

## HIP2100

100V/2A Peak, Low Cost, High Frequency Half Bridge Driver

FN4022  
Rev.16.00  
Aug 8, 2019

The [HIP2100](#) is a high frequency, 100V Half Bridge N-Channel power MOSFET driver IC. 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 level-shifter 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.

### Applications

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

### Related Literature

For a full list of related documents, visit our website:

- [HIP2100](#) device page

### Features

- Drives N-Channel MOSFET Half Bridge
- SOIC, EPSOIC, and QFN Package Options
- SOIC and EPSOIC Packages Compliant with 100V Conductor Spacing Guidelines of IPC-2221
- Pb-Free (RoHS Compliant)
- Bootstrap Supply Max Voltage to 114VDC
- On-Chip 1Ω Bootstrap Diode
- Fast Propagation Times for Multi-MHz Circuits
- Drives 1000pF Load with Rise and Fall Times Typ 10ns
- 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 Slew at High dv/dt
- Low Power Consumption
- Wide Supply Range
- Supply Undervoltage Protection
- 3Ω Driver Output Resistance
- QFN Package:
  - Compliant to JEDEC PUB95 MO-220
  - QFN - Quad Flat No Leads - Package Outline
  - Near Chip Scale Package Footprint, which Improves PCB Efficiency and has a Thinner Profile

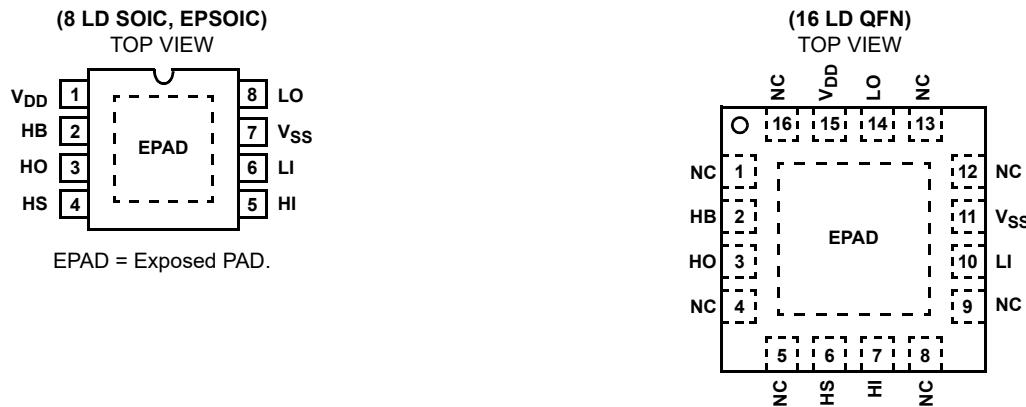
## Ordering Information

PART NUMBER ( <a href="#">Notes 2, 3</a> )	PART MARKING	TEMP. RANGE (°C)	TAPE AND REEL (Units) ( <a href="#">Note 1</a> )	PACKAGE (RoHS Compliant)	PKG. DWG. #
HIP2100IBZ	2100 IBZ	-40 to +125	-	8 Ld SOIC	M8.15
HIP2100IBZT	2100 IBZ	-40 to +125	2.5k	8 Ld SOIC	M8.15
HIP2100EIBZ	2100 EIBZ	-40 to +125	-	8 Ld EPSOIC	M8.15C
HIP2100EIBZT	2100 EIBZ	-40 to +125	2.5k	8 Ld EPSOIC	M8.15C
HIP2100IRZ	HIP 2100IRZ	-40 to +125	-	16 Ld 5x5 QFN	L16.5x5
HIP2100IRZT	HIP 2100IRZ	-40 to +125	6k	16 Ld 5x5 QFN	L16.5x5
HIP2100EVAL2	Evaluation Board				

## NOTES:

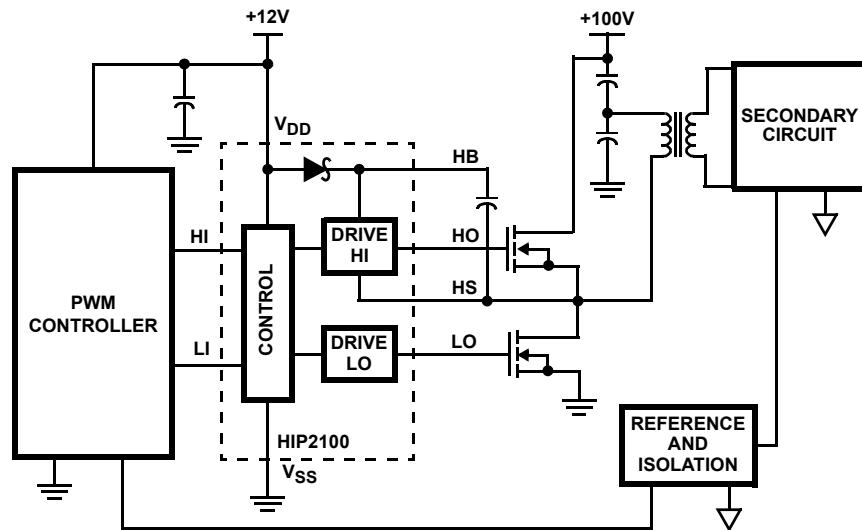
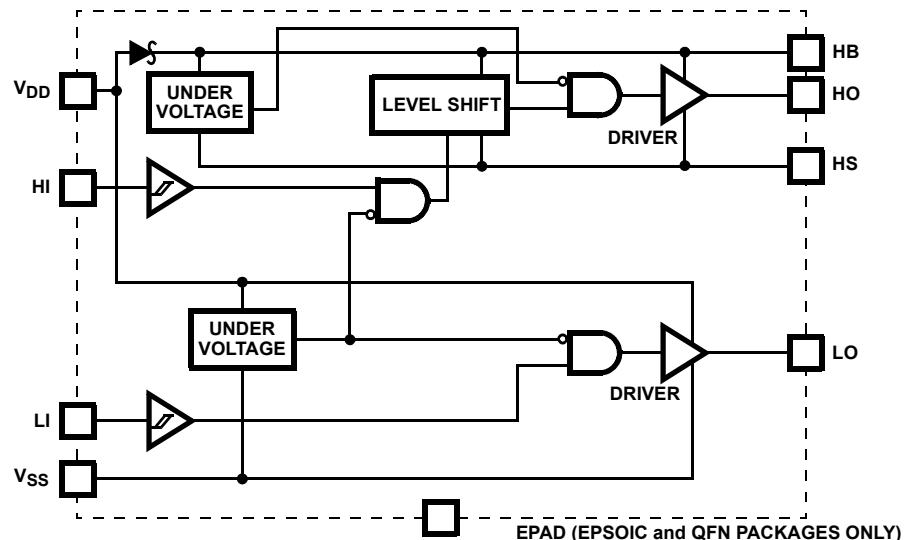
1. See [TB347](#) for details about reel specifications.
2. These Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J-STD-020.
3. For Moisture Sensitivity Level (MSL), see the [HIP2100](#) device page. For more information about MSL, see [TB363](#).

## Pinouts



## Pin Descriptions

SYMBOL	DESCRIPTION
V <sub>DD</sub>	Positive Supply to lower gate drivers. De-couple this pin to V <sub>SS</sub> . Bootstrap diode connected to HB.
HB	High-Side Bootstrap supply. External bootstrap capacitor is required. Connect positive side of bootstrap capacitor to this pin. Bootstrap diode is on-chip.
HO	High-Side Output. Connect to gate of High-Side power MOSFET.
HS	High-Side Source connection. Connect to source of High-Side power MOSFET. Connect negative side of bootstrap capacitor to this pin.
HI	High-Side input.
LI	Low-Side input.
V <sub>SS</sub>	Chip negative supply, generally will be ground.
LO	Low-Side Output. Connect to gate of Low-Side power MOSFET.
EPAD	Exposed Pad. Connect to ground or float. The EPAD is electrically isolated from all other pins.

**Application Block Diagram****Functional Block Diagram**

\*EPAD = Exposed Pad. The EPAD is electrically isolated from all other pins. For best thermal performance connect the EPAD to the PCB power ground plane.

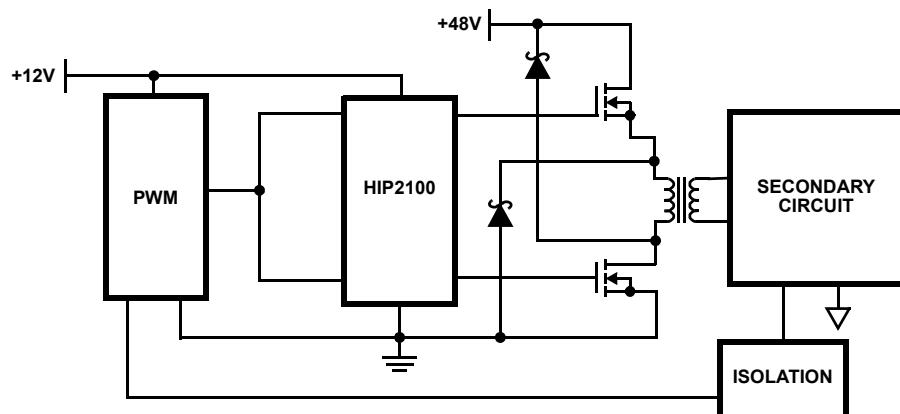


FIGURE 1. TWO-SWITCH FORWARD CONVERTER

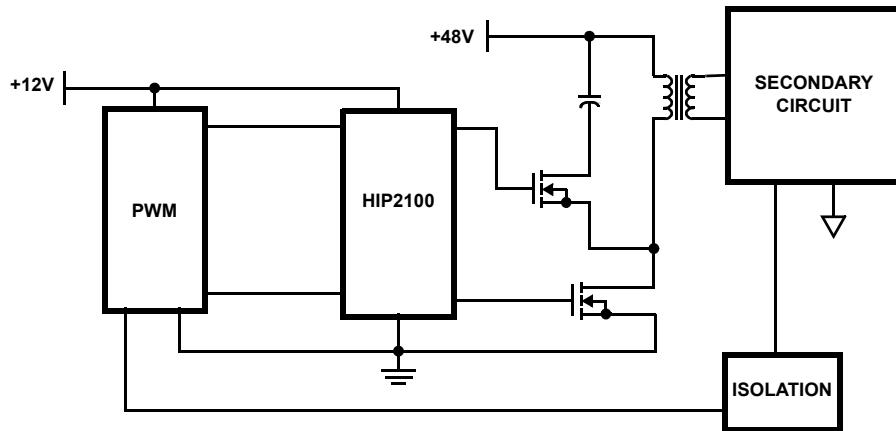


FIGURE 2. FORWARD CONVERTER WITH AN ACTIVE CLAMP

**Absolute Maximum Ratings**

Supply Voltage, $V_{DD}$ , $V_{HB}$ - $V_{HS}$ ( <a href="#">Notes 4, 5</a> )	-0.3V to 18V
LI and HI Voltages ( <a href="#">Note 5</a> )	-0.3V to $V_{DD}$ +0.3V
Voltage on LO ( <a href="#">Note 4</a> )	-0.3V to $V_{DD}$ +0.3V
Voltage on HO ( <a href="#">Note 4</a> )	$V_{HS}$ -0.3V to $V_{HB}$ +0.3V
Voltage on HS (Continuous) ( <a href="#">Note 4</a> )	-1V to 110V
Voltage on HB ( <a href="#">Note 4</a> )	+118V
Average Current in $V_{DD}$ to HB diode	100mA
ESD Classification	Class 1 (1kV)

**Thermal Information**

Thermal Resistance (Typical)	$\theta_{JA}$ (°C/W)	$\theta_{JC}$ (°C/W)
SOIC ( <a href="#">Note 6</a> )	95	50
EPSOIC ( <a href="#">Note 7</a> )	40	3.0
QFN ( <a href="#">Note 7</a> )	37	6.5
Max Power Dissipation at +25°C in Free Air (SOIC, <a href="#">Note 6</a> )	1.3W	
Max Power Dissipation at +25°C in Free Air (EPSOIC, <a href="#">Note 7</a> )	3.1W	
Max Power Dissipation at +25°C in Free Air (QFN, <a href="#">Note 7</a> )	3.3W	
Storage Temperature Range	-65°C to +150°C	
Junction Temperature Range	-55°C to +150°C	
Pb-Free Reflow Profile	see <a href="#">TB493</a>	

**Maximum Recommended Operating Conditions**

Supply Voltage, $V_{DD}$	+9V to 14.0VDC
Voltage on HS	-1V to 100V
Voltage on HS	(Repetitive Transient) -5V to 105V
Voltage on HB	$V_{HS}$ +8V to $V_{HS}$ +14.0V and $V_{DD}$ -1V to $V_{DD}$ +100V
HS Slew Rate	<50V/ns

**CAUTION:** Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions can adversely impact product reliability and result in failures not covered by warranty.

## NOTES:

4. The HIP2100 is capable of derated operation at supply voltages exceeding 14V. [Figure 16 on page 9](#) shows the high-side voltage derating curve for this mode of operation.
5. All voltages referenced to  $V_{SS}$  unless otherwise specified.
6.  $\theta_{JA}$  is measured with the component mounted on a high-effective thermal conductivity test board in free air. See [TB379](#) for details.
7.  $\theta_{JA}$  is measured in free air with the component mounted on a high-effective thermal conductivity test board with "direct attach" features.  $\theta_{JC}$ , the "case temp" is measured at the center of the exposed metal pad on the package underside. See [TB379](#) for details.

**Electrical Specifications**  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, unless otherwise specified.

PARAMETERS	SYMBOL	TEST CONDITIONS	$T_J = +25^\circ C$			$T_J = -40^\circ C$ TO $+125^\circ C$		UNIT
			MIN	TYP	MAX	MIN ( <a href="#">Note 8</a> )	MAX ( <a href="#">Note 8</a> )	
<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	$I_{HBS}$	$V_{HS} = V_{HB} = 114V$	-	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	7	-	8	V
Input Voltage Hysteresis	$V_{IHYS}$		-	0.4	-	-	-	V
Input Pulldown Resistance	$R_I$		-	200	-	100	500	$k\Omega$
<b>UNDERVOLTAGE PROTECTION</b>								
$V_{DD}$ Rising Threshold	$V_{DDR}$		7	7.3	7.8	6.5	8	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

**Electrical Specifications**  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, unless otherwise specified. (Continued)

PARAMETERS	SYMBOL	TEST CONDITIONS	$T_J = +25^\circ C$			$T_J = -40^\circ C \text{ TO } +125^\circ C$		UNIT
			MIN	TYP	MAX	MIN (Note 8)	MAX (Note 8)	
<b>BOOT STRAP DIODE</b>								
Low-Current Forward Voltage	$V_{DL}$	$I_{VDD-HB} = 100\mu A$	-	0.45	0.55	-	0.7	V
High-Current Forward Voltage	$V_{DH}$	$I_{VDD-HB} = 100mA$	-	0.7	0.8	-	1	V
Dynamic Resistance	$R_D$	$I_{VDD-HB} = 100mA$	-	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	$I_{OHL}$	$V_{LO} = 0V$	-	2	-	-	-	A
Peak Pulldown Current	$I_{OLL}$	$V_{LO} = 12V$	-	2	-	-	-	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	$I_{OHH}$	$V_{HO} = 0V$	-	2	-	-	-	A
Peak Pulldown Current	$I_{OLH}$	$V_{HO} = 12V$	-	2	-	-	-	A

**Switching Specifications**  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, unless otherwise specified.

PARAMETERS	SYMBOL	TEST CONDITIONS	$T_J = +25^\circ C$			$T_J = -40^\circ C \text{ TO } +125^\circ C$		UNIT
			MIN	TYP	MAX	MIN (Note 8)	MAX (Note 8)	
Lower Turn-Off Propagation Delay (LI Falling to LO Falling)	$t_{LPHL}$		-	20	35	-	45	ns
Upper Turn-Off Propagation Delay (HI Falling to HO Falling)	$t_{HPLH}$		-	20	35	-	45	ns
Lower Turn-On Propagation Delay (LI Rising to LO Rising)	$t_{LPLH}$		-	20	35	-	45	ns
Upper Turn-On Propagation Delay (HI Rising to HO Rising)	$t_{HPLH}$		-	20	35	-	45	ns
Delay Matching: Lower Turn-On and Upper Turn-Off	$t_{MON}$		-	2	8	-	10	ns
Delay Matching: Lower Turn-Off and Upper Turn-On	$t_{MOFF}$		-	2	8	-	10	ns
Either Output Rise/Fall Time	$t_{RC}, t_{FC}$	$C_L = 1000pF$	-	10	-	-	-	ns
Either Output Rise/Fall Time (3V to 9V)	$t_R, t_F$	$C_L = 0.1\mu F$	-	0.5	0.6	-	0.8	$\mu s$
Either Output Rise Time Driving DMOS	$t_{RD}$	$C_L = IRFR120$	-	20	-	-	-	ns
Either Output Fall Time Driving DMOS	$t_{FD}$	$C_L = IRFR120$	-	10	-	-	-	ns
Minimum Input Pulse Width that Changes the Output	$t_{PW}$		-	-	-	-	50	ns
Bootstrap Diode Turn-On or Turn-Off Time	$t_{BS}$		-	10	-	-	-	ns

## NOTE:

8. Parameters with MIN and/or MAX limits are 100% tested at  $+25^\circ C$ , unless otherwise specified. Temperature limits established by characterization and are not production tested.

## Timing Diagrams

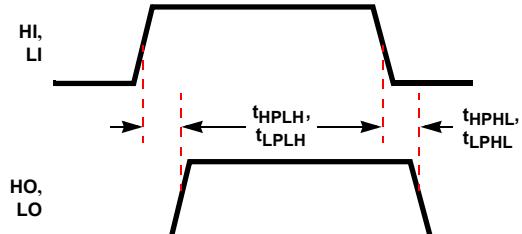


FIGURE 3.

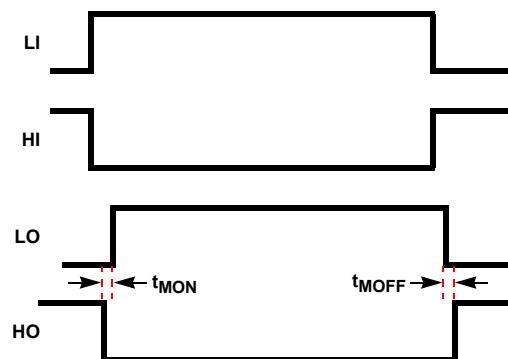


FIGURE 4.

## Typical Performance Curves

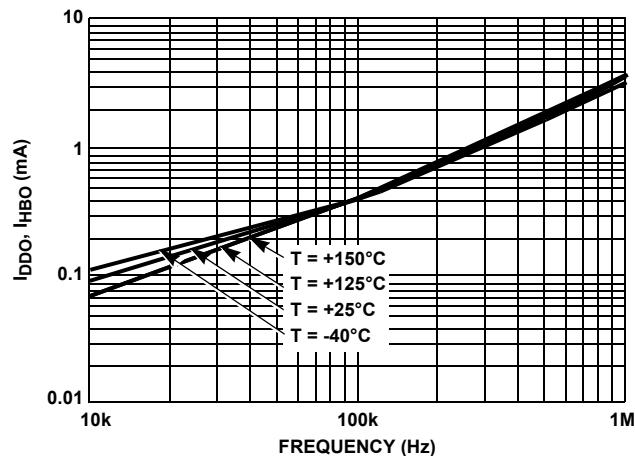


FIGURE 5. OPERATING CURRENT vs FREQUENCY

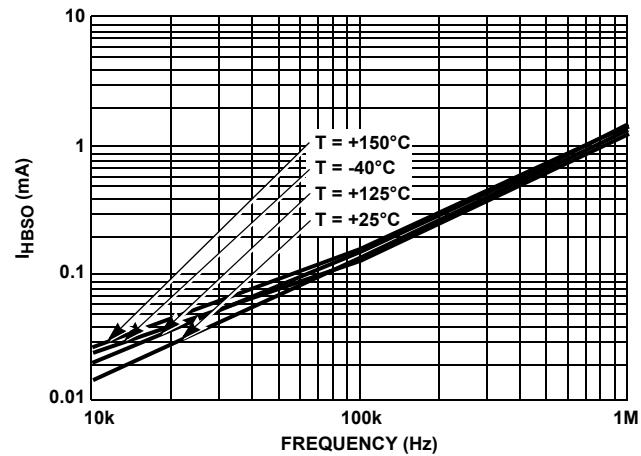
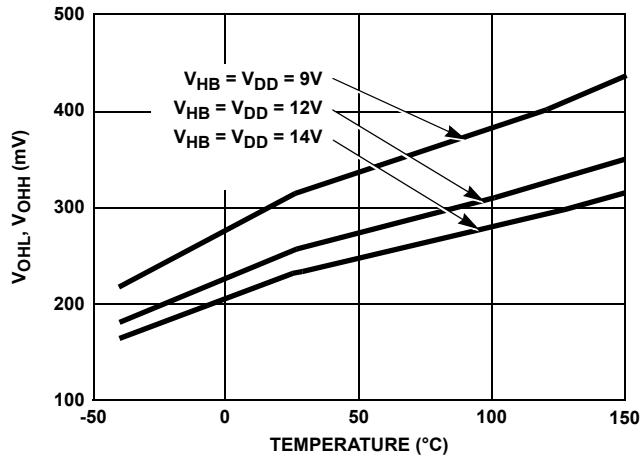
FIGURE 6. HB TO V<sub>SS</sub> OPERATING CURRENT vs FREQUENCY

FIGURE 7. HIGH LEVEL OUTPUT VOLTAGE vs TEMPERATURE

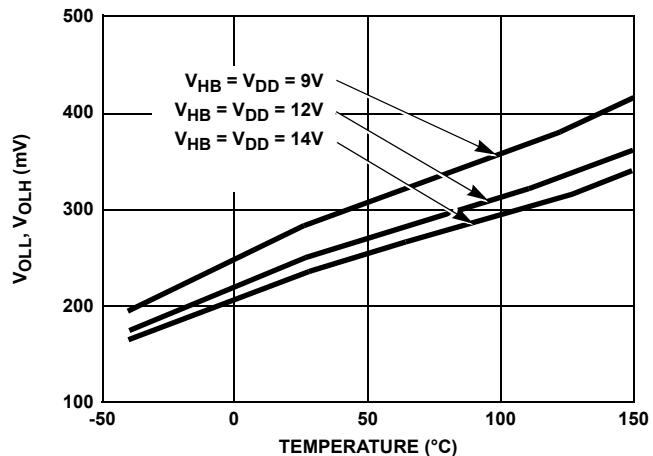


FIGURE 8. LOW LEVEL OUTPUT VOLTAGE vs TEMPERATURE

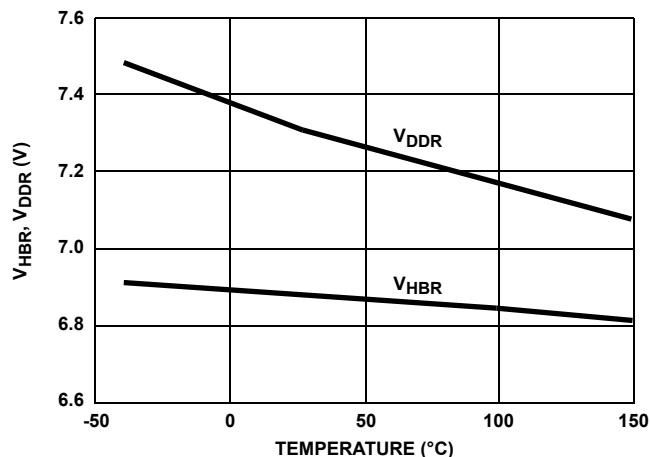
**Typical Performance Curves (Continued)**

FIGURE 9. UNDERVOLTAGE LOCKOUT THRESHOLD vs TEMPERATURE

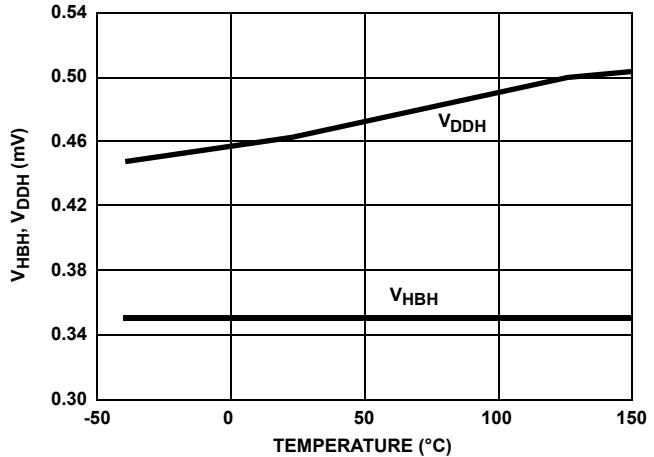


FIGURE 10. UNDERVOLTAGE LOCKOUT HYSTERESIS vs TEMPERATURE

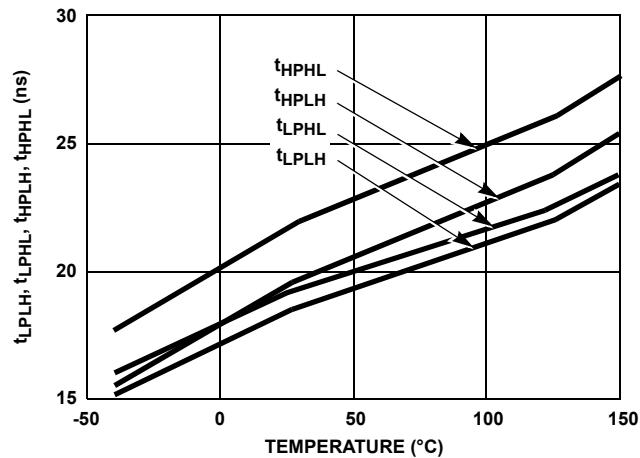


FIGURE 11. PROPAGATION DELAYS vs TEMPERATURE

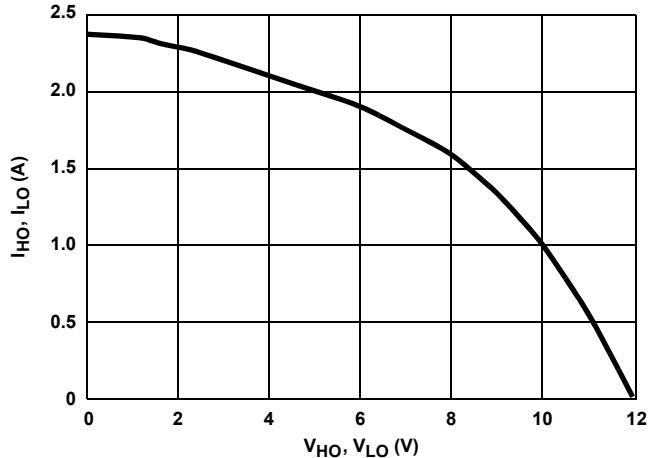


FIGURE 12. PEAK PULLUP CURRENT vs OUTPUT VOLTAGE

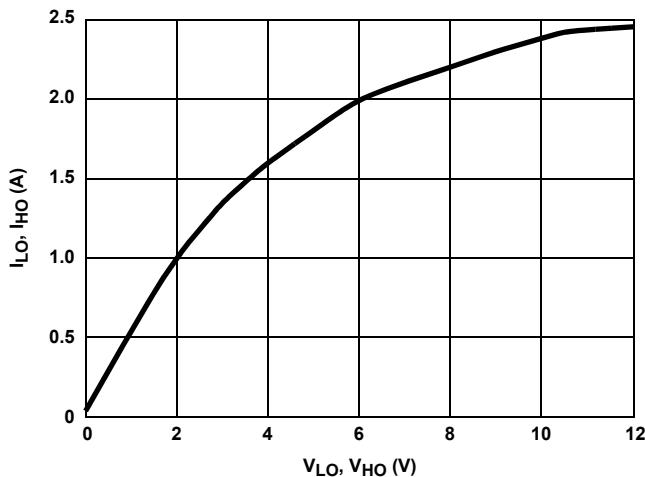


FIGURE 13. PEAK PULLDOWN CURRENT vs OUTPUT VOLTAGE

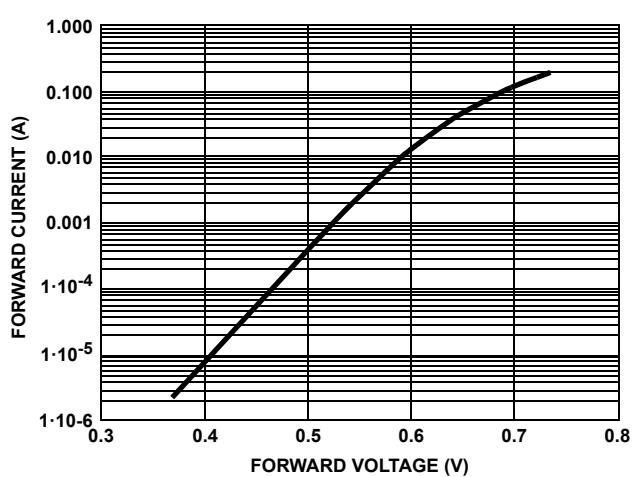


FIGURE 14. BOOTSTRAP DIODE I-V CHARACTERISTICS

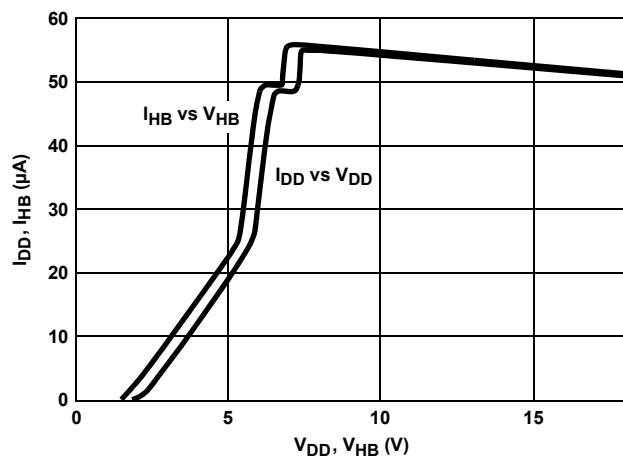
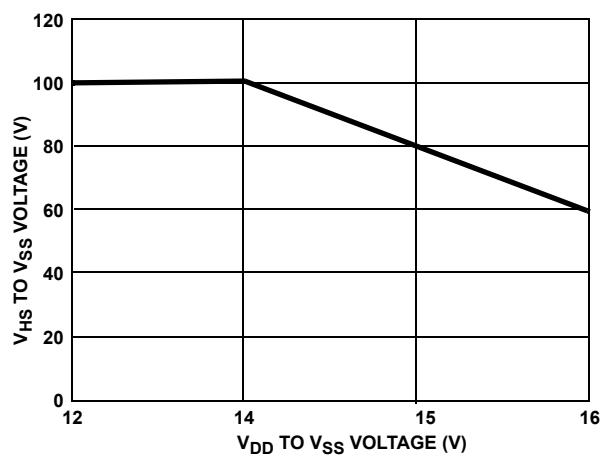
**Typical Performance Curves (Continued)**

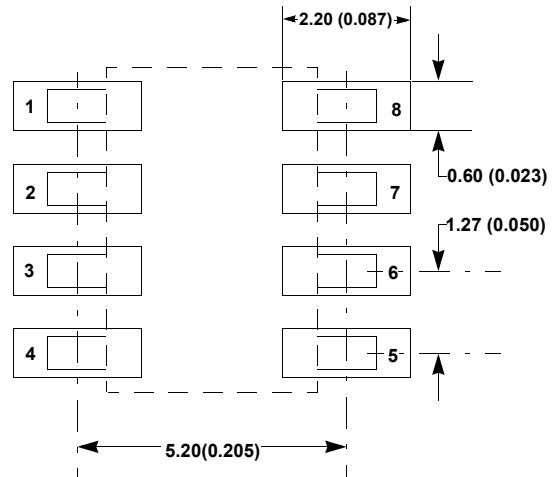
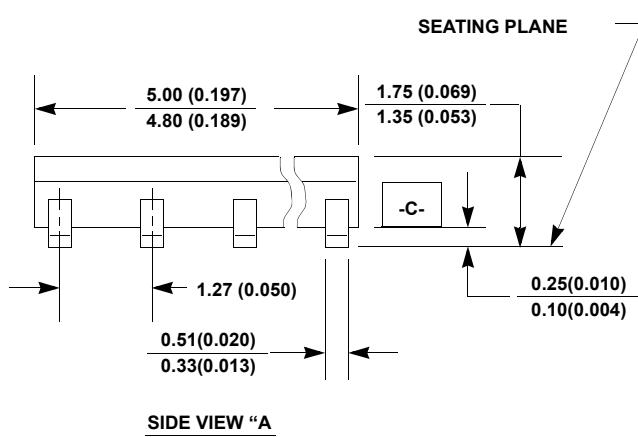
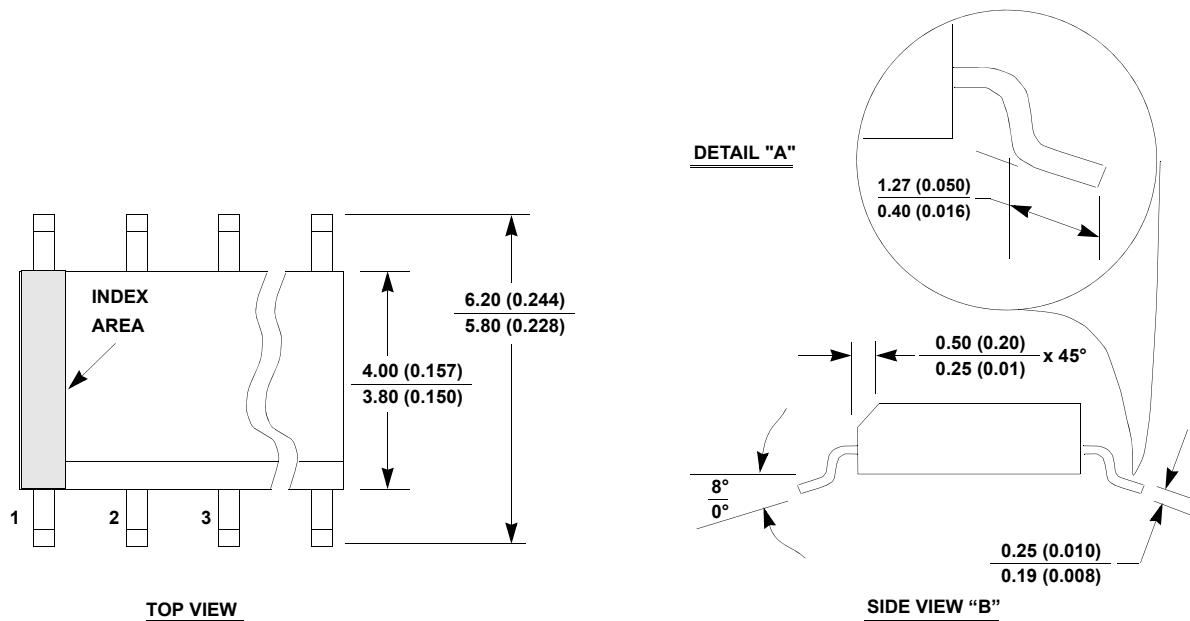
FIGURE 15. QUIESCENT CURRENT vs VOLTAGE

FIGURE 16.  $V_{HS}$  VOLTAGE vs  $V_{DD}$  VOLTAGE

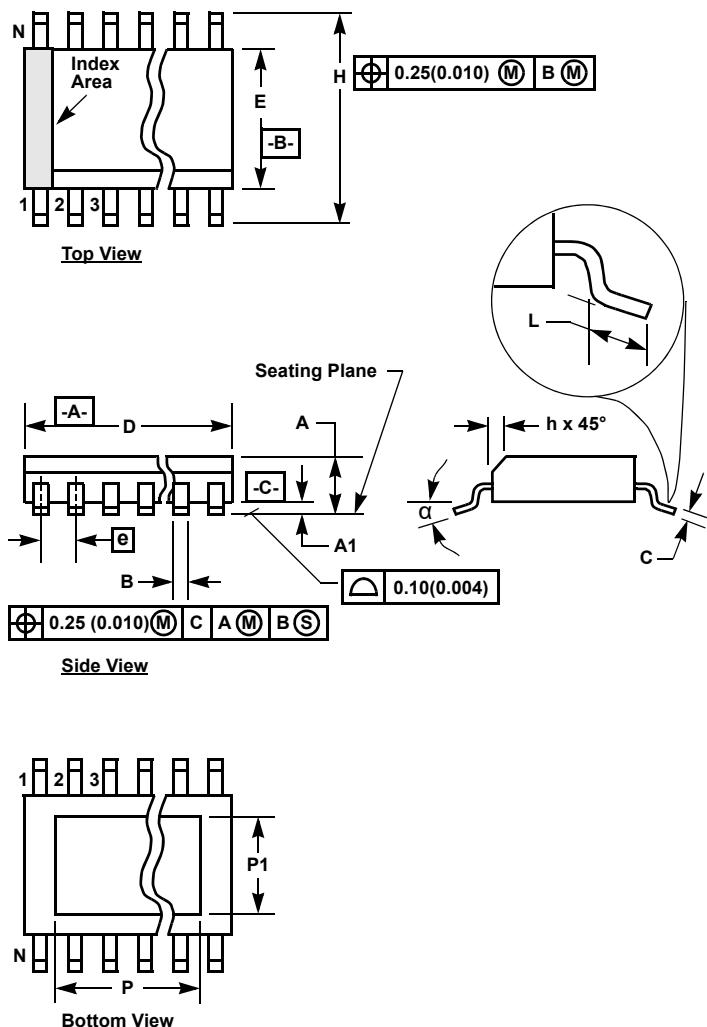
## Revision History

The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please go to the web to make sure that you have the latest revision.

DATE	REVISION	CHANGE
Aug 8, 2019	FN4022.16	<p>Added Related Literature</p> <p>Updated Links throughout.</p> <p>Updated Ordering Information table by removing retired parts, adding tape and reel information, and adding Note 3.</p> <p>Removed all information for DFN package.</p> <p>Removed About Intersil section.</p> <p>Updated disclaimer</p> <p>Updated POD M8.15C to the latest revision changes are as follows:</p> <ul style="list-style-type: none"> <li>-Updated Millimeter MIN and MAX values for A from: 1.43 MIN and 1.68 MAX to: 1.422 MIN and 1.700 MAX</li> <li>-Updated Inch MAX for A from: 0.066 to: 0.067</li> <li>-A1 Inches changed MIN from: 0.001 to 0.0, and A1 Millimeters MIN from 0.03 to 0.0</li> <li>-L Millimeter Min changed from: 0.41 to 0.406</li> </ul>
Aug 31, 2015	FN4022.15	<p>Updated Ordering Information Table on page 2.</p> <p>Added Revision History and About Intersil sections.</p> <p>Updated POD M8.15 from rev 1 to rev 4. Changes since rev 1:</p> <p>Updated to new format by removing table, moving dimensions onto drawing and adding land pattern</p> <p>Typical Recommended Land Pattern, changed the following:</p> <ul style="list-style-type: none"> <li>2.41(0.095) to 2.20(0.087)</li> <li>0.76 (0.030) to 0.60(0.023)</li> <li>0.200 to 5.20(0.205)</li> </ul> <p>Changed Note 1 "1982" to "1994"</p>

**Package Outline Drawings**For the most recent package outline drawing, see [M8.15](#).**M8.15****8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE**  
Rev 4, 1/12**NOTES:**

1. Dimensioning and tolerancing per ANSI Y14.5M-1994.
2. Package length 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.
3. Package width does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
4. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
5. Terminal numbers are shown for reference only.
6. The lead width 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).
7. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.
8. This outline conforms to JEDEC publication MS-012-AA ISSUE C.



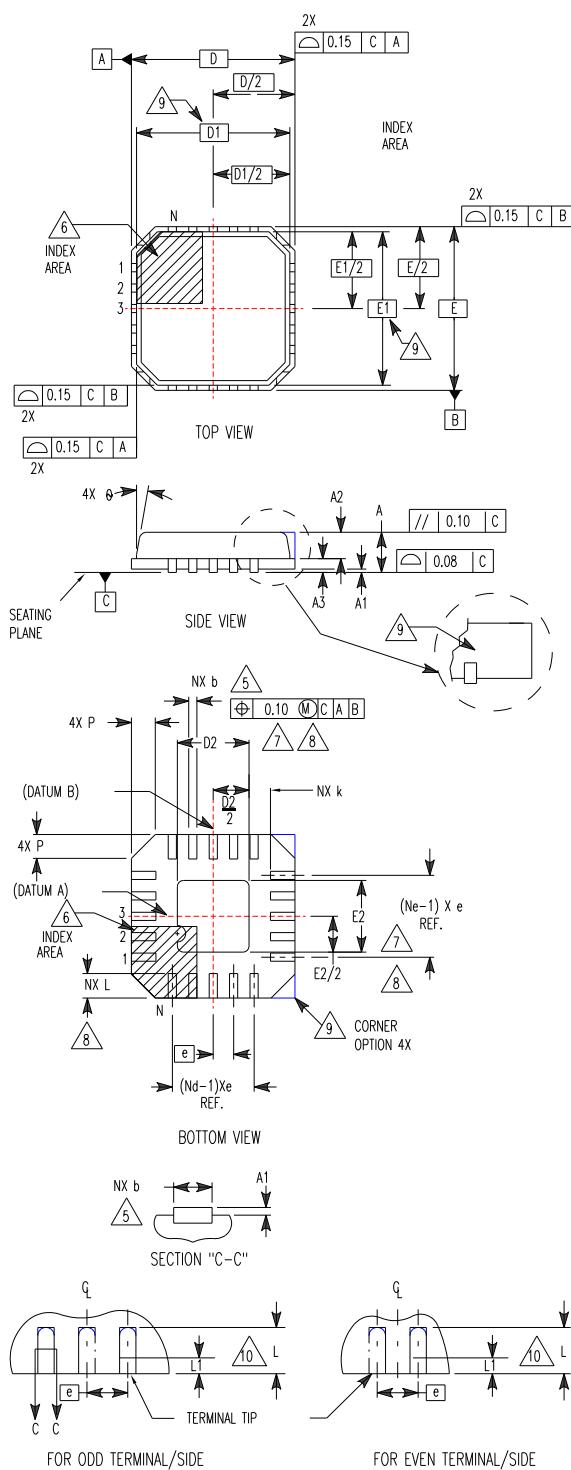
**M8.15C**  
8 Lead Narrow Body Small Outline Exposed Pad  
Plastic Package (EPSOIC)

Symbol	Inches		Millimeters		Notes
	Min	Max	Min	Max	
A	0.056	0.067	1.422	1.700	-
A1	0.0	0.005	0.0	0.13	-
B	0.0138	0.0192	0.35	0.49	9
C	0.0075	0.0098	0.19	0.25	-
D	0.189	0.196	4.80	4.98	3
E	0.150	0.157	3.811	3.99	4
e	0.050 BSC		1.27 BSC		-
H	0.230	0.244	5.84	6.20	-
h	0.010	0.016	0.25	0.41	5
L	0.016	0.035	0.406	0.89	6
N	8		8		7
$\alpha$	0°	8°	0°	8°	-
P	-	0.126	-	3.200	11
P1	-	0.099	-	2.514	11

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## 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.
11. Dimensions "P" and "P1" are thermal and/or electrical enhanced variations. Values shown are maximum size of exposed pad within lead count and body size.

For the most recent package outline drawing, see [L16.5x5](#).

## L16.5x5

16 LEAD QUAD FLAT NO-LEAD PLASTIC PACKAGE (QFN)  
(COMPLIANT TO JEDEC MO-220VHHB ISSUE C)

SYMBOL	MILLIMETERS			NOTES
	MIN	NOMINAL	MAX	
A	0.80	0.90	1.00	-
A1	-	-	0.05	-
A2	-	-	1.00	9
A3	0.20 REF			9
b	0.28	0.33	0.40	5, 8
D	5.00 BSC			-
D1	4.75 BSC			9
D2	2.55	2.70	2.85	7, 8
E	5.00 BSC			-
E1	4.75 BSC			9
E2	2.55	2.70	2.85	7, 8
e	0.80 BSC			-
k	0.25	-	-	-
L	0.35	0.60	0.75	8
L1	-	-	0.15	10
N	16			2
Nd	4			3
Ne	4	4		3
P	-	-	0.60	9
$\theta$	-	-	12	9

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## NOTES:

- Dimensioning and tolerancing conform to ASME Y14.5-1994.
- N is the number of terminals.
- Nd and Ne refer to the number of terminals on each D and E.
- All dimensions are in millimeters. Angles are in degrees.
- Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
- The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 identifier may be either a mold or mark feature.
- Dimensions D2 and E2 are for the exposed pads which provide improved electrical and thermal performance.
- Nominal dimensions are provided to assist with PCB Land Pattern Design efforts, see Intersil Technical Brief TB389.
- Features and dimensions A2, A3, D1, E1, P &  $\theta$  are present when Anvil singulation method is used and not present for saw singulation.
- Depending on the method of lead termination at the edge of the package, a maximum 0.15mm pull back (L1) maybe present. L minus L1 to be equal to or greater than 0.3mm.

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