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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

FAIRCHILD SEMICONDUCTOR TM

April 2001

IGBT

SGS23N60UFD

Ultra-Fast IGBT

General Description

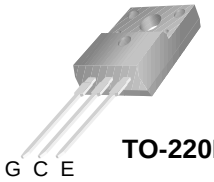
Fairchild's UFD series of Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses. The UFD series is designed for applications such as motor control and general inverters where high speed switching is a required feature.

Features

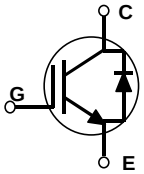
- High speed switching
- Low saturation voltage : $V_{CE(sat)}$ = 2.1 V @ I_C = 12A
- High input impedance
- CO-PAK, IGBT with FRD : t_{rr} = 42ns (typ.)

Application

AC & DC Motor controls, general purpose inverters, robotics, servo controls



TO-220F



Absolute Maximum Ratings

T_C = 25°C unless otherwise noted

Symbol	Description		SGS23N60UFD	Units
V_{CES}	Collector-Emitter Voltage		600	V
V_{GES}	Gate-Emitter Voltage		± 20	V
I_C	Collector Current	@ T_C = 25°C	23	A
	Collector Current	@ T_C = 100°C	12	A
$I_{CM\ (1)}$	Pulsed Collector Current		92	A
I_F	Diode Continuous Forward Current	@ T_C = 100°C	12	A
I_{FM}	Diode Maximum Forward Current		92	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	73	W
	Maximum Power Dissipation	@ T_C = 100°C	29	W
T_J	Operating Junction Temperature		-55 to +150	°C
T_{stg}	Storage Temperature Range		-55 to +150	°C
T_L	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
$R_{\theta JC}$(IGBT)	Thermal Resistance, Junction-to-Case	--	1.7	°C/W
$R_{\theta JC}$(DIODE)	Thermal Resistance, Junction-to-Case	--	1.2	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	°C/W

Electrical Characteristics of IGBT T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV_{CES}	Collector-Emitter Breakdown Voltage	V_{GE} = 0V, I_C = 250uA	600	--	--	V
$\Delta B_{VCES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	V_{GE} = 0V, I_C = 1mA	--	0.6	--	V/°C
I_{CES}	Collector Cut-off Current	V_{CE} = V_{CES}, V_{GE} = 0V	--	--	250	uA
I_{GES}	G-E Leakage Current	V_{GE} = V_{GES}, V_{CE} = 0V	--	--	± 100	µA
On Characteristics						
$V_{GE(th)}$	G-E Threshold Voltage	I_C = 12mA, V_{CE} = V_{GE}	3.5	4.5	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 12A, V_{GE} = 15V	--	2.1	2.6	V
		I_C = 23A, V_{GE} = 15V	--	2.6	--	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30V, V_{GE} = 0V, f = 1MHz	--	720	--	pF
C_{oes}	Output Capacitance		--	100	--	pF
C_{res}	Reverse Transfer Capacitance		--	25	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300 V, I_C = 12A, R_G = 23Ω, V_{GE} = 15V, Inductive Load, T_C = 25°C	--	17	--	ns
t_r	Rise Time		--	27	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	60	130	ns
t_f	Fall Time		--	70	150	ns
E_{on}	Turn-On Switching Loss		--	115	--	µJ
E_{off}	Turn-Off Switching Loss		--	135	--	µJ
E_{ts}	Total Switching Loss		--	250	400	µJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300 V, I_C = 12A, R_G = 23Ω, V_{GE} = 15V, Inductive Load, T_C = 125°C	--	23	--	ns
t_r	Rise Time		--	32	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	100	200	ns
t_f	Fall Time		--	220	250	ns
E_{on}	Turn - On Switching Loss		--	205	--	µJ
E_{off}	Turn - Off Switching Loss		--	320	--	µJ
E_{ts}	Total Switching Loss		--	525	800	µJ
Q_g	Total Gate Charge	V_{CE} = 300 V, I_C = 12A, V_{GE} = 15V	--	49	80	nC
Q_{ge}	Gate-Emitter Charge		--	11	17	nC
Q_{gc}	Gate-Collector Charge		--	14	22	nC
Le	Internal Emitter Inductance	Measured 5mm from PKG	--	7.5	--	nH

Electrical Characteristics of DIODE T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
V_{FM}	Diode Forward Voltage	I_F = 12A	T_C = 25°C	--	1.4	1.7	V
			T_C = 100°C	--	1.3	--	
t_{rr}	Diode Reverse Recovery Time	I_F = 12A, di/dt = 200A/µs	T_C = 25°C	--	42	60	ns
			T_C = 100°C	--	80	--	
I_{rr}	Diode Peak Reverse Recovery Current		T_C = 25°C	--	3.5	6.0	A
			T_C = 100°C	--	5.6	--	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	--	80	180	nC
			T_C = 100°C	--	220	--	

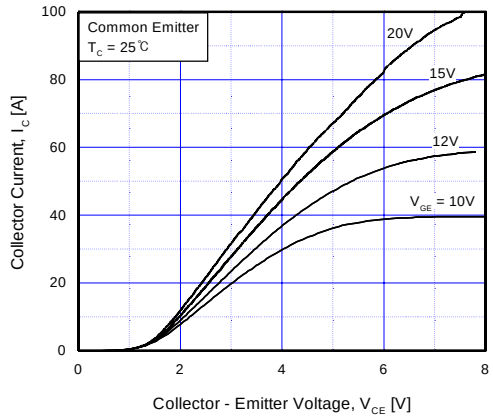


Fig 1. Typical Output Chacracteristics

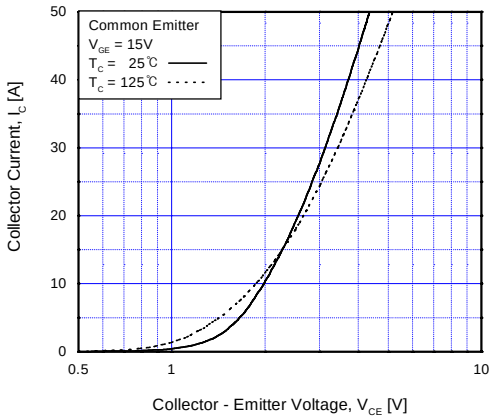


Fig 2. Typical Saturation Voltage Characteristics

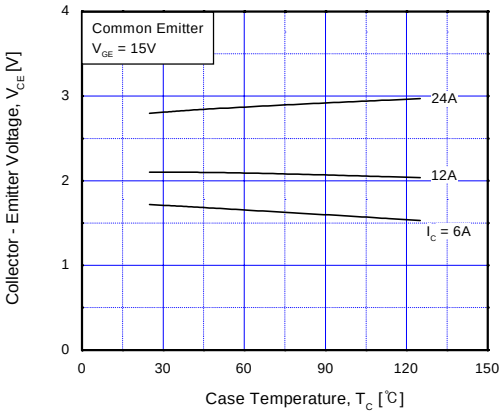


Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

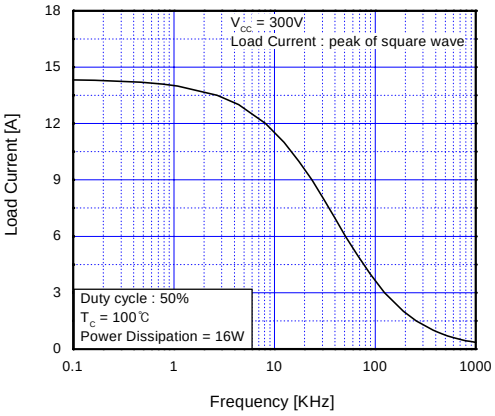


Fig 4. Load Current vs. Frequency

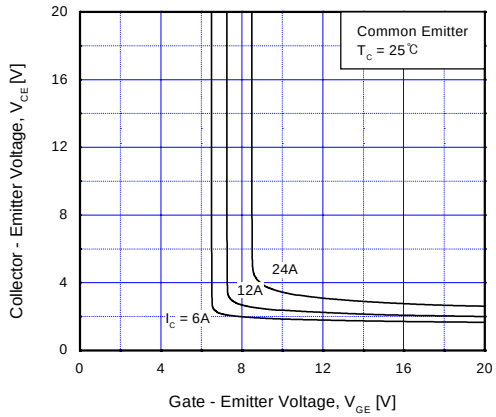


Fig 5. Saturation Voltage vs. V_{GE}

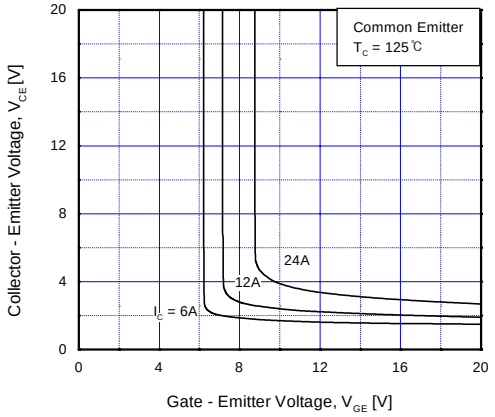


Fig 6. Saturation Voltage vs. V_{GE}

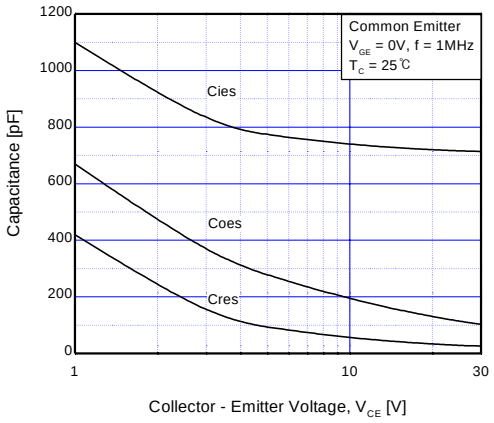


Fig 7. Capacitance Characteristics

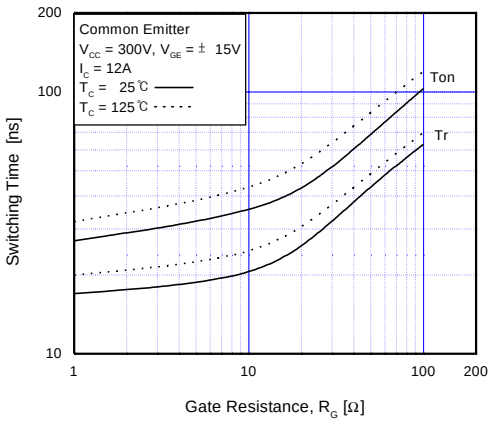


Fig 8. Turn-On Characteristics vs. Gate Resistance

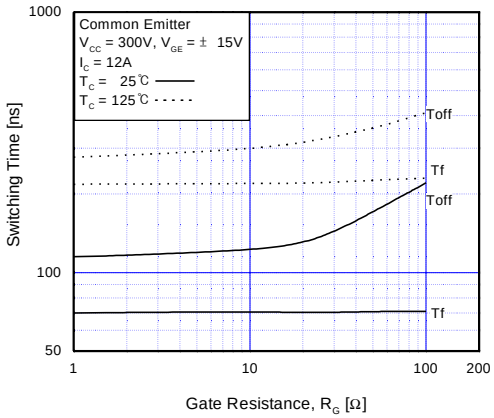


Fig 9. Turn-Off Characteristics vs. Gate Resistance

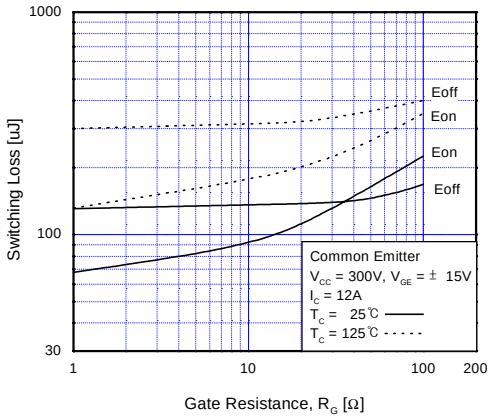


Fig 10. Switching Loss vs. Gate Resistance

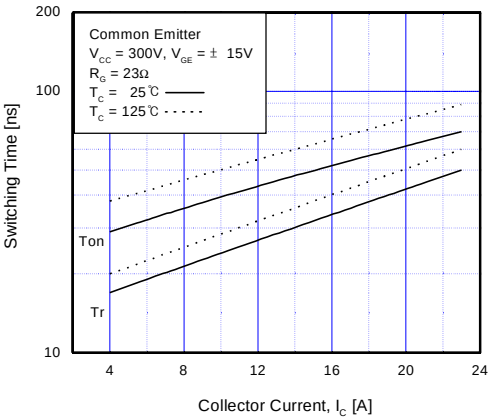


Fig 11. Turn-On Characteristics vs. Collector Current

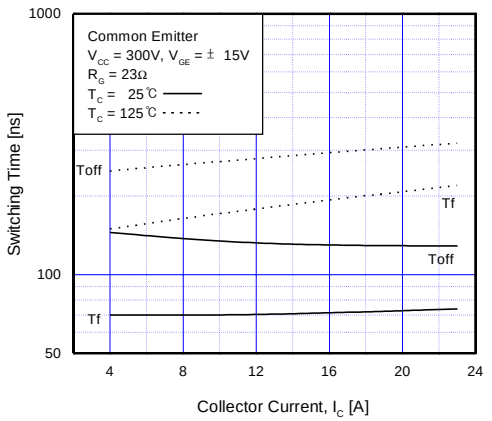


Fig 12. Turn-Off Characteristics vs. Collector Current

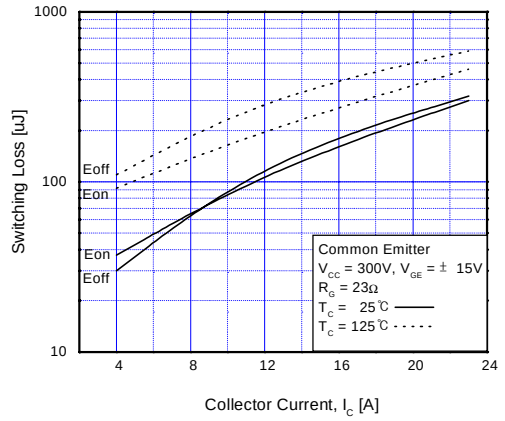


Fig 13. Switching Loss vs. Collector Current

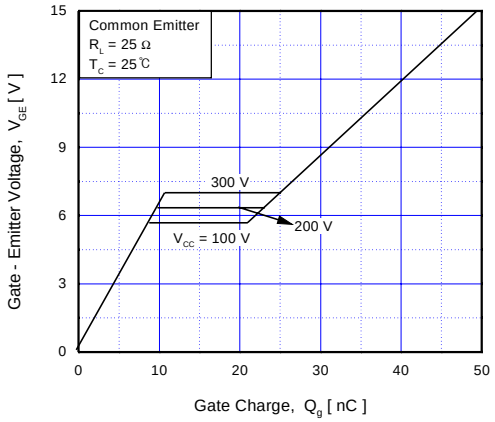


Fig 14. Gate Charge Characteristics

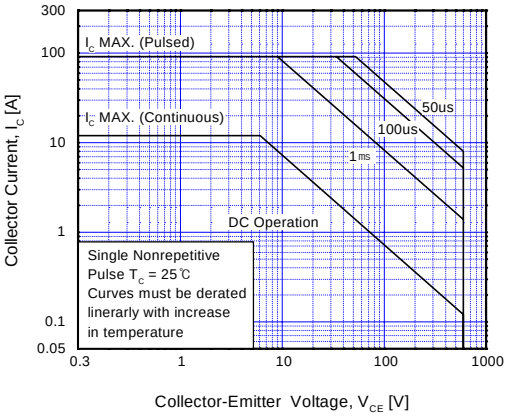


Fig 15. SOA Characteristics

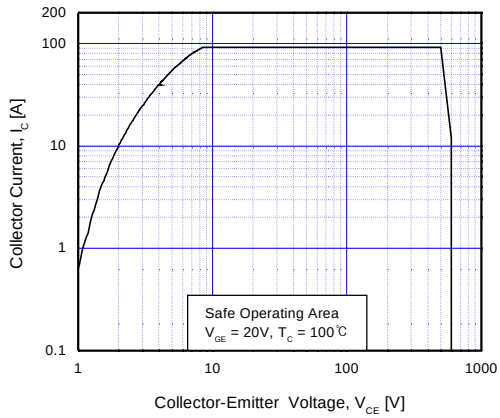


Fig 16. Turn-Off SOA Characteristics

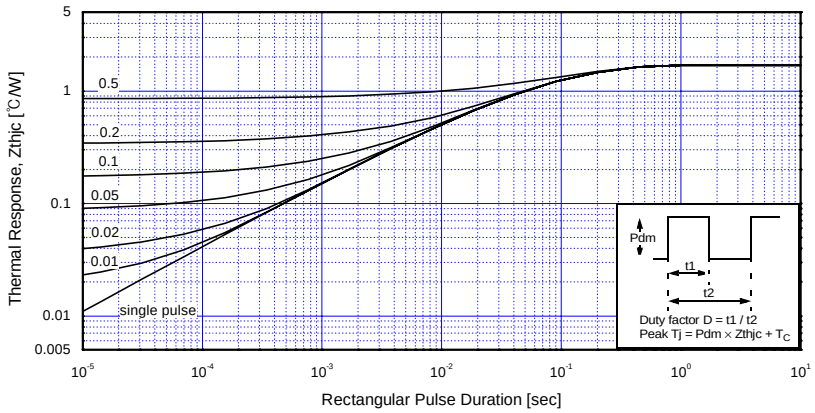


Fig 17. Transient Thermal Impedance of IGBT

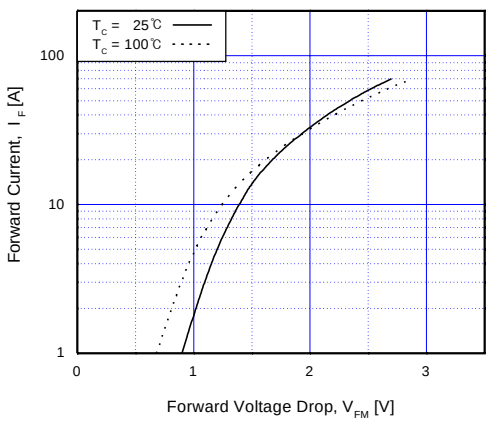


Fig 18. Forward Characteristics

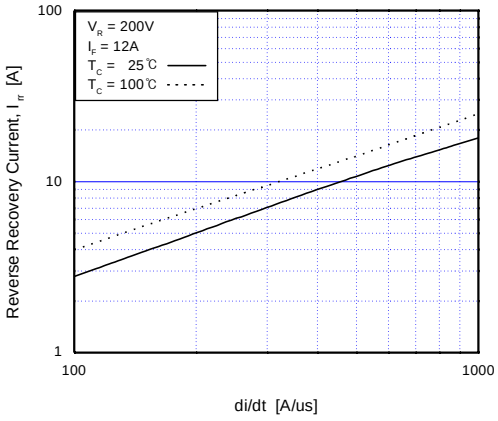


Fig 19. Reverse Recovery Current

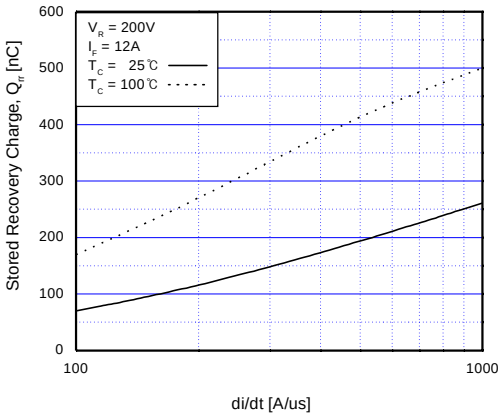


Fig 20. Stored Charge

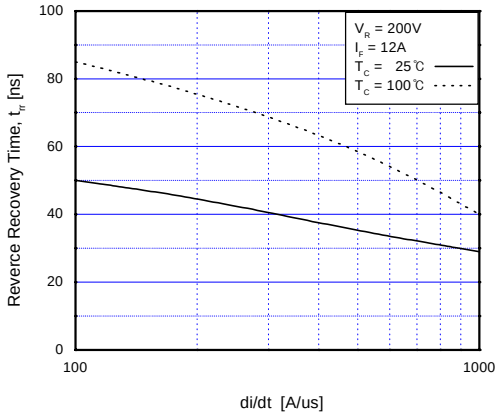
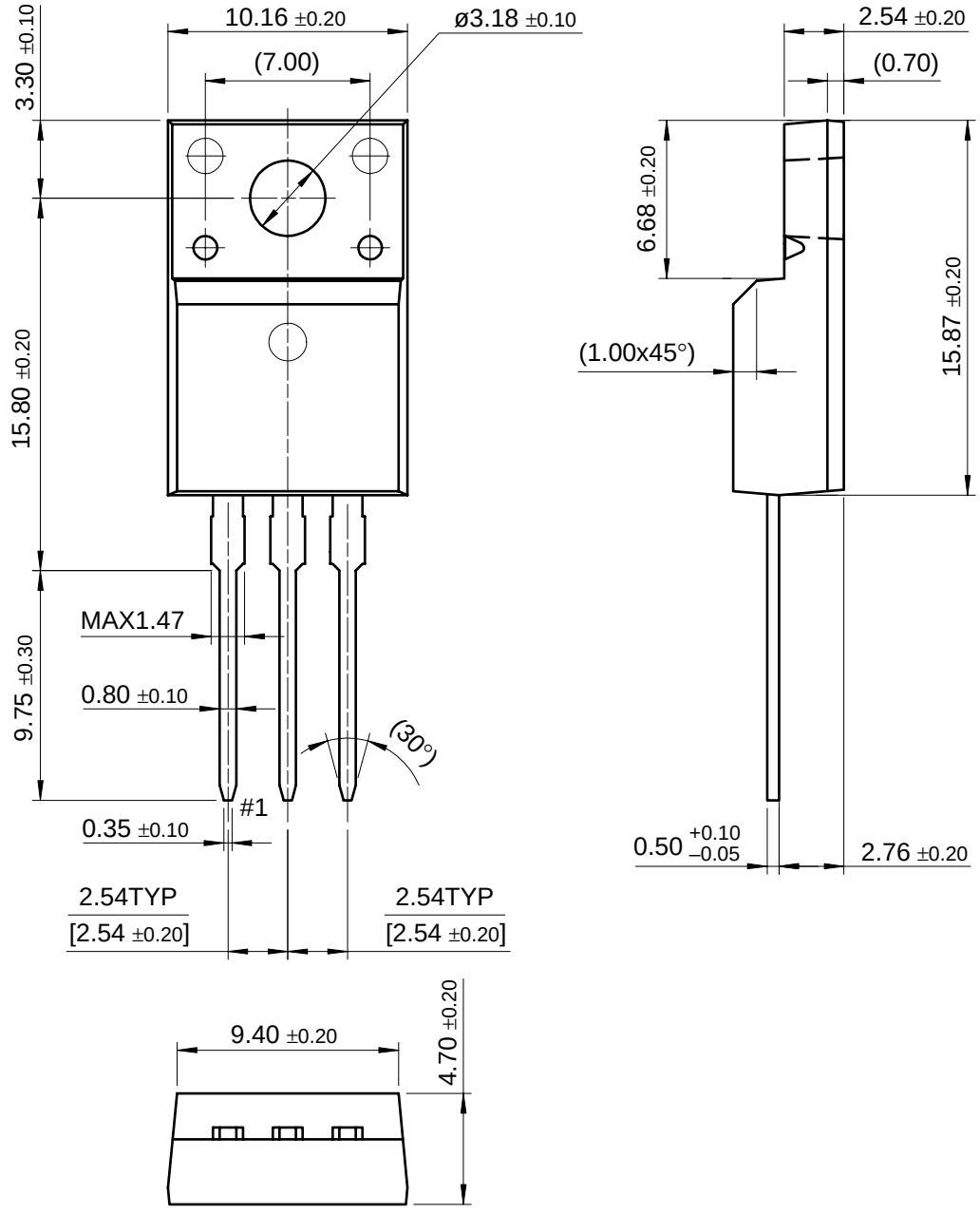


Fig 21. Reverse Recovery Time

Package Dimension

TO-220F (FS PKG CODE AQ)



Dimensions in Millimeters

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