International
IOR Rectifier

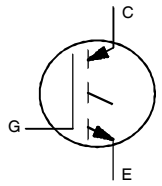
PD - 96358

IRGS15B60KPbF

INSULATED GATE BIPOLAR TRANSISTOR

Features

- Low VCE (on) Non Punch Through IGBT Technology.
- 10µs Short Circuit Capability.
- Square RBSOA.
- Positive VCE (on) Temperature Coefficient.
- Lead-Free



n-channel

V_{CES} = 600V

I_C = 15A, T_C=100°C

t_{sc} > 10µs, T_J=150°C

$V_{CE(on)}$ typ. = 1.8V

Benefits

- Benchmark Efficiency for Motor Control.
- Rugged Transient Performance.
- Low EMI.
- Excellent Current Sharing in Parallel Operation.

D^2Pak
IRGS15B60KPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	31	A
I_C @ T_C = 100°C	Continuous Collector Current	15	
I_{CM}	Pulse Collector Current Vge = 15V	62	
I_{LM}	Clamped Inductive Load Current Vge = 20V ④	62	
V_{GE}	Continuous Gate-to-Emitter Voltage	±20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	208	W
P_D @ T_C = 100°C	Maximum Power Dissipation	83	
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)	Junction-to-Case-IGBT	—	—	0.6	°C/W
$R_{\theta CS}$	Case-to-Sink (flat, greased surface)	—	0.5	—	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount steady state)①	—	—	40	
	Weight	—	1.44	—	g (oz)

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 = 500µA	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.3	—	V/°C	V_{GE} = 0V, I_C = 1.0mA (25°C-150°C)	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	1.5	1.8	2.2	V	I_C = 15A, V_{GE} = 15V, T_J = 25°C	5,6,7
		—	2.05	2.5		I_C = 15A, V_{GE} = 15V, T_J = 125°C	8,9,10
		—	2.1	2.6		I_C = 15A, V_{GE} = 15V, T_J = 150°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.5	4.5	5.5	V	V_{CE} = V_{GE}, I_C = 250µA	8,9
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-10	—	mV/°C	V_{CE} = V_{GE}, I_C =1.0mA (25°C - 150°C)	10,11
gfe	Forward Transconductance	—	10.6	—	S	V_{CE} = 50V, I_C = 20A, PW = 80µs	
I_{CES}	Collector-to-Emitter Leakage Current	—	5.0	150	µA	V_{GE} = 0V, V_{CE} = 600V, T_J = 25°C	
		—	500	1000		V_{GE} = 0V, V_{CE} = 600V, T_J = 150°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)	—	56	84	nC	I_C = 15A	
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	7.0	10		V_{GE} = 15V	CT1
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	26	39		V_{CC} = 400V	
E_{on}	Turn-On Switching Loss	—	220	330	µJ	I_C = 15A, V_{CC} = 400V, V_{GE} = 15V	CT4
E_{off}	Turn-Off Switching Loss	—	340	455		R_G = 22Ω, L = 200µH	
E_{total}	Total Switching Loss	—	560	785		L_S = 150nH T_J = 25°C ②	
$t_{d(on)}$	Turn-On delay time	—	34	44	ns	I_C = 15A, V_{CC} = 400V, V_{GE} = 15V	CT4
t_r	Rise time	—	16	22		R_G = 22Ω, L = 200µH	
$t_{d(off)}$	Turn-Off delay time	—	184	200		L_S = 150nH T_J = 25°C	
t_f	Fall time	—	20	26			
E_{on}	Turn-On Switching Loss	—	355	470	µJ	I_C = 15A, V_{CC} = 400V, V_{GE} = 15V	CT4
E_{off}	Turn-Off Switching Loss	—	490	600		R_G = 22Ω, L = 200µH	12,14
E_{total}	Total Switching Loss	—	835	1070		L_S = 150nH T_J = 150°C ②	WF1, WF2
$t_{d(on)}$	Turn-On delay time	—	34	44	ns	I_C = 15A, V_{CC} = 400V, V_{GE} = 15V	13, 15
t_r	Rise time	—	18	25		R_G = 22Ω, L = 200µH	CT4
$t_{d(off)}$	Turn-Off delay time	—	203	226		L_S = 150nH T_J = 150°C	WF1
t_f	Fall time	—	28	36			WF2
C_{ies}	Input Capacitance	—	850	—	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	—	75	—		V_{CC} = 30V	
C_{res}	Reverse Transfer Capacitance	—	35	—		f = 1.0Mhz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				I_C = 62A V_{CC} = 500V, Vp =600V Rg = 22Ω, V_{GE} = +20V to 0V, T_J =150°C	4 CT2
SCSOA	Short Circuit Safe Operating Area	10	—	—	µs	V_{CC} = 360V, Vp =600V ,T_J = 150°C Rg = 22Ω, V_{GE} = +15V to 0V	CT3 WF3

Note ① to ③ are on page 11

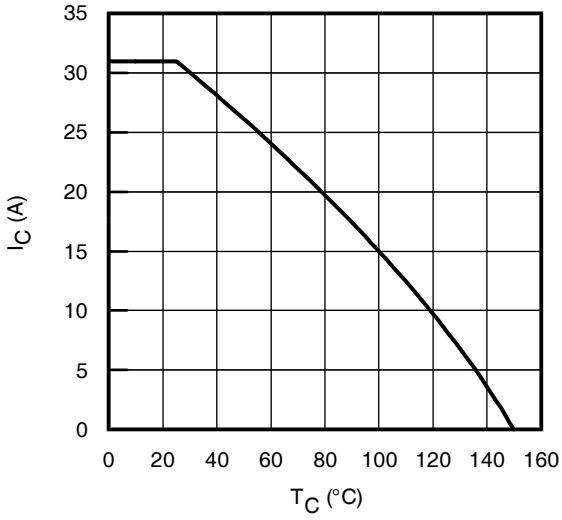


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

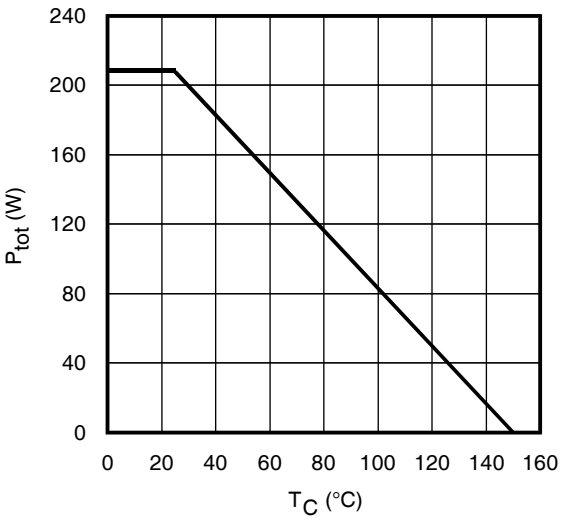


Fig. 2 - Power Dissipation vs. Case Temperature

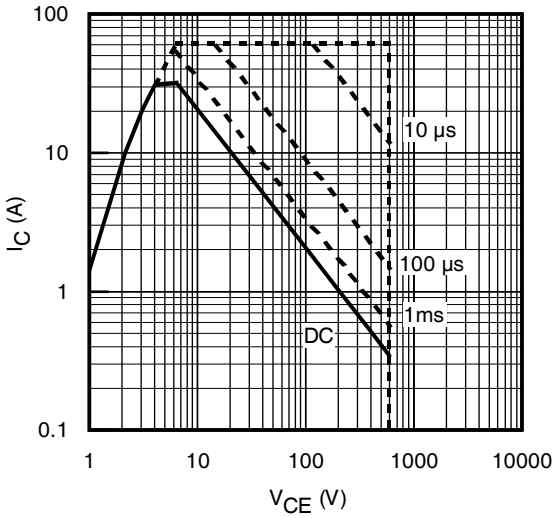


Fig. 3 - Forward SOA
T_C = 25°C; $T_J \leq$ 150°C

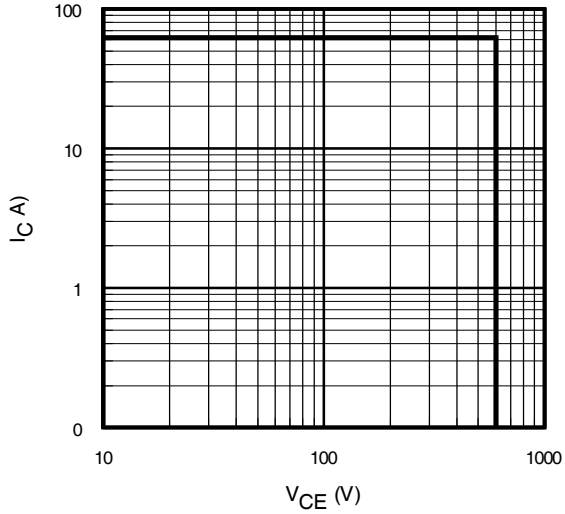


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} =15V

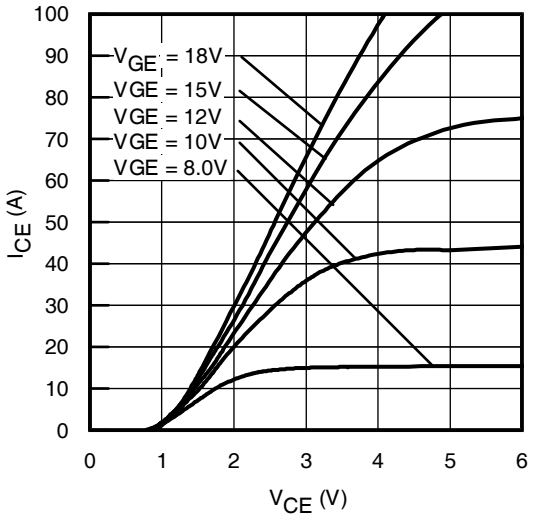


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 300µs

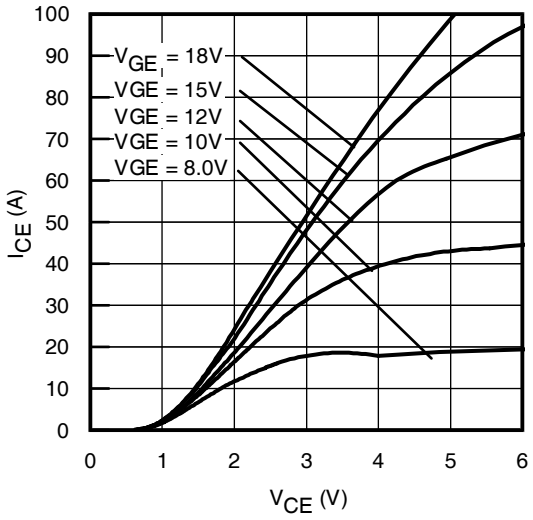


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 300µs

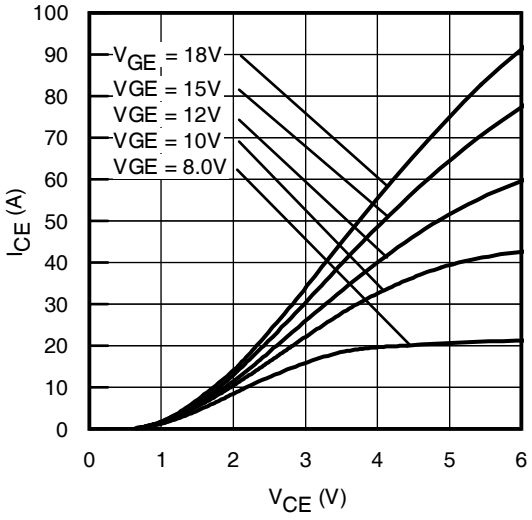


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 300µs

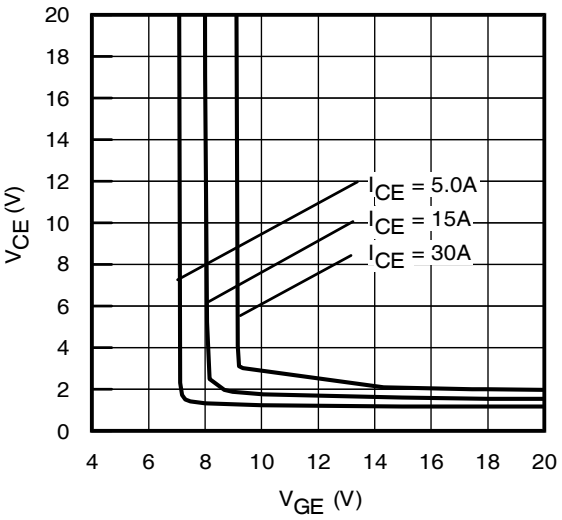


Fig. 8 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

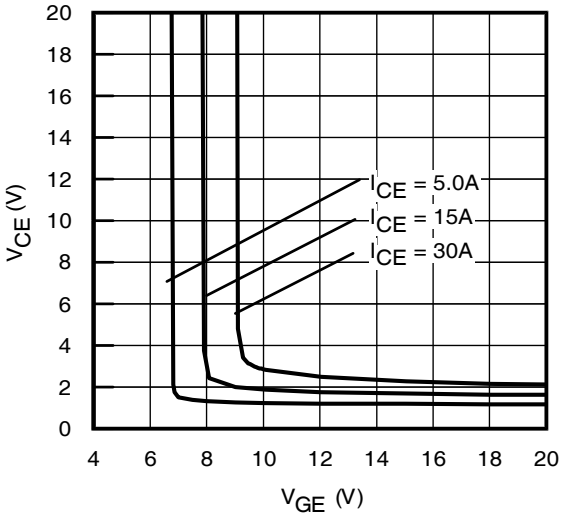


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

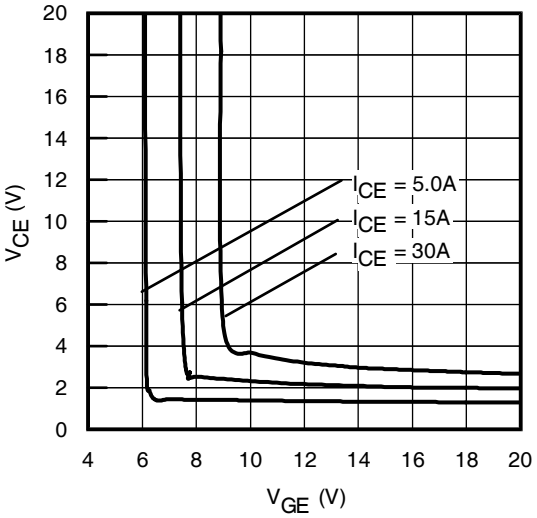


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 150°C

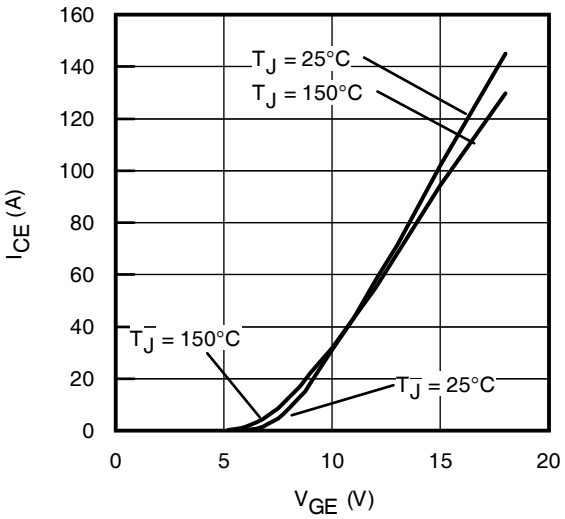


Fig. 11 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

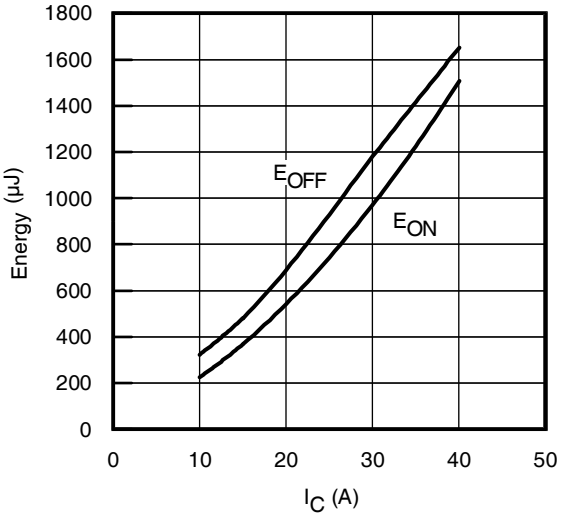


Fig. 12 - Typ. Energy Loss vs. I_C
T_J = 150°C; L=200µH; V_{CE}= 400V
R_G= 22Ω; V_{GE}= 15V

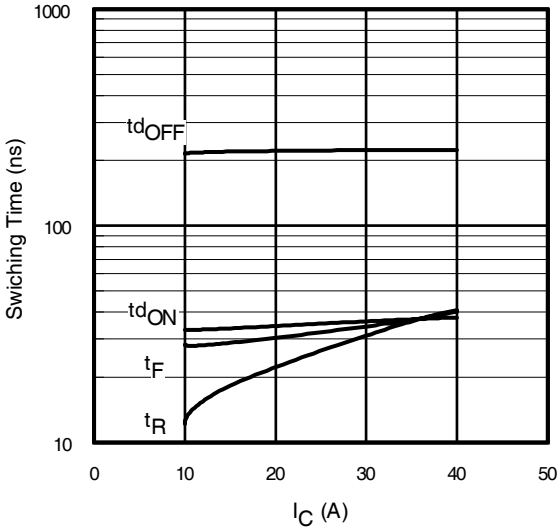


Fig. 13 - Typ. Switching Time vs. I_C
T_J = 150°C; L=200µH; V_{CE}= 400V
R_G= 22Ω; V_{GE}= 15V

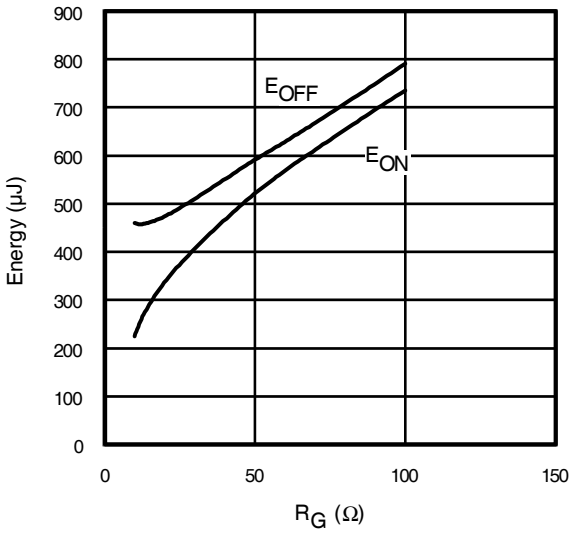


Fig. 14 - Typ. Energy Loss vs. R_G
T_J = 150°C; L=200µH; V_{CE}= 400V
I_{CE}= 15A; V_{GE}= 15V

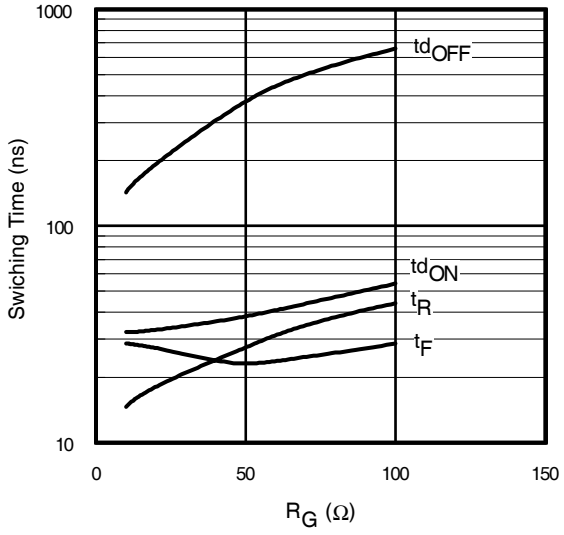


Fig. 15- Typ. Switching Time vs. R_G
T_J = 150°C; L=200µH; V_{CE}= 600V
I_{CE}= 15A; V_{GE}= 15V

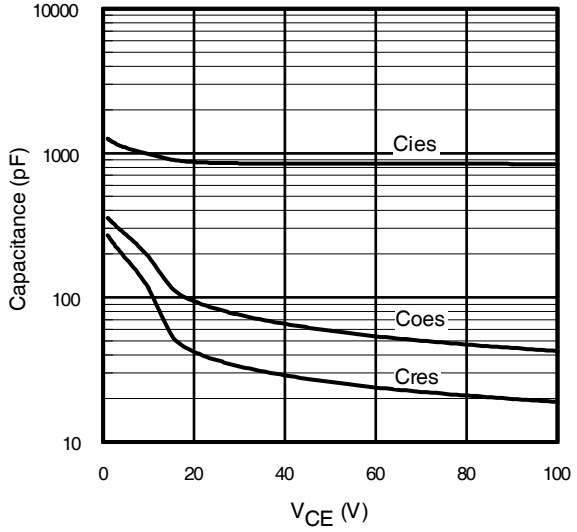


Fig. 16- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

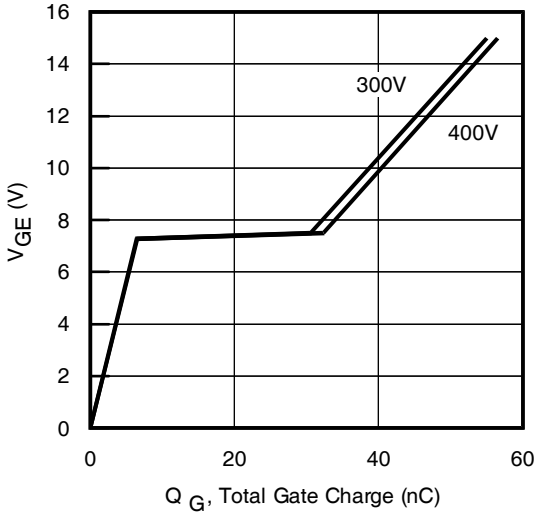


Fig. 17 - Typical Gate Charge vs. V_{GE}
I_{CE} = 15A; L = 600µH

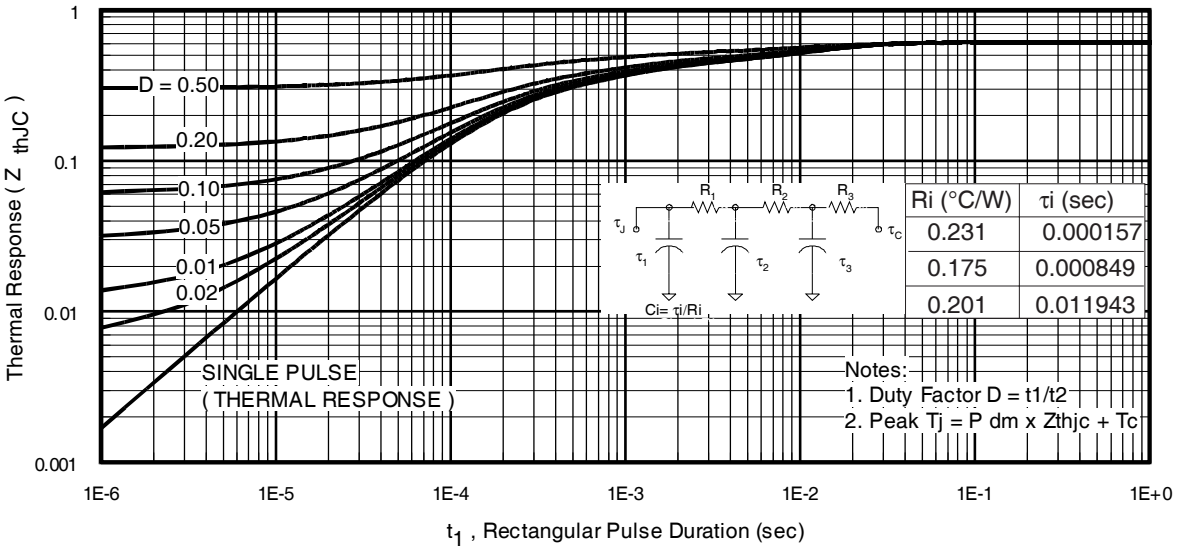


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

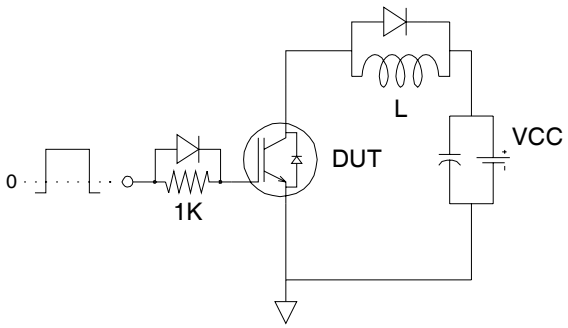


Fig.C.T.1 - Gate Charge Circuit (turn-off)

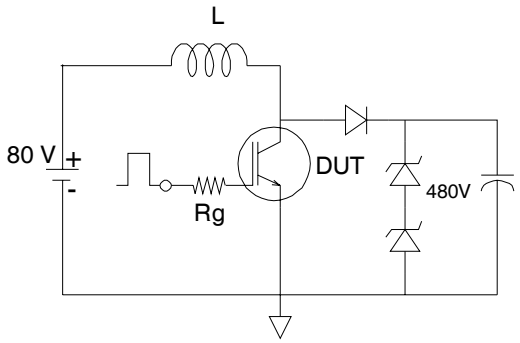


Fig.C.T.2 - RBSOA Circuit

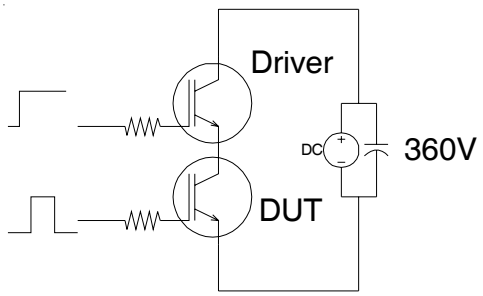


Fig.C.T.3 - S.C.SOA Circuit

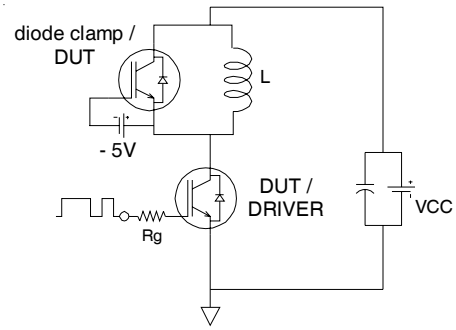


Fig.C.T.4 - Switching Loss Circuit

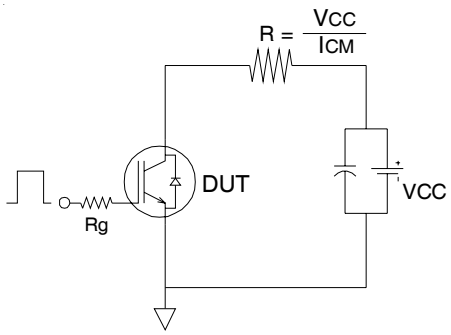
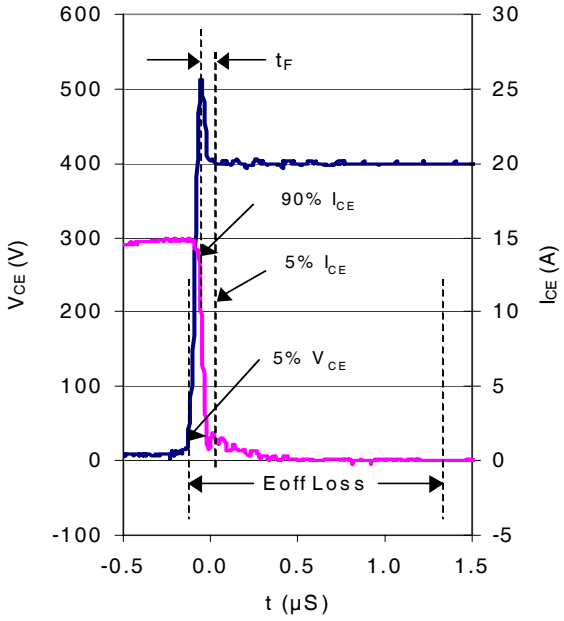
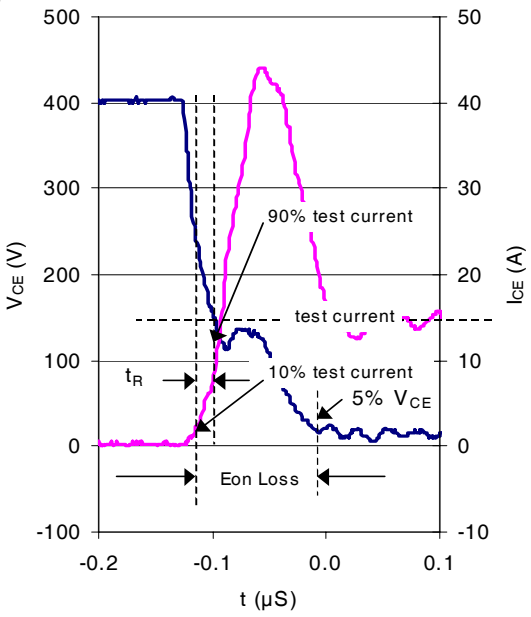


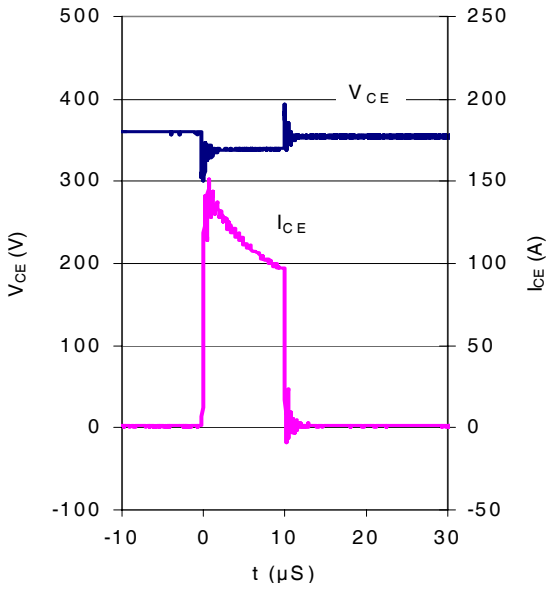
Fig.C.T.5 - Resistive Load Circuit



WF.1- Typ. Turn-off Loss
@ T_J = 150°C using CT.4



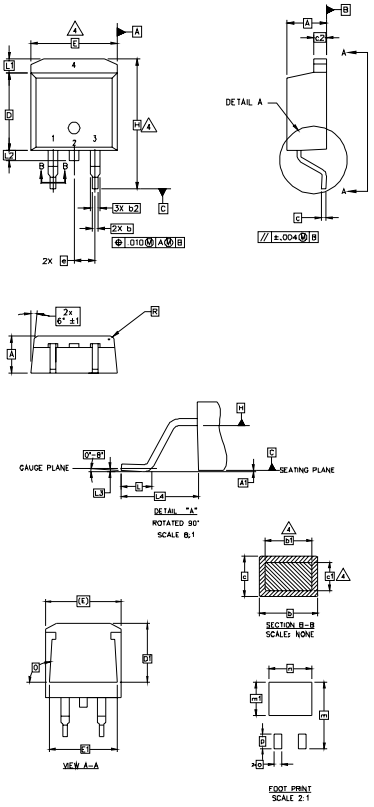
WF.2- Typ. Turn-on Loss
@ T_J = 150°C using Fig. CT.4



WF.3- Typ. Short Circuit
@ T_J = 150°C using CT.3

D²Pak 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.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

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	4
b2	1.14	1.78	.045	.070	
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	4
c2	1.14	1.65	.045	.065	
D	8.51	9.65	.335	.380	3
D1	6.86		.270		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1		1.65		.065	
L2	1.27	1.78	.050	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
R	0.51	0.71	.020	.028	
θ	90°	93°	90°	93°	

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

DIODES

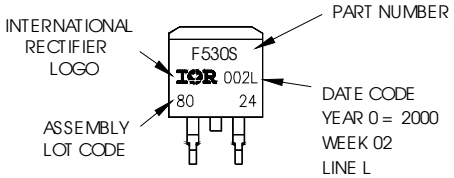
1.- ANODE *
2, 4.- CATHODE
3.- ANODE

* PART DEPENDENT.

D²Pak 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"



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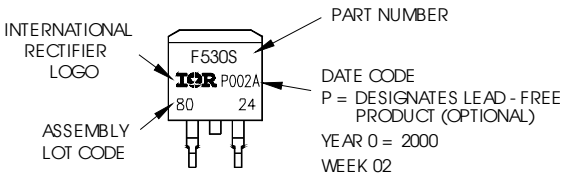
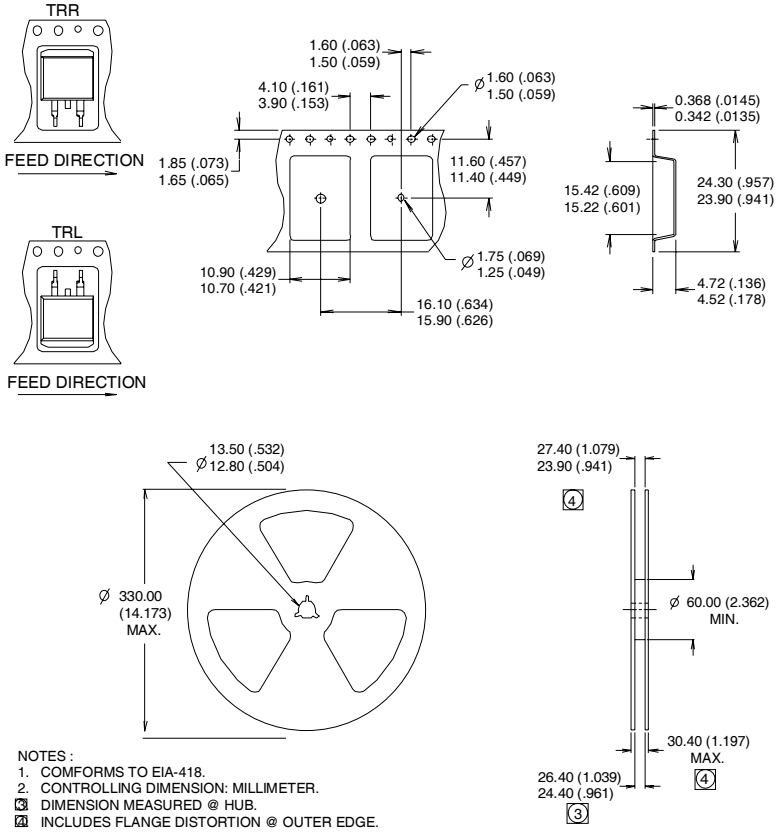


D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



Notes:

① This is applied to D²Pak, when mounted on 1" square PCB (FR-4 or G-10 Material).
For recommended footprint and soldering techniques refer to application note #AN-994.

② Energy losses include "tail" and diode reverse recovery, using Diode HF15D060ACE.

③ V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 100µH, R_G = 22Ω.

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
IOR Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd, California 90245, USA Tel: (310) 252-7105
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