

**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} Ⓞ
- 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

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

Absolute Maximum Ratings

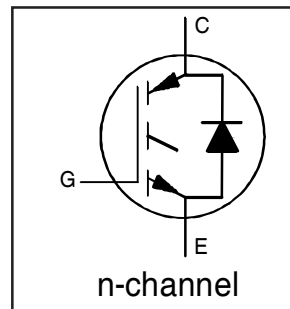
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated 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	55	A	
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	36		
$I_{NOMINAL}$	Nominal Current	24		
I_{CM}	Pulse Collector Current, $V_{GE} = 15V$	72		
I_{LM}	Clamped Inductive Load Current, $V_{GE} = 20V$ Ⓞ	96		
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	55		
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	36		
I_{FM}	Diode Maximum Forward Current Ⓜ	96		
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	217	W	
$P_D @ T_C = 100^\circ C$	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)		

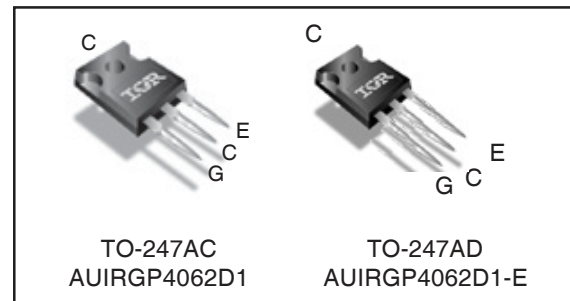
Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case (IGBT)Ⓜ	---	---	0.69	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case (Diode)Ⓜ	---	---	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/>



$V_{CES} = 600V$
$I_{C(Nominal)} = 24A$
$t_{SC} \geq 5\mu s, T_{J(max)} = 175^\circ C$
$V_{CE(on)} \text{ typ.} = 1.57V$



G	C	E
Gate	Collector	Emitter

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
ΔV _{(BR)CES} /ΔT _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
ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	—	-17	—	mV/°C	V _{CE} = V _{GE} , I _C = 1.0mA (25°C - 175°C)
g _f	Forward Transconductance	—	12	—	S	V _{CE} = 50V, I _C = 24A, P _W = 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, V _p ≤ 600V R _G = 10Ω, V _{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V _{CC} = 400V, V _p ≤ 600V R _G = 10Ω, V _{GE} = +15V to 0V
E _{rec}	Reverse Recovery Energy of the Diode	—	773	—	μJ	T _J = 175°C
t _{rr}	Diode Reverse Recovery Time	—	102	—	ns	V _{CC} = 400V, I _F = 24A
I _{rr}	Peak Reverse Recovery Current	—	32	—	A	V _{GE} = 15V, R _G = 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.

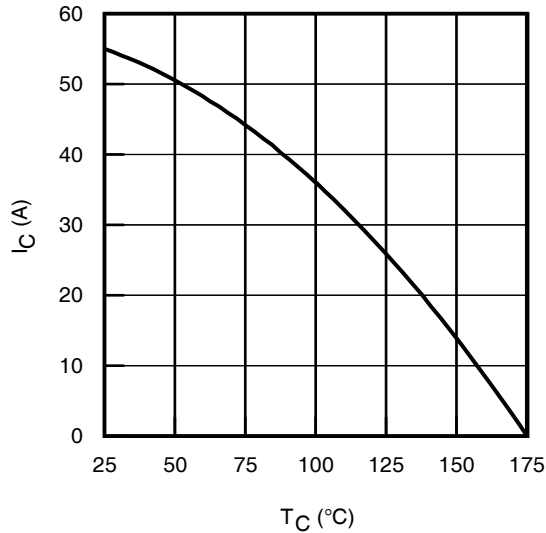


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

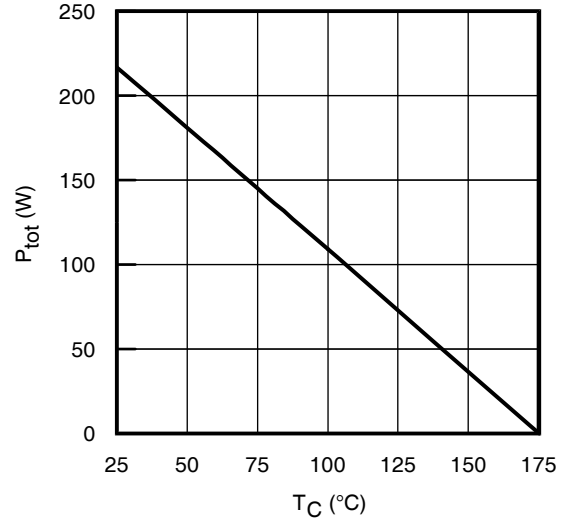


Fig. 2 - Power Dissipation vs. Case Temperature

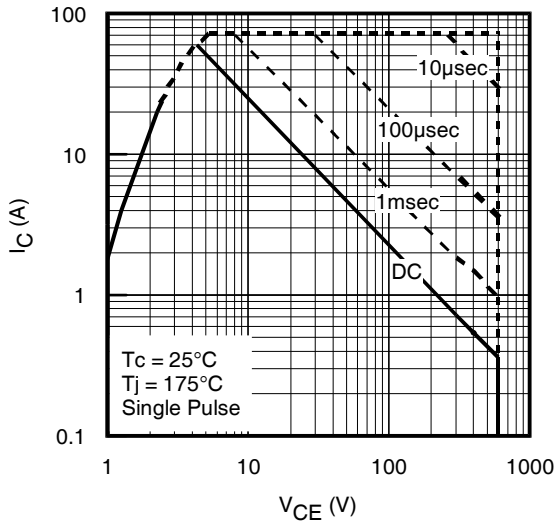


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$, $T_J \leq 175^\circ\text{C}$; $V_{GE} = 15\text{V}$

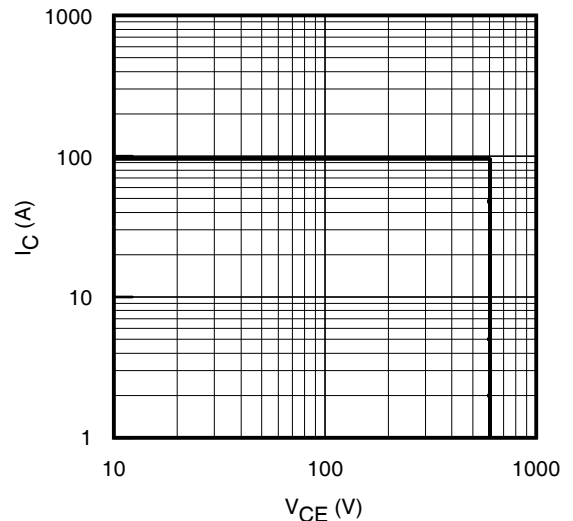


Fig. 4 - Reverse Bias SOA
 $T_J = 175^\circ\text{C}$; $V_{GE} = 20\text{V}$

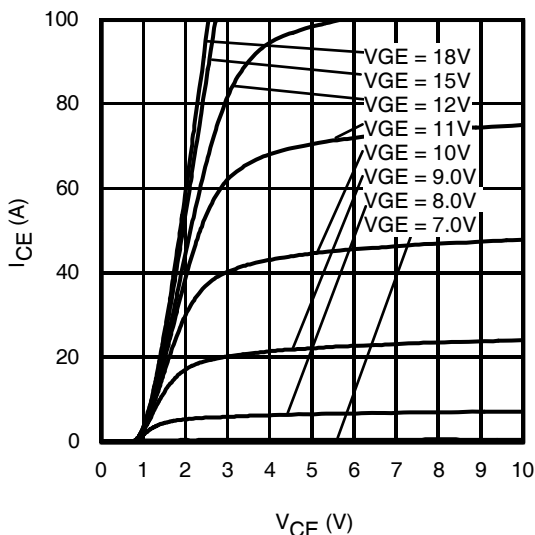


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 20\mu\text{s}$

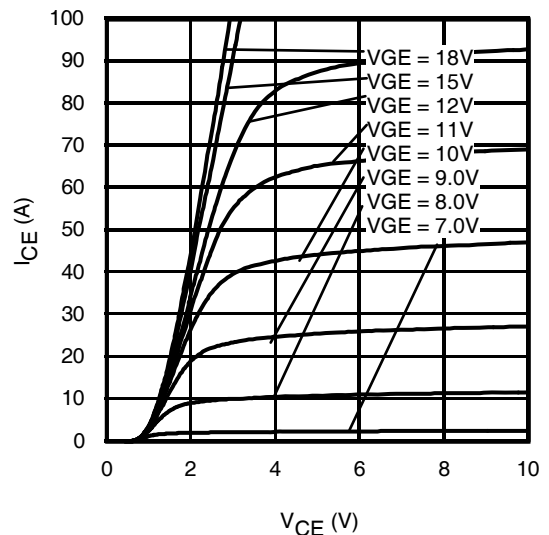


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 20\mu\text{s}$

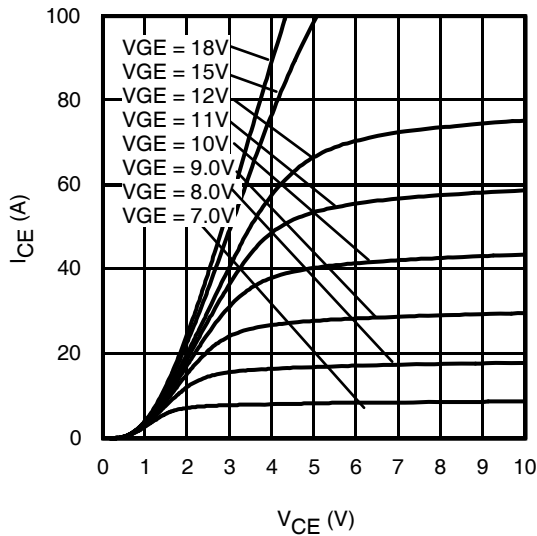


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 175^\circ\text{C}$; $t_p = 20\mu\text{s}$

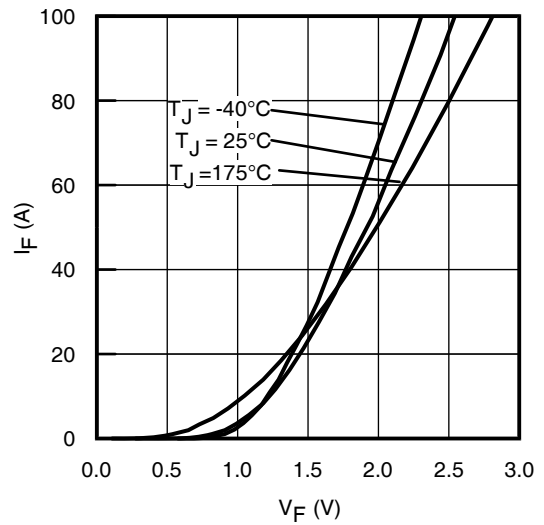


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 20\mu\text{s}$

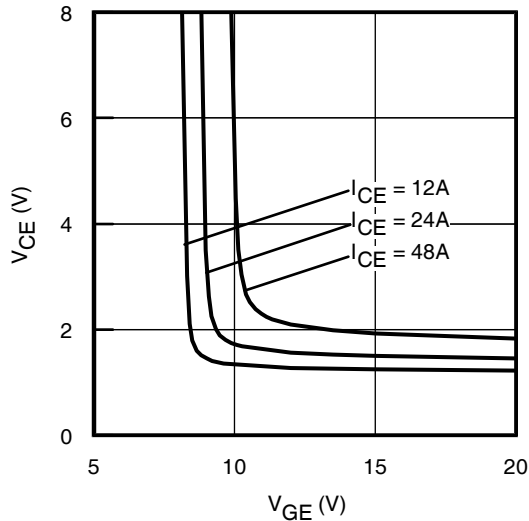


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

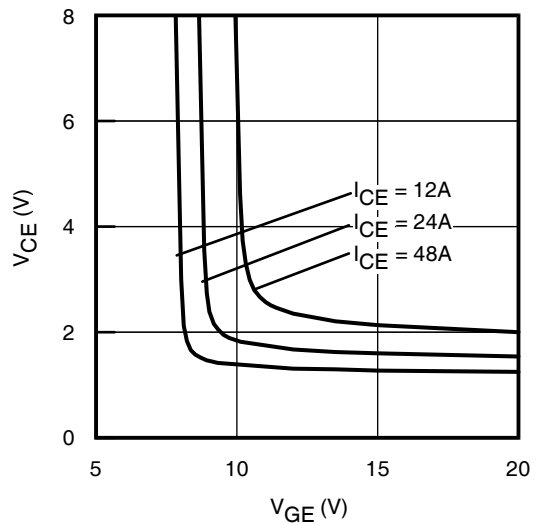


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

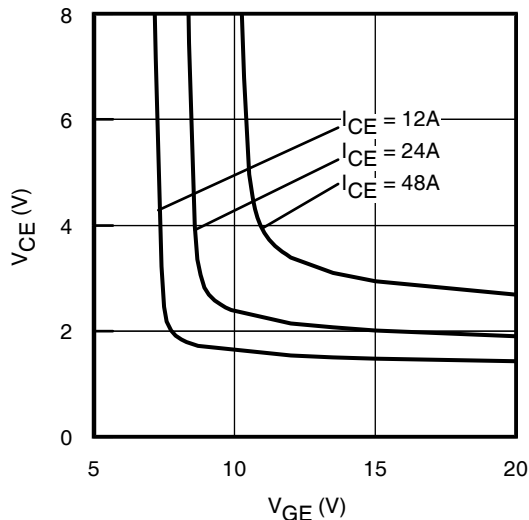


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 175^\circ\text{C}$

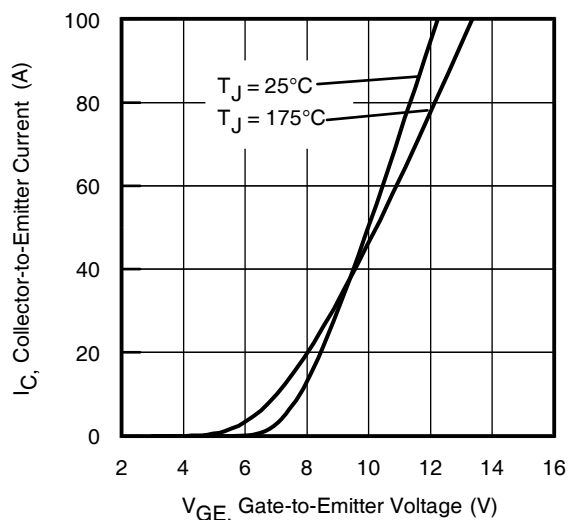
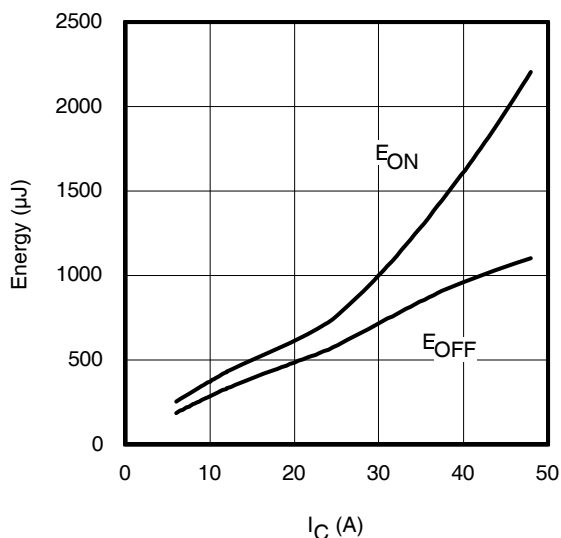
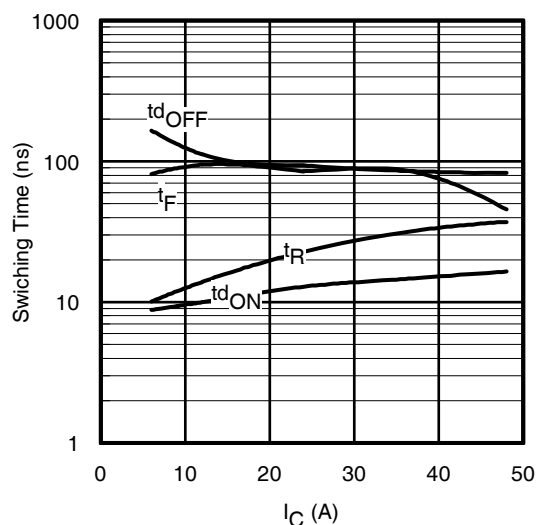
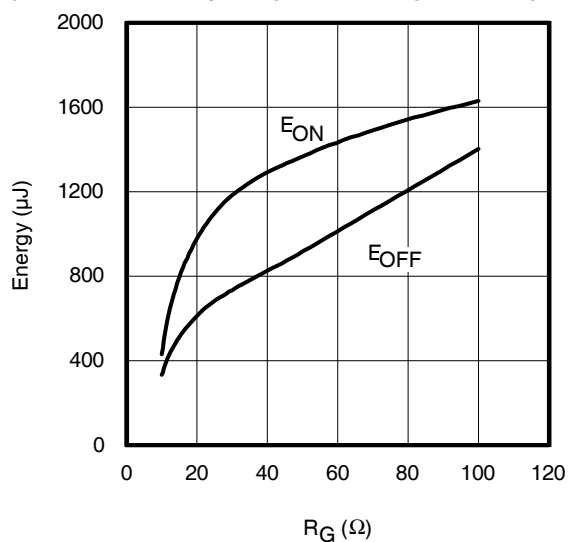
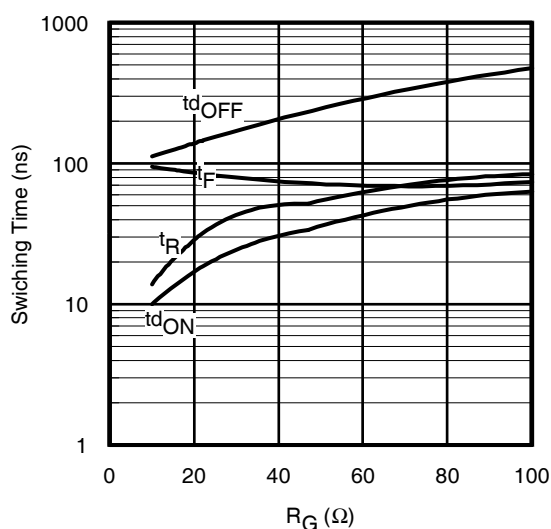
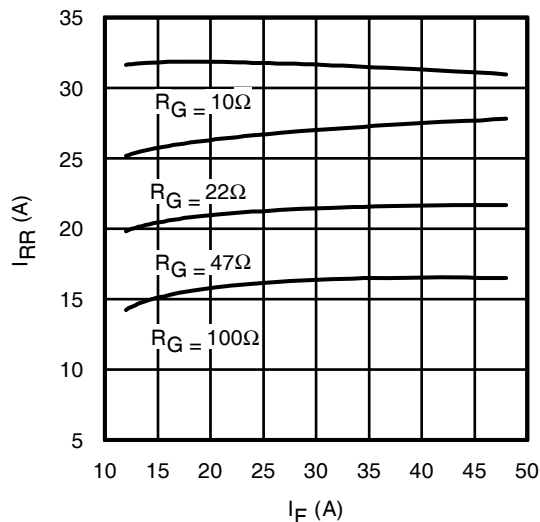
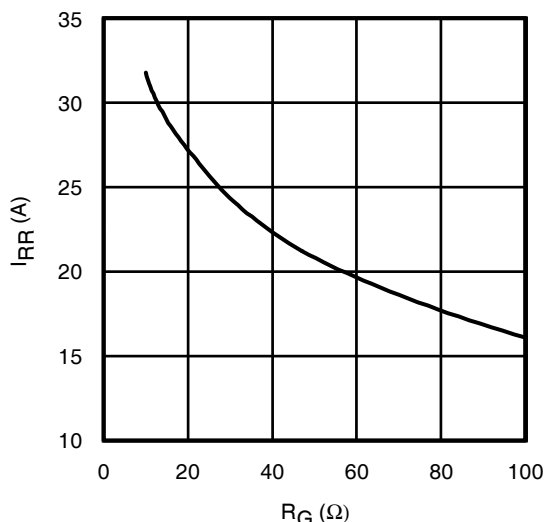


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 20\mu\text{s}$


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

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

Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 175^\circ\text{C}; L = 210\mu\text{H}; V_{CE} = 400\text{V}, I_{CE} = 24\text{A}; V_{GE} = 15\text{V}$

Fig. 16 - Typ. Switching Time vs. R_G
 $T_J = 175^\circ\text{C}; L = 210\mu\text{H}; V_{CE} = 400\text{V}, I_{CE} = 24\text{A}; V_{GE} = 15\text{V}$

Fig. 17 - Typ. Diode I_{RR} vs. I_F
 $T_J = 175^\circ\text{C}$

Fig. 18 - Typ. Diode I_{RR} vs. R_G
 $T_J = 175^\circ\text{C}$

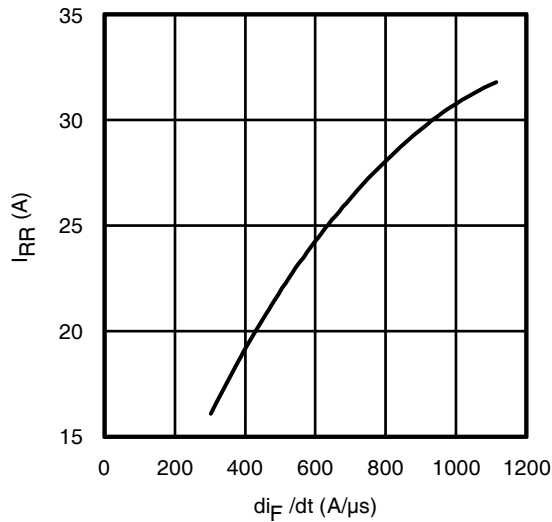


Fig. 19 - Typ. Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400V$; $V_{GE} = 15V$; $I_F = 24A$; $T_J = 175^\circ C$

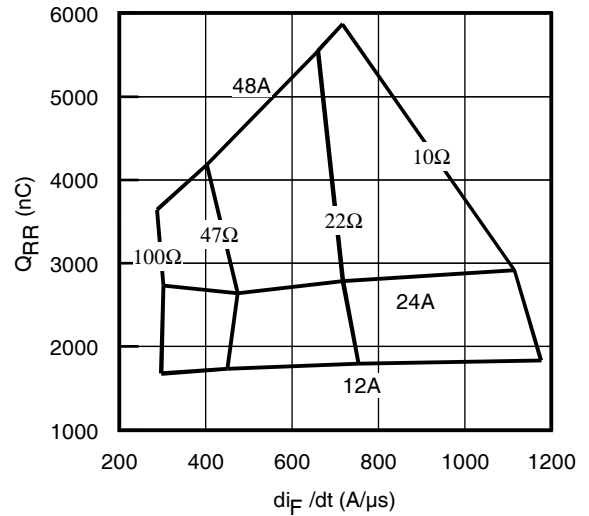


Fig. 20 - Typ. Diode Q_{RR} vs. di_F/dt
 $V_{CC} = 400V$; $V_{GE} = 15V$; $T_J = 175^\circ C$

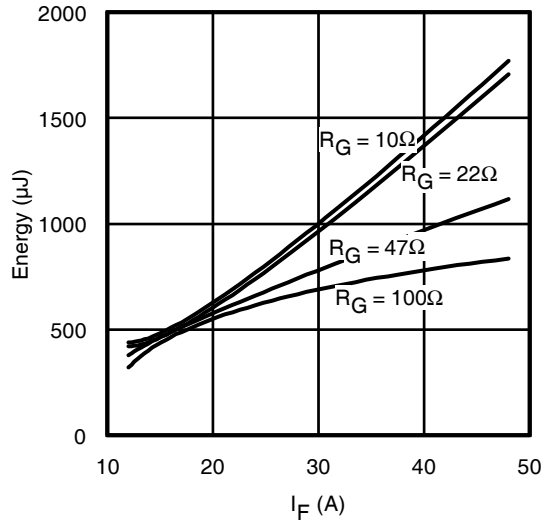


Fig. 21 - Typ. Diode E_{RR} vs. I_F
 $T_J = 175^\circ C$

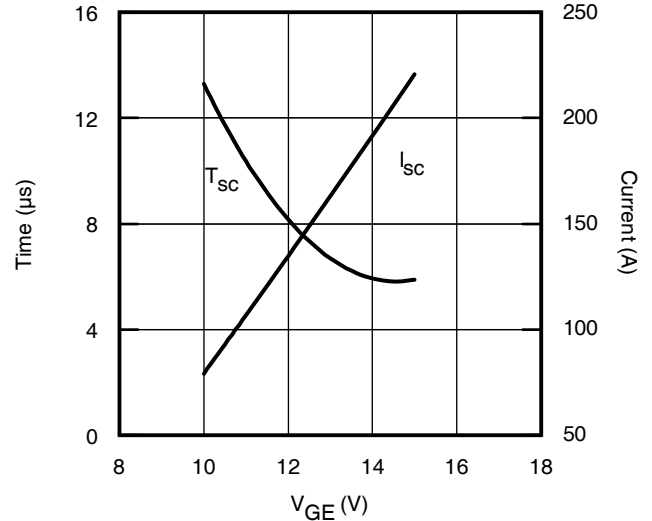


Fig. 22 - V_{GE} vs. Short Circuit Time
 $V_{CC} = 400V$; $T_C = 25^\circ C$

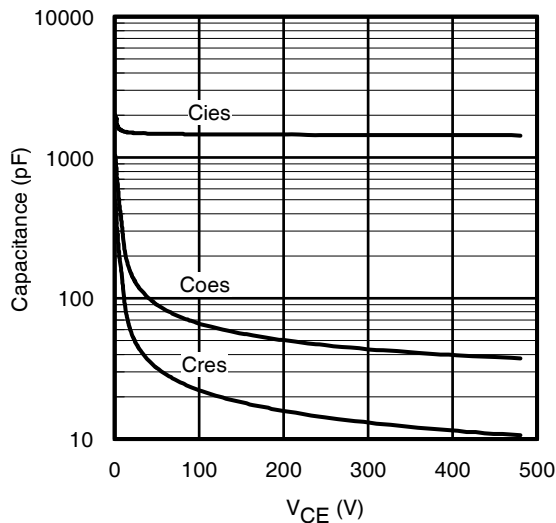


Fig. 23 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

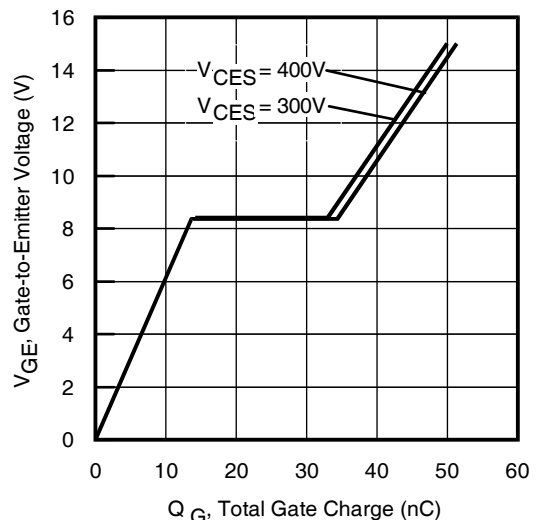
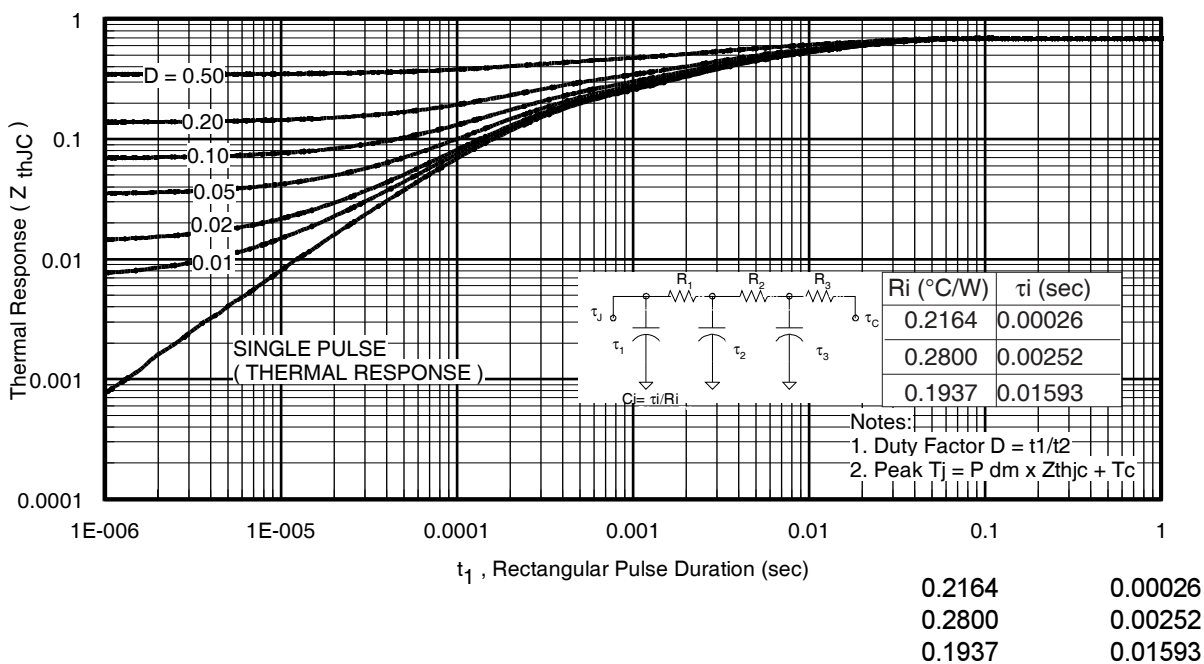
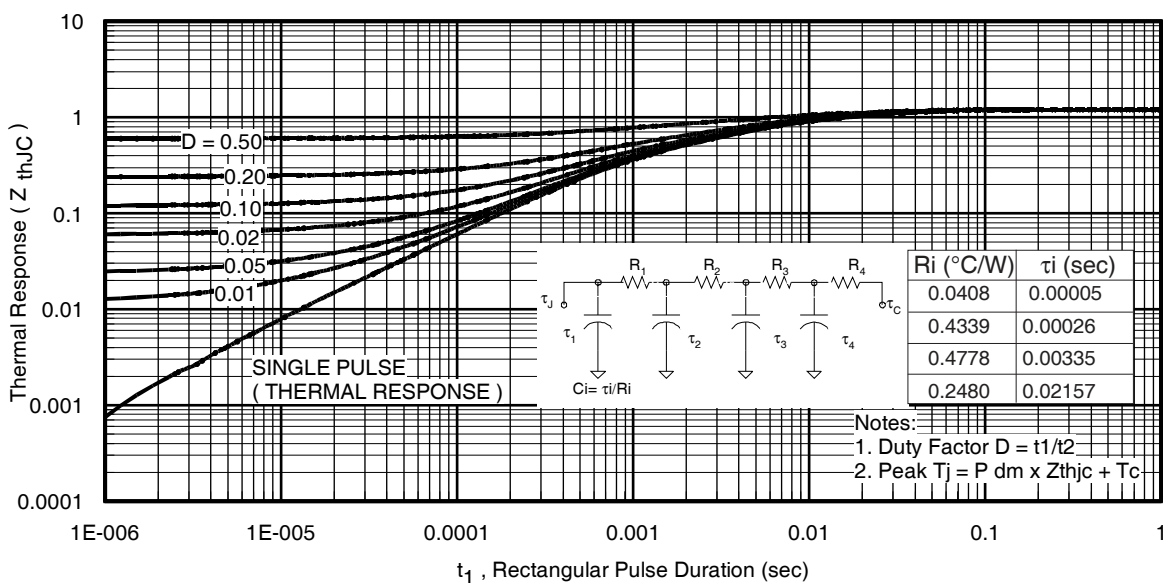


Fig. 24 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 24A$; $L = 585\mu H$


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

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

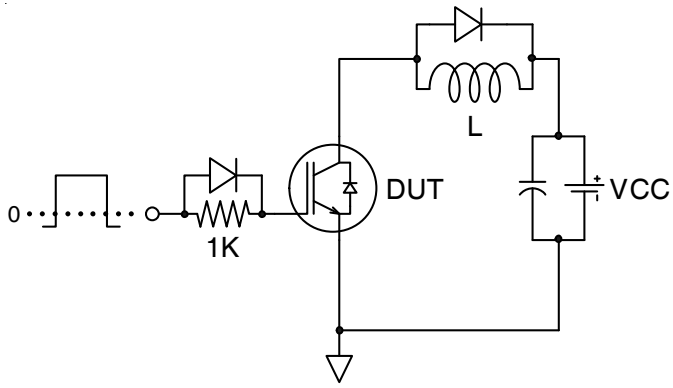


Fig.C.T.1 - Gate Charge Circuit (turn-off)

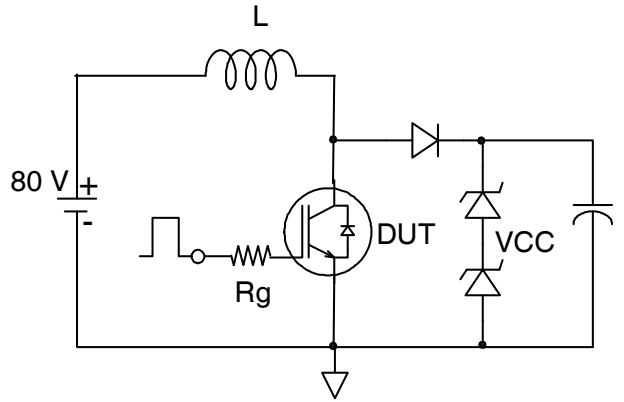
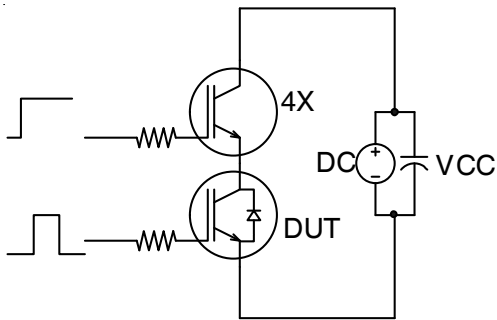


Fig.C.T.2 - RBSOA Circuit



SCSOA

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

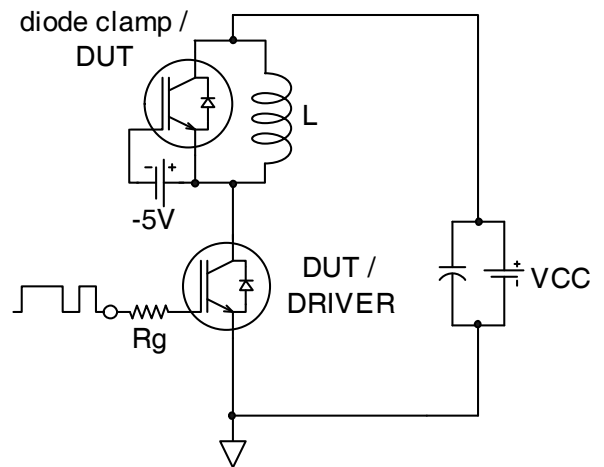


Fig.C.T.4 - Switching Loss Circuit

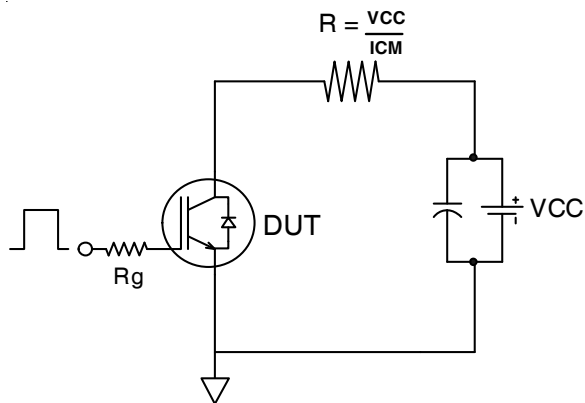


Fig.C.T.5 - Resistive Load Circuit

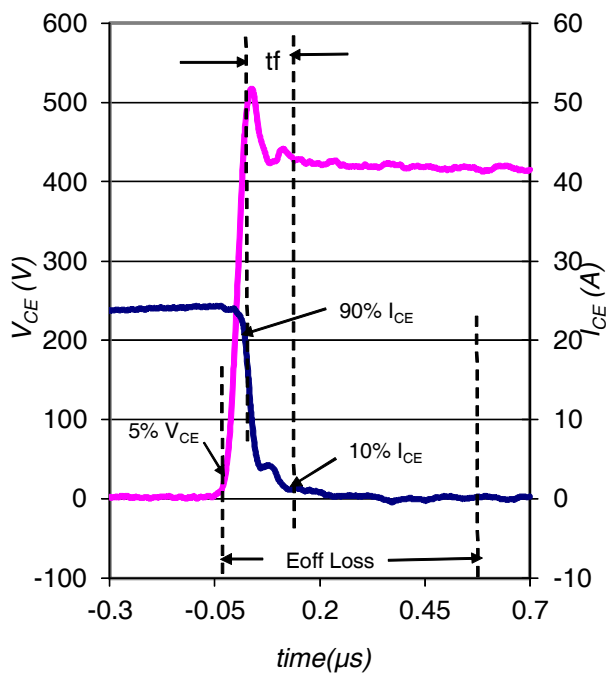


Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

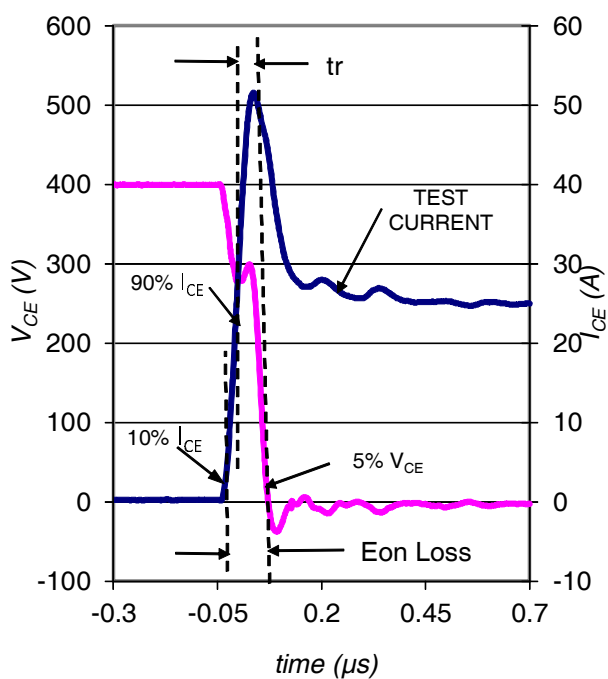


Fig. WF2 - Typ. Turn-on Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

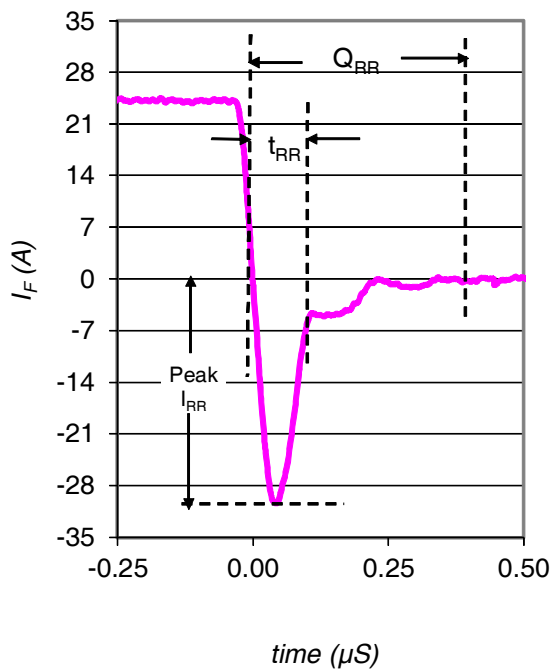


Fig. WF3 - Typ. Diode Recovery Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

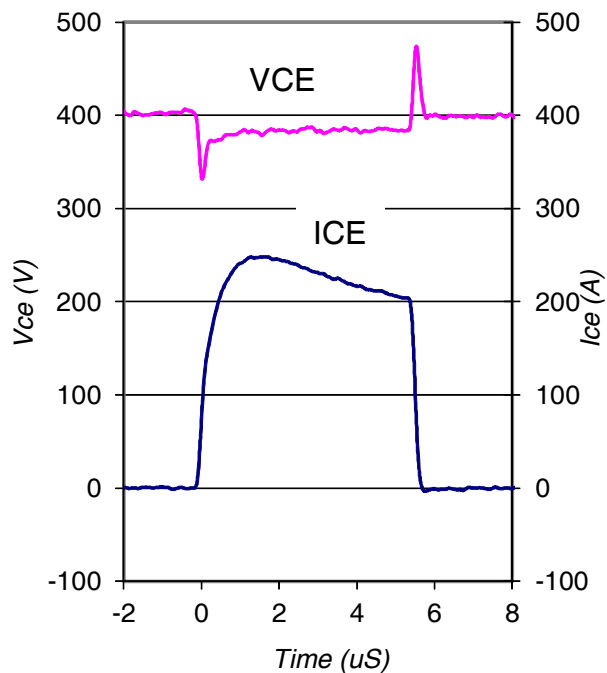
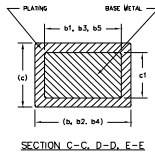
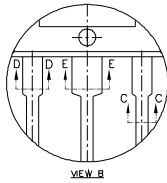
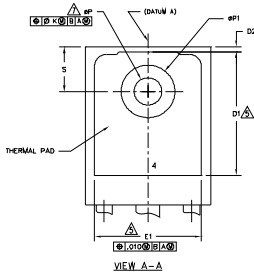
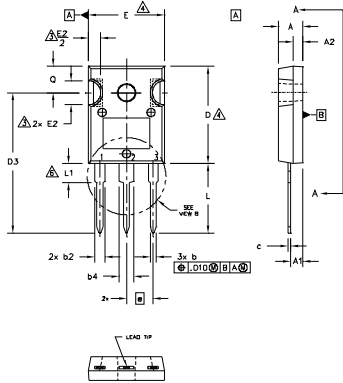


Fig. WF4 - Typ. S.C. Waveform
@ $T_J = 25^\circ\text{C}$ using Fig. CT.3

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	
D3	1.122	1.161	28.50	29.50	4
E	.602	.625	15.29	15.87	
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		

PART NUMBERS AFFECTED:

- AUIRGP4PH50S
- AUIRGP4066D1/E
- AUIRGP4063D/E
- AUIRGP50B60PD1/E
- AUIRGP35B60PD/E
- AUIRGP4062D1/E
- AUIRGP6542D0D
- AUIRGP6520D0
- AUIRGP/F66524D0
- AUIRGP/F76524D0
- AUIRGP/F66548D0
- AUIRGP/F76548D0

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

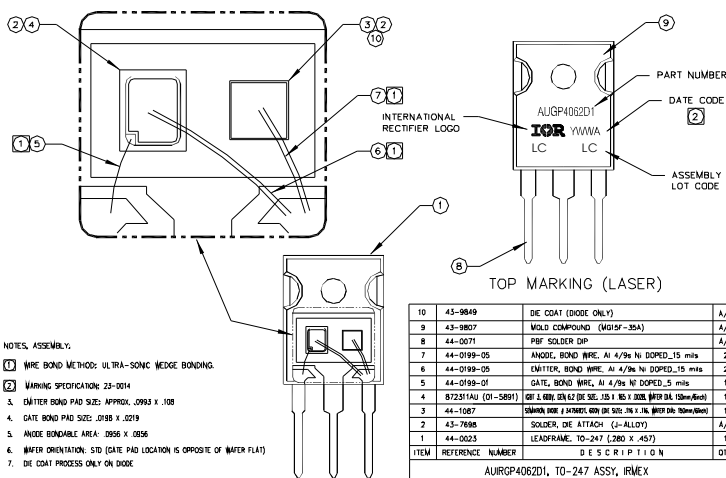
DIODES

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

SPECIAL NOTE:

- a) ADDED D3 FOR SPECIAL REQUIREMENT

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. .0983 x .108
 4. GATE BOND PAD SIZE: .098 x .0219
 5. ANODE BONDABLE AREA: .0958 x .0556
 6. WATER ORIENTATION: STD (GATE PAD LOCATION IS OPPOSITE OF WATER FLAT)
 7. DIE COAT PROCESS ONLY ON DIE

ITEM	REFERENCE NUMBER	DESCRIPTION	QTY
10	43-9849	DIE COAT (DIODE ONLY)	A/R
9	43-9807	MOLD COMPOUND (M012F-35A)	A/R
8	44-0071	PBF SOLDER DP	A/R
7	44-0199-05	ANGLED BOND WIRE, Al 4/96 Ni DOPED .15 mts	2
6	44-0199-05	EMITTER BOND WIRE, Al 4/96 Ni DOPED .15 mts	2
5	44-0199-01	GATE BOND WIRE, Al 4/96 Ni DOPED .5 mts	1
4	872317AU (01-5897)	ØP ± .001, ØP1 ± .002, ØP2 ± .002, ØP3 ± .002, ØP4 ± .002, ØP5 ± .002, ØP6 ± .002, ØP7 ± .002, ØP8 ± .002, ØP9 ± .002, ØP10 ± .002	A/R
3	44-1187	WIRE BOND WIRE, ØP ± .001, ØP1 ± .002, ØP2 ± .002, ØP3 ± .002, ØP4 ± .002, ØP5 ± .002, ØP6 ± .002, ØP7 ± .002, ØP8 ± .002, ØP9 ± .002, ØP10 ± .002	1
2	43-7698	SOLDER, DIE ATTACH (2-ALLOY)	A/R
1	44-0023	LEADFRAME, TO-247 (280 X .457)	1
TOTAL			1
AUIRGP4062D1, TO-247 ASSY, IRVEX			QTY

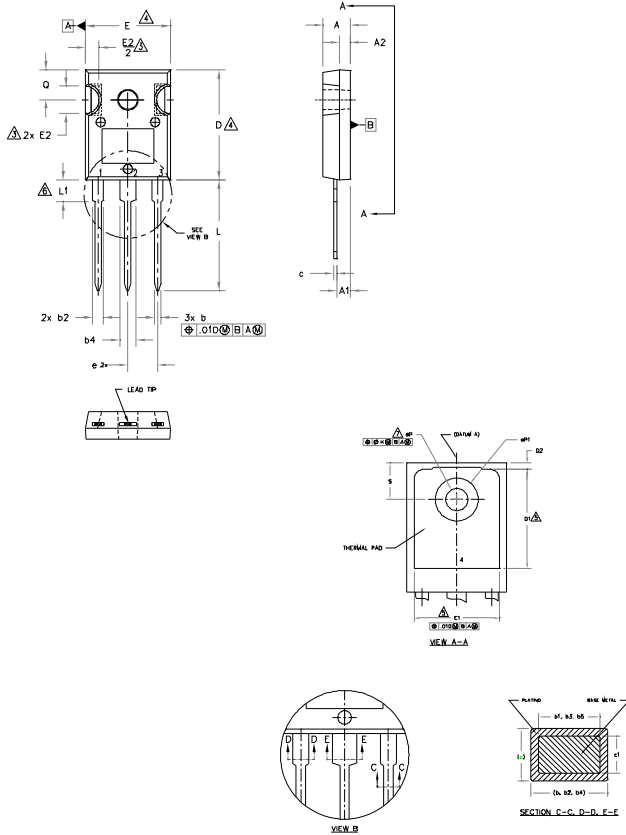
NOTES, PACKAGING:
1. TUBE - 25 UNITS/TUBE

ALL DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]

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

TO-247AD Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
- DIMENSIONS ARE SHOWN IN INCHES.
- CONTOUR OF SLOT OPTIONAL.
- 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.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
- LEAD FINISH UNCONTROLLED IN L1.
- φP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.
- 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		
eK	.010		0.25		
L	.780	.827	19.57	21.00	
L1	.146	.169	3.71	4.29	
φP	.140	.144	3.56	3.66	
φP1	-	.291	-	7.39	
φ	.209	.224	5.31	5.69	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS

HEXFET

- GATE
- DRAIN
- SOURCE
- DRAIN

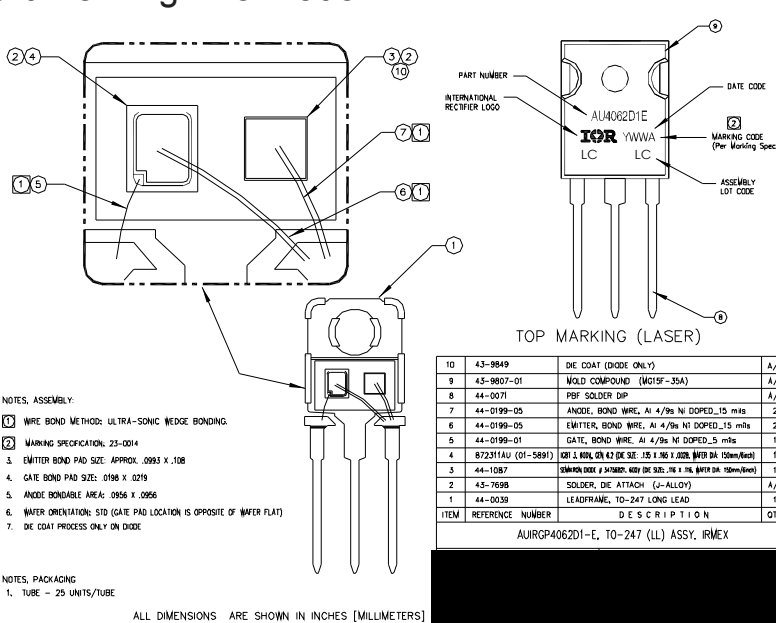
IGBTs, CoPACK

- GATE
- COLLECTOR
- EMITTER
- COLLECTOR

DIODES

- ANODE/OPEN
- CATHODE
- ANODE

TO-247AD Part Marking Information



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

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.

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

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

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