



# 5V, 250mA Voice Coil Driver with H-bridge, 4:1 Gain Switch, and Head Retract Circuitry

## Description

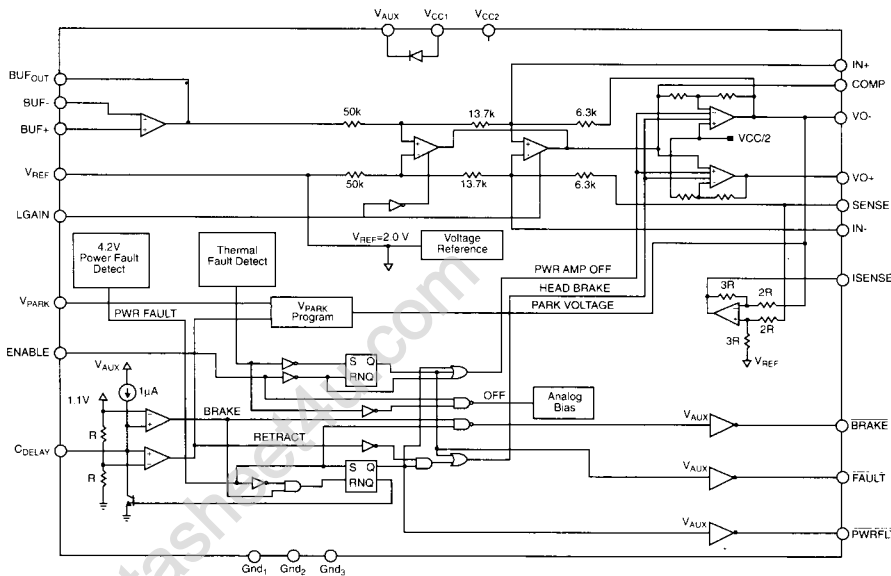
The CS-7104 is a voice coil motor driver used in 5V, 2.5 inch hard disk drive servo systems. It contains the complete H-bridge power amplifiers and all control functions. Head retraction circuitry is present

to allow controlled shutdown of the drive. Power fault and thermal fault detection are also included. A gain switch permits 4:1 transconductance changes.

## Absolute Maximum Ratings

Supply Voltage.....	10V
Auxiliary Supply Voltage.....	17V
Logic Input Voltage.....	-0.3V to $V_{AUX}$
Logic Output Voltage (not FAULT pin).....	-0.3V to 17V
Logic Output Voltage (not Brake pin).....	-0.3V to 17V
H-Bridge Output Current.....	250mA
Maximum Power Dissipation.....	500mW
Electrostatic Discharge (Human Body Model).....	2kV
Operating Temperature Range.....	0°C to 70°C
Storage Temperature Range.....	-65°C to 150°C
Maximum Junction Temperature.....	150°C

## Block Diagram

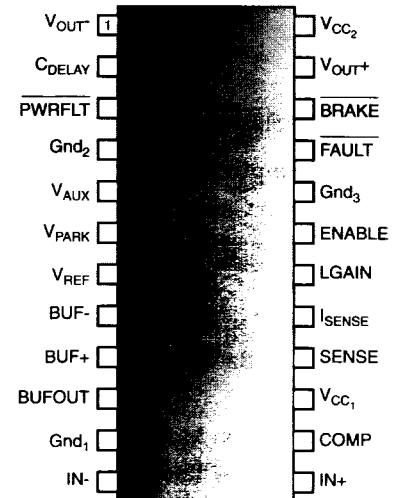


## Features

- Single 5V Power Supply
- Full 250mA H-Bridge
- Low System Offset Current (4mA)
- Low Supply Current (6mA)
- Low Standby Current
- Internally Compensated Amplifiers
- No Crossover Distortion
- 4:1 Gain Switch
- Programmable Retract Voltage
- Programmable Bandwidth
- Power Fault Detector
- On Chip Transient Protection

## Package Options

24 Lead SO Wide



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 East Greenwich, Rhode Island 02818-1530  
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 Telex WUWUWU www.DataSheet4U.com

Electrical Characteristics:  $V_{CC} = 4.5V$  to  $5.5V$ ;  $T_A = 0^\circ C$  to  $70^\circ C$  unless otherwise specified

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>■ Supply</b>					
Supply Voltage ( $V_{CC1}, V_{CC2}$ )		4.5	5.0	5.5	V
Auxiliary Voltage, $V_{AUX}$		2.0		15.0	V
Auxiliary Current, $I_{AUX}$	Head Brake Mode $V_{CC}=0; V_{AUX}=5.0V$		13	20	mA
Total Supply Current	$V_{ENABLE}=2.0V$ $V_{ENABLE}=0.8V$		12	25	mA
				3	mA
<b>■ Logic Inputs</b>					
Input Current					
ENABLE=High	$V_{IN}=2.0V$			100	$\mu A$
ENABLE=Low	$V_{IN}=0.8$			-100	$\mu A$
LGAIN Low input Current	$V_{IN}=0.8$			-200	$\mu A$
Logic High Voltage			1.5	2.0	V
Logic Low Voltage		0.8	1.5		V
Transconductance					
( $A_V=1; T_A=25^\circ C$ )	$I_{OUT}=100mA$ $I_{OUT}=25mA$	95 23.7	100 25.0	105 26.3	mA/V mA/V
Transconductance					
( $A_V=1; T_A=0^\circ C$ to $70^\circ C$ )	$I_{OUT}=100mA$ $I_{OUT}=25mA$	93 23.2	100 25.0	107 26.8	mA/V mA/V
Output Offset Current	$T_A=25^\circ C$ $T_A=0^\circ C$ to $70^\circ C$			1.0 1.25	mA mA
Input Voltage Range	$V_{REF}=2.0V$	0.50		3.50	V
Frequency Response		30			kHz
<b>■ Power Amplifier</b>					
Voltage Gain			14		V/V
Frequency Response		60			kHz
Bridge Output Current		250			mA
Quiescent Bias Current per side			4		mA
Bridge Saturation Voltage	$T_A=25^\circ C; I_{OUT}=100mA$			0.25	V
	$T_A=25^\circ C; I_{OUT}=200mA$			0.50	V
	$T_A=0^\circ C$ to $70^\circ C;$ $I_{OUT}=200mA$			0.60	V
Thermal Shutdown Temperature				160	$^\circ C$
<b>■ Buffer Amplifier</b>					
Open Loop Gain		60			dB
Input Offset Voltage				5	mV
Input Offset Current			10	100	nA
Input Bias Current			1.0	5.0	$\mu A$
Unity Gain Bandwidth		300	1000		kHz
PSRR		50			dB
Input Common Mode Range		0.1		3.5	V
Output Voltage Range		0.1		3.5	V
<b>■ I<sub>SENSE</sub> Amplifier</b>					
Closed Loop Gain	$V_{IN}=V_{OUT-SENSE}$	1.45	1.50	1.58	V/V
Input Offset Voltage				5	mV

## Electrical Characteristics: continued

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Power Fault Detection and Timer</b>					
$V_{\text{FAULT}}$		3.99	4.20	4.41	V
$V_{\text{FAULT}}$ Hysteresis			100	200	mV
$C_{\text{DELAY}}$ Charging Current		0.75	1.00	1.25	$\mu\text{A}$
$C_{\text{DELAY}}$ Park Voltage Threshold		0.45	0.55	0.65	V
$C_{\text{DELAY}}$ Break Voltage Threshold		0.90	1.10	1.30	V
<b>Head Park</b>					
$V_{\text{PARK}}$	$R_{\text{PARK}}=5\text{k}\Omega$ $I_{\text{COIL}}=1\text{mA}$	0.4	0.5	0.6	V
Park Current Capability		10	20		mA
<b>Voltage Reference</b>					
$V_{\text{REF}}$		1.92	2.00	2.08	V
$V_{\text{REF}}$ Output Current		2.0			V
PSRR		40			dB
<b>Head Brake</b>					
$V_{\text{OUT+}}$ Brake	$I_{\text{OUT}}=50\text{mA}; V_{\text{AUX}}=3.0\text{V}$			0.3	V
$V_{\text{OUT+}}$ Brake	$I_{\text{OUT}}=50\text{mA}; V_{\text{AUX}}=3.0\text{V}$			0.3	V
<b>Logic Outputs</b>					
$\overline{\text{BRAKE}} V_{\text{OUT}}$	$I_{\text{OUT}}=-10\mu\text{A}$			0.4	V
$\overline{\text{FAULT}} V_{\text{OUT}}$	$I_{\text{OUT}}=-10\mu\text{A}$			0.4	V
$\overline{\text{PWRFLT}} V_{\text{OUT}}$	$I_{\text{OUT}}=-10\mu\text{A}$			0.4	V

## Package Pin Description

PACKAGE PIN #	PIN SYMBOL	FUNCTION
<b>24 Lead SO Wide</b>		
1	$V_{\text{OUT-}}$	H-Bridge negative output
2	$C_{\text{DELAY}}$	An external capacitor on this pin sets the time intervals for Head Brake, HeadPark and Spin Brake
3	$\overline{\text{PWRFLT}}$	Digital output that signals a low supply voltage condition
4	Gnd2	Ground for H-bridge driver
5	$V_{\text{AUX}}$	Auxiliary power for head park during a VCC failure
6	$V_{\text{PARK}}$	Park voltage programming pin
7	$V_{\text{REF}}$	Internal voltage reference
8	BUF-	Buffer amplifier negative input
9	BUF+	Buffer amplifier positive input
10	$\text{BUF}_{\text{OUT}}$	Buffer amplifier output
11	Gnd1	Ground
12	IN-	Error amplifier negative input
13	IN+	Error amplifier positive input
14	COMP	Error amplifier compensation pin
15	$V_{\text{CC1}}$	Positive supply voltage
16	SENSE	VCM current sense input
17	$I_{\text{SENSE}}$	VCM current sense amplifier input

## Package Pin Description: continued

CS-7104

PACKAGE PIN #	PIN SYMBOL	FUNCTION
<b>24 Lead SO Wide</b>		
18	LGAIN	Digital input that selects high or low transconductance
19	ENABLE	Digital input that selects standby or full power mode
20	Gnd <sub>3</sub>	Ground for H-bridge driver
21	$\overline{\text{FAULT}}$	Digital signal indicating a thermal fault condition; the pin is reset through the ENABLE pin
22	$\overline{\text{BRAKE}}$	Digital output to brake the spin motor
23	V <sub>OUT+</sub>	H-bridge positive output
24	V <sub>CC2</sub>	Positive supply voltage for H-bridge driver

## Circuit Description

## Logic Functions

The ENABLE input is used to select full power mode or standby mode. When ENABLE is high, the circuit is full power mode. When ENABLE is low, the circuit is in standby mode with only the logic functions receiving power.

The LGAIN input selects high or low transconductance. When LGAIN is high, the circuit is in the low transconductance mode. The LGAIN input pin has a 50k $\Omega$  internal pull up resistor.

The  $\overline{\text{BRAKE}}$  output is a PNP transistor with a 70 k $\Omega$  internal pull down resistor that is intended to drive an external FET spin brake circuit.

The  $\overline{\text{FAULT}}$  line is an NPN transistor with a 70 k $\Omega$  internal pull up resistor.

The PWRFLT line is an NPN transistor with a 70 k $\Omega$  internal pull up resistor. Its correct logic state is maintained down to V<sub>CC</sub>=1.0V.

## Power Amplifier

The power amplifier is a full H-bridge with 250mA capability and built in protection diodes. The differential voltage gain of the bridge is 14.

The amplifier is protected from overload by thermal shutdown circuitry. If a thermal overload condition occurs, the amplifier is turned off and remains off until the ENABLE input line is toggled low then high.

## Buffer Amplifier

The buffer amplifier is a low offset operational amplifier that can be used either as an additional gain stage or as a second order low pass filter.

## Power Fault Detection

The power fault detection circuitry monitors V<sub>CC1</sub>. If an under voltage condition occurs, a timed sequence of events happens. First the head brake is activated. The head park follows and finally the  $\overline{\text{BRAKE}}$  line goes low, initiating the spin brake. If power recovers at any time during the sequence, the head brake and head park will complete their sequences. The spin brake will be canceled if the supply voltage recovers in time.

During head brake, both power NPN transistors in the H-bridge are turned on. Braking occurs in response to either a power fault or a thermal shutdown fault.

Head Park only occurs if there is a power fault. During head park, one side of the H-bridge is pulled low and a voltage, preset at the V<sub>PARK</sub> pin, is applied across the VCM.

The timing of the head brake, head park and spin brake is controlled by the power fault timer. The timer uses an internally generated charge current and an external capacitor. Two threshold levels create the three timing sequences. While the capacitor is charging to the first threshold, the head brake is initiated. Head park is initiated as the capacitor passes to the second threshold. Once the capacitor's charge exceeds the second threshold, the spin brake function is activated. The  $\overline{\text{BRAKE}}$  output is brought low and the timer remains in this state until power is restored. If power is restored while the timer is in this mode, the spin brake will be released.

Package Specification

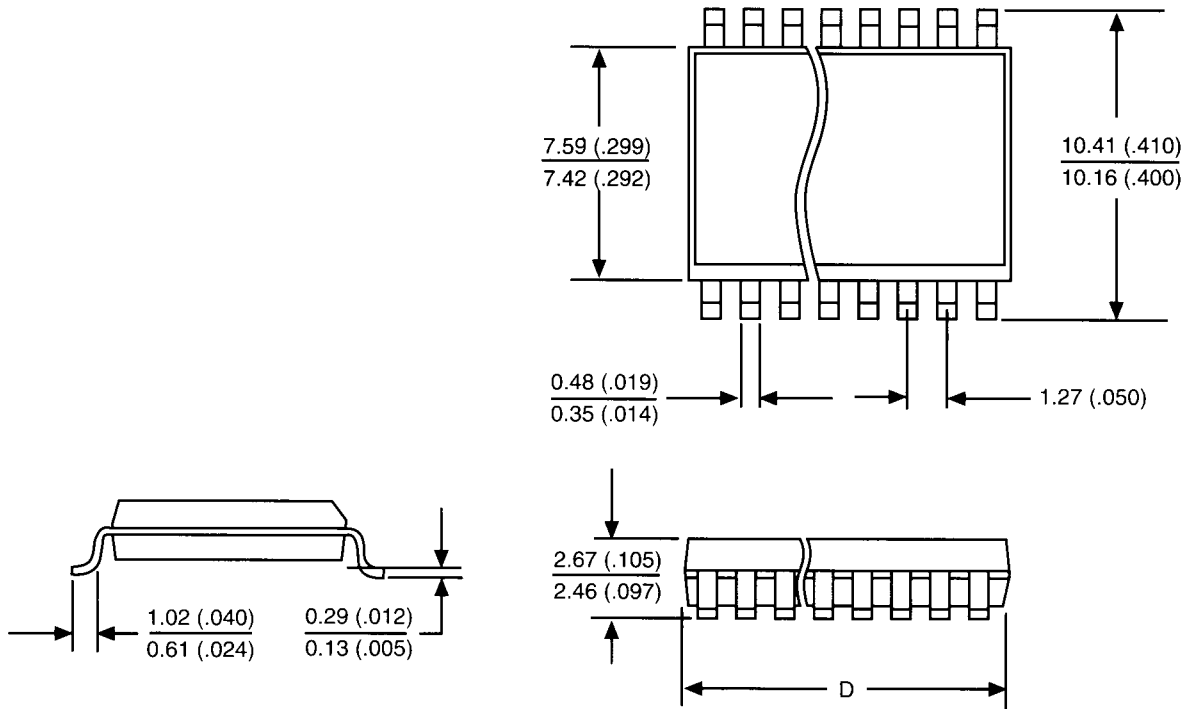
PACKAGE DIMENSIONS IN mm (INCHES)

Lead Count	Metric		English	
	Max	Min	Max	Min
24	15.54	15.29	.612	.602

PACKAGE THERMAL DATA

Thermal Data		24L SO Wide	
$R\theta_{JC}$	typ	16	$^{\circ}C/W$
$R\theta_{JA}$	typ	80	$^{\circ}C/W$

SO Wide



Preliminary

This product is in the preproduction stages of the design process. The data sheet contains preliminary data. CSC reserves the right to make changes to the specifications without notice. Please contact CSC for the latest available information.

Ordering Information

Part Number	Description
CS-7104DW24	24 Lead SO Wide