International
IOR Rectifier

PD - 91688A

PRELIMINARY

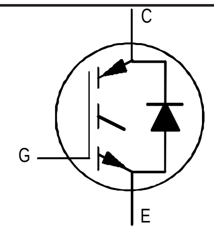
IRG4PSH71KD

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 short 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



n-channel

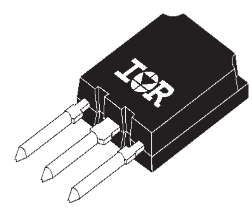
V_{CES} = 1200V

$V_{CE(on)\ typ.}$ = 2.97V

@V_{GE} = 15V, I_C = 42A

Benefits

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



SUPER - 247

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current	78	A
I_C @ T_C = 100°C	Continuous Collector Current	42	
I_{CM}	Pulsed Collector Current ①	156	
I_{LM}	Clamped Inductive Load Current ②	156	
I_F @ T_C = 100°C	Diode Continuous Forward Current	42	
I_{FM}	Diode Maximum Forward Current	156	
t_{sc}	Short Circuit Withstand Time	10	µs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	350	W
P_D @ T_C = 100°C	Maximum Power Dissipation	140	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	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	°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)

5/11/99

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage③	1200	—	—	V	V_{GE} = 0V, I_C = 250µA	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.1	—	V/°C	V_{GE} = 0V, I_C = 10mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.97	3.9	V	I_C = 42A	V_{GE} = 15V
		—	3.44	—		I_C = 78A	See Fig. 2, 5
		—	2.60	—		I_C = 42A, T_J = 150°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		V_{CE} = V_{GE}, I_C = 250µA	
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-12	—	mV/°C	V_{CE} = V_{GE}, I_C = 1.5mA	
g_{fe}	Forward Transconductance ④	25	38	—	S	V_{CE} = 50V, I_C = 42A	
I_{CES}	Zero Gate Voltage Collector Current	—	—	500	µA	V_{GE} = 0V, V_{CE} = 1200V	
		—	—	10	mA	V_{GE} = 0V, V_{CE} = 1200V, T_J = 150°C	
V_{FM}	Diode Forward Voltage Drop	—	2.5	3.7	V	I_C = 42A	See Fig. 13
		—	2.4	—		I_C = 42A, T_J = 150°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)	—	410	610	nC	I_C = 42A	
Q_{ge}	Gate - Emitter Charge (turn-on)	—	47	70		V_{CC} = 400V See Fig.8	
Q_{gc}	Gate - Collector Charge (turn-on)	—	145	220		V_{GE} = 15V	
$t_{d(on)}$	Turn-On Delay Time	—	67	—	ns		
t_r	Rise Time	—	84	—		T_J = 25°C	
$t_{d(off)}$	Turn-Off Delay Time	—	230	350		I_C = 42A, V_{CC} = 800V	
t_f	Fall Time	—	130	190		V_{GE} = 15V, R_G = 5.0Ω	
E_{on}	Turn-On Switching Loss	—	5.68	—	mJ	Energy losses include "tail"	
E_{off}	Turn-Off Switching Loss	—	3.23	—		and diode reverse recovery	
E_{ts}	Total Switching Loss	—	8.90	11.6		See Fig. 9,10,18	
t_{sc}	Short Circuit Withstand Time	10	—	—	µs	V_{CC} = 720V, T_J = 125°C	
						V_{GE} = 15V, R_G = 5.0Ω	
$t_{d(on)}$	Turn-On Delay Time	—	65	—	ns	T_J = 150°C, See Fig. 11,18	
t_r	Rise Time	—	87	—		I_C = 42A, V_{CC} = 800V	
$t_{d(off)}$	Turn-Off Delay Time	—	370	—		V_{GE} = 15V, R_G = 5.0Ω	
t_f	Fall Time	—	290	—		Energy losses include "tail"	
E_{ts}	Total Switching Loss	—	13.7	—	mJ	and diode reverse recovery	
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	—	5770	—	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	—	400	—		V_{CC} = 30V See Fig. 7	
C_{res}	Reverse Transfer Capacitance	—	100	—		ƒ = 1.0MHz	
t_{rr}	Diode Reverse Recovery Time	—	107	160	ns	T_J = 25°C See Fig.	
		—	160	240		T_J = 125°C 14	I_F = 42A
I_{rr}	Diode Peak Reverse Recovery Current	—	10	15	A	T_J = 25°C See Fig.	
		—	16	24		T_J = 125°C 15	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	—	680	1020	nC	T_J = 25°C See Fig.	
		—	1400	2100		T_J = 125°C 16	di/dt = 200A/µs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery	—	250	—	A/µs	T_J = 25°C See Fig.	
	During t_b	—	320	—		T_J = 125°C 17	

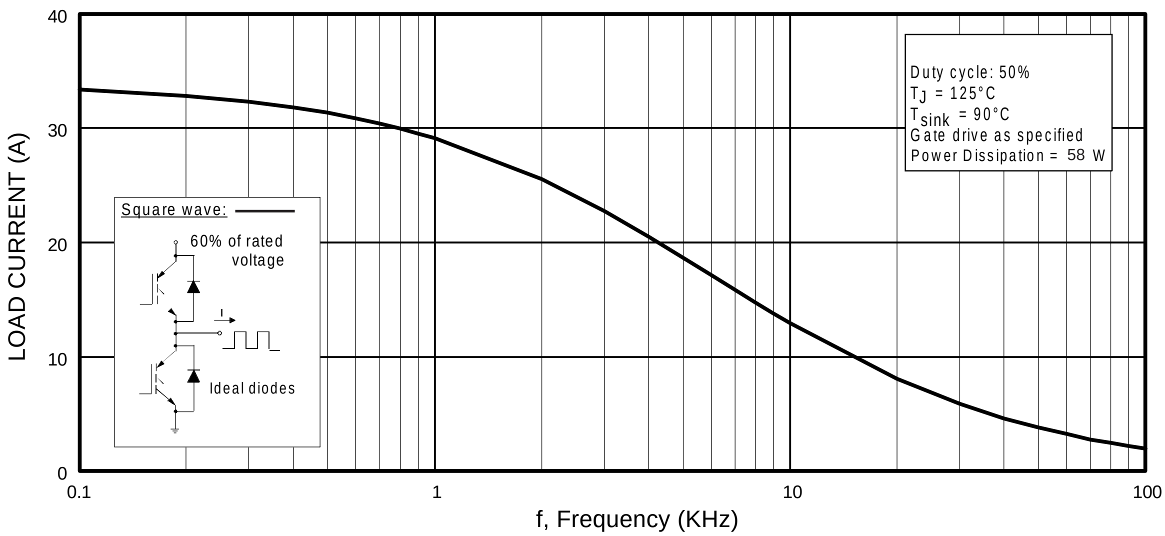


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

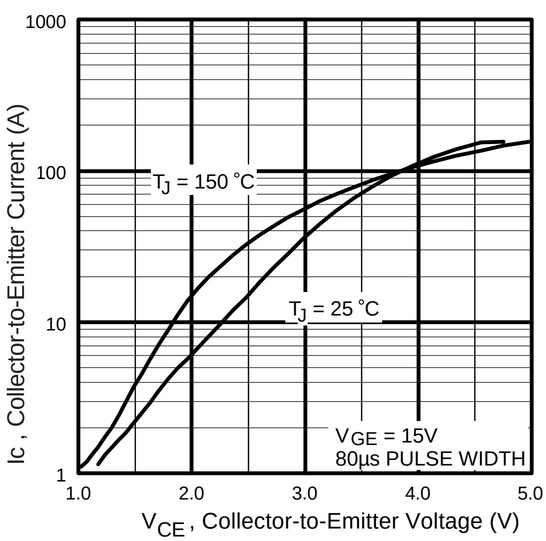


Fig. 2 - Typical Output Characteristics

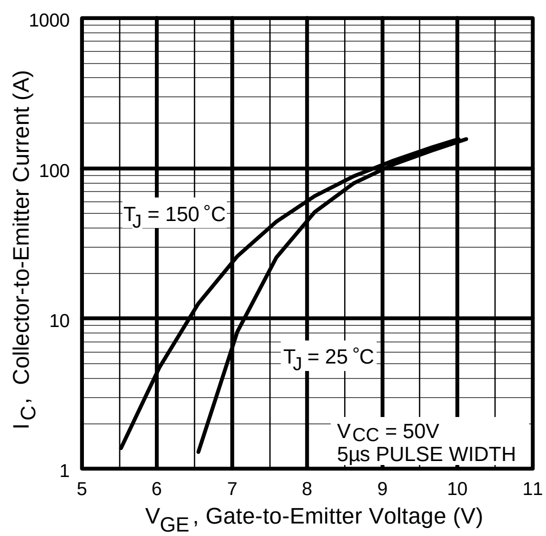


Fig. 3 - Typical Transfer Characteristics

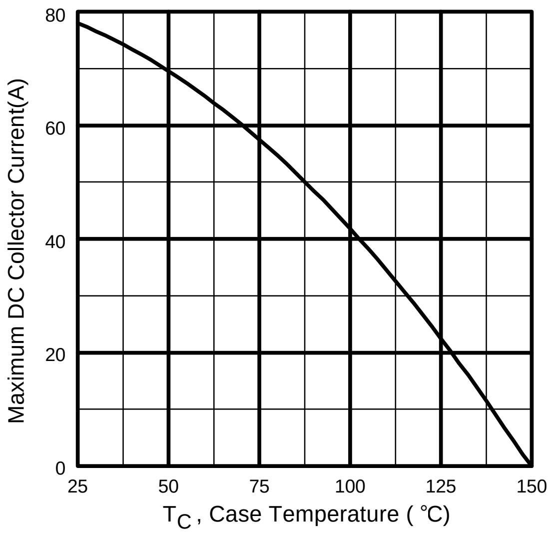


Fig. 4 - Maximum Collector Current vs. Case Temperature

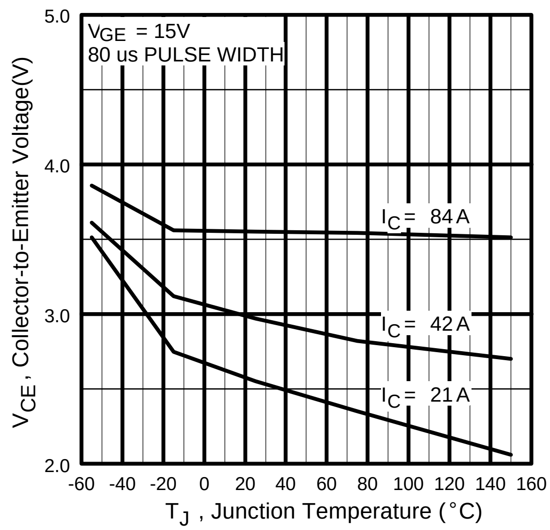


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

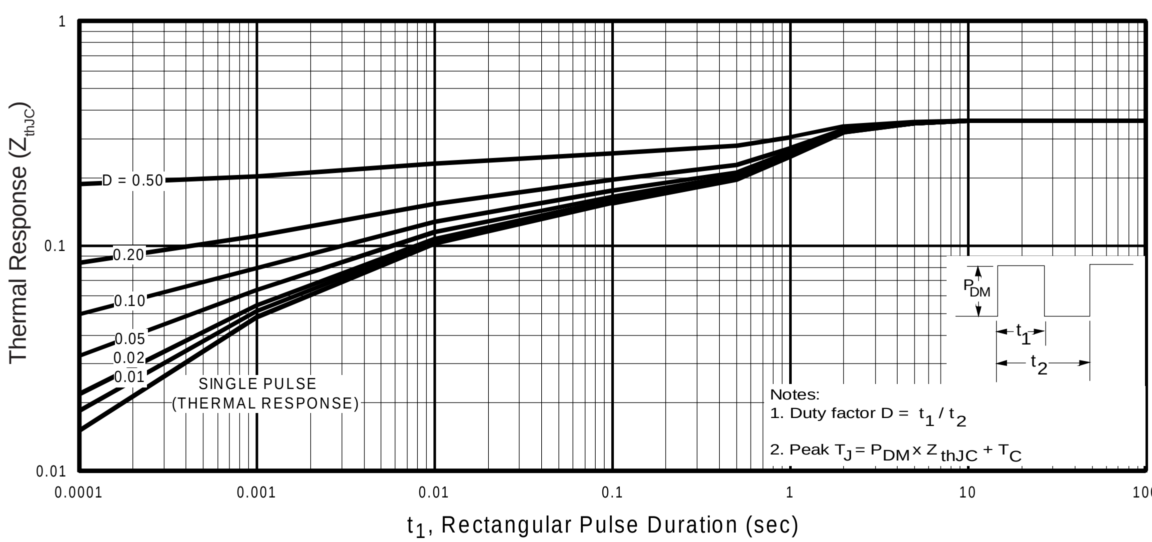


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

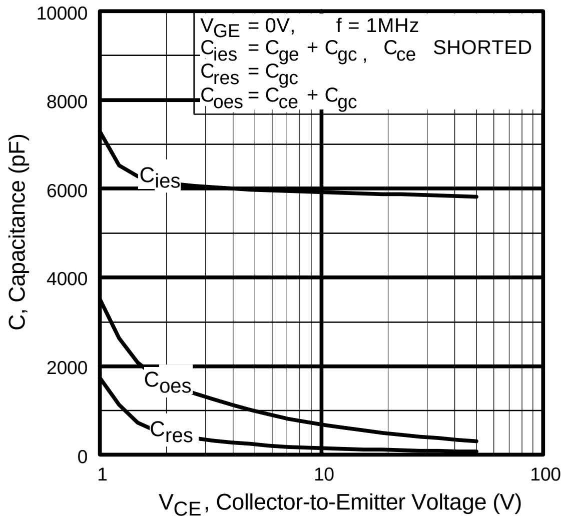


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

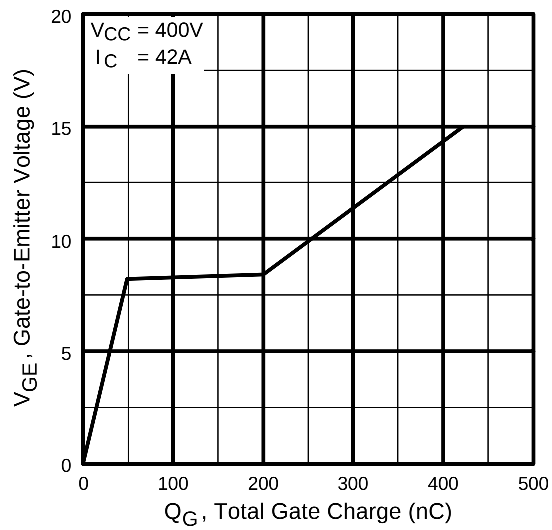


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

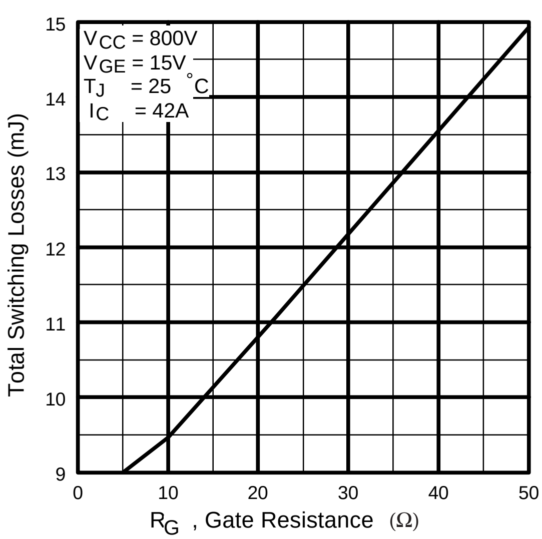


Fig. 9 - Typical Switching Losses vs. Gate Resistance

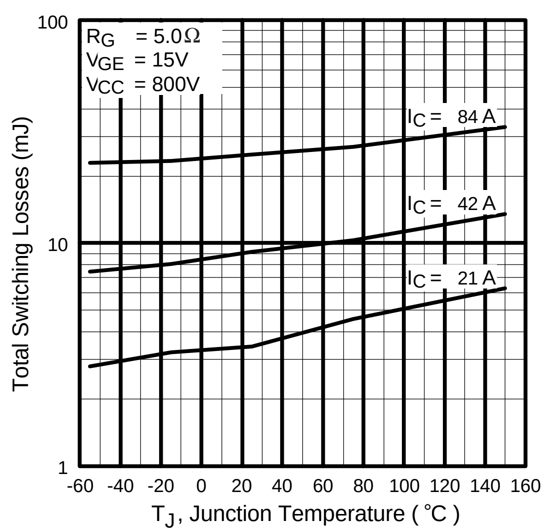
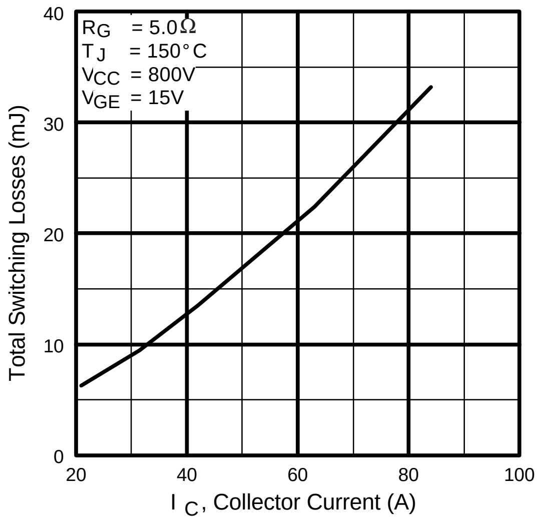
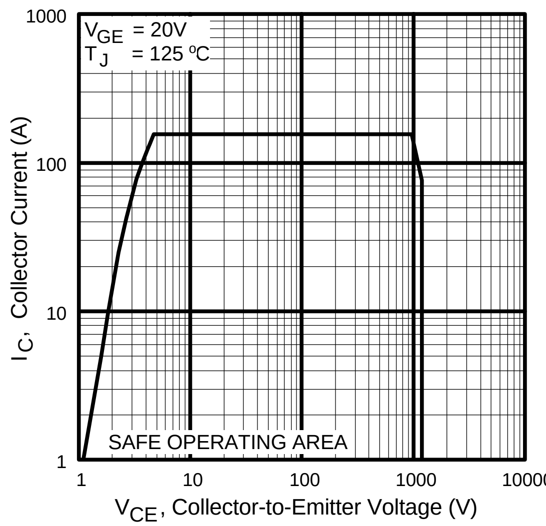


Fig. 10 - Typical Switching Losses vs. Junction Temperature

(Ω)





Collector-to-Emitter Current

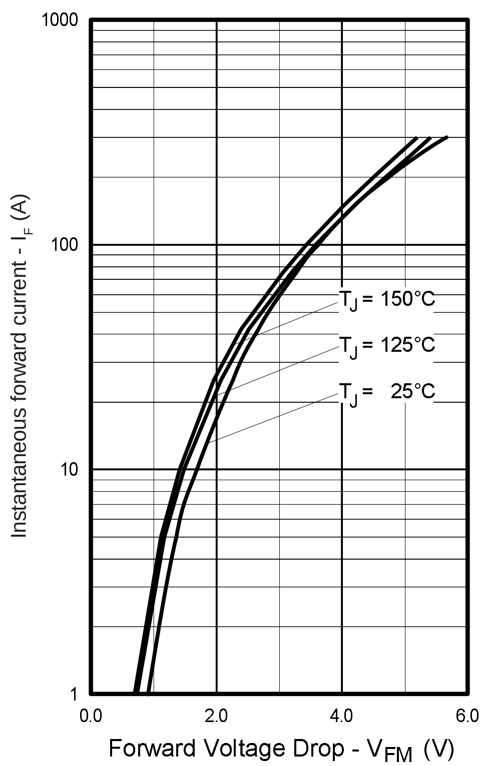


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

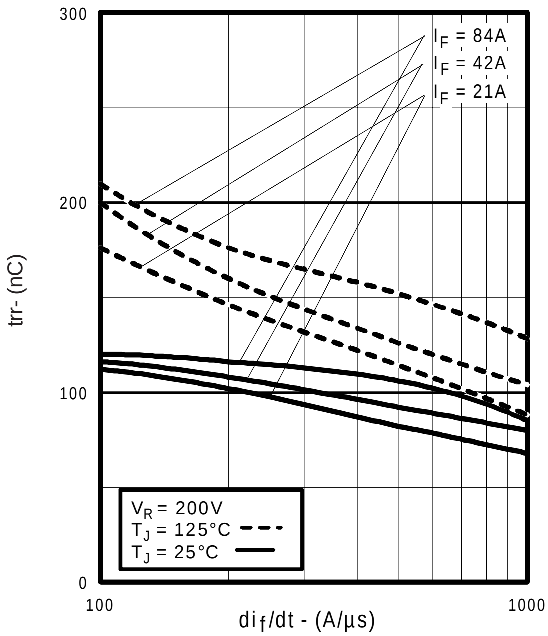


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

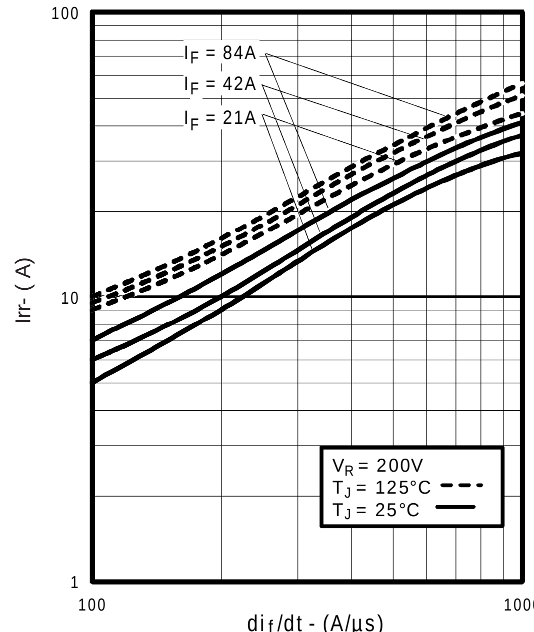


Fig. 15 - Typical Recovery Current vs. di_f/dt

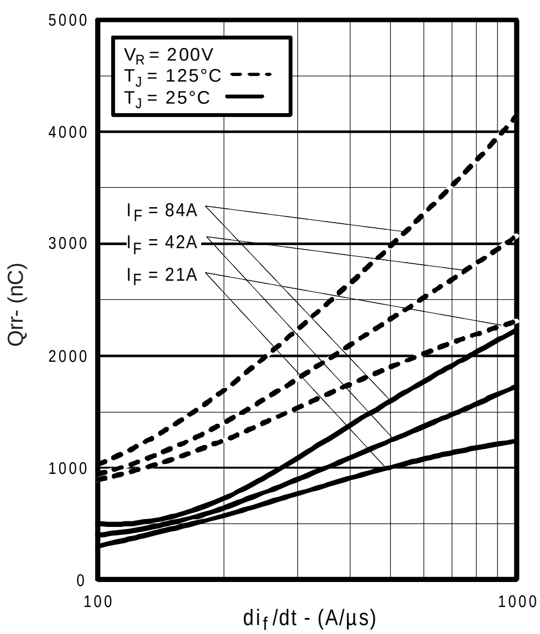


Fig. 16 - Typical Stored Charge vs. di_f/dt

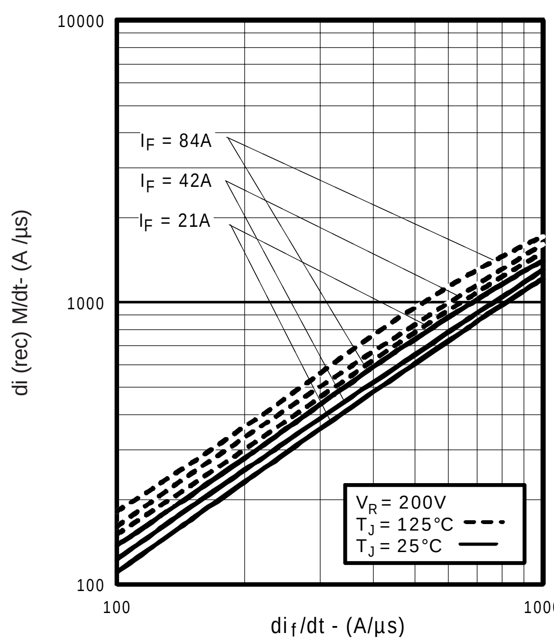


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

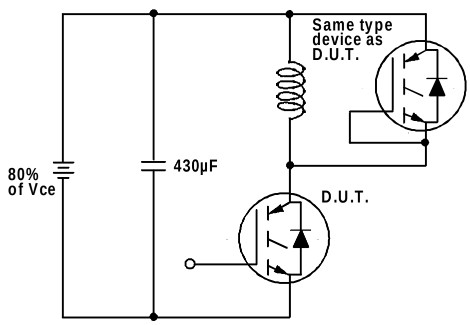


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

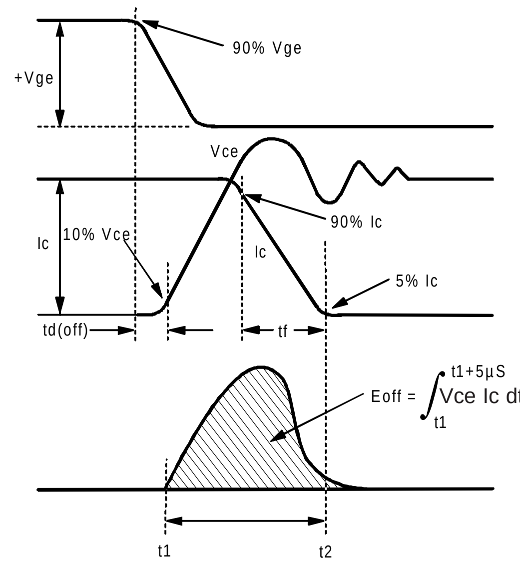


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

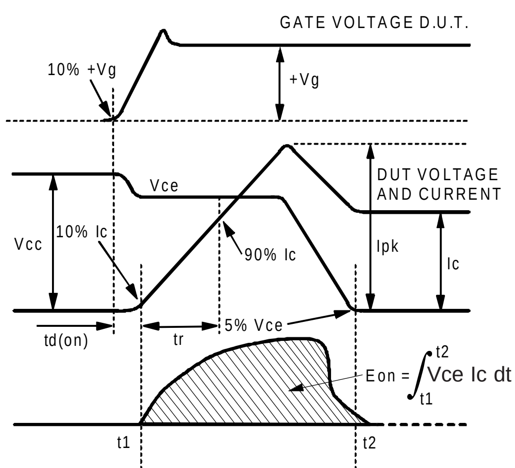


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

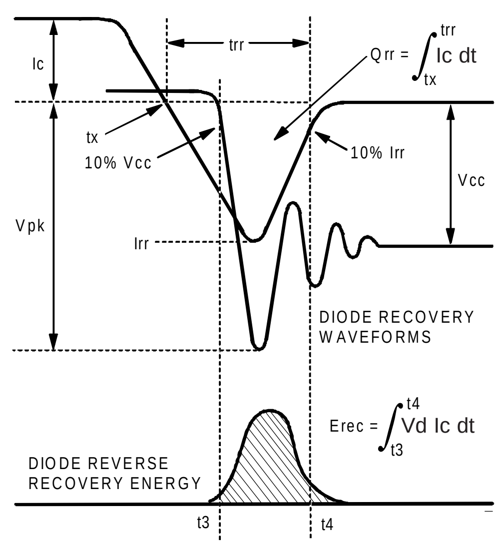


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

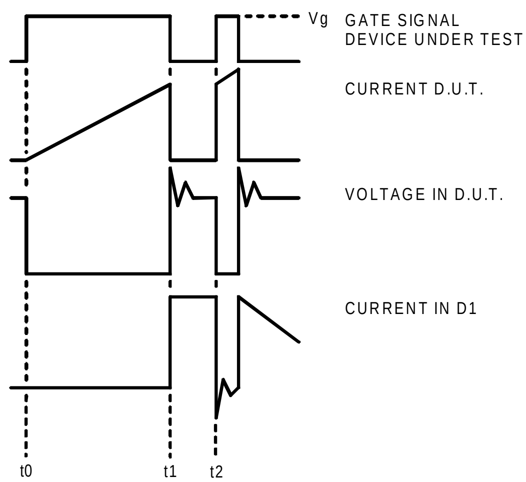


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

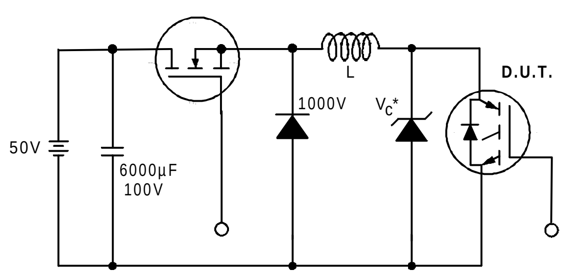


Figure 19. Clamped Inductive Load Test Circuit

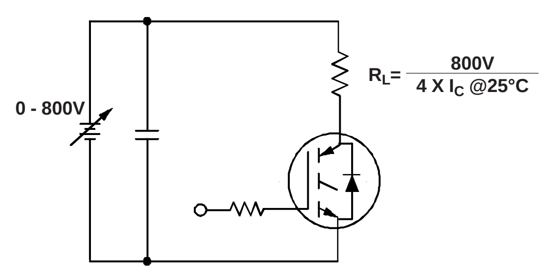


Figure 20. Pulsed Collector Current Test Circuit

Notes:

① Repetitive rating: V_{GE}=20V; pulse width limited by maximum junction temperature (figure 20)

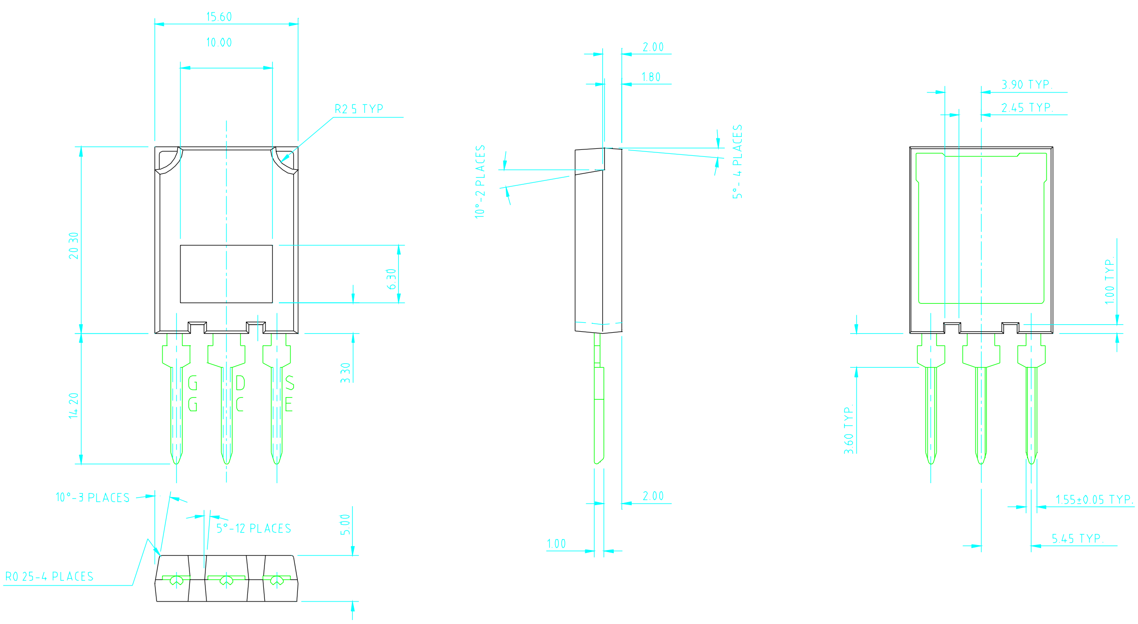
② V_{CC}=80%(V_{CES}), V_{GE}=20V, L=10µH, R_G= 5.0Ω (figure 19)

③ Pulse width ≤ 80µs; duty factor ≤ 0.1%

④ Pulse width 5.0µs, single shot

Case Outline and Dimensions — Super-247

Dimensions are shown in millimeters



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