

IRS2111(S)PbF

HALF-BRIDGE DRIVER

Features

- Floating channel designed for bootstrap operation
- Fully operational to +600 V
- Tolerant to negative transient voltage, dV/dt immune
- Gate drive supply range from 10 V to 20 V
- Undervoltage lockout for both channels
- CMOS Schmitt-triggered inputs with pull-down
- Matched propagation delay for both channels
- Internally set deadtime
- High-side output in phase with input
- RoHS compliant

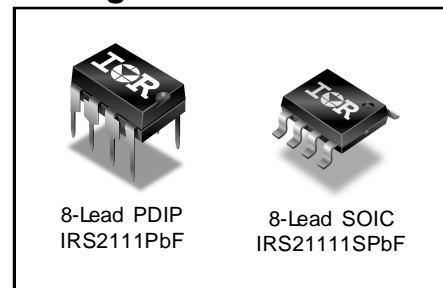
Product Summary

| | |
|----------------------------|-----------------|
| V_{OFFSET} | 600 V max. |
| $I_{\text{O}+/-}$ | 200 mA / 420 mA |
| V_{OUT} | 10 V - 20 V |
| $t_{\text{on/off}}$ (typ.) | 750 ns & 150 ns |
| Deadtime (typ.) | 650 ns |

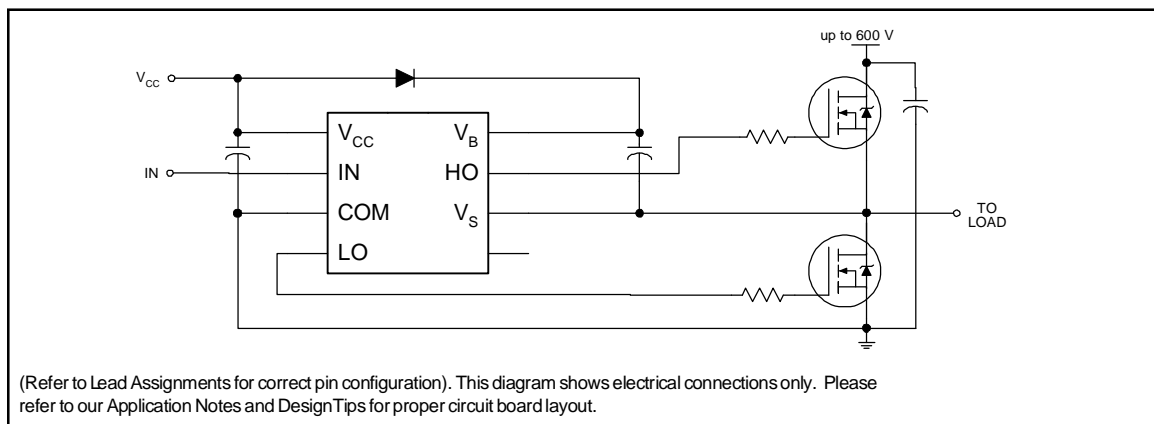
Description

The IRS2111 is a high voltage, high speed power MOSFET and IGBT driver with dependent high-side and low-side referenced output channels designed for half-bridge applications. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. Logic input is compatible with standard CMOS outputs. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. Internal deadtime is provided to avoid shoot-through in the output half-bridge. The floating channel can be used to drive an N-channel power MOSFET or IGBT in the high-side configuration which operates up to 600 V.

Packages



Typical Connection



Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to COM. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Additional information is shown in Figs. 7 through 10.

| Symbol | Definition | Min. | Max. | Units | |
|---------------------|---|----------------------|-----------------------|-------|------|
| V _B | High-side floating supply voltage | -0.3 | 625 (Note 1) | V | |
| V _S | High-side floating supply offset voltage | V _B - 25 | V _B + 0.3 | | |
| V _{HO} | High-side floating output voltage | V _S - 0.3 | V _B + 0.3 | | |
| V _{CC} | Low-side and logic fixed supply voltage | -0.3 | 25 (Note 1) | | |
| V _{LO} | Low-side output voltage | -0.3 | V _{CC} + 0.3 | | |
| V _{IN} | Logic input voltage | -0.3 | V _{CC} + 0.3 | | |
| dV _S /dt | Allowable offset supply voltage transient (Fig. 2) | — | 50 | V/ns | |
| P _D | Package power dissipation @ T _A ≤ +25 °C | (8 Lead PDIP) | — | 1.0 | W |
| | | (8 lead SOIC) | — | 0.625 | |
| R _{thJA} | Thermal resistance, junction to ambient | (8 lead PDIP) | — | 125 | °C/W |
| | | (8 lead SOIC) | — | 200 | |
| T _J | Junction temperature | — | 150 | °C | |
| T _S | Storage temperature | -55 | 150 | | |
| T _L | Lead temperature (soldering, 10 seconds) | — | 300 | | |

Note 1: All supplies are fully tested at 25 V, and an internal 20 V clamp exists for each supply

Recommended Operating Conditions

The input/output logic timing diagram is shown in Fig. 1. For proper operation the device should be used within the recommended conditions. The V_S offset rating is tested with all supplies biased at a 15 V differential.

| Symbol | Definition | Min. | Max. | Units |
|-----------------|--|---------------------|---------------------|-------|
| V _B | High-side floating supply absolute voltage | V _S + 10 | V _S + 20 | V |
| V _S | High-side floating supply offset voltage | Note 2 | 600 | |
| V _{HO} | High-side floating output voltage | V _S | V _B | |
| V _{CC} | Low-side and logic fixed supply voltage | 10 | 20 | |
| V _{LO} | Low-side output voltage | 0 | V _{CC} | |
| V _{IN} | Logic input voltage | 0 | V _{CC} | |
| T _A | Ambient temperature | -40 | 125 | °C |

Note 2: Logic operational for V_S of -5 V to +600 V. Logic state held for V_S of -5 V to -V_{BS}. (Please refer to the Design Tip DT97-3 for more details).

Dynamic Electrical Characteristics

V_{BIAS} (V_{CC} , V_{BS}) = 15 V, C_L = 1000 pF and T_A = 25 °C unless otherwise specified. The dynamic electrical characteristics are measured using the test circuit shown in Fig. 3.

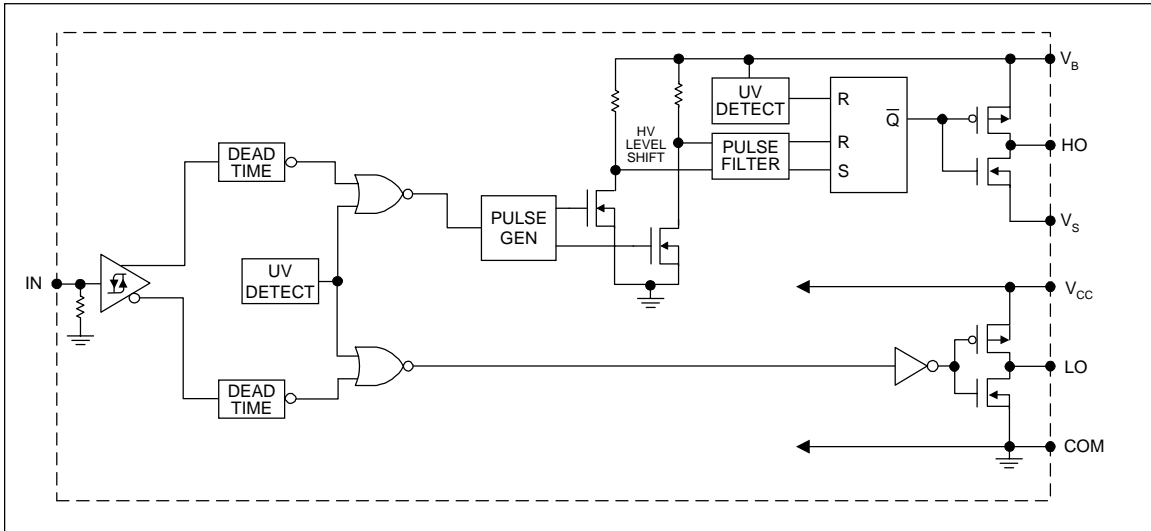
| Symbol | Definition | Min. | Typ. | Max. | Units | Test Conditions |
|-----------|---|------|------|------|-------|-----------------|
| t_{on} | Turn-on propagation delay | 550 | 750 | 950 | ns | $V_S = 0$ V |
| t_{off} | Turn-off propagation delay | — | 150 | 180 | | $V_S = 600$ V |
| t_r | Turn-on rise time | — | 75 | 130 | | |
| t_f | Turn-off fall time | — | 35 | 65 | | |
| DT | Deadtime, LS turn-off to HS turn-on & HS turn-off to LS turn-on | 480 | 650 | 820 | | |
| MT | Delay matching, HS & LS turn-on/off | — | 30 | — | | |

Static Electrical Characteristics

V_{BIAS} (V_{CC} , V_{BS}) = 15 V and T_A = 25 °C unless otherwise specified. The V_{IN} , V_{TH} , and I_{IN} parameters are referenced to COM. The V_O and I_O parameters are referenced to COM and are applicable to the respective output leads: HO or LO.

| Symbol | Definition | Min. | Typ. | Max. | Units | Test Conditions | |
|-------------|---|------|------|------|----------------------------|--|---------------------|
| V_{IH} | Logic "1" input voltage for HO & logic "0" for LO | 6.4 | — | — | V | $V_{CC} = 10$ V | |
| | | 9.5 | — | — | | $V_{CC} = 15$ V | |
| | | 12.6 | — | — | | $V_{CC} = 20$ V | |
| V_{IL} | Logic "0" input voltage for HO & logic "1" for LO | — | — | 3.8 | | $V_{CC} = 10$ V | |
| | | — | — | 6.0 | | $V_{CC} = 15$ V | |
| | | — | — | 8.3 | | $V_{CC} = 20$ V | |
| V_{OH} | High level output voltage, $V_{BIAS} - V_O$ | — | 0.05 | 0.2 | | | $I_O = 2$ mA |
| V_{OL} | Low level output voltage, V_O | — | 0.02 | 0.1 | | | |
| I_{LK} | Offset supply leakage current | — | — | 50 | | μ A | $V_B = V_S = 600$ V |
| I_{QBS} | Quiescent V_{BS} supply current | — | 50 | 100 | $V_{IN} = 0$ V or V_{CC} | | |
| I_{QCC} | Quiescent V_{CC} supply current | — | 70 | 180 | $V_{IN} = V_{CC}$ | | |
| I_{IN+} | Logic "1" input bias current | — | 30 | 50 | $V_{IN} = 0$ V | | |
| I_{IN-} | Logic "0" input bias current | — | — | 5.0 | | | |
| V_{BSUV+} | V_{BS} supply undervoltage positive going threshold | 7.6 | 8.6 | 9.6 | V | | |
| V_{BSUV-} | V_{BS} supply undervoltage negative going threshold | 7.2 | 8.2 | 9.2 | | | |
| V_{CCUV+} | V_{CC} supply undervoltage positive going threshold | 7.6 | 8.6 | 9.6 | | | |
| V_{CCUV-} | V_{CC} supply undervoltage negative going threshold | 7.2 | 8.2 | 9.2 | | | |
| I_{O+} | Output high short circuit pulsed current | 200 | 290 | — | mA | $V_O = 0$ V, $V_{IN} = V_{CC}$ $PW \leq 10$ μ s | |
| I_{O-} | Output low short circuit pulsed current | 420 | 600 | — | | $V_O = 15$ V, $V_{IN} = 0$ V $PW \leq 10$ μ s | |

Functional Block Diagram



Lead Definitions

| Symbol | Description |
|-----------------|--|
| IN | Logic input for high-side and low-side gate driver outputs (HO & LO), in phase with HO |
| V _B | High-side floating supply |
| HO | High-side gate drive output |
| V _S | High-side floating supply return |
| V _{CC} | Low-side and logic fixed supply |
| LO | Low-side gate drive output |
| COM | Low-side return |

Lead Assignments

| | |
|---|---|
| <p>8 Lead DIP</p> <p>IRS2111</p> | <p>8 Lead SOIC</p> <p>IRS2111S</p> |
| Part Number | |

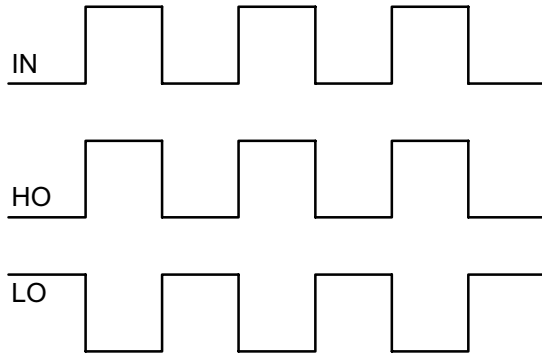


Figure 1. Input/Output Timing Diagram

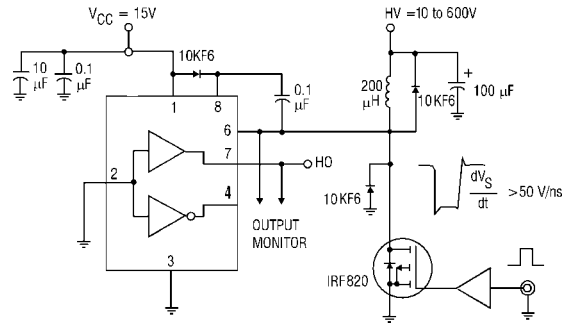


Figure 2. Floating Supply Voltage Transient Test Circuit

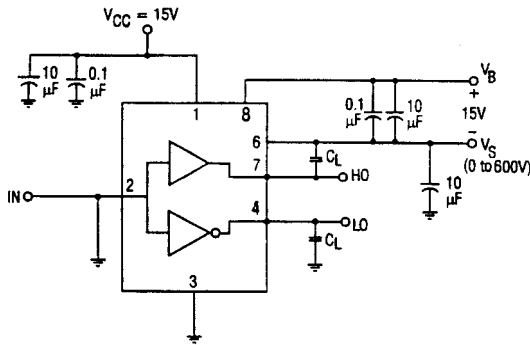


Figure 3. Switching Time Test Circuit

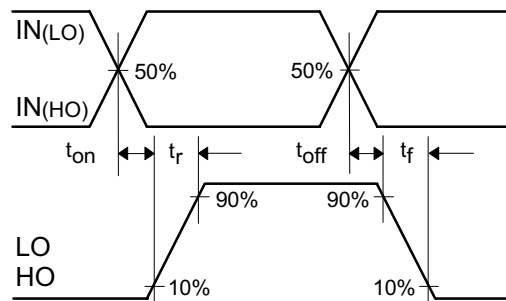


Figure 4. Switching Time Waveform Definition

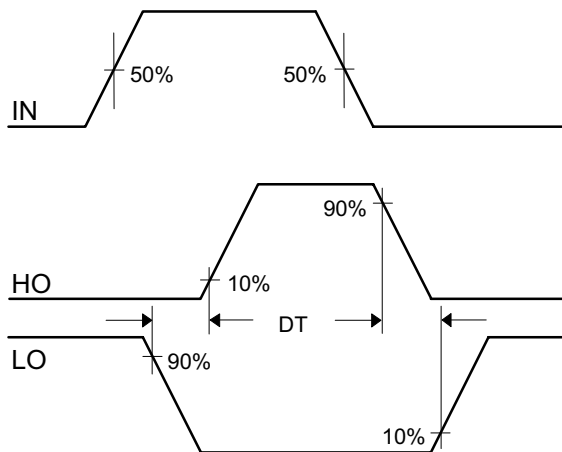


Figure 5. Deadtime Waveform Definitions

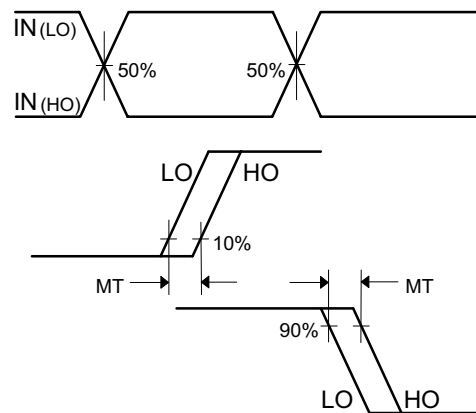


Figure 6. Delay Matching Waveform Definitions

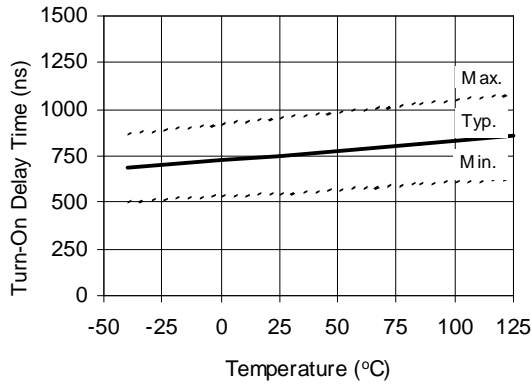


Figure 7A Turn-On Time vs Temperature

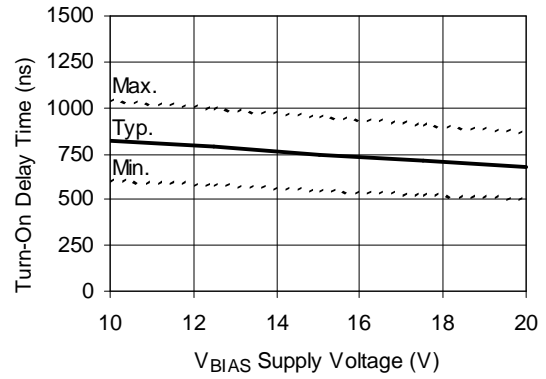


Figure 7B Turn-On Time vs Voltage

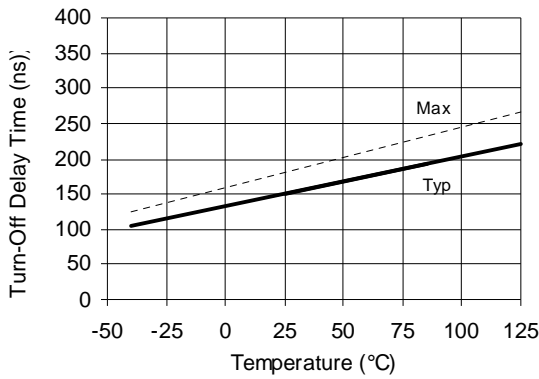


Figure 8A Turn-Off Time vs Temperature

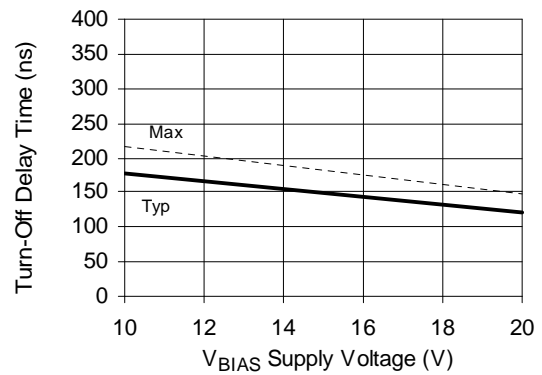


Figure 8B Turn-Off Time vs Voltage

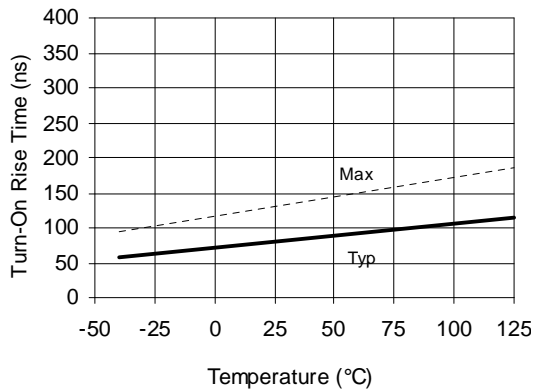


Figure 9A Turn-On Rise Time vs Temperature

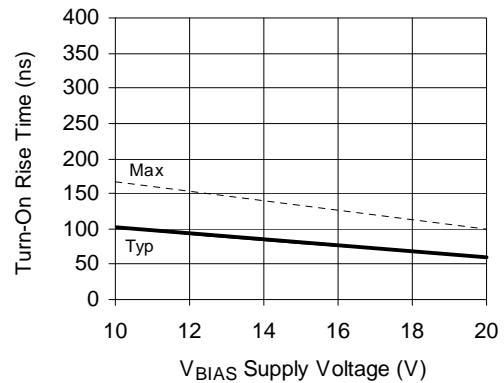


Figure 9B Turn-On Rise Time vs Voltage

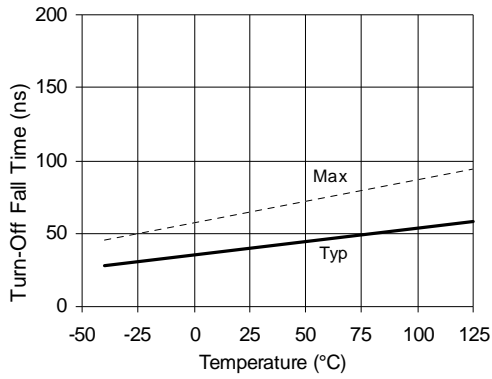


Figure 10A Turn-Off Fall Time vs Temperature

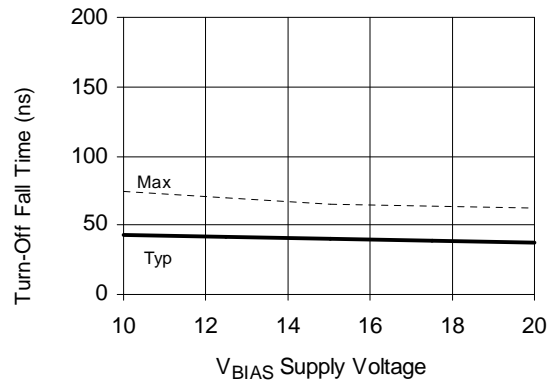


Figure 10B Turn-Off Fall Time vs Voltage

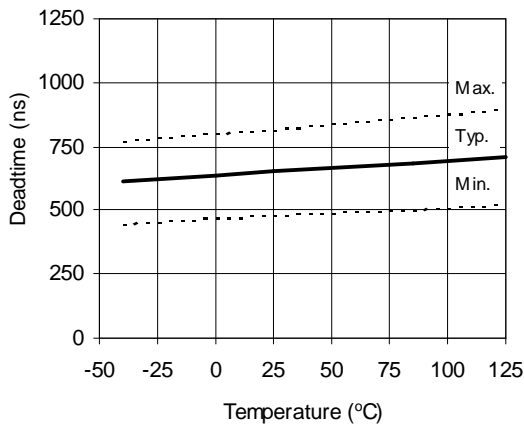


Figure 11A Deadtime vs Temperature

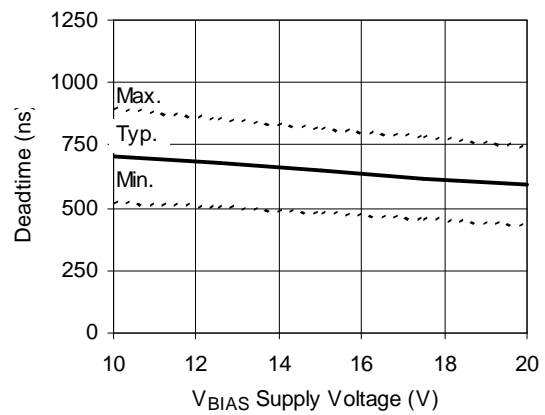


Figure 11B Deadtime vs Voltage

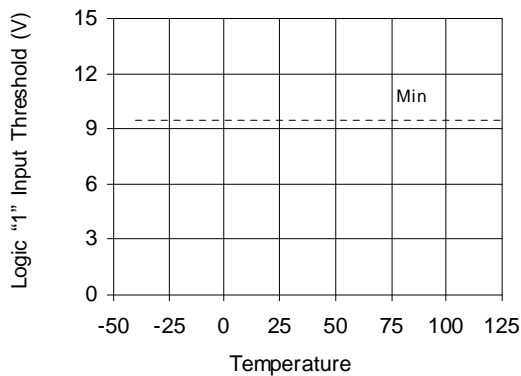


Figure 12A Logic "1" Input voltage for HO & Logic "0" for LO vs Temperature

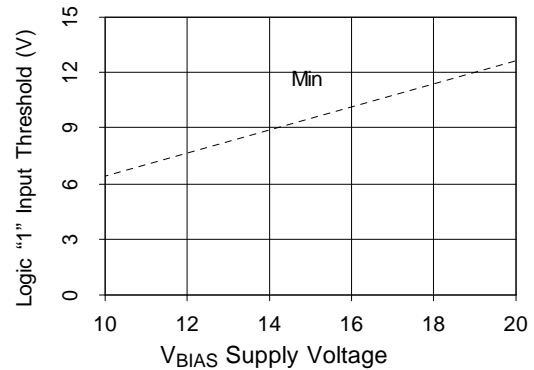


Figure 12B Logic "1" Input voltage for HO & Logic "0" for LO vs Voltage

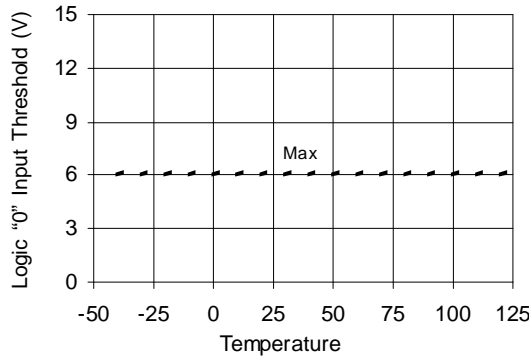


Figure 13A Logic "0" Input voltage for HO & Logic "1" for LO vs Temperature

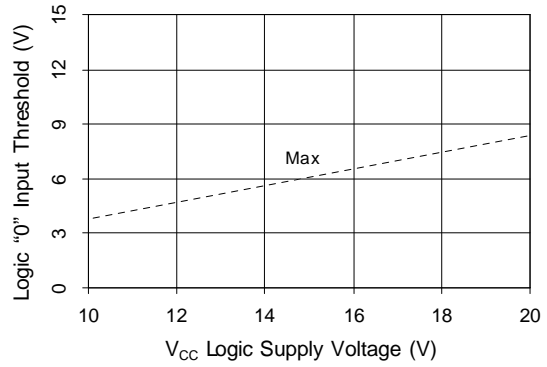


Figure 13B Logic "0" Input voltage for HO & Logic "1" for LO vs Voltage

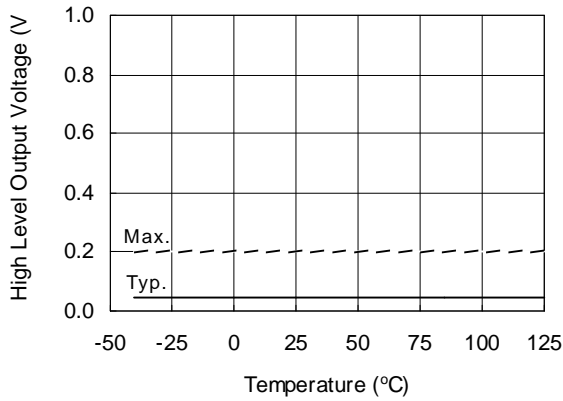


Figure 14A. High Level Output vs. Temperature

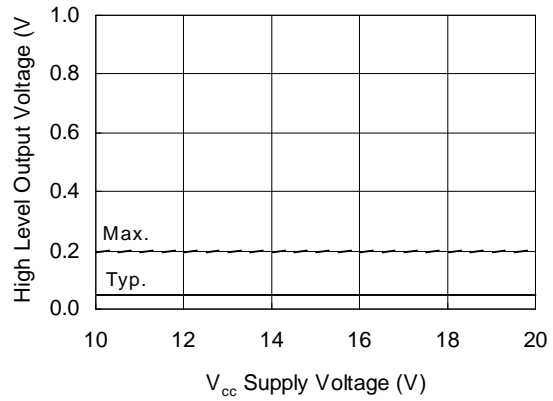


Figure 14B. High Level Output vs. Supply Voltage

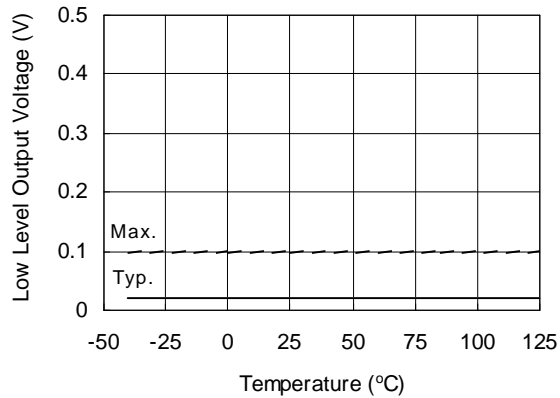


Figure 15A. Low Level Output vs. Temperature

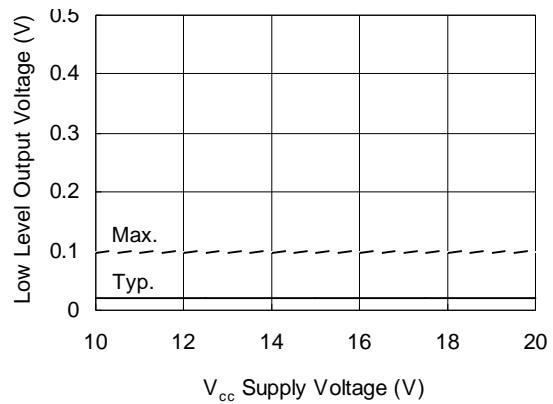


Figure 15B. Low Level Output vs. Voltage

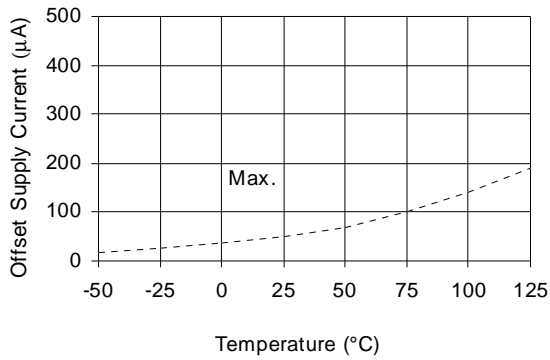


Figure 16A Offset Supply Current vs Temperature

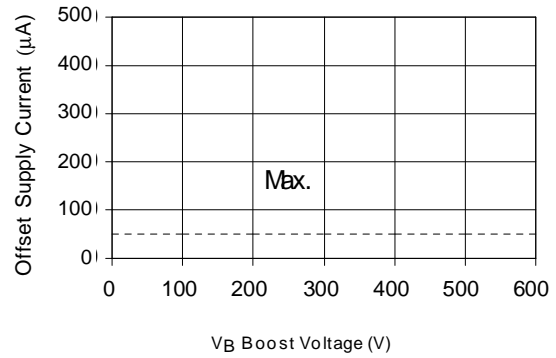


Figure 16B Offset Supply Current vs Voltage

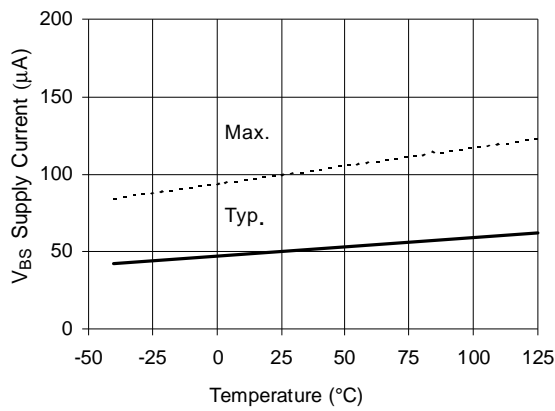


Figure 17A V_{BS} Supply Current vs Temperature

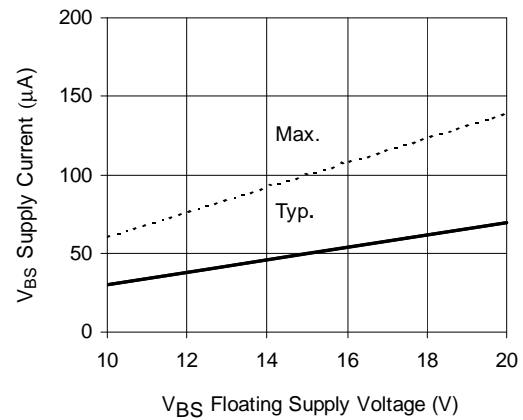


Figure 17B V_{BS} Supply Current vs Voltage

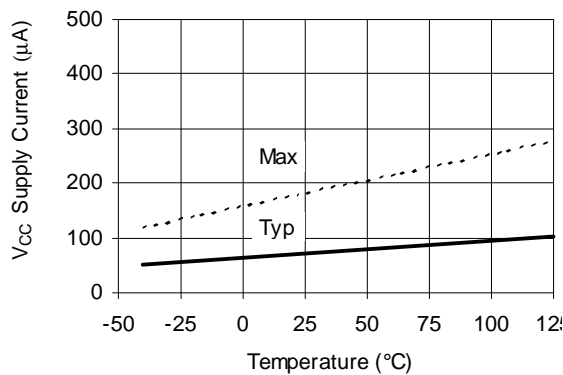


Figure 18A V_{CC} Supply Current vs Temperature

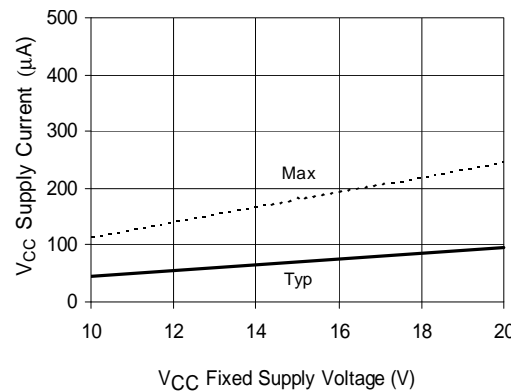


Figure 18B V_{CC} Supply Current vs Voltage

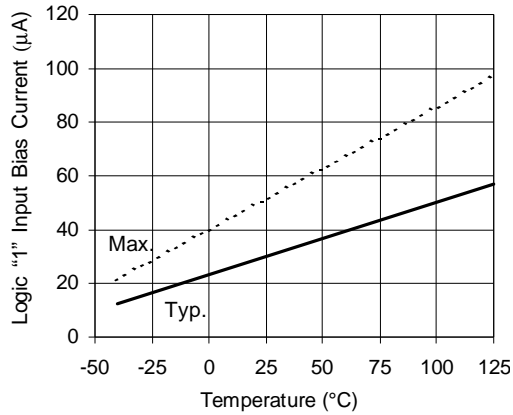


Figure 19A Logic "1" Input Current vs. Temperature

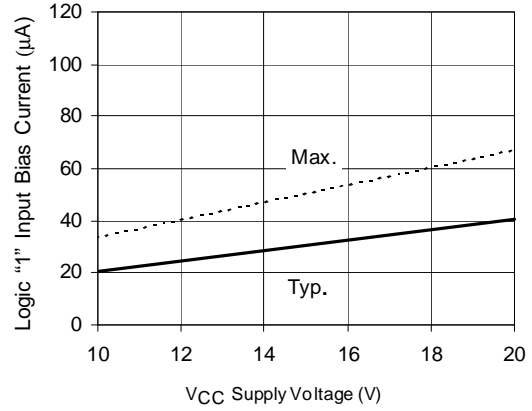


Figure 19B Logic "1" Input Current vs. V_{CC} Voltage

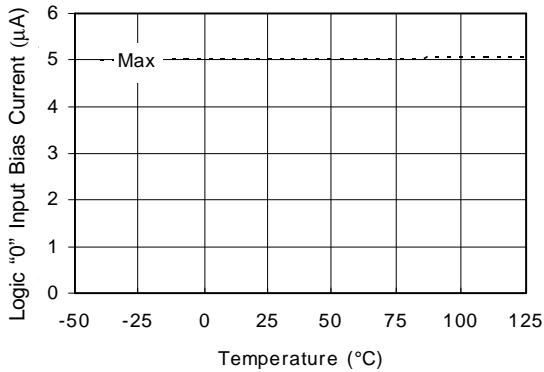


Figure 20A. Logic "0" Input Bias Current vs. Temperature

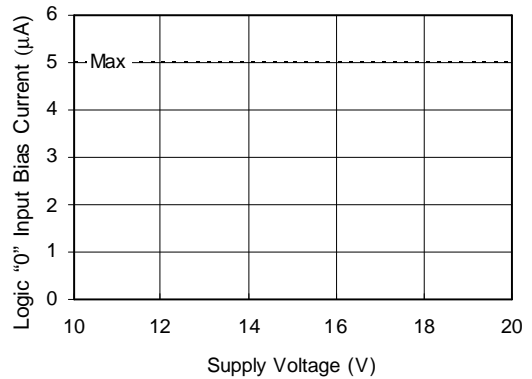


Figure 20B. Logic "0" Input Bias Current vs. V_{CC} Voltage

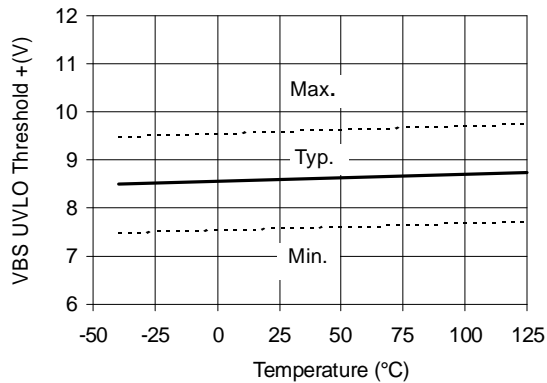


Figure 21 V_{BS} Undervoltage Threshold (+) vs. Temperature

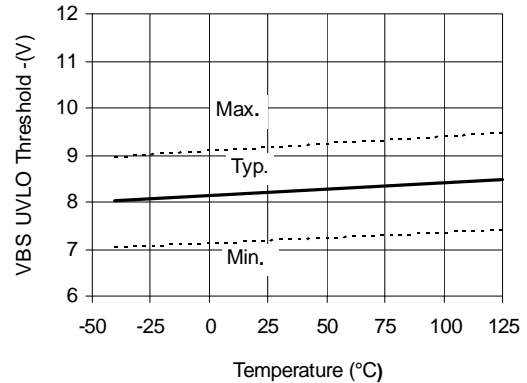


Figure 22 V_{BS} Undervoltage Threshold (-) vs. Temperature

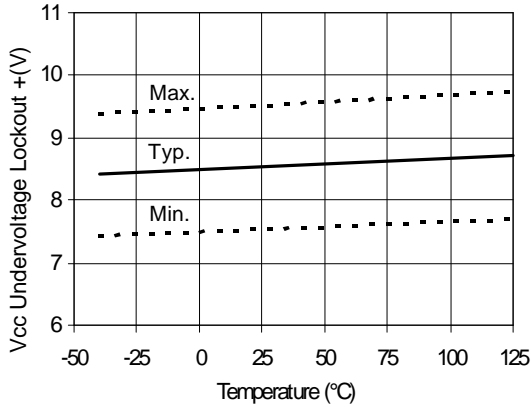


Figure 23 V_{CC} Undervoltage (-) vs Temperature

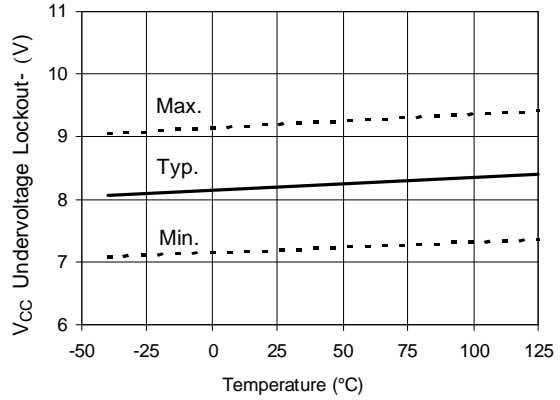


Figure 24 V_{CC} Undervoltage (-) vs Temperature

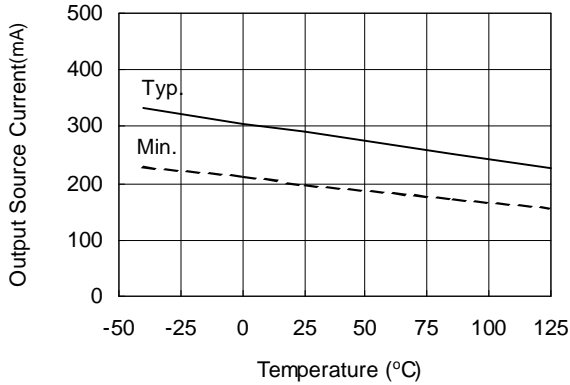


Figure 25A Output Source Current vs Temperature

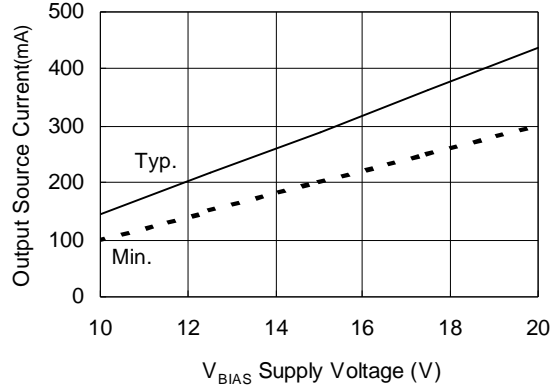


Figure 25B Output Source Current vs Voltage

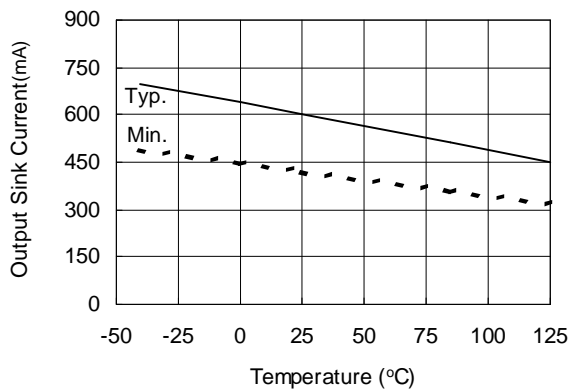


Figure 26A Output Sink Current vs Temperature

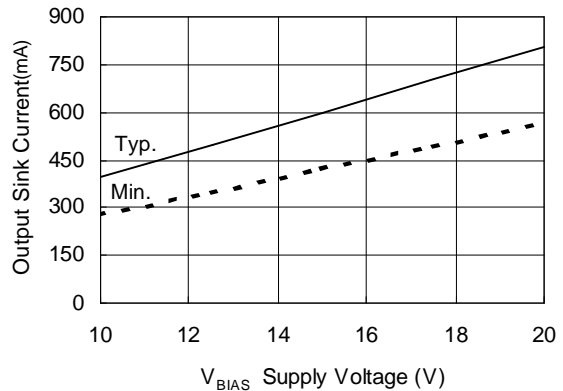
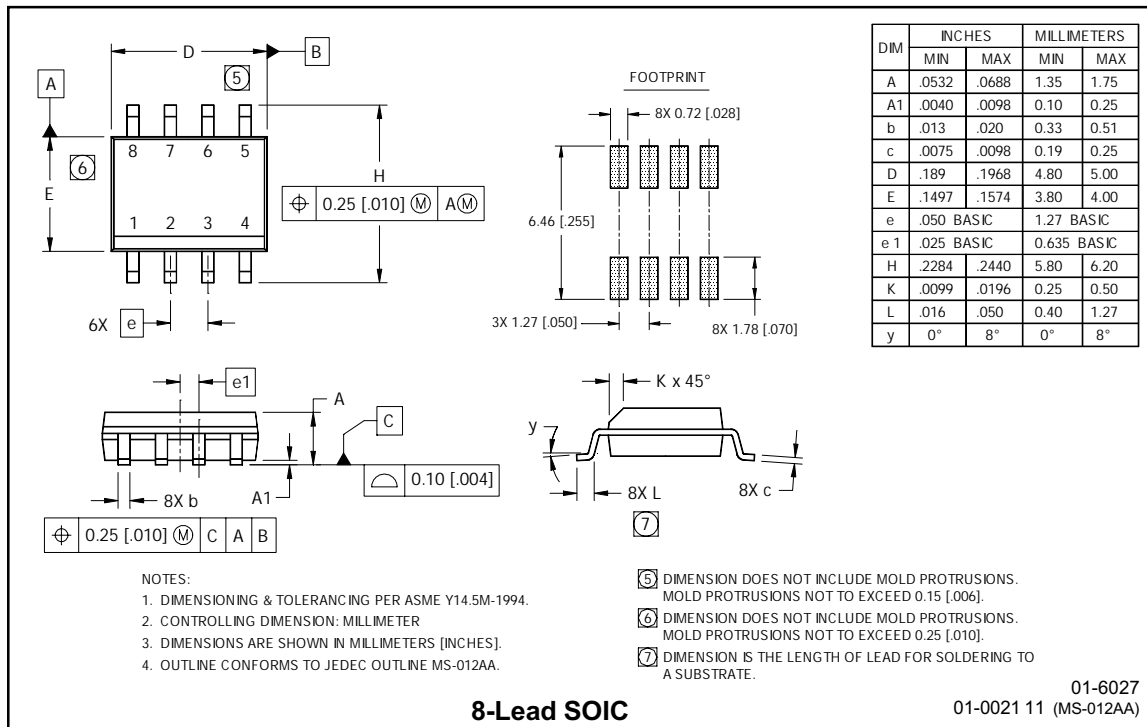
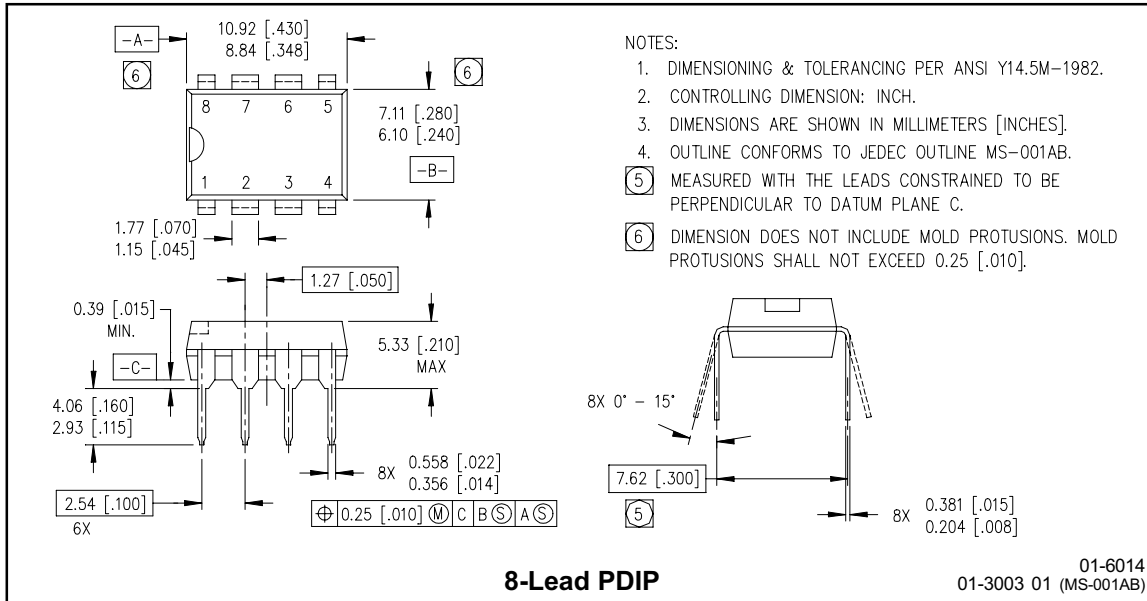
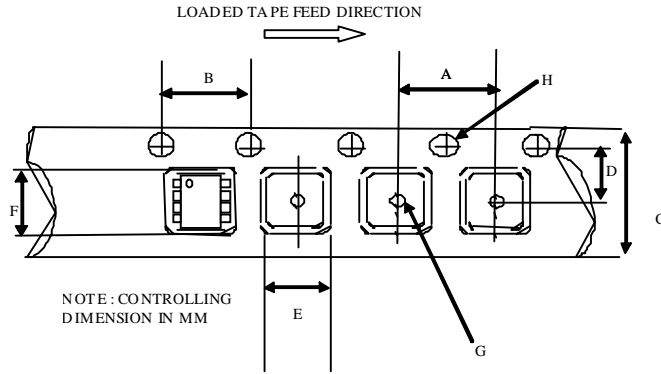


Figure 26B Output Sink Current vs Voltage

Case outlines

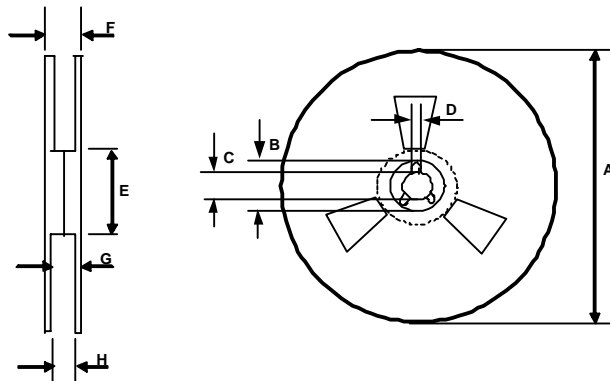


**Tape & Reel
8-lead SOIC**



CARRIER TAPE DIMENSION FOR 8SOICN

| Code | Metric | | Imperial | |
|------|--------|-------|----------|-------|
| | Min | Max | Min | Max |
| A | 7.90 | 8.10 | 0.311 | 0.318 |
| B | 3.90 | 4.10 | 0.153 | 0.161 |
| C | 11.70 | 12.30 | 0.46 | 0.484 |
| D | 5.45 | 5.55 | 0.214 | 0.218 |
| E | 6.30 | 6.50 | 0.248 | 0.255 |
| F | 5.10 | 5.30 | 0.200 | 0.208 |
| G | 1.50 | n/a | 0.059 | n/a |
| H | 1.50 | 1.60 | 0.059 | 0.062 |



REEL DIMENSIONS FOR 8SOICN

| Code | Metric | | Imperial | |
|------|--------|--------|----------|--------|
| | Min | Max | Min | Max |
| A | 329.60 | 330.25 | 12.976 | 13.001 |
| B | 20.95 | 21.45 | 0.824 | 0.844 |
| C | 12.80 | 13.20 | 0.503 | 0.519 |
| D | 1.95 | 2.45 | 0.767 | 0.096 |
| E | 98.00 | 102.00 | 3.858 | 4.015 |
| F | n/a | 18.40 | n/a | 0.724 |
| G | 14.50 | 17.10 | 0.570 | 0.673 |
| H | 12.40 | 14.40 | 0.488 | 0.566 |

