

International

IR Rectifier

INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

Features

- Fast: Optimized for medium operating frequencies (1-5 kHz in hard switching, >20 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

Absolute Maximum Ratings

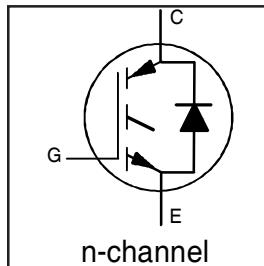
	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ\text{C}$	Continuous Collector Current	49	A
$I_C @ T_C = 100^\circ\text{C}$	Continuous Collector Current	27	
I_{CM}	Pulsed Collector Current ①	196	
I_{LM}	Clamped Inductive Load Current ②	196	
$I_F @ T_C = 100^\circ\text{C}$	Diode Continuous Forward Current	15	
I_{FM}	Diode Maximum Forward Current	200	W
V_{GE}	Gate-to-Emitter Voltage	± 20	
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	160	
$P_D @ T_C = 100^\circ\text{C}$	Maximum Power Dissipation	65	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	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

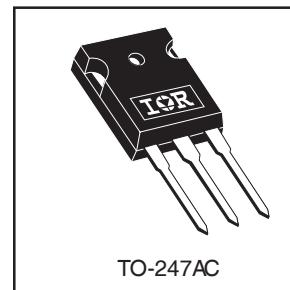
	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	-----	-----	0.77	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	-----	-----	1.7	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	-----	0.24	-----	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	-----	-----	40	
Wt	Weight	-----	6 (0.21)	-----	g (oz)

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Fast CoPack IGBT



$V_{CES} = 600\text{V}$
 $V_{CE(\text{on}) \text{ typ.}} = 1.50\text{V}$
 $@ V_{GE} = 15\text{V}, I_C = 27\text{A}$



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Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{CES}}$	Collector-to-Emitter Breakdown Voltage③	600	----	----	V	$V_{\text{GE}} = 0\text{V}$, $I_C = 250\mu\text{A}$
$\Delta V_{(\text{BR})\text{CES}/\Delta T_J}$	Temperature Coeff. of Breakdown Voltage	----	0.70	----	$\text{V}/^\circ\text{C}$	$V_{\text{GE}} = 0\text{V}$, $I_C = 1.0\text{mA}$
$V_{\text{CE}(\text{on})}$	Collector-to-Emitter Saturation Voltage	----	1.50	1.7	V	$I_C = 27\text{A}$ $V_{\text{GE}} = 15\text{V}$
		----	1.85	----		$I_C = 49\text{A}$ See Fig. 2, 5
		----	1.56	----		$I_C = 27\text{A}$, $T_J = 150^\circ\text{C}$
$V_{\text{GE}(\text{th})}$	Gate Threshold Voltage	3.0	----	6.0		$V_{\text{CE}} = V_{\text{GE}}$, $I_C = 250\mu\text{A}$
$\Delta V_{\text{GE}(\text{th})/\Delta T_J}$	Temperature Coeff. of Threshold Voltage	----	-12	----	$\text{mV}/^\circ\text{C}$	$V_{\text{CE}} = V_{\text{GE}}$, $I_C = 250\mu\text{A}$
g_{fe}	Forward Transconductance ④	9.2	12	----	S	$V_{\text{CE}} = 100\text{V}$, $I_C = 27\text{A}$
I_{CES}	Zero Gate Voltage Collector Current	----	----	250	μA	$V_{\text{GE}} = 0\text{V}$, $V_{\text{CE}} = 600\text{V}$
		----	----	3500		$V_{\text{GE}} = 0\text{V}$, $V_{\text{CE}} = 600\text{V}$, $T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	----	1.3	1.7	V	$I_C = 15\text{A}$ See Fig. 13
		----	1.2	1.6		$I_C = 15\text{A}$, $T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	----	----	± 100	nA	$V_{\text{GE}} = \pm 20\text{V}$

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	$I_C = 27\text{A}$
Q_{ge}	Gate - Emitter Charge (turn-on)	----	15	23		$V_{\text{CC}} = 400\text{V}$ See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	----	35	53		$V_{\text{GE}} = 15\text{V}$
$t_{d(\text{on})}$	Turn-On Delay Time	----	63	----	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	----	32	----		$I_C = 27\text{A}$, $V_{\text{CC}} = 480\text{V}$
$t_{d(\text{off})}$	Turn-Off Delay Time	----	230	350		$V_{\text{GE}} = 15\text{V}$, $R_G = 10\Omega$
t_f	Fall Time	----	170	250	mJ	Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18
E_{on}	Turn-On Switching Loss	----	0.95	----		
E_{off}	Turn-Off Switching Loss	----	2.01	----		
E_{ts}	Total Switching Loss	----	2.96	4.0	mJ	
$t_{d(\text{on})}$	Turn-On Delay Time	----	63	----		$T_J = 150^\circ\text{C}$, See Fig. 9, 10, 11, 18
t_r	Rise Time	----	33	----		$I_C = 27\text{A}$, $V_{\text{CC}} = 480\text{V}$
$t_{d(\text{off})}$	Turn-Off Delay Time	----	350	----		$V_{\text{GE}} = 15\text{V}$, $R_G = 10\Omega$
t_f	Fall Time	----	310	----	mJ	Energy losses include "tail" and diode reverse recovery.
E_{ts}	Total Switching Loss	----	4.7	----		
L_E	Internal Emitter Inductance	----	13	----		Measured 5mm from package
C_{ies}	Input Capacitance	----	2200	----	pF	$V_{\text{GE}} = 0\text{V}$
C_{oes}	Output Capacitance	----	140	----		$V_{\text{CC}} = 30\text{V}$ See Fig. 7
C_{res}	Reverse Transfer Capacitance	----	29	----		$f = 1.0\text{MHz}$
t_{rr}	Diode Reverse Recovery Time	----	42	60	ns	$T_J = 25^\circ\text{C}$ See Fig.
		----	74	120		$T_J = 125^\circ\text{C}$ 14
I_{rr}	Diode Peak Reverse Recovery Current	----	4.0	6.0	A	$T_J = 25^\circ\text{C}$ See Fig.
		----	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.
		----	220	600		$T_J = 125^\circ\text{C}$ 16
$dI_{(\text{rec})M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	----	188	----	A/ μs	$T_J = 25^\circ\text{C}$ See Fig.
		----	160	----		$T_J = 125^\circ\text{C}$ 17

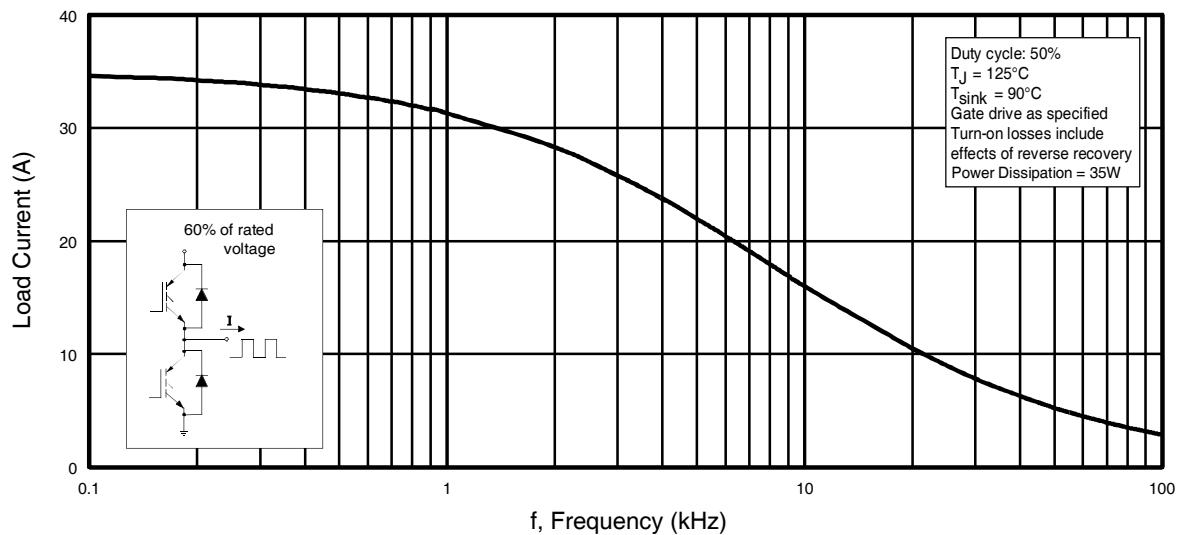


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

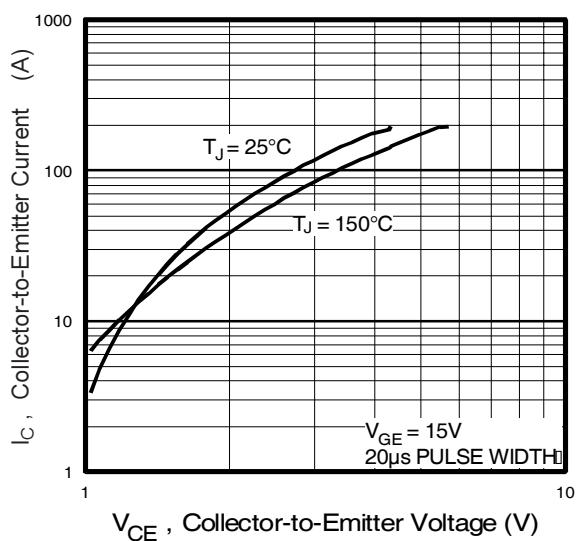


Fig. 2 - Typical Output Characteristics

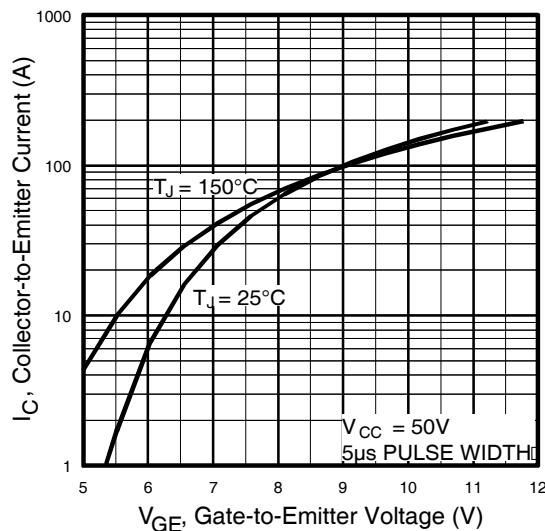


Fig. 3 - Typical Transfer Characteristics

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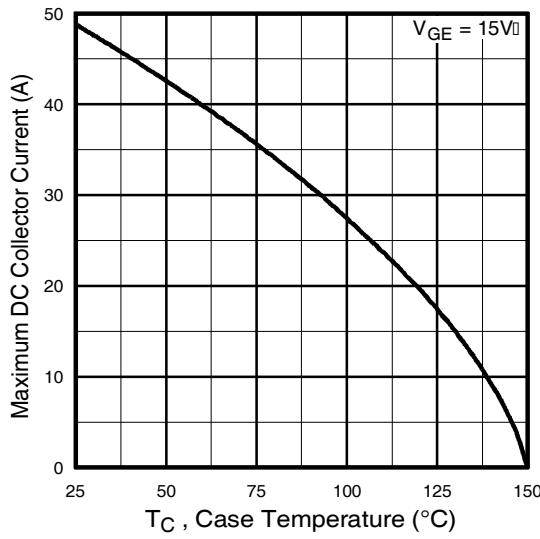


Fig. 4 - Maximum Collector Current vs. Case Temperature

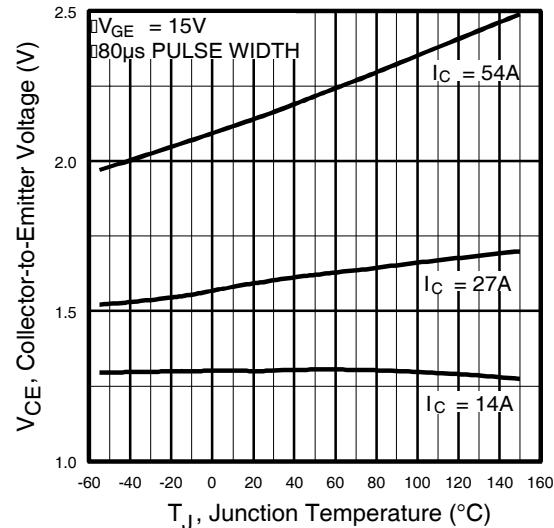


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

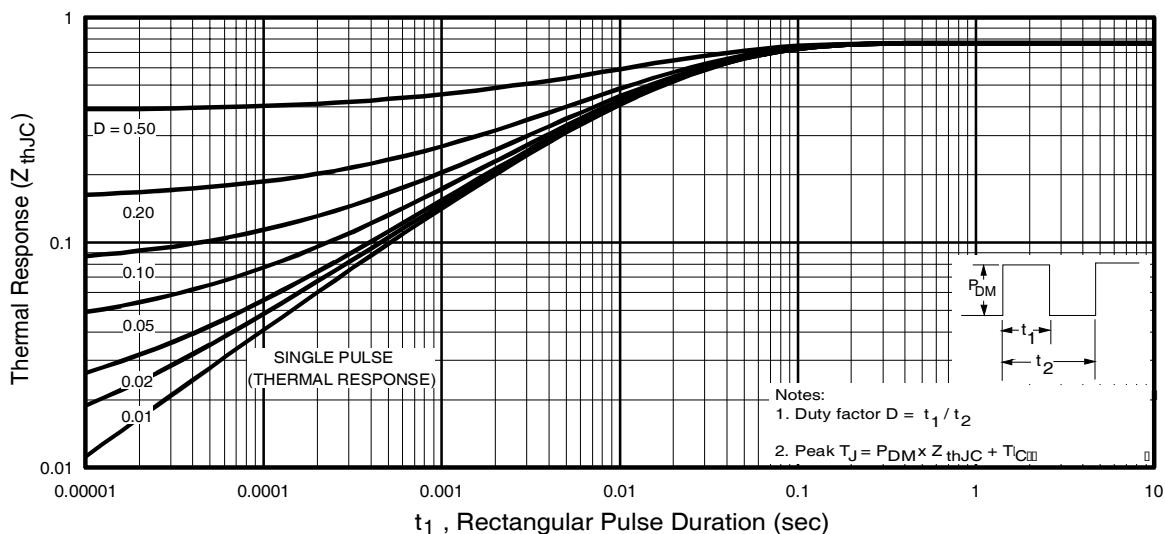
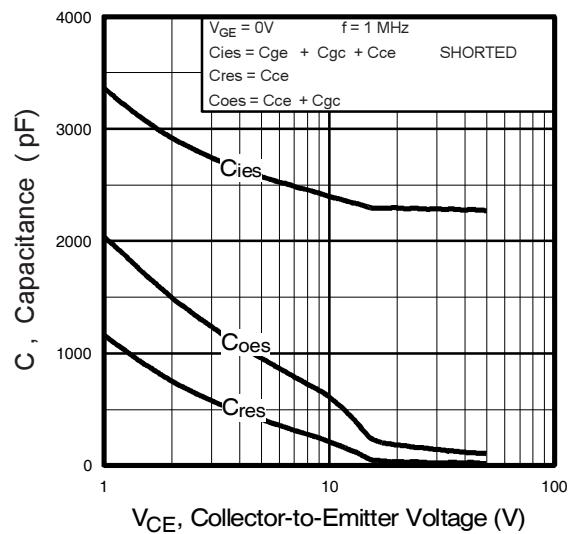
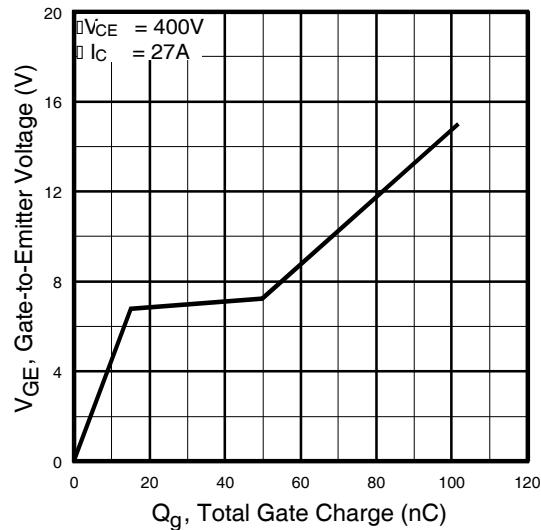


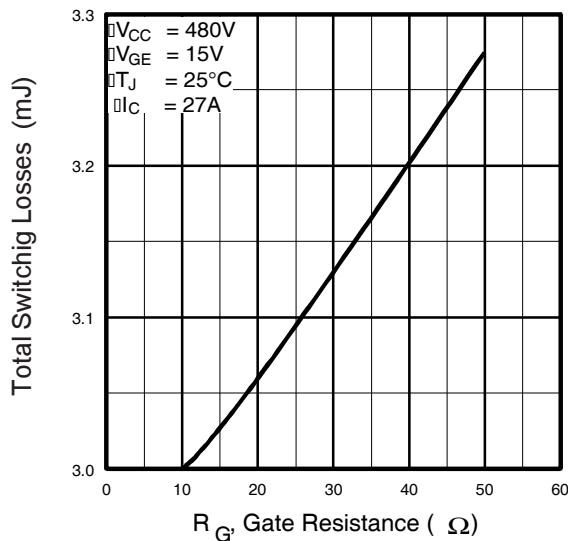
Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



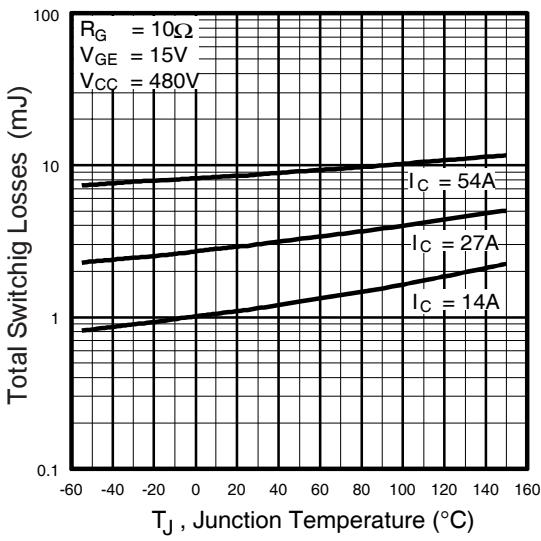
**Fig. 7 - Typical Capacitance vs.
Collector-to-Emitter Voltage**



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



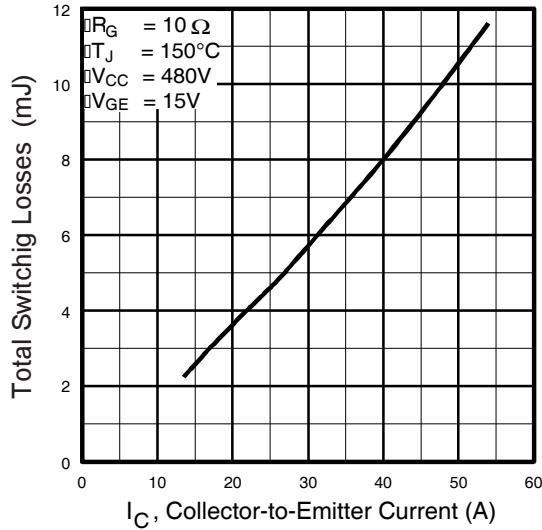
**Fig. 9 - Typical Switching Losses vs. Gate
Resistance**



**Fig. 10 - Typical Switching Losses vs.
Junction Temperature**

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

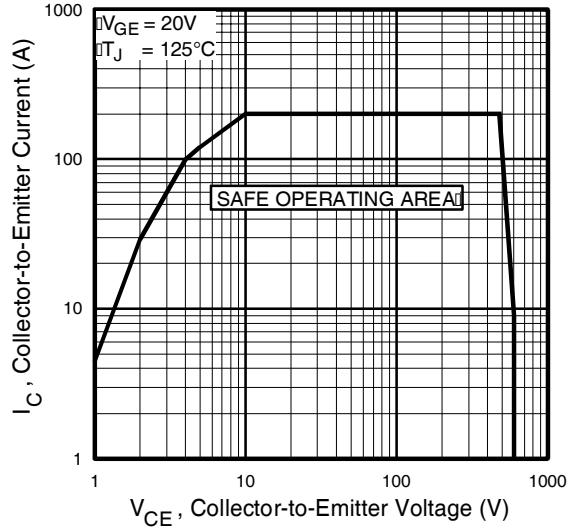


Fig. 12 - Turn-Off SOA

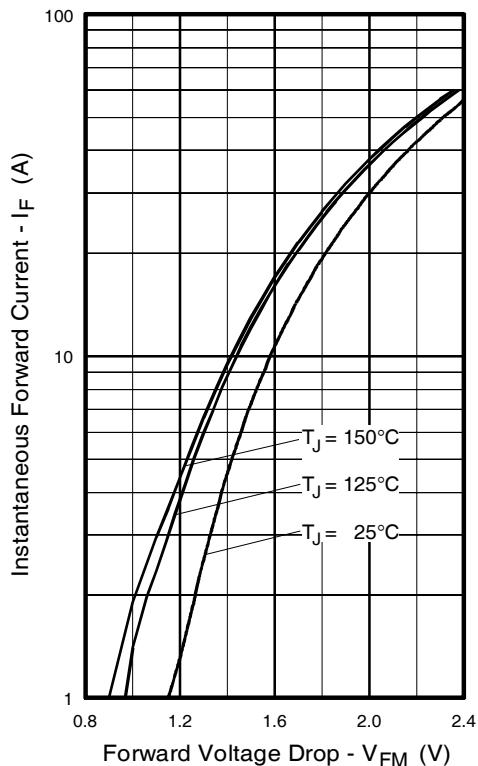


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

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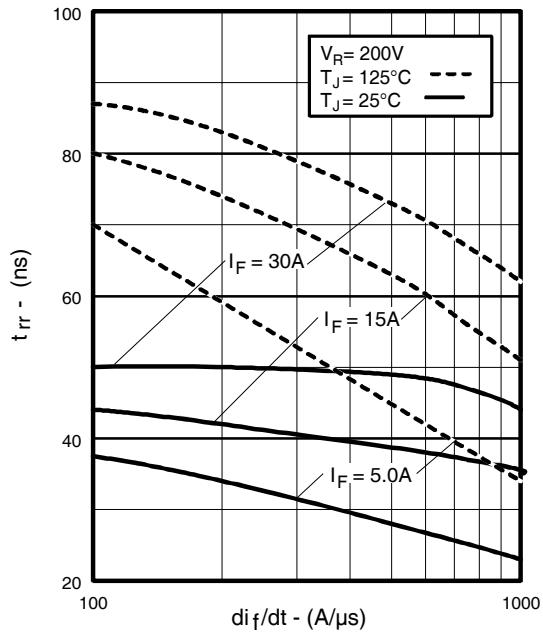


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

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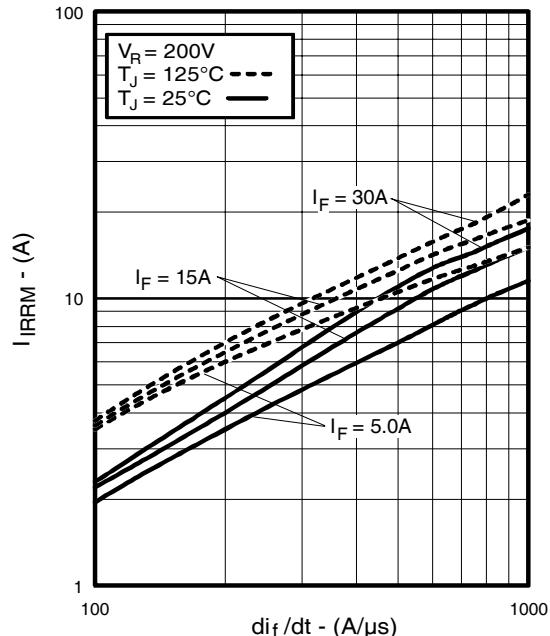


Fig. 15 - Typical Recovery Current vs. di_f/dt

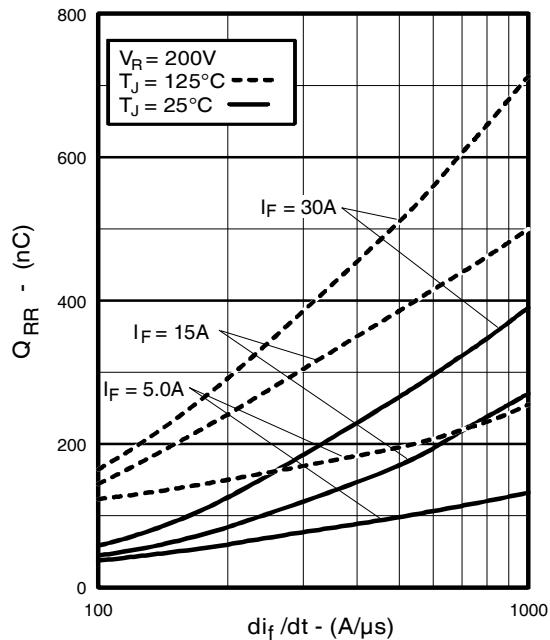


Fig. 16 - Typical Stored Charge vs. di_f/dt

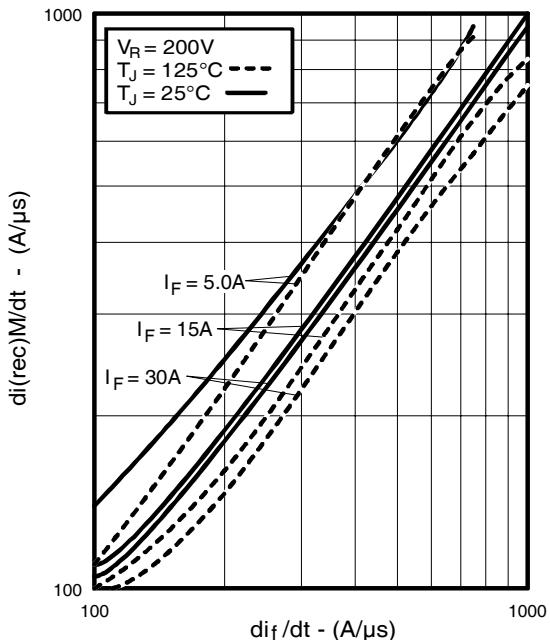


Fig. 17 - Typical $di_{(rec)}M/dt$ vs. di_f/dt

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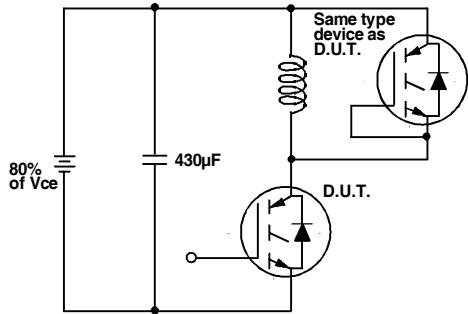


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off(diode)}$, t_{rr} , Q_{rr} , I_{rr} , $t_d(on)$, t_r , $t_d(off)$, t_f

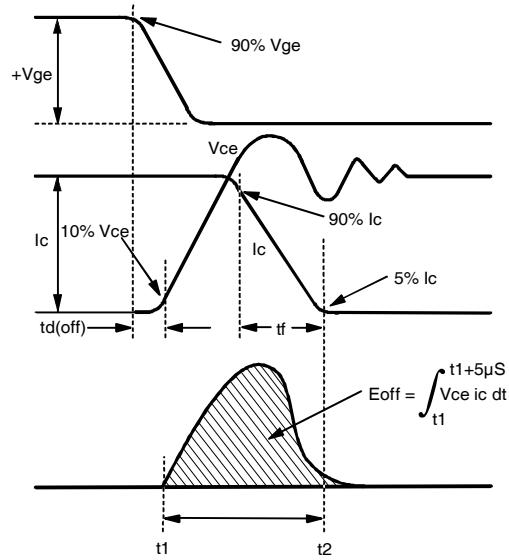


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

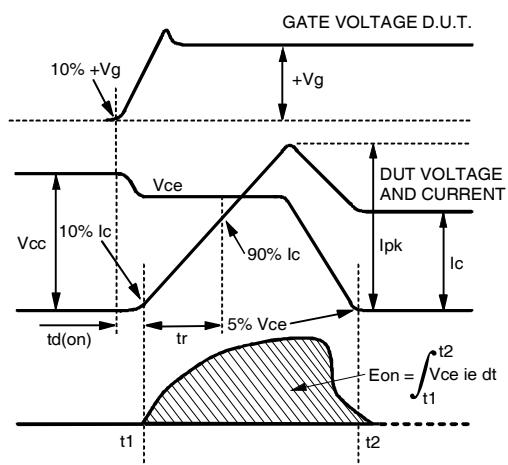


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

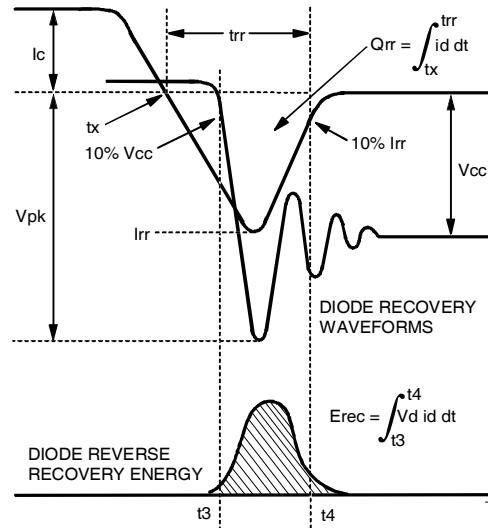


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

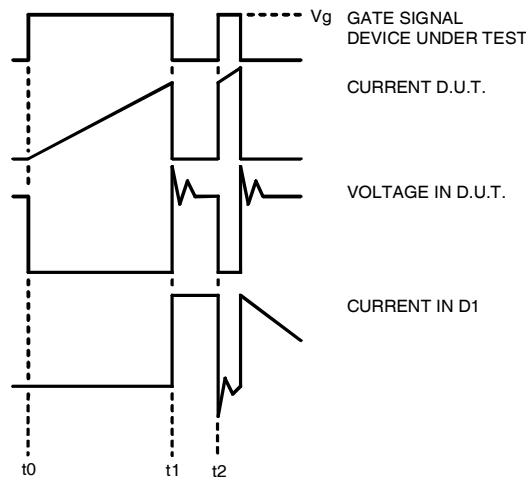


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

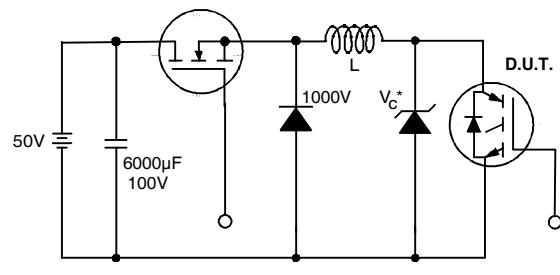


Figure 19. Clamped Inductive Load Test Circuit

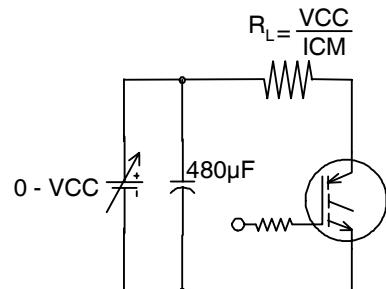


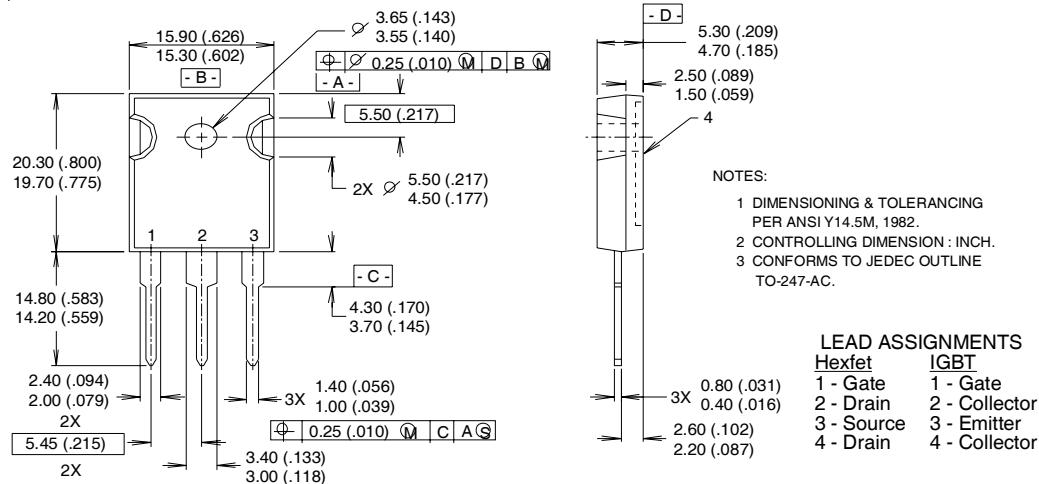
Figure 20. Pulsed Collector Current Test Circuit

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TO-247AC Package Outline

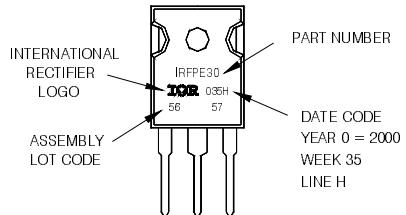
Dimensions are shown in millimeters (inches)



TO-247AC Part Marking Information

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"

Note: "P" in assembly line position indicates "Lead-Free"



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

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.

Data and specifications subject to change without notice.

International **IGR** Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903



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- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

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(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А