

# IRGS4064DPbF

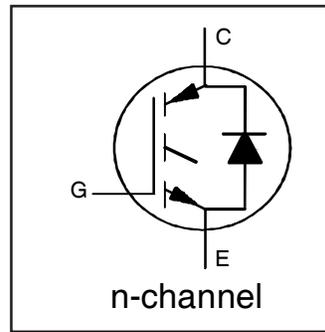
## INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

### Features

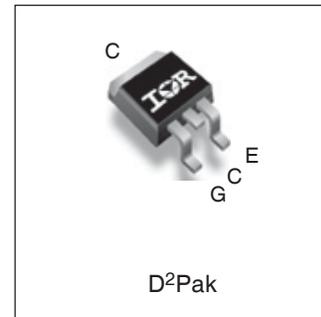
- Low  $V_{CE(on)}$  Trench IGBT Technology
- Low Switching Losses
- Maximum Junction temperature 175 °C
- 5µs SCSOA
- Square RBSOA
- 100% of The Parts Tested for ( $I_{LM}$ )
- Positive  $V_{CE(on)}$  Temperature Coefficient.
- Ultra Fast Soft Recovery Co-pak Diode
- Tighter Distribution of Parameters
- Lead-Free Package

### 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



$V_{CES} = 600V$
$I_C = 10A, T_C = 100^\circ C$
$t_{sc} > 5\mu s, T_{jmax} = 175^\circ C$
$V_{CE(on) typ.} = 1.6V$



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

### Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Breakdown Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	20	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	10	
$I_{CM}$	Pulsed Collector Current	40	
$I_{LM}$	Clamped Inductive Load Current ①	40	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	20	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	10	
$I_{FM}$	Diode Maximum Forward Current ②	40	
$V_{GE}$	Continuous Gate-to-Emitter Voltage	±20	V
	Transient Gate-to-Emitter Voltage	±30	
$P_D @ T_C = 25^\circ$	Maximum Power Dissipation	101	W
		$P_D @ T_C = 100^\circ$	
$T_J$	Operating Junction and	-55 to + 175	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (0.063 in. (1.6mm) from case)	

### Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT ③	---	---	1.49	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode ③	---	---	3.66	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	---	0.50	---	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount ③	---	---	40	
Wt	Weight		1.5		g

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

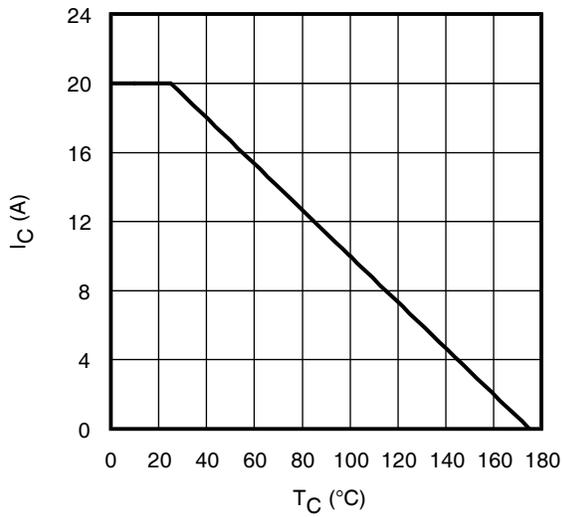
	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 100μA ④	CT 6
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	—	0.47	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 500μA (25°C-175°C)	
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	1.6	1.91	V	I <sub>C</sub> = 10A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 25°C	5,6,7,9, 10,11
		—	1.9	—		I <sub>C</sub> = 10A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 150°C	
		—	2.0	—		I <sub>C</sub> = 10A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 175°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> = 275μA	9,10,11,12
ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>	Threshold Voltage temp. coefficient	—	-11	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0mA (25°C - 175°C)	
g <sub>fe</sub>	Forward Transconductance	—	6.9	—	S	V <sub>CE</sub> = 50V, I <sub>C</sub> = 10A, PW = 80μs	
I <sub>CES</sub>	Collector-to-Emitter Leakage Current	—	—	25	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V	8
		—	328	—		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 175°C	
V <sub>FM</sub>	Diode Forward Voltage Drop	—	2.5	3.1	V	I <sub>F</sub> = 10A	
		—	1.7	—		I <sub>F</sub> = 10A, T <sub>J</sub> = 175°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)**

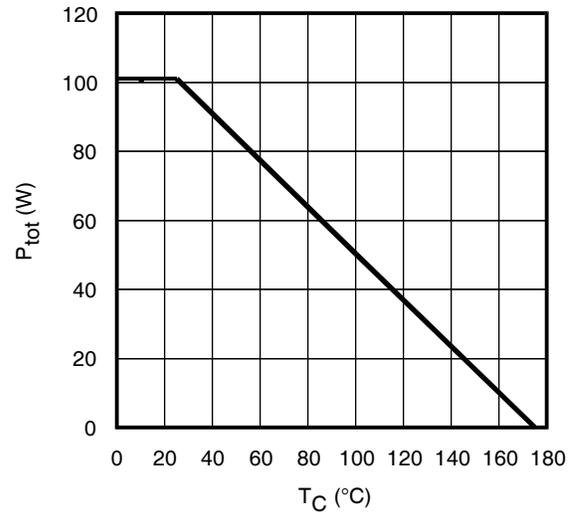
	Parameter	Min.	Typ.	Max. ⑤	Units	Conditions	Ref.Fig
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	21	32	nC	I <sub>C</sub> = 10A	24
Q <sub>ge</sub>	Gate-to-Emitter Charge (turn-on)	—	5.3	8.0		V <sub>GE</sub> = 15V	CT 1
Q <sub>gc</sub>	Gate-to-Collector Charge (turn-on)	—	8.9	13		V <sub>CC</sub> = 400V	
E <sub>on</sub>	Turn-On Switching Loss	—	29	40	μJ	I <sub>C</sub> = 10A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V	CT 4
E <sub>off</sub>	Turn-Off Switching Loss	—	200	281		R <sub>G</sub> = 22Ω, L = 1.0mH, T <sub>J</sub> = 25°C	
E <sub>total</sub>	Total Switching Loss	—	229	313		Energy losses include tail & diode reverse recovery	
t <sub>d(on)</sub>	Turn-On delay time	—	27	37	ns	I <sub>C</sub> = 10A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V	CT 4
t <sub>r</sub>	Rise time	—	15	23		R <sub>G</sub> = 22Ω, L = 1.0mH, T <sub>J</sub> = 25°C	
t <sub>d(off)</sub>	Turn-Off delay time	—	79	90			
t <sub>f</sub>	Fall time	—	21	29			
E <sub>on</sub>	Turn-On Switching Loss	—	99	—	μJ	I <sub>C</sub> = 10A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V	13,15
E <sub>off</sub>	Turn-Off Switching Loss	—	316	—		R <sub>G</sub> = 22Ω, L = 1.0mH, T <sub>J</sub> = 175°C ④	CT 4
E <sub>total</sub>	Total Switching Loss	—	415	—		Energy losses include tail & diode reverse recovery	WF 1,WF 2
t <sub>d(on)</sub>	Turn-On delay time	—	27	—	ns	I <sub>C</sub> = 10A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V	14,16
t <sub>r</sub>	Rise time	—	16	—		R <sub>G</sub> = 22Ω, L = 1.0mH, T <sub>J</sub> = 175°C	CT 4
t <sub>d(off)</sub>	Turn-Off delay time	—	98	—			WF 1,WF 2
t <sub>f</sub>	Fall time	—	33	—			
C <sub>ies</sub>	Input Capacitance	—	594	—	pF	V <sub>GE</sub> = 0V	22
C <sub>oes</sub>	Output Capacitance	—	49	—		V <sub>CC</sub> = 30V	
C <sub>res</sub>	Reverse Transfer Capacitance	—	17	—		f = 1.0Mhz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T <sub>J</sub> = 175°C, I <sub>C</sub> = 40A V <sub>CC</sub> = 480V, V <sub>p</sub> = 600V R <sub>G</sub> = 22Ω, V <sub>GE</sub> = +15V to 0V	4 CT 2
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V <sub>CC</sub> = 400V, V <sub>p</sub> = 600V R <sub>G</sub> = 22Ω, V <sub>GE</sub> = +15V to 0V	22, CT 3 WF 4
E <sub>rec</sub>	Reverse Recovery Energy of the Diode	—	191	—	μJ	T <sub>J</sub> = 175°C	17,18,19
t <sub>rr</sub>	Diode Reverse Recovery Time	—	62	—	ns	V <sub>CC</sub> = 400V, I <sub>F</sub> = 10A	20,21
I <sub>rr</sub>	Peak Reverse Recovery Current	—	16	—	A	V <sub>GE</sub> = 15V, R <sub>G</sub> = 22Ω, L = 1.0mH	WF 3

**Notes:**

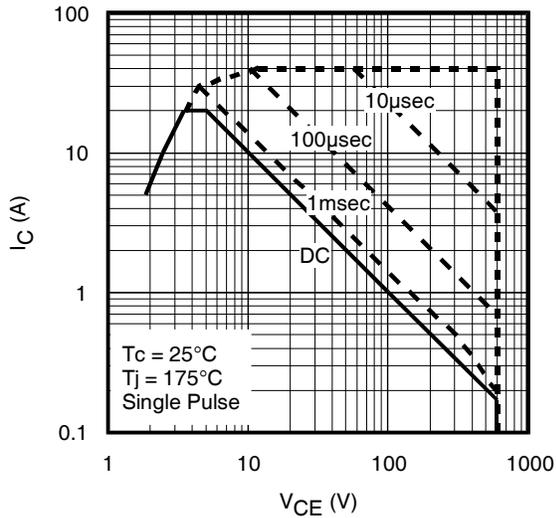
- ① V<sub>CC</sub> = 80% (V<sub>CES</sub>), V<sub>GE</sub> = 15V, L = 28 μH, R<sub>G</sub> = 22 Ω.
- ② Pulse width limited by max. junction temperature.
- ③ R<sub>θ</sub> is measured at T<sub>J</sub> approximately 90°C
- ④ Refer to AN-1086 for guidelines for measuring V<sub>(BR)CES</sub> safely
- ⑤ Maximum limits are based on statistical sample size characterization



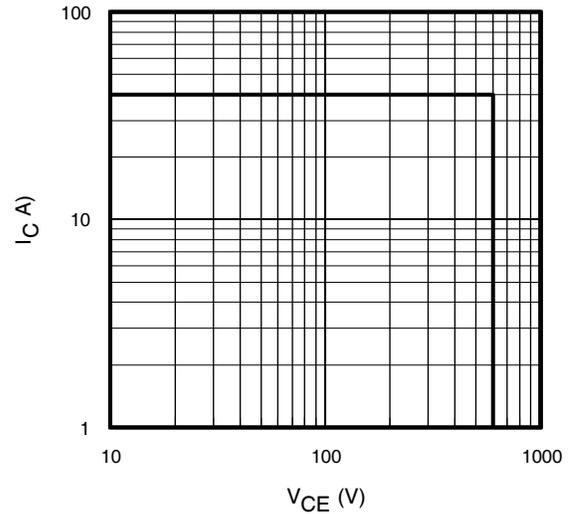
**Fig. 1** - Maximum DC Collector Current vs. Case Temperature



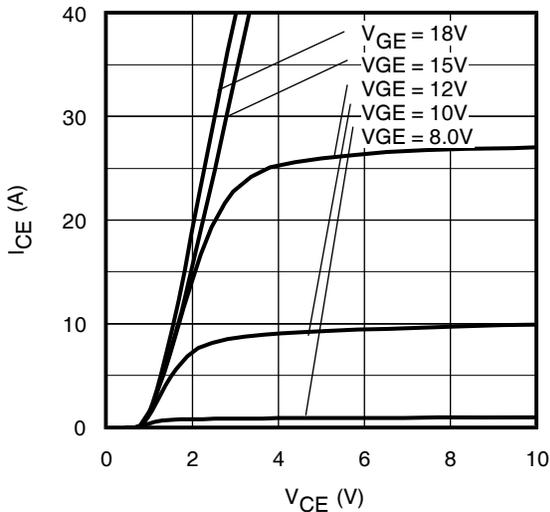
**Fig. 2** - Power Dissipation vs. Case Temperature



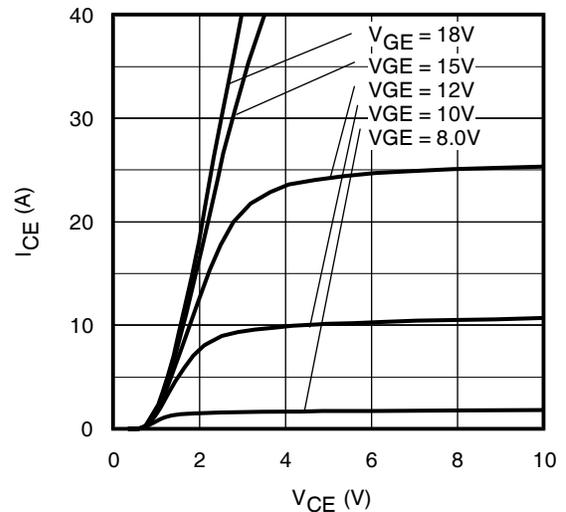
**Fig. 3** - Forward SOA,  
 $T_C = 25^\circ\text{C}$ ;  $T_J \leq 175^\circ\text{C}$



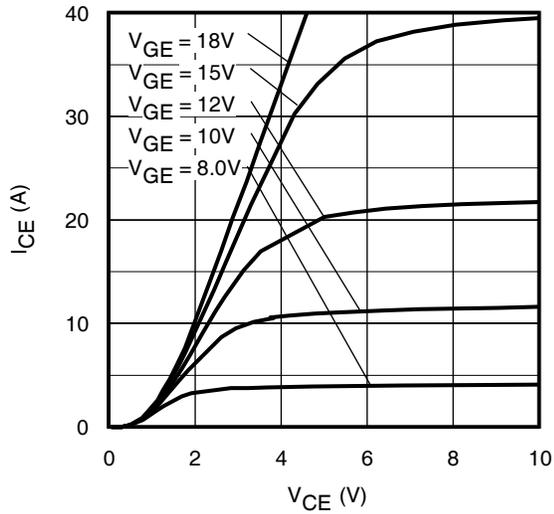
**Fig. 4** - Reverse Bias SOA  
 $T_J = 175^\circ\text{C}$ ;  $V_{CE} = 15\text{V}$



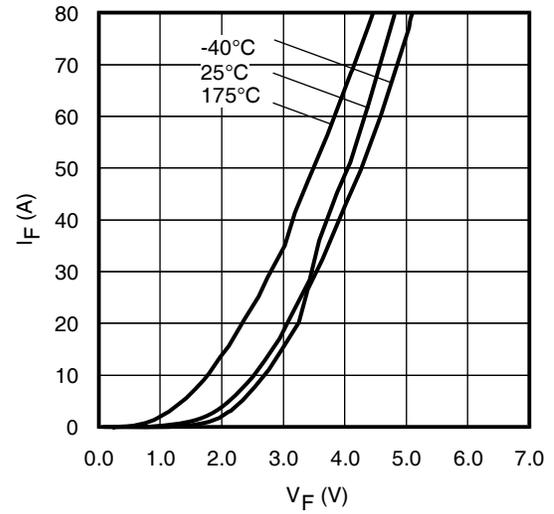
**Fig. 5** - Typ. IGBT Output Characteristics  
 $T_J = -40^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



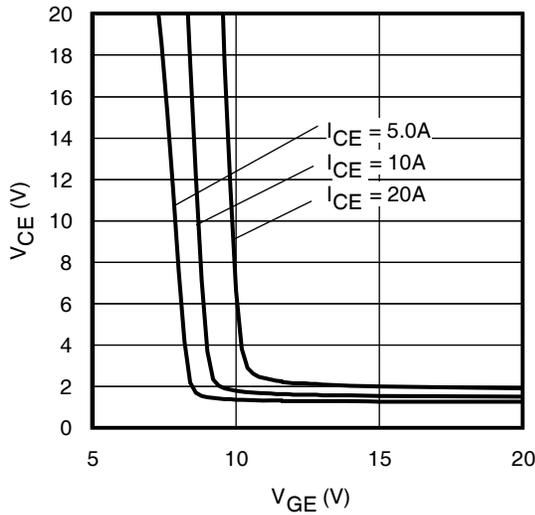
**Fig. 6** - Typ. IGBT Output Characteristics  
 $T_J = 25^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



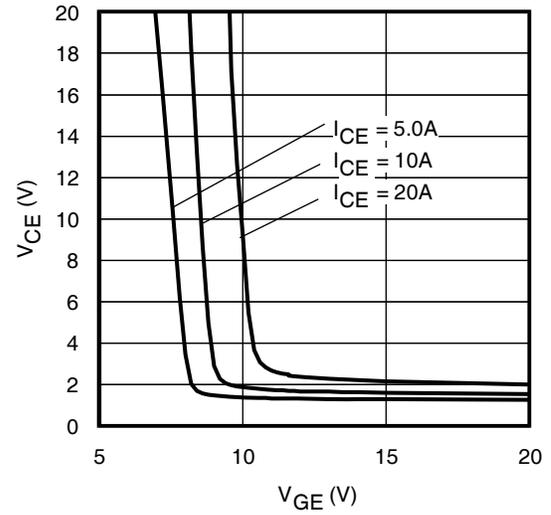
**Fig. 7** - Typ. IGBT Output Characteristics  
 $T_J = 175^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



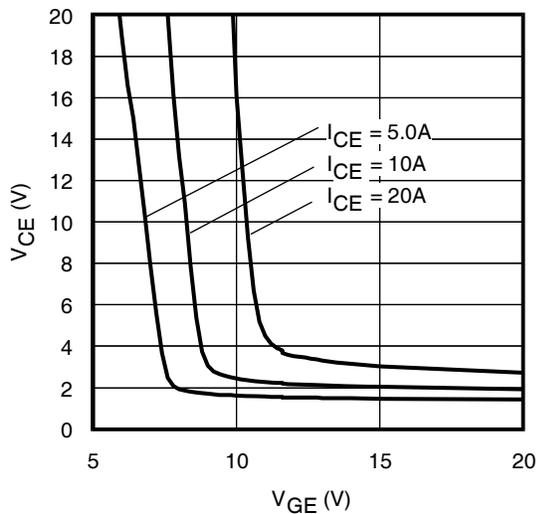
**Fig. 8** - Typ. Diode Forward Characteristics  
 $t_p = 80\mu\text{s}$



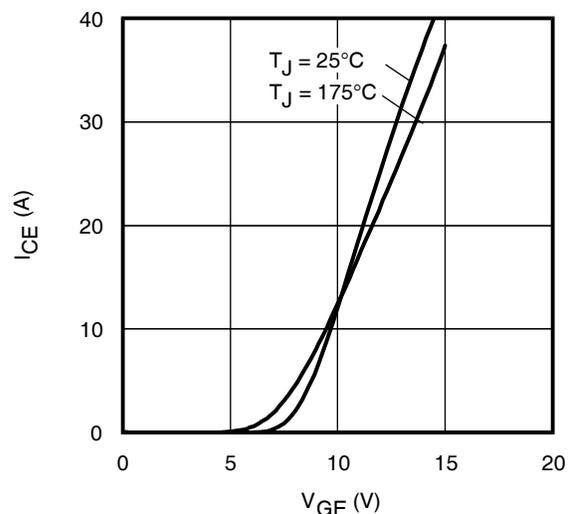
**Fig. 9** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$



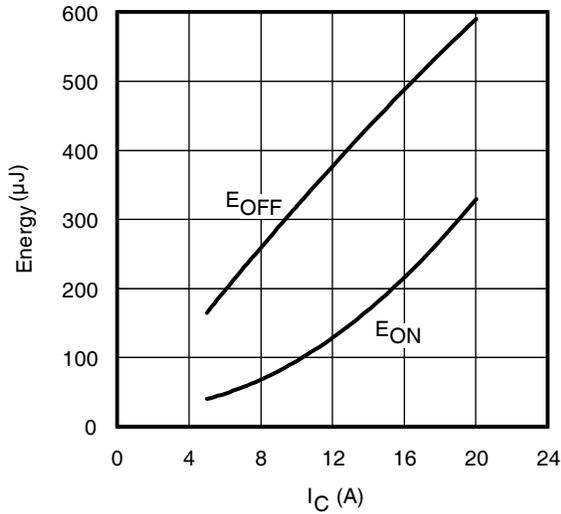
**Fig. 10** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$



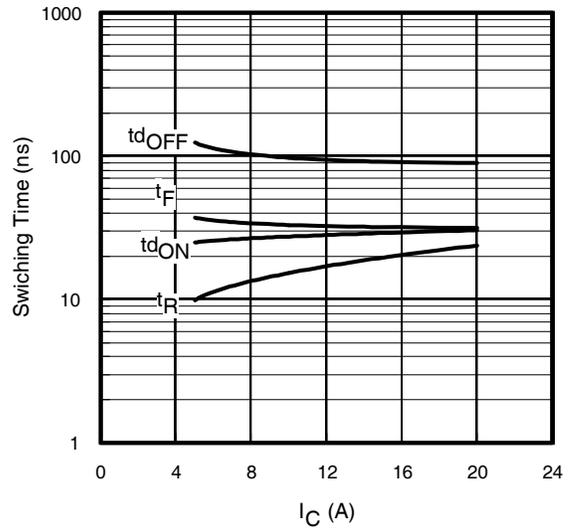
**Fig. 11** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 175^\circ\text{C}$



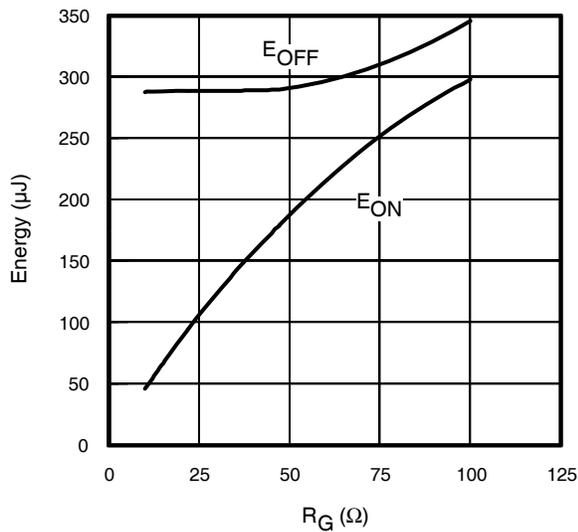
**Fig. 12** - Typ. Transfer Characteristics  
 $V_{CE} = 50\text{V}$ ;  $t_p = 10\mu\text{s}$



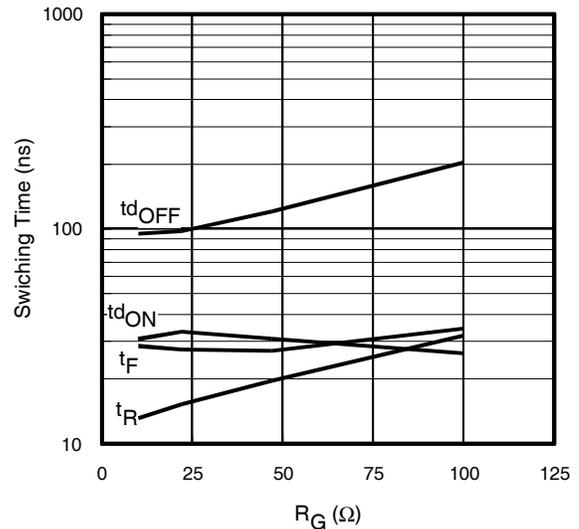
**Fig. 13** - Typ. Energy Loss vs.  $I_C$   
 $T_J = 175^\circ\text{C}$ ;  $L = 1\text{mH}$ ;  $V_{CE} = 400\text{V}$ ,  $R_G = 22\Omega$ ;  $V_{GE} = 15\text{V}$ .



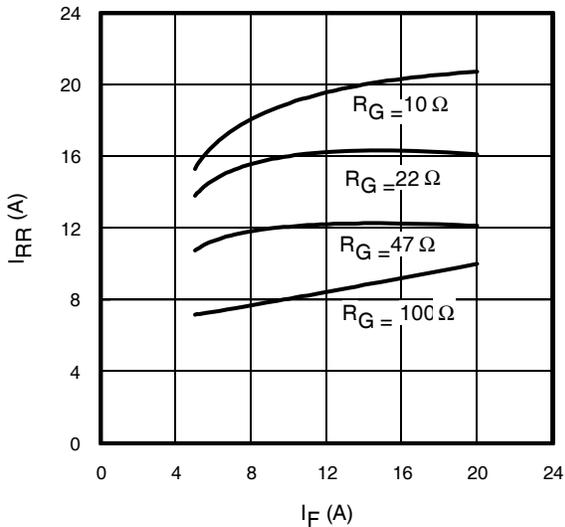
**Fig. 14** - Typ. Switching Time vs.  $I_C$   
 $T_J = 175^\circ\text{C}$ ;  $L = 1\text{mH}$ ;  $V_{CE} = 400\text{V}$   
 $R_G = 22\Omega$ ;  $V_{GE} = 15\text{V}$



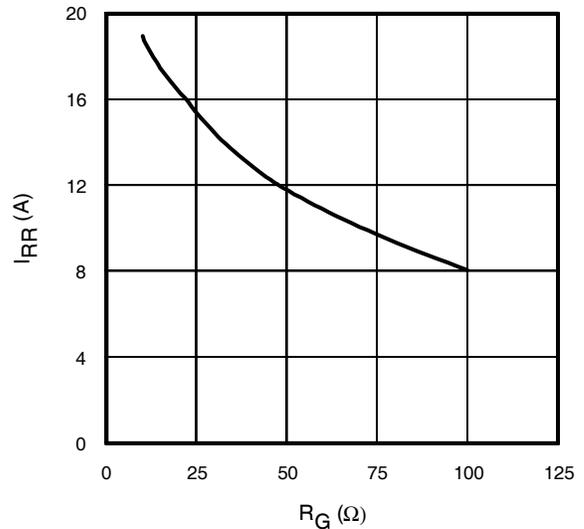
**Fig. 15** - Typ. Energy Loss vs.  $R_G$   
 $T_J = 175^\circ\text{C}$ ;  $L = 1\text{mH}$ ;  $V_{CE} = 400\text{V}$ ,  $I_{CE} = 10\text{A}$ ;  $V_{GE} = 15\text{V}$



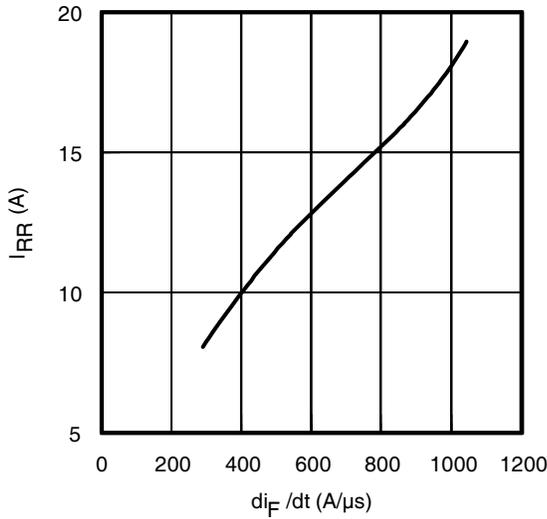
**Fig. 16** - Typ. Switching Time vs.  $R_G$   
 $T_J = 175^\circ\text{C}$ ;  $L = 1\text{mH}$ ;  $V_{CE} = 400\text{V}$   
 $I_{CE} = 10\text{A}$ ;  $V_{GE} = 15\text{V}$



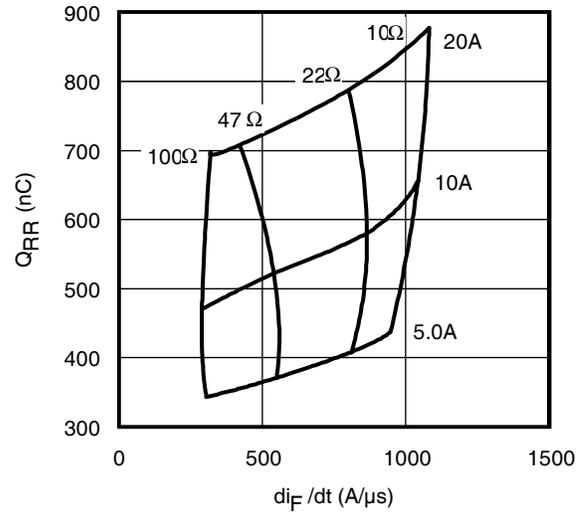
**Fig. 17** - Typical Diode  $I_{RR}$  vs.  $I_F$   
 $T_J = 175^\circ\text{C}$



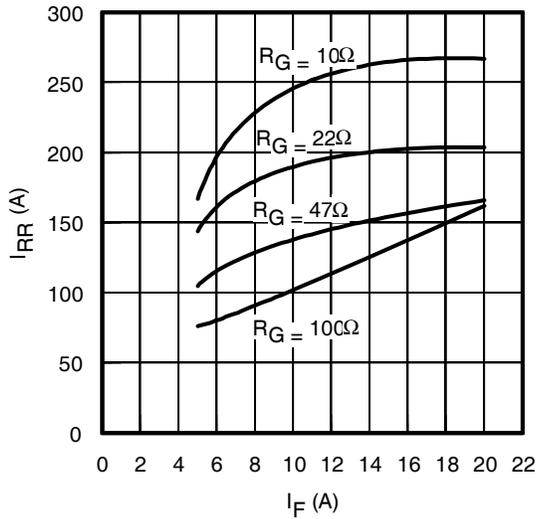
**Fig. 18** - Typical Diode  $I_{RR}$  vs.  $R_G$   
 $T_J = 175^\circ\text{C}$ ;  $I_F = 10\text{A}$



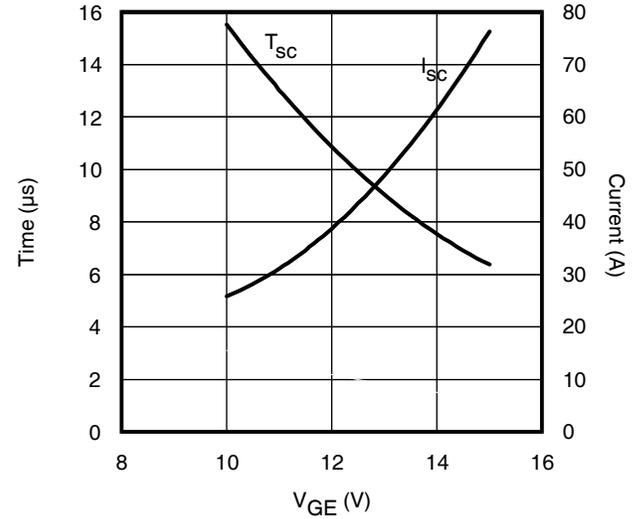
**Fig. 19**- Typical Diode  $I_{RR}$  vs.  $di_F/dt$   
 $V_{CC}=400V$ ;  $V_{GE}=15V$ ;  
 $I_{CE}=10A$ ;  $T_J=175^\circ C$



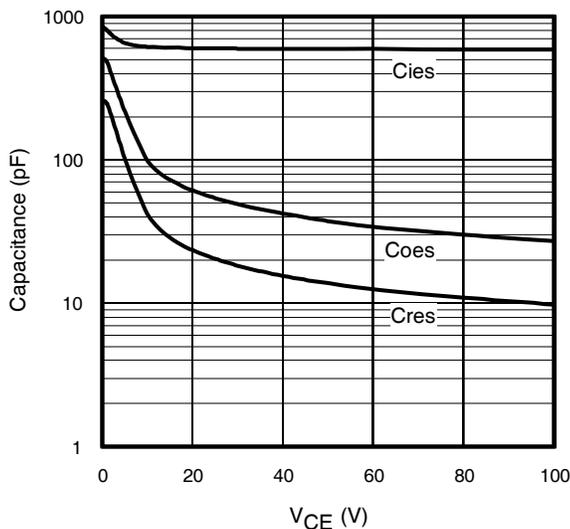
**Fig. 20** - Typical Diode  $Q_{RR}$   
 $V_{CC}=400V$ ;  $V_{GE}=15V$ ;  $T_J=175^\circ C$



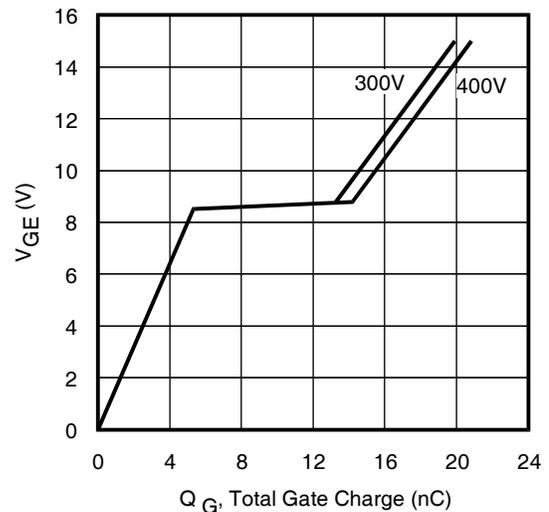
**Fig. 21** - Typical Diode  $E_{RR}$  vs.  $I_F$   
 $T_J=175^\circ C$



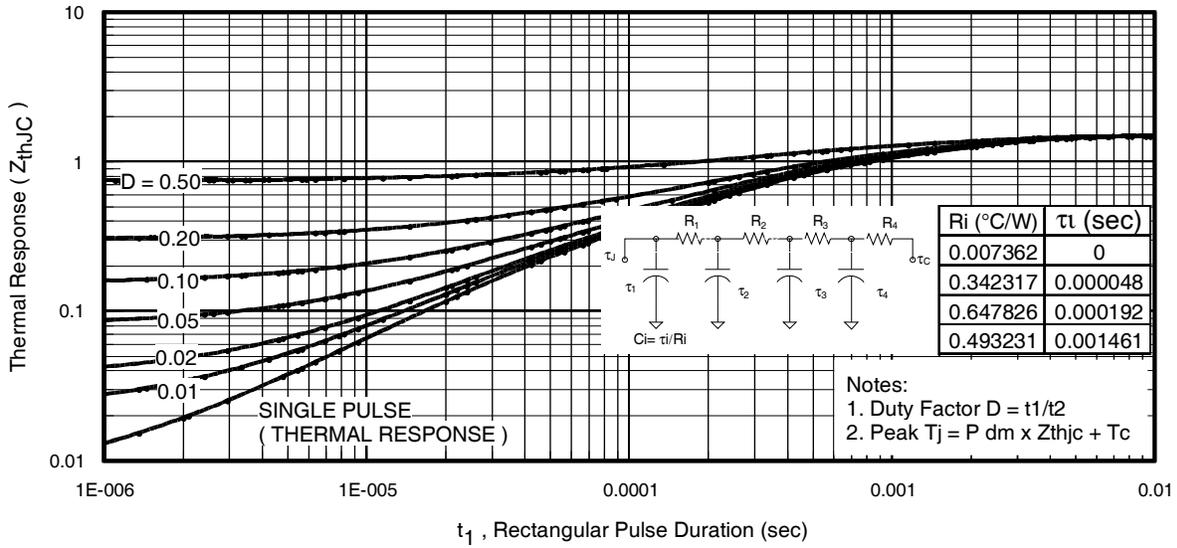
**Fig. 22**- Typ.  $V_{GE}$  vs Short Circuit Time  
 $V_{CC}=400V$ ,  $T_C=25^\circ C$



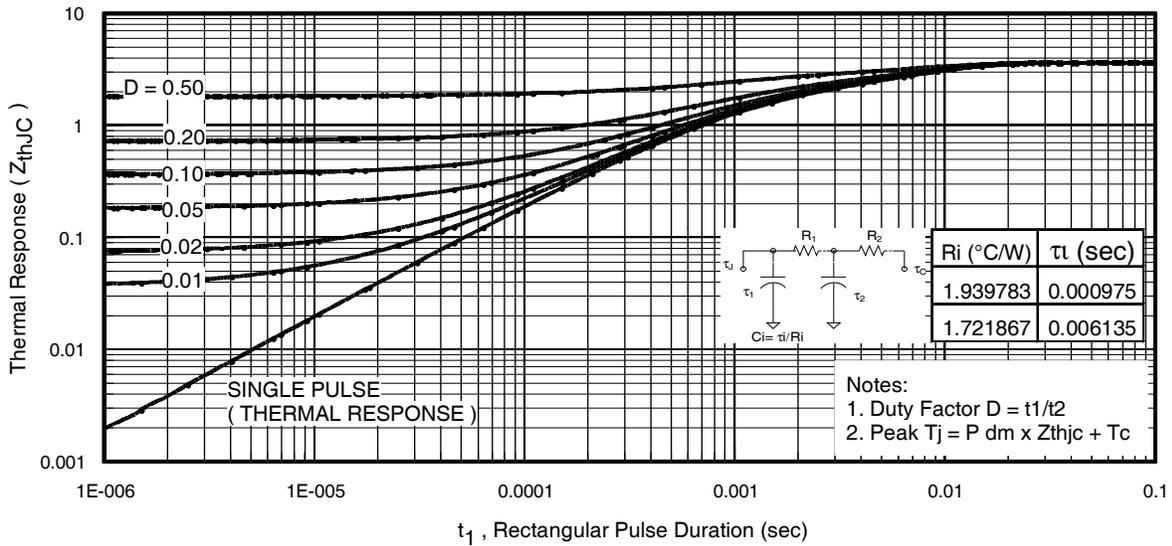
**Fig. 23**- Typ. Capacitance vs.  $V_{CE}$   
 $V_{GE}=0V$ ;  $f=1MHz$



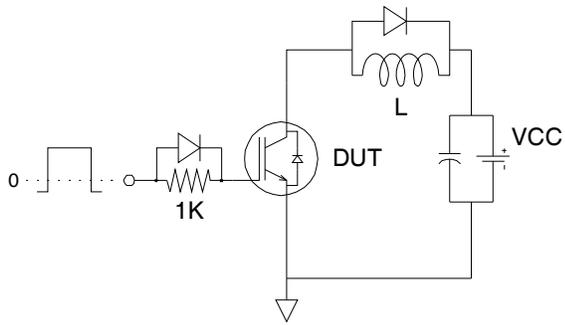
**Fig. 24** - Typical Gate Charge vs.  $V_{GE}$   
 $I_{CE}=10A$ ,  $L=600\mu H$



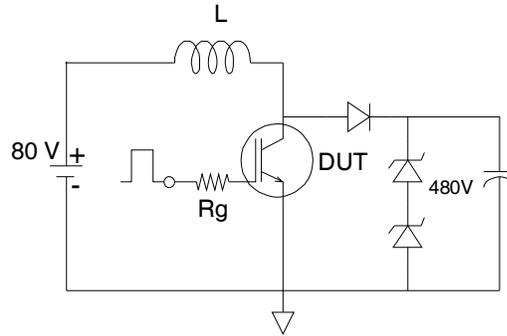
**Fig 25.** Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)



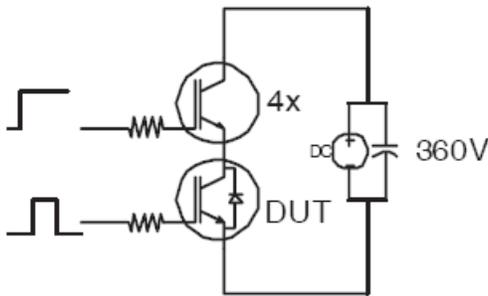
**Fig. 26.** Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)



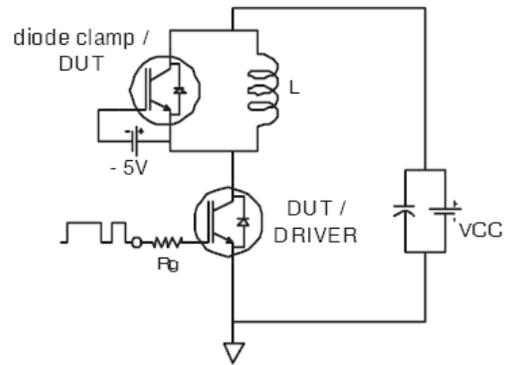
**Fig.C.T.1 - Gate Charge Circuit (turn-off)**



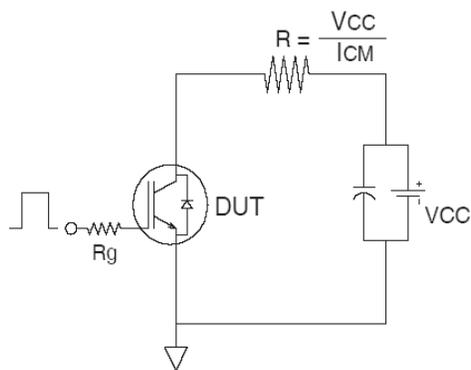
**Fig.C.T.2 - RBSOA Circuit**



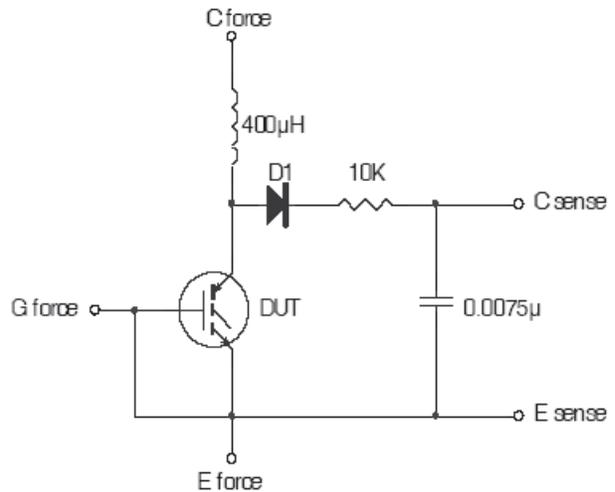
**Fig.C.T.3 - S.C.SOA Circuit**



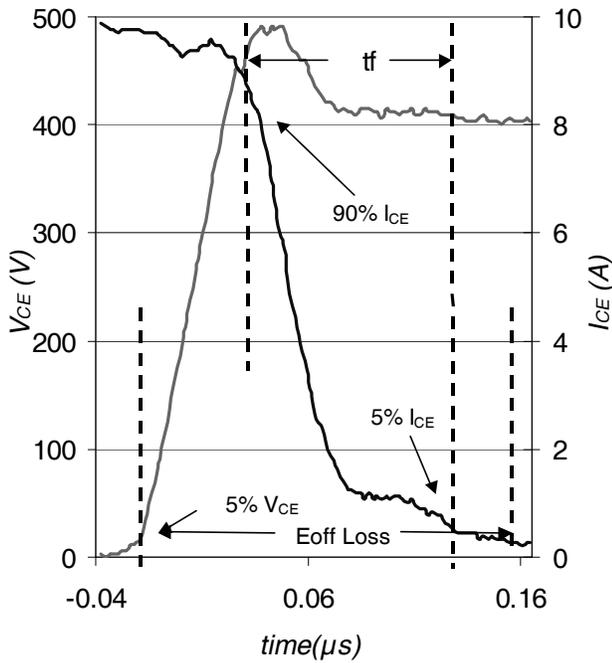
**Fig.C.T.4 - Switching Loss Circuit**



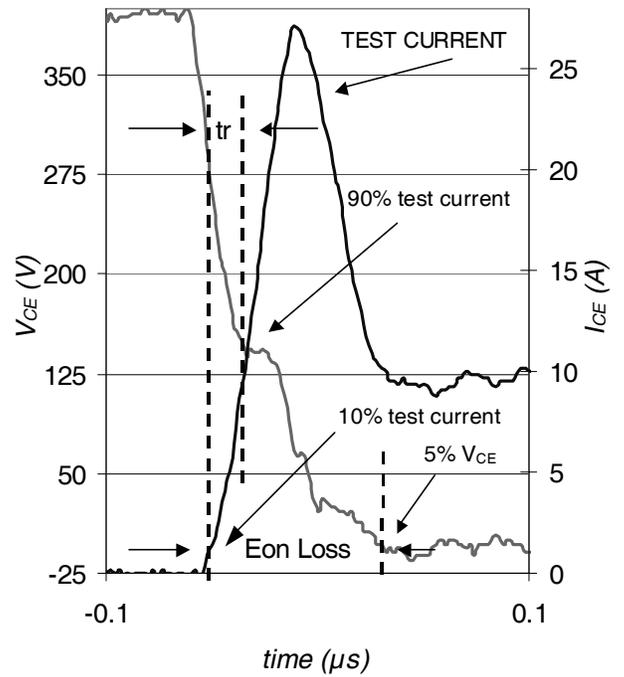
**Fig.C.T.5 - Resistive Load Circuit**



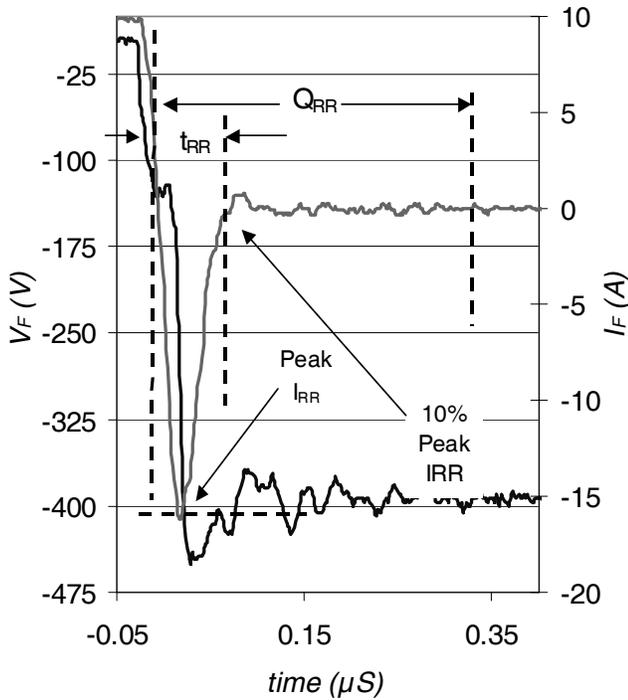
**Fig.C.T.6 - Typical Filter Circuit for  $V_{(BR)CES}$  Measurement**



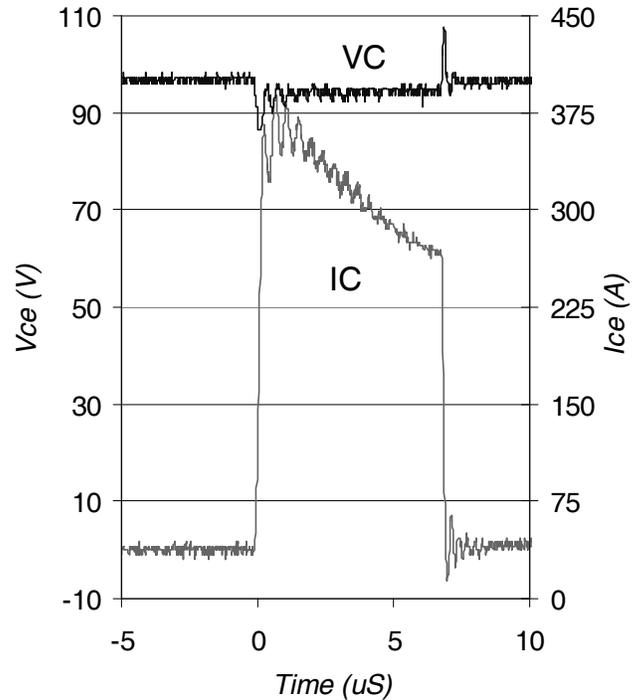
**Fig. WF1** - Typ. Turn-off Loss Waveform  
@  $T_J = 175^\circ C$  using Fig. CT.4



**Fig. WF2** - Typ. Turn-on Loss Waveform  
@  $T_J = 175^\circ C$  using Fig. CT.4

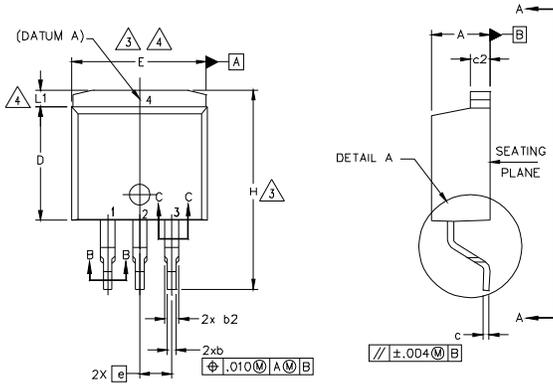


**WF.3**- Typ. Reverse Recovery Waveform  
@  $T_J = 175^\circ C$  using CT.4



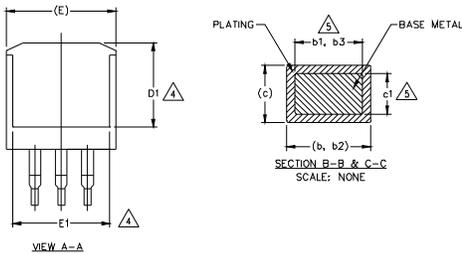
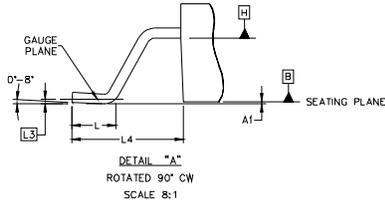
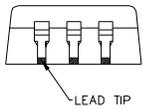
**WF.4**- Typ. Short Circuit Waveform  
@  $T_J = 25^\circ C$  using CT.3

## D<sup>2</sup>Pak Package Outline (Dimensions are shown in millimeters (inches))



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	5
A1	-	0.254	-	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	
D1	6.86	-	.270	-	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	-	.245	-	4
e	2.54 BSC		.100 BSC		4
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	-	1.65	-	.066	
L3	0.25 BSC		.010 BSC		4
L4	4.78	5.28	.188	.208	

**LEAD ASSIGNMENTS**

**HEXFET**

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

**IGBTs, CoPACK**

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

**DIODES**

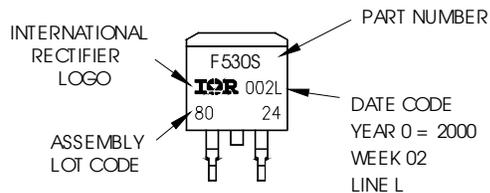
- 1.- ANODE \*
- 2, 4.- CATHODE
- 3.- ANODE

\* PART DEPENDENT.

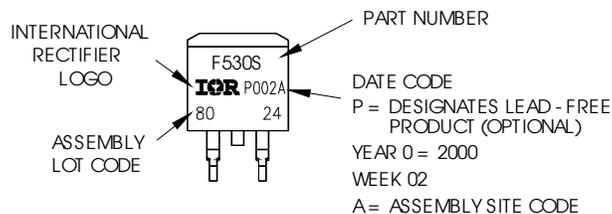
## D<sup>2</sup>Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH  
LOT CODE 8024  
ASSEMBLED ON WW 02, 2000  
IN THE ASSEMBLY LINE "L"

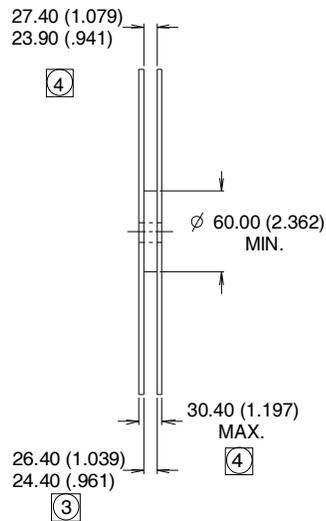
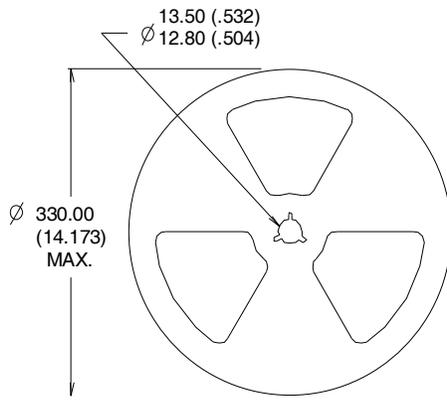
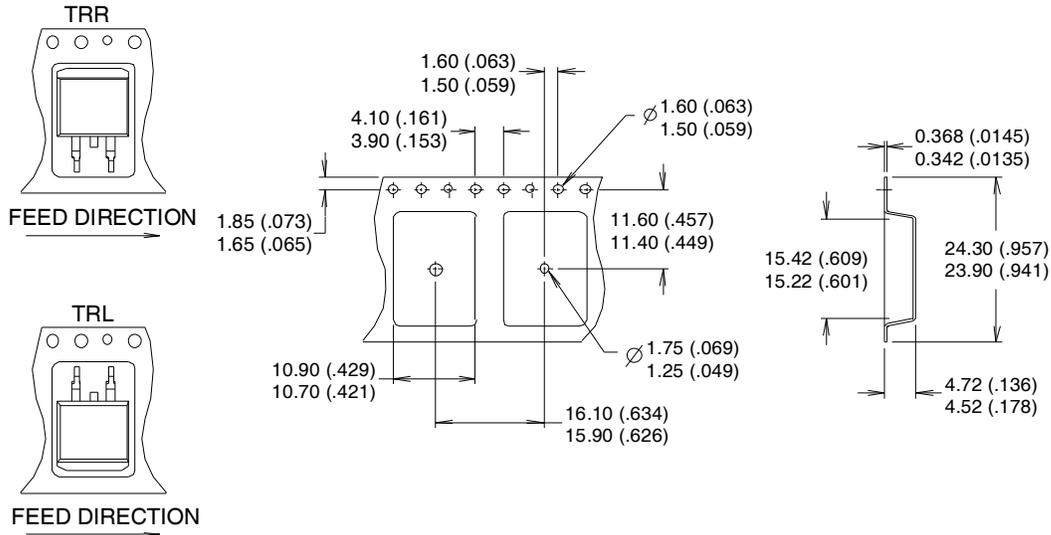
Note: "P" in assembly line position  
indicates "Lead - Free"



OR



D<sup>2</sup>Pak Tape & Reel Information



- NOTES:
1. COMFORMS TO EIA-418.
  2. CONTROLLING DIMENSION: MILLIMETER.
  - ③ DIMENSION MEASURED @ HUB.
  - ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.

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.



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.