

## 100V, 2A Peak, High Frequency Half-Bridge Drivers

The ISL2100A, ISL2101A are 100V, high frequency, half-bridge N-channel power MOSFET driver ICs. They are based on the popular HIP2100, HIP2101 half-bridge drivers, but offer several performance improvements. The ISL2100A has additional input hysteresis for superior operation in noisy environments and the inputs of the ISL2101A, like those of the ISL2100A, can now safely swing to the  $V_{DD}$  supply rail. Finally, both parts are available in a very compact 9 Ld DFN package to minimize the required PCB footprint

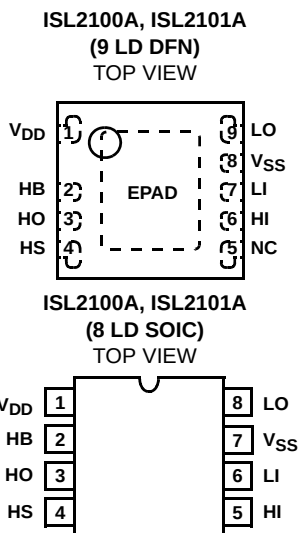
## Ordering Information

| PART NUMBER<br>(Note) | PART<br>MARKING | TEMP.<br>RANGE (°C) | PACKAGE<br>(Pb-Free) | PKG.<br>DWG. # |
|-----------------------|-----------------|---------------------|----------------------|----------------|
| ISL2100AAR3Z*         | 00AZ            | -40 to +125         | 9 Ld 3x3 DFN         | L9.3x3         |
| ISL2101AAR3Z*         | 01AZ            | -40 to +125         | 9 Ld 3x3 DFN         | L9.3x3         |
| ISL2100AABZ*          | 001ABZ          | -40 to +125         | 8 Ld SOIC            | M18.15         |
| ISL2101AABZ*          | 01ABZ           | -40 to +125         | 8 Ld SOIC            | M18.15         |

\*Add "-T" suffix for tape and reel. Please refer to TB347 for details on reel specifications.

NOTE: These Intersil 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). Intersil 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.

## Pinouts



NOTE: EPAD = Exposed PAD.

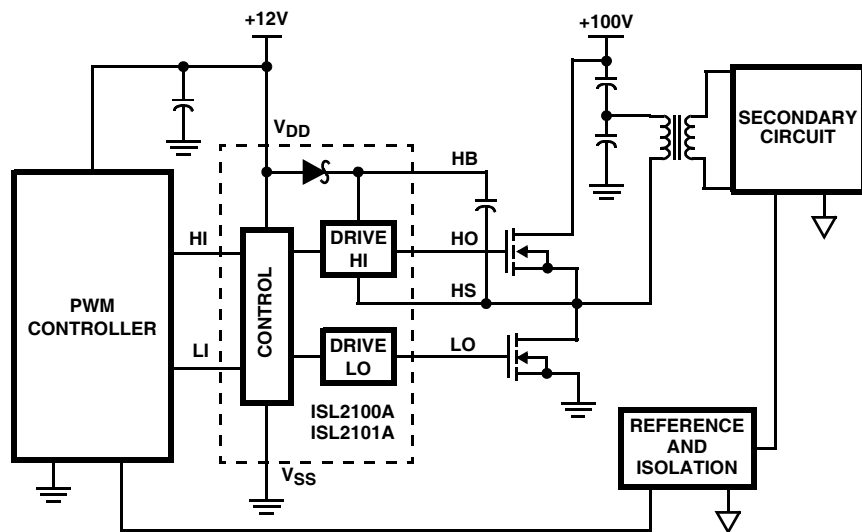
## Features

- Drives N-Channel MOSFET Half-Bridge
- Space-Saving DFN Package
- DFN Package Compliant with 100V Conductor Spacing Guidelines per 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 1nF Load with Typical Rise/Fall Times of 10ns
- CMOS Compatible Input Thresholds (ISL2100A)
- 3.3V/TTL Compatible Input Thresholds (ISL2101A)
- Independent Inputs Provide Flexibility
- 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 Voltage Range (9V to 14V)
- Supply Undervoltage Protection
- 2.5Ω Typical Output Pull-Up/Pull-Down Resistance

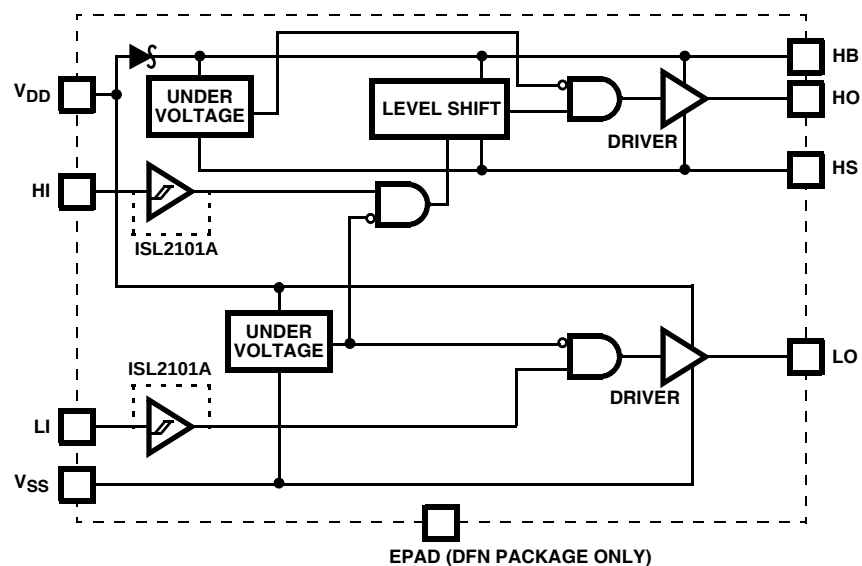
## Applications

- Telecom Half-Bridge Converters
- Telecom Full-Bridge Converters
- Two-Switch Forward Converters
- Active-Clamp Forward Converters
- Class-D Audio Amplifiers

## 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.

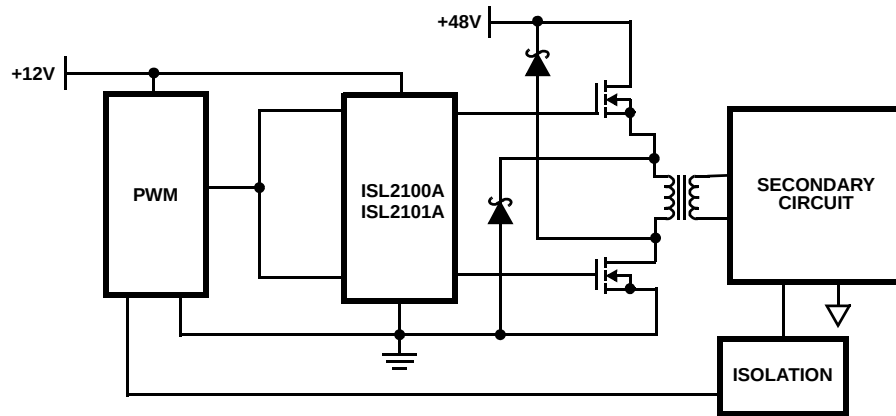


FIGURE 1. TWO-SWITCH FORWARD CONVERTER

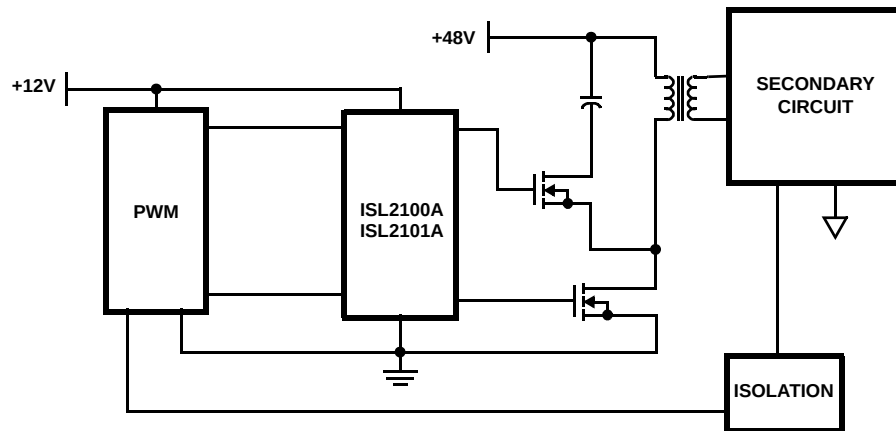


FIGURE 2. FORWARD CONVERTER WITH AN ACTIVE-CLAMP

### Absolute Maximum Ratings

Supply Voltage,  $V_{DD}$ ,  $V_{HB} - V_{HS}$  (Notes 1, 2) . . . . . -0.3V to 18V  
 LI and HI Voltages (Note 2) . . . . . -0.3V to  $V_{DD} + 0.3V$   
 Voltage on LO (Note 2) . . . . . -0.3V to  $V_{DD} + 0.3V$   
 Voltage on HO (Note 2) . . . . .  $V_{HS} - 0.3V$  to  $V_{HB} + 0.3V$   
 Voltage on HS (Continuous) (Note 2) . . . . . -1V to 110V  
 Voltage on HB (Note 2) . . . . . 118V  
 Average Current in  $V_{DD}$  to HB Diode . . . . . 100mA

### Thermal Information

Thermal Resistance (Typical)  $\theta_{JA}$  (°C/W)  $\theta_{JC}$  (°C/W)  
 DFN (Notes 3, 4) . . . . . 47 3.5  
 SOIC (Note 3) . . . . . 120 N/A  
 Max Power Dissipation at +25°C in Free Air (DFN, Note 3) . . . 2.27W  
 Storage Temperature Range . . . . . -65°C to +150°C  
 For Recommended soldering conditions see Tech Brief TB389.  
 Pb-Free Reflow Profile. . . . . see link below  
<http://www.intersil.com/pbfree/Pb-FreeReflow.asp>

### Maximum Recommended Operating Conditions

Supply Voltage,  $V_{DD}$  . . . . . 9V to 14V  
 Voltage on HS . . . . . -1V to 100V  
 Voltage on HS . . . . . (Repetitive Transient) -5V to 105V  
 Voltage on HB . .  $V_{HS} + 8V$  to  $V_{HS} + 14V$  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 may adversely impact product reliability and result in failures not covered by warranty.

#### NOTES:

1. The ISL2100A-ISL2101A are capable of derated operation at supply voltages exceeding 14V. Figure 22 shows the high-side voltage derating curve for this mode of operation.
2. All voltages referenced to  $V_{SS}$  unless otherwise specified.
3.  $\theta_{JA}$  is measured in free air with the component mounted on a high effective thermal conductivity test board with "direct attach" features.
4. For  $\theta_{JC}$ , the "case temp" is measured at the center of the exposed metal pad on the package underside. See Tech Brief 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 with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified. Temperature limits established by characterization and are not production tested.

| PARAMETERS                               | SYMBOL            | TEST CONDITIONS                                        | T <sub>J</sub> = +25°C |      |      | T <sub>J</sub> = -40°C to +125°C |      | UNITS |
|------------------------------------------|-------------------|--------------------------------------------------------|------------------------|------|------|----------------------------------|------|-------|
|                                          |                   |                                                        | MIN                    | TYP  | MAX  | MIN                              | MAX  |       |
| SUPPLY CURRENTS                          |                   |                                                        |                        |      |      |                                  |      |       |
| V <sub>DD</sub> Quiescent Current        | I <sub>DD</sub>   | ISL2100A; LI = HI = 0V                                 | -                      | 0.1  | 0.25 | -                                | 0.3  | mA    |
| V <sub>DD</sub> Quiescent Current        | I <sub>DD</sub>   | ISL2101A; LI = HI = 0V                                 | -                      | 0.3  | 0.45 | -                                | 0.55 | mA    |
| V <sub>DD</sub> Operating Current        | I <sub>DDO</sub>  | ISL2100A; f = 500kHz                                   | -                      | 1.6  | 2.2  | -                                | 2.7  | mA    |
| V <sub>DD</sub> Operating Current        | I <sub>DDO</sub>  | ISL2101A; f = 500kHz                                   | -                      | 1.9  | 2.5  | -                                | 3    | mA    |
| Total HB Quiescent Current               | I <sub>HB</sub>   | LI = HI = 0V                                           | -                      | 0.1  | 0.15 | -                                | 0.2  | mA    |
| Total HB Operating Current               | I <sub>HBO</sub>  | f = 500kHz                                             | -                      | 2.0  | 2.5  | -                                | 3    | mA    |
| HB to V <sub>SS</sub> Current, Quiescent | I <sub>HBS</sub>  | LI = HI = 0V; V <sub>HB</sub> = V <sub>HS</sub> = 114V | -                      | 0.05 | 1    | -                                | 10   | μA    |
| HB to V <sub>SS</sub> Current, Operating | I <sub>HBSO</sub> | f = 500kHz; V <sub>HB</sub> = V <sub>HS</sub> = 114V   | -                      | 0.9  | -    | -                                | -    | mA    |
| INPUT PINS                               |                   |                                                        |                        |      |      |                                  |      |       |
| Low Level Input Voltage Threshold        | V <sub>IL</sub>   | ISL2100A                                               | 3.7                    | 4.4  | -    | 2.7                              | -    | V     |
| Low Level Input Voltage Threshold        | V <sub>IL</sub>   | ISL2101A                                               | 1.4                    | 1.8  | -    | 1.2                              | -    | V     |
| High Level Input Voltage Threshold       | V <sub>IH</sub>   | ISL2100A                                               | -                      | 6.6  | 7.4  | -                                | 8.4  | V     |
| High Level Input Voltage Threshold       | V <sub>IH</sub>   | ISL2101A                                               | -                      | 1.8  | 2.2  | -                                | 2.4  | V     |
| Input Voltage Hysteresis                 | V <sub>IHYS</sub> | ISL2100A                                               | -                      | 2.2  | -    | -                                | -    | V     |
| Input Pull-down Resistance               | R <sub>I</sub>    |                                                        | -                      | 210  | -    | 100                              | 500  | kΩ    |
| UNDERVOLTAGE PROTECTION                  |                   |                                                        |                        |      |      |                                  |      |       |
| V <sub>DD</sub> Rising Threshold         | V <sub>DDR</sub>  |                                                        | 6.8                    | 7.3  | 7.8  | 6.5                              | 8.1  | V     |
| V <sub>DD</sub> Threshold Hysteresis     | V <sub>DDH</sub>  |                                                        | -                      | 0.6  | -    | -                                | -    | V     |
| HB Rising Threshold                      | V <sub>HBR</sub>  |                                                        | 6.2                    | 6.9  | 7.5  | 5.9                              | 7.8  | V     |

# ISL2100A, ISL2101A

**Electrical Specifications**  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, Unless Otherwise Specified. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified. Temperature limits established by characterization and are not production tested. **(Continued)**

| PARAMETERS                   | SYMBOL    | TEST CONDITIONS                                    | $T_J = +25^\circ C$ |      |     | $T_J = -40^\circ C$ to $+125^\circ C$ |     | UNITS    |
|------------------------------|-----------|----------------------------------------------------|---------------------|------|-----|---------------------------------------|-----|----------|
|                              |           |                                                    | MIN                 | TYP  | MAX | MIN                                   | MAX |          |
| HB Threshold Hysteresis      | $V_{HBH}$ |                                                    | -                   | 0.6  | -   | -                                     | -   | V        |
| <b>BOOTSTRAP DIODE</b>       |           |                                                    |                     |      |     |                                       |     |          |
| Low Current Forward Voltage  | $V_{DL}$  | $I_{VDD-HB} = 100\mu A$                            | -                   | 0.5  | 0.6 | -                                     | 0.7 | V        |
| High Current Forward Voltage | $V_{DH}$  | $I_{VDD-HB} = 100mA$                               | -                   | 0.7  | 0.9 | -                                     | 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    | $V_{OHL}$ | $I_{LO} = -100mA$ ,<br>$V_{OHL} = V_{DD} - V_{LO}$ | -                   | 0.25 | 0.3 | -                                     | 0.4 | V        |
| Peak Pull-Up Current         | $I_{OHL}$ | $V_{LO} = 0V$                                      | -                   | 2    | -   | -                                     | -   | A        |
| Peak Pull-Down 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    | $V_{OHH}$ | $I_{HO} = -100mA$ ,<br>$V_{OHH} = V_{HB} - V_{HO}$ | -                   | 0.25 | 0.3 | -                                     | 0.4 | V        |
| Peak Pull-Up Current         | $I_{OHH}$ | $V_{HO} = 0V$                                      | -                   | 2    | -   | -                                     | -   | A        |
| Peak Pull-Down Current       | $I_{OLH}$ | $V_{HO} = 12V$                                     | -                   | 2    | -   | -                                     | -   | A        |

**Electrical Specifications** **Switching Specifications**  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, Unless Otherwise Specified. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified. Temperature limits established by characterization and are not production tested.

| PARAMETERS                                                  | 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) | $t_{LPHL}$       |                  | -                   | 34  | 50  | -                                     | 60  | ns    |
| Upper Turn-Off Propagation Delay (HI Falling to HO Falling) | $t_{HPHL}$       |                  | -                   | 31  | 50  | -                                     | 60  | ns    |
| Lower Turn-On Propagation Delay (LI Rising to LO Rising)    | $t_{LPLH}$       |                  | -                   | 39  | 50  | -                                     | 60  | ns    |
| Upper Turn-On Propagation Delay (HI Rising to HO Rising)    | $t_{HPLH}$       |                  | -                   | 39  | 50  | -                                     | 60  | ns    |
| Delay Matching: Upper Turn-Off to Lower Turn-On             | $t_{MON}$        |                  | 1                   | 8   | -   | -                                     | 16  | ns    |
| Delay Matching: Lower Turn-Off to Upper Turn-On             | $t_{MOFF}$       |                  | 1                   | 6   | -   | -                                     | 16  | ns    |
| Either Output Rise/Fall Time (10% to 90%/90% to 10%)        | $t_{RC}, t_{FC}$ | $C_L = 1nF$      | -                   | 10  | -   | -                                     | -   | ns    |
| Either Output Rise/Fall Time (3V to 9V/9V to 3V)            | $t_R, t_F$       | $C_L = 0.1\mu F$ | -                   | 0.5 | 0.6 | -                                     | 0.8 | us    |
| Minimum Input Pulse Width that Changes the Output           | $t_{PW}$         |                  | -                   | -   | -   | -                                     | 50  | ns    |
| Bootstrap Diode Turn-On or Turn-Off Time                    | $t_{BS}$         |                  | -                   | 10  | -   | -                                     | -   | ns    |

## Pin Descriptions

| SYMBOL          | DESCRIPTION                                                                                                                                                 |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V <sub>DD</sub> | Positive supply to lower gate driver. Bypass this pin to V <sub>SS</sub> .                                                                                  |
| 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, which will generally 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.                                                             |

## Timing Diagrams

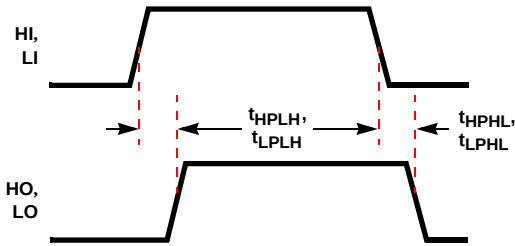


FIGURE 3. PROPAGATION DELAYS

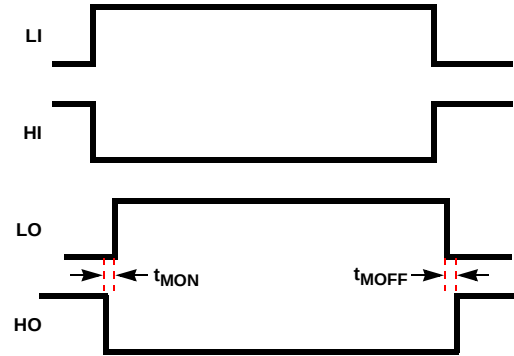


FIGURE 4. DELAY MATCHING

## Typical Performance Curves

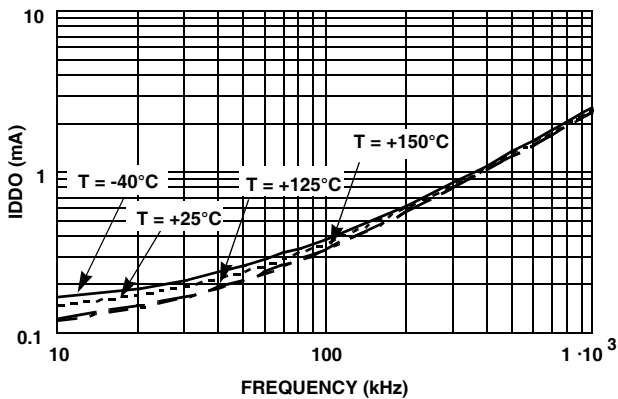


FIGURE 5. ISL2100A  $I_{DD}$  OPERATING CURRENT vs FREQUENCY

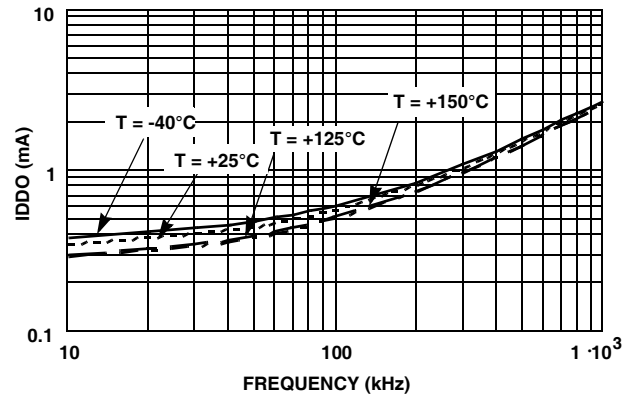


FIGURE 6. ISL2101A  $I_{DD}$  OPERATING CURRENT vs FREQUENCY

Typical Performance Curves (Continued)

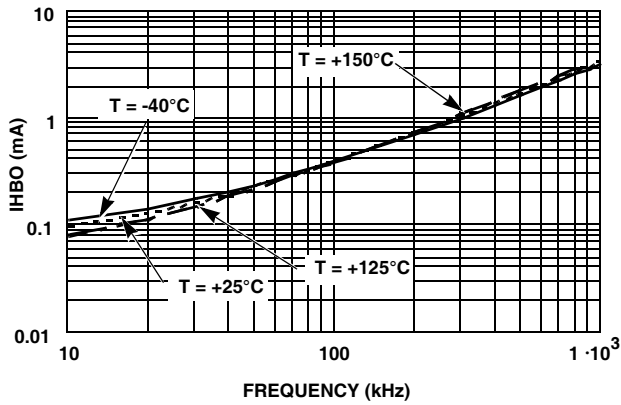


FIGURE 7. IHB OPERATING CURRENT vs FREQUENCY

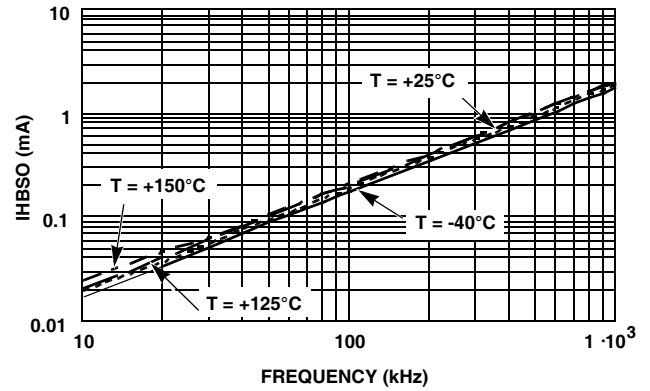


FIGURE 8. IHBS OPERATING CURRENT vs FREQUENCY

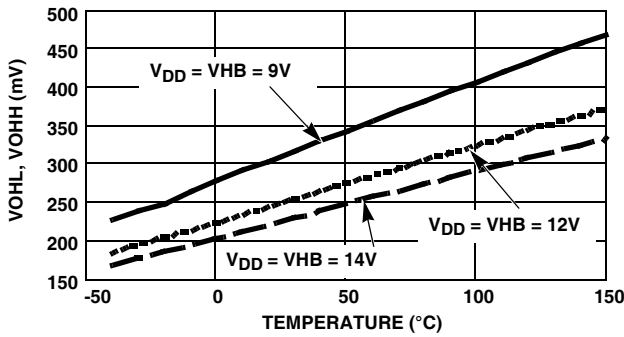


FIGURE 9. HIGH LEVEL OUTPUT VOLTAGE vs TEMPERATURE

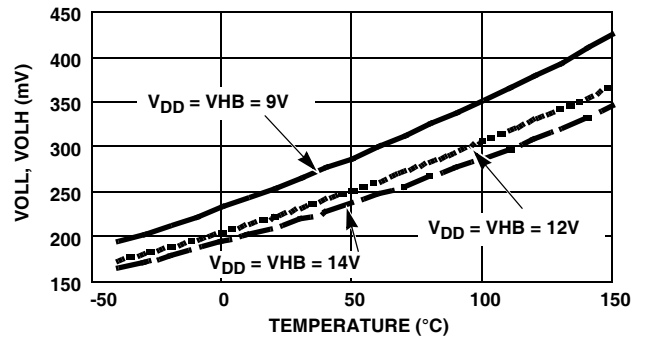


FIGURE 10. LOW LEVEL OUTPUT VOLTAGE vs TEMPERATURE

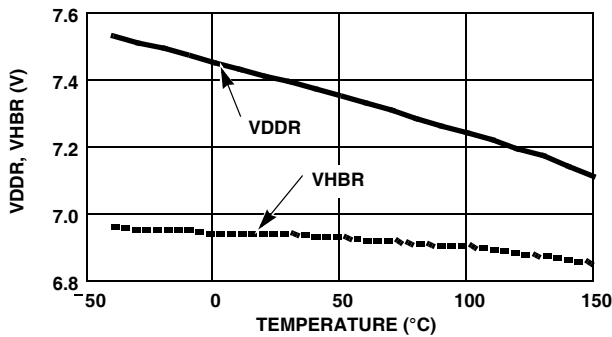


FIGURE 11. UNDERVOLTAGE LOCKOUT THRESHOLD vs TEMPERATURE

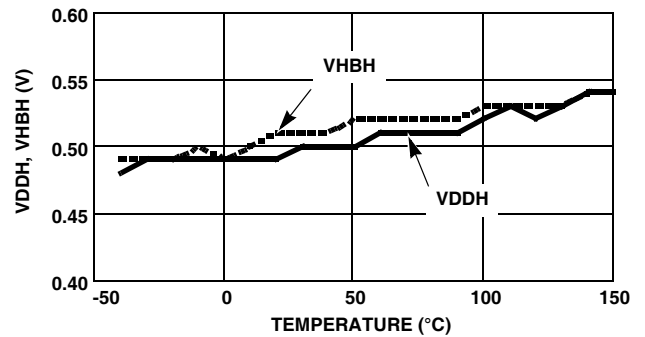


FIGURE 12. UNDERVOLTAGE LOCKOUT HYSTERESIS vs TEMPERATURE

Typical Performance Curves (Continued)

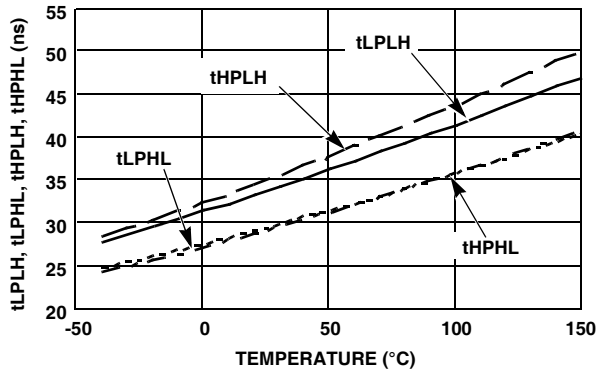


FIGURE 13. ISL2100A PROPAGATION DELAYS vs TEMPERATURE

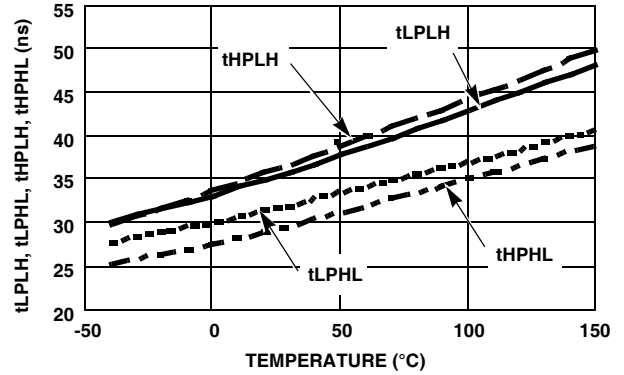


FIGURE 14. ISL2101A PROPAGATION DELAYS vs TEMPERATURE

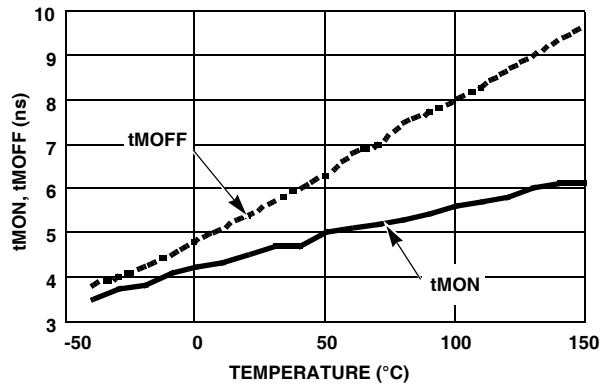


FIGURE 15. ISL2100A DELAY MATCHING vs TEMPERATURE

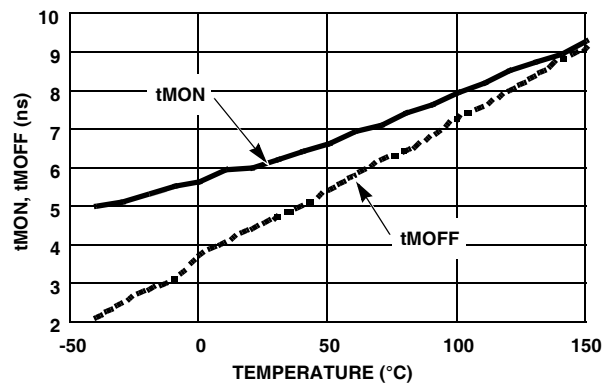


FIGURE 16. ISL2101A DELAY MATCHING vs TEMPERATURE

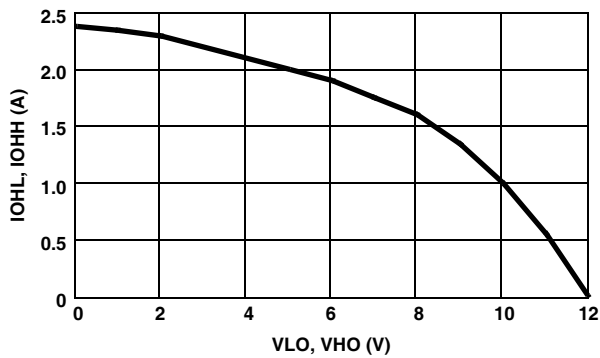


FIGURE 17. PEAK PULL-UP CURRENT vs OUTPUT VOLTAGE

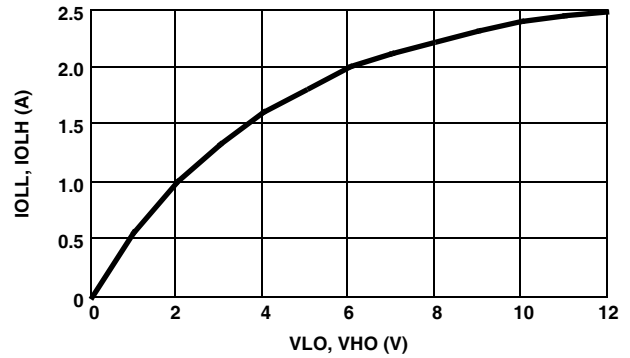


FIGURE 18. PEAK PULL-DOWN CURRENT vs OUTPUT VOLTAGE



Typical Performance Curves (Continued)

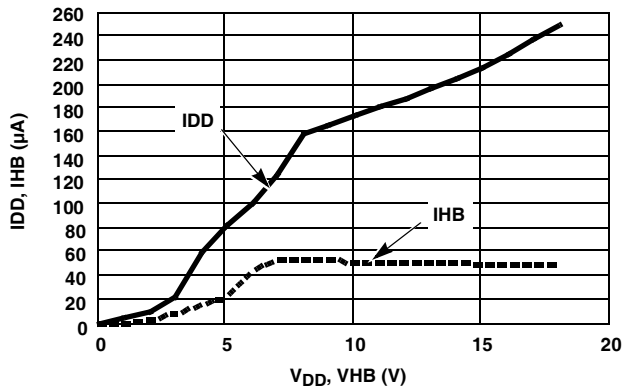


FIGURE 19. ISL2100A QUIESCENT CURRENT vs VOLTAGE

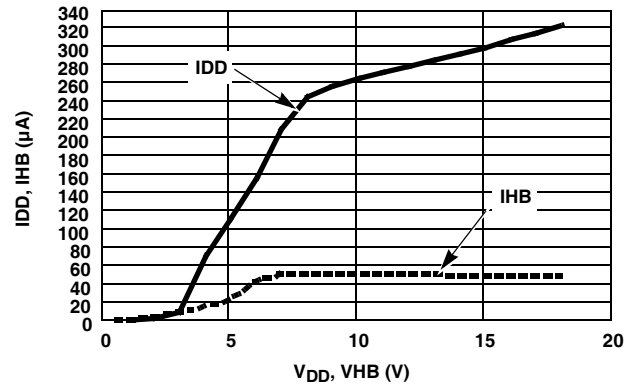


FIGURE 20. ISL2101A QUIESCENT CURRENT vs VOLTAGE

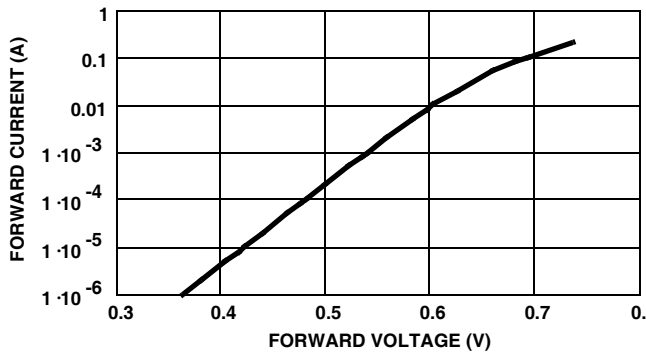


FIGURE 21. BOOTSTRAP DIODE I-V CHARACTERISTICS

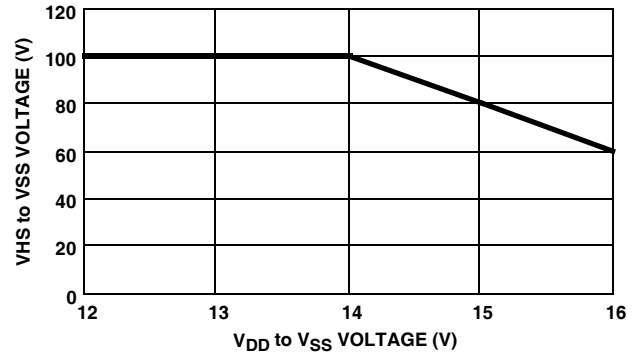
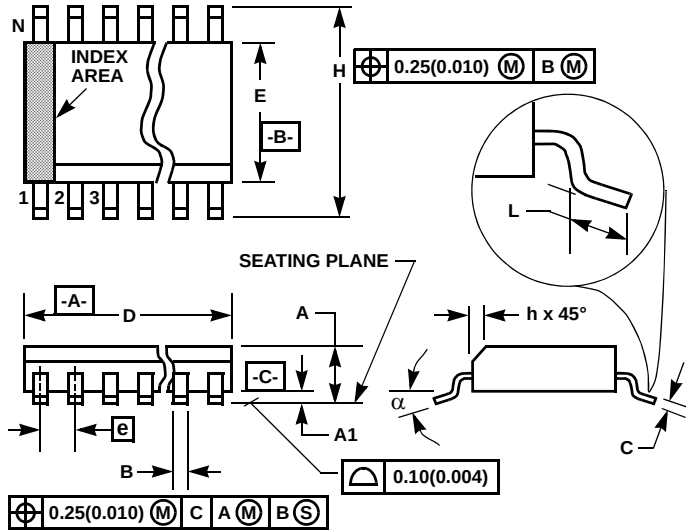


FIGURE 22. VHS VOLTAGE vs VDD VOLTAGE

Small Outline Plastic Packages (SOIC)



NOTES:

5. Symbols are defined in the "MO Series Symbol List" in Section 2.2 of Publication Number 95.
6. Dimensioning and tolerancing per ANSI Y14.5M-1982.
7. 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.
8. Dimension "E" does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
9. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
10. "L" is the length of terminal for soldering to a substrate.
11. "N" is the number of terminal positions.
12. Terminal numbers are shown for reference only.
13. 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).
14. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.

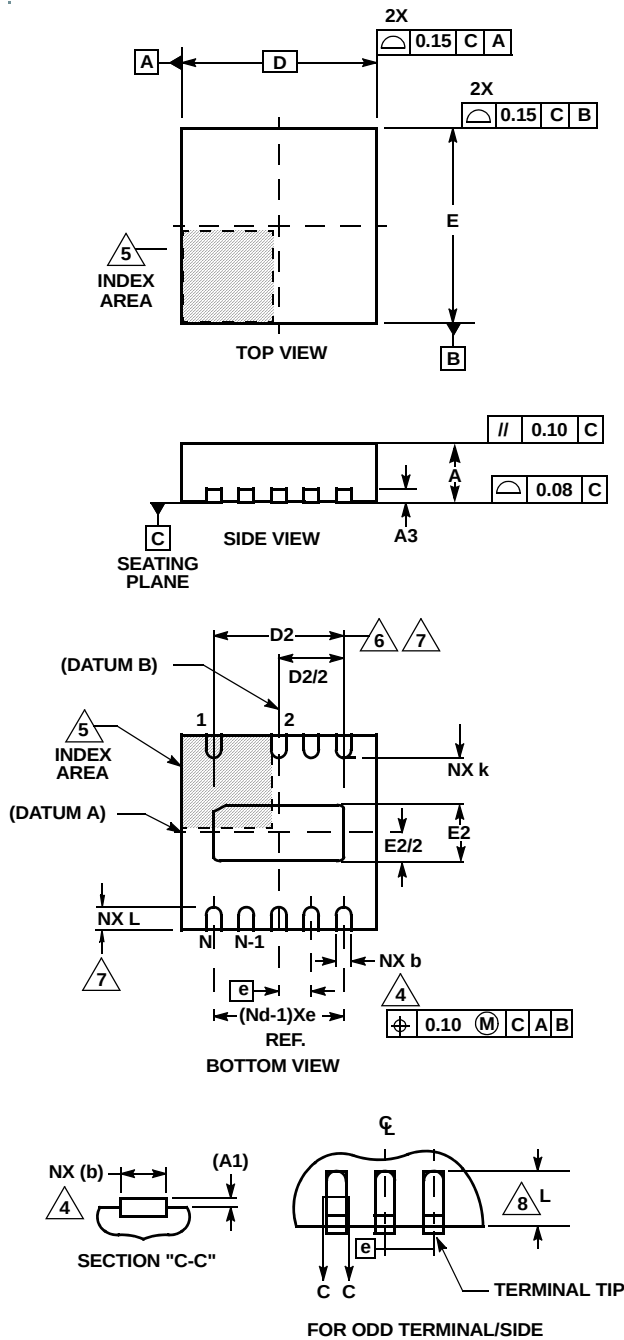
M8.15 (JEDEC MS-012-AA ISSUE C)

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°   | -     |

Rev. 1 6/05

# Dual Flat No-Lead Plastic Package (DFN)



## L9.3x3

### 9 LEAD DUAL FLAT NO-LEAD PACKAGE

| SYMBOL | MILLIMETERS |         |      | NOTES |
|--------|-------------|---------|------|-------|
|        | MIN         | NOMINAL | MAX  |       |
| A      | 0.80        | 0.90    | 1.00 | -     |
| A1     | -           | -       | 0.05 | -     |
| A3     | 0.20 REF    |         |      | -     |
| b      | 0.20        | 0.25    | 0.30 | 4, 7  |
| D      | 3.00 BSC    |         |      | -     |
| D2     | 1.85        | 2.00    | 2.10 | 6, 7  |
| E      | 3.00 BSC    |         |      | -     |
| E2     | 0.80        | 0.95    | 1.05 | 6, 7  |
| e      | 0.50 BSC    |         |      | -     |
| k      | 0.60        | -       | -    | -     |
| L      | 0.25        | 0.35    | 0.45 | 7     |
| N      | 9           |         |      | 2     |

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#### NOTES:

1. Dimensioning and tolerancing conform to ASME Y14.5-1994.
2. N is the number of terminals.
3. All dimensions are in millimeters. Angles are in degrees.
4. Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
5. 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.
6. Dimensions D2 and E2 are for the exposed pads which provide improved electrical and thermal performance.
7. Nominal dimensions are provided to assist with PCB Land Pattern Design efforts, see Intersil Technical Brief TB389.
8. COMPLIANT TO JEDEC MO-229-WEED-3 except for dimensions E2 & D2.

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