

IRG4PSC71KD

INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

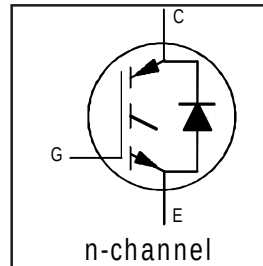
Short Circuit Rated
UltraFast IGBT

Features

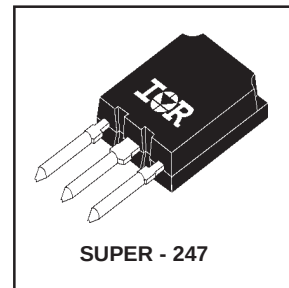
- Hole-less clip/pressure mount package compatible with TO-247 and TO-264, with reinforced pins
- High abort circuit rating IGBTs, optimized for motorcontrol
- Minimum switching losses combined with low conduction losses
- Tightest parameter distribution
- IGBT co-packaged with ultrafast soft recovery antiparallel diode
- Creepage distance increased to 5.35mm

Benefits

- Highest current rating copack IGBT
- Maximum power density, twice the power handling of the TO-247, less space than TO-264
- HEXFRED™ diode optimized for operation with IGBT, to minimize EMI, noise and switching losses



$V_{CES} = 600V$
 $V_{CE(on)} \text{ typ.} = 1.83V$
@ $V_{GE} = 15V, I_C = 60A$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	85 ⑤	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	60	
I_{CM}	Pulsed Collector Current ①	200	
I_{LM}	Clamped Inductive Load Current ②	200	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	50	
I_{FM}	Diode Maximum Forward Current	200	
t_{SC}	Short Circuit Withstand Time	10	μs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	350	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	140	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	

Thermal Resistance Mechanical

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	—	0.36	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	0.69	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	38	
	Recommended Clip Force	20.0(2.0)	—	—	N (kgf)
	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 ^③	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.5	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 10mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.83	2.3	V	$I_C = 60A, V_{GE} = 15V$
		—	2.20	—		$I_C = 100A$
		—	1.81	—		$I_C = 60A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-8.0	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1.5mA$
g_{fe}	Forward Transconductance ^④	31	46	—	S	$V_{CE} = 50V, I_C = 60A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	500	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	13	mA	$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	—	1.4	1.7	V	$I_C = 60A$
		—	1.3	—		$I_C = 60A, T_J = 150^\circ\text{C}$
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)	—	340	510	nC	$I_C = 60A$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	44	66		$V_{CC} = 400V$
Q_{gc}	Gate - Collector Charge (turn-on)	—	160	240		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	82	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 60A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 5.0\Omega$
t_r	Rise Time	—	107	—		
$t_{d(off)}$	Turn-Off Delay Time	—	282	423		
t_f	Fall Time	—	97	146	mJ	Energy losses include "tail" and diode reverse recovery See Fig. 9,10,18
E_{on}	Turn-On Switching Loss	—	3.95	—		
E_{off}	Turn-Off Switching Loss	—	2.33	—		
E_{ts}	Total Switching Loss	—	6.28	7.7	μs	$V_{CC} = 360V, T_J = 125^\circ\text{C}$ $V_{GE} = 15V, R_G = 5.0\Omega, V_{CPK} < 500V$
t_{sc}	Short Circuit Withstand Time	10	—	—		
$t_{d(on)}$	Turn-On Delay Time	—	87	—	ns	$T_J = 150^\circ\text{C}$, See Fig. 11,18 $I_C = 60A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 5.0\Omega$
t_r	Rise Time	—	104	—		
$t_{d(off)}$	Turn-Off Delay Time	—	374	—		
t_f	Fall Time	—	143	—	mJ	Energy losses include "tail" and diode reverse recovery
E_{ts}	Total Switching Loss	—	8.5	—		
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	6900	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ See Fig. 7 $f = 1.0MHz$
C_{oes}	Output Capacitance	—	730	—		
C_{res}	Reverse Transfer Capacitance	—	190	—		
t_{rr}	Diode Reverse Recovery Time	—	82	120	ns	$T_J = 25^\circ\text{C}$ See Fig. 14
		—	140	210		$T_J = 125^\circ\text{C}$
I_{rr}	Diode Peak Reverse Recovery Current	—	8.2	12	A	$T_J = 25^\circ\text{C}$ See Fig. 15
		—	13	20		$T_J = 125^\circ\text{C}$
Q_{rr}	Diode Reverse Recovery Charge	—	364	546	nC	$T_J = 25^\circ\text{C}$ See Fig. 16
		—	1084	1625		$T_J = 125^\circ\text{C}$
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	328	—	A/ μs	$T_J = 25^\circ\text{C}$ See Fig. 17
		—	266	—		$T_J = 125^\circ\text{C}$

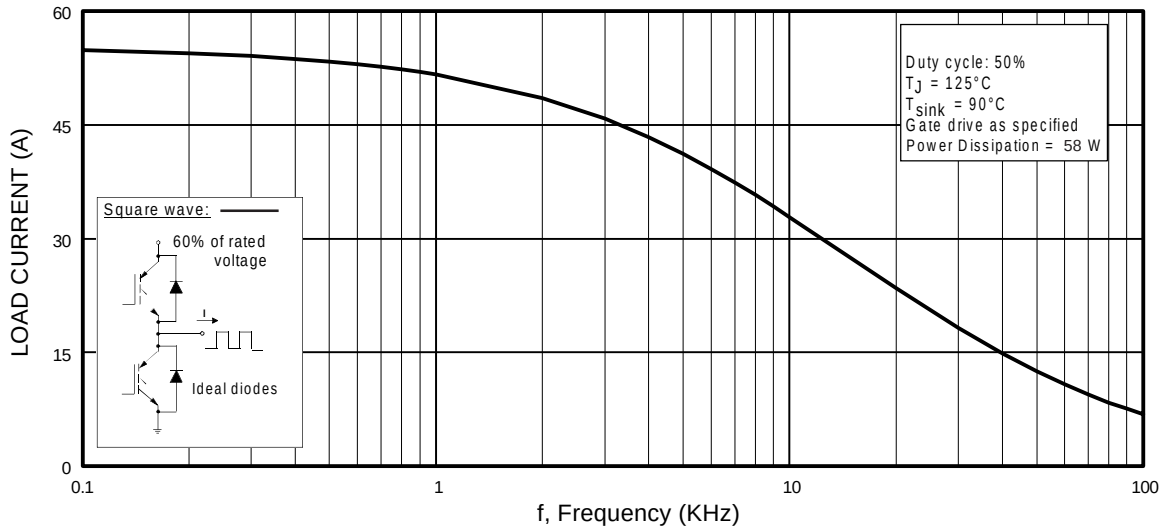


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

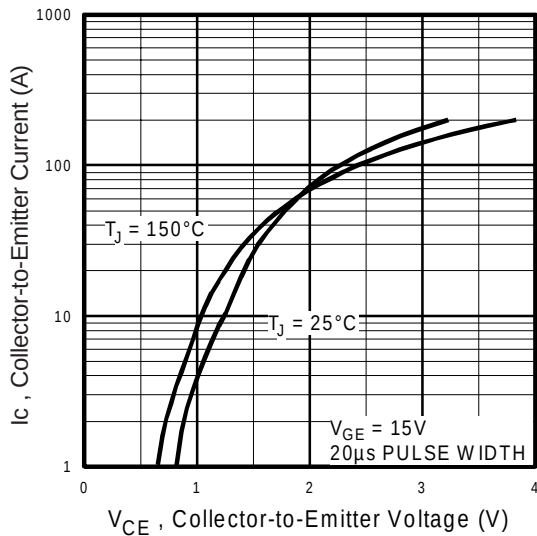


Fig. 2 - Typical Output Characteristics

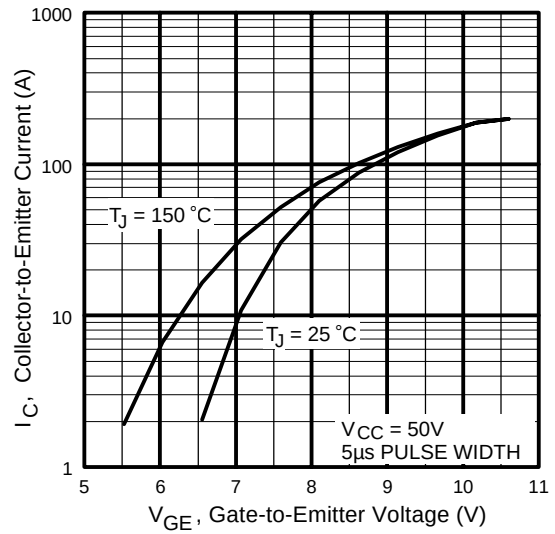


Fig. 3 - Typical Transfer Characteristics

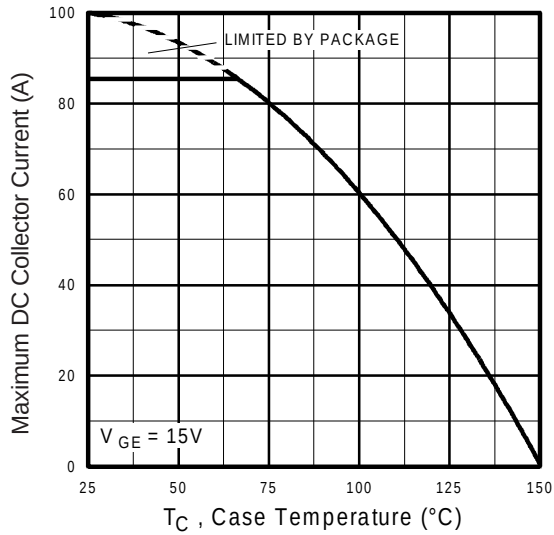


Fig. 4 - Maximum Collector Current vs. Case Temperature

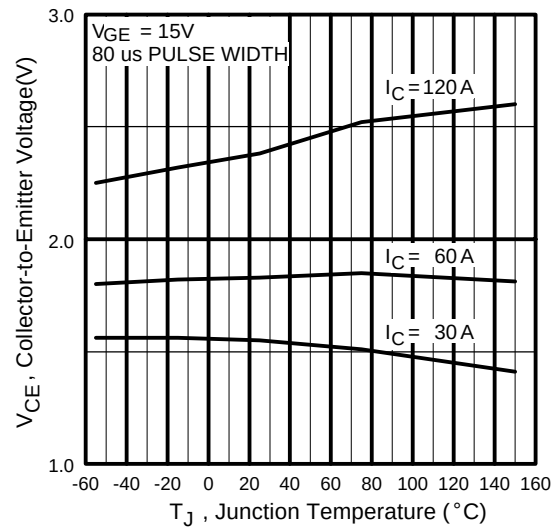


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

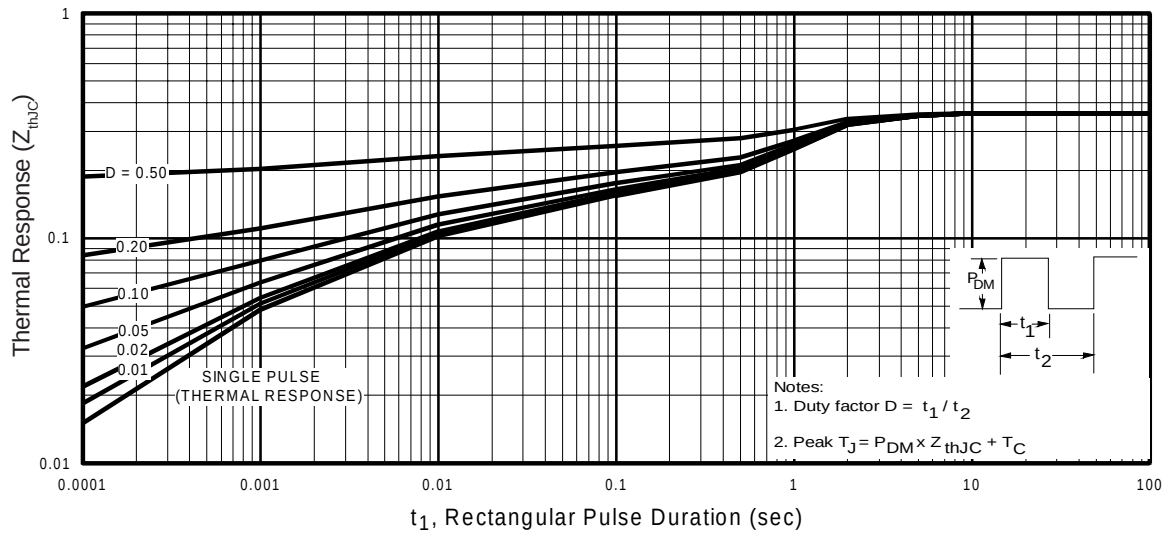


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

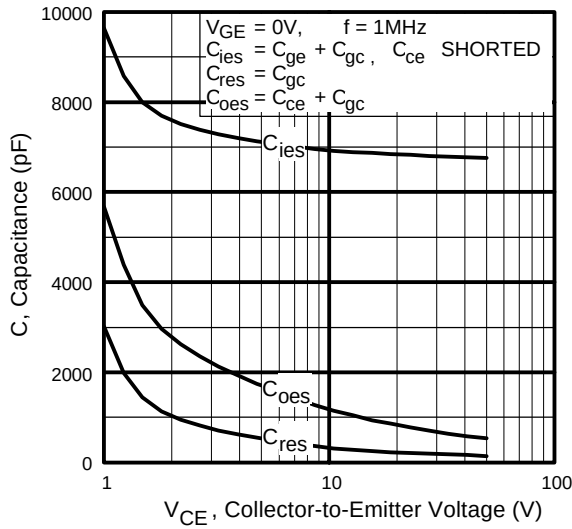


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

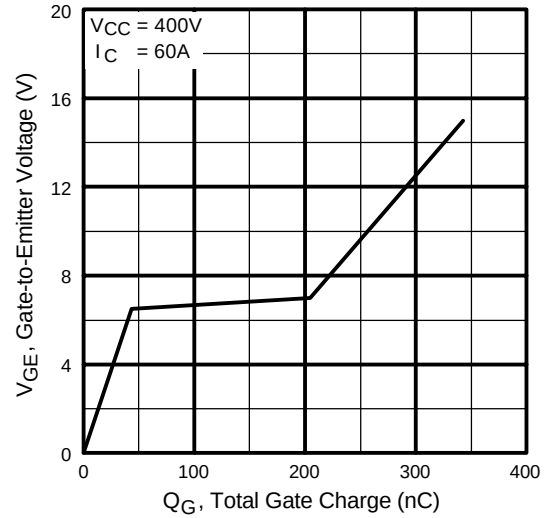


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

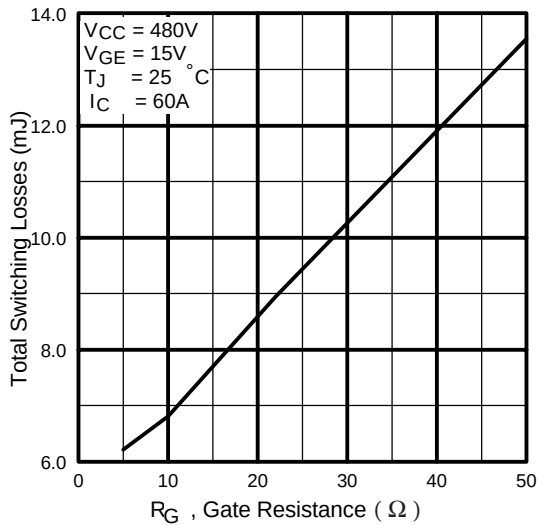


Fig. 9 - Typical Switching Losses vs. Gate Resistance

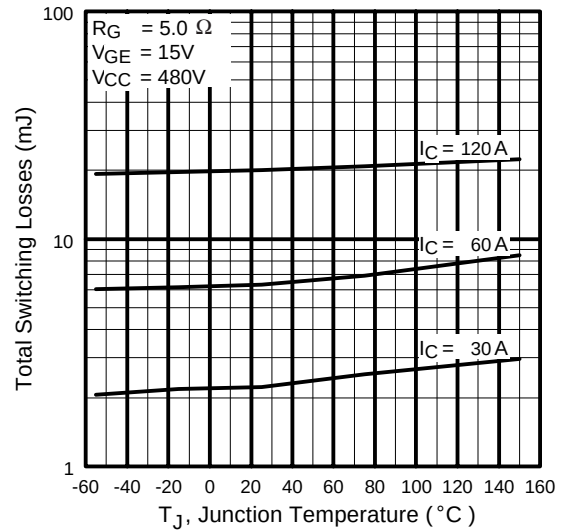


Fig. 10 - Typical Switching Losses vs. Junction Temperature

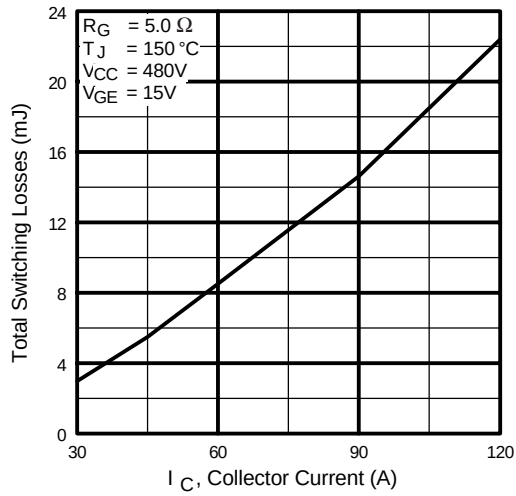


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

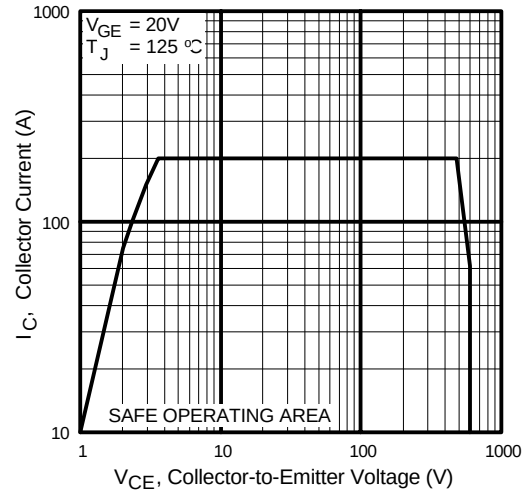


Fig. 12 - Turn-Off SOA

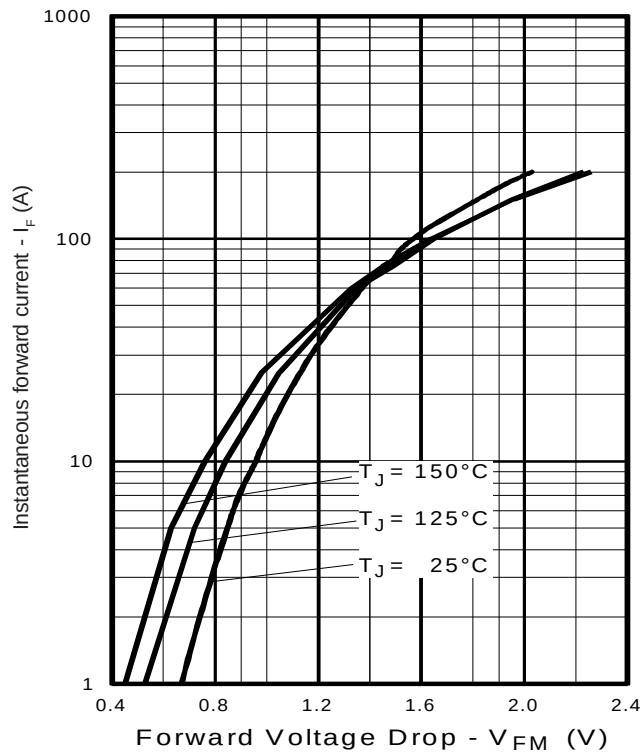


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

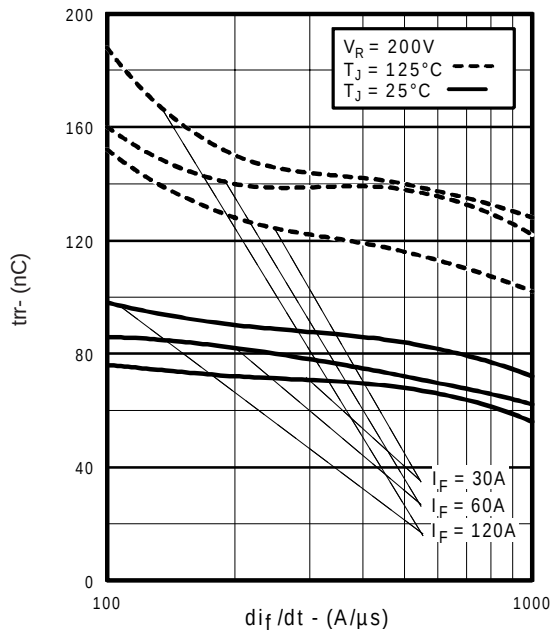


Fig. 14 - Typical Reverse Recovery vs. di/dt

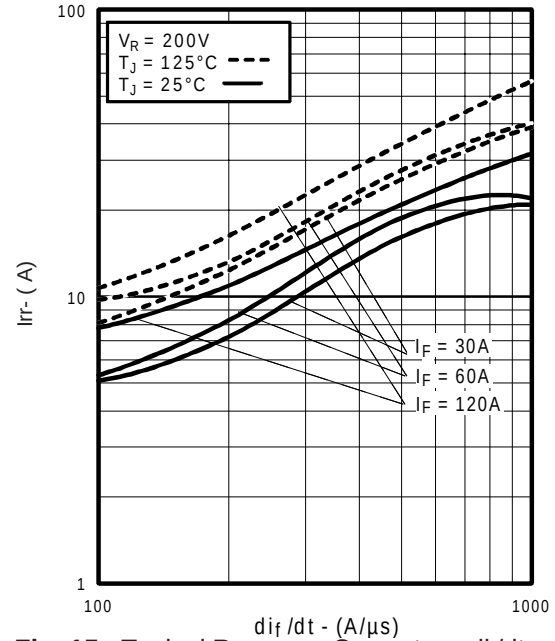


Fig. 15 - Typical Recovery Current vs. di/dt

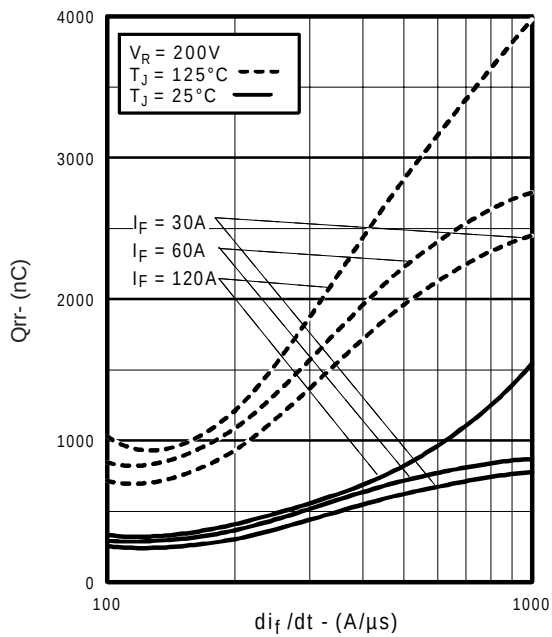


Fig. 16 - Typical Stored Charge vs. di/dt
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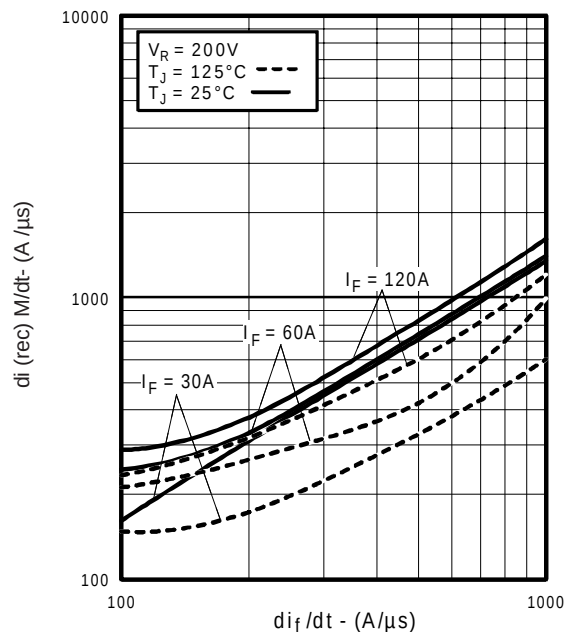


Fig. 17 - Typical $di_{(rec)}M/dt$ vs. di/dt

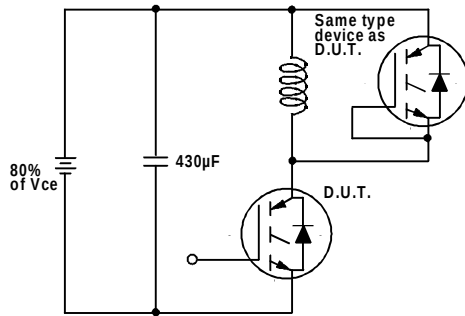


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

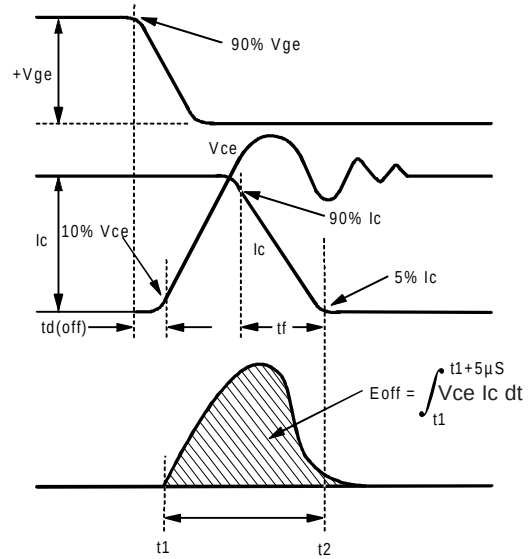


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

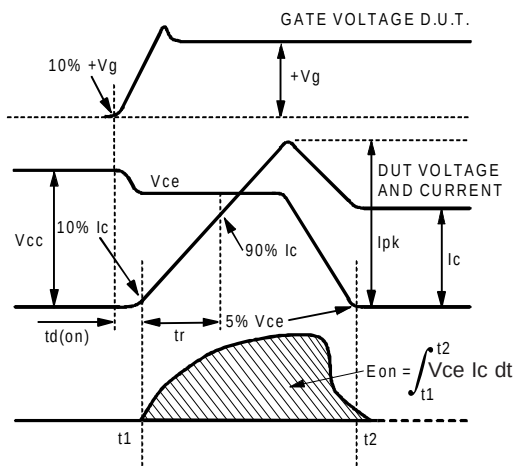


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

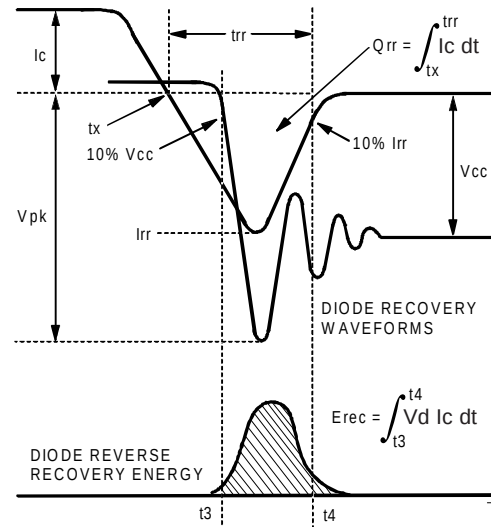


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

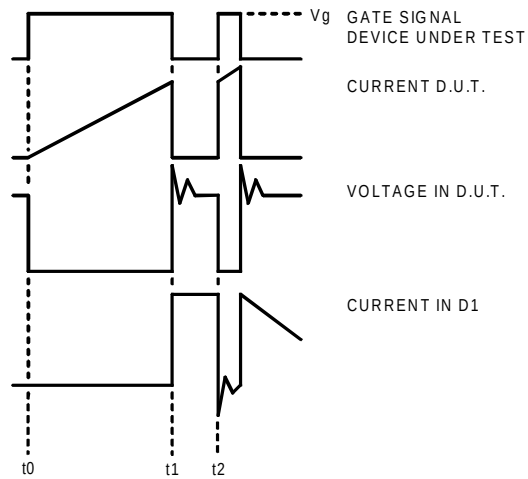


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

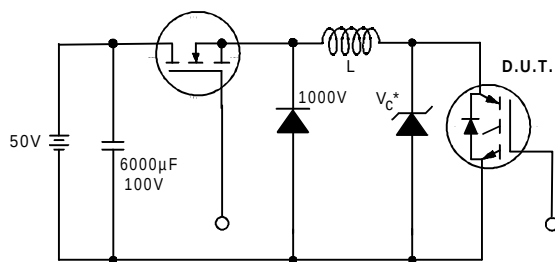


Figure 19. Clamped Inductive Load Test Circuit

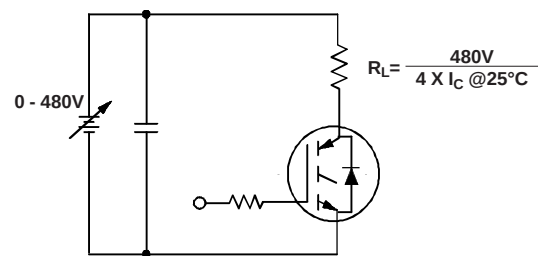


Figure 20. Pulsed Collector Current Test Circuit

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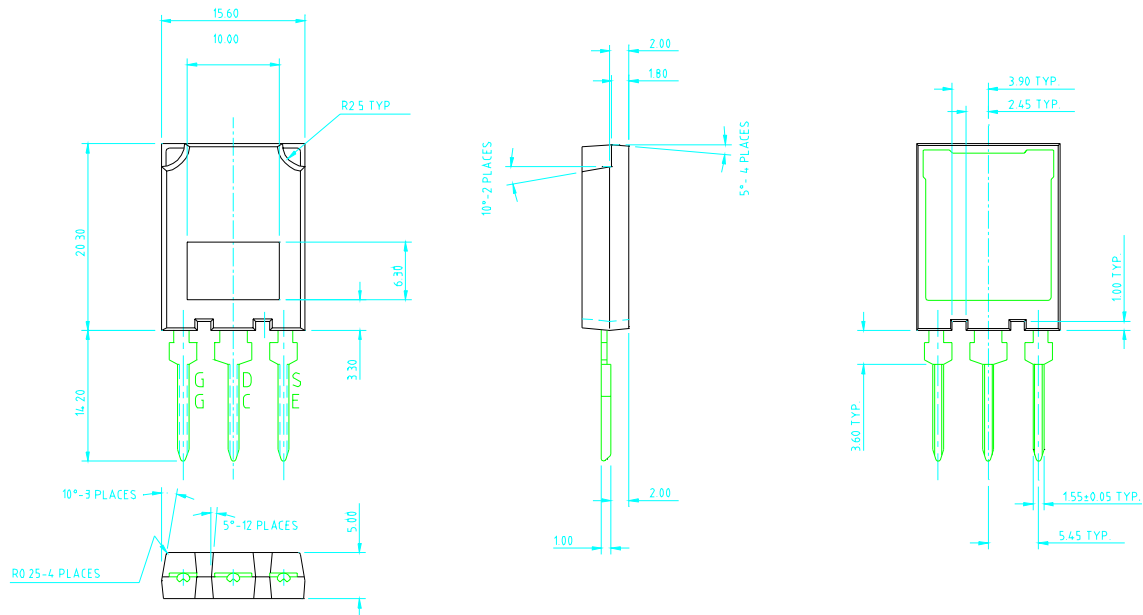
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Notes:

- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature (figure 20)
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G=5.0\Omega$ (figure 19)
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$
- ④ Pulse width $5.0\mu s$, single shot
- ⑤ Current limited by the package, (Die current = 100A)

Case Outline and Dimensions — Super-247

Dimensions are shown in millimeters



International
IR Rectifier

WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, Tel: (310) 322 3331

IR GREAT BRITAIN: Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020

IR CANADA: 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200

IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590

IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111

IR FAR EAST: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo Japan 171 Tel: 81 3 3983 0086

IR SOUTHEAST ASIA: 1 Kim Seng Promenade, Great World City West Tower, 13-11, Singapore 237994 Tel: ++ 65 838 4630

IR TAIWAN: 16 Fl. Suite D. 207, Sec. 2, Tun Haw South Road, Taipei, 10673, Taiwan Tel: 886-2-2377-9936

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