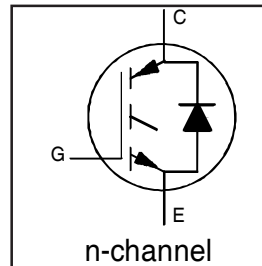


IRG4PH40UD2-E

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

Features

- UltraFast IGBT optimized for high operating frequencies up to 200kHz in resonant mode
- IGBT co-packaged with HEXFRED™ ultrafast ultra-soft-recovery anti-parallel diode for use in resonant circuits
- Industry standard TO-247AD package with extended leads



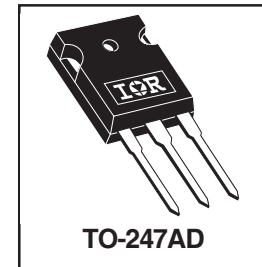
$V_{CES} = 1200V$
$V_{CE(on) typ.} = 2.43V$
@ $V_{GE} = 15V, I_C = 21A$

Benefits

- Higher switching frequency capability than competitive IGBTs
- Highest efficiency available
- HEXFRED diodes optimized for performance with IGBTs. Minimized recovery characteristics require less / no snubbing

Applications

- Induction cooking systems
- Microwave Ovens
- Resonant Circuits



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	41	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	21	
I_{CM}	Pulse Collector Current ①	82	
I_{LM}	Clamped Inductive Load current ②	82	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	10	
I_{FM}	Diode Maximum Forward Current	40	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	160	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	65	
T_J	Operating Junction and Storage Temperature Range	-55 to +150	°C
T_{STG}			
	Mounting Torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

Thermal / Mechanical Characteristics

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case- IGBT	—	—	0.77	°C/W
$R_{\theta JC}$	Junction-to-Case- Diode	—	—	2.5	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	40	
Wt	Weight	—	6 (0.21)	—	g (oz.)

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

Parameter	Min.	Typ.	Max.	Units	Conditions	
V _{(BR)CES}	1200	—	—	V	V _{GE} = 0V, I _C = 250μA	
V _{(BR)ECS}	18	—	—	V	V _{GE} = 0V, I _C = 1.0A	
ΔV _{(BR)CES} /ΔT _J	—	0.43	—	V/°C	V _{GE} = 0V, I _C = 1mA	
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	2.43	3.1	V	I _C = 21A, V _{GE} = 15V
		—	2.97	—		I _C = 41A, See Fig.2, 5
		—	2.47	—		I _C = 21A, T _J = 150°C
V _{GE(th)}	3.0	—	6.0		V _{CE} = V _{GE} , I _C = 250μA	
ΔV _{GE(th)} /ΔT _J	—	-11	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA	
g _f	16	24	—	S	V _{CE} = 100V, I _C = 21A	
I _{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	V _{GE} = 0V, V _{CE} = 1200V
		—	—	5000		V _{GE} = 0V, V _{CE} = 1200V, T _J = 150°C
V _{FM}	Diode Forward Voltage Drop	—	3.4	3.8	V	I _F = 10A, See Fig.13
		—	3.3	3.7		I _F = 10A, 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	—	100	150		I _C = 21A	
Q _{ge}	—	18	24	nC	V _{CC} = 400V, See Fig.8	
Q _{gc}	—	34	50		V _{GE} = 15V	
t _{d(on)}	—	22	—	ns	I _C = 21A, V _{CC} = 800V V _{GE} = 15V, R _G = 10Ω Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18	
t _r	—	26	—			
t _{d(off)}	—	100	140			
t _f	—	200	300			
E _{on}	—	1950	—	μJ	T _J = 150°C, See Fig. 9, 10, 11, 18 I _C = 21A, V _{CC} = 800V V _{GE} = 15V, R _G = 10Ω Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18	
E _{off}	—	1710	—			
E _{tot}	—	3660	4490			
t _{d(on)}	—	21	—	ns	T _J = 150°C, See Fig. 9, 10, 11, 18 I _C = 21A, V _{CC} = 800V V _{GE} = 15V, R _G = 10Ω Energy losses include "tail" and diode reverse recovery.	
t _r	—	25	—			
t _{d(off)}	—	220	—			
t _f	—	380	—			
E _{TS}	—	6220	—	μJ	Measured 5mm from package	
L _E	—	13	—	nH		
C _{ies}	—	2100	—	pF	V _{GE} = 0V V _{CC} = 30V, See Fig.7 f = 1.0MHz	
C _{oes}	—	99	—			
C _{res}	—	12	—			
t _{rr}	Diode Reverse Recovery Time	—	50	76	ns	T _J =25°C, See Fig. 14
		—	72	110		T _J =125°C
I _{rr}	Diode Peak Reverse Recovery Current	—	4.4	7.0	A	T _J =25°C, See Fig. 15
		—	5.9	8.8		T _J =125°C
Q _{rr}	Diode Reverse Recovery Charge	—	130	200	nC	T _J =25°C, See Fig. 16
		—	250	380		T _J =125°C
di _(rec) /dt	Diode Peak Rate of Fall of Recovery During t _b	—	210	—	A/μs	T _J =25°C, See Fig. 17
		—	180	—		T _J =125°C

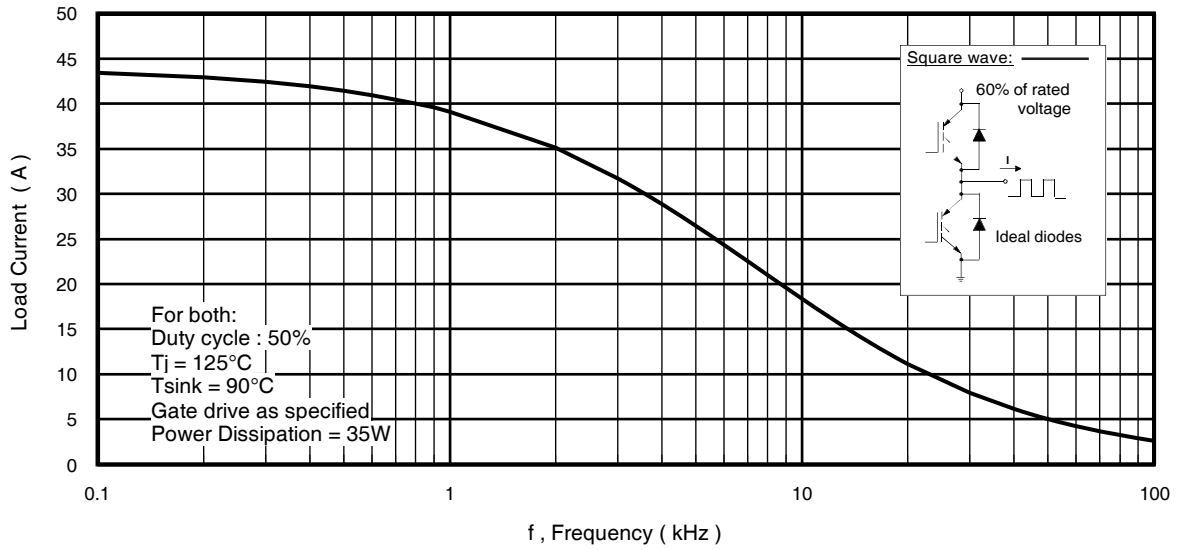


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

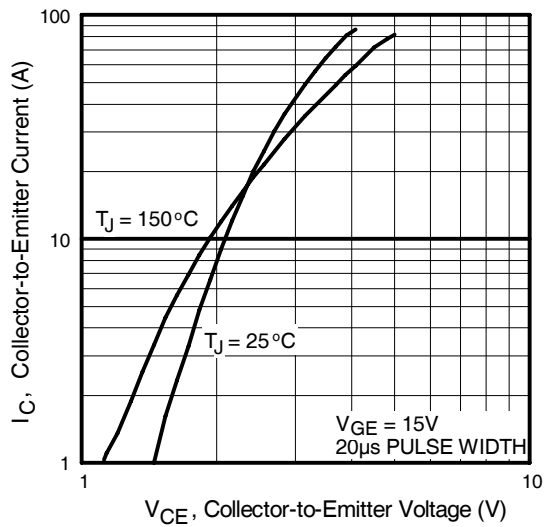


Fig. 2 - Typical Output Characteristics
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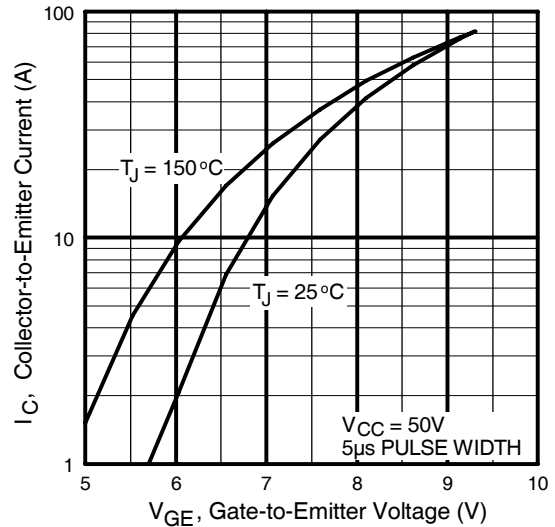


Fig. 3 - Typical Transfer Characteristics

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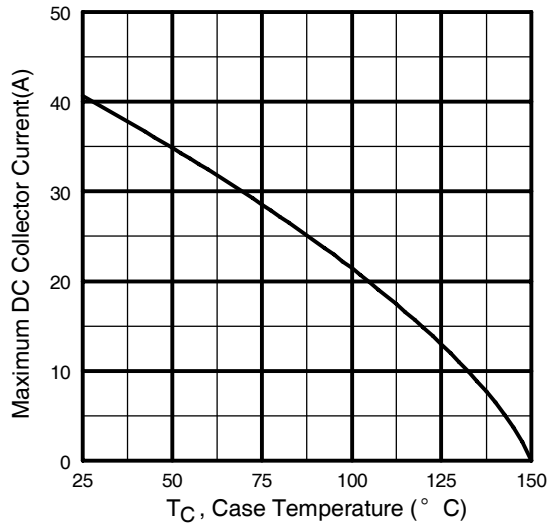


Fig. 4 - Maximum Collector Current vs. Case Temperature

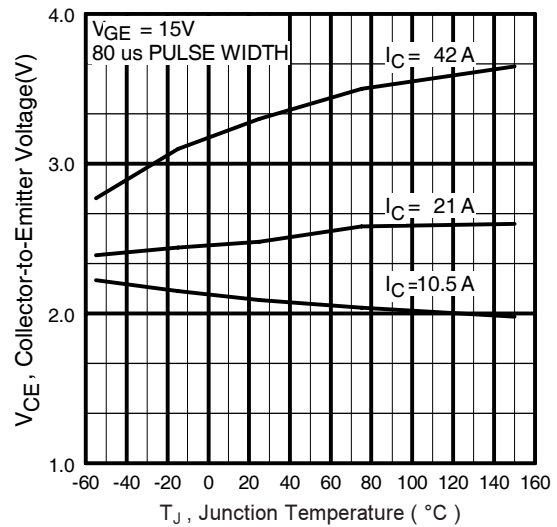


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

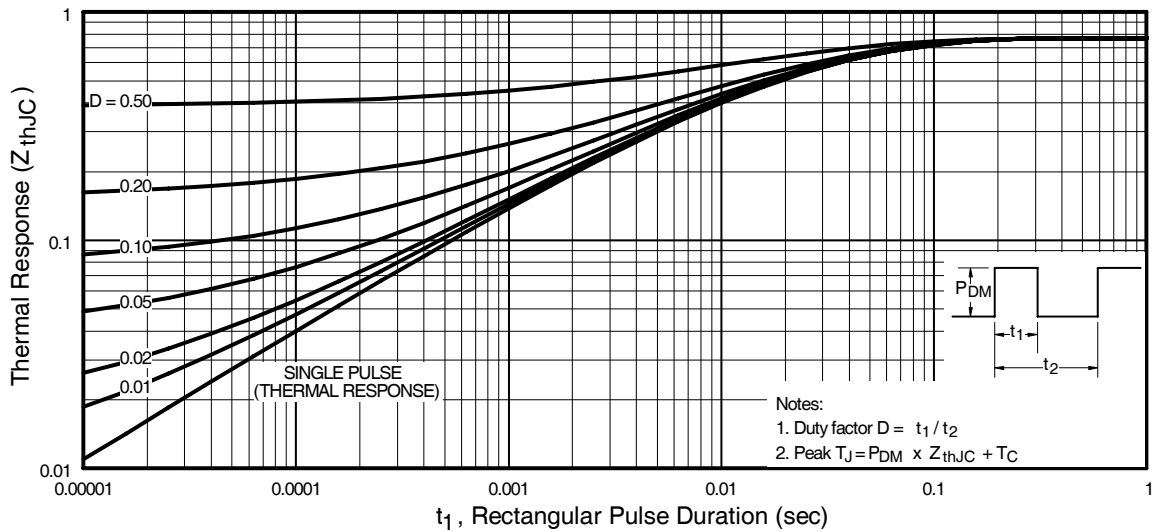


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

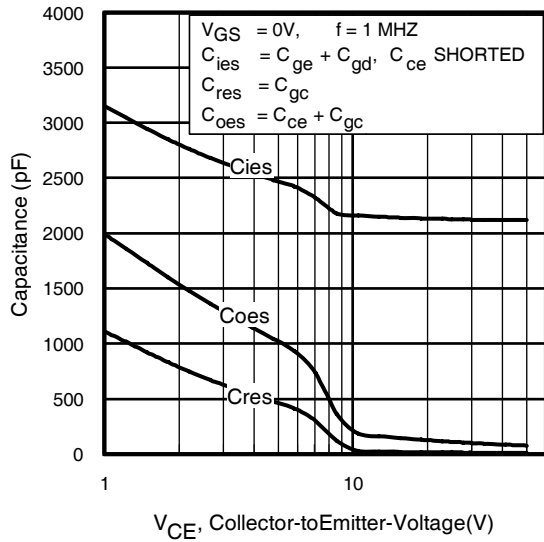


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

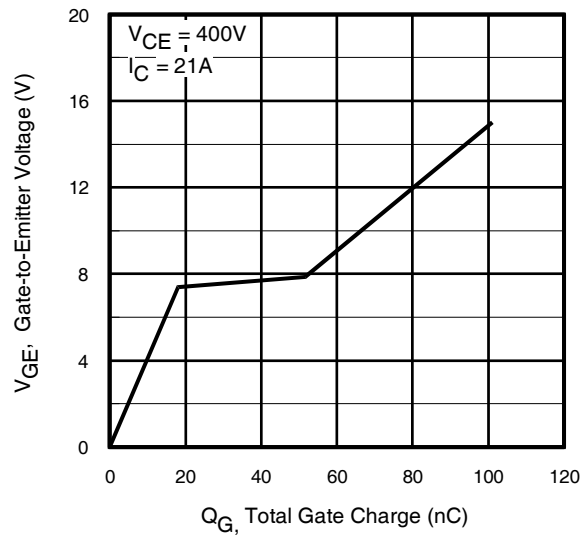


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

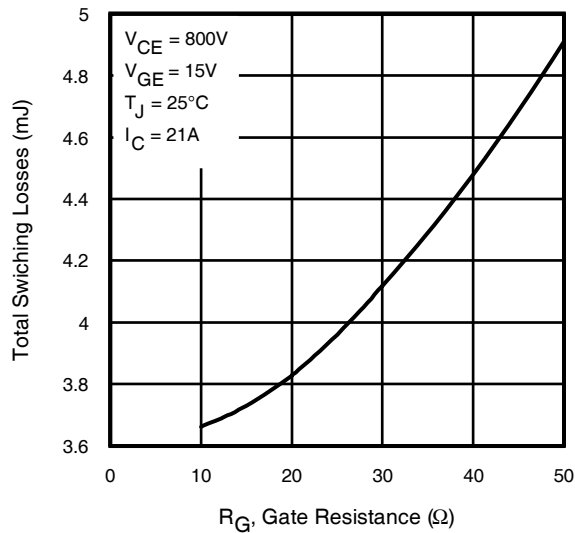


Fig. 9 - Typical Switching Losses vs. Gate Resistance

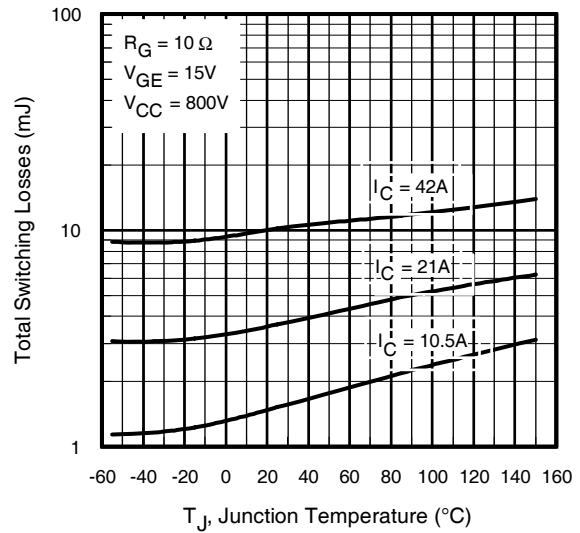


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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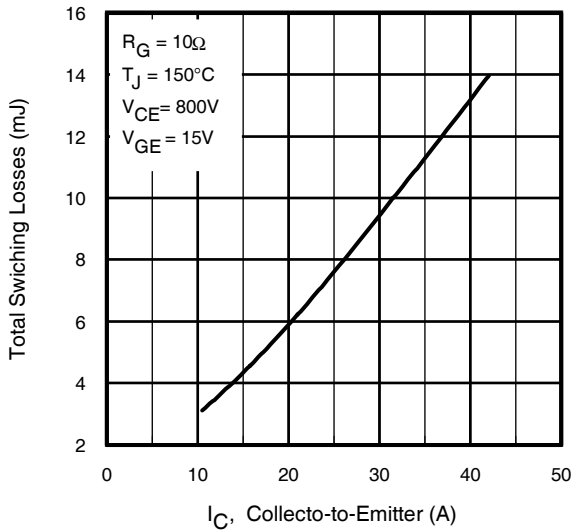


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

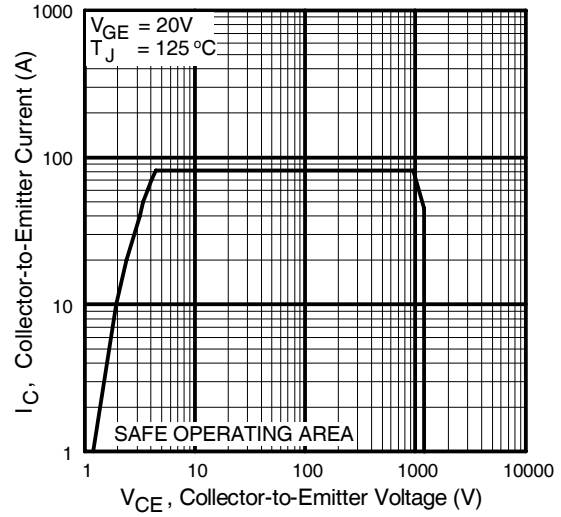


Fig. 12 - Turn-Off SOA

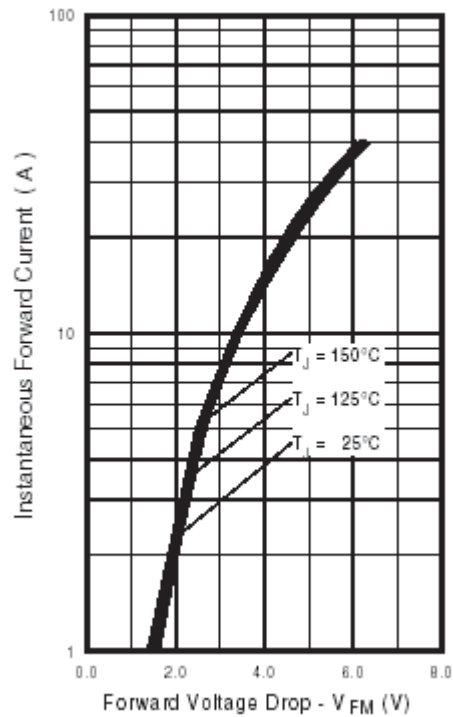


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

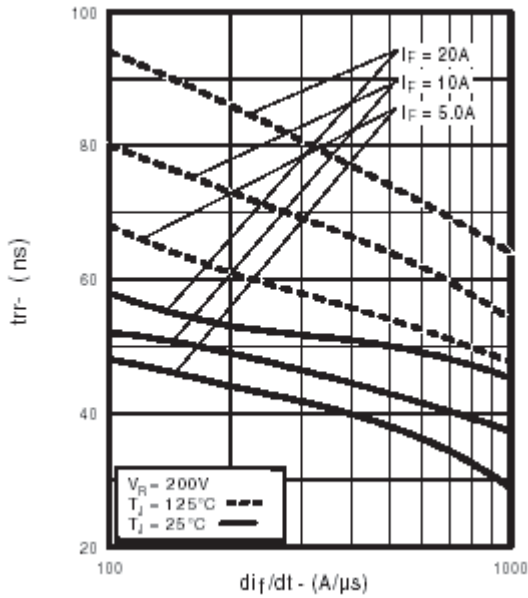


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

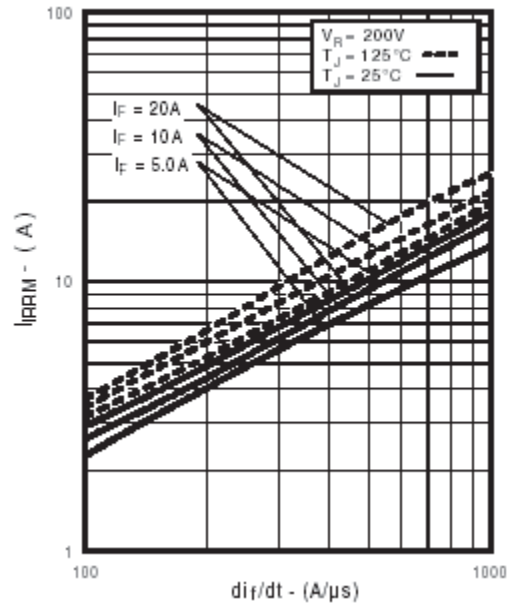


Fig. 15 - Typical Recovery Current vs. di_f/dt

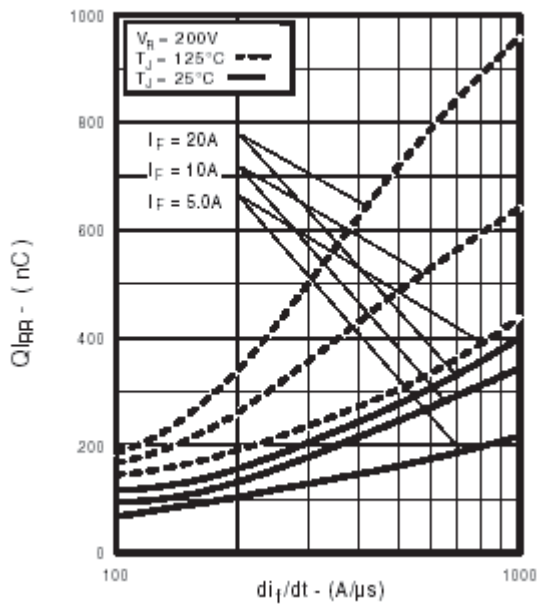


Fig. 16 - Typical Stored Charge vs. di_f/dt
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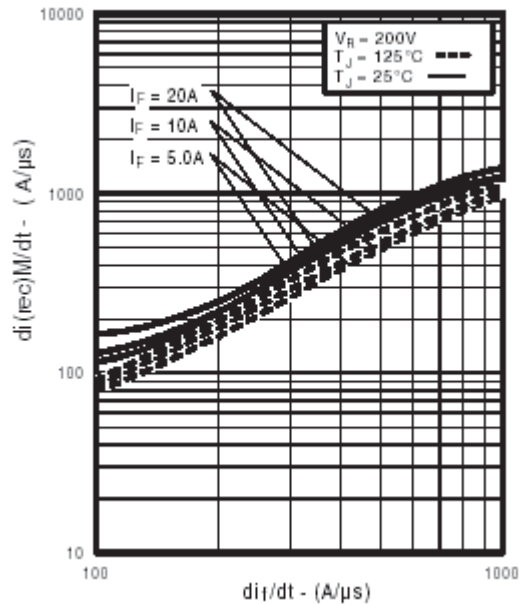


Fig. 17 - Typical $di_{(rec)}M/dt$ vs. di_f/dt

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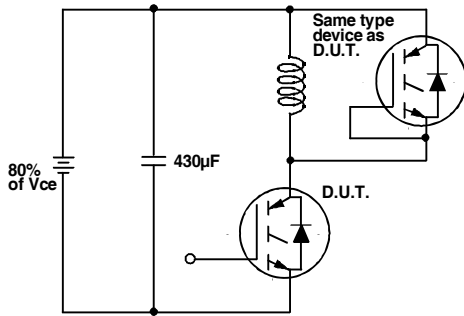


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

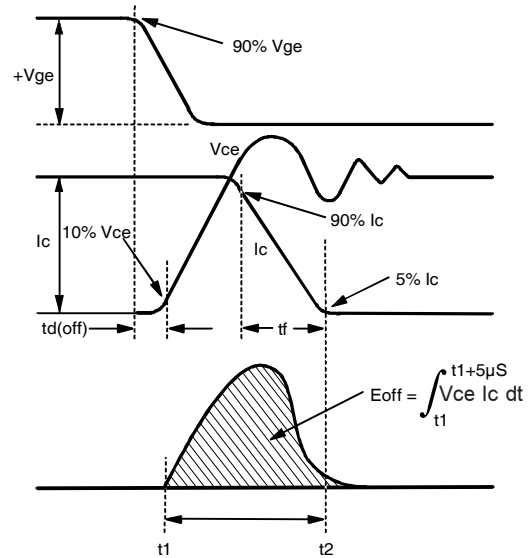


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

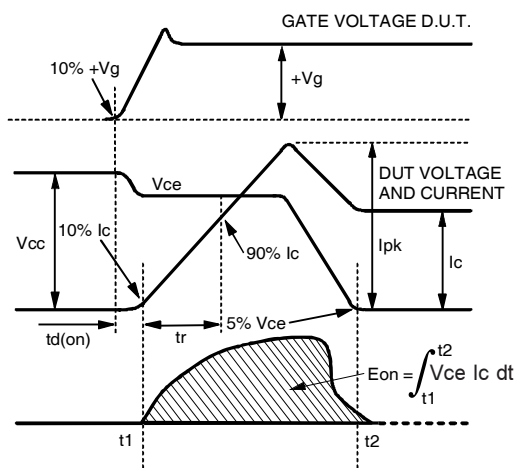


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

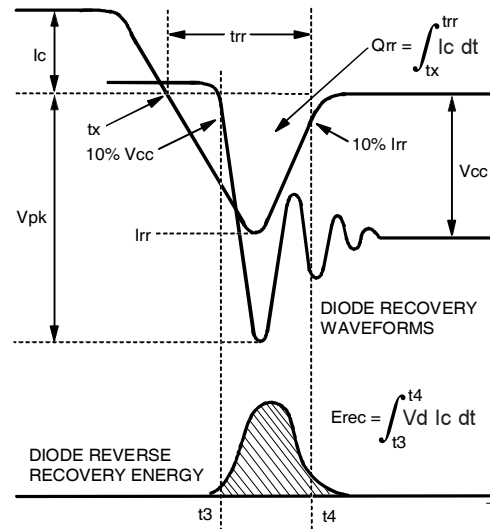


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

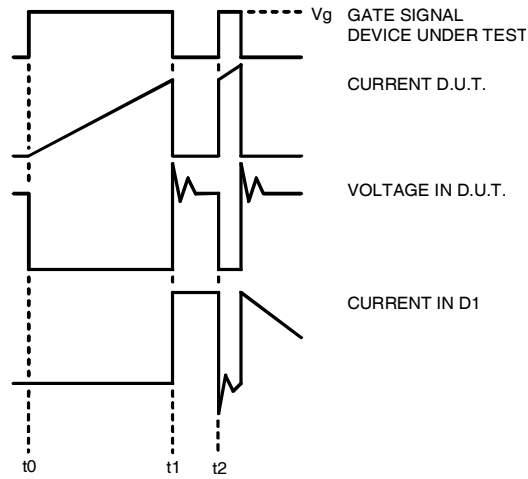


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

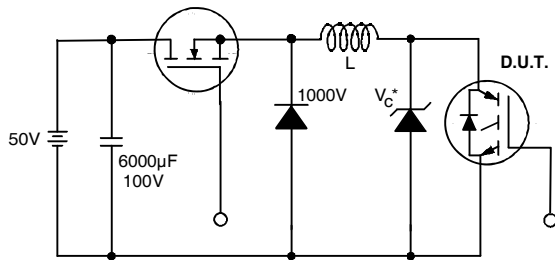


Figure 19. Clamped Inductive Load Test Circuit

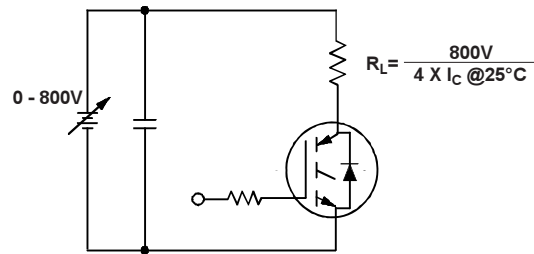


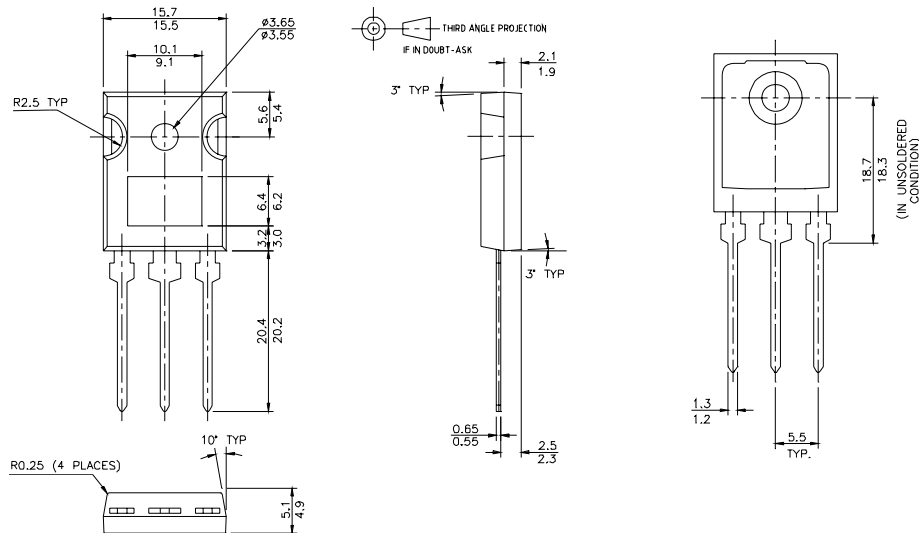
Figure 20. Pulsed Collector Current Test Circuit

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TO-247AD Package Outline

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Dimensions are shown in millimeters (inches)

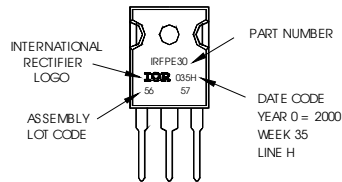


TO-247AD Part Marking Information

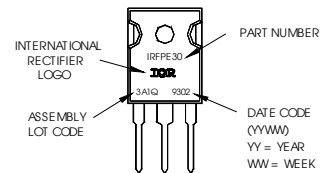
Notes: This part marking information applies to devices produced after 02/26/2001

Notes: This part marking information applies to devices produced before 02/26/2001 or for parts manufactured in GB.

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5667
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE "H"



EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 3A1Q



Notes:

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

TO-247AD package is not recommended for Surface Mount Application.

Data and specifications subject to change without notice.
This product has been designed and qualified for Industrial market.
Qualification Standards can be found on IR's Web site.

International
IR Rectifier

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www.irf.com

Note: For the most current drawings please refer to the IR website at:
<http://www.irf.com/package/>