FAIRCHILD SEMICONDUCTOR TM

April 2001

IGBT

SGS13N60UFD

Ultra-Fast IGBT

General Description

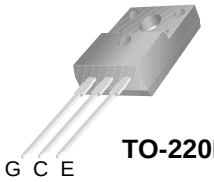
Fairchild's UFD series of Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses. The UFD series is designed for applications such as motor control and general inverters where high speed switching is a required feature.

Features

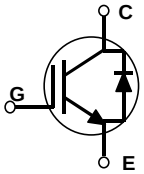
- High speed switching
- Low saturation voltage : $V_{CE(sat)}$ = 2.1 V @ I_C = 6.5A
- High input impedance
- CO-PAK, IGBT with FRD : t_{rr} = 37ns (typ.)

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		SGS13N60UFD	Units
V_{CES}	Collector-Emitter Voltage		600	V
V_{GES}	Gate-Emitter Voltage		± 20	V
I_C	Collector Current	@ T_C = 25°C	13	A
	Collector Current	@ T_C = 100°C	6.5	A
$I_{CM\ (1)}$	Pulsed Collector Current		52	A
I_F	Diode Continuous Forward Current	@ T_C = 100°C	8	A
I_{FM}	Diode Maximum Forward Current		56	A
P_D	Maximum Power Dissipation	@ T_C = 25°C	45	W
	Maximum Power Dissipation	@ T_C = 100°C	18	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	--	2.7	°C/W
$R_{\theta JC}$(DIODE)	Thermal Resistance, Junction-to-Case	--	1.7	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	°C/W

©2001 Fairchild Semiconductor Corporation

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	μA
I_{GES}	G-E Leakage Current	V_{GE} = V_{GES}, V_{CE} = 0V	--	--	± 100	nA
On Characteristics						
$V_{GE(th)}$	G-E Threshold Voltage	I_C = 6.5mA, V_{CE} = V_{GE}	3.5	4.5	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 6.5A, V_{GE} = 15V	--	2.1	2.6	V
		I_C = 13A, V_{GE} = 15V	--	2.6	--	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30V, V_{GE} = 0V, f = 1MHz	--	375	--	pF
C_{oes}	Output Capacitance		--	63	--	pF
C_{res}	Reverse Transfer Capacitance		--	13	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300 V, I_C = 6.5A, R_G = 50Ω, V_{GE} = 15V, Inductive Load, T_C = 25°C	--	20	--	ns
t_r	Rise Time		--	27	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	70	130	ns
t_f	Fall Time		--	97	150	ns
E_{on}	Turn-On Switching Loss		--	85	--	μJ
E_{off}	Turn-Off Switching Loss		--	95	--	μJ
E_{ts}	Total Switching Loss		--	180	270	μJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC} = 300 V, I_C = 6.5A, R_G = 50Ω, V_{GE} = 15V, Inductive Load, T_C = 125°C	--	30	--	ns
t_r	Rise Time		--	32	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	85	200	ns
t_f	Fall Time		--	168	250	ns
E_{on}	Turn - On Switching Loss		--	180	--	μJ
E_{off}	Turn - Off Switching Loss		--	165	--	μJ
E_{ts}	Total Switching Loss		--	345	500	μJ
Q_g	Total Gate Charge	V_{CE} = 300 V, I_C = 6.5A, V_{GE} = 15V	--	25	35	nC
Q_{ge}	Gate-Emitter Charge		--	7	12	nC
Q_{gc}	Gate-Collector Charge		--	8	14	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 = 8A	T_C = 25°C	--	1.4	1.7	V
			T_C = 100°C	--	1.3	--	
t_{rr}	Diode Reverse Recovery Time	I_F = 8A, di/dt = 200A/μs	T_C = 25°C	--	37	55	ns
			T_C = 100°C	--	55	--	
I_{rr}	Diode Peak Reverse Recovery Current		T_C = 25°C	--	3.5	5.0	A
			T_C = 100°C	--	4.5	--	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25°C	--	65	138	nC
			T_C = 100°C	--	124	--	

©2001 Fairchild Semiconductor Corporation

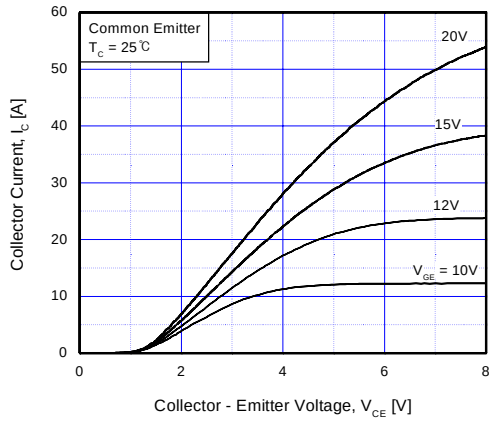


Fig 1. Typical Output Chacracteristics

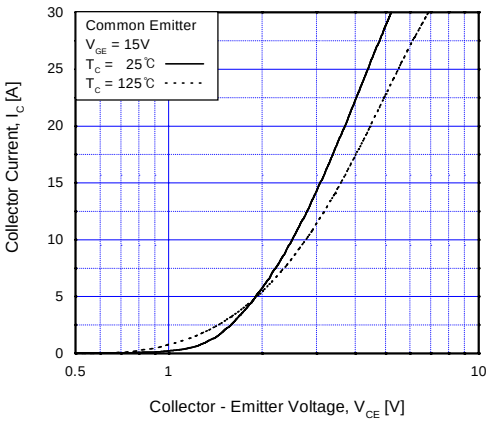


Fig 2. Typical Saturation Voltage Characteristics

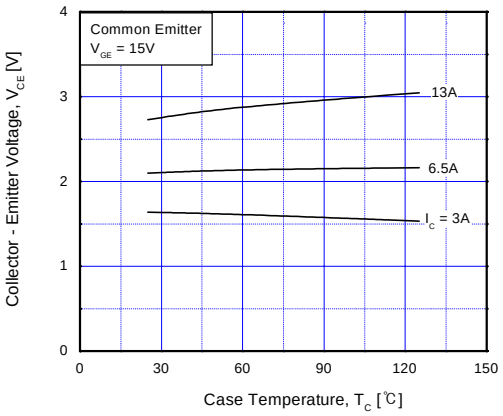


Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

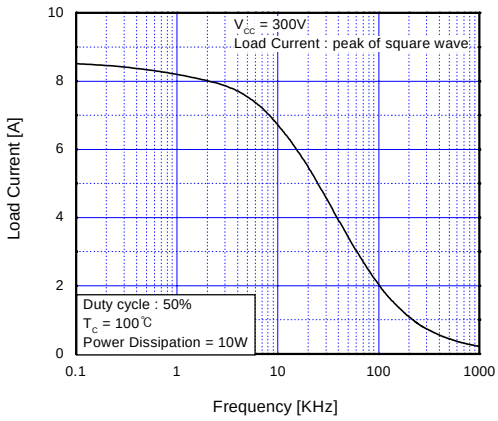


Fig 4. Load Current vs. Frequency

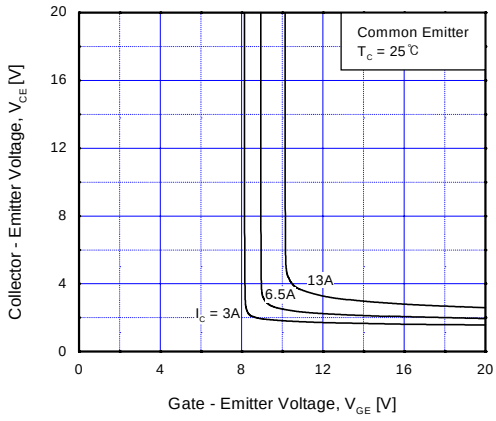


Fig 5. Saturation Voltage vs. V_{GE}

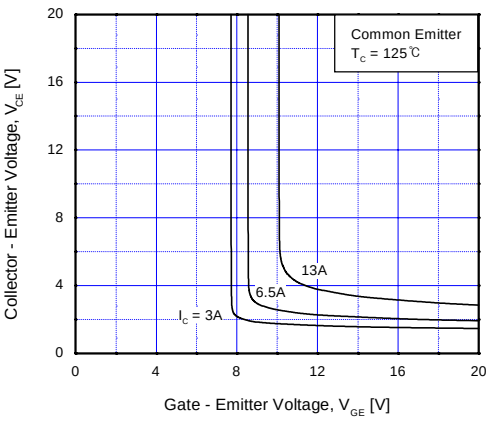


Fig 6. Saturation Voltage vs. V_{GE}

©2001 Fairchild Semiconductor Corporation

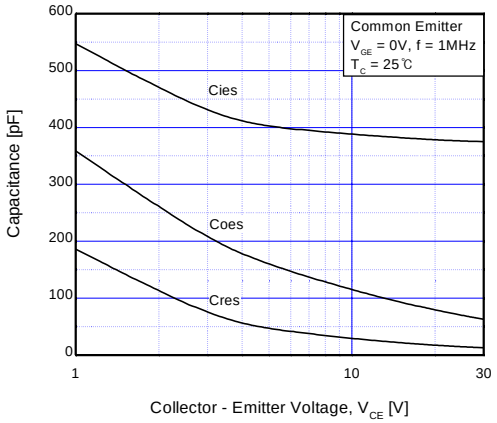


Fig 7. Capacitance Characteristics

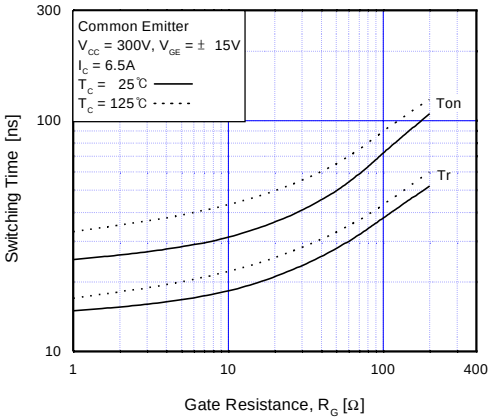


Fig 8. Turn-On Characteristics vs. Gate Resistance

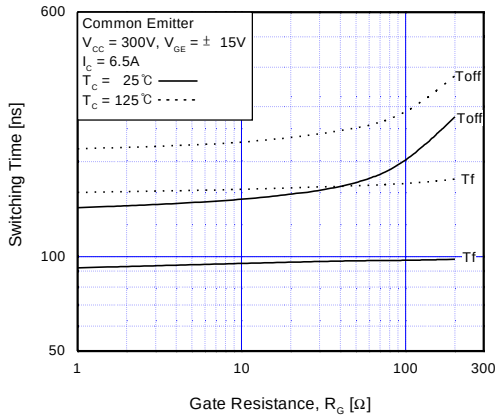


Fig 9. Turn-Off Characteristics vs. Gate Resistance

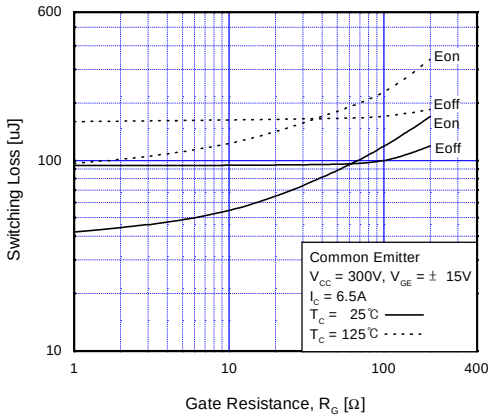


Fig 10. Switching Loss vs. Gate Resistance

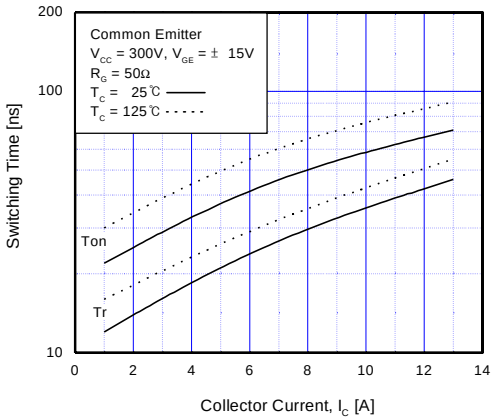


Fig 11. Turn-On Characteristics vs. Collector Current

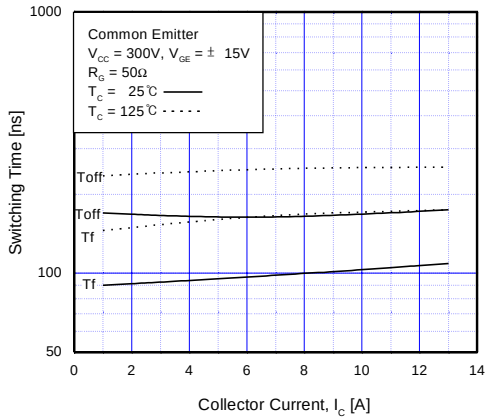


Fig 12. Turn-Off Characteristics vs. Collector Current

©2001 Fairchild Semiconductor Corporation

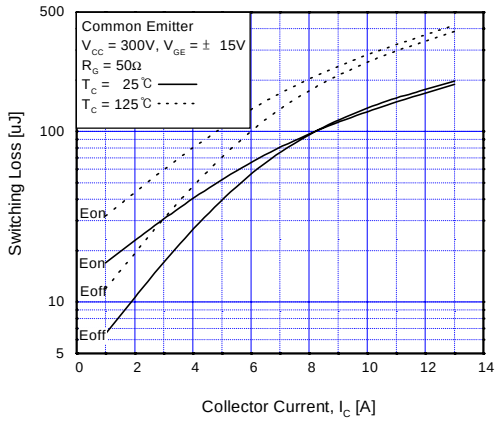


Fig 13. Switching Loss vs. Collector Current

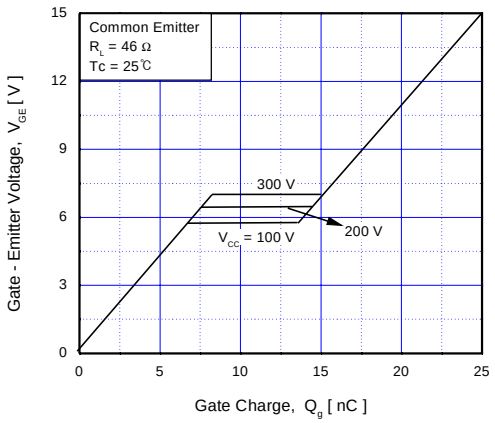


Fig 14. Gate Charge Characteristics

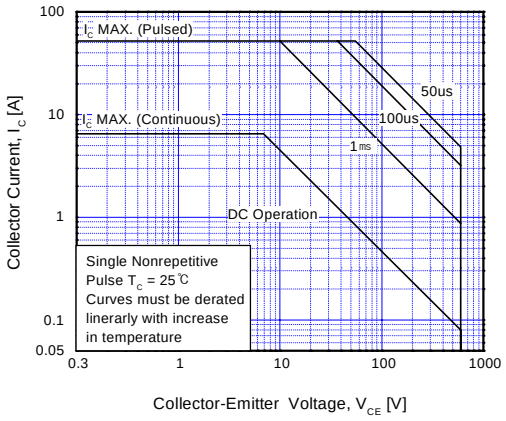


Fig 15. SOA Characteristics

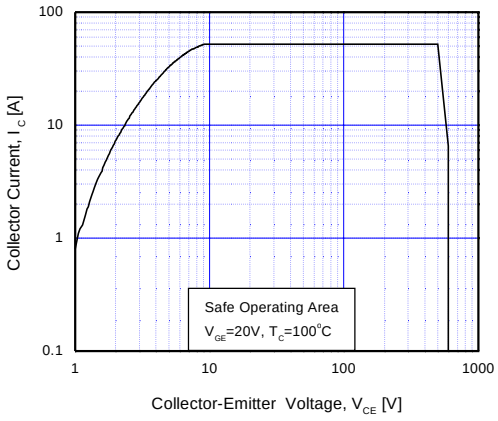


Fig 16. Turn-Off SOA Characteristics

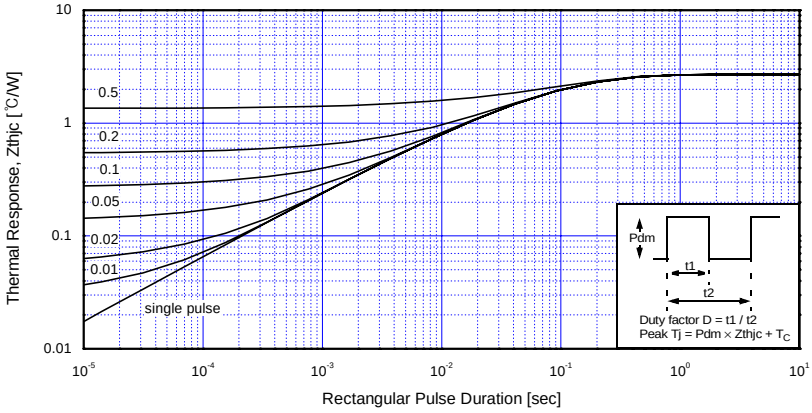


Fig 17. Transient Thermal Impedance of IGBT

©2001 Fairchild Semiconductor Corporation

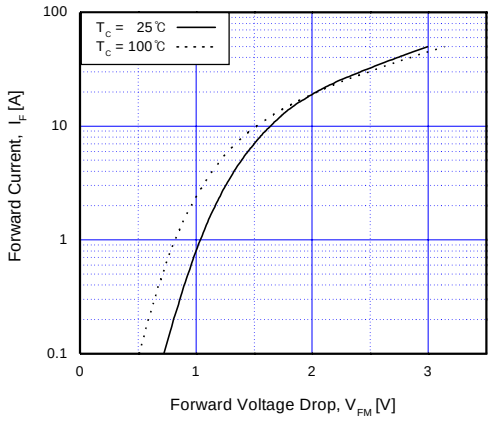


Fig 18. Forward Characteristics

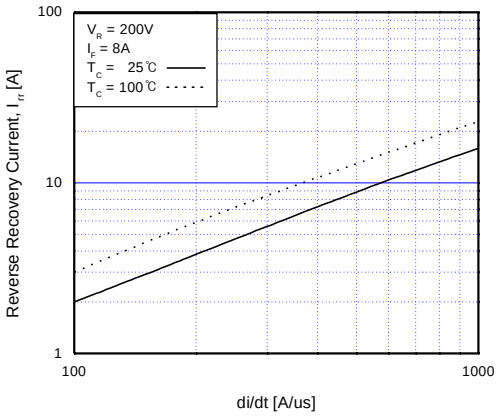


Fig 19. Reverse Recovery Current

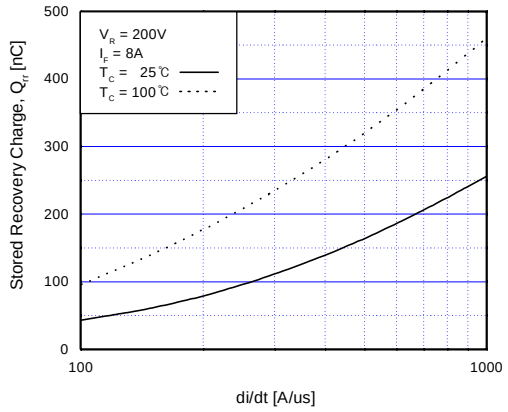


Fig 20. Stored Charge

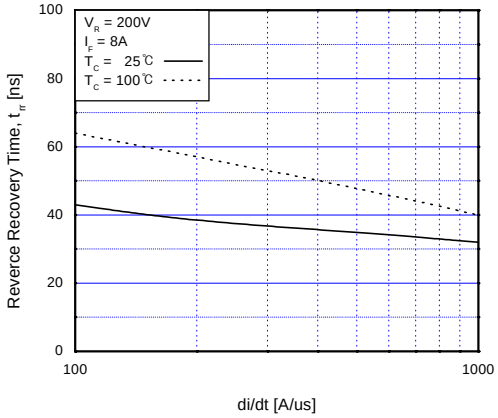
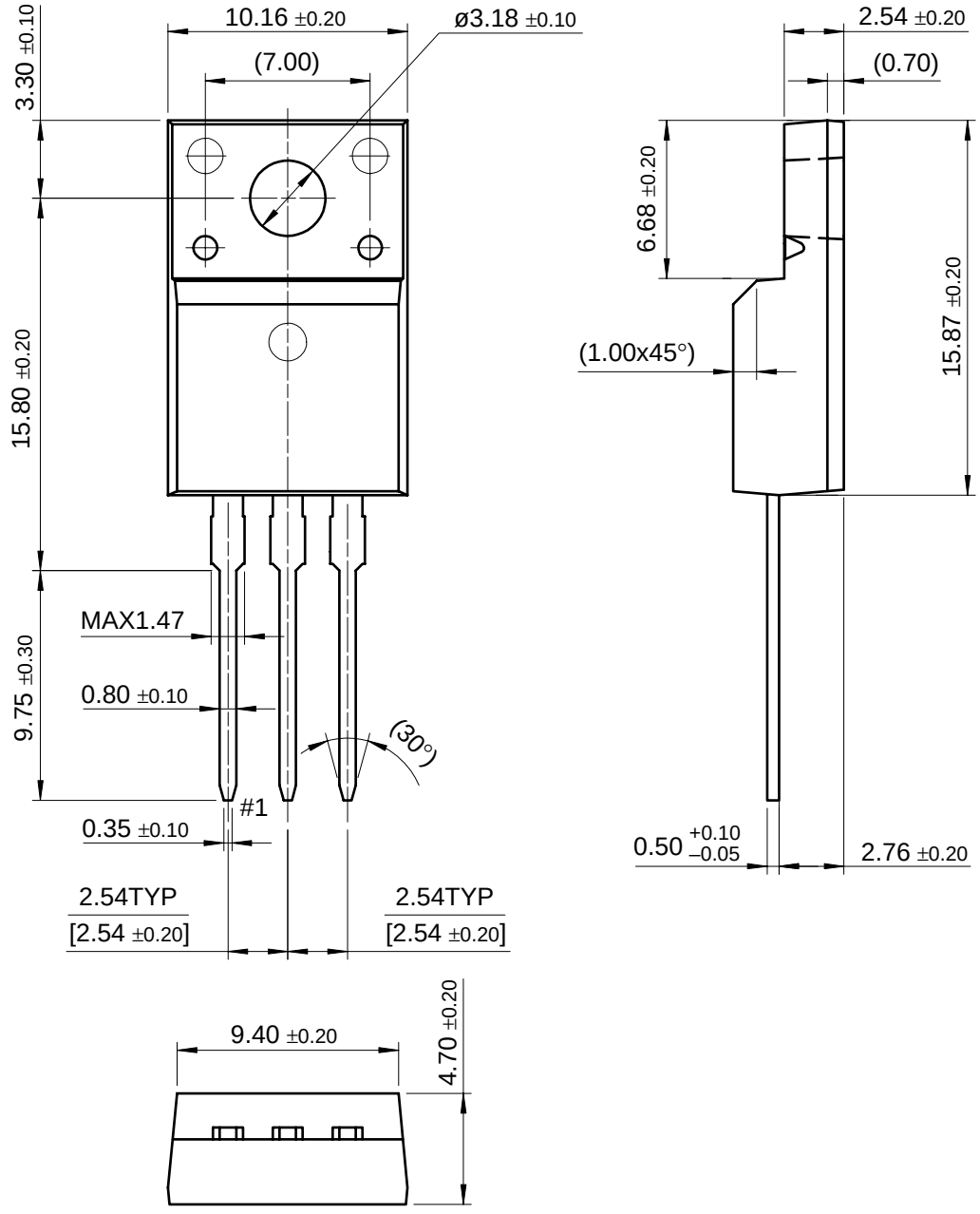


Fig 21. Reverse Recovery Time

©2001 Fairchild Semiconductor Corporation

Package Dimension

TO-220F (FS PKG CODE AQ)



Dimensions in Millimeters

©2001 Fairchild Semiconductor Corporation

TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

ACEx™
Bottomless™
CoolFET™
CROSSVOLT™
DenseTrench™
DOME™
EcoSPARK™
E^2CMOS™
EnSigna™
FACT™
FACT Quiet Series™
FAST®
FASTr™
GlobalOptoisolator™
GTO™
HiSeC™
ISOPLANAR™
LittleFET™
MicroFET™
MICROWIRE™
OPTOLOGIC™
OPTOPLANAR™
PACMAN™
POP™
PowerTrench®
QFET™
QS™
QT Optoelectronics™
Quiet Series™
SLIENT SWITCHER®
SMART START™
Star* Power™
Stealth™
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SyncFET™
TinyLogic™
UHC™
UltraFET®
VCX™

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

©2001 Fairchild Semiconductor Corporation