

**FAIRCHILD**  
SEMICONDUCTOR®

**IGBT**

## FGA50N60LS

### General Description

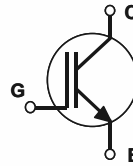
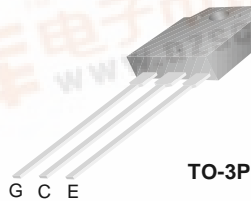
Fairchild's LS series product of Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses as well as short circuit ruggedness. The LS series is especially designed for applications in medium frequencies such as switched reluctance motor controls, AC & DC motor controls, general inverters etc.

### Features

- Short circuit rated 10 $\mu$ s @  $T_C = 100^\circ\text{C}$ ,  $V_{GE} = 15\text{V}$
- Low saturation voltage :  $V_{CE(sat)} = 1.6\text{V}$  @  $I_C = 50\text{A}$
- High input impedance
- Optimized for medium operating frequencies (1–5kHz)

### Applications

Switched Reluctance Motor Controls , AC & DC motor controls, general purpose inverters, Robotics, and Servo controls



### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

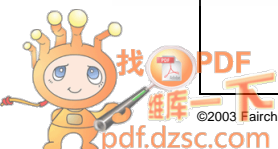
Symbol	Description	FGA50N60LS	Units
$V_{CES}$	Collector-Emitter Voltage	600	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	100	A
	Collector Current @ $T_C = 100^\circ\text{C}$	50	A
$I_{CM(1)}$	Pulsed Collector Current	150	A
$T_{SC}$	Short Circuit Withstand Time @ $T_C = 100^\circ\text{C}$	10	$\mu\text{s}$
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	240	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	96	W
$T_J$	Operating Junction Temperature	-55 to +150	$^\circ\text{C}$
$T_{stg}$	Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds	300	$^\circ\text{C}$

**Notes :**

(1) Repetitive rating : Pulse width limited by max. junction temperature

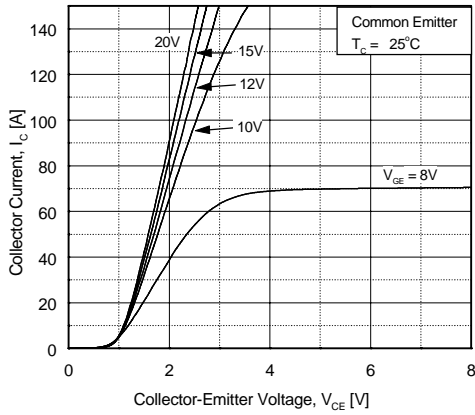
### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	0.52	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	40	$^\circ\text{C/W}$

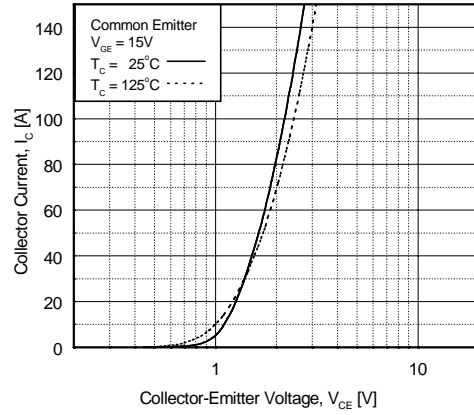


## Electrical Characteristics of the IGBT T<sub>C</sub> = 25°C unless otherwise noted

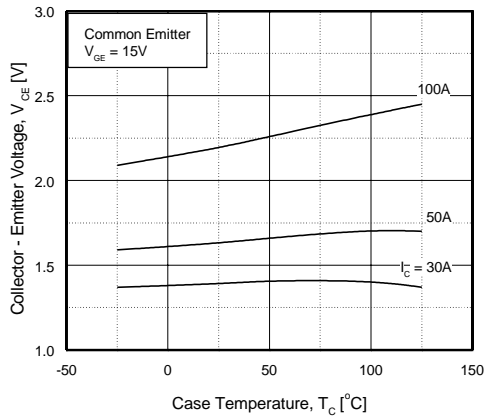
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
$BV_{CES}$	Collector-Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	600	--	--	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	--	0.6	--	V/°C
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	--	--	250	$\mu A$
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	--	--	$\pm 100$	nA
<b>On Characteristics</b>						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 50mA, V_{CE} = V_{GE}$	3.5	5.5	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 50A, V_{GE} = 15V$	--	1.6	1.8	V
		$I_C = 80A, V_{GE} = 15V$	--	1.96	--	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$	--	2660	--	pF
$C_{oes}$	Output Capacitance		--	250	--	pF
$C_{res}$	Reverse Transfer Capacitance		--	78	--	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 50A,$ $R_G = 5.9\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ C$	--	54	--	ns
$t_r$	Rise Time		--	96	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	146	220	ns
$t_f$	Fall Time		--	326	600	ns
$E_{on}$	Turn-On Switching Loss		--	1.1	--	mJ
$E_{off}$	Turn-Off Switching Loss		--	3.2	--	mJ
$E_{ts}$	Total Switching Loss	--	4.3	6.0	mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 50A,$ $R_G = 5.9\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ C$	--	56	--	ns
$t_r$	Rise Time		--	87	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	134	215	ns
$t_f$	Fall Time		--	575	880	ns
$E_{on}$	Turn-On Switching Loss		--	1.2	--	mJ
$E_{off}$	Turn-Off Switching Loss		--	5.0	--	mJ
$E_{ts}$	Total Switching Loss	--	6.2	8.7	mJ	
$T_{sc}$	Short Circuit Withstand Time	$V_{CC} = 300V, V_{GE} = 15V$ @ $T_C = 100^\circ C$	10	--	--	$\mu s$
$Q_g$	Total Gate Charge	$V_{CE} = 300V, I_C = 50A,$ $V_{GE} = 15V$	--	167	240	nC
$Q_{ge}$	Gate-Emitter Charge		--	27	35	nC
$Q_{gc}$	Gate-Collector Charge		--	68	100	nC
$L_e$	Internal Emitter Inductance	Measured 5mm from PKG	--	14	--	nH



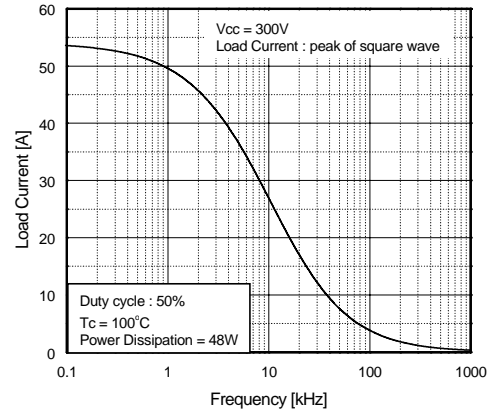
**Fig 1. Typical Output Characteristics**



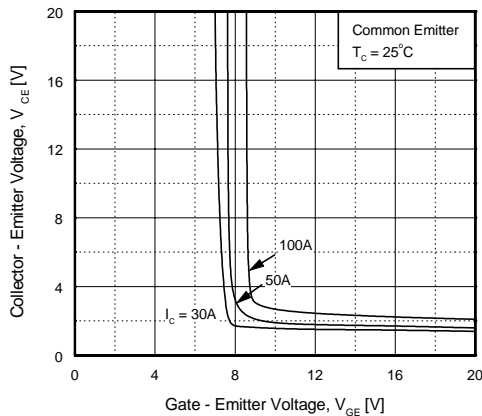
**Fig 2. Typical Saturation Voltage Characteristics**



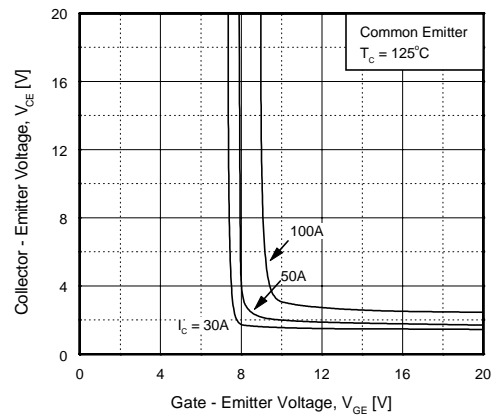
**Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level**



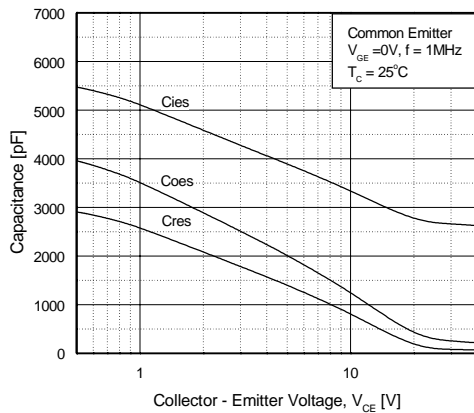
**Fig 4. Load Current vs. Frequency**



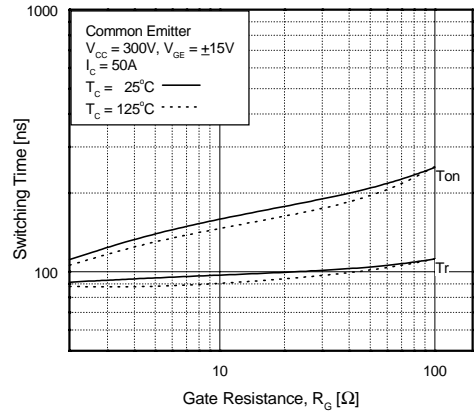
**Fig 5. Saturation Voltage vs.  $V_{GE}$**



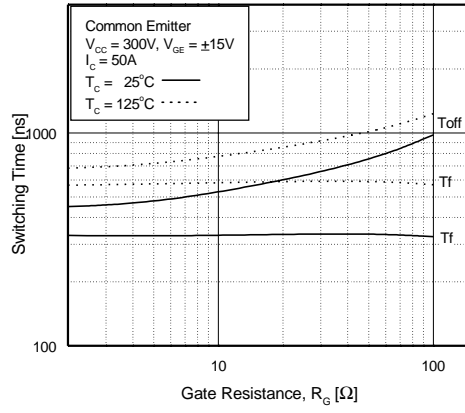
**Fig 6. Saturation Voltage vs.  $V_{GE}$**



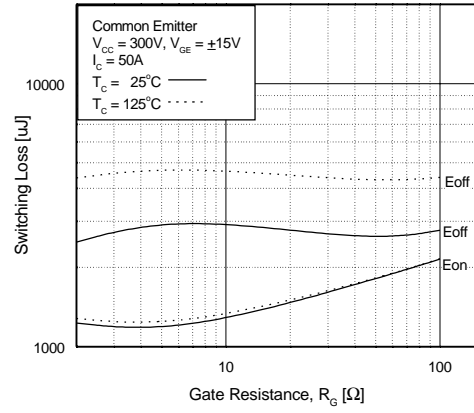
**Fig 7. Capacitance Characteristics**



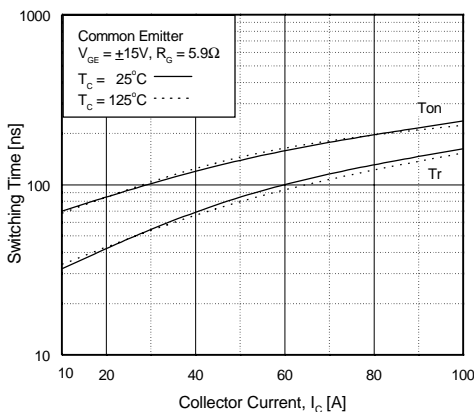
**Fig 8. Turn-On Characteristics vs. Gate Resistance**



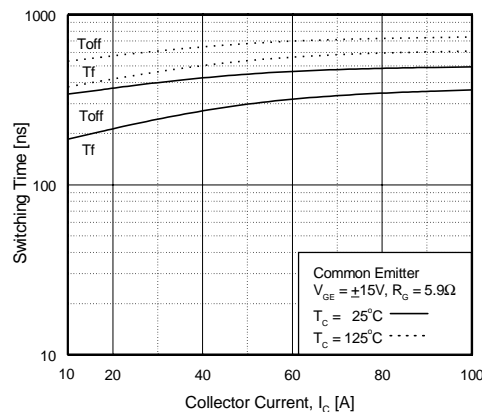
**Fig 9. Turn-Off Characteristics vs. Gate Resistance**



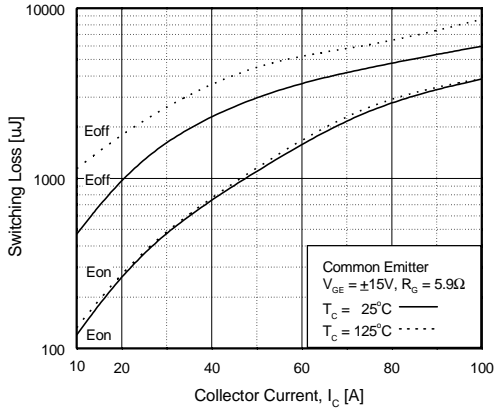
**Fig 10. Switching Loss vs. Gate Resistance**



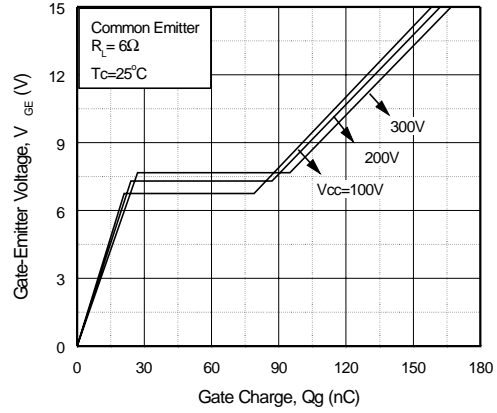
**Fig 11. Turn-On Characteristics vs. Collector Current**



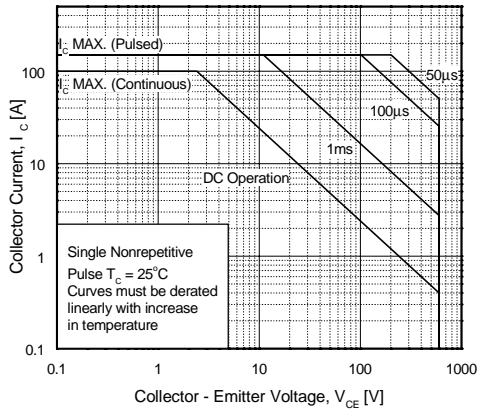
**Fig 12. Turn-Off Characteristics vs. Collector Current**



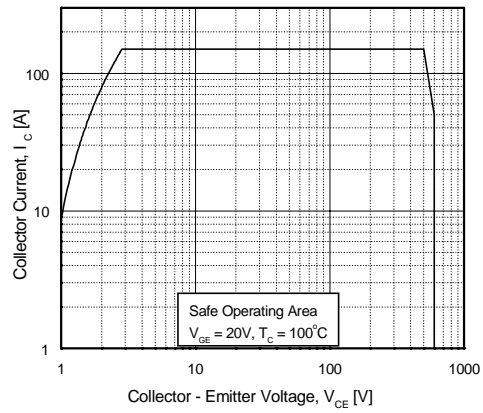
**Fig 13. Switching Loss vs. Collector Current**



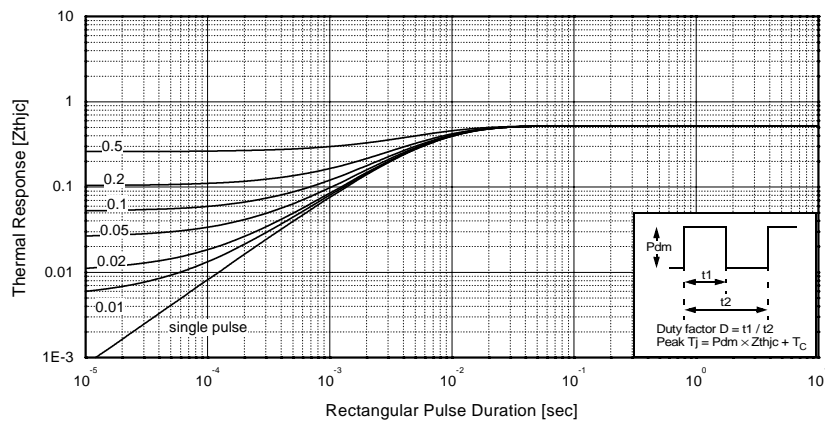
**Fig 14. Gate Charge Characteristics**



**Fig 15. SOA Characteristics**



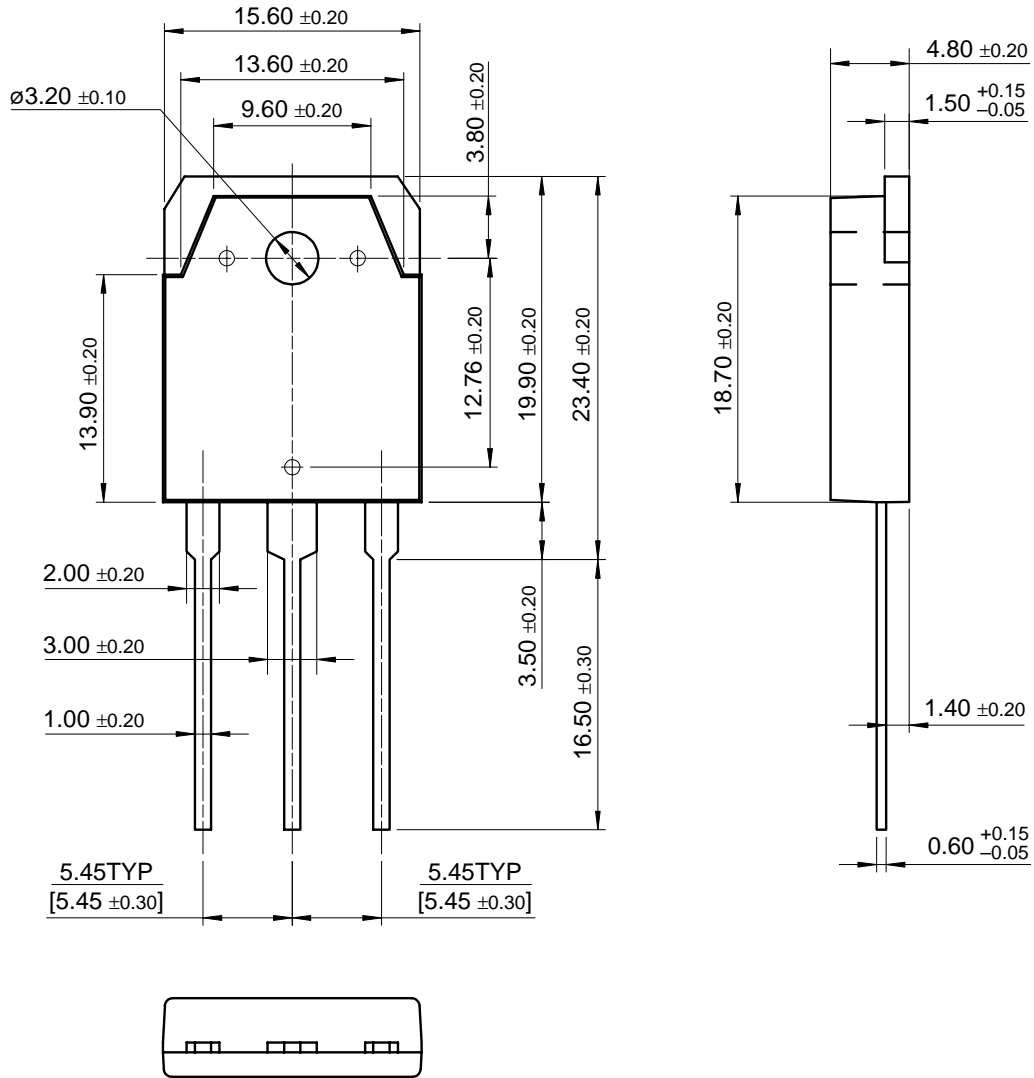
**Fig 16. Turn-Off SOA**



**Fig 17. Transient Thermal Impedance of IGBT**

# Package Dimension

## TO-3P



FGA50N60LS

Dimensions in Millimeters

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