

International IR Rectifier

INSULATED GATE BIPOLAR TRANSISTOR

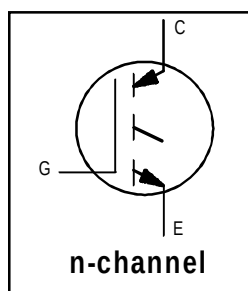
PD -94305D

IRG4MC40U

UltraFast Speed IGBT

Features

- Electrically Isolated and Hermetically Sealed
- Simple Drive Requirements
- Latch-proof
- UltraFast Speed Operation 8kHz - 40kHz,
> 200kHz in Resonant Mode
- High Operating Frequency
- Switching-loss Rating includes all "tail" Losses
- Ceramic Eyelets



$$V_{CES} = 600V$$

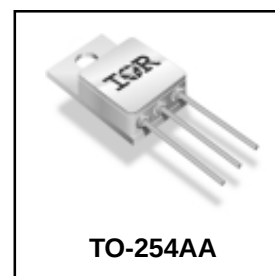
$$V_{CE(on) \max} = 2.1V$$

$$@V_{GE} = 15V, I_C = 20A$$

Benefits

- Generation 4 IGBT's offer highest efficiency available
- IGBT's optimized for specified application conditions
- Designed to be a "drop-in" replacement for equivalent IR Hi-Rel Generation 3 IGBT's

Insulated Gate Bipolar Transistors (IGBTs) from International Rectifier have higher usable current densities than comparable bipolar transistors, while at the same time having simpler gate-drive requirements of the familiar power MOSFET. They provide substantial benefits to a host of high-voltage, high-current applications.



TO-254AA

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	35*	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	20	
I_{CM}	Pulsed Collector Current ①	140	
I_{LM}	Clamped Inductive Load Current ②	140	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	125	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	50	
T_J	Operating Junction and	-55 to + 150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Lead Temperature	300 (0.063in./1.6mm from case for 10s)	
	Weight	9.3 (typical)	g

Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
R_{thJC}	Junction-to-Case	—	—	1.1	$^\circ C/W$	

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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	$V_{GE} = 0V, I_C = 1.0\text{ mA}$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ③	17	—	—	V	$V_{GE} = 0V, I_C = 1.0\text{ A}$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.5	—	V/°C	$V_{GE} = 0V, I_C = 1.0\text{ mA}$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	—	2.1	V	$I_C = 20A$ $V_{GE} = 15V$
		—	—	2.5		$I_C = 35A$ See Fig.2, 5
		—	—	2.0		$I_C = 20A, T_J = 125^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		$V_{CE} = V_{GE}, I_C = 1.0\text{ mA}$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-12	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$
g_{fe}	Forward Transconductance ④	11	—	—	S	$V_{CE} \geq 15V, I_C = 20A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	50	μA	$V_{GE} = 0V, V_{CE} = 480V$
		—	—	2000		$V_{GE} = 0V, V_{CE} = 480V, T_J = 125^\circ\text{C}$
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)	—	—	150	nC	$I_C = 20A$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	—	25		$V_{CC} = 300V$ See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	—	—	60		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	—	50	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	—	—	42		$I_C = 20A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	—	190		$V_{GE} = 15V, R_G = 9.1\Omega$
t_f	Fall Time	—	—	120		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	—	1.0	mJ	See Fig. 10, 11, 13, 14
$t_{d(on)}$	Turn-On Delay Time	—	—	40	ns	$T_J = 125^\circ\text{C},$
t_r	Rise Time	—	—	40		$I_C = 20A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	—	300		$V_{GE} = 15V, R_G = 9.1\Omega$
t_f	Fall Time	—	—	250		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	—	1.8	mJ	See Fig. 13, 14
$L_C + L_E$	Total Inductance	—	6.8	—	nH	Measured from Collector lead (6mm/ 0.25in. from package) to Emitter lead (6mm / 0.25in. from package)
C_{ies}	Input Capacitance	—	2215	—	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	—	135	—		$V_{CC} = 30V$ See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	25	—		$f = 1.0\text{ MHz}$

Notes:

- ① Repetitive rating; $V_{GE} = 20V$, pulse width limited by max. junction temperature. (See fig. 13b)
- ② $V_{CC} = 80\%(V_{CES}), V_{GE} = 20V, L = 100\mu\text{H}, R_G = 9.1\Omega$, (See fig. 13a)
- ③ Pulse width $\leq 80\mu\text{s}$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu\text{s}$, single shot.

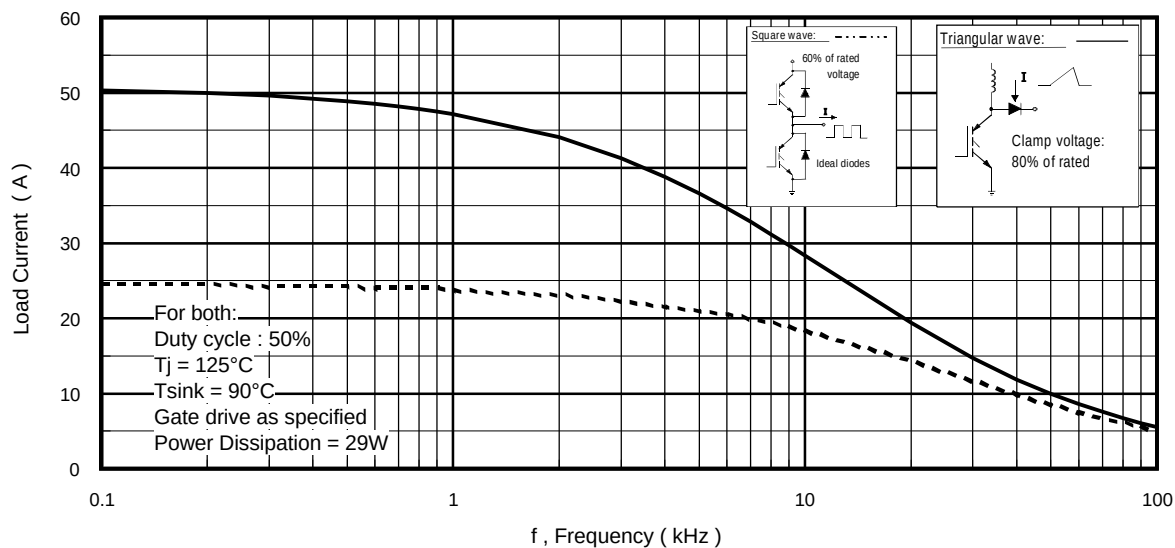


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I = I_{\text{RMS}}$ of fundamental; for triangular wave, $I = I_{\text{PK}}$)

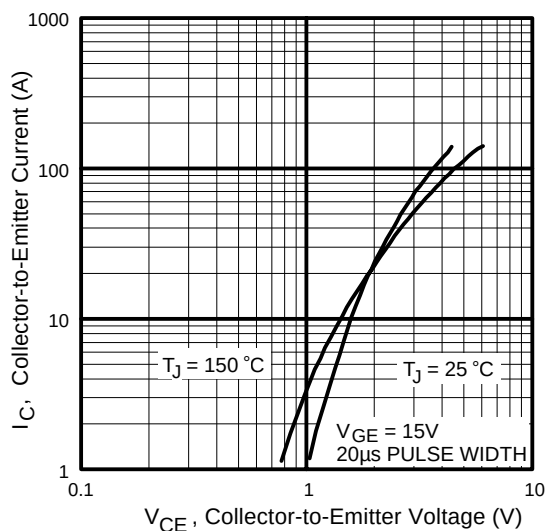


Fig. 2 - Typical Output Characteristics

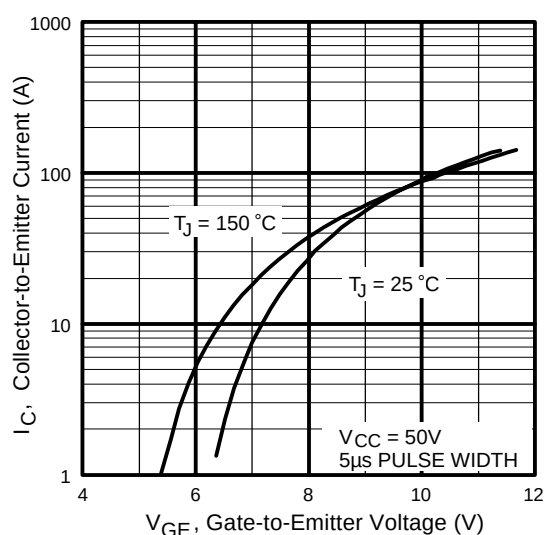


Fig. 3 - Typical Transfer Characteristics

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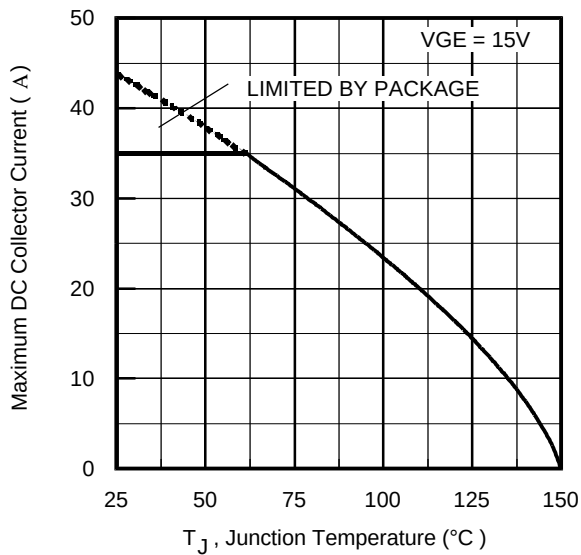


Fig. 4 - Maximum Collector Current vs. Case Temperature

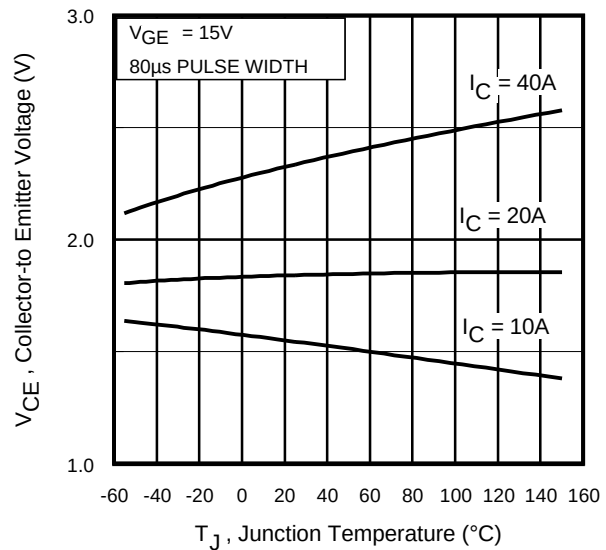


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

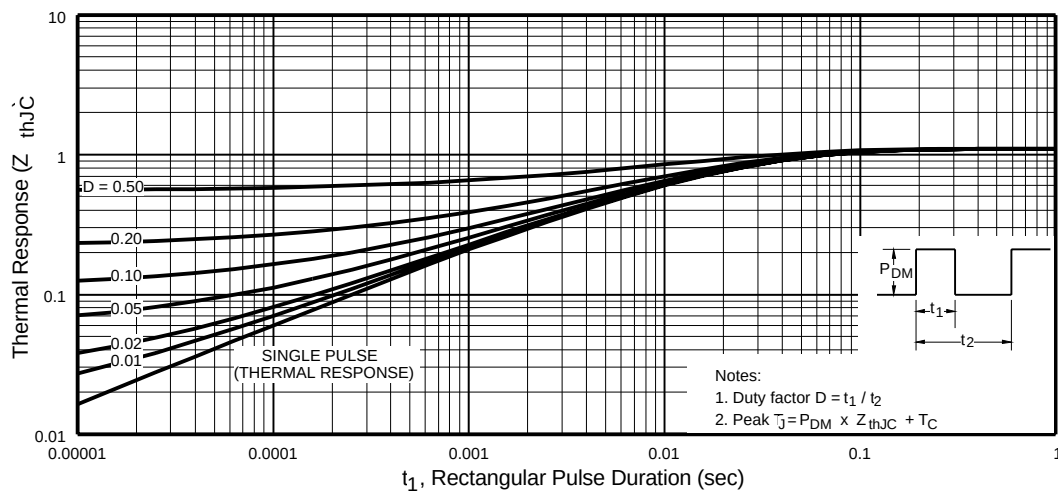


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

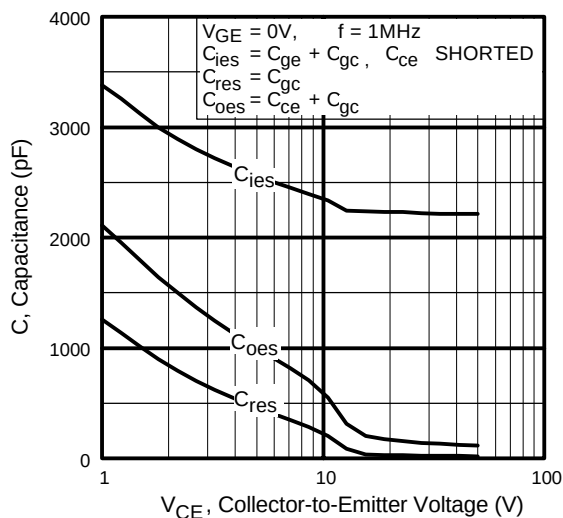


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

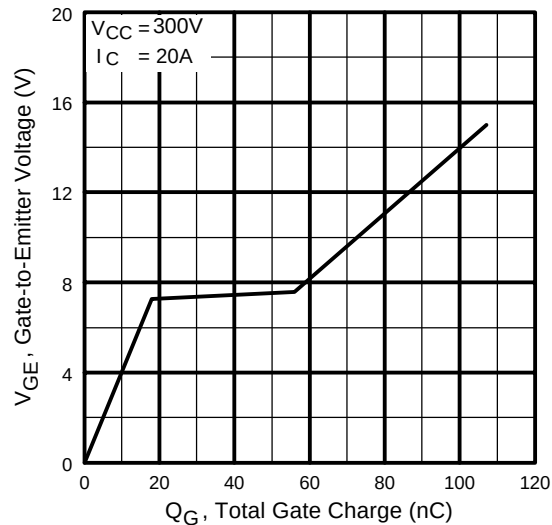


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

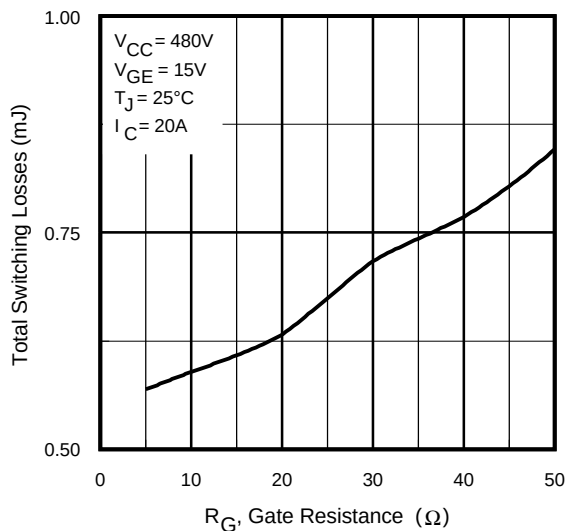


Fig. 9 - Typical Switching Losses vs. Gate Resistance

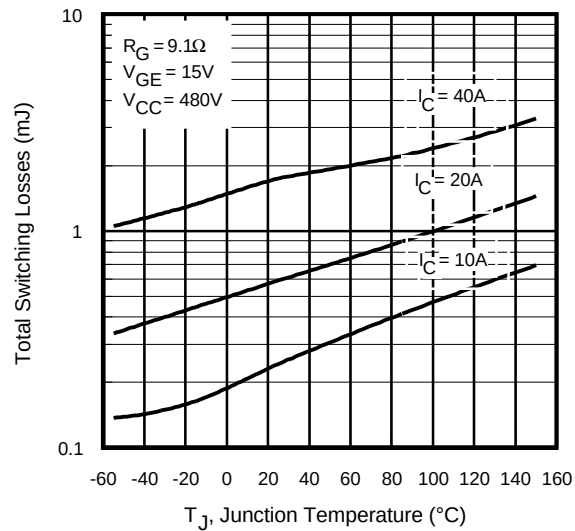


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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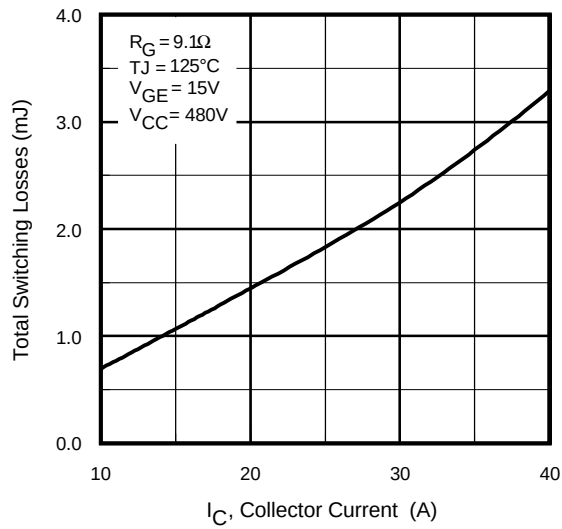


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

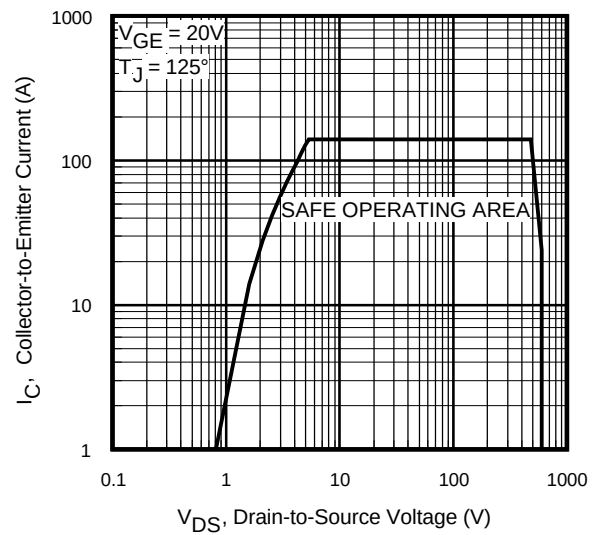
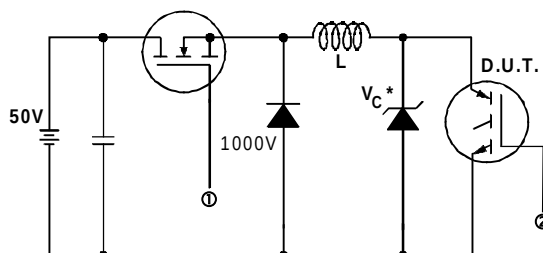


Fig. 12 - Turn-Off SOA



* 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

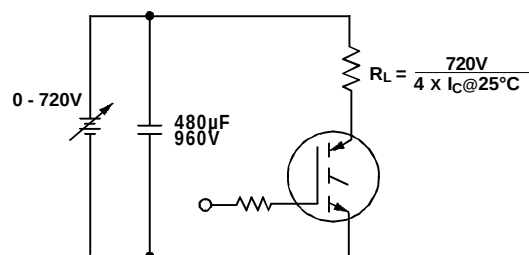


Fig. 13b - Pulsed Collector Current Test Circuit

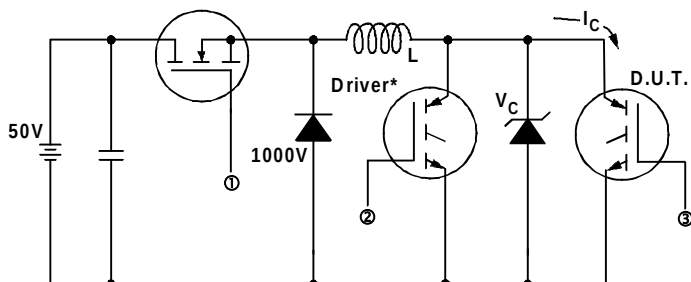


Fig. 14a - Switching Loss Test Circuit

* Driver same type as D.U.T., $V_C = 720V$

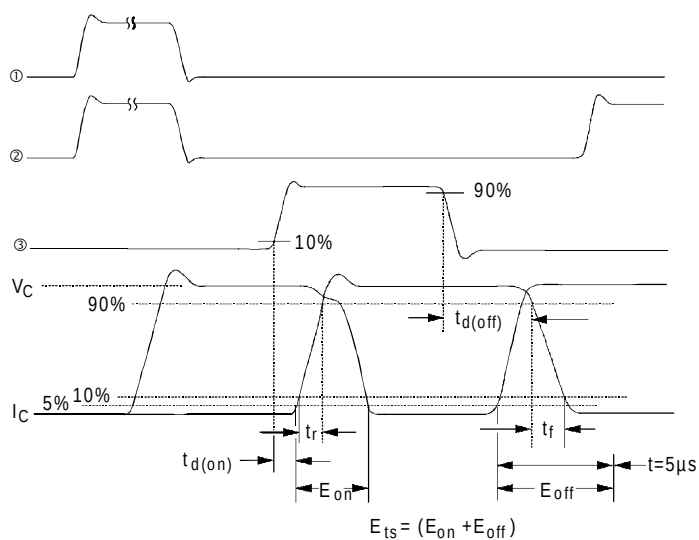
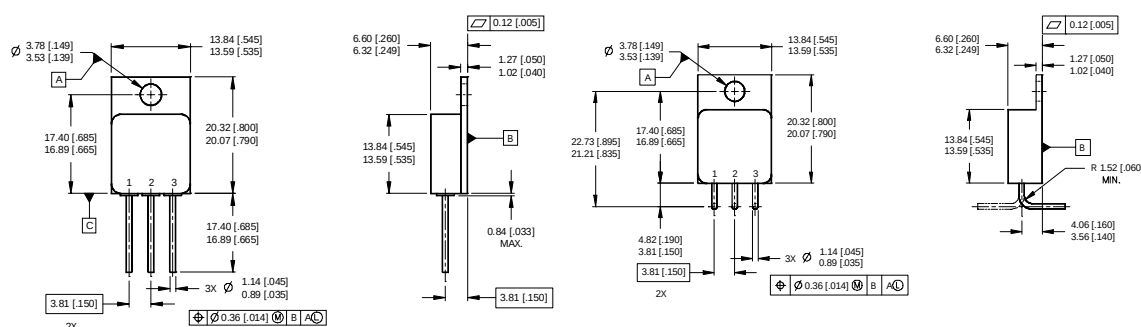


Fig. 14b - Switching Loss Waveforms

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Case Outline and Dimensions — TO-254AA



NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. CONTROLLING DIMENSION: INCH.
4. CONFORMS TO JEDEC OUTLINE TO-254AA.

PIN ASSIGNMENTS

- 1=COLLECTOR
- 2=EMITTER
- 3=GATE

CAUTION

BERYLLIA WARNING PER MIL-PRF-19500

Packages containing beryllia shall not be ground, sandblasted, machined, or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.

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