



# 85mA Dual H-Bridge Odometer Driver with Divide by Select and UVLO

## Description

The CS-4161 is a Stepper Motor Driver that implements an H-Bridge design in order to drive two coils in an eight step sequence per revolution in the divide by 1 mode; 16 step sequence in the divide by 2 mode. The H-Bridge is capable of delivering 85mA to the load.

The sequencer insures that the odometer is monotonic. This sequencer is configured such that simultaneous conduction does not occur. Before each successive output sequence the part is taken through a state where both outputs are turned off individually. This

tends to minimize the inductive kick back energy that the part must absorb. On chip clamp diodes are across each output to protect the part from the kick back energy that it must absorb.

The CS-4161 includes overvoltage and short circuit protection circuitry. It is lead for lead compatible with the CS-8441. The CS-4161 includes an additional undervoltage lockout (UVLO) function which disables the output stage until the supply voltage rises above 5.6V, typically. The UVLO has hysteresis to prevent any power up glitching.

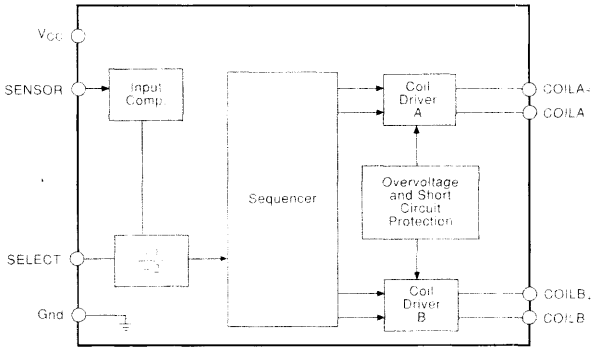
## Features

- **Monotonic**
- **Divide by 1 and Divide by 2 Modes**
- **Guaranteed Monotonic**
- **On Chip Flyback Diodes**
- **Fault Protection**
- **Overvoltage**
- **Load Dump Protection to 60V**

## Absolute Maximum Ratings

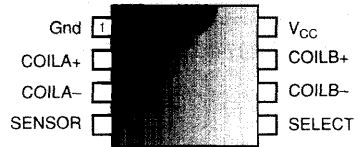
Supply Voltage ( $V_{CC}$ ) (continuous) -40°C to +105°C .....	-0.5 to 24V
(100ms pulse transient) -40°C to +105°C .....	-0.5 to 60V
Input Voltage ( $V_{IN}$ ) .....	-0.3 to $V_{CC} + 0.3V$
Operating Temperature Range .....	-40°C to 105°C
Storage Temperature Range (TSTG) .....	-65°C to 150°C
Junction Temperature Range .....	-40°C to 150°C
ESD (Human Body Model) .....	2kV
Lead Temperature Soldering	
Wave Solder (through hole styles only) .....	10 sec. max, 260°C peak

## Block Diagram



## Package Options

8 Lead PDIP



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■ Supply, V <sub>CC</sub>					
Supply Voltage Range	-40°C ≤ TA ≤ 105°C	6.5	15.5	V <sub>DC</sub>	
	-40°C ≤ TA ≤ 25°C	6.5	24.0	V <sub>DC</sub>	
	Transient Pulse, 100ms		35.0	V <sub>DC</sub>	
Supply Current	V <sub>CC</sub> = 15.5 V <sub>DC</sub> , Output not loaded			mA	
Overvoltage Shutdown		16	23	V	

■ Speed Sensor Input, SENSOR					
Input Frequency Range			0.2	1.0	kHz
Hysteresis		300	500		mV <sub>DC</sub>
Input Voltage Range	0V ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>	0		V <sub>CC</sub>	V <sub>DC</sub>
Input Clamp Current	I Clamp at V <sub>IN</sub> = 0V <sub>DC</sub>		-0.4	-5.0	mA

■ Divider Select Input, SELECT					
Logic 0 Input Voltage				100	mV <sub>DC</sub>
Logic 0 Input Current	0V ≤ V <sub>IN</sub> ≤ 100mV		-1	-100	μA

■ Coil Output Drivers					
Coil Load	+25°C	198	210	222	Ω
Coil Resistance Temperature Coefficient				0.35	%/°C
De-energized Coil Leakage Current			±100		μA

■ Short Circuit Protection					
Short Circuit Threshold I Coil A + I Coil B			275	400	mA
Short Circuit Hold-off Delay			5		μs

\* Voltage across the coils shall be measured at the specific voltages, but shall also be within linearly interpolated limits.

PACKAGE LEAD	LEAD SYMBOL	FUNCTION
<b>8L PDIP</b>		
1	Gnd	Ground connection.
2	COILA+	Output stage, when active, this lead supplies current to COIL A.
3	COILA-	Output stage, when active, this lead supplies current to COIL A.
4	SENSOR	Input signal from wheel speed or engine rpm.
5	SELECT	Selects divide by 1 or divide by 2 mode.
6	COILB-	Output stage, when active, this lead supplies current to COIL B.
7	COILB+	Output stage, when active, this lead supplies current to COIL B.
8	V <sub>CC</sub>	Supply Voltage.

SENSOR is a PNP comparator input which accepts either a sine wave or a square wave input. This input is protected from excursions above  $V_{CC}$  as well as any below ground as long as the current is limited to 1.5mA. It has an active clamp set to zero volts to prevent negative input voltages from disrupting normal operation. The sensor input can withstand  $150V_{DC}$  as long as the input current is limited to 1.5mA max. using a series resistor of 100k $\Omega$ .

**Coil Driver Outputs**

Simultaneously energizing the source and sink on either leg is not permitted, i.e. Q1 & Q2 or Q3 & Q4 cannot be energized simultaneously.

Circuit function is not affected by inductive transients due to coil loads as specified in the Transition States section.

The transition states occur as indicated in Table 1 without any intermediate states permitted.

**Table 1: Transition States**

Output State Table		
State	Coil A	Coil B
0	+	+
1	OFF	+
2	-	+
3	-	OFF
4	+	-
5	OFF	-
6	+	-
7	-	OFF

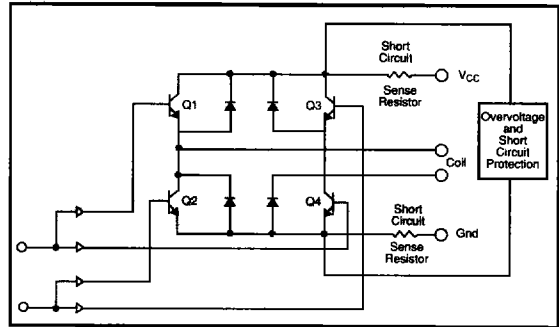
The polarity definition for the coil driver outputs is as follows:

Polarity	Connect Coil +	Connect Coil -
Positive (+)	$V_{CC}$	Gnd
Negative (-)	Gnd	$V_{CC}$

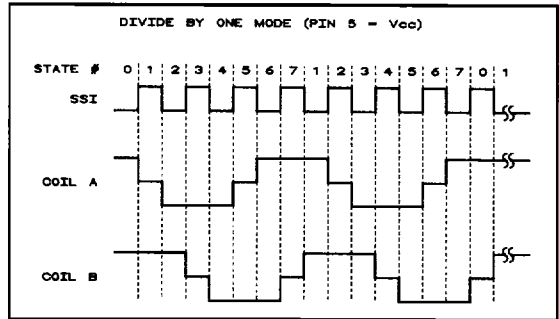
**Divider Select Input**

The speed sensor input frequency is either divided by one or divided by two depending on the state of the SELECT input as follows:

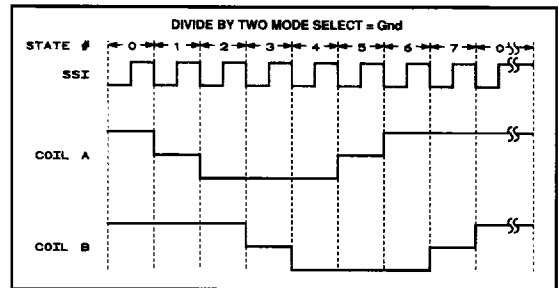
- Logic 0 = divide by 2
- Logic 1 = divide by 1



**Figure 1: Coil Driver Output**

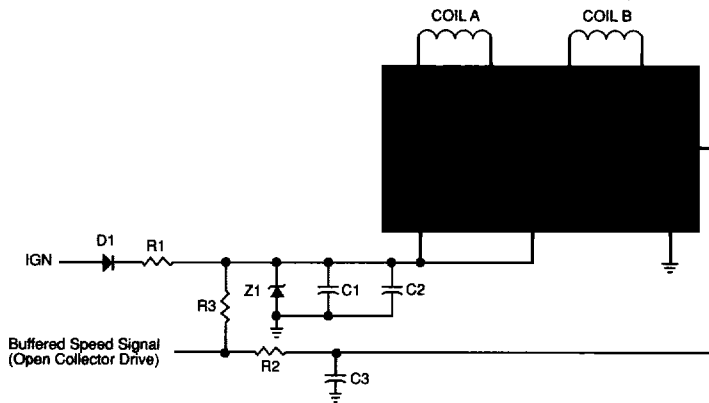


**Figure 2: Divide by 1 SELECT Mode**



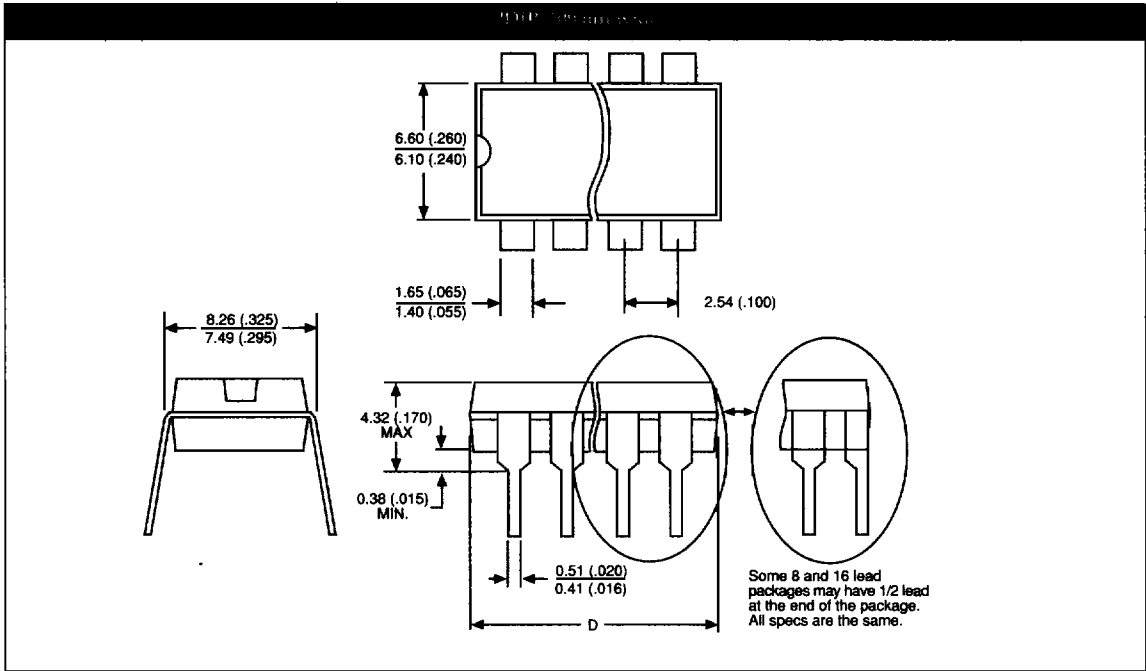
**Figure 3: Divide by 2 SELECT Mode**

- C1 - 10 $\mu$ F
- C2 - 0.1 $\mu$ F
- C3 - 0.01 $\mu$ F
- R1 - 3.9 $\Omega$ , 500mW
- R2 - 100k $\Omega$
- R3 - 15k $\Omega$
- D1 - 1A, 600PIV
- Z1 - 50V, 500mW
- COIL A - 210  $\pm$ 12 $\Omega$ , 80mH
- COIL B - 210  $\pm$ 12 $\Omega$ , 80mH



Lead Count	D			
	Metric		English	
	Max	Min	Max	Min
8L PDIP	9.40	9.14	.370	.360

Thermal Data		8L PDIP	
$R_{\theta JC}$	typ	52	$^{\circ}C/W$
$R_{\theta JA}$	typ	100	$^{\circ}C/W$



Defining Information

Part Number	Description
CS-4161N8	8L PDIP