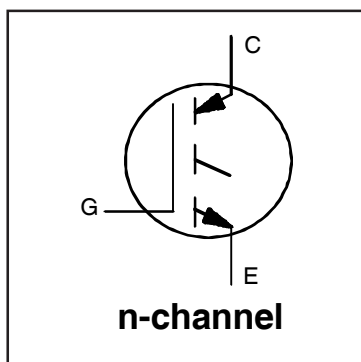


IRG7PH30K10PbF

INSULATED GATE BIPOLAR TRANSISTOR

Features

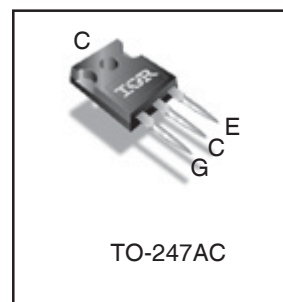
- Low $V_{CE(ON)}$ Trench IGBT Technology
- Low Switching Losses
- Maximum Junction Temperature 175 °C
- 10 μ S short Circuit SOA
- Square RBSOA
- 100% of the parts tested for I_{LM} ①
- Positive $V_{CE(ON)}$ Temperature Co-Efficient
- Tight Parameter Distribution
- Lead Free Package



$V_{CES} = 1200V$
$I_C = 23A, T_C = 100^\circ C$
$t_{SC} \geq 10\mu s, T_{J(max)} = 175^\circ C$
$V_{CE(on)} \text{ typ.} = 2.05V$

Benefits

- High Efficiency in a Wide Range of Applications
- Suitable for a Wide Range of Switching Frequencies due to Low $V_{CE(ON)}$ and Low Switching Losses
- Rugged Transient Performance for Increased Reliability
- Excellent Current Sharing in Parallel Operation



G	C	E
Gate	Collector	Emitter

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	33	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	23	
$I_{NOMINAL}$	Nominal Current	9.0	
I_{CM}	Pulse Collector Current $V_{ge} = 15V$	27	
I_{LM}	Clamped Inductive Load Current $V_{ge} = 20V$ ①	36	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 30	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	210	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	110	
T_J	Operating Junction and	-55 to +175	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.		
	Mounting Torque, 6-32 or M3 Screw	300 (0.063 in. (1.6mm) from case) 10 lbf-in (1.1 N-m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT) ④	—	—	0.70	$^\circ C/W$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	40	—	

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	1200	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$ ③	CT6
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.27	—	V/°C	$V_{GE} = 0V, I_C = 1mA$ (25°C-175°C) ③	CT6
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.05	2.35	V	$I_C = 9.0A, V_{GE} = 15V, T_J = 25^\circ\text{C}$ ②	5,6,7
		—	2.56	—		$I_C = 9.0A, V_{GE} = 15V, T_J = 150^\circ\text{C}$ ②	8,9,10
		—	2.65	—		$I_C = 9.0A, V_{GE} = 15V, T_J = 175^\circ\text{C}$ ②	
$V_{GE(th)}$	Gate Threshold Voltage	5.0	—	7.5	V	$V_{CE} = V_{GE}, I_C = 400\mu A$	8,9
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-16	—	mV/°C	$V_{CE} = V_{GE}, I_C = 400\mu A$ (25°C - 175°C)	10,11
gfe	Forward Transconductance	—	6.2	—	S	$V_{CE} = 50V, I_C = 9.0A, PW = 80\mu s$	
I_{CES}	Collector-to-Emitter Leakage Current	—	1.0	25	μA	$V_{GE} = 0V, V_{CE} = 1200V$	
		—	400	—		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 175^\circ\text{C}$	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 30V$	

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)	—	45	68	nC	$I_C = 9.0A$ ②	18
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	8.7	13		$V_{GE} = 15V$	CT1
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	20	30		$V_{CC} = 600V$	
E_{on}	Turn-On Switching Loss	—	530	760	μJ	$I_C = 9.0A, V_{CC} = 600V, V_{GE} = 15V$ ②	CT4
E_{off}	Turn-Off Switching Loss	—	380	600		$R_G = 22\Omega, L = 1000\mu H, L_S = 150nH, T_J = 25^\circ\text{C}$	
E_{total}	Total Switching Loss	—	910	1360		Energy losses include tail & diode reverse recovery	
$t_{d(on)}$	Turn-On delay time	—	14	31	ns	$I_C = 9.0A, V_{CC} = 600V, V_{GE} = 15V$ ②	CT4
t_r	Rise time	—	24	41		$R_G = 22\Omega, L = 1000\mu H, L_S = 150nH, T_J = 25^\circ\text{C}$	
$t_{d(off)}$	Turn-Off delay time	—	110	130			
t_f	Fall time	—	38	56			
E_{on}	Turn-On Switching Loss	—	850	—	μJ	$I_C = 9.0A, V_{CC} = 600V, V_{GE} = 15V$ ②	12,14
E_{off}	Turn-Off Switching Loss	—	750	—		$R_G = 22\Omega, L = 1000\mu H, L_S = 150nH, T_J = 175^\circ\text{C}$	CT4
E_{total}	Total Switching Loss	—	1600	—		Energy losses include tail & diode reverse recovery	WF1, WF2
$t_{d(on)}$	Turn-On delay time	—	12	—	ns	$I_C = 9.0A, V_{CC} = 600V, V_{GE} = 15V$ ②	13,15
t_r	Rise time	—	23	—		$R_G = 22\Omega, L = 1000\mu H, L_S = 150nH$	CT4
$t_{d(off)}$	Turn-Off delay time	—	130	—		$T_J = 175^\circ\text{C}$	WF1
t_f	Fall time	—	270	—			WF2
C_{ies}	Input Capacitance	—	1070	—	pF	$V_{GE} = 0V$	17
C_{oes}	Output Capacitance	—	63	—		$V_{CC} = 30V$	
C_{res}	Reverse Transfer Capacitance	—	26	—		$f = 1.0MHz$	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 175^\circ\text{C}, I_C = 36A$ $V_{CC} = 960V, V_p = 1200V$ $R_G = 10\Omega, V_{GE} = +20V \text{ to } 0V, T_J = 175^\circ\text{C}$	4 CT2
SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	$V_{CC} = 600V, V_p = 1200V, T_J = 150^\circ\text{C},$ $R_G = 22\Omega, V_{GE} = +15V \text{ to } 0V$	16, CT3 WF4

Notes:

- ① $V_{CC} = 80\%$ (V_{CES}), $V_{GE} = 20V$, $L = 200\mu H$, $R_G = 51\Omega$.
- ② Pulse width $\leq 400\mu s$; duty cycle $\leq 2\%$.
- ③ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
- ④ R_θ is measured at T_J of approximately 90°C .

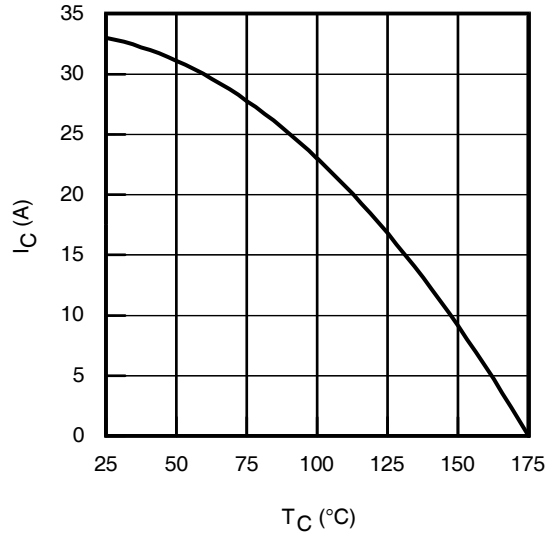


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

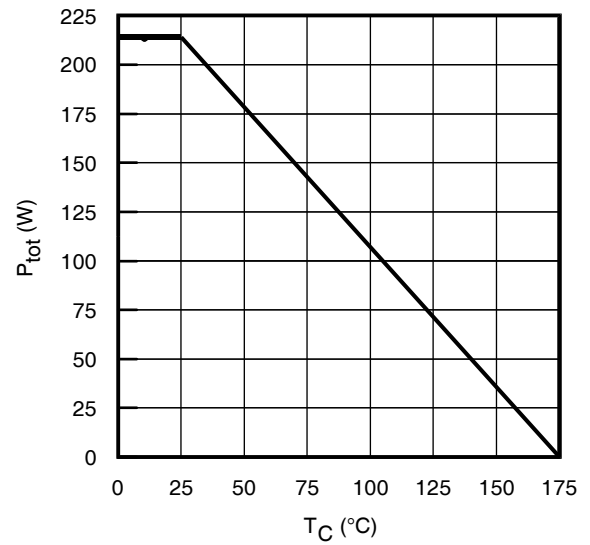


Fig. 2 - Power Dissipation vs. Case Temperature

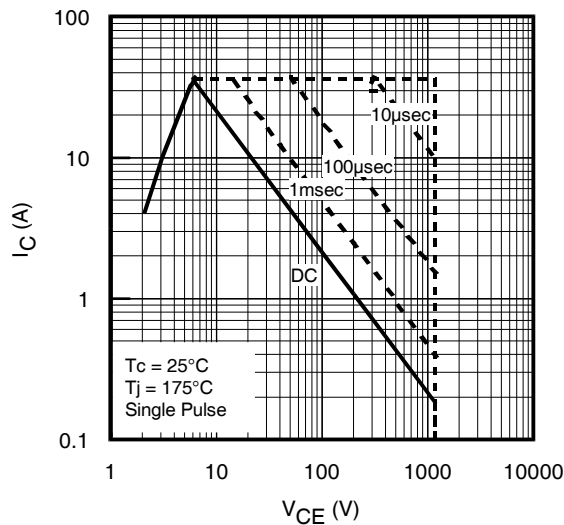


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$, $T_J \leq 175^\circ\text{C}$; $V_{GE} = 15\text{V}$

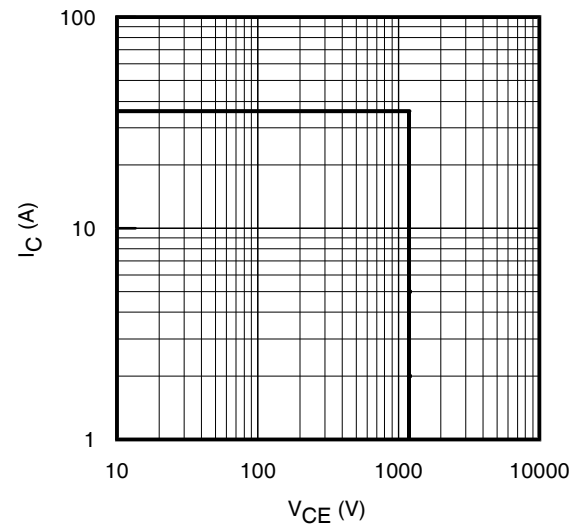


Fig. 4 - Reverse Bias SOA
 $T_J = 175^\circ\text{C}$; $V_{GE} = 20\text{V}$

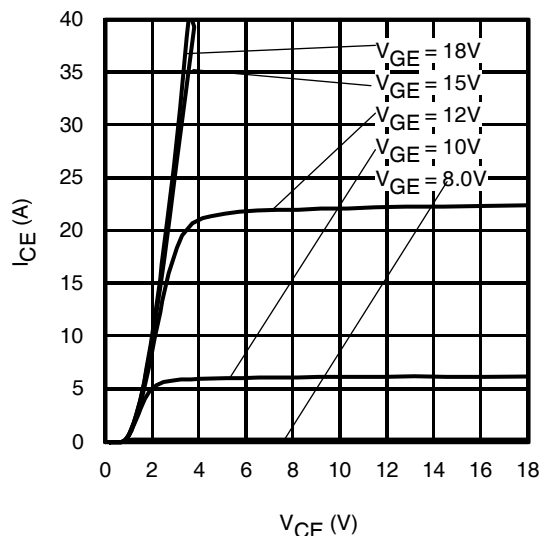


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

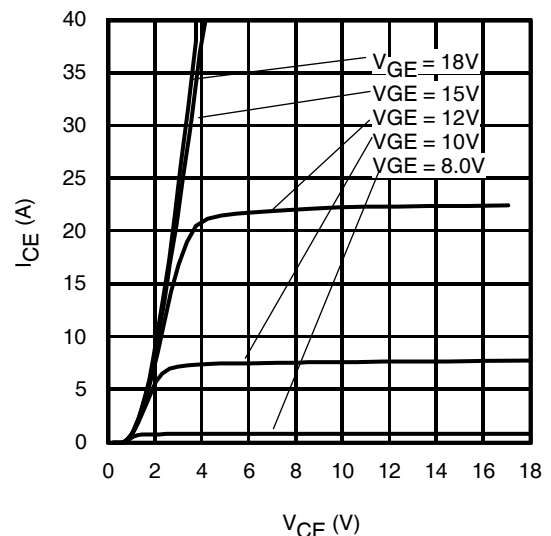


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

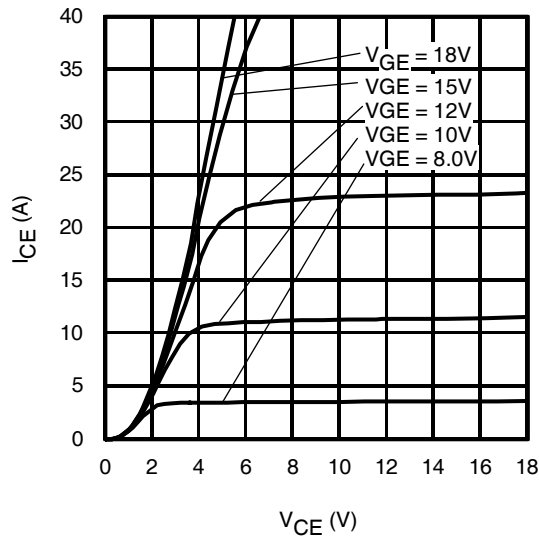


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 175^\circ\text{C}$; $t_p = 80\mu\text{s}$

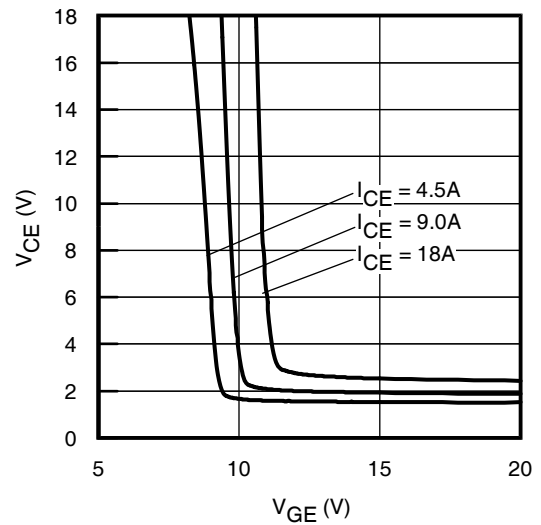


Fig. 8 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

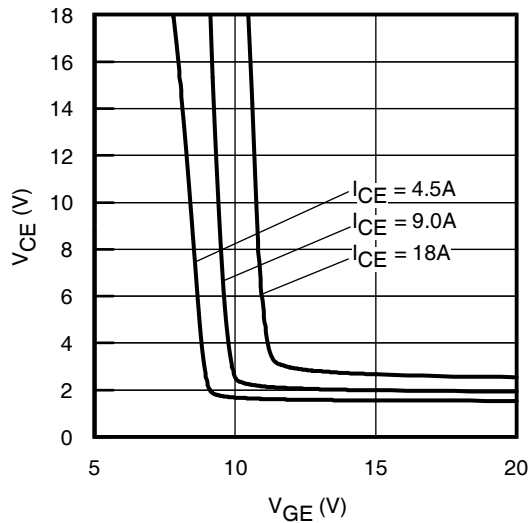


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

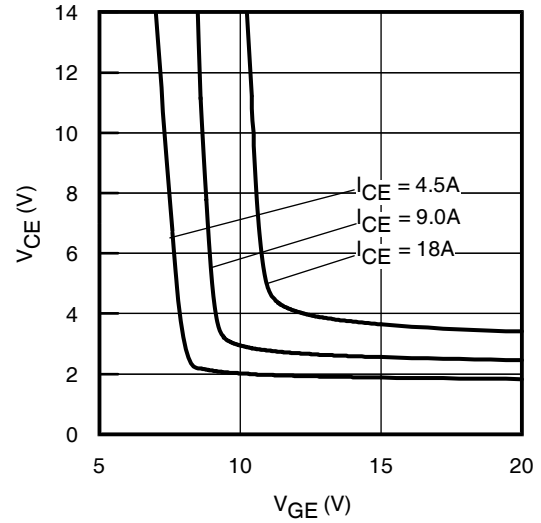


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 175^\circ\text{C}$

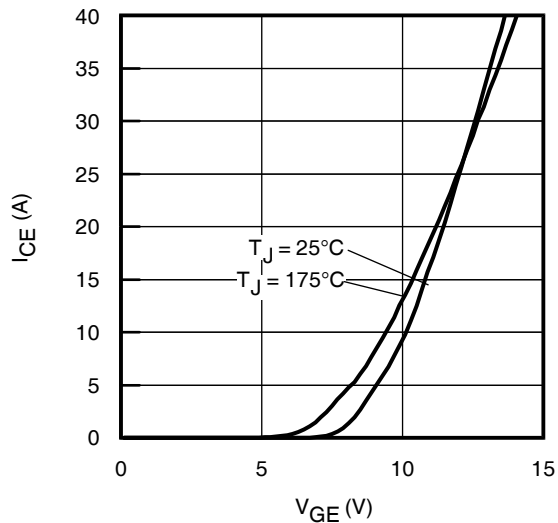


Fig. 11- Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

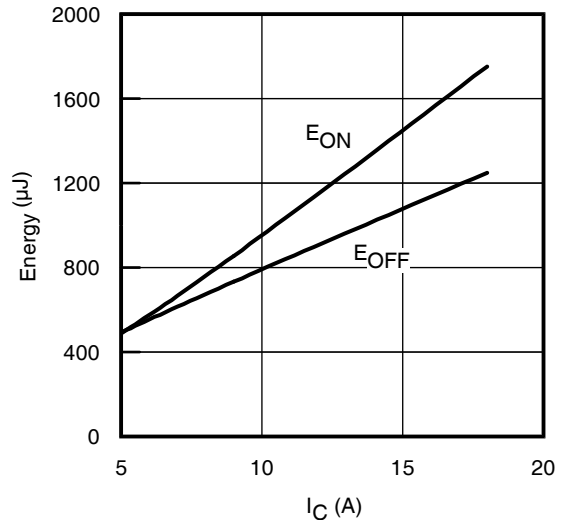


Fig. 12 - Typ. Energy Loss vs. I_C
 $T_J = 175^\circ\text{C}$; $L = 1000\mu\text{H}$; $V_{CE} = 600\text{V}$; $R_G = 22\Omega$; $V_{GE} = 15\text{V}$

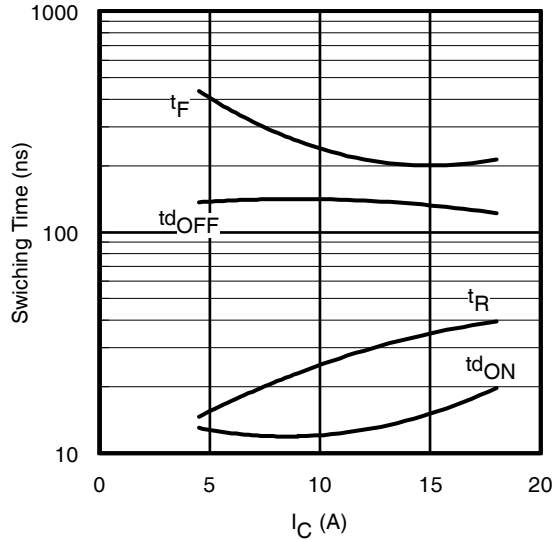


Fig. 13 - Typ. Switching Time vs. I_C

$T_J = 175^\circ\text{C}$; $L = 1000\mu\text{H}$; $V_{CE} = 600\text{V}$; $R_G = 22\Omega$; $V_{GE} = 15\text{V}$

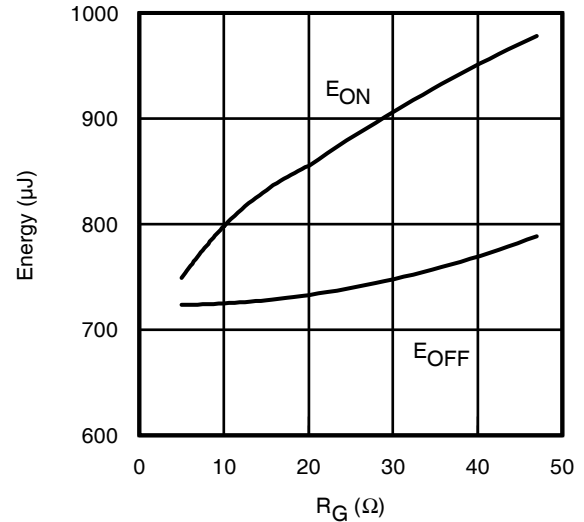


Fig. 14 - Typ. Energy Loss vs. R_G

$T_J = 175^\circ\text{C}$; $L = 1000\mu\text{H}$; $V_{CE} = 600\text{V}$; $I_{CE} = 9.0\text{A}$; $V_{GE} = 15\text{V}$

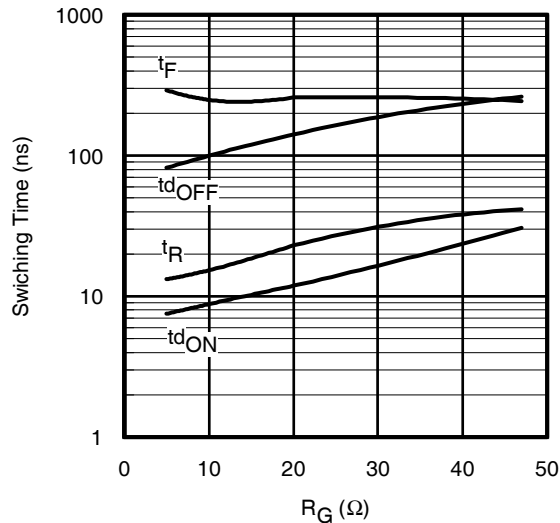


Fig. 15 - Typ. Switching Time vs. R_G

$T_J = 175^\circ\text{C}$; $L = 1000\mu\text{H}$; $V_{CE} = 600\text{V}$; $I_{CE} = 9.0\text{A}$; $V_{GE} = 15\text{V}$

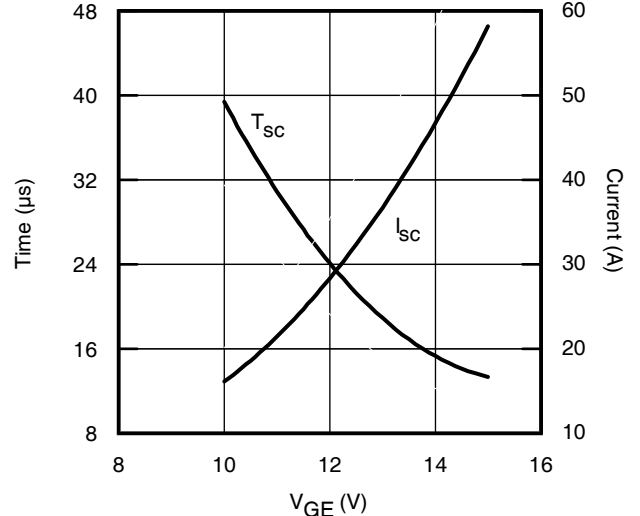


Fig. 16 - V_{GE} vs. Short Circuit Time

$V_{CC} = 600\text{V}$; $T_C = 150^\circ\text{C}$

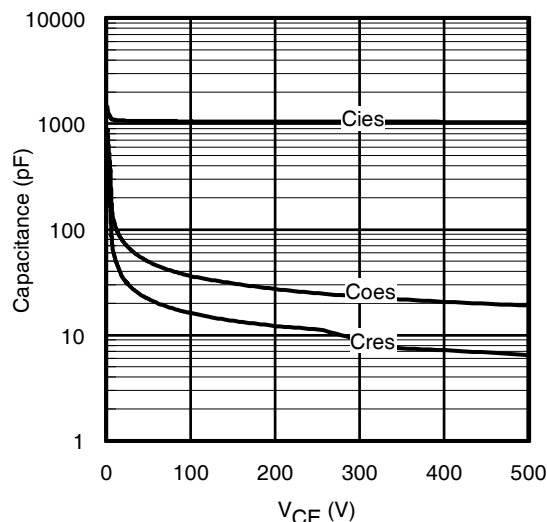


Fig. 17 - Typ. Capacitance vs. V_{CE}

$V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

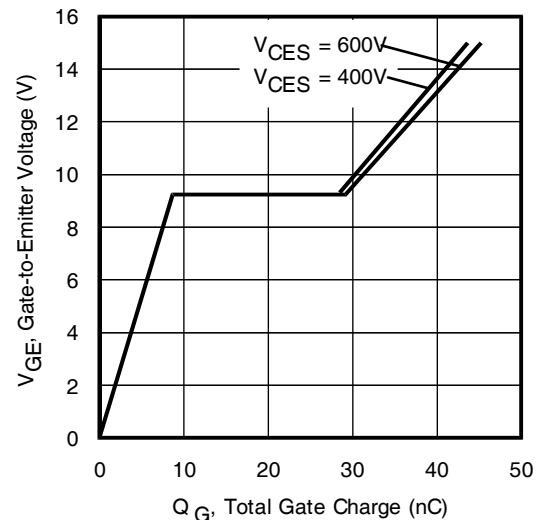


Fig. 18- Typical Gate Charge vs. V_{GE}

$I_{CE} = 9.0\text{A}$; $L = 1.0\text{mH}$

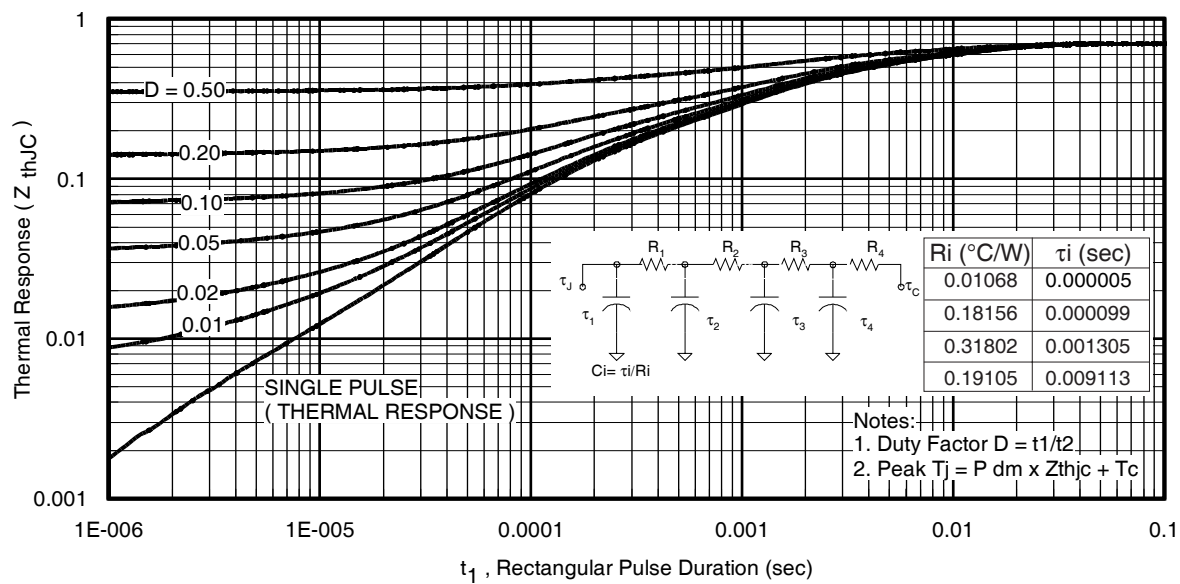


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case

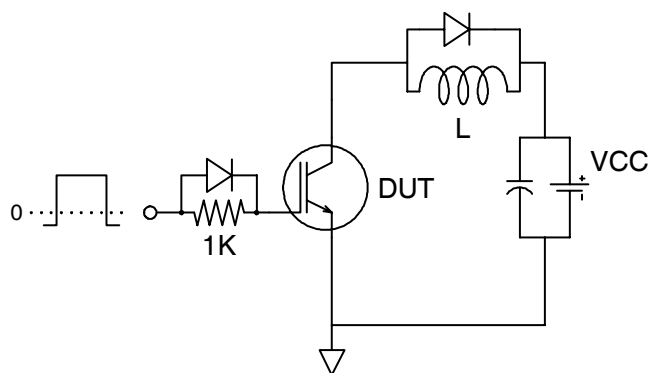


Fig.C.T.1 - Gate Charge Circuit (turn-off)

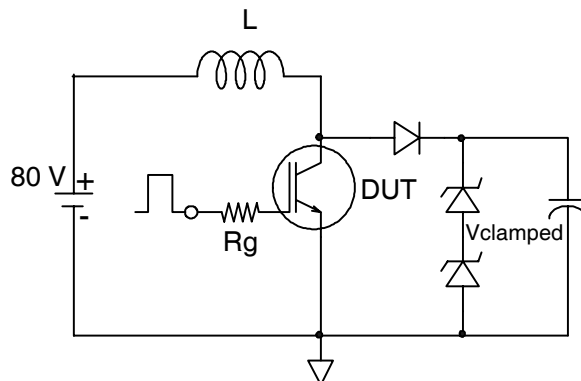


Fig.C.T.2 - RBSOA Circuit

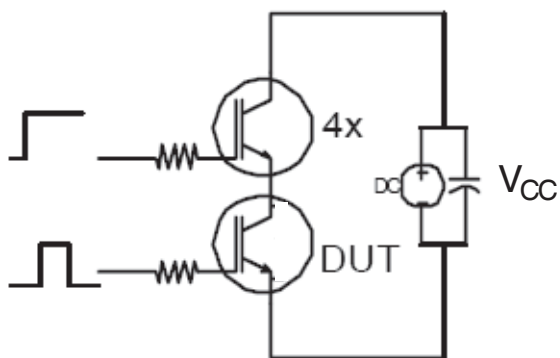


Fig.C.T.3 - S.C. SOA Circuit

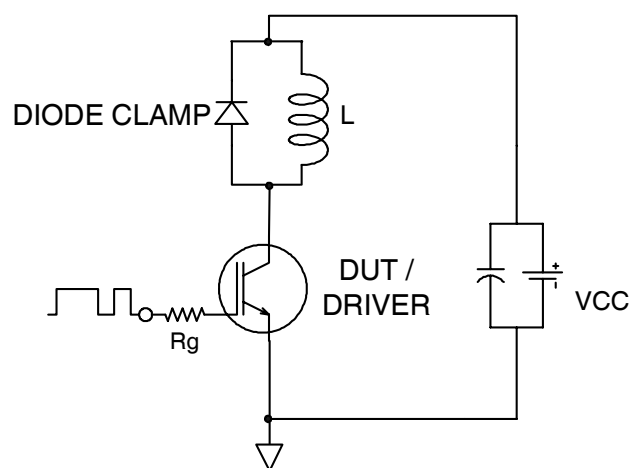


Fig.C.T.4 - Switching Loss Circuit

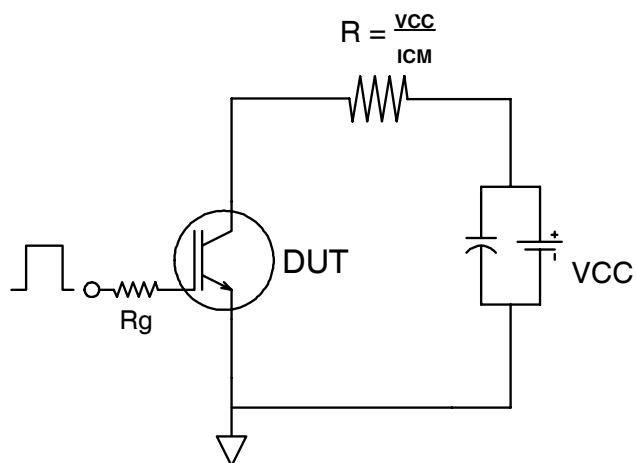


Fig.C.T.5 - Resistive Load Circuit

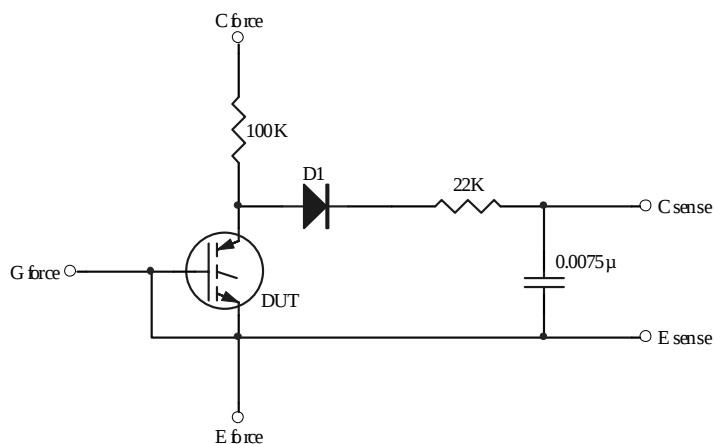


Fig.C.T.6 - BV CES Filter Circuit

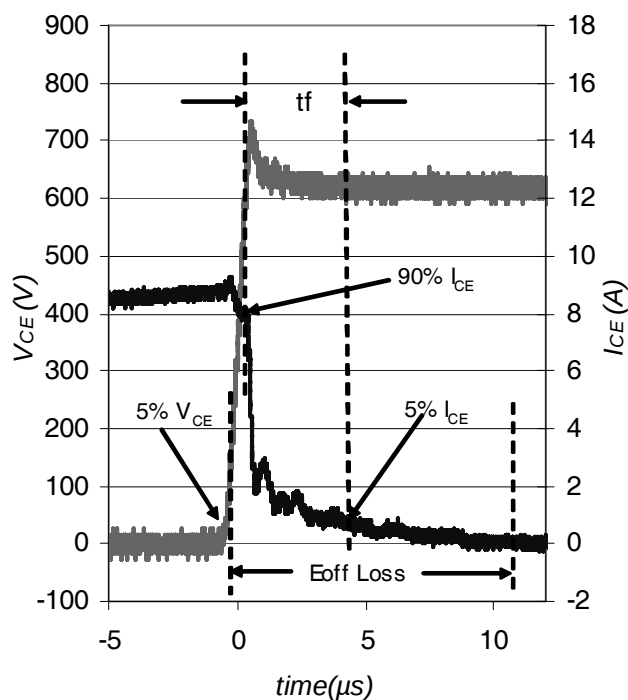


Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

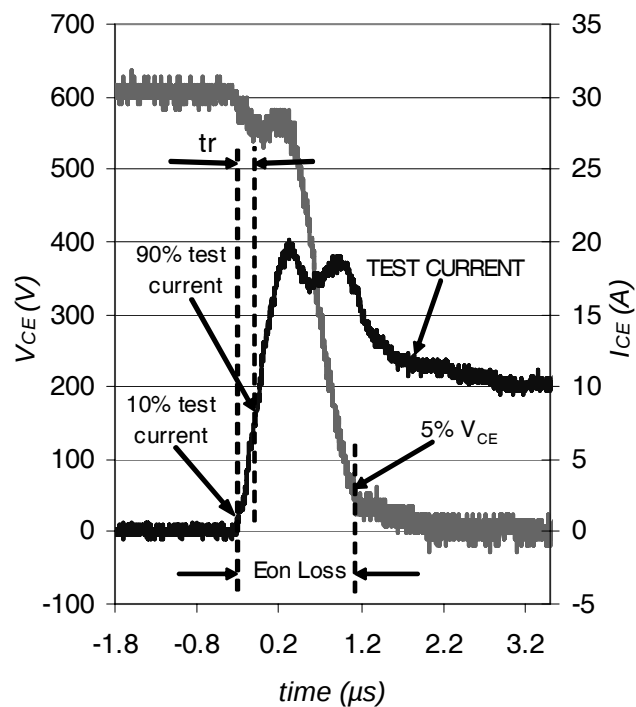


Fig. WF2 - Typ. Turn-on Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

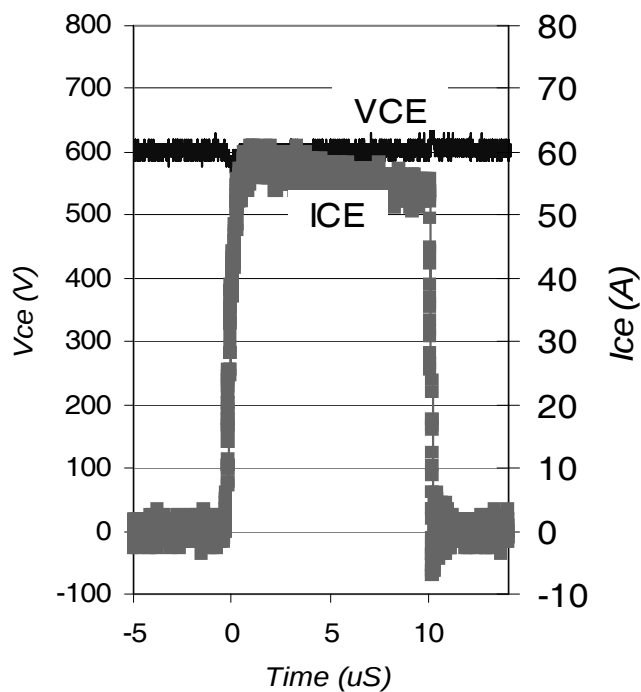
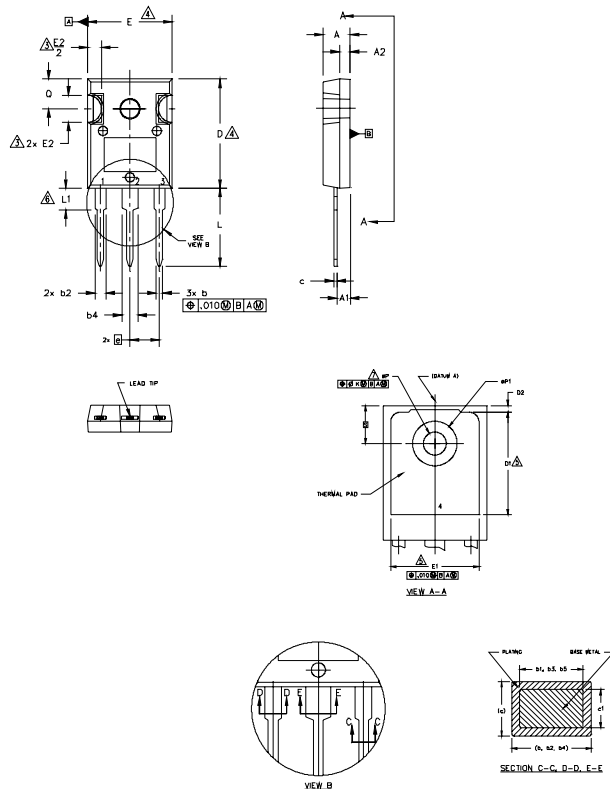


Fig. WF4 - Typ. S.C. Waveform
@ $T_J = 150^\circ\text{C}$ using Fig. CT.3

TO-247AC Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES.
3. CONTOUR OF SLOT OPTIONAL.
4. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
6. LEAD FINISH UNCONTROLLED IN L1.
7. ØP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AC .

SYMBOL	DIMENSIONS				NOTE
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.183	.209	4.65	5.31	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.039	.055	0.99	1.40	
b1	.039	.053	0.99	1.35	
b2	.065	.094	1.65	2.39	
b3	.065	.092	1.65	2.34	
b4	.102	.135	2.59	3.43	
b5	.102	.133	2.59	3.38	
c	.015	.035	0.38	0.89	
c1	.015	.033	0.38	0.84	
D	.776	.815	19.71	20.70	4
D1	.515	-	13.08	-	5
D2	.020	.053	0.51	1.35	
E	.602	.625	15.29	15.87	4
E1	.530	-	13.46	-	
E2	.178	.216	4.52	5.49	
e	.215 BSC		5.46 BSC		
Øk	.010		0.25		
L	.559	.634	14.20	16.10	
L1	.146	.169	3.71	4.29	
ØP	.140	.144	3.56	3.66	
ØP1	-	.291	-	7.39	
Q	.209	.224	5.31	5.69	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

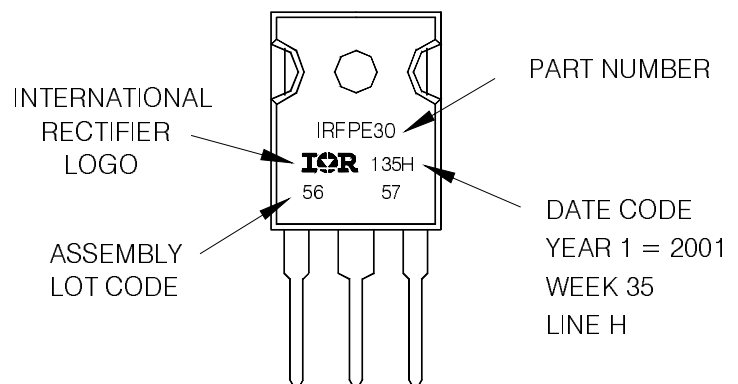
DIODES

- 1.- ANODE/OPEN
- 2.- CATHODE
- 3.- ANODE

TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2001
IN THE ASSEMBLY LINE "H"

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



TO-247AC package is not recommended for Surface Mount Application.

Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

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
IR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903

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