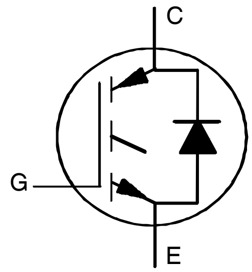
International
IOR Rectifier

AUTOMOTIVE GRADE

PD - 97726C

AUIRGPS4067D1

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE



n-channel

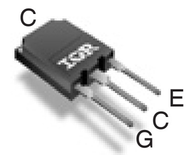
V_{CES} = 600V

I_C = 160A, T_C = 100°C

$t_{SC} \geq$ 6µs, $T_{J(max)}$ = 175°C

$V_{CE(on)}$ typ. = 1.70V

Features
- Low $V_{CE\ (on)}$ Trench IGBT Technology
- Low Switching Losses
- 6µs 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 *



Super-247
AUIRGPS4067D1

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

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°C	Continuous Collector Current	240⑤	A
I_C @ T_C = 100°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	
$I_{F\ NOMINAL}$	Diode Nominal Current ②	120⑤	
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°C	Maximum Power Dissipation	750	W
P_D @ T_C = 100°C	Maximum Power Dissipation	375	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +175	°C
	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
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.27	—	V/°C	V_{GE} = 0V, I_C = 15mA (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 = 5.6mA
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-17	—	mV/°C	V_{CE} = V_{GE}, I_C = 20mA (25°C - 175°C)
gfe	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	—	1.9	2.2	V	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, Vp =600V Rg = 4.7Ω, V_{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	6	—	—	μs	V_{CC} = 400V, Vp =600V Rg = 1.0Ω, V_{GE} = +15V to 0V
Erec	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, Rg = 4.7Ω, L =87μH

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 0.87μH, R_G = 50Ω, tested in production $I_{LM} \leq$ 400A.
② Pulse width limited by max. junction temperature.
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.
⑤ Calculated continuous current based on maximum allowable junction temperature. Package IGBT current limit is 195A. Package diode current limit is120A. 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

†† Highest passing voltage.

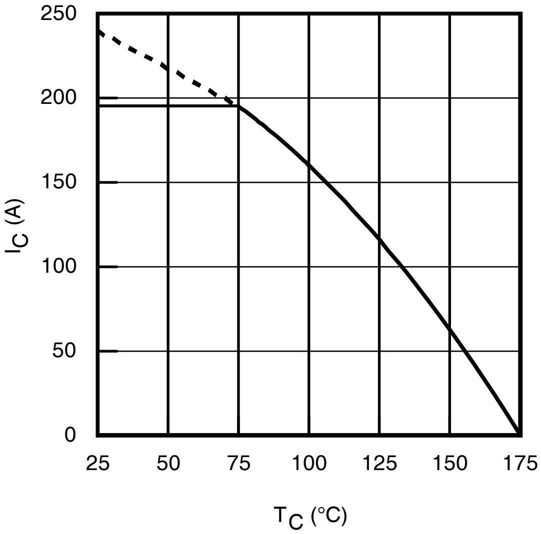


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

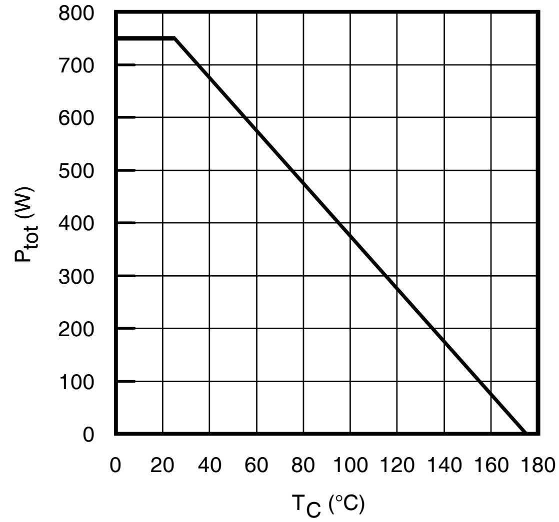


Fig. 2 - Power Dissipation vs. Case Temperature

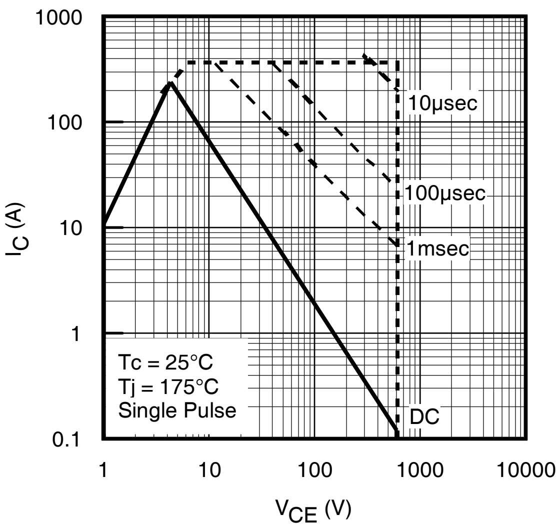


Fig. 3 - Forward SOA
T_C = 25°C, $T_J \leq$ 175°C; V_{GE} =15V

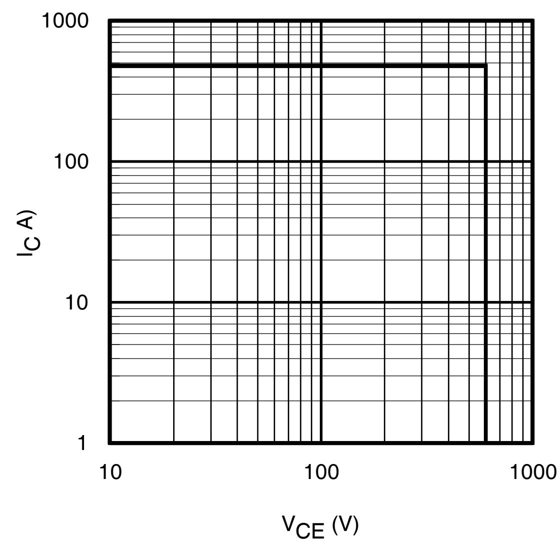


Fig. 4 - Reverse Bias SOA
T_J = 175°C; V_{GE} =20V

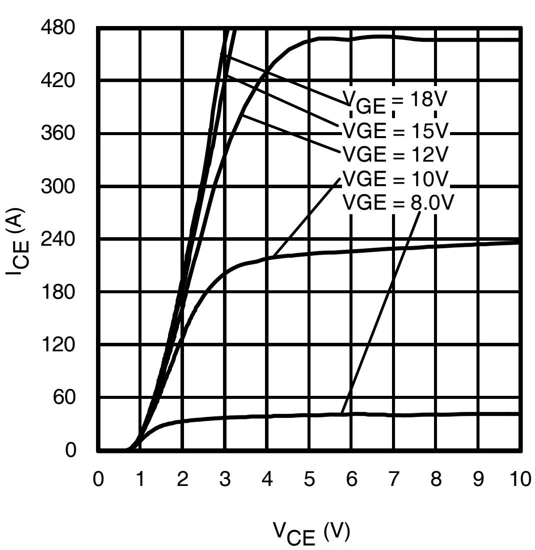


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 30μs

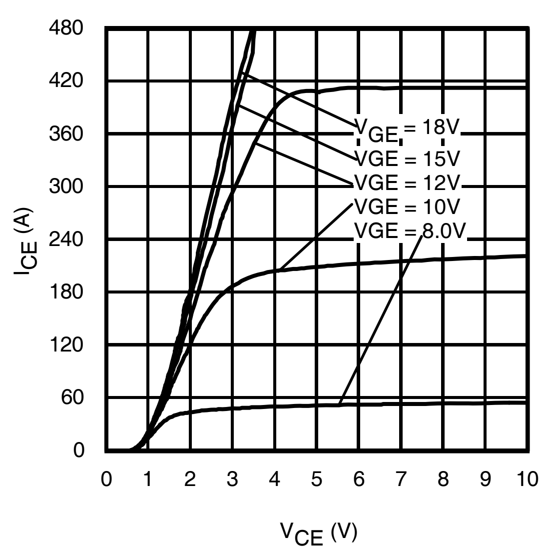


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 30μs

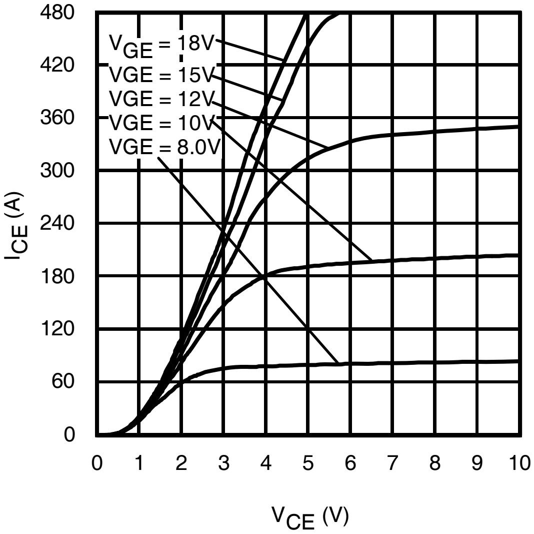


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 175°C; tp = 30µs

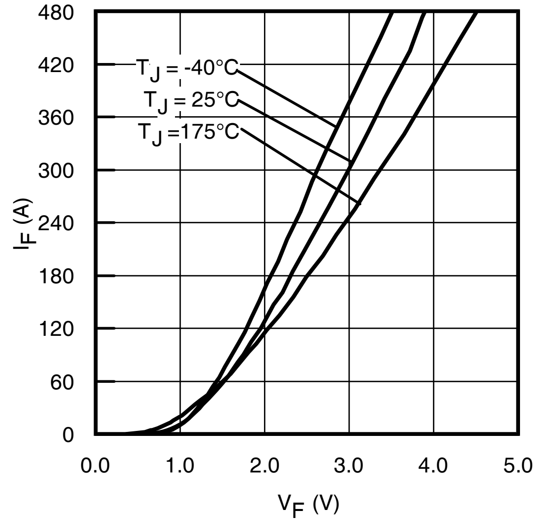


Fig. 8 - Typ. Diode Forward Characteristics
tp = 30µs

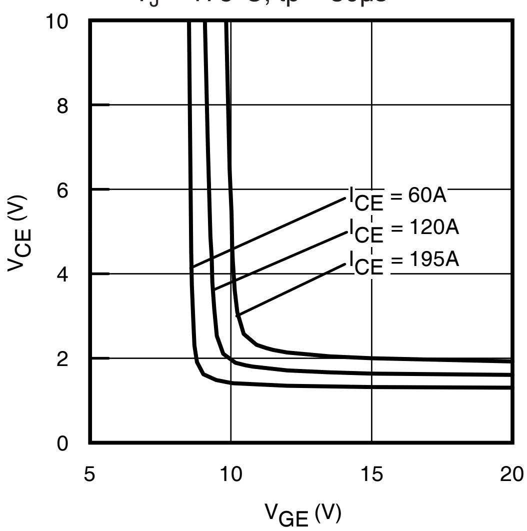


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

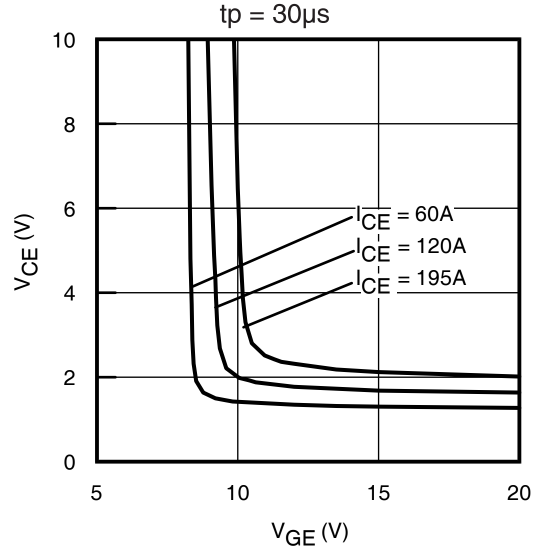


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

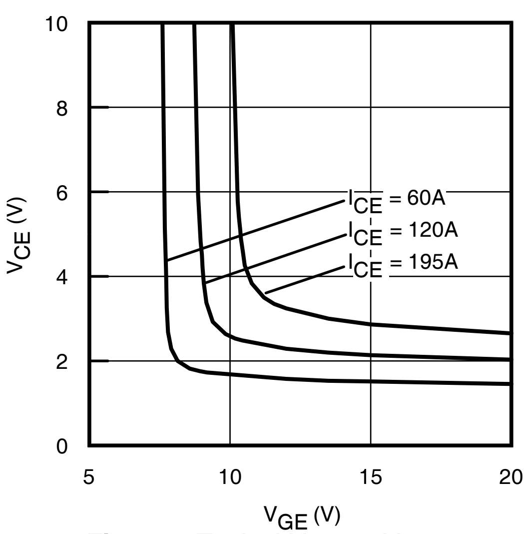


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 175°C

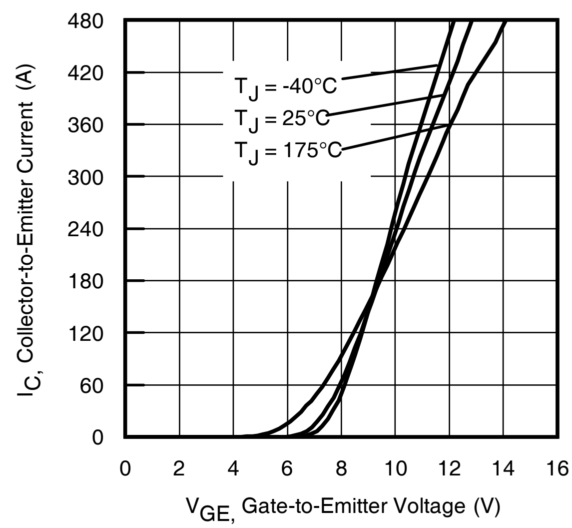


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

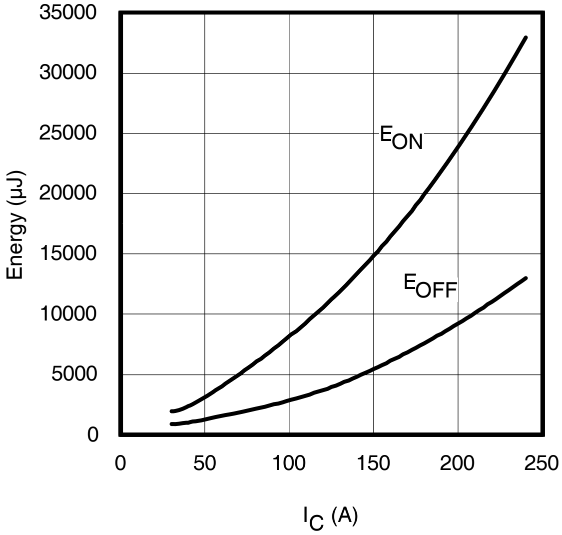


Fig. 13 - Typ. Energy Loss vs. I_C
$T_J = 175°C$; $L = 0.087mH$; $V_{CE} = 400V$, $R_G = 5.0\Omega$; $V_{GE} = 15V$

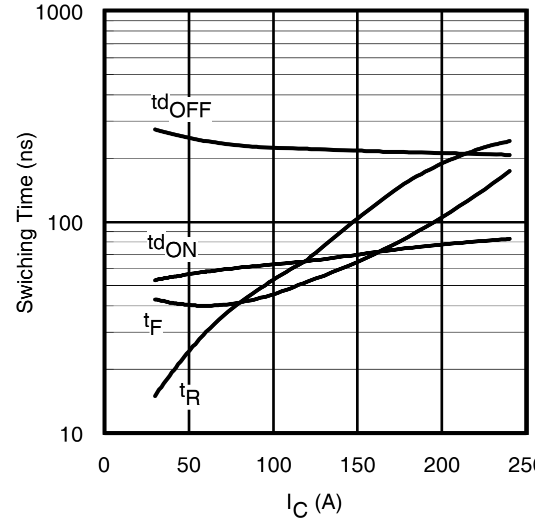


Fig. 14 - Typ. Switching Time vs. I_C
$T_J = 175°C$; $L = 0.087mH$; $V_{CE} = 400V$, $R_G = 5.0\Omega$; $V_{GE} = 15V$

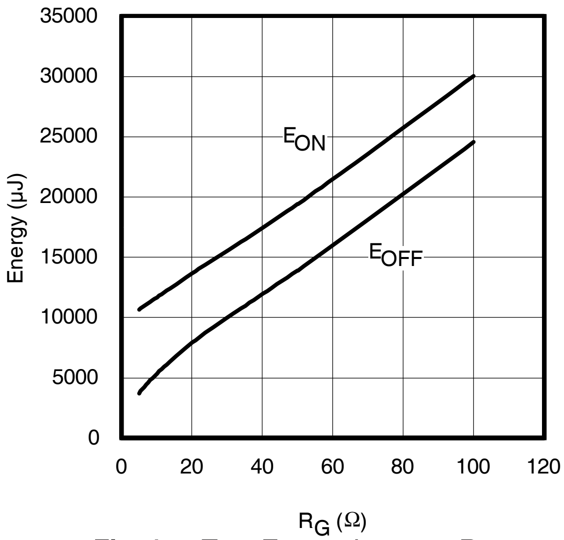


Fig. 15 - Typ. Energy Loss vs. R_G
$T_J = 175°C$; $L = 0.087mH$; $V_{CE} = 400V$, $I_{CE} = 120A$; $V_{GE} = 15V$

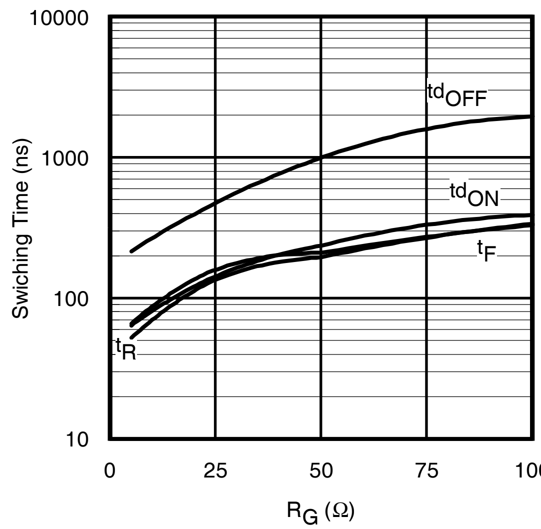


Fig. 16 - Typ. Switching Time vs. R_G
$T_J = 175°C$; $L = 0.087mH$; $V_{CE} = 400V$, $I_{CE} = 120A$; $V_{GE} = 15V$

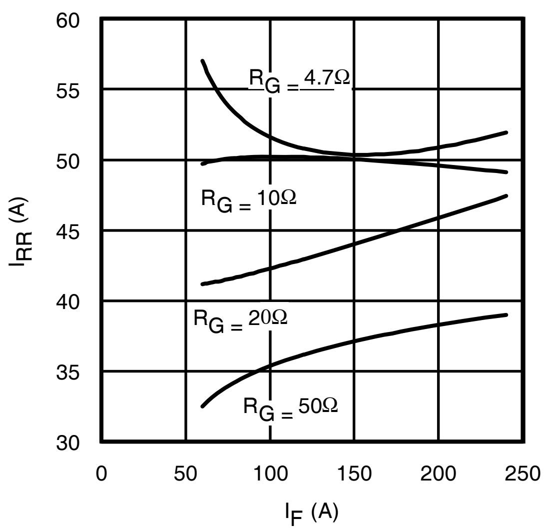


Fig. 17 - Typ. Diode I_{RR} vs. I_F
$T_J = 175°C$

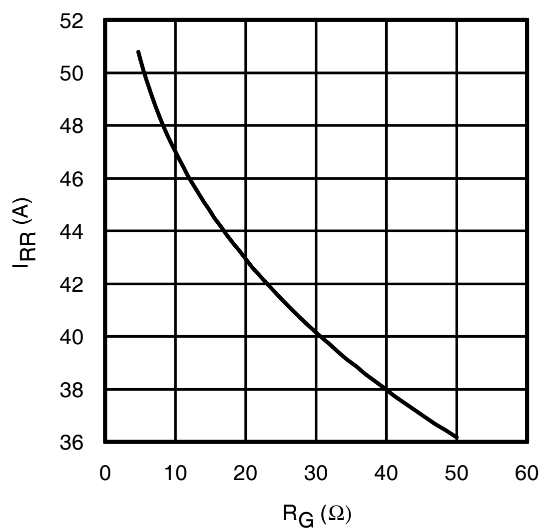


Fig. 18 - Typ. Diode I_{RR} vs. R_G
$T_J = 175°C$

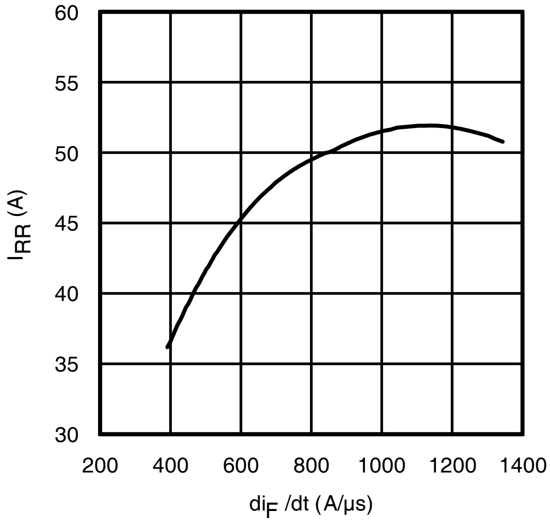


Fig. 19 - Typ. Diode I_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; I_F = 120A; T_J = 175°C

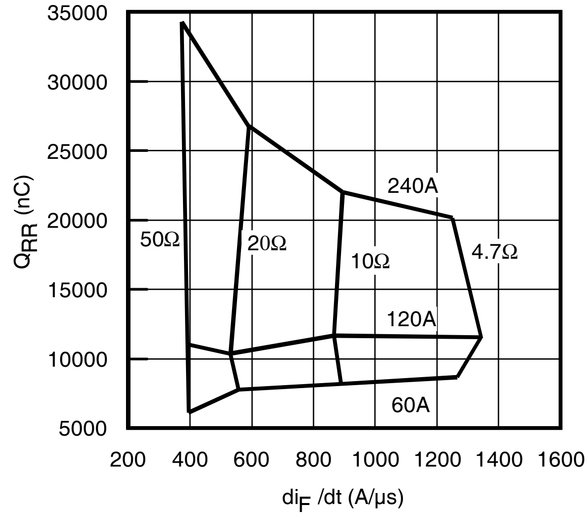


Fig. 20 - Typ. Diode Q_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; T_J = 175°C

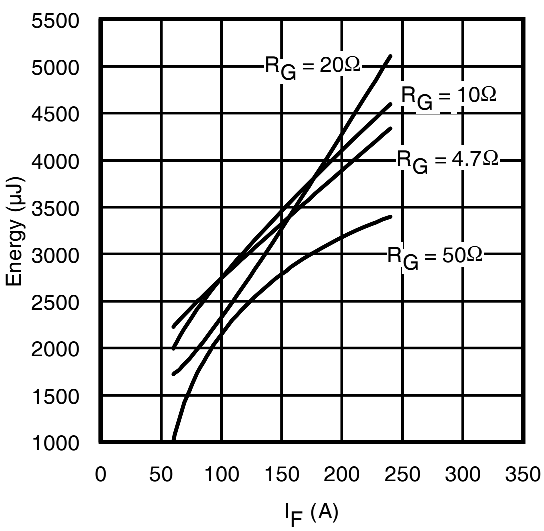


Fig. 21 - Typ. Diode E_{RR} vs. I_F
T_J = 175°C

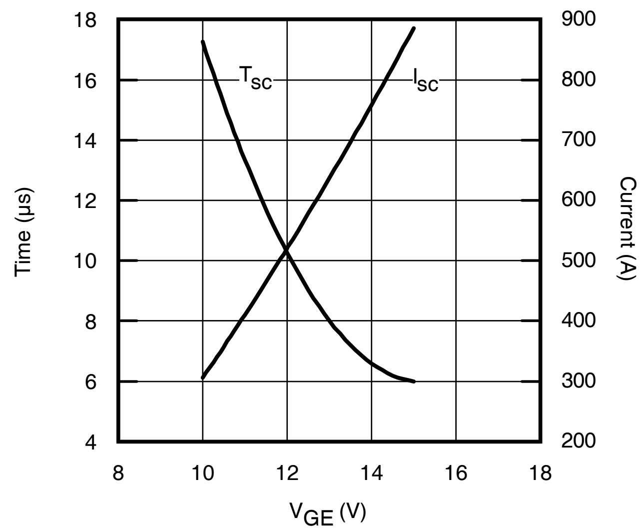


Fig. 22 - V_{GE} vs. Short Circuit Time
V_{CC} = 400V; T_C = 25°C

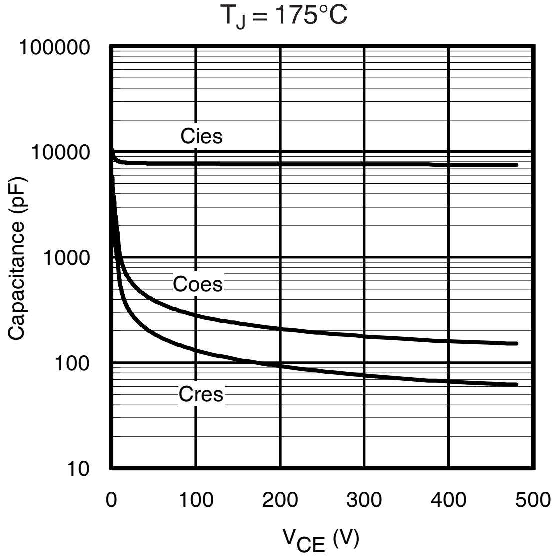


Fig. 23 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

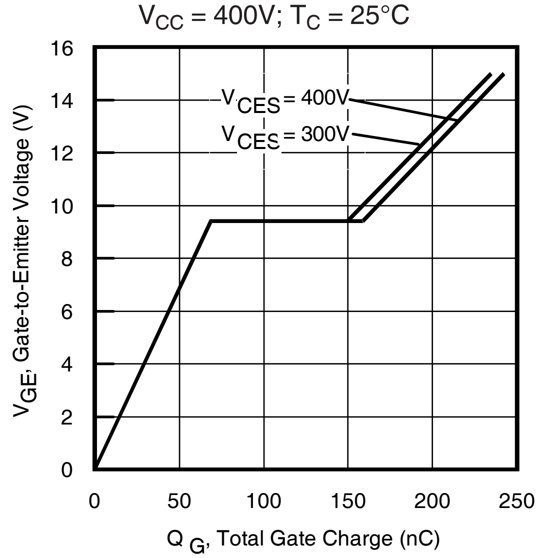


Fig. 24 - Typical Gate Charge vs. V_{GE}
I_{CE} = 120A

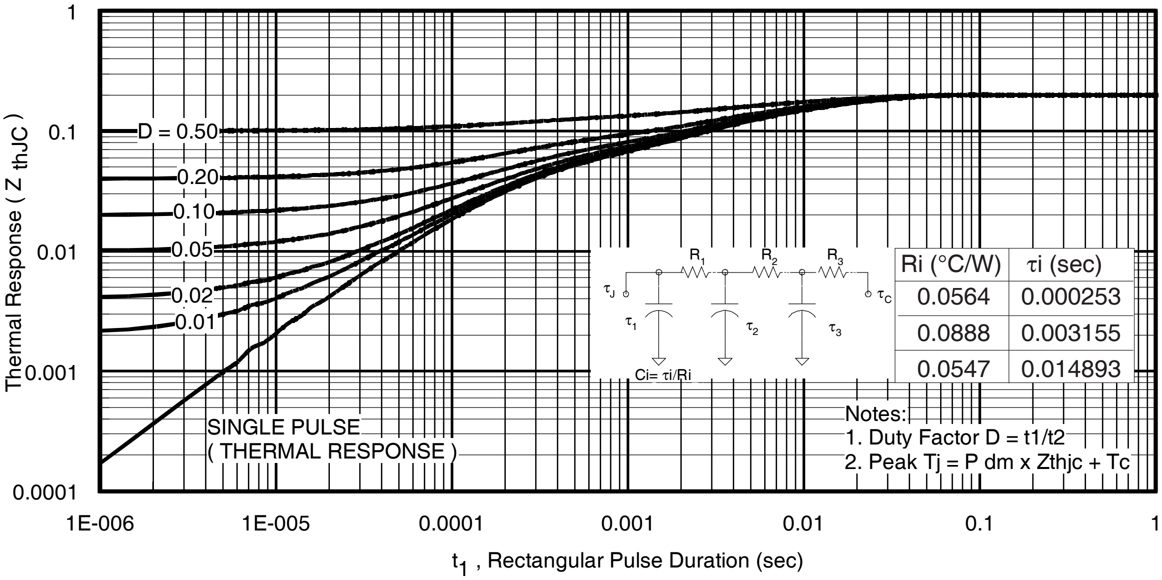


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

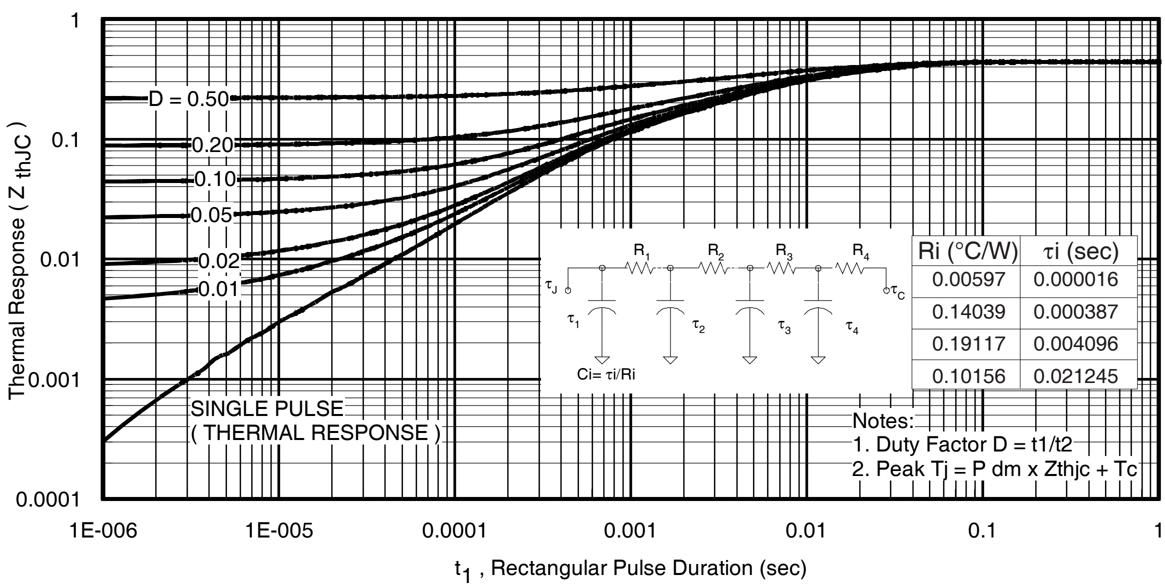


Fig. 26. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

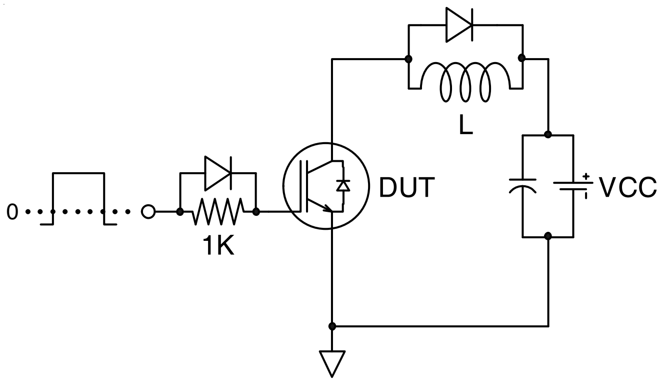


Fig.C.T.1 - Gate Charge Circuit (turn-off)

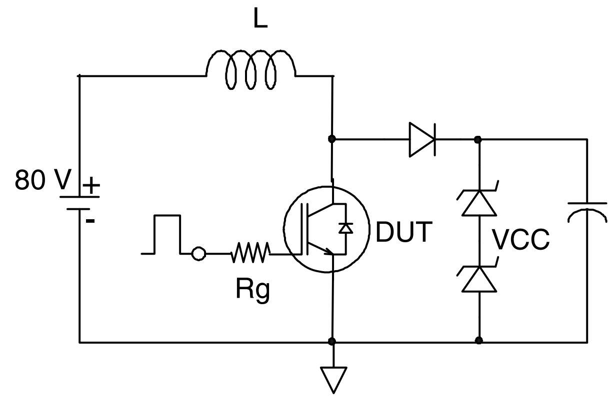


Fig.C.T.2 - RBSOA Circuit

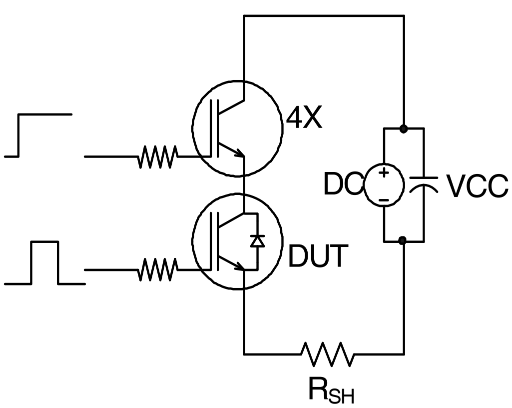


Fig.C.T.3 - S.C. SOA Circuit

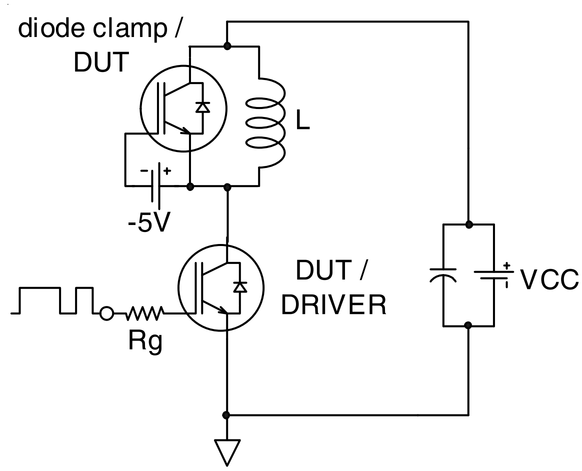


Fig.C.T.4 - Switching Loss Circuit

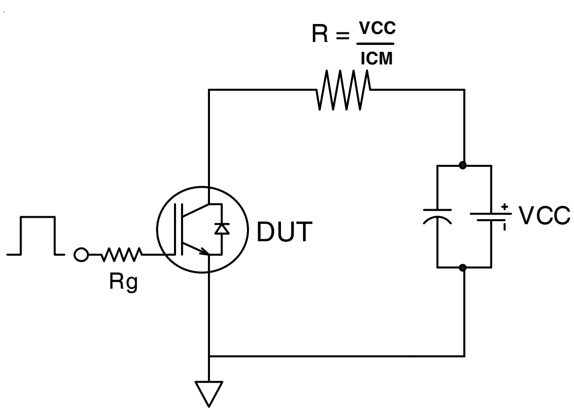


Fig.C.T.5 - Resistive Load Circuit

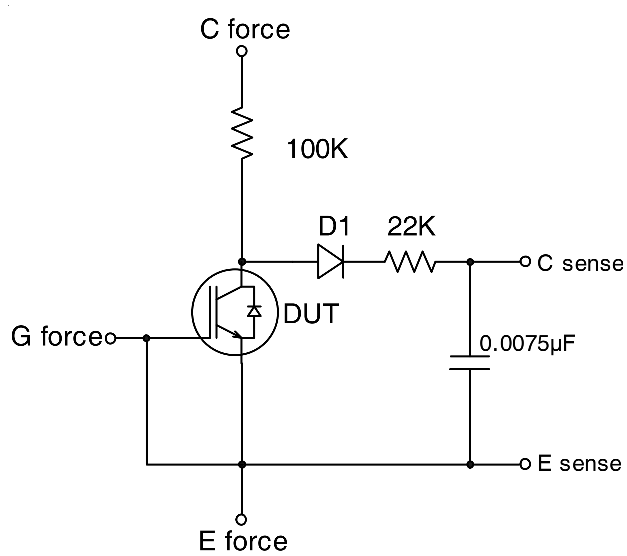


Fig.C.T.6 - BVCES Filter Circuit

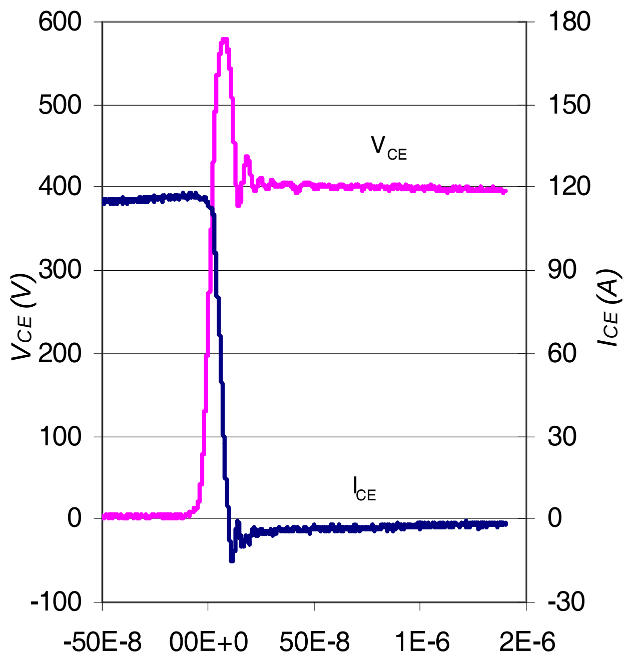


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 175°C using Fig. CT.4

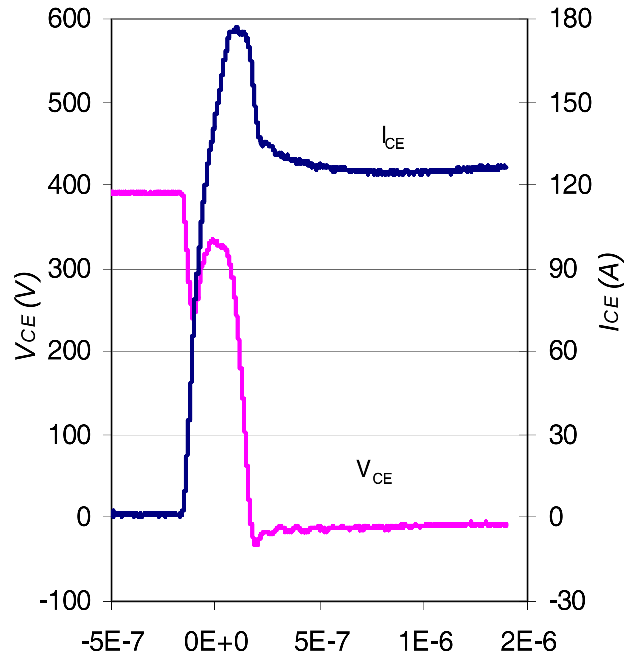


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 175°C using Fig. CT.4

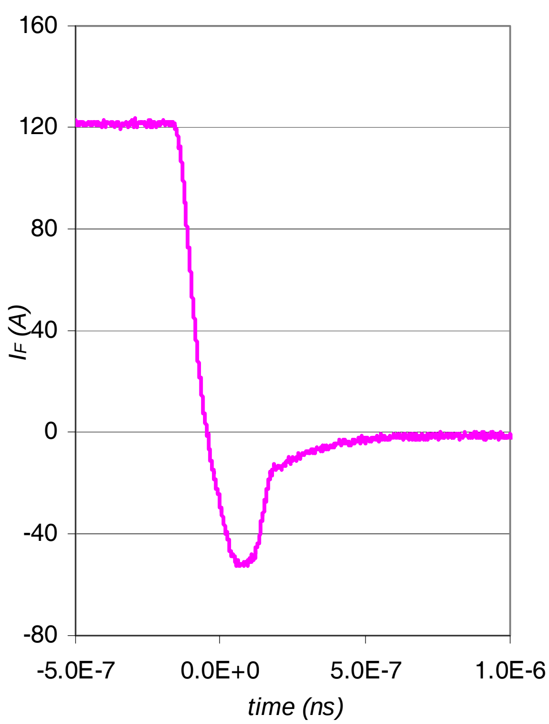


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 175°C using Fig. CT.4

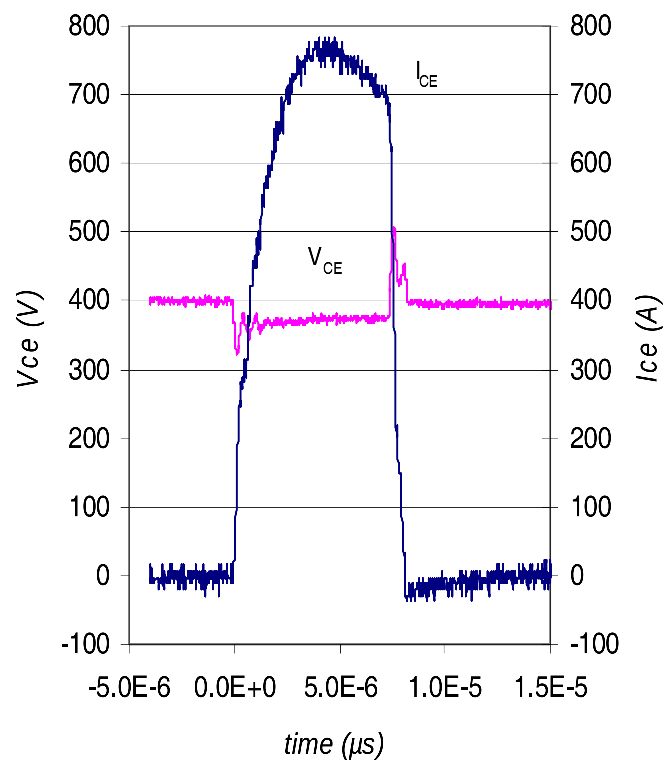
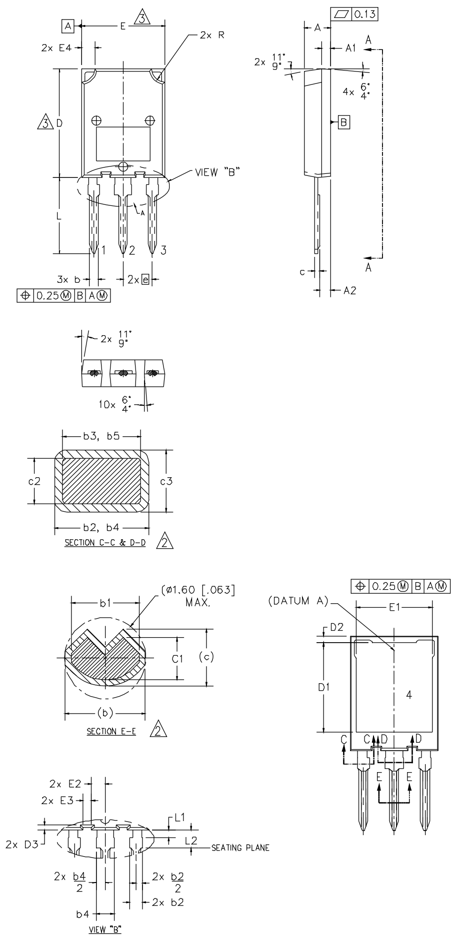


Fig. WF4 - Typ. S.C. Waveform
@ T_J = 25°C using Fig. CT.3

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

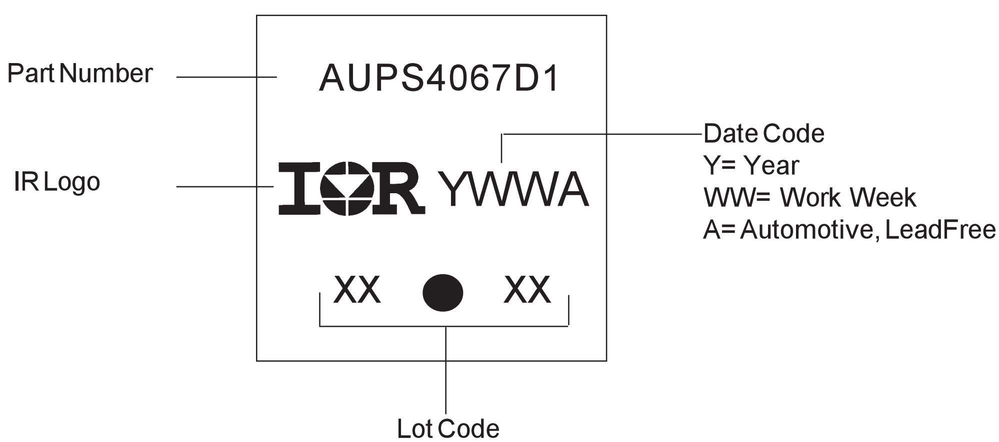
MOSFET

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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WORLD HEADQUARTERS:
101 N. Sepulveda Blvd., El Segundo, California 90245
Tel: (310) 252-7105