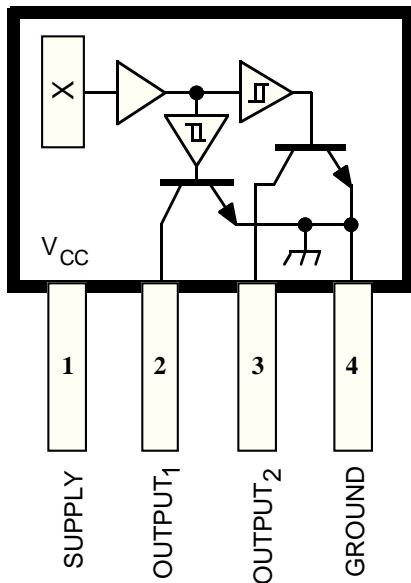


## DUAL-OUTPUT HALL-EFFECT SWITCH



Dwg. PH-007

Pinning is shown viewed from branded side.

### ABSOLUTE MAXIMUM RATINGS at $T_A = +25^\circ\text{C}$

Power Supply, $V_{CC}$ .....	<b>25 V</b>
Reverse Battery Voltage, $V_{RCC}$ .....	<b>-30 V</b>
Magnetic Flux Density, $B$ .....	<b>Unlimited</b>
Output OFF Voltage, $V_{OUT}$ .....	<b>25 V</b>
Output ON Current, $I_{OUT}$ .....	<b>50 mA</b>
Operating Temperature Range, $T_A$ .....	<b><math>-20^\circ\text{C}</math> to <math>+85^\circ\text{C}</math></b>
Storage Temperature Range $T_S$ .....	<b><math>-65^\circ\text{C}</math> to <math>+150^\circ\text{C}</math></b>

Type UGN3235K Hall-effect sensors are bipolar integrated circuits designed for commutation of brushless dc motors, and other rotary encoding applications using multi-pole ring magnets. The device features two outputs which are independently activated by magnetic fields of opposite polarity.

Each sensor IC includes a Hall voltage generator, two Schmitt triggers, a voltage regulator, output transistors, and on-board reverse polarity protection. The regulator enables these devices to operate from voltages ranging between 4.5 V and 24 V. On-chip compensation circuitry stabilizes the switch points over temperature.

Each open-collector output is independently operated by the proper amount and polarity of incident magnetic flux. Output 1 responds only to the positive flux from the south pole of a magnet, Output 2 to the negative flux from the north pole of a magnet. When the sensor experiences the field of a south magnetic pole greater than the maximum operate point of Output 1, that output switches to the LOW state and Output 2 is unaffected. When the incident flux falls below the minimum release point for Output 1, that output returns to the HIGH state and Output 2 remains unchanged.

Output 2 independently responds in the same manner to the negative flux from the north magnetic pole of a magnet. Figure 1 shows a zone in the region of 0 G,  $t_H$ , where both outputs are in the HIGH or OFF state. This constitutes a delay that is independent of rate of change of the incident magnetic field and ensures that both outputs are never ON simultaneously. This is an essential feature for driving brushless dc motors with a minimum of reactive transient currents.

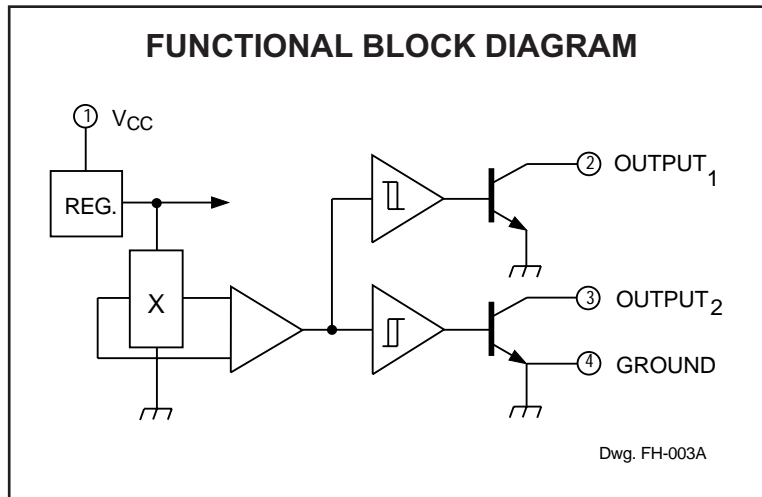
The UGN3235K is supplied in a four-pin plastic single in-line package (SIP).

### FEATURES

- Reliable and Rugged Magnetic Sensing Switch
- Two Outputs Independently Switched by North and South Poles
- Independent Actuation of Outputs Minimizes Inductive-Load Reactive Transient
- Built-in Hysteresis Minimizes Interference from Stray Fields
- Operates from 4.5 V to 24 V
- Outputs Compatible with All Logic Levels
- On-Board Reverse Polarity Protection
- Open-Collector, Active-Low Outputs

Always order by complete part number: **UGN3235K**.

# 3235 DUAL-OUTPUT HALL-EFFECT SWITCH



## ELECTRICAL CHARACTERISTICS at $T_A = +25^\circ\text{C}$ (unless otherwise noted).

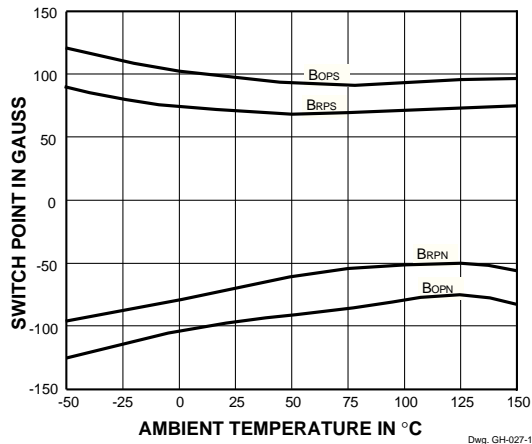
Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage	$V_{CC}$		4.5	—	24	V
Output Saturation Voltage	$V_{OUT(SAT)}$	$V_{CC} = 24\text{ V}$ , $I_{OUT} = 20\text{ mA}$	—	160	400	mV
Output Leakage Current	$I_{OFF}$	$V_{OUT} = 24\text{ V}$ , $V_{CC} = 24\text{ V}$	—	—	1.0	$\mu\text{A}$
Supply Current	$I_{CC}$	$V_{CC} = 24\text{ V}$ , Output Open	—	6.0	8.0	mA
Output Rise Time	$t_r$	$V_{CC} = 14\text{ V}$ , $R_L = 820\ \Omega$ , $C_L = 20\text{ pF}$	—	0.04	0.4	$\mu\text{s}$
Output Fall Time	$t_f$	$V_{CC} = 14\text{ V}$ , $R_L = 820\ \Omega$ , $C_L = 20\text{ pF}$	—	0.18	0.4	$\mu\text{s}$

## MAGNETIC CHARACTERISTICS at $V_{CC} = 4.5\text{ V to }24\text{ V}$

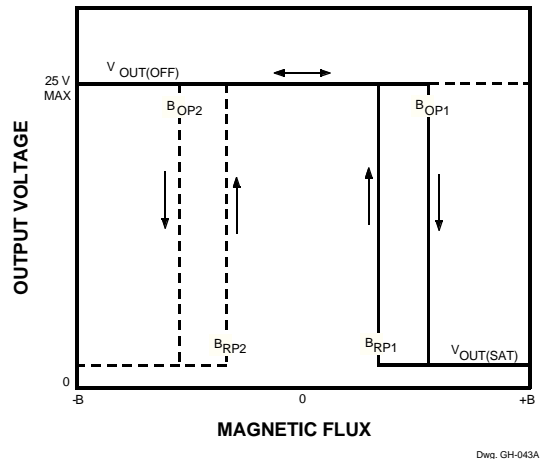
Characteristic	Test Conditions	Output	Min.	Max.	Units
Operate Point, $B_{OP}$	$T_A = +25^\circ\text{C}$	Q1	50	175	G
		Q2	-175	-50	G
	$T_A = -20^\circ\text{C to }+85^\circ\text{C}$	Q1	35	200	G
		Q2	-200	-35	G
Release Point, $B_{RP}$	$T_A = +25^\circ\text{C}$	Q1	25	160	G
		Q2	-160	-25	G
	$T_A = -20^\circ\text{C to }+85^\circ\text{C}$	Q1	15	190	G
		Q2	-190	-15	G
Hysteresis, $B_{hys}$	$T_A = +25^\circ\text{C}$	Q1 & Q2	15	100	G
	$T_A = -20^\circ\text{C to }+85^\circ\text{C}$	Q1 & Q2	15	110	G

# 3235 DUAL-OUTPUT HALL-EFFECT SWITCH

## SWITCH POINTS vs. TEMPERATURE

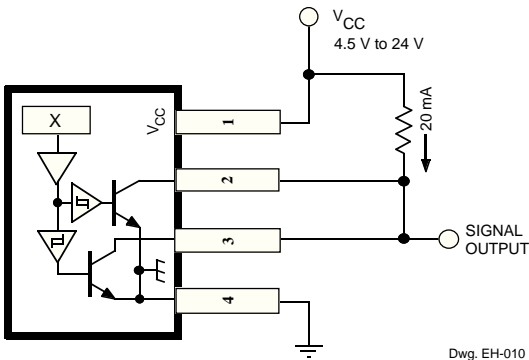


## TRANSFER CHARACTERISTICS



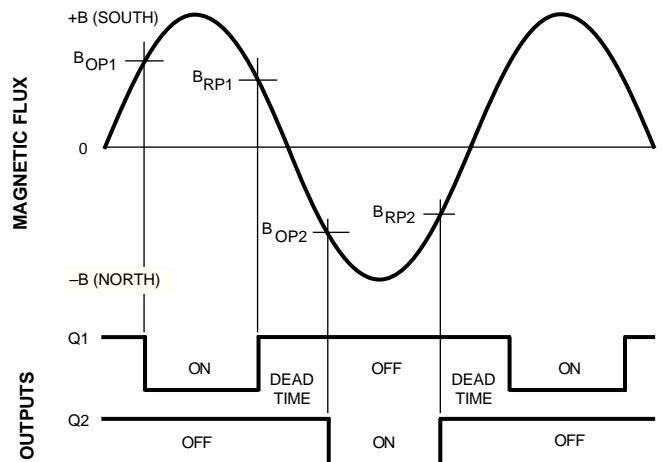
## APPLICATIONS

Figure 1 illustrates a method of sensing the presence of either a north or south magnetic pole. Because the UGN3235K is an open-collector device, it is possible to directly connect (wired OR) the two outputs. This causes the output to go LOW when either a north pole or south pole of sufficient magnitude is sensed. The device connected in this manner suits many applications, ranging from doubling the resolution of a ring-magnet encoder, to zero-crossing detection.



**FIGURE 1  
BIPOLAR DETECTOR**

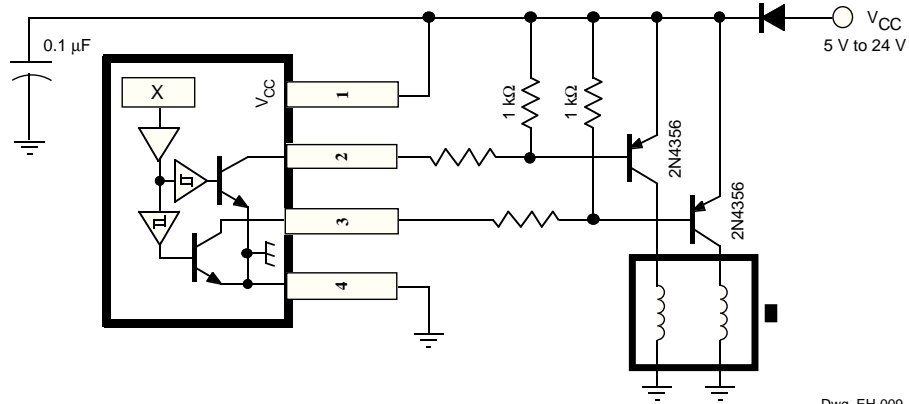
Figure 2 shows that there is a “dead time” approximately centered around 0 G. Thus, by sensing the HIGH portion of the UGN3235K wired-OR output, the zero-crossing can be detected.



**FIGURE 2  
ZERO-CROSSING DETECTION**

Figure 3 shows that the UGN3235K makes it possible to implement a very efficient brushless dc motor control using a minimum number of components. Referring again to Figure 1, the dead time (where both drivers are OFF) allows the motor coil field to decay sufficiently. This avoids both excessive reactive voltages and the magnetic drag resulting from the motor coils working in opposition to each other.

# 3235 DUAL-OUTPUT HALL-EFFECT SWITCH

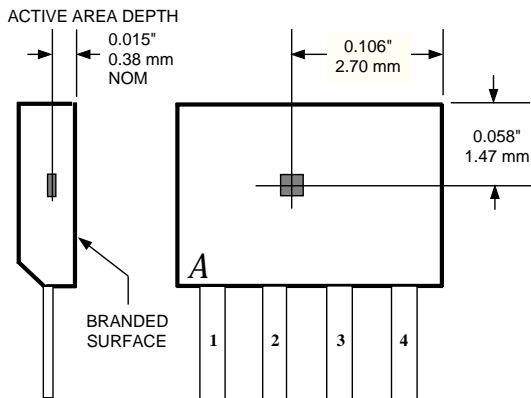


Dwg. EH-009

**FIGURE 3  
MOTOR DRIVER**

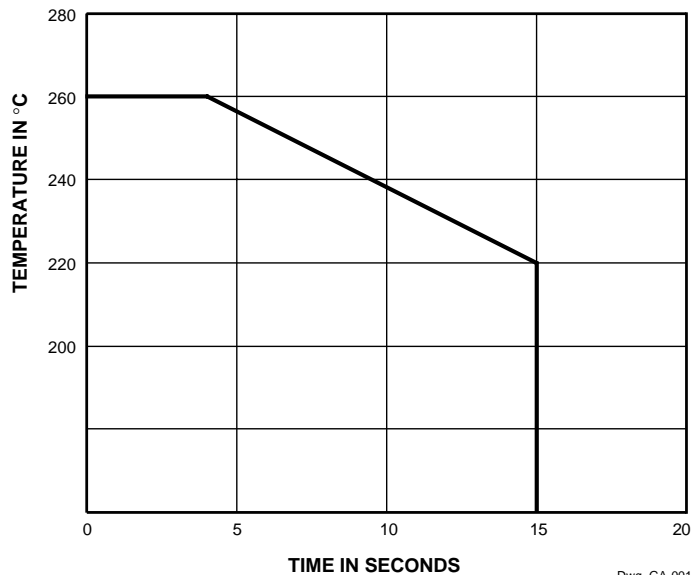
## SENSOR LOCATION

(±0.005" [0.13mm] die placement)



Dwg. MH-001-1B

## GUIDE TO INSTALLATION



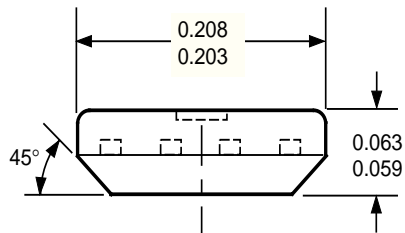
Dwg. GA-001

All Hall effect integrated circuits are susceptible to mechanical stress effects. Caution should be exercised to minimize the application of stress to the leads or the epoxy package. Use of epoxy glue is recommended. Other types may deform the epoxy package.

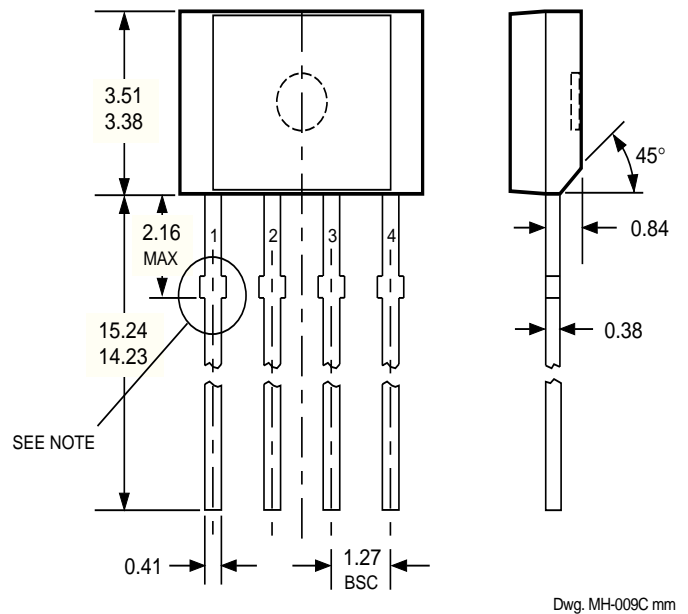
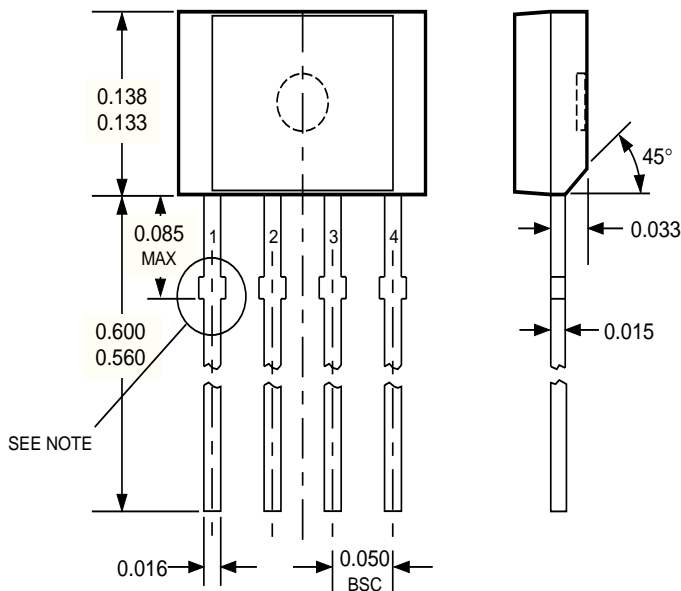
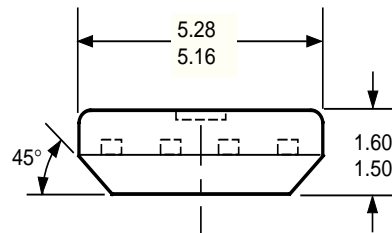
To prevent permanent damage to the Hall cell, heat-sink the leads during hand soldering. Recommended maximum conditions for wave soldering are shown in the graph above.

# 3235 DUAL-OUTPUT HALL-EFFECT SWITCH

**Dimensions in Inches**  
(controlling dimensions)



**Dimensions in Millimeters**  
(for reference only)



- NOTES:
1. Tolerances on package height and width represent allowable mold offsets. Dimensions given are measured at the widest point (parting line).
  2. Exact body and lead configuration at vendor's option within limits shown.
  3. Height does not include mold gate flash.
  4. Recommended minimum PWB hole diameter to clear transition area is 0.035" (0.89 mm).
  5. Where no tolerance is specified, dimension is nominal.

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**3235**  
**DUAL-OUTPUT**  
**HALL-EFFECT SWITCH**

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**3235**  
***DUAL-OUTPUT***  
***HALL-EFFECT SWITCH***

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**3235**  
**DUAL-OUTPUT**  
**HALL-EFFECT SWITCH**

**HALL-EFFECT SENSORS SELECTION GUIDE**

Partial Part Number	Avail. Oper. Temp.	Operate Limits Over Temp.			Function†	Notes
		B <sub>OP</sub> max	B <sub>RP</sub> min	B <sub>hys</sub> min		
3046	E/L	+200	-200	15	Gear-Tooth Sensor	
3054	K/S	+300	+5	5.0	Unipolar Multiplex	1
3056	E/L	+225	-225	15	Gear-Tooth Sensor	
3058	E/L	+300	-300	150	Gear-Tooth Sensor	
3059	K/S	+100	-100	20	AC Gear-Tooth Sensor	
3060	K/S	+35	-35	10	AC Gear-Tooth Sensor	
3121	E/L	+500	+80	60	Unipolar Switch	
3122	E/L	+430	+120	70	Unipolar Switch	
3123	E/L	+470	+160	70	Unipolar Switch	
3132	K/L/S	+95	-95	30	Bipolar Switch	
3133	K/L/S	+75	-75	30	Bipolar Switch	
3134	E/L	+50	-40	10	Bipolar Switch	
3141	E/L	+175	+10	20	Unipolar Switch	
3142	E/L	+245	+60	30	Unipolar Switch	
3143	E/L	+355	+150	30	Unipolar Switch	
3144	E/L	+450	+25	20	Unipolar Switch	
3161	E	+160	+30	5.0	2-Wire Unipolar Switch	
3175	S	+180	-180	80	Bipolar Latch	
3177	S	+150	-150	50	Bipolar Latch	
3185	E/L	+300	-300	280	Bipolar Latch	
3187	E/L	+175	-175	100	Bipolar Latch	
3188	E/L	+200	-200	160	Bipolar Latch	
3189	E/L	+250	-250	100	Bipolar Latch	
3195	E/L	+200	-200	110	Bipolar Latch	2, 3
3197	L	+200	-200	110	Bipolar Latch	3
3235	S	+200	+15	15	Unipolar Switch	4
		-200	-15	15	Unipolar Switch	
3275	S	+250	-250	100	Bipolar Latch	5
3421	E/L	+300	-300	240	Direction Detection	
3422	E/L	+85	-85	10	Direction Detection	
3503	S	Typ. 1.3 mV/G	–	–	Linear Sensor	
3515	E/L	Typ. 5.0 mV/G	–	–	Chopper-Stabilized Linear Sensor	
3516	E/L	Typ. 2.5 mV/G	–	–	Chopper-Stabilized Linear Sensor	
3517	L/S	Typ. 5.0 mV/G	–	–	Chopper-Stabilized Linear Sensor	
3518	L/S	Typ. 2.5 mV/G	–	–	Chopper-Stabilized Linear Sensor	
3625	S	+150	-150	200*	900 mA Bipolar Latch	3, 5, 6
3626	S	+150	-150	200*	400 mA Bipolar Latch	3, 5, 6
5140	E	+240	+25	20	300 mA Unipolar Switch	3, 6

Operating Temperature Ranges:

C = 0°C to +70°C, S = -20°C to +85°C, E = -40°C to +85°C, K = -40°C to +125°C, L = -40°C to +150°C

Notes

1. Multiplexed two-wire sensor; after proper address, power/signal bus current indicates magnetic field condition.

2. Active pull down.

3. Protected.

4. Output 1 switches on south pole, output 2 switches on north pole for 2-phase, bifilar-wound, unipolar-driven brushless dc motor control.

5. Complementary outputs for 2-phase bifilar-wound, unipolar-driven brushless dc motor control.

6. Power driver output.

\* Typical.

† Latches will not switch on removal of magnetic field; bipolar switches may switch on removal of field but require field reversal for reliable operation over operating temperature range.

