International
IOR Rectifier

AUTOMOTIVE GRADE

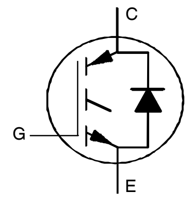
AUIRGP65G40D0
AUIRGF65G40D0

CooliR*IGBT* ™

ULTRAFAST IGBT WITH ULTRAFAST SOFT RECOVERY DIODE

Features

- Designed And Qualified for Automotive Applications
- Ultra Fast Switching IGBT:70-200kHz
- Extremely Low Switching Losses
- Maximum Junction Temperature 175 °C
- Square RBSOA
- Positive $V_{CE\ (on)}$ Temperature Coefficient



n-channel

V_{CES} = 600V

$V_{CE(on)}$ typ. = 1.8V

I_C@T_C=100°C = 41A

T_J max = 175°C

Benefits

- Optimized High Frequency Switching Applications
- Rugged Transient Performance for Increased Reliability
- Excellent Current Sharing in Parallel Operation

Applications

- DC-DC Converter
- PFC

TO-247AC
AUIRGP65G40D0

TO-247AD
AUIRGF65G40D0

G	C	E
Gate	Collector	Emitter

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRGP65G40D0	TO-247AC	Tube	25	AUIRGP65G40D0
AUIRGF65G40D0	TO-247AD	Tube	25	AUIRGF65G40D0

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 ⑥	62	A
I_C @ T_C = 100°C	Continuous Collector Current ⑥	41	
$I_{NOMINAL}$	Nominal Current @ 200kHz ⑦	20	
I_{CM}	Pulse Collector Current	84	
I_{LM}	Clamped Inductive Load Current ①	112	
I_F @ T_C = 25°C	Diode Continous Forward Current	46.1	
I_F @ T_C = 100°C	Diode Continous Forward Current	30	
I_{FRM}	Maximum Repetitive Forward Current ②	112	
V_{GE}	Gate-to-Emitter Voltage	±20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	625	W
P_D @ T_C = 100°C	Maximum Power Dissipation	313	
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
$R_{\theta JC}$ (IGBT)	Junction-to-Case-(each IGBT) ④	——	——	0.24	°C/W
$R_{\theta JC}$ (Diode)	Junction-to-Case-(each Diode) ④	——	——	1.78	
$R_{\theta CS}$	Case-to-Sink (flat, greased surface)	——	0.24	——	
$R_{\theta JA}$	Junction-to-Ambient (typical socket mount)	——	——	40	
		——	6.0 (0.21)	——	g (oz)

*Qualification standards can be found at http://www.irf.com/

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V_{GE} = 0V, I_C = 500μA ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.18	—	V/°C	V_{GE} = 0V, I_C = 1.0mA (25°C-175°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.4	—	V	I_C = 12A, V_{GE} = 15V, T_J = 25°C
		—	1.8	2.2		I_C = 20A, V_{GE} = 15V, T_J = 25°C
		—	1.9	—		I_C = 12A, V_{GE} = 15V, T_J = 150°C
		—	2.6	—		I_C = 20A, V_{GE} = 15V, T_J = 150°C
		—	2.2	—		I_C = 12A, V_{GE} = 15V, T_J = 175°C
		—	3.0	—		I_C = 20A, V_{GE} = 15V, T_J = 175°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5	V	V_{CE} = V_{GE}, I_C = 250μA
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-12	—	mV/°C	V_{CE} = V_{GE}, I_C = 1.0mA (25°C - 175°C)
gfe	Forward Transconductance	—	36	—	S	V_{CE} = 50V, I_C = 20A
I_{CES}	Collector-to-Emitter Leakage Current	—	3.2	25	μA	V_{GE} = 0V, V_{CE} = 600V
		—	0.81	—	mA	V_{GE} = 0V, V_{CE} = 600V, T_J = 175°C
V_{FM}	Diode Forward Voltage Drop	—	1.7	2.45	V	I_F = 20A
		—	1.4	—		I_F = 20A, 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)	—	180	270	nC	I_C = 20A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	28	42		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	64	96		V_{CC} = 400V
E_{on}	Turn-On Switching Loss	—	298	389	μJ	I_C = 20A, V_{CC} = 400V, V_{GE} = 15V
E_{off}	Turn-Off Switching Loss	—	147	234		R_G = 4.7Ω, L = 485μH, T_J = 25°C
E_{total}	Total Switching Loss	—	445	623		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	35	53	ns	I_C = 20A, V_{CC} = 400V, V_{GE} = 15V
t_r	Rise time	—	12	29		R_G = 4.7Ω, L = 485μH, T_J = 25°C
$t_{d(off)}$	Turn-Off delay time	—	142	163		
t_f	Fall time	—	15	32		
E_{on}	Turn-On Switching Loss	—	630	—	μJ	I_C = 20A, V_{CC} = 400V, V_{GE}=15V
E_{off}	Turn-Off Switching Loss	—	137	—		R_G = 4.7Ω, L = 485μH, T_J = 175°C
E_{total}	Total Switching Loss	—	767	—		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	33	—	ns	I_C = 20A, V_{CC} = 400V, V_{GE} = 15V
t_r	Rise time	—	12	—		R_G = 4.7Ω, L = 485μH
$t_{d(off)}$	Turn-Off delay time	—	165	—		T_J = 175°C
t_f	Fall time	—	16	—		
C_{ies}	Input Capacitance	—	4673	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	337	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	58	—		f = 1.0Mhz
C_{oes} eff.	Effective Output Capacitance (Time Related) ⑤	—	406	—		V_{GE} = 0V, V_{CE} = 0V to 480V
C_{oes} eff. (ER)	Effective Output Capacitance (Energy Related) ⑤	—	162	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 175°C, I_C = 80A V_{CC} = 480V, Vp ≤ 600V Rg = 4.7Ω, V_{GE} = +20V to 0V
t_{rr}	Diode Reverse Recovery Time	—	41	—	ns	T_J = 25°C I_F = 20A, V_R = 200V,
		—	70	—		T_J = 125°C di/dt = 200A/μs
Q_{rr}	Diode Reverse Recovery Charge	—	116	—	nC	T_J = 25°C I_F = 20A, V_R = 200V,
		—	580	—		T_J = 125°C di/dt = 200A/μs
I_{rr}	Peak Reverse Recovery Current	—	4.8	—	A	T_J = 25°C I_F = 20A, V_R = 200V,
		—	7.2	—		T_J = 125°C di/dt = 200A/μs

Notes ① through ⑦ are on page 13

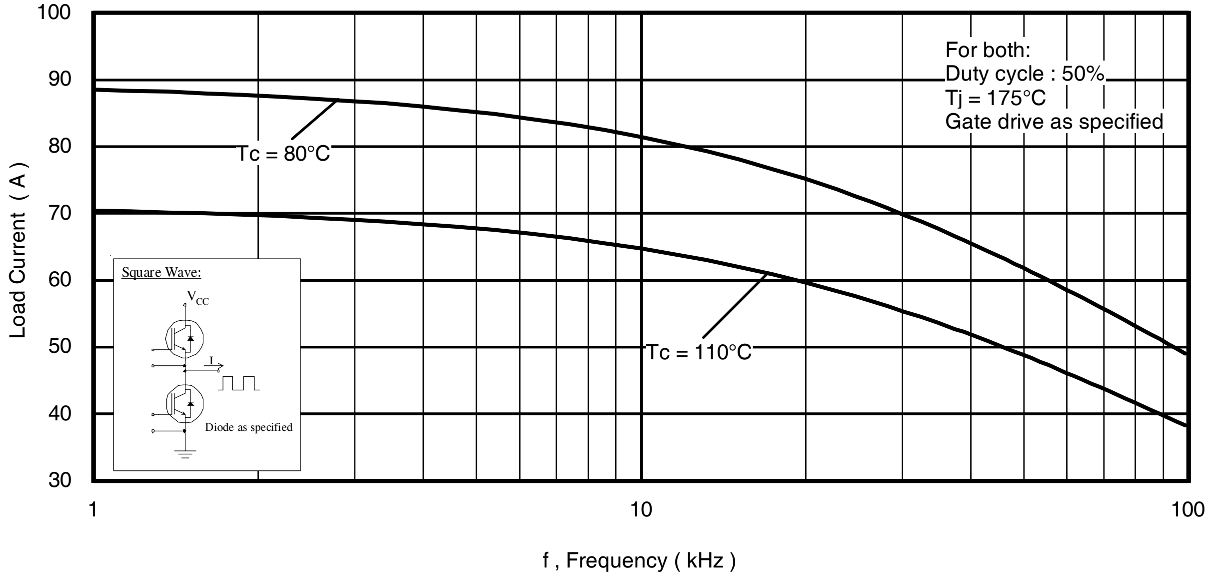


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = IRMS of fundamental)

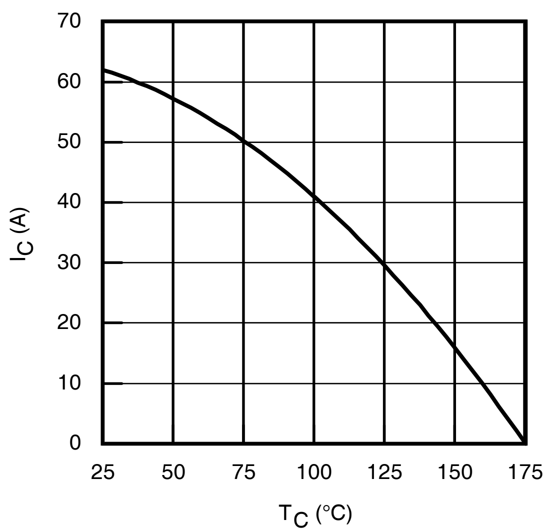


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

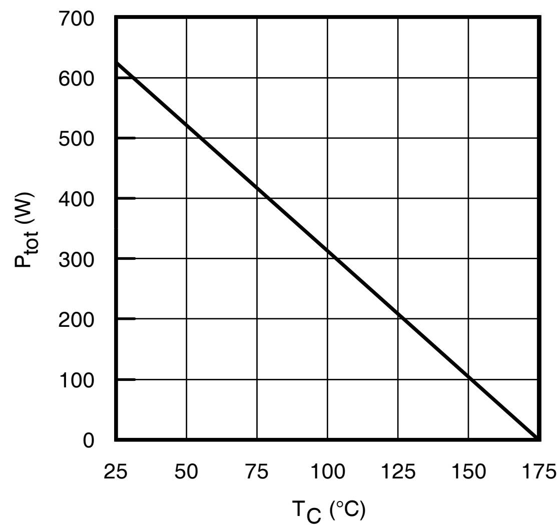


Fig. 3 - Power Dissipation vs. Case Temperature

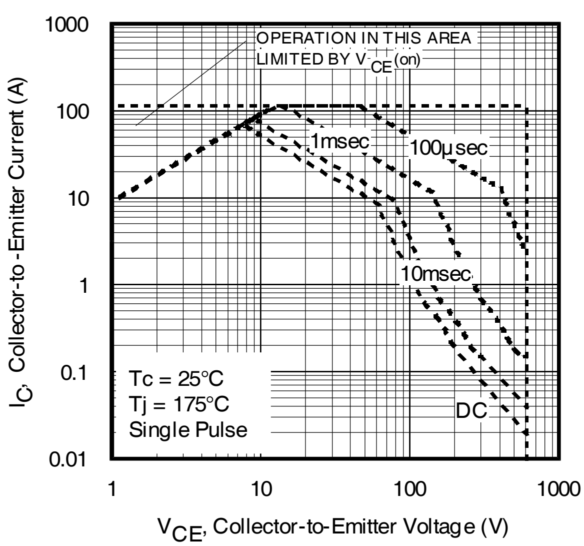


Fig. 4 - Forward SOA
T_C = 25°C; $T_J \leq$ 175°C; V_{GE} = 15V

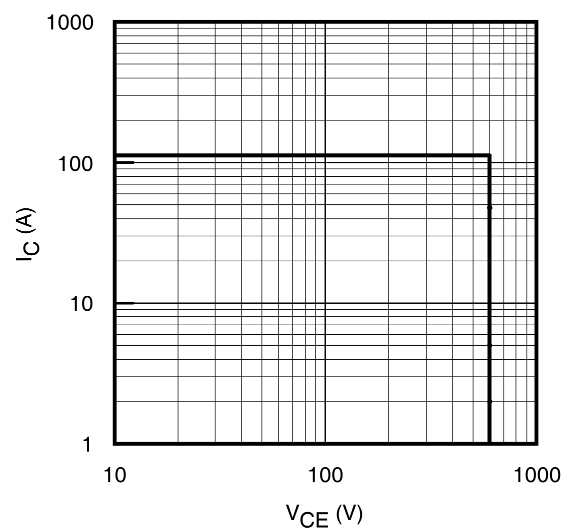


Fig. 5 - Reverse Bias SOA
T_J = 175°C; V_{GE} =20V

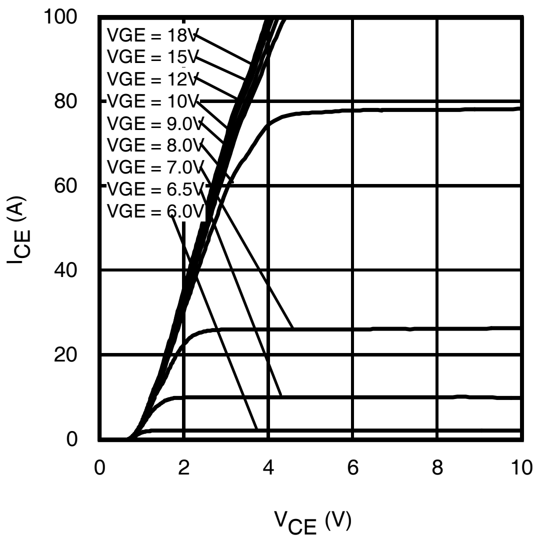


Fig. 6 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 30µs

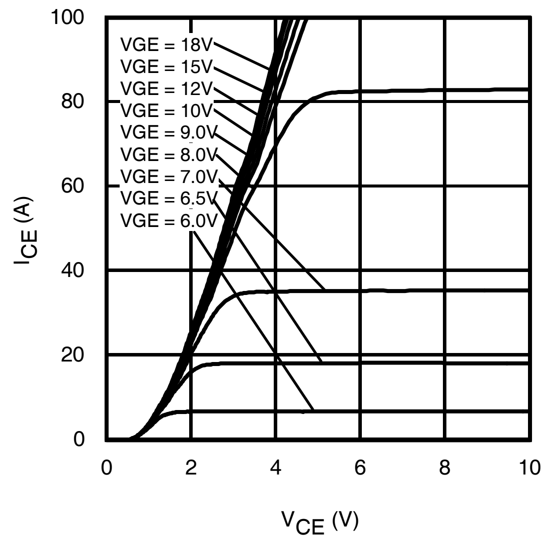


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 30µs

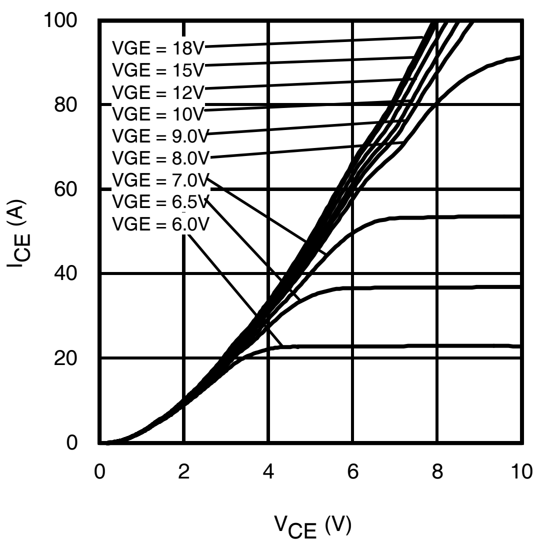


Fig. 8 - Typ. IGBT Output Characteristics
T_J = 175°C; tp = 30µs

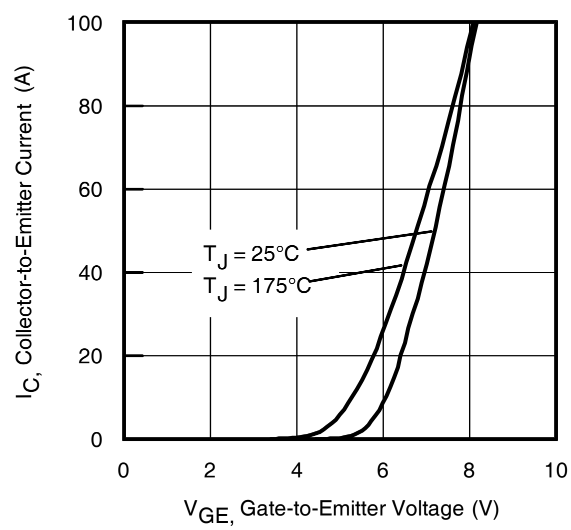


Fig. 9 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 30µs

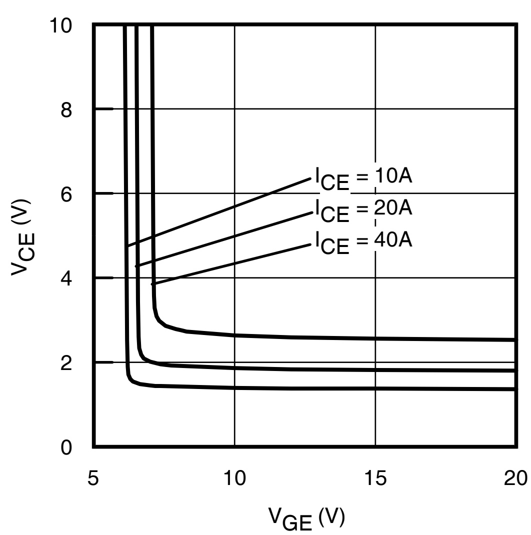


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

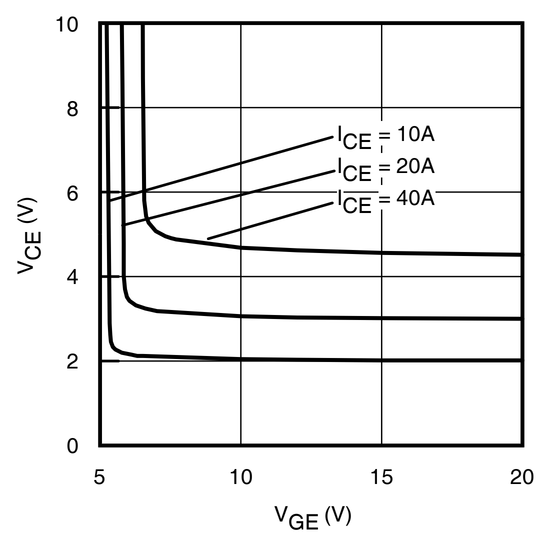


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 175°C

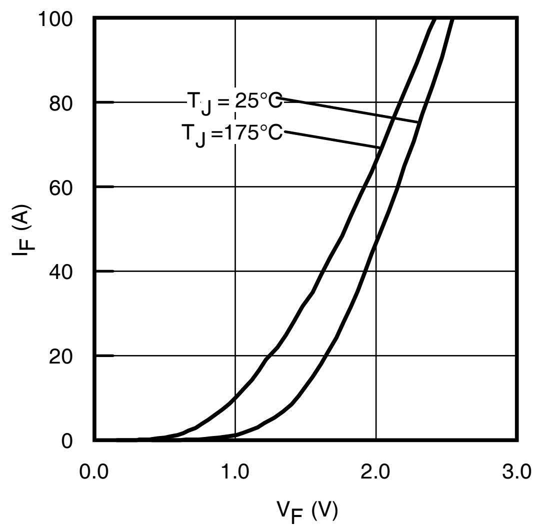


Fig. 12 - Typ. Diode Forward Characteristics
tp = 30µs

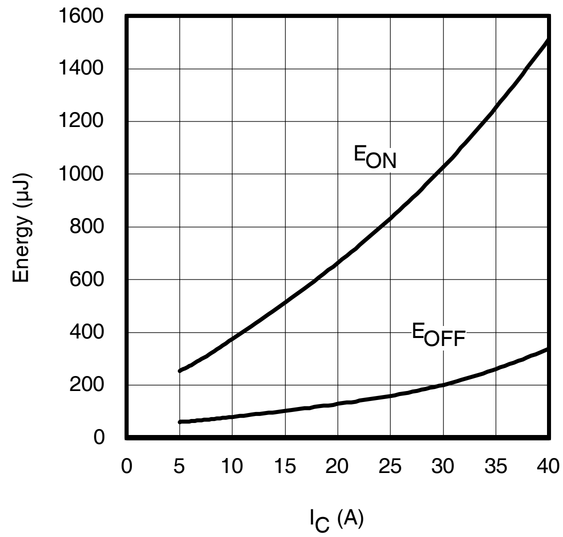


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 175°C; L = 0.49mH; V_{CE} = 400V, R_G = 4.7Ω; V_{GE} = 15V

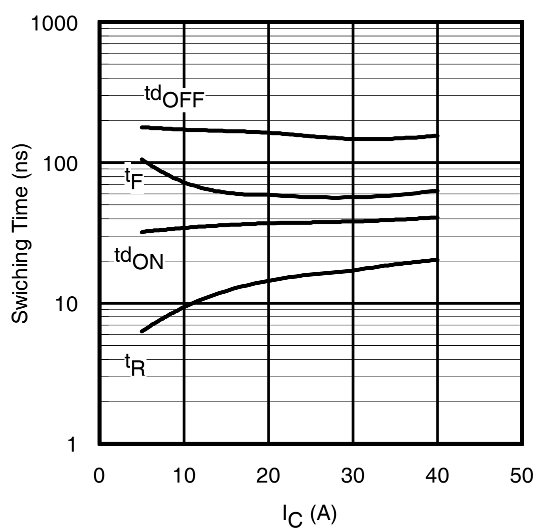


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 175°C; L = 0.49mH; V_{CE} = 400V, R_G = 4.7Ω; V_{GE} = 15V

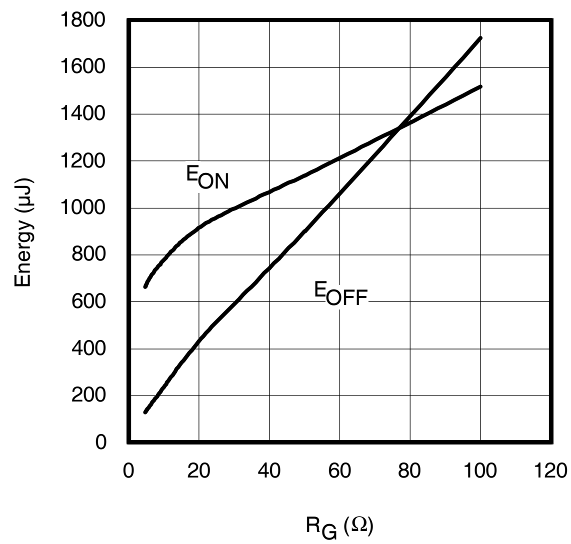


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 175°C; L = 0.49mH; V_{CE} = 400V, I_{CE} = 20A; V_{GE} = 15V

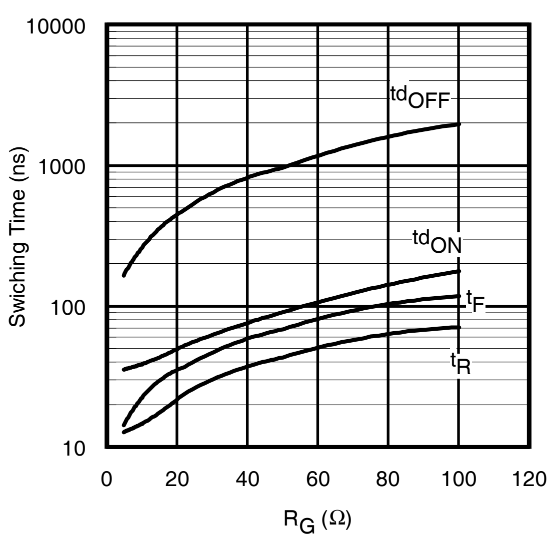


Fig. 16 - Typ. Switching Time vs. R_G
T_J = 175°C; L = 0.49mH; V_{CE} = 400V, I_{CE} = 20A; V_{GE} = 15V

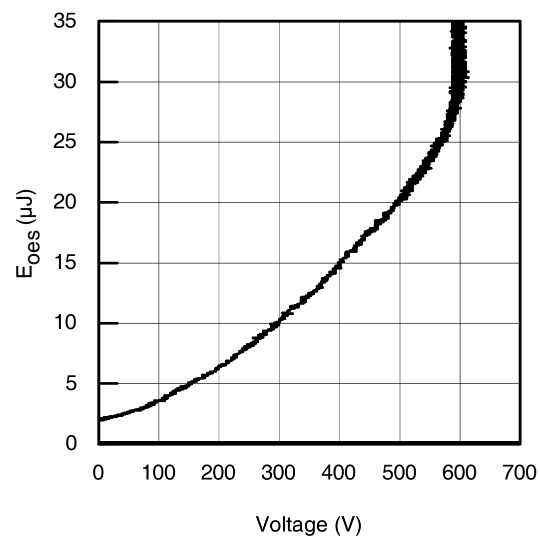


Fig. 17- Typ. Output Capacitance
Stored Energy vs. V_{CE}

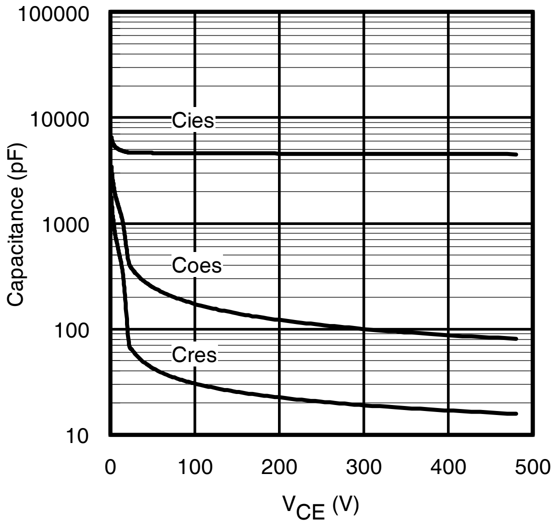


Fig. 18 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

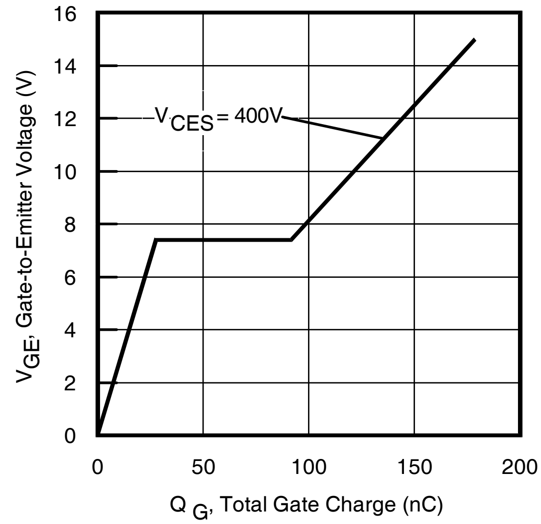


Fig. 19 - Typical Gate Charge vs. V_{GE}
I_{CE} = 20A; L = 200µH

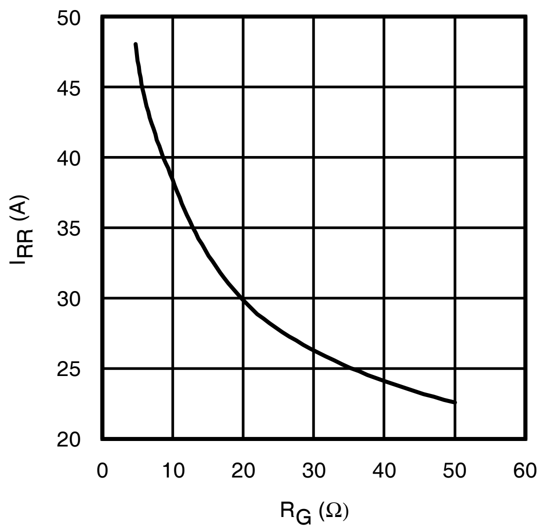


Fig. 20 - Typ. Diode I_{RR} vs. R_G
T_J = 175°C

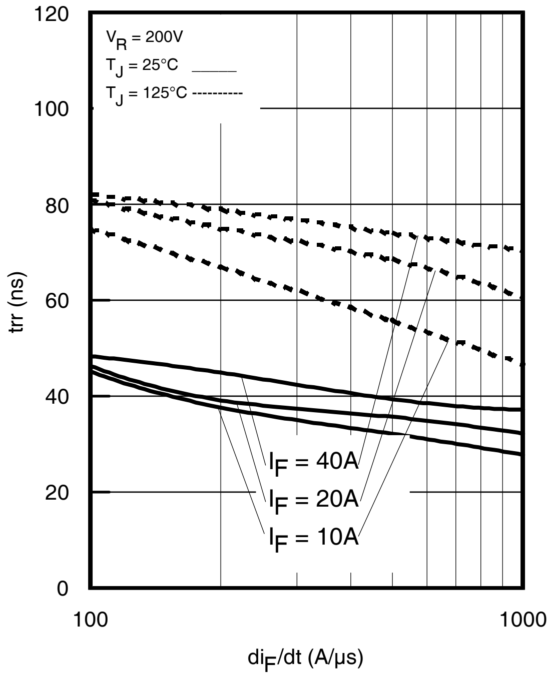


Fig. 21 - Typical Reverse Recovery vs. di_f/dt

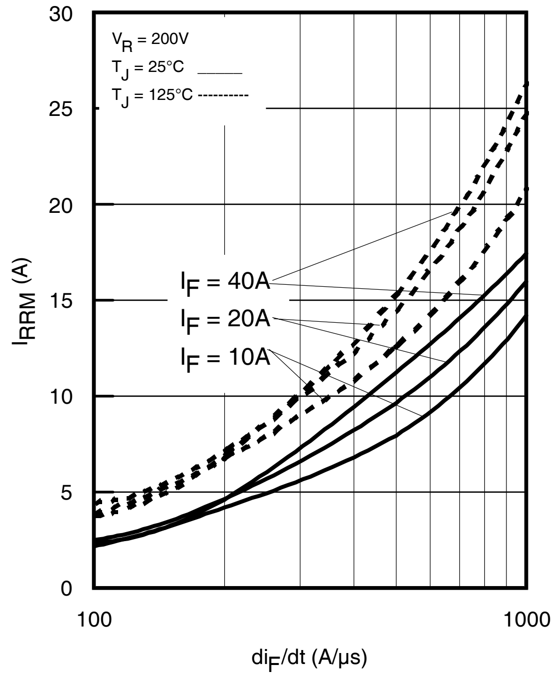


Fig. 22 - Typical Recovery Current vs. di_f/dt

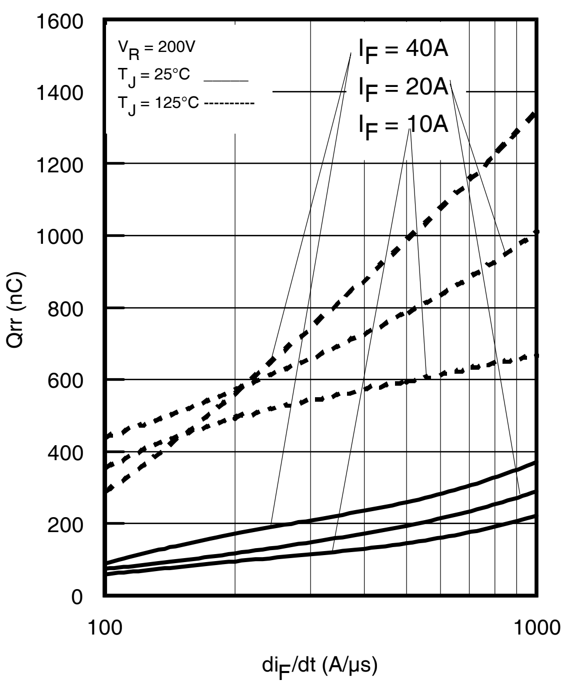


Fig. 23 - Typical Stored Charge vs. di_f/dt

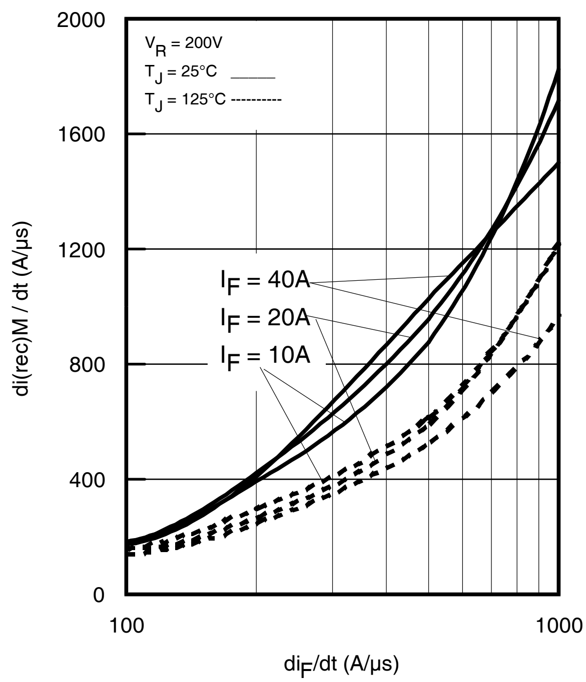


Fig. 24 - Typical $di_{(rec)M}/dt$ vs. di_f/dt,

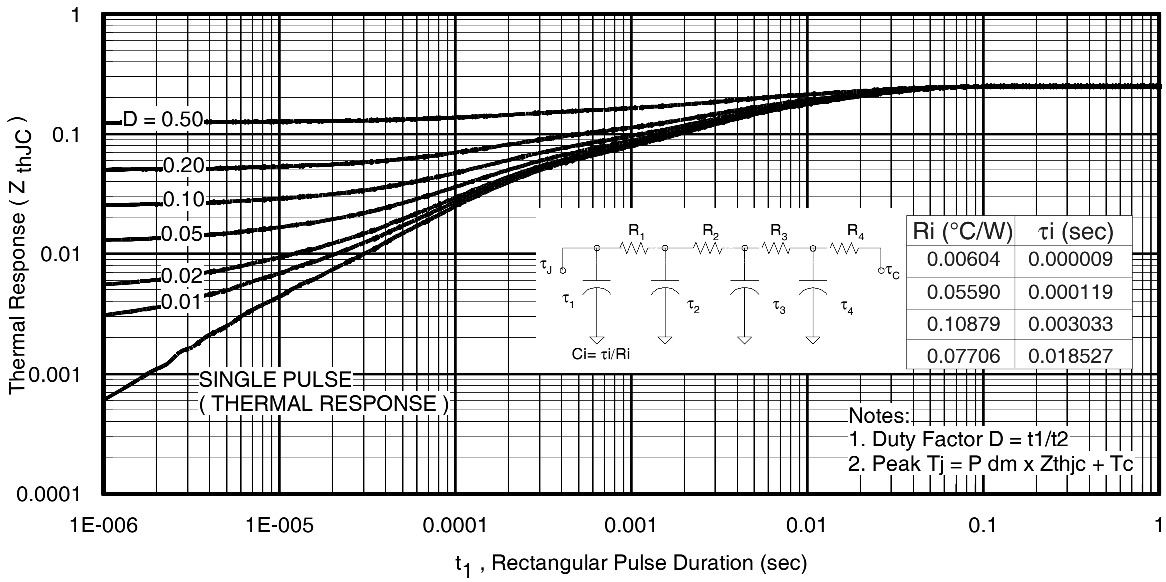


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

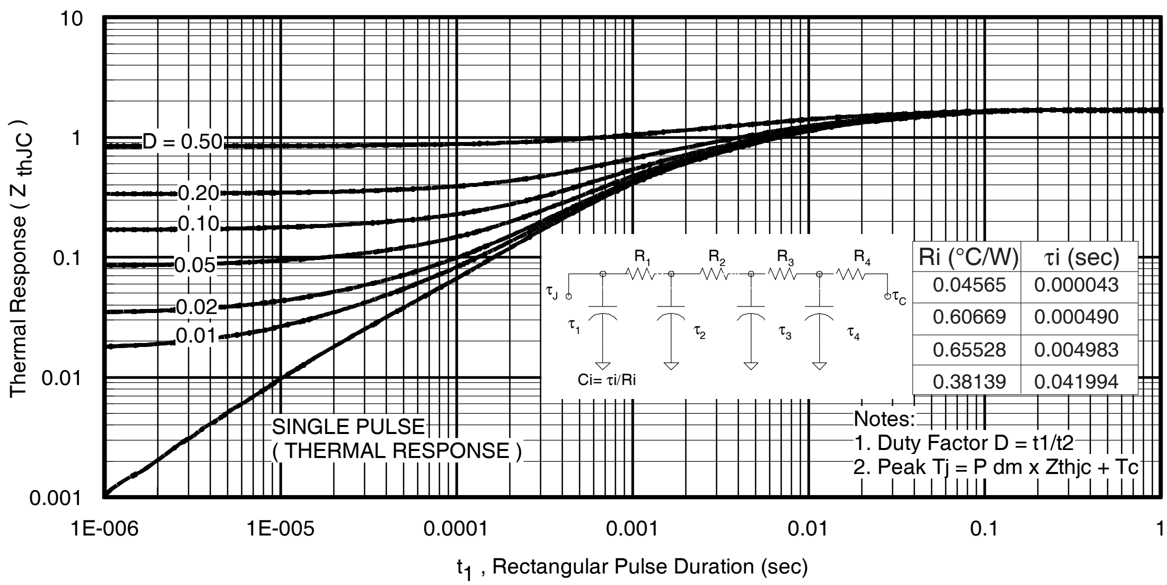


Fig. 26. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

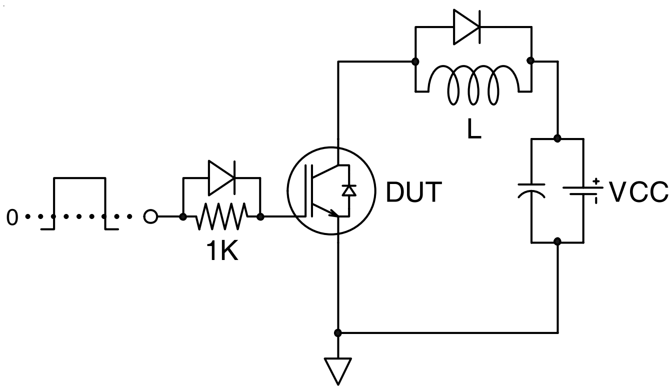


Fig.C.T.1 - Gate Charge Circuit (turn-off)

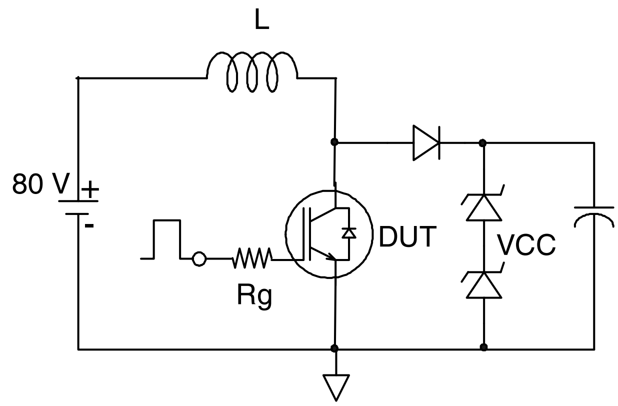


Fig.C.T.2 - RBSOA Circuit

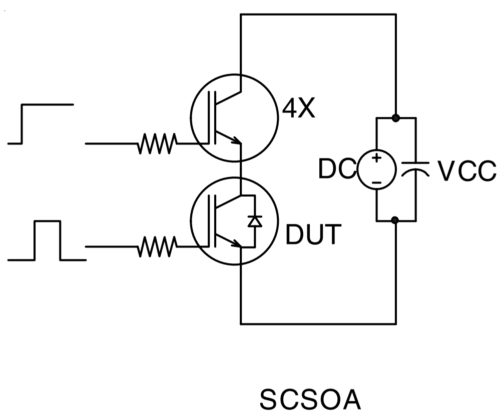


Fig.C.T.3 - S.C. SOA Circuit

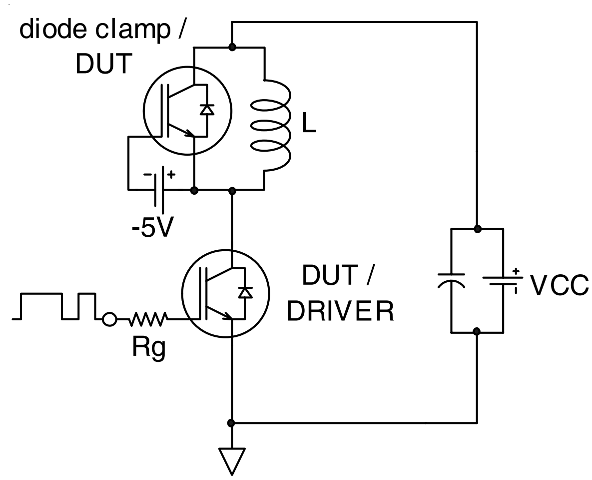


Fig.C.T.4 - Switching Loss Circuit

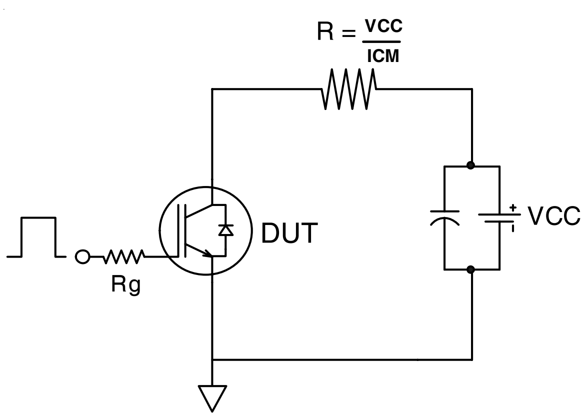


Fig.C.T.5 - Resistive Load Circuit

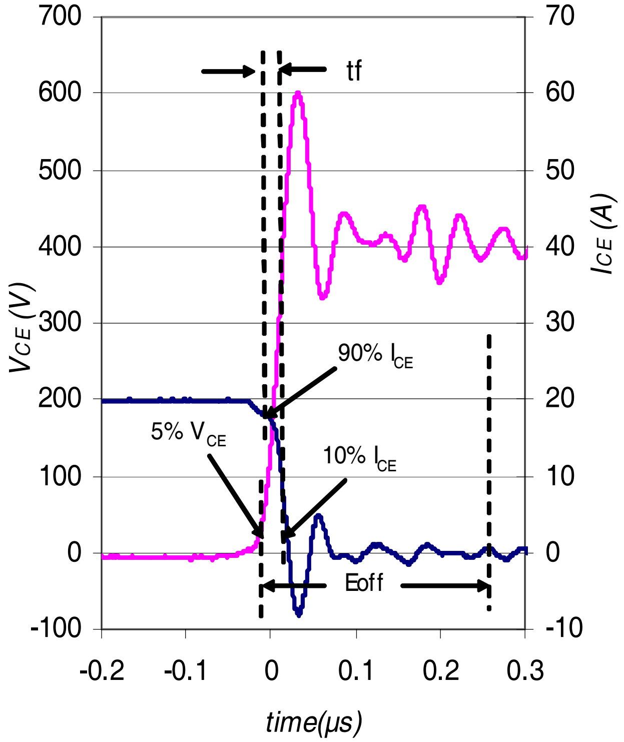


Fig. WF1 - Typ. Turn-off Loss Waveform @ T_J = 175°C using Fig. CT.4

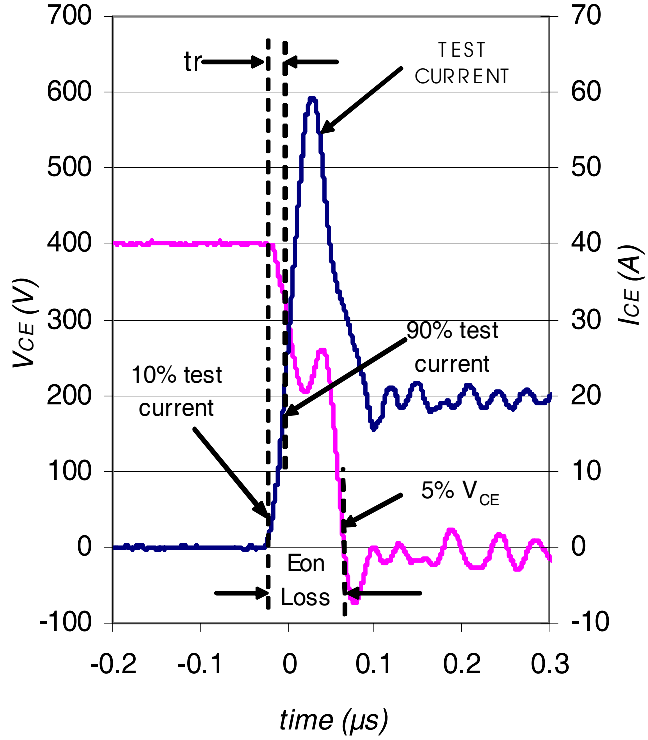
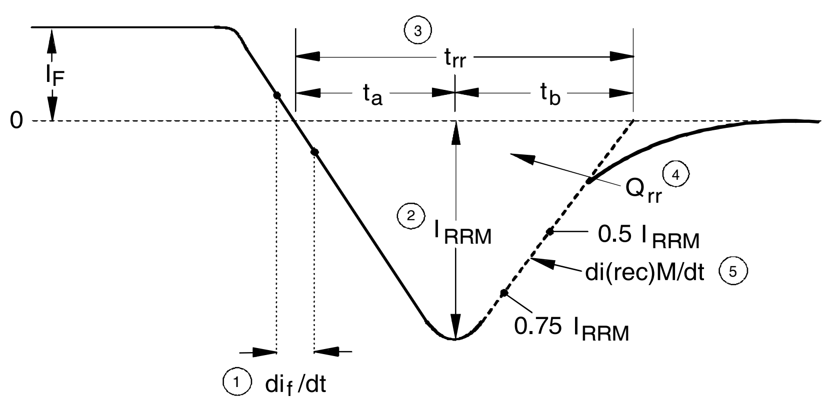


Fig. WF2 - Typ. Turn-on Loss Waveform @ T_J = 175°C using Fig. CT.4



1. di_f/dt - Rate of change of current through zero crossing
2. I_{RRM} - Peak reverse recovery current
3. trr - Reverse recovery time measured from zero crossing point of negative going I_F to point where a line passing through 0.75 I_{RRM} and 0.50 I_{RRM} extrapolated to zero current
4. Q_{rr} - Area under curve defined by t_{rr} and I_{RRM}

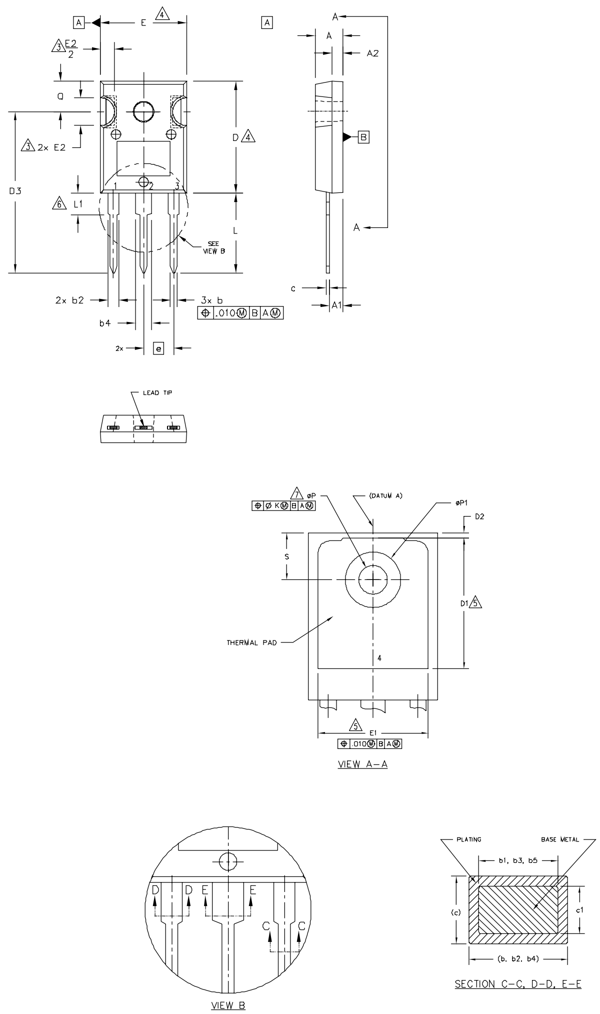
$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

5. $di_{(rec)M}/dt$ - Peak rate of change of current during t_b portion of t_{rr}

Fig. WF3 - Reverse Recovery Waveform and Definitions

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	
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		

SPECIAL NOTE:

a) ADDED D3 FOR SPECIAL REQUIREMENT

PART NUMBERS AFFECTED:

AUIRG4PH50S
AUIRGP4066D1/E
AUIRGP4063D/E
AUIRGP50B60PD1/E
AUIRGP35B60PD/E
AUIRGP4062D1/E
AUIRGP65A20D0
AUIRGP65G20D0
AUIRGP/F66524D0
AUIRGP/F76524D0
AUIRGP/F66548D0
AUIRGP/F76548D0

LEAD ASSIGNMENTS

HEXFET

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

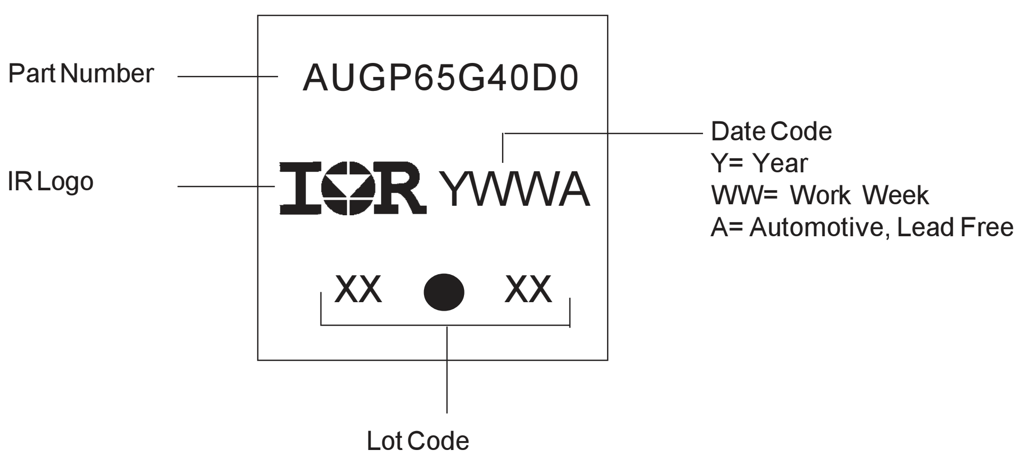
IGBTs, CoPACK

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

DIODES

1.– ANODE/OPEN
2.– CATHODE
3.– ANODE

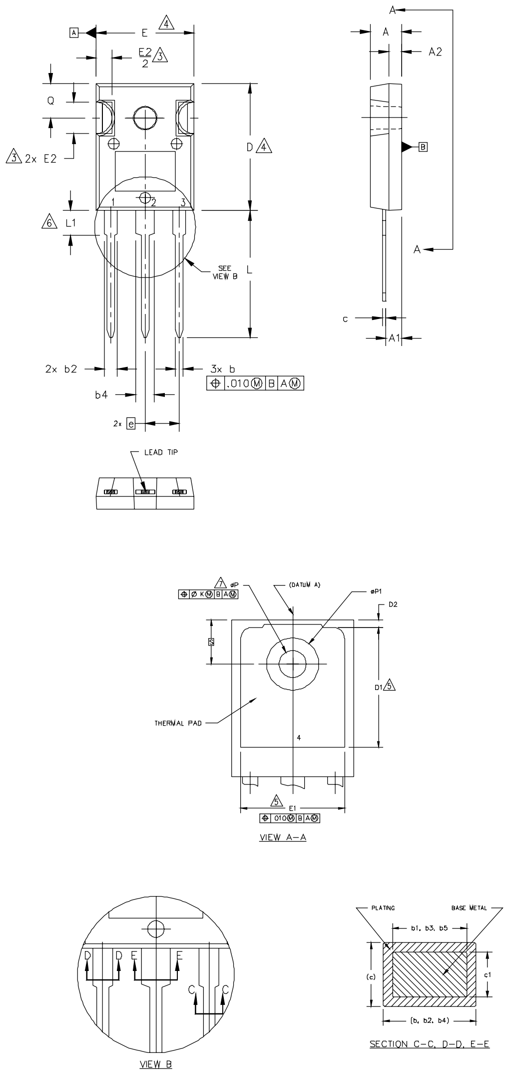
TO-247AC Part Marking Information



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	.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	.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		

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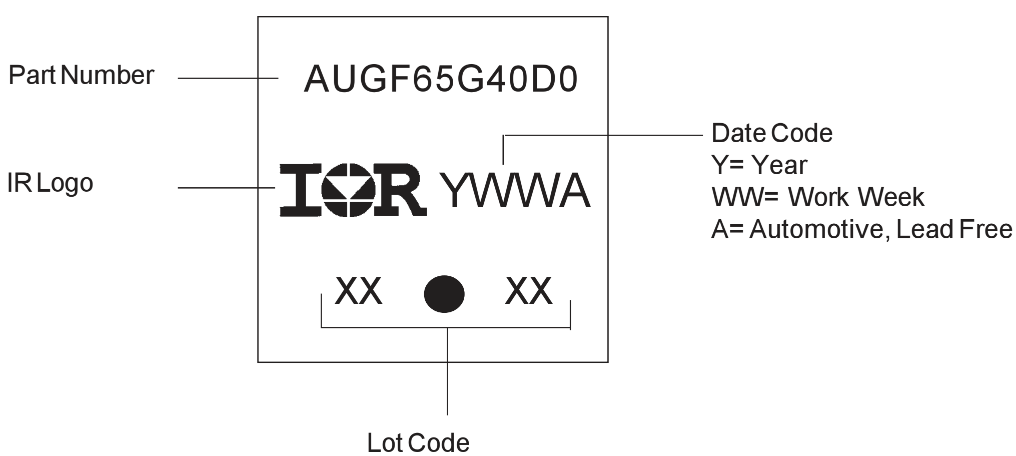
TO-247AD Part Marking Information



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		TO-247AC	N/A
		TO-247AD	N/A
ESD	Machine Model	Class M4 (+/- 400V)†† AEC-Q101-002	
	Human Body Model	Class H3B (+/- 8000V)†† AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 1000V)†† AEC-Q101-005	
RoHS Compliant		Yes	

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

†† Highest passing voltage.

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 485µH, R_G = 4.7Ω, tested in production $I_{LM} \leq$ 400A.

② Pulse width limited by max. junction temperature.

③ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.

④ R_θ is measured at T_J of approximately 90°C.

⑤ C_{oes} eff. is a fixed capacitance that gives the same charging time as C_{oes} while V_{CE} is rising from 0 to 80% V_{CES}. C_{oes} eff.(ER) is a fixed capacitance that stores the same energy as C_{oes} while V_{CE} is rising from 0 to 80% V_{CES}.

⑥ Calculated continuous current based on maximum allowable junction temperature.

⑦ Nominal current limit is suggested for 400V, 200kHz operation. Actual current rating varies with application and is subjected to Tj and SOA limits.

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For technical support, please contact IR’s Technical Assistance Center
http://www.irf.com/technical-info/

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Revision History

Date	Comments
9/8/2015	• Removed "short circuit rating on page 1 & 2.

