

IRG4PC40UDPbF

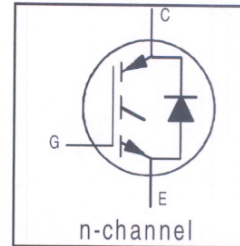
INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

Features

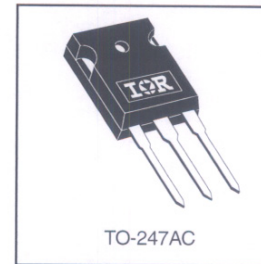
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft recovery anti-parallel diodes for use in bridge configurations
- Industry standard TO-247AC 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
- Designed to be a "drop-in" replacement for equivalent industry-standard Generation 3 IR IGBT's



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 1.72V$
@ $V_{GE} = 15V, I_C = 20A$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	40	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	20	
I_{CM}	Pulsed Collector Current ①	160	
I_{LM}	Clamped Inductive Load Current ②	160	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	15	
I_{FM}	Diode Maximum Forward Current	160	V
V_{GE}	Gate-to-Emitter Voltage	± 20	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	160	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	65	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting Torque, 6-32 or M3 Screw.	10 lbf•in (1.1 N•m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	-----	-----	0.77	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	-----	-----	1.7	
$R_{\theta CS}$	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)

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 ^③	600	----	----	V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	----	0.63	----	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	----	1.72	2.1	V	$I_C = 20A, V_{GE} = 15V$
		----	2.15	----		$I_C = 40A, V_{GE} = 15V$
		----	1.7	----		$I_C = 20A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	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/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ^④	11	18	----	S	$V_{CE} = 100V, I_C = 20A$
I_{CES}	Zero Gate Voltage Collector Current	----	----	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		----	----	3500		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	----	1.3	1.7	V	$I_C = 15A, V_{GE} = 15V$
		----	1.2	1.6		$I_C = 15A, T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	----	----	± 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)	----	100	150	nC	$I_C = 20A, V_{CC} = 400V, V_{GE} = 15V$
Q_{ge}	Gate - Emitter Charge (turn-on)	----	16	25		See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	----	40	60		
$t_{d(on)}$	Turn-On Delay Time	----	54	----	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	----	57	----		$I_C = 20A, V_{CC} = 480V, V_{GE} = 15V, R_G = 10\Omega$
$t_{d(off)}$	Turn-Off Delay Time	----	110	165		Energy losses include "tail" and diode reverse recovery.
t_f	Fall Time	----	80	120	mJ	See Fig. 9, 10, 11, 18
E_{on}	Turn-On Switching Loss	----	0.71	----		
E_{off}	Turn-Off Switching Loss	----	0.35	----		
E_{ts}	Total Switching Loss	----	1.10	1.5	mJ	$T_J = 150^\circ\text{C}, I_C = 20A, V_{CC} = 480V, V_{GE} = 15V, R_G = 10\Omega$
$t_{d(on)}$	Turn-On Delay Time	----	40	----		See Fig. 9, 10, 11, 18
t_r	Rise Time	----	52	----		
$t_{d(off)}$	Turn-Off Delay Time	----	200	----	ns	$T_J = 150^\circ\text{C}, I_C = 20A, V_{CC} = 480V, V_{GE} = 15V, R_G = 10\Omega$
t_f	Fall Time	----	130	----		Energy losses include "tail" and diode reverse recovery.
E_{ts}	Total Switching Loss	----	1.6	----		
L_E	Internal Emitter Inductance	----	13	----	nH	Measured 5mm from package
C_{ies}	Input Capacitance	----	2100	----	pF	$V_{GE} = 0V, V_{CC} = 30V, f = 1.0MHz$
C_{oes}	Output Capacitance	----	140	----		See Fig. 7
C_{res}	Reverse Transfer Capacitance	----	34	----		
t_{rr}	Diode Reverse Recovery Time	----	42	60	ns	$T_J = 25^\circ\text{C}$ See Fig. 14
		----	74	120		$T_J = 125^\circ\text{C}$ 15
I_{rr}	Diode Peak Reverse Recovery Current	----	4.0	6.0	A	$T_J = 25^\circ\text{C}$ See Fig. 15
		----	6.5	10		$T_J = 125^\circ\text{C}$ 15
Q_{rr}	Diode Reverse Recovery Charge	----	80	180	nC	$T_J = 25^\circ\text{C}$ See Fig. 16
		----	220	600		$T_J = 125^\circ\text{C}$ 16
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	----	190	----	A/ μs	$T_J = 25^\circ\text{C}$
		----	160	----		$T_J = 125^\circ\text{C}$

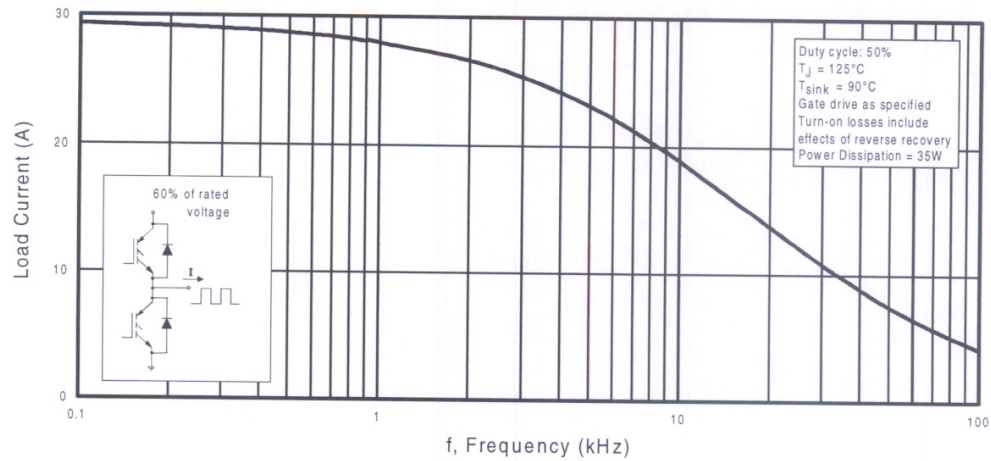


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

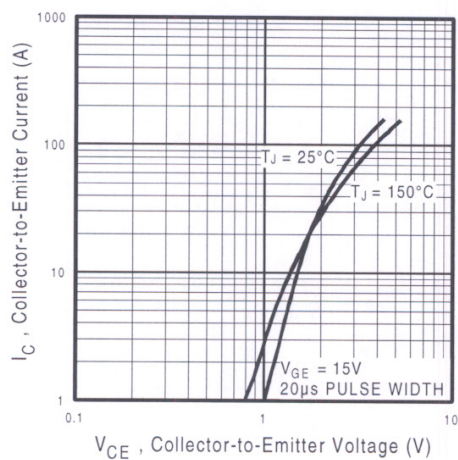


Fig. 2 - Typical Output Characteristics

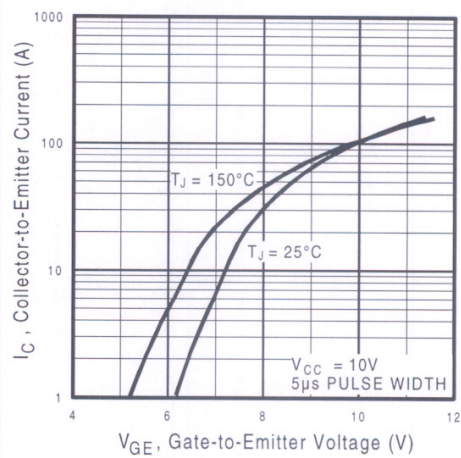


Fig. 3 - Typical Transfer Characteristics

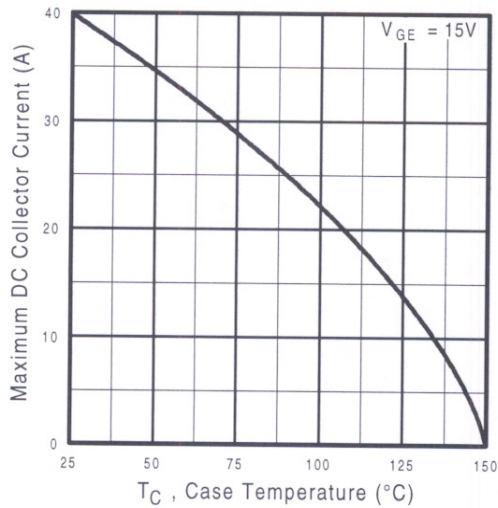


Fig. 4 - Maximum Collector Current vs. Case Temperature

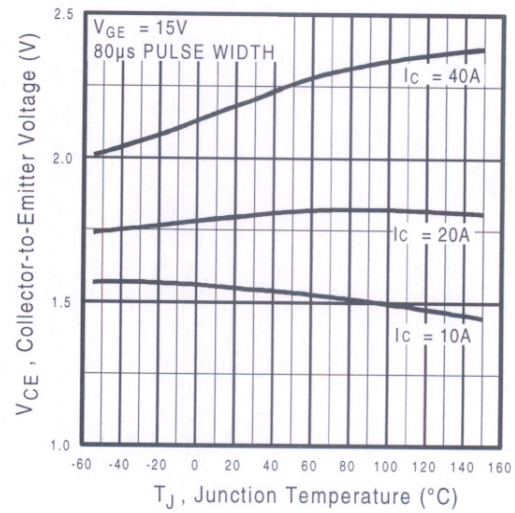


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

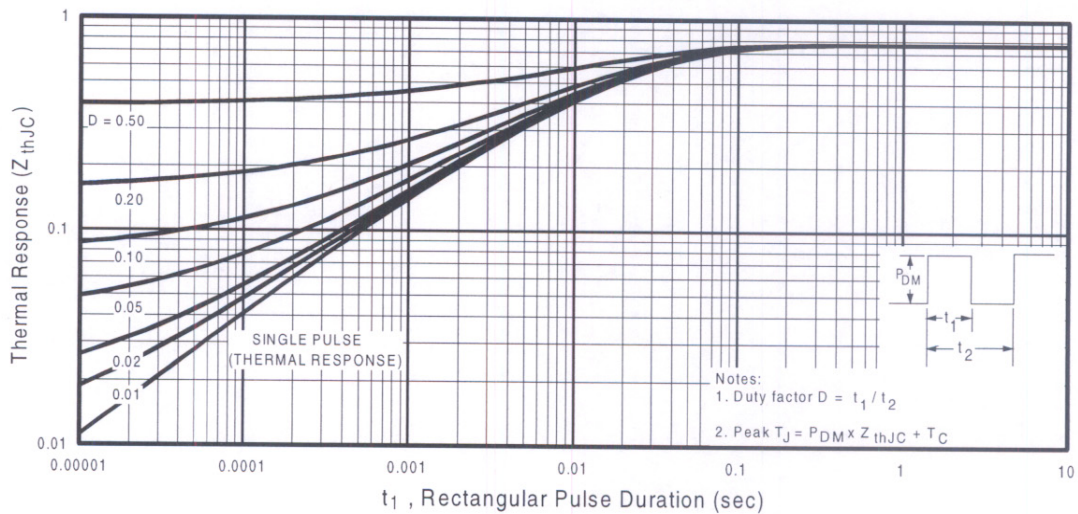


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

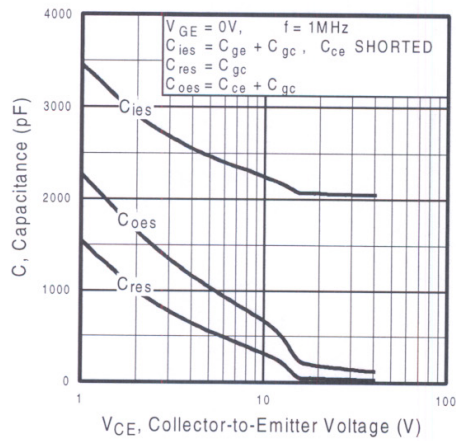


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

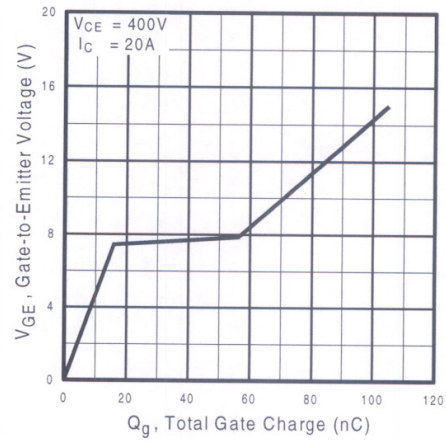


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

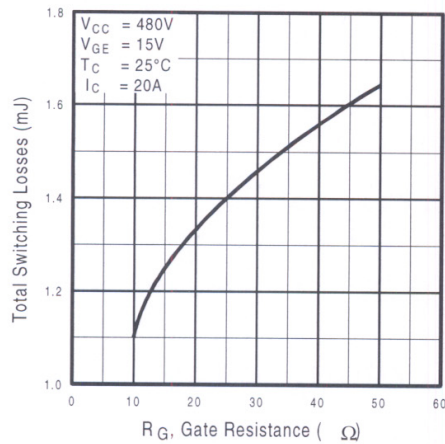


Fig. 9 - Typical Switching Losses vs. Gate Resistance

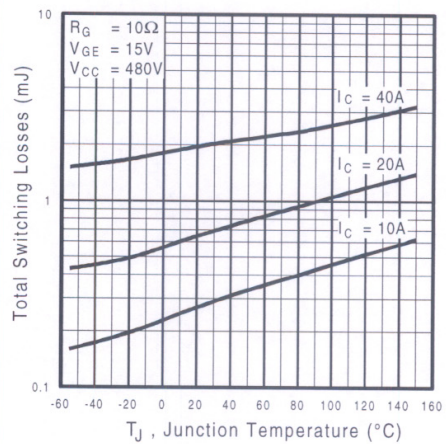
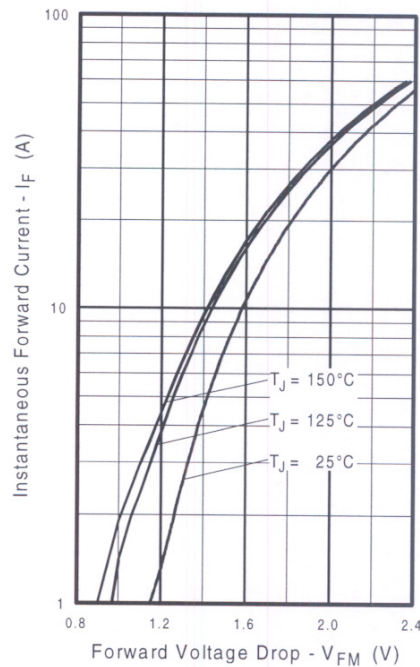
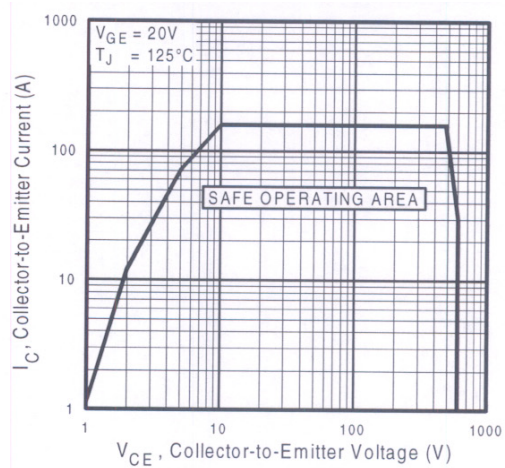
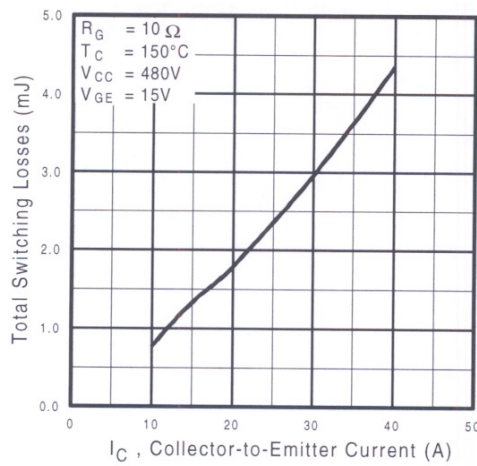


Fig. 10 - Typical Switching Losses vs. Junction Temperature



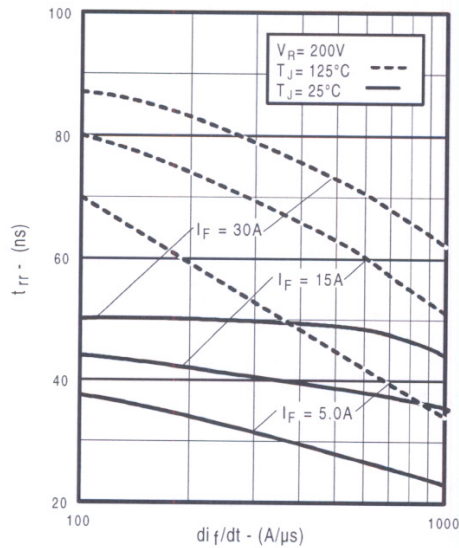


Fig. 14 - Typical Reverse Recovery vs. di/dt

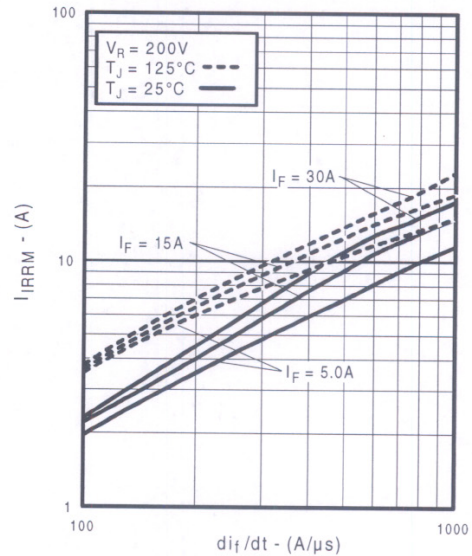


Fig. 15 - Typical Recovery Current vs. di/dt

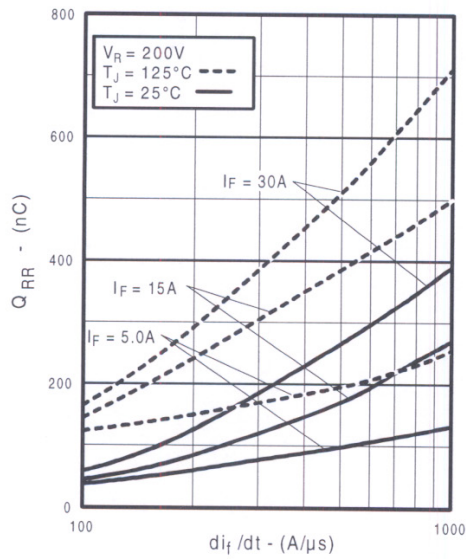


Fig. 16 - Typical Stored Charge vs. di/dt

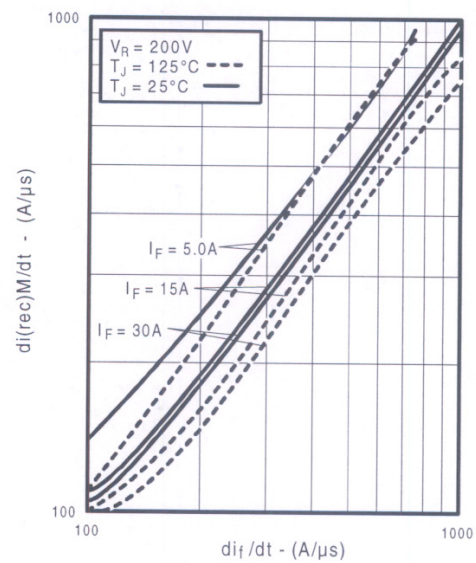


Fig. 17 - Typical $di_{(rec)}M/dt$ vs. di/dt

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International
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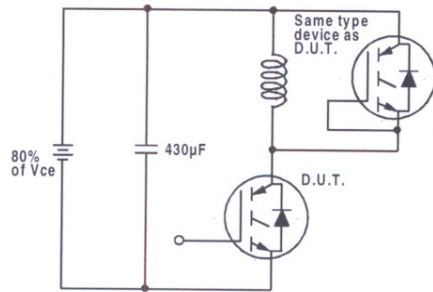


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

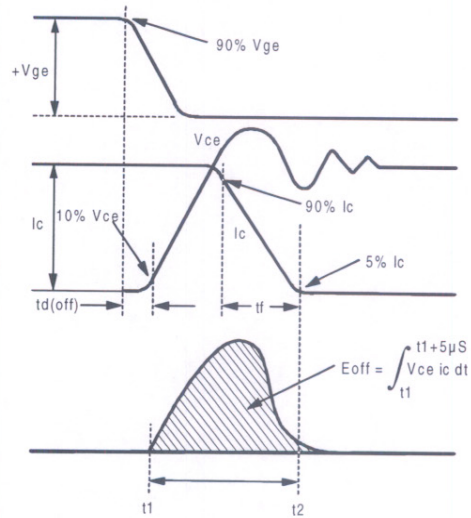


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

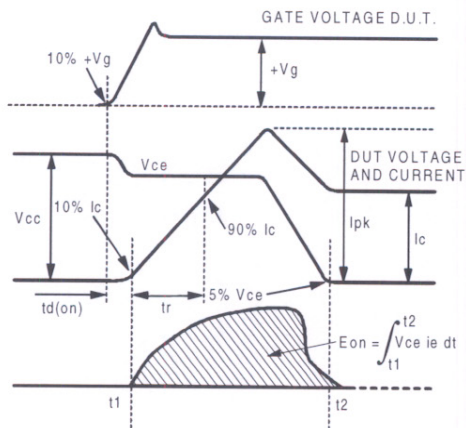


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

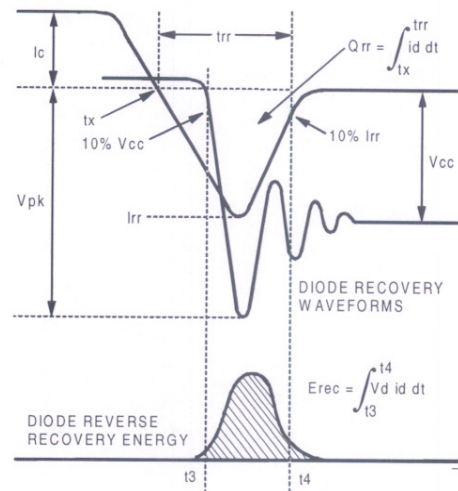


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

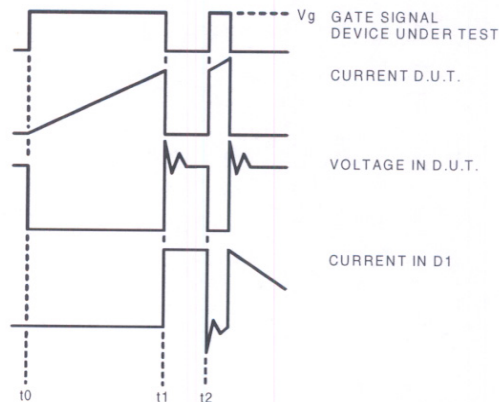


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

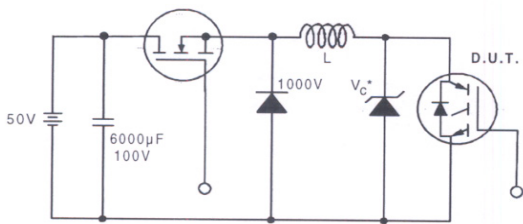


Figure 19. Clamped Inductive Load Test Circuit

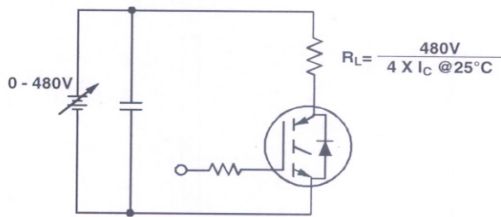
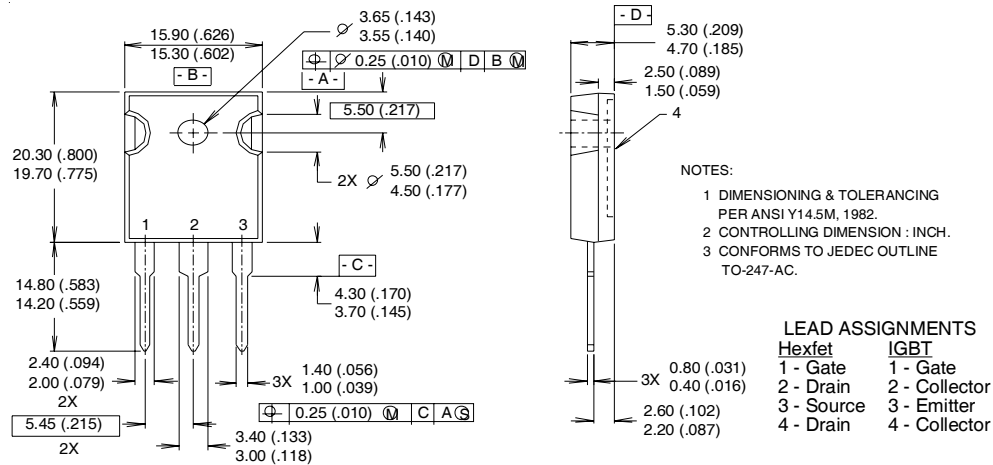


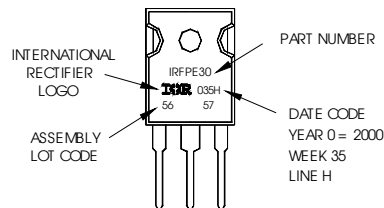
Figure 20. Pulsed Collector Current Test Circuit

International
IOR Rectifier

Dimensions are shown in millimeters (inches)



EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE "H"
Note: "P" in assembly line
position indicates "Lead-Free"



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 $\leq 80\mu\text{s}$; duty factor $\leq 0.1\%$.

④ Pulse width 5.0 μ s, single shot.

Data and specifications subject to change without notice.

International
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Note: For the most current drawings please refer to the IR website at:
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