

# International **IR** Rectifier

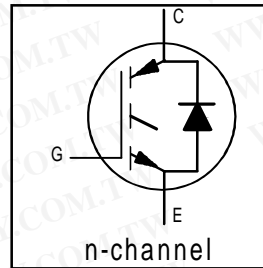
PD - 91682A

## IRG4PSC71UD

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE UltraFast CoPack IGBT

### Features

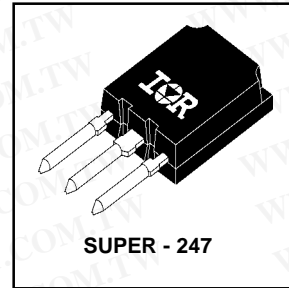
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency (minimum switching and conduction losses) than prior generations
- IGBT co-packaged with HEXFRED ultrafast, ultrasoft recovery anti-parallel diodes for use in bridge configurations
- Industry-benchmark Super-247 package with higher power handling capability compared to same footprint TO-247
- Creepage distance increased to 5.35mm



$V_{CES} = 600V$   
 $V_{CE(on) typ.} = 1.67V$   
 @ $V_{GE} = 15V, I_C = 60A$

### Benefits

- Generation 4 IGBT's offer highest efficiencies available
- Maximum power density, twice the power handling of TO-247, less space than TO-264
- IGBTs optimized for specific application conditions
- HEXFRED diodes optimized for performance with IGBTs
- Cost and space saving in designs that require multiple, paralleled IGBTs



### 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 <sup>⑤</sup>	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	60	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	200	
$I_{LM}$	Clamped Inductive Load Current <sup>②</sup>	200	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	60	
$I_{FM}$	Diode Maximum Forward Current	350	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	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)

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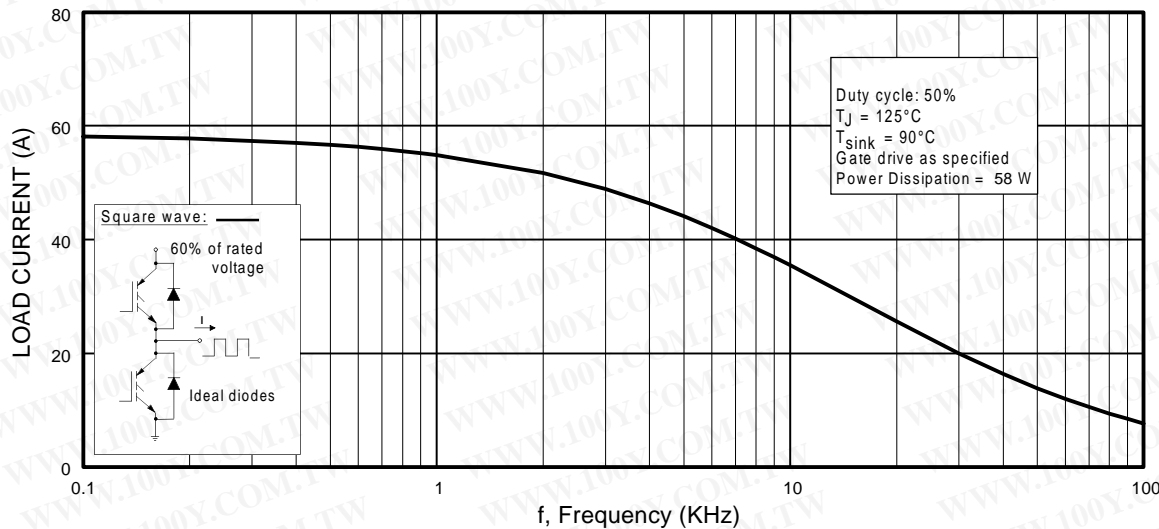
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### Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

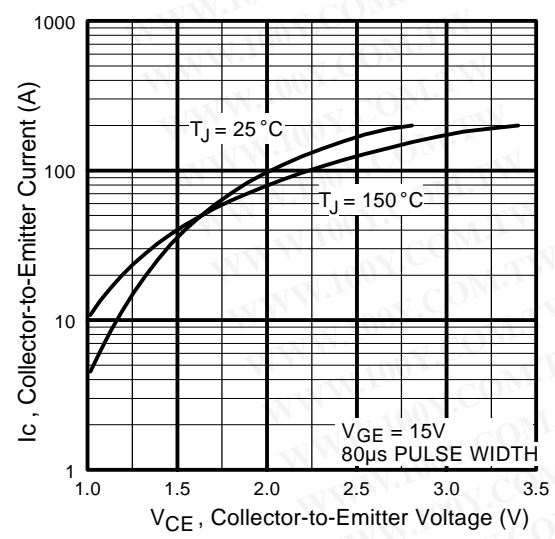
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage <sup>③</sup>	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.39	—	V/°C	$V_{GE} = 0V, I_C = 10mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.67	2.0	V	$I_C = 60A, V_{GE} = 15V$
		—	1.95	—		$I_C = 100A$
		—	1.71	—		$I_C = 60A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	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	—	-13	—	mV/°C	$V_{CE} = V_{GE}, I_C = 1.5mA$
$g_{fe}$	Forward Transconductance <sup>④</sup>	47	70	—	S	$V_{CE} = 50V, I_C = 60A$
$I_{CES}$	Zero Gate Voltage Collector Current	—	—	500	$\mu A$	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	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	—	—	$\pm 100$	nA	$V_{GE} = \pm 20V$

### Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

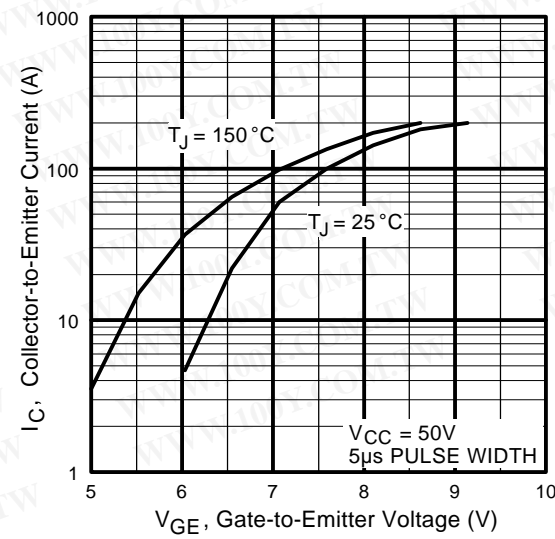
	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	340	520	nC	$I_C = 60A$
$Q_{ge}$	Gate - Emitter Charge (turn-on)	—	44	66		$V_{CC} = 400V$
$Q_{gc}$	Gate - Collector Charge (turn-on)	—	160	240		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	90	—	ns	$T_J = 25^\circ\text{C}$
$t_r$	Rise Time	—	94	—		$I_C = 60A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	245	368		$V_{GE} = 15V, R_G = 5.0\Omega$
$t_f$	Fall Time	—	110	167		Energy losses include "tail" and diode reverse recovery.
$E_{on}$	Turn-On Switching Loss	—	3.26	—	mJ	See Fig. 9, 10, 11, 18
$E_{off}$	Turn-Off Switching Loss	—	2.27	—		
$E_{ts}$	Total Switching Loss	—	5.53	7.2		
$t_{d(on)}$	Turn-On Delay Time	—	91	—	ns	$T_J = 150^\circ\text{C}$ , See Fig. 9, 10, 11, 18
$t_r$	Rise Time	—	88	—		$I_C = 60A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	353	—		$V_{GE} = 15V, R_G = 5.0\Omega$
$t_f$	Fall Time	—	150	—		Energy losses include "tail" and diode reverse recovery.
$E_{ts}$	Total Switching Loss	—	7.1	—	mJ	
$L_E$	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
$C_{ies}$	Input Capacitance	—	7500	—	pF	$V_{GE} = 0V$
$C_{oes}$	Output Capacitance	—	720	—		$V_{CC} = 30V$
$C_{res}$	Reverse Transfer Capacitance	—	93	—		$f = 1.0MHz$
$t_{rr}$	Diode Reverse Recovery Time	—	82	120	ns	$T_J = 25^\circ\text{C}$ See Fig.
		—	140	210		$T_J = 125^\circ\text{C}$ 14
$I_{rr}$	Diode Peak Reverse Recovery Current	—	8.2	12	A	$T_J = 25^\circ\text{C}$ See Fig.
		—	13	20		$T_J = 125^\circ\text{C}$ 15
$Q_{rr}$	Diode Reverse Recovery Charge	—	364	546	nC	$T_J = 25^\circ\text{C}$ See Fig.
		—	1084	1625		$T_J = 125^\circ\text{C}$ 16
$di_{(rec)M}/dt$ During $t_b$	Diode Peak Rate of Fall of Recovery	—	328	—	A/ $\mu s$	$T_J = 25^\circ\text{C}$ See Fig.
		—	266	—		$T_J = 125^\circ\text{C}$ 17



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



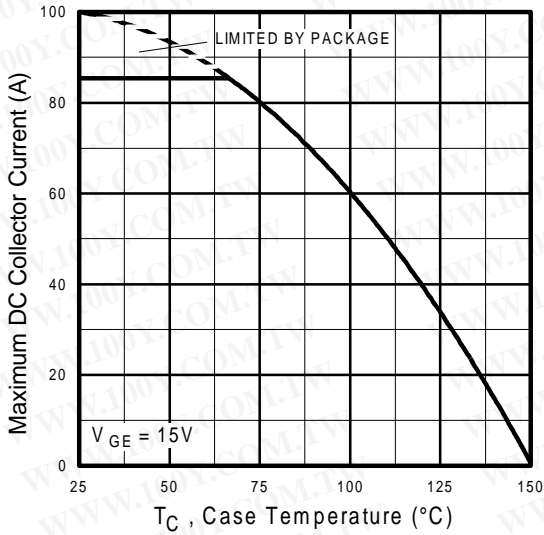
**Fig. 2 - Typical Output Characteristics**  
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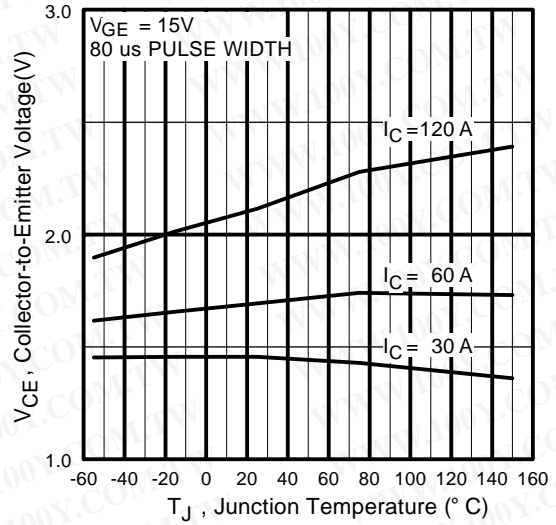
**Fig. 3 - Typical Transfer Characteristics**

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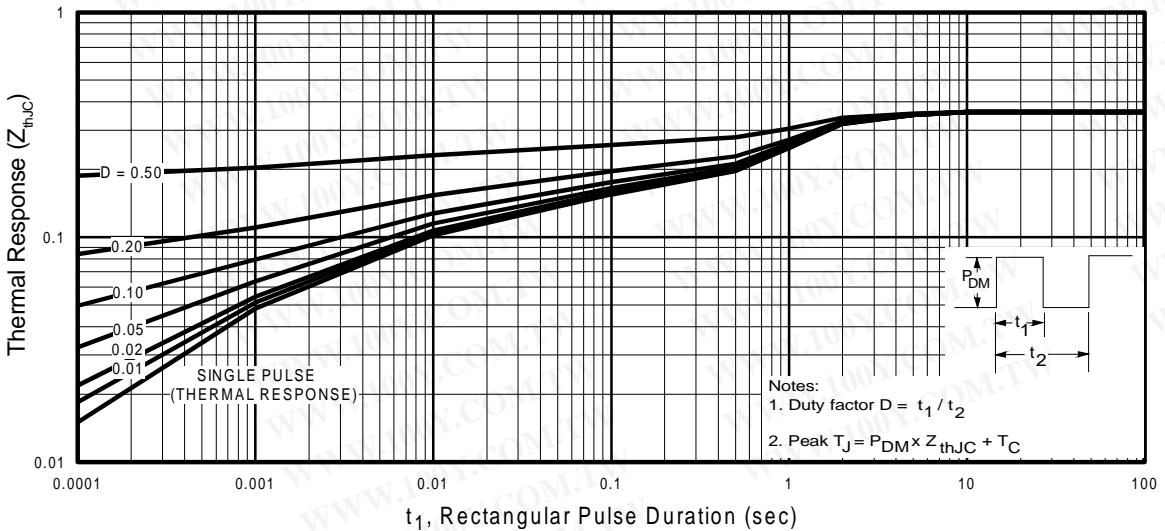
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**Fig. 4** - Maximum Collector Current vs. Case Temperature



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

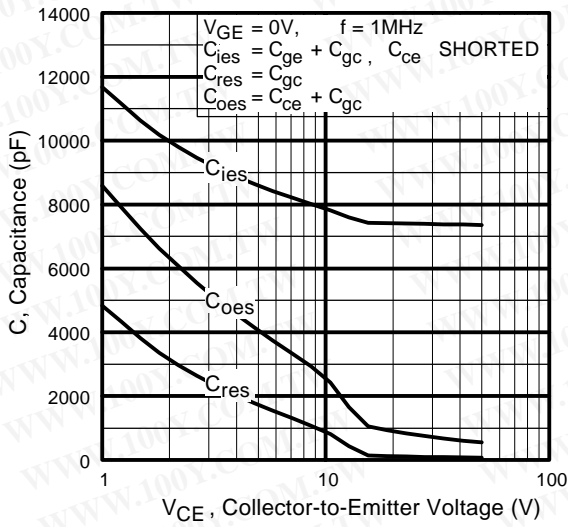


**Fig. 6** - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

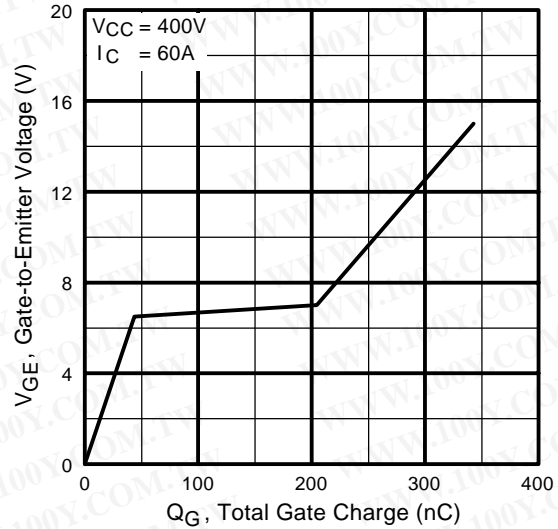


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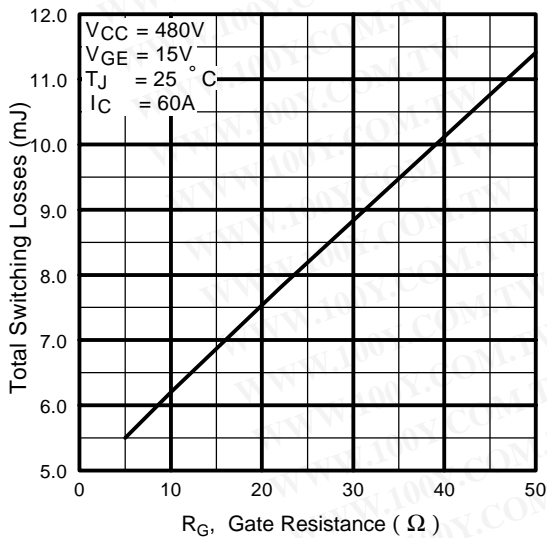
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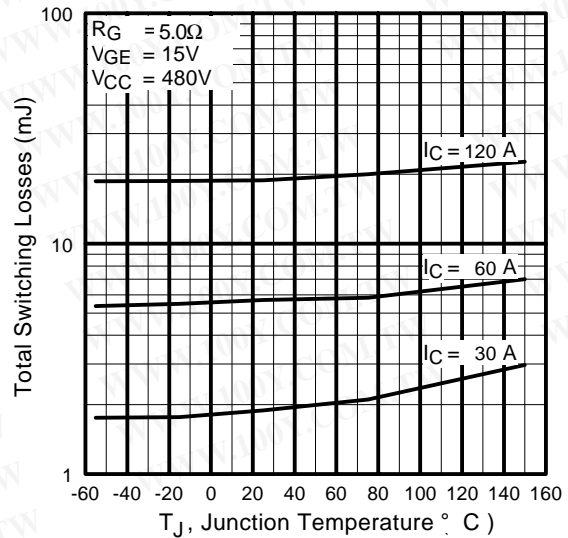
**Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage**



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



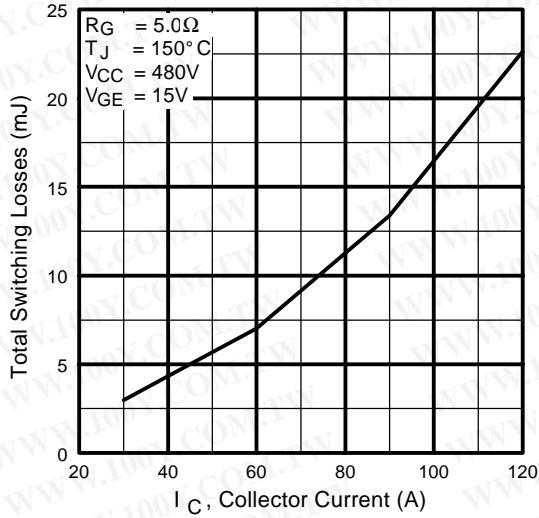
**Fig. 9 - Typical Switching Losses vs. Gate Resistance**



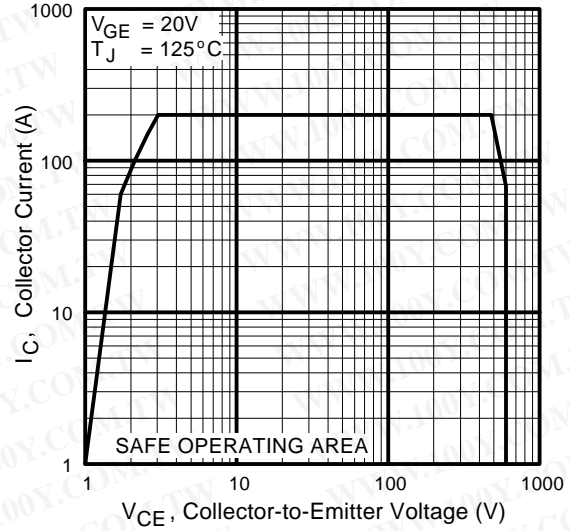
**Fig. 10 - Typical Switching Losses vs. Junction Temperature**

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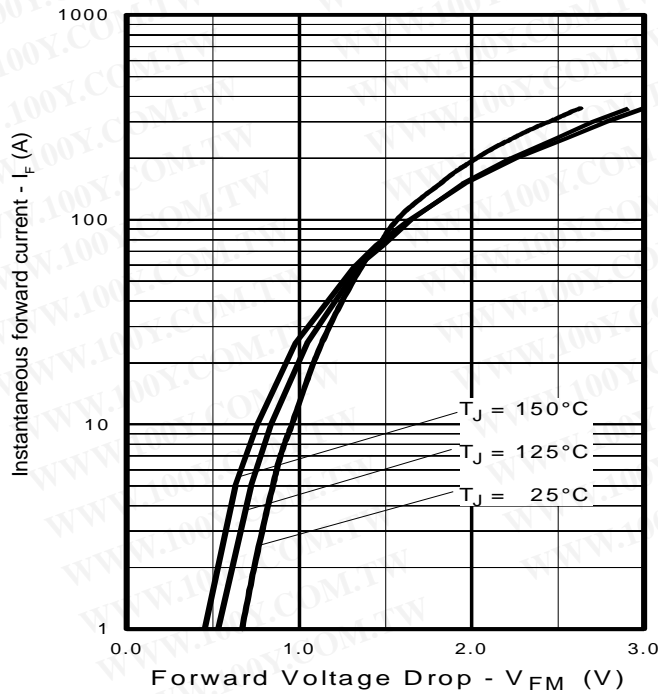
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**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



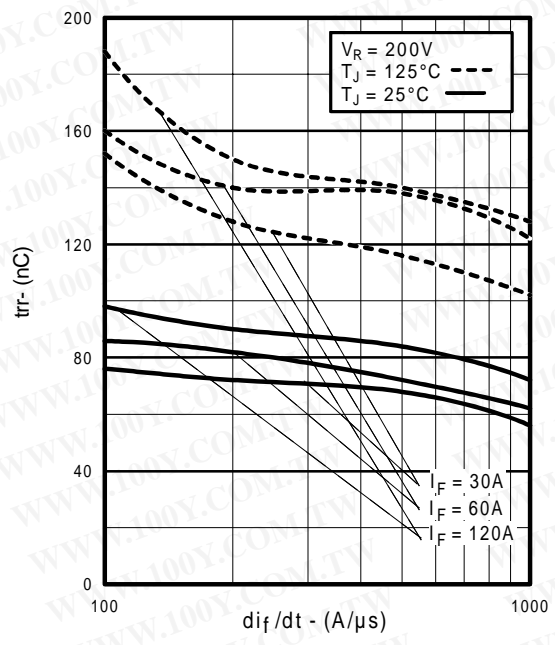
**Fig. 12** - Turn-Off SOA



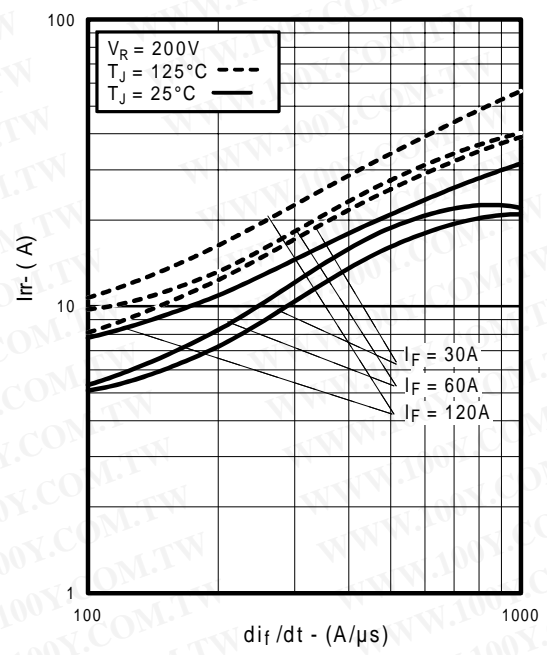
**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

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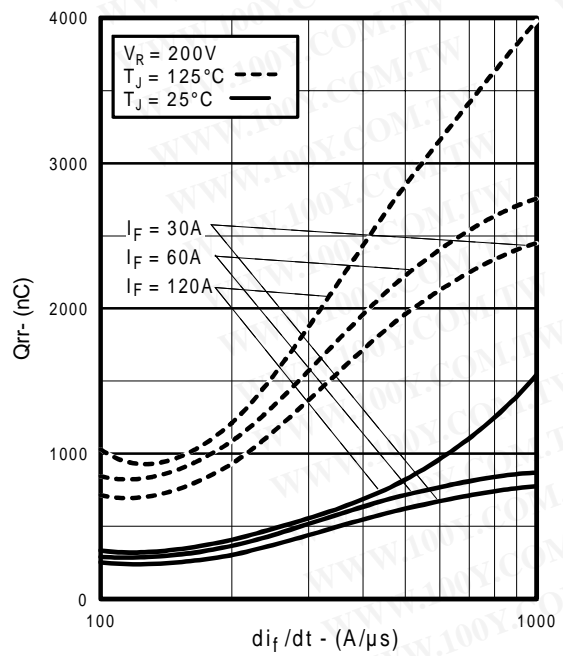
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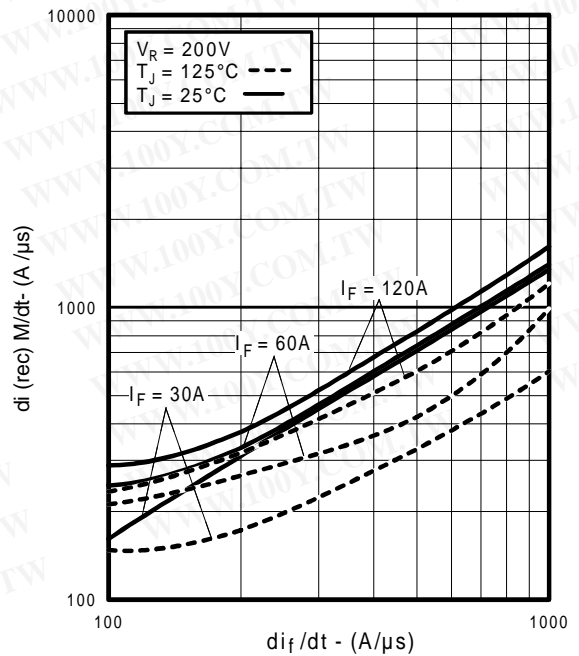
**Fig. 14** - Typical Reverse Recovery vs.  $di_f/dt$



**Fig. 15** - Typical Recovery Current vs.  $di_f/dt$



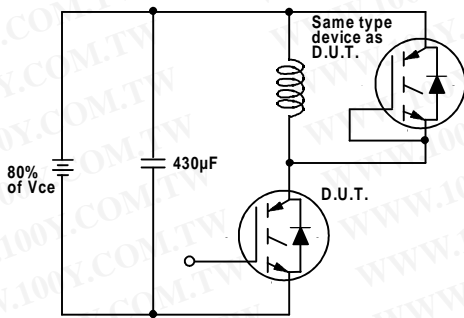
**Fig. 16** - Typical Stored Charge vs.  $di_f/dt$   
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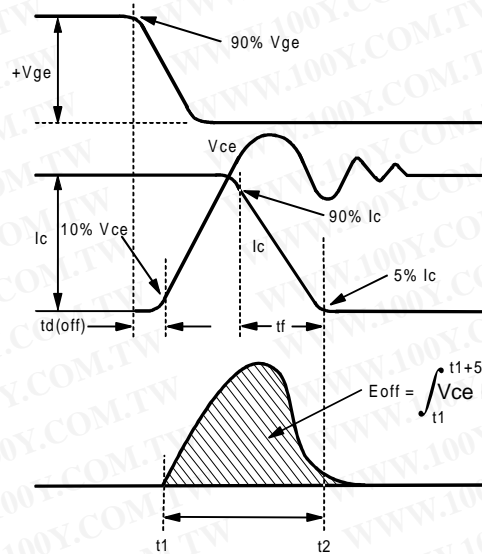
**Fig. 17** - Typical  $di_{(rec)M}/dt$  vs.  $di_f/dt$

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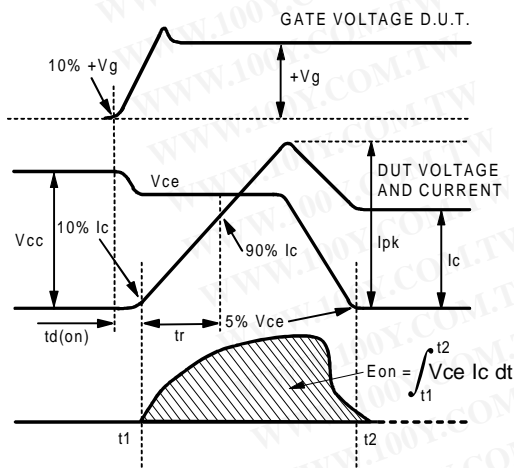
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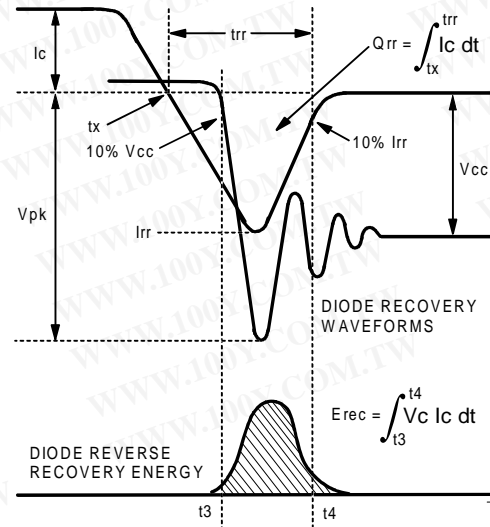
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}(\text{diode})$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



**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  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$



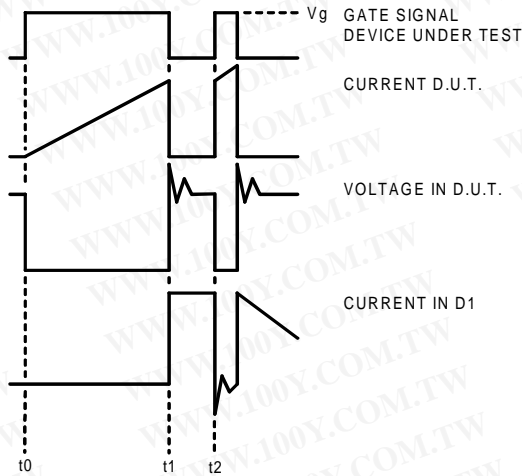


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

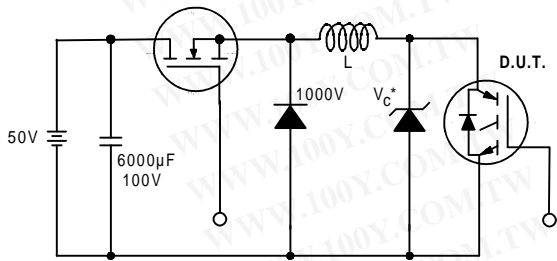


Figure 19. Clamped Inductive Load Test Circuit

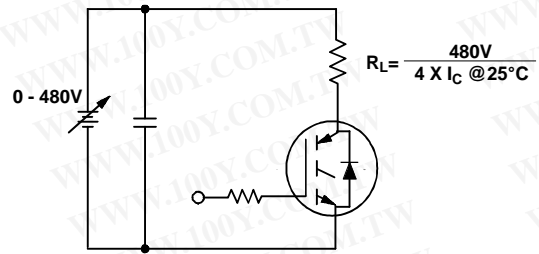


Figure 20. Pulsed Collector Current Test Circuit

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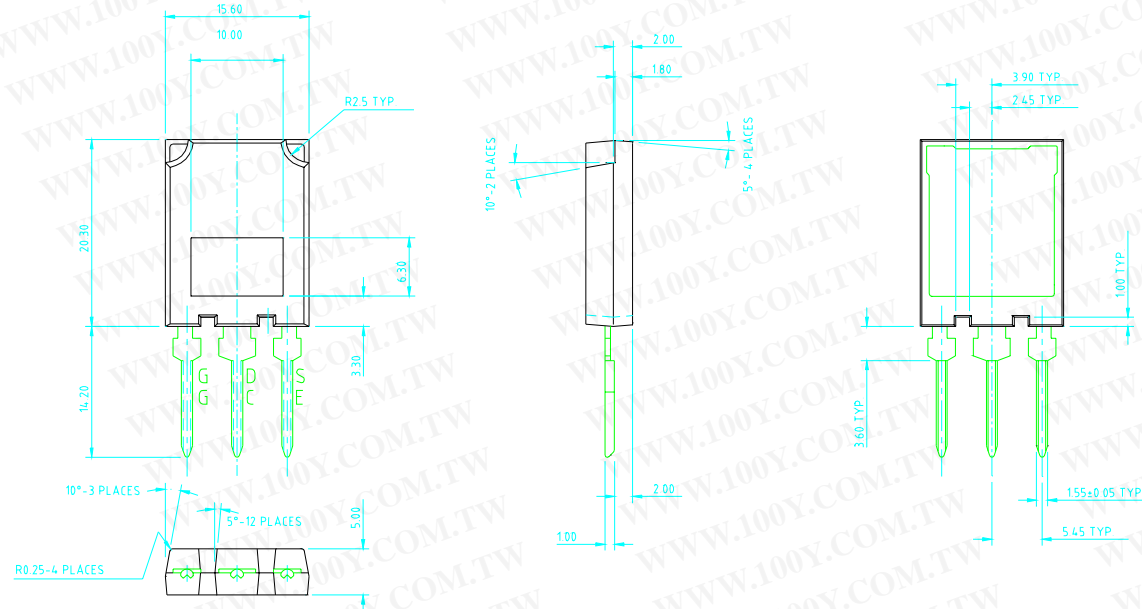
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### Notes:

- 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



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