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March 2015

### FGB20N60SFD 600 V, 20 A Field Stop IGBT

### **Features**

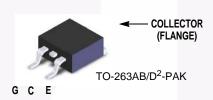
- High Current Capability
- Low Saturation Voltage: V<sub>CE(sat)</sub> = 2.2 V @ I<sub>C</sub> = 20 A
- High Input Impedance
- Fast Switching : E<sub>OFF</sub> = 8 uJ/A
- · RoHS Compliant

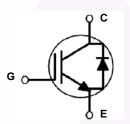
### **Applications**

• Solar Inverter, UPS, Welder, PFC

### **General Description**

Using novel field stop IGBT technology, Fairchild's field stop IGBTs offer the optimum performance for solar inverter, UPS, welder and PFC applications where low conduction and switching losses are essential.





### **Absolute Maximum Ratings**

Symbol	Description		Ratings	Unit
V <sub>CES</sub>	Collector to Emitter Voltage		600	V
V	Gate to Emitter Voltage Transient Gate-to-Emitter Voltage		±20	V
$V_{GES}$			±30	V
I <sub>C</sub>	Collector Current	@ T <sub>C</sub> = 25°C	40	A
ic	Collector Current	$@ T_C = 100^{\circ}C$	20	А
I <sub>CM (1)</sub>	Pulsed Collector Current @ T <sub>C</sub> = 25°C		60	А
I <sub>F</sub>	Diode Forward Current	@ T <sub>C</sub> = 25°C	20	A
	Diode Forward Current @ T <sub>C</sub> = 100°C		10	A
I <sub>FM(1)</sub>	Pulsed Diode Maximum Forward Current		60	A
P <sub>D</sub>	Maximum Power Dissipation	@ T <sub>C</sub> = 25°C	208	W
٠.	Maximum Power Dissipation	@ T <sub>C</sub> = 100°C	83	W
T <sub>J</sub>	Operating Junction Temperature		-55 to +150	°C
T <sub>stg</sub>	Storage Temperature Range		-55 to +150	°C
T <sub>L</sub>	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds		300	°C

#### Notes

Repetitive rating: Pulse width limited by max. junction temperature

### **Thermal Characteristics**

Symbol	Parameter	Тур.	Max.	Unit
$R_{\theta JC}(IGBT)$	Thermal Resistance, Junction to Case	-	0.6	°C/W
$R_{\theta JC}(Diode)$	Thermal Resistance, Junction to Case	-	2.6	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (PCB Mount)(2)	-	40	°C/W

Notes: 2: Mounted on 1" square PCB (FR4 or G-10 material)

### **Package Marking and Ordering Information**

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGB20N60SFD	FGB20N60SFD	D <sup>2</sup> -PAK	Reel	13" Dia	N/A	800

### Electrical Characteristics of the IGBT $T_C = 25$ °C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
Off Charac	teristics					
BV <sub>CES</sub>	Collector to Emitter Breakdown Voltage	$V_{GE} = 0 \text{ V}, I_{C} = 250 \mu\text{A}$	600	-	-	V
ΔBV <sub>CES</sub>	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0 \text{ V}, I_{C} = 250 \mu\text{A}$	-	0.6	-	V/°C
I <sub>CES</sub>	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0 V$	-	-	250	μΑ
I <sub>GES</sub>	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0 V$	-	-	±400	nA
On Charac	teristics					
V <sub>GE(th)</sub>	G-E Threshold Voltage	$I_C = 250  \mu A,  V_{CE} = V_{GE}$	4.0	5.0	6.5	V
		I <sub>C</sub> = 20 A, V <sub>GE</sub> = 15 V	-	2.2	2.8	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	$I_C = 20 \text{ A}, V_{GE} = 15 \text{ V},$ $T_C = 125^{\circ}\text{C}$	-	2.4	-	V
Dynamic C	Characteristics		1			
C <sub>ies</sub>	Input Capacitance		_	940	-	pF
C <sub>oes</sub>	Output Capacitance	$V_{CE} = 30 \text{ V}, V_{GE} = 0 \text{ V},$	-	110	-	pF
C <sub>res</sub>	Reverse Transfer Capacitance	f = 1 MHz	-	40	-	pF
Switching	Characteristics					
t <sub>d(on)</sub>	Turn-On Delay Time		-	13	-	ns
t <sub>r</sub>	Rise Time		-	16	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{CC} = 400 \text{ V}, I_{C} = 20 \text{ A},$	-	90	-	ns
t <sub>f</sub>	Fall Time	$R_G = 10 \Omega$ , $V_{GE} = 15 V$ ,	-	24	48	ns
E <sub>on</sub>	Turn-On Switching Loss	Inductive Load, T <sub>C</sub> = 25°C	-	0.37	- //	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.16	- (	mJ
E <sub>ts</sub>	Total Switching Loss		_	0.53	-	mJ
t <sub>d(on)</sub>	Turn-On Delay Time		-	12	-	ns
t <sub>r</sub>	Rise Time		-	16	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{CC} = 400 \text{ V}, I_{C} = 20 \text{ A},$ $R_{G} = 10 \Omega, V_{GE} = 15 \text{ V},$	-	95	-	ns
t <sub>f</sub>	Fall Time		-	28	-	ns
E <sub>on</sub>	Turn-On Switching Loss	Inductive Load, T <sub>C</sub> = 125°C	-	0.4	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.28	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	0.69	-	mJ

### Electrical Characteristics of the IGBT $T_C = 25^{\circ}\text{C}$ unless otherwise noted

$Q_g$	Total Gate Charge		-	65	-	nC
Q <sub>ge</sub>	Gate to Emitter Charge	$V_{CE} = 400 \text{ V}, I_{C} = 20 \text{ A},$ $V_{GE} = 15 \text{ V}$	-	7	-	nC
Q <sub>qc</sub>	Gate to Collector Charge	*GE = 10 *	-	33	-	nC

### Electrical Characteristics of the Diode $T_C = 25^{\circ}C$ unless otherwise noted

Symbol	Parameter	Test Conditio	ns	Min.	Тур.	Max	Unit
V <sub>FM</sub>	Y <sub>FM</sub> Diode Forward Voltage	I <sub>F</sub> = IU A	$T_C = 25^{\circ}C$	-	1.9	2.5	V
FIM			$T_{\rm C} = 125^{\rm o}{\rm C}$	-	1.7	-	
t <sub>rr</sub>	Diode Reverse Recovery Time	- I <sub>F</sub> =10 A, di <sub>F</sub> /dt = 200 A/μs	$T_C = 25^{\circ}C$	-	34	-	ns
11			$T_{\rm C} = 125^{\rm o}{\rm C}$	-	57	-	
Q <sub>rr</sub>	Diode Reverse Recovery Charge	η - 10 / 1, αιρ/αι - 200 //μο	$T_C = 25^{\circ}C$	-	41	-	nC
~11	Diede Neveree Necestary Charge		$T_{\rm C} = 125^{\rm o}{\rm C}$	-	96	-	

Figure 1. Typical Output Characteristics

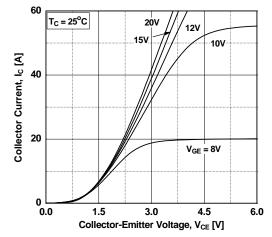


Figure 2. Typical Output Characteristics

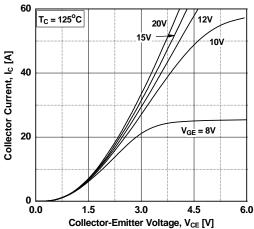
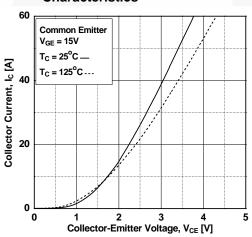


Figure 3. Typical Saturation Voltage Characteristics



**Figure 4. Transfer Characteristics** 

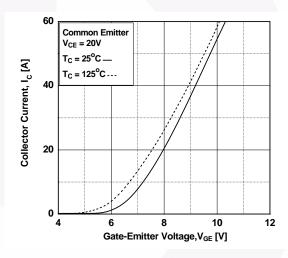


Figure 5. Saturation Voltage vs. Case
Temperature at Variant Current Level

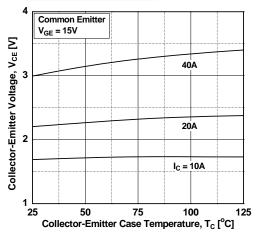


Figure 6. Saturation Voltage vs. V<sub>GE</sub>

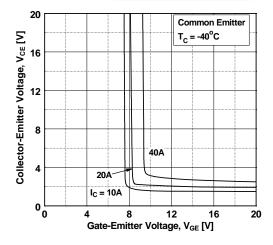


Figure 7. Saturation Voltage vs. V<sub>GE</sub>

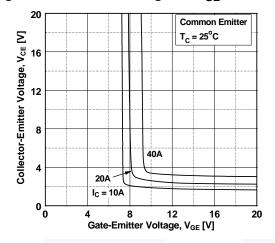


Figure 9. Capacitance Characteristics

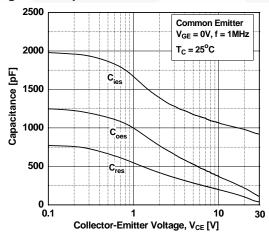


Figure 11. SOA Characteristics

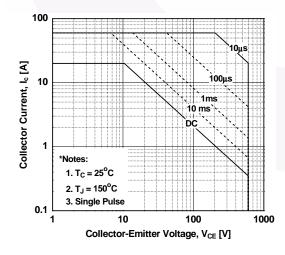


Figure 8. Saturation Voltage vs. V<sub>GE</sub>

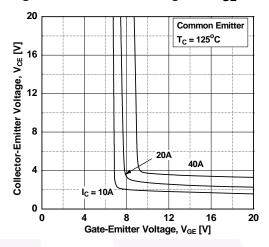


Figure 10. Gate charge Characteristics

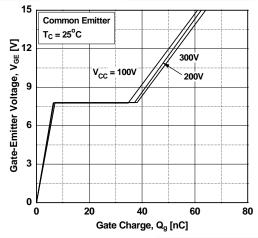


Figure 12. Turn-on Characteristics vs.
Gate Resistance

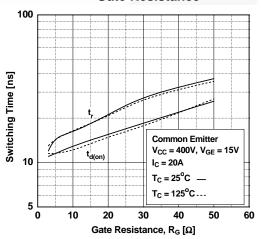


Figure 13. Turn-off Characteristics vs.
Gate Resistance

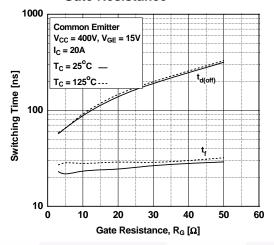


Figure 14. Turn-on Characteristics vs.
Collector Current

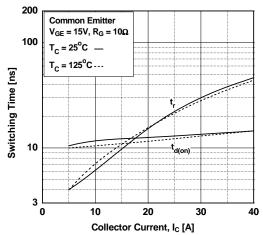


Figure 15. Turn-off Characteristics vs. Collector Current

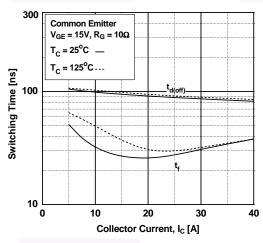


Figure 16. Switching Loss vs.
Gate Resistance

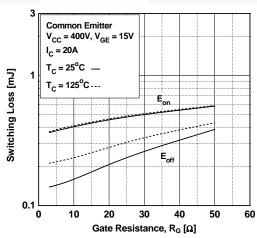


Figure 17. Switching Loss vs. Collector Current

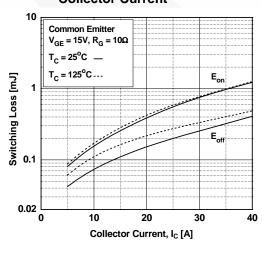


Figure 18. Turn off Switching SOA Characteristics

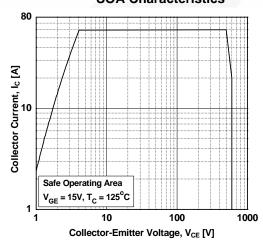


Figure 19. Forward Characteristics

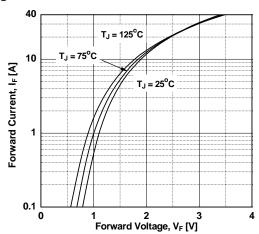


Figure 20. Reverse Current

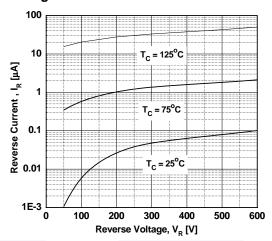


Figure 21. Stored Charge

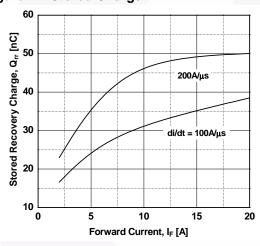


Figure 22. Reverse Recovery Time

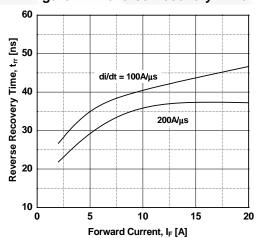
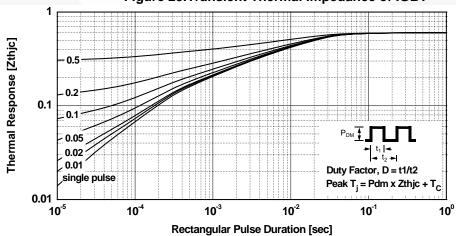


Figure 23. Transient Thermal Impedance of IGBT



### **Mechanical Dimensions**

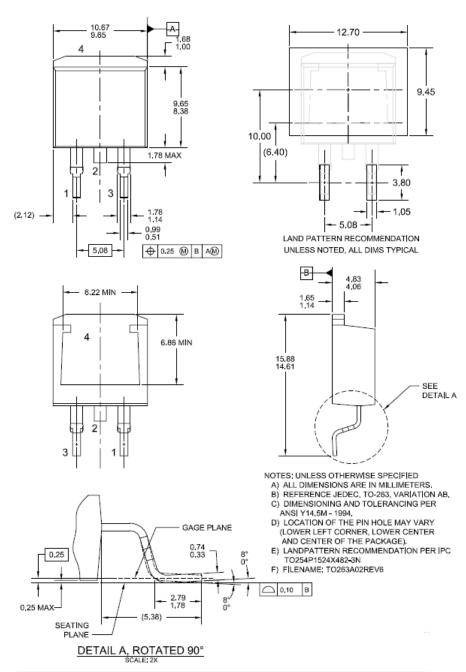


Figure 24. TO-263 2L (D2PAK) - 2LD, TO263, SURFACE MOUNT

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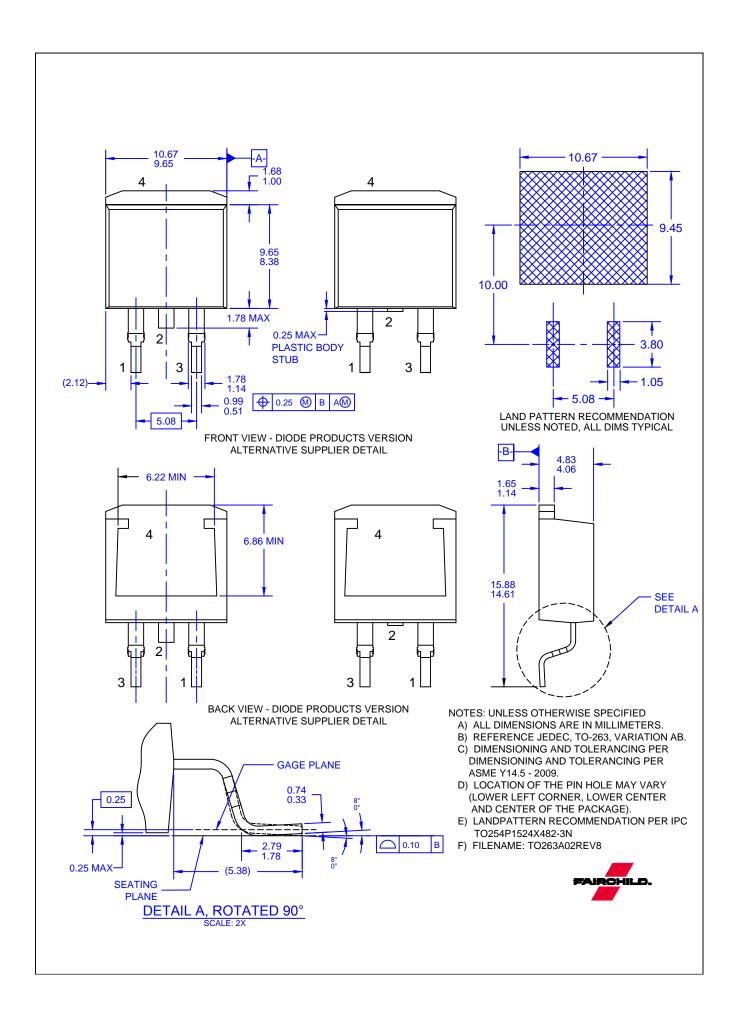
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