# NCP5181

# High Voltage High and Low Side Driver

The NCP5181 is a High Voltage Power MOSFET Driver providing two outputs for direct drive of 2 N−channel power MOSFETs arranged in a half−bridge (or any other high−side + low−side) configuration.

It uses the bootstrap technique to insure a proper drive of the High−side power switch. The driver works with 2 independent inputs to accommodate any topology (including half−bridge, asymmetrical half−bridge, active clamp and full−bridge…).

### Features

- High Voltage Range: up to 600 V
- dV/dt Immunity ±50 V/nsec
- Gate Drive Supply Range from 10 V to 20 V
- High and Low DRV Outputs
- Output Source / Sink Current Capability 1.4 A / 2.2 A
- 3.3 V and 5 V Input Logic Compatible
- Up to $V_{CC}$ Swing on Input Pins
- Matched Propagation Delays between Both Channels
- Outputs in Phase with the Inputs
- Independent Logic Inputs to Accommodate All Topologies
- Under $V_{CC}$ LockOut (UVLO) for Both Channels
- Pin to Pin Compatible with IR2181(S)
- These are Pb−Free Devices

### Applications

- High Power Energy Management
- Half−bridge Power Converters
- Any Complementary Drive Converters (asymmetrical half−bridge, active clamp)
- Full−bridge Converters
- Bridge Inverters for UPS Systems

### PIN ASSIGNMENT

| PIN | FUNCTION |
|---|---|
| IN_HI | Logic Input for High Side Driver Output In Phase |
| IN_LO | Logic Input for Low Side Driver Output In Phase |
| GND | Ground |
| DRV_LO | Low Side Gate Drive Output |
| $V_{CC}$ | Low Side and Main Power Supply |
| $V_{BOOT}$ | Bootstrap Power Supply |
| DRV_HI | High Side Gate Drive Output |
| BRIDGE | Bootstrap Return or High Side Floating Supply Return |

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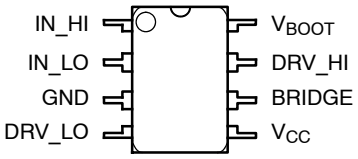
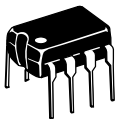


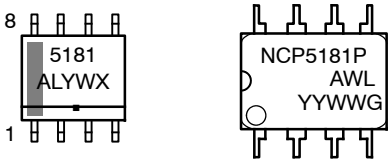


**SOIC−8**
**D SUFFIX**
**CASE 751**



**PDIP−8**
**P SUFFIX**
**CASE 626**

### MARKING DIAGRAMS




NCP5181P,
5181 = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y, YY = Year
W, WW = Work Week
G or ▪ = Pb−Free Package

### ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| NCP5181PG | PDIP−8 (Pb−Free) | 50 Units/Tube |
| NCP5181DR2G | SOIC−8 (Pb−Free) | 2.500/Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

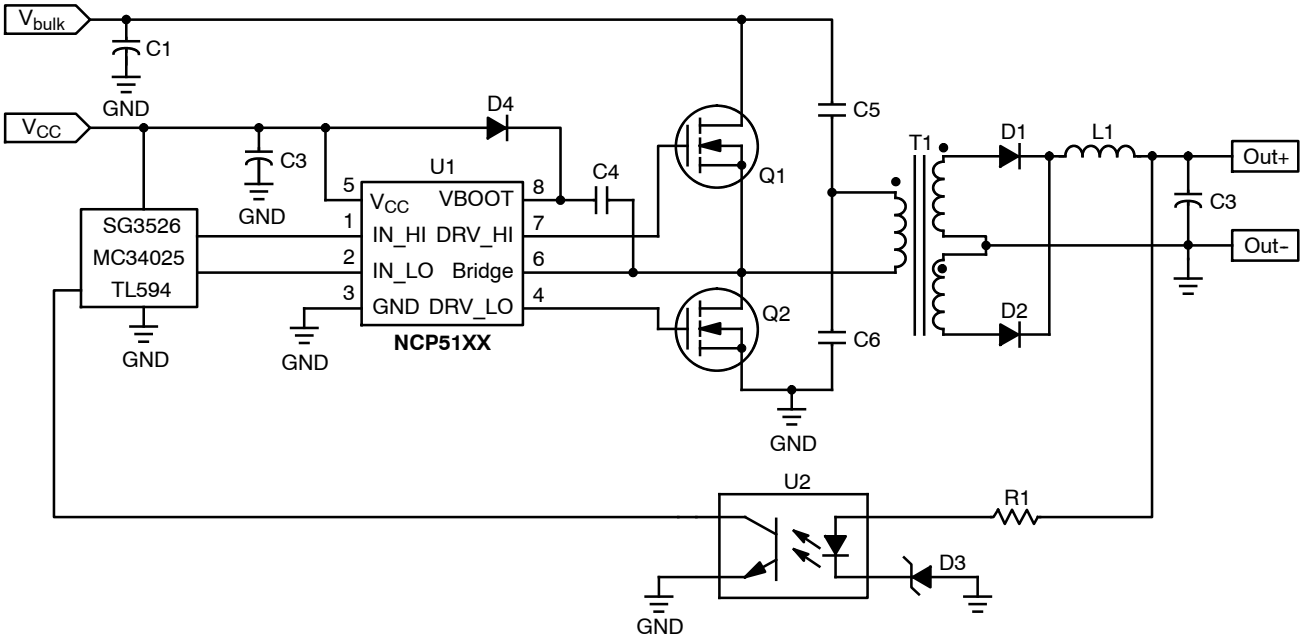



**Figure 1. Typical Application**

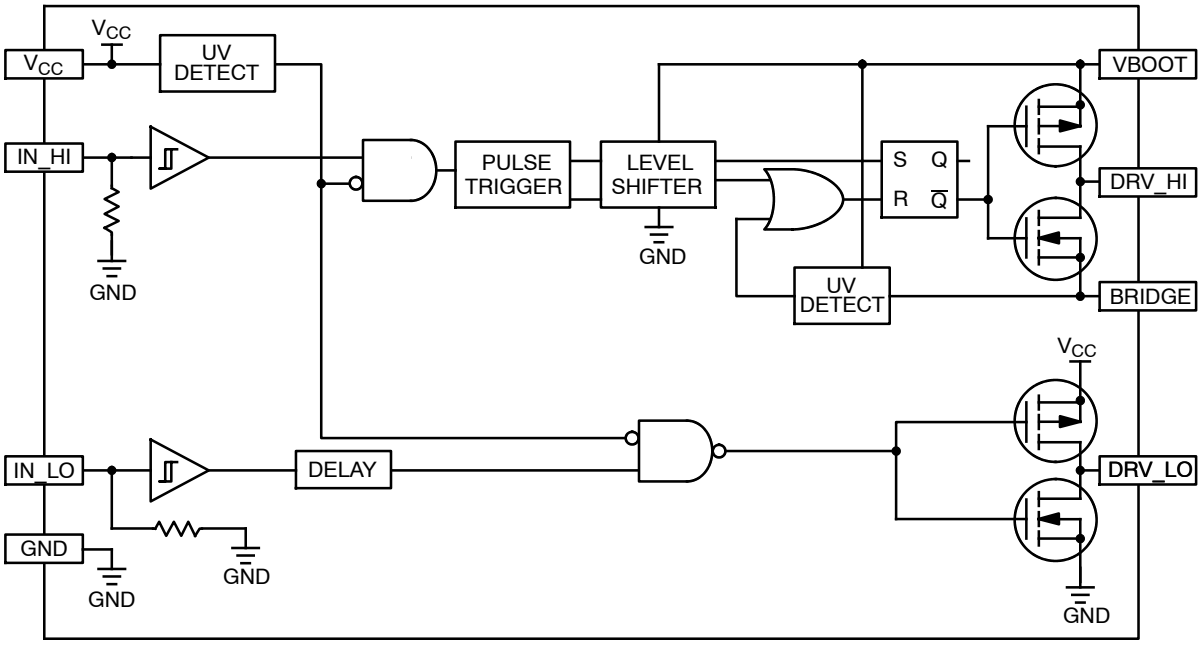



**Figure 2. Detailed Block Diagram**

**MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Main Power Supply Voltage | $V_{CC}$ | −0.3 to 20 | V |
| VHV: High Voltage BOOT Pin | $V_{BOOT}$ | −1 to 620 | V |
| VHV: High Voltage BRIDGE Pin | $V_{BRIDGE}$ | −1 to 600 | V |
| VHV: Floating Supply Voltage | $V_{BOOT}$ − $V_{BRIDGE}$ | 0 to 20 | V |
| VHV: High Side Output Voltage | $V_{DRV\_HI}$ | $V_{BRIDGE}$−0.3 to $V_{BOOT}$+0.3 | V |
| Low Side Output Voltage | $V_{DRV\_LO}$ | −0.3 to $V_{CC}$+0.3 | V |
| Allowable Output Slew Rate | $dV_{BRIDGE}/d_t$ | 50 | V/ns |
| Inputs IN_HI, IN_LO | $V_{IN\_XX}$ | −1.0 to $V_{CC}$+0.3 | V |
| ESD Capability:<br>Human Body Model (All Pins Except Pins 6−7−8)<br>Machine Model (All Pins Except Pins 6−7−8) | | <br>2.0<br>200 | <br>kV<br>V |
| Latchup Capability per Jedec JESD78 | | | |
| Power Dissipation and Thermal Characteristics<br>PDIP8: Thermal Resistance, Junction−to−Air<br>SO−8: Thermal Resistance, Junction−to−Air | <br>$R_{\theta JA}$<br>$R_{\theta JA}$ | <br>100<br>178 | °C/W |
| Maximum Operating Junction Temperature | $T_{J\_max}$ | +150 | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

**ELECTRICAL CHARACTERISTICS** ($V_{CC}$ = $V_{boot}$ = 15 V, $V_{gnd}$ = $V_{bridge}$, −40°C < $T_A$ < 125°C, Outputs loaded with 1 nF)

| Rating | Symbol | $T_A$ −40°C to 125°C | | | Units |
|---|---|---|---|---|---|
| **OUTPUT SECTION** | | | | | |
| | | **Min** | **Typ** | **Max** | |
| Output High Short Circuit pulsed Current<br>$V_{DRV}$ = 0 V, PW ≤ 10 μs, (Note 1) | $I_{DRVhigh}$ | − | 1.4 | − | A |
| Output Low Short Circuit Pulsed Current<br>$V_{DRV}$ = $V_{CC}$, PW ≤ 10 μs, (Note 1) | $I_{DRVlow}$ | − | 2.2 | − | A |
| Output Resistor (Typical Value @ 25°C Only)<br>Source | $R_{OH}$ | − | 5 | 12 | Ω |
| Output Resistor (Typical Value @ 25°C Only)<br>Sink | $R_{OL}$ | − | 2 | 8 | Ω |
| **DYNAMIC OUTPUT SECTION** | | | | | |
| **Rating** | **Symbol** | **Min** | **Typ** | **Max** | **Units** |
| Turn−on Propagation Delay ($V_{bridge}$ = 0 V) | $t_{ON}$ | − | 100 | 170 | ns |
| Turn−off Propagation Delay ($V_{bridge}$ = 0 V or 50 V) (Note 2) | $t_{OFF}$ | − | 100 | 170 | ns |
| Output Voltage Risetime<br>(from 10% to 90% @ $V_{CC}$ = 15 V) with 1 nF Load | $t_r$ | − | 40 | 60 | ns |
| Output Voltage Falling Edge<br>(from 90% to 10% @ $V_{CC}$ = 15 V) with 1 nF Load | $t_f$ | − | 20 | 40 | ns |
| Propagation Delay Matching between the High Side and the Low Side<br>@ 25°C (Note 3) | $\Delta_t$ | − | 20 | 35 | ns |
| Minimum Input Pulse Width that Changes the Output | $t_{PW}$ | − | − | 100 | ns |
| **INPUT SECTION** | | | | | |
| Low Level Input Voltage Threshold | $V_{IN}$ | − | − | 0.8 | V |
| Input Pulldown Resistor ($V_{IN}$ < 0.5 V) | $R_{IN}$ | − | 200 | − | kΩ |
| High Level Input Voltage Threshold | $V_{IN}$ | 2.3 | − | − | V |
| **SUPPLY SECTION** | | | | | |
| $V_{CC}$ UV Startup Voltage Threshold | $V_{CC\_stup}$ | 7.9 | 8.9 | 9.8 | V |
| $V_{CC}$ UV Shutdown Voltage Threshold | $V_{CC\_shtdwn}$ | 7.3 | 8.2 | 9.0 | V |
| Hysteresis on $V_{CC}$ | $V_{CC\_hyst}$ | 0.3 | 0.7 | − | V |
| $V_{boot}$ Startup Voltage Threshold Reference to Bridge Pin<br>($V_{boot\_stup}$ = $V_{boot}$ − $V_{bridge}$) | $V_{boot\_stup}$ | 7.9 | 8.9 | 9.8 | V |
| $V_{boot}$ UV Shutdown Voltage Threshold | $V_{boot\_shtdwn}$ | 7.3 | 8.2 | 9.0 | V |
| Hysteresis on $V_{boot}$ | $V_{boot\_shtdwn}$ | 0.3 | 0.7 | − | V |
| Leakage Current on High Voltage Pins to GND<br>($V_{BOOT}$ = $V_{BRIDGE}$ = DRV_HI = 600 V) | $I_{HV\_LEAK}$ | − | 0.5 | 40 | μA |
| Consumption in Active Mode<br>($V_{CC}$ = $V_{boot}$, $f_{sw}$ = 100 kHz and 1 nF Load on Both Driver Outputs) | $I_{CC1}$ | − | 4.5 | 6.5 | mA |
| Consumption in Inhibition Mode ($V_{CC}$ = $V_{boot}$) | $I_{CC2}$ | − | 250 | 400 | μA |
| $V_{CC}$ Current Consumption in Inhibition Mode | $I_{CC3}$ | − | 215 | − | μA |
| $V_{boot}$ Current Consumption in Inhibition Mode | $I_{CC4}$ | − | 35 | − | μA |

*Note: see also characterization curves
1. Guaranteed by design.
2. Turn−off propagation delay @ $V_{bridge}$ = 600 V is guaranteed by design
3. See characterization curve for $\Delta_t$ parameters variation on the full range temperature.
4. Timing diagram definition see Figures 4, 5 and 6.

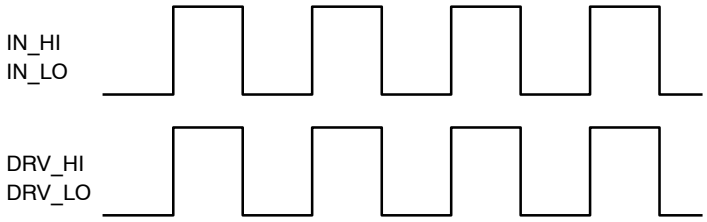



**Figure 3. Input/Output Timing Diagram**

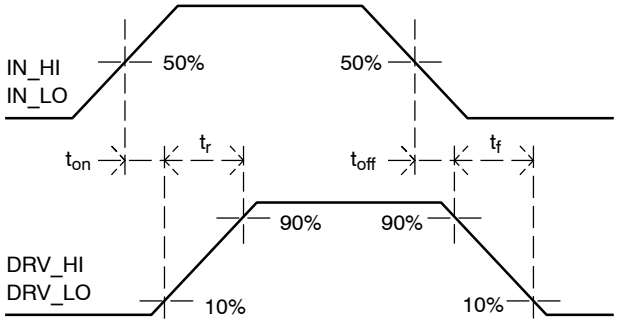



**Figure 4. Switching Time Waveform Definitions**

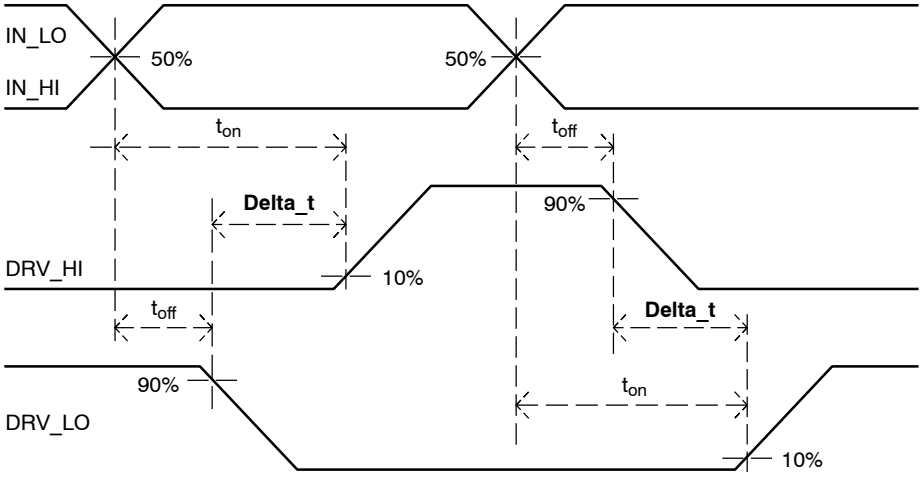



**Figure 5. Delay Matching Waveforms Definition**

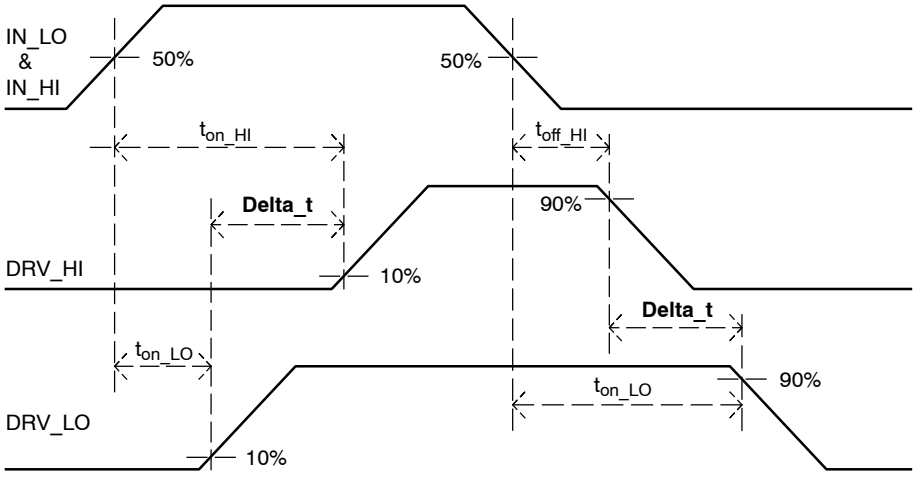



**Figure 6. Other Delay Matching Waveforms Definition**

## TYPICAL CHARACTERISTICS

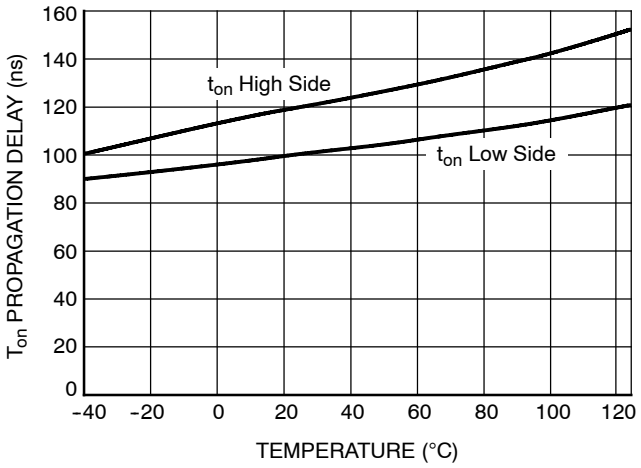



**Figure 7. Turn−on Propagation Delay vs. Temperature**

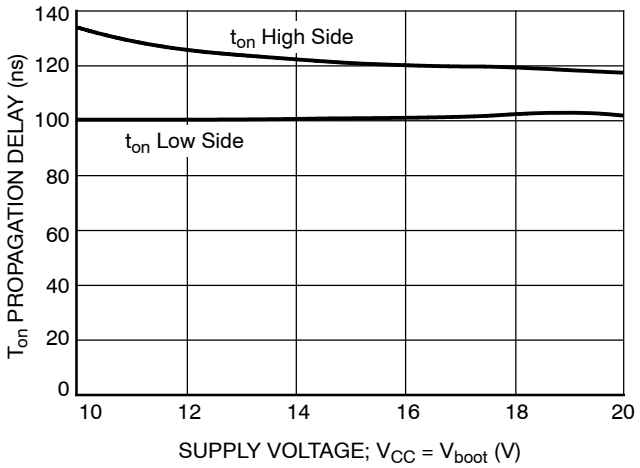



**Figure 8. Turn−on Propagation Delay vs. $V_{CC}$ Voltage ($V_{CC}$ = $V_{boot}$)**

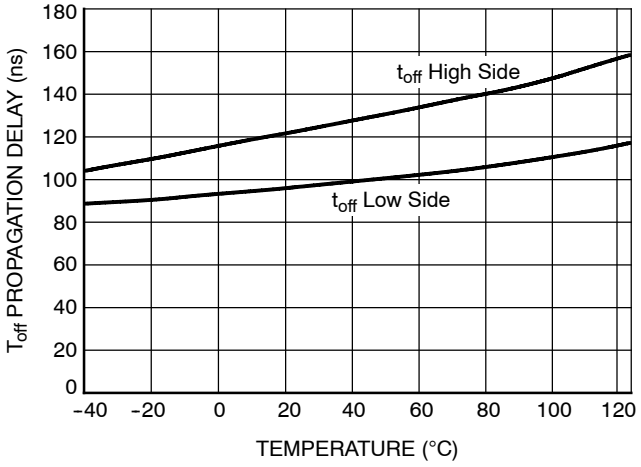



**Figure 9. Turn−off Propagation Delay vs. Temperature**

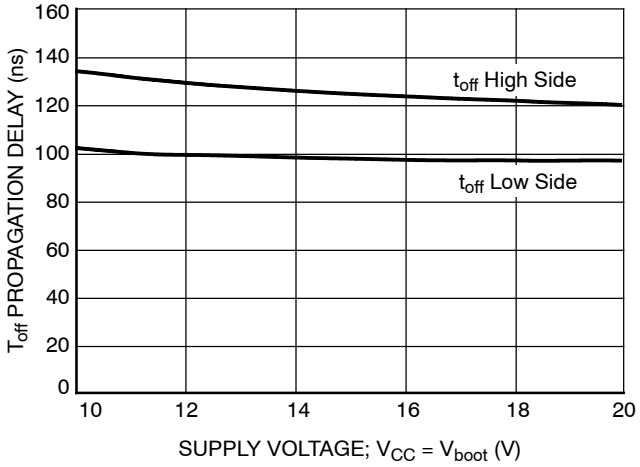



**Figure 10. Turn−off Propagation Delay vs. $V_{CC}$ Voltage ($V_{CC}$ = $V_{boot}$)**

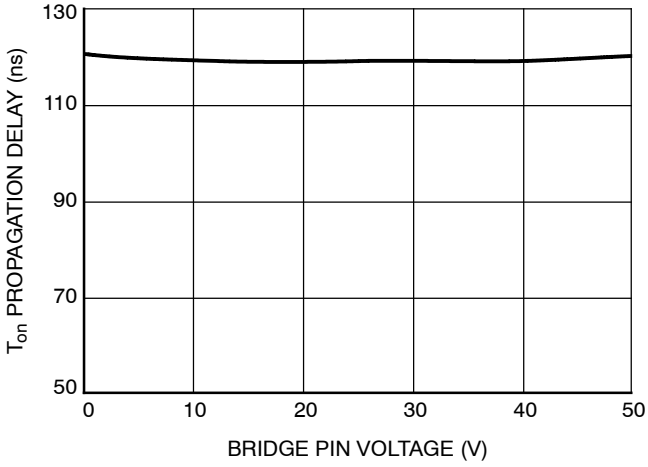



**Figure 11. High Side Turn−on Propagation Delay vs. $V_{BRIDGE}$ Voltage**

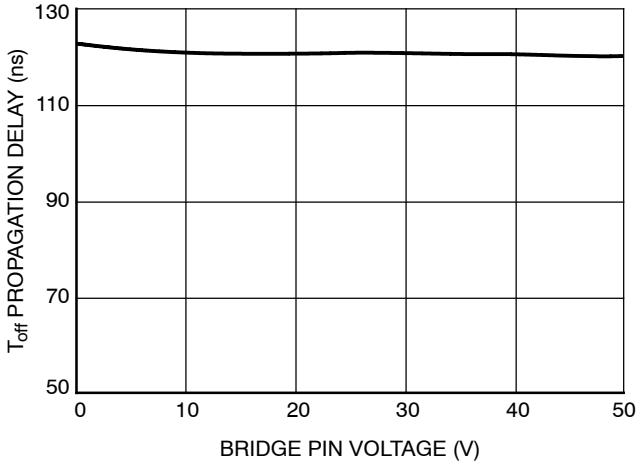



**Figure 12. High Side Turn−off Propagation Delay vs. $V_{BRIDGE}$ Voltage**

## TYPICAL CHARACTERISTICS

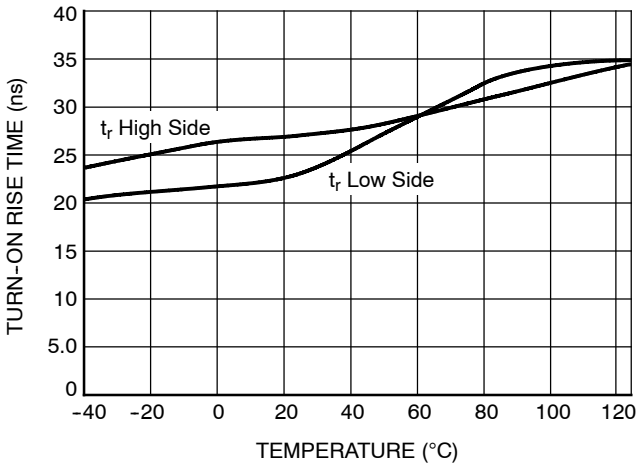



**Figure 13. Turn−on Rise Time vs. Temperature**

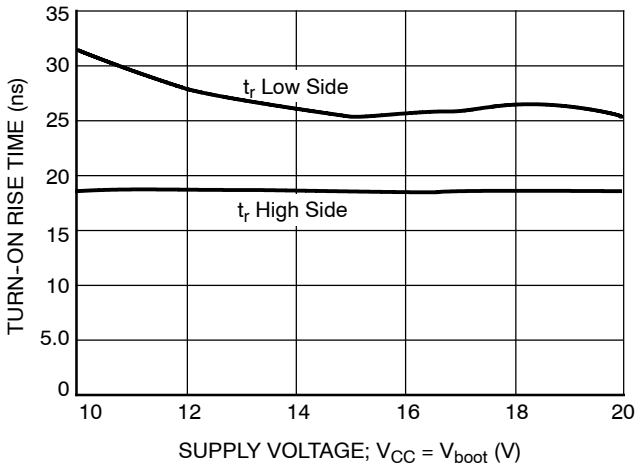



**Figure 14. Turn−on Rise Time vs. $V_{CC}$ Voltage ($V_{CC}$ = $V_{boot}$)**

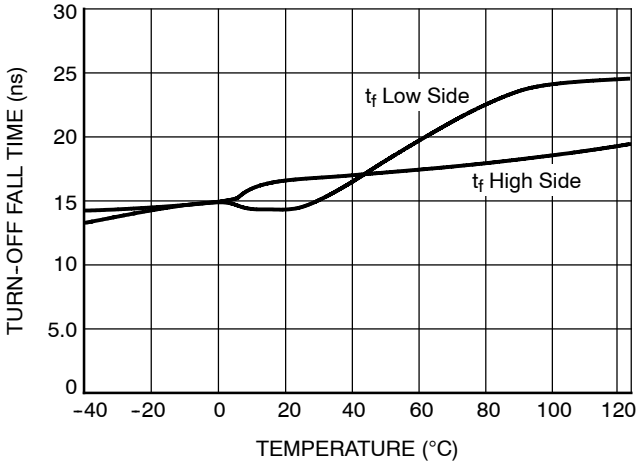



**Figure 15. Turn−off Fall Time vs. Temperature**

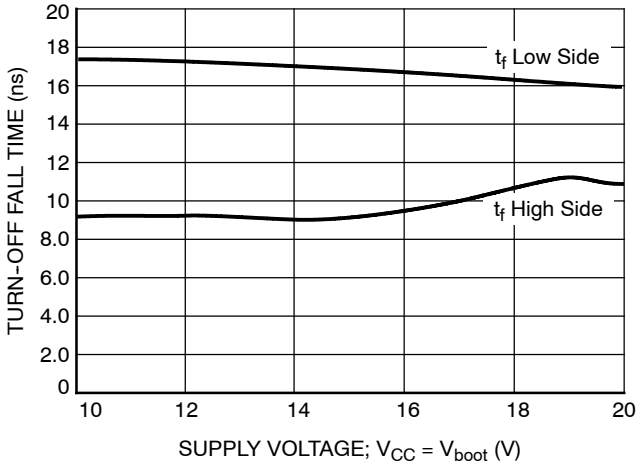



**Figure 16. Turn−off Fall Time vs. $V_{CC}$ Voltage ($V_{CC}$ = $V_{boot}$)**

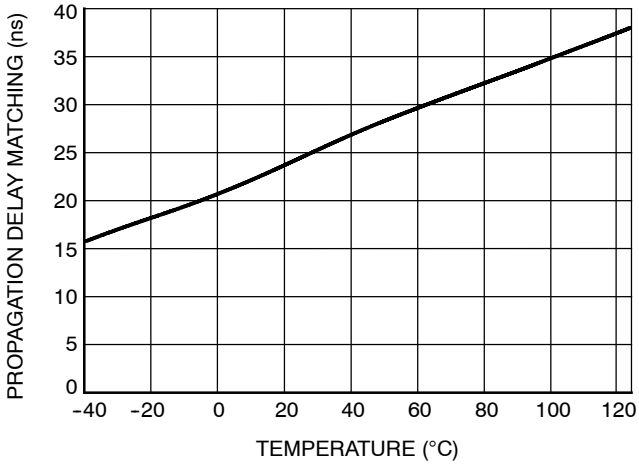



**Figure 17. Propagation Delay Matching Between High Side and Low Side Driver**

## TYPICAL CHARACTERISTICS

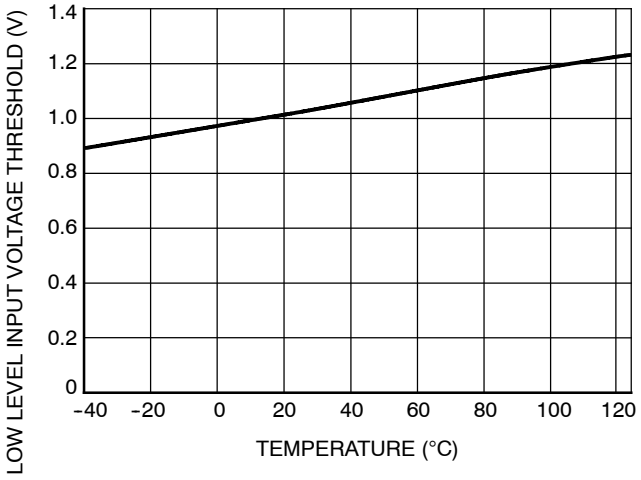



**Figure 18. Low Level Input Voltage Threshold vs. Temperature**

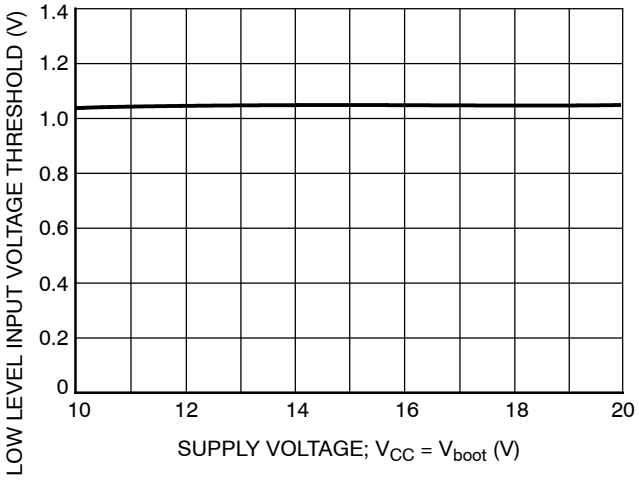



**Figure 19. Low Level Input Voltage Threshold vs. $V_{CC}$ Voltage**

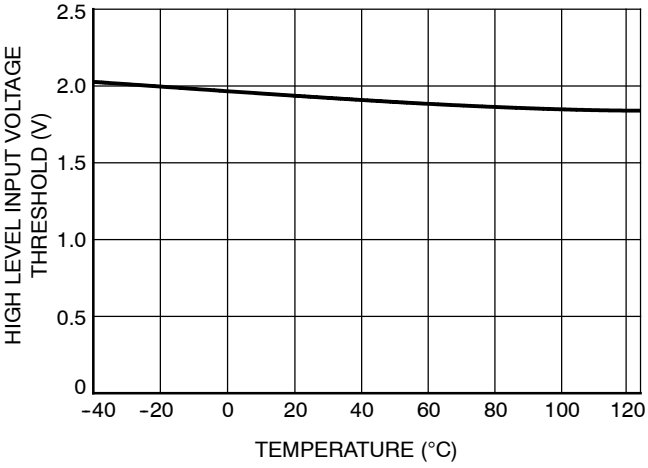



**Figure 20. High Level Input Voltage Threshold vs. Temperature**

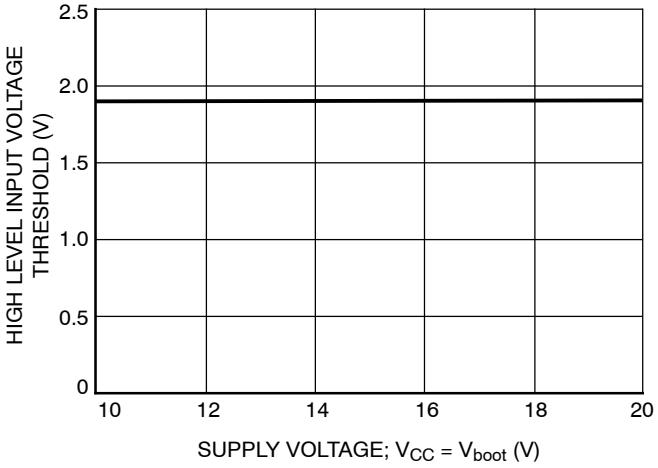



**Figure 21. High Level Input Voltage Threshold vs. $V_{CC}$ Voltage**

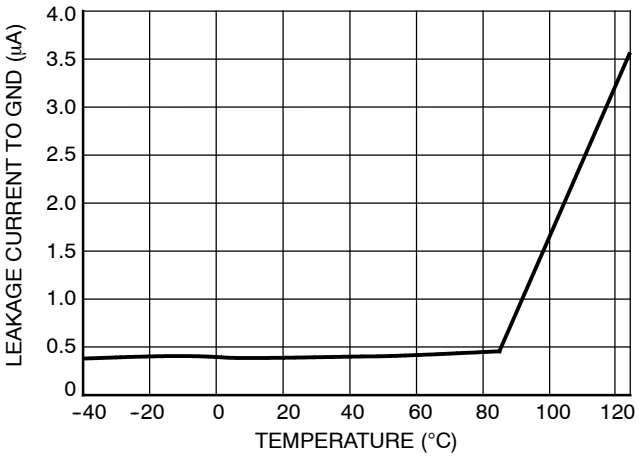



**Figure 22. Leakage Current on High Voltage Pins (600 V) to Ground vs. Temperature**

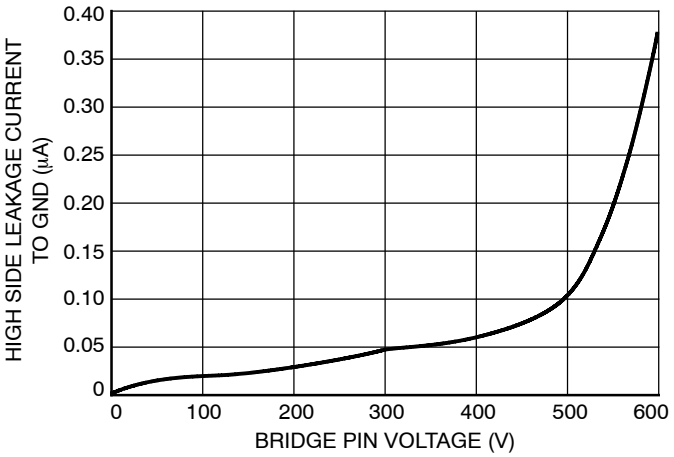



**Figure 23. Leakage Current on High Voltage Pins to Ground vs. $V_{bridge}$ Voltage ($V_{bridge}$ = $V_{boot}$ = $V_{DRV\_HI}$)**

## TYPICAL CHARACTERISTICS

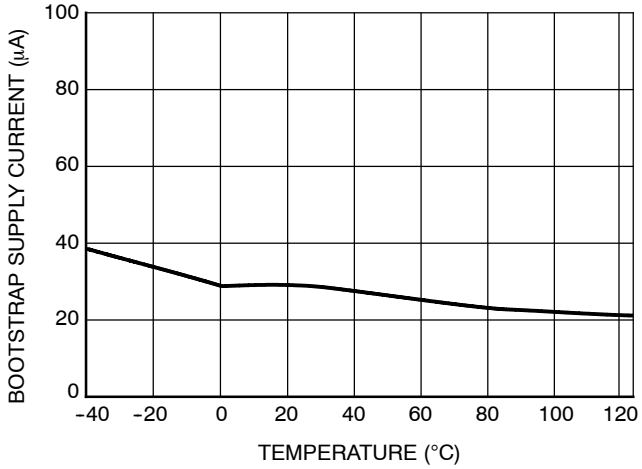



**Figure 24. High Side Supply Current vs. Temperature**

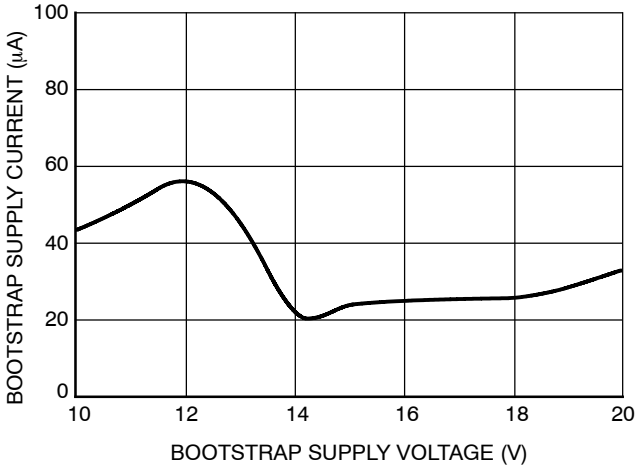



**Figure 25. High Side Supply Current vs. Bootstrap Supply Voltage**

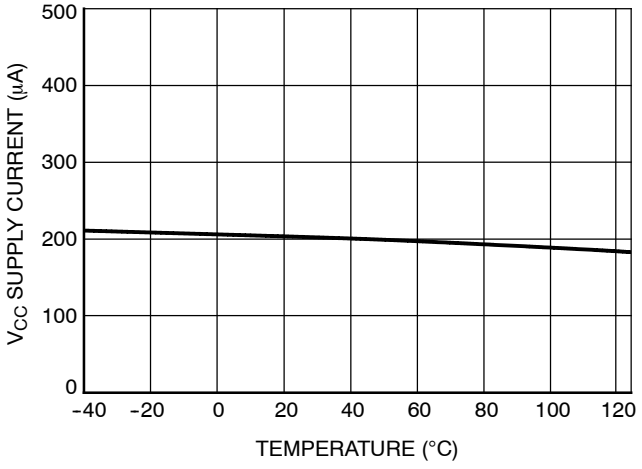



**Figure 26. $V_{CC}$ Supply Current vs. Temperature**

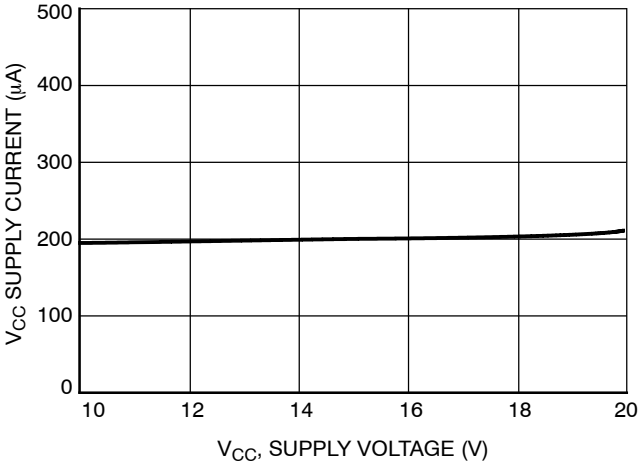



**Figure 27. $V_{CC}$ Supply Current vs. $V_{CC}$ Supply Voltage**

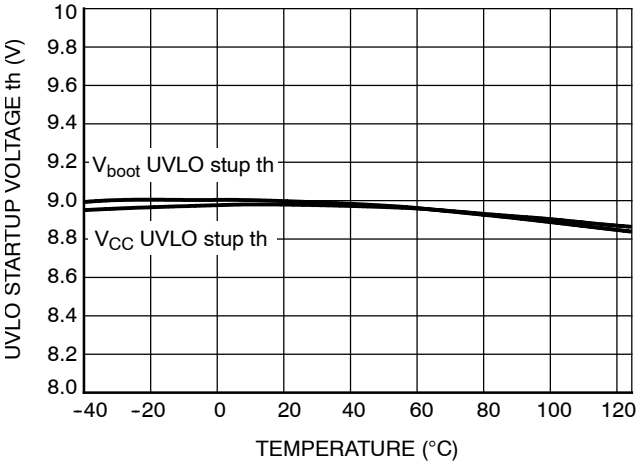



**Figure 28. UVLO Start Up Voltage vs. Temperature**

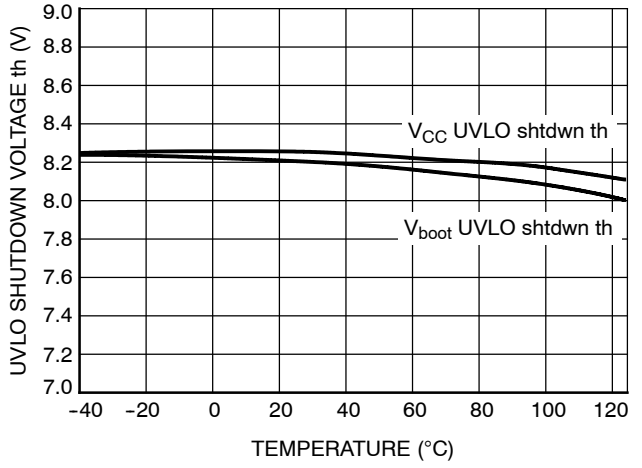



**Figure 29. UVLO Shut Down Voltage vs. Bootstrap Supply Voltage**

## TYPICAL CHARACTERISTICS

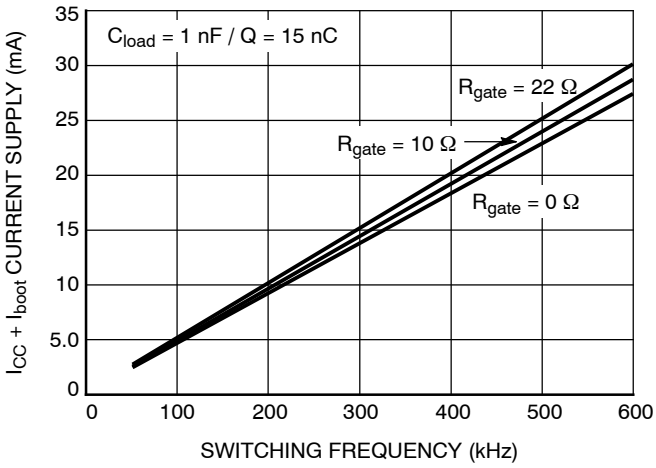



**Figure 30. ICC1 Consumption vs. Switching Frequency with 15 nC Load on Each Driver**

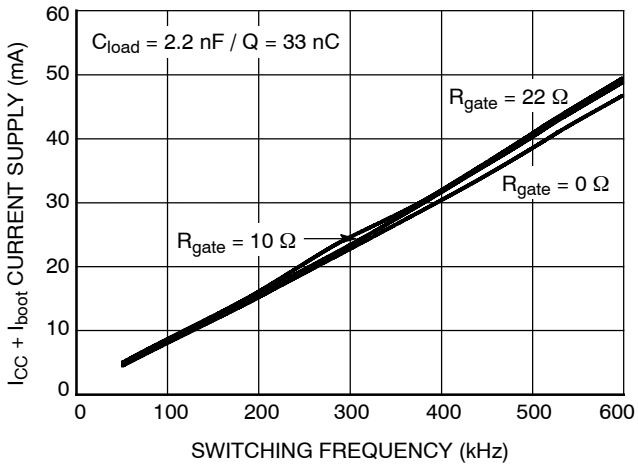



**Figure 31. ICC1 Consumption vs. Switching Frequency with 33 nC Load on Each Driver**

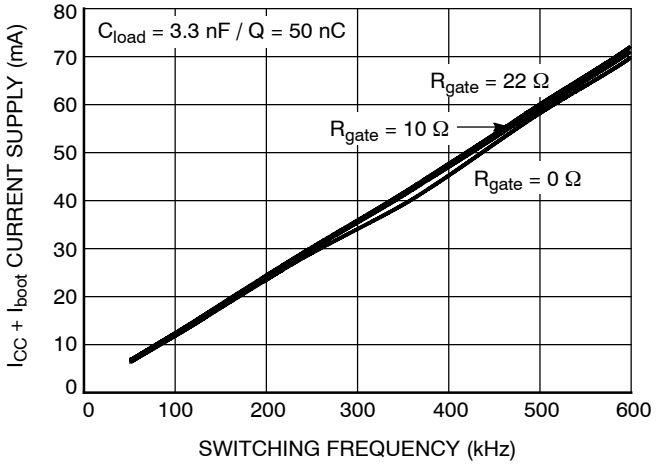



**Figure 32. ICC1 Consumption vs. Switching Frequency with 50 nC Load on Each Driver**

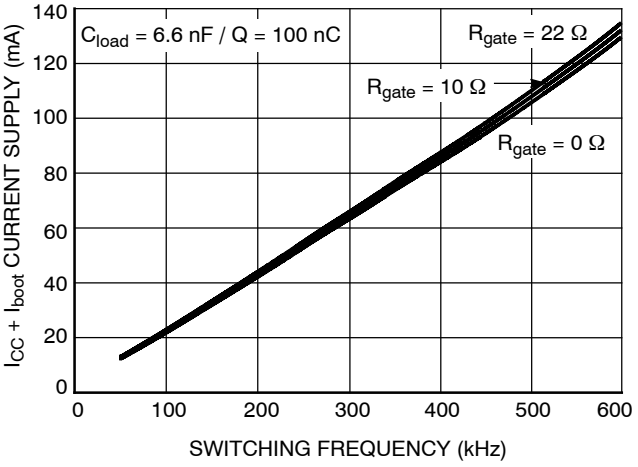
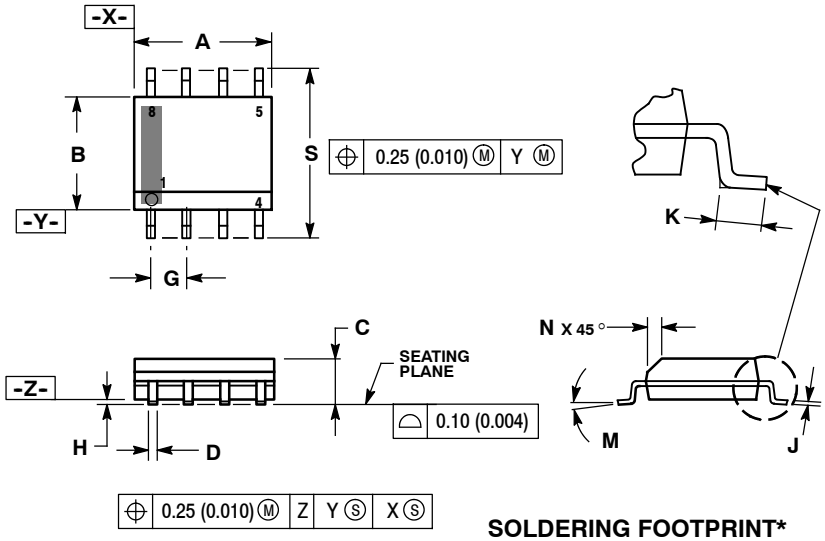



**Figure 33. ICC1 Consumption vs. Switching Frequency with 100 nC Load on Each Driver**

## PACKAGE DIMENSIONS

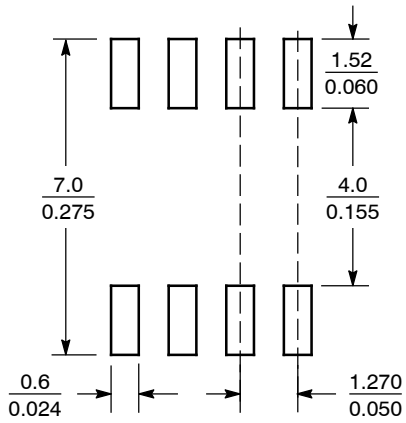
**SOIC−8 NB**
CASE 751−07
ISSUE AJ




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 4.80 | 5.00 | 0.189 | 0.197 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.053 | 0.069 |
| D | 0.33 | 0.51 | 0.013 | 0.020 |
| G | 1.27 BSC | | 0.050 BSC | |
| H | 0.10 | 0.25 | 0.004 | 0.010 |
| J | 0.19 | 0.25 | 0.007 | 0.010 |
| K | 0.40 | 1.27 | 0.016 | 0.050 |
| M | 0 ° | 8 ° | 0 ° | 8 ° |
| N | 0.25 | 0.50 | 0.010 | 0.020 |
| S | 5.80 | 6.20 | 0.228 | 0.244 |

### SOLDERING FOOTPRINT*

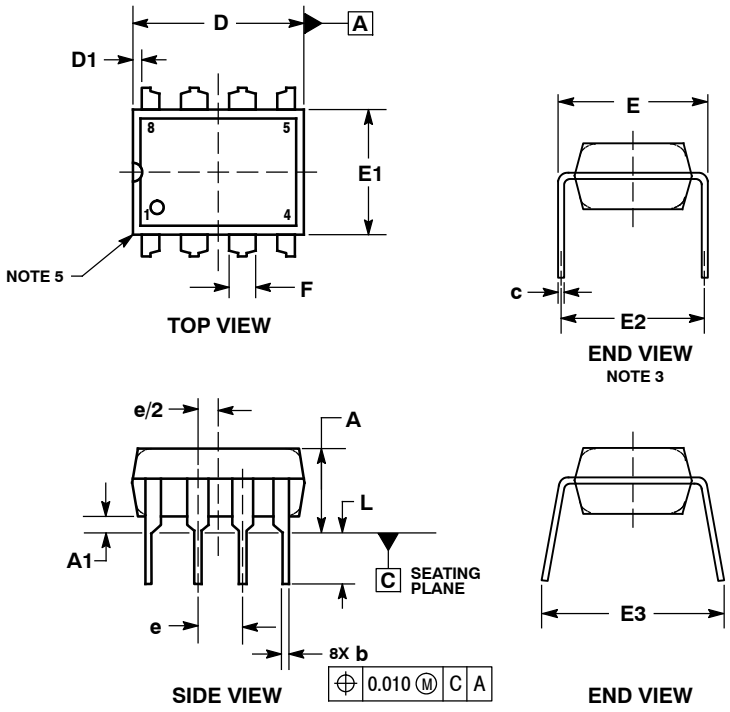



SCALE 6:1 (mm / inches)

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## PACKAGE DIMENSIONS

**8 LEAD PDIP**
CASE 626-05
ISSUE M




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION E IS MEASURED WITH THE LEADS RESTRAINED PARALLEL AT WIDTH E2.
4. DIMENSION E1 DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| | INCHES | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| A | ---- | ---- | 0.210 | ---- | ---- | 5.33 |
| A1 | 0.015 | ---- | ---- | 0.38 | ---- | ---- |
| b | 0.014 | 0.018 | 0.022 | 0.35 | 0.46 | 0.56 |
| C | 0.008 | 0.010 | 0.014 | 0.20 | 0.25 | 0.36 |
| D | 0.355 | 0.365 | 0.400 | 9.02 | 9.27 | 10.02 |
| D1 | 0.005 | ---- | ---- | 0.13 | ---- | ---- |
| E | 0.300 | 0.310 | 0.325 | 7.62 | 7.87 | 8.26 |
| E1 | 0.240 | 0.250 | 0.280 | 6.10 | 6.35 | 7.11 |
| E2 | 0.300 BSC | | | 7.62 BSC | | |
| E3 | ---- | ---- | 0.430 | ---- | ---- | 10.92 |
| e | 0.100 BSC | | | 2.54 BSC | | |
| L | 0.115 | 0.130 | 0.150 | 2.92 | 3.30 | 3.81 |



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