

IRG4BC20K-SPbF

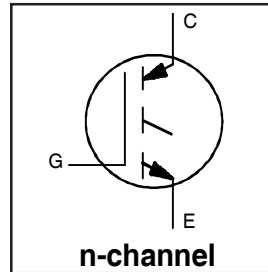
Short Circuit Rated
UltraFast IGBT

Features

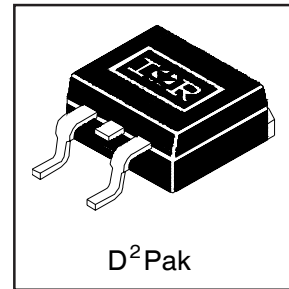
- High short circuit rating optimized for motor control, $t_{sc} = 10\mu s$, @360V V_{CE} (start), $T_J = 125^\circ C$, $V_{GE} = 15V$
- Combines low conduction losses with high switching speed
- Latest generation design provides tighter parameter distribution and higher efficiency than previous generations
- Lead-Free

Benefits

- As a Freewheeling Diode we recommend our HEXFRED™ ultrafast, ultrasoft recovery diodes for minimum EMI / Noise and switching losses in the Diode and IGBT
- Latest generation 4 IGBTs offer highest power density motor controls possible
- This part replaces the IRGBC20K-S and IRGBC20M-S devices



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 2.27V$
@ $V_{GE} = 15V, I_C = 9.0A$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	16	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	9.0	
I_{CM}	Pulsed Collector Current ①	32	
I_{LM}	Clamped Inductive Load Current ②	32	
t_{sc}	Short Circuit Withstand Time	10	μs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	29	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	60	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	24	
T_J	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ C$
T_{STG}			
	Mounting torque, 6-32 or M3 screw.	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
R_{gJC}	Junction-to-Case	---	2.1	$^\circ C/W$
R_{gCS}	Case-to-Sink, Flat, Greased Surface	0.5	---	
R_{gJA}	Junction-to-Ambient (PCB Mounted, steady-state)④	---	40	
Wt	Weight	1.44	---	g

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Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	$V_{GE} = 0V, I_C = 1.0A$
$DV_{(BR)CES}/DT_J$	Temperature Coeff. of Breakdown Voltage	—	0.49	—	V/°C	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.00	—	V	$V_{GE} = 15V$ See Fig.2, 5
		—	2.27	2.8		
		—	3.01	—		
		—	2.43	—		
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		$I_C = 6.0A$ $I_C = 9.0A$ $I_C = 16A$ $I_C = 9.0A, T_J = 150^\circ\text{C}$ $V_{CE} = V_{GE}, I_C = 250\mu A$
$DV_{GE(th)}/DT_J$	Temperature Coeff. of Threshold Voltage	—	-10	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ⑤	2.9	4.3	—	S	$V_{CE} = 100V, I_C = 9.0A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	2.0		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$
		—	—	1000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 20V$

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	34	51	nC	$I_C = 9.0A$ $V_{CC} = 400V$ $V_{GE} = 15V$ See Fig.8
Q_{ge}	Gate - Emitter Charge (turn-on)	—	4.9	7.4		
Q_{gc}	Gate - Collector Charge (turn-on)	—	14	21		
$t_{d(on)}$	Turn-On Delay Time	—	28	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 9.0A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" See Fig. 9,10,14
t_r	Rise Time	—	27	—		
$t_{d(off)}$	Turn-Off Delay Time	—	150	220		
t_f	Fall Time	—	100	150		
E_{on}	Turn-On Switching Loss	—	0.15	—	mJ	See Fig. 11,14
E_{off}	Turn-Off Switching Loss	—	0.25	—		
E_{ts}	Total Switching Loss	—	0.40	0.6		
t_{sc}	Short Circuit Withstand Time	10	—	—	μs	$V_{CC} = 400V, T_J = 125^\circ\text{C}$ $V_{GE} = 15V, R_G = 50\Omega, V_{CPK} < 500V$
$t_{d(on)}$	Turn-On Delay Time	—	28	—	ns	$T_J = 150^\circ\text{C},$ $I_C = 9.0A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" See Fig. 11,14
t_r	Rise Time	—	29	—		
$t_{d(off)}$	Turn-Off Delay Time	—	190	—		
t_f	Fall Time	—	190	—		
E_{ts}	Total Switching Loss	—	0.68	—	mJ	$T_J = 25^\circ\text{C}, V_{GE} = 15V, R_G = 50\Omega$ $I_C = 6.0A, V_{CC} = 480V$ Energy losses include "tail"
E_{on}	Turn-On Switching Loss	—	0.07	—		
E_{off}	Turn-Off Switching Loss	—	0.13	—		
E_{ts}	Total Switching Loss	—	0.20	—	nH	Measured 5mm from package
L_E	Internal Emitter Inductance	—	7.5	—		
C_{ies}	Input Capacitance	—	450	—		
C_{oes}	Output Capacitance	—	61	—	pF	$V_{CC} = 30V$ See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	14	—		
						$f = 1.0MHz$

Details of note ① through ⑥ are on the last page

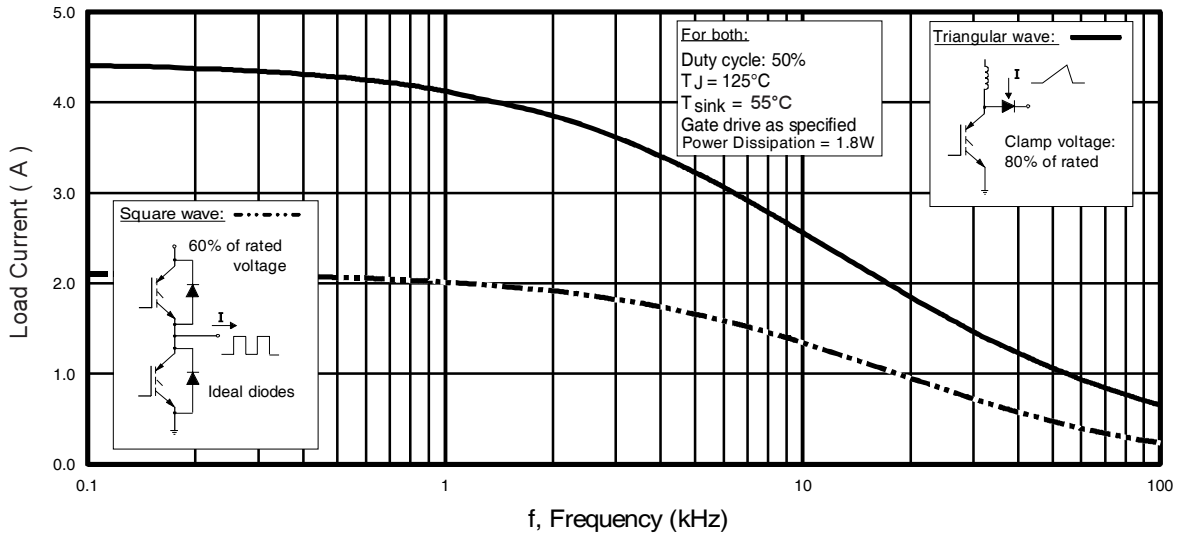


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

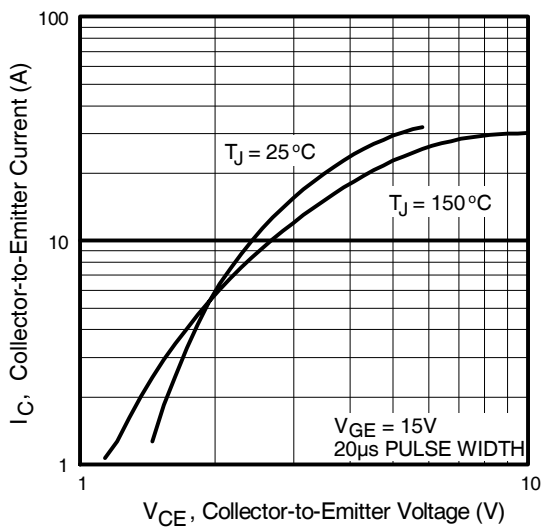


Fig. 2 - Typical Output Characteristics

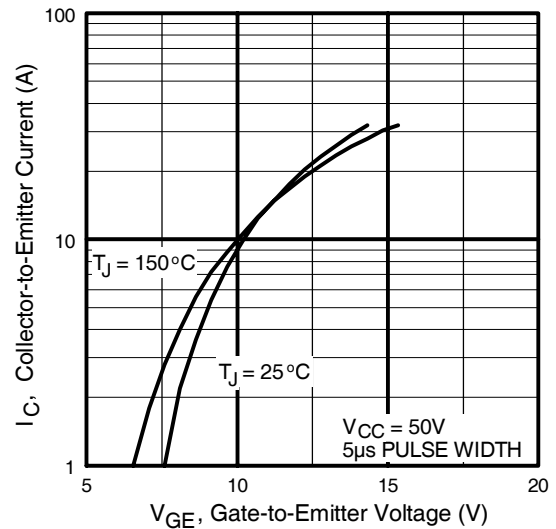


Fig. 3 - Typical Transfer Characteristics

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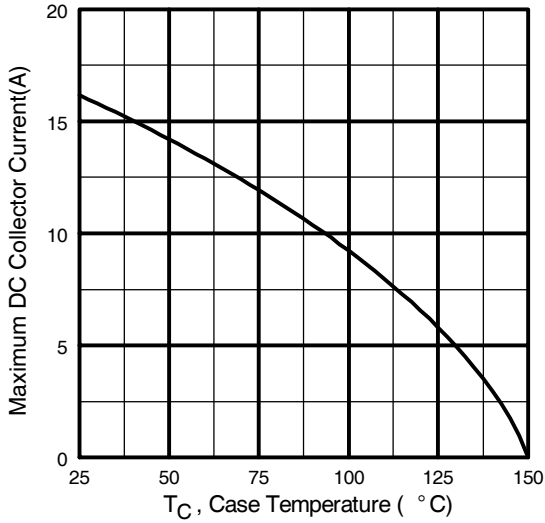


Fig. 4 - Maximum Collector Current vs. Case Temperature

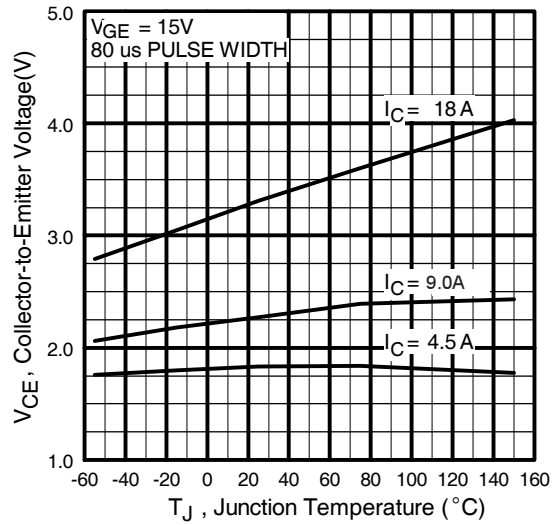


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

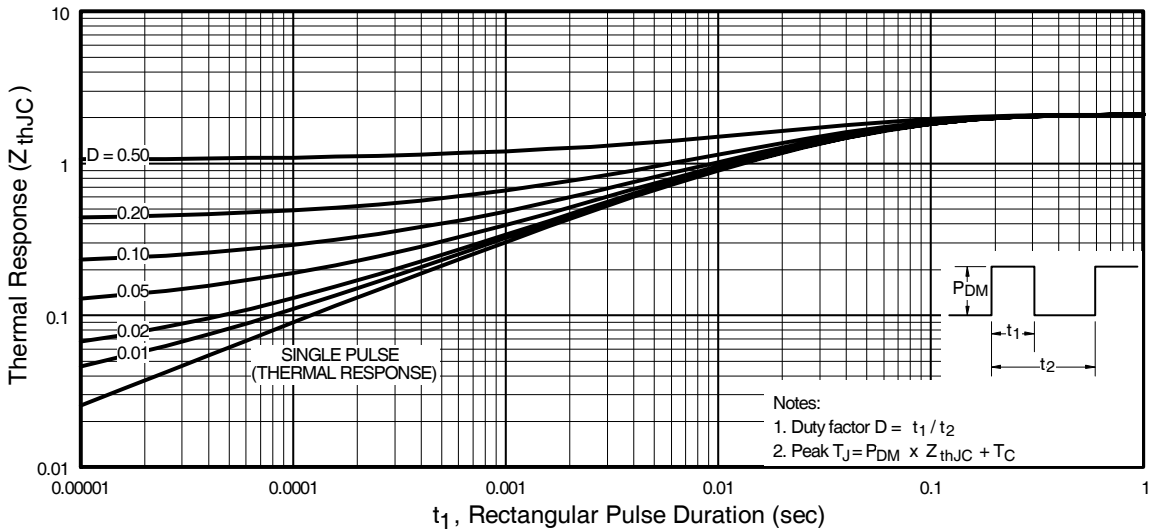


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

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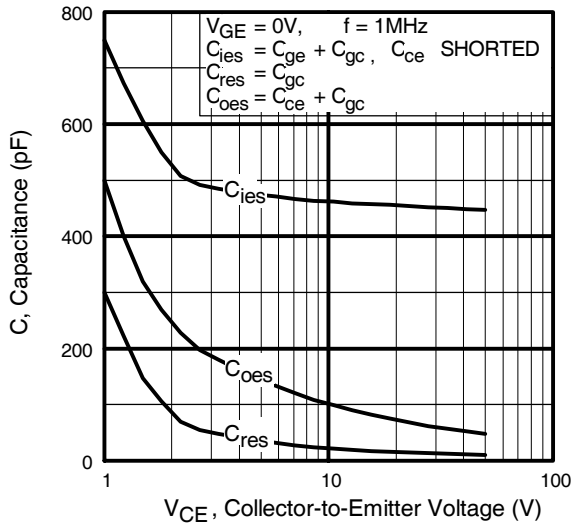


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

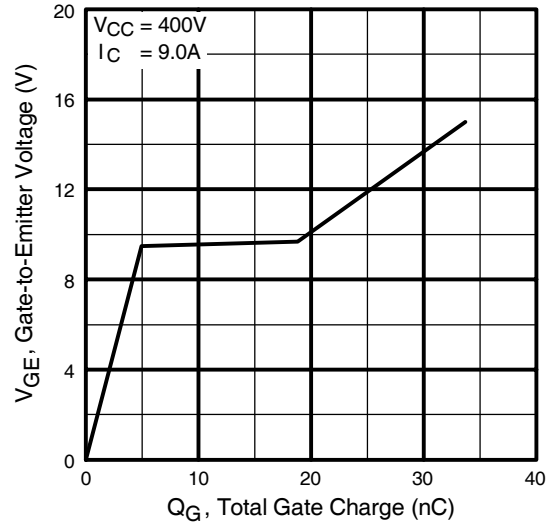


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

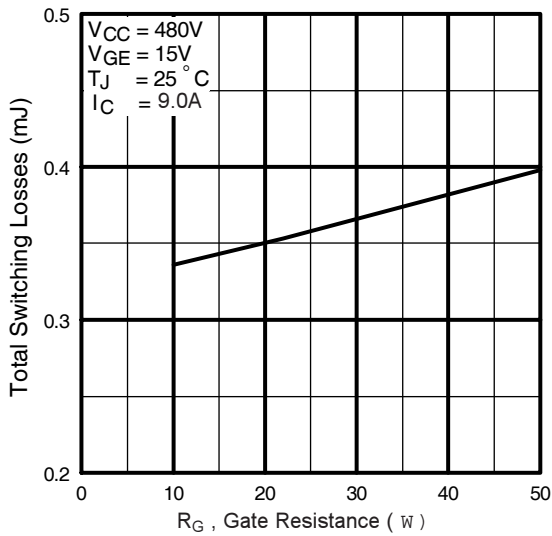


Fig. 9 - Typical Switching Losses vs. Gate Resistance

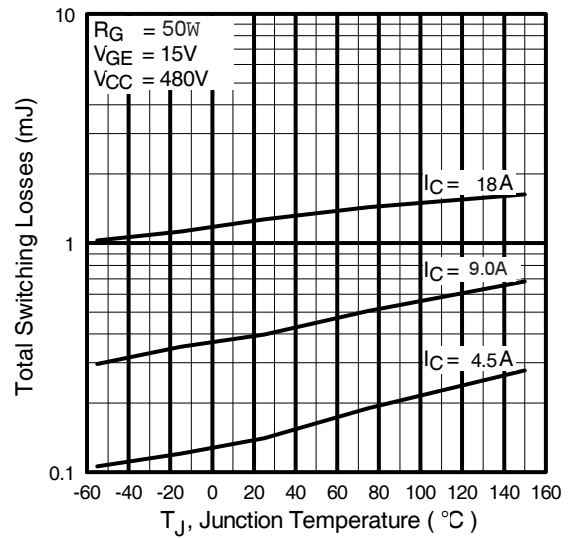


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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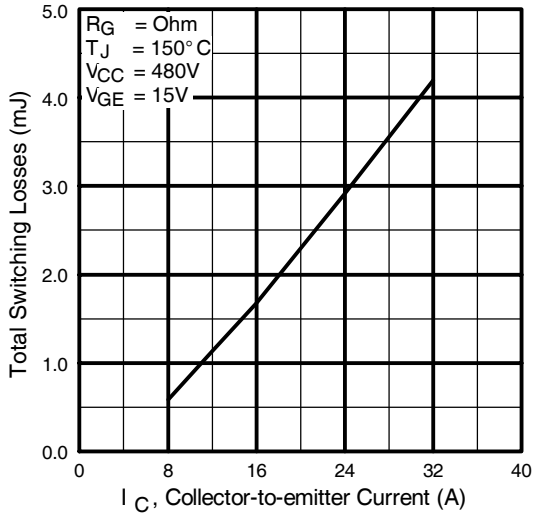


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

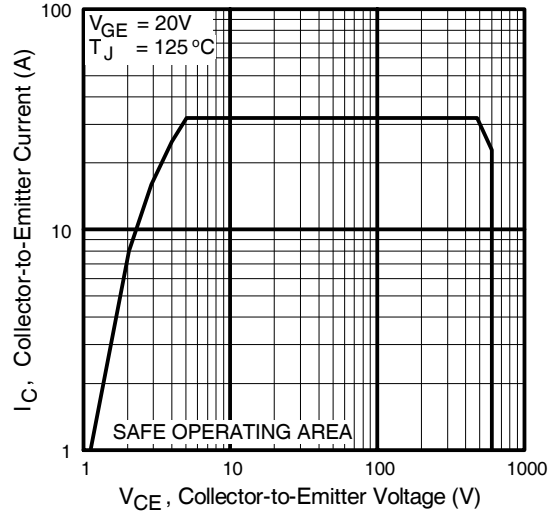
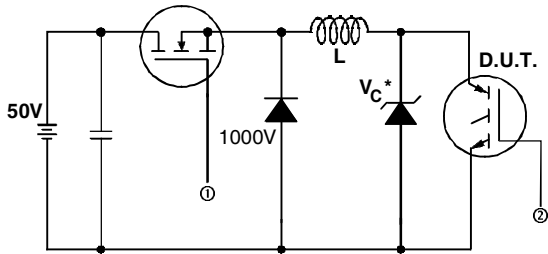


Fig. 12 - Turn-Off SOA



* Driver same type as D.U.T.; $V_c = 80\%$ of $V_{ce(max)}$
 * Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated I_d .

Fig. 13a - Clamped Inductive Load Test Circuit

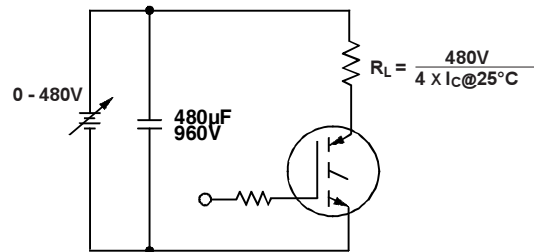


Fig. 13b - Pulsed Collector Current Test Circuit

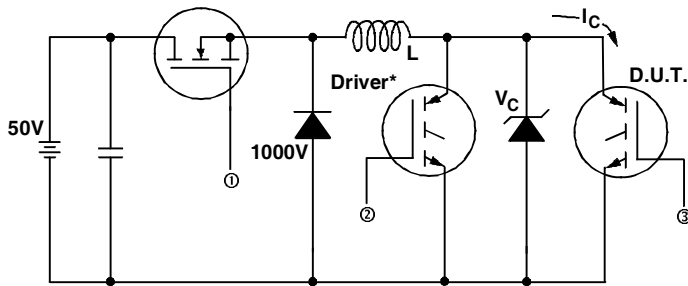


Fig. 14a - Switching Loss Test Circuit

* Driver same type as D.U.T., $V_c = 480V$

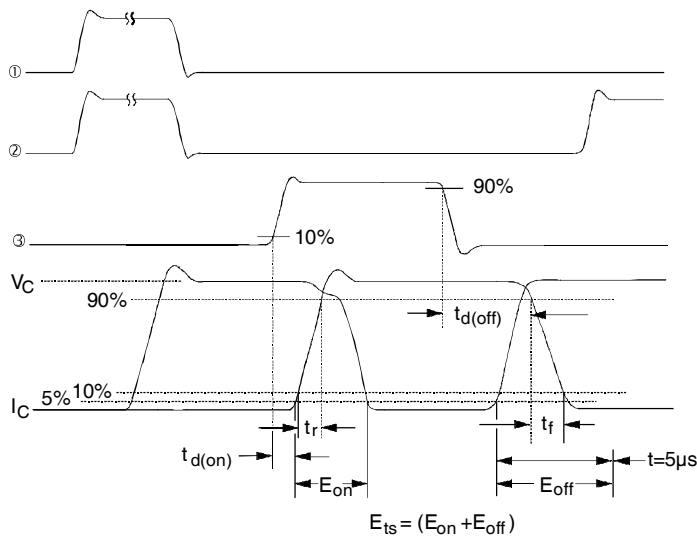


Fig. 14b - Switching Loss Waveforms

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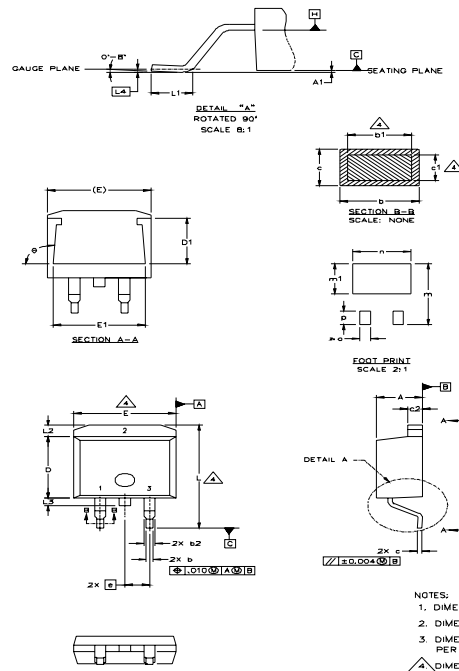


Notes:

- ① Repetitive rating; $V_{GE} = 20V$, pulse width limited by max. junction temperature. (See fig. 13b)
- ② $V_{CC} = 80\%(V_{CES})$, $V_{GE} = 20V$, $L = 10\mu H$, $R_G = 50\Omega$, (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ⑤ Pulse width $5.0\mu s$, single shot.
- ⑥ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.

D²Pak Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1		0.127	.005		
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	4
c	0.43	0.63	.017	.025	
c1	0.38	0.74	.015	.029	
c2	1.14	1.40	.045	.055	3
D	8.51	9.65	.335	.380	
D1	5.33		.210		3
E	9.65	10.67	.380	.420	
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	14.61	15.88	.575	.625	
L1	1.78	2.79	.070	.110	
L2			1.65	.065	
L3	1.27	1.78	.050	.070	
L4	0.25 BSC		.010 BSC		
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
theta	90°	93°	90°	93°	

LEAD ASSIGNMENTS

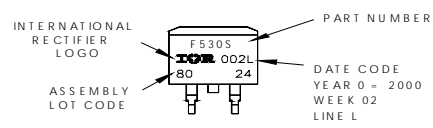
HEXFET	IGBTs, CoPACK	DIODES
1.- GATE	1.- GATE	1.- ANODE +
2.- DRAIN	2.- COLLECTOR	2.- CATHODE
3.- SOURCE	3.- EMITTER	3.- ANODE

* PART DEPENDENT.

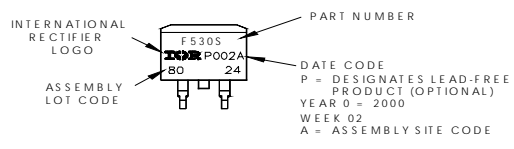
- NOTES:
- DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
 - DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
 - DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
 - DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
 - CONTROLLING DIMENSION: INCH.

D²Pak Part Marking Information (Lead-Free)

EXAMPLE: THIS IS AN IRF530S WITH LOT CODE 8024 ASSEMBLED ON WW 02, 2000 IN THE ASSEMBLY LINE "L"
 Note: "P" in assembly line position indicates "Lead-Free"

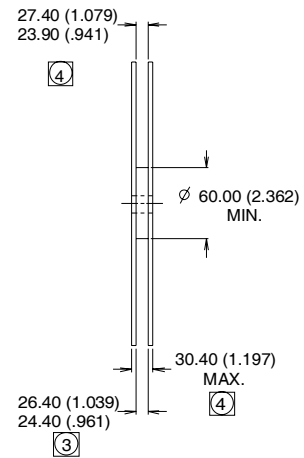
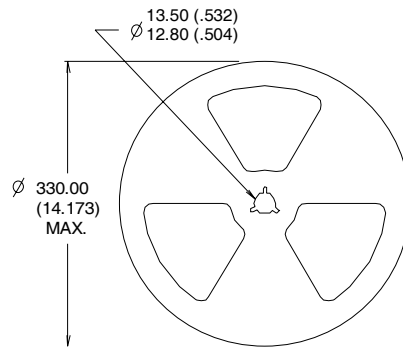
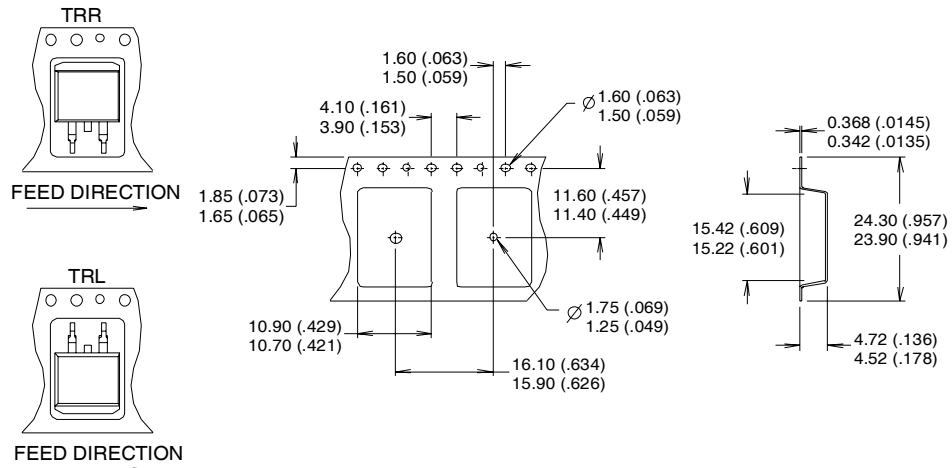


OR



D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



- NOTES :
1. COMFORMS TO EIA-418.
 2. CONTROLLING DIMENSION: MILLIMETER.
 - ③ DIMENSION MEASURED @ HUB.
 - ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.

Data and specifications subject to change without notice.

Note: For the most current drawings please refer to the IR website at:
<http://www.irf.com/package/>