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March 2015

# FGH40N60SFD 600 V, 40 A Field Stop IGBT

#### **Features**

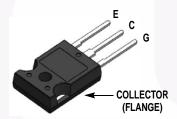
- High Current Capability
- Low Saturation Voltage: V<sub>CE(sat)</sub> = 2.3 V @ I<sub>C</sub> = 40 A
- High Input Impedance
- Fast Switching
- RoHS Compliant

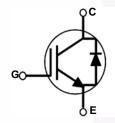
### **Applications**

Solar Inverter, UPS, Welder, PFC, Microwave Oven, Telecom, ESS

### **General Description**

Using novel field stop IGBT technology, Fairchild's field stop IGBTs offer the optimum performance for solar inverter, UPS, welder, microwave oven, telecom, ESS 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	
	Gate to Emitter Voltage	±20	- V		
V <sub>GES</sub>	Transient Gate-to-Emitter Voltage				±30
llo.	Collector Current	@ T <sub>C</sub> = 25°C	80	А	
IC	Collector Current	$@ T_C = 100^{\circ}C$	40	А	
I <sub>CM (1)</sub>	Pulsed Collector Current	@ T <sub>C</sub> = 25°C	120	Α	
P <sub>D</sub>	Maximum Power Dissipation	@ T <sub>C</sub> = 25°C	290	W	
י ט	Maximum Power Dissipation	$@ T_C = 100^{\circ}C$	116	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

1: 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	-	0.43	°C/W
$R_{\theta JC}(Diode)$	Thermal Resistance, Junction to Case	-	1.45	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	°C/W

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

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FGH40N60SFDTU	FGH40N60SFD	TO-247	Tube	N/A	N/A	30

### 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> / ΔT <sub>J</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	$I_{C} = 250 \mu\text{A},  V_{CE} = V_{GE}$	4.0	5.0	6.5	V
· GE(III)		I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V	_	2.3	2.9	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 125°C	-	2.5	-	V
Dynamic C	haracteristics					
C <sub>ies</sub>	Input Capacitance		-	2110	-	pF
C <sub>oes</sub>	Output Capacitance	$V_{CE} = 30 \text{ V}, V_{GE} = 0 \text{ V},$ f = 1  MHz	-	200	-	pF
C <sub>res</sub>	Reverse Transfer Capacitance	1 – 1 101112	-	60	-	pF
Switching	Characteristics					
t <sub>d(on)</sub>	Turn-On Delay Time		-	25	-	ns
t <sub>r</sub>	Rise Time		- /	42	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	V <sub>CC</sub> = 400 V, I <sub>C</sub> = 40 A,	-	115	-	ns
t <sub>f</sub>	Fall Time	$R_G = 10 \Omega$ , $V_{GE} = 15 V$ ,	-	27	54	ns
E <sub>on</sub>	Turn-On Switching Loss	Inductive Load, T <sub>C</sub> = 25°C	-	1.13	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.31	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	1.44	- /	mJ
t <sub>d(on)</sub>	Turn-On Delay Time		-	24	-	ns
t <sub>r</sub>	Rise Time		-	43	- \	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{CC} = 400 \text{ V}, I_{C} = 40 \text{ A},$	-	120	-	ns
t <sub>f</sub>	Fall Time	$R_G = 10 \Omega$ , $V_{GE} = 15 V$ ,	-	30	-	ns
E <sub>on</sub>	Turn-On Switching Loss	Inductive Load, T <sub>C</sub> = 125°C	-	1.14	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.48	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	1.62	-	mJ
$Q_g$	Total Gate Charge		-	120	-	nC
Q <sub>ge</sub>	Gate to Emitter Charge	$V_{CE} = 400 \text{ V}, I_{C} = 40 \text{ A},$ $V_{GF} = 15 \text{ V}$	-	14	-	nC
Q <sub>gc</sub>	Gate to Collector Charge	*GE = 10 *	-	58	-	nC

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

Symbol	Parameter	Test Conditions		Min.	Тур.	Max	Unit
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> = 20 A	$T_C = 25^{\circ}C$	-	1.95	2.6	V
FINI		1.5 = 2.7.	$T_{\rm C} = 125^{\rm o}{\rm C}$	-	1.85	-	
t <sub>rr</sub>		1 Ic =20 A. dic/dt = 200 A/us	$T_{\rm C} = 25^{\rm o}{\rm C}$	-	45	-	ns
YII			$T_{\rm C} = 125^{\rm o}{\rm C}$	-	140	-	
Q <sub>rr</sub>	Diode Reverse Recovery Charge		$T_{\rm C} = 25^{\rm o}{\rm C}$	ı	75	ì	nC
			$T_{\rm C} = 125^{\rm o}{\rm C}$	-	375	-	:

Figure 1. Typical Output Characteristics

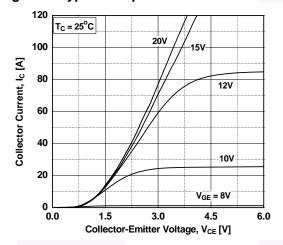


Figure 3. Typical Saturation Voltage Characteristics

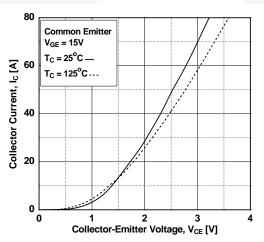
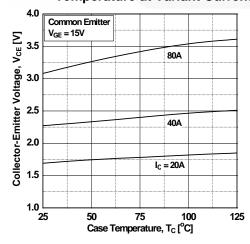


Figure 5. Saturation Voltage vs. Case
Temperature at Variant Current Level



**Figure 2. Typical Output Characteristics** 

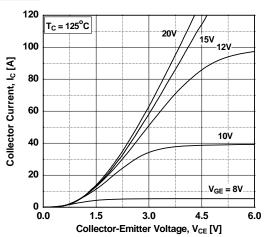


Figure 4. Transfer Characteristics

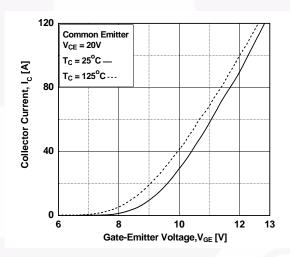


Figure 6. Saturation Voltage vs. V<sub>GE</sub>

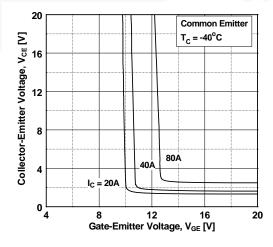


Figure 7. Saturation Voltage vs. V<sub>GE</sub>

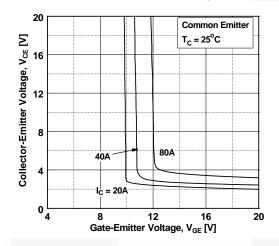


Figure 9. Capacitance Characteristics

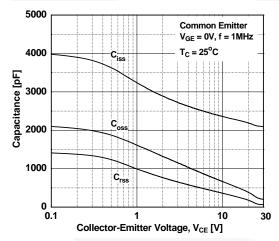


Figure 11. SOA Characteristics

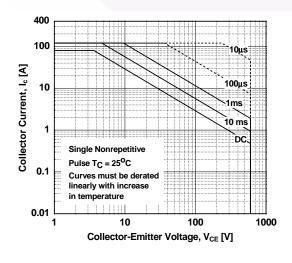


Figure 8. Saturation Voltage vs. V<sub>GE</sub>

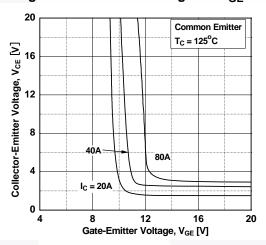


Figure 10. Gate charge Characteristics

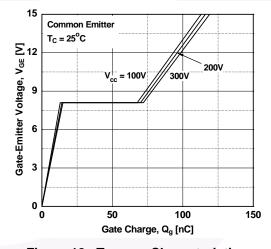


Figure 12. Turn-on Characteristics vs. Gate Resistance

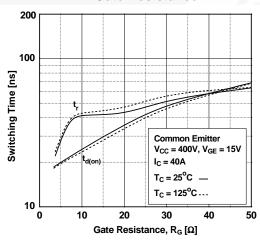


Figure 13. Turn-off Characteristics vs.
Gate Resistance

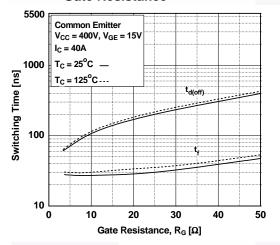


Figure 15. Turn-off Characteristics vs. Collector Current

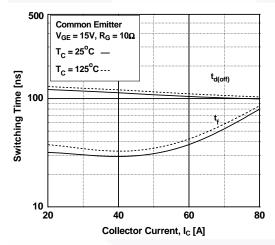


Figure 17. Switching Loss vs. Collector Current

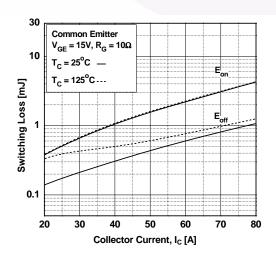


Figure 14. Turn-on Characteristics vs.
Collector Current

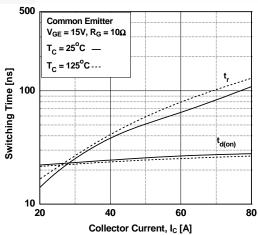


Figure 16. Switching Loss vs. Gate Resistance

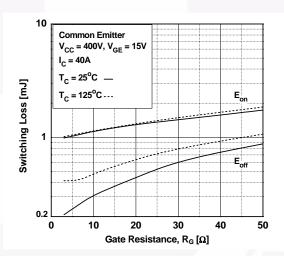


Figure 18. Turn off Switching SOA Characteristics

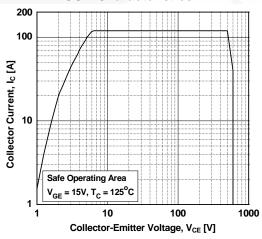


Figure 19. Forward Characteristics

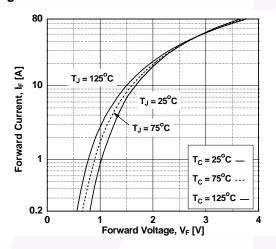


Figure 20. Reverse Current

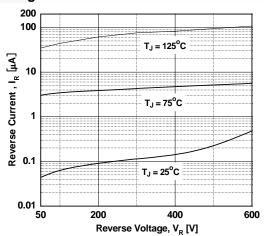


Figure 21. Stored Charge

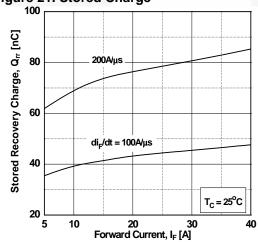


Figure 22. Reverse Recovery Time

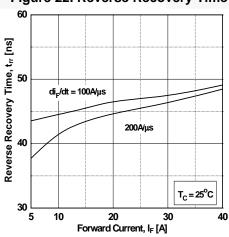
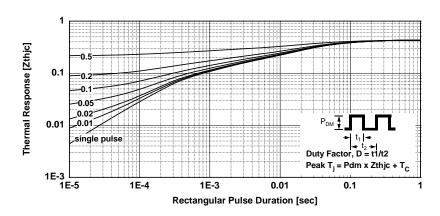
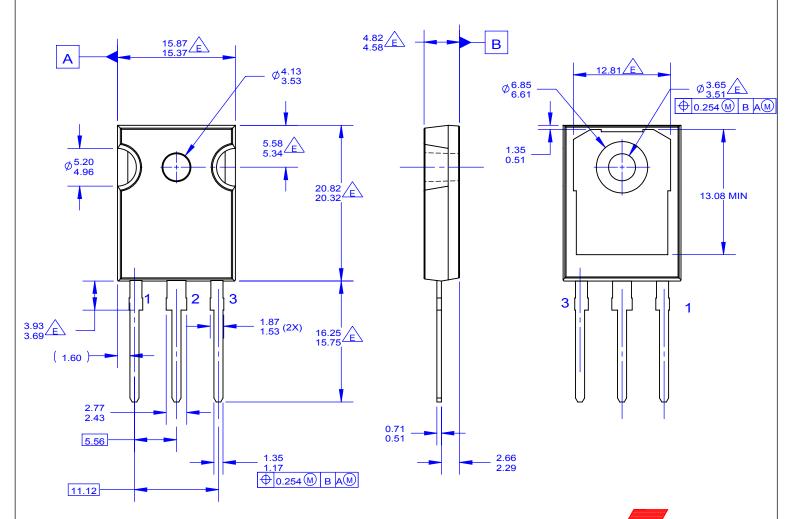


Figure 23. Transient Thermal Impedance of IGBT







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