

## FGH60N60SMD-VB Datasheet

### 650V Trench and Fieldstop IGBT

PRODUCT SUMMARY	
V <sub>CE</sub> (V)	650
I <sub>C</sub> (A)	120 (TC=25 °C) / 60 (TC=100 °C)
V <sub>CE (sat)</sub> (V)	1.7
I <sub>CM</sub> (A)	180

#### FEATURES

- Very Low V<sub>CEsat</sub>
- Low turn-off losses
- High speed switching
- Maximum junction temperature 175°C
- Ultra low gate charge (Q<sub>g</sub>)
- Avalanche energy rated (UIS)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

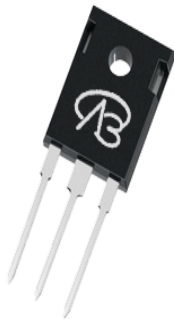
#### APPLICATIONS

- 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)

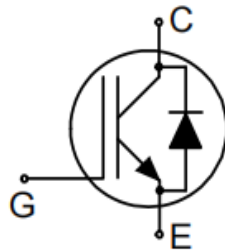
#### Package pin definition

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

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Top View



ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Collector-Emitter Voltage		V <sub>CE</sub>	650	V
Gate-Emitter Voltage		V <sub>GE</sub>	±30	
Continuous Collector Current (T <sub>J</sub> = 150 °C)	V <sub>GE</sub> at 15 V	I <sub>C</sub>	T <sub>C</sub> = 25 °C	120
			T <sub>C</sub> = 100 °C	60
Pulsed Collector Current <sup>a</sup>		I <sub>CM</sub>	180	A
Diode Forward Current <sup>b</sup>		I <sub>F</sub>	60	A
Maximum Power Dissipation		P <sub>D</sub>	T <sub>C</sub> = 25 °C	450
			T <sub>C</sub> = 100 °C	200
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	-55 to +175	°C
Short Circuit Withstand Time <sup>TC=150</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 400V	t <sub>sc</sub>	3	µs
Short Circuit Withstand Time <sup>TC=100</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 330V		5	
Soldering Recommendations (Peak Temperature) <sup>c</sup>	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
<b>Static</b>							
Collector-Emitter Breakdown Voltage	$BV_{CE}$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$ $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$		650 650	- -	- -	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	$I_{CES}$	$V_{CE} = 650\text{ V}, V_{GE} = 0\text{ V}, T_J = 25\text{ }^\circ\text{C}$		-	1	20	$\mu\text{A}$
		$V_{CE} = 650\text{ V}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	1000	-	$\mu\text{A}$
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	$g_{fs}$	$V_{CE} = 20\text{ V}, I_C = 60\text{ A}$		-	40	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V},$ $f = 500\text{ KHz}$		-	6210	-	pF
Output Capacitance	$C_{oes}$			-	228	-	
Reverse Transfer Capacitance	$C_{res}$			-	60	-	
Turn-on Energy	$E_{on}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 60\text{ A}, R_g = 10\Omega$		-	0.76	-	nJ
Turn-off Energy	$E_{off}$			-	0.26	-	
Total Gate Charge	$Q_g$	$V_{GE} = 15\text{ V}$	$I_C = 60\text{ A}, V_{CE} = 400\text{ V}$	-	165	-	nC
Gate-Emitter Charge	$Q_{ge}$			-	18	-	
Gate to Collector Charge	$Q_{gc}$			-	2 3	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 60\text{ A}, R_g = 10\Omega$		-	72	-	ns
Rise Time	$t_r$			-	42	-	
Turn-Off Delay Time	$t_{d(off)}$			-	170	-	
Fall Time	$t_f$			-	26	-	
Internal emitter inductance measured 5 mm	$L_E$			-	13	-	
<b>Diode Characteristics</b>							
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	$V_F$	$I_F = 60\text{ A}$		-	1.50	2.0	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 60\text{ A},$ $dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}$		-	60	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	0.3	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	11	-	A

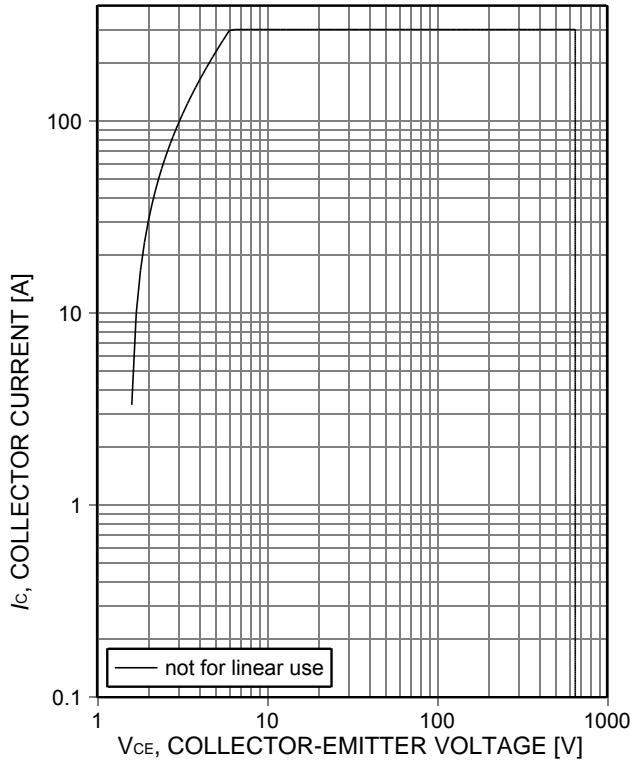


Figure 1. Forward bias safe operating area



Figure 2. Power dissipation as a function of case

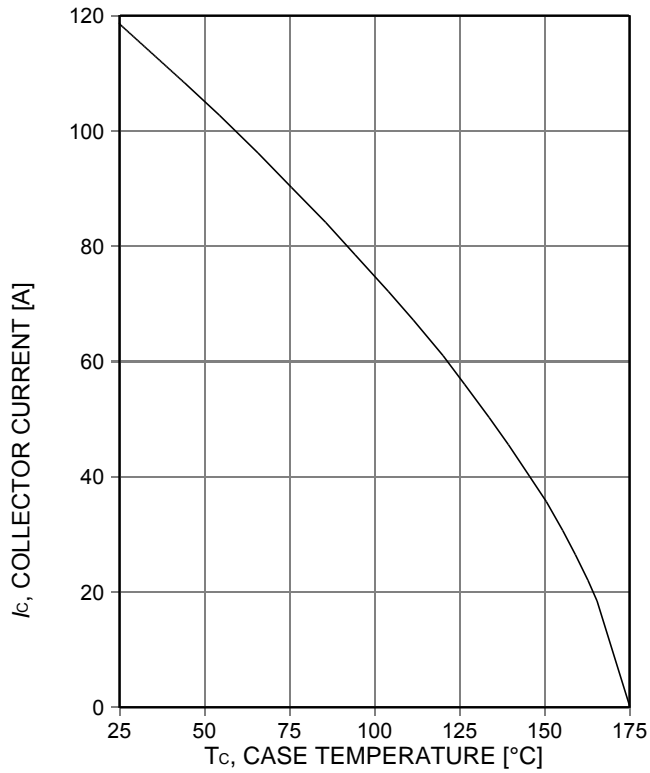


Figure 3. Collector current as a function of case temperature



Figure 4. Typical output characteristic



Figure 5. Typical output characteristic



Figure 6. Typical transfer characteristic

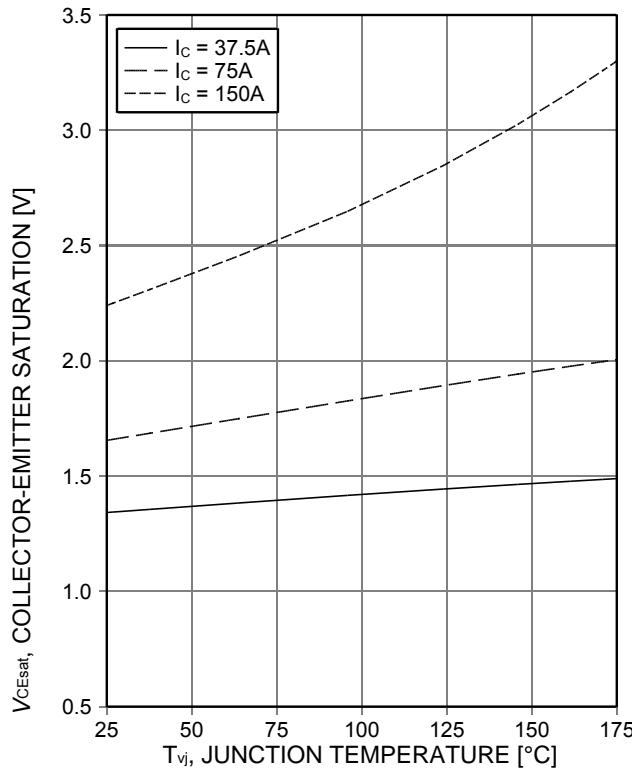


Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature

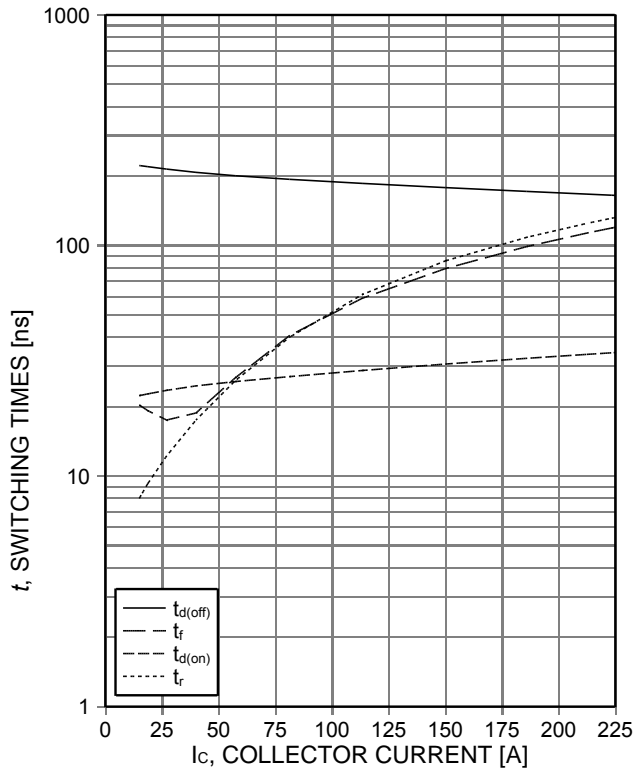


Figure 8. Typical switching times as a function of collector current

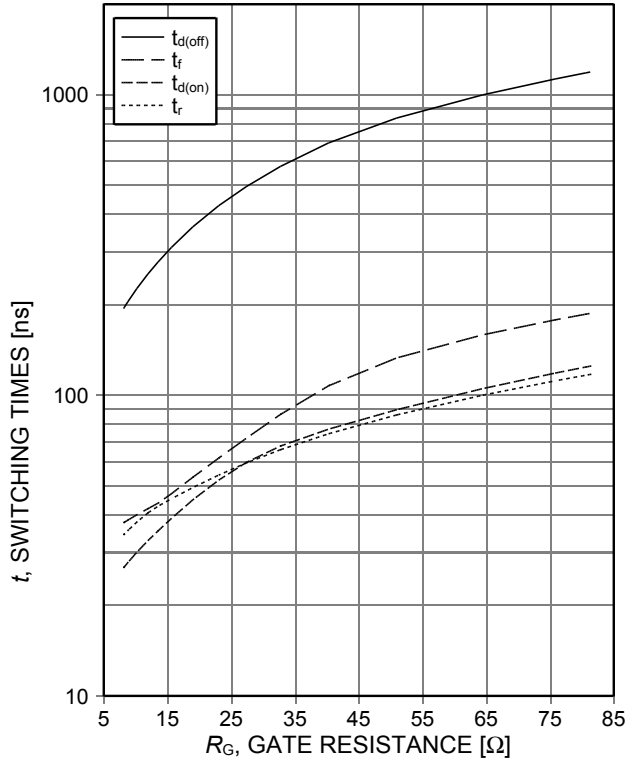


Figure 9. Typical switching times as a function of gate resistance

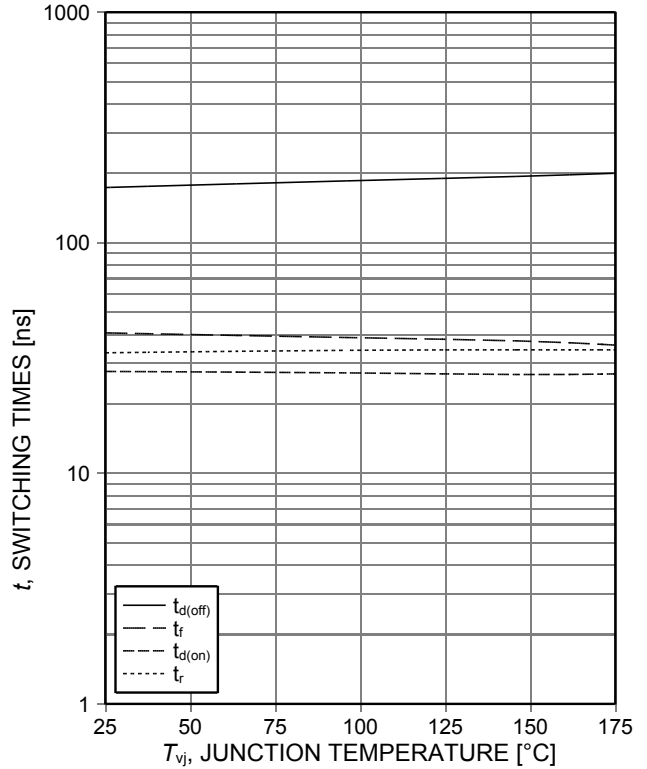


Figure 10. Typical switching times as a function of junction temperature

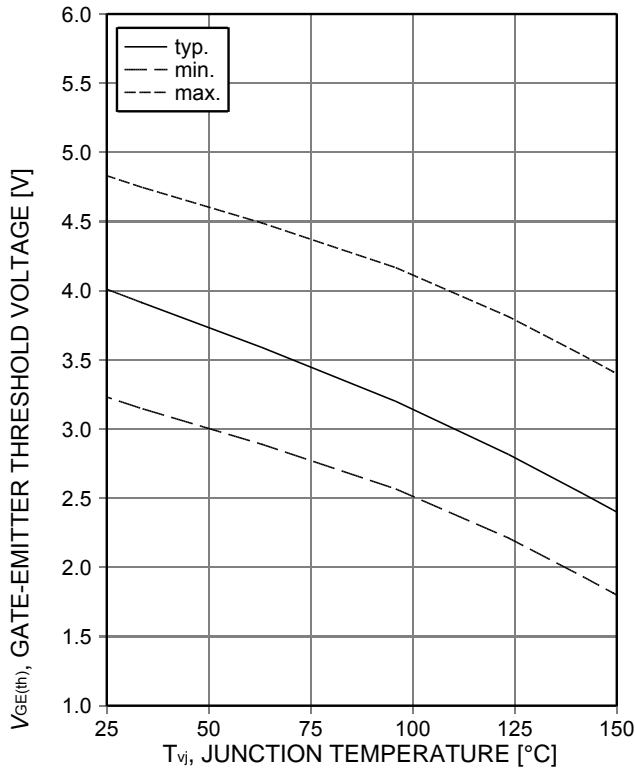


Figure 11. Gate-emitter threshold voltage as a function of junction temperature

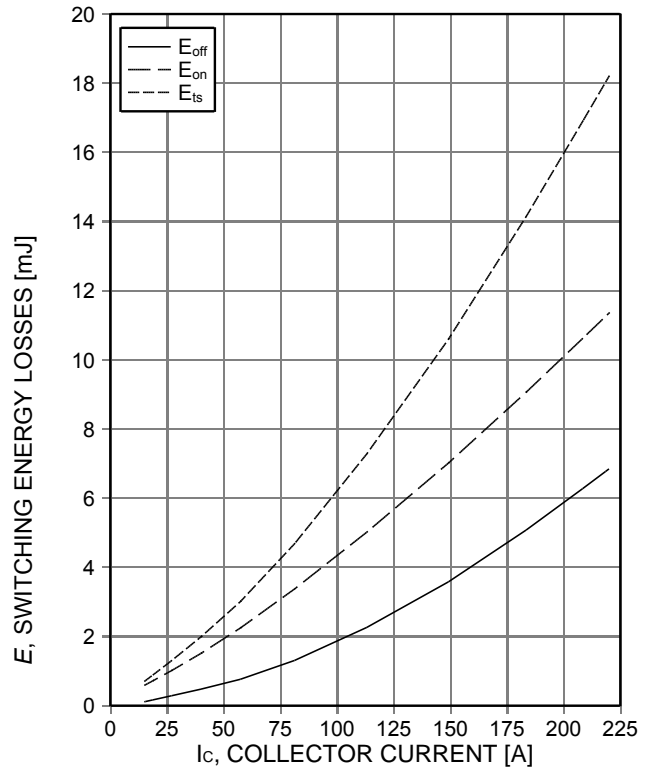


Figure 12. Typical switching energy losses as a function of collector current



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



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

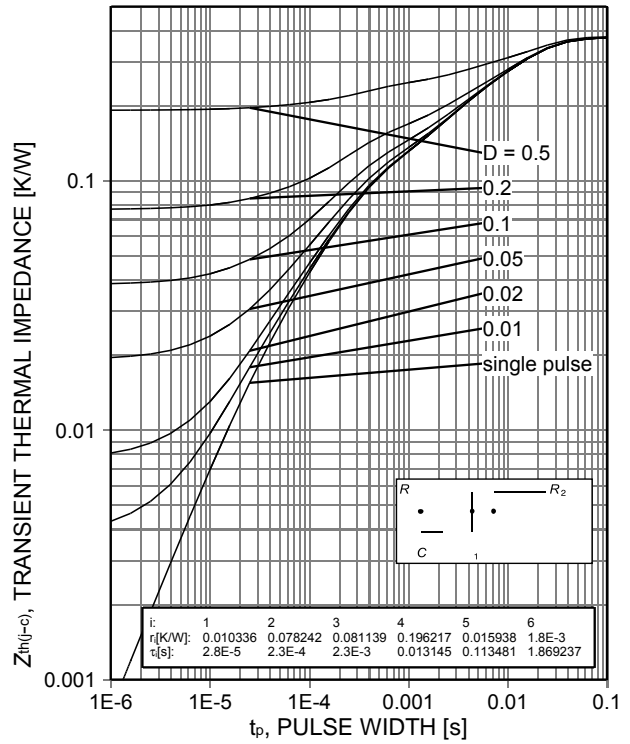


Figure 18. IGBT transient thermal impedance

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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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