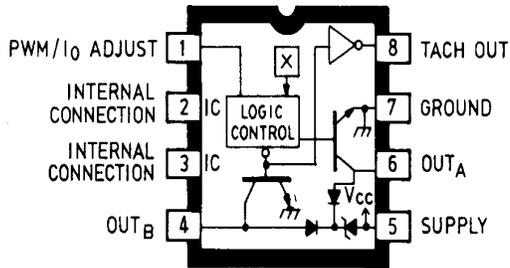


# 3625 AND 3626

## POWERHALL<sup>®</sup> SENSOR IC/DRIVERS FOR BRUSHLESS DC MOTORS



Dwg. No. PP-012

### ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $V_{CC}$ .....	See Table
Output Current, $I_O$ .....	See Table
PWM Current Control Voltage, $V_{ADJ}$ .....	See Applications
Magnetic Flux Density, $B$ .....	Unlimited
Package Power Dissipation, $P_D$ .....	See Graph
Operating Temperature Range, $T_A$ .....	-20°C to +85°C
Storage Temperature Range, $T_S$ .....	-65°C to +150°C

	UDN3625M	UDN3626M
$V_{CC(MAX)}$	14 V	26 V
$I_{O(CONT)}$	1.0 A	0.45 A
$I_{O(PEAK)}$	1.6 A	0.75 A

Output current rating will be limited by ambient temperature, supply voltage, and duty cycle. Under any set of conditions, do not exceed a junction temperature of +150°C.

Requiring a minimum of external components, the UDN3625M and UDN3626M are monolithic ICs that provide single-chip control and direct drive solutions for many small, single-phase, unipolar brushless dc motor applications. Integrated into the ICs are a high-sensitivity Hall-effect element, control and commutating logic, a stable voltage regulator, extensive self and system protective functions, and two high-current saturated npn outputs. Both ICs include thermal shutdown, output over-current limiting, and output transient protection/flyback diodes. The UDN3625M is nominally for 12 V motor applications while the UDN3626M is better suited to 24 V motors.

Output over-current limiting (relating to startup surge or a locked rotor condition) and short-circuit protection are provided by an internal current-sense resistor. The maximum (default) output load current is typically 1.3 A for the UDN3625M or 600 mA for the UDN3626M, but may be decreased by user selection of an external low-wattage resistor.

A separate low-level output provides tachometer capability for motor speed control or sensing a locked rotor condition. With appropriate external logic, pulse-width modulated (PWM) speed control can be accomplished at the output current adjust pin.

These sensor ICs/drivers are supplied in an 8-pin mini-DIP plastic package with a copper leadframe for increased package power handling capability.

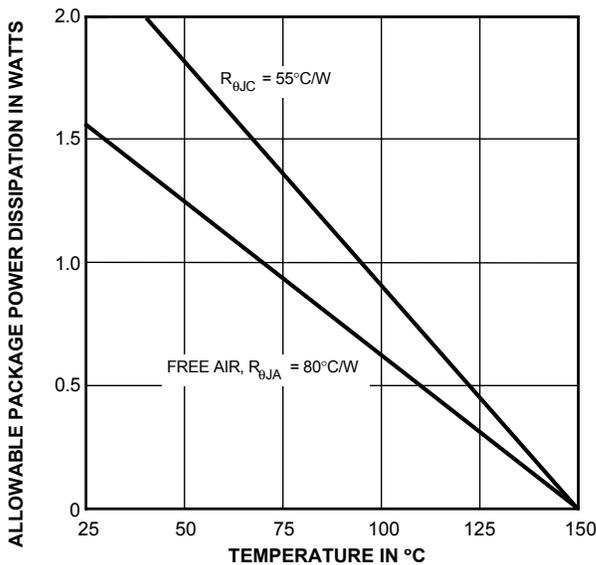
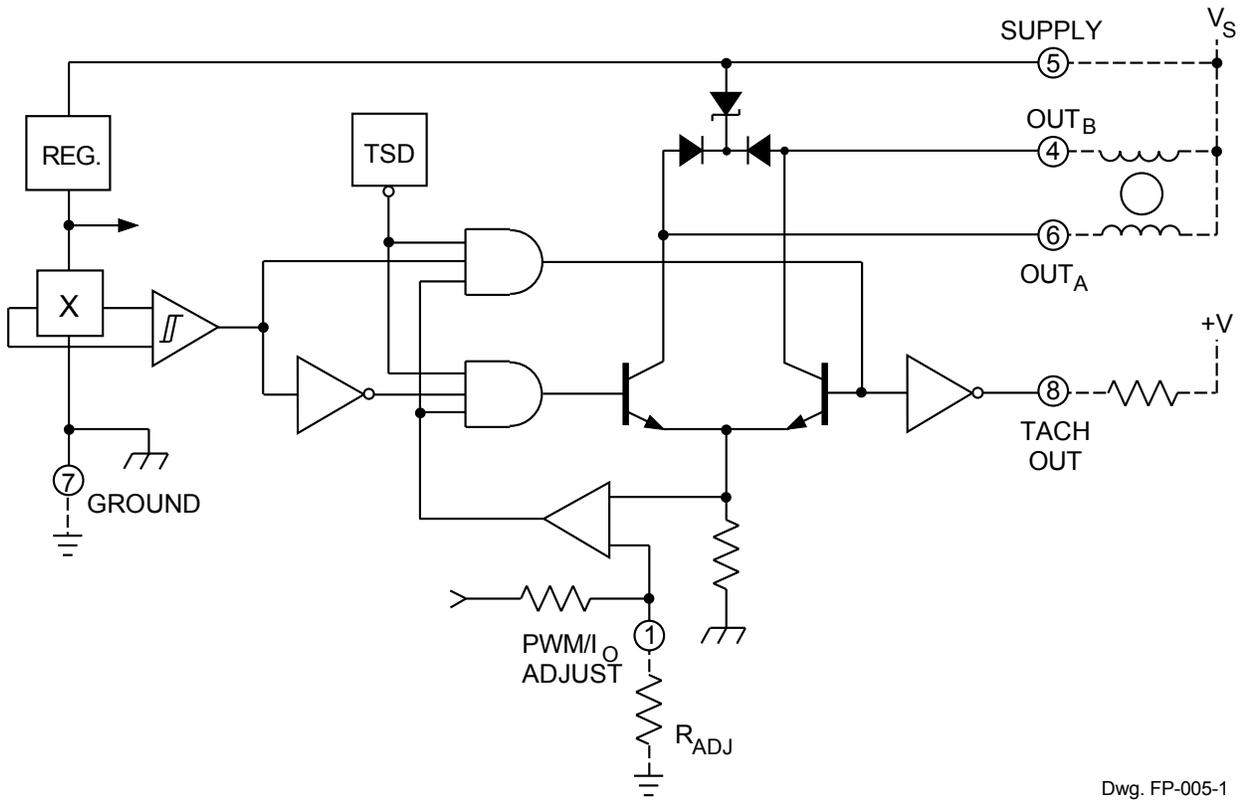
### FEATURES

- 900 mA/12 V or 400 mA/24 V Operation
- Speed-Control (PWM) Capability
- Locked-Rotor Indication
- Minimum External Components
- Over-Current Protected
- Thermal Protection
- Enhanced Reliability
- Reduced Cost

Always order by complete part number, e.g., **UDN3625M**.  
See Maximum Ratings at left.

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**SENSOR ICS/DRIVERS FOR**  
**BRUSHLESS DC MOTORS**

**FUNCTIONAL BLOCK DIAGRAM**



Dwg. GP-009-1B

**TRUTH TABLE**

Mag. Field	PWM/I <sub>O</sub> ADJ	OUT <sub>A</sub>	OUT <sub>B</sub>
> +B <sub>OP</sub>	Open	Low	High
> -B <sub>OP</sub>	Open	High	Low
Any	<0.3 V	High	High



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**ELECTRICAL CHARACTERISTICS at  $T_A = +25^\circ\text{C}$ ,  $R_{ADJ} = \infty$ , Over Operating Voltage Range (unless otherwise noted).**

Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
<b>UDN3625M</b>						
Operating Voltage Range	$V_S$		6.5	12	14	V
Output Leakage Current	$I_O$	$V_{CC} = V_O = 24\text{ V}$	—	—	100	$\mu\text{A}$
Output Breakdown Voltage	$V_{(BR)CEX}$	$V_{CC} = 24\text{ V}$ , $I_O = 10\text{ mA}^*$	34	—	—	V
Output Saturation Voltage	$V_{O(SAT)}$	$I_O = 450\text{ mA}$ , $V_S = 6.5\text{ V}$	—	0.25	0.4	V
		$I_O = 900\text{ mA}$ , $V_S = 12\text{ V}$	—	0.5	0.8	V
Output Current Limit	$I_O\text{ MAX}$	$R_{ADJ} = \infty$ , $V_O = 2\text{ V}$	1.0	1.3	1.6	A
Output Clamp Voltage (Test Fig. 1)	$V_{CL}$	$I_{CL} = 10\text{ mA}$ , $V_{CC} = 0$	11	12	13	V
		$I_{CL} = 450\text{ mA}$ , $V_{CC} = 0$	13	14	15	V
Output Switching Time	$t_{PLH}$	50% $V_{ADJ}$ to $V_O = 3.0\text{ V}$ , $I_O = 450\text{ mA}$	—	—	5.0	$\mu\text{s}$
Supply Current (Test Fig. 2)	$I_{CC}$	$R_{ADJ} = \infty$ , $V_S = 14\text{ V}$ , One Output ON	—	30	38	mA
		$R_{ADJ} = 0\ \Omega$ , $V_S = 14\text{ V}$ , Outputs OFF	—	8.0	10	mA
<b>UDN3626M</b>						
Operating Voltage Range	$V_S$		‡	24	26	V
Output Leakage Current	$I_O$	$V_{CC} = V_O = 30\text{ V}$	—	—	100	$\mu\text{A}$
Output Breakdown Voltage	$V_{(BR)CEX}$	$V_{CC} = 30\text{ V}$ , $I_O = 10\text{ mA}^*$	50	—	—	V
Output Saturation Voltage	$V_{O(SAT)}$	$I_O = 250\text{ mA}$ , $V_S = 6.5\text{ V}$	—	0.15	0.3	V
		$I_O = 400\text{ mA}$ , $V_S = 24\text{ V}$	—	0.3	0.5	V
Output Current Limit	$I_O\text{ MAX}$	$R_{ADJ} = \infty$ , $V_O = 2\text{ V}$	450	600	750	mA
Output Clamp Voltage (Test Fig. 1)	$V_{CL}$	$I_{CL} = 10\text{ mA}$ , $V_{CC} = 0$	17	18	20	V
		$I_{CL} = 250\text{ mA}$ , $V_{CC} = 0$	19	20	22	V
Output Switching Time	$t_{PLH}$	50% $V_{ADJ}$ to $V_O = 3.0\text{ V}$ , $I_O = 250\text{ mA}$	—	—	5.0	$\mu\text{s}$
Supply Current (Test Fig. 2)	$I_{CC}$	$R_{ADJ} = \infty$ , $V_S = 26\text{ V}$ , One Output ON	—	—	24	mA
		$R_{ADJ} = 0\ \Omega$ , $V_S = 26\text{ V}$ , Outputs OFF	—	8.0	10	mA

\*  $I_O$  is almost entirely Zener clamp current.

† Pulse test.

‡ Dependent on value of external series Zener diode (see Applications), 6.5 V without a Zener diode.

Continued next page...

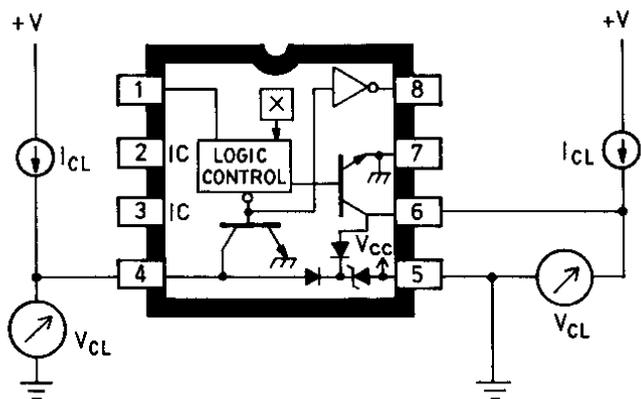
# 3625 AND 3626 POWERHALL® SENSOR ICS/DRIVERS FOR BRUSHLESS DC MOTORS

## ELECTRICAL CHARACTERISTICS continued

Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
<b>Both</b>						
Operate Point§	B <sub>OP</sub>		—	±100	±150	G
Hysteresis	B <sub>H</sub>		—	200	—	G
Output Current Limit Ratio	I <sub>O</sub> /I <sub>O</sub> MAX	R <sub>ADJ</sub> = 39 kΩ	—	0.75	—	—
		R <sub>ADJ</sub> = 17 kΩ	—	0.50	—	—
		R <sub>ADJ</sub> = 10 kΩ	—	0.25	—	—
PWM Control Current	I <sub>ADJ</sub>	V <sub>ADJ</sub> = 0	—	-350	-500	μA
Tach Output Leak. Current	I <sub>T</sub>	V <sub>T</sub> = 14 V	—	—	10	μA
Tach Output Sat. Voltage	V <sub>T(SAT)</sub>	I <sub>T</sub> = 750 μA	—	0.2	0.4	V
Thermal Shutdown	T <sub>J</sub>		—	165	—	°C
Thermal Hysteresis	ΔT <sub>J</sub>		—	10	—	°C

§ Magnetic flux density is measured at most sensitive area of device, nominally located 0.055" (1.40 mm) below the top of the package.

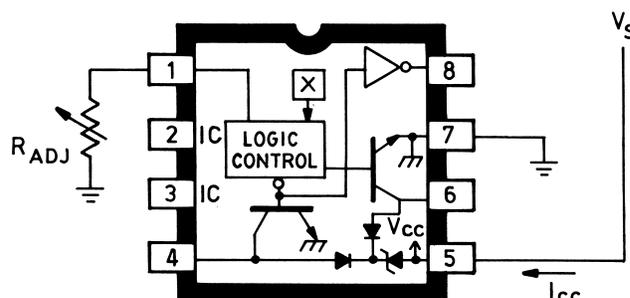
### OUTPUT CLAMP VOLTAGE TEST (ONE OUTPUT TESTED AT A TIME)



TEST FIG. 1

Dwg. EP-012

### SUPPLY CURRENT TEST

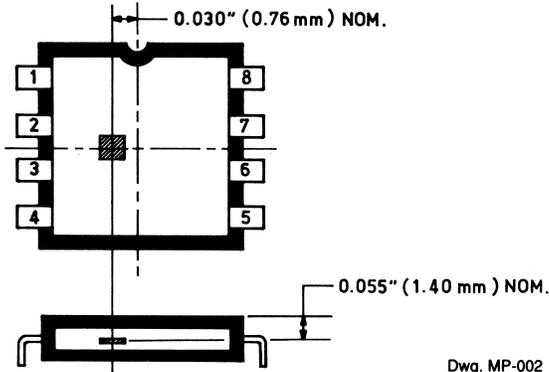


Dwg. No. EP-013

TEST FIG. 2

**3625 AND 3626**  
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**BRUSHLESS DC MOTORS**

**ELEMENT LOCATION**



**APPLICATIONS INFORMATION**

**Power Dissipation.** Care should be taken in evaluating the package power dissipation of these devices. Total power dissipated by the device will consist of power due to the internal regulator, logic and drive circuitry ( $I_{CC} \times V_{CC}$ ), power due to the output drivers ( $I_O \times V_{O(SAT)}$ ), and power due to the clamp circuitry ( $I_{CL} \times V_{CL} \times \text{duty cycle}$ ).

For example:

$$I_{CC} \times V_{CC} = 38 \text{ mA (max)} \times 14 \text{ V} = 532 \text{ mW (max)}$$

$$I_O \times V_{O(SAT)} = 450 \text{ mA} \times 0.4 \text{ V (max)} = 180 \text{ mW (max)}$$

$$I_{CL} \times V_{CL} \times \text{duty cycle} = 450 \text{ mA} \times 15 \text{ V (max)} \times 1\% = 67.5 \text{ mW (max)}$$

$$\text{Total package power dissipation} = 779.5 \text{ mW (max)}$$

Some of the power dissipated by the device ( $I_{CC} \times V_{CC}$ ) can be reduced by inserting a Zener diode in the supply line ( $Z_A$  in the figure). Note that the voltage at the  $V_{CC}$  pin under worst-case conditions must be greater than the minimum operating voltage (6.5 V).

**Transient Protection.** A note of caution concerns negative (below ground) excursions of the outputs. In application, the coupling of the two motor windings can provide for just such a case. Reducing the coupling between windings will help, but ground clamp diodes **or** diodes in series with the motor windings might be required ( $D_C$  **or**  $D_S$  in the figure). Most small brushless motors will not require these diodes.

System requirements usually utilize a diode type of reverse-polarity protection. If series diode protection is used with an inductive load (the usual fan application), a Zener clamp between  $V_S$  and ground ( $Z_B$  in the figure) is required. The Zener voltage must be greater than the supply voltage but less than the rated maximum allowable supply voltage.

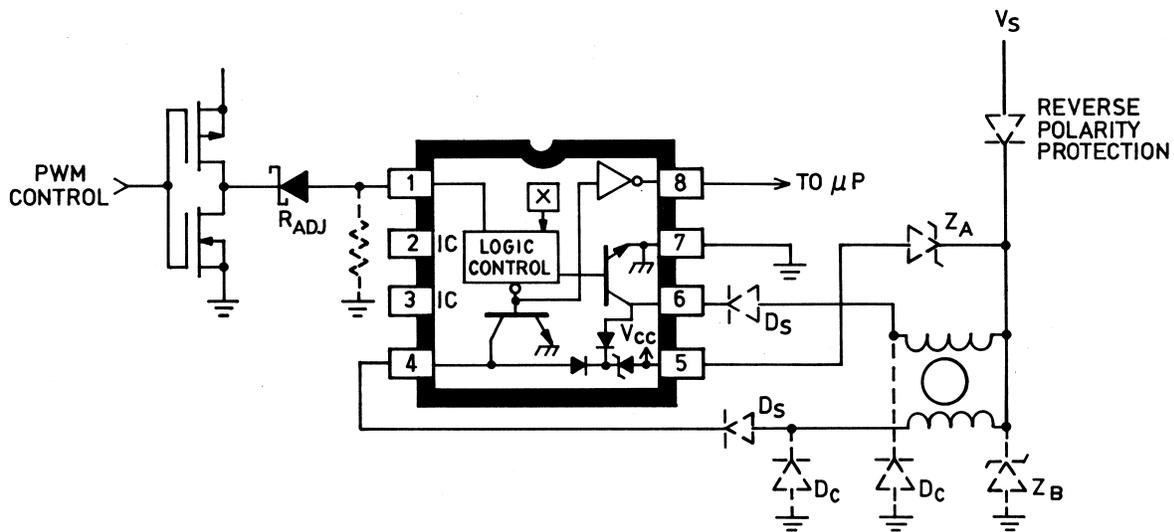
With diode reverse-polarity protection, a high-impedance supply, or a switched supply line, high-voltage spikes will be generated (especially with high-current or high-inductance loads) during normal operation, coasting, or immediately after turn-off. In these situations, a Zener clamp ( $Z_B$ ) from  $V_S$  to ground will be required.

**Over-Current Adjust Pin.** The over-current limit may be reduced from the default value ( $I_O \text{ MAX}$ ) by selection of an external resistor ( $R_{ADJ}$ ) at the PWM/ $I_O$  ADJ pin.

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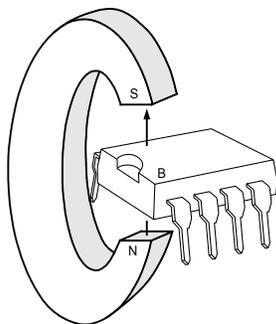
The external overcurrent adjust and the thermal shutdown are commoned at the PWM/I<sub>O</sub> ADJ pin and tying it to V<sub>CC</sub> will disable the thermal shut-down. PWM current/speed control can be performed at the PWM/I<sub>O</sub> ADJ pin from a standard totem-pole logic output with a series Schottky diode (1N5818, 1N5819, or equivalent) or by pulling it low through an open-collector transistor (no pull-up resistor). PWM/I<sub>O</sub> ADJ input voltages greater than 0.3 V are not recommended and may create an unstable operating condition.

**TYPICAL FAN APPLICATION**

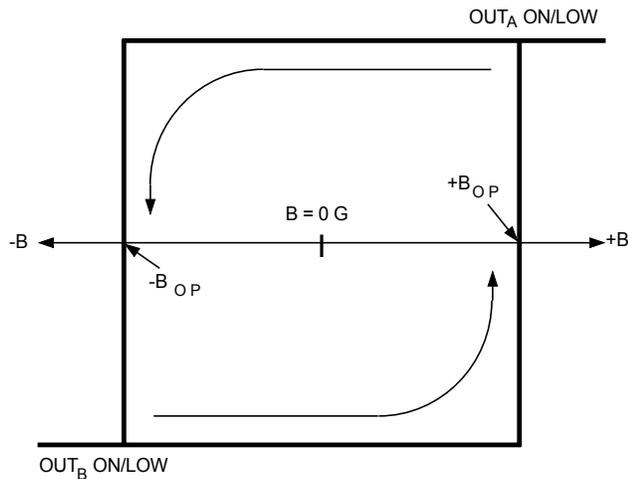


Dwg. EP-014

**MAGNETIC FIELD DEFINITIONS**



Dwg. AP-001-1

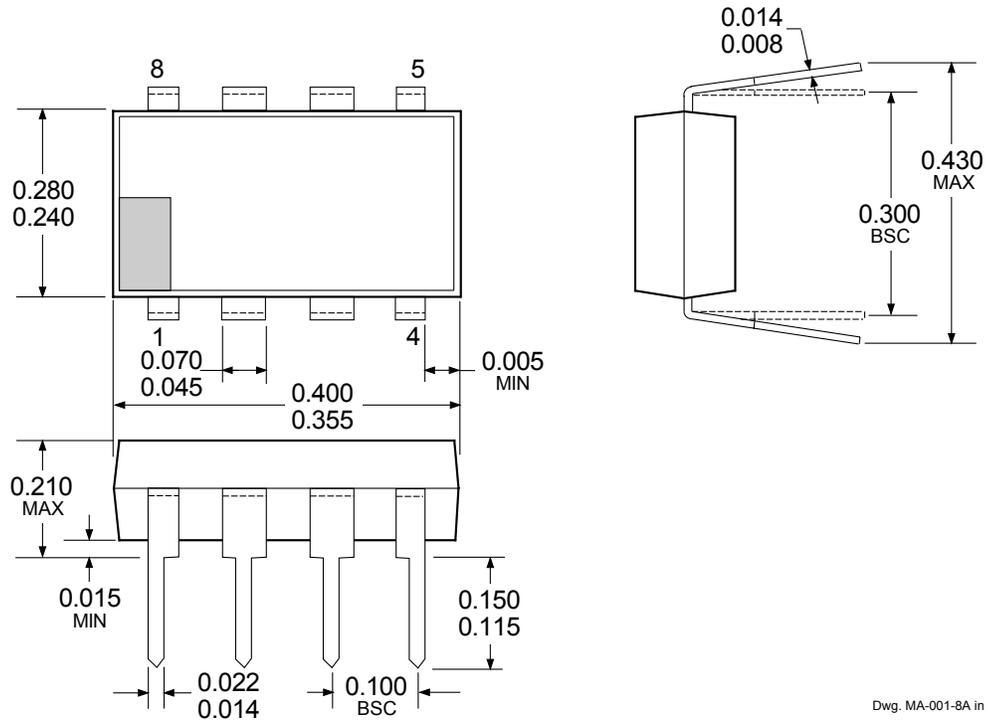


Dwg. GP-008

By accepted magnetic convention, lines of flux emanate from the north pole of a magnet and enter the south pole.

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**Dimensions in Inches**  
 (controlling dimensions)

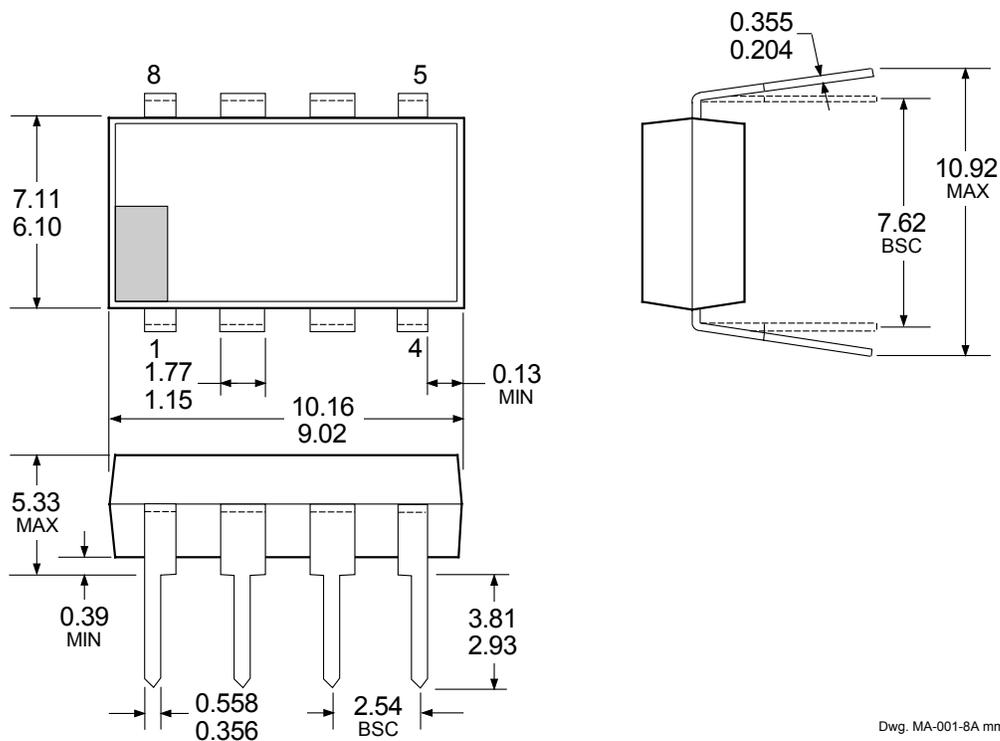


Dwg. MA-001-8A in

- NOTES: 1. Leads 1, 4, 5, and 8 may be half leads at vendor's option.  
 2. Lead thickness is measured at seating plane or below.  
 3. Lead spacing tolerance is non-cumulative.  
 4. Exact body and lead configuration at vendor's option within limits shown.

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



- NOTES: 1. Leads 1, 4, 5, and 8 may be half leads at vendor's option.  
 2. Lead thickness is measured at seating plane or below.  
 3. Lead spacing tolerance is non-cumulative.  
 4. Exact body and lead configuration at vendor's option within limits shown.

*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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