

**April 2013** 

# FGH60N60SFD 600 V, 60 A Field Stop IGBT

### **Features**

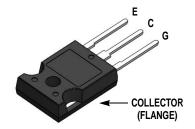
- · High Current Capability
- Low Saturation Voltage: V<sub>CE(sat)</sub> = 2.3 V @ I<sub>C</sub> = 60 A
- High Input Impedance
- Fast Switching
- RoHS Compliant

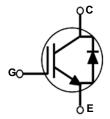
## **Applications**

• 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 <sub>GES</sub>	Gate to Emitter Voltage		± 20	V
I <sub>C</sub>	Collector Current	$^{\circ}$ T <sub>C</sub> = 25 $^{\circ}$ C	120	Α
·C	Collector Current	$@ T_C = 100^{\circ}C$	60	А
I <sub>CM (1)</sub>	Pulsed Collector Current	@ T <sub>C</sub> = 25°C	180	А
P <sub>D</sub>	Maximum Power Dissipation	$ T_C = 25^{\circ}C $	378	W
י ט	Maximum Power Dissipation	$@ T_C = 100^{\circ}C$	151	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 test, Pulse width limited by max. juntion temperature

## **Thermal Characteristics**

Symbol	Parameter	Тур.	Max.	Unit
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction to Case	-	0.33	°C/W
$R_{\theta JC}(Diode)$	Thermal Resistance, Junction to Case	-	1.1	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	°C/W

# **Package Marking and Ordering Information**

			Packaging		Max Qty
Device Marking	Device	Package	Type	Qty per Tube	per Box
FGH60N60SFD	FGH60N60SFDTU	TO-247	Tube	30ea	-

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

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
Off Charac	teristics					
BV <sub>CES</sub>	Collector to Emitter Breakdown Voltage	$V_{GE} = 0V, I_{C} = 250\mu A$	600	-	-	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	-	0.4	-	V/°C
I <sub>CES</sub>	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	-	-	250	μΑ
I <sub>GES</sub>	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	-	-	±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
02()		I <sub>C</sub> = 60A, V <sub>GE</sub> = 15V	-	2.3	2.9	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 60A, V <sub>GE</sub> = 15V, T <sub>C</sub> = 125°C	-	2.5	-	V
Dynamic C	haracteristics			•		
C <sub>ies</sub>	Input Capacitance		-	2820	-	pF
C <sub>oes</sub>	Output Capacitance	$V_{CE} = 30V_{,} V_{GE} = 0V_{,}$ f = 1MHz	-	350	-	pF
C <sub>res</sub>	Reverse Transfer Capacitance	1 - 1101112	-	140	-	pF
Switching	Characteristics					
t <sub>d(on)</sub>	Turn-On Delay Time		-	22	-	ns
t <sub>r</sub>	Rise Time		-	42	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{CC}$ = 400V, $I_{C}$ = 60A, $R_{G}$ = 5 $\Omega$ , $V_{GE}$ = 15V, Inductive Load, $T_{C}$ = 25°C	-	134	-	ns
t <sub>f</sub>	Fall Time		-	31	62	ns
E <sub>on</sub>	Turn-On Switching Loss		-	1.79	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	0.67	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	2.46	-	mJ
t <sub>d(on)</sub>	Turn-On Delay Time		-	22	-	ns
t <sub>r</sub>	Rise Time		-	44	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{CC} = 400V, I_{C} = 60A,$	-	144	-	ns
t <sub>f</sub>	Fall Time	$R_G = 5\Omega$ , $V_{GE} = 15V$ ,	-	43	-	ns
E <sub>on</sub>	Turn-On Switching Loss	Inductive Load, T <sub>C</sub> = 125°C	-	1.88	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	1.0	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	2.88	-	mJ
Qg	Total Gate Charge		-	198	-	nC
Q <sub>ge</sub>	Gate to Emitter Charge	$V_{CE} = 400V, I_{C} = 60A,$ $V_{GF} = 15V$	-	22	-	nC
Q <sub>gc</sub>	Gate to Collector Charge	*GE = 10 V	-	106	-	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	Diode Forward Voltage	I <sub>E</sub> = 30A	$T_{\rm C} = 25^{\rm o}{\rm C}$	-	2.0	2.6	V
	2.000 Formara Formage		$T_{\rm C} = 125^{\rm o}{\rm C}$	-	1.8	-	
t <sub>rr</sub>	Diode Reverse Recovery Time	$I_{ES} = 30A$ , $\alpha I_{ES}/\alpha I = 200A/\mu S$	$T_{\rm C} = 25^{\rm o}{\rm C}$	-	47	-	ns
11			$T_{\rm C} = 125^{\rm o}{\rm C}$	-	179	-	
Q <sub>rr</sub> Diode Rever	Diode Reverse Recovery Charge		$T_C = 25^{\circ}C$	-	83	-	nC
			$T_{\rm C} = 125^{\rm o}{\rm C}$	-	567	-	

Figure 1. Typical Output Characteristics

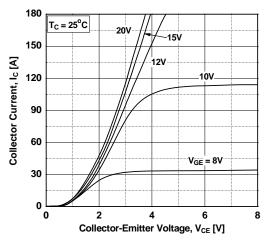


Figure 3. Typical Saturation Voltage Characteristics

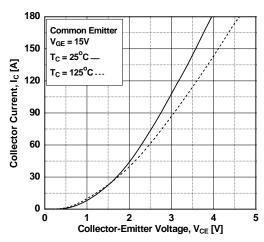
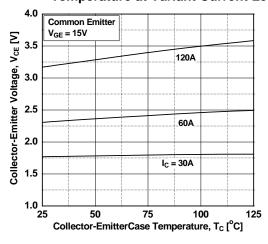
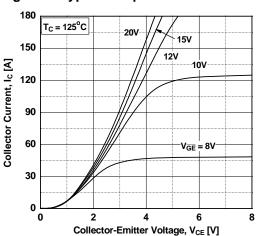


Figure 5. Saturation Voltage vs. Case

Temperature at Variant Current Level



**Figure 2. Typical Output Characteristics** 



**Figure 4. Transfer Characteristics** 

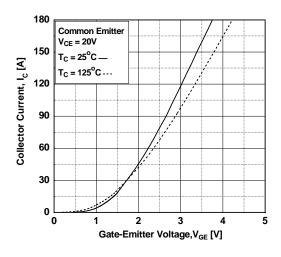


Figure 6. Saturation Voltage vs.  $V_{GE}$ 

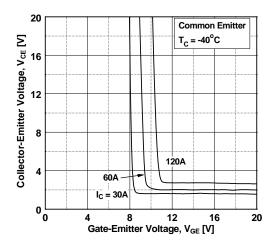


Figure 7. Saturation Voltage vs. V<sub>GE</sub>

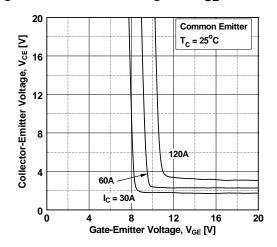


Figure 9. Capacitance Characteristics

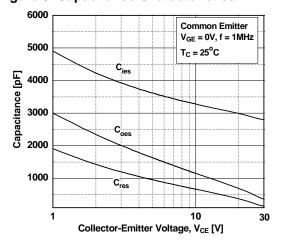


Figure 11. SOA Characteristics

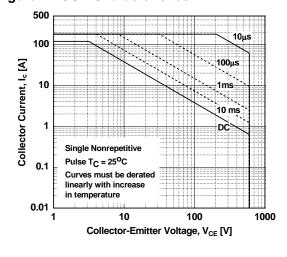


Figure 8. Saturation Voltage vs. V<sub>GE</sub>

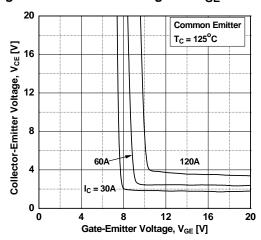


Figure 10. Gate charge Characteristics

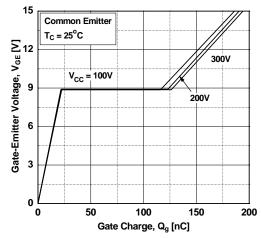


Figure 12. Turn off Switching SOA Characteristics

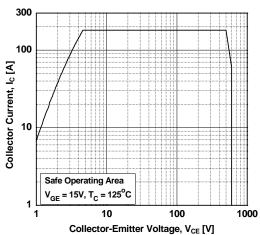


Figure 13. Turn-on Characteristics vs.
Gate Resistance

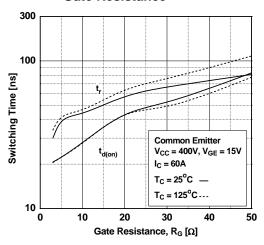


Figure 15. Turn-on Characteristics vs. Collector Current

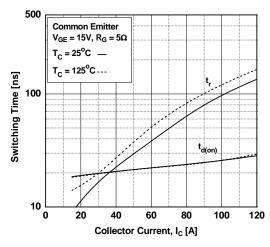


Figure 17. Switching Loss vs Gate Resistance

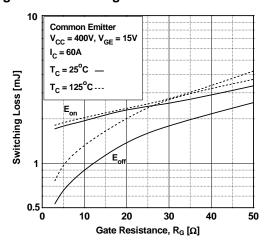


Figure 14. Turn-off Characteristics vs.
Gate Resistance

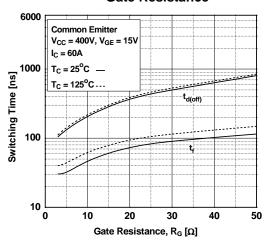


Figure 16. Turn-off Characteristics vs. Collector Current

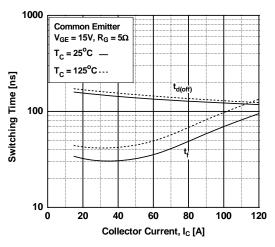


Figure 18. Switching Loss vs Collector Current

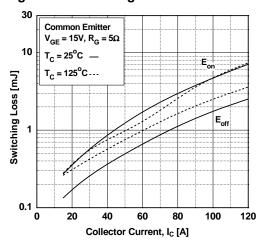


Figure 19. Forward Characteristics

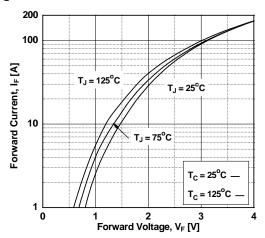


Figure 20. Reverse Current

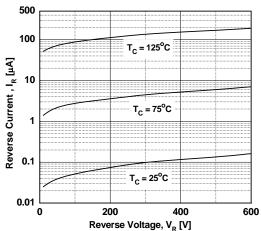


Figure 21. Stored Charge

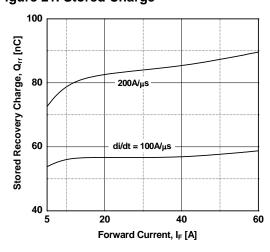


Figure 22. Reverse Recovery Time

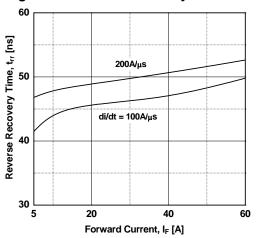
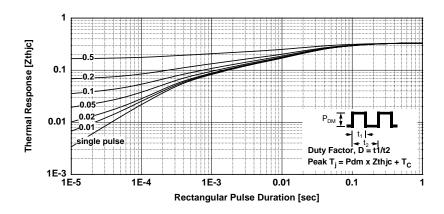
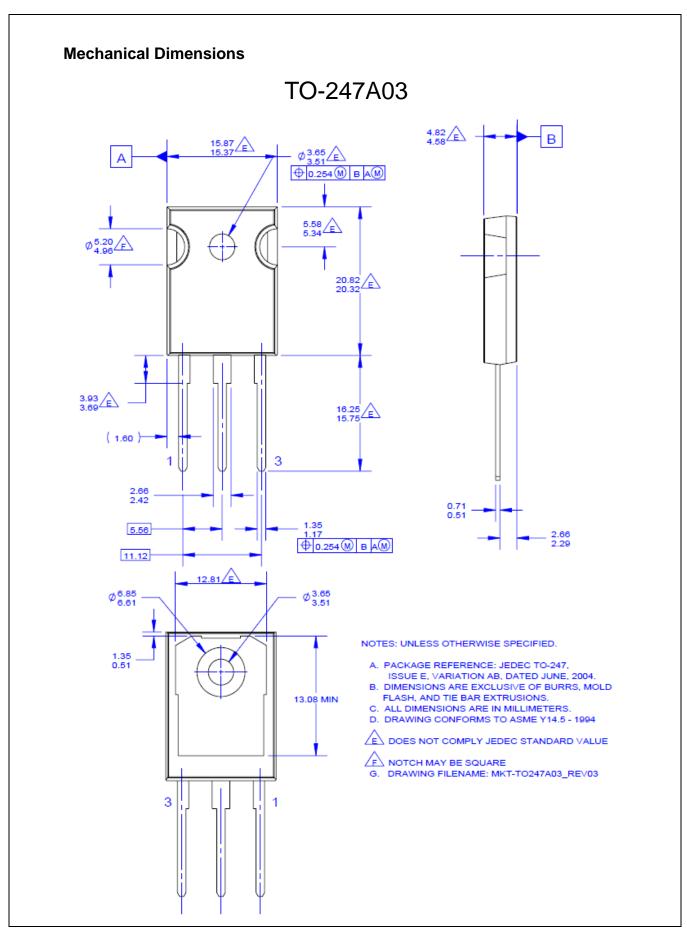


Figure 23. Transient Thermal Impedance of IGBT









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