International Rectifier

PD 9.1418

PRELIMINARY

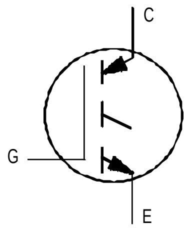
IRGMH40F

INSULATED GATE BIPOLAR TRANSISTOR

Fast Speed IGBT

Features

- Eletrically 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
- Ceramic eyelets



n-channel

V_{CES} = 1200V

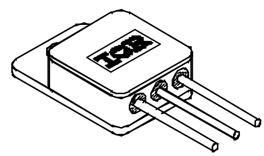
$V_{CE(sat)} \leq$ 3.6V

@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 "haft-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 = 100°C	Continuous Collector Current	13	A
I_{CM}	Pulsed Collector Current ①	48	
I_C @ T_C = 25°C	Continuous Collector Current	24	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
I_{LM}	Clamped Inductive Load Current ②	48	A
P_D @ T_C = 25°C	Maximum Power Dissipation	96	W
P_D @ T_C = 100°C	Maximum Power Dissipation	38	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C
	Lead Temperature, for 10 seconds	300 (1.6mm from case)	
	Weight	9.3 (typical)	g

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—–	1.3	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.21	—–	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—–	48	

Electrical Characteristics @ T_J = 25°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 = 250µA	
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	17	—	—	V	V_{GE} = 0V, I_C = 1.0A	
$\Delta V_{(BR)DSS}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.1	—	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.4	3.6	V	V_{GE} = 15V, I_C = 13A	See Fig. 2, 5
		—	3.1	—		V_{GE} = 15V, I_C = 24A	
		—	2.6	—		V_{CE} = 15V, I_C = 13A , T_J = 125°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5		V_{CE} = V_{GE}, I_C = 250µA	
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA	
g_{fe}	Forward Transconductance ⑤	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°C	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±20V	

Switching Characteristics @ T_J = 25°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. 7
Q_{gc}	Gate - Collector Charge (turn-on)	—	20	30		V_{GE} = 15V	
$t_{d(on)}$	Turn-On Delay Time	—	25	—	ns		
t_r	Rise Time	—	14	—		T_J = 25°C	
$t_{d(off)}$	Turn-Off Delay Time	—	270			I_C = 13A, V_{CC} = 960V	
t_f	Fall Time	—	270			V_{GE} = 15V, R_G = 10Ω	
E_{on}	Turn-On Switching Loss	—	0.50	—	mJ	Energy losses include "tail"	
E_{off}	Turn-Off Switching Loss	—	2.6	—		See Fig. 10, 11, 13, 14	
E_{ts}	Total Switching Loss	—	3.1	4.7			
$t_{d(on)}$	Turn-On Delay Time	—	25	—	ns	T_J = 125°C,	
t_r	Rise Time	—	14	—		I_C = 13A, V_{CC} = 960V	
$t_{d(off)}$	Turn-Off Delay Time	—	450	—		V_{GE} = 15V, R_G = 10Ω	
t_f	Fall Time	—	640	—		Energy losses include "tail"	
E_{ts}	Total Switching Loss	—	7.5	—	mJ	See Fig. 13, 14	
L_S	Internal Source Inductance	—	8.7	—	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	—	1400	—	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	—	82	—		V_{CC} = 30V	See Fig. 6
C_{res}	Reverse Transfer Capacitance	—	17	—		f = 1.0MHz	
C_{CC}	Case-to-Drain Capacitance	—	12	—			

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 = 10µH, R_G = 10Ω, (See fig. 13a)

③ Repetitive rating; pulse width limited by maximum junction temperature.

④ Pulse width ≤ 80µs; duty factor ≤ 0.1%.

⑤ Pulse width 5.0µs, single shot.

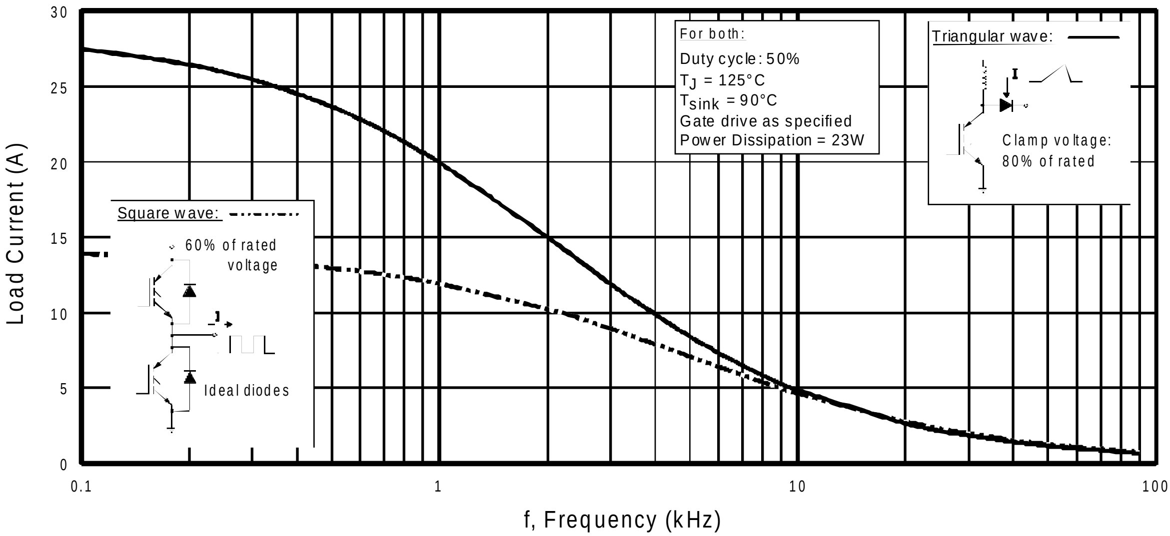


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

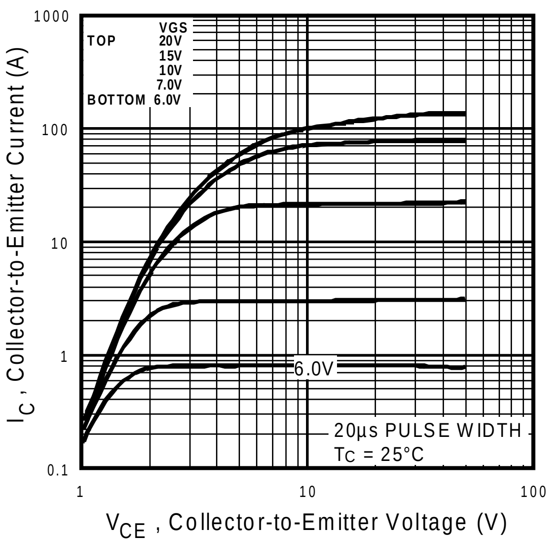


Fig. 2 - Typical Output Characteristics
T_C = 25°C

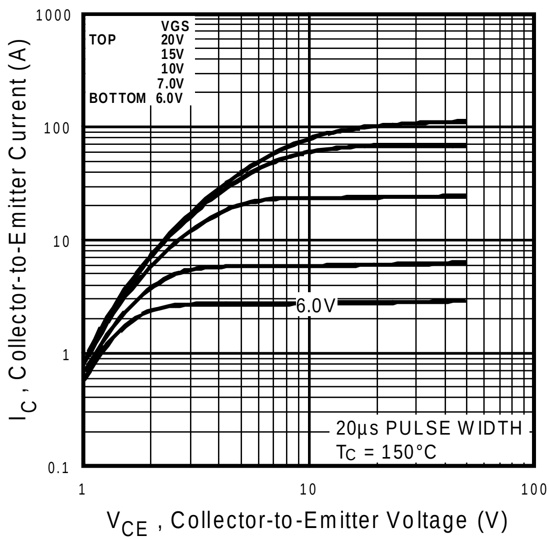


Fig. 3 - Typical Output Characteristics
T_C = 150°C

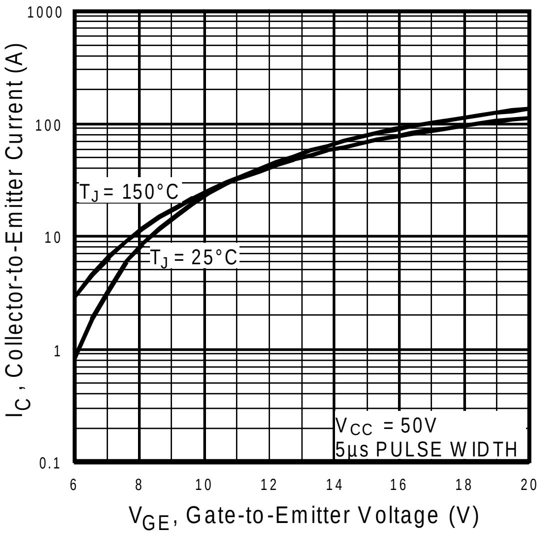


Fig. 4 - Typical Transfer Characteristics

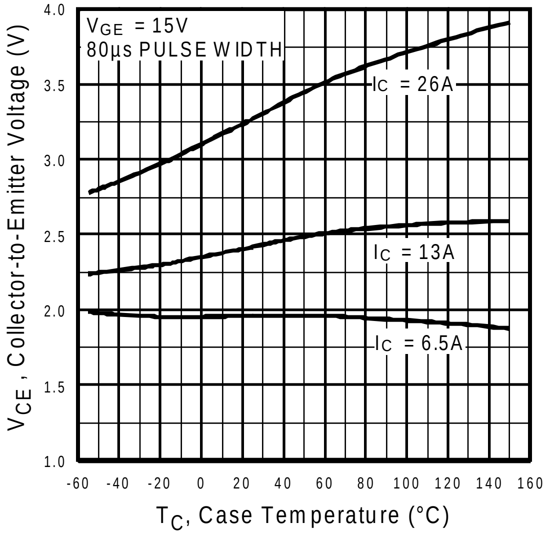


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

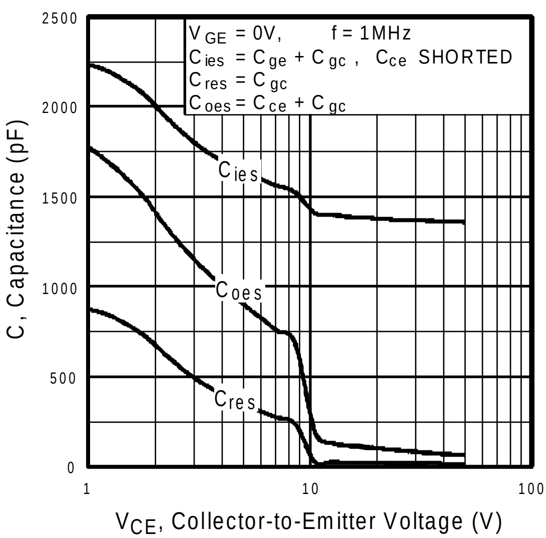


Fig. 6 - Typical Capacitance vs. Collector-to-Emitter Voltage

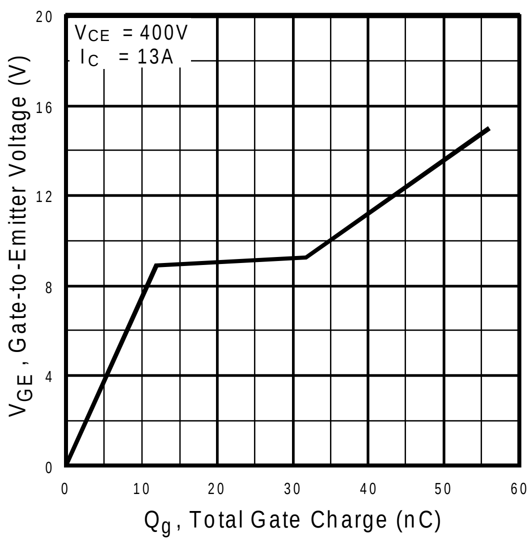


Fig. 7 - Typical Gate Charge vs. Gate-to-Emitter Voltage

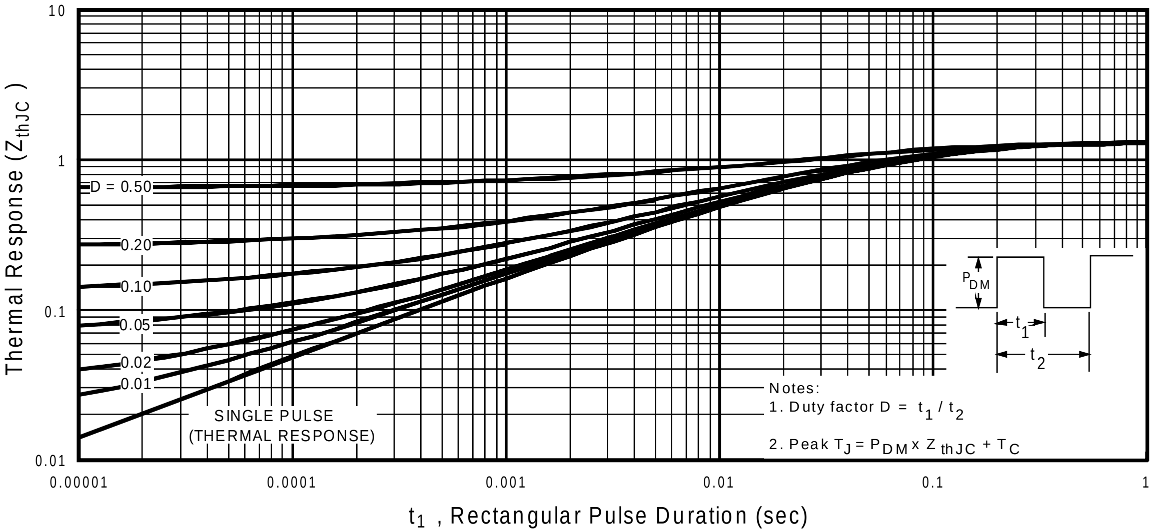


Fig. 8 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

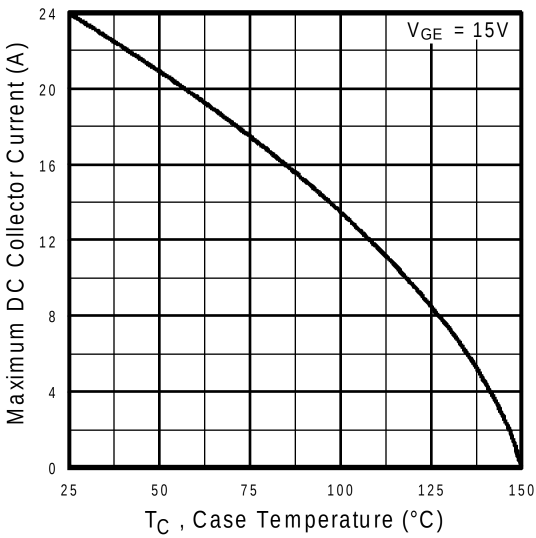


Fig. 9 - Maximum Collector Current vs. Case Temperature

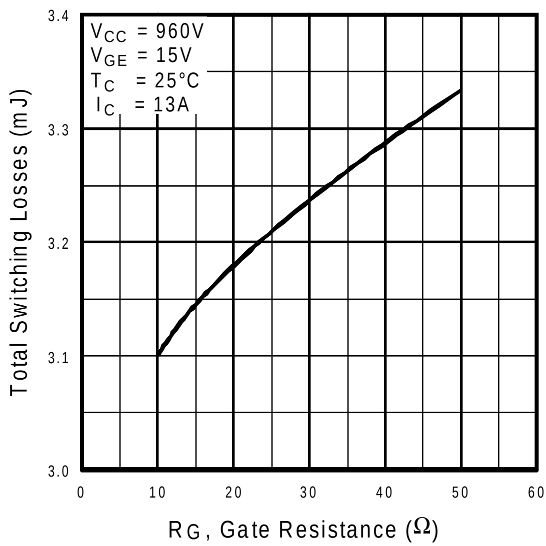


Fig. 10 - Typical Switching Losses vs. Gate Resistance

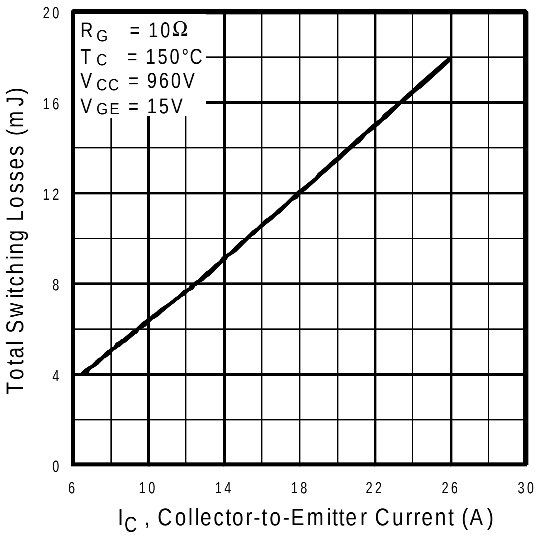


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

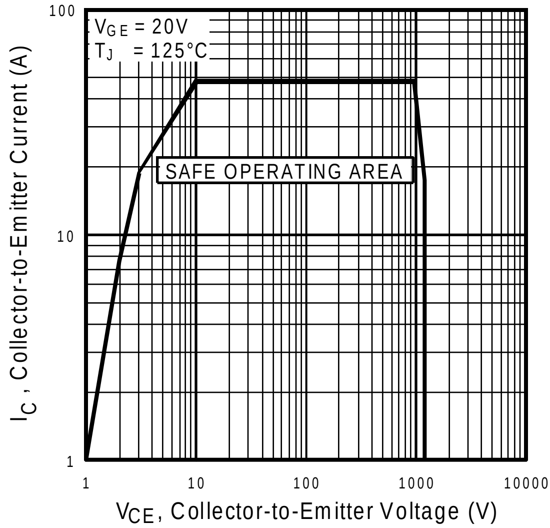


Fig. 12 - Turn-Off SOA

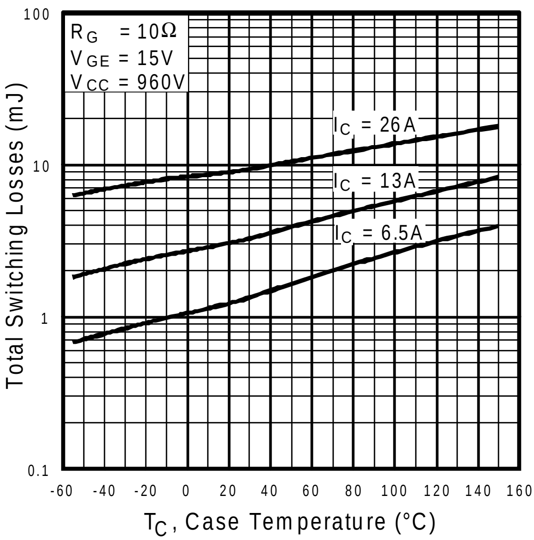
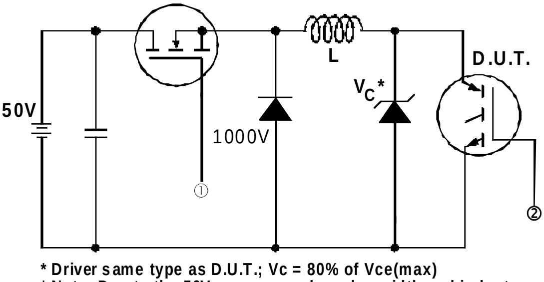


Fig. 13 - Typical Switching Losses vs. Case Temperature



* Driver same type as D.U.T.; Vc = 80% of Vce(max)
* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated Id.

Fig. 13a - Clamped Inductive Load Test Circuit

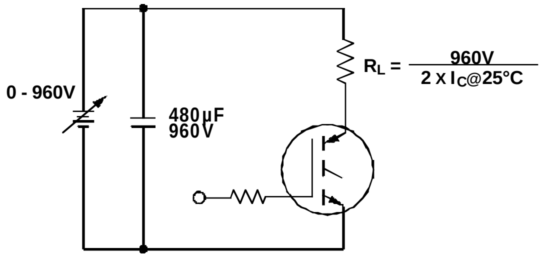


Fig. 13b - Pulsed Collector Current Test Circuit

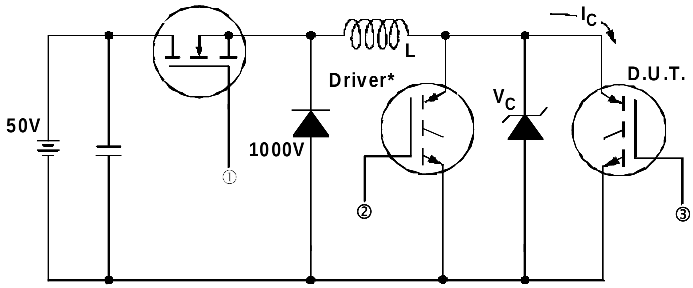
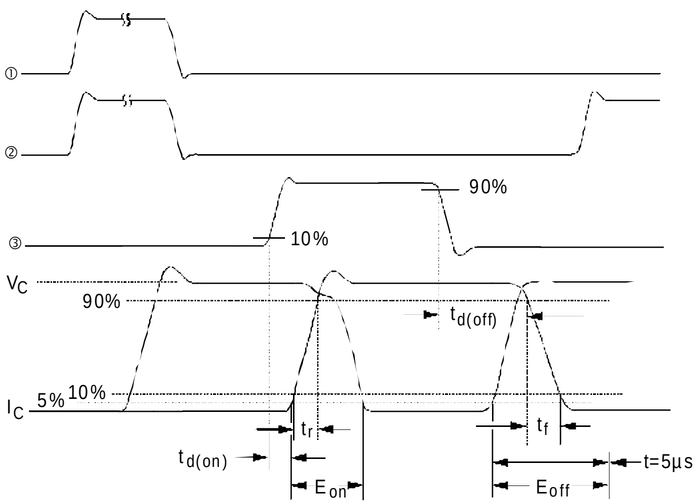


Fig. 14a - Switching Loss Test Circuit

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



$E_{ts} = (E_{on} + E_{off})$

Fig. 14b - Switching Loss Waveforms

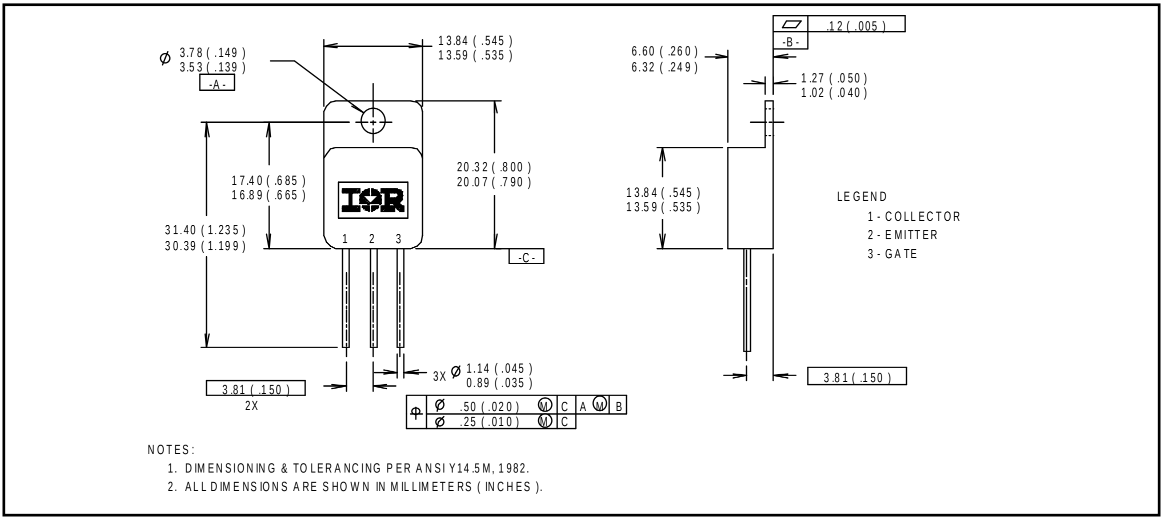


Fig. 15 - Conforms to JEDEC Outline TO-254AA
Dimensions in Millimeters and (Inches)

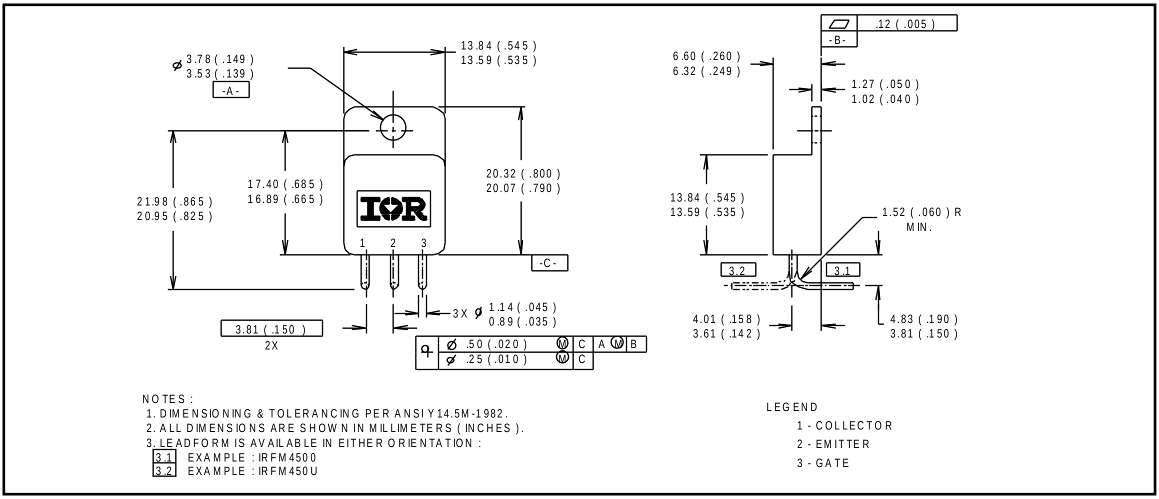


Fig. 16 - Optional Leadforms for TO-254

International
IOR Rectifier

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