

## IRS2301S HIGH AND LOW SIDE DRIVER

### Features

- Floating channel designed for bootstrap operation
- Fully operational to +600V
- Tolerant to negative transient voltage – dV/dt immune
- Gate drive supply range from 5V to 20V
- Undervoltage lockout for both channels
- 3.3V, 5V and 15V input logic compatible
- Matched propagation delay for both channels
- Outputs in phase with inputs
- Lower di/dt gate driver for better noise immunity
- Leadfree, RoHS compliant

### Typical Applications

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

### Product Summary

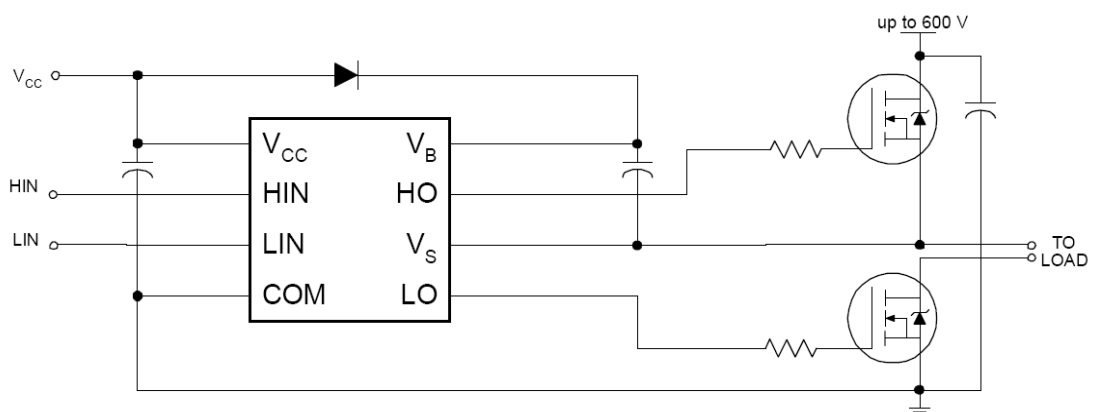
$V_{\text{OFFSET}}$	600V Max
$V_{\text{OUT}}$	5V – 20V
$I_{o+}$ & $I_{o-}$ (min)	120mA / 250mA
$t_{\text{ON}}$ & $t_{\text{OFF}}$ (typical)	220ns / 200ns
Delay Matching	50ns

### Package Options



8-Lead SOIC  
IRS2301S

### Typical Connection Diagram



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

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## Description

The IRS2301S 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. The floating channel can be used to drive an N-channel power MOSFET or IGBT in the high-side configuration which operates up to 600V.

**Qualification Information<sup>†</sup>**

<b>Qualification Level</b>		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.
<b>Moisture Sensitivity Level</b>		MSL2 <sup>†††</sup> 260°C (per IPC/JEDEC J-STD-020)
<b>ESD</b>	Machine Model	Class B (per JEDEC standard JESD22-A115)
	Human Body Model	Class 2 (per EIA/JEDEC standard EIA/JESD22-A114)
<b>IC Latch-Up Test</b>		Class I, Level A (per JESD78)
<b>RoHS Compliant</b>		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.

**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 (HIN & LIN)	COM -0.3	$V_{CC} + 0.3$	
$dV_S/dt$	Allowable offset supply voltage transient	—	50	V/ns
$P_D$	Package power dissipation @ $T_A \leq 25^\circ\text{C}$	—	0.625	W
$R_{thJA}$	Thermal resistance, junction to ambient	—	200	$^\circ\text{C}/\text{W}$
$T_J$	Junction temperature	—	150	$^\circ\text{C}$
$T_S$	Storage temperature	-50	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 15V differential.

Symbol	Definition	Min.	Max.	Units
$V_B$	High-side floating supply absolute voltage	$V_S + 5$	$V_S + 20$	V
$V_S$	High-side floating supply offset voltage	† 1	600	
$V_{HO}$	High-side floating output voltage	$V_S$	$V_B$	
$V_{CC}$	Low-side and logic fixed supply voltage	5	20	
$V_{LO}$	Low-side output voltage	0	$V_{CC}$	
$V_{IN}$	Logic input voltage (HIN & LIN)	COM	$V_{CC}$	
$T_A$	Ambient temperature	-40	125	$^\circ\text{C}$

†: 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).

**Static Electrical Characteristics**

$V_{BIAS}$  ( $V_{CC}$ ,  $V_{BS}$ ) = 15V and  $T_A$  = 25°C unless otherwise specified. The  $V_{IL}$ ,  $V_{IH}$  and  $I_{IN}$  parameters are referenced to COM and are applicable to the respective input leads: HIN and LIN. The  $V_O$ ,  $I_O$  and  $R_{on}$  parameters are referenced to COM and are applicable to the respective output leads: HO and LO.

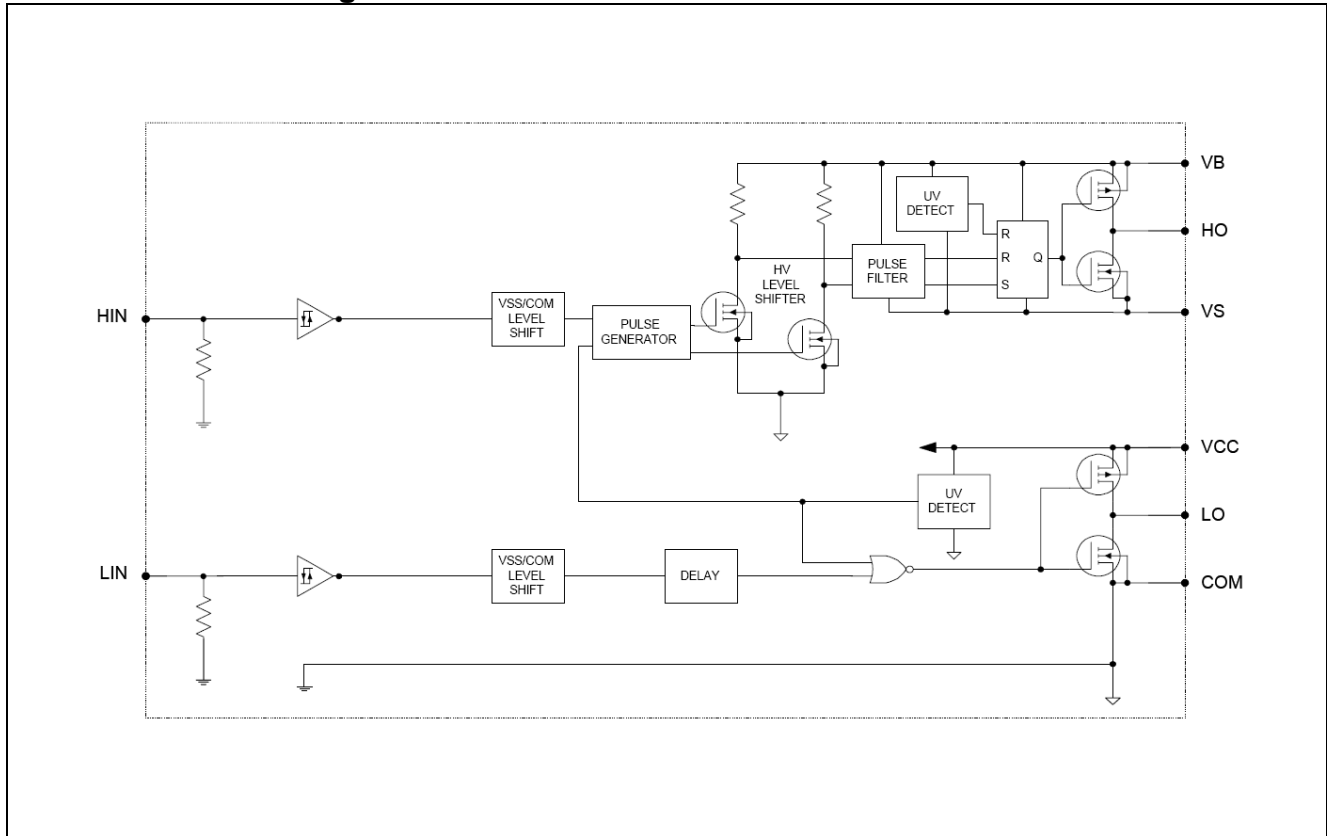
Symbol	Definition	Min	Typ	Max	Units	Test conditions
$V_{IH}$	Logic "1" input voltage	2.5	—	—	V	$V_{CC} = 10V$ to 20V
$V_{IL}$	Logic "0" input voltage	—	—	0.8		
$V_{OH}$	High level output voltage, $V_{BIAS} - V_O$	—	—	0.2	V	$I_O = 2mA$
$V_{OL}$	Low level output voltage, $V_O$	—	—	0.1		
$I_{LK}$	Offset supply leakage current	—	—	50	$\mu A$	$V_B = V_S = 600V$
$I_{QBS}$	Quiescent $V_{BS}$ supply current	60	160	260		$V_{IN} = 0V$ or 5V
$I_{QCC}$	Quiescent $V_{CC}$ supply current	60	160	260		$V_{IN} = 5V$
$I_{IN+}$	Logic "1" input bias current	—	5	20		$V_{IN} = 0V$
$I_{IN-}$	Logic "0" input bias current	—	—	5		
$V_{CCUV+}$ $V_{BSUV+}$	$V_{CC}$ and $V_{BS}$ supply undervoltage positive going threshold	3.3	4.1	5	V	
$V_{CCUV-}$ $V_{BSUV-}$	$V_{CC}$ and $V_{BS}$ supply undervoltage negative going threshold	3	3.8	4.7		
$V_{CCUVH}$ $V_{BSUVH}$	Hysteresis	0.1	0.3	—		
$I_{O+}$	Output high short circuit pulsed current	—	200	—	mA	$V_O = 0V$ , $PW \leq 10\mu s$
$I_{O-}$	Output low short circuit pulsed current	—	350	—		$V_O = 15V$ , $PW \leq 10\mu s$

**Dynamic Electrical Characteristics**

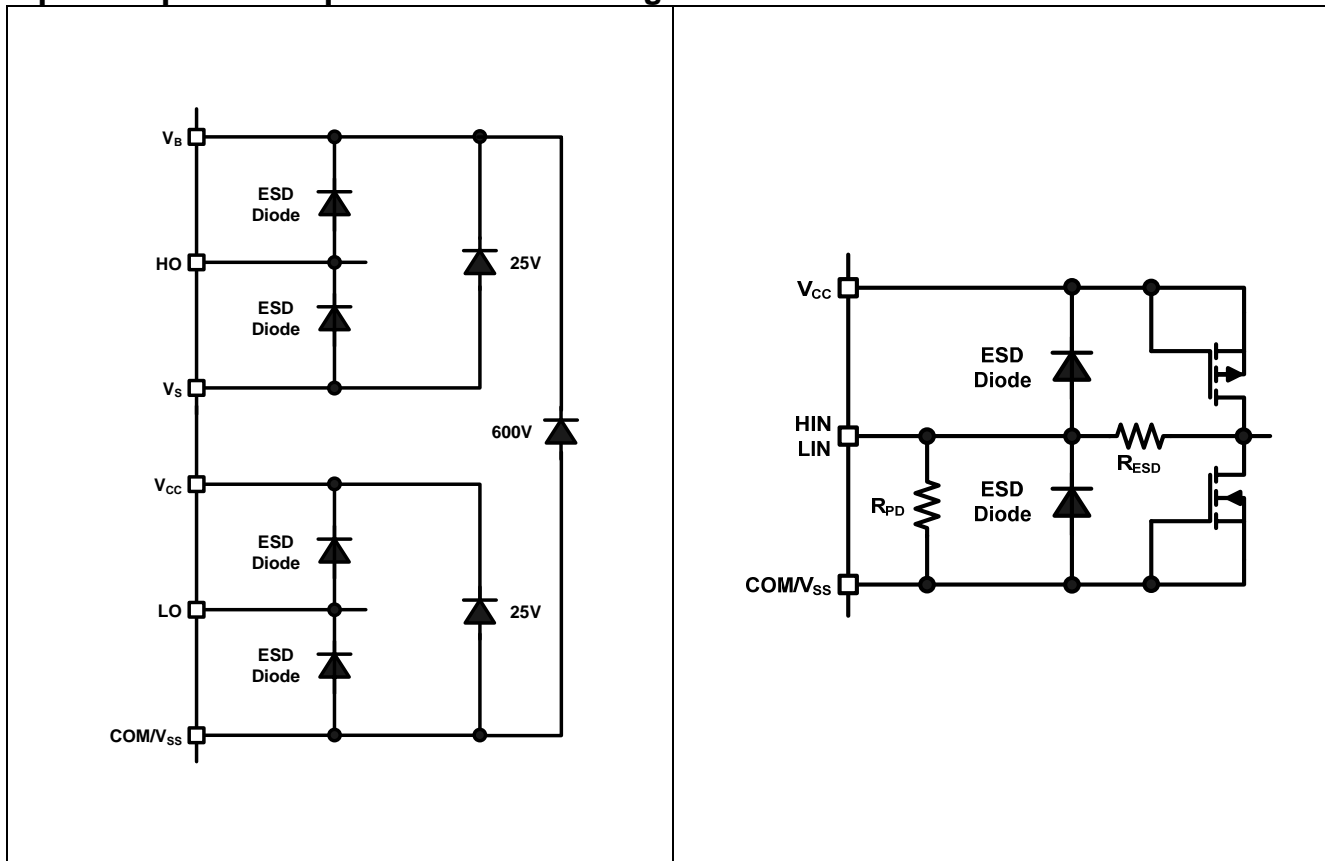
$V_{BIAS}$  ( $V_{CC}$ ,  $V_{BS}$ ) = 15V,  $C_L = 1000pF$ ,  $T_A = 25^\circ C$  unless otherwise specified.

Symbol	Definition	Min	Typ	Max	Units	Test conditions
$t_{on}$	Turn-on propagation delay	—	220	300	ns	$V_S = 0V$
$t_{off}$	Turn-off propagation delay	—	200	280		$V_S = 0V$ or 600V
MT	Delay matching, HS & LS turn-on/off	—	0	50		
$t_r$	Turn-on rise time	—	130	220		$V_S = 0V$
$t_f$	Turn-off fall time	—	50	80		

**Functional Block Diagram:**



**Input/Output Pin Equivalent Circuit Diagrams:**

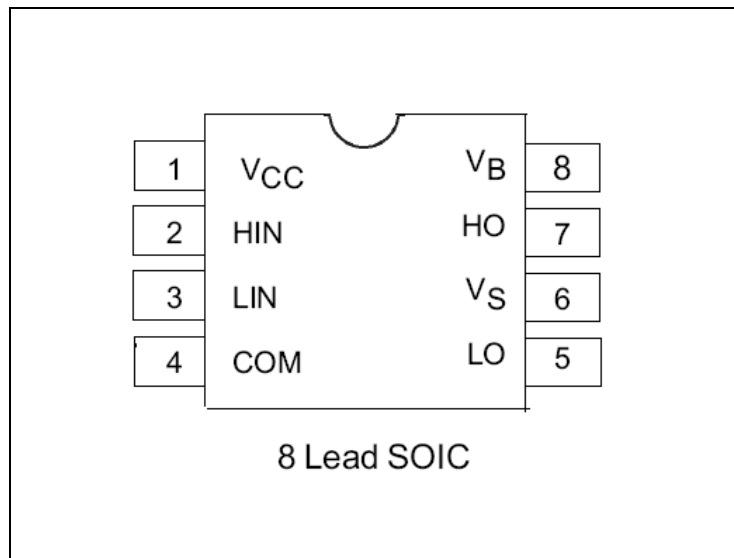




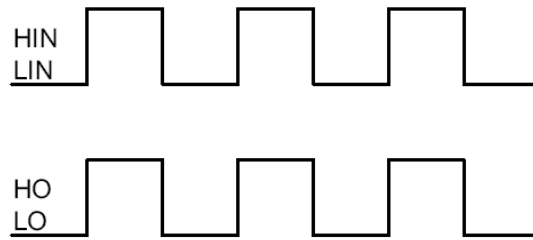
**Lead Definitions:**

PIN#	Symbol	Description
1	V <sub>CC</sub>	Low-side and logic fixed supply
2	HIN	Logic input for high-side gate driver outputs (HO), in phase with HO
3	LIN	Logic input for low-side gate driver outputs (LO), in phase with LO
4	COM	Low-side return
5	LO	Low-side gate drive output
6	V <sub>S</sub>	High-side floating supply return
7	HO	High-side gate drive output
8	V <sub>B</sub>	High-side floating supply

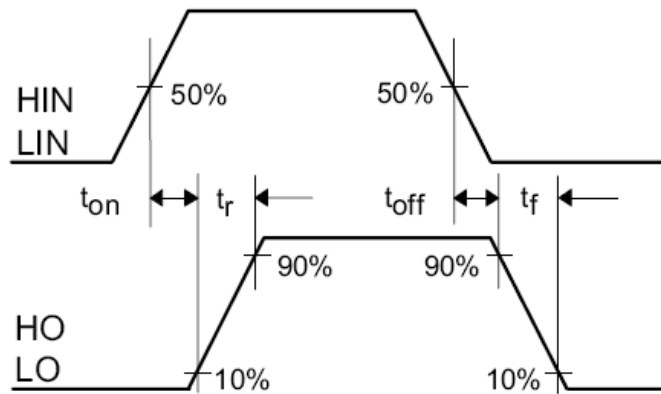
**Lead Assignments**



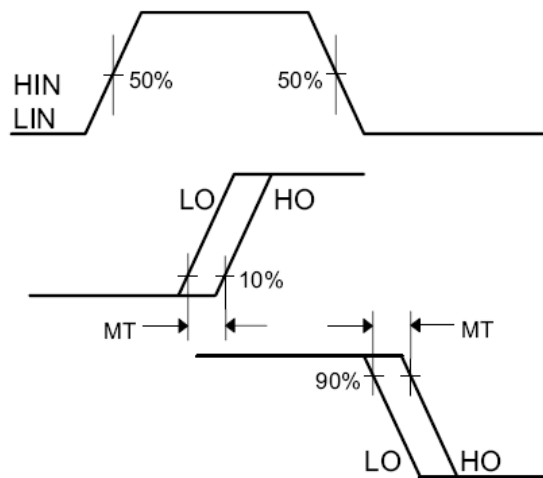
**Application Information and Additional Details**



**Figure 1: Input/Output Timing Diagram**



**Figure 2: Switching Time Waveform Definitions**



**Figure 3: Delay Matching Waveform Definitions**

**Tolerability to Negative  $V_s$  Transients**

The IRS2301S has been seen to withstand negative  $V_s$  transient conditions on the order of -25V for a period of 100 ns ( $V_{BIAS}$  ( $V_{CC}$ ,  $V_{BS}$ ) = 15V and  $T_A = 25^\circ\text{C}$ ).

An illustration of the IRS2301S performance can be seen in Figure 4.

Even though the IRS2301S has been shown able to handle these negative  $V_s$  transient conditions, it is highly recommended that the circuit designer always limit the negative  $V_s$  transients as much as possible by careful PCB layout and component use.

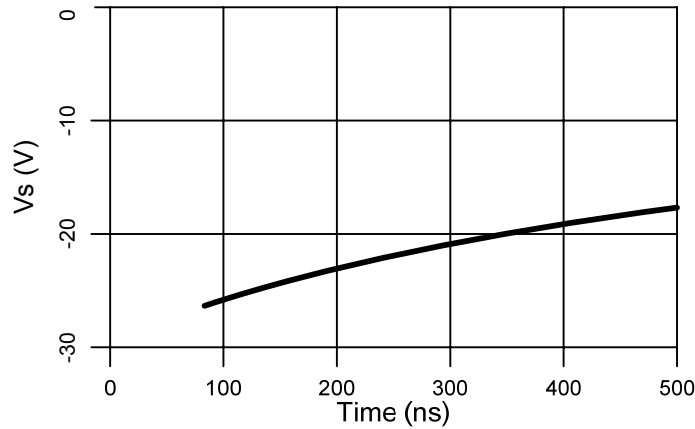


Figure 4: -Vs Transient results

**Package Details**

RECOMMENDED FOOTPRINT

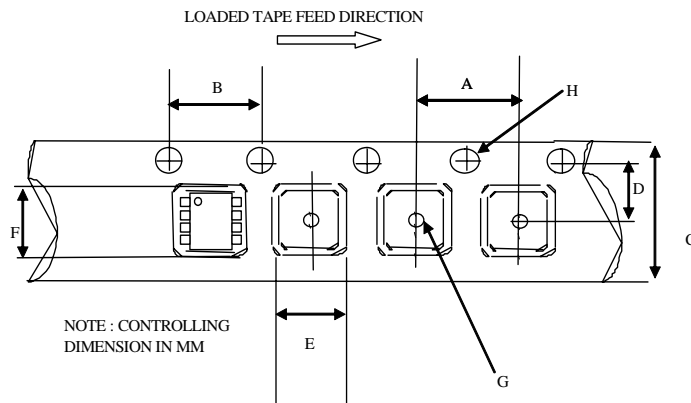
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
B	.014	.018	0.36	0.46
C	.0075	.0098	0.19	0.25
D	.189	.196	4.80	4.98
E	.150	.157	3.81	3.99
e	.050	BASIC	1.27	BASIC
e1	.025	BASIC	0.635	BASIC
H	.2284	.2440	5.80	6.20
K	.011	.019	0.28	0.48
L	.016	.050	0.41	1.27
y	0"	8"	0"	8"

NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.
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 0.25 [.006].
6. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.

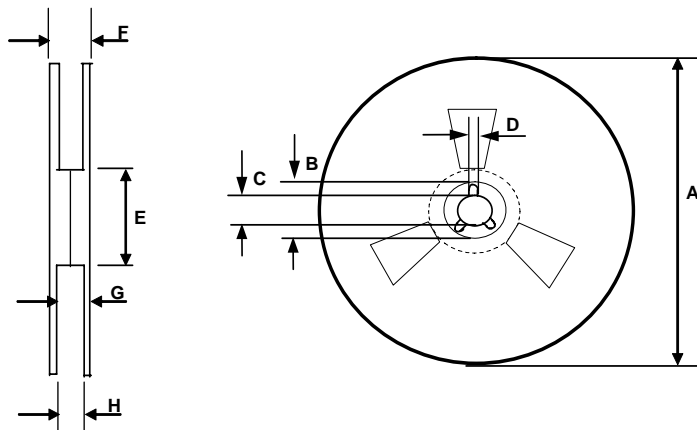
**8 Lead SOIC**

**Tape and Reel Details**



CARRIER TAPE DIMENSION FOR 8SOICN

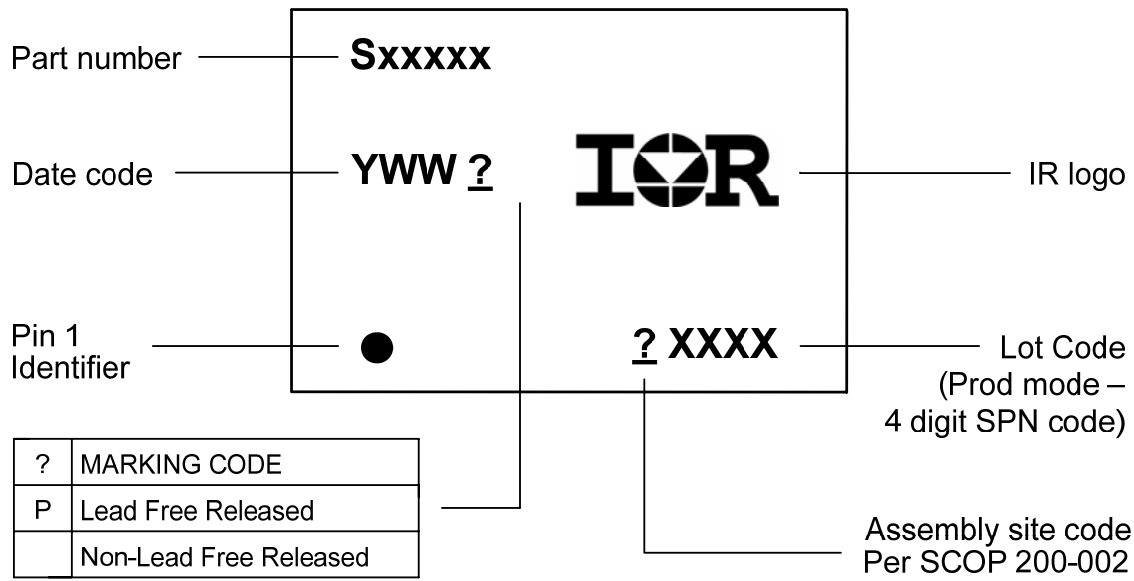
Code	Metric		Imperial	
	Min	Max	Min	Max
A	7.90	8.10	0.311	0.318
B	3.90	4.10	0.153	0.161
C	11.70	12.30	0.46	0.484
D	5.45	5.55	0.214	0.218
E	6.30	6.50	0.248	0.255
F	5.10	5.30	0.200	0.208
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



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

**Part Marking Information**



**Ordering Information**

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
IRS2301	SOIC8N	Tube/Bulk	95	IRS2301SPBF
		Tape and Reel	2500	IRS2301STRPBF

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