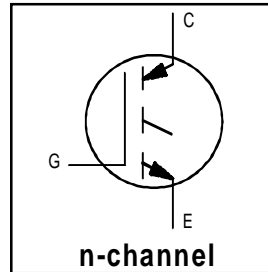


IRG4BC20K-S

Short Circuit Rated
UltraFast IGBT

Features

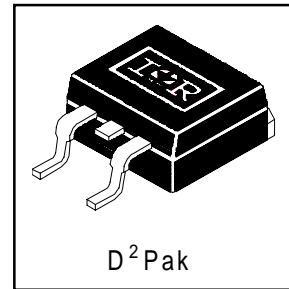
- High short circuit rating optimized for motor control, $t_{sc} = 10\mu s$, @360V V_{CE} (start), $T_J = 125^\circ C$, $V_{GE} = 15V$
- Combines low conduction losses with high switching speed
- Latest generation design provides tighter parameter distribution and higher efficiency than previous generations



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

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



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	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.		
	Mounting torque, 6-32 or M3 screw.	10 lbf•in (1.1N•m)	

Thermal Resistance

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

IRG4BC20K-S

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

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	$I_C = 9.0\text{A}$ $V_{CC} = 400\text{V}$ $V_{GE} = 15\text{V}$ 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	$T_J = 25^\circ\text{C}$ $I_C = 9.0\text{A}$, $V_{CC} = 480\text{V}$ $V_{GE} = 15\text{V}$, $R_G = 50\Omega$ 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. 9,10,14
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	$V_{CC} = 400\text{V}$, $T_J = 125^\circ\text{C}$ $V_{GE} = 15\text{V}$, $R_G = 50\Omega$, $V_{CPK} < 500\text{V}$
$t_{d(on)}$	Turn-On Delay Time	—	28	—	ns	$T_J = 150^\circ\text{C}$, $I_C = 9.0\text{A}$, $V_{CC} = 480\text{V}$ $V_{GE} = 15\text{V}$, $R_G = 50\Omega$ 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	
E_{on}	Turn-On Switching Loss	—	0.07	—	mJ	$T_J = 25^\circ\text{C}$, $V_{GE} = 15\text{V}$, $R_G = 50\Omega$ $I_C = 6.0\text{A}$, $V_{CC} = 480\text{V}$ Energy losses include "tail"
E_{off}	Turn-Off Switching Loss	—	0.13	—		
E_{ts}	Total Switching Loss	—	0.20	—		
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	450	—	pF	$V_{GE} = 0\text{V}$ $V_{CC} = 30\text{V}$ $f = 1.0\text{MHz}$ See Fig. 7
C_{oes}	Output Capacitance	—	61	—		
C_{res}	Reverse Transfer Capacitance	—	14	—		

Details of note ① through ⑥ are on the last page

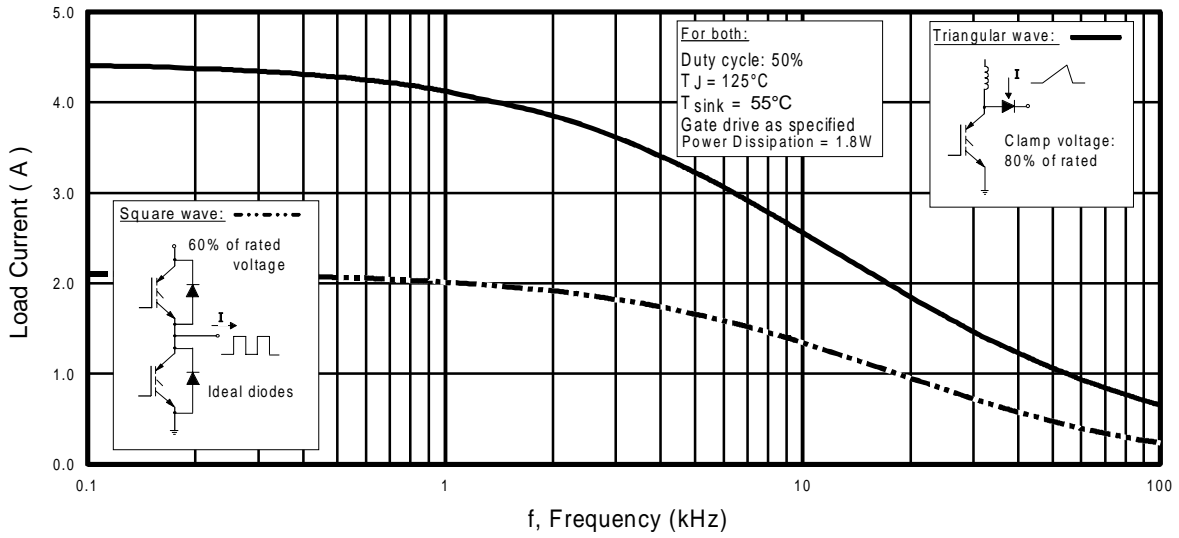


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

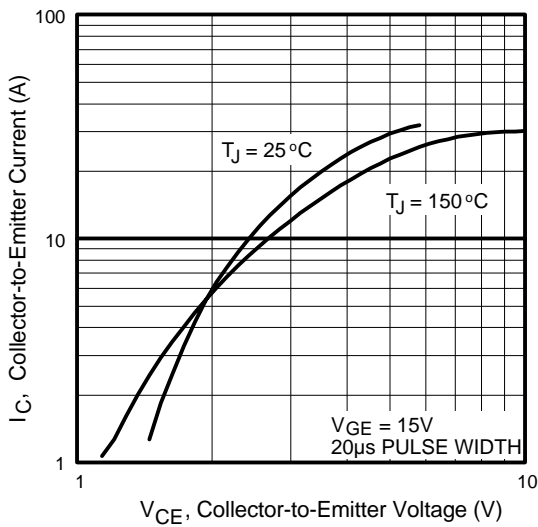


Fig. 2 - Typical Output Characteristics

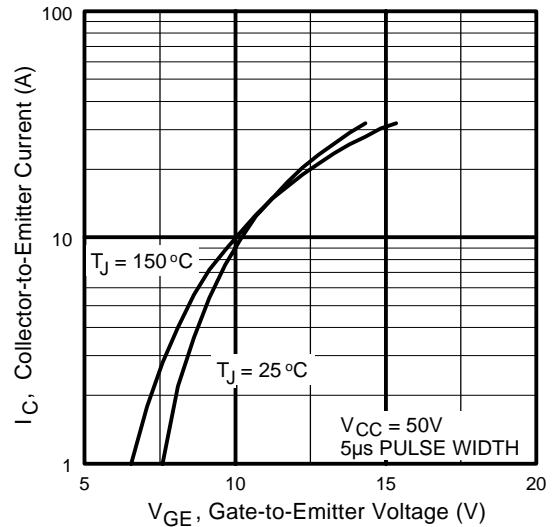


Fig. 3 - Typical Transfer Characteristics

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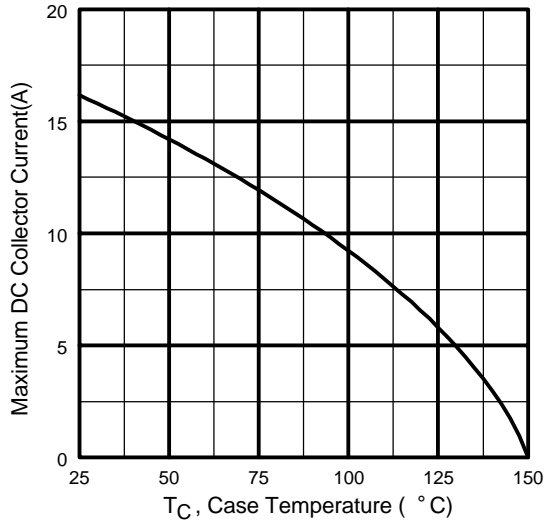


Fig. 4 - Maximum Collector Current vs. Case Temperature

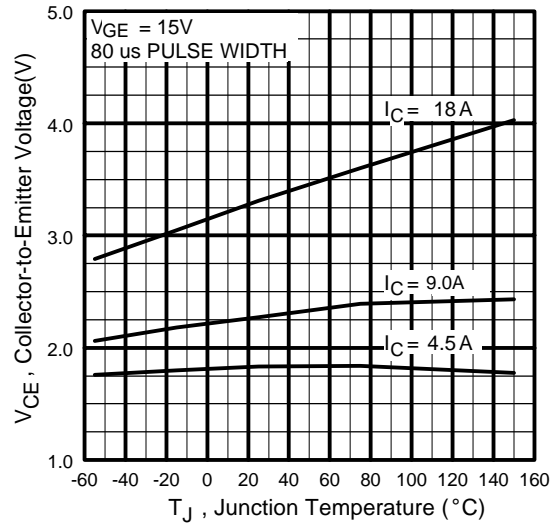


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

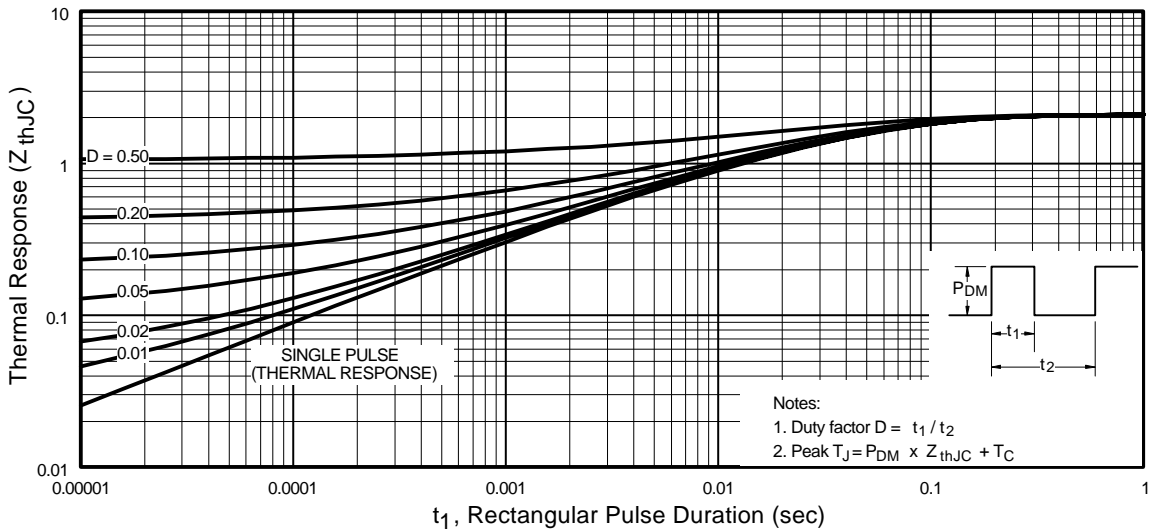


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

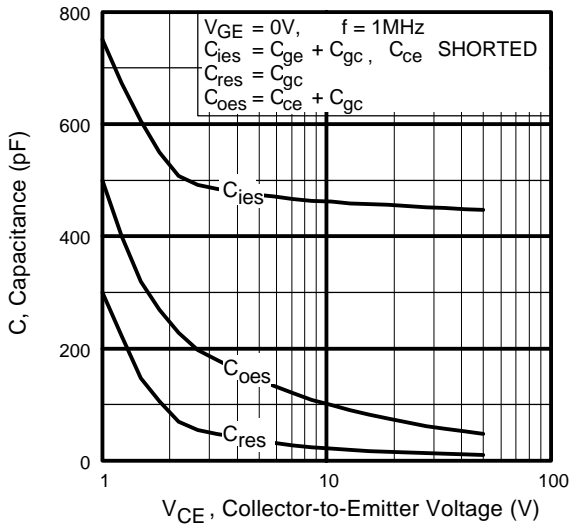


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

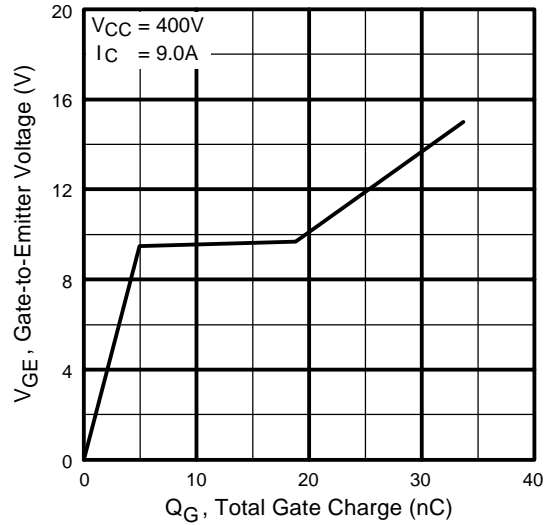


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

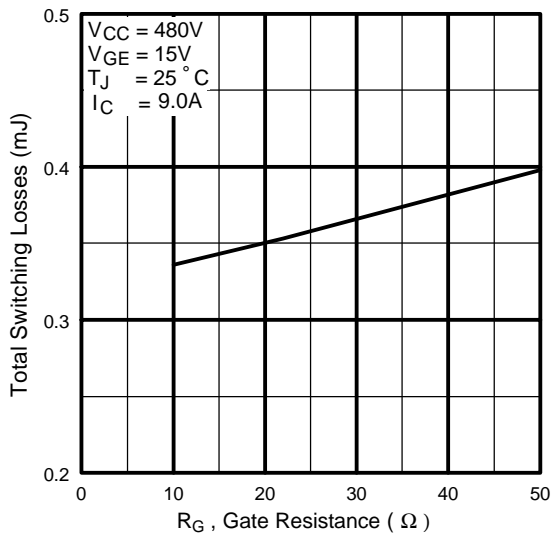


Fig. 9 - Typical Switching Losses vs. Gate Resistance

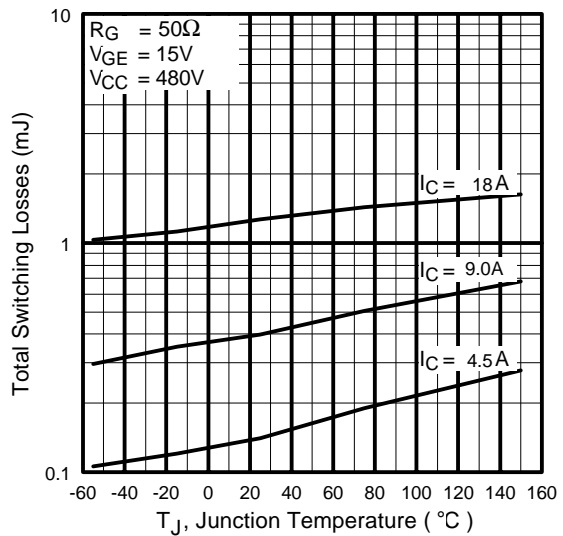


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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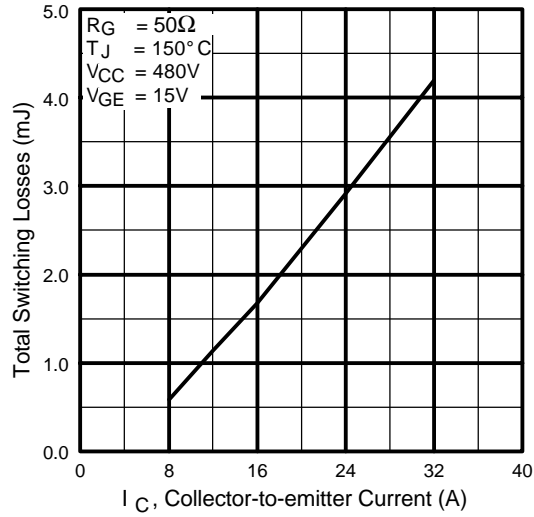


Fig. 11 - Typical Switching Losses vs. Collector-to-emitter Current

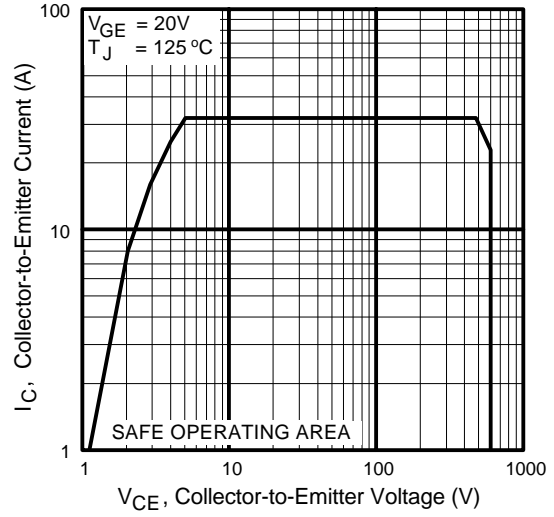
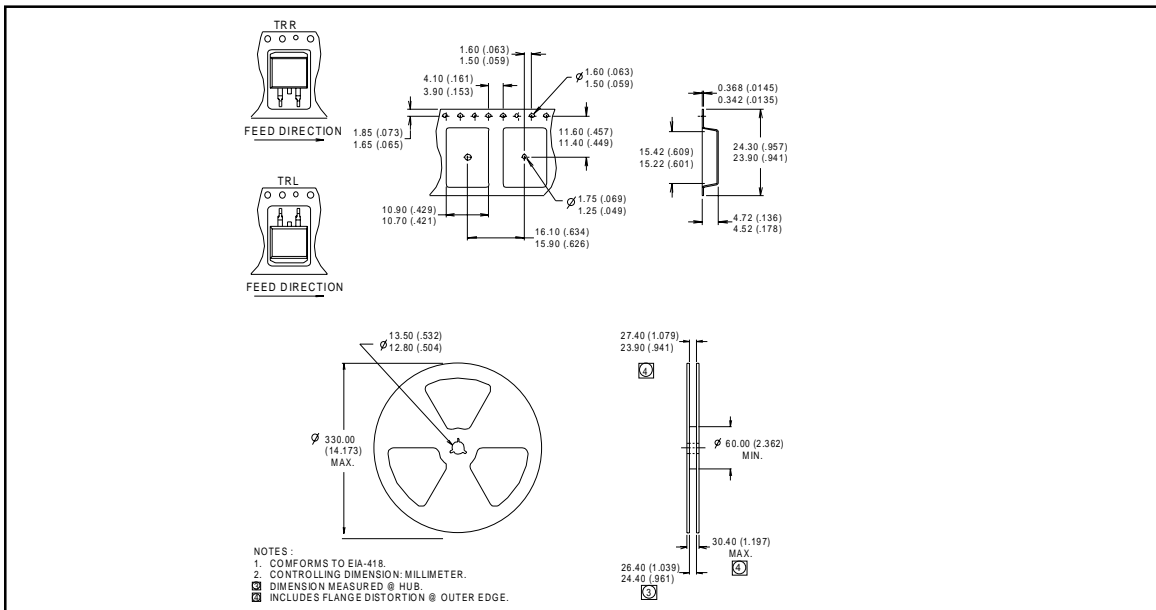
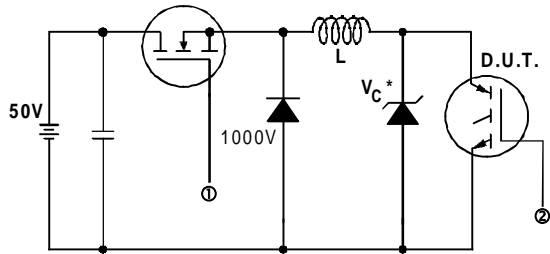


Fig. 12 - Turn-Off SOA

Tape & Reel Information

D²Pak





* 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

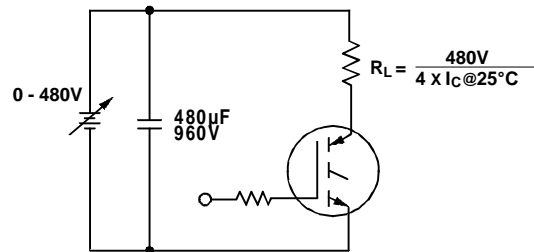


Fig. 13b - Pulsed Collector Current Test Circuit

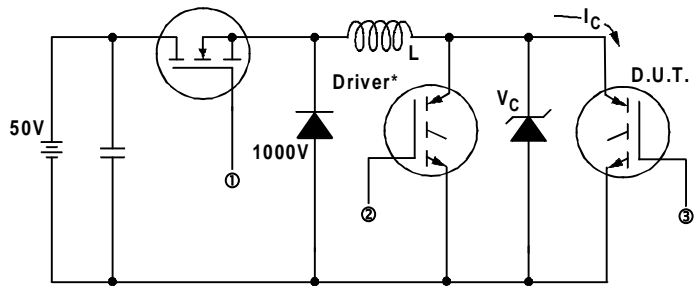


Fig. 14a - Switching Loss Test Circuit

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

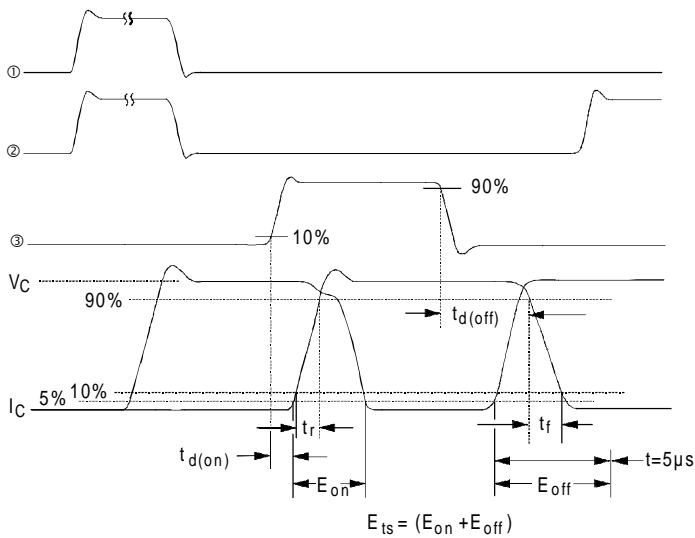


Fig. 14b - Switching Loss Waveforms

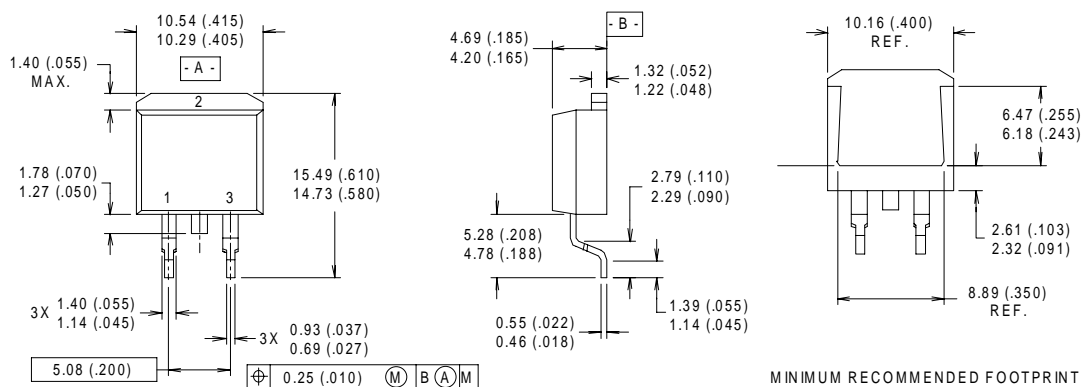
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Notes:

- 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



NOTES:

- 1 DIMENSIONS AFTER SOLDER DIP.
- 2 DIMENSIONING & TOLERANCING PER ANSII Y14.5M, 1982.
- 3 CONTROLLING DIMENSION : INCH.
- 4 HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

LEAD ASSIGNMENTS

- 1 - GATE
- 2 - DRAIN
- 3 - SOURCE

International
IR Rectifier

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IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 011 451 0111
IR JAPAN: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo 171 Tel: 81 (0)3 3983 0086
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IR TAIWAN: 16 Fl. Suite D. 207, Sec. 2, Tun Haw South Road, Taipei, 10673 Tel: 886-(0)2 2377 9936
Data and specifications subject to change without notice. 10/00

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