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November 2013



## FGP5N60LS 600 V, 5 A Field Stop IGBT

## **Features**

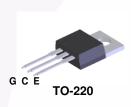
- · High Current Capability
- Low Saturation Voltage: V<sub>CE(sat)</sub> =1.7 V @ I<sub>C</sub> = 5 A
- High Input Impedance
- RoHS Compliant

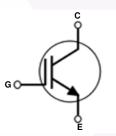
### **Applications**

HID Ballast

## **General Description**

Using novel field stop IGBT technology, Fairchild's new series of field stop IGBTs offer the optimum performance for HID ballast where low conduction 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 $@T_C = 25^{\circ}C$		10	A	
	Collector Current	@ T <sub>C</sub> = 100°C	5	A	
I <sub>CM (1)</sub>	Pulsed Collector Current	@ T <sub>C</sub> = 25°C	36	A	
P <sub>D</sub>	Maximum Power Dissipation	@ T <sub>C</sub> = 25°C	83	W	
	Maximum Power Dissipation	@ T <sub>C</sub> = 100 <sup>o</sup> C	33	W	
TJ	Operating Junction Temperature		-55 to +150	°C	
T <sub>stg</sub>	Storage Temperature Range		-55 to +150	°C	
TL	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 second	300	°C		

Notes: 1: Repetitive test , Pulse width = 100 usec , Duty = 0.2,  $V_{GE}$  = 13.5 V

### **Thermal Characteristics**

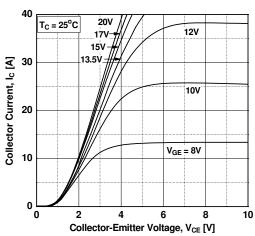
Symbol	Parameter	Тур.	Max.	Unit
$R_{ ext{ heta}JC}$	Thermal Resistance, Junction to Case	-	1.5	°C/W
$R_{\thetaJA}$	Thermal Resistance, Junction to Ambient	-	62.5	°C/W

Part Number Top Mark		Package	Packing Method	Reel Size	Ta	Tape Width		Quantity	
FGP5N6	FGP5N60LS FGP5N60LS TO-220		Tube N/A		N/A		50		
Electric	cal Ch	aracteristi	cs of the I	<b>GBT</b> $T_{C} = 25^{\circ}C$ unless other	nerwise noted				
Symbol		Parameter		Test Conditi	ons I	Min.	Тур.	Max.	Unit
Off Chara	otoristio	<b>c</b>							
BV <sub>CES</sub>	Cteristics Collector to Emitter Breakdown Voltage		V <sub>GE</sub> = 0 V, I <sub>C</sub> = 250 μA		600	-	_	V	
∆BV <sub>CES</sub>		Temperature Coefficient of Breakdown				000			
$\Delta T_{J}$	-	Voltage		$V_{GE}$ = 0 V, I <sub>C</sub> = 250 $\mu$ A		-	0.8	-	V/ºC
I <sub>CES</sub>	Collec	Collector Cut-Off Current		$V_{CE} = V_{CES}, V_{GE} = 0 V$		-	-	250	μA
I <sub>GES</sub>	G-E Le	G-E Leakage Current		$V_{GE} = V_{GES}, V_{CE} = 0$	/	-	-	±400	nA
On Charao	cteristic	s							
V <sub>GE(th)</sub>	-	hreshold Voltage		I <sub>C</sub> = 250 μA, V <sub>CE</sub> = V <sub>G</sub>	E	2.7	3.9	4.5	V
V <sub>CE(sat)</sub>		Collector to Emitter Saturation Voltage		$I_{\rm C} = 5 \text{ A}, V_{\rm GE} = 15 \text{ V}$	-	-	1.7	2.1	V
	Collec			$I_{C} = 5 \text{ A}, V_{GE} = 15 \text{ V},$ $T_{C} = 125^{\circ}\text{C}$		-	1.8	-	v
				$I_{C} = 14 \text{ A}, V_{GE} = 12 \text{ V}$		-	2.7	3.2	V
	Collector to Emitter Saturation Voltage		uration Voltage	$I_{C} = 14 \text{ A}, V_{GE} = 12 \text{ V},$ $T_{C} = 125^{\circ}\text{C}$		-	3.1	-	v
Dunamia	Charact	viation							
Dynamic ( C <sub>ies</sub>	-	Capacitance				-	278	-	pF
C <sub>oes</sub>		t Capacitance		V <sub>CE</sub> = 30 V <sub>,</sub> V <sub>GE</sub> = 0 V,		-	28	-	pF
C <sub>res</sub>		Reverse Transfer Capacitance		f = 1 MHz		-	11	-	pF
Switching	1						4.0		
t <sub>d(on)</sub>		Turn-On Delay Time     Rise Time     Turn-Off Delay Time     Fall Time     Turn-On Switching Loss     Turn-Off Switching Loss		_		-	4.3	-	ns
t <sub>r</sub>	-					-	1.6	-	ns
t <sub>d(off)</sub>				$V_{CC} = 400 \text{ V}, \text{ I}_{C} = 5 \text{ A},$ $R_{G} = 10 \Omega, \text{ V}_{GE} = 15 \text{ V}$	<u>,</u>	-	36 118	-	ns ns
t <sub>f</sub> E <sub>on</sub>				Inductive Load, $T_C = 2$	5°C	-	38	_	μJ
E <sub>off</sub>				+		-	130	-	μJ
⊑ <sub>oπ</sub> E <sub>ts</sub>		Switching Loss		-		-	168	-	μJ
t <sub>d(on)</sub>		On Delay Time				-	4.1		ns
t <sub>r</sub>	Rise T	,				-	1.8	-	ns
t <sub>d(off)</sub>	Turn-C	Off Delay Time		V <sub>CC</sub> = 400 V, I <sub>C</sub> = 5 A,		-	37	- (	ns
t <sub>f</sub>	Fall Time		R <sub>G</sub> = 10 Ω, V <sub>GE</sub> = 15 V,			150		ns	
E <sub>on</sub>	Turn-C	n Switching Loss		Inductive Load, $T_C = 1$	25°C	-	80	-	μJ
E <sub>off</sub>	Turn-C	Off Switching Loss				-	168	-	μJ
E <sub>ts</sub>	Total S	Switching Loss				-	248	-	μJ
Qg	Total C	Gate Charge				-	18.3	-	nC
Q <sub>ge</sub>	Gate t	o Emitter Charge		V <sub>CE</sub> = 400 V, I <sub>C</sub> = 5 A, V <sub>GE</sub> = 15 V		-	1.6	-	nC
Q <sub>gc</sub>	Gate t	o Collector Charg	е	GE - 10 V		-	7.9	-	nC

FGP5N60LS — 600 V, 5 A Field Stop IGBT

## **Typical Performance Characteristics**







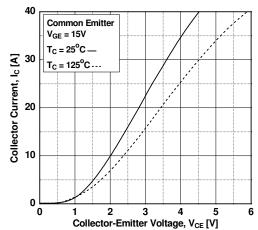


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

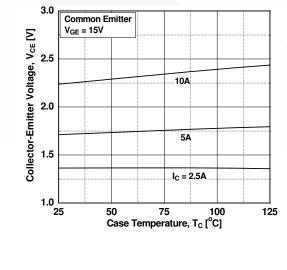


Figure 2. Typical Output Characteristics

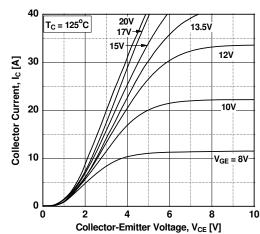


Figure 4. Transfer Characteristics

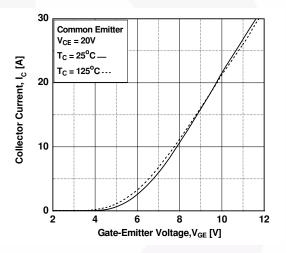
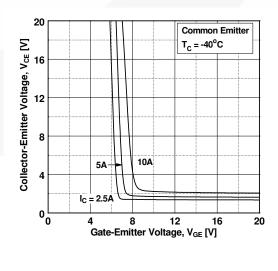


Figure 6. Saturation Voltage vs. V<sub>GE</sub>



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#### Figure 7. Saturation Voltage vs. V<sub>GE</sub> 20 20 Common Emitter $T_c = 25^{\circ}C$ Collector-Emitter Voltage, V<sub>CE</sub> [V] ≥ <sub>16</sub> 16 12 8 10A 4 5A 2.5A lc 0∟ 0 0 12 20 Δ 8 16 0 Gate-Emitter Voltage, V<sub>GE</sub> [V] **Figure 9. Capacitance Characteristics** 600 15 Common Emitter V<sub>GE</sub> = 0V, f = 1MHz 500 Gate-Emitter Voltage, V<sub>GE</sub> [V] 8 0 6 7 $T_C = 25^{\circ}C$ Cies Capacitance [pF] 000 200 200 C Cres 100 0 0 10 30 0 Collector-Emitter Voltage, V<sub>CE</sub> [V] Figure 11. SOA Characteristics 100 10 10µs 10 Collector Current, Ic [A] 100µs Switching Time [ns] 1ms 1 10ms DC Single Nonrepetitive 0.1 Pulse $T_C = 25^{\circ}C$ Curves must be derated linearly with increase in temperature 0.01 0.5 0.1 1 10 100 1000 0 Collector-Emitter Voltage, V<sub>CE</sub> [V]

**Typical Performance Characteristics** 

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

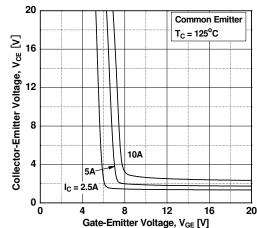


Figure 10. Gate charge Characteristics

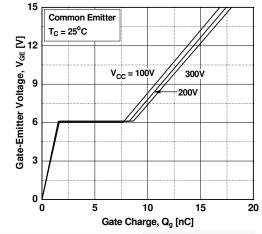
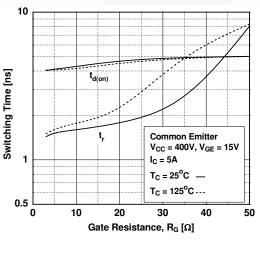
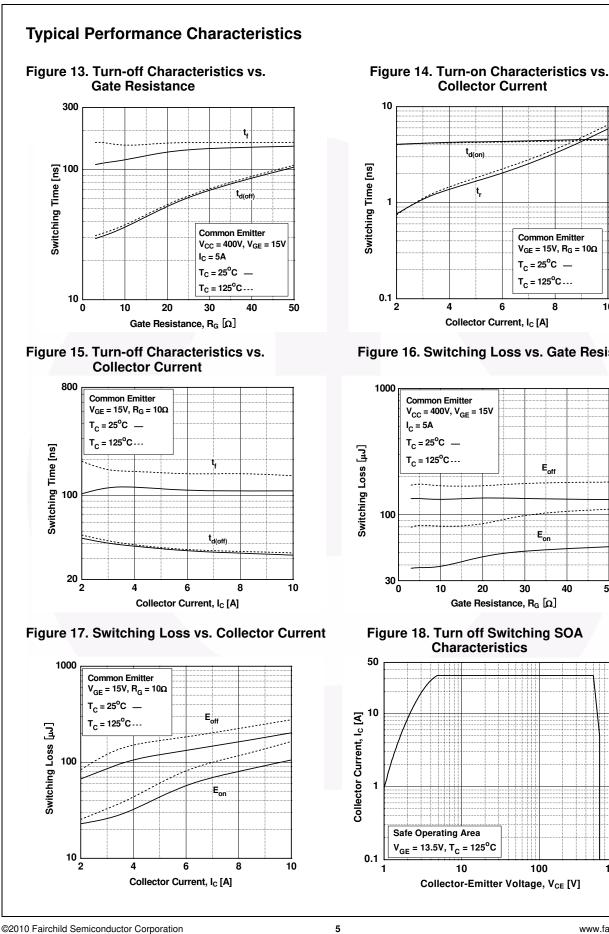


Figure 12. Turn-on Characteristics vs. Gate Resistance



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FGP5N60LS Rev. C1

Figure 16. Switching Loss vs. Gate Resistance

6

Collector Current, I<sub>C</sub> [A]

Common Emitter  $V_{GE} = 15V, R_G = 10\Omega$ 

8

10

 $T_{c} = 25^{\circ}C$  —

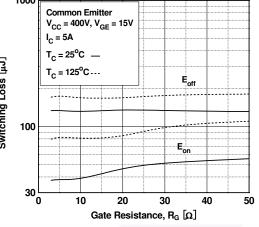
T<sub>C</sub> = 125°C ...

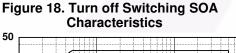
**Collector Current** 

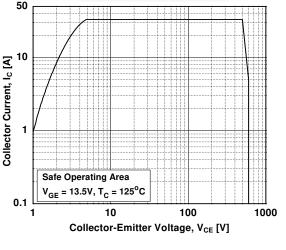
t<sub>d(on)</sub>

t,

4

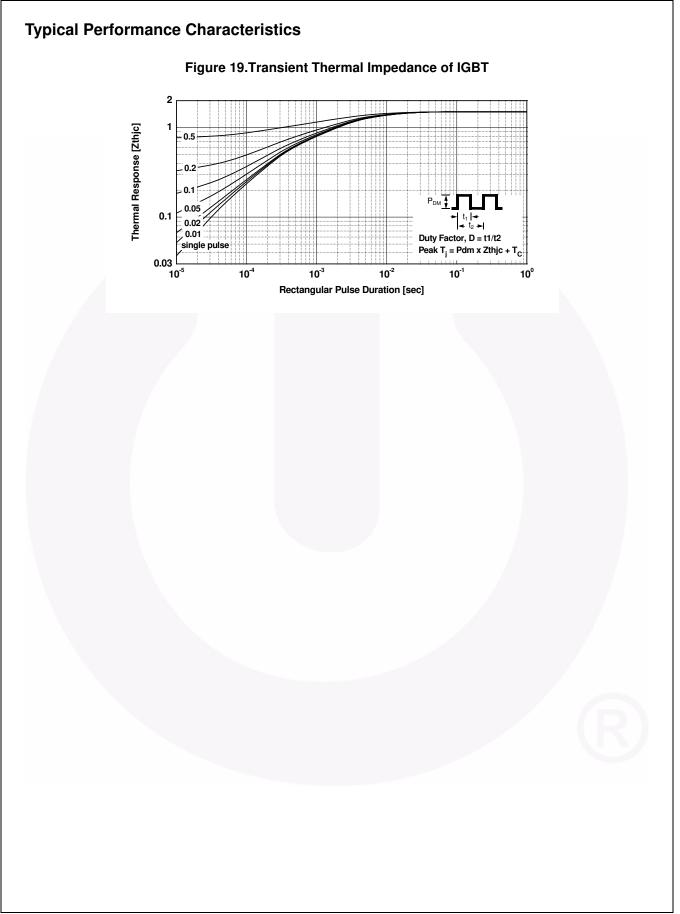






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#### **Mechanical Dimensions** ø<sup>4.09</sup> 3.50∆ ⊕ 0,36 M B AM в 4.83 3,56 А 10.67 9.65 8.89 6.86 3.43 2.54 6.86 7° 3' △13.40 12.19 16.51 14,22 ∆9.40 8.38 3 2 1 C 5° 6.35 MAX 5° 14.73 12.70 (1.91) -1,78 1,14 0,61 △0,33 1.02 0.38 2.92 ⊕ 0.36 M B AM 2.54 NOTES: UNLESS OTHERWISE SPECIFIED A) REFERENCE JEDEC, TO-220, ISSUE K, VARIATION AB, DATED APRIL, 2002. B) ALL DIMENSIONS ARE IN MILLIMETERS. 5.08 B) ALL DIMENSIONS ARE IN MILLIME TERS. C) DIMENSIONING AND TOLERANCING PER ANSI Y14.5 - 1973 D) LOCATION OF THE PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE) COMPLY JEDEC STANDARD VALUE, DIMENSION DEPERCENT IN SOLUTION "A1" DIMENSIONS REPRESENT LIKE BELOW: SINGLE GAUGE = 0.51 - 0.61 DUAL GAUGE = 1,14 - 1,40 щ щ G) DRAWING FILE NAME: TO220B03REV6 Figure 20. TO-220 3L - TO-220, MOLDED, 3LEAD, JEDEC VARIATION AB

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