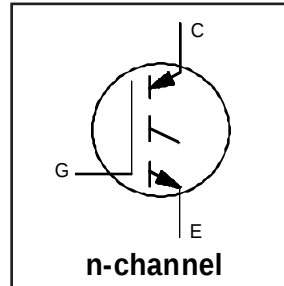


INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated
UltraFast IGBT

Features

- Short circuit rated - $10\mu\text{s}$ @ 125°C , $V_{\text{GE}} = 15\text{V}$
- Switching-loss rating includes all "tail" losses
- Optimized for high operating frequency (over 5kHz) See Fig. 1 for Current vs. Frequency curve

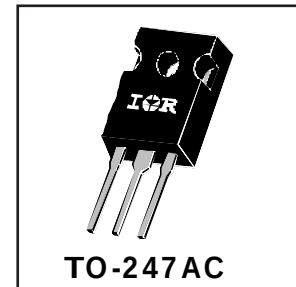


$V_{\text{CES}} = 600\text{V}$
$V_{\text{CE(sat)}} \leq 3.5\text{V}$
@ $V_{\text{GE}} = 15\text{V}$, $I_{\text{C}} = 6.0\text{A}$

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.

These new short circuit rated devices are especially suited for motor control and other applications requiring short circuit withstand capability.



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_{\text{C}} @ T_{\text{C}} = 25^\circ\text{C}$	Continuous Collector Current	10	A
$I_{\text{C}} @ T_{\text{C}} = 100^\circ\text{C}$	Continuous Collector Current	6.0	
I_{CM}	Pulsed Collector Current ①	20	
I_{LM}	Clamped Inductive Load Current ②	20	
t_{sc}	Short Circuit Withstand Time	10	μs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	5.0	mJ
$P_{\text{D}} @ T_{\text{C}} = 25^\circ\text{C}$	Maximum Power Dissipation	60	W
$P_{\text{D}} @ T_{\text{C}} = 100^\circ\text{C}$	Maximum Power Dissipation	24	
T_{J}	Operating Junction and	-55 to +150	$^\circ\text{C}$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting torque, 6-32 or M3 screw.	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta\text{JC}}$	Junction-to-Case	—	—	2.1	$^\circ\text{C/W}$
$R_{\theta\text{CS}}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta\text{JA}}$	Junction-to-Ambient, typical socket mount	—	—	40	
Wt	Weight	—	6 (0.21)	—	g (oz)

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	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage	② 20	—	—	V	$V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.37	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.4	3.5	V	$I_C = 6.0A, V_{GE} = 15V$
		—	3.6	—		$I_C = 10A, V_{GE} = 15V$
		—	2.9	—		$I_C = 6.0A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	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 ⑤	1.9	3.3	—	S	$V_{CE} = 100V, I_C = 6.0A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	1000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
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)	—	17	26	nC	$I_C = 6.0A$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	4.3	6.8		$V_{CC} = 400V$
Q_{gc}	Gate - Collector Charge (turn-on)	—	6.4	11		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	29	—	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	—	18	—		$I_C = 6.0A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	58	90		$V_{GE} = 15V, R_G = 50\Omega$
t_f	Fall Time	—	120	200		Energy losses include "tail"
E_{on}	Turn-On Switching Loss	—	0.11	—	mJ	See Fig. 9, 10, 11, 14
E_{off}	Turn-Off Switching Loss	—	0.13	—		
E_{ts}	Total Switching Loss	—	0.24	0.31		
t_{sc}	Short Circuit Withstand Time	10	—	—	μs	$V_{CC} = 400V, T_J = 125^\circ\text{C}$ $V_{GE} = 15V, R_G = 50\Omega, V_{CPK} < 500V$
$t_{d(on)}$	Turn-On Delay Time	—	28	—	ns	$T_J = 150^\circ\text{C}$
t_r	Rise Time	—	22	—		$I_C = 6.0A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	200	—		$V_{GE} = 15V, R_G = 50\Omega$
t_f	Fall Time	—	145	—		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	0.50	—	mJ	See Fig. 10, 14
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	360	—	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	—	45	—		$V_{CC} = 30V$
C_{res}	Reverse Transfer Capacitance	—	4.7	—		$f = 1.0MHz$

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.

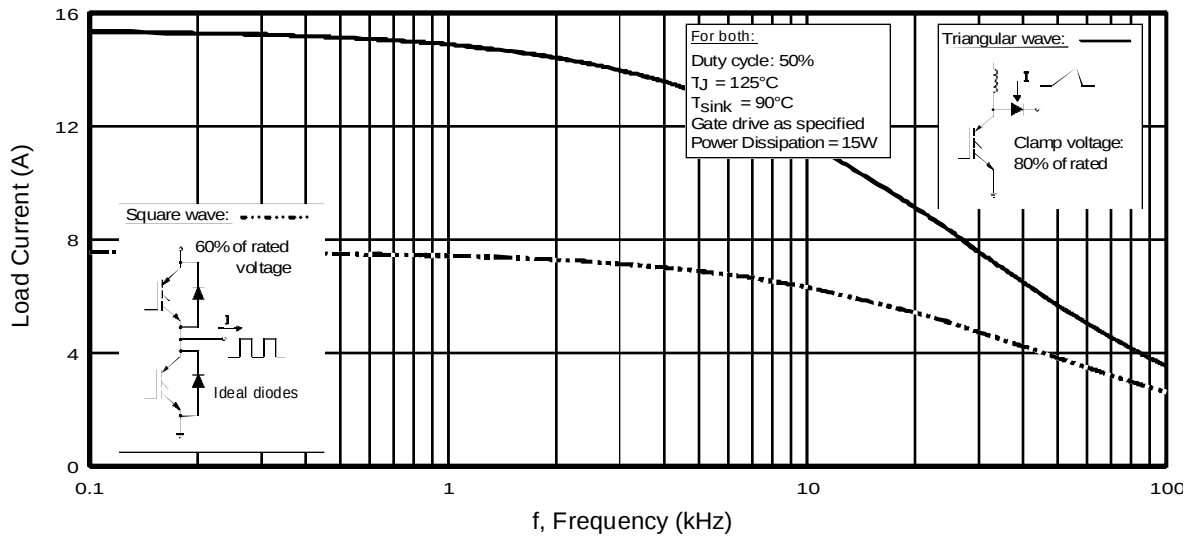


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I = I_{\text{RMS}}$ of fundamental; for triangular wave, $I = I_{\text{PK}}$)

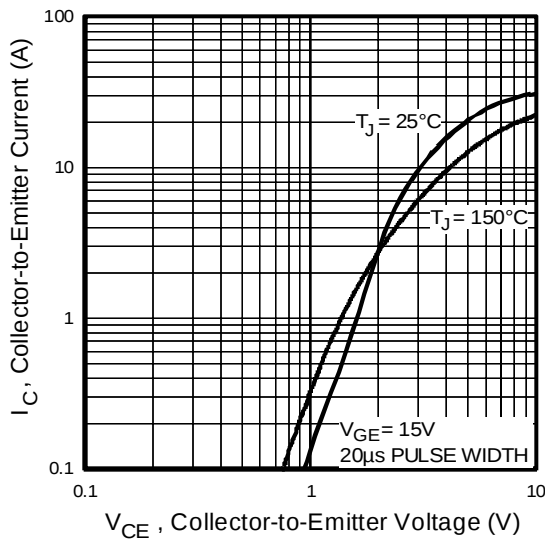


Fig. 2 - Typical Output Characteristics

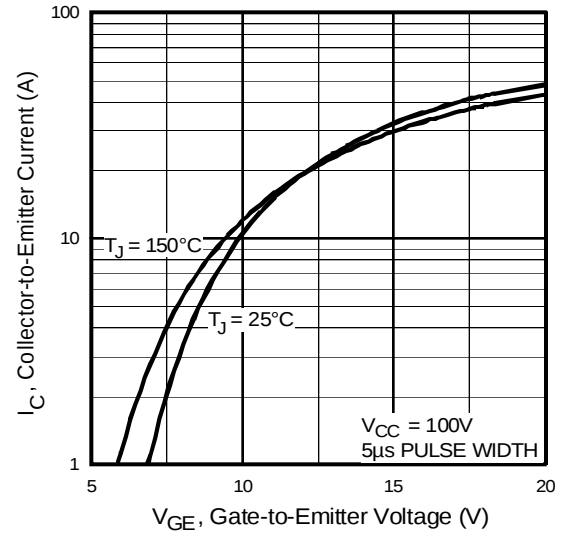


Fig. 3 - Typical Transfer Characteristics

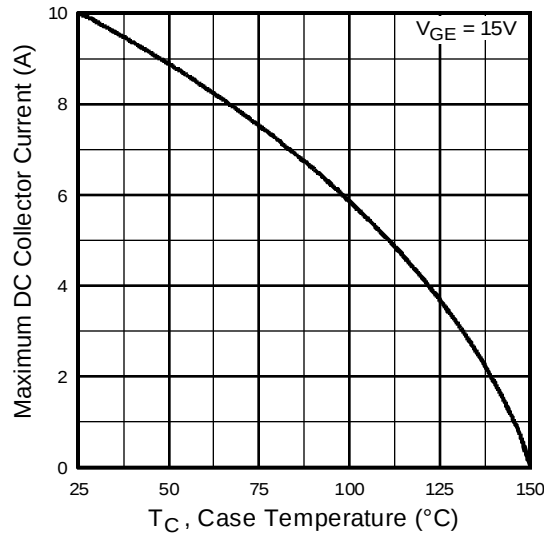


Fig. 4 - Maximum Collector Current vs. Case Temperature

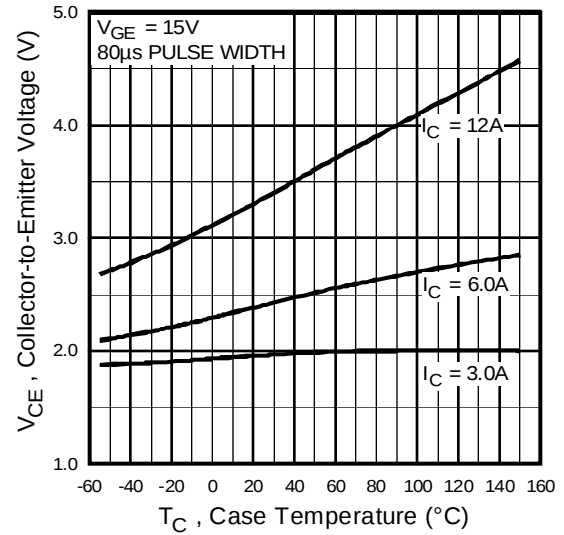


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

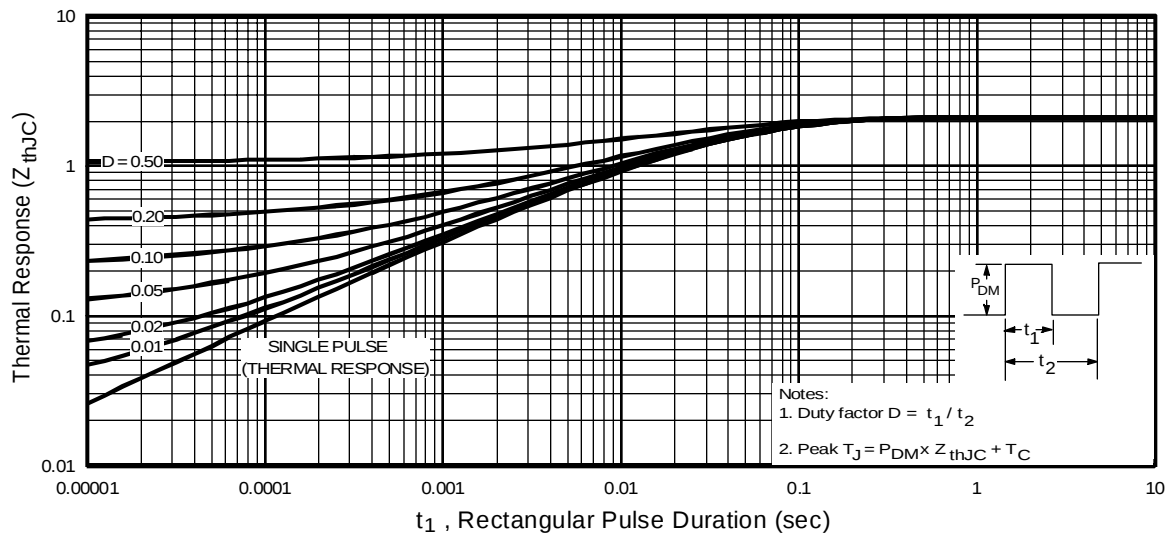
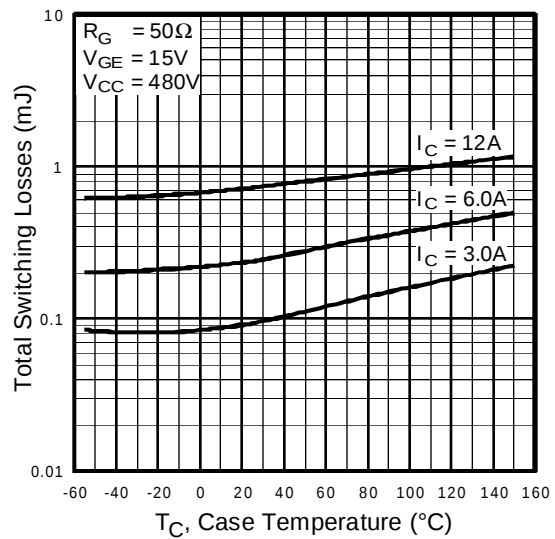
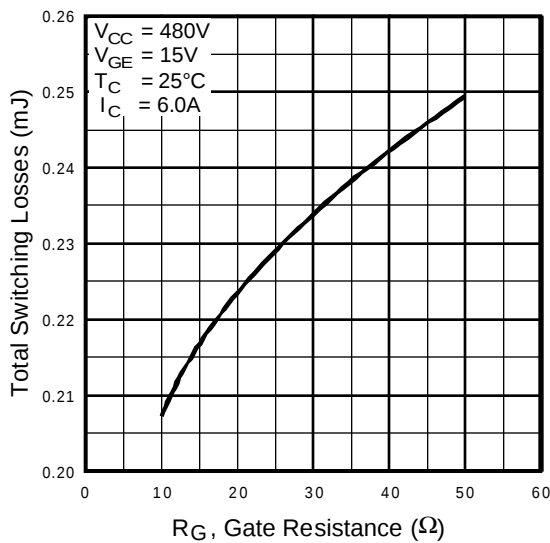
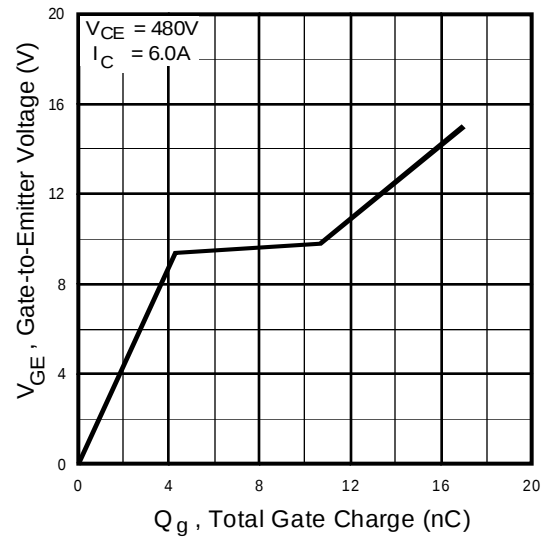
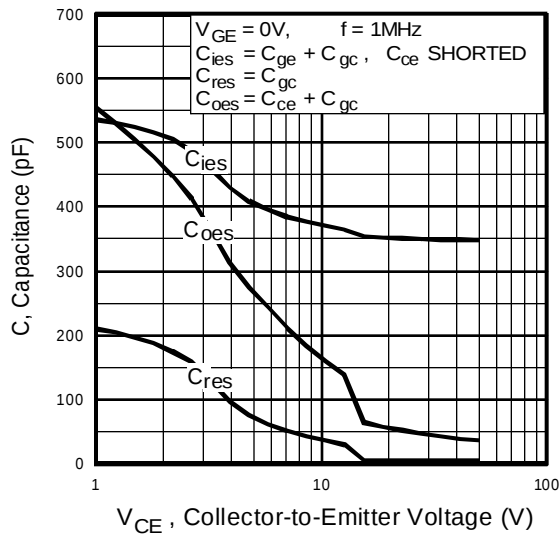


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



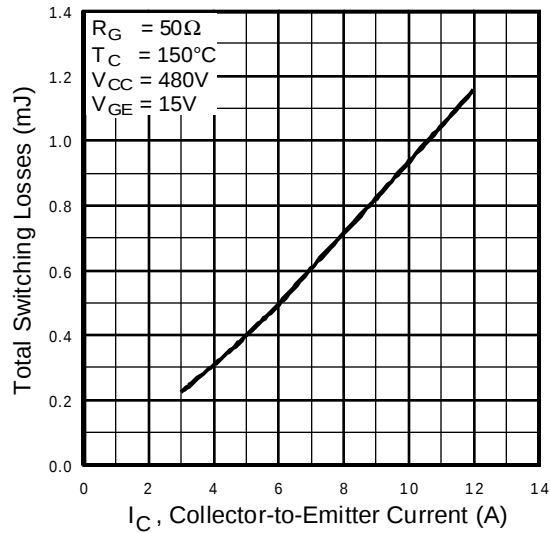


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

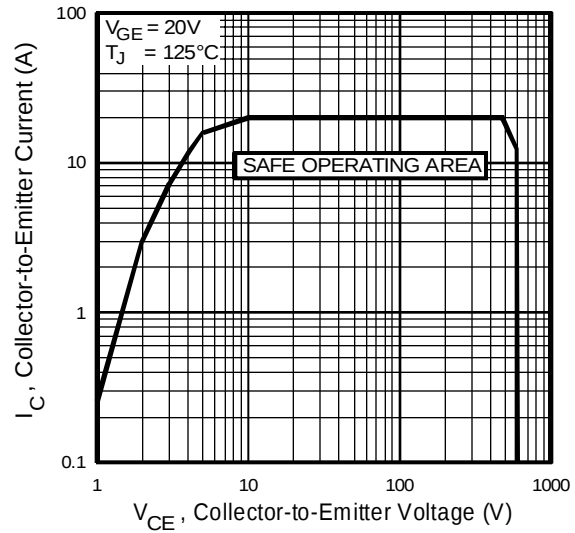
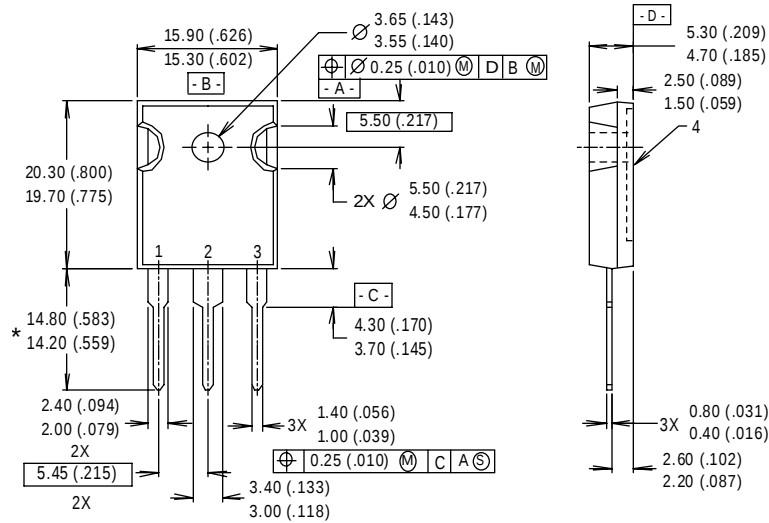


Fig. 12 - Turn-Off SOA



NOTES:

- 1 DIMENSIONS & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH.
- 3 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
- 4 CONFORMS TO JEDEC OUTLINE TO-247AC.

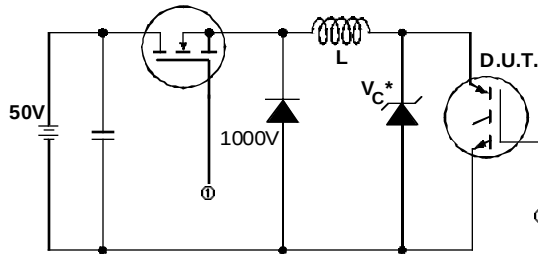
LEAD ASSIGNMENTS

- 1 - GATE
- 2 - COLLECTOR
- 3 - EMITTER
- 4 - COLLECTOR

* LONGER LEADED (20mm) VERSION AVAILABLE (TO-247AD) TO ORDER ADD "-E" SUFFIX TO PART NUMBER

CONFORMS TO JEDEC OUTLINE TO-247AC (TO-3P)

Dimensions in Millimeters and (Inches)



* 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

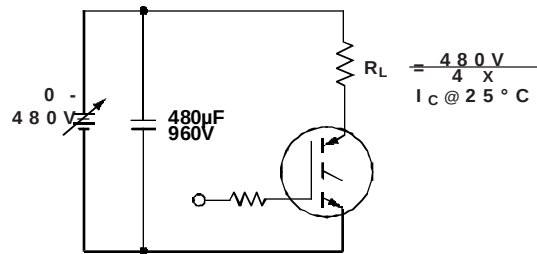


Fig. 13b - Pulsed Collector Current Test Circuit

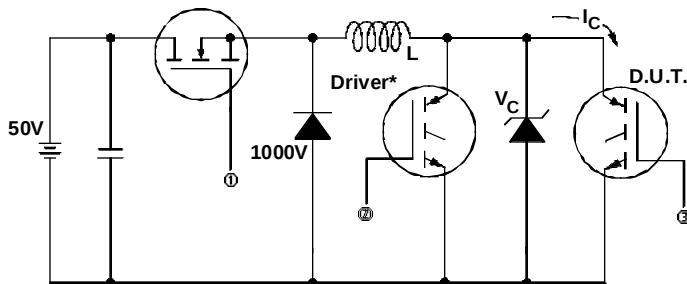


Fig. 14a - Switching Loss Test Circuit

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

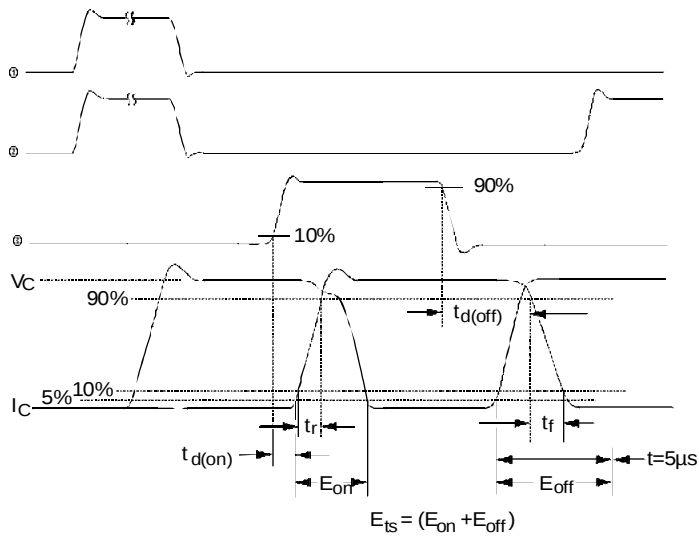


Fig. 14b - Switching Loss Waveforms