

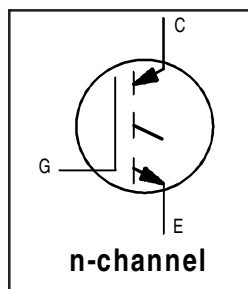
IRGMH40F

INSULATED GATE BIPOLAR TRANSISTOR

Fast Speed IGBT

Features

- Electrically Isolated and Hermetically Sealed
- Simple Drive Requirements
- Latch-proof
- Fast Speed operation 3 kHz - 8 kHz
- High operating frequency
- Switching-loss rating includes all "tail" losses



$$V_{CES} = 1200V$$

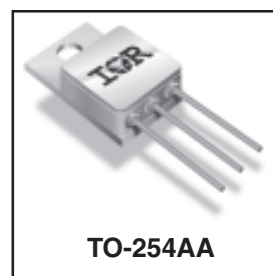
$$V_{CE(on) \max} = 3.6V$$

$$@ V_{GE} = 15V, I_C = 13A$$

Description

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.

The performance of various IGBTs varies greatly with frequency. Note that IR now provides the designer with a speed benchmark ($f_{ic/2}$, or the "half-current frequency"), as well as an indication of the current handling capability of the device.



TO-254AA

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	13	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	48	
I_{CM}	Pulsed Collector Current ①	24	
I_{LM}	Clamped Inductive Load Current ②	48	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	96	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	36	
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	—	—	1.3	$^\circ C/W$	
R_{thCS}	Case-to-Sink	—	0.21	—		
R_{thJA}	Junction-to-Ambient	—	—	48		

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 ③	17	—	—	V	$V_{GE} = 0V, I_C = 1.0 A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.1	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0 mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.4	3.6	V	$I_C = 13A$ $V_{GE} = 15V$
		—	3.1	—		$I_C = 24A$ See Fig.2, 5
		—	2.6	—		$I_C = 13A, T_J = 125^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5		$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ④	5.0	—	—	S	$V_{CE} \geq 15V, I_C = 13A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	100	μA	$V_{GE} = 0V, V_{CE} = 960V$
		—	—	1200		$V_{GE} = 0V, V_{CE} = 960V, T_J = 125^\circ\text{C}$
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)	—	56	84	nC	$I_C = 13A$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	12	18		$V_{CC} = 400V$ See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	—	20	30		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	25	—	ns	$I_C = 13A, V_{CC} = 960V$ Energy losses include "tail" See Fig. 9, 10, 14
t_r	Rise Time	—	14	—		
$t_{d(off)}$	Turn-Off Delay Time	—	270	—		
t_f	Fall Time	—	270	—		
E_{on}	Turn-On Switching Loss	—	0.5	—	mJ	
E_{off}	Turn-off Switching Loss	—	2.6	—		
E_{ts}	Total Switching Loss	—	3.1	4.7		
$t_{d(on)}$	Turn-On Delay Time	—	25	—	ns	$T_J = 125^\circ\text{C}$ $I_C = 13A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail" See Fig. 11, 14
t_r	Rise Time	—	14	—		
$t_{d(off)}$	Turn-Off Delay Time	—	450	—		
t_f	Fall Time	—	650	—		
E_{ts}	Total Switching Loss	—	7.5	—	mJ	
$L_C + L_E$	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	—	1400	—	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	—	82	—		$V_{CC} = 30V$ See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	17	—		$f = 1.0MHz$

Note: Corresponding Spice and Saber models are available on the Website.

For footnotes refer to the last page

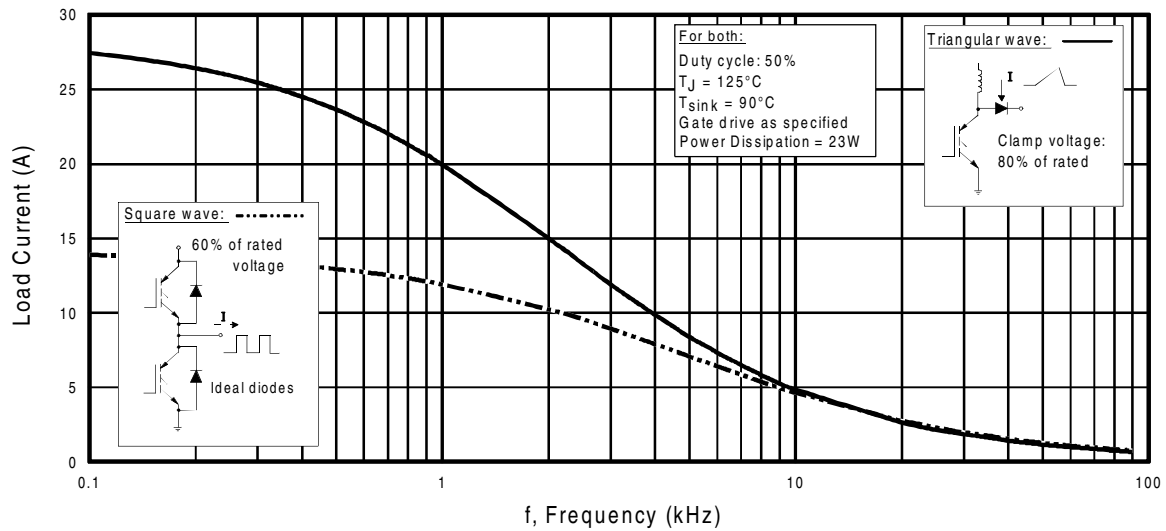


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I = I_{\text{RMS}}$ of fundamental; for triangular wave, $I = I_{\text{PK}}$)

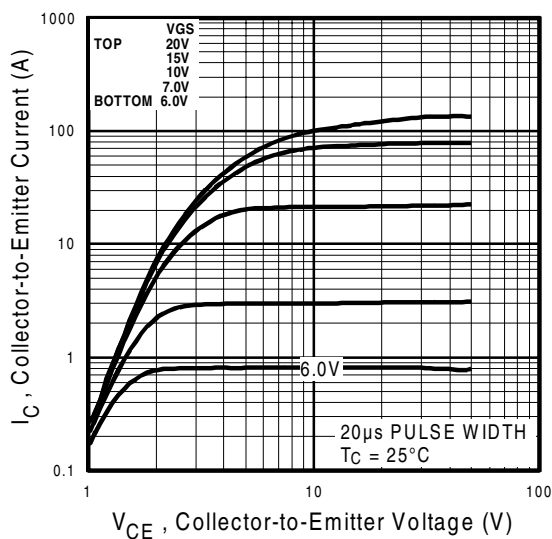


Fig. 2 - Typical Output Characteristics

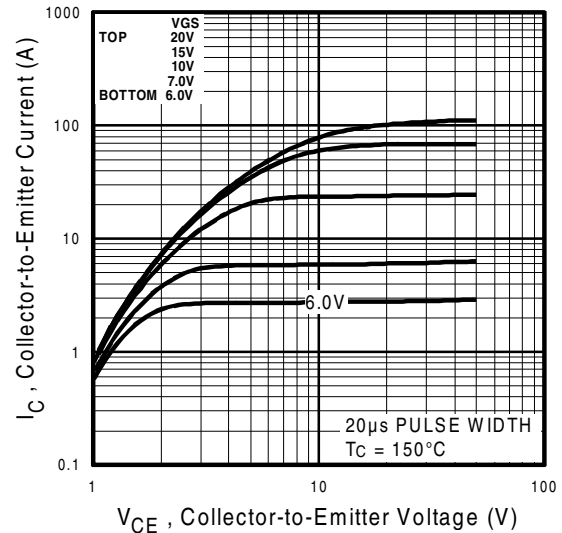


Fig. 3 - Typical Transfer Characteristics

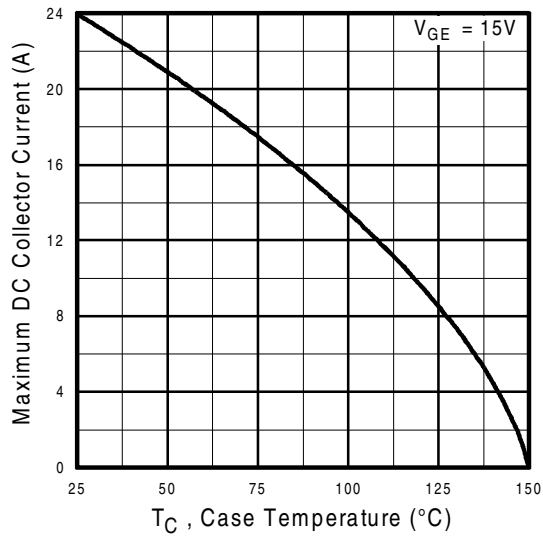


Fig. 4 - Maximum Collector Current vs. Case Temperature

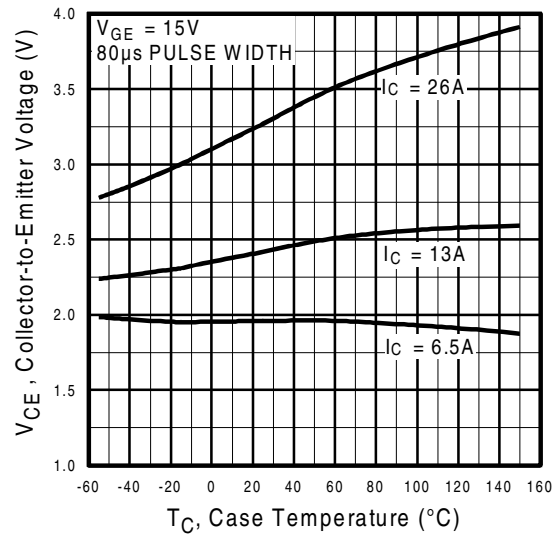


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

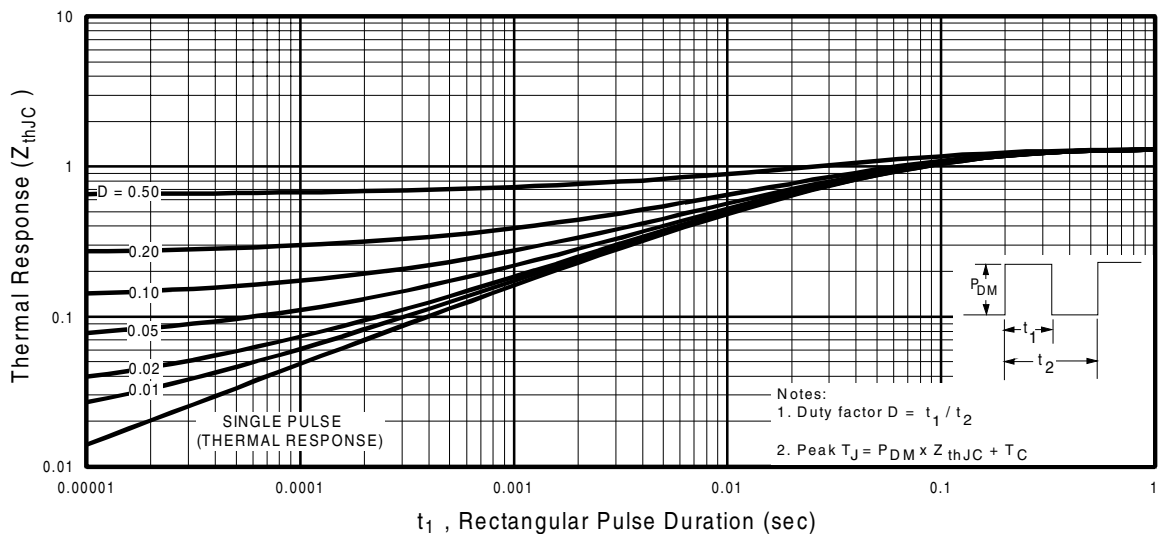


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

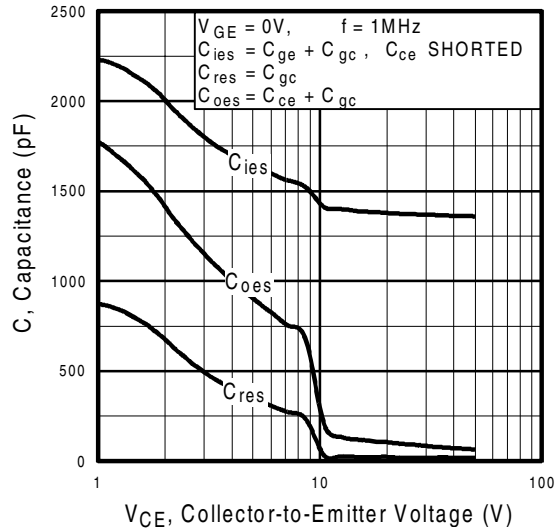


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

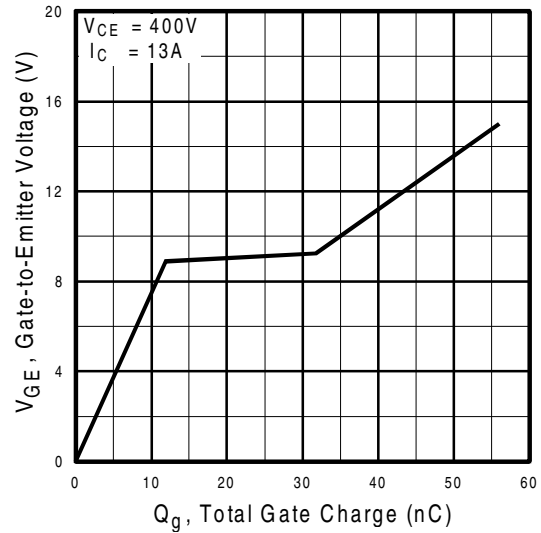


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

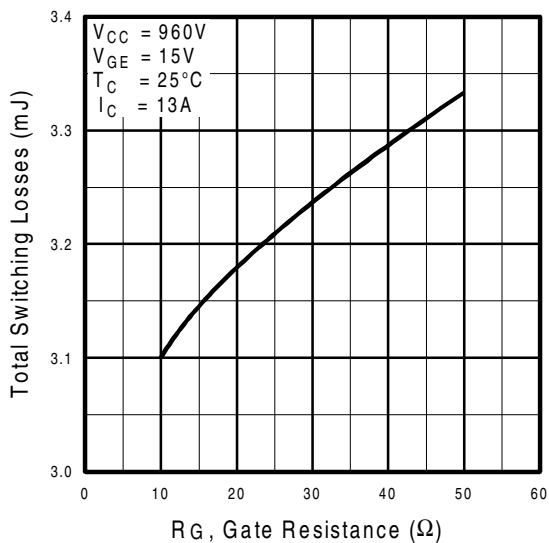


Fig. 9 - Typical Switching Losses vs. Gate Resistance

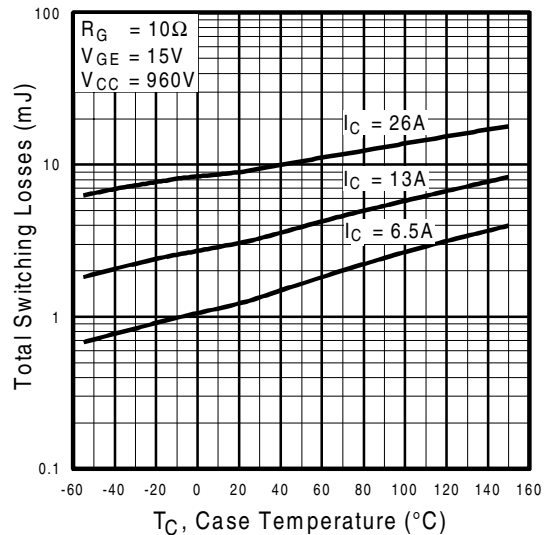


Fig. 10 - Typical Switching Losses vs. Junction Temperature

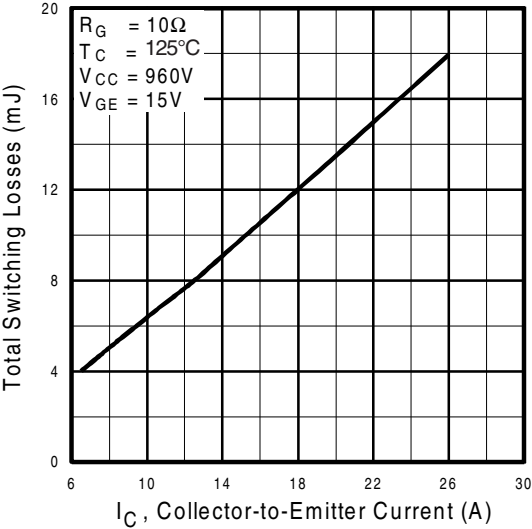


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

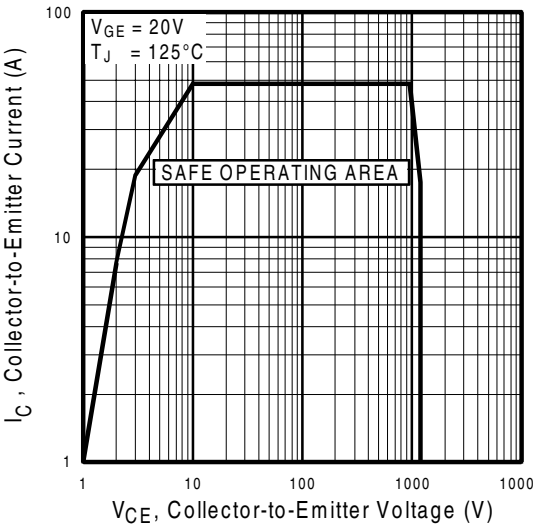


Fig. 12 - Turn-Off SOA

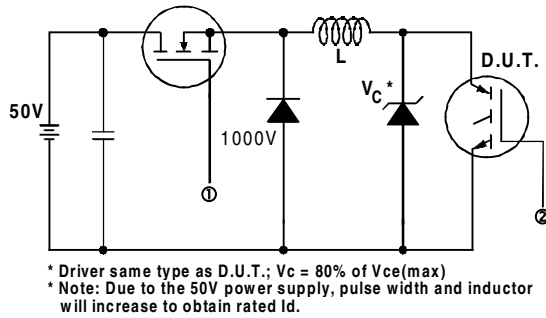


Fig. 13a - Clamped Inductive Load Test Circuit

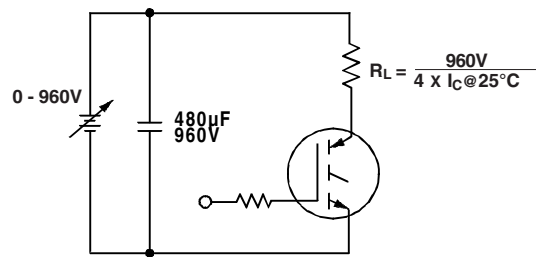


Fig. 13b - Pulsed Collector Current Test Circuit

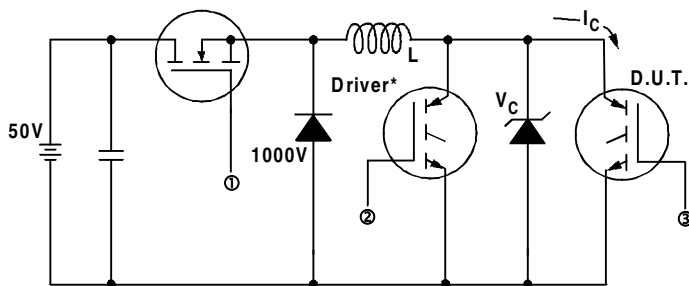


Fig. 14a - Switching Loss Test Circuit

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

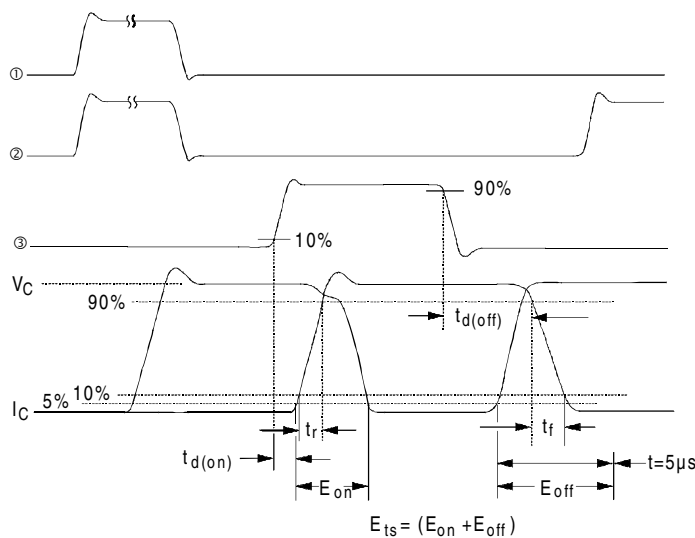
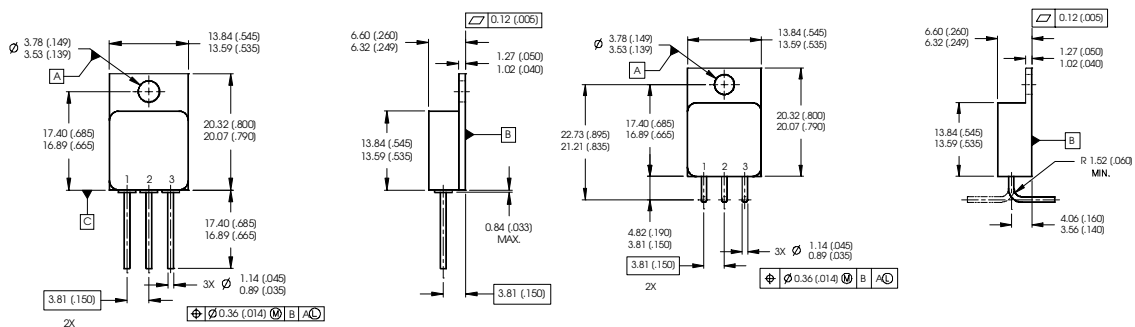


Fig. 14b - Switching Loss Waveforms

Notes:

- ① Repetitive rating; $V_{GE} = 20V$, pulse width limited by max. junction temperature.
- ② $V_{CC} = 80\%(V_{CES})$, $V_{GE} = 20V$, $L = 10\mu H$, $R_G = 10\Omega$
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.

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.

LEGEND

- 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.