

# IRG7RC07SDPbF

**Optimized for line frequency, 50/60Hz switching frequency**

## Features

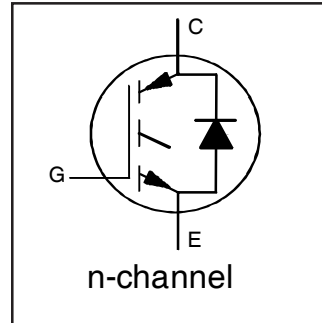
- Standard speed IGBT for switching frequency less than 1KHz
- Very low  $V_{CE(ON)}$
- Ultra fast soft recovery diode

## Benefits

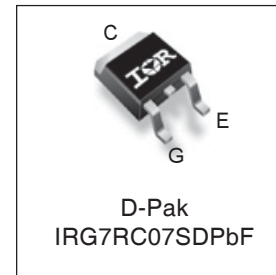
- High efficiency for line frequency applications
- Higher reliability from reduced conduction losses
- Ultra fast diode optimized for high frequency commutation

## Applications

- Solar Inverters (50/60Hz Switch)
- Welding machine output stage
- Steering Switch in BLDC motor
- Induction heating operating in capacitive mode



$V_{CES} = 600V$
$I_C = 8.5A, T_C = 100^\circ C$
$V_{CE(on)} \text{ typ. } = 1.2V @ I_C = 3A$



<b>G</b>	<b>C</b>	<b>E</b>
Gate	Collector	Emitter

## Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	16	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	8.5	
$I_{CM}$	Pulse Collector Current	18	
$I_M$	Clamped Inductive Load Current ①	6.0	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	16	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	8.5	
$I_{FM}$	Diode Maximum Forward Current ②	16	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 30$	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	39	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	16	
$T_J$	Operating Junction and	-55 to +150	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	

## Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT) ③	—	—	3.2	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode) ③	—	—	6.1	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.50	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (PCB mount Steady state)	—	50	—	

### 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	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.72	—	V/°C	$V_{GE} = 0V, I_C = 250\mu A$ (25°C-150°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.2	1.5	V	$I_C = 3.0A, V_{GE} = 15V, T_J = 25^\circ\text{C}$
		—	1.2	—		$I_C = 3.0A, V_{GE} = 15V, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5	V	$V_{CE} = V_{GE}, I_C = 100\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-8.3	—	mV/°C	$V_{CE} = V_{GE}, I_C = 1.0mA$ (25°C - 150°C)
$g_{fe}$	Forward Transconductance	—	4.3	—	S	$V_{CE} = 50V, I_C = 3.0A$
$I_{CES}$	Collector-to-Emitter Leakage Current	—	1.0	20	$\mu A$	$V_{GE} = 0V, V_{CE} = 600V$
		—	100	—		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
$V_{FM}$	Diode Forward Voltage Drop	—	1.4	1.8	V	$I_F = 3.0A$
		—	1.1	—		$I_F = 3.0A, T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{GE} = \pm 30V$

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	13	20	nC	$I_C = 3.0A$ $V_{GE} = 15V$ ① $V_{CC} = 400V$
$Q_{ge}$	Gate-to-Emitter Charge (turn-on)	—	2.0	3.0		
$Q_{gc}$	Gate-to-Collector Charge (turn-on)	—	5.0	7.5		
$E_{on}$	Turn-On Switching Loss	—	80	170	$\mu J$	$I_C = 3.0A, V_{CC} = 400V, V_{GE} = 15V$ $R_G = 100\Omega, L = 1mH, T_J = 25^\circ\text{C}$ ② Energy losses include tail & diode reverse recovery
$E_{off}$	Turn-Off Switching Loss	—	620	790		
$E_{total}$	Total Switching Loss	—	700	960		
$t_{d(on)}$	Turn-On delay time	—	20	40	ns	$I_C = 3.0A, V_{CC} = 400V, V_{GE} = 15V$ $R_G = 100\Omega, L = 1mH, T_J = 25^\circ\text{C}$ ②
$t_r$	Rise time	—	10	30		
$t_{d(off)}$	Turn-Off delay time	—	580	730		
$t_f$	Fall time	—	550	670		
$E_{on}$	Turn-On Switching Loss	—	140	—	$\mu J$	$I_C = 3.0A, V_{CC} = 400V, V_{GE} = 15V$ $R_G = 100\Omega, L = 1mH, T_J = 150^\circ\text{C}$ Energy losses include tail & diode reverse recovery
$E_{off}$	Turn-Off Switching Loss	—	1100	—		
$E_{total}$	Total Switching Loss	—	1240	—		
$t_{d(on)}$	Turn-On delay time	—	20	—	ns	$I_C = 3.0A, V_{CC} = 400V, V_{GE} = 15V$ $R_G = 100\Omega, L = 1mH, T_J = 150^\circ\text{C}$
$t_r$	Rise time	—	15	—		
$t_{d(off)}$	Turn-Off delay time	—	870	—		
$t_f$	Fall time	—	1020	—		
$C_{ies}$	Input Capacitance	—	350	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$
$C_{oes}$	Output Capacitance	—	22	—		
$C_{res}$	Reverse Transfer Capacitance	—	7.0	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ\text{C}, I_C = 6A$ $V_{CC} = 480V, V_p = 600V$ $R_G = 100\Omega, V_{GE} = +20V$ to 0V
$E_{rec}$	Reverse Recovery Energy of the Diode	—	21	—	$\mu J$	$T_J = 150^\circ\text{C}$
$t_{rr}$	Diode Reverse Recovery Time	—	64	—	ns	$V_{CC} = 400V, I_F = 3.0A$
$I_{rr}$	Peak Reverse Recovery Current	—	7.3	—	A	$V_{GE} = 15V, R_G = 100\Omega, L = 1mH$

#### Notes:

- ①  $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 1mH, R_G = 100\Omega$ .
- ② Pulse width limited by max. junction temperature.
- ③  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ④ Max limit based on statistical sample size characterization.

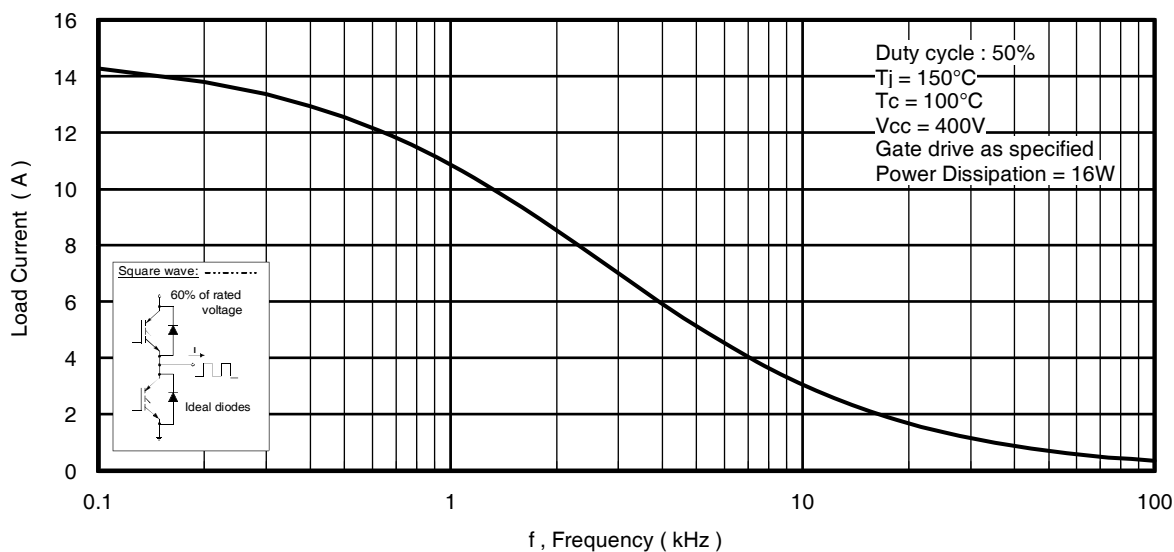


Fig. 1 - Typical Load Current vs. Frequency

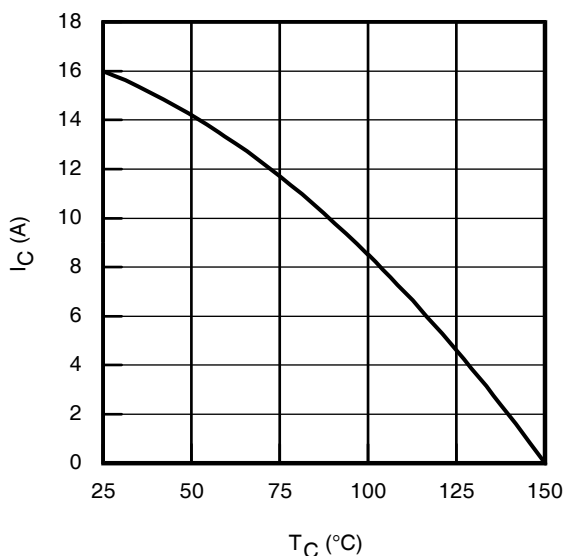


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

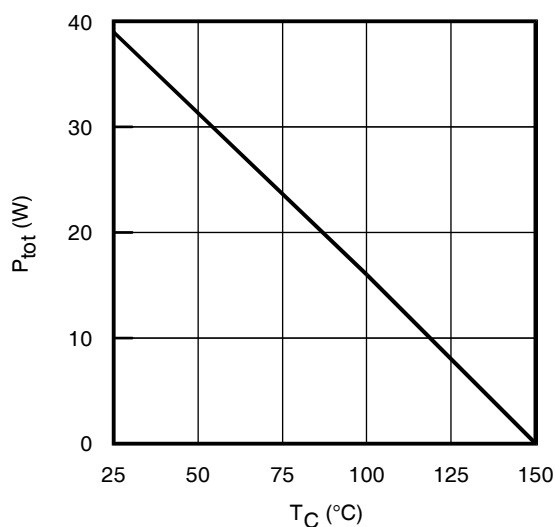


Fig. 3 - Power Dissipation vs. Case Temperature

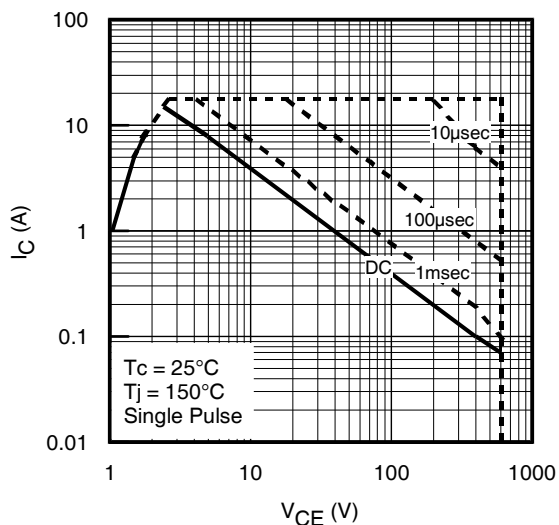


Fig. 4 - Forward SOA

$T_C = 25^\circ\text{C}$ ,  $T_J \leq 150^\circ\text{C}$ ;  $V_{GE} = 15\text{V}$

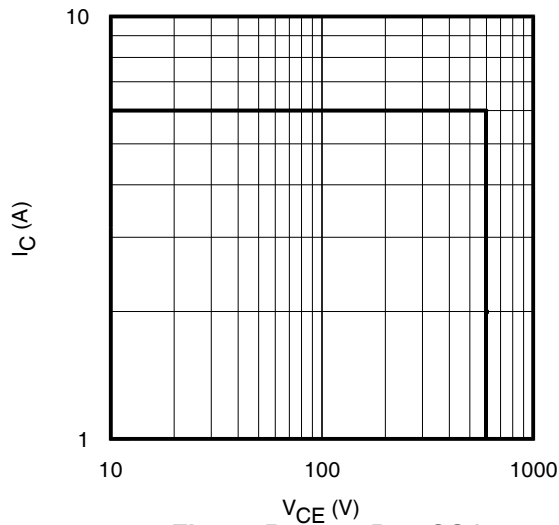
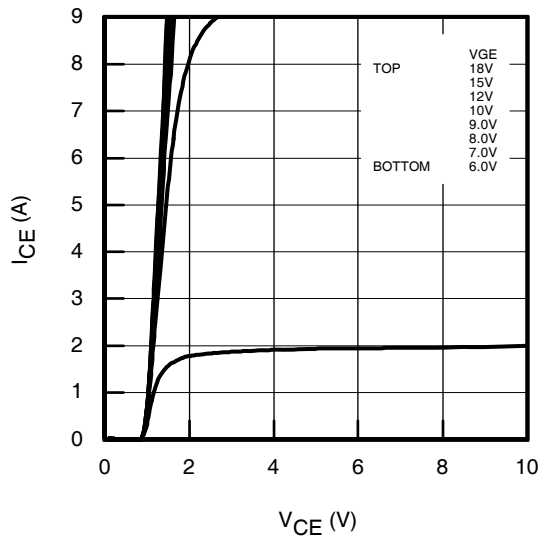
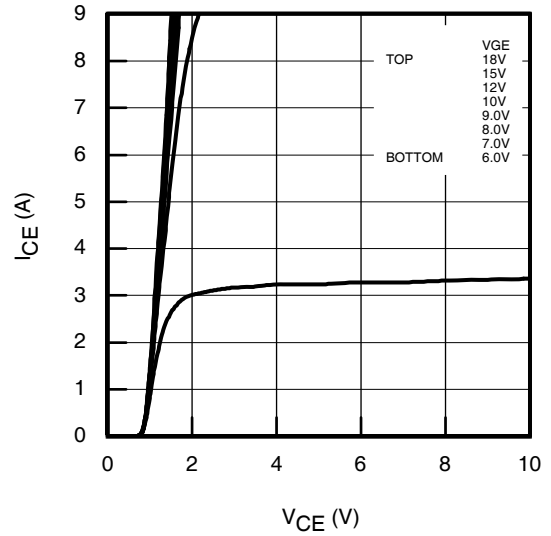


Fig. 5 - Reverse Bias SOA

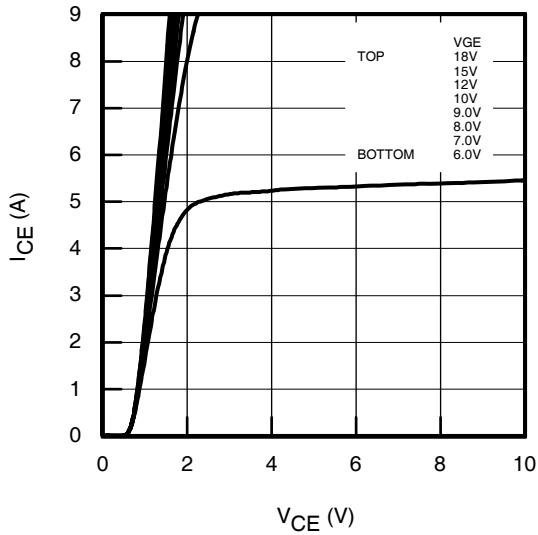
$T_J = 150^\circ\text{C}$ ;  $V_{GE} = 20\text{V}$



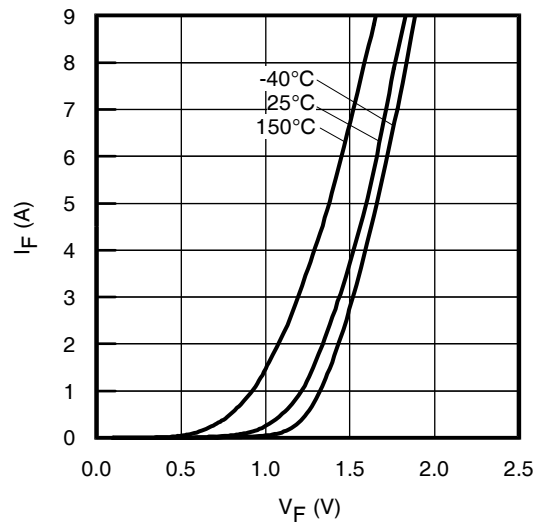
**Fig. 6** - Typ. IGBT Output Characteristics  
 $T_J = -40^\circ\text{C}$ ;  $t_p = 20\mu\text{s}$



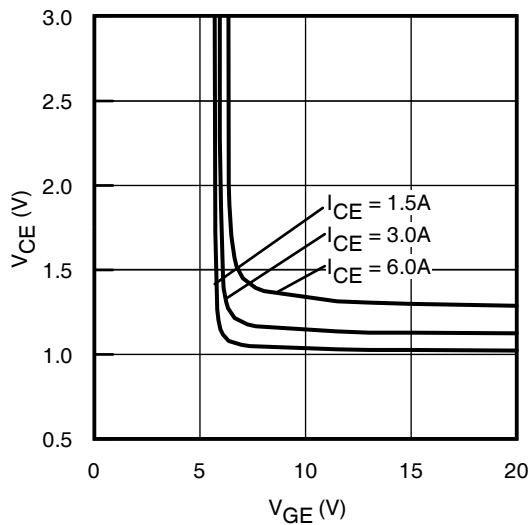
**Fig. 7** - Typ. IGBT Output Characteristics  
 $T_J = 25^\circ\text{C}$ ;  $t_p = 20\mu\text{s}$



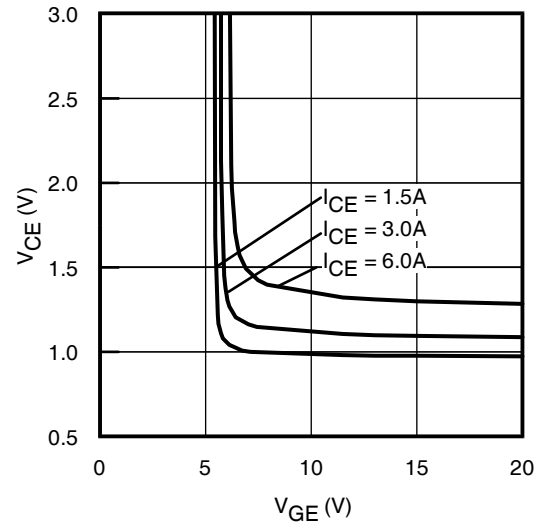
**Fig. 8** - Typ. IGBT Output Characteristics  
 $T_J = 150^\circ\text{C}$ ;  $t_p = 20\mu\text{s}$



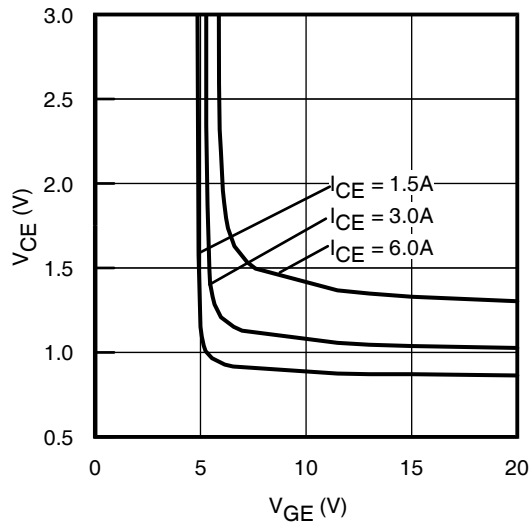
**Fig. 9** - Typ. Diode Forward Characteristics  
 $t_p = 20\mu\text{s}$



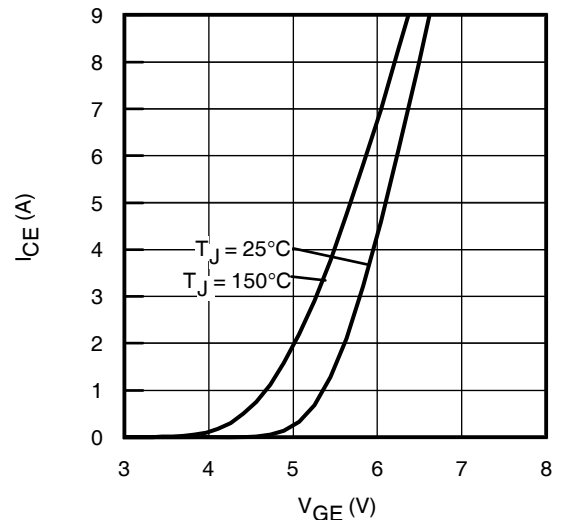
**Fig. 10** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$



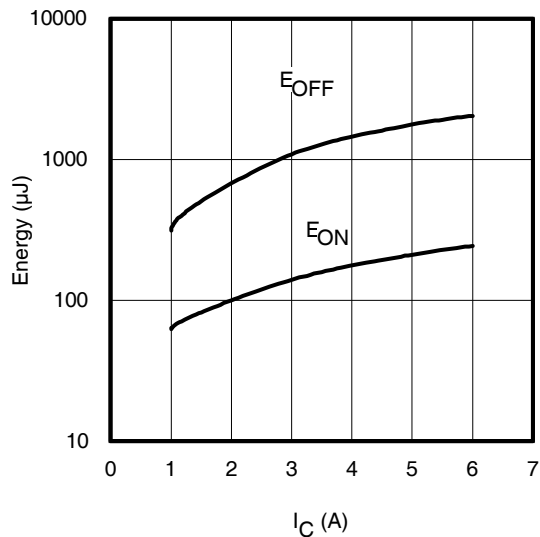
**Fig. 11** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$



**Fig. 12** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 150^\circ C$

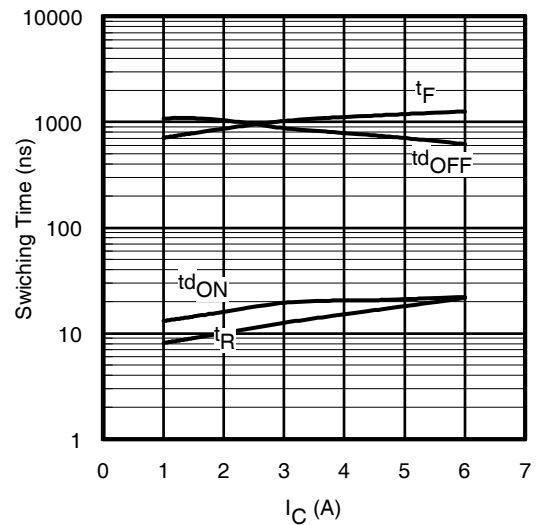


**Fig. 13** - Typ. Transfer Characteristics  
 $V_{CE} = 50V$ ;  $t_p = 20\mu s$



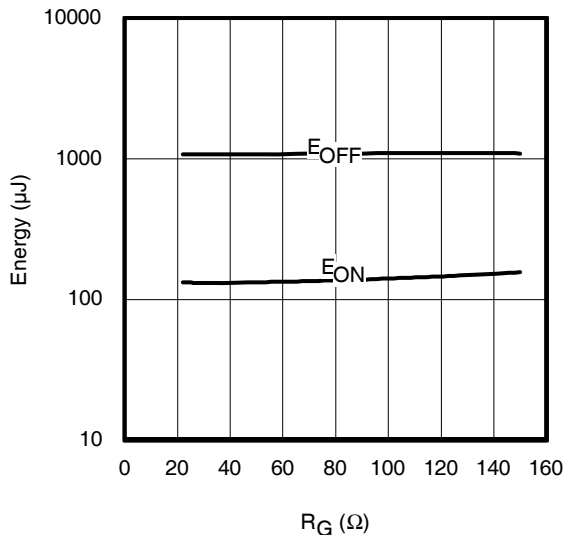
**Fig. 14** - Typ. Energy Loss vs.  $I_C$

$T_J = 150^\circ C$ ;  $L = 1mH$ ;  $V_{CE} = 400V$ ;  $R_G = 100\Omega$ ;  $V_{GE} = 15V$



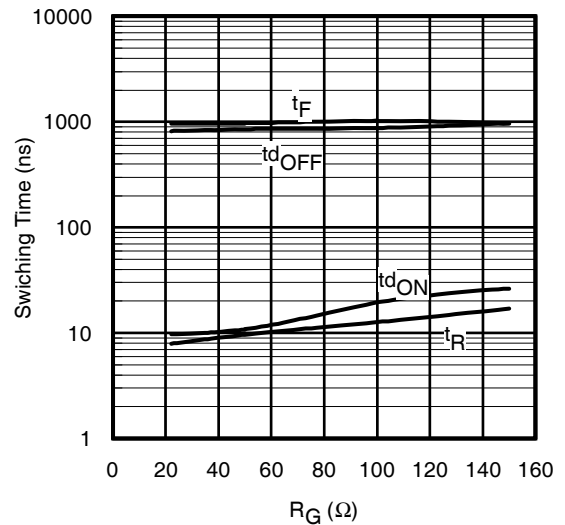
**Fig. 15** - Typ. Switching Time vs.  $I_C$

$T_J = 150^\circ C$ ;  $L = 1mH$ ;  $V_{CE} = 400V$ ;  $R_G = 100\Omega$ ;  $V_{GE} = 15V$



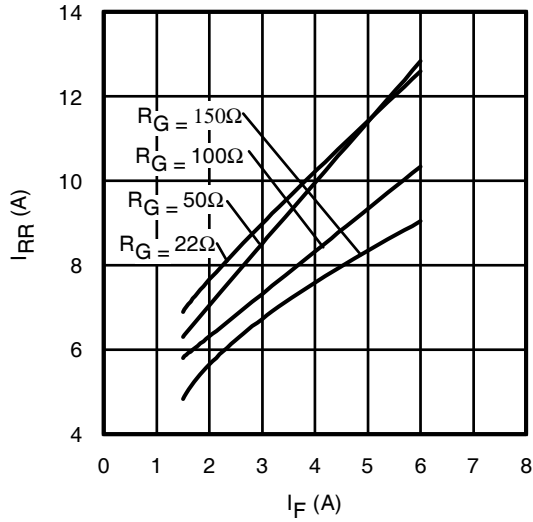
**Fig. 16** - Typ. Energy Loss vs.  $R_G$

$T_J = 150^\circ C$ ;  $L = 1mH$ ;  $V_{CE} = 400V$ ;  $I_{CE} = 3.0A$ ;  $V_{GE} = 15V$

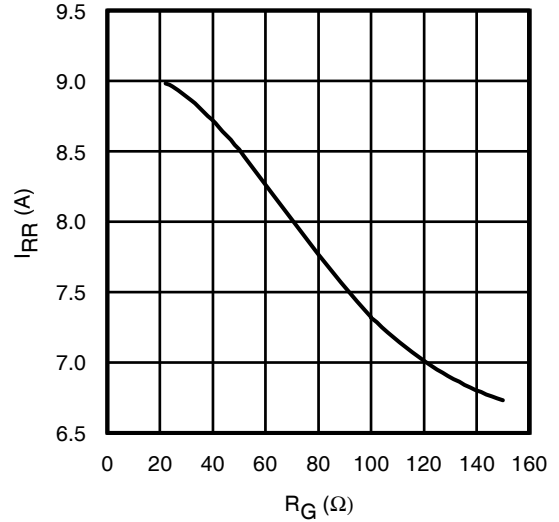


**Fig. 17** - Typ. Switching Time vs.  $R_G$

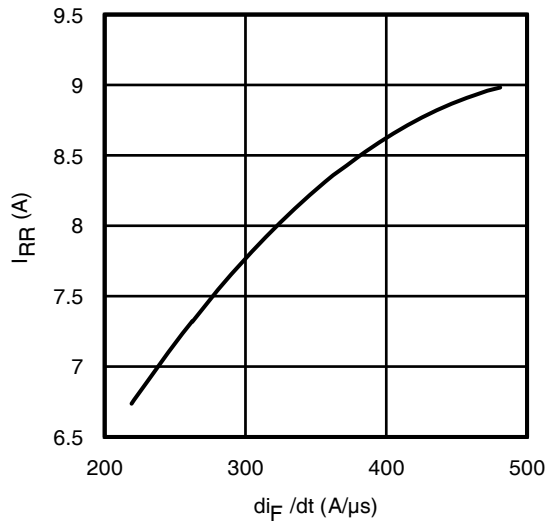
$T_J = 150^\circ C$ ;  $L = 1mH$ ;  $V_{CE} = 400V$ ;  $I_{CE} = 3.0A$ ;  $V_{GE} = 15V$



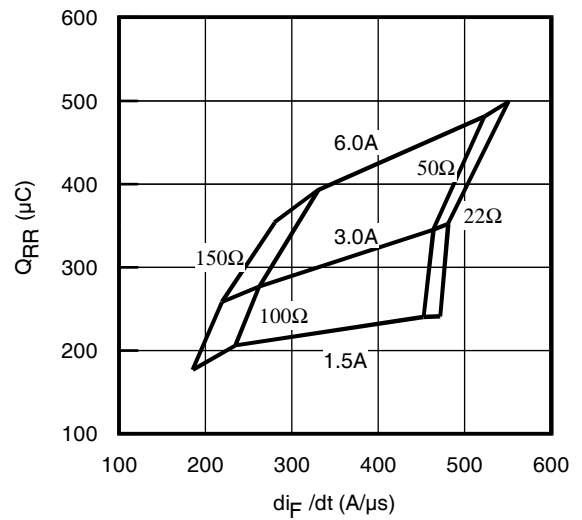
**Fig. 18** - Typ. Diode  $I_{RR}$  vs.  $I_F$   
 $T_J = 150^\circ\text{C}$



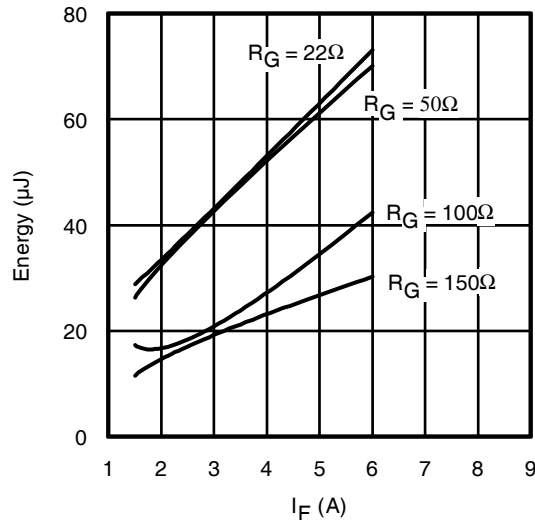
**Fig. 19** - Typ. Diode  $I_{RR}$  vs.  $R_G$   
 $T_J = 150^\circ\text{C}$



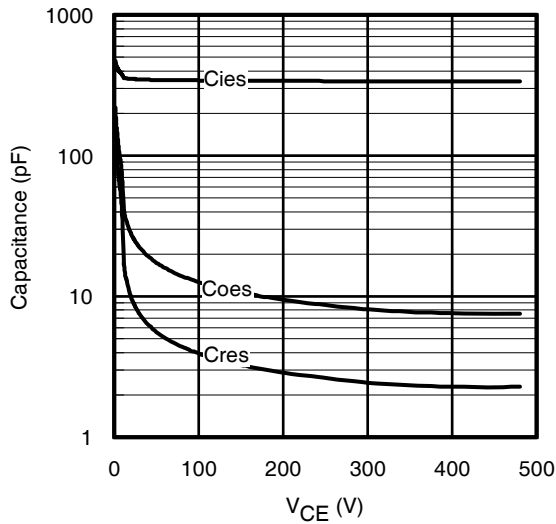
**Fig. 20** - Typ. Diode  $I_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V}; I_F = 3.0\text{A}; T_J = 150^\circ\text{C}$



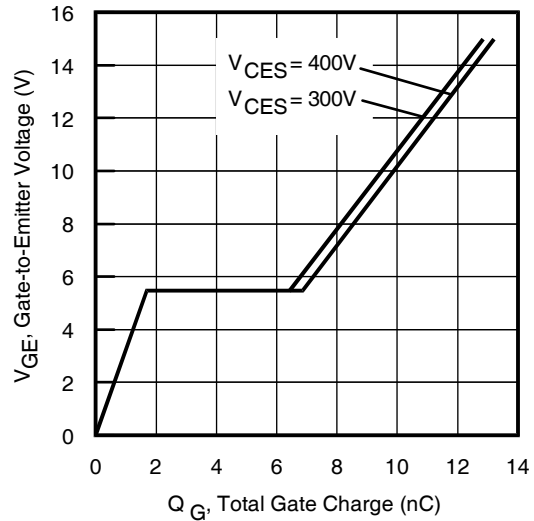
**Fig. 21** - Typ. Diode  $Q_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V}; T_J = 150^\circ\text{C}$



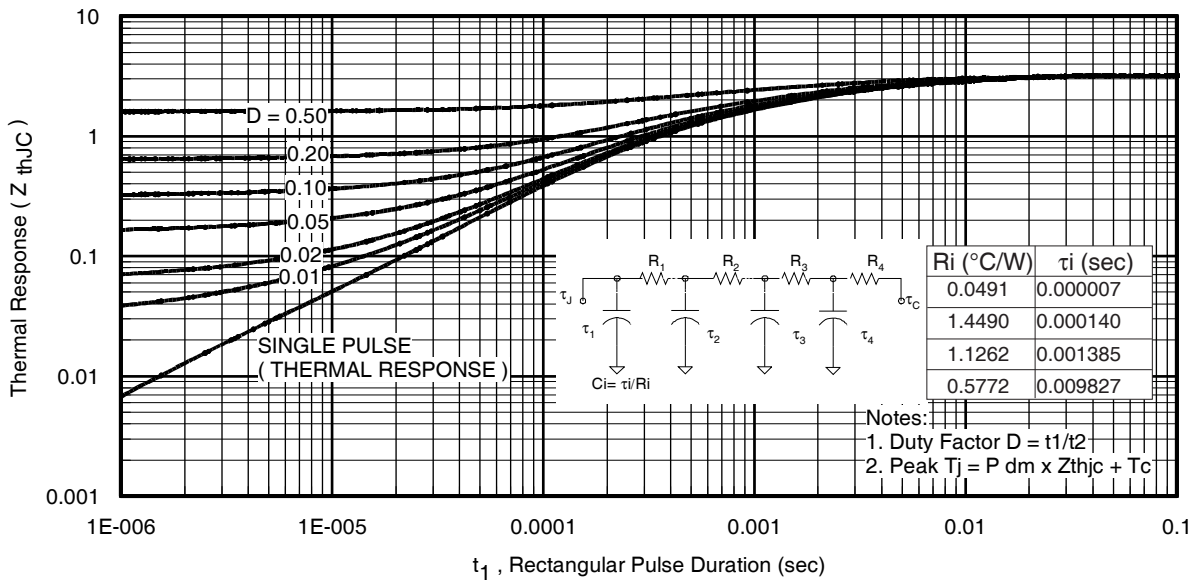
**Fig. 22** - Typ. Diode  $E_{RR}$  vs.  $I_F$   
 $T_J = 150^\circ\text{C}$



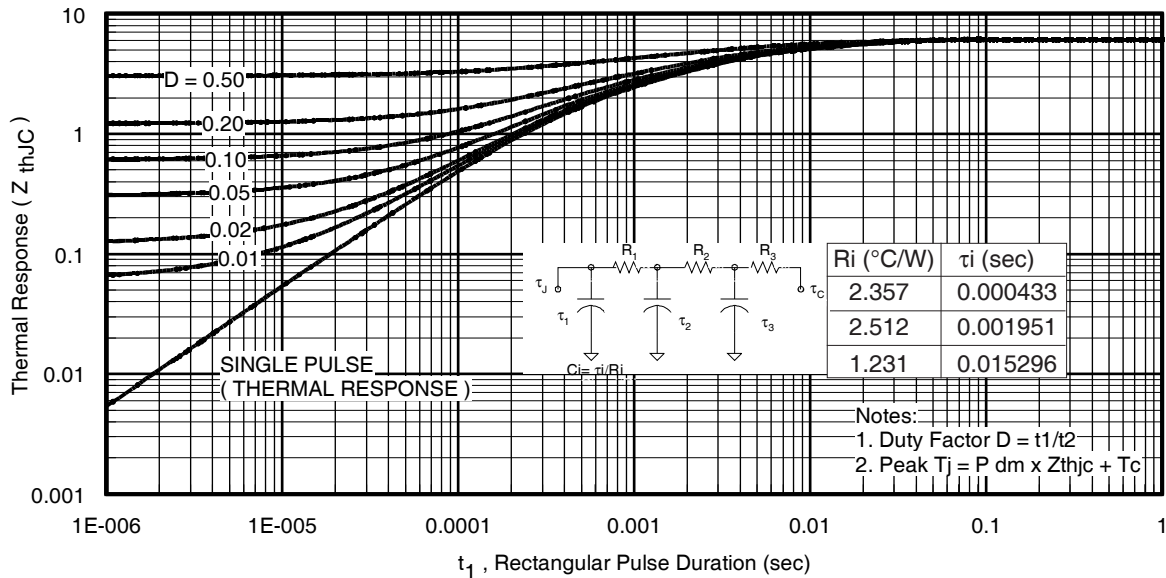
**Fig. 23** - Typ. Capacitance vs. V<sub>CE</sub>  
V<sub>GE</sub> = 0V; f = 1MHz



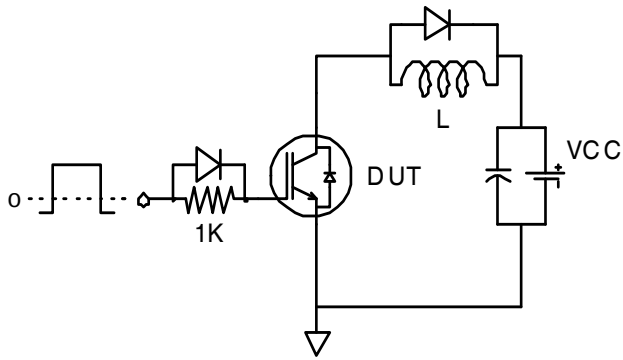
**Fig. 24**- Typical Gate Charge vs. V<sub>GE</sub>  
I<sub>CE</sub> = 3.0A



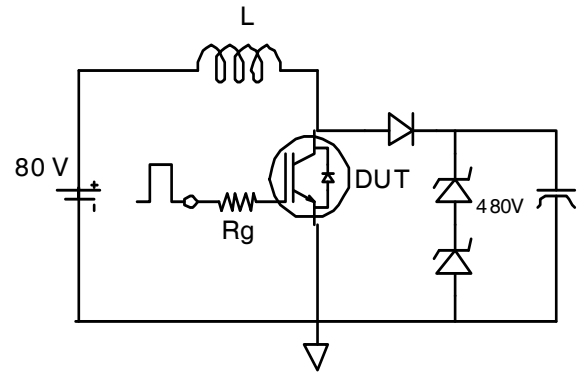
**Fig 25.** Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)



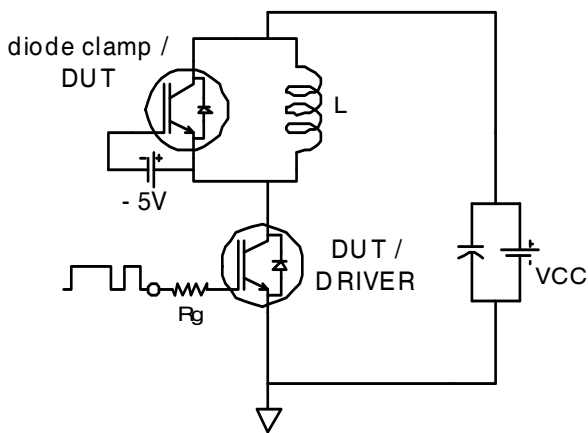
**Fig. 26.** Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)



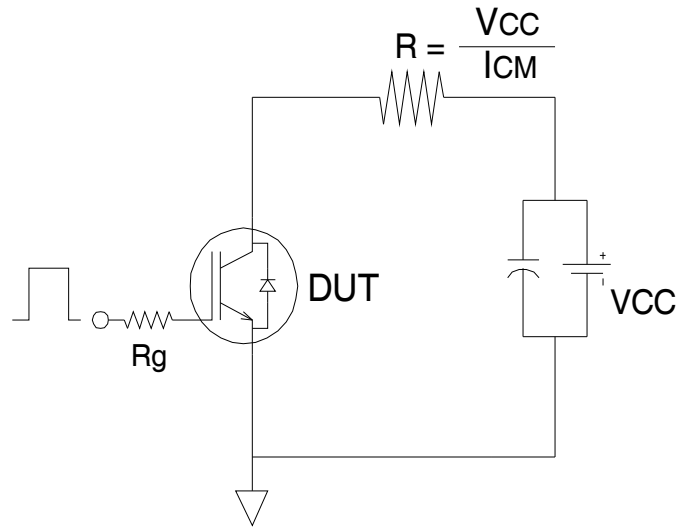
**Fig.C.T.1** - Gate Charge Circuit (turn-off)



**Fig.C.T.2** - RBSOA Circuit

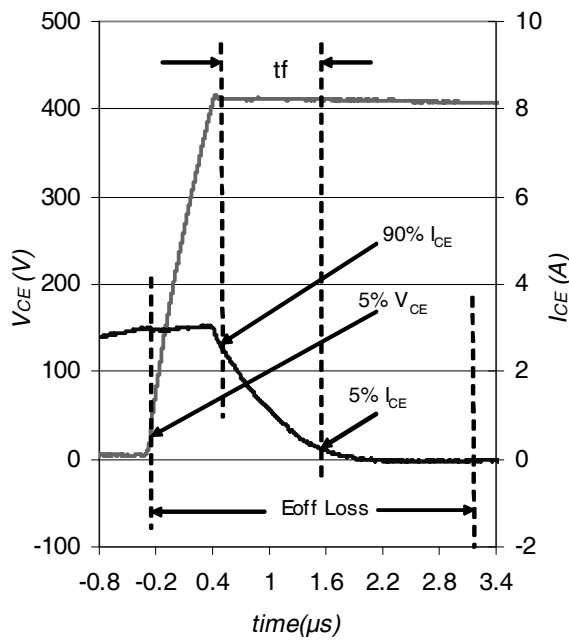


**Fig.C.T.3** - Switching Loss Circuit

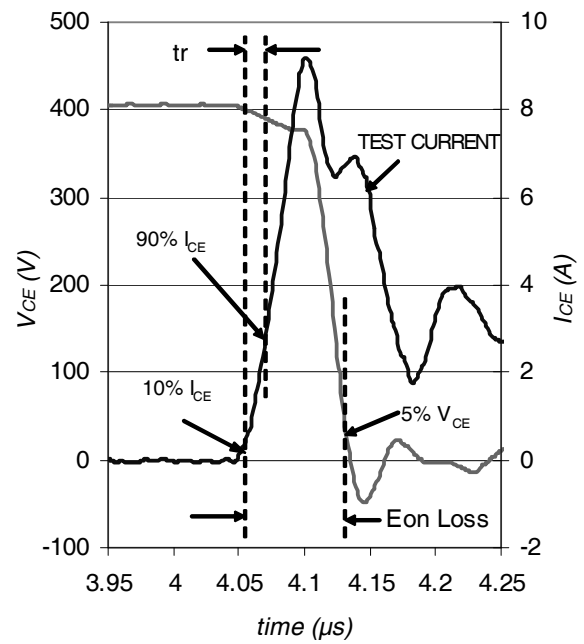


**Fig.C.T.4** - Resistive Load Circuit

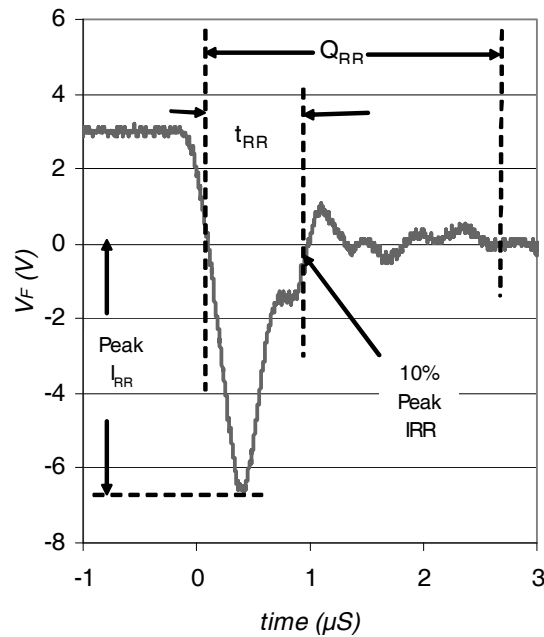




**Fig. WF1** - Typ. Turn-off Loss Waveform  
@  $T_J = 150^\circ\text{C}$  using Fig. CT.3



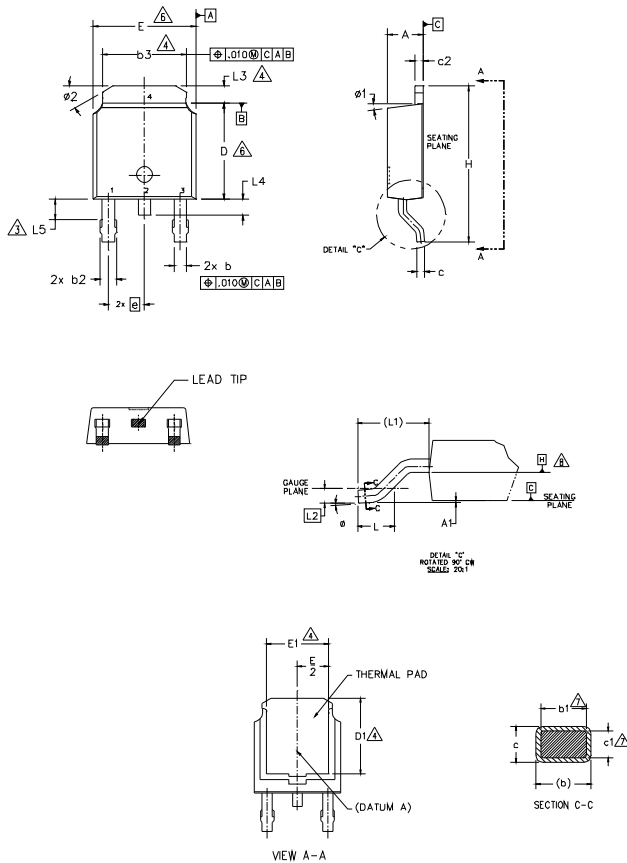
**Fig. WF2** - Typ. Turn-on Loss Waveform  
@  $T_J = 150^\circ\text{C}$  using Fig. CT.3



**Fig. WF3** - Typ. Diode Recovery Waveform  
@  $T_J = 150^\circ\text{C}$  using Fig. CT.3

## D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)



**NOTES:**

- 1.- DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
- 2.- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
- 3.- LEAD DIMENSION UNCONTROLLED IN L5.
- 4.- DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
- 5.- SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.
- 6.- DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
- 7.- DIMENSION b1 & c1 APPLIED TO BASE METAL ONLY.
- 8.- DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
- 9.- OUTLINE CONFORMS TO JEDEC OUTLINE TO-252AA.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	.086	.094	
A1	-	0.13	-	.005	
b	0.64	0.89	.025	.035	
b1	0.65	0.79	.025	.031	7
b2	0.76	1.14	.030	.045	
b3	4.95	5.46	.195	.215	4
c	0.46	0.61	.018	.024	
c1	0.41	0.56	.016	.022	7
c2	0.46	0.89	.018	.035	
D	5.97	6.22	.235	.245	6
D1	5.21	-	.205	-	4
E	6.35	6.73	.250	.265	6
E1	4.32	-	.170	-	4
e	2.29 BSC		.090 BSC		
H	9.40	10.41	.370	.410	
L	1.40	1.78	.055	.070	
L1	2.74 BSC		.108 REF.		
L2	0.51 BSC		.020 BSC		
L3	0.89	1.27	.035	.050	4
L4	-	1.02	-	.040	
L5	1.14	1.52	.045	.060	3
ø	0"	10"	0"	10"	
ø1	0"	15"	0"	15"	
ø2	25"	35"	25"	35"	

**LEAD ASSIGNMENTS**

**HEXFET**

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

**IGBT & CoPAK**

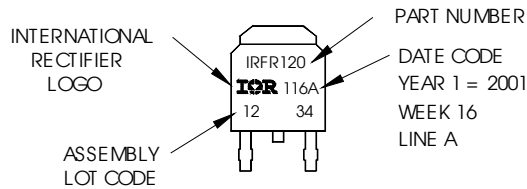
- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

## D-Pak (TO-252AA) Part Marking Information

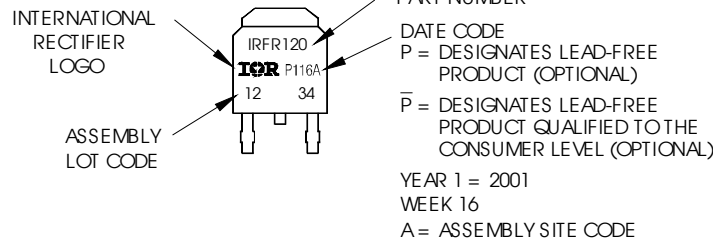
EXAMPLE: THIS IS AN IRFR120  
WITH ASSEMBLY  
LOT CODE 1234  
ASSEMBLED ON WW 16, 2001  
IN THE ASSEMBLY LINE "A"

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

"P̄" in assembly line position indicates  
"Lead-Free" qualification to the consumer-level



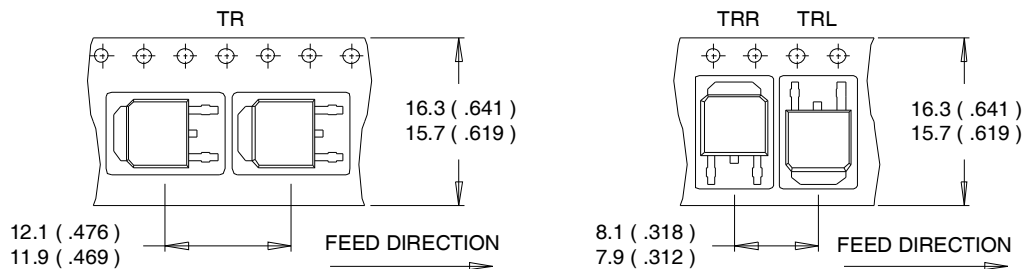
OR



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

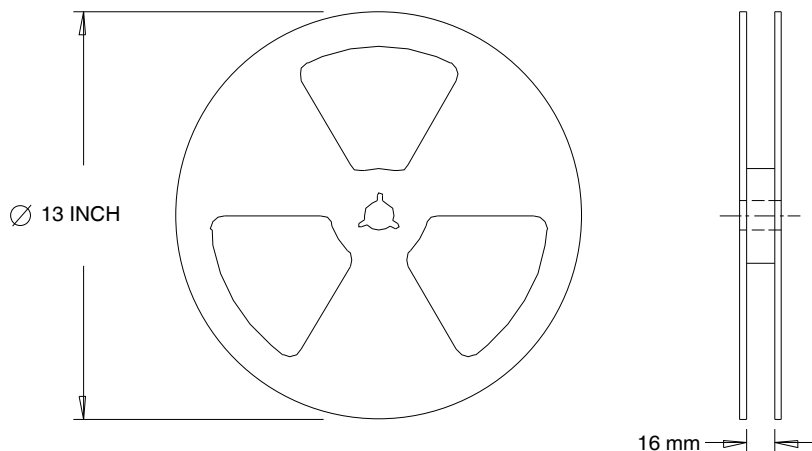
## D-Pak (TO-252AA) Tape & Reel Information

Dimensions are shown in millimeters (inches)



**NOTES :**

1. CONTROLLING DIMENSION : MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS ( INCHES ).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



**NOTES :**

1. OUTLINE CONFORMS TO EIA-481.

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.  
 This product has been designed and qualified for Industrial market.  
 Qualification Standards can be found on IR's Web site.

International  
**IR** 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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