

## UGN-3030T/U AND UGS-3030T/U BIPOLAR HALL EFFECT DIGITAL SWITCHES

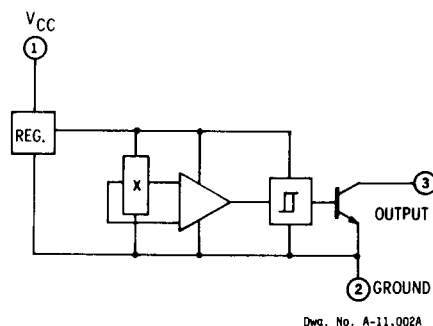
### FEATURES

- 4.5 V to 24 V Operation
- For Use with Multipole Ring Magnets
- High Reliability—No Moving Parts
- Small Size
- Output Compatible with All Digital Logic Families
- Constant Output Amplitude

**B**IPOLAR Type 3030 Hall Effect integrated circuits cleanly track rotation of multipole ring magnets as digital transducers in counter and control circuits. They provide logic-compatible output free of ringing or stuttering while operating in contaminated and electrically noisy environments. The magnetically activated electronic switches are available with two operating temperature ranges and in two three-pin plastic packages.

Each Hall Effect circuit includes a voltage regulator, Hall voltage generator, signal amplifier, Schmitt trigger, and open-collector output on a single silicon chip. The on-board regulator permits operation over the supply-voltage range of 4.5 V to 24 V.

The switches' open-collector outputs can sink up to 20 mA at a conservatively rated repe-



Dwg. No. A-11,002A

### FUNCTIONAL BLOCK DIAGRAM

titution rate of 100 kHz. They can be used directly with bipolar or MOS logic circuits. Selected devices, with outputs capable of sinking 50 mA, are available on special order.

Types UGN-3030T and UGN-3030U are rated for operation over the temperature range of  $-20^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . Types UGS-3030T and UGS-3030U have an operating range of  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

The Hall Effect switches are offered in two three-pin plastic packages—a 60-mil (1.54 mm) magnetically optimized "U" package, and one 80 mils (2.03 mm) thick specified by the suffix "T."

### ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $V_{CC}$	25 V
Magnetic Flux Density, B	Unlimited
Output OFF Voltage	25 V
Output ON Current, $I_{SINK}$	25 mA
Operating Temperature Range, $T_A$	
UGN-3030T	$-20^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
UGN-3030U	$-20^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
UGS-3030T	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}^*$
UGS-3030U	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}^*$
Storage Temperature Range, $T_S$	$-65^{\circ}\text{C}$ to $+150^{\circ}\text{F}$

\*Selected devices are available with a  $T_A$  range of  $-55^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ .

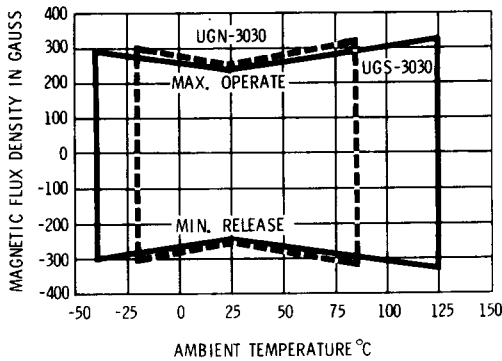
These Hall Effect sensors are also supplied in SOT 89 (TO-243AA) packages for surface-mount application. The regular SOT 89 package is specified by substituting an "LT" for the last character of the part number. The long leaded SOT 89 package is specified by substituting an "LL" for the last character of the part number and the Low profile "U" package is available by substituting "UA" for the last character of the part number (e.g., UGN-3XXXLT, UGN-3XXXLL, UGN-3XXXUA).

**ELECTRICAL CHARACTERISTICS at  $T_A = +25^\circ\text{C}$ ,  $V_{CC} = 4.5\text{ V to }24\text{ V}$  (unless otherwise noted)**

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Operate Point*	$B_{OP}$		—	160	250	G
Release Point*	$B_{RP}$		-250	110†	—	G
Hysteresis*	$B_H$		20	50	—	G
Output Saturation Voltage	$V_{CE(SAT)}$	$B \geq 250\text{ G}$ , $I_{SINK} = 20\text{ mA}$	—	85	400	mV
Output Leakage Current	$I_{OFF}$	$B \leq -250\text{ G}$ , $V_{OUT} = 24\text{ V}$	—	0.05	10	$\mu\text{A}$
Supply Current	$I_{CC}$	$B \leq -250\text{ G}$ , $V_{CC} = 4.5\text{ V}$ , Output Open	—	2.3	5.0	mA
		$B \leq -250\text{ G}$ , $V_{CC} = 24\text{ V}$ , Output Open	—	3.0	5.0	mA
Output Rise Time	$t_r$	$V_{CC} = 12\text{ V}$ , $R_L = 820\Omega$ , $C_L = 20\text{ pF}$	—	150	—	ns
Output Fall Time	$t_f$	$V_{CC} = 12\text{ V}$ , $R_L = 820\Omega$ , $C_L = 20\text{ pF}$	—	400	—	ns

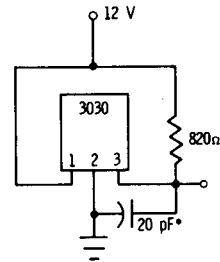
\*Magnetic flux density is measured at most sensitive area of device located at  $0.036'' \pm 0.002''$  ( $0.91\text{ mm} \pm 0.05\text{ mm}$ ) below the branded face of the 'T' package and  $0.016'' \pm 0.002''$  ( $0.41\text{ mm} \pm 0.05\text{ mm}$ ) below the branded face of the 'U' package.  
† $B_{RP}$  not guaranteed at positive flux density. Bipolar magnetic switching is recommended.

**GUARANTEED OPERATE AND RELEASE POINTS AS FUNCTIONS OF TEMPERATURE**



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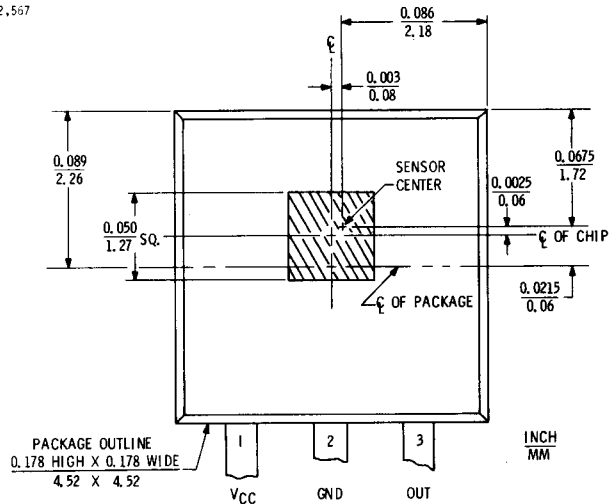
**TEST CIRCUIT**



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\*Includes probe and test fixture capacitance.

**SENSOR-CENTER LOCATION**



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**OPERATION**

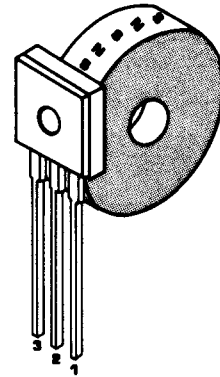
The simplest form of magnet that will operate the Hall Effect bipolar digital switch is a multipole ring magnet as shown in Figure 1. The magnet must provide a +250 gauss to -250 gauss magnetic flux density range at the sensor to ensure reliable operation. Such magnets are commercially available and inexpensive.

Under power-up conditions, and in the absence of an externally applied magnetic field, the output transistor of most Type 3030 switches is ON and capable of sinking 25 mA of current. This is, however, a formally ambiguous state and should be treated as such.

In normal operation, the output transistor turns ON as the strength of the magnetic field perpendicular to the surface of the chip reaches the Operate Point. The output transistor switches OFF as magnetic field reversal takes magnetic flux density to the Release Point.

Note that the device is typically turned ON by presenting the south pole of a magnet to the branded face of the package, which is opposite the side with the ejector pin indentation. With the branded side facing you and the pins pointing down, pinouts are, from left to right: (1)  $V_{CC}$ , (2) GND, (3)  $V_{OUT}$ .

Type 3030 Hall Effect switches are offered in two packages. The "U" package is about 0.020" (0.05



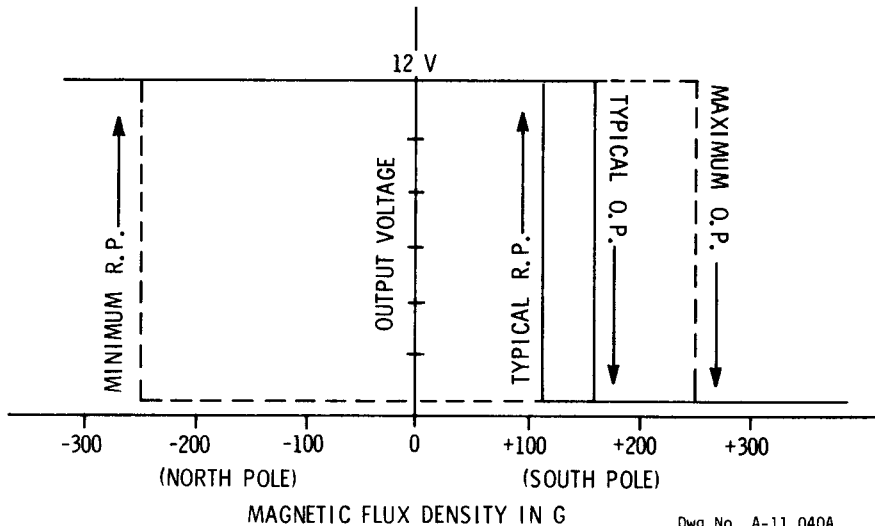
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**Figure 1**

mm) thinner than the "T" package. The difference is found in the distance from the surface of the Hall cell to the branded face of the package: The active area depth. The "T" pack's active area depth is 0.036" (0.9 mm); the "U" pack's is 0.016" (0.4 mm).

Total effective air gap is the sum of active area depth and the distance between the package's surface and the magnet's surface. There is a considerable increase in flux density at the sensor provided by the thinner package. The actual gain depends on the characteristic slope of flux density for a particular magnet.

**TRANSFER CHARACTERISTICS AT  $T_A = +25^\circ\text{C}$**



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