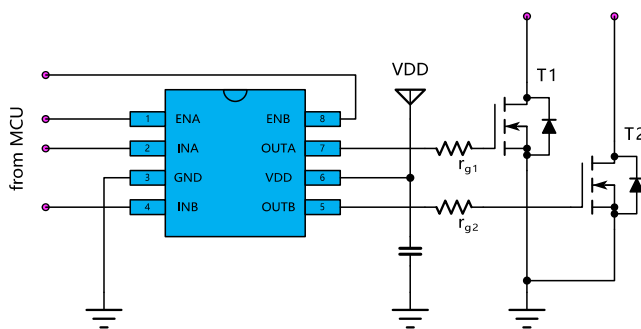


### FEATURES

- Typical 5-A peak source and sink drive current for each channel
- Input and enable pins capable of handling -12 V
- Output capable of handling -2 V transients
- Absolute maximum VDD voltage: 35 V
- Wide VDD operating range from 4.5 V to 30 V with UVLO
- Two independent gate drive channels
- Independent enable function for each output
- Hysteretic-logic thresholds for high noise immunity
- VDD independent input thresholds (TTL compatible)
- Fast propagation delays (22-ns typical)
- Fast rise and fall times (6-ns and 9-ns typical)
- 1-ns typical delay matching between the two channels
- Two channels can be paralleled for higher drive current
- SOP-8L and DFN2X2-8L package options
- Operating junction temperature range of -40 °C to 150 °C

### APPLICATIONS

- Switch-mode power-supplies (SMPS)
- Power factor correction (PFC) circuits
- DC-DC converter
- Motor drives
- Solar power supplies
- Pulse transformer driver



Typical Application Circuit

### GENERAL DESCRIPTION

The HP3000 is a dual-channel, high-speed, low-side gate driver that effectively drives MOSFET, IGBT, SiC, and GaN power switches. It has a typical peak drive strength of 5 A which reduces rise and fall times of the power switches, lowers switching losses, and increases efficiency. The fast propagation delay (22-ns typical) yields better power stage efficiency by improving the dead time optimization, pulse width utilization, control loop response, and transient performance of the system.

HP3000 can handle -12 V at its inputs, which improves robustness in systems with moderate ground bouncing. The inputs are independent of supply voltage and can be connected to most controller outputs for maximum control flexibility. An independent enable signal allows the power stage to be controlled independently of main control logic. In the event of a system fault, the gate driver can quickly shut-off by pulling enable low. Many high-frequency switching power supplies exhibit noise at the gate of the power device, which can get injected into the output pin on the gate driver and can cause the driver to malfunction. The HP3000's transient reverse current and reverse voltage capability allow it to tolerate noise on the gate of the power device or pulse-transformer and avoid driver malfunction.

The HP3000 also features under voltage lockout (UVLO) for improved system robustness. When there is not enough bias voltage to fully enhance the power device, the gate driver output is held low by the strong internal pull down MOSFET.

### Device Information

PART NUMBER	PACKAGE	BODY SIZE
HP3000	SOP-8L	4.90 mm × 3.90 mm
HP3000	DFN2X2-8L	2.00 mm × 2.00 mm

- (1) For all available packages, see the orderable addendum at the end of the data sheet.

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REVISION HISTORY

Version	Date	Owner	Descriptions
Rev. 1.0	11/2023	Bin.Yang	Initial version

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

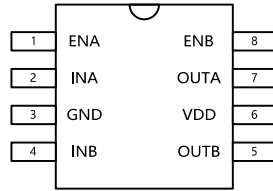


Figure 1 8-Pin SOP-8L Configuration

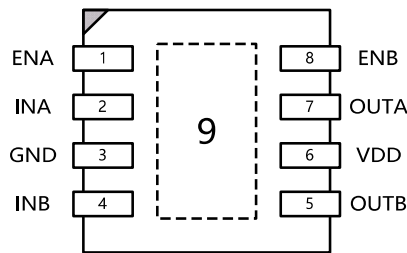


Figure 4 8-pin DFN-8L Configuration

**Table 1. Pin Function Descriptions for HP3000-SO8/VO8**

No.	Name	Type <sup>1</sup>	Primary Function
1	ENA	I	Enable input for Channel A. Biasing ENA, LOW will disable Channel A output regardless of the state of INA. Pulling ENA, HIGH enables the Channel A output. If ENA is left floating, Channel A is enabled by default due to an internal pull-up resistor. It is recommended to connect this pin to VDD if unused.
2	INA	I	Input to Channel A. INA is the non-inverting input of the HP3000 device. OUTA is held LOW if INA is unbiased or floating by default due to an internal pulldown resistor. Connect this pin to GND if unused.
3	GND	-	Ground: All signals are referenced to this pin.
4	INB	I	Input to Channel B. INB is the non-inverting input of the HP3000 device. OUTB is held LOW if INB is unbiased or floating by default due to an internal pulldown resistor. Connect this pin to GND if unused.
5	OUTB	O	Channel B Output
6	VDD	I	Bias supply input. Bypass this pin with two ceramic capacitors, generally $\geq 1 \mu\text{F}$ and $0.1 \mu\text{F}$ , which are referenced to GND pin of this device.
7	OUTA	O	Channel A Output
8	ENB	I	Enable input for Channel B. Biasing ENB, LOW will disable Channel B output regardless of the state of INB. Pulling ENB, HIGH enables the Channel B output. If ENB is left floating, Channel B is enabled by default due to an internal pull-up resistor. It is recommended to connect this pin to VDD if unused.
9	Thermal Pad	-	Connect to GND through large copper plane. This pad is not a low-impedance path to GND

1. I = Input; O = Output

## SPECIFICATIONS

$V_{DD} = 12.0\text{ V}$ ,  $T_J = -40^\circ\text{C}$  to  $+150^\circ\text{C}$ , 1- $\mu\text{F}$  capacitor from  $V_{DD}$  to GND, no load on the output, for minimum and maximum specifications, and  $T_A = 25^\circ\text{C}$  for typical specifications, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>POWER SUPPLY</b>						
Operating Supply Voltage	$V_{DD}$		4.5	12	30	V
$V_{DD}$ quiescent supply current	$I_{DD\_Q}$	$V_{INx} = 3.3\text{ V}$ , $V_{DD} = 3.4\text{ V}$ , $ENx = V_{DD}$		260	500	$\mu\text{A}$
$V_{DD}$ static supply current	$I_{DD}$	$V_{INx} = 3.3\text{ V}$ , $ENx = V_{DD}$		0.4	0.8	mA
$V_{DD}$ operating current	$I_{DDO}$	$V_{INx} = 0.0\text{ V}$ , $ENx = V_{DD}$		0.35	0.7	mA
		$f_{sw} = 1000\text{ kHz}$ , $V_{INx} = 0.0\text{ V}$ to $3.3\text{ V}$ PWM, $ENx = V_{DD}$		3.6	4.2	mA
Shutdown current	$I_{DD\_SD}$	$V_{INx} = 3.3\text{ V}$ , $ENx = 0\text{ V}$		0.5	0.9	mA
<b>UNDER VOLTAGE LOCKOUT (UVLO)</b>						
$V_{DD}$ UVLO rising threshold	$V_{DD\_ON}$		3.8	4.1	4.4	V
$V_{DD}$ UVLO falling threshold	$V_{DD\_OFF}$		3.5	3.8	4.1	V
$V_{DD}$ UVLO hysteresis	$V_{DD\_HYST}$			0.3		V
<b>INPUT (INA, INB)</b>						
Input signal high threshold	$V_{INx\_H}$	Output High, $ENx = \text{HIGH}$	1.8	2	2.2	V
Input signal low threshold	$V_{INx\_L}$	Output Low, $ENx = \text{HIGH}$	0.8	1	1.2	V
Input signal hysteresis	$V_{INx\_HYST}$			1		V
Input pin pulldown resistor	$R_{INx}$	$INx = 3.3\text{ V}$		120		k $\Omega$
<b>ENABLE (ENA, ENB)</b>						
Enable signal high threshold	$V_{ENx\_H}$	Output High, $INx = \text{HIGH}$	1.8	2	2.2	V
Enable signal low threshold	$V_{ENx\_L}$	Output Low, $INx = \text{HIGH}$	0.8	1	1.2	V
Enable signal hysteresis	$V_{ENx\_HYST}$			1		V
Enable pin pull-up resistor	$R_{ENx}$	$ENx = 0\text{ V}$		200		k $\Omega$
<b>OUTPUTS (OUTA, OUTB)</b>						
Peak output source current	$I_{SRC}$	$V_{DD} = 12\text{ V}$ , $C_{VDD} = 10\text{ }\mu\text{F}$ , $C_L = 0.1\text{ }\mu\text{F}$ , $f = 1\text{ kHz}$		5		A
Peak output sink current	$I_{SNK}$	$V_{DD} = 12\text{ V}$ , $C_{VDD} = 10\text{ }\mu\text{F}$ , $C_L = 0.1\text{ }\mu\text{F}$ , $f = 1\text{ kHz}$		5		A
Pullup resistance	$R_{CH}$	$I_{OUT} = -50\text{ mA}$		0.8	1.32	$\Omega$
Pulldown resistance	$R_{CL}$	$I_{OUT} = 50\text{ mA}$		0.6	1.15	$\Omega$
<b>Switching Characteristics</b>						
Rise time	$t_{Rx}$	$C_{LOAD} = 1.8\text{ nF}$ , 20% to 80%, $V_{in} = 0\text{ V}$ to $3.3\text{ V}$		7	13	ns
Fall time	$t_{Fx}$	$C_{LOAD} = 1.8\text{ nF}$ , 80% to 20%, $V_{in} = 0\text{ V}$ to $3.3\text{ V}$		9	15	ns
Turn-on propagation delay	$t_{D1x}$	$C_{LOAD} = 1.8\text{ nF}$ , $V_{INx\_H}$ of the input rise to 10% of output rise, $V_{in} = 0\text{ V}$ to $3.3\text{ V}$ , $F_{sw} = 500\text{ kHz}$ , 50% duty cycle, $T_J = 125^\circ\text{C}$		22	32	ns
Turn-off propagation delay	$t_{D2x}$	$C_{LOAD} = 1.8\text{ nF}$ , $V_{INx\_L}$ of the input fall to 90% of output fall, $V_{in} = 0\text{ V}$		22	32	ns

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Enable propagation delay	$t_{D3x}$	to 3.3 V, $F_{sw} = 500$ kHz, 50% duty cycle, $T_J = 125^\circ\text{C}$ $C_{LOAD} = 1.8$ nF, $V_{ENx\_H}$ of the enable rise to 10% of output rise, $V_{in} = 0$ V to 3.3 V, $F_{sw} = 500$ kHz, 50% duty cycle, $T_J = 125^\circ\text{C}$		22	32	ns
Disable propagation delay	$t_{D4x}$	$C_{LOAD} = 1.8$ nF, $V_{ENx\_L}$ of the enable fall to 10% of output fall, $V_{in} = 0$ V to 3.3 V, $F_{sw} = 500$ kHz, 50% duty cycle, $T_J = 125^\circ\text{C}$		22	32	ns
Delay matching between two channels	$t_M$	$C_{LOAD} = 1.8$ nF, $V_{in} = 0$ V to 3.3 V, $F_{sw} = 500$ kHz, 50% duty cycle, $INA = INB$ , $ t_{RA} - t_{RB} $ , $ t_{FA} - t_{FB} $		1	2	ns
Minimum input pulse width	$t_{PWmin}$	$C_L = 1.8$ nF, $V_{in} = 0$ V to 3.3 V, $F_{sw} = 500$ kHz, $V_o > 1.5$ V		10	15	ns

## ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply voltage, VDD (Continuous)	35 V
Output voltage, OUTA, OUTB (DC)	-0.3 V to V <sub>DD</sub> + 0.3 V
Output voltage, OUTA, OUTB (200ns Pulse)	-2 V to V <sub>DD</sub> + 3 V
Input voltage INA, INB, ENA, ENB	-12 V to 35 V
Operating temperature range (junction)	-40°C to +150°C
Soldering conditions	JEDEC J-STD-020
<b>Electrostatic Discharge (ESD)</b>	
Human body model	2000 V
Charged device model	1000 V

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

## THERMAL RESISTANCE

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Close attention to PCB thermal design is required.

$\theta_{JA}$  is the natural convection junction to ambient thermal resistance measured in a one cubic foot sealed enclosure.

$\theta_{JC}$  is the junction to case thermal resistance.

Table 4. Thermal Resistance

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
8-lead SOP	133.9	59.7	°C/W
8-lead DFN2x2-8L	92	74.5	°C/W

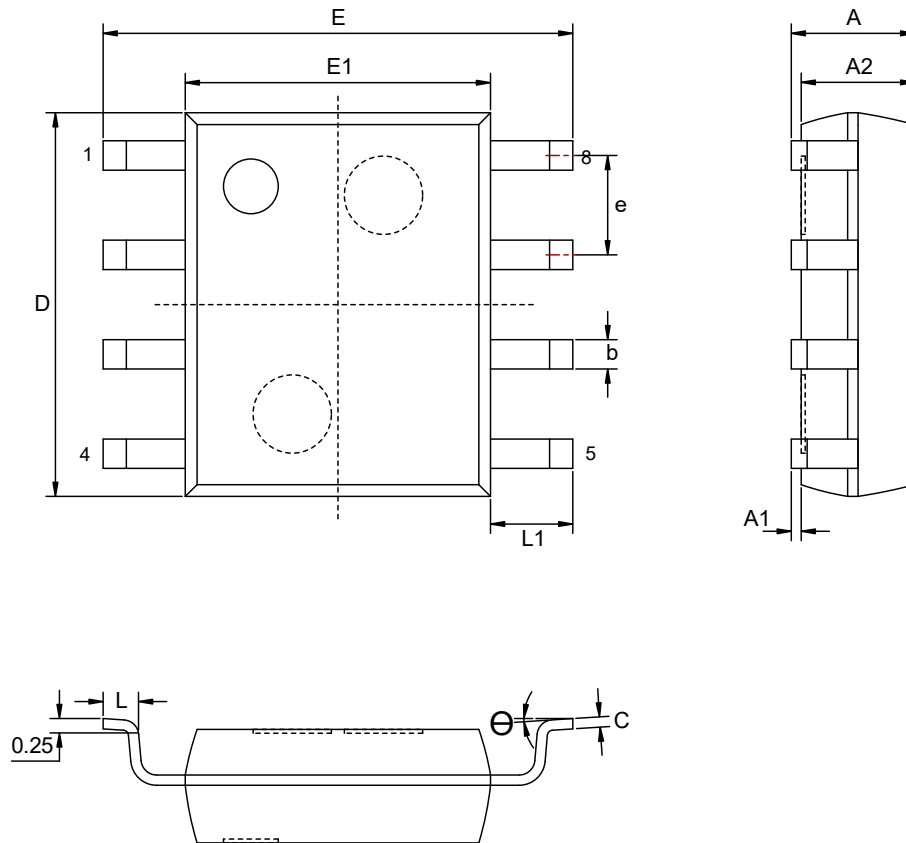
## ESD CAUTION



### Electrostatic Discharge Sensitive Device.

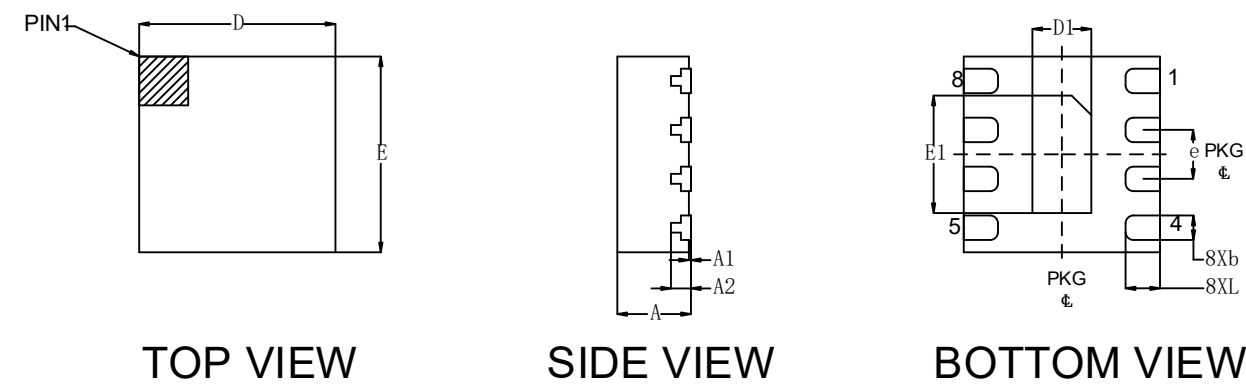
Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## PACKAGE OUTLINE DIMENSIONS



SYMBOLS	DIMENSION IN MILLIMETERS		
	MIN	NOM	MAX
A	-	-	1.75
A1	0.10	-	0.25
A2	1.35	1.45	1.55
b	0.30	-	0.51
C	0.17	-	0.25
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.40	-	1.27
θ	0°	-	8°

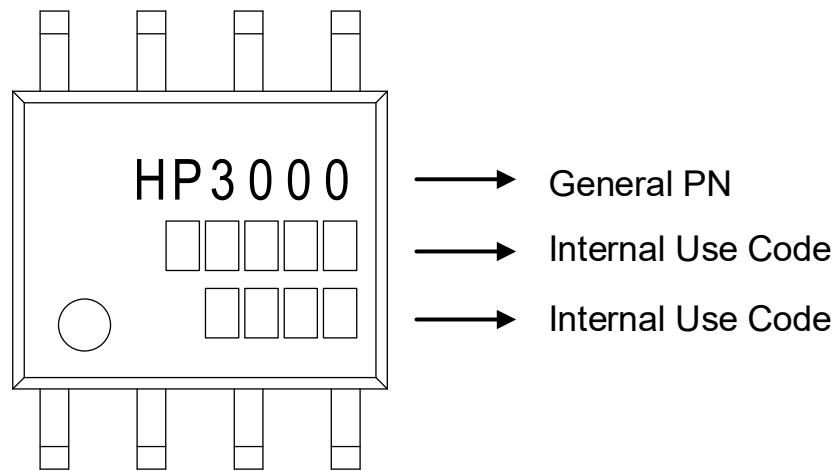
Figure 2. HP3000-SOP8L Package



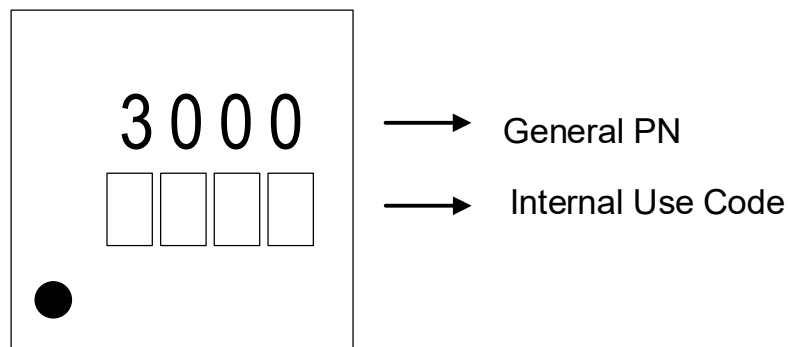
	DIMENSION IN MILLIMETERS		
SYMBOLS	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A2	0.203 REF		
b	0.20	0.25	0.30
D	2 BSC		
E	2 BSC		
e	0.5 BSC		
L	0.30	0.35	0.40
D1	0.55	0.60	0.65
E1	1.15	1.20	1.25

Figure 3 HP3000- DFN2X2-8L Package



**PACKAGE TOP MARKING**

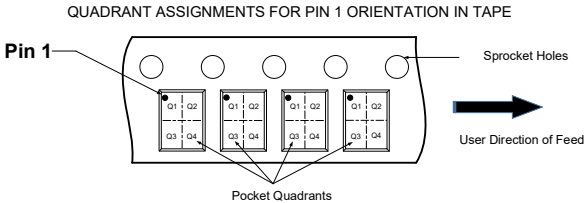
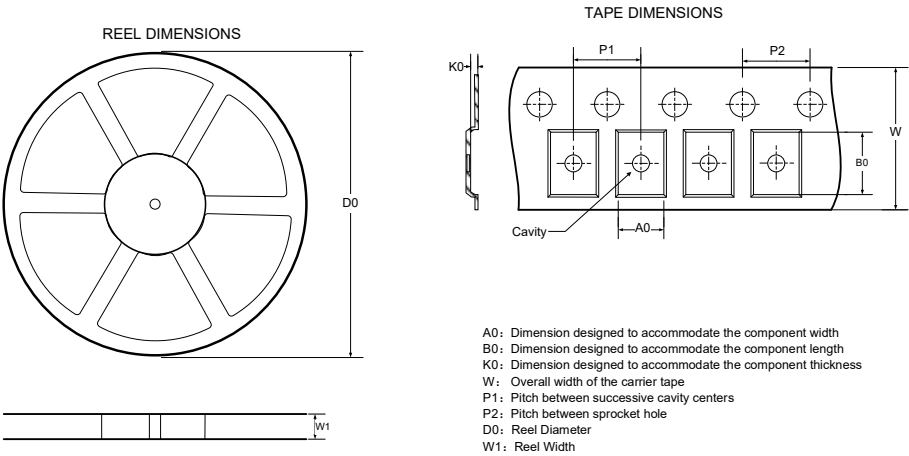
SOP 8L

*Figure 4 HP3000 SOP-8L Package Top Marking*

DFN2X2-8L

*Figure 5 HP3000 DFN2x2-8L Package Top Marking*

ORDERING GUIDE



DIMENSIONS AND PIN1 ORIENTATION

Device	Package Type	D0 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant	Quantity
HP3000-AAXXX-SP08R	SOP8L	330.00	12.40	6.40	5.40	2.10	8.00	4.00	12.00	Q1	4000
HP3000-ADXXX-HD08R	DFN2X2-8L	180.00	9.50	2.30	2.30	1.10	4.00	4.00	8.00	Q2	4000

All dimensions are nominal

Device ID	Package Type	Tj Temp (°C)	MSL	Package Option	Package Qty
HP3000-AA000-SP08R	SOP8L	-40~150		T&R	4000ea
HP3000-AD000-HD08R	DFN2X2-8L	-40~150		T&R	4000ea

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