

IRS2104(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
- 3.3 V, 5 V, and 15 V input logic compatible
- Cross-conduction prevention logic
- Internally set deadtime
- High-side output in phase with input
- Shutdown input turns off both channels
- Matched propagation delay for both channels
- RoHS compliant

Description

The IRS2104 is a high voltage, high speed power MOSFET and IGBT driver with dependent high- and low-side referenced output channels. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. The logic input is compatible with standard CMOS or LSTTL output, down to 3.3 V logic. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. The floating channel can be used to drive an N-channel power MOSFET or IGBT in the high-side configuration which operates from 10 V to 600 V.

Product Summary

| | |
|----------------------------|---------------|
| V_{OFFSET} | 600 V max. |
| $I_{\text{O+/-}}$ | 130 mA/270 mA |
| V_{OUT} | 10 V - 20 V |
| $t_{\text{on/off (typ.)}}$ | 680 ns/150 ns |
| Deadtime (typ.) | 520 ns |

Packages

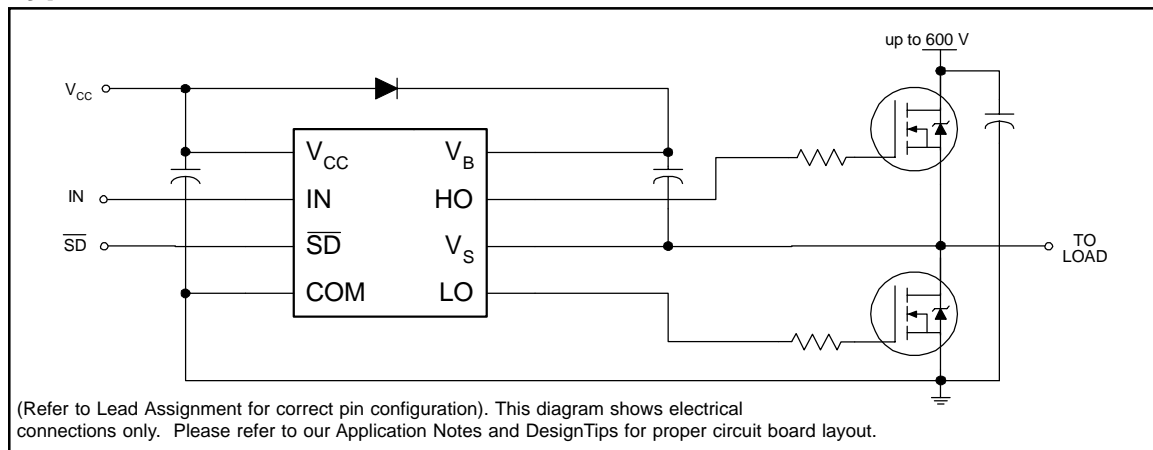


8 Lead SOIC
IRS2104S



8 Lead PDIP
IRS2104

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.

| Symbol | Definition | | Min. | Max. | Units |
|---------------------|---|---------------|----------------------|-----------------------|-------|
| V _B | High-side floating absolute voltage | | -0.3 | 625 | 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 | |
| V _{LO} | Low-side output voltage | | -0.3 | V _{CC} + 0.3 | |
| V _{IN} | Logic input voltage (IN & \overline{SD}) | | -0.3 | V _{CC} + 0.3 | |
| dV _S /dt | Allowable offset supply voltage transient | | — | 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 | |

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 1 | 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 (IN & \overline{SD}) | 0 | V_{CC} | |
| T_A | Ambient temperature | -40 | 125 | $^\circ\text{C}$ |

Note 1: 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.

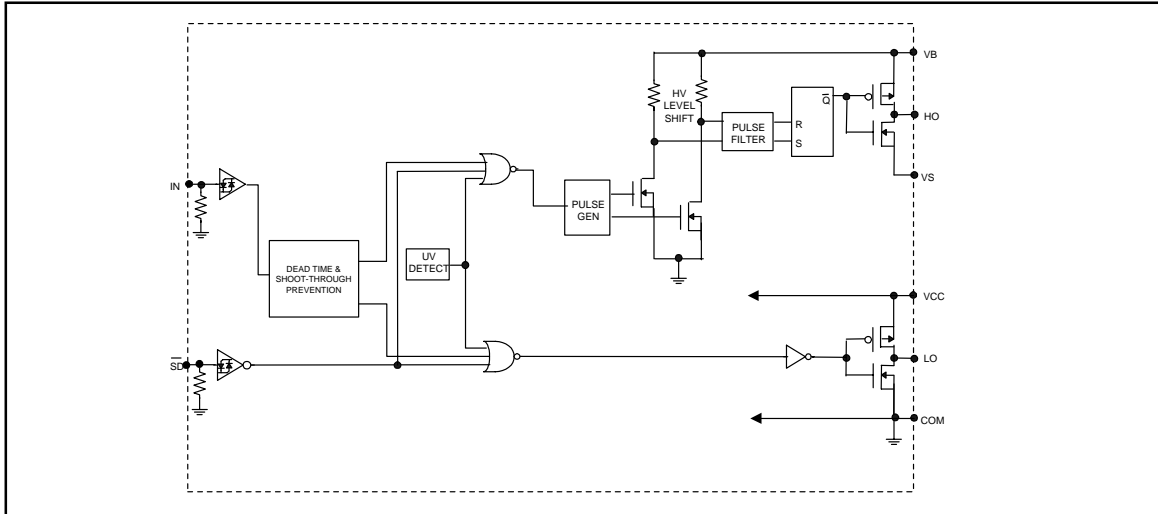
| Symbol | Definition | Min. | Typ. | Max. | Units | Test Conditions |
|-----------|---|------|------|------|-------|-----------------|
| t_{on} | Turn-on propagation delay | — | 680 | 820 | ns | $V_S = 0$ V |
| t_{off} | Turn-off propagation delay | — | 150 | 220 | | $V_S = 600$ V |
| t_{sd} | Shutdown propagation delay | — | 160 | 220 | | |
| t_r | Turn-on rise time | — | 70 | 170 | | |
| t_f | Turn-off fall time | — | 35 | 90 | | |
| DT | Deadtime, LS turn-off to HS turn-on & HS turn-on to LS turn-off | 400 | 520 | 650 | | |
| MT | Delay matching, HS & LS turn-on/off | — | — | 60 | | |

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” (HO) & Logic “0” (LO) input voltage | 2.5 | — | — | V | $V_{CC} = 10$ V to 20 V |
| V_{IL} | Logic “0” (HO) & Logic “1” (LO) input voltage | — | — | 0.8 | | |
| $V_{SD,TH+}$ | SD input positive going threshold | 2.5 | — | — | | |
| $V_{SD,TH-}$ | SD input negative going threshold | — | — | 0.8 | | |
| 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 | — | 30 | 55 | | $V_{IN} = 0$ V or 5 V |
| I_{QCC} | Quiescent V_{CC} supply current | — | 150 | 270 | | |
| I_{IN+} | Logic “1” input bias current | — | 3 | 10 | | $V_{IN} = 5$ V |
| I_{IN-} | Logic “0” input bias current | — | — | 5 | | $V_{IN} = 0$ V |
| V_{CCUV+} | V_{CC} supply undervoltage positive going threshold | 8 | 8.9 | 9.8 | V | |
| V_{CCUV-} | V_{CC} supply undervoltage negative going threshold | 7.4 | 8.2 | 9 | | |
| I_{O+} | Output high short circuit pulsed current | 130 | 290 | — | mA | $V_O = 0$ V $PW \leq 10$ μ s |
| I_{O-} | Output low short circuit pulsed current | 270 | 600 | — | | $V_O = 15$ V $PW \leq 10$ μ s |

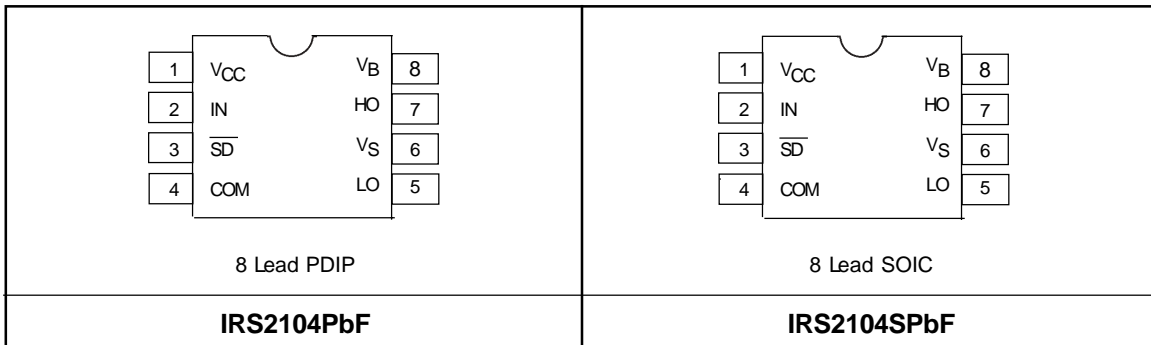
Functional Block Diagram



Lead Definitions

| Symbol | Description |
|------------------------|--|
| IN | Logic input for high-side and low-side gate driver outputs (HO and LO), in phase with HO |
| $\overline{\text{SD}}$ | Logic input for shutdown |
| 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



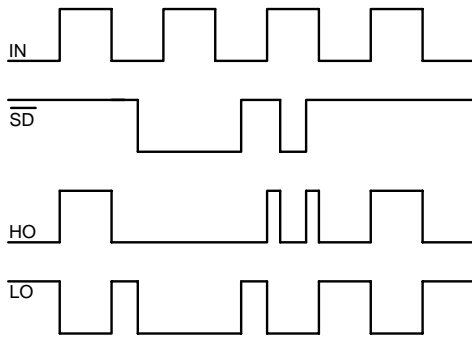


Figure 1. Input/Output Timing Diagram

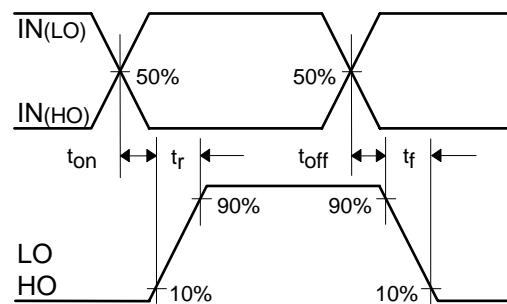


Figure 2. Switching Time Waveform Definitions

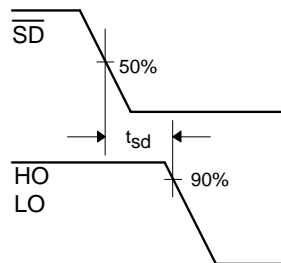


Figure 3. Shutdown Waveform Definitions

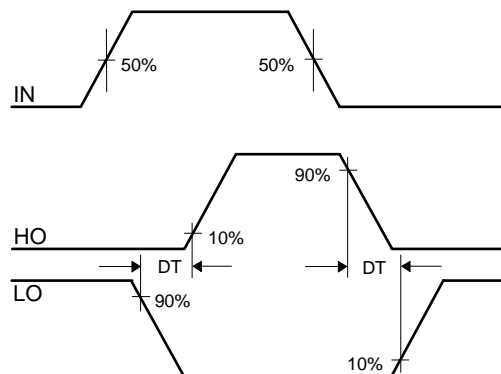


Figure 4. Deadtime Waveform Definitions

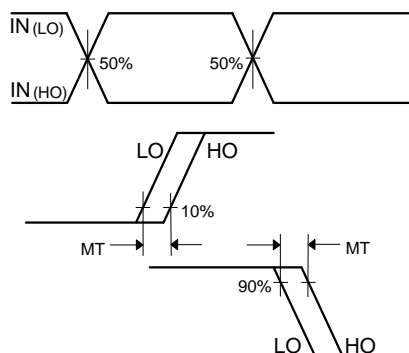


Figure 5. Delay Matching Waveform Definitions

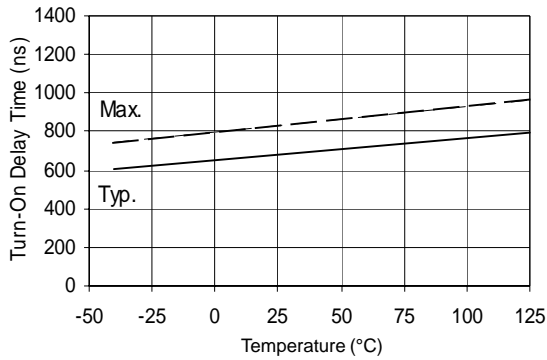


Figure 6A. Turn-On Time vs. Temperature

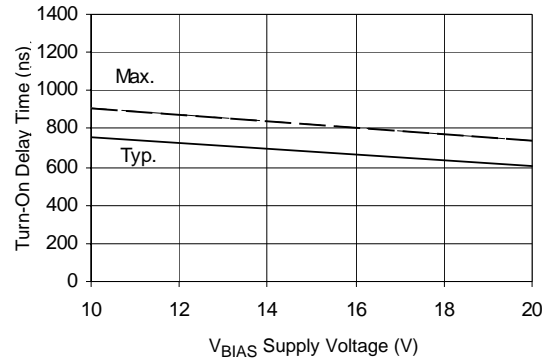


Figure 6B. Turn-On Time vs. Supply Voltage

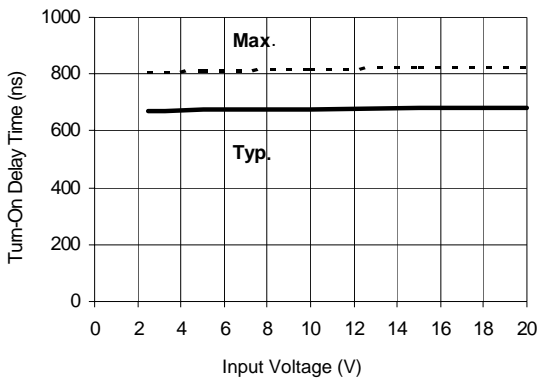


Figure 6C. Turn-On Time vs. Input Voltage

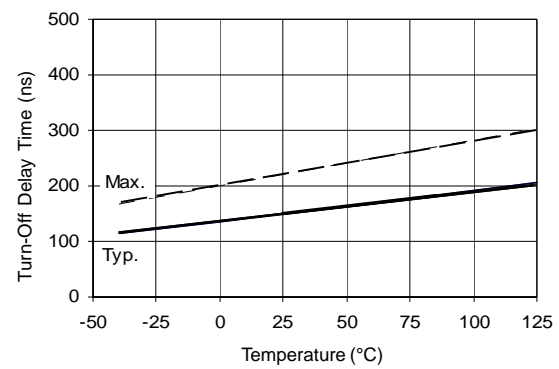


Figure 7A. Turn-Off Time vs. Temperature

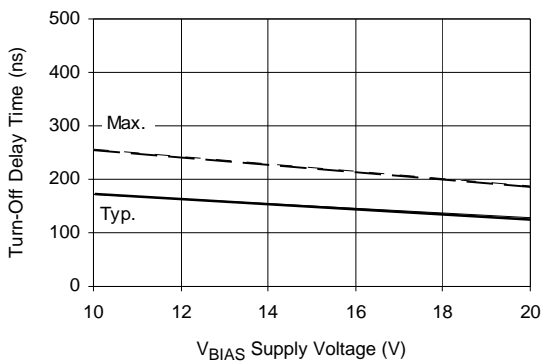


Figure 7B. Turn-Off Time vs. Supply Voltage

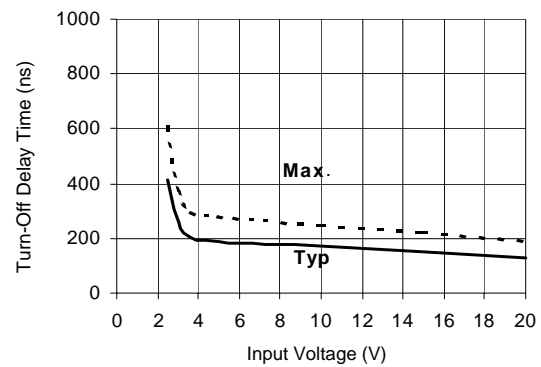


Figure 7C. Turn-Off Time vs. Input Voltage

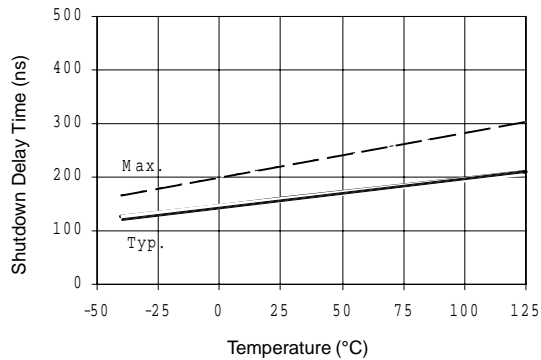


Figure 8A. Shutdown Time vs. Temperature

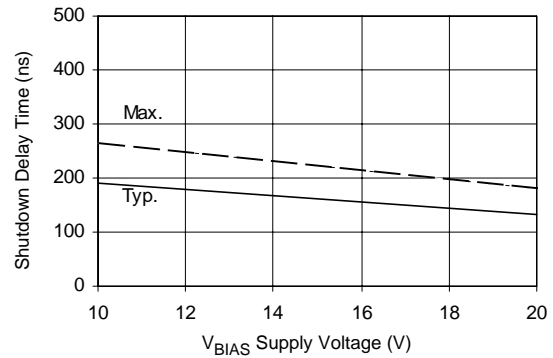


Figure 8B. Shutdown Time vs. Voltage

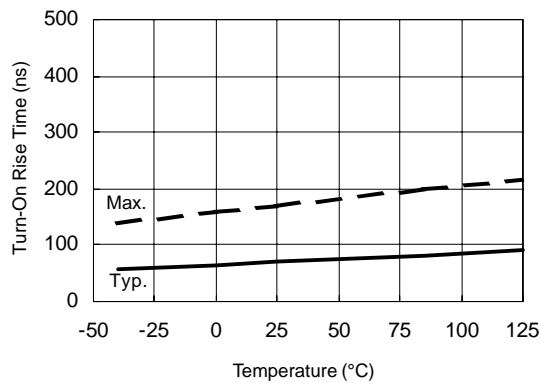


Figure 9A. Turn-On Rise Time vs. Temperature

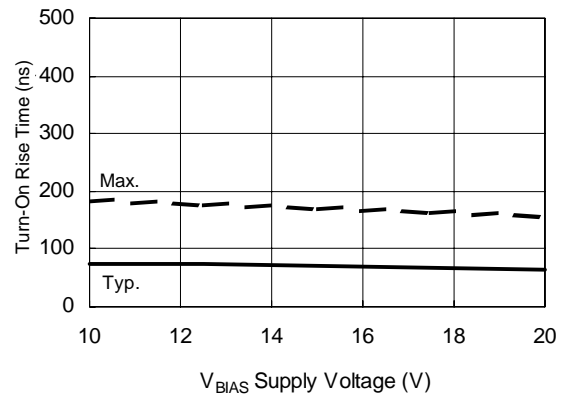


Figure 9B. Turn-On Rise Time vs. Voltage

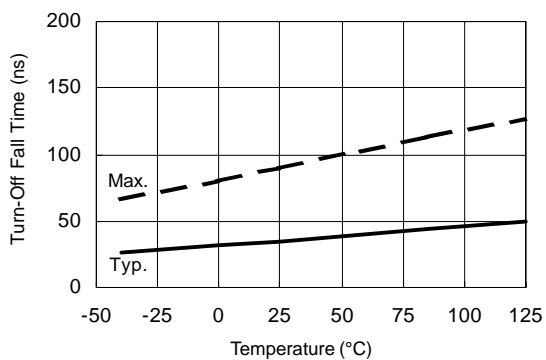


Figure 10A. Turn-Off Fall Time vs. Temperature

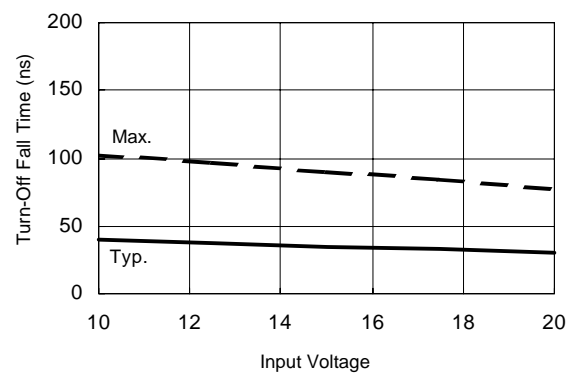


Figure 10B. Turn-Off Fall Time vs. Input Voltage

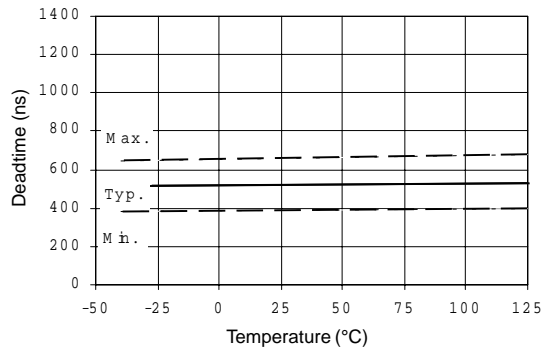


Figure 11A. Deadtime vs. Temperature

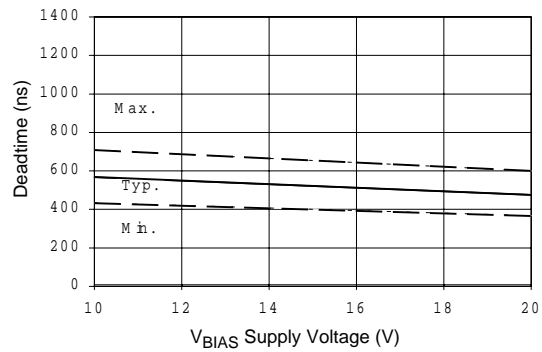


Figure 11B. Deadtime vs. Voltage

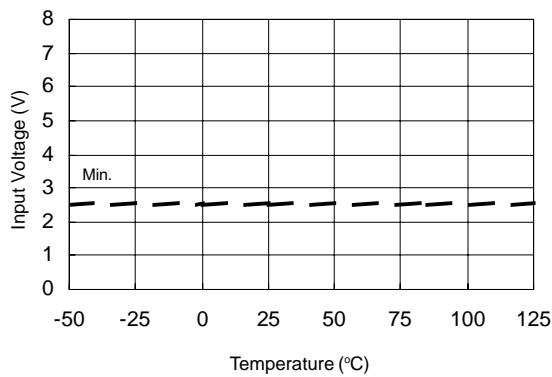


Figure 12A. Logic "1" Input Voltage vs. Temperature

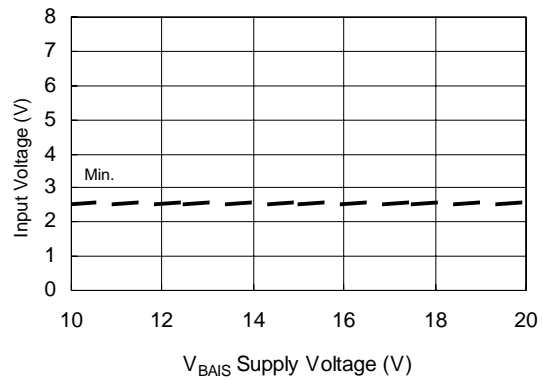


Figure 12B. Logic "1" Input Voltage vs. Supply Voltage

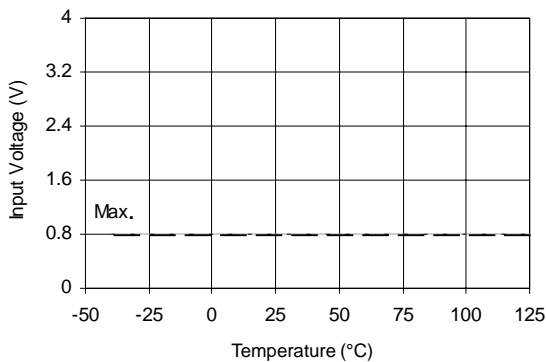


Figure 13A. Logic "0" (HO) & Logic "1" (LO) & Active SD Input Voltage vs. Temperature

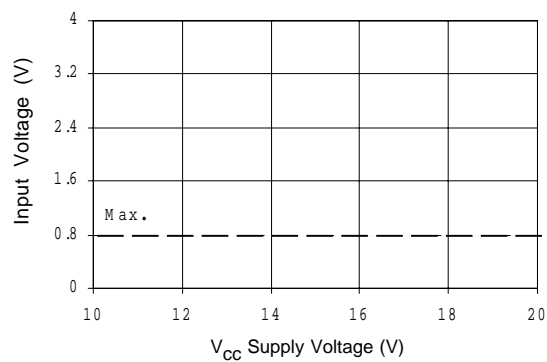


Figure 13B. Logic "0" (HO) & Logic "1" (LO) & Active SD Input Voltage vs. Voltage

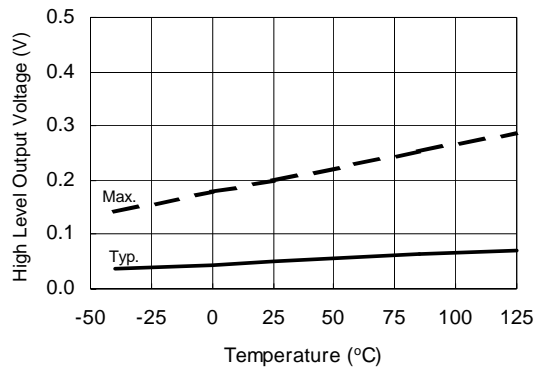


Figure 14A. High Level Output Voltage vs. Temperature

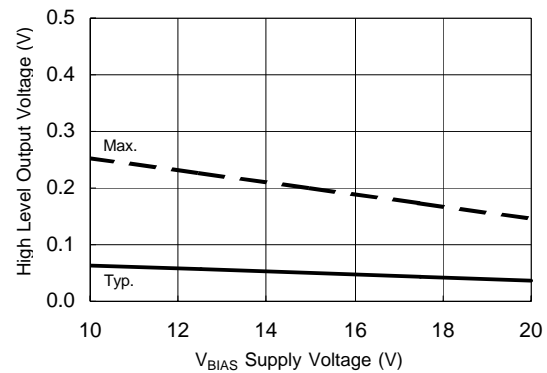


Figure 14B. High Level Output Voltage vs. Supply Voltage

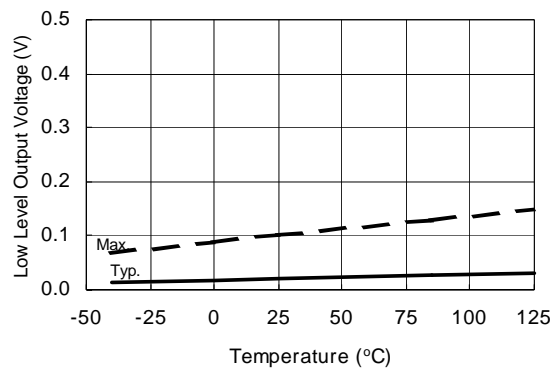


Figure 15A. Low Level Output Voltage vs. Temperature

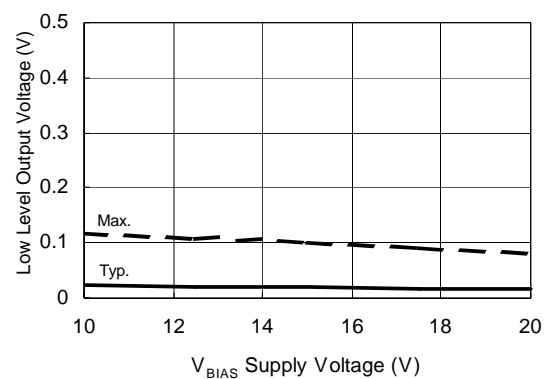


Figure 15B. Low Level Output Voltage vs. Supply Voltage

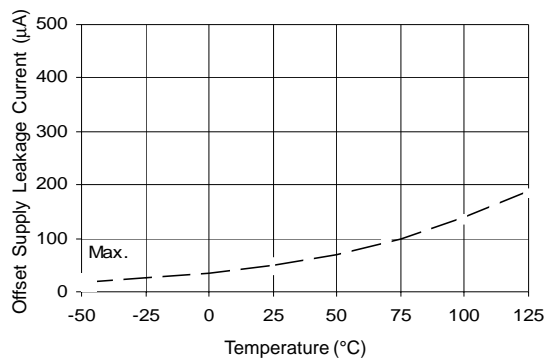


Figure 16A. Offset Supply Current vs. Temperature

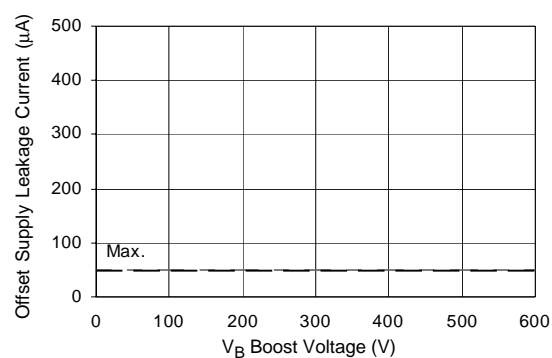


Figure 16B. Offset Supply Current vs. Voltage

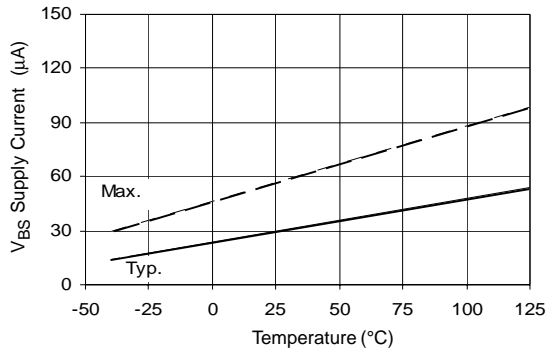


Figure 17A. V_{BS} Supply Current vs. Temperature

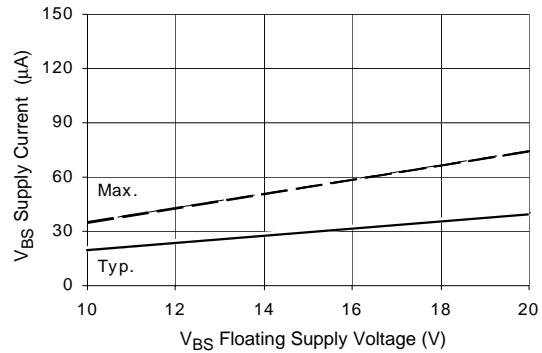


Figure 17B. V_{BS} Supply Current vs. Voltage

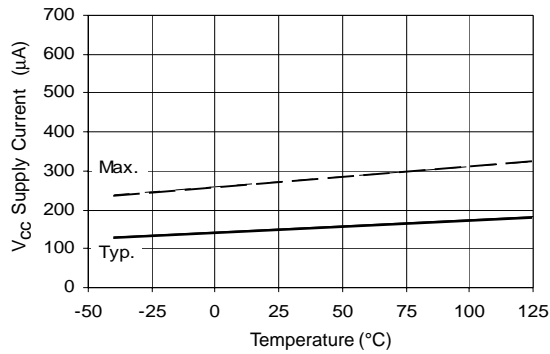


Figure 18A. V_{CC} Supply Current vs. Temperature

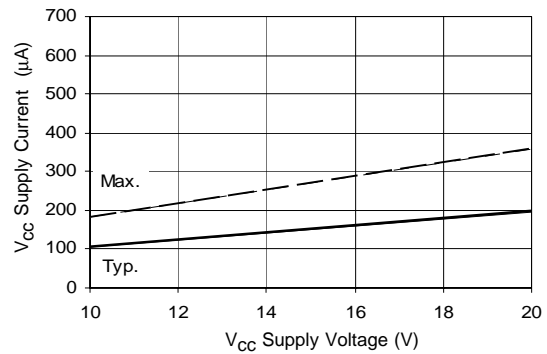


Figure 18B. V_{CC} Supply Current vs. Voltage

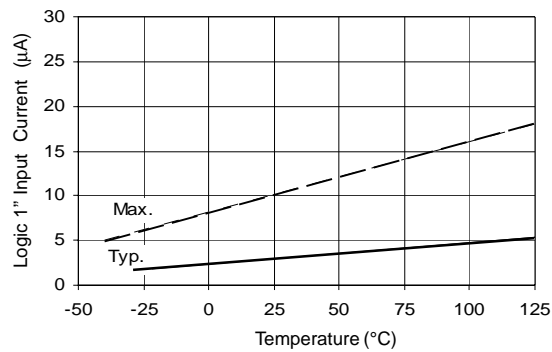


Figure 19A. Logic "1" Input Current vs. Temperature

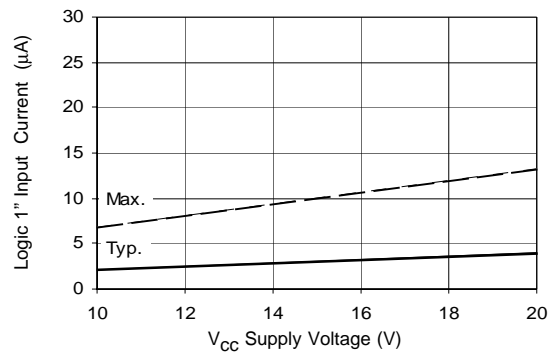


Figure 19B. Logic "1" Input Current vs. Voltage

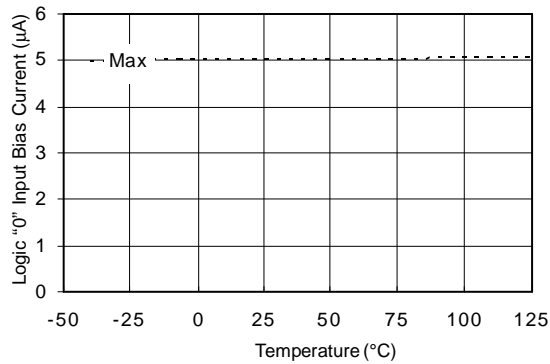


Figure 20A. Logic "0" Input Bias Current vs. Temperature

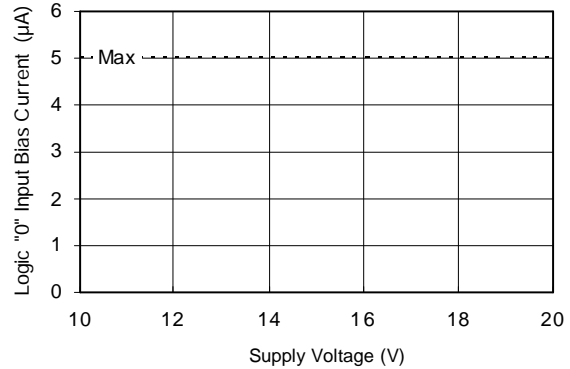


Figure 20B. Logic "0" Input Bias Current vs. Voltage

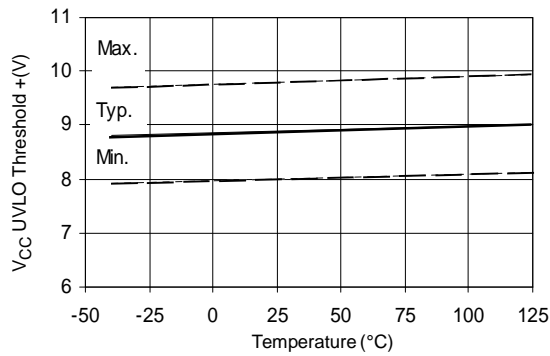


Figure 21A. V_{CC} Undervoltage Threshold(+) vs. Temperature

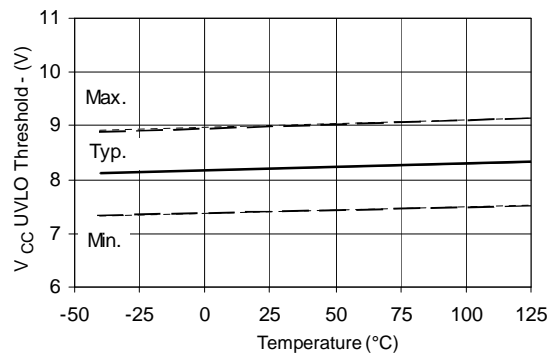


Figure 21B. V_{CC} Undervoltage Threshold(-) vs. Temperature

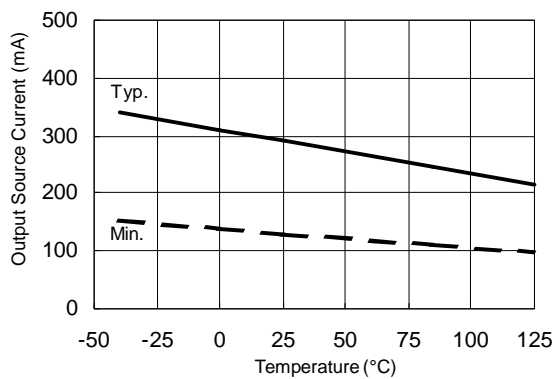


Figure 22A. Output Source Current vs. Temperature

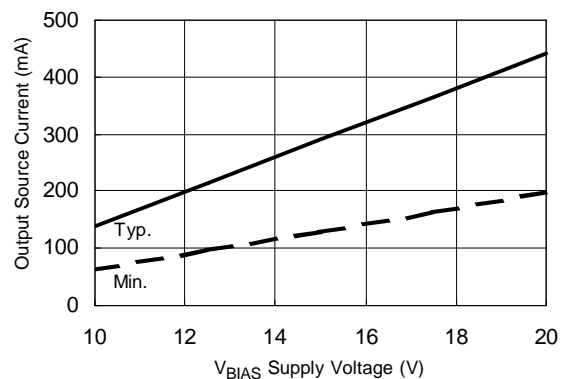


Figure 22B. Output Source Current vs. Voltage

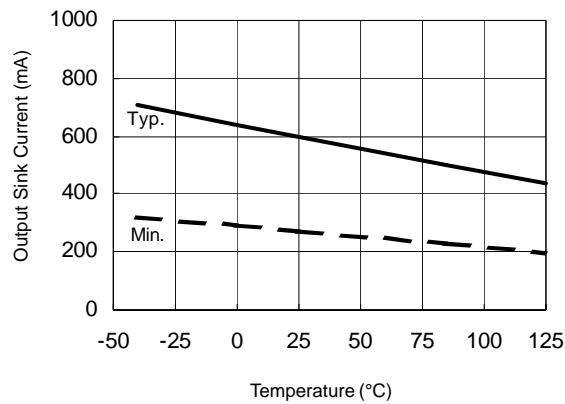


Figure 23A. Output Sink Current vs. Temperature

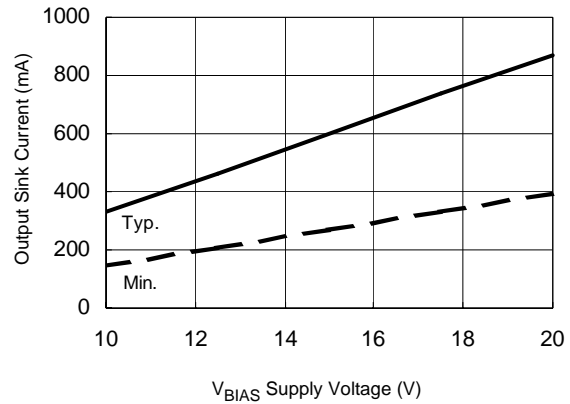


Figure 23B. Output Sink Current vs. Supply Voltage

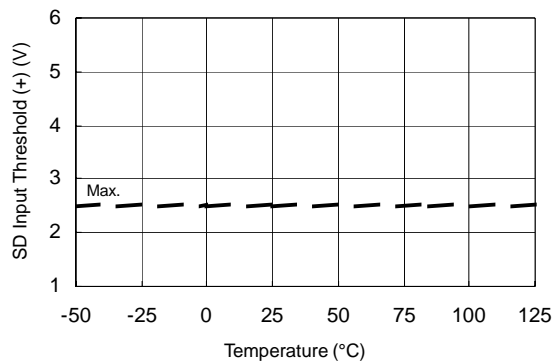


Figure 24A. SD Input Positive Going Threshold (+) vs. Temperature

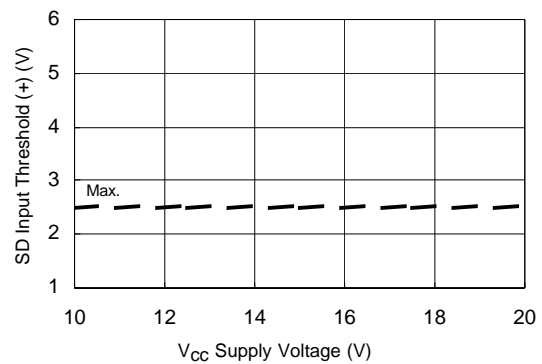
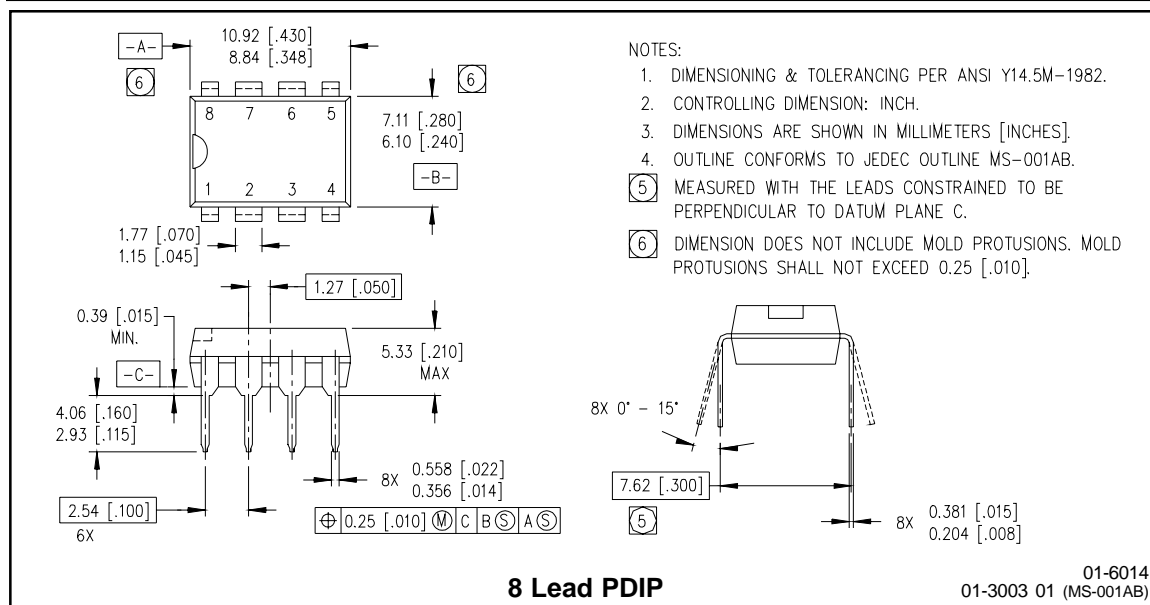
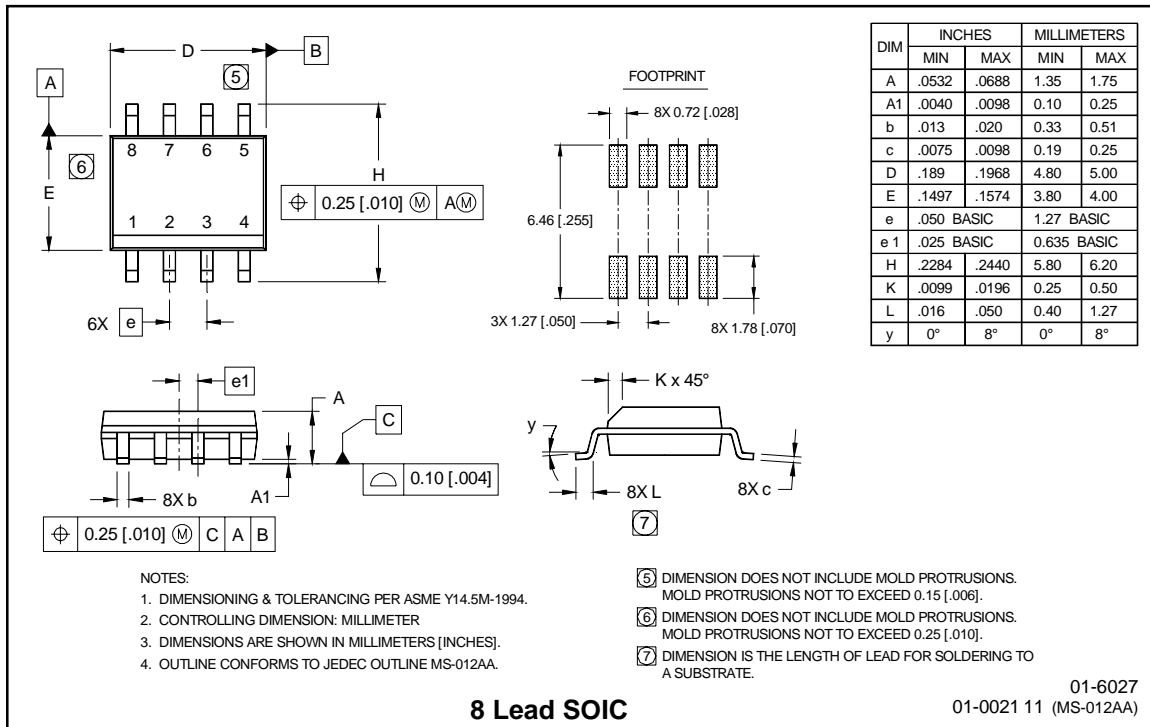
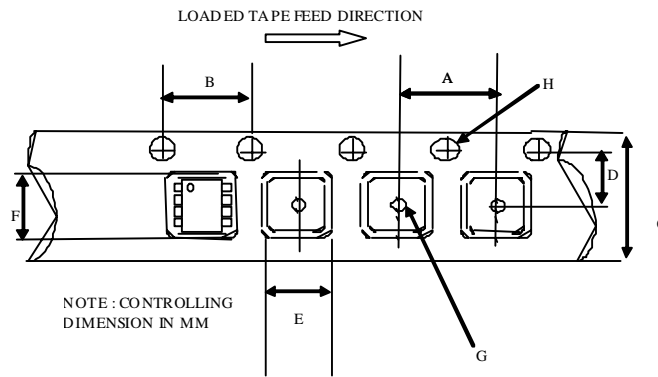


Figure 24B. SD Input Positive Going Threshold (+) vs. Supply Voltage

Case Outline

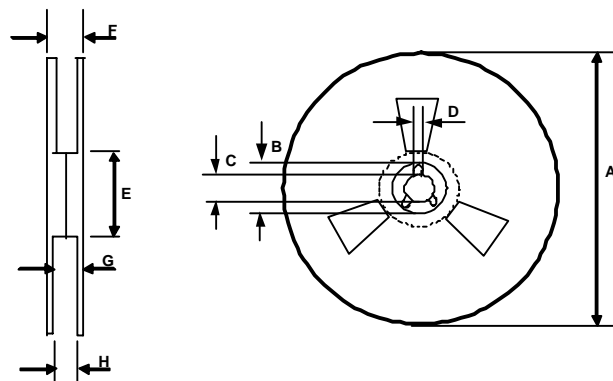


Tape & Reel 8-lead SOIC



CARRIER TAPE DIMENSION FOR 8SOICN

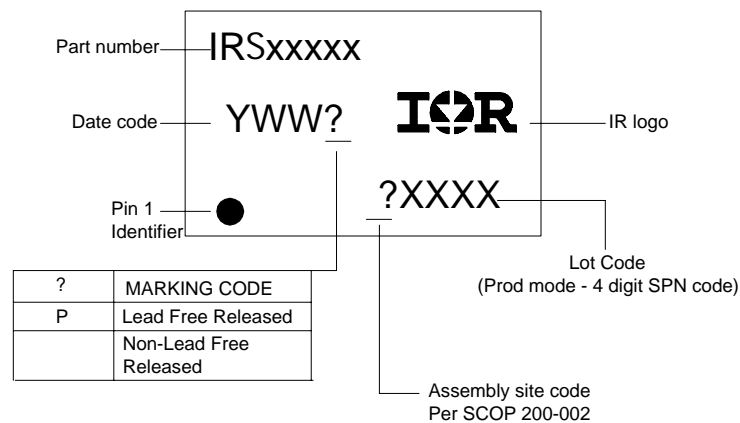
| Code | Metric | | Imperial | |
|------|--------|-------|----------|-------|
| | Min | Max | Min | Max |
| A | 7.90 | 8.10 | 0.311 | 0.318 |
| B | 3.90 | 4.10 | 0.153 | 0.161 |
| C | 11.70 | 12.30 | 0.46 | 0.484 |
| D | 5.45 | 5.55 | 0.214 | 0.218 |
| E | 6.30 | 6.50 | 0.248 | 0.255 |
| F | 5.10 | 5.30 | 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 |

LEADFREE PART MARKING INFORMATION



ORDER INFORMATION

8-Lead PDIP IRS2104PbF
 8-Lead SOIC IRS2104SPbF
 8-Lead SOIC Tape & Reel IRS2104STRPbF