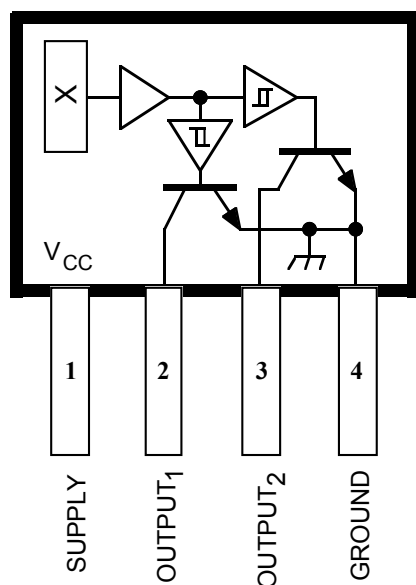


## DUAL-OUTPUT HALL-EFFECT SWITCH



Dwg. PH-007

Pinning is shown viewed from branded side.

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

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

Type UGN3235K Hall-effect sensor ICs 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 device 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 IC 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

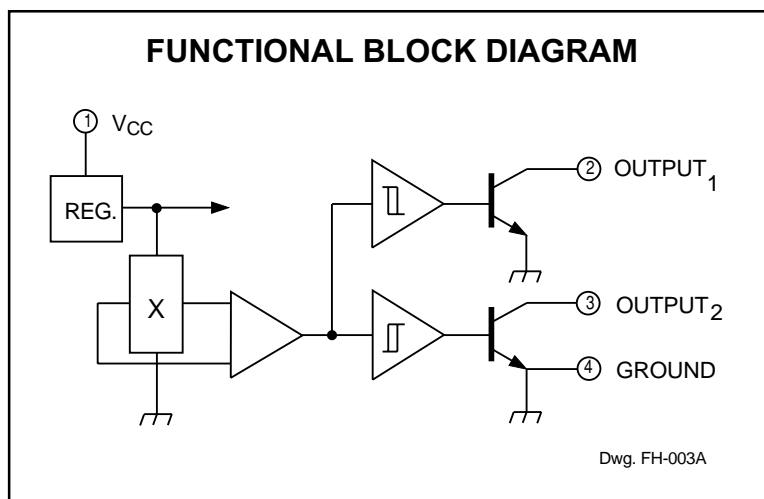
- Reliable and Rugged Magnetic Sensing Switch
- Two Outputs Independently Switched by North and South Poles
- Independent Actuation of Outputs Minimizes Inductive-Load Reactive Transient
- Built-in Hysteresis Minimizes Interference from Stray Fields
- Operates from 4.5 V to 24 V
- Outputs Compatible 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).

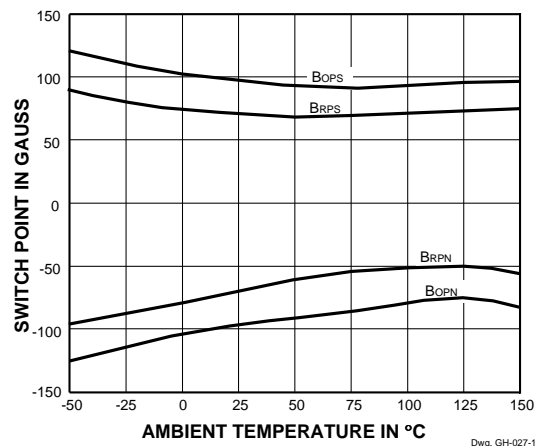
Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage	$V_{CC}$		4.5	—	24	V
Output Saturation Voltage	$V_{OUT(SAT)}$	$V_{CC} = 24\text{ V}$ , $I_{OUT} = 20\text{ mA}$	—	160	400	mV
Output Leakage Current	$I_{OFF}$	$V_{OUT} = 24\text{ V}$ , $V_{CC} = 24\text{ V}$	—	—	1.0	$\mu\text{A}$
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 $V_{CC} = 4.5\text{ V to }24\text{ V}$

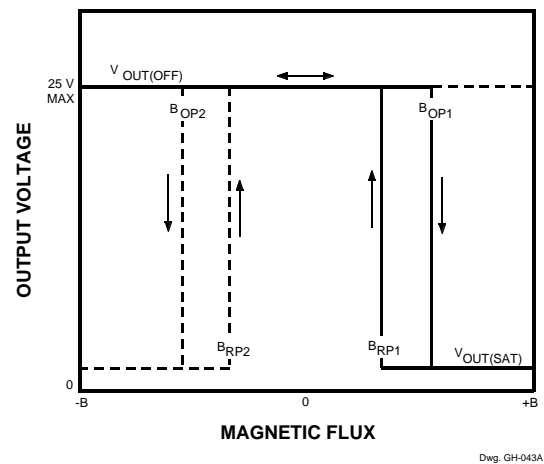
Characteristic	Test Conditions	Output	Min.	Max.	Units
Operate Point, $B_{OP}$	$T_A = +25^\circ\text{C}$	Q1	50	175	G
		Q2	-175	-50	G
	$T_A = -20^\circ\text{C to }+85^\circ\text{C}$	Q1	35	200	G
		Q2	-200	-35	G
Release Point, $B_{RP}$	$T_A = +25^\circ\text{C}$	Q1	25	160	G
		Q2	-160	-25	G
	$T_A = -20^\circ\text{C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

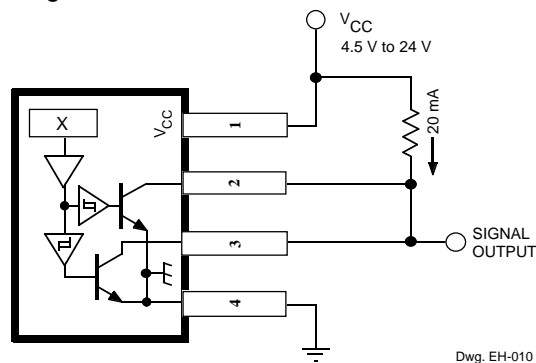


## TRANSFER CHARACTERISTICS



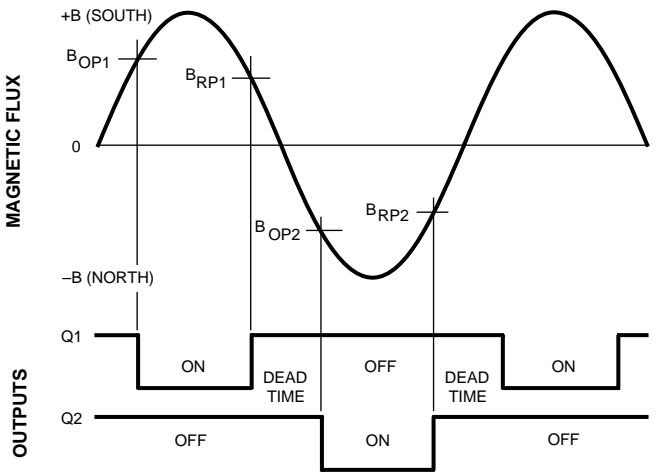
## APPLICATIONS

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**  
Omnipolar detector

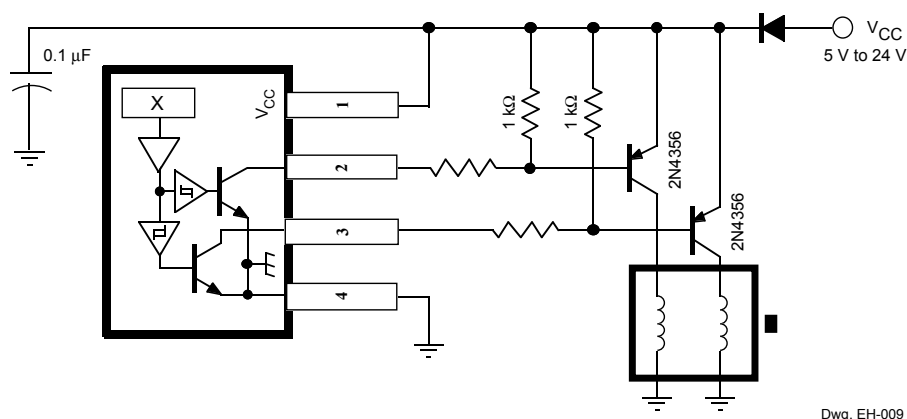
Figure 2 shows that there is a “dead time” approximately centered around 0 G. Thus, by sensing the HIGH portion of the UGN3235K wired-OR output, the zero-crossing can be detected.



**Figure 2**  
Zero-crossing detection

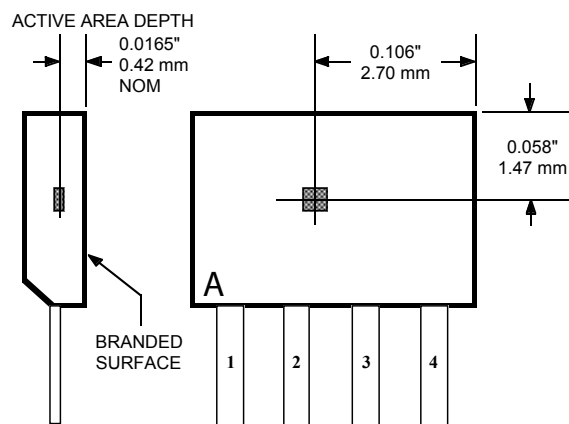
Figure 3 shows that the UGN3235K makes it possible to implement a very efficient brushless dc motor control using a minimum number of components. Referring again to Figure 1, the dead time (where both drivers are OFF) allows the motor coil field to decay sufficiently. This avoids both excessive reactive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

# 3235 DUAL-OUTPUT HALL-EFFECT SWITCH

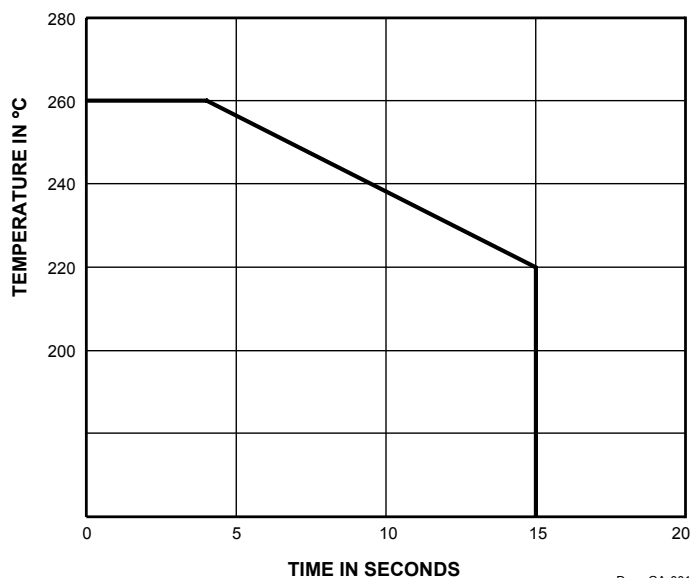


**Figure 3**  
**Motor driver**

## ELEMENT LOCATION



## GUIDE TO INSTALLATION

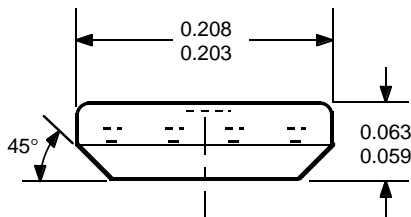


All Hall-effect integrated circuits are susceptible to mechanical stress effects. Caution should be exercised to minimize the application of stress to the leads or the epoxy package. Use of epoxy glue is recommended. Other types may deform the epoxy package.

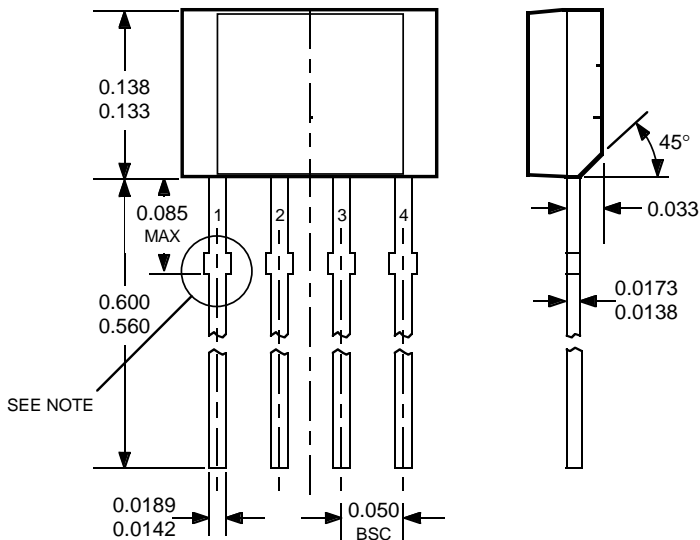
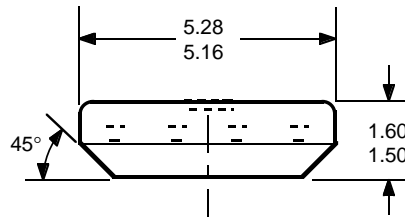
To prevent permanent damage to the Hall cell, heat-sink the leads during hand soldering. Recommended maximum conditions for wave soldering are shown in the graph above.

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

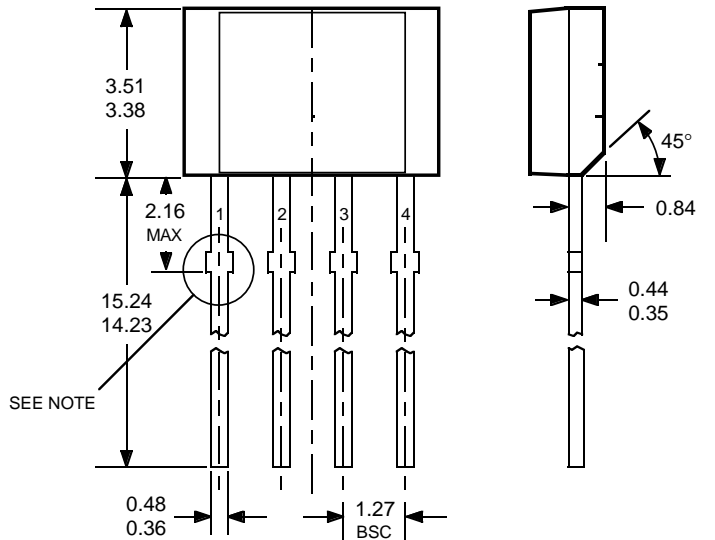
**Dimensions in Inches**  
(controlling dimensions)



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

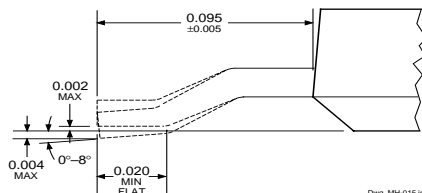


Dwg. MH-009D in

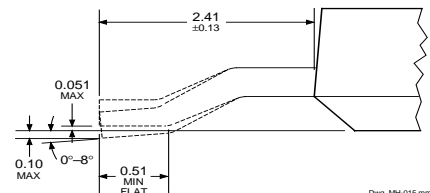


Dwg. MH-009D mm

## Surface-Mount Lead Form (Suffix -TL)



Dwg. MH-015



Dwg. MH-015 mm

- 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.
6. Supplied in bulk pack (500 pieces per bag).

# **3235**

## **DUAL-OUTPUT**

### **HALL-EFFECT SWITCH**

*The products described herein are manufactured under one or more of the following U.S. patents: 5,045,920; 5,264,783; 5,442,283; 5,389,889; 5,581,179; 5,517,112; 5,619,137; 5,621,319; 5,650,719; 5,686,894; 5,694,038; 5,729,130; 5,917,320; and other patents pending.*

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