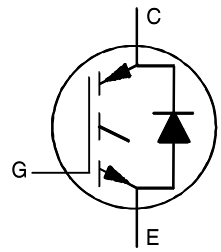
International
IOR Rectifier

AUTOMOTIVE GRADE

AUIRGP4062D1
AUIRGP4062D1-E

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE



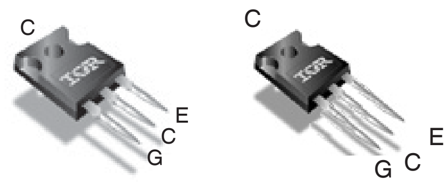
n-channel

V_{CES} = 600V

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

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

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



TO-247AC AUIRGP4062D1 TO-247AD AUIRGP4062D1-E

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
- 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
- EV Inverter
- Battery charger
- DC-DC converter

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	55	A
I_C @ T_C = 100°C	Continuous Collector Current	36	
$I_{NOMINAL}$	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	55	
I_F @ T_C = 100°C	Diode Continous Forward Current	36	
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	217	W
P_D @ T_C = 100°C	Maximum Power Dissipation	109	
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	–––	–––	0.69	°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)	–––	0.24	–––	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	–––	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 = 100µA ④
$\Delta V_{(BR)CES}/\Delta T_J$	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 ④
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†

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		3L-TO-247AC	N/A
		3L-TO-247AD	
ESD	Machine Model	Class M4 (+/- 700V) (per AEC-Q101-002)	
	Human Body Model	Class H1C (+/- 2000V) (per AEC-Q101-001)	
	Charged Device Model	Class C5(+/- 2000V) (per AEC-Q101-005)	
RoHS Compliant		Yes	

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

†† Highest passing voltage.

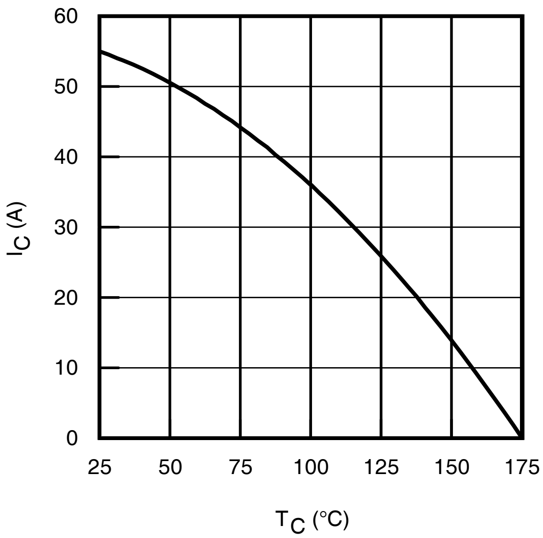


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

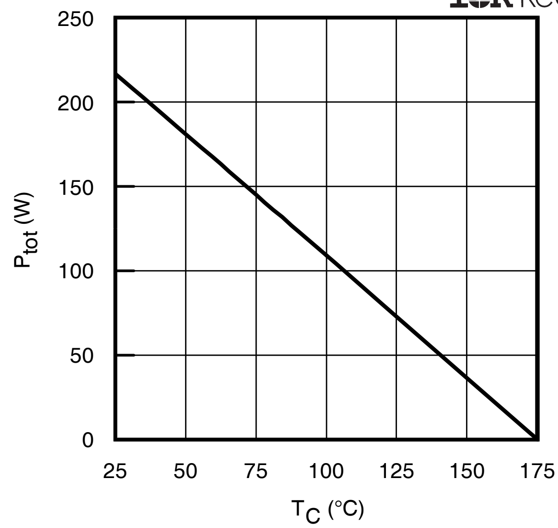


Fig. 2 - Power Dissipation vs. Case Temperature

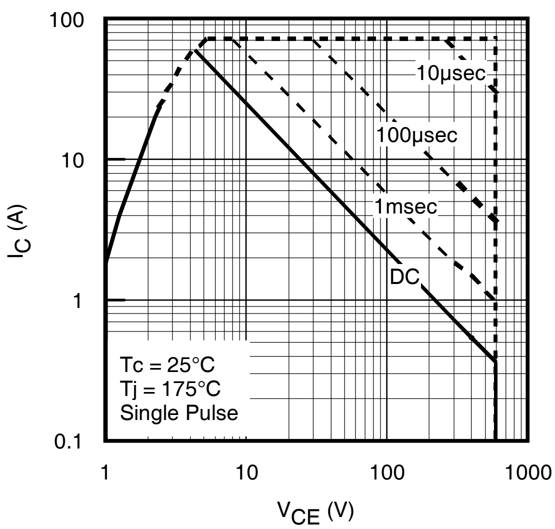


Fig. 3 - Forward SOA
T_C = 25°C, $T_J \leq$ 175°C; V_{GE} =15V

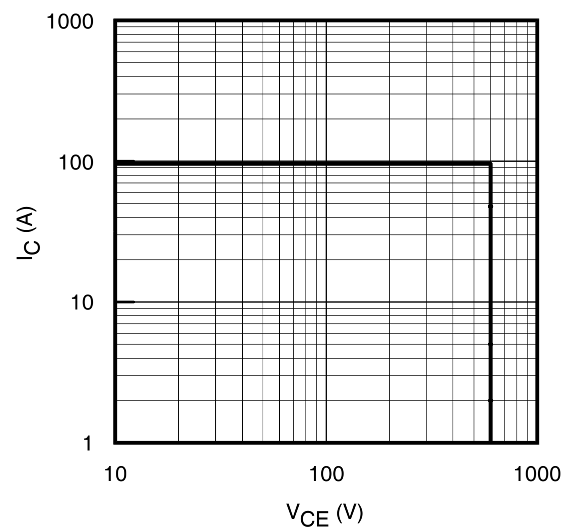


Fig. 4 - Reverse Bias SOA
T_J = 175°C; V_{GE} = 20V

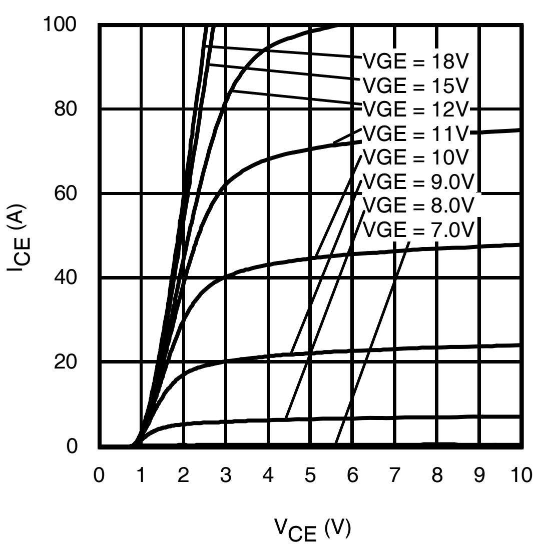


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 20µs

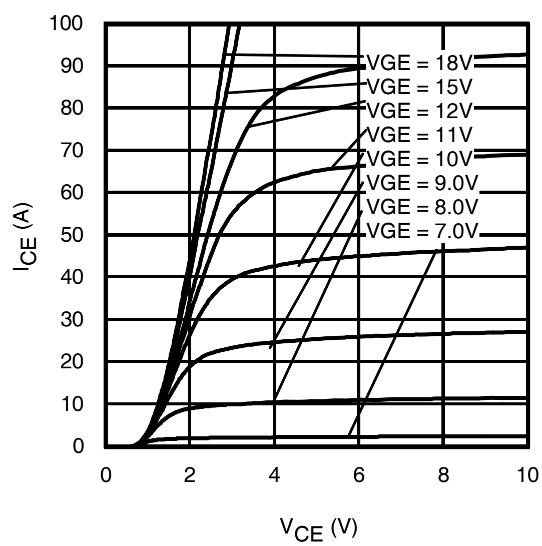


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 20µs

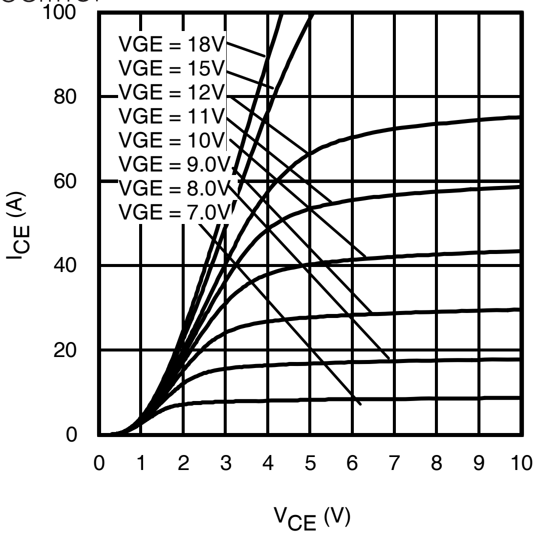


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 175°C; tp = 20µs

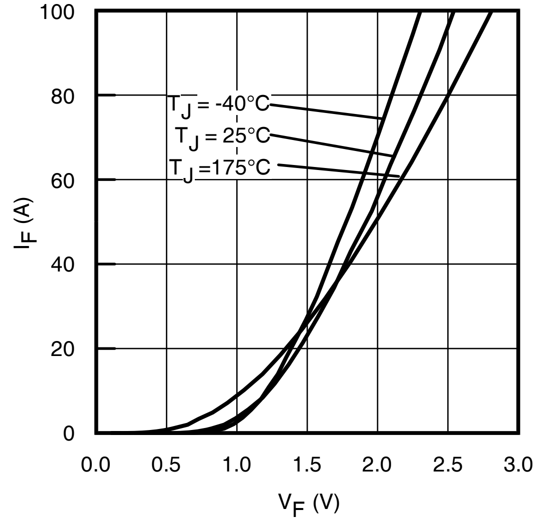


Fig. 8 - Typ. Diode Forward Characteristics
tp = 20µs

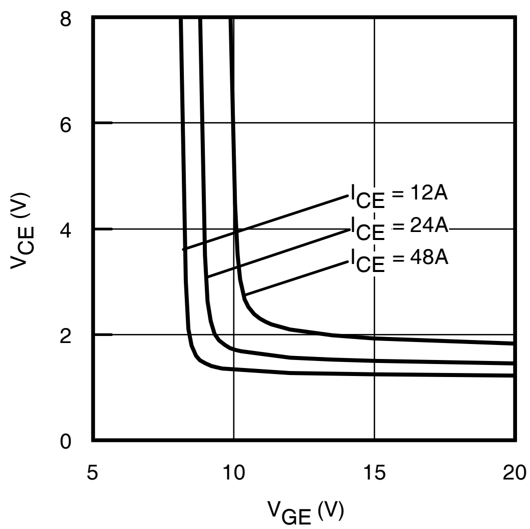


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

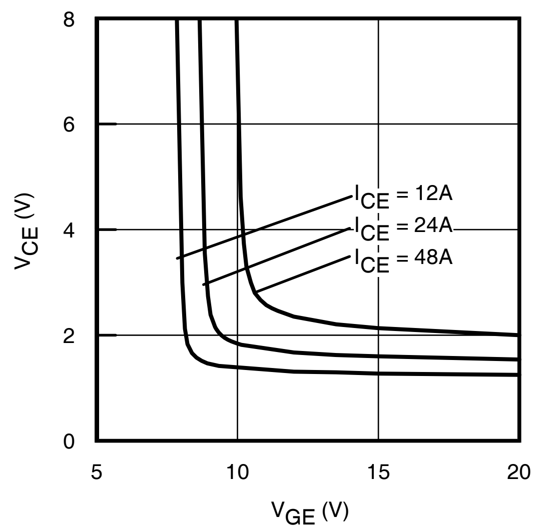


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

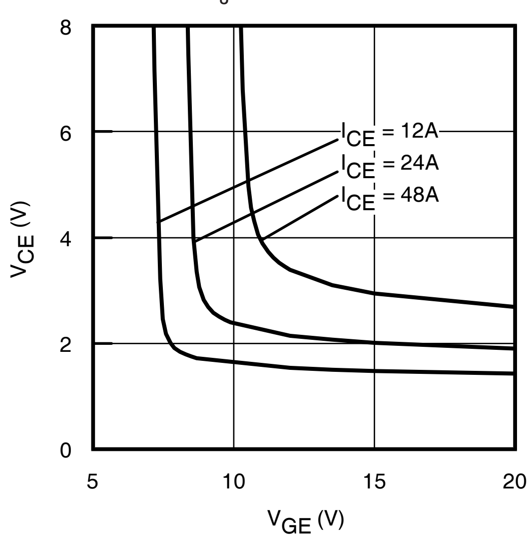


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 175°C

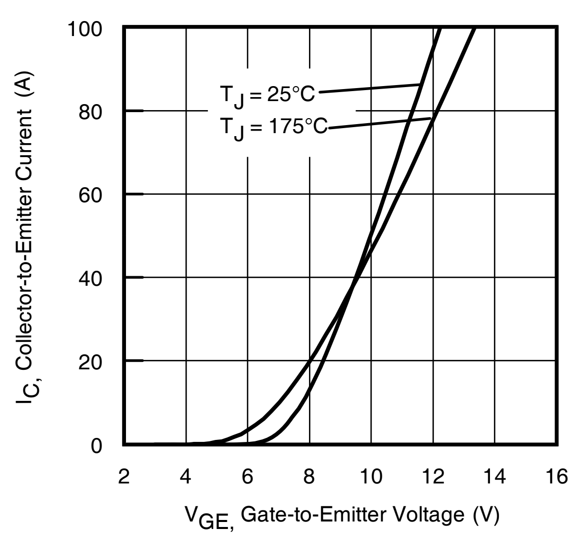


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 20µs

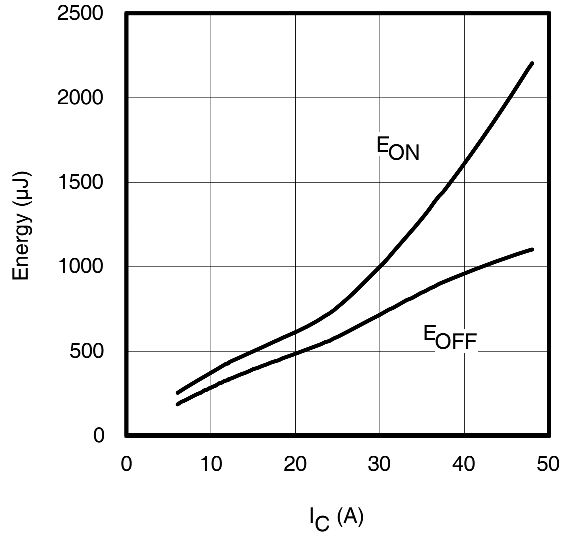


Fig. 13 - Typ. Energy Loss vs. I_C
$T_J = 175°C$; $L = 210μH$; $V_{CE} = 400V$, $R_G = 10Ω$; $V_{GE} = 15V$

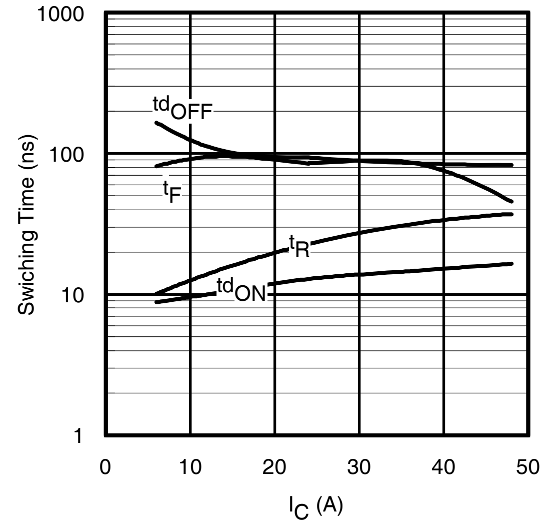


Fig. 14 - Typ. Switching Time vs. I_C
$T_J = 175°C$; $L = 210μH$; $V_{CE} = 400V$, $R_G = 10Ω$; $V_{GE} = 15V$

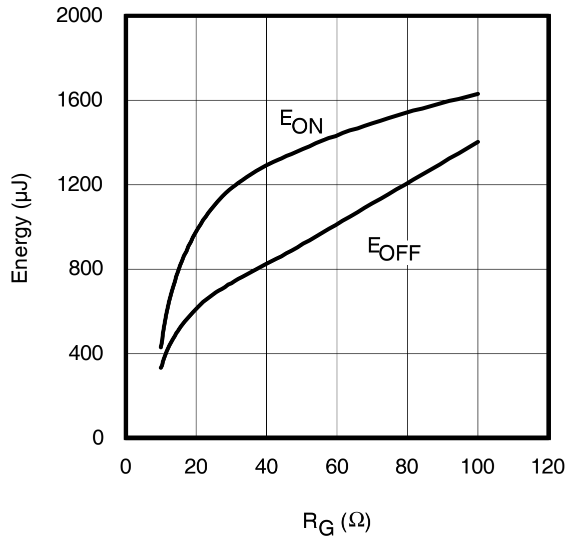


Fig. 15 - Typ. Energy Loss vs. R_G
$T_J = 175°C$; $L = 210μH$; $V_{CE} = 400V$, $I_{CE} = 24A$; $V_{GE} = 15V$

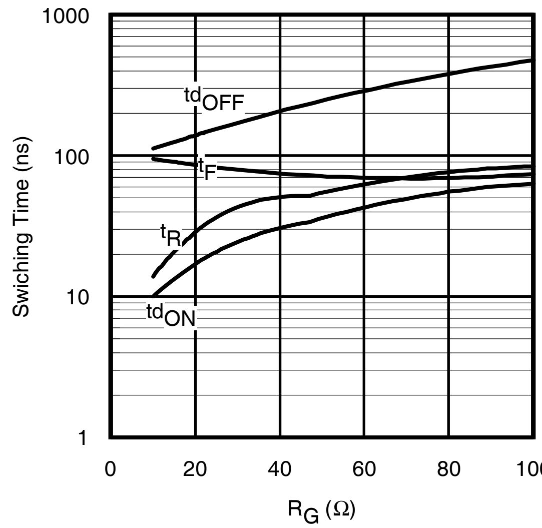


Fig. 16 - Typ. Switching Time vs. R_G
$T_J = 175°C$; $L = 210μH$; $V_{CE} = 400V$, $I_{CE} = 24A$; $V_{GE} = 15V$

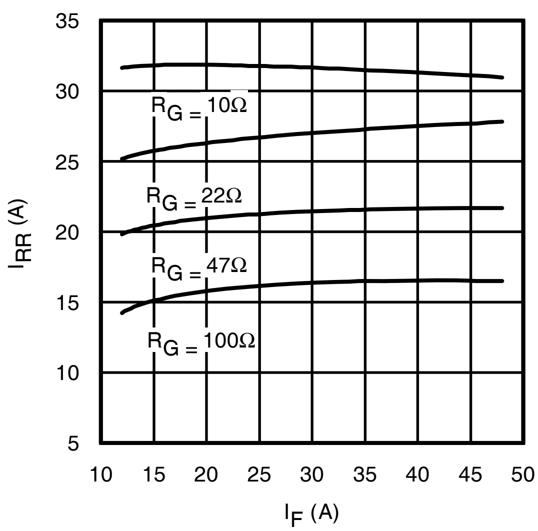


Fig. 17 - Typ. Diode I_{RR} vs. I_F
$T_J = 175°C$

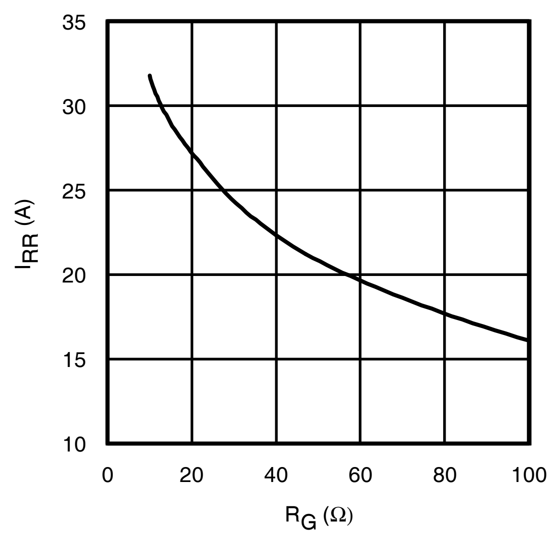


Fig. 18 - Typ. Diode I_{RR} vs. R_G
$T_J = 175°C$

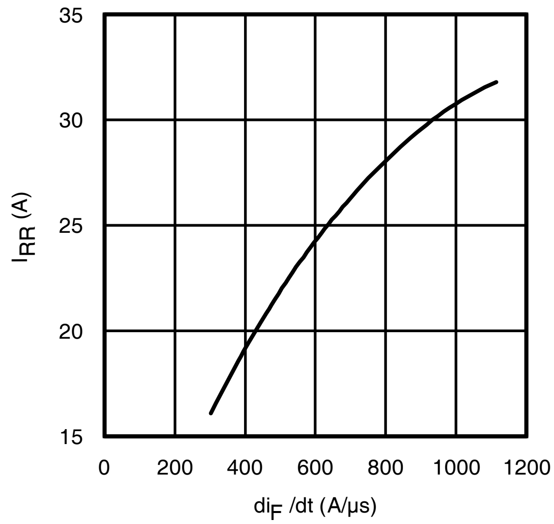


Fig. 19 - Typ. Diode I_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; I_F = 24A; T_J = 175°C

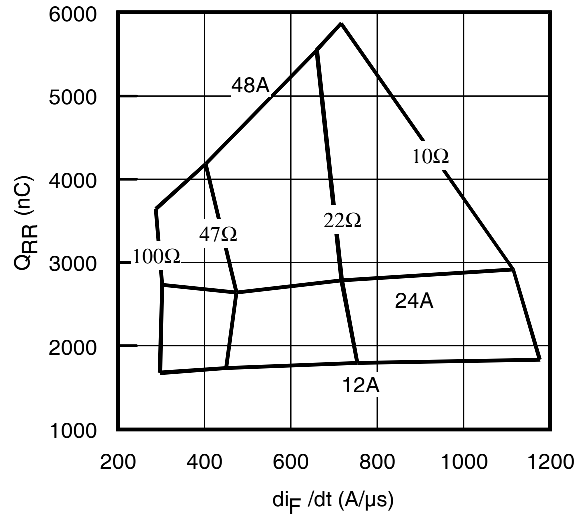


Fig. 20 - Typ. Diode Q_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; T_J = 175°C

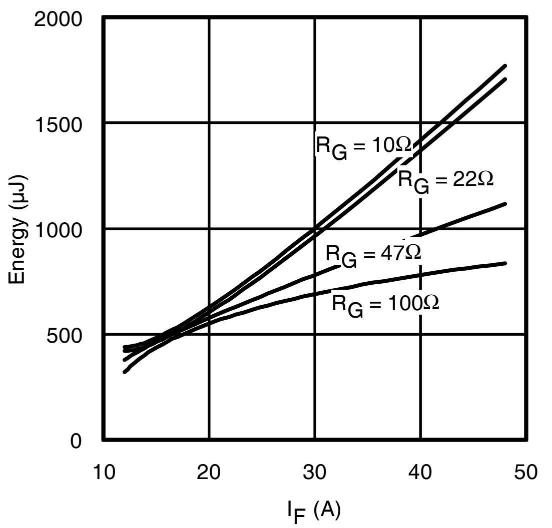


Fig. 21 - Typ. Diode E_{RR} vs. I_F
T_J = 175°C

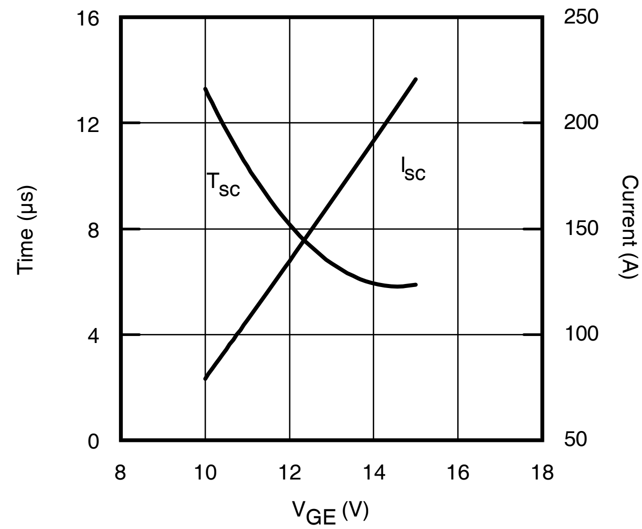


Fig. 22 - V_{GE} vs. Short Circuit Time
V_{CC} = 400V; T_C = 25°C

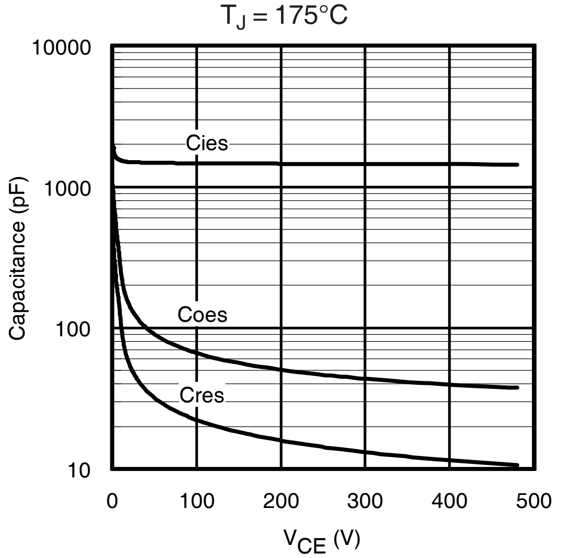


Fig. 23 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

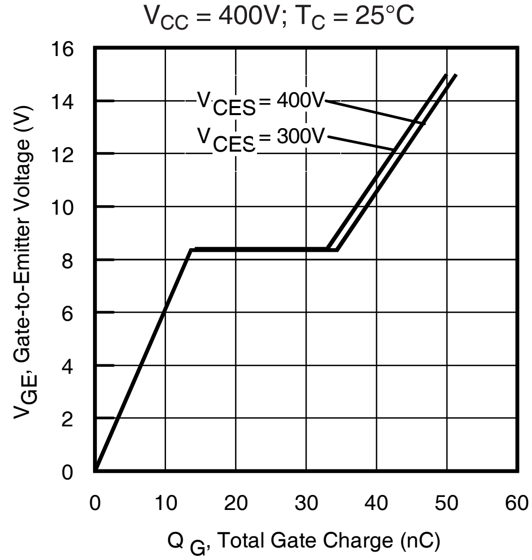
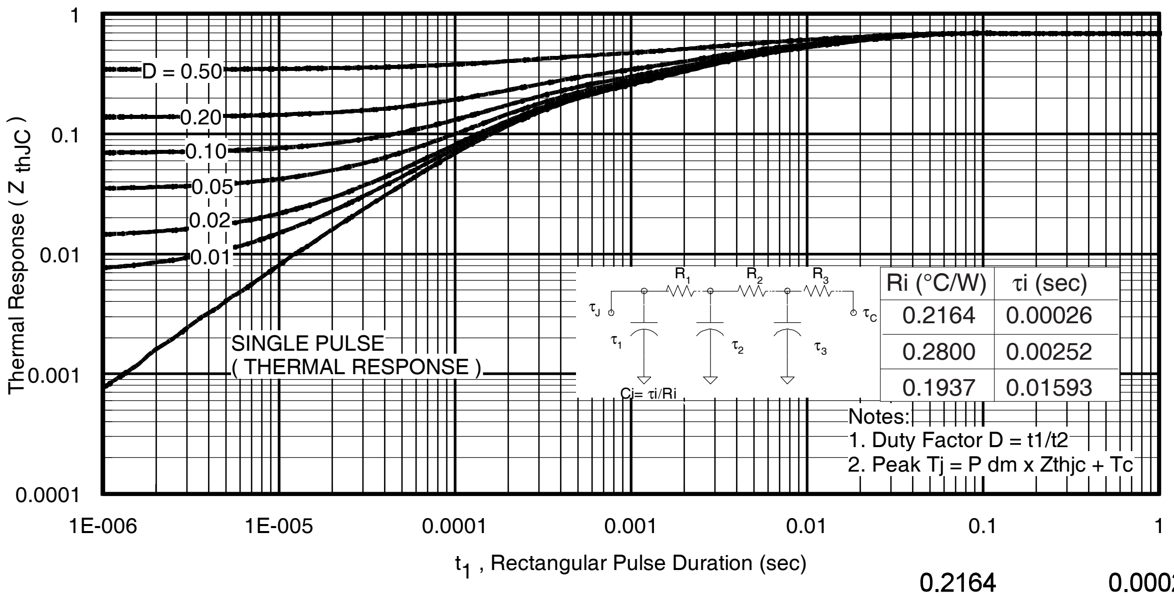


Fig. 24 - Typical Gate Charge vs. V_{GE}
I_{CE} = 24A; L = 585µH



0.2164	0.00026
0.2800	0.00252
0.1937	0.01593

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

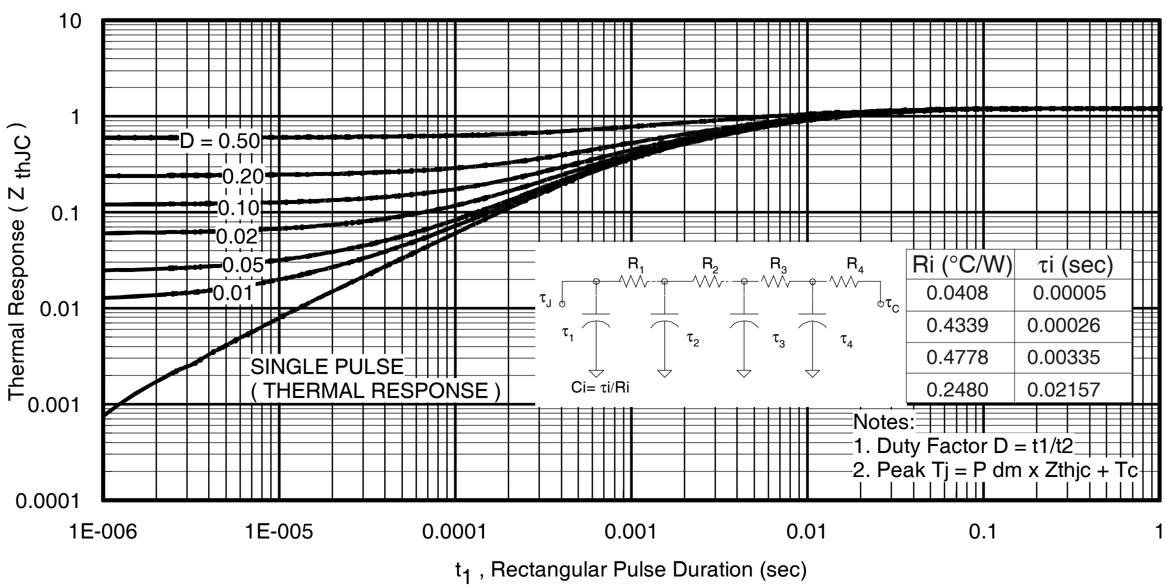


Fig. 26. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

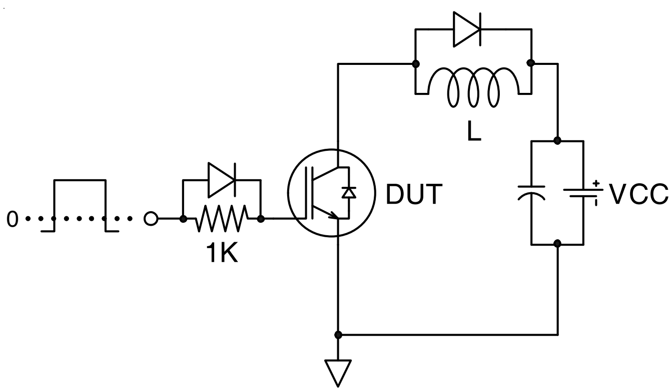


Fig.C.T.1 - Gate Charge Circuit (turn-off)

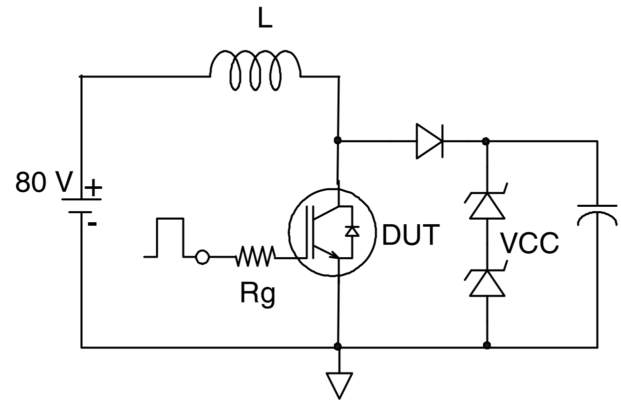


Fig.C.T.2 - RBSOA Circuit

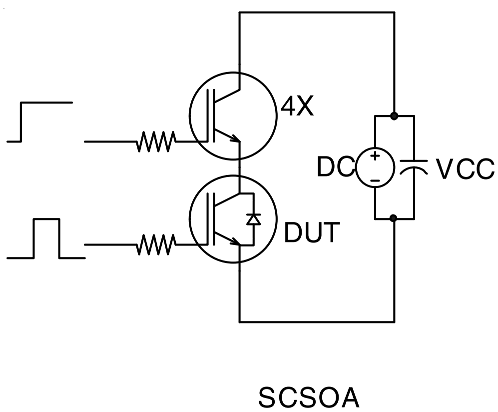


Fig.C.T.3 - S.C. SOA Circuit

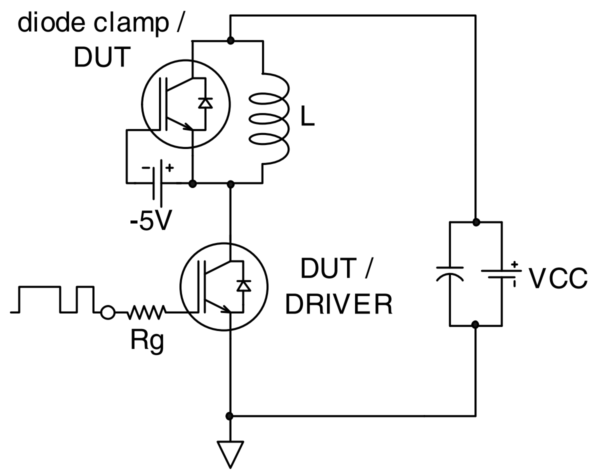


Fig.C.T.4 - Switching Loss Circuit

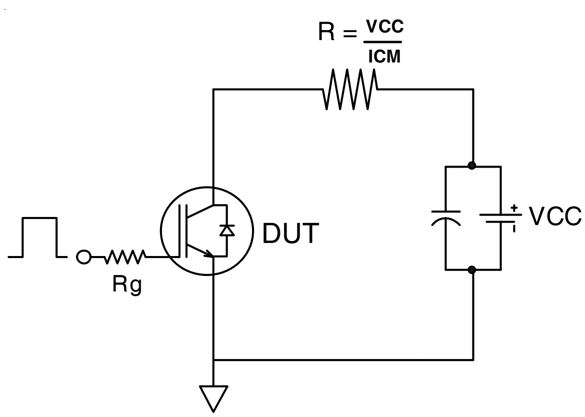


Fig.C.T.5 - Resistive Load Circuit

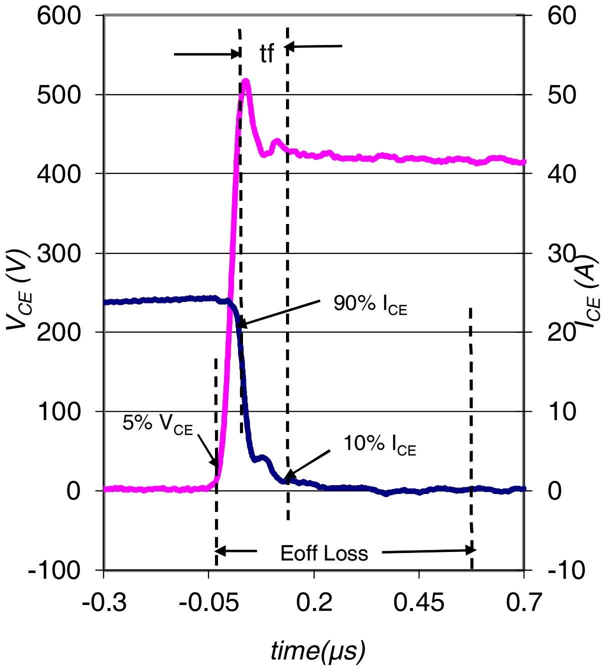


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 175°C using Fig. CT.4

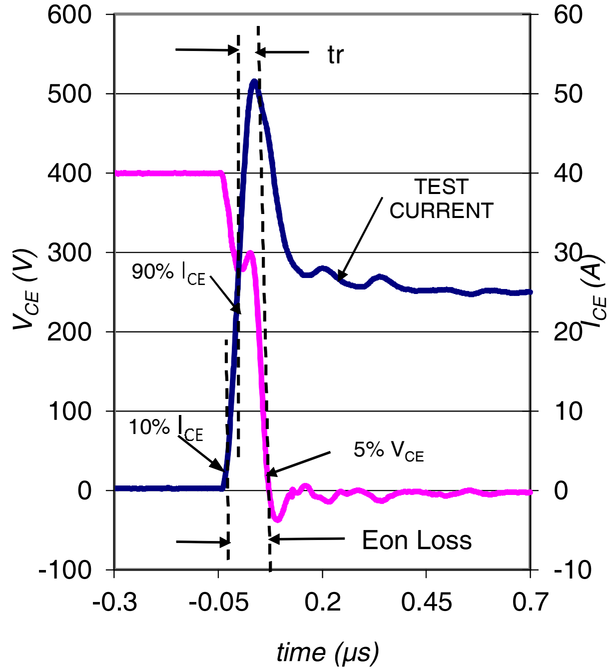


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 175°C using Fig. CT.4

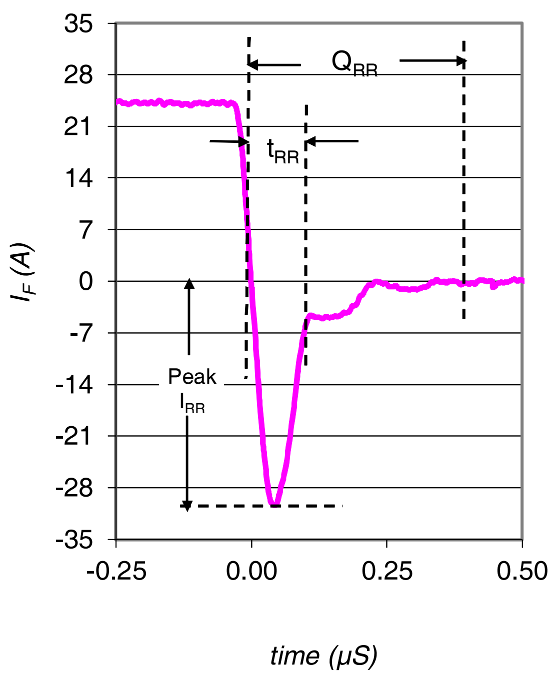


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 175°C using Fig. CT.4

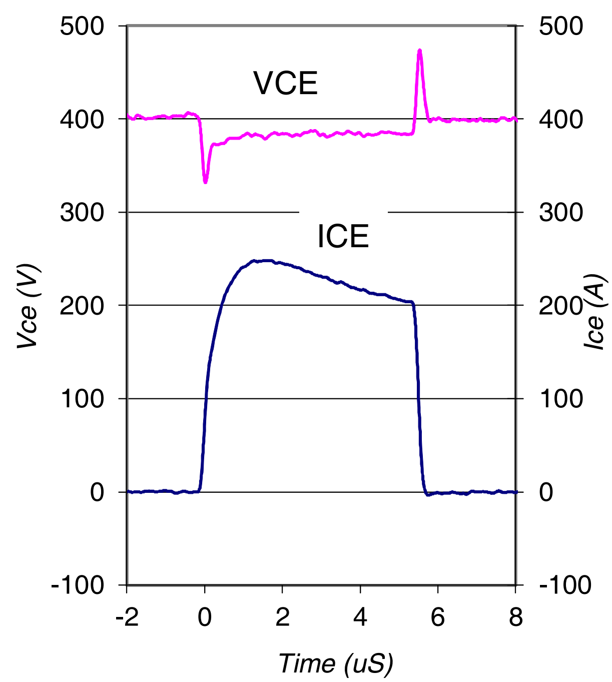
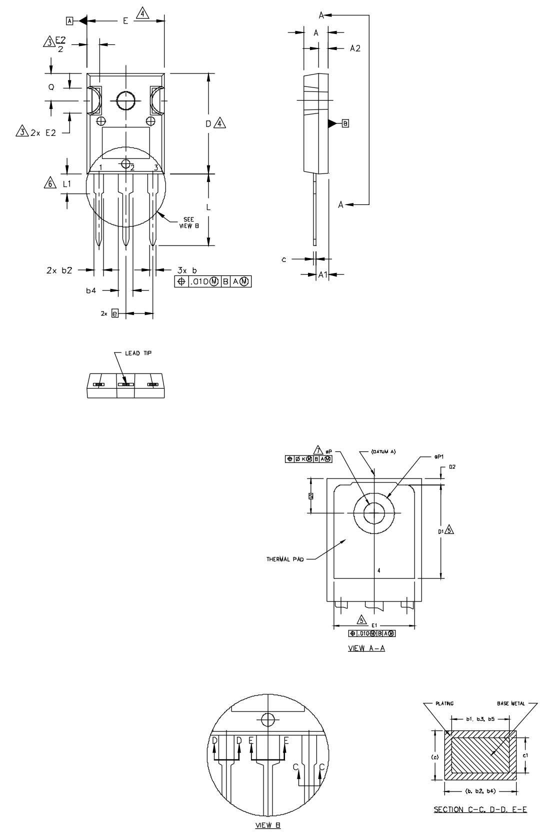


Fig. WF4 - Typ. S.C. Waveform
@ T_J = 25°C using Fig. CT.3

TO-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				NOTES
	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

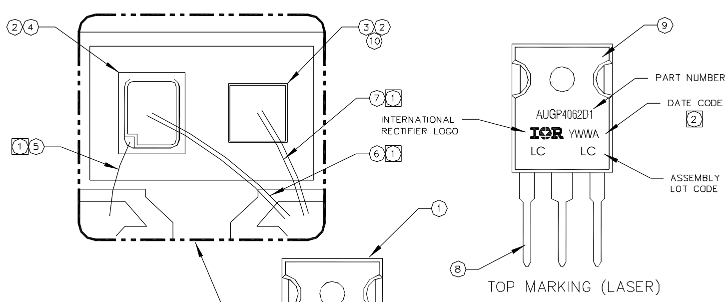
IGBTs, CoPACK

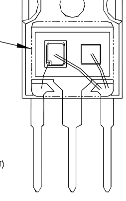
1.- GATE
2.- COLLECTOR
3.- EMITTER
4.- COLLECTOR

DIODES

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

TO-247AC Part Marking Information





NOTES, ASSEMBLY:

1. WIRE BOND METHOD: ULTRA-SONIC WEDGE BONDING.
2. MARKING SPECIFICATION: 23-0014
3. EMITTER BOND PAD SIZE: APPROX. .0993 X .108
4. GATE BOND PAD SIZE: .0198 X .0219
5. ANODE BONDABLE AREA: .0956 X .0956
6. WAFER ORIENTATION: STD (GATE PAD LOCATION IS OPPOSITE OF WAFER FLAT)
7. DIE COAT PROCESS ONLY ON DIODE

NOTES, PACKAGING

1. TUBE - 25 UNITS/TUBE

ITEM	REFERENCE NUMBER	DESCRIPTION	QTY
10	43-9849	DIE COAT (DIODE ONLY)	A/R
9	43-9807	MOLD COMPOUND (MG15F-35A)	A/R
8	44-0071	PBF SOLDER DIP	A/R
7	44-0199-05	ANODE, BOND WIRE, Al 4/9s Ni DOPED_15 mils	2
6	44-0199-05	EMITTER, BOND WIRE, Al 4/9s Ni DOPED_15 mils	2
5	44-0199-01	GATE, BOND WIRE, Al 4/9s Ni DOPED_5 mils	1
4	872311AU (01-5891)	IGBT 3, 600V, GEN 6.2 (DIE SIZE: .135 X .165 X .0028, WAFER DIA: 150mm/6inch)	1
3	44-1087	SEMIKRON DIODE # 34756821, 600V (DIE SIZE: .116 X .116, WAFER DIA: 150mm/6inch)	1
2	43-7698	SOLDER, DIE ATTACH (J-ALLOY)	A/R
1	44-0023	LEADFRAME, TO-247 (.280 X .457)	1

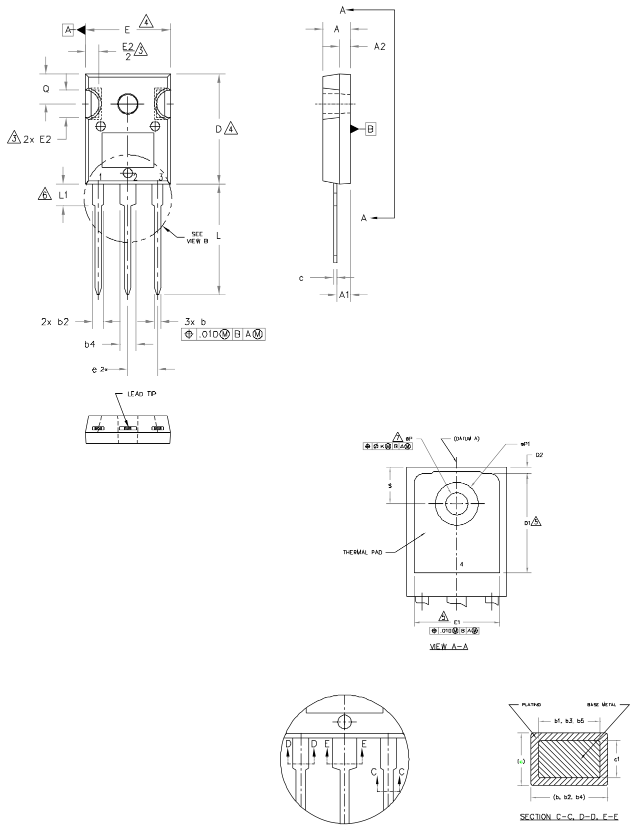
AUIRGP4062D1, TO-247 ASSY, IRMEX

ALL DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]

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

TO-247AD 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-247AD.

SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.190	.203	4.83	5.13	
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	.780	.827	19.57	21.00	
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

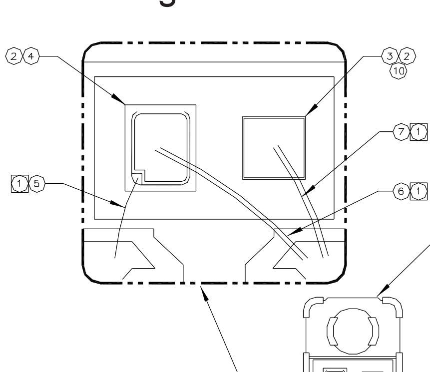
IGBTs, CoPACK

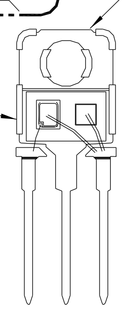
1.- GATE
2.- COLLECTOR
3.- EMITTER
4.- COLLECTOR

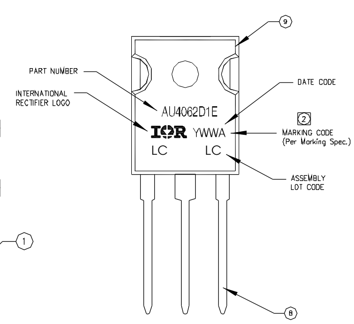
DIODES

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

TO-247AD Part Marking Information







TOP MARKING (LASER)

10	43-9849	DIE COAT (DIODE ONLY)	A/R
9	43-9807-01	MOLD COMPOUND (MG15F-35A)	A/R
8	44-0071	PBF SOLDER DIP	A/R
7	44-0199-05	ANODE, BOND WIRE, Al 4/9s Ni DOPED_15 mils	2
6	44-0199-05	EMITTER, BOND WIRE, Al 4/9s Ni DOPED_15 mils	2
5	44-0199-01	GATE, BOND WIRE, Al 4/9s Ni DOPED_5 mils	1
4	872311AU (01-5891)	IGBT 3, 600V, GEN 6.2 (DIE SIZE: .135 X .165 X .0028, WAFER DIA: 150mm/6inch)	1
3	44-1087	SEMIKRON DIODE # 34756B21, 600V (DIE SIZE: .116 X .116, WAFER DIA: 150mm/6inch)	1
2	43-7698	SOLDER, DIE ATTACH (J-ALLOY)	A/R
1	44-0039	LEADFRAME, TO-247 LONG LEAD	1
ITEM	REFERENCE NUMBER	DESCRIPTION	QTY
AUIRGP4062D1-E, TO-247 (LL) ASSY, IRMEX			

NOTES, ASSEMBLY:

1. WIRE BOND METHOD: ULTRA-SONIC WEDGE BONDING.
2. MARKING SPECIFICATION: 23-0014
3. EMITTER BOND PAD SIZE: APPROX. .0993 X .108
4. GATE BOND PAD SIZE: .0198 X .0219
5. ANODE BONDABLE AREA: .0956 X .0956
6. WAFER ORIENTATION: STD (GATE PAD LOCATION IS OPPOSITE OF WAFER FLAT)
7. DIE COAT PROCESS ONLY ON DIODE

NOTES, PACKAGING

1. TUBE - 25 UNITS/TUBE

ALL DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]

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	
AUIRGP4062D1	TO-247AC	Tube	25	AUIRGP4062D1
AUIRGP4062D1-E	TO-247AD	Tube	25	AUIRGP4062D1-E

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

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