CS4161

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

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 85 mA 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 CS8441. The CS4161 includes an additional undervoltage lockout (UVLO) function which disables the output stage until the supply voltage rises above 5.6 V, 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 60 V

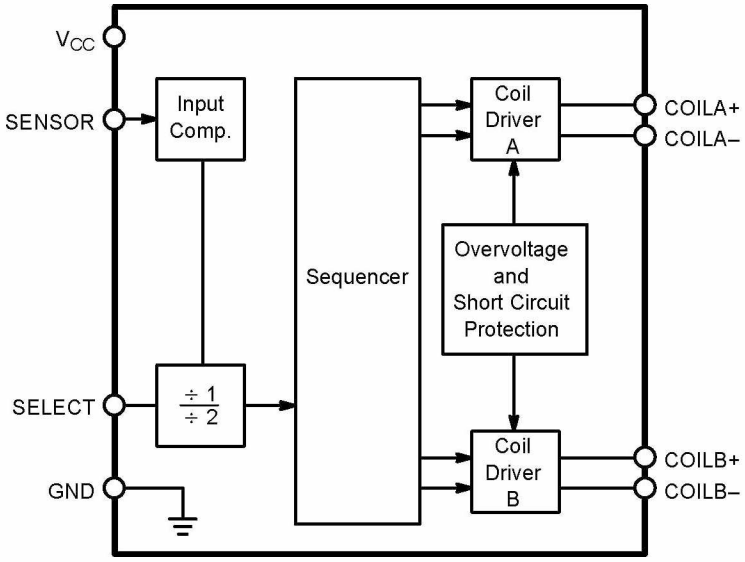

Figure 1. Block Diagram

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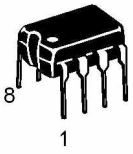
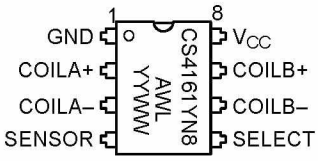


DIP–8
N SUFFIX
CASE 626

PIN CONNECTIONS AND MARKING DIAGRAM



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week

ORDERING INFORMATION

Device	Package	Shipping
CS4161YN8	DIP–8	50 Units/Rail

ABSOLUTE MAXIMUM RATINGS*

Rating		Value	Unit
Supply Voltage (V_{CC}) (Note 1):	Continuous 100 ms Pulse Transient	–0.5 to 24 –0.5 to 60	V V
Input Voltage (V_{IN})		–0.3 to V_{CC} + 0.3	V
Operating Temperature Range		–40 to 125	°C
Storage Temperature Range (TSTG)		–65 to 150	°C
Junction Temperature Range		–40 to 150	°C
ESD (Human Body Model)		2.0	kV
Lead Temperature Soldering:	Wave Solder: (through hole styles only) (Note 2)	260 peak	°C

1. –40°C to +125°C.
2. 10 second maximum.

*The maximum package power dissipation must be observed.

ELECTRICAL CHARACTERISTICS

(–40°C ≤ T_A ≤ 125°C, 6.5 V ≤ V_{CC} ≤ 15.5 V; unless otherwise stated. All voltage shall be referenced to GND unless otherwise noted. Overvoltage shutdown of coils occurs when V_{CC} > 16 V.)

Characteristic	Test Conditions	Min	Typ	Max	Unit
Supply, V_{CC}					
Supply Voltage Range	–40°C ≤ T_A ≤ 125°C –40°C ≤ T_A ≤ 25°C Transient Pulse, 100 ms	6.5 6.5 –	– – –	15.5 24 35	V_{DC} V_{DC} 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 UVLO Hysteresis	5.1 200	5.6 600	6.1 1000	V 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	0.8 V_{DC} ≤ V_{IN} ≤ V_{CC}	–	0.1	±1.0	μA
Input Voltage Range	–	0	–	V_{CC}	V_{DC}
Operating Input Voltage	10 kΩ Resistor in Series	–	–	–15 to V_{CC}	V_{DC}
Input Clamp Current	I Clamp at V_{IN} = 0 V_{DC}	–	–0.4	–5.0	mA
Divider Select Input, SELECT					
Logic 0 Input Voltage	–	–	–	100	mV_{DC}
Logic 1 Input Voltage	–	3.0	–	V_{CC}	V_{DC}
Logic 0 Input Current	0 V ≤ V_{IN} ≤ 100 mV	–	–1.0	–100	μA
Logic 1 Input Current	3.0 V ≤ V_{IN} ≤ 15.5 V_{DC}	–	0.75	2.0	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 (Note 3) (Both Polarities) A and B	V_{CC} = 6.5 V_{DC} V_{CC} = 10 V_{DC} V_{CC} = 15.5 V_{DC}, –20°C ≤ T_A ≤ 125°C V_{CC} = 15.5 V_{DC}, –40°C ≤ T_A ≤ –20°C	V_{CC} – 1.5 V V_{CC} – 1.6 V V_{CC} – 1.75 V V_{CC} – 2.0 V	V_{CC} – 0.9 V V_{CC} – 1.0 V V_{CC} – 1.1 V V_{CC} – 1.2 V	– – – –	V_{DC} V_{DC} V_{DC} V_{DC}

ELECTRICAL CHARACTERISTICS (continued) (–40°C ≤ T_A ≤ 125°C, 6.5 V ≤ V_{CC} ≤ 15.5 V; unless otherwise stated. All voltage shall be referenced to GND unless otherwise noted. Overvoltage shutdown of coils occurs when V_{CC} > 16 V.)

Characteristic	Test Conditions	Min	Typ	Max	Unit
Coil Output Drivers (continued)					
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	–	–	5.0	–	μs

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

PACKAGE PIN DESCRIPTION

PACKAGE PIN # DIP–8	PIN SYMBOL	FUNCTION
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 1.5 mA. It has an active clamp set to zero volts to prevent negative input voltages from disrupting normal operation. The sensor input can withstand 150 V_{DC} as long as the input current is limited to 1.5 mA max. using a series resistor of 100 kΩ.

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

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.

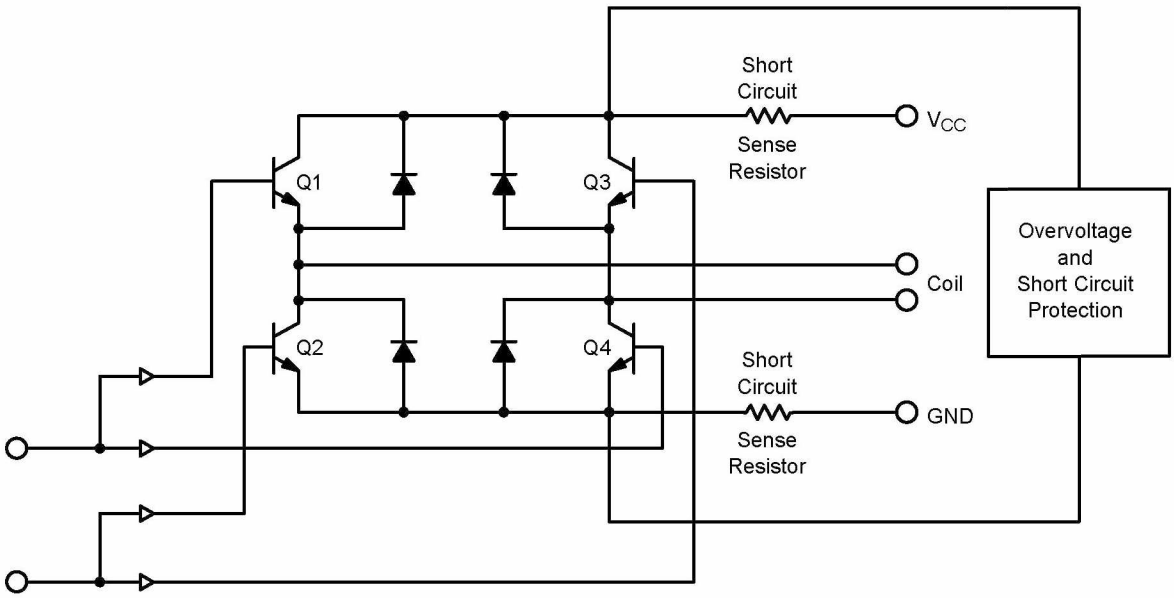


Figure 2. Coil Driver Output

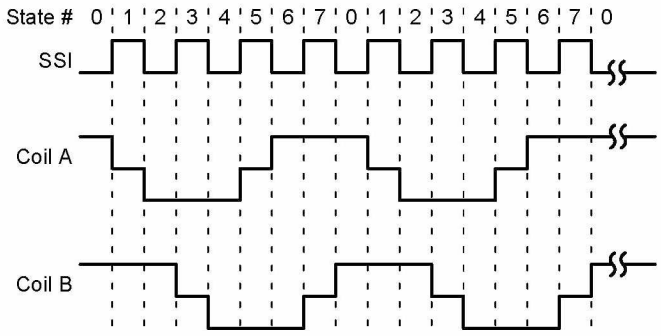


Figure 3. Divide by 1 (8 Step Mode), SELECT = 1

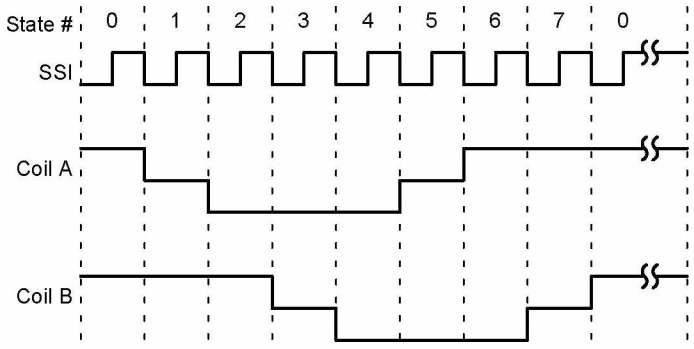


Figure 4. Divide by 2 (16 Step Mode), SELECT = 0

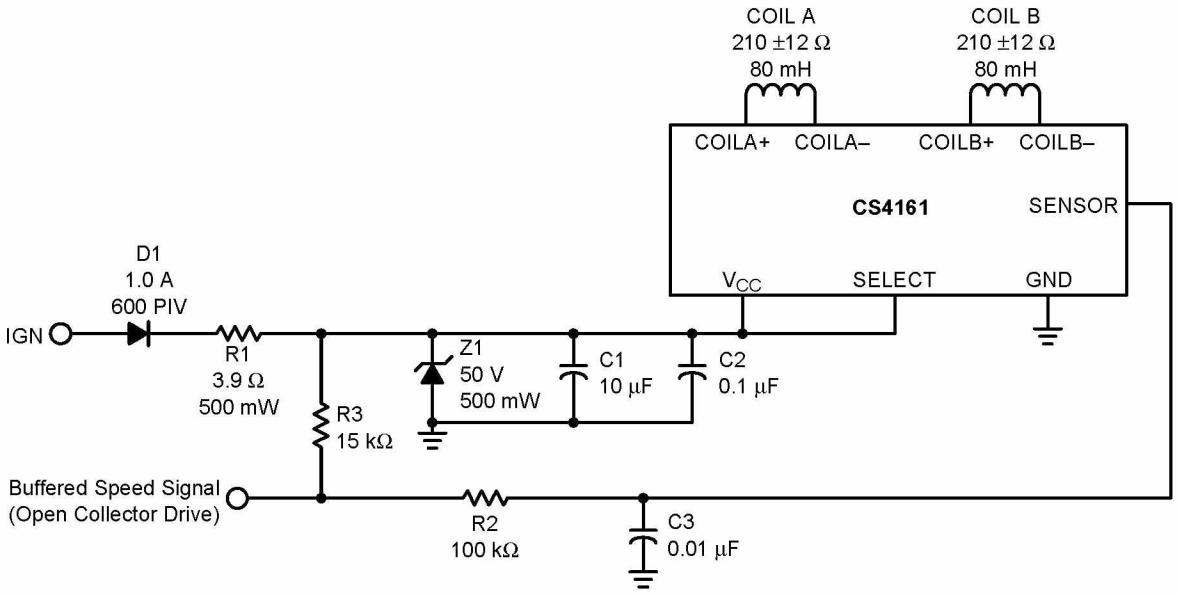


Figure 5. Odometer Application Diagram

PACKAGE THERMAL DATA

Parameter		DIP−8	Unit
$R_{\Theta JC}$	Typical	52	°C/W
$R_{\Theta JA}$	Typical	100	°C/W