

# **IGBT**

## **SGH40N60UF**

### **Ultra-Fast IGBT**

#### **General Description**

Fairchild's Insulated Gate Bipolar Transistor(IGBT) UF series provides low conduction and switching losses. UF series is designed for the applications such as motor control and general inverters where High Speed Switching is required.

#### **Features**

- High Speed Switching
- Low Saturation Voltage :  $V_{CE(sat)} = 2.1 \text{ V}$  @  $I_C = 20\text{A}$
- High Input Impedance

#### **Application**

AC & DC Motor controls, General Purpose Inverters, Robotics, Servo Controls



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

Symbol	Description	SGH40N60UF	Units
$V_{CES}$	Collector-Emitter Voltage	600	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	40	A
	Collector Current @ $T_C = 100^\circ\text{C}$	20	A
$I_{CM(1)}$	Pulsed Collector Current	160	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	160	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	64	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 :**

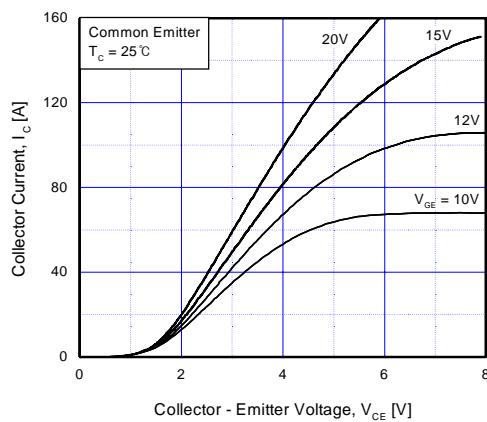
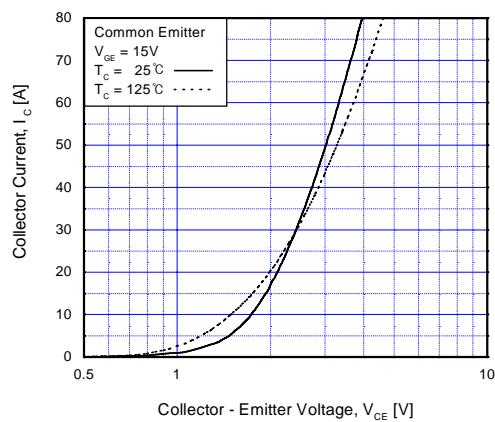
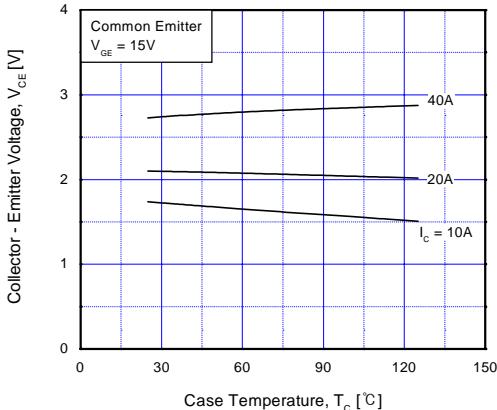
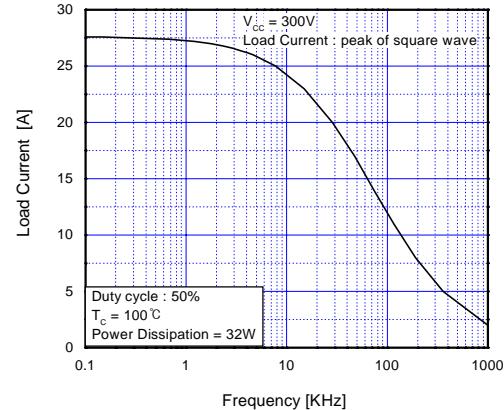
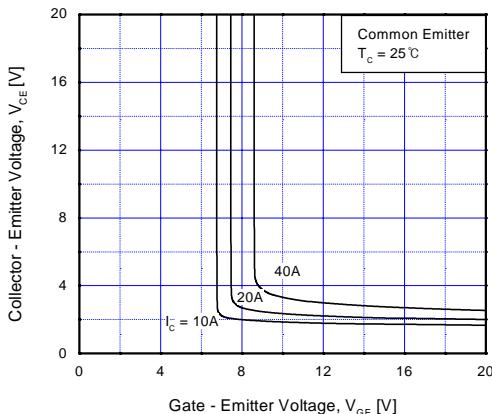
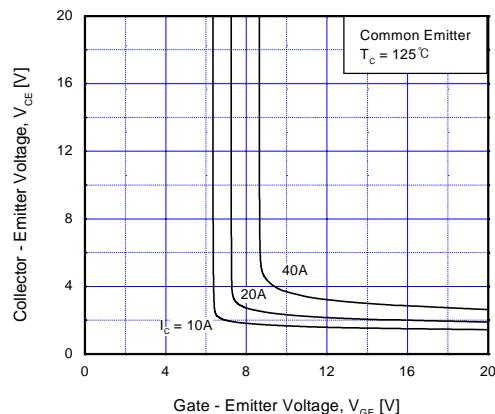
(1) Repetitive rating : Pulse width limited by max. junction temperature

#### **Thermal Characteristics**

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	0.77	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	40	$^\circ\text{C/W}$

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
$BV_{CES}$	Collector-Emitter Breakdown Voltage	$V_{GE} = 0\text{V}$ , $I_C = 250\text{uA}$	600	--	--	V
$\Delta B_{VCES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	$V_{GE} = 0\text{V}$ , $I_C = 1\text{mA}$	--	0.6	--	$\text{V}/^\circ\text{C}$
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}$ , $V_{GE} = 0\text{V}$	--	--	250	$\text{uA}$
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}$ , $V_{CE} = 0\text{V}$	--	--	$\pm 100$	$\text{nA}$
<b>On Characteristics</b>						
$V_{GE(\text{th})}$	G-E Threshold Voltage	$I_C = 20\text{mA}$ , $V_{CE} = V_{GE}$	3.5	4.5	6.5	V
$V_{CE(\text{sat})}$	Collector to Emitter Saturation Voltage	$I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$	--	2.1	2.6	V
		$I_C = 40\text{A}$ , $V_{GE} = 15\text{V}$	--	2.6	--	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30\text{V}$ , $V_{GE} = 0\text{V}$ , $f = 1\text{MHz}$	--	1430	--	pF
$C_{oes}$	Output Capacitance		--	170	--	pF
$C_{res}$	Reverse Transfer Capacitance		--	50	--	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300\text{ V}$ , $I_C = 20\text{A}$ , $R_G = 10\Omega$ , $V_{GE} = 15\text{V}$ , Inductive Load, $T_C = 25^\circ\text{C}$	--	15	--	ns
$t_r$	Rise Time		--	30	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	65	130	ns
$t_f$	Fall Time		--	50	150	ns
$E_{on}$	Turn-On Switching Loss		--	160	--	uJ
$E_{off}$	Turn-Off Switching Loss		--	200	--	uJ
$E_{ts}$	Total Switching Loss		--	360	600	uJ
$t_{d(on)}$	Turn-On Delay Time		--	30	--	ns
$t_r$	Rise Time		--	37	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	110	200	ns
$t_f$	Fall Time	$V_{CC} = 300\text{ V}$ , $I_C = 20\text{A}$ , $R_G = 10\Omega$ , $V_{GE} = 15\text{V}$ , Inductive Load, $T_C = 125^\circ\text{C}$	--	144	250	ns
$E_{on}$	Turn- On Switching Loss		--	310	--	uJ
$E_{off}$	Turn- Off Switching Loss		--	430	--	uJ
$E_{ts}$	Total Switching Loss		--	740	1200	uJ
$Q_g$	Total Gate Charge	$V_{CE} = 300\text{ V}$ , $I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$	--	97	150	nC
$Q_{ge}$	Gate-Emitter Charge		--	20	30	nC
$Q_{gc}$	Gate-Collector Charge		--	25	40	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. VGE**

**Fig 6. Saturation Voltage vs. VGE**

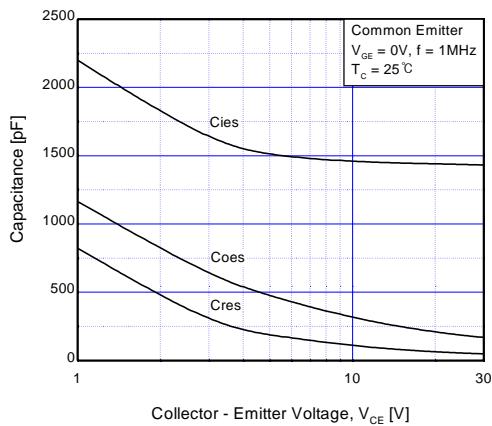


Fig 7. Capacitance Characteristics

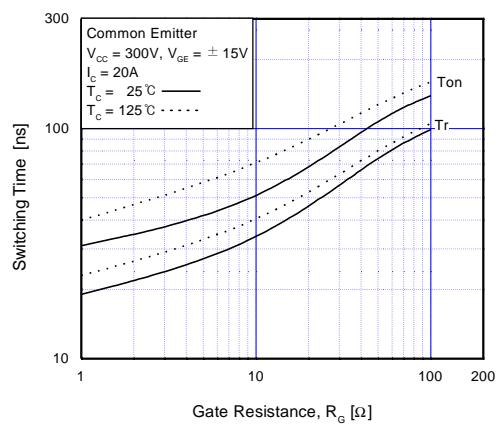


Fig 8. Turn-On Characteristics vs. Gate Resistance

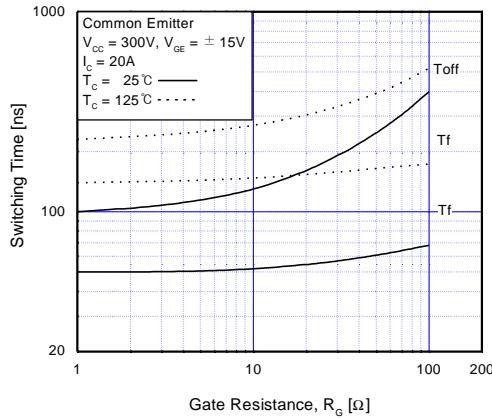


Fig 9. Turn-Off Characteristics vs. Gate Resistance

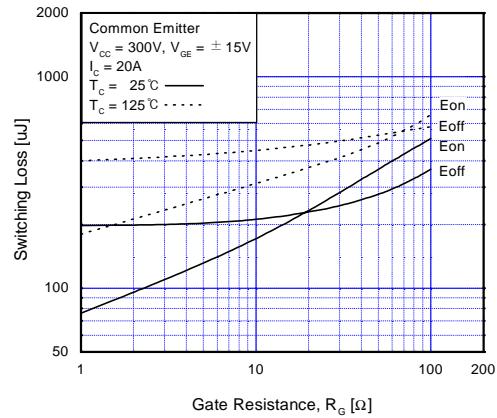


Fig 10. Switching Loss vs. Gate Resistance

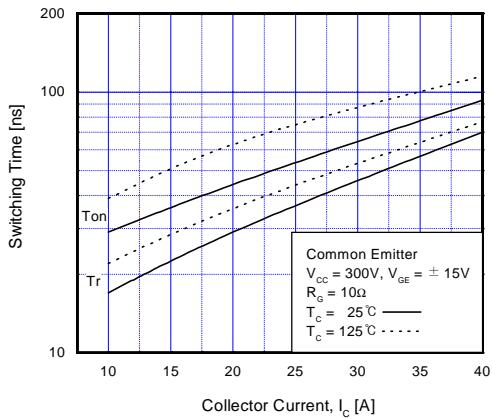


Fig 11. Turn-On Characteristics vs. Collector Current

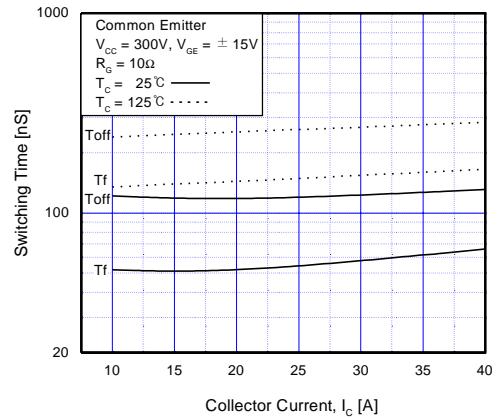


Fig 12. Turn-Off Characteristics vs. Collector Current

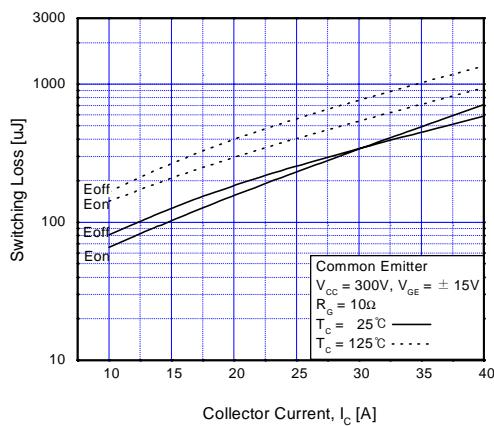


Fig 13. Switching Loss vs. Collector Current

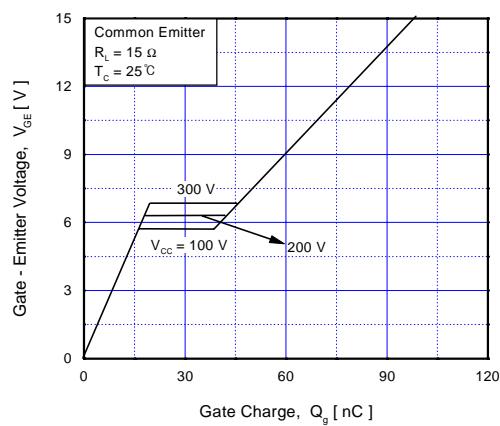


Fig 14. Gate Charge Characteristics

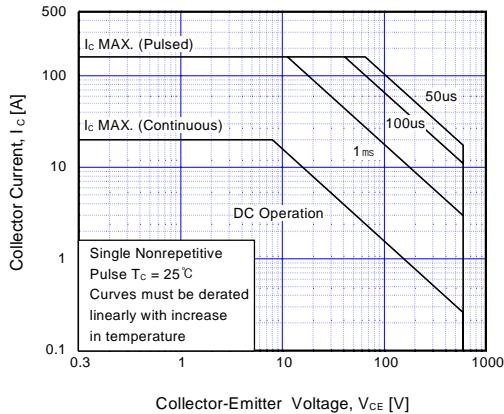


Fig 15. SOA Characteristics

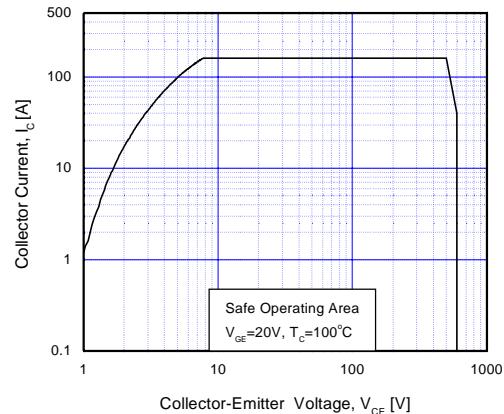


Fig 16. Turn-Off SOA Characteristics

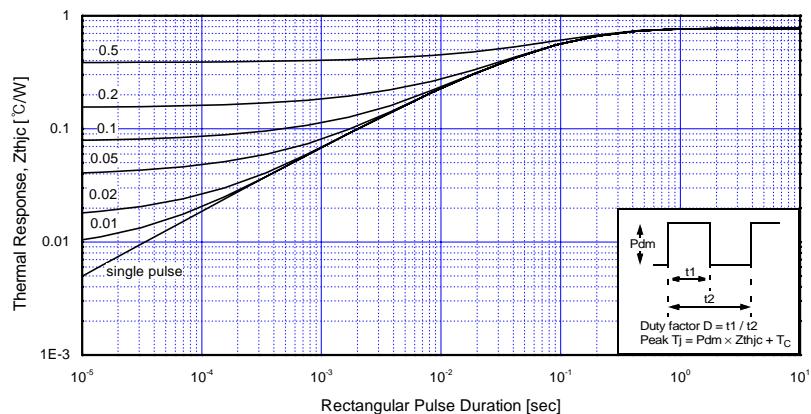


Fig 17. Transient Thermal Impedance of IGBT

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