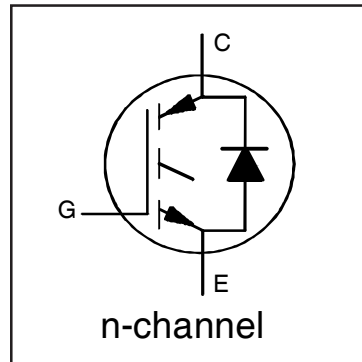


# IRGI4062DPbF

## INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

### Features

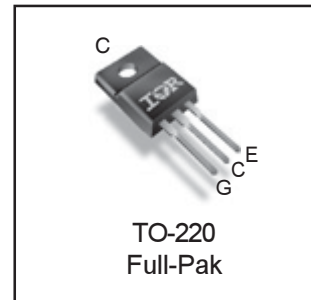
- Low  $V_{CE(ON)}$  Trench IGBT Technology
- Low switching losses
- 5  $\mu$ S short circuit SOA
- Square RBSOA
- 100% of the parts tested for  $I_{LM}$
- Positive  $V_{CE(ON)}$  Temperature co-efficient
- Ultra fast soft Recovery Co-Pak Diode
- Tight parameter distribution
- Lead Free Package



$V_{CES} = 600V$
$I_C = 12A, T_C = 100^\circ C$
$t_{SC} \geq 5\mu s, T_{J(max)} = 150^\circ C$
$V_{CE(on)} \text{ typ.} = 1.34V$

### Benefits

- High Efficiency in a wide range of applications
- Suitable for a wide range of switching frequencies due to Low  $V_{CE(ON)}$  and Low Switching losses
- Rugged transient Performance for increased reliability
- Excellent Current sharing in parallel operation
- Low EMI



<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	22	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	12	
$I_{CM}$	Pulse Collector Current	44	
$I_{LM}$	Clamped Inductive Load Current ①	44	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	22	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	12	
$I_{FM}$	Diode Maximum Forward Current ②	44	
$V_{GE}$	Continuous Gate-to-Emitter Voltage	$\pm 20$	V
	Transient Gate-to-Emitter Voltage	$\pm 30$	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	48	W
		$P_D @ T_C = 100^\circ C$	
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ C$
		Soldering Temperature, for 10 sec.	
	Mounting Torque, 6-32 or M3 Screw	10 lbf-in (1.1 N-m)	

### Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT)	—	—	2.6	$^\circ C/W$
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode)	—	—	4.2	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.50	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	—	65	

**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

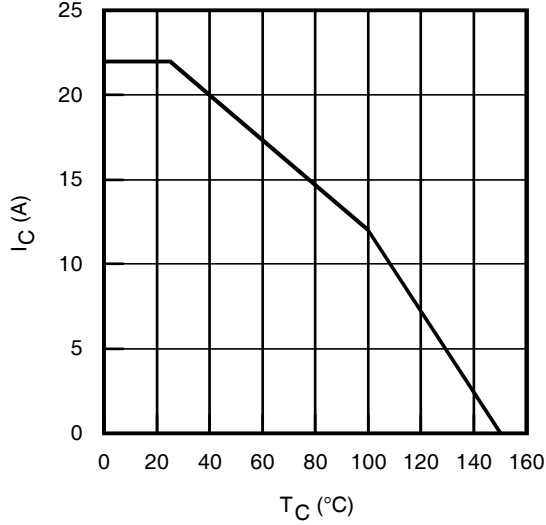
	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 100μA ③	CT6
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	—	0.80	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA (-55°C-150°C)	CT6
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	1.34	1.58	V	I <sub>C</sub> = 12A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 25°C	5,6,7
		—	1.49	—		I <sub>C</sub> = 12A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 125°C	9,10,11
		—	1.54	—		I <sub>C</sub> = 12A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 150°C	
V <sub>GE(th)</sub>	Gate Threshold Voltage	4.0	—	6.5	V	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 700μA	9, 10,
ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>	Threshold Voltage temp. coefficient	—	-14	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0mA (-55°C - 150°C)	11, 12
g <sub>fe</sub>	Forward Transconductance	—	13	—	S	V <sub>CE</sub> = 50V, I <sub>C</sub> = 12A, PW = 80μs	
I <sub>CES</sub>	Collector-to-Emitter Leakage Current	—	—	25	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V	
		—	—	250		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 150°C	
V <sub>FM</sub>	Diode Forward Voltage Drop	—	1.70	2.05	V	I <sub>F</sub> = 12A	8
		—	1.22	—		I <sub>F</sub> = 12A, T <sub>J</sub> = 150°C	
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±100	nA	V <sub>GE</sub> = ±20V	

**Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

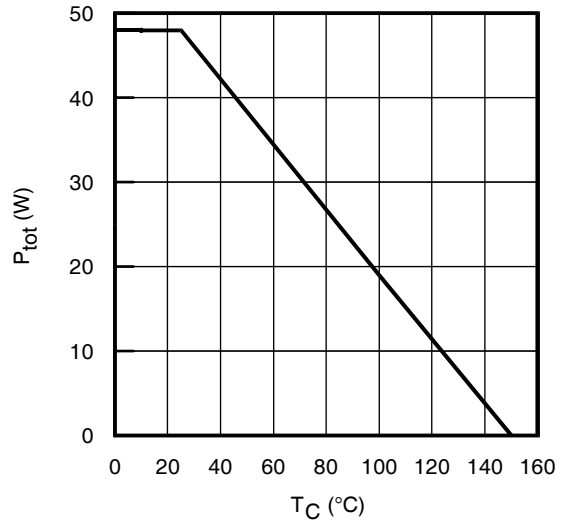
	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	48	72	nC	I <sub>C</sub> = 12A	24
Q <sub>ge</sub>	Gate-to-Emitter Charge (turn-on)	—	13	20		V <sub>GE</sub> = 15V	CT1
Q <sub>gc</sub>	Gate-to-Collector Charge (turn-on)	—	18	27		V <sub>CC</sub> = 400V	
E <sub>on</sub>	Turn-On Switching Loss	—	31	131	μJ	I <sub>C</sub> = 12A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V	CT4
E <sub>off</sub>	Turn-Off Switching Loss	—	183	283		R <sub>G</sub> = 10Ω, L = 0.13mH, T <sub>J</sub> = 25°C	
E <sub>total</sub>	Total Switching Loss	—	214	414		Energy losses include tail & diode reverse recovery	
t <sub>d(on)</sub>	Turn-On delay time	—	41	53	ns	I <sub>C</sub> = 12A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V	CT4
t <sub>r</sub>	Rise time	—	18	25		R <sub>G</sub> = 10Ω, L = 0.13mH, T <sub>J</sub> = 25°C	
t <sub>d(off)</sub>	Turn-Off delay time	—	100	110			
t <sub>f</sub>	Fall time	—	27	35			
E <sub>on</sub>	Turn-On Switching Loss	—	130	—	μJ	I <sub>C</sub> = 12A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V	13, 15
E <sub>off</sub>	Turn-Off Switching Loss	—	275	—		R <sub>G</sub> = 10Ω, L = 0.13mH, T <sub>J</sub> = 150°C ③	CT4
E <sub>total</sub>	Total Switching Loss	—	405	—		Energy losses include tail & diode reverse recovery	WF1, WF2
t <sub>d(on)</sub>	Turn-On delay time	—	39	—	ns	I <sub>C</sub> = 12A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V	14, 16
t <sub>r</sub>	Rise time	—	16	—		R <sub>G</sub> = 10Ω, L = 0.13mH	CT4
t <sub>d(off)</sub>	Turn-Off delay time	—	119	—		T <sub>J</sub> = 150°C	WF1
t <sub>f</sub>	Fall time	—	39	—			WF2
C <sub>ies</sub>	Input Capacitance	—	1528	—	pF	V <sub>GE</sub> = 0V	23
C <sub>oes</sub>	Output Capacitance	—	126	—		V <sub>CC</sub> = 30V	
C <sub>res</sub>	Reverse Transfer Capacitance	—	39	—		f = 1.0Mhz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T <sub>J</sub> = 150°C, I <sub>C</sub> = 44A V <sub>CC</sub> = 480V, V <sub>p</sub> = 600V R <sub>G</sub> = 100Ω, V <sub>GE</sub> = +15V to 0V	4 CT2
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V <sub>CC</sub> = 400V, V <sub>p</sub> = 600V R <sub>G</sub> = 100Ω, V <sub>GE</sub> = +15V to 0V	22, CT3 WF4
E <sub>rec</sub>	Reverse Recovery Energy of the Diode	—	362	—	μJ	T <sub>J</sub> = 150°C	17, 18, 19
t <sub>rr</sub>	Diode Reverse Recovery Time	—	56	—	ns	V <sub>CC</sub> = 400V, I <sub>F</sub> = 12A	20, 21
I <sub>rr</sub>	Peak Reverse Recovery Current	—	30	—	A	V <sub>GE</sub> = 15V, R <sub>G</sub> = 10Ω, L = 0.13mH	WF3

**Notes:**

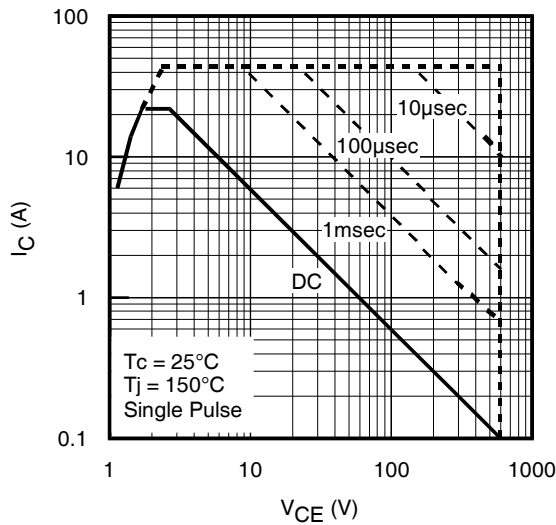
- ① V<sub>CC</sub> = 80% (V<sub>CES</sub>), V<sub>GE</sub> = 15V, L = 28μH, R<sub>G</sub> = 10Ω.
- ② Pulse width limited by max. junction temperature.
- ③ Refer to AN-1086 for guidelines for measuring V<sub>(BR)CES</sub> safely.



**Fig. 1** - Maximum DC Collector Current vs. Case Temperature

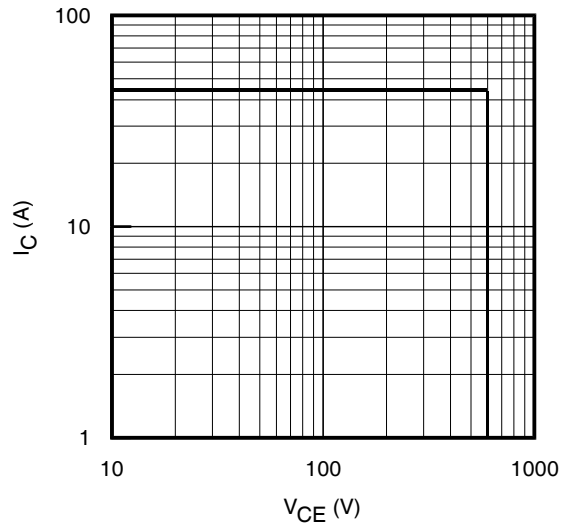


**Fig. 2** - Power Dissipation vs. Case Temperature



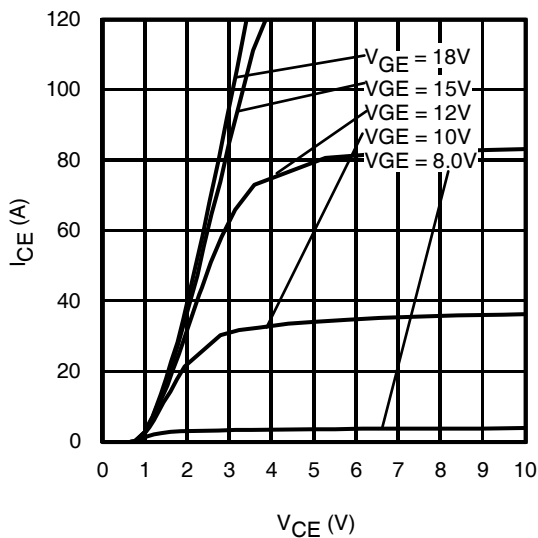
**Fig. 3** - Forward SOA

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

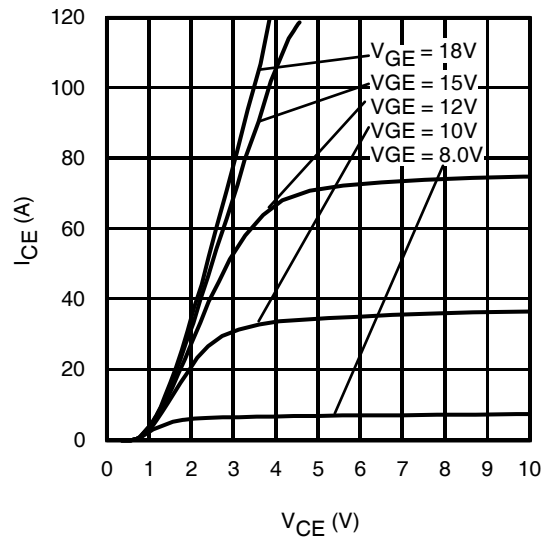


**Fig. 4** - Reverse Bias SOA

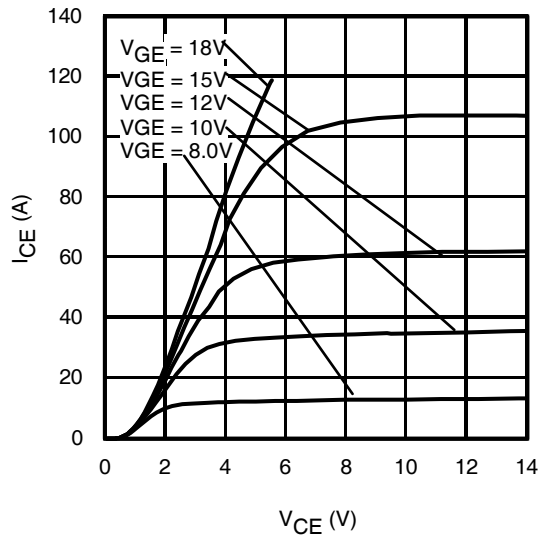
$T_J = 150^\circ\text{C}$ ;  $V_{GE} = 15\text{V}$



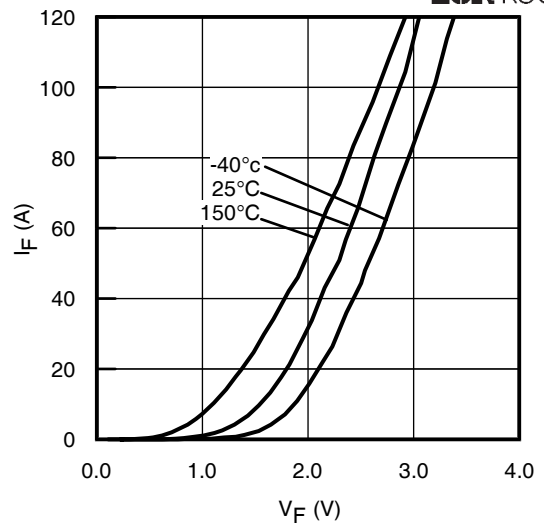
**Fig. 5** - Typ. IGBT Output Characteristics  
 $T_J = -40^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



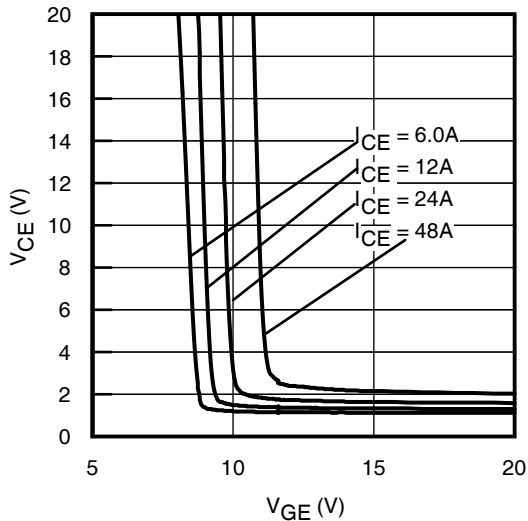
**Fig. 6** - Typ. IGBT Output Characteristics  
 $T_J = 25^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



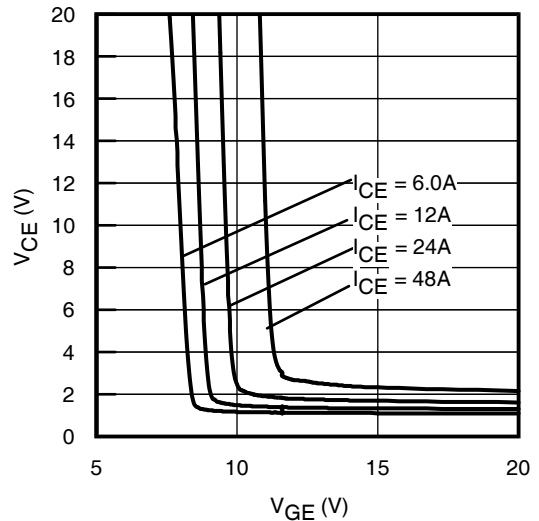
**Fig. 7** - Typ. IGBT Output Characteristics  
 $T_J = 150^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



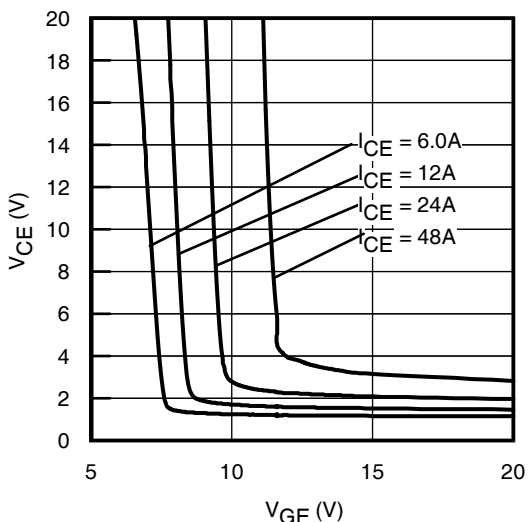
**Fig. 8** - Typ. Diode Forward Characteristics  
 $t_p = 80\mu\text{s}$



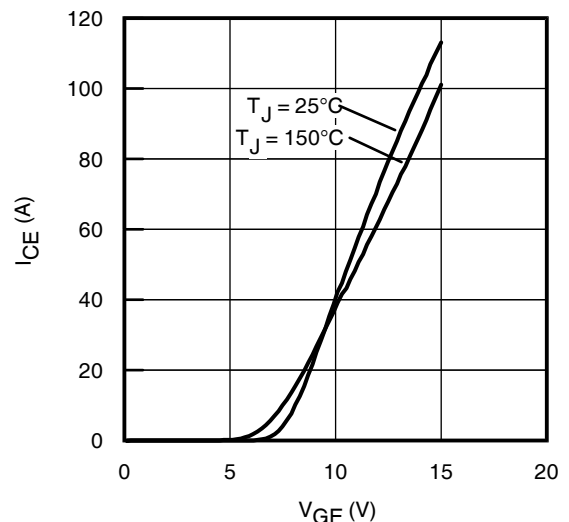
**Fig. 9** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$



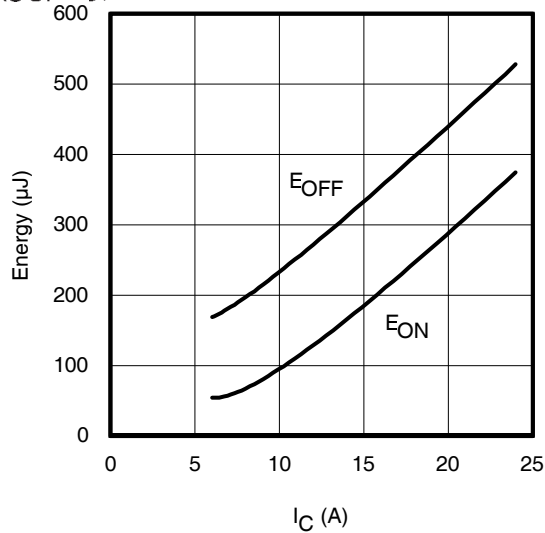
**Fig. 10** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$



**Fig. 11** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 150^\circ\text{C}$

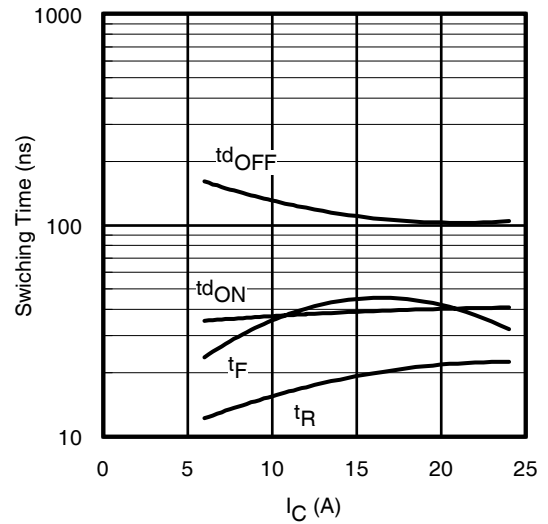


**Fig. 12** - Typ. Transfer Characteristics  
 $V_{CE} = 50\text{V}$ ;  $t_p = 10\mu\text{s}$



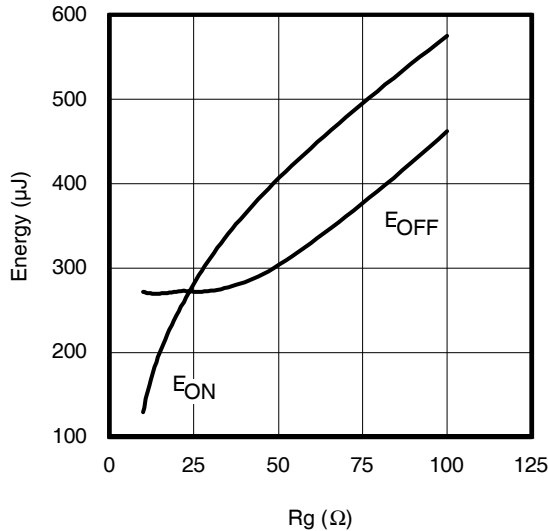
**Fig. 13** - Typ. Energy Loss vs.  $I_C$

$T_J = 150^\circ\text{C}$ ;  $L = 0.13\text{mH}$ ;  $V_{CE} = 400\text{V}$ ,  $R_G = 10\Omega$ ;  $V_{GE} = 15\text{V}$



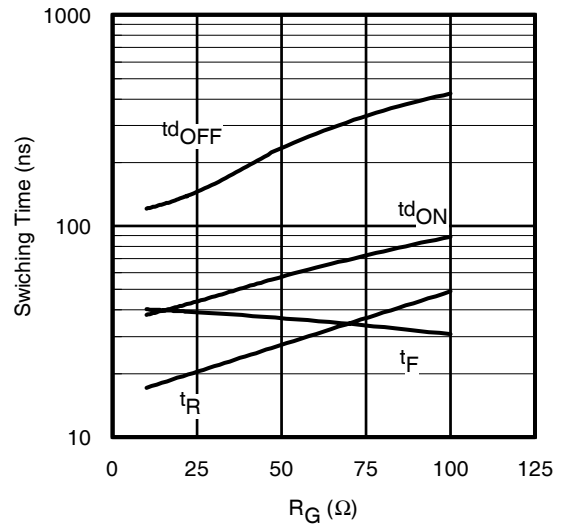
**Fig. 14** - Typ. Switching Time vs.  $I_C$

$T_J = 150^\circ\text{C}$ ;  $L = 0.13\text{mH}$ ;  $V_{CE} = 400\text{V}$ ,  $R_G = 10\Omega$ ;  $V_{GE} = 15\text{V}$



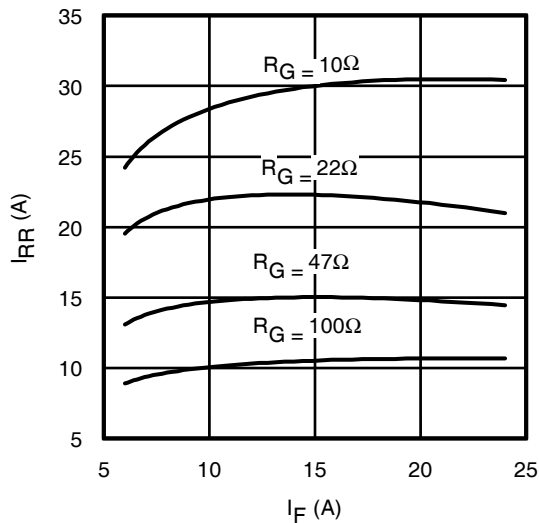
**Fig. 15** - Typ. Energy Loss vs.  $R_G$

$T_J = 150^\circ\text{C}$ ;  $L = 0.13\text{mH}$ ;  $V_{CE} = 400\text{V}$ ,  $I_{CE} = 12\text{A}$ ;  $V_{GE} = 15\text{V}$



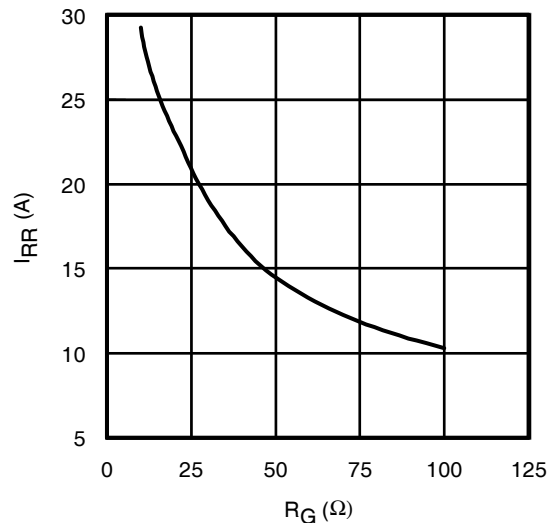
**Fig. 16** - Typ. Switching Time vs.  $R_G$

$T_J = 150^\circ\text{C}$ ;  $L = 0.13\text{mH}$ ;  $V_{CE} = 400\text{V}$ ,  $I_{CE} = 12\text{A}$ ;  $V_{GE} = 15\text{V}$



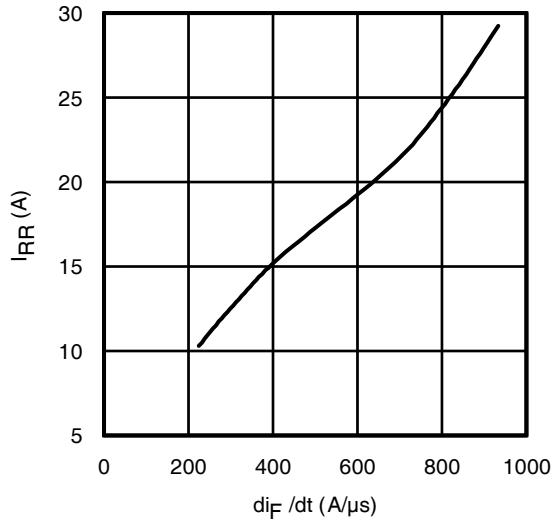
**Fig. 17** - Typ. Diode  $I_{RR}$  vs.  $I_F$

$T_J = 150^\circ\text{C}$

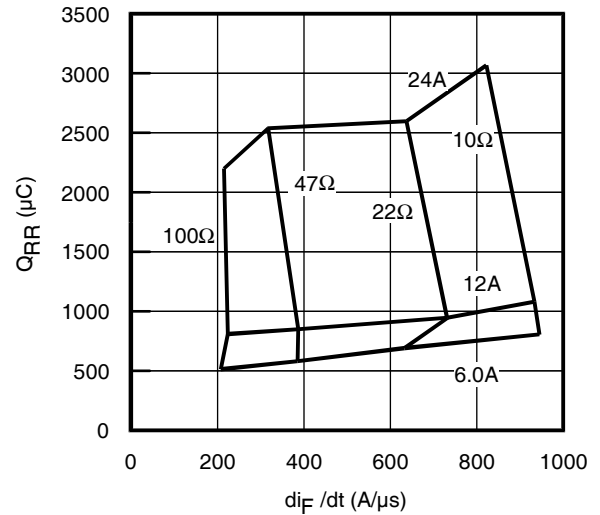


**Fig. 18** - Typ. Diode  $I_{RR}$  vs.  $R_G$

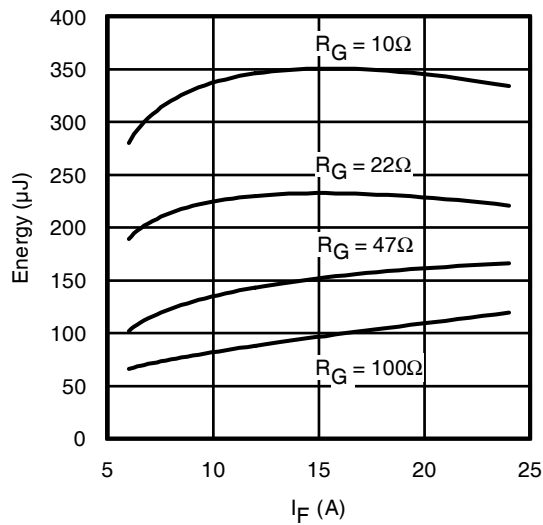
$T_J = 150^\circ\text{C}$



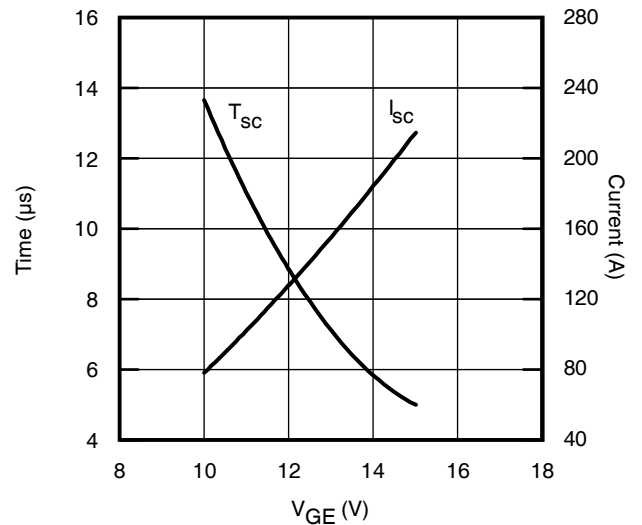
**Fig. 19** - Typ. Diode  $I_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400V$ ;  $V_{GE} = 15V$ ;  $I_F = 12A$ ;  $T_J = 150^\circ C$



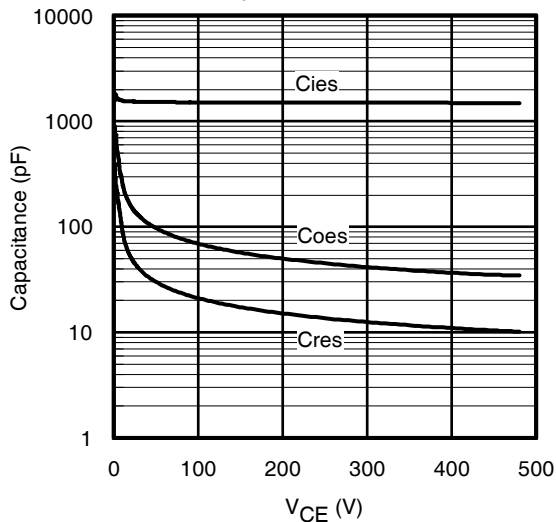
**Fig. 20** - Typ. Diode  $Q_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400V$ ;  $V_{GE} = 15V$ ;  $T_J = 150^\circ C$



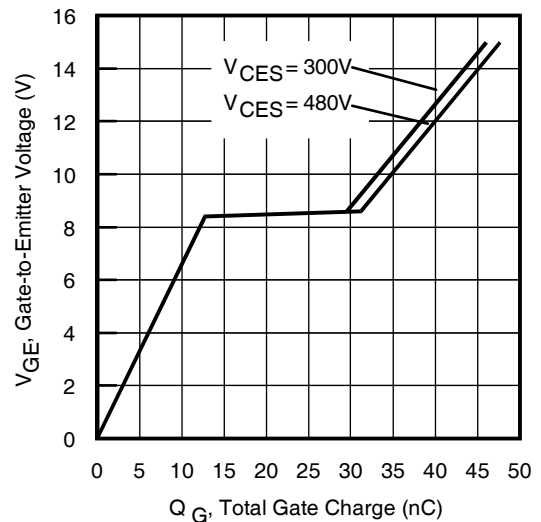
**Fig. 21** - Typ. Diode  $E_{RR}$  vs.  $I_F$   
 $T_J = 150^\circ C$



**Fig. 22** -  $V_{GE}$  vs. Short Circuit Time  
 $V_{CC} = 400V$ ;  $T_C = 25^\circ C$



**Fig. 23** - Typ. Capacitance vs.  $V_{CE}$   
 $V_{GE} = 0V$ ;  $f = 1MHz$



**Fig. 24** - Typical Gate Charge vs.  $V_{GE}$   
 $I_{CE} = 12A$ ;  $L = 1700\mu H$

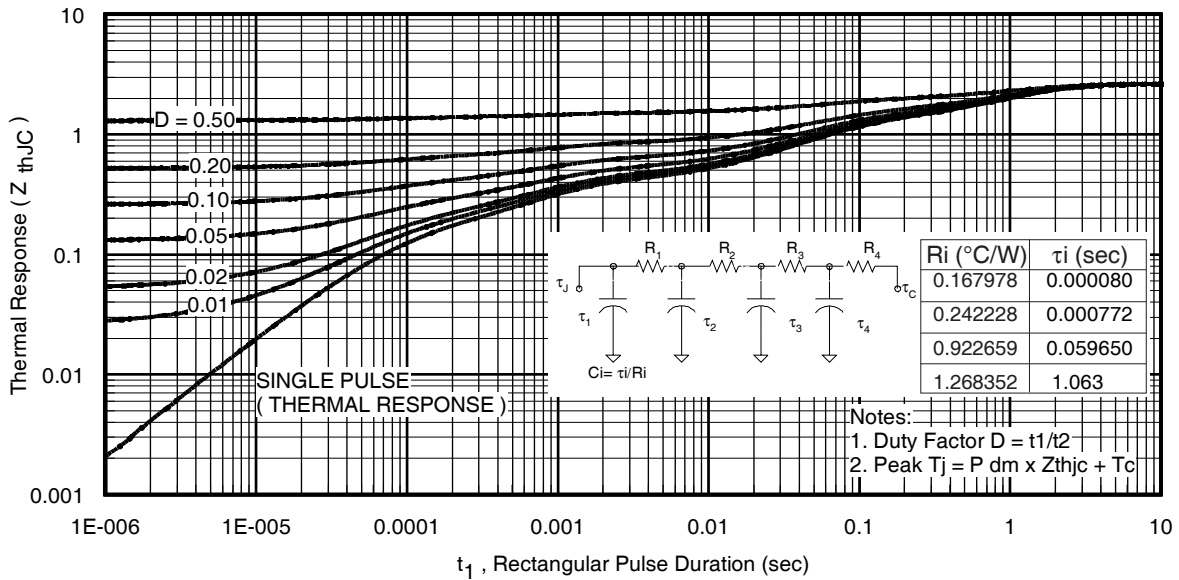


Fig 23. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

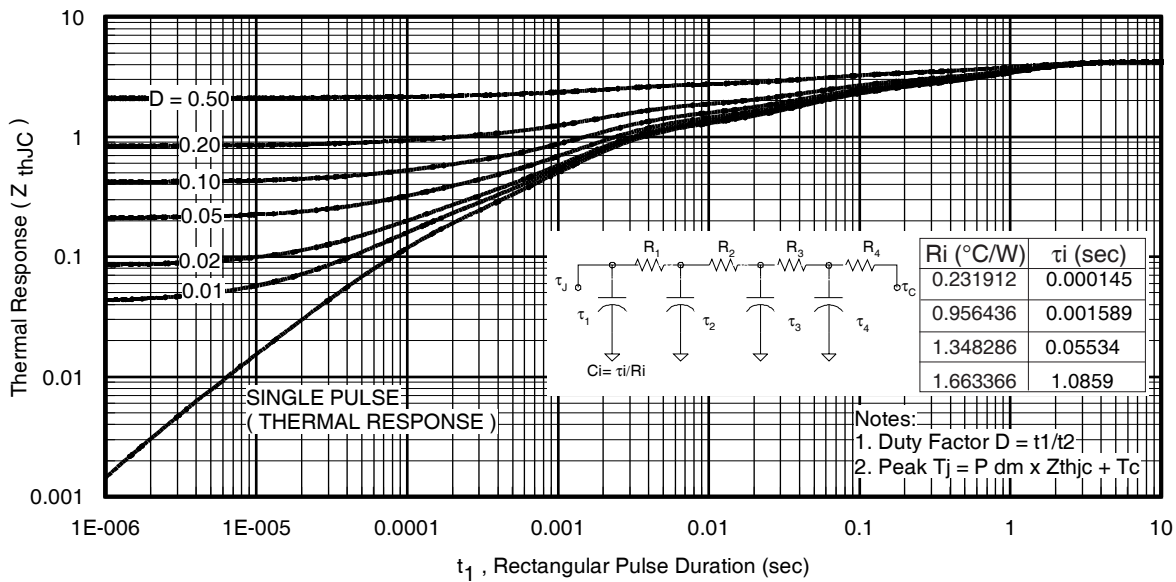
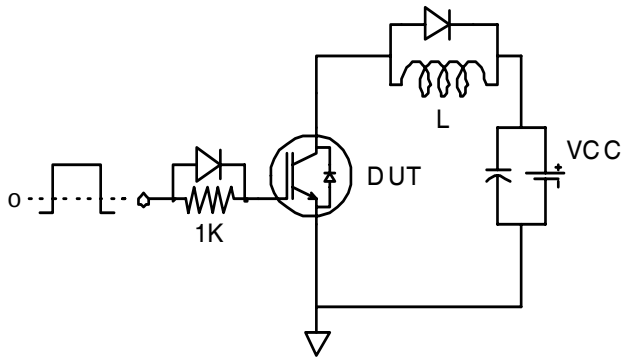
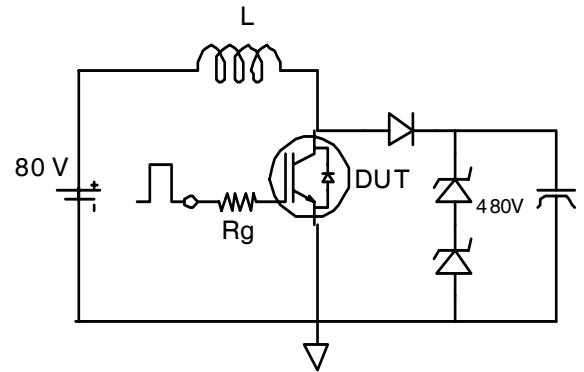


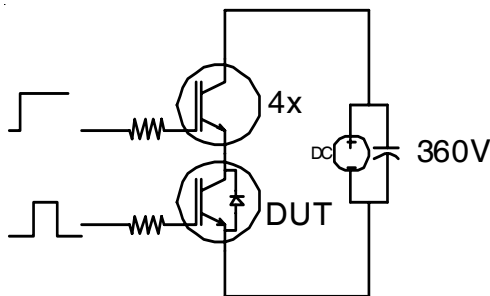
Fig. 24. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)



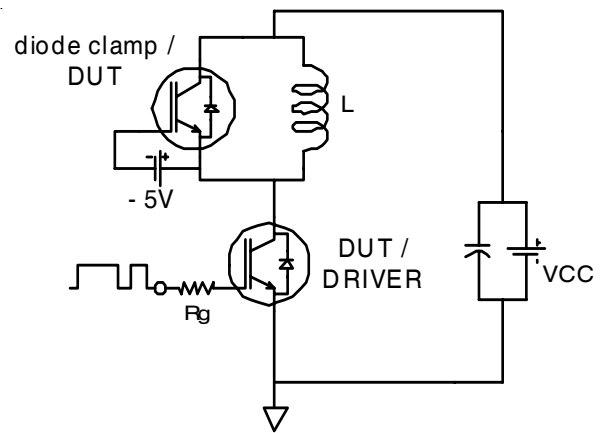
**Fig.C.T.1** - Gate Charge Circuit (turn-off)



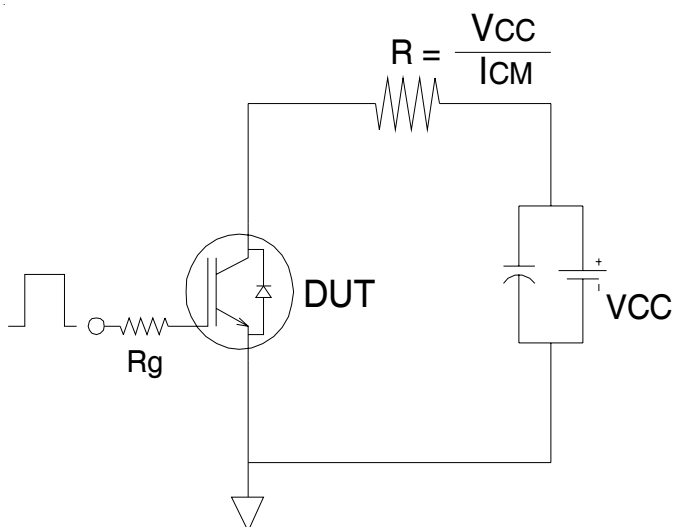
**Fig.C.T.2** - RBSOA Circuit



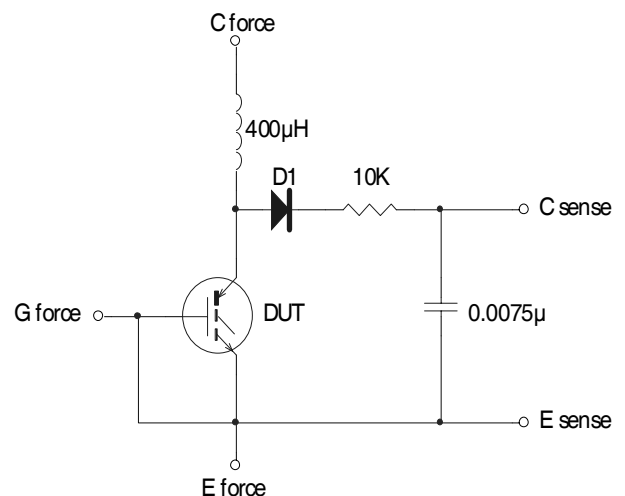
**Fig.C.T.3** - S.C. SOA Circuit



**Fig.C.T.4** - Switching Loss Circuit

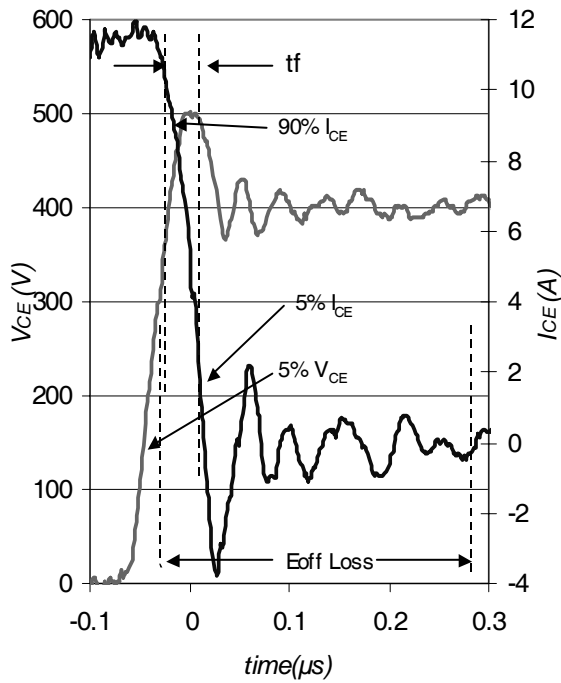


**Fig.C.T.5** - Resistive Load Circuit

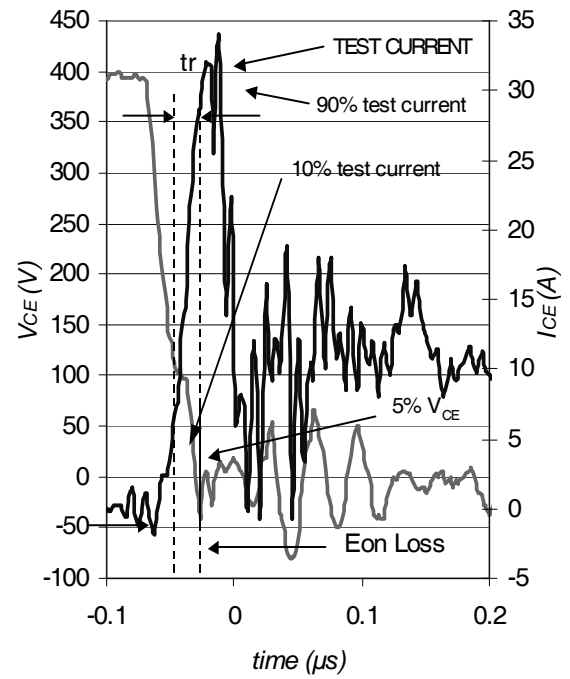


**Fig.C.T.6** - BVGES Filter Circuit

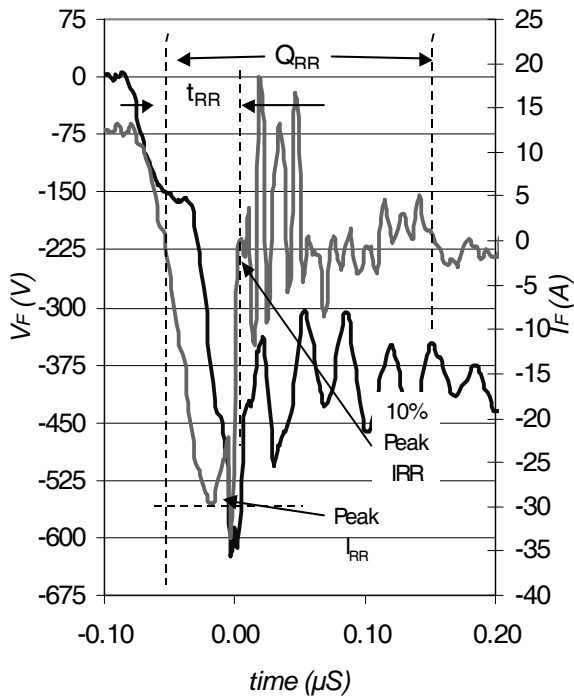




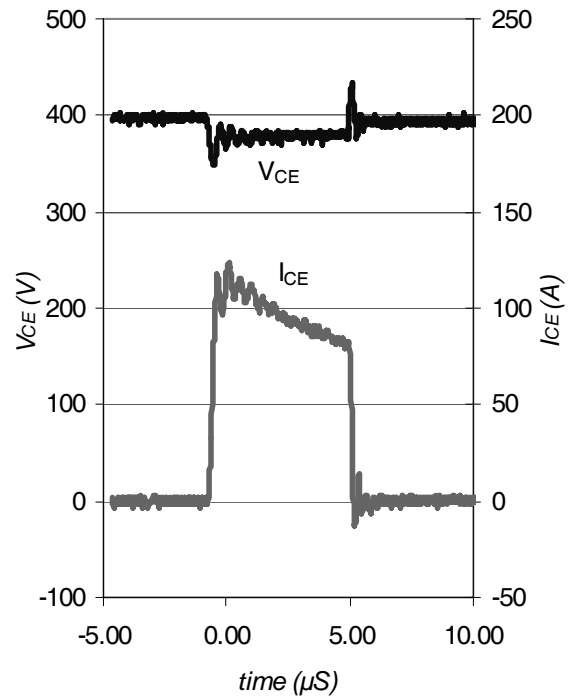
**Fig. WF1** - Typ. Turn-off Loss Waveform  
@  $T_J = 150^\circ\text{C}$  using Fig. CT.4



**Fig. WF2** - Typ. Turn-on Loss Waveform  
@  $T_J = 150^\circ\text{C}$  using Fig. CT.4



**Fig. WF3** - Typ. Diode Recovery Waveform  
@  $T_J = 150^\circ\text{C}$  using Fig. CT.4

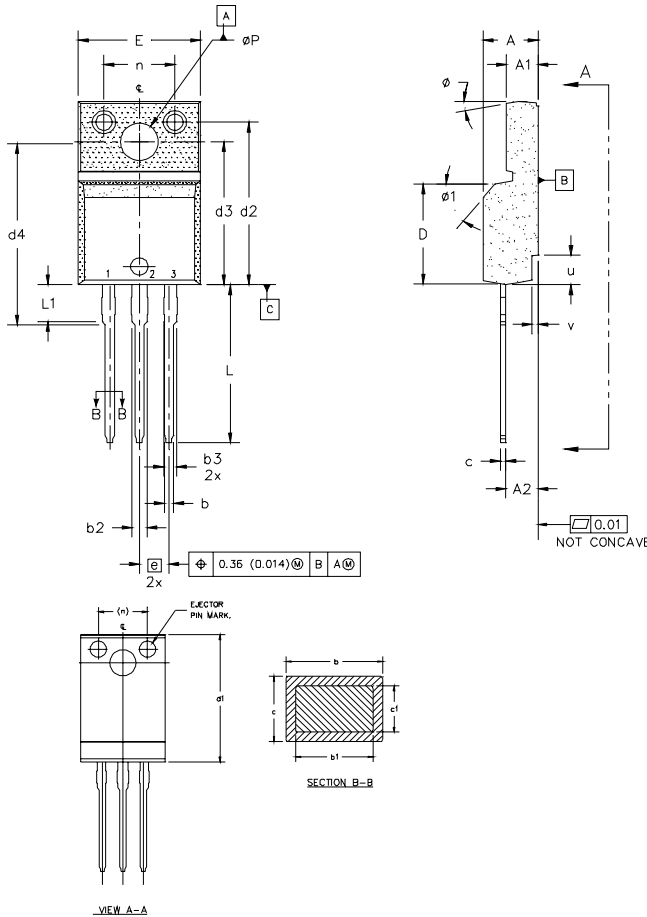


**Fig. WF4** - Typ. S.C. Waveform  
@  $T_J = 25^\circ\text{C}$  using Fig. CT.3

# IRGI4062DPbF

## TO-220 Full-Pak Package Outline

Dimensions are shown in millimeters (inches)



- NOTES:
- 1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
  - 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
  - 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
  - 4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
  - 5.0 DIMENSION b1 APPLY TO BASE METAL ONLY.
  - 6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
  - 7.0 CONTROLLING DIMENSION : INCHES.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.57	4.83	0.180	0.190	
A1	2.57	2.83	0.101	0.114	
A2	2.51	2.85	0.099	0.112	
b	0.622	0.89	0.024	0.035	
b1	0.622	0.838	0.024	0.033	5
b2	1.229	1.400	0.048	0.055	
b3	1.229	1.400	0.048	0.055	
c	0.440	0.629	0.017	0.025	
d	0.440	0.584	0.017	0.023	4
d1	8.65	9.80	0.341	0.386	
d2	15.80	16.12	0.622	0.635	
d3	13.97	14.22	0.550	0.560	
d4	12.30	12.92	0.484	0.509	
d4	8.64	9.91	0.340	0.390	
E	10.36	10.63	0.408	0.419	4
e	2.54 BSC		0.100 BSC		
L	13.20	13.73	0.520	0.541	
L1	3.10	3.50	0.122	0.138	3
n	6.05	6.15	0.238	0.242	
phi P	3.05	3.45	0.120	0.136	
u	2.40	2.50	0.094	0.098	6
v	0.40	0.50	0.016	0.020	6
phi	3"	7"	3"	7"	
phi 1		45'		45'	

LEAD ASSIGNMENTS

HEXFET

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

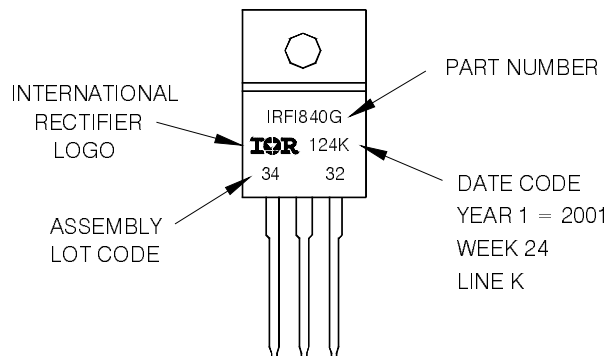
IGBTs, CoPACK

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

## TO-220 Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRFI840G  
WITH ASSEMBLY  
LOT CODE 3432  
ASSEMBLED ON WW 24, 2001  
IN THE ASSEMBLY LINE "K"

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



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

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.