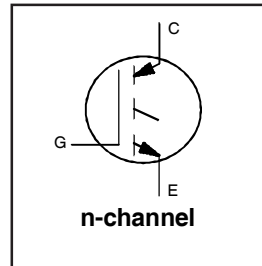


IRGS15B60KPbF

INSULATED GATE BIPOLAR TRANSISTOR

Features

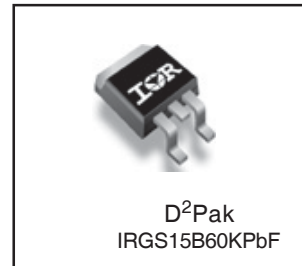
- Low VCE (on) Non Punch Through IGBT Technology.
- 10μs Short Circuit Capability.
- Square RBSOA.
- Positive VCE (on) Temperature Coefficient.
- Lead-Free



$V_{CES} = 600V$
 $I_C = 15A, T_C = 100^\circ C$
 $t_{sc} > 10\mu s, T_J = 150^\circ C$
 $V_{CE(on)} \text{ typ.} = 1.8V$

Benefits

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



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	31	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	15	
I_{CM}	Pulse Collector Current $V_{ge} = 15V$	62	
I_{LM}	Clamped Inductive Load Current $V_{ge} = 20V$ ④	62	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	208	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	83	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.		

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Junction-to-Case-IGBT	—	—	0.6	$^\circ C/W$
$R_{\theta CS}$	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)

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Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 500\mu A$	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.3	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA (25^\circ\text{C}-150^\circ\text{C})$	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	1.5	1.8	2.2	V	$I_C = 15A, V_{GE} = 15V, T_J = 25^\circ\text{C}$	5,6,7
		—	2.05	2.5		$I_C = 15A, V_{GE} = 15V, T_J = 125^\circ\text{C}$	8,9,10
		—	2.1	2.6		$I_C = 15A, V_{GE} = 15V, T_J = 150^\circ\text{C}$	
$V_{GE(th)}$	Gate Threshold Voltage	3.5	4.5	5.5	V	$V_{CE} = V_{GE}, I_C = 250\mu A$	8,9
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-10	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1.0mA (25^\circ\text{C} - 150^\circ\text{C})$	10,11
gfe	Forward Transconductance	—	10.6	—	S	$V_{CE} = 50V, I_C = 20A, PW = 80\mu s$	
I_{CES}	Collector-to-Emitter Leakage Current	—	5.0	150	μA	$V_{GE} = 0V, V_{CE} = 600V, T_J = 25^\circ\text{C}$	
		—	500	1000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 20V$	

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
Q_g	Total Gate Charge (turn-on)	—	56	84	nC	$I_C = 15A$	CT1
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	7.0	10		$V_{GE} = 15V$	
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		$R_G = 22\Omega, L = 200\mu H$	
E_{total}	Total Switching Loss	—	560	785		$L_S = 150nH \quad T_J = 25^{\circ}C \text{ ②}$	
$t_{d(on)}$	Turn-On delay time	—	34	44	ns	$I_C = 15A, V_{CC} = 400V, V_{GE} = 15V$	CT4
t_r	Rise time	—	16	22		$R_G = 22\Omega, L = 200\mu H$	
$t_{d(off)}$	Turn-Off delay time	—	184	200		$L_S = 150nH \quad T_J = 25^{\circ}C$	
t_f	Fall time	—	20	26	μJ	$I_C = 15A, V_{CC} = 400V, V_{GE} = 15V$	CT4 12,14
E_{on}	Turn-On Switching Loss	—	355	470		$R_G = 22\Omega, L = 200\mu H$	
E_{off}	Turn-Off Switching Loss	—	490	600		$L_S = 150nH \quad T_J = 150^{\circ}C \text{ ②}$	
E_{total}	Total Switching Loss	—	835	1070	ns	$I_C = 15A, V_{CC} = 400V, V_{GE} = 15V$	13, 15 CT4 WF1
$t_{d(on)}$	Turn-On delay time	—	34	44		$R_G = 22\Omega, L = 200\mu H$	
t_r	Rise time	—	18	25		$L_S = 150nH \quad T_J = 150^{\circ}C$	
$t_{d(off)}$	Turn-Off delay time	—	203	226	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0Mhz$	WF2
t_f	Fall time	—	28	36			
C_{ies}	Input Capacitance	—	850	—			
C_{oes}	Output Capacitance	—	75	—	μs	$I_C = 62A$ $V_{CC} = 500V, V_p = 600V$ $R_G = 22\Omega, V_{GE} = +20V \text{ to } 0V, T_J = 150^{\circ}C$	4 CT2
C_{res}	Reverse Transfer Capacitance	—	35	—			
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE					
SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	$V_{CC} = 360V, V_p = 600V, T_J = 150^{\circ}C$ $R_g = 22\Omega, V_{GE} = +15V \text{ to } 0V$	CT3 WF3

Note ① to ③ are on page 11

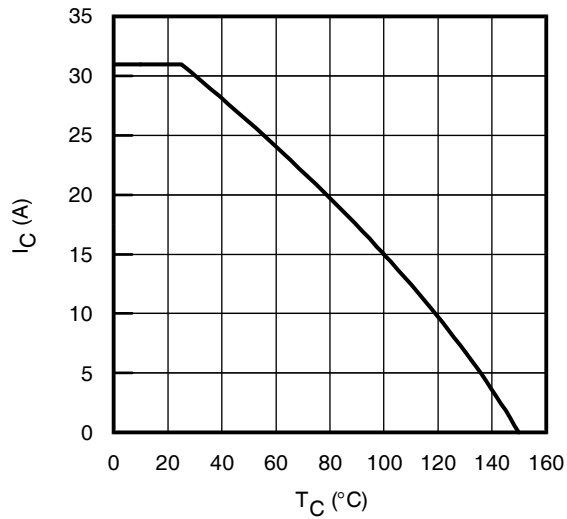


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

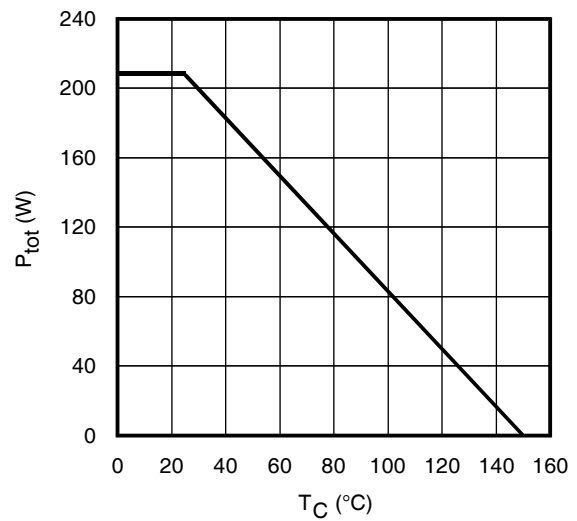


Fig. 2 - Power Dissipation vs. Case Temperature

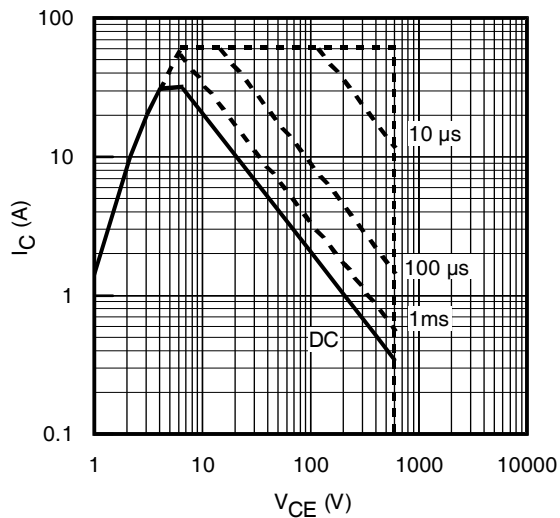


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$; $T_J \leq 150^\circ\text{C}$

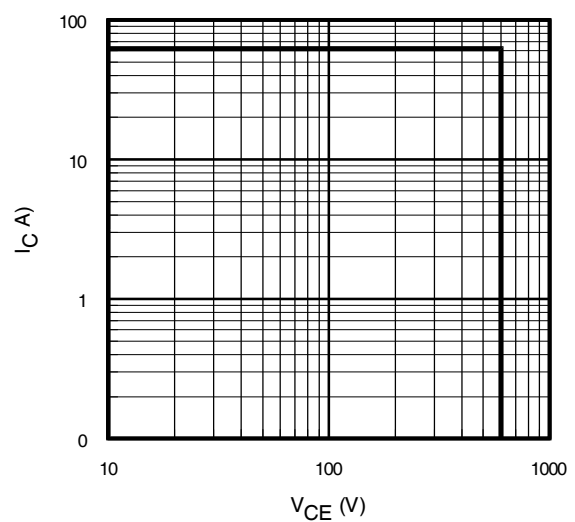


Fig. 4 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$; $V_{GE} = 15\text{V}$

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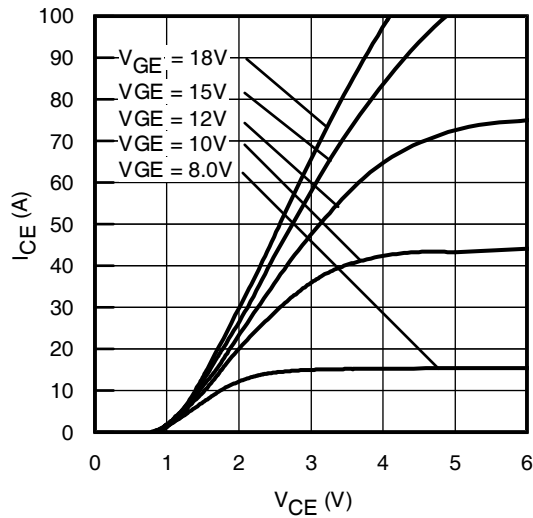


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^{\circ}\text{C}$; $t_p = 300\mu\text{s}$

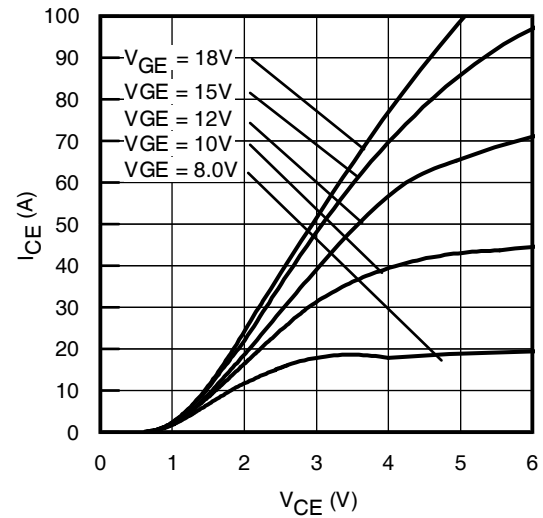


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^{\circ}\text{C}$; $t_p = 300\mu\text{s}$

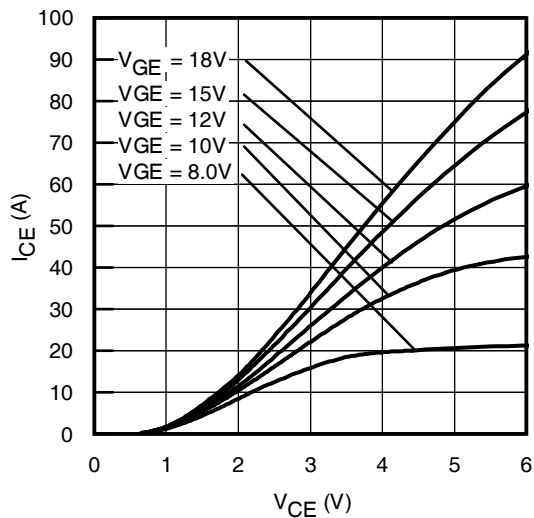


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 150^{\circ}\text{C}$; $t_p = 300\mu\text{s}$

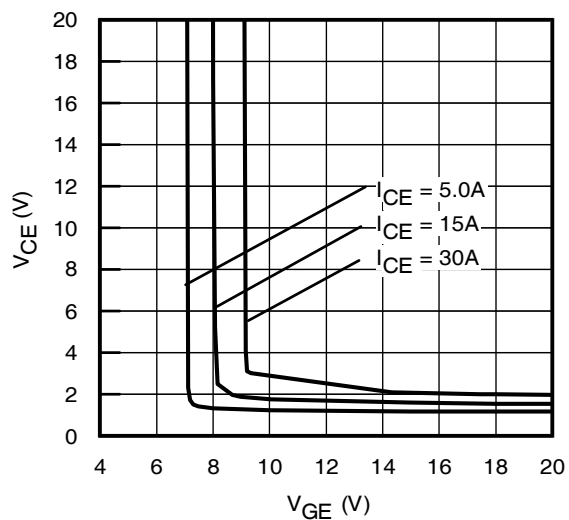


Fig. 8 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^{\circ}\text{C}$

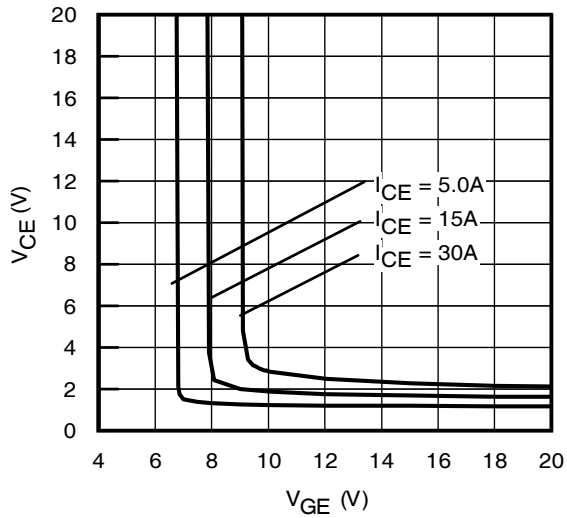


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

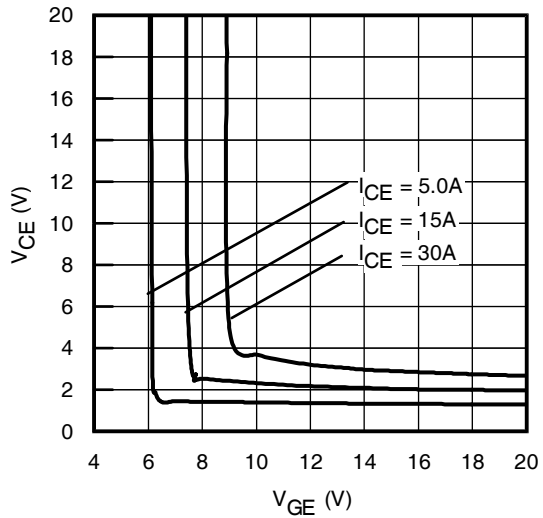


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

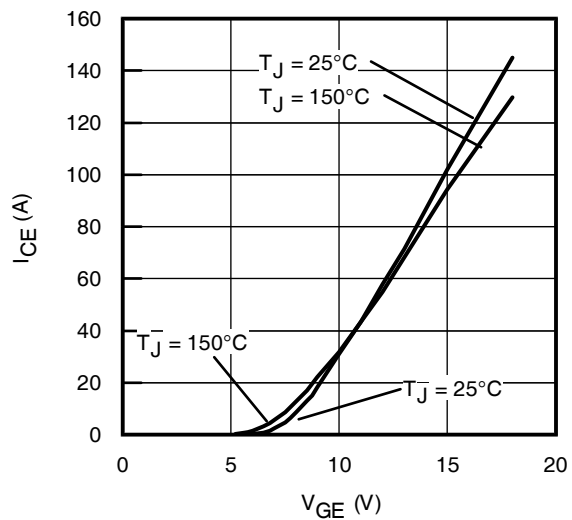


Fig. 11 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

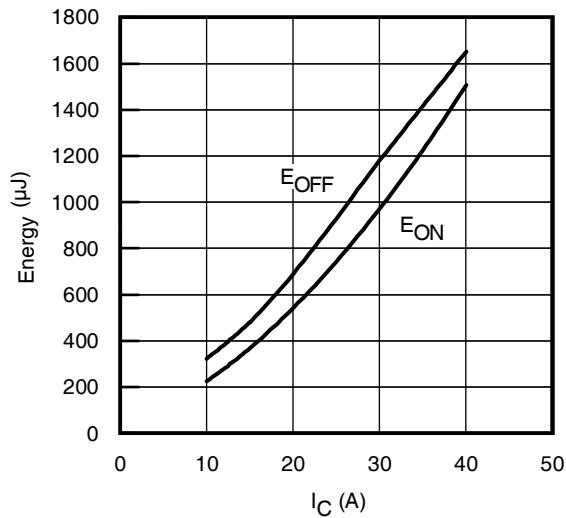


Fig. 12 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$
 $R_G=22\Omega$; $V_{GE}=15\text{V}$

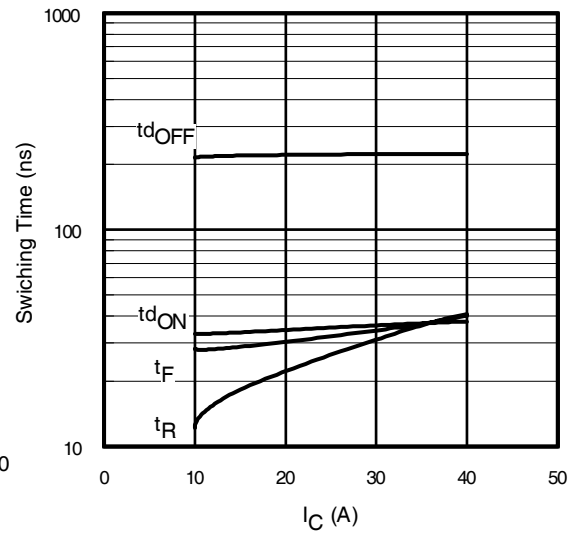


Fig. 13 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$
 $R_G=22\Omega$; $V_{GE}=15\text{V}$

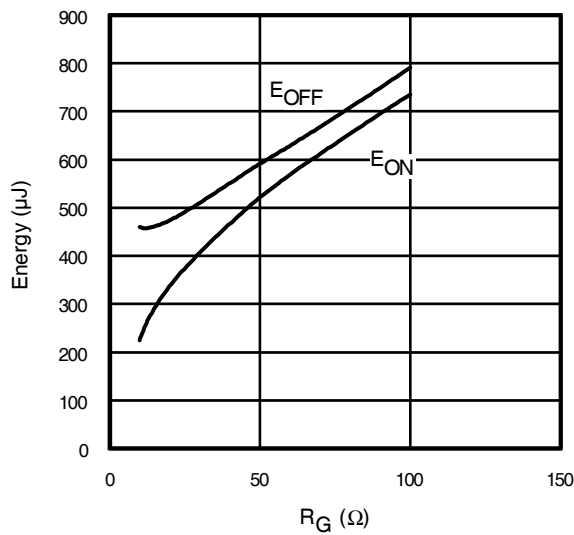


Fig. 14 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$
 $I_{CE}=15\text{A}$; $V_{GE}=15\text{V}$

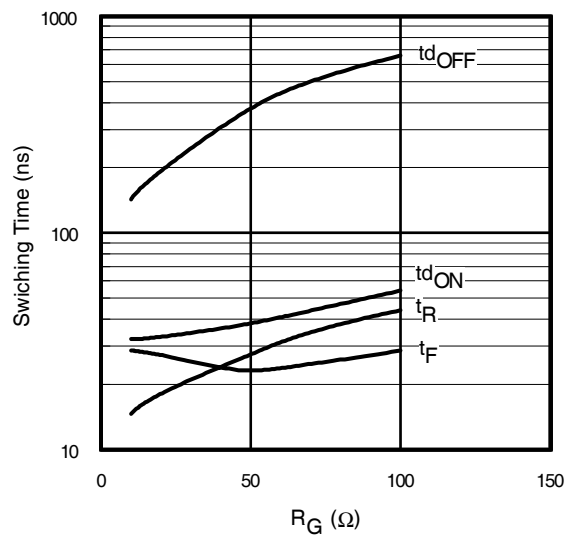


Fig. 15 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=600\text{V}$
 $I_{CE}=15\text{A}$; $V_{GE}=15\text{V}$

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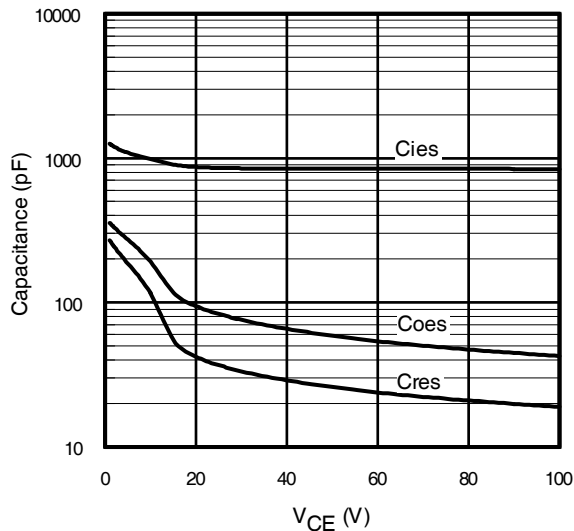


Fig. 16- Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

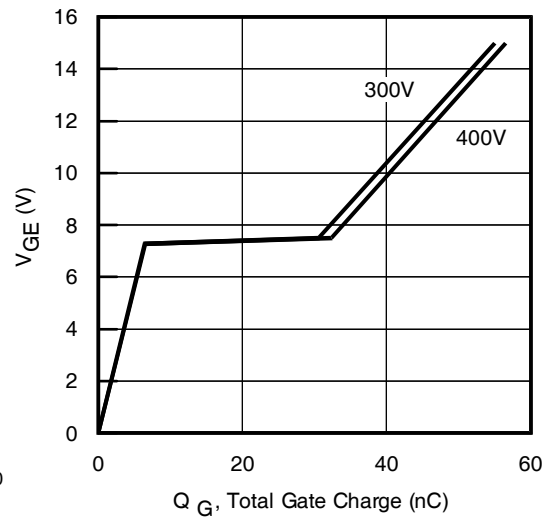


Fig. 17 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 15A$; $L = 600\mu H$

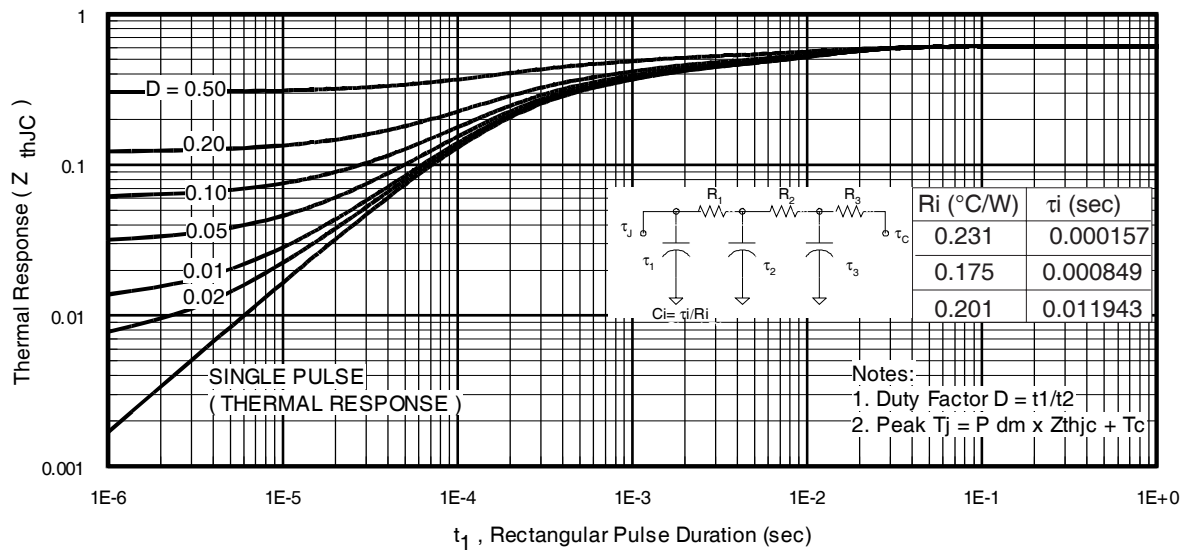


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

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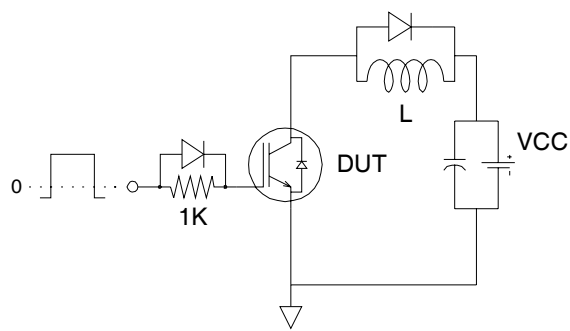


Fig.C.T.1 - Gate Charge Circuit (turn-off)

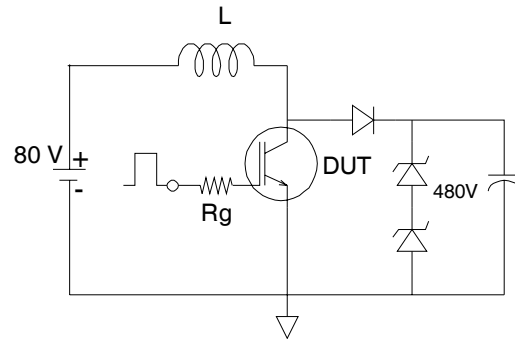


Fig.C.T.2 - RBSOA Circuit

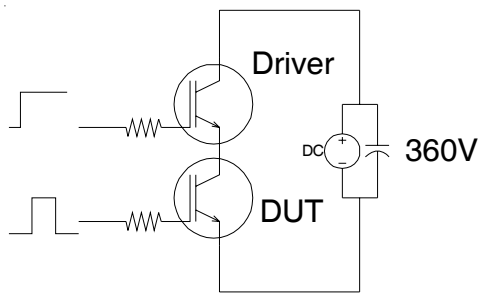


Fig.C.T.3 - S.C.SOA Circuit

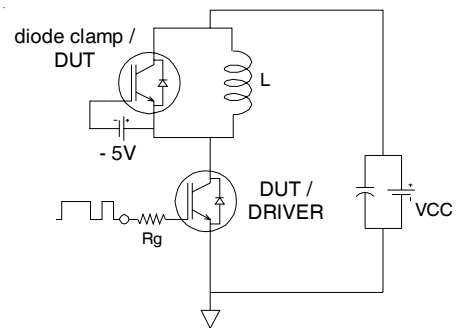


Fig.C.T.4 - Switching Loss Circuit

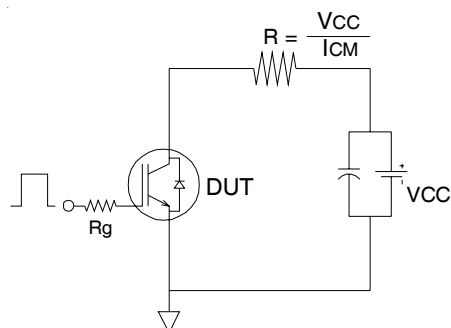
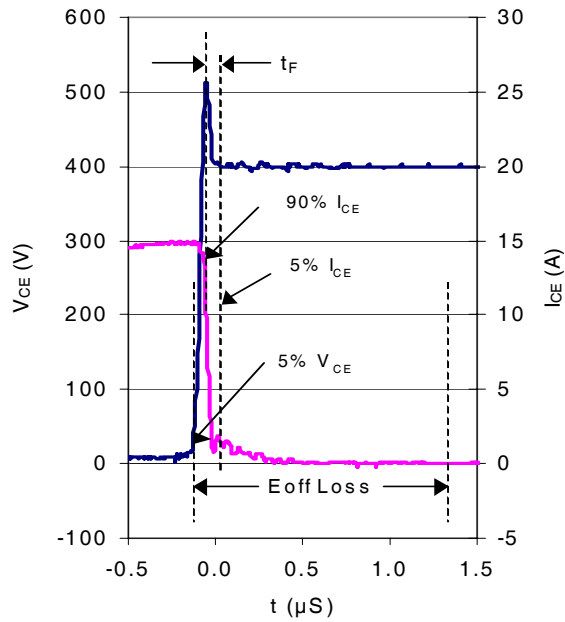
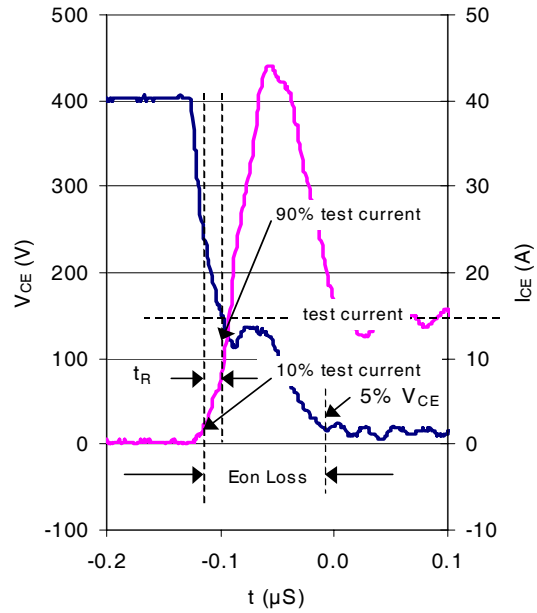


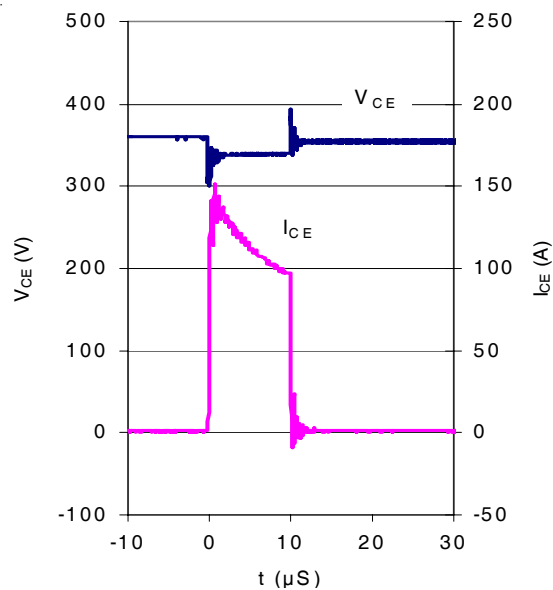
Fig.C.T.5 - Resistive Load Circuit



WF.1- Typ. Turn-off Loss
@ $T_J = 150^\circ\text{C}$ using CT.4



WF.2- Typ. Turn-on Loss
@ $T_J = 150^\circ\text{C}$ using Fig. CT.4



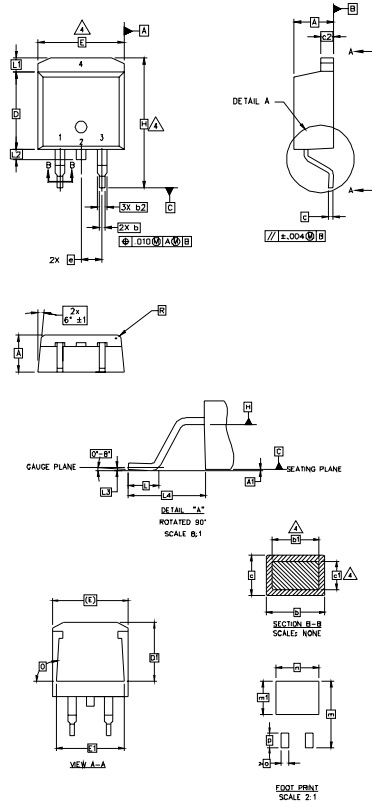
WF.3- Typ. Short Circuit
@ $T_J = 150^\circ\text{C}$ using CT.3

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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 [0.005"] 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	4
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.78	.045	.070	4
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	
c2	1.14	1.65	.045	.065	
D	8.51	9.65	.335	.380	3
D1	8.86		.270		
E	9.65	10.67	.380	.420	
E1	6.22		.245		
e	2.54 BSC		.100 BSC		3
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	3
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	
m	17.78		.700		3
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		3
R	0.51	0.71	.020	.028	
ø	90°	93°	90°	93°	

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

DIODES

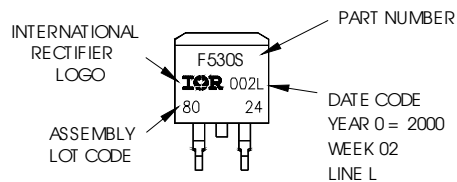
- 1.- ANODE *
- 2, 4.- CATHODE
- 3.- ANODE

* PART DEPENDENT.

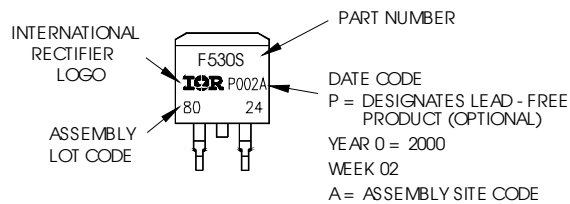
D²Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH
LOT CODE 8024
ASSEMBLED ON WW02, 2000
IN THE ASSEMBLY LINE "L"

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

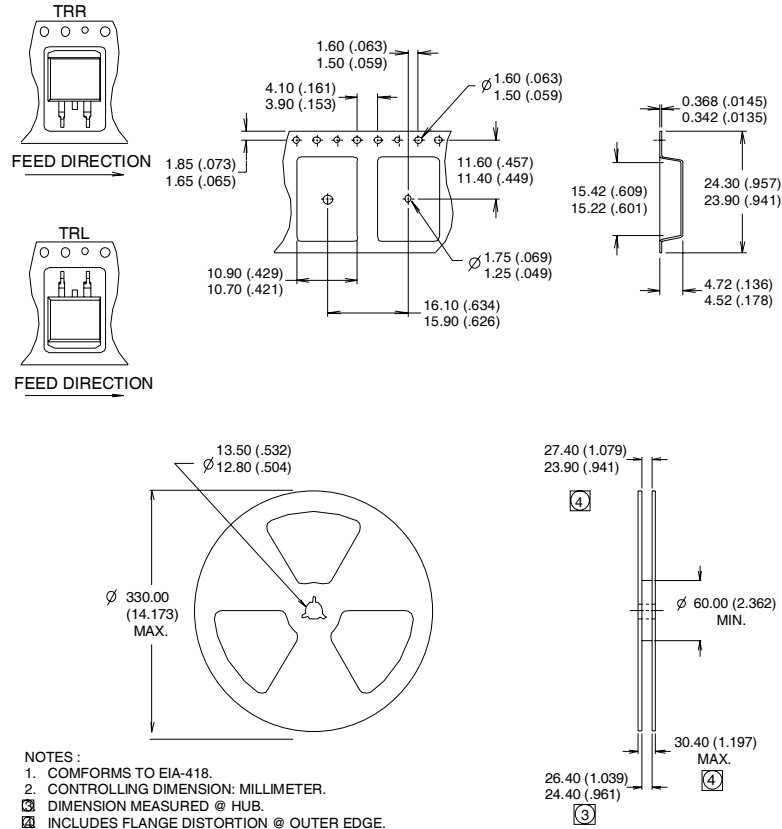


OR



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 $V_{CC} = 80\% (V_{CES})$, $V_{GE} = 20V$, $L = 100\mu H$, $R_G = 22\Omega$.

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.

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IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903

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