

**Features**

- Low  $V_{CE(on)}$  Planar IGBT Technology
- Low Switching Losses
- Square RBSOA
- 100% of The Parts Tested for  $I_{LM}$ ①
- Positive  $V_{CE(on)}$  Temperature Coefficient.
- Lead-Free, RoHS Compliant
- Automotive Qualified \*

**Benefits**

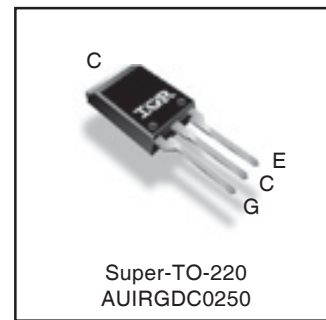
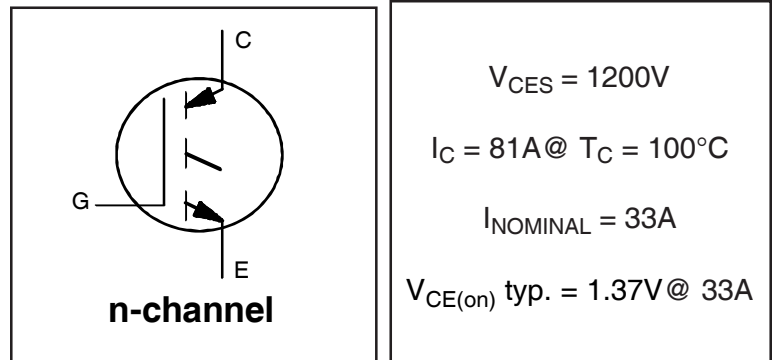
- Device optimized for soft switching applications
- High Efficiency due to Low  $V_{CE(on)}$ , low switching losses
- Rugged transient performance for increased reliability
- Excellent current sharing in parallel operation
- Low EMI

**Application**

- PTC Heater
- Relay Replacement

**Absolute Maximum Ratings**

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature ( $T_A$ ) is 25°C, unless otherwise specified.



<b>G</b>	<b>C</b>	<b>E</b>
Gate	Collector	Emitter

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	141 ⑤	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	81	
$I_{NOMINAL}$	Nominal Current	33	
$I_{CM}$	Pulse Collector Current, $V_{GE} = 15V$ ②	99	
$I_{LM}$	Clamped Inductive Load Current, $V_{GE} = 20V$ ①	99	
$V_{GE}$	Continuous Gate-to-Emitter Voltage	$\pm 20$	V
	Transient Gate-to-Emitter Voltage	$\pm 30$	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	543	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	217	
$T_J$	Operating Junction and	-55 to +150	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 sec. (1.6mm from case)	300	
	Mounting Torque, 6-32 or M3 Screw	10 lbf-in (1.1N·m)	

**Thermal Resistance**

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case (IGBT) ④	—	—	0.23	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.50	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	—	62	—	

\*Qualification standards can be found at <http://www.irf.com/>

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{GE} = 0V, I_C = 100\mu\text{A}$ ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.2	—	V/°C	$V_{GE} = 0V, I_C = 1\text{mA}$ (25°C-150°C) ③
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.37	1.57	V	$I_C = 33A, V_{GE} = 15V, T_J = 25^\circ\text{C}$
		—	1.45	—		$I_C = 33A, V_{GE} = 15V, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	$V_{CE} = V_{GE}, I_C = 1\text{mA}$
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-12	—	mV/°C	$V_{CE} = V_{GE}, I_C = 1.0\text{mA}$ (25°C - 150°C)
$g_{fe}$	Forward Transconductance	—	30	—	S	$V_{CE} = 50V, I_C = 33A, PW = 20\mu\text{s}$
$I_{CES}$	Collector-to-Emitter Leakage Current	—	—	250	$\mu\text{A}$	$V_{GE} = 0V, V_{CE} = 1200V$
		—	—	2.0		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$
		—	—	1000		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{GE} = \pm 20V$

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	151	227	nC	$I_C = 33A$ $V_{GE} = 15V$ $V_{CC} = 600V$
$Q_{ge}$	Gate-to-Emitter Charge (turn-on)	—	26	39		
$Q_{gc}$	Gate-to-Collector Charge (turn-on)	—	62	93		
$E_{off}$	Turn-Off Switching Loss	—	15	16	mJ	$I_C = 33A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 5\Omega, L = 400\mu\text{H}, T_J = 25^\circ\text{C}$ Energy losses include tail
$t_{d(off)}$	Turn-Off delay time	—	485	616	ns	$I_C = 33A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 5\Omega, L = 400\mu\text{H}, T_J = 25^\circ\text{C}$
$t_f$	Fall time	—	1193	1371		
$E_{off}$	Turn-Off Switching Loss	—	29	—	mJ	$I_C = 33A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 5\Omega, L = 400\mu\text{H}, T_J = 25^\circ\text{C}$ Energy losses include tail
$t_{d(off)}$	Turn-Off delay time	—	689	—	ns	$I_C = 33A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 5\Omega, L = 400\mu\text{H}, T_J = 25^\circ\text{C}$
$t_f$	Fall time	—	2462	—		
$C_{ies}$	Input Capacitance	—	3804	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0\text{Mhz}$
$C_{oes}$	Output Capacitance	—	161	—		
$C_{res}$	Reverse Transfer Capacitance	—	31	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ\text{C}, I_C = 99A$ $V_{CC} = 960V, V_p \leq 1200V$ $R_g = 5\Omega, V_{GE} = +20V \text{ to } 0V$

### Notes:

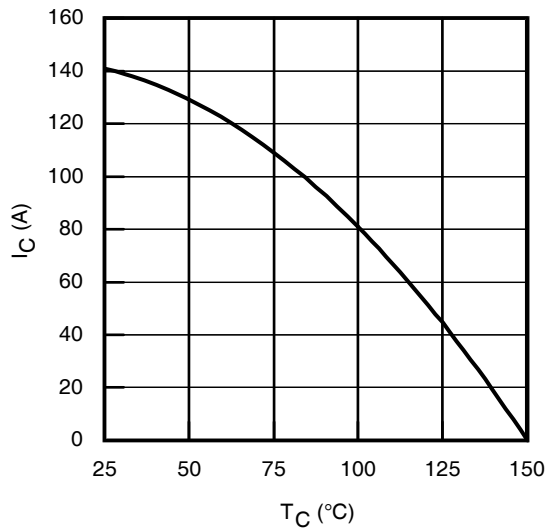
- ①  $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 400\mu\text{H}, R_G = 50\Omega$ .
- ② Pulse width limited by max. junction temperature.
- ③ Refer to AN-1086 for guidelines for measuring  $V_{(BR)CES}$  safely.
- ④  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ⑤ Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 78A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements.

**Qualification Information†**

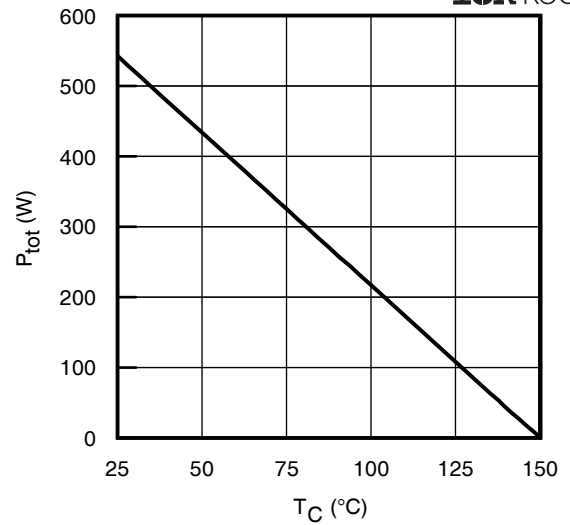
<b>Qualification Level</b>		Automotive (per AEC-Q101) ††	
		Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
<b>Moisture Sensitivity Level</b>		3L-Super-TO-220	N/A
<b>ESD</b>	Machine Model	Class M4 (+/- 800 V ) (per AEC-Q101-002)	
	Human Body Model	Class H3A (+/- 6000V ) (per AEC-Q101-001)	
	Charged Device Model	Class C5 (+/- 2000 V ) (per AEC-Q101-005)	
<b>RoHS Compliant</b>		Yes	

† Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/>

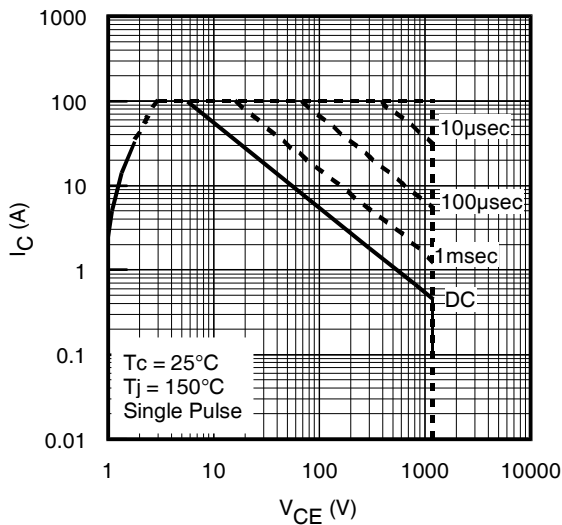
†† Highest passing voltage.



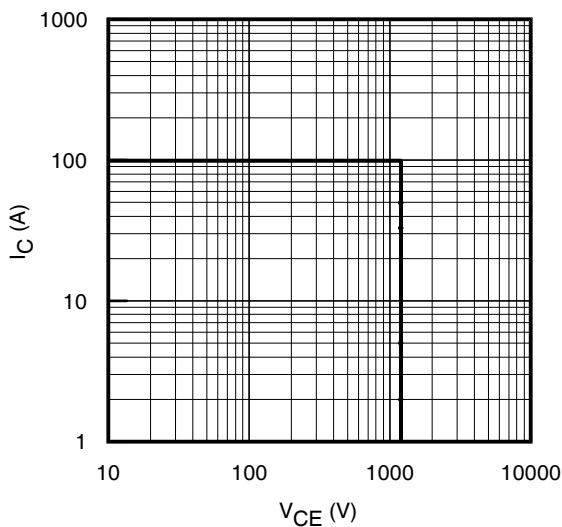
**Fig. 1** - Maximum DC Collector Current vs. Case Temperature



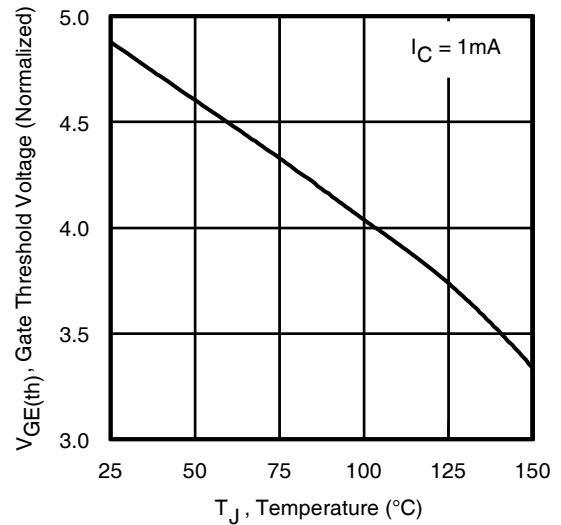
**Fig. 2** - Power Dissipation vs. Case Temperature



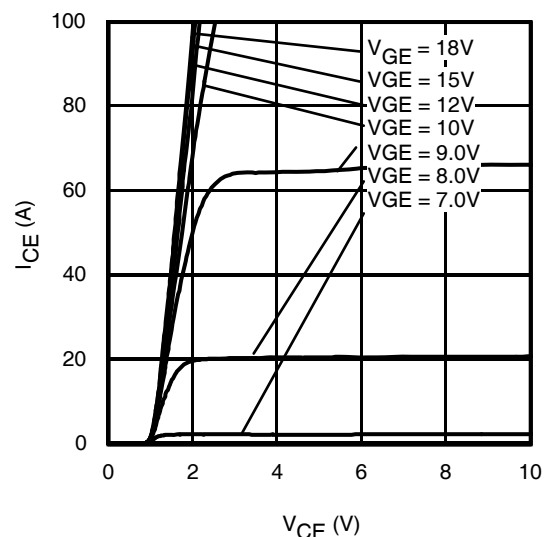
**Fig. 3** - Forward SOA  
 $T_C = 25^\circ\text{C}$ ,  $T_J \leq 150^\circ\text{C}$ ;  $V_{GE} = 15\text{V}$



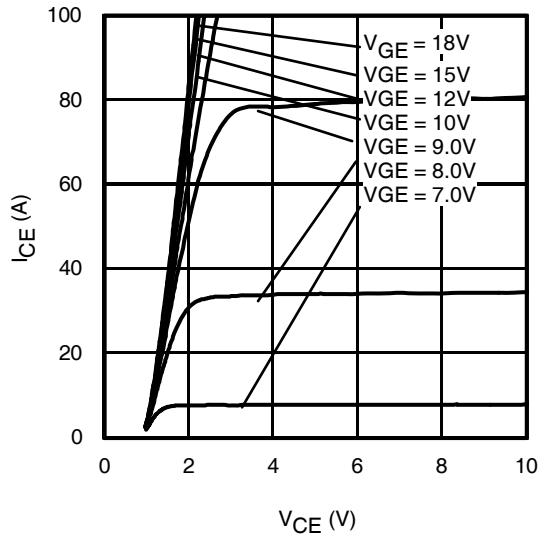
**Fig. 5** - Reverse Bias SOA  
 $T_J = 150^\circ\text{C}$ ;  $V_{GE} = 20\text{V}$



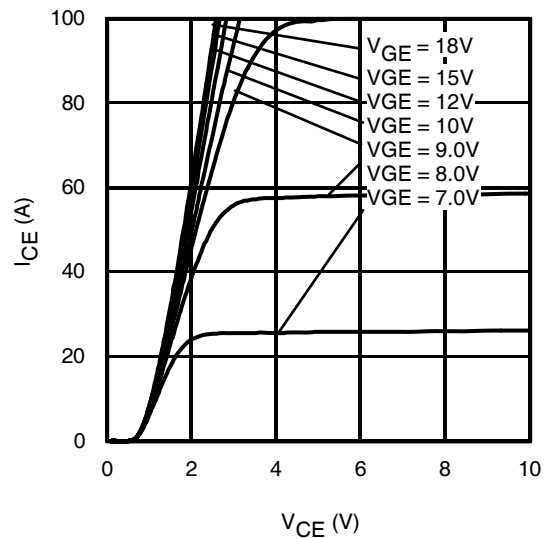
**Fig. 4** - Typical Gate Threshold Voltage (Normalized) vs. Junction Temperature



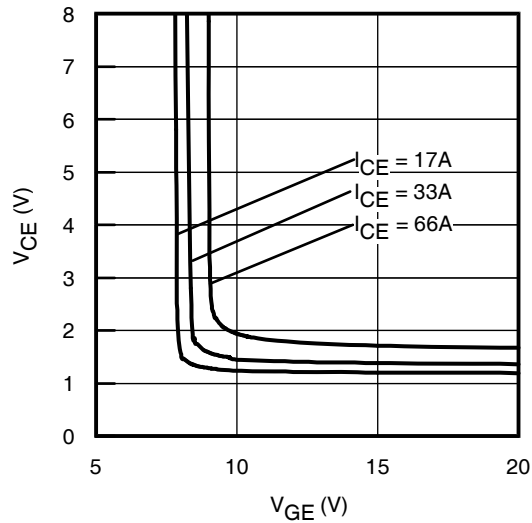
**Fig. 6** - Typ. IGBT Output Characteristics  
 $T_J = -40^\circ\text{C}$ ;  $t_p = 20\mu\text{s}$



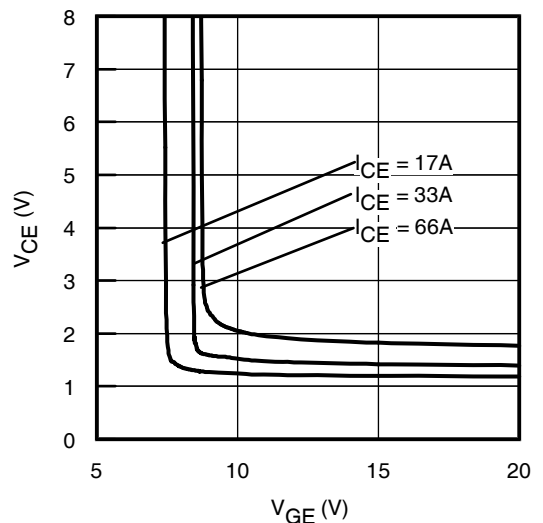
**Fig. 7** - Typ. IGBT Output Characteristics  
 $T_J = 25^\circ\text{C}$ ;  $t_p = 20\mu\text{s}$



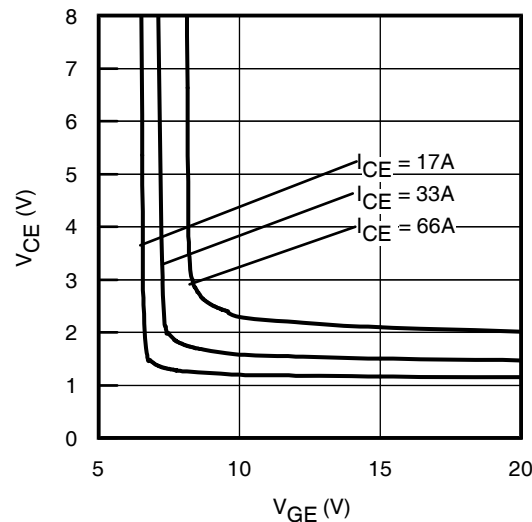
**Fig. 8** - Typ. IGBT Output Characteristics  
 $T_J = 150^\circ\text{C}$ ;  $t_p = 20\mu\text{s}$



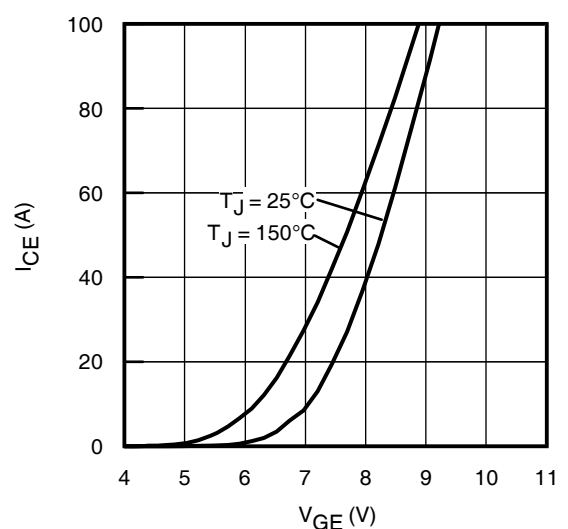
**Fig. 9** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$



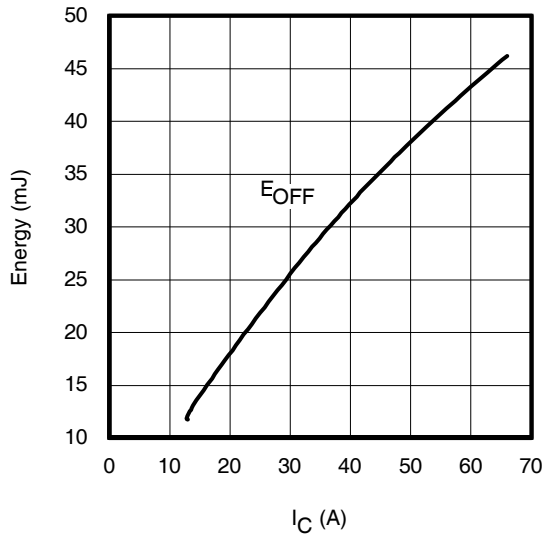
**Fig. 10** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$



**Fig. 11** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 150^\circ\text{C}$

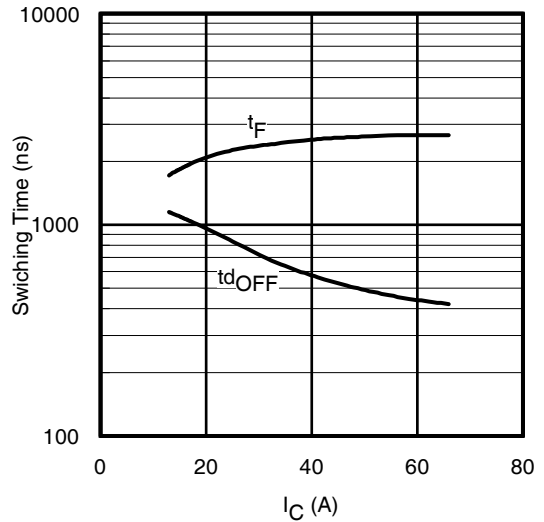


**Fig. 12** - Typ. Transfer Characteristics  
 $V_{CE} = 50\text{V}$ ;  $t_p = 20\mu\text{s}$



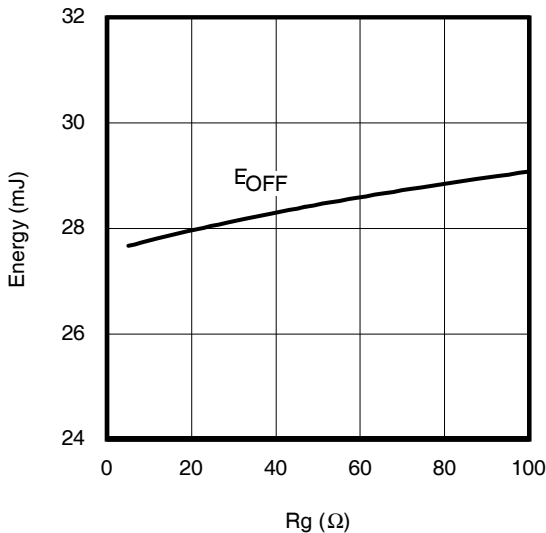
**Fig. 13** - Typ. Energy Loss vs.  $I_C$

$T_J = 150^\circ\text{C}$ ;  $L = 400\mu\text{H}$ ;  $V_{CE} = 600\text{V}$ ,  $R_G = 5\Omega$ ;  $V_{GE} = 15\text{V}$



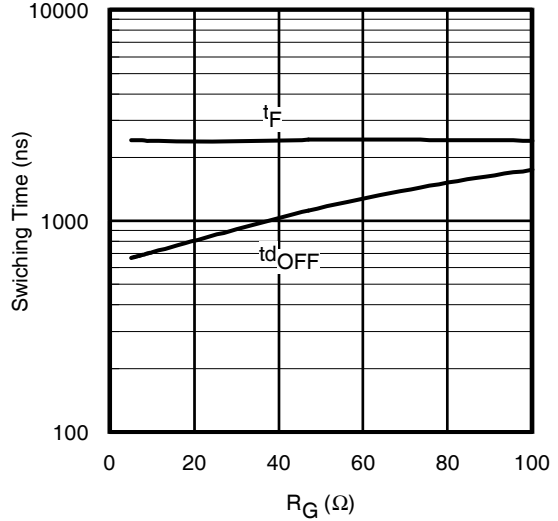
**Fig. 14** - Typ. Switching Time vs.  $I_C$

$T_J = 150^\circ\text{C}$ ;  $L = 400\mu\text{H}$ ;  $V_{CE} = 600\text{V}$ ,  $R_G = 5\Omega$ ;  $V_{GE} = 15\text{V}$



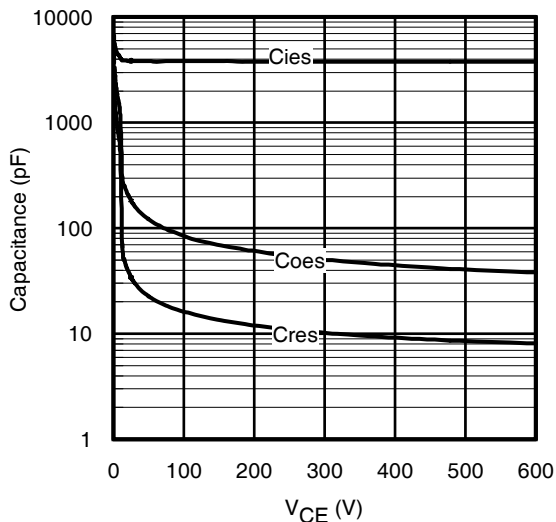
**Fig. 15** - Typ. Energy Loss vs.  $R_G$

$T_J = 150^\circ\text{C}$ ;  $L = 400\mu\text{H}$ ;  $V_{CE} = 600\text{V}$ ,  $I_{CE} = 33\text{A}$ ;  $V_{GE} = 15\text{V}$

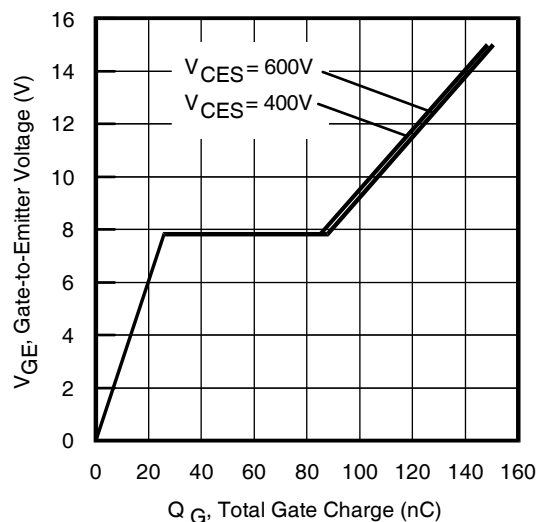


**Fig. 16** - Typ. Switching Time vs.  $R_G$

$T_J = 150^\circ\text{C}$ ;  $L = 400\mu\text{H}$ ;  $V_{CE} = 600\text{V}$ ,  $I_{CE} = 33\text{A}$ ;  $V_{GE} = 15\text{V}$



**Fig. 17** - Typ. Capacitance vs.  $V_{CE}$   
 $V_{GE} = 0\text{V}$ ;  $f = 1\text{MHz}$



**Fig. 18** - Typical Gate Charge vs.  $V_{GE}$   
 $I_{CE} = 33\text{A}$ ;  $L = 2.0\text{mH}$

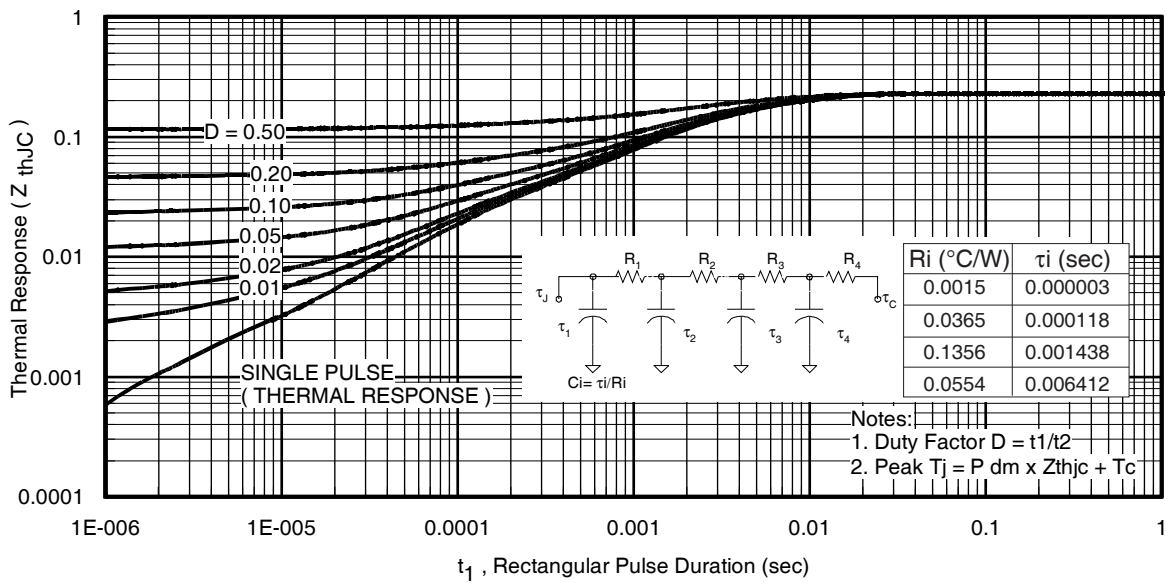


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

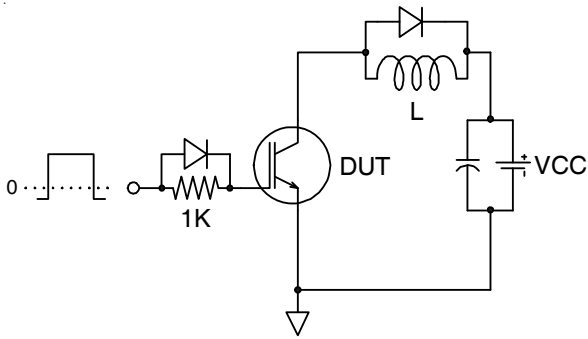


Fig.C.T.1 - Gate Charge Circuit (turn-off)

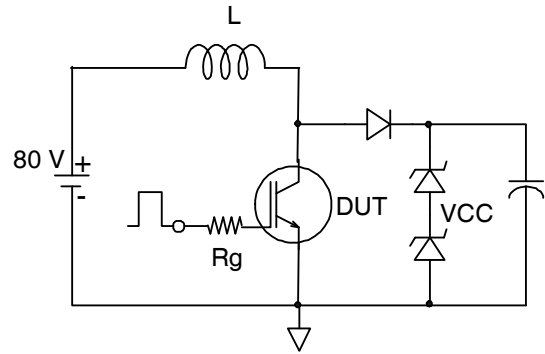


Fig.C.T.2 - RBSOA Circuit

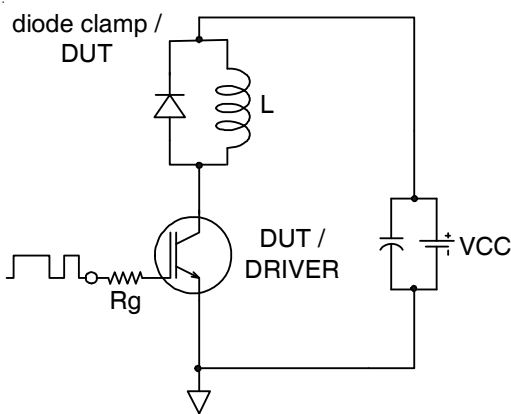


Fig.C.T.3 - Switching Loss Circuit

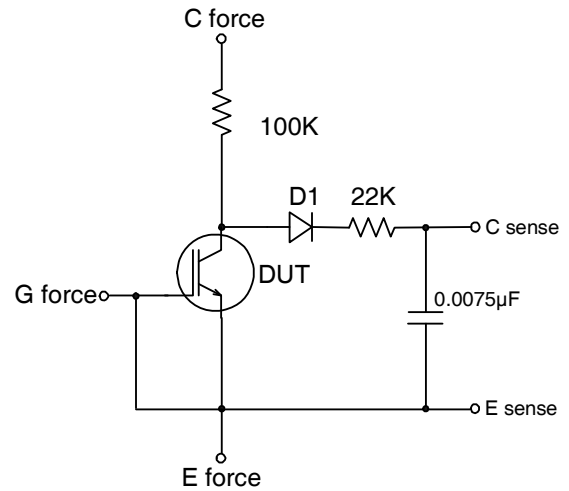


Fig.C.T.4 - BVCES Filter Circuit

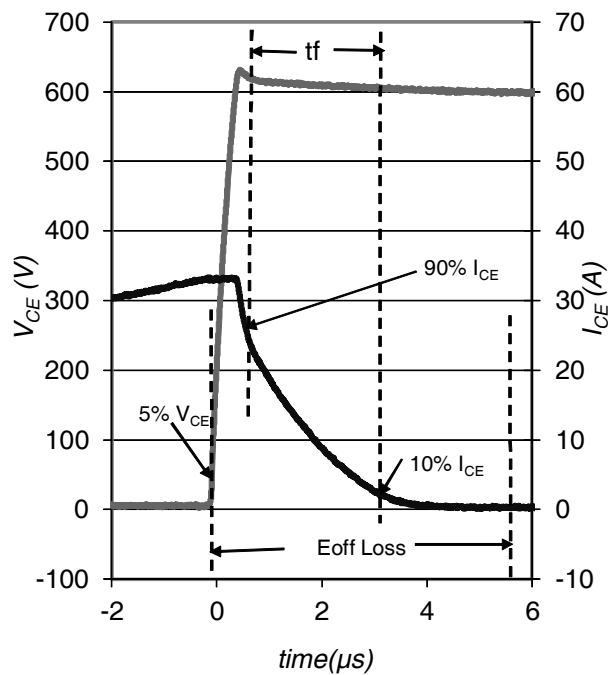
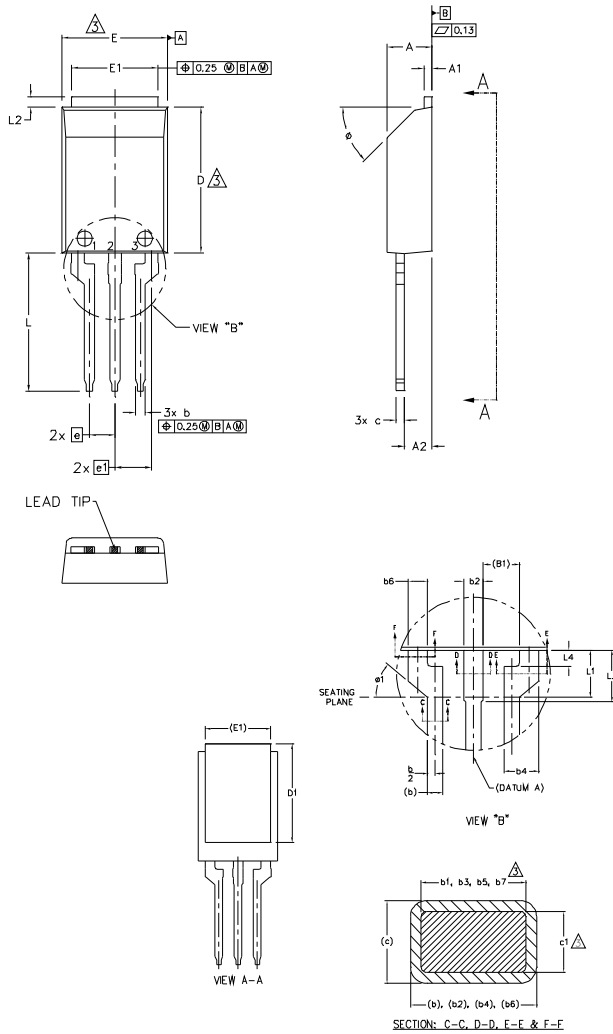


Fig. WF1 - Typ. Turn-off Loss Waveform  
@  $T_J = 150^{\circ}\text{C}$  using Fig. CT.3



**Super-TO-220 Package Outline**

Dimensions are shown in millimeters (inches)



NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M-1994
2. DIMENSIONS b1, b3, b5, b7 & c1 APPLY TO BASE METAL ONLY.
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 OUTER EXTREMES OF THE PLASTIC BODY.
4. - b2 AND b6 DO NOT INCLUDE MOLD FLASH.
5. - (X.XX) MEANS REFERENCE DIMENSION.
6. - ALL DIMENSIONS SHOWN IN MILLIMETERS.
7. - CONTROLLING DIMENSION: MILLIMETER.
8. - OUTLINE CONFORMS TO JEDEC OUTLINE TO-273AA.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.34	4.74	.171	.187	
A1	0.50	1.00	.020	.039	
A2	2.50	3.00	.098	.118	
B1	(2.2)	-	(.087)	-	5
b	0.90	1.30	.035	.051	
b1	0.80	1.10	.031	.043	2
b2	1.25	1.65	.049	.065	4
b3	1.10	1.55	.043	.061	2
b4	2.35	2.55	.093	.100	
b5	2.30	2.50	.091	.098	2
b6	1.25	1.65	.049	.065	4
b7	1.10	1.55	.043	.061	2
c	0.70	1.00	.028	.039	
c1	0.60	0.90	.024	.035	2
D	14.00	15.00	.0551	.591	3
D1	12.50	13.50	.492	.531	
E	10.00	11.00	.394	.433	3
E1	8.00	9.00	.315	.354	
e	2.55 BSC		.100 BSC		
e1	3.66 BSC		.144 BSC		
L	13.00	14.50	.512	.571	
L1	3.00	3.50	.118	.138	
L2	0.50	1.50	.020	.059	
L3	3.50	4.00	.138	.157	
L4	-	1.50	-	.059	
ø	42.5*	47.5*	42.5*	47.5*	
ø1	-	42.5*	-	42.5*	

LEAD ASSIGNMENTS

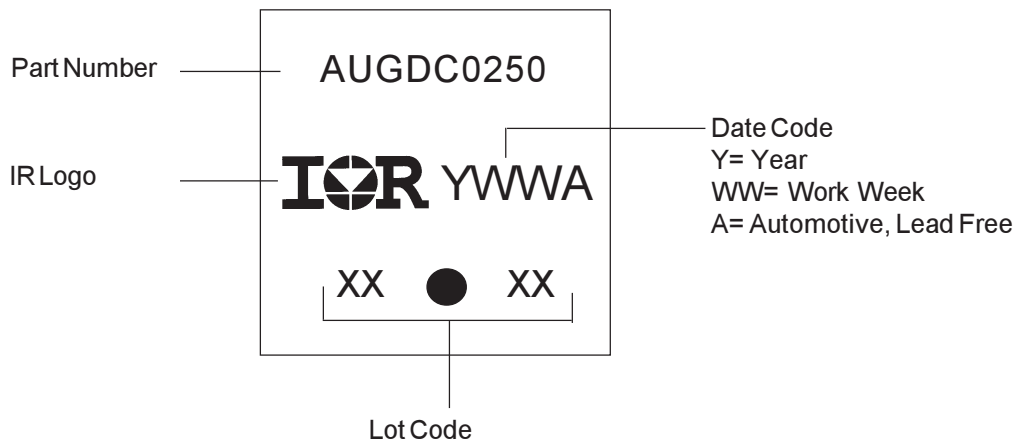
MOSFET

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

IGBT

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

**Super-TO-220 Part Marking Information**



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

## Ordering Information

Base part number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRGDC0250	Super-TO-220	Tube	50	AUIRGDC0250

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For technical support, please contact IR's Technical Assistance Center

<http://www.irf.com/technical-info/>

### WORLD HEADQUARTERS:

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