

CS-2017

High Efficiency Precision Servo Controller

Description

The CS-2017 is designed to reduce the power consumption and space required for closed-loop control of voice coil actuator motors in disk head positioning servos and other precision servos. The CS-2017 includes the current sense amplifier, bridge output power drive and the error amplifier.

The CS-2017 saves power by using a Class D (chopper) mode output drive during the high current "seek" operation. System dissipation is reduced by a factor of three providing higher reliability and easier heat management. During the lower current "tracking" operation, the amplifier switches to conventional Class B analog mode for noise-free data retrieval. A logic input selects the operation mode. The bridge output stage is designed for minimum saturation voltage allowing efficient operation with

single supply voltage from 4.5 to 17V. A low offset differential amplifier senses the output current in the bridge ground return and provides a proportional voltage added to the externally-generated common-mode reference voltage. This closes the loop and makes the servo amplifier a voltage in, current out system.

The CS-2017 contains all of the control circuitry required for the application. This allows the circuit designer to select power transistors and catch diodes to meet the output voltage and current specifications of almost any application. External transistors also allow greater flexibility for thermal and space management.

The CS-2017 is available in both 20L PDIP and 20L PLCC.

Features

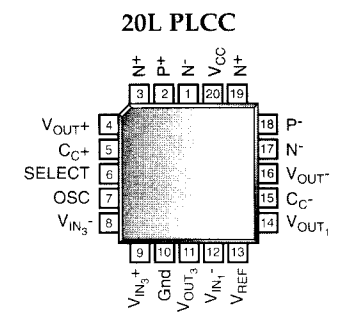
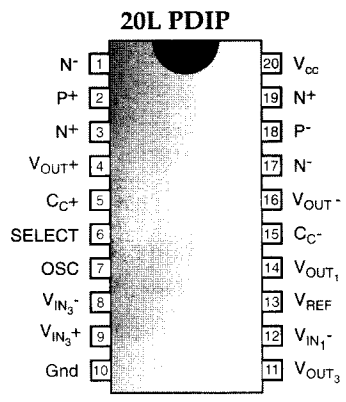
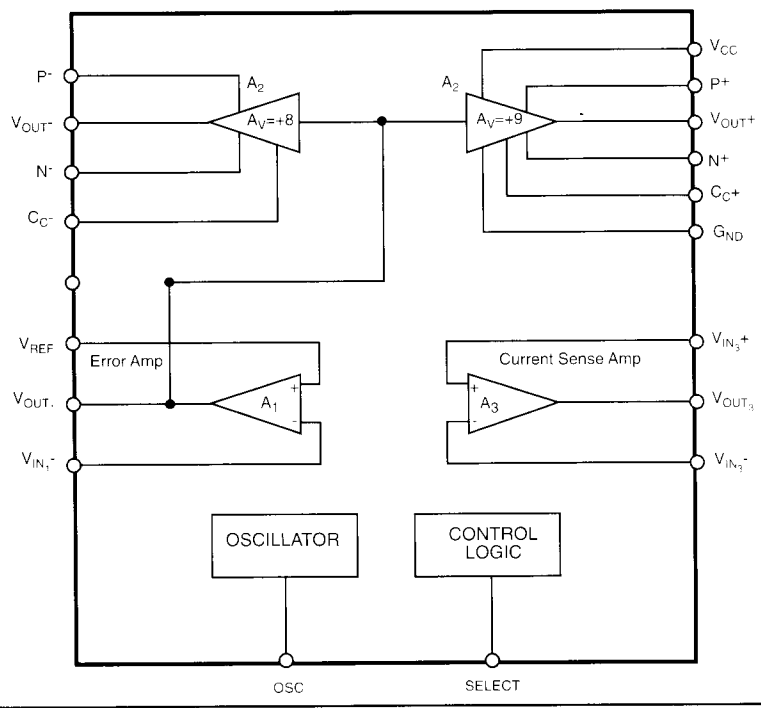
- Low Saturation Voltage
- Precision Current Sense Amplifier
- Class D Switch Mode
- Class B Track Mode
- Single Supply Operation 4.5 to 17V

Applications:

- Winchester Disk Head Positioning Servo
- 3.5" Disk Drive Servo
- Robotics
- DC Motor Controls

Package Options

Block Diagram



Cherry Semiconductor Corporation
 2000 South County Trail
 East Greenwich, Rhode Island 02818
 Tel: (401)885-3600 Fax (401)885-5786
 Telex WUI 6817157

Absolute Maximum Ratings

Supply Voltage	17V
Input Voltage Range (any logic pin)	-0.3V to V_{CC}
Sense Amp Input Voltage Range	-1.5V to V_{CC}
Sense Amp Differential Input Voltage Range	$\pm 5V$
Junction Temperature	150°C
Operating Temperature Range	-25°C to +85°C
Lead Temperature (soldering, 10 seconds)	300°C
Storage Temperature	-65°C to +150°C
Power Dissipation (T_A -25°C)	1.25W

Electrical Characteristics: $T_J = T_A = 25^\circ\text{C}$ (Note 7)

PARAMETER	MODE	VOLTS			MIN	TYP	MAX	UNIT
		V_S	V_{REF}	V_{IN}				
■ System, Closed-Loop								
Gain Constant	B	12	5	Note 1	0.85	1	1.15	A/V
$I_{OUT}/V_{IN}, I_{OUT} = \pm 100\text{mA}$								
Output Offset Current	B	12	5	5	-35	5	35	mA
	B	12	8	8	-40	5	40	mA
	B	12	2	2	-40	5	40	mA
	B	4.5	2	2	-40	5	40	mA
	B	17	2	2	-40	5	40	mA
	B	17	13	13	-40	5	40	mA
	Standby	12	5	5	-2	0	2	mA
Quiescent Supply Current	B	12	5	Open		25	50	mA
	D	12	5	Open		20	50	mA
	Standby	12	5	Open		12	25	mA
	B	17	5	Open		40	100	mA
	D	17	5	Open		25	100	mA
	Standby	17	5	Open		20	50	mA
Output Drive Current	B	12	5	Note 2	15	30		mA
	D	12	5	Note 2	45	60		mA
Standby Output Resistance (Note 4)	Standby	12	5	Open	1	4		k Ω
Select High Current (16V)	B	12	5	5		0	10	μA
Select Low Current (0V)	D	12	5	5		-10	-200	μA
Oscillator Low Current (0.4V)	Standby	12	5	5		-100	-400	μA
Reference Voltage Bias Current	Standby	12	5	Open	0.2	0.6	1.0	mA
■ Current Sense Amplifier								
Current Sense Amp Gain, $V_{IN3+} = \pm 400\text{mV}$	Standby	12	5	Open	3.6	4	4.4	V/V
Current Sense Amp Output Offset	Standby	12	5	Open	-20	5	20	mV
	Standby	12	8	Open	-30	5	30	mV
	Standby	12	2	Open	-30	5	30	mV
	Standby	4.5	2	Open	-30	5	30	mV
	Standby	17	2	Open	-30	5	30	mV
	Standby	17	13	Open	-30	5	30	mV
Reference Voltage Rejection Ratio	Standby	20	Note 5	Open	50	75		dB
Power Supply Rejection Ratio	Standby	Note 6	2	Open	50	75		dB

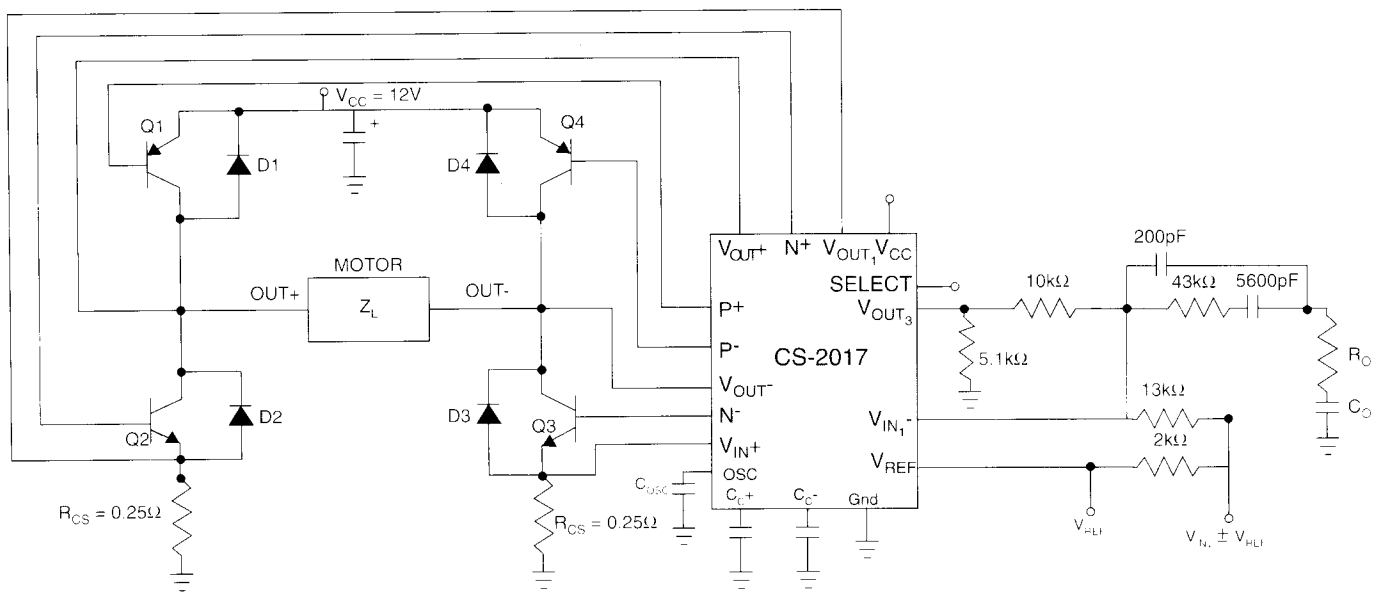
PARAMETER	MODE	V _{IN} (V)			MIN	TYP	MAX	UNIT
		V _{IN3-}	V _{IN3+}	V _{IN}				
■ Current Sense Amplifier (continued)								
Common-Mode Rejection Ratio $V_{IN3-} = V_{IN3+} = \pm 500\text{mV}$	Standby	12	5	Open	50	75		dB
Output Source Current	Standby	12	5	Open	+5	+10		mA
Input Current	Standby	12	5	Open	0.2	0.6	1.0	mA
■ Error Amplifier								
Offset Voltage	B	12	5	Open	-10	2	10	mV
	B	12	8	Open	-10	2	10	mV
	B	12	2	Open	-10	2	10	mV
	B	4.5	2.0	Open	-10	2	10	mV
	B	17	2	Open	-10	2	10	mV
	B	17	13	Open	-10	2	10	mV
Reference Voltage Rejection Ratio	B	17	Note 5	Open	50	75		dB
Power Supply Rejection Ratio	B	Note 6	2	Open	50	75		dB
Output Current	B	12	5	Open	± 5	± 20		mA
■ Driver Amplifier								
Driver Amp Gain, $I_{OUT} = \pm 750\text{mA}$	B	12	5	Note 1	10	17	20	V/V
Switching Frequency $I_{OUT} = \pm 500\text{mA}$	D	12	5	Note 1	20	30	40	kHz
Duty Cycle, $I_{OUT} = \pm 500\text{mA}$	D	12	5	Note 1	35	45	55	%
Supply Voltage Operating Range	Guaranteed by above tests				4.5	12.0	17.0	V
Reference Operating Range	Guaranteed by above tests				2	5	V_{CC-4}	V

NOTES:

1. V_{IN} is adjusted to set I_{OUT} .
2. $V_{IN} = 2\text{V}$ for $I_{OUT} \leq 0\text{A}$, and $V_{IN} = 8\text{V}$ for $I_{OUT} > 0\text{A}$.
3. $2.5\text{V} < V_{REF} < 13\text{V}$.
4. $V_{OUT} = V_S/2$.
5. $2\text{V} < V_{REF} < 13\text{V}$.
6. $4.5\text{V} < V_S < 17\text{V}$.
7. Mode B is forced with Select = 2.0V and OSC open.
Mode D is forced with Select = 0.6V and OSC open.
Standby is forced with Select = 0.6V and OSC = 0.4V.

20L PDIP	20L PLCC	FUNCTION	FUNCTION
1, 17	1, 17	N ⁻	Base drive lower power NPN in one half of H bridge
2	2	P ⁺	Base drive to upper power PNP in H bridge
3, 19	3, 19	N ⁺	Base drive to lower power NPN in one half of H bridge
4	4	V _{OUT+}	Positive output of half of H bridge
5	5	C _{C+}	Compensation Capacitor for one of H bridge power amplifiers
6	6	SELECT	Sets the operation mode (class B or D) of the H bridge
7	7	OSC	Timing capacitor for oscillator
8	8	V _{IN3-}	Negative input to current sense amplifier, A3
9	9	V _{IN3+}	Positive input to current sense amplifier, A3
10	10	Gnd	Ground Connection
11	11	V _{OUT3}	Output of current sense amplifier, A3
12	12	V _{IN1-}	Inverting error amplifier input, A1
13	13	V _{REF}	Noninverting input to error amplifier, A1
14	14	V _{OUT1}	Error amplifier output; internally connected to A2 input
15	15	C _{C-}	Compensation Capacitor for one of H bridge
16	16	V _{OUT-}	Negative output of half of H bridge
18	18	P-	Base drive to upper power PNP in H bridge
20	20	V _{CC}	Supply voltage

Application Diagram



- Q1, 4 = MJE210
- Q2, 3 = MJE200
- D1, 2, 3, 4 = 1N4933

Package Specification

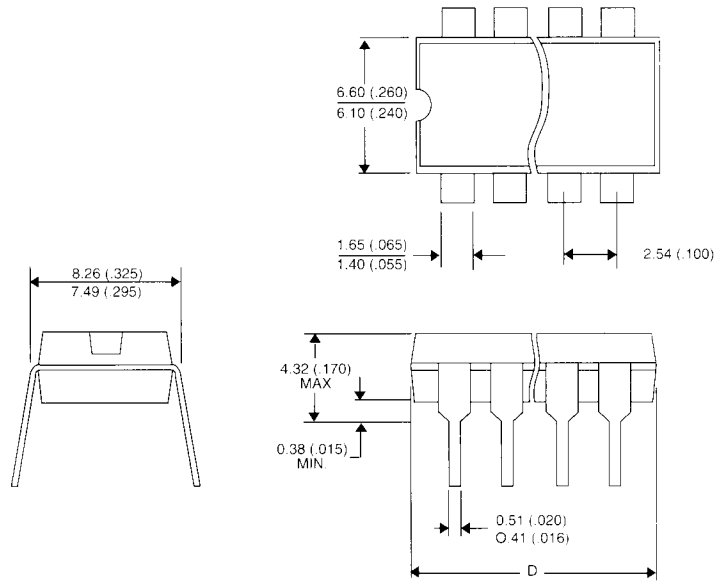
CS-2017

PACKAGE DIMENSIONS IN mm (INCHES)

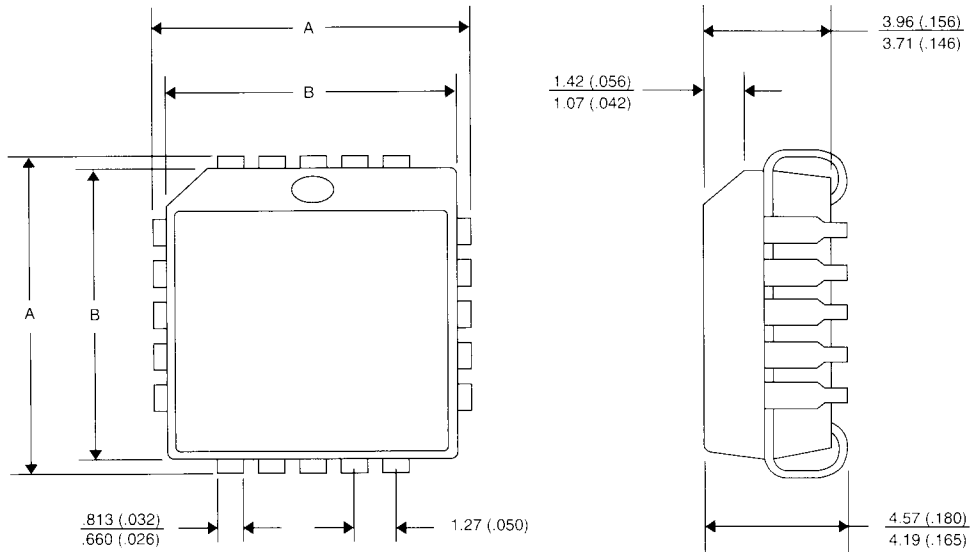
PACKAGE THERMAL DATA

Lead Count	D				Thermal Data		20L PDIP	20L PLCC	°C/W
	Metric		English		R θ_{JC}	typ			
20L PDIP	Max	Min	Max	Min	R θ_{JA}	typ	25	30	°C/W
20L PLCC (A)	26.29	26.04	1.035	1.025			65	80	°C/W
20L PLCC (B)	10.03	9.78	.395	.385					
	8.99	8.89	.354	.350					

20L PDIP



20L PLCC



Ordering Information

Part Number	Temp. Range	Description
CS-2017N20	-25 to +85°C	20L PDIP
CS-2017FN20	-25 to +85°C	20L PLCC



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