COOLiR*IGBT*™

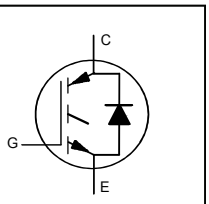
INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

V_{CES} = 600V

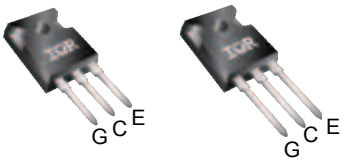
$I_{NOMINAL}$ = 24A

Tsc ≥ 6µs, $T_{J(MAX)}$ = 175°C

$V_{CE(ON)}$ typ. = 1.60V



n-channel



TO-247AC
AUIRGP66524D0

TO-247AD
AUIRGF66524D0

G	C	E
Gate	Collector	Emitter

Applications
- Air Conditioning Compressor
- Auxiliary Motor Drive

Features	→	Benefits
Low $V_{CE(on)}$ Trench IGBT Technology		High Efficiency in a Wide Range of Applications
Low Switching Losses		Suitable for a Wide Range of Switching Frequencies
6µs SCSOA Guaranteed		Enables Short Circuit Protection Scheme
Square RBSOA and 100% Clamp IL Tested		Rugged Hard Switching Operation
Positive $V_{CE(on)}$ Temperature Coefficient		Enables Easy Paralleling of Devices
Ultra Fast Soft Recovery Co-pak Diode		Better Efficiency and Improved EMI Performance
Lead-Free, RoHS Compliant, Automotive Qualified *		Environmentally Friendly

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRGP66524D0	TO-247AC	Tube	25	AUIRGP66524D0
AUIRGF66524D0	TO-247AD	Tube	25	AUIRGF66524D0

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
$I_{Nominal}$	Nominal Collector Current	24	A
I_C @ T_C = 25°C	Continuous Collector Current	60	
I_C @ T_C = 100°C	Continuous Collector Current	40	
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	35	
I_{FM}	Diode Maximum Forward Current ②	72	
V_{GE}	Continuous Gate-to-Emitter Voltage	±20	V
	Transient Gate-to-Emitter Voltage	±30	
dV/dt	Maximum Voltage Transient	15	V/ns
P_D @ T_C = 25°C	Maximum Power Dissipation	214	W
P_D @ T_C = 100°C	Maximum Power Dissipation	107	
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)	

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

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Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case (each IGBT) ④	——	0.7	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case (each Diode) ④	——	1.1	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	0.24	——	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	——	40	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V_{GE} = 0V, I_C = 100µA ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.21	—	V/°C	V_{GE}=0V, I_C=20mA (25°C-175°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.60	1.90	V	I_C = 24A, V_{GE} = 15V, T_J = 25°C
		—	1.95	—		I_C = 24A, V_{GE} = 15V, T_J = 150°C
		—	2.0	—		I_C = 24A, V_{GE} = 15V, T_J = 175°C
$V_{GE(th)}$	Gate Threshold Voltage	5.5	6.5	7.5	V	V_{CE} = V_{GE}, I_C = 250µA
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-28	—	mV/°C	V_{CE}=V_{GE}, I_C=1mA(25°C-175°C)
gfe	Forward Transconductance	—	21	—	S	V_{CE} = 50V, I_C = 24A, PW = 20µs
I_{CES}	Collector-to-Emitter Leakage Current	—	1.1	50	µA	V_{GE} = 0V, V_{CE} = 600V
V_{FM}	Diode Forward Voltage Drop	—	1.50	1.90	V	I_F = 24A
		—	1.40	—		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)	—	50	80	nC	I_C = 24A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	16	24		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	26	39		V_{CC} = 400V
E_{on}	Turn-On Switching Loss	—	915	1045	µJ	
E_{off}	Turn-Off Switching Loss	—	280	395		
E_{total}	Total Switching Loss	—	1195	1440		I_C = 24A, V_{CC} = 400V, V_{GE} = 15V
$t_{d(on)}$	Turn-On delay time	—	30	50	ns	R_G = 10Ω, L = 740µH, T_J = 25°C
t_r	Rise time	—	25	45		Energy losses include tail & diode
$t_{d(off)}$	Turn-Off delay time	—	75	95		reverse recovery
t_f	Fall time	—	25	45		
E_{on}	Turn-On Switching Loss	—	1280	—	µJ	
E_{off}	Turn-Off Switching Loss	—	550	—		
E_{total}	Total Switching Loss	—	1830	—		I_C = 24A, V_{CC} = 400V, V_{GE} = 15V
$t_{d(on)}$	Turn-On delay time	—	30	—	ns	R_G = 10Ω, L = 740µH, T_J = 175°C
t_r	Rise time	—	25	—		Energy losses include tail & diode
$t_{d(off)}$	Turn-Off delay time	—	100	—		reverse recovery
t_f	Fall time	—	95	—		
C_{ies}	Input Capacitance	—	1460	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	120	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	50	—		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	6	—	—	µs	T_J = 150°C, V_{CC} = 400V, Vp ≤600V Rg = 50Ω, V_{GE} = +15V to 0V
Erec	Reverse Recovery Energy of the Diode	—	570	—	µJ	T_J = 175°C
t_{rr}	Diode Reverse Recovery Time	—	176	—	ns	V_{CC} = 400V, I_F = 24A
I_{rr}	Peak Reverse Recovery Current	—	19	—	A	V_{GE} = 15V, Rg = 10Ω, L = 740µH

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 740µH, R_G = 10Ω.

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 approximately 90°C.

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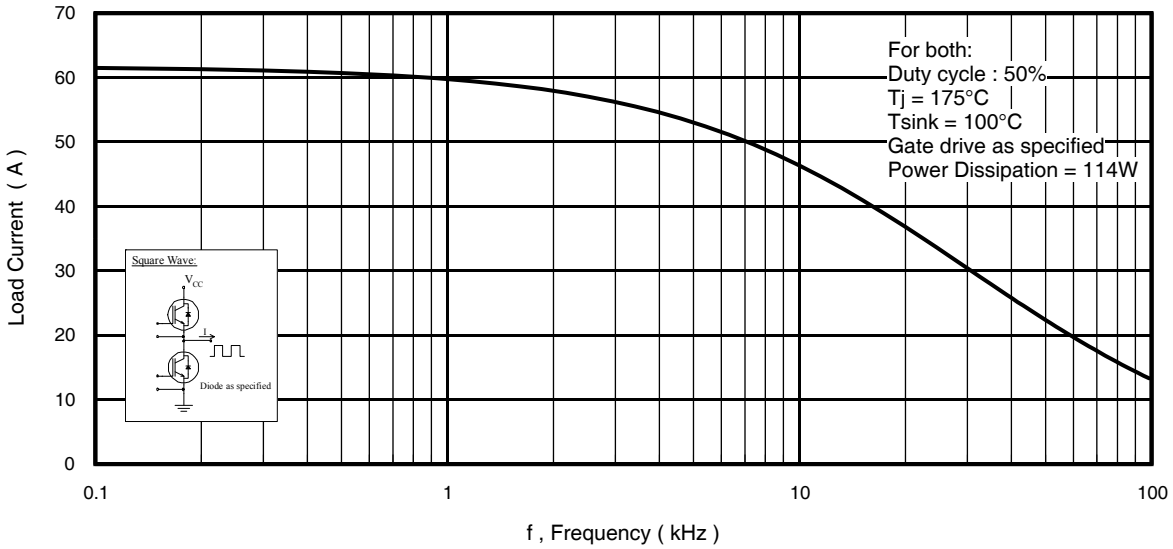


Fig. 1 - Typical Load Current vs. Frequency

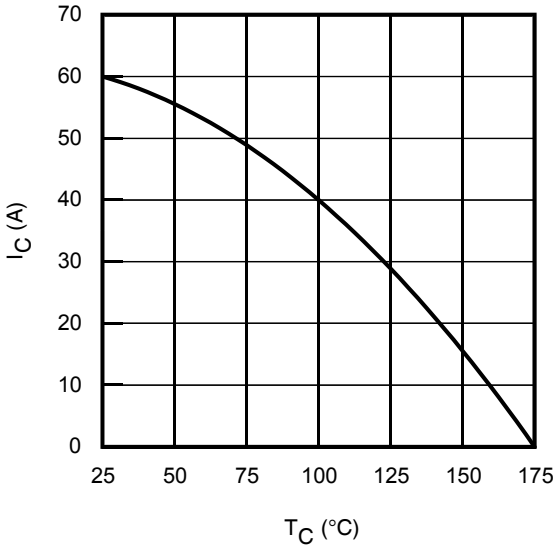


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

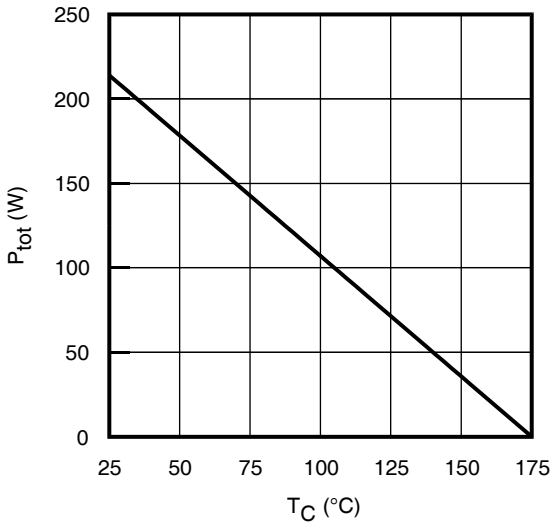


Fig. 3 - Power Dissipation vs. Case Temperature

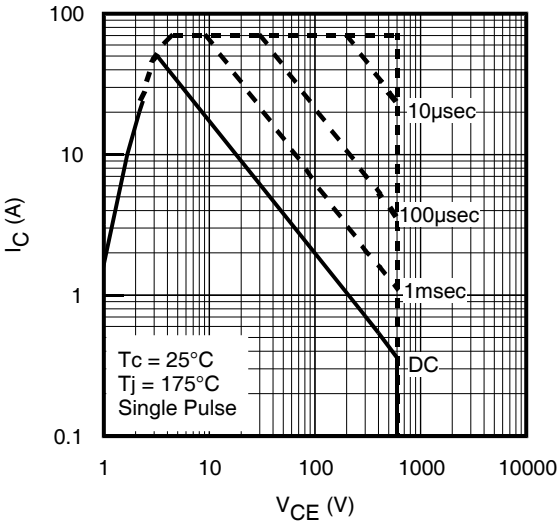


Fig. 4 - Forward SOA
T_C = 25°C, T_J @ 175°C; V_{GE} =15V

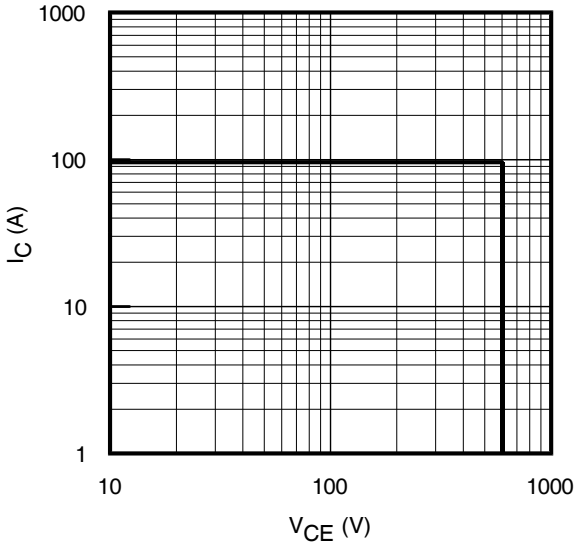


Fig. 5 - Reverse Bias SOA
T_J = 175°C; V_{GE} = 20V

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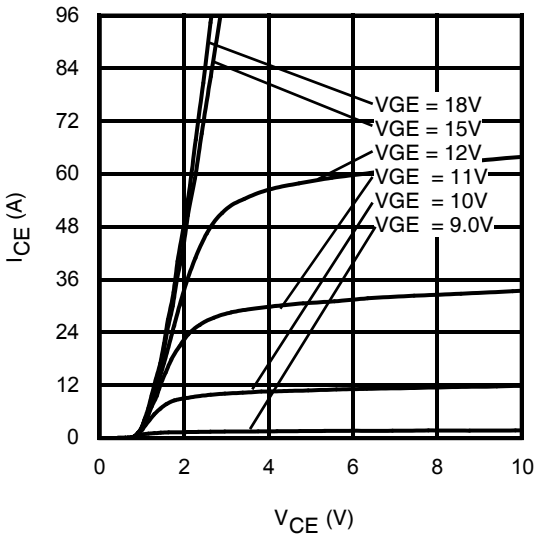


Fig. 6 - - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 20µs

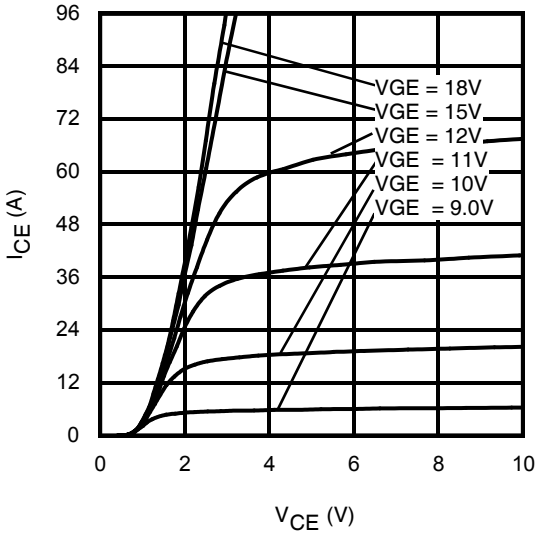


Fig. 7 - Typ. IGBT Output Characteristics
TJ = 25°C; tp = 20µs

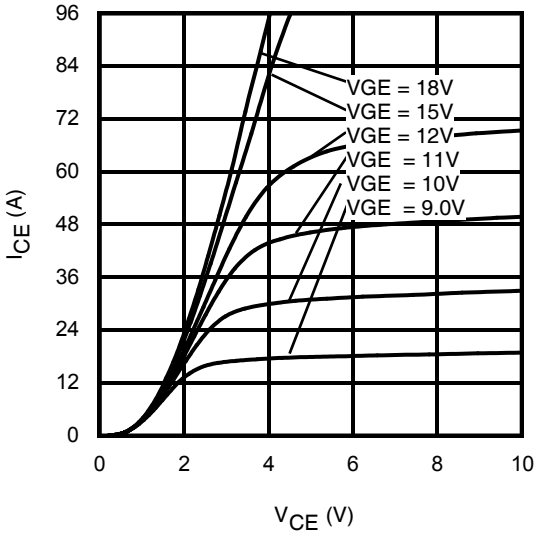


Fig. 8 - Typ. IGBT Output Characteristics
T_J = 175°C; tp = 20µs

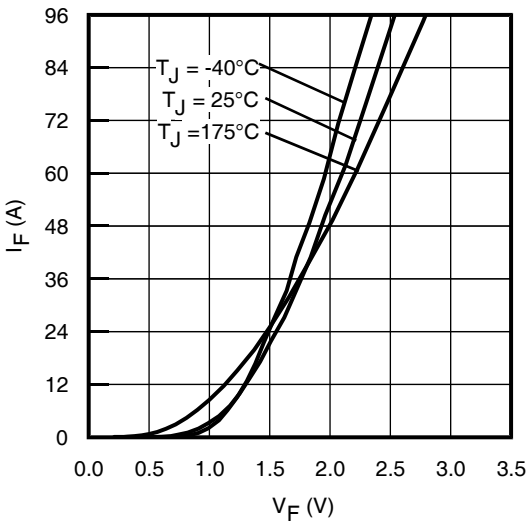


Fig. 9 - Typ. Diode Forward Characteristics
tp = 20µs

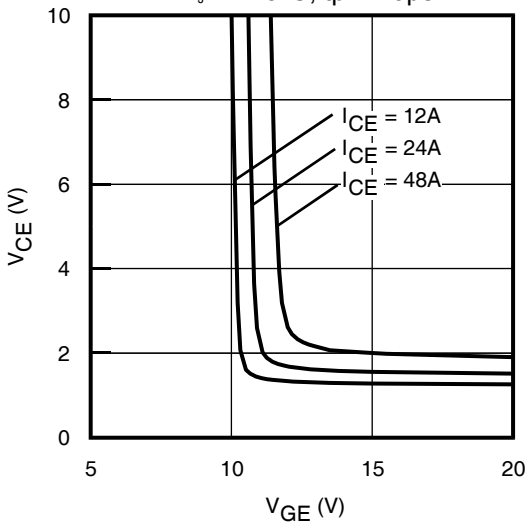


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

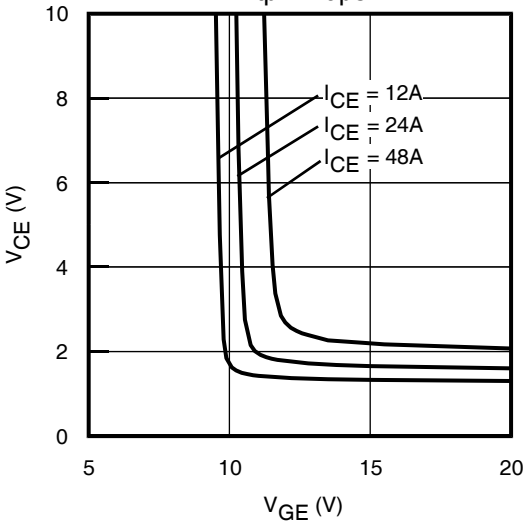


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

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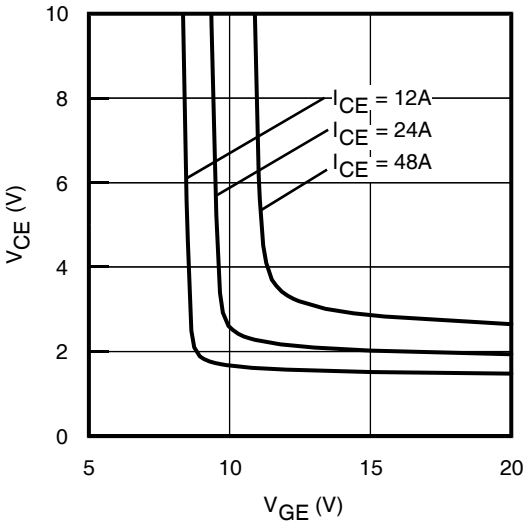


Fig. 12 - Typical V_{CE} vs. V_{GE}
T_J = 175°C

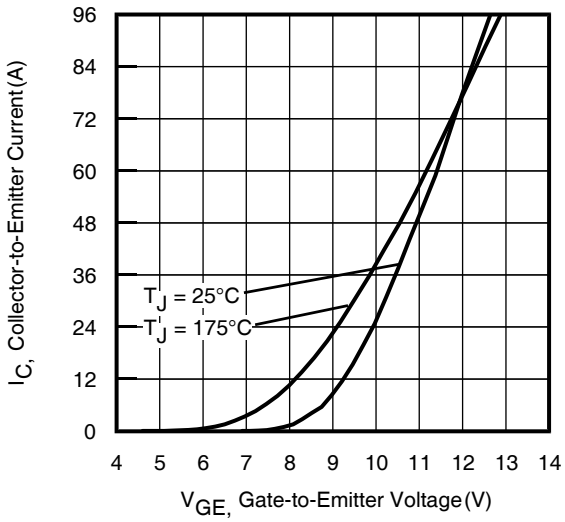


Fig. 13 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 20µs

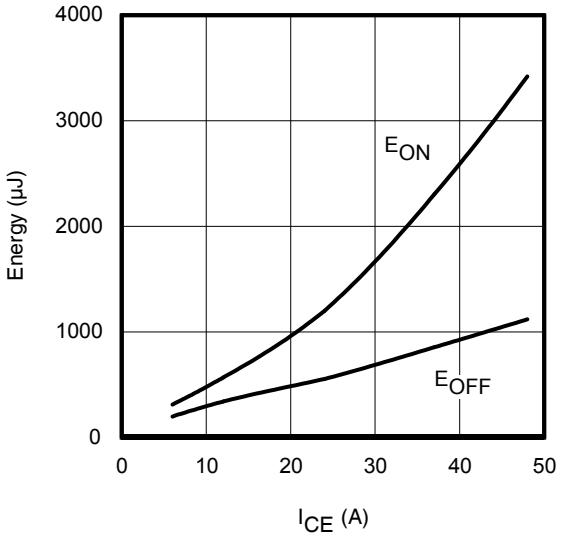


Fig. 14 - Typ. Energy Loss vs. I_C
T_J = 175°C; L = 740µH; V_{CE} = 400V, R_G = 10Ω; V_{GE} = 15V

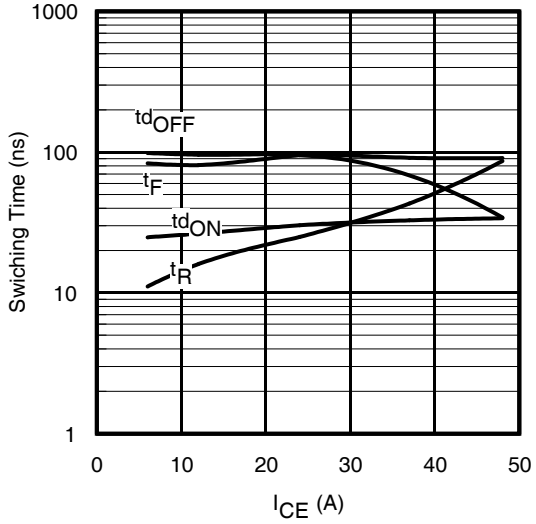


Fig. 15 - Typ. Switching Time vs. IC
TJ = 175°C; L = 740µH; V_{CE} = 400V, R_G = 10Ω; V_{GE} = 15V

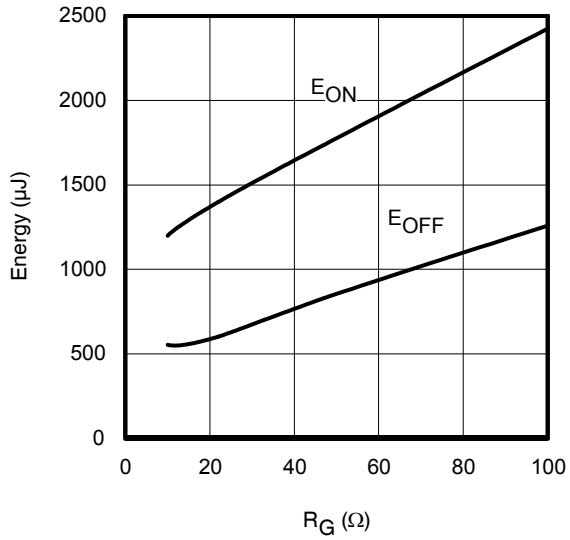


Fig. 16 - Typ. Energy Loss vs. R_G
T_J = 175°C; L = 740µH; V_{CE} = 400V, I_{CE} = 24A; V_{GE} = 15V

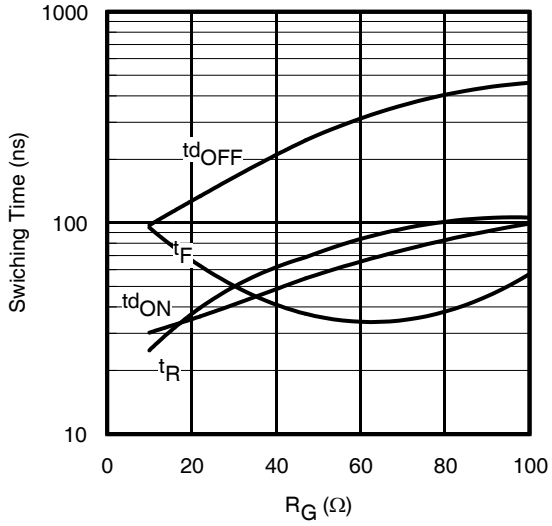


Fig. 17 - Typ. Switching Time vs. R_G
T_J = 175°C; L = 740µH; V_{CE} = 400V, I_{CE} = 24A; V_{GE} = 15V

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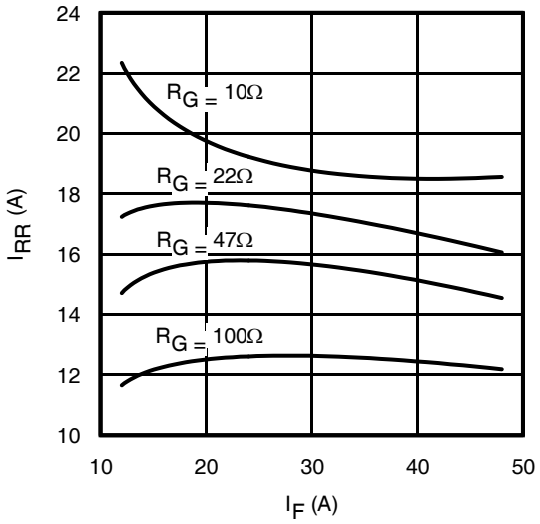


Fig. 18 - Typ. Diode I_{RR} vs. I_F
T_J = 175°C

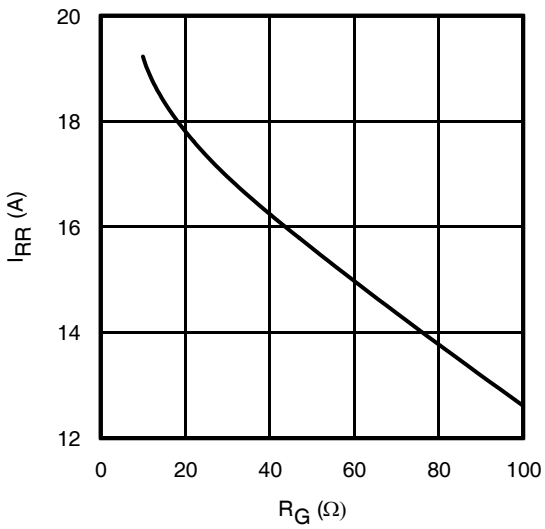


Fig. 19 - Typ. Diode I_{RR} vs. R_G
T_J = 175°C

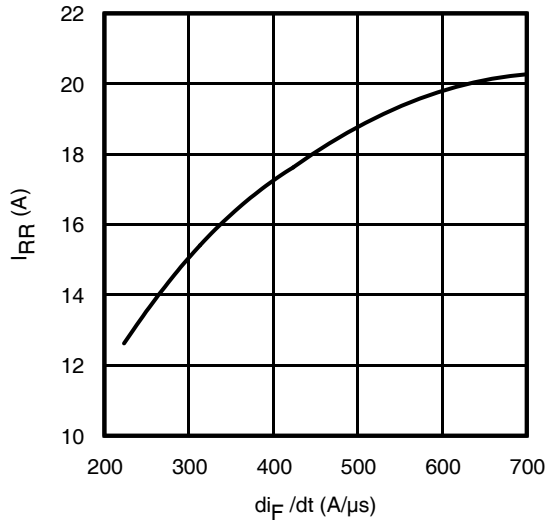


Fig. 20 - Typ. Diode I_{RR} vs. diF/dt
V_{CC} = 400V; V_{GE} = 15V; I_F = 24A; T_J = 175°C

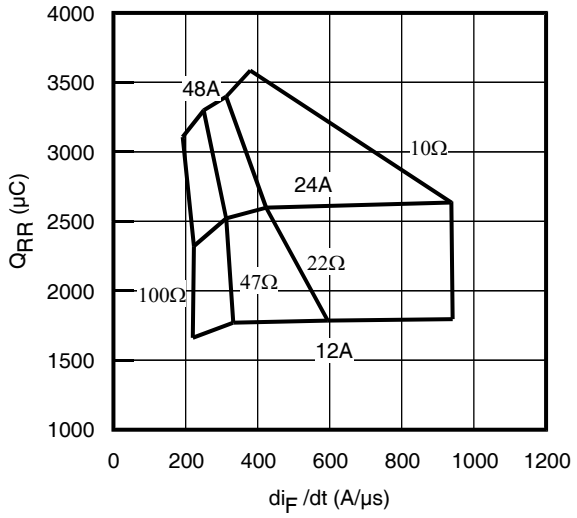


Fig. 21 - Typ. Diode Q_{RR} vs. diF/dt
V_{CC} = 400V; V_{GE} = 15V; T_J = 175°C

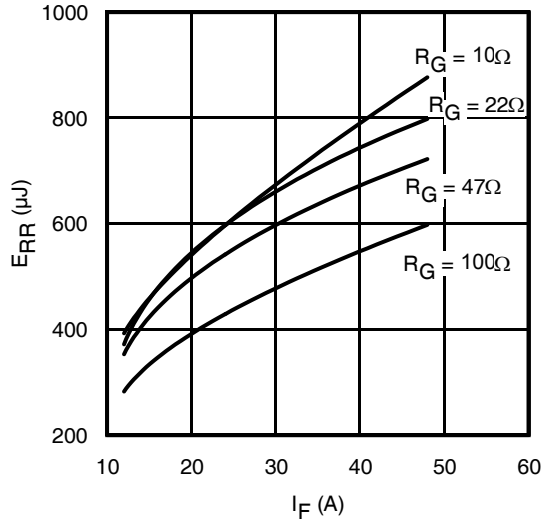


Fig. 22 - Typ. Diode E_{RR} vs. I_F
T_J = 175°C

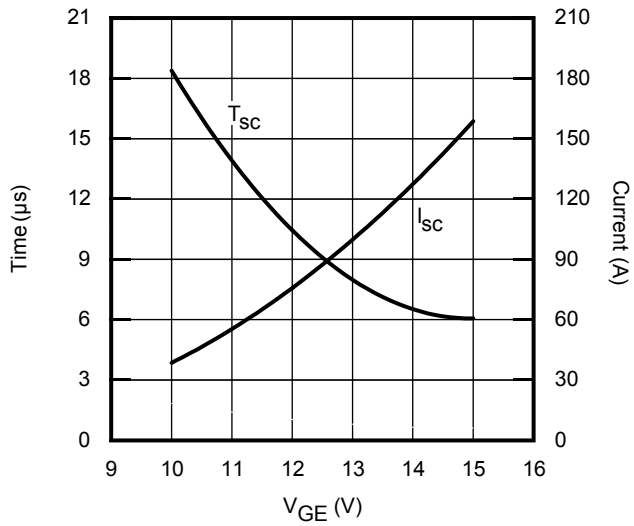


Fig. 23 - V_{GE} vs. Short Circuit Time
V_{CC} = 400V; T_C = 150°C

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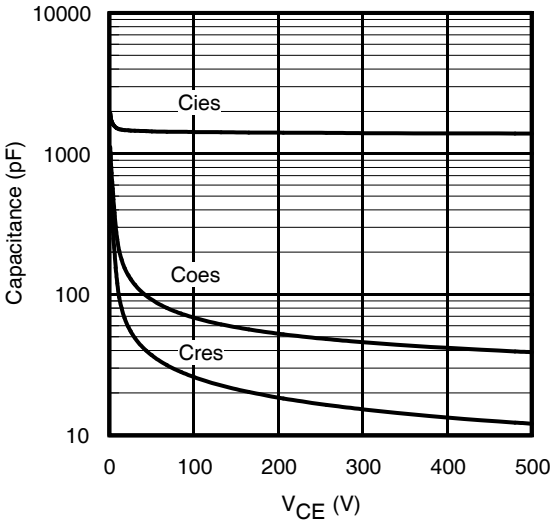


Fig. 24 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

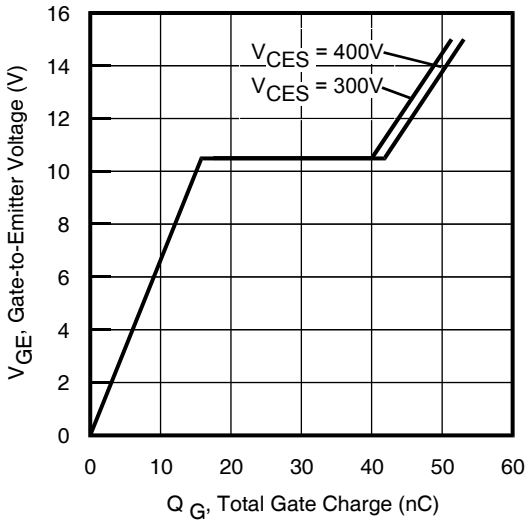


Fig. 25 - Typical Gate Charge vs. V_{GE}
I_{CE} = 24A; L= 485µH

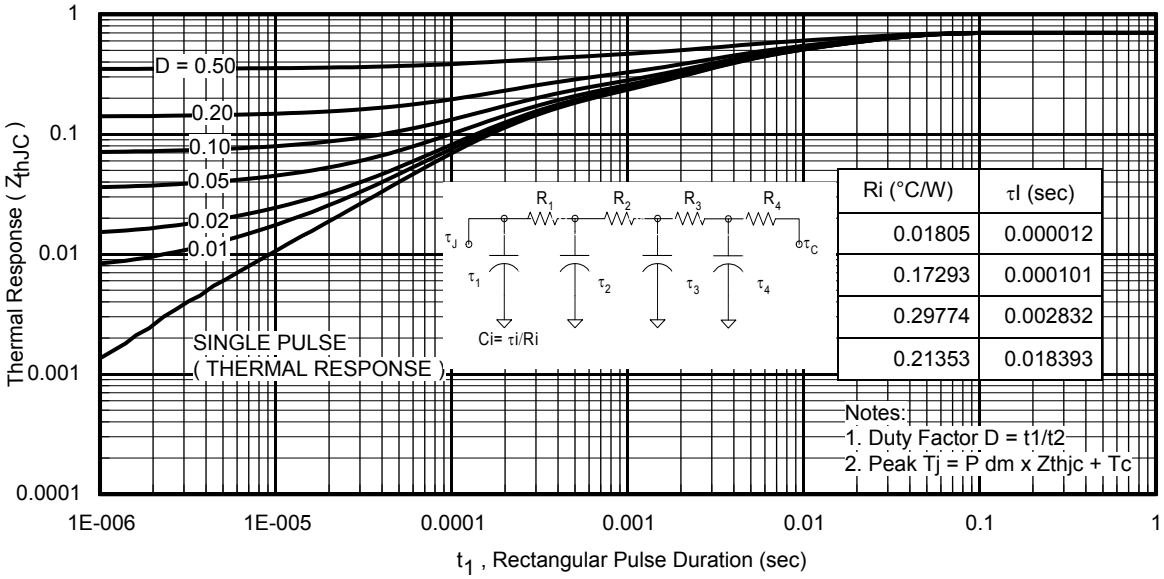


Fig 26. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

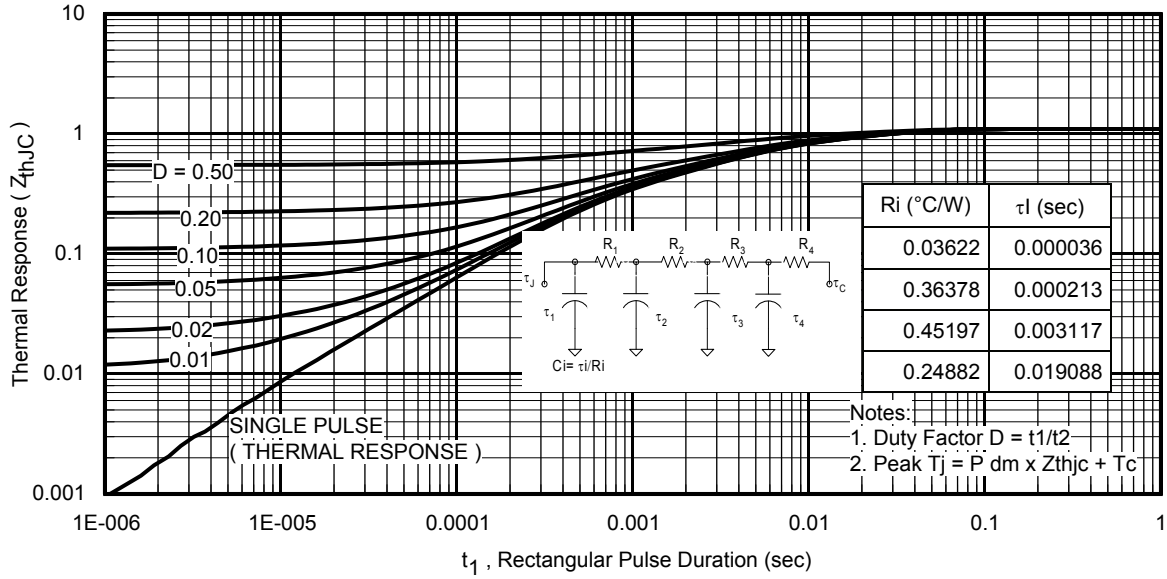
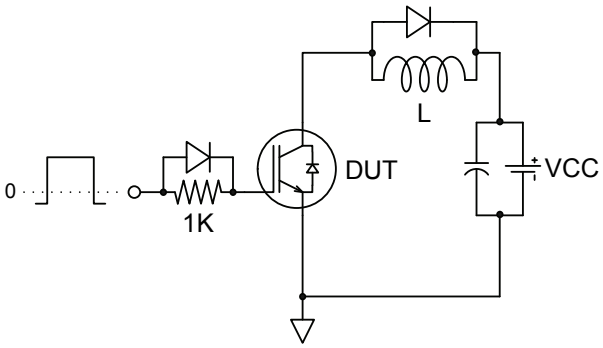


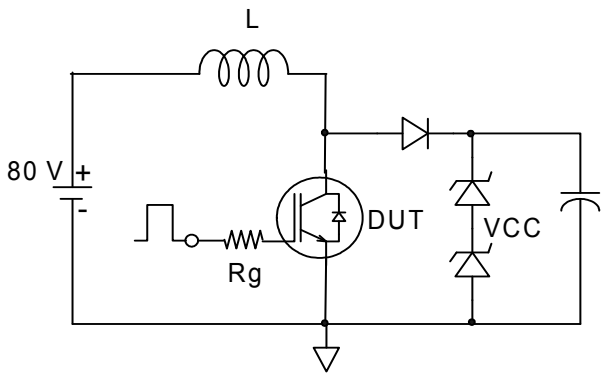
Fig 27. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

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Gate Charge Circuit

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



RBSOA Circuit

Fig.C.T.2 - RBSOA Circuit

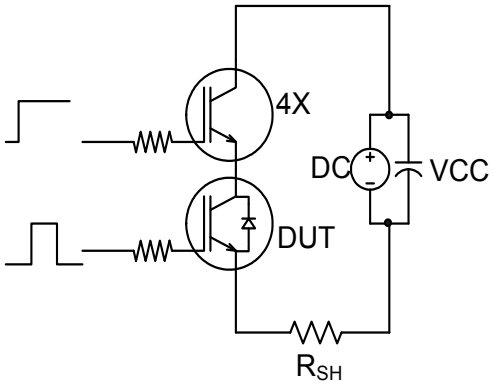
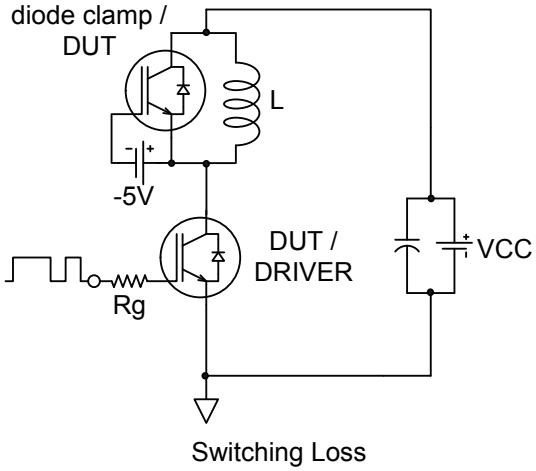


Fig.C.T.3 - S.C. SOA Circuit



Switching Loss

Fig.C.T.4 - Switching Loss Circuit

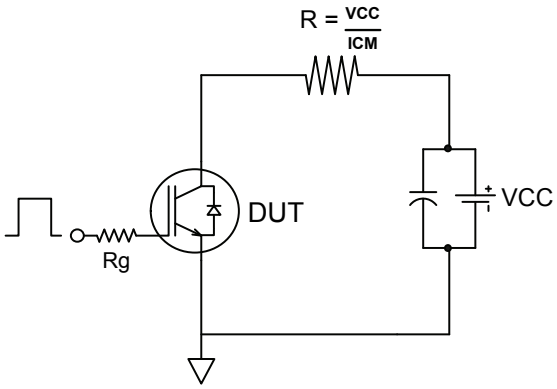


Fig.C.T.5 - Resistive Load Circuit

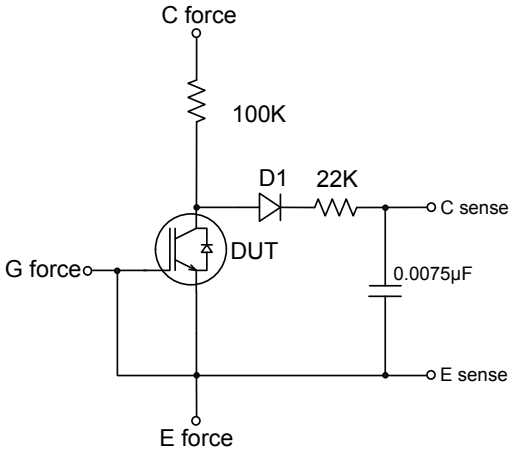


Fig.C.T.6 - BVCES Filter Circuit

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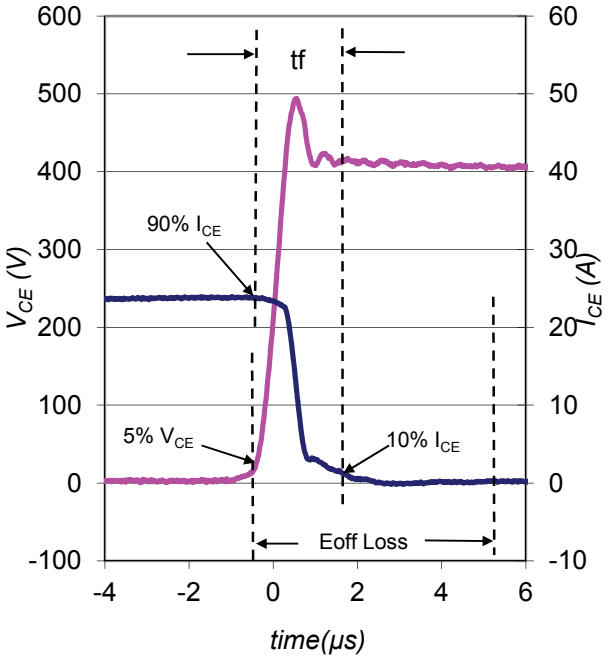


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 175°C using Fig. CT.4

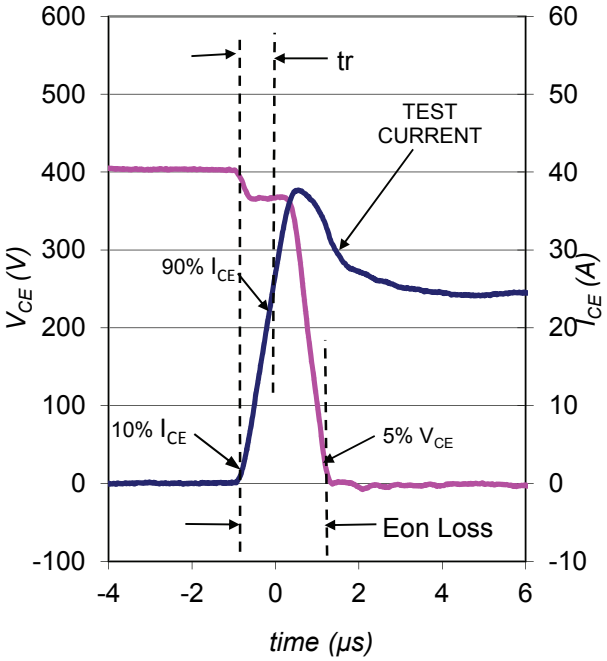


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 175°C using Fig. CT.4

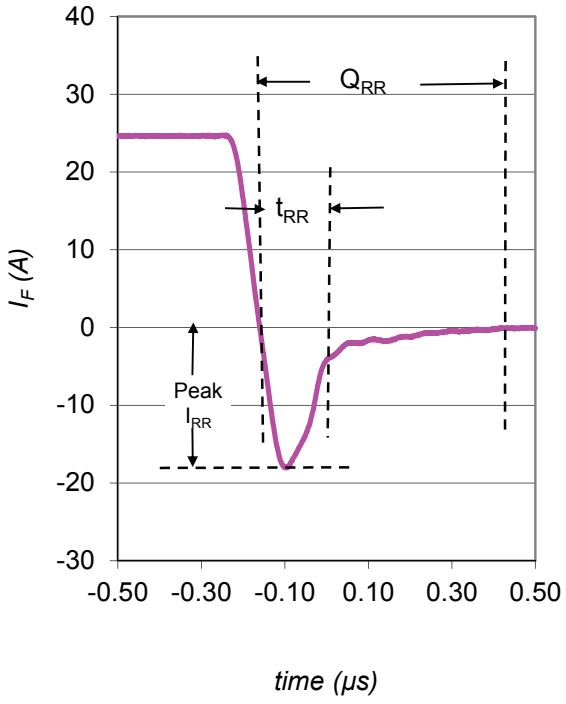


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 175°C using Fig. CT.4

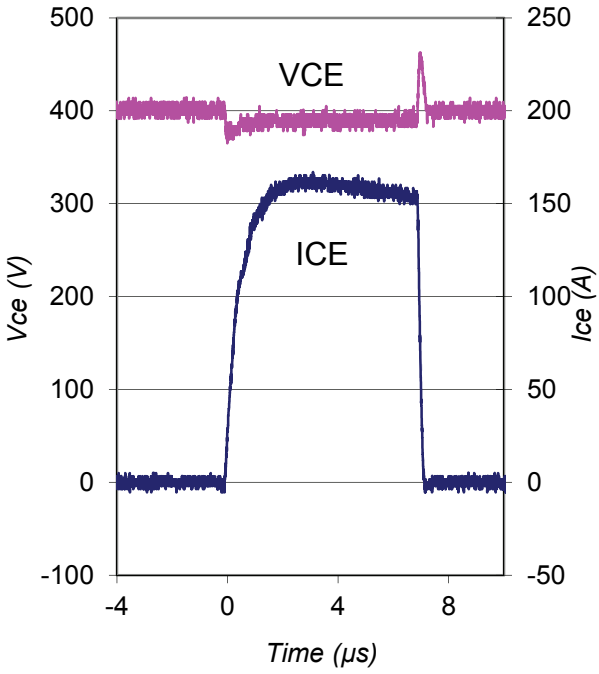
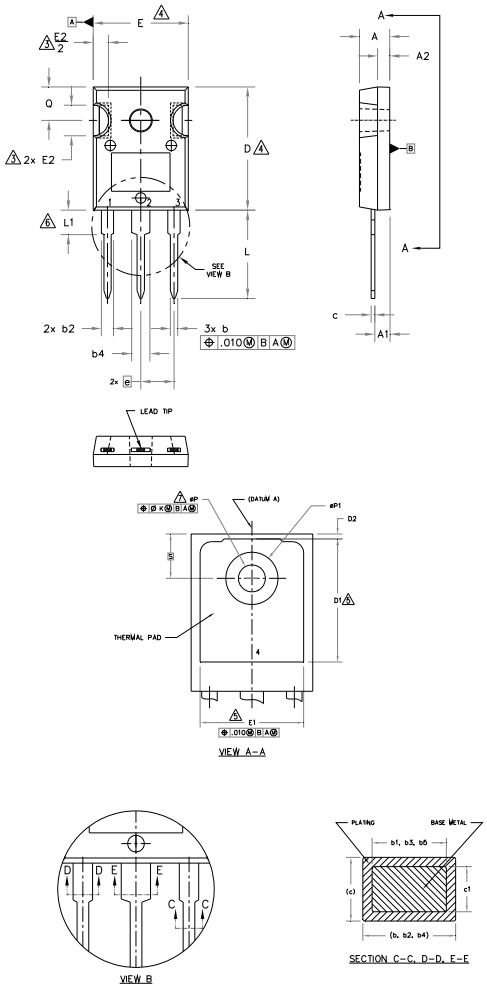


Fig. WF4 - Typ. S.C. Waveform
@ T_J = 150°C using Fig. CT.3

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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 .
9. DIMENSION "A" HAS TIGHTER TOLERANCE WITH REFERENCE TO 115-0051 POD

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	.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

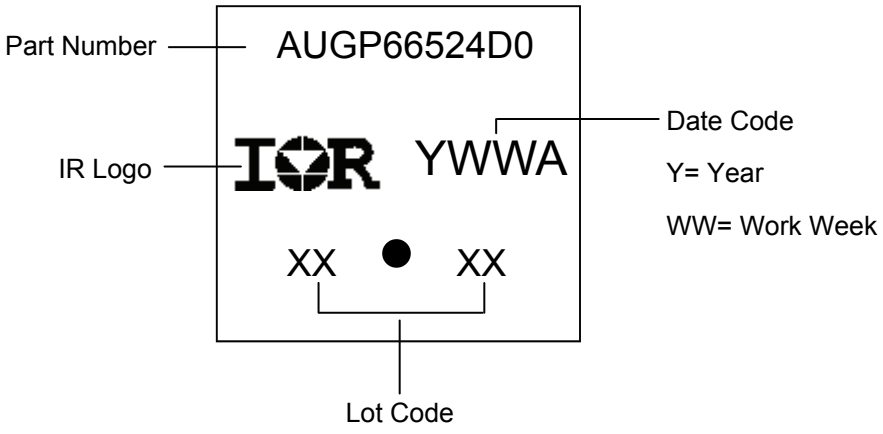
IGBTs, CoPACK

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

DIODES

1.– ANODE/OPEN
2.– CATHODE
3.– ANODE

TO-247AC Part Marking Information



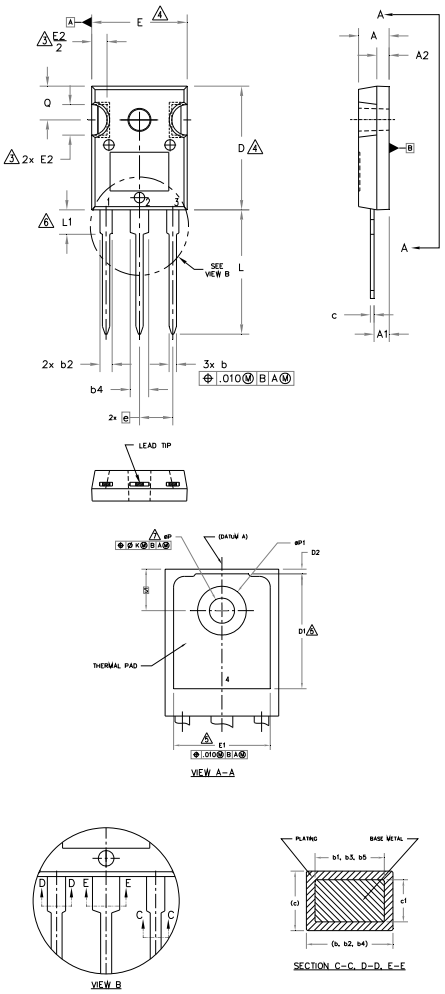
TO-247AC package is not recommended for Surface Mount Application.

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

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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.
9. TIGHTEN DIMENSIONS A, b, b2, b4, c, D, E, E1, L.

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	.041	.051	1.04	1.30	
b1	.039	.053	0.99	1.35	
b2	.080	.094	2.02	2.38	
b3	.065	.092	1.65	2.34	
b4	.118	.134	3.00	3.40	
b5	.102	.133	2.59	3.38	
c	.017	.035	0.44	0.88	
c1	.015	.033	0.38	0.84	
D	.780	.795	19.80	20.20	4
D1	.515	–	13.08	–	5
D2	.020	.053	0.51	1.35	
E	.604	.624	15.35	15.85	4
E1	.530	.544	13.46	13.82	
E2	.178	.216	4.52	5.49	
e	.215 BSC		5.46 BSC		
øk	.010		0.25		
L	.791	.823	20.10	20.90	
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

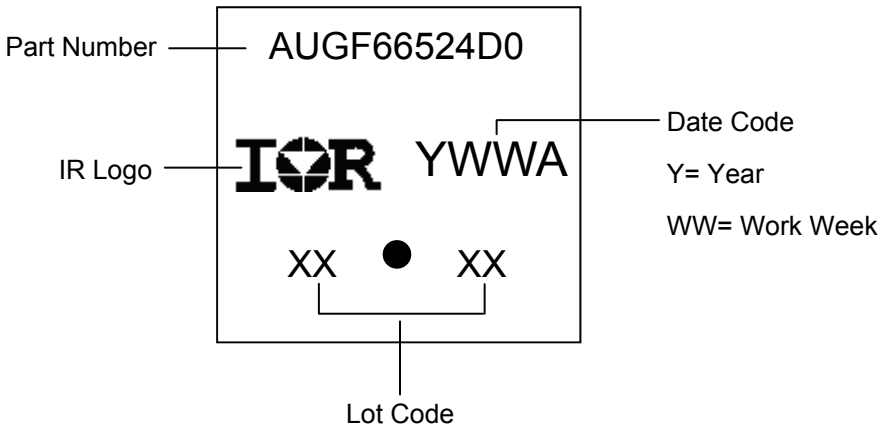
IGBTs, CoPACK

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

DIODES

1.– ANODE/OPEN
2.– CATHODE
3.– ANODE

TO-247AD Part Marking Information



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/

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Qualification Information†

Qualification Level		Automotive (per AEC-Q101) †	
		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	
ESD	Human Body Model	Class H1C(+/- 2000)†† AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 1000)†† 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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