

# IRGS4062DPbF IRGSL4062DPbF

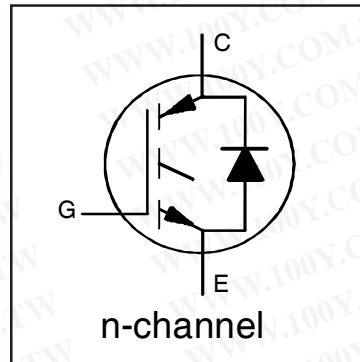
## INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

### Features

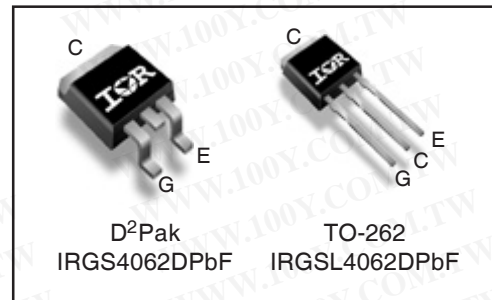
- Low  $V_{CE(ON)}$  Trench IGBT Technology
- Low switching losses
- Maximum Junction temperature 175 °C
- 5  $\mu$ S short circuit SOA
- Square RBSOA
- 100% of the parts tested for 4X rated current ( $I_{LM}$ )
- Positive  $V_{CE(ON)}$  Temperature co-efficient
- Ultra fast soft Recovery Co-Pak Diode
- Tight parameter distribution
- 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



$V_{CES} = 600V$
$I_C = 24A, T_C = 100^\circ C$
$t_{SC} \geq 5\mu s, T_{J(max)} = 175^\circ C$
$V_{CE(on)} \text{ typ.} = 1.65V$



<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	48	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	24	
$I_{CM}$	Pulse Collector Current	96	
$I_{LM}$	Clamped Inductive Load Current ①	96	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	48	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	24	
$I_{FM}$	Diode Maximum Forward Current ②	96	V
$V_{GE}$	Continuous Gate-to-Emitter Voltage	$\pm 20$	
	Transient Gate-to-Emitter Voltage	$\pm 30$	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	250	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	125	
$T_J$	Operating Junction and	-55 to +175	°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)	—	—	0.60	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode)	—	—	1.53	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.50	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	80	—	

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

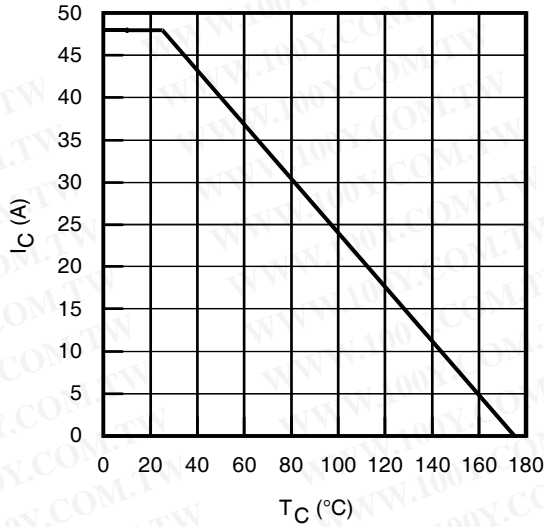
	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 100μA ②	CT6
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	—	0.30	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA (25°C-175°C)	CT6
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	1.60	1.95	V	I <sub>C</sub> = 24A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 25°C	5,6,7
		—	2.03	—		I <sub>C</sub> = 24A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 150°C	9,10,11
		—	2.04	—		I <sub>C</sub> = 24A, 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> = 700μA	9, 10,
ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>	Threshold Voltage temp. coefficient	—	-18	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0mA (25°C - 175°C)	11, 12
g <sub>fe</sub>	Forward Transconductance	—	17	—	S	V <sub>CE</sub> = 50V, I <sub>C</sub> = 24A, PW = 80μs	
I <sub>CES</sub>	Collector-to-Emitter Leakage Current	—	2.0	25	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V	
		—	775	—		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 175°C	
V <sub>FM</sub>	Diode Forward Voltage Drop	—	1.80	2.6	V	I <sub>F</sub> = 24A	8
		—	1.28	—		I <sub>F</sub> = 24A, 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)**

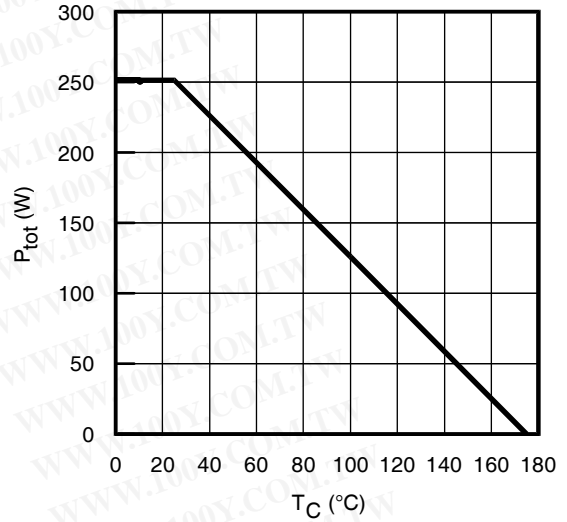
	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	50	75	nC	I <sub>C</sub> = 24A V <sub>GE</sub> = 15V V <sub>CC</sub> = 400V	24
Q <sub>ge</sub>	Gate-to-Emitter Charge (turn-on)	—	13	20			CT1
Q <sub>gc</sub>	Gate-to-Collector Charge (turn-on)	—	21	31			
E <sub>on</sub>	Turn-On Switching Loss	—	115	201	μJ	I <sub>C</sub> = 24A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V R <sub>G</sub> = 10Ω, L = 200μH, L <sub>S</sub> = 150nH, T <sub>J</sub> = 25°C Energy losses include tail & diode reverse recovery	CT4
E <sub>off</sub>	Turn-Off Switching Loss	—	600	700			
E <sub>total</sub>	Total Switching Loss	—	715	901			
t <sub>d(on)</sub>	Turn-On delay time	—	41	53	ns	I <sub>C</sub> = 24A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V R <sub>G</sub> = 10Ω, L = 200μH, L <sub>S</sub> = 150nH, T <sub>J</sub> = 25°C	CT4
t <sub>r</sub>	Rise time	—	22	31			
t <sub>d(off)</sub>	Turn-Off delay time	—	104	115			
t <sub>f</sub>	Fall time	—	29	41			
E <sub>on</sub>	Turn-On Switching Loss	—	420	—	μJ	I <sub>C</sub> = 24A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V R <sub>G</sub> = 10Ω, L = 100μH, L <sub>S</sub> = 150nH, T <sub>J</sub> = 175°C ③ Energy losses include tail & diode reverse recovery	13, 15
E <sub>off</sub>	Turn-Off Switching Loss	—	840	—			CT4
E <sub>total</sub>	Total Switching Loss	—	1260	—			WF1, WF2
t <sub>d(on)</sub>	Turn-On delay time	—	40	—	ns	I <sub>C</sub> = 24A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V R <sub>G</sub> = 10Ω, L = 200μH, L <sub>S</sub> = 150nH T <sub>J</sub> = 175°C	14, 16
t <sub>r</sub>	Rise time	—	24	—			CT4
t <sub>d(off)</sub>	Turn-Off delay time	—	125	—			WF1
t <sub>f</sub>	Fall time	—	39	—			WF2
C <sub>ies</sub>	Input Capacitance	—	1490	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0Mhz	23
C <sub>oes</sub>	Output Capacitance	—	129	—			
C <sub>res</sub>	Reverse Transfer Capacitance	—	45	—			
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T <sub>J</sub> = 175°C, I <sub>C</sub> = 96A V <sub>CC</sub> = 480V, V <sub>p</sub> = 600V R <sub>G</sub> = 10Ω, 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> = 10Ω, V <sub>GE</sub> = +15V to 0V	22, CT3 WF4
E <sub>rec</sub>	Reverse Recovery Energy of the Diode	—	621	—	μJ	T <sub>J</sub> = 175°C	17, 18, 19
t <sub>rr</sub>	Diode Reverse Recovery Time	—	89	—	ns	V <sub>CC</sub> = 400V, I <sub>F</sub> = 24A	20, 21
I <sub>rr</sub>	Peak Reverse Recovery Current	—	37	—	A	V <sub>GE</sub> = 15V, R <sub>G</sub> = 10Ω, L = 200μH, L <sub>S</sub> = 150nH	WF3

**Notes:**

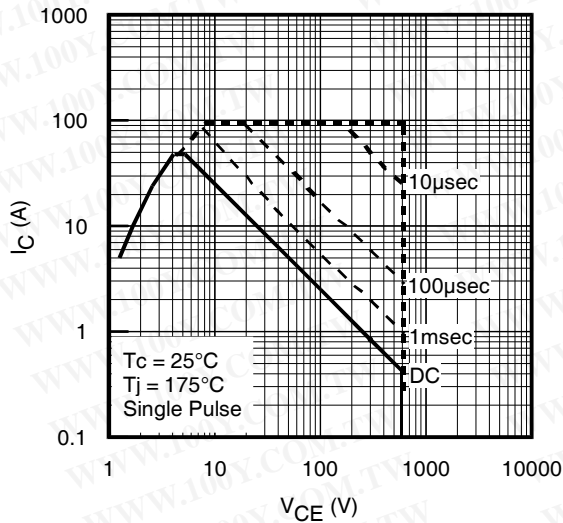
- ① V<sub>CC</sub> = 80% (V<sub>CES</sub>), V<sub>GE</sub> = 20V, L = 100μH, R<sub>G</sub> = 10Ω.
- ② Pulse width limited by max. junction temperature.
- ③ Refer to AN-1086 for guidelines for measuring V<sub>(BR)CES</sub> safely.



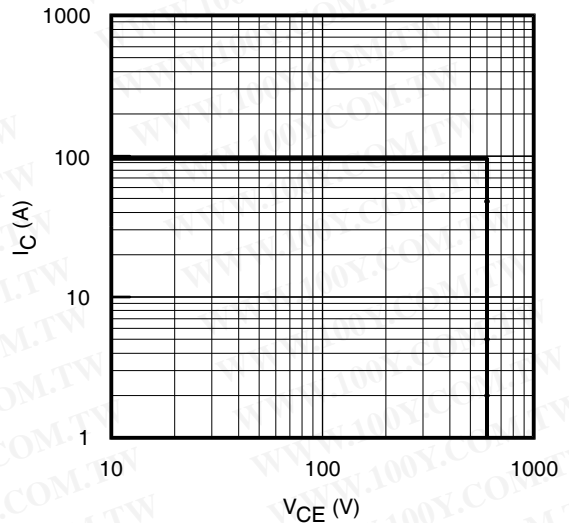
**Fig. 1** - Maximum DC Collector Current vs. Case Temperature



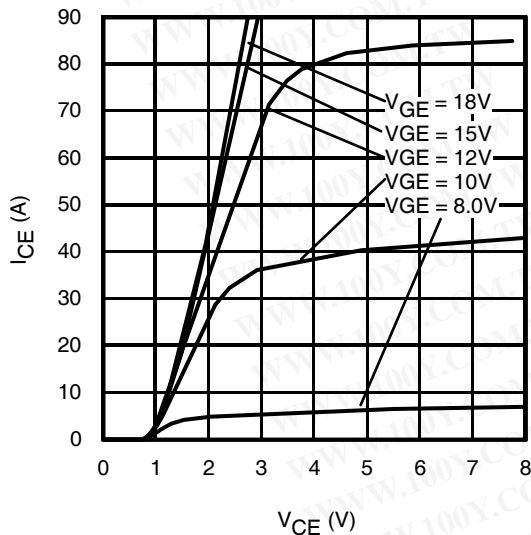
**Fig. 2** - Power Dissipation vs. Case Temperature



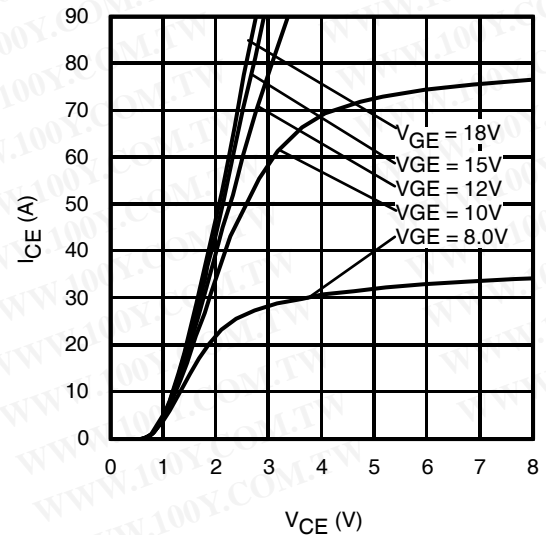
**Fig. 3** - Forward SOA  
 $T_C = 25^{\circ}C$ ,  $T_J \leq 175^{\circ}C$ ;  $V_{GE} = 15V$



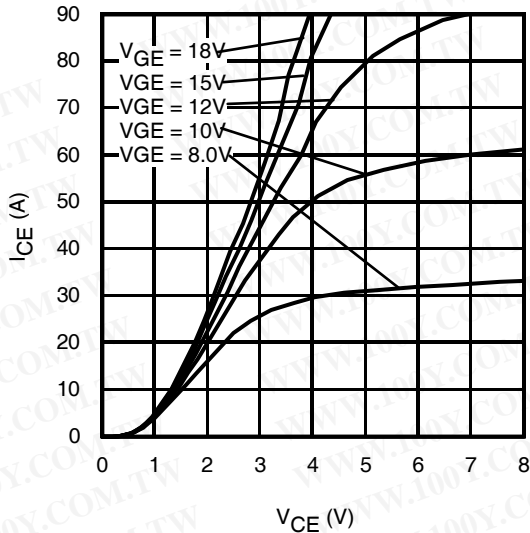
**Fig. 4** - Reverse Bias SOA  
 $T_J = 175^{\circ}C$ ;  $V_{GE} = 15V$



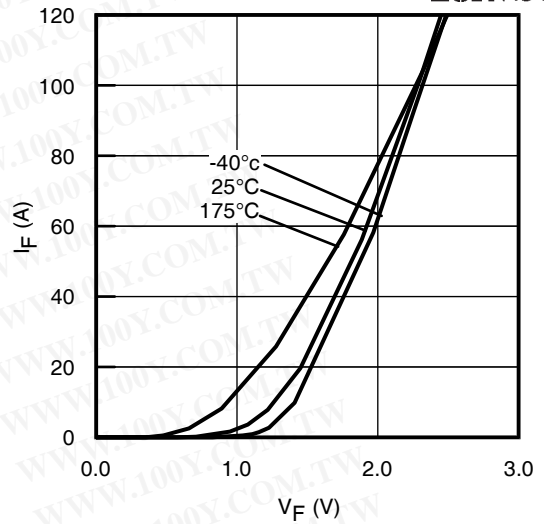
**Fig. 5** - Typ. IGBT Output Characteristics  
 $T_J = -40^{\circ}C$ ;  $t_p = 80 \mu$ s



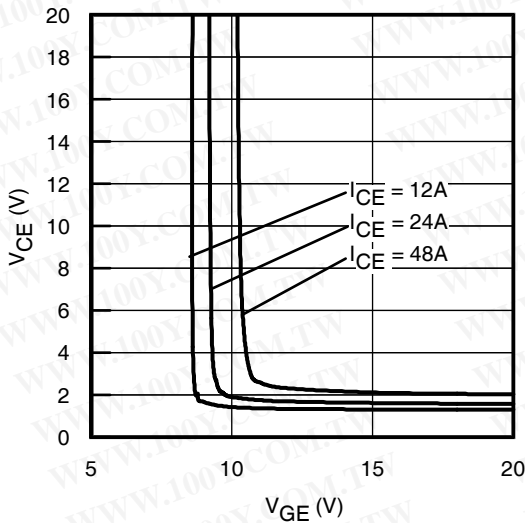
**Fig. 6** - Typ. IGBT Output Characteristics  
 $T_J = 25^{\circ}C$ ;  $t_p = 80 \mu$ s



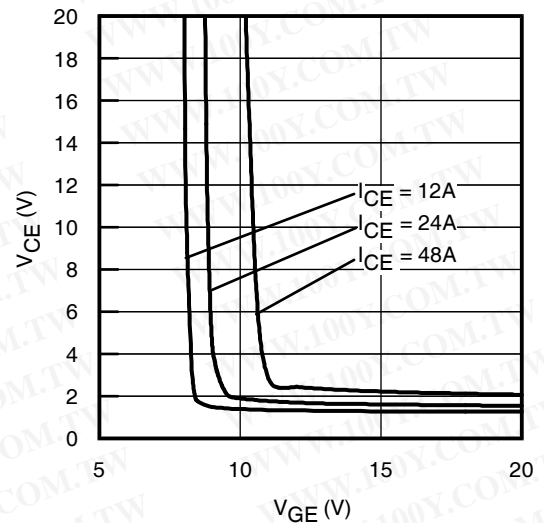
**Fig. 7** - Typ. IGBT Output Characteristics  
 $T_J = 175^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



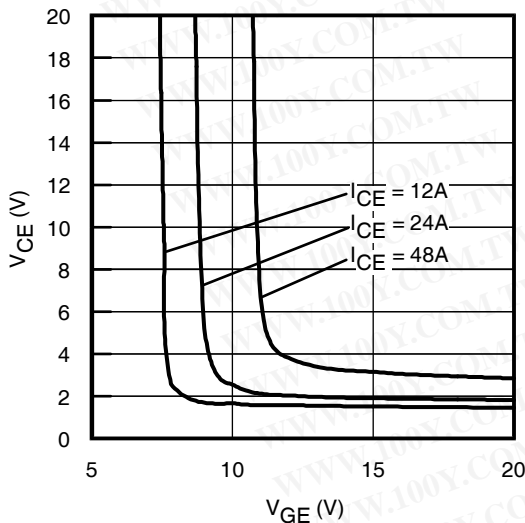
**Fig. 8** - Typ. Diode Forward Characteristics  
 $t_p = 80\mu\text{s}$



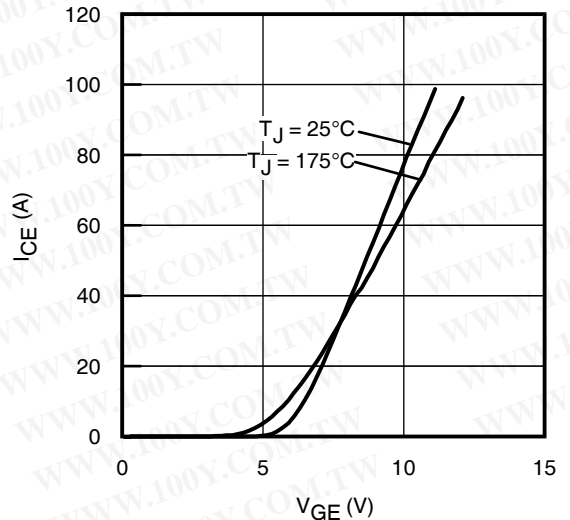
**Fig. 9** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$



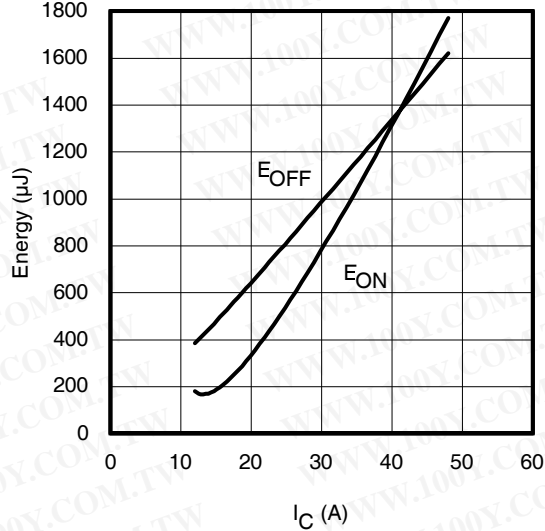
**Fig. 10** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$



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

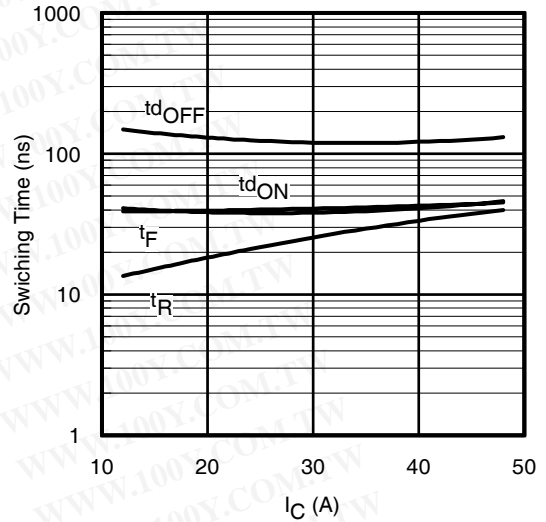


**Fig. 12** - Typ. Transfer Characteristics  
 $V_{CE} = 50\text{V}$ ;  $t_p = 10\mu\text{s}$



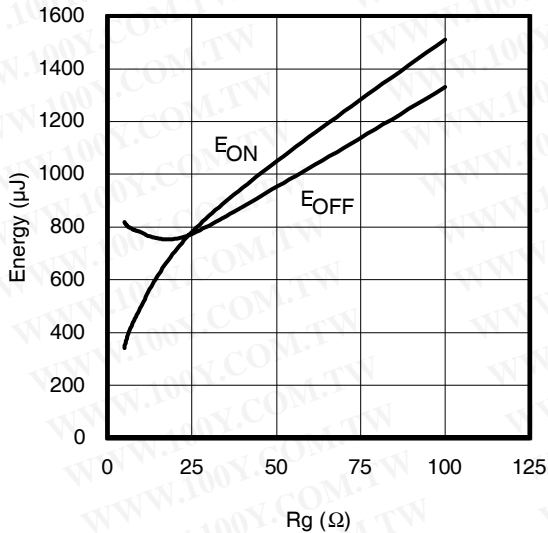
**Fig. 13** - Typ. Energy Loss vs.  $I_C$

$T_J = 175^\circ\text{C}$ ;  $L = 200\mu\text{H}$ ;  $V_{CE} = 400\text{V}$ ,  $R_G = 10\Omega$ ;  $V_{GE} = 15\text{V}$



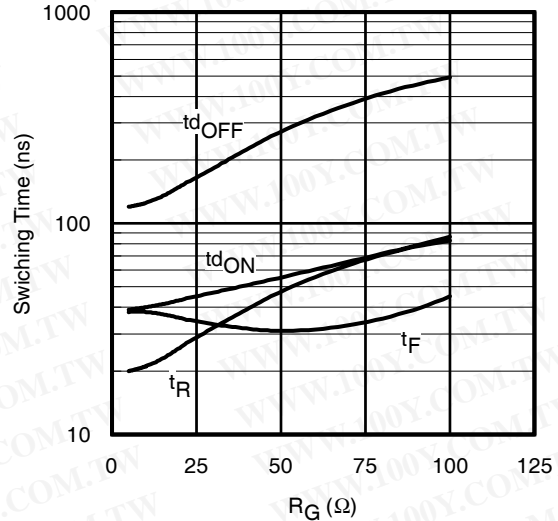
**Fig. 14** - Typ. Switching Time vs.  $I_C$

$T_J = 175^\circ\text{C}$ ;  $L = 200\mu\text{H}$ ;  $V_{CE} = 400\text{V}$ ,  $R_G = 10\Omega$ ;  $V_{GE} = 15\text{V}$



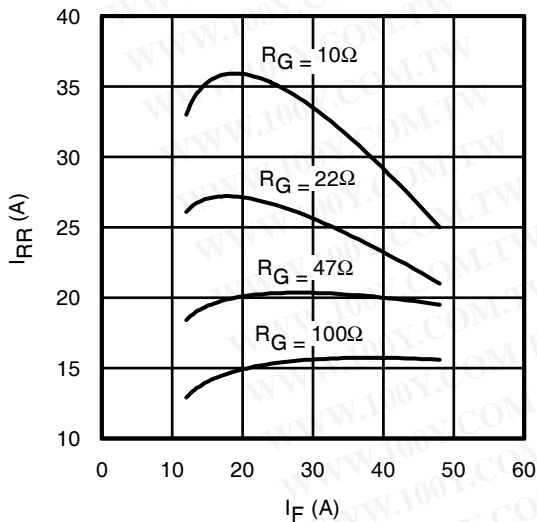
**Fig. 15** - Typ. Energy Loss vs.  $R_G$

$T_J = 175^\circ\text{C}$ ;  $L = 200\mu\text{H}$ ;  $V_{CE} = 400\text{V}$ ,  $I_{CE} = 24\text{A}$ ;  $V_{GE} = 15\text{V}$



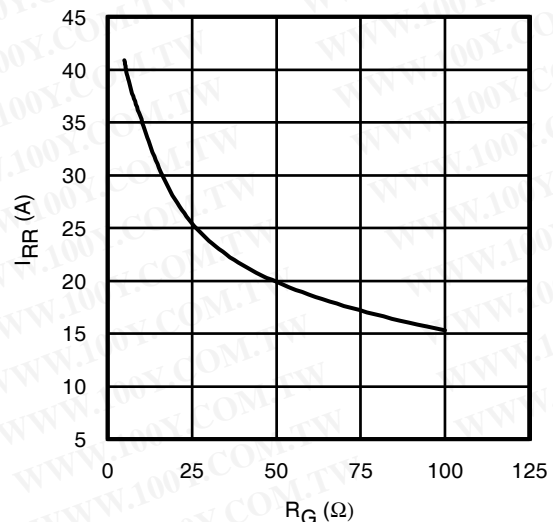
**Fig. 16** - Typ. Switching Time vs.  $R_G$

$T_J = 175^\circ\text{C}$ ;  $L = 200\mu\text{H}$ ;  $V_{CE} = 400\text{V}$ ,  $I_{CE} = 24\text{A}$ ;  $V_{GE} = 15\text{V}$



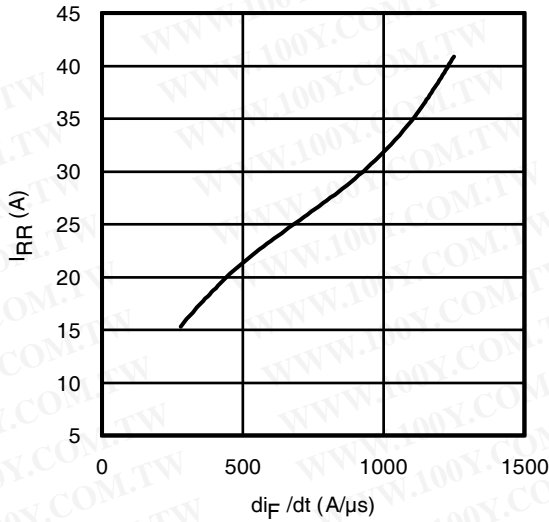
**Fig. 17** - Typ. Diode  $I_{RR}$  vs.  $I_F$

$T_J = 175^\circ\text{C}$

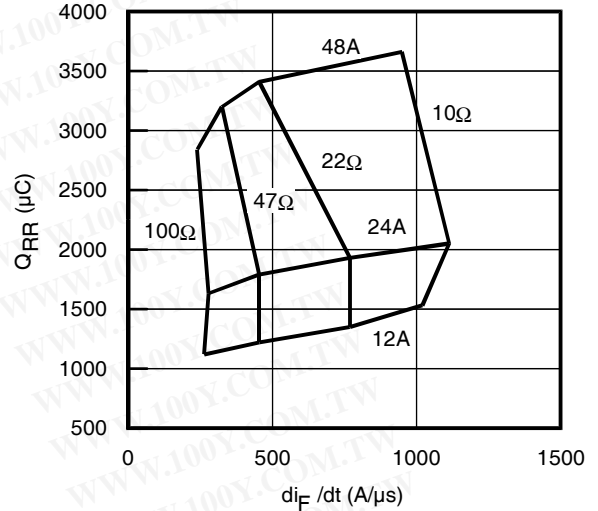


**Fig. 18** - Typ. Diode  $I_{RR}$  vs.  $R_G$

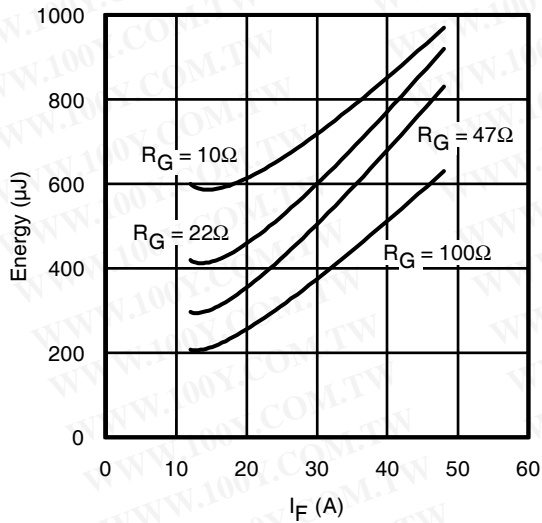
$T_J = 175^\circ\text{C}$



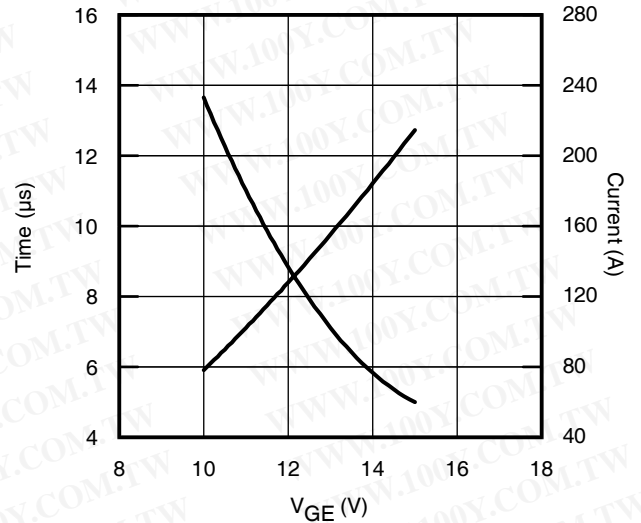
**Fig. 19** - Typ. Diode  $I_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400V$ ;  $V_{GE} = 15V$ ;  $I_F = 24A$ ;  $T_J = 175^\circ C$



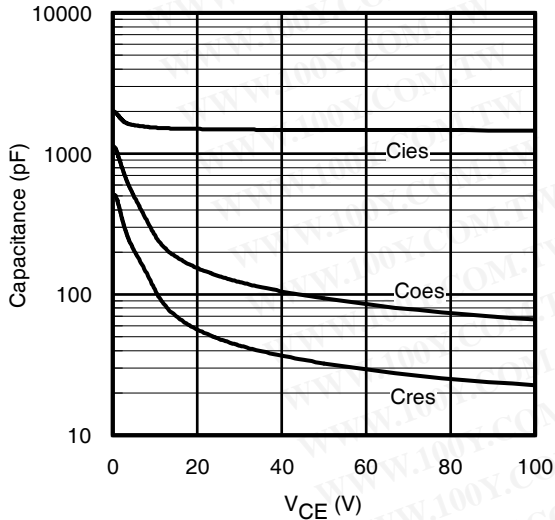
**Fig. 20** - Typ. Diode  $Q_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400V$ ;  $V_{GE} = 15V$ ;  $T_J = 175^\circ C$



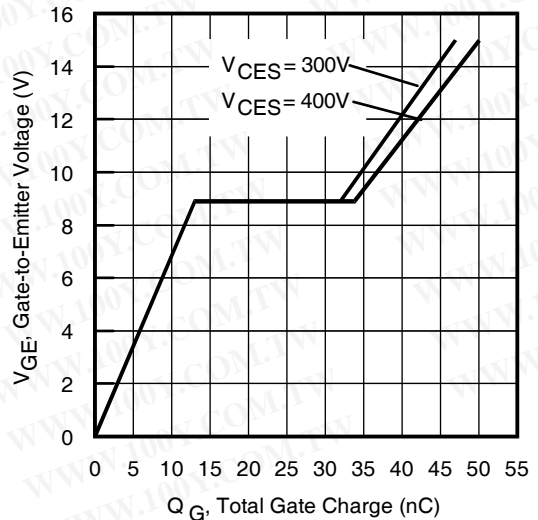
**Fig. 21** - Typ. Diode  $E_{RR}$  vs.  $I_F$   
 $T_J = 175^\circ C$



**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.  $V_{GE}$   
 $I_{CE} = 24A$ ;  $L = 600\mu H$

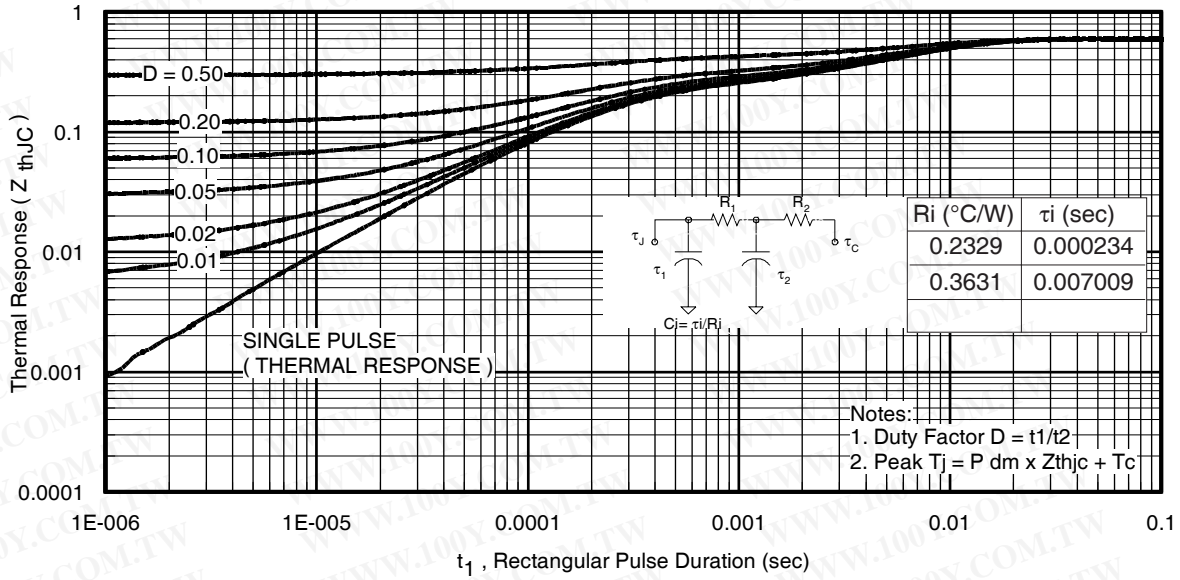


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

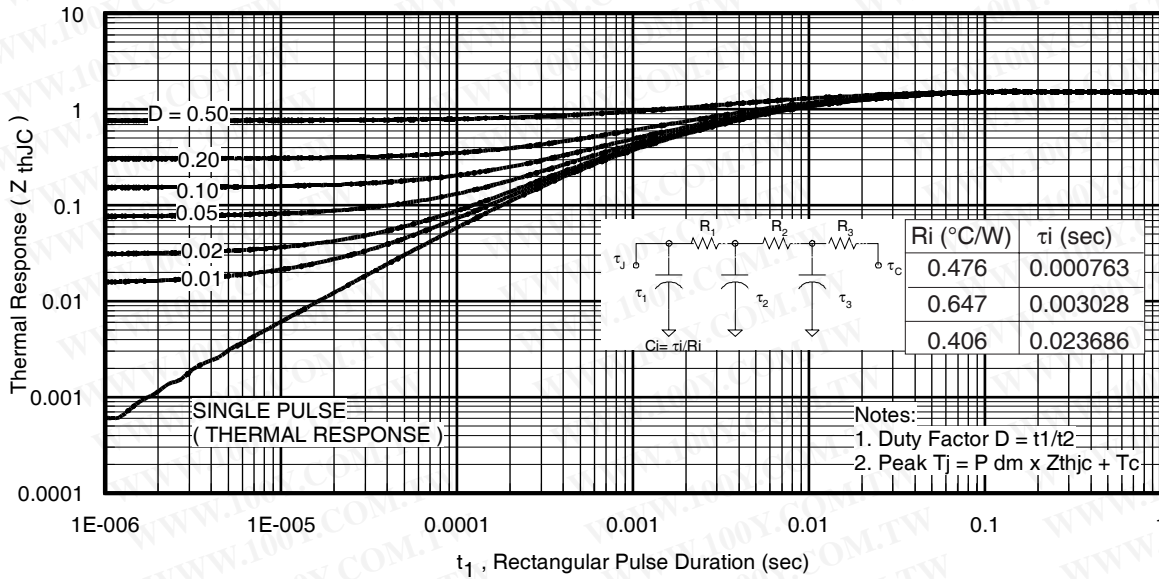
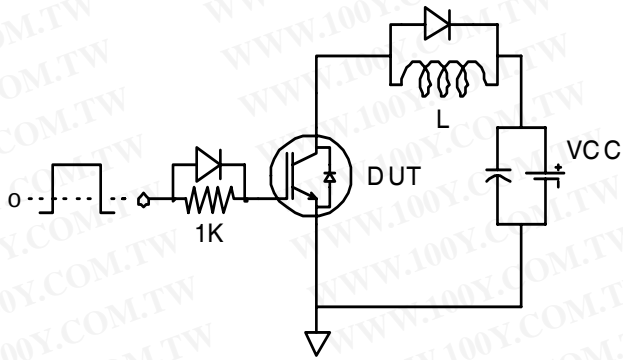
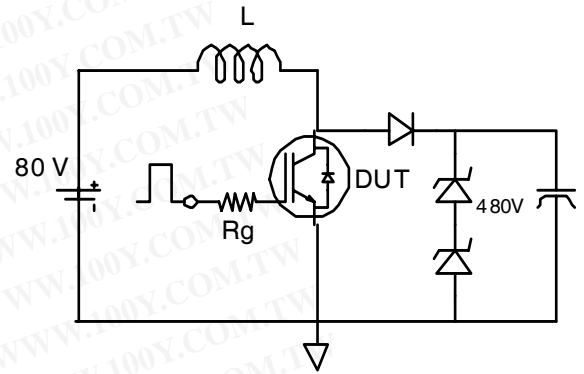


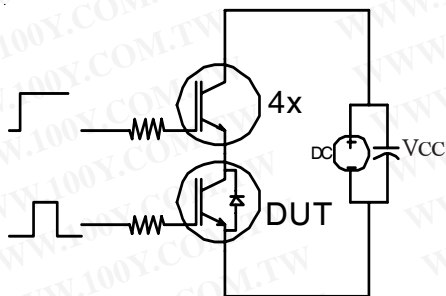
Fig. 26. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)



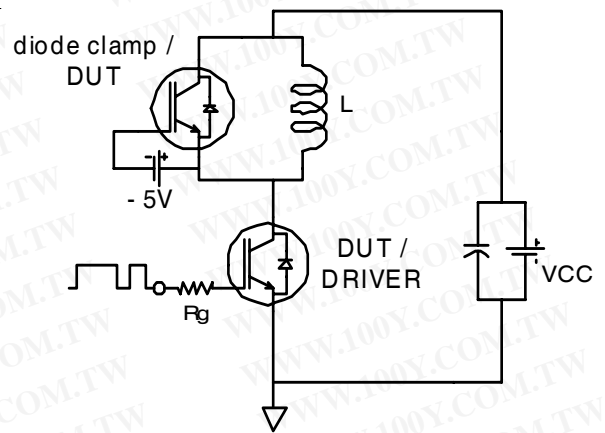
**Fig.C.T.1** - Gate Charge Circuit (turn-off)



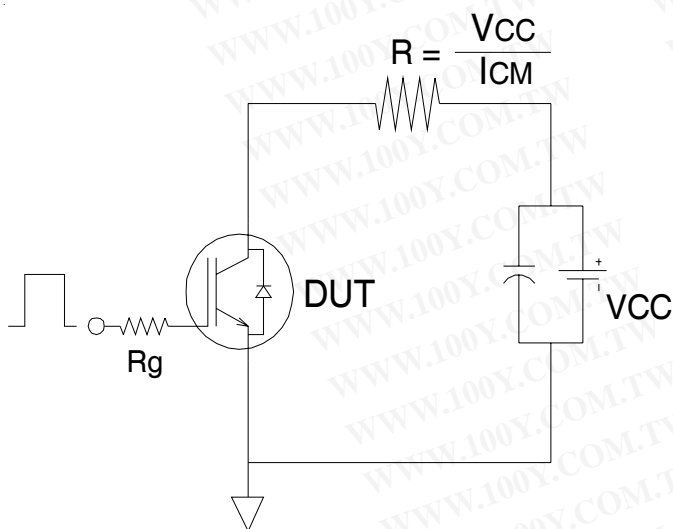
**Fig.C.T.2** - RBSOA Circuit



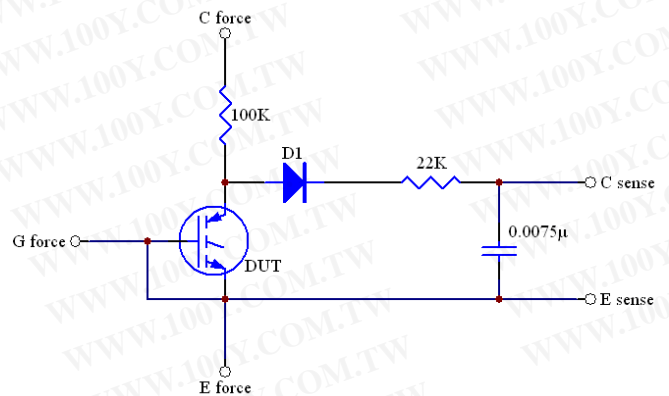
**Fig.C.T.3** - S.C. SOA Circuit



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

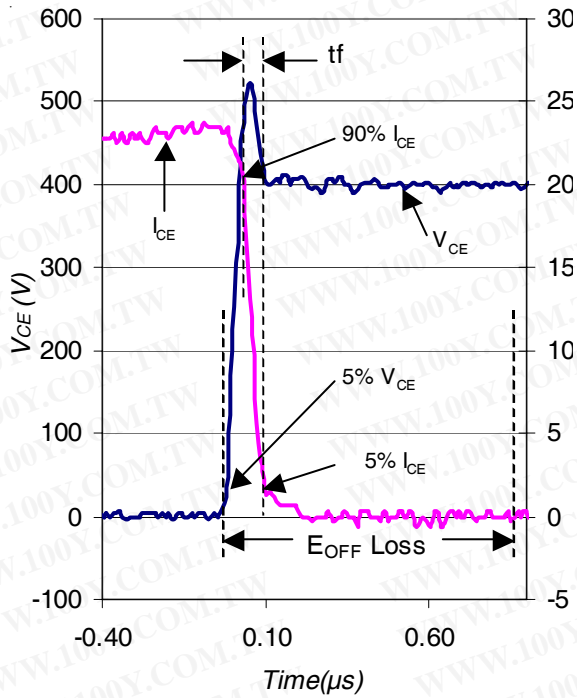


**Fig.C.T.5** - Resistive Load Circuit

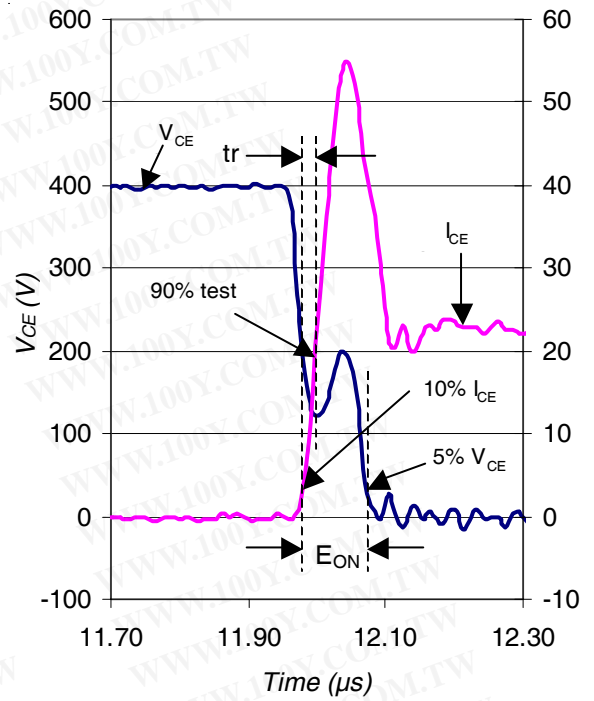


**Fig.C.T.6** - BVCES Filter Circuit

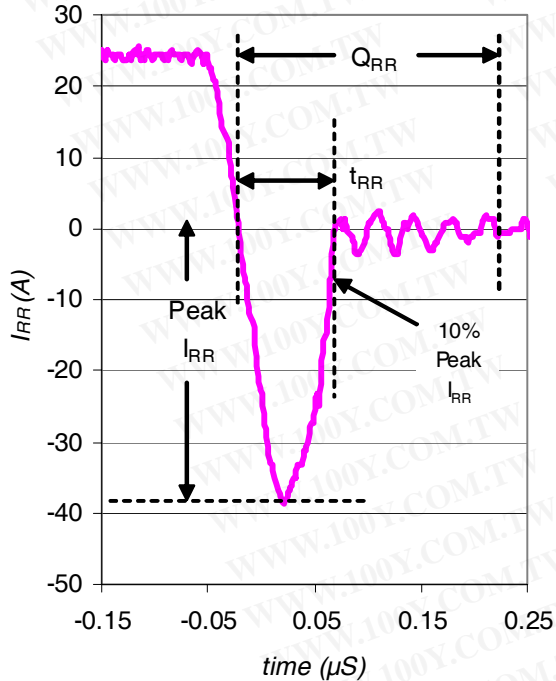




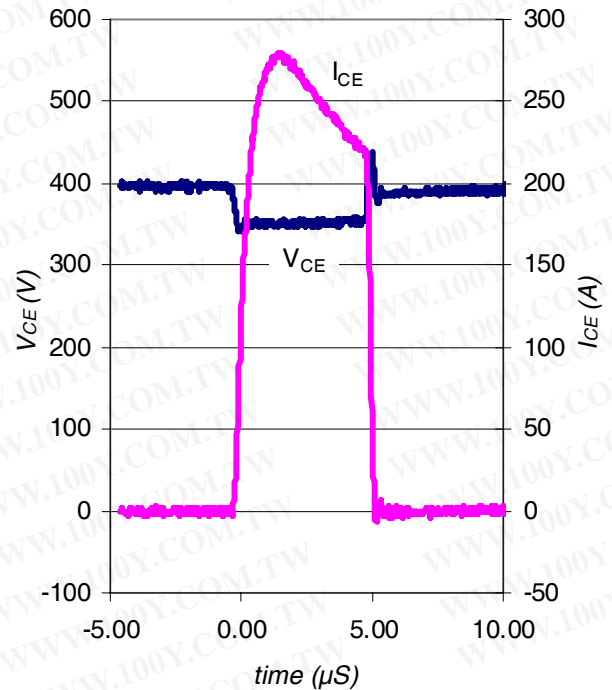
**Fig. WF1** - Typ. Turn-off Loss Waveform  
@  $T_J = 175^\circ\text{C}$  using Fig. CT.4



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



**Fig. WF3** - Typ. Diode Recovery Waveform  
@  $T_J = 175^\circ\text{C}$  using Fig. CT.4

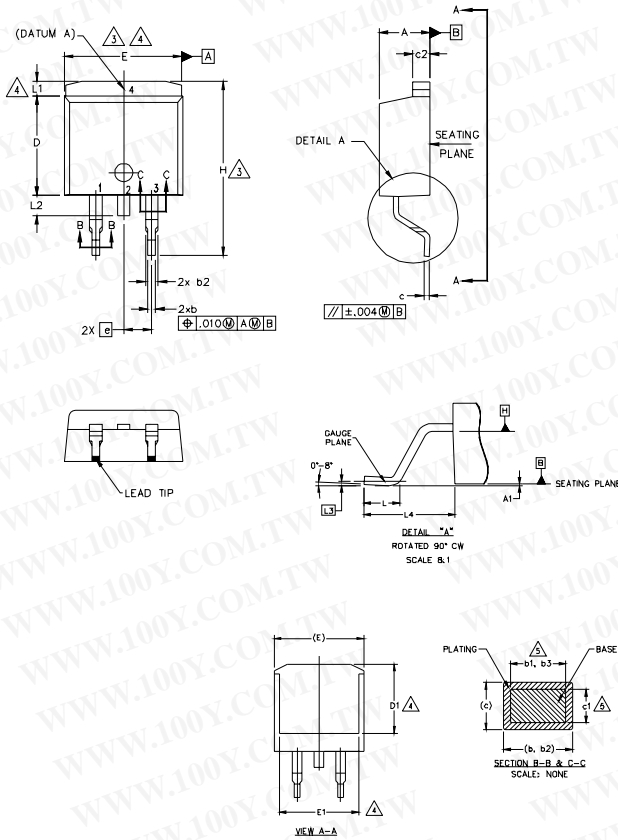


**Fig. WF4** - Typ. S.C. Waveform  
@  $T_J = 25^\circ\text{C}$  using Fig. CT.3

# IRGS/SL4062DPbF

## D<sup>2</sup>Pak (TO-263AB) 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.

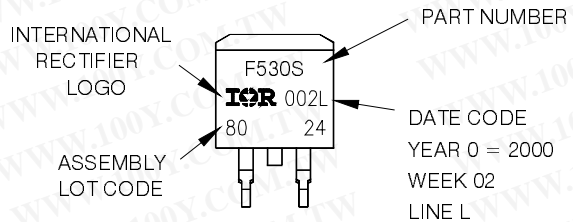
SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
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		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	-	1.65	-	.066	
L2	1.27	1.78	-	.070	
L3	0.25 BSC		.010 BSC		
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.

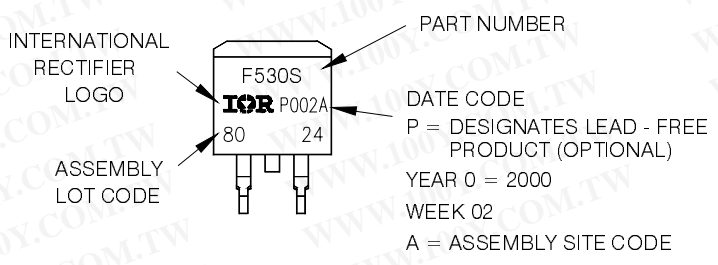
## D<sup>2</sup>Pak (TO-263AB) Part Marking Information

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"



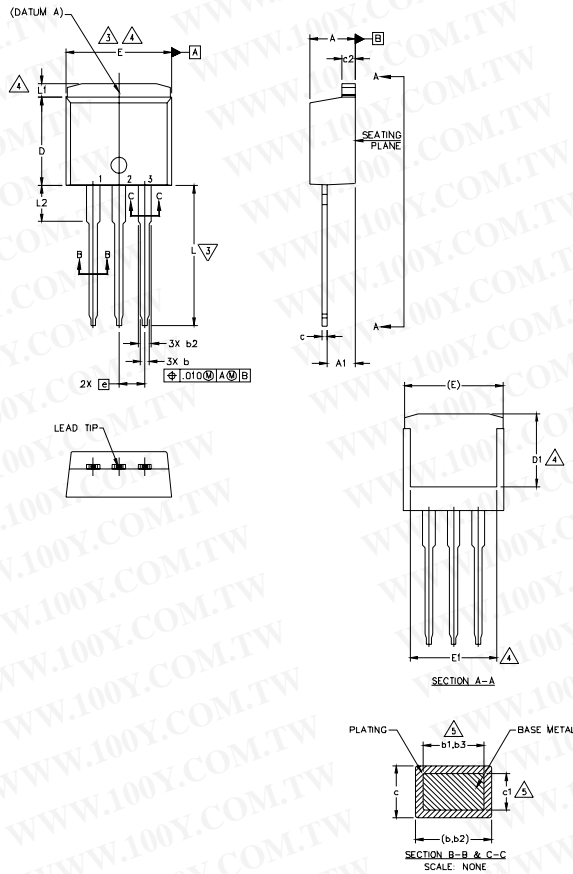
OR



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

International  
**IR** Rectifier  
**TO-262 Package Outline**  
 Dimensions are shown in millimeters (inches)

# IRGS/SL4062DPbF



- 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 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
  4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E. L1, D1 & E1.
  5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
  6. CONTROLLING DIMENSION: INCH.
  7. OUTLINE CONFORM TO JEDEC TO-262 EXCEPT A1(max.), b(min.) AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	2.03	3.02	.080	.119	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
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		
L	13.46	14.10	.530	.555	
L1	-	1.65	-	.065	4
L2	3.56	3.71	.140	.146	

**LEAD ASSIGNMENTS**

**HEXFET**

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

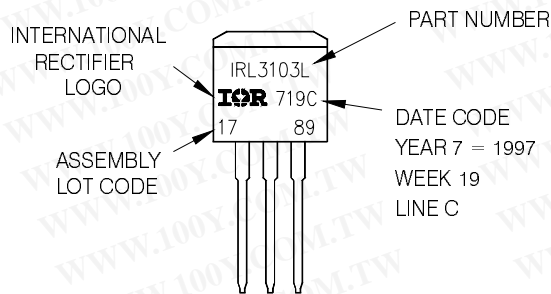
**IGBTs, CoPACK**

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

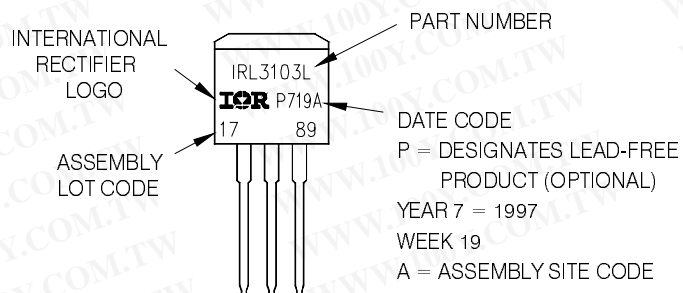
## TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE "C"

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



OR



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

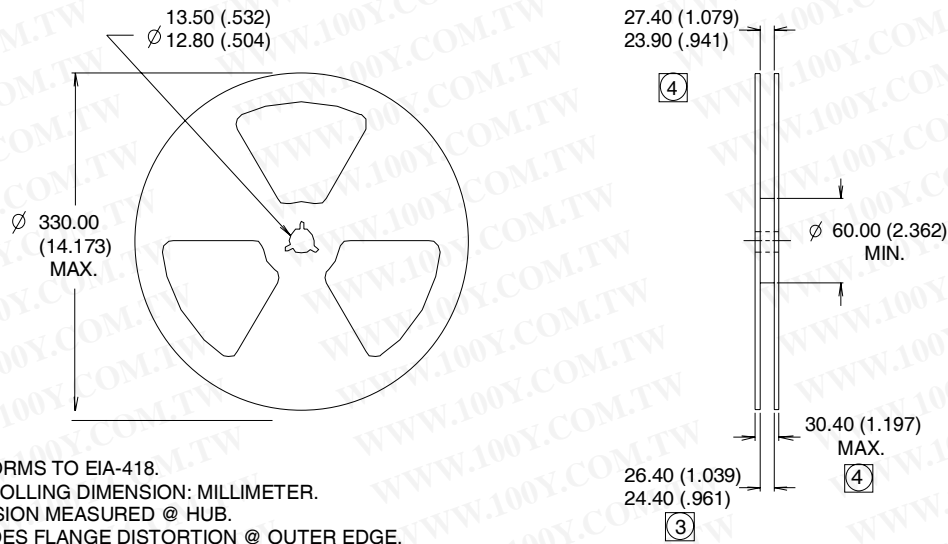
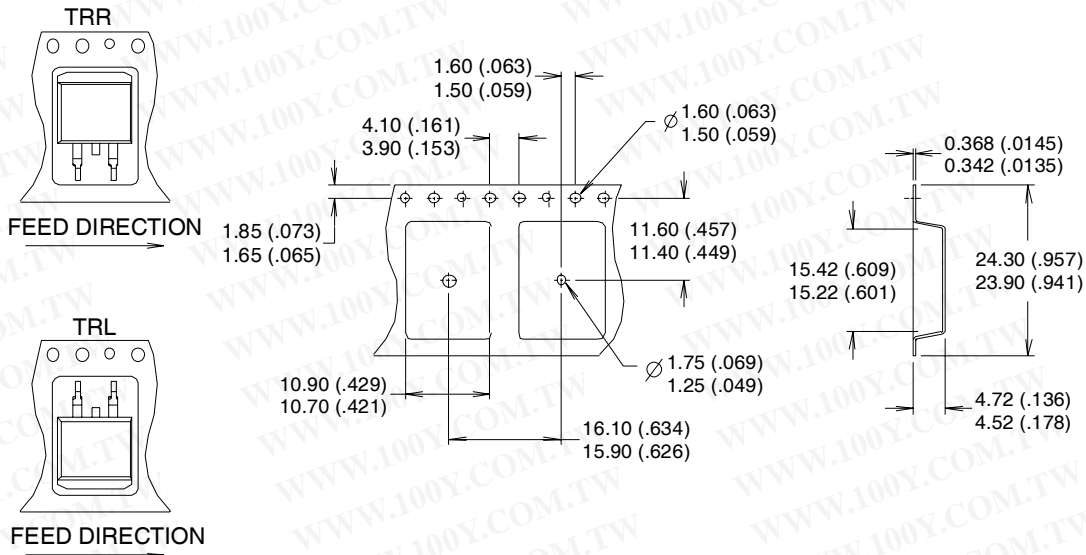
# IRGS/SL4062DPbF

勝特力材料 886-3-5753170  
 勝特力电子(上海) 86-21-34970699  
 勝特力电子(深圳) 86-755-83298787  
 Http://www.100y.com.tw

International  
**IR** Rectifier

## D<sup>2</sup>Pak (TO-263AB) Tape & Reel Information

Dimensions are shown in millimeters (inches)



### NOTES :

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

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

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

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 TAC Fax: (310) 252-7903

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