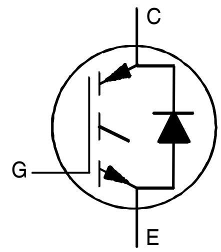
International
IOR Rectifier

AUTOMOTIVE GRADE

AUIRGB4062D1
AUIRGS4062D1
AUIRGSL4062D1

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE



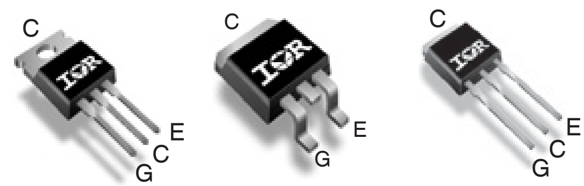
n-channel

V_{CES} = 600V

$I_{C(Nominal)}$ = 24A

$t_{SC} \geq 5\mu s$, $T_{J(max)}$ = 175°C

$V_{CE(on)}$ typ. = 1.57V



TO-220AB	D²Pak	TO-262
AUIRGB4062D1	AUIRGS4062D1	AUIRGSL4062D1

G	C	E
Gate	Collector	Emitter

Features
- Low $V_{CE\ (on)}$ Trench IGBT Technology
- Low Switching Losses
- 5µs SCSOA
- Square RBSOA
- 100% of The Parts Tested for I_{LM}①
- Positive $V_{CE\ (on)}$ Temperature Coefficient.
- Ultra Fast Soft Recovery Co-pak Diode
- Tighter Distribution of Parameters
- Lead-Free, RoHS Compliant
- Automotive Qualified *

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
- Low EMI

Applications
- Air Conditioning Compressor

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	59	A
I_C @ T_C = 100°C	Continuous Collector Current	39	
$I_{NOMINAL}$	Nominal Current	24	
I_{CM}	Pulse Collector Current, V_{GE} = 15V	72	
I_{LM}	Clamped Inductive Load Current, V_{GE} = 20V ①	96	
I_F @ T_C = 25°C	Diode Continous Forward Current	59	
I_F @ T_C = 100°C	Diode Continous Forward Current	39	
I_{FM}	Diode Maximum Forward Current ②	96	
V_{GE}	Continuous Gate-to-Emitter Voltage	±20	V
	Transient Gate-to-Emitter Voltage	±30	
P_D @ T_C = 25°C	Maximum Power Dissipation	246	W
P_D @ T_C = 100°C	Maximum Power Dissipation	123	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +175	°C
	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)③	–––	–––	0.61	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case (Diode)③	–––	–––	1.2	
$R_{\theta CS}$	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°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 = 100μA ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.3	—	V/°C	V_{GE} = 0V, I_C = 10mA (25°C-175°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.57	1.77	V	I_C = 24A, V_{GE} = 15V, T_J = 25°C
		—	1.87	—		I_C = 24A, V_{GE} = 15V, T_J = 150°C
		—	1.94	—		I_C = 24A, V_{GE} = 15V, T_J = 175°C
$V_{GE(th)}$	Gate Threshold Voltage	4.0	—	6.5	V	V_{CE} = V_{GE}, I_C = 700μA
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-17	—	mV/°C	V_{CE} = V_{GE}, I_C = 1.0mA (25°C - 175°C)
gfe	Forward Transconductance	—	12	—	S	V_{CE} = 50V, I_C = 24A, PW = 20μs
I_{CES}	Collector-to-Emitter Leakage Current	—	1.0	25	μA	V_{GE} = 0V, V_{CE} = 600V
		—	3.5	—	mA	V_{GE} = 0V, V_{CE} = 600V, T_J = 175°C
V_{FM}	Diode Forward Voltage Drop	—	1.57	—	V	I_F = 24A
		—	1.40	—		I_F = 19A
		—	1.47	—		I_F = 24A, 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)	—	51	77	nC	I_C = 24A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	14	21		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	21	32		V_{CC} = 400V
E_{on}	Turn-On Switching Loss	—	532	754	μJ	I_C = 24A, V_{CC} = 400V, V_{GE} = 15V
E_{off}	Turn-Off Switching Loss	—	311	526		R_G = 10Ω, L = 210μH, T_J = 25°C
E_{total}	Total Switching Loss	—	843	1280		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	19	36	ns	I_C = 24A, V_{CC} = 400V, V_{GE} = 15V
t_r	Rise time	—	24	41		R_G = 10Ω, L = 210μH, T_J = 25°C
$t_{d(off)}$	Turn-Off delay time	—	90	109		
t_f	Fall time	—	23	40		
E_{on}	Turn-On Switching Loss	—	726	—	μJ	I_C = 24A, V_{CC} = 400V, V_{GE}=15V
E_{off}	Turn-Off Switching Loss	—	549	—		R_G=10Ω, L= 210μH,T_J = 175°C ③
E_{total}	Total Switching Loss	—	1275	—		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	12	—	ns	I_C = 24A, V_{CC} = 400V, V_{GE} = 15V
t_r	Rise time	—	23	—		R_G = 10Ω, L = 200μH, L_S = 150nH
$t_{d(off)}$	Turn-Off delay time	—	92	—		T_J = 175°C
t_f	Fall time	—	84	—		
C_{ies}	Input Capacitance	—	1487	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	118	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	44	—		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 175°C, I_C = 96A V_{CC} = 480V, Vp ≤ 600V Rg = 10Ω, V_{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V_{CC} = 400V, Vp ≤ 600V Rg = 10Ω, V_{GE} = +15V to 0V
Erec	Reverse Recovery Energy of the Diode	—	773	—	μJ	T_J = 175°C
t_{rr}	Diode Reverse Recovery Time	—	102	—	ns	V_{CC} = 200V, I_F = 24A
I_{rr}	Peak Reverse Recovery Current	—	32	—	A	V_{GE} = 15V, Rg = 10Ω, L =210μH

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 210μH, R_G = 50Ω.
② Pulse width limited by max. junction temperature.
③ R_θ is measured at T_J of approximately 90°C.
④ Maximum limits are based on statistical sample size characterization.

Qualification Information†

<table>
<tr><td rowspan="2" colspan="2">Qualification Level</td><td colspan="2">Automotive
(per AEC-Q101) ††</td></tr>
<tr><td colspan="2">Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.</td></tr>
<tr><td rowspan="3" colspan="2">Moisture Sensitivity Level</td><td>3L-TO-220</td><td rowspan="2">N/A</td></tr>
<tr><td>3L-TO-262</td></tr>
<tr><td>3L-D2 PAK</td><td>MSL1</td></tr>
<tr><td rowspan="3">ESD</td><td>Machine Model</td><td colspan="2">Class M4 (+/- 700V)
(per AEC-Q101-002)</td></tr>
<tr><td>Human Body Model</td><td colspan="2">Class H1C (+/- 2000V)
(per AEC-Q101-001)</td></tr>
<tr><td>Charged Device Model</td><td colspan="2">Class C5 (+/- 2000V)
(per AEC-Q101-005)</td></tr>
<tr><td colspan="2">RoHS Compliant</td><td colspan="2">Yes</td></tr>
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† Qualification standards can be found at International Rectifier's web site: http//www.irf.com/

†† Highest passing voltage.

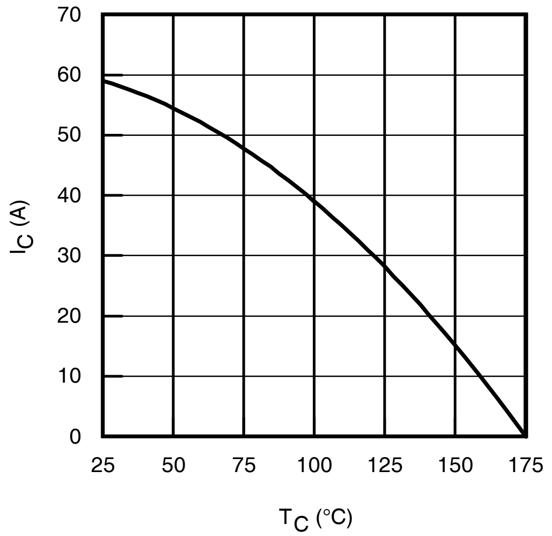


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

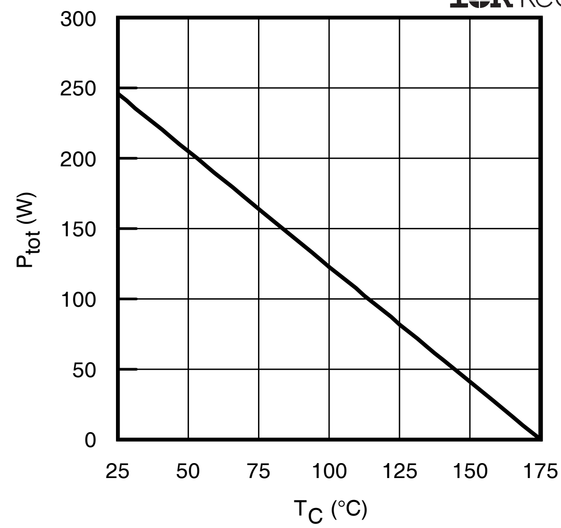


Fig. 2 - Power Dissipation vs. Case Temperature

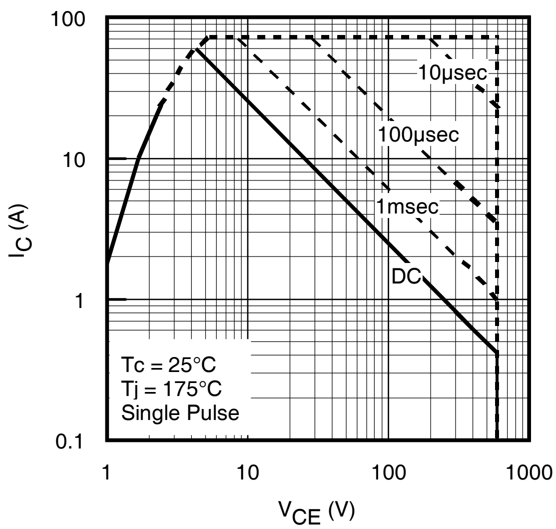


Fig. 3 - Forward SOA
T_C = 25°C, $T_J \leq$ 175°C; V_{GE} =15V

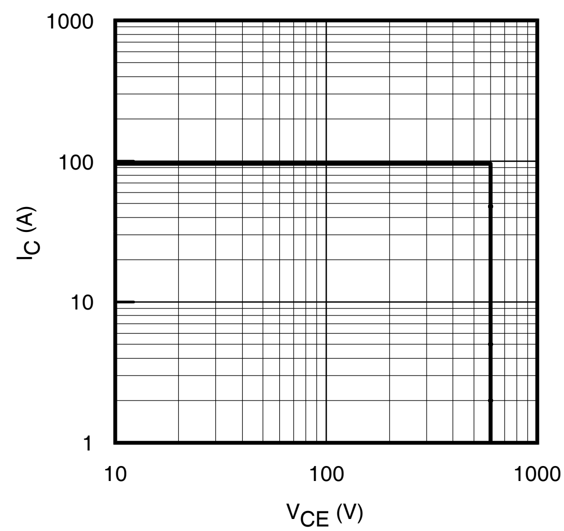


Fig. 4 - Reverse Bias SOA
T_J = 175°C; V_{GE} = 20V

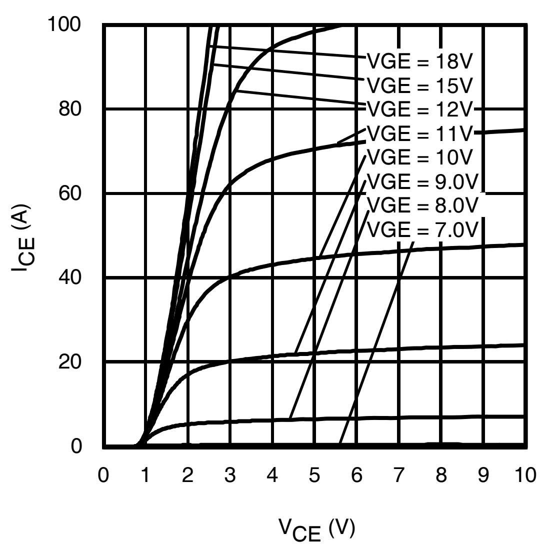


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 20µs

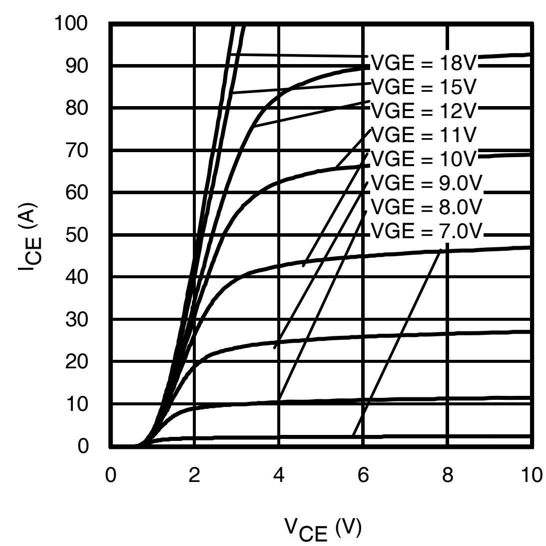


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 20µs

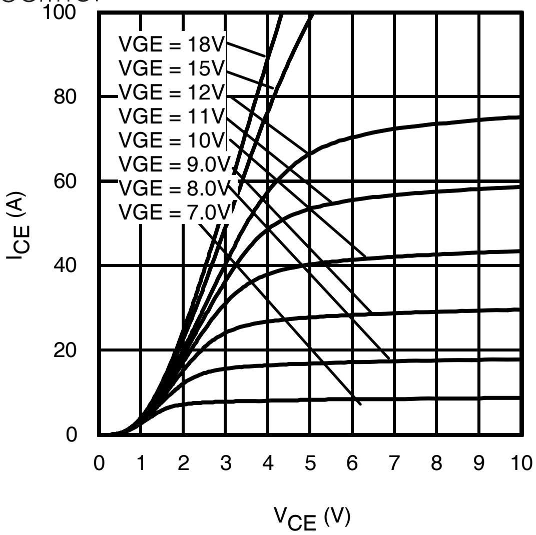


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 175°C; tp = 20µs

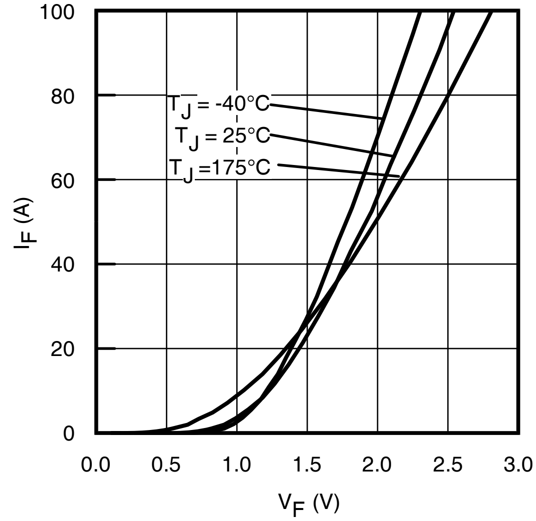


Fig. 8 - Typ. Diode Forward Characteristics
tp = 20µs

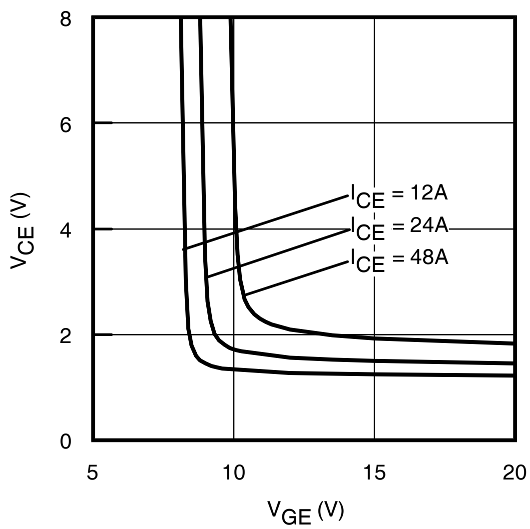


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

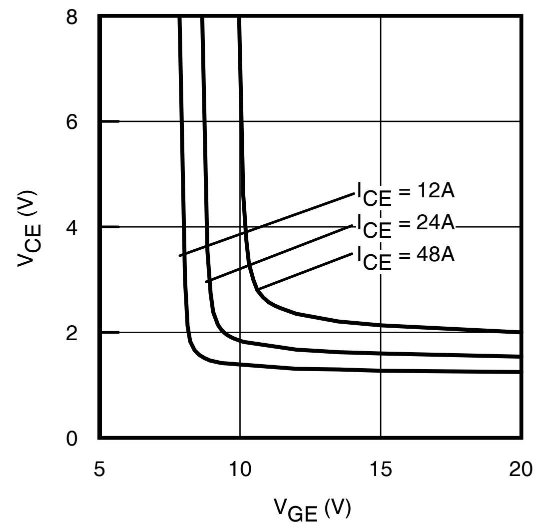


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

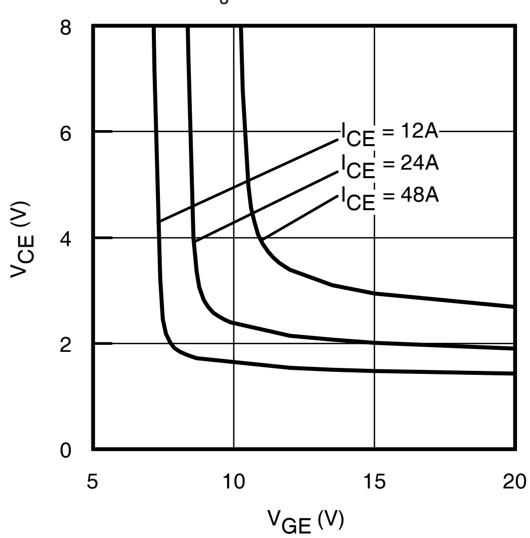


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 175°C

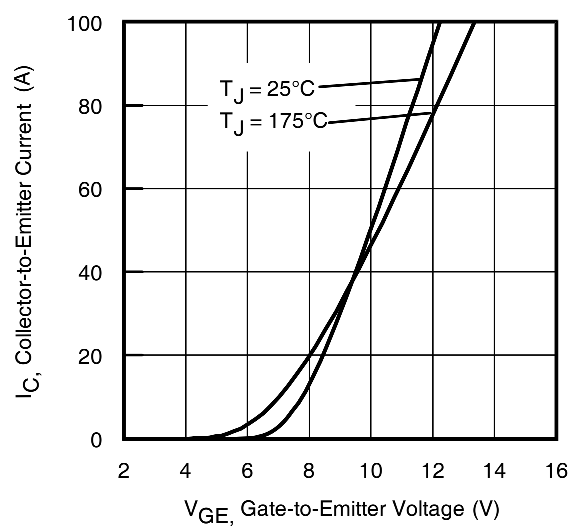


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 20µs

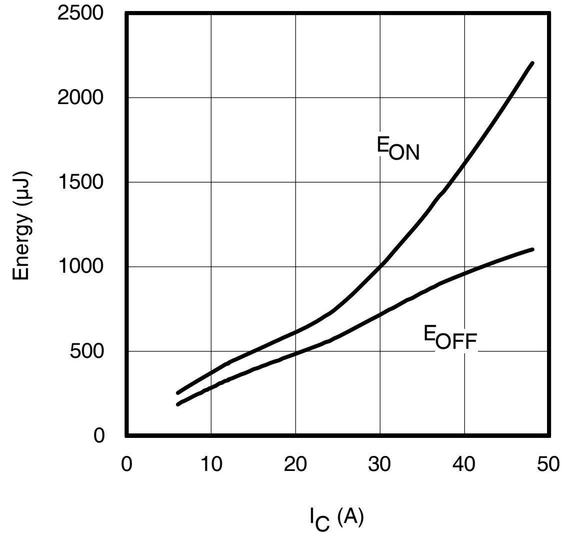


Fig. 13 - Typ. Energy Loss vs. I_C
$T_J = 175°C$; $L = 210µH$; $V_{CE} = 400V$, $R_G = 10\Omega$; $V_{GE} = 15V$

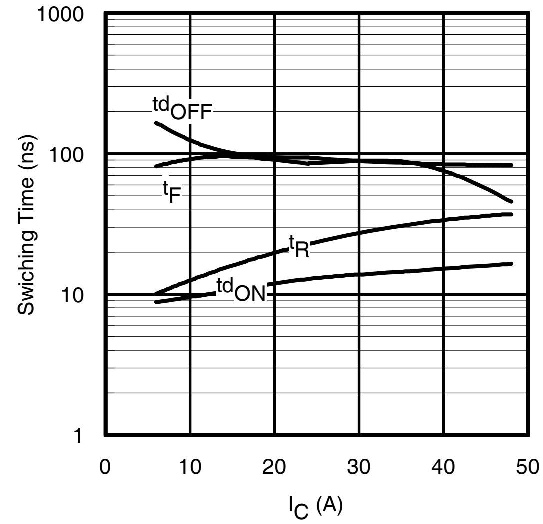


Fig. 14 - Typ. Switching Time vs. I_C
$T_J = 175°C$; $L = 210µH$; $V_{CE} = 400V$, $R_G = 10\Omega$; $V_{GE} = 15V$

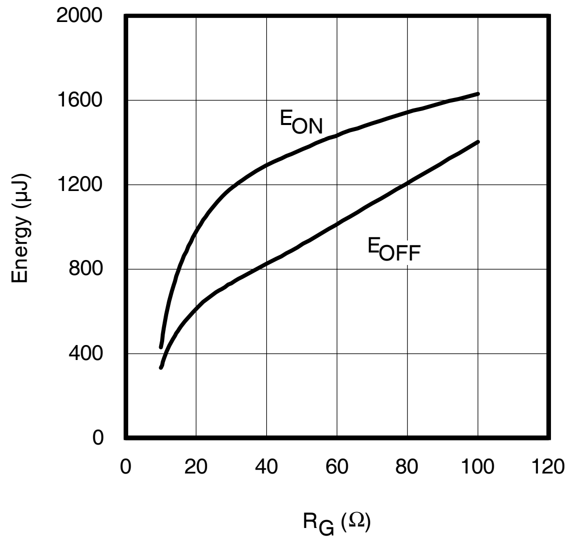


Fig. 15 - Typ. Energy Loss vs. R_G
$T_J = 175°C$; $L = 210µH$; $V_{CE} = 400V$, $I_{CE} = 24A$; $V_{GE} = 15V$

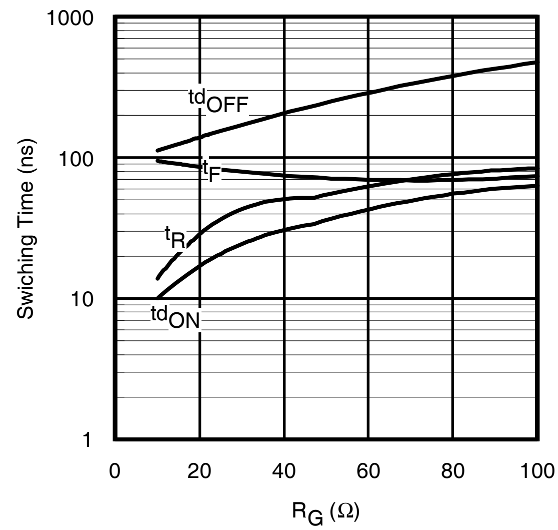


Fig. 16 - Typ. Switching Time vs. R_G
$T_J = 175°C$; $L = 210µH$; $V_{CE} = 400V$, $I_{CE} = 24A$; $V_{GE} = 15V$

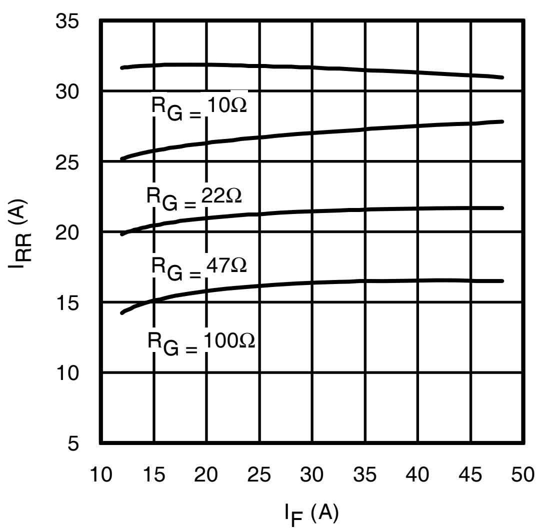


Fig. 17 - Typ. Diode I_{RR} vs. I_F
$T_J = 175°C$

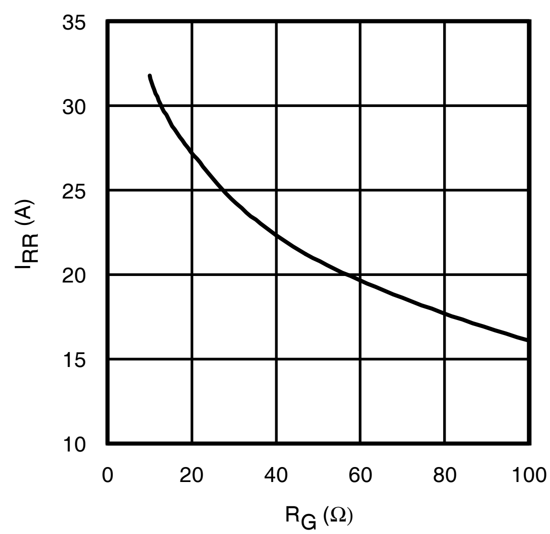


Fig. 18 - Typ. Diode I_{RR} vs. R_G
$T_J = 175°C$

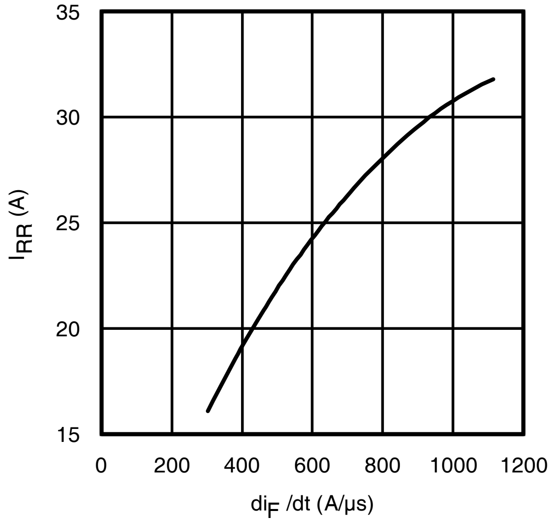


Fig. 19 - Typ. Diode I_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; I_F = 24A; T_J = 175°C

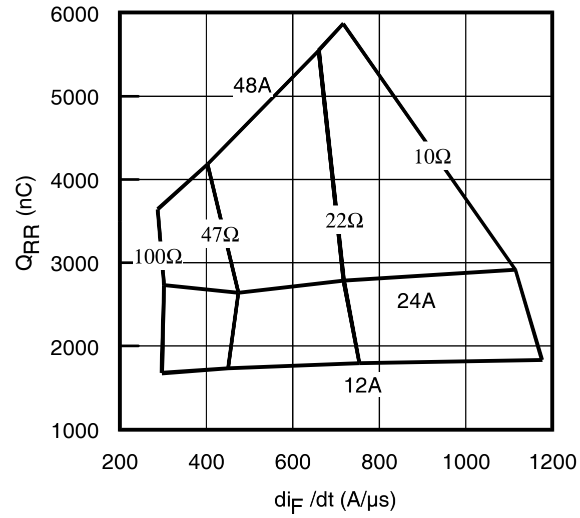


Fig. 20 - Typ. Diode Q_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; T_J = 175°C

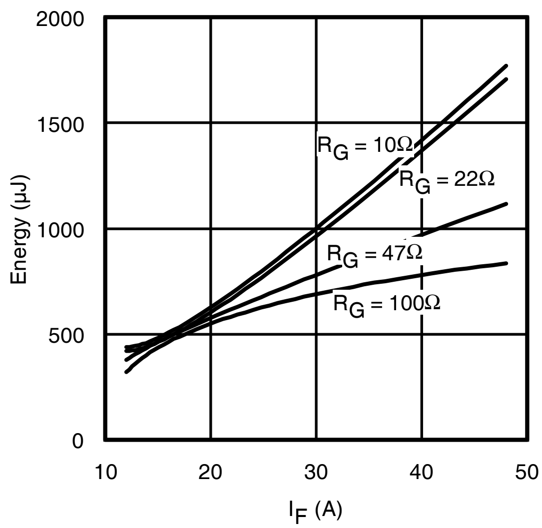


Fig. 21 - Typ. Diode E_{RR} vs. I_F
T_J = 175°C

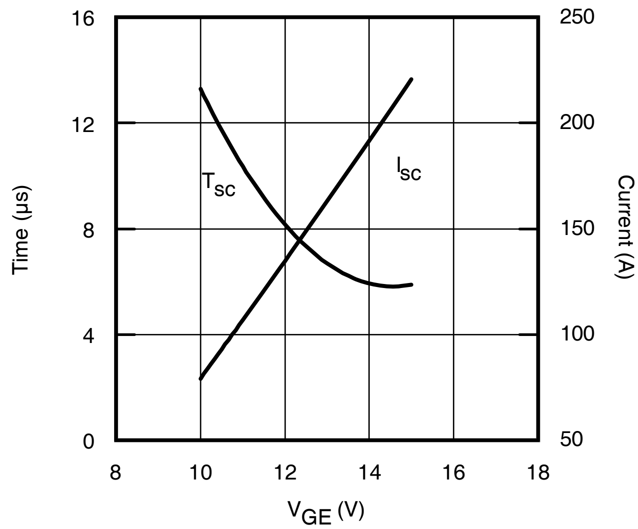


Fig. 22 - V_{GE} vs. Short Circuit Time
V_{CC} = 400V; T_C = 25°C

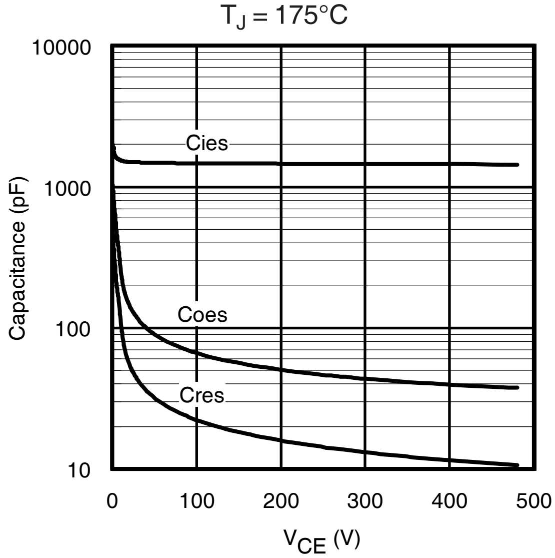


Fig. 23 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

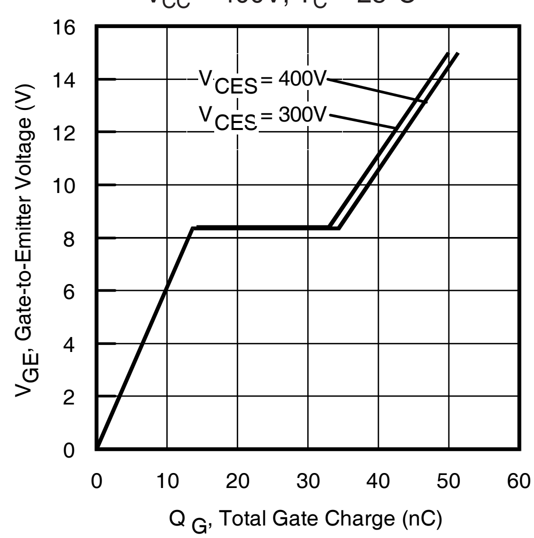
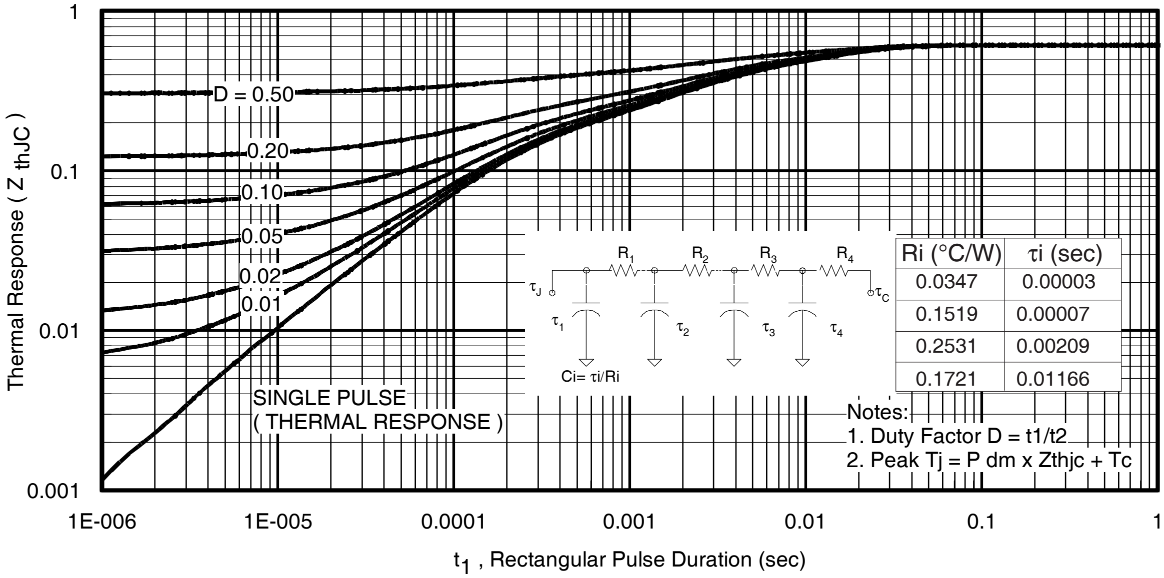
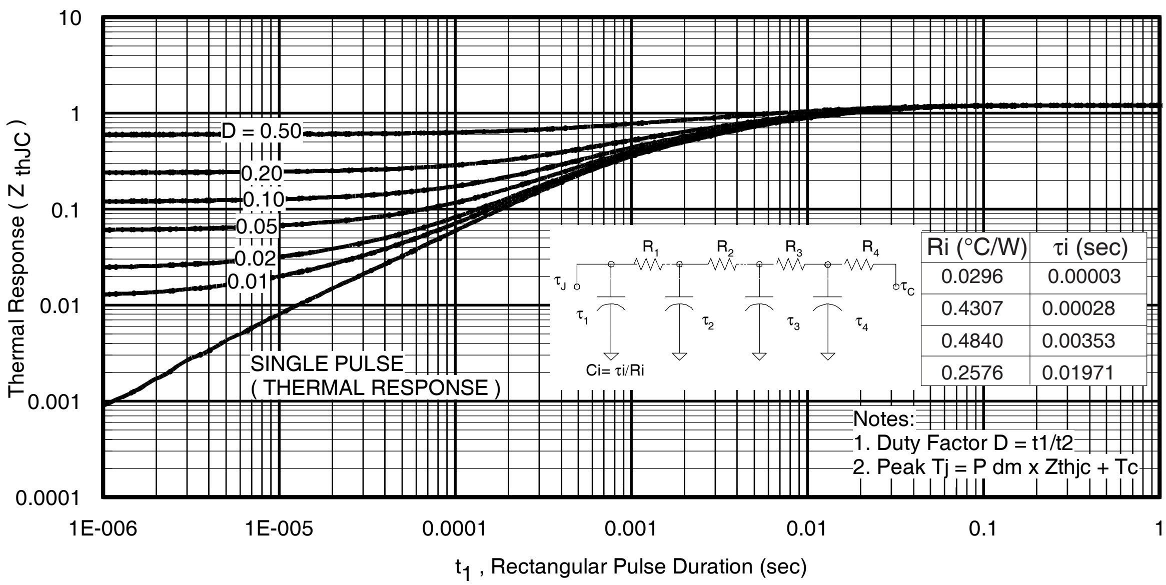


Fig. 24 - Typical Gate Charge vs. V_{GE}
I_{CE} = 24A; L = 585µH



Ri (°C/W)	τi (sec)
0.0347	0.00003
0.1519	0.00007
0.2531	0.00209
0.1721	0.01166

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



Ri (°C/W)	τi (sec)
0.0296	0.00003
0.4307	0.00028
0.4840	0.00353
0.2576	0.01971

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

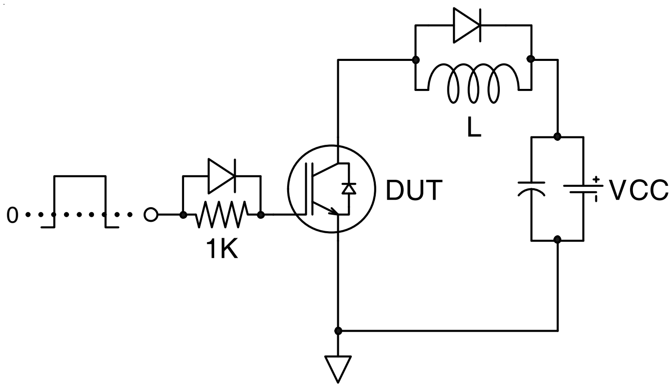


Fig.C.T.1 - Gate Charge Circuit (turn-off)

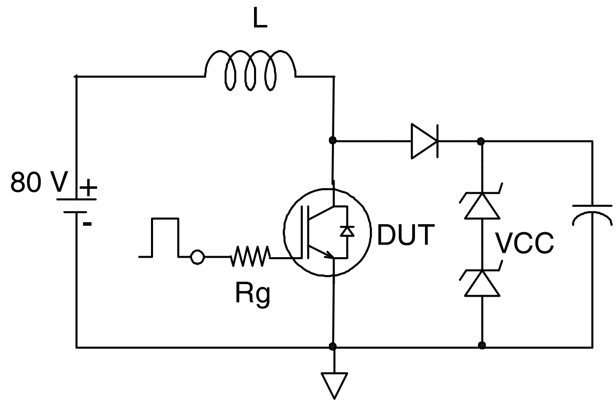


Fig.C.T.2 - RBSOA Circuit

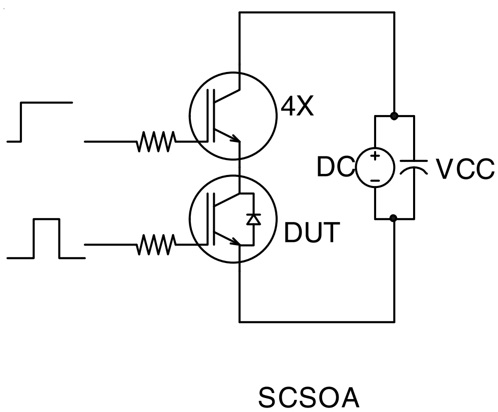


Fig.C.T.3 - S.C. SOA Circuit

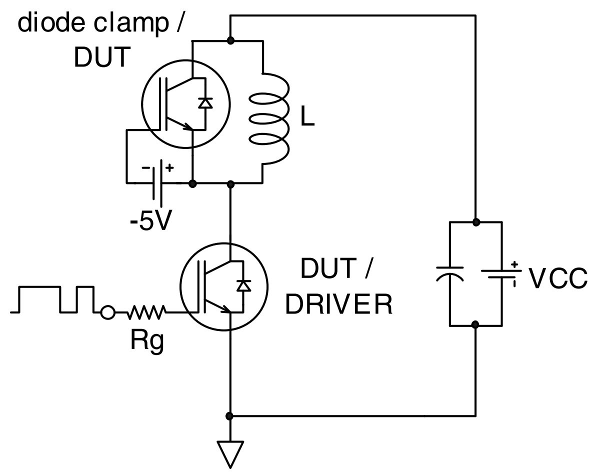


Fig.C.T.4 - Switching Loss Circuit

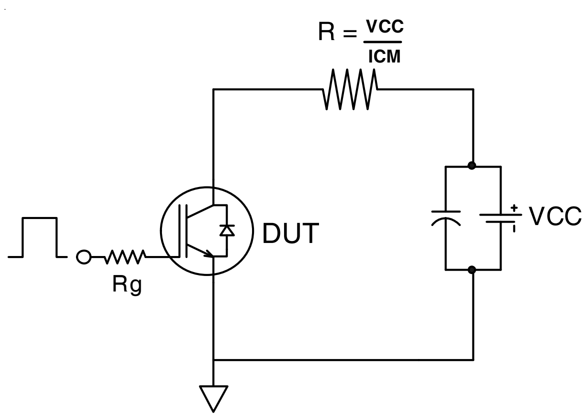


Fig.C.T.5 - Resistive Load Circuit

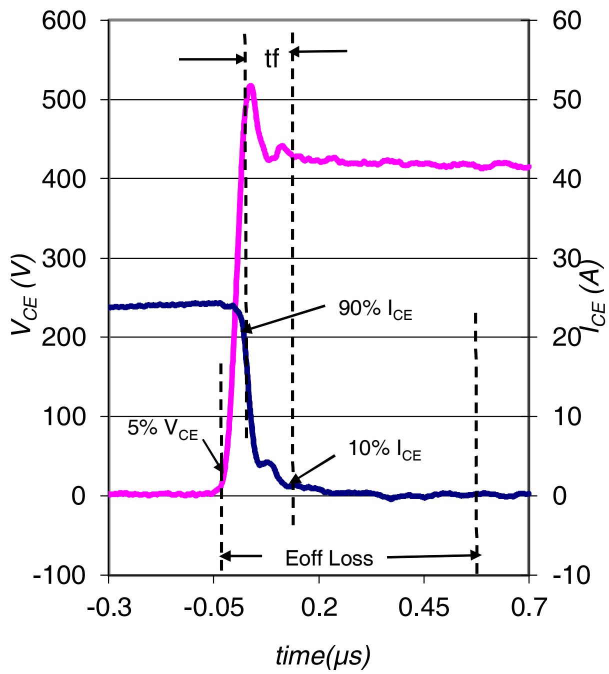


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 175°C using Fig. CT.4

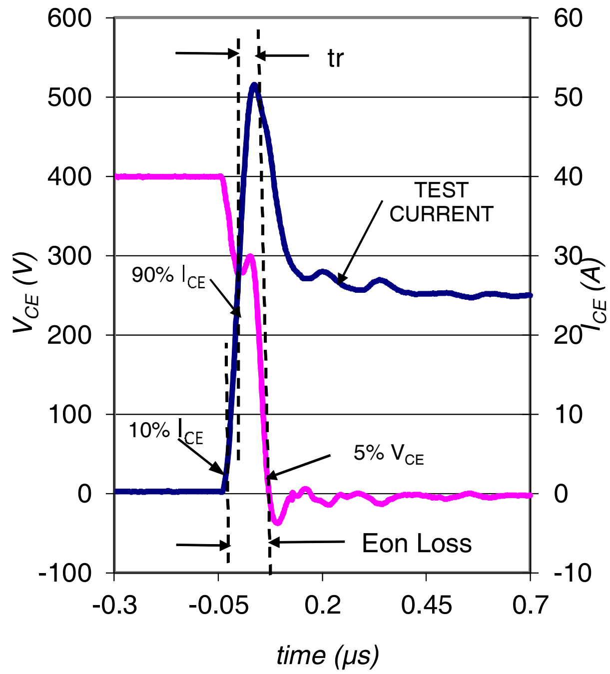


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 175°C using Fig. CT.4

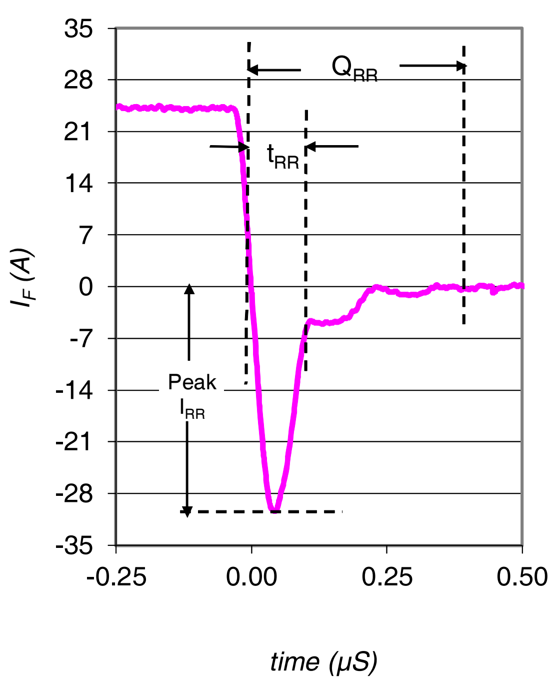


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 175°C using Fig. CT.4

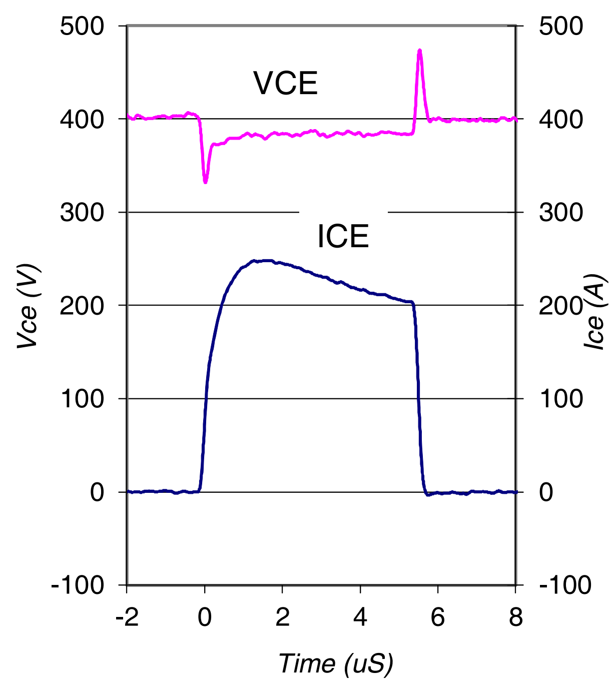
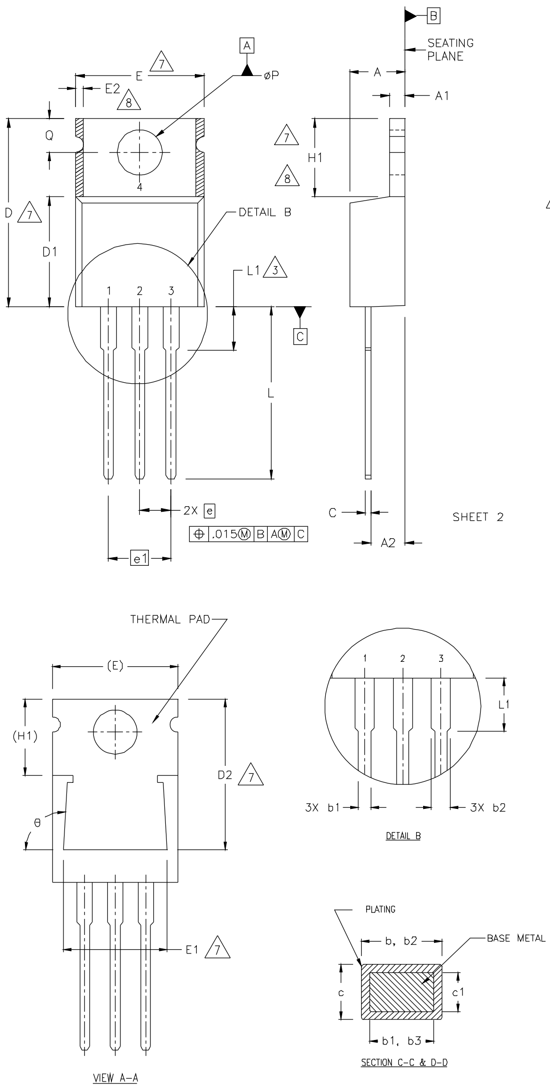


Fig. WF4 - Typ. S.C. Waveform
@ T_J = 25°C using Fig. CT.3

TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
2. DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3. LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
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. DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
6. CONTROLLING DIMENSION : INCHES.
7. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
8. DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.82	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.04	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.96	.015	.038	5
b2	1.15	1.77	.045	.070	
b3	1.15	1.73	.045	.068	
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	12.19	12.88	.480	.507	7
E	9.66	10.66	.380	.420	4,7
E1	8.38	8.89	.330	.350	7
e	2.54 BSC		.100 BSC		
e1	5.08		.200 BSC		
H1	5.85	6.55	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	–	6.35	–	.250	3
øP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	
ø	90°-93°		90°-93°		

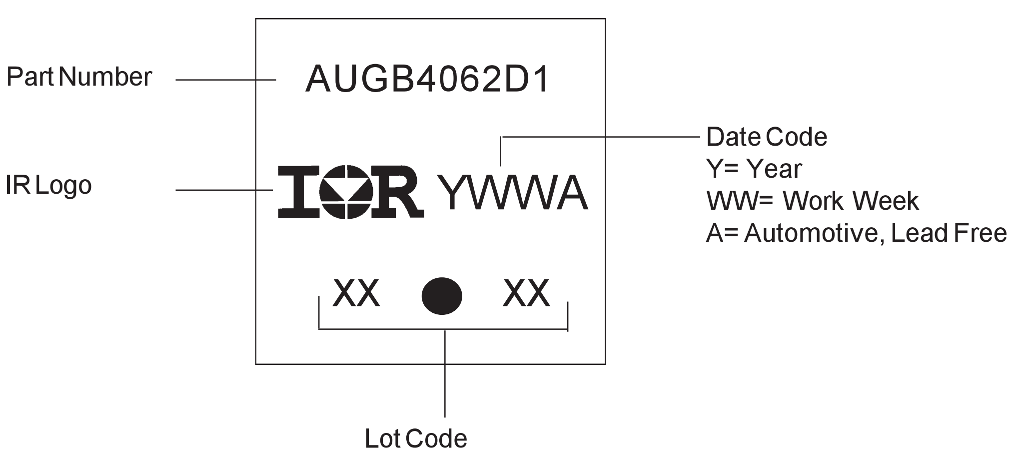
LEAD ASSIGNMENTS

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

IGBTs, CoPACK
1.- GATE
2.- COLLECTOR
3.- EMITTER

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

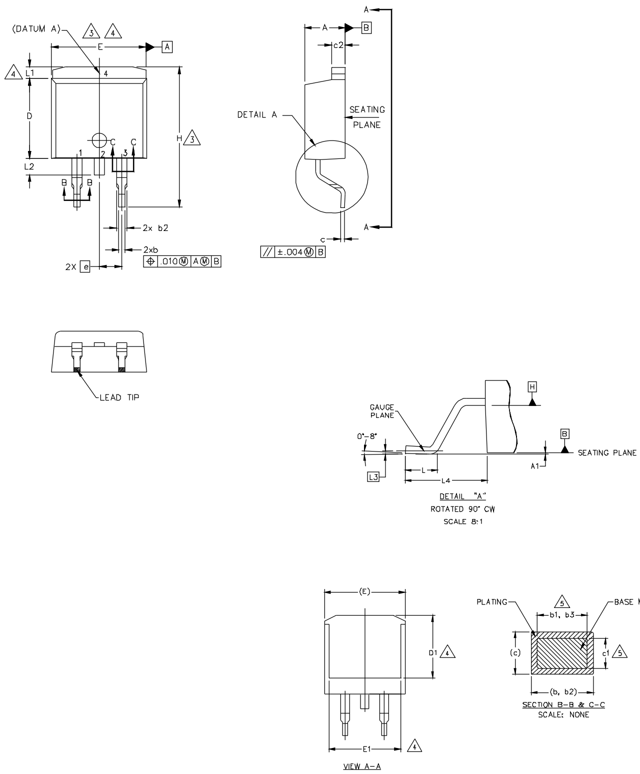
TO-220AB Part Marking Information



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

D²Pak (TO-263AB) Package Outline

Dimensions are shown in millimeters (inches)



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 AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	–	.270		4
E	9.65	10.67	.380	.420	3,4
E1	6.22	–	.245		4
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	–	1.65	–	.066	4
L2	1.27	1.78	–	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	

LEAD ASSIGNMENTS

HEXFET

1.– GATE
2, 4.– DRAIN
3.– SOURCE

IGBTs, CoPACK

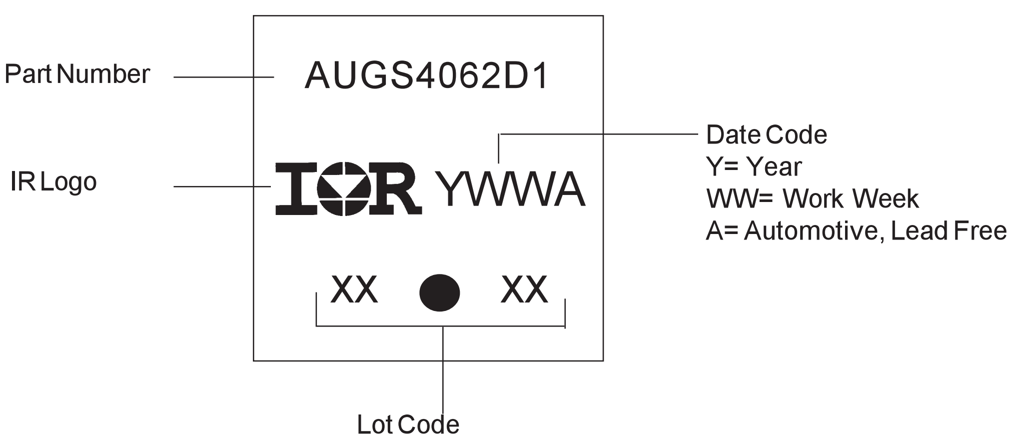
1.– GATE
2, 4.– COLLECTOR
3.– EMITTER

DIODES

1.– ANODE *
2, 4.– CATHODE
3.– ANODE

* PART DEPENDENT.

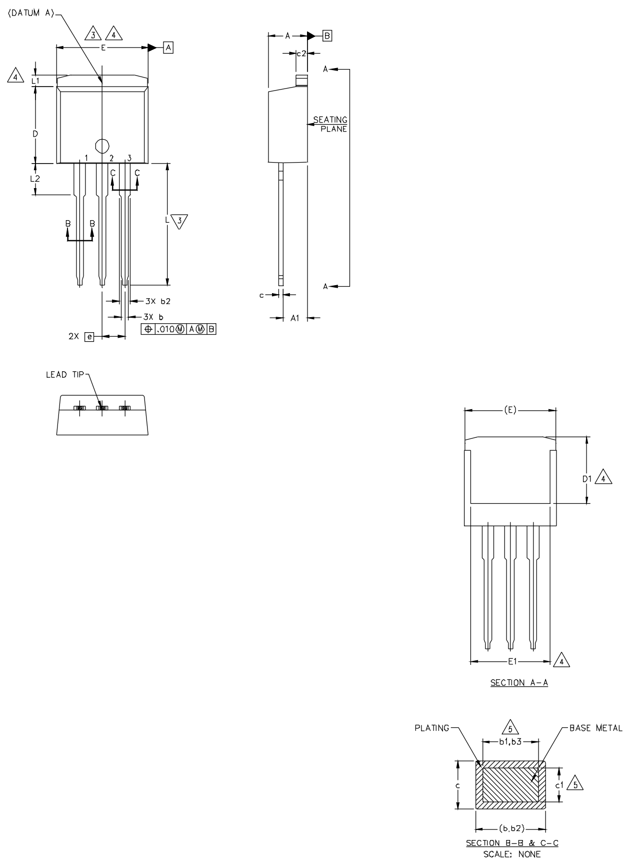
D²Pak (TO-263AB) Part Marking Information



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

TO-262 Package Outline

Dimensions are shown in millimeters (inches)



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. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. CONTROLLING DIMENSION: INCH.
7.- OUTLINE CONFORM TO JEDEC TO-262 EXCEPT A1(max.), b(min.) AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	2.03	3.02	.080	.119	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	–	.270	–	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	–	.245		4
e	2.54 BSC		.100 BSC		
L	13.46	14.10	.530	.555	
L1	–	1.65	–	.065	4
L2	3.56	3.71	.140	.146	

LEAD ASSIGNMENTS

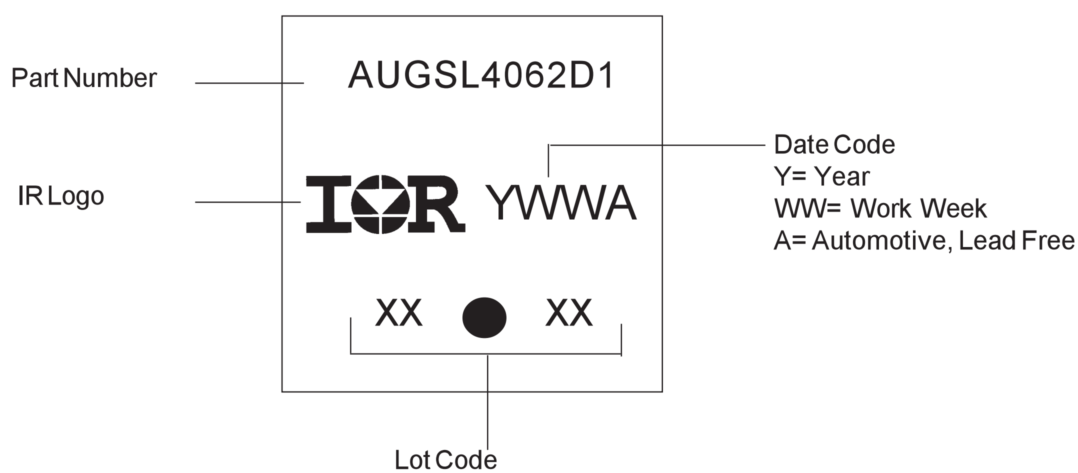
HEXFET

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

IGBTs, CoPACK

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

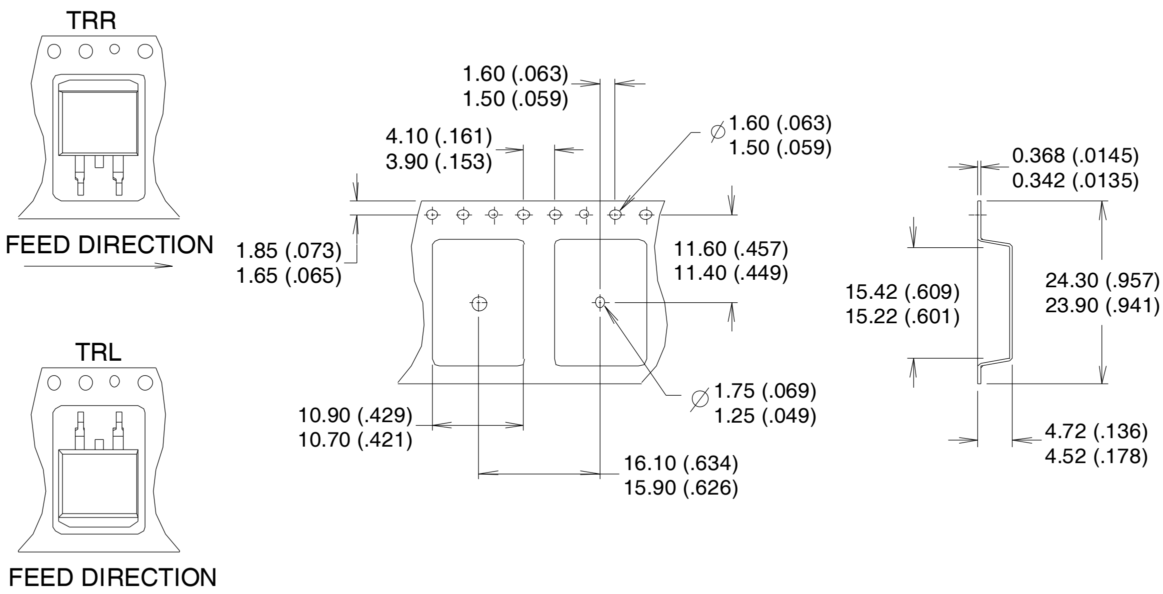
TO-262 Part Marking Information

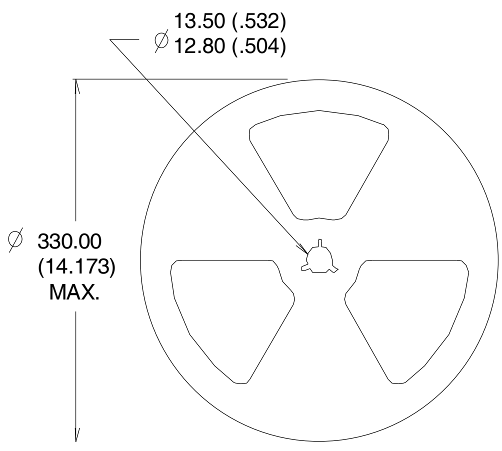


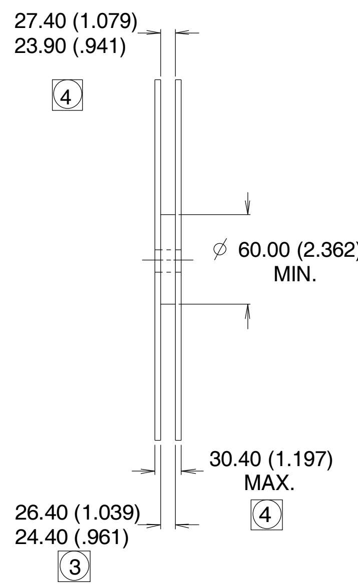
Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)







NOTES :
1. COMFORMS TO EIA-418.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION MEASURED @ HUB.
4. INCLUDES FLANGE DISTORTION @ OUTER EDGE.

Ordering Information

Base part number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRGB4062D1	TO-220	Tube	50	AUIRGB4062D1
AUIRGSL4062D1	TO-262	Tube	50	AUIRGSL4062D1
AUIRGS4062D1	D2Pak	Tube	50	AUIRGS4062D1
		Tape and Reel Left	800	AUIRGS4062D1TRL
		Tape and Reel Right	800	AUIRGS4062D1TRR

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

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