

# FGAF40N60UF

## Ultrafast IGBT

### General Description

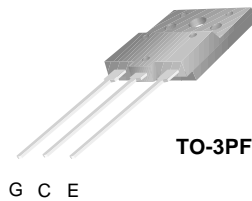
Fairchild's UF series of Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses. The UF series is designed for applications such as motor control and general inverters where high speed switching is a required feature.

### Features

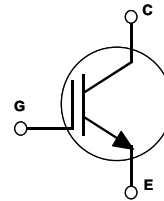
- High speed switching
- Low saturation voltage :  $V_{CE(sat)} = 2.3 \text{ V @ } I_C = 20\text{A}$
- High input impedance

### Applications

AC & DC motor controls, general purpose inverters, robotics, and servo controls.



TO-3PF



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

Symbol	Description	FGAF40N60UF	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	40	A
	Collector Current @ T <sub>C</sub> = 100°C	20	A
I <sub>CM(1)</sub>	Pulsed Collector Current	160	A
P <sub>D</sub>	Maximum Power Dissipation @ T <sub>C</sub> = 25°C	100	W
	Maximum Power Dissipation @ T <sub>C</sub> = 100°C	40	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> (IGBT)	Thermal Resistance, Junction-to-Case	--	1.2	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	--	40	°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 <sub>CES</sub>	Collector-Emitter Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250uA	600	--	--	V
ΔBV <sub>CES</sub> /ΔT <sub>J</sub>	Temperature Coefficient 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	uA
I <sub>GES</sub>	G-E Leakage Current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V	--	--	± 100	nA

### On Characteristics

V <sub>GE(th)</sub>	G-E Threshold Voltage	I <sub>C</sub> = 20mA, V <sub>CE</sub> = V <sub>GE</sub>	3.5	5.1	6.5	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 20A, V <sub>GE</sub> = 15V	--	2.3	3.0	V
		I <sub>C</sub> = 40A, V <sub>GE</sub> = 15V	--	3.1	--	V

### Dynamic Characteristics

C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V, f = 1MHz	--	1075	--	pF
C <sub>oes</sub>	Output Capacitance		--	170	--	pF
C <sub>res</sub>	Reverse Transfer Capacitance		--	50	--	pF

### Switching Characteristics

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 300 V, I <sub>C</sub> = 20A, R <sub>G</sub> = 10Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 25°C	--	15	--	ns	
t <sub>r</sub>	Rise Time		--	30	--	ns	
t <sub>d(off)</sub>	Turn-Off Delay Time		--	65	130	ns	
t <sub>f</sub>	Fall Time		--	35	100	ns	
E <sub>on</sub>	Turn-On Switching Loss		--	470	--	uJ	
E <sub>off</sub>	Turn-Off Switching Loss		--	130	--	uJ	
E <sub>ts</sub>	Total Switching Loss		--	600	1000	uJ	
t <sub>d(on)</sub>	Turn-On Delay Time		V <sub>CC</sub> = 300 V, I <sub>C</sub> = 20A, R <sub>G</sub> = 10Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 125°C	--	30	--	ns
t <sub>r</sub>	Rise Time			--	37	--	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	--		110	200	ns	
t <sub>f</sub>	Fall Time	--		80	250	ns	
E <sub>on</sub>	Turn-On Switching Loss	--		500	--	uJ	
E <sub>off</sub>	Turn-Off Switching Loss	--		310	--	uJ	
E <sub>ts</sub>	Total Switching Loss	--		810	1200	uJ	
Q <sub>g</sub>	Total Gate Charge	V <sub>CE</sub> = 300 V, I <sub>C</sub> = 20A, V <sub>GE</sub> = 15V		--	77	150	nC
Q <sub>ge</sub>	Gate-Emitter Charge			--	20	30	nC
Q <sub>gc</sub>	Gate-Collector Charge		--	25	40	nC	
L <sub>e</sub>	Internal Emitter Inductance	Measured 5mm from PKG	--	14	--	nH	

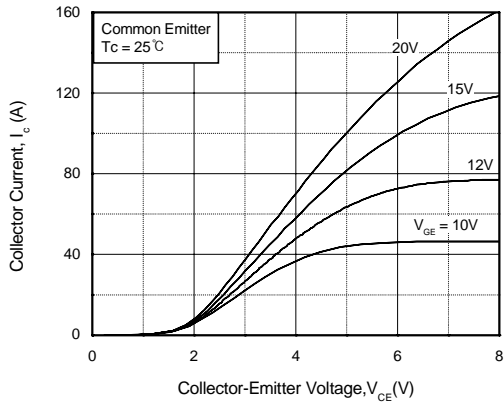


Fig 1. Typical Output Characteristics

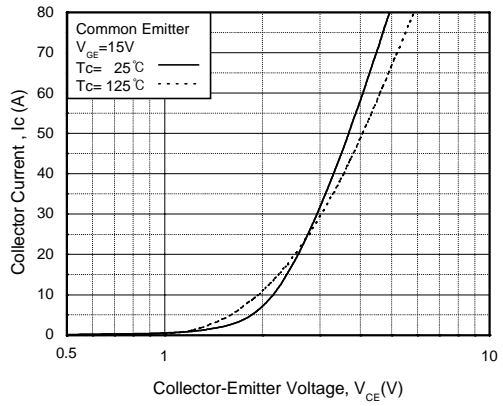


Fig 2. Typical Saturation Voltage Characteristics

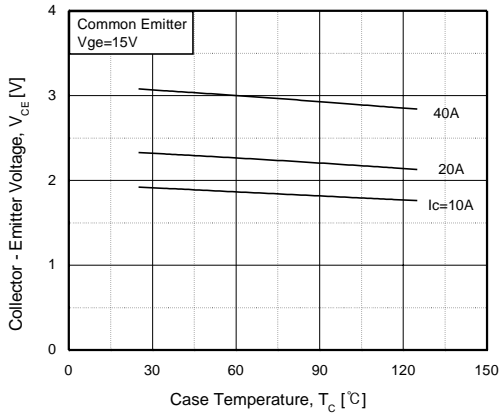


Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

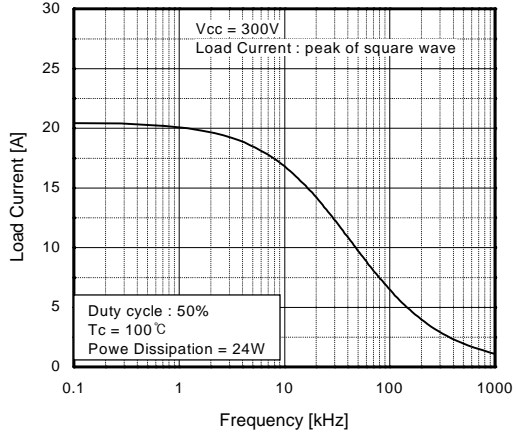


Fig 4. Load Current vs. Frequency

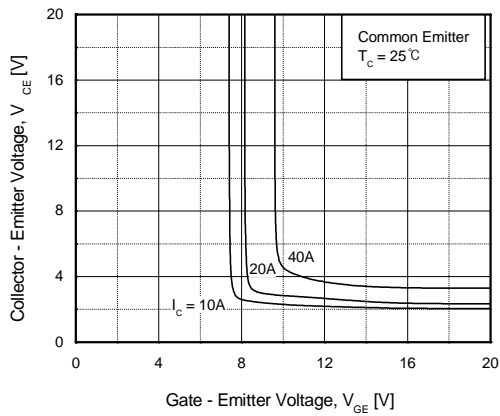


Fig 5. Saturation Voltage vs.  $V_{GE}$

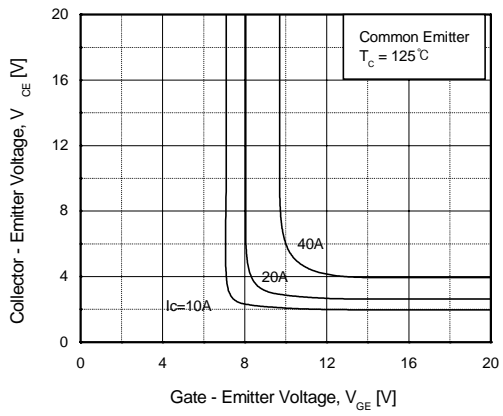


Fig 6. Saturation Voltage vs.  $V_{GE}$

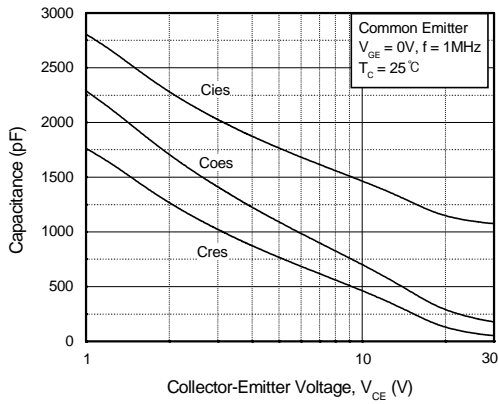


Fig 7. Capacitance Characteristics

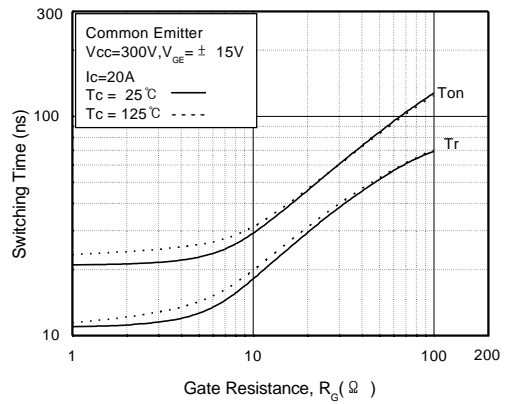


Fig 8. Turn-On Characteristics vs. Gate Resistance

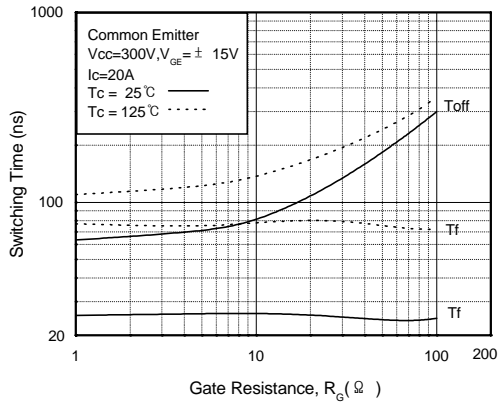


Fig 9. Turn-Off Characteristics vs. Gate Resistance

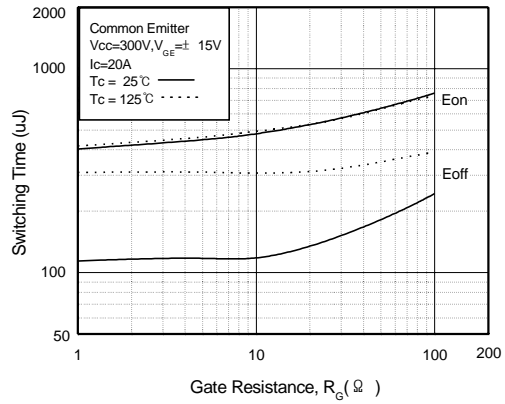


Fig 10. Switching Loss vs. Gate Resistance

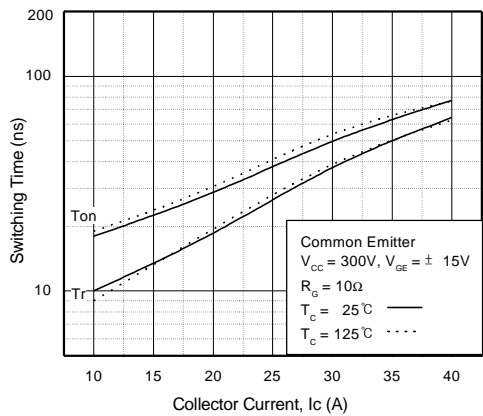


Fig 11. Turn-On Characteristics vs. Collector Current

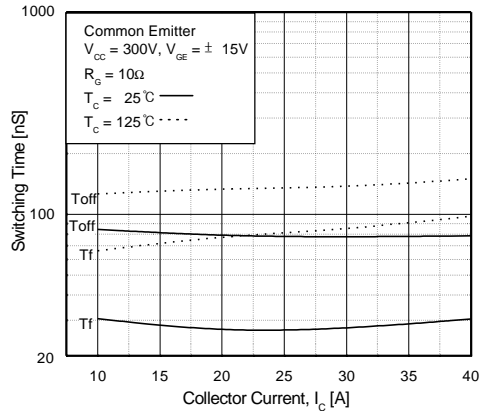
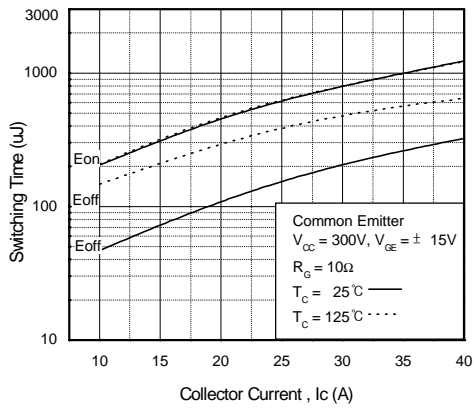
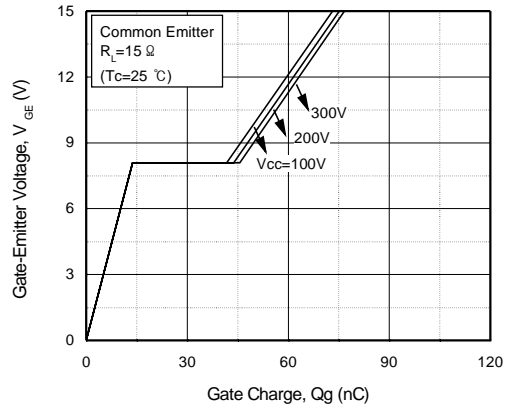


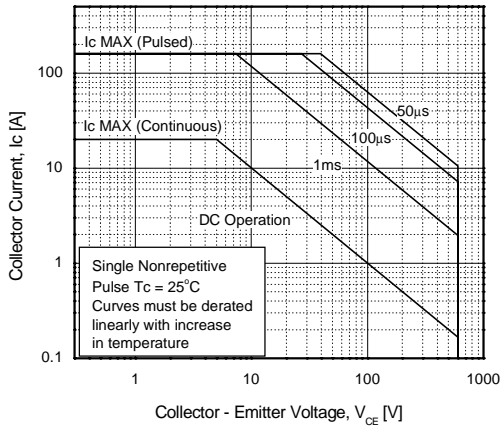
Fig 12. Turn-Off Characteristics vs. Collector Current



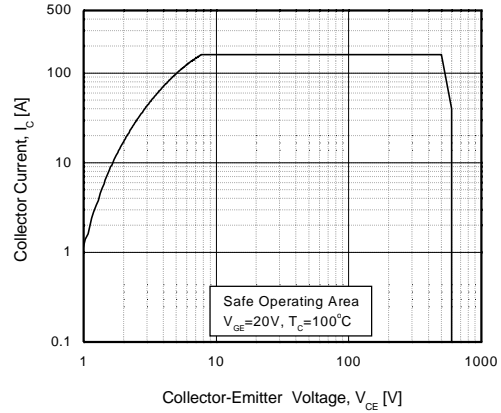
**Fig 13. Switching Loss vs. Collector Current**



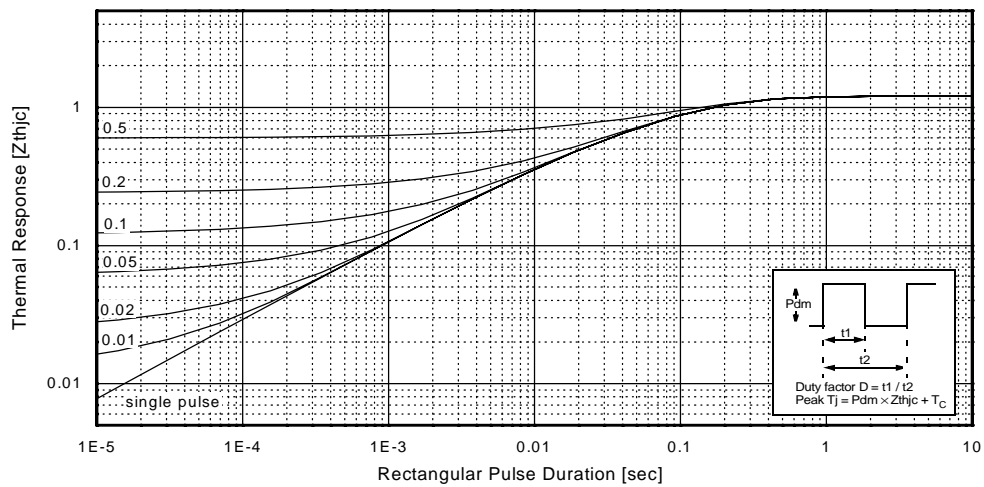
**Fig 14. Gate Charge Characteristics**



**Fig 15. SOA Characteristics**



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

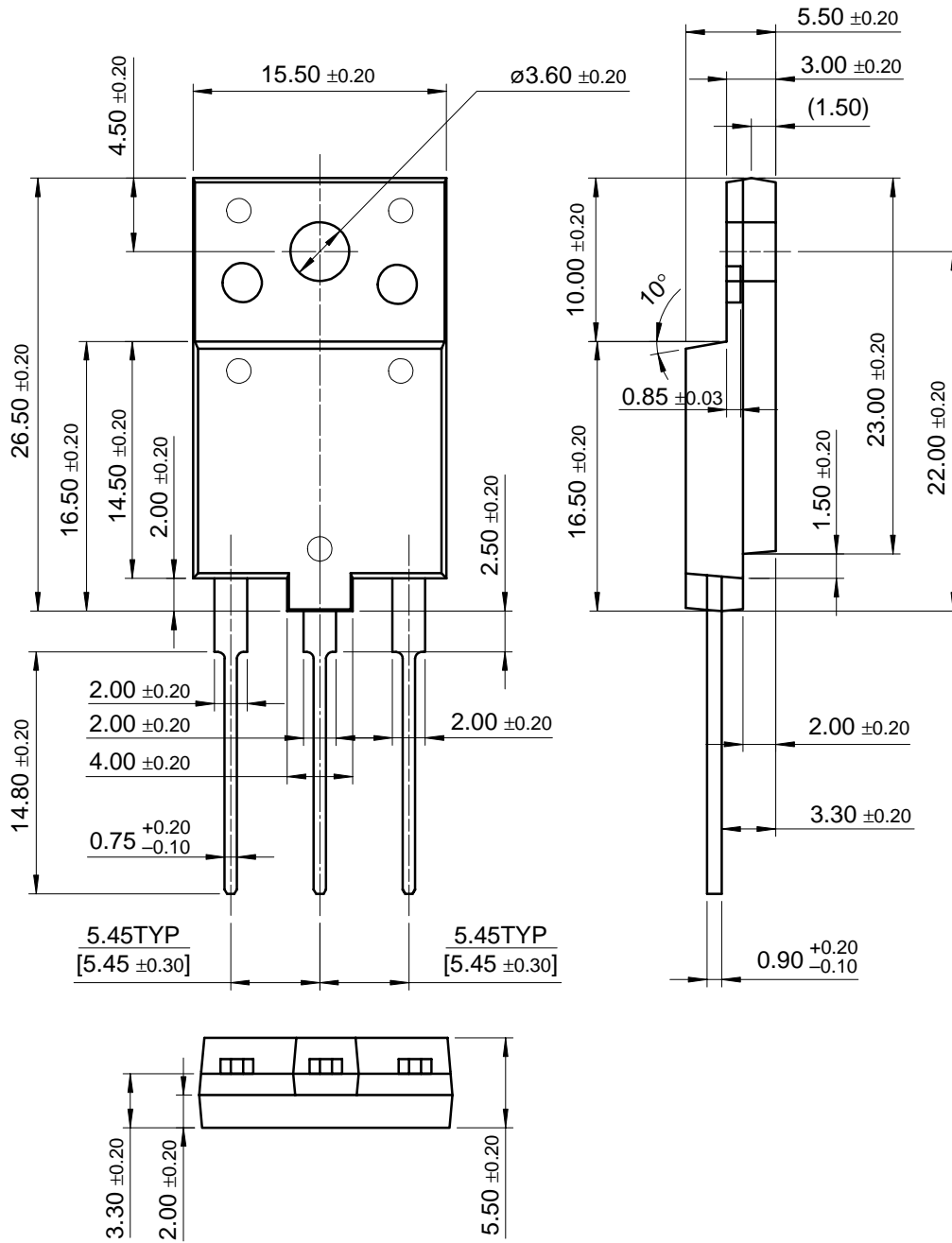


**Fig 17. Transient Thermal Impedance of IGBT**

Package Dimensions

TO-3PF

FGAF40N60UF



Dimensions in Millimeters

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