

## 100V/1A Peak, Low Cost, High Frequency Half Bridge Driver

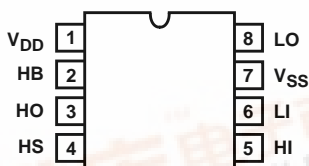
The HIP2106 is a high frequency, 100V Half Bridge N-Channel MOSFET driver IC, available in 8 lead plastic SOIC. The low-side and high-side gate drivers are independently controlled and matched to 8ns. This gives the user maximum flexibility in dead-time selection and driver protocol. Undervoltage protection on both the low-side and high-side supplies force the outputs low. An on-chip diode eliminates the discrete diode required with other driver ICs. A new levelshifter topology yields the low-power benefits of pulsed operation with the safety of DC operation. Unlike some competitors, the high-side output returns to its correct state after a momentary undervoltage of the high-side supply.

### Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
HIP2106IB	-40 to 85	8 Ld SOIC	M8.15
HIP2106IP	-40 to 85	8 Ld PDIP	E8.3

### Pinout

HIP2106 (SOIC, PDIP)  
TOP VIEW



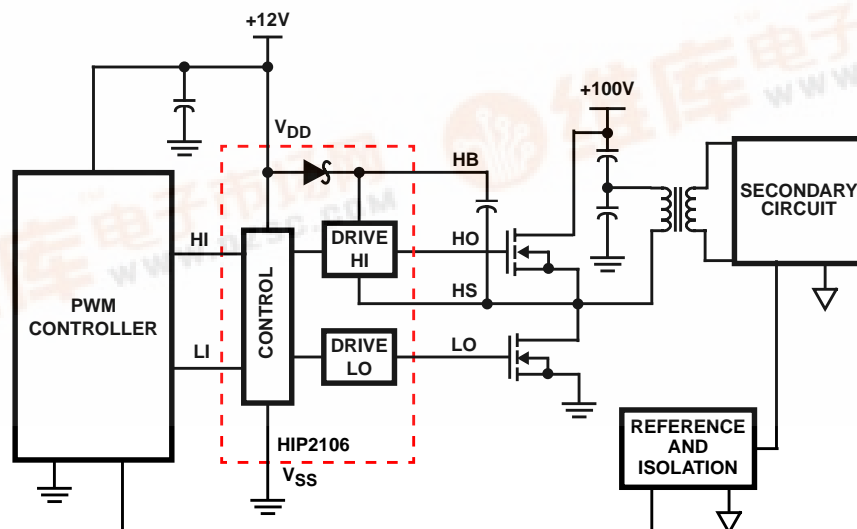
### Features

- Drives N-Channel MOSFET Half Bridge
- Space Saving SO8 Package
- Bootstrap Supply Max Voltage to 116V<sub>DC</sub>
- On-Chip 1Ω Bootstrap Diode
- Fast Propagation Times Needed for Multi-MHz Circuits
- Drives 1000pF Load at 500kHz with Rise and Fall Times of Typically 20ns
- CMOS Input Thresholds for Improved Noise Immunity
- Independent Inputs for Non-Half Bridge Topologies
- No Start-Up Problems
- Outputs Unaffected by Supply Glitches, HS Ringing Below Ground, or HS Slewing at High dv/dt
- Low Power Consumption
- Wide Supply Range
- Supply Undervoltage Protection
- 3Ω Output Resistance

### Applications

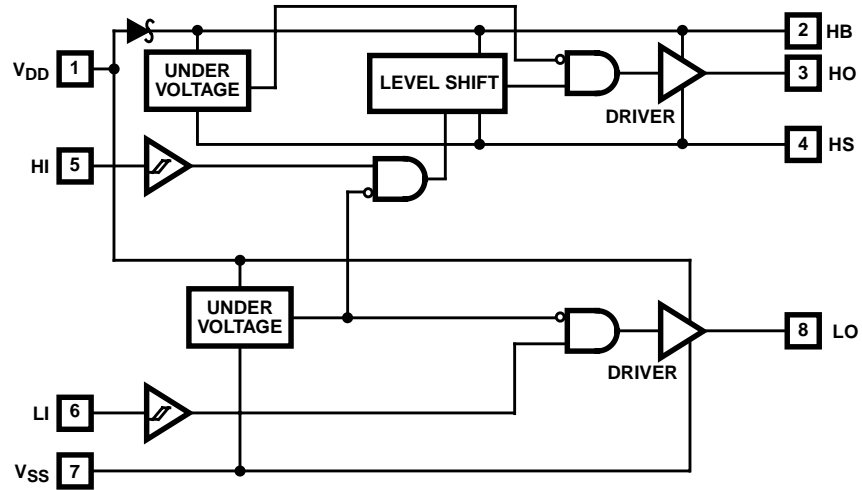
- Telecom Half Bridge Power Supplies
- Avionic DC-DC Converters
- Two-Switch Forward Converters
- Active Clamp Forward Converters

### Application Block Diagram



# HIP2106

## Functional Block Diagram



## Other Applications

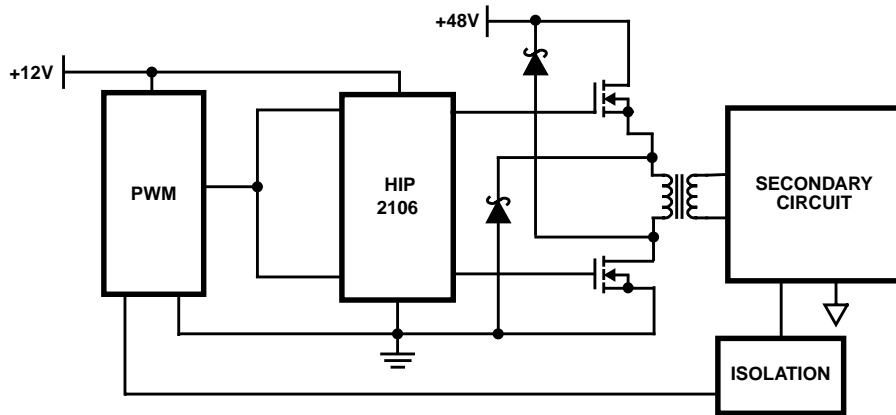


FIGURE 1. TWO-SWITCH FORWARD CONVERTER

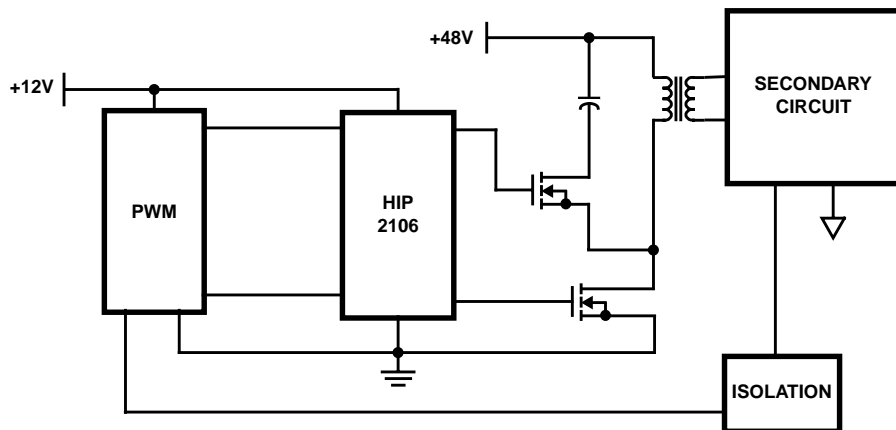


FIGURE 2. FORWARD CONVERTER WITH AN ACTIVE CLAMP

# HIP2106

## Absolute Maximum Ratings

Supply Voltage, $V_{DD}$ , $V_{HB}$ - $V_{HS}$	-0.3V to 18V
LI and HI Voltages	-3V to $V_{DD} + 0.3V$
Voltage on LO	-0.3V to $V_{DD} + 0.3V$
Voltage on HO	$V_{HS} - 0.3V$ to $V_{HB} + 0.3V$
Voltage on HS (Continuous)	-1V to 110V
Voltage on HB	+118V
Average Current in $V_{DD}$ to HB Diode	100mA
ESD Classification	Class 1 (1kV)

## Thermal Information

Thermal Resistance (Typical, Note 1)	$\theta_{JA}$ (°C/W)
SOIC Package	160
PDIP Package	100
HS Slew Rate	10V/ns
Maximum Power Dissipation at 25°C in Free Air	780mW
Maximum Storage Temperature Range	-65°C to 150°C
Maximum Junction Temperature Range	-55°C to 150°C
Maximum Lead Temperature (Soldering 10s)	300°C (Lead Tips Only)

## Recommended Operating Conditions

Supply Voltage, $V_{DD}$	+9V to +16.5V
Voltage on HS	-1V to 100V

Voltage on HS	(Repetitive Transient) -5V to 105V
Voltage on HB	$V_{HS} + 8V$ to $V_{HS} + 16.5V$ and $V_{DD} - 1V$ to $V_{DD} + 100V$

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### NOTES:

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.
- All Voltages Relative to Pin 4,  $V_{SS}$  Unless Otherwise Specified.

Electrical Specifications  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	$T_J = 25^\circ C$			$T_J = -40^\circ C$ TO $125^\circ C$		UNITS
			MIN	TYP	MAX	MIN	MAX	
<b>SUPPLY CURRENTS</b>								
$V_{DD}$ Quiescent Current	$I_{DD}$	LI = HI = 0V	-	0.1	0.15	-	0.2	mA
$V_{DD}$ Operating Current	$I_{DDO}$	f = 500kHz	-	1.5	2.5	-	3	mA
Total HB Quiescent Current	$I_{HB}$	LI = HI = 0V	-	0.1	0.15	-	0.2	mA
Total HB Operating Current	$I_{HBO}$	f = 500kHz	-	1.5	2.5	-	3	mA
HB to $V_{SS}$ Current, Quiescent	$I_{HBS}$	$V_{HS} = V_{HB} = 116.5V$	-	0.05	1	-	10	$\mu A$
HB to $V_{SS}$ Current, Operating	$I_{HBSO}$	f = 500kHz	-	0.7	-	-	-	mA
<b>INPUT PINS</b>								
Low Level Input Voltage Threshold	$V_{IL}$		4	5.4	-	3	-	V
High Level Input Voltage Threshold	$V_{IH}$		-	5.8	8	-	9	V
Input Voltage Hysteresis	$V_{IHYS}$		-	0.4	-	-	-	V
Input Pulldown Resistance	$R_I$		-	200	-	100	500	k $\Omega$
<b>UNDER VOLTAGE PROTECTION</b>								
$V_{DD}$ Rising Threshold	$V_{DDR}$		7	7.3	8	6.5	8.5	V
$V_{DD}$ Threshold Hysteresis	$V_{DDH}$		-	0.5	-	-	-	V
HB Rising Threshold	$V_{HBR}$		6.5	6.9	7.5	6	8	V
HB Threshold Hysteresis	$V_{HBH}$		-	0.4	-	-	-	V
<b>BOOT STRAP DIODE</b>								
Low-Current Forward Voltage	$V_{DL}$	$I_{V_{DD}-HB} = 100\mu A$	-	0.45	0.55	-	0.7	V
High-Current Forward Voltage	$V_{DH}$	$I_{V_{DD}-HB} = 100mA$	-	0.7	0.8	-	1	V
Dynamic Resistance	$R_D$	$I_{V_{DD}-HB} = 100mA$	-	0.8	1	-	1.5	$\Omega$
<b>LO GATE DRIVER</b>								
Low Level Output Voltage	$V_{OLL}$	$I_{LO} = 100mA$	-	0.25	0.3	-	0.4	V
High Level Output Voltage	$V_{OHL}$	$I_{LO} = -100mA$ , $V_{OHL} = V_{DD} - V_{LO}$	-	0.25	0.3	-	0.4	V
Peak Pullup Current	$I_{OHL}$	$V_{LO} = 0V$	-	1	-	-	-	A
Peak Pulldown Current	$I_{OLL}$	$V_{LO} = 12V$	-	1	-	-	-	A
<b>HO GATE DRIVER</b>								
Low Level Output Voltage	$V_{OLH}$	$I_{HO} = 100mA$	-	0.25	0.3	-	0.4	V
High Level Output Voltage	$V_{OHH}$	$I_{HO} = -100mA$ , $V_{OHH} = V_{HB} - V_{HO}$	-	0.25	0.3	-	0.4	V
Peak Pullup Current	$I_{OHH}$	$V_{HO} = 0V$	-	1	-	-	-	A

# HIP2106

Electrical Specifications  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, Unless Otherwise Specified (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	$T_J = 25^\circ C$			$T_J = -40^\circ C$ TO $125^\circ C$		UNITS
			MIN	TYP	MAX	MIN	MAX	
Peak Pulldown Current	$I_{OLH}$	$V_{HO} = 12V$	-	1	-	-	-	A

Switching Specifications  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	$T_J = 25^\circ C$			$T_J = -40^\circ C$ TO $125^\circ C$		UNITS
			MIN	TYP	MAX	MIN	MAX	
Lower Turn-Off Propagation Delay (LI Falling to LO Falling)	$t_{LPHL}$		-	40	70	-	90	ns
Upper Turn-Off Propagation Delay (HI Falling to HO Falling)	$t_{HPLH}$		-	40	70	-	90	ns
Lower Turn-On Propagation Delay (LI Rising to LO Rising)	$t_{LPLH}$		-	40	70	-	90	ns
Upper Turn-On Propagation Delay (HI Rising to HO Rising)	$t_{HPLH}$		-	40	70	-	90	ns
Delay Matching: Lower Turn-On and Upper Turn-Off	$t_{MON}$		-	4	16	-	20	ns
Delay Matching: Lower Turn-Off and Upper Turn-On	$t_{MOFF}$		-	4	16	-	20	ns
Either Output Rise/Fall Time	$t_{RC}, t_{FC}$	$C_L = 1000pF$	-	20	-	-	-	ns
Either Output Rise/Fall Time (3V to 9V)	$t_R, t_F$	$C_L = 0.1\mu F$	-	1.0	1.2	-	1.6	us
Either Output Rise Time Driving DMOS	$t_{RD}$	$C_L = IRFR120$	-	40	-	-	-	ns
Either Output Fall Time Driving DMOS	$t_{FD}$	$C_L = IRFR120$	-	20	-	-	-	ns
Minimum Input Pulse Width that Changes the Output	$t_{PW}$		-	-	-	-	100	ns
Bootstrap Diode Turn-On or Turn-Off Time	$t_{BS}$		-	20	-	-	-	ns

## Pin Descriptions

PIN NUMBER	SYMBOL	DESCRIPTION
1	$V_{DD}$	Positive Supply to lower gate drivers. De-couple this pin to $V_{SS}$ (Pin 7). Bootstrap diode connected to HB (pin 2).
2	HB	High-Side Bootstrap supply. External bootstrap capacitor is required. Connect positive side of bootstrap capacitor to this pin. Bootstrap diode is on-chip.
3	HO	High-Side Output. Connect to gate of High-Side power MOSFET.
4	HS	High-Side Source connection. Connect to source of High-Side power MOSFET. Connect negative side of bootstrap capacitor to this pin.
5	HI	High-Side input.
6	LI	Low-Side input.
7	$V_{SS}$	Chip negative supply, generally will be ground.
8	LO	Low-Side Output. Connect to gate of Low-Side power MOSFET.

## Timing Diagrams

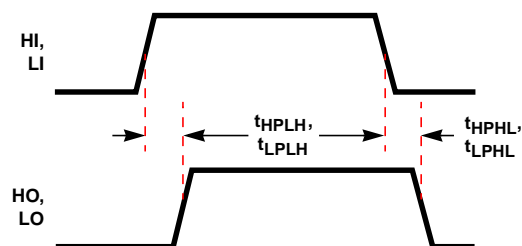


FIGURE 3.

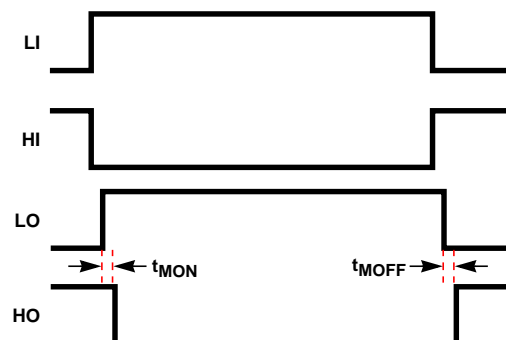


FIGURE 4.

Typical Performance Curves

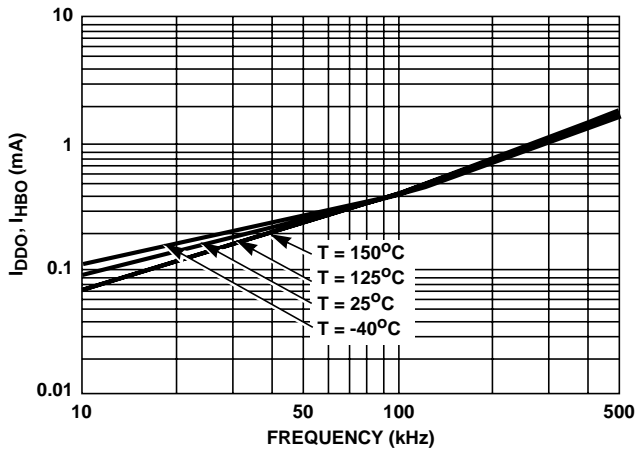


FIGURE 5. OPERATING CURRENT vs FREQUENCY

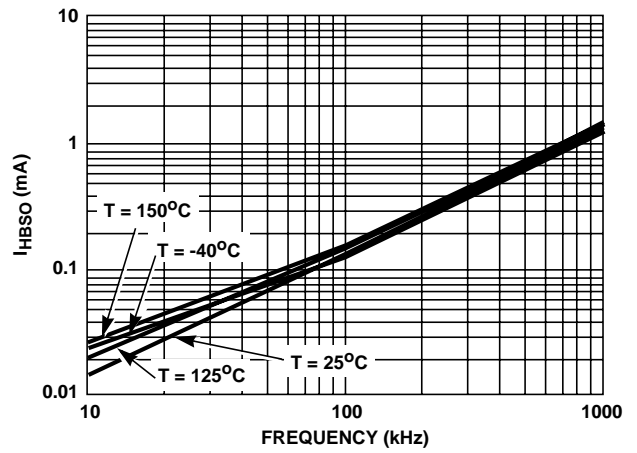


FIGURE 6. LEVEL SHIFTER CURRENT vs FREQUENCY

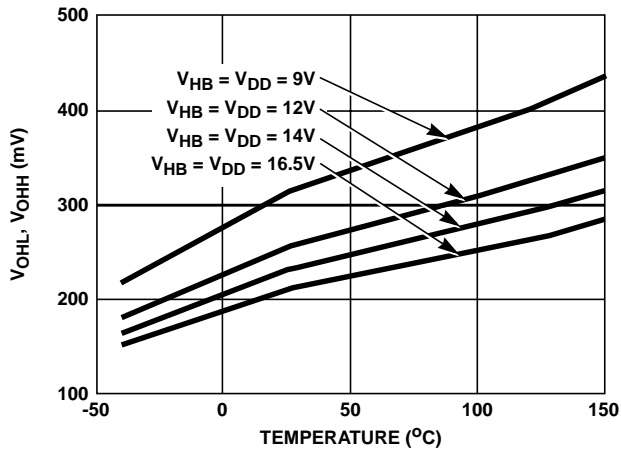


FIGURE 7. HIGH LEVEL OUTPUT VOLTAGE vs TEMPERATURE

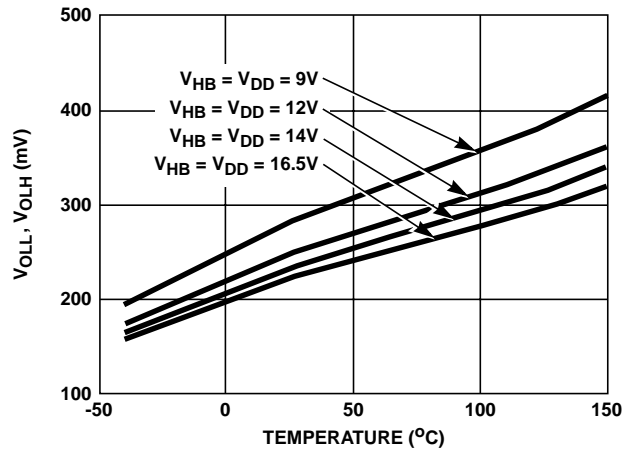


FIGURE 8. LOW LEVEL OUTPUT VOLTAGE vs TEMPERATURE

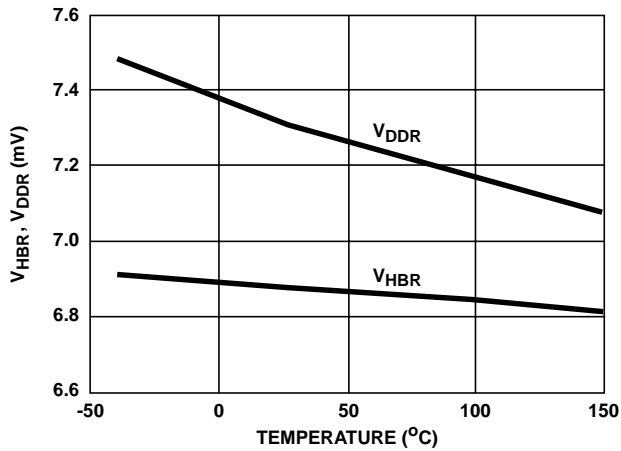


FIGURE 9. UNDERVOLTAGE LOCKOUT THRESHOLD vs TEMPERATURE

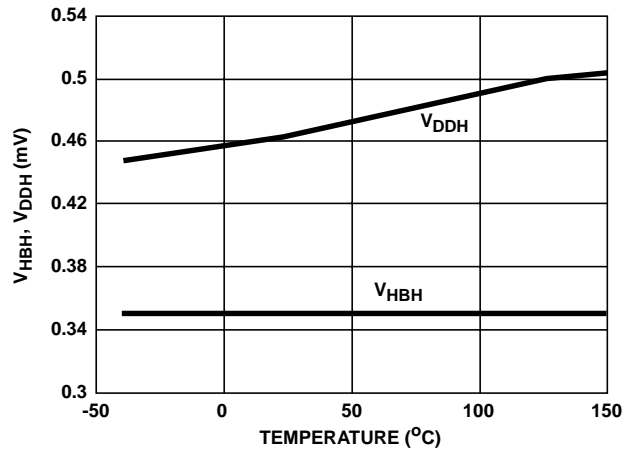


FIGURE 10. UNDERVOLTAGE LOCKOUT HYSTERESIS vs TEMPERATURE

Typical Performance Curves (Continued)

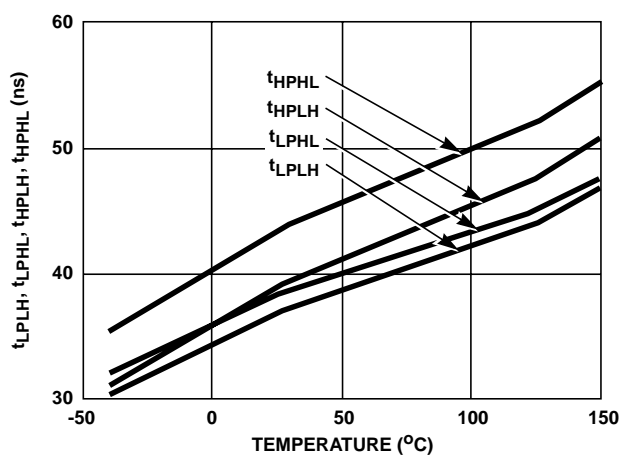


FIGURE 11. PROPAGATION DELAYS vs TEMPERATURE

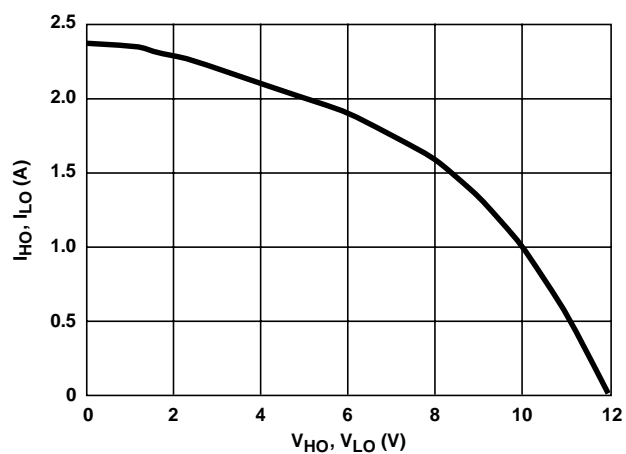


FIGURE 12. PULLUP CURRENT vs OUTPUT VOLTAGE

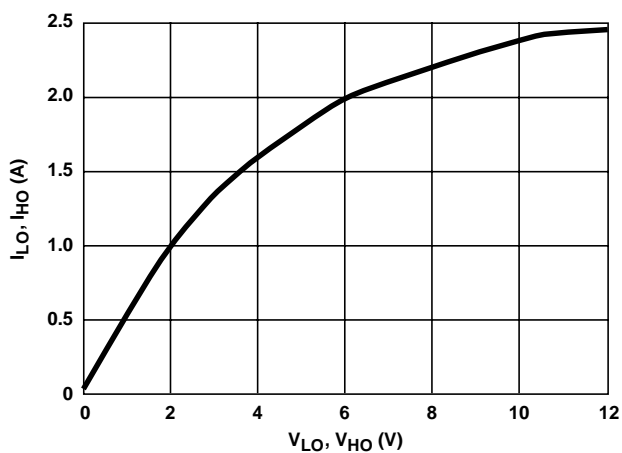


FIGURE 13. PULLDOWN CURRENT vs OUTPUT VOLTAGE

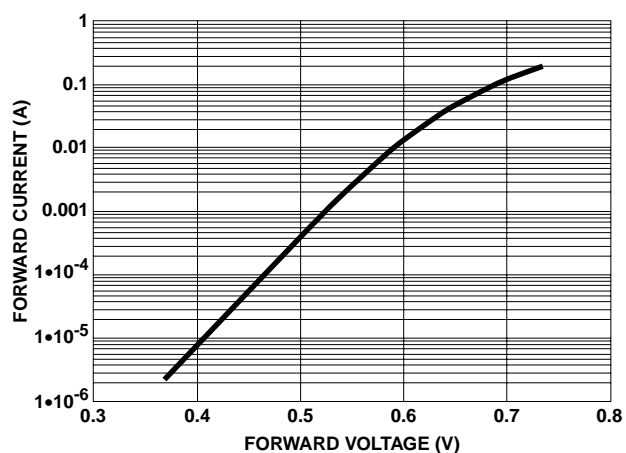


FIGURE 14. BOOTSTRAP DIODE I-V CHARACTERISTICS

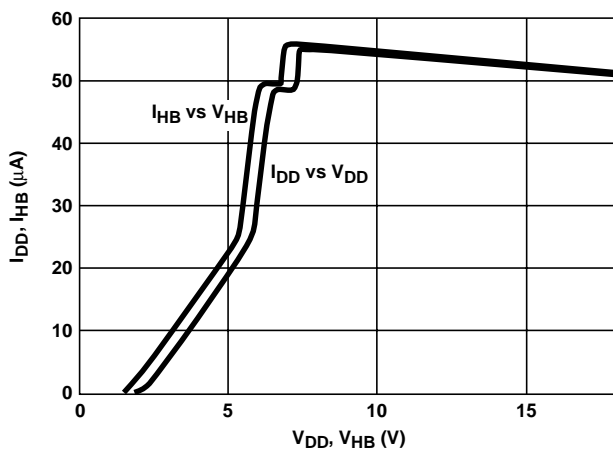
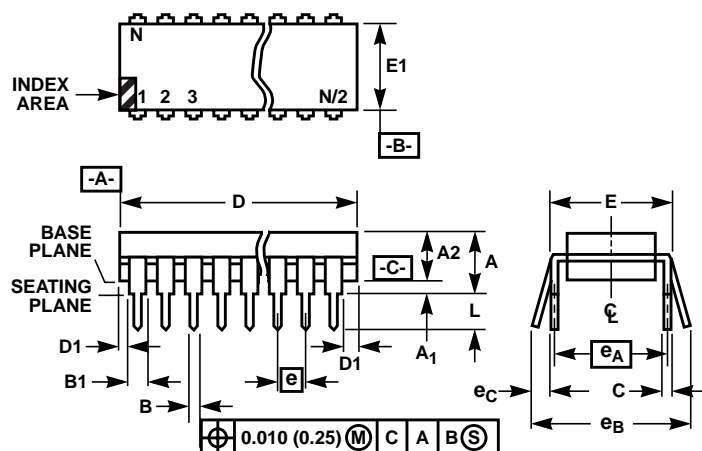


FIGURE 15. BIAS CURRENT vs VOLTAGE

# HIP2106

## Dual-In-Line Plastic Packages (PDIP)



### NOTES:

- Controlling Dimensions: INCH. In case of conflict between English and Metric dimensions, the inch dimensions control.
- Dimensioning and tolerancing per ANSI Y14.5M-1982.
- Symbols are defined in the "MO Series Symbol List" in Section 2.2 of Publication No. 95.
- Dimensions A, A1 and L are measured with the package seated in JEDEC seating plane gauge GS-3.
- D, D1, and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch (0.25mm).
- E and  $e_A$  are measured with the leads constrained to be perpendicular to datum  $-C-$ .
- $e_B$  and  $e_C$  are measured at the lead tips with the leads unconstrained.  $e_C$  must be zero or greater.
- B1 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25mm).
- N is the maximum number of terminal positions.
- Corner leads (1, N, N/2 and N/2 + 1) for E8.3, E16.3, E18.3, E28.3, E42.6 will have a B1 dimension of 0.030 - 0.045 inch (0.76 - 1.14mm).

### E8.3 (JEDEC MS-001-BA ISSUE D) 8 LEAD DUAL-IN-LINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.210	-	5.33	4
A1	0.015	-	0.39	-	4
A2	0.115	0.195	2.93	4.95	-
B	0.014	0.022	0.356	0.558	-
B1	0.045	0.070	1.15	1.77	8, 10
C	0.008	0.014	0.204	0.355	-
D	0.355	0.400	9.01	10.16	5
D1	0.005	-	0.13	-	5
E	0.300	0.325	7.62	8.25	6
E1	0.240	0.280	6.10	7.11	5
e	0.100 BSC		2.54 BSC		-
$e_A$	0.300 BSC		7.62 BSC		6
$e_B$	-	0.430	-	10.92	7
L	0.115	0.150	2.93	3.81	4
N	8		8		9

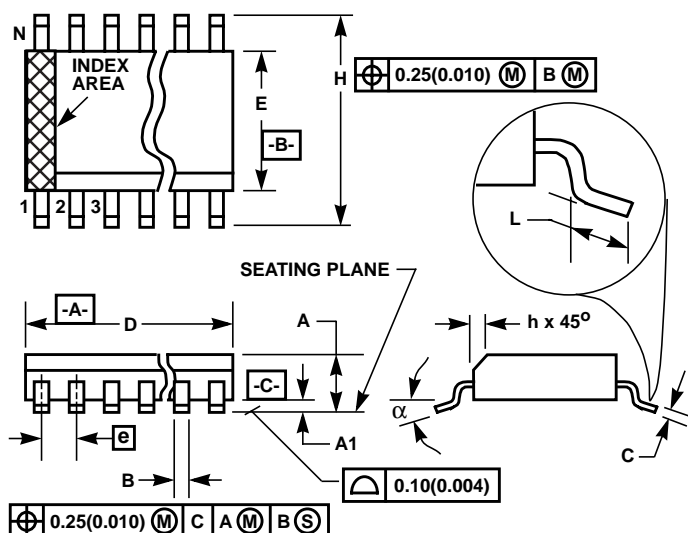
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# HIP2106

## Small Outline Plastic Packages (SOIC)

### M8.15 (JEDEC MS-012-AA ISSUE C) 8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.0532	0.0688	1.35	1.75	-
A1	0.0040	0.0098	0.10	0.25	-
B	0.013	0.020	0.33	0.51	9
C	0.0075	0.0098	0.19	0.25	-
D	0.1890	0.1968	4.80	5.00	3
E	0.1497	0.1574	3.80	4.00	4
e	0.050 BSC		1.27 BSC		-
H	0.2284	0.2440	5.80	6.20	-
h	0.0099	0.0196	0.25	0.50	5
L	0.016	0.050	0.40	1.27	6
N	8		8		7
$\alpha$	0°	8°	0°	8°	-



#### NOTES:

1. Symbols are defined in the "MO Series Symbol List" in Section 2.2 of Publication Number 95.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
4. Dimension "E" does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. "L" is the length of terminal for soldering to a substrate.
7. "N" is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. The lead width "B", as measured 0.36mm (0.014 inch) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024 inch).
10. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.

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