

## High and Low Side Driver

### Features

- Gate drive supplies up to 20V per channel
- Undervoltage lockout for  $V_{CC}$ ,  $V_{BS}$
- 3.3 V, 5V, 15V input logic compatible
- Tolerant to negative transient voltage
- Designed for use with bootstrap power supplies
- Matched propagation delays
- Output in phase with the Inputs
- -40°C to 125°C operating range
- RoHS compliant

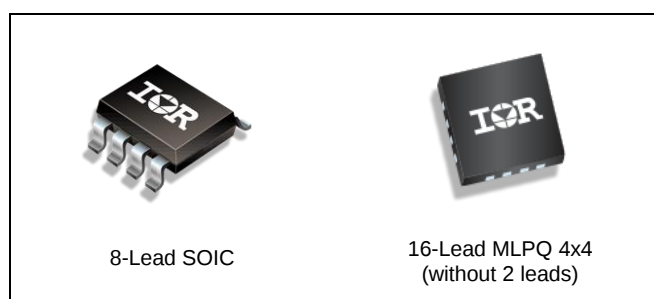
### Description

The IRS2005 is a high voltage, high speed power MOSFET and IGBT driver with independent 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 3.3V 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 up to 200 V. Propagation delays are matched to simplify the HVIC's use in high frequency applications.

### Product Summary

|                                          |                    |
|------------------------------------------|--------------------|
| $V_{\text{OFFSET}}$                      | $\leq 200\text{V}$ |
| $V_{\text{OUT}}$                         | 10 V – 20V         |
| $I_{\text{O+}} \& I_{\text{O-}}$ (typ.)  | 290mA & 600mA      |
| $t_{\text{ON}} \& t_{\text{OFF}}$ (typ.) | 160ns & 150ns      |
| Delay matching (max.)                    | 50ns               |

### Package Options

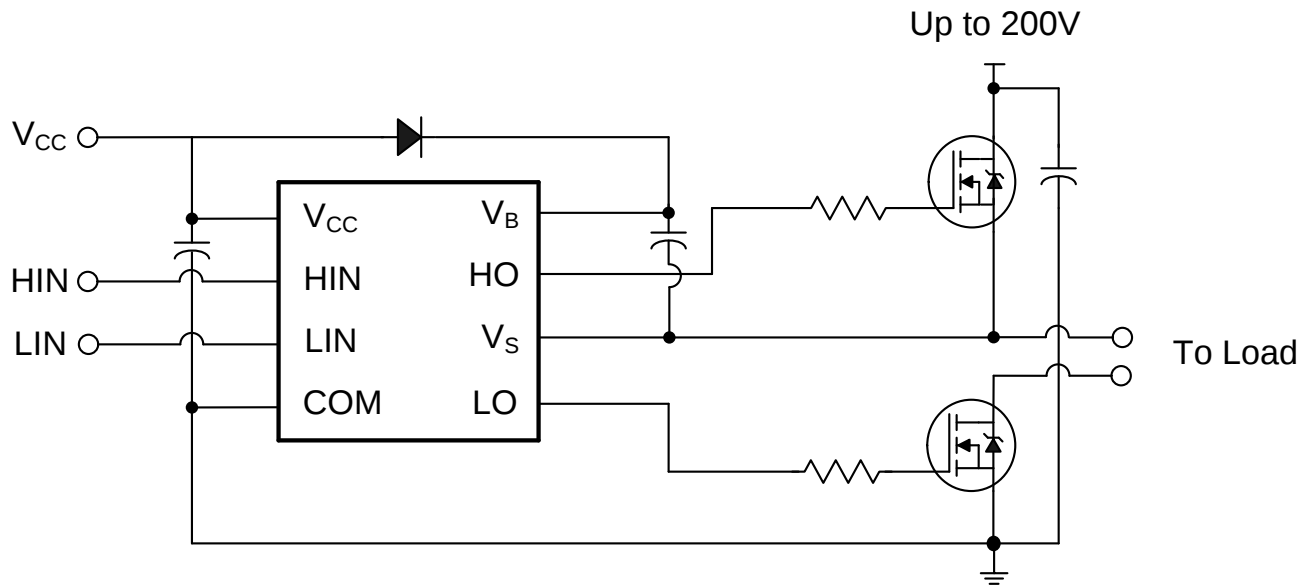


### Typical Applications

- Appliance motor drives
- Servo drives
- Micro inverter drives
- General purpose three phase inverters

| Base Part Number | Package Type     | Standard Pack |          | Orderable Part Number |
|------------------|------------------|---------------|----------|-----------------------|
|                  |                  | Form          | Quantity |                       |
| IRS2005SPBF      | 8-Lead SOIC      | Tube/Bulk     | 95       | IRS2005SPBF           |
|                  |                  | Tape and Reel | 2500     | IRS2005STRPBF         |
| IRS2005MPBF      | 14-Lead MLPQ 4x4 | Tape and Reel | 3000     | IRS2005MTRPBF         |

## Typical Connection Diagram



(Refer to Lead Assignments for correct pin configuration). This diagram shows electrical connections only. Please refer to our Application Notes & DesignTips for proper circuit board layout.

## 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 unless otherwise stated in the table. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions.

| Symbol     | Definition                                               | Min.             | Max.            | Units              |
|------------|----------------------------------------------------------|------------------|-----------------|--------------------|
| $V_{CC}$   | Low side supply voltage                                  | -0.3             | 25 <sup>†</sup> | V                  |
| $V_{IN}$   | Logic input voltage                                      | COM - 0.3        | $V_{CC} + 0.3$  |                    |
| $V_B$      | High-side floating well supply voltage                   | -0.3             | 225             |                    |
| $V_S$      | High-side floating well supply return voltage            | $V_B - 25$       | $V_B + 0.3$     |                    |
| $V_{HO}$   | Floating gate drive output voltage                       | $V_S - 0.3$      | $V_B + 0.3$     |                    |
| $V_{LO}$   | Low-side output voltage                                  | COM - 0.3        | $V_{CC} + 0.3$  |                    |
| COM        | Power ground                                             | $V_{CC} - 25$    | $V_{CC} + 0.3$  |                    |
| $dV_S/dt$  | Allowable $V_S$ offset supply transient relative to COM  | —                | 50              | V/ns               |
| $P_D$      | Package power dissipation @ $T_A \leq +25^\circ\text{C}$ | 8-Lead SOIC      | 0.625           | W                  |
|            |                                                          | 14-Lead MLPQ 4x4 | 2.08            |                    |
| $R_{thJA}$ | Thermal resistance, junction to ambient                  | 8-Lead SOIC      | 200             | $^\circ\text{C/W}$ |
|            |                                                          | 14-Lead MLPQ 4x4 | 36              |                    |
| $T_J$      | Junction temperature                                     | —                | 150             | $^\circ\text{C}$   |
| $T_S$      | Storage temperature                                      | -55              | 150             |                    |
| $T_L$      | Lead temperature (soldering, 10 seconds)                 | —                | 300             |                    |

† All supplies are tested at 25V.

## Recommended Operating Conditions

For proper operation, the device should be used within the recommended conditions. All voltage parameters are absolute voltages referenced to COM unless otherwise stated in the table. The offset rating is tested with supplies of  $(V_{CC} - \text{COM}) = (V_B - V_S) = 15\text{V}$ .

| Symbol   | Definition                                                 | Min                  | Max        | Units            |
|----------|------------------------------------------------------------|----------------------|------------|------------------|
| $V_{CC}$ | Low-side supply voltage                                    | 10                   | 20         | V                |
| $V_{IN}$ | Logic input voltage                                        | 0                    | $V_{CC}$   |                  |
| $V_B$    | High-side floating well supply voltage                     | $V_S + 10$           | $V_S + 20$ |                  |
| $V_S$    | High-side floating well supply offset voltage <sup>†</sup> | COM - 8 <sup>†</sup> | 200        |                  |
| $V_{HO}$ | Floating gate drive output voltage                         | $V_S$                | $V_B$      |                  |
| $V_{LO}$ | Low-side output voltage                                    | COM                  | $V_{CC}$   |                  |
| $T_A$    | Ambient temperature                                        | -40                  | 125        | $^\circ\text{C}$ |

† Logic operation for  $V_S$  of -8 V to 200 V. Logic state held for  $V_S$  of -8 V to  $-V_{BS}$ . Please refer to Design Tip DT97-3 for more details.

## Static Electrical Characteristics

$(V_{CC} - COM) = (V_B - V_S) = 15V$ .  $T_A = 25^\circ C$  unless otherwise specified. The  $V_{IN}$  and  $I_{IN}$  parameters are referenced to COM. The  $V_O$  and  $I_O$  parameters are referenced to respective  $V_S$  and COM and are applicable to the respective output leads HO or LO. The  $V_{CCUV}$  parameters are referenced to COM. The  $V_{BSUV}$  parameters are referenced to  $V_S$ .

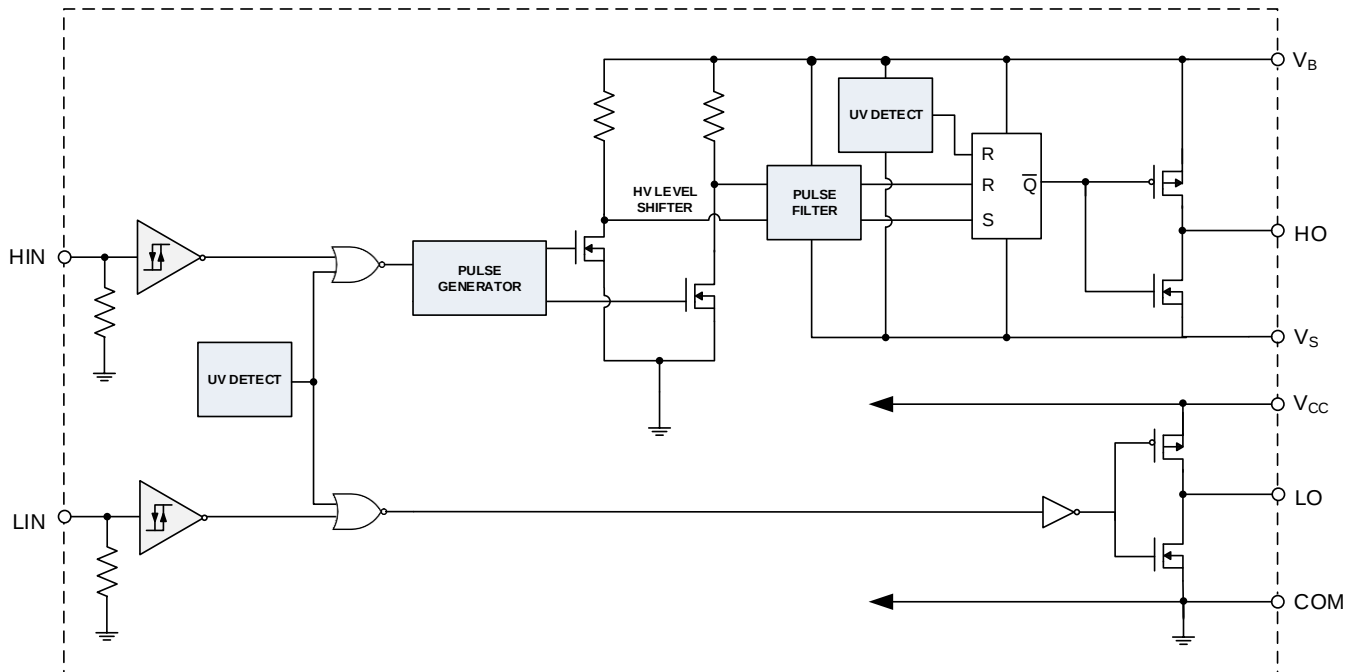
| Symbol       | Definition                                            | Min. | Typ. | Max. | Units   | Test Conditions                               |
|--------------|-------------------------------------------------------|------|------|------|---------|-----------------------------------------------|
| $V_{BSUV+}$  | $V_{BS}$ supply undervoltage positive going threshold | 8.0  | 8.9  | 9.8  | V       |                                               |
| $V_{BSUV-}$  | $V_{BS}$ supply undervoltage negative going threshold | 7.4  | 8.2  | 9    |         |                                               |
| $V_{BSUVHY}$ | $V_{BS}$ supply undervoltage hysteresis               | —    | 0.7  | —    |         |                                               |
| $V_{CCUV+}$  | $V_{CC}$ supply undervoltage positive going threshold | 8.0  | 8.9  | 9.8  |         |                                               |
| $V_{CCUV-}$  | $V_{CC}$ supply undervoltage negative going threshold | 7.4  | 8.2  | 9    |         |                                               |
| $V_{CCUVHY}$ | $V_{CC}$ supply undervoltage hysteresis               | —    | 0.7  | —    |         |                                               |
| $I_{LK}$     | High-side floating well offset supply leakage         | —    | —    | 50   | $\mu A$ | $V_B = V_S = 200V$                            |
| $I_{QBS}$    | Quiescent $V_{BS}$ supply current                     | —    | 45   | 75   |         | All inputs are in the off state               |
| $I_{QCC}$    | Quiescent $V_{CC}$ supply current                     | —    | 300  | 520  |         |                                               |
| $V_{OH}$     | High level output voltage drop, $V_{BIAS} - V_O$      | —    | 0.05 | 0.2  | V       | $I_O = 2\text{ mA}$                           |
| $V_{OL}$     | Low level output voltage drop, $V_O$                  | —    | 0.02 | 0.1  |         |                                               |
| $I_{O+}$     | Output high short circuit pulsed current              | 200  | 290  | —    | mA      | $V_O = 0V, V_{IN} = 0V$<br>$PW \leq 10\mu s$  |
| $I_{O-}$     | Output low short circuit pulsed current               | 420  | 600  | —    |         | $V_O = 15V, V_{IN} = 5V$<br>$PW \leq 10\mu s$ |
| $V_{IH}$     | Logic "1" input voltage                               | 2.5  | —    | —    | V       |                                               |
| $V_{IL}$     | Logic "0" input voltage                               | —    | —    | 0.8  |         |                                               |
| $I_{IN+}$    | Input bias current (HO = High)                        | —    | 3    | 10   | $\mu A$ | $V_{IN} = 5V$                                 |
| $I_{IN-}$    | Input bias current (HO = Low)                         | —    | —    | 5    |         | $V_{IN} = 0V$                                 |

## Dynamic Electrical Characteristics

$V_{CC} = V_B = 15V$ ,  $V_S = COM$ ,  $T_A = 25^\circ C$ , and  $C_L = 1000pF$  unless otherwise specified.

| Symbol    | Definition                                   | Min. | Typ. | Max. | Units | Test Conditions      |
|-----------|----------------------------------------------|------|------|------|-------|----------------------|
| $t_{ON}$  | Turn-on propagation delay                    | —    | 160  | 220  | ns    | $V_S = 0V$ or $200V$ |
| $t_{OFF}$ | Turn-off propagation delay                   | —    | 150  | 220  |       | $V_S = 0V$           |
| $t_R$     | Turn-on rise time                            | —    | 70   | 170  |       |                      |
| $t_F$     | Turn-off fall time                           | —    | 30   | 90   |       |                      |
| $t_{FIL}$ | Minimum pulse input filter time              | —    | 300  | —    |       |                      |
| MT        | Delay matching time ( $t_{ON}$ , $t_{OFF}$ ) | —    | —    | 50   |       |                      |

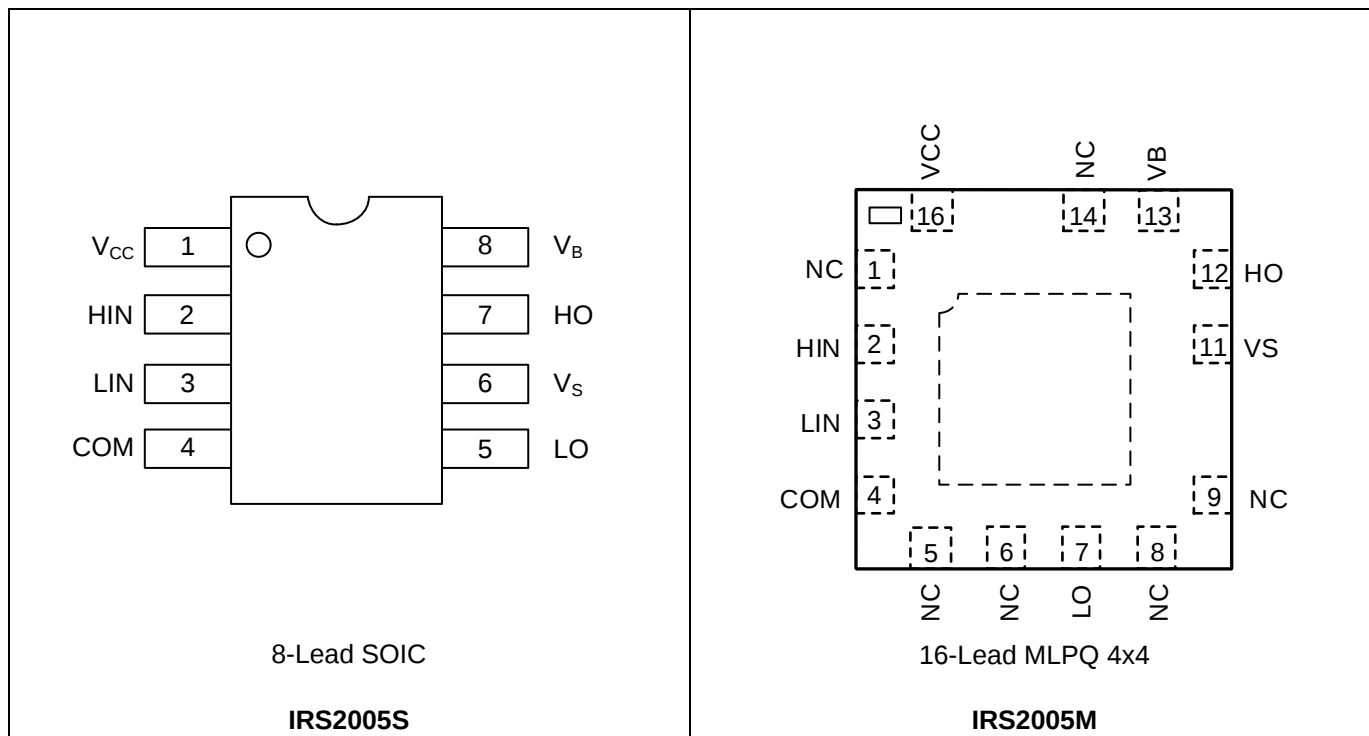
## Functional Block Diagram



## Lead Definitions

| Symbol | Description                                                  |
|--------|--------------------------------------------------------------|
| VCC    | Low-side and logic supply voltage                            |
| VB     | High-side gate drive floating supply                         |
| VS     | High voltage floating supply return                          |
| HIN    | Logic inputs for high-side gate driver output (HO), in phase |
| LIN    | Logic inputs for low-side gate driver output (LO), in phase  |
| HO     | High-side driver output                                      |
| LO     | Low-side driver output                                       |
| COM    | Low-side gate drive return                                   |

## Lead Assignments



## Application Information and Additional Details

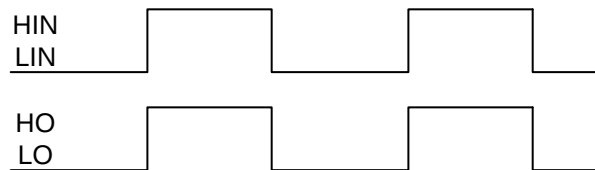


Figure 1. Input/Output Timing Diagram

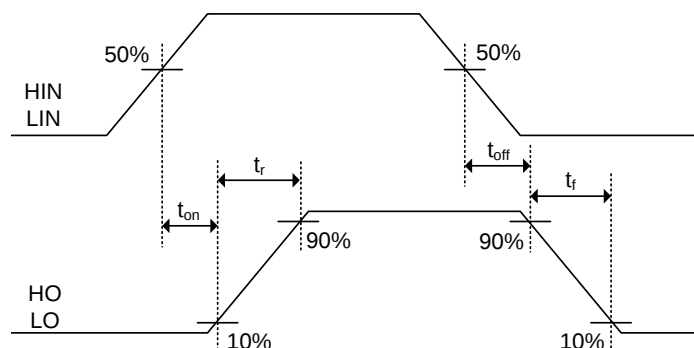


Figure 2. Switching Time Waveform Definitions

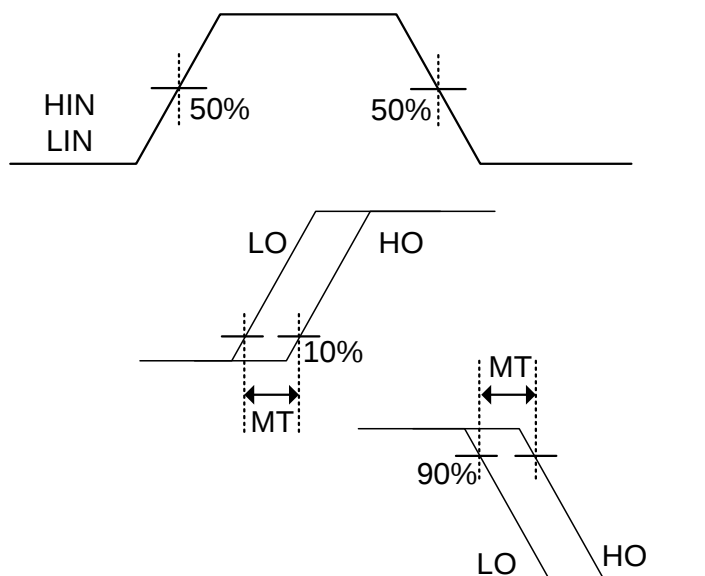


Figure 3. Delay Matching Waveform Definitions

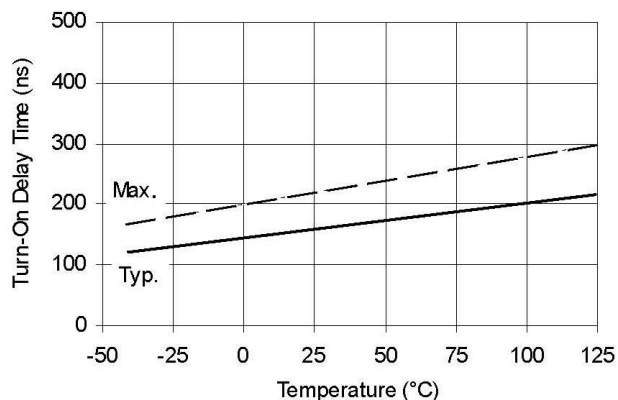


Figure 4A. Turn-On Delay Time vs. Temperature

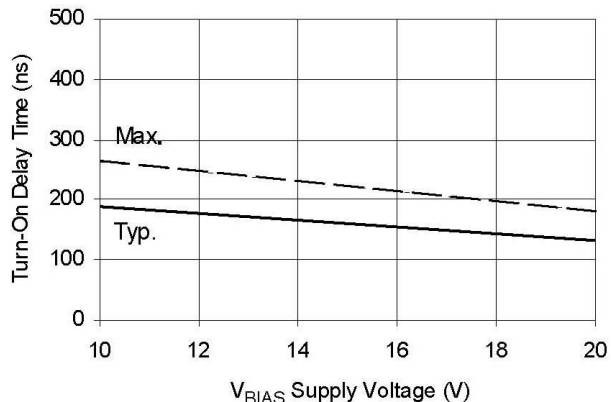


Figure 4B. Turn-On Delay Time vs. Supply Voltage

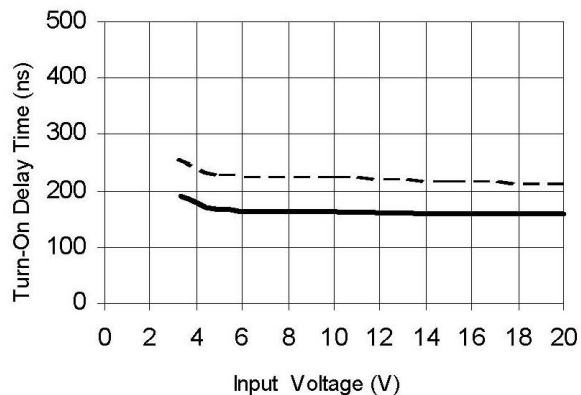


Figure 4C. Turn-On Delay Time vs. Input Voltage

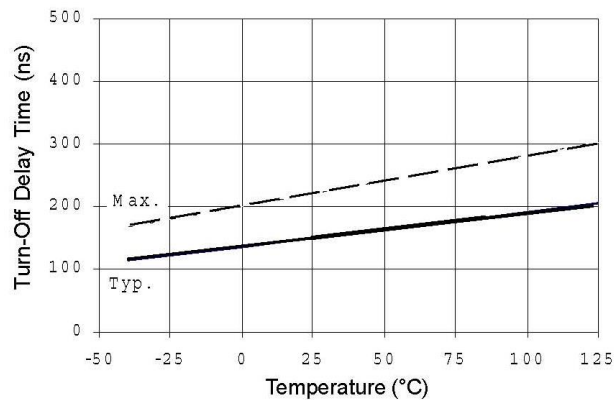


Figure 5A. Turn-Off Delay Time vs. Temperature

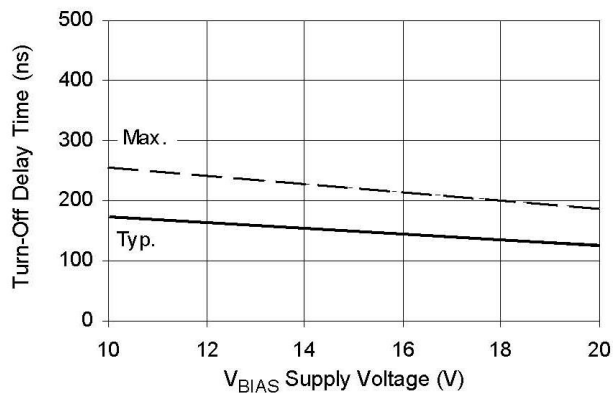


Figure 5B. Turn-Off Delay Time vs. Supply Voltage

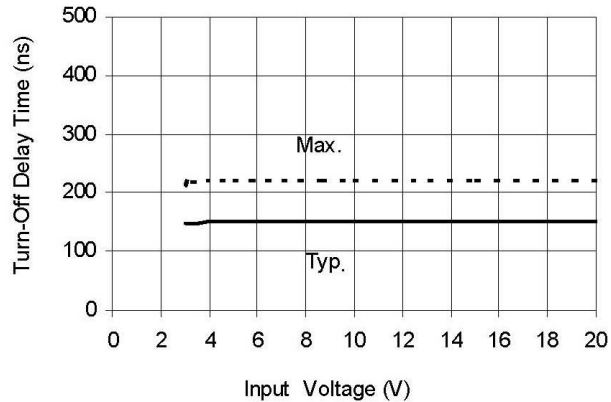


Figure 5C. Turn-Off Time vs. Input Voltage

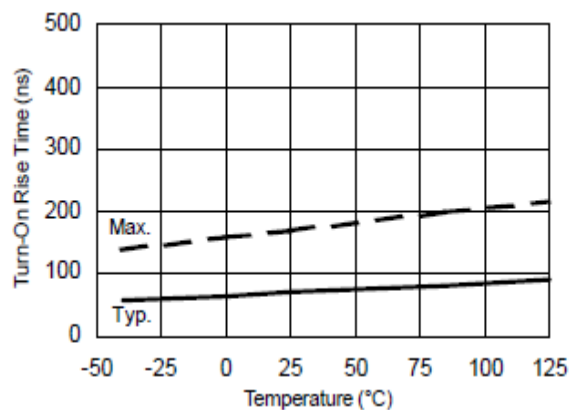


Figure 6A. Turn-On Rise Time vs. Temperature

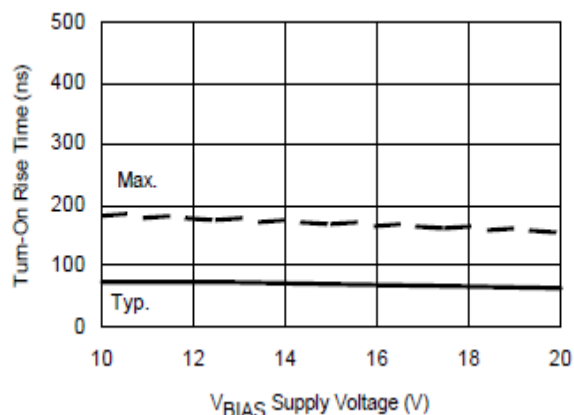


Figure 6B. Turn-On Rise Time vs. Voltage

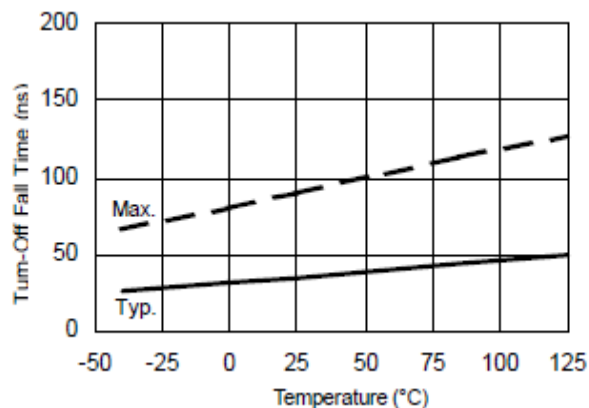


Figure 7A. Turn-Off Fall Time vs. Temperature

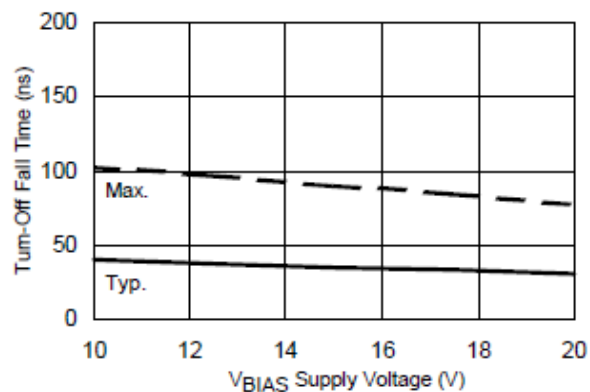


Figure 7B. Turn-Off Fall Time vs. Voltage

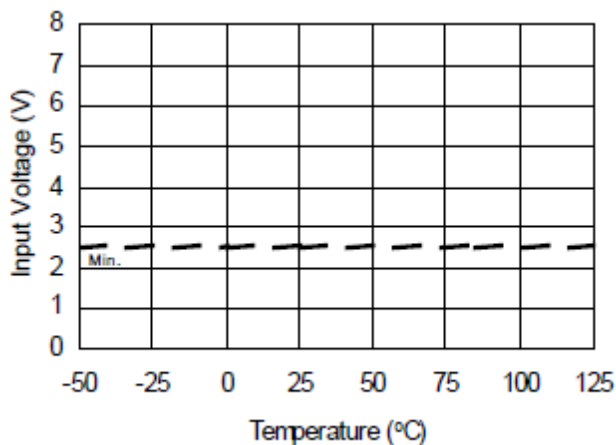


Figure 8A. Logic "1" Input Voltage vs. Temperature

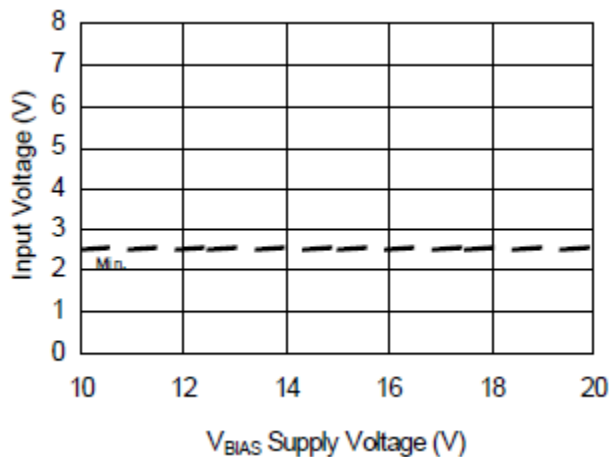


Figure 8B. Logic "1" Input Voltage vs. Voltage

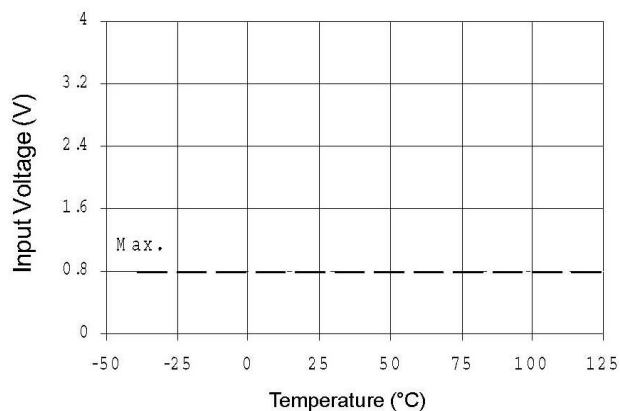


Figure 9A. Logic "0" Input Voltage vs. Temperature

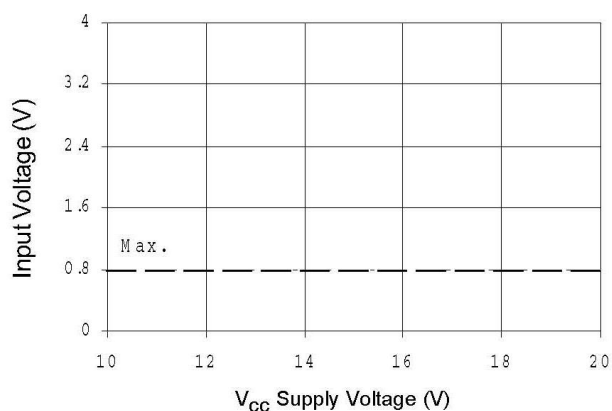


Figure 9B. Logic "0" Input Voltage vs. Supply Voltage

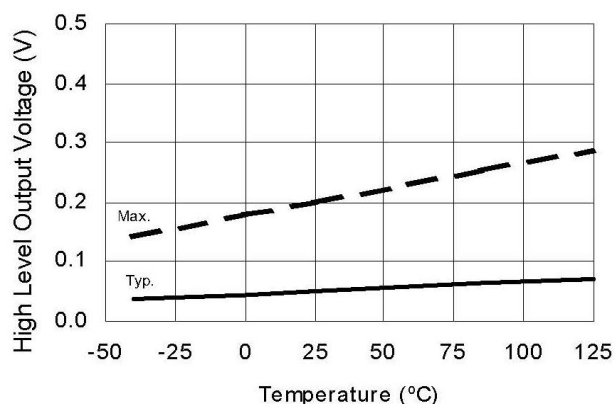


Figure 10A. High Level Output Voltage vs. Temperature

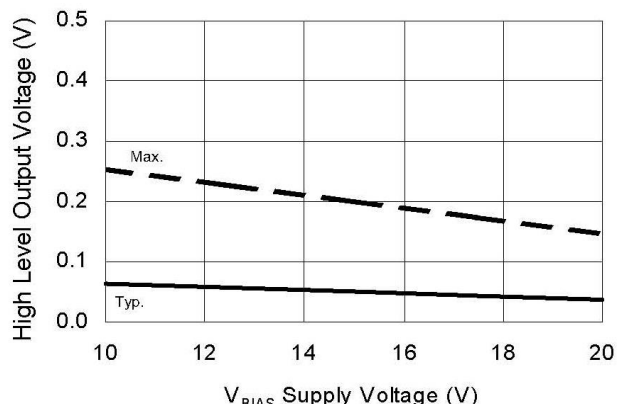


Figure 10B. High Level Output vs. Supply Voltage

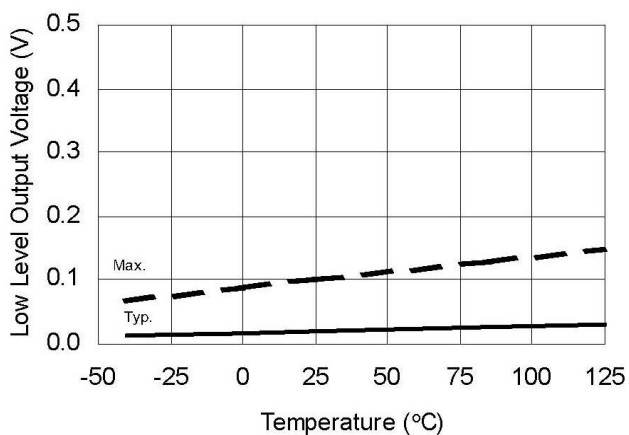


Figure 11A. Low Level Output Voltage vs. Temperature

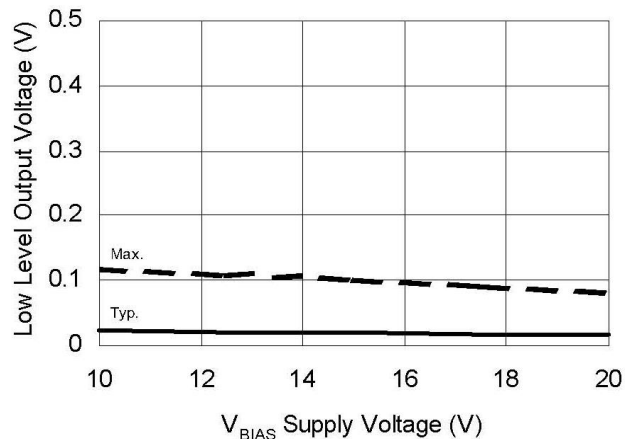


Figure 11B. Low Level Output vs. Supply Voltage

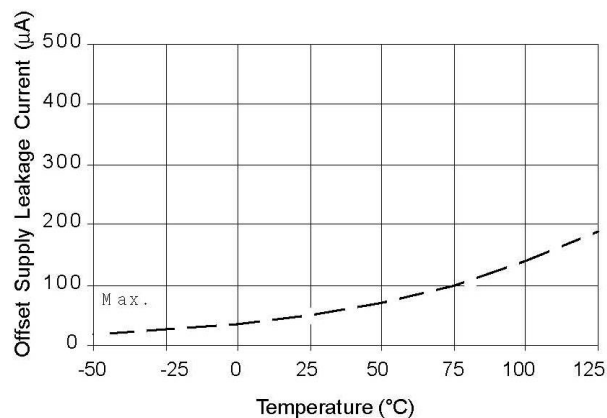


Figure 12A. Offset Supply Current vs. Temperature

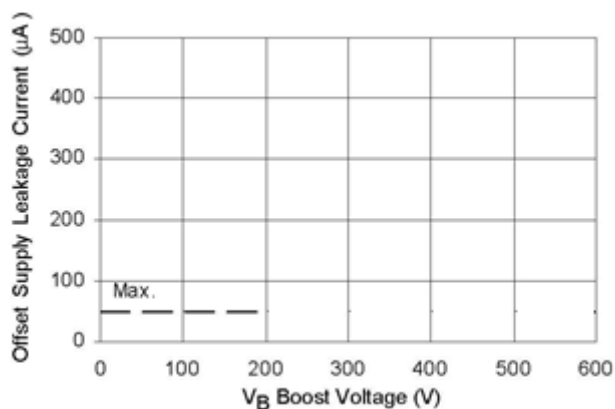


Figure 12B. Offset Supply Current vs. Voltage

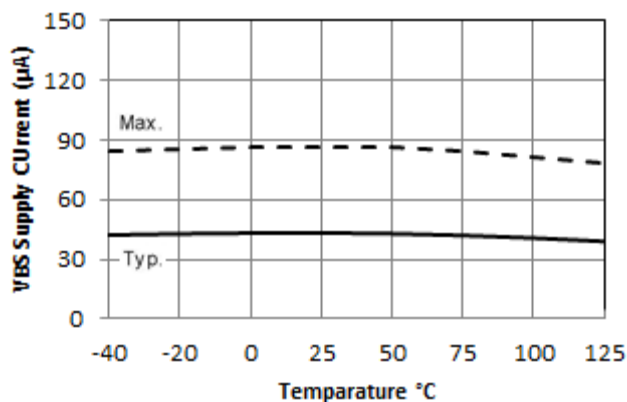


Figure 13A.  $V_{BS}$  Supply Current vs. Temperature

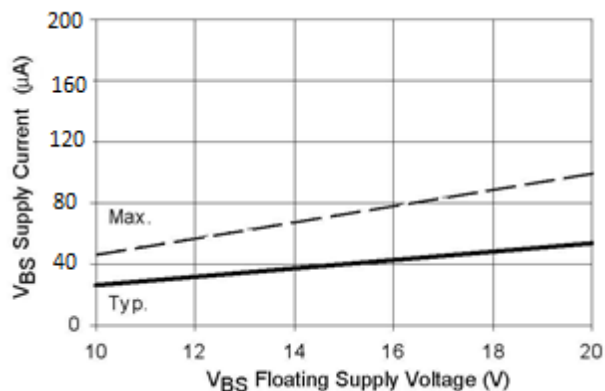


Figure 13B.  $V_{BS}$  Supply Current vs. Voltage

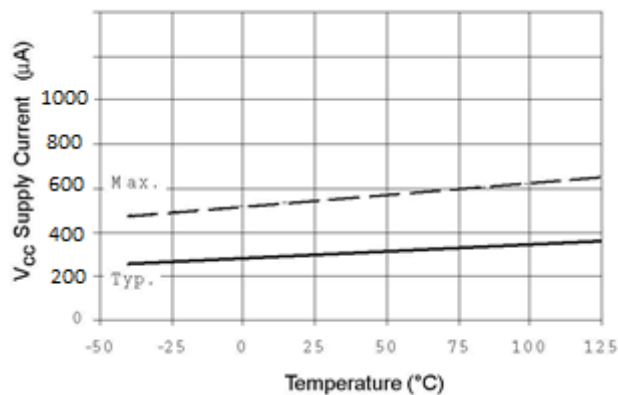


Figure 14A.  $V_{CC}$  Supply Current vs. Temperature

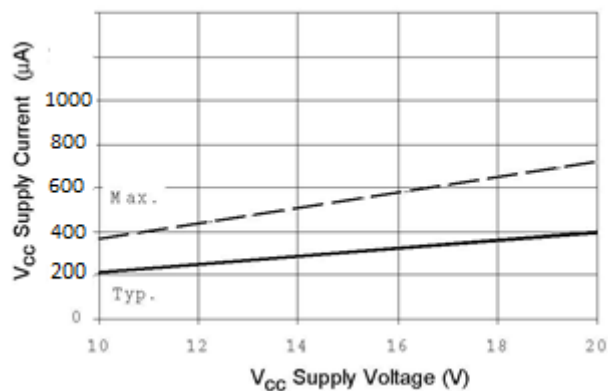


Figure 14B.  $V_{CC}$  Supply Current vs. Voltage

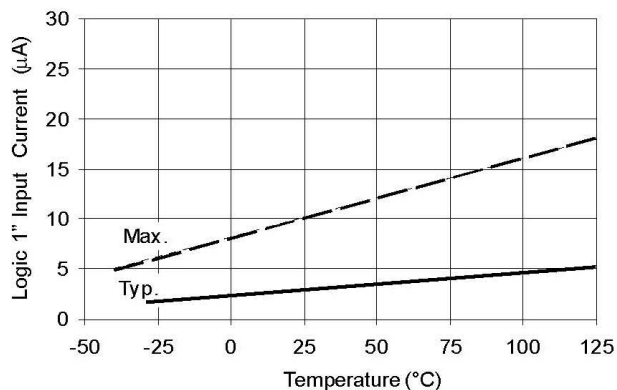


Figure 15A. Logic "1" Input Current vs. Temperature

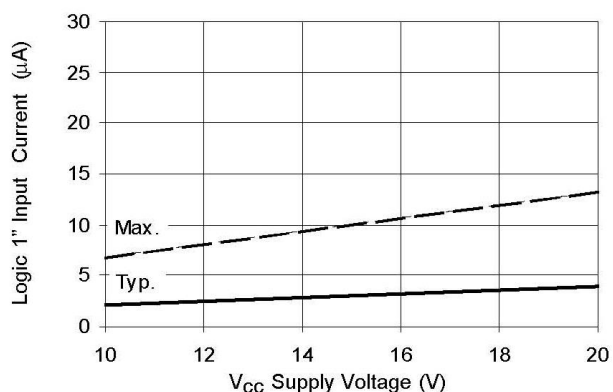


Figure 15B. Logic "1" Input Current vs. Voltage

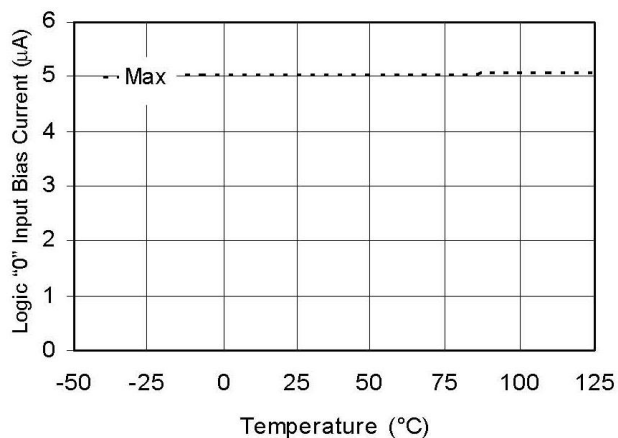


Figure 16A. Logic "0" Input Bias Current

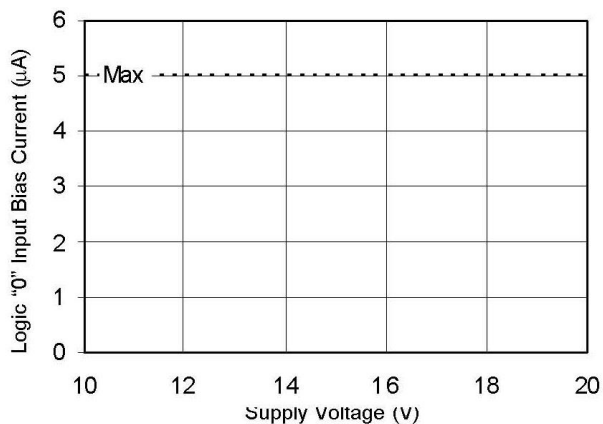


Figure 16B. Logic "0" Input Bias Current

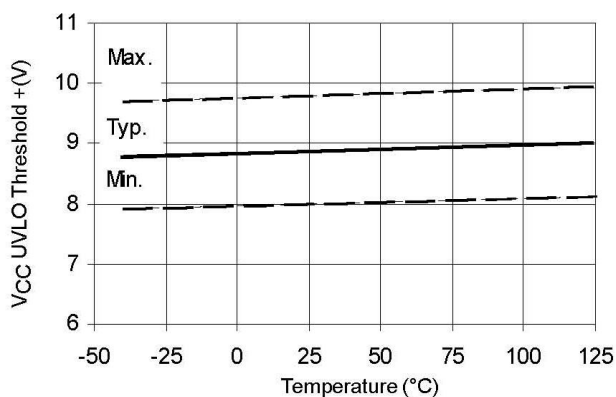


Figure 17A.  $V_{CC}/V_{BS}$  Undervoltage Threshold(+) vs. Temperature

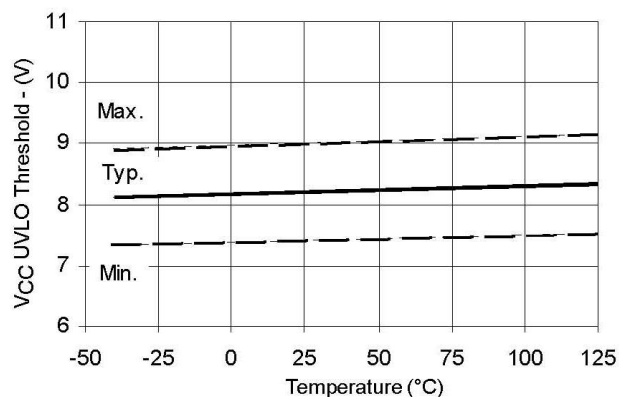


Figure 17B.  $V_{CC}/V_{BS}$  Undervoltage Threshold(-) vs. Temperature

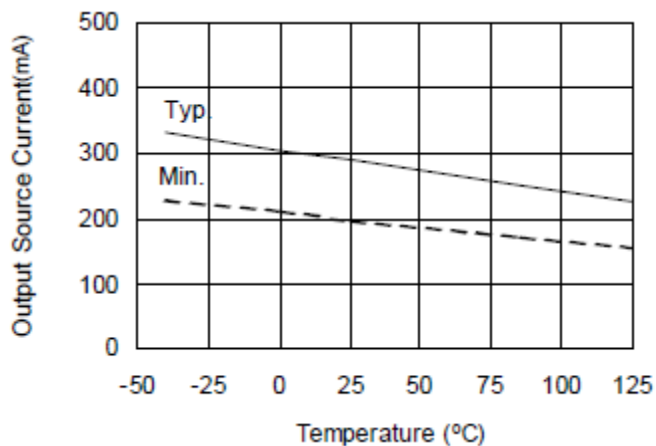


Figure 18A. Output Source Current vs. Temperature

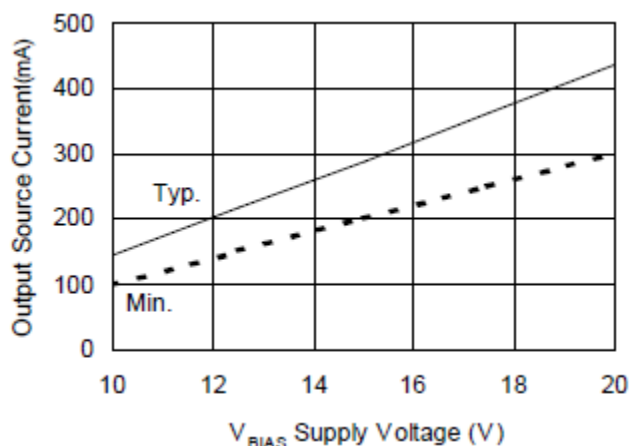


Figure 18B. Output Source Current vs. Supply Current

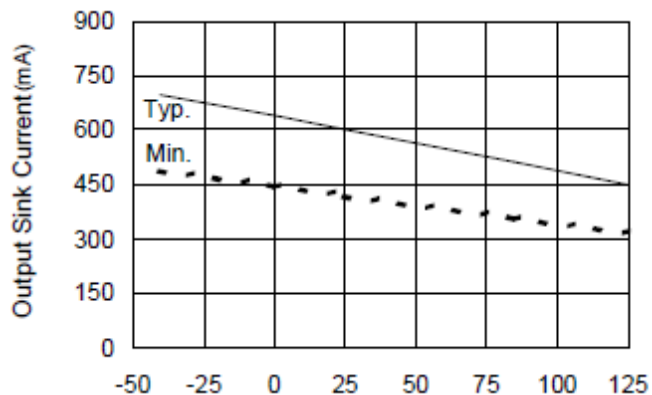


Figure 19A. Output Sink Current vs. Temperature

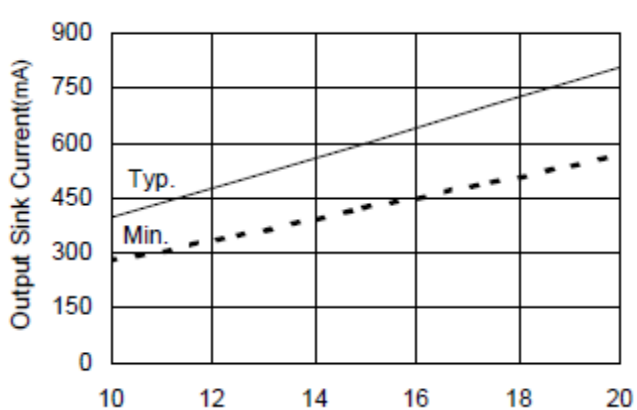
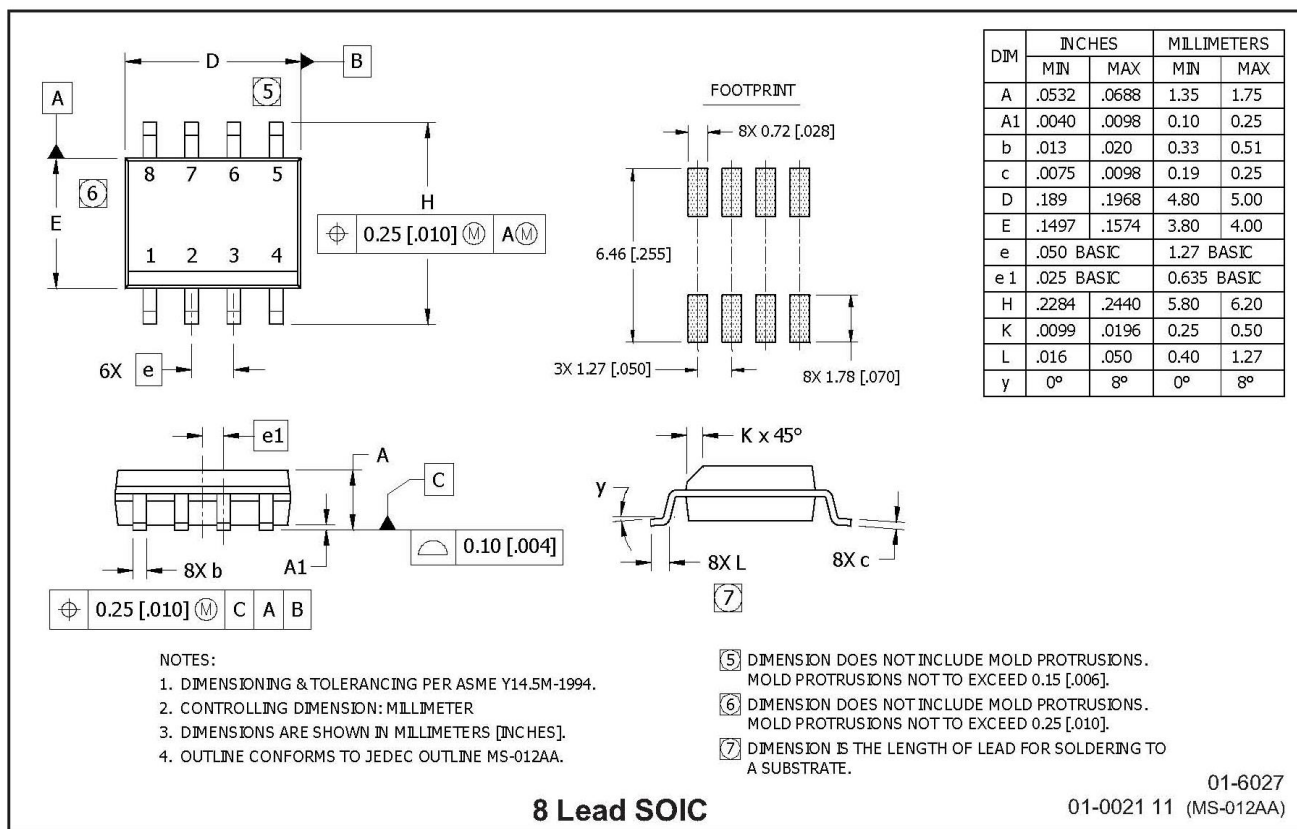
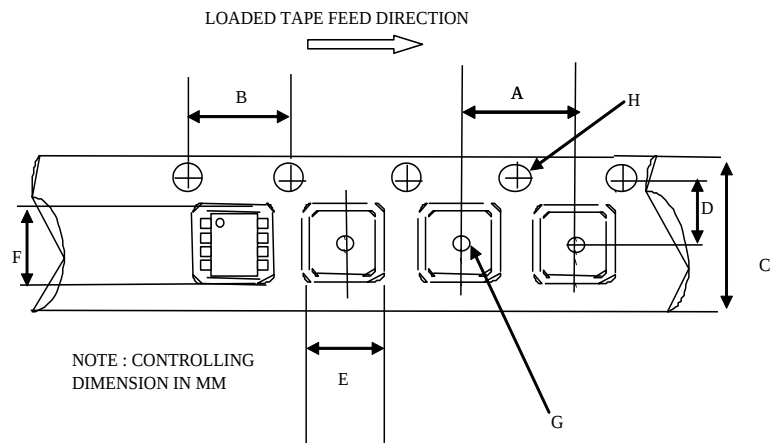


Figure 19B. Output Sink Current vs. Supply Voltage

## Package Details: 8-Lead SOIC

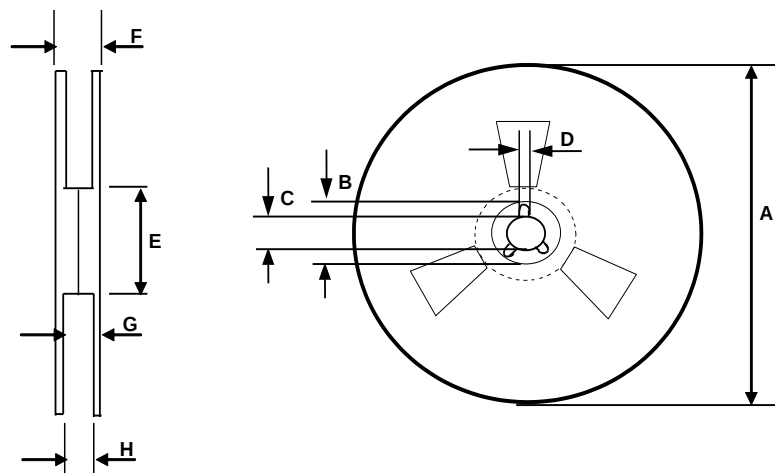


## Tape and Reel Details: 8-Lead SOIC



CARRIER TAPE DIMENSION FOR 8SOICN

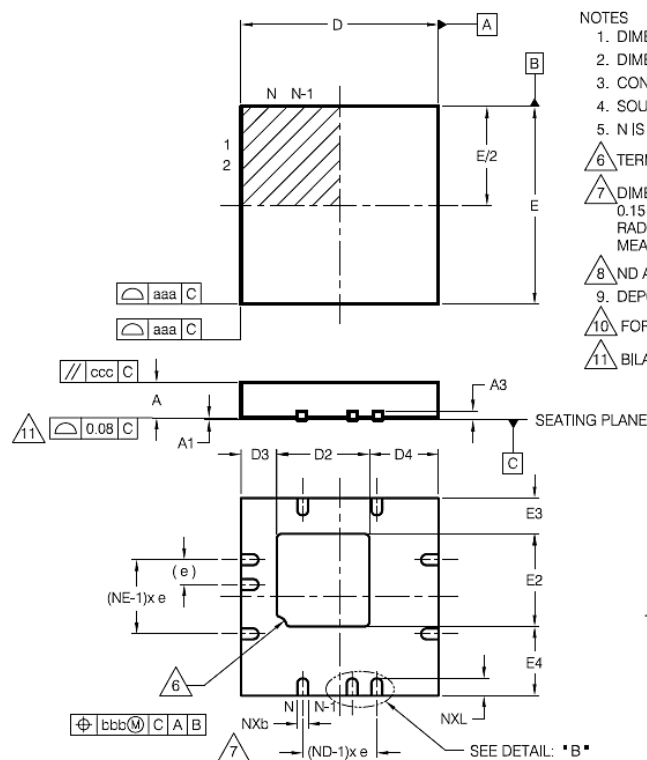
| Code | Metric |       | Imperial |       |
|------|--------|-------|----------|-------|
|      | Min    | Max   | Min      | Max   |
| A    | 7.90   | 8.10  | 0.311    | 0.318 |
| B    | 3.90   | 4.10  | 0.153    | 0.161 |
| C    | 11.70  | 12.30 | 0.46     | 0.484 |
| D    | 5.45   | 5.55  | 0.214    | 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

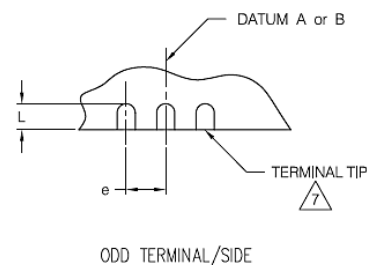
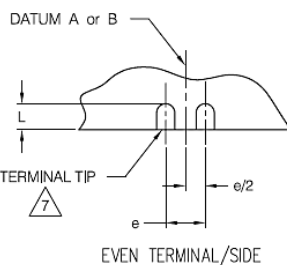
| Code | Metric |        | Imperial |        |
|------|--------|--------|----------|--------|
|      | Min    | Max    | Min      | Max    |
| A    | 329.60 | 330.25 | 12.976   | 13.001 |
| B    | 20.95  | 21.45  | 0.824    | 0.844  |
| C    | 12.80  | 13.20  | 0.503    | 0.519  |
| D    | 1.95   | 2.45   | 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  |

## Package Details: 14-Lead MLPQ 4x4



### NOTES

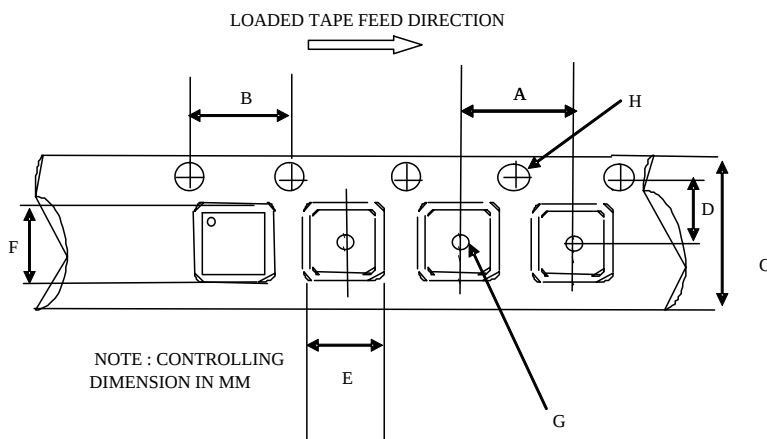
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
2. DIMENSIONS ARE SHOWN IN MILLIMETERS AND INCHES.
3. CONTROLLING DIMENSION: MILLIMETER.
4. SOURCE: JEDEC MO-220
5. N IS THE TOTAL NUMBER OF TERMINALS.
6. TERMINAL # 1 IDENTIFIER.
7. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 mm AND 0.30 mm FROM THE TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
8. ND AND NE TO THE NUMBER OF TERMINAL ON EACH D AND E SIDE.
9. DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.
10. FOR A COMPLETE SET OF DIMENSIONS FOR EACH VARIATION, SEE THE INDIVIDUAL VARIATION.
11. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.



DETAIL : " B "

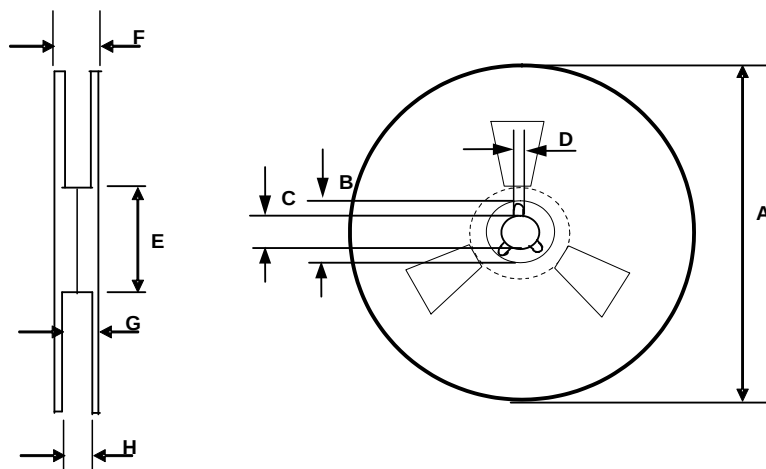
| SYMBOL | VGGD-10     |      |      |            |       |       |
|--------|-------------|------|------|------------|-------|-------|
|        | MILLIMETERS |      |      | INCHES     |       |       |
|        | MIN         | NOM  | MAX  | MIN        | NOM   | MAX   |
| A      | 0.80        | 0.90 | 1.00 | .032       | .035  | .039  |
| A1     | 0.00        | 0.02 | 0.05 | .000       | .0008 | .0019 |
| A3     | 0.20 REF    |      |      | .008 REF   |       |       |
| b      | 0.18        | 0.25 | 0.30 | .007       | .010  | .012  |
| D2     | 1.78        | 1.88 | 1.98 | .070       | .074  | .078  |
| D3     | 0.73 REF    |      |      | .029 REF   |       |       |
| D4     | 1.40 REF    |      |      | .055 REF   |       |       |
| D      | 4.00 BSC    |      |      | .157 BSC   |       |       |
| E      | 4.00 BSC    |      |      | .157 BSC   |       |       |
| E4     | 1.40 REF    |      |      | .055 REF   |       |       |
| E3     | 0.73 REF    |      |      | .029 REF   |       |       |
| E2     | 1.78        | 1.88 | 1.98 | .070       | .074  | .078  |
| L      | 0.30        | 0.40 | 0.50 | .012       | .016  | .020  |
| e      | 0.50 PITCH  |      |      | .020 PITCH |       |       |
| N      | 16          |      |      | 16         |       |       |
| ND     | 4           |      |      | 4          |       |       |
| NE     | 4           |      |      | 4          |       |       |
| aaa    | 0.15        |      |      | .0059      |       |       |
| bbb    | 0.10        |      |      | .0039      |       |       |
| ccc    | 0.10        |      |      | .0039      |       |       |
| ddd    | 0.05        |      |      | .0019      |       |       |

## Tape and Reel Details: 14-Lead MLPQ 4x4



CARRIER TAPE DIMENSION FOR MLPQ4x4

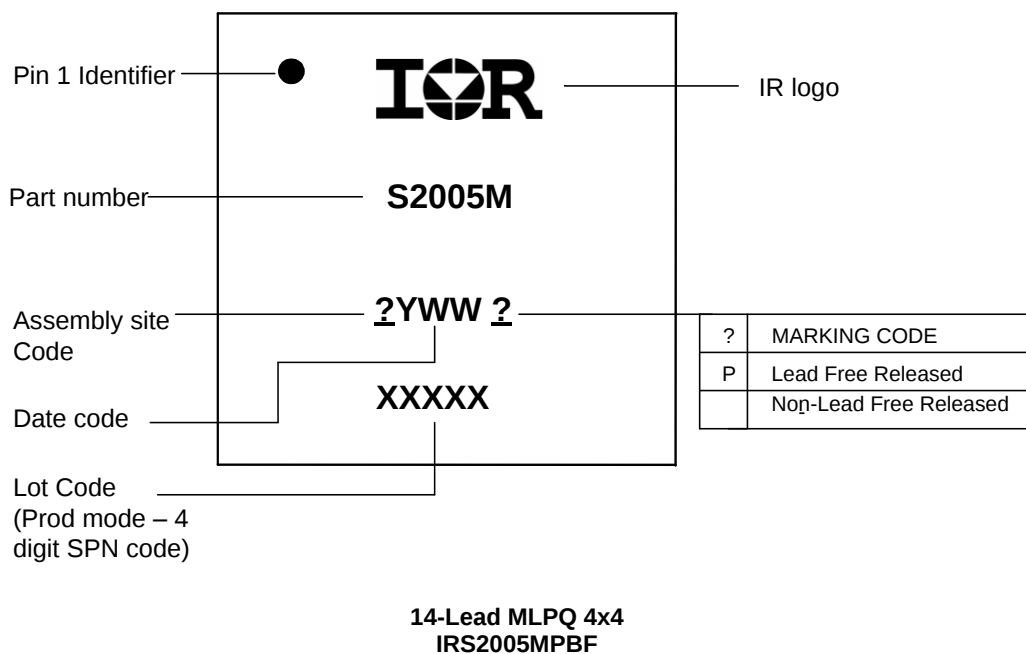
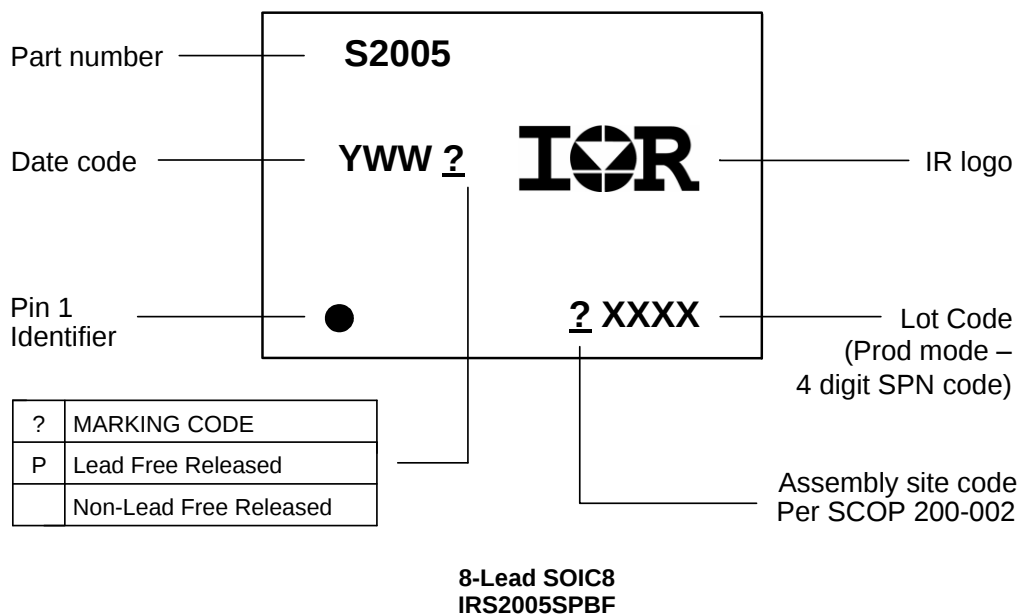
| Code | Metric |       | Imperial |       |
|------|--------|-------|----------|-------|
|      | Min    | Max   | Min      | Max   |
| A    | 7.90   | 8.10  | 0.311    | 0.358 |
| B    | 3.90   | 4.10  | 0.153    | 0.161 |
| C    | 11.70  | 12.30 | 0.461    | 0.484 |
| D    | 5.45   | 5.55  | 0.215    | 0.219 |
| E    | 4.25   | 4.45  | 0.168    | 0.176 |
| F    | 4.25   | 4.45  | 0.168    | 0.176 |
| G    | 1.50   | n/a   | 0.069    | n/a   |
| H    | 1.50   | 1.60  | 0.069    | 0.063 |



REEL DIMENSIONS FOR MLPQ4x4

| 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  |

## Part Marking Information



## Qualification Information<sup>†</sup>

|                            |                  |                                                                                                                                                                     |                                                          |
|----------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Qualification Level        |                  | Industrial <sup>††</sup>                                                                                                                                            |                                                          |
|                            |                  | Comments: This family of ICs has passed JEDEC's Industrial qualification. IR's Consumer qualification level is granted by extension of the higher Industrial level. |                                                          |
| Moisture Sensitivity Level |                  | 8 Lead SOIC                                                                                                                                                         | MSL2 <sup>†††</sup> , 260°C<br>(per IPC/JEDEC J-STD-020) |
|                            |                  | 14-Lead MLPQ 4x4                                                                                                                                                    |                                                          |
| ESD                        | Human Body Model | Class 2<br>(per JEDEC standard JESD22-A114)                                                                                                                         |                                                          |
|                            | Machine Model    | Class A<br>(per EIA/JEDEC standard EIA/JESD22-A115)                                                                                                                 |                                                          |
| IC Latch-Up Test           |                  | Class I<br>(per JESD78)                                                                                                                                             |                                                          |
| RoHS Compliant             |                  | Yes                                                                                                                                                                 |                                                          |

† Qualification standards can be found at International Rectifier's web site <http://www.irf.com/>

†† Higher qualification ratings may be available should the user have such requirements. Please contact your International Rectifier sales representative for further information.

††† Higher MSL ratings may be available for the specific package types listed here. Please contact your International Rectifier sales representative for further information.