Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

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International Rectifier

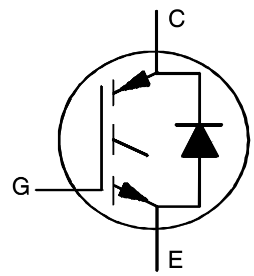
PD - 96197

IRGS4056DPbF

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 μS 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



n-channel

V_{CES} = 600V

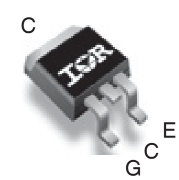
I_C = 12A, T_C = 100°C

$t_{SC} \geq$ 5μs, $T_{J(max)}$ = 175°C

$V_{CE(on)}$ typ. = 1.55V

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



D^2Pak

G	C	E
Gate	Collector	Emitter

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	24	A
I_C @ T_C = 100°C	Continuous Collector Current	12	
I_{CM}	Pulse Collector Current	48	
I_{LM}	Clamped Inductive Load Current ①	48	
I_F @ T_C = 25°C	Diode Continous Forward Current	24	
I_F @ T_C = 100°C	Diode Continous Forward Current	12	
I_{FM}	Diode Maximum Forward Current ③	48	
V_{GE}	Continuous Gate-to-Emitter Voltage	±20	V
	Transient Gate-to-Emitter Voltage	±30	
P_D @ T_C = 25°C	Maximum Power Dissipation	140	W
P_D @ T_C = 100°C	Maximum Power Dissipation	70	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +175	°C
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting Torque, 6-32 or M3 Screw	10 lbf·in (1.1 N·m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{θJC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT)	——	——	1.07	°C/W
$R_{θJC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode)	——	——	3.66	
$R_{θCS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	——	0.50	——	
$R_{θJA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	——	80	——	

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V_{GE} = 0V, I_C = 100μA ④	CT6
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.30	—	V/°C	V_{GE} = 0V, I_C = 1mA (25°C-175°C)	CT6
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.55	1.85	V	I_C = 12A, V_{GE} = 15V, T_J = 25°C	5,6,7
		—	1.90	—		I_C = 12A, V_{GE} = 15V, T_J = 150°C	9,10,11
		—	1.97	—		I_C = 12A, V_{GE} = 15V, T_J = 175°C	
$V_{GE(th)}$	Gate Threshold Voltage	4.0	—	6.5	V	V_{CE} = V_{GE}, I_C = 350μA	9, 10,
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-18	—	mV/°C	V_{CE} = V_{GE}, I_C = 1.0mA (25°C - 175°C)	11, 12
gfe	Forward Transconductance	—	7.7	—	S	V_{CE} = 50V, I_C = 12A, PW = 80μs	
I_{CES}	Collector-to-Emitter Leakage Current	—	2.0	25	μA	V_{GE} = 0V, V_{CE} = 600V	
		—	475	—		V_{GE} = 0V, V_{CE} = 600V, T_J = 175°C	
V_{FM}	Diode Forward Voltage Drop	—	2.10	3.10	V	I_F = 12A	8
		—	1.61	—		I_F = 12A, T_J = 175°C	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±20V	

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
Q_g	Total Gate Charge (turn-on)	—	25	38	nC	I_C = 12A	24
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	7.0	11		V_{GE} = 15V	CT1
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	11	16		V_{CC} = 400V	
E_{on}	Turn-On Switching Loss	—	75	118	μJ	I_C = 12A, V_{CC} = 400V, V_{GE} = 15V	CT4
E_{off}	Turn-Off Switching Loss	—	225	273		R_G = 22Ω, L = 200μH, L_S = 150nH, T_J = 25°C	
E_{total}	Total Switching Loss	—	300	391		Energy losses include tail & diode reverse recovery	
$t_{d(on)}$	Turn-On delay time	—	31	40	ns	I_C = 12A, V_{CC} = 400V, V_{GE} = 15V	CT4
t_r	Rise time	—	17	24		R_G = 22Ω, L = 200μH, L_S = 150nH, T_J = 25°C	
$t_{d(off)}$	Turn-Off delay time	—	83	94			
t_f	Fall time	—	24	31			
E_{on}	Turn-On Switching Loss	—	185	—	μJ	I_C = 12A, V_{CC} = 400V, V_{GE}=15V	13, 15
E_{off}	Turn-Off Switching Loss	—	355	—		R_G=22Ω, L=100μH, L_S=150nH, T_J = 175°C ④	CT4
E_{total}	Total Switching Loss	—	540	—		Energy losses include tail & diode reverse recovery	WF1, WF2
$t_{d(on)}$	Turn-On delay time	—	30	—	ns	I_C = 12A, V_{CC} = 400V, V_{GE} = 15V	14, 16
t_r	Rise time	—	18	—		R_G = 22Ω, L = 200μH, L_S = 150nH	CT4
$t_{d(off)}$	Turn-Off delay time	—	102	—		T_J = 175°C	WF1
t_f	Fall time	—	41	—			WF2
C_{ies}	Input Capacitance	—	765	—	pF	V_{GE} = 0V	23
C_{oes}	Output Capacitance	—	52	—		V_{CC} = 30V	
C_{res}	Reverse Transfer Capacitance	—	23	—		f = 1.0Mhz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 175°C, I_C = 48A V_{CC} = 480V, Vp =600V Rg = 22Ω, V_{GE} = +15V to 0V	4 CT2
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V_{CC} = 400V, Vp =600V Rg = 22Ω, V_{GE} = +15V to 0V	22, CT3 WF4
Erec	Reverse Recovery Energy of the Diode	—	280	—	μJ	T_J = 175°C	17, 18, 19
t_{rr}	Diode Reverse Recovery Time	—	68	—	ns	V_{CC} = 400V, I_F = 12A	20, 21
I_{rr}	Peak Reverse Recovery Current	—	19	—	A	V_{GE} = 15V, Rg = 22Ω, L =200μH, L_s = 150nH	WF3

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 100μH, R_G = 22Ω.
② This is only applied to TO-220AB package.
③ Pulse width limited by max. junction temperature.
④ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.

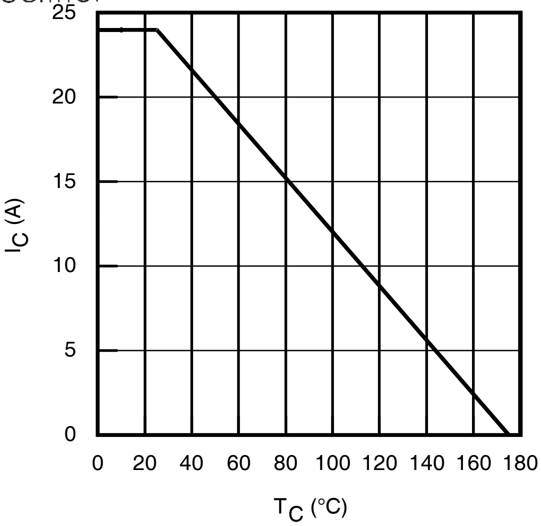


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

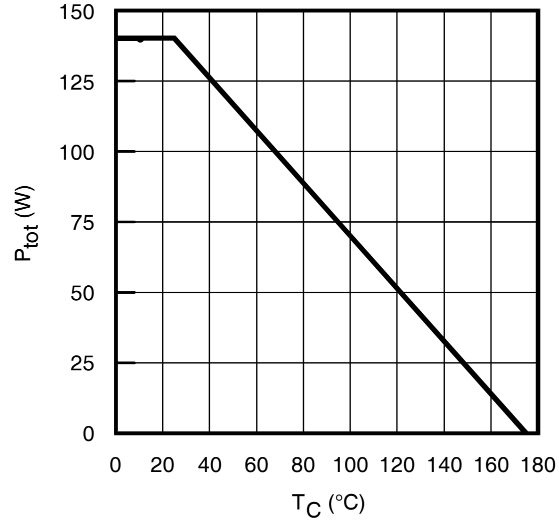


Fig. 2 - Power Dissipation vs. Case Temperature

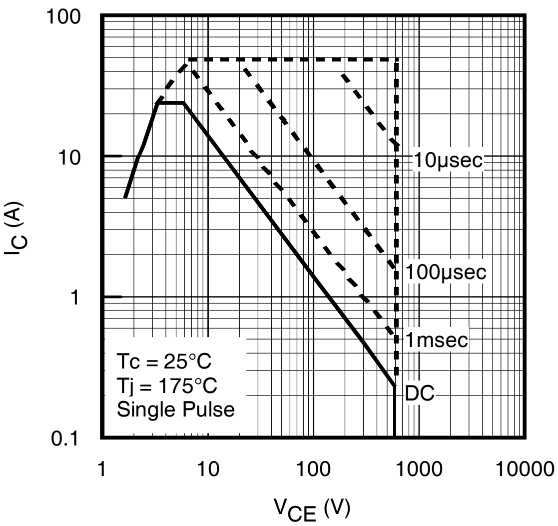


Fig. 3 - Forward SOA
T_C = 25°C, $T_J \leq$ 175°C; V_{GE} =15V

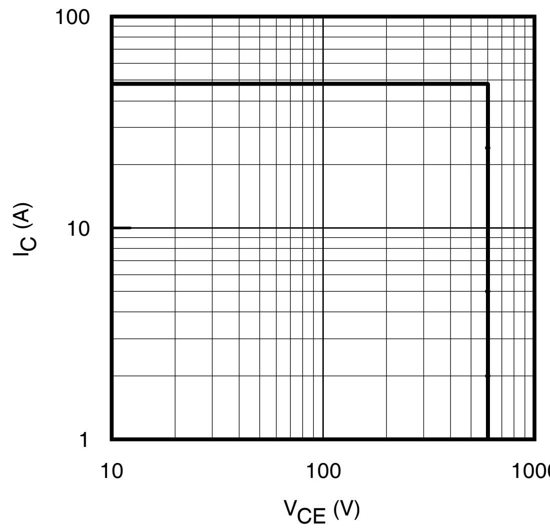


Fig. 4 - Reverse Bias SOA
T_J = 175°C; V_{GE} =15V

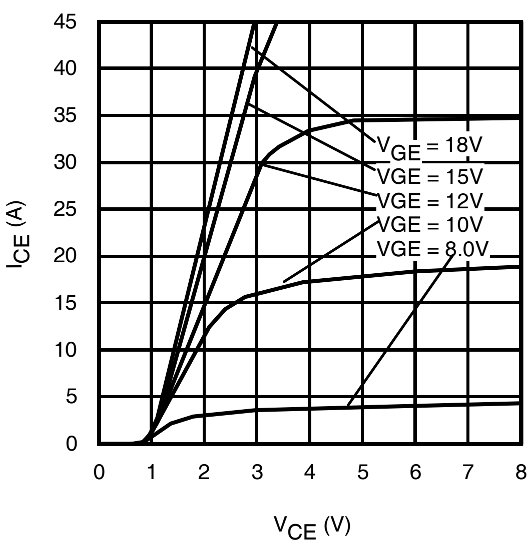


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 80µs

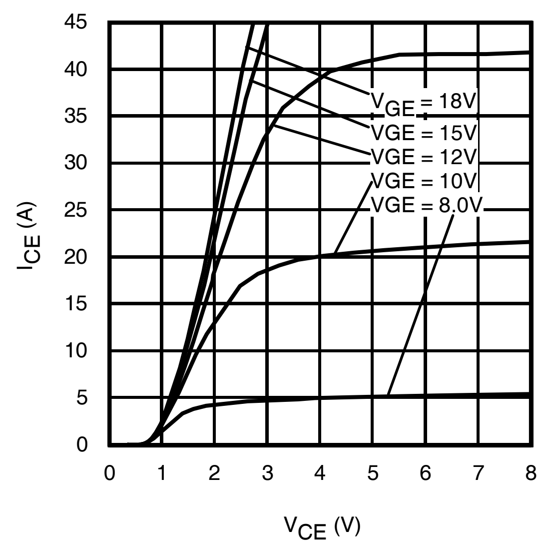


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80µs

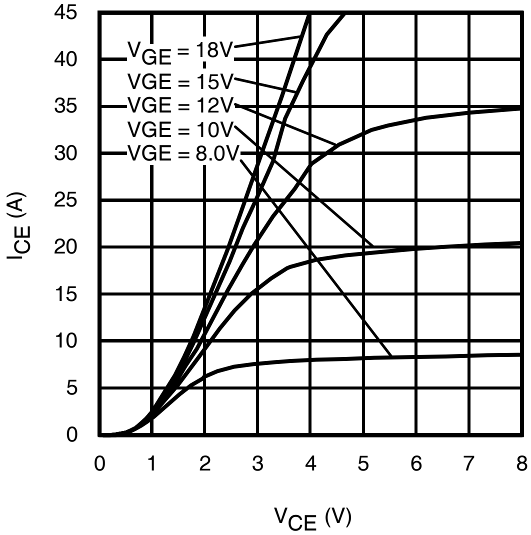


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 175°C; tp = 80µs

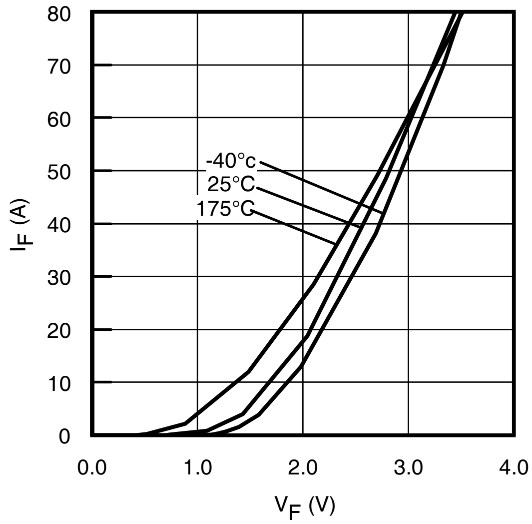


Fig. 8 - Typ. Diode Forward Characteristics
tp = 80µs

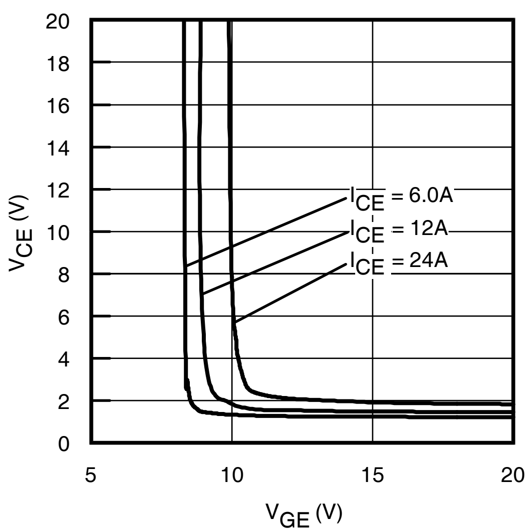


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

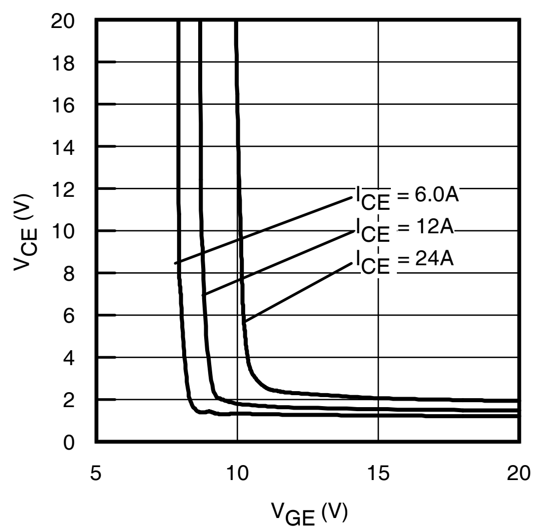


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

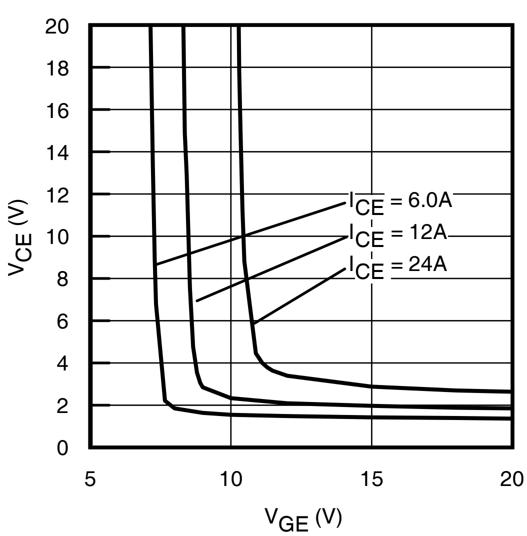


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 175°C

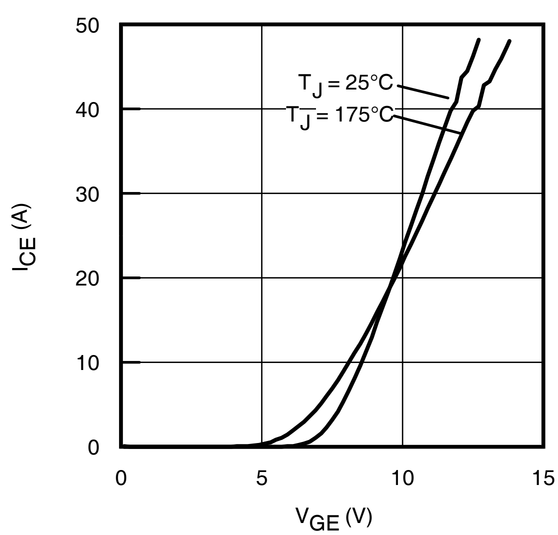


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

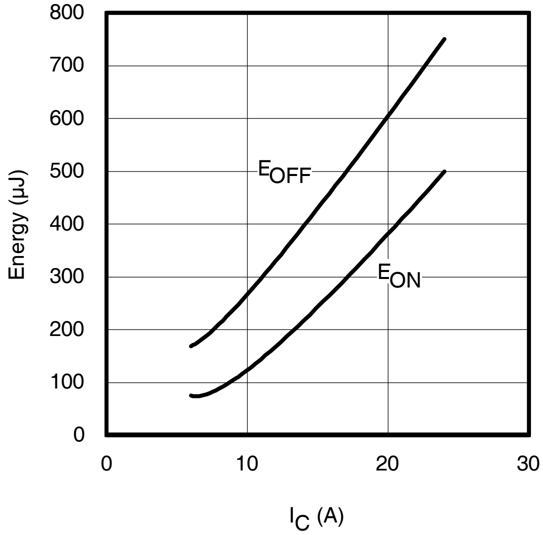


Fig. 13 - Typ. Energy Loss vs. I_C
$T_J = 175°C$; $L = 200µH$; $V_{CE} = 400V$, $R_G = 22\Omega$; $V_{GE} = 15V$

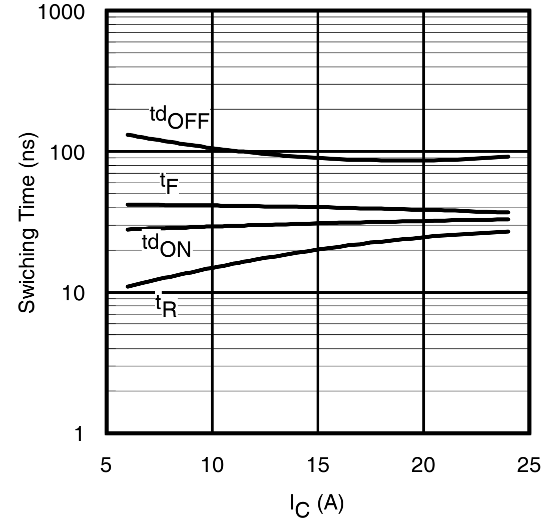


Fig. 14 - Typ. Switching Time vs. I_C
$T_J = 175°C$; $L = 200µH$; $V_{CE} = 400V$, $R_G = 22\Omega$; $V_{GE} = 15V$

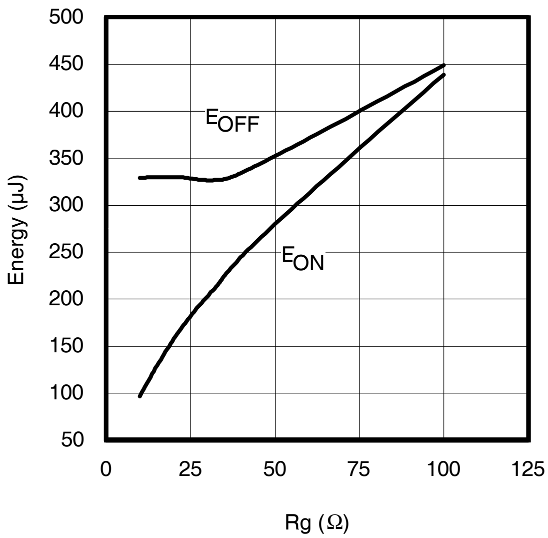


Fig. 15 - Typ. Energy Loss vs. R_G
$T_J = 175°C$; $L = 200µH$; $V_{CE} = 400V$, $I_{CE} = 12A$; $V_{GE} = 15V$

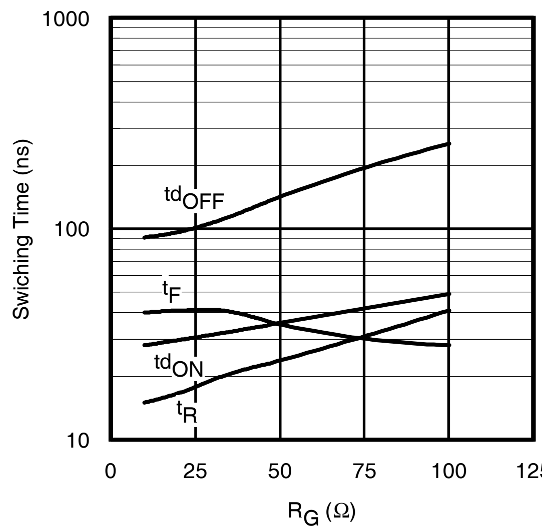


Fig. 16 - Typ. Switching Time vs. R_G
$T_J = 175°C$; $L = 200µH$; $V_{CE} = 400V$, $I_{CE} = 12A$; $V_{GE} = 15V$

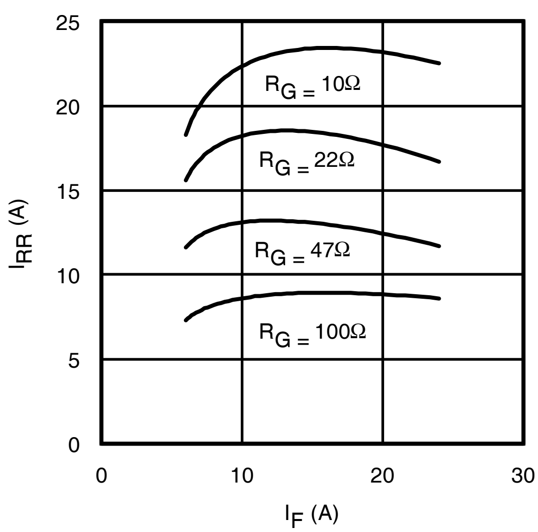


Fig. 17 - Typ. Diode I_{RR} vs. I_F
$T_J = 175°C$

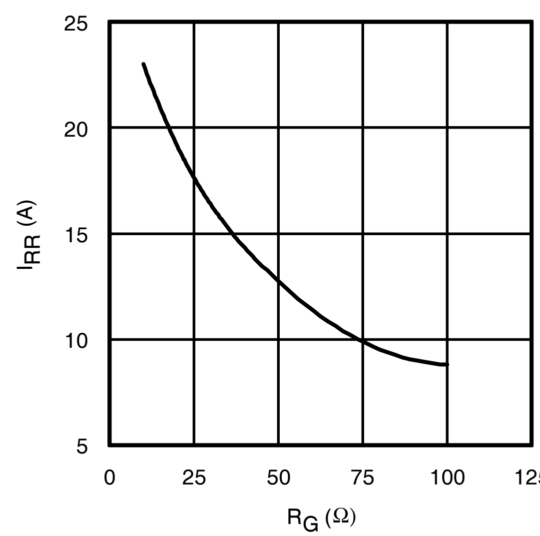


Fig. 18 - Typ. Diode I_{RR} vs. R_G
$T_J = 175°C$

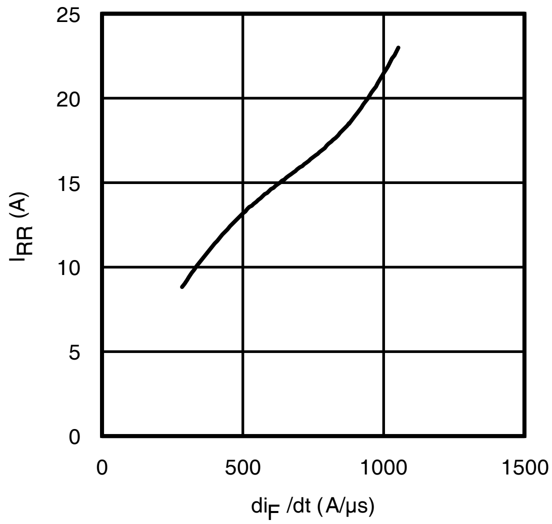


Fig. 19 - Typ. Diode I_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; I_F = 12A; T_J = 175°C

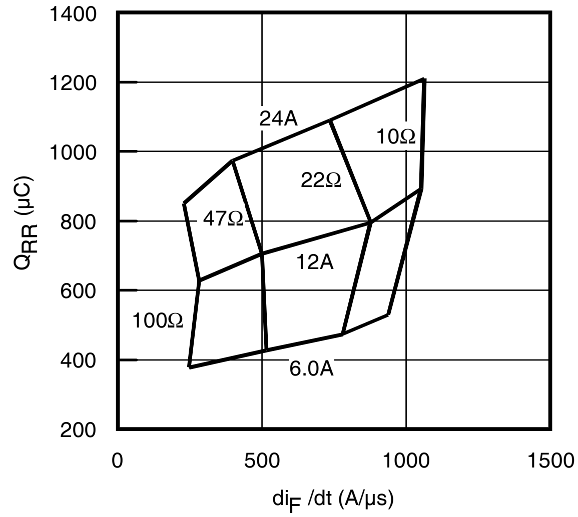


Fig. 20 - Typ. Diode Q_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; T_J = 175°C

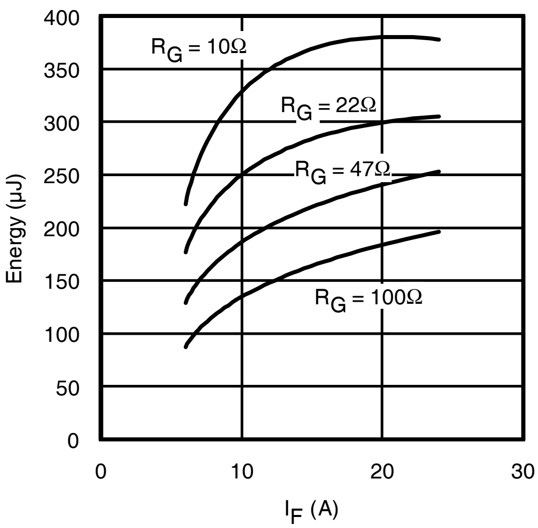


Fig. 21 - Typ. Diode E_{RR} vs. I_F
T_J = 175°C

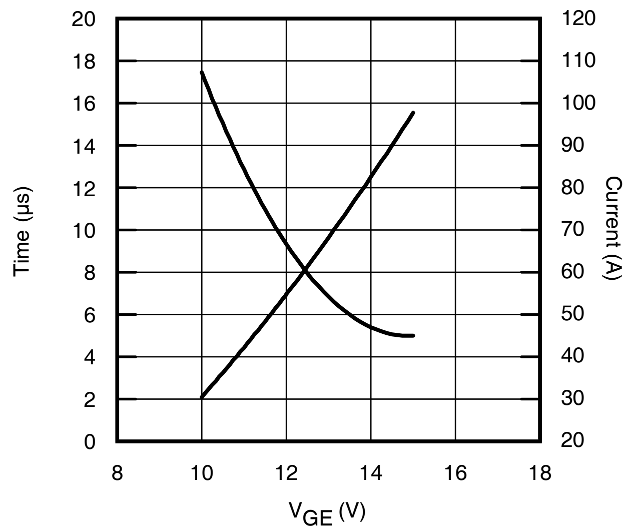


Fig. 22 - V_{GE} vs. Short Circuit Time
V_{CC} = 400V; T_C = 25°C

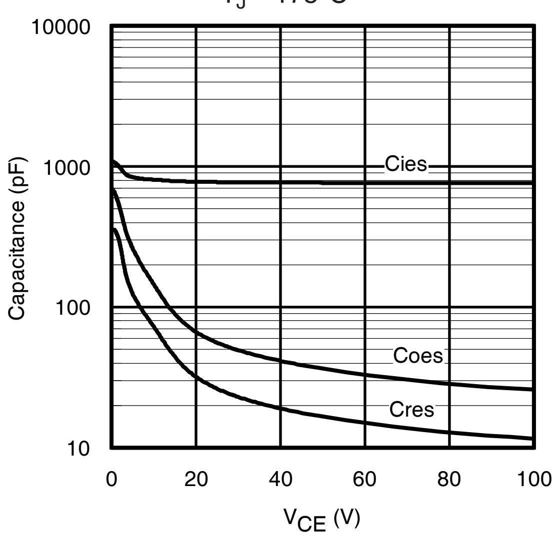


Fig. 23 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

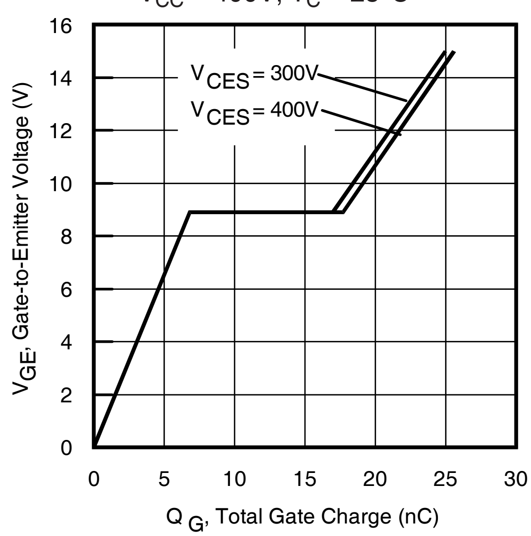


Fig. 24 - Typical Gate Charge vs. V_{GE}
I_{CE} = 12A; L = 600μH

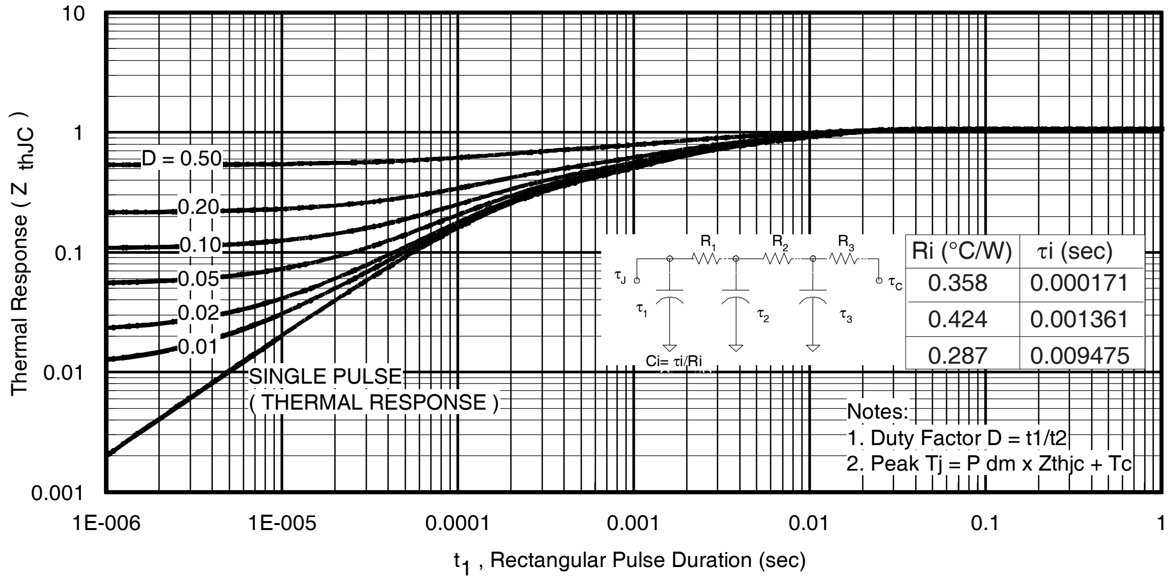


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

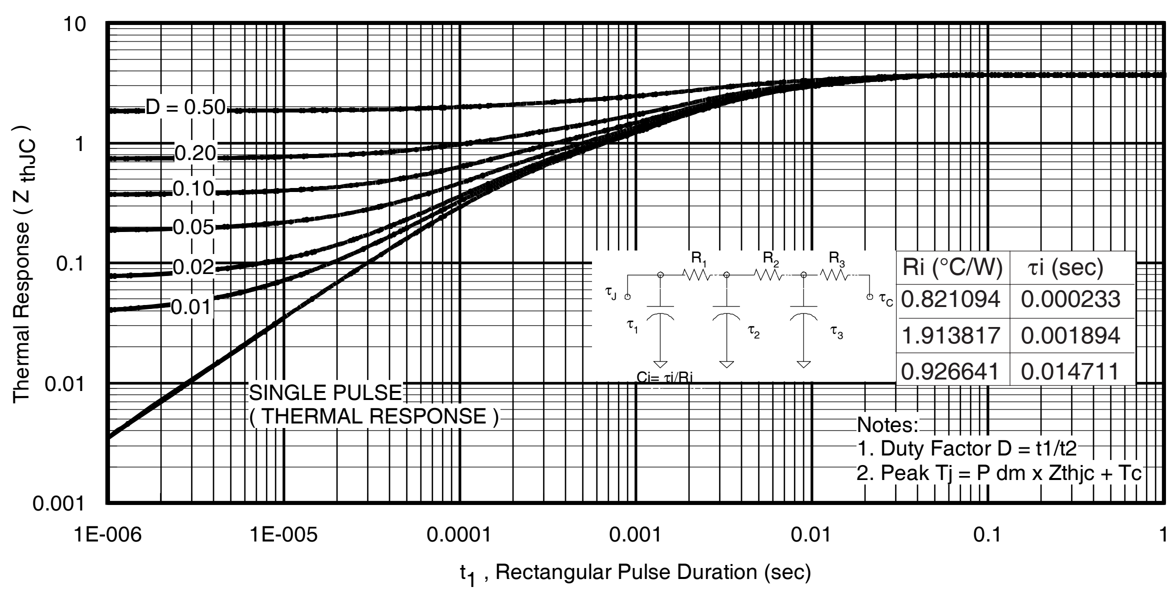


Fig. 26. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

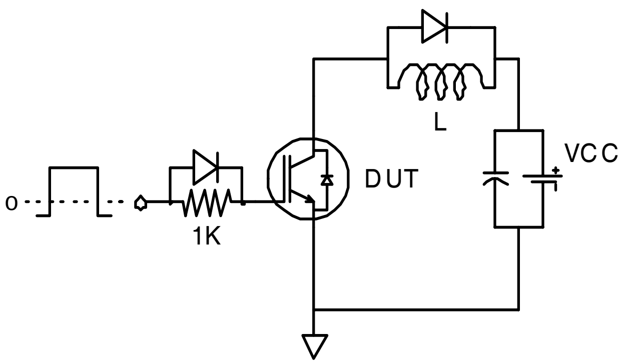


Fig.C.T.1 - Gate Charge Circuit (turn-off)

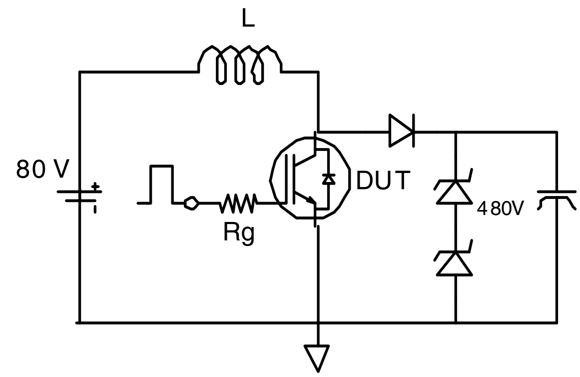


Fig.C.T.2 - RBSOA Circuit

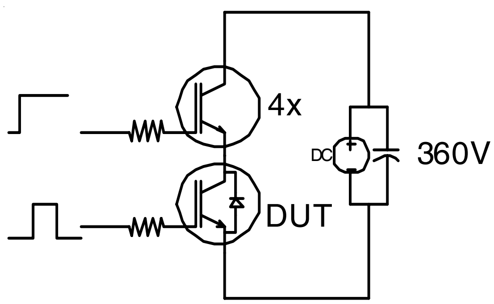


Fig.C.T.3 - S.C. SOA Circuit

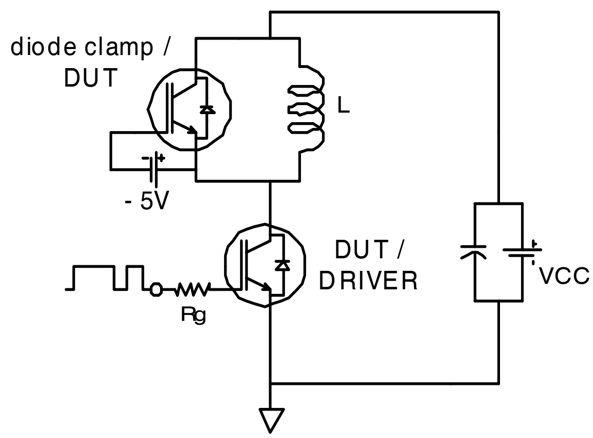


Fig.C.T.4 - Switching Loss Circuit

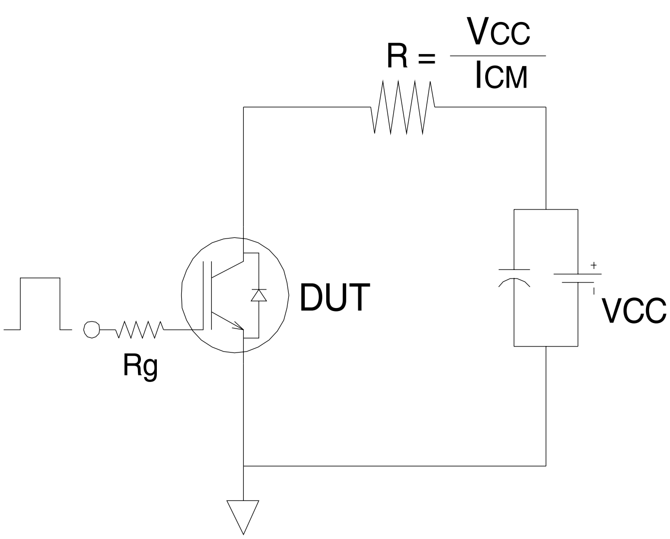


Fig.C.T.5 - Resistive Load Circuit

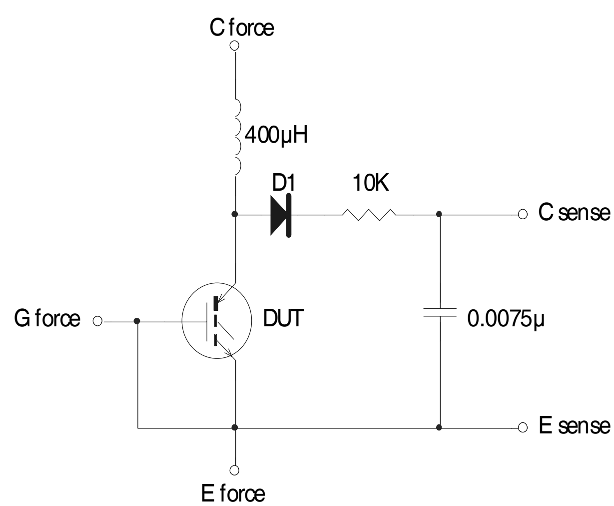


Fig.C.T.6 - BVCES Filter Circuit

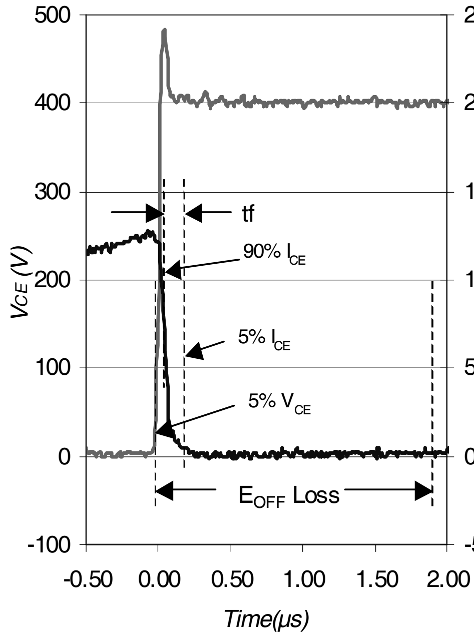


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 175°C using Fig. CT.4

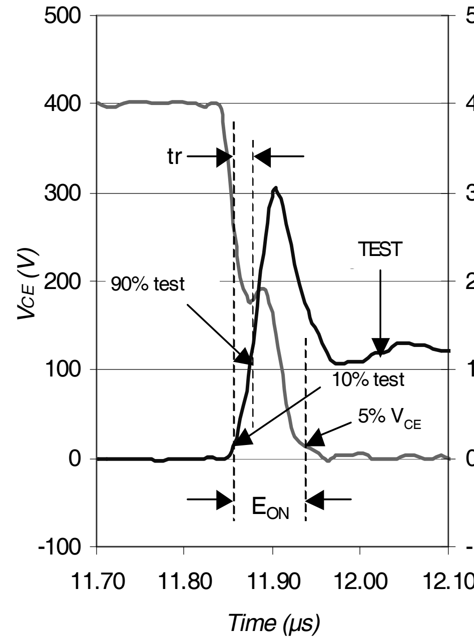


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 175°C using Fig. CT.4

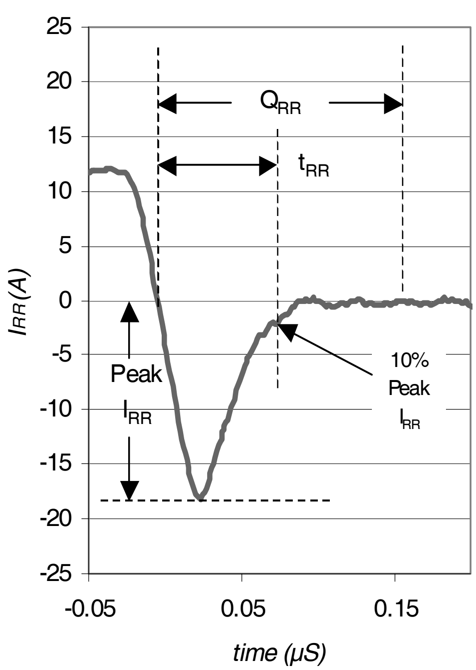


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 175°C using Fig. CT.4

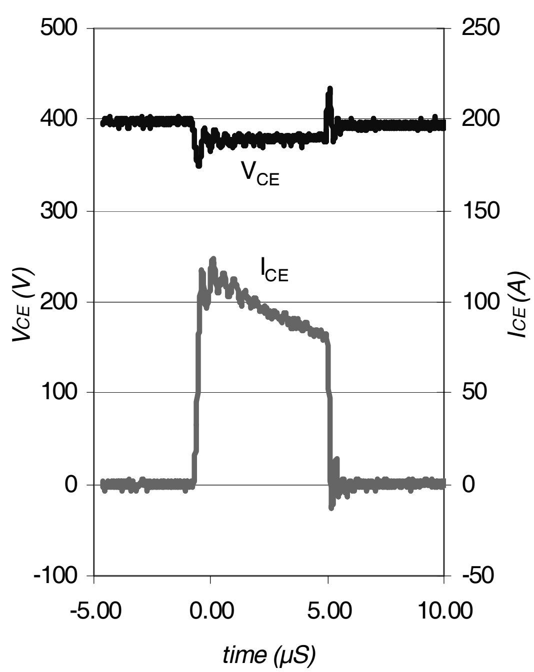
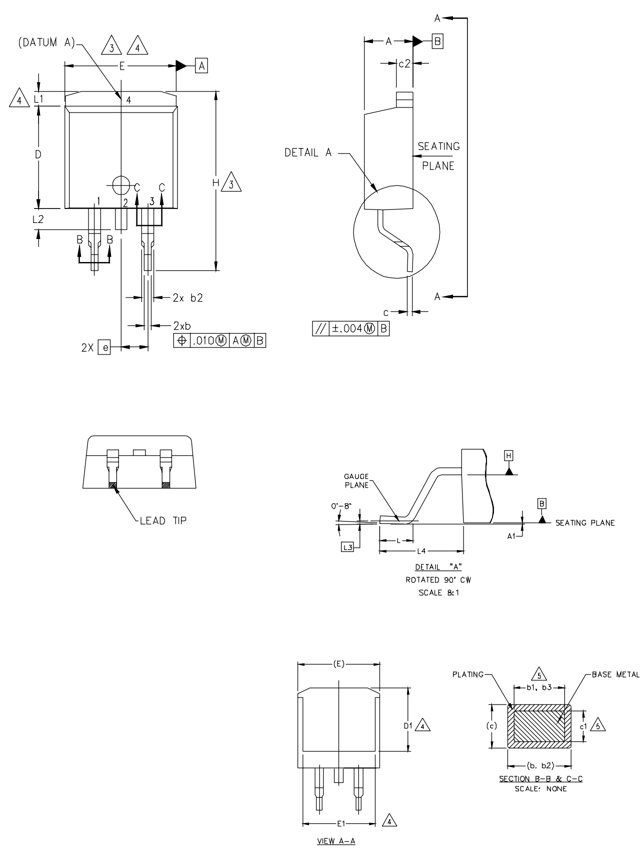


Fig. WF4 - Typ. S.C. Waveform
@ T_J = 25°C using Fig. CT.3

D²Pak (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 [.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	4
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

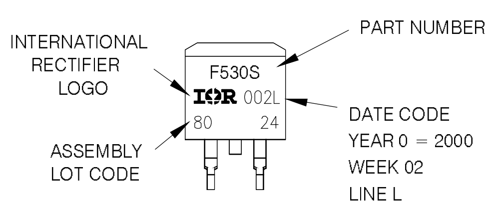
DIODES
1.- ANODE *
2, 4.- CATHODE
3.- ANODE

* PART DEPENDENT.

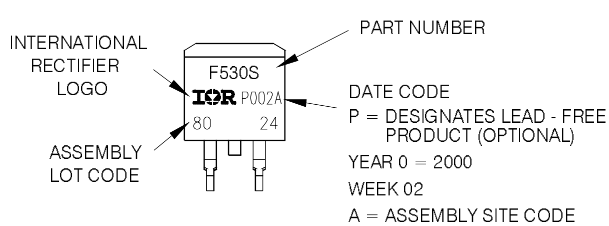
D²Pak (TO-263AB) Part Marking Information

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"



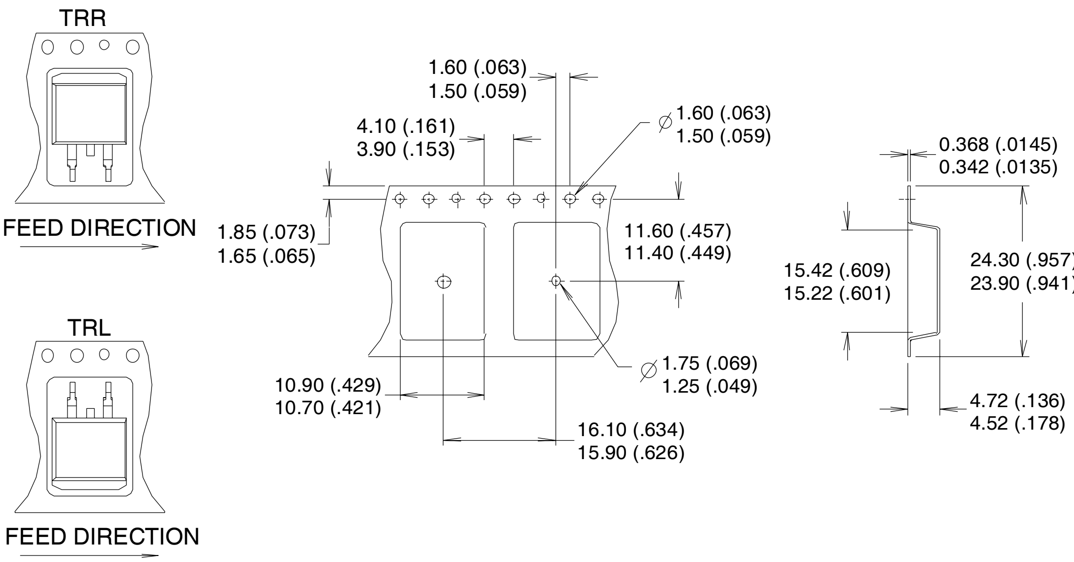
OR

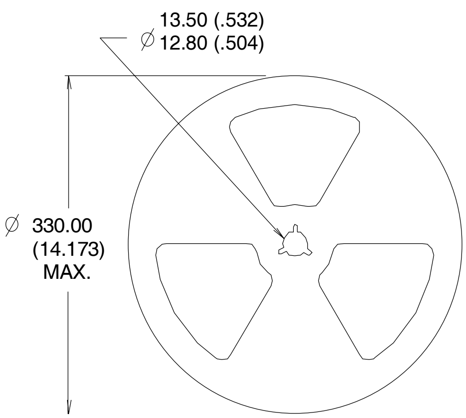


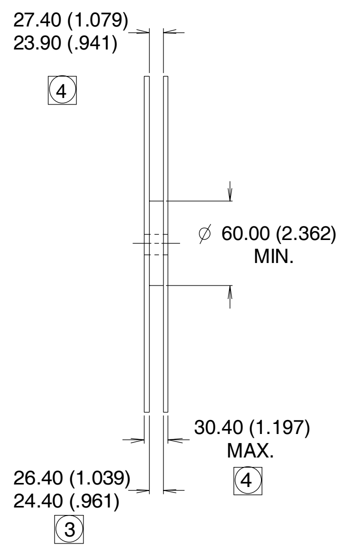
Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

D^2Pak (TO-263AB) Tape & Reel Information

Dimensions are shown in millimeters (inches)







NOTES :
1. COMFORMS 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/

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
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