

AUIRGPS4067D1

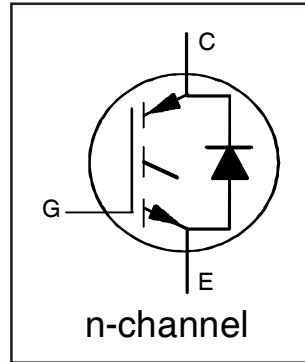
INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

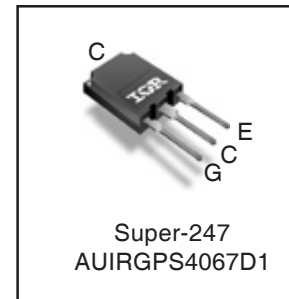
- Low $V_{CE(on)}$ Trench IGBT Technology
- Low Switching Losses
- 5 μ s SCSOA
- Square RBSOA
- 100% of the parts tested for I_{LM} ①
- Positive $V_{CE(on)}$ Temperature Coefficient
- Soft Recovery Co-pak Diode
- Lead-Free, RoHS Compliant
- Automotive Qualified *

Benefits

- High Efficiency in a Wide Range of Applications
- Suitable for Applications in the Low to Mid-Range Frequencies
- Rugged Transient Performance for Increased Reliability
- Excellent Current Sharing in Parallel Operation
- Low EMI



$V_{CES} = 600V$
$I_C = 160A, T_C = 100^\circ C$
$t_{SC} \geq 5\mu s, T_{J(max)} = 175^\circ C$
$V_{CE(on)} \text{ typ.} = 1.70V$



G	C	E
Gate	Collector	Emitter

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.

	Parameter	Max.	Units	
V_{CES}	Collector-to-Emitter Voltage	600	V	
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	240 ^②	A	
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	160		
$I_{NOMINAL}$	Nominal Current	120		
I_{CM}	Pulse Collector Current, $V_{GE} = 15V$	360		
I_{LM}	Clamped Inductive Load Current, $V_{GE} = 20V$ ①	480		
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	240		
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	160		
I_{FM}	Diode Maximum Forward Current ②	480		
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20		V
	Transient Gate-to-Emitter Voltage	± 30		
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	750	W	
		$P_D @ T_C = 100^\circ C$		375
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)		

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT) ④	—	—	0.20	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode) ④	—	—	0.44	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	40	—	

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

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
V _{(BR)CES}	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V _{GE} = 0V, I _C = 500μA ③
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	0.19	—	V/°C	V _{GE} = 0V, I _C = 30mA (25°C-175°C)
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.70	2.05	V	I _C = 120A, V _{GE} = 15V, T _J = 25°C
		—	2.15	—		I _C = 120A, V _{GE} = 15V, T _J = 150°C
		—	2.20	—		I _C = 120A, V _{GE} = 15V, T _J = 175°C
V _{GE(th)}	Gate Threshold Voltage	4.0	—	6.5	V	V _{CE} = V _{GE} , I _C = 1.0mA
ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	—	-28	—	mV/°C	V _{CE} = V _{GE} , I _C = 1.0mA (25°C - 175°C)
g _f	Forward Transconductance	—	85	—	S	V _{CE} = 50V, I _C = 120A
I _{CES}	Collector-to-Emitter Leakage Current	—	2.3	200	μA	V _{GE} = 0V, V _{CE} = 600V
		—	9.4	—	mA	V _{GE} = 0V, V _{CE} = 600V, T _J = 175°C
V _{FM}	Diode Forward Voltage Drop	—	—	1.46	V	I _F = 41A
		—	1.9	—		I _F = 120A
		—	2.0	—		I _F = 120A, T _J = 175°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
Q _g	Total Gate Charge (turn-on)	—	240	360	nC	I _C = 120A
Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	69	104		V _{GE} = 15V
Q _{gc}	Gate-to-Collector Charge (turn-on)	—	90	135		V _{CC} = 400V
E _{on}	Turn-On Switching Loss	—	8.2	10	mJ	I _C = 120A, V _{CC} = 400V, V _{GE} = 15V
E _{off}	Turn-Off Switching Loss	—	2.9	3.2		R _G = 4.7Ω, L = 87μH, T _J = 25°C
E _{total}	Total Switching Loss	—	11.1	13.2		Energy losses include tail & diode reverse recovery
t _{d(on)}	Turn-On delay time	—	69	82	ns	I _C = 120A, V _{CC} = 400V, V _{GE} = 15V
t _r	Rise time	—	65	82		R _G = 4.7Ω, L = 87μH, T _J = 25°C
t _{d(off)}	Turn-Off delay time	—	198	230		
t _f	Fall time	—	38	48		
E _{on}	Turn-On Switching Loss	—	10	—	mJ	I _C = 120A, V _{CC} = 400V, V _{GE} = 15V
E _{off}	Turn-Off Switching Loss	—	3.8	—		R _G = 4.7Ω, L = 87μH, T _J = 175°C ③
E _{total}	Total Switching Loss	—	13.8	—		Energy losses include tail & diode reverse recovery
t _{d(on)}	Turn-On delay time	—	63	—	ns	I _C = 120A, V _{CC} = 400V, V _{GE} = 15V
t _r	Rise time	—	64	—		R _G = 4.7Ω, L = 200μH
t _{d(off)}	Turn-Off delay time	—	230	—		T _J = 175°C
t _f	Fall time	—	51	—		
C _{ies}	Input Capacitance	—	7780	—	pF	V _{GE} = 0V
C _{oes}	Output Capacitance	—	505	—		V _{CC} = 30V
C _{res}	Reverse Transfer Capacitance	—	245	—		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 175°C, I _C = 480A V _{CC} = 480V, V _p = 600V R _G = 4.7Ω, V _{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V _{CC} = 400V, V _p = 600V R _G = 4.7Ω, V _{GE} = +15V to 0V
E _{rec}	Reverse Recovery Energy of the Diode	—	2440	—	μJ	T _J = 175°C
t _{rr}	Diode Reverse Recovery Time	—	360	—	ns	V _{CC} = 400V, I _F = 120A
I _{rr}	Peak Reverse Recovery Current	—	53	—	A	V _{GE} = 15V, R _G = 4.7Ω, L = 87μH

Notes:

- V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 0.87μH, R_G = 4.7Ω, tested in production I_{LM} ≤ 400A.
- Pulse width limited by max. junction temperature.
- Refer to AN-1086 for guidelines for measuring V_{(BR)CES} safely.
- R_θ is measured at T_J of approximately 90°C.
- Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 195A. Note that current limitations arising from heating of the device leads may occur.

Qualification Information[†]

Qualification Level		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.	
Moisture Sensitivity Level		Super-247	N/A
ESD	Machine Model	Class M4 (+/- 400V) ^{†††} AEC-Q101-002	
	Human Body Model	Class H3B (+/- 8000V) ^{†††} AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 1000V) ^{†††} AEC-Q101-005	
RoHS Compliant		Yes	

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

†† Exceptions (if any) to AEC-Q101 requirements are noted in the qualification report.

††† Highest passing voltage.

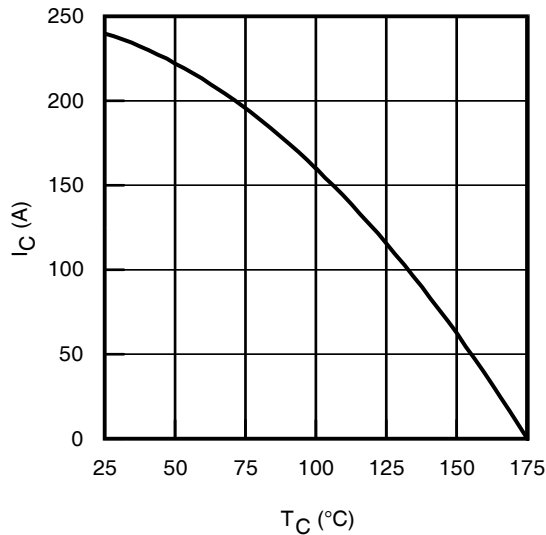


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

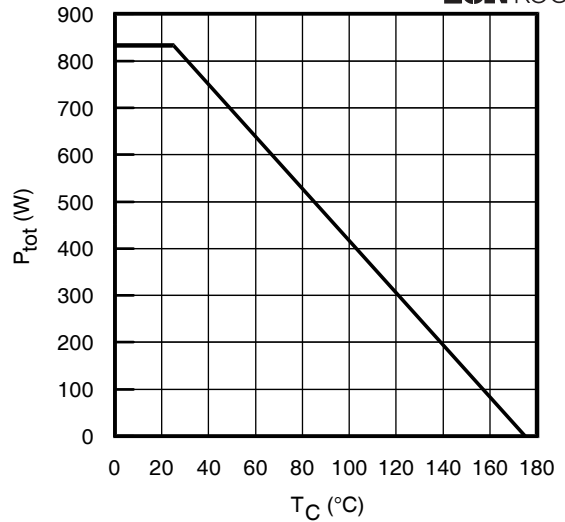


Fig. 2 - Power Dissipation vs. Case Temperature

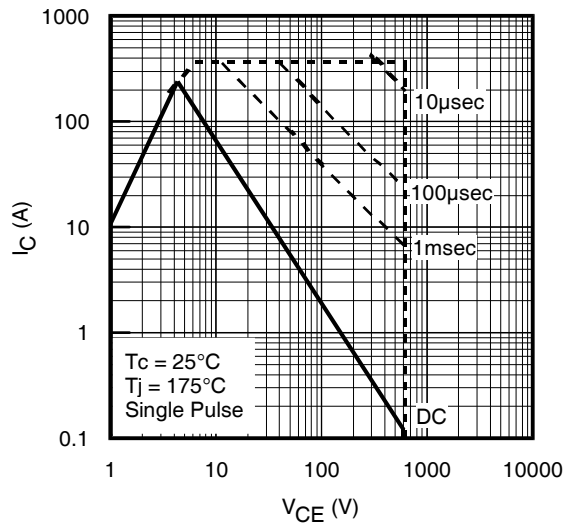


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$, $T_J \leq 175^\circ\text{C}$; $V_{GE} = 15\text{V}$

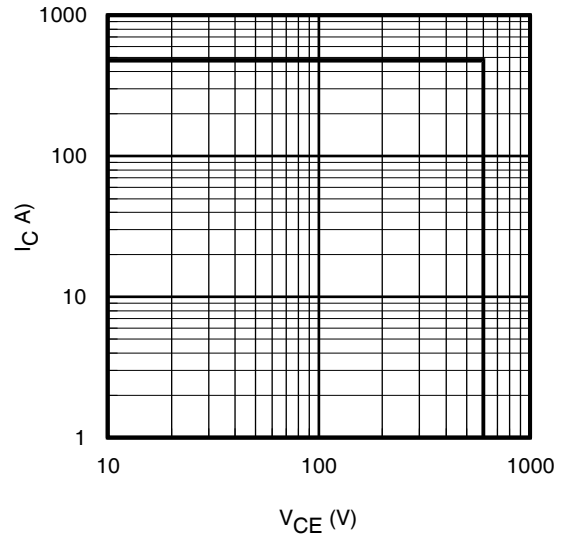


Fig. 4 - Reverse Bias SOA
 $T_J = 175^\circ\text{C}$; $V_{GE} = 20\text{V}$

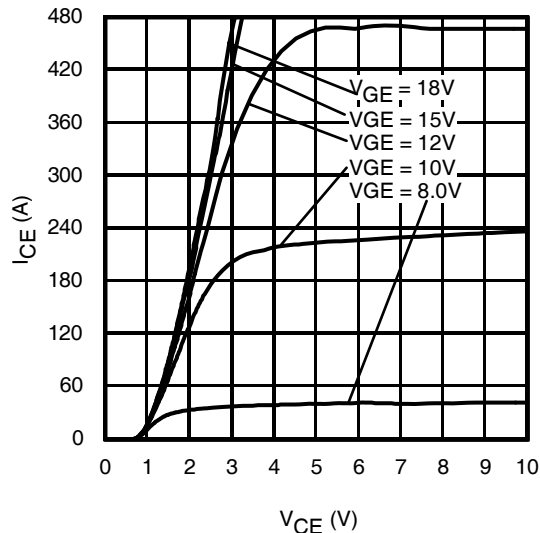


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 30\mu\text{s}$

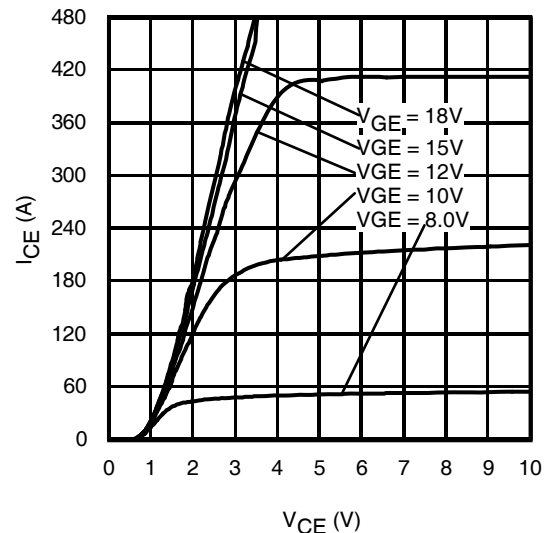


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 30\mu\text{s}$

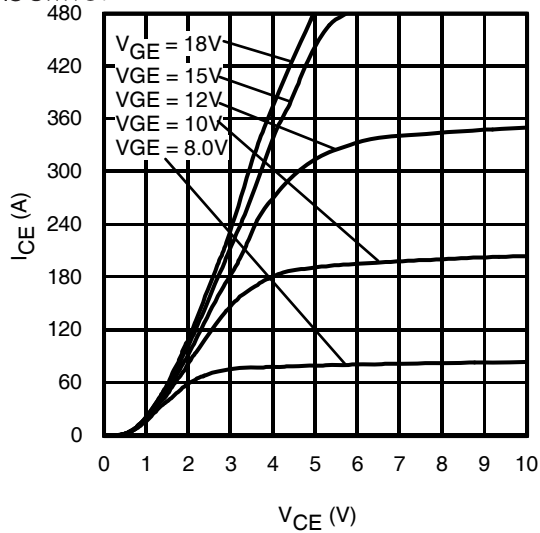


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 175^\circ\text{C}$; $t_p = 30\mu\text{s}$

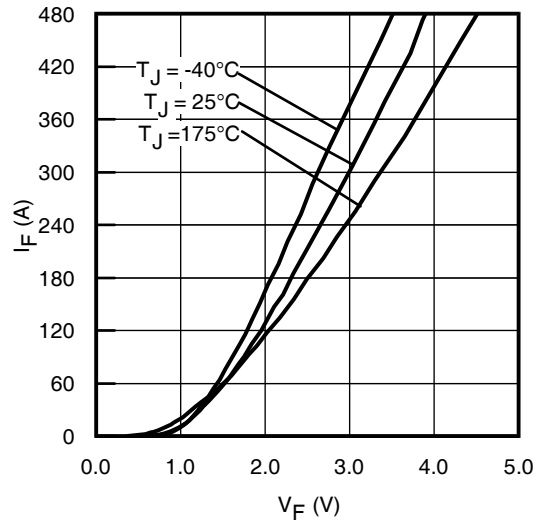


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 30\mu\text{s}$

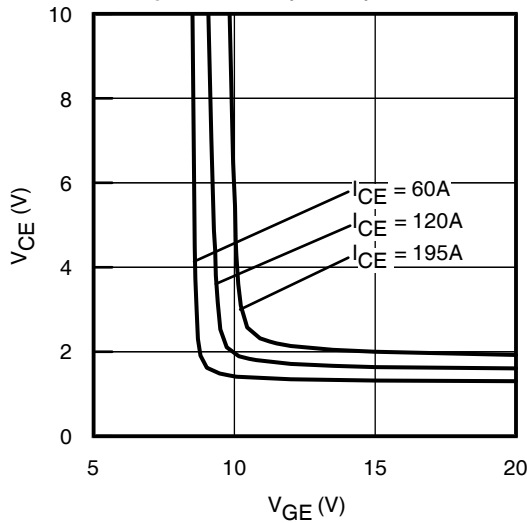


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

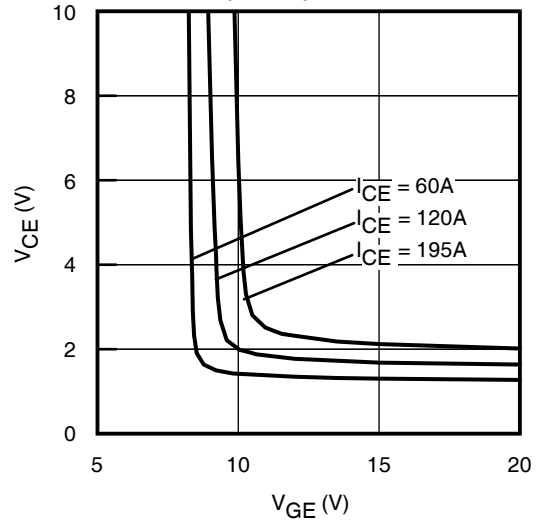


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

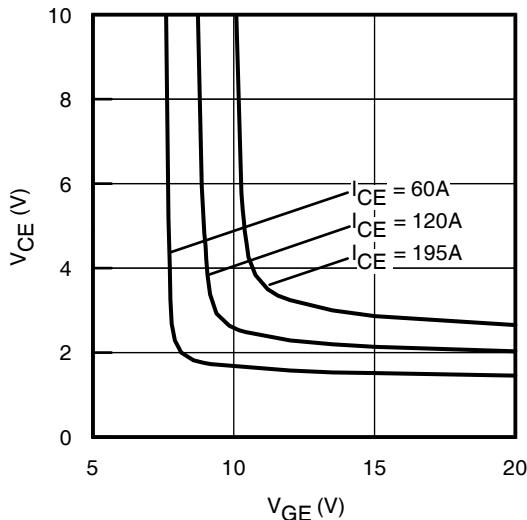


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 175^\circ\text{C}$

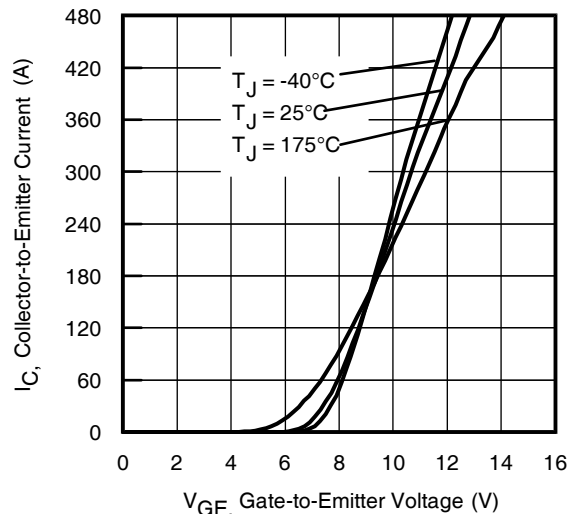


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

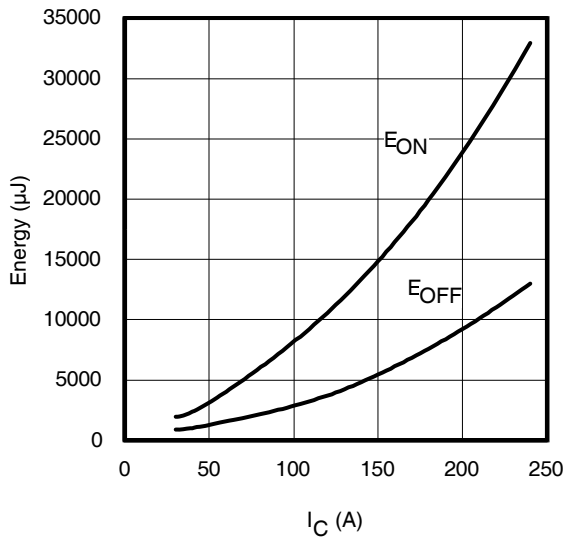


Fig. 13 - Typ. Energy Loss vs. I_C

$T_J = 175^\circ\text{C}$; $L = 0.087\text{mH}$; $V_{CE} = 400\text{V}$, $R_G = 5.0\Omega$; $V_{GE} = 15\text{V}$

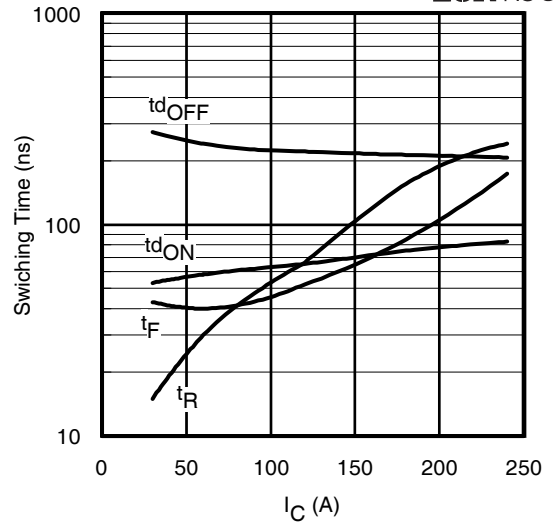


Fig. 14 - Typ. Switching Time vs. I_C

$T_J = 175^\circ\text{C}$; $L = 0.087\text{mH}$; $V_{CE} = 400\text{V}$, $R_G = 5.0\Omega$; $V_{GE} = 15\text{V}$

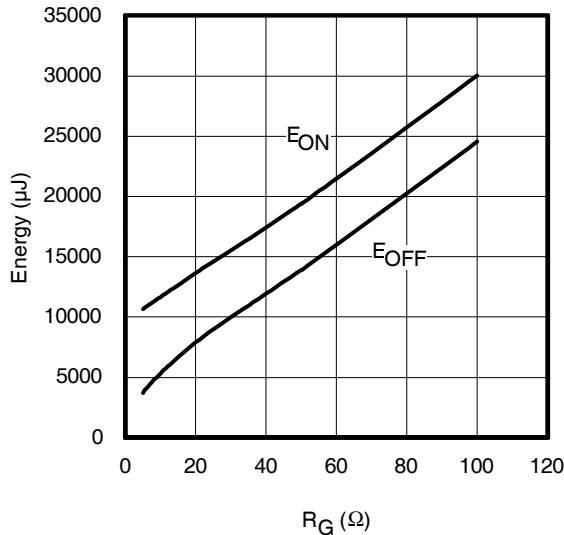


Fig. 15 - Typ. Energy Loss vs. R_G

$T_J = 175^\circ\text{C}$; $L = 0.087\text{mH}$; $V_{CE} = 400\text{V}$, $I_{CE} = 120\text{A}$; $V_{GE} = 15\text{V}$

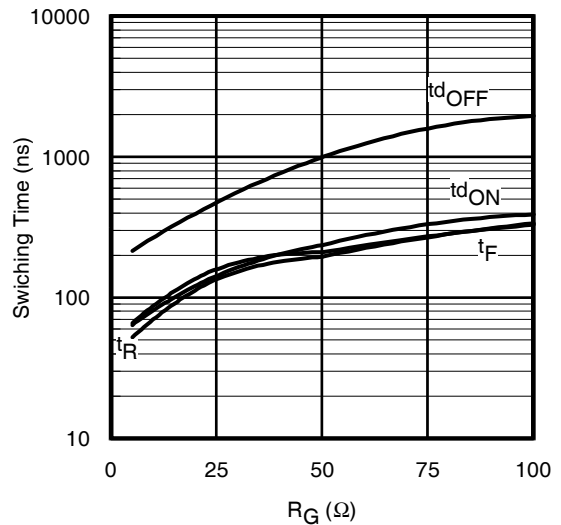


Fig. 16 - Typ. Switching Time vs. R_G

$T_J = 175^\circ\text{C}$; $L = 0.087\text{mH}$; $V_{CE} = 400\text{V}$, $I_{CE} = 120\text{A}$; $V_{GE} = 15\text{V}$

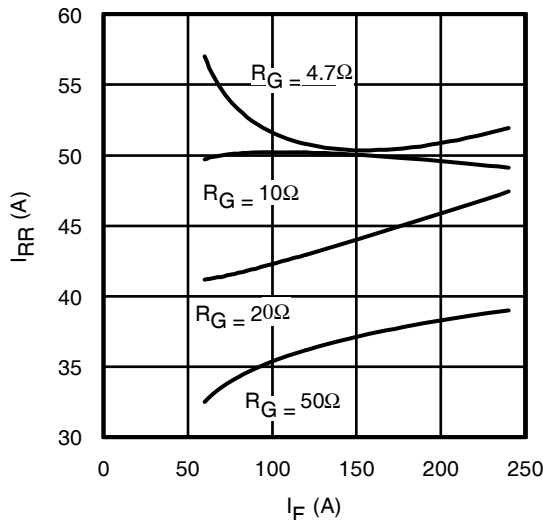


Fig. 17 - Typ. Diode I_{RR} vs. I_F

$T_J = 175^\circ\text{C}$

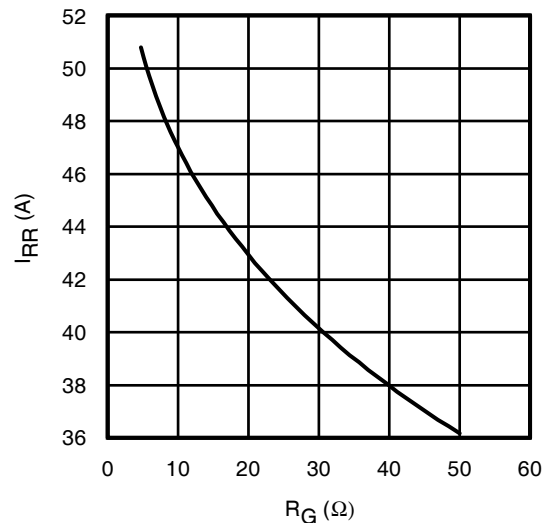


Fig. 18 - Typ. Diode I_{RR} vs. R_G

$T_J = 175^\circ\text{C}$

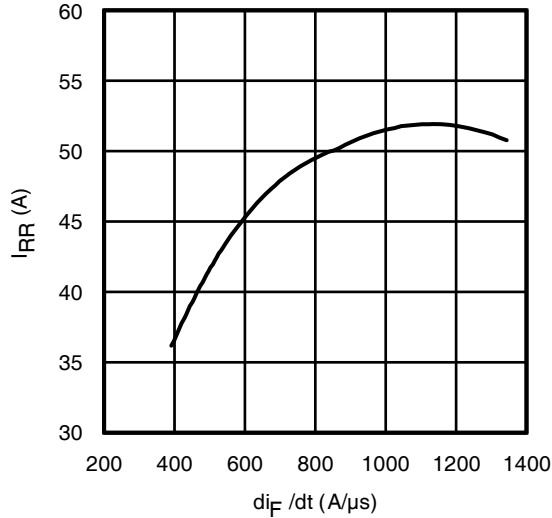


Fig. 19 - Typ. Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400V$; $V_{GE} = 15V$; $I_F = 120A$; $T_J = 175^\circ C$

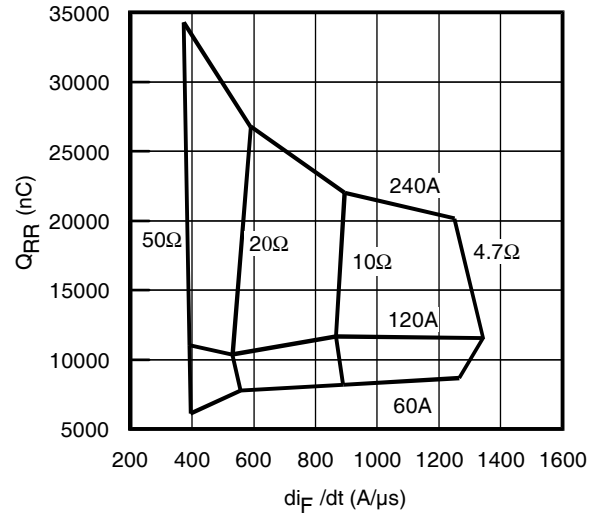


Fig. 20 - Typ. Diode Q_{RR} vs. di_F/dt
 $V_{CC} = 400V$; $V_{GE} = 15V$; $T_J = 175^\circ C$

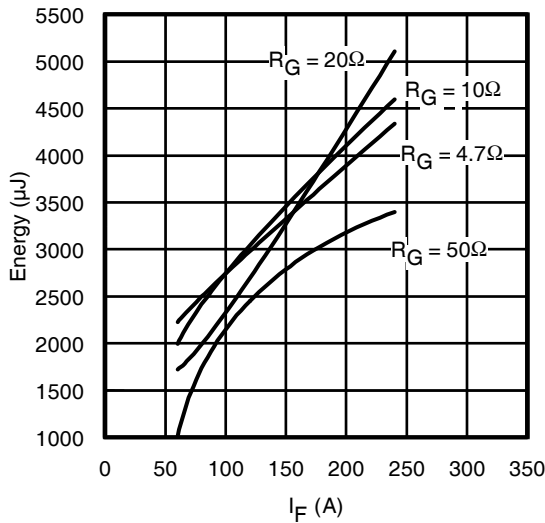


Fig. 21 - Typ. Diode E_{RR} vs. I_F
 $T_J = 175^\circ C$

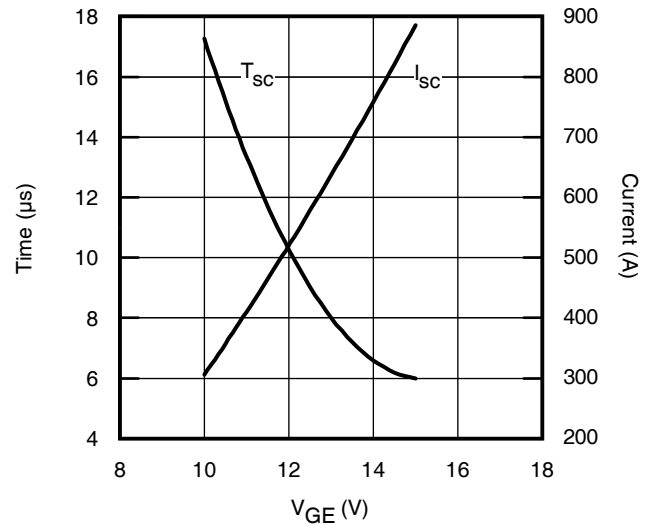


Fig. 22 - V_{GE} vs. Short Circuit Time
 $V_{CC} = 400V$; $T_C = 25^\circ C$

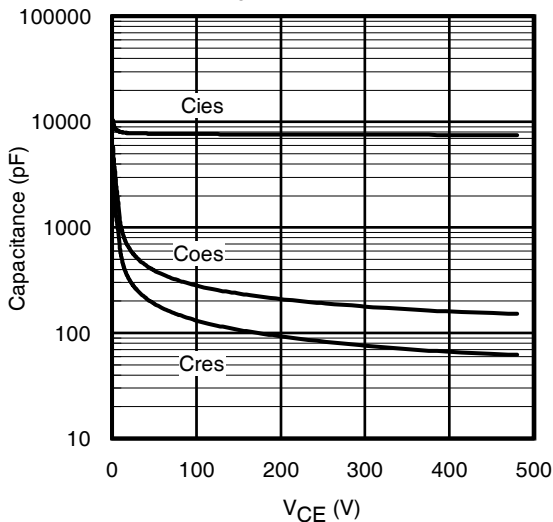


Fig. 23 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

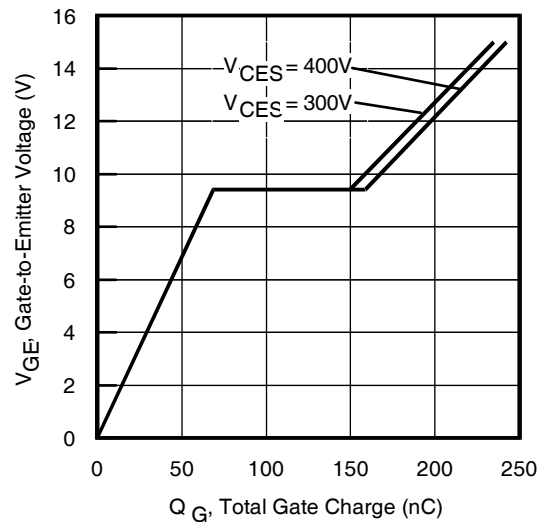


Fig. 24 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 120A$

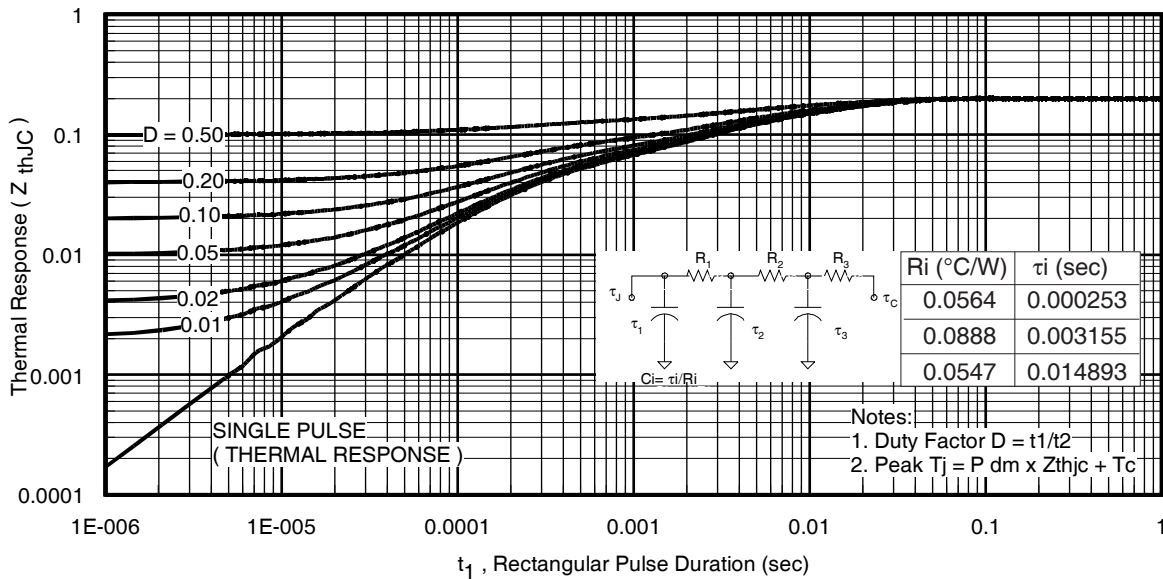


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

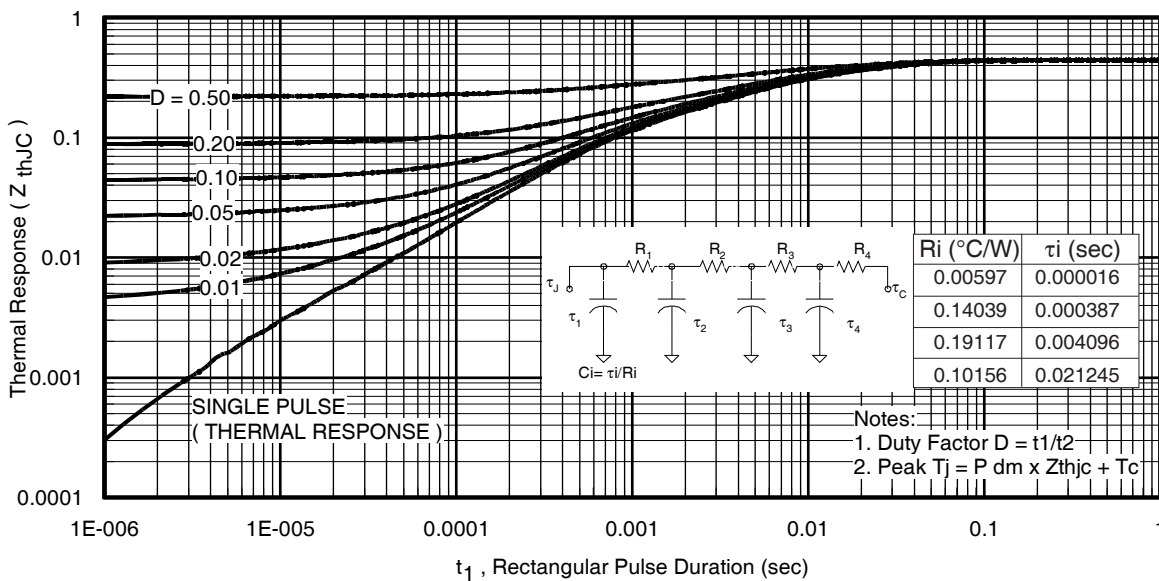


Fig. 26. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

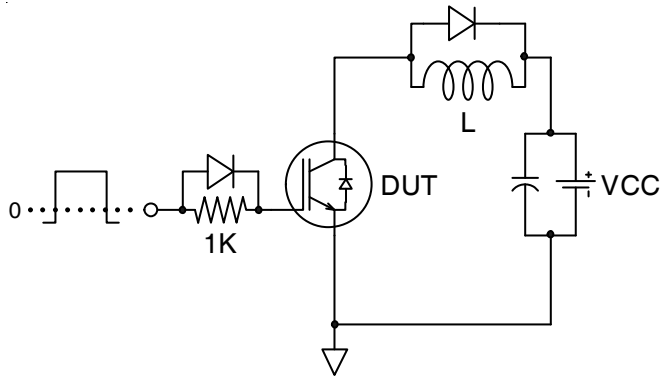


Fig.C.T.1 - Gate Charge Circuit (turn-off)

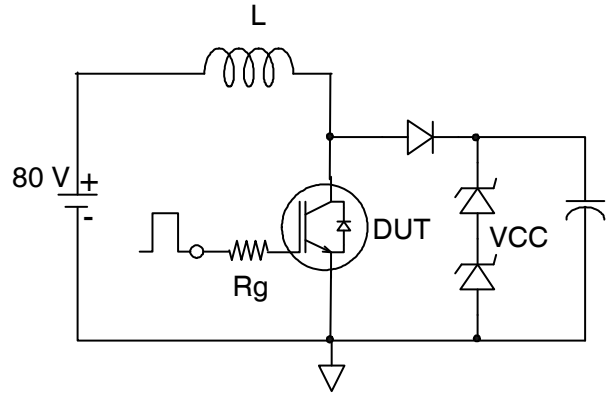


Fig.C.T.2 - RBSOA Circuit

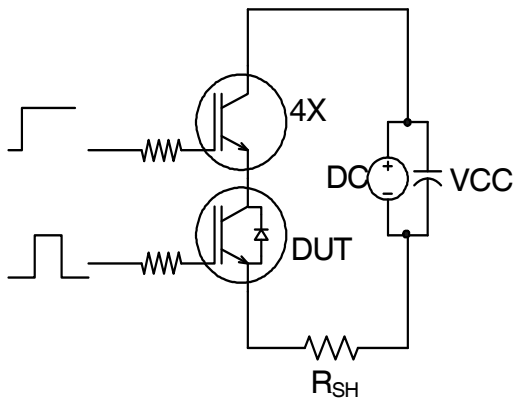


Fig.C.T.3 - S.C. SOA Circuit

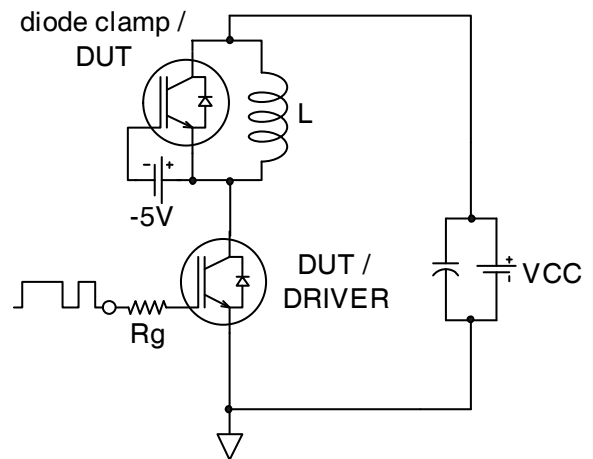


Fig.C.T.4 - Switching Loss Circuit

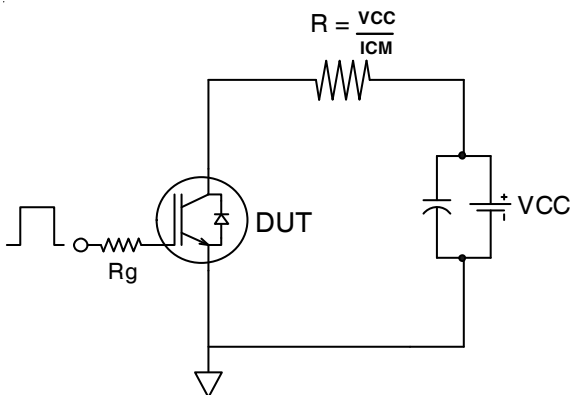


Fig.C.T.5 - Resistive Load Circuit

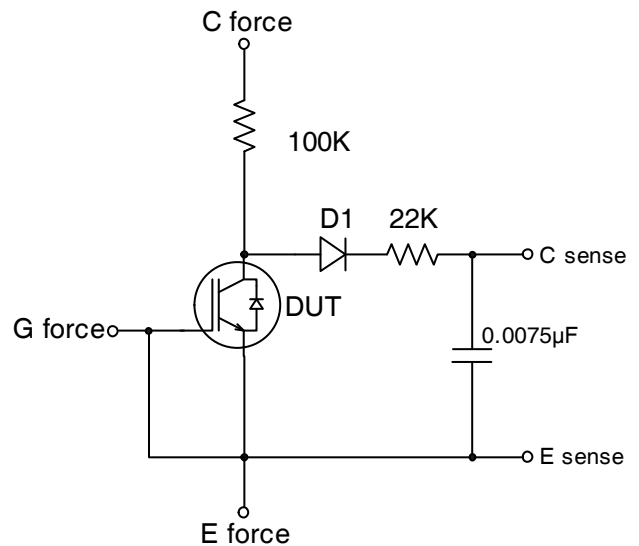


Fig.C.T.6 - BVCES Filter Circuit

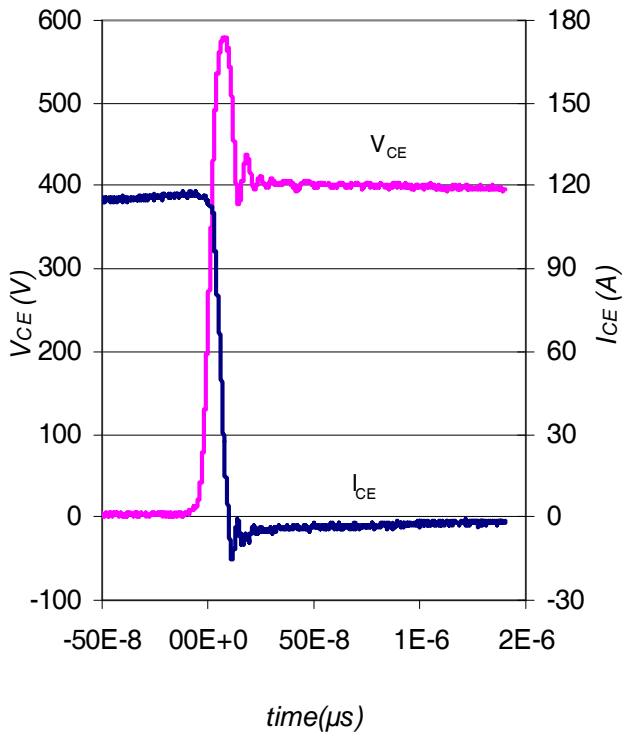


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 175°C using Fig. CT.4

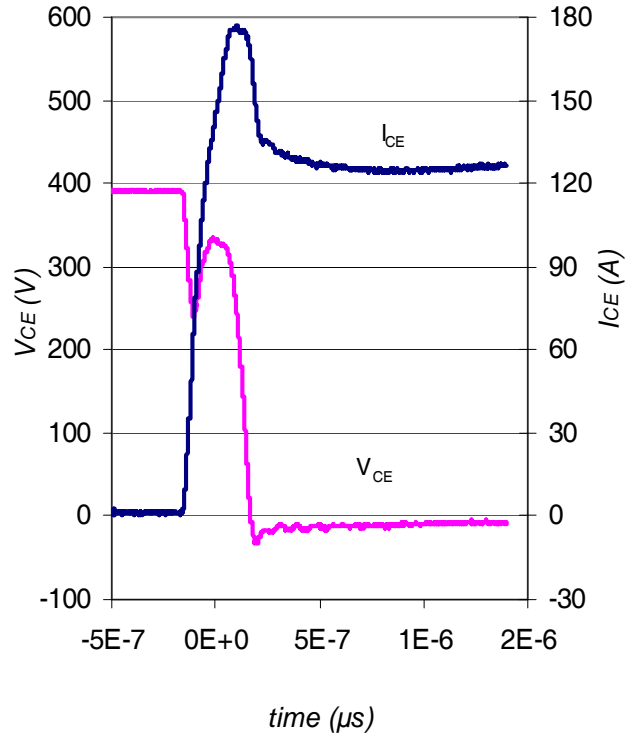


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 175°C using Fig. CT.4

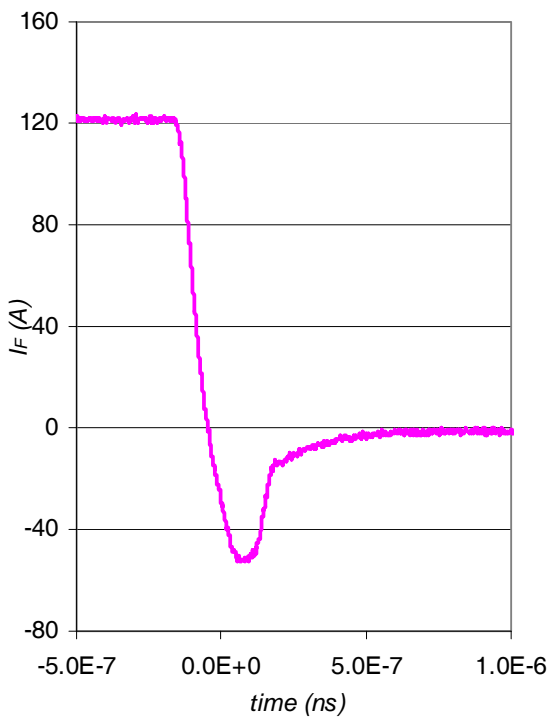


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 175°C using Fig. CT.4

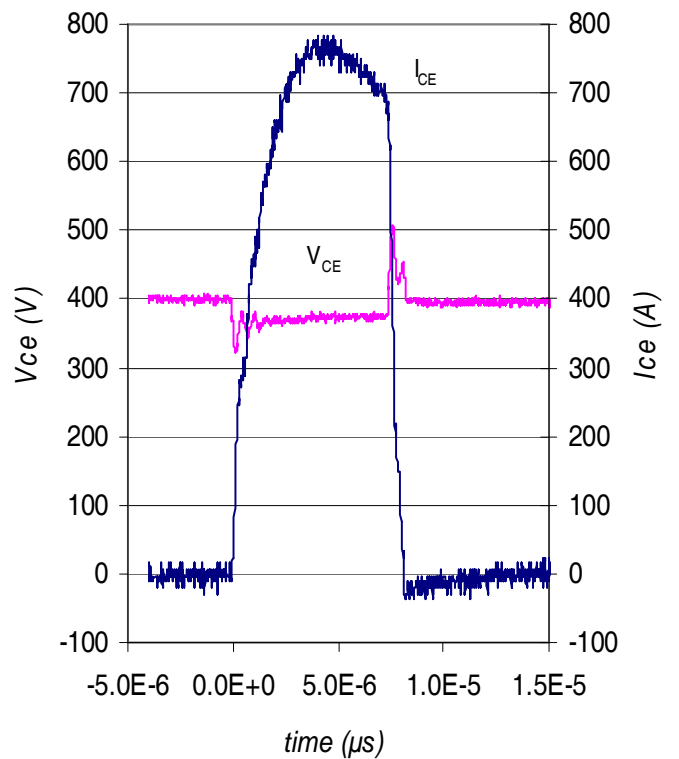
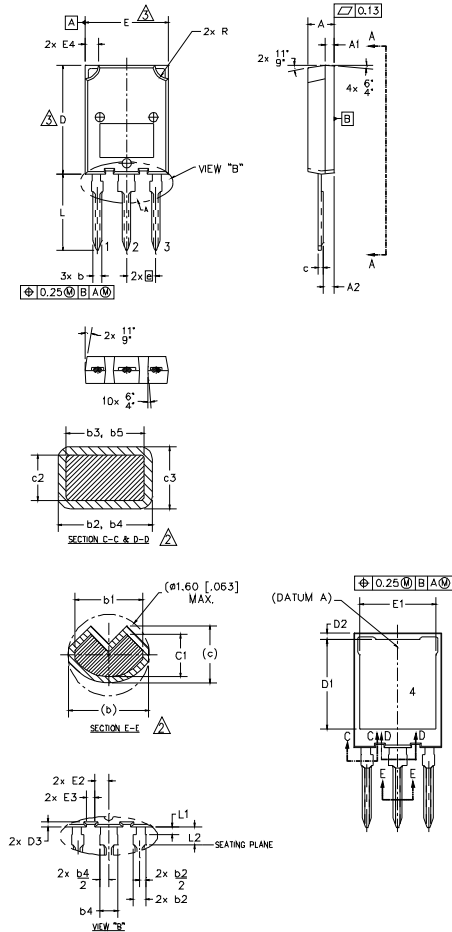


Fig. WF4 - Typ. S.C. Waveform
@ T_J = 25°C using Fig. CT.3

Case Outline and Dimensions — Super-247



NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M-1994
2. DIMENSIONS b1, b3, b5, c1 & c3 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.- ALL DIMENSIONS SHOWN IN MILLIMETERS.
- 5.- CONTROLLING DIMENSION: MILLIMETER.
- 6.- OUTLINE CONFORMS TO JEDEC OUTLINE TO-274AA

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.50	5.50	.177	.217	
A1	1.45	2.15	.057	.085	
A2	1.65	2.35	.065	.093	
b	1.45	1.60	.054	.063	
b1	1.40	1.50	.055	.059	2
b2	2.00	2.40	.079	.094	
b3	1.95	2.35	.077	.093	2
b4	3.00	3.15	.118	.124	
b5	2.95	3.35	.116	.132	2
c	1.10	1.30	.043	.051	
c1	0.90	1.10	.035	.043	2
c2	0.65	0.85	.026	.033	
c3	0.50	0.70	.020	.028	2
D	19.80	20.80	.780	.819	3
D1	15.50	16.10	.610	.634	
D2	0.70	1.30	.028	.051	
D3	0.75	1.25	.030	.049	
E	15.10	16.10	.594	.634	3
E1	13.30	13.90	.524	.547	
E2	2.25	2.70	.089	.109	
E3	1.20	1.70	.047	.067	
E4	2.00	3.00	.079	.118	
e	5.45 BSC		.215 BSC		
L	13.80	14.80	.535	.583	
L1	1.00	1.60	.039	.063	
L2	3.85	4.25	.152	.167	
R	2.00	3.00	.079	.118	

LEAD ASSIGNMENTS

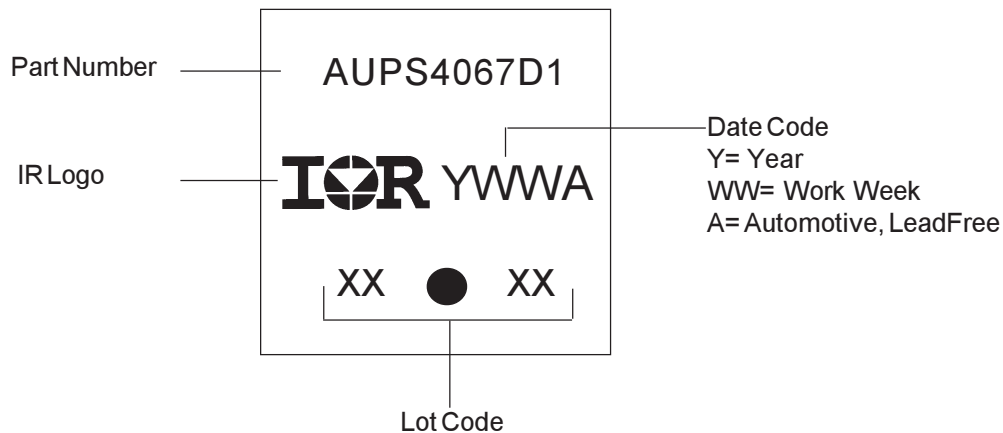
MOSFET

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

IGBT

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

Super-247 (TO-274AA) 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	
AUIRGPS4067D1	Super-247	Tube	25	AUIRGPS4067D1

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