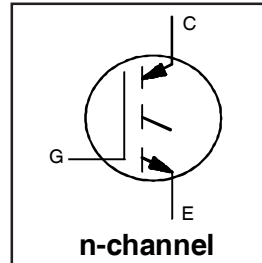


Features

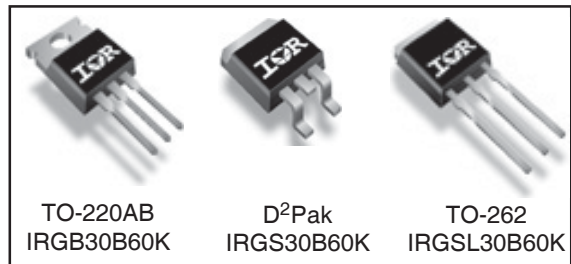
- Low VCE (on) Non Punch Through IGBT Technology.
- 10μs Short Circuit Capability.
- Square RBSOA.
- Positive VCE (on) Temperature Coefficient.
- Maximum Junction Temperature rated at 175°C.

Benefits

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



$V_{CES} = 600V$
 $I_C = 50A, T_C = 100^\circ C$
at $T_J = 175^\circ C$
 $t_{sc} > 10\mu s, T_J = 150^\circ C$
 $V_{CE(on)} \text{ typ.} = 1.95V$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	78 ^⑤	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	50	
I_{CM}	Pulse Collector Current (Ref.Fig.C.T.5)	120	
I_{LM}	Clamped Inductive Load current ①	120	
V_{ISOL}	RMS Isolation Voltage, Terminal to Case, t=1 min.	2500	V
V_{GE}	Gate-to-Emitter Voltage	±20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	370	
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	180	
T_J	Operating Junction and	-55 to +175	°C
T_{STG}	Storage Temperature Range		
	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 / Mechanical Characteristics

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case- IGBT	—	—	0.41	°C/W
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount ②	—	—	62	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount, Steady State) ③	—	—	40	
Wt	Weight	—	1.44	—	g

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	—	0.40	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1mA (25^\circ\text{C}-150^\circ\text{C})$	
$V_{CE(on)}$	Collector-to-Emitter Voltage	—	1.95	2.35	V	$I_C = 30A, V_{GE} = 15V, T_J = 25^\circ\text{C}$	5,6,7
		—	2.40	2.75		$I_C = 30A, V_{GE} = 15V, T_J = 150^\circ\text{C}$	8,9,10
		—	2.6	2.95		$I_C = 30A, V_{GE} = 15V, T_J = 175^\circ\text{C}$	
$V_{GE(th)}$	Gate Threshold Voltage	3.5	4.5	5.5	V	$V_{CE} = V_{GE}, I_C = 250\mu A$	8,9,10
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-10	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1.0mA (25^\circ\text{C}-150^\circ\text{C})$	11
g_{fe}	Forward Transconductance	—	18	—	S	$V_{CE} = 50V, I_C = 50A, PW = 80\mu s$	
I_{CES}	Zero Gate Voltage Collector Current	—	5.0	250	μA	$V_{GE} = 0V, V_{CE} = 600V$	
		—	1000	2000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$	
		—	1830	3000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 175^\circ\text{C}$	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 20V, V_{CE} = 0V$	

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)	—	102	153	nC	$I_C = 30A$	17
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	14	21		$V_{CC} = 400V$	CT1
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	44	66		$V_{GE} = 15V$	
E_{on}	Turn-On Switching Loss	—	350	620	μJ	$I_C = 30A, V_{CC} = 400V$	CT4
E_{off}	Turn-Off Switching Loss	—	825	955		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	
E_{tot}	Total Switching Loss	—	1175	1575		$T_J = 25^\circ\text{C} \text{ ④}$	
$t_{d(on)}$	Turn-On delay time	—	46	60	ns	$I_C = 30A, V_{CC} = 400V$	CT4
t_r	Rise time	—	28	39		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	
$t_{d(off)}$	Turn-Off delay time	—	185	200		$T_J = 25^\circ\text{C}$	
t_f	Fall time	—	31	40			
E_{on}	Turn-On Switching Loss	—	635	1085	μJ	$I_C = 30A, V_{CC} = 400V$	CT4
E_{off}	Turn-Off Switching Loss	—	1150	1350		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	12,14
E_{tot}	Total Switching Loss	—	1785	2435		$T_J = 150^\circ\text{C} \text{ ④}$	WF1,WF2
$t_{d(on)}$	Turn-On delay time	—	46	60	ns	$I_C = 30A, V_{CC} = 400V$	13,15
t_r	Rise time	—	28	39		$V_{GE} = 15V, R_G = 10\Omega, L = 200\mu H$	CT4
$t_{d(off)}$	Turn-Off delay time	—	205	235		$T_J = 150^\circ\text{C}$	WF1
t_f	Fall time	—	32	42			WF2
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	—	1750	2500	pF	$V_{GE} = 0V$	16
C_{oes}	Output Capacitance	—	160	255		$V_{CC} = 30V$	
C_{res}	Reverse Transfer Capacitance	—	60	90		$f = 1.0MHz$	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ\text{C}, I_C = 120A, V_p = 600V$ $V_{CC}=500V, V_{GE} = +15V \text{ to } 0V, R_G = 10\Omega$	4 CT2
SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	$T_J = 150^\circ\text{C}, V_p = 600V, R_G = 10\Omega$ $V_{CC}=360V, V_{GE} = +15V \text{ to } 0V$	CT3 WF3
$I_{SC} \text{ (Peak)}$	Peak Short Circuit Collector Current	—	200	—	A		WF3

Note ① to ⑤ are on page 13

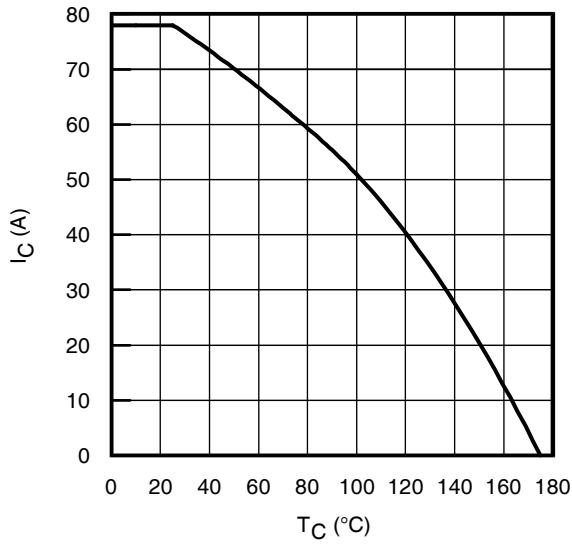


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

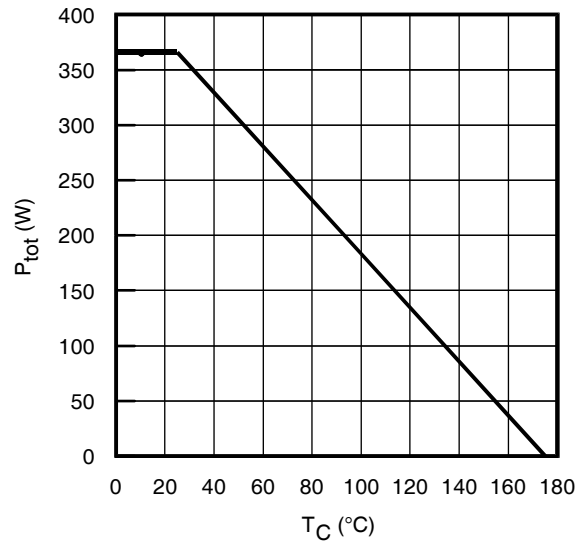


Fig. 2 - Power Dissipation vs. Case Temperature

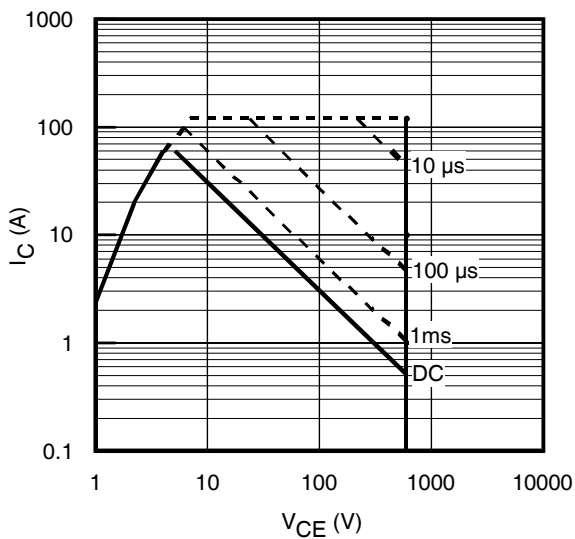


Fig. 3 - Forward SOA
 $T_C = 25^{\circ}\text{C}$; $T_J \leq 150^{\circ}\text{C}$

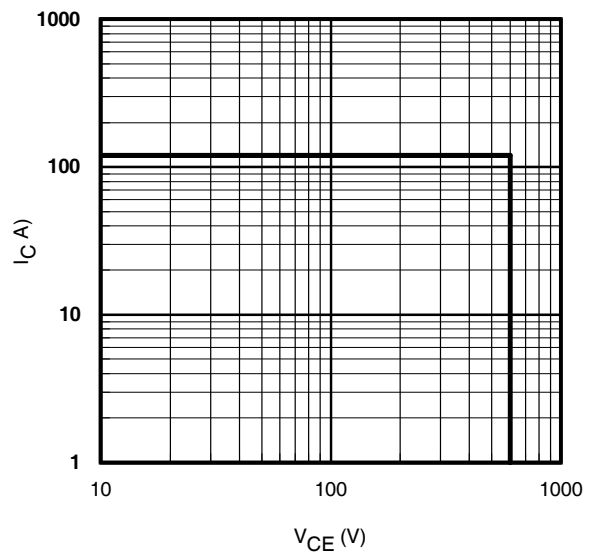


Fig. 4 - Reverse Bias SOA
 $T_J = 150^{\circ}\text{C}$; $V_{GE} = 15\text{V}$

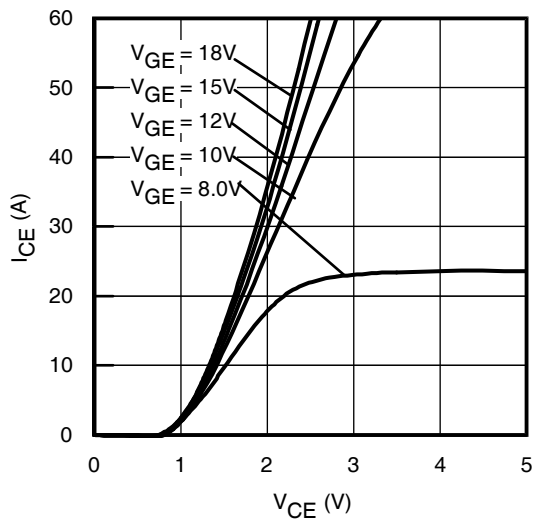


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

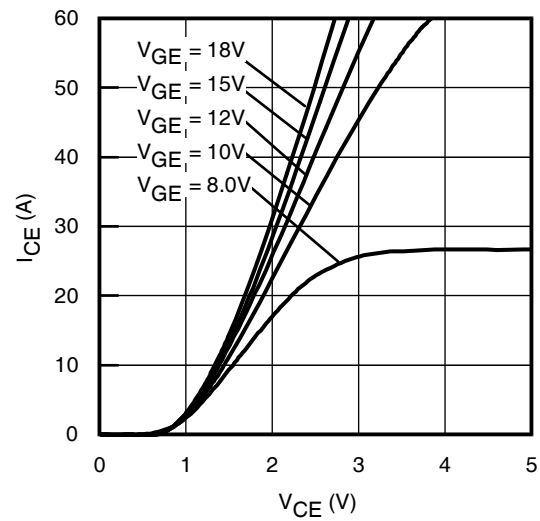


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

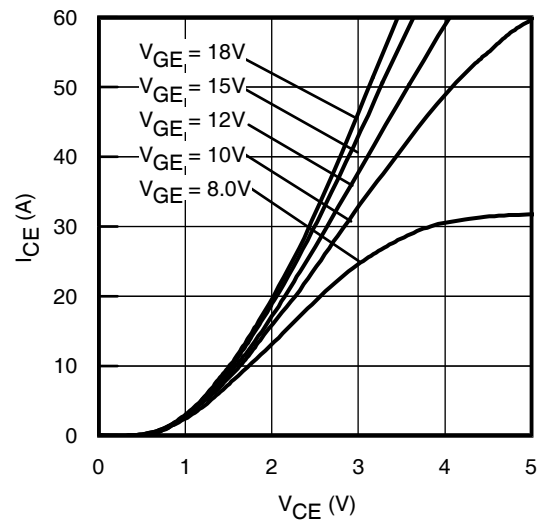


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 80\mu\text{s}$

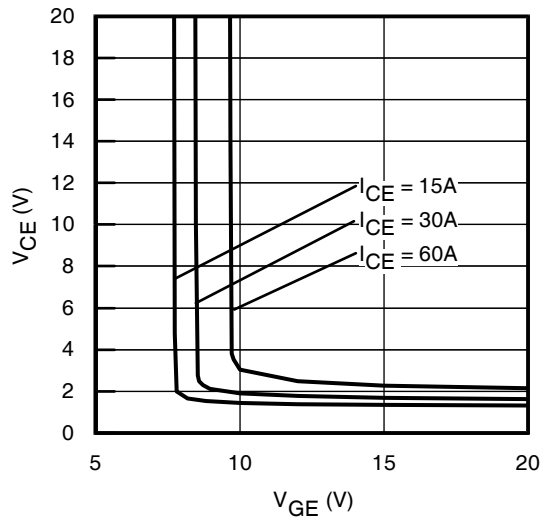


Fig. 8 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^{\circ}\text{C}$

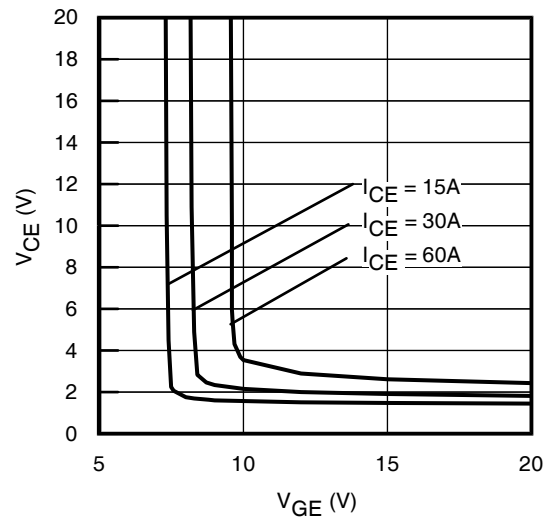


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^{\circ}\text{C}$

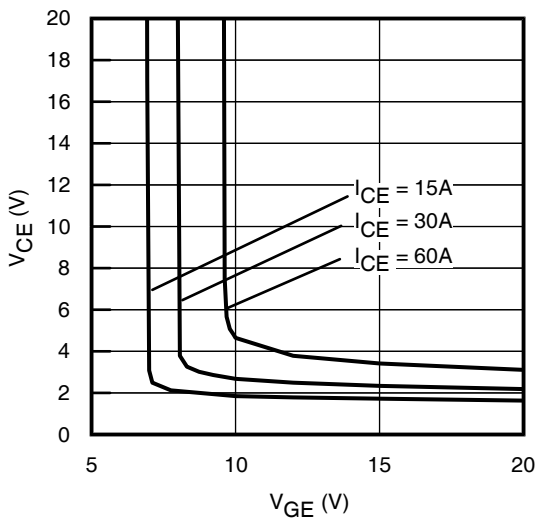


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^{\circ}\text{C}$

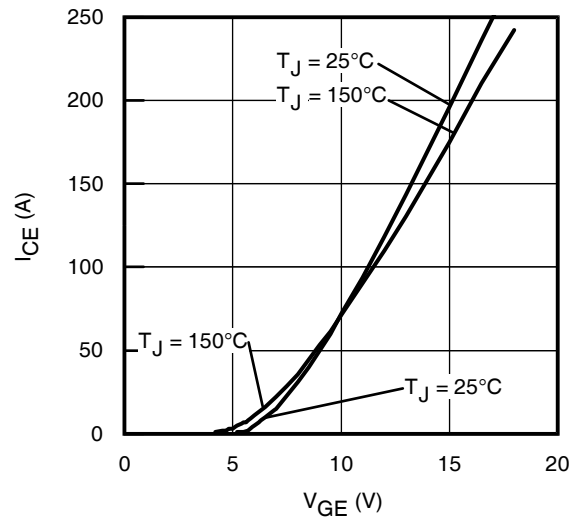


Fig. 11 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

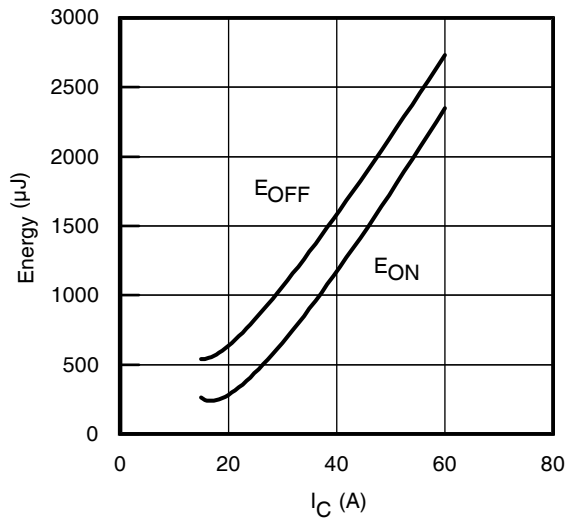


Fig. 12 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$,
 $R_G=10\Omega$; $V_{GE}=15\text{V}$

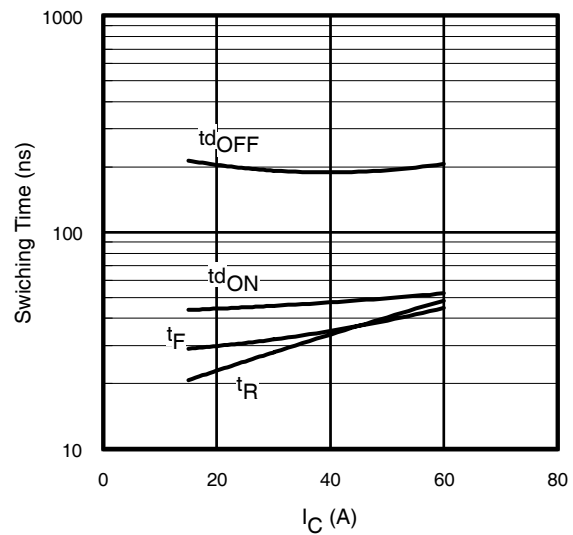


Fig. 13 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$
 $R_G=10\Omega$; $V_{GE}=15\text{V}$

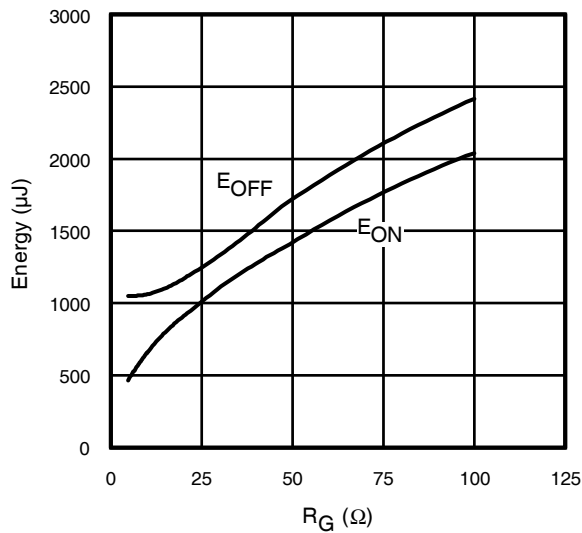


Fig. 14 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$
 $I_{CE}=30\text{A}$; $V_{GE}=15\text{V}$

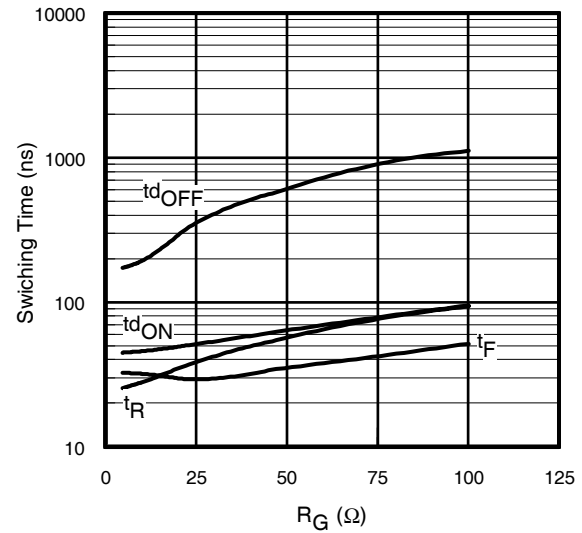


Fig. 15 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=400\text{V}$
 $I_{CE}=30\text{A}$; $V_{GE}=15\text{V}$

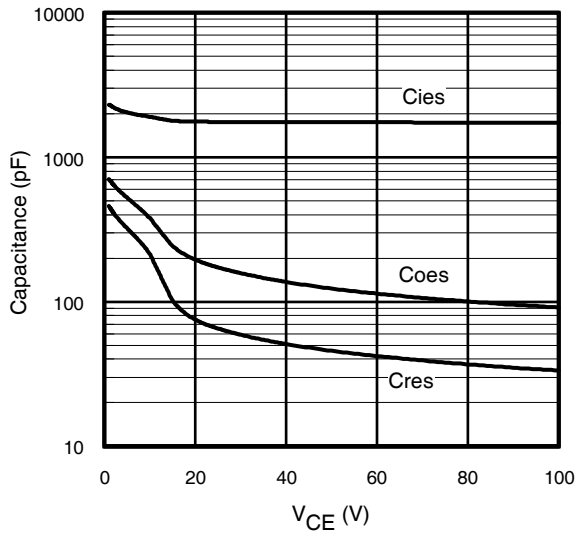


Fig. 16- Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

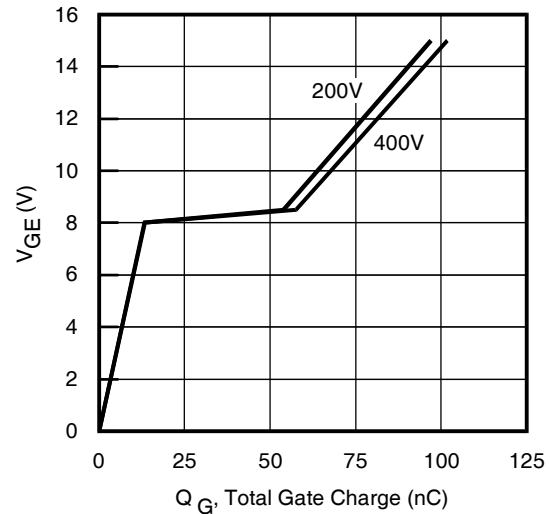


Fig. 17 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 30A$; $L = 600\mu H$

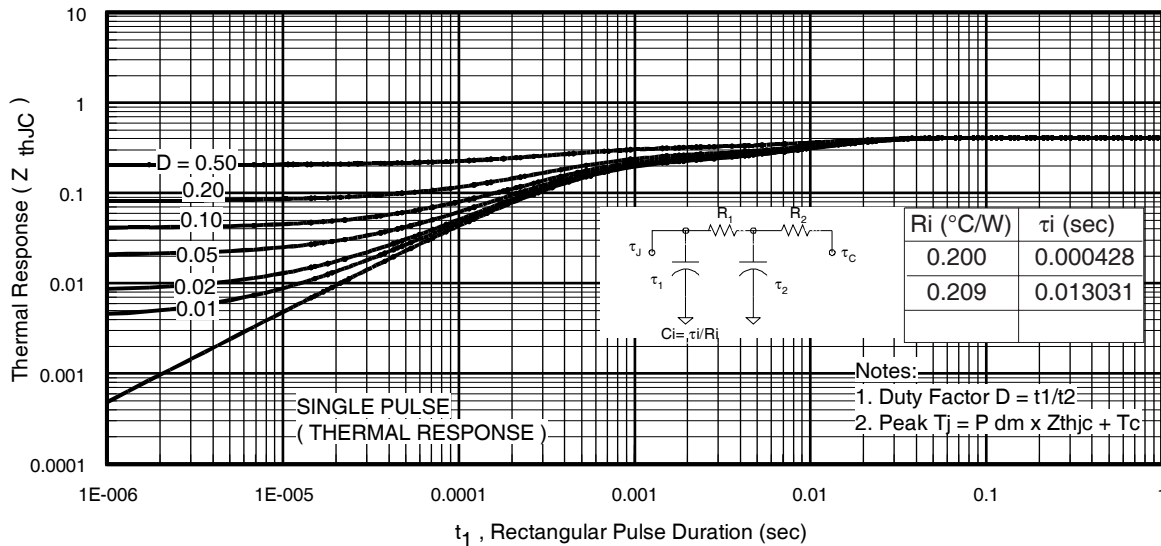


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

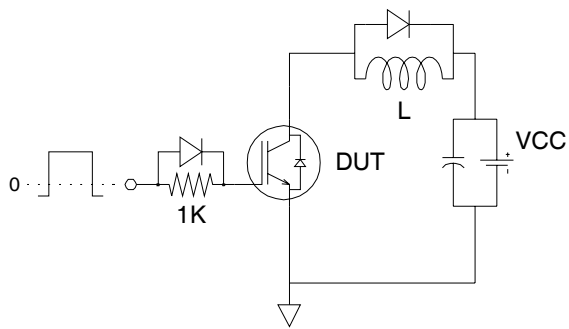


Fig.C.T.1 - Gate Charge Circuit (turn-off)

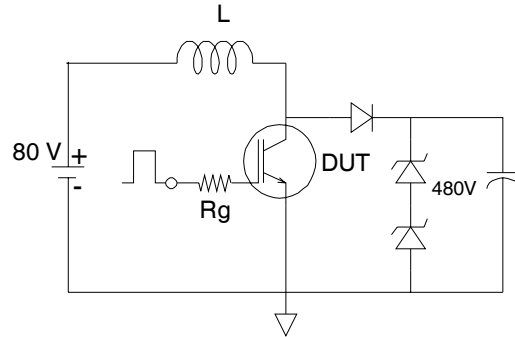


Fig.C.T.2 - RBSOA Circuit

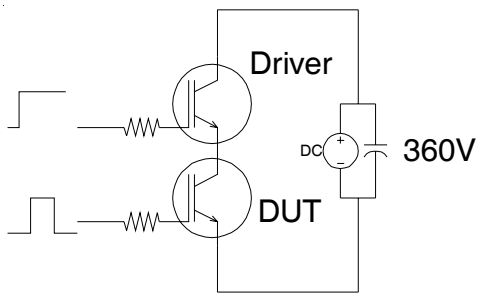


Fig.C.T.3 - S.C.SOA Circuit

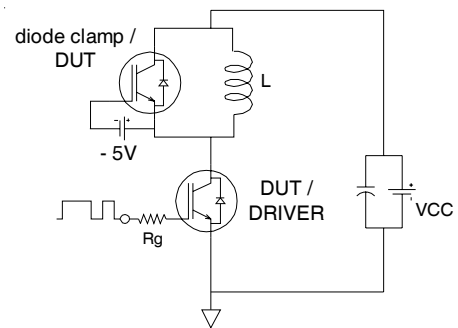


Fig.C.T.4 - Switching Loss Circuit

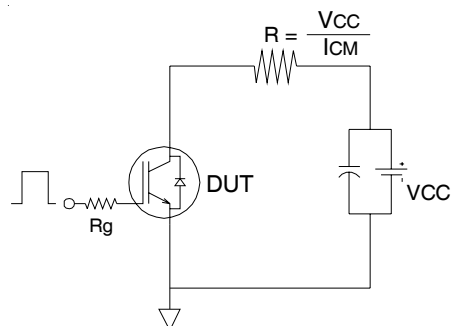


Fig.C.T.5 - Resistive Load Circuit

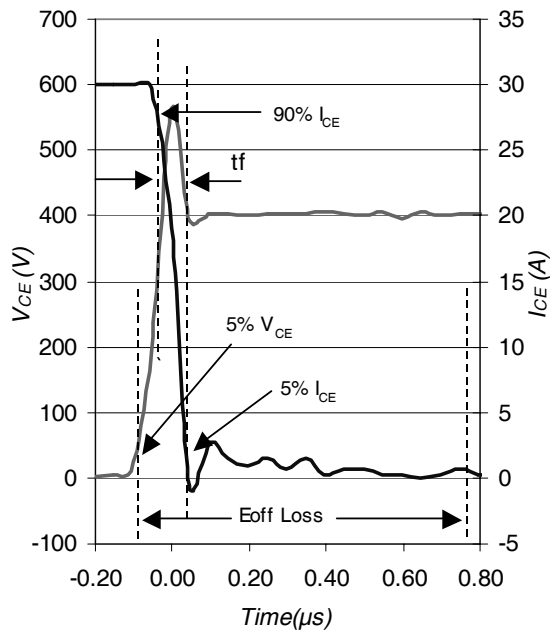


Fig. WF1- Typ. Turn-off Loss Waveform
@ $T_J = 150^{\circ}\text{C}$ using Fig. CT.4

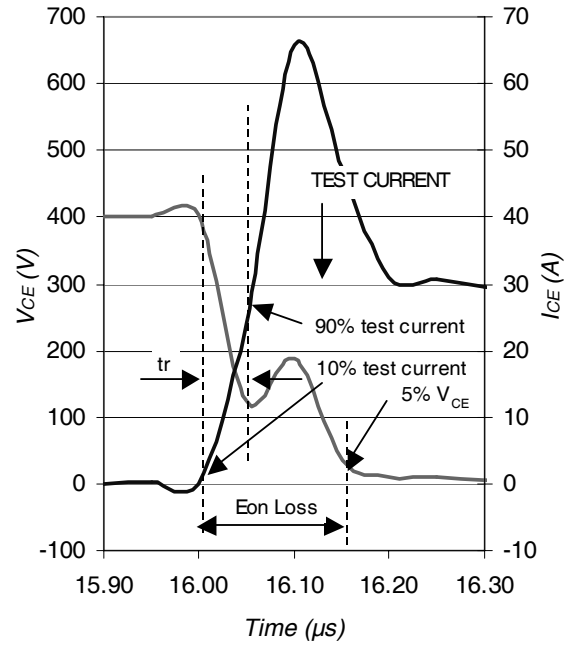


Fig. WF2- Typ. Turn-on Loss Waveform
@ $T_J = 150^{\circ}\text{C}$ using Fig. CT.4

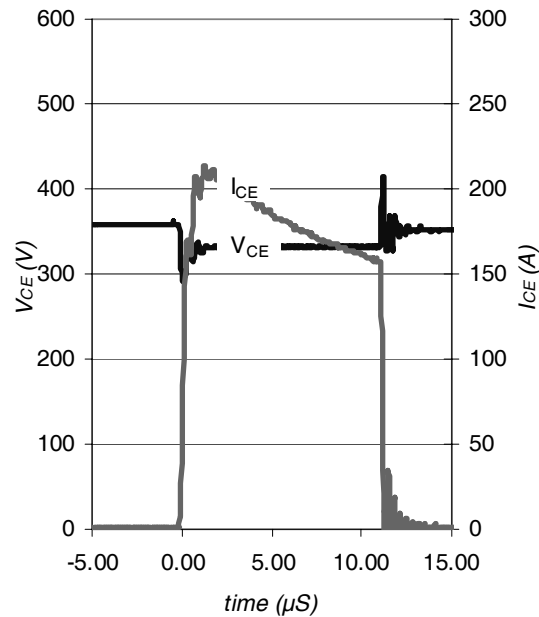


Fig. WF3- Typ. S.C Waveform
@ $T_C = 150^{\circ}\text{C}$ using Fig. CT.3

International
IOR Rectifier

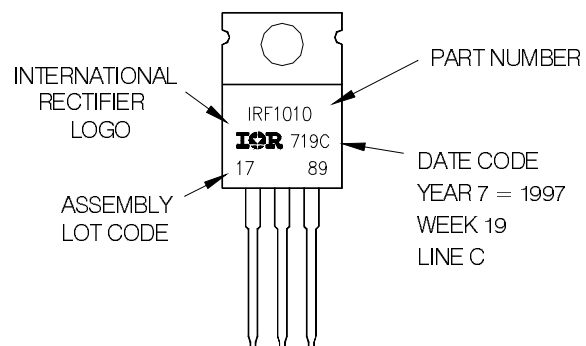
Dimensions are shown in millimeters (inches)



- 1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH

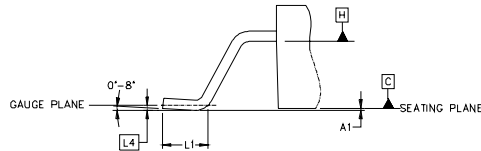
- 3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

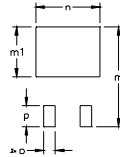
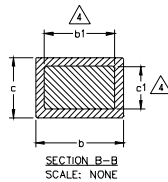
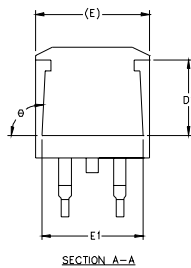


D²Pak Package Outline

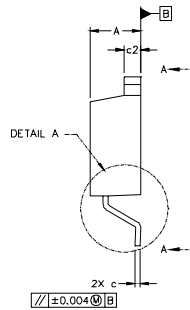
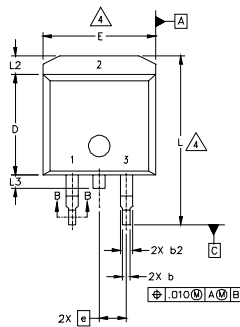
Dimensions are shown in millimeters (inches)



DETAIL "A"
ROTATED 90°
SCALE: 8:1



FOOT PRINT
SCALE: 2:1



IRGB/S/SL30B60K

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1		0.127		.005	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	4
c	0.43	0.63	.017	.025	
c1	0.38	0.74	.015	.029	
c2	1.14	1.40	.045	.055	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		3
E	9.65	10.67	.380	.420	
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	14.61	15.88	.575	.625	
L1	1.78	2.79	.070	.110	
L2		1.65		.065	
L3	1.27	1.78	.050	.070	
L4	0.25 BSC		.010 BSC		
m	17.78	93°	.700	93°	
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
θ	90°	93°	90°	93°	

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

DIODES

1.- ANODE
2.- CATHODE
3.- ANODE

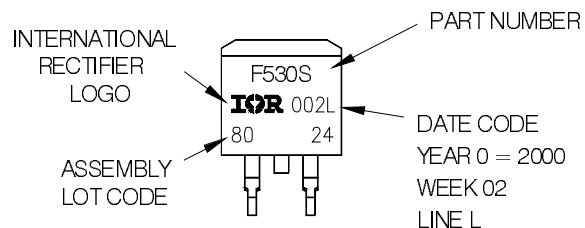
* PART DEPENDENT.

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.

D²Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH
LOT CODE 8024
ASSEMBLED ON WW 02, 2000
IN THE ASSEMBLY LINE "L"

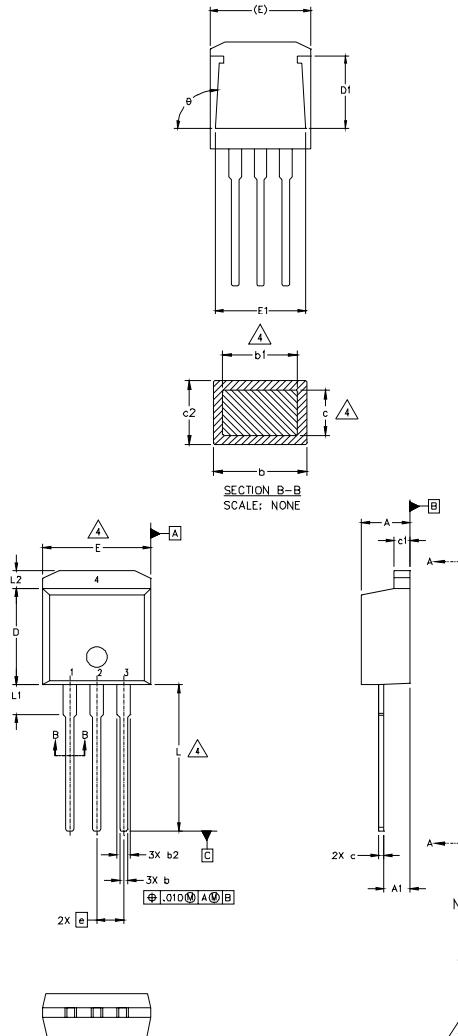


IRGB/S/SL30B60K

TO-262 Package Outline

Dimensions are shown in millimeters (inches)

International
IR Rectifier



S Y M B O L	DIMENSIONS				N O T E S
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	4
c	0.38	0.63	.015	.025	
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

LEAD ASSIGNMENTS

HEXFET

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

IGBT

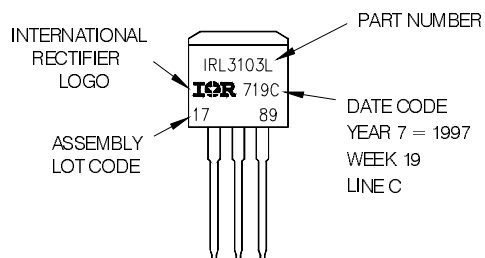
- 1- GATE
- 2- COLLECTOR
- 3- EMITTER
- 4- COLLECTOR

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.

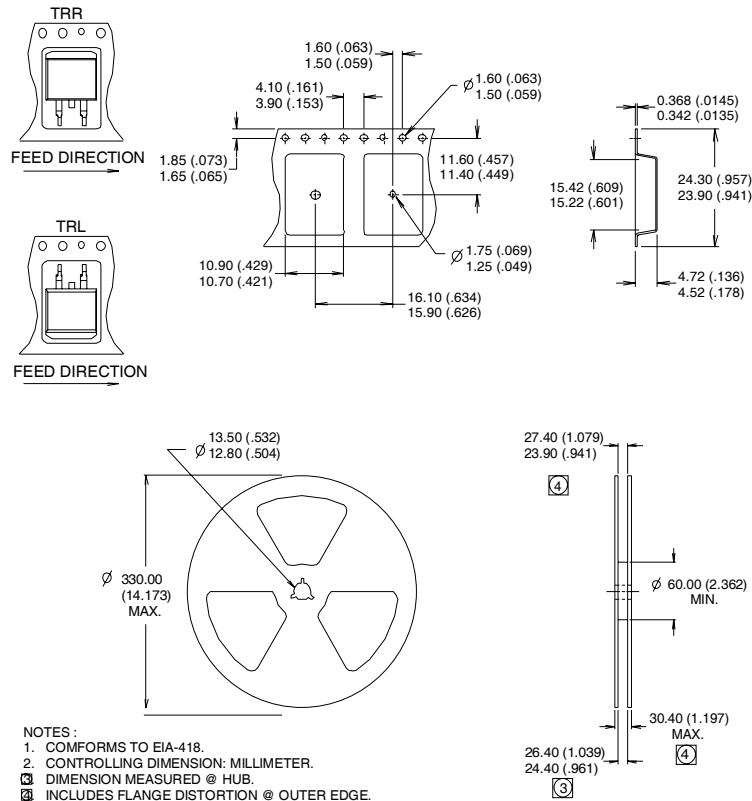
TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"



D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



Notes:

- ① $V_{CC} = 80\% (V_{CES})$, $V_{GE} = 20V$, $L = 28\mu H$, $R_G = 22\Omega$.
- ② This is only applied to TO-220AB package.
- ③ 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.
- ④ Energy losses include "tail" and diode reverse recovery.
- ⑤ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A.

TO-220AB package is not recommended for Surface Mount Application.

Data and specifications subject to change without notice.

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Note: For the most current drawings please refer to the IR website at:
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