

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

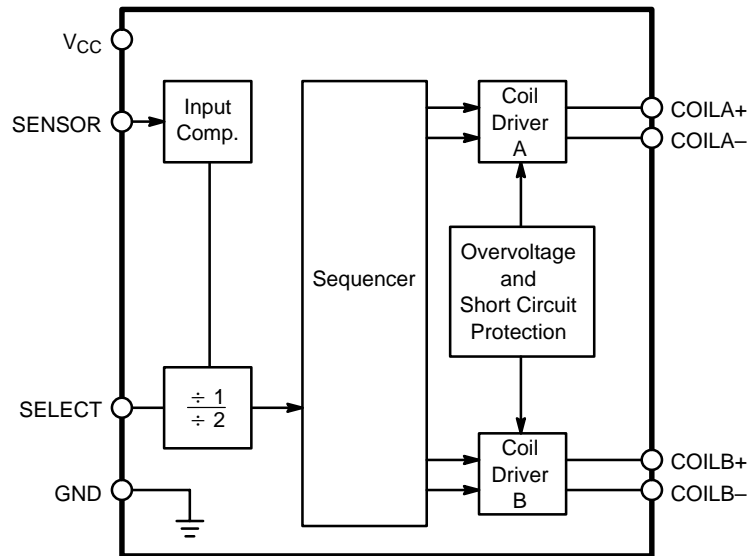
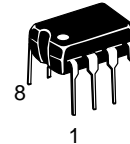


Figure 1. Block Diagram



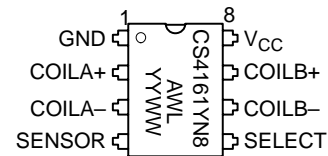
ON Semiconductor™

<http://onsemi.com>



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

CS4161

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

- 40°C to +125°C.
- 10 second maximum.

*The maximum package power dissipation must be observed.

ELECTRICAL CHARACTERISTICS ($-40^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$, $6.5\text{ V} \leq V_{CC} \leq 15.5\text{ V}$; unless otherwise stated. All voltage shall be referenced to GND unless otherwise noted. Overvoltage shutdown of coils occurs when $V_{CC} > 16\text{ V}$.)

Characteristic	Test Conditions	Min	Typ	Max	Unit
----------------	-----------------	-----	-----	-----	------

Supply, V_{CC}

Supply Voltage Range	$-40^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$ $-40^{\circ}\text{C} \leq T_A \leq 25^{\circ}\text{C}$ Transient Pulse, 100 ms	6.5 6.5 -	- - -	15.5 24 35	V_{DC} V_{DC} V_{DC}
Supply Current	$V_{CC} = 15.5\text{ V}_{DC}$, 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	$0.8\text{ V}_{DC} \leq V_{IN} \leq V_{CC}$	-	0.1	± 1.0	μA
Input Voltage Range	-	0	-	V_{CC}	V_{DC}
Operating Input Voltage	10 k Ω Resistor in Series	-	-	-15 to V_{CC}	V_{DC}
Input Clamp Current	I Clamp at $V_{IN} = 0\text{ V}_{DC}$	-	-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	$0\text{ V} \leq V_{IN} \leq 100\text{ mV}$	-	-1.0	-100	μA
Logic 1 Input Current	$3.0\text{ V} \leq V_{IN} \leq 15.5\text{ V}_{DC}$	-	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

CS4161

ELECTRICAL CHARACTERISTICS (continued) ($-40^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$, $6.5\text{ V} \leq V_{CC} \leq 15.5\text{ V}$; unless otherwise stated. All voltage shall be referenced to GND unless otherwise noted. Overvoltage shutdown of coils occurs when $V_{CC} > 16\text{ V}$.)

Characteristic	Test Conditions	Min	Typ	Max	Unit
Coil Output Drivers (continued)					
Energized Coil Voltage (Note 3.) (Both Polarities) A and B	$V_{CC} = 6.5 V_{DC}$	$V_{CC} - 1.5\text{ V}$	$V_{CC} - 0.9\text{ V}$	–	V_{DC}
	$V_{CC} = 10 V_{DC}$	$V_{CC} - 1.6\text{ V}$	$V_{CC} - 1.0\text{ V}$	–	V_{DC}
	$V_{CC} = 15.5 V_{DC}$, $-20^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$	$V_{CC} - 1.75\text{ V}$	$V_{CC} - 1.1\text{ V}$	–	V_{DC}
	$V_{CC} = 15.5 V_{DC}$, $-40^{\circ}\text{C} \leq T_A \leq -20^{\circ}\text{C}$	$V_{CC} - 2.0\text{ V}$	$V_{CC} - 1.2\text{ V}$	–	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	–	–	5.0	–	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 #	PIN SYMBOL	FUNCTION
DIP-8		
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 k Ω .

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.

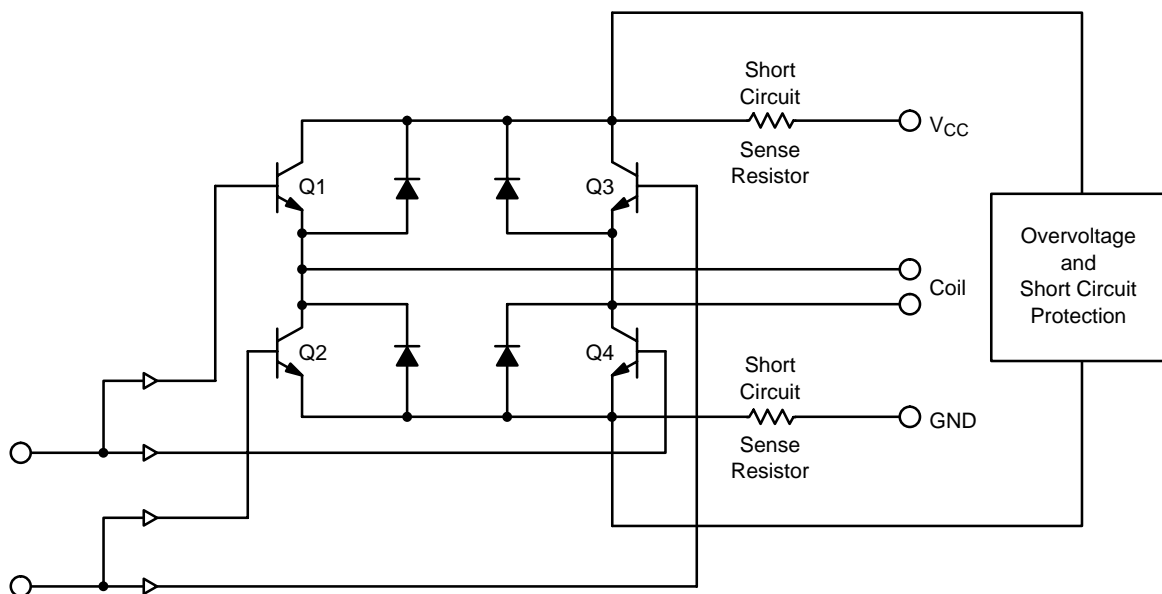


Figure 2. Coil Driver Output

CS4161

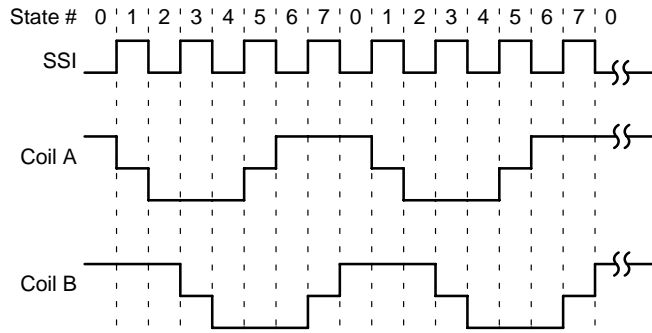


Figure 3. Divide by 1 (8 Step Mode), SELECT = 1

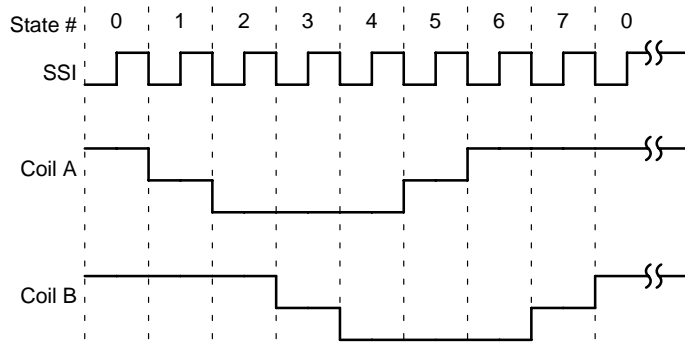


Figure 4. Divide by 2 (16 Step Mode), SELECT = 0

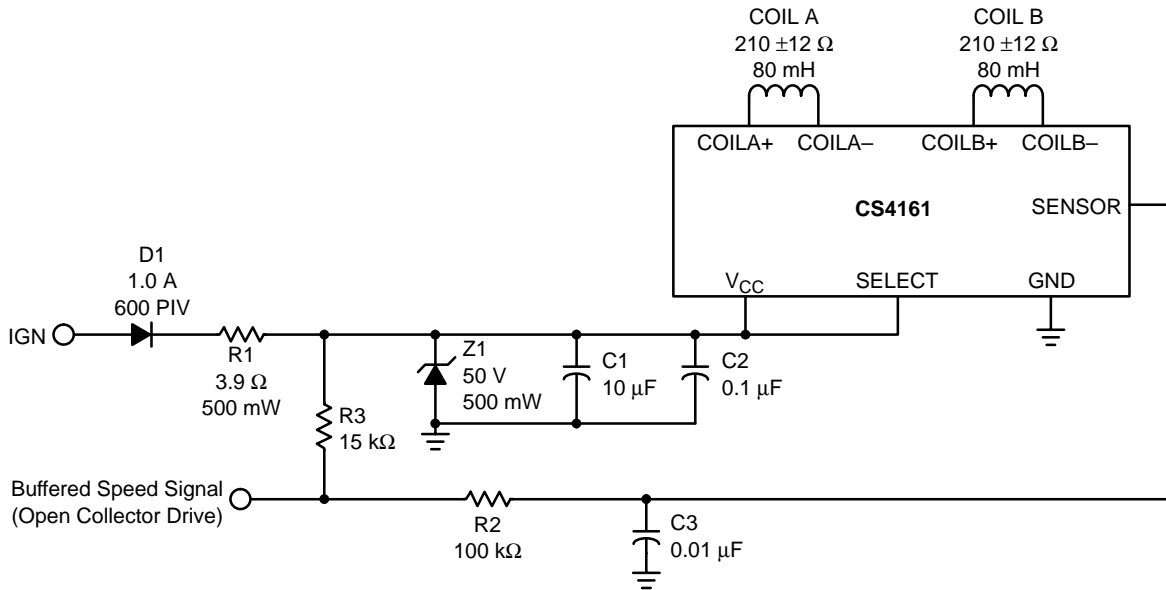
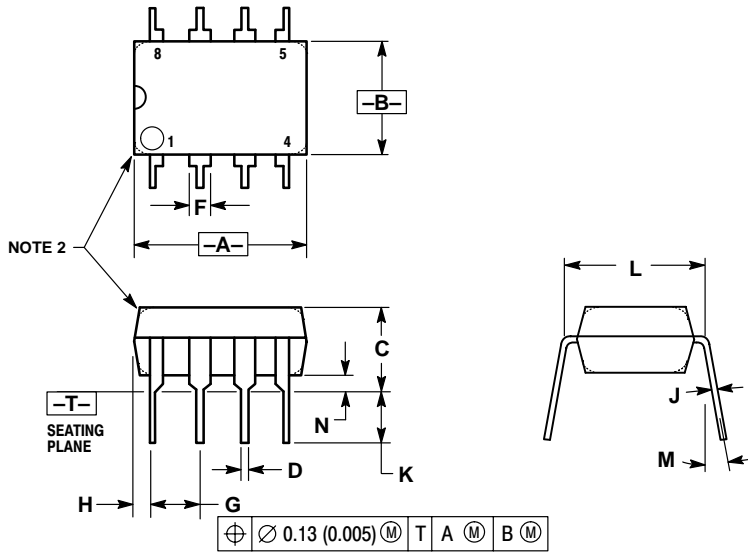


Figure 5. Odometer Application Diagram

CS4161

PACKAGE DIMENSIONS

DIP-8
N SUFFIX
CASE 626-05
ISSUE L



- NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
 2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
 3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	---	10°	---	10°
N	0.76	1.01	0.030	0.040

PACKAGE THERMAL DATA

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

Notes

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer.

PUBLICATION ORDERING INFORMATION

NORTH AMERICA Literature Fulfillment:

Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: ONlit@hibbertco.com
Fax Response Line: 303-675-2167 or 800-344-3810 Toll Free USA/Canada

N. American Technical Support: 800-282-9855 Toll Free USA/Canada

EUROPE: LDC for ON Semiconductor – European Support

German Phone: (+1) 303-308-7140 (Mon-Fri 2:30pm to 7:00pm CET)
Email: ONlit-german@hibbertco.com
French Phone: (+1) 303-308-7141 (Mon-Fri 2:00pm to 7:00pm CET)
Email: ONlit-french@hibbertco.com
English Phone: (+1) 303-308-7142 (Mon-Fri 12:00pm to 5:00pm GMT)
Email: ONlit@hibbertco.com

EUROPEAN TOLL-FREE ACCESS*: 00-800-4422-3781

*Available from Germany, France, Italy, UK, Ireland

CENTRAL/SOUTH AMERICA:

Spanish Phone: 303-308-7143 (Mon-Fri 8:00am to 5:00pm MST)
Email: ONlit-spanish@hibbertco.com
Toll-Free from Mexico: Dial 01-800-288-2872 for Access –
then Dial 866-297-9322

ASIA/PACIFIC: LDC for ON Semiconductor – Asia Support

Phone: 1-303-675-2121 (Tue-Fri 9:00am to 1:00pm, Hong Kong Time)
Toll Free from Hong Kong & Singapore:
001-800-4422-3781
Email: ONlit-asia@hibbertco.com

JAPAN: ON Semiconductor, Japan Customer Focus Center

4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-0031
Phone: 81-3-5740-2700
Email: r14525@onsemi.com

ON Semiconductor Website: <http://onsemi.com>

For additional information, please contact your local Sales Representative.