

International **IR** Rectifier

PD -93960

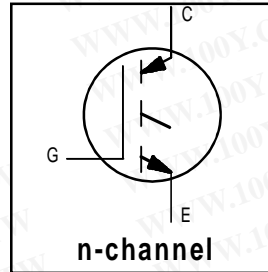
IRG4BH20K-S

INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated
 UltraFast IGBT

Features

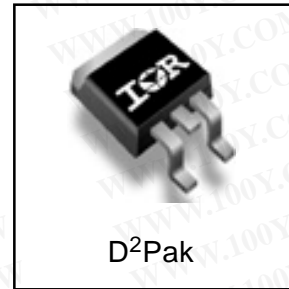
- High short circuit rating optimized for motor control, $t_{sc} = 10\mu s$ @ $V_{CC} = 720V$, $T_J = 125^\circ C$, $V_{GE} = 15V$
- Combines low conduction losses with high switching speed
- Latest generation design provides tighter parameter distribution and higher efficiency than previous generations
- Industry standard D²Pak package



$V_{CES} = 1200V$
$V_{CE(on)} \text{ typ.} = 3.17V$
@ $V_{GE} = 15V, I_C = 5.0A$

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 IGBT's offer highest power density motor controls possible



D²Pak

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	11	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	5.0	
I_{CM}	Pulsed Collector Current ①	22	
I_{LM}	Clamped Inductive Load Current ②	22	
t_{sc}	Short Circuit Withstand Time	10	μs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	130	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 T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ C$

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	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	40	
Wt	Weight	6 (0.21)	—	g (oz)

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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	1200	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	$V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.13	—	$V/^\circ\text{C}$	$V_{GE} = 0V, I_C = 2.5mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	3.17	4.3	V	$I_C = 5.0A$ $V_{GE} = 15V$
		—	4.04	—		$I_C = 11A$ See Fig.2, 5
		—	2.84	—		$I_C = 5.0A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.5	—	6.5		$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-10	—	$mV/^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1mA$
g_{fe}	Forward Transconductance ⑤	2.3	3.5	—	S	$V_{CE} = 100V, I_C = 5.0A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 1200V$
		—	—	2.0		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$
		—	—	1000		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ\text{C}$
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)	—	28	43	nC	$I_C = 5.0A$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	4.4	6.6		$V_{CC} = 400V$ See Fig.8
Q_{gc}	Gate - Collector Charge (turn-on)	—	12	18		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	23	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 5.0A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 50\Omega$
t_r	Rise Time	—	26	—		
$t_{d(off)}$	Turn-Off Delay Time	—	93	140		
t_f	Fall Time	—	270	400		
E_{on}	Turn-On Switching Loss	—	0.45	—		
E_{off}	Turn-Off Switching Loss	—	0.44	—	mJ	Energy losses include "tail" See Fig. 9,10,14
E_{ts}	Total Switching Loss	—	0.89	1.2	μs	$V_{CC} = 720V, T_J = 125^\circ\text{C}$ $V_{GE} = 15V, R_G = 50\Omega$
t_{sc}	Short Circuit Withstand Time	10	—	—		
$t_{d(on)}$	Turn-On Delay Time	—	23	—	ns	$T_J = 150^\circ\text{C}$, $I_C = 5.0A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" See Fig. 10,11,14
t_r	Rise Time	—	28	—		
$t_{d(off)}$	Turn-Off Delay Time	—	100	—		
t_f	Fall Time	—	620	—		
E_{ts}	Total Switching Loss	—	1.7	—		
L_E	Internal Emitter Inductance	—	7.5	—	nH	Between lead and center of die contact
C_{ies}	Input Capacitance	—	435	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ See Fig. 7 $f = 1.0MHz$
C_{oes}	Output Capacitance	—	44	—		
C_{res}	Reverse Transfer Capacitance	—	8.3	—		

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.
- * When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.

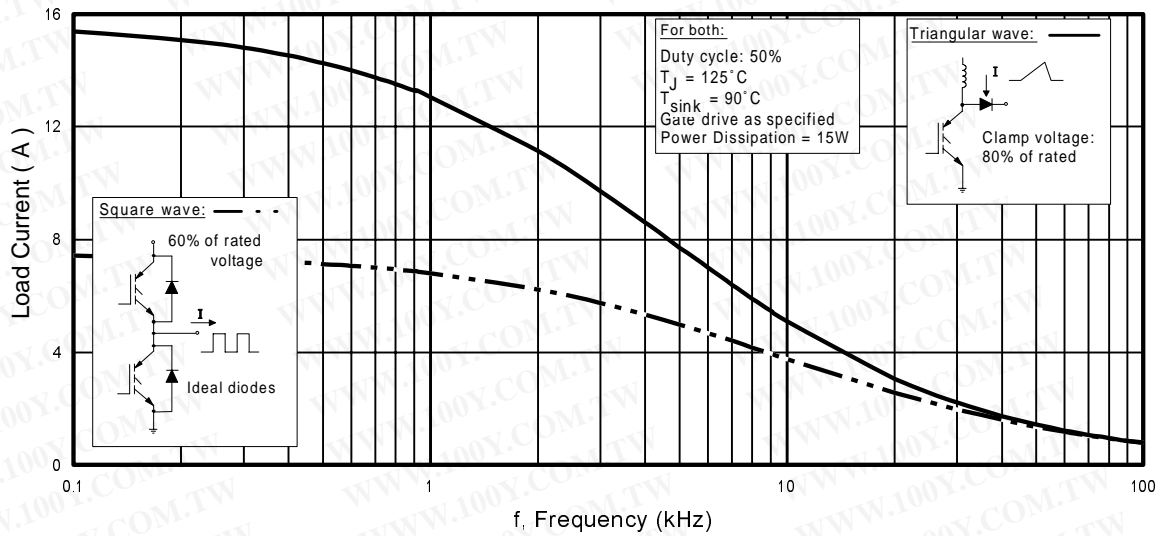


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

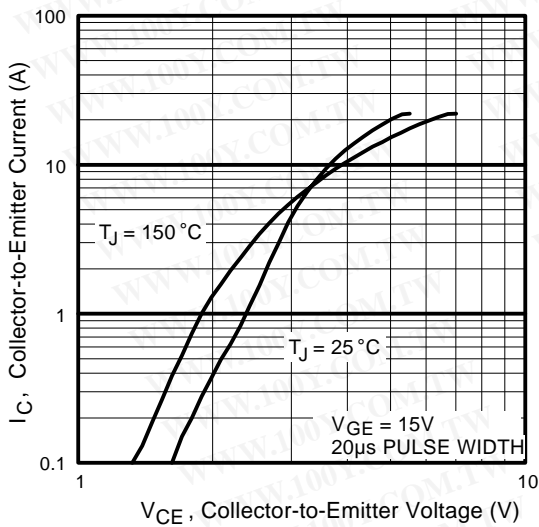


Fig. 2 - Typical Output Characteristics
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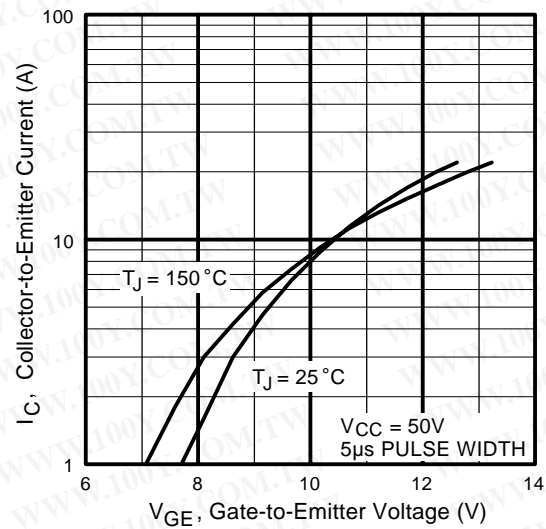


Fig. 3 - Typical Transfer Characteristics

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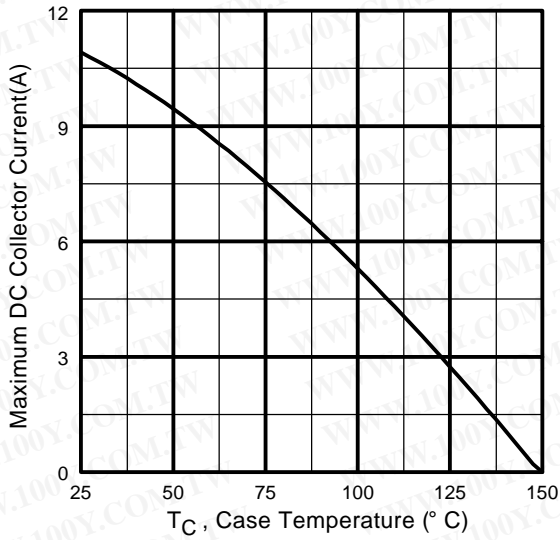


Fig. 4 - Maximum Collector Current vs. Case Temperature

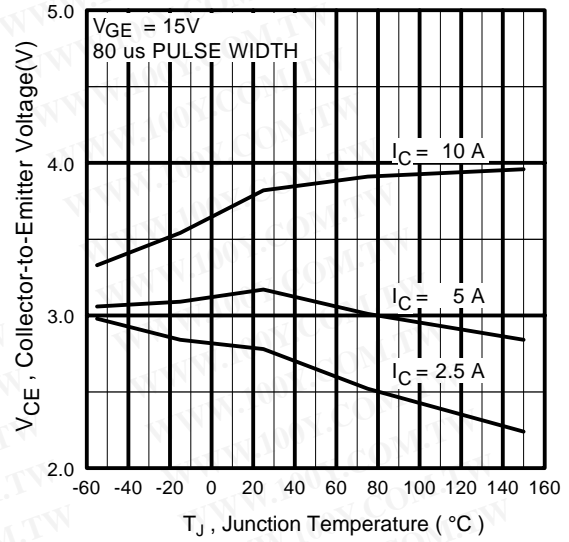


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

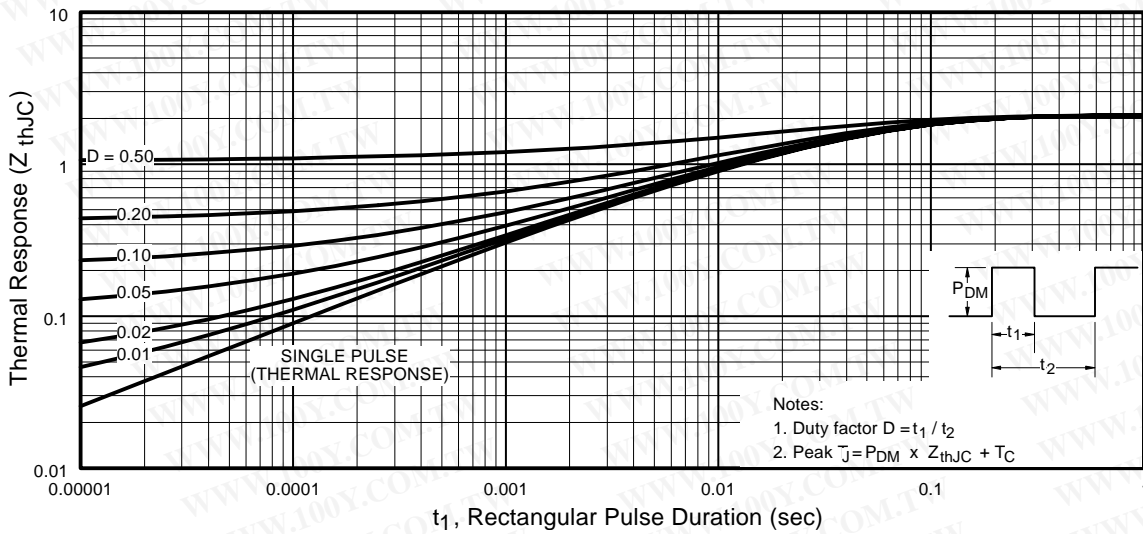


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

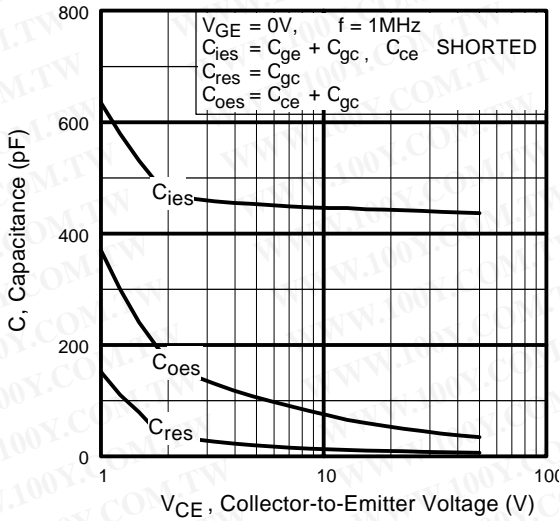


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

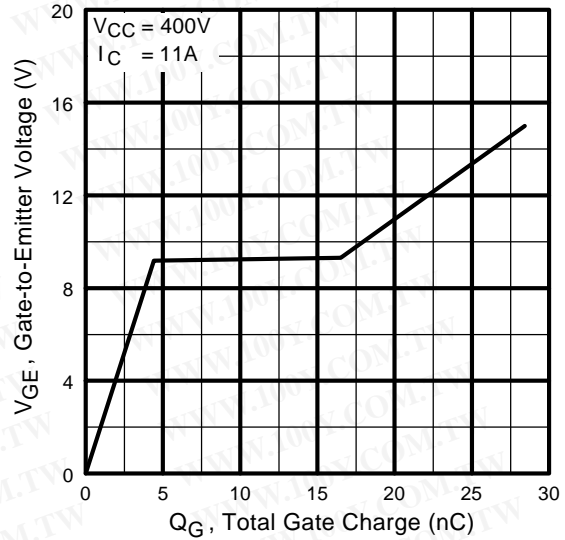


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

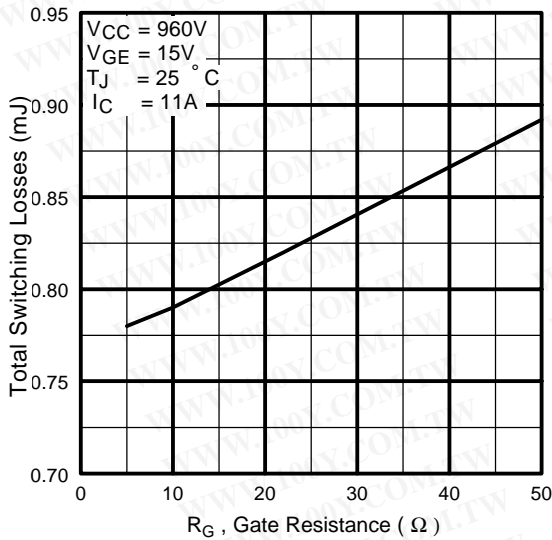


Fig. 9 - Typical Switching Losses vs. Gate Resistance

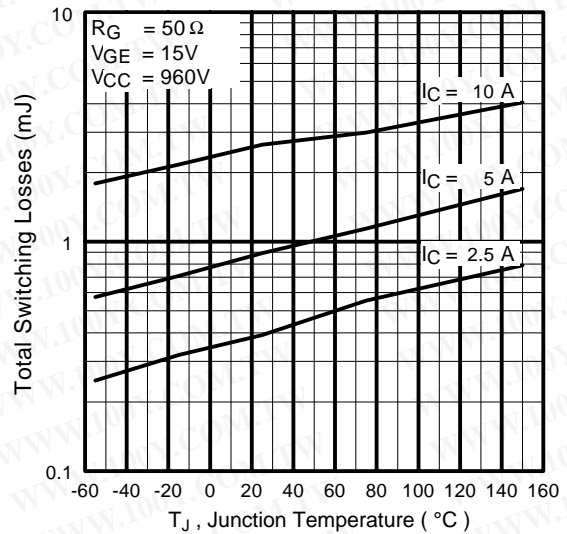


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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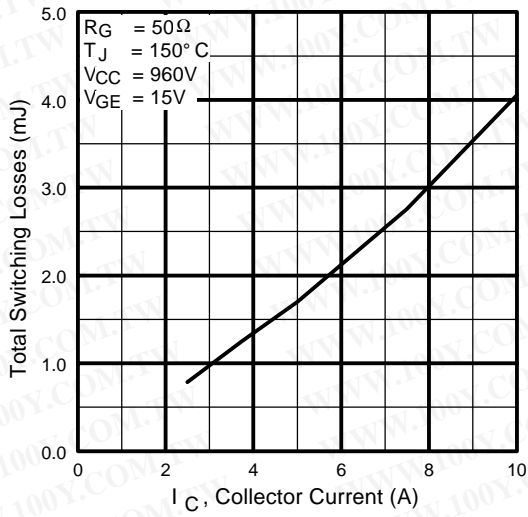


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

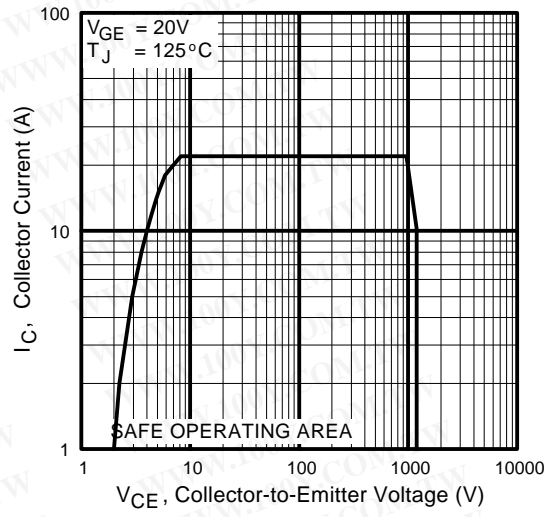
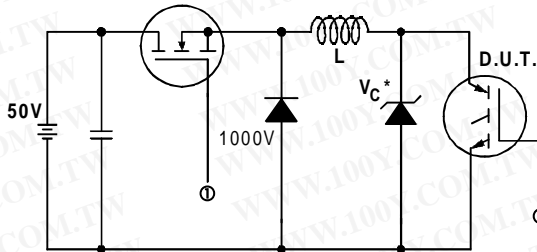


Fig. 12 - Turn-Off SOA



* 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

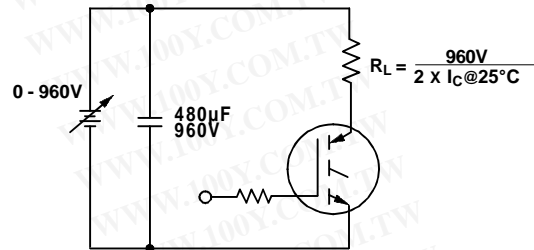


Fig. 13b - Pulsed Collector Current Test Circuit

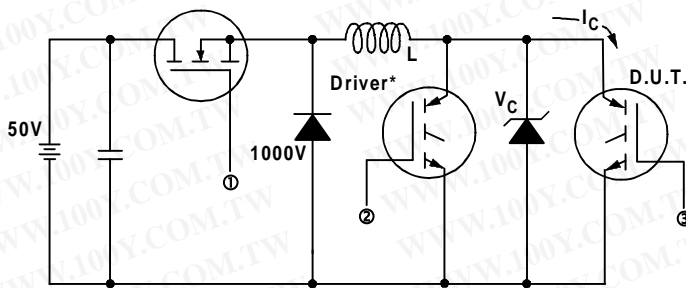


Fig. 14a - Switching Loss Test Circuit

* Driver same type as D.U.T., $V_C = 960V$

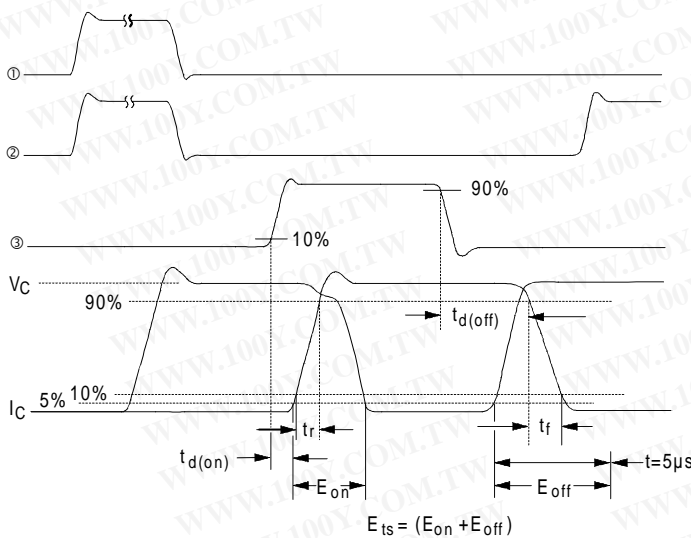
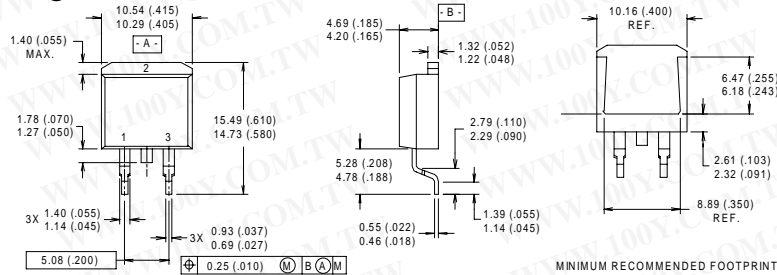


Fig. 14b - Switching Loss Waveforms

IRG4BH20K-S D²Pak Package Outline

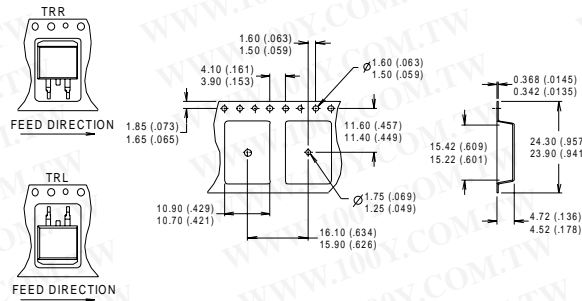
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- NOTES:
- 1 DIMENSIONS AFTER SOLDER DIP.
 - 2 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
 - 3 CONTROLLING DIMENSION : INCH.
 - 4 HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

- LEAD ASSIGNMENTS
- 1 - GATE
 - 2 - DRAIN
 - 3 - SOURCE

D²Pak Tape and Reel



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

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Data and specifications subject to change without notice. 8/00

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