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# SGS5N60RUF D

## Short Circuit Rated IGBT

### General Description

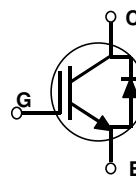
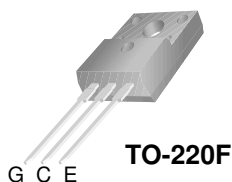
Fairchild's RUF D series of Insulated Gate Bipolar Transistors (IGBTs) provide low conduction and switching losses as well as short circuit ruggedness. The RUF D series is designed for applications such as motor control, uninterrupted power supplies (UPS) and general inverters where short circuit ruggedness 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 :  $V_{CE(\text{sat})} = 2.2\text{V}$  @  $I_C = 5\text{A}$
- High input impedance
- CO-PAK, IGBT with FRD :  $t_{rr} = 37\text{ns}$  (typ.)

### 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	SGS5N60RUF D	Units
$V_{CES}$	Collector-Emitter Voltage	600	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	8	A
	Collector Current @ $T_C = 100^\circ\text{C}$	5	A
$I_{CM(1)}$	Pulsed Collector Current	15	A
$T_{SC}$	Short Circuit Withstand Time @ $T_C = 100^\circ\text{C}$	10	$\mu\text{s}$
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	8	A
$I_{FM}$	Diode Maximum Forward Current	56	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	35	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	14	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	--	3.5	$^\circ\text{C/W}$
$R_{\theta JC}$ (DIODE)	Thermal Resistance, Junction-to-Case	--	5.0	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	$^\circ\text{C/W}$

**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	$V_{GE} = 0V, I_C = 250\mu A$	600	--	--	V
$\Delta BV_{CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	--	0.6	--	$V/^\circ C$
$I_{CES}$	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	$I_C = 5mA, V_{CE} = V_{GE}$	5.0	6.0	8.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 5A, V_{GE} = 15V$	--	2.2	2.8	V
		$I_C = 8A, V_{GE} = 15V$	--	2.5	--	V

**Dynamic Characteristics**

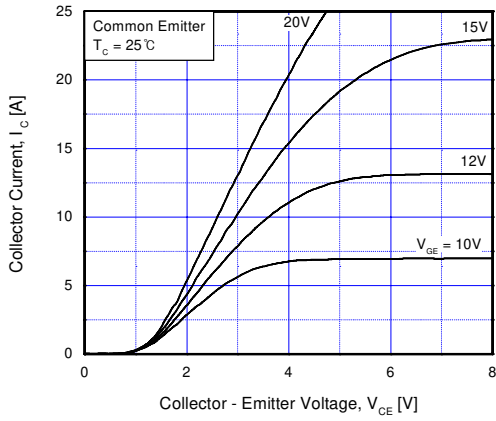
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$	--	354	--	pF
$C_{oes}$	Output Capacitance		--	67	--	pF
$C_{res}$	Reverse Transfer Capacitance		--	14	--	pF

**Switching Characteristics**

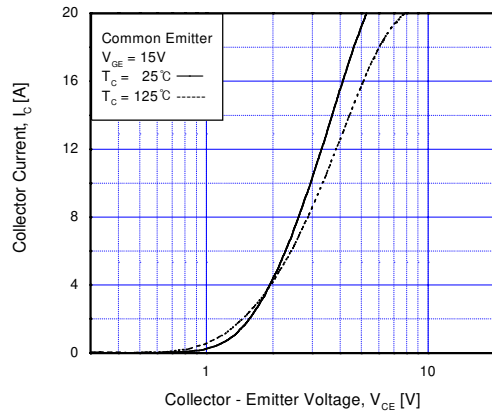
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 5A,$ $R_G = 40\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ C$	--	13	--	ns	
$t_r$	Rise Time		--	24	--	ns	
$t_{d(off)}$	Turn-Off Delay Time		--	34	50	nS	
$t_f$	Fall Time		--	136	200	ns	
$E_{on}$	Turn-On Switching Loss		--	88	--	$\mu J$	
$E_{off}$	Turn-Off Switching Loss		--	107	--	$\mu J$	
$E_{ts}$	Total Switching Loss		--	195	280	$\mu J$	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC} = 300V, I_C = 5A,$ $R_G = 40\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ C$	--	13	--	ns
$t_r$	Rise Time			--	26	--	ns
$t_{d(off)}$	Turn-Off Delay Time			--	40	60	ns
$t_f$	Fall Time	--		250	350	ns	
$E_{on}$	Turn-On Switching Loss	--		103	--	$\mu J$	
$E_{off}$	Turn-Off Switching Loss	--		220	--	$\mu J$	
$E_{ts}$	Total Switching Loss	--		323	--	$\mu J$	
$T_{sc}$	Short Circuit Withstand Time	$V_{CC} = 300V, V_{GE} = 15V$ @ $T_C = 100^\circ C$	10	--	--	$\mu s$	
$Q_g$	Total Gate Charge	$V_{CE} = 300V, I_C = 5A,$ $V_{GE} = 15V$	--	16	24	nC	
$Q_{ge}$	Gate-Emitter Charge		--	3	6	nC	
$Q_{gc}$	Gate-Collector Charge		--	7	14	nC	
$L_e$	Internal Emitter Inductance	Measured 5mm from PKG	--	7.5	--	nH	

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

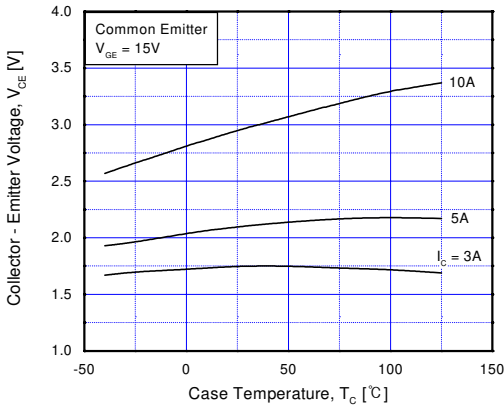
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 8A$	$T_C = 25^\circ C$	--	1.4	1.7	V
			$T_C = 100^\circ C$	--	1.3	--	
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 8A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	37	55	ns
			$T_C = 100^\circ C$	--	55	--	
$I_{rr}$	Diode Peak Reverse Recovery Current	$I_F = 8A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	3.5	5.0	A
			$T_C = 100^\circ C$	--	4.5	--	
$Q_{rr}$	Diode Reverse Recovery Charge	$I_F = 8A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	65	138	nC
			$T_C = 100^\circ C$	--	124	--	



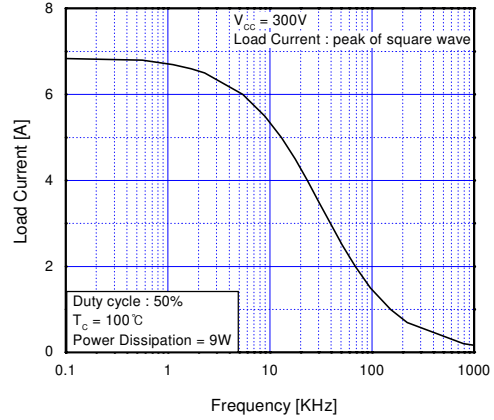
**Fig 1. Typical Output Characteristics**



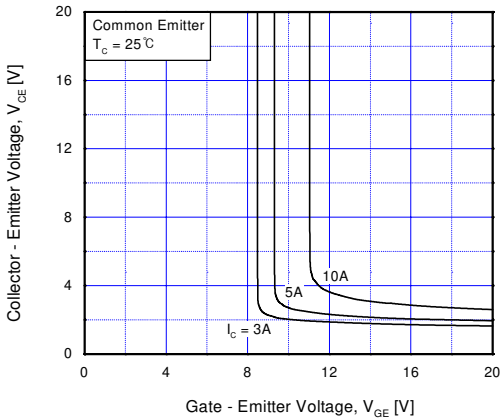
**Fig 2. Typical Saturation Voltage Characteristics**



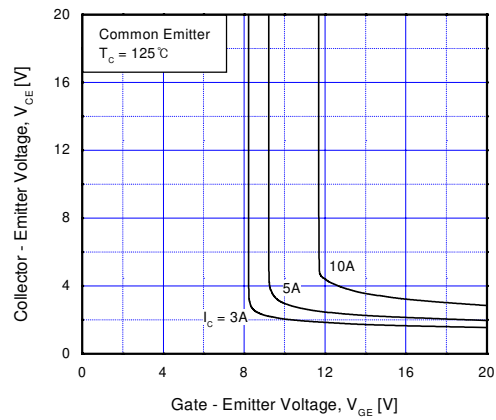
**Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level**



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

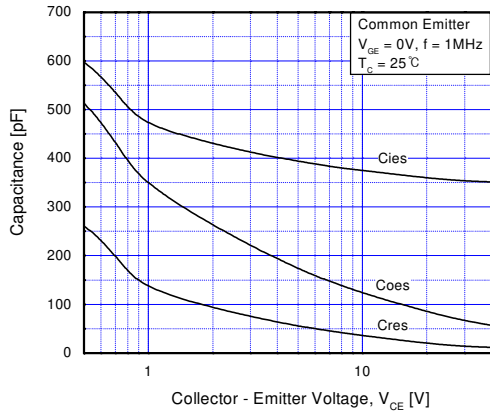


**Fig 5. Saturation Voltage vs.  $V_{GE}$**

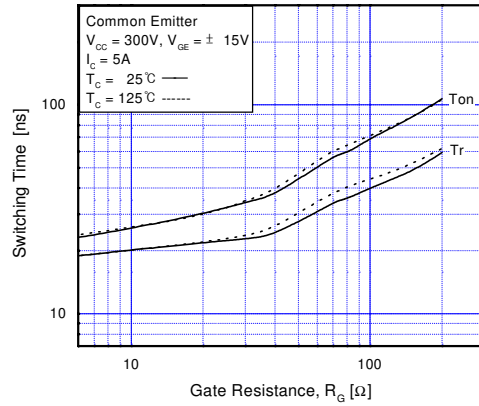


**Fig 6. Saturation Voltage vs.  $V_{GE}$**

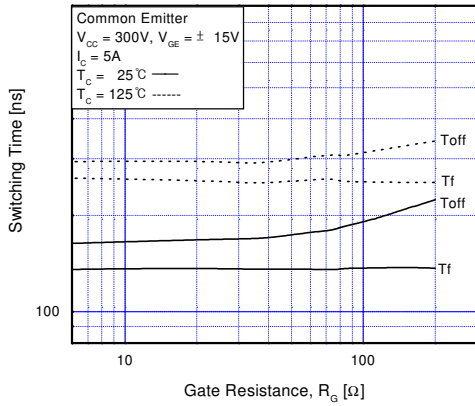




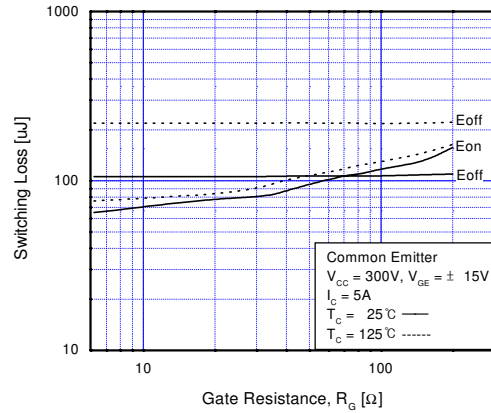
**Fig 7. Capacitance Characteristics**



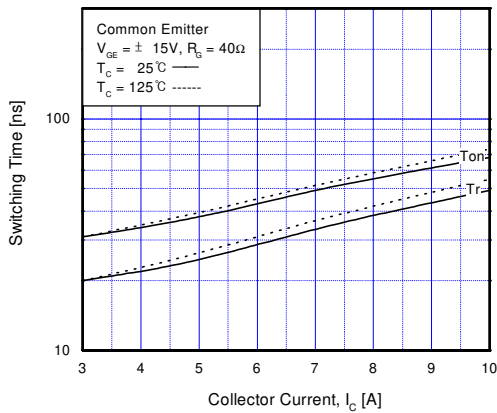
**Fig 8. Turn-On Characteristics vs. Gate Resistance**



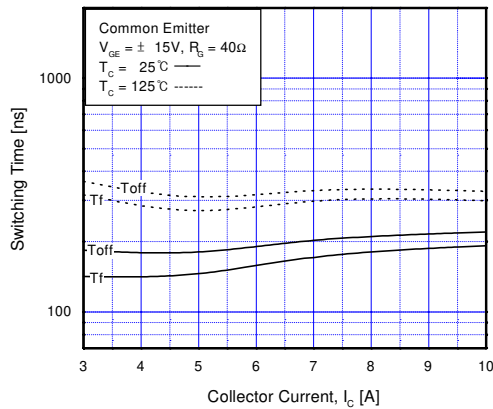
**Fig 9. Turn-Off Characteristics vs. Gate Resistance**



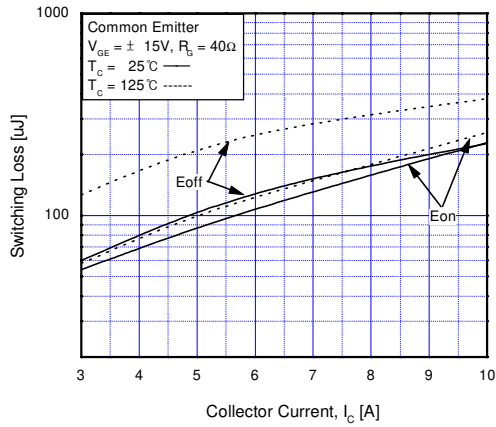
**Fig 10. Switching Loss vs. Gate Resistance**



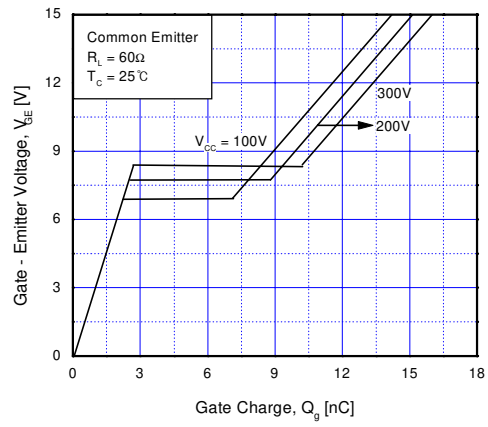
**Fig 11. Turn-On Characteristics vs. Collector Current**



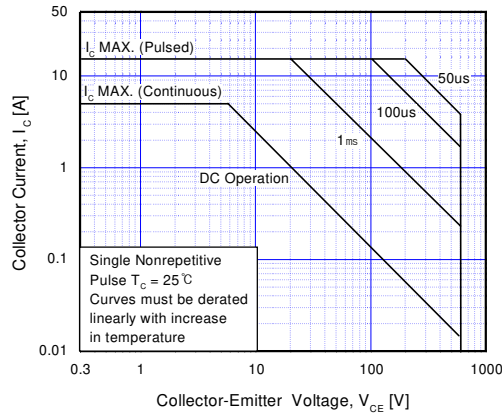
**Fig 12. Turn-Off Characteristics vs. Collector Current**



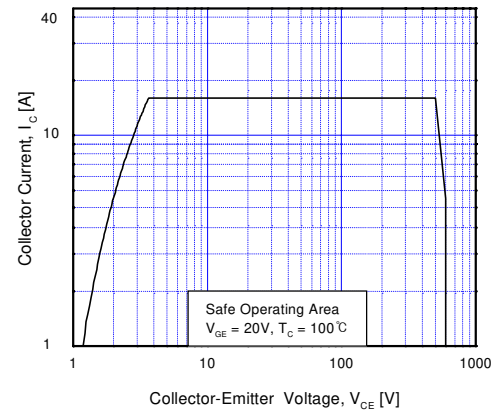
**Fig 13. Switching Loss vs. Collector Current**



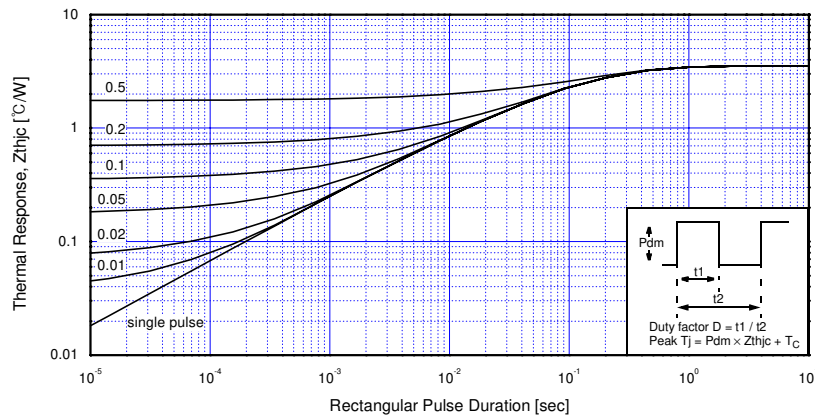
**Fig 14. Gate Charge Characteristics**



**Fig 15. SOA Characteristic**



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



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

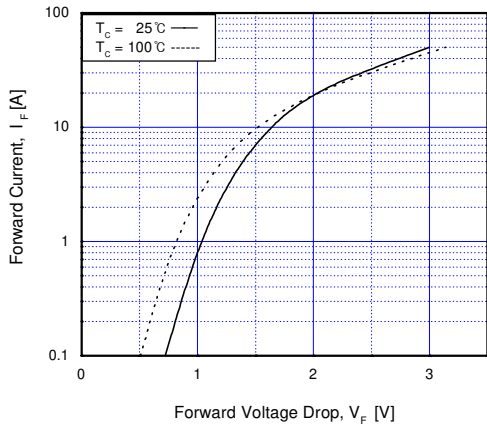


Fig 18. Forward Characteristics

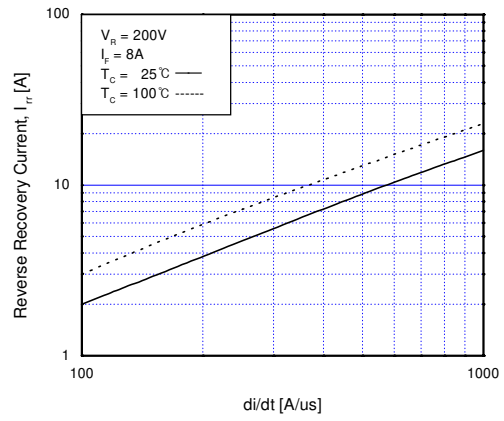


Fig 19. Reverse Recovery Current

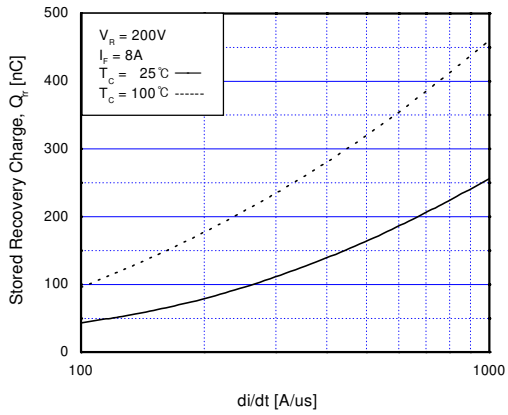


Fig 20. Stored Charge

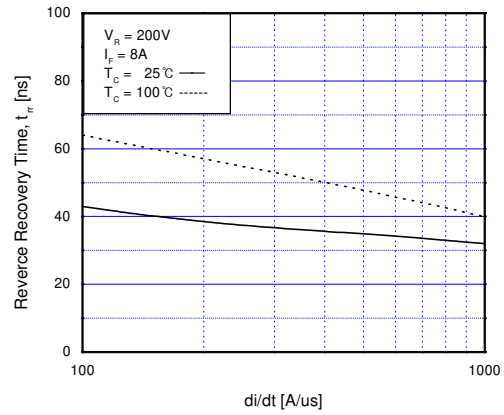
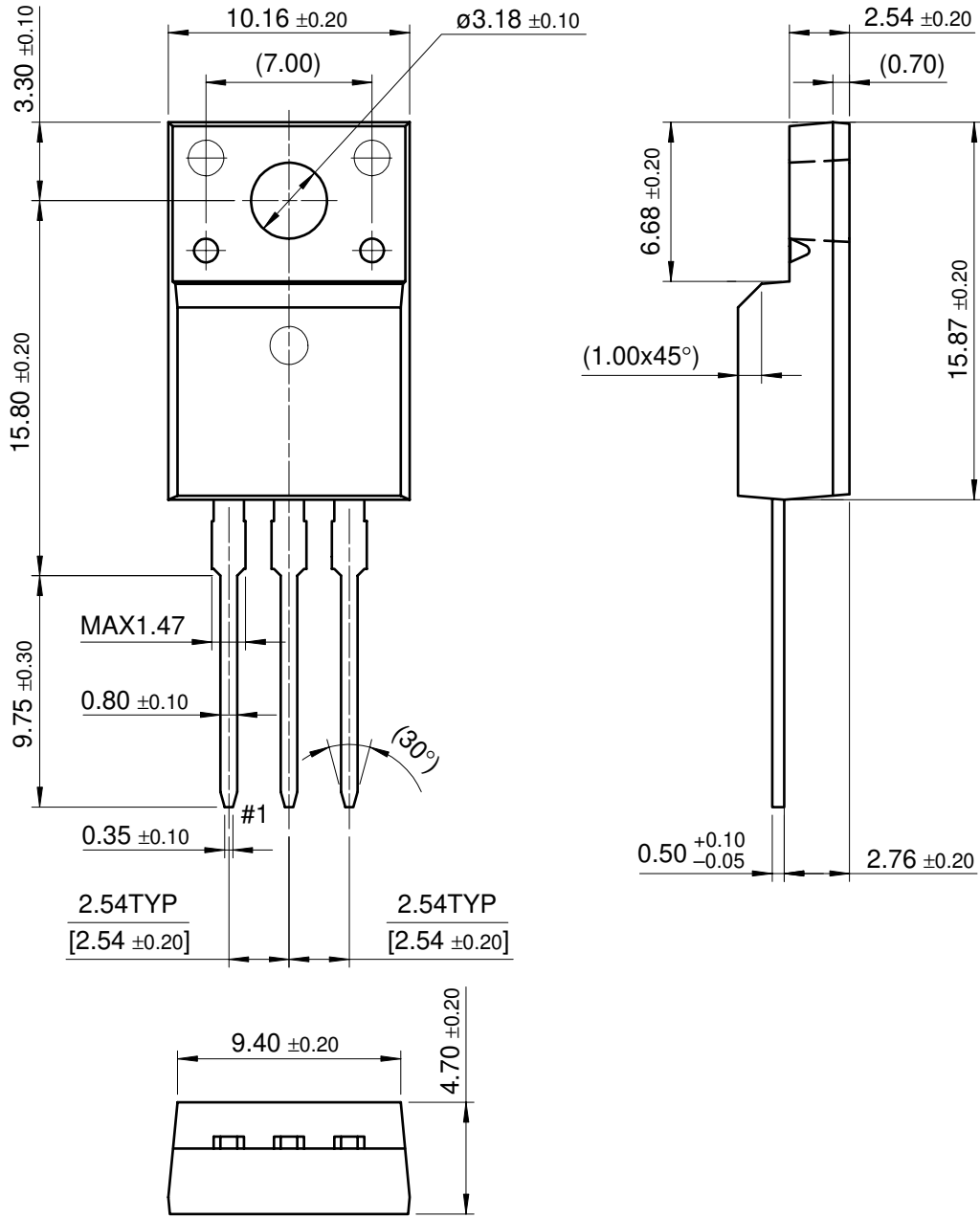


Fig 21. Reverse Recovery Time

Package Dimension

TO-220F (FS PKG CODE AQ)



Dimensions in Millimeters



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