

## SGP5N60RUF

### Short Circuit Rated IGBT

#### General Description

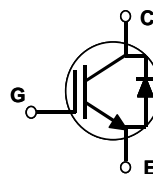
Fairchild's RUF series of Insulated Gate Bipolar Transistors (IGBTs) provide low conduction and switching losses as well as short circuit ruggedness. The RUF series is designed for applications such as motor control, uninterrupted power supplies (UPS) and general inverters where short circuit ruggedness 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 :  $V_{CE(sat)} = 2.2\text{V}$  @  $I_C = 5\text{A}$
- High input impedance
- CO-PAK, IGBT with FRD :  $t_{rr} = 37\text{ns}$  (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	SGP5N60RUF	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
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	8	A
$I_{FM}$	Diode Maximum Forward Current	56	A
$T_{SC}$	Short Circuit Withstand Time @ $T_C = 100^\circ\text{C}$	10	us
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	60	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	25	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	--	2.0	$^\circ\text{C/W}$
$R_{\theta JC}$ (DIODE)	Thermal Resistance, Junction-to-Case	--	1.25	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	$^\circ\text{C/W}$

**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	--	$V/^\circ C$
$I_{CES}$	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**

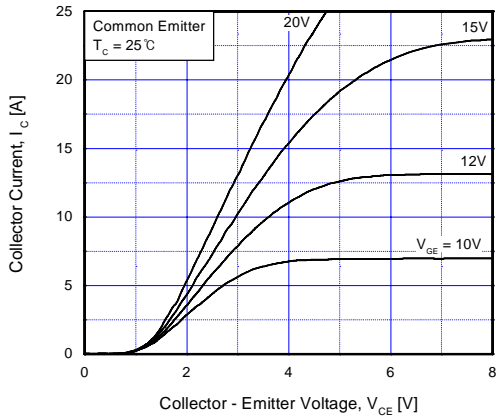
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$	--	354	--	pF
$C_{oes}$	Output Capacitance		--	67	--	pF
$C_{res}$	Reverse Transfer Capacitance		--	14	--	pF

**Switching Characteristics**

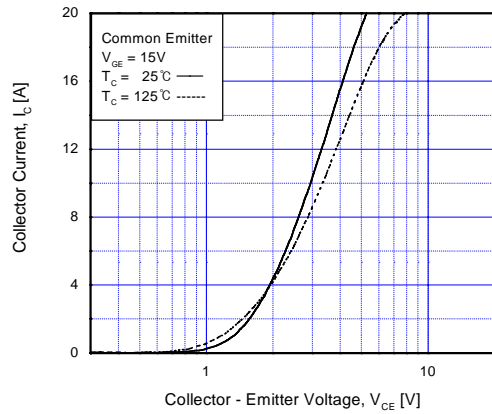
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 5A,$ $R_G = 40\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ C$	--	13	--	ns
$t_r$	Rise Time		--	24	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	34	50	ns
$t_f$	Fall Time		--	136	200	ns
$E_{on}$	Turn-On Switching Loss		--	88	--	$\mu J$
$E_{off}$	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

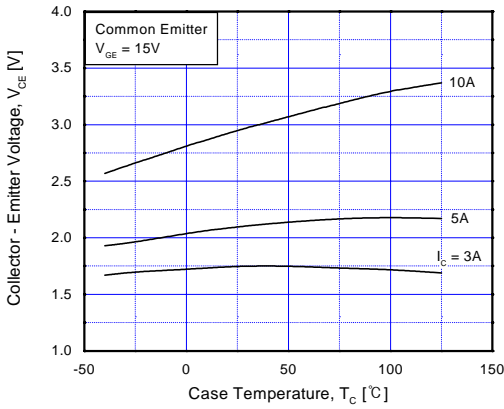
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 8A$	$T_C = 25^\circ C$	--	1.4	1.7	V
			$T_C = 100^\circ C$	--	1.3	--	
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 8A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	37	55	ns
			$T_C = 100^\circ C$	--	55	--	
$I_{rr}$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



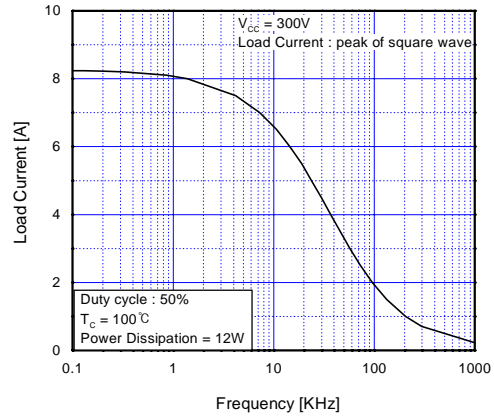
**Fig 1. Typical Output Characteristics**



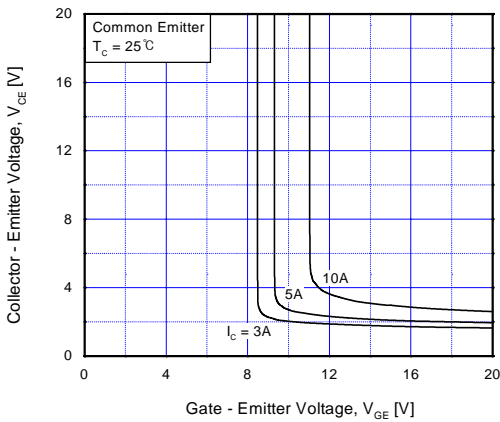
**Fig 2. Typical Saturation Voltage Characteristics**



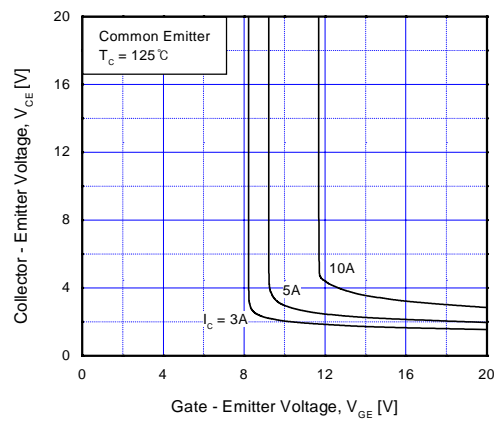
**Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level**



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



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



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

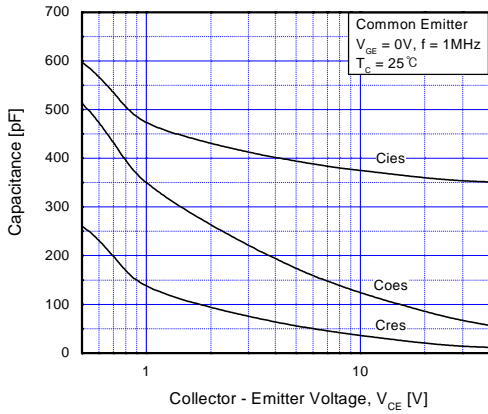


Fig 7. Capacitance Characteristics

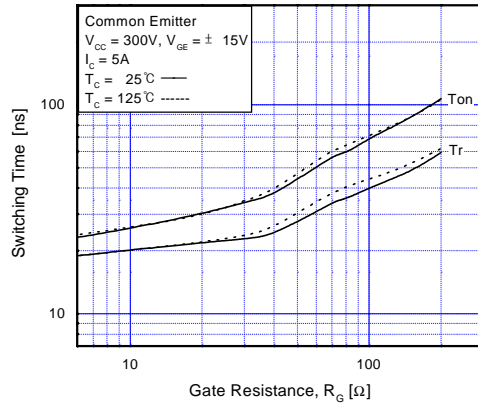


Fig 8. Turn-On Characteristics vs. Gate Resistance

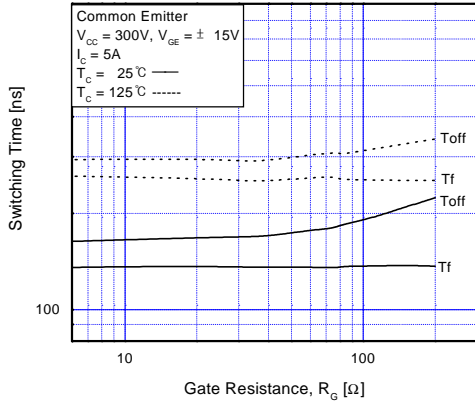


Fig 9. Turn-Off Characteristics vs. Gate Resistance

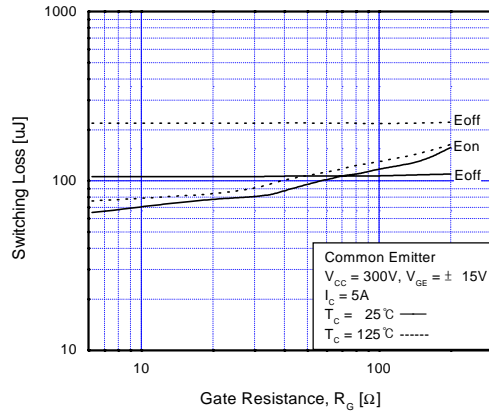


Fig 10. Switching Loss vs. Gate Resistance

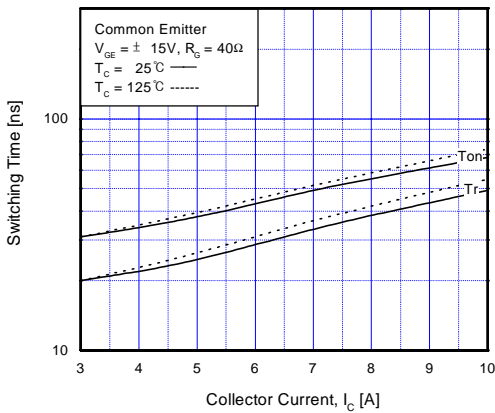


Fig 11. Turn-On Characteristics vs. Collector Current

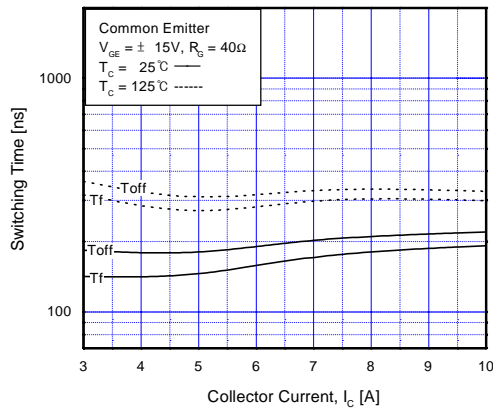
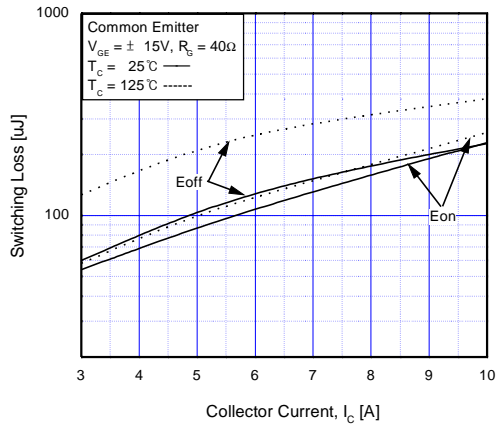
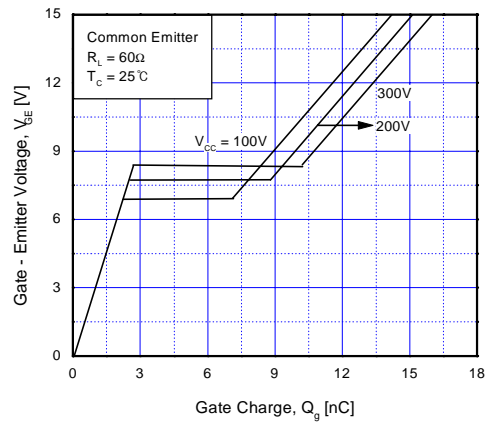


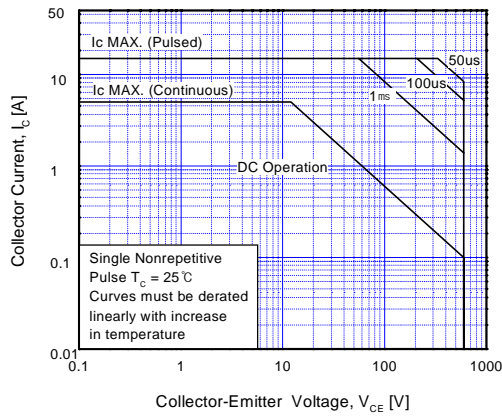
Fig 12. Turn-Off Characteristics vs. Collector Current



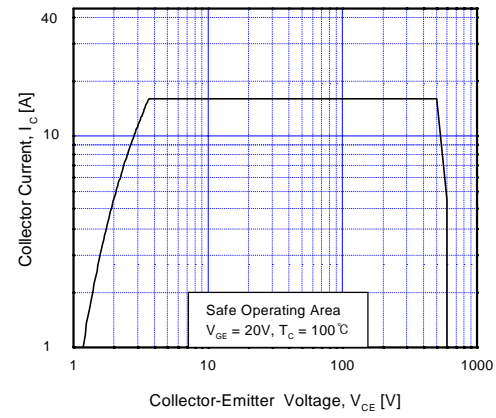
**Fig 13. Switching Loss vs. Collector Current**



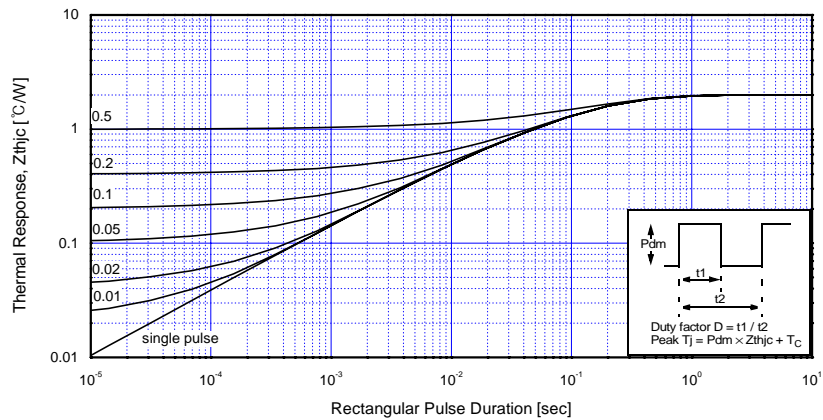
**Fig 14. Gate Charge Characteristics**



**Fig 15. SOA Characteristic**



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



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

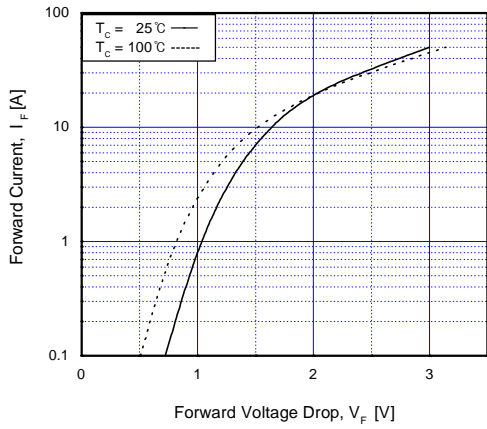


Fig 18. Forward Characteristics

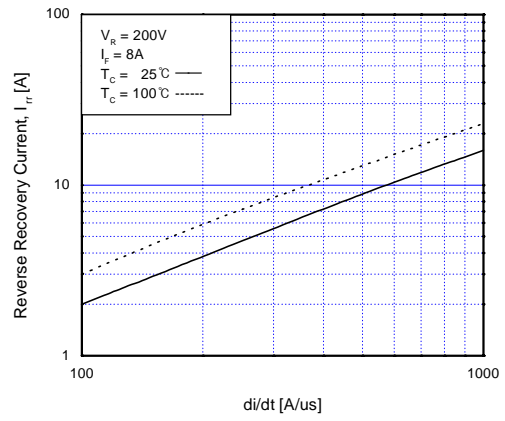


Fig 19. Reverse Recovery Current

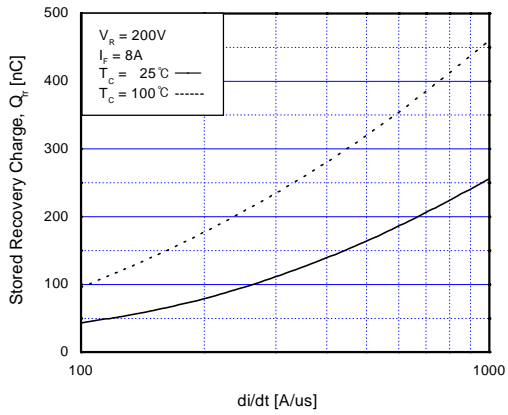


Fig 20. Stored Charge

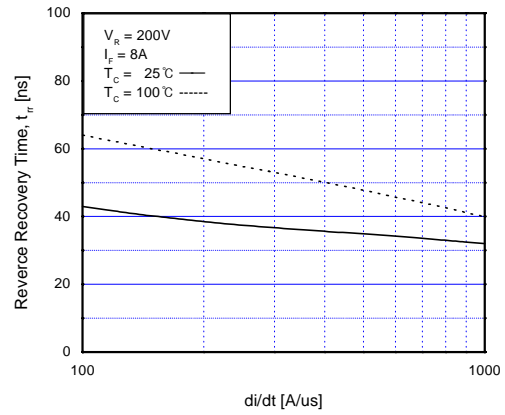
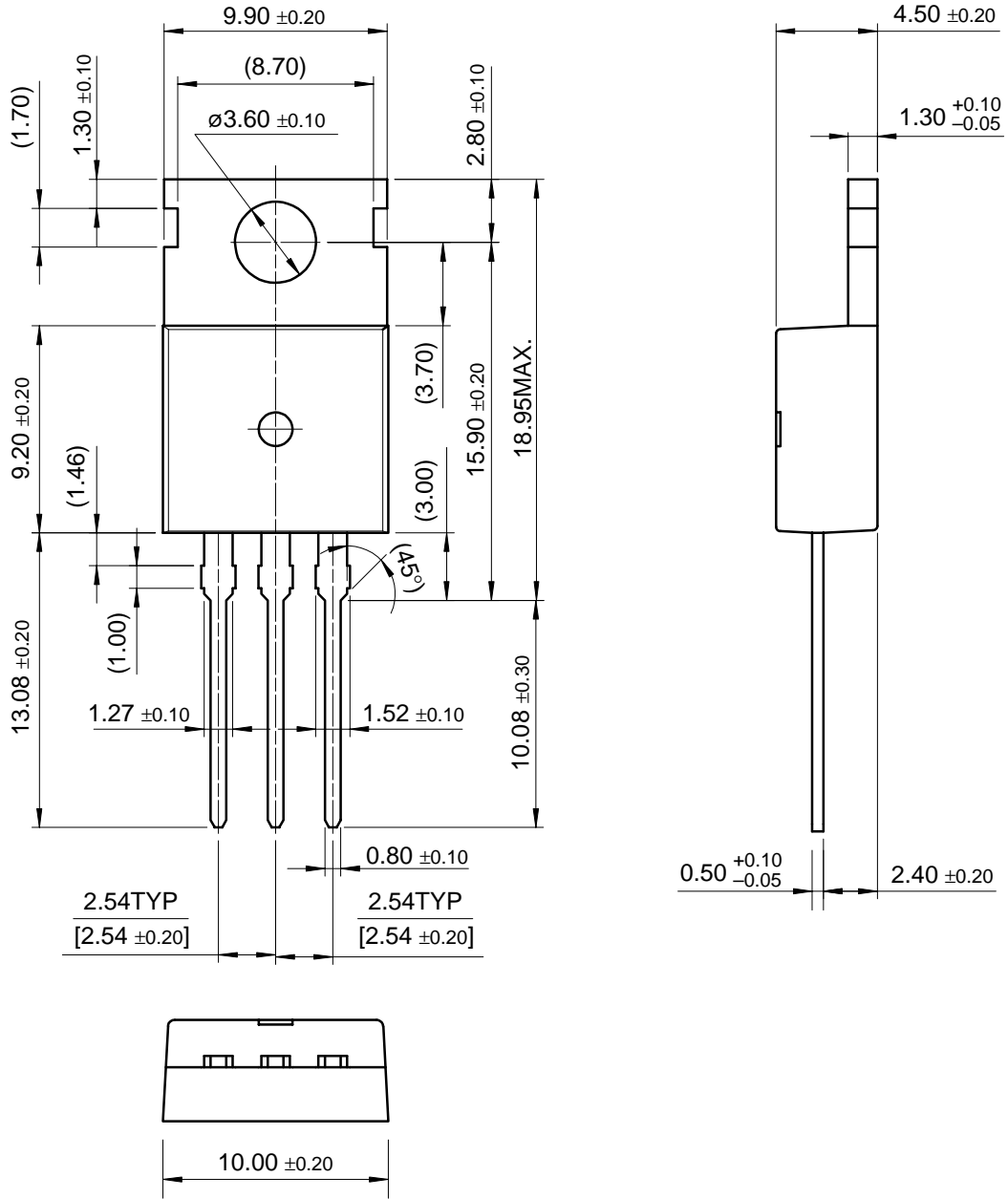


Fig 21. Reverse Recovery Time

Package Dimension

TO-220



Dimensions in Millimeters

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DOMETM	HiSeC™	Power247™	SuperSOT™-3	
EcoSPARK™	I <sup>2</sup> C™	PowerTrench®	SuperSOT™-6	
E <sup>2</sup> CMOS™	ISOPLANAR™	QFET™	SuperSOT™-8	
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