

IRG4BC30FD1

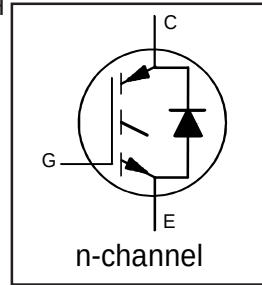
Fast CoPack IGBT

Features

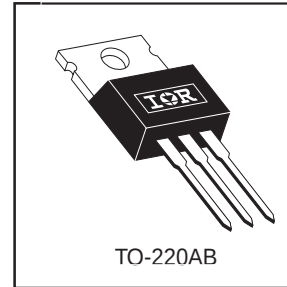
- Fast: optimized for medium operating frequencies (1-5 kHz in hard switching, >20kHz in resonant mode).
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3.
- IGBT co-packaged with Hyperfast FRED diodes for ultra low recovery characteristics.
- Industry standard TO-220AB package.

Benefits

- Generation 4 IGBT's offer highest efficiency available.
- IGBT's optimized for specific application conditions.
- FRED diodes optimized for performance with IGBT's. Minimized recovery characteristics require less / no snubbing.



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 1.59V$
@ $V_{GE} = 15V, I_C = 17A$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	31	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	17	
I_{CM}	Pulse Collector Current (Ref.Fig.C.T.5) ①	120	
I_{LM}	Clamped Inductive Load current ②	120	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	8	
I_{FM}	Diode Maximum Forward Current	16	V
V_{GE}	Gate-to-Emitter Voltage	± 20	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	100	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	42	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Storage Temperature Range, 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 / Mechanical Characteristics

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case- IGBT	—	—	1.2	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case- Diode	—	—	2.0	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	80	
Wt	Weight	—	2.0 (0.07)	—	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	—	0.69	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1mA$
$V_{CE(on)}$	Collector-to-Emitter Voltage	—	1.59	1.8	V	$I_C = 17A, V_{GE} = 15V$
		—	1.99	—		$I_C = 31A$ See Fig. 2, 5
		—	1.7	—		$I_C = 17A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-11	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ④	6.1	10	—	S	$V_{CE} = 100V, I_C = 17A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	2500		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	—	2.0	2.4	V	$I_F = 8.0A$ See Fig. 13
		—	1.3	1.8		$I_F = 8.0A, T_J = 150^\circ\text{C}$
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)	—	57	62	nC	$I_C = 17A$
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	10	12		$V_{CC} = 400V$ See Fig. 8
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	21	24		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On delay time	—	22	—	ns	$T_J = 25^\circ\text{C}$
t_r	Rise time	—	24	—		$I_C = 17A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off delay time	—	250	320		$V_{GE} = 15V, R_G = 23\Omega$
t_f	Fall time	—	160	210		Energy losses include "tail" and diode reverse recovery.
E_{on}	Turn-On Switching Loss	—	370	—	μJ	See Fig. 9, 10, 11, 18
E_{off}	Turn-Off Switching Loss	—	1420	—		
E_{ts}	Total Switching Loss	—	1800	2290		
$t_{d(on)}$	Turn-On delay time	—	21	—	ns	$T_J = 150^\circ\text{C}$ See Fig. 9,10,11,18
t_r	Rise time	—	25	—		$I_C = 17A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off delay time	—	400	—		$V_{GE} = 15V, R_G = 23\Omega$
t_f	Fall time	—	340	—		Energy losses include "tail" and diode reverse recovery.
E_{ts}	Total Switching Loss	—	3280	—	μJ	
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	1170	—	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	—	100	—		$V_{CC} = 30V$ See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	11	—		$f = 1.0MHz$
t_{rr}	Diode Reverse Recovery Time	—	46	61	ns	$T_J = 25^\circ\text{C}$ See Fig. 14
		—	85	93		$T_J = 125^\circ\text{C}$
I_{rr}	Diode Peak Reverse Recovery Current	—	4.8	6.5	A	$T_J = 25^\circ\text{C}$ See Fig. 15
		—	8.5	10		$T_J = 125^\circ\text{C}$
Q_{rr}	Diode Reverse Recovery Charge	—	110	190	nC	$T_J = 25^\circ\text{C}$ See Fig. 16
		—	410	550		$T_J = 125^\circ\text{C}$
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	260	—	A/ μs	$T_J = 25^\circ\text{C}$ See Fig. 17
		—	270	—		$T_J = 125^\circ\text{C}$

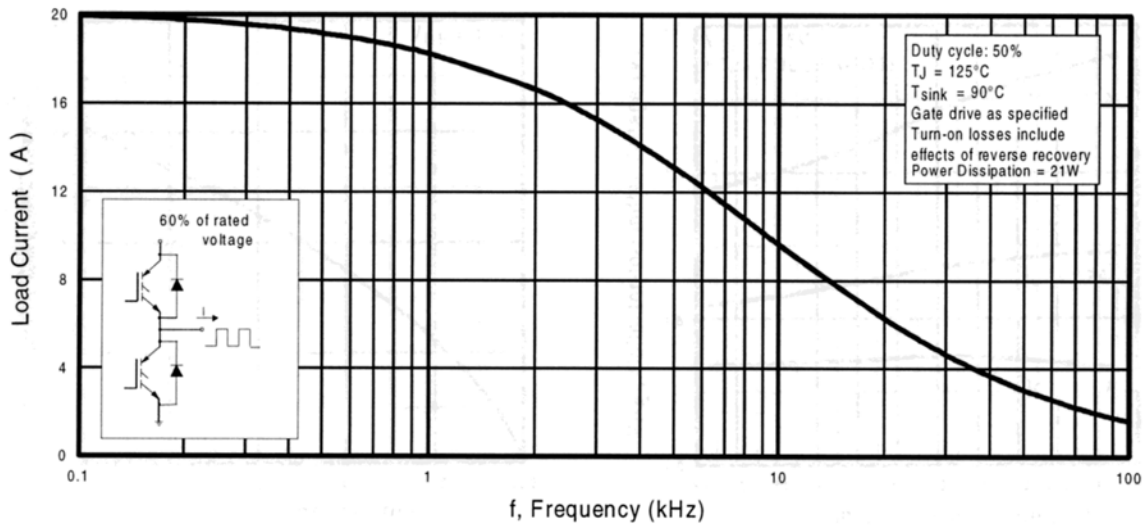


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I = I_{RMS}$ of fundamental; for triangular wave, $I = I_{PK}$)

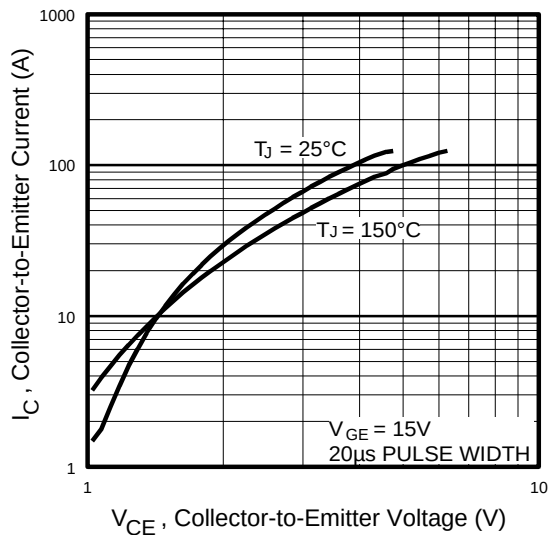


Fig. 2 - Typical Output Characteristics

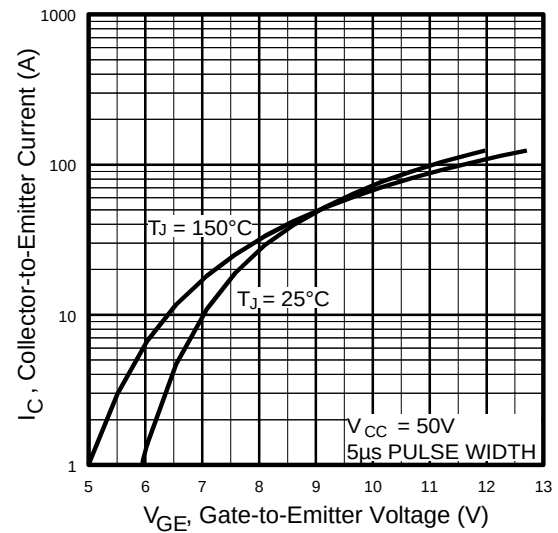


Fig. 3 - Typical Transfer Characteristics

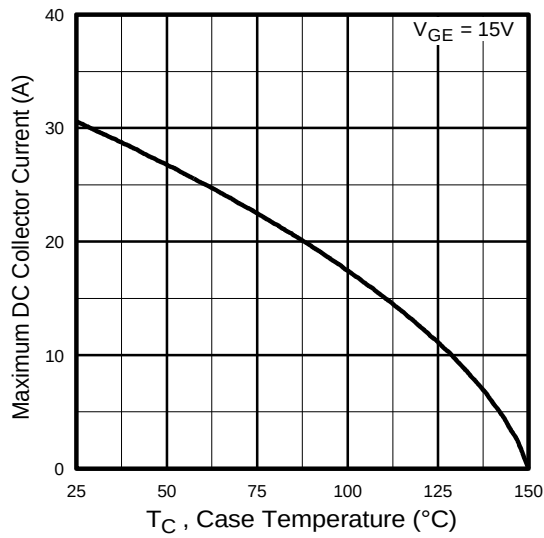


Fig. 4 - Maximum Collector Current vs. Case Temperature

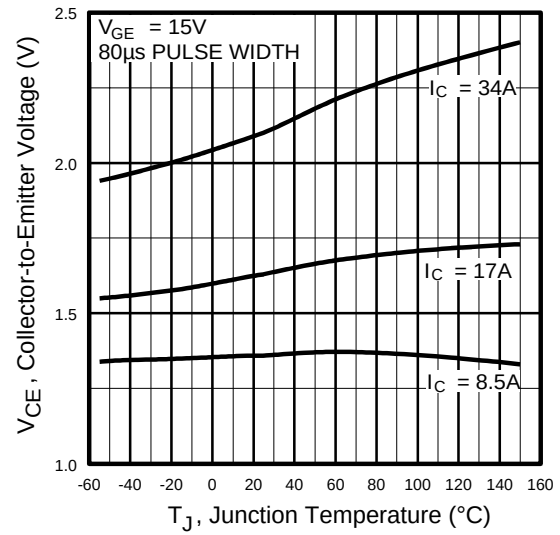


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

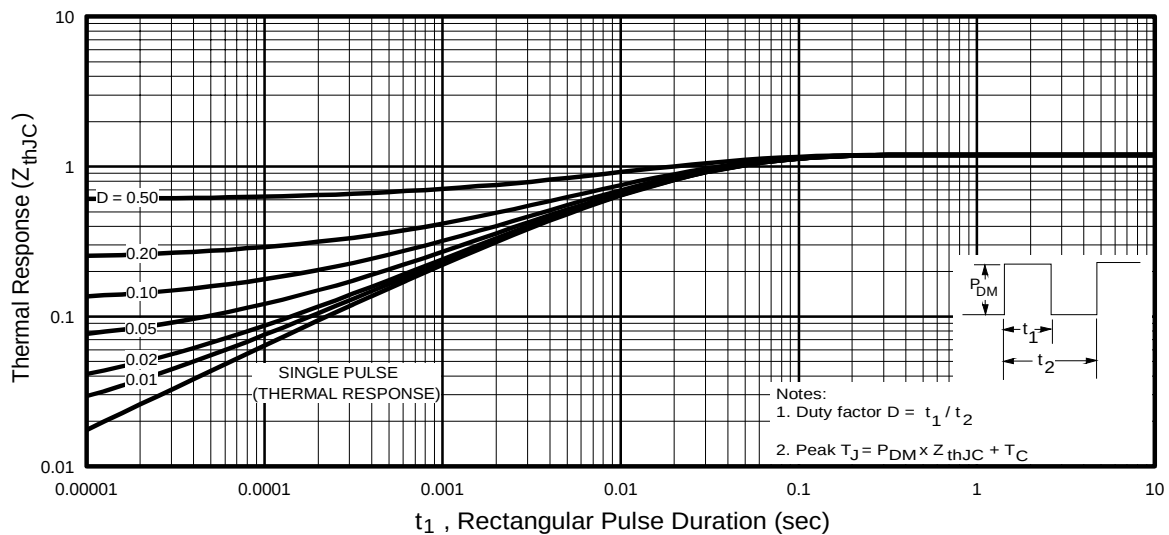
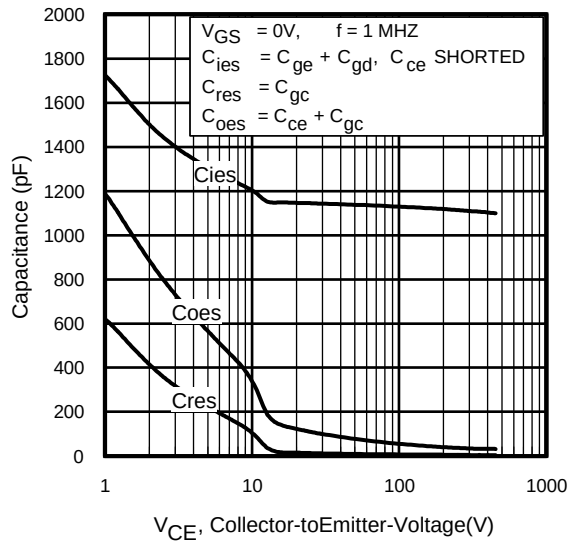
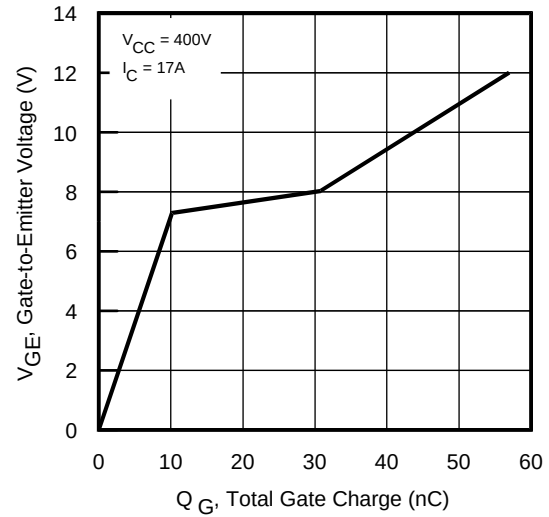
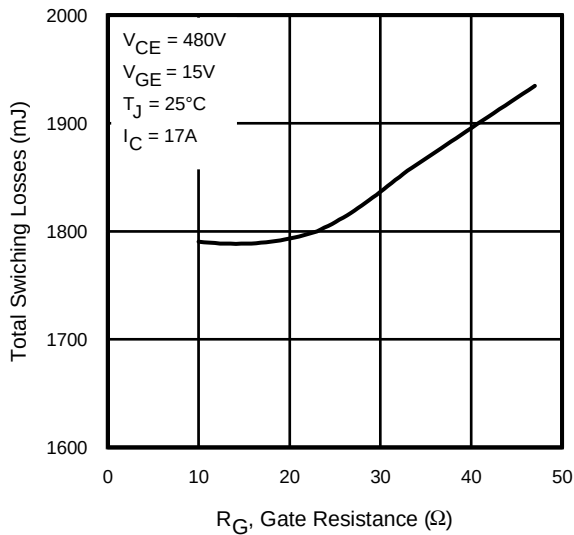
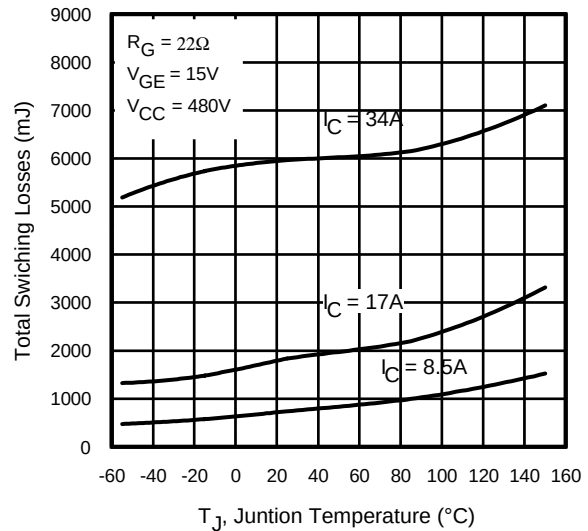


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



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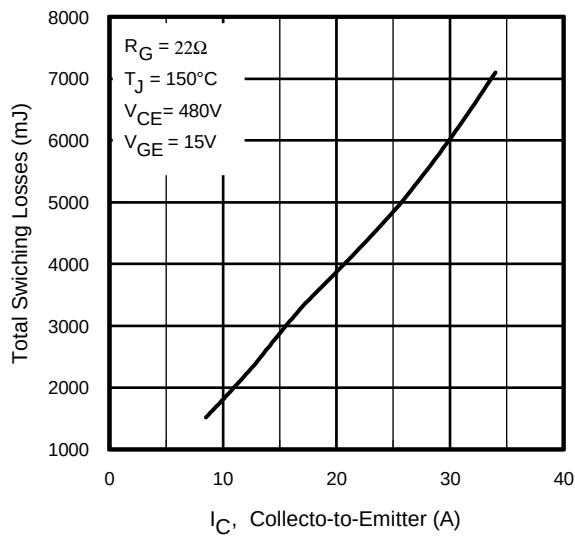


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

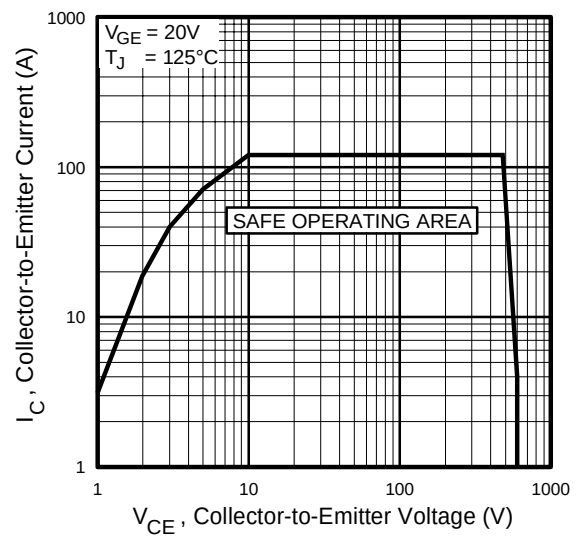


Fig. 12 - Turn-Off SOA

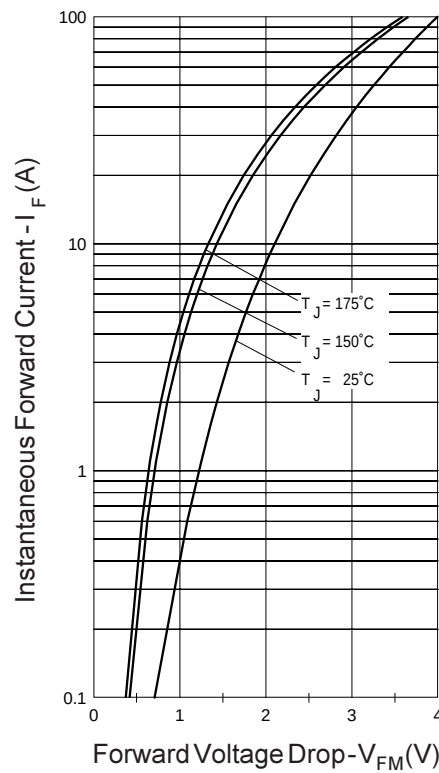


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

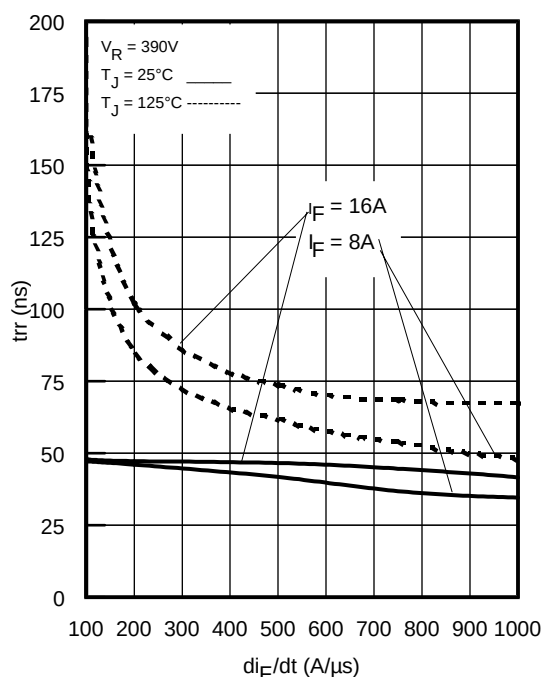


Fig. 14 - Typical Reverse Recovery vs. di_F/dt

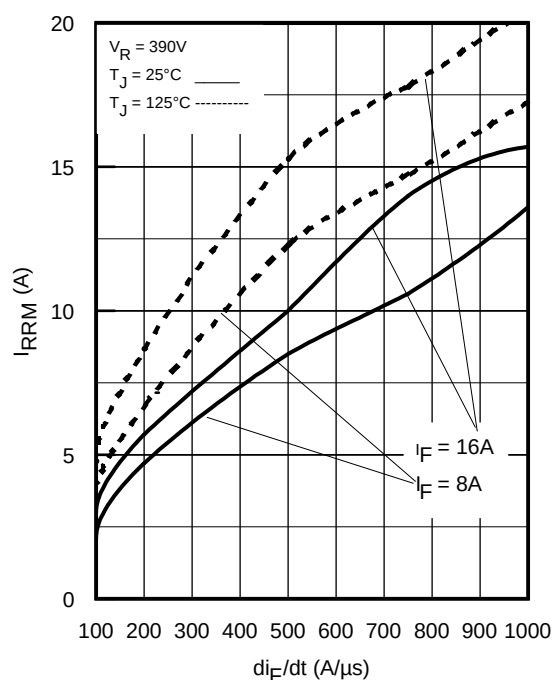


Fig. 15 - Typical Recovery Current vs. di_F/dt

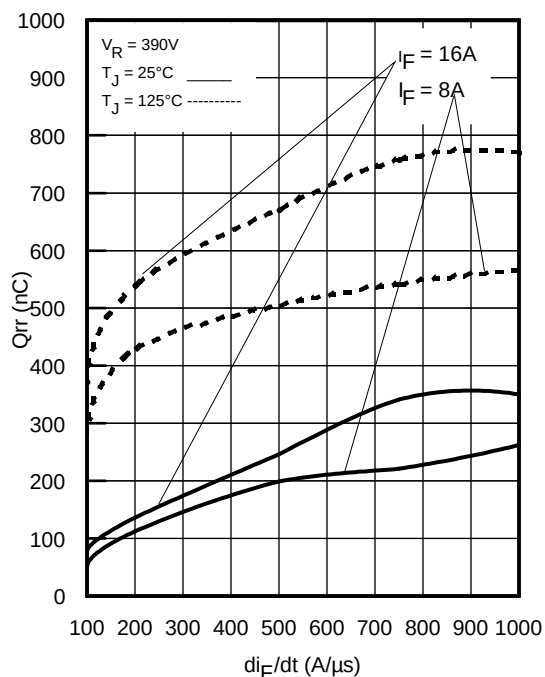


Fig. 16 - Typical Stored Charge vs. di_F/dt

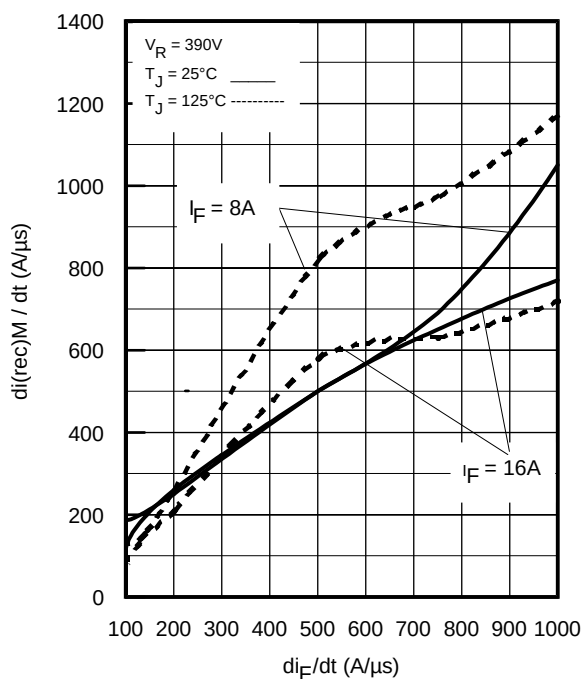


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_F/dt

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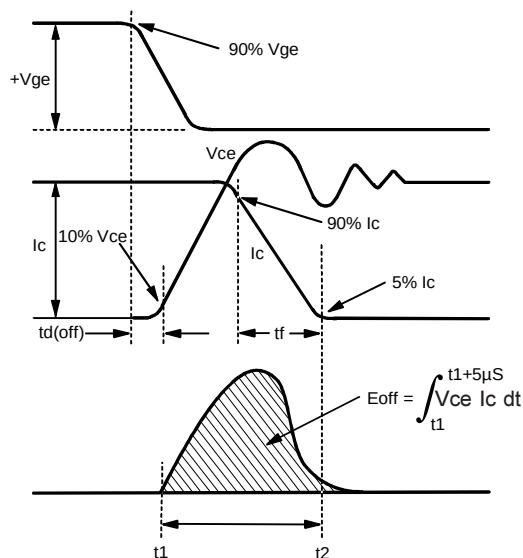
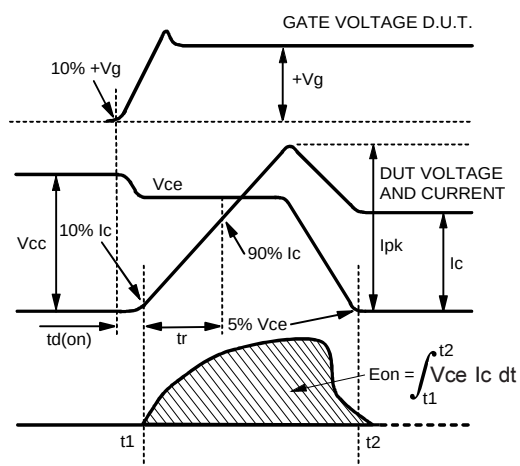


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f



The diagram illustrates the diode recovery process during a switching event. The top portion shows the current waveform (solid line) and the voltage waveform (dashed line) over time. The current waveform starts at a high level, drops to a negative value, and then returns to zero. The voltage waveform starts at a low level, rises to a high level, and then returns to zero. Key parameters labeled include:

- I_c : Current level during the initial forward bias.
- t_{rr} : Reverse recovery time, the time interval from the current crossing zero to the current reaching its negative peak.
- $Q_{rr} = \int_{t_x}^{t_{rr}} I_c dt$: Reverse recovery charge, the area under the current waveform during the reverse recovery period.
- t_x : Time at which the current crosses zero.
- $10\% V_{cc}$: Voltage level at 10% of the supply voltage.
- $10\% I_{rr}$: Current level at 10% of the reverse current.
- V_{pk} : Peak voltage during the reverse recovery period.
- I_{rr} : Reverse current, the negative peak of the current waveform.
- V_{cc} : Supply voltage.

The bottom portion of the diagram shows the diode reverse recovery energy waveform, which is a shaded area under the current waveform. The energy is calculated as:

$$E_{rec} = \int_{t_3}^{t_4} V_d I_c dt$$

where t_3 and t_4 are the time intervals over which the energy is calculated.

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

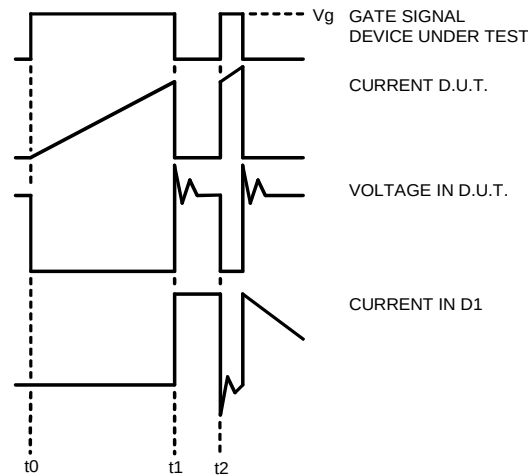


Fig.18e - Macro Waveforms for Figure 18a's Test Circuit

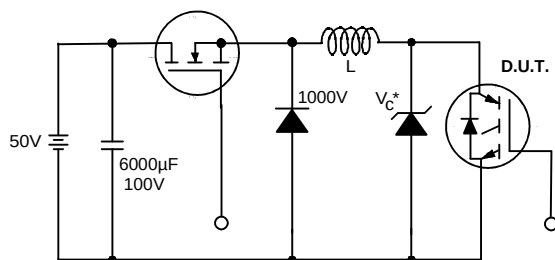


Fig. 19 - Clamped Inductive Load Test Circuit

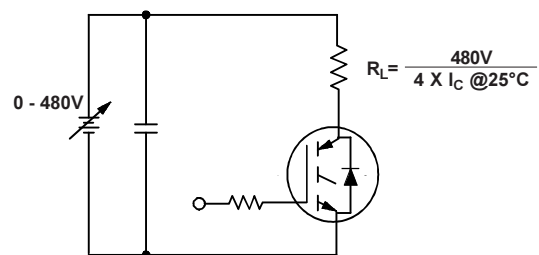


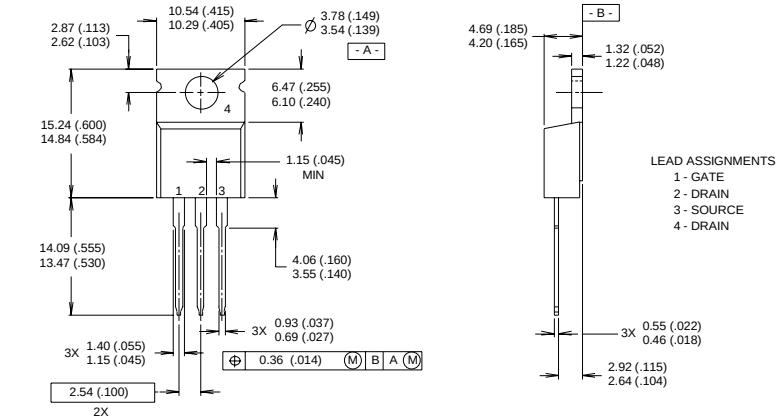
Fig. 20 - Pulsed Collector Current Test Circuit

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TO-220AB Package Outline

Dimensions are shown in millimeters (inches)

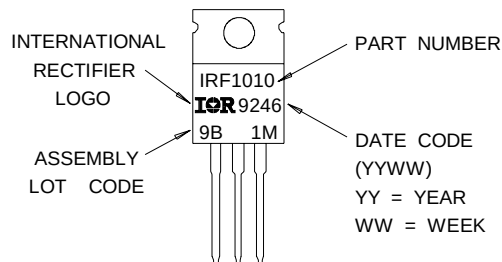
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- NOTES:
- 1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
 - 2 CONTROLLING DIMENSION : INCH
 - 3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
 - 4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

TO-220AB Part Marking Information

EXAMPLE : THIS IS AN IRF1010
WITH ASSEMBLY
LOT CODE 9B1M



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 μs , single shot.
- ⑤ Energy losses include "tail" and diode reverse recovery, using Diode FD100H06A5.

TO-220 package is not recommended for Surface Mount Application.

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

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