

CRG60T60AK3HD-VB Datasheet

600V Trench and Fieldstop IGBT

PRODUCT SUMMARY		
V _{CE} (V)	600	
I _C (A)	120 (T _C =25 °C)	60 (T _C =100 °C)
V _{CE (sat)} (V)	1.8	
I _{CM} (A)	180	

FEATURES

- Very Low V_{CEsat}
- Low turn-off losses
- High speed switching
- Maximum junction temperature 175°C
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Telecommunications
 - Server and telecom power supplies
- Lighting
 - High-intensity discharge (HID)
 - Fluorescent ballast lighting
- Consumer and computing
 - ATX power supplies
- Industrial
 - Welding
 - Battery chargers
- Renewable energy
 - Solar (PV inverters)
- Switch mode power supplies (SMPS)

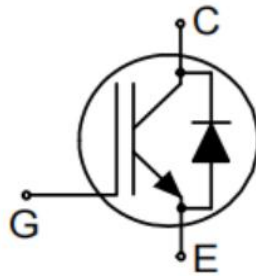
Package pin definition

- Pin1 G - Gate
- Pin2 C & backside - Collector
- Pin3 E - Emitter

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Top View



ABSOLUTE MAXIMUM RATINGS (T _C = 25 °C, unless otherwise noted)					
PARAMETER		SYMBOL	LIMIT	UNIT	
Collector-Emitter Voltage		V _{CE}	600	V	
Gate-Emitter Voltage		V _{GE}	±30		
Continuous Collector Current (T _J = 150 °C)	V _{GE} at 15 V	I _C	T _C = 25 °C	120	A
			T _C = 100 °C	60	
Pulsed Collector Current ^a		I _{CM}	180		
Diode Forward Current ^b		I _F	60	A	
Maximum Power Dissipation		P _D	T _C = 25 °C	319	W
			T _C = 100 °C	159	W
Operating Junction and Storage Temperature Range		T _J , T _{stg}	-55 to +175	°C	
Short Circuit Withstand Time ^{TC=150}	V _{GE} = 15V, V _{CE} 400V	t _{sc}	3	µs	
Short Circuit Withstand Time ^{TC=100}	V _{GE} = 15V, V _{CE} 330V		5		
Soldering Recommendations (Peak Temperature) ^c	for 10 s		260	°C	

Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- Current limited by maximum junction temperature.
- 1.6 mm from case.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	40	°C/W
Maximum Junction-to-Case	R_{thJC}	-	0.5	

SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Collector-Emitter Breakdown Voltage	BV_{CE}	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$ $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$		600 600	- -	- -	V
Gate-Source Threshold Voltage (N)	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_D = 250\text{ }\mu\text{A}$		4	5	6	V
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE} = 600\text{ V}, V_{GE} = 0\text{ V}, T_J = 25\text{ }^\circ\text{C}$		-	1	20	μA
		$V_{CE} = 600\text{ V}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	1000	-	μA
Gate-Emitter Leakage Current	I_{GES}	$V_{CE} = 0\text{ V}, V_{GS} = \pm 2\text{ V}$		-	-	100	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}$	$I_C = 60\text{ A}$	-	1.8	2.1	V
Forward Transconductance	g_{fs}	$V_{CE} = 20\text{ V}, I_C = 60\text{ A}$		-	17	-	S
Dynamic							
Input Capacitance	C_{ies}	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V},$ $f = 500\text{ KHz}$		-	6800	-	pF
Output Capacitance	C_{oes}			-	198	-	
Reverse Transfer Capacitance	C_{res}			-	138	-	
Turn-on Energy	E_{on}	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 60\text{ A}, R_g = 10\Omega$		-	11	-	nJ
Turn-off Energy	E_{off}			-	0.9	-	
Total Gate Charge	Q_g	$V_{GE} = 20\text{ V}$	$I_C = 60\text{ A}, V_{CE} = 400\text{ V}$	-	253	-	nC
Gate-Emitter Charge	Q_{ge}			-	75	-	
Gate to Collector Charge	Q_{gc}			-	130	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 60\text{ A}, R_g = 10\Omega$		-	62	-	ns
Rise Time	t_r			-	48	-	
Turn-Off Delay Time	$t_{d(off)}$			-	186	-	
Fall Time	t_f			-	31	-	
Internal emitter inductance measured 5 mm	L_E			-	13	-	
Diode Characteristics							
Diode Forward Current	I_F	IGBT symbol showing the integral reverse junction diode		-	-	60	A
Pulsed Diode Forward Current	I_{FM}			-	-	180	
Diode Forward Voltage	V_F	$I_F = 60\text{ A}$		-	1.65	2.0	V
Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = 60\text{ A},$ $dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}$		-	70	-	ns
Reverse Recovery Charge	Q_{rr}			-	0.48	-	μC
Reverse Recovery Current	I_{RRM}			-	8	-	A



Figure 1. **Forward bias safe operating area**
($D=0$, $T_C=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$.
Recommended use at $V_{GE}\geq 7.5\text{V}$)



Figure 2. **Power dissipation as a function of case temperature**
($T_{vj}\leq 175^\circ\text{C}$)



Figure 3. **Collector current as a function of case temperature**



Figure 4. **Typical output characteristic**



Figure 5. Typical output characteristic ($T_{vj}=150^{\circ}\text{C}$)



Figure 6. Typical transfer characteristic ($V_{CE}=20\text{V}$)



Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature



Figure 8. Typical switching times as a function of collector current

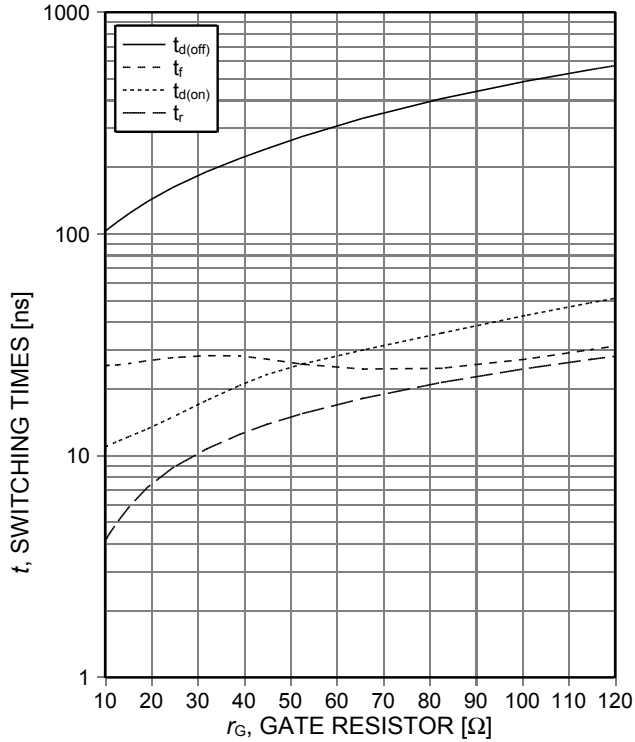


Figure 9. Typical switching times as a function of gate resistor

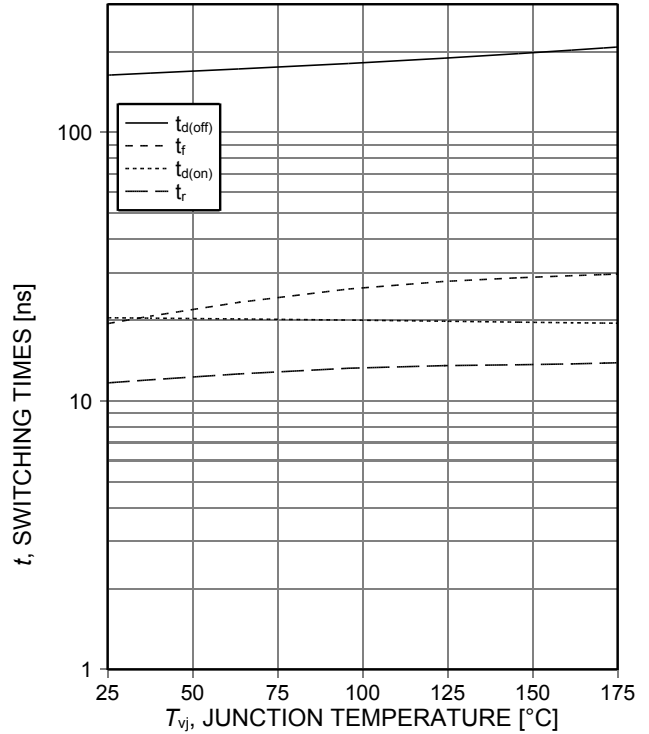


Figure 10. Typical switching times as a function of junction temperature



Figure 11. Gate-emitter threshold voltage as a function of junction temperature



Figure 12. Typical switching energy losses as a function of collector current



Figure 13. Typical switching energy losses as a function of gate resistor



Figure 14. Typical switching energy losses as a function of junction temperature



Figure 15. Typical switching energy losses as a function of collector emitter voltage



Figure 16. Typical gate charge



Figure 17. Typical capacitance as a function of collector-emitter voltage

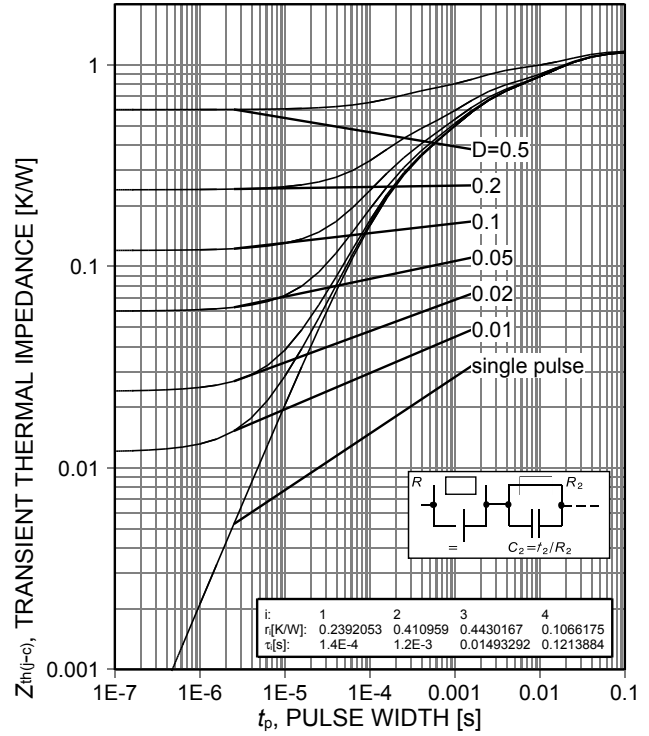


Figure 18. IGBT transient thermal impedance

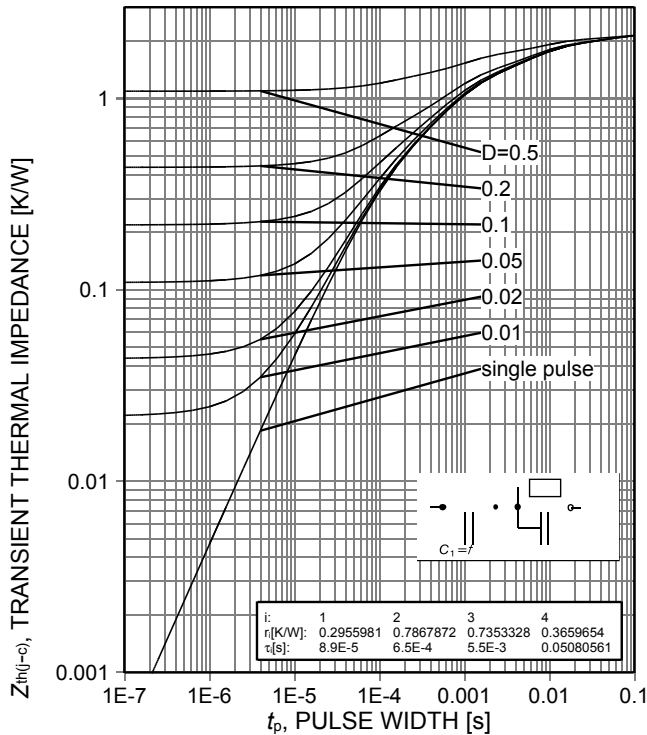


Figure 19. Diode transient thermal impedance as a function of pulse width

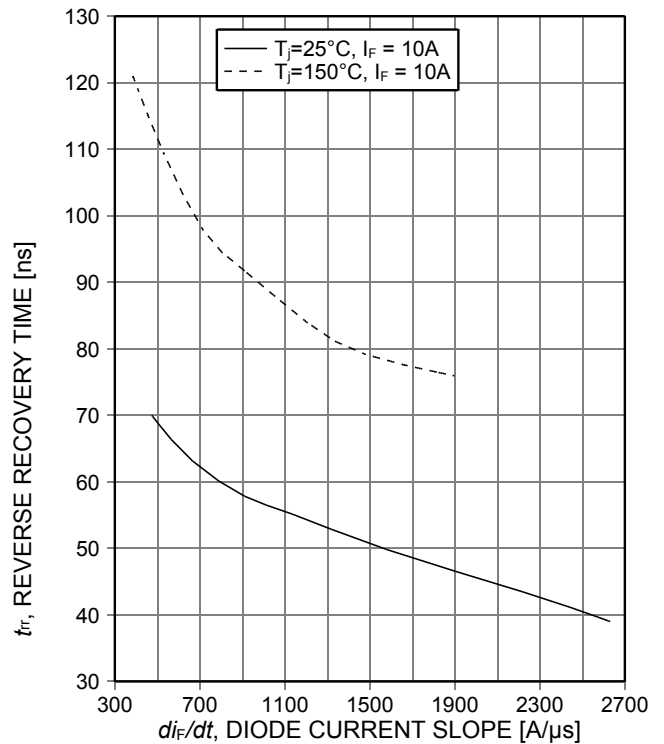
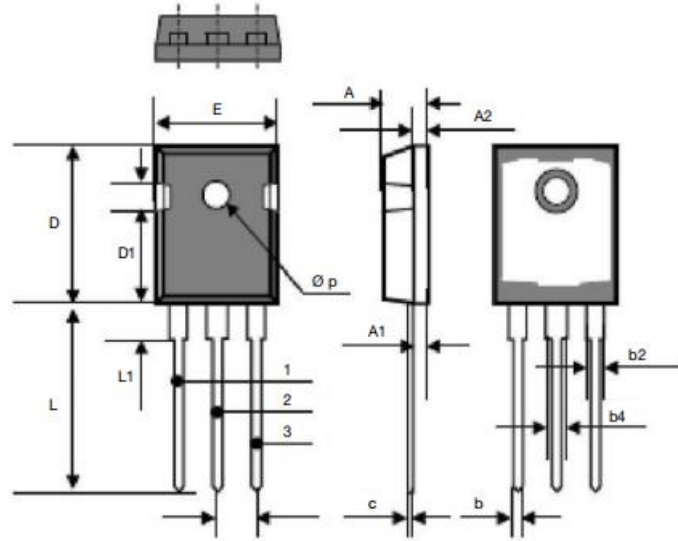


Figure 20. Typical reverse recovery time as a function of diode current slope

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DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.70	5.31	0.185	0.209
A1	2.21	2.59	0.087	0.102
A2	1.50	2.49	0.059	0.098
b	0.99	1.40	0.039	0.055
b2	1.65	2.41	0.065	0.095
b4	2.59	3.43	0.102	0.135
c	0.61 BSC		0.024 BSC	
D	20.80	21.46	0.819	0.845
D1	3.68	5.49	0.145	0.216
(e)	5.46 BSC		0.215 BSC	
E	15.49	16.26	0.610	0.640
L	19.81	20.32	0.780	0.800
L1	4.06	4.50	0.160	0.177
$\varnothing p$	3.51	3.66	0.138	0.144

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