

IRG4PC40UDPbF

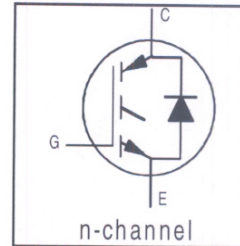
INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

Features

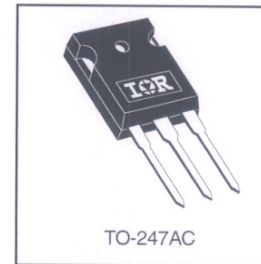
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft recovery anti-parallel diodes for 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 Voltage③	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/°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/°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	$I_C = 15A, \text{See Fig. 13}$
		----	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	$I_C = 20A$
Q_{ge}	Gate - Emitter Charge (turn-on)	----	16	25		$V_{CC} = 400V, \text{See Fig. 8}$
Q_{gc}	Gate - Collector Charge (turn-on)	----	40	60		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	----	54	----	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	----	57	----		$I_C = 20A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	----	110	165		$V_{GE} = 15V, R_G = 10\Omega$
t_f	Fall Time	----	80	120		Energy losses include "tail" and diode reverse recovery.
E_{on}	Turn-On Switching Loss	----	0.71	----	mJ	See Fig. 9, 10, 11, 18
E_{off}	Turn-Off Switching Loss	----	0.35	----		
E_{ts}	Total Switching Loss	----	1.10	1.5		
$t_{d(on)}$	Turn-On Delay Time	----	40	----	ns	$T_J = 150^\circ\text{C}, \text{See Fig. 9, 10, 11, 18}$
t_r	Rise Time	----	52	----		$I_C = 20A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	----	200	----		$V_{GE} = 15V, R_G = 10\Omega$
t_f	Fall Time	----	130	----		Energy losses include "tail" and diode reverse recovery.
E_{ts}	Total Switching Loss	----	1.6	----	mJ	
L_E	Internal Emitter Inductance	----	13	----	nH	Measured 5mm from package
C_{ies}	Input Capacitance	----	2100	----	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	----	140	----		$V_{CC} = 30V, \text{See Fig. 7}$
C_{res}	Reverse Transfer Capacitance	----	34	----		$f = 1.0MHz$
t_{rr}	Diode Reverse Recovery Time	----	42	60	ns	$T_J = 25^\circ\text{C}, \text{See Fig. 14}$
		----	74	120		$T_J = 125^\circ\text{C}, \text{See Fig. 15}$
I_{rr}	Diode Peak Reverse Recovery Current	----	4.0	6.0	A	$T_J = 25^\circ\text{C}, \text{See Fig. 15}$
		----	6.5	10		$T_J = 125^\circ\text{C}, \text{See Fig. 16}$
Q_{rr}	Diode Reverse Recovery Charge	----	80	180	nC	$T_J = 25^\circ\text{C}, \text{See Fig. 16}$
		----	220	600		$T_J = 125^\circ\text{C}, \text{See Fig. 16}$
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	----	190	----	A/ μs	$T_J = 25^\circ\text{C}$
		----	160	----		$T_J = 125^\circ\text{C}$

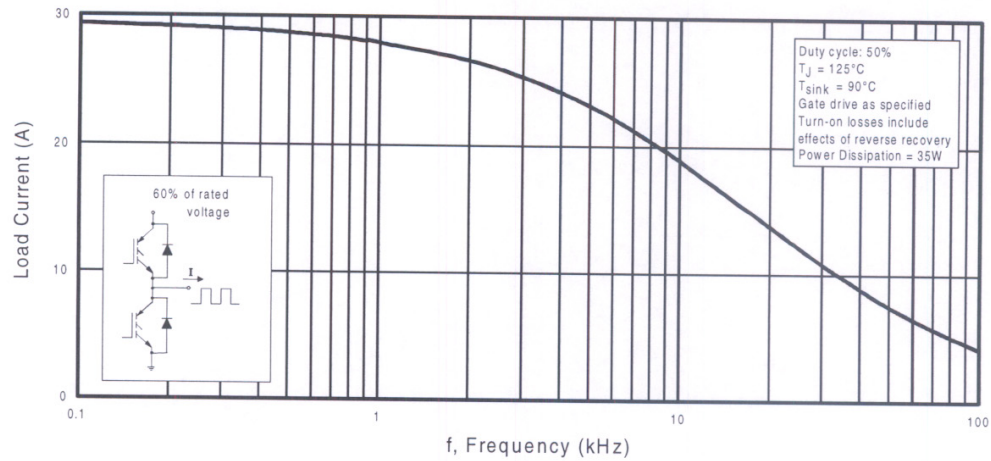


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

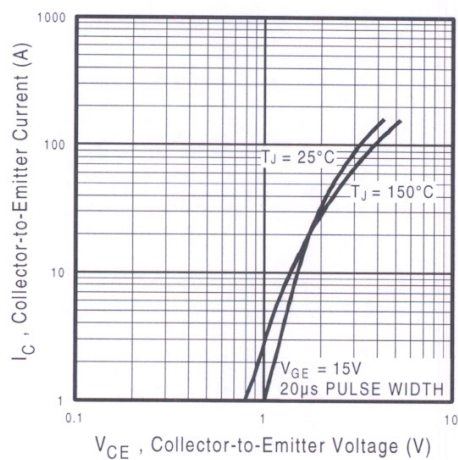


Fig. 2 - Typical Output Characteristics

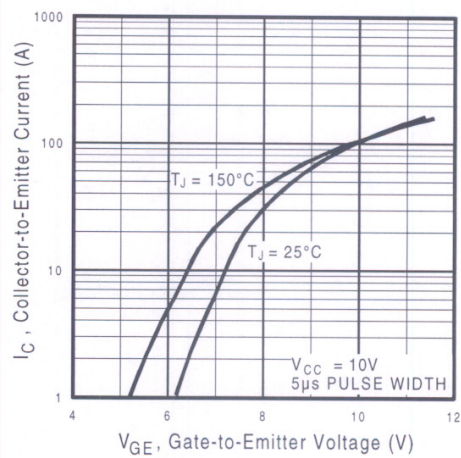


Fig. 3 - Typical Transfer Characteristics

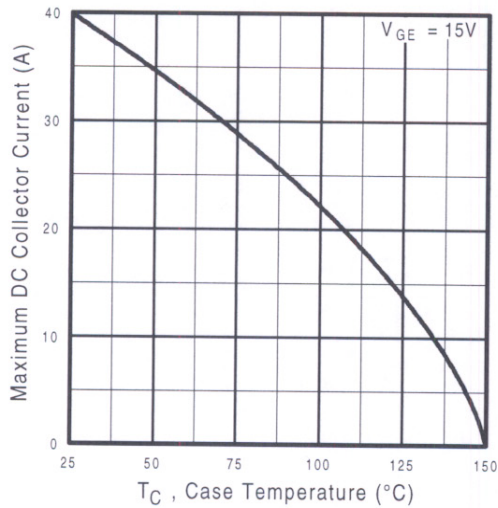


Fig. 4 - Maximum Collector Current vs. Case Temperature

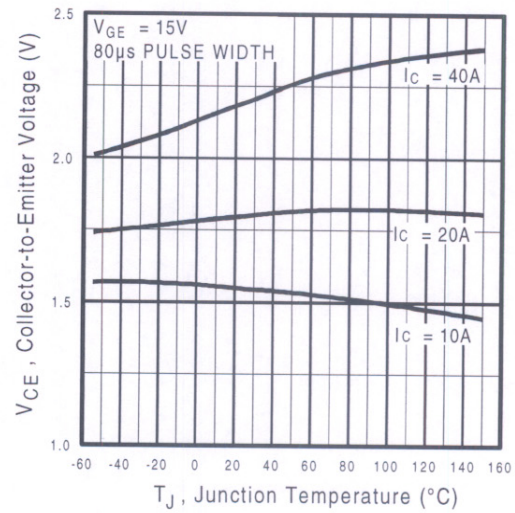


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

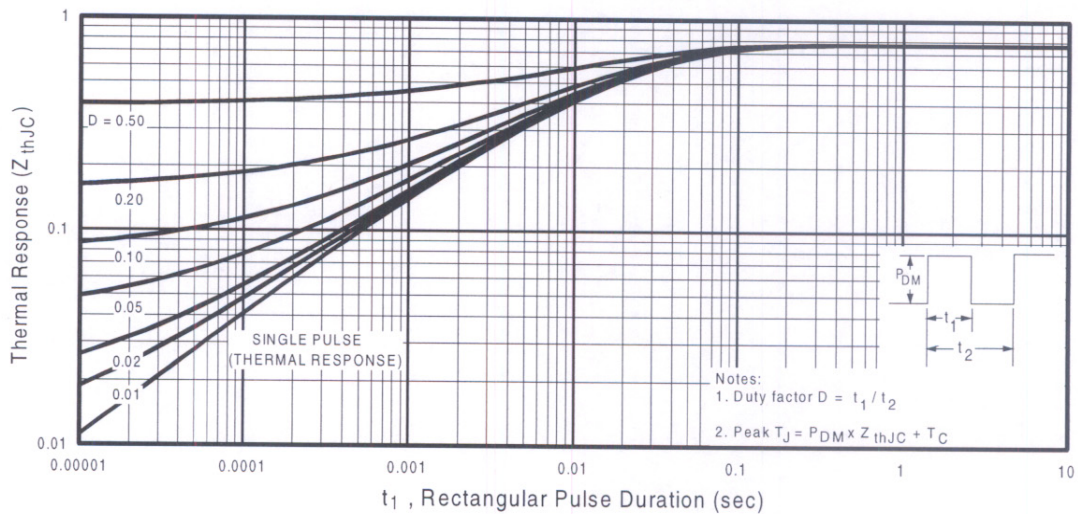


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

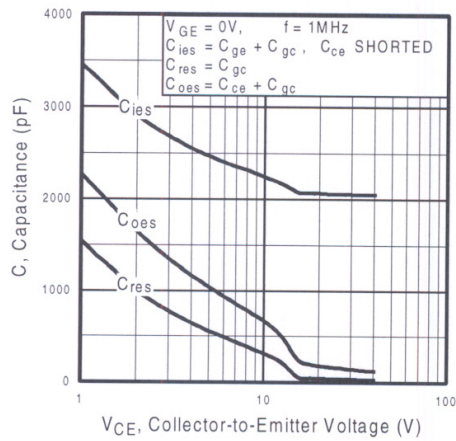


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

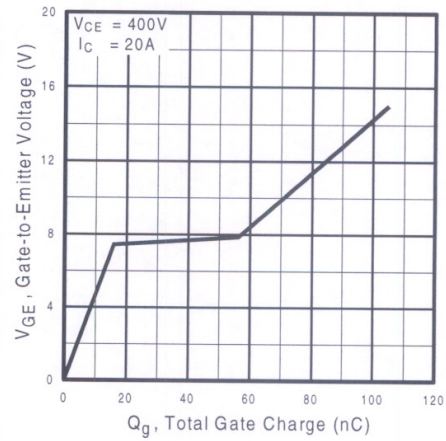


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

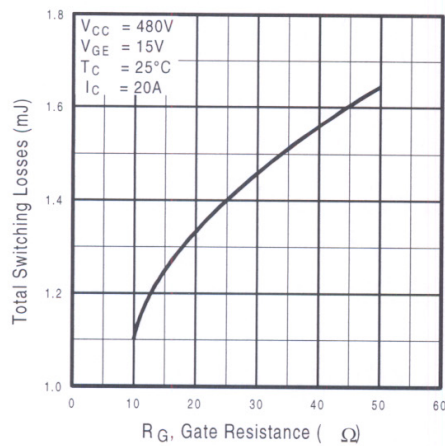


Fig. 9 - Typical Switching Losses vs. Gate Resistance

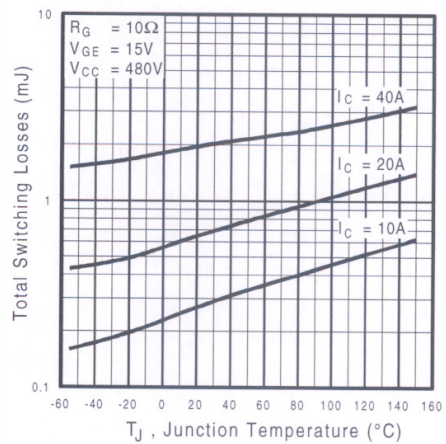
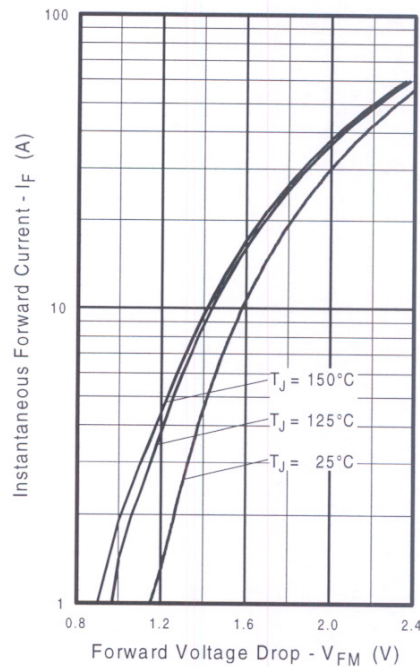
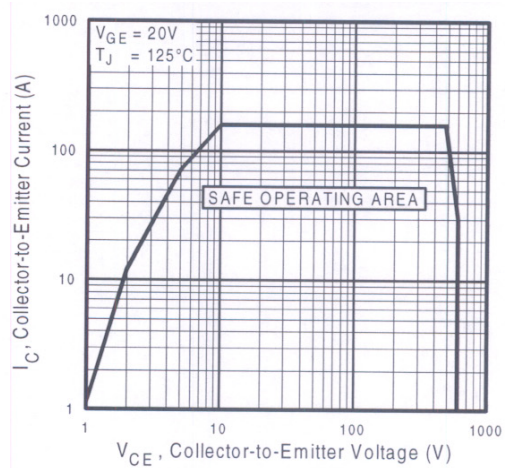
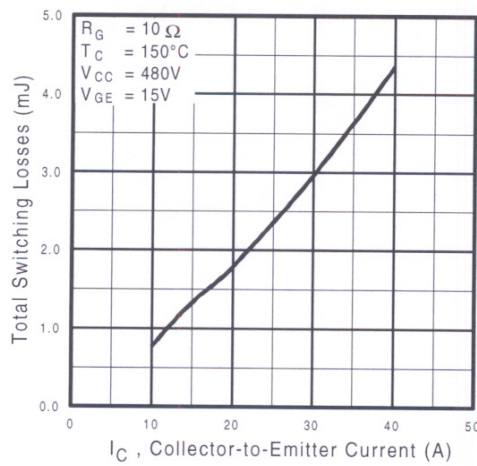


Fig. 10 - Typical Switching Losses vs. Junction Temperature



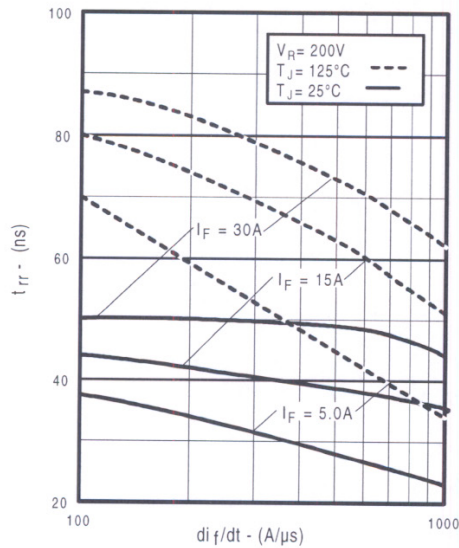


Fig. 14 - Typical Reverse Recovery vs. di/dt

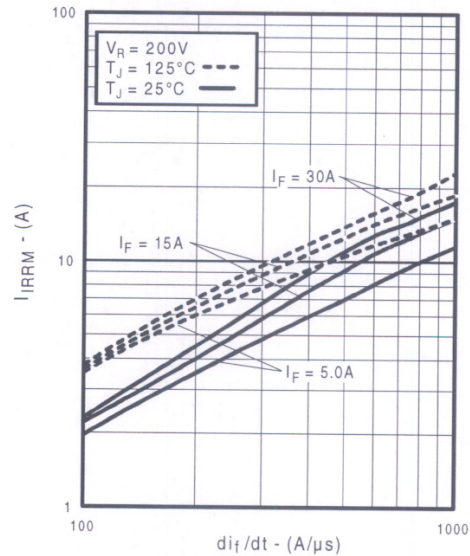


Fig. 15 - Typical Recovery Current vs. di/dt

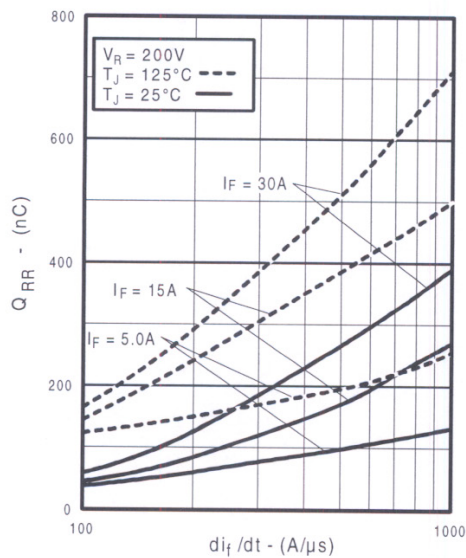


Fig. 16 - Typical Stored Charge vs. di/dt

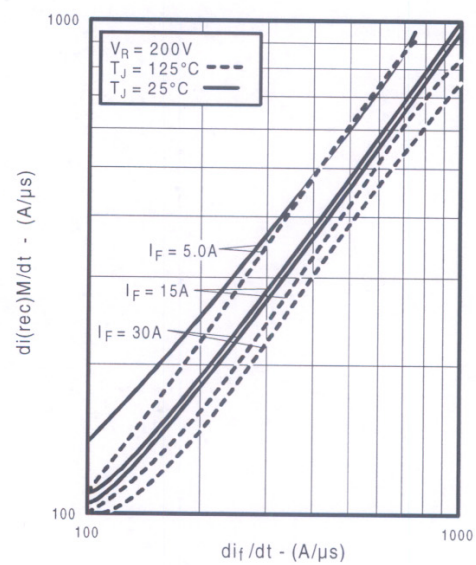


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di/dt

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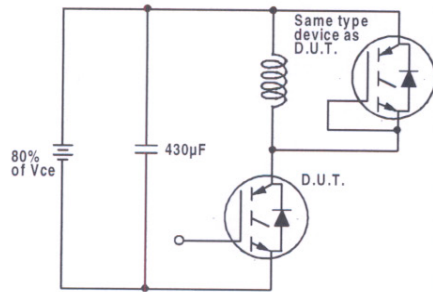


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

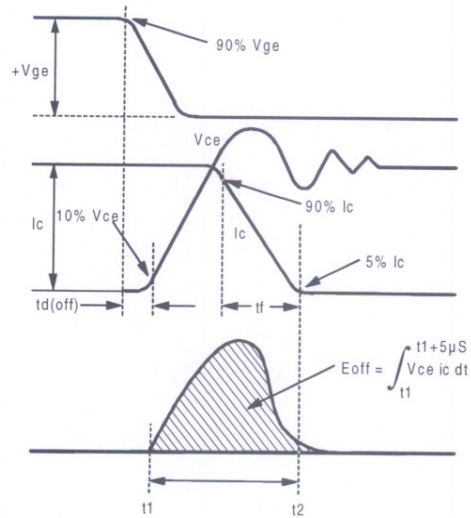


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

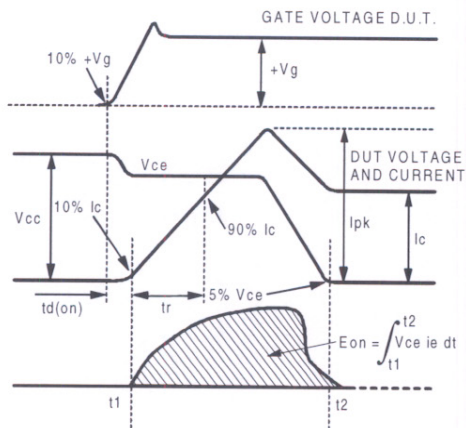


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

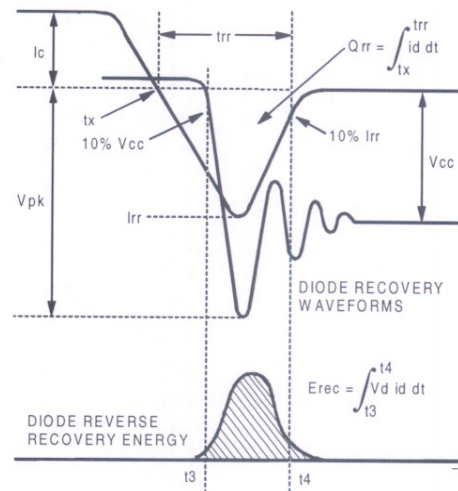


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

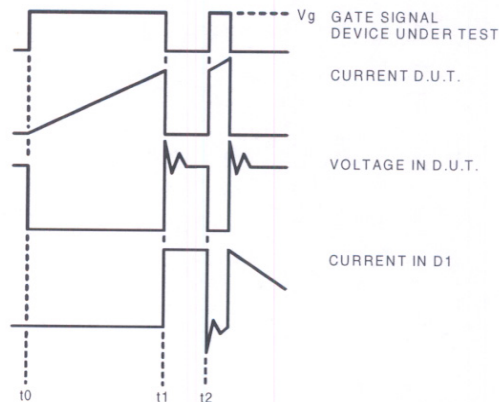


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

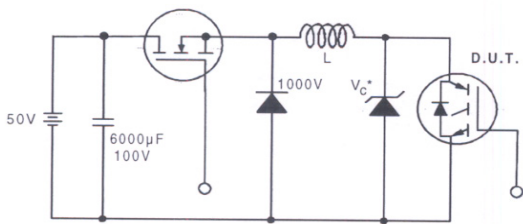


Figure 19. Clamped Inductive Load Test Circuit

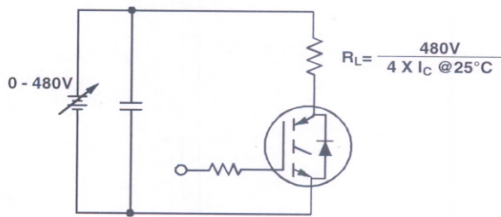
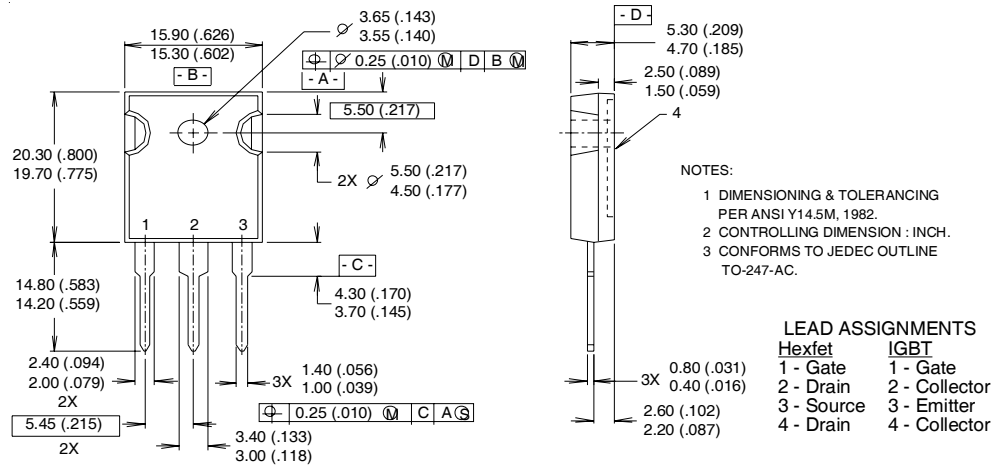


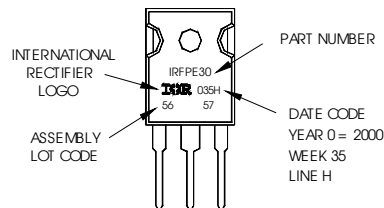
Figure 20. Pulsed Collector Current Test Circuit

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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.

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