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 = 500µA	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.78	—	V/°C	V_{GE} = 0V, I_C = 1mA (25°C-125°C)	
R_G	Internal Gate Resistance	—	1.7	—	Ω	1MHz, Open Collector	4,5,6,8,9
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.85	2.15	V	I_C = 22A, V_{GE} = 15V	
		—	2.25	2.55		I_C = 35A, V_{GE} = 15V	
		—	2.37	2.80		I_C = 22A, V_{GE} = 15V, T_J = 125°C	
		—	3.00	3.45		I_C = 35A, V_{GE} = 15V, T_J = 125°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.0	4.0	5.0	V	I_C = 250µA	7,8,9
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-10	—	mV/°C	V_{CE} = V_{GE}, I_C = 1.0mA	
gfe	Forward Transconductance	—	36	—	S	V_{CE} = 50V, I_C = 22A,PW = 80µs	
I_{CES}	Collector-to-Emitter Leakage Current	—	3.0	375	µA	V_{GE} = 0V, V_{CE} = 600V	
		—	0.35	—	mA	V_{GE} = 0V, V_{CE} = 600V,T_J = 125°C	
V_{FM}	Diode Forward Voltage Drop	—	1.30	1.70	V	I_F = 15A	10
		—	1.20	1.60		I_F = 15A, T_J = 125°C	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±20V, V_{CE} = 0V	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref. Fig.
Q_g	Total Gate Charge (turn-on)	—	160	240	nC	I_C = 22A	17
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	55	83		V_{GE} = 15V	CT1
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	21	32		V_{CC} = 400V	
E_{on}	Turn-On Switching Loss	—	220	270	µJ		
E_{off}	Turn-Off Switching Loss	—	215	265			
E_{total}	Total Switching Loss	—	435	535		I_C = 22A, V_{CC} = 390V,	
$t_{d(on)}$	Turn-On delay time	—	26	34	ns	V_{GE} = +15V,	CT3
t_r	Rise time	—	6.0	8.0		R_G = 3.3Ω, L = 200µH,	
$t_{d(off)}$	Turn-Off delay time	—	110	122		T_J = 25°C ④	
t_f	Fall time	—	8.0	10			
E_{on}	Turn-On Switching Loss	—	410	465	µJ		CT3
E_{off}	Turn-Off Switching Loss	—	330	405			11,13
E_{total}	Total Switching Loss	—	740	870		I_C = 22A, V_{CC} = 390V,	WF1,WF2
$t_{d(on)}$	Turn-On delay time	—	26	34	ns	V_{GE} = +15V,	CT3
t_r	Rise time	—	8.0	11		R_G = 3.3Ω, L = 200µH,	12,14
$t_{d(off)}$	Turn-Off delay time	—	130	150		T_J = 125°C ④	WF1,WF2
t_f	Fall time	—	12	16			
C_{ies}	Input Capacitance	—	3715	—	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	—	265	—		V_{CC} = 30V	16
C_{res}	Reverse Transfer Capacitance	—	47	—		f = 1.0Mhz	
$C_{oes\ eff.}$	Effective Output Capacitance (Time Related)	—	135	—		V_{GE} = 0V, V_{CE} = 0V to 480V	15
$C_{oes\ eff.\ (ER)}$	Effective Output Capacitance (Energy Related)	—	179	—			
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 120A V_{CC} = 480V, Vp ≤ 600V Rg = 22Ω, V_{GE} = +15V to 0V	3 CT2
t_{rr}	Diode Reverse Recovery Time	—	42	60	ns	T_J = 25°C	19
		—	74	120		T_J = 125°C	
Q_{rr}	Diode Reverse Recovery Charge	—	80	180	nC	T_J = 25°C	21
		—	220	600		T_J = 125°C	
I_{rr}	Peak Reverse Recovery Current	—	4.0	6.0	A	T_J = 25°C	19,20,21,22
		—	6.5	10		T_J = 125°C	CT5

I_F = 15A, V_R = 200V, di/dt = 200A/µs

Notes:

① $R_{CE(on)}$ typ. = equivalent on-resistance = $V_{CE(on)}$ typ./ I_C, where $V_{CE(on)}$ typ.= 1.85V and I_C =22A. I_D (FET Equivalent) is the equivalent MOSFET I_D rating @ 25°C for applications up to 150kHz. These are provided for comparison purposes (only) with equivalent MOSFET solutions.

② V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 28 µH, R_G = 22 Ω

③ Pulse width limited by max. junction temperature.

④ Energy losses include "tail" and diode reverse recovery, Data generated with use of Diode 30ETH06.

⑥ 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}.

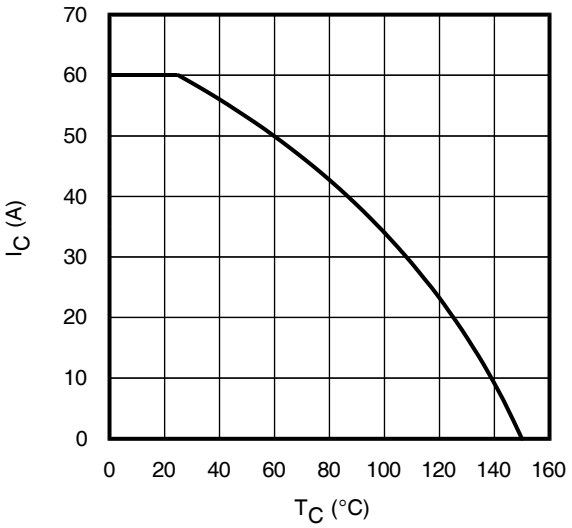


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

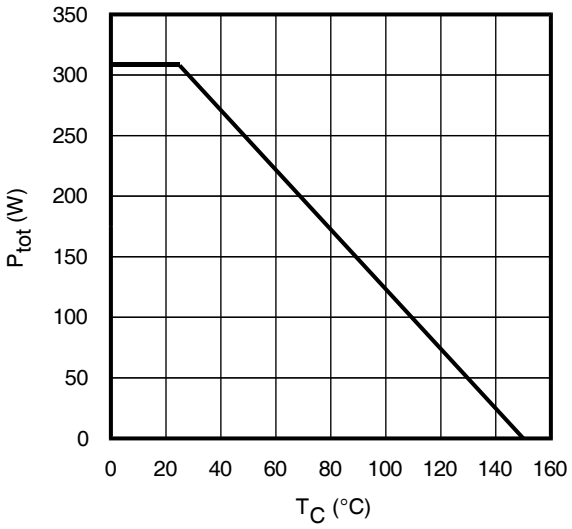


Fig. 2 - Power Dissipation vs. Case Temperature

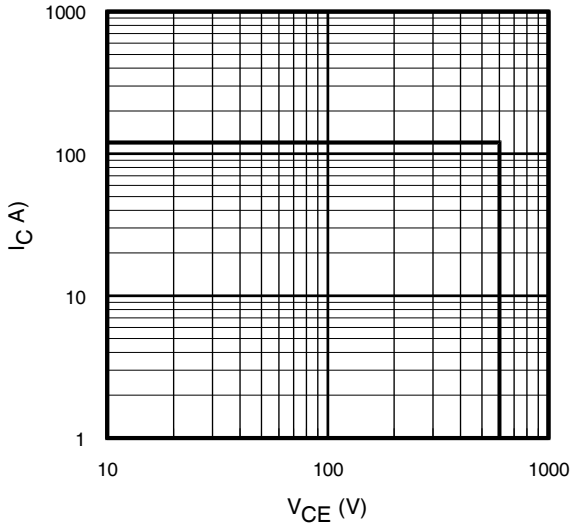


Fig. 3 - Reverse Bias SOA
T_J = 150°C; V_{GE} = 15V

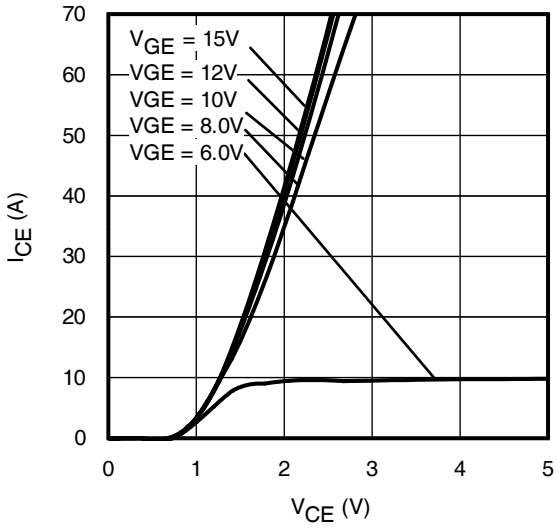


Fig. 4 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 80µs

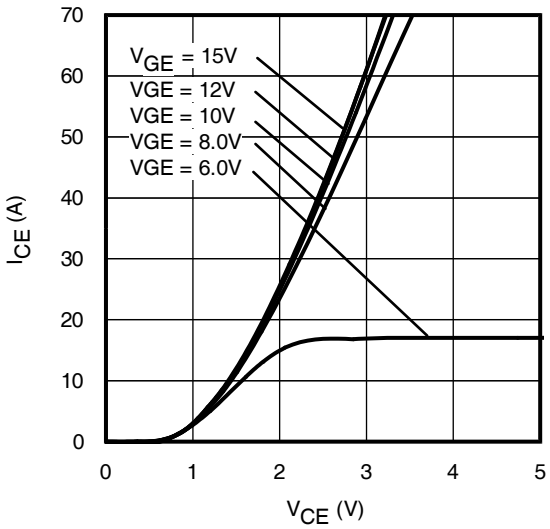


Fig. 5 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80µs

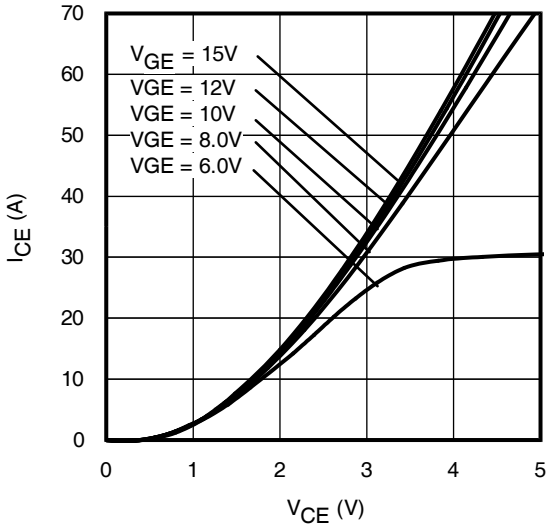


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 125°C; tp = 80µs

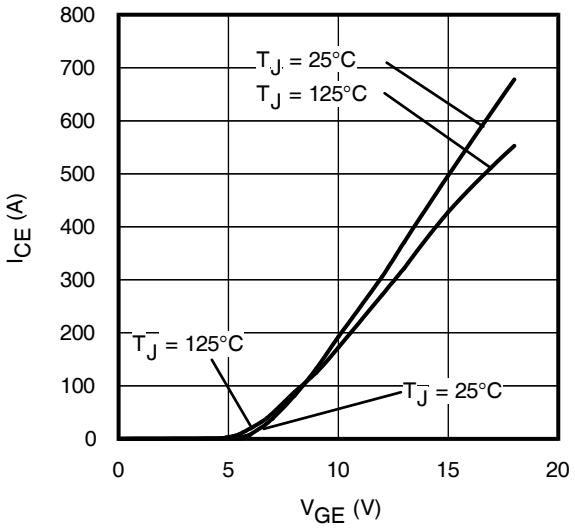


Fig. 7 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

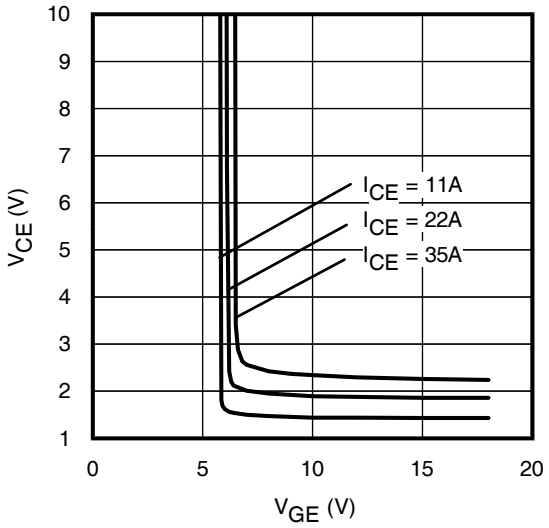


Fig. 8 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

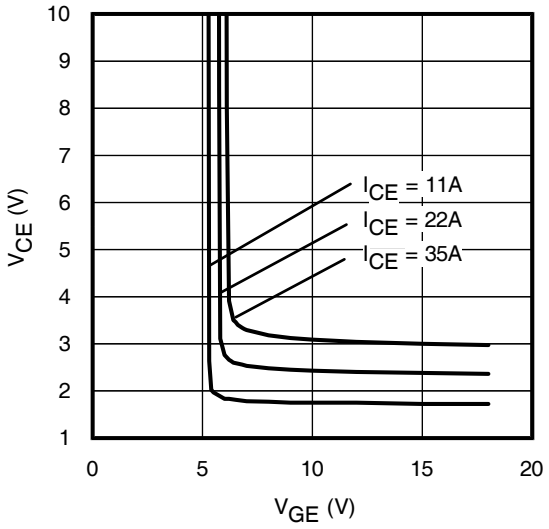


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = 125°C

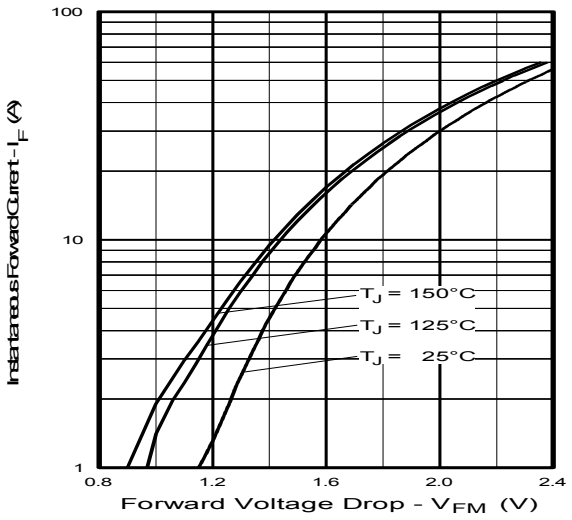


Fig. 10 - Typ. Diode Forward Characteristics
tp = 80µs

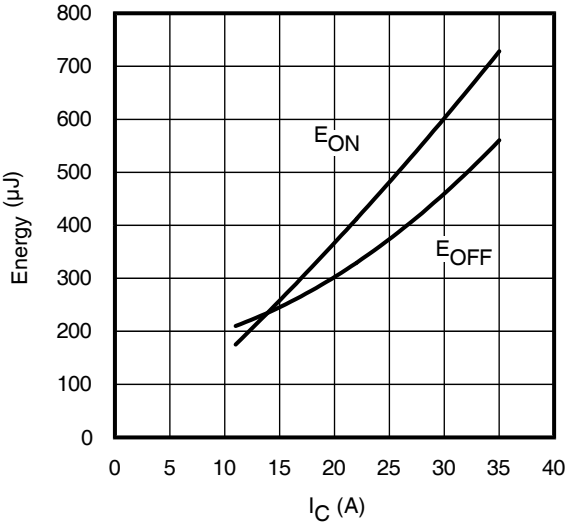


Fig. 11 - Typ. Energy Loss vs. I_C
T_J = 125°C; L = 200µH; V_{CE} = 390V, R_G = 3.3Ω; V_{GE} = 15V.
Diode clamp used: 30ETH06 (See C.T.3)

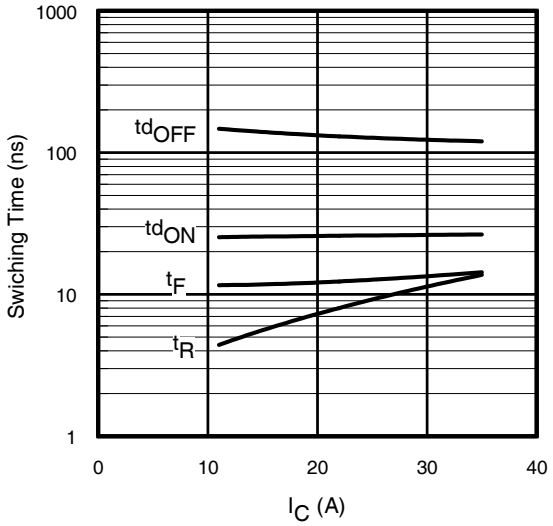


Fig. 12 - Typ. Switching Time vs. I_C
T_J = 125°C; L = 200µH; V_{CE} = 390V, R_G = 3.3Ω; V_{GE} = 15V.
Diode clamp used: 30ETH06 (See C.T.3)

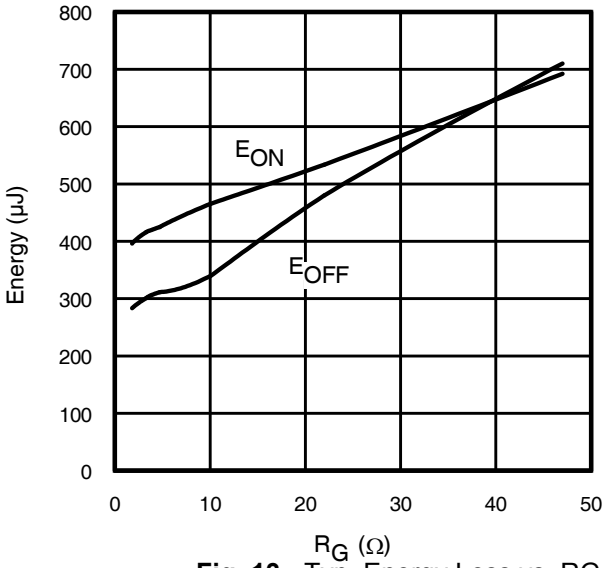


Fig. 13 - Typ. Energy Loss vs. RG
T_J = 125°C; L = 200µH; V_{CE} = 390V, I_{CE} = 22A; V_{GE} = 15V
Diode clamp used: 30ETH06 (See C.T.3)

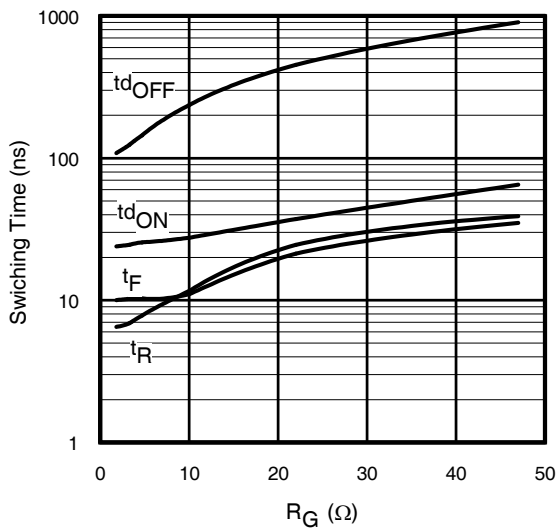


Fig. 14 - Typ. Switching Time vs. R_G
T_J = 125°C; L = 200µH; V_{CE} = 390V, I_{CE} = 22A; V_{GE} = 15V
Diode clamp used: 30ETH06 (See C.T.3)

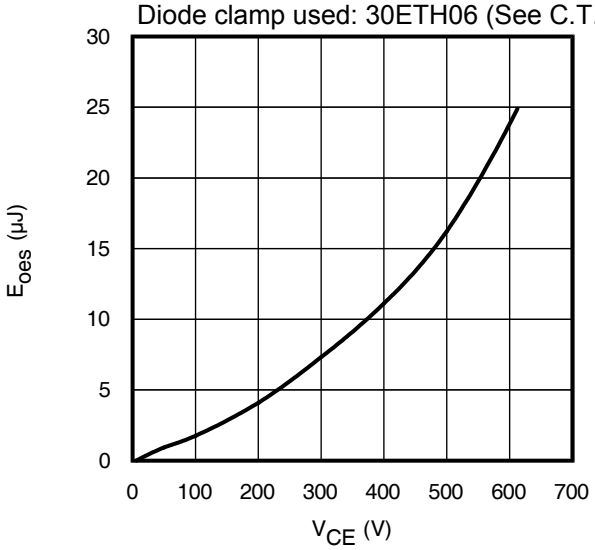


Fig. 15 - Typ. Output Capacitance Stored Energy vs. V_{CE}

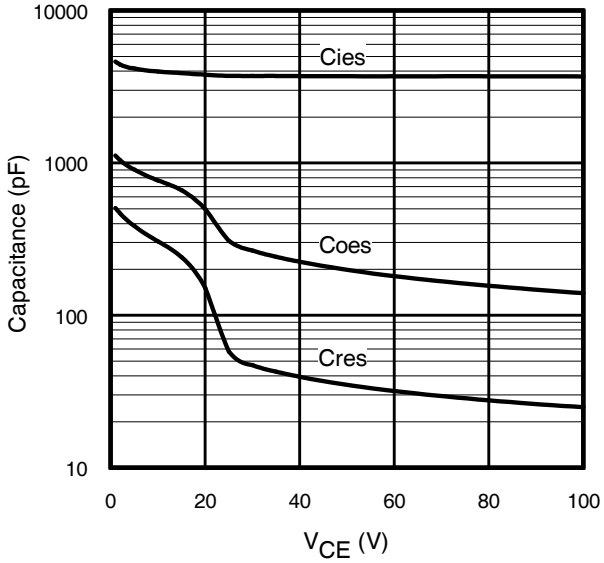


Fig. 16 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

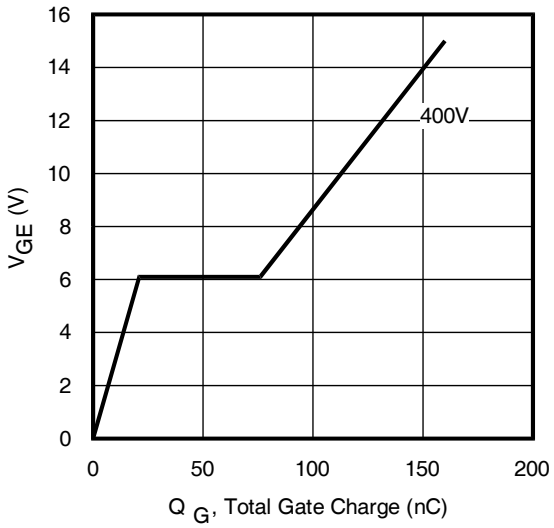


Fig. 17 - Typical Gate Charge vs. V_{GE}
I_{CE} = 22A

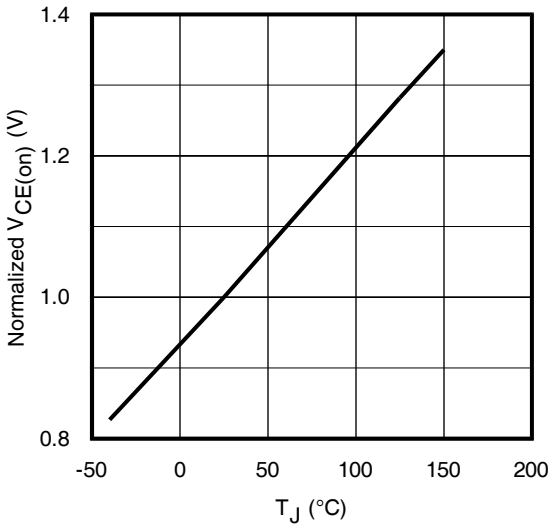


Fig. 18 Normalized Typ. $V_{CE(on)}$ vs. Junction Temperature
I_C = 22A, V_{GE}= 15V

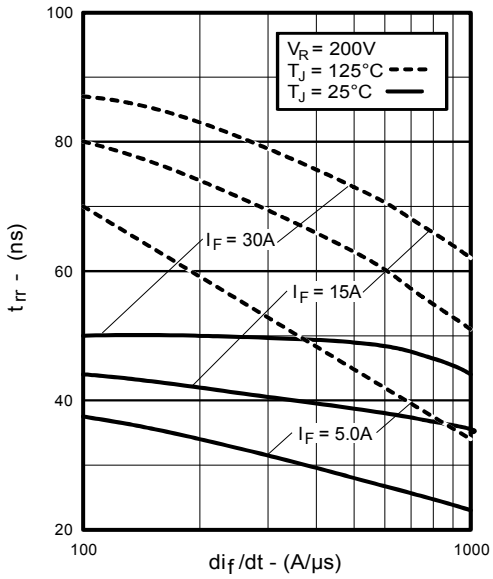


Fig. 19 - Typical Reverse Recovery vs. dif/dt

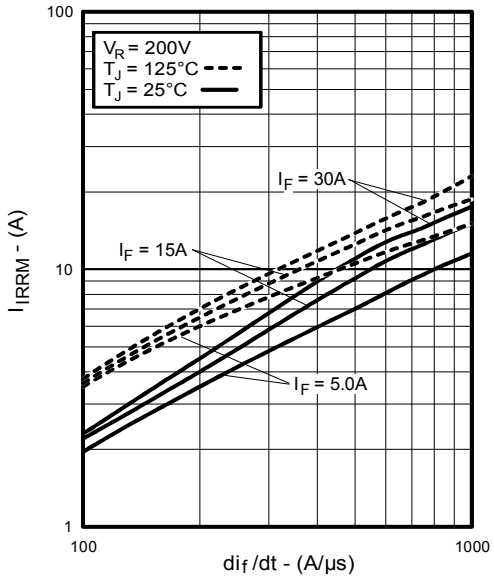


Fig. 20 - Typical Recovery Current vs. dif/dt

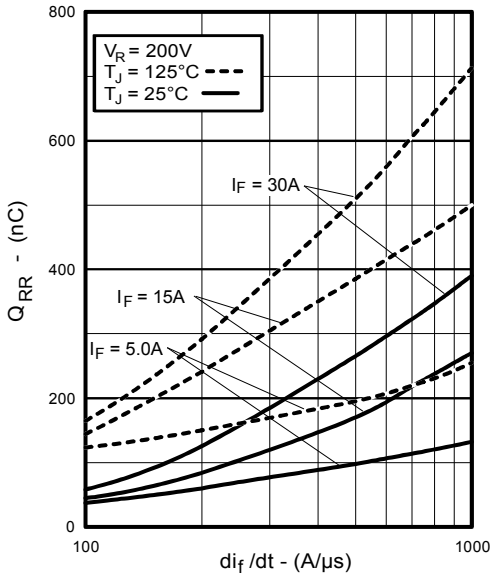


Fig. 21 - Typical Stored Charge vs. dif/dt

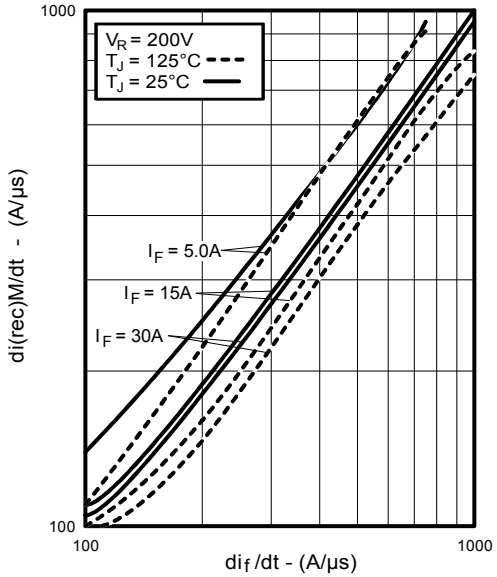


Fig. 22 - Typical di(rec)M/dt vs. dif/dt,

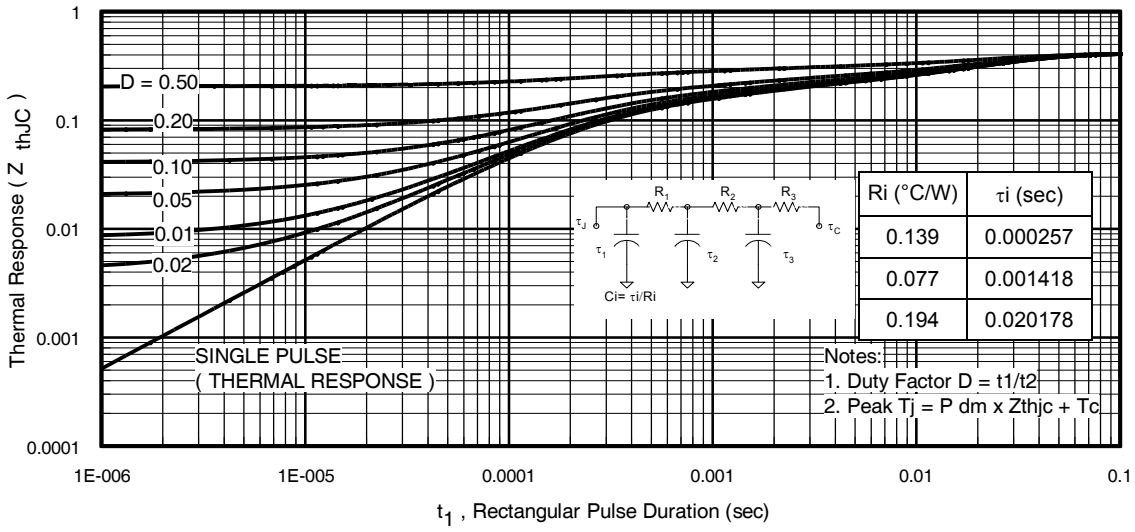


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

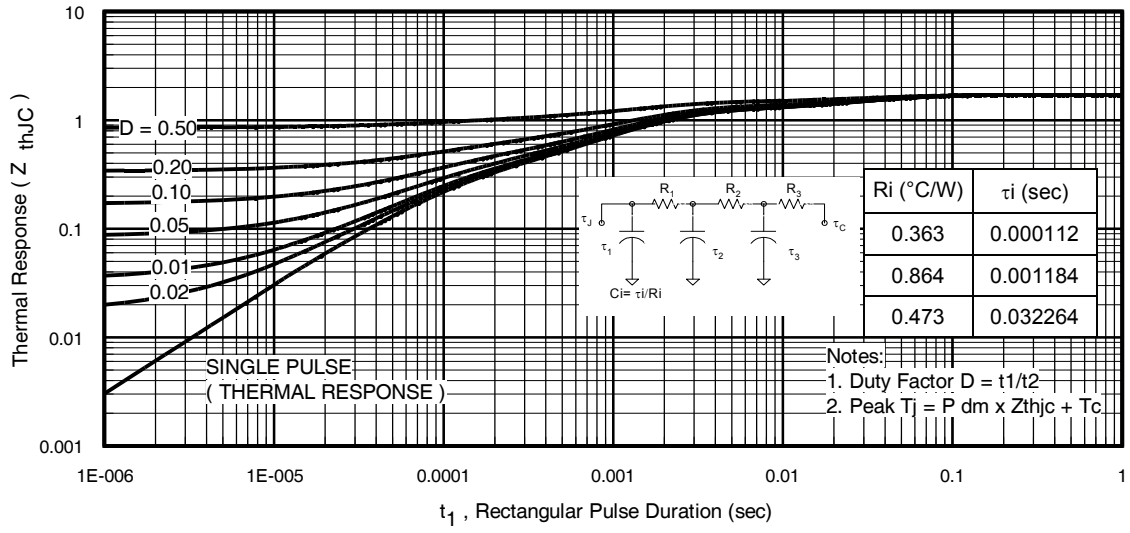


Fig 26. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

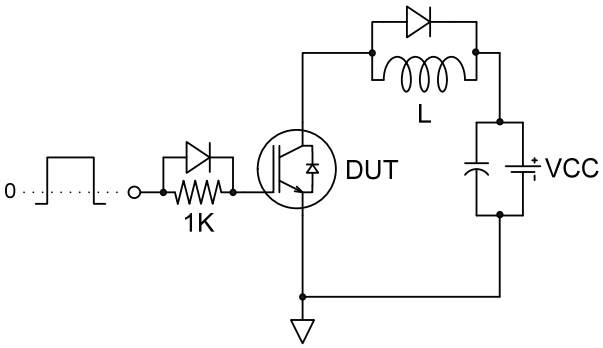


Fig.C.T.1 - Gate Charge Circuit (turn-off)

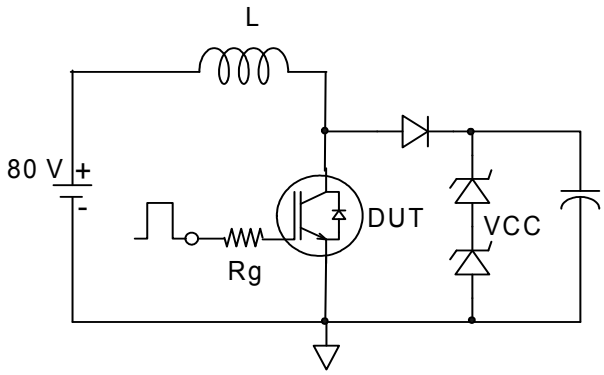


Fig.C.T.2 - RBSOA Circuit

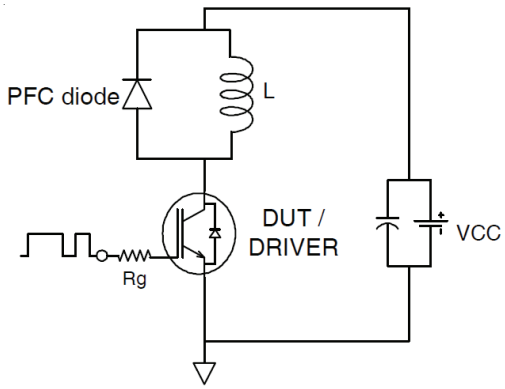


Fig.C.T.3 - Switching Loss Circuit

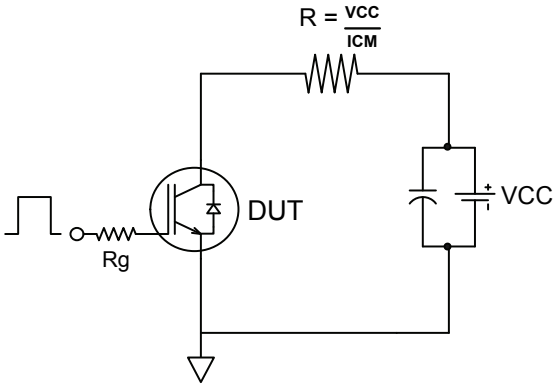


Fig.C.T.4 - Resistive Load Circuit

REVERSE RECOVERY CIRCUIT

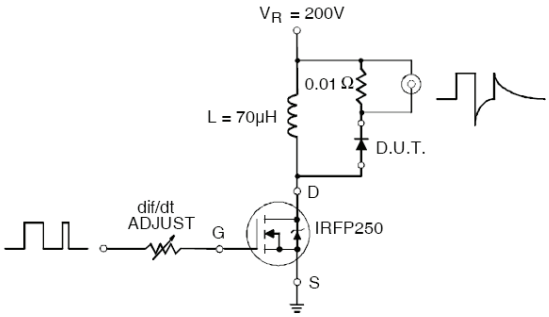


Fig.C.T.5 - Reverse Recovery Parameter Test Circuit

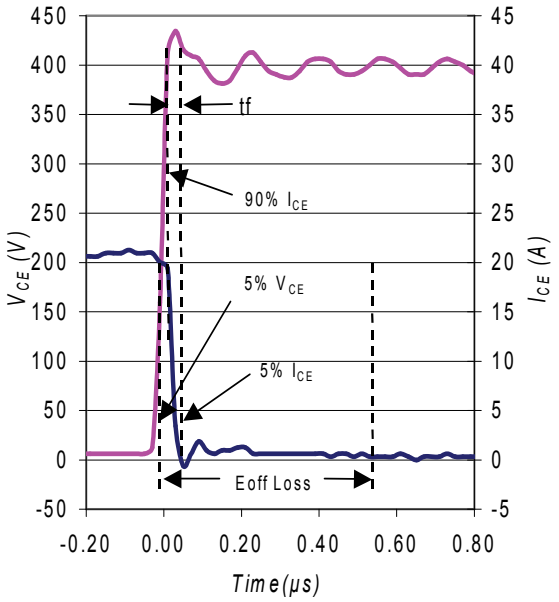


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 25°C using Fig. CT.3

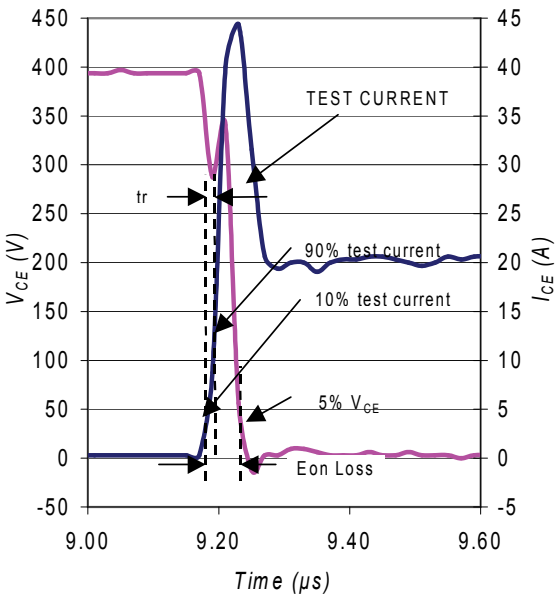
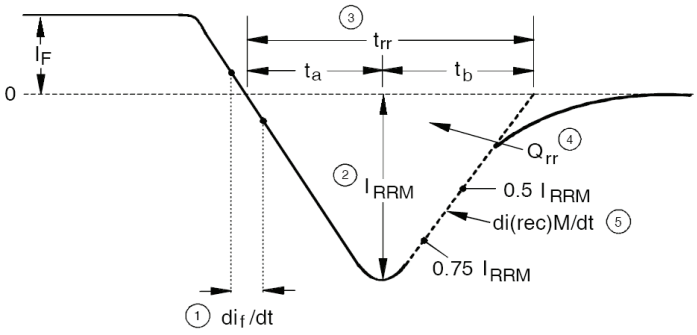


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 25°C using Fig. CT.3

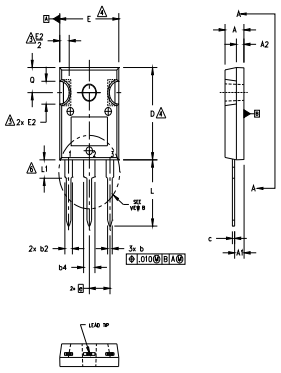


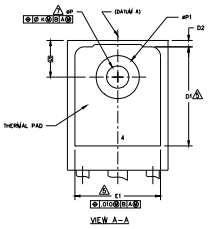
1. di_f/dt - Rate of change of current through zero crossing
2. I_{RRM} - Peak reverse recovery current
3. trr - Reverse recovery time measured from zero crossing point of negative going I_F to point where a line passing through 0.75 I_{RRM} and 0.50 I_{RRM} extrapolated to zero current
4. Q_{rr} - Area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

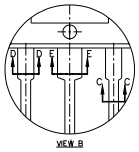
Fig. WF3 - Reverse Recovery Waveform and Definitions

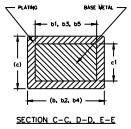
TO-247AC Package Outline

(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	
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

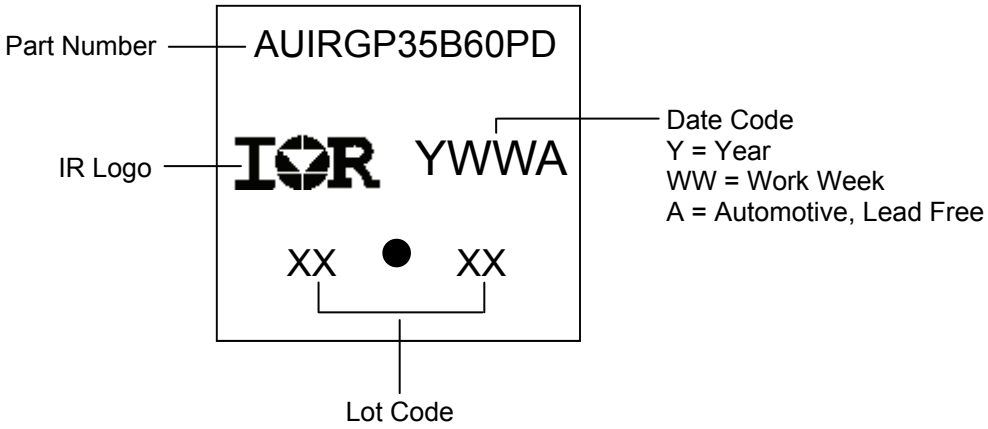
IGBTs, CoPACK

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.

Qualification Information

Qualification Level		Automotive (per AEC-Q101)	
		This part number(s) passed Automotive qualification. Infineon's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		TO-247	N/A
ESD	Machine Model	Class M4(+/- 425V)† AEC-Q101-002	
	Human Body Model	Class H2(+/- 4000V)† AEC-Q101-001	
	Charged Device Model	Class C5 (+/- 1125V)† AEC-Q101-005	
RoHS Compliant		Yes	

† Highest passing voltage.

Revision History

Date	Comments
8/24/2017	• Updated datasheet with corporate template • Corrected typo Qual table -Moisture Sensitivity Level-from "MSL1" to N/A-page 11 • Corrected part marking on pages 10

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