors—ICM-3300

### Screw Terminals

- 1 Aux. Encoder B+
- 2 Aux. Encoder B-
- 3 Aux. Encoder A+
- 4 Aux. Encoder A-
- 5 Main Encoder Index +
- 6 Main Encoder Index -
- 7 Main Encoder B+
- 8 Main Encoder B-
- 9 Main Encoder A+
- 10 Main Encoder A-
- 11 Hall C
- 12 Hall B
- 13 Hall A
- 14 Ground
- 15 5V
- 16 Abort Input †
- 17 Digital Input 8+
- 18 Digital Input 8-
- 19 Digital Input 7 †
- 20 Digital Input 6 †
- 21 Digital Input 5 †
- 22 Digital Input 4 †
- 23 Digital Input 3 †
- 24 Digital Input 2 †
- 25 Digital Input 1 †
- 26 Input Common
- 27 Limit Switch Common
- 28 Home Input †
- 29 Reverse Limit Input †
- 30 Forward Limit Input †
- 31 Output Compare
- 32 Amplifier Enable Output †
- 33 Ground
- 34 Output Power Return
- 35 Output Power Supply
- 36 Digital Output 10 †
- 37 Digital Output 9 †
- 38 Digital Output 8 †
- 39 Digital Output 7 †
- 40 Digital Output 6 †
- 41 Digital Output 5 †
- 42 Digital Output 4 †
- 43 Digital Output 3 †
- 44 Digital Output 2 †
- 45 Digital Output 1 †
- 46 Brake Power Supply
- 47 Brake Output (Sinking)
- 48 -12V output
- 49 +12V Output
- 50 +5V Output
- 51 Analog Output 1
- 52 Analog Input 2
- 53 Analog Input 1
- 54 Analog Input Ground
- 55 Ground
- 56 Reset\*

### **J2** 15-pin, Hi-density Female D-sub

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

†Optically isolated

SINGLE AXIS

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## CDS-3310

### Distributed Control

In some mechanical systems it is advantageous to have CDS-3310 single axis motion controllers physically distributed throughout the system to reduce wiring. Up to eight CDS-3310 units can be distributed per network.

Communication overhead and motion coordination issues typical with distributed, single-axis systems are minimized with the CDS-3310. The communication burden with a host PC is minimized because the PC communicates to the CDS-3310 controller configured as the master, which in turn communicates with all other CDS-3310 controllers on the network. This allows multiple controllers connected on an Ethernet network to be programmed as a single controller. A special set of commands for distributed control ease communication issues on the network. For example, the command HC configures the network. The complete list of distributed commands is found in the instruction set shown below.

#### Distributed Control Commands

HA	Handle Assignment	SA	Send slave command
HC	Automatic handle configuration	ZA	Ethernet user variable
HQ	Handle Query	ZB	Ethernet user variable
HW	Handle wait		

### Servo Drive Specifications

The CDS-3310 contains a transconductance, PWM drive for driving brushless or brush-type servo motors. The amplifier drives motors operating at 18–72 VDC (voltage at motor is 10% less), up to 7 Amps continuous, 10 Amps peak. 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 amplifier offers protection for over-voltage, under-voltage, over-current, and short-circuit. The amplifier status can be read through the controller, and the BS command allows easy hall sensor set-up. The SR-19900 shunt regulator is available for the CDS-3310.

### Ordering Information

PART NUMBER	DESCRIPTION	QUANTITY 1	QUANTITY 100
CDS-3310	1-axis motion controller with 500W servo drive; Ethernet/RS232	\$ 745	\$ 495
-DIN	DIN-rail mounting clip	\$ 25	\$ 20
ICM-3300	Screw terminal interface with optical isolation	\$ 245	\$ 145
DB-28040	I/O expansion board for 8 analog inputs and 40 digital I/O (outputs source 3.3 V)	\$ 295	\$ 195
DB-28040-5V	I/O expansion board for 40 digital I/O (maximum 24 digital outputs) and 8 analog inputs. Outputs are open collector and sink 5 V	\$ 295	\$ 195
SR-19900	Shunt regulator for CDS-3310	\$ 75	\$ 40
CABLE-15-1M	15-pin HD D sub to discrete wires—1 meter	\$ 25	\$ 17
CABLE-15-2M	15-pin HD D sub to discrete wires—2 meter	\$ 30	\$ 20
WSDK	Set-up, tuning and analysis software	\$ 195	

### I/O Expansion Options

#### DB-28040 I/O Expansion Board

The DB-28040 mounts directly to the CDS-3310 motor controller and provides an additional 40 digital inputs and outputs, and eight  $\pm 10$  V analog inputs (default I/O is 3.3 V. For 5 V I/O, order DB-28040-5V). The small 2.55"  $\times$  3.08" board attaches directly to the 50-pin header on the CDS-3310 controller, and no cable is required between the controller and I/O board.

The 40 digital I/O signals are available on a 50-pin IDC header, and the analog inputs are available on a 16-pin header. With a controller firmware modification, the I/O board can also be modified to accept feedback from SSI encoders.

#### ICM-3300 Interconnect Module

The ICM-3300 attaches directly to the CDS-3310 and breaks out the 37-pin D-sub connector into convenient screw terminals allowing for quick and easy connection to system elements. The ICM-3300 also provides optical isolation for inputs and outputs with the exception of the following signals: brake output, output compare, reset input and digital input 8. Outputs 1 through 4 are high-side, 500 mA drives. The maximum com-

mon voltage for the I/O is 28 VDC. The ICM-3300 includes a high density 15-pin D-sub connector which allows direct connection to Galil's BLM-N23 brushless servo motor.



ICM-3300 attached to CDS-3310

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Galil offers additional quantity discounts for purchases between 1 and 100. Consult Galil for a quotation.

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