CS4161

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

Description

The CS4161 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 CS4161 includes overvoltage and short circuit protection circuitry. It is lead for lead compatible with the CS-8441. The CS4161 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.
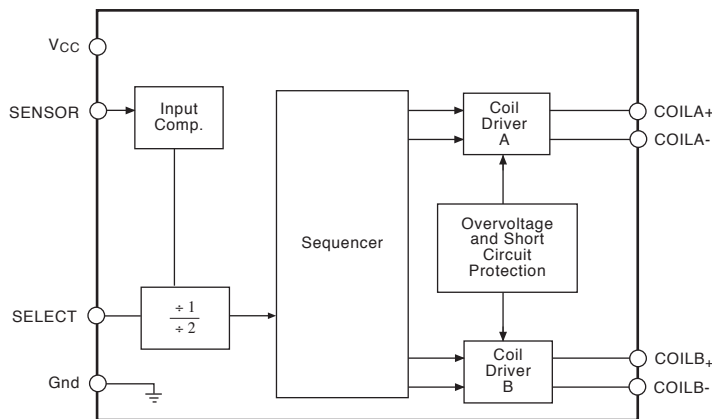
Features

- **Undervoltage Lockout**
- **Cross-conduction Prevention Logic**
- **Divide by 1 and Divide by 2 Modes**
- **Guaranteed Monotonic**
- **On Chip Flyback Diodes**
- **Fault Protection**
    Overvoltage
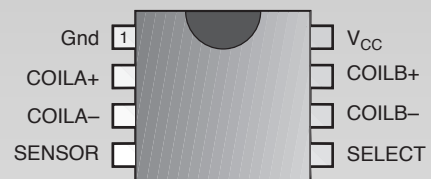   Load Dump Protection to 60V

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

Package Option

8 Lead PDIP

Gnd	1	V_{CC}
COILA+		COILB+
COILA–		COILB–
SENSOR		SELECT

Block Diagram

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Rev. 1/28/97

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Electrical Characteristics: Unless otherwise stated, these specifications apply for -40°C ≤ T_A ≤ 105°C, 6.5V ≤ V_{CC} ≤ 15.5V. All voltage shall be referenced to Gnd unless otherwise noted. Overvoltage shutdown of coils occurs when V_{CC} > 16V.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
■ **Supply, V_{CC}**					
Supply Voltage Range	-40°C ≤ TA ≤ 105°C	6.5		15.5	V_{DC}
	-40°C ≤ TA ≤ 25°C	6.5		24.0	V_{DC}
	Transient Pulse, 100ms			35.0	V_{DC}
Supply Current	V_{CC} = 15.5 V_{DC}, Outputs not loaded		24	35	mA
Overvoltage Shutdown		16		23	V
Undervoltage Lockout Voltage	V_{CC} Initial Power up	5.1	5.6	6.1	V
	UVLO Hysteresis	200	600	1000	mV
■ **Speed Sensor Input, SENSOR**					
Input Frequency Range			0.2	1.0	kHz
Switching Threshold		1.2		2.6	V_{DC}
Hysteresis		300	500		mV_{DC}
Input Bias Current	$0.8V_{DC}$ ≤ V_{IN} ≤ V_{CC}		0.1	±1.0	μA
Input Voltage Range		0		V_{CC}	V_{DC}
Operating Input Voltage	10kΩ Resistor in Series			-15 to V_{CC}	V_{DC}
Input Clamp Current	I Clamp at V_{IN} = $0V_{DC}$		-0.4	-5.0	mA
■ **Divider Select Input, SELECT**					
Logic 0 Input Voltage				100	mV_{DC}
Logic 1 Input Voltage		3.0			V_{DC}
Logic 0 Input Current	0V ≤ V_{IN} ≤ 100mV		-1	-100	μA
Logic 1 Input Current	3V ≤ V_{IN} ≤ 15.5 V_{DC}		0.75	2.00	mA
■ **Coil Output Drivers**					
Coil Load	+25°C	198	210	222	Ω
Coil Inductance			80		mH
Coil Resistance Temperature	Coefficient			0.35	% / °C
* Energized Coil Voltage (Both Polarities) A and B	V_{CC} = 6.5 V_{DC}	V_{CC} - 1.5V	V_{CC} - 0.9V		V_{DC}
	V_{CC} = 10.0 V_{DC}	V_{CC} - 1.6V	V_{CC} - 1.0V		V_{DC}
	V_{CC} = 15.5 V_{DC}, -20°C ≤ T_A ≤ 105°C	V_{CC} - 1.75V	V_{CC} - 1.1V		V_{DC}
	V_{CC} = 15.5 V_{DC}, -40°C ≤ T_A ≤ -20°C	V_{CC} - 2.0V	V_{CC} - 1.2V		V_{DC}
De-energized Coil Leakage Current			±100		μA
■ **Short Circuit Protection**					
Short Circuit Threshold I Coil A + I Coil B			275	400	mA
Short Circuit Turn-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 Description

PACKAGE LEAD #	LEAD SYMBOL	FUNCTION
8L PDIP		
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_{CC}	Supply Voltage.

Circuit Operation

Speed Sensor Input

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 100kΩ.

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:
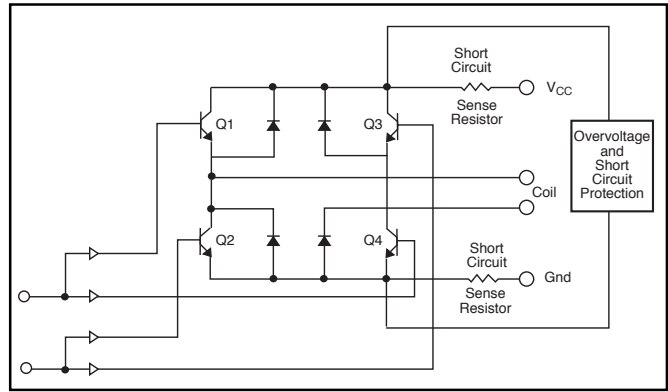
Logic 0 = divide by 2

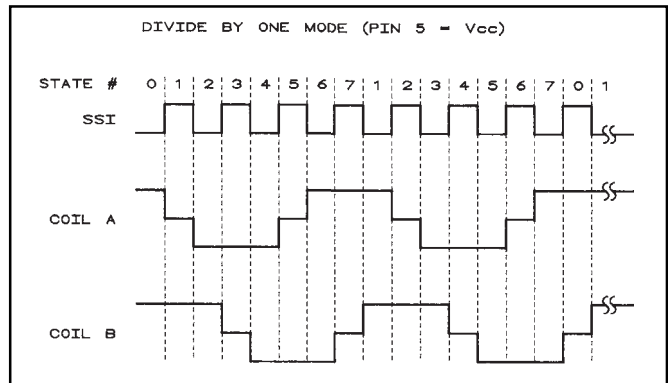Logic 1 = divide by 1

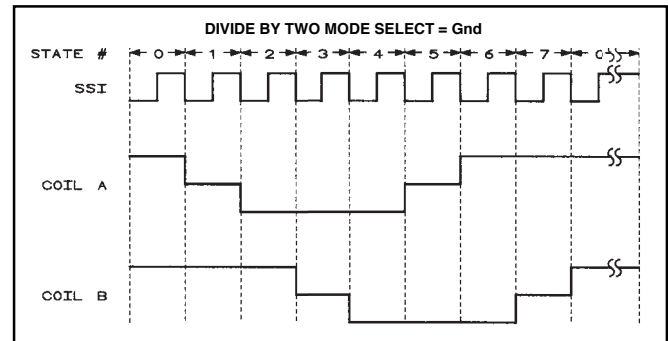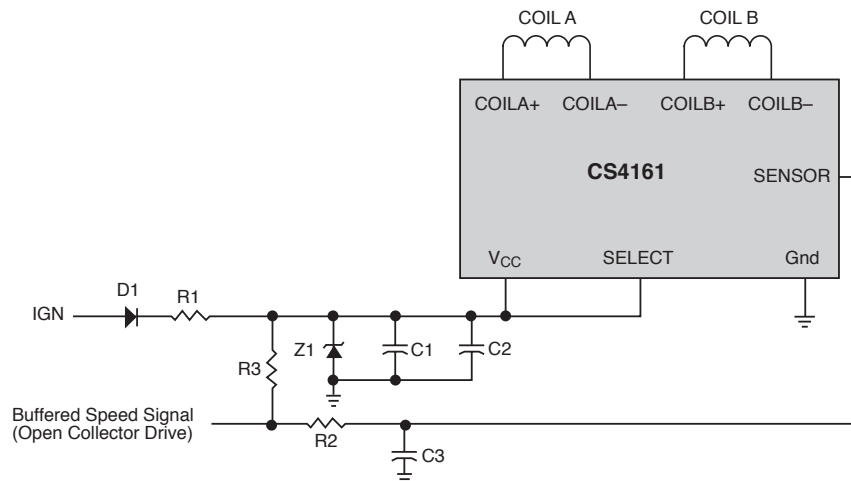**Figure 1: Coil Driver Output**

Figure 2: Divide by 1 SELECT Mode

Figure 3: Divide by 2 SELECT Mode

Odometer Application Diagram

C1 - 10μF
C2 - 0.1μF
C3 - 0.01μF
R1 - 3.9Ω, 500mW
R2 - 100kΩ
R3 - 15kΩ
D1 - 1A, 600PIV
Z1 - 50V, 500mW
COIL A - 210 ±12Ω, 80mH
COIL B - 210 ±12Ω, 80mH

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CS4161

Package Specification

PACKAGE DIMENSIONS IN mm (INCHES)

Lead Count	D			
	Metric		English	
	Max	Min	Max	Min
8L PDIP	10.16	9.02	.400	.355

PACKAGE THERMAL DATA

Thermal Data		8L PDIP	
$R_{\Theta JC}$	typ	52	˚C/W
$R_{\Theta JA}$	typ	100	˚C/W

Plastic DIP (N); 300 mil wide

7.11 (.280)
6.10 (.240)

1.77 (.070)
1.14 (.045)

2.54 (.100) BSC

8.26 (.325)
7.62 (.300)

3.68 (.145)
2.92 (.115)

.356 (.014)
.203 (.008)

0.39 (.015)
MIN.

.558 (.022)
.356 (.014)

D

Some 8 and 16 lead
packages may have
1/2 lead at the end
of the package.
All specs are the same.
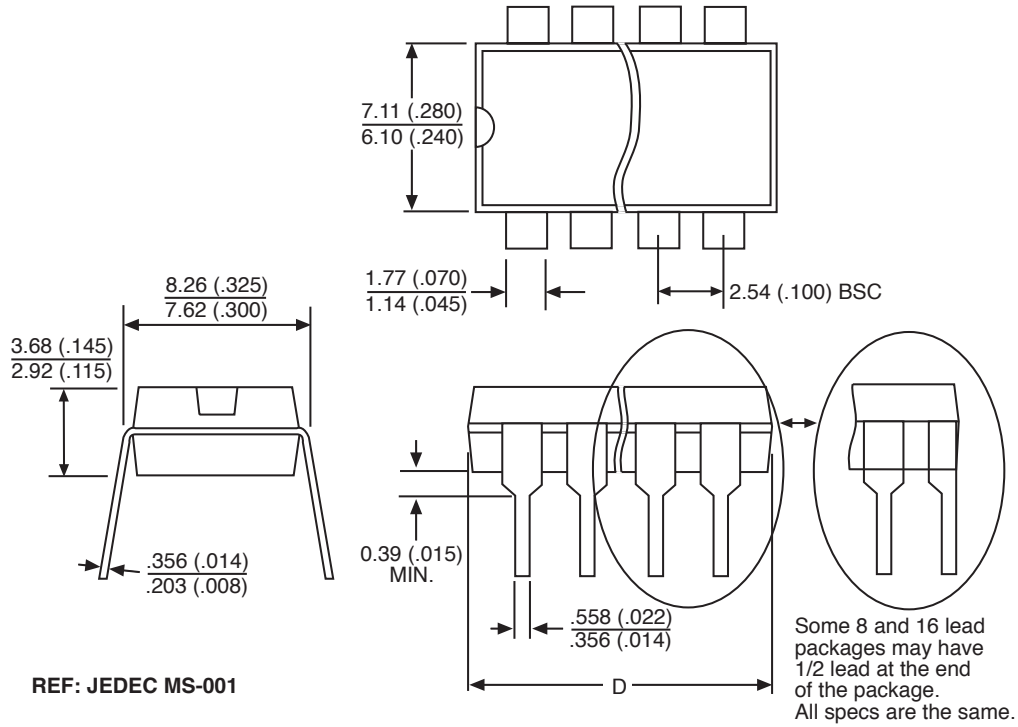
REF: JEDEC MS-001

Ordering Information

Part Number	Description
CS4161XN8	8L PDIP

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