

**April 2009** 

## FGH60N60UFD 600V, 60A Field Stop IGBT

#### **Features**

- · High current capability
- Low saturation voltage:  $V_{CE(sat)} = 1.9V @ I_C = 60A$
- High input impedance
- Fast switching
- RoHS compliant

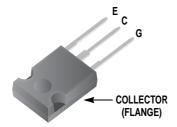
### **Applications**

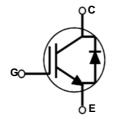
• Induction Heating, UPS, SMPS, PFC



### **General Description**

Using Novel Field Stop IGBT Technology, Fairchild's new series of Field Stop IGBTs offer the optimum performance for Induction Heating, UPS, SMPS and PFC applications where low conduc tion and switching losses are essential.





### **Absolute Maximum Ratings**

Symbol	Description		Ratings	Units
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	$@ T_C = 25^{\circ}C$	120	А
	Collector Current	$ T_C = 100^{\circ}C $	60	А
I <sub>CM (1)</sub>	Pulsed Collector Current	$^{\circ}$ T <sub>C</sub> = 25 $^{\circ}$ C	180	А
$P_{D}$	Maximum Power Dissipation	$@ T_C = 25^{\circ}C$	298	W
	Maximum Power Dissipation	$@ T_C = 100^{\circ}C$	119	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. junction temperature

#### **Thermal Characteristics**

Symbol	Parameter	Тур.	Max.	Units	
$R_{\theta JC}(IGBT)$	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	Туре	Qty per Tube	per Box
FGH60N60UFD	FGH60N60UFDTU	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.	Units
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	$V_{GE} = 0V, I_{C} = 250\mu A$	-	0.67	-	V/°C
I <sub>CES</sub>	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	-	-	250	μА
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
GL(III)	5	I <sub>C</sub> = 60A, V <sub>GE</sub> = 15V	-	1.9	2.4	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	-	2.1	-	V
Dynamic C	haracteristics				!	
C <sub>ies</sub>	Input Capacitance		-	2855	-	pF
C <sub>oes</sub>	Output Capacitance	$V_{CE} = 30V_{,} V_{GE} = 0V_{,}$ f = 1MHz	-	325	-	pF
C <sub>res</sub>	Reverse Transfer Capacitance	1 = 11/11/12	-	110	-	pF
Switching	Characteristics			,		
$t_{d(on)}$	Turn-On Delay Time		-	23	-	ns
t <sub>r</sub>	Rise Time		-	58	-	ns
$t_{d(off)}$	Turn-Off Delay Time	$V_{CC}$ = 400V, $I_{C}$ = 60A, $R_{G}$ = 5 $\Omega$ , $V_{GE}$ = 15V, Inductive Load, $T_{C}$ = 25°C	-	130	-	ns
$t_{f}$	Fall Time		-	40	80	ns
$E_{on}$	Turn-On Switching Loss		-	1.81	-	mJ
$E_{off}$	Turn-Off Switching Loss		-	0.81	-	mJ
$E_ts$	Total Switching Loss		-	2.62	-	mJ
$t_{d(on)}$	Turn-On Delay Time		-	22	-	ns
t <sub>r</sub>	Rise Time		-	61	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{CC} = 400V, I_{C} = 60A,$	-	141	-	ns
t <sub>f</sub>	Fall Time	$R_G = 5\Omega$ , $V_{GE} = 15V$ ,	-	63	-	ns
E <sub>on</sub>	Turn-On Switching Loss	Inductive Load, T <sub>C</sub> = 125°C	-	1.92	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	1.23	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	3.15	-	mJ
Qg	Total Gate Charge		-	188	-	nC
Q <sub>ge</sub>	Gate to Emitter Charge	$V_{CE} = 400V, I_{C} = 60A,$ $V_{GF} = 15V$		21	-	nC
Q <sub>gc</sub>	Gate to Collector Charge	▼GE = 10 V	-	97	-	nC

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

Symbol	Parameter	Test Conditions		Min.	Тур.	Max	Units
V <sub>FM</sub>	Diode Forward Voltage	I <sub>E</sub> = 30A	$T_C = 25^{\circ}C$	-	2.0	2.6	V
Diode i si wara voltage	2.000 r ormana romage		$T_{\rm C} = 125^{\rm o}{\rm C}$	-	1.8	-	
t <sub>rr</sub>		$I_{ES} = 30A$ , $dI_{ES}/dt = 200A/\mu s$	$T_C = 25^{\circ}C$	ı	47	ı	ns
-11			$T_{\rm C} = 125^{\rm o}{\rm C}$		179	ı	
$Q_{rr}$	Diode Reverse Recovery Charge		$T_C = 25^{\circ}C$	ì	83	ı	nC
-11			$T_{\rm C} = 125^{\rm o}{\rm C}$	-	567	-	]

**Figure 1. Typical Output Characteristics** 

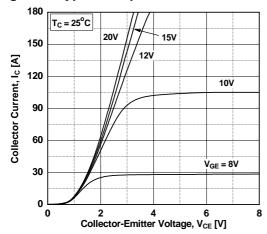


Figure 3. Typical Saturation Voltage Characteristics

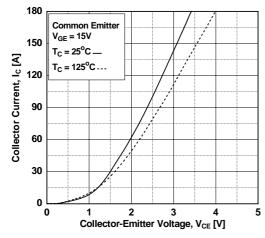
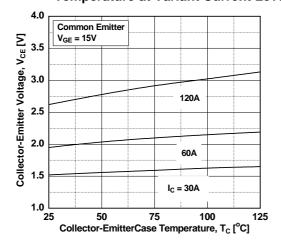


Figure 5. Saturation Voltage vs. Case
Temperature at Variant Current Level



**Figure 2. Typical Output Characteristics** 

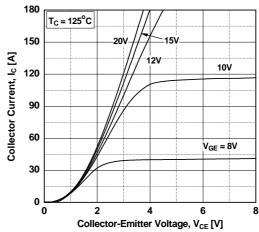


Figure 4. Transfer Characteristics

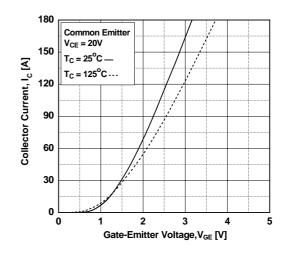


Figure 6. Saturation Voltage vs. V<sub>GE</sub>

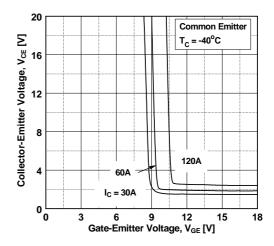


Figure 7. Saturation Voltage vs. V<sub>GE</sub>

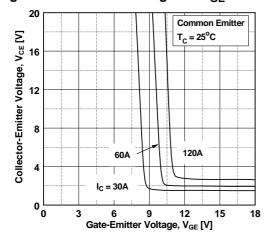


Figure 8. Saturation Voltage vs. V<sub>GE</sub>

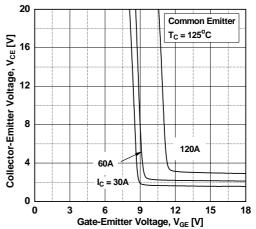


Figure 9. Capacitance Characteristics

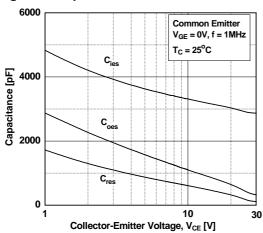


Figure 10. Gate charge Characteristics

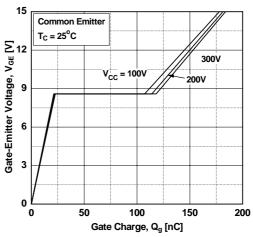


Figure 11. SOA Characteristics

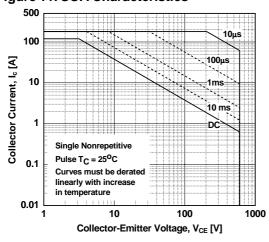


Figure 12. Turn off Switching SOA Characteristics

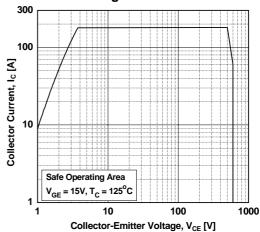


Figure 13. Turn-on Characteristics vs.
Gate Resistance

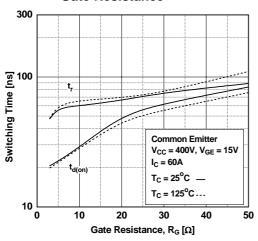


Figure 14. Turn-off Characteristics vs.
Gate Resistance

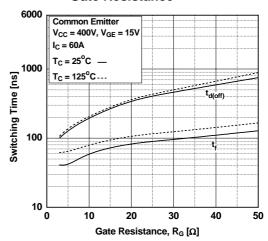


Figure 15. Turn-on Characteristics vs. Collector Current

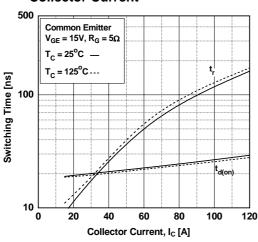


Figure 16. Turn-off Characteristics vs. Collector Current

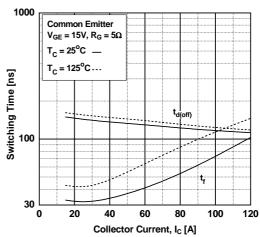


Figure 17. Switching Loss vs. Gate Resistance

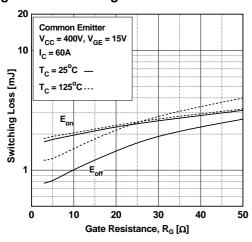


Figure 18. Switching Loss vs. Collector Current

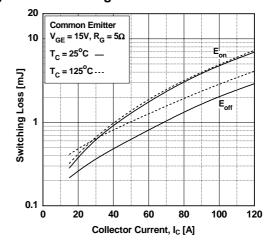


Figure 19. Forward Characteristics

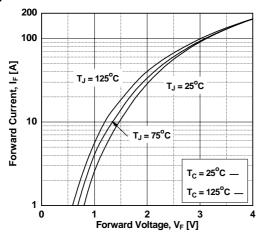


Figure 20. Reverse Current

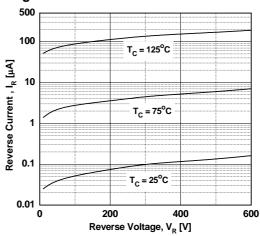


Figure 21. Stored Charge

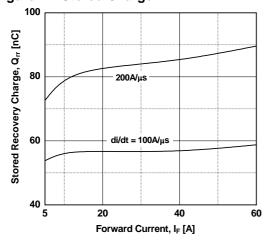


Figure 22. Reverse Recovery Time

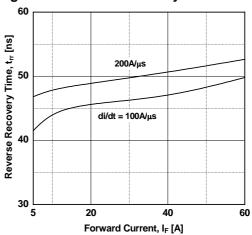
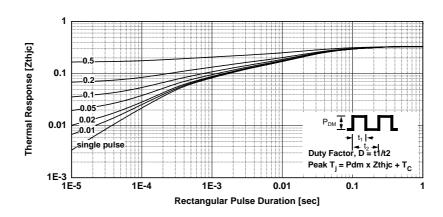
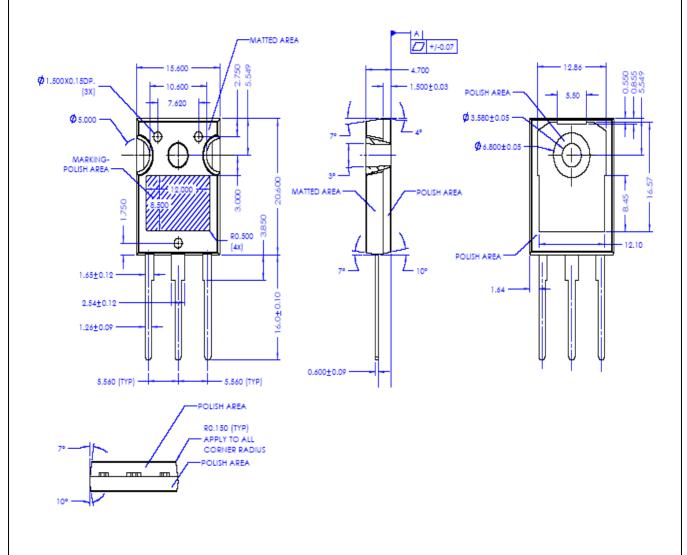


Figure 23. Transient Thermal Impedance of IGBT



### **Mechanical Dimensions**

# TO-247AB (FKS PKG CODE 001)







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