PD - 96358

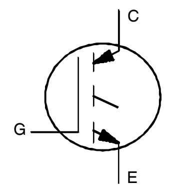
International
IOR Rectifier

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 T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	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

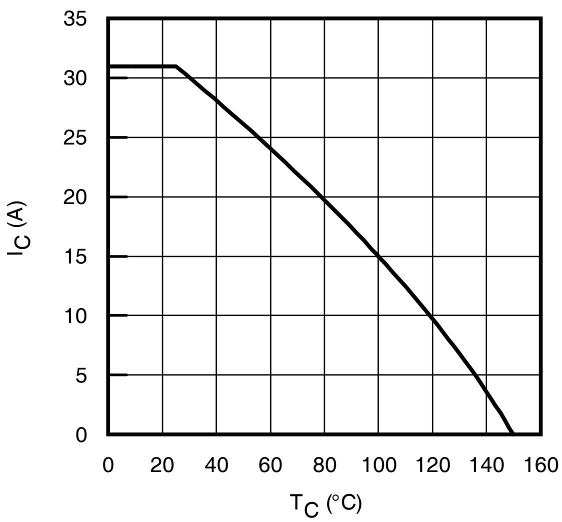


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

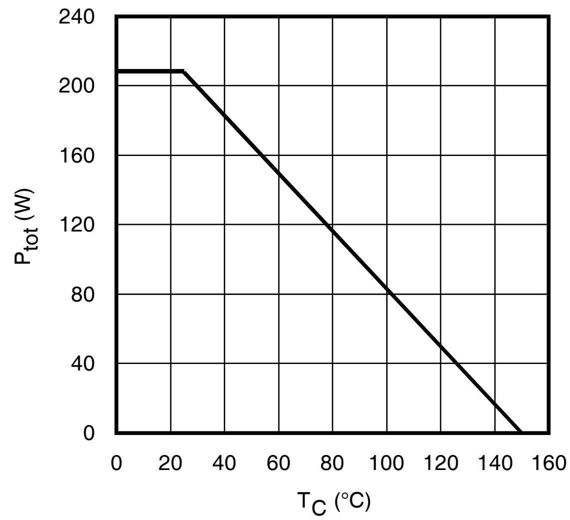


Fig. 2 - Power Dissipation vs. Case Temperature

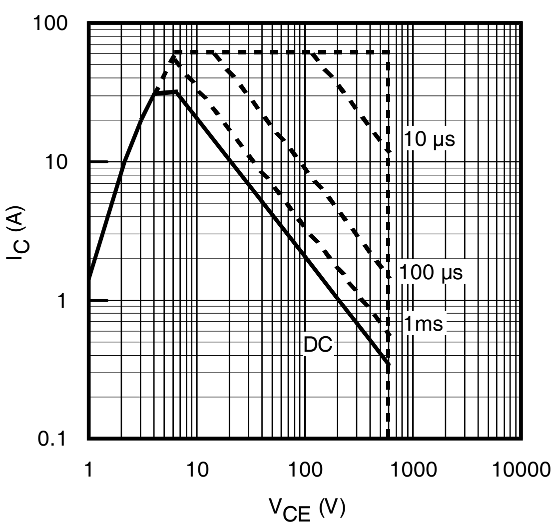


Fig. 3 - Forward SOA
T_C = 25°C; $T_J \leq$ 150°C

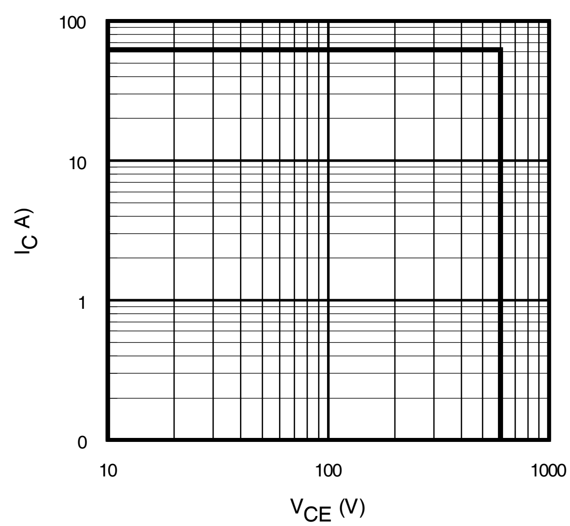


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} =15V

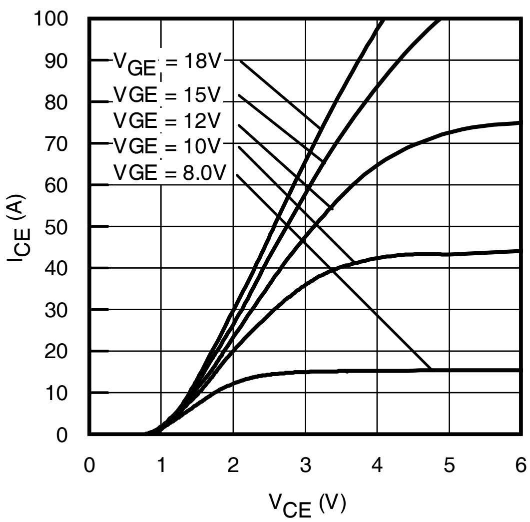


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 300µs

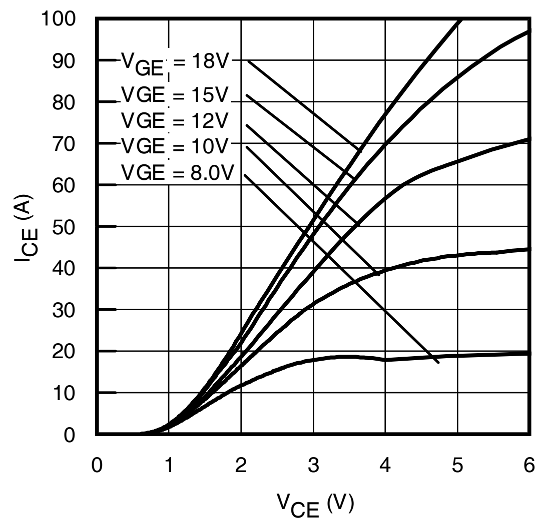


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 300µs

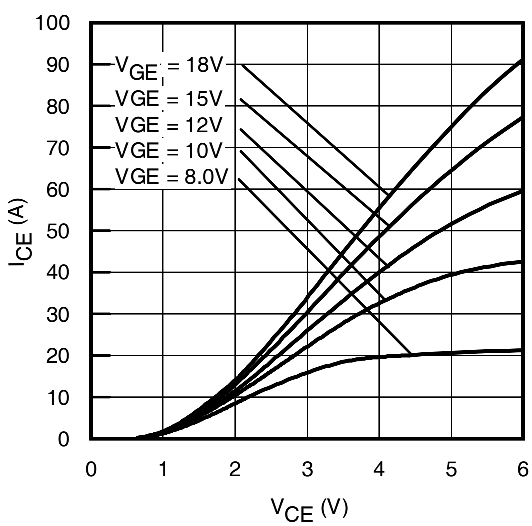


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 300µs

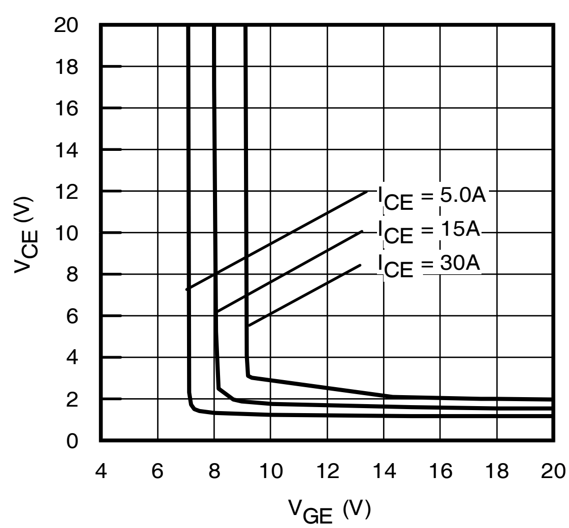


Fig. 8 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

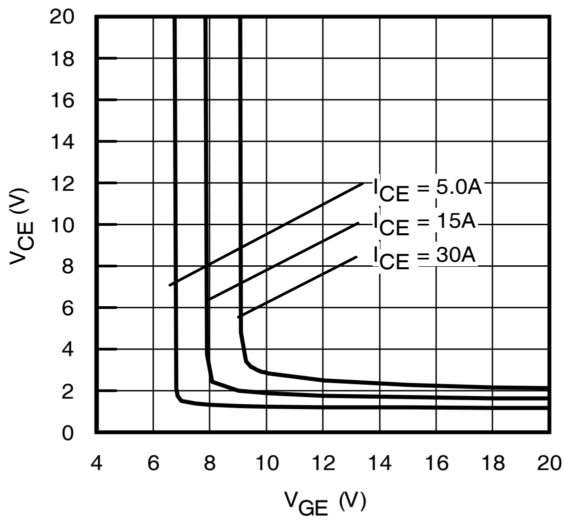


Fig. 9 - Typical V_{CE} vs. V_{GE}
$T_J = 25°C$

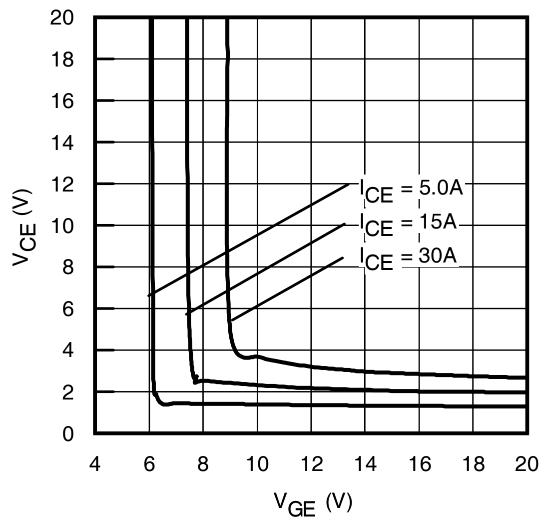


Fig. 10 - Typical V_{CE} vs. V_{GE}
$T_J = 150°C$

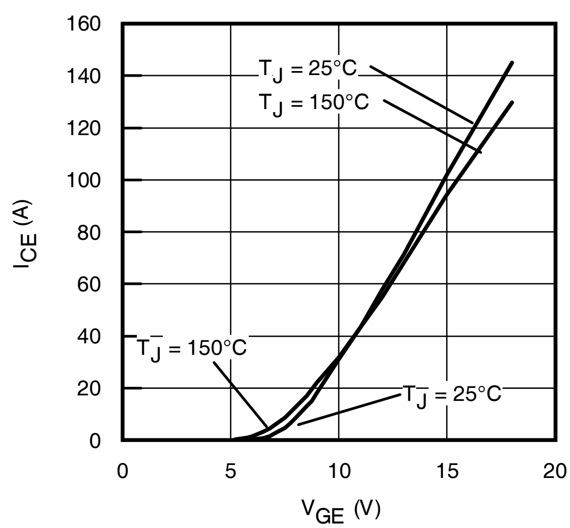


Fig. 11 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

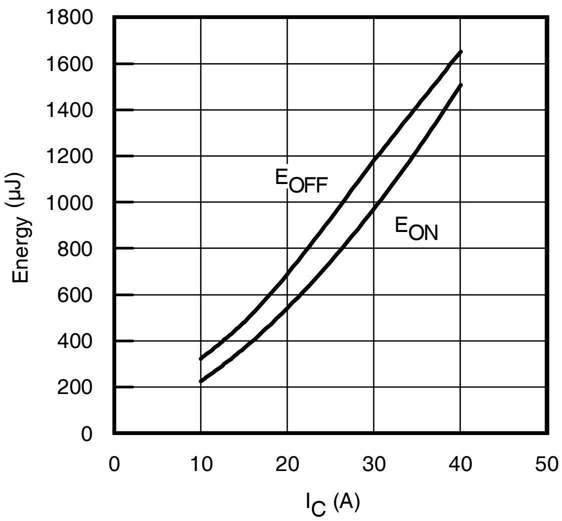


Fig. 12 - Typ. Energy Loss vs. I_C
T_J = 150°C; L=200μH; V_{CE}= 400V
R_G= 22Ω; V_{GE}= 15V

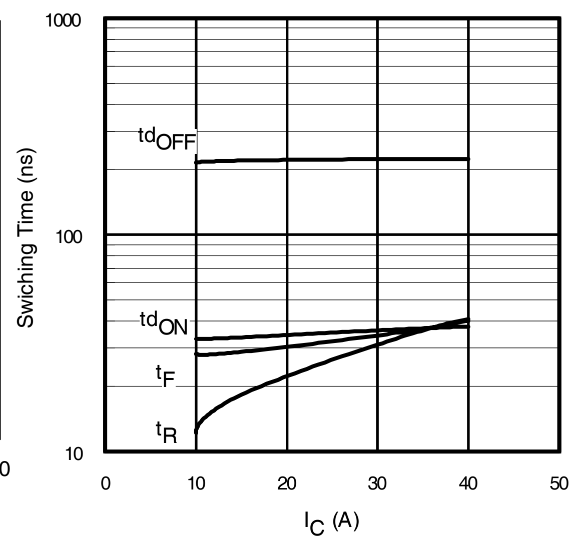


Fig. 13 - Typ. Switching Time vs. I_C
T_J = 150°C; L=200μH; V_{CE}= 400V
R_G= 22Ω; V_{GE}= 15V

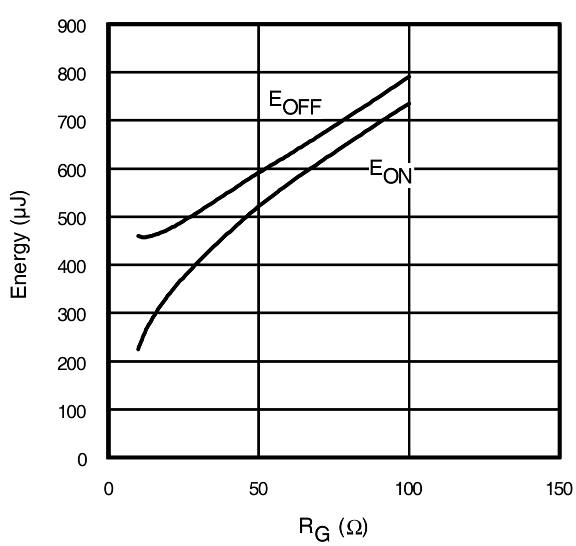


Fig. 14 - Typ. Energy Loss vs. R_G
T_J = 150°C; L=200μH; V_{CE}= 400V
I_{CE}= 15A; V_{GE}= 15V

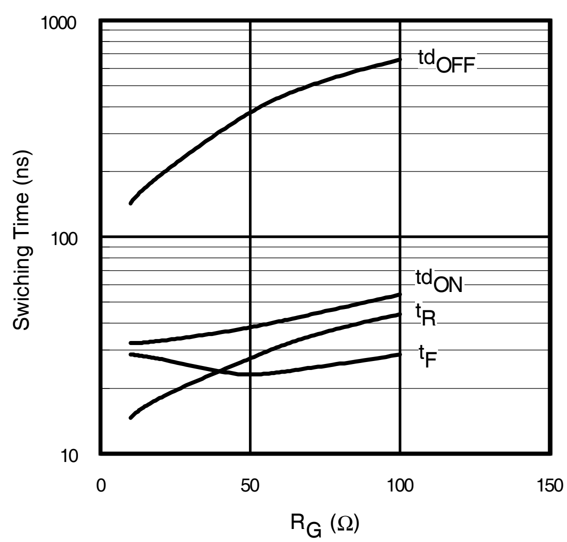


Fig. 15- Typ. Switching Time vs. R_G
T_J = 150°C; L=200μH; V_{CE}= 600V
I_{CE}= 15A; V_{GE}= 15V

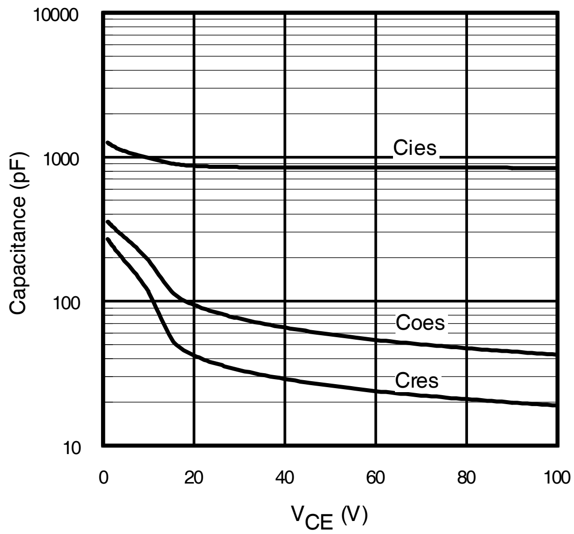


Fig. 16- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

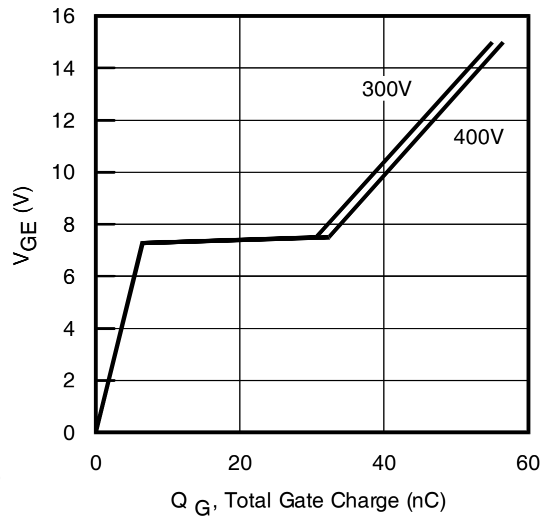


Fig. 17 - Typical Gate Charge vs. V_{GE}
I_{CE} = 15A; L = 600µH

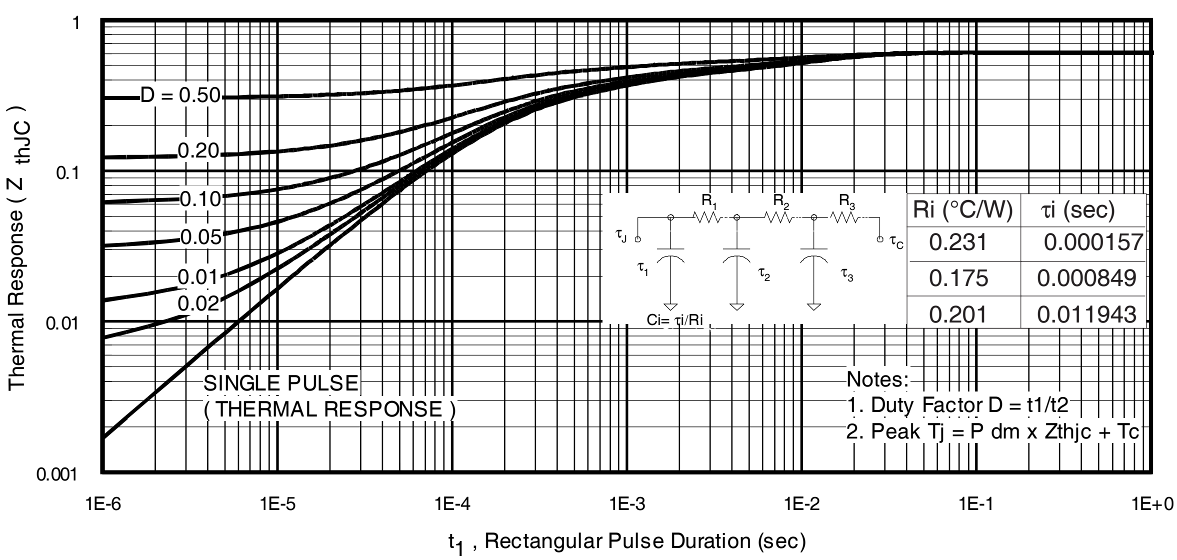


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

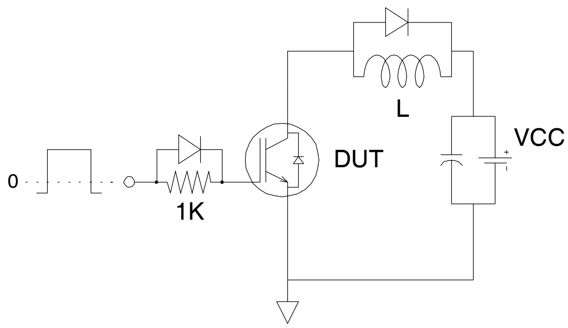


Fig.C.T.1 - Gate Charge Circuit (turn-off)

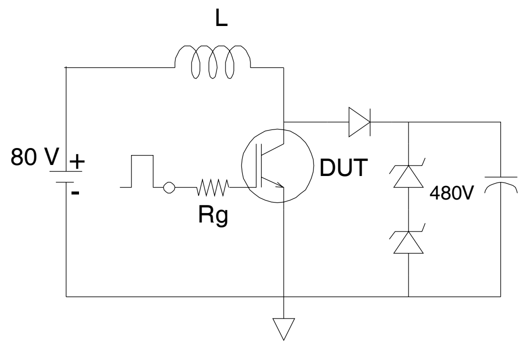


Fig.C.T.2 - RBSOA Circuit

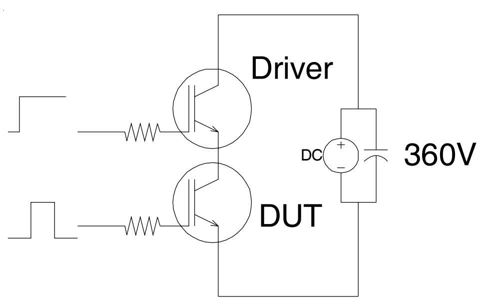


Fig.C.T.3 - S.C.SOA Circuit

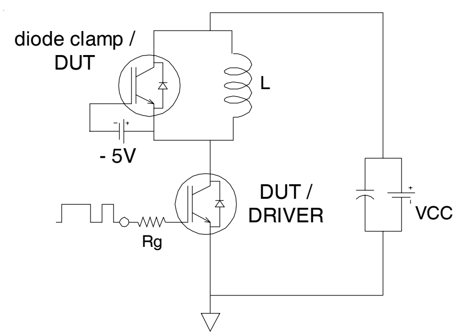


Fig.C.T.4 - Switching Loss Circuit

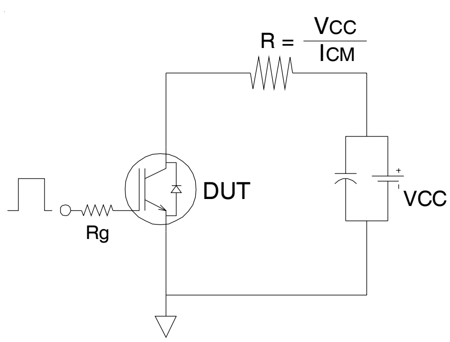
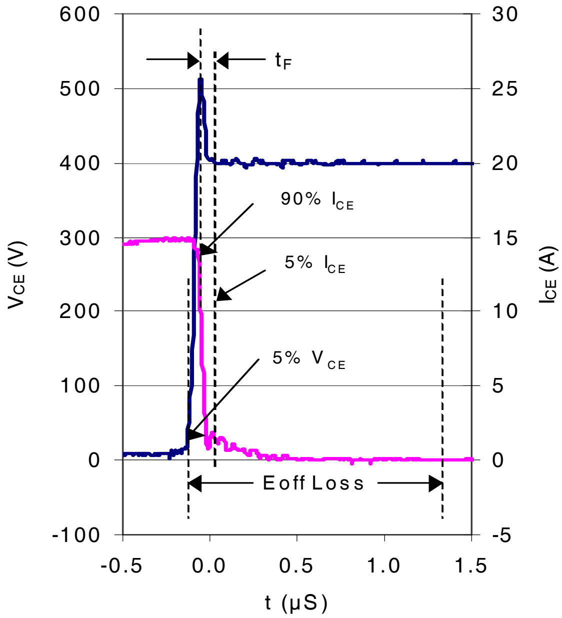
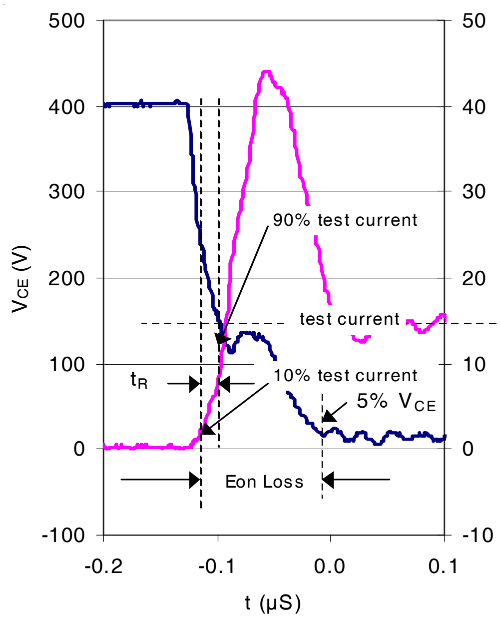


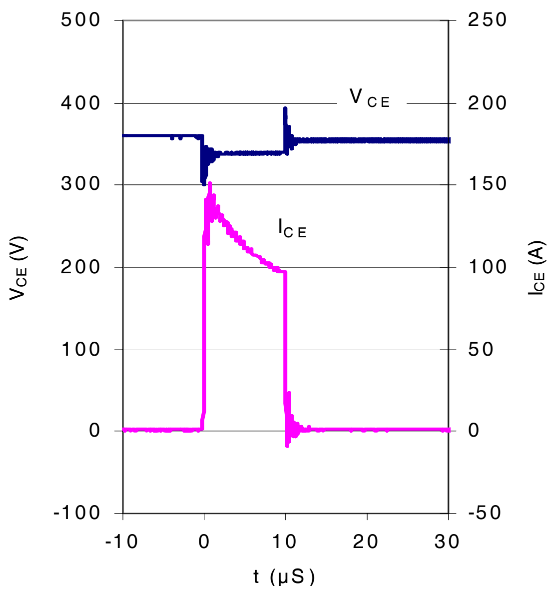
Fig.C.T.5 - Resistive Load Circuit



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



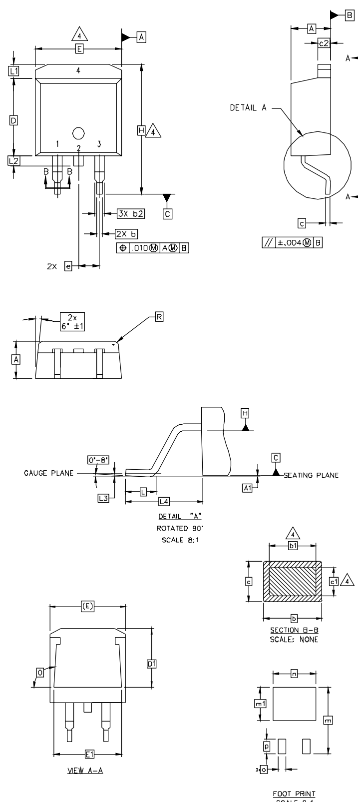
WF.2- Typ. Turn-on Loss
@ T_J = 150°C using Fig. CT.4



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

D^{2}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 [.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

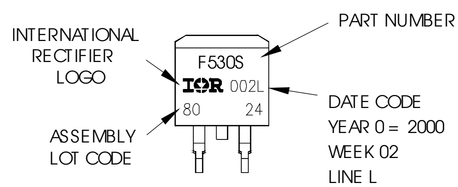
1.- ANODE *
2, 4.- CATHODE
3.- ANODE

* PART DEPENDENT.

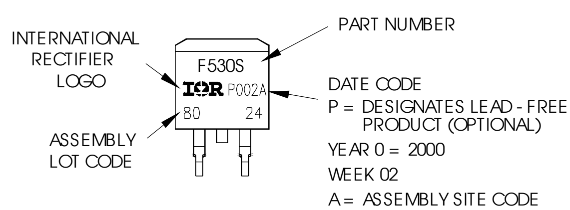
D^{2}Pak Part Marking Information

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"

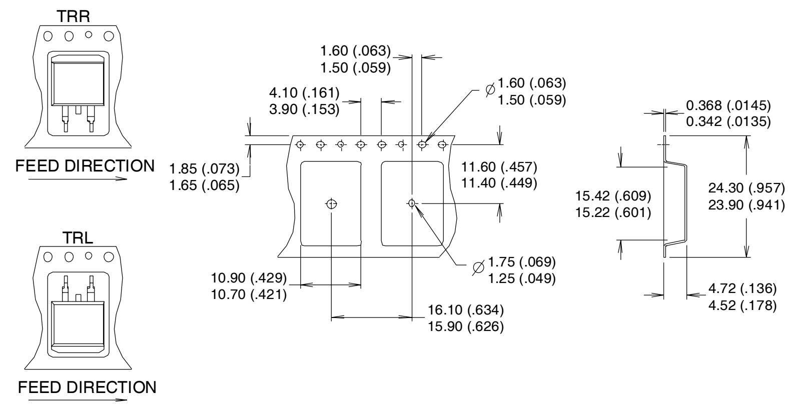


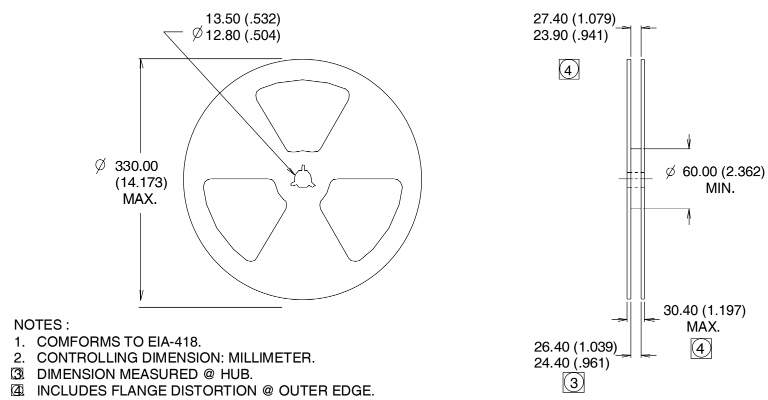
OR



D^2Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)





Notes:

① This is applied to D^2Pak, 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.

International
IOR Rectifier

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