International IRR Rectifier

IRS2003(S)PbF

HALF-BRIDGE DRIVER

Features

- Floating channel designed for bootstrap operation
- Fully operational to +200 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 logic compatible
- Cross-conduction prevention logic
- Matched propagation delay for both channels
- Internal set deadtime
- High-side output in phase with HIN input
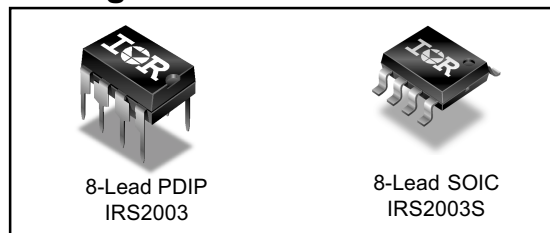- Low-side output out of phase with $\overline{\text{LIN}}$ input
- RoHS compliant

Description

The IRS2003 is a high voltage, high speed power MOSFET and IGBT drivers 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 up to 200 V.
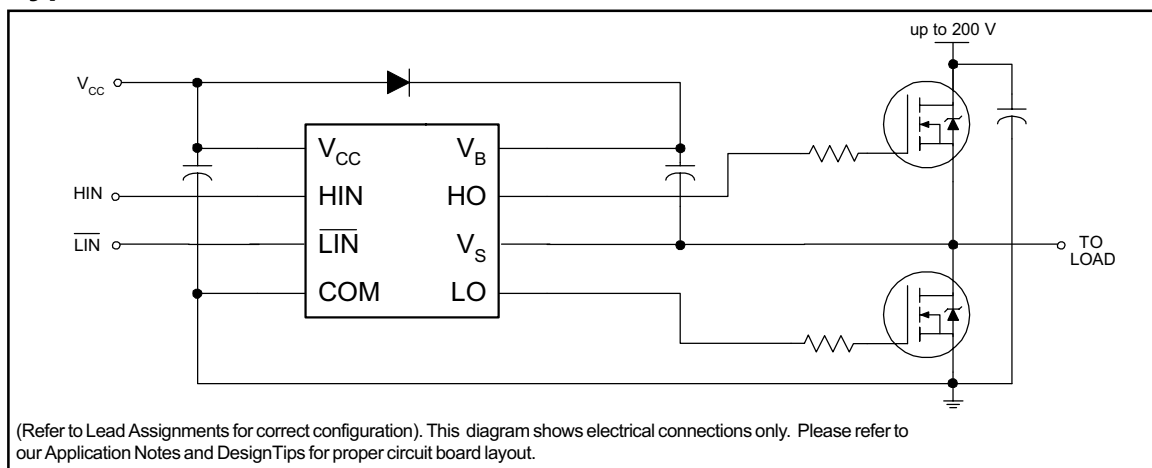
Product Summary

V_{OFFSET}	200 V max.
I_O+/-	130 mA/270 mA
V_{OUT}	10 V - 20 V
$t_{on/off}$ (typ.)	680 ns/150 ns
Deadtime (typ.)	520 ns

Packages

8-Lead PDIP
IRS2003

8-Lead SOIC
IRS2003S

Typical Connection

(Refer to Lead Assignments for correct configuration). This diagram shows electrical connections only. Please refer to our Application Notes and 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. 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	225	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 (HIN & $\overline{\text{LIN}}$)		-0.3	V_{CC} + 0.3	
dV_S/dt	Allowable offset supply voltage transient		—	50	V/ns
P_D	Package power dissipation @ $T_A \leq$ +25 °C	(8 Lead PDIP)	—	1.0	W
		(8 Lead SOIC)	—	0.625	
Rth_{JA}	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	200	
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 (HIN & $\overline{\text{LIN}}$)	0	V_{CC}	
T_A	Ambient temperature	-40	125	°C

Note 1: Logic operational for V_S of -5 V to +200 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		V_S = 0 V
t_{off}	Turn-off propagation delay	—	150	220		V_S = 200 V
t_r	Turn-on rise time	—	70	170		
t_f	Turn-off fall time	—	35	90	ns	
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" (HIN) & Logic "0" ($\overline{LIN}$) input voltage	2.5	—	—		V_{CC} = 10 V to 20 V
V_{IL}	Logic "0" (HIN) & Logic "1" ($\overline{LIN}$) input voltage	—	—	0.8	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		V_B = V_S = 200 V
I_{QBS}	Quiescent V_{BS} supply current	—	30	55		
I_{QCC}	Quiescent V_{CC} supply current	—	150	270	µA	V_{IN} = 0 V or 5 V
I_{IN+}	Logic "1" input bias current	—	3	10		HIN = 5 V, $\overline{LIN}$ = 0 V
I_{IN-}	Logic "0" input bias current	—	—	5		HIN = 0 V, $\overline{LIN}$ = 5 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, V_{IN} = V_{IH} PW ≤ 10 µs
I_{O-}	Output low short circuit pulsed current	270	600	—		V_O = 15 V, V_{IN} = V_{IL} PW ≤ 10 µs

International IOR Rectifier

IRS2003(S)PbF

Functional Block Diagram
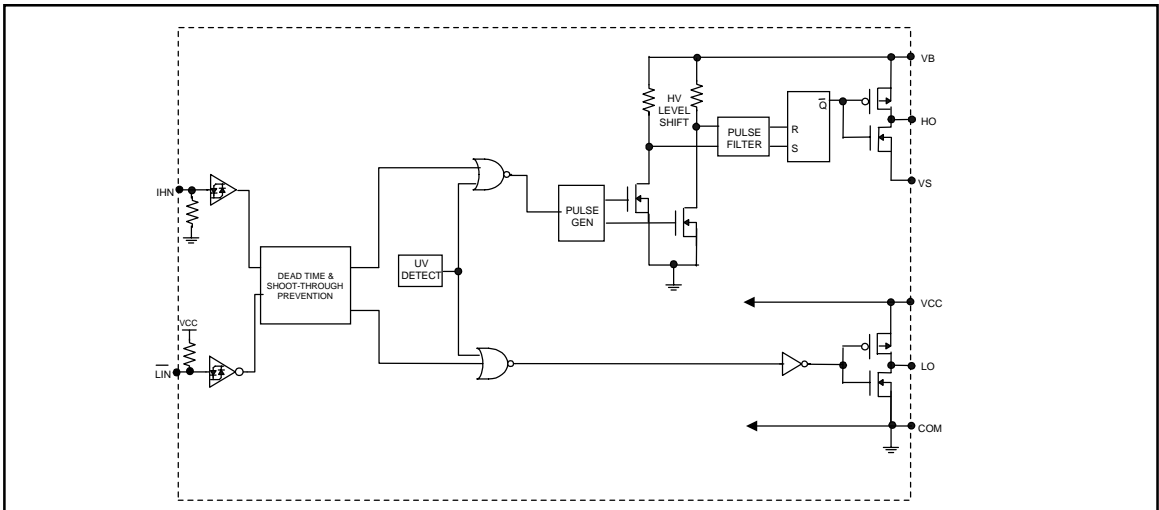
Lead Definitions

| Symbol	Description
HIN	Logic input for high-side gate driver output (HO), in phase
$\overline{\text{LIN}}$	Logic input for low-side gate driver output (LO), out of phase
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

8 Lead PDIP

IRS2003PbF

8 Lead SOIC

IRS2003SPbF

IRS2003(S)PbF
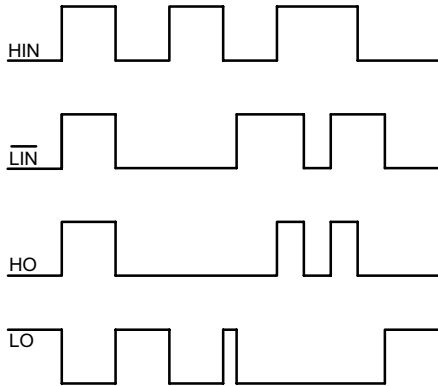
Figure 1. Input/Output Timing Diagram
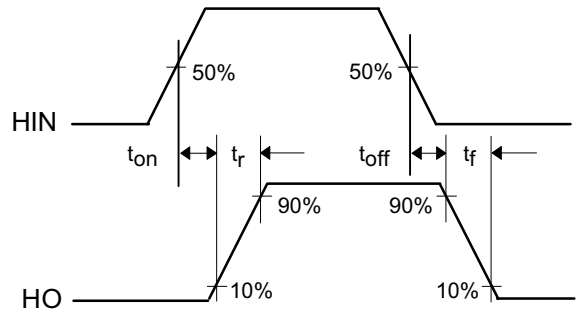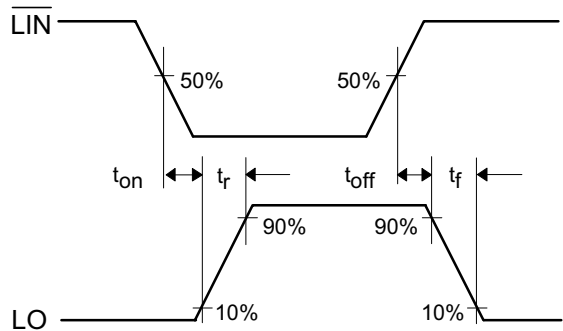
Figure 2. Switching Time Waveform Definitions
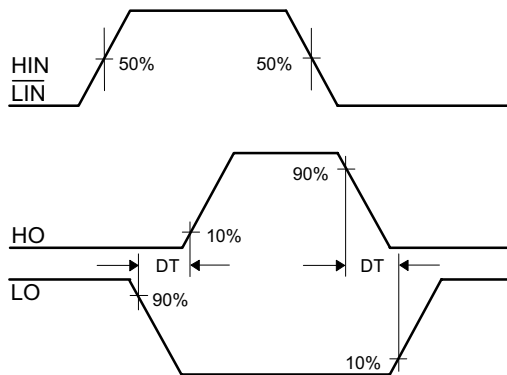
Figure 3. Deadtime Waveform Definitions

IRS2003(S)PbF
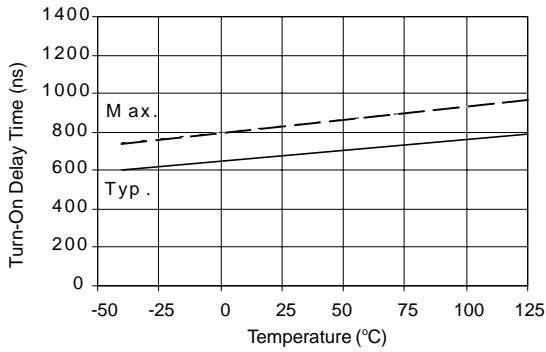
Figure 4A. Turn-On Time vs. Temperature
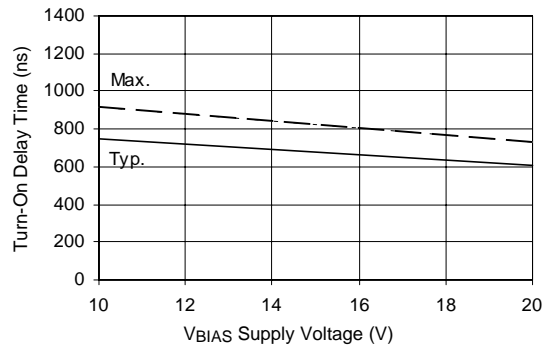
Figure 4B. Turn-On Time vs. Supply Voltage
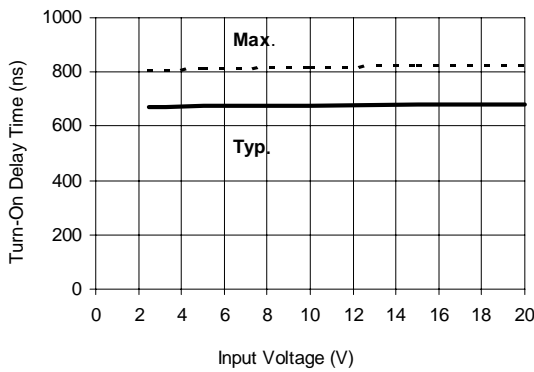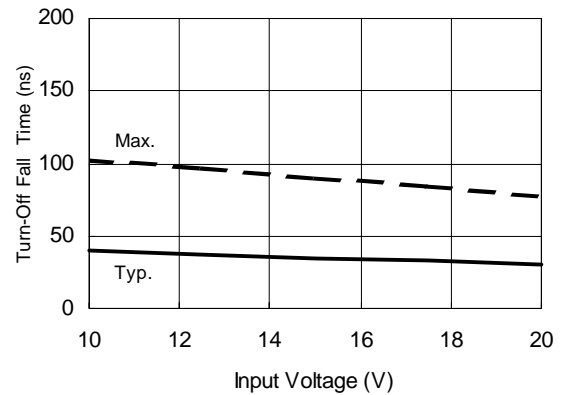

Figure 4C. Turn-On Time vs. Input Voltage
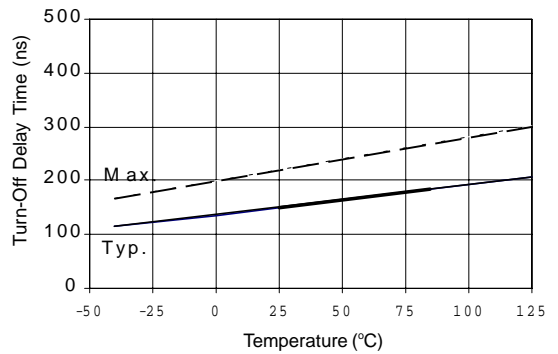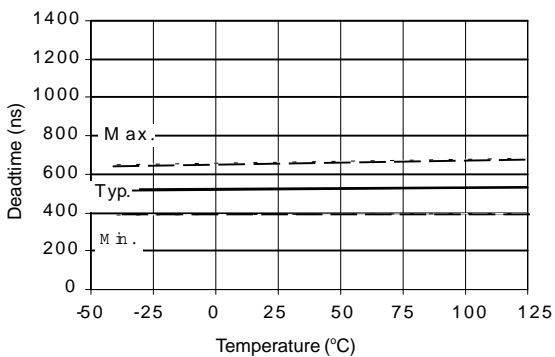

Figure 5A. Turn-Off Time vs. Temperature
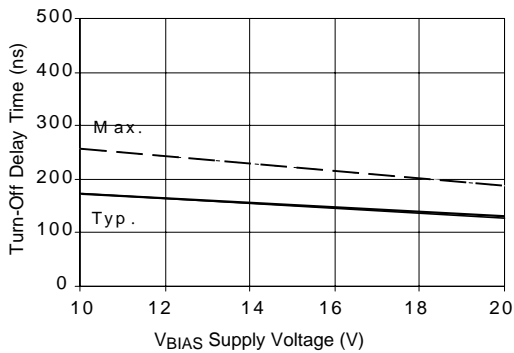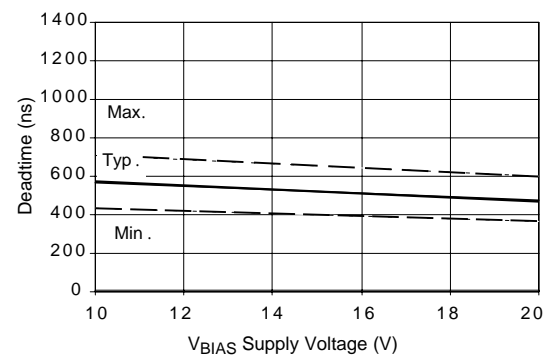

Figure 5B. Turn-Off Time vs. Supply Voltage
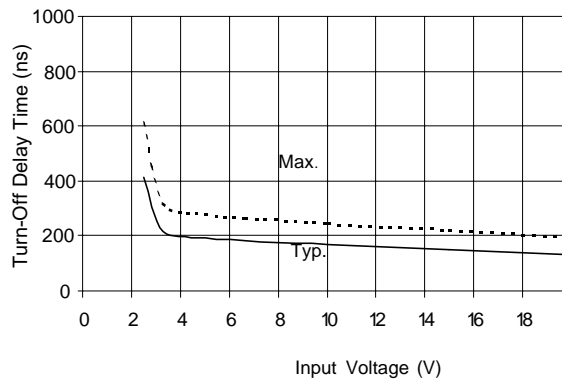
Figure 5C. Turn-Off Time vs. Input Voltage
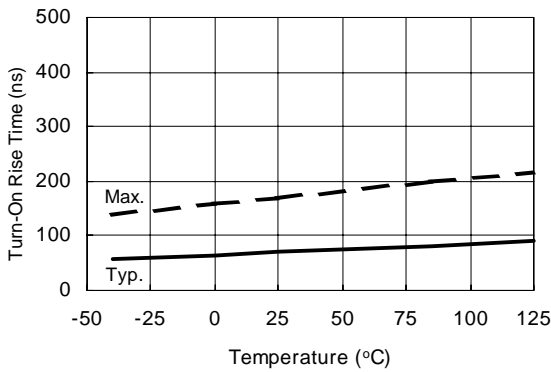
**Figure 6A. Turn-On Rise Time
vs. Temperature**
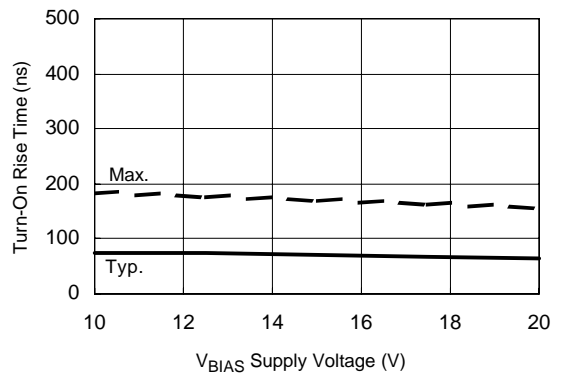
**Figure 6B. Turn-On Rise Time
vs. Voltage**
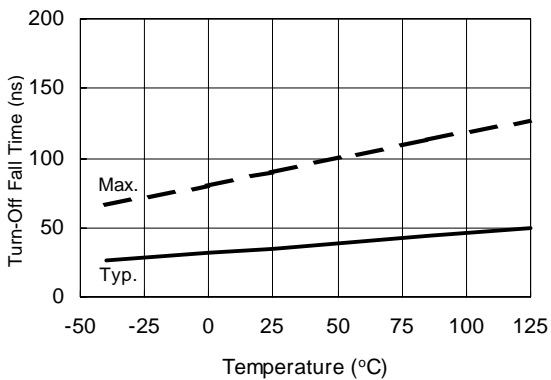
**Figure 7A. Turn-Off Fall Time
vs. Temperature**

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

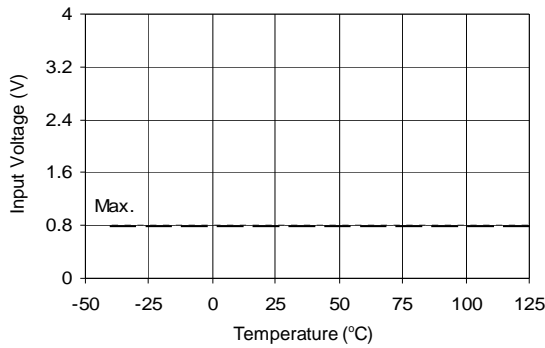**Figure 8A. Deadtime vs. Temperature**
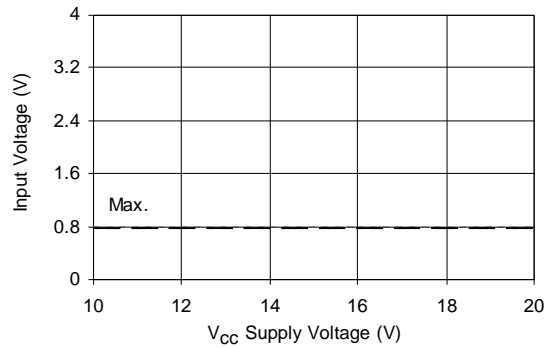

Figure 8B. Deadtime vs. Voltage
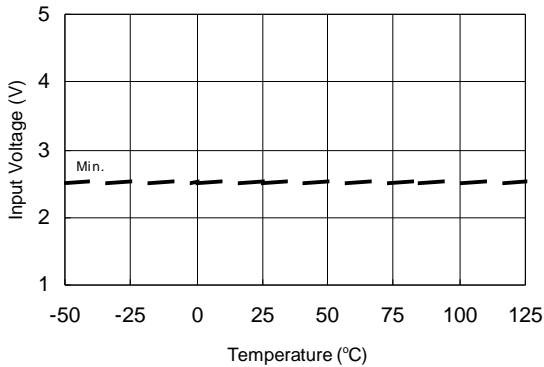
**Figure 9A. Logic "1" Input Voltage
vs. Temperature**
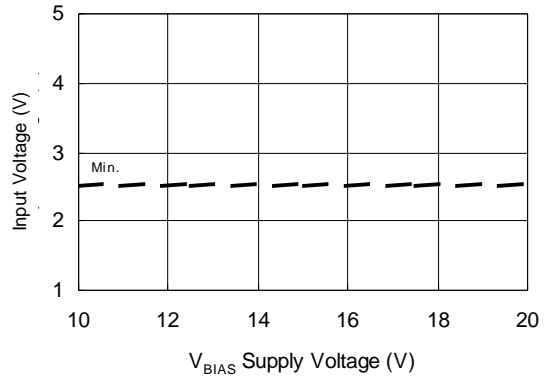
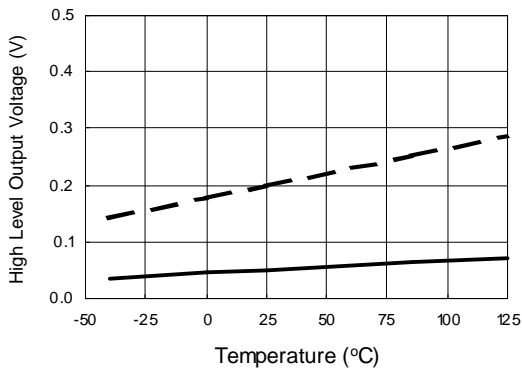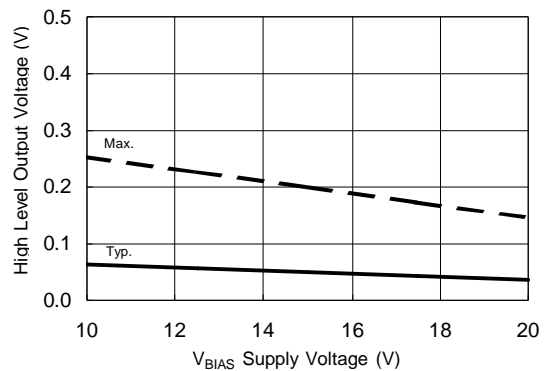**Figure 9B. Logic "1" Input Voltage
vs. Supply Voltage**

**Figure 10A. Logic "0"(HIN) & Logic "1" ($\overline{\text{LIN}}$)
Input Voltage vs. Temperature**

**Figure 10B. Logic "0"(HIN) & Logic "1" ($\overline{\text{LIN}}$)
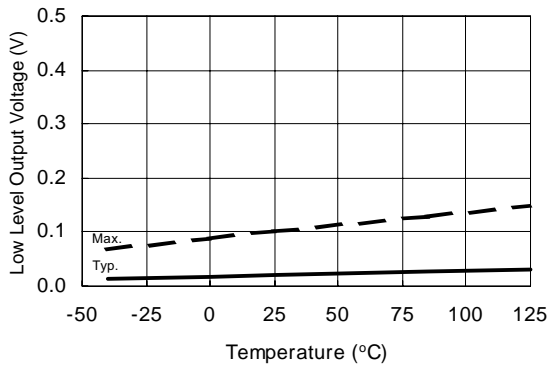Input Voltage vs. Voltage**

**Figure 11A. High Level Output Voltage
vs. Temperature**
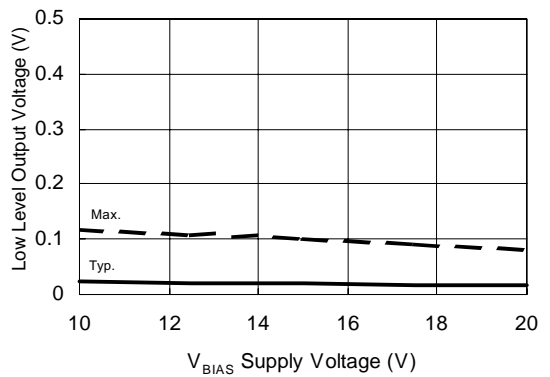
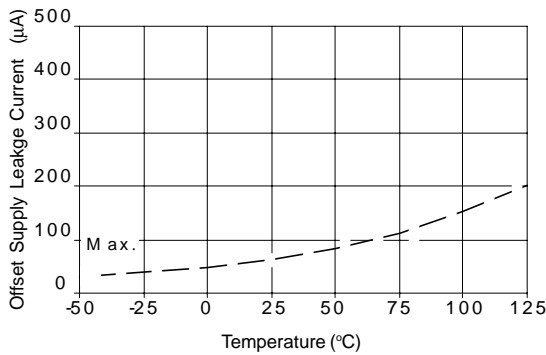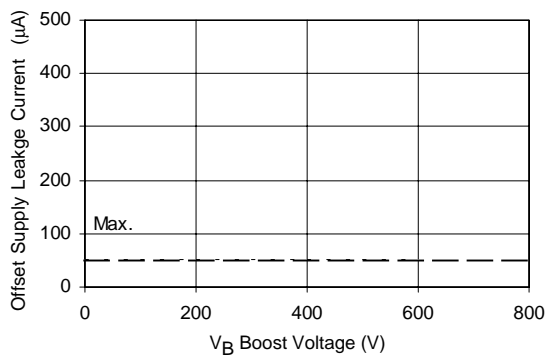**Figure 11B. High Level Output Voltage
vs. Supply Voltage**

Figure 12A. Low Level Output Voltage
vs. Temperature
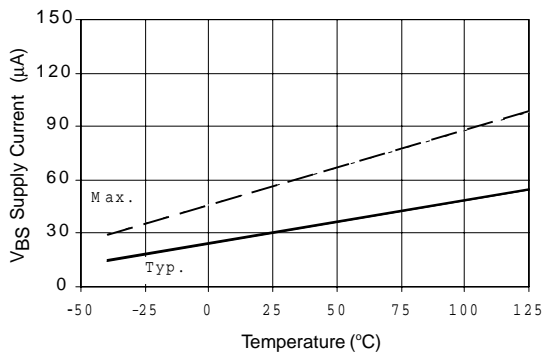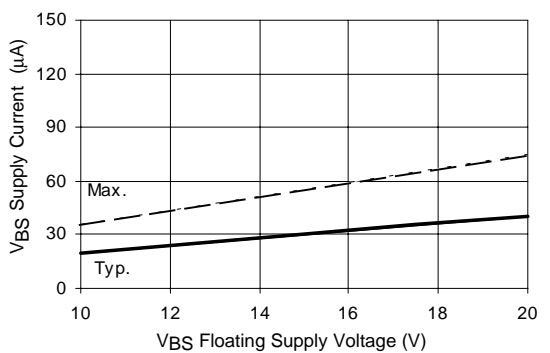
Figure 12B. Low Level Output Voltage
vs. Supply Voltage

Figure 13A. Offset Supply Current
vs. Temperature

Figure 13B. Offset Supply Current vs. Voltage

Figure 14A. V$_{BS}$ Supply Current
vs. Temperature
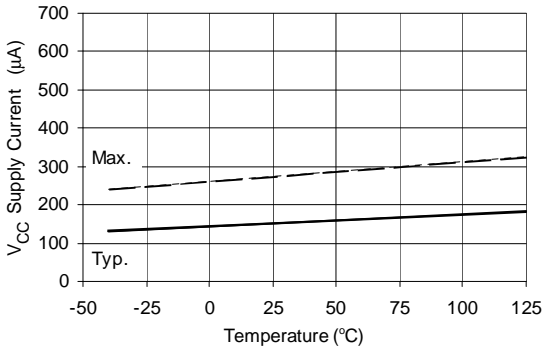
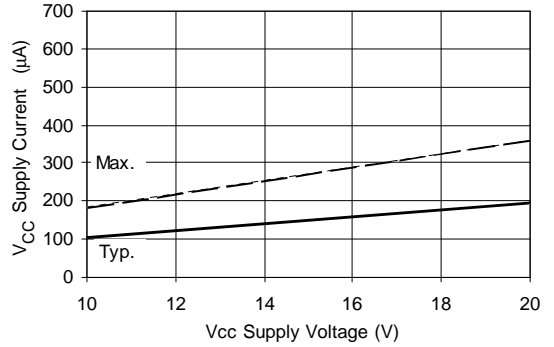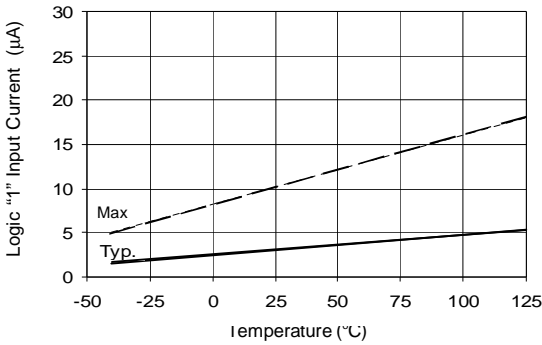Figure 14B. V$_{BS}$ Supply Current vs. Voltage

Figure 15A. Vcc Supply Current vs. Temperature

Figure 15B. Vcc Supply Current vs. Voltage

Figure 16A. Logic "1" Input Current vs. Temperature
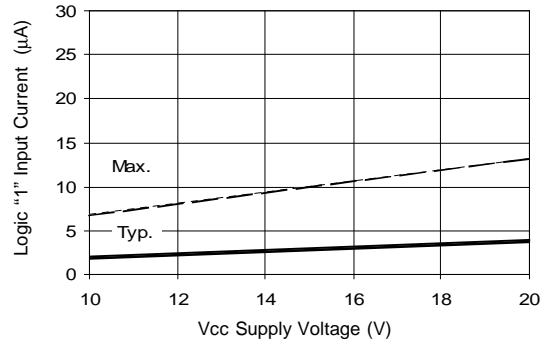
Figure 16B. Logic "1" Input Current vs. Voltage
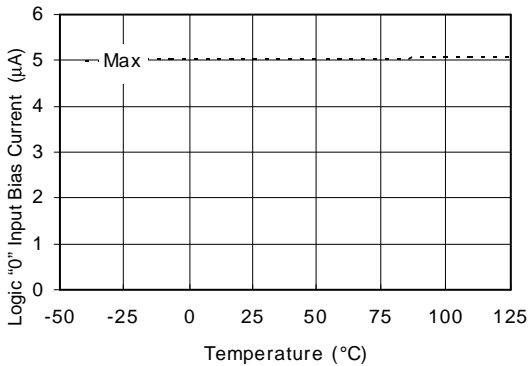
Figure 17A. Logic "0" Input Bias Current vs. Temperature
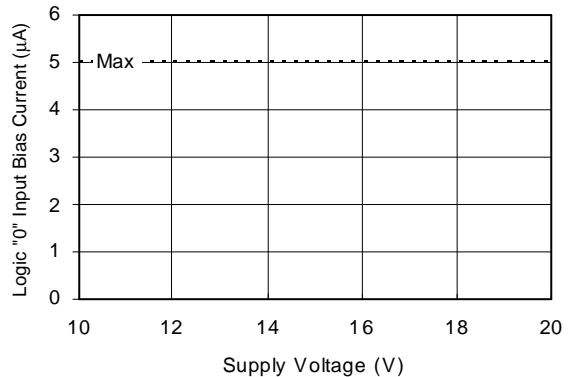
Figure 17B. Logic "0" Input Bias Current vs. Voltage
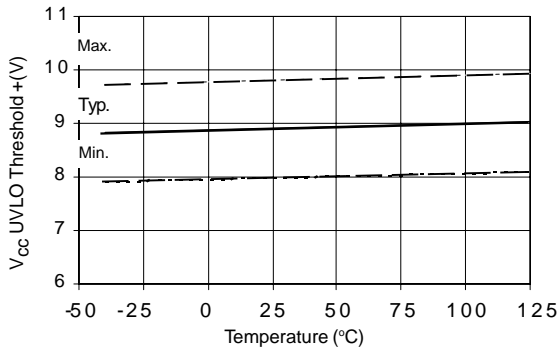
**Figure 18A. V$_{CC}$ Undervoltage Threshold(+)
vs. Temperature**
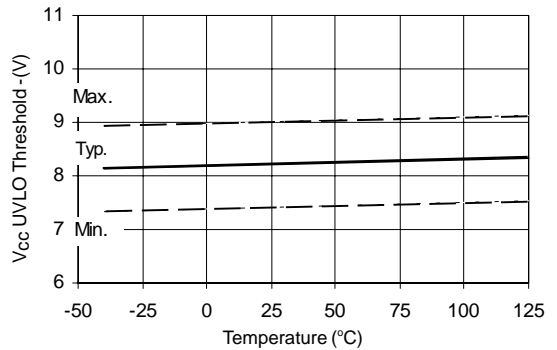
**Figure 18B. V$_{CC}$ UndervoltageThreshold (-)
vs. Temperature**

**Figure 19A. Output Source Current
vs. Temperature**

**Figure 19B. Output Source Current
vs. Supply Voltage**

**Figure 20A. Output Sink Current
vs. Temperature**
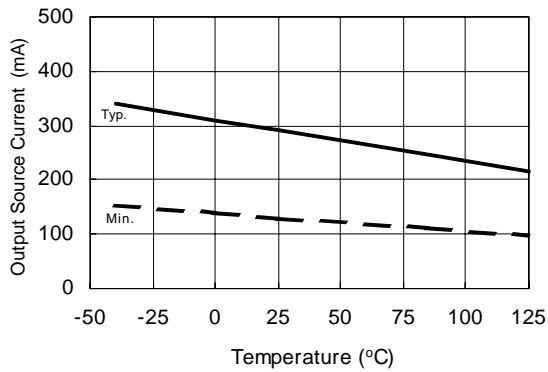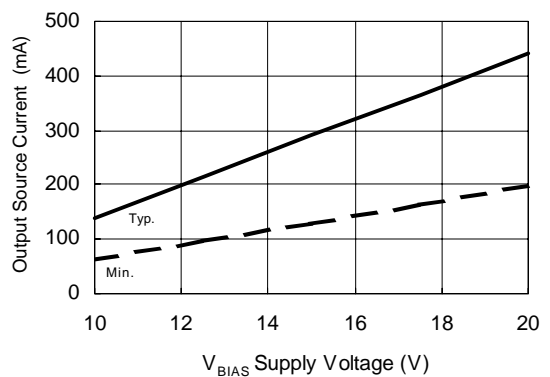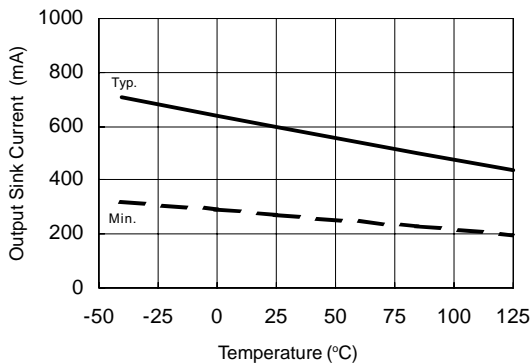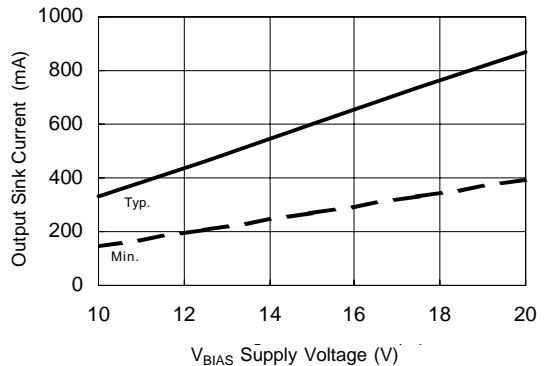

**Figure 20B. Output Sink Current
vs. Supply Voltage**

IRS2003(S)PbF

Case Outlines

NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M−1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS−001AB.
5. MEASURED WITH THE LEADS CONSTRAINED TO BE PERPENDICULAR TO DATUM PLANE C.
6. DIMENSION DOES NOT INCLUDE MOLD PROTUSIONS. MOLD PROTUSIONS SHALL NOT EXCEED 0.25 [.010].

01-6014
01-3003 01 (MS-001AB)

8-Lead PDIP

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
b	.013	.020	0.33	0.51
c	.0075	.0098	0.19	0.25
D	.189	.1968	4.80	5.00
E	.1497	.1574	3.80	4.00
e	.050 BASIC		1.27 BASIC	
e 1	.025 BASIC		0.635 BASIC	
H	.2284	.2440	5.80	6.20
K	.0099	.0196	0.25	0.50
L	.016	.050	0.40	1.27
y	0°	8°	0°	8°

NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.

5. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.15 [.006].
6. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.25 [.010].
7. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.

01-6027
01-0021 11 (MS-012AA)

8-Lead SOIC

IRS2003(S)PbF

**Tape & Reel
8-lead SOIC**

LOADED TAPE FEED DIRECTION

NOTE : CONTROLLING
DIMENSION IN MM
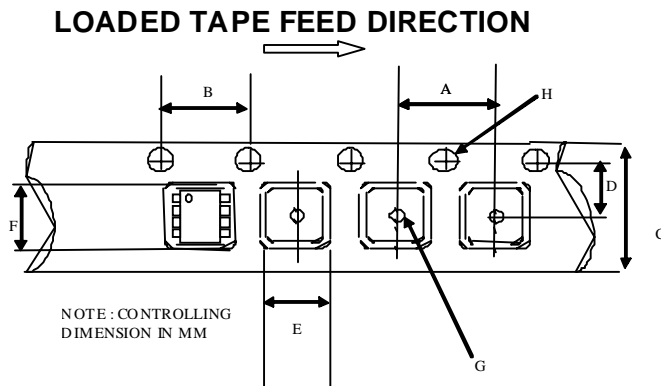
CARRIER TAPE DIMENSION FOR 8SOICN

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
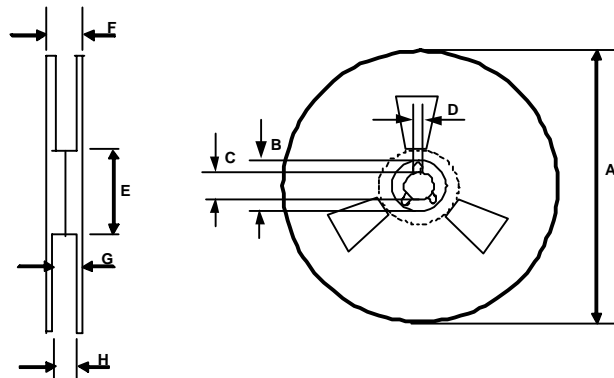
REEL DIMENSIONS FOR 8SOICN

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

International
I⊕R Rectifier

IRS2003(S)PbF

LEADFREE PART MARKING INFORMATION

Part number ——— IRSxxxxx

Date code ——— YWW?   **I⊕R** ——— IR logo

Pin 1
Identifier ——— ●   ?XXXX

Lot Code
(Prod mode - 4 digit SPN code)

?	MARKING CODE
P	Lead Free Released
	Non-Lead Free Released

Assembly site code
Per SCOP 200-002
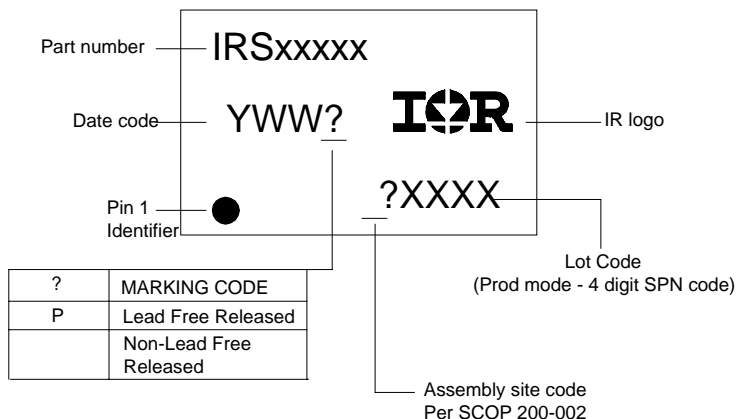
ORDER INFORMATION

8-Lead PDIP IRS2003PbF
8-Lead SOIC IRS2003SPbF
8-Lead SOIC Tape & Reel IRS2003STRPbF

International
I⊕R Rectifier

The SOIC-8 is MSL2 qualified.
This product has been designed and qualified for the industrial level.
Qualification standards can be found at www.irf.com
IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245 Tel: (310) 252-7105
Data and specifications subject to change without notice. 11/27/2006