

**FAIRCHILD**  
SEMICONDUCTOR™

April 2001

**IGBT**

## SGS23N60UF

### Ultra-Fast IGBT

#### General Description

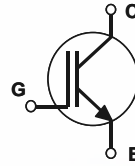
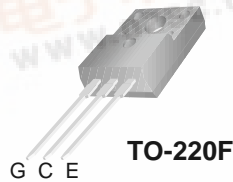
Fairchild's UF series of Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses. The UF series is designed for applications such as motor control and general inverters where high speed switching is a required feature.

#### Features

- High speed switching
- Low saturation voltage :  $V_{CE(sat)} = 2.1 \text{ V @ } I_C = 12 \text{ A}$
- High input impedance

#### Application

AC & DC Motor controls, general purpose inverters, robotics, servo controls



#### Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted

Symbol	Description	SGS23N60UF	Units
V <sub>CES</sub>	Collector-Emitter Voltage	600	V
V <sub>GES</sub>	Gate-Emitter Voltage	± 20	V
I <sub>C</sub>	Collector Current @ T <sub>C</sub> = 25°C	23	A
	Collector Current @ T <sub>C</sub> = 100°C	12	A
I <sub>CM (1)</sub>	Pulsed Collector Current	92	A
P <sub>D</sub>	Maximum Power Dissipation @ T <sub>C</sub> = 25°C	73	W
	Maximum Power Dissipation @ T <sub>C</sub> = 100°C	29	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

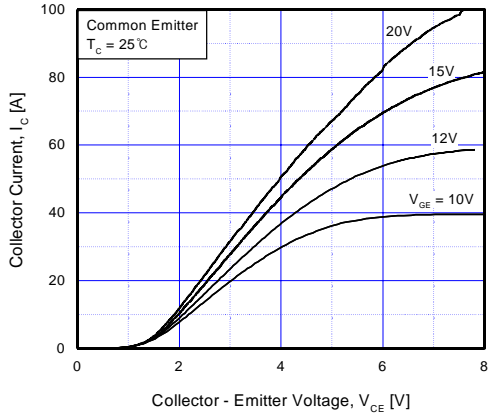
#### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	--	1.7	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	--	62.5	°C/W

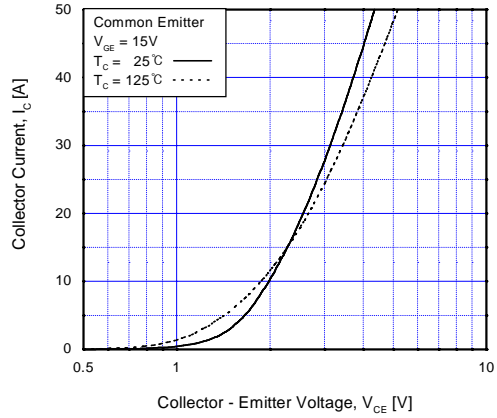


## Electrical Characteristics of IGBT T<sub>C</sub> = 25°C unless otherwise noted

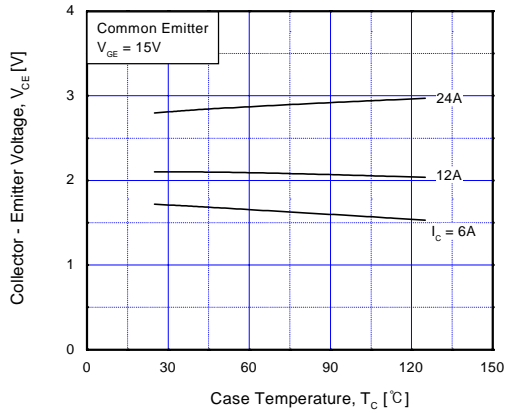
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
<b>Off Characteristics</b>							
BV <sub>CES</sub>	Collector-Emitter Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA	600	--	--	V	
ΔB <sub>VCES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA	--	0.6	--	V/°C	
I <sub>CES</sub>	Collector Cut-off Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V	--	--	250	μA	
I <sub>GES</sub>	G-E Leakage Current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V	--	--	± 100	nA	
<b>On Characteristics</b>							
V <sub>GE(th)</sub>	G-E Threshold Voltage	I <sub>C</sub> = 12mA, V <sub>CE</sub> = V <sub>GE</sub>	3.5	4.5	6.5	V	
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 12A, V <sub>GE</sub> = 15V	--	2.1	2.6	V	
		I <sub>C</sub> = 23A, V <sub>GE</sub> = 15V	--	2.6	--	V	
<b>Dynamic Characteristics</b>							
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V, f = 1MHz	--	720	--	pF	
C <sub>oes</sub>	Output Capacitance		--	100	--	pF	
C <sub>res</sub>	Reverse Transfer Capacitance		--	25	--	pF	
<b>Switching Characteristics</b>							
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 300 V, I <sub>C</sub> = 12A, R <sub>G</sub> = 23Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 25°C	--	17	--	ns	
t <sub>r</sub>	Rise Time		--	27	--	ns	
t <sub>d(off)</sub>	Turn-Off Delay Time		--	60	130	ns	
t <sub>f</sub>	Fall Time		--	70	150	ns	
E <sub>on</sub>	Turn-On Switching Loss		--	115	--	μJ	
E <sub>off</sub>	Turn-Off Switching Loss		--	135	--	μJ	
E <sub>ts</sub>	Total Switching Loss		--	250	400	μJ	
t <sub>d(on)</sub>	Turn-On Delay Time		V <sub>CC</sub> = 300 V, I <sub>C</sub> = 12A, R <sub>G</sub> = 23Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 125°C	--	23	--	ns
t <sub>r</sub>	Rise Time			--	32	--	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	--		100	200	ns	
t <sub>f</sub>	Fall Time	--		220	250	ns	
E <sub>on</sub>	Turn- On Switching Loss	--		205	--	μJ	
E <sub>off</sub>	Turn- Off Switching Loss	--		320	--	μJ	
E <sub>ts</sub>	Total Switching Loss	--		525	800	μJ	
Q <sub>g</sub>	Total Gate Charge	V <sub>CE</sub> = 300 V, I <sub>C</sub> = 12A, V <sub>GE</sub> = 15V		--	49	80	nC
Q <sub>ge</sub>	Gate-Emitter Charge			--	11	17	nC
Q <sub>gc</sub>	Gate-Collector Charge		--	14	22	nC	
Le	Internal Emitter Inductance	Measured 5mm from PKG	--	7.5	--	nH	



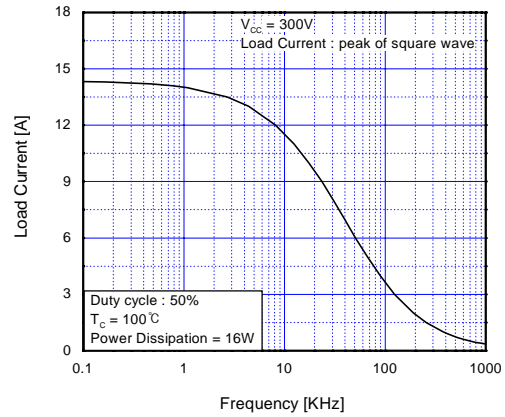
**Fig 1. Typical Output Characteristics**



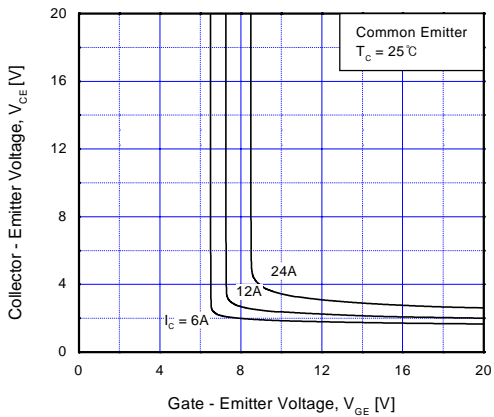
**Fig 2. Typical Saturation Voltage Characteristics**



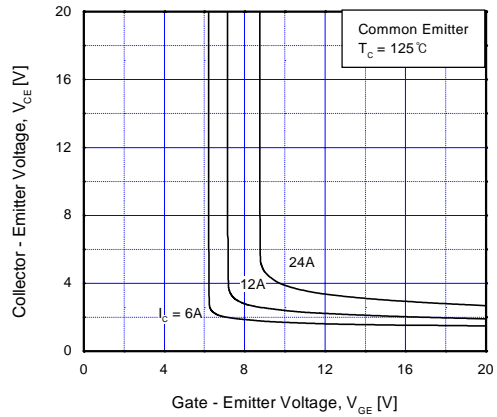
**Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level**



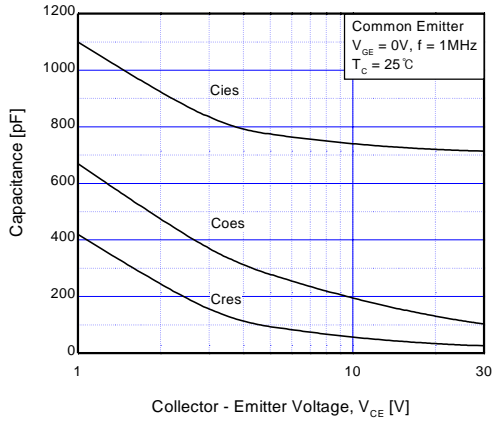
**Fig 4. Load Current vs. Frequency**



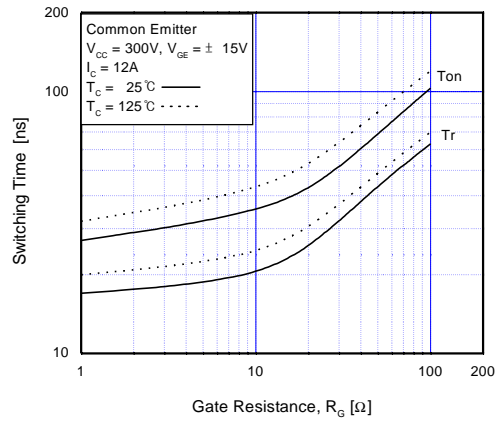
**Fig 5. Saturation Voltage vs.  $V_{GE}$**



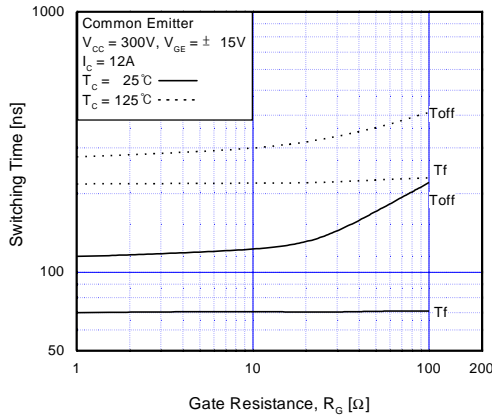
**Fig 6. Saturation Voltage vs.  $V_{GE}$**



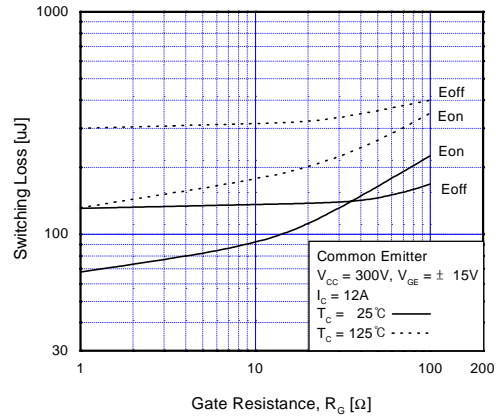
**Fig 7. Capacitance Characteristics**



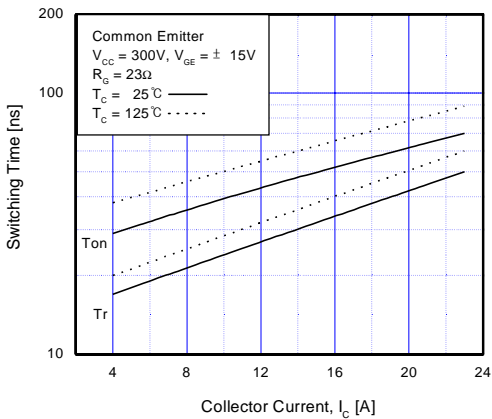
**Fig 8. Turn-On Characteristics vs. Gate Resistance**



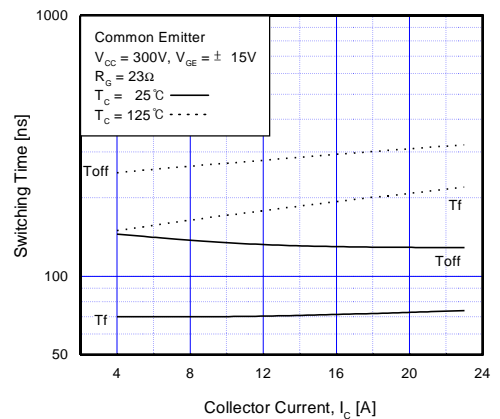
**Fig 9. Turn-Off Characteristics vs. Gate Resistance**



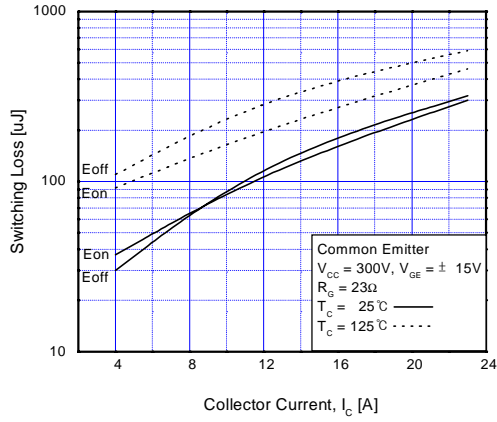
**Fig 10. Switching Loss vs. Gate Resistance**



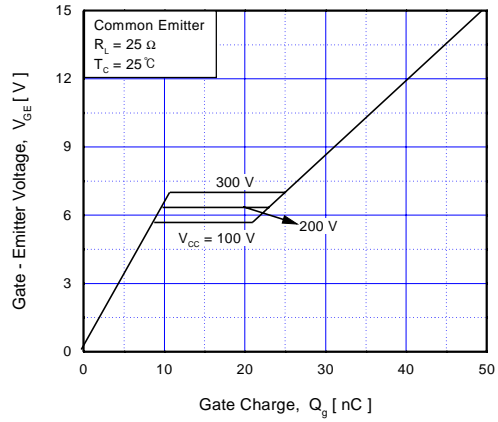
**Fig 11. Turn-On Characteristics vs. Collector Current**



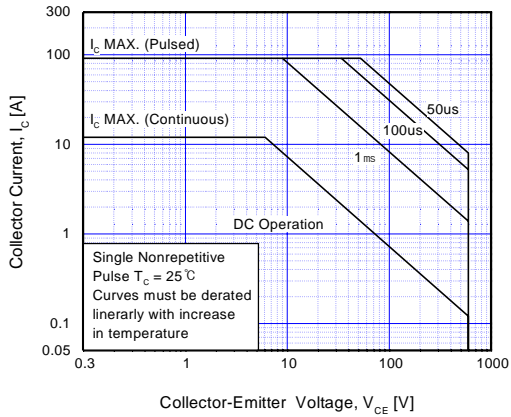
**Fig 12. Turn-Off Characteristics vs. Collector Current**



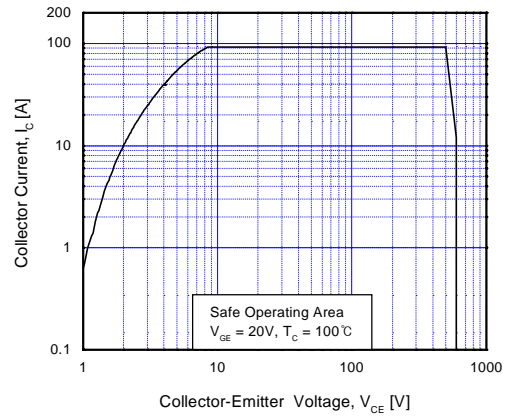
**Fig 13. Switching Loss vs. Collector Current**



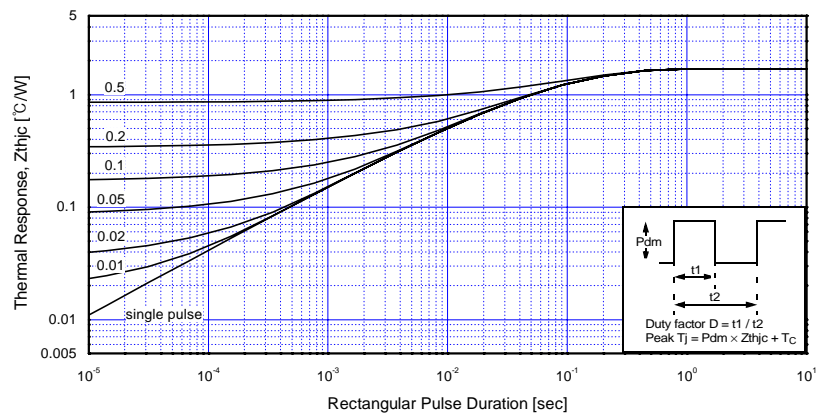
**Fig 14. Gate Charge Characteristics**



**Fig 15. SOA Characteristics**



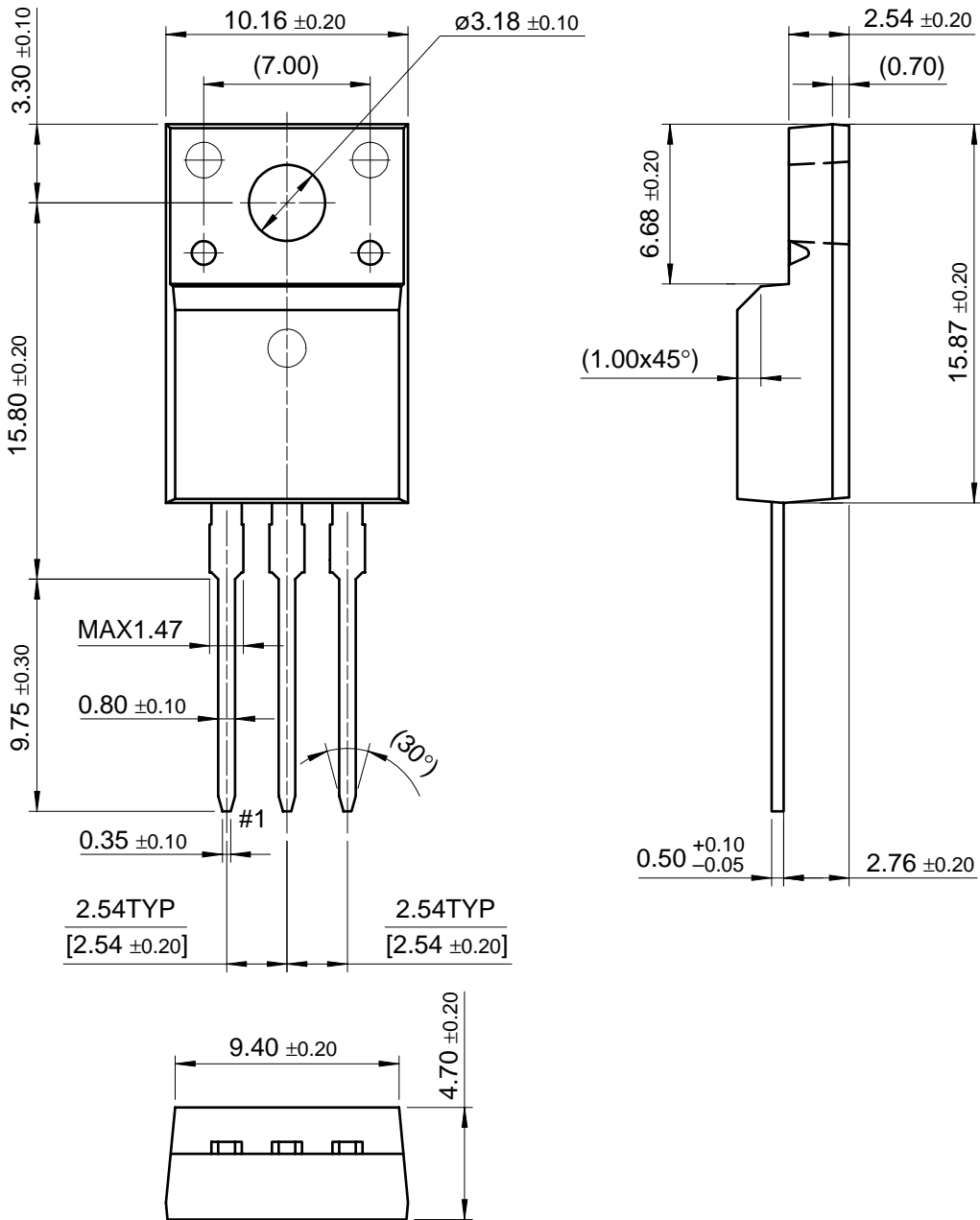
**Fig 16. Turn-Off SOA Characteristics**



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

Package Dimension

TO-220F (FS PKG CODE AQ)



Dimensions in Millimeters

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