

IRG4ZH50KD

INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

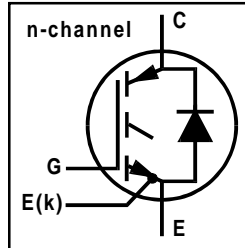
Surface Mountable Short
Circuit Rated UltraFast IGBT

Features

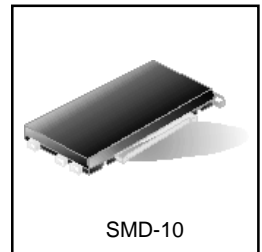
- High short circuit rating optimized for motor control, $t_{sc} = 10\mu s$, $V_{CC} = 720V$, $T_J = 125^\circ C$, $V_{GE} = 15V$
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft recovery antiparallel diodes for use in bridge configurations
- Combines low conduction losses with high switching speed
- Low profile low inductance SMD-10 Package
- Separated control & Power-connections for easy paralleling
- Good coplanarity
- Easy solder inspection and cleaning

Benefits

- Highest power density and efficiency available
- HEXFRED Diodes optimized for performance with IGBTs. Minimized recovery characteristics
- High input impedance requires low gate drive power
- Less noise and interference



$V_{CES} = 1200V$
$V_{CE(ON)typ} = 2.79V$
@ $V_{GE} = 15V$, $I_C = 29A$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	54	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	29	
I_{CM}	Pulsed Collector Current ①	108	
I_{LM}	Clamped Inductive Load Current ②	108	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	16	
I_{FM}	Diode Maximum Forward Current	108	
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	210	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	83	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	—	0.60	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	1.20	
$R_{\theta CS}$	SMD-10 Case-to-Heatsink (typical), *	—	0.44	—	
Wt	Weight	—	6.0(0.21)	—	g (oz)

* Assumes device soldered to 3.0 oz. Cu on 3.0mm IMS/Aluminum board, mounted to flat, greased heatsink.

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.

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
V _{(BR)CES}	Collector-to-Emitter Breakdown Voltage ③	1200	—	—	V	V _{GE} = 0V, I _C = 250μA
DV _{(BR)CES/DT_J}	Temperature Coeff. of Breakdown Voltage	—	0.91	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	2.79	3.5	V	I _C = 29A V _{GE} = 15V
		—	3.32	—		I _C = 54A see figures 2, 5
		—	2.66	—		I _C = 29A, T _J = 150°C
V _{GE(th)}	Gate Threshold Voltage	3.0	—	6.0		V _{CE} = V _{GE} , I _C = 250μA
DV _{GE(th)/DT_J}	Temperature Coeff. of Threshold Voltage	—	-10	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA
g _{fe}	Forward Transconductance ④	14	21	—	S	V _{CE} = 100V, I _C = 29A
I _{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	V _{GE} = 0V, V _{CE} = 1200V
		—	—	6500		V _{GE} = 0V, V _{CE} = 1200V, T _J = 150°C
V _{FM}	Diode Forward Voltage Drop	—	2.5	3.5	V	I _C = 16A see figure 13
		—	2.1	—		I _C = 16A, 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)	—	190	280	nC	I _C = 29A
Q _{ge}	Gate - Emitter Charge (turn-on)	—	25	38		V _{CC} = 400V see figure 8
Q _{gc}	Gate - Collector Charge (turn-on)	—	70	110		V _{GE} = 15V
t _{d(on)}	Turn-On Delay Time	—	110	—	ns	T _J = 25°C I _C = 29A, V _{CC} = 800V V _{GE} = 15V, R _G = 5.0Ω
t _r	Rise Time	—	43	—		
t _{d(off)}	Turn-Off Delay Time	—	150	230		
t _f	Fall Time	—	200	290		
E _{on}	Turn-On Switching Loss	—	3.20	—	mJ	Energy losses include "tail" and diode reverse recovery see figures 9,10,18
E _{off}	Turn-Off Switching Loss	—	2.28	—		
E _{ts}	Total Switching Loss	—	5.48	6.5		
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	—	73	—	ns	T _J = 150°C, see figures 10,11,18 I _C = 29A, V _{CC} = 800V V _{GE} = 15V, R _G = 5.0Ω, Energy losses include "tail" and diode reverse recovery
t _r	Rise Time	—	72	—		
t _{d(off)}	Turn-Off Delay Time	—	290	—		
t _f	Fall Time	—	390	—		
E _{ts}	Total Switching Loss	—	10.12	—	mJ	
L _E	Internal Emitter Inductance	—	2.0	—	nH	Measured 5mm from package
C _{ies}	Input Capacitance	—	2800	—	pF	V _{GE} = 0V V _{CC} = 30V see figure 7 f = 1.0MHz
C _{oes}	Output Capacitance	—	140	—		
C _{res}	Reverse Transfer Capacitance	—	53	—		
t _{rr}	Diode Reverse Recovery Time	—	90	135	ns	T _J = 25°C see figure
		—	164	245		T _J = 125°C 14
I _{rr}	Diode Peak Reverse Recovery Current	—	5.8	10	A	T _J = 25°C see figure
		—	8.3	15		T _J = 125°C 15
Q _{rr}	Diode Reverse Recovery Charge	—	260	675	nC	T _J = 25°C see figure
		—	680	1838		T _J = 125°C 16
di _{(rec)M/dt}	Diode Peak Rate of Fall of Recovery During t _b	—	120	—	A/μs	T _J = 25°C see figure
		—	76	—		T _J = 125°C 17

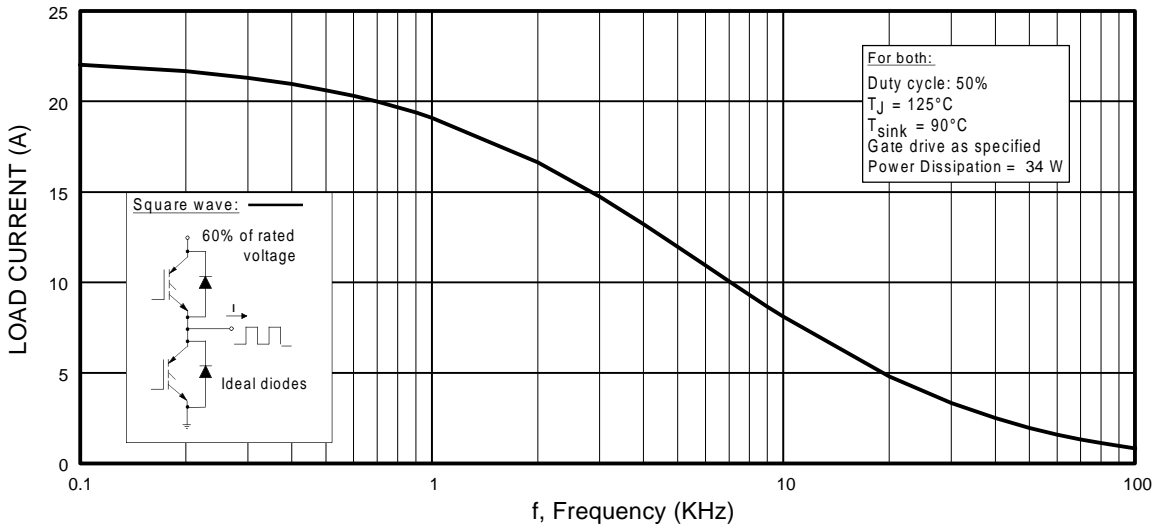


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

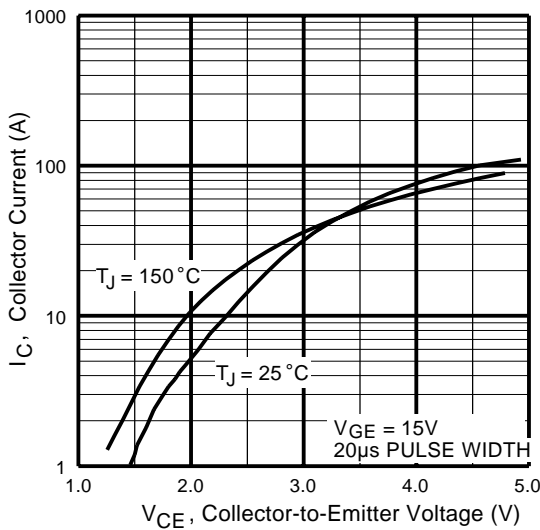


Fig. 2 - Typical Output Characteristics

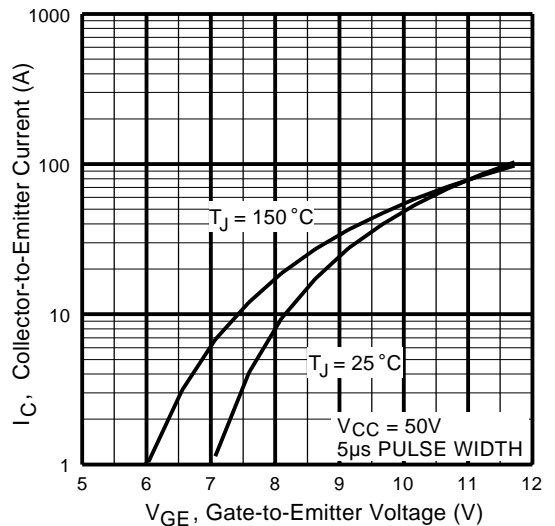


Fig. 3 - Typical Transfer Characteristics

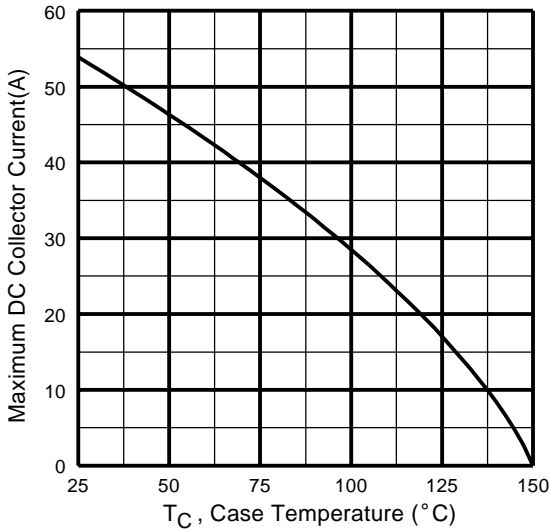


Fig. 4 - Maximum Collector Current vs. Case Temperature

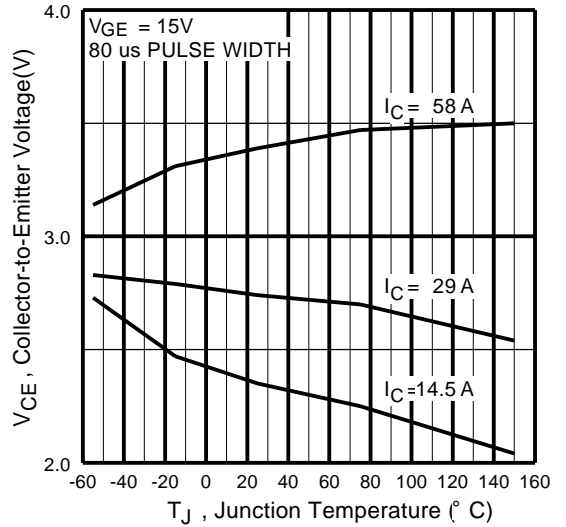


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

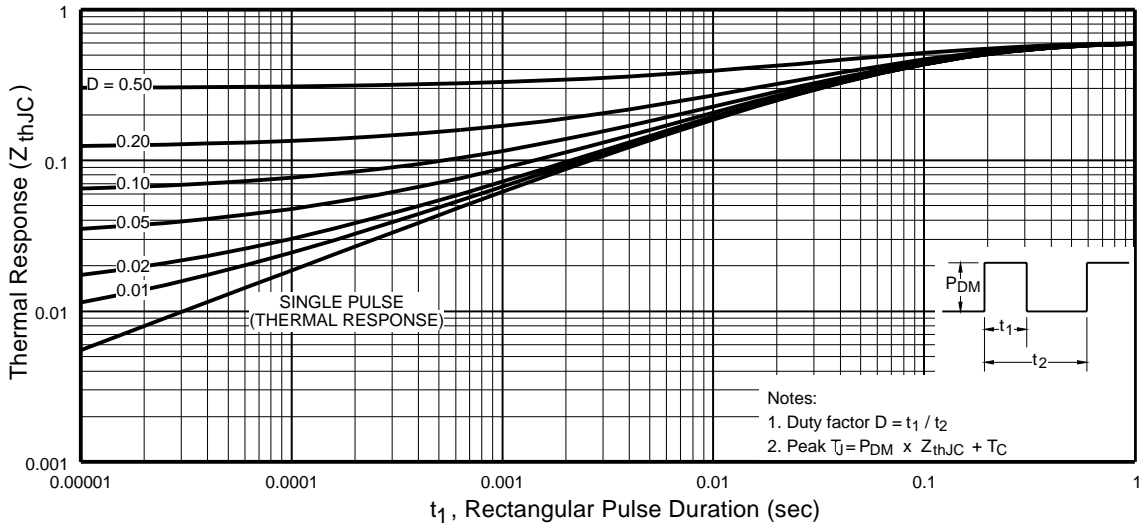


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

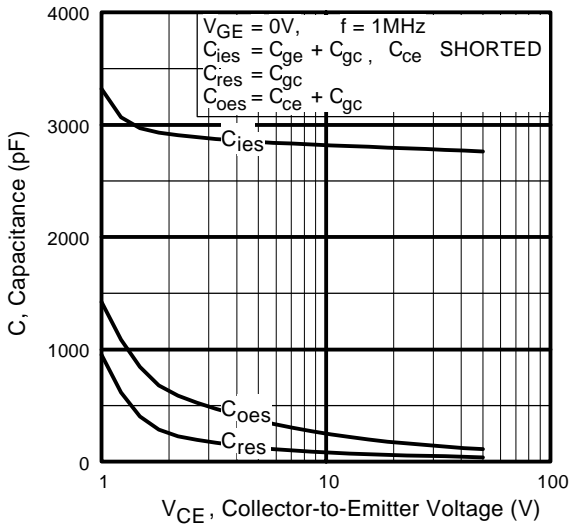


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

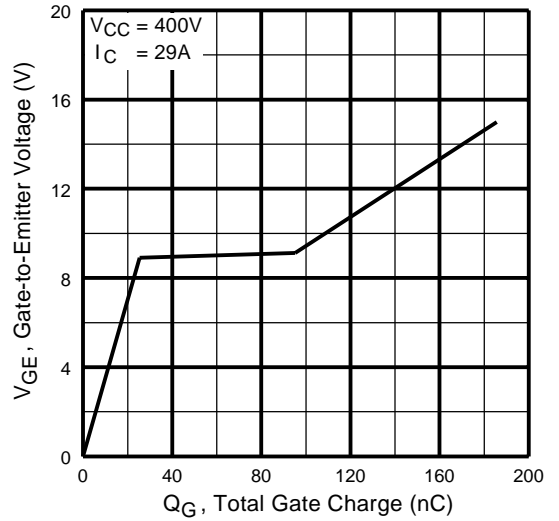


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

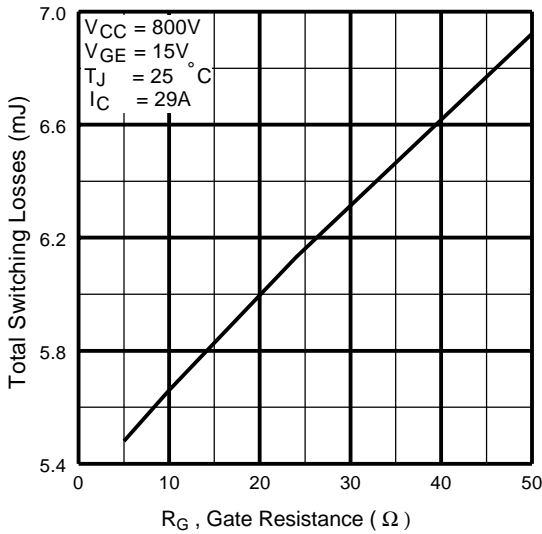


Fig. 9 - Typical Switching Losses vs. Gate Resistance

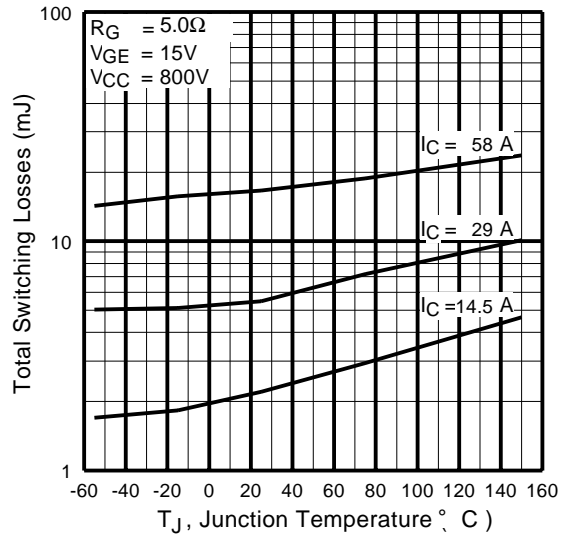


Fig. 10 - Typical Switching Losses vs. Junction Temperature

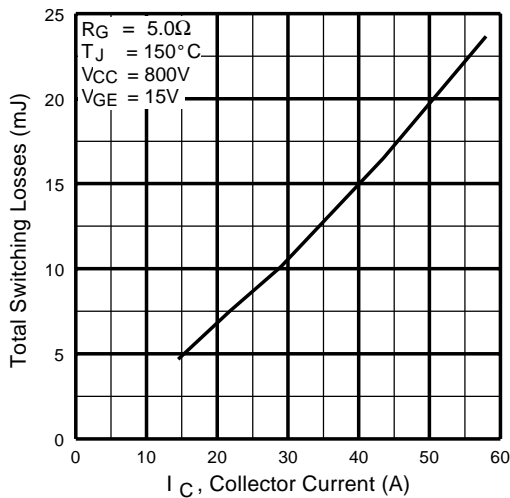


Fig. 11 - Typical Switching Losses vs. Collector Current

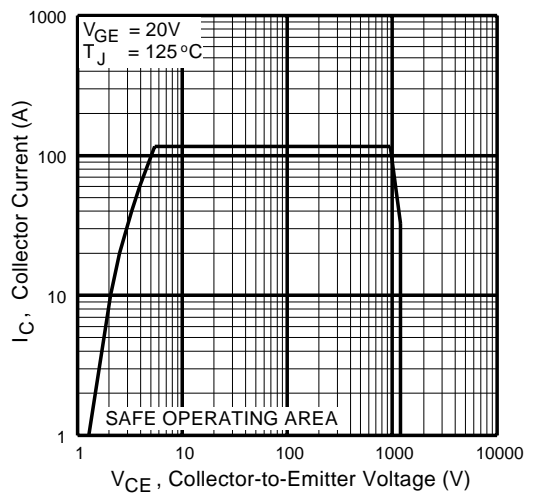


Fig. 12 - Turn-Off SOA

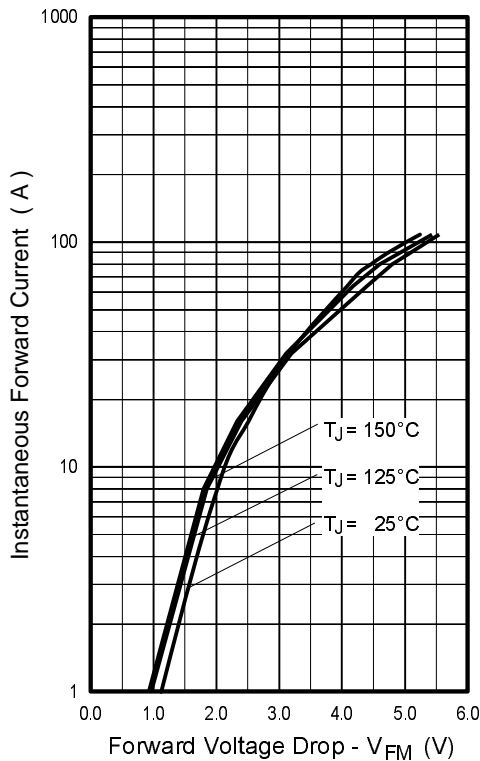


Fig. 13 - Typical Forward Voltage Drop vs. Instantaneous Forward Current

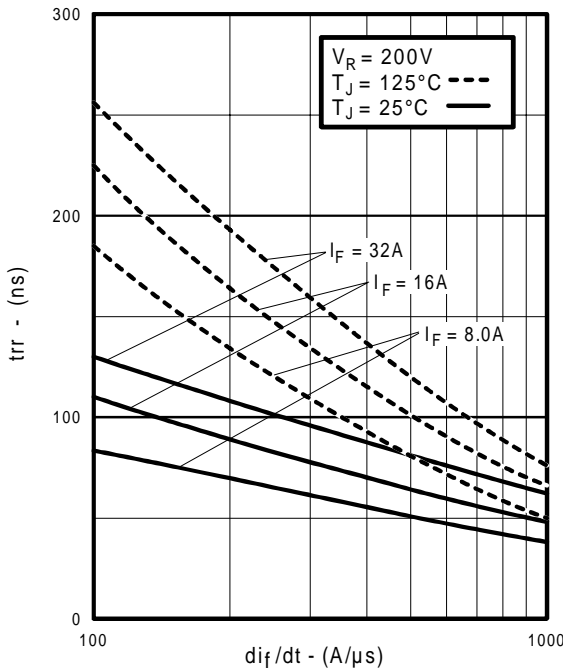


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

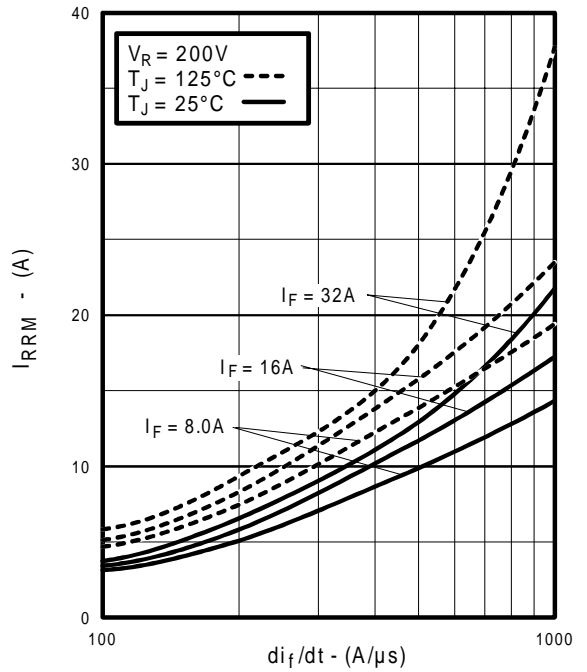


Fig. 15 - Typical Recovery Current vs. di_f/dt

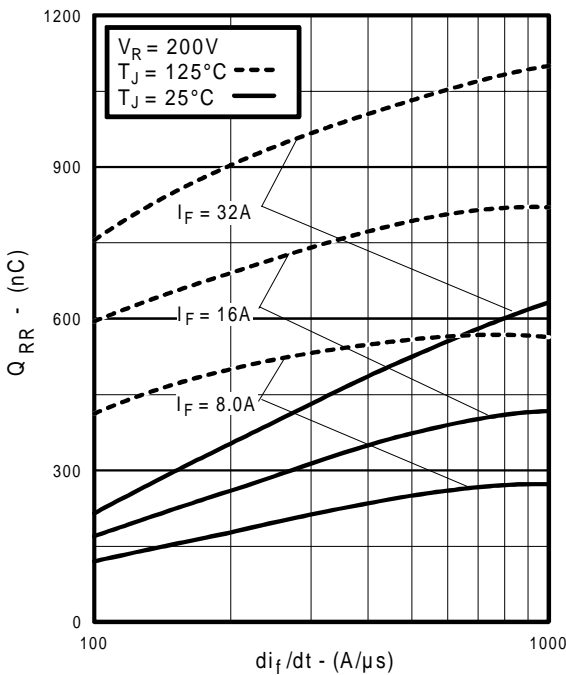


Fig. 16 - Typical Stored Charge vs. di_f/dt

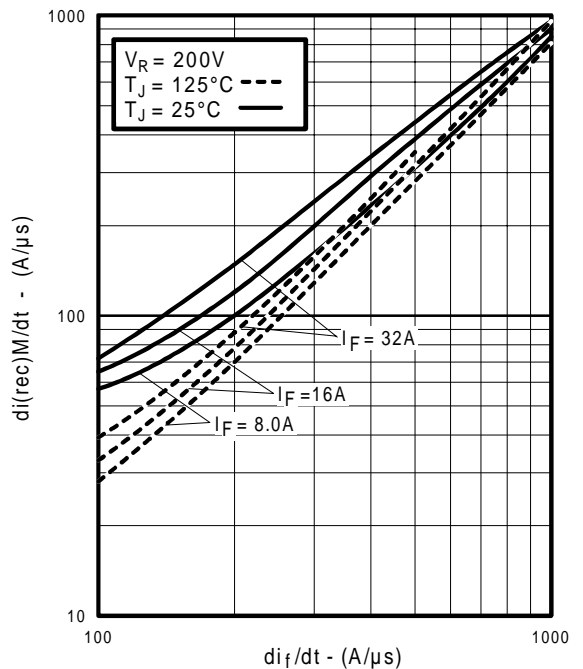


Fig. 17 - Typical $di_{(rec)}M/dt$ vs. di_f/dt

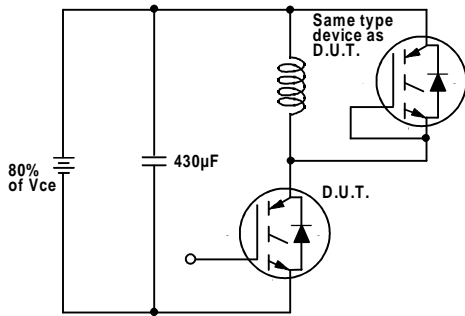


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

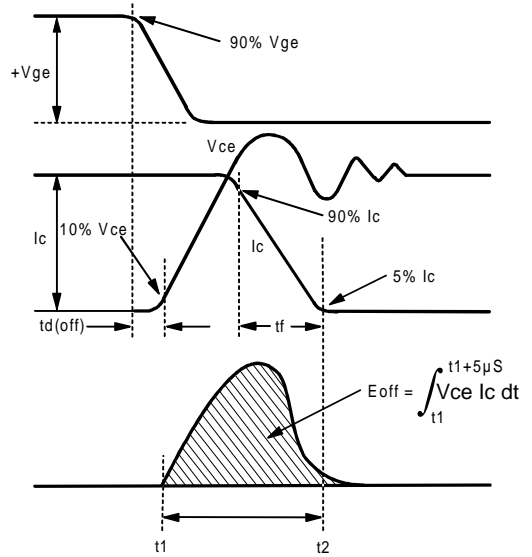


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

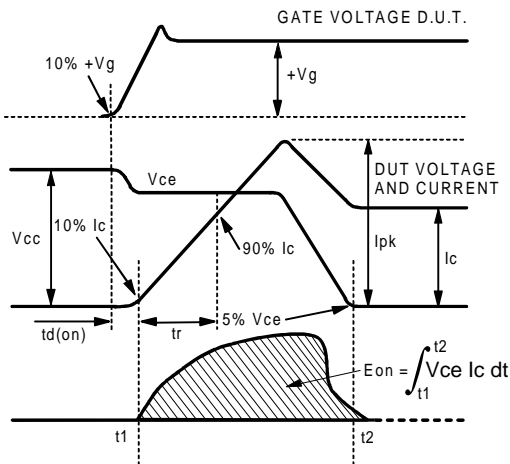


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

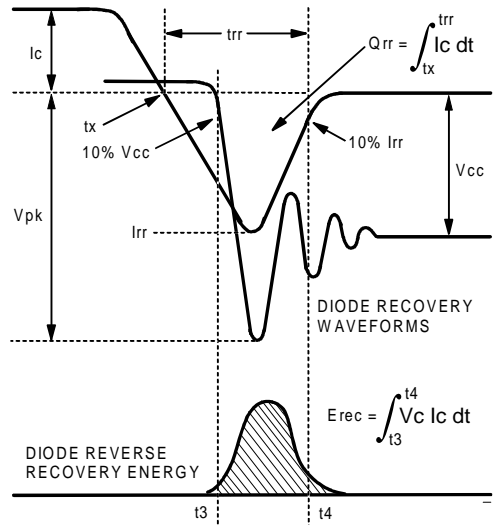


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

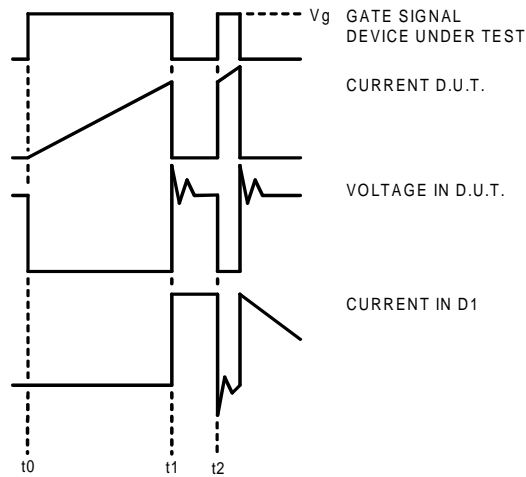


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

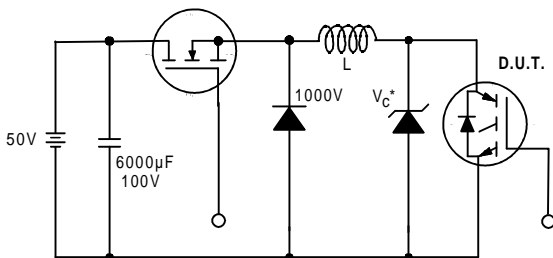


Figure 19. Clamped Inductive Load Test Circuit

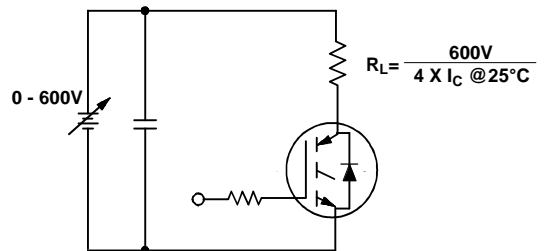
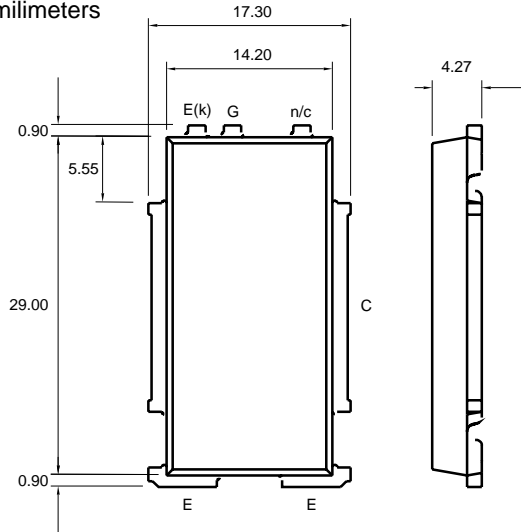


Figure 20. Pulsed Collector Current Test Circuit

Case Outline — SMD-10

Dimensions are shown in millimeters



Recommended footprint

