

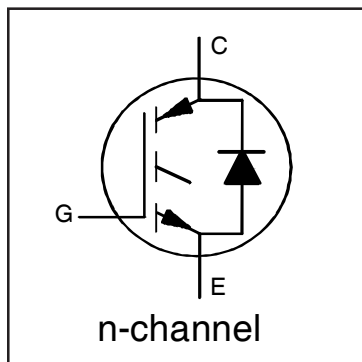
INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

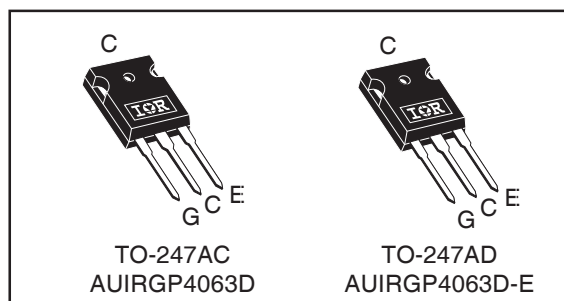
- Low $V_{CE(ON)}$ Trench IGBT Technology
- Low switching losses
- Maximum Junction temperature 175 °C
- 5 μ S short circuit SOA
- Square RBSOA
- 100% of the parts tested for 4X rated current (I_{LM})
- Positive $V_{CE(ON)}$ Temperature co-efficient
- Ultra fast soft Recovery Co-Pak Diode
- Tight parameter distribution
- Lead Free Package

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



$V_{CES} = 600V$
$I_C = 60A, T_C = 100^\circ C$
$t_{SC} \geq 5\mu s, T_{J(max)} = 175^\circ C$
$V_{CE(on)} \text{ typ.} = 1.6V$



G	C	E
Gate	Collector	Emitter

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRGP4063D	TO-247	Tube	25	AUIRGP4063D
AUIRGP4063D-E	TO-247	Tube	25	AUIRGP4063D-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	100	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	60	
I_{CM}	Pulse Collector Current, $V_{GE} = 15V$	144	
I_{LM}	Clamped Inductive Load Current, $V_{GE} = 20V$ ①	192	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	82	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	50	V
I_{FM}	Diode Maximum Forward Current ②	192	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20	
	Transient Gate-to-Emitter Voltage	± 30	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	330	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	170	
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)	
	Mounting Torque, 6-32 or M3 Screw	10 lbf-in (1.1 N·m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
R _{θJC} (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT)	—	—	0.45	°C/W
R _{θJC} (Diode)	Thermal Resistance Junction-to-Case-(each Diode)	—	—	0.92	
R _{θCS}	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
R _{θJA}	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	80	—	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref. Fig
V _{(BR)CES}	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V _{GE} = 0V, I _C = 150μA ④	CT6
∂V _{(BR)CES} /∂T _J	Temperature Coeff. of Breakdown Voltage	—	0.30	—	V/°C	V _{GE} = 0V, I _C = 1mA (25°C-175°C)	CT6
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.6	1.9	V	I _C = 48A, V _{GE} = 15V, T _J = 25°C	5.6,7
		—	1.9	—		I _C = 48A, V _{GE} = 15V, T _J = 150°C	9,10,11
		—	2.0	—		I _C = 48A, V _{GE} = 15V, T _J = 175°C	
V _{GE(th)}	Gate Threshold Voltage	4.0	—	6.5	V	V _{CE} = V _{GE} , I _C = 1.4mA	9, 10,
∂V _{GE(th)} /∂T _J	Threshold Voltage temp. coefficient	—	-21	—	mV/°C	V _{CE} = V _{GE} , I _C = 1.0mA (25°C - 175°C)	11, 12
g _{fe}	Forward Transconductance	—	32	—	S	V _{CE} = 50V, I _C = 48A, PW = 80μs	
I _{CES}	Collector-to-Emitter Leakage Current	—	1.0	150	μA	V _{GE} = 0V, V _{CE} = 600V	
		—	450	1000		V _{GE} = 0V, V _{CE} = 600V, T _J = 175°C	
V _{FM}	Diode Forward Voltage Drop	—	1.95	2.91	V	I _F = 48A	8
		—	1.45	—		I _F = 48A, 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	Ref. Fig
Q _g	Total Gate Charge (turn-on)	—	95	140	nC	I _C = 48A	24
Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	28	42		V _{GE} = 15V	CT1
Q _{gc}	Gate-to-Collector Charge (turn-on)	—	35	53		V _{CC} = 400V	
E _{on}	Turn-On Switching Loss	—	625	1141	μJ	I _C = 48A, V _{CC} = 400V, V _{GE} = 15V	CT4
E _{off}	Turn-Off Switching Loss	—	1275	1481		R _G = 10Ω, L = 200μH, L _S = 150nH, T _J = 25°C	
E _{total}	Total Switching Loss	—	1900	2622		Energy losses include tail & diode reverse recovery	
t _{d(on)}	Turn-On delay time	—	60	78	ns	I _C = 48A, V _{CC} = 400V, V _{GE} = 15V	CT4
t _r	Rise time	—	40	56		R _G = 10Ω, L = 200μH, L _S = 150nH, T _J = 25°C	
t _{d(off)}	Turn-Off delay time	—	145	176			
t _f	Fall time	—	35	46			
E _{on}	Turn-On Switching Loss	—	1625	—	μJ	I _C = 48A, V _{CC} = 400V, V _{GE} = 15V	13, 15
E _{off}	Turn-Off Switching Loss	—	1585	—		R _G = 10Ω, L = 200μH, L _S = 150nH, T _J = 175°C ④	CT4
E _{total}	Total Switching Loss	—	3210	—		Energy losses include tail & diode reverse recovery	WF1, WF2
t _{d(on)}	Turn-On delay time	—	55	—	ns	I _C = 48A, V _{CC} = 400V, V _{GE} = 15V	14, 16
t _r	Rise time	—	45	—		R _G = 10Ω, L = 200μH, L _S = 150nH	CT4
t _{d(off)}	Turn-Off delay time	—	165	—		T _J = 175°C	WF1
t _f	Fall time	—	45	—			WF2
C _{ies}	Input Capacitance	—	3025	—	pF	V _{GE} = 0V	23
C _{oes}	Output Capacitance	—	245	—		V _{CC} = 30V	
C _{res}	Reverse Transfer Capacitance	—	90	—		f = 1.0Mhz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 175°C, I _C = 192A V _{CC} = 480V, V _p = 600V R _G = 10Ω, V _{GE} = +15V to 0V	4 CT2
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V _{CC} = 400V, V _p = 600V R _G = 10Ω, V _{GE} = +15V to 0V	22, CT3 WF4
E _{rec}	Reverse Recovery Energy of the Diode	—	845	—	μJ	T _J = 175°C	17, 18, 19
t _{rr}	Diode Reverse Recovery Time	—	115	—	ns	V _{CC} = 400V, I _F = 48A	20, 21
I _{rr}	Peak Reverse Recovery Current	—	40	—	A	V _{GE} = 15V, R _G = 10Ω, L = 200μH, L _S = 150nH	WF3

Notes:

- ① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 200μH, R_G = 10Ω.
 ② This is only applied to TO-247AC package.

- ③ Pulse width limited by max. junction temperature.
 ④ Refer to AN-1086 for guidelines for measuring V_{(BR)CES} safely.

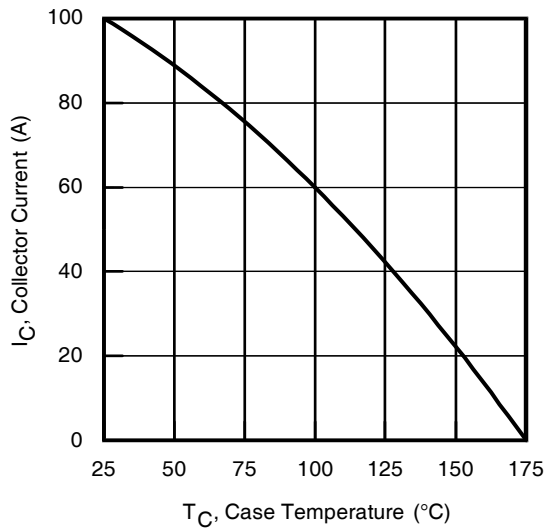


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

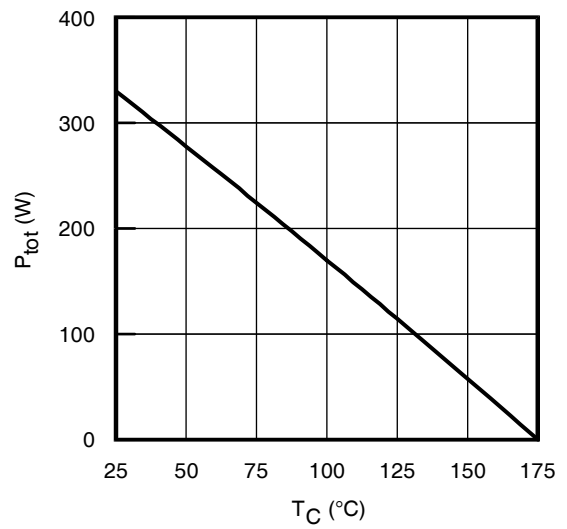


Fig. 2 - Power Dissipation vs. Case Temperature

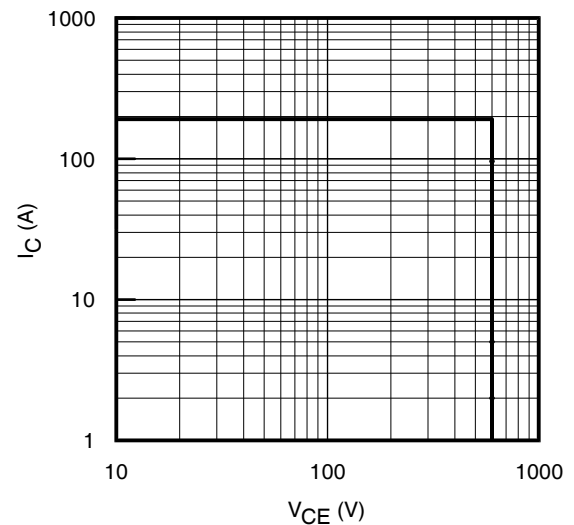
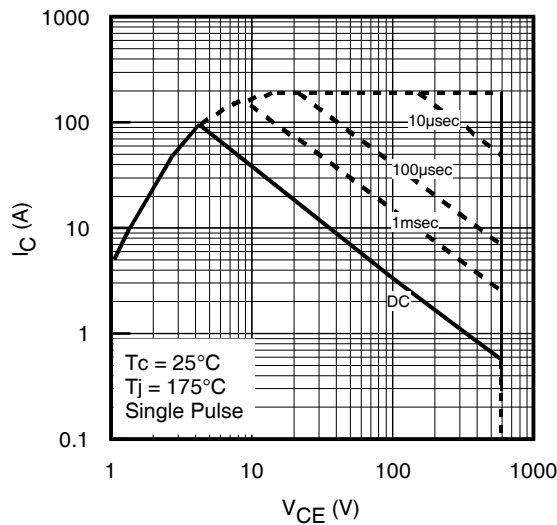


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$, $T_J \leq 175^\circ\text{C}$; $V_{GE} = 15\text{V}$

Fig. 4 - Reverse Bias SOA
 $T_J = 175^\circ\text{C}$; $V_{GE} = 15\text{V}$

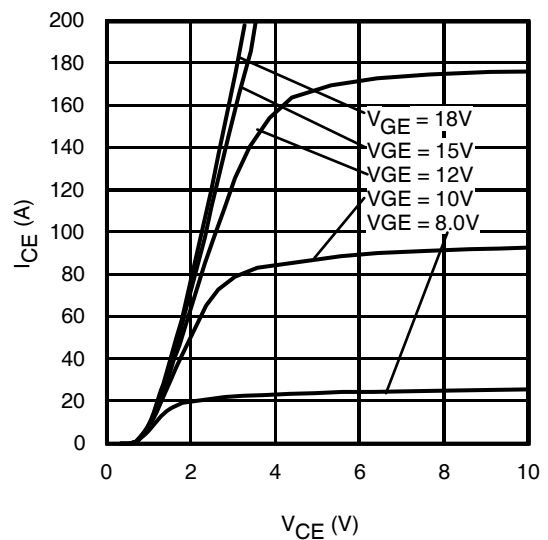
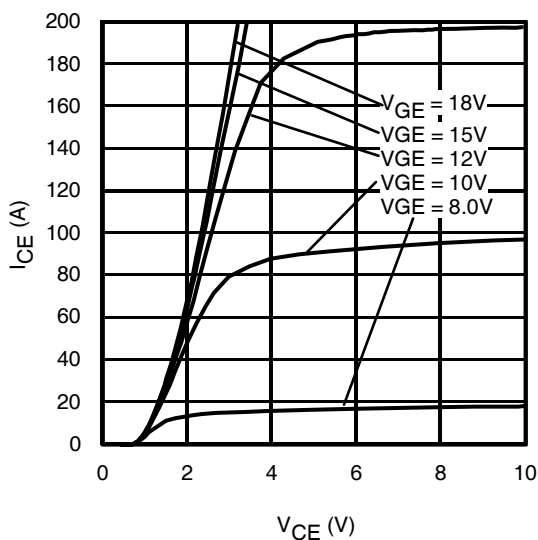


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

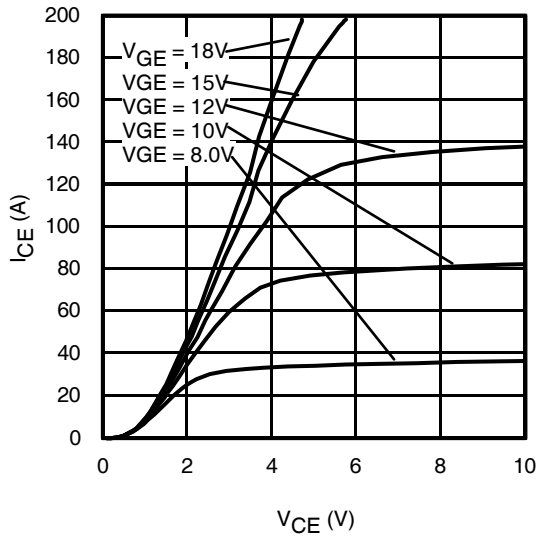


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 175^\circ\text{C}$; $t_p = 80\mu\text{s}$

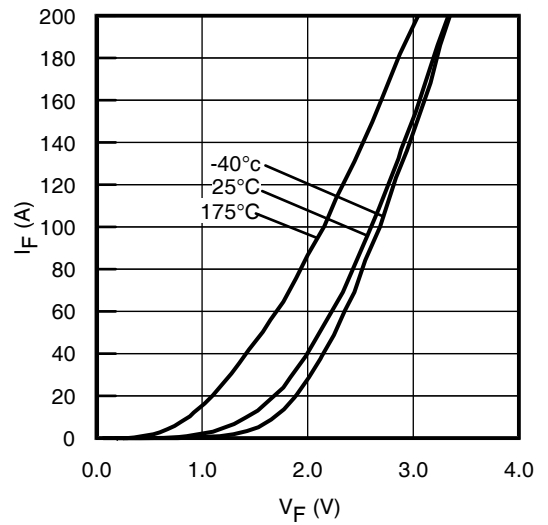


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 80\mu\text{s}$

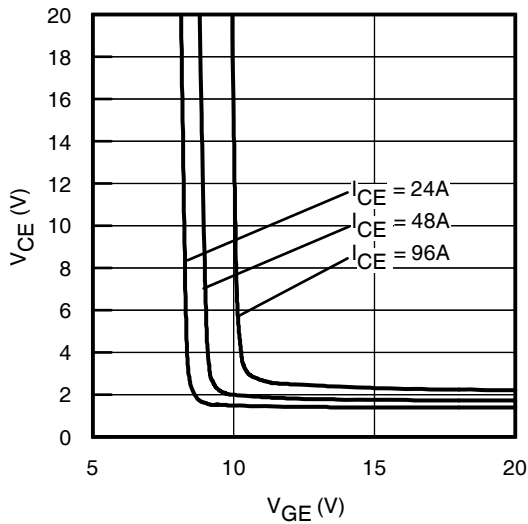


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

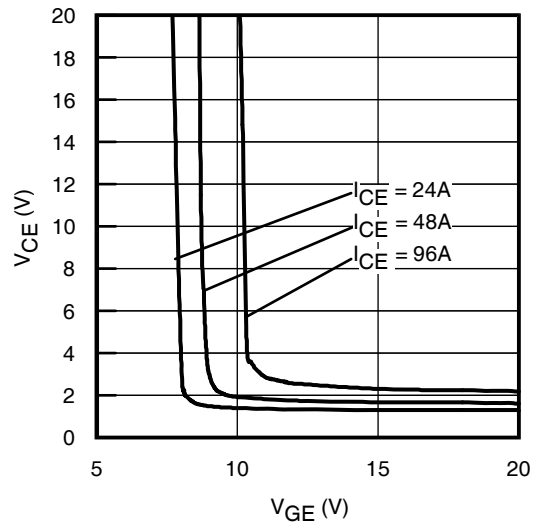


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

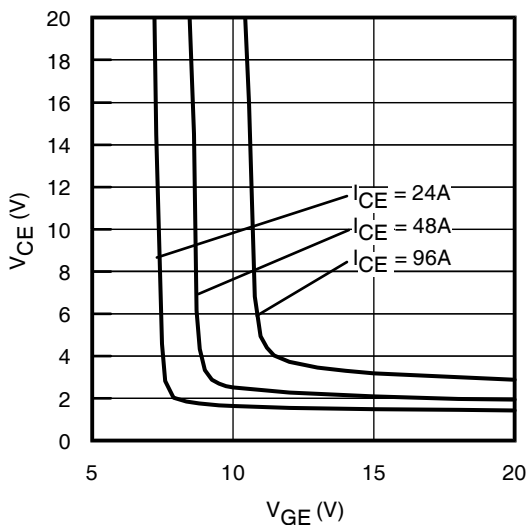


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 175^\circ\text{C}$

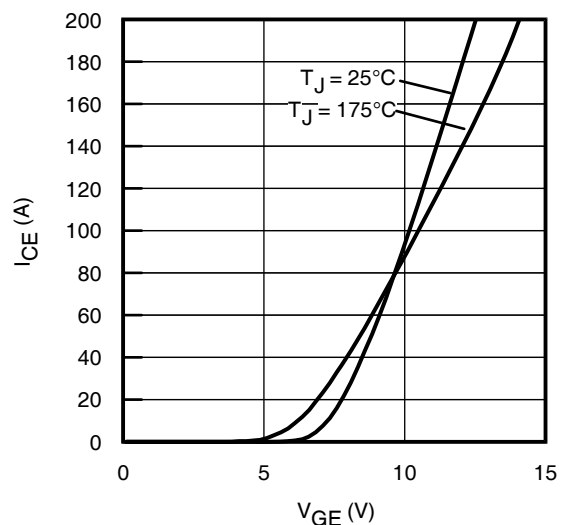


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 50V$; $t_p = 10\mu\text{s}$

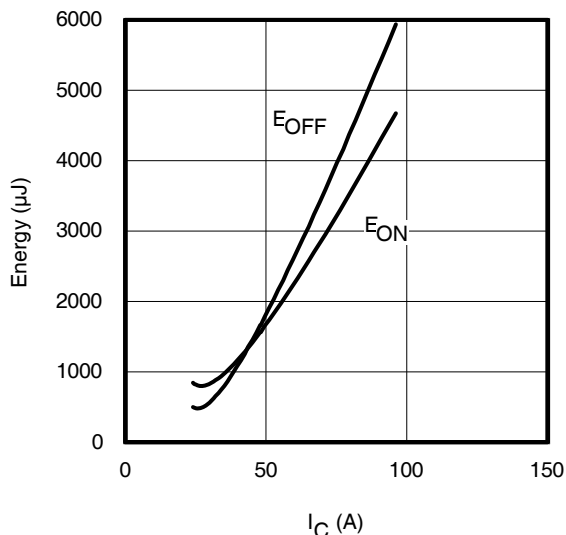


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 175^\circ C$; $L = 200\mu H$; $V_{CE} = 400V$, $R_G = 10\Omega$; $V_{GE} = 15V$

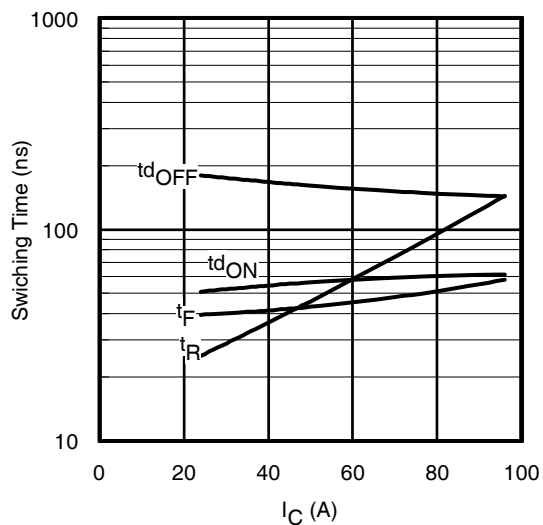


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 175^\circ C$; $L = 200\mu H$; $V_{CE} = 400V$, $R_G = 10\Omega$; $V_{GE} = 15V$

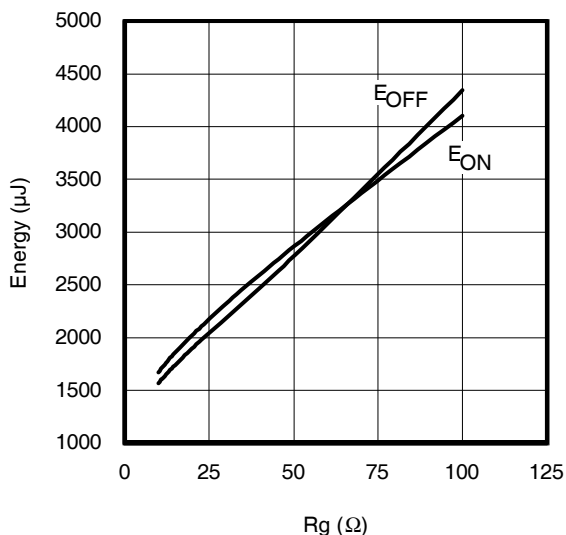


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 175^\circ C$; $L = 200\mu H$; $V_{CE} = 400V$, $I_{CE} = 48A$; $V_{GE} = 15V$

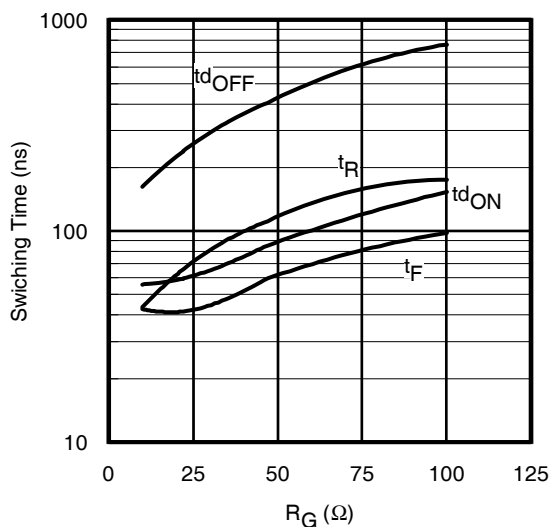


Fig. 16 - Typ. Switching Time vs. R_G
 $T_J = 175^\circ C$; $L = 200\mu H$; $V_{CE} = 400V$, $I_{CE} = 48A$; $V_{GE} = 15V$

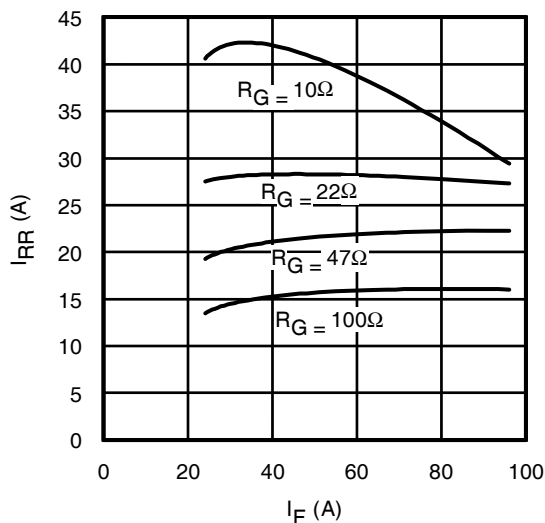


Fig. 17 - Typ. Diode I_{RR} vs. I_F
 $T_J = 175^\circ C$

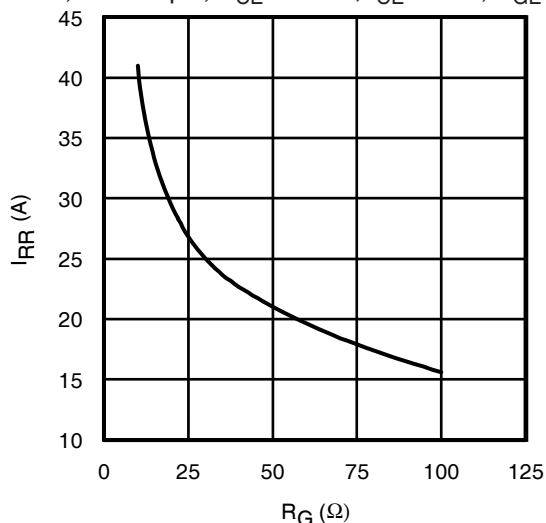


Fig. 18 - Typ. Diode I_{RR} vs. R_G
 $T_J = 175^\circ C$

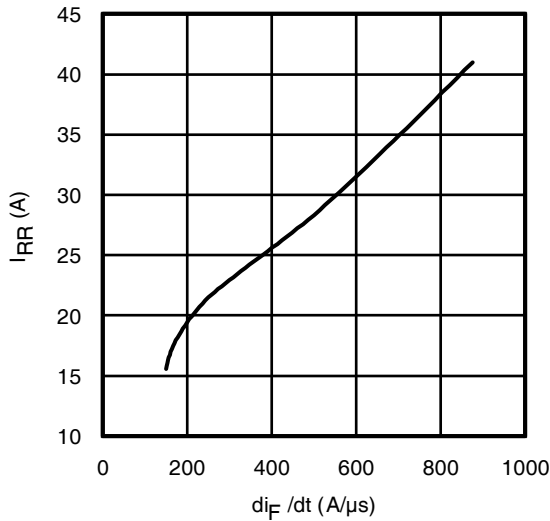


Fig. 19 - Typ. Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400V$; $V_{GE} = 15V$; $I_F = 48A$; $T_J = 175^\circ C$

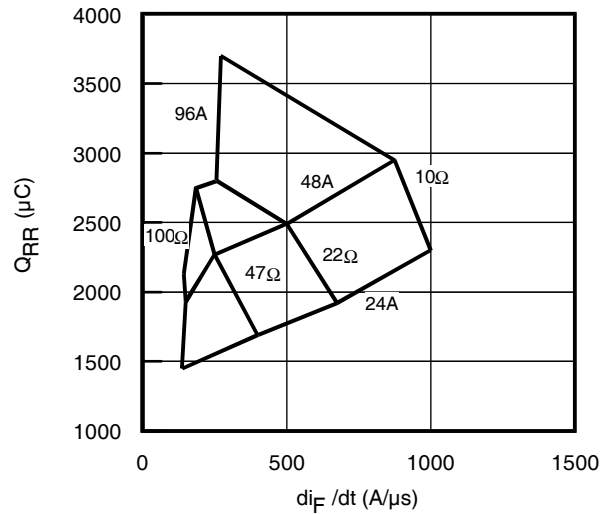


Fig. 20 - Typ. Diode Q_{RR} vs. di_F/dt
 $V_{CC} = 400V$; $V_{GE} = 15V$; $T_J = 175^\circ C$

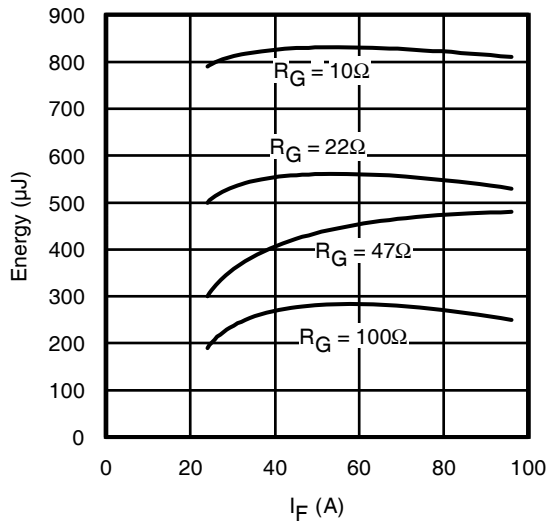


Fig. 21 - Typ. Diode E_{RR} vs. I_F
 $T_J = 175^\circ C$

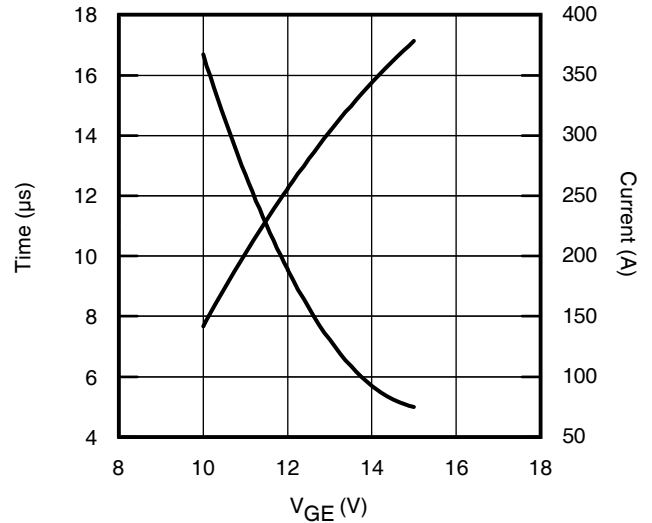


Fig. 22 - V_{GE} vs. Short Circuit Time
 $V_{CC} = 400V$; $T_C = 25^\circ C$

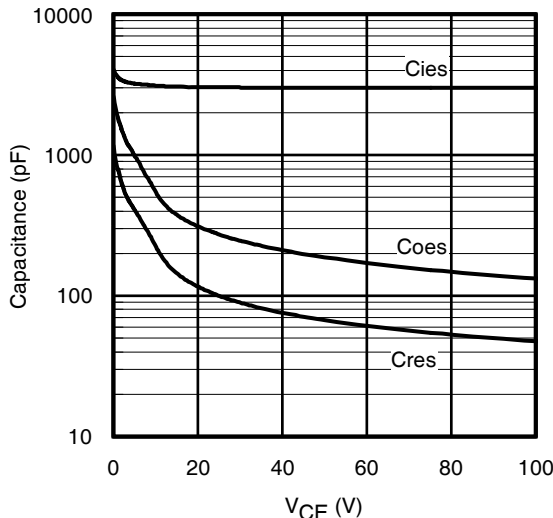


Fig. 23 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

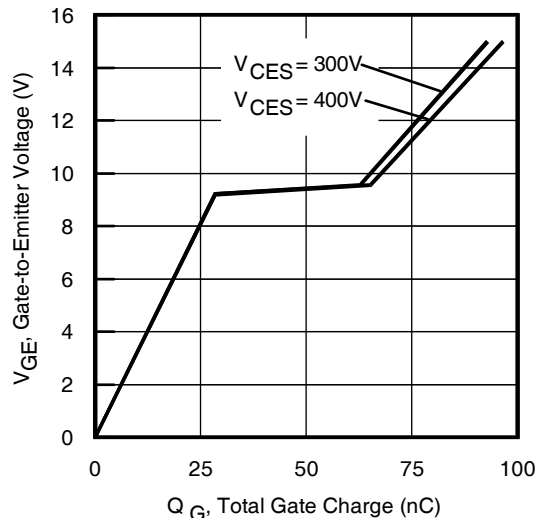


Fig. 24 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 48A$; $L = 600\mu H$

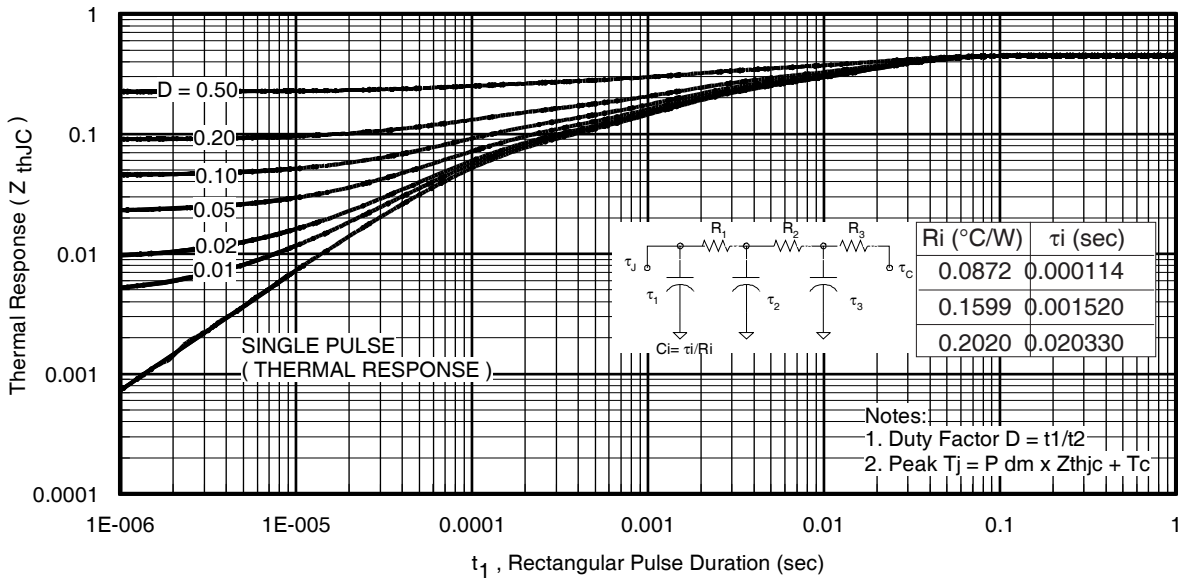


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

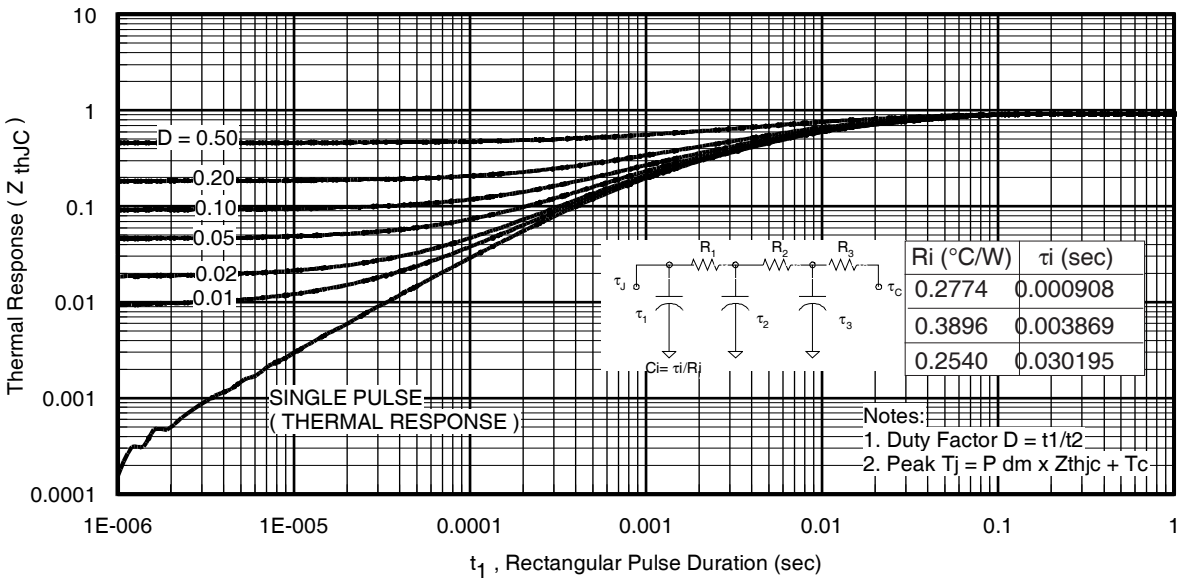


Fig. 26. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

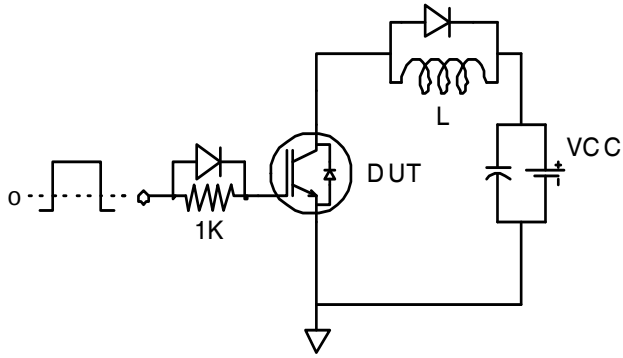


Fig.C.T.1 - Gate Charge Circuit (turn-off)

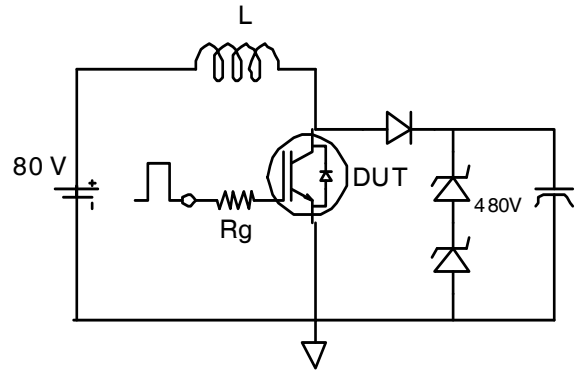


Fig.C.T.2 - RBSOA Circuit

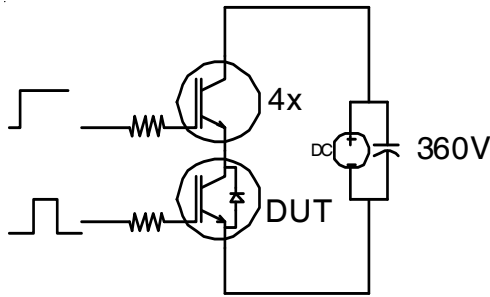


Fig.C.T.3 - S.C. SOA Circuit

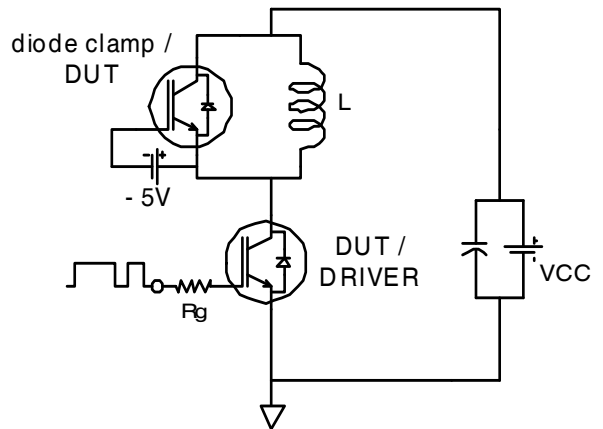


Fig.C.T.4 - Switching Loss Circuit

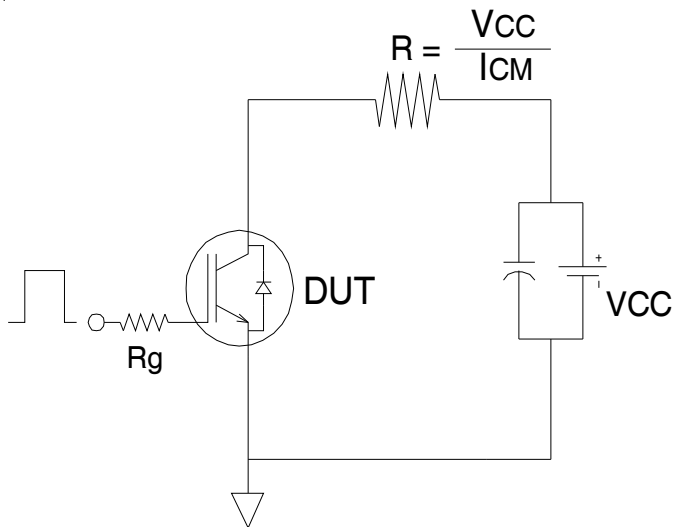


Fig.C.T.5 - Resistive Load Circuit

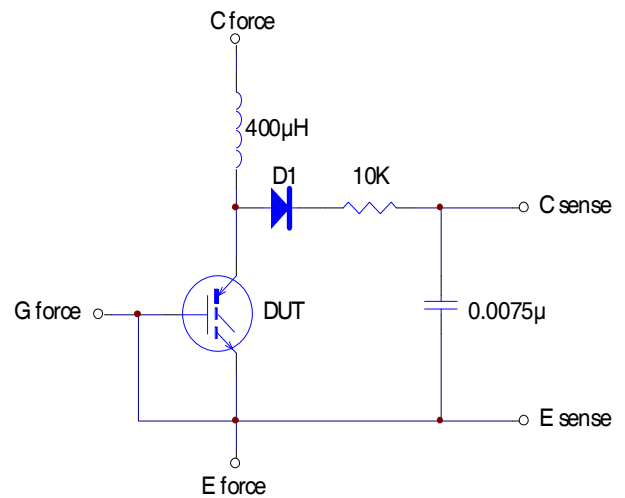


Fig.C.T.6 - BVCES Filter Circuit

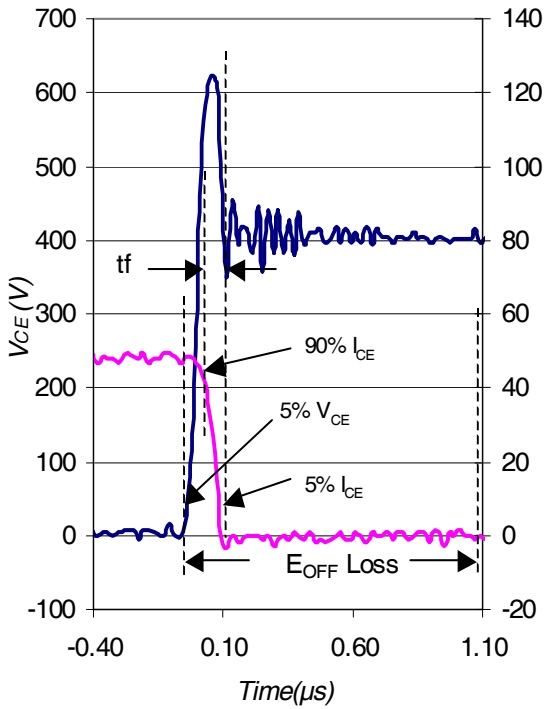


Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

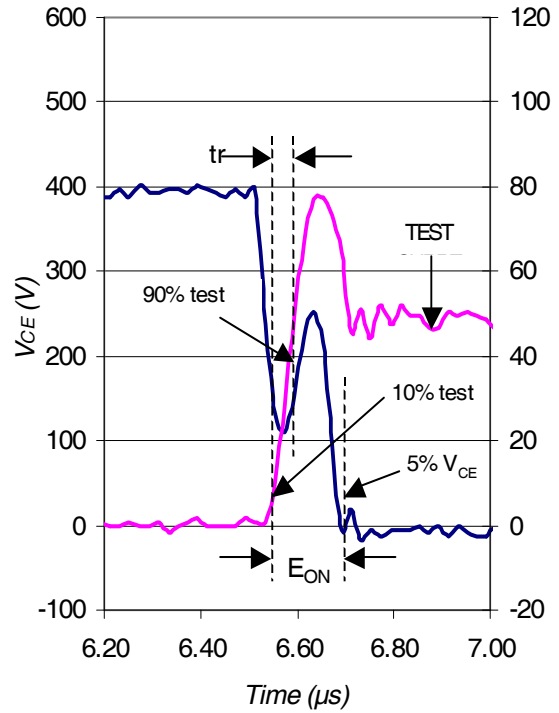


Fig. WF2 - Typ. Turn-on Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

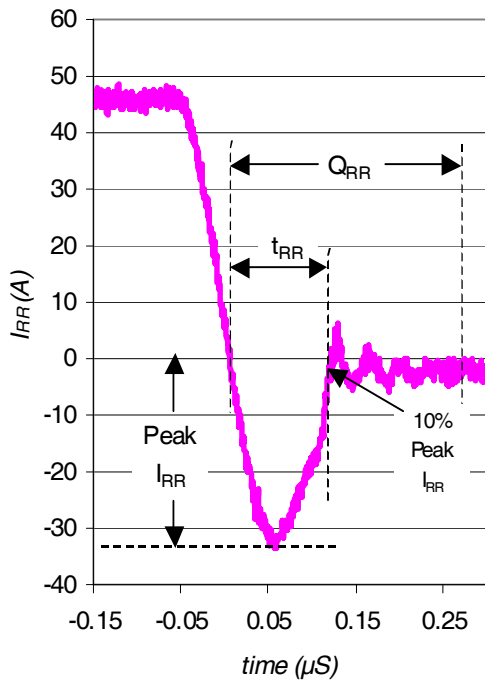


Fig. WF3 - Typ. Diode Recovery Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

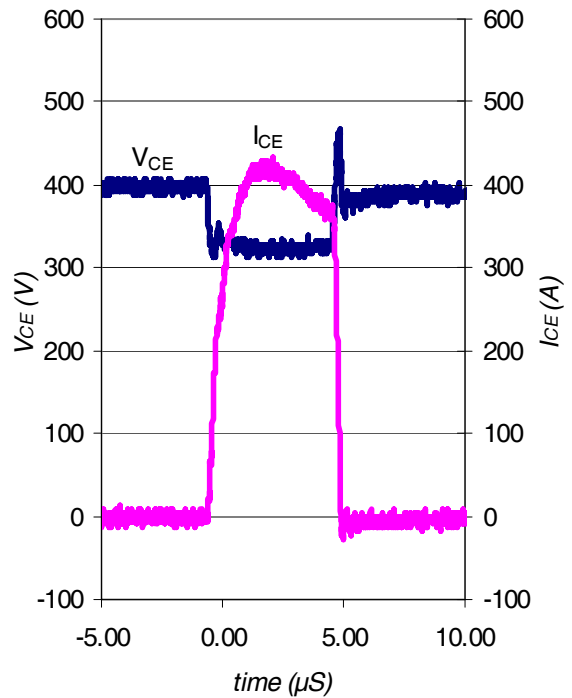
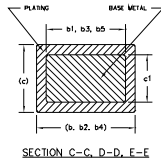
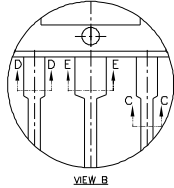
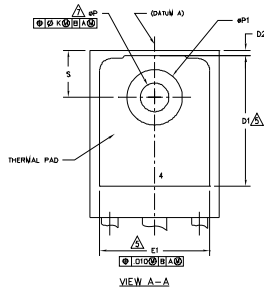
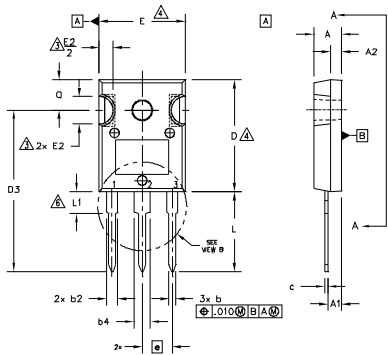


Fig. WF4 - Typ. S.C. Waveform
@ $T_J = 25^\circ\text{C}$ using Fig. CT.3

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.
CONTOUR OF SLOT OPTIONAL.
3. 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.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
5. LEAD FINISH UNCONTROLLED IN L1.
6. 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:

- AUIRG4PH50S
- AUIRGP4066D1/E
- AUIRGP40630/E
- AUIRGP50860PD1/E
- AUIRGP35860PD/E
- AUIRGP4062D1/E
- AUIRGP65A20D0
- 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

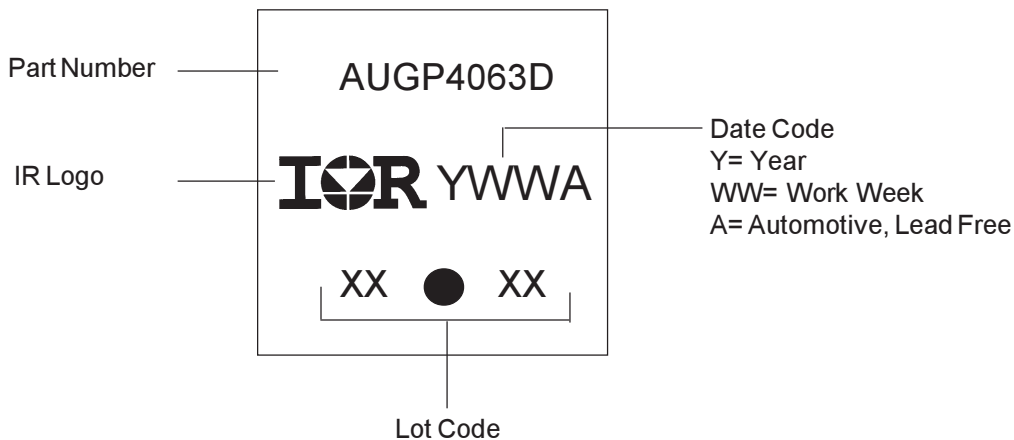
DIODES

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

SPECIAL NOTE:

- a) ADDED D3 FOR SPECIAL REQUIREMENT

TO-247AC Part Marking Information

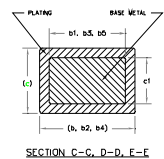
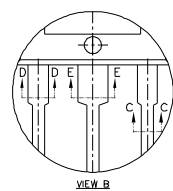
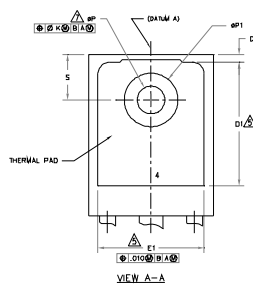
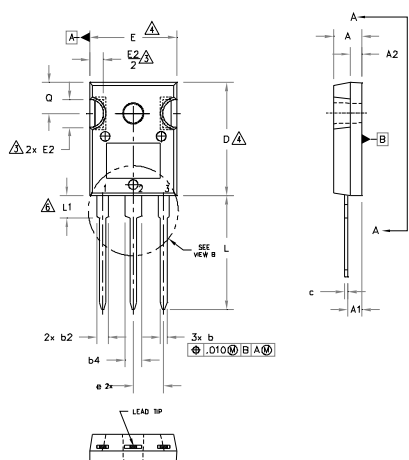


TO-247AC package is not recommended for Surface Mount Application.

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.
 - CONTOUR OF SLOT OPTIONAL.
 3. 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.
 4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
 5. LEAD FINISH UNCONTROLLED IN L1.
 6. ϕP 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		
ϕk	.010		0.25		
L	.780	.827	19.57	21.00	
L1	.146	.169	3.71	4.29	
ϕP	.140	.144	3.56	3.66	
$\phi P1$	-	.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

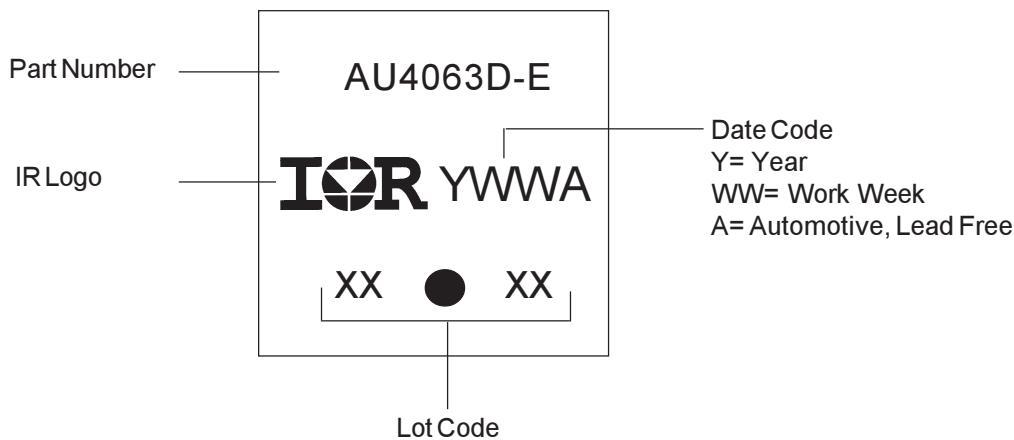
IGBTs, CoPACK

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

DIODES

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

TO-247AD Part Marking Information



TO-247AD package is not recommended for Surface Mount Application.

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		TO-247AC	N/A
		TO-247AD	N/A
ESD	Machine Model	Class M4 (±425V) ^{††} (per AEC-Q101-002)	
	Human Body Model	Class H2 (±4000V) ^{††} (per AEC-Q101-001)	
	Charged Device Model	Class C5 (±1125V) ^{††} (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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