

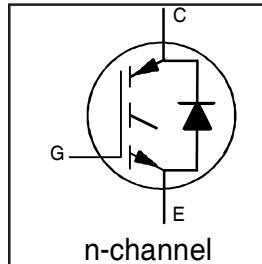
INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

IRG4BC30UDPbF

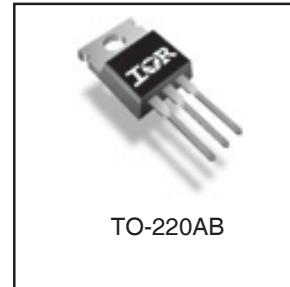
UltraFast CoPack IGBT

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-220AB package
- Lead-Free



$V_{CES} = 600V$
 $V_{CE(on)} \text{ typ.} = 1.95V$
 $\text{@ } V_{GE} = 15V, I_C = 12A$



Benefits

- Generation -4 IGBT's offer highest efficiencies available
- IGBTs optimized for specific application conditions
- HEXFRED diodes optimized for performance with IGBTs. Minimized recovery characteristics require less/no snubbing
- Designed to be a "drop-in" replacement for equivalent industry-standard Generation 3 IR IGBTs

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	23	
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	12	
I_{CM}	Pulsed Collector Current ①	92	A
I_{LM}	Clamped Inductive Load Current ②	92	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	12	
I_{FM}	Diode Maximum Forward Current	92	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	100	
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	42	W
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ C$
	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	-----	-----	1.2	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	-----	-----	2.5	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	-----	0.50	-----	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	-----	-----	80	
Wt	Weight	-----	2 (0.07)	-----	g (oz)

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 Voltage ^③	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	----	0.63	----	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	----	1.95	2.1	V	$I_C = 12\text{A}$
		----	2.52	----		$I_C = 23\text{A}$
		----	2.09	----		$I_C = 12\text{A}$, $T_J = 150^\circ\text{C}$
$V_{\text{GE}(\text{th})}$	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	----	-11	----	mV/ $^\circ\text{C}$	$V_{\text{CE}} = V_{\text{GE}}$, $I_C = 250\mu\text{A}$
g_{fe}	Forward Transconductance ^④	3.1	8.6	----	S	$V_{\text{CE}} = 100\text{V}$, $I_C = 12\text{A}$
I_{CES}	Zero Gate Voltage Collector Current	----	----	250	μA	$V_{\text{GE}} = 0\text{V}$, $V_{\text{CE}} = 600\text{V}$
		----	----	2500		$V_{\text{GE}} = 0\text{V}$, $V_{\text{CE}} = 600\text{V}$, $T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	----	1.4	1.7	V	$I_C = 12\text{A}$
		----	1.3	1.6		$I_C = 12\text{A}$, $T_J = 150^\circ\text{C}$
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)	----	50	75		$I_C = 12\text{A}$
Q_{ge}	Gate - Emitter Charge (turn-on)	----	8.1	12	nC	$V_{\text{CC}} = 400\text{V}$ See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	----	18	27		$V_{\text{GE}} = 15\text{V}$
$t_{\text{d}(\text{on})}$	Turn-On Delay Time	----	40	----		$T_J = 25^\circ\text{C}$
t_r	Rise Time	----	21	----	ns	$I_C = 12\text{A}$, $V_{\text{CC}} = 480\text{V}$
$t_{\text{d}(\text{off})}$	Turn-Off Delay Time	----	91	140		$V_{\text{GE}} = 15\text{V}$, $R_G = 23\Omega$
t_f	Fall Time	----	80	130		Energy losses include "tail" and diode reverse recovery.
E_{on}	Turn-On Switching Loss	----	0.38	----		See Fig. 9, 10, 11, 18
E_{off}	Turn-Off Switching Loss	----	0.16	----	mJ	
E_{ts}	Total Switching Loss	----	0.54	0.9		
$t_{\text{d}(\text{on})}$	Turn-On Delay Time	----	40	----		$T_J = 150^\circ\text{C}$, See Fig. 9, 10, 11, 18
t_r	Rise Time	----	22	----		
$t_{\text{d}(\text{off})}$	Turn-Off Delay Time	----	120	----	ns	$I_C = 12\text{A}$, $V_{\text{CC}} = 480\text{V}$
t_f	Fall Time	----	180	----		$V_{\text{GE}} = 15\text{V}$, $R_G = 23\Omega$
E_{ts}	Total Switching Loss	----	0.89	----		Energy losses include "tail" and diode reverse recovery.
L_E	Internal Emitter Inductance	----	7.5	----		Measured 5mm from package
C_{ies}	Input Capacitance	----	1100	----		$V_{\text{GE}} = 0\text{V}$
C_{oes}	Output Capacitance	----	73	----	pF	$V_{\text{CC}} = 30\text{V}$ See Fig. 7
C_{res}	Reverse Transfer Capacitance	----	14	----		$f = 1.0\text{MHz}$
t_{rr}	Diode Reverse Recovery Time	----	42	60		$T_J = 25^\circ\text{C}$ See Fig.
I_{rr}	Diode Peak Reverse Recovery Current	----	80	120		$T_J = 125^\circ\text{C}$ 14
		----	3.5	6.0	A	$T_J = 25^\circ\text{C}$ See Fig.
Q_{rr}	Diode Reverse Recovery Charge	----	5.6	10		$T_J = 125^\circ\text{C}$ 15
		----	80	180	nC	$T_J = 25^\circ\text{C}$ See Fig.
$\text{di}_{(\text{rec})\text{M}/\text{dt}}$	Diode Peak Rate of Fall of Recovery	----	220	600		$T_J = 125^\circ\text{C}$ 16
		----	180	----	A/ μs	$T_J = 25^\circ\text{C}$ See Fig.
	During t_b	----	120	----		$T_J = 125^\circ\text{C}$ 17

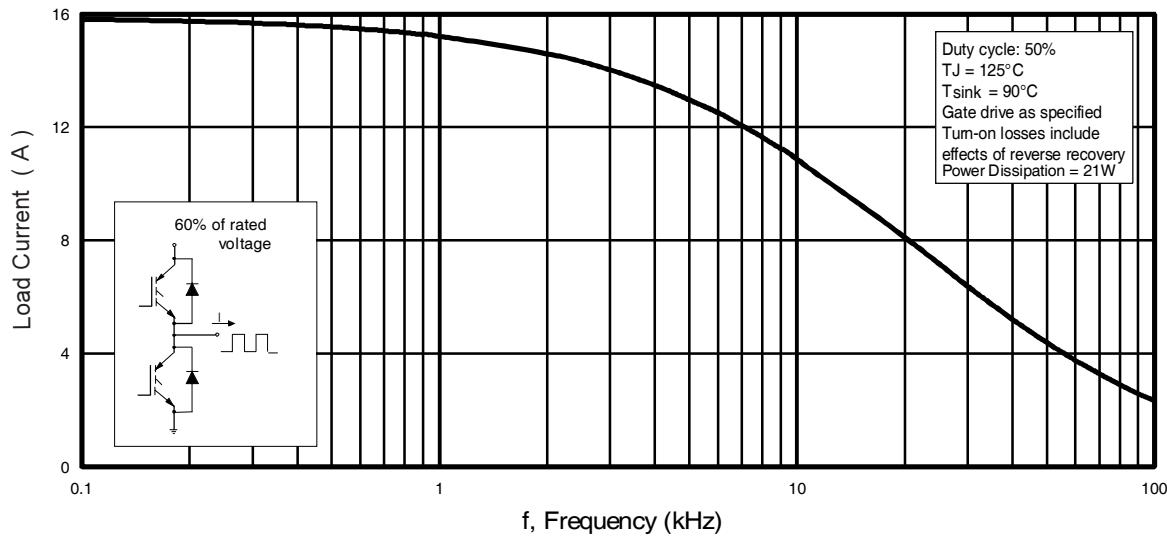


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

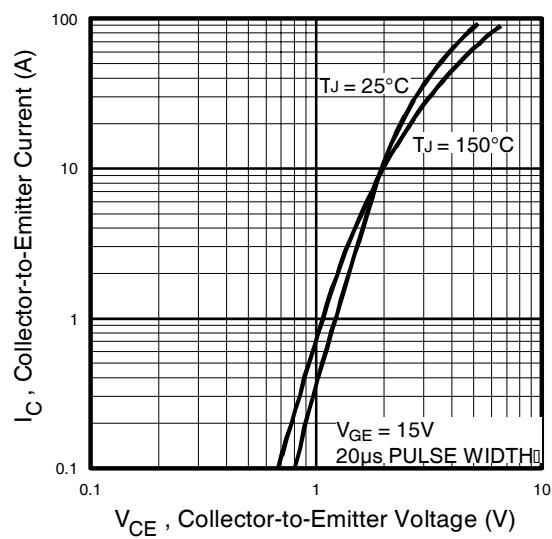


Fig. 2 - Typical Output Characteristics

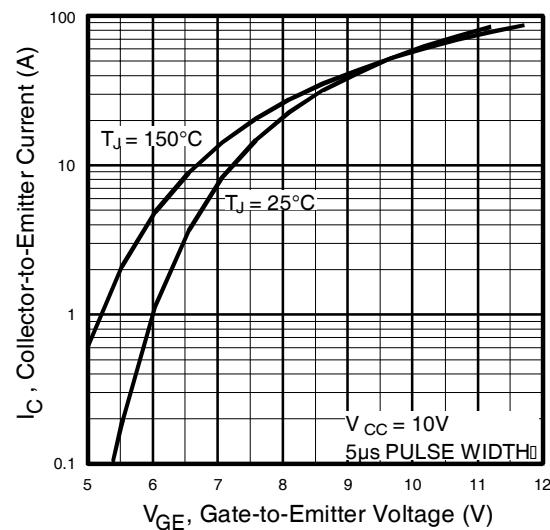


Fig. 3 - Typical Transfer Characteristics

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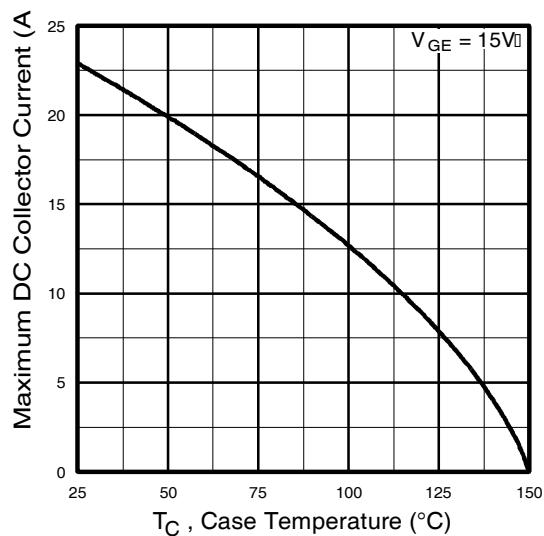


Fig. 4 - Maximum Collector Current vs. Case Temperature

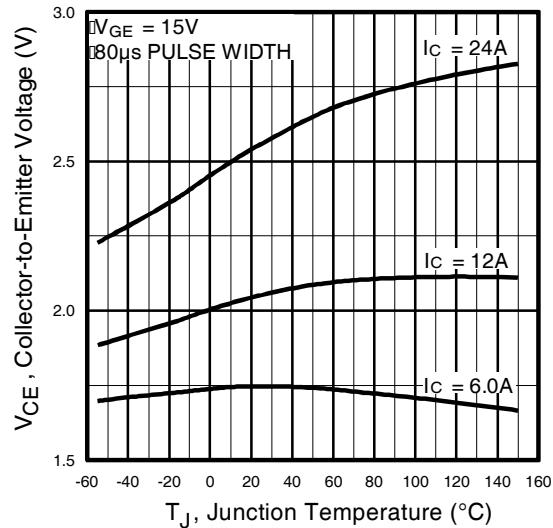


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

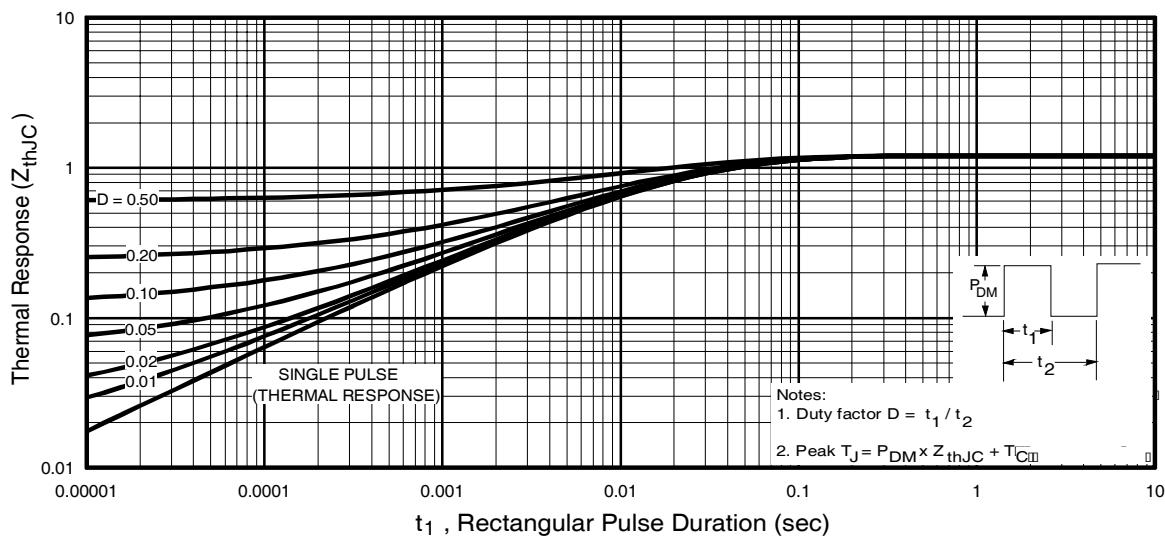


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

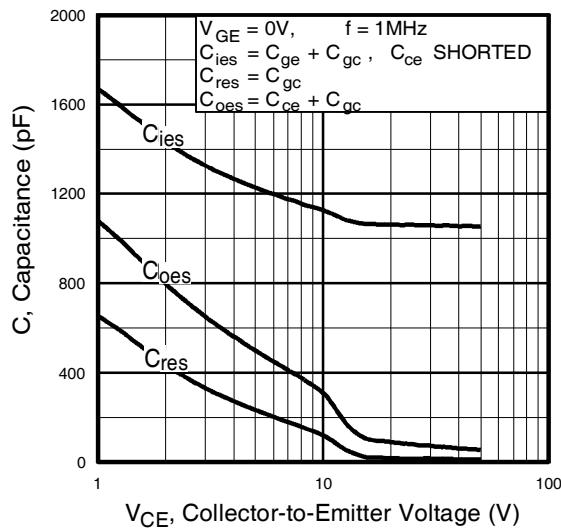


Fig. 7 - Typical Capacitance vs.
 Collector-to-Emitter Voltage

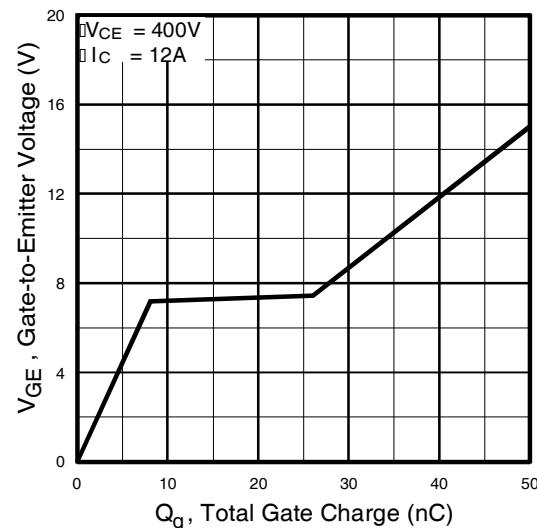


Fig. 8 - Typical Gate Charge vs.
 Gate-to-Emitter Voltage

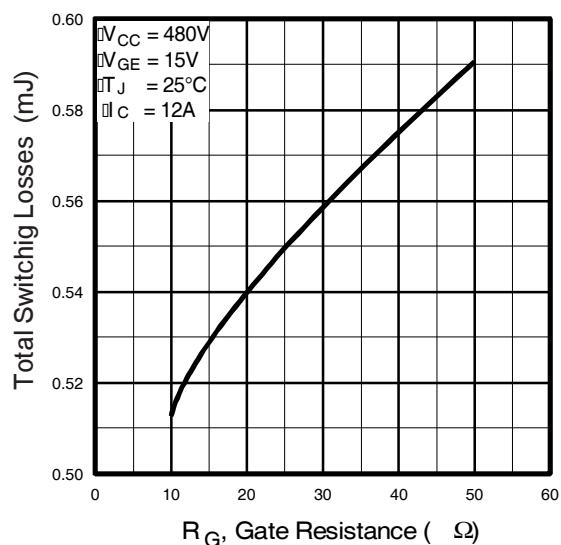


Fig. 9 - Typical Switching Losses vs. Gate
 Resistance

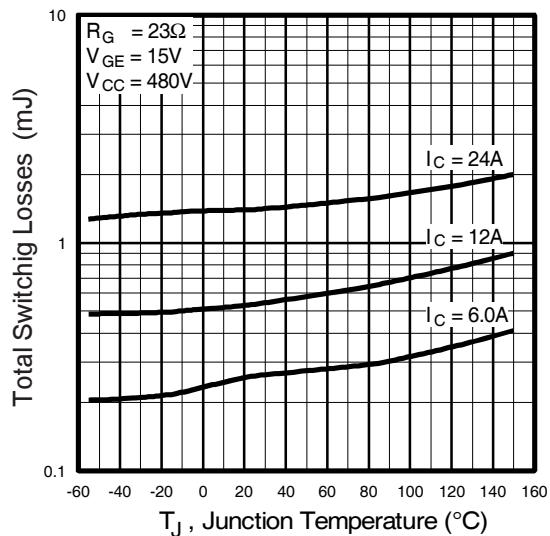


Fig. 10 - Typical Switching Losses vs.
 Junction Temperature

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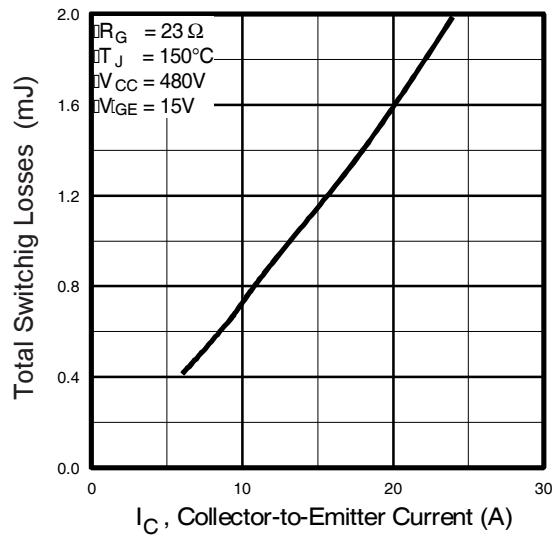


Fig. 11 - Typical Switching Losses vs.
Collector-to-Emitter Current

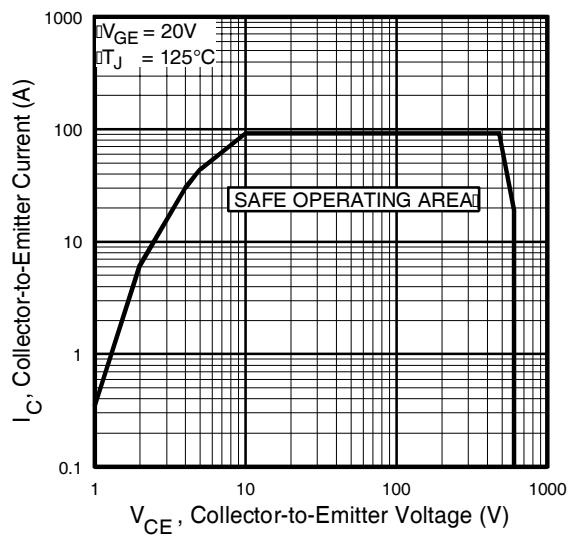


Fig. 12 - Turn-Off SOA

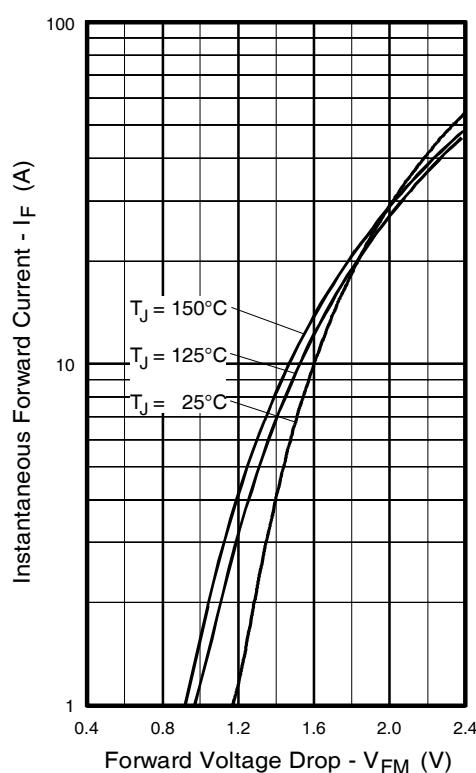


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

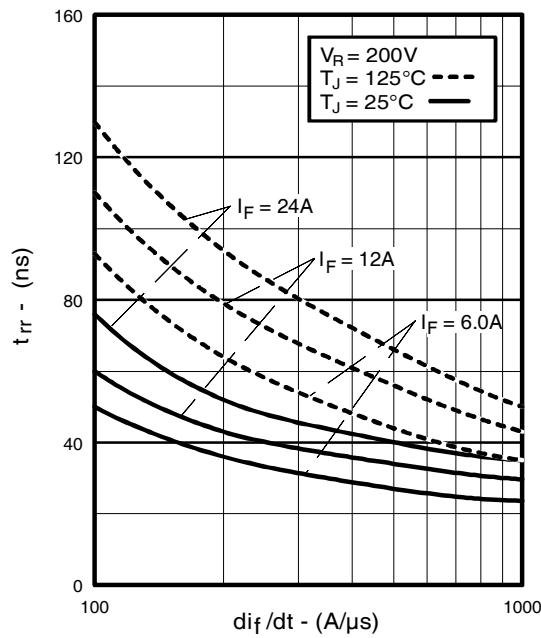


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

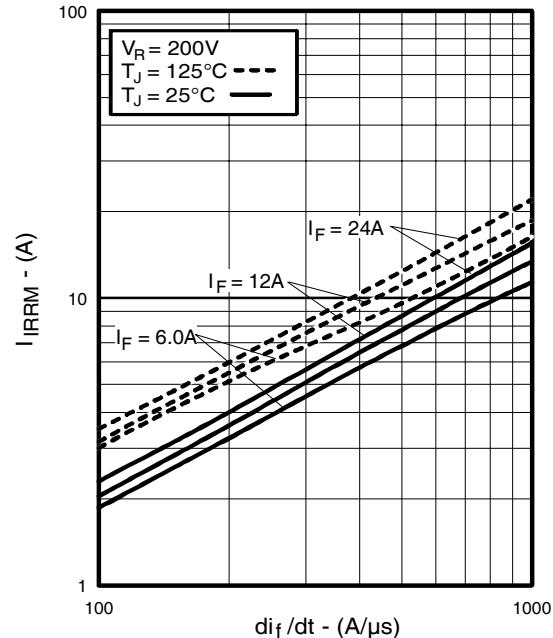


Fig. 15 - Typical Recovery Current vs. di_f/dt

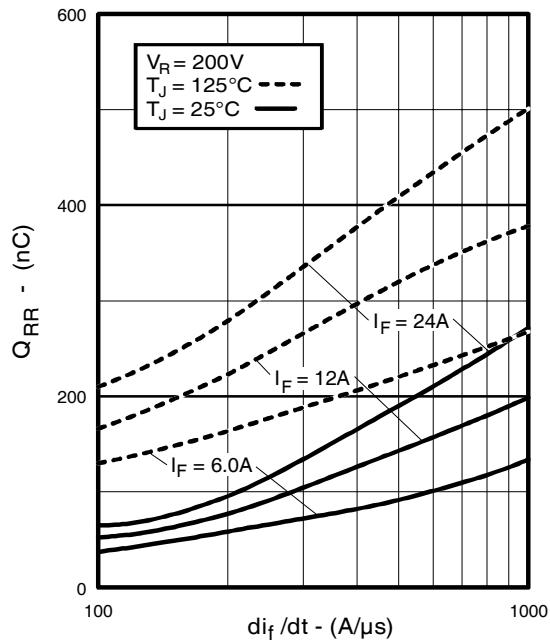


Fig. 16 - Typical Stored Charge vs. di_f/dt

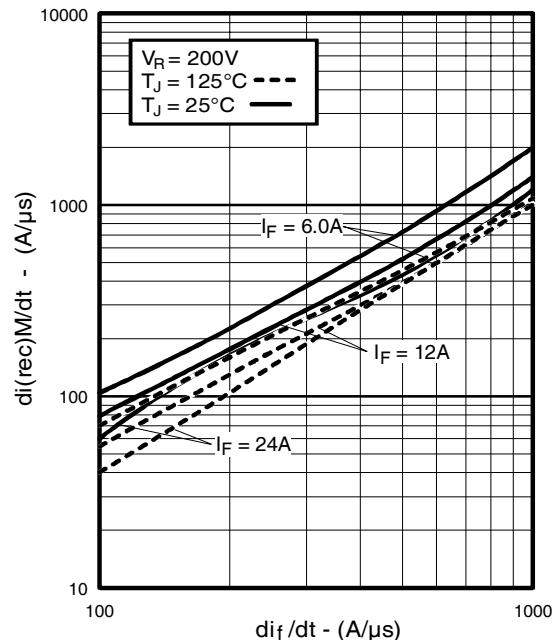


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

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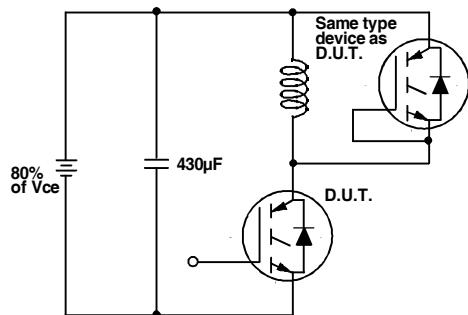


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off(diode)}$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

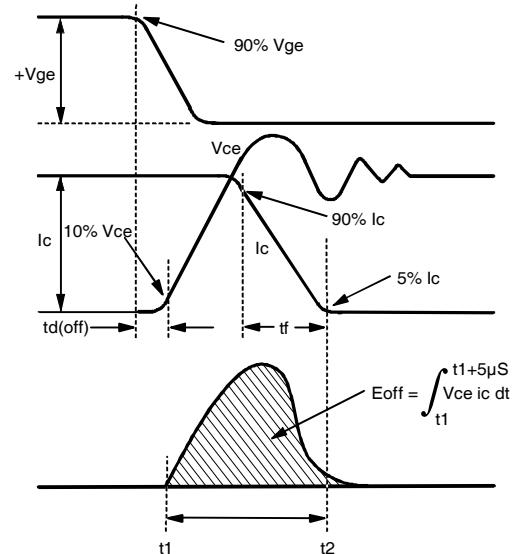


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

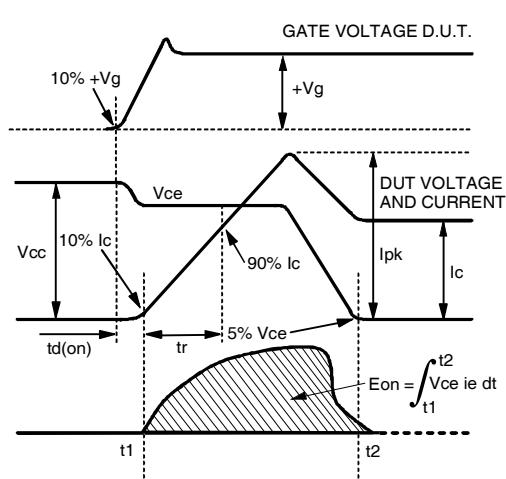


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

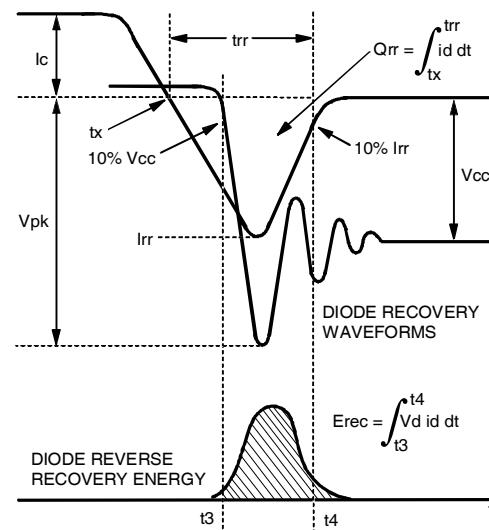


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

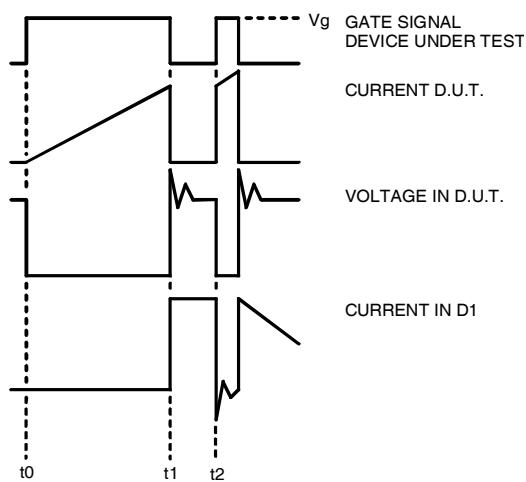


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

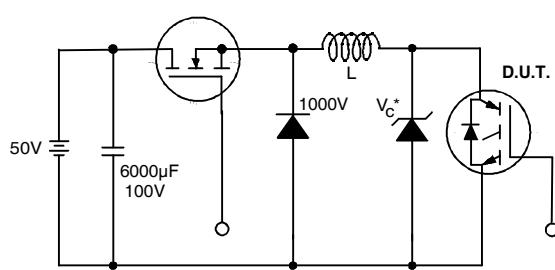
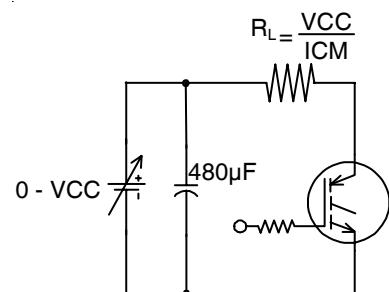


Figure 19. Clamped Inductive Load Test Circuit



Pulsed Collector Current Test Circuit

Figure 20. Pulsed Collector Current Test Circuit

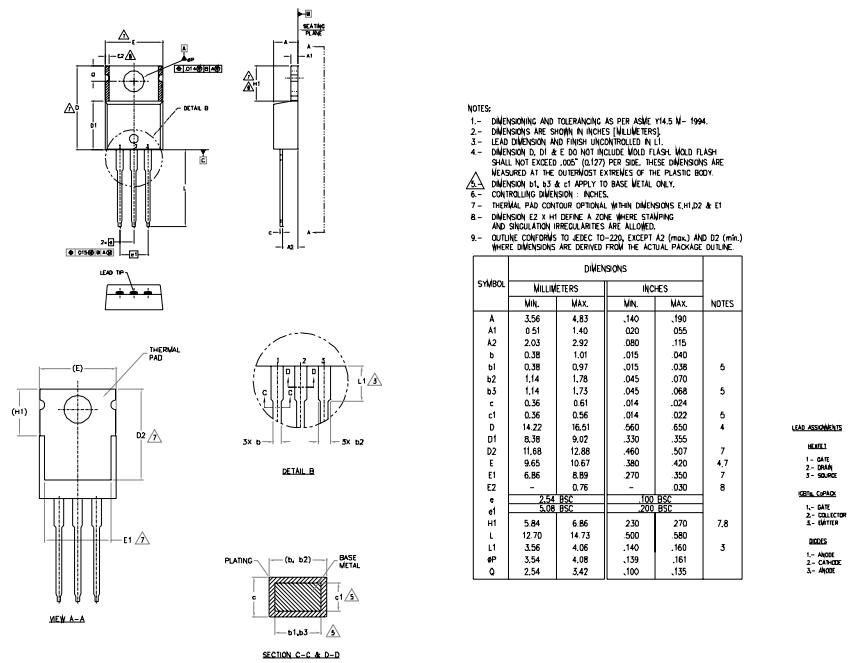
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Notes:

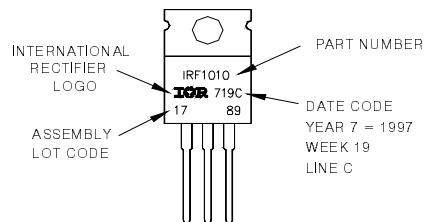
- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature (figure 20)
- ② $V_{CC}=80\% (V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G = 23\Omega$ (figure 19)
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.

TO-220AB Package Outline (Dimensions are shown in millimeters (inches))



TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE 'C'
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/>

Data and specifications subject to change without notice.

International
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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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