International IΩR Rectifier

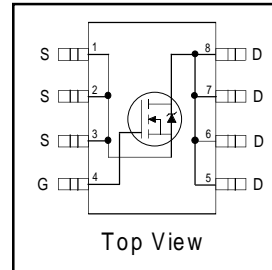# IRF7401

HEXFET® Power MOSFET

- Generation V Technology
- Ultra Low On-Resistance
- N-Channel Mosfet
- Surface Mount
- Available in Tape & Reel
- Dynamic dv/dt Rating
- Fast Switching

Top View

$V_{DSS} = 20V$

$R_{DS(on)} = 0.022\Omega$

Description

Fifth Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve the lowest possible on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET Power MOSFETs are well known for, provides the designer with an extremely efficient device for use in a wide variety of applications.

The SO-8 has been modified through a customized leadframe for enhanced thermal characteristics and multiple-die capability making it ideal in a variety of power applications. With these improvements, multiple devices can be used in an application with dramatically reduced board space. The package is designed for vapor phase, infra red, or wave soldering techniques. Power dissipation of greater than 0.8W is possible in a typical PCB mount application.
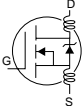

SO-8
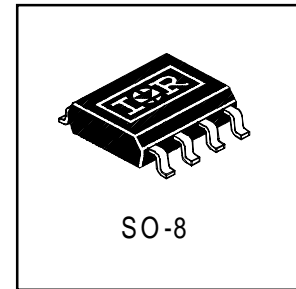
Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_A = 25°C$	10 Sec. Pulsed Drain Current, V_{GS} @ 4.5V	10	A
I_D @ $T_A = 25°C$	Continuous Drain Current, V_{GS} @ 4.5V	8.7	
I_D @ $T_A = 70°C$	Continuous Drain Current, V_{GS} @ 4.5V	7.0	
I_{DM}	Pulsed Drain Current ①	35	
P_D @$T_A = 25°C$	Power Dissipation	2.5	W
	Linear Derating Factor	0.02	W/°C
V_{GS}	Gate-to-Source Voltage	± 12	V
dv/dt	Peak Diode Recovery dv/dt ②	5.0	V/ns
T_J, T_{STG}	Junction and Storage Temperature Range	-55 to + 150	°C
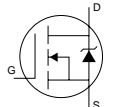
Thermal Resistance Ratings

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient④	——	50	°C/W

02/13/01

IRF7401

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	20	——	——	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	0.044	——	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(ON)}$	Static Drain-to-Source On-Resistance	——	——	0.022	Ω	V_{GS} = 4.5V, I_D = 4.1A ③
		——	——	0.030		V_{GS} = 2.7V, I_D = 3.5A ③
$V_{GS(th)}$	Gate Threshold Voltage	0.70	——	——	V	V_{DS} = V_{GS}, I_D = 250µA
g_{fs}	Forward Transconductance	11	——	——	S	V_{DS} = 15V, I_D = 4.1A
I_{DSS}	Drain-to-Source Leakage Current	——	——	1.0	µA	V_{DS} = 16V, V_{GS} = 0V
		——	——	25		V_{DS} = 16V, V_{GS} = 0V, T_J = 125 °C
I_{GSS}	Gate-to-Source Forward Leakage	——	——	100	nA	V_{GS} = 12V
	Gate-to-Source Reverse Leakage	——	——	-100		V_{GS} = -12V
Q_g	Total Gate Charge	——	——	48	nC	I_D = 4.1A
Q_{gs}	Gate-to-Source Charge	——	——	5.1		V_{DS} = 16V
Q_{gd}	Gate-to-Drain ("Miller") Charge	——	——	20		V_{GS} = 4.5V, See Fig. 6 and 12 ③
$t_{d(on)}$	Turn-On Delay Time	——	13	——	ns	V_{DD} = 10V
t_r	Rise Time	——	72	——		I_D = 4.1A
$t_{d(off)}$	Turn-Off Delay Time	——	65	——		R_G = 6.0Ω
t_f	Fall Time	——	92	——		R_D = 2.4Ω, See Fig. 10 ③
L_D	Internal Drain Inductance	——	2.5	——	nH	Between lead tip and center of die contact
L_S	Internal Source Inductance	——	4.0	——		
C_{iss}	Input Capacitance	——	1600	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	690	——		V_{DS} = 15V
C_{rss}	Reverse Transfer Capacitance	——	310	——		f = 1.0MHz, See Fig. 5

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	3.1	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	35		
V_{SD}	Diode Forward Voltage	——	——	1.0	V	T_J = 25°C, I_S = 2.0A, V_{GS} = 0V ③
t_{rr}	Reverse Recovery Time	——	39	59	ns	T_J = 25°C, I_F = 4.1A
Q_{rr}	Reverse RecoveryCharge	——	42	63	nC	di/dt = 100A/µs ③
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)

② I_{SD} ≤ 4.1A, di/dt ≤ 100A/µs, V_{DD} ≤ $V_{(BR)DSS}$, T_J ≤ 150°C

③ Pulse width ≤ 300µs; duty cycle ≤ 2%.
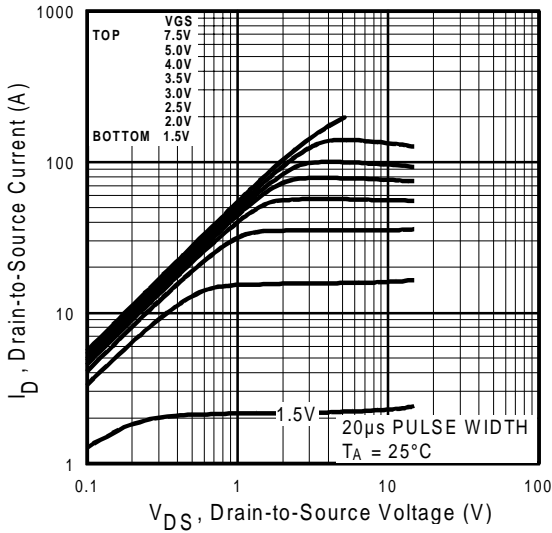
④ Surface mounted on FR-4 board, t ≤ 10sec.
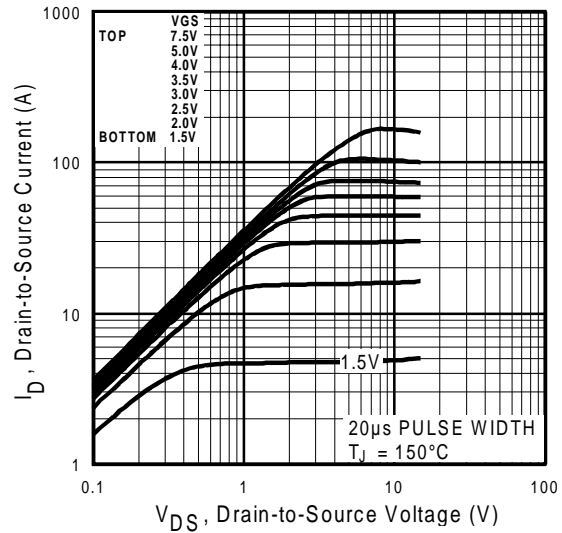
Fig 1. Typical Output Characteristics
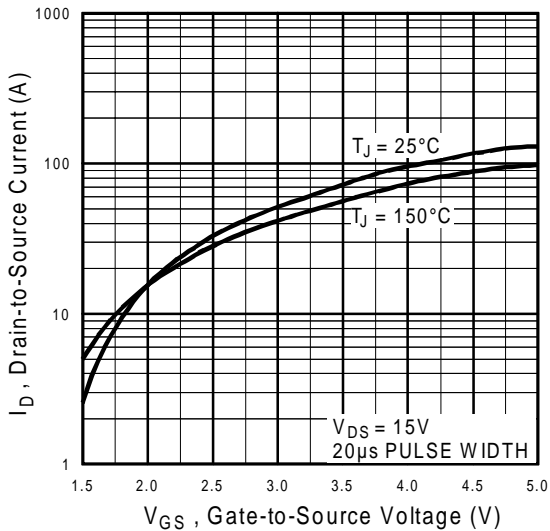

Fig 2. Typical Output Characteristics

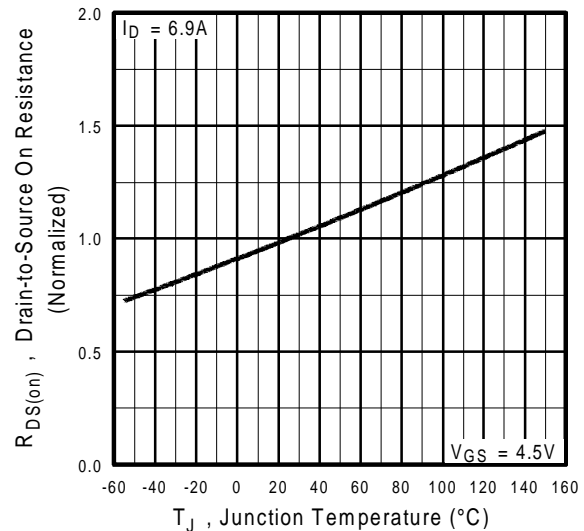**Fig 3.** Typical Transfer Characteristics

Fig 4. Normalized On-Resistance
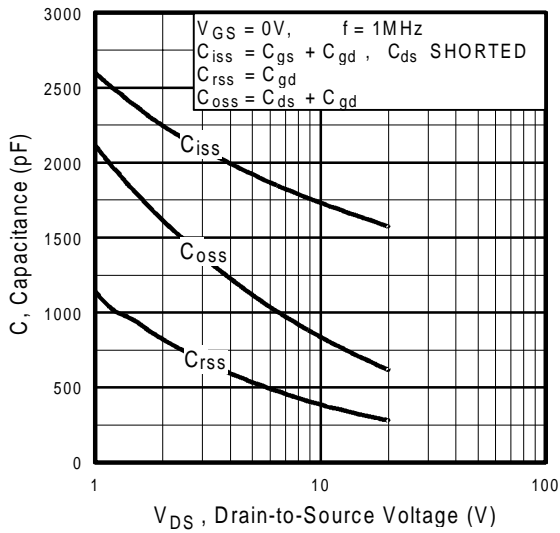Vs. Temperature

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Fig 5. Typical Capacitance Vs.
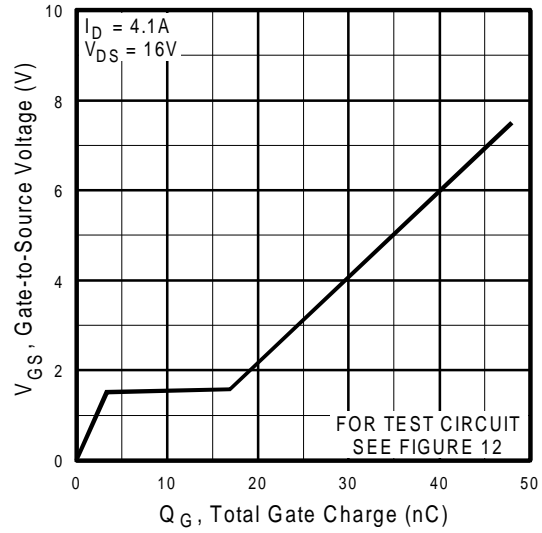Drain-to-Source Voltage

Fig 6. Typical Gate Charge Vs.
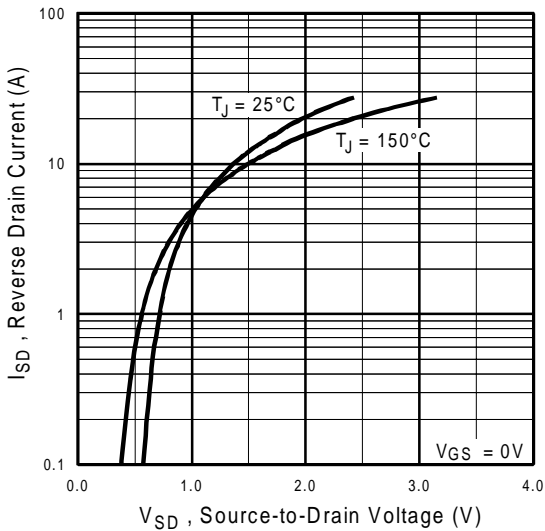Gate-to-Source Voltage

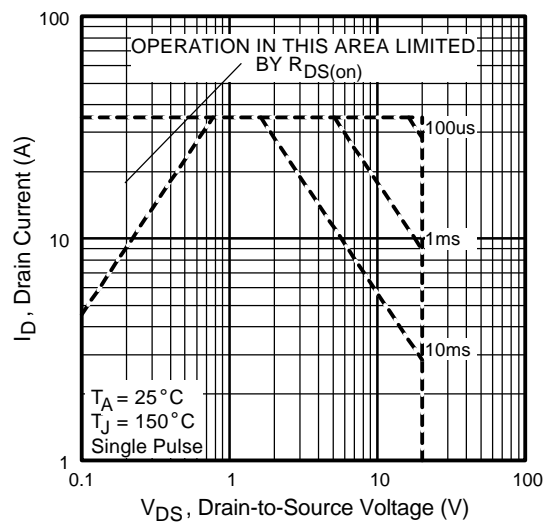

Fig 7. Typical Source-Drain Diode
Forward Voltage

Fig 8. Maximum Safe Operating Area
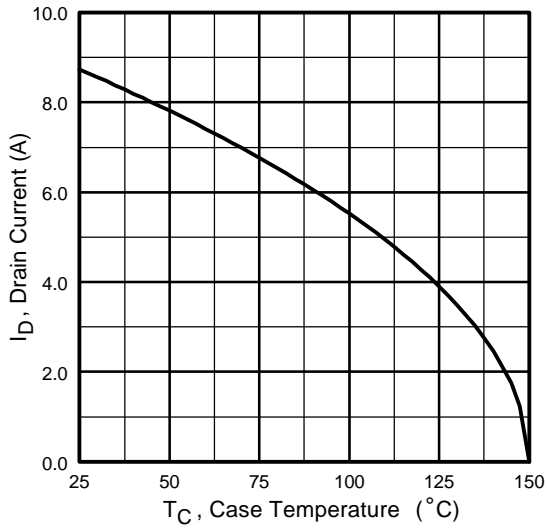
Fig 9. Maximum Drain Current Vs. Ambient Temperature
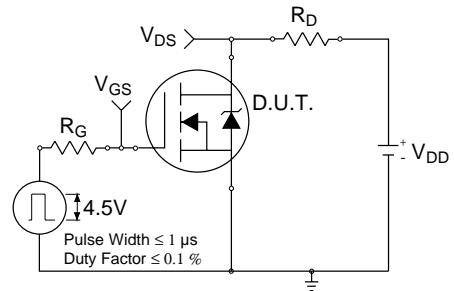
Fig 10a. Switching Time Test Circuit
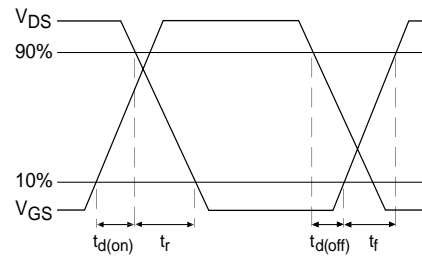
Fig 10b. Switching Time Waveforms

Notes:
1. Duty factor $D = t_1 / t_2$
2. Peak $T_J = P_{DM} \times Z_{thJA} + T_A$
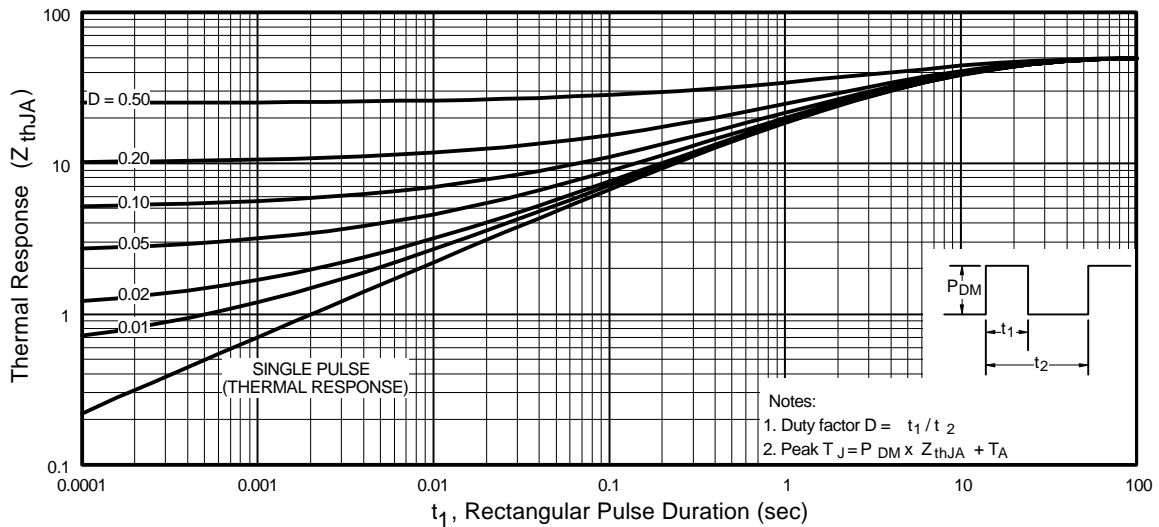
Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient
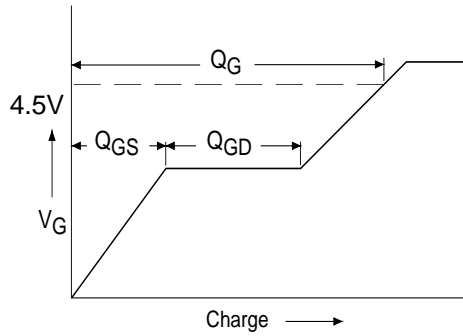
Fig 12a. Basic Gate Charge Waveform
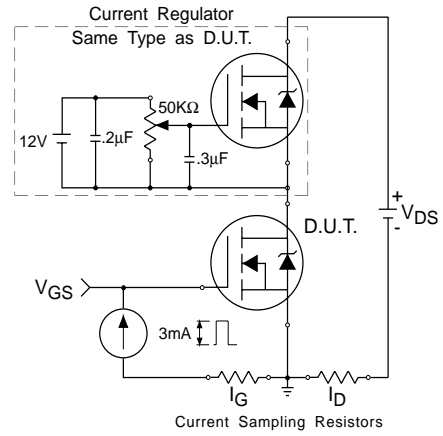
Fig 12b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit

D.U.T

Circuit Layout Considerations
- Low Stray Inductance
- Ground Plane
- Low Leakage Inductance Current Transformer

③

②

④

①

R_G

V_{GS}*

- dv/dt controlled by R_G
- I_{SD} controlled by Duty Factor "D"
- D.U.T. - Device Under Test

**

+ V_{DD} *
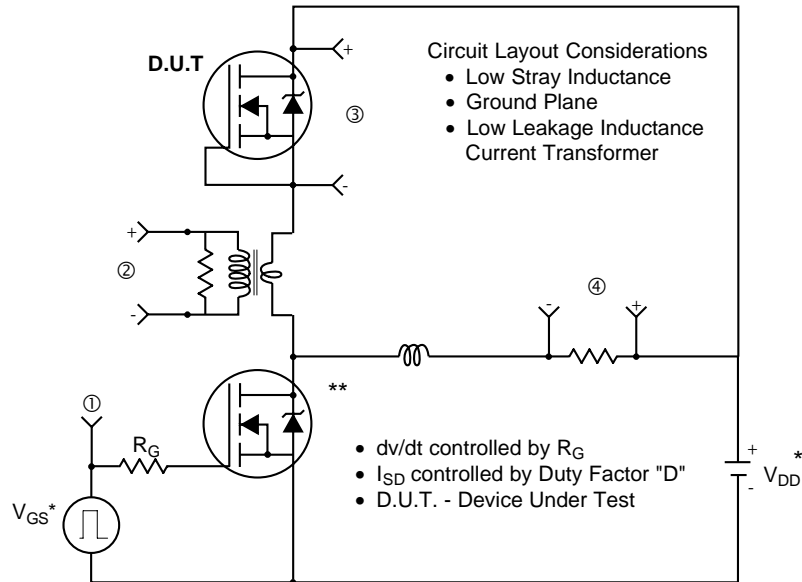
* Reverse Polarity for P-Channel
** Use P-Channel Driver for P-Channel Measurements

① Driver Gate Drive

$D = \dfrac{P.W.}{Period}$

P.W.

Period

$\left[V_{GS}=10V \right]$ ***

② D.U.T. I_{SD} Waveform

Reverse Recovery Current

Body Diode Forward Current

di/dt

③ D.U.T. V_{DS} Waveform

Diode Recovery dv/dt

$\left[V_{DD} \right]$

Re-Applied Voltage

Body Diode Forward Drop

④ Inductor Curent

Ripple ≤ 5%

$\left[I_{SD} \right]$
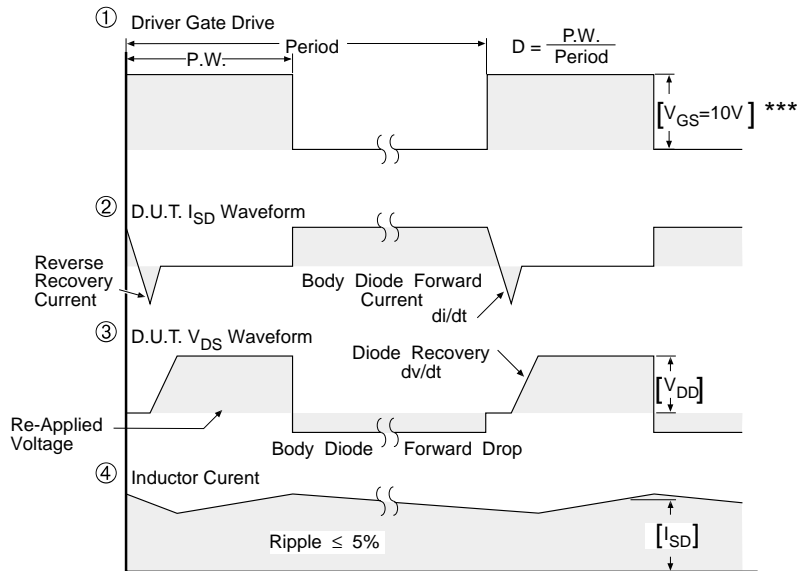
*** V_{GS} = 5.0V for Logic Level and 3V Drive Devices

Fig 13. For N-Channel HEXFETS

IRF7401

Package Outline

SO-8 Outline
Dimensions are shown in millimeters (inches)

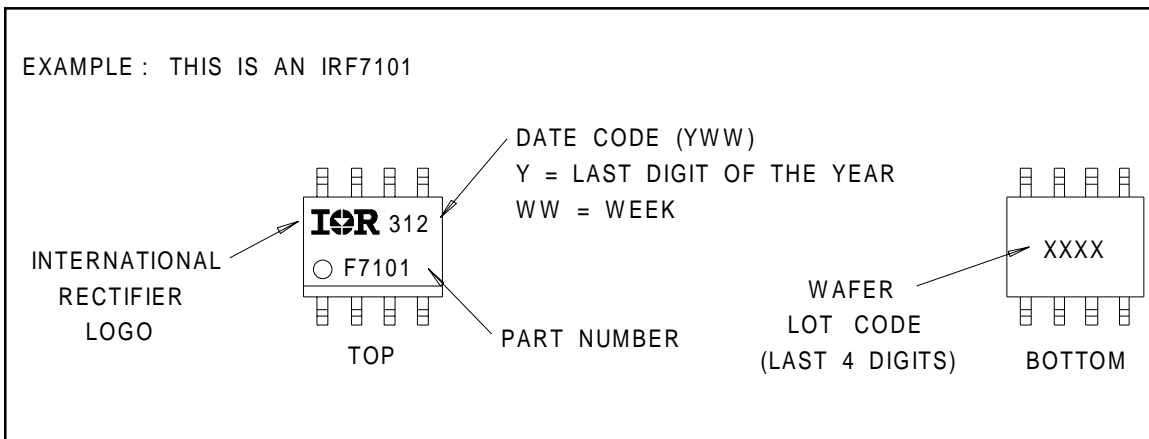| DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
B	.014	.018	0.36	0.46
C	.0075	.0098	0.19	0.25
D	.189	.196	4.80	4.98
E	.150	.157	3.81	3.99
e	.050 BASIC		1.27 BASIC	
e1	.025 BASIC		0.635 BASIC	
H	.2284	.2440	5.80	6.20
K	.011	.019	0.28	0.48
L	0.16	.050	0.41	1.27
θ	0°	8°	0°	8°

RECOMMENDED FOOTPRINT
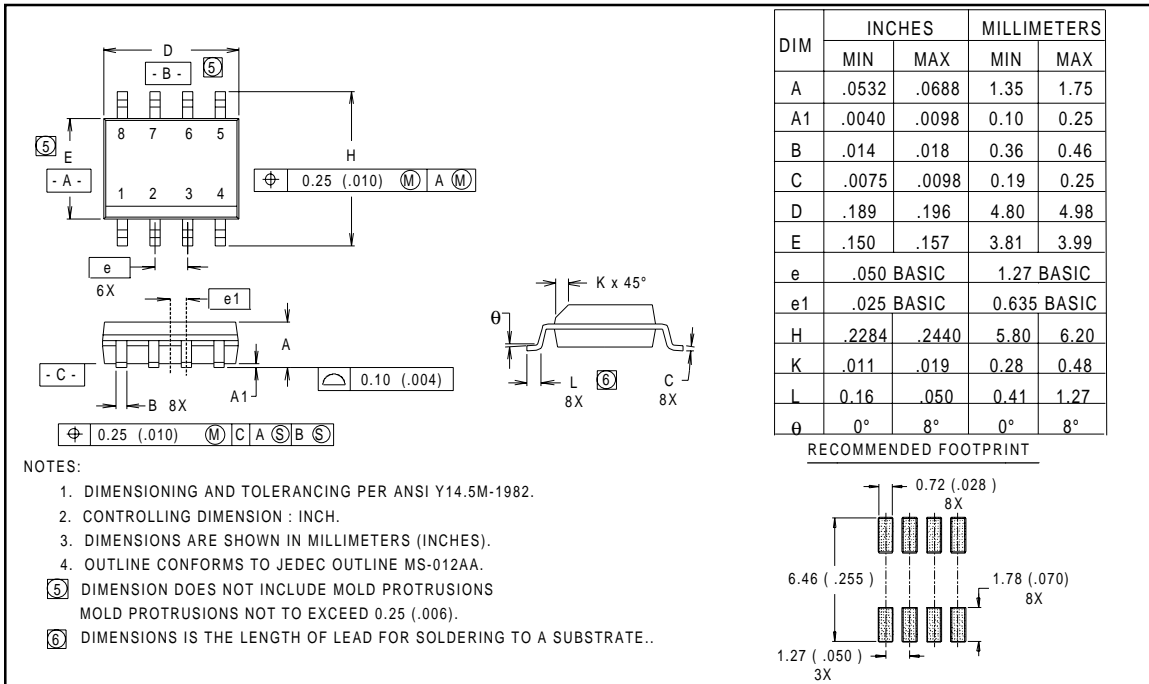
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
2. CONTROLLING DIMENSION : INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
5. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS
   MOLD PROTRUSIONS NOT TO EXCEED 0.25 (.006).
6. DIMENSIONS IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE..
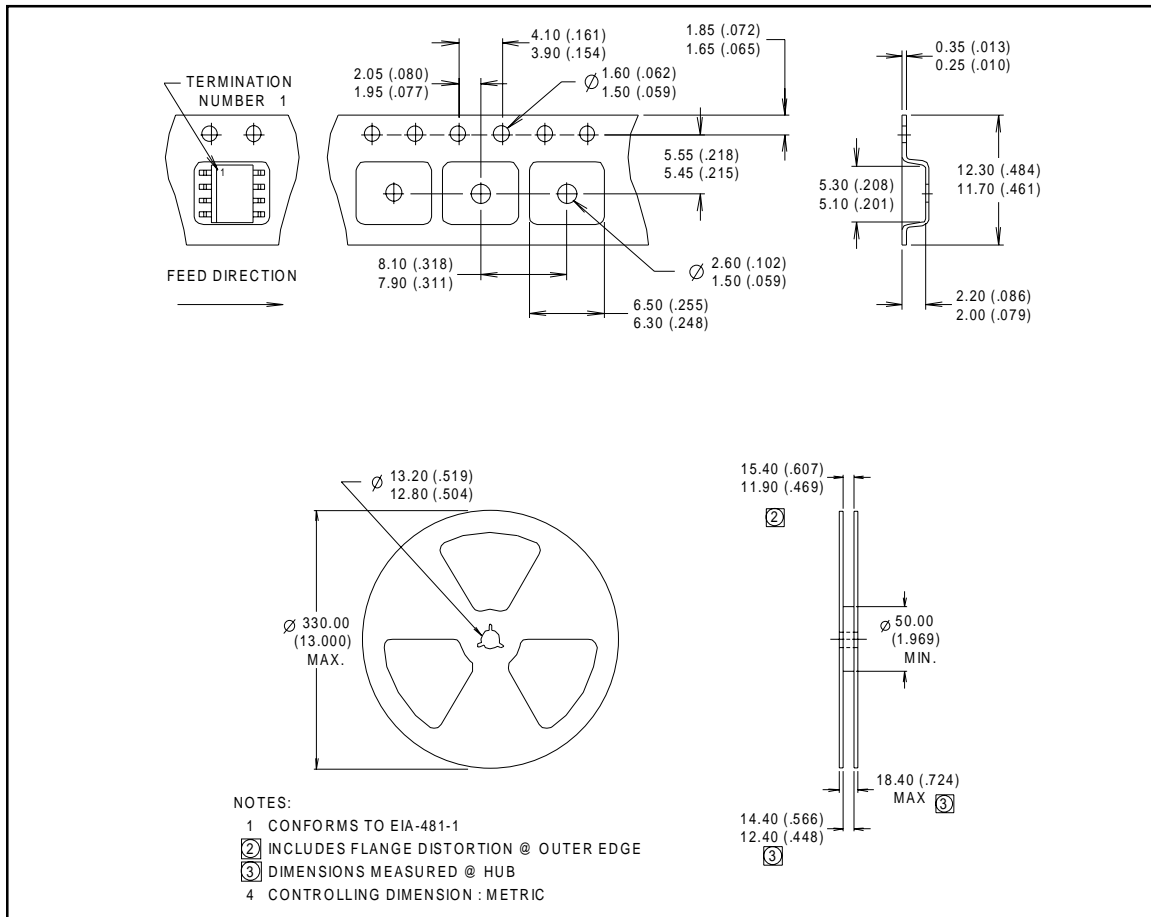
Part Marking Information

SO-8

EXAMPLE : THIS IS AN IRF7101

INTERNATIONAL
RECTIFIER
LOGO

DATE CODE (YWW)
Y = LAST DIGIT OF THE YEAR
WW = WEEK

IOR 312

○ F7101

TOP

PART NUMBER

WAFER
LOT CODE
(LAST 4 DIGITS)

XXXX

BOTTOM

Tape & Reel Information

SO-8
Dimensions are shown in millimeters (inches)

4.10 (.161)
3.90 (.154)

1.85 (.072)
1.65 (.065)

0.35 (.013)
0.25 (.010)

TERMINATION
NUMBER 1

2.05 (.080)
1.95 (.077)

Ø 1.60 (.062)
1.50 (.059)

5.55 (.218)
5.45 (.215)

5.30 (.208)
5.10 (.201)

12.30 (.484)
11.70 (.461)

FEED DIRECTION

8.10 (.318)
7.90 (.311)

Ø 2.60 (.102)
1.50 (.059)

2.20 (.086)
2.00 (.079)

6.50 (.255)
6.30 (.248)

Ø 13.20 (.519)
12.80 (.504)

15.40 (.607)
11.90 (.469)
②

Ø 330.00
(13.000)
MAX.

Ø 50.00
(1.969)
MIN.

18.40 (.724)
MAX ③

14.40 (.566)
12.40 (.448)
③

NOTES:
1 CONFORMS TO EIA-481-1
② INCLUDES FLANGE DISTORTION @ OUTER EDGE
③ DIMENSIONS MEASURED @ HUB
4 CONTROLLING DIMENSION : METRIC

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IƆR Rectifier

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