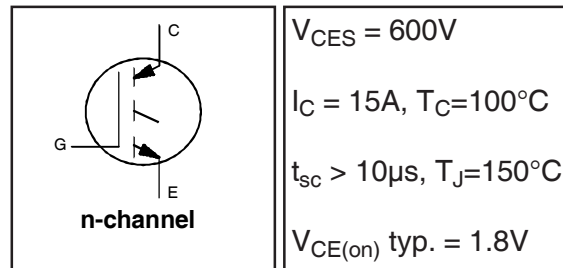


IRGS15B60KPbF

INSULATED GATE BIPOLAR TRANSISTOR

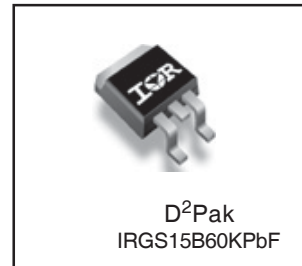
Features

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



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.	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	$^\circ C/W$
$R_{\theta CS}$	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°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	
ΔV _{(BR)CES} /ΔT _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
ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	—	-10	—	mV/°C	V _{CE} = V _{GE} , I _C = 1.0mA (25°C - 150°C)	10,11
g _{fe}	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 V _{GE} = 15V V _{CC} = 400V	CT1
Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	7.0	10			
Q _{gc}	Gate-to-Collector Charge (turn-on)	—	26	39			
E _{on}	Turn-On Switching Loss	—	220	330	μJ	I _C = 15A, V _{CC} = 400V, V _{GE} = 15V R _G = 22Ω, L = 200μH L _S = 150nH T _J = 25°C ②	CT4
E _{off}	Turn-Off Switching Loss	—	340	455			
E _{total}	Total Switching Loss	—	560	785			
t _{d(on)}	Turn-On delay time	—	34	44	ns	I _C = 15A, V _{CC} = 400V, V _{GE} = 15V R _G = 22Ω, L = 200μH L _S = 150nH T _J = 25°C	CT4
t _r	Rise time	—	16	22			
t _{d(off)}	Turn-Off delay time	—	184	200			
t _f	Fall time	—	20	26			
E _{on}	Turn-On Switching Loss	—	355	470			
E _{off}	Turn-Off Switching Loss	—	490	600	μJ	I _C = 15A, V _{CC} = 400V, V _{GE} = 15V R _G = 22Ω, L = 200μH L _S = 150nH T _J = 150°C ②	CT4 12,14 WF1, WF2
E _{total}	Total Switching Loss	—	835	1070			
t _{d(on)}	Turn-On delay time	—	34	44			
t _r	Rise time	—	18	25	ns	I _C = 15A, V _{CC} = 400V, V _{GE} = 15V R _G = 22Ω, L = 200μH L _S = 150nH T _J = 150°C	13, 15 CT4 WF1 WF2
t _{d(off)}	Turn-Off delay time	—	203	226			
t _f	Fall time	—	28	36			
C _{ies}	Input Capacitance	—	850	—	pF	V _{GE} = 0V V _{CC} = 30V f = 1.0Mhz	
C _{oes}	Output Capacitance	—	75	—			
C _{res}	Reverse Transfer Capacitance	—	35	—			
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				I _C = 62A V _{CC} = 500V, V _p = 600V R _G = 22Ω, V _{GE} = +20V to 0V, T _J = 150°C	4 CT2
SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	V _{CC} = 360V, V _p = 600V, T _J = 150°C R _G = 22Ω, V _{GE} = +15V to 0V	CT3 WF3

Note ① to ③ are on page 11

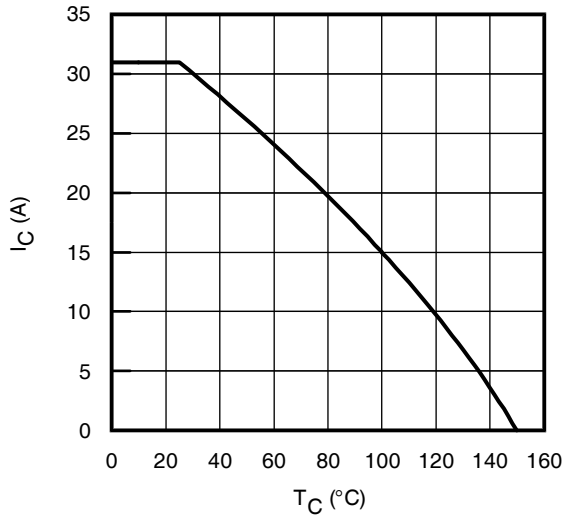


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

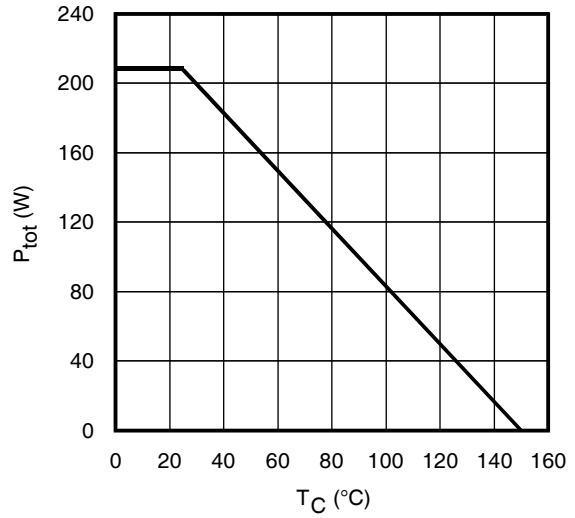


Fig. 2 - Power Dissipation vs. Case Temperature

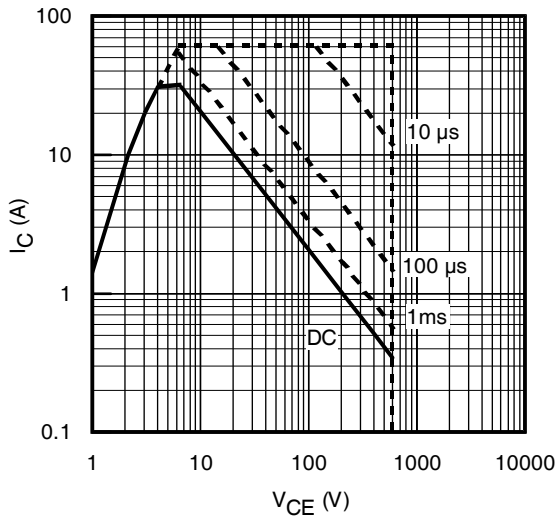


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$; $T_J \leq 150^\circ\text{C}$

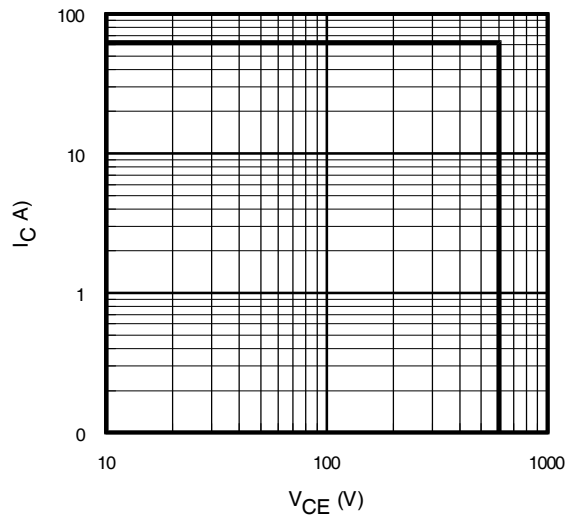


Fig. 4 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$; $V_{GE} = 15\text{V}$

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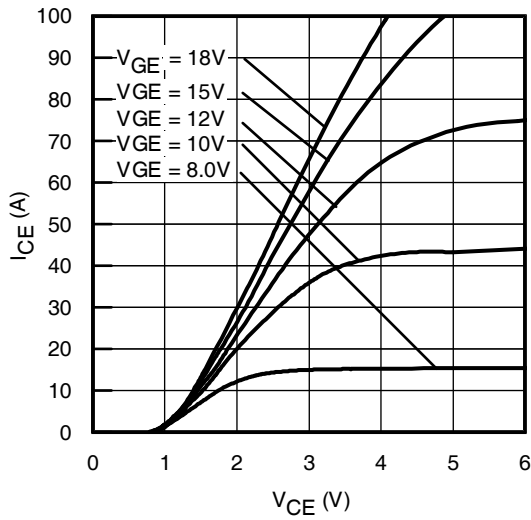


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 300\mu\text{s}$

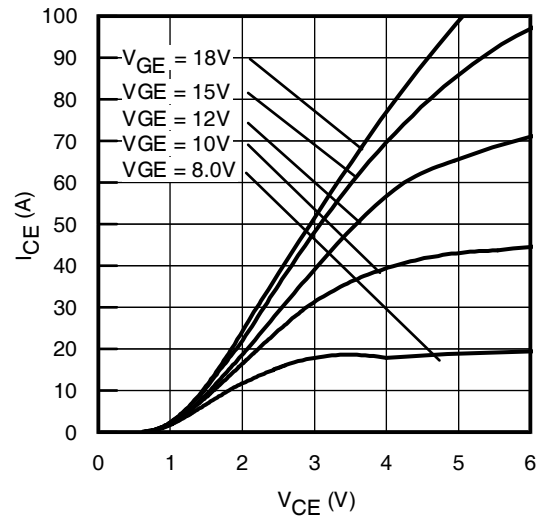


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 300\mu\text{s}$

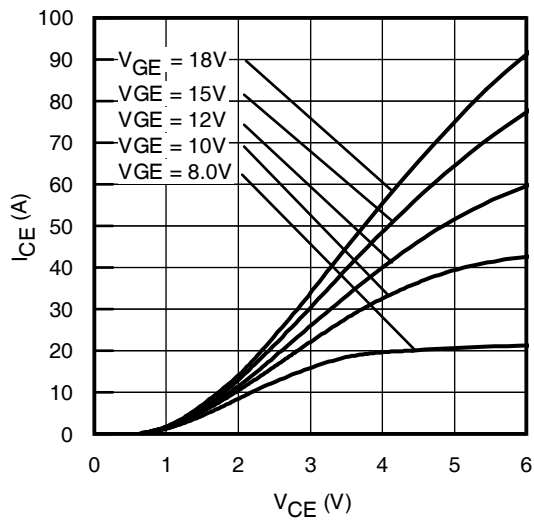


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 300\mu\text{s}$

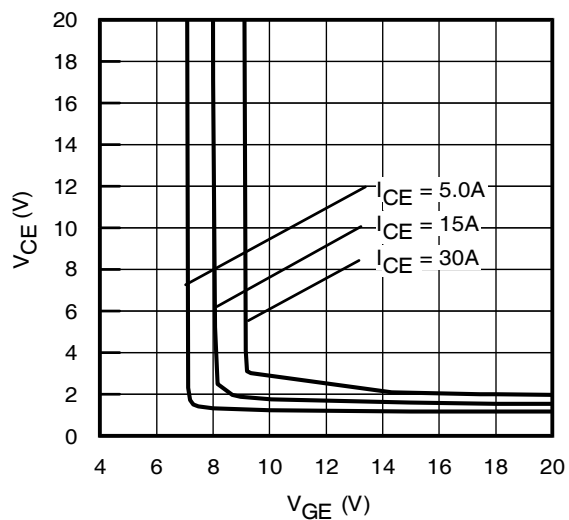


Fig. 8 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

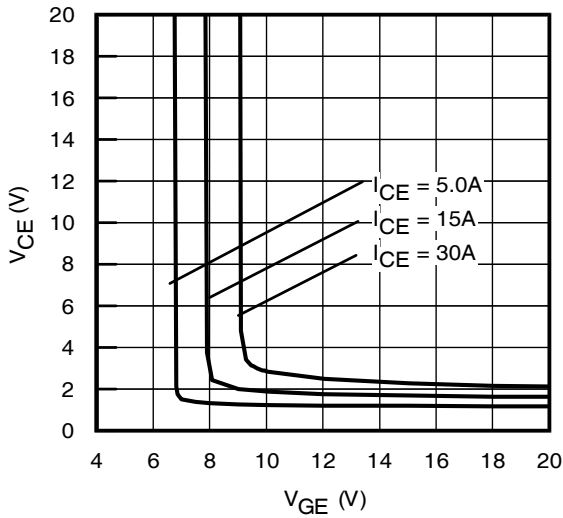


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

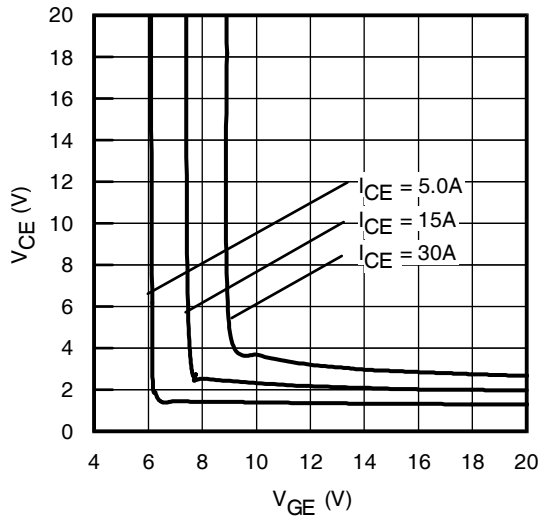


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

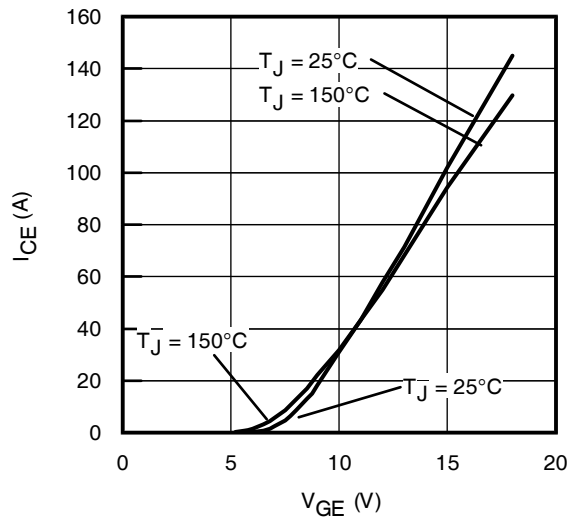


Fig. 11 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

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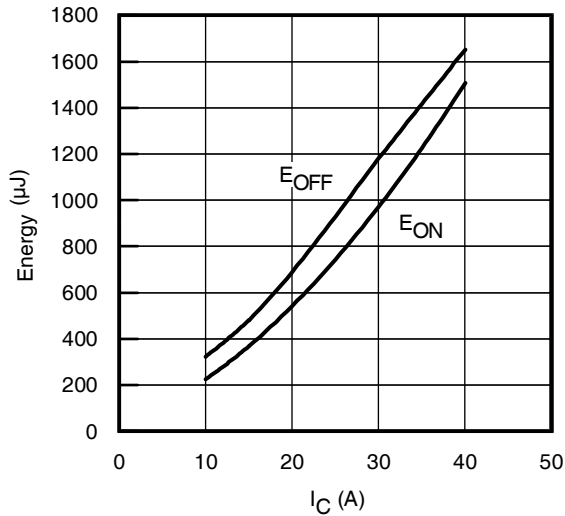


Fig. 12 - Typ. Energy Loss vs. I_C
T_J = 150°C; L=200μH; V_{CE}= 400V
R_G= 22Ω; V_{GE}= 15V

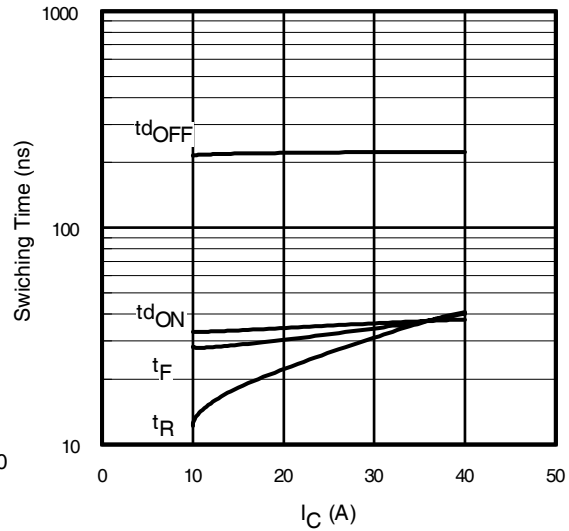


Fig. 13 - Typ. Switching Time vs. I_C
T_J = 150°C; L=200μH; V_{CE}= 400V
R_G= 22Ω; V_{GE}= 15V

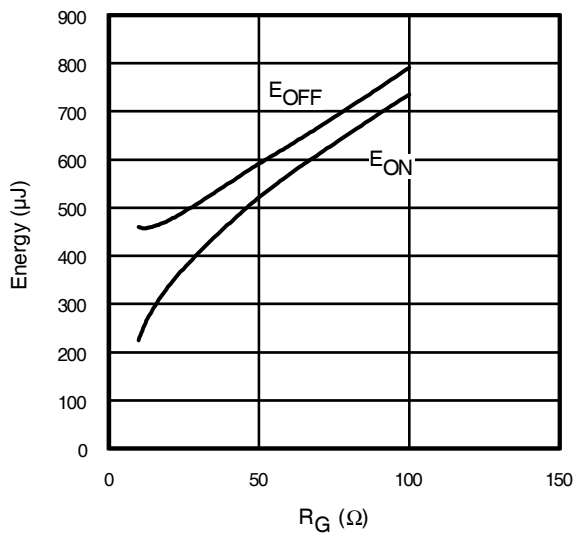


Fig. 14 - Typ. Energy Loss vs. R_G
T_J = 150°C; L=200μH; V_{CE}= 400V
I_{CE}= 15A; V_{GE}= 15V

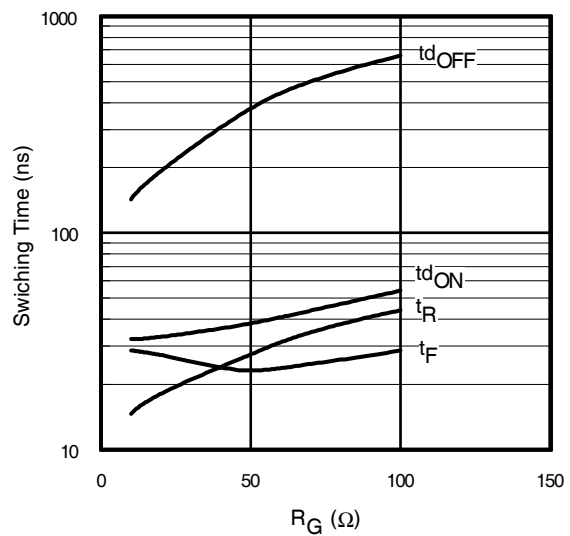


Fig. 15 - Typ. Switching Time vs. R_G
T_J = 150°C; L=200μH; V_{CE}= 600V
I_{CE}= 15A; V_{GE}= 15V

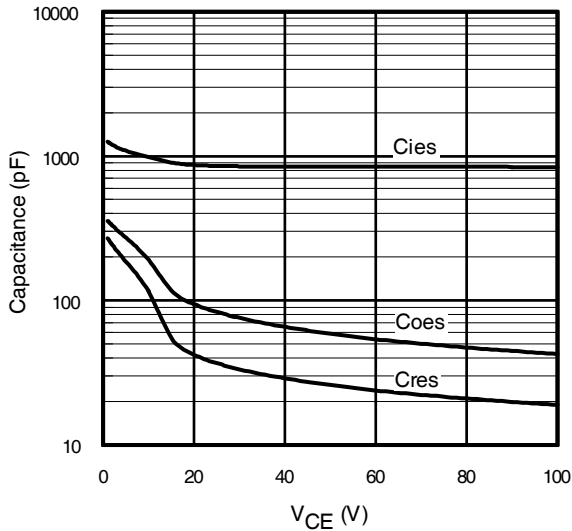


Fig. 16- Typ. Capacitance vs. V_{CE}
V_{GE} = 0V; f = 1MHz

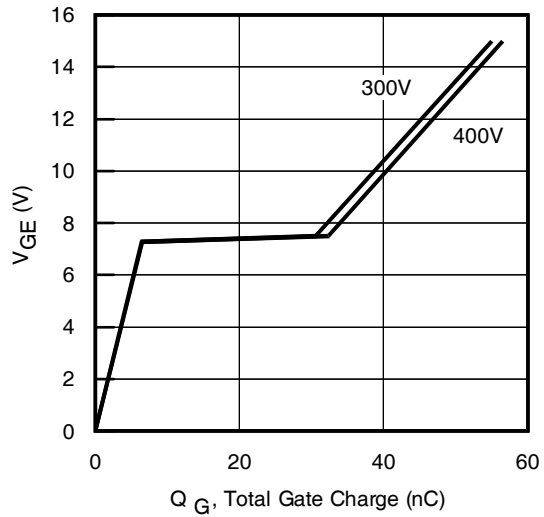


Fig. 17 - Typical Gate Charge vs. V_{GE}
I_{CE} = 15A; L = 600μH

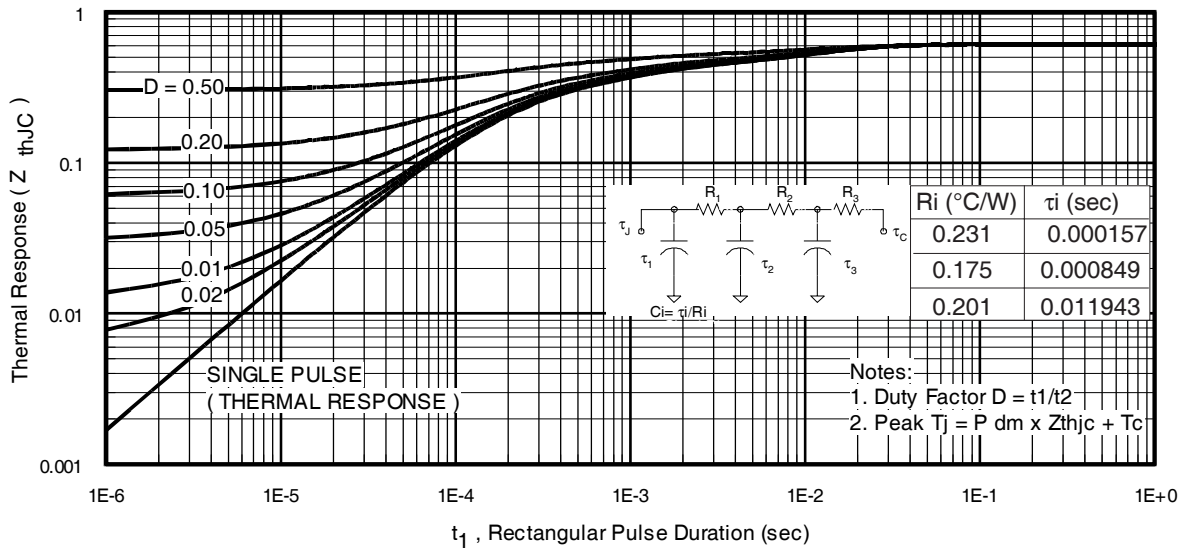


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

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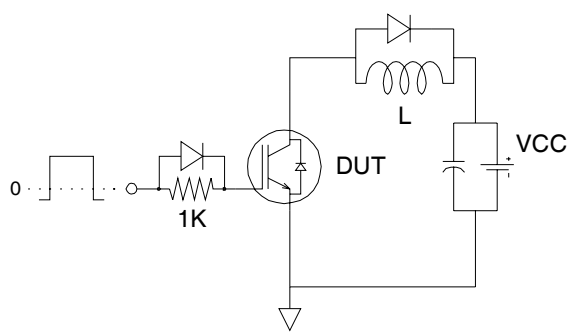


Fig.C.T.1 - Gate Charge Circuit (turn-off)

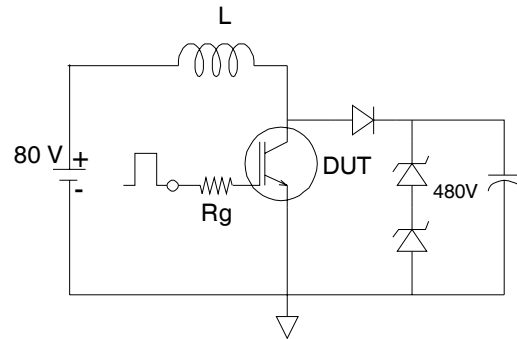


Fig.C.T.2 - RBSOA Circuit

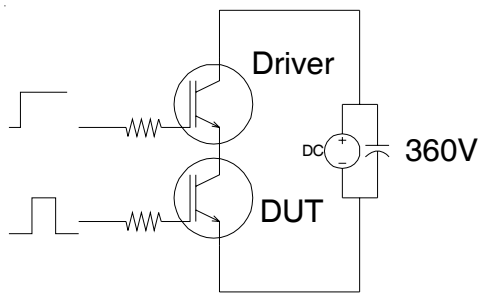


Fig.C.T.3 - S.C.SOA Circuit

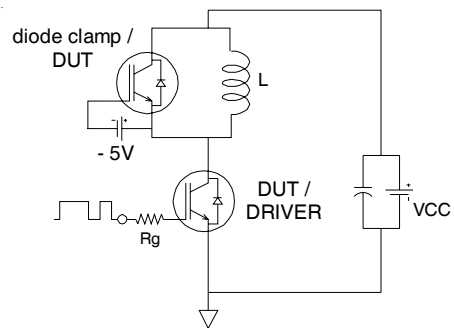


Fig.C.T.4 - Switching Loss Circuit

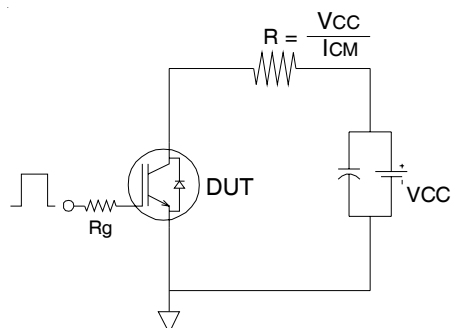
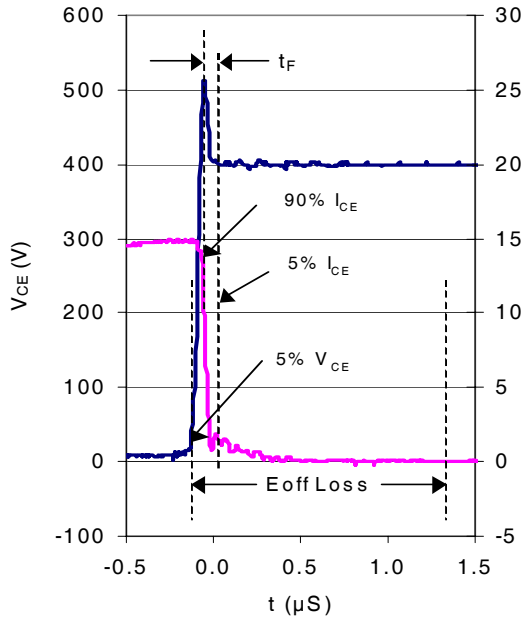
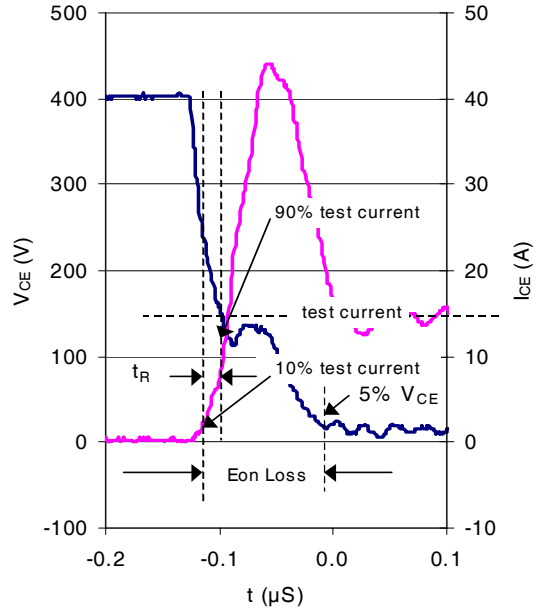


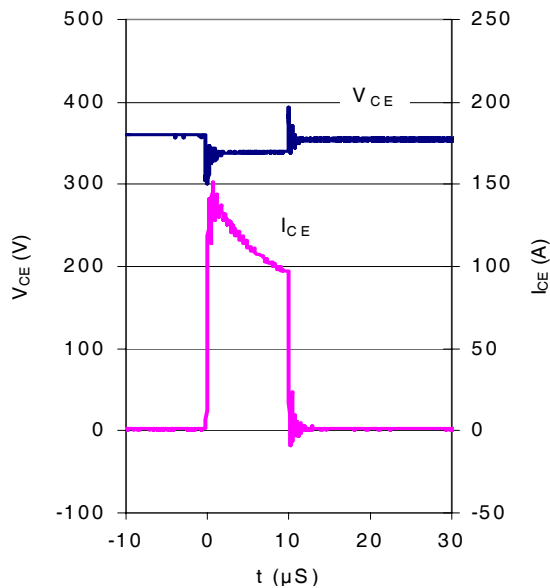
Fig.C.T.5 - Resistive Load Circuit



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



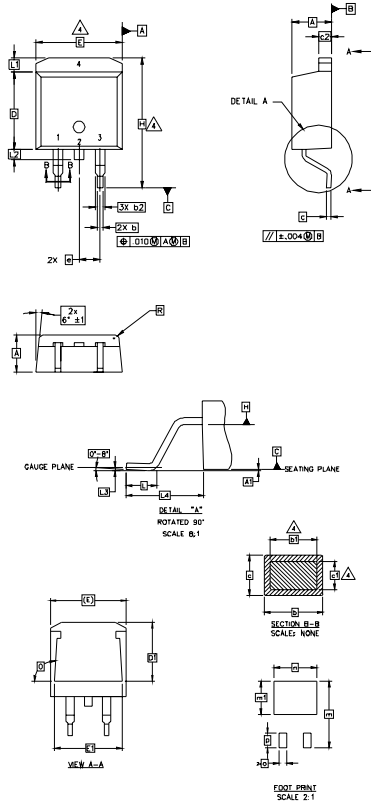
WF.3- Typ. Short Circuit
@ $T_J = 150^\circ\text{C}$ using CT.3

IRGS15B60KPbF



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	4
b1	0.51	0.89	.020	.035	
b2	1.14	1.78	.045	.070	3
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	3
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

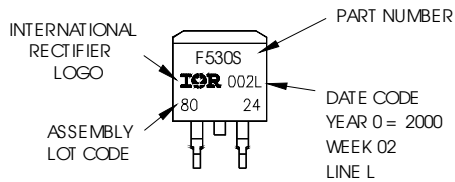
- 1.- ANODE *
- 2, 4.- CATHODE
- 3.- ANODE

* PART DEPENDENT.

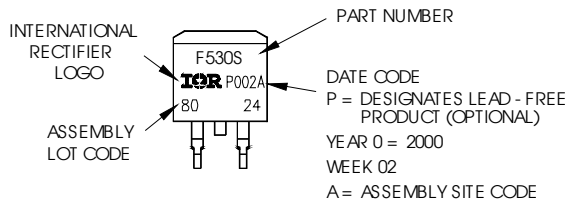
D²Pak Part Marking Information

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

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

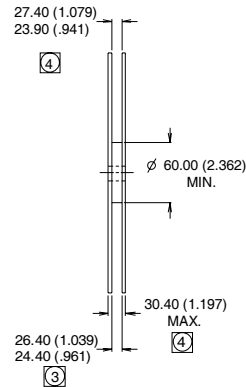
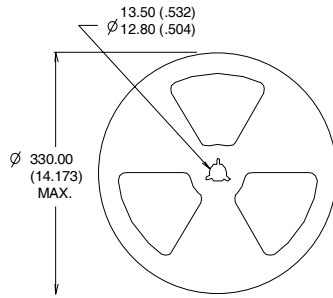
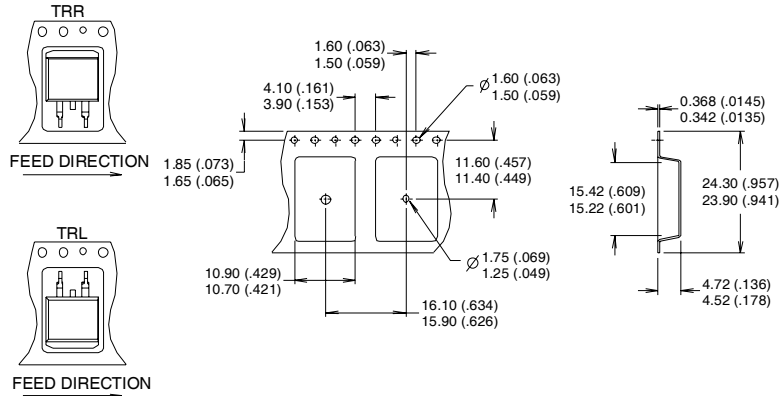


OR



D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



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

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.