

IRG4RC10SDPbF

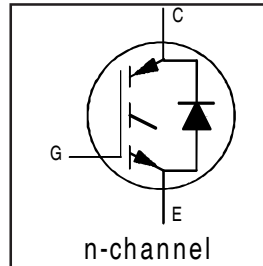
INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE Standard Speed CoPack IGBT

Features

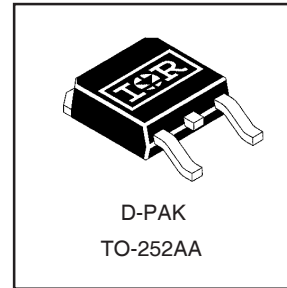
- Extremely low voltage drop 1.1V(typ) @ 2A
- S-Series: Minimizes power dissipation at up to 3 KHz PWM frequency in inverter drives, up to 4 KHz in brushless DC drives.
- Tight parameter distribution
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft-recovery anti-parallel diodes for use in bridge configurations
- Industry standard TO-252AA package
- Lead-Free

Benefits

- Generation 4 IGBT's offer highest efficiencies available
- IGBT's optimized for specific application conditions
- HEXFRED diodes optimized for performance with IGBT's . Minimized recovery characteristics require less/no snubbing
- Lower losses than MOSFET's conduction and Diode losses



$V_{CES} = 600V$
 $V_{CE(on)} \text{ typ.} = 1.10V$
 @ $V_{GE} = 15V, I_C = 2.0A$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	14	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	8.0	
I_{CM}	Pulsed Collector Current ①	18	
I_{LM}	Clamped Inductive Load Current ②	18	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	4.0	
I_{FM}	Diode Maximum Forward Current	16	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	38	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	15	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	3.3	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	—	7.0	
$R_{\theta JA}$	Junction-to-Ambient (PCB mount)*	—	50	
Wt	Weight	0.3 (0.01)	—	g (oz)

* When mounted on 1" square PCB (FR-4 or G-10 Material).
 For recommended footprint and soldering techniques refer to application note #AN-994

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Electrical Characteristics @ T_J = 25°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 = 250μA
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	0.64	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.58	1.7	V	I _C = 8.0A
		—	2.05	—		I _C = 14.0A
		—	1.68	—		I _C = 8.0A, T _J = 150°C
V _{GE(th)}	Gate Threshold Voltage	3.0	—	6.0		V _{CE} = V _{GE} , I _C = 250μA
ΔV _{GE(th)} /ΔT _J	Temperature Coeff. of Threshold Voltage	—	-9.5	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA
g _{fe}	Forward Transconductance ^④	3.65	5.48	—	S	V _{CE} = 100V, I _C = 8.0A
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°C
V _{FM}	Diode Forward Voltage Drop	—	1.5	1.8	V	I _C = 4.0A
		—	1.4	1.7		I _C = 4.0A, 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)	—	15	22	nC	I _C = 8.0A	
Q _{ge}	Gate - Emitter Charge (turn-on)	—	2.42	3.6		V _{CC} = 400V	
Q _{gc}	Gate - Collector Charge (turn-on)	—	6.53	9.8		V _{GE} = 15V	
t _{d(on)}	Turn-On Delay Time	—	76	—	ns	T _J = 25°C	
t _r	Rise Time	—	32	—		I _C = 8.0A, V _{CC} = 480V	
t _{d(off)}	Turn-Off Delay Time	—	815	1200		V _{GE} = 15V, R _G = 100Ω	
t _f	Fall Time	—	720	1080		Energy losses include "tail" and diode reverse recovery.	
E _{on}	Turn-On Switching Loss	—	0.31	—		mJ	See Fig. 9, 10, 18
E _{off}	Turn-Off Switching Loss	—	3.28	—			
E _{ts}	Total Switching Loss	—	3.60	10.9			
E _{ts}	Total Switching Loss	—	1.46	2.6		mJ	I _C = 5.0A
t _{d(on)}	Turn-On Delay Time	—	70	—		ns	T _J = 150°C, See Fig. 10,11, 18
t _r	Rise Time	—	36	—			I _C = 8.0A, V _{CC} = 480V
t _{d(off)}	Turn-Off Delay Time	—	890	—	V _{GE} = 15V, R _G = 100Ω		
t _f	Fall Time	—	890	—	Energy losses include "tail" and diode reverse recovery.		
E _{ts}	Total Switching Loss	—	3.83	—	mJ		
L _E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package	
C _{ies}	Input Capacitance	—	280	—	pF	V _{GE} = 0V	
C _{oes}	Output Capacitance	—	30	—		V _{CC} = 30V	
C _{res}	Reverse Transfer Capacitance	—	4.0	—		f = 1.0MHz	
t _{rr}	Diode Reverse Recovery Time	—	28	42	ns	T _J = 25°C See Fig. 14	
		—	38	57		T _J = 125°C	
I _{rr}	Diode Peak Reverse Recovery Current	—	2.9	5.2	A	T _J = 25°C See Fig. 15	
		—	3.7	6.7		T _J = 125°C	
Q _{rr}	Diode Reverse Recovery Charge	—	40	60	nC	T _J = 25°C See Fig. 16	
		—	70	105		T _J = 125°C	
di _{(rec)M} /dt	Diode Peak Rate of Fall of Recovery During t _b	—	280	—	A/μs	T _J = 25°C See Fig. 17	
		—	235	—		T _J = 125°C	

Details of note ① through ④ are on the last page

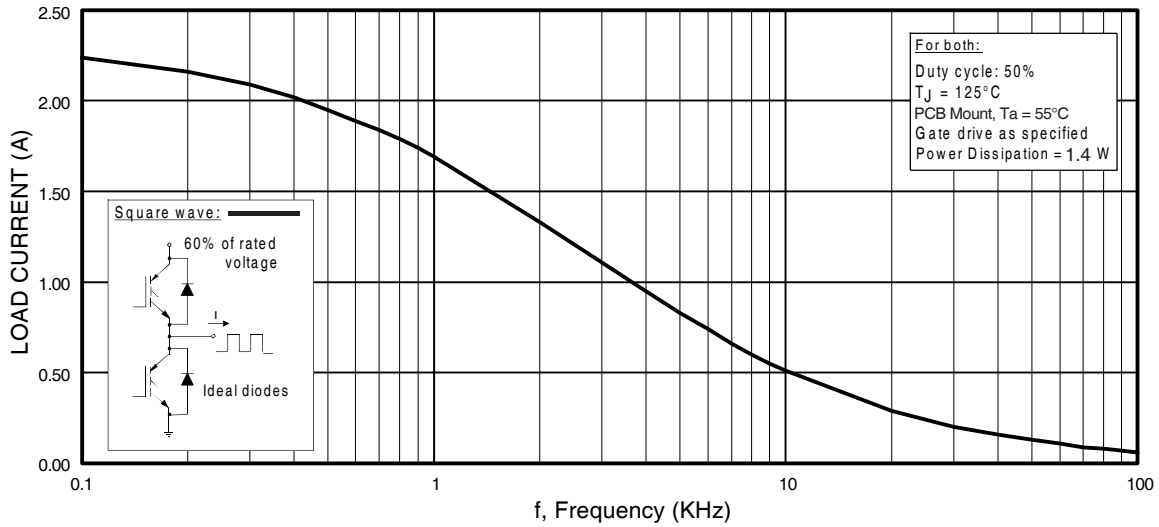


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

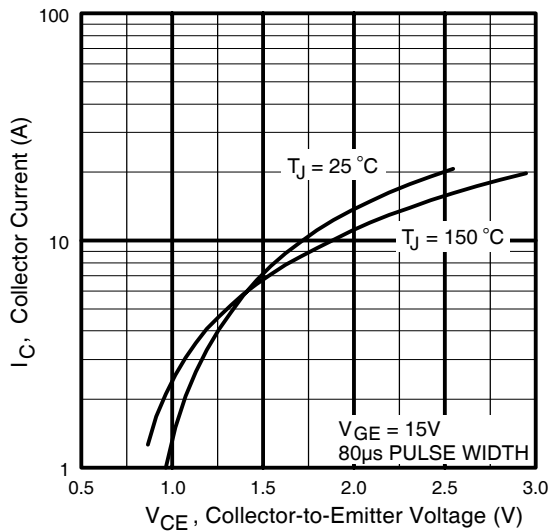


Fig. 2 - Typical Output Characteristics

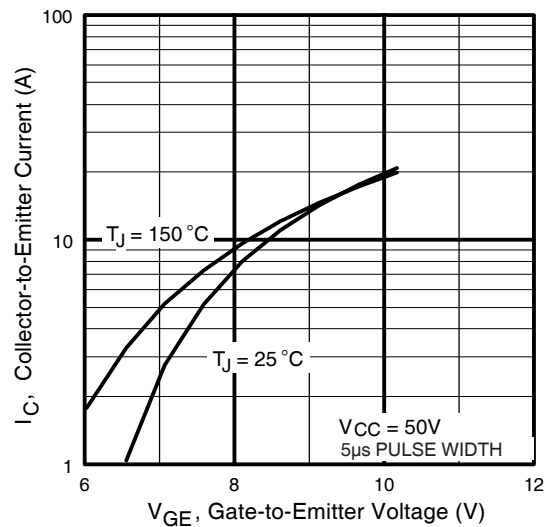


Fig. 3 - Typical Transfer Characteristics

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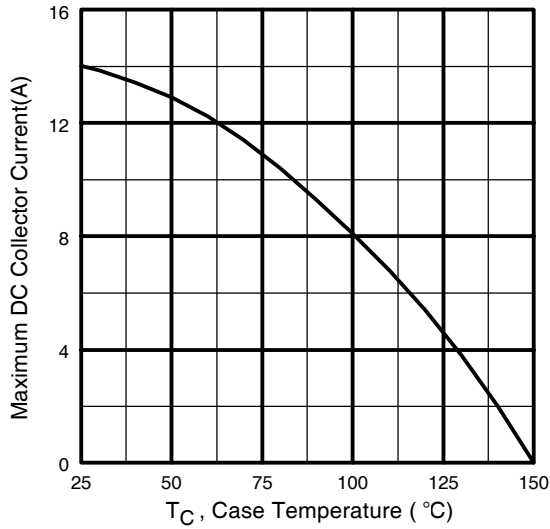


Fig. 4 - Maximum Collector Current vs. Case Temperature

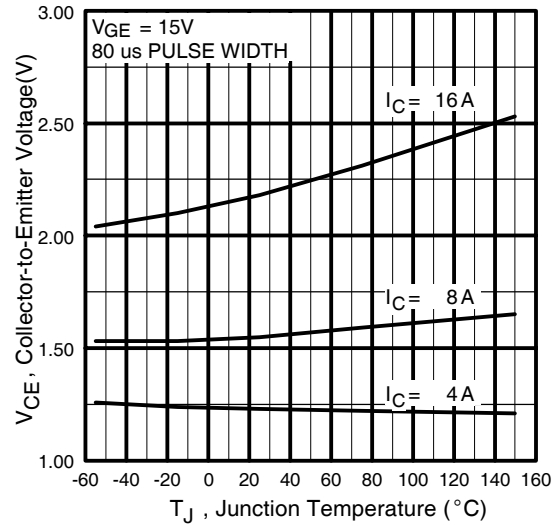


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

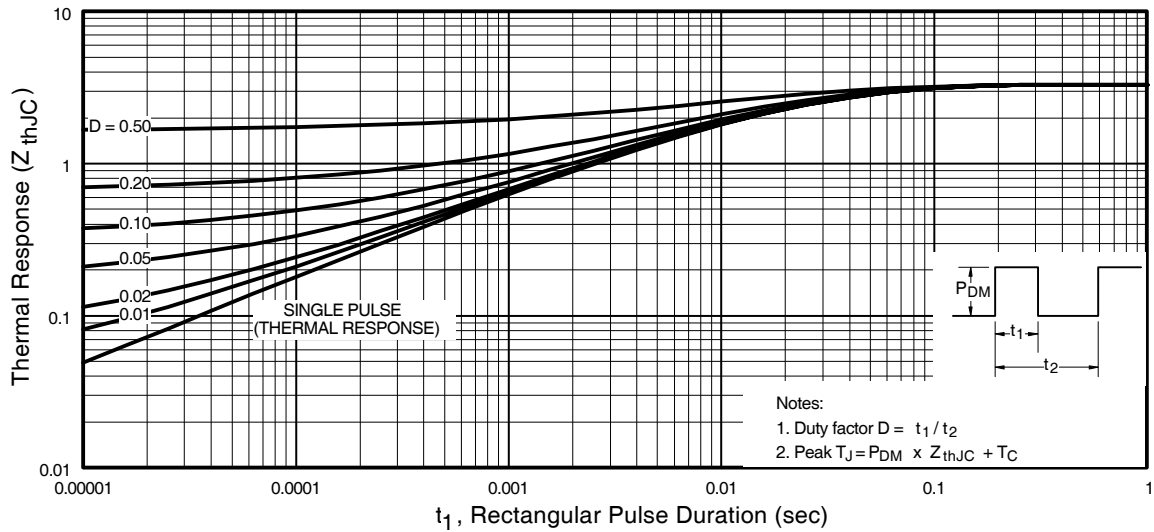


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

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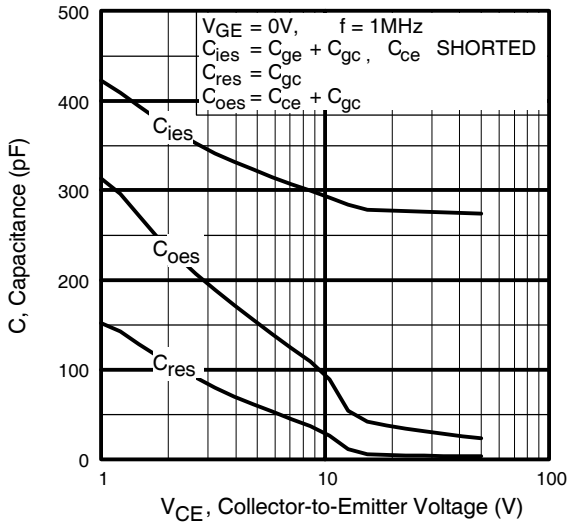


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

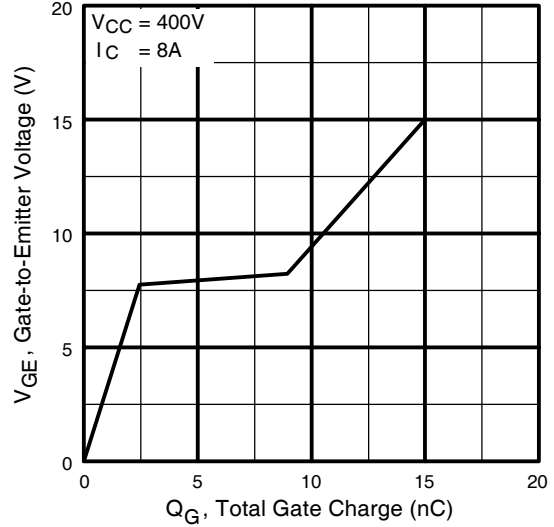


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

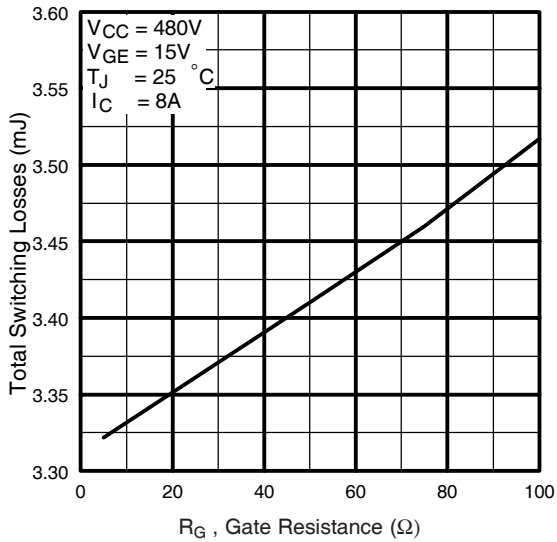


Fig. 9 - Typical Switching Losses vs. Gate Resistance

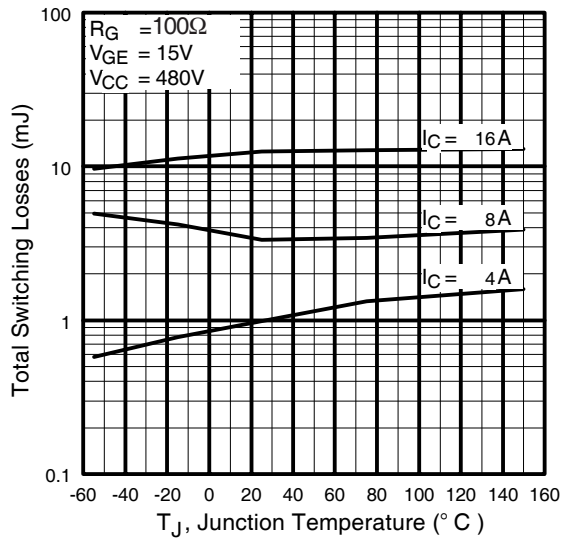


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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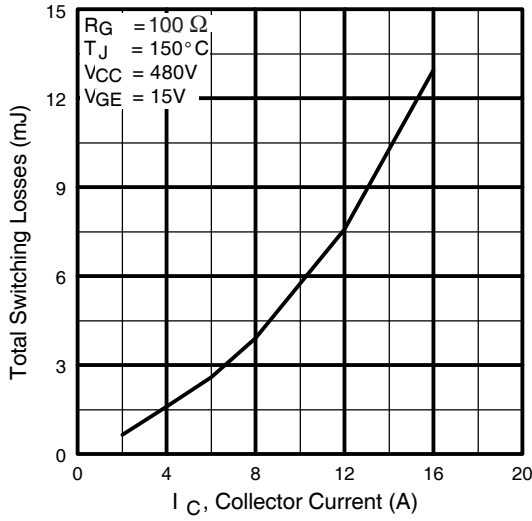


Fig. 11 - Typical Switching Losses vs. Collector Current

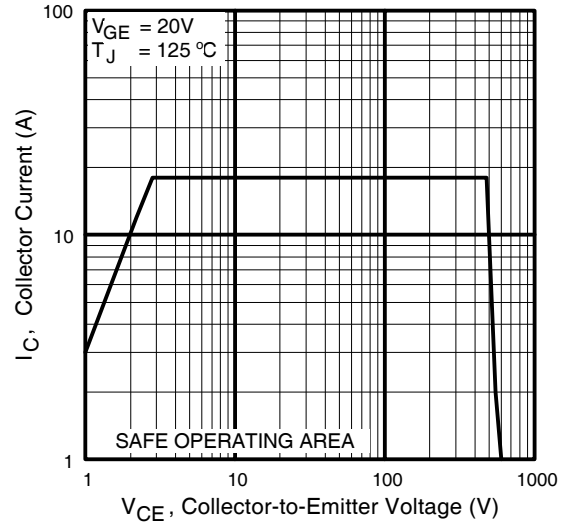


Fig. 12 - Turn-Off SOA

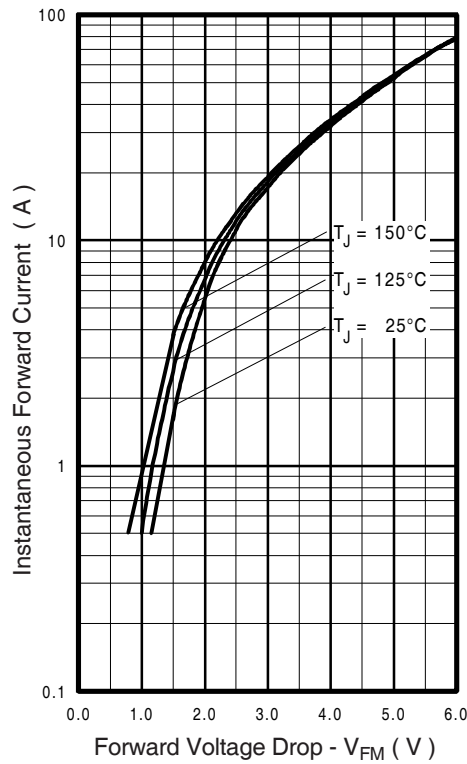


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

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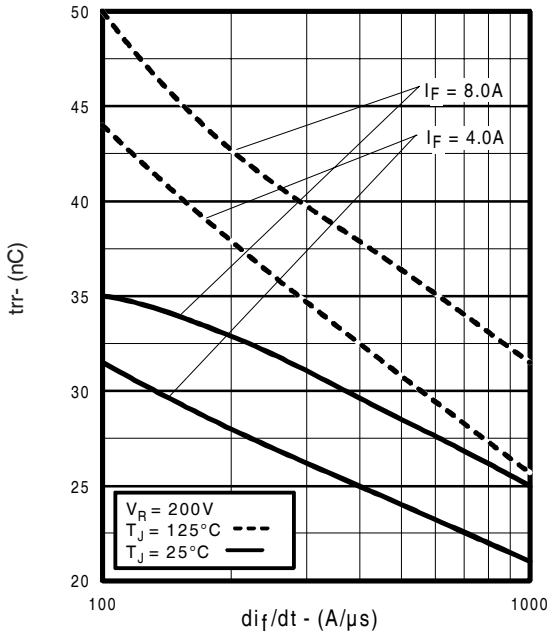


Fig. 14 - Typical Reverse Recovery vs. dI_f/dt

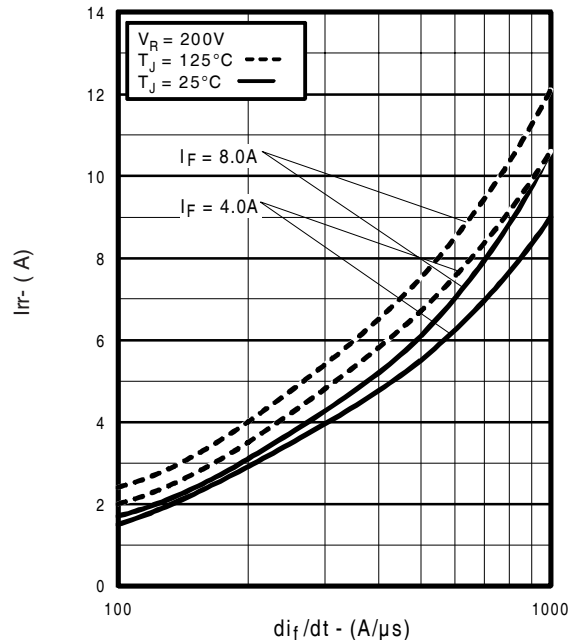


Fig. 15 - Typical Recovery Current vs. dI_f/dt

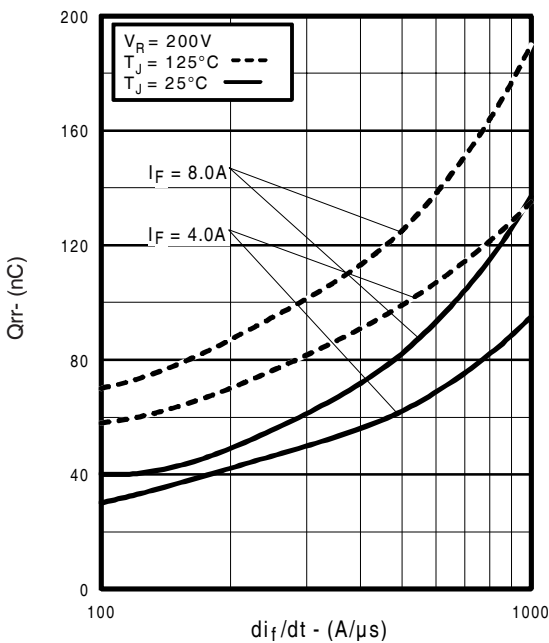


Fig. 16 - Typical Stored Charge vs. dI_f/dt

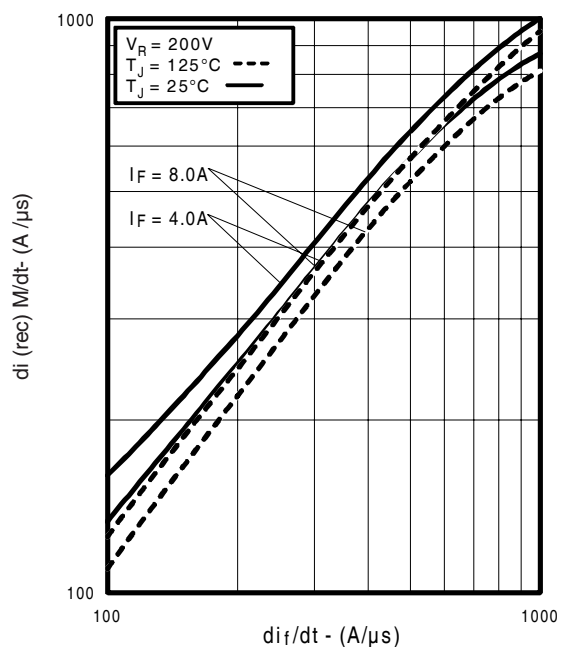


Fig. 17 - Typical $dI_{(rec)M}/dt$ vs. dI_f/dt ,

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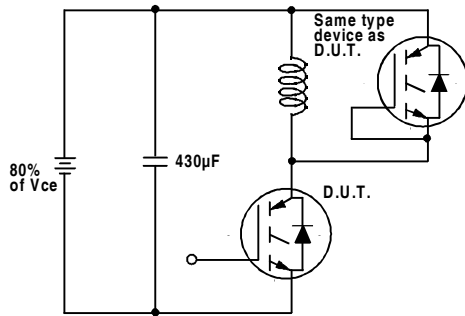


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

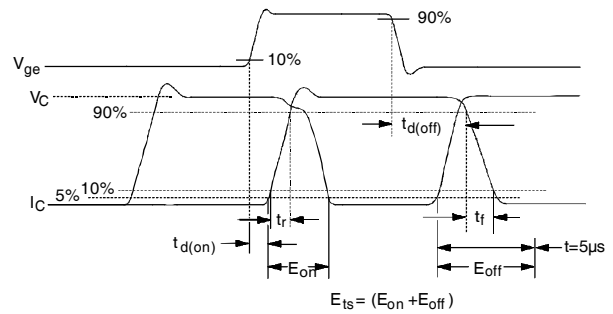


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

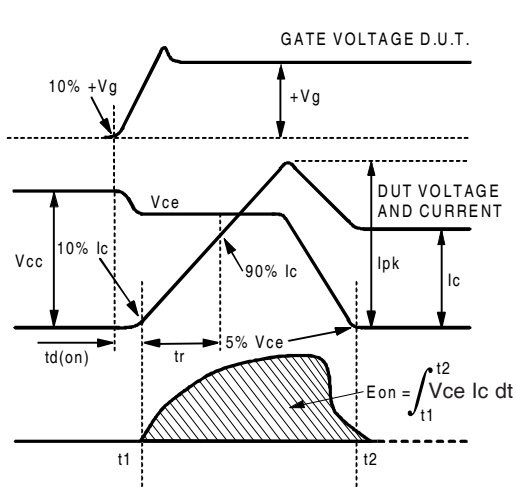


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

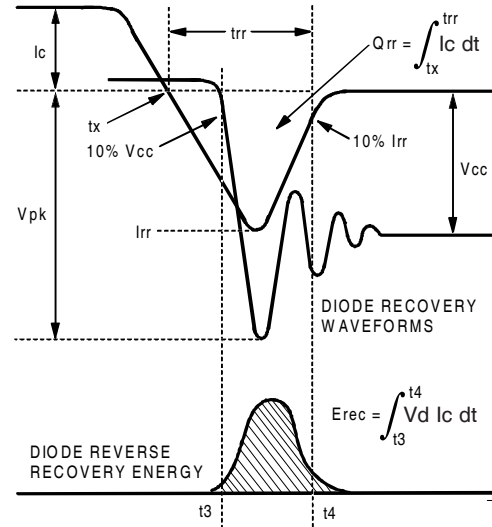


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

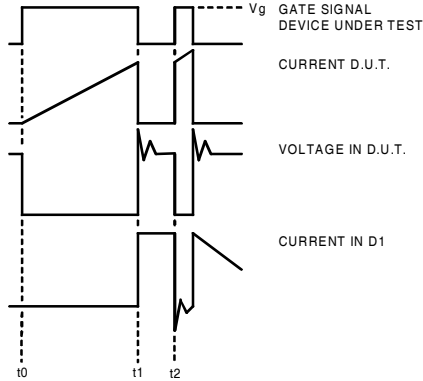


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

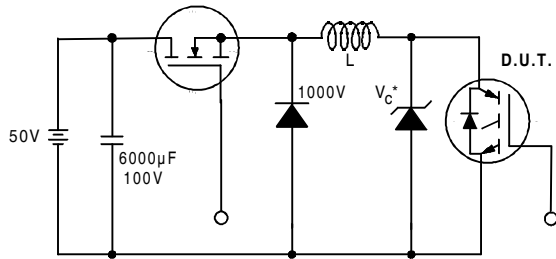


Figure 19. Clamped Inductive Load Test Circuit

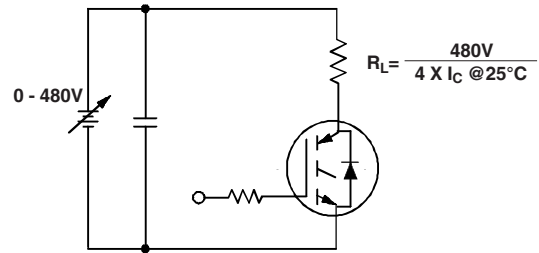
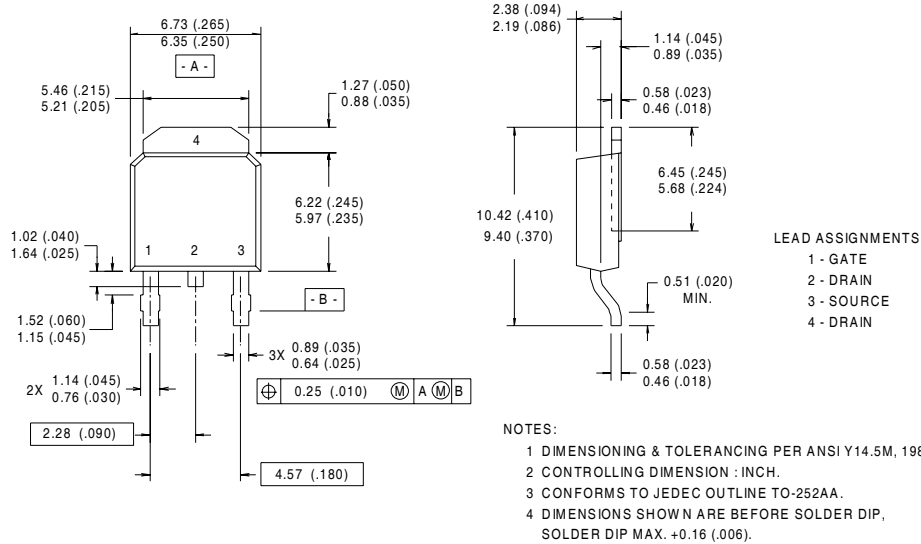


Figure 20. Pulsed Collector Current Test Circuit

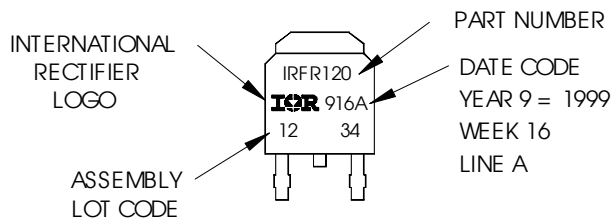
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D-Pak (TO-252AA) Package Outline

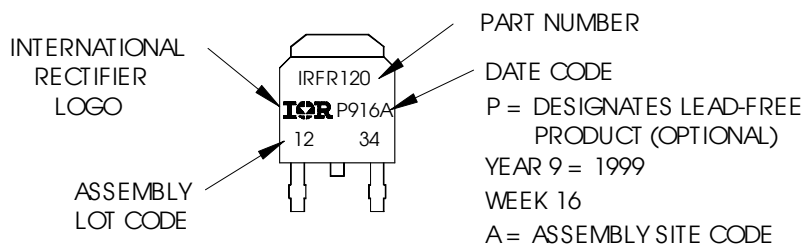


D-Pak (TO-252AA) Part Marking Information

EXAMPLE: THIS IS AN IRFR120
 WITH ASSEMBLY
 LOT CODE 1234
 ASSEMBLED ON WW 16, 1999
 IN THE ASSEMBLY LINE "A"
 Note: "P" in assembly line
 position indicates "Lead-Free"



OR

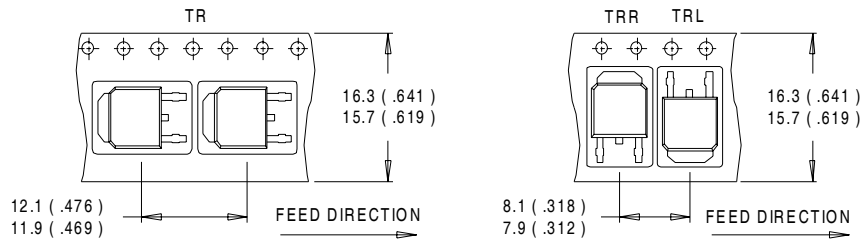


Notes:

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

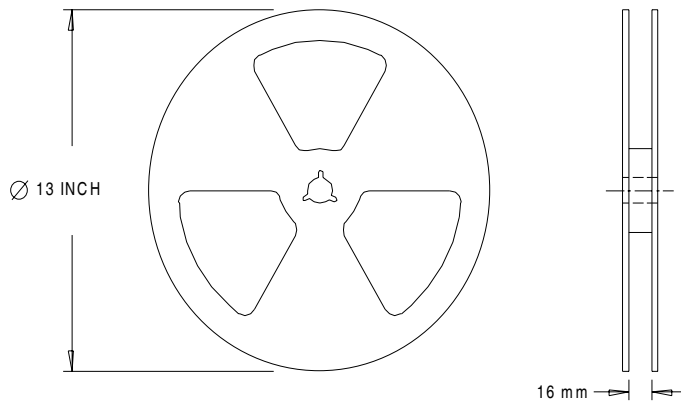
D-Pak (TO-252AA) Tape & Reel Information

Dimensions are shown in millimeters (inches)



NOTES :

- 1. CONTROLLING DIMENSION : MILLIMETER.
- 2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
- 3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



NOTES :

- 1. OUTLINE CONFORMS TO EIA-481.