

# SGH20N60RUFD

## Short Circuit Rated IGBT

### General Description

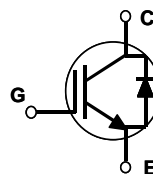
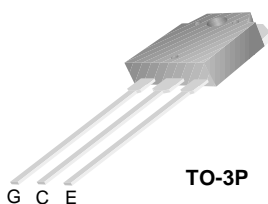
Fairchild's RUF D series of Insulated Gate Bipolar Transistors (IGBTs) provide low conduction and switching losses as well as short circuit ruggedness. The RUF D series is designed for applications such as motor control, uninterrupted power supplies (UPS) and general inverters where short circuit ruggedness is a required feature.

### Features

- Short circuit rated 10us @  $T_C = 100^\circ\text{C}$ ,  $V_{GE} = 15\text{V}$
- High speed switching
- Low saturation voltage :  $V_{CE(sat)} = 2.2\text{V}$  @  $I_C = 20\text{A}$
- High input impedance
- CO-PAK, IGBT with FRD :  $t_{rr} = 50\text{ns}$  (typ.)

### Applications

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	SGH20N60RUFD	Units
$V_{CES}$	Collector-Emitter Voltage	600	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	32	A
	Collector Current @ $T_C = 100^\circ\text{C}$	20	A
$I_{CM(1)}$	Pulsed Collector Current	60	A
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	25	A
$I_{FM}$	Diode Maximum Forward Current	220	A
$T_{SC}$	Short Circuit Withstand Time @ $T_C = 100^\circ\text{C}$	10	us
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	195	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	75	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
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction-to-Case	--	0.64	$^\circ\text{C/W}$
$R_{\theta JC}$ (DIODE)	Thermal Resistance, Junction-to-Case	--	0.83	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	40	$^\circ\text{C/W}$

**Electrical Characteristics of the 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	$V_{GE} = 0V, I_C = 250\mu A$	600	--	--	V
$\Delta BV_{CES}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	--	0.6	--	V/ $^\circ\text{C}$
$I_{CES}$	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

**On Characteristics**

$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 20mA, V_{CE} = V_{GE}$	5.0	6.0	8.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 20A, V_{GE} = 15V$	--	2.2	2.8	V
		$I_C = 32A, V_{GE} = 15V$	--	2.5	--	V

**Dynamic Characteristics**

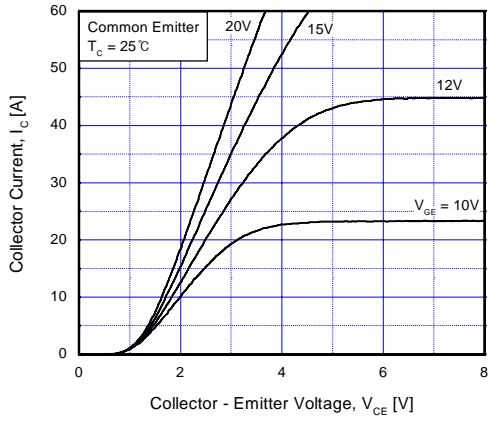
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$	--	1323	--	pF
$C_{oes}$	Output Capacitance		--	254	--	pF
$C_{res}$	Reverse Transfer Capacitance		--	47	--	pF

**Switching Characteristics**

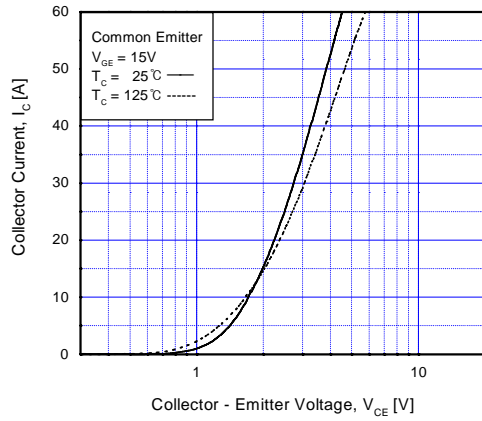
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 20A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ\text{C}$	--	30	--	ns
$t_r$	Rise Time		--	49	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	48	70	ns
$t_f$	Fall Time		--	152	200	ns
$E_{on}$	Turn-On Switching Loss		--	524	--	$\mu J$
$E_{off}$	Turn-Off Switching Loss		--	473	--	$\mu J$
$E_{ts}$	Total Switching Loss	--	997	1400	$\mu J$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 20A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ\text{C}$	--	30	--	ns
$t_r$	Rise Time		--	51	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	52	75	ns
$t_f$	Fall Time		--	311	400	ns
$E_{on}$	Turn-On Switching Loss		--	568	--	$\mu J$
$E_{off}$	Turn-Off Switching Loss		--	1031	--	$\mu J$
$E_{ts}$	Total Switching Loss	--	1599	2240	$\mu J$	
$T_{sc}$	Short Circuit Withstand Time	$V_{CC} = 300V, V_{GE} = 15V$ @ $T_C = 100^\circ\text{C}$	10	--	--	$\mu s$
$Q_g$	Total Gate Charge	$V_{CE} = 300V, I_C = 20A,$ $V_{GE} = 15V$	--	55	80	nC
$Q_{ge}$	Gate-Emitter Charge		--	10	15	nC
$Q_{gc}$	Gate-Collector Charge		--	25	40	nC
$L_e$	Internal Emitter Inductance	Measured 5mm from PKG	--	14	--	nH

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

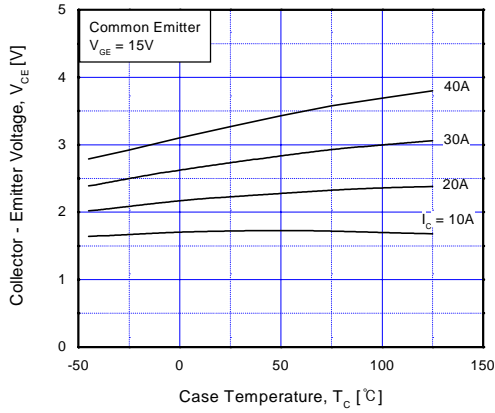
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 25A$	$T_C = 25^\circ\text{C}$	--	1.4	1.7	V
			$T_C = 100^\circ\text{C}$	--	1.3	--	
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 25A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ\text{C}$	--	50	95	ns
			$T_C = 100^\circ\text{C}$	--	105	--	
$I_{rr}$	Diode Peak Reverse Recovery Current	$I_F = 25A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ\text{C}$	--	4.5	10	A
			$T_C = 100^\circ\text{C}$	--	8.5	--	
$Q_{rr}$	Diode Reverse Recovery Charge	$I_F = 25A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ\text{C}$	--	112	375	nC
			$T_C = 100^\circ\text{C}$	--	420	--	



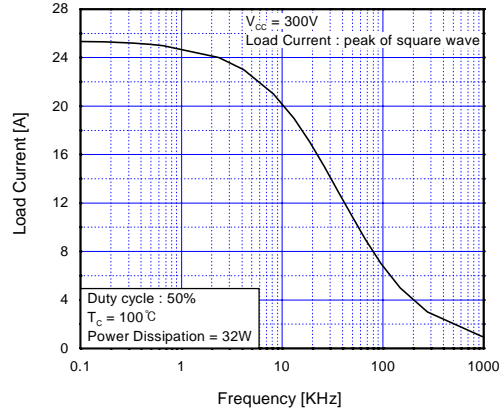
**Fig 1. Typical Output Characteristics**



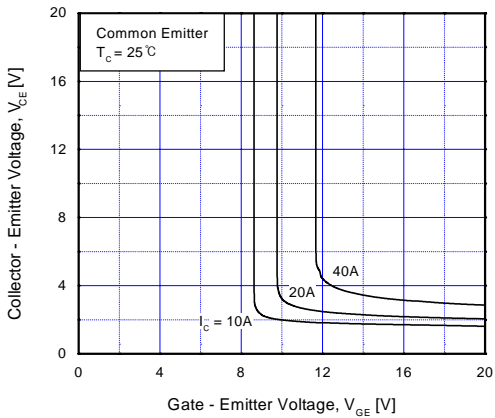
**Fig 2. Typical Saturation Voltage Characteristics**



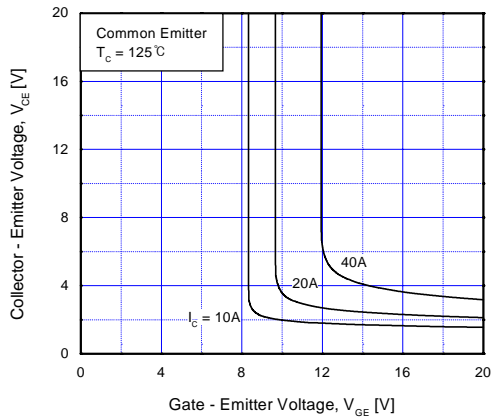
**Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level**



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



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



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

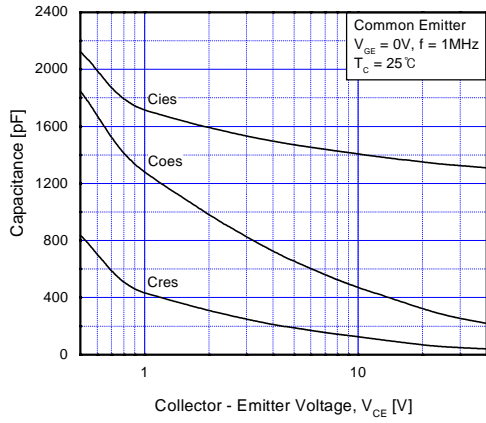


Fig 7. Capacitance Characteristics

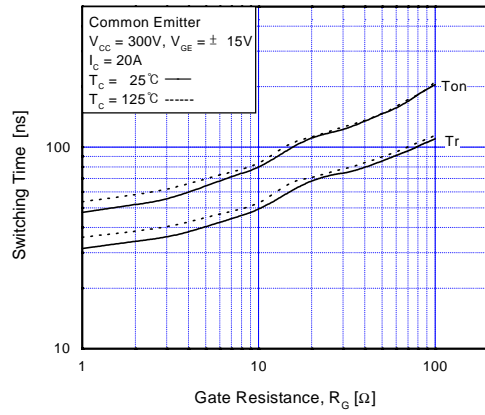


Fig 8. Turn-On Characteristics vs. Gate Resistance

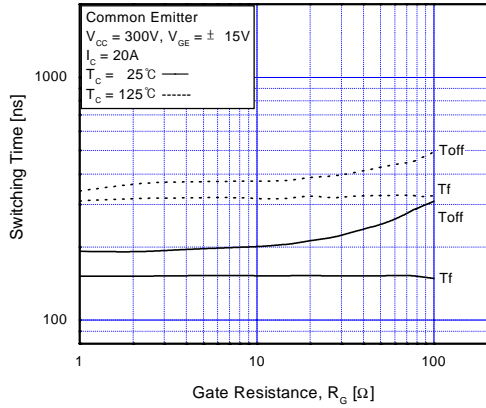


Fig 9. Turn-Off Characteristics vs. Gate Resistance

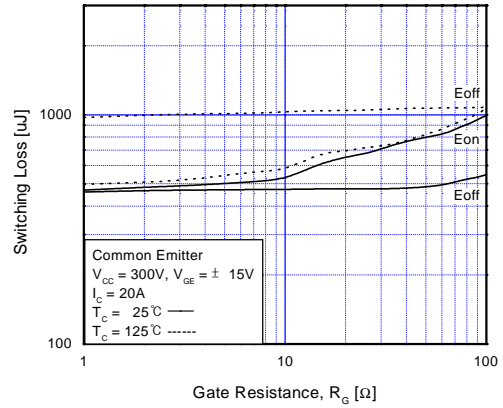


Fig 10. Switching Loss vs. Gate Resistance

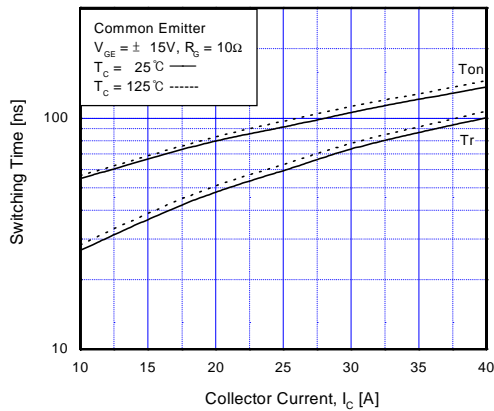


Fig 11. Turn-On Characteristics vs. Collector Current

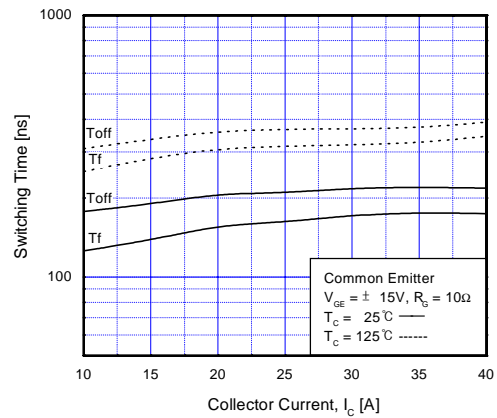
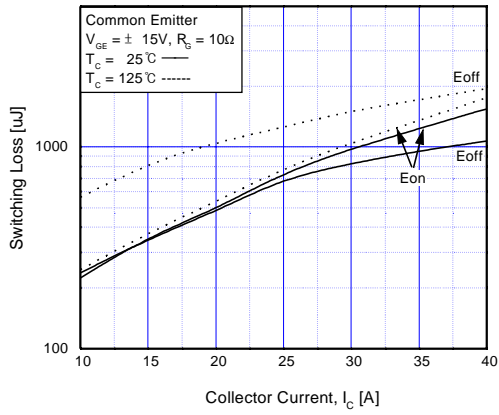
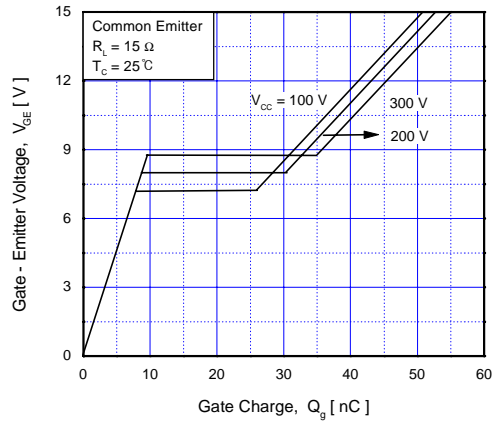


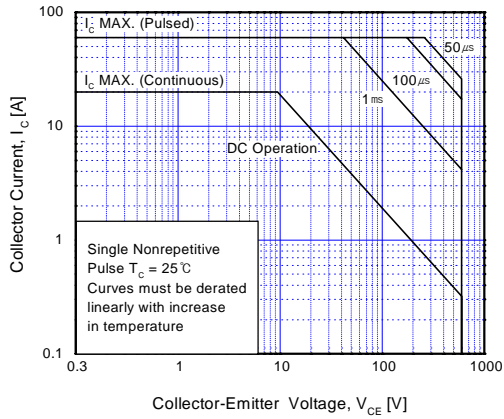
Fig 12. Turn-Off Characteristics vs. Collector Current



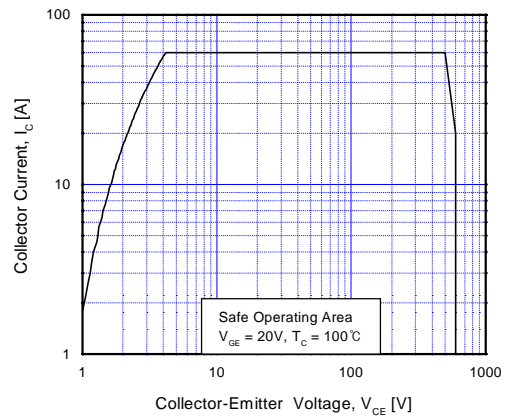
**Fig 13. Switching Loss vs. Collector Current**



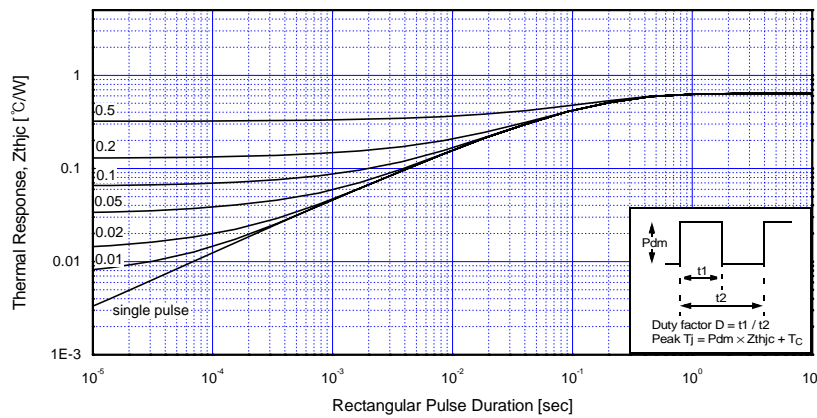
**Fig 14. Gate Charge Characteristics**



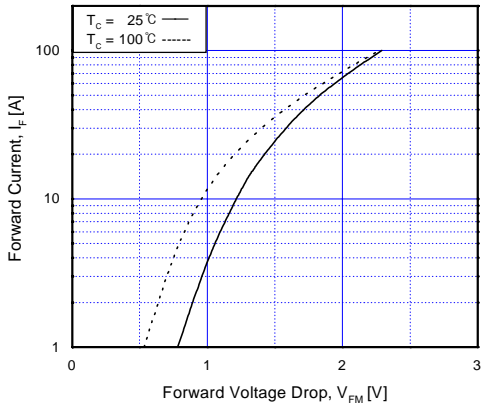
**Fig 15. SOA Characteristics**



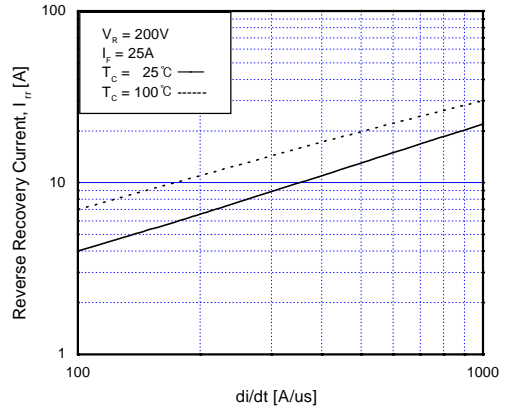
**Fig 16. Turn-Off SOA Characteristics**



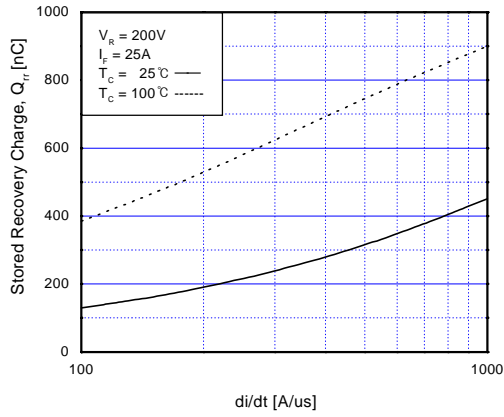
**Fig 17. Transient Thermal Impedance of IGBT**



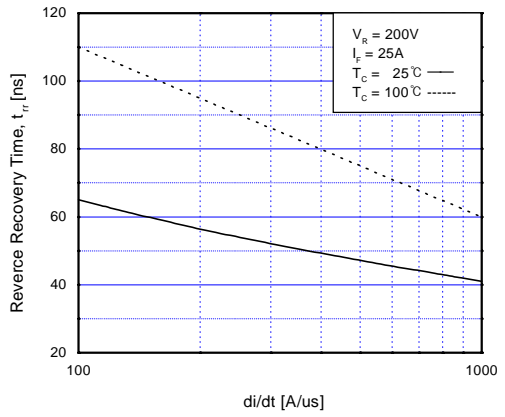
**Fig 18. Forward Characteristics**



**Fig 19. Reverse Recovery Current**



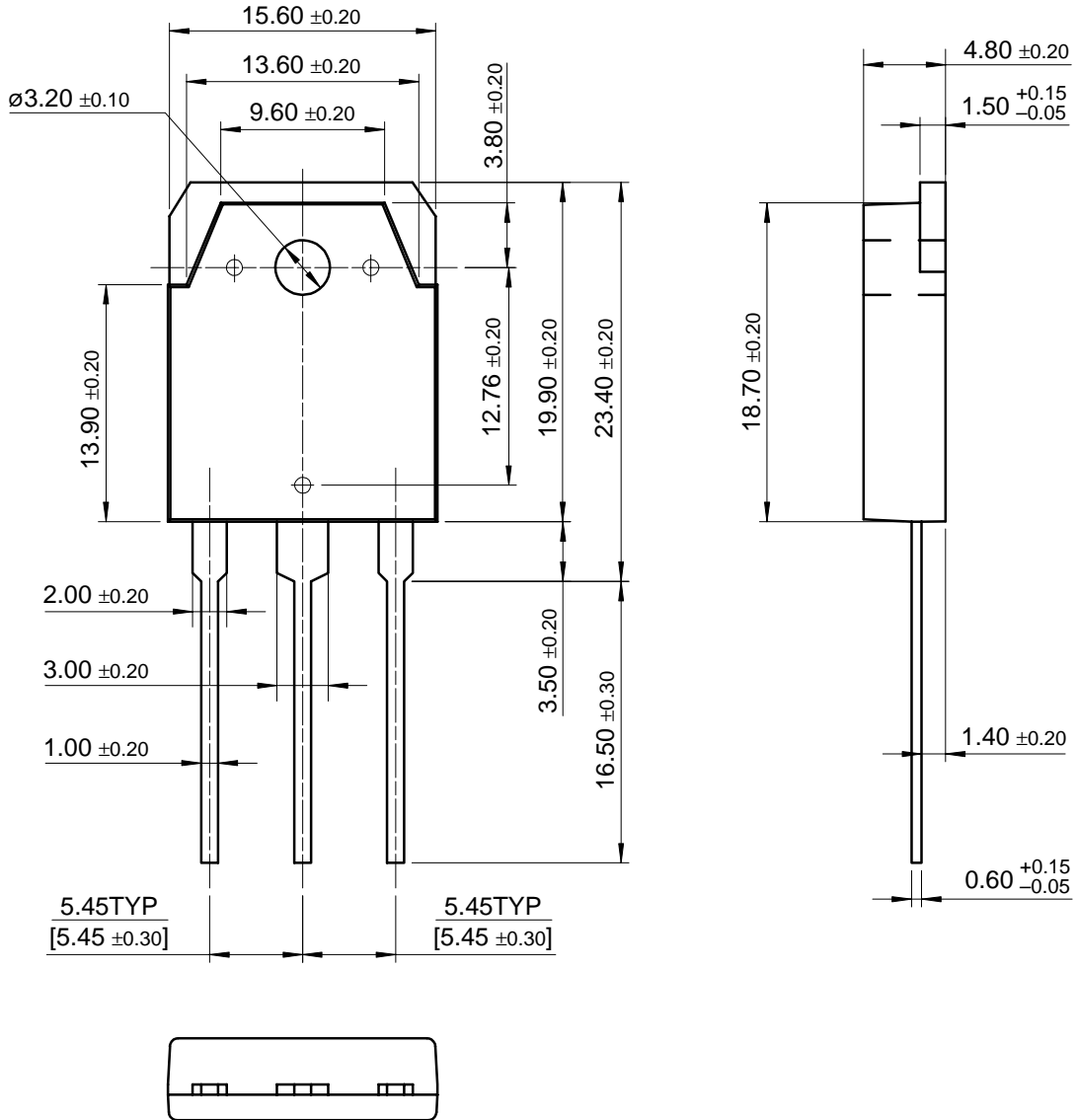
**Fig 20. Stored Charge**



**Fig 21. Reverse Recovery Time**

Package Dimension

TO-3P



SGH20N60RUF-D

Dimensions in Millimeters

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